Important Information

Thank you for choosing Freenove products!

Getting Started

If you have not yet downloaded the zip file, associated with this kit, please do so now and unzip it.
https://github.com/Freenove/Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi

Get Support and Offer Input

Freenove provides free and responsive product and technical support, including but not limited to:

- Product quality issues
- Product use and build issues
- Questions regarding the technology employed in our products for learning and education
- Your input and opinions are always welcome
- We also encourage your ideas and suggestions for new products and product improvements

For any of the above, you may send us an email to:

support@freenove.com

Safety and Precautions

Please follow the following safety precautions when using or storing this product:

- Keep this product out of the reach of children under 6 years old.
- This product should be **used only when there is adult supervision present** as young children lack necessary judgment regarding safety and the consequences of product misuse.
- This product contains small parts and parts, which are sharp. This product contains electrically conductive parts. **Use caution with electrically conductive parts near or around power supplies, batteries and powered (live) circuits.**
- When the product is turned ON, activated or tested, some parts will move or rotate. **To avoid injuries to hands and fingers keep them away from any moving parts!**
- It is possible that an improperly connected or shorted circuit may cause overheating. **Should this happen, immediately disconnect the power supply or remove the batteries and do not touch anything until it cools down!** When everything is safe and cool, review the product tutorial to identify the cause.
- Only operate the product in accordance with the instructions and guidelines of this tutorial, otherwise parts may be damaged or you could be injured.
- Store the product in a cool dry place and avoid exposing the product to direct sunlight.
- After use, always turn the power OFF and remove or unplug the batteries before storing.

About Freenove

Freenove provides open source electronic products and services worldwide.

Freenove is committed to assist customers in their education of robotics, programming and electronic circuits so that they may transform their creative ideas into prototypes and new and innovative products. To this end, our services include but are not limited to:

- Educational and Entertaining Project Kits for Robots, Smart Cars and Drones
- Educational Kits to Learn Robotic Software Systems for Arduino, Raspberry Pi and micro: bit
- Electronic Component Assortments, Electronic Modules and Specialized Tools
- **Product Development and Customization Services**

You can find more about Freenove and get our latest news and updates through our website:

http://www.freenove.com

sale@freenove.com

Copyright

Contents

Preface

Welcome to use the Freenove Computer Case Kit Pro for Raspberry Pi

This product is exclusively designed for the RPi 5, a popular single-board computer (SBC). Follow this tutorial, you can install a sleek, multi-functional computer case kit for your Raspberry Pi 5 (RPi 5).

The RPi 5 delivers highly powerful performance with a CPU frequency of up to 2.4GHz. However, this increased power consumption also leads to significant heat generation. Without an appropriate heatsink, thermal throttling may severely limit the Raspberry Pi 5's performance. Additionally, the removal of the 3.5mm audio jack in the RPi 5 has caused inconvenience for many users.

In this context, our case kit came into being. It not only addresses these issues, but also introduces advanced features.

If you encounter any issues, feel free to contact us for prompt and free technical support.

support@freenove.com

Key Features

This product integrates a wide range of features and supports multiple optional expansions, as detailed below:

- **Standard Features:**
  - Built-in dual 4Ω 3W speakers for audio output
  - Equipped with a 3.5mm JACK audio interface
  - Applying a tower cooler for more efficient heat dissipation
  - Built-in five ARGB 4010 cooling fans for lower overall case temperature and enhanced lighting effects
  - Classic case design
  - Integrated 2x6 ARGB lights, supporting multiple lighting modes and customizable effects
  - Power button with indicator light
  - Low standby power consumption design; all lights and power can be turned off after shutdown
  - Integrated a 0.96-inch OLED display for real-time system information monitoring
  - Built-in case temperature sensor for real-time internal temperature monitoring
  - Featuring a 1220 RTC battery holder
  - Ports are uniformly arranged on the back of the case, including USB, Ethernet, UART, HDMI, 3.5mm JACK, SD card slot, and power interface for easy connection and management
- **Optional Features:**
  - Optional 4.3-inch IPS display with true-to-life colors and responsive touch control, suitable for real-time monitoring and displaying comprehensive system operation information
  - Supports MVMe M.2 slot expansion in 2230/2242/2260/2280 specifications; optional configurations of 1/2/4 slots to meet different storage needs
  - Optional 128GB SSD for basic storage requirements

Product Variants

This product is currently offered in multiple variants. The primary distinction lies in the display functionality, divided into two series: **one without a display** and **one equipped with a 4.3-inch IPS display**.
Beyond this, further model differentiation is available based on the presence and number of SSD slots.
The table below details the specific configurations of the **non-display series**.

non-display series	NVMe M.2 SSD x1	Number of NVMe Slot
FNK0107A	✗	1
FNK0107B	✗	2
FNK0107C	✗	4
FNK0107H	✓	1
FNK0107K	✓	2
FNK0107L	✓	4

The table below shows the detailed configurations of the variants **equipped with the 4.3-inch IPS display**.

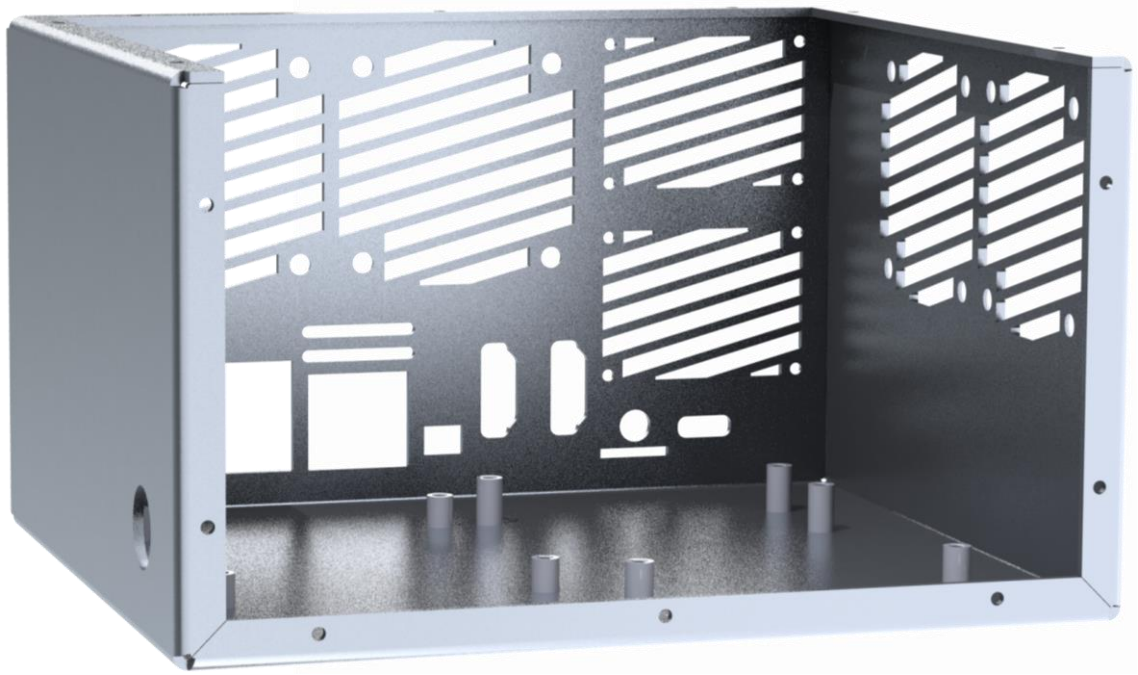
with 4.3inch IPS display	NVMe M.2 SSD x1	Number of NVMe Slot
FNK0107P	✗	1
FNK0107Q	✗	2
FNK0107R	✗	4
FNK0107U	✓	1
FNK0107V	✓	2
FNK0107W	✓	4

List

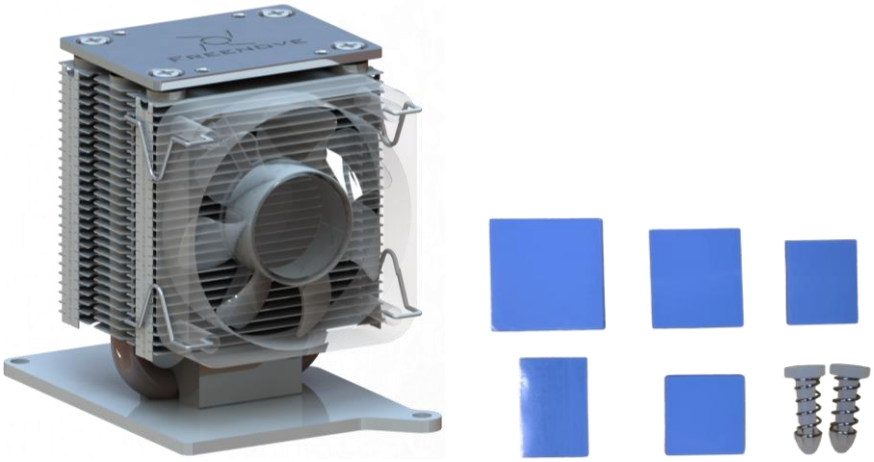
Before getting started, please check the part list. If any component is missing from your kit, do not start assembly; instead, please email our support team at support@freenove.com to get the missing parts.

Metal Parts

Metal case x1



Tower Cooler x1
Thermal Pad x5
Nylon Standoff x2



Acrylic Parts

Note: Please tear off the protective films from the acrylic parts before use.

Acrylic Top Plate x 1 	Acrylic Top Plate × 1 Landscape Orientation Screen Bracket × 2 Portrait Orientation Screen Bracket × 2 (Only for FNK0107P\Q\R\U\V\W)
Acrylic Side Plate x 1 	Acrylic Side Plate(Only for FNK0107P\Q\R\U\V\W)
LED Light Diffusion Plate x 1 	Acrylic for OLED x1 Speaker Acrylic Pad x2

Machinery Parts

All fasteners come in a larger bag, please open it and check whether they are complete.

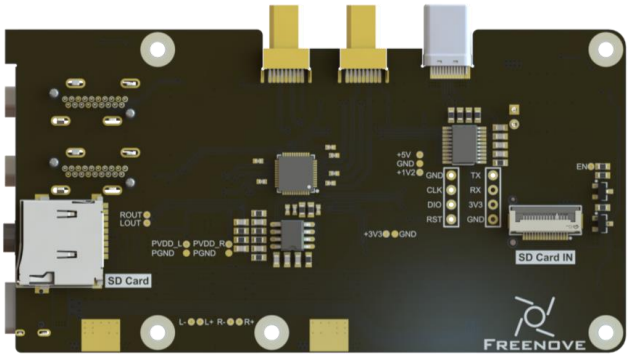
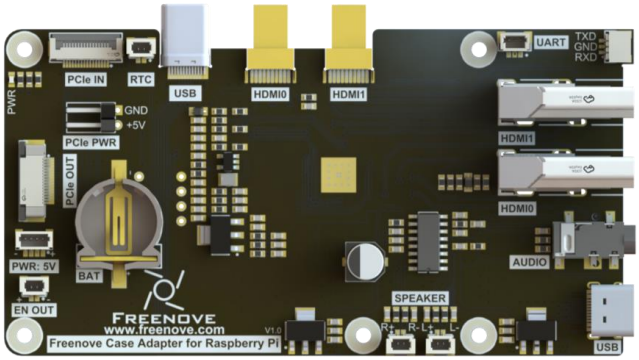
M2.5*5 Countersunk Head Screw  x50 Freenove	M3.7*10 Countersunk Head Screw  x18 Freenove	M2*6 Countersunk Head Screw  x10 Freenove
M2.5*12 Brass Standoff  x2 Freenove	M2.5*12+4 Brass Standoff  x4 Freenove	M2.5*25+4 Brass Standoff  x3 Freenove

The fasteners listed below are not packaged in the same bag as those above. They are only provided with the **FNK0107P/Q/R/U/V/W** versions.

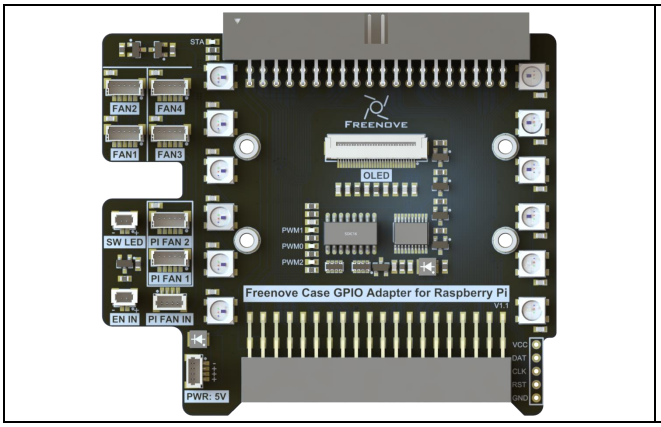
M2.5*9 Brass Standoff  x5 Freenove

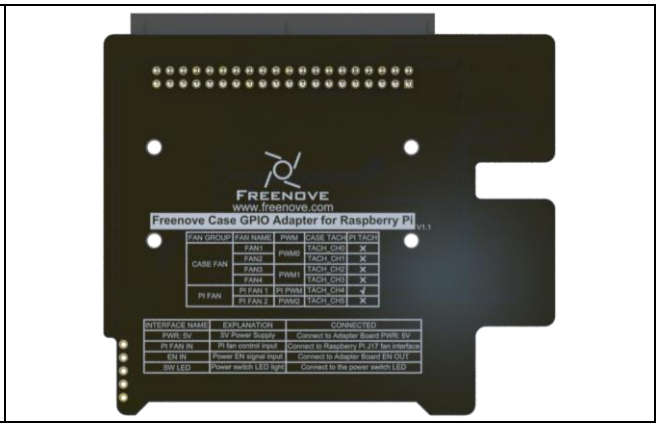
Electronic Parts

Freenove Case Adapter for Raspberry Pi

Freenove Case GPIO Adapter for Raspberry Pi



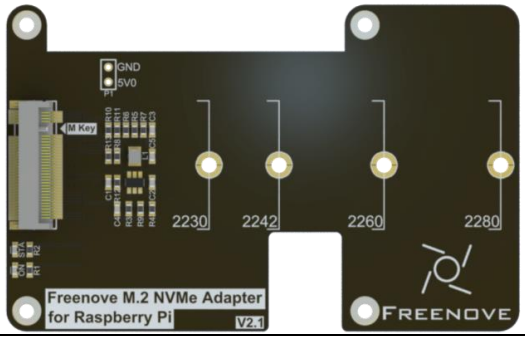


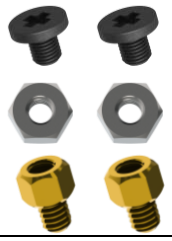
Freenove Power Button Board for Raspberry Pi

Freenove M.2 NVMe Adapter Series for Raspberry Pi

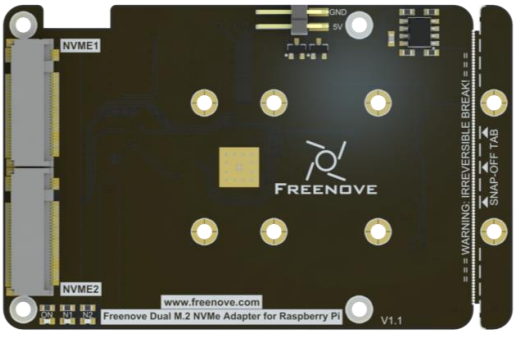
Note: The components included in the NVMe Adapter Combo Pack vary by product version. Please verify that the contents match your model before installation.

Freenove M.2 Nvme Adapter for Raspberry Pi Combo Pack x1 (Only for FNK0107A/H/P/U)

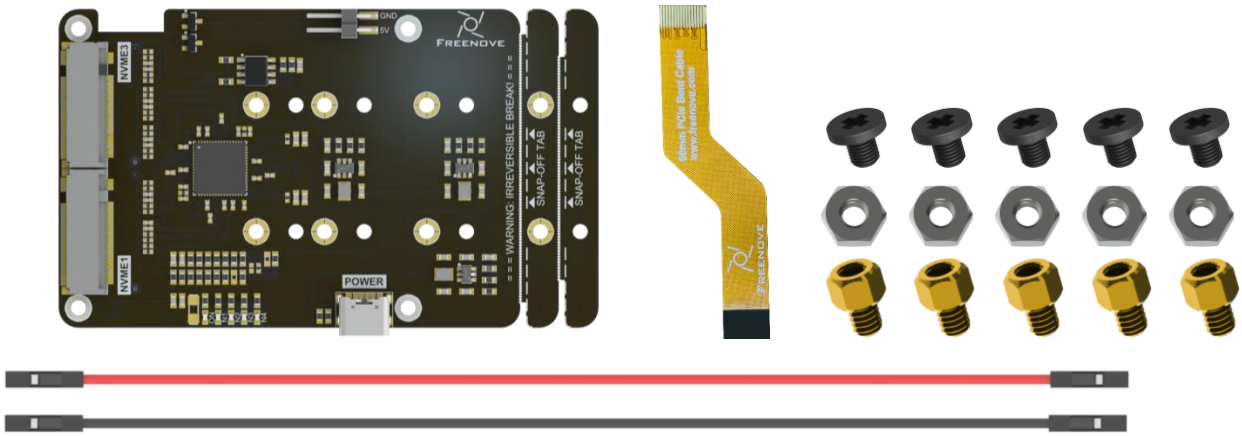




Freenove Dual M.2 Nvme Adapter for Raspberry Pi Combo Pack x1 (Only for FNK0107B/K/Q/V)

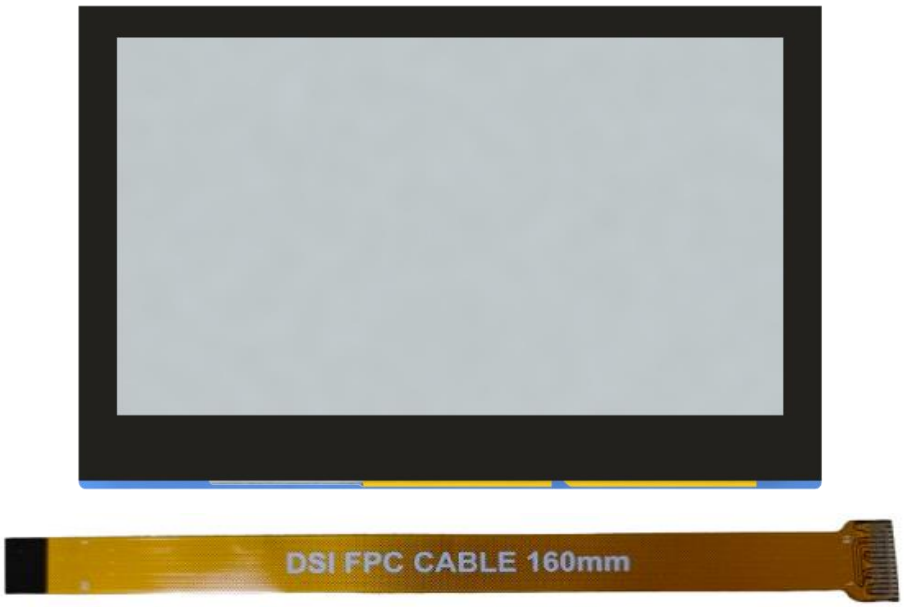


Freenove Quad M.2 Nvme Adapter for Raspberry Pi Combo Pack x1 (Only for FNK0107C/L/R/W)



Electronic Modules

4.3-inch Screen x1, DSI FPC CABLE 160mm x1 (Only for FNK0107P/Q/R/U/V/W)



0.96 inch OLED display x1

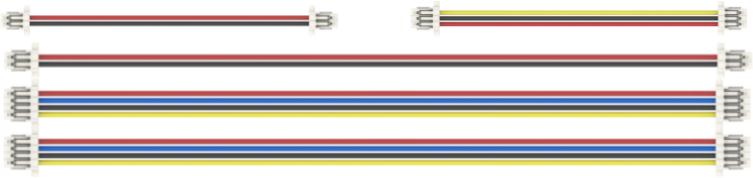
Important: The display glass is fragile – please exercise extreme caution during installation.

ARGB Fan x4

Speaker x2

Wires

SH1.0mm_2P Same-Direction Cable 5cm x1
SH1.0mm_3P Same-Direction Cable 5cm x1
SH1.0mm_2P Same-Direction Cable 15cm x1
SH1.0mm_4P Same-Direction Cable 15cm x2



SH1.0mm 2-Pin to 2.8mm Quick-Disconnect Terminal Cable (Red-Black), 7cm, × 1
1.25mm 2-Pin to 2.8mm Quick-Disconnect Terminal Cable (Yellow-Yellow), 7cm, × 1

SD Card to 0.5mm-16P FPC cable

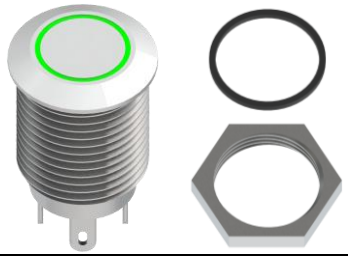
reverse straight cable x1

Tools

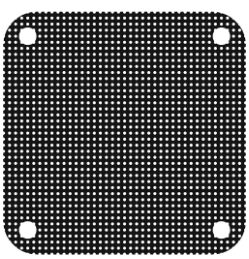
Screwdriver Bit Holder × 1
Hex Shank Phillips #2 Bit × 1
Hex Shank Phillips #0 Bit × 1

Others

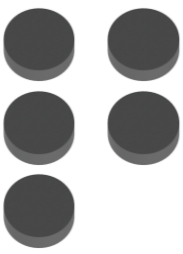
12mm LED Power Button x1
Black Sealing Gasket x1
M12 Nut x1



Fan Dust Filter x4



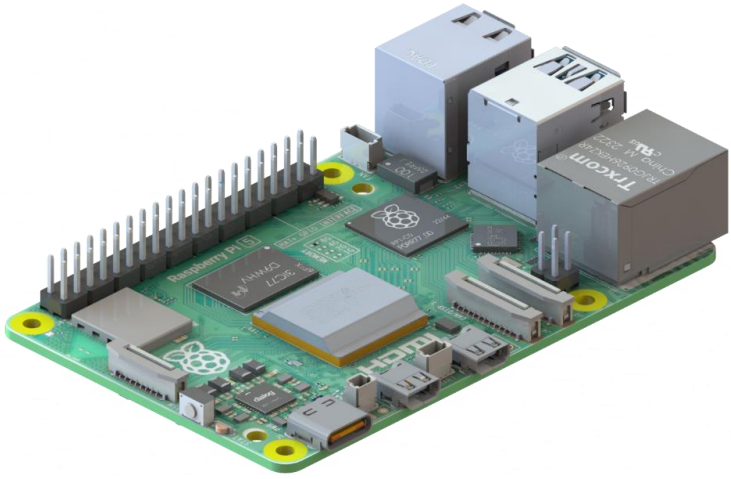
Round Black Non-Slip Foot Pad x5



Masking Tape x 1

Rquired but NOT Contained Parts

Raspberry Pi 5 x 1



27W Power Adapter x 1 (or a power adapter compatible with Raspberry Pi official one that can output 5.1V/5A)

Micro SD Card (TF Card), Card Reader x 1

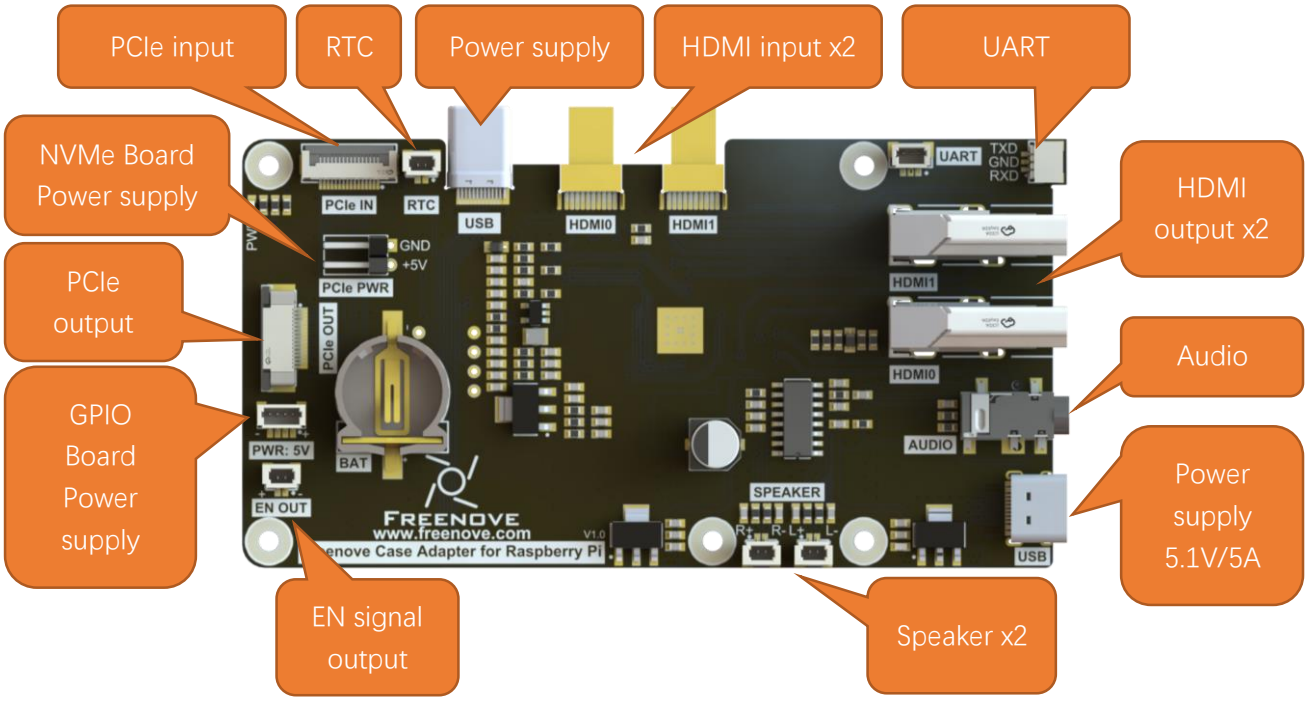
Before getting started, please check the part list. If any component is missing from your kit, do not start assembly; instead, please email our support team at support@freenove.com to get the missing parts.

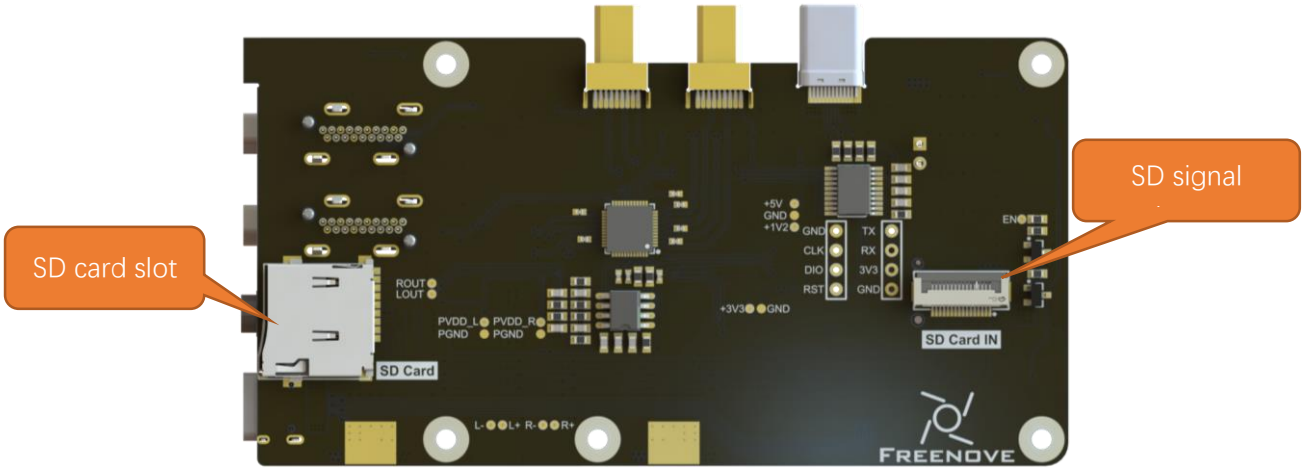
Chapter 1 Introduction to Main Components

In this chapter, we will mainly introduce the main components of this case and their functionalities.

1.1 Introduction to Freenove Case Adapter for Raspberry Pi

In this tutorial, we name this component as **Audio-Video Board**.

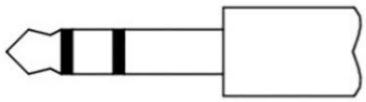
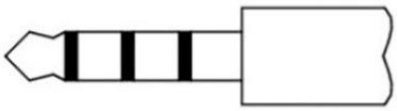
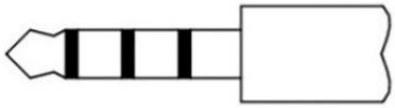




The Audio-Video Board is specifically designed for the Raspberry Pi 5, aiming to transform it into a fully functional home computer. This board integrates a wide range of interfaces, significantly expanding its native capabilities. Key features includes a PCIe adapter port, an RTC interface, a Type-C power supply interface, dual HDMI adapter ports, a UART adapter port, a 3.5mm JACK audio interface, dual speaker connectors, an EN (Enable) signal interface, a power interface for the GPIO Board, a power interface for the NVMe adapter board, and an SD card slot.

3.5mm JACK Audio Interface

In the RPi 5 design, the traditional 3.5mm audio output interface has been removed, and audio signals are now solely output through HDMI. To address this, we have developed an audio separation circuit on the Case Adapter Board. This circuit enables audio to be output via the 3.5mm audio interface on the board, You can use the external 3.5mm TRS headphone jack on the Raspberry Pi 5 to listen to audio output. For proper functionality, ensure your headphone connector is compatible. Below is an explanation of common jack types:

<table>
<tr><td colspan="2" rowspan="3">TRS JACK
 
Tip Ring Sleeve</td><td>Tip</td><td>Left Channel</td></tr>
<tr><td>Ring</td><td>Right Channel</td></tr>
<tr><td>Sleeve</td><td>GND</td></tr>
<tr><td rowspan="4">OMTP</td><td rowspan="4">TRRS JACK
 
Tip Ring 1 Ring 2 Sleeve</td><td>Tip</td><td>Left Channel</td></tr>
<tr><td>Ring1</td><td>Right Channel</td></tr>
<tr><td>Ring2</td><td>MIC</td></tr>
<tr><td>Sleeve</td><td>GND</td></tr>
<tr><td rowspan="4">CTIA</td><td rowspan="4">TRRS JACK
 
Tip Ring 1 Ring 2 Sleeve</td><td>Tip</td><td>Left Channel</td></tr>
<tr><td>Ring1</td><td>Right Channel</td></tr>
<tr><td>Ring2</td><td>GND</td></tr>
<tr><td>Sleeve</td><td>MIC</td></tr>
</table>

Speaker Interface

Additionally, we have designed an audio amplification circuit. With this circuit, you can control the two speakers, each with an impedance of 4Ω and a power rating of 3W。

PCIe Interface

This interface adapts the PCIe interface from the RPi 5 to the Audio-Video Board, enabling convenient connection to 1/2/4-slot NVMe adapter boards. To ensure stability during high-power SSD operation or when multiple SSDs are running simultaneously, an additional 2-pin independent power supply interface has been integrated onto the board. This design effectively prevents potential device damage caused by power insufficiency and guarantees the stable operation of your NVMe storage system.

EN OUT

This signal is used to control the power to both the Audio-Video Board and the GPIO Board. When the Raspberry Pi 5 is shut down, it automatically cuts off power and lighting, achieving high energy efficiency and complete silence.

SD Card Slot

This interface adapts the Raspberry Pi 5's SD card slot to the case interface area, achieving a unified layout where all ports are located on the same side. The design strictly complies with the SDR104 transmission

protocol, ensuring full compatibility with official Raspberry Pi SD cards and delivering bus speeds of up to 104 MB/s.
https://www.raspberrypi.com/documentation/accessories/sd-cards.html#content
https://www.sdcard.org/developers/sd-standard-overview/bus-speed-default-speed-high-speed-uhs-sd-express/

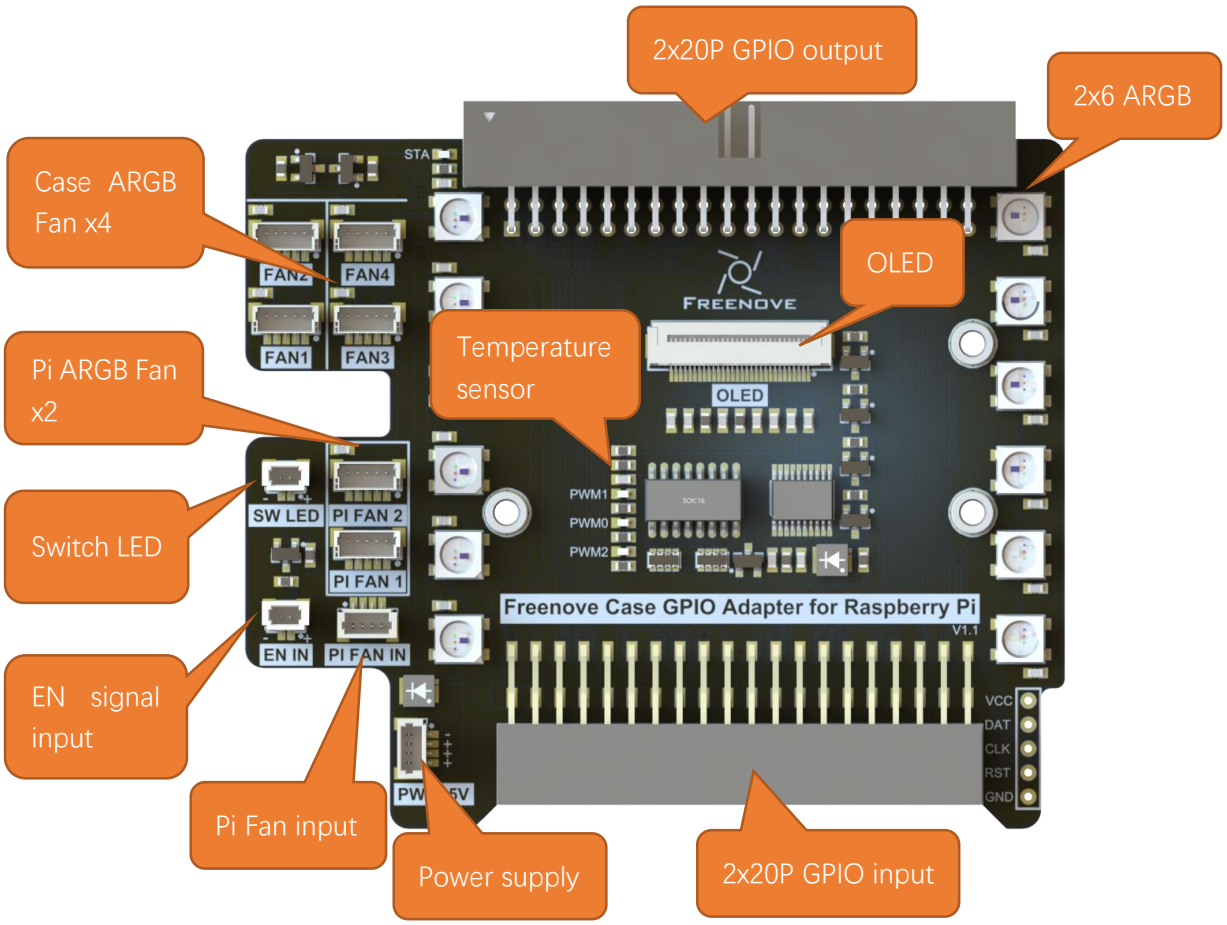
RTC Interface

To enhance the accuracy of the Raspberry Pi's clock, it is advisable to add a battery to the RTC. For this purpose, we have installed a battery holder on the board. If you decide to add a battery, we recommend either purchasing a rechargeable lithium-manganese button-cell battery (with dimensions of 1220 and a voltage of 3V) or an official battery.
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#real-time-clock-rtc

Due to the addition of audio processing capabilities, multiple lighting effects, an enhanced cooling system, and multiple NVMe interfaces (supporting additional SSDs), the overall power consumption during operation has increased. Therefore, only the official 5.1V/5A power adapter (or compatible models with equivalent specifications) should be used to ensure stable system performance.

1.2 Introduction to Freenove Case GPIO Adapter for Raspberry Pi

In this tutorial, we name this model as **GPIO Board**.



The GPIO Board extends all GPIO pins of the Raspberry Pi 5 to the exterior of the case, significantly simplifying the connection and debugging of external devices. Additionally, the board is highly integrated with multiple control functions, including interfaces for 2×6 ARGB LEDs and 6 ARGB fans, supporting customizable lighting modes. It also features onboard connectors for an OLED display and an EN (Enable) power control interface, further enhancing system expandability and power management capabilities.

ARGB

The board features 2×6 onboard ARGB LEDs, which operate synchronously in two channels. Via I²C communication, users can switch between multiple preset lighting modes and individually control each LED, enabling highly customizable dynamic lighting effects.

Case ARGB Fans

The case is equipped with four ARGB fan headers, whose lighting effects are synchronized with the onboard ARGB LEDs. The system supports two-channel independent PWM control, allowing users to precisely adjust fan speeds via I²C communication and monitor real-time RPM data for each fan. This enables efficient thermal management while maintaining unified visual aesthetics.

Pi ARGB Fan

Pi FAN 1: It is controlled directy by Raspberry Pi 5. For details, see:
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#fan-cases
Pi FAN 2: It is controlled by GPIO board. The way to control it is the same as the aforementioned Case ARGB Fans.

EN IN (Enable Input)

This interface connects to the EN_OUT port on the Audio-Video Board to synchronize the power state of the entire system. When the Raspberry Pi is shut down, it automatically cuts off all power to the GPIO Board, effectively eliminating standby power consumption and ensuring that all connected devices (such as lighting) are completely turned off.

Temperature sensor

Equipped with athe temperature sensor, the system monitors the internal temperature in real-time and linearly adjusts the fan speed based on the temperature data, achieving automatic closed-loop control of the cooling system. At the same time, users can view precise temperature readings at any time to clearly monitor the internal operating status of the case.

1.3 Introduction to Freenove Power Button Board for Raspberry Pi

In this tutorial, we name this model as **Switch Board**.

The Switch Board connects to the J2 interface of the Raspberry Pi 5 via pogo pins, enabling the use of a custom power button. A 12mm power button with an indicator light is included, offering identical functionality to the onboard power button of the Raspberry Pi 5. For detailed specifications and usage of the power button, please refer to the Raspberry Pi official documentation:
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#power-button

1.4 Introduction to Freenove M.2 NVMe Adapter Series for Raspberry Pi

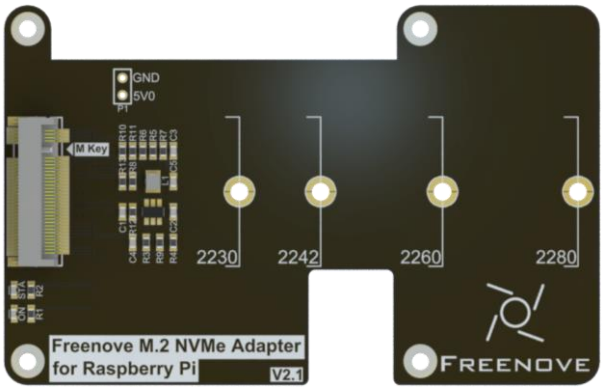
The Raspberry Pi 5 includes a PCIe x1 slot that is certified for PCIe Gen 2.0, providing a theoretical maximum throughput of 5GT/sec, which roughly translates to 500MB/sec for read and write operations. Although this slot is not officially certified for PCIe Gen 3.0, it is possible to force the use of Gen 3.0 for potentially higher speeds.

The PCIe consortium states that the speed of PCIe Gen 3.0 x1 is up to 8GT/sec, which translates to approximately 985MB/sec.
https://en.wikipedia.org/wiki/PCI_Express#Comparison_table
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#pcie-gen-3-0

SSDs generally provide significantly faster read and write speeds compared to SD cards and USB drives, which can notably elevate the user experience when operating the Raspberry Pi 5.

1.4.1 Freenove M.2 NVMe Adapter for Raspberry Pi

In this tutorial, we name this model as **NVMe Adapter Board**.

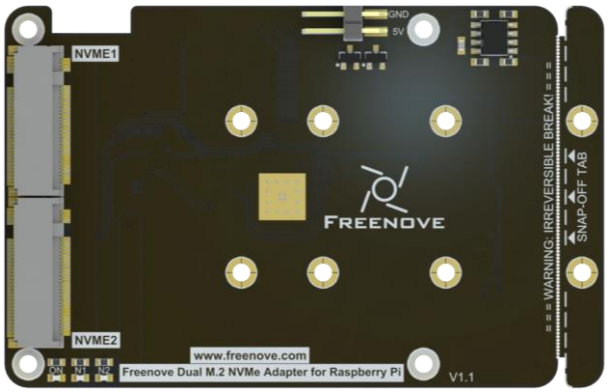


Here are its key features:

- **Interface Type**: M.2 with M-Key
- **Supported Protocol**: NVMe
- **PCIe Channel**: PCIe 3.0 x1(Compatible with PCIe 2.0)
- **Compatible Sizes**: 2230, 2242, 2260, 2280
- **Power Supply**: 3.3V, up to 3A (maximum)
- **Indicator Lights**: Includes both power and SSD status LEDs.

1.4.2 Freenove Dual M.2 Nvme Adapter for Raspberry Pi

This model has four NVMe SSD interface, supporting up to 2 NVMe SSDs to run simultaneously. In this tutorial, we name this model as **Dual-NVMe Adapter Board**.

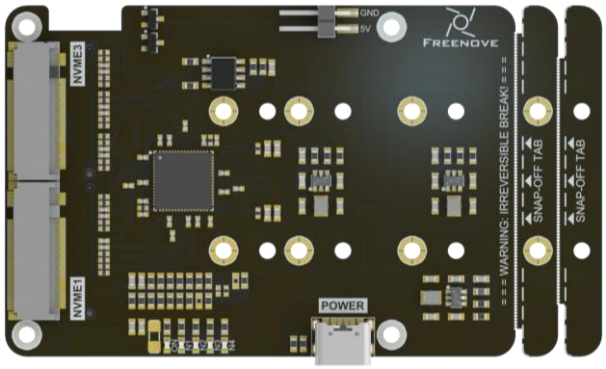


Here are its key features:

- **Interface Type**: 2x M.2 with M-Key
- **Supported Protocol**: NVMe
- **PCIe Channel**: PCIe 2.0 x2
- **Compatible Sizes**: 2230, 2242, 2260, 2280
- **Power Supply**: 3.3V, up to 3A (maximum)
- **Indicator Lights**: Includes both power and x2 SSD status LEDs.

1.4.3 Freenove Quad M.2 Nvme Adapter for Raspberry Pi

This model has four NVMe SSD interface, supporting up to 4 NVMe SSDs to run simultaneously. In this tutorial, we name this model as **Quad-NVMe Adapter Board**.

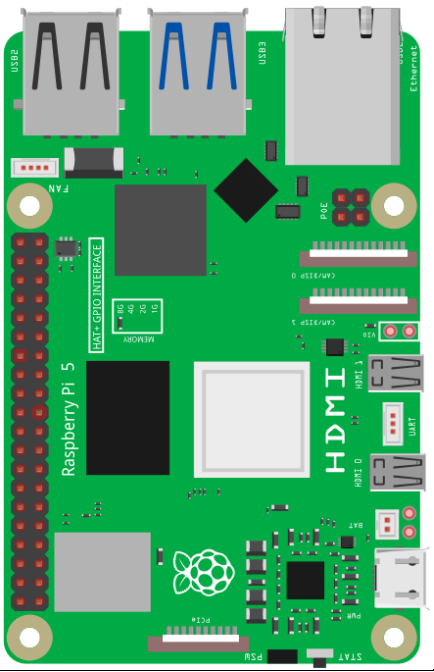


Here are its key features:

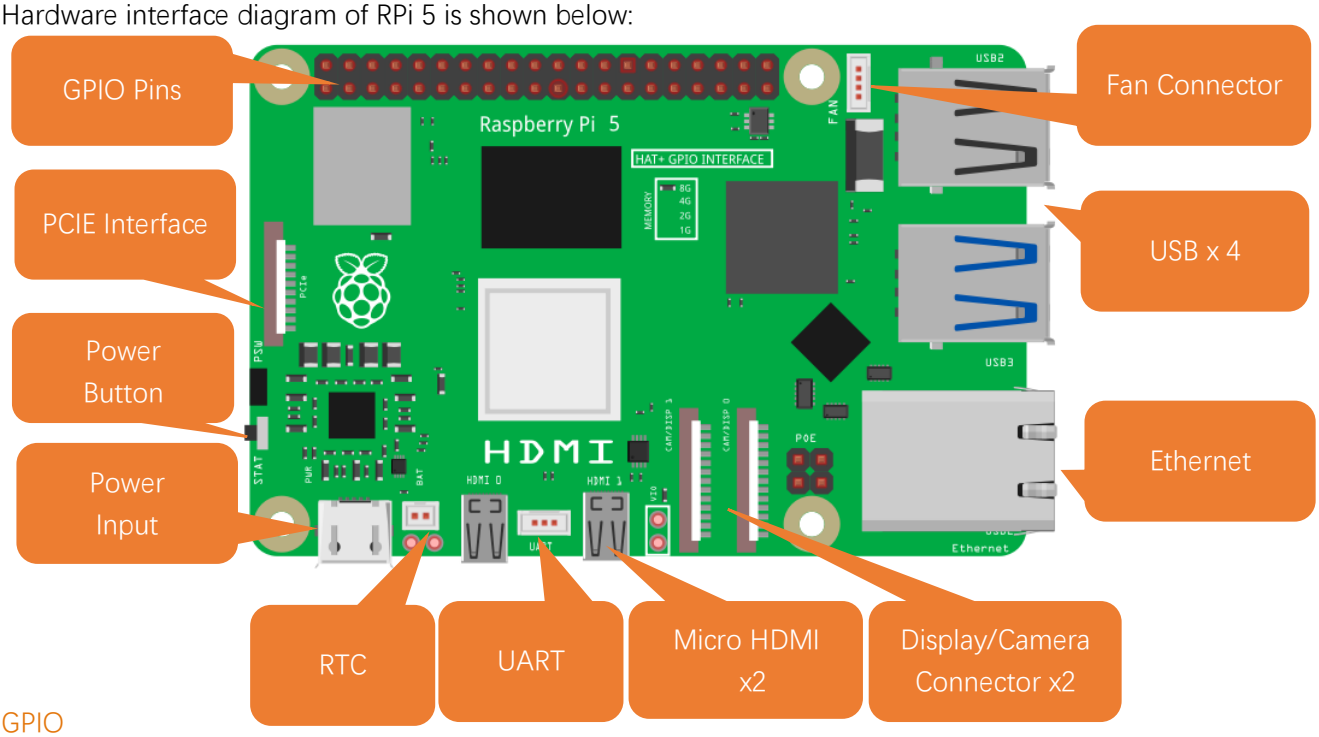
- **Interface Type**: 4x M.2 with M-Key
- **Supported Protocol**: NVMe
- **PCIe Channel**: PCIe 2.0 x4
- **Compatible Sizes**: 2230, 2242, 2260, 2280
- **Power Supply**: 3.3V, up to 3A (maximum)
- **Indicator Lights**: Includes both power and x4 SSD status LEDs.

1.5 Introduction to Raspberry Pi 5(RPi 5)

At the time of this writing, this product only supports RPi5. The following shows the physical and model figures of an RPi 5.

Practicality picture of Raspberry Pi 5:	Model diagram of Raspberry Pi 5:
	

Hardware interface diagram of RPi 5 is shown below:



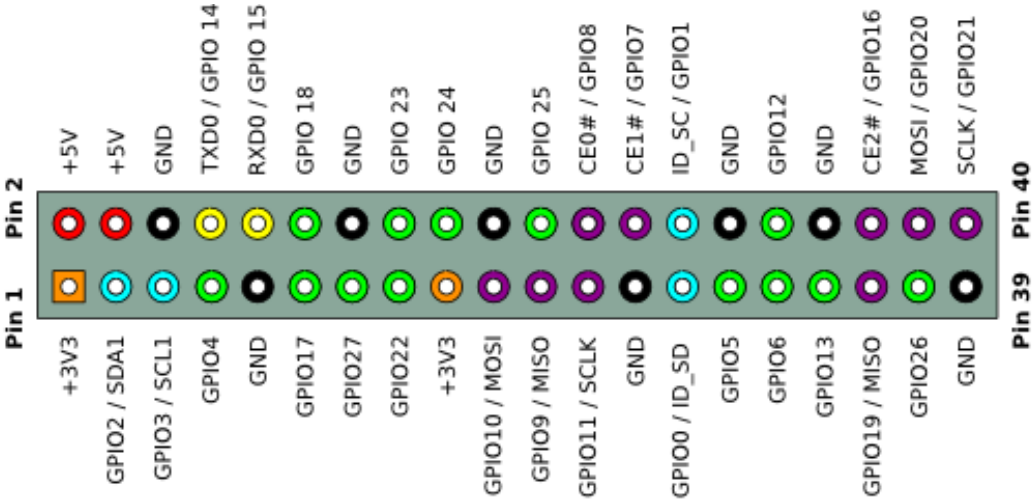
GPIO

GPIO: General purpose input/output. We will introduce the specific feature of the pins on the Raspberry Pi and how you can utilize them in all sorts of ways in your projects. Most RPi Module pins can be used as either an input or output, depending on your program and its functions. When programming the GPIO pins, there are three different ways to reference them: GPIO numbering, physical numbering, WiringPi GPIO Numbering.

BCM GPIO Numbering

The Raspberry Pi CPU uses Broadcom (BCM) processing chips BCM2835, BCM2836 or BCM2837. GPIO pin numbers are assigned by the processing chip manufacturer and are how the computer recognizes each pin. The pin numbers themselves do not make sense or have meaning, as they are only a form of identification. Since their numeric values and physical locations have no specific order, there is no way to remember them, so you will need to have a printed reference or a reference board that fits over the pins.

Each pin is defined as below:



For more details about pin definition of GPIO, please refer to https://pinout.xyz/

Power requirements of various versions of Raspberry Pi are shown in following table:

Product	Recommended PSU current capacity	Maximum total USB peripheral current draw	Typical bare-board active current consumption
Raspberry Pi Model A	700mA	500mA	200mA
Raspberry Pi Model B	1.2A	500mA	500mA
Raspberry Pi Model A+	700mA	500mA	180mA
Raspberry Pi Model B+	1.8A	600mA/1.2A (switchable)	330mA
Raspberry Pi 2 Model B	1.8A	600mA/1.2A (switchable)	350mA
Raspberry Pi 3 Model B	2.5A	1.2A	400mA
Raspberry Pi 3 Model A+	2.5A	Limited by PSU, board, and connector ratings only.	350mA
Raspberry Pi 3 Model B+	2.5A	1.2A	500mA
Raspberry Pi 4 Model B	3.0A	1.2A	600mA
Raspberry Pi 5 Model B	5.0A	1.6A (600mA if using a 3A power supply)	800mA
Raspberry Pi Zero W	1.2A	Limited by PSU, board, and connector ratings only.	150mA
Raspberry Pi Zero	1.2A	Limited by PSU, board, and connector ratings only	100mA

For more details, please refer to
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#power-supply

In this product, the Raspberry Pi 5 is used and it must be powered by a 5.1V/5A power supply. Insufficient power may cause various functions to operate abnormally, or even permanently damage your Raspberry Pi 5. Therefore, we strongly recommend using a 5.1V/5A power supply to ensure optimal performance and avoid potential hardware failure.

Chapter 2 Case Assembly

It is recommended to assemble and use the Freenove Computer Case Kit Pro for Raspberry Pi according to this tutorial. Otherwise, it may lead to incorrect device installation or damage. Please check all the parts again. Before getting started, please check the part list. If any component is missing from your kit, do not start assembly; instead, please email our support team at support@freenove.com to get the missing parts.

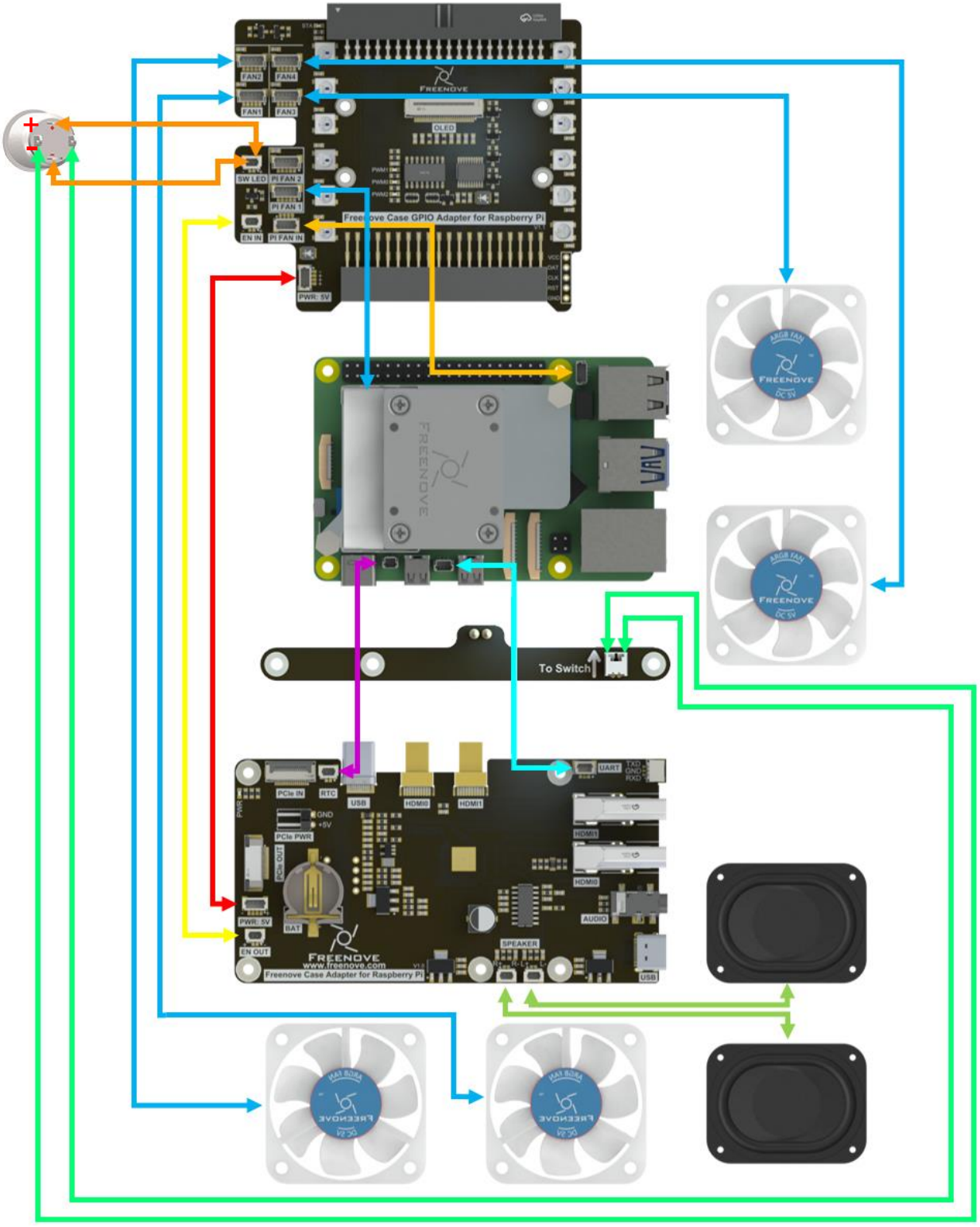
Ensure the device is powered off before assembly.

Use of the Screwdriver Bit Holder

When installing the brass standoff, simply place it directly into the bit holder. 
When installing the M3.7x10 Countersunk Head Screws, please use the PH2 hexagonal cross-bit. 
When installing other screws, please use the PH0 hexagonal cross-bit 

Overall Wiring Diagram

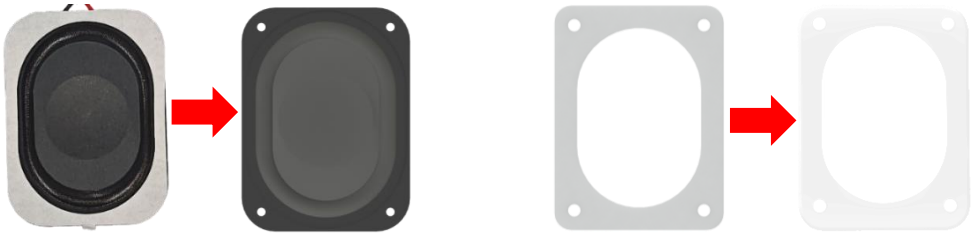
Note: The figure below is for reference only. Please assemble the Raspberry Pi case strictly according subsequent assembly steps.



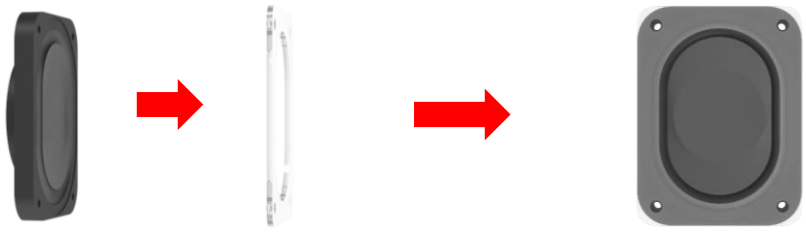
2.1 Assmbly of Speakers, Fans, and the Power Button

2.1.1 Assembling Speakers

Step 1: Remove the white protective film from the speaker and the speaker's acrylic pad.

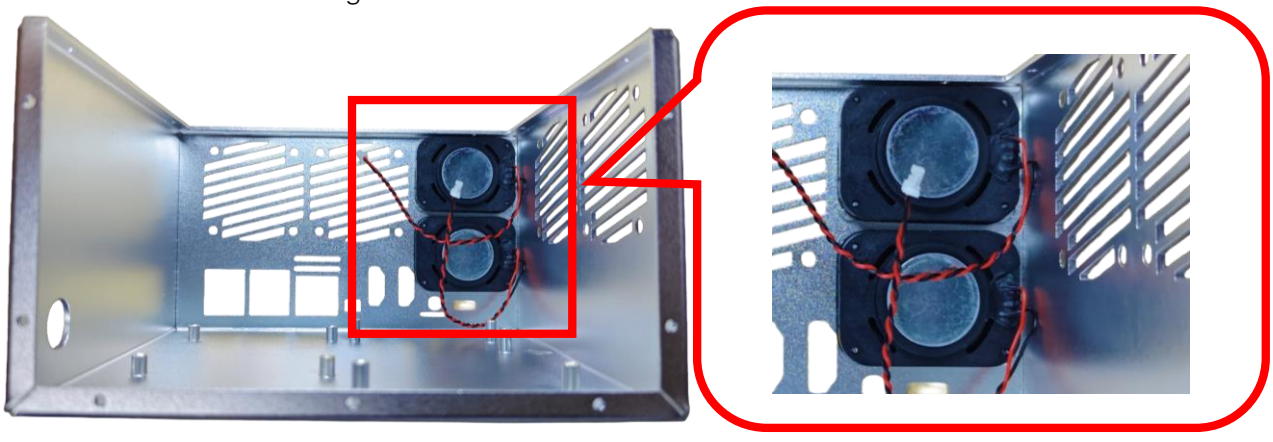


Step 2: Align the speaker acrylic pad with the speaker and attach them together.



Step 3: Mount the two speakers to the case from the outside with M2x6 Countersunk Head Screws.

Note: When installing, ensure the speaker orientation matches the diagram below, with the twisted pair located near the case housing.

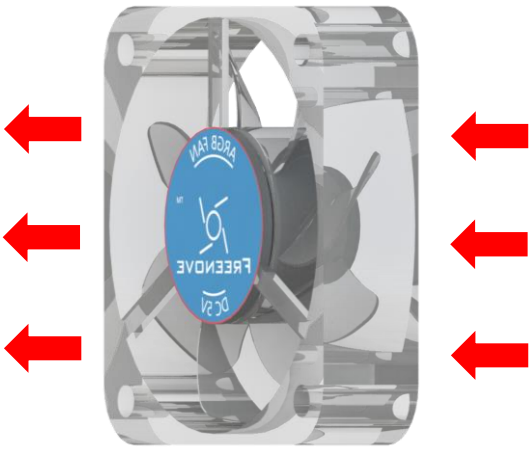


2.1.2 Assembling Fans

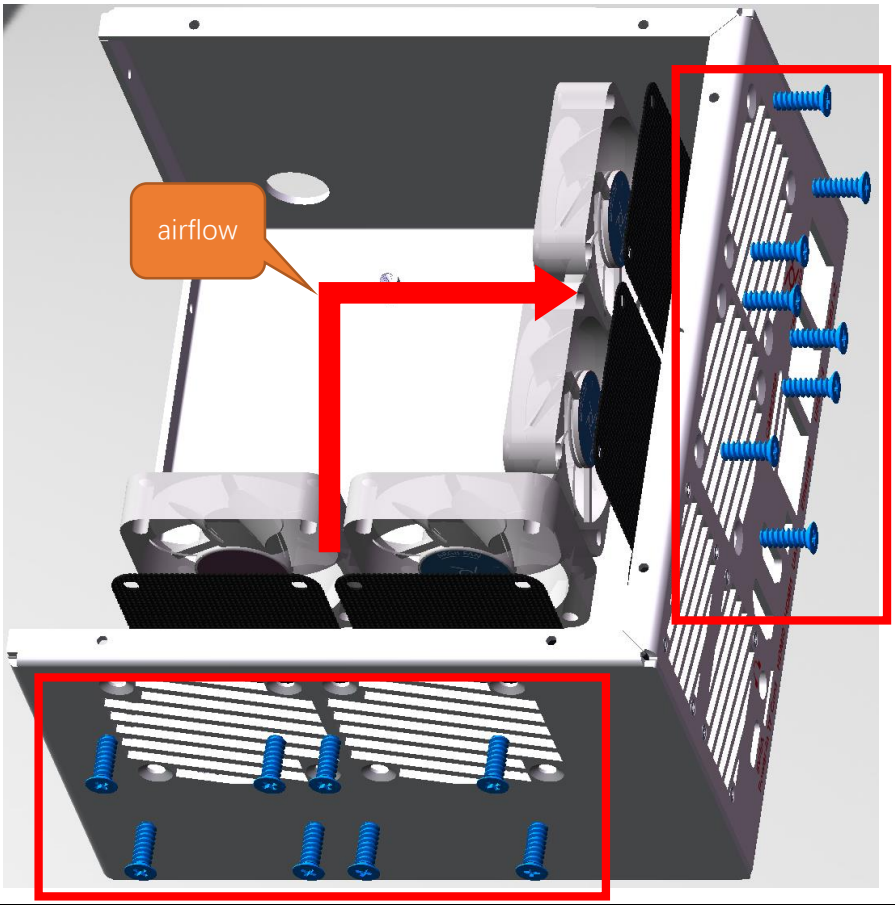
Airflow Direction Description:

The full fan blades are visible, is the **air intake**.

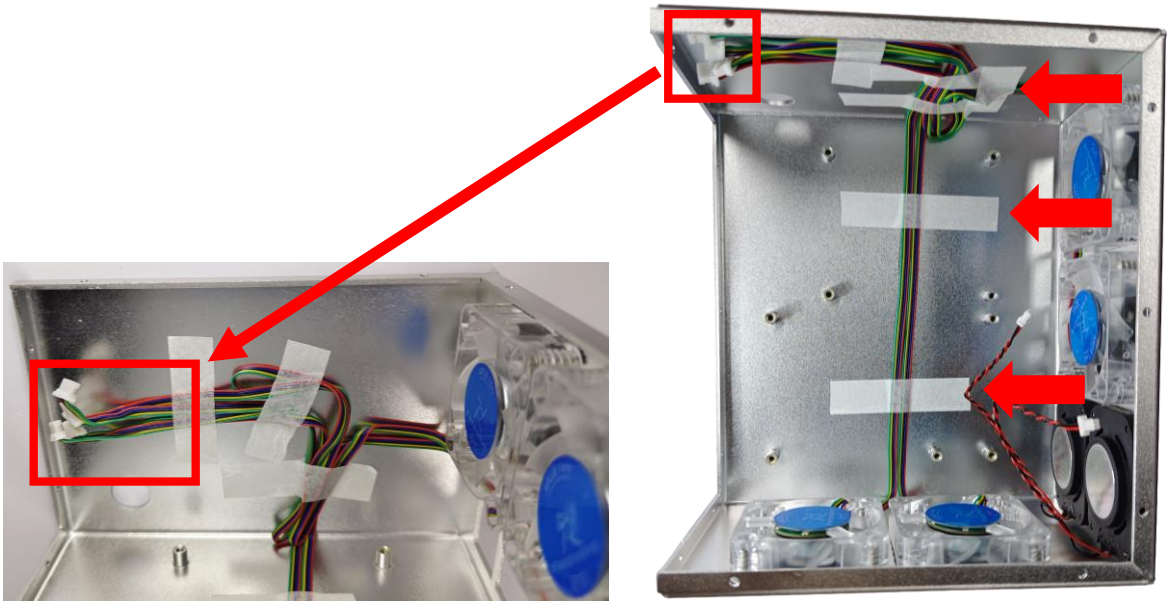
The side with the motor frame and protective grille is the **air outlet**.



Step 1: Install the case fan. Place the dust filter between the fan and the case. Secure the fan using four M3.7x10 countersunk head screws from the outside of the case. Note: During installation, ensure the fan's airflow direction is correct – it should draw cool air in from the bottom of the case and exhaust hot air from the right side. This creates a consistent airflow, effectively lowering the internal operating temperature of the case. Note: For a cleaner cable layout, the fan cable side should be positioned to the bottom of the case.



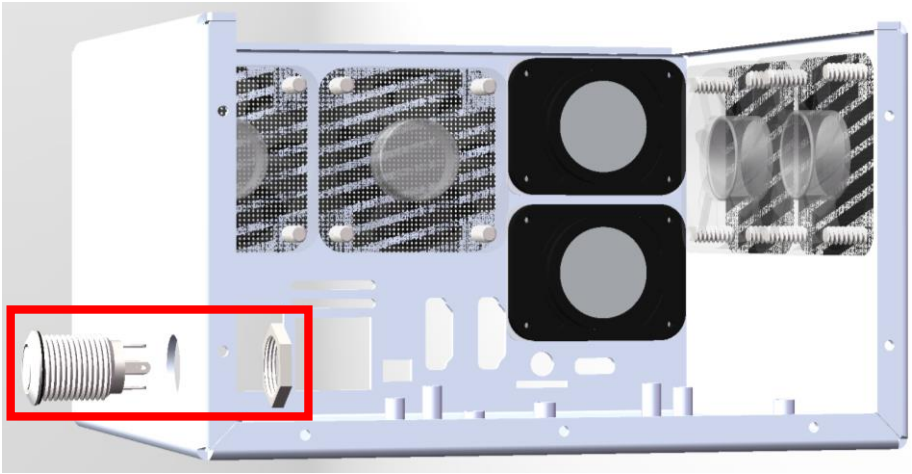
Step 2: Secure the fan cable to the case frame using masking tape. Route the connector to the center of the case for easy connection to the GPIO board, thus maintaining a tidy interior.



2.1.3 Installing the Power Button

Step 1: Insert the Black Sealing Gasket into the 12mm LED Power Button.

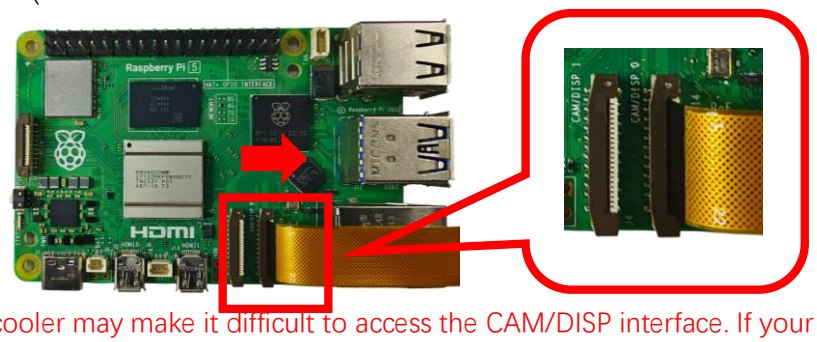
Step 2: Install the 12mm LED Power Button into the circular hole on the top of the case, and secure it from the inside with an M12 nut.



2.2 Installing Electronic Parts and Connecting Cables

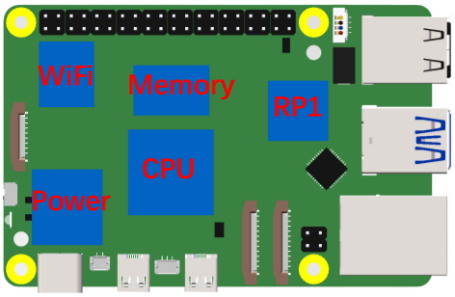
2.2.1 Insalling the Tower Cooler

Step 1: For users buying the variants equipped with **a 4.3-inch touchscreen (FNK0107P\Q\R\U\V\W)** and those who want to use the camera with this kit, please connect the DSI cable and the camera cable to the Raspberry Pi's **CAM/DISP** interface. (**The red arrow below indicates the orientation of the contacts**)

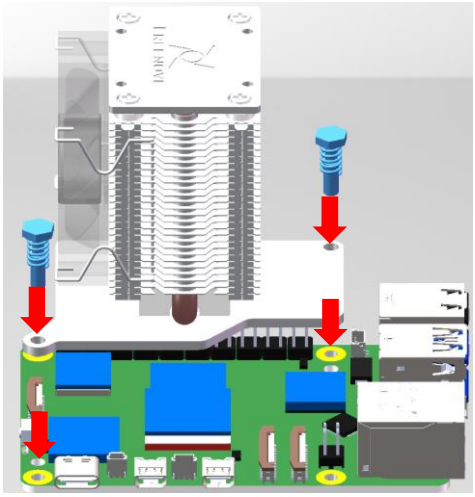


Note: The installation of a tower cooler may make it difficult to access the CAM/DISP interface. If your model includes a 4.3-inch screen (FNK0107P/Q/R/U/V/W) or if you need to connect a device (such as a camera) to this interface, you must connect the cable before installing the cooler. Otherwise, you may skip this step.

Step 2: Identify the five thermal pads by size and apply each one to its corresponding chip on the RPi 5. (Important: Ensure you remove the protective film from both sides of each pad to guarantee optimal thermal conductivity.)

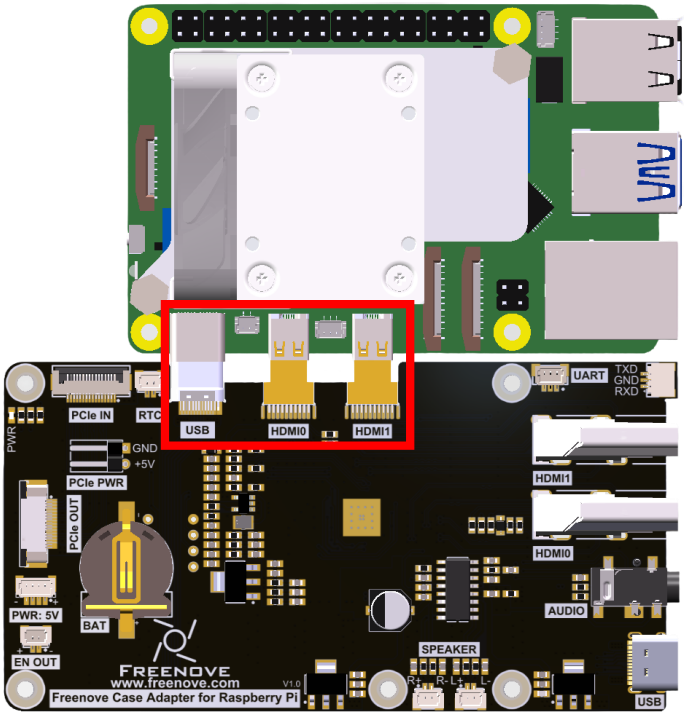


Steps 3: Fix the Tower Cooler to RPi 5 with the Nylon standoffs.

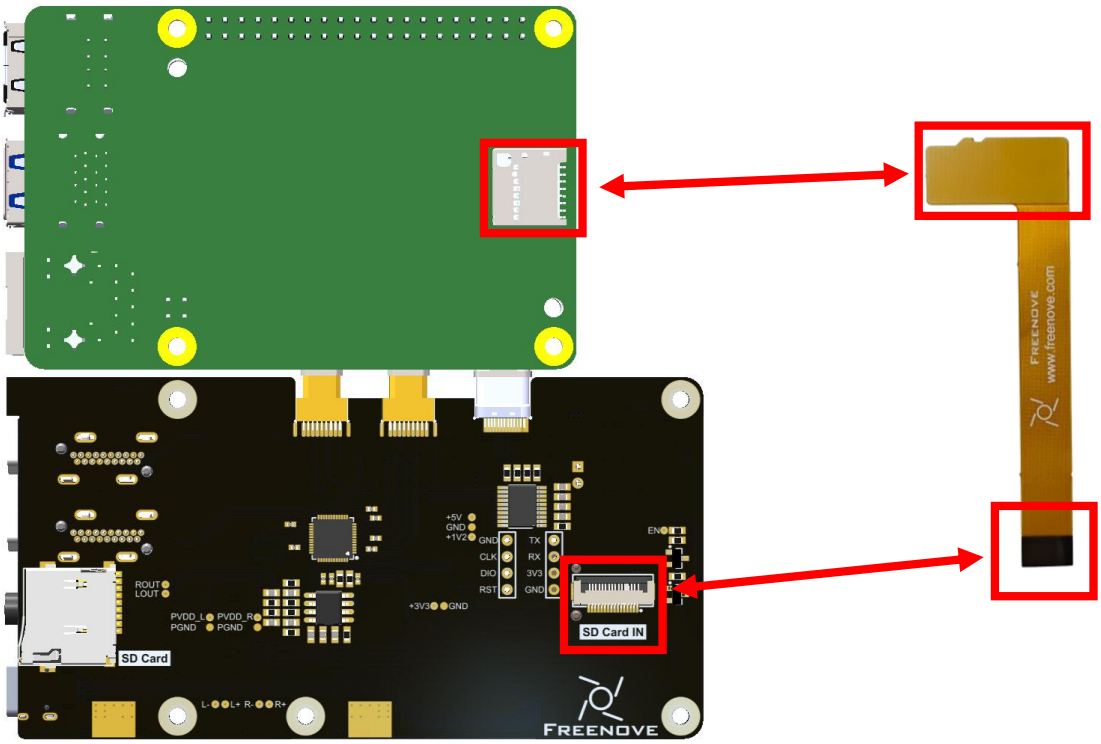


2.2.2 Instlaing Audio-Video Board

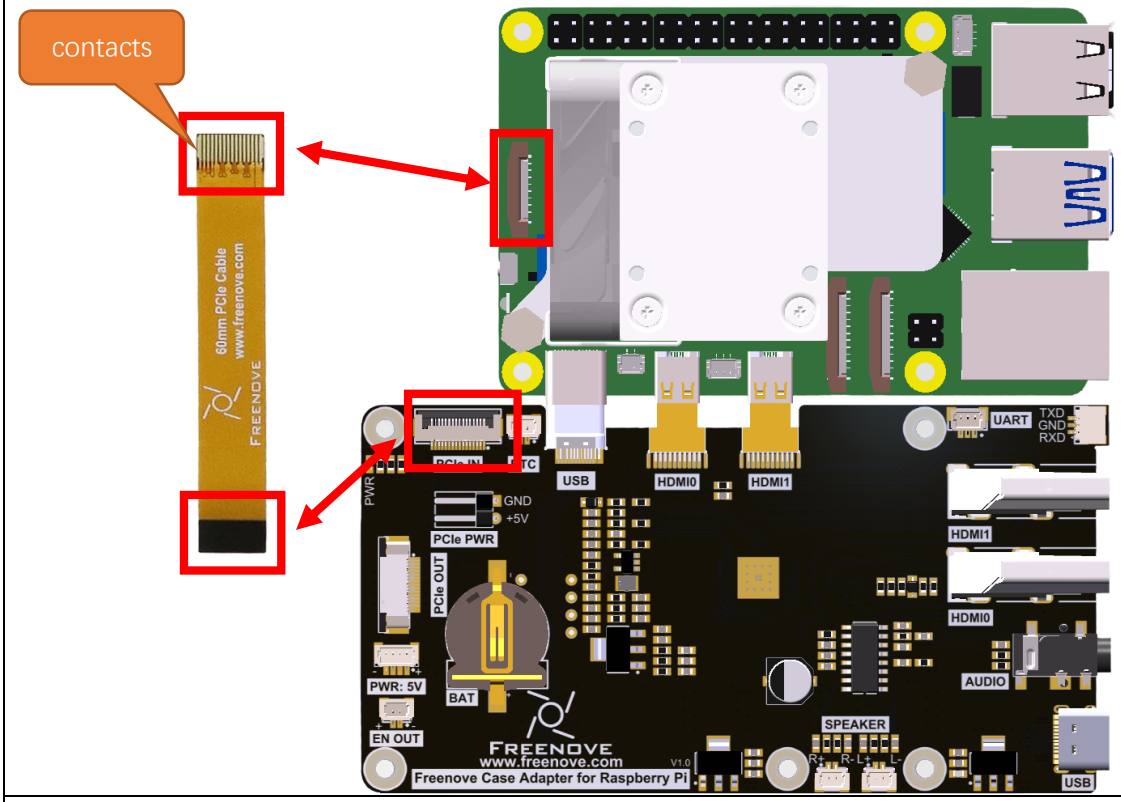
Step 1: Align the Type-C and HDMI ports of the Raspberry Pi 5 and the Audio-Video Board, then insert the Audio-Video Board into the Raspberry Pi 5.



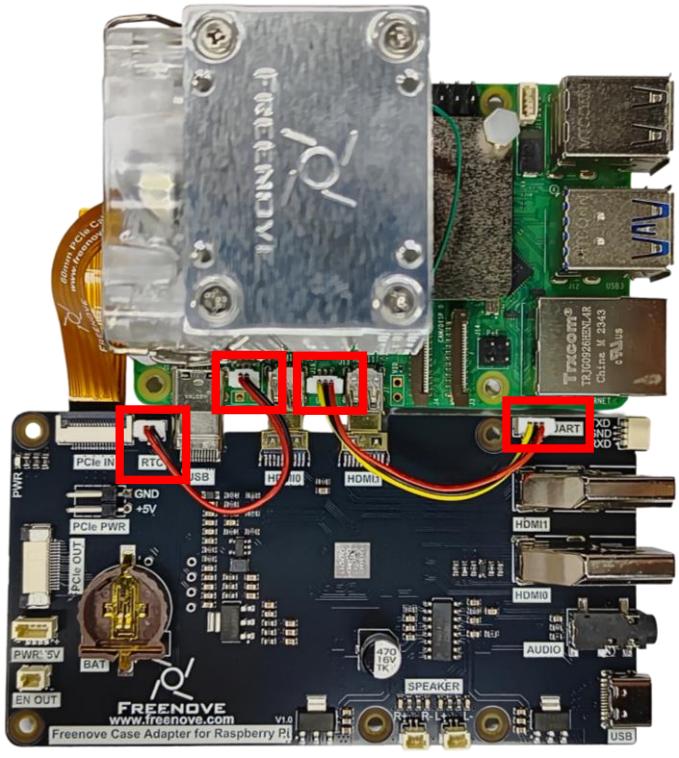
Step 2: Insert the **To Pi** end of the SD Card to 0.5mm-16P FPC cable to the **RPi 5's SD card slot**, then connect the **To Adapter** end to the **SD Card IN interface** on te Audio-Video Board. (Contacts bottom)



Step 3: Insert one end of the reverse straight cable to the RPi 5's **PCIe interface** (The contacts should face the active cooler.), then connect the other end to the **PCIe IN interface** on the Audio-Video Board (The contacts should face the bottom.).

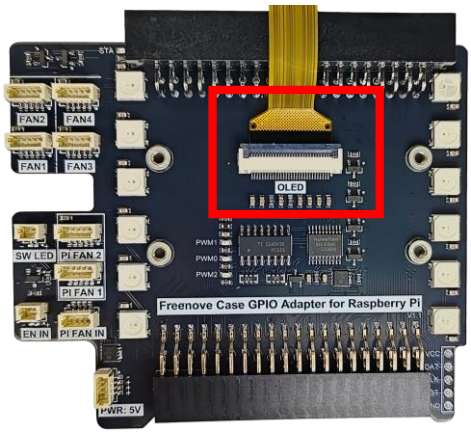


Step 4: Connect the **RTC interface** between the RPi 5 and the Audio-Video Board using a 5cm SH1.0mm 2-pin cable. Then, connect their **UART interface** using a 5cm SH1.0mm 3-pin cable.



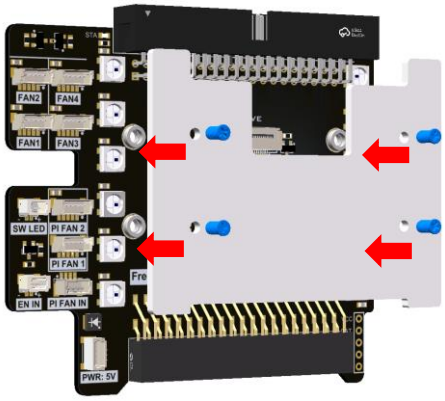
2.2.3 Installing the GPIO Board

Step 1: Connect the flex cable of the 0.96-inch OLED display to the OLED interface on the GPIO Board, with the contacts facing the bottom

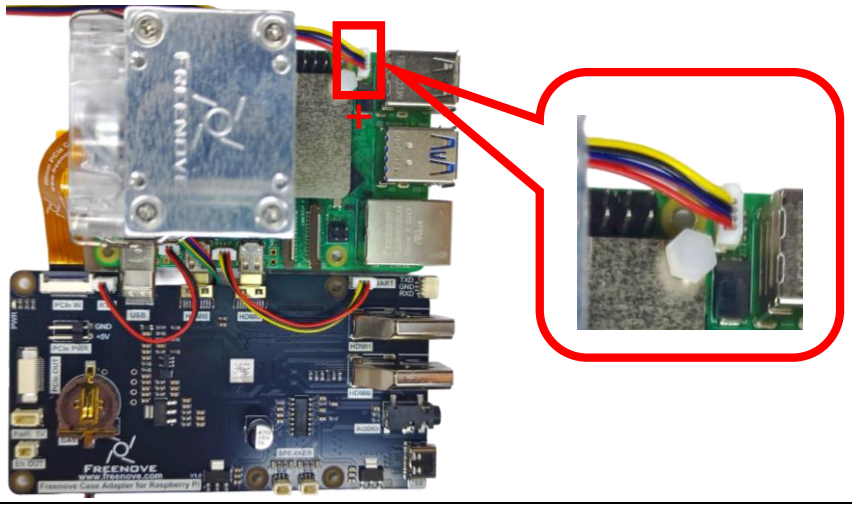


Important: The display glass is fragile – please exercise extreme caution during installation.

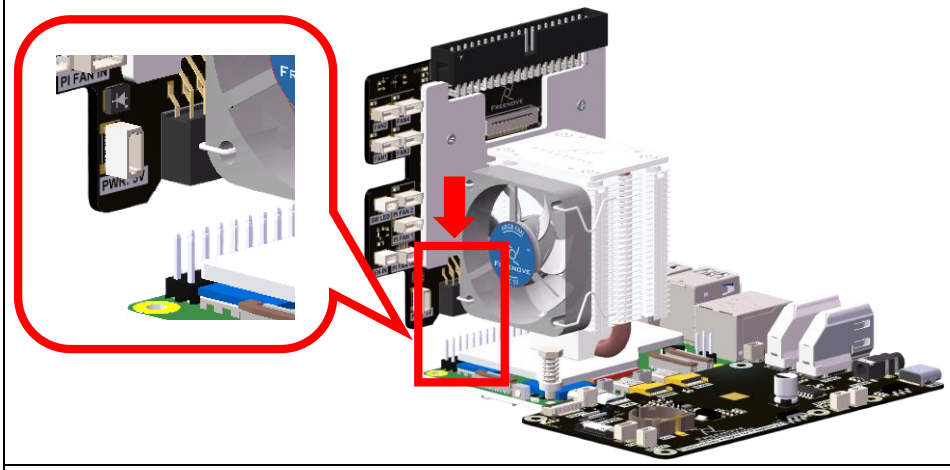
Step 2: Secure the LED light diffusion plate to the GPIO board's threaded insert with M2.5x5 countersunk head screws.



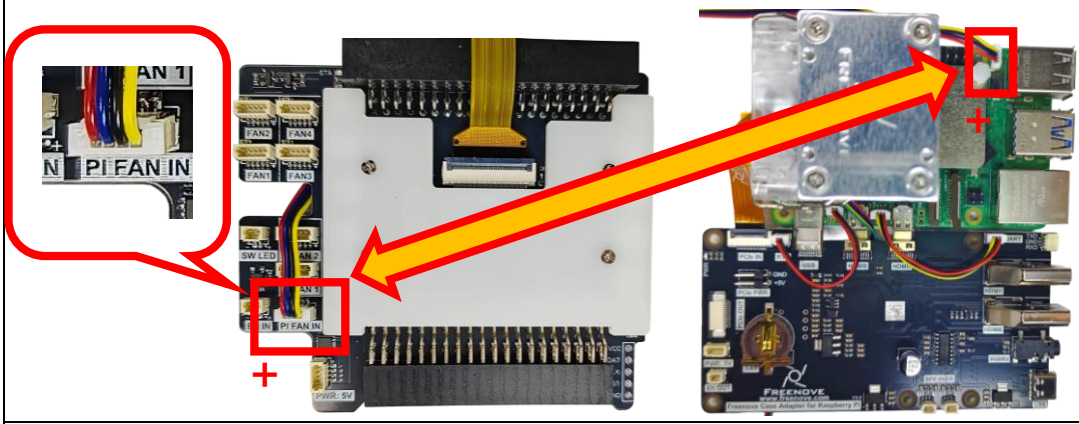
Step 3: Connect the 15cm SH1.0mm 4-pin cable to the FAN (J17) interface on the RPi 5. (Ensure the red wire connects to the terminal marked '+'. This is a non-reversible connector. Improper handling or misalignment during connection will result in permanent damage to the interface.)



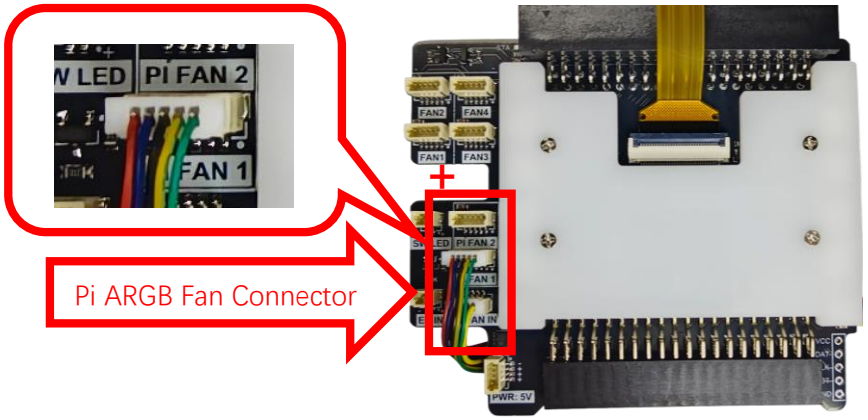
Step 4: Align the **female header** of the GPIO Board with the **GPIO header** on the RPi 5, then press the GPIO Board down to insert it. (**Caution: Proper alignment is imperative for installation. Failure to do so could lead to a short circuit and permanent burnout of the unit.**)



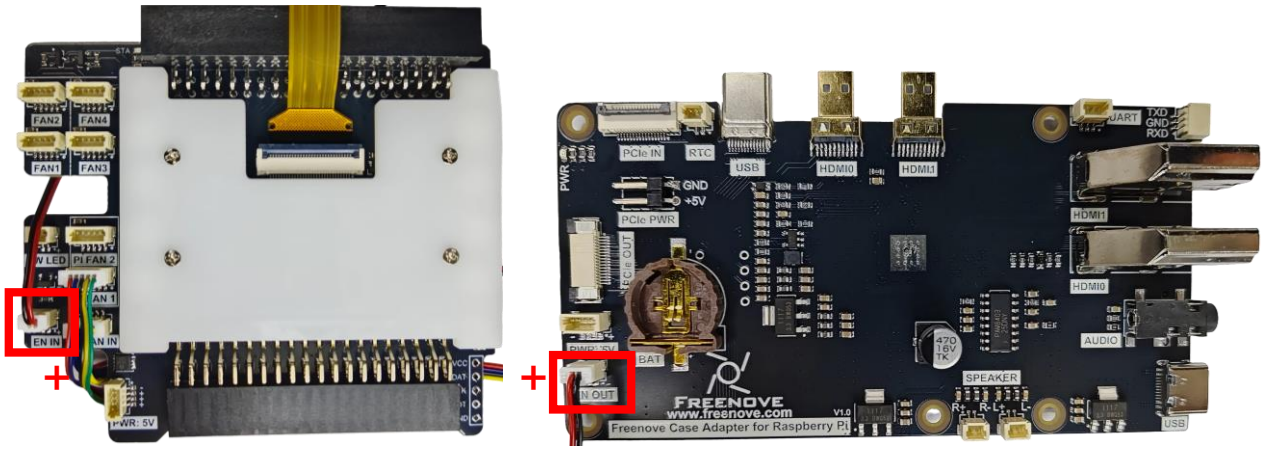
Step 5: Connect the other end of the 15cm SH1.0mm 4-pin cable to the "**PI FAN IN**" interface on the GPIO Board. (Caution: Do not connect it to the "PWR:5V" interface, as this may damage the components. The red wire must go to the terminal marked '+'. This is a non-reversible connector. Improper handling or misalignment during connection will result in permanent damage to the interface.)



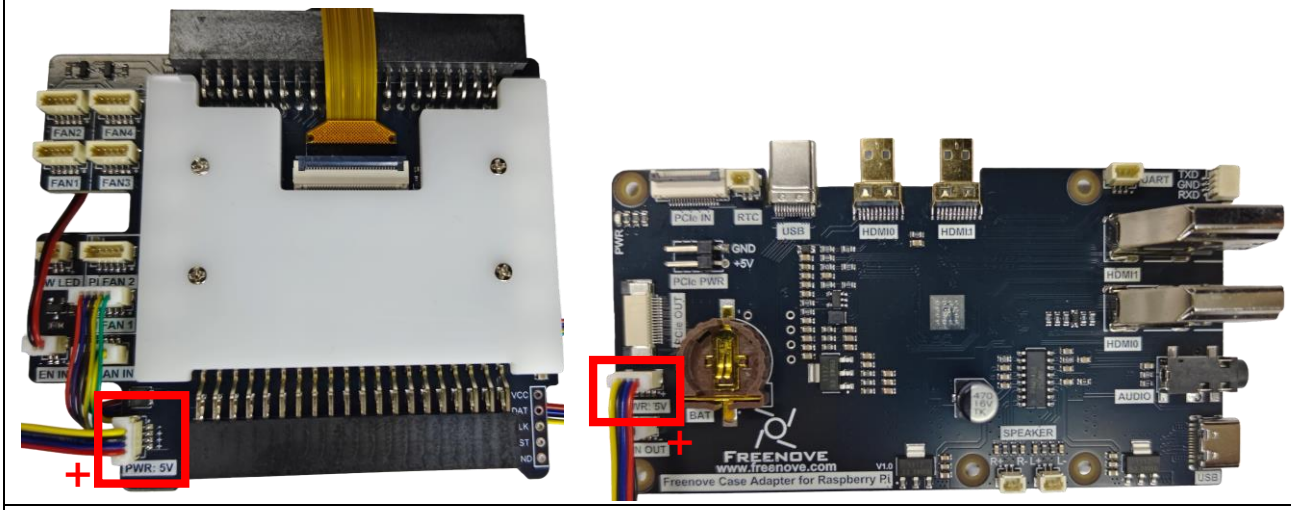
Step 6: Route the fan cable of the tower cooler around the bottom of the RPi 5 to the back of the GPIO Board, then insert it into either the **PI FAN 1 or PI FAN 2 interface**. PI FAN 1 is directly controlled by RPi 5 and PI FAN 2 is controlled by the GPIO board. We recommend connecting it to the PI FAN 1 interface.(Note: Align the red wire with the '+' mark and insert carefully to avoid bending the pins. Use tweezers to gently straighten any bent pins. This is a non-reversible connector. Improper handling or misalignment during connection will result in permanent damage to the interface.)



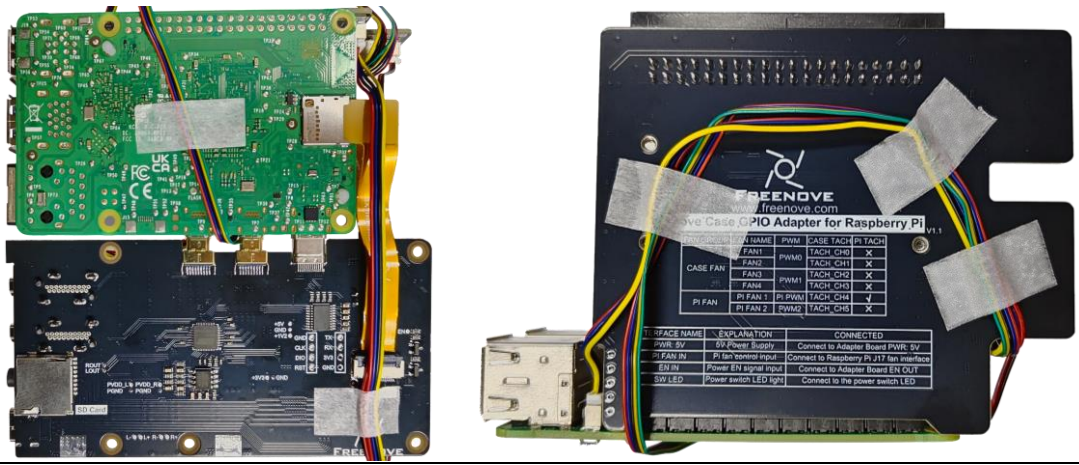
Step 7: Use the 15cm SH1.0mm 2-pin cable. Connect one end to the **EN IN interface** on the GPIO Board and the other end to the **EN OUT interface** on the Audio-Video Board. (Note: The red wire must be aligned with the terminal marked '+'. This is a non-reversible connector. Improper handling or misalignment during connection will result in permanent damage to the interface.)



Step 8: Use the 15cm SH1.0mm 4-pin cable. Connect one end to the **PWR: 5V interface** on the GPIO Board and the other end to **the PWR: 5V interface** on the Audio-Video Board. (Note: The red wire must be aligned with the terminal marked '+'. This is a non-reversible connector. Improper handling or misalignment during connection will result in permanent damage to the interface.).

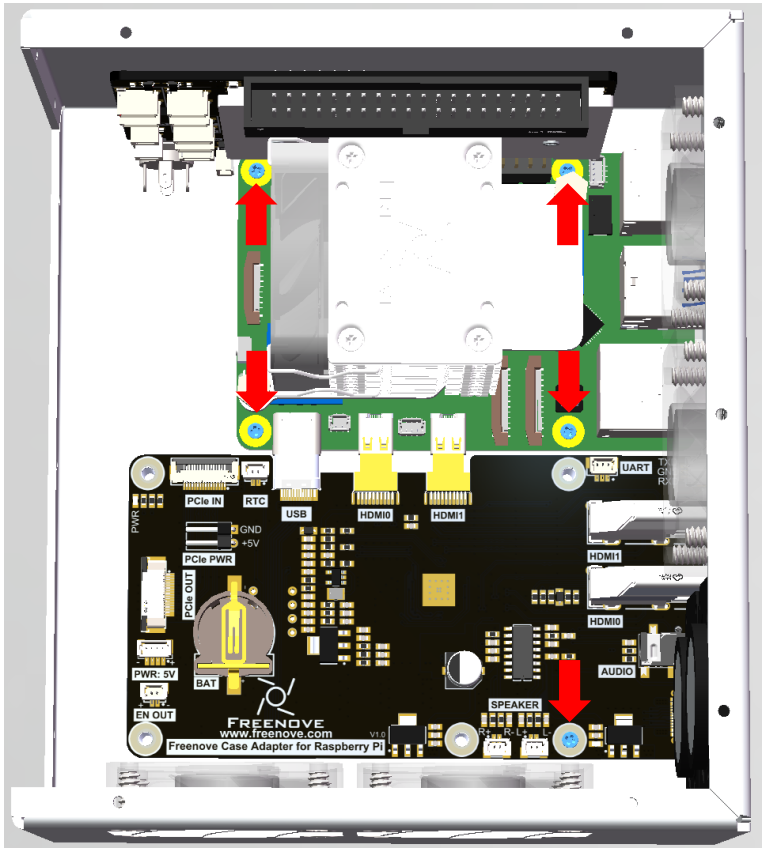


Step 9: For a clean installation, use masking tape to manage loose cables by securing them to the back or bottom of the PCB.

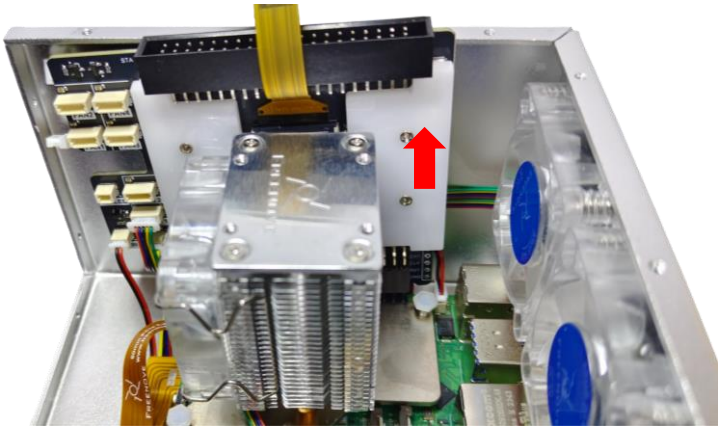


2.2.4 Installing to the Case Shell

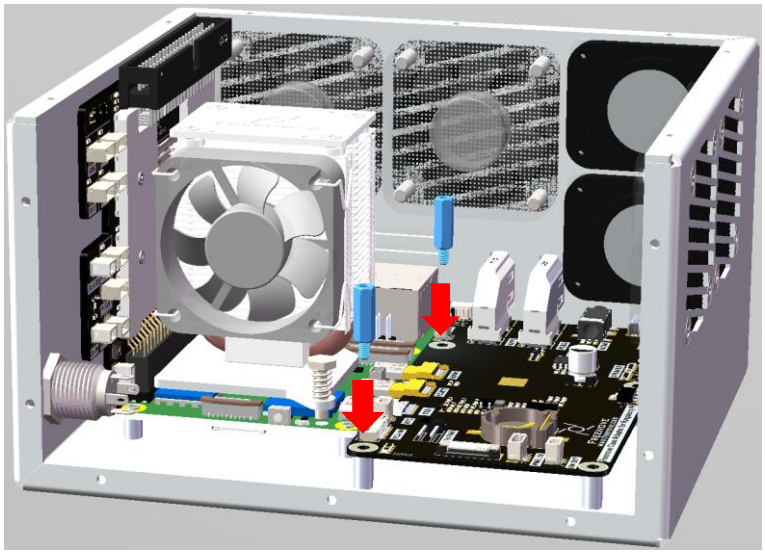
Step 1: Place the pre-assembled modules (RPi 5, Audio-Video Board, and GPIO Board) into the case. Align it with all the mounting posts, and then use M2.5x5 countersunk head screws to secure them to the case.



If there is insufficient operating space while installing the screw near the **RPi 5's FAN (J17) interface**, you can gently lift the GPIO Board on this side slightly upward. After the screw installation is complete, press it back into its original position.



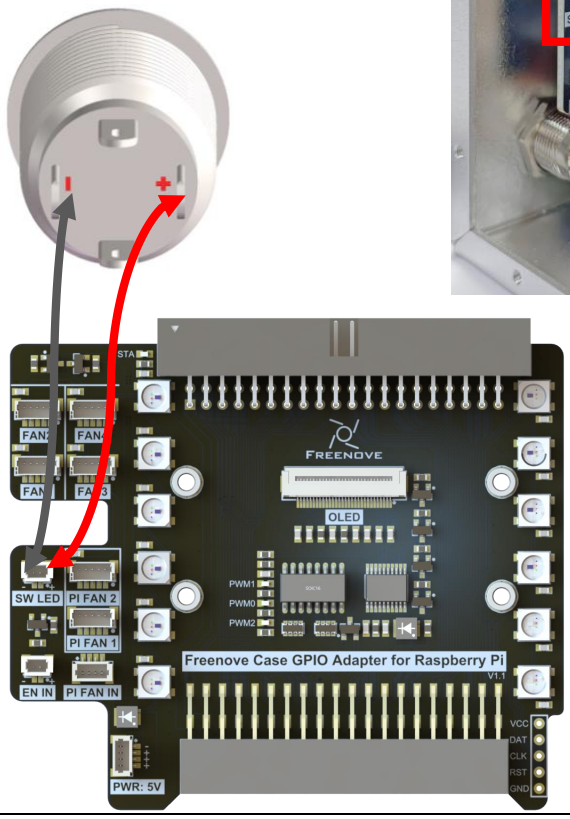
Use the M2.5x14+4 brass standoffs to secure the side of the Audio-Video Board closest to the RPi 5 onto the mounting post below.



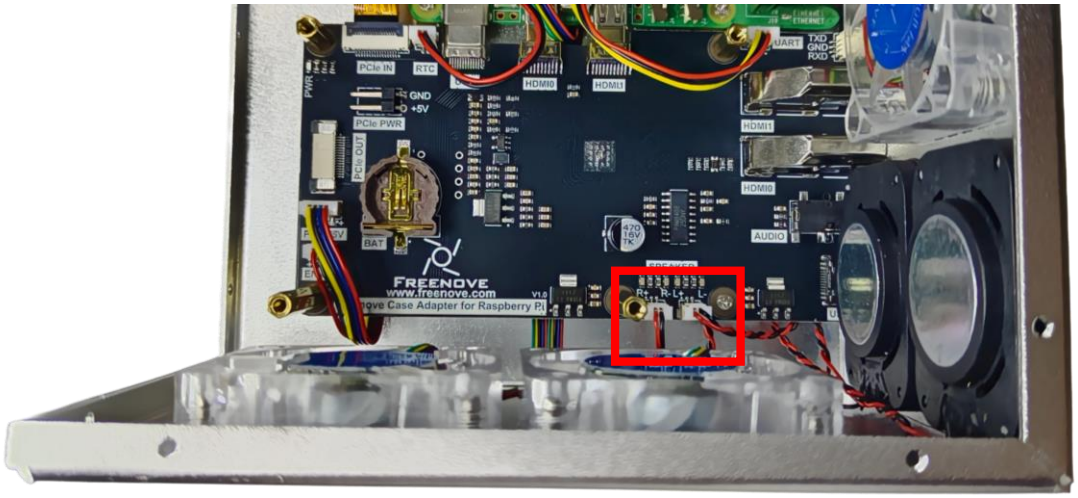
Use the M2.5x25+4 brass standoffs to secure the opposite side of the Audio-Video Board onto the mounting post.

2.2.5 Connecting Cables

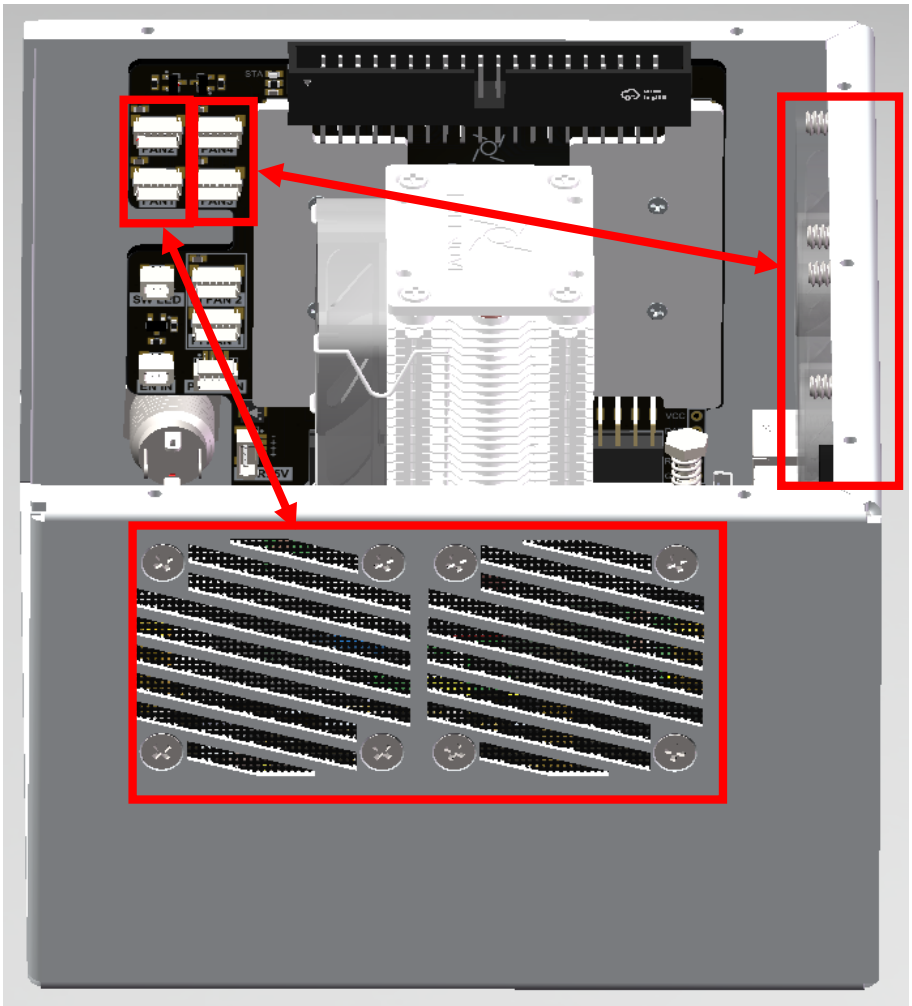
Step 1: Connect the quick-disconnect terminal end of the 7cm SH1.0mm to quick-disconnect terminal cable (red/black) to the 12mm LED Power Switch. (Note: The red wire connects to the switch's '+' terminal, and the black wire connects to the '-' terminal.) Then, connect the other end to the **SW LED interface** on the GPIO Board. (For a physical wiring reference, please see the actual installation photo below.)



Step 2: Connect the two speakers to the **SPEAKER interface** of the Audio-Video Board.

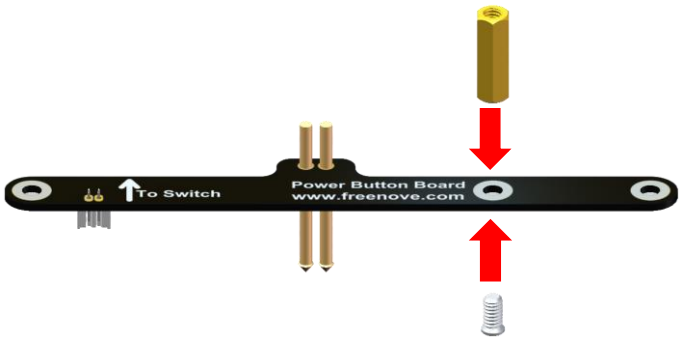


Step 3: Divide the four fans into two groups: FAN1/2 as one group, and FAN3/4 as the other. Connect the **rear fans** to the **FAN3/4 interface**, and connect the **bottom fans** to the **FAN1/2 interface**. (Note: This is a non-reversible connector; Please insert carefully to avoid bending the pins. Use tweezers to gently straighten any bent pins.)

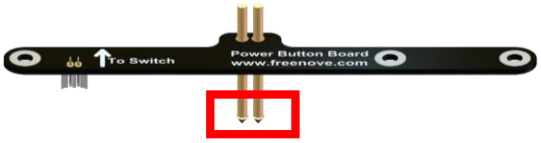


2.2.6 Connecting Switch Board

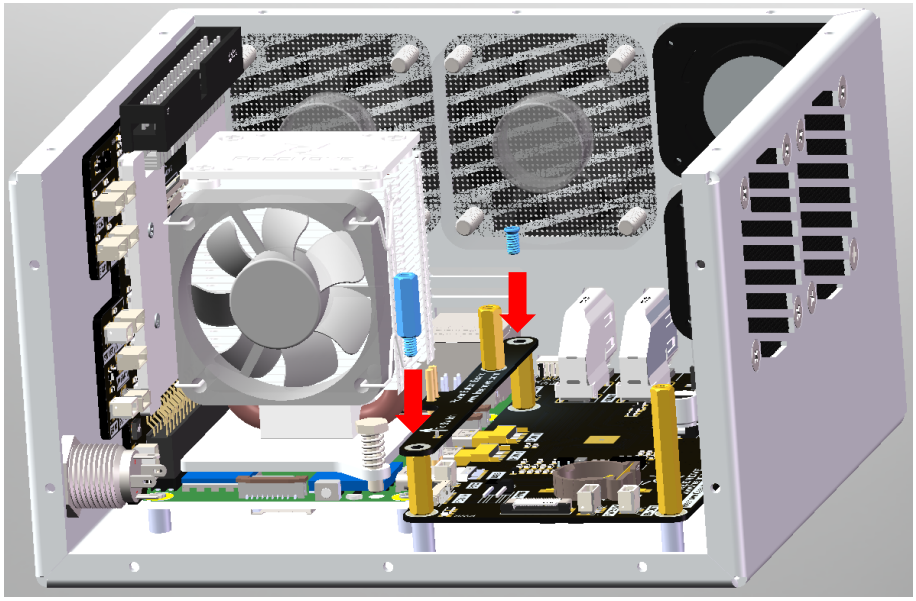
Step 1: Install the M2.5x12 brass standoff to the middle positioning location on the Switch Board, noting the orientation.



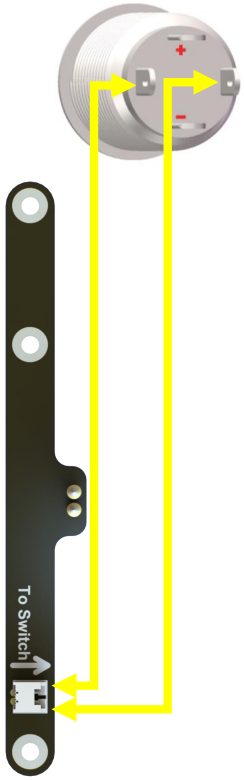
Step 2 : Align the pogo pin with the **J2 pad** located between the RPi 5's Type-C and HDMI0 ports, and then gently press the Switch Board into place.

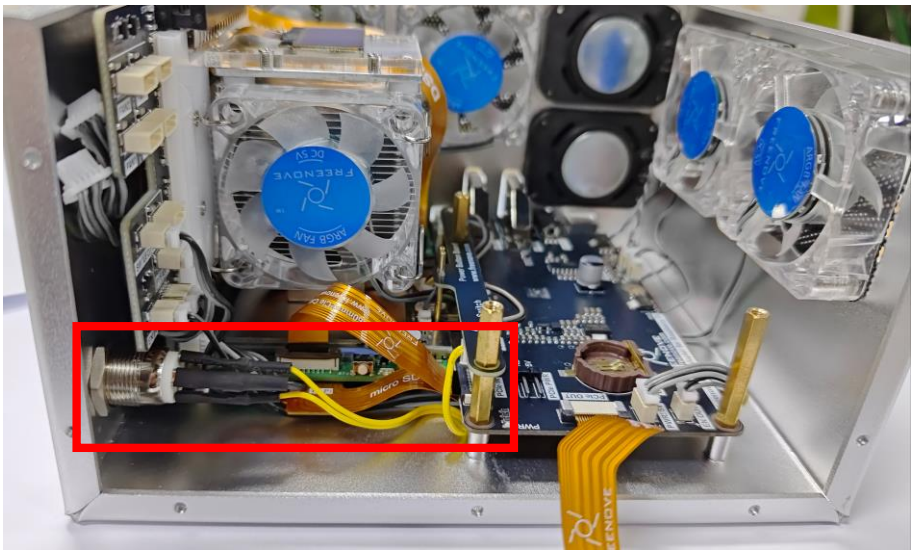


Secure the inner side of the Switch Board with M2.5x5 Countersunk Head Screws. Then, fasten the outer side with the M2.5x12+4 Brass Standoffs.



Step 3: Insert the **terminal end** of the 7cm 1.25mm-to-2.8 quick-disconnect terminal cable (yellow-yellow) into the 12mm LED Power Switch. Then, insert the other end into the interface on the Switch Board.





2.2.7 Installing the NVMe Adapter Board

Please select your product model below to view the corresponding installation instructions for the NVMe Adapter Board.

For **FNK0107A/H/P/U**: NVMe Adapter Board

For **FNK0107B/K/Q/V**: Dual-NVMe Adapter Board

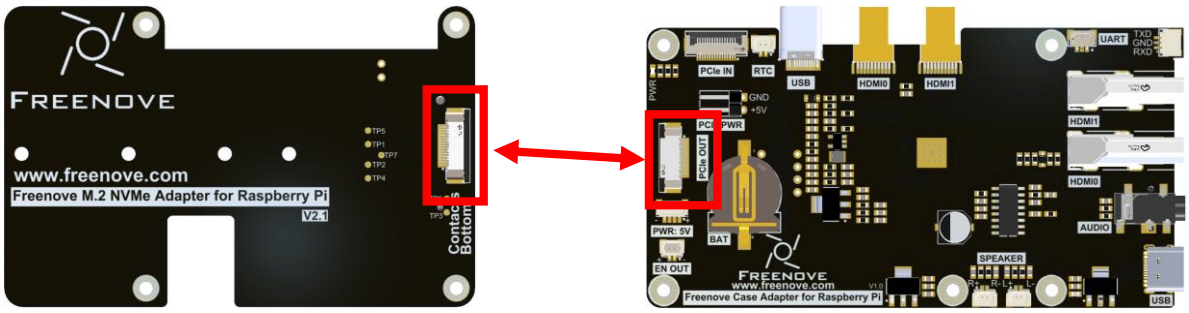
For **FNK0107C/L/R/W**: Quad-NVMe Adapter Board

Installing NVMe Adapter Board

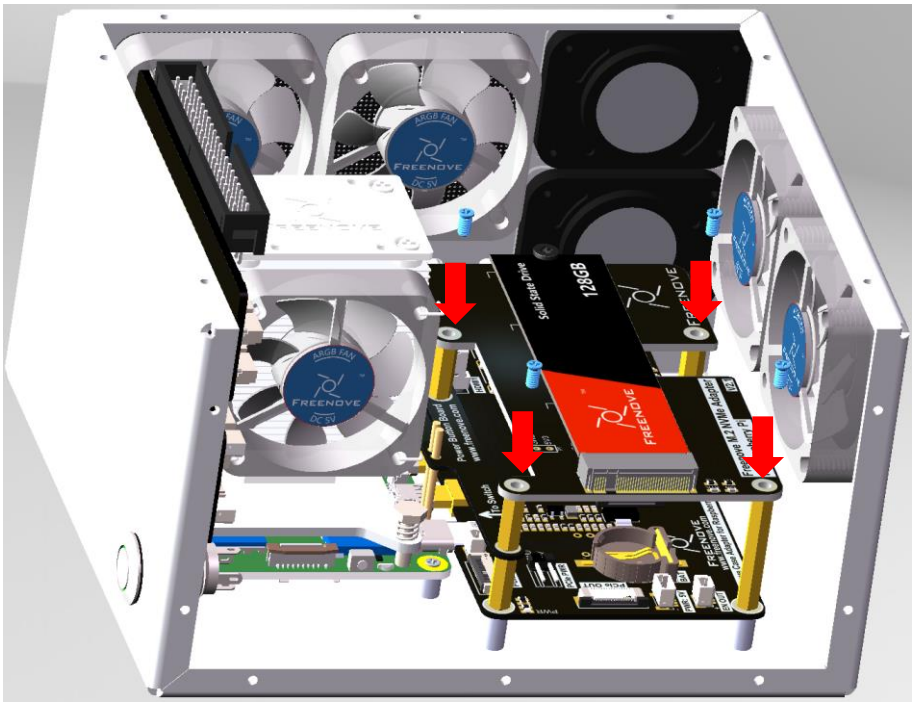
Step 1: Based on the physical dimensions of your SSD, install the M2.5x3+3 brass standoff into the mounting hole corresponding to the 2230/2242/2260/2280 specification. Secure it from the reverse side using an M2.5 nut.

Step 2: Tilt the SSD to insert it into the NVMe slot, and then secure it using an M2.5x2.5x5 flat-head screw.

Step 3: Connect one end of the NVMe cable to the PCIe OUT interface on the Audio-Video Board (**contacts facing up**), then connect the other end to the FPC interface on the reverse side of the NVMe Adapter Board (**contacts facing down).**



Step 4: Secure the NVMe Adapter Board with M2.5x5Countersunk Head Screws

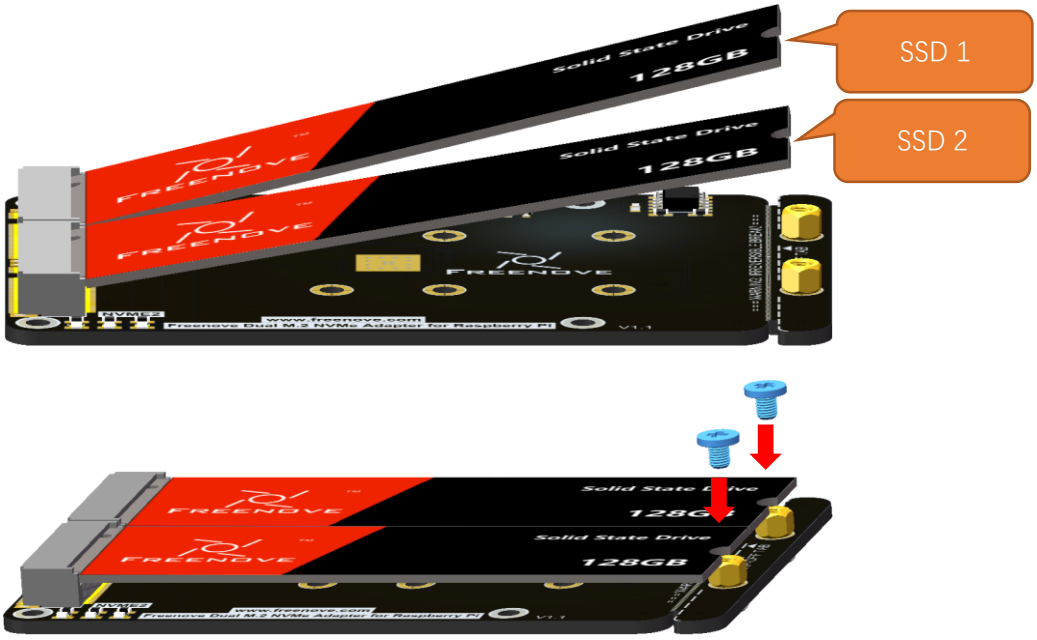


Installing Dual-NVMe Adapter Board

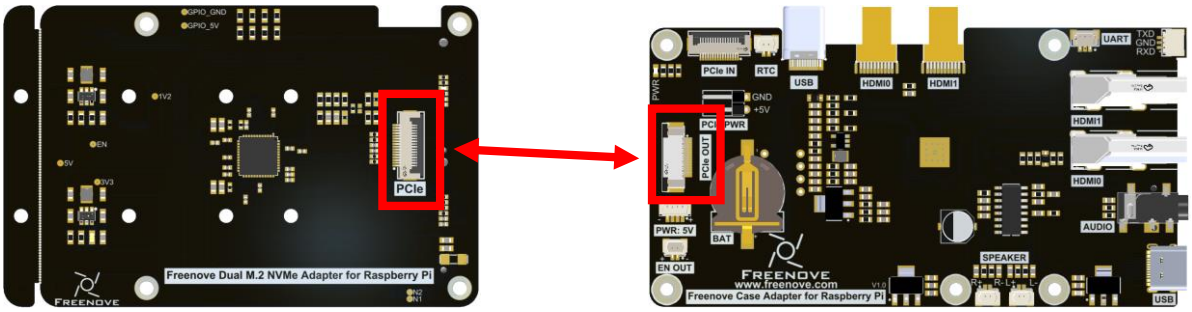
Step 1: Based on the physical dimensions of your SSD, install two M2.5x3+3 brass standoffs into the mounting hole corresponding to the 2230/2242/2260/2280 specification. Secure them from the reverse side with M2.5 nuts.

Note: This Adapter Board supports up to two SSDs. Install 0 to 2 SSDs based on your preference.

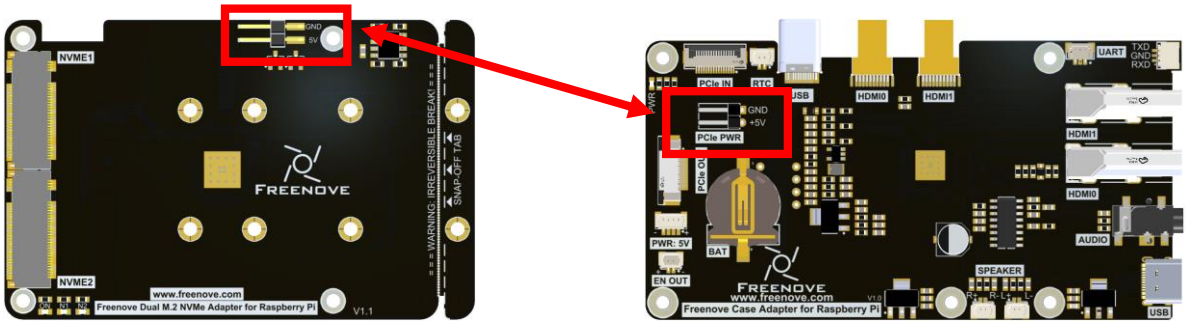
Step 2: Tilt the SSDs to inster them into the two NVMe slots, and then secure them using M2.5x2.5x5 flat-head screws.



Step 3: Connect one end of the NVMe cable to the PCIe OUT interface on the Audio-Video Board (**contacts facing up**), then connect the other end to the FPC interface on the reverse side of the NVMe Adapter Board (**contacts facing toward the board).**

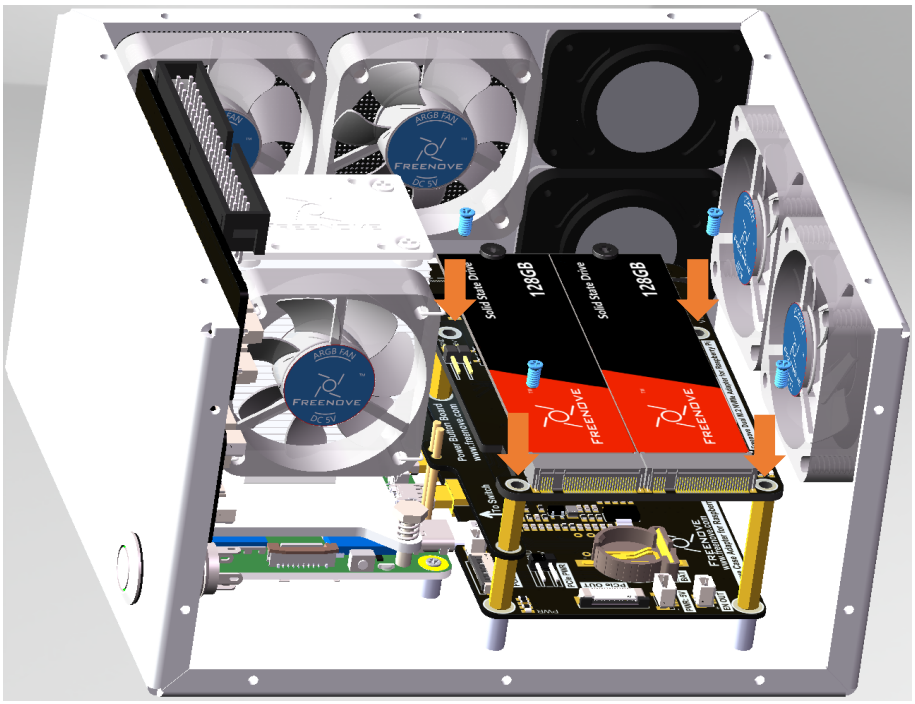


Step 4: Connect two female-to-female jumper wires. Attach one end to the **PCIe PWR interface** on the Audio-Video Board, and the other end to the **pin headers** on the Dual-NVMe Adapter Board. (Caution: The red wire must connect to the 5V pin, and the black wire to the GND pin. Incorrect wiring may cause a short circuit and damage the device.)



Generally, connecting the two jumper wires is not required. However, for SSDs with higher power consumption, it is necessary to connect them to ensure adequate power supply and stable operation.

Step 5: Secure the Dual-NVMe Adapter Board with M2.5x5Countersunk Head Screws.



Installing Quad-NVMe Adapter Board

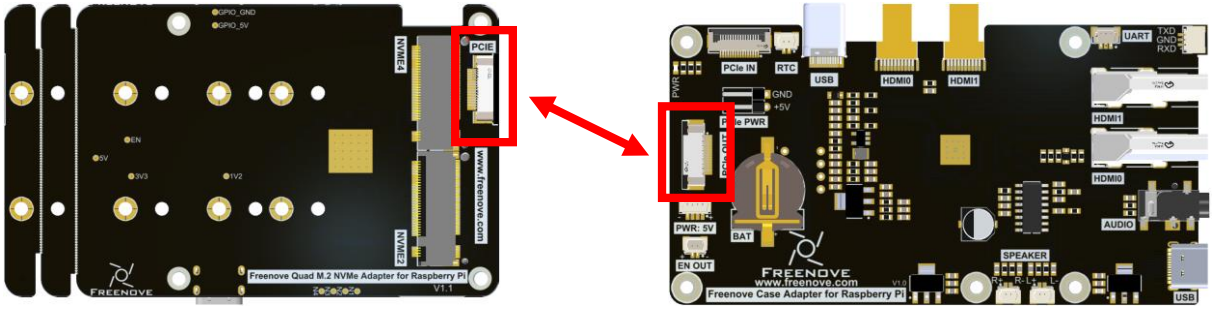
Step 1: Based on the physical dimensions of your SSD, install four M2.5x3+3 brass standoffs into the mounting hole corresponding to the 2230/2242/2260/2280 specification. Secure them from the reverse side with M2.5 nuts. It is recommended that you install standoffs to all the four mounting holes.

Note: This Adapter Board supports up to four SSDs. Install 0 to 4 SSDs based on your preference.

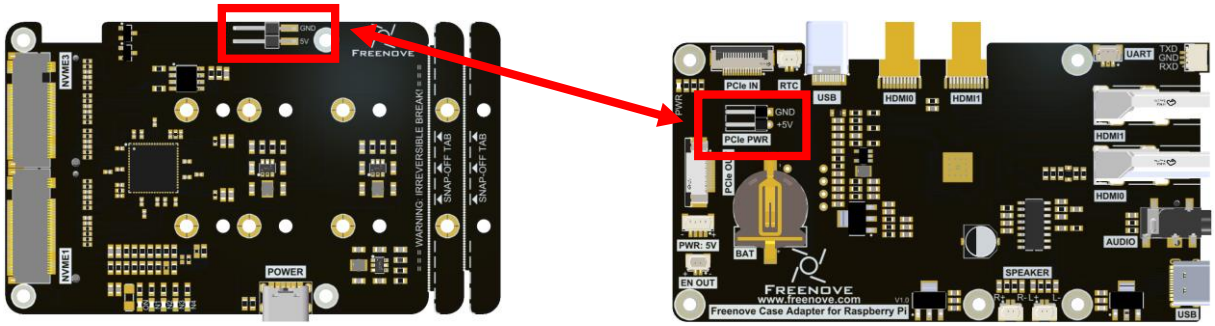
Step 2: Tilt the SSDs to inster them into the two NVMe slots on the front side, and then secure them using M2.5x2.5x5 flat-head screws.

Step 3: Tilt the SSDs to inster them into the two NVMe slots on the back side, and secure them using M2.5x2.5x5 flat-head screws.

Step 4: Connect one end of the NVMe cable to the **PCIe OUT interface** on the Audio-Video Board (**contacts facing up**), and connect the other end to the **PCIe interface** on the reverse side of the Quad-NVMe Adapter Board (**contacts facing toward the board**).

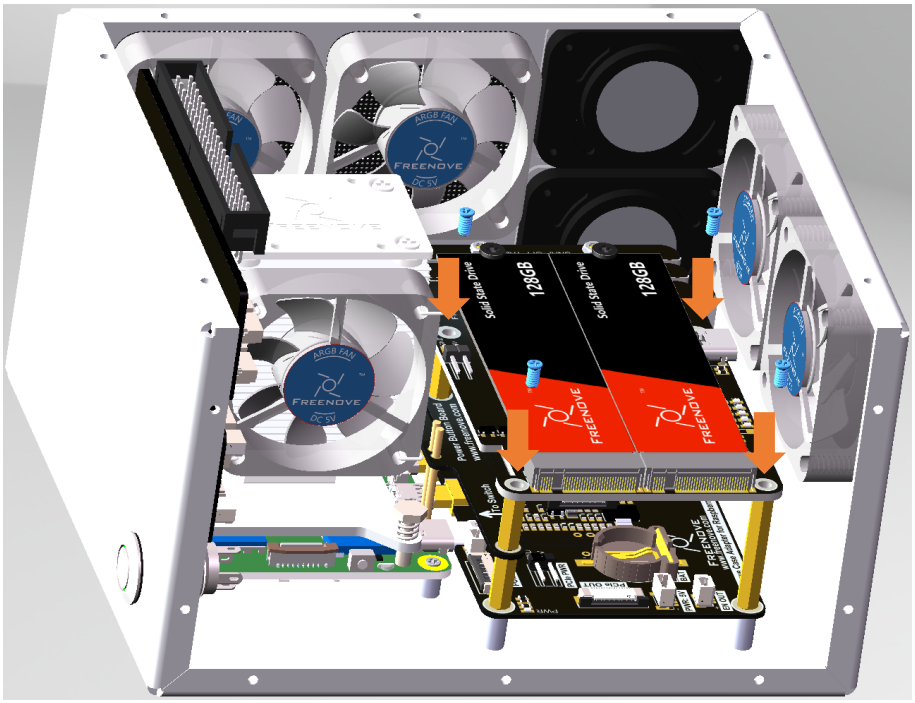


Step 5: Connect two female-to-female jumper wires. Attach one end to the **PCIe PWR interface** on the Audio-Video Board, and the other end to the **pin headers** on the Quad-NVMe Adapter Board. (Caution: The red wire must connect to the 5V pin, and the black wire to the GND pin. Incorrect wiring may cause a short circuit and damage the device.)



Generally, connecting the two jumper wires is not required. However, for SSDs with higher power consumption, it is necessary to connect them to ensure adequate power supply and stable operation.

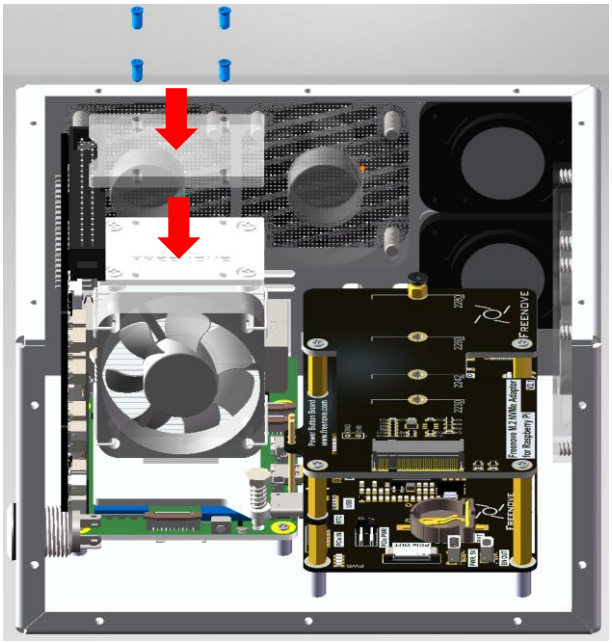
Step 6: Secure the Dual-NVMe Adapter Board with M2.5x5Countersunk Head Screws.



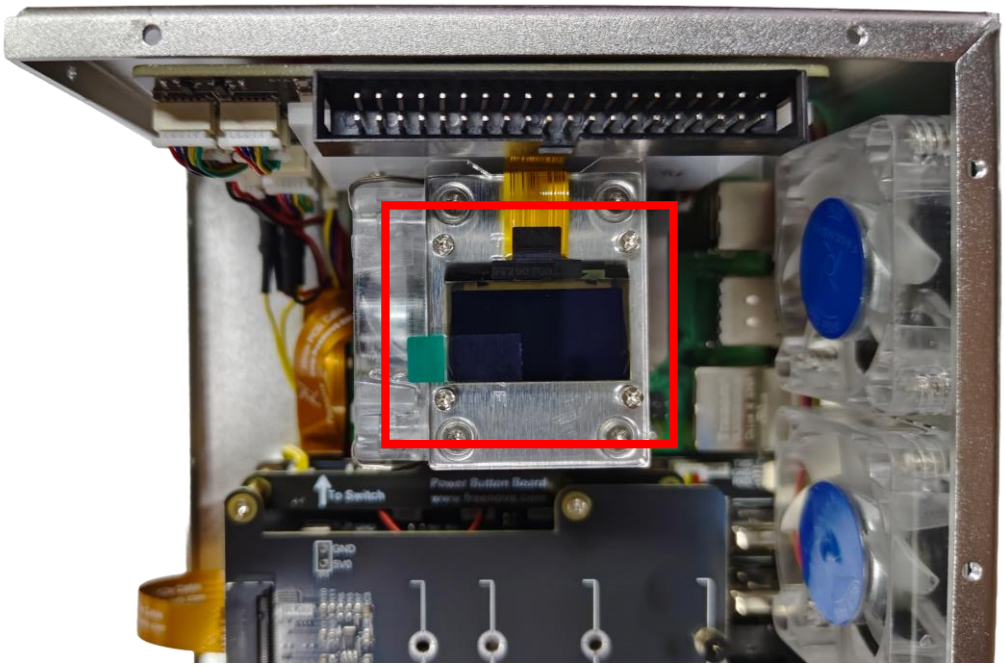
2.3 Installing Acrylic Parts and 4.3" Touchscreen

2.3.1 Installing OLED's Acrylic

Step 1: Mount the acrylic part for the OLED to the top of the tower cooler with M2.5x5 countersunk head screws. Ensure the acrylic notch faces the GPIO Board.



Step 2: Remove the white film from the 3M adhesive on the back of the OLED, align it with the center of the four screw holes, and press it into place.



Note: The glass on the 0.96-inch OLED display is fragile. Ensure it is properly aligned before applying. Repeated attachment and removal may cause the glass to crack.

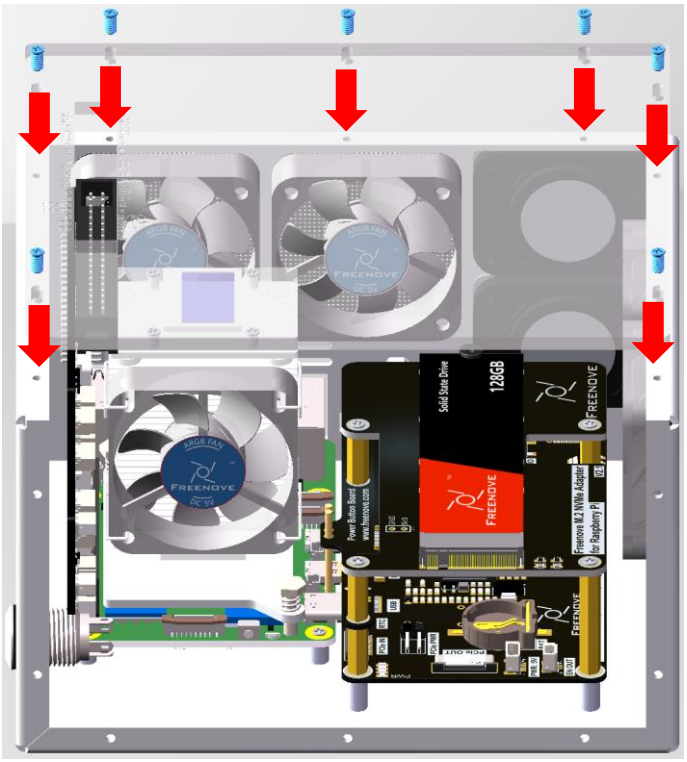
2.3.2 Installing Case Acrylic

- **For models without a 4.3-inch Screen (Model numbers: FNK0107A/B/C/H/K/L):**
  If you have purchased one of the models listed above, your kit does not include a 4.3-inch Screen. To view the installation details for the corresponding acrylic case, please click here: Installation without Screen

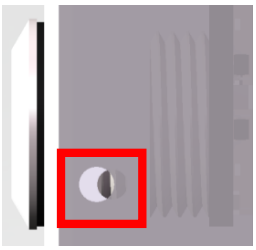
- **For models equipped with a 4.3-inch Screen (Model numbers: FNK0107P\Q\R\U\V\W):**
  If you have purchased one of the models listed above, your kit includes a 4.3-inch Screen and two sets of acrylic case parts with different structures, supporting both landscape and portrait orientations. Please choose your preferred installation method: Landscape Mounting or Portrait Mounting.

Installation without Screen

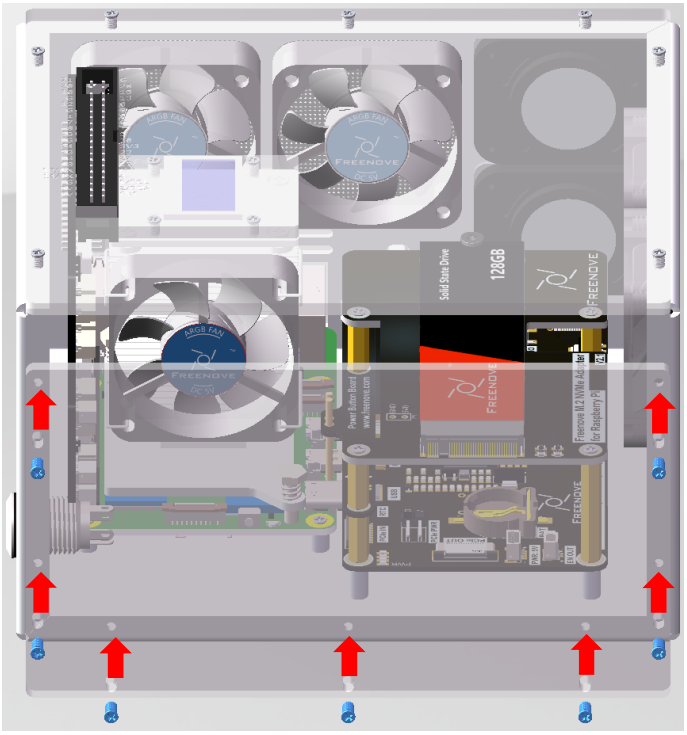
Step 1: Align the top acrylic platel with the GPIO headers, and secure it using M2.5x5 countersunk head screws.



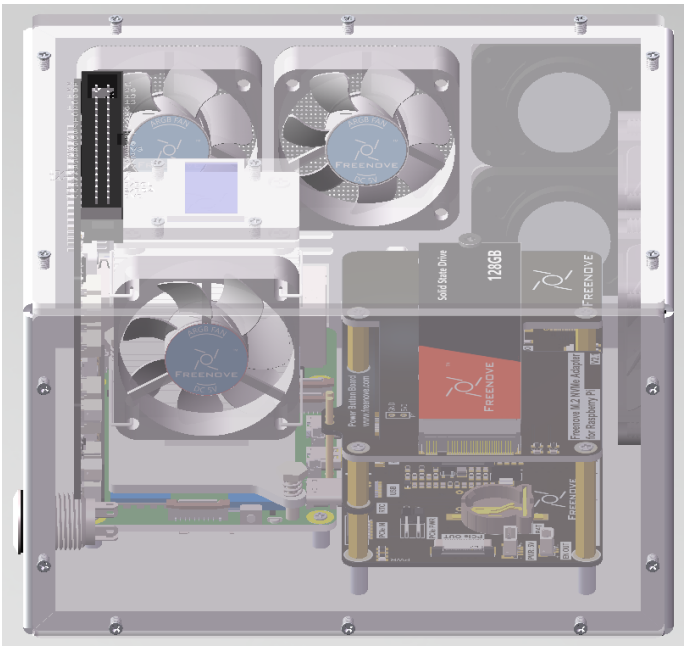
Note: Owing to the machining precision limitations of sheet metal parts, if you notice that certain screw holes do not align properly, this is not an indication of an error. In such cases, you can apply force to bend and align them as needed.



Step 2: Secure the side acylic plate with M2.5x5 countersunk head screws.

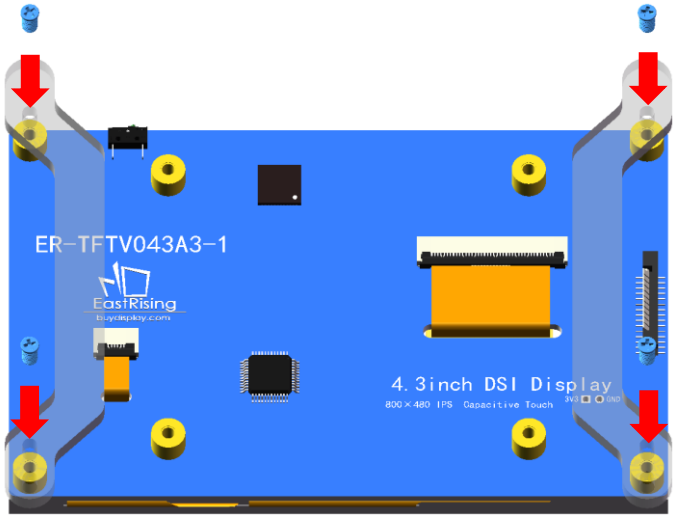


Now you have finished assembling the case without the touchscreen.

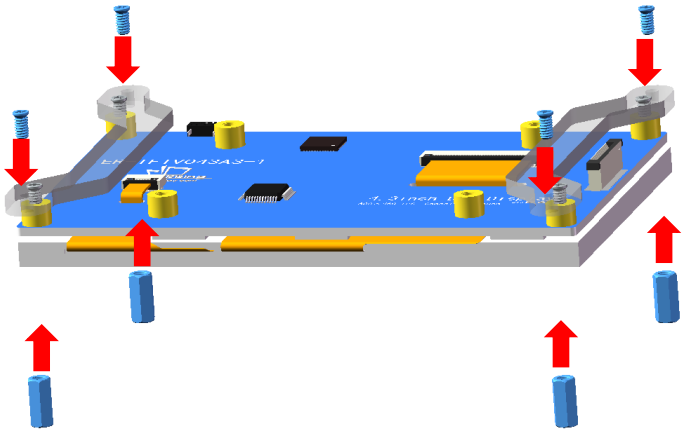


Landscape Mounting

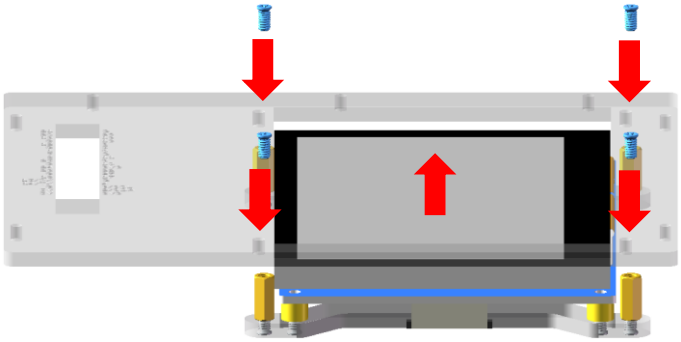
Step 1: Secure the **landscape display bracket** to the back of the 4.3-inch display using M2.5x5 countersunk head screws. The fixing holes are the **inner set of holes** on the bracket.



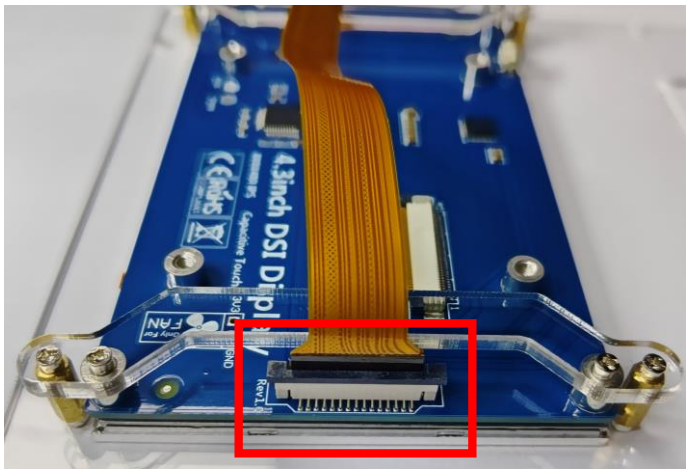
Step 2: Secure the M2.5x9 brass standoff to the landscape display bracket using M2.5x5 countersunk head screwS. Use the **outer set of holes** on the bracket.



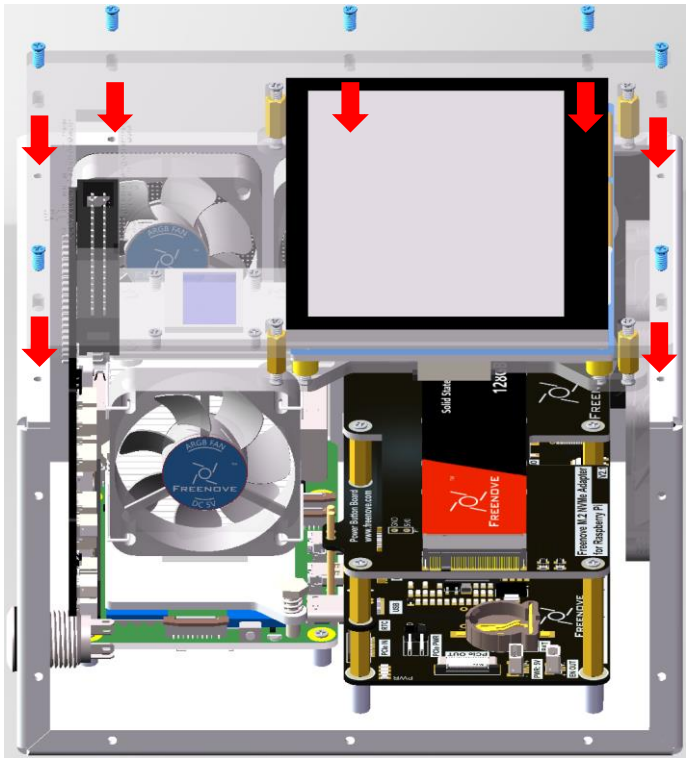
Step 3: Align the pre-assembled 4.3-inch screen with the mounting holes on the top acrylic plate, and secure it using M2.5x5 countersunk head screws.



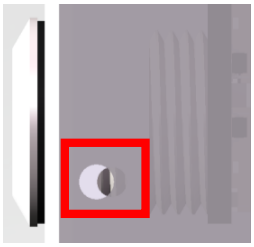
Step 4: Connect the other end of the 160mm DSI FPC cable to the connector on the back of the 4.3-inch screen, ensuring the contacts are facing inward toward the display.



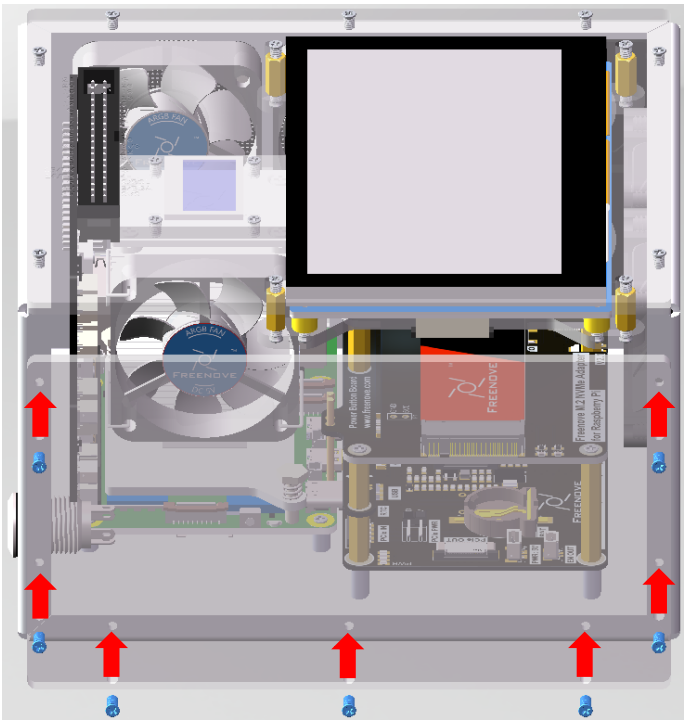
Step 5: Align the top acrylic platel with the GPIO headers, and secure it using M2.5x5 countersunk head screws.



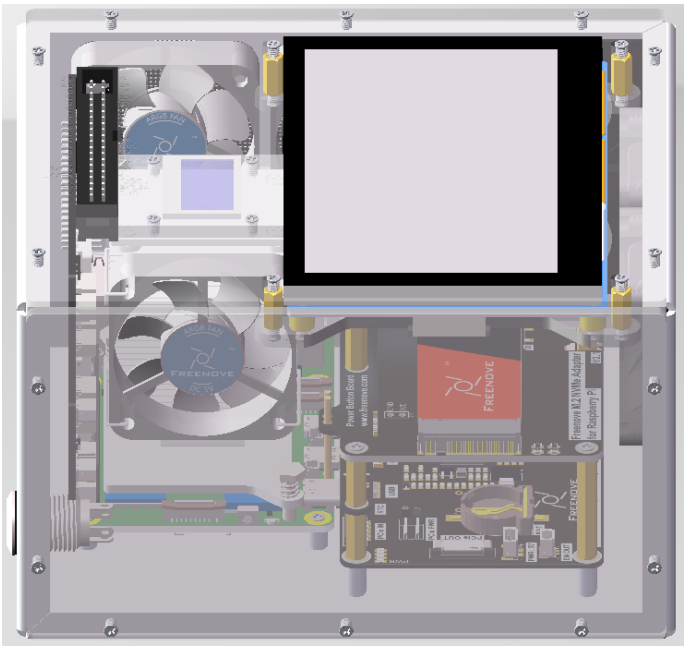
Note: Owing to the machining precision limitations of sheet metal parts, if you notice that certain screw holes do not align properly, this is not an indication of an error. In such cases, you can apply force to bend and align them as needed.



Step 6: Secure the side acylic plate with M2.5x5 countersunk head screws.

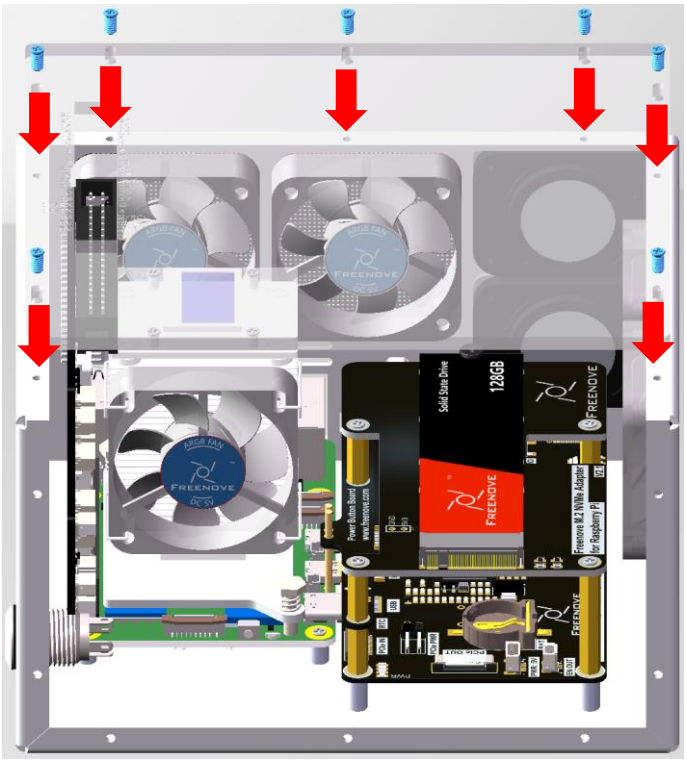


Now, you have finished assembling the case with a lanscape-oriented display.

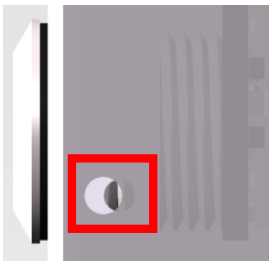


Portrait Mounting

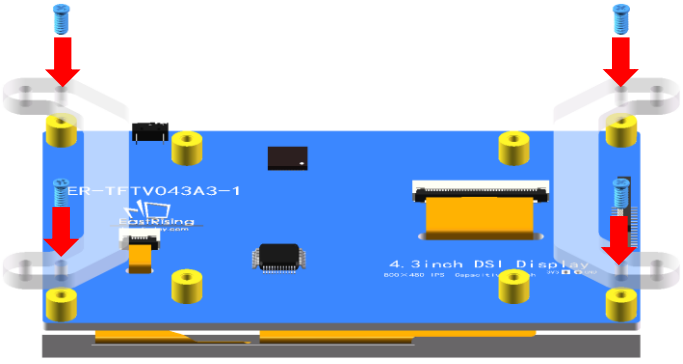
Step 1: Align the top acrylic platel with the GPIO headers, and secure it using M2.5x5 countersunk head screws.



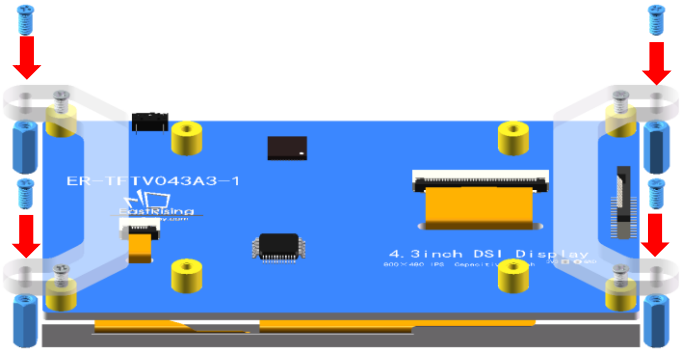
Note: Owing to the machining precision limitations of sheet metal parts, if you notice that certain screw holes do not align properly, this is not an indication of an error. In such cases, you can apply force to bend and align them as needed.



Step 2: Secure the **portrait display bracket** to the back of the 4.3-inch display using M2.5x5 countersunk head screws. The fixing holes are the **inner set of holes** on the bracket.

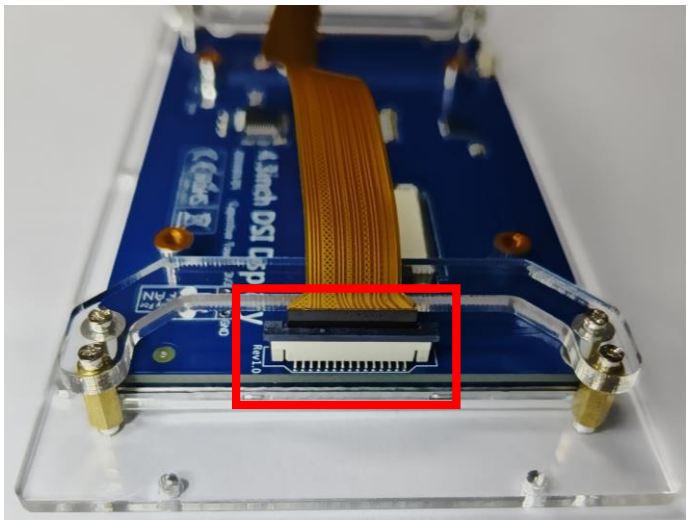


Step 3: Secure the M2.5x9 brass standoff to the portrait display bracket using M2.5x5 countersunk head screws. Use the **outer set of holes** on the bracket.

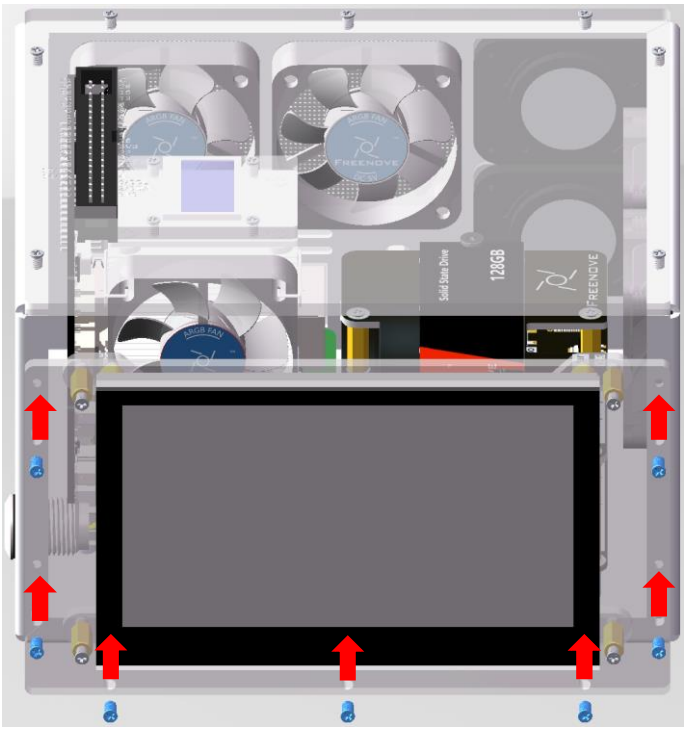


Step 4: Align the pre-assembled 4.3-inch screen with the mounting holes on the top acrylic plate, and secure it using M2.5x5 countersunk head screws.

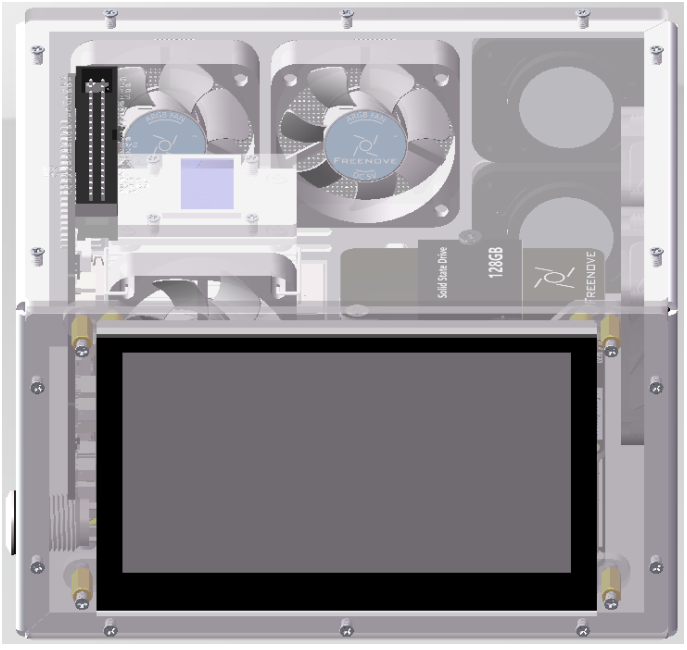
Step 5: Connect the other end of the 160mm DSI FPC cable to the connector on the back of the 4.3-inch screen, ensuring the contacts are facing inward toward the display.



Step 6: Secure the side acylic plate with M2.5x5 countersunk head screws.

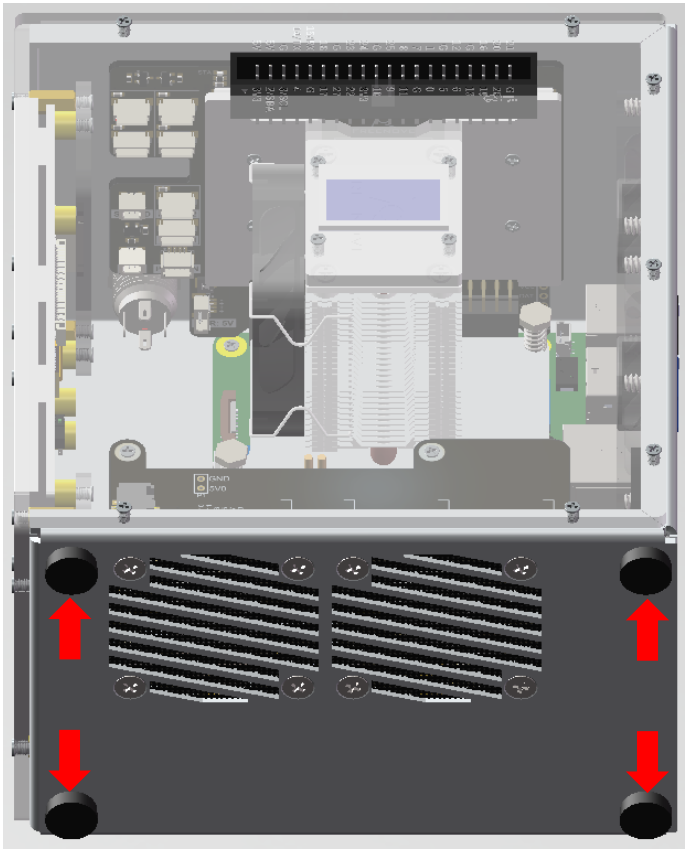


Now, you have finished assembling the case with a portriat-oriented display



2.3.3 Attaching Non-Slip Foot Pad

Peel off the white backing from the 3M adhesive on the black non-slip feet and apply one to each of the four corners on the bottom of the case.



Chapter 3 Installing Raspberry Pi OS

After the assembly is complete, we will start installing the system for the Raspberry Pi. Regardless of whether you want to install the system on the NVMe SSD or not, you need to install the system on an SD card or USB flash drive first.

Analysis

1. First of all, make sure you can enter the Raspberry Pi OS via SD card or U drive.
2. After booting the Raspberry Pi, you can use it to flash the OS image directly onto the NVMe SSD. Alternatively, you can purchase an NVMe SSD to USB adapter and flash the image using USB on Windows or macOS, much like you would for an SD card or USB drive.
3. With this analysis in mind, we can systematically carry out the necessary steps.

Raspberry Pi models manufactured at different times might not boot up in the same way as described, but that's okay; just follow our guide to proceed.
There are various ways to burn the Raspberry Pi OS to SSD, each requiring different hardware tools.

Ways	Ways of burning	Requirements
1	Use Raspberry Pi to burn the OS. This requires that you can successfully boot up the Raspberry Pi via SD card or U disk. (**Recommended, described in this tutorial**)	An SD card or a U disk that can access the Raspberry Pi OS.
2	Purchase an NVMe SSD to USB adapter and flash the image just like you would with an SD card or USB drive.	NVME SSD to USB adapter (need to be bought separately)
3	If there are spare M.2 NVME interface on the motherboard of your PC, you can insert the SSD to it to flash the OS.	PC with M.2 NVME interface

Caution: Incompatible SSDs

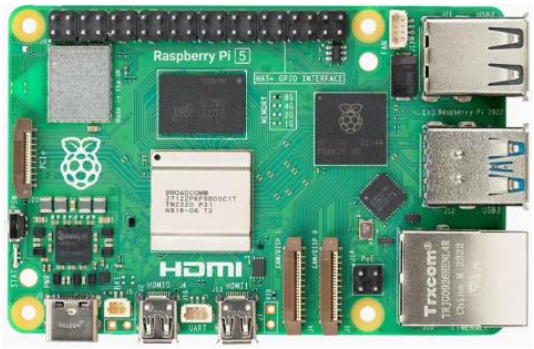
The recognition and read/write operations of the NVMe SSD are handled by the drivers of the Raspberry Pi 5. If you find that your SSD cannot be recognized by Pi 5 or is not readable/writable, please try to find a driver suitable for your SSD and install it on the Raspberry Pi, or replace the SSD, or purchase the adapter kit that comes with the SSD.

3.1 Flashing OS to SD Card or USB Drive

Based on the analysis above, our first step should be to install the Raspberry Pi operating system onto an SD card or USB drive, with a capacity of at least 16GB. If you are already able to boot the Raspberry Pi using an SD card or USB drive, you can skip this section and move on to the next section.

3.1.1 Component List

Required Components

Raspberry Pi 5 x 1 	One 27W power adapter (or a power adapter compatible with Raspberry Pi official one that can output 5.1V/5A) 
Micro SD Card（TF Card）x1，Card Reader x1 	

3.1.2 Raspberry Pi OS

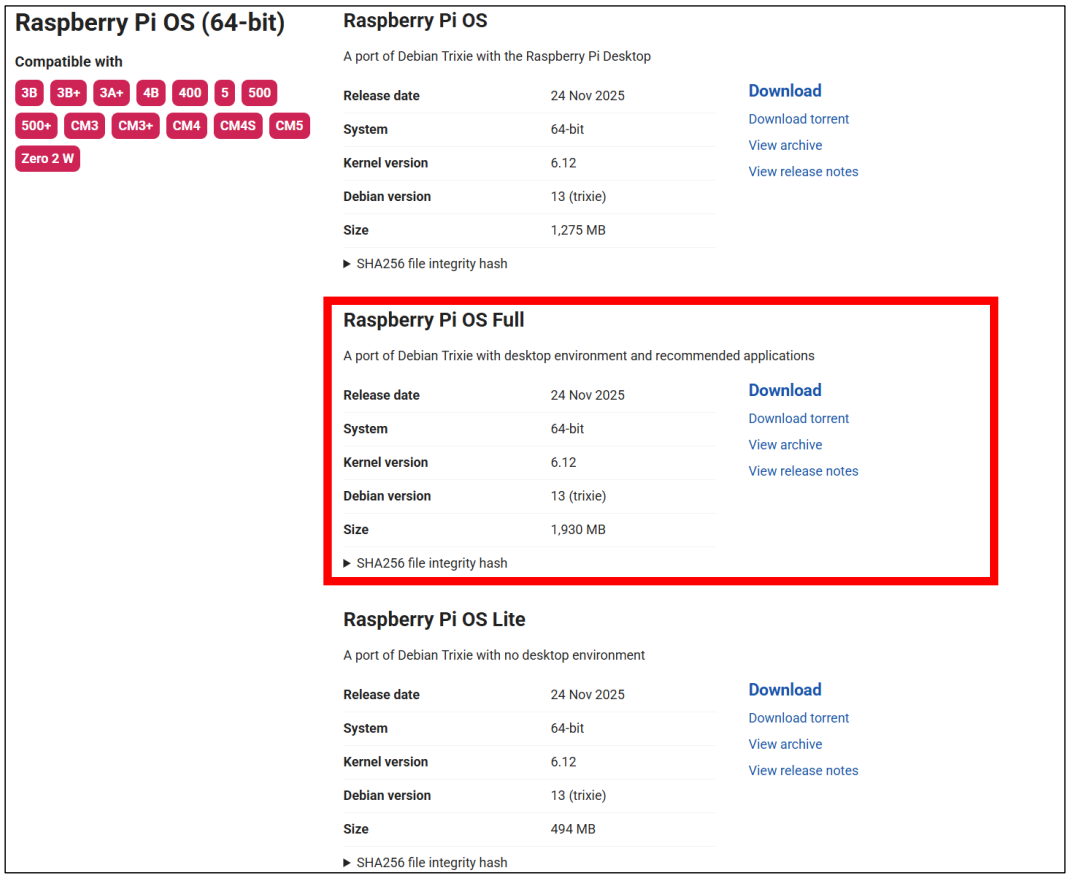
Without Screen - Use Raspberry Pi - under Windows PC: https://youtu.be/XpiT_ezb_7c
With Screen - Use Raspberry Pi - under Windows PC: https://youtu.be/HEywFsFrj3I

Automatically Method (Recommended)

You can follow the official method to install the system for raspberry pi via visiting link below:
https://projects.raspberrypi.org/en/projects/raspberry-pi-setting-up/2
In this way, the system will be downloaded **automatically** via the application.

Manually Methed

After installing the Imager Tool in the **link above**. You can **also** download the system **manually** first. (Note: Unless necessary, it is not recommended to manually download the offline installation package.)
Visit https://www.raspberrypi.com/software/operating-systems/

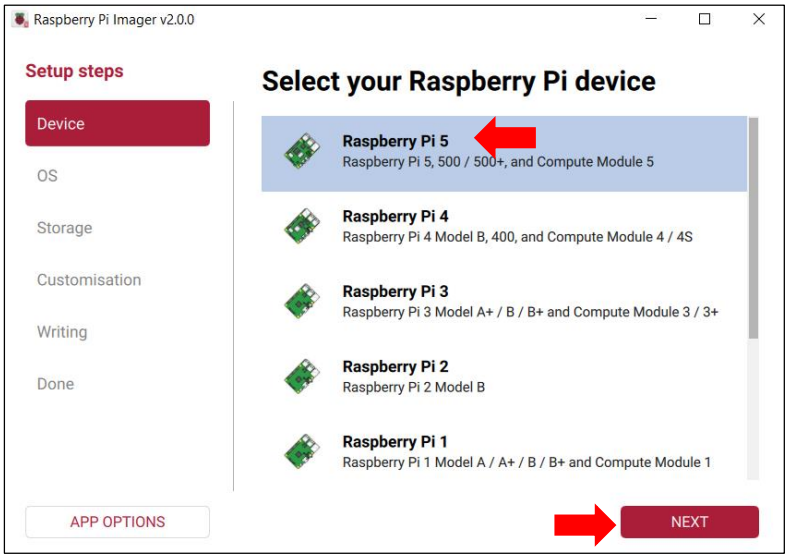


Choose Raspberry Pi Device

First, put your Micro **SD card** into card reader and connect it to USB port of PC.

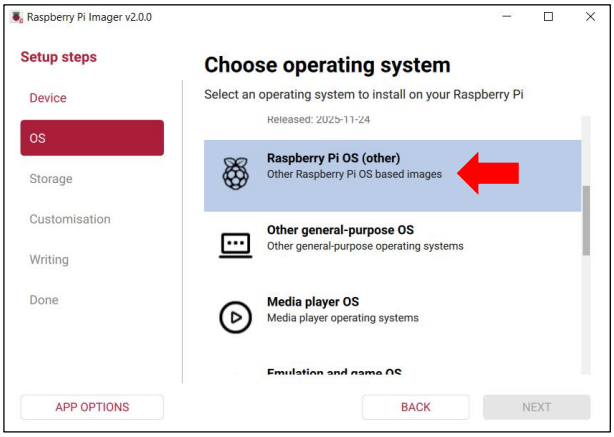
Open Raspberry Pi Imager.

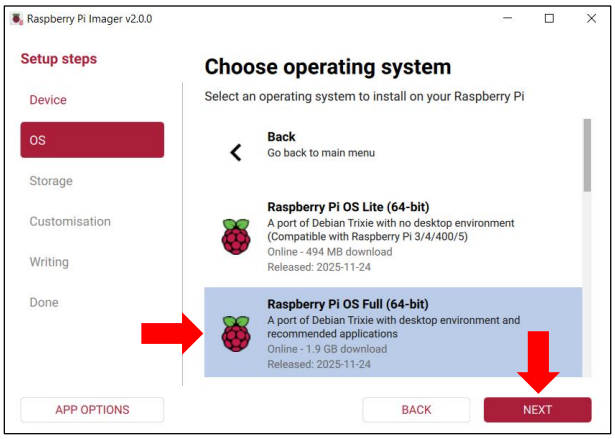
Select **Raspberry Pi 5** under Device, and then click NEXT.



Choose Operating System

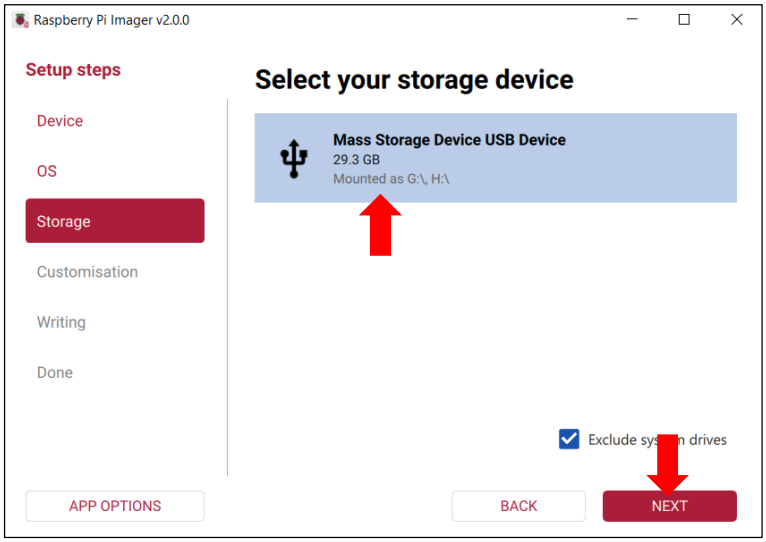
Click OS, scroll down to **locate and click Raspberry Pi OS (other)**, and then select **Raspberry Pi OS Full(64-bit)**. Click NEXT.





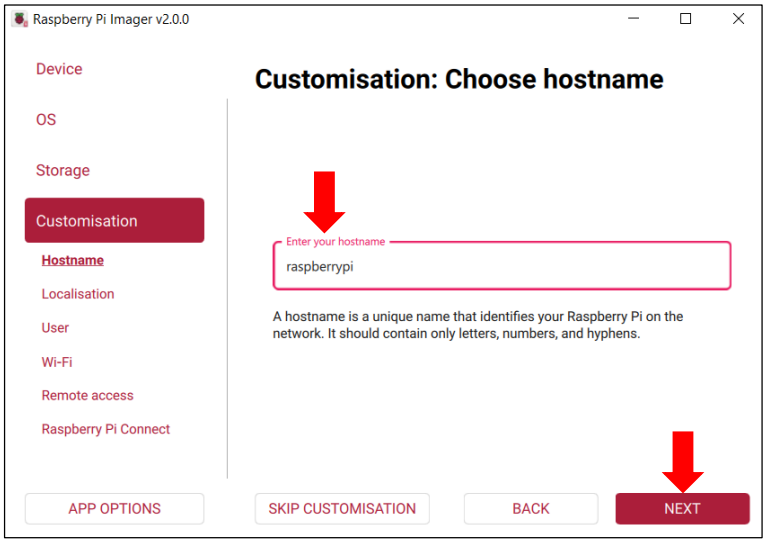
Choose Storage Devide

Choose the SD card and click on Next.

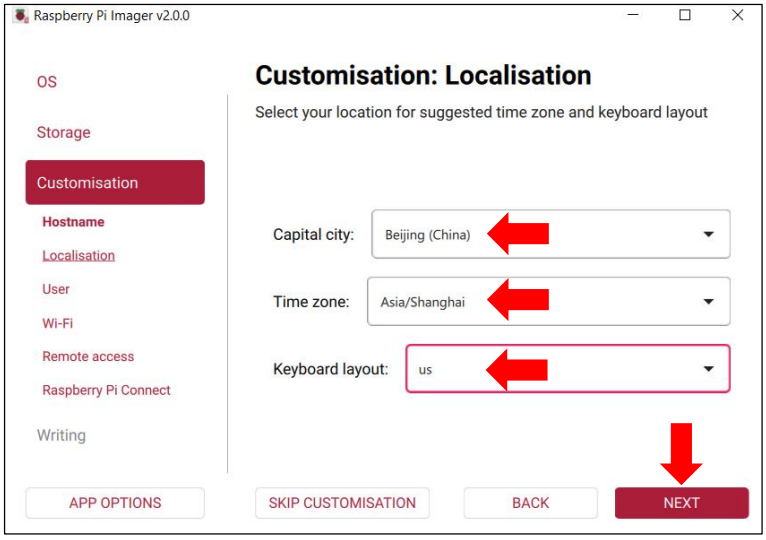


Customisation

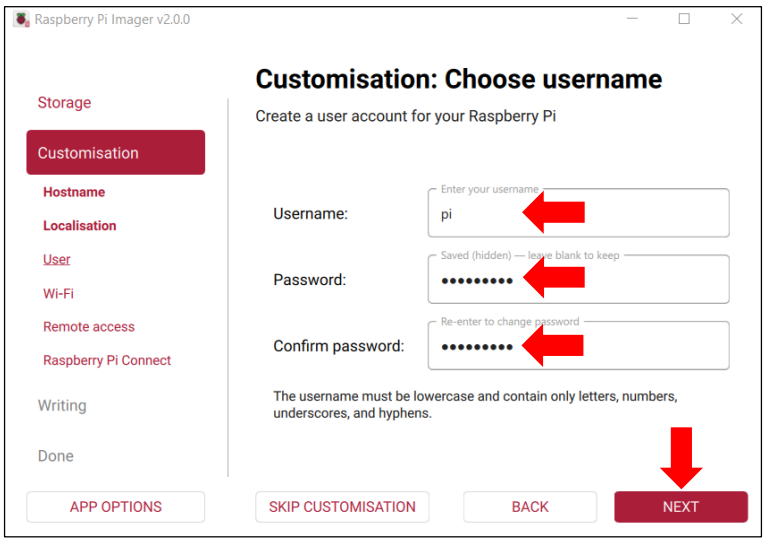
Step 1: Input the hostname, which is "**raspberrypi**" by default. Then click NEXT.



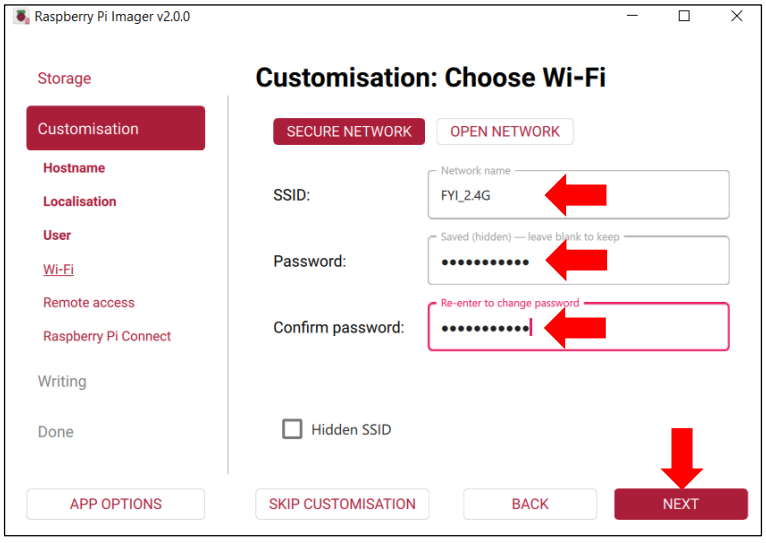
Step 2: Select your location, timezone and keyboard layout. Then click NEXT.



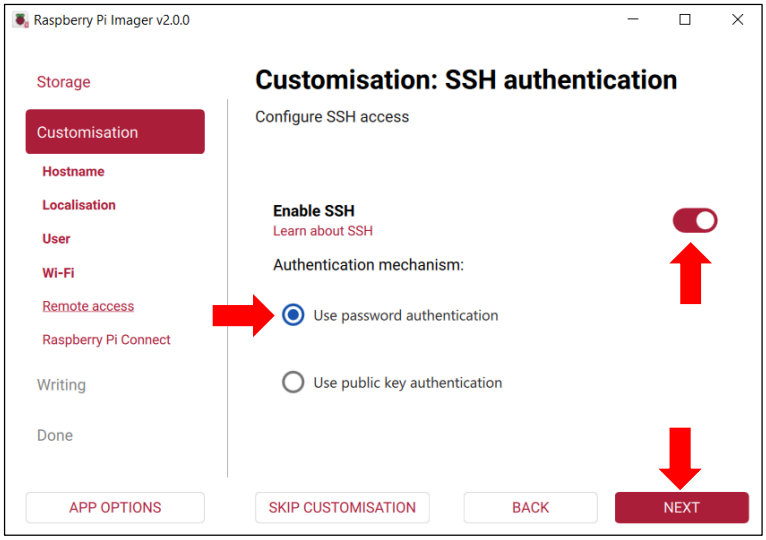
Step 3: Configure your username and passowrd. The password needs to re-enter to confirm. The default username is **pi** and the default password is **raspberry**. Then click NEXT.



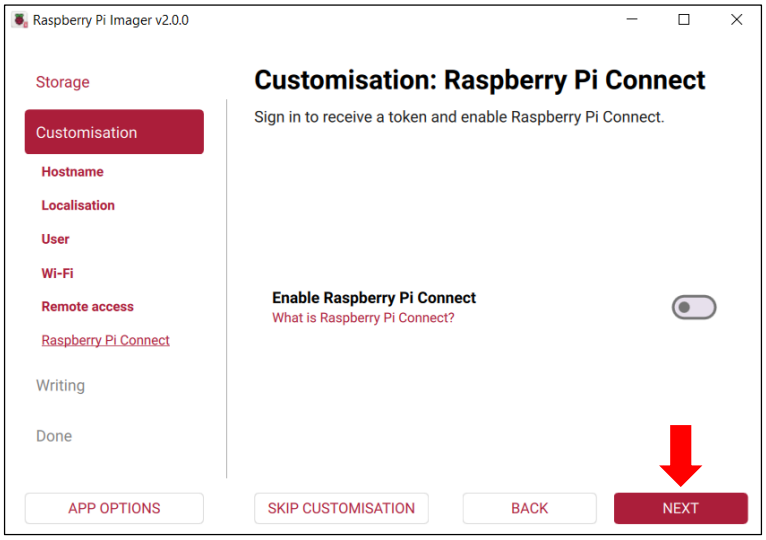
Step 4: Input the SSID and password of your wireless network. The passwords needs to re-enter to confirm. Then click NEXT.



Step 5: Enable SSH for ssh remote and click NEXT.

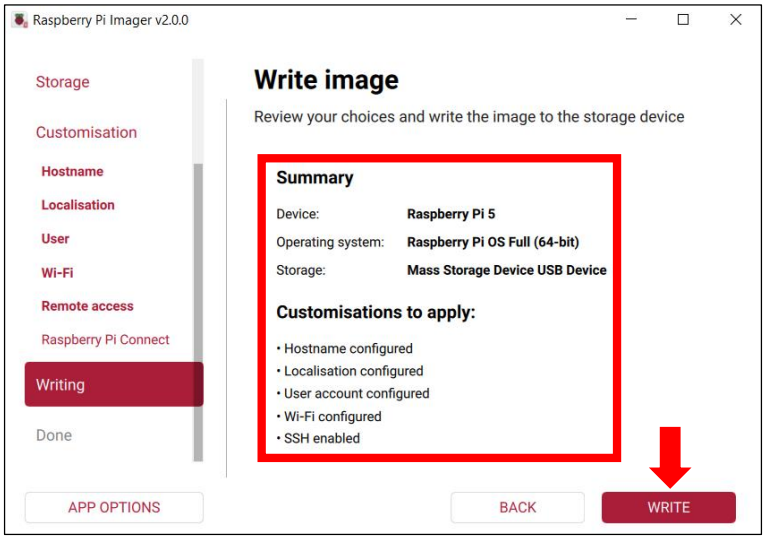


Step 6: Click NEXT.

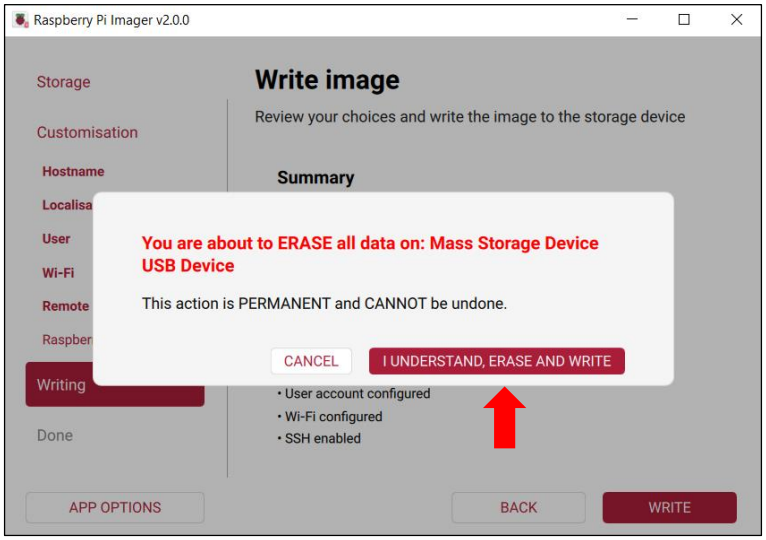


Writing System to Micro SD Card

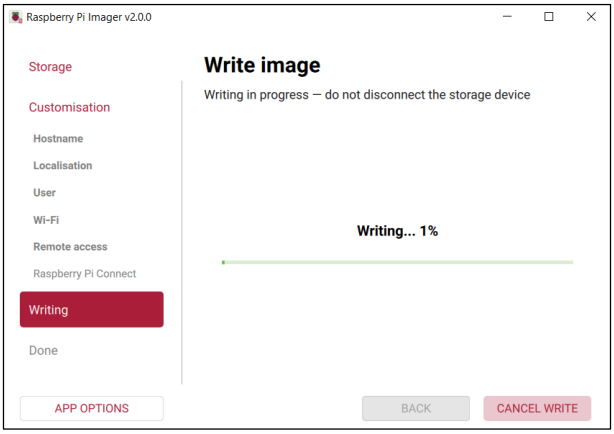
After finishing customisation configuration, the interface will show all the configuration you have made. Click WRITE to write the OS to your SD card after confirming everything is correct.

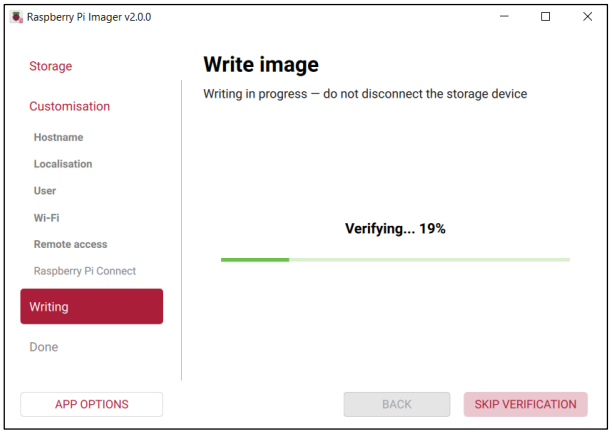


Warning: Before starting the write process, ensure you have backed up all data on the storage device. This operation will permanently erase all data on the device. If you have completed the backup, click **I UNDERSTAND, ERASE AND WRITE** to continue.



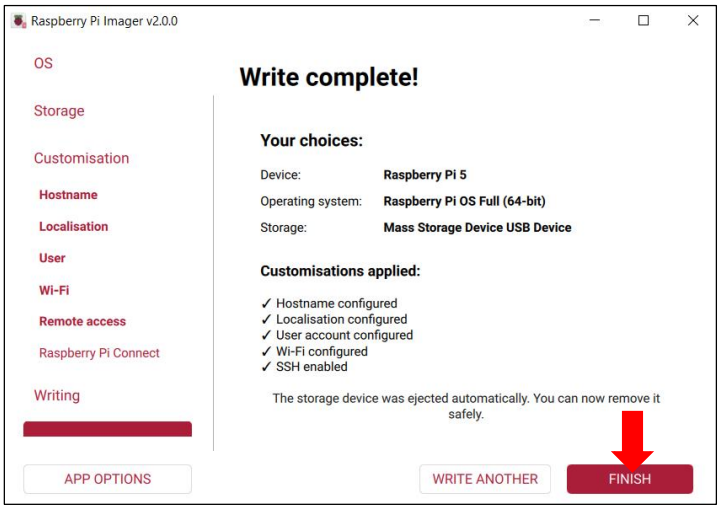
Wait for it to finish writing and verifying.



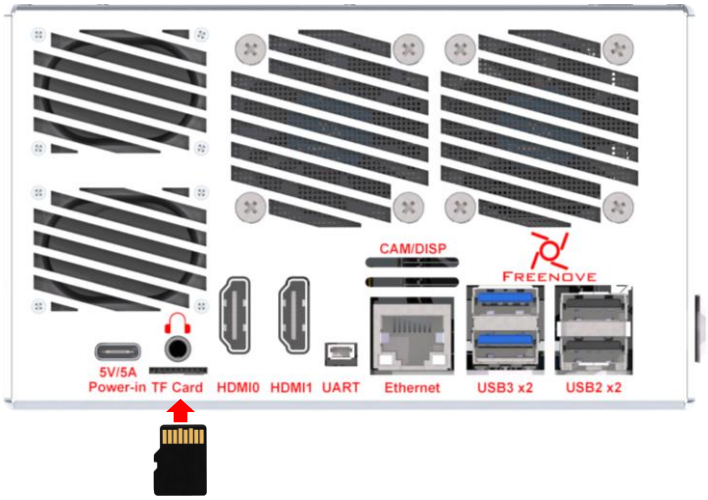


Done

Congratulations! The Raspberry Pi OS has been successfully written to the SD card. All your custom configurations have taken effect. Click FINISH to complete the process.



3.1.3 How to Insert and Take out SD Card



Remove the SD card with the written system from the card reader.
Insert it into the self-ejecting TF card slot on the back of the case with the gold contacts facing up.
Push the SD card in until you hear a click, indicating it is securely locked in place.
To eject the SD card, press it in again until you hear a click, and the card will pop out.
If you have a display ready, please continue reading the tutorial below.
If not, please skip directly to the Remote desktop & VNC section.

3.1.4 DSI Touchscreen Desktop

If your model is equipped with a 4.3-inch Screen (Models: **FNK0107P\Q\R\U\V\W**), after connecting the power and booting up the RPi 5, you will see the following interface.

The system will automatically detect and enable the DSI touchscreen functionality. You can directly use your finger to tap icons, swipe through pages, and perform other operations. To change the screen orientation, you can configure it via **Preferences > Screen Configuration**.

3.1.5 HDMI Monitor desktop

Connect the Raspberry Pi 5 to your display via the HDMI interface, attach your mouse and keyboard through the USB ports, and finally, connect your power supply (making sure that it meets the specifications required by your RPi Module Version. Your RPi should start (power up). Later, after setup, you will need to enter your user name and password to login. The default user name: pi; password: raspberry. After login, you should see the following screen.

Congratulations! You have successfully installed the RASPBERRY PI OS on your RPi.

Raspberry Pi 5 integrates a Wi-Fi adaptor. You can use it to connect to your Wi-Fi. Then you can use the wireless remote desktop to control your RPi. This will be helpful for the following work.

3.1.6 Remote desktop & VNC

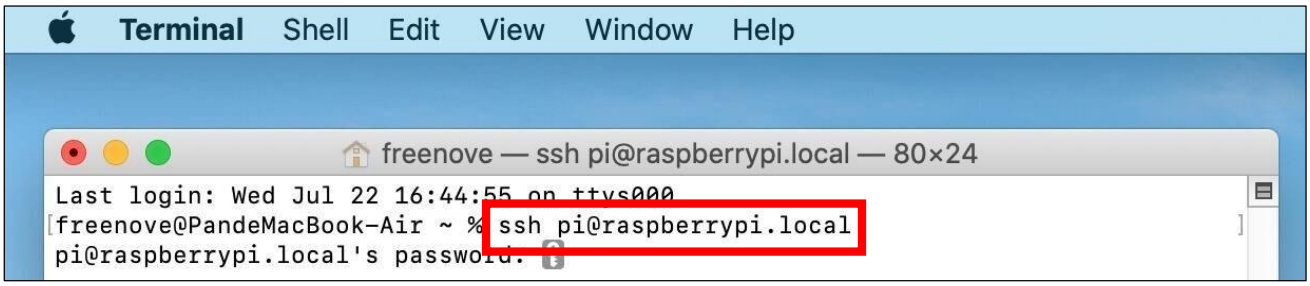
If you don't have a spare display, mouse and keyboard for your RPi, you can use a remote desktop to share a display, keyboard, and mouse with your PC. Below is how to use:
MAC OS remote desktop and Windows OS remote desktop.

Mac OS Remote desktop

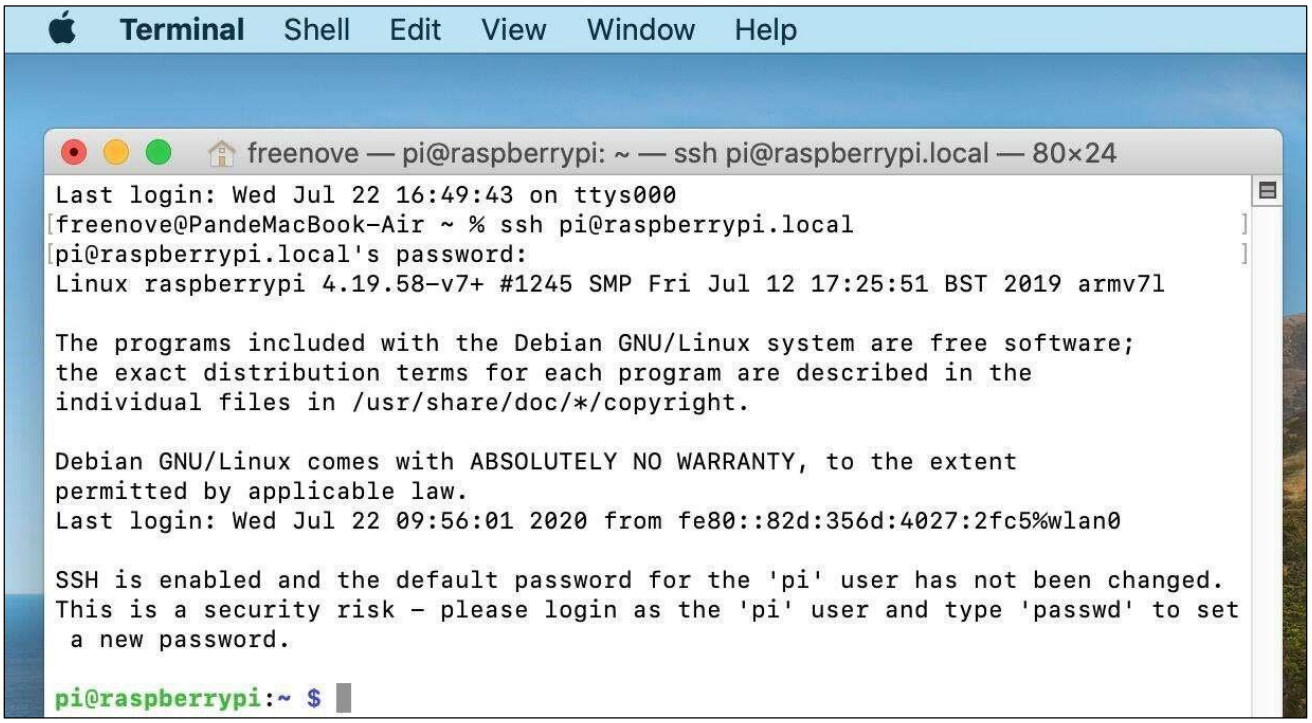
Open the terminal and type following command.
If you have set your own hostname during writing the OS, please modify it accordingly.
If this command doesn't work, please move to next page.

```
ssh pi@raspberrypi.local
```

The password is **raspberry** by default, case sensitive.



You may need to type **yes** during the process.

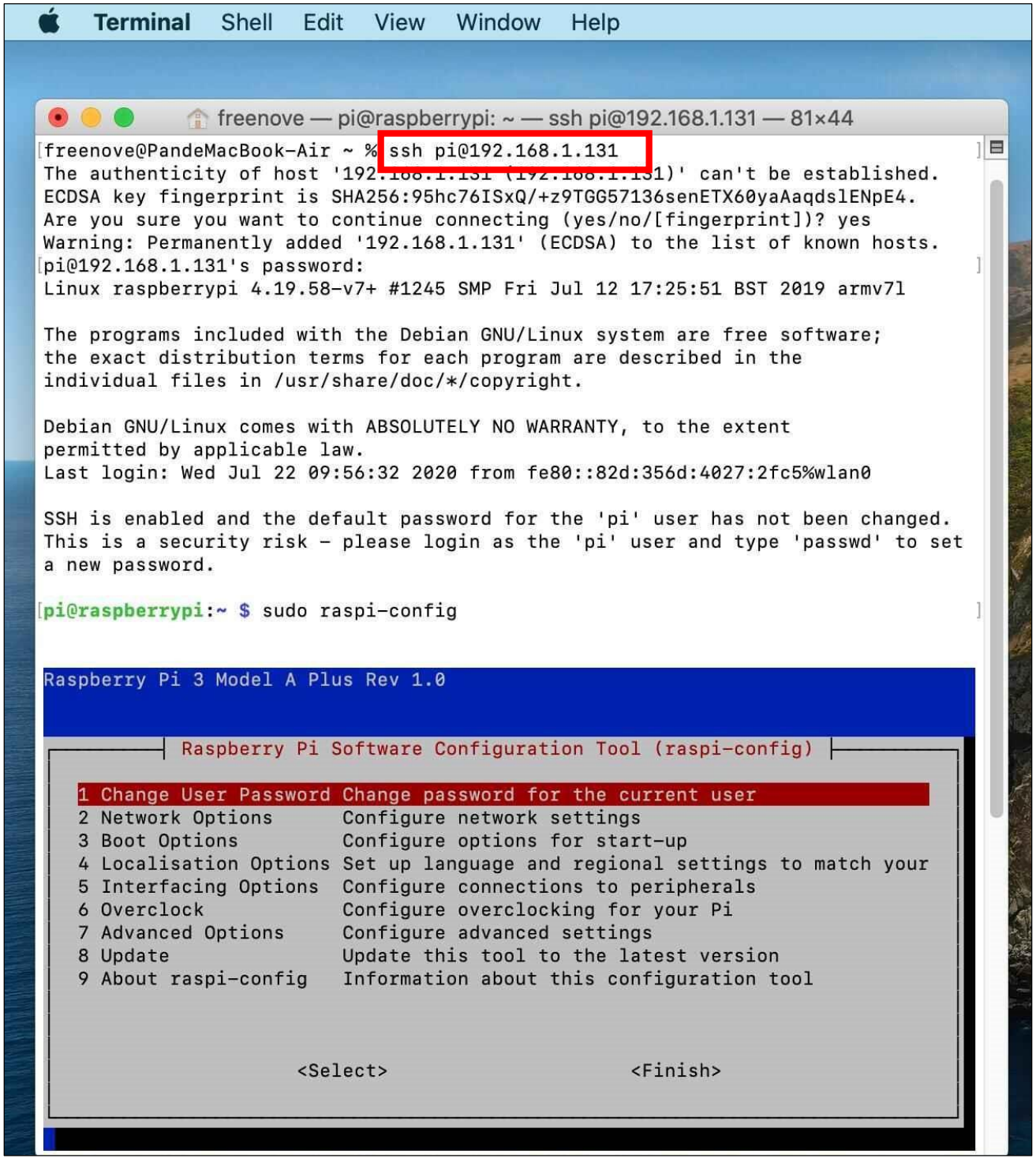


You can also use the IP address to log in Pi.
Enter **router** client to **inquiry IP address** named "raspberry pi". For example, I have inquired to **my RPi IP address, and it is "192.168.1.131".**

Open the terminal and type following command.

```
ssh pi@192.168.1.131
```

When you see **pi@raspberrypi:~ $,** you have logged in Pi successfully. Then you can skip to next section.



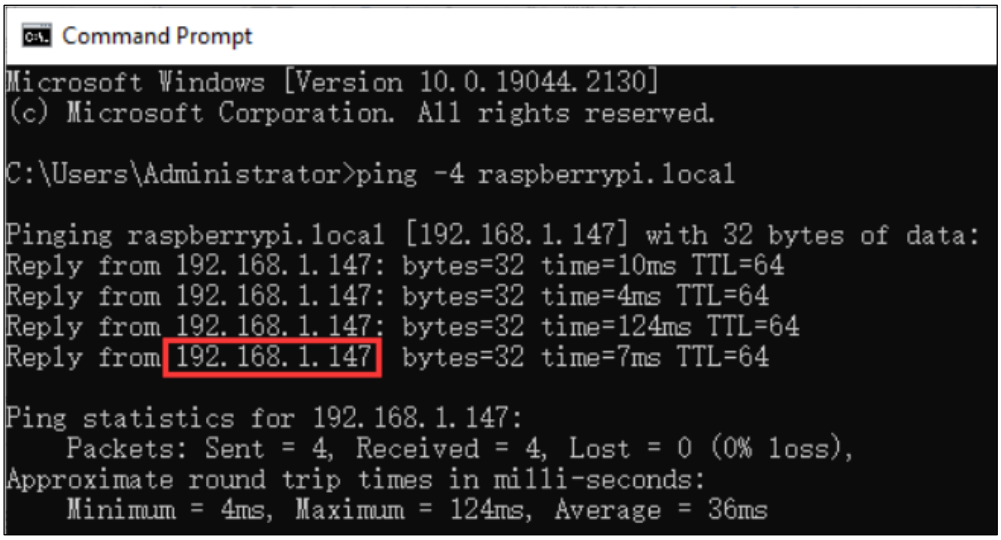
Then you can skip to VNC Viewer.

Windows OS remote desktop

If you are using win10, you can use follow way to login Raspberry Pi without desktop.

Press **Win+R**. Enter **cmd**. Then use this command to check IP:

```
ping -4 raspberrypi.local
```



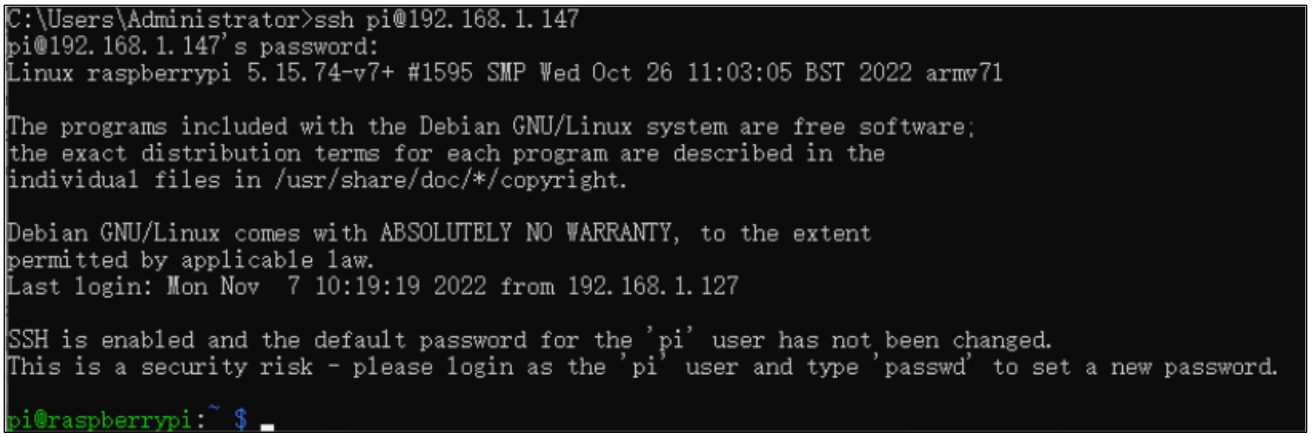
Then 192.168.1.147 is my Raspberry Pi IP.

Or enter **router** client to **inquiry IP address** named "**raspberrypi**". For example, I have inquired to **my RPi IP address, and it is "192.168.1.147".**

```
ssh pi@xxxxxxxxxxx(IP address)
```

Enter the following command:

```
ssh pi@192.168.1.147
```

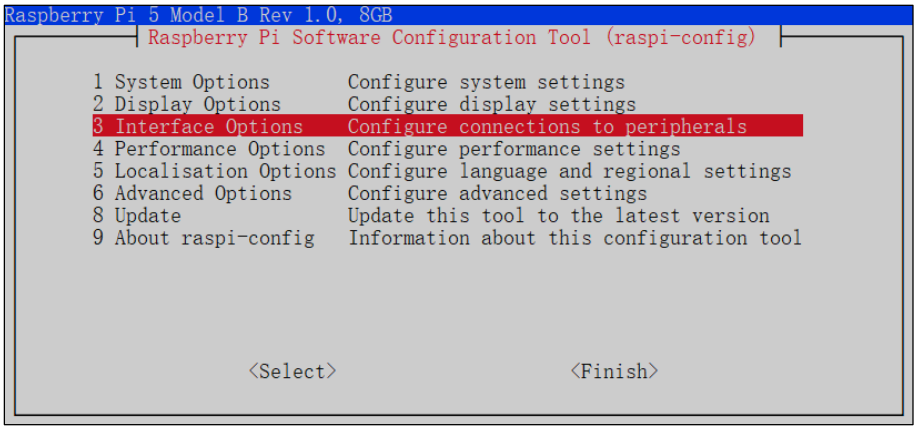


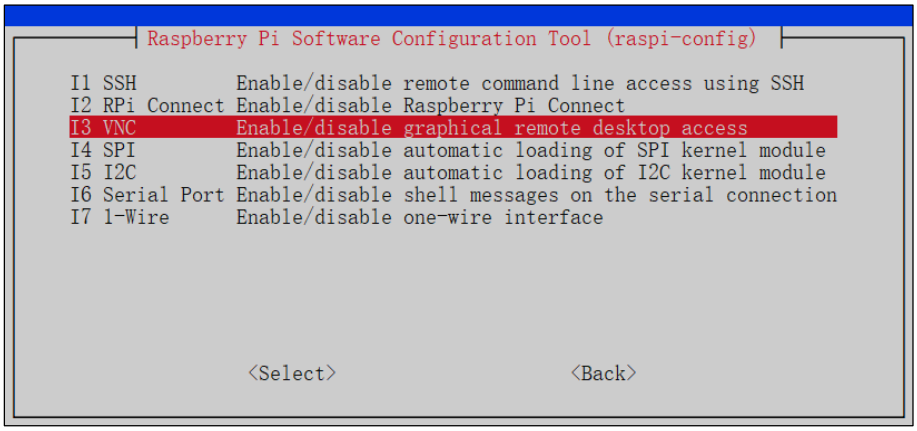
3.1.7 VNC Viewer & VNC

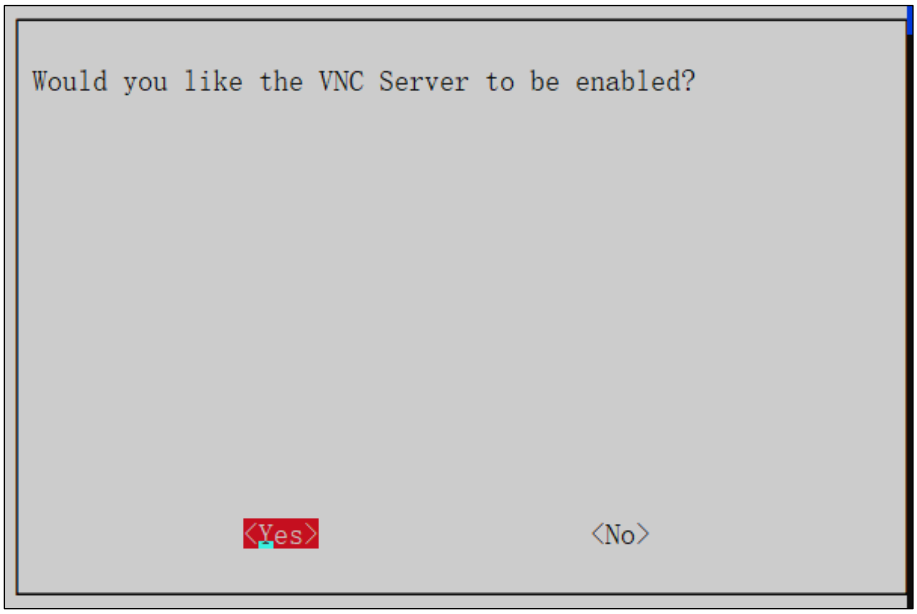
Enable VNC

Enter the following commands: select Interface Options -> I3 VNC -> Enter -> Yes -> OK. You may need to restart the Raspberry Pi 5 here, select OK, and then open the VNC interface.

```
sudo raspi-config
```

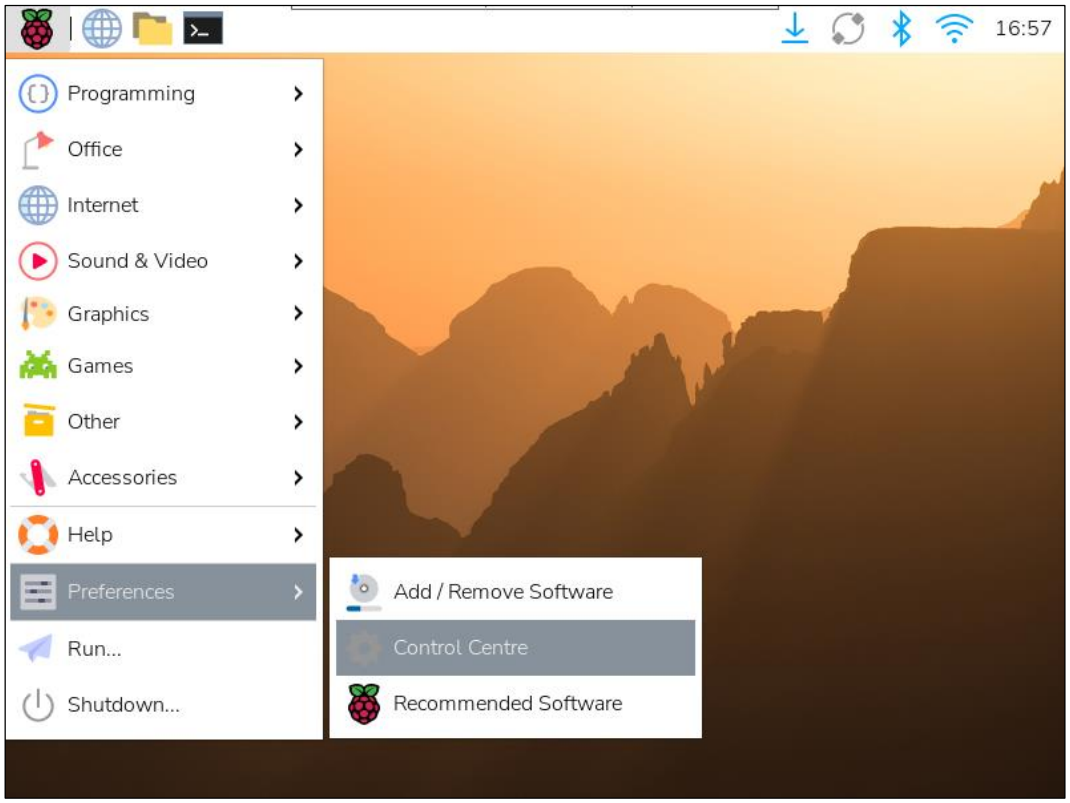


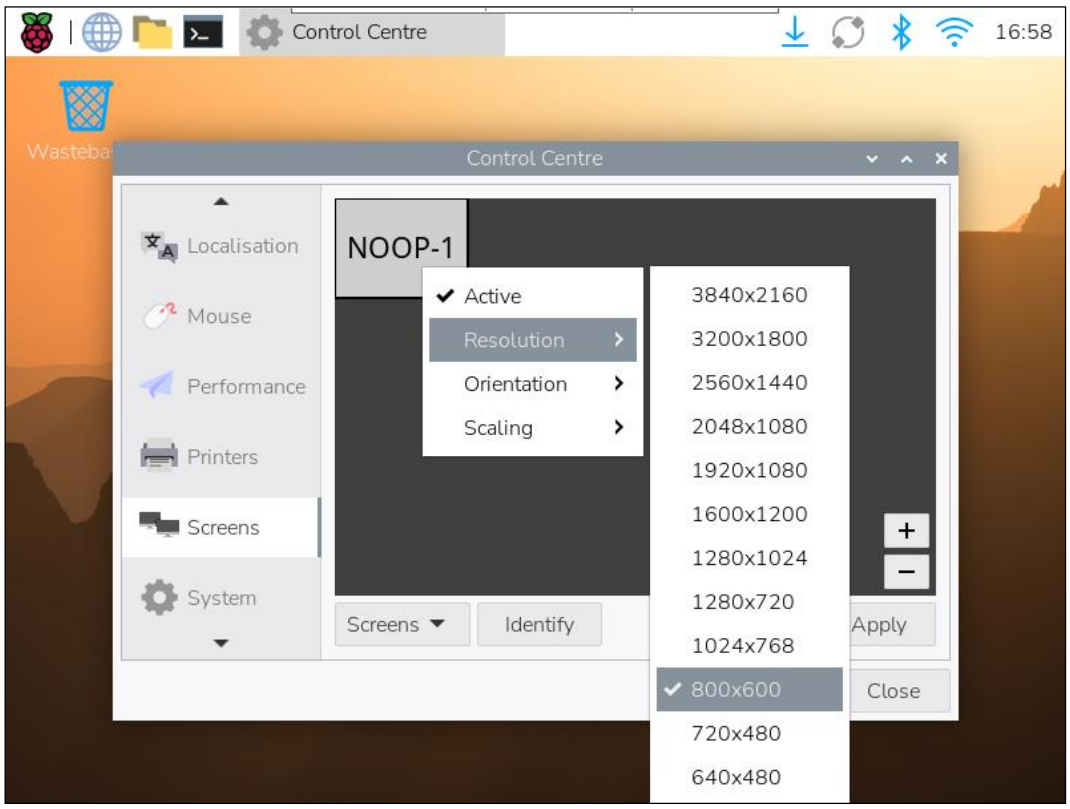




Set Resolution

You can also set other resolutions. If you don't know what to set, you can set it as 800x600 first.

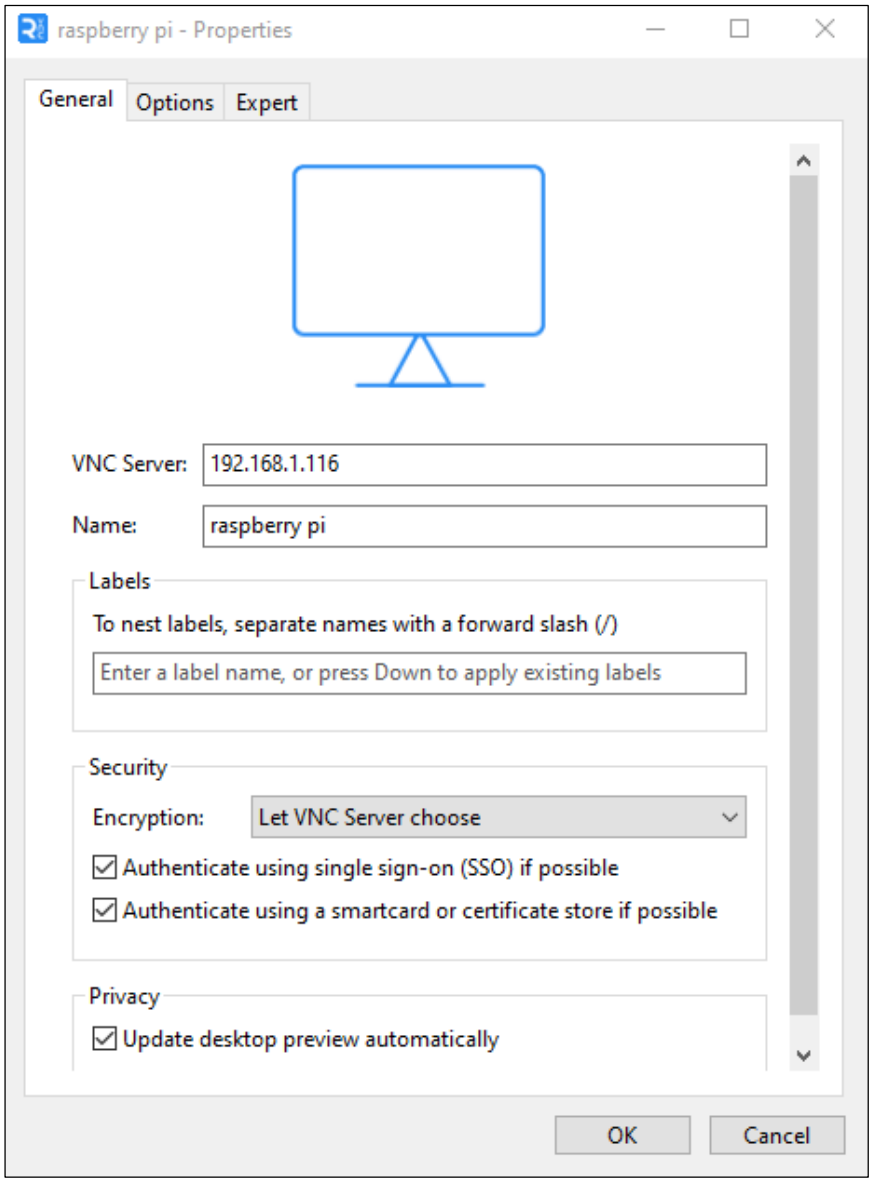




Then download and install VNC Viewer according to your computer system by click following link:

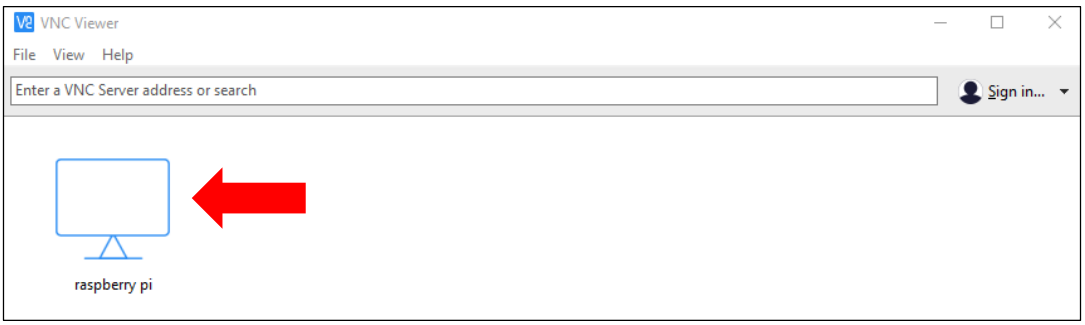
https://www.realvnc.com/en/connect/download/viewer/

After installation is completed, open VNC Viewer. And click File -> New Connection. Then the interface is shown below.



Enter ip address of your Raspberry Pi and fill in a name. Then click OK.

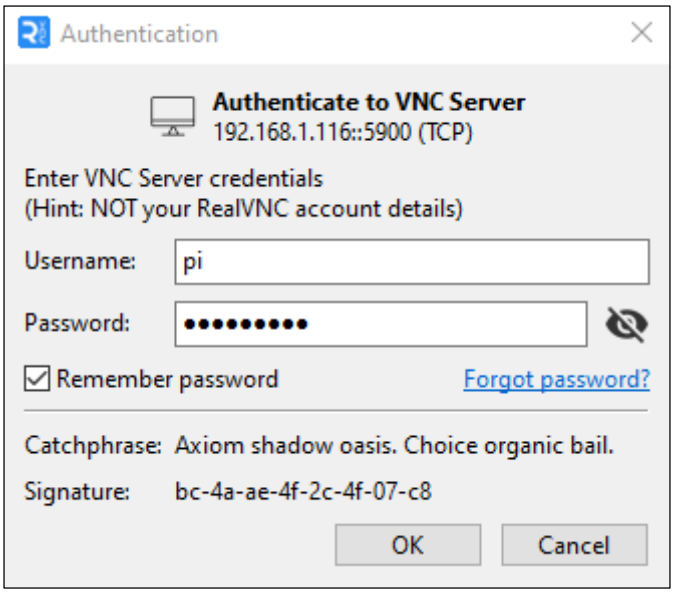
Then on the VNC Viewer panel, double-click new connection you just created,



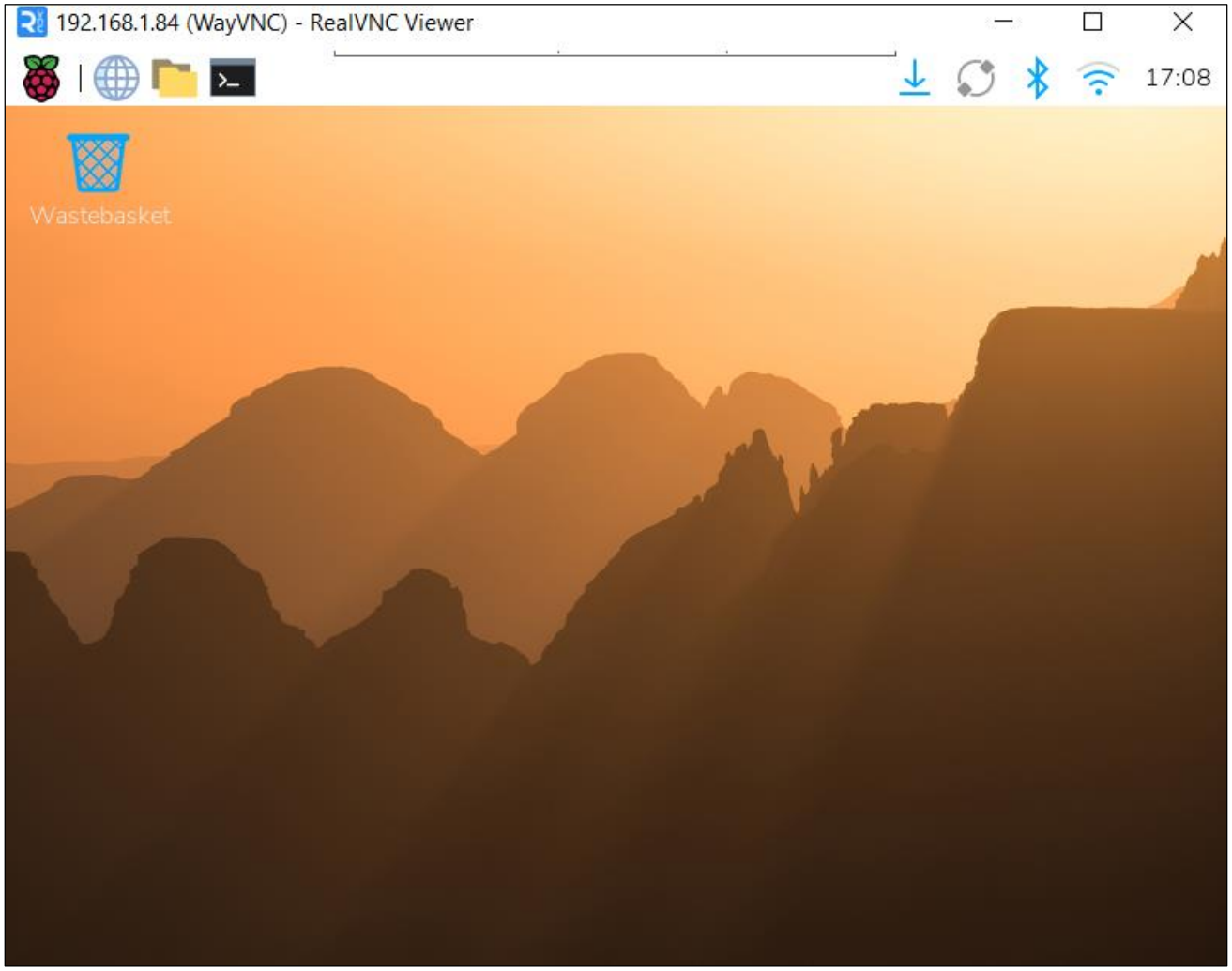
Then the following dialog box pops up.

Enter username: **pi** and Password: **raspberry**.

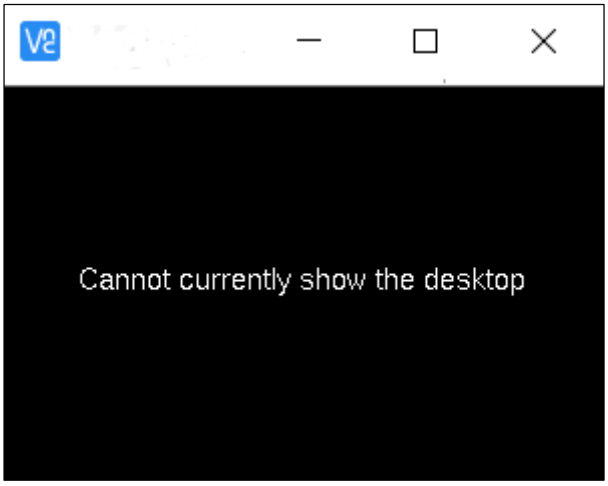
If you have set your own username and password, please input them accordingly. Then click OK.



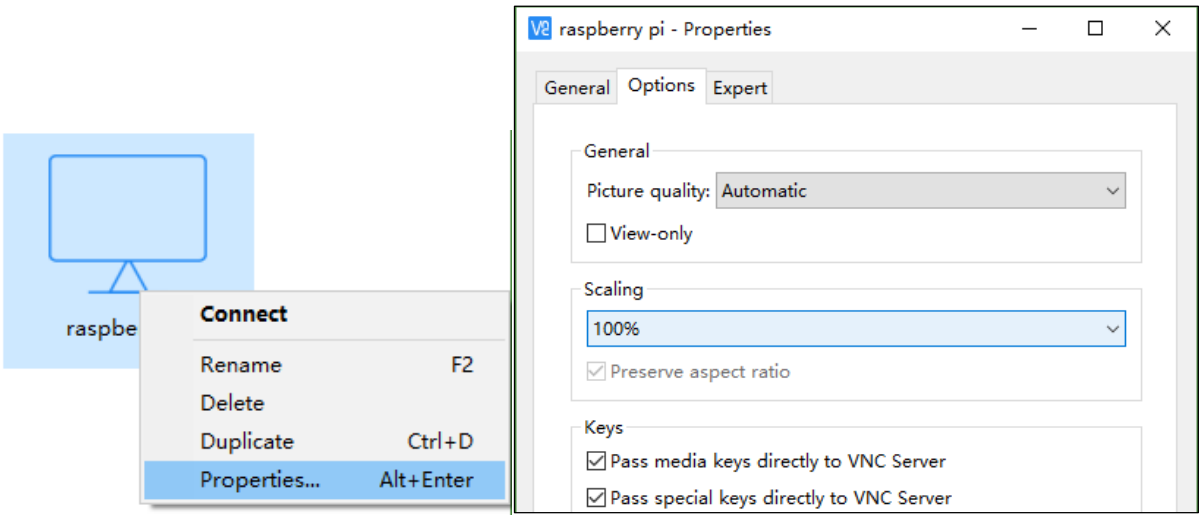
Here, you have logged in to Raspberry Pi successfully by using VNC Viewer.



If there is black window, please set another resolution.



In addition, your VNC Viewer window may zoom your Raspberry Pi desktop. You can change it. On your VNC View control panel, click right key. And select Properties->Options label->Scaling. Then set proper scaling.



Here, you have logged in to Raspberry Pi successfully by using VNC Viewer and operated proper setting.

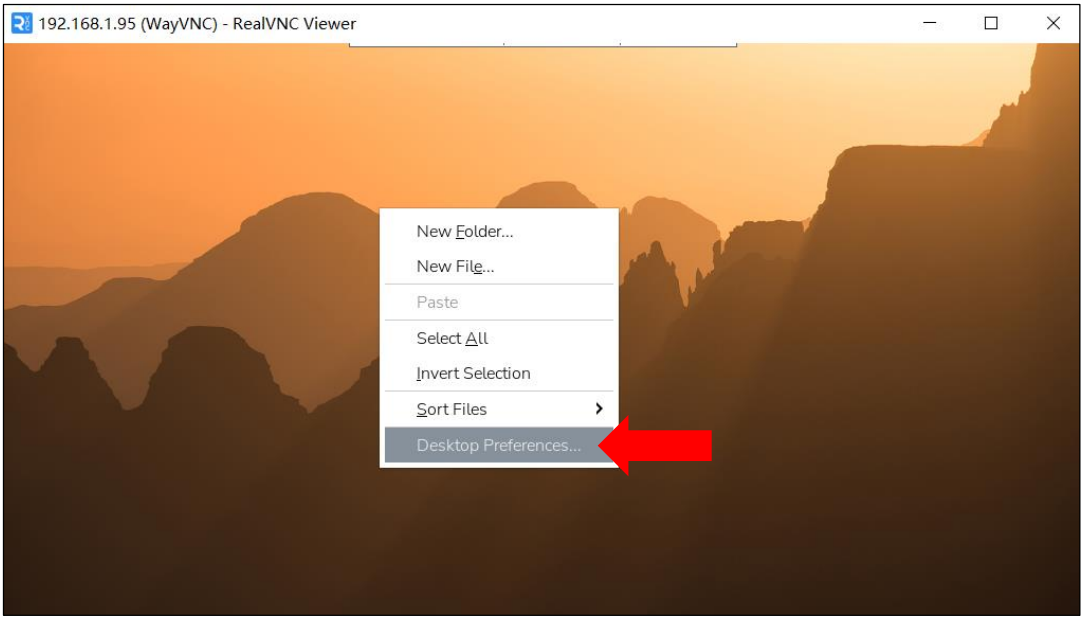
Raspberry Pi 5 integrates a Wi-Fi adaptor.If you did not connect Pi to WiFi. You can connect it to wirelessly control the robot.

3.1.8 Switching Taskbar Display

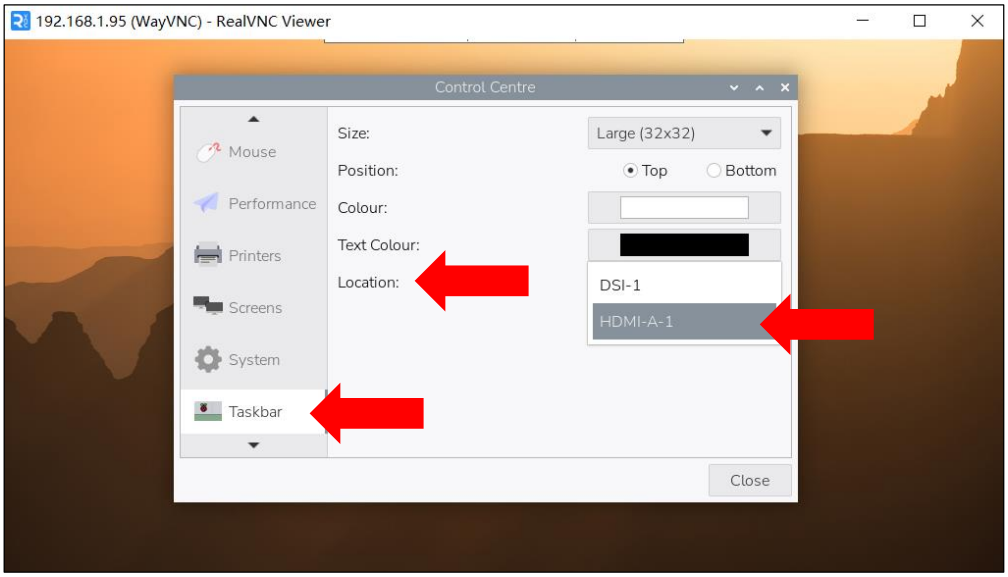
If your kit is a non-display verion (**Model numbers: FNK0107A/B/C/H/K/L**), you can skip this section by clicking here.

For versions equipped with a 4.3-inch IPS screen (**Model numbers: FNK0107P/Q/R/U/V/W**), after booting the RPi 5, the system will create two independent display areas: DSI-1 and HDMI-A-1. When connecting via VNC, you are viewing a mirrored display of HDMI-A-1. Since the system status bar is prioritized for display on the DSI screen, it is not included by default in the VNC interface. Please follow the instructions below to display the status bar in the HDMI-A-1 area.

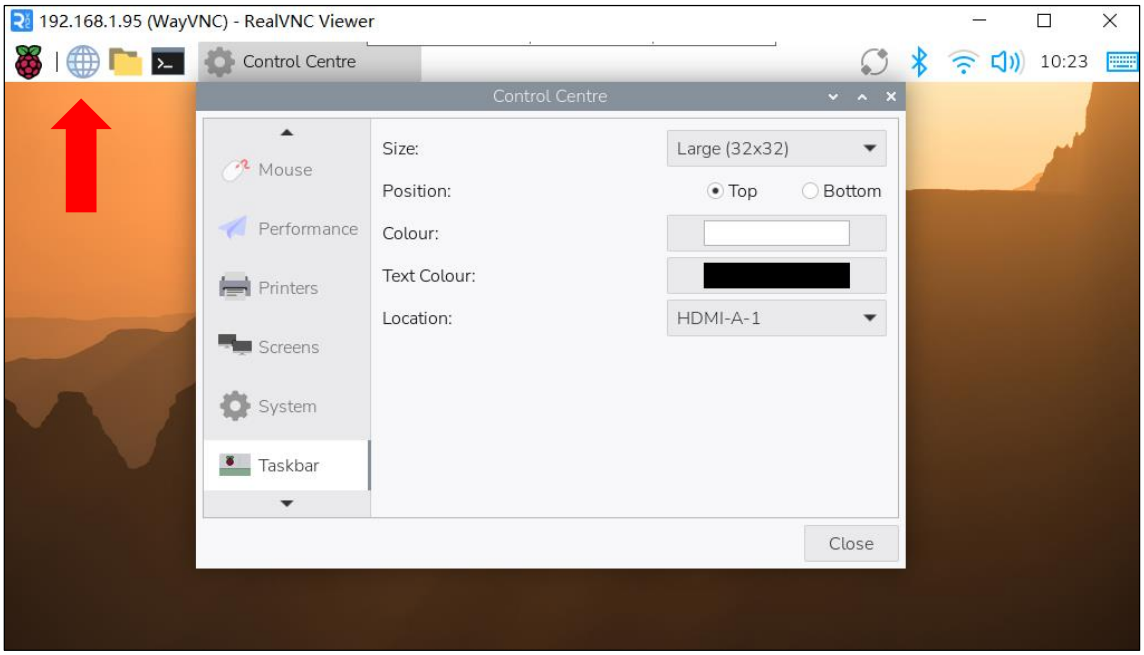
Right-click in any blank area upon the desktop and choose "**Desktop Preferences...**".



In the pop-up Control Centre window, select "**Taskbar**" from the left pane. Find the "**Location**" setting and change it from DSI-1 to HDMI-A-1.



Once configured, the system status bar will switch over from the DSI-1 display area to the HDMI-A-1 display area.



For known system issues in VNC, such as incomplete display or misaligned mouse clicks after resolution switching, please refer to the "**FNK0107-troubleshooting**" document located in the same directory.

3.2 Flashing OS to NVMe SSD

This step is to install the Raspberry Pi OS into the NVME SSD.
If you do not use SSD or if you do not want to install the Raspberry Pi OS into the SSD, you can skip to the Chapter 4.

3.2.1 SSD Detection

(Note: Not all SSDs are supported by Pi5.)
Booting the Rpi 5 from SD card, and run the following command in the Terminal to check whether SSD is detected.
Note that the information varies among SSDs.

lspci

```
pi@raspberrypi:~ $ lspci
0000:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries Device 2712 (rev 21)
0000:01:00.0 Non-Volatile memory controller: Silicon Motion, Inc. SM2263EN/SM2263XT SSD Controller (rev 03)
0001:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries Device 2712 (rev 21)
0001:01:00.0 Ethernet controller: Device 1de4:0001
```

lsblk

```
pi@raspberrypi:~ $ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
mmcblk0     179:0    0  29.8G  0 disk
├─mmcblk0p1 179:1    0   512M  0 part /boot/firmware
└─mmcblk0p2 179:2    0  29.3G  0 part /
nvme0n1     259:0    0 476.9G  0 disk
pi@raspberrypi:~ $
```

As shown in the figure above, the device ‘nvme0n1’ with a capacity of 476.9GBytes shows up, indicating that the SSD has been correctly recognized. The detected capacity will depend on the size of your SSD. If your drive has been previously partitioned, you may also see some partition information displayed.

Please note: Installing the system will format the SSD, erasing all data. If necessary, please back up any data on your SSD before proceeding.

3.2.2 Enable PCIe 3.0(on OS written into SD Card)

Note: This section does not apply to the Dual-NVMe Adapter Board or the Quad-NVMe Adapter Board, as they do not support the PCIe 3.0 protocol.

If your SSD with Phison controller, you may need to enable PCIE 3.0. (This step is strongly recommended; without this step, the later process may fail.)
If it is not with Phison controller, you do not need to enable PCIE 3.0. **You may skip this section.**

Run the command lspci to check the controller.

```
pi@raspberrypi:~ $ lspci
0000:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries BCM2712 PCIe Bridge (rev 21)
0000:01:00.0 Non-Volatile memory controller: Phison Electronics Corporation PS5021-E21
 PCIe4 NVMe Controller (DRAM-less) (rev 01)
0001:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries BCM2712 PCIe Bridge (rev 21)
0001:01:00.0 Ethernet controller: Raspberry Pi Ltd RP1 PCIe 2.0 South Bridge
```

(The above screenshot is the result of a 128GB SSD with Phison as main controller.)

Enable PCIe Gen 3.0

Add the line dtparam=pciex1_gen=3 to /boot/firmware/config.txt to enable PCIe Gen3.0.
As shown below, enter the command to open the file.

```
sudo nano /boot/firmware/config.txt
```

Add the line dtparam=pciex1_gen=3 to the end of the file, as shown below:

```
  GNU nano 7.2                 /boot/firmware/config.txt *
otg_mode=1

[all]

dtparam=pciex1_gen=3
```

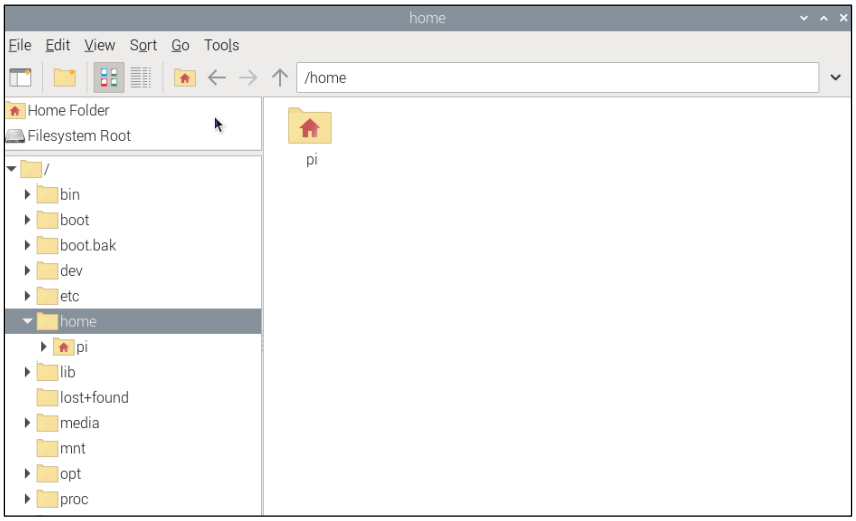
Press Ctrl-O to save the file, Enter to confirm, and Ctrl-X to exit.

Reboot your Raspberry Pi.

```
sudo reboot
```

3.2.3 SSD Partitioning and Formatting

This step is not a must-do, but it can further test whether the SSD perform normally on Raspberry Pi to ensure smooth performance in later steps.
At this point, the hard drive cannot be seen in the file manager as the disk has not been partitioned yet.



Install a disk management tool with the following command:

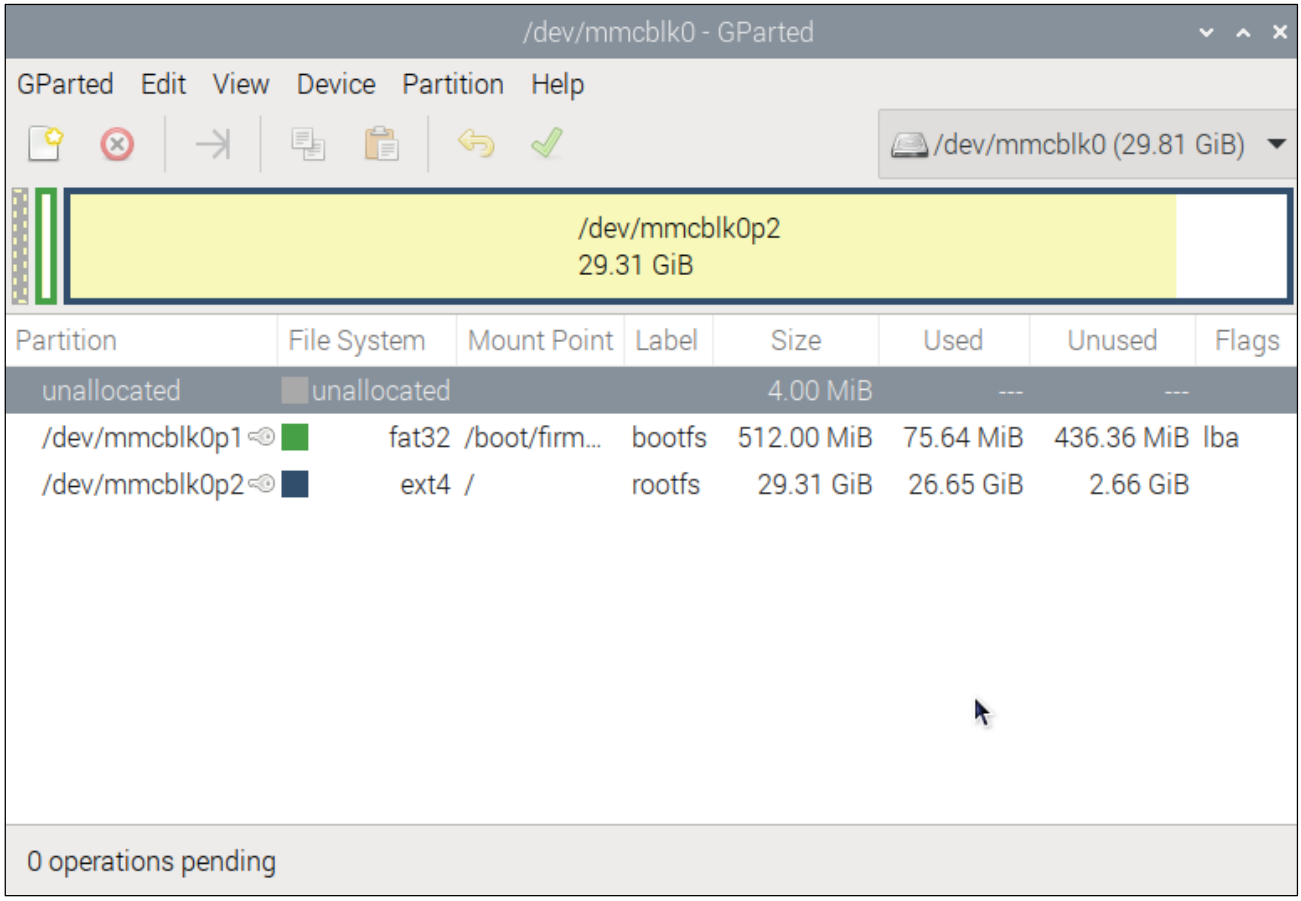
```
sudo apt-get install gparted
```

```
The following NEW packages will be installed:
  gparted gparted-common
0 upgraded, 2 newly installed, 0 to remove and 164 not upgraded.
Need to get 772 kB/2,483 kB of archives.
After this operation, 8,638 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://deb.debian.org/debian bookworm/main arm64 gparted arm64 1.3.1-1 [77
2 kB]
Fetched 772 kB in 0s (2,579 kB/s)
Selecting previously unselected package gparted-common.
(Reading database ... 222757 files and directories currently installed.)
Preparing to unpack .../gparted-common_1.3.1-1_all.deb ...
Unpacking gparted-common (1.3.1-1) ...
Selecting previously unselected package gparted.
Preparing to unpack .../gparted_1.3.1-1_arm64.deb ...
Unpacking gparted (1.3.1-1) ...
Setting up gparted-common (1.3.1-1) ...
Setting up gparted (1.3.1-1) ...
Processing triggers for mailcap (3.70+nmu1) ...
Processing triggers for desktop-file-utils (0.26-1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1.1) ...
Processing triggers for man-db (2.11.2-2) ...
pi@raspberrypi:~ $
```

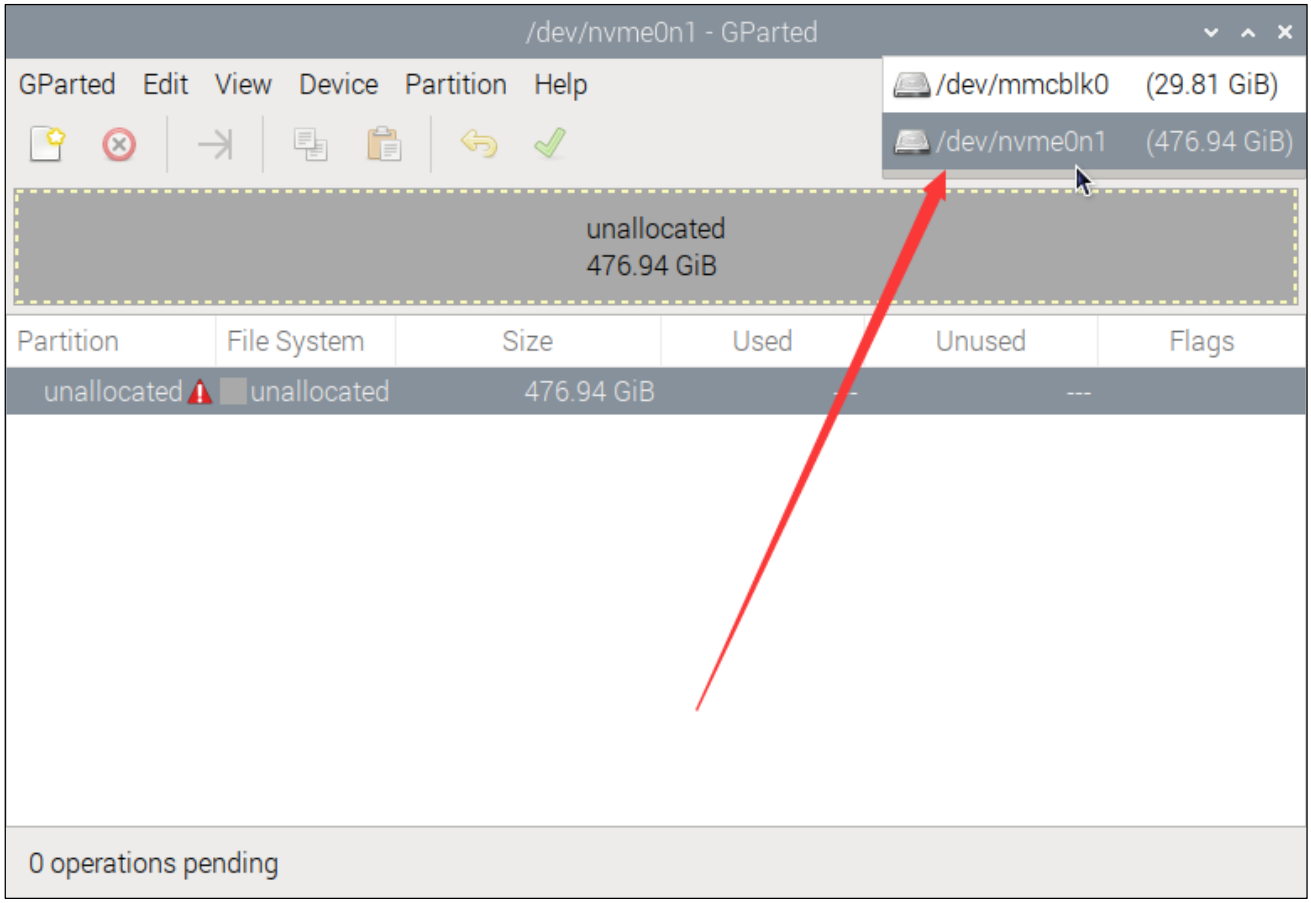
Open gparted with the command:

```
sudo gparted
```

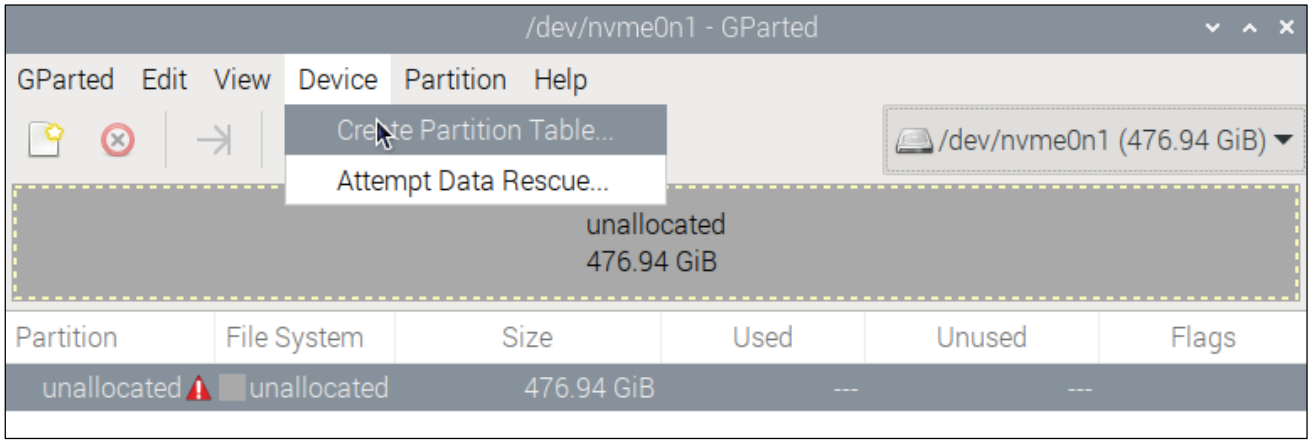
```
pi@raspberrypi:~ $ sudo gparted
error: XDG_RUNTIME_DIR is invalid or not set in the environment.
GParted 1.3.1
configuration --enable-libparted-dmraid --enable-online-resize
libparted 3.5
/dev/nvme0n1: unrecognised disk label
```



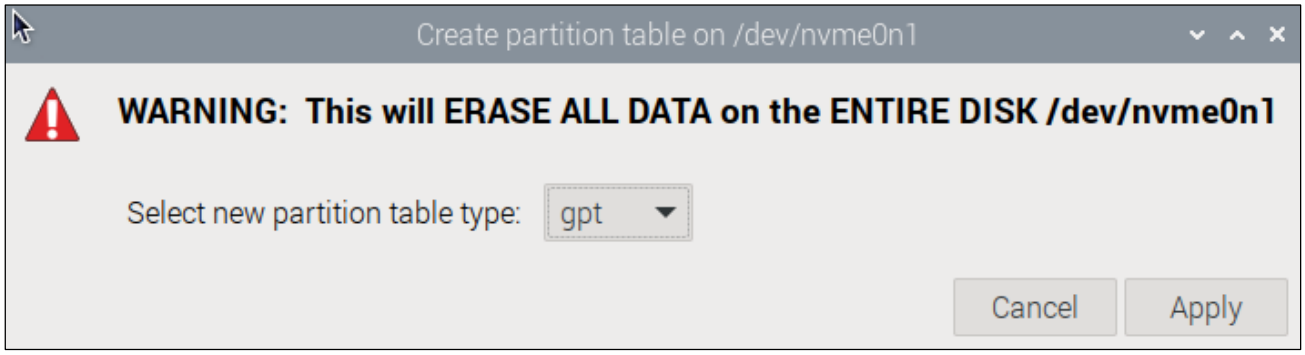
Click on the dropdown menu in the upper right corner and switch to NVME SSD.



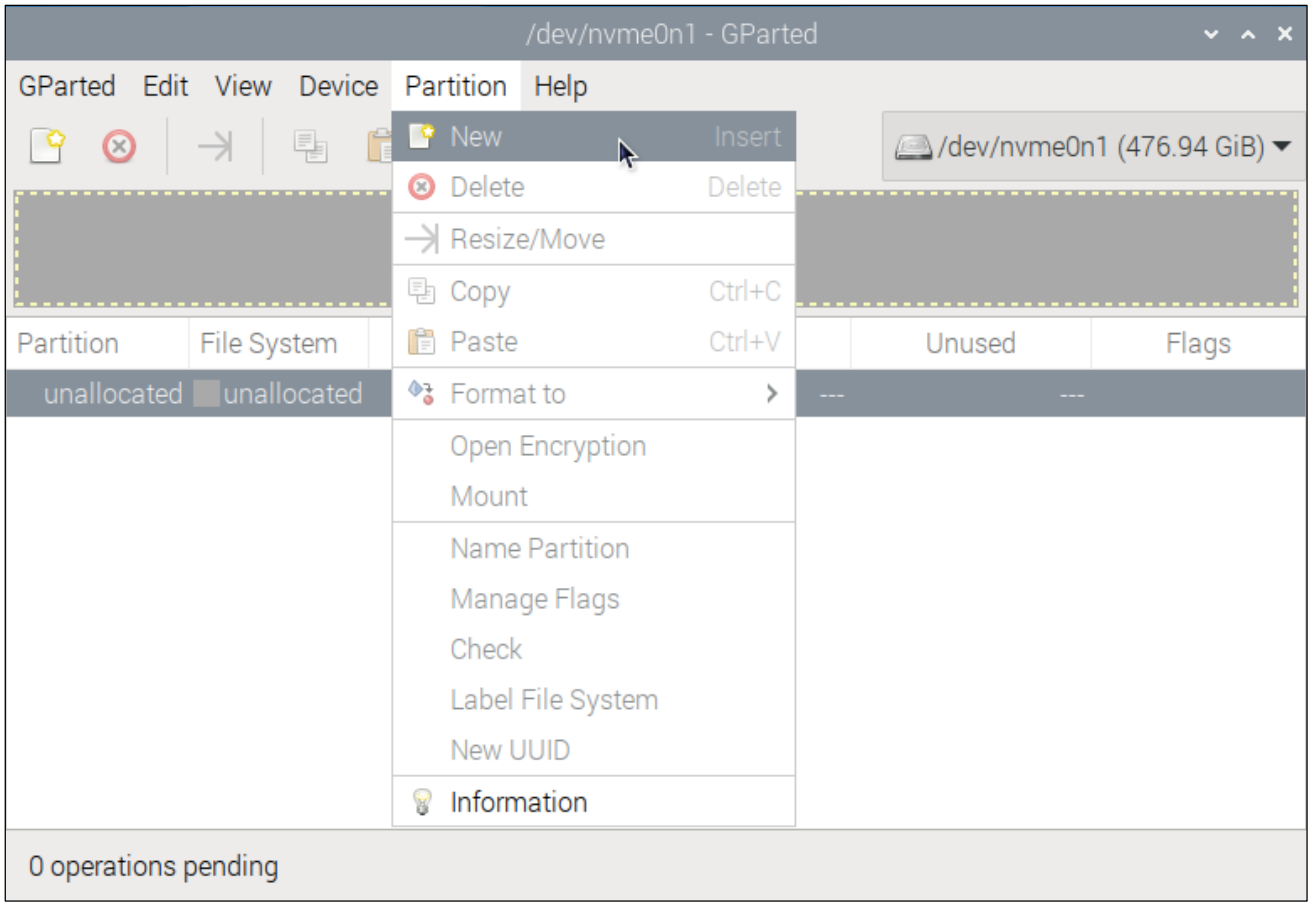
Click Device on the menu bar and select Create Partition Table.



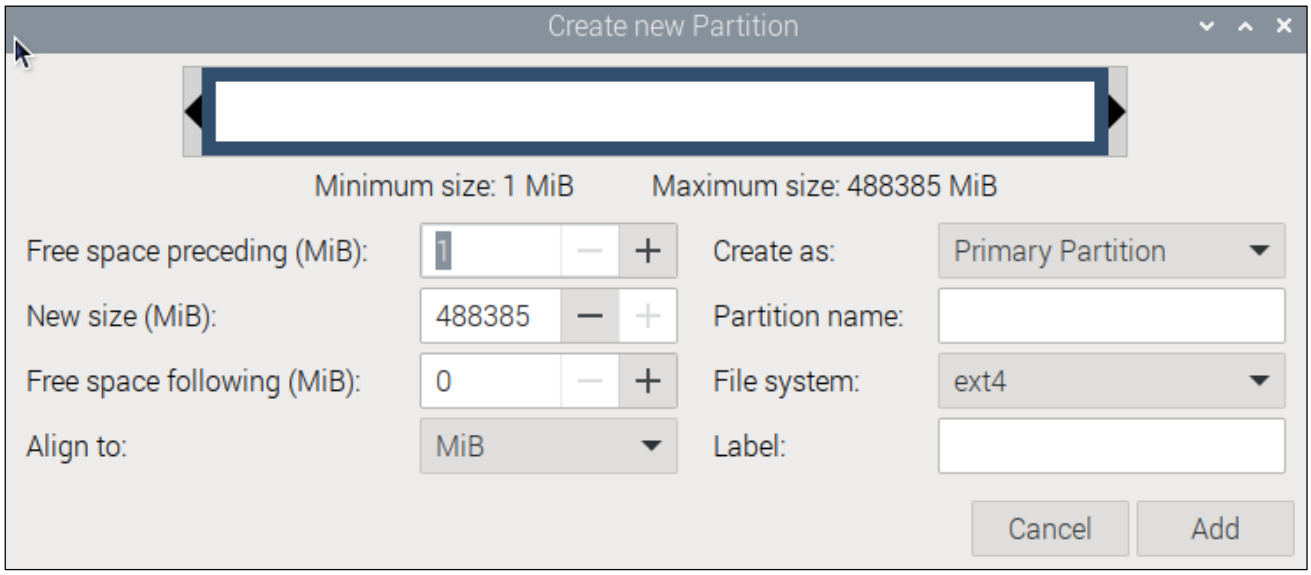
You will see the prompt that data will be erased. It is recommended to select gpt for partition table type. Click Apply.



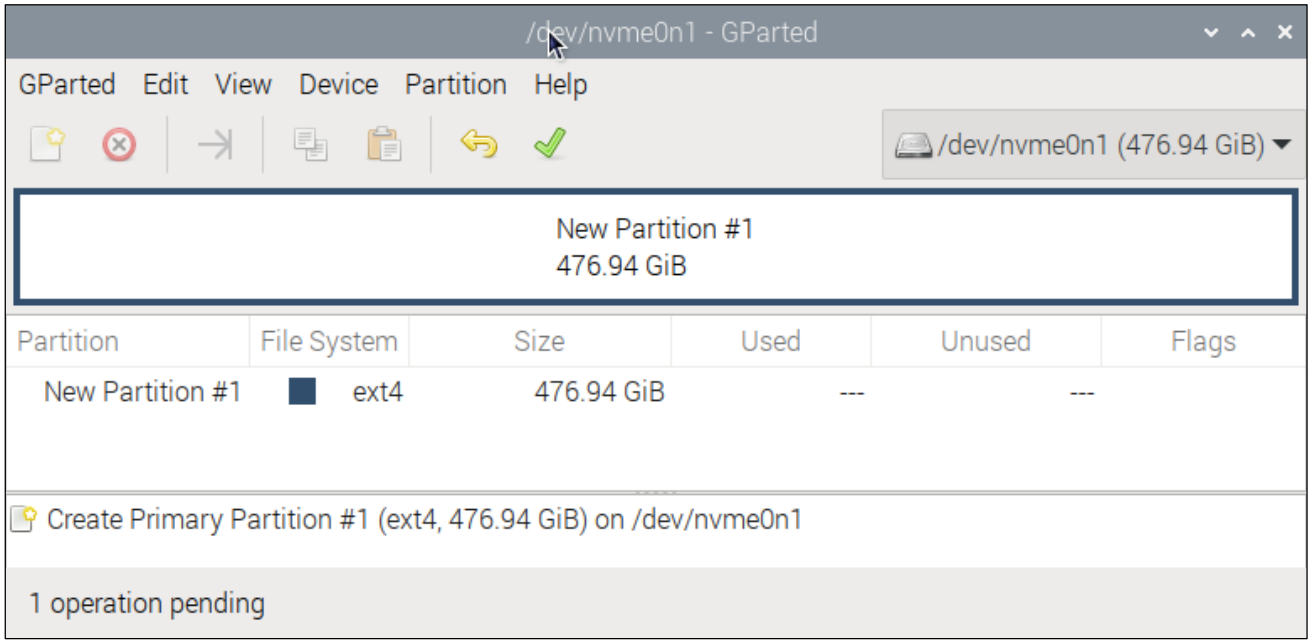
Click Partition on the menu bar, choose New.



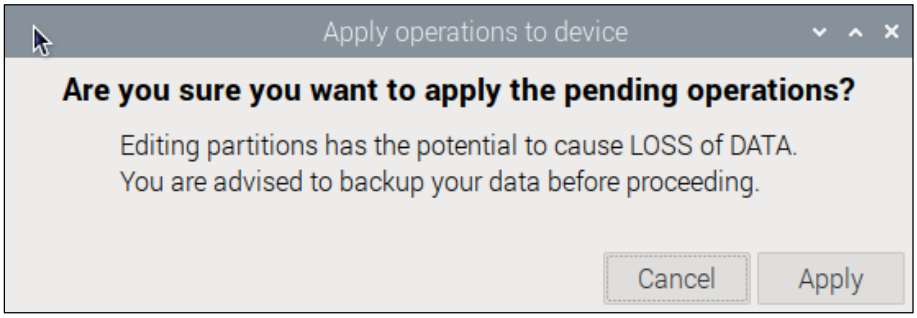
As shown in the figure below, the size of partition can be adjusted by dragging the mouse left and right, or by entering the size directly. The other options can be left as default setting. Here, we allocate all the capacity to a single partition. Click on Add.



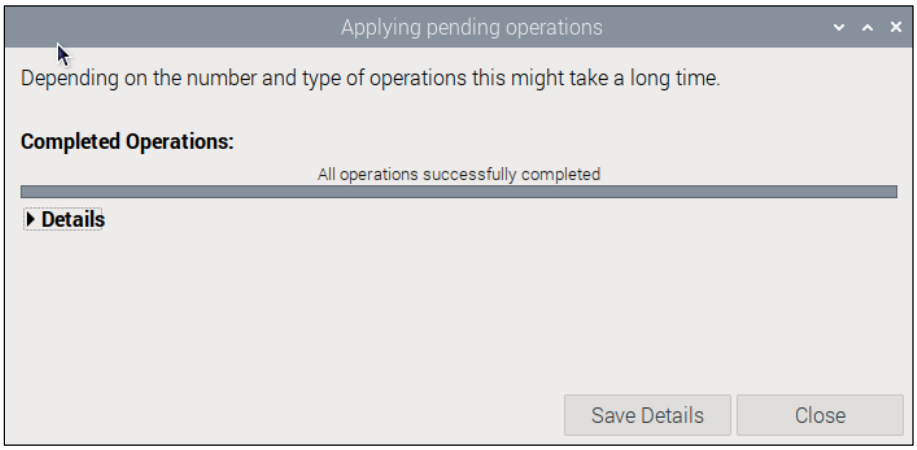
Click the check icon  to save the partition just built, as illustrated below.



Click on Apply.



Wait for it to complete and click on Close.

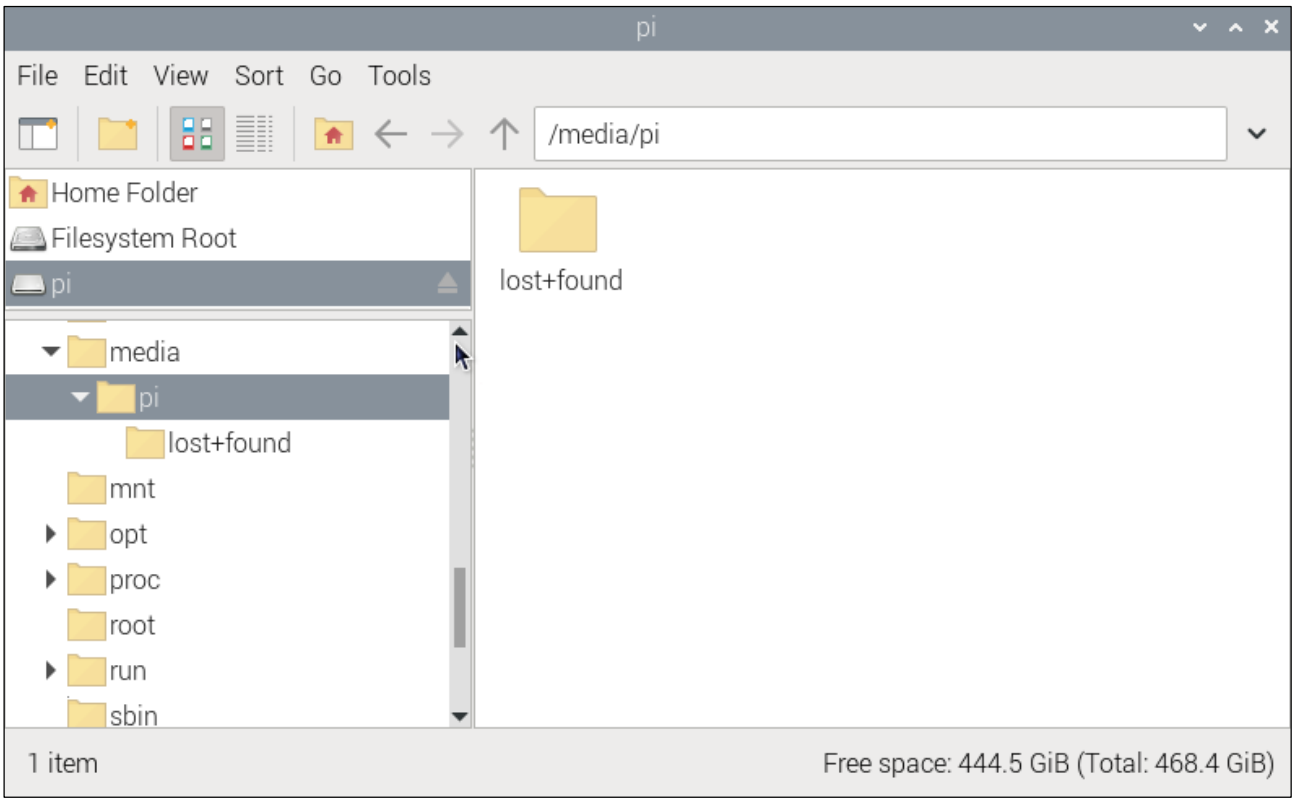


At this point, you can mount the disk using the mount command and then access the disk space through the file manager. Use the following command to mount the SSD:

```
mkdir pi
sudo mount /dev/nvme0n1p1 /media/pi
```

```
pi@raspberrypi:~ $ mkdir pi
pi@raspberrypi:~ $ sudo mount /dev/nvme0n1p1 /media/pi
```

Open the file manager, as shown below.



If you plan to use the SSD as a standard storage device, you can conclude the process here. However, if you want to further proceed with installing an operating system on the SSD, please read on.

3.2.4 Flashing the OS

Install the OS to SSD with the method similar to that in the previous section on installing a system onto an SD card. This time, operate on the Raspberry Pi.

Install rpi-imager with the following command:

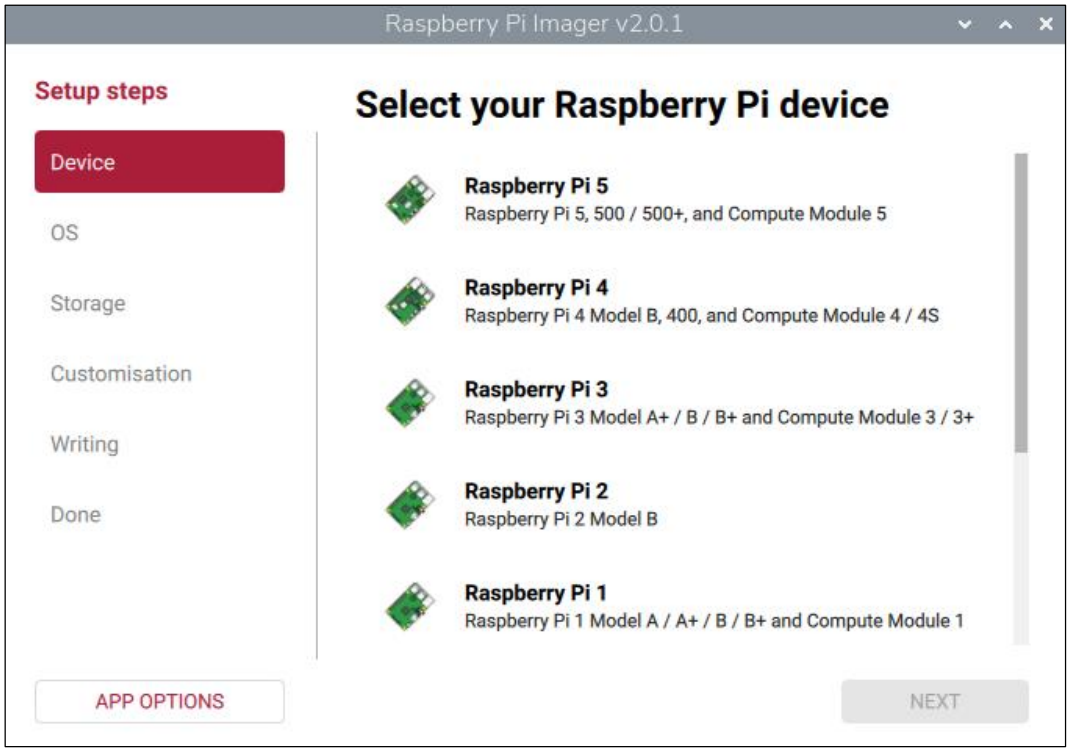
```
sudo apt install rpi-imager
```

```
pi@raspberrypi:~ $ sudo apt install rpi-imager
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
rpi-imager is already the newest version (1.8.5+rpt1).
0 upgraded, 0 newly installed, 0 to remove and 164 not upgraded.
pi@raspberrypi:~ $
```

Open rpi-imager:

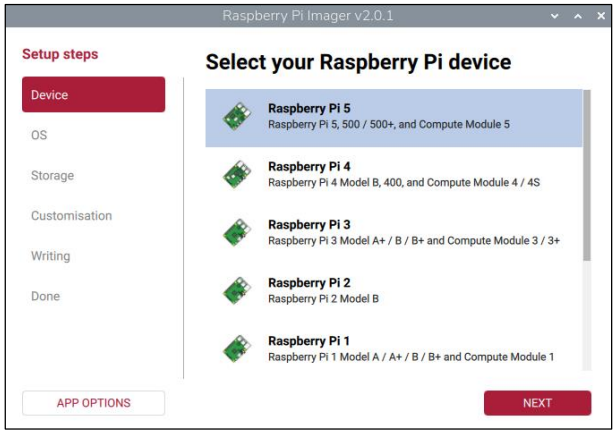
```
sudo rpi-imager
```

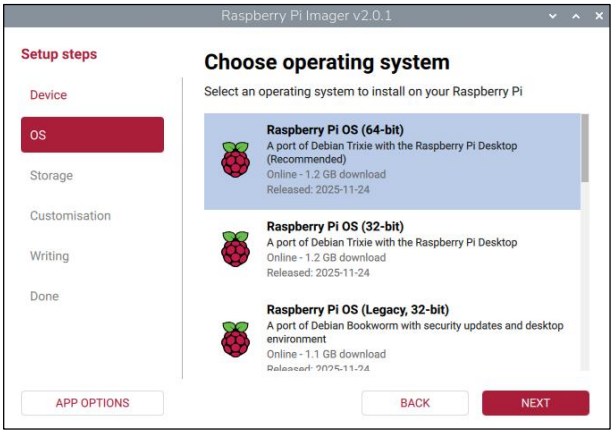
```
pi@raspberrypi:~ $ sudo rpi-imager
Running as root via sudo
Original user: pi
Original UID: 1000
Original home directory: /home/pi
DISPLAY already set to: :0
```

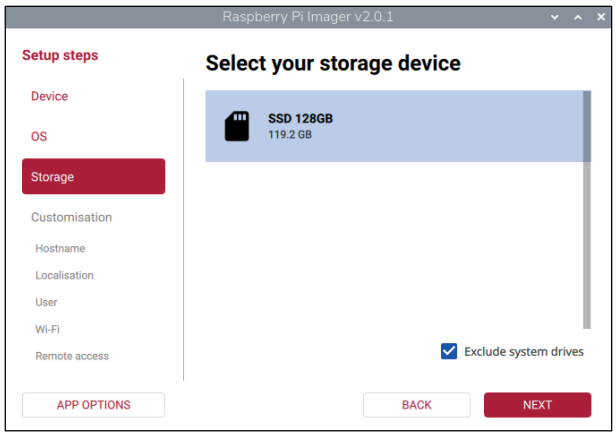


By this point, you should be quite familiar with the process.

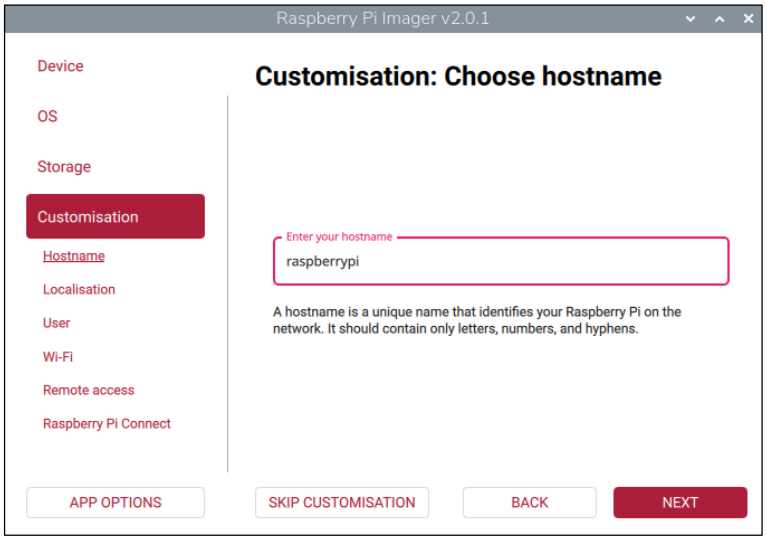
Select the Raspberry Pi 5 as your device and choose the online download for the operating system. (It is recommended to use a 64-bit Raspberry Pi system with recommended software). Choose your NVME SSD as the storage device. Click NEXT.



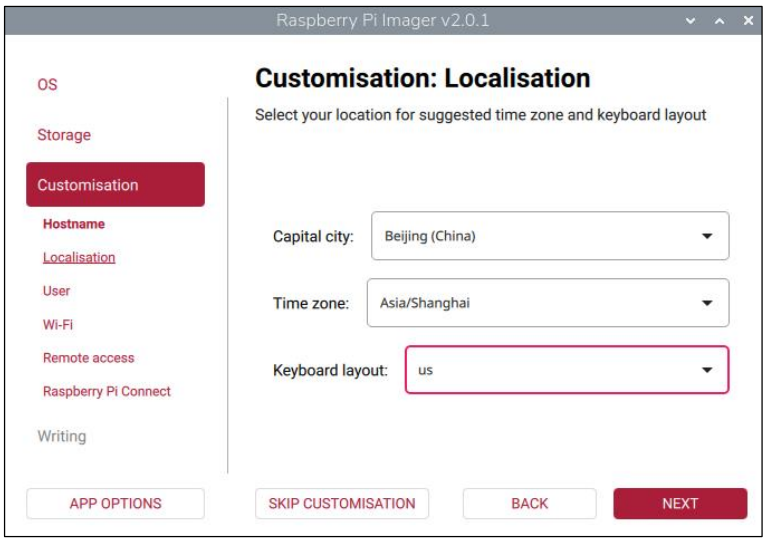




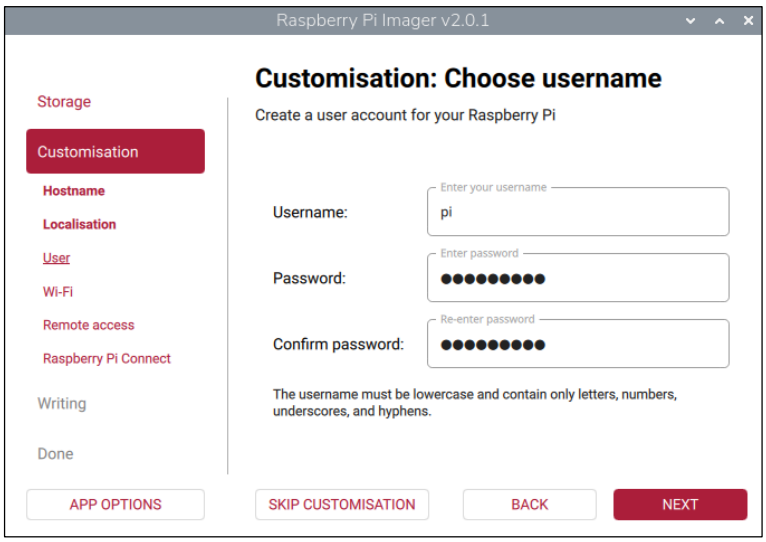
Enter the hostname.



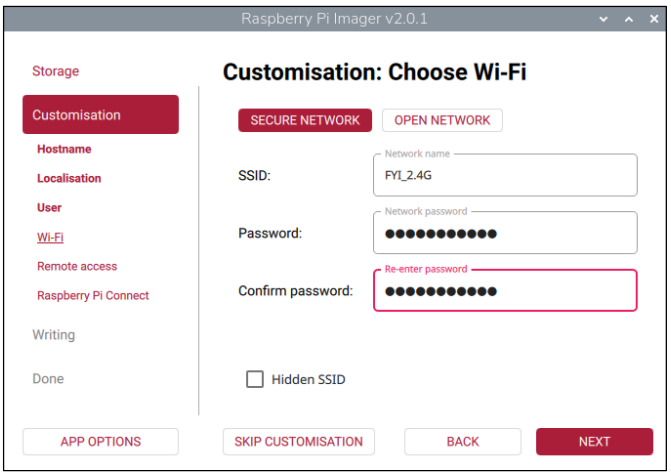
Select your location, timezone and keyboard layout. Then click NEXT.



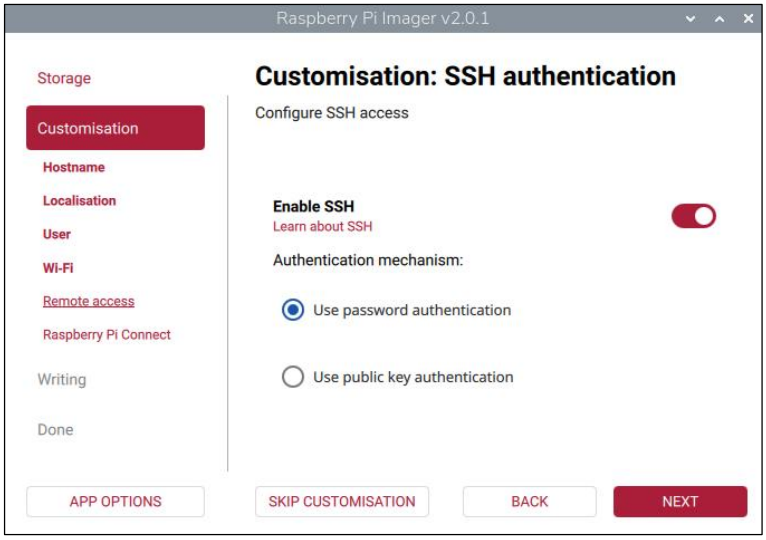
Configure your username and passowrd. The password needs to re-enter to confirm.



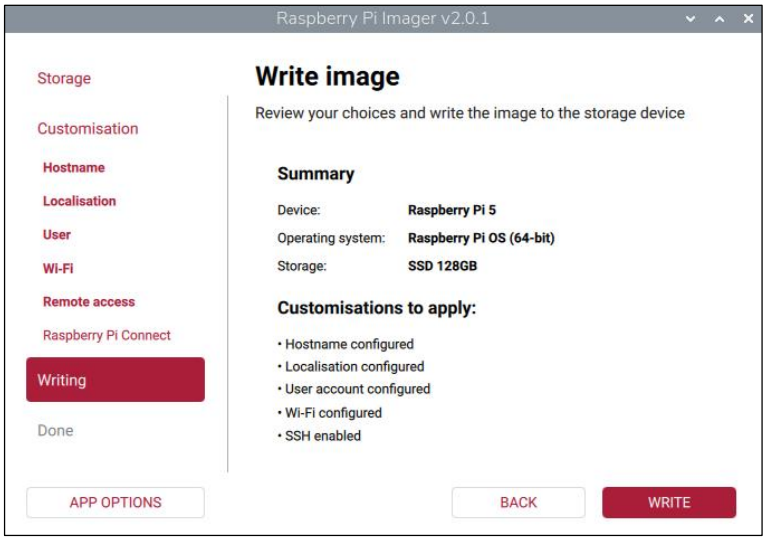
Step 4: Input the SSID and password of your wireless network. The passwords needs to re-enter to confirm. Then click NEXT.



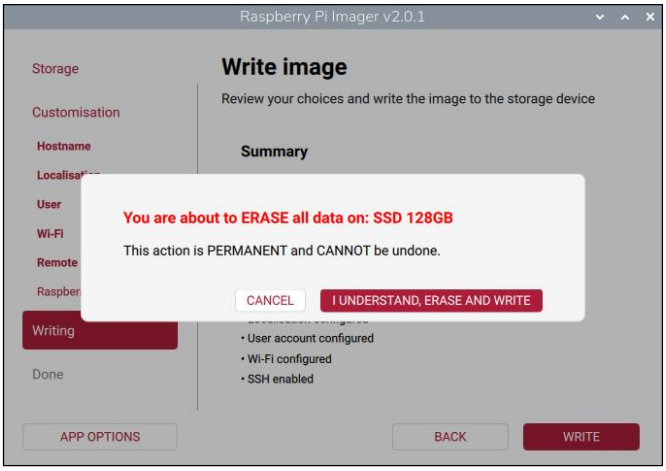
Enable SSH for ssh remote and click NEXT.



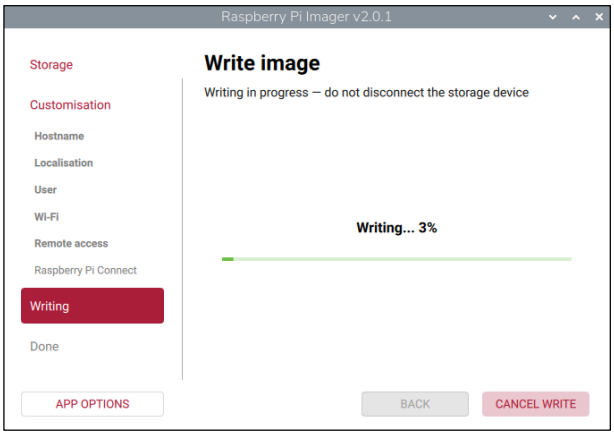
After finishing customisation configuration, the interface will show all the configuration you have made. Click **WRITE** to write the OS to your SD card after confirming everything is correct.

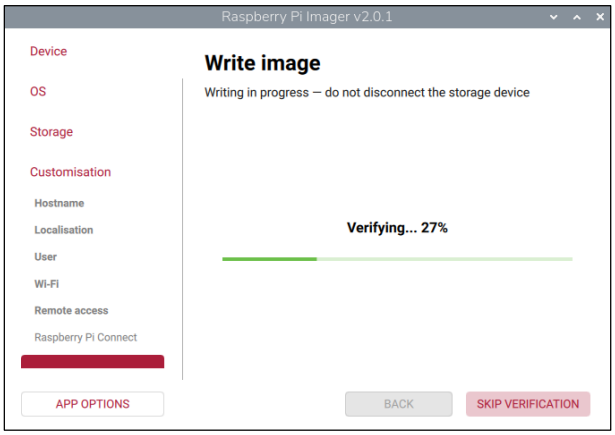


Warning: Before starting the write process, ensure you have backed up all data on the storage device. This operation will permanently erase all data on the device. If you have completed the backup, click **I UNDERSTAND, ERASE AND WRITE** to continue.

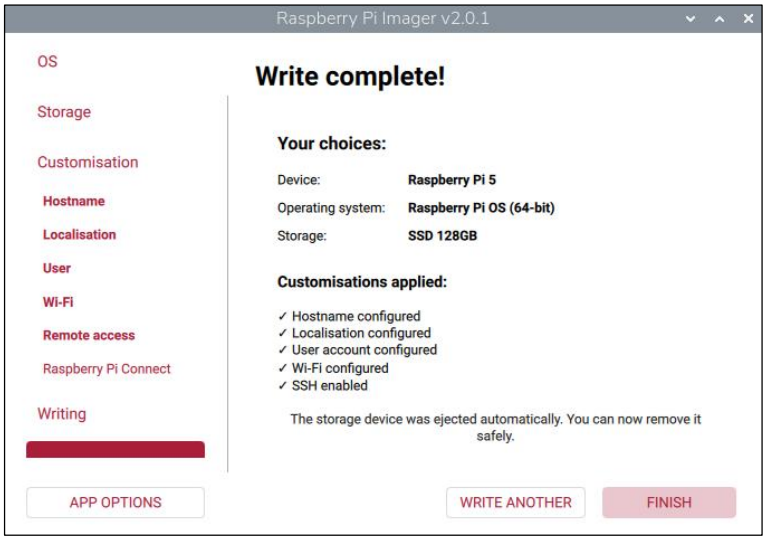


Wait for it to finish writing and verifying.





Congratulations! You have done the trickiest and the time-consuming part. Now that you have successfully installed the operating system onto the NVMe SSD, you are very close to achieving a triumph.



Next, boot into the system from SSD.

3.2.5 Enable PCIe 3.0 (on system written into SSD)

Note: This section does not apply to the Dual-NVMe Adapter Board or the Quad-NVMe Adapter Board, as they do not support the PCIe 3.0 protocol. If enabled, it may fail to boot from SSD.

If you have confirmed that SSD is with Phison controller in step 2, then you also need to enable PCIE3.0 on the system written into SSD.
If the controller of your SSD is not from Phison, **you can skip this section.**

The operation is as below:
Run the command lsblk to check the partitions of the SSD with Raspberry Pi OS written, as shown below:

```
pi@raspberrypi:~ $ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
mmcblk0     179:0    0  29.3G  0 disk
├─mmcblk0p1 179:1    0   512M  0 part /boot/firmware
└─mmcblk0p2 179:2    0  28.8G  0 part /
nvme0n1     259:0    0 119.2G  0 disk
├─nvme0n1p1 259:1    0   512M  0 part
└─nvme0n1p2 259:2    0 118.7G  0 part
pi@raspberrypi:~ $
```

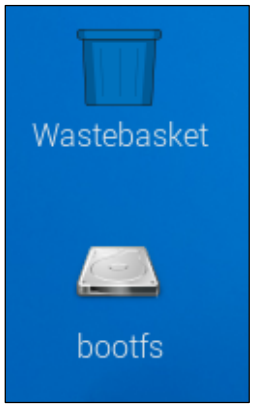
(The above screenshot is the result of a 128GB SSD with Phison as main controller.)

Run the following commands one by one to mount partition 1 of the SSD to the directory of /media/pi.

```
sudo mkdir /media/pi
sudo mount /dev/nvme0n1p1 /media/pi
```

```
pi@raspberrypi:~ $ sudo mkdir /media/pi
pi@raspberrypi:~ $ sudo mount /dev/nvme0n1p1 /media/pi
```

If it mounts successfully, you'll see the following disk icon on the desktop.



Open and modify the config.txt file with the following command.

```
sudo nano /media/pi/config.txt
```

```
pi@raspberrypi:~ $ sudo nano /media/pi/config.txt
```

Add the line dtparam=pciex1_gen=3 to the end of the file, as shown below:

```
# Disable compensation for displays with overscan
disable_overscan=1

# Run as fast as firmware / board allows
arm_boost=1

[cm4]
# Enable host mode on the 2711 built-in XHCI USB controller.
# This line should be removed if the legacy DWC2 controller is required
# (e.g. for USB device mode) or if USB support is not required.
otg_mode=1

[cm5]
dtoverlay=dwc2,dr_mode=host

[all]
dtparam=pciex1_gen=3
```

Press Ctrl-O to save the file, Enter to confirm, and Ctrl-X to exit.

3.2.6 Booting from SSD

After finishing flashing the OS to SSD, shutdown Raspberry Pi, **remove the power supply, and remove the SD card. Then connect the power, the Raspberry Pi will boot from SSD**.

The default boot order of Raspberry Pi is SD card → SSD → USB, Therefore, when the SD card is removed, the Raspberry Pi cannot detect the SD card, it will boot from SSD. By far, the Raspberry Pi can boot successfully from NVME SSD.

```
B1 SD Card Boot  Boot from SD Card before trying NVMe and then USB (RECOMMENDED)
B2 NVMe/USB Boot Boot from NVMe before trying USB and then SD Card
B3 Network Boot  Boot from Network unless override by SD Card
```

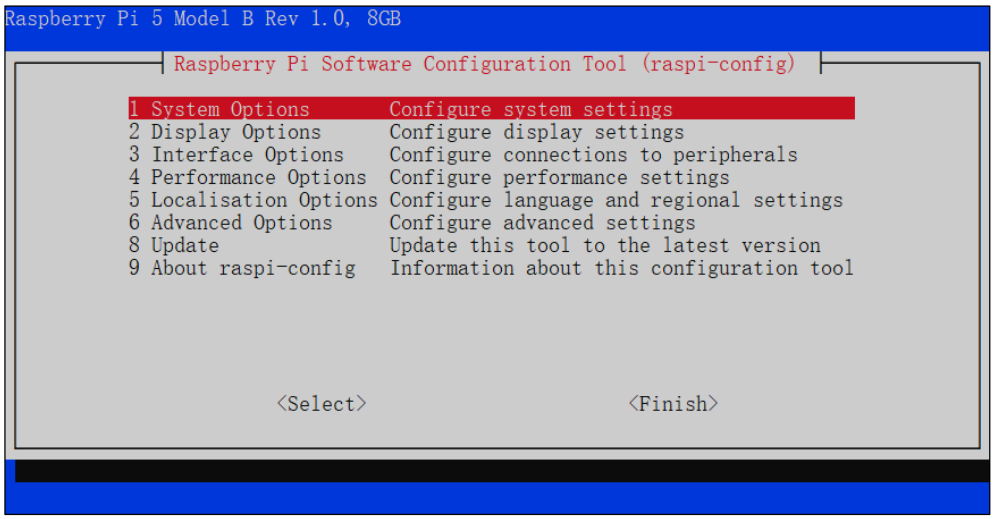
If you want the Raspberry Pi to boot from the SSD first, please continue with the following steps to modify the boot order. The boot order is saved in the Pi's EEPROM, so it does not matter whether you modify the boot order on SD card system or SSD system.

If you do not want to change the boot order, please skip this chapter.

Configuring the Boot Order

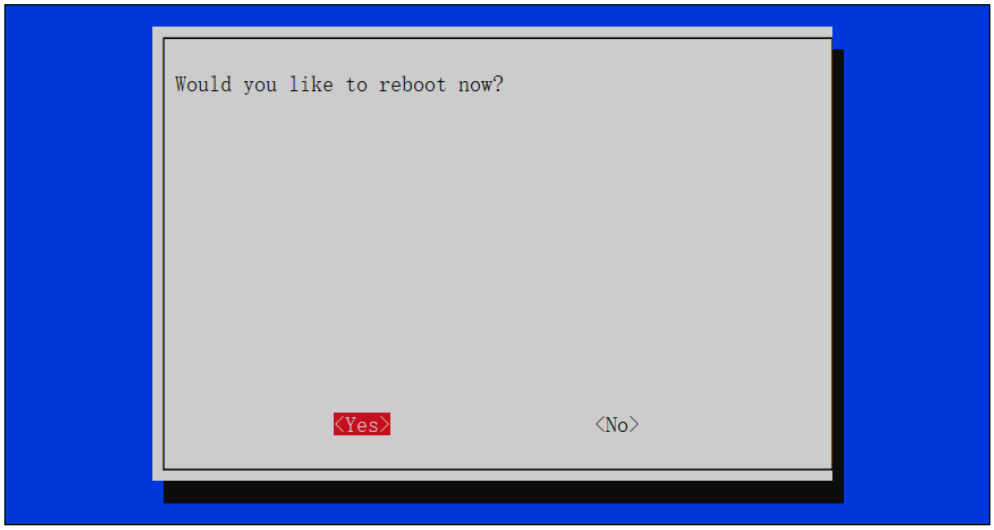
Type the following command in the Terminal.

```
sudo raspi-config
```



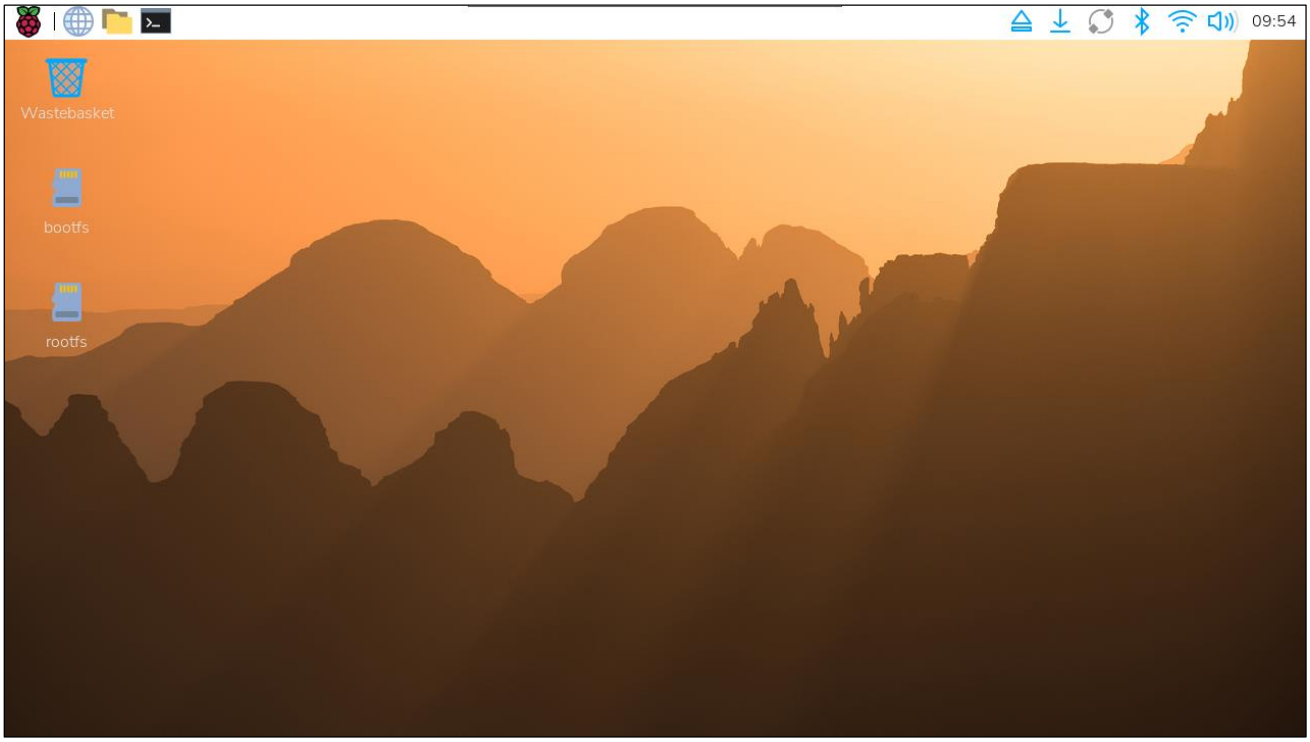
Using the keyboard's arrow keys and the Enter key, select the options in sequence.
"6 Advanced Options" →"A4 Boot Order"→"B2 NVME/USB Boot ···"

Select "OK"→"Finish"→"Yes", and reboot your Raspberry Pi.



At this point, upon restarting, the Raspberry Pi will boot from the NVME SSD first. If you are using an external monitor, you will see that the Raspberry Pi has booted up correctly. If your SD card is still inserted, you will also see an icon on the desktop as shown below.

With this, the process of booting the Raspberry Pi from the NVME SSD has been fully completed.



If you use VNC viewer, you will need to repeat the previous steps to activate the VNC service as it is not yet enabled in the new system on the SSD. Here, we take Windows as an example.

Run the following command:

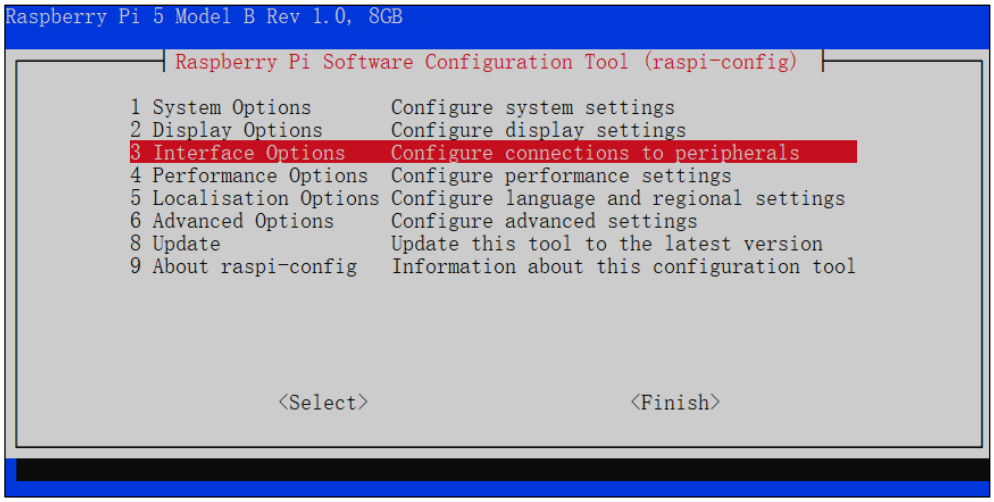
```
ssh pi@raspberrypi.local
```

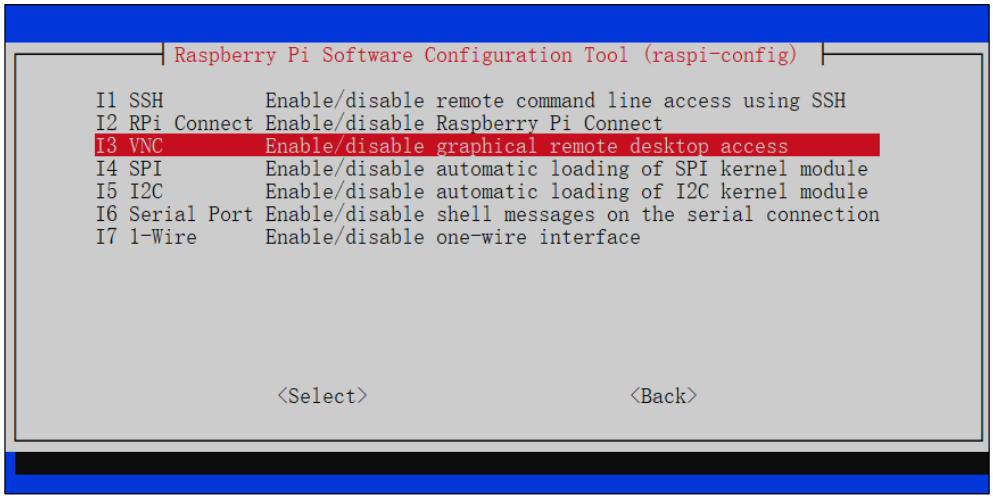
```
C:\Users\Administrator>ssh pi@raspberrypi.local
The authenticity of host 'raspberrypi.local (240e:3b4:3812:1fc0:954e:f55f:a772:fed5)' can't be established.
ECDSA key fingerprint is SHA256:hcx7u6H73nUsIc5WXA3HWa5GPSZEDroiz/mMbQx3ogc.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'raspberrypi.local,240e:3b4:3812:1fc0:954e:f55f:a772:fed5' (ECDSA) to the list of known hosts
.
pi@raspberrypi.local's password:
Linux raspberrypi 6.6.20+rpt-rpi-2712 #1 SMP PREEMPT Debian 1:6.6.20-1+rpt1 (2024-03-07) aarch64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Jun  3 16:50:25 2024

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set a new password.

pi@raspberrypi:~ $
```

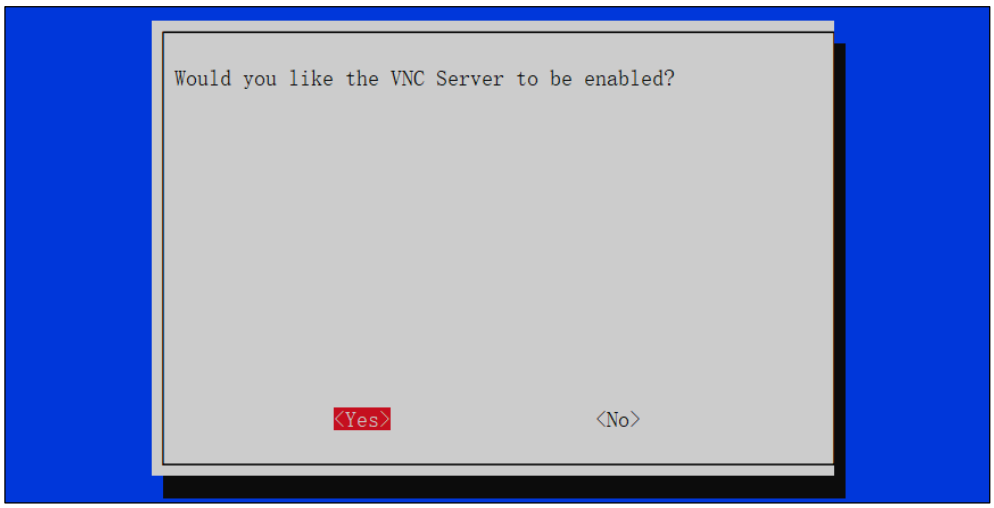
Once successfully ssh into Raspberry Pi, run the following command to open the configuration and enable VNC.

```
sudo raspi-config
```

Select “3 Interface Options”→”I2 VNC”→”Yes”→”Finish”.







Now you should be able to access Raspberry Pi via VNC.

Chapter 4 APP Control

Before powering on the Freenove Computer Case Kit Pro for Raspberry Pi, please make sure that all cable connections are correct.

Due to its multiple functions, this case requires an adequate power supply. We highly recommend using the official Raspberry Pi 5.1V / 5A power adapter (https://www.raspberrypi.com/products/27w-power-supply). Failure to do so may result in the Freenove Computer Case Kit Pro for Raspberry Pi being unusable or causing damage to components.

4.1 Boot Behavior & Environment Settings

4.1.1 What to Expect on First Startup

When you first power on the assembled chassis, the Raspberry Pi does not talk to the GPIO adapter board. This causes the board to operate on its own in a default mode, and you will observe the following.

1. The case RGB lights will operate in rainbow mode.
2. During initial startup, the fan will run at maximum speed for 3 seconds.
   After this period, the system switches to temperature-controlled mode, where fan speed is regulated by the thermal sensor on the GPIO adapter board
3. The screen will remain off during this phase - this is normal and expected.

Troubleshooting Guide:

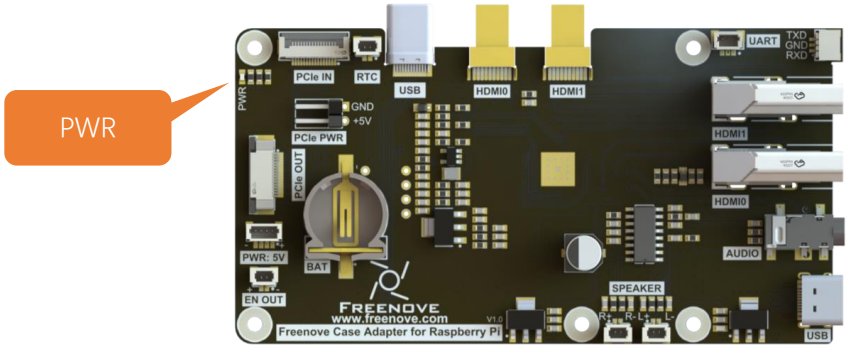
If the RGB lights fail to illuminate, or if the fan doesn't perform the 3-second full-speed initialization, please:
Immediately power off the system

- Verify proper alignment and connection between the GPIO adapter board and Raspberry Pi
- Check all relevant power and data connections

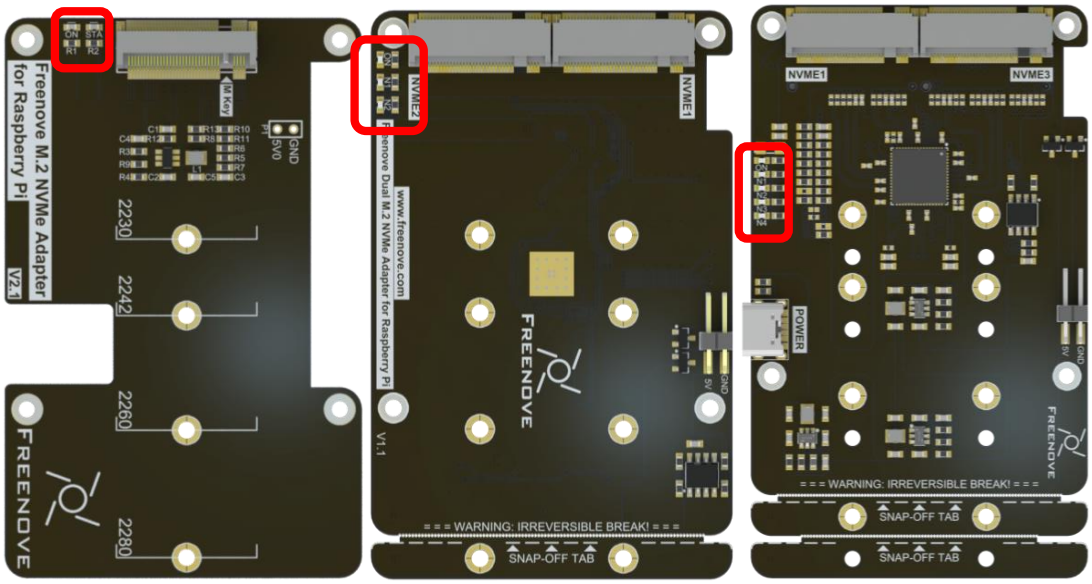
If you have any questions of the above, please contact us at **support@freenove.com**

4. RPi 5 Status LED: The green STAT LED will remain steadily illuminated. If this LED is not lit or displays any pattern other than a steady green light, it indicates that the Raspberry Pi operating system has not booted successfully. In this case, please check your Raspberry Pi hardware and OS installation separately.

5. The PWR indicator light on the Audio-Video Board remains steadily lit.



6. NVMe Adapter Board Indicators:
   ON LED: Steadily lit.
   STA LED: Blinks in sync with the SSD's built-in activity light.



Should the ON indicator fail to illuminate, please check the cable connection.

Important: It is imperative to utilize the onboard pin header for supplemental power when operating multiple solid-state drives to mitigate risks associated with inadequate power supply.

If all components behaves as expected, then your computer case is correctly assembled and functioning well. In this case, you can connect a screen to your Raspberry Pi or access it via VNC viewer.

If you have any questions of the above, please contact us at **support@freenove.com**

4.1.2 Software Setup

Code downloading

Open the Raspberry Pi Terminal, type the following two commands one by one to download the code for the case.

```
cd
git clone https://github.com/Freenove/Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi.git
```

```
pi@raspberrypi:~ $ cd
pi@raspberrypi:~ $ git clone https://github.com/Freenove/Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi.git
Cloning into 'Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi'...
remote: Enumerating objects: 45, done.
remote: Counting objects: 100% (45/45), done.
remote: Compressing objects: 100% (40/40), done.
remote: Total 45 (delta 2), reused 45 (delta 2), pack-reused 0 (from 0)
Receiving objects: 100% (45/45), 9.14 MiB | 3.36 MiB/s, done.
Resolving deltas: 100% (2/2), done.
```

Software Packages Update

Run the following command on the terminal to update your Raspberry Pi's package list to the latest version.

```
sudo apt update
```

```
pi@raspberrypi:~ $ sudo apt update
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://deb.debian.org/debian trixie-updates InRelease
Hit:3 http://deb.debian.org/debian-security trixie-security InRelease
Hit:4 http://archive.raspberrypi.com/debian trixie InRelease
24 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

OLED Library Installation (Important)

Run the following command to install the OLED library. Fail to do so will result in software malfunction.

```
sudo apt install python3-luma.oled
```

```
pi@raspberrypi:~ $ sudo apt install python3-luma.oled
Installing:
  python3-luma.oled

Installing dependencies:
  python3-cbor2  python3-ftdi  python3-luma.core  python3-usb

Suggested packages:
  python-cbor2-doc
```

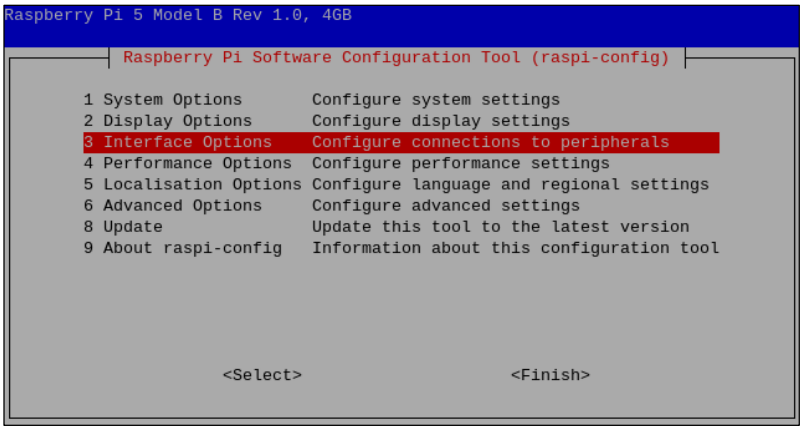
Enable I2C (Important)

The I2C function must be enabled, as it is required for communication between the Raspberry Pi, the OLED display, and the GPIO adapter board. Without it, the chassis software will fail to operate.

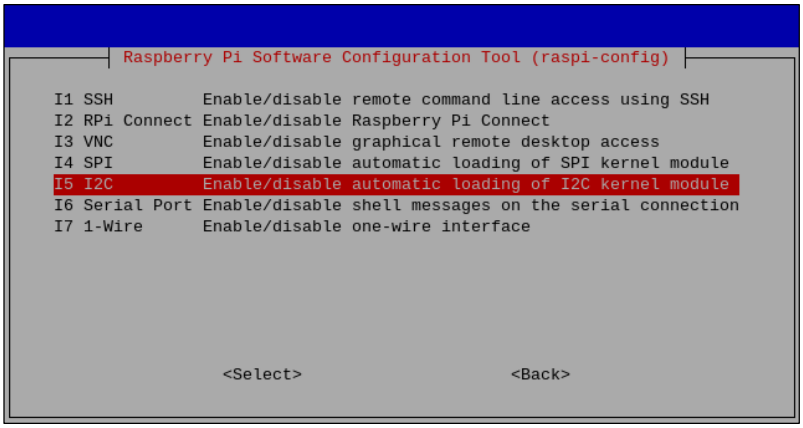
Run the following command to open the Raspberry Pi configuration interface.

```
sudo raspi-config
```

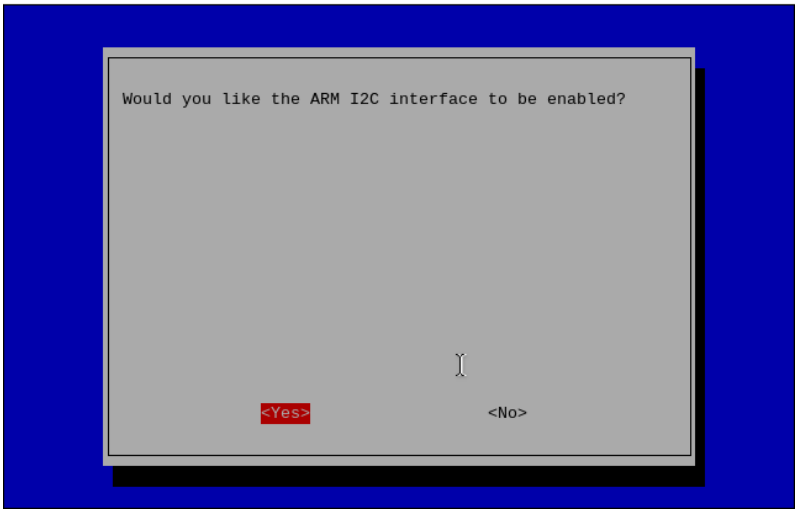
Navigate to Interface Options and press Enter.



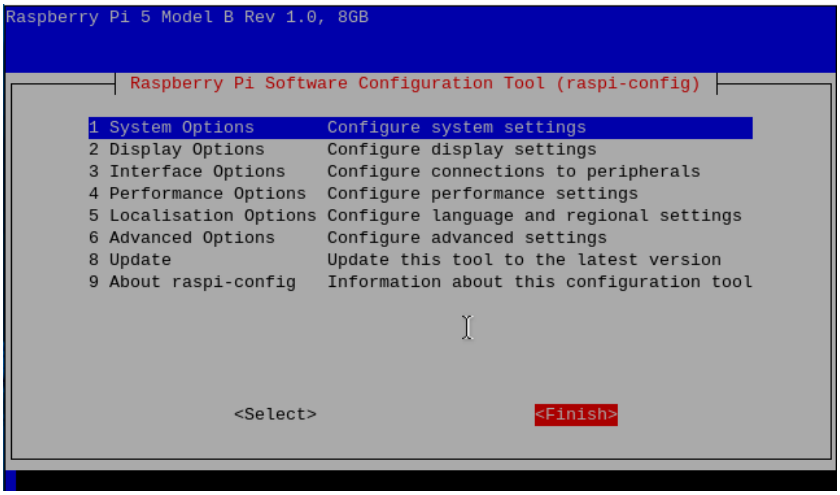
Select I2C and press Enter to enable it.



Select Yes, and press Enter.



Select Finish to save the change and exit the configuration inferface.

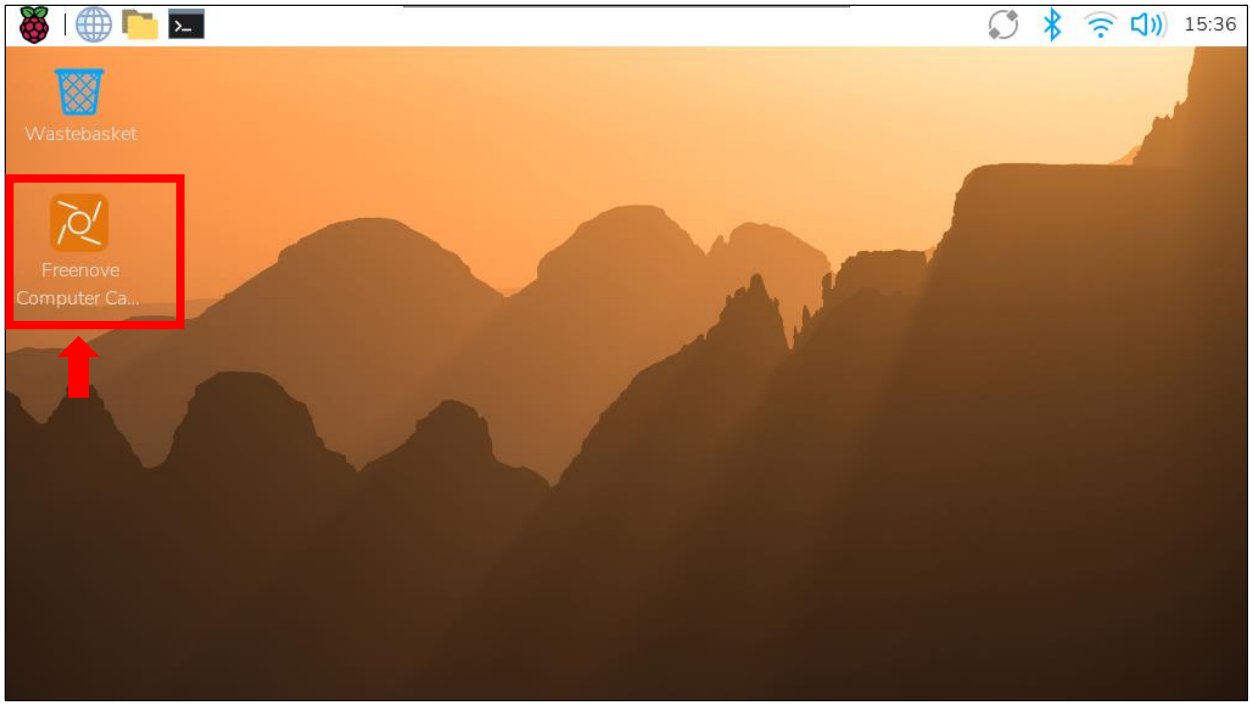


Creating Desktop Shortcut

Run the following two commands one by one in the Raspberry Pi terminal to create a desktop shortcut for the case control software.

```
cd Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code/
sudo python create_desktop_shortcut.py
```

```
pi@raspberrypi:~/Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code $ sudo python create_desktop_shortcut.py
Current directory: /home/pi/Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code
Created new desktop file directly on desktop
Desktop file and script set as executable
Desktop shortcut created successfully!
```

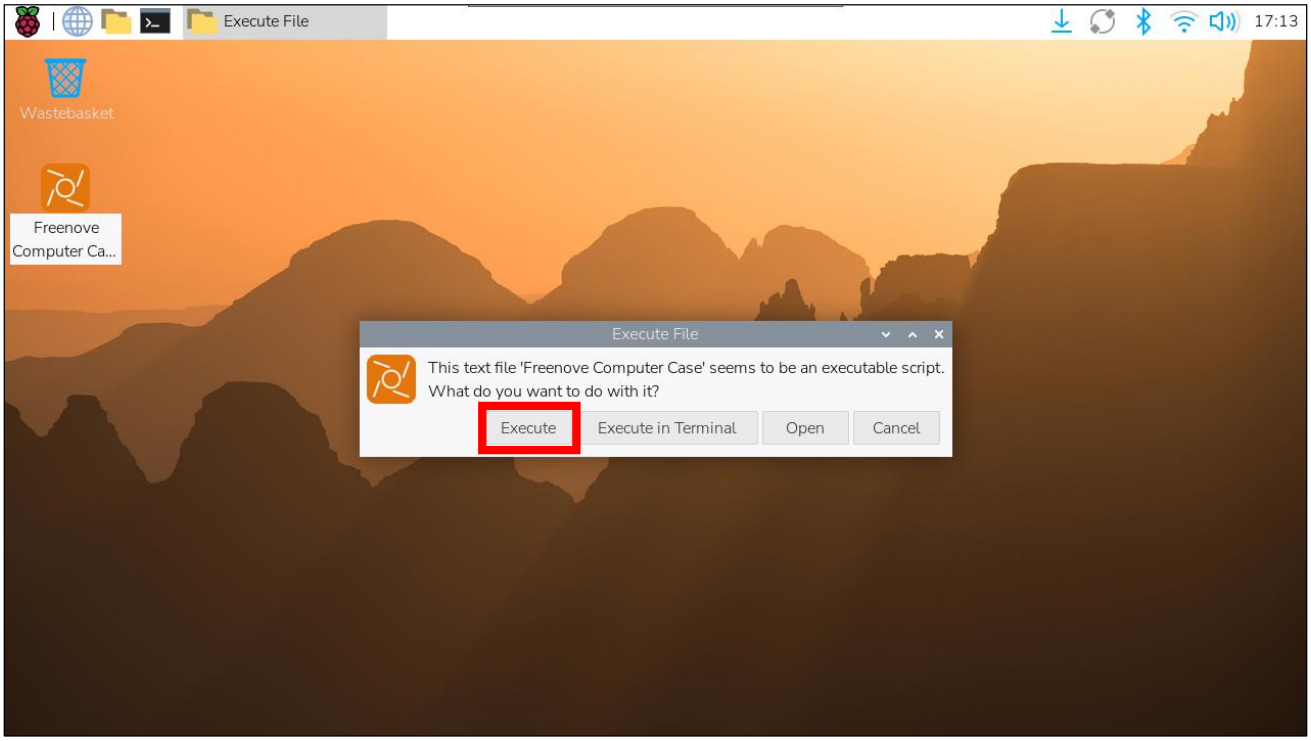


If you are interested in the code implementation, you can explore the files in the Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code directory.
Should you wish to modify the code, please ensure you back it up first to avoid potential software malfunctions caused by unintended changes.

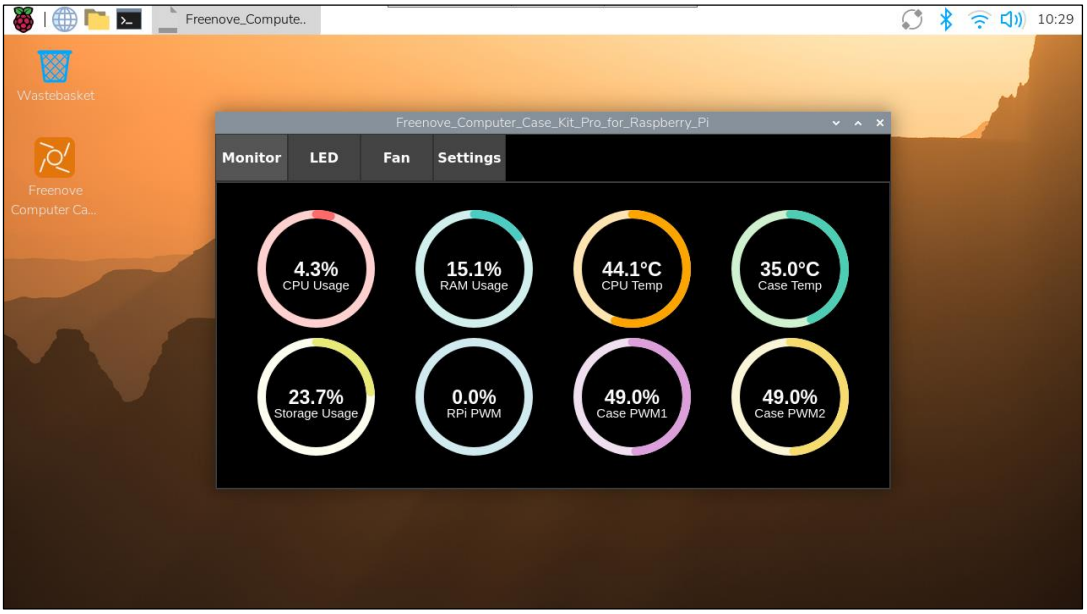
4.2 About the Case Control Software

With the environment configured from the previous chapter, the accompanying host software can now be used to manage case functions including ARGB lighting, the OLED display, and fan control.
This chapter provides a detailed guide on the software's usage. For insight into the interface design, the app_ui.py file is available in the Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code directory.

Double click the software with Freenove logo on RPi's desktop, and a window will pop up. Click "**Execute**" to run the program.

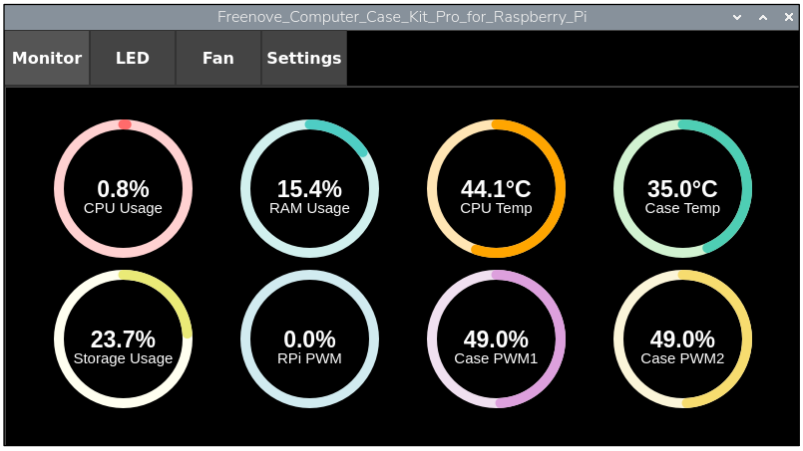


The software interface is as shown below.



4.2.1 Dashboard Monitoring

The dashboard provides live monitoring of key RPi 5 and case component stats, giving you an at-a-glance view of the system status.



Below is a detailed explanation of the parameters displayed on the monitoring interface:

- **CPU Usage**: Current processor utilization percentage of the Raspberry Pi 5
- **RAM Usage**: Current system memory utilization percentage of the Raspberry Pi 5
- **CPU TEMP**: The internal temperature of the Raspberry Pi 5's SoC (System on Chip)
- **Case Temp**: The temperature inside the chassis, provided by the temperature sensor on the GPIO Board
- **Storage Usage**: The total storage space utilization. This value reflects the usage of the SD card if one is used. If single or multiple SSDs are installed, it calculates the aggregate usage across all drives.
- **RPi PWM**: PWM duty cycle for the Raspberry Pi's active cooler fan
- **Case PWM1**: PWM duty cycle for case fan group 1 (FAN1/FAN2)
- **Case PWM2**: PWM duty cycle for case fan group 2 (FAN3/FAN4)

Data Source & Troubleshooting:

CPU Usage, RAM Usage, CPU Temp, Storage Usage, and RPi PWM are retrieved directly from the Raspberry Pi. If any of these values are missing, check the Raspberry Pi for faults.

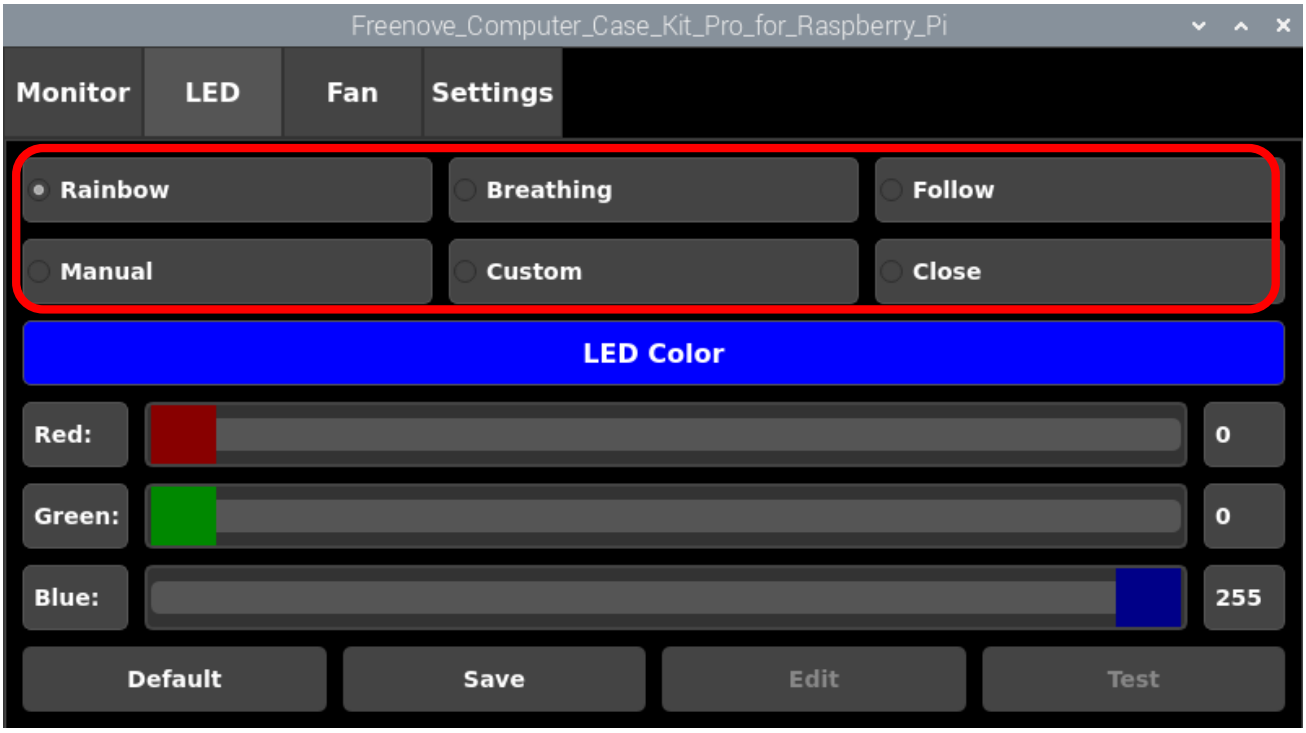
Case Temp, Case PWM1, and Case PWM2 are read from the GPIO Board via I2C communication with Raspberry Pi 5.

If these data cannot be obtained consistently, please contact us by email: **support@freenove.com**

For those interested in the interface implementation, please refer to the files api_systemInfo.py and api_expansion.py in the Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code directory.

4.2.2 LED Control Interface

This is the control interface for the case ARGB lights. You can select different modes to display various lighting effects.



It is set to rainbow mode by default, as shown below.

There are four preset lighting modes available: **Rainbow**、**Breathing**、**Follow**、**Manual**. You can select the corresponding option to switch among the modes.

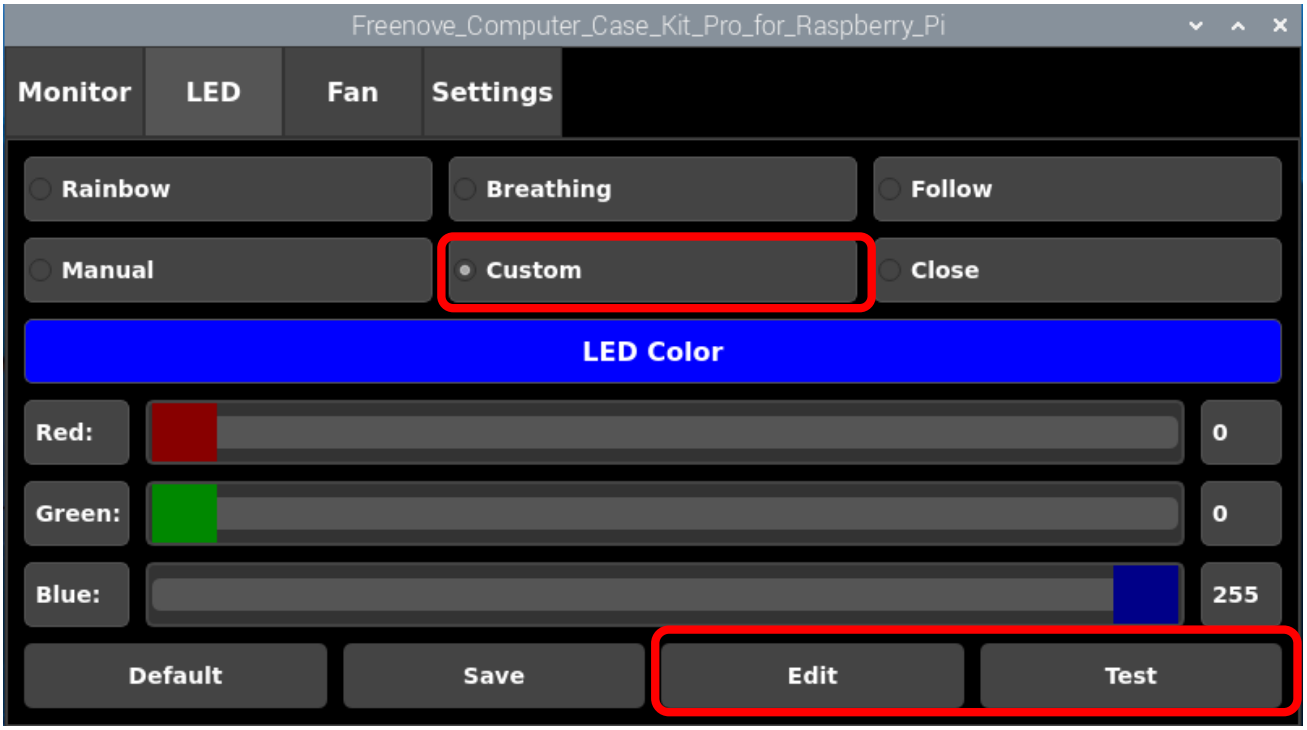
Note: Only in **Breathing, Follow, and Manual** modes can the color of the RGB lights be controlled using the slider below. In other modes, the color of the RGB lights cannot be adjusted.

If you do not turn ON the RGB lights, you can select the Close mode to turn off them.

Please note: Any lighting mode you select is temporary. The case will revert to its default mode after a shutdown and restart.
To set a new default mode, select your desired mode and click the "**Save**" button.

To restore the RGB lights and sliders to their default settings, click the "**Default**" button once.

If the four preset lighting modes do not meet your needs, you can use the "**Custom**" mode for personalized settings.



Click "**Edit**" will open the "task_led.py" file. You can modify the code in the editor.
Click "**Test**" will create a temporary thread and run task_led.py, allowing you to quickly debug and observe the LED light effects.
You can also view the source code directly:
Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code/task_led.py
For more about LED control interface, you can refer to the source file:
Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code/api_expansion.py

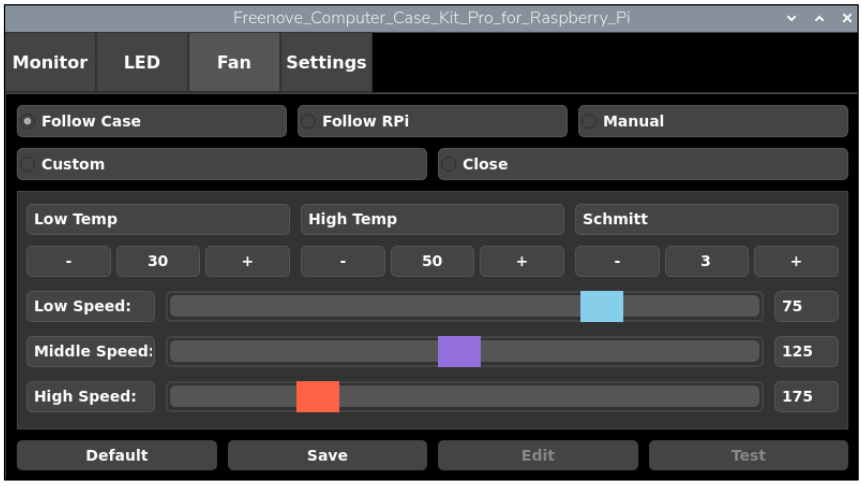
Important Notes:

1. Back up the source code before making any modifications.
2. Custom mode is an advanced feature. Modifying the code in task_led.py requires a basic understanding of Python programming. If you are not familiar with programming, we do not recommend editing this file.
3. The "Test" button only runs the code in the current state. The code will not automatically run after rebooting the Raspberry Pi.
4. If the LED lights show no response after you modify the code and click "Test," it indicates an error in your code preventing it from running properly. Please review your code.
5. If you want the Custom mode code to execute automatically on every startup, please refer to the instructions in the "4.2.4 Settings Interface" Section.

4.2.3 Fan Control Interface

This is the case fan control interface for convenient fan management. The interface will change when you select different modes: Follow Case, Follow RPi, or Manual mode.

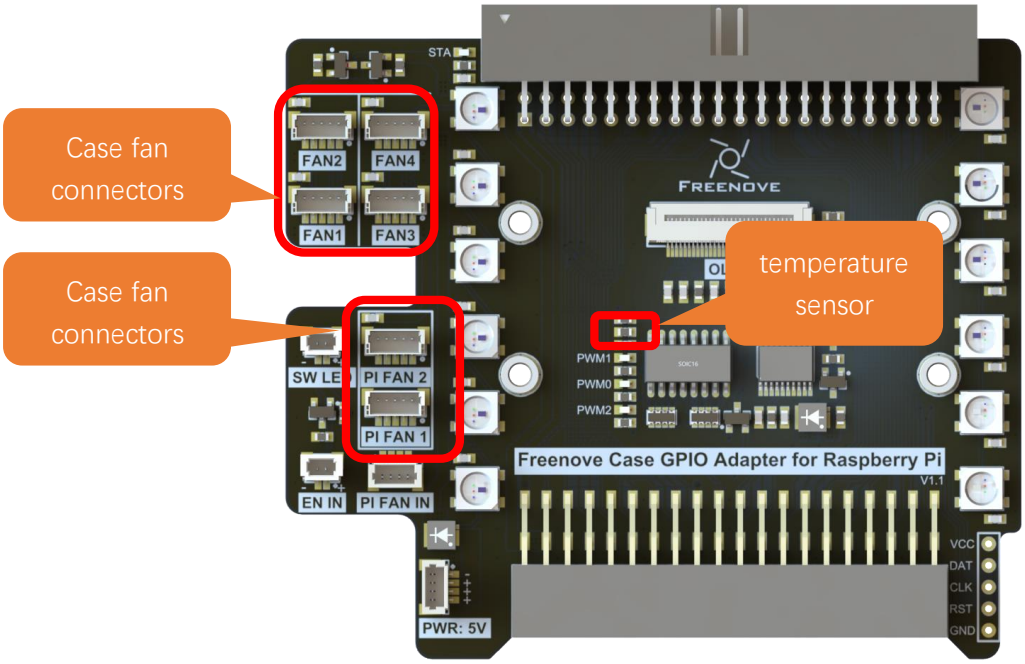
Follow Case Mode



Follow RPi Mode

Manual Mode

The following diagram illustrates the locations of the case fan connectors and the temperature sensor.



The fan connectors controll by GPIO Adapter board are divideded into three groups:

- Group 1: FAN1 + FAN2
- Group 2: FAN3 + FAN4
- Group 3: PI FAN 2

For the RPi 5' active cooler, it is recommended that it connect connect to PI FAN 1. In this way, it is controlled by Raspberry Pi.

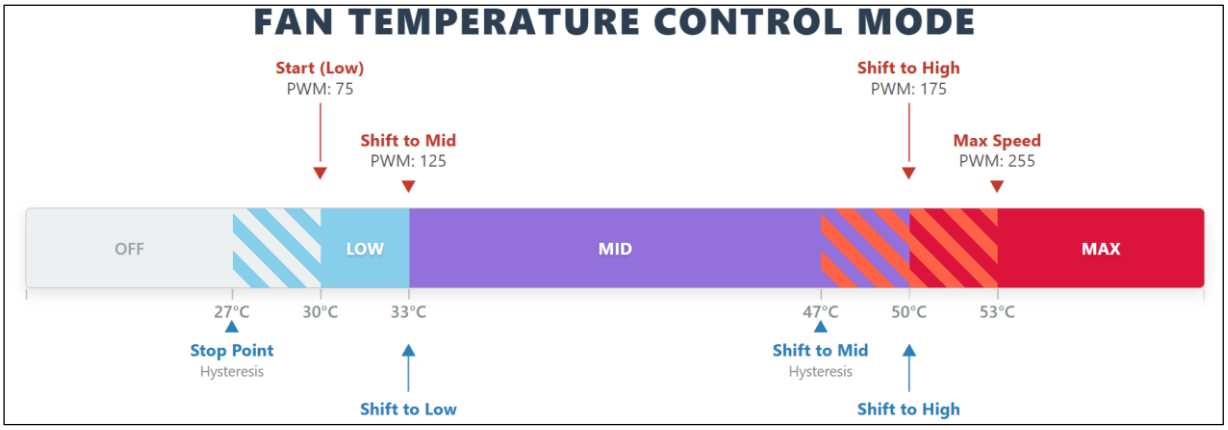
If connecting to PI FAN 2 connector, it will be controlled by the GPIO Adapter Board.

Next, we will walk you through the different fan modes to help you better understand the case fan control interface.

Follow Case

In Follow Case mode, the GPIO Adapter board samples the temperature sensor at regular intervals and regulates the fan PWM signal based on the readings.

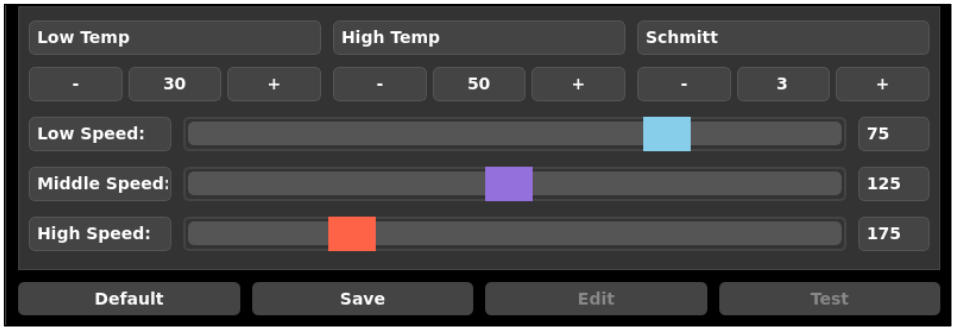
The specific control logic governing this process is depicted in the following figure.



The diagram uses various colors to represent different temperature zones. All values shown are configurable defaults.

- **Heating Phase:**
  - When temperature ⩾ **Low Temp** (default: 30°C), the fans start at **Low Speed** (default: 75).
  - When temperature ⩾ **Low Temp** + **Schmitt** (default: 30 + 3 = 33°C), the fan speed increases to **Middle Speed** (default: 125).
  - When temperature ⩾ **High Temp** (default: 50°C), the fan speed increases to **High Speed** (default: 175).
  - When temperature ⩾ **High Temp**+ **Schmitt** (default: 50 + 3 = 53°C), the fan runs at **full speed** (255).
- **Cooling Phase:**
  - When temperature < **High Temp** (default: 50°C), the fan speed drops back to **High Speed** (default: 175).
  - When temperature < **High Temp**- **Schmitt** (default: 50 - 3 = 47°C), the fan speed decreases to **Middle Speed** (default: 125).
  - When temperature < **Low Temp + Schmitt** (default: 30 + 3 = 33°C), the fan speed decreases to **Low Speed** (default: 75).
  - When temperature < **Low Temp- Schmitt** (default: 30 - 3 = 27°C), the fan stops.

You can configure the following parameters via the software.



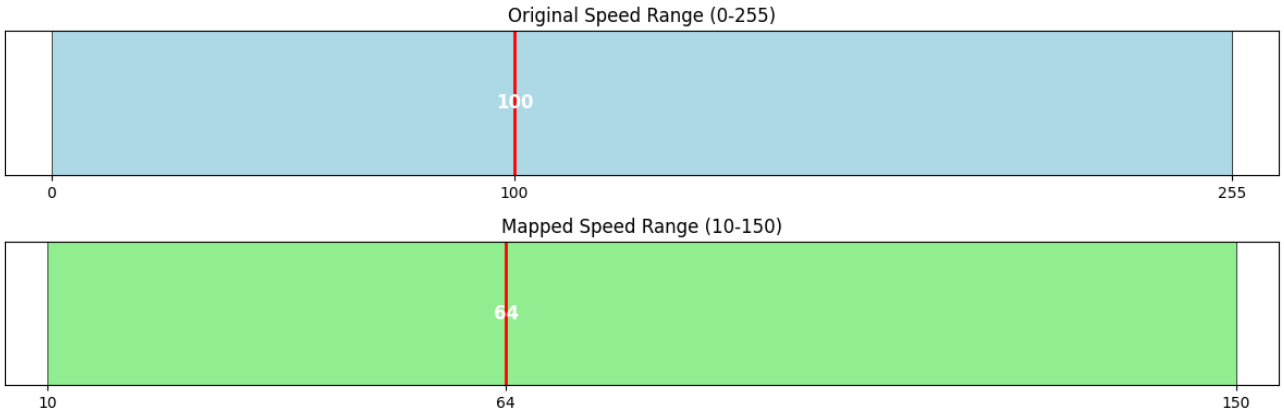
- **Low Temp**: The minimum temperature threshold to activate the case fans. Once reached, the fans begin spinning to accelerate airflow and expel warm air from the case.
- **High Temp**: A higher temperature threshold indicating significant heat buildup. When reached, the fans operate at a higher speed to enable rapid cooling of the system.
- **Schmitt (Hysteresis)**: A hysteresis value that prevents the fans from frequently switching on/off or changing speeds near a temperature threshold. It is recommended to keep it at the default value.
- **Low Speed**: The PWM duty cycle applied when the temperature first exceeds the Low Temp threshold. This low speed provides a quiet and power-efficient means of initial cooling.
- **Middle Speed**: The medium PWM duty cycle used when the temperature is between the Low Temp and High Temp thresholds. This speed ensures stable thermal conditions for the Raspberry Pi during sustained workloads, preventing performance fluctuations caused by rapid speed changes.
- **High Speed**: The high PWM duty cycle activated when the temperature exceeds the High Temp threshold. This is critical during heavy computational loads to maximize cooling efficiency, expel heat rapidly, and maintain optimal Raspberry Pi performance.

Follow Rpi

In Follow RPi mode, the GPIO adapter board periodically samples the PWM value from the PI FAN IN interface (which originates from the Raspberry Pi, with a range of 0-255). It then calculates a new PWM value and outputs it to the FAN1-4 and PI FAN 2 connectors.

Calculation Example:

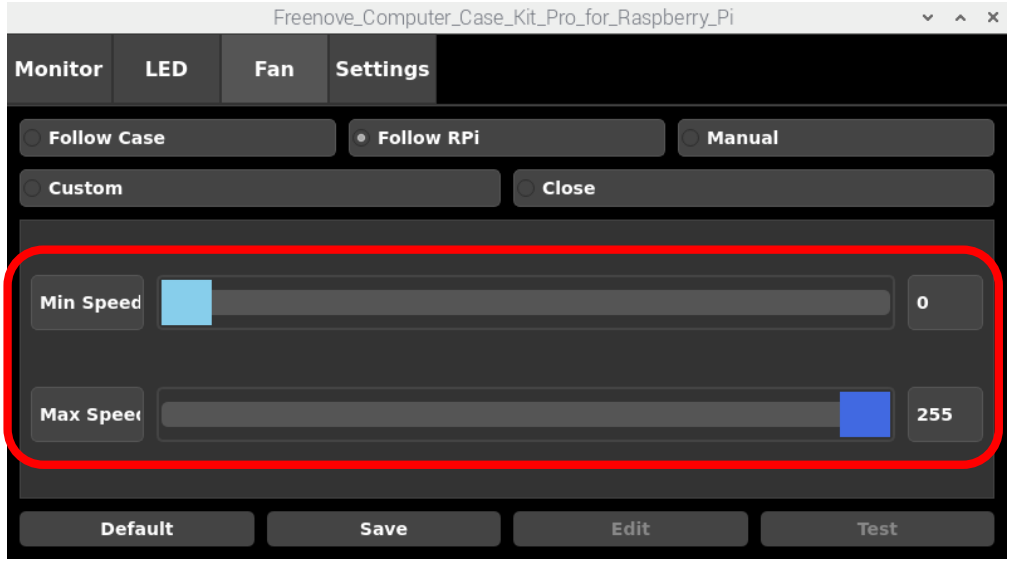
If the sampled PWM value is 100, and the software-configured limits are Min Speed = 10 and Max Speed = 150, the output PWM on the GPIO Adapter will be scaled to 64.



The Calculation formula is shown below:

$$\text{Mapped PWM} = \text{Original PWM} \times \frac{\text{(Max Speed-Min Speed)}}{\text{(255-0)}} + \text{Min Speed}$$

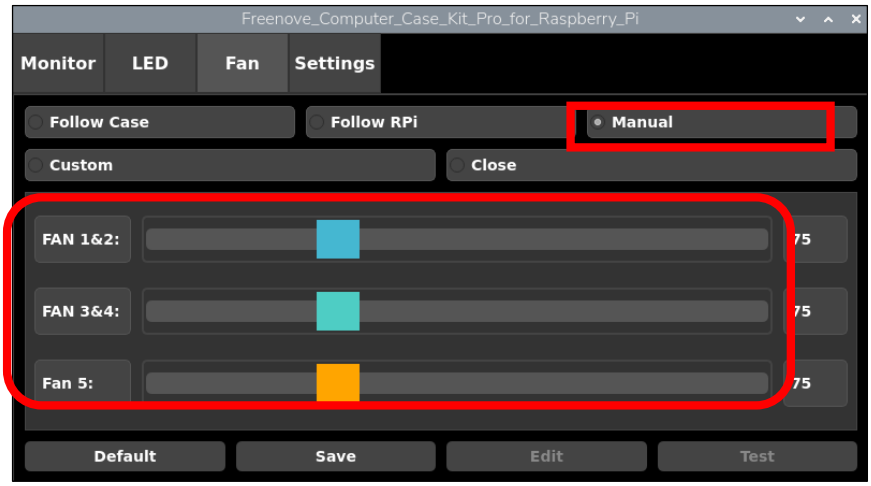
You can configure the Min Speed 和 Max Speed via the software.



Manual

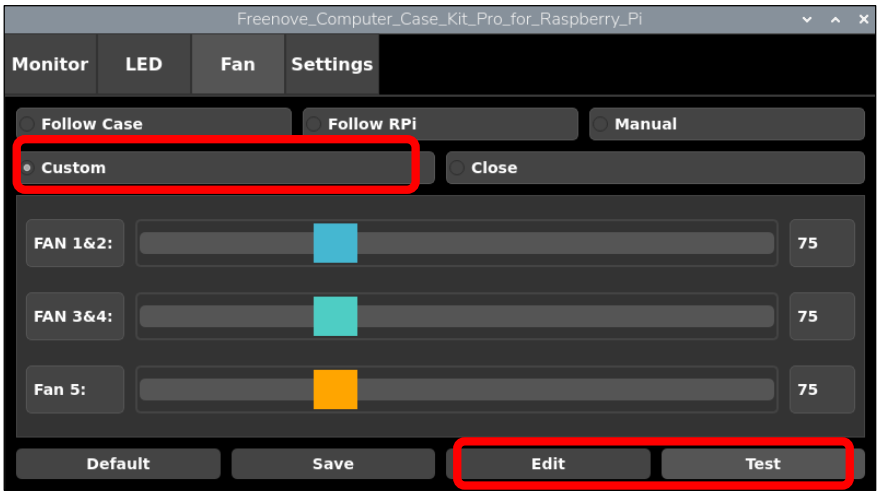
In Manual mode, you can directly set the PWM output for the FAN1-4 and PI FAN 2 connectors via the software.

Note: The slider labeled "**FAN 5**" in the interface controls the **PI FAN 2**. To manually adjust the speed of the Raspberry Pi 5 active cooler, it must be connected to the **PI FAN 2** header.



Custom

If the predefined modes do not meet your needs, you can select the **Custom** mode for advanced configuration.



Click "**Edit**" will open the “task_fan.py” file. You can modify the code in the editor.
Click "**Test**" will create a temporary thread and run task_fan.py, allowing you to quickly debug and observe the fan effects.
You can also view the source code directly:
Freenove_Computer_Case_Kit_Pro_for_Raspberry_Pi/Code/task_fan.py

Important Notes:

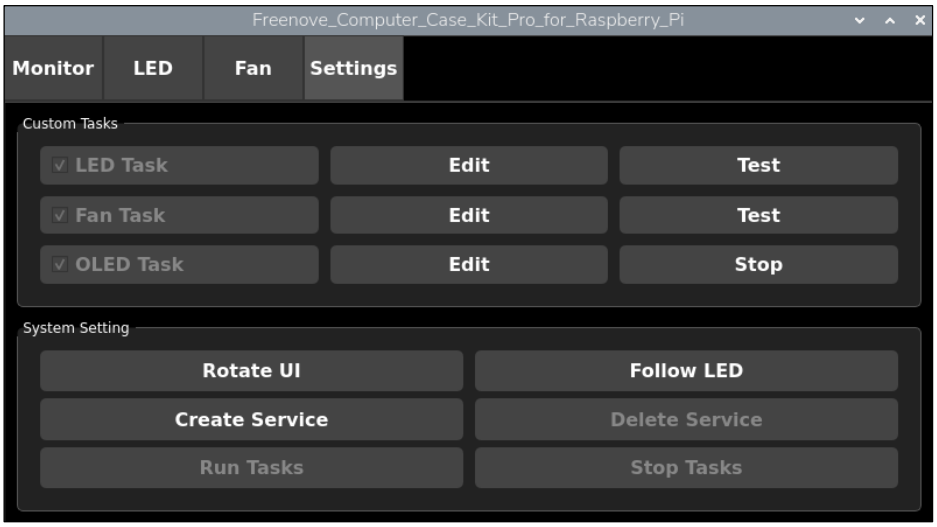
1. Back up the source code before making any modifications.
2. Custom mode is an advanced feature. Modifying the code in task_fan.py requires a basic understanding

of Python programming. If you are not familiar with programming, we do not recommend editing this file.

3. The "Test" button only runs the code in the current state. The code will not automatically run after rebooting the Raspberry Pi.
4. If the fans do no response after you modify the code and click "Test," it indicates an error in your code preventing it from running properly. Please review your code.
5. If you want the Custom mode code to execute automatically on every startup, please refer to the instructions in the "4.2.4 Settings Interface" Section.

4.2.4 Settings Interface

This interface integrates advanced customization features, allowing you to edit code, debug, and create startup tasks for the case LED lights, fans, and OLED display.



Enable Terminal Display (For Debugging))

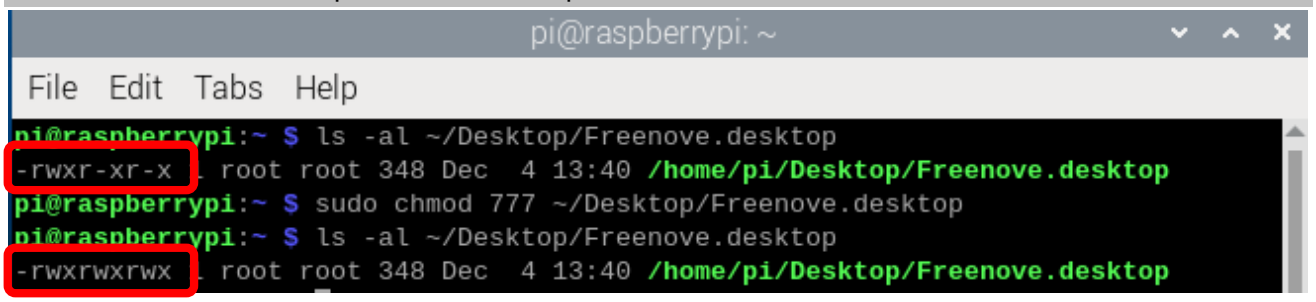
Before getting started, we can configure a desktop shortcut to run the software with a visible terminal window. This will allow you to view debug messages and other code output.

Steps:

Open the terminal on your Raspberry Pi.

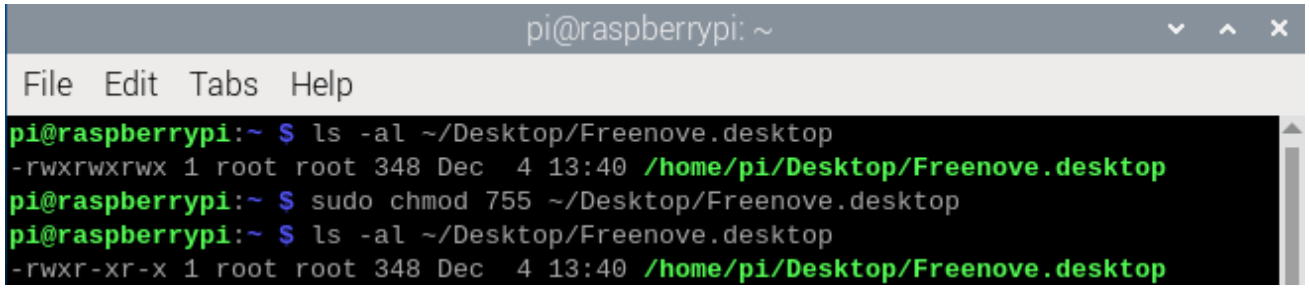
Run the following command to set the correct permissions for the Freenove desktop software:

```
ls -al ~/Desktop/Freenove.desktop
sudo chmod 777 ~/Desktop/Freenove.desktop
```



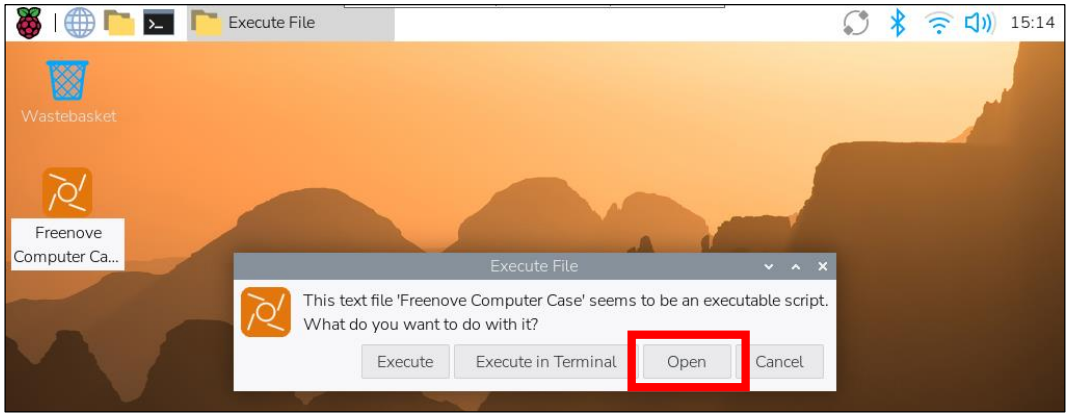
To revert to the default permissions, run the following command:

```
ls -al ~/Desktop/Freenove.desktop
sudo chmod 755 ~/Desktop/Freenove.desktop
```

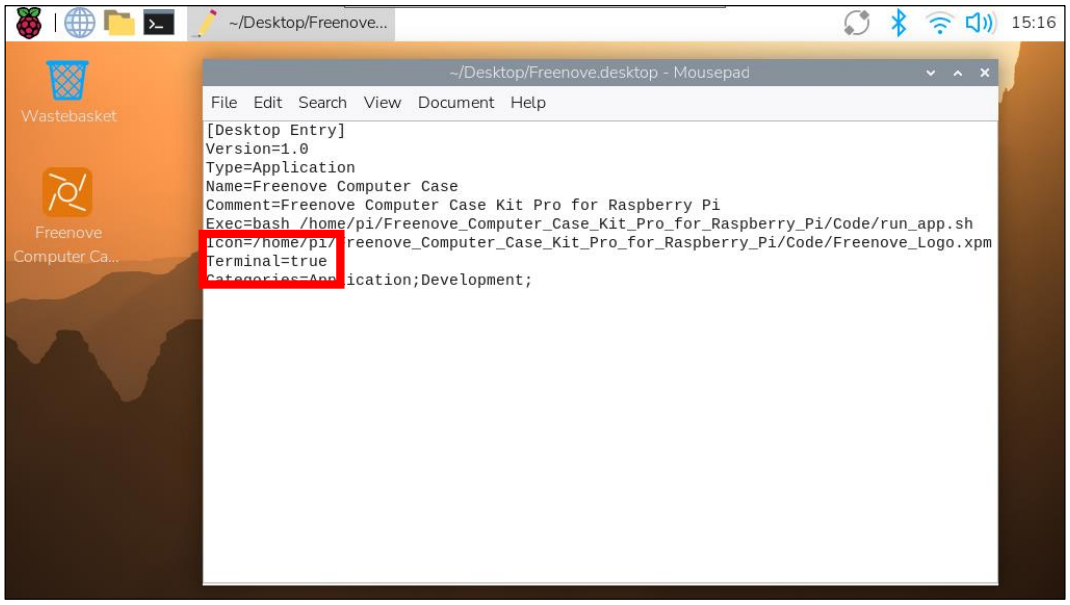


After modifying the permissions for Freenove.desktop, please follow these steps:

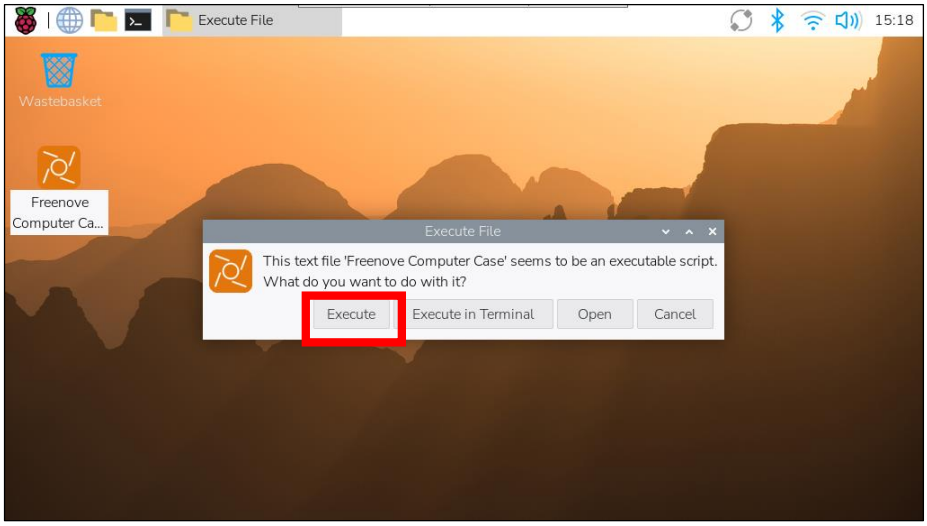
1. Close the current upper-computer software completely.
2. Double-click the Freenove software on the desktop to restart the application.
3. In the pop-up window, click **Open** to launch the software.



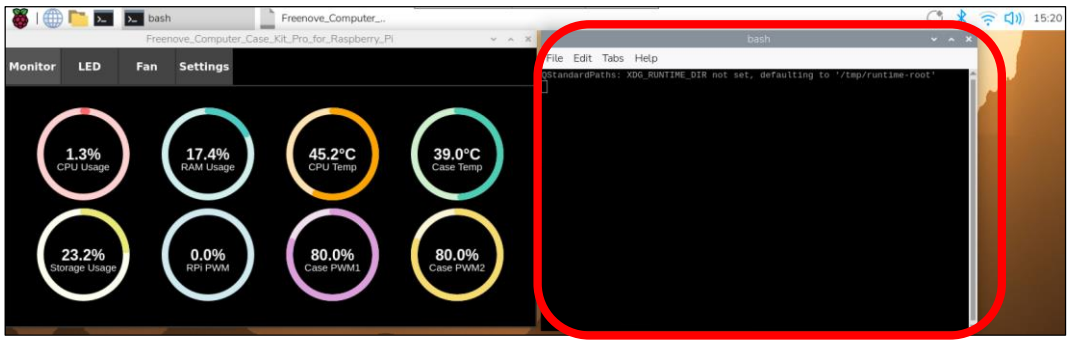
Change the parameter of **Terminal** from false to **ture**, save and clost the file.



Double click Freenove software on the desktop, click **"Execute**"upon the pop-up window to launch it

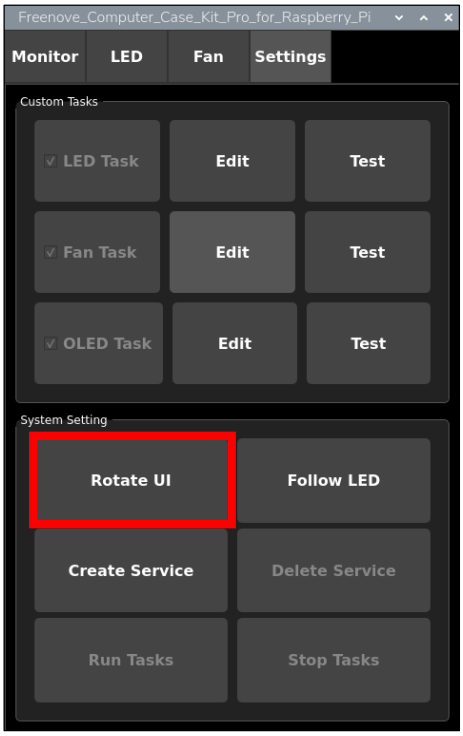


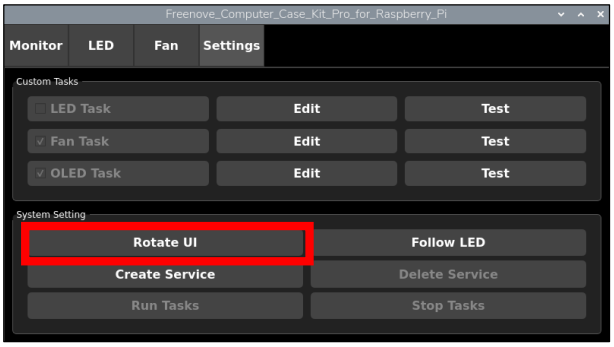
When you open the Freenove software control interface, a command terminal will automatically launch alongside it. All debug information and program logs will be displayed in this terminal window.



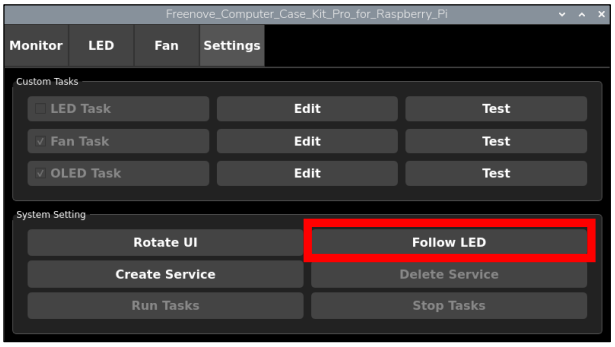
Interface Configuration

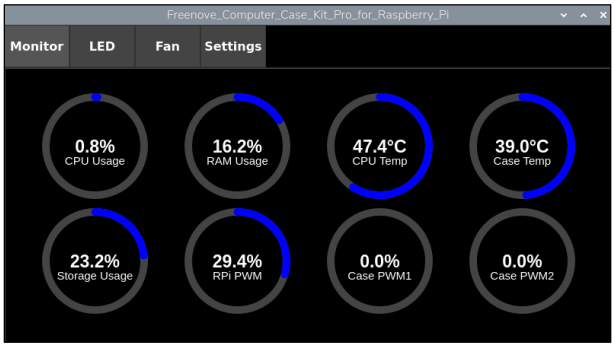
The "**Rotate UI**" button toggles the software interface instantly between landscape and portrait display modes.



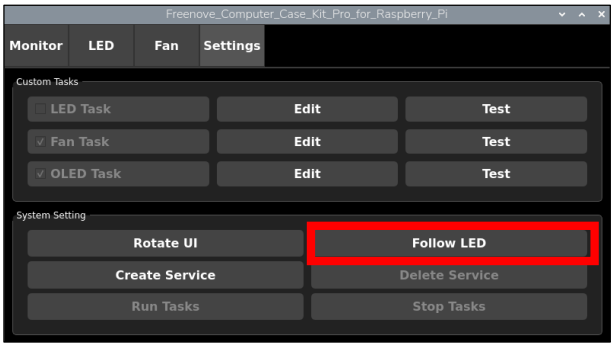


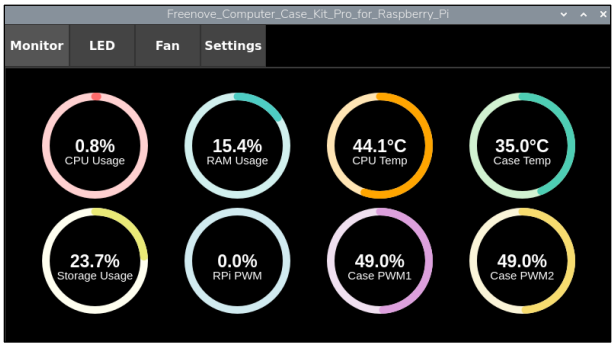
Clicking the "**Follow LED**" button activates synchronization between the LED effects and the Monitor interface. Once enabled, the color of the circular progress bar will mirror any real-time changes you make to the LED colors.





The "**Default Color**" button reverts the circular progress bar (on the Monitor interface) to its default color.

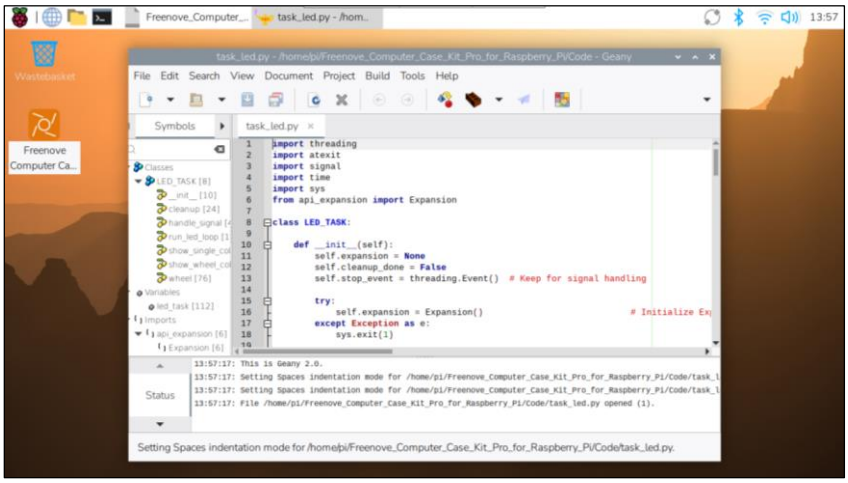




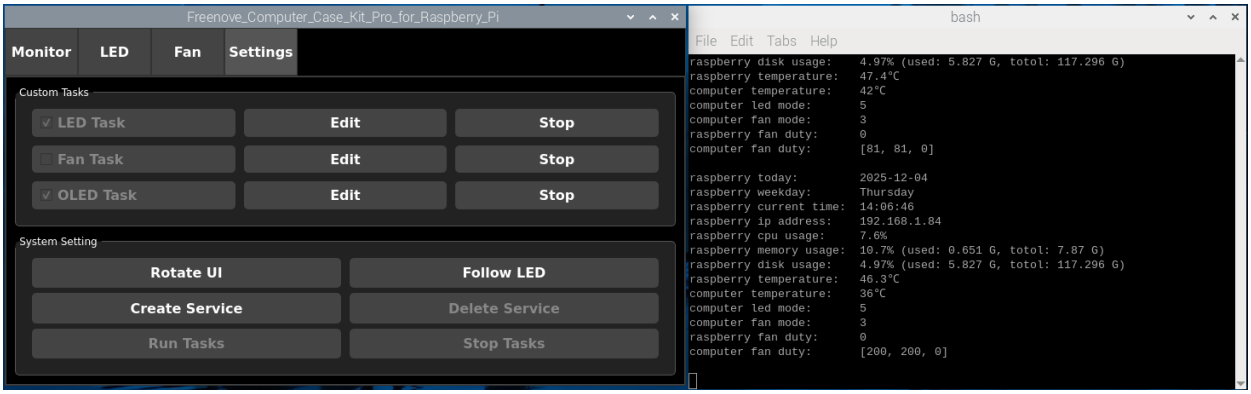
Code Editing and Testing

The Edit and Test buttons on the Settings interface allows for quick editing and testing of your code.

You can open and edit the task_led.py, task_fan.py, task_oled.py files by click the corresponding Edit button.

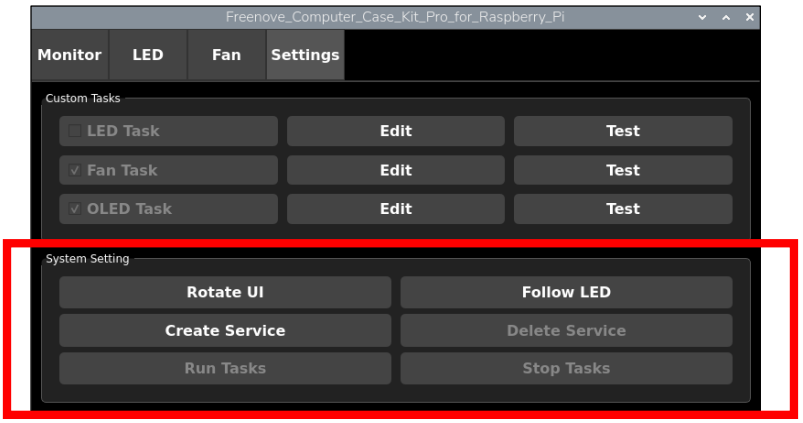


Similarly, you can click Test to quickly verify if the edited code performs as expected. Debug information will typically be printed in the terminal window.



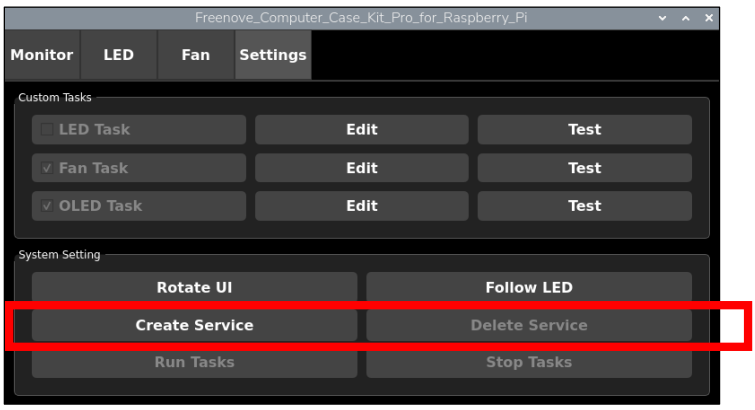
Background Task Management

This section is for comprehensive configuration. Here you can set up the software's interface features and configure background tasks for automatic operation of LEDs, fans, and the OLED display.



Click the "**Create Service**" button creates a background system service on your Raspberry Pi. This service will automatically run every time the case boots up, ensuring that your customized task_led.py, task_fan.py, and task_oled.py scripts are executed after startup.

This service is activated with every boot of the Raspberry Pi 5.

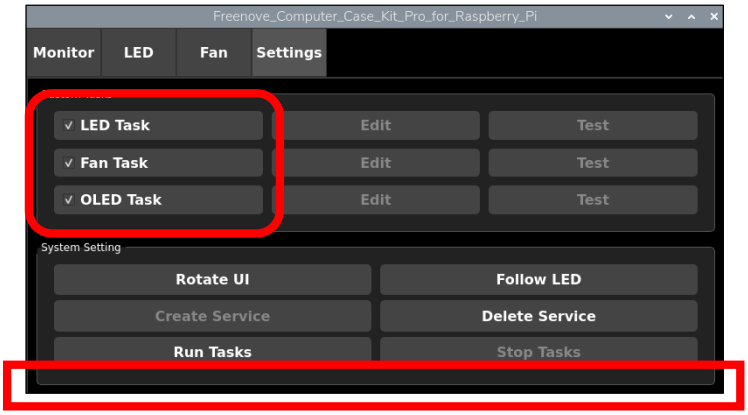


To prevent the background service from running on startup, click the **Delete Service button** to remove it.

Delete Service: Click to permanently remove the service. This prevents it from running automatically upon case startup.

Run Tasks: Click to temporarily start the service for immediate testing.

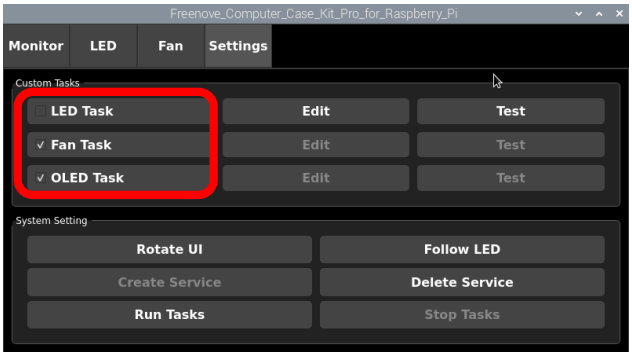
Stop Tasks: Click to temporarily halt the currently running service.



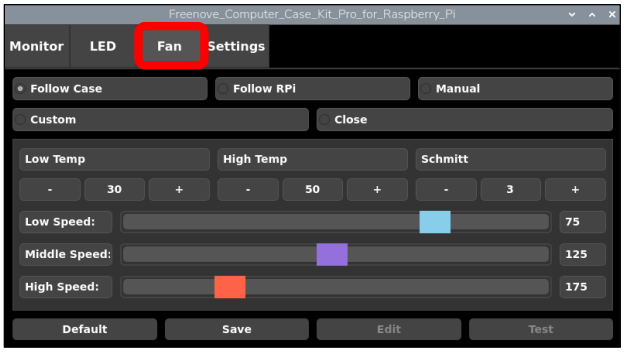
You can enable the execution of one or more custom tasks by checking their corresponding boxes

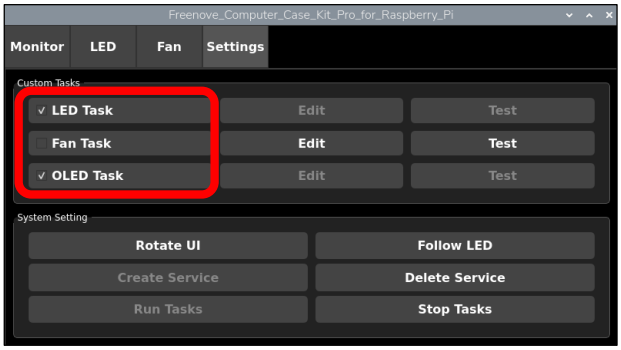
Please Note:
When switching from the Settings interface to the LED or Fan control interface, the corresponding **LED Task** or **Fan Task** will be automatically unchecked, pausing their background operation. You can re-enable them by checking the boxes again.

To stop the custom LED task and use a built-in mode instead, simply switch from the Settings interface to the LED interface and select one of the preset modes (Rainbow, Breathing, Follow, or Manual). This action will automatically uncheck the **LED Task**.



To stop the custom Fan Task and use a preset mode instead, simply switch from the Settings interface to the Fan interface and select one of the standard modes (Follow Case, Follow RPi, or Manual). This action will automatically uncheck the **Fan Task**.





Chapter 5 Speed Test

This is an additional chapter for those who wish to test the read and write speeds of their SSD and SD Card.

5.1 SD Card Speed Test

Raspberry Pi's official microSD cards support DDR50 and SDR104 bus speeds, with a maximum transfer rate of up to 104 MB/s.
https://www.raspberrypi.com/documentation/accessories/sd-cards.html#content
https://www.sdcard.org/developers/sd-standard-overview/bus-speed-default-speed-high-speed-uhs-sd-express/

Open the terminal and enter the following command:

```
git clone https://github.com/TheRemote/PiBenchmarks
```

```
pi@raspberrypi:~ $ git clone https://github.com/TheRemote/PiBenchmarks
Cloning into 'PiBenchmarks'...
remote: Enumerating objects: 652, done.
remote: Counting objects: 100% (112/112), done.
remote: Compressing objects: 100% (80/80), done.
remote: Total 652 (delta 69), reused 65 (delta 31), pack-reused 540 (from 1)
Receiving objects: 100% (652/652), 119.41 KiB | 269.00 KiB/s, done.
Resolving deltas: 100% (386/386), done.
```

Enter the directory:

```
cd PiBenchmarks/
```

Grant executable permissions to the script:

```
chmod +x Storage.sh
```

```
pi@raspberrypi:~ $ cd PiBenchmarks/
pi@raspberrypi:~/PiBenchmarks $ ls
CODE_OF_CONDUCT.md  CONTRIBUTING.md  LICENSE  README.md  Storage.sh
pi@raspberrypi:~/PiBenchmarks $ chmod +x Storage.sh
pi@raspberrypi:~/PiBenchmarks $
```

Start the speed test. Please be aware that the first execution will involve downloading the required dependencies, so the process could take a relatively long time.

```
sudo ./Storage.sh ~/
```

```
pi@raspberrypi:~/PiBenchmarks $ sudo ./Storage.sh ~/
Trimming and syncing drives ...
/boot/firmware: 424.5 MiB (445118464 bytes) trimmed on /dev/mmcblk0p1
/: 21.4 GiB (22927368192 bytes) trimmed on /dev/mmcblk0p2
Board information: Manufacturer: Raspberry Pi Foundation - Model: Raspberry Pi 5 Model B Rev 1.0 - Architecture:
 aarch64 - OS: Debian GNU/Linux 13 (trixie)
Fetching required components ...
Install lshw
Hit:1 http://deb.debian.org/debian trixie InRelease
Hit:2 http://deb.debian.org/debian trixie-updates InRelease
Hit:3 http://deb.debian.org/debian-security trixie-security InRelease
Hit:4 http://archive.raspberrypi.com/debian trixie InRelease
Reading package lists... Done
```

After the speed test is completed, follow the prompts to enter a description and a name for your SSD (you can use any arbitrary characters).

```
RandRead: 8181 - RandWrite: 2405 - Read: 13783 - Write: 2344
Enter a description of your storage and setup (Example: Kingston A400 SSD on Pi 4 using StarTech SATA to USB ada
pter)
Description: sd1
(Optional) Enter alias to use on benchmark results.  Leave blank for completely anonymous.
Alias (leave blank for Anonymous): sd1
Result submitted successfully and will appear live on https://pibenchmarks.com within a couple of minutes.
```

Test result:

Category	Test	Result
HDParm	Disk Read	87.49 MB/sec
HDParm	Cached Disk Read	88.76 MB/sec
DD	Disk Write	21.1 MB/s
FIO	4k random read	2261 IOPS (9047 KB/s)
FIO	4k random write	598 IOPS (2395 KB/s)
IOZone	4k read	13783 KB/s
IOZone	4k write	2344 KB/s
IOZone	4k random read	8181 KB/s
IOZone	4k random write	2405 KB/s
	Score: 1095	

5.2 SSD Speed Test

The Raspberry Pi 5 includes a PCIe x1 slot that is certified for PCIe Gen 2.0, providing a theoretical maximum throughput of 5GT/sec, which roughly translates to 500MB/sec for read and write operations. Although this slot is not officially certified for PCIe Gen 3.0, it is possible to force the use of Gen 3.0 for potentially higher speeds. **At the time of this writing, due to the limitation of the expansion chip, both the Dual-NVMe Adapter Board and Quad-NVMe Adapter Board only support the PCIe 2.0 protocol.**

In actual tests, it is found that most SSDs can work stably at PCIE2.0, but are slightly unstable at PCIE3.0, while others are just the opposite. Therefore, please choose PCIE2.0 or PCIE3.0 according to your actual situation.

The PCIe consortium states that the speed of PCIe Gen 3.0 x1 is up to 8GT/sec, which translates to approximately 985MB/sec.
https://en.wikipedia.org/wiki/PCI_Express#Comparison_table
https://www.raspberrypi.com/documentation/computers/raspberry-pi.html#pcie-gen-3-0

5.2.1 Mounting SSD Devices

Open the terminal, run the following commpad to get the SSD's information.

```
lsblk
```

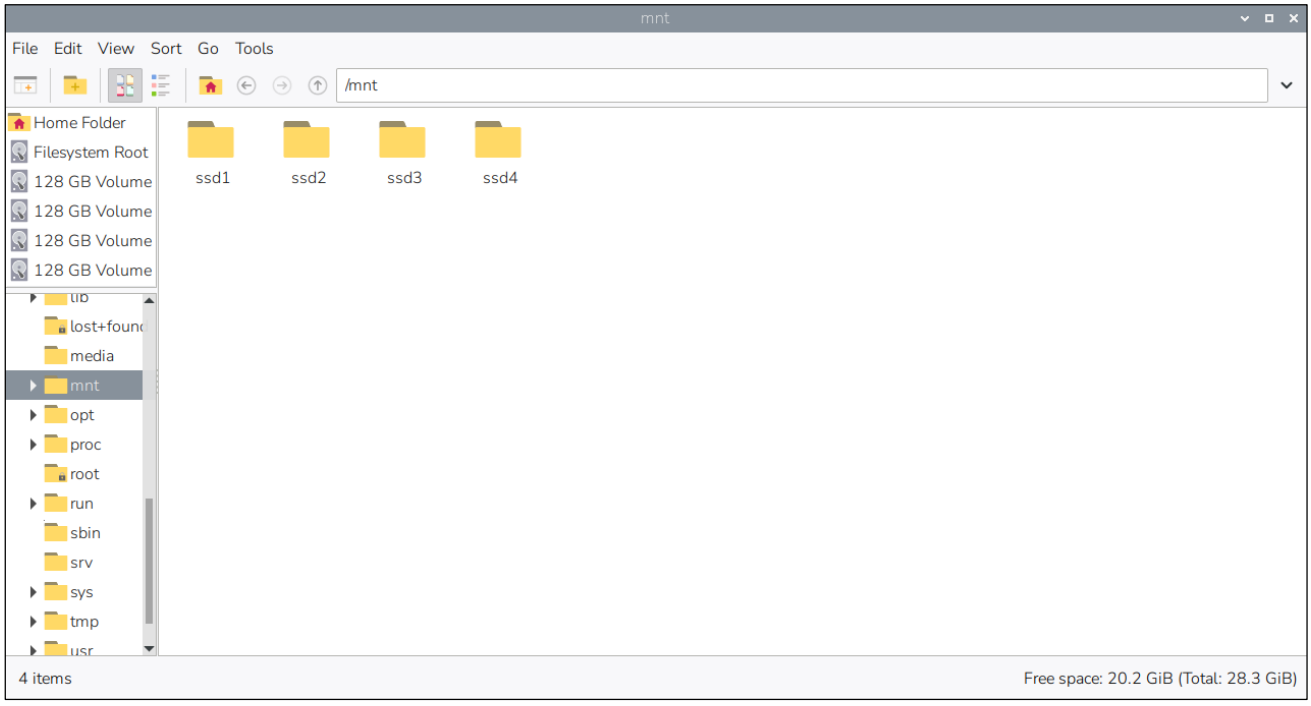
```
pi@raspberrypi:~ $ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
loop0         7:0    0     2G  0 loop
mmcblk0     179:0    0  29.3G  0 disk
├─mmcblk0p1 179:1    0   512M  0 part /boot/firmware
└─mmcblk0p2 179:2    0  28.8G  0 part /
zram0       254:0    0     2G  0 disk [SWAP]
nvme0n1     259:0    0 119.2G  0 disk
└─nvme0n1p1 259:4    0 119.2G  0 part
nvme1n1     259:1    0 119.2G  0 disk
└─nvme1n1p1 259:6    0 119.2G  0 part
nvme2n1     259:2    0 119.2G  0 disk
└─nvme2n1p1 259:7    0 119.2G  0 part
nvme3n1     259:3    0 119.2G  0 disk
└─nvme3n1p1 259:5    0 119.2G  0 part
```

As shown in the image above, the Raspberry Pi 5 has successfully detected four NVMe SSDs, with mmcb0p1 being the system drive. Prior to this, we have already partitioned all NVMe SSD devices (click here if your SSD is not partitioned). Next, we need to mount all the SSDs so they can be used by the Raspberry Pi's file system. If you have already mounted them, click here to proceed to the next step.

```
sudo mkdir -p /mnt/ssd1
sudo mkdir -p /mnt/ssd2
sudo mkdir -p /mnt/ssd3
sudo mkdir -p /mnt/ssd4
```

```
pi@raspberrypi:~ $ sudo mkdir -p /mnt/ssd1
pi@raspberrypi:~ $ sudo mkdir -p /mnt/ssd2
pi@raspberrypi:~ $ sudo mkdir -p /mnt/ssd3
pi@raspberrypi:~ $ sudo mkdir -p /mnt/ssd4
```

You can view the created SSD mount points (ssd1/ssd2/ssd3/ssd4) in the /mnt directory.



Execute the following commands to complete the mounting process.

```
sudo mount /dev/nvme0n1p1 /mnt/ssd1
sudo mount /dev/nvme1n1p1 /mnt/ssd2
sudo mount /dev/nvme2n1p1 /mnt/ssd3
sudo mount /dev/nvme3n1p1 /mnt/ssd4
```

```
pi@raspberrypi:~ $ sudo mount /dev/nvme0n1p1 /mnt/ssd1
pi@raspberrypi:~ $ sudo mount /dev/nvme1n1p1 /mnt/ssd2
pi@raspberrypi:~ $ sudo mount /dev/nvme2n1p1 /mnt/ssd3
pi@raspberrypi:~ $ sudo mount /dev/nvme3n1p1 /mnt/ssd4
```

5.2.2 Speed Test

After completing the mounting of all NVMe SSD devices, execute the following command to enter the PiBenchmarks directory. We will proceed with individual device speed testing.

```
cd PiBenchmarks/
```

```
pi@raspberrypi:~ $ cd PiBenchmarks/
pi@raspberrypi:~/PiBenchmarks $
```

Run the following command to start the speed test for the first mounted device, **ssd1**.

```
sudo ./Storage.sh /mnt/ssd1
```

```
pi@raspberrypi:~/PiBenchmarks $ sudo ./Storage.sh /mnt/ssd1
Trimming and syncing drives ...
/mnt/ssd4: 116.8 GiB (125423808512 bytes) trimmed on /dev/nvme3n1p1
/mnt/ssd3: 116.8 GiB (125423808512 bytes) trimmed on /dev/nvme2n1p1
/mnt/ssd2: 116.8 GiB (125423808512 bytes) trimmed on /dev/nvme1n1p1
/mnt/ssd1: 116.8 GiB (125423808512 bytes) trimmed on /dev/nvme0n1p1
/boot/firmware: 424.5 MiB (445118464 bytes) trimmed on /dev/mmcblk0p1
/: 21.3 GiB (22861807616 bytes) trimmed on /dev/mmcblk0p2
Board information: Manufacturer: Raspberry Pi Foundation - Model: Raspberry Pi 5
 Model B Rev 1.0 - Architecture: aarch64 - OS: Debian GNU/Linux 13 (trixie)
Fetching required components ...
Clock speeds: CPU: 2400 - Core: 910
Chosen partition (/mnt/ssd1) has been detected as /dev/nvme0n1p1 (nvme0n1p1)
Starting INXI hardware identification...
```

After the speed test is completed, follow the prompts to enter a description and a name for your SSD (you can use any arbitrary characters).

```
RandRead: 46786 - RandWrite: 95069 - Read: 125241 - Write: 96006
Enter a description of your storage and setup (Example: Kingston A400 SSD on Pi 4 using
StarTech SATA to USB adapter)
Description: ssd1
(Optional) Enter alias to use on benchmark results.  Leave blank for completely anonymou
s.
Alias (leave blank for Anonymous): ssd1
Result submitted successfully and will appear live on https://pibenchmarks.com within a
couple of minutes.
```

Test result:

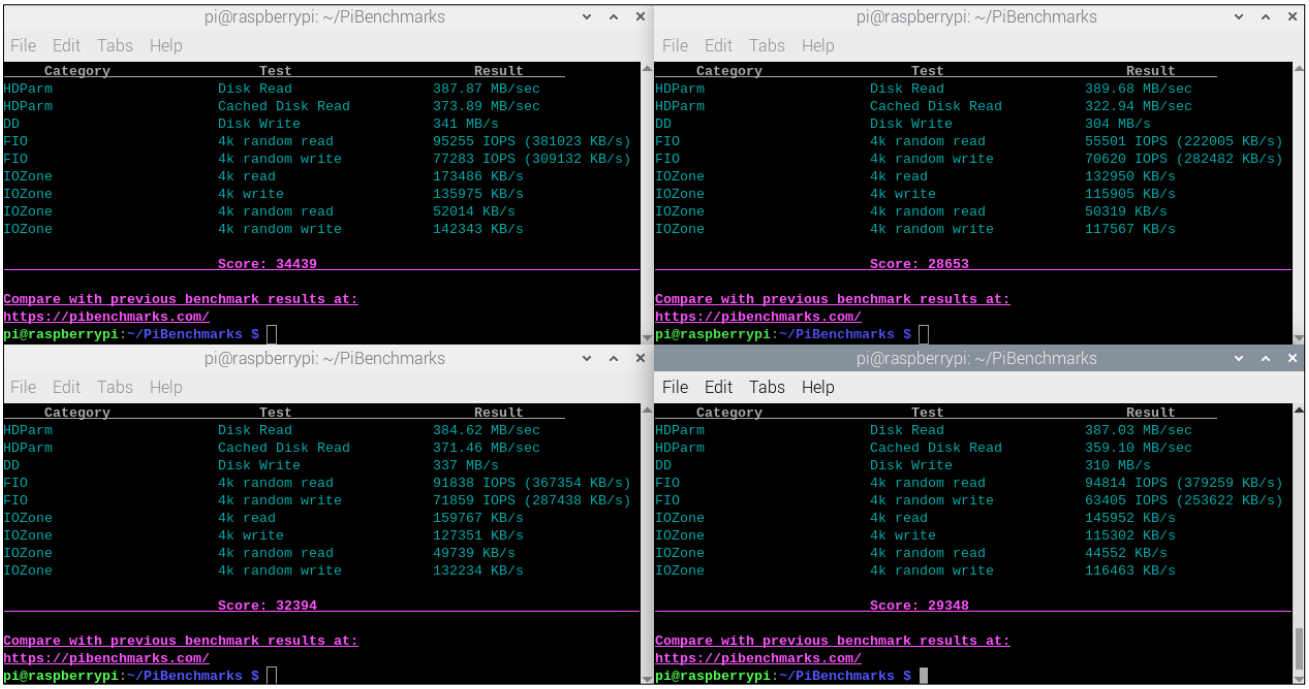
```
Category                Test                    Result
HDParm                  Disk Read               387.83 MB/sec
HDParm                  Cached Disk Read        376.84 MB/sec
DD                      Disk Write              339 MB/s
FIO                     4k random read          95255 IOPS (381023 KB/s)
FIO                     4k random write         76704 IOPS (306816 KB/s)
IOZone                  4k read                 170906 KB/s
IOZone                  4k write                135278 KB/s
IOZone                  4k random read          51424 KB/s
IOZone                  4k random write         137275 KB/s

                        Score: 33798
```

Next, we will sequentially execute the following commands to perform individual speed tests on each SSD.

```
sudo ./Storage.sh /mnt/ssd2
sudo ./Storage.sh /mnt/ssd3
sudo ./Storage.sh /mnt/ssd4
```

```
pi@raspberrypi:~/PiBenchmarks $ sudo ./Storage.sh /mnt/ssd2
Trimming and syncing drives ...
/mnt/ssd4: 0 B (0 bytes) trimmed on /dev/nvme3n1p1
/mnt/ssd3: 0 B (0 bytes) trimmed on /dev/nvme2n1p1
/mnt/ssd2: 0 B (0 bytes) trimmed on /dev/nvme1n1p1
/mnt/ssd1: 624.2 MiB (654471168 bytes) trimmed on /dev/nvme0n1p1
/boot/firmware: 424.5 MiB (445118464 bytes) trimmed on /dev/mmcblk0p1
/: 0 B (0 bytes) trimmed on /dev/mmcblk0p2
Board information: Manufacturer: Raspberry Pi Foundation - Model: Raspberry Pi 5 Model B
```

The performance varies among different SSDs, and each test may have certain error, which is normal. The following figures show the speed test results of the four SSDs.



5.2.3 PCIe Gen3.0 Speed Test

In the Preface, it is mentioned that the Raspberry Pi's PCIe Gen 3.0 has not been officially certified. While it is functional, its performance is not as reliable as desired. This chapter is presented as an exploratory section for assessing the speed capabilities of SSDs when used with PCIe Gen 3.0. **For practical applications, it is advised to opt for PCIe Gen 2.0 to ensure greater stability and dependability.**
If your kit includes an NVMe Adapter Board (Model: **FNK0107A/H/P/U)**, you can enable PCIe Gen 3.0 mode. If your adapter is a different model or no adjustment is needed, please skip this step.

Enable PCIe Gen 3.0

Add the line `dtparam=pciex1_gen=3` to /boot/firmware/config.txt to enable PCIe Gen3.0.
As shown below, enter the command to open the file.

```
sudo nano /boot/firmware/config.txt
```

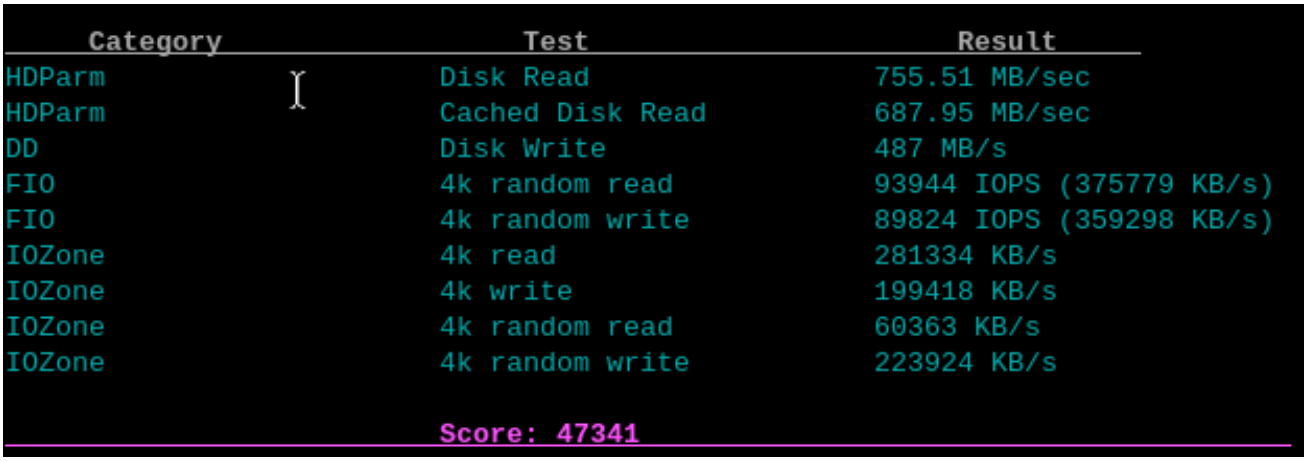
Add the line `dtparam=pciex1_gen=3` to the end of the file, as shown below:

Press Ctrl-O to save the file, Enter to confirm, and Ctrl-X to exit.

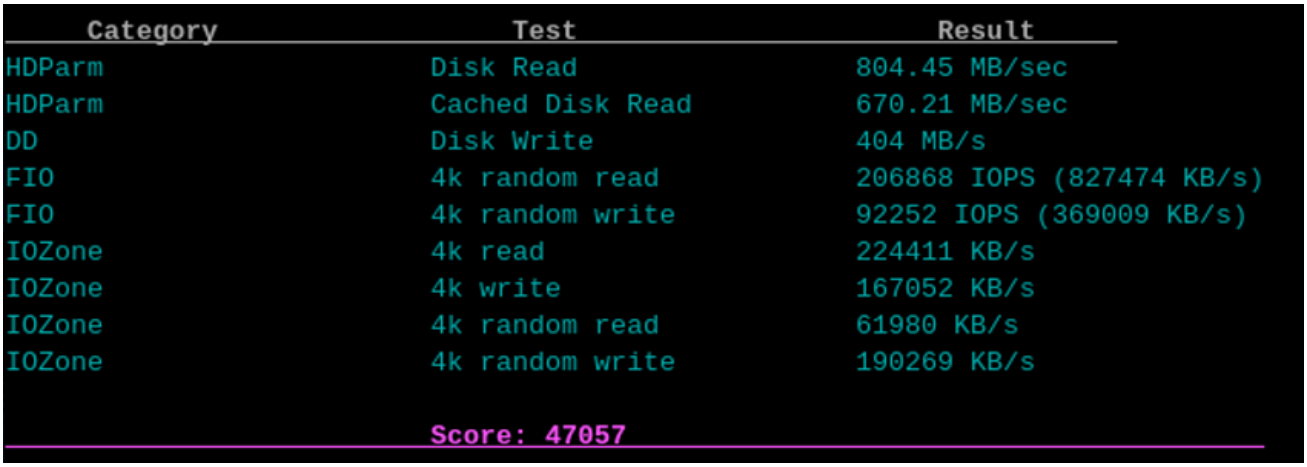
Reboot your Raspberry Pi.

```
sudo reboot
```

After rebooting, test the speed again.



The speed of another SSD.



Category	Test	Result
HDParm	Disk Read	804.45 MB/sec
HDParm	Cached Disk Read	670.21 MB/sec
DD	Disk Write	404 MB/s
FIO	4k random read	206868 IOPS (827474 KB/s)
FIO	4k random write	92252 IOPS (369009 KB/s)
IOZone	4k read	224411 KB/s
IOZone	4k write	167052 KB/s
IOZone	4k random read	61980 KB/s
IOZone	4k random write	190269 KB/s
	Score: 47057	

Disable PCIe Gen 3.0

Delete the line added with the previous step to disable PCIe Gen3.0.

Delete the line `dtparam=pciex1_gen=3` in the boot/firmware/config.txt file.

After the line is removed, it will change to PCIe Gen2.0.

What's next?

Thank you again for choosing Freenove products.

THANK YOU for participating in this learning experience!

We have reached the end of this Tutorial. If you find errors, omissions, or you have suggestions and/or questions about the Tutorial or component contents of this Kit, please feel free to contact us:
support@freenove.com

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

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