Radxa Orion O6 User Manual

ARM AI PC Motherboard

Version 0.8

2025-04-22

Radxa Computer

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2 Revision Control Table

Table 1: Revision Control

Version	Date	Changes from previous version
0.1	2024/12/13	First draft version
0.8	2025/1/18	First public 0.8 version

3 Safety Precautions

The motherboard features delicate electronic circuits and components that are vulnerable to electrostatic discharge (ESD) damage. Before installation, thoroughly read this User Manual and adhere to the following precautions:

1. **Warranty Stickers**
   - Do not remove or damage the motherboard’ s S/N (Serial Number) or warranty sticker prior to usage. These are essential for warranty validation.
2. **Power Disconnection**
   - Always unplug the power cord from the power outlet before installing or removing the motherboard or other hardware.
   - Ensure the power supply is turned off before connecting or disconnecting the power supply cable from the motherboard.
3. **Component Connection**
   - Securely connect hardware components to the motherboard’ s internal connectors. Loose connections can lead to malfunctions.
4. **Handling Precautions**
   - Avoid touching any metal leads or connectors.
   - Use an ESD wrist strap or discharge static electricity by touching a grounded metal object before handling.
   - Place the motherboard on an antistatic pad or inside an electrostatic shielding container when not installing.
   - Spinning fan blades can cause injury; keep hands, cables, and other objects away from the fan area during operation.
5. **Power Settings**
   - Ensure the power supply voltage matches local voltage standards before powering on.
6. **Pre-operation Checks**
   - Verify all cables and power connectors are properly connected.
7. **Hardware Safety**
   - Avoid contact between screws and the motherboard circuit or components.
   - Remove any leftover screws or metal components from the motherboard or casing.
8. **Placement Considerations**
   - Do not place the system on an uneven surface.
   - Avoid high-temperature or humid environments.
9. **Installation Process Safety**
   - Turning on the computer power during hardware installation can cause damage.
10. **Professional Assistance**
    - If unsure about installation steps or encountering problems, consult a certified technician.

11. **Adapter and Cable Usage**
    - Refer to the manufacturer’ s guidelines when using power adapters or cables.
12. **Power Source Handling**
    - Avoid using multiple power sources simultaneously.
    - The Orion O6 supports ATX PSU, USB PD power input (20V/2A or higher), and dummy USB-C power input (20V). Recommended power is at least 65W.
13. **Temperature Considerations**
    - Operational range: 0°C~50°C.
    - If the SoC (P1) approaches 80°C under heavy load, performance throttling may occur. Additional cooling (heatsinks/fans) is advised.

4 About This Manual

This User Manual provides information for installing and configuring the **Radxa Orion O6** motherboard. For the latest version of this manual, visit:
https://radxa.com/products/orion/o6#downloads

4.1 Where to Find More Information

- **Radxa Website** (https://radxa.com/)
- **Radxa Documentation Site** (https://docs.radxa.com/)
- **Radxa Forum** (https://forum.radxa.com/)
- **Radxa GitHub** (https://github.com/radxa)

5 Package Content

When you receive the Radxa Orion O6 package, check for:

- 1x O6 motherboard
- 1x I/O Shield
- 1x Cooler (pre-installed)
- 1x Acrylic case (pre-installed)
- 2x M.2 Screws (pre-installed)
- 1x Sticker

If any items are missing or damaged, please contact Radxa customer service or your vendor immediately.

6 Product Overview

6.1 Introduction

The Radxa Orion O6 is a professional-grade Mini ITX motherboard designed for AI computing and multimedia applications. Powered by the Cix P1 SoC and featuring up to 64GB LPDDR5 RAM, it delivers server-class performance in a compact form factor. With comprehensive I/O options including quad display outputs, dual 5GbE networking, and PCIe Gen4 expansion, the Orion O6 is ideal for AI development workstations, edge computing nodes, and high-performance personal computing.

6.2 Key Features

- **High-performance Cix P1 SoC**: Manufactured using TSMC 6nm
- **Arm v9 Instruction Set & EDK II UEFI** for software compatibility
- **Mini-ITX Form Factor**: Fits standard PC enclosures
- **Native Debian/Ubuntu Linux** support for easy deployment
- **Expandable**: PCIe x16 (Gen4 x8), M.2 NVMe, M.2 Wi-Fi/BT

6.3 Specification

Specification	Details
Motherboard Type	ARM - based mini - ITX motherboard
Dimensions	170 x 170 x 25mm
CPU	Cix P1 - CD8180 • Quad Big Cortex®-A720, Quad Medium Cortex®-A720, Quad Little Cortex®-A520 • 12MB L3 shared across all cores
GPU	Arm® Immortals™ G720 MC10 GPU supporting: • Hardware-based Ray-Tracing • OpenGL® ES3.2 • OpenCL® 3.0 • Vulkan® 1.3
NPU	supporting INT4 / INT8 / INT16 / FP16 / BF16 and TF32 acceleration and computing power is up to 28.8TOPs
Video Decoding	AV1 / H.265 / H.264 / VP9 / VP8 / H.263 / MPEG-4 / MPEG-2 up to 8K@60fps
Video Encoding	H.265 / H.264 / VP9 / VP8 up to 8K@30fps
Memory	Type: 128bit LPDDR5, soldered on board Capacity Options: 8GB, 12GB, 16GB, 24GB, 32GB, 64GB Speed: 5500MT/S
Storage Interfaces	1x M.2 M Key: PCIe Gen4 4 - lane for NVMe SSD
Wireless	1x M.2 E Key: PCIe Gen4 2 - lane and USB for WiFi/BT modules

Specification	Details
PCIe Slot	1x PCIe x16 full slot with PCIe Gen4 8 - lane
Video Outputs	• 1x HDMI up to 4Kp60 • 1x DisplayPort (DP) up to 4Kp120 with 2 streams MST • 1x USB - C (DP capable) up to 4Kp60 • 1x eDP up to 4Kp60
Ethernet Ports	2x 1G / 2.5G / 5 Gigabit Ethernet ports
USB Ports	• 2x USB 2.0 Type A (Back Panel) • 2x USB 3.2 10Gbps Type A (Back Panel) • 2x USB 2.0 (Front Panel internal connector) • 2x USB Type-C (Back Panel) with USB 3.2 10Gbps and one supports DP display
Audio	• 1x Headphone Jack with Microphone Input (Back Panel) • 1x Front Panel Audio Connector for front panel 3.5mm audio jack
Internal Connectors	• 1x 24P ATX power connector • 1x M.2 M Key Connectors for NVMe SSD with PCIe Gen4 4-lane support • 1x M.2 E Key Connectors for WiFi / BT with PCIe Gen4 2-lane and USB • 2x Camera port (2x four-lane MIPI CSI or 2x two-lane MIPI CSI) • 1x eDP port with Touch panel interface for eDP LCD panel • 1x front panel connector for power / reset / status led • 1x front USB 2.0 connector for two USB 2.0 • 1x audio connector for front audio jack • 1x PCIe x16 slot with PCIe Gen4 8-lane • 1x serial console for low level debug message • 1x RTC Battery Connector • 1x 4P Fan with PWM Control and TACH • 4x Heatsink Mounting Holes(75mm x 75mm) • 1x UART for low-level debug message
Back Panel Connectors	• 1x USB Type-C™ port supporting DP display up to 4Kp60 and USB 3.0 HOST 10Gbps • 1x USB Type-C™ port supporting USB 3.0 HOST 10Gbps • 1x Standard HDMI output port, supporting up to 4Kp60 display output • 1x Standard DP output port, supporting up to 4Kp120 display output with 2 streams MST • 2x 1G / 2.5G / 5 Gigabit Ethernet ports • 2x USB 2 Type A HOST ports • 2x USB 3.2 10Gbps Type A HOST ports • 1x Headphone Jack with Microphone Input
Power Input	• ATX 24P Power Connector • USB C PD power supply (20V/2A or higher) • Dummy USB C power input (20V)
Recommended Power	At least 65W
Operating Temperature	0°C to 40°C

Specification	Details
Cooling	• 4x Heatsink Mounting Holes (75mm x 75mm) • 1x 4P Fan with PWM Control and TACH
RTC	RTC battery holder (supports CR1220 battery)
Supported Operating Systems	Debian/Ubuntu Linux

Table: Orion O6 Specification

7 Block Diagram

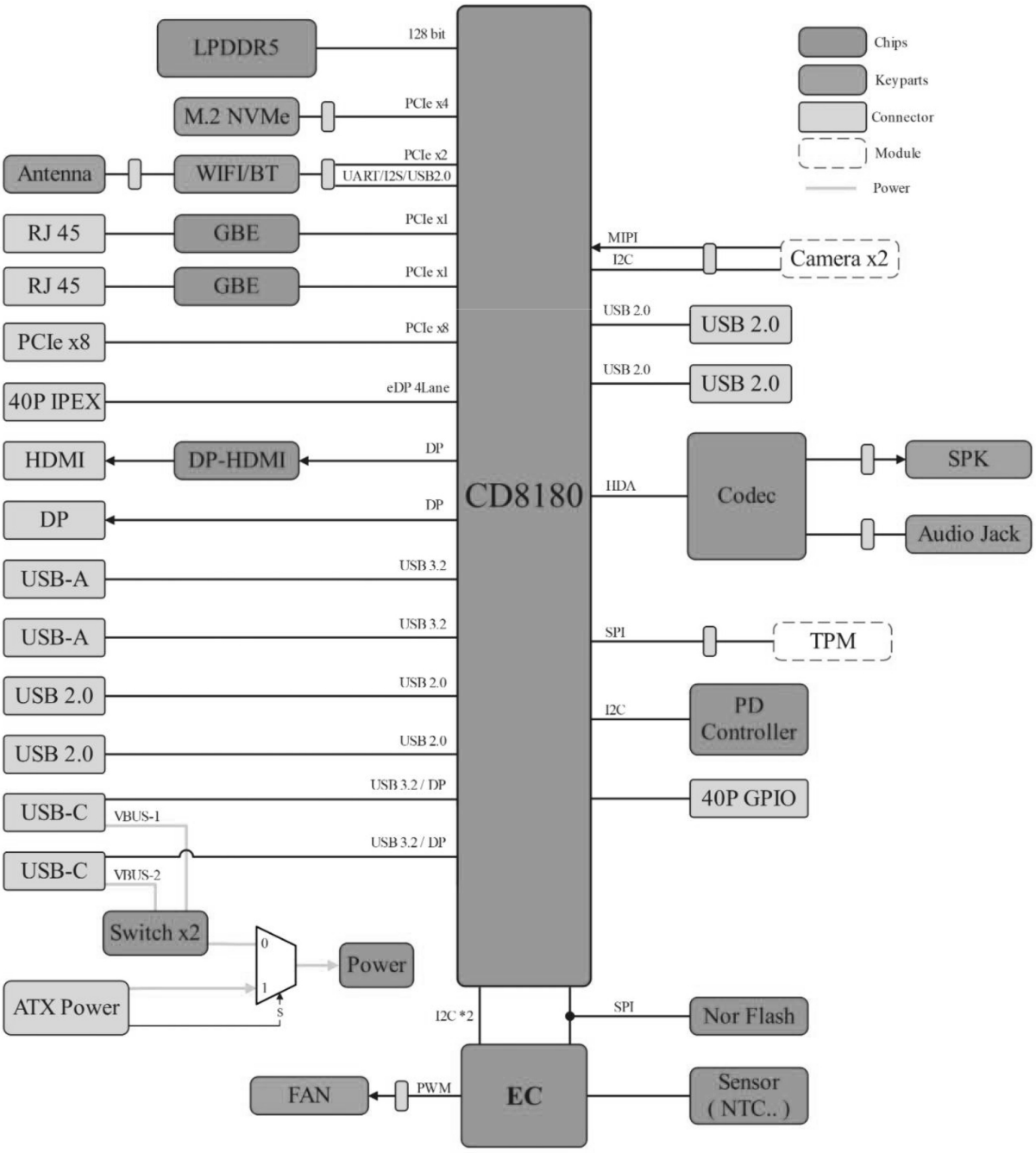


Figure 1: Orion O6 Block Diagram

8 Board Layout

Detailed O6 board layout with labels of number as below:

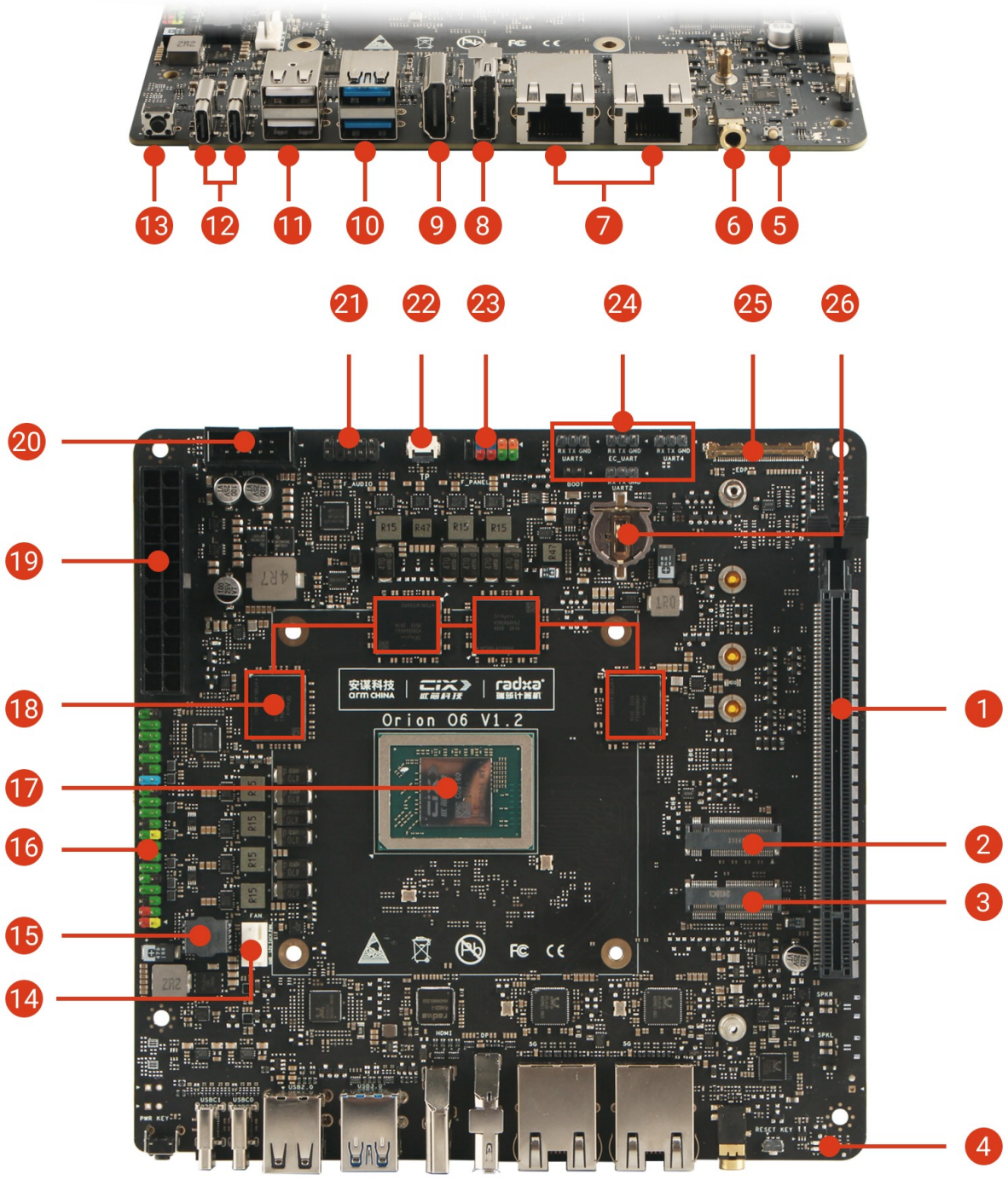


Figure 2: Orion O6 Board Layout with Components Label

No.	Description	No.	Description	No.	Description
①	PCIe X16 Slot	⑩	Double USB 3.2	⑲	ATX Power Connector
②	M.2 M Key	⑪	Double USB 2.0	⑳	F_USB Connector
③	M.2 E Key	⑫	USB-C Ports	㉑	F_Audio Connector
④	On board Status LED	⑬	Power Button	㉒	TP Connector
⑤	Reset Button	⑭	FAN Connector	㉓	F_Panel Connector

No.	Description	No.	Description	No.	Description
⑥	Headphone Jack	⑮	BIOS Flash Holder	㉔	Debug Connector
⑦	RJ45 Ethernets	⑯	40Pin GPIO Connector	㉕	eDP Connector
⑧	DP Port	⑰	CPU Cix CD8180	㉖	RTC Battery Holder
⑨	HDMI Port	⑱	LPDDR5 RAM		

Table: Components Lists

8.1 Back Panel

8.1.1 Power Button ⑬

The O6 board includes a dedicated power button for manual power control.

- **When the OS is running**: Short press the power button to trigger a power event. Depending on the OS settings, this action may display the power menu, initiate a shutdown, or put the system into suspend mode.
- **When the OS is powered off**: Short press the power button to power on the board.
- **Long press (4 seconds)**: Forces the board to power off.

8.1.2 USB-C Ports ⑫

The dual USB-C ports on the O6 support **USB 3.2 Gen 2** (10Gbps), **DP Alt Mode** (4K@60Hz), and **Power Delivery (PD)**.

- A **65W PD power supply(20V / 3.25A)** is recommended for powering the O6 from the USB-C port.
- Either USB-C port can power the board. If two power sources are connected simultaneously (e.g., when using two USB-C monitors with PD capability), the first plugged-in PD source will supply power to the board.
- Each USB-C port can deliver up to **3A** to power external USB-C devices.

8.1.3 Double USB 2.0 ⑪

The double-layer USB 2.0 host ports provide standard USB support. The combined current limit for the two ports is **1.4A**.

8.1.4 Double USB 3.2 ⑩

The dual USB 3.2 host ports on the O6 provide **SuperSpeed USB** (10Gbps). Each port has a current limit of **1A**.

8.1.5 HDMI ⑨

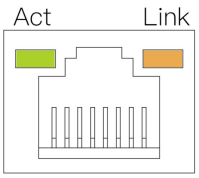
The HDMI Type-A port on the O6 supports a maximum resolution of **4K@60Hz**. Note that **HDMI CEC** is not supported.

8.1.6 DP ⑧

The DisplayPort (DP) on the O6 supports a maximum resolution of **4K@120Hz** and offers **2x MST (Multi-Stream Transport)** capability.

8.1.7 Dual 5GbE ⑦

The dual Ethernet ports provide a wired connection with speeds up to **5Gbps**. The LED indicators for these ports are described below:



LED	State	Meaning
Orange	Solid	Link established (device is connected to the network)
Green	Blinking	Data transmission occurring (network activity)
Off	-	No link detected (cable unplugged or network issue)

Table 4: RJ45 Ethernet Port LED Status Indicators

8.1.8 Headphone Jack ⑥

The **3.5mm headphone jack** on the O6 supports both audio input and output. It can drive standard headphones and is compatible with commonly used ring configurations.

8.1.9 Reset Button ⑤

The O6 is equipped with a reset button for system resets. A short press will reboot the system.

8.2 Internal Components

8.2.1 CPU - Cix CD8180 ⑰

The CPU on the O6 board, the Cix CD8180, is soldered directly onto the board and is non-replaceable.

8.2.2 DRAM ⑱

The DRAM on the O6 is soldered onto the board and is non-replaceable. It consists of four 32-bit LPDDR5 chips combined into a 128-bit memory bus, achieving speeds of up to **5500 MT/s**, with a total bandwidth of **80 GB/s**.

8.2.3 PCIe X16 Slot ①

The O6 features a full-size PCIe X16 slot, supporting **PCIe Gen4 x8** signals. PCIe bifurcation is not supported for this port.

- Power supply:
  - With ATX power: Maximum power from the PCIe slot is **60W**.
  - With USB-C PD power: Maximum power from the PCIe slot is **15W**.

8.2.4 M.2 M Key ②

An M.2 M Key connector is provided on the O6, supporting **2230**, **2242**, **2260**, and **2280** SSD types. The connector offers **PCIe Gen4 x4** signals.

- Power supply:
  - **Constant power**: **15W**
  - **Peak power**: **28W**

8.2.5 M.2 E Key ③

A M.2 E Key connector is provided on O6, with 2230 WiFi / BT card support. PCIe Gen4 x2 and USB 2.0 signal is available from the connector. Constant 15W peak 28W powed is supplied from this connector.

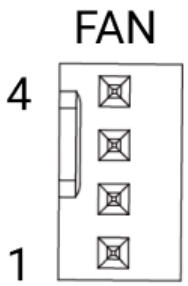
8.2.6 On board LED ④

Two LEDs are included on the O6 board:

- **Green LED**: Indicates power status.
- **Blue LED**: Indicates system status.
  - When the BIOS is running, the Blue LED remains on.
  - When the OS is running, the Blue LED blinks to represent the system heartbeat.

8.2.7 FAN Connector ⑭

The O6 features a standard ATX fan connector. The pinout is defined as follows:



Pin.	Name	Description
1	GND	Ground connection
2	VCC12V	Power supply (12V)
3	TACH	Tachometer signal (fan speed feedback)
4	PWM	Pulse Width Modulation control signal (3.3V)

Table 5: F_Panel Connector Pinout

8.2.8 BIOS Flash chip Holder ⑮

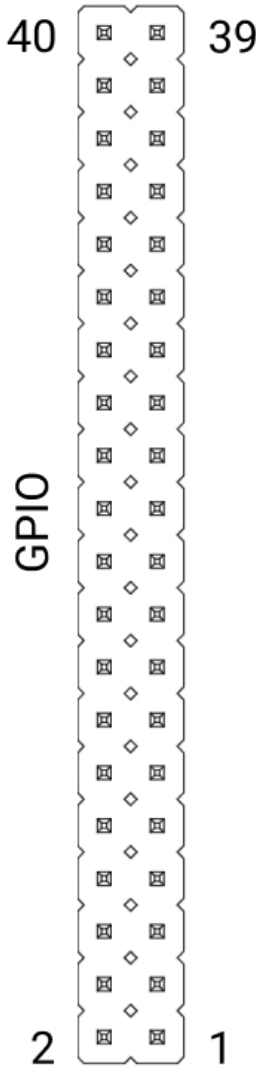
The O6 board includes a BIOS flash chip holder designed for developers to easily remove or replace the BIOS chip.

- **Chip compatibility**: Supports SOP8 footprint flash chips.
- **Chip capacity**: 8MB (64Mbit).
- **Voltage level**: 1.8V.

This feature facilitates firmware development and debugging by allowing convenient BIOS chip replacement.

8.2.9 40Pin GPIO Connector ⑯

A 40-pin GPIO connector is included on the O6 board, designed for low-speed bus connections and general-purpose input/output (GPIO) functionality.

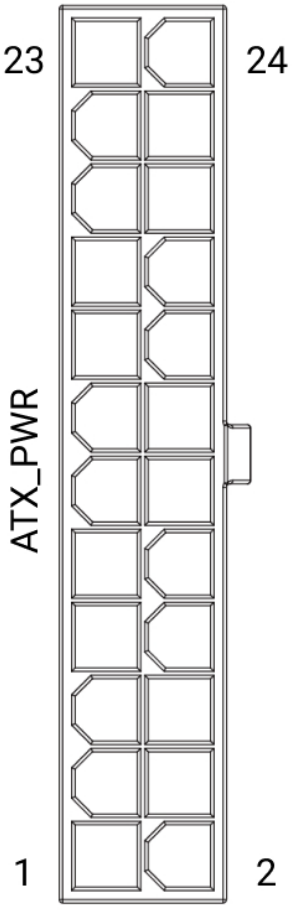


Pin.	Name	Description
1	3.3 V	Power supply (3.3V)
2	5V	Power supply (5V)
3	SDA	I2C data line (3.3V)
4	5V	Power supply (5V)
5	SCL	I2C clock line (3.3V)
6	UART3_TXD	UART3 transmit signal (3.3V)
7	GPIO	General-purpose I/O (3.3V)
8	UART3_RXD	UART3 receive signal (3.3V)
9	GND	Ground
10	I2S4_SCK	I2S4 serial clock (3.3V)
11	GPIO_PWM	GPIO with PWM capability (3.3V)
12	GPIO	General-purpose I/O (3.3V)
13	GPIO_PWM	GPIO with PWM capability (3.3V)
14	GND	Ground
15	GPIO	General-purpose I/O (3.3V)
16	GPIO	General-purpose I/O (3.3V)
17	3.3 V	Power supply (3.3V)
18	GPIO	General-purpose I/O (3.3V)
19	SPI2_MOSI	SPI2 master-out/slave-in signal (3.3V)
20	GND	Ground
21	SPI2_MISO	SPI2 master-in/slave-out signal (3.3V)
22	GPIO	General-purpose I/O (3.3V)
23	SPI2_CLK	SPI2 clock signal (3.3V)
24	SPI2_CS0	SPI2 chip select 0 (3.3V)
25	GPIO	General-purpose I/O (3.3V)
26	SPI2_CS1	SPI2 chip select 1 (3.3V)
27	GPIO	General-purpose I/O (3.3V)
28	GPIO	General-purpose I/O (3.3V)
29	GPIO	General-purpose I/O (3.3V)
30	GND	Ground
31	GPIO	General-purpose I/O (3.3V)
32	GPIO	General-purpose I/O (3.3V)
33	GPIO	General-purpose I/O (3.3V)
34	GND	Ground
35	I2S4_TWS	I2S4 word select (3.3V)
36	I2S4_MCLK	I2S4 master clock (3.3V)
37	GPIO	General-purpose I/O (3.3V)
38	I2S4_DATA_IN	I2S4 data input (3.3V)
39	GND	Ground
40	I2S4_DATA_OUT	I2S4 data output (3.3V)

Table 6: 40Pin GPIO Pinout

8.2.10 ATX Power Connector ⑲

An ATX-compatible 24-pin power connector is included on the O6 board for standard ATX power supply compatibility.

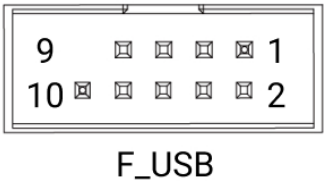


Pin.	Name	Description
3	GND	Ground connection
5	GND	Ground connection
7	GND	Ground connection
8	PWR_OK	Power good signal (logic high: 3.3V or 5V)
9	5VSB	Standby power supply (+5V, always on)
10	12V	Power supply (+12V)
11	12V	Power supply (+12V)
13	NC	Not connected
14	NC	Not connected
15	GND	Ground connection
16	PS_ON	Power supply on (active low signal)
17	GND	Ground connection
18	GND	Ground connection
19	GND	Ground connection
20	NC	Not connected
21	NC	Not connected
22	NC	Not connected
23	NC	Not connected
24	GND	Ground connection

Table 7: ATX Power Connector Pinout

8.2.11 F_USB Connector ⑳

The F_USB connector is designed to support the front panel USB functionality of a PC enclosure. The pinout configuration is as follows:



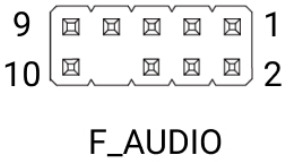
F_USB

Pin.	Name	Description
1	5V_1	Power supply (+5V)
2	5V_2	Power supply (+5V)
3	USB_DM_1	USB data negative signal
4	USB_DM_2	USB data negative signal
5	USB_DP_1	USB data positive signal
6	USB_DP_2	USB data positive signal
7	GND	Ground connection
8	GND	Ground connection
9	/	Reserved or not connected
10	GND	Ground connection

Table 8: F_USB Connector Pinout

8.2.12 F_Audio Connector ㉑

The F_Audio connector is designed to support the front panel audio functionality of a PC enclosure. The pinout configuration is as follows:



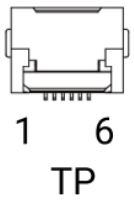
F_AUDIO

Pin.	Name	Description
1	MIC_INL	Microphone input (Left)
2	GND	Ground connection
3	MIC_INR	Microphone input (Right)
4	GND	Ground connection
5	HP_OUT_R	Headphone output (Right)
6	FRONT_MIC_JD	Front microphone jack detection
7	GND	Ground connection
8	/	Reserved or not connected
9	HP_OUT_L	Headphone output (Left)
10	FRONT_HP_JD	Front headphone jack detection

Table 9: F_Audio Connector Pinout

8.2.13 TP Connector ㉒

A touch panel connector is included on the O6 board to enable touch panel integration. Combined with the eDP connector, it provides a direct interface for connecting a touchscreen.

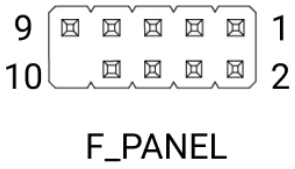


Pin.	Name	Description
1	Reset	Reset signal for touch controller (3.3V)
2	VCC	Power supply for touch panel (3.3V)
3	GND	Ground connection
4	EINT	External interrupt signal (3.3V)
5	SDA	I2C data line for touch communication (3.3V)
6	SCL	I2C clock line for touch communication (3.3V)
7	GND	Ground connection
8	GND	Ground connection

Table 10: Touch Panel Connector Pinout

8.2.14 F_Panel Connector ㉓

The F_Panel connector is designed to support the front panel power button, reset button, and LED functionality of a PC enclosure. The pinout configuration is as follows:



Pin.	Name	Description
1	SSD_LED+	Solid State Drive (SSD) activity LED (+)
2	PWR_LED+	Power LED (+)
3	SSD_LED-	SSD activity LED (-)
4	PWR_LED-	Power LED (-)
5	RESET-	Reset switch (-)
6	PWR_ON	Power switch ON signal
7	RESET+	Reset switch (+)
8	PWR_GND	Power ground
9	RSV(5V)	Reserved pin (5V power supply)
10	NC	Not connected

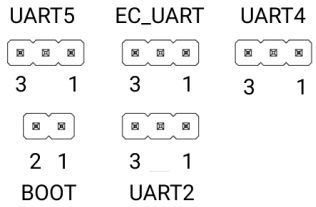
Table 11: F_Panel Connector Pinout

8.2.15 Debug Connectors ㉔

Four dedicated UART interfaces are included on the O6 board for various debugging purposes. Additionally, an EC UART is provided for the EC serial console.

- **UART2**: BIOS and OS debug logs
- **UART4**: Power management, voltage, and frequency monitoring
- **UART5**: Secure BootROM debug logs
- **EC UART**: On board Embedded Controller debug logs

The UART pinout configuration is as follows:



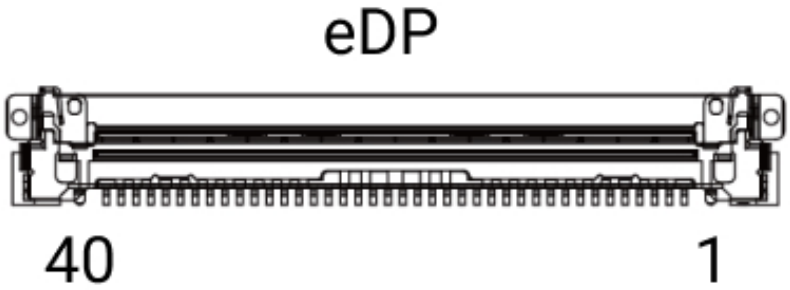
UART_x Pinout		
Pin.	**Name**	**Description**
1	GND	Ground connection
2	UART_TX	UART transmit signal (3.3V)
3	UART_RX	UART receive signal (3.3V)

BOOT Pinout		
Pin.	**Name**	**Description**
1	BOOT_STRAP	Boot Strap pin
2	GND	Ground connection

Table 12: Debug Connector Pinout

8.2.16 eDP Connector ㉕

A 40-pin eDP connector is included on the O6 board to enable direct connection to eDP panels, supporting resolutions up to **4K@60Hz**. The connector uses an **IPEX 40-pin, 0.5mm pitch** design. The eDP connector provides a maximum power output of **12V / 2A**.



Pin.	Name	Description
1	NC	Not Connected
2	GND	Ground
3	3N	eDP Lane 3 Negative Signal
4	3P	eDP Lane 3 Positive Signal
5	GND	Ground
6	2N	eDP Lane 2 Negative Signal
7	2P	eDP Lane 2 Positive Signal
8	GND	Ground
9	1N	eDP Lane 1 Negative Signal
10	1P	eDP Lane 1 Positive Signal
11	GND	Ground
12	0N	eDP Lane 0 Negative Signal
13	0P	eDP Lane 0 Positive Signal
14	GND	Ground
15	AUXP	eDP Auxiliary Channel Positive
16	AUXN	eDP Auxiliary Channel Negative
17	GND	Ground
18	VDD1	Power Supply (+3.3V)
19	VDD2	Power Supply (+3.3V)
20	VDD3	Power Supply (+3.3V)
21	VDD4	Power Supply (+3.3V)
22	NC	Not Connected
23	GND	Ground
24	GND	Ground
25	GND	Ground
26	GND	Ground
27	NC	Not Connected
28	GND	Ground
29	GND	Ground
30	GND	Ground
31	GND	Ground
32	BL_EN	Backlight Enable Signal
33	PWM	PWM Signal for Backlight Control
34	NC	Not Connected
35	NC	Not Connected
36	VBL1	Backlight Power Supply
37	VBL2	Backlight Power Supply
38	VBL3	Backlight Power Supply
39	VBL4	Backlight Power Supply
40	NC	Not Connected
41	NC	Not Connected
42	NC	Not Connected
43	GND	Ground

Table 13: eDP Connector Pinout

8.2.17 RTC Battery Holder ㉖

The RTC battery holder on the O6 is designed for a **CR1220 battery**, which provides timekeeping functionality. Note that removing the RTC battery will not clear the BIOS settings.

9 Quick Start Guide

9.1 Product Package Content Check

Upon receiving the Radxa Orion O6 package, the first step is to verify its contents.

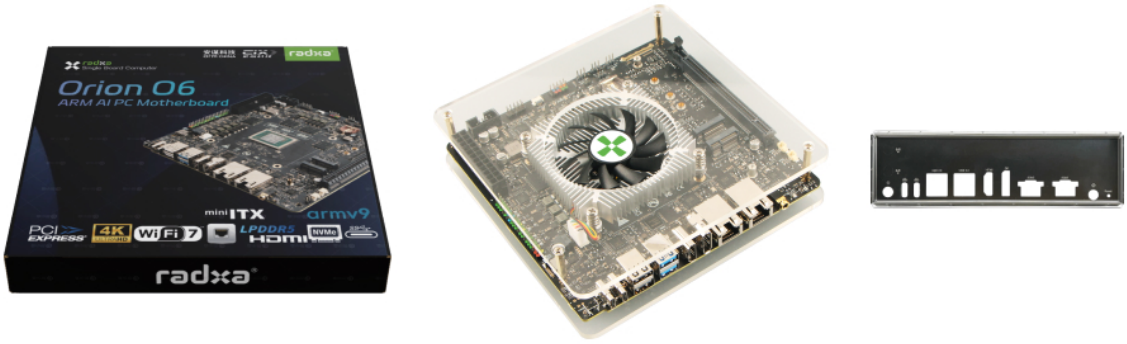


Figure 3: Package List

1. Open the package box. Inside, you will find the motherboard securely placed in an anti-static packaging bag. Carefully remove it and place it on a clean, debris-free surface.
2. Refer to the included detailed packing list to confirm that all accessories are present. The motherboard comes with a pre-installed **Heatsink 8420B** and an **Acrylic Case for Orion O6**. Pay special attention to the following key components during the inspection:

- **Heatsink 8420B**: Ensure it is firmly attached to the SoC, with neatly aligned fins. Check that the cooling fan rotates smoothly without stuttering or noise, and verify that the power cable is intact and undamaged.
- **Acrylic Case**: Check for any visible scratches or cracks. Ensure the edges are polished smooth to prevent injury. Verify that the screws and standoffs securing the case and motherboard are intact.

If any accessories are missing, damaged, or differ from the packing list, contact the seller or manufacturer’ s customer service team immediately for prompt resolution.

> **Note**:
> Always ensure the motherboard is powered off before disassembly or assembly.

9.2 Additional Items Needed

To use the Orion O6, the following items are required:

- **USB PD Power Adapter**: A **65W USB-C PD (20V/3.25A)** or **USB-C DC (20V/3.25A)** power supply is recommended.
- **M.2 NVMe SSD**:
  - Supported types: **2230**, **2242**, **2260**, **2280**
  - Supported interfaces: **PCIe Gen3** or **Gen4** (SATA M.2 SSDs are not supported).
- **USB Keyboard and Mouse**: Required for operation.
- **USB Drive**: For OS installation.
  - Supported: **USB 2.0/3.0**, USB-A or USB-C drives (USB 3.0 is recommended for faster installation).
- **Monitor or TV**: Must support **HDMI**, **DP**, or **USB-C video input**.

Optional:

- **M.2 Wireless Module**: For WiFi/Bluetooth functionality.

9.3 Creating a Bootable USB Drive

To create a bootable USB drive, you will need another computer (Host Computer) running Windows, Linux, or macOS.

1. **Download the image**:
   - Visit the Radxa Orion O6 website and download the Debian 12 pre-installed image.
2. **Download the imaging tool**:
   - Use a tool like Etcher to write the image to the USB drive.
3. **Write the image**:
   - Insert the USB drive into the Host Computer.
   - Open the Etcher tool, select the downloaded image, and write it to the USB drive. This process may take over 10 minutes, depending on the speed of your USB drive and Host Computer.

9.4 Disassemble the Top Cover

1. Unscrew the **4x CM3x5x5 screws** securing the acrylic upper cover using a Phillips screwdriver. Apply gentle, even force to avoid stripping the screws.
2. Remove the acrylic upper cover carefully, as shown below:

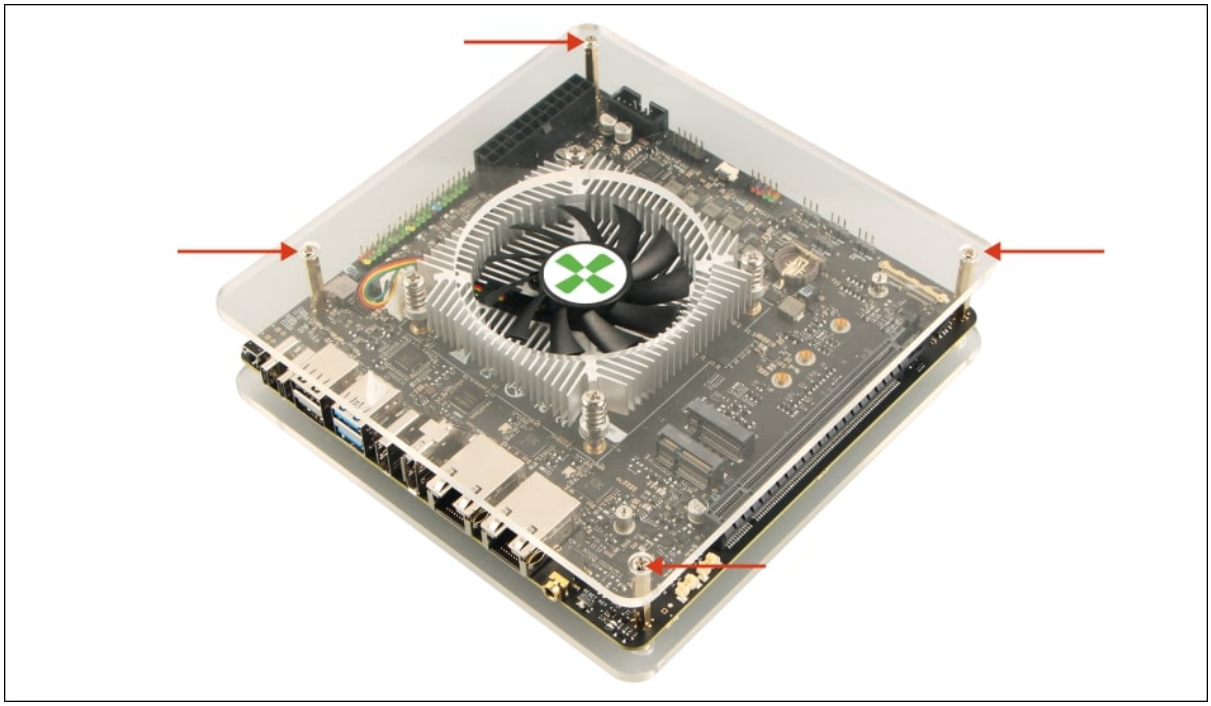


Figure 4: Initial Step for Quick Start

9.5 Install NVMe SSD

The O6 motherboard does not include a pre-installed SSD. Follow these steps to install an M.2 NVMe SSD:

1. Locate the **M.2 M Key connector** on the motherboard. Identify the correct mounting positions for the copper standoffs based on your SSD’ s size.

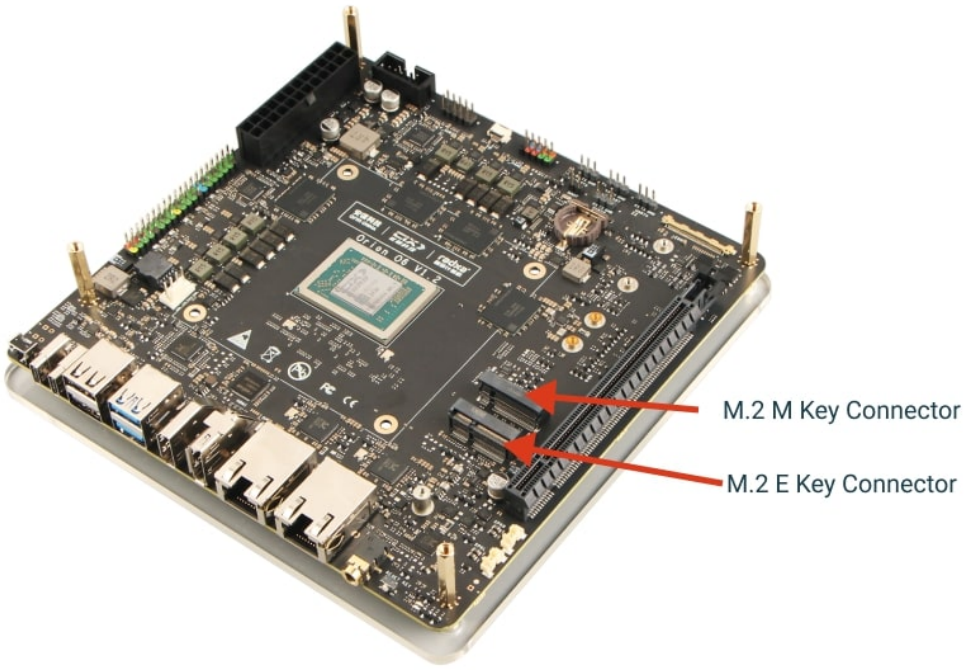


Figure 5: How to Install NVMe SSD 01

2. Install the standoffs securely to provide stable support.
3. Align the NVMe SSD with the M.2 connector, ensuring the correct orientation. Insert the SSD gently to avoid damage.
4. Secure the SSD with **CM2x2.5 screws**.

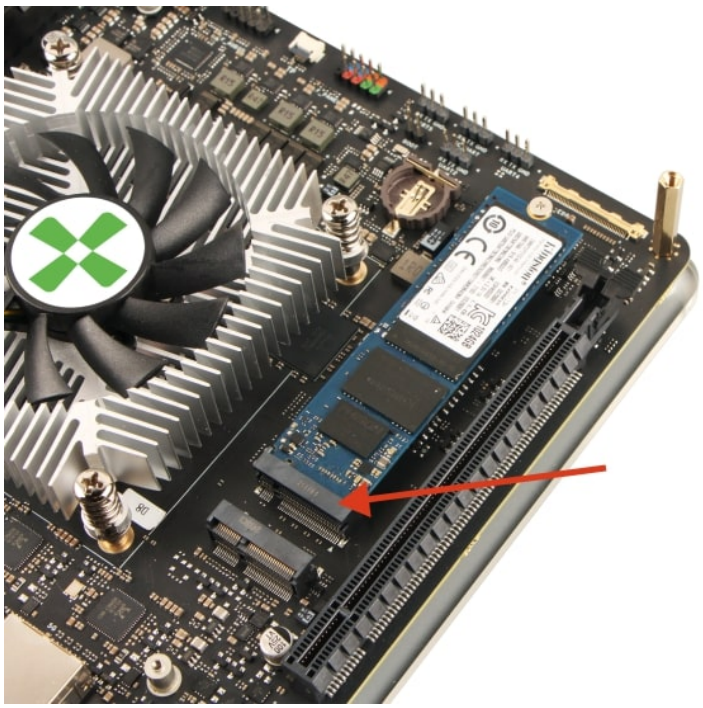


Figure 6: How to Install NVMe SSD 02

9.6 Install WiFi Module (Optional)

If desired, install a WiFi/Bluetooth module:

1. Locate the **M.2 E Key connector** on the motherboard. Align the module (e.g., Radxa Wireless Module A8) with the connector and gently insert it.

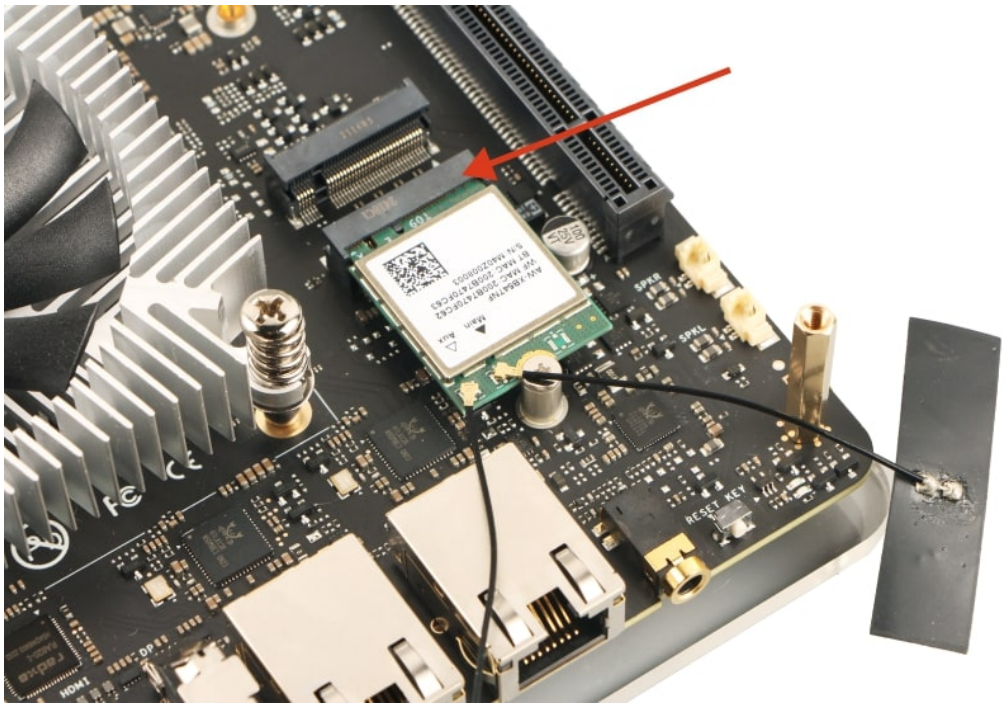


Figure 7: How to Install Radxa Wireless Module A8 01

2. Secure the module with **CM2x4x5 screws**.

9.7 Connecting Peripherals

1. Plug the USB drive into a **USB 3.2 port** ⑫.
2. Connect the USB keyboard and mouse to any **USB 2.0 port** ⑫.
3. Attach a monitor or TV via **HDMI** ⑩ or **DP** ⑨.

Figure 8: Connecting Peripherals

9.8 Powering on and Install OS to NVMe SSD

1. Insert the USB Type-C power adapter into either USB-C port. The green LED will light up, followed by the blue LED, and the fan will start spinning.

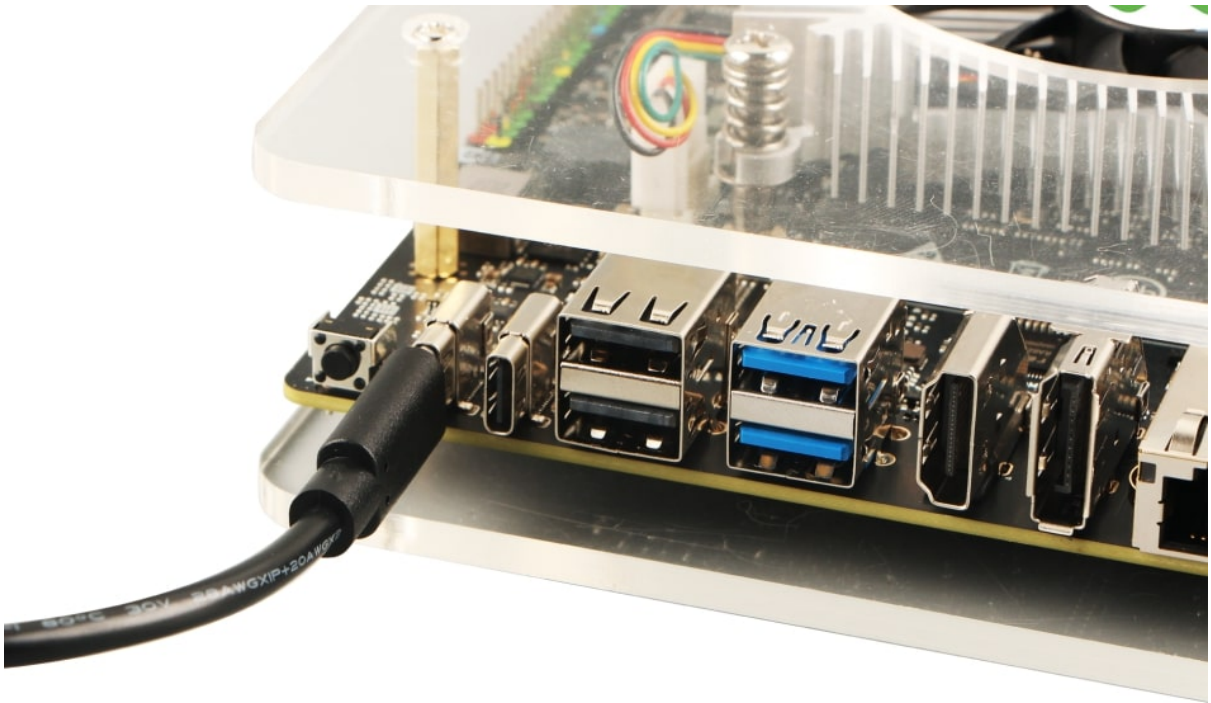


Figure 9: USB Type C Power Supply

2. The BIOS menu should appear on the monitor. Press the **ESC** key on the keyboard to enter

the UEFI/BIOS menu.

Figure 10: BIOS Screen

Figure 11: BIOS Menu

3. From the BIOS menu:

- Choose **Boot Manager** and press **Enter** to select your USB drive from the **Boot Manager Menu**, it should looks like:

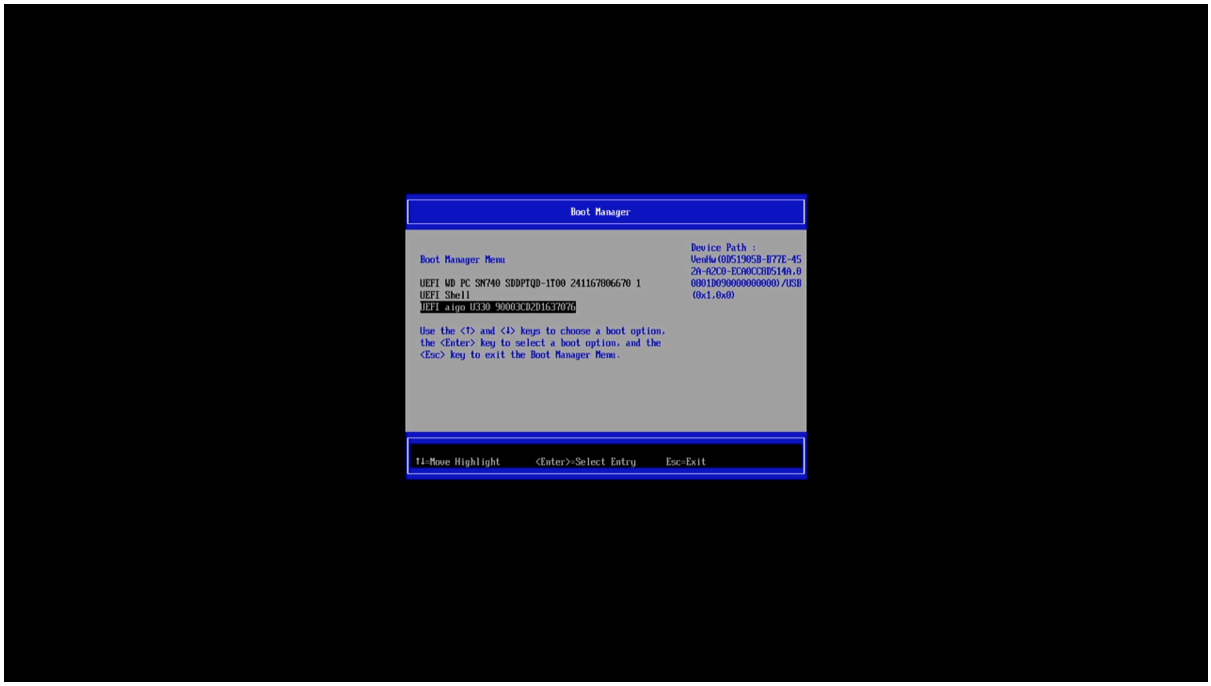


Figure 12: BIOS boot device

4. The system is now booting from the USB drive. This process may take approximately **20 seconds** or longer, depending on the speed of the USB drive. During this time, the monitor may remain blank.

Figure 13: Grub Memu

5. Once the USB drive has successfully booted, the Debian desktop will appear on the monitor.

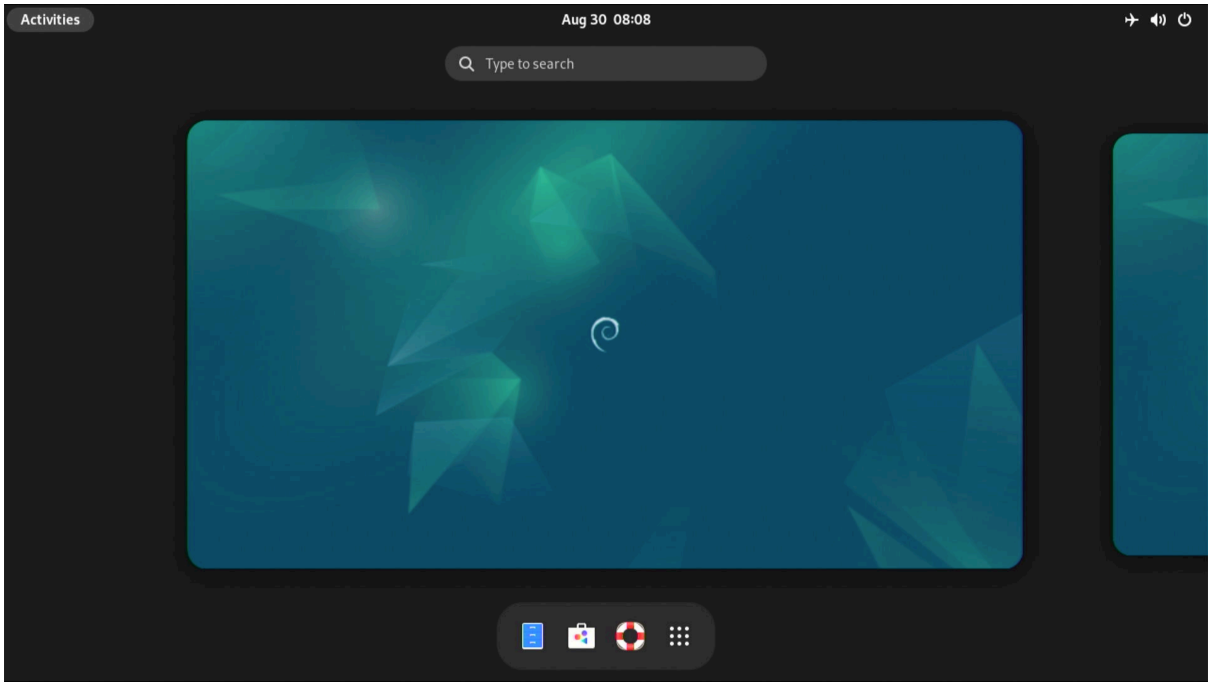


Figure 14: Debian Desktop

6. Click the Application Menu located on the bottom-right taskbar and select **balenaEtcher**.

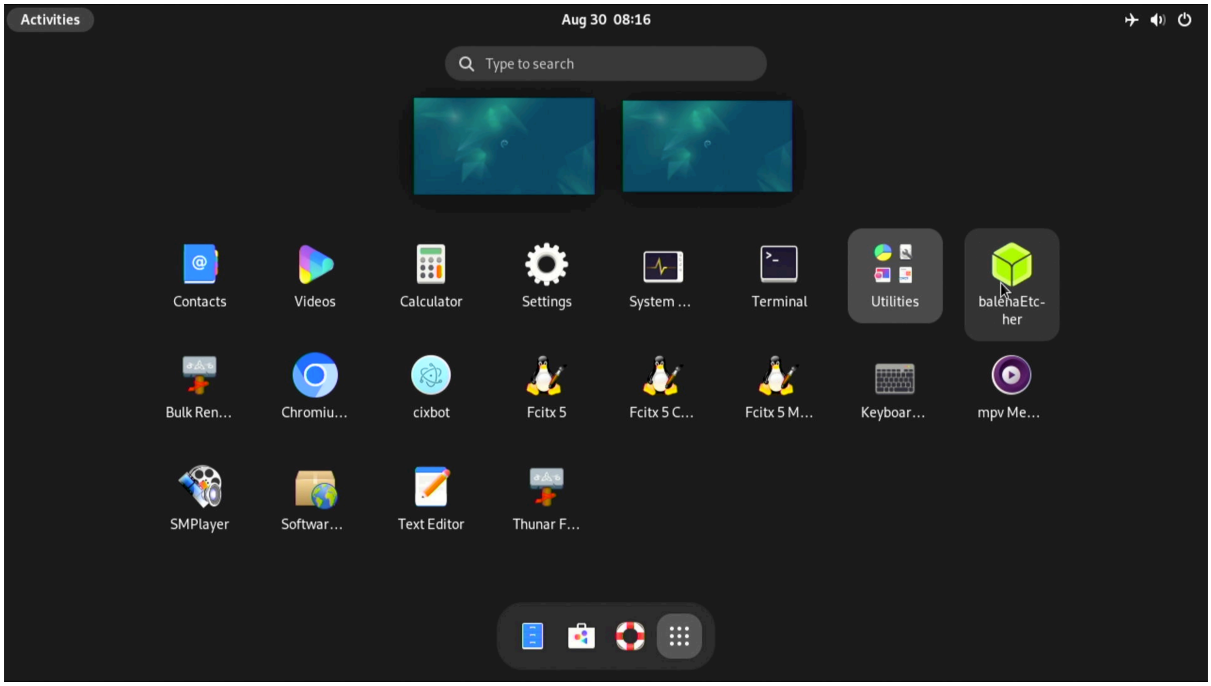


Figure 15: OS Installation: Select Ecther

7. Click **Flash from file** on the left icon and select the image located in the **Home folder**:

- orion-o6-debian12-preinstalled-desktop-b1.img

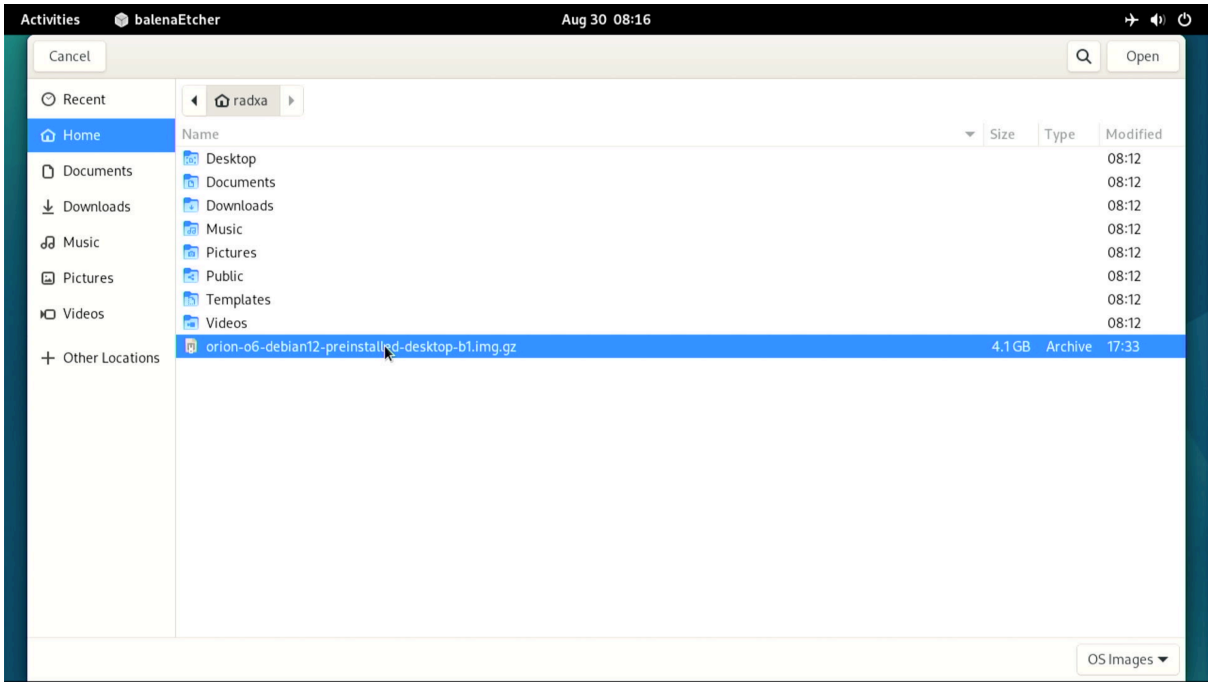


Figure 16: OS Installation: Select Image

8. Click **Change** on the middle icon, then click **Show 1 Hidden**. **Deselect** the USB drive and select the **System drive**, which refers to the NVMe SSD.

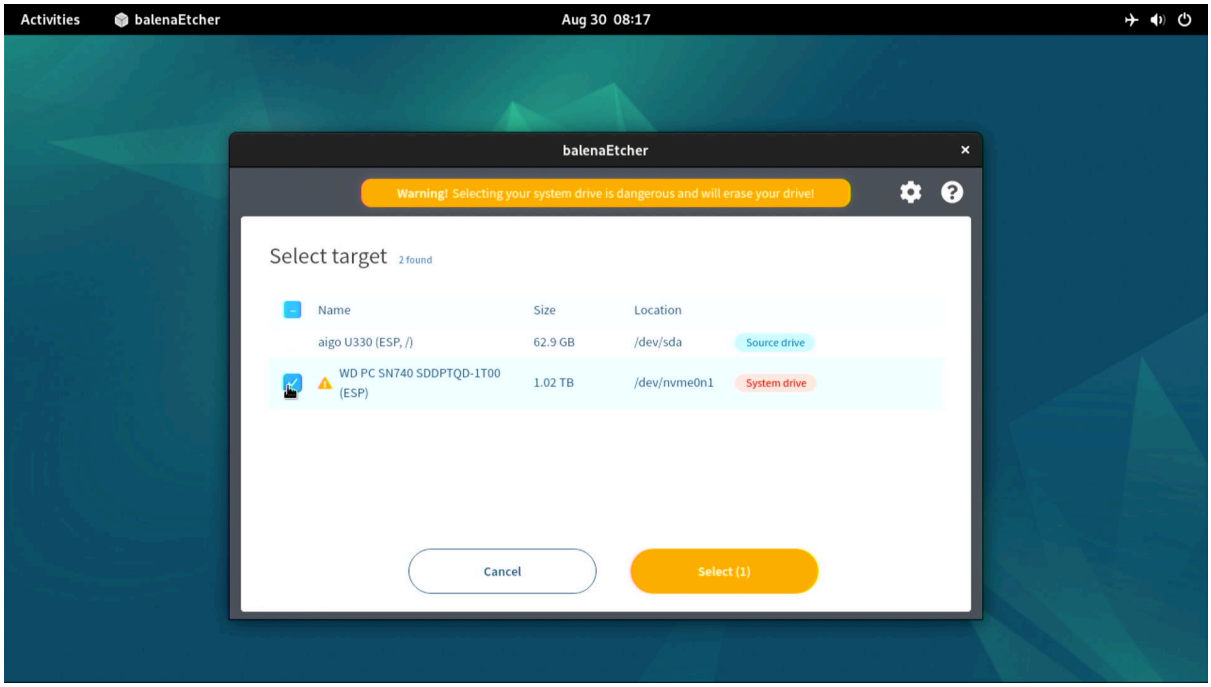


Figure 17: OS Installation: Select Drive

9. Click **Flash** and then confirm by clicking **"Yes, I' m sure"** to begin writing the image to the SSD.

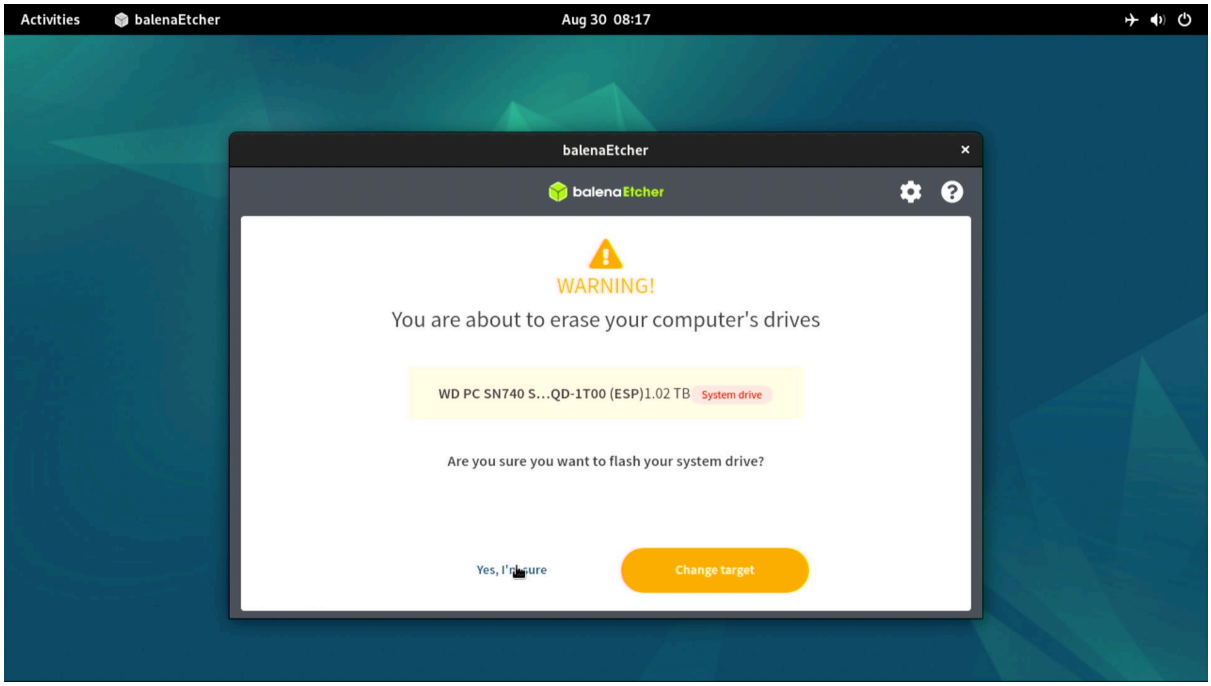


Figure 18: OS Installation: Erase Confirm

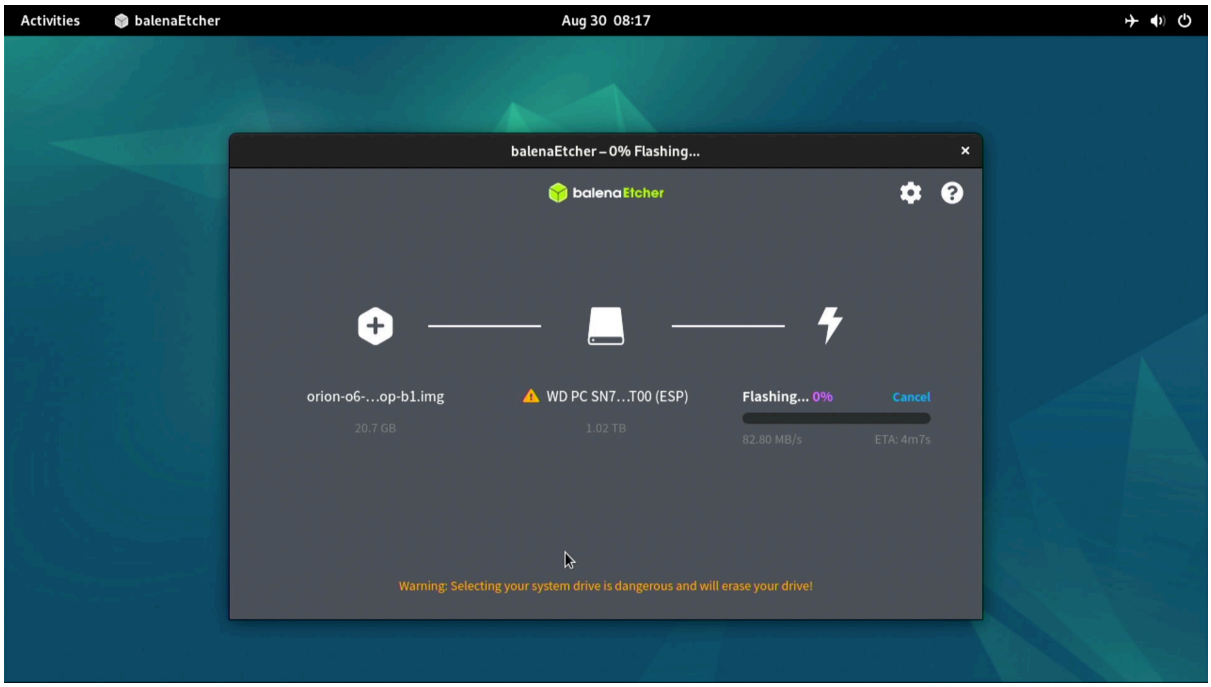


Figure 19: OS Installation: Start Writing

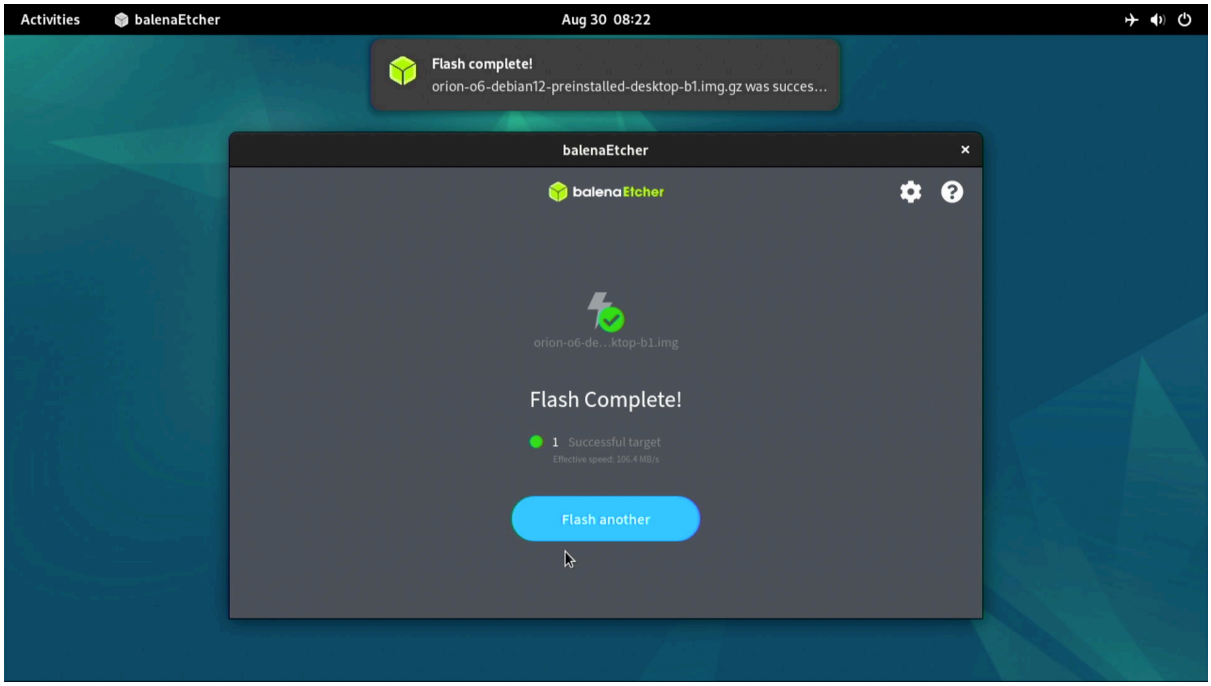


Figure 20: OS Installation: Write Finish

10. The image has been successfully installed on the NVMe SSD. You can now power off the motherboard and remove the USB drive. When you power it on again, the system will boot from the NVMe SSD.

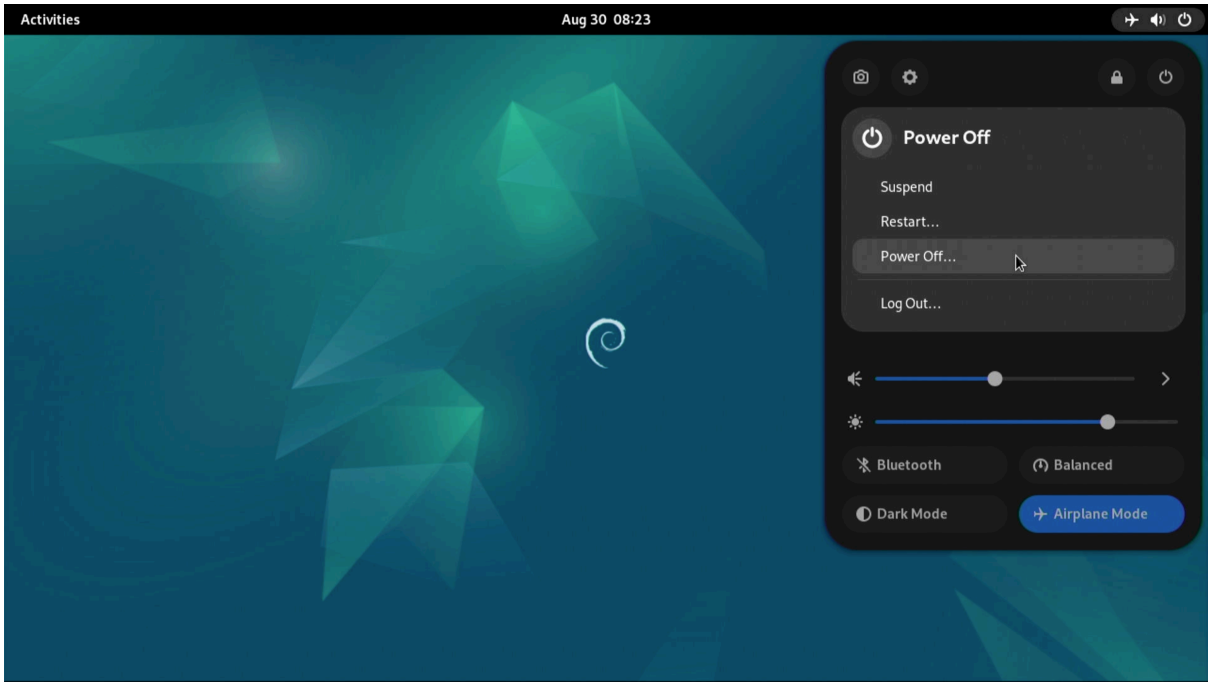


Figure 21: OS Installation: Power Off

10 Software Configuration

This section covers the essential steps for preparing and installing software on the **Radxa Orion O6**. Unlike x86 motherboards, the Orion O6 uses an **ARM64** (ARM v9) processor, which affects the choice of operating system images, firmware, and drivers.

10.1 UEFI / Firmware Setup

Orion O6 uses an **EDK II-based UEFI firmware**. You can configure boot order, enable/disable onboard controllers, manage security features such as Secure Boot, and monitor hardware status (CPU temperature, fan RPM, etc.) through the UEFI interface.

10.2 Operating System Configuration

- TBD

10.3 Driver Installation

- TBD

11 Troubleshooting

11.1 Power - related Issues

- If the board doesn’ t power on, check the power source connections and ensure the correct power supply is used.
- If there are issues with power throttling, verify the cooling system is functioning properly.

11.2 Display Problems

- If there’ s no display, check the display cable connections and ensure the correct display port is used.
- For resolution or display quality issues, update the graphics drivers.

11.3 Connectivity Problems

- For network connectivity issues, check the Ethernet cable and settings.
- For USB device issues, try different USB ports or update USB drivers.

11.4 Audio Problems

- If there’ s no audio, check the audio cable connections and volume settings.

12 Mechanical Specification

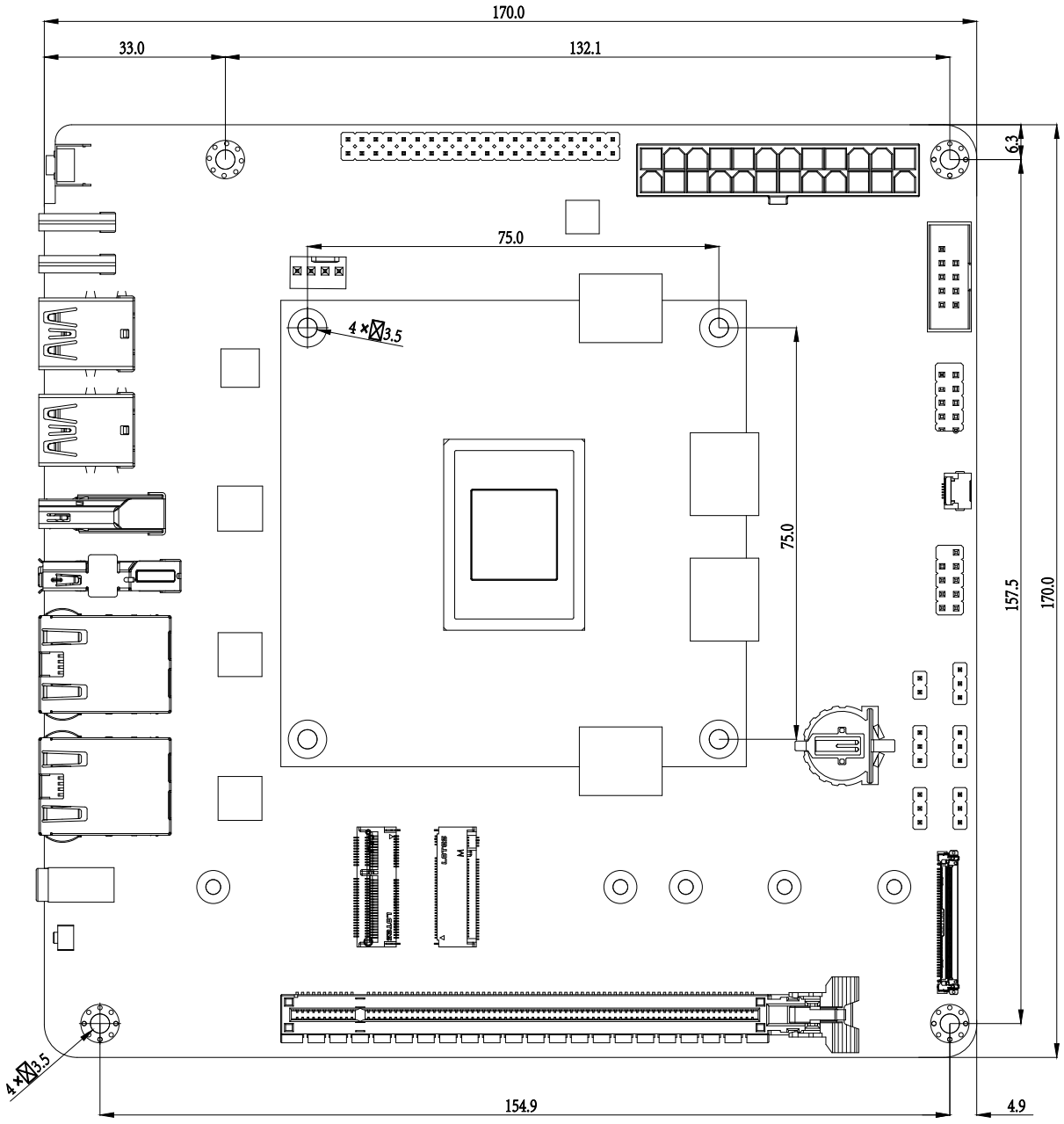


Figure 22: Orion O6 Mechanical Drawing

13 Appendix

13.1 Appendix1: PC Enclosure Installation Guide

13.1.1 Case Compatibility Requirements

The Radxa Orion O6 is designed in the Mini-ITX form factor (170mm × 170mm) and is compatible with standard Mini-ITX cases. When selecting a case, ensure:

- Minimum clearance of 25mm above the motherboard for components
- Adequate ventilation for proper cooling
- Support for standard ATX power supply if using ATX power
- Front panel connectors compatibility
- Sufficient space for PCIe cards if needed

13.1.2 Cooling Installation

The Orion O6 comes with a heatsink and fan pre-installed. If you want to use your own coolers, refer to the notes below. For instructions on assembling and disassembling the pre-installed cooler, check the Appendix 3&4.

CPU Cooling

- **Mounting holes**: 75mm × 75mm pattern
- **Support**: Both active and passive cooling
- **Recommended TDP handling**: 30W

Fan Installation

- 4-pin PWM fan header
- Supports speed monitoring
- Fan control through UEFI settings

Thermal Considerations

- Apply thermal paste if using a heatsink
- Ensure proper contact with SoC
- Maintain airflow path in the case

Temperature Monitoring

- Operating range: 0°C to 40°C
- Throttling may occur above 80°C
- Monitor temperatures through system tools

13.1.3 Motherboard Installation

Prepare the Case

1. Remove side panels and any protective covers.
2. Install standoffs in the correct Mini-ITX mounting positions.
3. Ensure proper grounding between the case and motherboard.

Mount the Motherboard

1. Align the motherboard with pre-installed standoffs.
2. Match the I/O shield with the rear case opening.
3. Secure the motherboard using 4 M3 screws in the following order:
    - First, insert and slightly tighten two diagonal screws into the respective holes.
    - Check the motherboard’ s position. If adjustment is needed, loosen the tightened screws, adjust, and retighten.
    - Then, tighten the other two diagonal screws in sequence to secure the motherboard firmly.
4. **Recommended torque**: 0.5 Nm

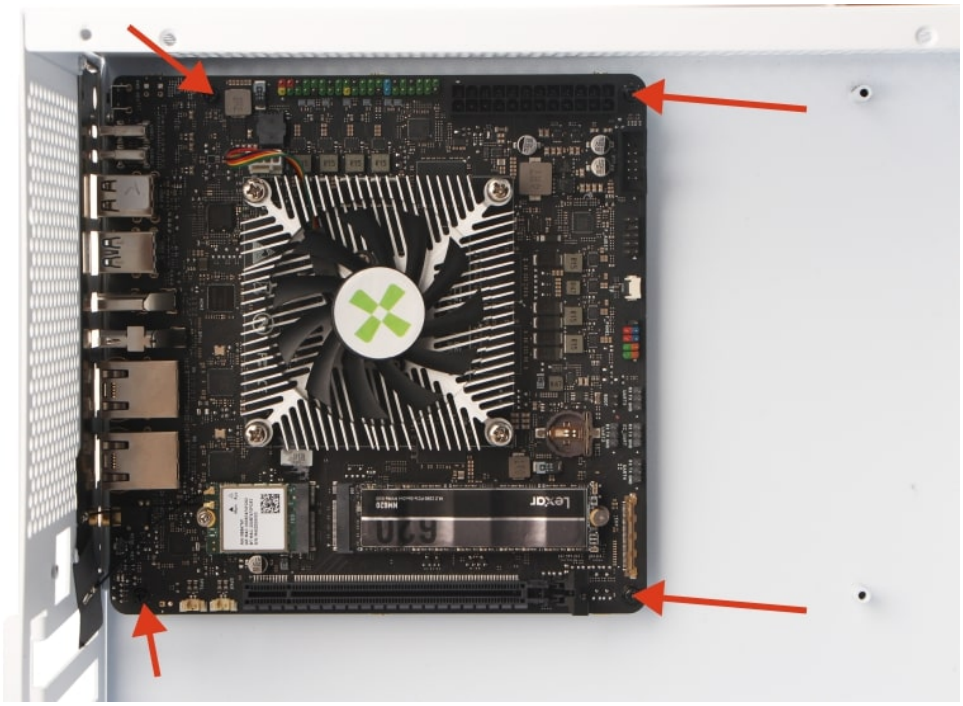


Figure 23: Mounting Holes

13.1.4 Front Panel Connections

Connect the following front panel headers:

1. **Power Button & LED Header**

```
2-4: Power LED +/-
6-8: Power Button
5-7: Reset Button
1-3: HDD LED
```

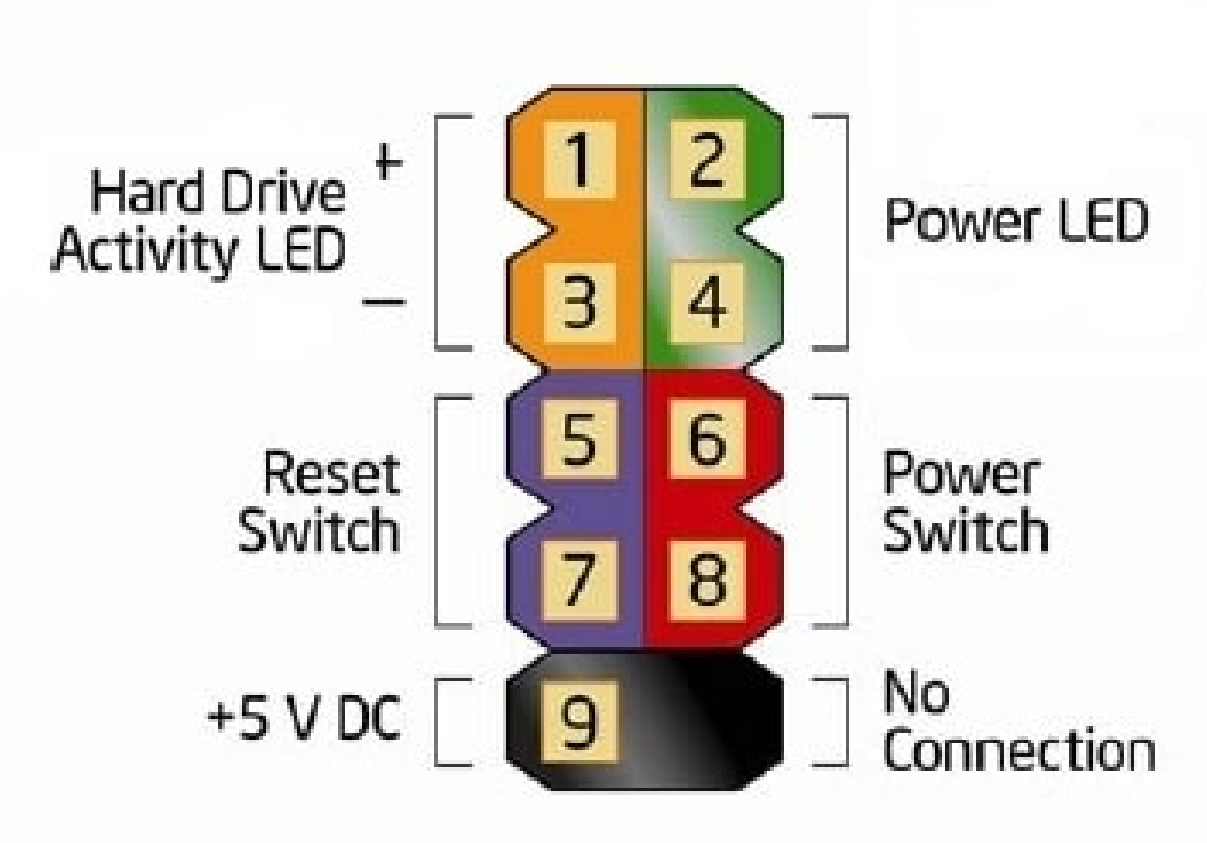


Figure 24: Front Panel

2. **USB 2.0 Headers**

   - Support for two USB 2.0 ports
   - Pin 1 marked with triangle
   - Observe correct orientation

3. **Audio Header**

   - HD Audio compatible
   - Supports front panel audio jacks
   - Pin 1 marked for orientation

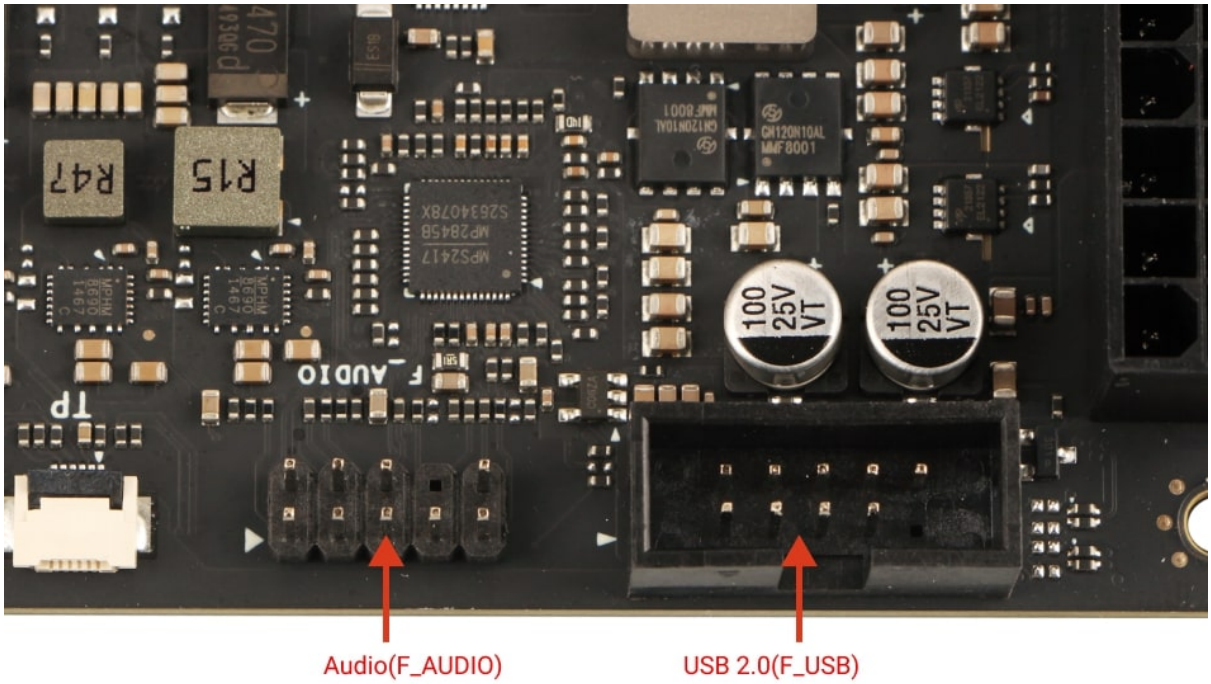


Figure 25: Front USB 2.0 & Audio

How to Install the Power Button, Reset Button and LED Header Interface

- Locate the F_PANEL interface on the Orion O6 motherboard. The front panel interface (F_PANEL) of the Orion O6 is used to connect the power supply, the reset button, the power status light and the hard disk status light, so as to achieve the corresponding functions and status display.
- As shown in the figure, insert the corresponding interfaces one by one. During the operation, be sure to pay attention to the positive and negative poles.
- **Power LED**

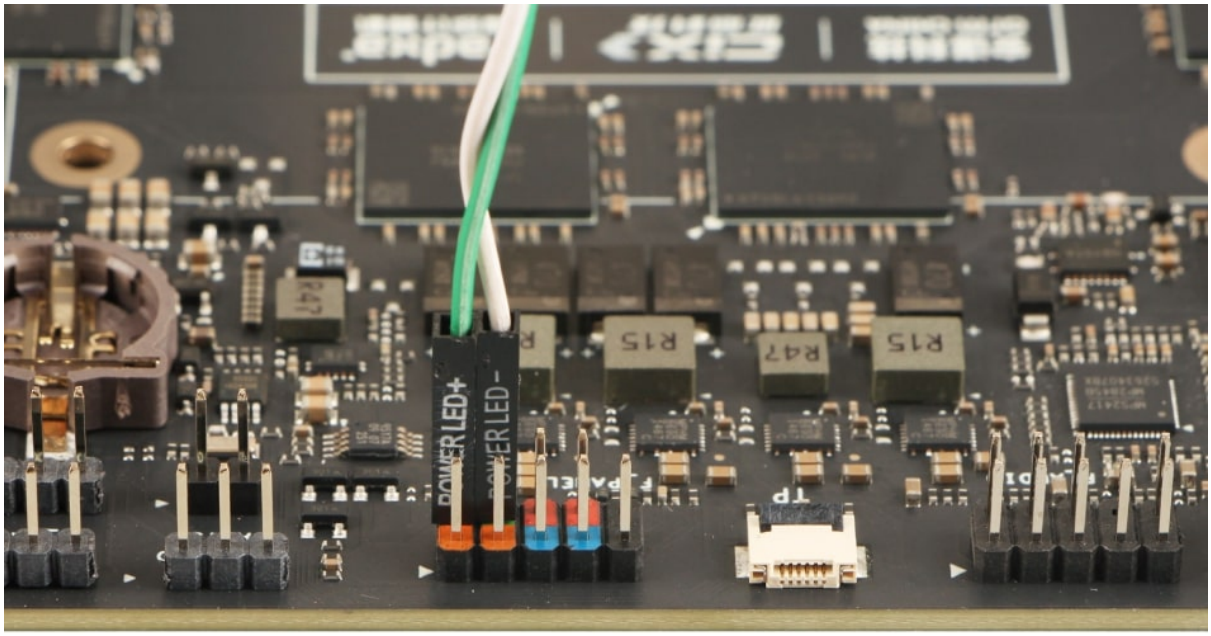


Figure 26: Power LED

- **Power Button**

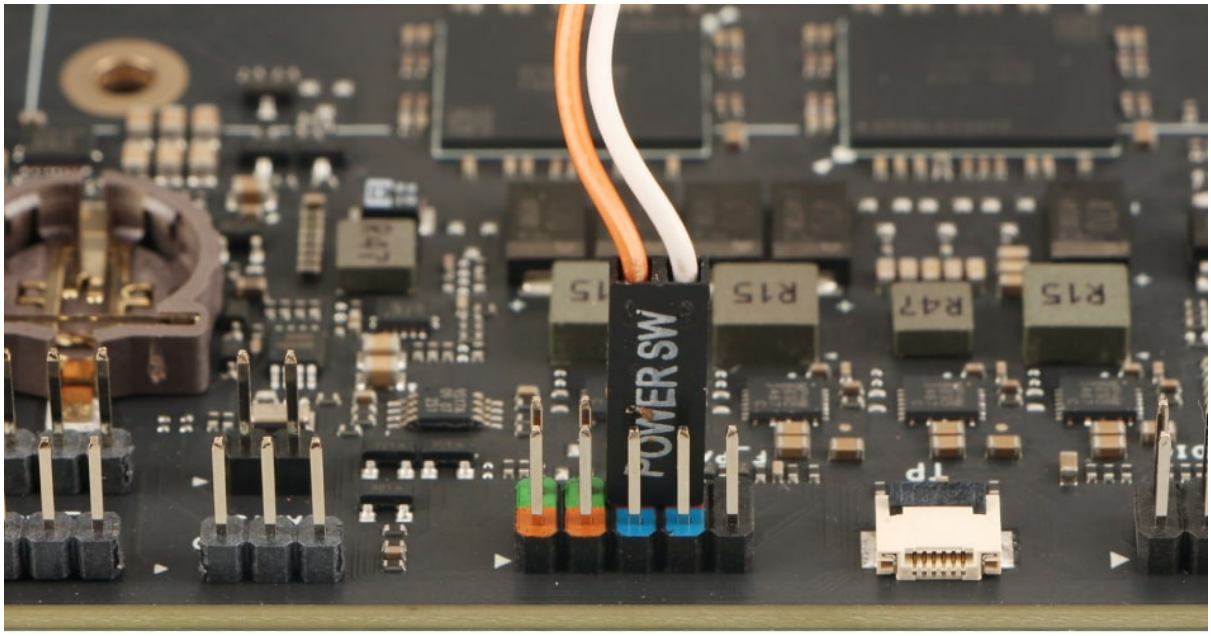


Figure 27: Power Button

- **Reset Button**

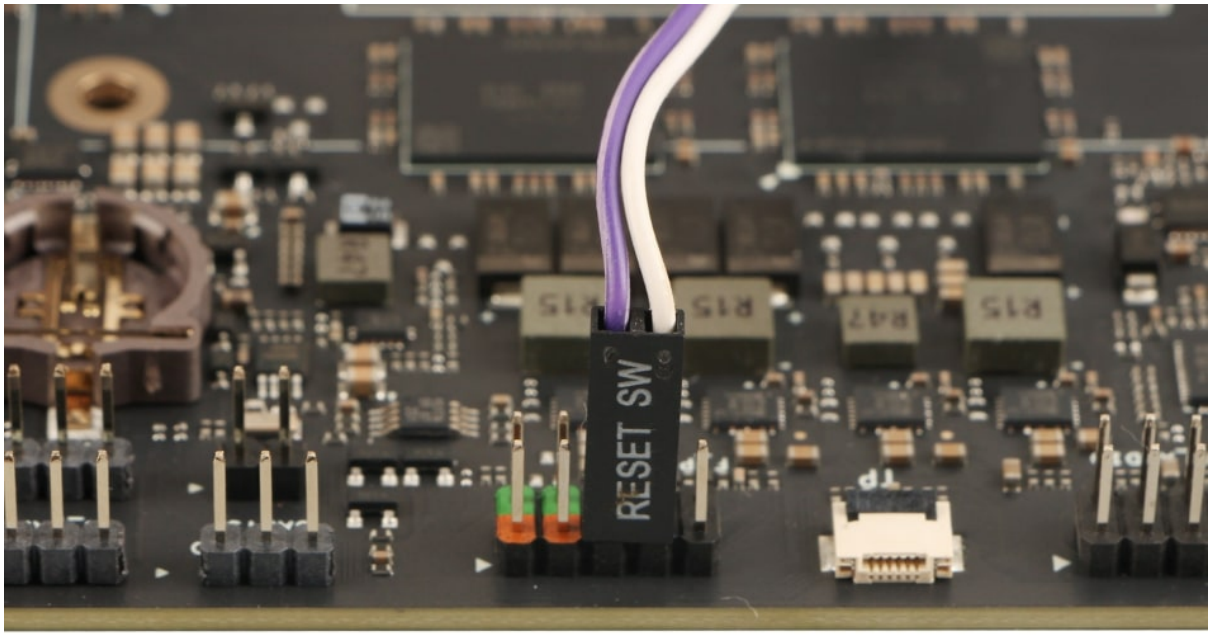


Figure 28: Reset Button

How to Install the Front USB 2.0 Interface

- Locate the F_USB interface on the Orion O6 motherboard. The front USB 2.0 interface (F_USB) of the Orion O6 is used to connect to the USB 2.0 ports.
- When carrying out the installation, please pay attention to the F_USB interface. This interface has distinct features: it generally appears as a 10-pin socket, but in fact, it only has 9 pins. If you observe carefully, you will find that one pin is missing, which can effectively avoid the risk of incorrect insertion. During the installation process, you just need to precisely align the corresponding plug with the position of this missing pin and then insert it smoothly to ensure that the connection is accurate.

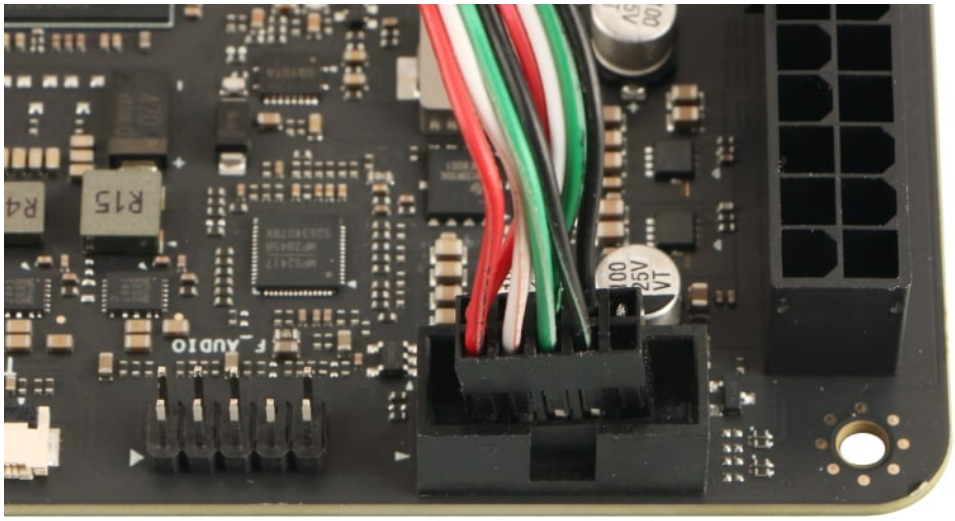


Figure 29: Front USB 2.0

How to Install the Front Audio Interface

- Locate the F_AUDIO interface on the Orion O6 motherboard. The front audio interface (F_AUDIO) of the Orion O6 is used to connect to the audio ports.
- When carrying out the installation, please pay attention to the F_AUDIO interface. This interface has distinct features: it generally appears as a 10-pin socket, but in fact, it only has 9 pins. If you observe carefully, you will find that one pin is missing, which can effectively avoid the risk of incorrect insertion. During the installation process, you just need to precisely align the corresponding plug with the position of this missing pin and then insert it smoothly to ensure that the connection is accurate.

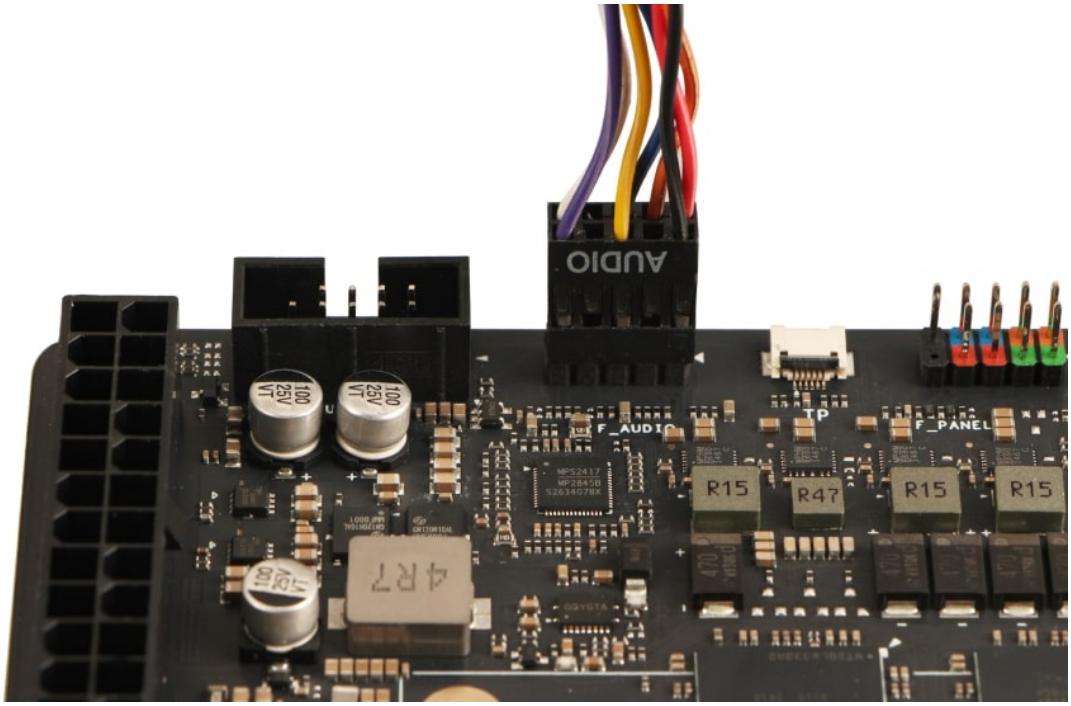


Figure 30: Front Audio

13.1.5 Additional Components

1. **Storage Installation**
   - M.2 M-Key slot for NVMe SSD
     - Supports PCIe Gen4 x4
     - 2280 form factor
   - Secure with mounting screw
2. **Wireless Card Installation**
   - M.2 E-Key slot
     - Supports PCIe Gen4 x2 + USB
     - Compatible with standard WiFi/BT modules
   - Attach antennas if required
3. **PCIe Card Installation**
   - x16 slot (operating at x8 Gen4)
   - Supports full-length cards
   - Ensure proper case clearance
   - Secure with bracket screws

How to Install the NVMe SSD and Wireless Module

- **Prepare an NVMe SSD of an appropriate size according to your own needs. This motherboard supports NVMe SSDs with the sizes of 2230 / 2242 / 2260 / 2280. Meanwhile, it comes with pre-installed CM2x2.5 D=5x0.4 screws and M2x5+2.5 copper pillars for fixation.**

- Before disassembly, make sure the motherboard is in a powered-off state. Locate the M.2 M Key connector on the motherboard. Based on the size of the selected NVMe SSD, determine the specific position where the copper pillar M2x5+2.5 needs to be installed. Remove the copper pillar, align it with the corresponding hole, and install the copper pillar firmly so that it won’ t shake or fall off. Carefully align the prepared NVMe SSD with the M.2 M Key connector. Pay special attention to ensuring that the interface direction is correct. The end of the NVMe SSD with the gold fingers should be smoothly inserted into the slot of the connector, avoiding any damage to the gold fingers or the slot due to excessive force. After confirming that the NVMe SSD is correctly inserted into the M.2 M Key connector, use the CM2x2.5 D=5X0.4 screws to fix it.
- Locate the M.2 E Key connector on the motherboard. Align the Radxa Wireless Module A8 wireless module with the M.2 E Key connector and gently insert it in the correct direction. During the insertion process, avoid using excessive force to prevent damage to the interface. As shown in the figure. After confirming that the wireless module is correctly inserted into the M.2 E Key connector, use the prepared CM2x4x5 screws to fix it.

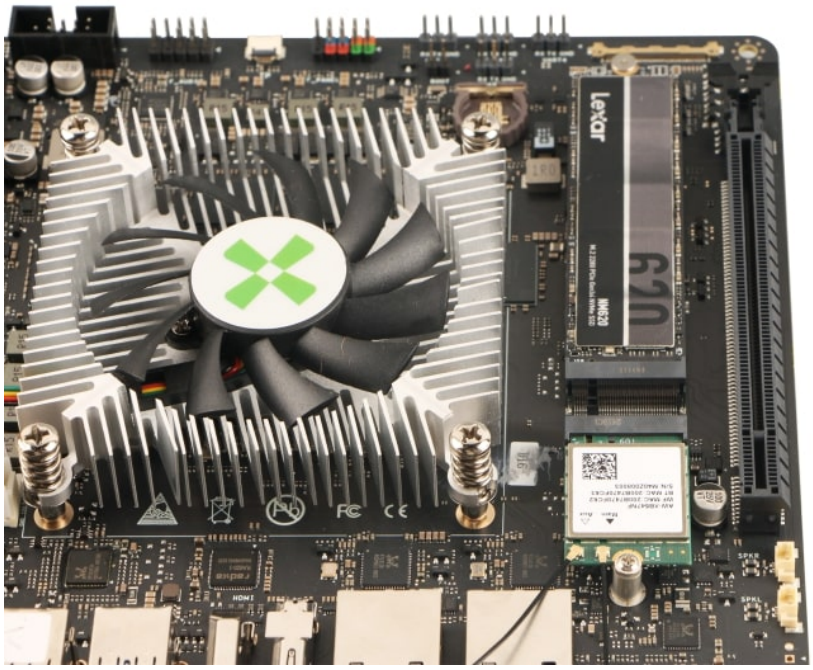


Figure 31: NVMe SSD and Wireless Module

13.1.6 Power Connection

The Orion O6 supports multiple power input methods:

1. **ATX Power Supply (Recommended for Desktop Usage)**
   - Connect the 24-pin ATX power connector
   - Ensure PSU can provide at least 65W
   - Recommended: 120W or higher for full performance
2. **Power Sequence**
   - Connect power supply to motherboard

- Connect power supply to AC outlet
- Turn on power supply before system power

How to install the ATX Power Interface

- Before installing, ensure that the ATX power is disconnected. This is to avoid damage to the hardware caused by improper operation.
- Align the ATX power plug with the 24-Pin ATX power socket on the motherboard, making sure that the notch on the plug matches the protrusion on the socket to ensure the correct orientation. After confirming the orientation, hold the plug with both hands and gently insert it along the direction of the socket with a steady and even force. During the insertion process, keep the plug horizontal and avoid tilting it to ensure that each pin can smoothly slide into the corresponding socket hole. When you hear a slight "click" sound and the plug fits completely against the socket and can no longer be inserted further, it indicates that the plug has been properly installed.

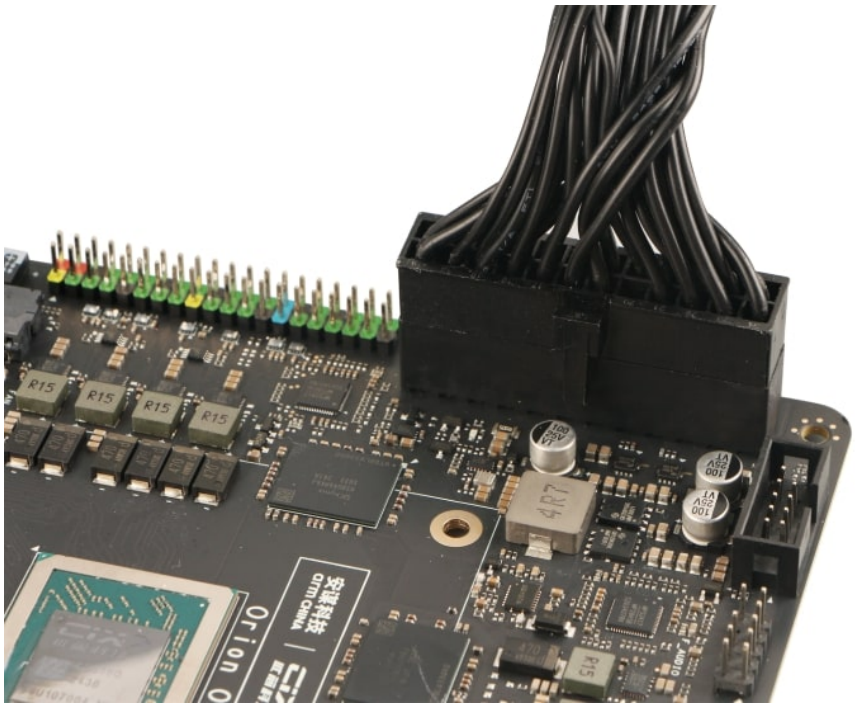


Figure 32: ATX Power Interface

13.1.7 Post-Installation Checklist

- ☐ All screws properly tightened
- ☐ Power connections secure
- ☐ Front panel headers correctly oriented
- ☐ Cooling solution properly mounted
- ☐ Storage devices secured
- ☐ PCIe cards fully seated
- ☐ No loose cables or components

13.2 Appendix 2: List of Heatsink 8420B Materials

- Heatsink 85mm x 85mm x 20mm
- Cooling Fan: 12V 4-PIN with a pitch of 2.54mm
- Heatsink Bracket 87.5mm x 86.8mm x 4.4mm

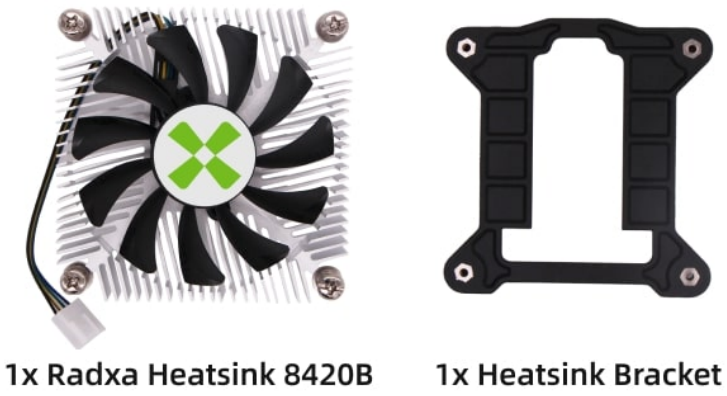


Figure 33: List of Heatsink 8420B Materials

Note:

- **Before Disassembly or Assembly, make sure the motherboard is in a powered-off state.**

13.3 Appendix 3: Radxa Heatsink 8420B Disassembly

1. Remove the acrylic upper cover by unscrewing 4 CM3x5x5 screws.

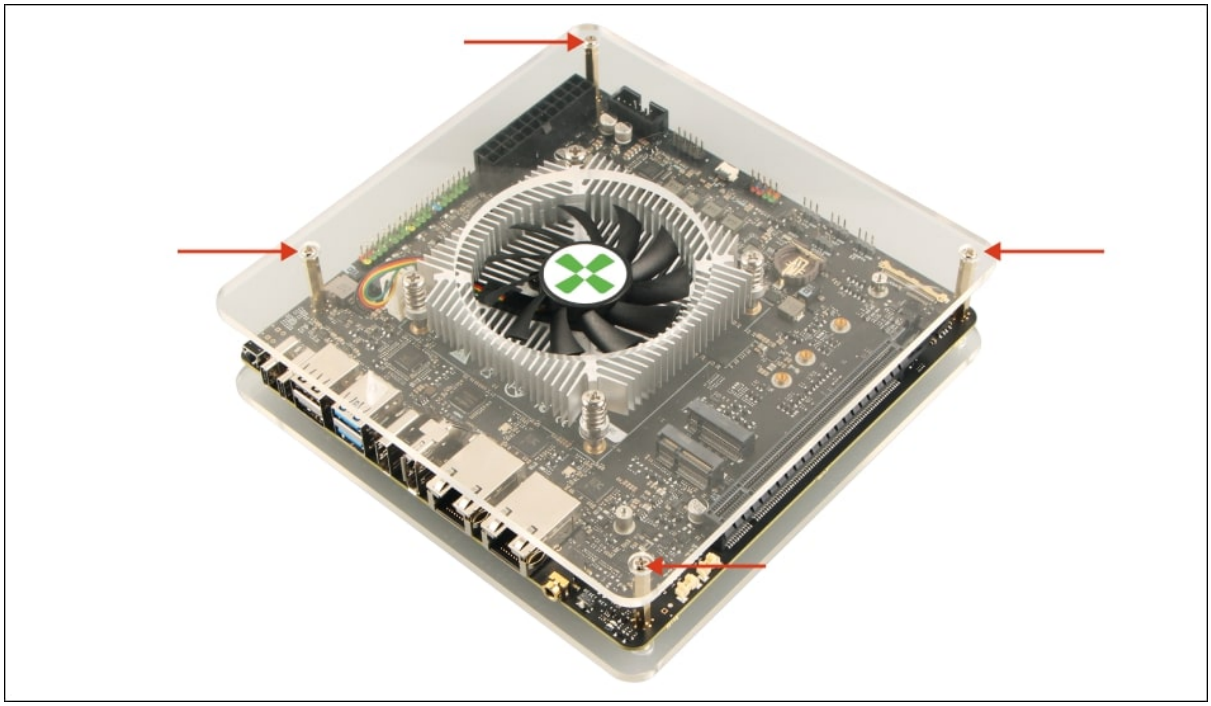


Figure 34: How to Disassembly of Heatsink 8420B 01

2. Loosen heatsink screws diagonally for even stress distribution.

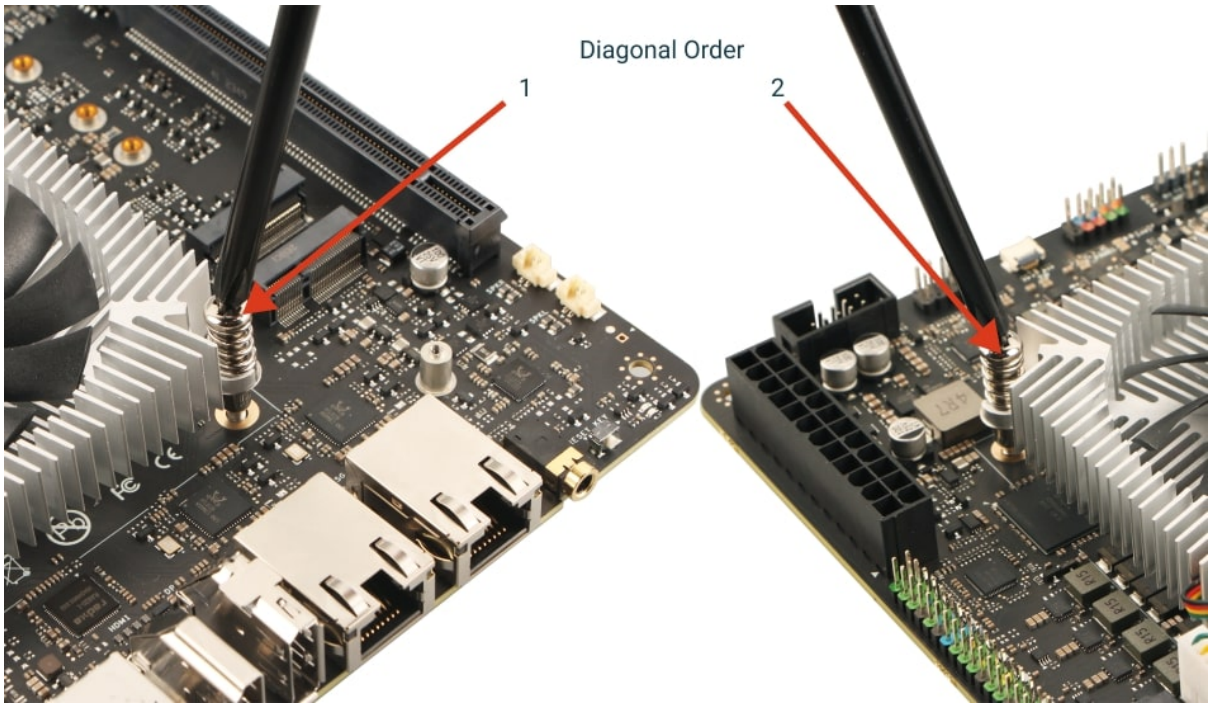


Figure 35: How to Disassembly of Heatsink 8420B 02

3. Gently disconnect the fan interface.

13.4 Appendix 4: Heatsink 8420B Assembly

1. Apply thermal paste evenly on the SoC.

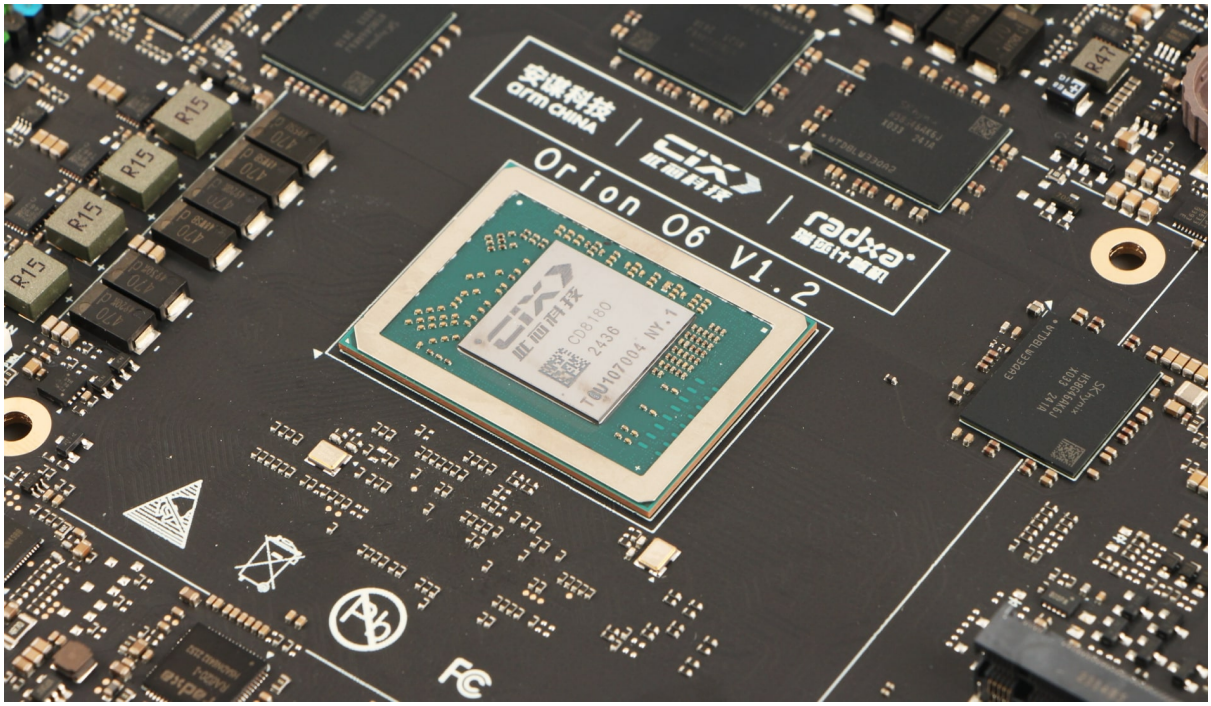


Figure 36: How to Install Assembly of Heatsink 8420B 01

2. Align the heatsink and bracket with the mounting holes.

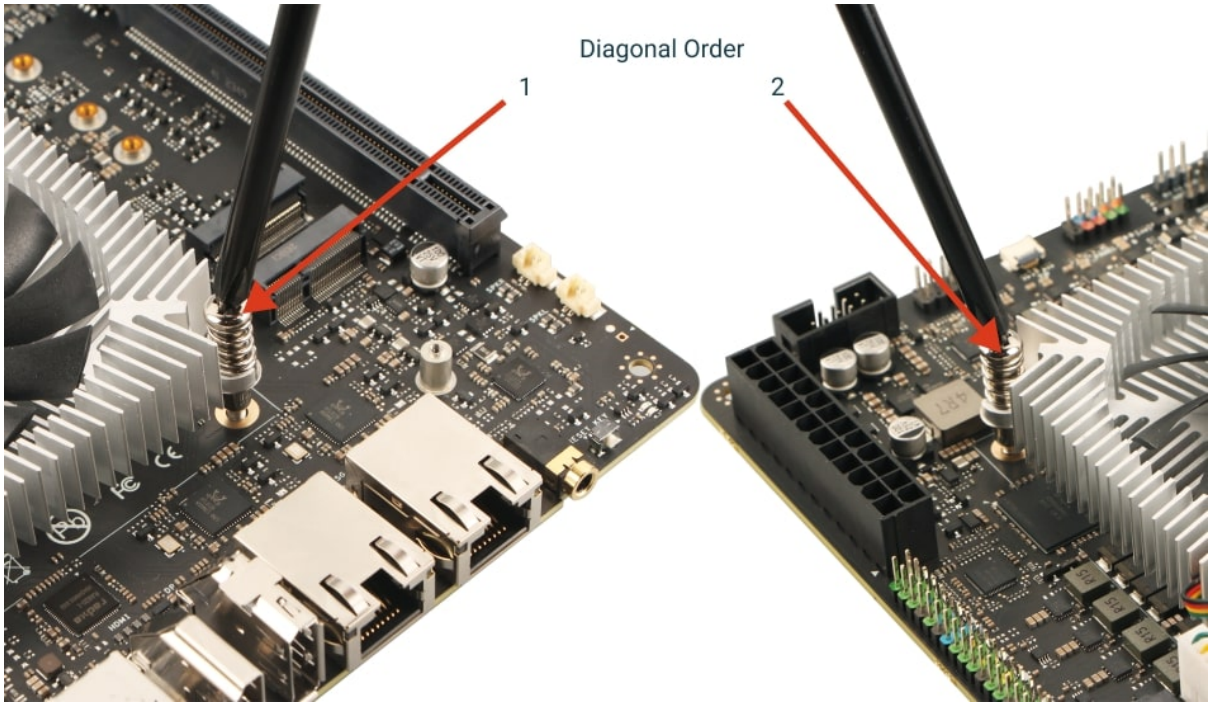


Figure 37: How to Disassembly of Heatsink 8420B 02

3. Tighten screws diagonally to ensure even pressure.

4. Connect the fan interface securely.

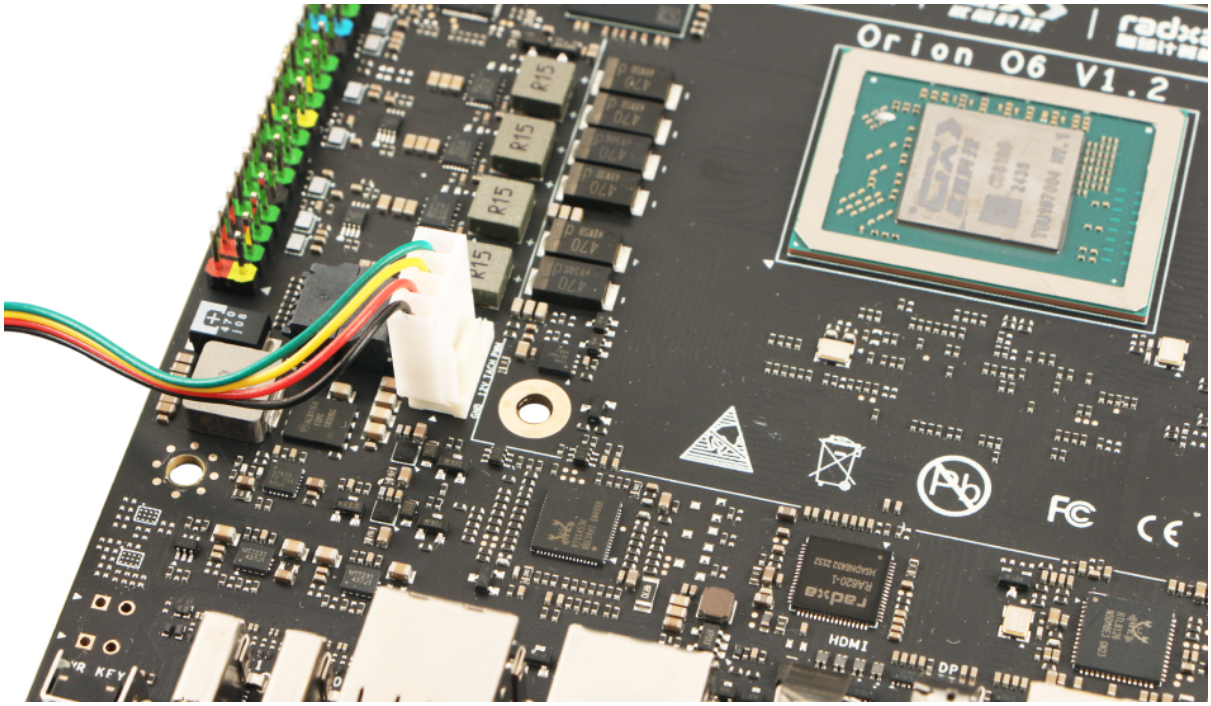


Figure 38: How to Install Assembly of Heatsink 8420B 02