Orange Pi 3B
User Manual

Catalog

1. Basic features of Orange Pi 3B

1.1. What is Orange Pi 3B

Orange Pi 3B adopts Rockchip RK3566 quad-core 64-bit Cortex-A55 processor, adopts 22nm process, the main frequency can reach up to 1.8GHz, integrates ARM Mali-G52 GPU, embedded high-performance 2D image acceleration module, built-in 1 The AI accelerator NPU of Tops computing power can choose 2GB, 4GB or 8GB memory, and has up to 4K display processing capability.

Orange Pi 3B brings out quite a lot of interfaces, including HDMI output, M.2 PCIe2.0x1, Gigabit Ethernet port, USB2.0, USB3.0 interface and 40pin expansion pin header, etc. It can be widely used in high-end tablet, edge computing, artificial intelligence, cloud computing, AR/VR, smart security, smart home and other fields, covering various AIoT industries.

Orange Pi 3B supports Android11, Ubuntu22.04, Ubuntu20.04, Debian11, Debian12, OpenHarmony 4.0 Beta1, Orange Pi OS (Arch), Orange Pi OS (OH) based on OpenHarmony and other operating systems.

1.2. Purpose of Orange Pi 3B

We can use it to achieve:

- A Linux desktop computer
- A Linux web server
- Android tablet
- Android game console, etc.

Of course, there are more functions. Relying on a powerful ecosystem and a variety of expansion accessories, Orange Pi can help users easily realize the delivery from idea to prototype to mass production. It is a maker, dreamer, hobby The ideal creative platform for readers.

1. 3. Hardware Features of Orange Pi 3B

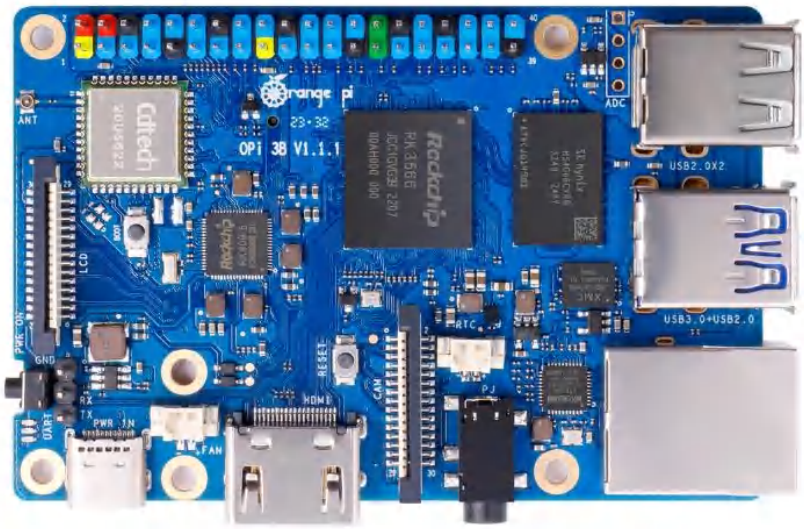
Introduction to hardware features	
Master chip	Rockchip RK3566
CPU	Quad-core 64-bit Cortex-A55 processor, 22nm advanced technology, main frequency up to 1.8GHz
GPU	• ARM Mali G52 2EE graphics processor • Support OpenGL ES 1.1/2.0/3.2, OpenCL 2.0, Vulkan 1.1 • Embedded high-performance 2D acceleration hardware
NPU	• Integrated RKNN NPU AI accelerator, 0.8Tops@INT8 performance • Supports one-click conversion of Caffe/TensorFlow/TFLite/ONNX/PyTorch/Keras/Darknet architecture models
VPU	• 4K@60fps H.265/H.264/VP9 video decoding • 1080P@100fps H.265 video encoding • **1080P@60fpsH.264** video encoding
PMU	Rockchip RK809-5
Memory	2GB/4GB/8GB （LPDDR4/4x）
storage	• Support eMMC module: 16GB/32GB/64GB/128GB/256GB • SPI Flash: 16MB/32MB • M.2 M-KEY slot: SATA3 or PCIe2.0 NVME SSD • TF card slot
Wi-Fi+Bluetooth	Wi-Fi 5+BT 5.0，BLE
ethernet transceiver	10/100/1000Mbps Ethernet (onboard PHY chip: YT8531C)
show	• 1x HDMI TX 2.0, maximum support 4K@60FPS • 1xMIPI DSI 2 Lane • eDP1.3

Camera	1xMIPI CSI 2 Lane camera interface
USB	• 1xUSB 2.0 supports Device or HOST mode • 1xUSB 3.0 HOST • 2xUSB 2.0 HOST
Audio	3.5mm headphone jack audio input/output
Button	1x MaskROM key, 1xRESET key, 1 xPOWER key
FAN	2Pin 1.25mm 5V fan interface
RTC	2Pin 1.25mm backup battery interface
40Pin	40Pin function expansion interface, supports the following interface types: GPIO, UART, I2C, SPI, PWM
Power Supply	Type-C 5V3A
Supported OS	Android11, Ubuntu22.04, Ubuntu20.04, Debian11, Debian12, OpenHarmony 4.0 Beta1, Orange Pi OS (Arch), Orange Pi OS (OH) based on OpenHarmony and other operating systems.
Introduction of Appearance Specifications	
PCB size	89mm x 56mm x 17mm
weight	52g
range Pi™ is a registered trademark of Shenzhen Xunlong Software Co., Ltd.	

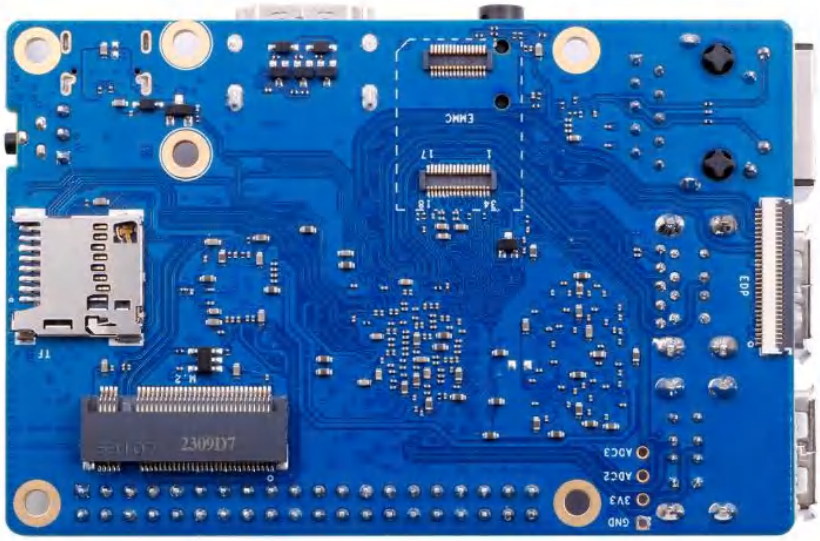
1. 4. Top and Bottom Views of Orange Pi 3B

1. 4. 1. Top and Bottom Views of Orange Pi 3B (v1.1.1)

Top view:

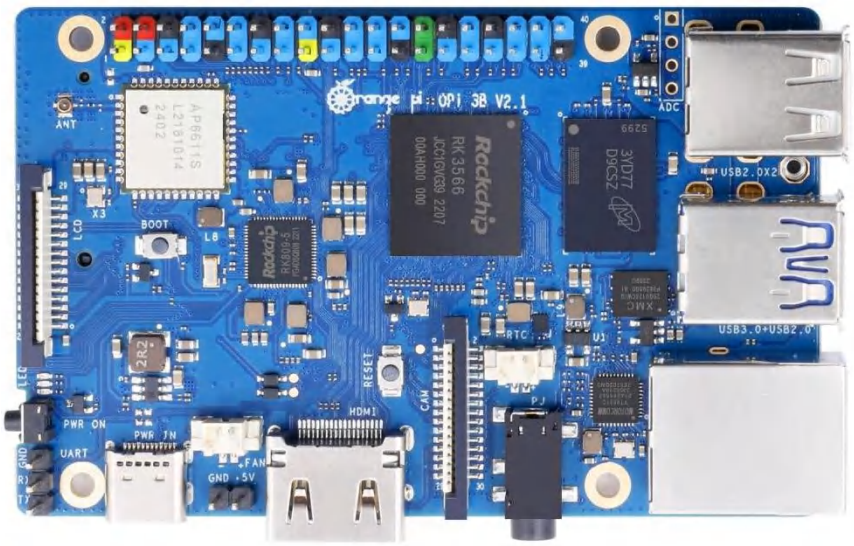


Bottom view：

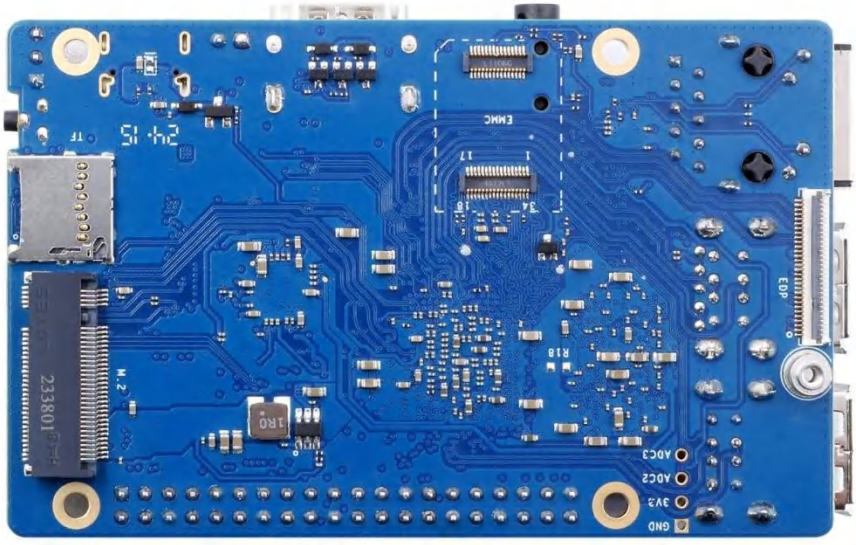


1. 4. 2. Top and Bottom Views of Orange Pi 3B (v2.1)

Top view:

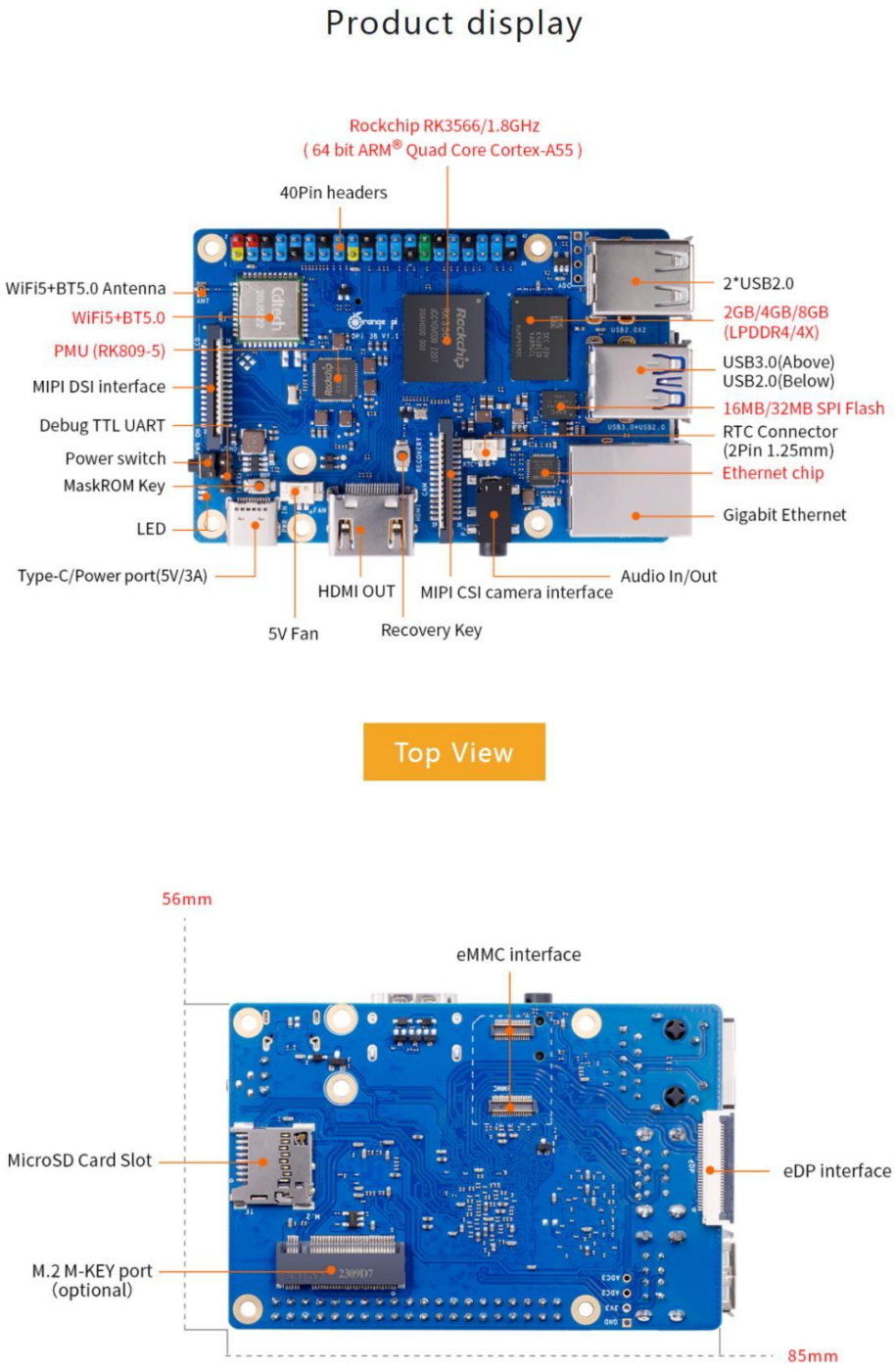

range pi OPi 3B V2.1
Rockchip
RK3566
ANT
BOOT
RESET
HDMI
CAN
RTC
PWR ON
PWR IN
UART
FAN
GND 5V
ADC
USB2.0X2
USB3.0+USB2.0

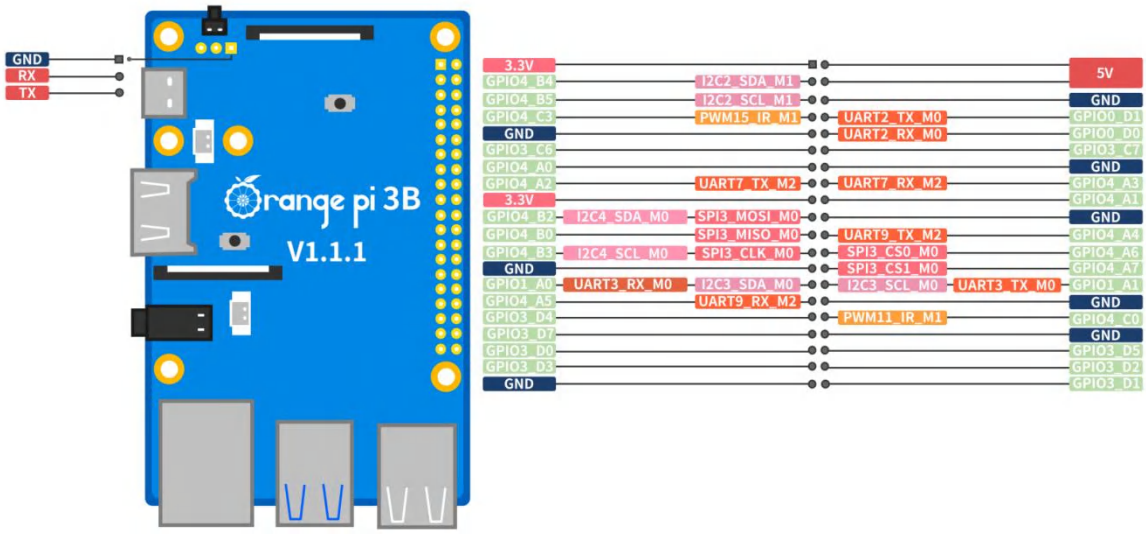
Bottom view：


EMMC
M.2
EDP
ADC3
ADC2
3V3
GND

1. 5. Interface details diagram of Range Pi 3B

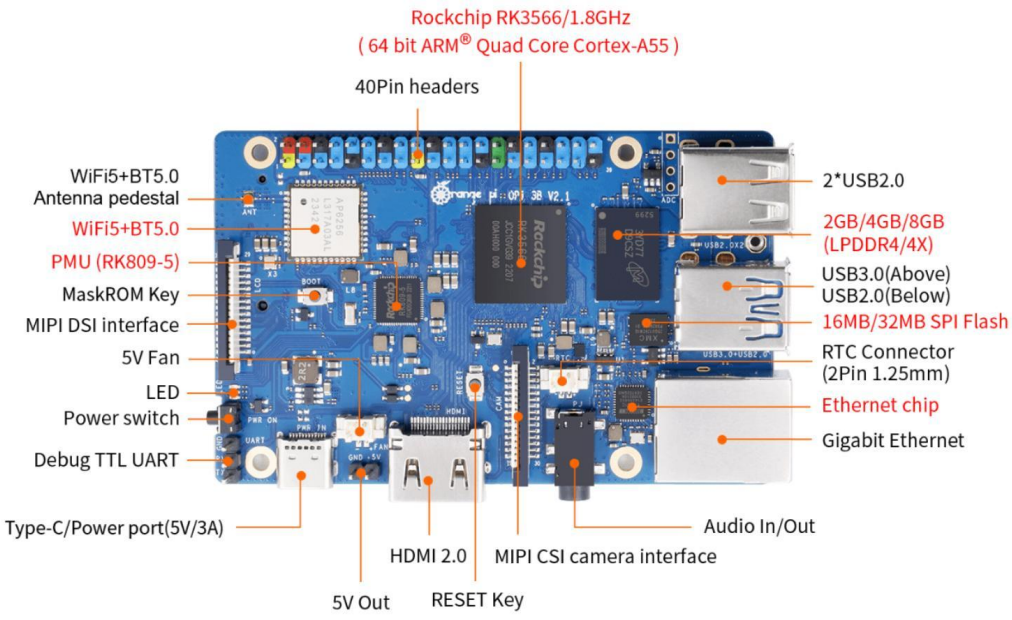
1. 5. 1. Orange Pi 3B（v1.1.1）



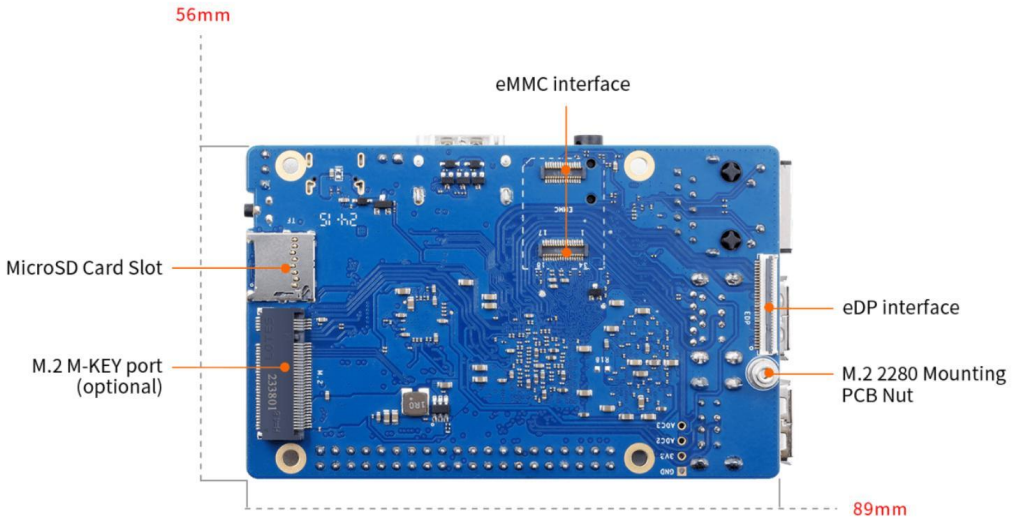


The diameter of the four positioning holes is 2.7mm, and the diameter of the M.2 PICE device fixing hole is 2.9mm.

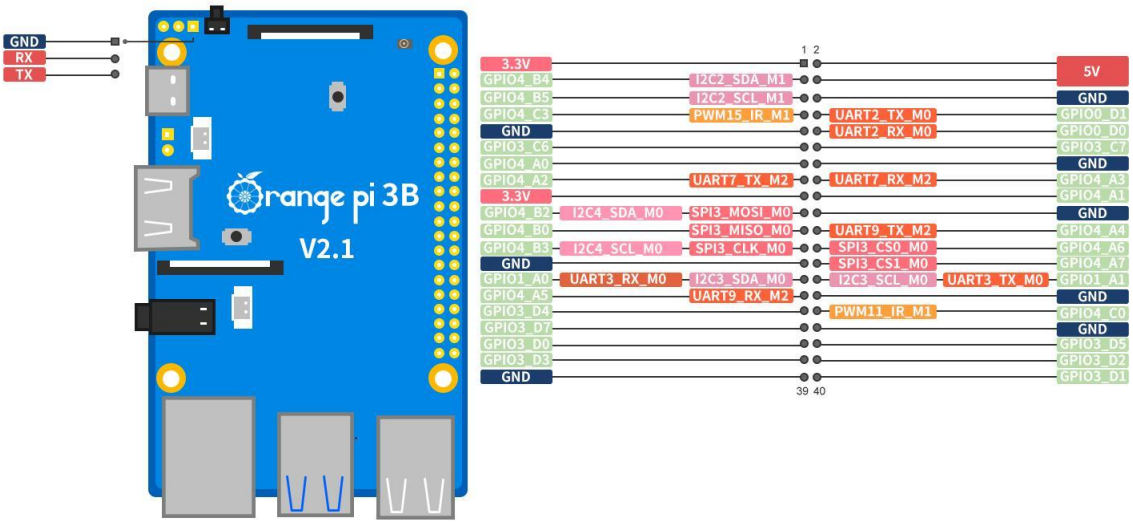
1. 5. 2. Interface details diagram of Orange Pi 3B (v2.1)



Top View



Bottom View



The diameter of the four positioning holes is 2.7mm.

2. Introduction to the use of the development board

2. 1. Prepare the required accessories

1) TF card, **class 10** or above high-speed SanDisk card with a minimum capacity of 16GB (recommended 32GB or above)

2) TF card reader, used to burn the image into the TF card

3) Display with HDMI interface

4) HDMI to HDMI cable, used to connect the development board to an HDMI monitor or TV for display

Note, if you want to connect a 4K monitor, please make sure that the HDMI cable supports 4K video output.

5) Power adapter, Orange Pi 3B is recommended to use 5V/3A Type-C power supply for power supply

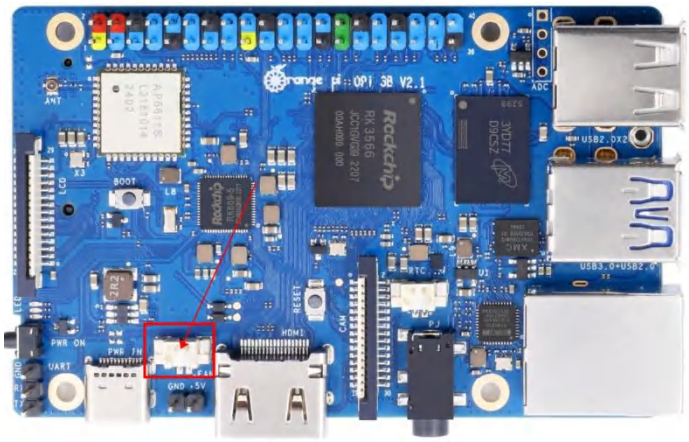
6) The mouse and keyboard of the USB interface, as long as the mouse and keyboard of the standard USB interface are acceptable, the mouse and keyboard can be used to control the Orange Pi development board

7) USB camera

8) PCIe NVMe SSD. The Orange Pi 3B v1.1.1 development board supports SSD of M.2 2230 and M.2 2242 specifications, and M.2 2280 is also supported, but cannot be fixed with screws. The Orange Pi 3B v2.1 development board supports fixed M.2 2280 SSD.

9) 5V cooling fan. As shown in the figure below, there is an interface on the development board for connecting the cooling fan, with a specification of **2pin 1.25mm spacing**

The fan on the development board can be adjusted for speed and on/off through PWM.



10) 100M or 1000M network cable, used to connect the development board to the Internet

11) USB2.0 male-to-male data cable, used to burn images to eMMC, NVMe SSD and other functions

12) **3.3V** USB to TTL module and DuPont line, when using serial port debugging function, need USB to TTL module and DuPont line to connect the development board and computer

13) A personal computer with Ubuntu and Windows operating systems installed

1	Ubuntu22.04 PC	Optional, used to compile Linux source code
2	Windows PC	For burning Android and Linux images

2.2. Download the image of the development board and related materials

1) The website for downloading the English version of materials is:

http://www.orangepi.org/html/hardWare/computerAndMicrocontrollers/service-and-support/Orange-Pi-3B.html

2) The information mainly includes

a. **Android source code:** saved on Google Cloud Disk
b. **Linux source code:** saved on Github
c. **User manual and schematic diagram:** saved on Google Cloud Disk
d. **Official tools:** mainly include the software that needs to be used during the use of the development board
e. **Android image:** saved on Google Cloud Disk
f. **Ubuntu image:** saved on Google Cloud Disk
g. **Debian image:** saved on Google Cloud Disk

h. **Orange Pi OS Arch image:** saved on Google Cloud Disk
i. **Orange Pi OS OH image:** saved on Google Cloud Disk
j. **OpenWRT image:** saved on Google Cloud Disk

2. 3. Method of burning Linux image to TF card based on Windows PC

Note that the Linux image mentioned here specifically refers to the images of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page.

2. 3. 1. How to use balenaEtcher to burn Linux image

1) First prepare a TF card with a capacity of 16GB or more. The transmission speed of the TF card must be **class 10** or above. It is recommended to use a TF card of SanDisk and other brands

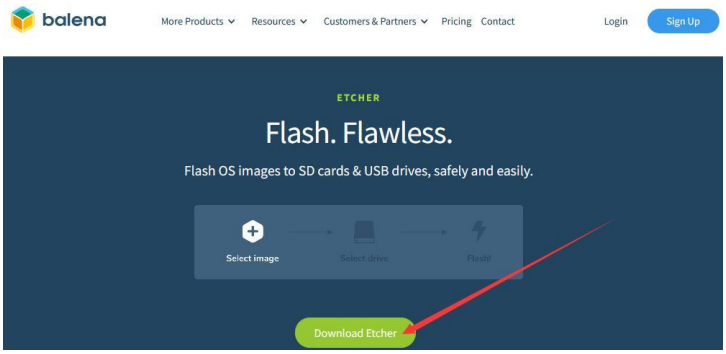
2) Then use the card reader to insert the TF card into the computer

3) Download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system. The size is generally above 2GB.

4) Then download the burning software of Linux image—**balenaEtcher**, the download address is:

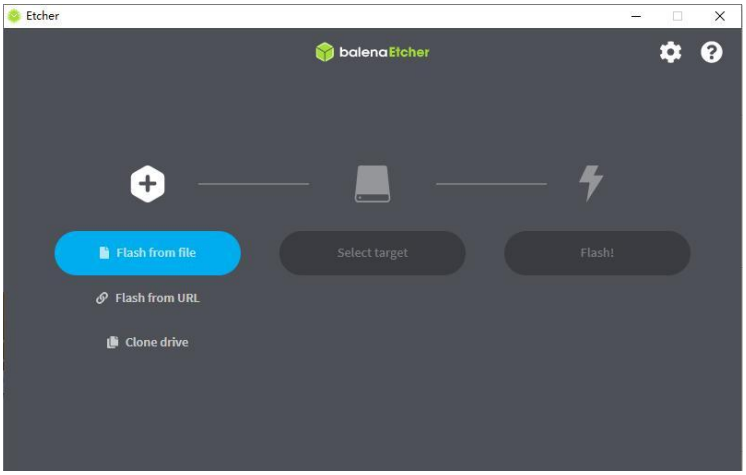
https://www.balena.io/etcher/

5) After entering the balenaEtcher download page, click the green download button to jump to the place where the software is downloaded

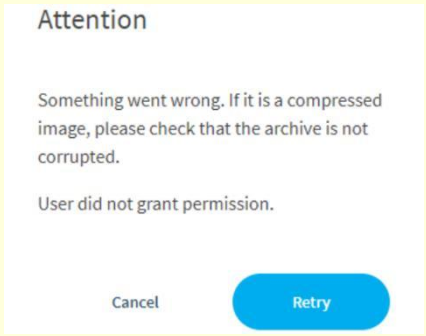


6) Then you can choose to download the Portable version of balenaEtcher software. The Portable version does not need to be installed, and you can use it by double-clicking to open it

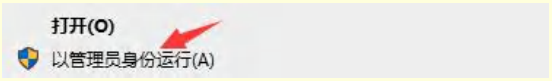
7) If the downloaded version of balenaEtcher needs to be installed, please install it before using it. If you downloaded the Portable version of balenaEtcher, just double-click to open it. The balenaEtcher interface after opening is shown in the figure below:



When opening balenaEtcher, if the following error is prompted:



Please select balenaEtcher, right-click, and select Run as administrator.

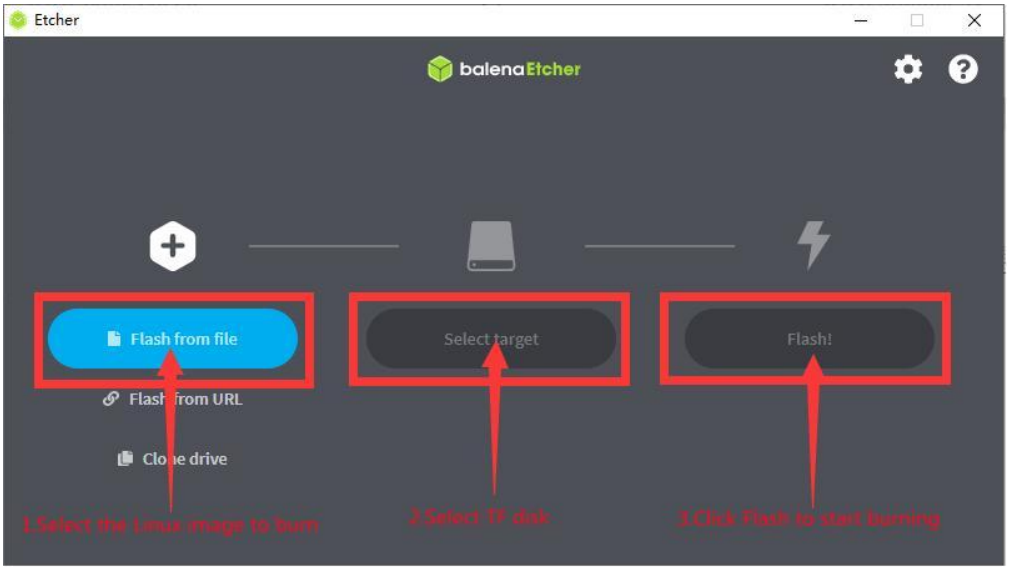


8) The specific steps to use balenaEtcher to burn the Linux image are as follows

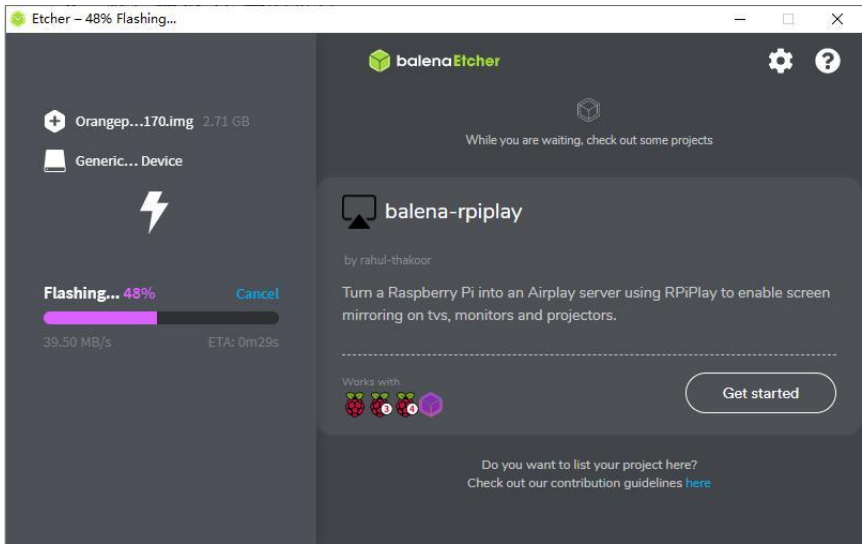
a. First select the path of the Linux image file to be burned

b. Then select the drive letter of the TF card

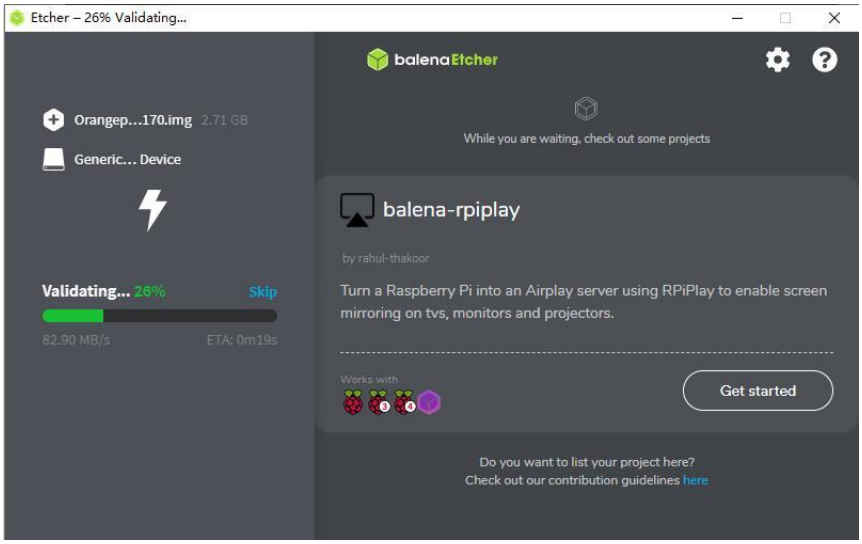
c. Finally click Flash to start burning the Linux image to the TF card



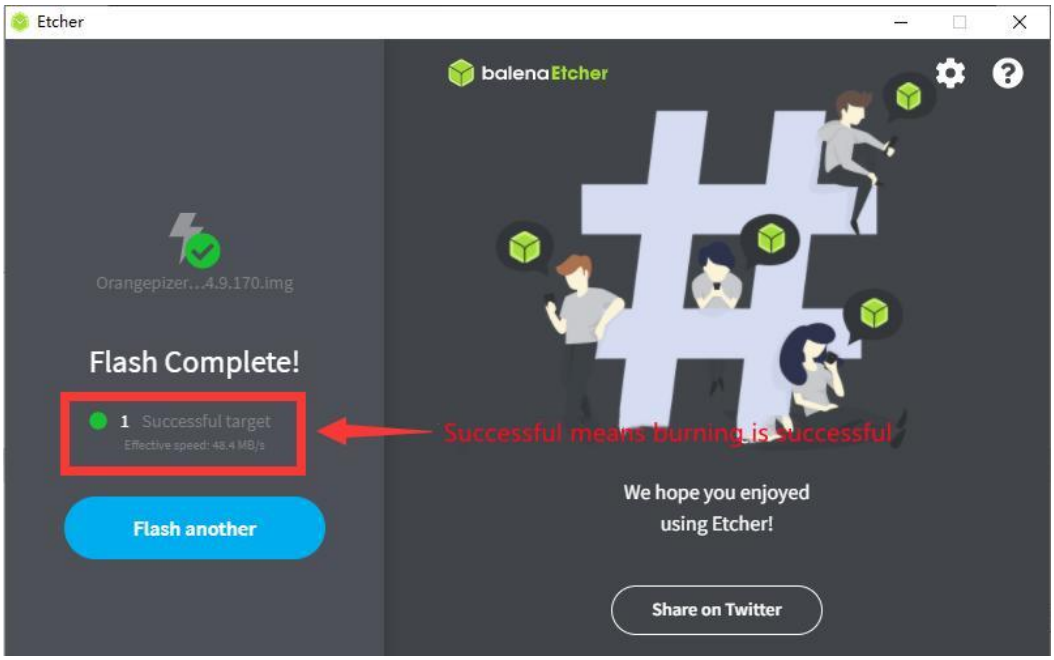
9) The interface displayed in the process of burning the Linux image by balenaEtcher is shown in the figure below, and the progress bar displays purple, indicating that the Linux image is being burned into the TF card



10) After burning the Linux image, balenaEtcher will also verify the image burned into the TF card by default to ensure that there is no problem in the burning process. As shown in the figure below, a green progress bar indicates that the image has been burnt, and balenaEtcher is verifying the burnt image



11) After successful burning, the display interface of balenaEtcher is as shown in the figure below. If a green indicator icon is displayed, it means that the image burning is successful. At this time, you can exit balenaEtcher, and then pull out the TF card and insert it into the TF card slot of the development board for use.



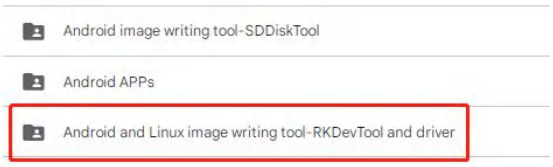
2. 3. 2. How to use RKDevTool to burn Linux image to TF card

1) First, you need to prepare a good quality USB2.0 male-to-male data cable

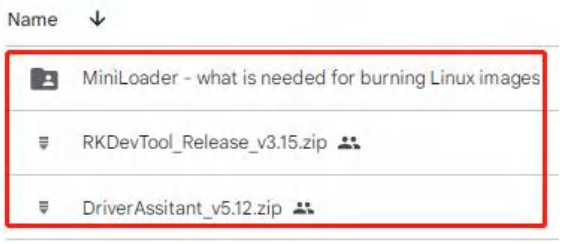
2) You also need to prepare a 16GB or larger capacity TF card. The transmission speed of the TF card must be **class** 10 or above. It is recommended to use a TF card of SanDisk and other brands

3) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the **Orange Pi data download page**

a. On the data download page of Orange Pi, first select the **official tool**, and then enter the following folder



b. Then download all the files below



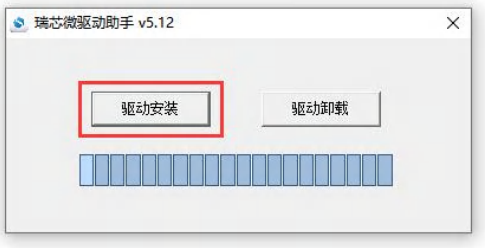
Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

4) Then download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

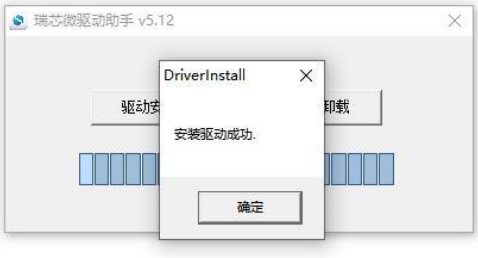
5) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

6) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

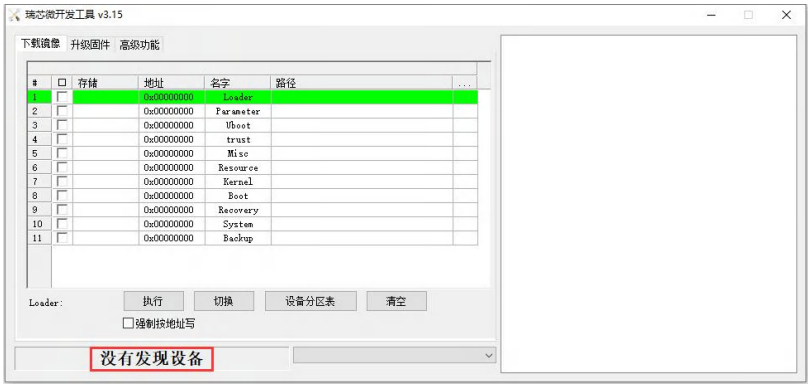


b. After waiting for a period of time, a pop-up window will prompt "**The driver is installed successfully**", and then click the "**OK**" button.



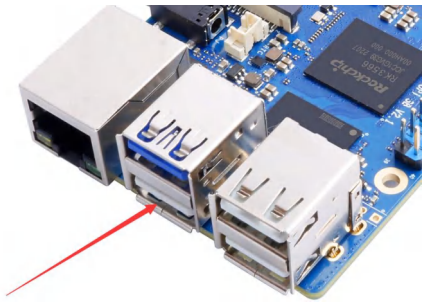
7) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

8) After opening the **RKDevTool** burning tool, because the computer has not connected to the development board through the USB2.0 male-to-male data cable at this time, the lower left corner will prompt "**No device found**"



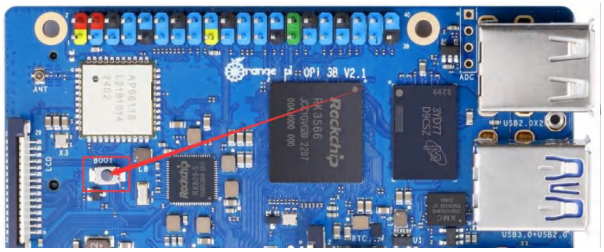
9) Then start burning the Linux image to the TF card

a. First, connect the development board to the Windows computer through the USB2.0 male-to-male data cable. The position of the USB2.0 programming port of the development board is shown in the figure below

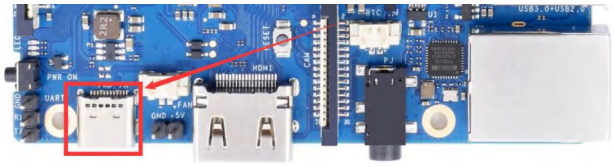


b. Make sure the TF card slot is not inserted into the TF card

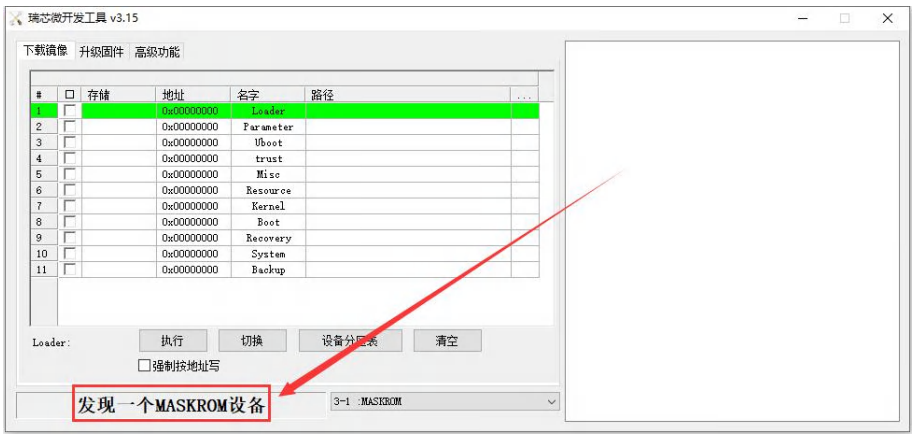
c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:



d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button

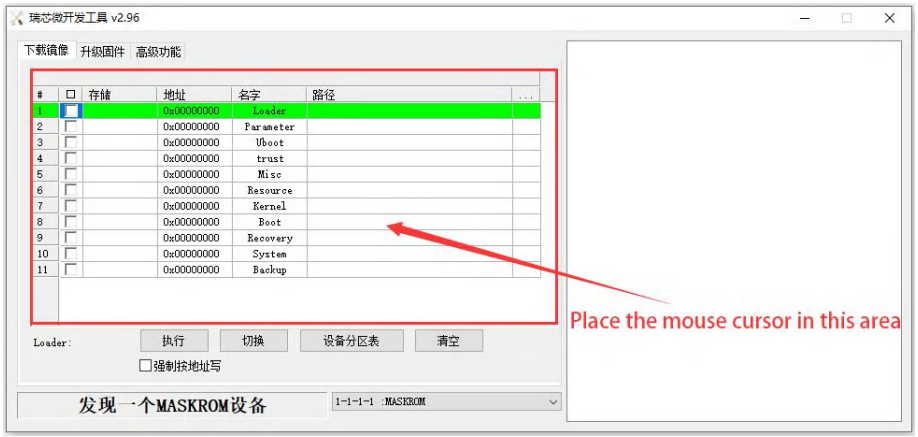


e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"

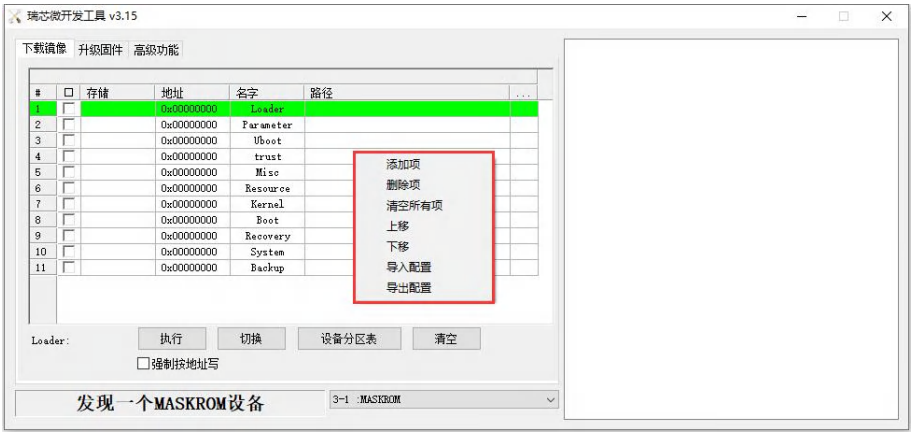


f. At this time, please insert the TF card into the TF card slot

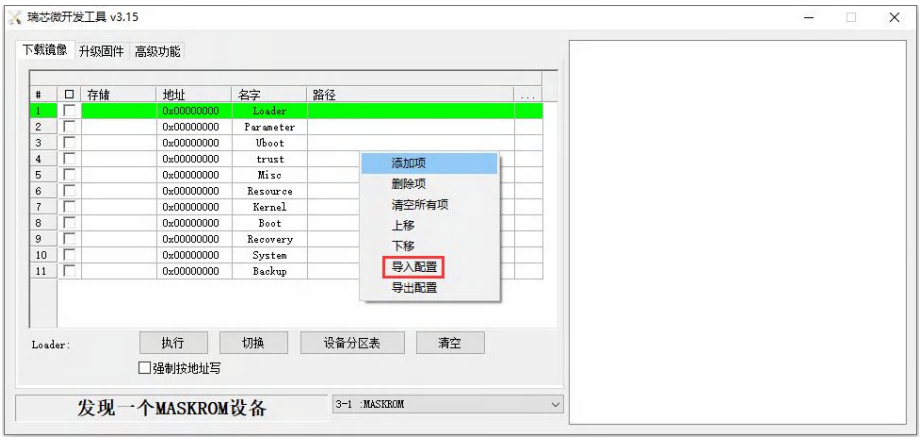
g. Then place the mouse cursor in the area below



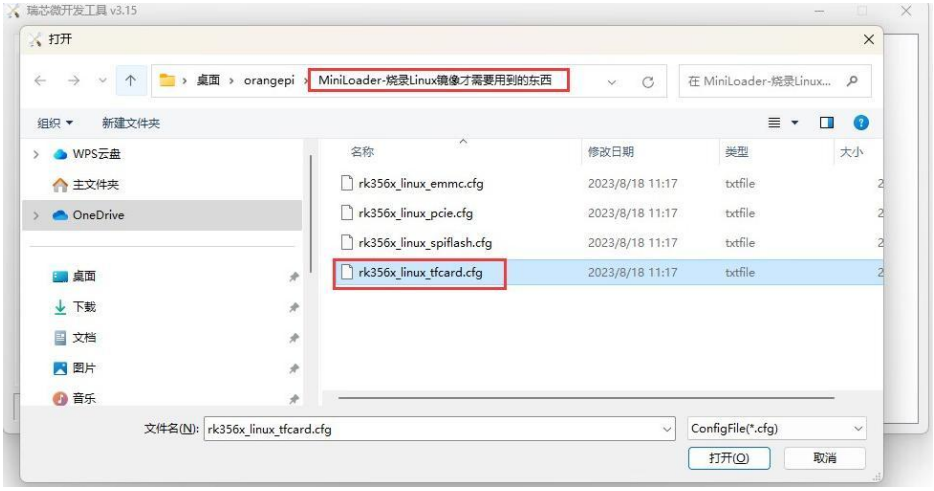
h. Then click the right mouse button and the selection interface shown in the figure below will pop up



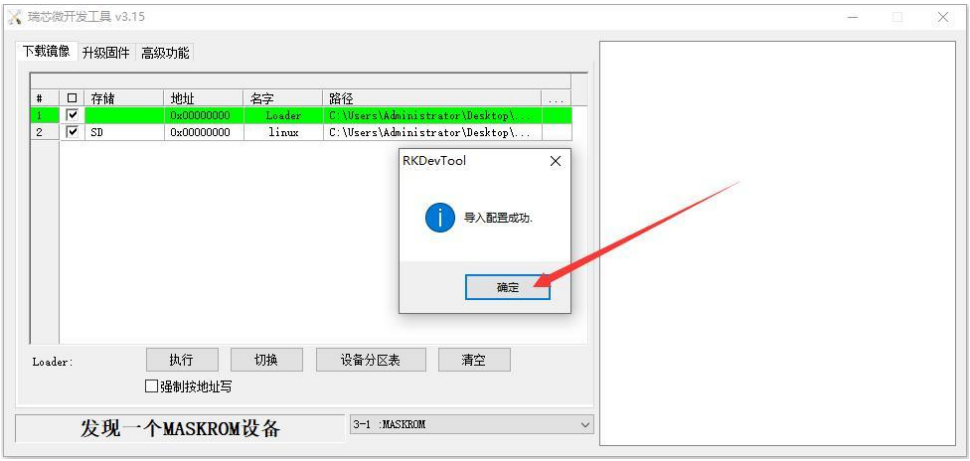
i. Then select the **import configuration** option



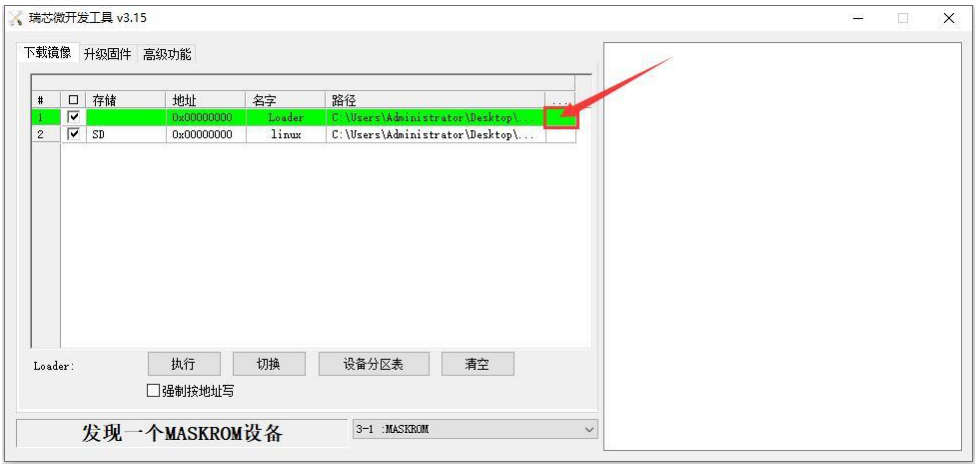
j. Then select the **rk356x_linux_tfcard.cfg** configuration file in the **MiniLoader** folder downloaded earlier, and click **Open**



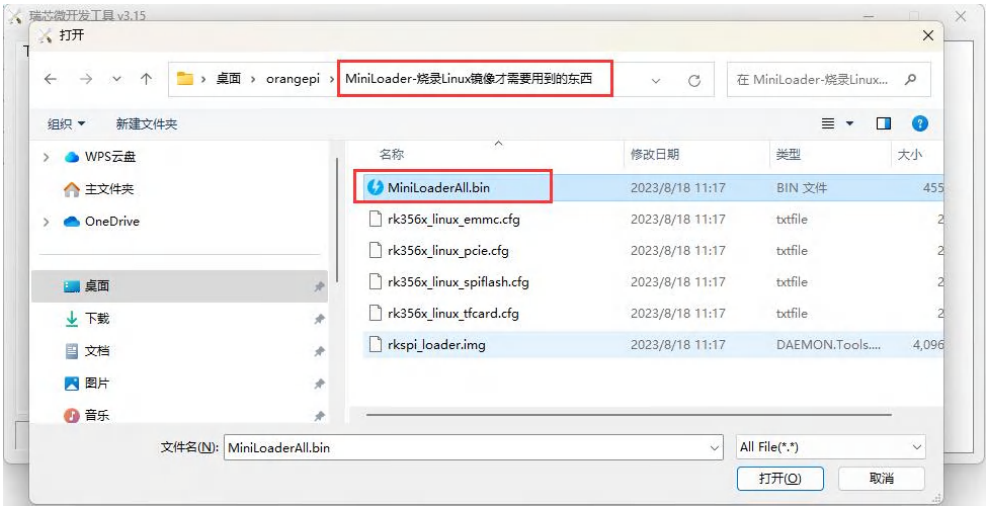
k. Then click **OK**



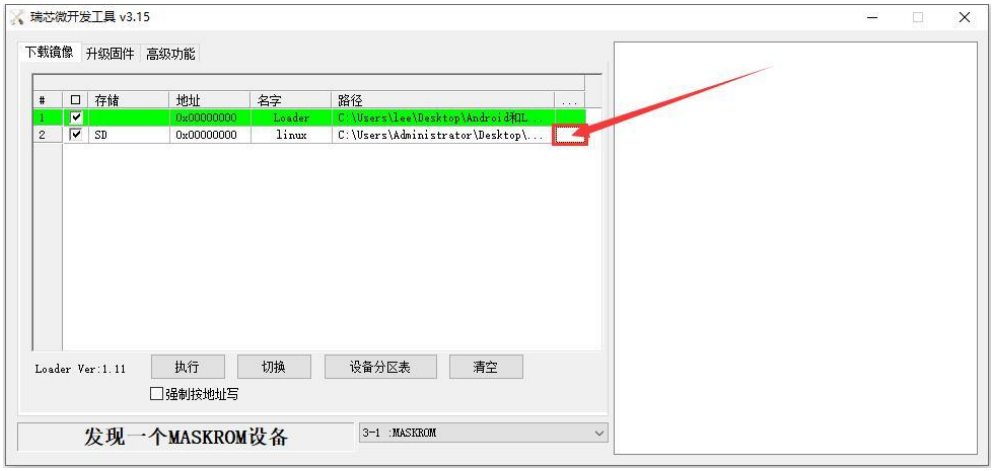
l. Then click the position shown in the figure below



m. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and click to **open**

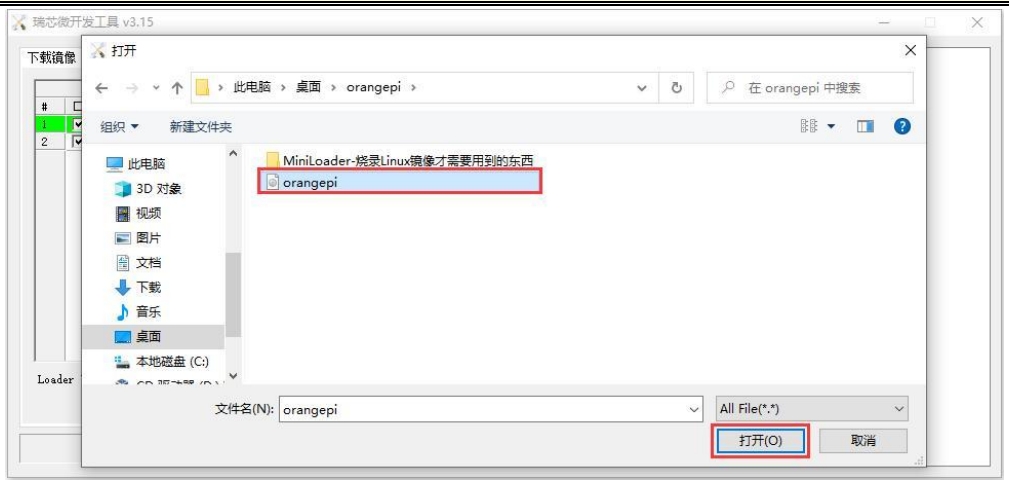


n. Then click the position shown in the figure below

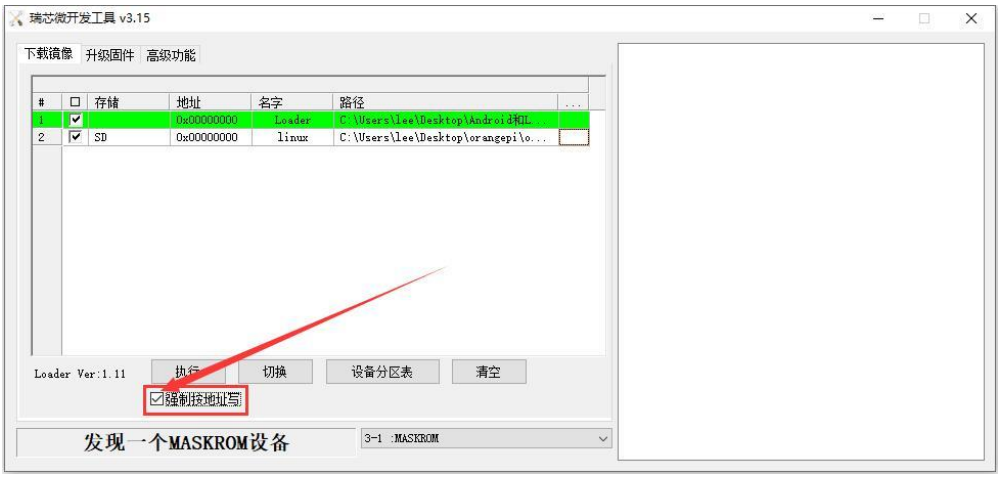


o. Then select the path of the Linux image you want to burn, and then click **Open**

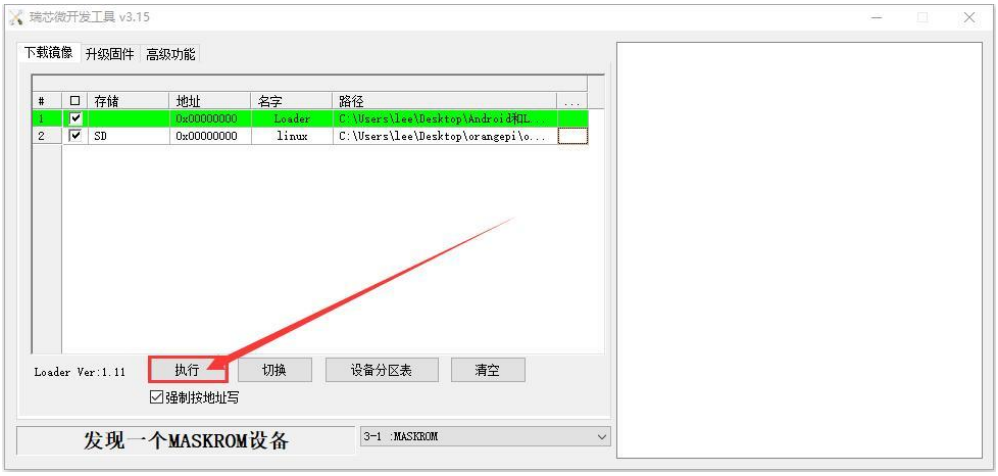
Before burning the image, it is recommended to rename the Linux image to be burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



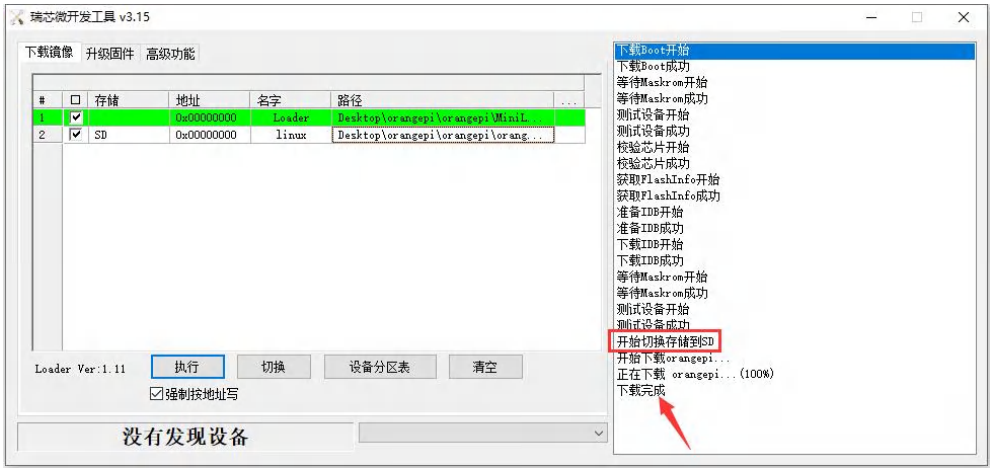
p. Then please check the **mandatory write by address** option



q. Click the execute button again to start burning the Linux image to the tf card of the development board



r. The display log after burning the Linux image is shown in the figure below



s. After burning the Linux image to the TF card, the Linux system will start automatically.

2. 3. 3. How to use Win32Diskimager to burn Linux image

1) First prepare a TF card with a capacity of 16GB or more. The transmission speed of the TF card must be **class 10** or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

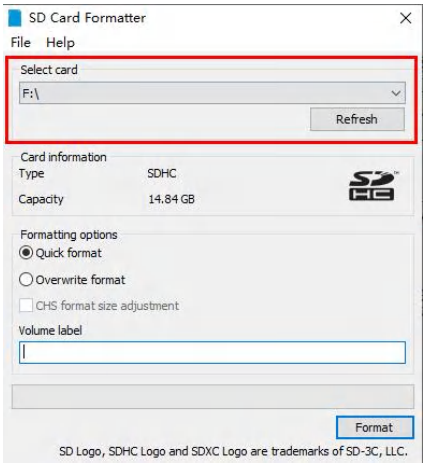
3) Then format the TF card

a. **SD Card Formatter** can be used to format the TF card. The download address is:

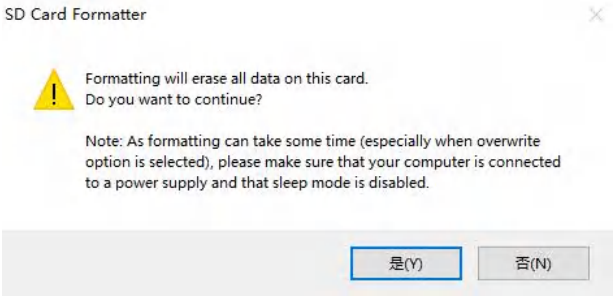
https://www.sdcard.org/downloads/formatter/eula_windows/SDCardFormatterv5_WinEN.zip

b. After downloading, unzip and install directly, and then open the software

c. If only a TF card is inserted into the computer, the drive letter of the TF card will be displayed in the "**Select card**" column. If multiple USB storage devices are inserted into the computer, you can select the corresponding drive letter of the TF card through the drop-down box



d. Then click "**Format**", a warning box will pop up before formatting, and formatting will start after selecting "**Yes (Y)**"



e. After formatting the TF card, the information shown in the figure below will pop up, click OK

4) Download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system. The size is generally more than 2GB

5) Use **Win32Diskimager** to burn the Linux image to the TF card

a. The download page of Win32Diskimager is

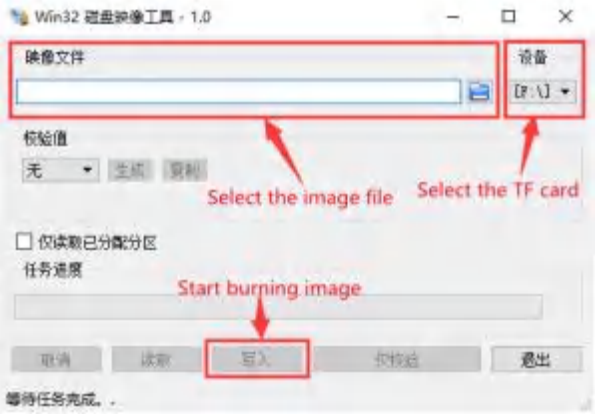
http://sourceforge.net/projects/win32diskimager/files/Archive/

b. After downloading, install it directly. The interface of Win32Diskimager is as follows

a) First select the path of the image file

b) Then confirm that the drive letter of the TF card is consistent with that displayed in the "**Device**" column

c) Finally click "**Write**" to start burning



c. After the image writing is completed, click the "**Exit**" button to exit, and then you can pull out the TF card and insert it into the development board to start

2.4. Method of burning Linux image to TF card based on Ubuntu PC

Note that the Linux image mentioned here specifically refers to the images of Linux distributions such as Debian, Ubuntu, `OpenWRT or OPi OS Arch` downloaded from the Orange Pi data download page, and the Ubuntu PC refers to the personal computer with the Ubuntu system installed.

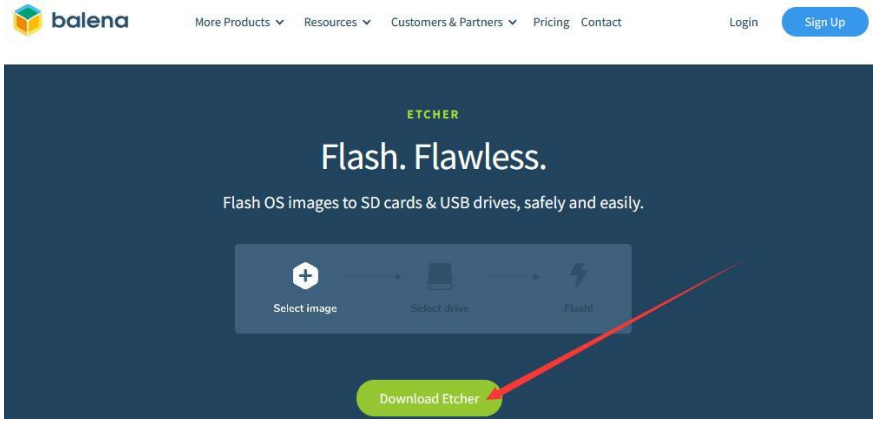
1) First prepare a TF card with a capacity of 16GB or more. The transmission speed of the TF card must be **class 10** or above. It is recommended to use a TF card of SanDisk and other brands

2) Then use the card reader to insert the TF card into the computer

3) Download the balenaEtcher software, the download address is

https://www.balena.io/etcher/

4) After entering the balenaEtcher download page, click the green download button to jump to the place where the software is downloaded



5) Then choose to download the Linux version of the software

6) Download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is

the image file of the operating system. The size is generally more than 2GB

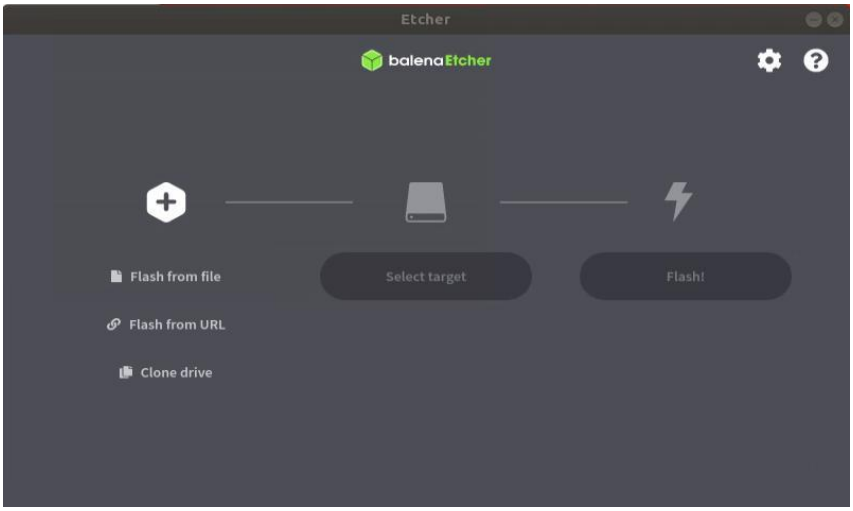
The decompression command for the compressed package ending in 7z is as follows

```
test@test:~$ 7z x Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.7z
test@test:~$ ls Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.*
Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.7z
Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.sha      #checksum file
Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.img      #mirror file
```

7) After decompressing the image, you can first use the **sha256sum -c *.sha** command to calculate whether the checksum is correct. If the prompt is successful, it means that the downloaded image is **correct**, and you can safely burn it to the TF card. If it prompts that the **checksum does not match**, it means There is a problem with the downloaded image, please try to download again

```
test@test:~$ sha256sum -c *.sha
Orangepi3b_1.0.0_debian_bullseye_desktop_xfce_Linux5.10.160.img: OK
```

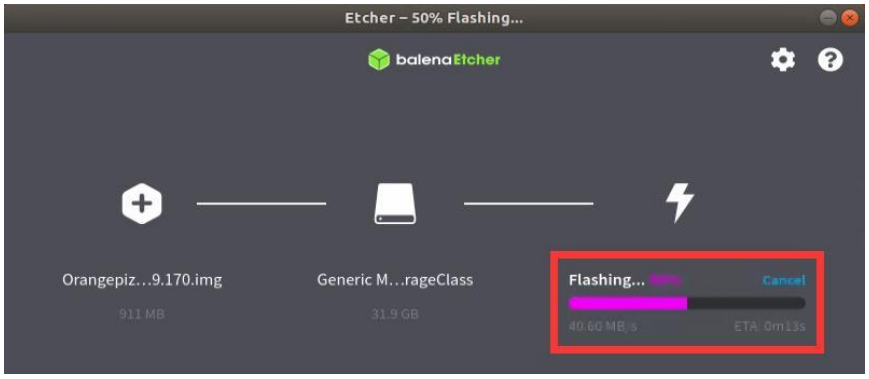
8) Then double-click **balenaEtcher-1.5.109-x64.AppImage** on the graphical interface of Ubuntu PC to open balenaEtcher (no installation required), and the interface after balenaEtcher is opened is shown in the figure below



9) The specific steps of using balenaEtcher to burn the Linux image are as follows

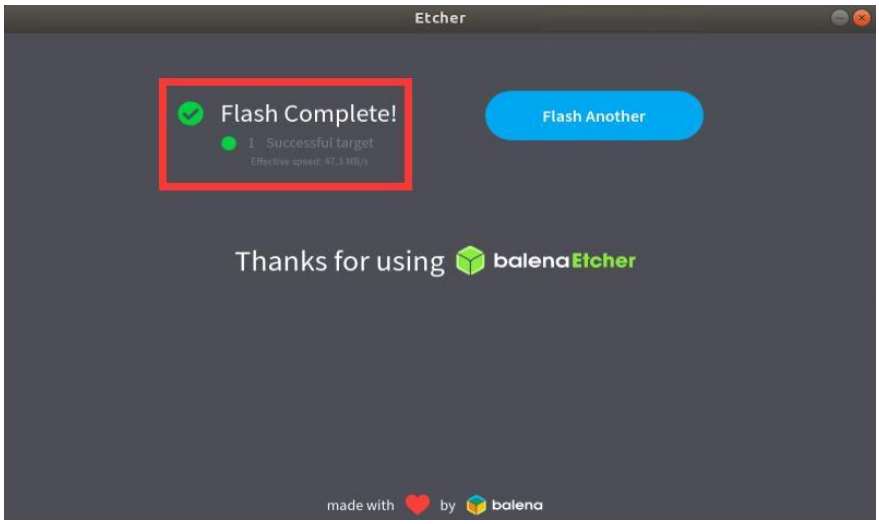
a. First select the path of the Linux image file to be burned
b. Then select the drive letter of the TF card
c. Finally, click Flash to start burning the Linux image to the TF card

10) The interface displayed in the process of burning the Linux image by balenaEtcher is shown in the figure below, and the progress bar displays purple, indicating that the Linux image is being burned into the TF card



11) After burning the Linux image, balenaEtcher will also verify the image burned into the TF card by default to ensure that there is no problem in the burning process. As shown in the figure below, a green progress bar indicates that the image has been burnt, and balenaEtcher is verifying the burnt image

12) After successful burning, the display interface of balenaEtcher is as shown in the figure below. If a green indicator icon is displayed, it means that the image burning is successful. At this time, you can exit balenaEtcher, and then pull out the TF card and insert it into the TF card slot of the development board for use.



2. 5. How to burn Linux image to eMMC

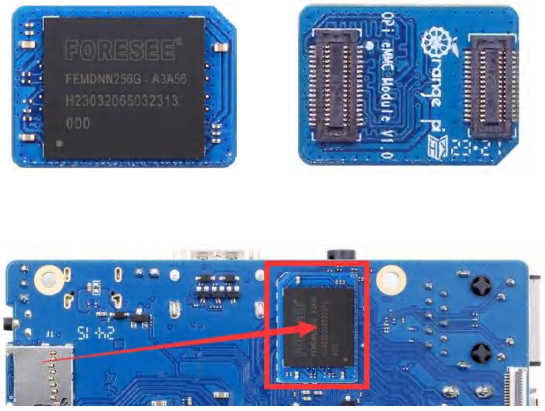
2. 5. 1. Using RKDevTool to burn the Linux image into eMMC

Note that all the following operations are performed on a Windows computer.

Note that the Linux image mentioned here specifically refers to the images of Linux distributions such as Debian, Ubuntu, `OpenWRT or OPi OS Arch` and Ubuntu downloaded from the Orange Pi data download page.

1) The development board reserves the expansion interface of the eMMC module.

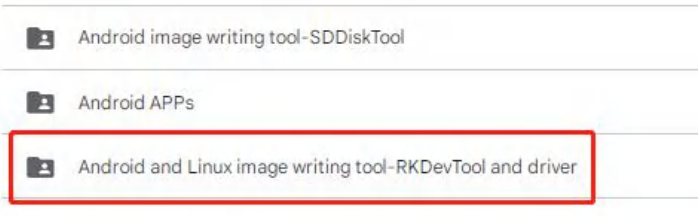
Before burning the system to the eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



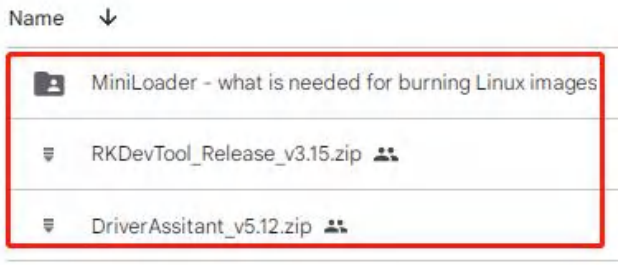
2) You also need to prepare a good quality USB2.0 male-to-male data cable

3) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the **Orange Pi data download page**

a. On the data download page of Orange Pi, first select the official tool, and then enter the following folder



b. Then download all the files below



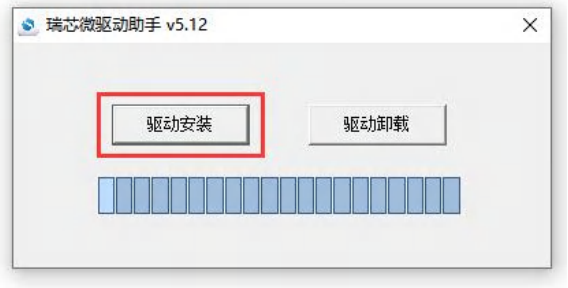
Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

4) Then download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

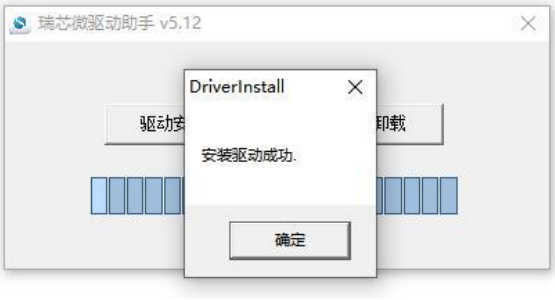
5) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

6) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

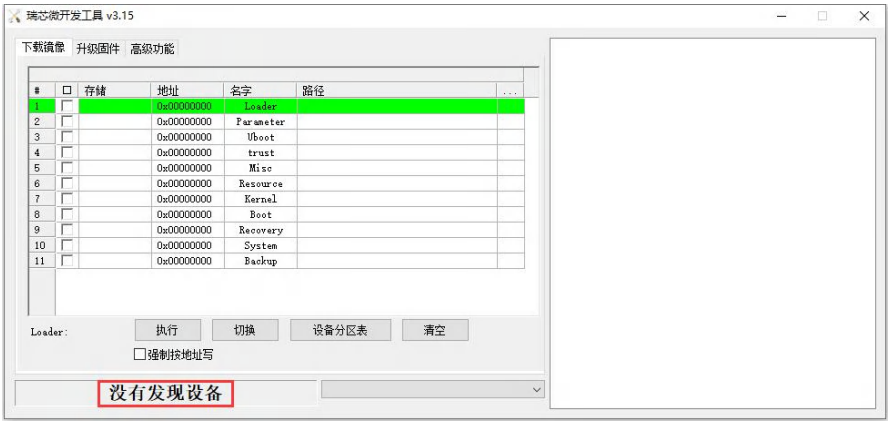


b. After waiting for a period of time, a pop-up window will prompt "**The driver is installed successfully**", and then click the "**OK**" button.



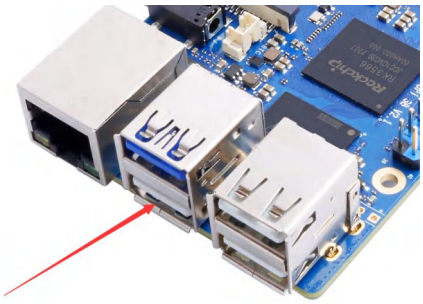
7) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

8) After opening the **RKDevTool** burning tool, because the computer has not connected to the development board through the USB2.0 male-to-male data cable at this time, the lower left corner will prompt "**No device found**"



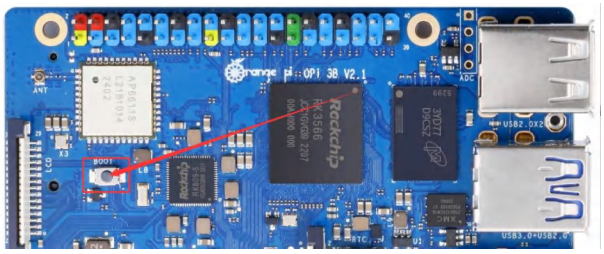
9) Then start burning the Linux image into eMMC

a. First, connect the development board to the Windows computer through the USB2.0 male-to-male data cable. The position of the USB2.0 programming port of the development board is shown in the figure below

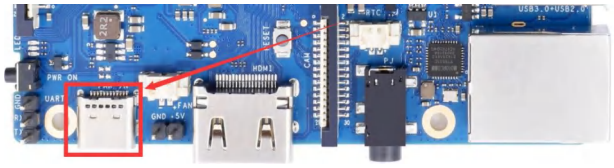


b. Make sure that the development board is not inserted into the TF card and not connected to the power supply

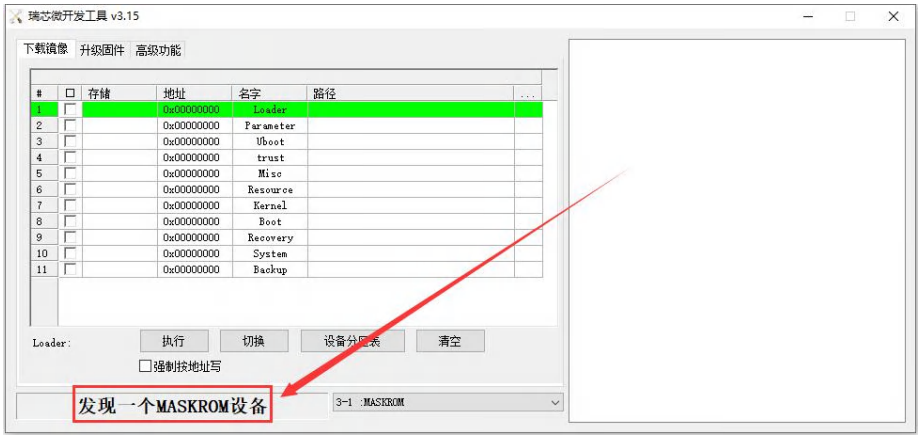
c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:



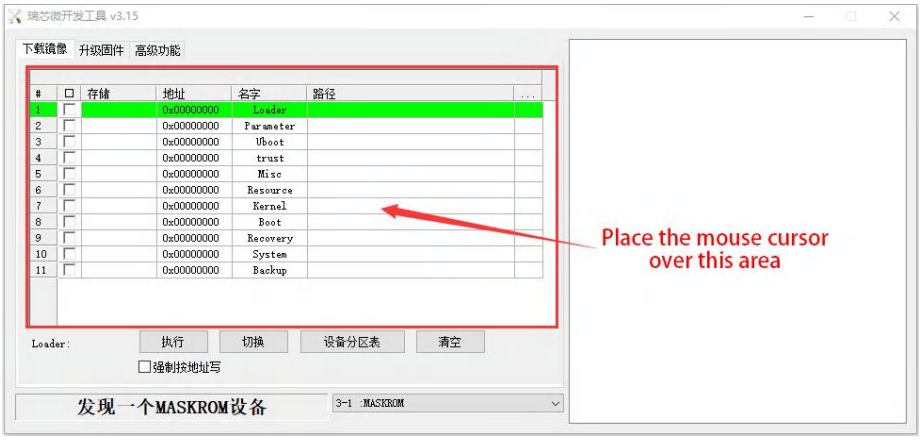
d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



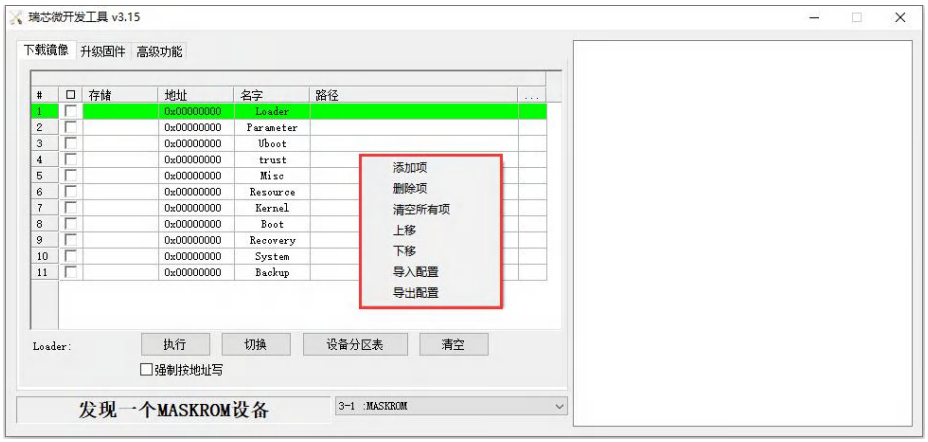
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



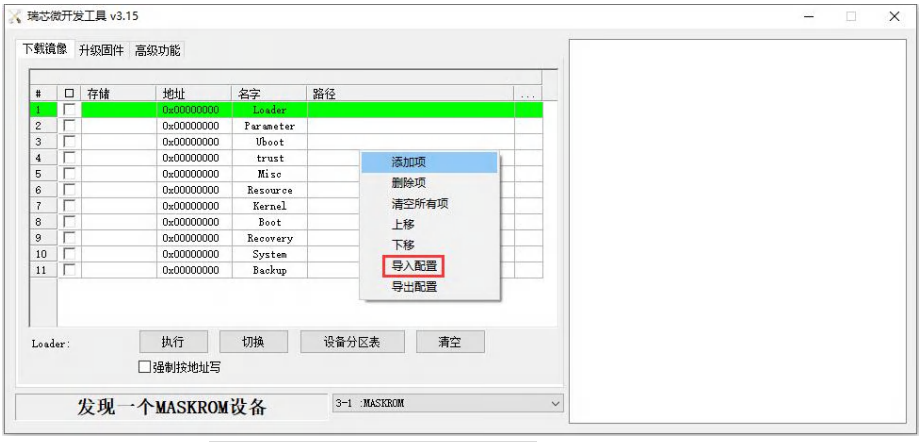
f. Then place the mouse cursor in the area below



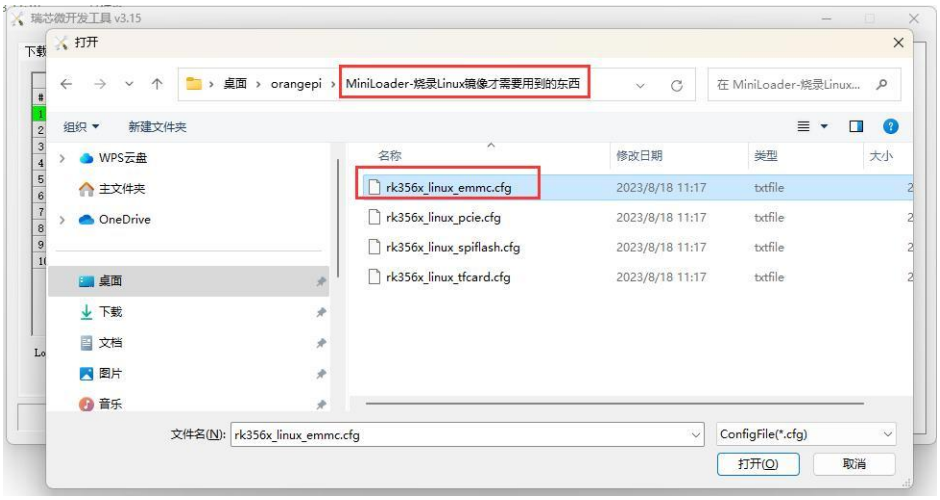
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



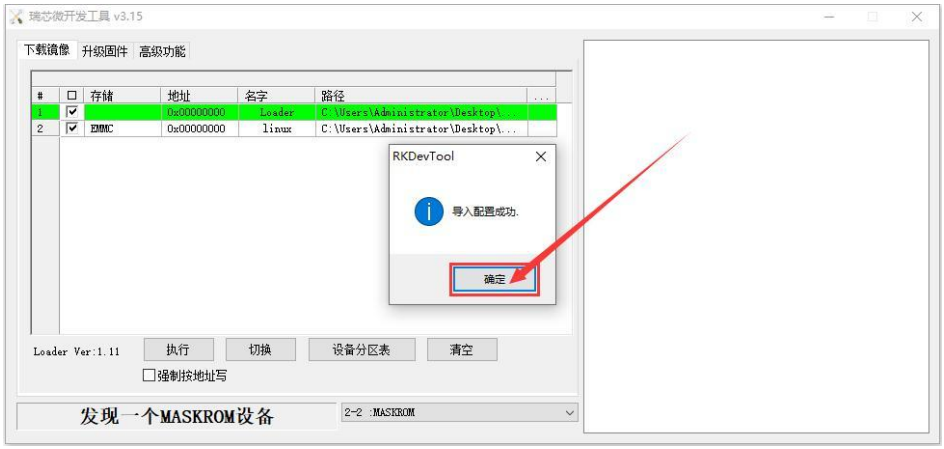
h. Then select the **import configuration** option



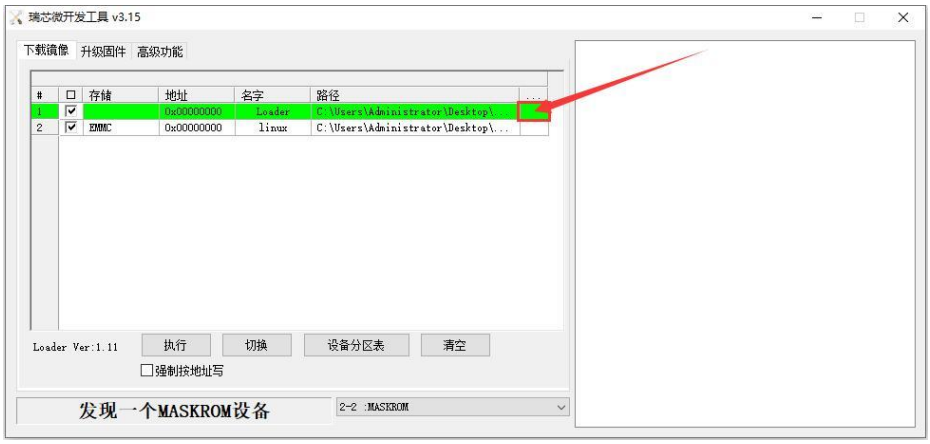
i. Then select the **rk356x_linux_emmc.cfg** configuration file in the **MiniLoader** folder downloaded earlier, and click **Open**



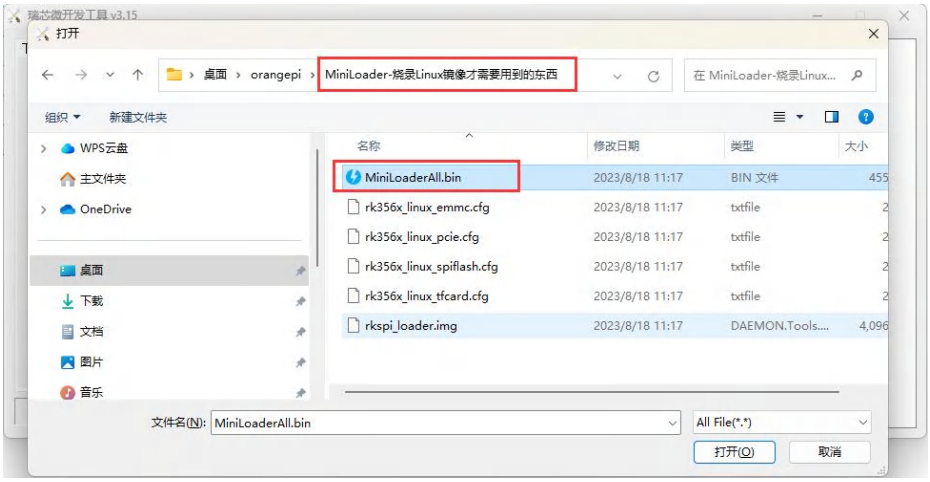
j. Then click **OK**



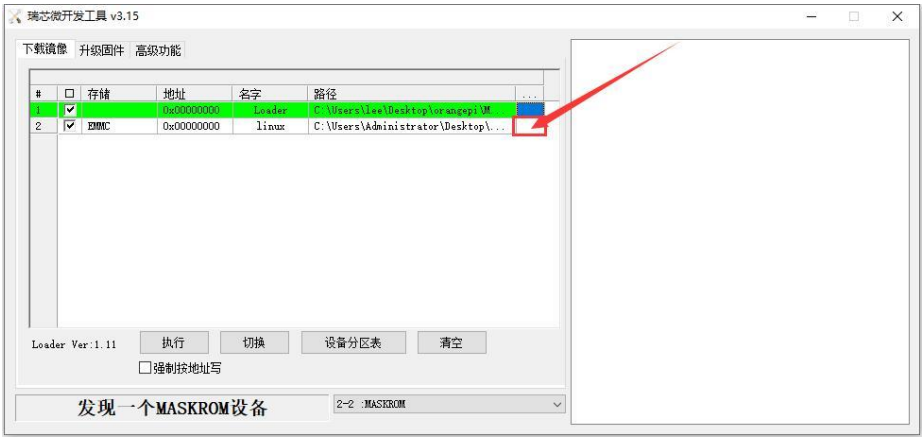
k. Then click the position shown in the figure below



l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to **open**

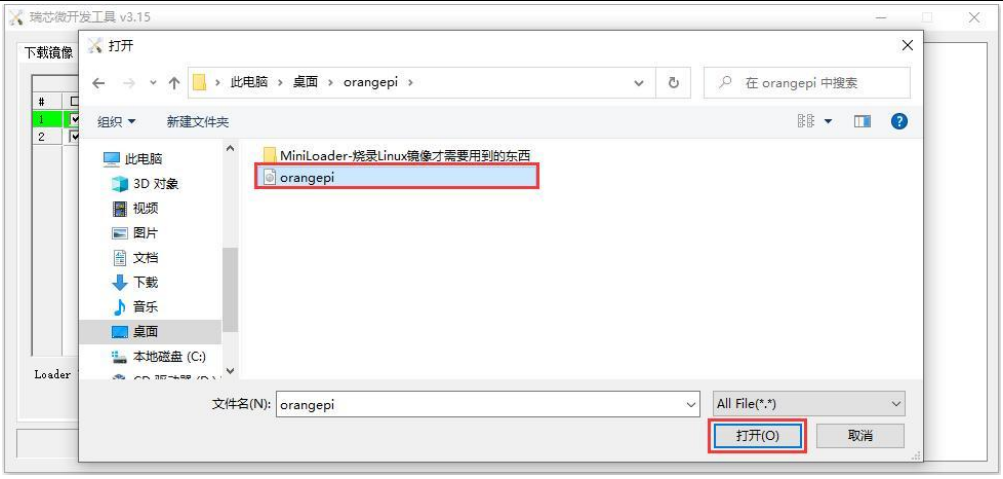


m. Then click the position shown in the figure below

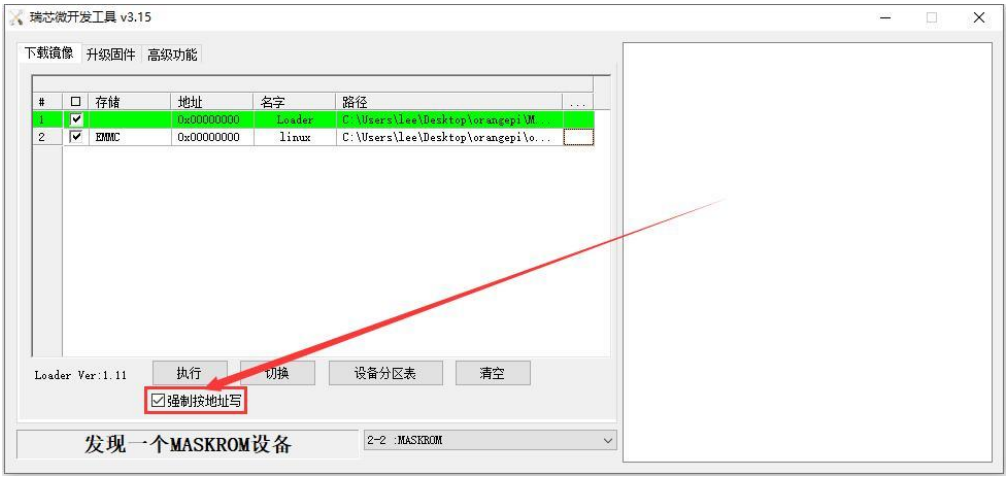


n. Then select the path of the Linux image you want to burn, and then click **Open**

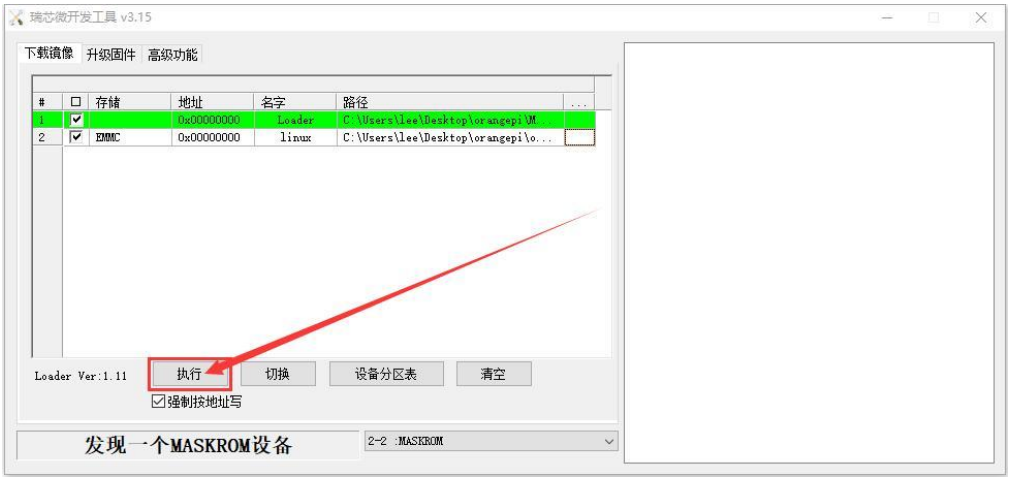
Before burning the image, it is recommended to rename the Linux image to be burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



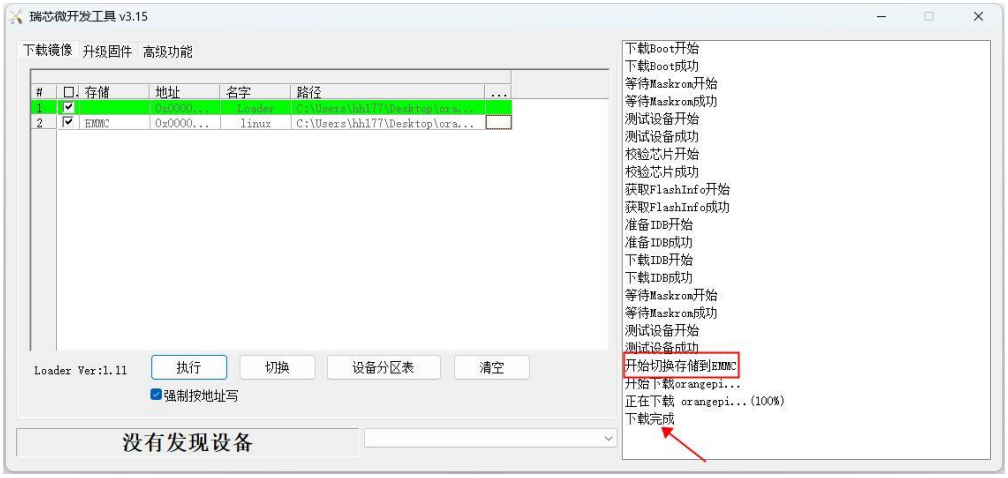
o. Then please check the option to **force writing by address**



p. Click the execute button again to start burning the Linux image to the eMMC of the development board



q. The log displayed after burning the Linux image is shown in the figure below



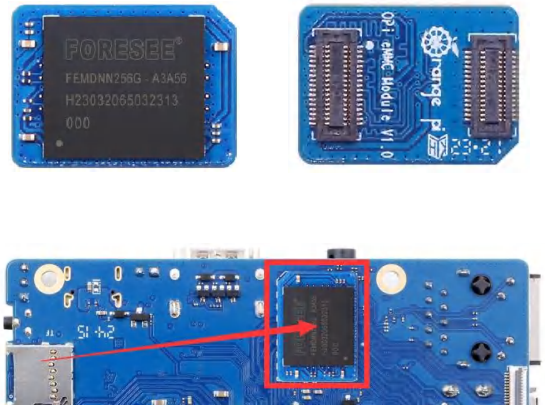
r. After burning the Linux image into the eMMC, the Linux system will start automatically.

Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2. 5. 2. Use the dd command to burn the Linux image into eMMC

Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page.

1) The development board reserves the expansion interface of the eMMC module. Before burning the system to the eMMC, you first need to purchase an eMMC module that matches the eMMC interface of the development board. Then install the eMMC module to the development board. The eMMC module and the method of plugging into the development board are as follows:



2) Using the dd command to burn the Linux image to eMMC needs to be completed with the help of a TF card, so first you need to burn the Linux image to the TF card, and then use the TF card to start the development board to enter the Linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC**.

3) After using the TF card to start the Linux system, we first upload the decompressed Linux image file (Debian, Ubuntu image, OpenWRT or OPi Arch image downloaded from the official website) to the TF card. For the method of uploading the Linux image

file to the development board, please refer to the description in the section of **the method of uploading files to the development board Linux system**.

4) After uploading the image to the Linux system of the development board, we enter the storage path of the image file in the command line of the Linux system of the development board. For example, I store the Linux image of the development board in the **/home/orangepi/Desktop** directory Download it, and then enter the **/home/orangepi/Desktop** directory to see the uploaded image file.

```
orangepi@orangepi:~$ cd /home/orangepi/Desktop
orangepi@orangepi:~/Desktop$ ls
Orangepi3b_x.x.x_debian_bullseye_desktop_xfce_Linux5.10.160.img
```

How to enter the command line of the development board Linux system?

1. For the method of using the serial port to log in to the terminal, please refer to the instructions in the section on how to use the debugging serial port.

2. Use ssh to remotely log in to the Linux system, please refer to the instructions in the section of SSH remote login to the development board.

3. If HDMI, LCD and other display screens are connected, you can open a command line terminal on the desktop.

5) Next, we first use the following command to confirm the device node of eMMC

```
orangepi@orangepi:~/Desktop$ ls /dev/mmcblk*boot0 | cut -c1-12
/dev/mmcblk0
```

6) Then we can use the dd command to clear the eMMC. Note that after the **of=** parameter, please fill in the output result of the above command

```
orangepi@orangepi:~/Desktop$ sudo dd bs=1M if=/dev/zero of=/dev/mmcblk0 count=1000 status=progress
orangepi@orangepi:~/Desktop$ sudo sync
```

7) Then you can use the dd command to burn the Linux image of the development board into the eMMC

a. In the following command, the if= parameter is followed by the full path where the Linux image is stored + the name of the Linux image (such as **the name of /home/orangepi/Desktop/Linux image**). Because we have entered the path of the Linux image above, we only need to fill in the name of the Linux image.

b. Please do not copy the Linux image name in the following command, but replace it with the actual image name (because the version number of the image may be updated).

```
sudo dd bs=1M if=Orangepi3b_x.x.x_debian_bullseye_desktop_xfce_Linux5.10.160.img of=/dev/mmcblk0 status=progress

sudo sync
```

Note, if you upload a .7z or .xz Linux image compressed file, please remember to decompress it before using the dd command to burn.

The detailed description of all parameters of the dd command and more usage can be viewed by executing the man dd command in the Linux system.

8) After successfully burning the Linux image of the development board to the eMMC, you can use the **poweroff** command to shut down. Then please pull out the TF card, and then short press the power button to turn on, and then the Linux system in the eMMC will be started.

Note, after burning the image into eMMC, if the test finds that it cannot be started, please clear the SPIFlash and try again. For the method of clearing SPIFlash, please refer to the method of using RKDevTool to clear SPIFlash.

2. 6. How to write Linux image to SPIFlash+NVMe SSD

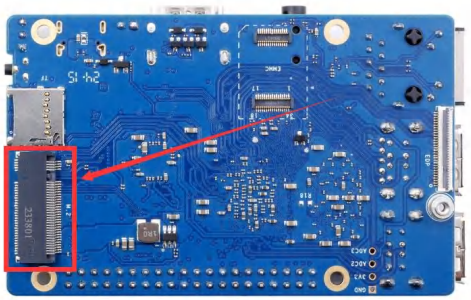
Note that the Linux image mentioned here specifically refers to the images of Linux distributions such as Debian, Ubuntu, OpenWRT or OPi OS Arch downloaded from the Orange Pi data download page.

Note that all the following operations are performed on a Windows computer.

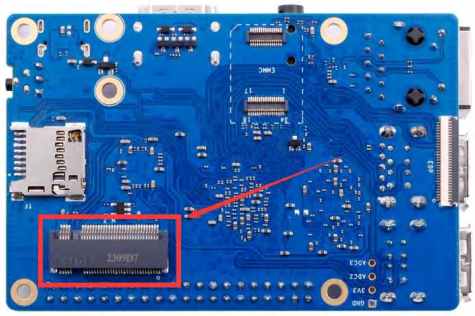
2. 6. 1. Using RKDevTool to burn

1) Firstly, it is necessary to prepare an NVMe SSD solid state drive. The PCIe supported by the M.2 slot on the development board is PCIe 2.0x1, with a theoretical maximum speed of 500MB/s. PCIe 3.0 and PCIe 4.0 NVMe SSDs can also be used, but the highest speed is only PCIe 2.0x1.

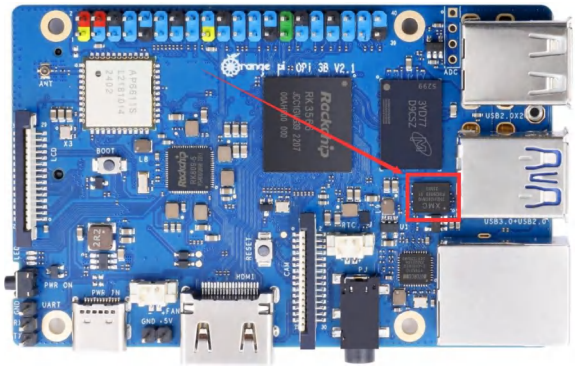
2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and secure it. The Orange Pi 3B has two hardware versions, and the M.2 PCIe interface position for version 2.1 is shown in the following figure:



The position of the M.2 PCIe interface in v1.1.1 version is shown in the following figure



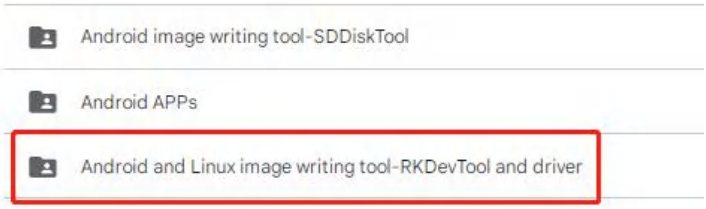
3) The position of the SPI Flash on the development board is shown in the figure below, no other settings are required before starting the programming



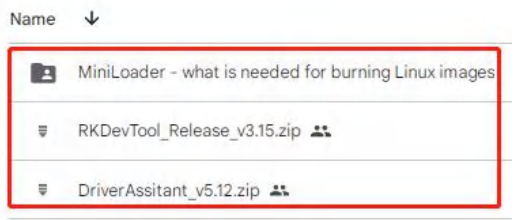
4) Then you need to prepare a good quality USB2.0 male-to-male data cable

5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

a. On the data download page of Orange Pi, first select the **official tool**, and then enter the following folder



b. Then download all the files below



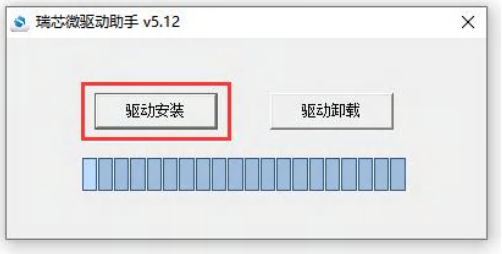
Note that the "MiniLoader-things needed to burn the Linux image" folder is hereinafter referred to as the MiniLoader folder.

6) Then download the Linux operating system image file compression package that you want to burn from the **Orange Pi data download page**, and then use the decompression software to decompress it. Among the decompressed files, the file ending with "**.img**" is the image file of the operating system , the size is generally more than 2GB

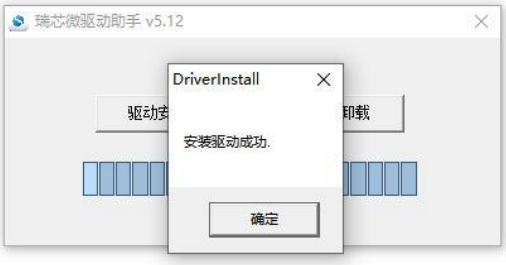
7) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

8) After opening **DriverInstall.exe**, the steps to install the Rockchip driver are as follows

a. Click the "**Driver Installation**" button

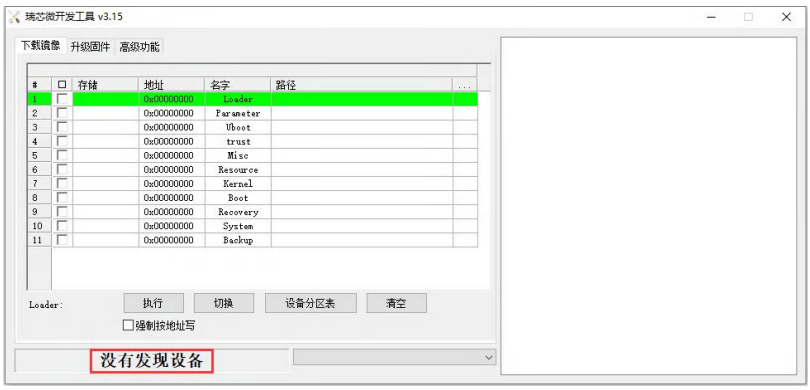


b. After waiting for a period of time, a pop-up window will prompt "**The driver is installed successfully**", and then click the "**OK**" button.



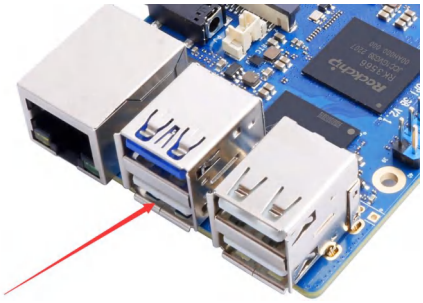
9) Then decompress **RKDevTool_Release_v3.15.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

10) After opening the **RKDevTool** burning tool, because the computer is not connected to the development board through the USB2.0 male-to-male data cable at this time, the lower left corner will prompt "**No device found**"



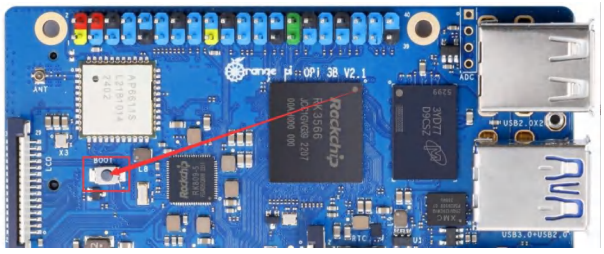
11) Then start burning the Linux image to the SSD

a. First, connect the development board to the Windows computer through the USB2.0 male-to-male data cable. The position of the USB2.0 programming interface of the development board is shown in the figure below

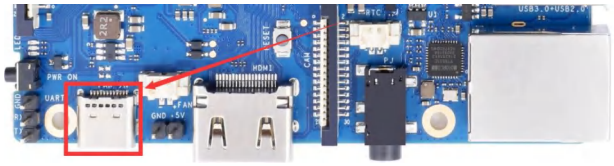


b. Make sure that the development board is not connected to the power supply and inserted into the TF card and eMMC

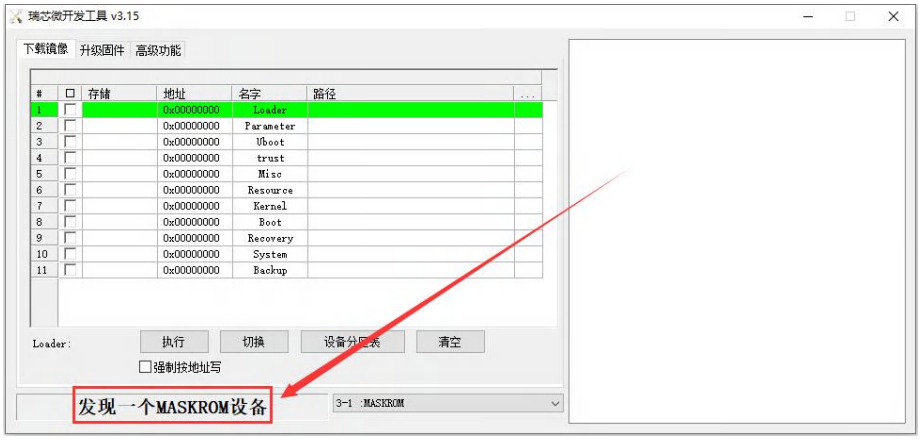
c. Then press and hold the MaskROM button on the development board, the position of the MaskROM button on the development board is shown in the figure below:



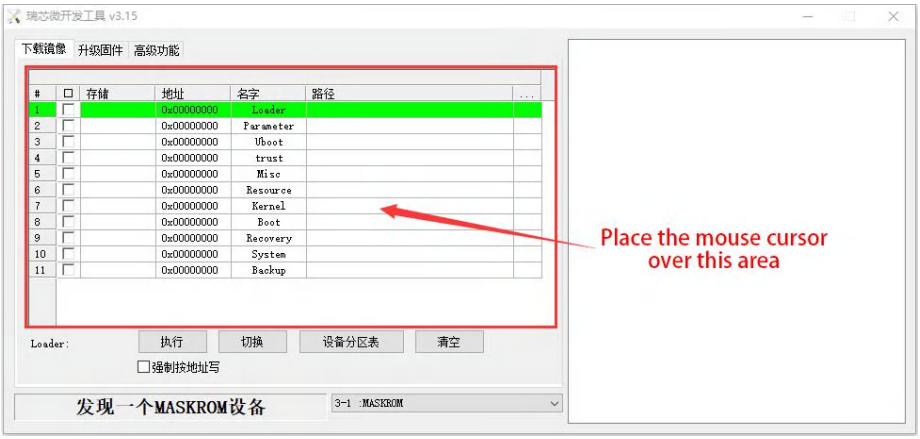
d. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



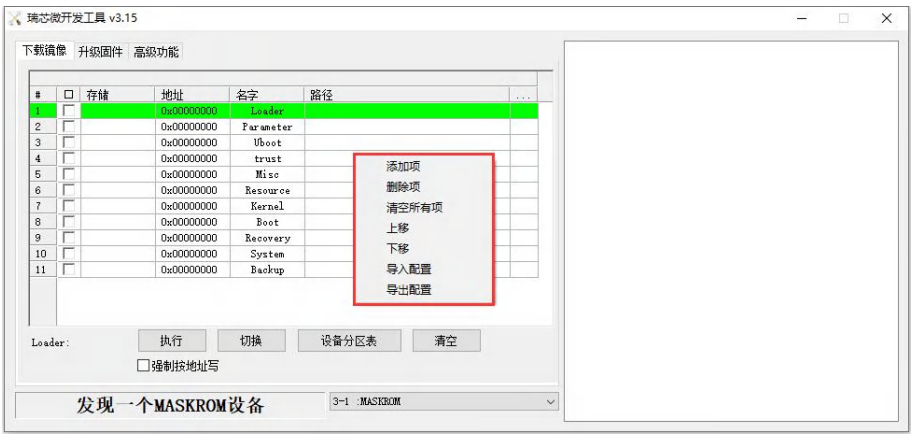
e. If the previous steps are successful, the development board will enter the **MASKROM** mode at this time, and the interface of the burning tool will prompt "**found a MASKROM device**"



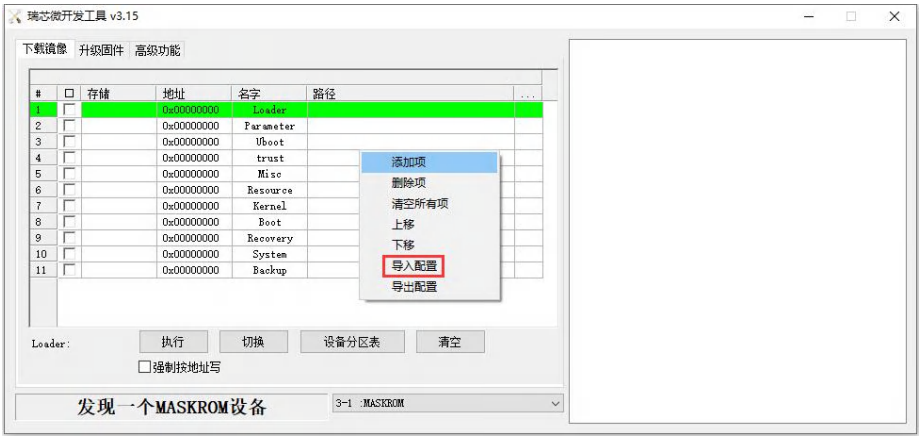
f. Then place the mouse cursor in the area below



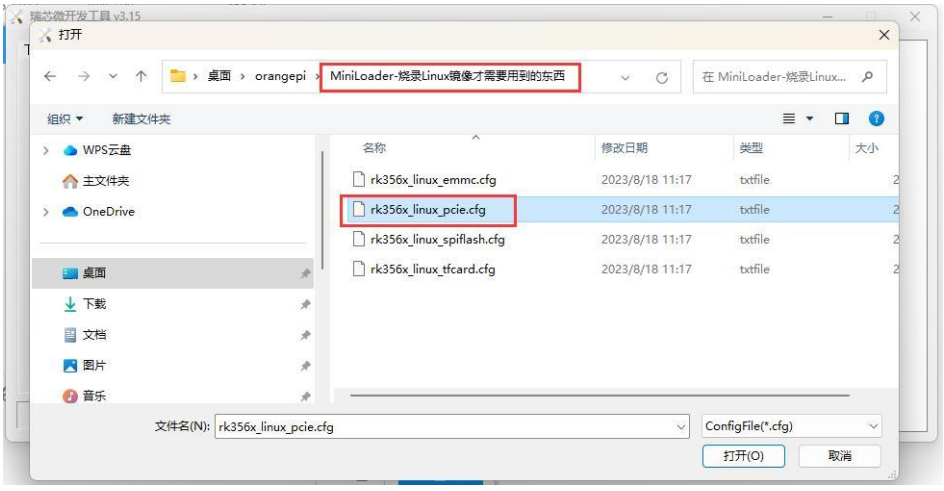
g. Then click the right mouse button and the selection interface shown in the figure below will pop up



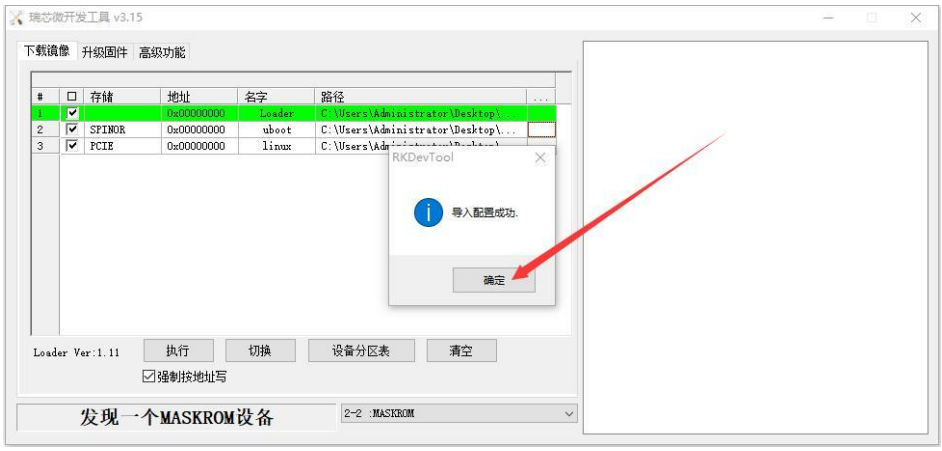
h. Then select the **import configuration** option



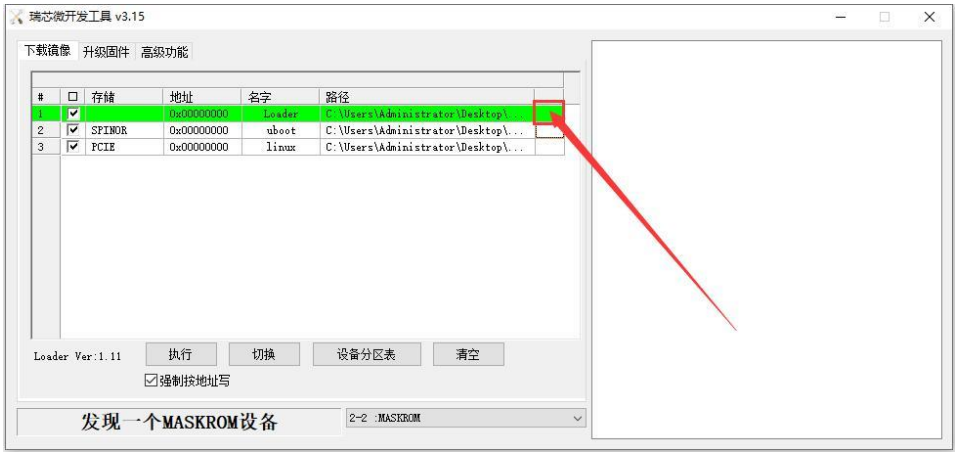
i. i. Then enter the **MiniLoader** folder downloaded earlier, then select the **rk356x_linux_pcie.cfg** configuration file, and click **Open**



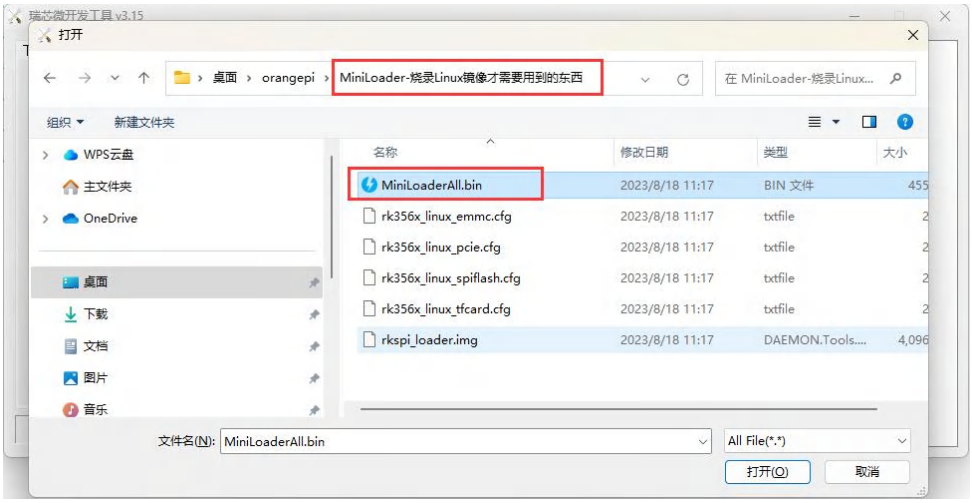
j. Then click **OK**



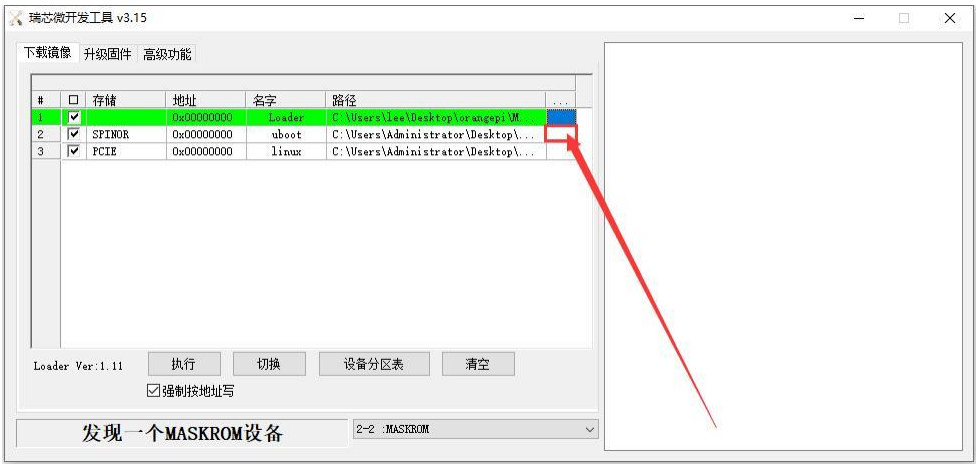
k. Then click the position shown in the figure below



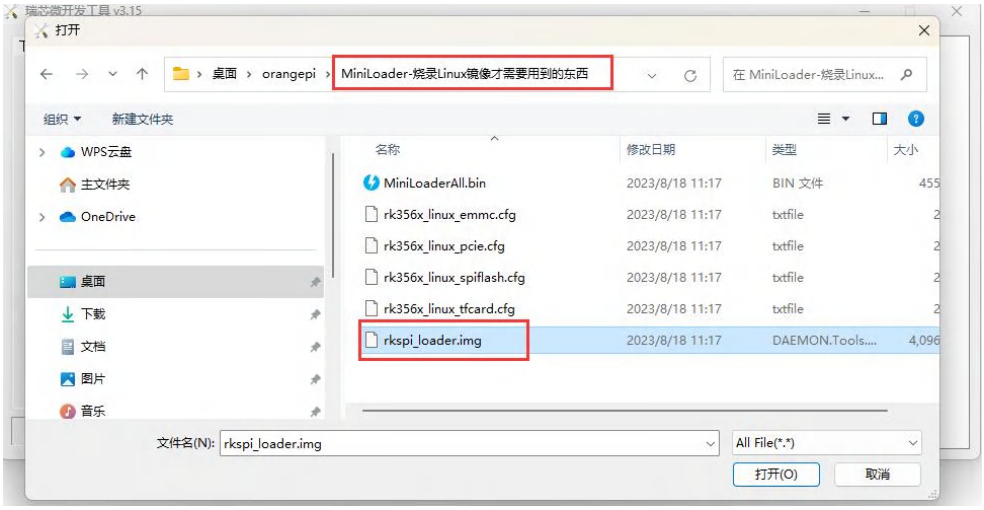
l. Then select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to **open**



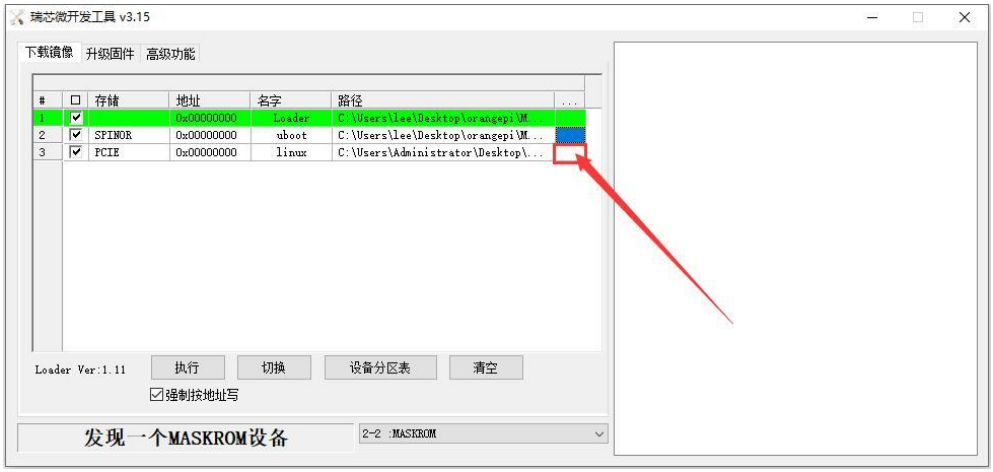
m. Then click the position shown in the figure below



n. Then enter the MiniLoader folder downloaded earlier, select **rkspi_loader.img**, and click **Open**

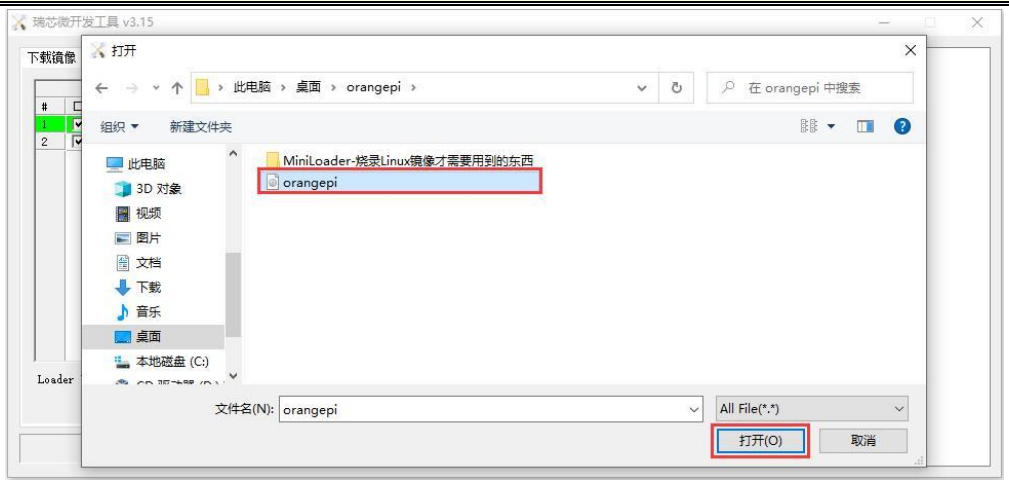


o. Then click the position shown in the figure below

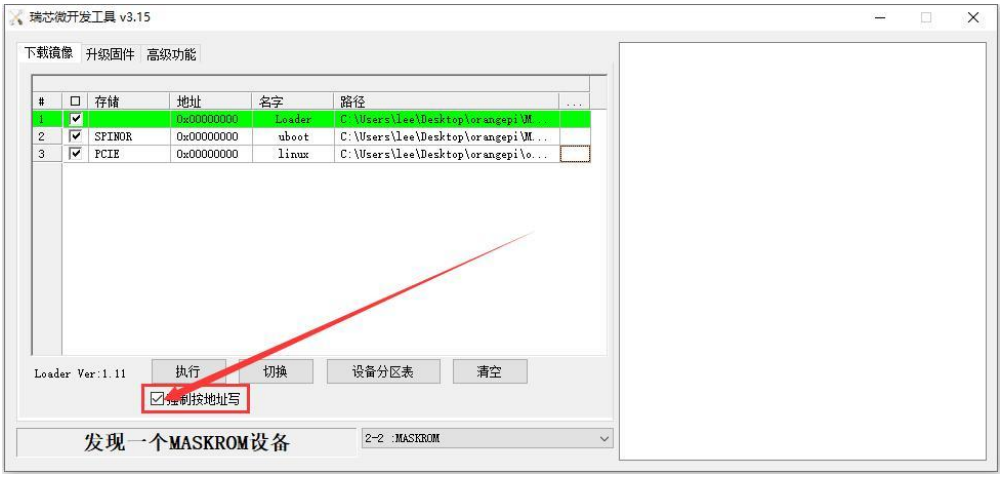


p. Then select the path of the Linux image you want to burn, and then click **Open**

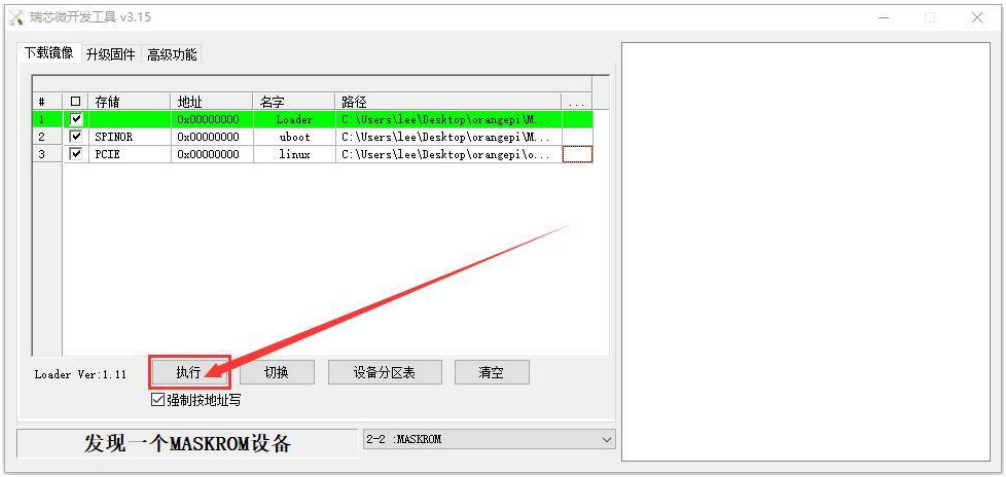
Before burning the image, it is recommended to rename the Linux image to be burned to orangepi.img or other shorter names, so that you can see the percentage value of the burning progress when burning the image.



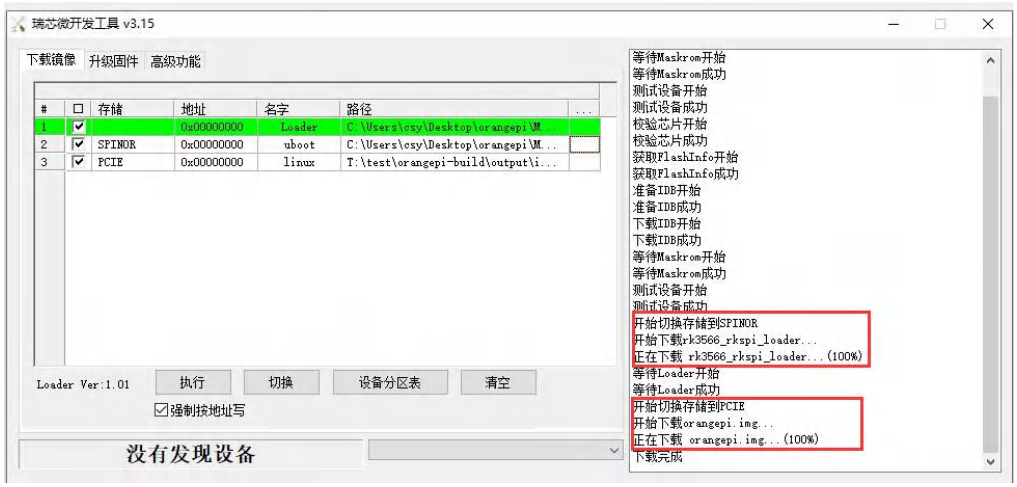
q. Then please check the option to force writing by address



r. Click the Execute button again to start burning the Linux image to the SSD



s. The log displayed after burning the Linux image is shown in the figure below



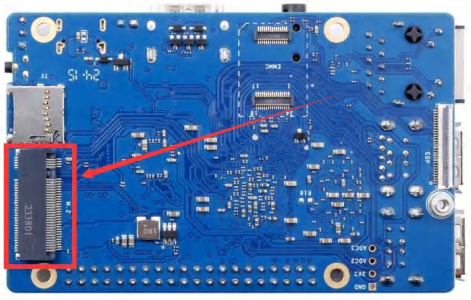
If there is a problem with burning, please clear the SPIFlash first and then try burning again. For the method of clearing SPIFlash, please refer to the description of the method of using RKDevTool to clear SPIFlash.

t. After the image is burnt, it will automatically start the Linux system in SPIFlash+PCIe SSD. If it does not start normally, please power on and try again.

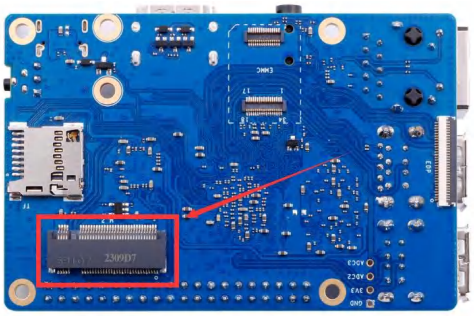
2.6.2. The method of using the dd command to burn

1) Firstly, it is necessary to prepare an NVMe SSD solid state drive. The PCIe supported by the M.2 slot on the development board is PCIe 2.0x1, with a theoretical maximum speed of 500MB/s. PCIe 3.0 and PCIe 4.0 NVMe SSDs can also be used, but the highest speed is only PCIe 2.0x1.

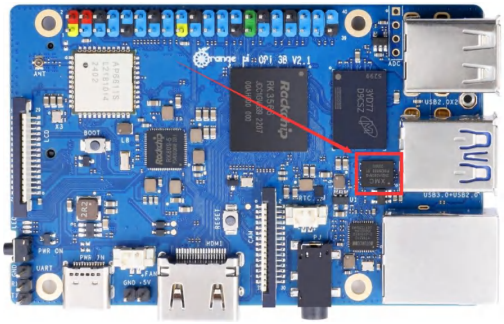
2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and secure it. The Orange Pi 3B has two hardware versions, and the M.2 PCIe interface position for version 2.1 is shown in the following figure:



The position of the M.2 PCIe interface in v1.1.1 version is shown in the following figure:



3) The position of SPI Flash on the development board is shown in the following figure, and no other settings are required before starting the burning process



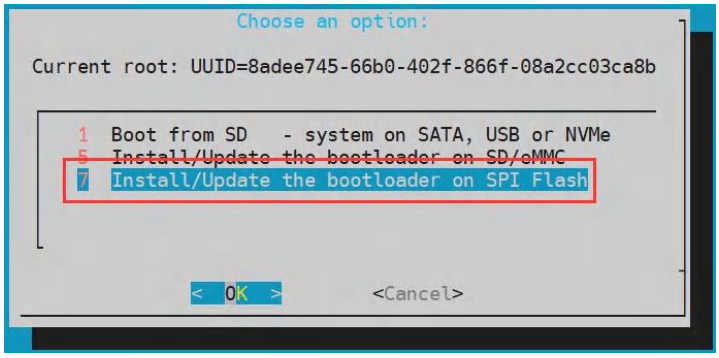
4) Burning the Linux image to SPIFlash+NVMe SSD requires a TF card, so first you need to burn the Linux image to the TF card, and then use the TF card to start the development board to enter the Linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **Method of burning Linux image to TF card based on Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC**.

5) After using the TF card to start the Linux system, we first burn the u-boot image into the SPI Flash

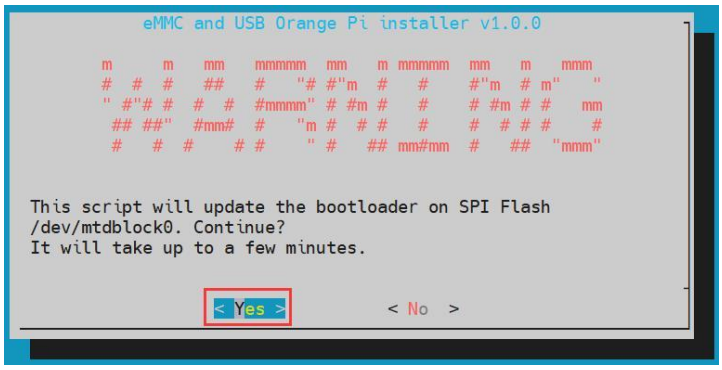
a. Run nand-sata-install first, **ordinary users remember to add sudo permission**

```
orangepi@orangepi:~$ sudo nand-sata-install
```

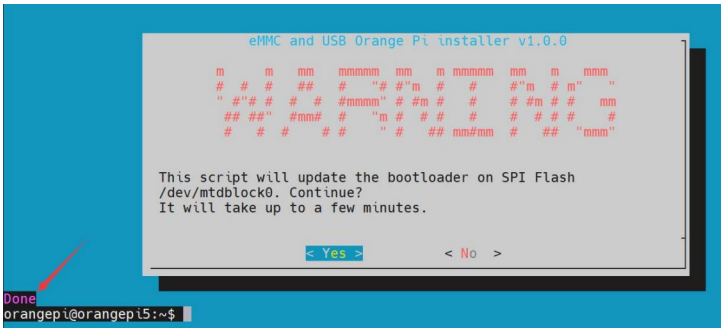
b. Then select **7 Install/Update the bootloader on SPI Flash**



c. Then select **<Yes>**



d. Then please wait patiently for the burning to complete. After the burning is completed, the display will be as follows (a **Done** will be displayed in the lower left corner):



6) Then upload the Linux image file (Debian or Ubuntu image downloaded from the official website) to the TF card. For the method of uploading the Linux image file to the development board, please refer to the description in the section of **the method of uploading files to the development board Linux system**.

7) After uploading the image to the Linux system of the development board, we enter the storage path of the image file in the command line of the Linux system of the development board. For example, I store the Linux image of the development board in

the **/home/orangepi/Desktop** directory Download it, and then enter the **/home/orangepi/Desktop** directory to see the uploaded image file.

```
orangepi@orangepi:~$ cd /home/orangepi/Desktop
orangepi@orangepi:~/Desktop$ ls
Orangepi3b_x.x.x_debian_bullseye_desktop_xfce_Linux5.10.160.img
```

How to enter the command line of the development board Linux system?

1. For the method of using the serial port to log in to the terminal, please refer to the instructions in the section on how to use the debugging serial port.

2. Use ssh to remotely log in to the Linux system, please refer to the instructions in the section of SSH remote login to the development board.

3. If HDMI, LCD and other display screens are connected, you can open a command line terminal on the desktop.

8) Next, let's confirm that the NVMe SSD has been recognized by the development board's Linux. If the NVMe SSD is recognized normally, use the **sudo fdisk -l** command to see **nvme** related information

```
orangepi@orangepi:~/Desktop$ sudo fdisk -l | grep "nvme0n1"
Disk /dev/nvme0n1: 1.86 TiB, 2048408248320 bytes, 4000797360 sectors
```

Use the **lspci** command to see an NVMe-related PCI device

```
orangepi@orangepi:~/Desktop$ lspci
00:00.0 PCI bridge: Fuzhou Rockchip Electronics Co., Ltd Device 3566 (rev 01)
01:00.0 Non-Volatile memory controller: Realtek Semiconductor Co., Ltd. Device 5765 (rev 01)
```

2) Then we can use the dd command to clear the NVMe SSD (optional)

```
orangepi@orangepi3b:~/Desktop$ sudo dd bs=1M if=/dev/zero of=/dev/nvme0n1 count=2000 status=progress
orangepi@orangepi3b:~/Desktop$ sudo sync
```

3) Then you can use the dd command to burn the Linux image of the development board to the NVMe SSD

a. In the following command, the **if**= parameter is followed by the full path where the Linux image is stored + the name of the Linux image (such as **the name of /home/orangepi/Desktop/Linux image**). Because we have entered the path of the Linux image above, we only need to fill in the name of the Linux image.

b. Please do not copy the Linux image name in the following command, but replace it with the actual image name (because the version number of the image may be updated).

```
sudo dd bs=1M if=Orangepi3b_x.x.x_debian_bullseye_desktop_xfce_Linux5.10.160.img of=/dev/nvme0n1 status=progress

sudo sync
```

Note, if you upload a .7z or .xz or .gz Linux image compressed file, please remember to decompress it before using the dd command to burn.

The detailed description of all parameters of the dd command and more usage can be viewed by executing the man dd command in the Linux system.

4) After successfully burning the Linux image of the development board to the NVMe SSD, you can use the poweroff command to shut down. Then please pull out the TF card, and then short press the power button to turn on, then the Linux system in SPIFlash+NVMe SSD will be started.

5) After starting the system in the NVMe SSD, use the **df -h** command to see the actual hard disk capacity

a. 128GB NVMe SSD

```
orangepi@orangepi:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.8G  8.0K  3.8G   1% /dev
tmpfs           769M  1.4M  768M   1% /run
/dev/nvme0n1p2  118G  5.8G  111G   5% /
tmpfs           3.8G     0  3.8G   0% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
tmpfs           3.8G   16K  3.8G   1% /tmp
/dev/nvme0n1p1  256M   90M  166M  36% /boot
/dev/zram1      194M  9.9M  170M   6% /var/log
tmpfs           769M   60K  769M   1% /run/user/1000
tmpfs           769M   48K  769M   1% /run/user/0
```

b. 2TB NVMe SSD

```
orangepi@orangepi:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.8G  8.0K  3.8G   1% /dev
tmpfs           769M  1.4M  768M   1% /run
/dev/nvme0n1p2  1.9T  4.1G  1.8T   1% /
tmpfs           3.8G     0  3.8G   0% /dev/shm
tmpfs           5.0M  4.0K  5.0M   1% /run/lock
/dev/zram2      3.7G   76K  3.5G   1% /tmp
/dev/nvme0n1p1  256M   90M  166M  36% /boot
/dev/zram1      194M   15M  165M   9% /var/log
tmpfs           769M   60K  769M   1% /run/user/1000
tmpfs           769M   48K  769M   1% /run/user/0
```

6) When the same system is programmed in the TF card and NVMe SSD, **if both the TF card and NVMe SSD are inserted into the development board, then power on and start the development board, and u-boot will give priority to starting the system in the TF card.** However, since the systems in the TF card and the NVMe SSD are exactly the same, the UUIDs of the /**boot** partition and the **rootfs** partition in the two storage devices are also the same, which may cause the partition in the NVMe SSD to be loaded when the TF card starts. Running the script below resolves this issue.

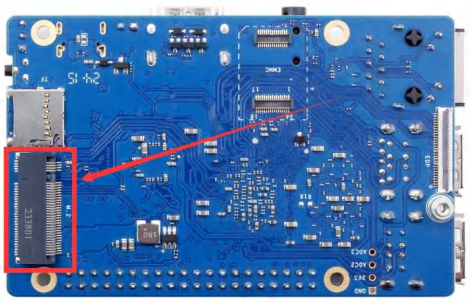
```
orangepi@orangepi:~$ sudo fix_mmc_ssd.sh
```

Exactly the same system means that the image name is exactly the same. Even if they are all Debian11 systems, the versions are different.

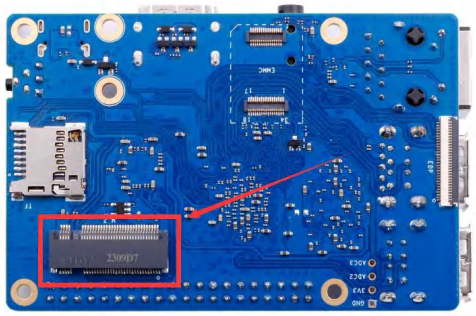
2.6.3. How to use balenaEtcher software to burn

1) Firstly, it is necessary to prepare an NVMe SSD solid state drive. The PCIe supported by the M.2 slot on the development board is PCIe 2.0x1, with a theoretical maximum speed of 500MB/s. PCIe 3.0 and PCIe 4.0 NVMe SSDs can also be used, but the highest speed is only PCIe 2.0x1.

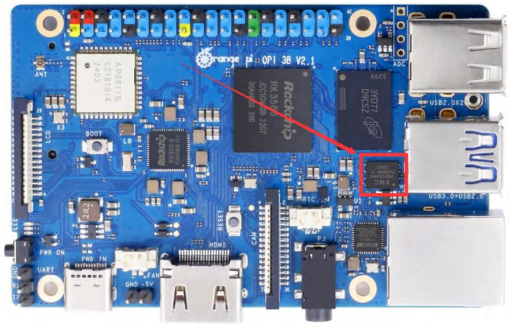
2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and secure it. The Orange Pi 3B has two hardware versions, and the M.2 PCIe interface position for version 2.1 is shown in the following figure:



The position of the M.2 PCIe interface in v1.1.1 version is shown in the following figure:



3) The position of SPI Flash on the development board is shown in the following figure, and no other settings are required before starting the burning process



4) Burning the Linux image to SPIFlash+NVMe SSD requires a TF card, so first you need to burn the Linux image to the TF card, and then use the TF card to start the development board to enter the Linux system. For the method of burning the Linux image to the TF card, please refer to the instructions in the two sections of **the method of burning the Linux image to the TF card based on the Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC**.

5) After booting into the Linux system in the TF card, please confirm that the NVMe SSD has been properly recognized by the Linux of the development board. If the NVMe SSD is recognized normally, use the **sudo fdisk -l** command to see **nvme** related

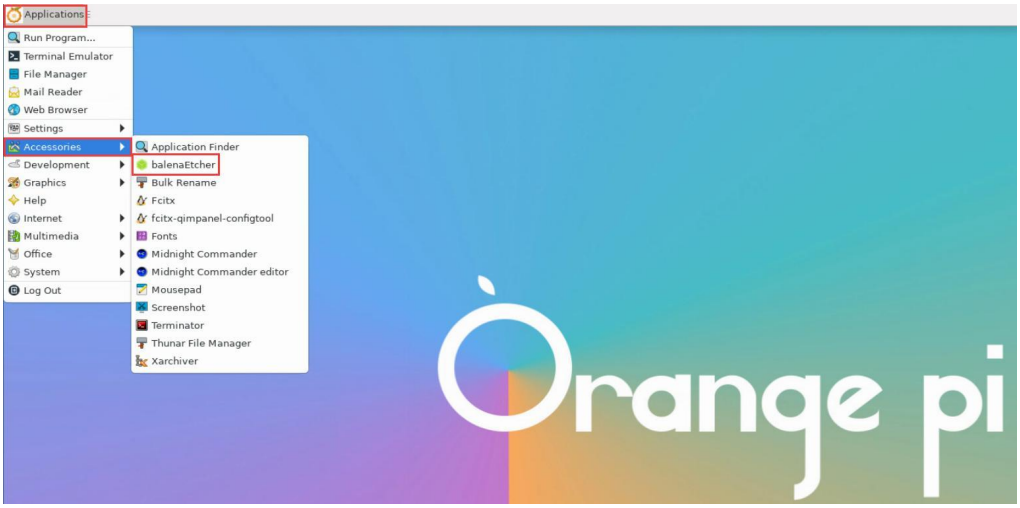
information

```
orangepi@orangepi:~/Desktop$ sudo fdisk -l | grep "nvme0n1"
Disk /dev/nvme0n1: 1.86 TiB, 2048408248320 bytes, 4000797360 sectors
```

Use the **lspci** command to see an NVMe-related PCI device

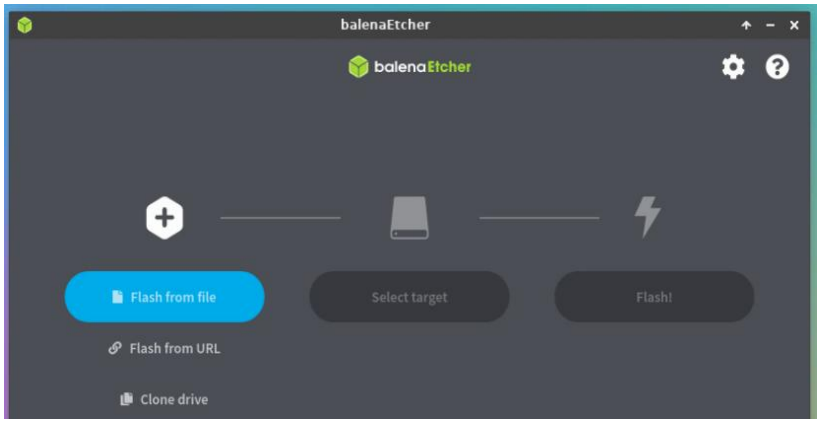
```
orangepi@orangepi:~/Desktop$ lspci
00:00.0 PCI bridge: Fuzhou Rockchip Electronics Co., Ltd Device 3566 (rev 01)
01:00.0 Non-Volatile memory controller: Realtek Semiconductor Co., Ltd. Device 5765 (rev 01)
```

6) The balenaEtcher has been pre-installed in the Linux image, and the opening method is as follows:



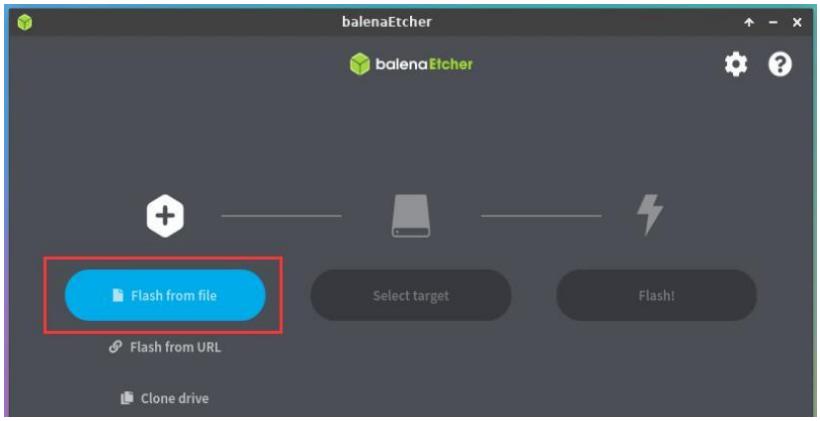
If it is not pre-installed, for how to download and install the arm64 version of balenaEtcher, please refer to the instructions in the section on how to download and install the arm64 version of balenaEtcher.

7) The interface after balenaEtcher is opened is as follows:

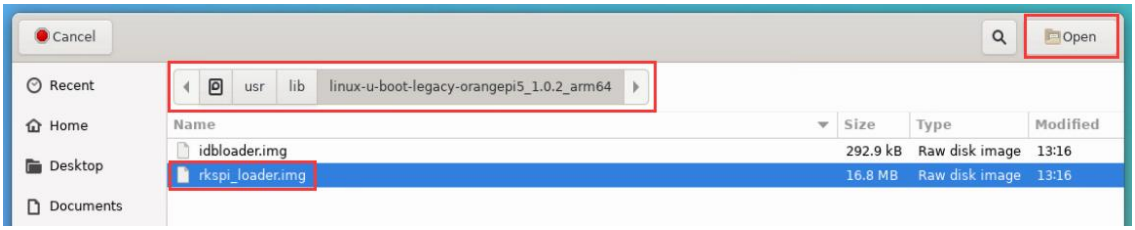


8) The method of using balenaEtcher to burn u-boot to the SPI Flash of the development board is as follows:

a. First click on **Flash from file**

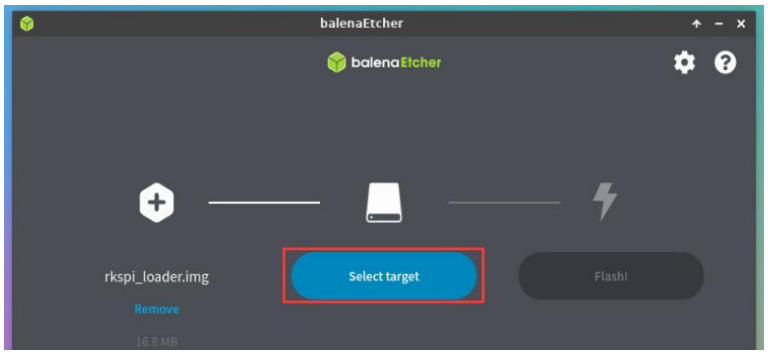


b. Then enter the **/usr/lib/Linux-u-boot-legacy-orangepi3b_1.x.x_arm64** directory, select **rkspi_loader.img**, and click **Open** to open

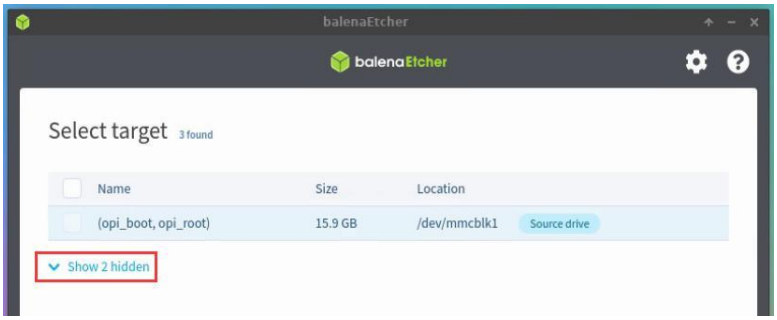


c. The interface after opening **rkspi_loader.img** is as follows:

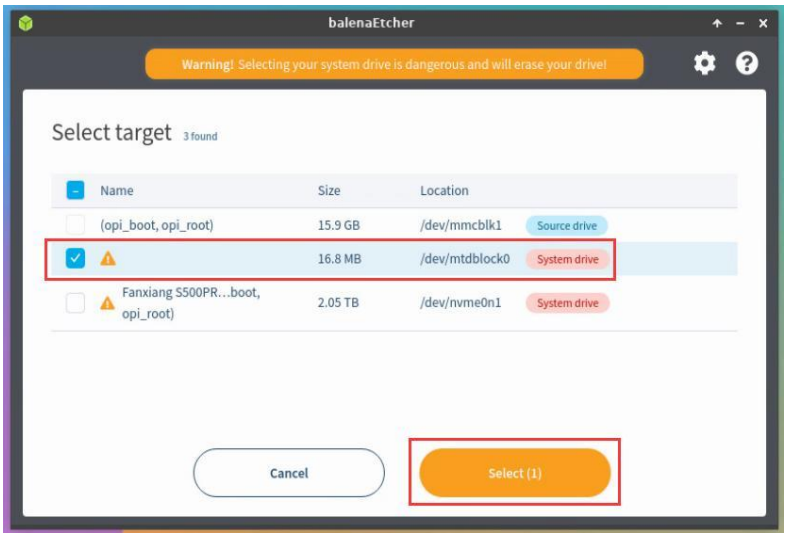
d. Then click **Select target**



e. Then click **Show 2 hidden** to open more options for storage devices

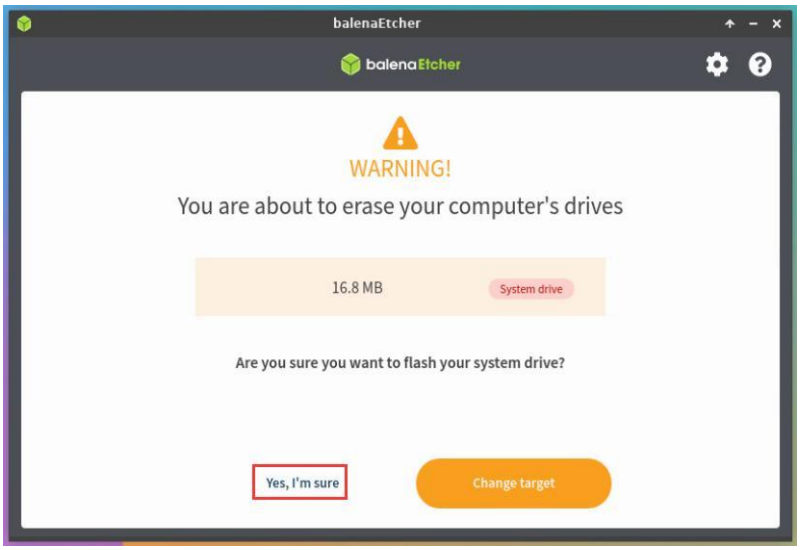


f. Then select the device name of SPI Flash **/dev/mtdblock0**, and click **Select**

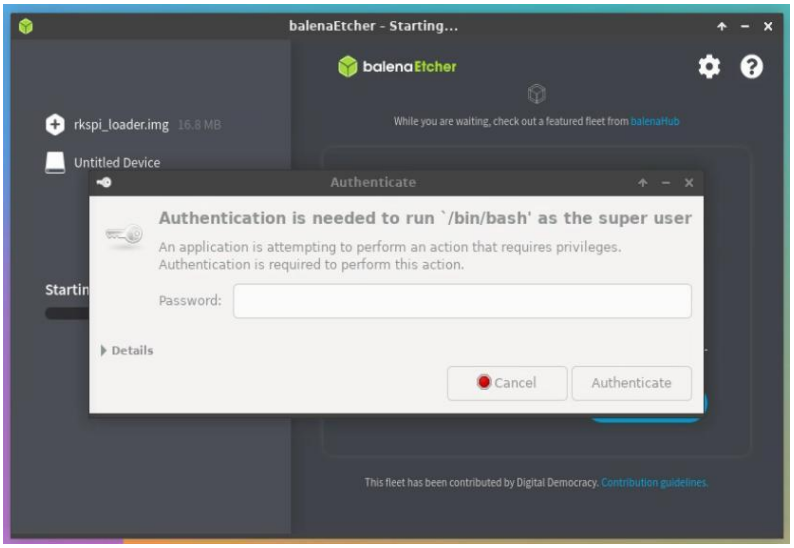


g. Then click **Flash**

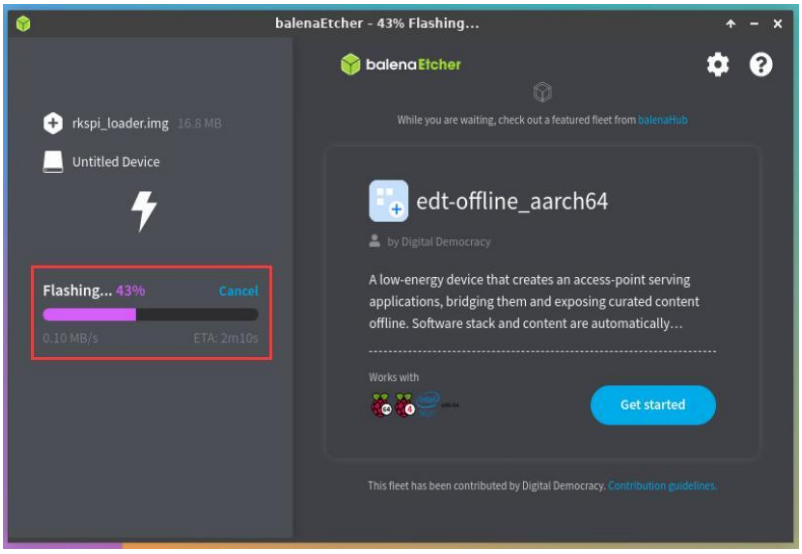
h. Then click **Yes, I'm sure**



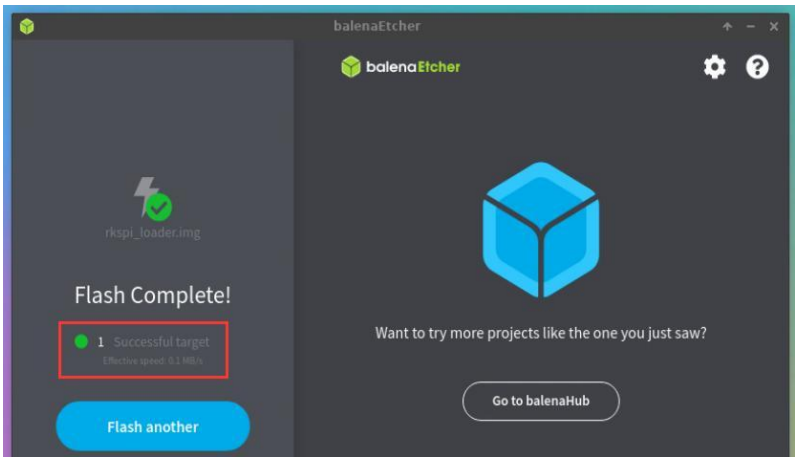
i. Then enter the password **orangepi** of the development board Linux system, and it will start burning the u-boot image into the SPI Flash



j. The display of the burning process is as follows:

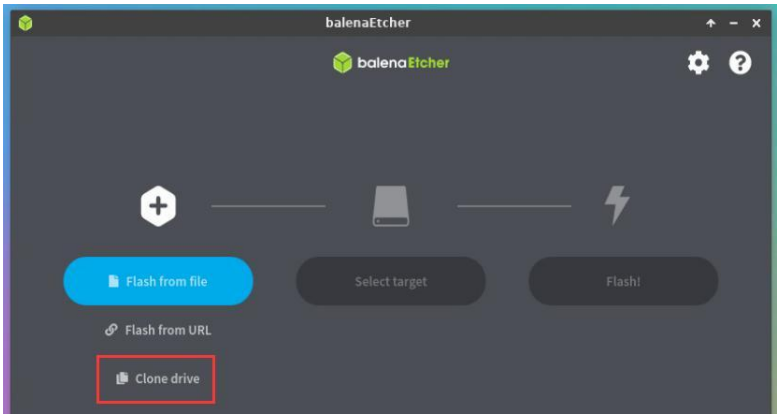


k. The display after burning is as follows:

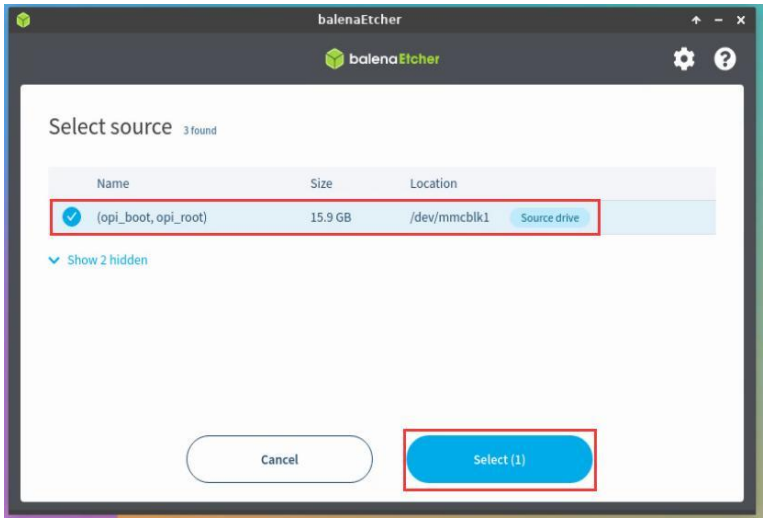


9) The method of burning the Linux system in the TF card to the NVMe SSD (this method is equivalent to cloning the system in the TF card to the NVMe SSD)

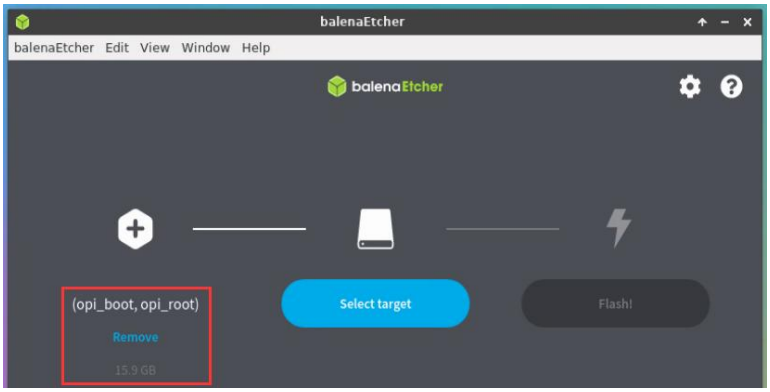
a. First click **Clone drive**



b. Then select the device name of the TF card **/dev/mmcblk1**

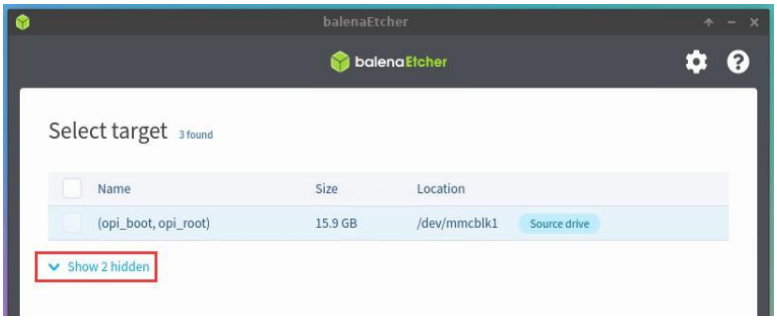


c. The interface after opening the TF card is as follows:

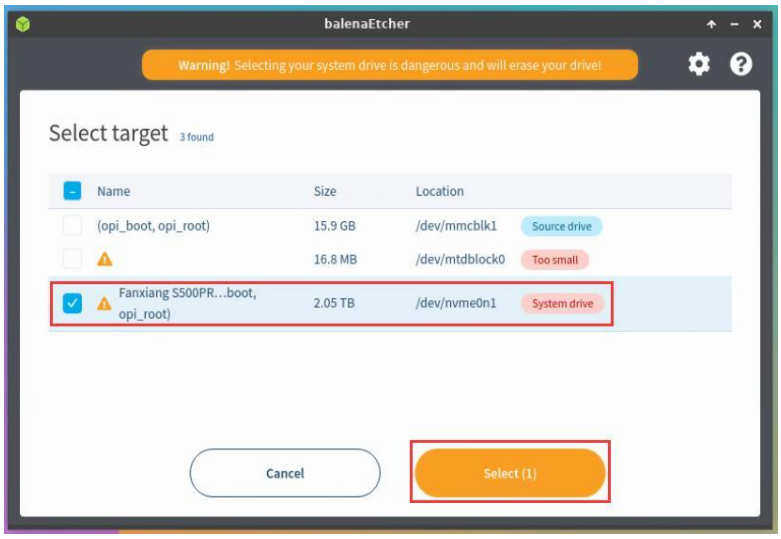


d. Then click **Select target**

e. Then click **Show 2 hidden** to open more options for storage devices

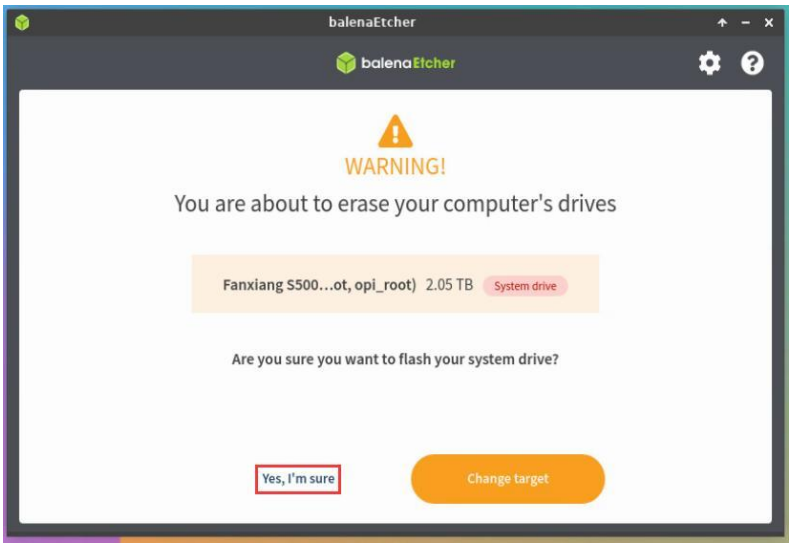


f. Then select the device name of the NVMe SSD **/dev/nvme0n1**, and click **Select**

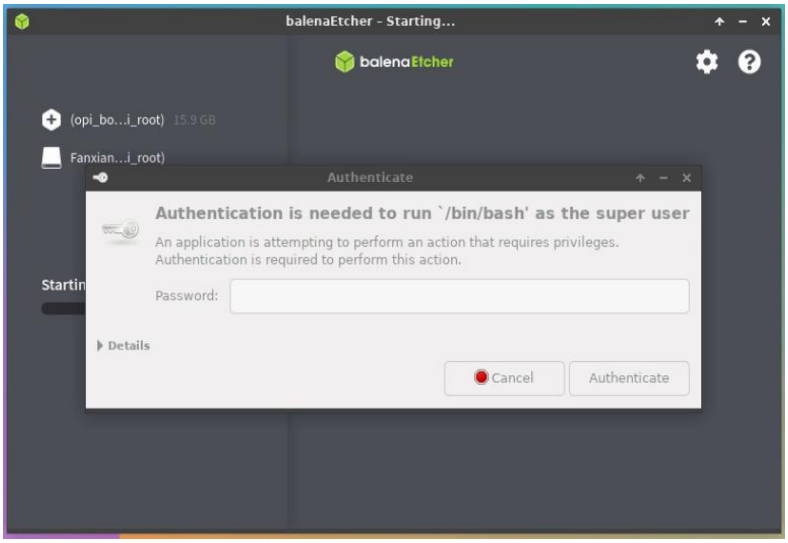


g. Then click **Flash**

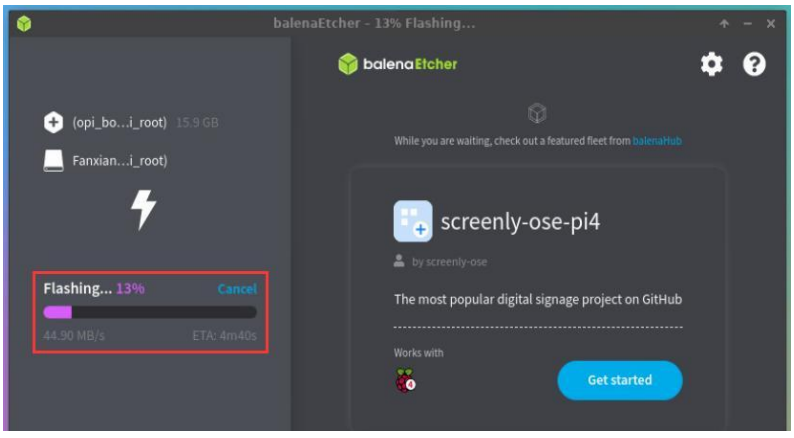
h. Then click **Yes, I'm sure**

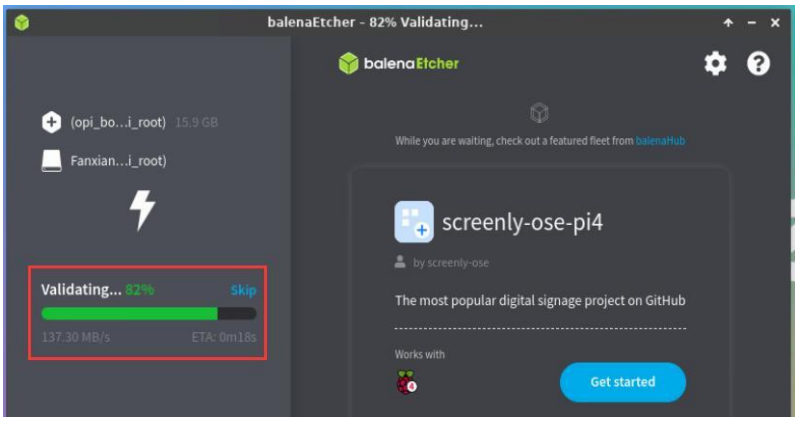


i. Then enter the password orangepi of the Linux system on the development board, and it will start burning the Linux image to the SSD

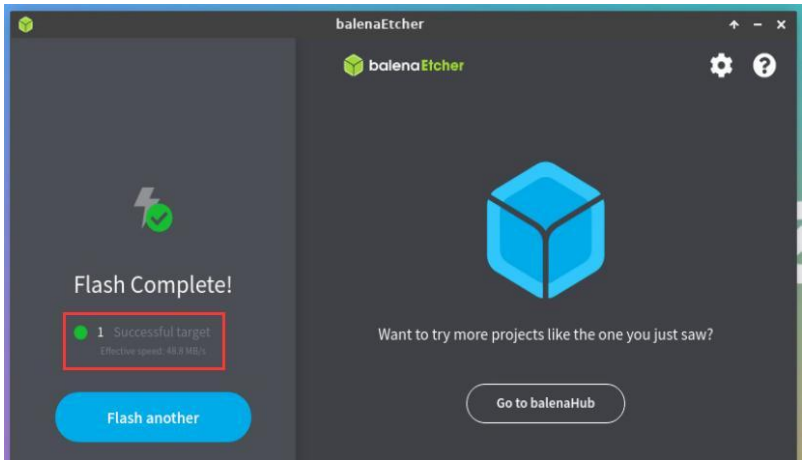


j. The display of the burning process is as follows:





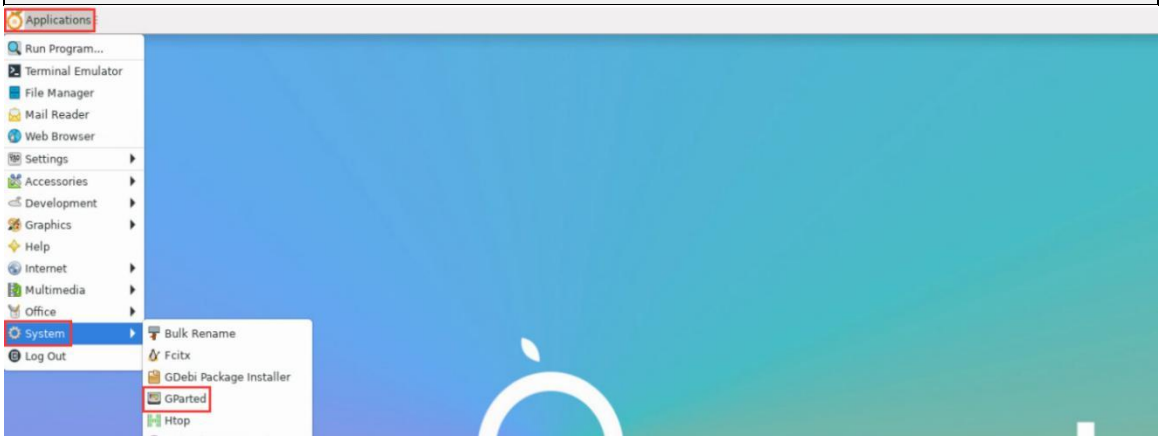
k. The display after burning is as follows:



l. Then you need to expand the capacity of the rootfs partition in the NVMe SSD. The steps are as follows:

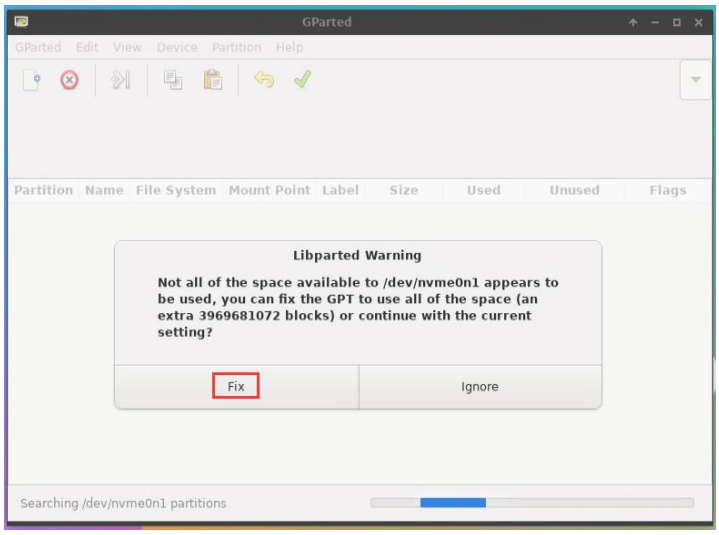
a) Open **GParted** first, if the system does not have Gparted pre-installed, please use the apt command to install it

```
orangepi@orangepi:~$ sudo apt-get install -y gparted
```

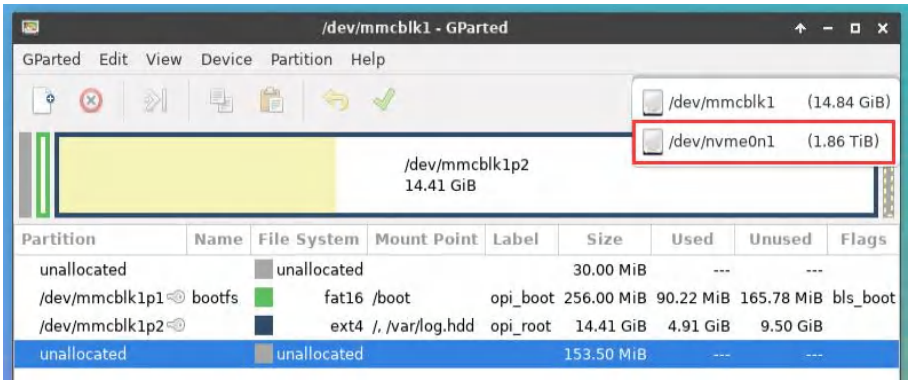


b) Then enter the password orangepi of the Linux system, and click **Authenticate**

c) Then click **Fix**



d) Then select NVMe SSD



e) The display interface after selecting NVMe SSD is as follows: