

Orange Pi 5 User Manual



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1. Basic features of Orange Pi 5

1.1. What is Orange Pi 5

The Orange Pi 5 uses the new-generation Rockchip RK3588S ARM processor, which consists of quad-core A76 and quad-core A55. It features Samsung's 8nm LP process technology, a large-core main frequency of up to 2.4GHz, and an integrated ARM Mali-G610 MP4 GPU for high-performance 3D and 2D image acceleration. In addition, it comes embedded with an AI accelerator NPU that can handle up to 6 Tops of computing power. The device also has 4GB/8GB/16GB/32GB (LPDDR4/4x) memory and supports up to 8K display processing capabilities.

Orange Pi 5 offers a wide range of interfaces, such as HDMI output, Type-C, M.2 pcie 2.0, Gigabit Ethernet port, USB 2.0, USB 3.0 interface, and 26 pin expansion pin header. it can be used extensively in high-end tablets, edge computing, artificial intelligence, cloud computing, ar/vr, smart security, smart home, and other fields, covering various aiot industries.

Orange Pi 5 is compatible with several operating systems, including the official Orange Pi OS. additionally, it supports Android 12.1, Debian 11, Ubuntu 20.04, Ubuntu 22.04, and other systems.

1.2. Uses of Orange Pi 5

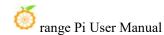
We can use it to achieve:

- A linux desktop computer
- A linux network server
- An android tablet
- An android game console, etc.

Of course, there are many more functions available because orange pi 5 development board can install Linux systems such as Debian and ubuntu, as well as android. this means that within the range of hardware and software support provided by the development board, we can implement various types of functions.

1.3. Hardware features of Orange Pi 5

	Introduction to hardware features		
CPU GPU	 Rockchip RK3588S (8nm LP processor) 8-core 64-bit processor 4-core Cortex-A76 and 4-core Cortex-A55 core architecture • The main frequency of the large core is up to 2.4GHz, and the main frequency of the small core is up to 1.8GHz Integrated ARM Mali-G610 		
NPU	 OpenGL ES1.1/2.0/3.2, OpenCL 2.2 and Vulkan 1.2 Built-in AI accelerator NPU with a computing power of up to 6 Tops Support INT4/INT8/INT16 mixed operation 		
Video Output	 HDMI 2.1, up to 8K @60Hz DP1.4 (DisplayPort) 2*MIPI D-PHY TX 4Lan 		
Memorry	4GB/8GB/16GB (LPDDR4/4x)		
Camera	 1 * MIPI CSI 4Lane 2 * MIPI D-PHY RX 4Lane		
PMU	RK806-1		
Onboard Storage	 16MB QSPI Nor FLASH MicroSD (TF) Card slot PCIe2.0x1 M.2 M-KEY (SSD) slot 		
Ethernet	10/100/1000Mbps ethernet (YT8531C)		
Audio	 3.5mm headphone jack audio in/out Onboard MIC input HDMI output 		
PCIe M.2 M-KEY	Support PCIe WIFI6+BT5.0+BLE Support SSD		
USB Interface	1 * USB3.0 Interface 2 * USB2.0 Interface (One of them is shared with the		



	Type-C interface)
	1 * USB3.0 Type-C Interface
26pin Extension Header	Used to expand UART, PWM, I2C, SPI, CAN and GPIO
	interfaces
Debug Serial Port	3pin debug serial port
LED Light	Power light and status light
Button	1 * Mask ROM key, 1 * RECOVERY, 1 * switch key
Power Supply	5V/4A Type-C power supply
Supported OS	Orange Pi OS(Droid), Orange Pi OS(Arch), Android12.1,
Supported OS	Debian11、Ubuntu20.04 and Ubuntu22.04 operating systems
I	ntroduction of Appearance Specifications
Product Size	100mm*62mm
Weight	46g

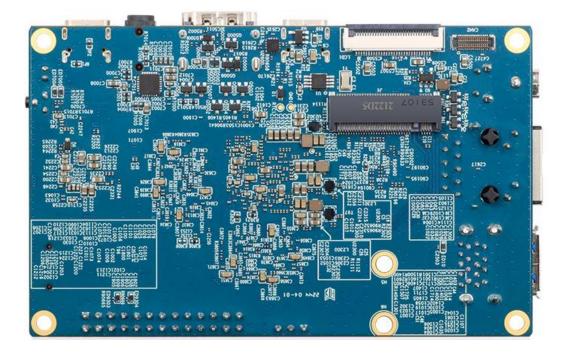
orange PiTM is a registered trademark of Shenzhen Xunlong Software Co., Ltd

1.4. Top view and bottom view of Orange Pi 5

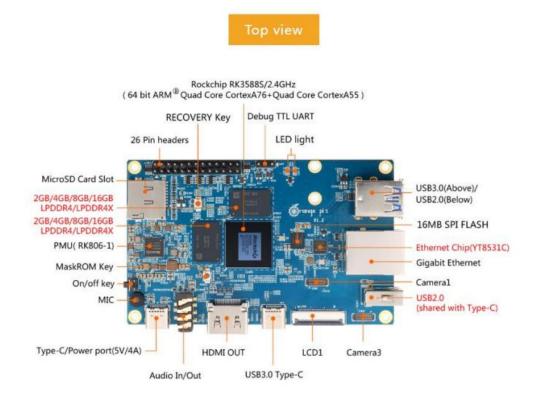
Top view:

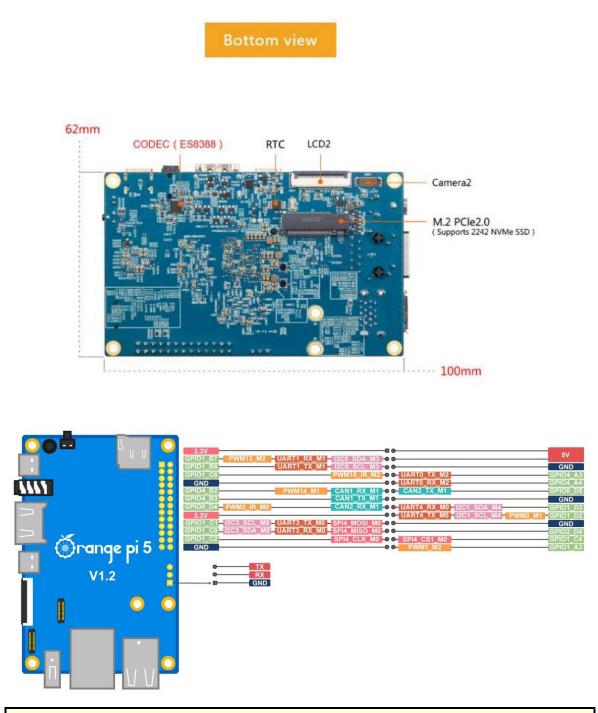


Bottom view:



1.5. Interface details of Orange Pi 5





The diameter of the four positioning holes is 3.0mm, and the diameter of the two M.2 PCIE device fixing holes is 3.5mm.

2. How to use the development board

2.1. Prepare the required accessories

1) TF card, a class 10 or above high-speed SanDisk card with a minimum capacity of 8GB (32GB or above is recommended)



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 or 8K display, please make sure that the HDMI cable supports 4K or 8K video output.

5) Type-C to HDMI cable, connect the development board to an HDMI monitor or TV for display through the Type-C interface



6) Type-C to USB adapter, used to connect USB storage devices or USB devices such as mouse and keyboard



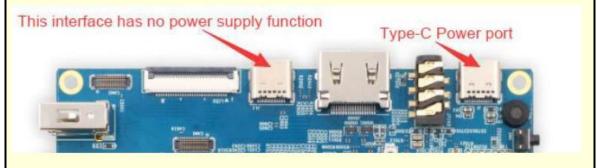
7) 10.1-inch MIPI screen, used to display the system interface of the development board



8) Power adapter, Orange Pi 5 is recommended to use 5V/4A Type-C power supply for power supply



There are two Type-C ports that look the same on the development board. The one on the right is the power port, and the one in the middle has no power supply function. Please don't connect it wrong.



The Type-C power interface of the development board does not support the PD negotiation function, and only supports a fixed 5V voltage input.'

9) 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 Orange Pi development board



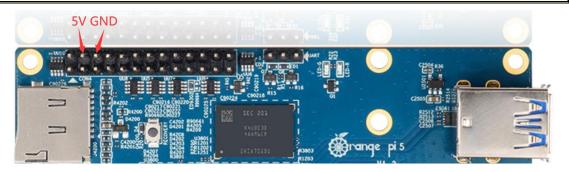
10) USB Camera



11) 5V cooling fan. As shown in the figure below, the 5V and GND pins on the 26pin interface of the development board can be connected to the cooling fan. The spacing between the 26pin headers is **2.54mm**. The power interface of the cooling fan can be purchased according to this specification

Note that the 5V pin on the 26pin pin header can be used directly after the development board is plugged into the power supply of the Type-C interface. No other settings are required. In addition, the output voltage of the 5V pin on the

26pin pin header cannot be adjusted and turned off by software. (no PWM function).



12) 100M or 1000M network cable, used to connect the development board to the Internet

13) The data cable of the Type-C interface, used to burn the image to NVMe SSD, use ADB and other functions



14) AP6275P PCIe WIFI6+Blustooth 5.0 2 in 1 module





15) OV13850 camera with 13 million MIPI interface



16) OV13855 camera with 13 million MIPI interface



17) Matching shell (pictures and assembly methods to be added)

18) **3.3V** USB to TTL module and DuPont line, when using the serial port debugging function, need USB to TTL module and DuPont line to connect the development board and compute





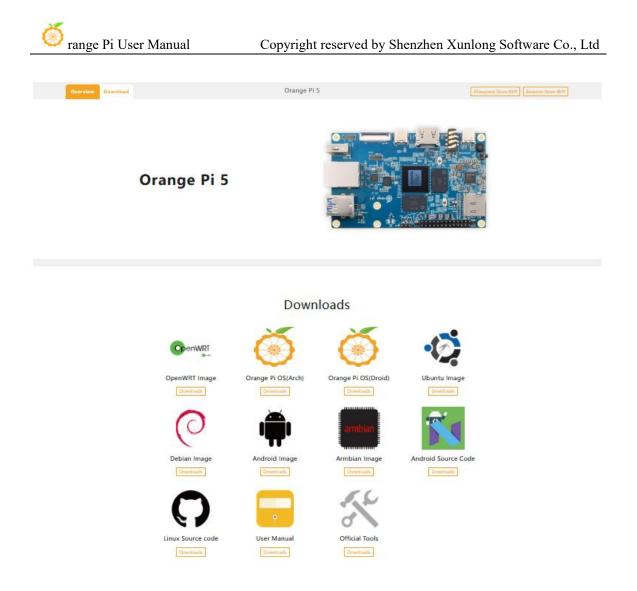
19) Personal computer with Ubuntu and Windows operating systems

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:

http://www.orangepi.org/html/hardWare/computerAndMicrocontrollers/service-and -support/Orange-pi-5.html



- 2) The information mainly includes
 - a. Android source code: saved on Google Drive
 - b. Linux source code: saved on Github
 - c. User manual and schematic diagram: saved on Google Drive
 - 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 Drive
 - f. Ubuntu image: saved on Google Drive
 - g. Debian image: saved on Google Drive
 - h. Orange Pi OS image: saved on Google Drive
 - i. **OpenWRT** image: saved on Google Drive

2.3. How to burn Linux image to TF card based on Windows PC

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.

Note that the OpenWRT image currently only supports TF card booting, and does not support SPIFlash+SSD booting.

Before the external TF card starts the OpenWRT image, if the U-boot is burned in the SPI Flash, please erase it first, otherwise the OpenWRT image in the TF card cannot be started. The command to erase U-boot in SPI Flash is:

orangepi@orangepi:~\$ sudo dd if=/dev/zero of=/dev/mtdblock0

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

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

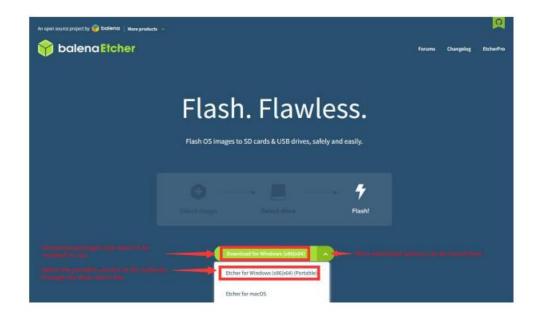
2) Then use the card reader to insert the TF card into the computer

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 more than 2G

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

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

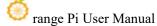
5) After entering the balenaEtcher download page, click the green download button to download the installation package of balenaEtcher. You can also select the Portable version of the balenaEtcher software through the drop-down box. The Portable version does not need to be installed, and it can be used by double-clicking to open it

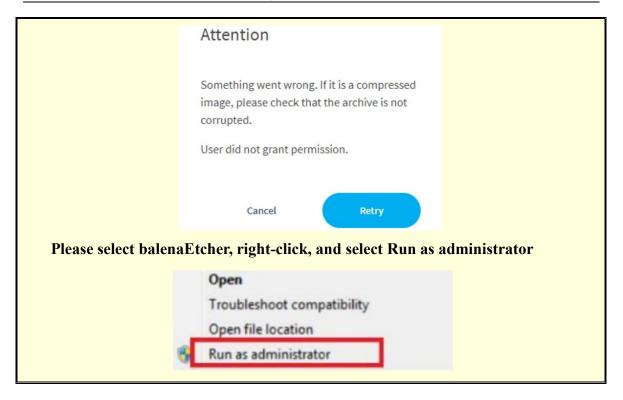


6) If the downloaded version of balenaEtcher needs to be installed, please install it before using it. If you downloaded the Portable version of balenaEtcher, just double-click to open it. The opened balenaEtcher interface is shown in the figure below

😂 Etcher			-	×
	🜍 balena Etcher		\$?
÷		4	7	
Flash from file Solution Solution				
u Clone drive				

When opening balenaEtcher, if the following error is prompted:



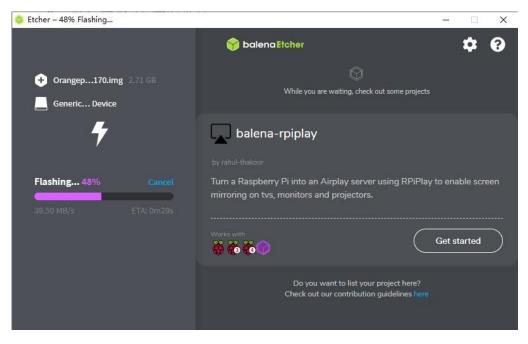


- 7) The specific steps to use balenaEtcher to burn the Linux image are aa follow
 - a. First select the path of the Linux image file to burned
 - b. Then select the drive letter of the TF card
 - c. Finally, click Flash to start burning the Linux image to the TF card

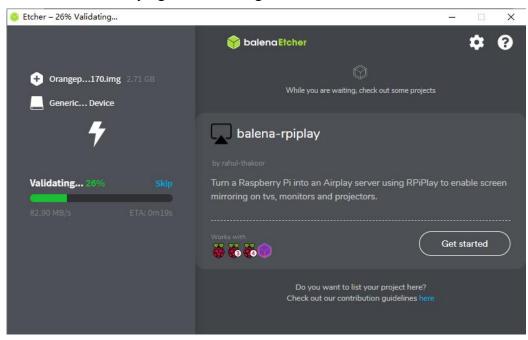


8) The interface displayed in the process of burning the Linux image by balenaEtcher is shown in the figure below, and the progress bar displays purple, indicating that the Linux

image is being burned into the TF card

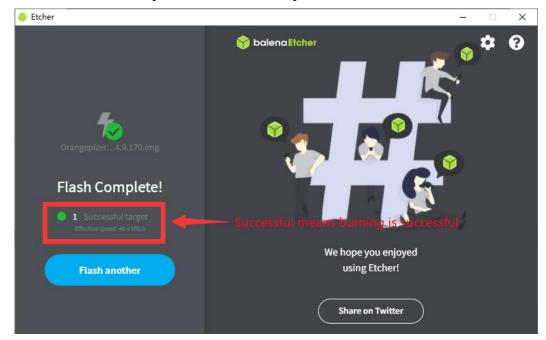


9) After burning the Linux image, balenaEtcher will also verify the image burned into the TF card by default to ensure that there is no problem in the burning process. As shown in the figure below, a green progress bar indicates that the image has been burnt, and balenaEtcher is verifying the burnt image



10) After successful burning, the display interface of balenaEtcher is 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 up



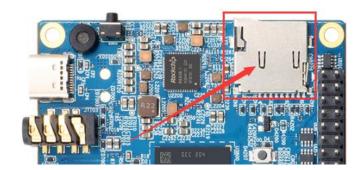
2. 3. 2. How to use RKDevTool to burn Linux image to TF card

1) First, you need to prepare a data cable with a good quality Type-C interface



2) You also need to prepare a 16GB or larger 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 insert the TF card into the card slot of the development board

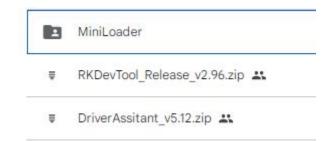


4) Then download Rockchip **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v2.96.zip** from the **Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

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



b. Then download all the files below



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

5) 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 above 2GB

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

名称 ^	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📑 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
🥞 DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

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

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

驱动安装	驱动卸载	
9E-00x44		

b. After waiting for a while, a pop-up window will prompt "driver installed successfully", and then click the "OK" button.

			_	
	DriverInstall	×		
9区z力5	È		印载	
	安装驱动成功.			
	确定	-		
		驱动线 安装驱动成功.	驱动支 安装驱动成功.	驱动ਤ 印载 安装驱动成功. 1000000000000000000000000000000000000

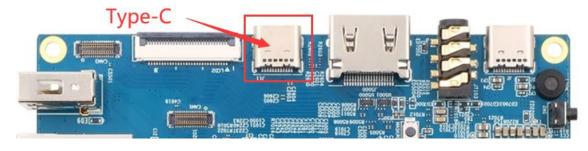
8) Then decompress RKDevTool_Release_v2.96.zip, this software does not need to be

名称	修改日期	类型	大小
<mark> </mark> bin	2022/12/1 15:07	文件夹	
📙 Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
📓 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

installed, just find **RKDevTool** in the decompressed folder and open it

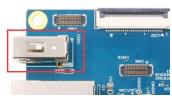
9) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"

- 10) Then start burning the Linux image into eMMC
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



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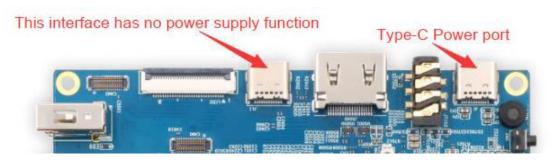
- b. Make sure the board is not connected to power
- c. Also make sure that the white USB2.0 interface in the position shown below is not plugged into a USB device



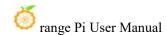
d. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is shown in the figure below:



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



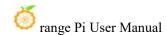
f. If the previous steps are successful, the development board will enter the MASKROM mode at this time, and the interface of the burning tool will prompt "found a MASKROM device"



0x00000000 0x00000000 0x00000000	Loader Parameter Vboot			
				A. 4 (1975)
 0x00000000	Theat			
	00001			
0x00000000	trust			
0x00000000	Misc			
0x00000000	Resource			
0x00000000	Kernel			
0x00000000	Boot			a
0x00000000	Recovery			
0x00000000	System			
0x00000000	Backup			
	0x0000000 0x0000000 0x0000000 0x0000000 0x000000	0x0000000 Resource 0x0000000 Kernel 0x0000000 Boot 0x00000000 Boot 0x00000000 Recovery 0x00000000 System	0x00000000 Resource 0x00000000 Kernel 0x00000000 Boot 0x00000000 Becovery 0x00000000 System	0x00000000 Resource 0x00000000 Kernel 0x00000000 Boot 0x00000000 Becovery 0x00000000 Recovery 0x000000000 System

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



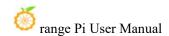
#		存储	地址	名字	路径	
1			0x00000000	Loader		
2	Г		0x00000000	Parameter		
3			0x00000000	Vboot	添加项	
4			0x00000000	trust	删除项	
5			0x00000000	Misc		
6			0x00000000	Resource	清空所有项	
7	Г		0x00000000	Kernel	上移	
8	Г		0x00000000	Boot	下移	
9	Г		0x00000000	Recovery		
10	Г		0x00000000	System	导入配置	
11	Г		0x00000000	Backup	导出配置	
.0 a d	ler:		执行	切换	设备分区表有空	

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

		存储	地址 0x00000000	名字 Loader	路径					
	÷		0x000000000000000000000000000000000000	Parameter			1.1.1			
	÷		0x00000000	Uboot			24 - 12 - 12 - 12 - 12 - 12 - 12 - 12 -			
2	i'r		0x00000000	trust						
	ÍΓ		0x00000000	Misc						
			0x00000000	Resource	1					
	Г		0x00000000	Kernel						
	Г		0x00000000	Boot		添加项	1			
			0x00000000	Recovery		删除项				
0	Г		0x00000000	System						
1			0x00000000	Backup		清空所有项				
ad	er:	[执行	切换	设备分	上移 下移 导入配置 导出配置				

j. Then select the rk3588_linux_tfcard.cfg configuration file in the MiniLoader folder downloaded earlier, and click Open

3	< 瑞芯微开发工具 v2.96	- 0 ×
🔀 打开		
← → 丶 个 📑 > 此	电脑 → 桌面 → orangepi → MiniLoader-烧录Linux稳像才需要用到的东西	✓ ∂
组织▼ 新建文件夹		88 - 🔟 🔮
 ↓ 电脑 3D 对象 副 视频 ● 関片 ● 文档 ◆ 下載 ● 育乐 ● 重 虞面 	pcie_loader sata_loader rk3588_linux_spiflash.cfg rk3588_linux_tfcard.cfg	
文件	목(N): rk3588_linux_tfcard.cfg	✓ ConfigFile(*.cfg) ✓
		打开(Q) 取消
	发现一个MASKROM设备 1-1-1-1 ::MASKROM V	



k. Then click **OK**

	存储	地址	名字	路径	
•		0x00000000	Loader	C:\Users\Administrator\Desktop\	
	SD	0x00000000	linux	C:\Users\Administrator\Desktop\	
				导入配置成功.	
				 · · · · · · · · · · · · · · ·	

1. Then click the position shown in the figure below

m. Select MiniLoaderAll.bin in the MiniLoader folder downloaded earlier, and then click to open

CO)	
9	range Pi User Manual

打开			
	> 桌面 > orangepi > MiniLoader-烧录Linux镜像才需要用到的东西 >	✓ Č 戶在MiniLi	oader-烧灵Linux
目织 ▼ 新建文件夹			88 - 💷 🤇
 此电脑 30 万余 四片 四片 四片 ① 文档 ↓ 下載 〕 音乐 二 桌面 	 pcie_loader stat_loader stat_loader rk3588_linux_ernmc.cfg rk3588_linux_spiflash.cfg rk3588_linux_tfcard.cfg rkspi_loader orkspi_loader_sata 		
文件名(N):		 ✓ All File(*.*) 打开(O) 	取消

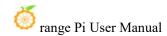
n. Then click the position shown in the figure below

(存储	地址	名字	路径	
			0x00000000	Loader	C:\Users\Administrator\Desktop\	
		SD	0x00000000	linux	C:\Users\Administrator\Desktop\	
ade	ar Ve	r:1.0b	执行	切换	设备分区表 清空	

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

	🔀 瑞芯微开发工具 v2.96	- III X
🕻 打开		>
← → ~ ↑ <mark> </mark> > J	t:电脑 → 桌面 → orangepi →	✓ O 在 orangepi 中搜索
组织 ▼ 新建文件夹		88 - 💷 🛛
 ■ 此电脑 ③ 3D 对象 圖 视频 ■ 图片 ① 文档 ◆ 下戦 ♪ 音乐 ■ 桌面 	 MiniLoader 焼衆Linux塊像ブ無要用到的东西 Orangepi5_1.1.0_ubuntu jammy_server_linux5.10.110 	
文件	名(N): Orangepi5_1.1.0_ubuntu jammy_server_linux5.10.110	 ✓ All File(*.*)
		打开(0) 取満
	发现一个MASKROM设备 1-1-1-1 : MASKROM	×

p. Then please check the option to force write by address



瑞芯谷	数开发]	[具 v2.96							×
下载镜	像升	级固件 高级	吸功能						
#		存储	地址 0x00000000	名字 Loader	路径 C:\Users\Administrator\Desktop\				
2		SD	0x00000000	linux	C:\Users\Administrator\Desktop\				
Load	er Ver	and the second se	井石 隆制技地址写	切换	设备分区表 清空				
	发	灾现一个	MASKROM	设备	1-1-1-1 :MASKROM	~		 	

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

		江具 v2.96					
载镜	像	升级固件	高级功能				
			- Die La		05/7		
#		存储	地址 0x00000000	名字 Loader	路径 C:\Users\Administrator\Desktop\		
2		SD	0x00000000	linux	C:\Users\Administrator\Desktop\		
Load	ler Ve	er : 1. Ob	执行 ✓]强制技地址写)	切换	设备分区表 清空		

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

载镜	像チ	计级固件 高	高级功能			下载Boot开始
#		存储	地址	名字	路径	等待Maskrom成功
1 2	•	SD	0x00000000 0x00000000	Loader linux	C:\Users\Administrator\Desktop\ C:\Users\Administrator\Desktop\	测试设备开始 测试设备成功
						按验芯片成功 获取FlashInfo成功 准备IDF开始
						/在面1107%和 注着T110席功 下载I10席功 下载110席功 等待Maskrom开始 等待Maskrom成功 测试设备开始 <u>测试设备</u> 成功 开始切换存储到SD 开始「数0rangepi5_1.1.0_ubuntu_jammy_server_linux5.10.110

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

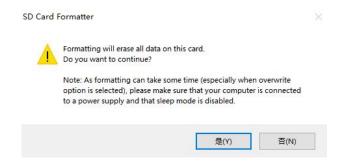
- 2) Then use the card reader to insert the TF card into the computer
- 3) Then format the TF
 - a. **SD Card Formatter** can be used to format the TF card. The download address is:

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

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

Select card		
F:\		~
		Refresh
Card information	1	
Туре	SDHC	52
Capacity	14.84 GB	
Formatting optic Quick format	ns	
Overwrite for	mat	
CHS format s	ize adjustment	
Volume label		
1		

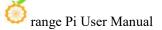
d. Then click "Format", a warning box will pop up before formatting, and formatting will start after selecting "Yes (Y) "



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



4) 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 above 2GB



Note that if you download an OpenWRT image, you will see the following three types of images in the download link of the OpenWRT image. Please select the "TF card boot image" folder. Name ↑ SD Card Image SD Card Image SPIFlash-NVME SSD Image SPIFlash-SATA SSD Image Then select the image compression package below to download

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
 - 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 burn

變 Win32 磁盘映像工具 - 1.0 映像文件		口 × し ひ
		[F:\] ▼
校验值		1
无 ▼ 生成 复制		/
	ci Select	the TE car
Select the im-	age file Select	the TF card
Select the im	age file Select	the TF card
Select the im	age me	the TF card
□ 仅读取已分配分区 任务进度	age me	the TF card
Select the im.	age me	the TF card

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. How to burn Linux image to TF card based on Ubuntu

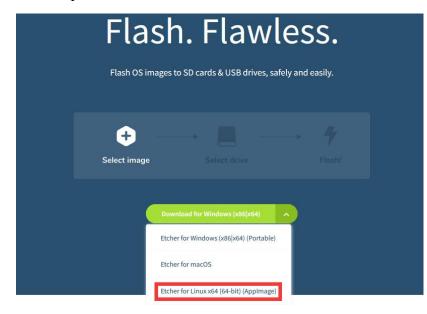
Note that the Linux image mentioned here specifically refers to the image of Linux distributions such as Debian or Ubuntu downloaded from the Orange Pi data download page, and the Ubuntu PC refers to the personal computer with the Ubuntu system installed.

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 brand

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

 Download the balenaEtcher software, the download address is: https://www.balena.io/etcher/

4) After entering the balenaEtcher download page, please select the Linux version of the software from the drop-down box to download



5) 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

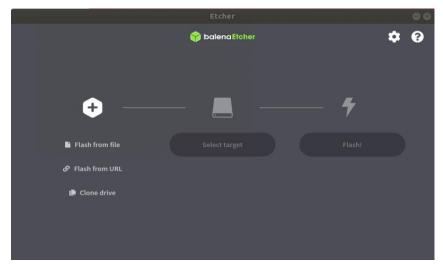
software to decompress it. Among the decompressed files, the file ending with ".img" is the image file of the operating system. The size is generally more than 22GB

The decompression command for the compressed package ending in 7z is as follow test@test:~\$ 7z x Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.7z test@test:~\$ ls Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.* Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.7z Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.sha #checksum file Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.img #Image file

6) 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

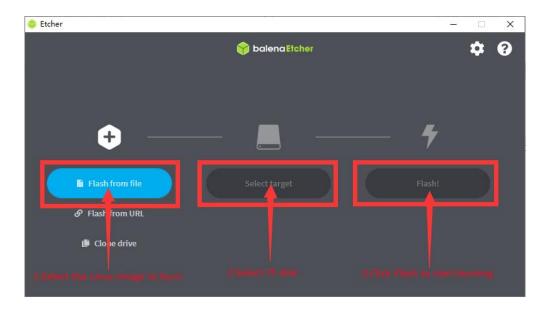
test@test:~\$ sha256sum -c *.sha
Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.160.img: OK

7) 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 belobalenaEtcher



- 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

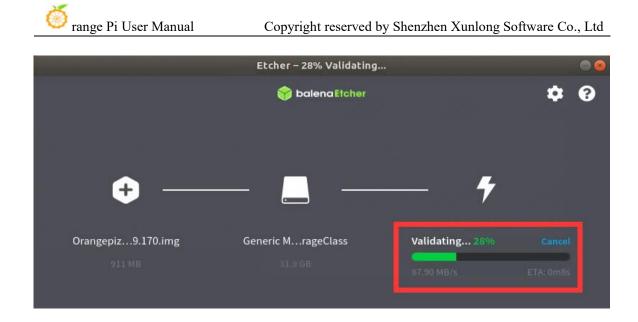
www.orangepi.org



9) The interface displayed during 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

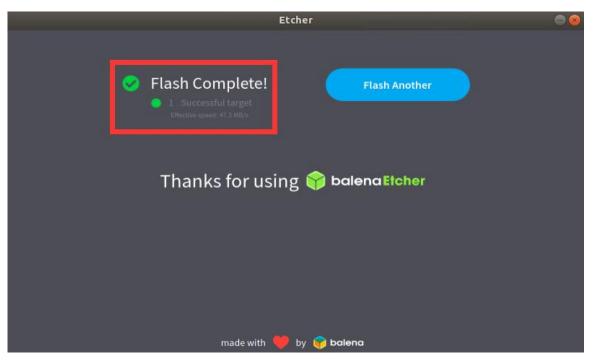
	Etcher – 50% Flashing		e	0
	🌍 balena Etcher		\$	•
.	— 🛄 —	- +		
Orangepiz9.170.img	Generic M…rageClass	Flashing		
911 MB		40.60 MB/s	ETA Omlas	

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) The display interface of Balenaetcher after the successful record is completed. If the green indicator icon is displayed in the figure below, the image burning is successful, then you can exit Balenaetcher, then unplug the TF card into the TF card slot in the development board and use

it.



2. 5. How to write Linux image to SPI Flash+NVMe SSD

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

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

2. 5. 1. How to use RKDevTool to burn

1) First, you need to prepare an NVMe SSD. The PCIe supported by the M.2 slot of the development board is PCIe2.0x1, and the theoretical maximum speed is 500MB/s. PCIe3.0 and PCIe4.0 NVMe SSDs are also available, but the highest speed is only PCIe2.0.

a. The M.2 2230 SSD is as follows



b. The M.2 2242 SSD is as follows



2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



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 data cable with good quality Type-C interface

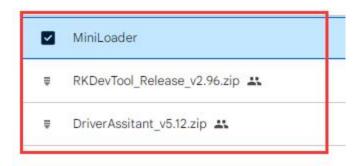


5) Then download Rockchip **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v2.96.zip** from the **Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

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



b. Then download all the files below



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

5) 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 above 2GB

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

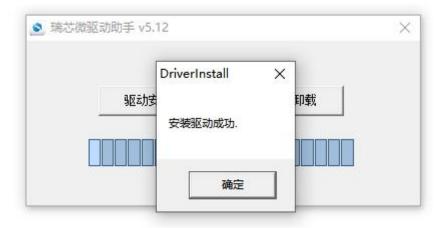
名称	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
le DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

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

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

	驱动安装	驱动卸载
--	------	------

b. After waiting for a while, a pop-up window will prompt "driver installed successfully", and then click the "OK" button.



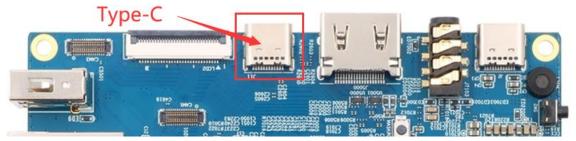
8) Then decompress **RKDevTool_Release_v2.96.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

名称 ^	修改日期	类型	大小
bin bin	2022/12/1 15:07	文件夹	
Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
🤬 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

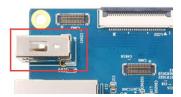
9) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left

corner will prompt "No device found"

- 10) Then start burning the Linux image to the SSD
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below.



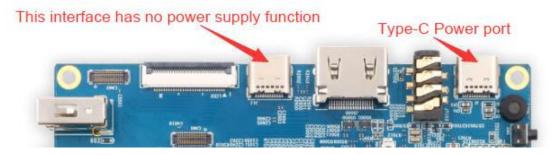
- b. Make sure that the development board is not connected to the power supply and inserted into the TF card.
- c. Also make sure that the white USB2.0 interface in the position shown below is not plugged into a USB deviceUSB2.0.



d. 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:



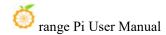
e. Then connect the power supply of the Type-C interface to the development board, and power on, and then release the MaskROM button



f. 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"

	□ 存储 地址 名字 路径	
Γ	0x00000000 Loader	
Γ	0x00000000 Parameter	
	0x00000000 Vboot	
	0x00000000 trust	
	0x0000000 Misc	
	0x00000000 Resource	
	0x0000000 Kernel	
	0x0000000 Boot	
	0x00000000 Recovery	
1.2		
Γ	0x00000000 Backup	
1.2	0x0000000 System	

g. Then place the mouse cursor in the area below

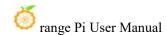


#		存储	地址 0x00000000	名字 Loader	路径		
2	-		0x00000000	Parameter			
3	ΪĒ		0x00000000	Uboot			
4	Г		0x00000000	trust			
5			0x00000000	Misc			
6	Г		0x00000000	Resource			
7	Г		0x00000000	Kernel		11	
8			0x00000000	Boot		11 81	
9			0x00000000	Recovery			
10			0x00000000	System			
11			0x00000000	Backup			
II Load	ler:		执行 强制技地址写	backup 切换	设备分区表 清空]	Place the mouse cursor in this

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

#		存储	地址	名字	路径	
1			0x00000000	Loader		
2	Г		0x00000000	Parameter		
3	Г		0x00000000	Vboot	添加项	
1			0x00000000	trust	删除项	
5			0x00000000	Misc		
3			0x00000000	Resource	清空所有项	
1	Г		0x00000000	Kernel	上移	
3	Г		0x00000000	Boot	下移	
3	Г		0x00000000	Recovery	a desire a second a s	
10	Г		0x00000000	System	导入配置	
11	Г		0x00000000	Backup	导出配置	
.0 a d	er:		执行 □强制按地址写	切换	设备分区表 清空	

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

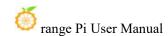


#		存储	地址	名字	路径						
1			0x00000000	Loader							
2	Г		0x00000000	Parameter			C				
3			0x00000000	Uboot							
4			0x00000000	trust							
5			0x00000000	Misc							
6			0x00000000	Resource							
7	Г		0x00000000	Kernel							
8	Г		0x00000000	Boot		添加项	1				
9	Г		0x00000000	Recovery		删除项					
10	Г		0x00000000	System							
11	Г		0x00000000	Backup		清空所有项					
Load	er:	[执行	切换	设备分	上移 下移 导入配置 导出配置					

j. Then enter the **MiniLoader** folder downloaded earlier, and then enter the pcie_loader folder, then select the **rk3588_linux_pcie.cfg** configuration file, and click **Open**.

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	×
此电脑 > 桌面 > orangepi > MiniLoader-烧录Linux镜像才需要用到的东西 > pcie_loader	✓ ひ
	## • 🛄 💡
rk3588_linux_pcie.cfg	
@ uboot	
v	
名(N): rk3588_linux_pcie.cfg	✓ All File(*.*) ✓
	打开(0) 取消
发现一个MASKROM设备 1 ^{−1−1−1} :MASKROM ✓	
	此規論 → 貞面 → orangepi → MiniLoader-焼泉Linux鎮像才需要用到的东西 → pcie_loader

k. Then click **OK**



	存储	地址	名字	路径	
V	SPINOR	0x00000000 0x00004000	Loader uboot	C:\Users\Administrator\Desktop\ C:\Users\Administrator\Desktop\	
1	PCIE	0x00004000	linux	C: \Users\Administrator\uesktop\	
				● → 配置成功.	
				确定	

1. Then click the position shown in the figure below

敦硯		升级固件 高	級功能				
#		存储	地址	名字	路径		
1			0x00000000	Loader	C:\Users\Administrator\Desktop\		
2		SPINOR	0x00004000	uboot	C:\Users\Administrator\Desktop\		
3	~	PCIE	0x00000000	linux	C:\Users\Administrator\Desktop\		
.oad	er Ve	er:1.0b	执行	切换	设备分区表 有空		

m. Select MiniLoaderAll.bin in the MiniLoader folder downloaded earlier, and then click to open

A 10	际态微开发上具 v2.96	- 0 ×
🔀 打开		
🔶 🌙 🔹 🕇 🔒 × 此电源	> 桌面 > orangepi > MiniLoader-烧录Linux镜像才需要用到的东西	✓ O 在 MiniLoader-焼泉Linux
组织 🔹 新建文件夹		BB 🔻 🛄 🌘
 ■ 此电脑 ③ 3D 对象 ■ 机炭 ■ 間片 ① 文档 ◆ 下號 → 音乐 ■ 興面 	 pcie_loader sata_loader MiniLoaderAll.bin rr43588_linux_spiflash.cfg rk3588_linux_tfcard.cfg rksji_loader rkspi_loader_sata 	
文件名(N	: MiniLoaderAll.bin	All File(*.*)
	发现一个MASKROM设备 I=I=I=I #MASIGON	打开(0) 取消

n. Then click the position shown in the figure below

	SPINOR	地址 0x00000000 0x00004000	名字 Loader	路径 C:\Users\Administrator\Desktop\		
V	SPINOR	0+00004000				
•			uboot	C:\Users\Administrator\Desktop\		
	PCIE	0x00000000	linux	C:\Users\Administrator\Desktop\		

o. Then enter the **MiniLoader** folder downloaded earlier, then enter the pcie loader folder, then select the **uboot** file, and click **Open**.

	🔀 瑞芯微开发工具 v2.96	- 0 X
🔀 打开		×
← → • ↑ <mark>.</mark> •	此电脑 > 桌面 > orangepi > MiniLoader-烧裂Linux确像才需要用到的东西 > pcie_loader	✓ O 在 pcie_loader 中搜索
组织 ▼ 新建文件夹		BR - 🛄 📀
 ↓ 此电脑 3D 对象 3D 对象 ■ 視频 ● 图片 ● 2 大档 ◆ 下戦 → 音乐 ■ 桌面 	^	
文	件名(N): uboot	✓ All File(*.*) ✓
		打开(Q) 取満
	发现一个MASKROM设备 1-1-1-1: MASIRBOM ~	

p. Then click the position shown in the figure below



				Y				
	存储	地址	名字	路径				
		0x00000000	Loader	C:\Users\Administrator\Desktop\				
•	SPINOR	0x00004000	uboot	C:\Users\Administrator\Desktop\				
\checkmark	PCIE	0x00000000	linux	C:\Users\Administrator\Desktop\				

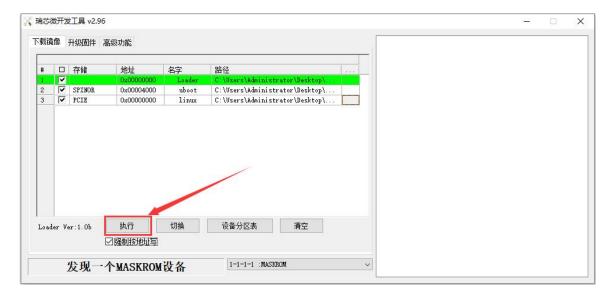
q. Then select the path of the linux image you want to burn, and click **Open**

1. 13	芯微开发工具 v2.96		- 🗆 🗙
🔀 打开			×
🔶 -> -> 🛧 📙 > 此电脑	→ 桌面 → orangepi →	v	● 在 orangepi 中搜索
组织 ▼ 新建文件夹			## • 🔳 💡
 ↓ 此电脑 ↓ ■ 初次歳 ▶ ■ 祝坂 ▶ ■ 大档 ▶ ↓ 下戦 ▶ ■ 音乐 > ■ 真面 	 MiniLoader.焼泉Linux機像才需要用到的东西 Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.110 		
文件名(N)	Crangepi5_1.1.0_ubuntu_jammy_server_linux5.10.110		✓ All File(*.*) ✓
			打开(Q) 取消
	发现一个MASKROM设备 1-1-1-1 : MASKROM	~	

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

PINOR 0x00004000	: 路径 oader C. \Users\Administrator\Desktop aboot C: \Users\Administrator\Desktop Linux C: \Users\Administrator\Desktop	Access to the second
0x00000000	.oader C:\Users\Administrator\Desktop uboot C:\Users\Administrator\Desktop	
PINOR 0x00004000	uboot C:\Users\Administrator\Desktop	Access to the second
LE 0x0000000	linux C:\Users\Administrator\Desktop	<u>A</u>
1.	ob țing 切抽	

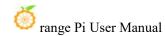
s. Click the Execute button again to start burning the linux image to the SSD



t. The log displayed after burning the linux image is shown in the figure below

	n /13%19	^件 高级功能			等待Maskrom开始 等待Maskrom成功 测试设备开始
	□ 存储	地址	名字	路径	测试设备成功
		0x00000000	Loader	C:\Users\Administrator\Desktop\	校验芯片开始
-	SPINC		uboot	C:\Users\Administrator\Desktop\	校验芯片成功
3	PCIE	0x00000000	linux	C:\Users\Administrator\Desktop\	获取FlashInfo开始 获取FlashInfo成功
Loader	r Ver:1.0	执行	切换	设备分区表 清空	 卵i試设备开始 卵i试设备成功 开始切换存储写USINOR 开始订款phoot 正在下载 uboot(100%) 等待Loader开始 等待Loader成功 开始订换存储型FCIE

- u. Then burn the uboot image required by the linux system in the SSD to SPIFlash, and **first enter the MaskROM mode again**.
- v. Then select the import configuration option



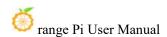
载镜	像	升级固件 高	级功能			等待Maskrom历功 等待Maskrom成功
#		存储	地址	名字	路径 …	
1			0x00000000	Loader	C:\Users\Administrator\Desktop\	校验芯片开始
2		SPINOR	0x00004000	uboot	C:\Users\Administrator\Desktop\	校验芯片成功
3	~	PCIE	0x00000000	linux	C:\Users\Administrator\Desktop\	·····································
Load	er Ve		执行]强制按地址写 「发现设备	切换	清空所有项 上移 下移 导入配置 导出配置 设备分区表 清空	下戦IDB成功 等待Maskrom开始 等待Maskrom成功 测试设备开始 测试设备成功 开始订线存储理(STINOR 开始下载, boot(100%) 等待Loade开始 等待Loade开始 等待Loade开始 等待Loader成功 开始切填存储理(PCIE 开始下载0rangeji5_1.1.0_ubuntu_jammy_server_linux5.10.11 正在下载 0rangepi5_1.1.0_ubuntu_jammy_server_linux5.10.11

w. Then select the rk3588_linux_spiflash.cfg configuration file in the MiniLoader folder downloaded earlier, and click **Open**.

	🗙 瑞芯微开发工具 v2.96	- 0 X
※打开 ← → ~ ↑ □ → 止	/甩脑 → 貞面 → orangepi → MiniLoader-烧录Linux狼缘才需要用到的东西	× む の 在 MiniLoader 機製Linux
组织 ▼ 新建文件夹	 pcie_loader sata loader 	BB - 🛄 🥹
 3D 対象 器 视频 ご 图片 ゴ 文档 	MiniLoaderAllbin hts388.jinux_emmc.cfg k3588.jinux_spiflash.cfg k3588.jinux_spiflash.cfg	
 ↓ 下戴 ♪ 音乐 	 inder inder_sata 	
■ 桌面 文件	< ۲۵۱۷: Orangepi5_1.1.0_ubuntu jammy_server_linux5.10.110	✓ All File(*.*) ✓ 打开(Q) 取満
	发现一个MASKROM设备 1-1-1-1 IMASK80M ~	h

x. Then click **OK**

					等待Maskrom成功 测试设备开始
#	口存	诸 地址	名字	路径	. 测试设备成功
1		0x00000000	Loader	C:\Users\Administrator\Desktop\	校验芯片开始
2	SP	ENOR 0x00000000	uboot	C:\Users\Administrator\Desktop\	校验芯片成功 获取FlashInfo开始
				RKDevTool X 引和国成功. 適定	获取FlashInfo成功 准备IDB开始 准备IDB开始 下载IDB成功 下载IDB成功 等待Maskron开始 等待Maskron开始 等待Maskron成功 测试设备开始 测试设备开始 测试设备有约 开始切换存储到(SPINOR 开始切换存储到(SPINOR 开始订数中载ubot
		.0b 执行	切换	设备分区表 清空	正在下载 uboot(100%) 等待Loader开始 等待Loader成功 开始切换存储智FCIE

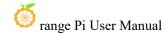


- 🔀 瑞芯微开发工具 v2.92 × -下载镜像 升级固件 高级功能 等待Maskrom开始 ^ 等待Maskrom成功 测试设备开始 测试设备成功 口 存储 地址 名字 路径 # 校验芯片开始 校验芯片成功 SPINOR 2 0x00000000 uboot C:\Users\Administrator\Desktop\. 获取FlashInfo开始 (100%) 切换 设备分区表 执行 清空 Loader Ver:1.0b ☑ 强制按地址写 开始下载Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.11 正在下载 Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.1 1-1-1-1 : MASKROM 发现一个MASKROM设备 ~ 下载完成 v
- y. Then click the position shown in the figure below

z. Select **MiniLoaderAll.bin** in the **MiniLoader** folder downloaded earlier, and then click to open

3	瑞芯微开发工具 v2.96	- 0 X
🗙 打开		×
← → * ↑ → ₺	电脑 > 桌面 > orangepi > MiniLoader-烧录Linux镜像才需要用到的东西	✓ ひ 戸 在 MiniLoader-焼卖Linux
组织 ▼ 新建文件夹		BB 🔫 🛄 💡
● 此电脑 ③ 3D 对象 圖 视频 ● 問片 ● 文档 ◆ 下载 ● 音乐 ● 真面	 pcie_loader sata_loader Minit.GoaderAllibin rk3588_linux_emmc.cfg rk3588_linux_tfcard.cfg rkss88_linux_tfcard.cfg rkspi_loader @ rkspi_loader_sata 	
文件名	S(N): MiniLoaderAll.bin	✓ All File(*.*) ✓ 打开(2) 取消
	发现一个MASKROM设备 I=1=1=1 :MASTGOM	

aa. Then click the location shown in the figure below



载镜	i像;	升级固件 高	级功能			等待Maskrom开始 等待Maskrom成功 测试设备开始
#		存储	地址 0x00000000	名字 Loader	路径 C:\Users\Administrator\Desktop\	则叫设备开始 则试设备成功 校验芯片开始
2		SPINOR	0x0000000	uboot	C:\Users\Administrator\Desktop\	校验芯片成功 家取FlashInfo成功 准备IDB开始 准备IDB成功 下载IDB成功 下载IDB成功 等待Maskrom开始 等待Maskrom成功 则iT设备开始 则iT设备成功 开始U独存储到SFINOR 开始U独存储到SFINOR 开始U独存(if)SFINOR 开始U独存(if)SFINOR 开始U独存(if)SFINOR 开始U独存(if)SFINOR
		er:1.0b	执行	切换	设备分区表 清空	等待Loader开始 等待Loader成功 开始切换存储到FCIE
Load	er Ve		强制按地址写			开始下载Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.1

ab. Then select **rkspi_loader** in the **MiniLoader** folder downloaded earlier, and then click to **open**

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元 (→ × ↑ (→ × ↑)	此电脑 → 桌面 → orangepi → MiniLoader-烧录Linux魏喙才需要用到的东西 →	× v む の 在 MiniLoader-提录Linux
组织 ▼ 新建文件夹		BB - 🔟 💡
 ○ 此电脑 3D 对象 ◎ 副 视频 ○ 圖 化频 ○ 圖 文档 ○ ● 下號 ○ ● 示, ○ ■ 桌面 	 pcie_joader sata_loader MinikoaderAll.bin rk3588_linux_emmc.cfg rk3588_linux_tfcard.cfg rks3588_linux_tfcard.cfg rkspi_loader rkspi_loader_sata 	
文件	μ ξ(Ν): [✓ All File(*.*) ✓ 打开(O) 取満
	发现一个MASKROM设备 1-1-1-1 MASISOM ~	

ac. Then please make sure that the option to **force writing by address** is ticked

彩塊	像升纲	级固件 高级功能			等待Maskrom开始 等待Maskrom成功
#	口存	存储 地址	名字 10 Loader	路径 C:\Users\Administrator\Desktop\	测试设备开始 测试设备成功 检验芯片开始
2	and the second se	SPINOR 0x000000		C:\Users\Administrator\Desktop\	校验芯片成功 获取FlashInfo成功 获取FlashInfo成功 准备IDB开始 准备IDB开始 下载IDB开始
					F 334.105845 等待Maskrom开始 等待Maskrom开始 测试设备和均 列试设备和均 开始切换存储到SPINOR 开始下载uboot 下存下载 uboot(100%)

- 🔏 瑞芯微开发工具 v2.92 _ × 下载镜像 升级固件 高级功能 等待Maskrom开始 ~ 等待Maskrom成功 测试设备开始 测试设备成功 口 存储 地址 名字 路径 SPINOR 校验芯片开始 校验芯片成功 0x00000000 uboot C:\Users\Administrator\Desktop\. 获取FlashInfo开始 获取FlashInfo成功 准备IDB开始 准备IDB成功 下载IDB开始 下载IDB成功 等待Maskrom开始 等待Maskrom成功 测试设备开始 则试设备成功 开始切换存储到SPINOR 开始下载uboot. 正在下载 uboot. (100%) 等待Loader开始 切换 设备分区表 Loader Ver:1.0b 执行 清空 等待Loader成功 开始切换存储到PCIE ☑强制按地址写 开始下载Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.11 正在下载 Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.1 1-1-1-1 :MASKROM 发现一个MASKROM设备 下载完成
- ad. Click the Execute button again to start burning the u-boot image into SPIFlash

ae. The display log after burning the u-boot image is shown in the figure below.

	升级固件 高	高级功能		(下载Boot开始 下载Boot成功		
ŧ 🗆		地址 0×00000000	名字 Loader	路径 C:\Users\Administrator\Desktop\	等待Maskrom开始 等待Maskrom成功 测试设备开始		
2	SPINOR	0x00000000	uboot	C:\Users\Administrator\Desktop\	测试设备成功 校验芯片开始 校验芯片成功 获取FlashInfo开始 获取FlashInfo成功		

af. After the u-boot image is burnt, it will automatically start the linux system in the SPIFlash+PCIe SSD. If it does not start normally, please power on and try again.

2. 5. 2. How to use the dd command to burn

1) First, you need to prepare an NVMe SSD. The PCIe supported by the M.2 slot of the development board is PCIe2.0x1, and the theoretical maximum speed is 500MB/s. PCIe3.0 and PCIe4.0 NVMe SSDs are also available, but the highest speed is only PCIe2.0x1 PCIe2.0x1.

a. The M.2 2230 SSD is as follow



b. The M.2 2242 SSD is as follow



2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



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

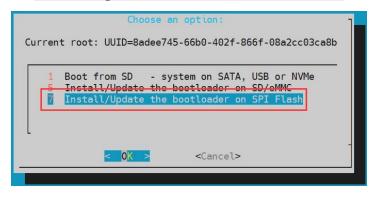


4) Burning the linux image to SPIFlash+NVMe SDD needs to be completed with the help of a TF card, so first you need to burn the linux image to the TF card, and then use the TF card to start the development board to enter the linux system. For the method of burning the Linux image to the TF card, please 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

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

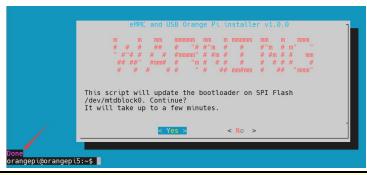
b. Then select 7 Install/Update ther bootloader on SPI Flash



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)

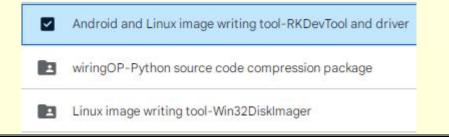


There is no nand-sata-install script in OPi OS Arch system, please use the following command to image u-boot to SPI Flash:

[orangepi@orangepi~]\$ sudo dd if=/boot/rkspi loader.img of=/dev/mtdblock0

If you need to start the OpenWRT image, you need to download the latest version of u-boot image from the official website, and then burn it into SPI Flash. The download steps are as follows:

a. First enter the data download page of the development board, then select the official tool on the data download page, and then enter the folder below



b. Then choose t	o enter th	e following directory	
		MiniLoader	
	\$	RKDevTool_Release_v2.96.zip 🚜	
	Ŧ	DriverAssitant_v5.12.zip	
c. Then downloa	d rkspi_l	oader.img	
		sata_loader	
		pcie_loader	
		rkspi_loader_sata.img	
		rkspi_loader.img	
of the developmen the method of uplo Finally, execut (note that this com	t board. I bading file te the folle umand is e	der.img to the Ubuntu or Debian or OPi OS For the upload method, please refer to the es to the Linux system of the development owing command to burn the u-boot image executed in Ubuntu, Debian, or OPi OS An dd if=rkspi_loader.img of=/dev/mtdblock(instructions in board. into SPI Flash rch):

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**

Note that if you download an OpenWRT image, you will see the following

three types of images in the download link of the OpenWRT image. Please select the "TF card boot image" folder.

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

Orangepi5_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 **nyme** 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

0004:40:00.0 PCI bridge: Fuzhou Rockchip Electronics Co., Ltd Device 3588 (rev 01) 0004:41:00.0 Non-Volatile memory controller: MAXIO Technology (Hangzhou) Ltd. NVMe SSD Controller MAP1202 (rev 01)

9) Then we can use the dd command to clear the NVMe SSD(Optional)

orangepi@orangepi5:~/Desktop\$ sudo dd bs=1M if=/dev/zero of=/dev/nvme0n1 count=2000 status=progress orangepi@orangepi5:~/Desktop\$ sudo sync

10) Then you can use the dd command to burn the linux image of the development board to the NVMe SSD.

- a. 下面 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=Orangepi5_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 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.

11) 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, and then the linux system in SPIFlash+NVMe SSD will be started.

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

a. 128GB NVMe SSD

orangepi@orange	pi:~ \$ df	-h		
Filesystem	Size U	sed Av	ail 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	90N	1 166N	1 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 NVI	Me SSD			
orangepi@orange	pi:~\$ df	-h		
Filesystem	Size U	sed Av	ail 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	1.8 T	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	90N	1 166N	1 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

13) When the TF card and NVMe SSD are programmed with exactly the same system, if both the TF card and NVMe SSD are inserted into the development board, power on the development board at this time, and u-boot will give priority to starting the system in the TF card. However, since the systems in the TF card and 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

There is no fix_mmc_ssd.sh script in OPi OS Arch system.

2. 5. 3. How to use the balenaEtcher to burn Please do not use this method for OPi OS Arch system.

1) First, you need to prepare an NVMe SSD. The PCIe supported by the M.2 slot of the development board is PCIe2.0x1, and the theoretical maximum speed is 500MB/s. PCIe3.0 and PCIe4.0 NVMe SSDs are also available, but the highest speed is only PCIe2.0x1.

a. The M.2 2230 SSD is as follows



b. The M.2 2242 SSD is as follows



2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



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) Burning the linux image to SPIFlash+NVMe SDD 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.

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** 0004:40:00.0 PCI bridge: Fuzhou Rockchip Electronics Co., Ltd Device 3588 (rev 01) 0004:41:00.0 Non-Volatile memory controller: MAXIO Technology (Hangzhou) Ltd. NVMe SSD Controller MAP1202 (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 **Flash from file**



b. Then enter the /usr/lib/linux-u-boot-legacy-orangepi5_1.x.x_arm64 directory, selectrkspi_loader.img, and click Open to open

Cancel			٩	Dpen 📴
③ Recent	♦ 🕑 usr lib linux-u-boot-legacy-orangepi5_1.0.2_arm64 🕨			
ට Home	Name	▼ Size	Туре	Modified
	🗋 idbloader.img	292.9	kB Raw disk image	13:16
Desktop	📑 rkspi_loader.img	16.8	4B Raw disk image	13:16
Documents				

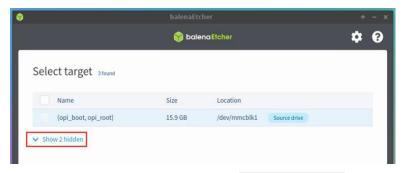
c. The interface after opening **rkspi_loader.img** is as follow:



d. Then click Select target



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



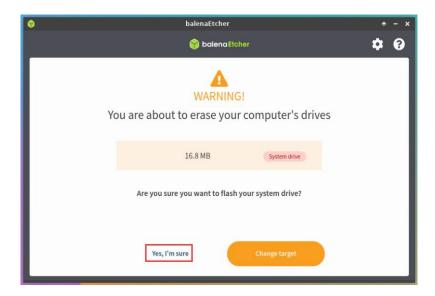
f. Then select the device name of SPI Flash /dev/mtdblock0, and click Select

۲		balenaEtc	her		↑ - ×
	Warning! Selecti	ng your system drive	is dangerous and will erase	your drivel	\$ 0
Γ	Select target 3 found				
	- Name	Size	Location		
	(opi_boot, opi_root)	15.9 GB	/dev/mmcblk1 s	iource drive	
	A	16.8 MB	/dev/mtdblock0 s	lystem drive	
Ľ	Fanxiang S500PRboot, opi_root)	2.05 TB	/dev/nvme0n1 s	system drive	
L					
L					
		ancel	Select (1)		

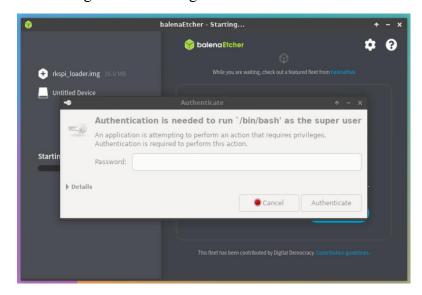
g. Then click Flash



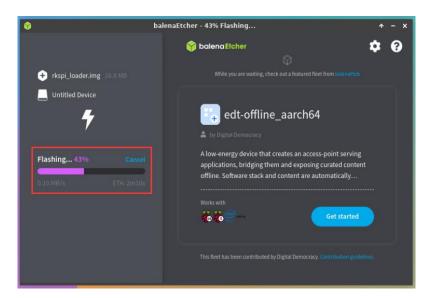
h. And then click Yes, I'm sure



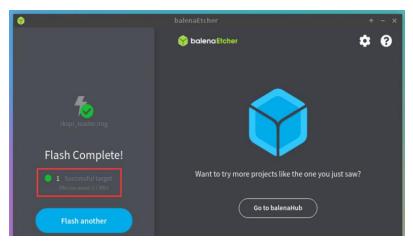
i. Then enter the password **orangepi** of the development board linux system, and it will start burning the u-boot image into the SPI F.



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



k. The display after burning is as follow:



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

	balenaEtch	er	↑ - ×
	😚 balen	aEtcher	¢ 0
Select source 3 found			
Name	Size	Location	
(opi_boot, opi_root)	15.9 GB	/dev/mmcblk1 Source drive	
✓ Show 2 hidden			
	Cancel	Select (1)	

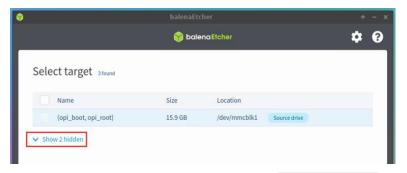
c. The interface after opening the TF card is as follows:

0	balenaEtcher	↑ - ×
balenaEtcher Edit View Window Help		
	😚 balena Etcher	¢0
÷	*	
(opi_boot, opi_root) Remove 15.9 68	Select target Flash!	D

d. Then click Select target



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



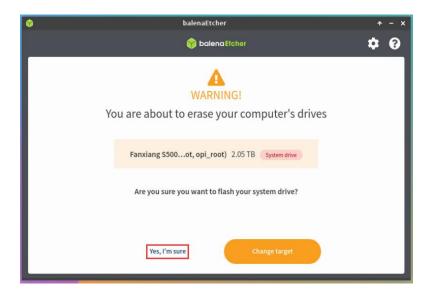
f. Then select the device name of the NVMe SSD /dev/nvme0n1, and click Select

٥	balenaEtc	her	↑ - ×
Warnin	g! Selecting your system drive	is dangerous and will erase your drive	\$ 9
Select target 3 found			
- Name	Size	Location	
(opi_boot, opi_root)	15.9 GB	/dev/mmcblk1 Source drive	
	16.8 MB	/dev/mtdblock0 Too small	
Fanxiang S500PR. opi_root)	boot, 2.05 TB	/dev/nvme0n1 System drive	
	Cancel	Select (1)	

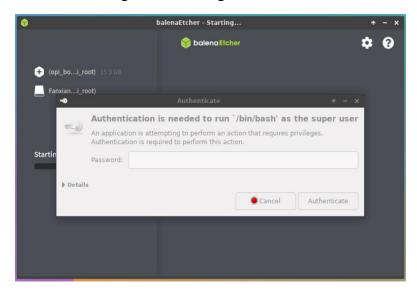
g. Then click Flash



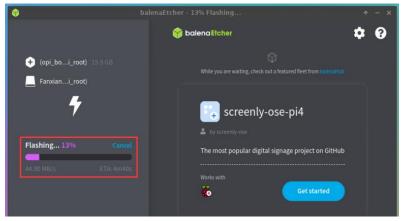
h. Then click Yes, I'm sure

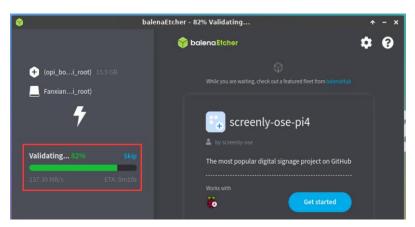


i. Then enter the password orangepi of the linux system on the development board, and it will start burning the linux image to the SSD



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

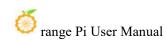


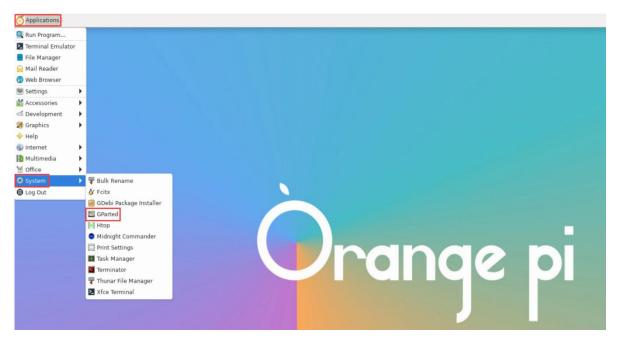


k. The display after burning is as follow:

0	balenaEtcher	+ - ×
		¢Ø
Flash Complete!		Ĵ
Successful target Effective spend: 48.8 MB/s	Want to try more projects like the	e one you just saw?
Flash another	Go to balenaHub	

- 1. Then you need to expand the capacity of the rootfs partition in the NVMe SSD. The steps are as follows:
 - a) First open GParted





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

	Authen	ticate	★ - ×
			arted
			equires privileges.
Password:	•••••		
ils			
		Cancel	Authenticate
	Partition An applicatio Authenticati Password:	Authentication is requ Partition Editor as roo An application is attempting to Authentication is required to pe Password:	ls

c) Then click **Fix**

GParted Edit Vie	G w Device Partition Help	iParted				↑ - c	ı X
P 🙁 🕅	li 🔓 🥱 🗸						-
Partition Name	File System Mount Point	Label	Size	Used	Unused	Flag	5
	Lil	oparted Wa	arning				
	Not all of the space av be used, you can fix tl extra 3969681072 blo setting?	ne GPT to a	use all of	the space (a	an		
	Fix			Ignore			
Searching /dev/nvr	ne0n1 partitions						

d) Then select NVMe SSD

2		/dev/r	nmcblk1 - GPar	ted			ب ا	- 🗆 X
GParted Edit V	iew Device	e Partition He	elp					
· 😣 👌		6	1			🔵 /dev/mm	cblk1 (14	4.84 GiB)
			/dev/mmcl 14.41 GiB	blk1p2		/dev/nvm	neOnl (1.	86 TiB)
Partition	Name	File System	Mount Point	Label	Size	Used	Unused	Flags
unallocated /dev/mmcblk1p /dev/mmcblk1p;			/boot /, /var/log.hdd	opi_boot opi_root	30.00 MiB 256.00 MiB 14.41 GiB		 165.78 MiB 9.50 GiB	bls_boo
unallocated		unallocated			153.50 MiB			

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

1		/dev/n	vme0n1 - GPar	ted			^	– 🗆 🗙
GParted Edit View	Device	e Partition He	elp					
▶ ⊗ 🔊			1			/dev/nvn	ne0nl (1.80	6 TiB) 🔻
			unallo 1.85 T					
Partition	Name	File System	Mount Point	Label	Size	Used	Unused	Flags
	1-	unallocated				202		
unallocated		unanocated			30.00 MiB			
unallocated /dev/nvme0n1p1	bootfs	-	/boot	opi_boot	256.00 MiB			bls_boot
	bootfs	-	/boot	opi_boot opi_root		 6.38 GiB		bls_boot

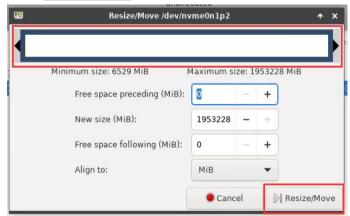
 f) Then select the /dev/nvme0n1p2 partition, click the right button again, and then select Resize/Move

Dented Edit Minu	Devi		ivme0n1 - GPar	ted			*	- ¤ ×
GParted Edit View	Device	Partition He	elp					
🕑 🙁 🔊			2			/dev/nvr	me0n1 (1.86	5 TiB) 🔻
			unallo 1.85 T					
Partition	Name	File System	Mount Point	Label	Size	Used	Unused	Flags
unallocated		unallocated			30.00 MiB			
/dev/nvme0n1p1🛕	bootfs	fat16	/boot	opi_boot	256.00 MiB		202	bls_boot
/dev/nvme0n1p2		ext4		opi_root	o New	e on ein	Insert	
unallocated		unallocated			Delete		Delete	
					Resize/M	ove		
					탄 Copy		Ctrl+C	
					📔 Paste		Ctrl+V	
					Format to		•	
					Open Enc	ryption		
					Mount			
					Name Pa	rtition		
0 operations pending					Manage F	lags		
o operacions periarity					Check			_
					Label File	System		
					New UUI	D		
					💡 Informati			

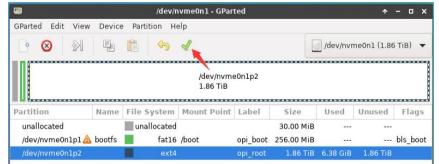
g) Then drag the capacity to the maximum at the position shown in the figure below

8	Resize/Move /dev/n	vme0n1p2				٠	×
		Maximum si	ze: 1		B MIB		
	Free space preceding (MiB):	_		+			
	New size (MiB):	14754	-	+			
	Free space following (MiB):	1938474	-	+			
	Align to:	Мів		•			
		Canc	el		Resize	/Mo\	/e

h) Then click **Resize/Move**



i) Then click the green $\sqrt{}$ in the picture



j) Then Click Apply

	/dev/nvme0n1p2 1.86 TiB	
	2.00 1.0	
unallocated /dev/nvme0n1p1 /dev/nvme0n1p2 Editing partitio	pply operations to device sure you want to appl operations? ns has the potential to cause LO d to backup your data before pro	bis_boo 3 1.86 TiB DSS of DATA.
Cance	al 🚽 A	Apply
Grow /dev/nvme0n1p2 from 14.41 GiB to	1.86 TiB	

k) Then click **Close** to close

🖾 /dev/nvme0n1 - G	Parted 🛧 – 🗆 🗙
GParted Edit View Device Partition Help	
🕒 🙁 🕅 🖶 🛅 🥱 🖌	/dev/nvme0n1 (1.86 TiB) 🔻
/dev/n 1.86 T	vme0n1p2 iB
🔤 Applying pending	operations 🛧 🖬 🗙 🚥
Part un Depending on the number and type of operations th	is might take a long time.
/d Completed Operations:	poot
/d All operations succ	essfully completed
Details	
≫l G	Save Details X Close

m. At this point, you can use the **sudo 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 SPIFlash+NVMe SSD will be started.

10) Step **9**) is to clone the system in the TF card to the NMVe SSD. We can also directly burn the linux image file to the NVMe SSD. Here are the step

- a. Upload the linux image file to the linux system of the development board
- b. Then use balenaEtcher to burn.



c. After using this method to burn the image, there is no need to manually expand the capacity, and it will automatically expand the capacity at the first startup.

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

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

2. 6. 1. How to use the dd command to burn

- 1) First, you need to prepare a SATA SSD solid state drive
 - a. The M.2 2242 SSD is as folloews



b. M.2 The 2280 specification SSD is as follows (the 2280 specification SATA SSD can also be used, but the SSD will exceed the development board after being inserted into the development board



2) Then insert the SSD into the M.2 interface of the development board and fix it



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) Burning the linux image to SPIFlash+SDD 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 on the Ubuntu PC.

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

a. sata ssd startup dedicated u-boot image storage path is:

/usr/sh	are/orangepi5/rkspi_loader_sata.img
h	Make sure that risen leader sate impervices in the Linux system and then use

b. Make sure that **rkspi_loader_sata.img** exists in the Linux system, and then use the following command to burn it into the SPIFlash of the development board

orangepi@orangepi:~\$ cd /usr/share/orangepi5/ orangepi@orangepi:~\$ sudo dd if=rkspi_loader_sata.img of=/dev/mtdblock0 orangepi@orangepi:~\$ sudo sync

The storage path of the u-boot image of the OPi OS Arch system is somewhat different, as shown below:

e. OPi OS Arch system sata ssd boot dedicated u-boot image storage path is:

/boot/rkspi_loader_sata.img

f. Make sure**rkspi_loader_sata.img** exists in the OPi OS Arch system, and then use the following command to burn it into the SPIFlash of the development board:

[orangepi@orangepi boot]\$ cd /boot/

[orangepi@orangepi boot]\$ sudo dd if=rkspi_loader_sata.img of=/dev/mtdblock0

[orangepi@orangepi boot]\$ sudo sync

If you need to start the OpenWRT image, you need to download the latest version of u-boot image from the official website, and then burn it into SPI Flash. The download steps are as follows:

a. First enter the data download page of the development board, then select the official tool on the data download page, and then enter the folder below

🥮 range Pi User Mai	nual Copyright reserved by Shenzhen Xunlong Software Co., Ltd
D	Android and Linux image writing tool-RKDevTool and driver
	wiringOP-Python source code compression package
	Linux image writing tool-Win32DiskImager
b. Then choose to en	nter the following directory
🖪 MiniLoa	ader - what is needed for burning Linux images
c. Then download r	kspi_loader_sata.img
	rkspi_loader_sata.img
system of the develo	bi_loader_sata.img to the Ubuntu, Debian or OPi OS Arch pment board. For the upload method, please refer to the nethod of uploading files to the Linux system of the development
•	the following command to burn the u-boot image into SPI Flash and is executed in Ubuntu, Debian, or OPi OS Arch):
orangepi@orangepi:~	\$ sudo dd if=rkspi_loader_sata.img of=/dev/mtdblock0

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**

Note that if you download an OpenWRT image, you will see the following three types of images in the download link of the OpenWRT image. Please select the image file in the "SPIFlash+SATA SSD boot image" folder.

×	1 selected	
Name	\uparrow	Owner
19	SD Card Image	or me
Ŀ	SPIFlash-NVME SSD Image	owe me
13	SPIFlash-SATA SSD Image	erre me

×

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

Orangepi5_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) Then please refer to the instructions in the section of the method of using SATA SSD

to open the sata ssd configuration to ensure that the system can recognize the ssd normally.

OPi OS Arch For the method of opening the sata ssd configuration in the OPi OS Arch system, please refer to the instructions in the section of the method of using SATA SSD in the OPi OS Arch system.

9) Then we can use the dd command to empty the SSD (Optional)

sudo dd bs=1M if=/dev/zero of=/dev/sda count=2000 status=progress

sudo sync

10) Then you can use the dd command to burn the linux image of the development board into the 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=Orangepi5_x.x.x_debian_bullseye_desktop_xfce_linux5.10.160.img of=/dev/sda status=progress

sudo sync

Note, if you upload a linux image compressed file ending in .7z or xz, 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.

11) After successfully burning the linux image of the development board to the SATA SSD, it cannot be used directly at this time. Because the default setting of the linux image is to only recognize NVMe SSDs, but not SATA SSDs, the following settings need to be done:

a. First mount the boot partition of the SATA SSD to the /mnt directory of the TF card card Linux system.

orangepi@orangepi:~/Desktop\$ sudo mount /dev/sda1 /mnt/

b. Then open the SATA SSD configuration in the **orangepiEnv.txt** file in the boot partition of the SATA SSD (**please note that it is not /boot/orangepiEnv.txt in the TF card**)

orangepi@orangepi:~/Desktop\$ sudo vim /mnt/orangepiEnv.txt overlays=ssd-sata

Note that this step is somewhat different for the OPi OS Arch system, please add the following configuration in /boot/extlinux/extlinux.conf:

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-ssd-sata.dtbo

c. Then uninstall the boot partition of the SATA SSD

orangepi@orangepi:~/Desktop\$ sudo umount /mnt/

12) At this point, 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

SPIFlash+SATA SSD will be started

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

orangepi@orangepi:~\$ df -h					
Filesystem	Size U	Jsed Av	ail Use%	Mounted on	
udev	3.8G	8.0K	3.8G	1% /dev	
tmpfs	769M	1.4M	768M	1% /run	
/dev/sda2	233G	4.3G	226G	2% /	
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/sda1	256M	90M	166M	36% /boot	
/dev/zram1	194M	10M	170M	6% /var/log	
tmpfs	769M	60K	769M	1% /run/user/1000	

14) When the same system is burned in the TF card and SSD, if both the TF card and SSD are inserted into the development board, and the development board is powered on at this time, u-boot will give priority to starting the system in the TF card. However, since the systems in the TF card and the 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 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, different versions are different.

There is no fix_mmc_ssd.sh script in OPi OS Arch system.

2. 6. 2. How to use balenaEtcher software to burn Please do not use this method for OPi OS Arch system.

- 1) First, you need to prepare a SATA SSD solid state drive
 - a. The M.2 2242 SSD is as follow



b. The 2280 specification SSD is as follows (the 2280 specification SATA SSD can also be used, but the SSD will exceed the development board after being inserted into the development board)



2) Then insert the SSD into the M.2 interface of the development board and fix it.



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) Burning the linux image to SPIFlash+SDD 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.

5) Then please refer to the instructions in the section of the method of using SATA SSD to open the sata ssd configuration to ensure that the system can recognize the ssd normally.

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 follow:



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

a. First click Flash from file



b. Then enter the /usr/share/orangepi5/ directory, select rkspi_loader_sata.img, and click **Open** to open.

Cancel				٩	Open
⊘ Recent	🔹 🔟 usr share orangepi5 🕨				
🔂 Home	Name	*	Size	Туре	Modified
🛅 Desktop	rkspi_loader_sata.img		16.8 MB	Raw disk image	17:27
Documents					
↓ Downloads					

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



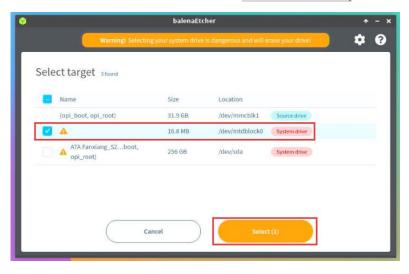
d. Then click Select target

0	balenaEtcher		* - ×
	🌍 balena Elcher		¢ 0
€ —		- 4	
rkspi_loasata.img Remove 16.8 MB	Select target	Flasht	

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

)		balenaEtc	her		*	
		🌍 bale	naEtcher		\$	8
Sel	ect target 3 found	Size	Location			
	(opi_boot, opi_root)	15.9 GB	/dev/mmcblk1	Source drive		

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



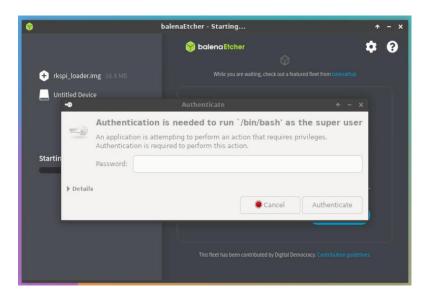
g. Then click Flash



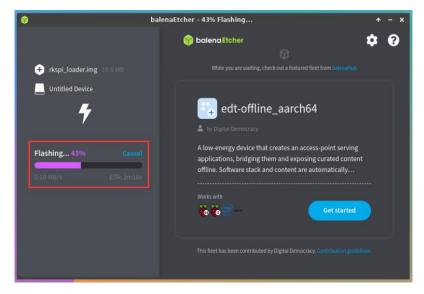
h. Then click Yes, I'm sure

٢	balenaEtcher	↑ - ×
	🌍 balena Etcher	\$
	WARNING! You are about to erase your computer's drives	
	16.8 MB System drive	
	Are you sure you want to flash your system drive?	
	Yes, I'm sure Change target	

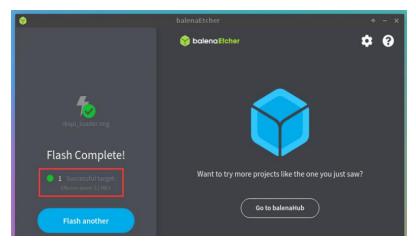
i. Then enter the password orangepi of the development board linux system, and it will start burning the u-boot image into the SPI Flash



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

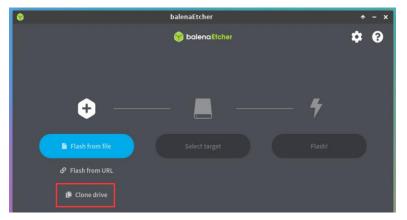


k. The display after burning is as follows:



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

a. First click Clone drive



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

\$	balenaEtcher	★ - ×
	🜍 balena Etcher	¢ 0
Select source 3 found		
Name	Size Location	
(opi_boot, opi_root)	15.9 GB /dev/mmcblk1 Source drive	
♥ Show 2 hidden	Cancel Select (1)	

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



d. Then click Select target



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

١				
	🌍 bale	naEtcher		\$ 8
Select target 3 found				
Name	Size	Location		
(opi_boot, opi_root)	15.9 GB	/dev/mmcblk1	Source drive	
✓ Show 2 hidden				

f. Then select the SSD device name /dev/sda, and click Select

	balenaEto	:her		ب -
Warning! Selecting	your system drive	is dangerous and will e	rase your drivel	\$
Select target 3 found				
Name	Size	Location		
(opi_boot, opi_root)	31.9 GB	/dev/mmcblk1	Source drive	
A	16.8 MB	/dev/mtdblock0	Too small	
ATA Fanxiang_S2boot, opi_root)	256 GB	/dev/sda	System drive	
Can		Selec		
Can		Selec	- ()	

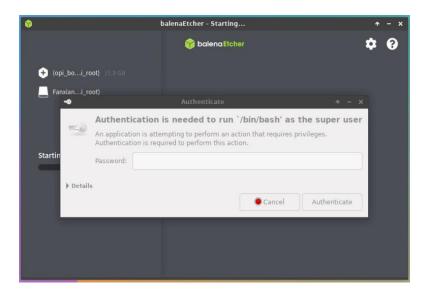
g. Then click Flash



h. Then click Yes, I'm sure

0	balenaEtcher	+ - ×
	🌍 balena Etcher	¢ 0
	Δ	
	WARNING!	
	You are about to erase your computer's drives	
	ATA Fanxiangot, opi_root) 256 GB System drive	
	Are you sure you want to flash your system drive?	
	Yes, I'm sure Change target	

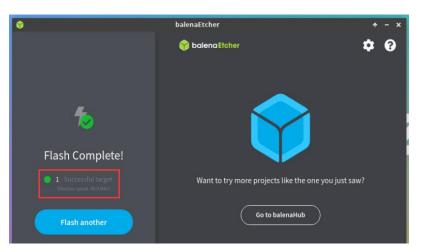
i. Then enter the password **orangepi** of the linux system on the development board, and it will start burning the linux image to the SSD.



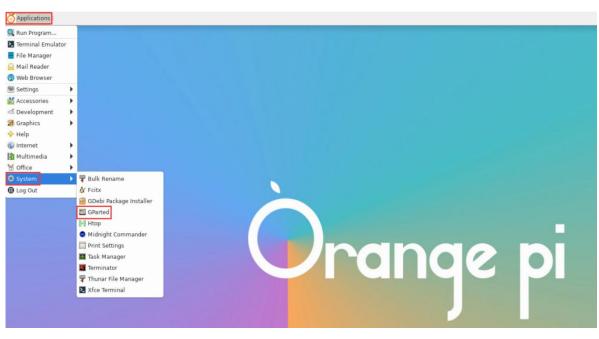
j. The display of the burning process is as follows:

8	balenaEtcher - 13% Flashing		
	🜍 balena Etcher	¢ 0	
	screenly-ose-pi4		
Flashing 13% Cancel	 by screenly-ose The most popular digital signage project on GitHub 		
44.90 MB/s ETA: 4m40s	Works with		
			-
0 t	alenaEtcher - 82% Validating	* -	×
() t	valenaEtcher - 82% Validating 🌍 balenaEicher	* •	×
		, - ¢0	×
	😭 balena Etcher	* 0	×
	balenaEtcher While you are waiting, check out a featured fleet from balenaHub screenly-ose-pi4	, - ¢ 0	×

k. The display after burning is as follow:

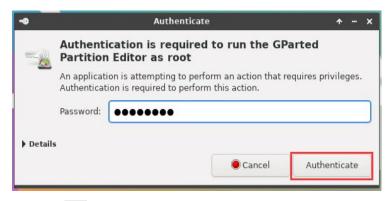


1. Then you need to expand the capacity of the rootfs partition in the SSD. The steps are as follow:



a) First open **GParted**

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



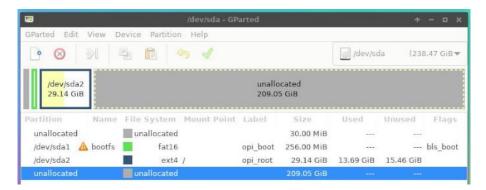
c) Then click Fix

GParted Edit Va	ew Device P					+ ×
Partition Name	Not al used,	Mount Point Label Libpar I of the space availa you can fix the GPT 4240 blocks) or cont	ted Warning ble to /dev/ to use all of	sda appears f the space (an extra	Flags
Searching /dev/sda	a partitions	Fix		Ignore		

d) Then choose SSD

Partition Name File System Mount Point Label Size Used Unused Flag: unallocated unallocated 30,00 MiB	/dev/sda2 29.14 GiB			unallo 209.0			
	/dev/sda1 🛕	unallocated		opi_boot	30.00 MiB 256.00 MiB	 	
	8.500 (1) 8 STREPHOL		• •				

e) The display interface after selecting SSD is as follow:



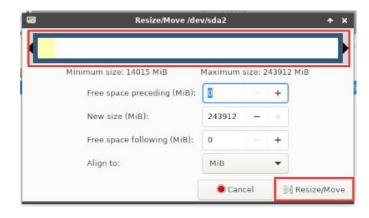
f) Then select the /dev/sda2 partition, then right-click, and then select Resize/Move

9		/dev/sda - GP	arted				*	- 🗆 ×
GParted Edit View D	evice Partition	n Help						
🕑 🔕 🔊 🗌		⊳ √				/dev/se	da (238	8.47 GiB▼
<mark>/dev</mark> /sda2 29.14 GiB				located 05 GiB				
Partition Name	File System	Mount Point	Label	Size		Used	Unused	Flags
unallocated	unallocated			30.00	MiB	1555		
/dev/sda1 🛕 bootfs	fat16		opi_boot	256.00	MiB	222		bls_boot
/dev/sda2	ext4			insert -	GiB	13.69 GiB	15.46 GiB	
unallocated	unallocated	🗵 Delete		Delete 15	GiB			
		🔊 Resize/Mov	/e					
	1	튼) Copy		Ctrl+C				
		Paste		Ctrl+V				
		Format to		•				
		Open Encry Mount on	ption	•				
		Name Parti	tion					
0 operations pending		Manage Fla Check	ags					
		Label File S	system					
		New UUID						
		💡 Information	n					

g) Then drag the capacity to the maximum at the position shown in the figure below

	Resize/Move /de	v/sda2			*
1_		Maximum	size: 2	43912 M	liB
	Free pace preceding (MiB): New size (MiB):	29842	-	+	
	Free space following (MiB):	214070	3 - 7	+	
	Align to: 🦻	MiB Can	cel	•)] []] F	lesize/Mo

h) Then click **Resize/Move**



i) Then click the green $\sqrt{}$

100 I		/dev/sda - GP	arted			*	- 0 X
GParted Edit View	Device Partition	n Help					
P 🛞 🕅	B 🔒 🛉	5			/dev/s	da (238	.47 GiB▼
	5		lev/sda2 38.20 GiB				
	e File System	Mount Point	Label	Size	Used	Unused	
Partition Nan							Flags
unallocated	unallocated			30.00 MiB			Flags
In the second	unallocated		opi_boot				Flags bls_boot

j) Then click Apply

/dev/sda2	
238.20 GiB	
unallocated Are you sure you want to apply the pending operations?	nused Flags bls_boot 24.51 GiB
Cancel Apply	
Grow /dev/sda2 from 29.14 GiB to 238.20 GiB	

k) Then click Close

2		/dev/sda - GParted		* - ¤ ×
-	dit View Device Parti	ition Help	/dev/s	da (238.47 GiBマ
		~) «	/dev/s	ua (238,47 GIB •
		/dev/sda2 238.20 Gi		
art		Applying pending opera	tions	* = ×
ur Dep	inding on the number and t	type of operations this mig	ht take a long time.	
/de Con	pleted Operations:			oot
/de		All operations successfully	completed	
► D	etails			
A G			Save Details	X Close

m. At this point, you can use the **sudo 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 SPIFlash+STAT SSD will be started.

10) Step 9) is to clone the system in the TF card to the SSD. We can also directly burn the linux image file to the SSD. Here are the steps:

- a. Upload the linux image file to the linux system of the development board
- b. Then use balenaEtcher to burn

٢		balenaEtcher		+ - ×
		🜍 balena Etcher		¢ 0
	Orangepi50.110.img Remove 6.55 GB	Fanxiang opi_root) Change 2.05 TB	Flashi	
	1. Choose image path Warning: Select	2. Choose NVMe SSD	3. Click Flash erase your drive!	

- c. After using this method to burn the image, there is no need to manually expand the capacity, and it will automatically expand the capacity at the first startup.
- d. After successfully burning the linux image of the development board to the SATA SSD, it cannot be used directly at this time. Because the default setting of the linux image is to only recognize NVMe SSDs, but not SATA SSDs, the following settings need to be done:
 - a) First mount the boot partition of the SATA SSD to the /mnt directory of the TF card Linux system

orangepi@orangepi:~/Desktop\$ sudo mount /dev/sda1 /mnt/

b) Then open the SATA SSD configuration in the orangepiEnv.txt file in the boot partition of the SATA SSD (note that it is not /boot/orangepiEnv.txt in the TF card)

orangepi@orangepi:~/Desktop\$ sudo vim /mnt/orangepiEnv.txt overlays=ssd-sata

c) Then unmount the boot partition of the SATA SSD

orangepi@orangepi:~/Desktop\$ sudo umount /mnt/

e. At this point, you can use the **sudo 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 SPIFlash+STAT SSD will be started.

2.7. How to write Linux image to SPIFlash+USB storage devices

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

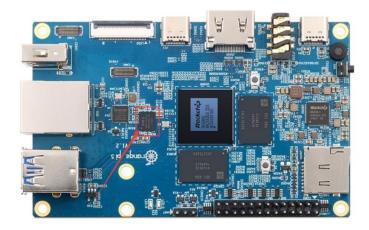
1) First, you need to prepare a USB storage device, such as a U Disk

2) Then 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 to burn the Linux image to the USB storage device. There is no difference between burning the Linux image to the USB storage device and burning the Linux image to the TF card is inserted into the card reader, the card reader at this time is actually equivalent to a U disk.)

3) Then insert the USB storage device with the programmed Linux system into the USB3.0 interface of the development board, Note, please do not insert the USB storagedevice with the programmed system into other USB interfaces of the development board. Only the USB3.0 interface shown supports booting the Linux system.



4) 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

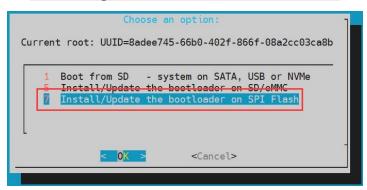


5) Burning the u-boot image to SPIFlash needs to be completed with the help of a TF card, so first you need to burn the linux image to the TF card, and then use the TF card to start the development board to enter the linux system. For the method of burning the Linux image to the TF card, please refer 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**

6) After using the TF card to start the Linux system, you can 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 ther 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):

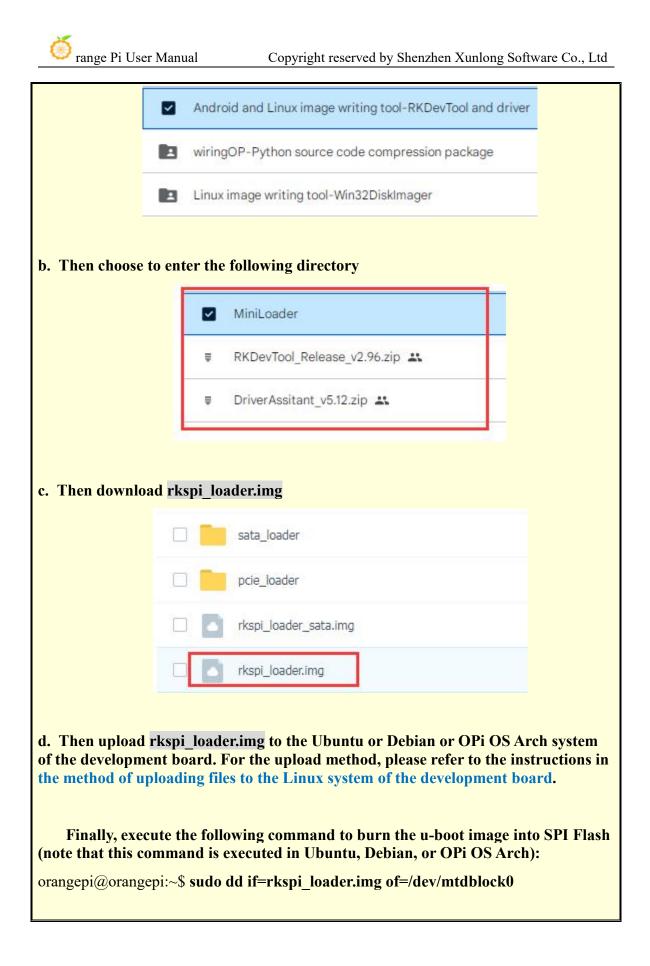


There is no nand-sata-install script in OPi OS Arch system, please use the following command to image u-boot to SPI Flash:

[orangepi@orangepi~]\$ sudo dd if=/boot/rkspi_loader.img of=/dev/mtdblock0

If you need to start the OpenWRT image, you need to download the latest version of u-boot image from the official website, and then burn it into SPI Flash. The download steps are as follows:

a. First enter the data download page of the development board, then select the official tool on the data download page, and then enter the folder below



7) At this point, 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 SPIFlash+USB storage device will be started

8) After starting the system in the USB storage device, use the **df -h** command to see the actual capacity of the USB storage device

orangepi@orange	pi:~\$ df	-h		
Filesystem	Size U	Jsed Av	ail Use%	Mounted on
udev	3.8G	8.0K	3.8G	1% /dev
tmpfs	769M	588K	769M	1% /run
/dev/sda2	15 G	1.6G	13G	11% /
tmpfs	3.8G	0	3.8G	0% /dev/shm
tmpfs	5.0M	4.0K	5.0M	1% /run/lock
/dev/zram2	3.7G	60K	3.5G	1% /tmp
/dev/sda1	256M	111M	146M	44% /boot
/dev/zram1	194M	9.0M	171M	5% /var/log
tmpfs	769M	0	769M	0% /run/user/1000

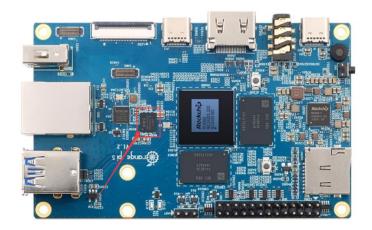
2.8. Method of burning OpenWRT image into SPI FLASH

The method introduced in this section is to burn the entire OpenWRT image into SPI Flash. No SSD or USB disk is required. In other words, u-boot, kernel and rootfs are all stored in SPI Flash.

Since the SPI Flash on the development board is only 16MB, this system cannot install much software and can only implement some basic functions at present.

2. 8. 1. How to burn using RKDevTool

1) The location of SPI Flash on the development board is as shown in the picture below. No other settings are required before starting burning.

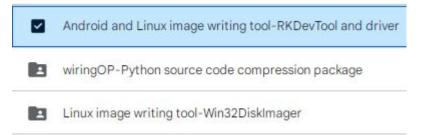


2) Then you need to prepare a good quality Type-C interface data cable

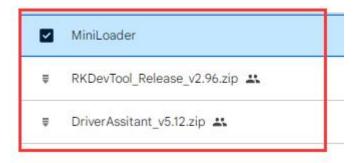


3) Then download the Rockchip micro-driver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v2.96.zip** from the Orange Pi data download page. Please ensure that the version of the downloaded **RKDevTool** tool is **v2.96**

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



b. Then download all the files below



Note that the "MiniLoader-things needed to burn Linux images" folder will be referred to as the MiniLoader folder below.

4) Then download the **OpenWRT** image that can be booted from **SPIFlash** from the **Orange Pi download page**. Due to the capacity of **SPIFlash**, the image is less than **16MB**.

a. After opening the download link, you can see the following three types of **OpenWRT** images. Please select the image in the **SPIFlash startup image** folder.



- b. Then you can see a "Partition Image" folder and a separate OpenWRT image file. The difference between them is:
 - a) The three files u-boot, dtb, and firmware (including kernel and rootfs) files contained in the "Partition Image" folder, together form an OpenWRT image.
 - b) The image file shown in the figure below is a complete image file generated by packaging u-boot, dtb, and firmware in the "Partition Image" folder
- 分区镜像-使用OpenWRT的mtd工具烧录时要用到

openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin

c. Here we need to select the packaged complete image



── 分区镜像-使用OpenWRT的mtd工具烧录时要用到

openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin

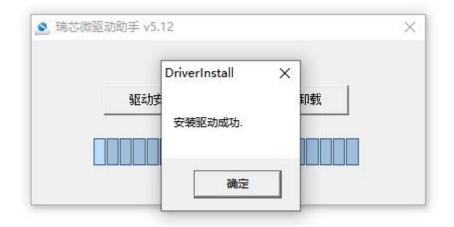
5) Then use decompression software to decompress **DriverAssitant_v5.12.zip**, then find the **DriverInstall.exe** executable file in the decompressed folder and open it.

名称	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
🍓 DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

- 6) Open **DriverInstall.exe** and install the Rockchip microdriver as follows:
 - a. Click the "Driver Installation" button

驱动安装	驱动卸载
业动安装	

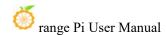
b. After waiting for a period of time, a window will pop up prompting "Driver installation successful", then click the "OK" button.



7) Then unzip **RKDevTool_Release_v2.96.zip**. This software does not need to be installed. Just find **RKDevTool** in the unzipped folder and open it.

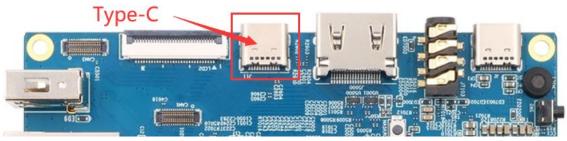
名称	修改日期	类型	大小
<mark> </mark> bin	2022/12/1 15:07	文件夹	
📙 Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
📓 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
📓 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

8) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, "**No device found**" will be prompted in the lower left corner.

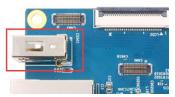


1] 存储	地址	名字	路径			
ſ		0x00000000	Loader				
ſ		0x00000000	Parameter		5. B		
		0x00000000	Uboot				
		0x00000000	trust				
1		0x00000000	Misc				
		0x00000000	Resource				
		0x00000000	Kernel				
ſ		0x00000000	Boot				
ſ		0x00000000	Recovery				
ſ		0x00000000	System	9			
ſ		0x00000000	Backup				
ler		执行 □强制按地址写	切换	设备分区表 清空			

- 9) Then start burning the OpenWRT image into SPI FLASH
 - a. First, connect the development board and Windows computer through the Type-C data cable. The location of the Type-C interface of the development board is as shown in the figure below.



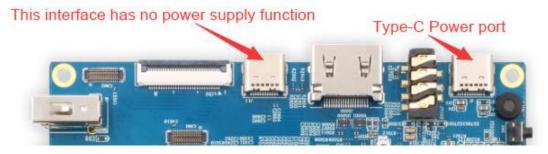
- b. Make sure the development board is not connected to the power supply and the TF card is not inserted.
- c. Also make sure that no USB device is plugged into the white USB2.0 interface in the picture below



d. Then press and hold the MaskROM button of the development board. The position of the MaskROM button on the development board is as shown in the figure below:



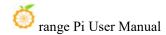
e. Then connect the power supply of the Type-C interface to the development board, power it on, and then release the MaskROM button.



f. If the previous steps go well, the development board will enter MASKROM mode at this time, and the interface of the burning tool will prompt "A MASKROM device was found"

#		存储	地址	名字	路径				
1	Г		0x00000000	Loader					
2	Г		0x00000000	Parameter		the Base State			
3			0x00000000	Uboot					
1			0x00000000	trust					
5			0x00000000	Misc					
6			0x00000000	Resource					
7	Г		0x0000000	Kernel					
3	Г		0x00000000	Boot					
3	Г		0x00000000	Recovery					
0	Г		0x00000000	System					
11			0x00000000	Backup					
.o a d	er:		执行 □强制按地址写	切换	设备分区表 清空				

g. Then place the mouse cursor in the area below

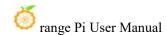


#		存储	地址 0x00000000	名字 Loader	路径		
2	-		0x00000000	Parameter			
3	ΪĒ		0x00000000	Uboot			
4	Г		0x00000000	trust			
5			0x00000000	Misc			
6	Г		0x00000000	Resource			
7	Г		0x00000000	Kernel		11	
8			0x00000000	Boot		11 81	
9			0x00000000	Recovery			
10			0x00000000	System			
11			0x00000000	Backup			
II Load	ler:		执行 强制技地址写	backup 切换	设备分区表 清空]	Place the mouse cursor in this

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

	-	名字	路径	
	0x00000000	Loader		
1			· · · · · · · · · · · · · · · · · · ·	
_				
Ē	0x00000000	Misc		
Ē	0x00000000	Resource	清空所有项	
Г	0x00000000	Kernel	上移	
Г	0x00000000	Boot	下線	
	0x00000000	Recovery		
	0x00000000	System		
	0x00000000	Backup	导出配置	
		0x0000000 0x0000000 0x0000000 0x0000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000	0x0000000 Uboot 0x0000000 trust 0x00000000 Misc 0x00000000 Resource 0x00000000 Resource 0x00000000 Resource 0x00000000 Recovery 0x00000000 Recovery 0x00000000 System	0x0000000 Uboot 添加项 0x00000000 trust 删除项 0x00000000 Miso 清空所有项 0x00000000 Kernel 上移 0x00000000 Boot 下移 0x00000000 Reoverey 导入配置

i. Then select the Import Configuration option



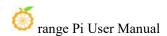
#		存储	地址	名字	路径		 			
1			0x00000000	Loader						
2	Г		0x00000000	Parameter						
3			0x00000000	Vboot						
4			0x00000000	trust						
5			0x00000000	Misc						
6			0x00000000	Resource						
7	Г		0x00000000	Kernel						
8	Г		0x00000000	Boot		添加项				
9	Г		0x00000000	Recovery		删除项				
10	Г		0x00000000	System						
11	Г		0x00000000	Backup		清空所有项				
Loa	ler :		执行	切换	设备分	上移 下移 导入配置 导出配置				

j. Then select the **rk3588_linux_spiflash.cfg** configuration file in the **MiniLoader** folder downloaded earlier, and then click to **open**

	🔀 瑞芯微开发工具 v2.96	- 0 ×
🔀 打开		×
← → ~ ↑ <mark>.</mark> > 1	此电脑 > 桌面 > orangepi > MiniLoader-烧录Linux稳像才需要用到的东西	✓ ひ ク 在 MiniLoader-焼泉Linux
组织 ▼ 新建文件夹		## - 11 ()
 □ 此电脑 ③ 3D 对象 圖 视频 ■ 图片 ☆ だ档 ◆ 下载 ♪ 音乐 ■ 媒面 	 pcie_loader sata_loader MiniLoaderAll.bin rk3588_linux_spiflash.cfg rk3588_linux_tfcard.cfg rks358_loader rkspi_loader_sata 	
文件	K≊(M): Orangepi5_1.1.0_ubuntu jammy_server_linux5.10.110	✓ All File(*.*) ✓ 打开(Q) 取消
	发现一个MASKROM设备 1-1-1-1:MASKROM ~	

k. Then click **OK**

		工具 v2.96 升级固件 着	级功能						
# 1 2	- - -	存储 SPINOR	地址 0x00000000 0x00000000	名字 Loader uboot	路径 C:\Users\Administrator\Desktop\ C:\Users\Administrator\Desktop\				
					RKDevTool 导入配置成功.	×			
					漢定				
Load	er:	(执行 〕强制按地址写	切换	设备分区表 清空				
		发现	一个MSC设	备	2-3 :MSC	~			



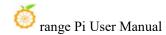
1. Then click the location shown in the picture below

载镜	-						
#		存储	地址	名字	路径		
1			0x00000000	Loader	C:\Users\Administrator\Desktop\		
2		SPINOR	0x00000000	uboot	C:\Vsers\Administrator\Desktop\		
					N		

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

X	瑞芯微开发工具 v2.96	- D X
	脑 > 奧面 > orangepi > <mark>MiniLoader-烧录Linux稳象才需要用到的东西</mark>	× む ア 在 MiniLoader-提录Linux
组织 ▼ 新建文件夹 ● 此电脑 ③ 3D 对象 圖 机频 ● 問片 ○ 文档 ● 下載 ● 音乐 ■ 真面	 pcie_loader sata_loader MiniLoaderAll.bin rk3568_linux_enmc.cfg rk3568_linux_tfard.cfg rk3568_linux_tfard.cfg rkspi_loader_sata 	88 - O
文件名(ND: MiniLoaderAll.bin	✓ All File(*.*) ✓ 打开② 取満
	发现一个MASKROM设备 1-1-1-1 : MASKROM ·	

n. Then click on the location shown in the picture below

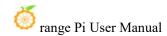


开发工具 v2.9 象 升级固件				- 0
□ 存储 ✓	地 <u>址</u> 0x00000000	名字 Loader	路径 C:\Users\Administrator\Desktop\	
SPINOR	0x00000000	uboot	C:\Users\Administrator\Desktop\	
			Ν	

Then select the path of the OpenWRT image you want to burn, and then click
 Open

🔀 打开					×
← → * ↑	此电脑 > Windows (C:) > 用户 > Administrator > Desktop		ٽ ~	○ 在 Desktop 中搜	素
组织 🔹 新建文件部					•
 ★ 快速访问 OneDrive 此电脑 ♂ 网络 	名称 ^ / MiniLoader·授录Linux镜象才需要用到的东西 / Openwrt-rock.chip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin	侍改日期 2023/4/27 16:55 2023/4/27 10:30	英型 文件夹 BIN 文件	大小 15,617 KB	
Ż	(神名(1)):		~	All File(*.*) 打开(<u>O</u>)	~ 取消

p. Then please make sure that the Force writing by address option is checked.



制艺科	微开发	之工具 v2.96						
载镜	像	升级固件 高	级功能					
#		存储	地址	名字	路径			
1 2	>	SPINOR	0x00000000 0x00000000	Loader uboot	C:\Users\Administrator\Desktop\ C:\Users\Administrator\Desktop\			
	1		执行	171				
					设备分区表 清空			
.0 a d	ler Ve	er:1.0b	Concernant of the second se					
.0 8 0	der Ve		强制按地址写					
Load		E	Concernant of the second se		2-7 :MASKROM			

q. Click the **Execute** button again to start burning the OpenWRT image into SPIFlash.

				N		
ŧ 🗆		地址	名字	路径		
		0x00000000	Loader	C:\Users\Administrator\Desktop\		
2	SPINOR	0x00000000	uboot	C:\Users\Administrator\Desktop\		

r. The display log after the r.OpenWRT image is burned is as shown below

载镜	像升	·级固件 「高	級功能			下载Boot开始 下载Boot成功
#		存储	地址	名字	路径	等待Maskrom开始 等待Maskrom成功
1	•	SPINOR	0x00000000 0x00000000	Loader uboot	C:\Users\Administrator\Desktop\ C:\Users\Administrator\Desktop\	测试设备开始 测试设备成功
						校验芯片成功
						1233のJFRAJJ 家取FlashInfo成功 準备TDB开始 注着TDB开始 下载TDB成功 下载TDB成功 等待Maskrom开始 等待Maskrom开始 等待Maskrom成功 则试设备开始 列试设备开始 列试设备有达DFINOR 开始切换存储型(SFINOR 开始了戰のpenwrtrookchip-armw8-xunlong_orangepi-5-spi-squ

s. OpenWRT image will start automatically after burning. If it does not start normally, please power on again and try again.

2. 8. 2. How to use the mtd tool of the OpenWRT system for burning

1) Burning the OpenWRT image that supports spi boot into SPIFlash requires the use of a TF card, so you first need to burn the OpenWRT image that supports TF card boot to the TF card, and then use the TF card to boot the development board to enter the OpenWRT system. For the method of burning the OpenWRT image to the TF card, please refer to the instructions in the two sections: **How to burn the Linux image to the TF card based on Windows PC** and **the method of burning the Linux image to the TF card based on the Ubuntu PC**.

2) After the TF card starts the OpenWRT system, execute the following command to see that SPIFlash contains 3 partitions, namely uboot, dtb and firmware partitions, of which firmware contains the kernel and rootfs

root@	OpenWrt:	~# cat /pro	vc/mtd
dev:	size	erasesize	name
mtd0:	00200000	00001000	"uboot"
mtd1:	00040000	00001000	"dtb"
mtd2:	00dc0000	00001000	"firmware"

3) Then download the **OpenWRT** image that can be booted from **SPIFlash** from the **Orange Pi download page**

a. After opening the download link, you can see the following three types of

OpenWRT images. Please select the image in the SPIFlash startup image folder to download.



- b. Then you can see a "Partition Image" folder and a separate OpenWRT image file. The difference between them is:
 - a) The three files u-boot, dtb, and firmware (including kernel and rootfs) files contained in the "Partition Image" folder, together form an OpenWRT image.
 - b) The image file shown in the figure below is a complete image file generated by packaging u-boot, dtb, and firmware in the "Partition Image" folder
 - 🗌 📒 分区镜像-使用OpenWRT的mtd工具烧录时要用到
 - openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin
- c. Because only partitions can be burned in the OpenWRT system, here we need to select the partition image folder

分区镜像-使用OpenWRT的mtd工具烧录时要用到

- openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin
- d. After entering the **partition image** folder, you can see the following three image files, and then we need to download these three partition image files.
 -] 🧴 openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-uboot.bin
 - 📄 🤷 openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-firmware.bin
 - openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-dtb.bin

4) Then upload the 3 partition images downloaded from the official website to the TF card.

```
www.orangepi.org
```

5) Then execute the following three commands to burn uboot, dtb and firmware partition images into the corresponding partitions of SPIFlash respectively.

root@OpenWrt:~# mtd -e uboot write openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-uboot.bin uboot

Unlocking uboot ...

Erasing uboot ...

Writing from openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-uboot.bin to uboot ...

root@OpenWrt:~# mtd -e dtb write openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-dtb.bin dtb Unlocking dtb ...

Erasing dtb ...

Writing from openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-dtb.bin to dtb ...

root@OpenWrt:~# **mtd -e firmware write openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-firmware.bin firmware** Unlocking firmware ... Erasing firmware ... Writing from openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-firmware.bin to firmware ...

6) At this point, you can use the **poweroff** command to shut down the computer. Then please pull out the TF card and short press the power button to turn on the computer. At this time, the OpenWRT system in SPIFlash will be started.

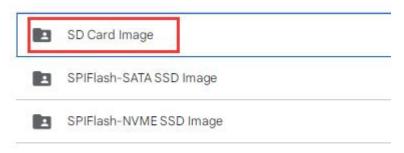
2.9. How to burn Android image to TF Card

2) First prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

3) Then use the card reader to insert the TF card into the card

4) Then download the SDDiskTool programming tool from the Orange Pi data download page, please ensure that the version of the SDDiskTool tool is the latest v1.72

- 5) Then download the Android12 image from the Orange Pi download page
 - a. After opening the download link of the Android image, you can see the following three types of Android images, please select the image in SD card image folder to download



- b. After entering the **TF card image** folder, you can see the following two images, the difference between them is:
 - a) The image without lcd is specially used for HDMI display and supports 8K display. If you do not use the LCD screen, please download the image without lcd
 - b) If you want to use LCD screen, please choose image with lcd



6) Then use the decompression software to decompress the compressed package of the downloaded Android image. Among the decompressed files, the file ending with "**.img**" is the Android image file, and the size is more than 1GB

7) Then use decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.exe** in the decompressed folder and open it

orange Pi User Manual	Copyright reserved by	Shenzhen Xunlong So	oftware Co., Ltd
길 Language	2022/9/5 15:04	文件夹	
config	2020/3/18 17:27	配置设置	2 KB
revision	2021/4/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/9/3 9:52	CONFIG 文件	1 KB
🔒 SD_Firmware_Tool	2021/4/21 17:57	应用程序	698 KB
SDBoot.bin	2015/9/29 17:13	BIN 文件	149 KB

8) After opening SDDiskTool, if the TF card is recognized normally, the inserted disk device will be displayed in the "Select Removable Disk Device" column. Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn, if there is no display, you can try to unplug the TF card .

第一步	·法塔司移动战争设备		SDBoot:2.12
	Generic MassStorageClass	USB Device 29.7G	~
第二步	送择功能模式		
	□ 固件升级	🗌 рсваллії,	☑SD启动
第三步	选择升级固件		□修复
			选择固件
第四步	:选择Demo数据(可选)		
			选择Demo
			开始创建
			恢复磁盘

9) After confirming the drive letter, you can format the TF card first, click the **restore disk button** in SDDiskTool, or use the **SD Card Formatter** mentioned above to format the TF card

	Generic MassSto	rageClass USB [Device 29.7G	~	
第二步	⇒:选择功能模式				
	固件升级		PCBA测试		SD启动
第三步	;:选择升级固件	SD_Firmwar	e_Tool	×□	修复
					选择固件
第四步	ラ∶选择Demo数据(i		灰复磁盘成功.		
					选择Demo
] [确定		
					开始创建

10) Then start writing the Android image to the TF card

ł

- a. First check "SD Boot" in "Select Function Mode"
- b. Then select the path of the Android image in the "Select to upgrade firmware" column
- c. Finally, click the "**Start Create**" button to start burning the Android image to the TF card

	:选择可移动磁盘设备 Generic MassStorageClass USB Device 29.7G 、	SDBoot:2.12
5二步	:选择功能模式	
	□ 固件升级 □ PCBA测试	☑SD启动
三步	:选择升级固件	□修复
		选择固件
驷步	:选择Demo数据(可选)	
		选择Demo
		_
		开始创建

11) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start

10 (C)	:选择可移动的 Generic Mass	戦曲 収 囲 StorageClass USB Device 2	9.7G 🗸	SDBoot:2.12
<u>第一</u> 步	:选择功能模:	7;		
₩ ₩	□ 固件升级	SD_Firmware_Tool	×	SD启动
第三步	:选择升级固	() 创建升级磁盘。	1 () () () () () () () () () (修复
	istrator\Desk		mg	选择固件
第四步	:选择Demo数	S	_	
		确注	ŧ	选择Demo
				开始创建

2. 10. How to burn Android image to SPIFlash+NVMe SSD

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

- 1) First, you need to prepare an NVMe SSD solid state drive
 - a. The M.2 2230 SSD is as follow



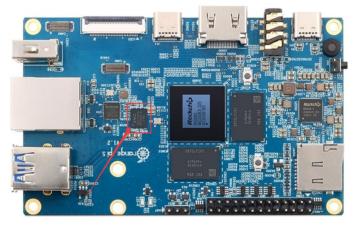
b. The M.2 2242 SSD is as follow



2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



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) Prepare a data cable with a good quality Type-C interface



5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and the burning tool **RKDevTool_Release_v2.96.zip** from the **Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

- 6) Then download the image of Android 12
 - a. After opening the download link of the Android image, you can see the following three types of Android images, please select the image in the SPIFlash-NVME SSD folder to download



- b. After entering the **SPIFlash-NVME SSD** folder, you can see the following two images. Their differences are:
 - a) The image without lcd is specially used for HDMI display and supports 8K display. If you do not use the LCD screen, please download the image without lcd
 - b) If you want to use LCD screen, please choose image with LCD
 - OrangePi5_RK3588S_Android12_spi-nvme_v1.0.0.tar.gz
 OrangePi5_RK3588S_Android12_spi-nvme_lcd_v1.0.0.tar.gz

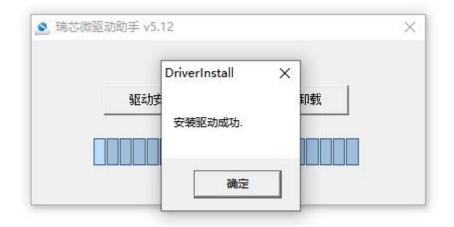
7) Then use the decompression software to decompress **DriverAssitant_v5.12.zip**, and then find the **DriverInstall.exe** executable file in the decompressed folder and open it

名称	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
😒 DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

8) After opening Driver Install.exe, the steps to install the Rockchip driver are as followsa. Click the "Driver Install"

驱动安装	驱动卸载	
JE OUX AL		

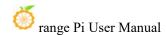
b. After waiting for a period of time, a pop-up window will prompt "The driver is installed successfully", and then click the "OK" button



9) Then decompress **RKDevTool_Release_v2.96.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

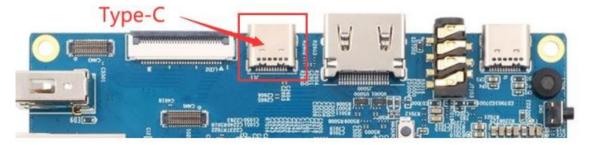
名称	修改日期	类型	大小
<mark>bin</mark>	2022/12/1 15:07	文件夹	
Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
📓 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

10) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt "**No device found**"



		存储	地址	名字	路径			
1			0x00000000	Loader				
2			0x00000000	Parameter	-			
3			0x00000000	Vboot				
4			0x00000000	trust				
5			0x00000000	Misc				
6			0x00000000	Resource				
7	Г		0x00000000	Kernel				
3	Г		0x00000000	Boot				
3	Г		0x00000000	Recovery				
10	Г		0x00000000	System				
11	Г		0x00000000	Backup				
10	Ē		0x00000000	System				

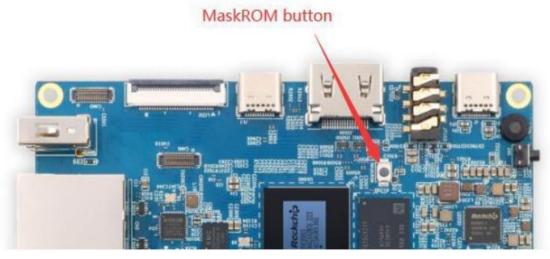
- 11) Then start burning the Android image to SPIFlash+NVMe SSD
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



- b. Make sure that the development board is not inserted into the TF card and not connected to the power supply
- c. Also need to ensure that the white USB2.0 interface in the position shown below is not plugged into a USB device



d. 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:



e. Then connect the power supply of the Type-C interface to the development board and power on



f. 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"

	存储	地址	名字	路径						
Г		0x00000000	Loader							
Г		0x00000000	Parameter		4. 8. 9. 6.					
		0x00000000	Vboot							
		0x00000000	trust							
		0x00000000	Misc							
		0x00000000	Resource							
		0x00000000	Kernel							
		0x00000000	Boot							
1		0x00000000	Recovery							
J		0x00000000	System							
		0x00000000	Backup							
			0x00000000 0x00000000	0x0000000 Loader 0x0000000 Parameter 0x0000000 Uboot 0x0000000 Uboot 0x0000000 Miso 0x0000000 Miso 0x0000000 Kersel 0x0000000 Kernel 0x0000000 Kernel 0x0000000 Boot 0x0000000 Reovery 0x00000000 System	0x00000000 Loader 0x00000000 Parameter 0x00000000 Vbot 0x00000000 trust 0x00000000 Misc 0x00000000 Misc 0x00000000 Kernel 0x00000000 Boot 0x00000000 Kernel 0x00000000 Boot 0x00000000 Beovery 0x00000000 System	0x00000000 Loader 0x00000000 Parameter 0x00000000 Vbot 0x00000000 thost 0x00000000 thost 0x00000000 thist 0x00000000 Misc 0x00000000 Kernel 0x00000000 Bost 0x00000000 Beovery 0x00000000 System	Ox00000000 Lowder Ox00000000 Faraneter Ox00000000 Uboot Ox00000000 Uboot Ox00000000 trust Ox00000000 Miso Ox00000000 Kersel Ox00000000 Kersel Ox00000000 Boot Ox00000000 Recovery Ox00000000 System	0x00000000 Loader 0x00000000 Parameter 0x00000000 Uboot 0x00000000 trust 0x00000000 Krso 0x00000000 Kernel 0x00000000 Kernel 0x00000000 Recovery 0x00000000 Recovery	0x00000000 Loader 0x00000000 Parameter 0x00000000 Uboot 0x00000000 Uboot 0x00000000 trust 0x00000000 Miso 0x00000000 Kernel 0x00000000 Boot 0x00000000 Beovery 0x00000000 Resource 0x00000000 Boot 0x00000000 System	0x0000000 Loader 0x0000000 Parameter 0x0000000 Uboot 0x0000000 Uboot 0x0000000 trust 0x0000000 Miso 0x0000000 Kernel 0x0000000 Boot 0x0000000 Kernel 0x0000000 Boot 0x0000000 System

g. Then click the "Upgrade Firmware" column of the burn

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 - · · ×

 「下數遺傳 升級 切換
 - · · ×

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 - · · ×

 」
 Bith 新和

 」
 Loader版本:
 芯片信息:

 」
 面件:

h. Then click the "**Firmware**" button to select the Android image to be burn

芯微开发工具 v2.96			-	×
城鏡像 升级固件 高级	吸功能			
固件 升级	切换			
固件版本:	Loader版本:	芯片信息:		
固件:				

 Finally, click the "Upgrade" button to start burning. The burning process is shown in the figure below. You can see that the firmware will be burned into SPIFlash first, and then burned into PCIE. After burning is completed, the Android system will start automatically

、瑞芯微开发工具 v2.96			×
下载镜像 升级固件 高级功能 固件 升级 切換 固件版本: 12.0.00 Loader版本: 1.0b 芯片信息: 固件: rator\Desktop\OrangePi5_RK3588S_Android12_spiravm	下载Boot开始 下载Boot成功 等待MaStrom开始 等待MaStrom开始 等待MaStrom开始 等待MaStrom开始 定在下载第1份固件,存储为SPINOR 测LUS省开始 测LUS省开始 测LUS省开始 WILUS省开始 東部Life开始 存起芯片开始 校验芯片成功 常取PlashInfo成功 正看TDB开始 注着IDB成功 下载IDH开始 正在下载图(100%) 下载IDH开始 正在下载词(100%) 下载IDH开始 正在下载第2份固件,存储为PCIE 则IUS省开始 現试设备成功 常待Loader开始 正在下载海2份固件成功 常待Loader开始 正在下载海2份因件,存储为PCIE 则IUS省开始		
没有发现设备	→ 【 <a> ✓ 校验芯片成功		~

2.11. How to burn Android image to SPI Flash+SATA SSD

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

- 1) First, you need to prepare a SATA SSD solid state drive
 - a. The M.2 2242 SSD is as follow



b. The 2280 specification SSD is as follows (the 2280 specification SATA SSD can also be used, but the SSD will exceed the development board after being inserted into the development board)



2) Then insert the SSD into the M.2 PCIe interface of the development board and fix it



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) Prepare a data cable with a good quality Type-C



5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and the burning tool **RKDevTool_Release_v2.96.zip**.zip from **the Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

- 6) Then download the image of Android 12
 - a. After opening the download link of the Android image, you can see the following three types of Android images, please select the image in the SPIFlash-SATA SSD folder to download



- b. 进入 After entering the **SPIFlash-SATA SSD** folder, you can see the following two images, the difference between them is:
 - a) The image without lcd is specially used for HDMI display and supports 8K display. If you do not use the LCD screen, please download the image without lcd
 - b) If you want to use LCD screen, please choose image with lcd



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.

名称 个	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
interinstall 😒	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

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

a. Click the "Driver Installation" button

	驱动安装	驱动卸载
--	------	------

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

		_
	DriverInstall X	
马区云力学		印载
	安装驱动成功.	
	确定	

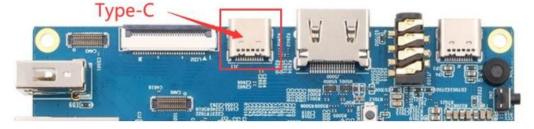
9) Then decompress **RKDevTool_Release_v2.96.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

🍏 range Pi User Manual	Copyright reserved by	Shenzhen Xunlong S	oftware Co., Ltd
	修改日期	类型	大小
bin .	2022/12/1 15:07	文件夹	
Language	2022/12/1 15:07	文件夹	
🗋 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🛐 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
KDevTool	2022/5/27 9:06	应用程序	1,212 KB
☑ 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

10) After opening the **RKDevTool** burning tool, because the computer has not been connected to the development board through the Type-C cable at this time, the lower left corner will prompt **"No device found**"

#		存储	地址	名字	路径	
	Г		0x00000000	Loader		
2	Г		0x00000000	Parameter		8. B
3			0x00000000	Vboot		
4			0x00000000	trust		
5			0x00000000	Misc		
8			0x00000000	Resource		
7	Г		0x00000000	Kernel		
3	Г		0x00000000	Boot		4
3	Г		0x00000000	Recovery		
10	Г		0x00000000	System		
11			0x00000000	Backup		

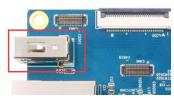
- 11) Then start burning the Android image to SPIFlash+SATA SSD
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



b. Make sure that the development board is not inserted into the TF card and not

connected to the power supply

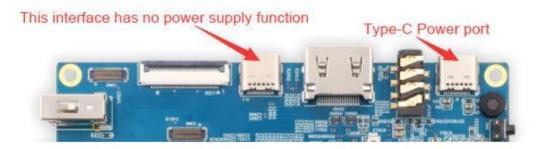
c. Also need to ensure that the white USB2.0 interface in the position shown below is not plugged into a USB device



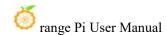
d. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is shown in the figure below:



e. Then connect the power supply of the Type-C interface to the development board and power on



f. 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"



L		存储	地址	名字	路径				
	Г		0x00000000	Loader					
2	Г		0x00000000	Parameter					
3			0x00000000	Vboot					
4			0x00000000	trust					
5			0x00000000	Misc					
6			0x00000000	Resource					
7	Г		0x00000000	Kernel					
8	Г		0x00000000	Boot					
9	Γ		0x00000000	Recovery					
10	Г		0x00000000	System					
11			0x00000000	Backup		23 23			

g. Then click the "Upgrade Firmware" column of the burning tool

× 1	_{常芯} 微开发工具	<mark>具</mark> v2.96					9 <u>252</u>	×
T	載鏡像 升级	固件 高级功	能					
	固件	升级	切换					
	固件版本:		Loader版本:	芯片信息:				
	固件:							

h. Then click the "Firmware" button to select the Android image to be burned

🔀 瑞芯微开发工具 v2.96			×
下载镜像 升级固件 高级		 	
固件 升级	切换		
固件版本:	Loader版本: 芯片信息:		
固件:			

i. Finally, click the "Upgrade" button to start burning. The burning process is shown in the figure below. As you can see, the firmware will be burned to SPIFlash first, and then the firmware will be burned to SATA SSD. After burning is completed, the Android system will start automatically 动。

瑞芯微开发工具 v2.96	- 0	×
K教遺像 升级固件 高級功能 固件 升级 切換 固件版本: 12.0.00 Loader版本: 1.0b 芯片信息: RK3588 固件: ^{id_12\rockdev\OrangePi5_RK3588S_Android12_spi-sata_v1.0.1.img}	下戦Boot开始 下戦Boot成功 等待Maskrom开始 準確Maskrom开始 準確Maskrom开始 準確Maskrom开始 測试设备成功 校验芯片成功 校验芯片成功 获取FlashInfo开始 获取FlashInfo开始 接面IDB开始 准备IDB成功 下戦IDB开始 正在下戦團件开始 正在下戦團件(100%) 下戦国件开始 正在下戦團件(100%) 下戦国件开始 正在下戦團件(100%) 下戦国件开始 定在下戦戰(100%)	,

2.12. Method of burning Orange Pi OS (Droid) image into TF card

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

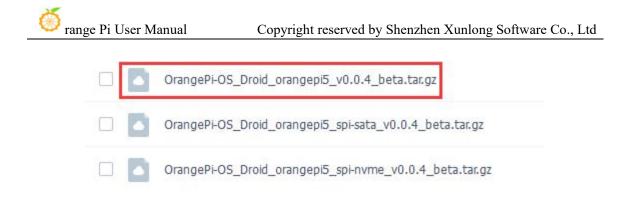
1) First prepare a TF card with 8GB or larger capacity. The transmission speed of the TF card must be class10 or above. It is recommended to use a TF card of SanDisk and other brands

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

3) Then download the SDDiskTool programming tool from the Orange Pi data download page, please ensure that the version of the SDDiskTool tool is the latest v1.72

4) Then download the Orange Pi OS (Droid) image from **the Orange Pi data download page**, open the download link of the Orange Pi OS (Droid) image and you can see the following three types of images, please select the image below

200



5) Then use the decompression software to decompress the compressed package of the downloaded Orange Pi OS (Droid) image. Among the decompressed files, the file ending with ".img" is the Orange Pi OS (Droid) image file, and the size is more than 1GB

6) Then use the decompression software to decompress **SDDiskTool_v1.72.zip**, this software does not need to be installed, just find **SD_Firmware_Tool.exe** in the decompressed folder and open it

길 Language	2022/9/5 15:04	文件夹	
🗊 config	2020/3/18 17:27	配置设置	2 KB
📋 revision	2021/4/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/9/3 9:52	CONFIG 文件	1 KB
船 SD_Firmware_Tool	2021/4/21 17:57	应用程序	698 KB
SDBoot.bin	2015/9/29 17:13	BIN 文件	149 KB

7) After opening **SDDiskTool**, if the TF card is recognized normally, the inserted disk device will be displayed in the "**Select Removable Disk Device**" column. **Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn Yes**, if there is no display, you can try to unplug the TF card

第一步	·讲择可移动就会设备	SDBoot:2.12
	Generic MassStorageClass USB Device 29.7G	~
第二步	:选择功能模式	7.
	□ 固件升级 □ PCBA测试	☑SD启动
第三步	:选择升级固件	□修复
	×	选择固件
第四步	:选择Demo数据(可选)	
		选择Demo
		开始创建

8) After confirming the drive letter, you can format the TF card first, **click the restore disk** button in **SDDiskTool**, or use the **SD Card Formatter** mentioned above to format the TF card

第一步	·:选择可移动磁盘 Generic MassSto	设备 rageClass USB Device 29.7G	SDBoot:2.12
第二步	:选择功能模式		
	□固件升级	PCBA测试	☑ SD启动
第三步	;:选择升级固件	SD_Firmware_Tool ×	└──修复
at mut		恢复磁盘成功.	选择固件
弗四步	7:J选择DemogyI描(选择Demo
		· · · · · · · · · · · · · · · · · · ·	开始创建
	п	始格式化用户盘	恢复磁盘

- 9) Then start to write the Orange Pi OS (Droid) image to the TF card
 - a. First check "SD Boot" in "Select Function Mode"
 - b. Then select the path of the Orange Pi OS (Droid) image in the "Select to upgrade firmware" column
 - c. Finally, click the "**Start Create**" button to start burning the Orange Pi OS (Droid) image to the TF card

range Pi User Manual	Copyright reserved by S	Shenzhen Xunlong Software Co., Ltd
🔒 瑞芯微台	刘建升级磁盘工具 v1.72	×
第一步	:选择可移动磁盘设备	SDBoot:2.12
	Generic MassStorageClass USB Device 29.7G $$ $$ $$	
第二步	: 选择功能模式 □ 固件升级 □ PCBA测试 □	Jsp启动
第三步	:选择升级固件	〕 修复 选择固件
第四步	::选择Demo数据(可选)	
		选择Demo
		开始创建
		恢复磁盘

10) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start

#	:选择可移动磁盘设备	SDBoot:2.1
	Generic MassStorageClass USB Device 29.	7G ~
第二步	:选择功能模式	
	SD_Firmware_Tool	×
第三步	:选择升级固	□修复
	istrator\Desk 创建升级磁盘成功	为. mg 选择固件
第四步	:选择Demo数:	_
	确定	选择Demo
		开始创建

2. 13. Burn Orange Pi OS (Droid) image to SPIFlash+NVMe SSD

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

- 1) First, you need to prepare an NVMe SSD solid state drive
 - a. The a.M.2 2230 SSD is as follows



b. The M.2 2242 SSD is as follows



2) Then insert the NVMe SSD into the M.2 PCIe interface of the development board and fix it



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) It is also necessary to prepare a data cable with a good quality Type-C interface



5) Then download Rockchip **DriverAssitant_v5.12.zip** and burning tool **RKDevTool_Release_v2.96.zip** from the **Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

6) Then download the Orange Pi OS (Droid) image, open the download link of the Orange Pi OS (Droid) image, you can see the following three types of images, please choose the image with **spi-nyme** to download



7) Then use the decompression software to decompress DriverAssitant_v5.12.zip, and

```
www.orangepi.org
```

then find the **DriverInstall.exe** executable file in the decompressed folder and open it

名称	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
😒 DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

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

a. Click the "Driver Installation" button 击

	驱动安装	驱动卸载
--	------	------

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

		-
	DriverInstall X	
驱运力学		印载
	安装驱动成功.	
	确定	

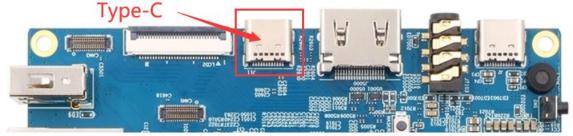
9) Then decompress **RKDevTool_Release_v2.96.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

🍏 range Pi User Manual	Copyright reserved by	Shenzhen Xunlong S	oftware Co., Ltd
名称 人名	修改日期	类型	大小
bin .	2022/12/1 15:07	文件夹	
Language	2022/12/1 15:07	文件夹	
📋 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
◎ 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

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

2 0x0000000 Parameter 3 0x0000000 Uboot 4 0x0000000 trust 5 0x0000000 Miso 6 0x0000000 Resource 7 0x0000000 Kernel 8 0x0000000 Recovery 10 0x0000000 System 11 0x0000000 Baokup	#		存储	地址	名字	路径		
8 0x0000000 Uboot 4 0x0000000 trust 5 0x0000000 Miso 8 0x0000000 Resource 7 0x0000000 Kernel 3 0x0000000 Boot 9 0x0000000 Recovery 10 0x0000000 System 11 0x0000000 Backup	1			0x00000000	Loader			
4 C 0x0000000 trust 5 C 0x0000000 Miso 8 Ox0000000 Resource C 7 Ox0000000 Rernel S 8 Ox0000000 Boot S 9 Ox0000000 Recovery S 10 Ox0000000 System S 11 Ox0000000 Backup S	2	1						
3 0x00000000 Miso 3 0x00000000 Resource 7 0x00000000 Boot 8 0x00000000 Boot 9 0x00000000 Resovery 10 0x00000000 System 11 0x00000000 Backup	3				Uboot			
3 0x00000000 Resource 7 0x00000000 Kernel 8 0x00000000 Boot 9 0x00000000 Recovery 10 0x00000000 System 11 0x00000000 Backup	4			0x00000000				
7 0x0000000 Kernel 8 0x0000000 Boot 9 0x0000000 Recovery 10 0x0000000 System 11 0x0000000 Backup	5			0x00000000	Misc			
3 Image: Constraint of the constraint	6			0x00000000	Resource			
0 0x00000000 Recovery 10 0x00000000 System 11 0x00000000 Backup	7	Г		0x00000000	Kernel			
10 0x00000000 System 11 11 0x00000000 Backup	8	Г		0x00000000	Boot			
11 Dx00000000 Backup	9	Г		0x00000000	Recovery			
	10	Г		0x00000000	System			
	11	Г		0x00000000	Backup			
	11	Γ				设备分区表	清空	
	Load							

- 11) Then start burning the Orange Pi OS (Droid) image to SPIFlash+NVMe SSD
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on 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

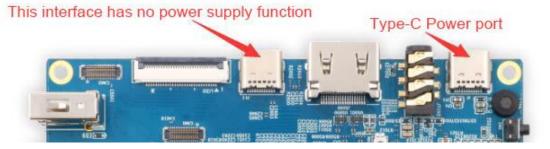
c. It is also necessary to ensure that the white USB2.0 interface in the position shown below is not plugged into a USB device



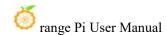
d. Then press and hold the MaskROM button on the development board. The position of the MaskROM button on the development board is shown in the figure below:



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



f. 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"



0x00000000 0x00000000 0x00000000	Loader Parameter Vboot		
0x00000000			
	Vboot		
0.0000000			
0x00000000	trust		
0x00000000	Misc		
0x00000000	Resource		
0x00000000	Kernel		
0x00000000	Boot		
0x00000000	Recovery		
0x0000000	System		
0x00000000	Backup		
	0x0000000 0x0000000 0x0000000 0x0000000 0x000000	0x0000000 Resource 0x0000000 Kernel 0x0000000 Boot 0x0000000 Recovery 0x00000000 System	0x00000000 Resource 0x000000000 Kernel 0x000000000 Boot 0x00000000 Recovery 0x00000000 Recovery 0x00000000 System

g. Then click the "Upgrade Firmware" column of the burning tool

🔀 瑞芯微开发工具	<mark>≹</mark> v2.96					1000	×
下载镜像 升级	固件 <mark>高级功</mark>	ŧĽ					
固件	升级	切换					
固件版本:		Loader版本:	芯片信息:				
固件:							

h. Then click the "Firmware" button to select the Orange Pi OS (Droid) image to be burned

🔆 瑞芯微开发工具 v2.96	- 🗆 🗙
下载遺像 升级固件 高级功能	
固件 升级 切换	
芯片信息:	
固件:	

i. Finally, click the "Upgrade" button to start burning. The burning process is shown in the figure below. You can see that the firmware will be burned into SPIFlash first, and then burned into PCIE. After burning, the Orange Pi OS (Droid) system will start automatically.

RK35688 - Android 12_spi - nvme_v1.0.0.img 校校 RK35688 - Android 12_spi - nvme_v1.0.0.img 校校 RK35688 - Android 12_spi - nvme_v1.0.0.img 校校	载Boot开始 载Boot成功 待Mastrom开始 待Mastrom成功 在下载第1份固件,存储为SPINOR I式设备成功 输芯片开始
筆 注 で で で で で で で で で で で で で で で で で で	acu与开始 acu与开始 取FlaskInfo开始 取FlaskInfo成功 备IDB开始 备IDB开始 截IDB成功 载IDB成功 载IDB成功 载IDB成功 载IDB开始 在下载固件(100%) 载固件开始 待Loader开始 待Loader开始 待Loader开始 待Loader开始 待Loader开始 待Loader开始

2.14. Burn Orange Pi OS (Droid) image to SPIFlash+SATA SSD

Note, All the following operations are performed on a Windows computer.

- 1) First, you need to prepare a SATA SSD solid state drive
 - a. The a.M.2 2242 SSD is as follows



b. M.2 The 2280 specification SSD is as follows (the 2280 specification SATA SSD can also be used, but the SSD will exceed the development board after being inserted into the development board)

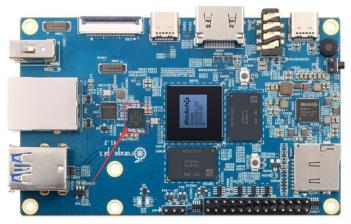


2) Then insert the SSD into the M.2 PCIe interface of the development board and fix it

A



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) It is also necessary to prepare a data cable with a good quality Type-C interface



5) Then download the Rockchip driver **DriverAssitant_v5.12.zip** and the burning tool **RKDevTool_Release_v2.96.zip** from **the Orange Pi data download page**, please make sure that the version of the downloaded **RKDevTool** tool is **v2.96**

6) Then download the Orange Pi OS (Droid) image, open the download link of the Orange Pi OS (Droid) image and you can see the following three types of images, please



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

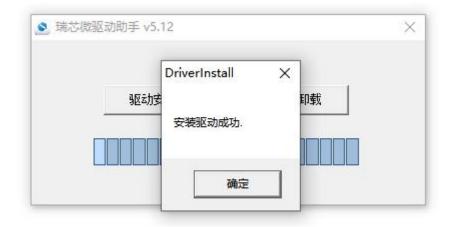
名称 个	修改日期	类型	大小
ADBDriver	2022/12/1 15:07	文件夹	
📙 bin	2022/12/1 15:07	文件夹	
Driver	2022/12/1 15:07	文件夹	
🔄 config	2014/6/3 15:38	配置设置	1 KB
🕒 DriverInstall	2022/2/28 14:11	应用程序	491 KB
Readme	2018/1/31 17:44	文本文档	1 KB
revison	2022/2/28 14:14	文本文档	1 KB

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

a. Click the "Driver Installation" button

驱动安装	驱动卸载	

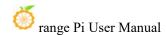
b. After waiting for a period of time, a pop-up window will prompt "The driver is installed successfully", and then click the "OK" button



9) Then decompress **RKDevTool_Release_v2.96.zip**, this software does not need to be installed, just find **RKDevTool** in the decompressed folder and open it

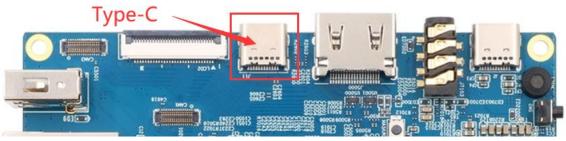
名称	修改日期	类型	大小
📙 bin	2022/12/1 15:07	文件夹	
Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
📓 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

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

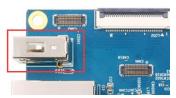


#		存储	地址	名字	路径	
	Г		0x00000000	Loader		
2	Г		0x00000000	Parameter		
3			0x00000000	Vboot		
S.			0x00000000	trust		
			0x00000000	Misc		
3			0x00000000	Resource		
2	Г		0x00000000	Kernel		
<u> </u>	Г		0x00000000	Boot		3 3
	Г		0x00000000	Recovery		
.0	Г		0x00000000	System	· ·	
11	Г		0x00000000	Backup		

- 11) Then start burning the Orange Pi OS (Droid) image to SPIFlash+SATA SSD
 - a. First, connect the development board to the Windows computer through the Type-C data cable. The position of the Type-C interface on the development board is shown in the figure below



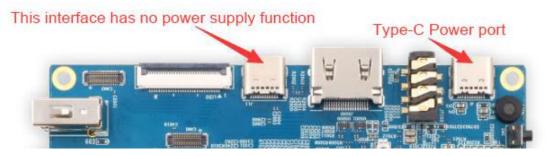
- b. Make sure that the development board is not inserted into the TF card and not connected to the power supply
- c. Also need to ensure that the white USB2.0 interface in the position shown below is not plugged into a USB device



d. 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:



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



f. 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"

	口存储	地址	名字	路径			
		0x00000000	Loader				
2		0x00000000	Parameter				
3		0x00000000	Uboot				
1		0x00000000	trust				
5		0x00000000	Misc				
6		0x000000x0	Resource				
7		0x000000x0	Kernel				
3		0x000000x0	Boot				
3		0x00000000	Recovery				
10		0x00000000	System				
11		0x00000000	Backup				

g. Then click the "Upgrade Firmware" column of the burning tool

h. Then click the "Firmware" button to select the Orange Pi OS (Droid) image to be burned

芯微开发工具 v2.96		<u> </u>	×
載镜像 升级固件 高	及功能		
固件 升级	切换		
固件版本:	Loader版本: 芯片信息:		
固件:			

i. Finally, click the "**Upgrade**" button to start burning. The burning process is shown in the figure below. You can see that the firmware will be burned to SPIFlash first, and then the firmware will be burned to SATA SSD. After burning, the Orange Pi OS (Droid) system will start automatically.

+DAM (m 1167)			下载Boot开始	
較現像 开级	固件 高级功能		下载Boot成功	
固件	升级 切换		等待Maskrom开始 等待Maskrom成Th	
固件版本:	12.0.00 Loader版本: 1.0	b 芯片信息: RK3588	正在下载第1份固件,存储为SPINOR 测试设备开始 测试设备成功	
固件:	id_12\rockdev\OrangePi5_RK3588	S_Android12_spi=sata_v1.0.1.img	校验芯片开始 校验芯片成功 获取FlashInfo开始	
			获取FlashInfo成功 准备IDB开始 准备IDB成功	
			下载IDB开始 下载IDB成功 下载固件开始	
			正在下载固件(100%) 下载固件成功	
			等待Loader开始 等待Loader成功	
			等待Loader开始	

2.15. How to burn Orange Pi OS (OH) image to TF card

Note that all operations below are performed on a Windows computer.

1) First prepare a TF card with 8GB or larger capacity. The transmission speed of the TF

card must be class10 or above. It is recommended to use TF cards from SanDisk and other brands.

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

3) Then download the SDDiskTool burning tool from the Orange Pi download page. Please ensure that the version of the SDDiskTool tool is the latest v1.72

4) Then download the image of Orange Pi OS (OH) from the Orange Pi download page

Opios-oh-4.0-release-aarch64-opi5-24.1-linux5.10.tar.gz

5) Then use decompression software to decompress the compressed package of the downloaded Orange Pi OS (OH) image. In the decompressed file, the file ending with ".img" is the Orange Pi OS (OH) image file, with a size of more than 1GB.

6) Then use decompression software to decompress **SDDiskTool_v1.72.zip**. This software does not need to be installed. Just find **SD_Firmware_Tool.exe** in the decompressed folder and open it.

길 Language	2022/9/5 15:04	文件夹	
Config	2020/3/18 17:27	配置设置	2 KB
revision	2021/4/21 18:01	文本文档	1 KB
sd_boot_config.config	2014/9/3 9:52	CONFIG 文件	1 KB
船 SD_Firmware_Tool	2021/4/21 17:57	应用程序	698 KB
SDBoot.bin	2015/9/29 17:13	BIN 文件	149 KB

7) After opening SDDiskTool, if the TF card is recognized normally, the inserted disk device will be displayed in the "Select Removable Disk Device" column. Please make sure that the displayed disk device is consistent with the drive letter of the TF card you want to burn. Yes, if there is no display, you can try to remove the TF card.



	创建升级磁盘工具 v1.72	
第一步	计择可称计磁舟设备	SDBoot:2.12
	Generic MassStorageClass USB Device 29.7G	~
第二步	:选择功能模式	
	□ 固件升级 □ PCBA测试	☑SD启动
第三步	选择升级固件	□修复
		选择固件
第四步	:选择Demo数据(可选)	
		选择Demo
		开始创建
		恢复磁盘

8) After confirming the drive letter, you can format the TF card first and click the **Recover Disk** button in **SDDiskTool**. You can also use the **SD Card Formatter** mentioned earlier to format the TF card.

10 0	:选择可移动磁盘 Generic MassSto	rageClass USB Device 29.7G	SDBoot:2.12
第二步	:选择功能模式		
	固件升级	PCBA测试	_ 🗹 SD启动
第三步	:选择升级固件	SD_Firmware_Tool X	□修复
		佐夏磁素成功 。	选择固件
第四步	:选择Demo数据(~ V1 4/
		确定	选择Demo
			开始创建

- 9) Then start writing the Orange Pi OS (OH) image to the TF card
 - b. First check "SD boot" in "Select Function Mode"
 - c. Then select the path to the Orange Pi OS (OH) image in the "Select Upgrade Firmware" column
 - d. Finally, click the "**Start Creating**" button to start burning the Orange Pi OS (OH) image to the TF card.

of range Pi User Manual	Copyright reserved l	by Shenzhen Xunlong Software Co., Ltd
	🋃 瑞芯微创建升级磁盘工具 v1.72	×
	第一步: 选择可移动磁盘设备 Generic MassStorageClass USB Device 29.7G 、	SDBoot:2.12
	第二步: 选择功能模式 □ 固件升级	☑ sn启动
	■ 第三步: 选择升级固件	□ 修夏
	第四步:选择Demo数据(可选)	选择Demo
		大 · · · · · · · · · · · · · · · · · · ·
		WA SELMAADD

10) After burning, you can exit the SDDiskTool software, and then you can pull out the TF card from the computer and insert it into the development board to start.

95-V	:选择可移动磁盘设备	SDBoot:2.12
	Generic MassStorageClass USB Device 29.7G V	
第二步	:选择功能模式 SD_Firmware_Tool X □ 固件升级	ZSD启动
第三步	:选择升级固t istrator\Desk] 修复 选择固件
第四步	:选择Demo数:	7214EULT
		选择Demo
		开始创建

2.16. How to clear SPIFlash using RKDevTool

1) The location of SPI Flash on the development board is as shown in the figure below

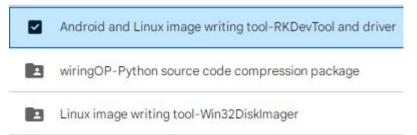


2) First you need to prepare a good quality Type-C interface data cable

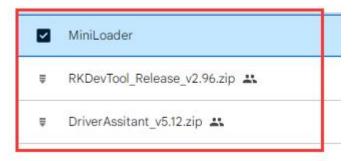


3) Then download the Rockchip microdriver **DriverAssitant_v5.12.zip** and **MiniLoader** and the burning tool **RKDevTool_Release_v3.15.zip** from the Orange Pi data download page

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



b. Then download all the files below



Note that the "MiniLoader-things needed to burn Linux images" folder will be referred to as the MiniLoader folder below.

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

🍎 range Pi User Manual	Copyright reserved	by Shenzhen X	Kunlong Software Co.	, Ltd
名称 ^ ^ ^	修改日期	类型	大小	
ADBDriver	2022/12/1 15:07	文件夹		
🔄 bin	2022/12/1 15:07	文件夹		
Driver	2022/12/1 15:07	文件夹		
🔄 config	2014/6/3 15:38	配置设置	1 KB	
S DriverInstall	2022/2/28 14:11	应用程序	491 KB	
Readme	2018/1/31 17:44	文本文档	1 KB	
revison	2022/2/28 14:14	文本文档	1 KB	

- 5) Open **DriverInstall.exe** and install the Rockchip microdriver as follows:
 - a. Click the "Driver Installation" button

	驱动安装	驱动卸载	
L	11400女表		

b. After waiting for a period of time, a window will pop up prompting "Driver installation successful", then click the "OK" button.

	DriverInstall X	1
驱动学		印载
	安装驱动成功.	

6) Then unzip **RKDevTool_Release_v3.15.zip**. This software does not need to be installed. Just find **RKDevTool** in the unzipped folder and open it.

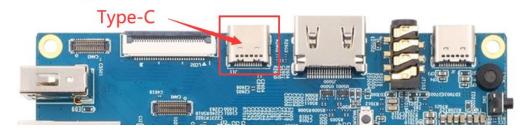
名称	修改日期	类型	大小
📙 bin	2022/12/1 15:07	文件夹	
📙 Language	2022/12/1 15:07	文件夹	
📄 config.cfg	2022/3/23 9:11	CFG 文件	7 KB
🔄 config	2021/11/30 11:04	配置设置	2 KB
revision	2022/5/27 9:09	文本文档	3 KB
🔀 RKDevTool	2022/5/27 9:06	应用程序	1,212 KB
◎ 开发工具使用文档_v1.0	2021/8/27 10:28	Foxit PDF Reade	450 KB

7) After opening the **RKDevTool** burning tool, because the computer has not yet been

connected to the development board through the Type-C cable, a message "**No device found**" will be displayed in the lower left corner.

		存储	地址	名字	路径			
			0x00000000	Loader				
			0x00000000	Parameter				
£.,			0x00000000	Uboot				
2			0x00000000	trust				
			0x000000x0	Misc				
Š.			0x000000x0	Resource				
			0x00000000	Kernel				
	Г		0x00000000	Boot				
r.	Г		0x000000x0	Recovery				
0	Г		0x00000000	System				
1			0x00000000	Backup				
bad	er:		执行 强制按地址写	切換	设备分区表 清空			

- 8) Then you can start clearing the contents of SPI FLASH
 - a. First, connect the development board and Windows computer through the Type-C data cable. The location of the Type-C interface of the development board is as shown in the figure below.



- b. Make sure that the TF card is not inserted into the development board and the power supply is not connected.
- c. Also make sure that no USB device is plugged into the white USB2.0 interface in the picture below



d. Then press and hold the MaskROM button of the development board. The position of the MaskROM button on the development board is as shown in the figure below:



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



f. If the previous steps go well, the development board will enter MASKROM mode at this time, and the interface of the burning tool will prompt "A MASKROM device was found"

#		存储	地址	名字	路径	
1	Г		0x00000000	Loader		
2	Г		0x00000000	Parameter		
3	Г		0x00000000	Uboot		
4			0x00000000	trust		
5			0x00000000	Misc		
6			0x00000000	Resource		
7	Г		0x00000000	Kernel		
8	Г		0x00000000	Boot		
9			0x00000000	Recovery		
10	Г		0x00000000	System		
11	Г		0x00000000	Backup		
	er:	L.	执行	IJ换	设备分历表 清空	

g. Then please select advanced functions

微	开发	工具 v3.15	;				
竟信	R ;	升级固件	高级功能			.[
						-	
		存储	土址	名字	路径		
	Г		0:0000000	Loader			
	Г		0x00000000	Parameter			
	Г		0x0000000	Uboot			
1	Г		0x0000000	trust			
	Г		0x00000000	Misc			
	Г		0x00000000	Resource			
	Г		0x00000000	Kernel			
	Г		0x00000000	Boot			
			0x00000000	Recovery			
	Г		0x00000000	System			
	Г		0x00000000	Backup			

h. Then click the location shown in the picture below

🔀 瑞芯微开发工具 v3	.15				- 0 X
下載镜像 升级固件	高级功能				
Boot:				下载	
固件:				解包	
读取FlashID	读取Flash信息	读取Chip信息	读职Capability	1. FlASH 2. EMUC 3. 5D 4. 5D1	
测试设备	重启设备	进入Maskron	切换存储	6. SPINOR 6. SPINAND 7. RAM 8. USB	
清空序列号	检测安全模式	导出串口日志	获取当前存储	8. 058 9. SATA 10. PCIE	
导出镜像	擦除扇区	擦除所有			
起始扇区:					
扇区数:					
发现	一个MASKRO	M设备	1-2-3 :MASKF	ом	

i. Then select MiniLoaderAll.bin in the MiniLoader folder downloaded earlier, and then click Open

· 个 🔜 > 此电脑 > 桌面 > orangepi > MiniLoader-烧录Linux	漁像才需要用到的东西 ✓ ♂ ← MiniLoader-烧录Linux
组织 ▼ 新建文件夹 ■ 此电脑 ^ MiniLoaderAll.bin	88 - 🛄 💡
3D 对象 rk3588_linux_emm.cfg 视频 rk3588_linux_prie.cfg 图片 rk3588_linux_spiflash.cfg 文档 rk3588_linux_tfcard.cfg 予訴 盧面 *< 本時認識(C) *	
文件名(N): MiniLoaderAll.bin	✓ All File(*,*) ✓

j. Then click download

瑞芯微开发工具 v3					 - 0
下载镜像 升级固件	高级功能				
Boot: C:\1	Users\hh177\Deskt	op\orangepi\Minil	Loader-烧	下载	
固件:				解包	
读取FlashID	读取Flash信息	读取Chip信息	读取Capability	1. FlASH 2. EMMC 3. SD 4. SD1	
测试设备	重启设备	进入Maskron	切换存储	5. SPINOR 6. SPINAND 7. RAM	
清空序列号	检测安全模式	导出串口日志	获取当前存储	8. USB 9. SATA 10. PCIE	
导出镜像	擦除扇区	擲除所有	l		
起始扇区:					
扇区数:					
发现	一个MASKRO	M设备	1-2-3 :MASKRO	DM ~	

k. After downloading MiniLoaderAll.bin, the display is as shown below

🧼 range Pi User Manual

瑞芯微开发工具 v	3.15						-	×
下載镜像 升级固件	- 高级功能					下载Boot开始 下载Boot成功		 _
Boot: C:\	Users\hh177\Deskt	op\orangepi\Minil	.oader-烧	•••	下载	+		
固件:				•••	解包			
读取FlashID	读取Flash信息	读取Chip信息	读取Capa		1. Flash 2. EMMC 3. SD			
测试设备	重启设备	进入Maskrom	切换有	宇储	4. SD1 5. SPINOR 6. SPINAND 7. RAM			
清空序列号	检测安全模式	导出串口日志	获取当前	前存储	8. USB 9. SATA 10. PCIE			
导出镜像	擦除扇区	擦除所有						
起始扇区:								
扇区数:						1		
发现	一个MASKRO	M设备	1-2-3	:MASKRO	ж	~		

1. Then select the storage device as **SPINOR**

战镜像 升级固件	- 10142-5316					下載Boot开始 下载Boot成功	
Boot: C:\	Users\hh177\Deskt	op\orangepi\Minil	Loader-烧		下载		
固件:				•••	解包		
读取FlashID	读取Flash信息	读取Chip信息	读取Capa		L. FlASH 2. ENONC 3. SD 4. SD1		
测试设备	重启设备	进入Maskron	切换在	子储 📙	5. SPINOR 5. SPINAND 7. RAM		
清空序列号	检测安全模式	导出串口日志	获取当前	前存储 9	3. USB 9. SATA 10. PCIE		
导出镜像	擲除扇区	擦除所有		L			
起始扇区:							
扇区数:							

m. Then click Switch Storage

线镜像 升级固件	高級切配				下載Boot开始 下載Boot成功	
Boot: C:\1	Users\hh177\Deskt	op\orangepi\MiniLos	ader-烧	下载		
固件:				解包		
读取FlashID	读取Flash信息	读取Chip信息	读取Capability	1. Flash 2. ENNC 3. SD		
测试设备	重启设备	进入Maskron	切换存储	4. SD1 5. SPINOR 6. SPINAND 7. RAM		
清空序列号	检测安全模式	导出串口日志	获取当前存储	8. USB 9. SATA 10. PCIE		
导出镜像	擲除扇区	擲除所有				
起始扇区:						
扇区数:						

n. Then click Erase All to start erasing SPIFlash.

🔀 瑞芯微开发工	具 v3.15						-	×
下载镜像 升级	過件 高级功能					下载Boot开始 下载Boot成功		
Boot:	C:\Users\hh177\Deskt	op\orangepi\MiniL	.oader-烧	•••	下载			
固件:					解包			
读取Flash	hID 读取Flash信息	读取Chip信息	读取Capa	bility	1. Flash 2. EMMC 3. SD 4. SD1			
测试设备	重启设备	进入Maskron	切换有	テ储	5. SPINOR 6. SPINAND 7. RAM			
清空序列	号检测安全模式	导出串口日志	获取当前	存储	B. USB 9. SATA 10. PCIE			
导出镜像	擲徐扇区	擦除所有						
起始扇区:								
扇区数:								
发	现一个MASKRO	M设备	1-2-3	:MASKRO	n	~		

o. The display log after erasing SPIFlash is as shown below

镜像 升级固件						擦除扇区开始,起始(0x0),数量(0x8000) 正在擦除(100%) 擦除扇区成功	
oot: <u>C:\</u>	Users\hh177\Deskt	op\orangep1\Minil	.oader-)決		下载		
]件:				•••	解包		
读取FlashID	读取Flash信息	读取Chip信息	读取Capa		1. Flash 2. EMMC 3. SD		
测试设备	重启设备	进入Maskron	切换有	写储	4. SD1 5. SPINOR 6. SPINAND 7. RAM		
清空序列号	检测安全模式	导出串口日志	获取当前	前存储	8. USB 9. SATA 10. PCIE		
导出镜像	擲除扇区	擦除所有		l			
3始扇区:							
舅区数:							

2.17. Start the Orange Pi development board

1) Insert the TF card with the burned image into the TF card slot of the Orange Pi development board. If the image of SPIFlash+NVMe SSD has been burnt, then there is no need to insert a TF card, just make sure that the NVMe SSD is inserted into the development board normally.

2) The development board has an HDMI interface, and the development board can be connected to a TV or HDMI display through an HDMI-to-HDMI cable. If you buy an LCD screen, you can also use the LCD screen to display the system interface of the development board. If there is a Type-C to HDMI cable, the system interface of the development board can also be displayed through the Type-C interface.

3) Connect a USB mouse and keyboard to control the Orange Pi development board.

4) The development board has an Ethernet port, which can be plugged into a network cable for Internet access.

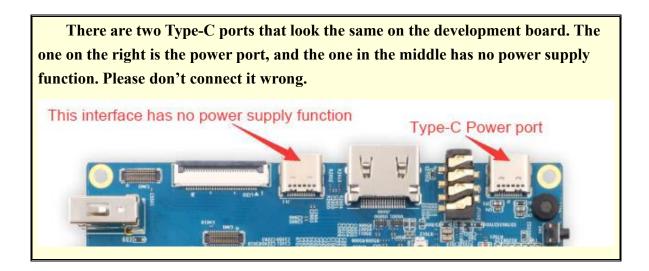
5) Connect a high-quality power adapter with a 5V/4A USB Type-C interface.

Remember not to plug in a power adapter with a voltage output greater than 5V, as this will burn out the development board.

Many unstable phenomena during the power-on and start-up process of the system are basically caused by problems with the power supply, so a reliable power adapter is very important. If you find that there is a phenomenon of continuous restart during the startup process, please replace the power supply or the Type-C data cable and try again.

The Type-C power port does not support PD negotiation.

In addition, please do not connect the USB interface of the computer to power the development board.



6) Then turn on the switch of the power adapter. If everything is normal, you can see the startup screen of the system on the HDMI monitor or LCD screen.

7) If you want to view the output information of the system through the debugging serial port, please use the serial cable to connect the development board to the computer. For the connection method of the serial port, please refer to **the section on how to use the debugging serial** port.

2.18. How to use the debugging serial port

2. 18. 1. Connection instruction of debugging serial port

1) First, you need to prepare a **3.3V** USB to TTL module, and then insert the USB interface end of the USB to TTL module into the USB interface of the computer.

For better compatibility, it is recommended to use the CH340 USB to TTL module instead of the CP2102 USB to TTL module.

Before purchasing a USB to TTL module, please confirm that the module supports a baud rate of 1500000.



2) The corresponding relationship between GND, RXD and TXD pins of the debugging serial port of the development board is shown in the figure below

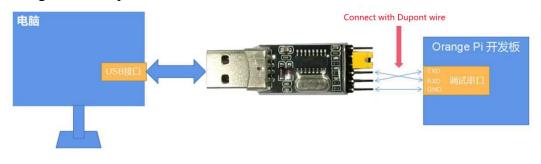


3) The GND, TXD and RXD pins of the USB to TTL module need to be connected to the debugging serial port of the development board through a DuPont line

- a. The GND of the USB to TTL module is connected to the GND of the development board
- b. The RX of the USB to TTL module is connected to the TX of the development board
- c. The TX of the USB to TTL module is connected to the RX of the development

board

4) The schematic diagram of connecting the USB to TTL module to the computer and the Orange Pi development board is as follows



Schematic diagram of connecting the USB to TTL module to the computer and the Orange Pi development board

The TX and RX of the serial port need to be cross-connected. If you don't want to carefully distinguish the order of TX and RX, you can connect the TX and RX of the serial port casually. If there is no output in the test, then exchange the order of TX and RX, so that there is always a the order is right

2. 18. 2. How to use the debugging serial port on the Ubuntu platform There are many serial port debugging software that can be used under Linux,

such as putty, minicom, etc. The following demonstrates how to use putty.

1) First, insert the USB-to-TTL module into the USB port of the Ubuntu computer. If the connection and recognition of the USB-to-TTL module is normal, you can see the corresponding device node name under /dev on the Ubuntu PC. Remember this node name, and then set the serial port software will be used

```
test@test:~$ ls /dev/ttyUSB*
/dev/ttyUSB0
```

2) Then use the following command to install putty on Ubuntu PC

test@test:~\$ sudo apt-get update

test@test:~\$ sudo apt-get install -y putty

3) Then run putty, **remember to add sudo permission**

test@test:~\$ sudo putty

4) After executing the putty command, the following interface will pop up

	PuTTY Configuration	- 🗆 🔕
Category: ▼ Session	Basic options for your PuTTY sessi Specify the destination you want to connect to	
Logging Terminal	Host <u>N</u> ame (or IP address)	Port 22
Keyboard Bell	Connection type:	⊖ Se <u>r</u> ial
Features • Window Appearance	Load, save or delete a stored session Sav <u>e</u> d Sessions	
Behaviour Translation Selection	Default Settings	Load
Colours		Save
Fonts Connection Data		Delete
Proxy Telnet Rlogin > SSH	Close window on exit: Always Never Only on clear	n exit
About	<u>O</u> pen	<u>C</u> ancel

5) First select the setting interface of the serial port

Options controllin	n local serial lines
Select a serial line	giocarsenarines
Seria <u>l</u> line to connect to	/dev/ttyUSB0
Configure the serial line	
<u>S</u> peed (baud)	1500000
Data <u>b</u> its	8
S <u>t</u> op bits	1
<u>P</u> arity	None
Flow control	None
<u> </u>	
	Serial line to connect to Configure the serial line Speed (baud) Data bits Stop bits Parity

- 6) Then set the parameters of the serial port
 - a. Set the Serial line to connect to as /dev/ttyUSB0 (modify to the corresponding node name, generally /dev/ttyUSB0)

- b. Set Speed(baud) to **1500000** (the baud rate of the serial port)
- c. Set Flow control to None

	PuTTY Configuration	00
Features Window 3. Set Appearance Behaviour Translation Selection Colours Fonts Connection	Options controlling Select a serial line Serial line to connect to device node name of the serial configure the serial line Sp Set (Babd) to 1500000 Data bits Stop bits Parity Elow control 4. Set Flow control to None 1. Select the setting interf	/dev/ttyUSB0 port module 1500000 8 1 None • None •
About		<u>O</u> pen <u>C</u> ancel

- 7) After setting the serial port setting interface, return to the Session interface
 - a. First select the Connection type as Serial
 - b. Then click the Open button to connect to the serial port

	PuTTY Configuration	
Category: 🖌 1.	Go back to the Session interface Basic options for your PuTTY ses	sion
 Session 	Specify the destination you want to connect	to
Logging	Serial li <u>n</u> e	Speed
▼ Terminal	/dev/ttyUSB0	1500000
Keyboard Bell	Connection type:	• Se <u>r</u> ial
Features ▼ Window	Load, save or delete a stored session Sav <u>e</u> d Sessions	
Appearance Behaviour		
Translation Selection	Default Settings	Load
Colours		Sa <u>v</u> e
Fonts		Delete
 Connection Data Proxy 		
Telnet Rlogin	Close window on e <u>x</u> it: Always Never Only on cle	an exit
• ссн	3. Finally click the Open button	
About	Open	Cancel

8) After starting the development board, you can see the Log information output by the system from the opened serial port terminal

	/d	ev/tt	:yU	SB0 - PuTT	Y	000
R0=0×18						
MR4=0×1						
MR5=0×1						
MR8=0x8						
MR12=0x72						
MR14=0x72 MR18=0x0						
MR19=0x0						
MR24=0x8						
MR25=0x0						
R0=0x18						
MR4=0×1						
MR5=0x1						
MR8=0x8						
MR12=0x72						
MR14=0×72						
MR18=0×0						
MR19=0×0						
MR24=0x8						
MR25=0x0						
channel O training pass!						
channel 1 training pass!						
change freq to 416MHz 0,1						
Channel 0: LPDDR4,416MHz Bus Width=32 Col=10 Bank=8	Dou-15/15	CC-0	Die	Puo-liidth-16	Cite-2040MD	
Channel 1: LPDDR4,416MHz	100-10/10	03-2	Die	bas widen-10	0126-2040l/lb	
Bus Width=32 Col=10 Bank=8	Rou=15/15	CS=2	Die	Bus-Midth=16	Size=2048MB	
256B stride	1100 201 20			242 01300-10	CILC LO IOID	
D0-0-10						

2. 18. 3. How to use the debugging serial port on Windows platform

There are many serial port debugging software that can be used under Windows, such as SecureCRT, MobaXterm, etc. The following demonstrates how to use MobaXterm. This software has a free version and can be used without buying a serial number.

1) Download MobaXterm

a. Download MobaXterm website as follows

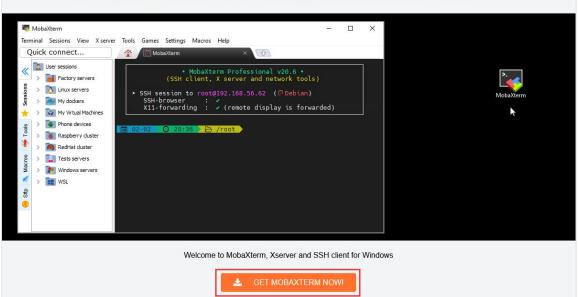
https://mobaxterm.mobatek.net

b. After entering the MobaXterm download page, click GET XOBATERM NOW!

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MobaXterm

Enhanced terminal for Windows with X11 server, tabbed SSH client, network tools and much more



c. Then choose to download the Home version

essional Edition
/ 49€ per user*
ding tax. Volume discounts available
y feature from Home Edition +
ize your startup message and logo
Modify your profile script
nwanted games, screensaver or tools
Inlimited number of sessions
ed number of tunnels and macros
ted run time for network daemons
Enhanced security settings
2-months updates included
Deployment inside company
Lifetime right to use

d. Then select Portable portable version, no need to install after downloading, just open it and use it

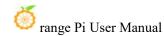
🥯 range Pi User Manual	Copyright reserved by Shenzhen Xunlong Software Co., Ltd
MobaXterm Home Edition	
Download MobaXterm Home Edition (current version):
MobaXterm Home Edition v2	
(Portable edition)	(Installer edition)
Download previous stable version: MobaXterm Por	table v22.1 MobaXterm Installer v22.1
By downloading MobaXterm software, you accept Mo	baXterm terms and conditions
You can download the third party plugins and compo	nents sources here
rou cuir downodd aro and party plagno and compo	
If you use MobaXterm inside your company yo	u should consider subscribing to MobaXterm Professional Edition: your subscription will
	the "Customizer" software. This customizer will allow you to generate personalized
	b, your default settings and your welcome message.
Please contact us for more information.	

2) After downloading, use decompression software to decompress the downloaded compressed package, you can get the executable software of MobaXterm, and then double-click to open

名称 ^	修改日期	类型	大小
CygUtils.plugin	2022/9/24 20:16	PLUGIN 文件	17,484 KB
MobaXterm_Personal_22.2	2022/10/22 16:53	应用程序	16,461 KB

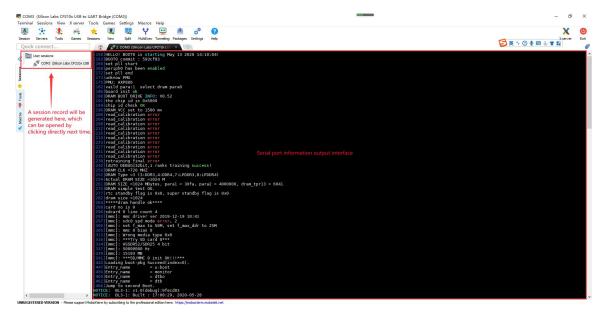
- 3) After opening the software, the steps to set up the serial port connection are as follows
 - a. Open the session settings interface
 - b. Select the serial port type
 - c. Select the port number of the serial port (select the corresponding port number according to the actual situation), if you cannot see the port number, please use 360 Driver Master to scan and install the driver for the USB to TTL serial port chip
 - d. Select the baud rate of the serial port as 1500000
 - e. Finally click the "**OK**" button to complete the setup

10



ssion	Servers	X Tools	Games	🜟 Sessions	View	split	Y MultiExec	Tunneling	Packages	settings	(?) Help					
)uick (connect				(¢)											
S 🔝	Session set	ttings														
	SSH	Telnet	Rsh	Xdmcp	I RDP	VNC	FTF	9 <mark>(</mark> 9 SFT	D Seria	al File	Shell	Browser	Mosh	S3	WSL	
	S Ba	asic Seria	al settings	3						~	2. Select	the serial	port			
		Serial p	_	iose at ses				~		Speed (bps) * 150	0000 ~				
		dvanced \$	_	M3 (Silico	n Labs CF				rk setting:		1					
			3. Se	lect the p	ort numk	per of th	e serial	port	4. Se	elect the l	baud rate	as 150000	0			
														×	6	
						Serial	(COM)	session								
						Serial		session	5							

4) After clicking the "**OK**" button, you will enter the following interface. At this time, start the development board and you can see the output information of the serial port



2. 19. Instructions for using the 5v pin in the 26pin interface of the development board to supply power

The power supply method we recommend for the development board is to use the 5V/4A Type C interface power cord to plug into the Type-C power interface of the development board for power supply. If you need to use the 5V pin in the 26pin interface to power the development board, please make sure that the power cable and power adapter used can meet the power supply requirements of the development board. If the use is unstable, please switch back to the Type-C power supply.

1) First, you need to prepare a power cord as shown in the figure below



The power cord shown in the picture above can be bought on Taobao, please search and buy by yourself.

2) Use the 5V pin in the 26pin interface to supply power to the development board. The connection method of the power line is as follows

- a. The USB A port of the power cord shown in the above picture needs to be plugged into the 5V/4A power adapter connector (please do not plug into the USB port of the computer for power supply)
- b. The red DuPont line needs to be plugged into the 5V pin of the development board 26pin
- c. The black DuPont line needs to be inserted into the GND pin of the 26pin interface

d. The position of the 5V pin and GND pin of the 26pin interface on the development board is shown in the figure below, remember not to reverse the connection



3. Ubuntu/Debian Server and Xfce desktop system

usage instructions

本章内容是基于 linux 服务器版本的镜像和 xfce 桌面版本镜像编写的。 如果使用的是 Ubuntu22.04 Gnome 镜像,请先查看 Ubuntu22.04 Gnome Wayland 桌面系统使用说明一章的说明, Ubuntu22.04 Gnome Wayland 桌面系统使用说明一章中不存在的内容,可以参 考此章的说明,但是有些细节是会有差异的,这点请特别注意下。 如果使用的是 OPi OS Arch 镜像,请查看 Orange Pi OS Arch 系统使用说明一 章的内容。

3.1. Supported Linux image types and kernel versions

Linux Image Type	Kernel	Server Version	Desktop
	Version		Version
Debian 11 - Bullseye	Linux5.10	Support	Support
Ubuntu 20.04 - Focal	Linux5.10	Support	Support
Ubuntu 22.04 - Jammy	Linux5.10	Support	Support
Debian 11 - Bullseye	Linux6.1	Support	Support
Debian 12 - Bookworm	Linux6.1	Support	Support



Ubuntu 20.04 - Focal	Linux6.1	Support	Support
Ubuntu 22.04 - Jammy	Linux6.1	Support	Support

3.2. Linux system adaptation

Function Debian11 Debian12 Ubuntu20.04 Ubuntu22.04 xfce USB2.0x2 OK OK OK OK USB3.0x1 OK OK OK OK USB Type-C 3.0 OK OK OK OK **DP** Display OK OK OK OK M.2 NVMe SSD Boot OK OK OK OK M.2 SATA SSD Boot OK OK OK OK OK **USB Boot System** OK OK OK OK AP6275P-WIFI OK OK OK **AP6275P-Bluetooth** OK OK OK OK GPIO (26pin) OK OK OK OK UART (26pin) OK OK OK OK SPI (26pin) OK OK OK OK I2C (26pin) OK OK OK OK CAN (26pin) OK OK OK OK PWM (26pin) OK OK OK OK **3pin Debugging** OK OK OK OK **Serial Port TF Card Start** OK OK OK OK OK **HDMI Video** OK OK OK HDMI Audio OK OK OK OK OV13850 Camera OK OK OK OK OV13855 Camera OK OK OK OK LCD1 OK OK OK OK LCD2 OK OK OK OK **Gigabit Ethernet** OK OK OK OK Port

3. 2. 1. Linux5.10 system adaptation situation

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Network Port Status

OK

OK

OK

OK

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Light				
MIC	OK	OK	ОК	OK
Headphone Playback	OK	OK	ОК	OK
Headphone	OK	OK	ОК	OK
Recording				
LED Lights	OK	ОК	ОК	OK
GPU	OK	OK	ОК	OK
NPU	OK	OK	ОК	OK
VPU	OK	OK	ОК	OK
Switch Button	OK	OK	ОК	OK
Watchdog Test	OK	OK	ОК	OK
Chromium Hard	OK	ОК	ОК	OK
Solution Video				

3. 2. 2. Linux6.1 system adaptation situation

Function	Debian11	Debian12	Ubuntu20.04	Ubuntu22.04
USB2.0x2	ОК	ОК	ОК	ОК
USB3.0x1	OK	OK	OK	OK
USB Type-C 3.0	OK	ОК	OK	ОК
DP Display	ОК	OK	ОК	ОК
M.2 NVMe SSD Boot	ОК	OK	OK	OK
M.2 SATA SSD Boot	ОК	OK	OK	OK
USB Boot System	ОК	ОК	OK	OK
AP6275P-WIFI	ОК	ОК	OK	OK
AP6275P-Bluetooth	ОК	OK	OK	OK
GPIO (26pin)	ОК	OK	OK	OK
UART (26pin)	ОК	OK	OK	OK
SPI (26pin)	ОК	OK	ОК	ОК
I2C (26pin)	ОК	OK	ОК	OK
CAN (26pin)	NO	NO	NO	NO
PWM (26pin)	ОК	OK	OK	OK
3pin Debugging	ОК	ОК	OK	OK
Serial Port				
TF Card Start	ОК	ОК	OK	OK
HDMI Video	ОК	ОК	OK	OK
HDMI Audio	ОК	ОК	ОК	OK

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OV13850 Camera	ОК	OK	ОК	ОК
OV13855 Camera	ОК	OK	ОК	ОК
LCD1	ОК	OK	ОК	ОК
LCD2	ОК	ОК	ОК	ОК
Gigabit Ethernet	ОК	OK	ОК	ОК
Port				
Network Port Status	ОК	OK	ОК	ОК
Light				
MIC	ОК	OK	ОК	ОК
Headphone Playback	ОК	OK	ОК	ОК
Headphone	OK	ОК	ОК	ОК
Recording				
LED Lights	ОК	OK	ОК	ОК
GPU	ОК	OK	OK	ОК
NPU	OK	ОК	ОК	OK
VPU	ОК	OK	ОК	ОК
Switch Button	ОК	OK	ОК	ОК
Watchdog Test	ОК	OK	ОК	ОК
Chromium Hard	OK	ОК	ОК	ОК
Solution Video				

3. 3. The format of linux commands in this manual

1) All commands that need to be entered in the Linux system in this manual will be boxed with the following box

As shown below, the content in the yellow box indicates the content that needs special attention, except for the commands in it.

2) Description of the prompt type in front of the command

a. The prompt in front of the command refers to the content of the red part in the

box below, which is not part of the linux command, so when entering the command in the linux system, please do not enter the content of the red font part.

orangepi@orangepi:~\$ sudo apt update root@orangepi:~# vim /boot/boot.cmd test@test:~\$ ssh root@192.168.1.xxx root@test:~# ls

- b. root@orangepi:~\$ The prompt indicates that this command is entered in the linux system of the development board. The last \$ of the prompt indicates that the current user of the system is an ordinary user. When executing a privileged command, sudo needs to be added
- c. root@orangepi:~# The prompt indicates that this command is entered in the linux system of the development board, and the # at the end of the prompt indicates that the current user of the system is the root user, who can execute any desired command
- d. test@test:~\$ prompt indicates that this command is entered in the Ubuntu PC or Ubuntu virtual machine, not in the linux system of the development board. The \$ at the end of the prompt indicates that the current user of the system is an ordinary user. When executing privileged commands, sudo needs to be added
- e. root@test:~# prompt indicates that this command is entered in the Ubuntu PC or Ubuntu virtual machine, not in the linux system of the development board. The # at the end of the prompt indicates that the current user of the system is the root user and can execute any command you want
- 3) What are the commands that need to be entered?
 - a. As shown below, **the black bold part** is the command that needs to be input, and the content below the command is the output content (some commands have output, some may not have output), this part of the content does not need to be input

root@orangepi:~# cat /boot/orangepiEnv.txt
verbosity=7
bootlogo=false
console=serial

b. As shown below, some commands cannot be written in one line and will be placed on the next line. As long as the black and bold parts are all commands that need to be input. When these commands are entered into one line, the last "\" of each line needs to be removed, this is not part of the command. In addition,

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there are spaces in different parts of the command, please don't miss it orangepi@orangepi:~\$ echo \ "deb [arch=\$(dpkg --print-architecture) \ signed-by=/usr/share/keyrings/docker-archive-keyring.gpg] \ https://download.docker.com/linux/debian \ \$(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null

3.4. Linux system login instructions

3. 4. 1. Linux system default login account and password

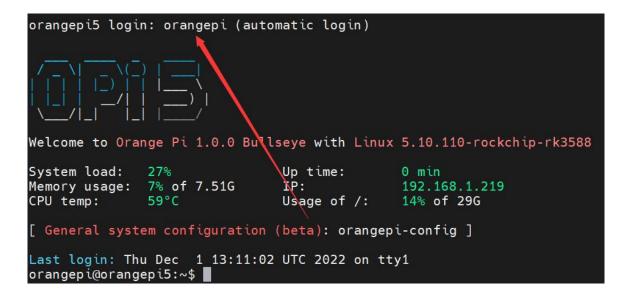
Account	Password
root	orangepi
orangepi	orangepi

Notice, When entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.

When the wrong password is prompted, or there is a problem with the ssh connection, please note that as long as you are using the Linux image provided by Orange Pi, please do not suspect that the above password is wrong, but look for other reasons.

3. 4. 2. How to set automatic terminal login in linux system

1) By default, the Linux system automatically logs in to the terminal, and the default login user name is **orangepi**



2) Use the following command to set the root user to automatically log in to the terminal orangepi@orangepi:~\$ sudo auto_login_cli.sh root

3) Use the following command to disable automatic login terminal orangepi@orangepi:~\$ sudo auto login cli.sh -d

4) Use the following command to set the orangepi user to automatically log in to the terminal again

orangepi@orangepi:~\$ sudo auto_login_cli.sh orangepi

3. 4. 3. Instructions for automatic login of Linux desktop version system

1) After the desktop version system is started, it will automatically log in to the desktop without entering a password



2) Run the following command to prohibit the desktop system from automatically logging into the desktop

orangepi@orangepi:~\$ sudo disable desktop autologin.sh

3) Then restart the system and a login dialog box will appear, at which point a **password** is required to enter the system



3. 4. 4. The setting method of root user automatic login in Linux desktop version system

1) Execute the following command to set the desktop system to automatically log in as the root user

orangepi@orangepi:~\$ sudo desktop login.sh root

2) Then restart the system, it will automatically use the root user to log in to the desktop



Note that if you log in to the desktop system as the root user, you cannot use pulseaudio in the upper right corner to manage audio devices.

Also note that this is not a bug, since pulseaudio is not allowed to run as root.

3) Execute the following command to set the desktop system to automatically log in as the orangepi user again

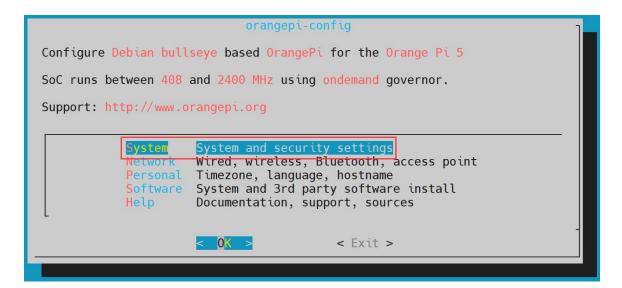
orangepi@orangepi:~\$ sudo desktop_login.sh orangepi

3. 4. 5. The method of disabling the desktop in the Linux desktop version system

1) First enter the following command in the command line, **please remember to add sudo permission**

orangepi@orangepi:~\$ sudo orangepi-config

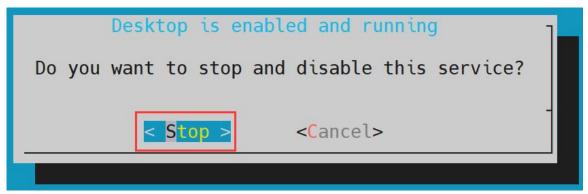
2) Then select System



3) Then select **Desktop**

System settings	1
InstallInstall to/update boot loaderBootenvEdit boot environmentCPUSet CPU speed and governorAvahiAnnounce system in the networkSSHReconfigure SSH daemonFirmwareRun apt update & apt upgrade7SHInstall 7SH with plugins and tmuxDesktopDisable desktop or change login type	
< 0 <mark>K ></mark> < Back >	

4) Then select <Stop>



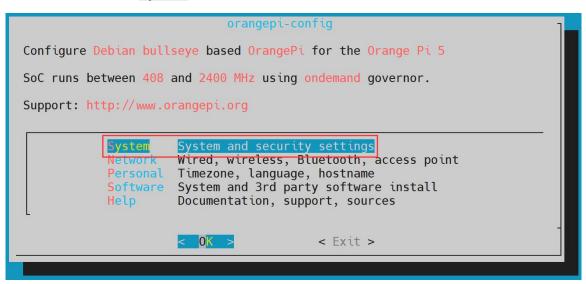
www.orangepi.org

5) Then restart the Linux system and you will find that the desktop will not be displayed

- 6) The steps to reopen the desktop are as follows:
 - a. First enter the following command on the command line, **please remember to** add sudo permission

orangepi@orangepi:~\$ sudo orangepi-config

b. Then select **System**

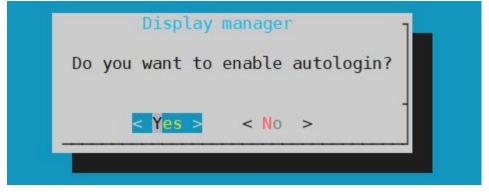


c. Then select **Desktop** Enable desktop

	System settings
Install	Install to/update boot loader
Bootenv	Edit boot environment
CPU	Set CPU speed and governor
Avahi	Disable system announce in the network
SSH	Reconfigure SSH daemon
Firmware	Run apt update & apt upgrade
75H	Install ZSH with plugins and tmux
Desktop	Enable desktop
	< 0K > < Back >

d. Then choose whether to automatically log in to the desktop, if you select **<Yes>**, it will automatically log in to the desktop, if you select **<No>**, it will display the

user and password input interface, and you need to enter the password to enter the desktop



e. After selection, the HDMI monitor will display the desktop

3. 5. Onboard LED Light Test Instructions

1) There are two LED lights on the development board, one is green and the other is red. The location is shown in the figure below:



2) As long as the development board is powered on, the red LED light will always be on, which is controlled by the hardware and cannot be turned off by the software.

3) The green LED light will keep flashing after the kernel is started, which is controlled by software.

4) The method of setting the green light on and off and flashing is as follows

No	te that the following operations should be performed under the root user.
a.	First enter the setting directory of the green light
root@o	rangepi:~# cd /sys/class/leds/status_led

b. The command to set the green light to stop flashing is as follows

🧭 range Pi User Manual

root@orangepi:/sys/class/leds/status led# echo none > trigger

c. The command to set the green light to be on is as follows

root@orangepi:/sys/class/leds/status_led# echo default-on > trigger

d. The command to set the green light to flash is as follows

root@orangepi:/sys/class/leds/status_led# echo heartbeat > trigger

3.6. Network Connection Test

3. 6. 1. Ethernet port test

1) First, insert one end of the network cable into the Ethernet interface of the development board, and connect the other end of the network cable to the router, and ensure that the network is unblocked

2) After the system starts, it will automatically assign an IP address to the Ethernet card through **DHCP without any other configuration**

3) The command to view the IP address in the Linux system of the development board is as follows

orangepi@orangepi:~\$ ip addr show eth0

2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc mq state UP group default qlen 1000

link/ether 4a:fe:2b:3d:17:1c brd ff:ff:ff:ff:ff:ff

inet **192.168.1.150**/24 brd 192.168.1.255 scope global dynamic noprefixroute eth0 valid_lft 43150sec preferred_lft 43150sec

inet6 fe80::9a04:3703:faed:23be/64 scope link noprefixroute

valid_lft forever preferred_lft forever

When using ifconfig to view the IP address, if the following information is prompted, it is because sudo is not added. The correct command is: sudo ifconfig

orangepi@orangepi:~\$ ifconfig

Command 'ifconfig' is available in the following places

* /sbin/ifconfig

* /usr/sbin/ifconfig

The command could not be located because '/sbin:/usr/sbin' is not included in the PATH

environment variable.

This is most likely caused by the lack of administrative privileges associated with your user account.

ifconfig: command not found

There are three ways to check the IP address after the development board starts:

1. Connect the HDMI monitor, then log in to the system and use the ip addr show eth0 command to view the IP address

2. Enter the **ip addr show eth0** command in the debugging serial terminal to view the IP address

3. If there is no debugging serial port and no HDMI display, you can also check the IP address of the development board's network port through the router's management interface. However, in this method, some people often cannot see the IP address of the development board normally. If you can't see it, the debug method looks like this:

A) First check whether the Linux system has started normally. If the green light of the development board is blinking, it is generally started normally. If only the red light is on, it means that the system has not started normally;

B) Check whether the network cable is plugged in tightly, or try another network cable;

C) Try another router (I have encountered many problems with the router, such as the router cannot assign the IP address normally, or the IP address has been assigned normally but cannot be seen in the router);

D) If there is no router to replace, you can only connect to an HDMI display or use the debugging serial port to check the IP address.

In addition, it should be noted that the development board DHCP automatically assigns an IP address without any settings.

4) The command to test the network connectivity is as follows, the **ping** command can be interrupted through the shortcut key of **Ctrl+C**

orangepi@orangepi:~\$ **ping www.baidu.com -I eth0** PING www.a.shifen.com (14.215.177.38) from 192.168.1.12 eth0: 56(84) bytes of data. 64 bytes from 14.215.177.38 (14.215.177.38): icmp_seq=1 ttl=56 time=6.74 ms 64 bytes from 14.215.177.38 (14.215.177.38): icmp_seq=2 ttl=56 time=6.80 ms 64 bytes from 14.215.177.38 (14.215.177.38): icmp_seq=3 ttl=56 time=6.26 ms 64 bytes from 14.215.177.38 (14.215.177.38): icmp_seq=4 ttl=56 time=7.27 ms ^C

--- www.a.shifen.com ping statistics ---

4 packets transmitted, 4 received, 0% packet loss, time 3002ms

rtt min/avg/max/mdev = 6.260/6.770/7.275/0.373 ms

3. 6. 2. WIFI connection test

First of all, please note that there is no WIFI module on the Orange Pi 5 development board, and an external PCIe network card or USB network card is required to use the WIFI function.

For instructions on using the external PCIe network card, please refer to the section on how to use the AP6275P PCIe network card.

For instructions on using the external USB network card, please refer to the USB wireless network card test section.

Please do not connect to WIFI by modifying the /etc/network/interfaces configuration file. There will be problems connecting to the WIFI network in this way.

3. 6. 2. 1. The server version image connects to WIFI through commands

When the development board is not connected to Ethernet, not connected to HDMI display, but only connected to the serial port, it is recommended to use the commands demonstrated in this section to connect to the WIFI network. Because nmtui can only display characters in some serial port software (such as minicom), and cannot display the graphical interface normally. Of course, if the development board is connected to an Ethernet or HDMI display, you can also use the commands demonstrated in this section to connect to the WIFI network.

1) First log in to the linux system, there are the following three ways

a. If the development board is connected with a network cable, you can **remotely** log in to the Linux system through ssh

- a. If the development board is connected to the debugging serial port, you can use the serial port terminal to log in to the Linux system
- b. If the development board is connected to the HDMI display, you can log in to the linux system through the terminal displayed on the HDMI

2) First use the **nmcli dev wifi** command to scan the surrounding WIFI hotspots

orange	pi@orangepi:~\$1	nmcli dev wifi						
root@or IN-USE	angepi:~# nmcli dev BSSID	wifi SSID	MODE	CHAN	RATE	SIGNAL	BARS	SECURITY
	28:6C:07:6E:87:2E	orangepi	Infra	9	260 Mbit/s	97		WPA1 WPA2
	D8:D8:66:A5:BD:D1	and the second	Infra	10	270 Mbit/s	90		WPA1 WPA2
	A0:40:A0:A1:72:20		Infra		405 Mbit/s	82		WPA2
	28:6C:07:6E:87:2F	orangepi 5G	Infra	149	540 Mbit/s	80		WPA1 WPA2
	CA:50:E9:89:E2:44	Chinablet TOIS	Infra	1	130 Mbit/s	79		WPA1 WPA2
	A0:40:A0:A1:72:31		Infra	100	405 Mbit/s	67		WPA2
	D4:EE:07:08:A9:E0		Infra		130 Mbit/s	55		WPA1 WPA2
	88:C3:97:49:25:13		Infra		130 Mbit/s	52		WPA1 WPA2
	00:BD:82:51:53:C2		Infra	12	130 Mbit/s	49		WPA1 WPA2
	C0:61:18:FA:49:37		Infra	149	270 Mbit/s	47		WPA1 WPA2
	04:79:70:8D:0C:B8		Infra	153	270 Mbit/s	47		WPA2
	04:79:70:FD:0C:B8		Infra	153	270 Mbit/s	47		WPA2
	9C:A6:15:DD:E6:0C		Infra		270 Mbit/s	45		WPA1 WPA2
	B4:0F:3B:45:D1:F5		Infra		270 Mbit/s	45		WPA1 WPA2
	E8:CC:18:4F:7B:44		Infra	157	135 Mbit/s	45		WPA1 WPA2
	B0:95:8E:D8:2F:ED		Infra		405 Mbit/s			WPA1 WPA2
	C0:61:18:FA:49:36		Infra	11	270 Mbit/s	24		WPA1 WPA2
root@or	angepi:~#							

- 3) Then use the **nmcli** command to connect to the scanned WIFI hotspot, where:
 - a. **wifi_name** needs to be replaced with the name of the WIFI hotspot you want to connect to
 - b. **wifi_passwd** needs to be replaced with the password of the WIFI hotspot you want to connect to

orangepi@orangepi:~\$ sudo nmcli dev wifi connect wifi_name password wifi_passwd Device 'wlan0' successfully activated with 'cf937f88-ca1e-4411-bb50-61f402eef293'.

4) Through the **ip addr show wlan0** command, you can view the IP address of wifi

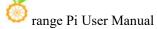
orangepi@orangepi:~\$ ip addr show wlan0

11: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000

link/ether 23:8c:d6:ae:76:bb brd ff:ff:ff:ff:ff:ff

inet **192.168.1.11**/24 brd 192.168.1.255 scope global dynamic noprefixroute wlan0 valid_lft 259192sec preferred_lft 259192sec

inet6 240e:3b7:3240:c3a0:c401:a445:5002:ccdd/64 scope global dynamic



noprefixroute

valid_lft 259192sec preferred_lft 172792sec inet6 fe80::42f1:6019:a80e:4c31/64 scope link noprefixroute valid lft forever preferred lft forever

5) Use the **ping** command to test the connectivity of the wifi network, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

```
orangepi@orangepi:~$ ping www.orangepi.org -I wlan0

PING www.orangepi.org (182.92.236.130) from 192.168.1.49 wlan0: 56(84) bytes of

data.

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=1 ttl=52 time=43.5 ms

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=2 ttl=52 time=41.3 ms

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=3 ttl=52 time=44.9 ms

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=4 ttl=52 time=45.6 ms

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=5 ttl=52 time=45.6 ms

64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=5 ttl=52 time=48.8 ms

^C

--- www.orangepi.org ping statistics ---

5 packets transmitted, 5 received, 0% packet loss, time 4006ms

rtt min/avg/max/mdev = 41.321/44.864/48.834/2.484 ms
```

3. 6. 2. 2. The server image connects to WIFI in a graphical way

1) First log in to the linux system, there are the following three ways

- a. If the development board is connected with a network cable, you can **remotely** log in to the Linux system through ssh
- b. If the development board is connected to the debugging serial port, you can use the serial port terminal to log in to the linux system (please use MobaXterm for the serial port software, and the graphical interface cannot be displayed when using minicom)
- c. If the development board is connected to the HDMI display, you can log in to the linux system through the terminal displayed on the HDMI

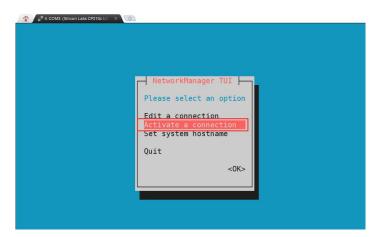
2) Then enter the nmtui command in the command line to open the wifi connection interface

orangepi@orangepi:~\$ sudo nmtui

3) Enter the nmtui command to open the interface as shown below



4) Select Activate a connect and press Enter



5) Then you can see all the searched WIFI hotspots

Wired * Wired connection 1	Ť	<deactivate></deactivate>	
Wi-Fi _orangepi_5G 	*** **** **** ***		
	*** *** ** ** ** **	<back></back>	ched WiFi signal

6) Select the WIFI hotspot you want to connect to, then use the Tab key to position the cursor on **Activate** and press Enter

Wired * Wired connection 1	† [Activate>
Wi-Fi	. I	
orangepi 5G	***	
Jrangepi	****	
	****	ant to connect to
S F		
S Z N.T. AR 10	***	
H H	*** ** **	
E Y/F	**	
(' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '		Back>

7) Then a dialog box for entering a password will pop up, enter the corresponding password in **Pssword** and press Enter to start connecting to WIFI

Wired * Wired connection 1 Wi-Fi Authentication required asswords or encryption keys are ireless network 'orange Password	by wireless net required to ac pi'. 1. Enter	cess the WiFi password
	-	

8) After the WIFI connection is successful, a "*" will be displayed in front of the connected WIFI name



9) You can view the IP address of wifi through the **ip addr show wlan0** command

orangepi@orangepi:~\$ ip addr show wlan0

11: wlan0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000

link/ether 24:8c:d3:aa:76:bb brd ff:ff:ff:ff:ff:ff

inet **192.168.1.11**/24 brd 192.168.1.255 scope global dynamic noprefixroute wlan0 valid_lft 259069sec preferred_lft 259069sec

inet6 240e:3b7:3240:c4a0:c401:a445:5002:ccdd/64 scope global dynamic noprefixroute

valid_lft 259071sec preferred_lft 172671sec

inet6 fe80::42f1:6019:a80e:4c31/64 scope link noprefixroute

valid_lft forever preferred_lft forever

10) Use the **ping** command to test the connectivity of the wifi network, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

orangepi@orangepi:~\$ ping www.orangepi.org -I wlan0

PING www.orangepi.org (182.92.236.130) from 192.168.1.49 wlan0: 56(84) bytes of data.

```
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=1 ttl=52 time=43.5 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=2 ttl=52 time=41.3 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=3 ttl=52 time=44.9 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=4 ttl=52 time=45.6 ms
64 bytes from 182.92.236.130 (182.92.236.130): icmp_seq=5 ttl=52 time=48.8 ms
^C
```

```
--- www.orangepi.org ping statistics ---
```

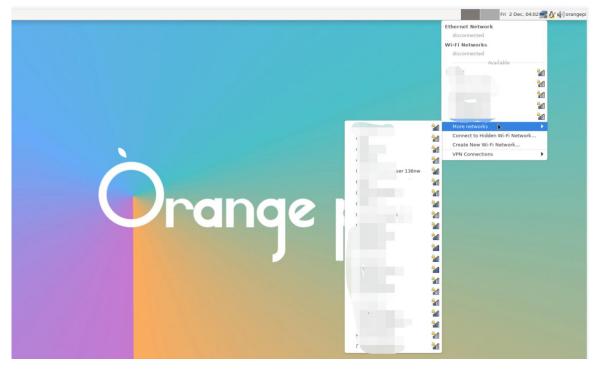
5 packets transmitted, 5 received, 0% packet loss, time 4006ms rtt min/avg/max/mdev = 41.321/44.864/48.834/2.484 ms

3. 6. 2. 3. Test method of desktop image

1) Click the network configuration icon in the upper right corner of the desktop (please do not connect the network cable when testing WIFI)



2) Click **More networks** in the pop-up drop-down box to see all scanned WIFI hotspots, and then select the WIFI hotspot you want to connect to



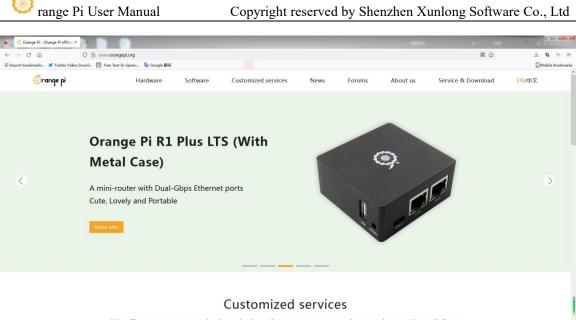
3) Then enter the password of the WIFI hotspot, and then click **Connect** to start connecting to WIFI



4) After connecting to WIFI, you can open the browser to check whether you can access the Internet. The entrance of the browser is shown in the figure below

Applications			
Run Program			
Terminal Emula	tor		
🖥 File Manager			
Mail Reader			
Web Browser			
Settings	•		
Accessories	•		
Development	•		
Graphics	•		
> Help			
Internet	Image:	Chromium Browser	
Multimedia			
Office	•		
9 System	•		
Log Out			

5) If you can open other web pages after opening the browser, it means that the WIFI connection is normal



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3. 6. 3. How to set a static IP address

Please do not set a static IP address by modifying the /etc/network/interfaces configuration file.

3. 6. 3. 1. Use the nmtui command to set a static IP address

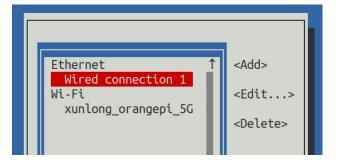
1) First run the **nmtui** command

orangepi@orangepi:~\$ nmtui

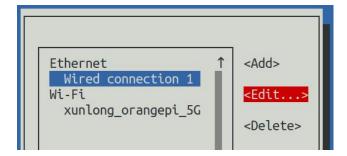
2) Then select Edit a connection and press Enter

NetworkManager TUI
Please select an option
Edit a connection
Activate a connection Set system hostname
Quit
<0K>
<01/2

3) Then select the network interface that needs to set a static IP address, for example, to set the static IP address of the **Ethernet** interface, select **Wired connection 1**.



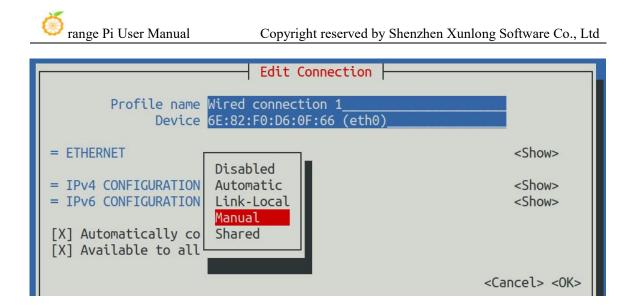
4) Then select Edit with the Tab key and press Enter



5) Then use the Tab key to move the cursor to the **<Automatic>** position shown in the figure below to configure IPv4

Edit Connection				
Profile name Wired connection 1 Device 6E:82:F0:D6:0F:66 (eth0)				
= ETHERNET	<show></show>			
<pre>= IPv4 CONFIGURATION <automatic> = IPv6 CONFIGURATION <automatic></automatic></automatic></pre>	<show> <show></show></show>			
[X] Automatically connect [X] Available to all users				
	<cancel> <ok></ok></cancel>			

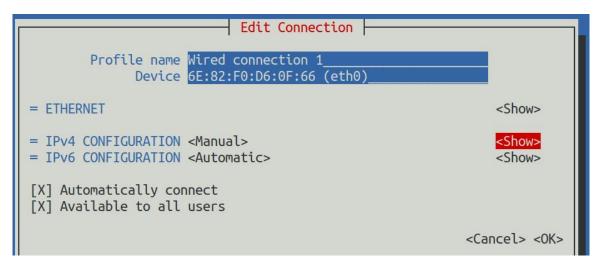
6) Then press Enter, select **Manual** through the up and down arrow keys, and press Enter to confirm



7) The display after selection is shown in the figure below

Edit Connection	
Profile name Wired connection 1 Device 6E:82:F0:D6:0F:66 (eth0)	
= ETHERNET	<show></show>
<pre>= IPv4 CONFIGURATION < Manual> = IPv6 CONFIGURATION < Automatic></pre>	<show> <show></show></show>
[X] Automatically connect [X] Available to all users	
	<cancel> <ok></ok></cancel>

8) Then move the cursor to **<Show>** via the Tab key



9) Then press Enter, and the following setting interface will pop up after entering

Edit Connection				
Profile name Wired connection 1				
Device 6E:82:F0:D6:0F:66 (eth0)				
= ETHERNET	<show></show>			
∓ IPv4 CONFIGURATION <manual></manual>	<hide></hide>			
Addresses <add></add>				
Gateway DNS servers <add></add>				
Search domains <add></add>				
Routing (No custom routes) <edit></edit>				
[] Ignore automatically obtained routes				
[] Ignore automatically obtained DNS parameters				
[]] Decuire TDu4 addression for this connection				
[] Require IPv4 addressing for this connection				
= IPv6 CONFIGURATION <automatic></automatic>	<show></show>			
[X] Automatically connect				
[X] Available to all users				
	<cancel> <ok></ok></cancel>			

10) Then you can set the IP address (Addresses), gateway (Gateway) and DNS server address in the position shown in the figure below (there are many other setting options in it, please explore by yourself), please set according to your specific needs, The values set in the image below are just an example

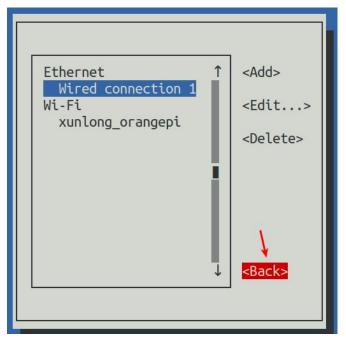
Edit Connection	
Profile name Wired connection 1 Device eth0 (86:F2:85:2C:81:CE)	
= ETHERNET	<show></show>
= IPv4 CONFIGURATION <manual> Addresses 192.168.1.177/24 <remove></remove></manual>	<hide></hide>
<a>	
Gateway 192.168.1.1 DNS servers 8.8.8.8 <remove></remove>	
<add> Search domains <add></add></add>	

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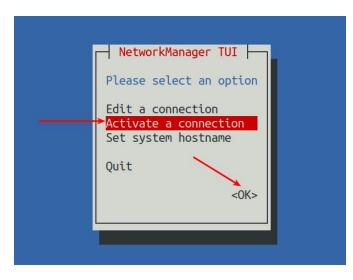
11) After setting, move the cursor to **<OK>** in the lower right corner, and press Enter to confirm



12) Then click **<Back>** to return to the previous selection interface



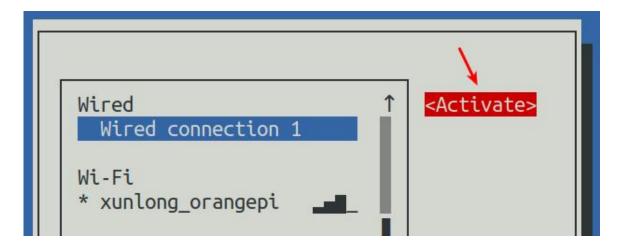
13) Then select **Activate a connection**, move the cursor to **<OK>**, and finally click Enter



14) Then select the network interface that needs to be set, such as **Wired connection 1**, then move the cursor to **<Deactivate>**, and press Enter to disable **Wired connection 1**

Wired ↑ * Wired connection 1	<deactivate></deactivate>
Wi-Fi * xunlong_orangepi	

15) Then please do not move the cursor, and then press the Enter key to re-enable **Wired connection 1**, so that the static IP address set earlier will take effect



16) Then you can exit nmtui through the **<Back>** and **Quit** buttons

	NetworkManager TUI
Wired Wired connection 1	Please select an option
Wi-Fi * xunlong_orangepi	Edit a connection Activate a connection Set system hostname Quit
↓ <mark>\</mark>	<0K>

17) Then through **ip addr show eth0**, you can see that the IP address of the network port has changed to the static IP address set earlier

orangepi@orangepi:~\$ **ip addr show eth0** 3: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000

link/ether 5e:ac:14:a5:92:b3 brd ff:ff:ff:ff:ff:ff

inet **192.168.1.177**/24 brd 192.168.1.255 scope global noprefixroute eth0

valid_lft forever preferred_lft forever

```
inet6 241e:3b8:3240:c3a0:e269:8305:dc08:135e/64 scope global dynamic noprefixroute
```

valid_lft 259149sec preferred_lft 172749sec

inet6 fe80::957d:bbbe:4928:3604/64 scope link noprefixroute

valid_lft forever preferred_lft forever

18) Then you can test the connectivity of the network to check whether the IP address is configured OK, and the **ping** command can be interrupted through the shortcut key **Ctrl+C**

orangepi@orangepi:~\$ ping 192.168.1.47 -I eth0 PING 192.168.1.47 (192.168.1.47) from 192.168.1.188 eth0: 56(84) bytes of data. 64 bytes from 192.168.1.47: icmp_seq=1 ttl=64 time=0.233 ms 64 bytes from 192.168.1.47: icmp_seq=2 ttl=64 time=0.263 ms 64 bytes from 192.168.1.47: icmp_seq=3 ttl=64 time=0.273 ms 64 bytes from 192.168.1.47: icmp_seq=4 ttl=64 time=0.269 ms 64 bytes from 192.168.1.47: icmp_seq=5 ttl=64 time=0.275 ms ^C --- 192.168.1.47 ping statistics ---5 packets transmitted, 5 received, 0% packet loss, time 4042ms rtt min/avg/max/mdev = 0.233/0.262/0.275/0.015 ms

3. 6. 3. 2. Use the nmcli command to set a static IP address

1) If you want to set the static IP address of the network port, please insert the network cable into the development board first. If you need to set the static IP address of WIFI, please connect the WIFI first, and then start to set the static IP address

2) Then you can view the name of the network device through the **nmcli con show** command, as shown below

- a. **orangepi** is the name of the WIFI network interface (the name is not necessarily the same)
- b. Wired connection 1 is the name of the Ethernet interface

orangepi@orangepi:~\$ nmcli con show			
NAME	UUID	TYPE	DEVICE
orangepi	cfc4f922-ae48-46f1-84e1-2f19e9ec5e2a	wifi	wlan0
Wired connection 1	9db058b7-7701-37b8-9411-efc2ae8bfa30	ethernet	eth0

3) Then enter the following command, where

a. "Wired connection 1" means to set the static IP address of the Ethernet port. If

you need to set the static IP address of the WIFI, please modify it to the corresponding name of the WIFI network interface (you can get it through the **nmcli con show** command)

- b. **ipv4.addresses** is followed by the static IP address to be set, which can be modified to the value you want to set
- c. **ipv4.gateway** represents the address of the gateway

```
orangepi@orangepi:~$ sudo nmcli con mod "Wired connection 1" \
ipv4.addresses "192.168.1.110" \
ipv4.gateway "192.168.1.1" \
ipv4.dns "8.8.8.8" \
ipv4.method "manual"
```

4) Then restart the linux system

orangepi@orangepi:~\$ sudo reboot

5) Then re-enter the linux system and use the **ip addr show eth0** command to see that the IP address has been set to the desired value

orangepi@orangepi:~\$ ip addr show eth0

3: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP group default qlen 1000

link/ether 5e:ae:14:a5:91:b3 brd ff:ff:ff:ff:ff:ff

inet 192.168.1.110/32 brd 192.168.1.110 scope global noprefixroute eth0

valid_lft forever preferred_lft forever

inet6 240e:3b7:3240:c3a0:97de:1d01:b290:fe3a/64 scope global dynamic noprefixroute

valid_lft 259183sec preferred_lft 172783sec

inet6 fe80::3312:861a:a589:d3c/64 scope link noprefixroute

valid_lft forever preferred_lft forever

3. 6. 4. How to use AP6275P PCIe network card

1) First, you need to purchase an AP6275P PCIe network card as shown in the figure below



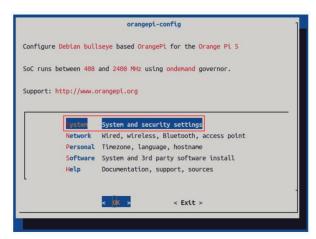
2) Then insert the AP6275P PCIe network card into the M.2 interface of the development board and fix it



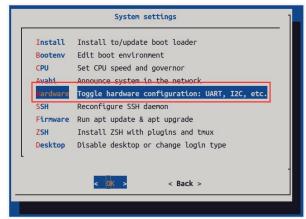
3) Then open the configuration of the AP6275P PCIe network card in the linux system, the steps are as follows:

a. First run **orangepi-config**, normal users remember to add **sudo** permission orangepi@orangepi:~\$ **sudo orangepi-config**

b. Then select **System**



c. Then select **Hardware**



d. Then use the arrow keys on the keyboard to navigate to **wifi-ap6275p**, and then use **the space** to select

Please do not select ssd-sata at the same time.

 Image: Image:



f. Then select <Back>



g. Then select **<Reboot>** to restart the system to make the configuration take effect

Appl	lying changes
Reboot to	enable new features?
	<u> </u>
<reboo< td=""><td>ot> <cancel></cancel></td></reboo<>	ot> <cancel></cancel>

The above settings will eventually add the configuration of overlays=wifi-ap6275p to /boot/orangepiEnv.txt. After setting, you can check it first. If this configuration does not exist, then there is a problem with the settings.

If you find it troublesome to use orangepi-config, you can also open /boot/orangepiEnv.txt, and then add the configuration of overlays=wifi-ap6275p.

orangepi@orangepi:~\$ cat /boot/orangepiEnv.txt | grep "ap6275p" overlays=wifi-ap6275p

4) If everything is normal after restarting the system, use the following command to see the device nodes of WIFI and Bluetooth

a. The command to view the WIFI device node is as follows:

orangepi@orangepi:~\$ ip addr show wlan0

 wlan0: <NO-CARRIER,BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state DORMANT group default qlen 1000

link/ether 70:f7:54:b8:b3:17 brd ff:ff:ff:ff:ff:ff

b. The command to view the Bluetooth device node is as follows:

orangepi@orangepi:~\$ hciconfig -a

hci0: Type: Primary Bus: UART

BD Address: 82:CC:AE:62:CE:3E ACL MTU: 1021:8 SCO MTU: 64:1 UP RUNNING

RX bytes:958 acl:0 sco:0 events:73 errors:0

TX bytes:5544 acl:0 sco:0 commands:73 errors:0 Features: 0xbf 0xfe 0xcf 0xfe 0xdb 0xff 0x7b 0x87 Packet type: DM1 DM3 DM5 DH1 DH3 DH5 HV1 HV2 HV3 Link policy: RSWITCH SNIFF Link mode: SLAVE ACCEPT Name: 'orangepi5' Class: 0x1c0000 Service Classes: Rendering, Capturing, Object Transfer Device Class: Miscellaneous, HCI Version: 5.1 (0xa) Revision: 0x3f9 LMP Version: 5.1 (0xa) Subversion: 0x1111 Manufacturer: Broadcom Corporation (15)

5) For wifi connection and test methods, please refer to the section of **WIFI connection test**, so I won't go into details here

6) For the test method of Bluetooth, please refer to the section on **Bluetooth usage**, so I won't go into details here

3. 6. 5. AP6275P PCIe network card creates WIFI hotspot through create_ap

create_ap is a script that helps quickly create WIFI hotspots on Linux, and supports bridge and NAT modes. It can automatically combine hostapd, dnsmasq and iptables to complete the setting of WIFI hotspots, avoiding complex configuration for users. The github address is as follows:

https://github.com/oblique/create_ap

If you are using the latest image, the create_ap script has been pre-installed, and you can create a WIFI hotspot through the create_ap command. The basic command format of create ap is as follows:

create_ap [options] <wifi-interface> [<interface-with-internet>] [<access-point-name> [<passphrase>]]

* options: You can use this parameter to specify the encryption method, the frequency band of the WIFI hotspot, the bandwidth mode, the network sharing

method, etc. You can get the options through create_ap -h * wifi-interface: The name of the wireless network card * interface-with-internet: The name of the network card that can be connected to the Internet, generally eth0 * access-point-name: hotspot name * passphrase: hotspot password

3. 6. 5. 1. create ap method to create WIFI hotspot in NAT mode

1) Enter the following command to create a WIFI hotspot named **orangepi** and password **orangepi** in NAT mode

orangepi@orangepi:~\$ sudo create_ap -m nat wlan0 eth0 orangepi orangepi

2) If the following information is output, it means that the WIFI hotspot is created successfully

orangepi@orangepi:~\$ sudo create_ap -m nat wlan0 eth0 orangepi orangepi Config dir: /tmp/create_ap.wlan0.conf.fPItFUJ2 PID: 3831 Network Manager found, set ap0 as unmanaged device... DONE Creating a virtual WiFi interface... ap0 created. Sharing Internet using method: nat hostapd command-line interface: hostapd_cli -p /tmp/create_ap.wlan0.conf.fPItFUJ2/hostapd_ctrl ap0: interface state UNINITIALIZED->ENABLED ap0: AP-ENABLED

3) Take out the mobile phone at this time, and you can find the WIFI hotspot named **orangepi** created by the development board in the searched WIFI list, and then you can click **orangepi** to connect to the hotspot, and the password is the **orangepi** set above

く设置	无线局域网	编辑
无线局	域网	
🗸 xunlon	ig_orangepi_5G	l ≈ (j)
我的网络		
orange	epi	ê ╤ (j)

4) After the connection is successful, the display is as shown in the figure below

〈 设	<u> </u>	无线局域网	编辑
	无线局域网		
~	orangepi		🕯 🗢 🚺

5) In NAT mode, the wireless device connected to the hotspot of the development board requests an IP address from the DHCP service of the development board, so there will be two different network segments, for example, the IP of the development board is

192.168.1.X

orangepi@orangepi:~\$ ifconfig eth0			
eth0: flags=4163 <up,broadcast,running,multicast> mtu 1500</up,broadcast,running,multicast>			
inet 192.168.1.150 netmask 255.255.255.0 broadcast 192.168.1.255			
inet6 fe80::938f:8776:5783:afa2			
ether 4a:a0:c8:25:42:82 txqueuelen 1000 (Ethernet)			
RX packets 25370 bytes 2709590 (2.7 MB)			

```
RX errors 0 dropped 50 overruns 0 frame 0
TX packets 3798 bytes 1519493 (1.5 MB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
device interrupt 83
```

By default, the DHCP service of the development board will assign an IP address of **192.168.12.0/24** to the device connected to the hotspot. At this time, click on the connected WIFI hotspot **orangepi**, and then you can see that the IP address of the mobile phone is **192.168.12.X**

く设置	无线局域	湖 编辑
无线局	域网	
🗸 orange	epi	a ≈ (i)
IPV4地址		
配置IP		自动 >
IP地址		192.168.12.249
子网掩码		255.255.255.0
路由器		192.168.12.1

6) If you want to specify a different network segment for the connected device, you can specify it through the -g parameter, such as specifying the network segment of the access point AP through the -g parameter as 192.168.2.1

Note that in the following command, Debian12 needs to modify eth0 to end1. orangepi@orangepi:~\$ sudo create_ap -m nat wlan0 eth0 orangepi orangepi -g 192.168.2.1 At this time, after connecting to the hotspot through the mobile phone, click the connected WIFI hotspot **orangepi**, and then you can see that the IP address of the mobile phone is **192.168.2.X**

く设置	无线局域网	编辑
无线局域网	3	
🗸 orangepi		ê 🗢 i
IPV4 地址		
配置IP		自动 >
IP地址	19	2.168.2.249
子网掩码	25	5.255.255.0
路由器		192.168.2.1

7) If the **--freq-band** parameter is not specified, the hotspot created by default is in the 2.4G frequency band. If you want to create a hotspot in the 5G frequency band, you can specify it through the **--freq-band 5** parameter. The specific command is as follows

Note that in the following command, Debian12 needs to modify eth0 to end1.

orangepi@orangepi:~\$ sudo create_ap -m nat wlan0 eth0 orangepi orangepi --freq-band 5

8) If you need to hide the SSID, you can specify the **--hidden** parameter, the specific command is as follows

Note that in the following command, Debian12 needs to modify eth0 to end1. orangepi@orangepi:~\$ sudo create_ap -m nat wlan0 eth0 orangepi orangepi --hidden

At this time, the mobile phone cannot search for the WIFI hotspot. You need to

manually specify the name of the WIFI hotspot and enter the password to connect to the WIFI hotspot

	输入网络信息	
取消	其他网络	加入
名称	orangepi	
安全忙	生	WPA >
密码		

3. 6. 5. 2. create_ap method to create WIFI hotspot in bridge mode

1) Eer the following command to create a WIFI hotspot named **orangepi** and password **orangepi** in bridge mode

orangepi@orangepi:~\$ sudo create_ap -m bridge wlan0 eth0 orangepi orangepi

2) If the following information is output, it means that the WIFI hotspot is created successfully

orangepi@orangepi:~\$ sudo create_ap -m bridge wlan0 eth0 orangepi orangepi [sudo] password for orangepi: Config dir: /tmp/create_ap.wlan0.conf.fg9U5Xgt PID: 3141 Network Manager found, set ap0 as unmanaged device... DONE Creating a virtual WiFi interface... ap0 created. Sharing Internet using method: bridge Create a bridge interface... br0 created. hostapd command-line interface: hostapd_cli -p /tmp/create_ap.wlan0.conf.fg9U5Xgt/hostapd_ctrl ap0: interface state UNINITIALIZED->ENABLED ap0: AP-ENABLED 3) Take out your mobile phone at this time, and you can find the WIFI hotspot named **orangepi** created by the development board in the searched WIFI list, and then you can click **orangepi** to connect to the hotspot, and the password is the **orangepi** set above

く设置	无线局域网	编辑
无线局	域网	
🗸 xunlon	g_orangepi_5G	a ≈ (j)
我的网络		
orange	pi	ê ≈ (j)

4) After the connection is successful, the display is as shown in the figure below

〈 设	<mark>گ</mark>	无线局域网	编辑
	无线局域网	L.	
~	orangepi		🔒 🗢 🚺

5) In bridge mode, the wireless device connected to the hotspot of the development board also requests an IP address from the DHCP service of the main router (the router connected to the development board), for example, the IP of the development board is **192.168.1.X**

orangepi@orangepi:~\$ ifconfig eth0	
eth0: flags=4163 <up,broadcast,running,multicas< th=""><th>T> mtu 1500</th></up,broadcast,running,multicas<>	T> mtu 1500

inet 192.168.1.150 netmask 255.255.255.0 broadcast 192.168.1.255 inet6 fe80::938f:8776:5783:afa2 prefixlen 64 scopeid 0x20<link> ether 4a:a0:c8:25:42:82 txqueuelen 1000 (Ethernet) RX packets 25370 bytes 2709590 (2.7 MB) RX errors 0 dropped 50 overruns 0 frame 0 TX packets 3798 bytes 1519493 (1.5 MB) TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0 device interrupt 83

The IP of the device connected to the WIFI hotspot is also assigned by the main router, so the mobile phone connected to the WIFI hotspot and the development board are in the same network segment. At this time, click on the connected WIFI hotspot **orangepi**, and then you can see the IP address of the mobile phone Also **192.168.1.X**



6) If the **--freq-band** parameter is not specified, the hotspot created by default is in the 2.4G frequency band. If you want to create a hotspot in the 5G frequency band, you can specify it through the **--freq-band 5** parameter. The specific command is as follows

Note that in the following command, Debian12 needs to modify eth0 to end1.

orangepi@orangepi:~\$ sudo create_ap -m bridge wlan0 eth0 orangepi orangepi --freq-band 5

7) If you need to hide the SSID, you can specify the **--hidden** parameter, the specific command is as follows

Note that in the following command, Debian12 needs to modify eth0 to end1.			
orangepi@orangepi:~\$ sudo create_a	p -m bridge wlan0 eth0 orangepi orangepihidden		

At this time, the mobile phone cannot search for the WIFI hotspot. You need to manually specify the name of the WIFI hotspot and enter the password to connect to the WIFI hotspot

30 	输入网络信息	
取消	其他网络	加入
名称	orangepi	
安全性	ŧ	WPA >
密码		

3.7. SSH remote login development board

Linux systems enable ssh remote login by default and allow the root user to log in to the system. Before logging in with ssh, you first need to ensure that the Ethernet or wifi network is connected, and then use the ip addr command or check the router to obtain the IP address of the development board.

3. 7. 1. SSH remote login development board under Ubuntu

1) Get the IP address of the development board

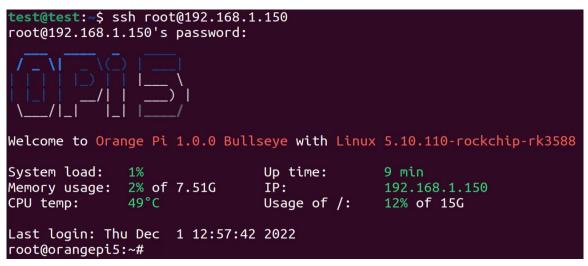
2) Then you can remotely log in to the linux system through the ssh command

test@test:~\$ ssh root@192.168.1.xxx	(Need to be replaced with the IP address
of the development board)	
root@192.168.1.xx's password:	(Enter the password here, the default password
is orangepi)	

Note that when entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.

If you are prompted to refuse the connection, as long as you are using the image provided by Orange Pi, please do not suspect that the password orangepi is wrong, but look for other reasons.

3) After successfully logging in to the system, the display is as shown in the figure below



If ssh cannot log in to the linux system normally, please first check whether the IP address of the development board can be pinged. If the ping is ok, you can log in to the linux system through the serial port or HDMI display and then enter the following command on the development board and try again. Is it possible to connect:

root@orangepi:~# reset_ssh.sh

If it still doesn't work, try to reset the system.

3. 7. 2. SSH remote login development board under Windows

1) First obtain the IP address of the development board

2) Under Windows, you can use MobaXterm to remotely log in to the development board, first create a new ssh session

- a. Open Session
- b. Then select SSH in Session Setting
- c. Then enter the IP address of the development board in the Remote host
- d. Then enter the user name **root** or **orangepi** of the linux system in **Specify username**
- e. Finally click **OK**

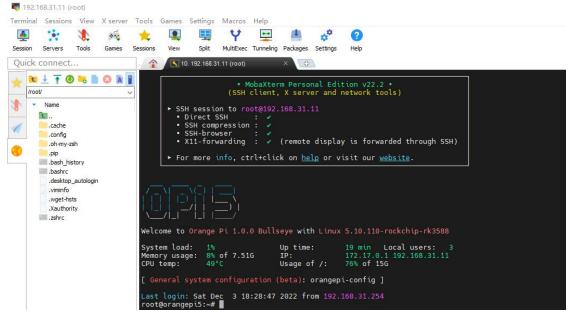
MobaXterm Terminal Sessions View X server Tools Games	Settings Macros Help	- 0	×
🖲 🔆 🐮 🕫 🚖 🖳	🗱 Y 🕮 🖄 🕫 🕖 Salt NullDec Turneling Podages Settings Heb	X server	ext Ext
Compared and the second s	3. Enter the IP address of the development board Secure Shell (SSH) session 5. Finally click OK (SSH) session 5. Finally click OK		\$

3) Then you will be prompted to enter a password. The default passwords for root and orangepi users are orangepi

Note that when entering the password, the specific content of the entered password will not be displayed on the screen, please do not think that there is any fault, just press Enter after inputting.

I92.1	68.1.122 (r	oot)										
Terminal	Sessions	View	X server	Tools	Games	Settings	Macros	Help				
	1.	1		*			Y	**	4	*	2	
Session	Servers	Tools	Games	Sessions	View	Split	MultiExec	Tunneling	Packages	Settings	Help	
Quiek	connect	·			3	. 192.168.1.1	122 (root)		×			
« 🔍	User sessions	3. 1. 122 (r	0		root(019 <mark>2</mark> .1	.68.1.	122's	pass	word:		$\left(\right)$
Sessions	192,100), 1, 122 (r	oot)							/		
Ses								Her	re enter	passwo	rd oran	igepi
*												
sio												

4) The display after successfully logging in to the system is shown in the figure below



3.8. How to use ADB

3.8.1. How to use network adb

1) After the system starts, please confirm that **adbd** has been started

C	orangepi@orangep	oi:~\$ ps	-ax grep "adbd"
	808 ?	S1	0:00 /usr/bin/adbd
	3707 ttyFIQ0	S+	0:00 grepcolor=auto adbd

2) Then check the IP address of the development board and write it down

3) Then install the adb tool on the Ubuntu PC

test@test:~\$ sudo apt-get update	
test@test:~\$ sudo apt-get install -y adb	

4) Then use the following command to connect to the network adb

test@test:~\$ adb connect 192.168.1.xx:5555	#IP address please replace with the
IP address of the development board	
* daemon not running; starting now at tcp:5037	
* daemon started successfully	

connected to 192.168.1.xx:5555 test@test:~\$ adb devices List of devices attached 192.168.1.xx:5555 device

5) Then use the following command to log in to the linux system of the development board

test@test:~\$ adb shell

root@orangepi5:/# <--- After seeing this prompt, it means that you have successfully logged in to the development board

6) The command to upload files to the development board using adb is as follows

test@test:~\$ adb push filename /root

filename: 1 file pushed. 3.7 MB/s (1075091 bytes in 0.277s)

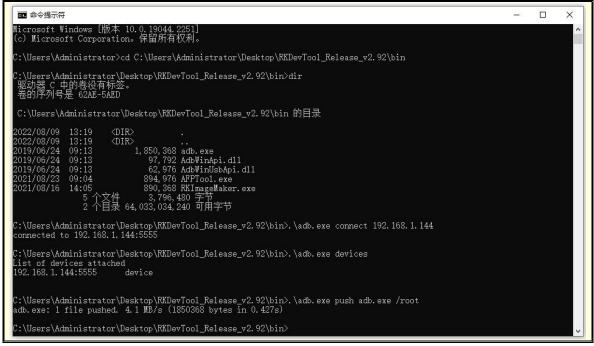
7) The command to restart the development board using adb is as follows

test@test:~\$ adb reboot

If you do not have the adb tool in your Windows system, you can use the adb program in the **RKDevTool** software (this software is useful in the section on how to burn the Android image to SPIFlash+NVMe SSD).

名称	修改日期	类型	大小
📧 adb	2019/6/24 9:13	应用程序	1,807 KB
AdbWinApi.dll	2019/6/24 9:13	应用程序扩展	96 KB
🐔 📑 AdbWinUsbApi.dll	2019/6/24 9:13	应用程序扩展	62 KB
AFPTool	2021/8/23 9:04	应用程序	874 KB
* 📧 RKImageMaker	2021/8/16 14:05	应用程序	870 KB

An example using adb in Windows looks like this:



3. 8. 2. Use a type-c data cable to connect to adb

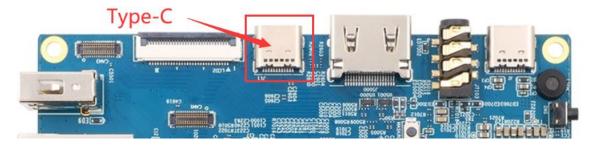
1) First prepare a good quality Type-C data cable



2) Then please make sure that there is no USB device plugged into the USB interface below



3) Then connect the development board and Ubuntu PC through the Type-C data cable. The position of the Type-C interface of the development board is shown in the figure below:



4) Then run the following command to set the Type-C interface to device mode orangepi@orangepi:~\$ sudo set_device.sh

If the **set_device.sh** script does not exist in the Linux system, please use the following command directly:

orangepi@orangepi:~\$ sudo bash -c "echo device > /sys/kernel/debug/usb/fc000000.usb/mode" orangepi@orangepi:~\$ sudo systemctl restart usbdevice

5) Then please make sure that adbd has been started

orangepi@orangep	oi:~\$	ps -ax grep "adbd"
808 ?	S1	0:00 /usr/bin/adbd
3707 ttyFIQ0	S+	0:00 grepcolor=auto adbd

6) Then install the adb tool on the Ubuntu PC

test@test:~\$ sudo apt-get update test@test:~\$ sudo apt-get install -y adb

7) Then use the following command to see if the adb device is recognized

test@test:~\$ **adb devices** List of devices attached **e0f9f71bc343c305 device**

8) Then use the following command to log in to the linux system of the development board

test@test:~\$ adb shell

www.orangepi.org



root@orangepi5:/# <--- After seeing this prompt, it means that you have successfully logged in to the development board

9) The command to upload files to the development board using adb is as follows

test@test:~\$ adb push filename /root

filename: 1 file pushed. 3.7 MB/s (1075091 bytes in 0.277s)

If you do not have the adb tool in your Windows system, you can use the adb program in the **RKDevTool** software (this software is useful in the section on how to burn the Android image to SPIFlash+NVMe SSD).

桌面 → RKDevTool_Release_v2.92 → bin

名称	修改日期	类型	大小
📧 adb	2019/6/24 9:13	应用程序	1,807 KB
AdbWinApi.dll	2019/6/24 9:13	应用程序扩展	96 KB
AdbWinUsbApi.dll	2019/6/24 9:13	应用程序扩展	62 KB
I AFPTool	2021/8/23 9:04	应用程序	874 KB
RKImageMaker	2021/8/16 14:05	应用程序	870 KB

An example using adb in Windows looks like this:

▲ 命令提示符 × (icrosoft Windows [版本 10.0.19044.2251] c) Microsoft Corporation。保留所有权利。 \Users\Administrator>cd C:\Users\Administrator\Desktop\RKDevToo1_Re1ease_v2.92\bin :\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>dir 驱动器 C 中的卷没有标签。 卷的序列号是 62AE-5AED C:\Users\Administrator\Desktop\RKDevToo1_Release_v2.92\bin 的目录 <DIR> <DIR> 022/08/09 019/06/24 019/06/24 1,850,368 adb. 09:13 09:13 97, 792 AdbWinApi. d11 62, 976 AdbWinUsbApi. d11 19/06/24 976 AFPTool.exe 368 RKImageMaker.exe 121/08/23 09:04 14:05 21/08/16 个文件 3,796,480 字节 个目录 63,988,027,392 可用字节 \Users\Administrator\Desktop\RKDevToo1_Release_v2.92\bin>adb devices ist of devices attached 0f9f71bc424c305 device :\Users\Administrator\Desktop\RKDevTool_Release_v2.92\bin>adb push adb.exe /root db.exe: 1 file pushed. 3.2 MB/s (1850368 bytes in 0.552s) \Users\Administrator\Desktop\RKDevTool Release v2.92\bin>

3.9. The method of uploading files to the Linux system of the development board

3.9.1. The method of uploading files to the development board Linux system in Ubuntu PC

3. 9. 1. 1. How to upload files using the scp command

1) Use the scp command to upload files from the Ubuntu PC to the Linux system of the development board. The specific commands are as follows

- a. **file_path:** need to be replaced with the path of the file to be uploaded
- b. **orangepi:** It is the user name of the Linux system of the development board, and it can also be replaced with other ones, such as root
- c. **192.168.xx.xx:** It is the IP address of the development board, please modify it according to the actual situation
- d. /home/orangepi: The path in the Linux system of the development board, which can also be modified to other paths

test@test:~\$ scp file_path orangepi@192.168.xx.xx:/home/orangepi/

2) If you want to upload a folder, you need to add the -r parameter

test@test:~\$ scp -r dir_path orangepi@192.168.xx.xx:/home/orangepi/

3) There are more usages of scp, please use the following command to view the man manual

test@test:~\$ man scp

3. 9. 1. 2. How to upload files using filezilla

1) First install filezilla in Ubuntu PC

test@test:~\$ sudo apt install -y filezilla

2) Then use the following command to open filezilla

test@test:~\$ filezilla

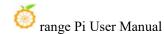
3) The interface after filezilla is opened is as follows, at this time, the display under the remote site on the right is empty

			File	Zilla			
文件(F) 编辑(E) 查看	看(V) 传输(T) 服务器(S)	书签(B) 帮助(H)					
¥ • •	🗂 🗰 🛛 🎼 🔇) 🗽 🐌 🔳 🖉 🤄	•				
E机(H):	用户名(U):	密码(w):	端口	コ(P):	快速连接(Q) ▼		
本地站点: //			~	远程站点:			
cdrom				61 9			
て件名 へ lib32	文件大小 文件类型	最近修改					
lib64	目录 目录	2022年11月06… 2022年08月09…					
libx32	日录	2022年08月09… 2022年11月06…					
lost+found	日录	2022年11月05…		文件名 へ	文件大小 文件类型 最近修改	权限 所有者/	组
media	日录	2022年12月03…					
mnt	目录	2022年08月09…					
opt	日录	2022年11月06…			没有连接到任何服务器		
proc	日录	2022年12月03…					
root	日录	2022年12月03…					
run	目录	2022年12月03…					
个文件和26个日录。	大小总计: 2.2 GB			未连接。			
	方向远程文件	大小 优先组	π +++ π	5			_

4) The method of connecting the development board is shown in the figure below

Filez 3.Password: orange	illa pi 5.Click Quick Connect
文件(F) 编辑(E) 查看(V) 传输(T) 服务器(S) 书签(B) 帮助(H)	S. ORCK GUILK CONNECT
# - BTT# 0 # 0 ½ ½ = 4 +	
主机(H): 192.168.1.100 用户名(U): root 密码(W): 端口	(P): 22 快速连接(Q) ▼
1.IP address 2.Username	4.Port number 22
2.Username	4.Port number 22

5) Then choose to save the password, and then click OK



	记住密码?	×
您想让 FileZilla 记住密码	吗?	
如果允许 FileZilla 记住密	码,重启 FileZilla 后重新连接无	需再次输入密码。
● 保存密码(E)		
○ 不要保存密码(O)		
保存主密码保护的密码	马(V)	
主密码(M):		
再次输入密码(R):		
主密码一旦丢失无法恢	恢复!请牢记您的密码。	
	取消	确定(O)

6) Then choose to always trust this host, and then click OK

	未定义的快捷键		×
1	该服务器的主机密匙是未知的。不能保证该服务器 认定的那台计算机。 详细资料 主机:	就是您所	
	主机密匙算法: 指纹:		
	信任该主机并继续连接?		
		取消	确定

7) After the connection is successful, you can see the directory structure of the development board linux file system on the right side of the filezilla software

		sftp://ro	ot@192.1	68.31.11 - FileZilla				9	
文件(F) 编辑(E) 查看(\	V) <mark>传输(T) 服务器(S) =</mark>	书签(B) 帮助(H)							
	• • • • • • • • • • • • • • • • • • •) 🗼 🏷 🄳 🍳	o 🙈						
主机(H): tp://192.168.31	1.11 用户名(U): root	密码(w):	端	コ(P): 作	快速连接(Q) ▼				
状态: Connected to 192. 状态: 读取目录列表 状态: Listing directory / 状态: 列出"/root"的目录	/root								
本地站点: /			~	远程站点: /root					3
				✓ ? / > □ root					
 文件名 ^	文件大小 文件类型	最近修改 2023年11月06m							
之件名 へ lib32	目录	2022年11月06…							
2件名 へ lib32 lib64	目录	2022年11月06… 2022年08月09…							
(件名 へ lib32 lib64 libx32	目录 目录 目录	2022年11月06…			文件大小 文件类型	最近修改	权限	所有者	/组
(件名 へ lib32 lib64 libx32	目录 目录 目录 目录	2022年11月06… 2022年08月09… 2022年11月06…			文件大小 文件类型	最近修改	权限	所有者	/组
之件名 へ lib32 lib64 libx32 lost+found	目录 目录 目录	2022年11月06… 2022年08月09… 2022年11月06… 2022年11月05…		> ■ root 文件名 ▲	目录	最近修改 2022年12月…			
文件名 へ lib32 lib64 libx32 lost+found media	目录 目录 目录 目录 目录 目录	2022年11月06… 2022年08月09… 2022年11月06… 2022年11月05… 2022年11月05… 2022年12月03…		> ■ root 文件名 ^	目录 目录	2022年12月… 2022年12月…	drwx drwxr-xr-x	root ro root ro	ot
文件名 へ lib32 lib64 libx32 lost-found media mnt opt	目录 目录 目录 目录 目录 目录 目录 目录	2022年11月06… 2022年08月09… 2022年11月06… 2022年11月05… 2022年12月03… 2022年08月09…		> ■ root 文件名 ^	目录 目录 目录	2022年12月··· 2022年12月··· 2022年12月···	drwx drwxr-xr-x drwxr-xr-x	root ro root ro root ro	ot ot ot
文件名 へ lib32 lib64 libx32 lost+found media mnt opt proc	目录 目录录 目录录 目录 录录 目录 录录 目录 目录	2022年11月06… 2022年08月09… 2022年11月06… 2022年11月05… 2022年12月03… 2022年08月09… 2022年11月06…		> ■ root 文件名 へ .cache .coche .ohmy-zsh .pip	目录 目录 目录 目录	2022年12月… 2022年12月… 2022年12月… 2022年12月…	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x	root ro root ro root ro root ro	ot ot ot
文件名 へ 1b32 1b64 1bx32 lost+found media mnt	目 目 目 日 日 日 京 录 录 录 录 录 录 录 录 录 录 录 录 录 录 录 录	2022年11月06… 2022年08月09… 2022年11月06… 2022年11月05… 2022年12月03… 2022年08月09… 2022年11月06… 2022年11月06…		 文件名 ▲ … .cache .config .oh-my-zsh .pip .Xauthority 	目录 目录 目录 目录 55 B 文件	2022年12月… 2022年12月… 2022年12月… 2022年12月… 2022年12月… 2022年12月…	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw	root ro root ro root ro root ro root ro	oot oot oot oot
lib64 libx32 lost+found media mnt opt proc root	目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目目	2022年11月06 2022年08月09 2022年11月06 2022年11月05 2022年12月03 2022年08月09 2022年12月03 2022年12月03 2022年12月03		 文件名 へ .coche .config .oh-my-zsh .pip .Xauthority .bash history 	目录 目录 目录 目录	2022年12月… 2022年12月… 2022年12月… 2022年12月…	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw	root ro root ro root ro root ro	oot oot oot oot

8) Then select the path to be uploaded to the development board on the right side of the

filezilla software, and then select the file to be uploaded on the Ubuntu PC on the left side of the filezilla software, then click the right mouse button, and then click the upload option to start uploading the file to the development board bingo.

		sftp://root@	192.16	8.31.11 - FileZilla			×
文件(F) 编辑(E) 查看(V) 传输	俞(T) 服务器(S) 书签(B) ₹	帮助(H)					
	C 🕸 O 🗽	5 🗉 🖉 🧕	*				
主机(H): tp://192.168.31.11 月	用户名(U): root 密	码(W):	端口((P): 快	速连接(Q) 🔹		
状态: 列出"/home"的目录成功 状态: 读取"/home/orangepi"的 状态: Listing directory /home/o 状态: 列出"/home/orangepi"的	orangepi						
本地站点: /home/test/Downloa	ds/test/		~	远程站点: /home/	orangepi		~
 test Music Pictures Public Templates Videos VirtualBox VMs bin 	-			? boot ? dev ? etc > low in home ✓ orangeg ? .cach ? .cach ? .cach ? .cach	e amon		
	小 文件类型 最近的	8改		文件名 ^	文件大小 文件类型	最近修改 权限	所有者/组
nomachine_8.2.3_3	上传(U) 添加文件到队列(A) 打开(Q)	Ē12月03···· 】		.bashrc .profile .viminfo .xscreensaver .xsession-errors .xsession-errors.	2411	2022年12月・・・Fw-F-F- 2022年12月・・・Fw-F-F- 2022年12月・・・Fw 2022年12月・・・Fw-F- 2022年12月・・・Fw 2022年12月・・・Fw 2022年12月・・・Fw	orangepi orangepi orangepi orangepi orangepi orangepi
洗择了1个文件。大小总共:0B	编辑(<u>E</u>)			.zshrc	4.0 KB 文件 目录。大小总计: 6.2 GB	2022年12月··· -rw-rw-r-	orangepi
服务器/本地文件 方(创建目录(C) 创建目录并进入(Y) 刷新(E) 删除(D)	大小 优先级	10.5	15 1 18 14 AU 16 1 F	1 Mr. 7 / 1020 IT: 0.7 GB		
	重命名(图)						
列队的文件 传输失败 成功的	传输						••//

9) After the upload is complete, you can go to the corresponding path in the development board linux system to view the uploaded files

10) The method of uploading folders is the same as that of uploading files, so I won't go into details here

3. 9. 2. The method of uploading files to the Linux system of the development board in Windows PC

3. 9. 2. 1. How to upload files using filezilla

1) First download the installation file of the Windows version of the filezilla software, the download link is as follows

https://filezilla-project.org/download.php#close

FileZillaThe free FTP



Please select	Please select your edition of FileZilla Client						
	FileZilla	FileZilla with manual	FileZilla Pro	FileZilla Pro + CLI			
Standard FTP	Yes	Yes	Yes	Yes			
FTP over TLS	Yes	Yes	Yes	Yes			
SFTP	Yes	Yes	Yes	Yes			
Comprehensive PDF manual	-	Yes	Yes	Yes			
Amazon S3	-	-	Yes	Yes			
Backblaze B2	-	-	Yes	Yes			
Dropbox	-	-	Yes	Yes			
Microsoft OneDrive	-	-	Yes	Yes			
Google Drive	-	-	Yes	Yes			
Google Cloud Storage	-	-	Yes	Yes			
Microsoft Azure Blob + File Storage	-	-	Yes	Yes			
WebDAV	-	-	Yes	Yes			
OpenStack Swift	-	-	Yes	Yes			
Box	-	-	Yes	Yes			
Site Manager synchronization	-	-	Yes	Yes			
Command-line interface	-	-	-	Yes			
Batch transfers	-	-	-	Yes			
	Download	Select	Select	Select			

2) The downloaded installation package is as follows, and then double-click to install directly

FileZilla_Server_1.5.1_win64-setup.exe

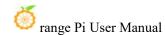
During the installation process, please select **Decline** on the following installation interface, and then select **Next>**



3) The interface after filezilla is opened is as follows, at this time, the display under the remote site on the right is empty

尼 FileZilla	/) 传输(T) 服务器(S) 书签(B)	翻刷h(Lin)				- 0
机(H):	用户名(U):	密码(W):);用口(P):	(快速连接(Q) ▼		
地站点: C:\Users\test			~	远程站点:		
			^			
一國 文档						
由						
e a c	10.					
	and the second se					
	4.00					
			4			
2(4:5	文件大小 文件类型	最近修改	^	文件名 文件大小 文件类型 最近修得	て収得	所有者/组
	文件夹	2022/12/3 20:06:			Para.	
	文件夹	2022/11/6 0:23:28				
	文件夹	2022/11/19 1:30:		没有连接到任何服务器		
	文件夹	2022/12/3 15:40:				
	文件夹	2022/12/3 19:41:				
	文件夹	2022/12/3 20:05:				
	文件夹	2022/11/6 0:23:28				
	文件夹	2022/11/6 0:23:28				
Contraction of the local division of the loc	文件夹	2022/12/3 20:06:				
	文件夹	2022/11/6 0:23:28				
	文件夹	2022/12/3 19:41:				
-	文件夹	2019/12/7 17:14:				
	文件夹	2022/11/6 0:25:57				
			v			
个文件和27个目录。	大小总计: 8,003,604 字节			未连接。		
發騰/本地文件	方向 远程文件	大小 优先	設 状さ			
列队的文件 传输失败	成功的传输					
					③ 队列:空	

4) The method of connecting the development board is shown in the figure below:



	FileZilla 3.Password: orangepi	5.Click Quick Connect	- • ×
文件(F) 编辑(E) 查看(V) 传输(T) 服务器(S)	书签(B) 帮助(H)		
# • * * * * * * * *) 🕵 🦆 🎟 🖉 🤌 🙈		
主机(H): 192.168.1.100 用户名(U): root	密码(W): 端口(P): 22	快速连接(Q) ▼	
1.IP address	4 Port	number 22	
2.Userna	me 4.Port	humber 22	

5) Then choose to save the password, and then click OK

记住密码?		×
您想让 FileZilla 记住密码吗?		
如果允许 FileZilla 记住密码,重启 f 保存密码(E) 〇 不要保存密码(O)	FileZilla 后重新连接无	需再次输入密码。
○保存主密码保护的密码(V)		
主密码(M):		
再次输入密码(R):		
主密码一旦丢失无法恢复! 请牢	记你的家庭	

6) Then select Always trust this host, and click OK

	该服务器的E 机。	主机密匙是未知的。不能保证该	服务器就是您所认定的那	台计算
	详细资料			
	主机:	192.168.31.11:22		
	主机密匙算	章法: ssh-ed25519 255		
	指纹:	SHA256:cHNLFRmncAMr	QoietFlAyEfdRQcewhW	pgodyPsILw3v
1	信任该主机法	并继续连接?		
6		该主机,并将该密钥加入缓存(4	N	

7) After the connection is successful, you can see the directory structure of the development board linux file system on the right side of the filezilla software

🍈 range Pi User Manual

l(H): sftp://192.168.3	81. 用户名(U): root	密码(W): ••••••	端口(P):	快速连接(Q) ▼						
E Connected to 192	168 31 11									
	100.0111									
Elisting directory /r	root									
A Disting directory / A 列出"/root"的目录。										
地站点: C:\			~	远程站点: /root						
	-			B-2 / B root			e11			
	文件大小 文件类型	最近修改	~	The unectory and	icture of t		ine system o	in the deve	sopment be	/aru
FX		2022/12/3 18:57:		文件名 ^	文件大小	文件类型	最近修改	权限	所有者/组	
FX		2022/12/3 18:57:	- 1	-	文件大小					
		2022/12/3 18:57: 2022/12/3 18:57:	- 1		文件大小	文件夹	2022/12/3 16	drwx	root root	
	文件夹	2022/12/3 18:57: 2022/12/3 18:57: 2022/11/11 1:48:	- 1	 .cache .config	文件大小	文件夹 文件夹	2022/12/3 16 2022/12/3 4:	drwx drwxr-xr-x	root root root root	
*	文件夹 文件夹	2022/12/3 18:57: 2022/12/3 18:57: 2022/11/11 1:48: 2022/12/3 18:55:	- 1		文件大小	文件夹 文件夹 文件夹	2022/12/3 16 2022/12/3 4: 2022/12/3 5:	drwx drwxr-xr-x drwxr-xr-x	root root root root root root	
	文件夹 文件夹 文件夹	2022/12/3 18:57: 2022/12/3 18:57: 2022/11/11 1:48: 2022/12/3 18:55: 2022/12/3 0:17:04	- 1	 .cache .config .oh-my-zsh		文件夹 文件夹 文件夹 文件夹	2022/12/3 16 2022/12/3 4: 2022/12/3 5: 2022/12/3 16	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x	root root root root root root root root	
*	文件夹 文件夹 文件夹 文件夹 文件夹	2022/12/3 18:57: 2022/12/3 18:57: 2022/11/11 1:48: 2022/12/3 18:55: 2022/12/3 0:17:04 2022/12/3 0:14:		 .cache .config .oh-my-zsh .pip bash_history	793	文件夹 文件夹 文件夹 文件夹 BASH_HIS	2022/12/3 16 2022/12/3 4: 2022/12/3 5: 2022/12/3 16 2022/12/3 18	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw	root root root root root root root root root root	
	文件夹 文件夹 文件夹 文件夹 文件夹 文件夹	2022/12/3 18:57: 2022/12/3 18:57: 2022/11/11 1:48: 2022/12/3 18:55: 2022/12/3 0:17:04 2022/11/13 0:14: 2022/12/3 19:57:			793 3,523	文件夹 文件夹 文件夹 BASH_HIS BASHRC	2022/12/3 16 2022/12/3 4: 2022/12/3 5: 2022/12/3 16 2022/12/3 18 2022/12/3 4:	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw	root root root root root root root root root root root root	
	文/4英 文/4英 文/4英 文/4英 文/4英 文/4英	2022/12/3 18:57 2022/12/3 18:57 2022/11/11 1:48 2022/12/3 18:55 2022/12/3 18:55 2022/12/3 0:17:04 2022/12/3 19:57 2022/11/26 19:2			793 3,523 0	文件夹 文件夹 文件夹 BASH_HIS BASHRC DESKTOP	2022/12/3 16 2022/12/3 4 2022/12/3 5 2022/12/3 16 2022/12/3 18 2022/12/3 4 2022/12/3 4	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw-r -rw-rr -rw-rr	root root root root root root root root root root root root root root	
	文件 英 文件 英 文件 英 文件 英 文件 英 文件 英 文件 英 文件 英	2022/12/3 18:57 2022/12/3 18:57 2022/11/11 1:48 2022/12/3 18:55 2022/12/3 0:17:04 2022/12/3 19:57 2022/11/26 19:2 2022/11/26 19:2		 .cache .config .oh-my-zsh .pip bash history .bash history .desktop_autologin .viminfo	793 3,523 0 1,375	文件夹 文件夹 文件夹 BASH_HIS BASHRC DESKTOP VIMINFO	2022/12/3 16 2022/12/3 4 2022/12/3 5 2022/12/3 16 2022/12/3 18 2022/12/3 4 2022/12/3 4 2022/12/3 17	drwx drwxr-xr-x drwxr-xr-x drwxr-xr-x -rw-r-x -rw-r -rw-r	root root root root root root root root root root root root root root root root	
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8) Then select the path to be uploaded to the development board on the right side of the filezilla software, and then select the file to be uploaded on the Windows PC on the left side of the filezilla software, then click the right mouse button, and then click the upload option to start uploading the file to the development board bingo

orange Pi User Manual

状态: Connected to 192.168.31.11 状态: 岐阜田豪列集。 状态: Usting directory /root 状态: 列出'/root'的目表成功								
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9) After the upload is complete, you can go to the corresponding path in the Linux system of the development board to view the uploaded file

10) The method of uploading a folder is the same as that of uploading a file, so I won't go into details here

3.10. HDMI Test

3. 10. 1. HDMI display test

1) Use HDMI to HDMI cable to connect Orange Pi development board and HDMI display



2) After starting the linux system, if the HDMI display has image output, it means that the HDMI interface is in normal use.

Note that although many notebook computers have an HDMI interface, the HDMI interface of the notebook generally only has the output function, and does not have the function of HDMI in, that is to say, the HDMI output of other devices cannot be displayed on the notebook screen.

When you want to connect the HDMI of the development board to the HDMI port of the laptop, please make sure that your laptop supports the HDMI in function.

When the HDMI is not displayed, please check whether the HDMI cable is plugged in tightly. After confirming that there is no problem with the connection, you can change a different screen and try to see if it is displayed.

3. 10. 2. HDMI to VGA display test

- 1) First, you need to prepare the following accessories
 - a. HDMI to VGA converter



b. A VGA cable



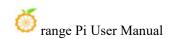
- c. A monitor or TV that supports VGA port
- 2) The HDMI to VGA display test is as follows

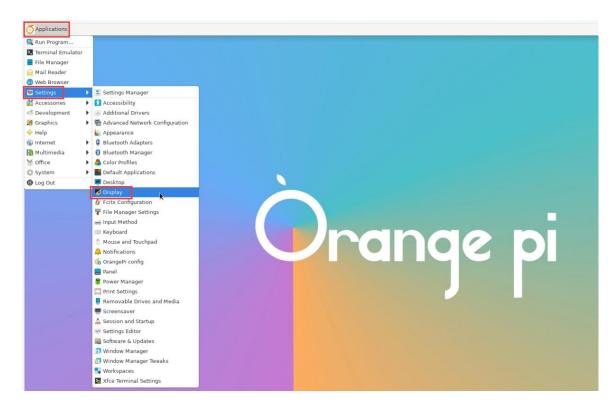


When using HDMI to VGA display, the development board and the Linux system of the development board do not need to make any settings, only the HDMI interface of the development board can display normally. So if there is a problem with the test, please check whether there is a problem with the HDMI to VGA converter, VGA cable and monitor.

3. 10. 3. HDMI resolution setting method

1) First open **Display** in **Settings**

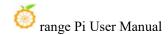




2) Then you can see the current resolution of the system

Di Di	splay		- • ×
General Advanced			
	HDMI-1		•
*	Resolution:	1920x1080*	16:9 🔻
	Scale:	lx	•
HDMI-1	Refresh rate:	60.0 Hz	•
	Rotation:	None	•
	Reflection:	None	•
			✓ Apply
😫 Help			× Close

3) Click the drop-down box of Resolution to see all resolutions currently supported by

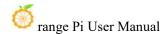


. 1	• .
tha	monitor
unc	monitor

General Advanced			
	HDMI-1		
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•	Scale:	1280x1024	16- 5:
		1280x960	4:
HDMI-1	Refresh rate:	1152x864	4:
	Rotation:	1280x720	16:9
	Reflection:	1024x768	4:
	Nenectori.	800x600	4:
		720x576	5:
		720x480	3:

4) Then select the resolution you want to set, and click Apply

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+		HDMI-1				-
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		Scale:	lx			
	HDMI-1	Refresh rate:	60.0 Hz			
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		ion will be restored in 1 seconds if you do not reply to this question.	keflection:	None	*
	Kee	p this configuration Restore the previous configuration			✓ Apply
		to Help			× Close

5) After the new resolution is set, select Keep the configuration

3.11. How to Use Bluetooth

Please note that there is no Bluetooth module on the Orange Pi 5 development board, and an external PCIe network card with Bluetooth or a USB network card with Bluetooth is required to use the Bluetooth function.

For instructions on using the external PCIe network card, please refer to the section on how to use the AP6275P PCIe network card.

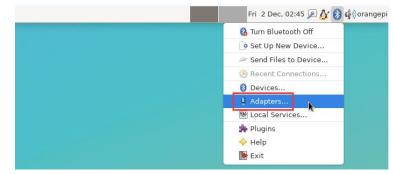
For instructions on using the external USB network card, please refer to the USB wireless network card test section.

3. 11. 1. Test method of desktop image

1) Click on the Bluetooth icon in the upper right corner of the desktop



2) Then select the adapter



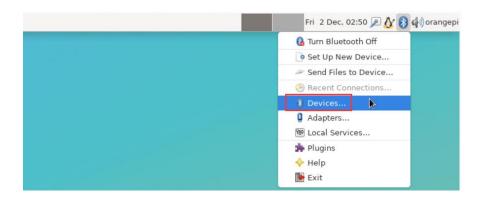
3) If prompted the following interface, please select Yes

Shall bluetooth get e	nabled automatically?	
Yes	No	

4) Then set the **Visibility Setting** to **Always visible** in the Bluetooth adapter setting interface, and then close it

1	Bluetooth Adapters	٠	-	×
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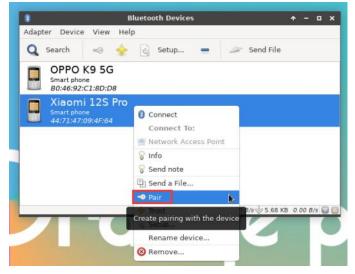
5) Then open the configuration interface of the Bluetooth device



6) Click Search to start scanning the surrounding Bluetooth devices

*			Blueto	ooth	1 Devices				+	+	•	×
Adapter	Device	View	Help									
Q Sei	arch	-9			Setup	-	14	> Send	File			
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6) Then select the Bluetooth device you want to connect to, and then click the right button of the mouse to pop up the operation interface of the Bluetooth device, select **Pair** to start pairing, and the demonstration here is to pair with an Android phone



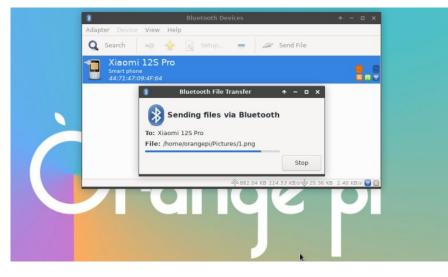
7) When pairing, a pairing confirmation box will pop up in the upper right corner of the desktop, just select **Confirm** to confirm, and the phone also needs to confirm at this time



8) After pairing with the mobile phone, you can select the paired Bluetooth device, then right-click and select **Send a File** to start sending a picture to the mobile phone

Adapter Device View Q Search	🔶 🧕 Setup 💻 🥔 Send F	ile
		92 KB 0.00 B/s

9) The interface for sending pictures is as follows



3. 12. USB Interface Test

The USB interface can be connected to a USB hub to expand the number of USB interfaces.

3. 12. 1. Connect USB mouse or keyboard test

1) Insert the USB interface keyboard into the USB interface of the Orange Pi development board

2) Connect Orange Pi board to HDMI display

3) If the mouse or keyboard can operate normally, it means that the USB interface is working normally (the mouse can only be used in the desktop version of the system)

3. 12. 2. Connect USB storage device test

1) First insert the U disk or USB mobile hard disk into the USB interface of the Orange Pi development board

2) Execute the following command, if you can see the output of sdX, it means that the U disk is recognized successfully

orangepi@orangepi:~\$ cat /proc/partitions grep "sd*"				
major minor	#blo	ocks name		
8	0	30044160 sda		
8	1	30043119 sda1		

3) Use the mount command to mount the U disk to **/mnt**, and then you can view the files in the U disk

orangepi@orangepi:~\$ sudo mount /dev/sda1 /mnt/ orangepi@orangepi:~\$ ls /mnt/ test.txt

4) After mounting, you can view the capacity usage and mount point of the U disk through the **df -h** command

orangepi@orangepi:~\$ **df -h | grep "sd"** /dev/sda1 29G 208K 29G 1% /mnt

3. 12. 3. USB wireless network card test

The usable USB wireless network cards that **have been tested** so far are as follows. For other types of USB wireless network cards, please test them yourself. If they cannot be used, you need to transplant the corresponding USB wireless network card driver.

serial number	model	
1	RTL8723BU Support 2.4G WIFI+BT4.0	WY FILL RESIDENCE
2	RTL8811 Support 2.4G +5G WIFI	GRIS
3	RTL8821CU Support 2.4G +5G WIFI Support BT 4.2	Chik are.

3. 12. 3. 1. **RTL8723BU test**

1) First insert the RTL8723BU wireless network card module into the USB interface of the development board

2) Then the linux system will automatically load the RTL8723BU bluetooth and WIFI-related kernel modules, through the lsmod command, you can see that the following kernel modules have been automatically loaded

orangepi@oran	epi:~\$ lsmod	
Module	Size Used by	
rfcomm	57344 16	
rtl8xxxu	106496 0	
rtk_btusb	61440 0	

3) Through the dmesg command, you can see the loading information of the RTL8723BU module

orangepi@orangepi:~\$ dme	sg
---------------------------	----

83.438901] usb 2-1: new high-speed USB device number 2 using ehci-platform 83.588375] usb 2-1: New USB device found, idVendor=0bda, idProduct=b720, bcdDevice= 2.00 83.588403] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3 83.588422] usb 2-1: Product: 802.11n WLAN Adapter 83.588443] usb 2-1: Manufacturer: Realtek 83.588460] usb 2-1: SerialNumber: 00e04c000001 83.601974] Bluetooth: hci0: RTL: examining hci ver=06 hci rev=000b lmp ver=06 lmp subver=8723 83.603894] Bluetooth: hci0: RTL: rom version status=0 version=1 83.603920] Bluetooth: hci0: RTL: loading rtl bt/rtl8723b fw.bin 83.610108] Bluetooth: hci0: RTL: loading rtl bt/rtl8723b config.bin 83.611274] Bluetooth: hci0: RTL: cfg sz 68, total sz 22564 83.658494] rtk btusb: Realtek USB driver Bluetooth ver 3.1.6d45ddf.20220519-142432 83.658651] usbcore: registered new interface driver rtk btusb 83.667124] usb 2-1: This Realtek USB WiFi dongle (0x0bda:0xb720) is untested! 83.667137] usb 2-1: Please report results to Jes.Sorensen@gmail.com 83.890140] usb 2-1: Vendor: Realtek 83.890153] usb 2-1: Product: 802.11n WLAN Adapter 83.890159] usb 2-1: rtl8723bu parse efuse: dumping efuse (0x200 bytes): 83.890412] usb 2-1: RTL8723BU rev E (SMIC) 1T1R, TX queues 3, WiFi=1, BT=1, GPS=0, HI PA=0 83.890417] usb 2-1: RTL8723BU MAC: 00:13:ef:f4:58:ae 83.890421] usb 2-1: rtl8xxxu: Loading firmware rtlwifi/rtl8723bu nic.bin 83.895289] usb 2-1: Firmware revision 35.0 (signature 0x5301) 84.050893] Bluetooth: hci0: RTL: fw version 0x0e2f9f73 84.266905] Bluetooth: RFCOMM TTY layer initialized 84.266949] Bluetooth: RFCOMM socket layer initialized 84.266999] Bluetooth: RFCOMM ver 1.11 84.884270] usbcore: registered new interface driver rtl8xxxu 84.912046] rtl8xxxu 2-1:1.2 wlx0013eff458ae: renamed from wlan0

4) Then through the sudo ifconfig command, you can see the device node of

RTL8723BU WIFI. For the connection and test method of WIFI, please refer to the section of **WIFI connection test**, which will not be repeated here

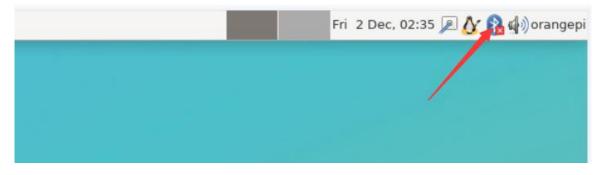
orangepi@orangepi:~\$ sudo ifconfig wlx0013eff458ae wlx0013eff458ae: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500 ether 00:13:ef:f4:58:ae txqueuelen 1000 (Ethernet) RX packets 0 bytes 0 (0.0 B) RX errors 0 dropped 0 overruns 0 frame 0 TX packets 0 bytes 0 (0.0 B) TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

5) Then you can see the USB Bluetooth device through the hciconfig command

orangepi@orangepi:~\$ sudo apt update && sudo apt install bluez orangepi@orangepi:~\$ hciconfig

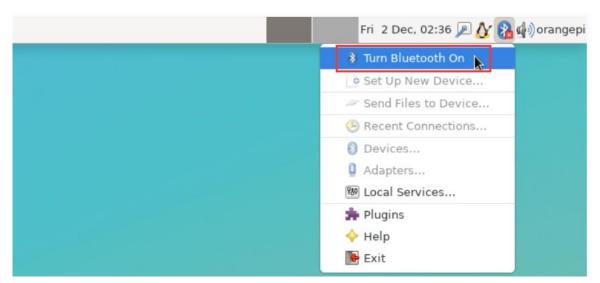
hci0: Type: Primary Bus: USB BD Address: 00:13:EF:F4:58:AE ACL MTU: 820:8 SCO MTU: 255:16 DOWN RX bytes:1252 acl:0 sco:0 events:125 errors:0 TX bytes:23307 acl:0 sco:0 commands:125 errors:0

6) You can also see the Bluetooth icon on the desktop. At this time, Bluetooth is not turned on, so a red \mathbf{x} will be displayed



7) Click **Turn Bluetooth On** to turn on Bluetooth





8) The display after turning on Bluetooth is as follows

Fri 2 Dec, 02:37 🔎 🏠 🚯 🏟 orangepi

9) For the test method of Bluetooth, please refer to the section on **Bluetooth usage**, and will not repeat it here

3. 12. 3. 2. RTL8811 test

1) First insert the RTL8811 wireless network card module into the USB interface of the development board

2) Then the linux system will automatically load the kernel module related to RTL8811 WIFI, through the lsmod command, you can see that the following kernel module has been automatically loaded

orangepi@orangepi:~\$ lsmod				
Module	Size	Used by		
8821cu	1839104	0		

3) Through the dmesg command, you can see the loading information of the RTL8811 module

orangepi@orangepi:~\$ dmesg

118.618194] usb 2-1: new high-speed USB device number 2 using ehci-platform

[118.767152] usb 2-1: New USB device found, idVendor=0bda, idProduct=c811, bcdDevice= 2.00

118.767181] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3

118.767199] usb 2-1: Product: 802.11ac NIC

118.767219] usb 2-1: Manufacturer: Realtek

118.767235] usb 2-1: SerialNumber: 123456

119.500530] usbcore: registered new interface driver rtl8821cu

119.525498] rtl8821cu 2-1:1.0 wlx1cbfced9d260: renamed from wlan0

4) Then you can see the WIFI device node through the **sudo ifconfig** command. For the WIFI connection and test method, please refer to the **WIFI connection test** section, and I won't go into details here

```
orangepi@orangepi:~$ sudo ifconfig wlx1cbfced9d260
wlx1cbfced9d260: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
ether 1c:bf:ce:d9:d2:60 txqueuelen 1000 (Ethernet)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

3. 12. 3. 3. **RTL8821CU test**

1) First insert the rtl8821cu wireless network card module into the usb interface of the development board

2) Then use the **lsusb** command to see the device information of the rtl8821cu usb wifi module, please make sure that the USB module is not in Driver CDROM Mode

orangepi@orangepi:~**\$ Isusb | grep "Realtek"** Bus 002 Device 003: ID 0bda:c820 Realtek Semiconductor Corp. 802.11ac NIC orangepi@orangepi:~\$ lsusb | grep "Realtek"

Bus 002 Device 002: ID 0bda:1a2b Realtek Semiconductor Corp. RTL8188GU 802.11n WLAN Adapter (Driver CDROM Mode)

If the USB WIFI module seen by the lsusb command is in Driver CDROM Mode, please unplug the USB WIFI module again. If not, please manually execute the following command to switch to the next mode:

orangepi@orangepi:~\$ sudo usb_modeswitch -KW -v 0bda -p 1a2b

3) The linux system will automatically load the rtl8821cu bluetooth and wifi related kernel modules, through the lsmod command, you can see that the following kernel modules have been automatically loaded

orangepi@orangepi:~\$ lsmod				
Module	Size	Used by		
8821cu	1839104	0		
rtk_btusb	61440	0		

4) Through the dmesg command, you can see the loading information of the rtl8821cu module

orangepi@orangepi:~\$ dmesg

•••••

57.083693] usb 2-1: new high-speed USB device number 2 using ehci-platform

[57.231888] usb 2-1: New USB device found, idVendor=0bda, idProduct=1a2b, bcdDevice= 2.00

57.231916] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=0

57.231937] usb 2-1: Product: DISK

57.231956] usb 2-1: Manufacturer: Realtek

57.242594] usb-storage 2-1:1.0: USB Mass Storage device detected

57.245674] scsi host0: usb-storage 2-1:1.0

58.069172] usb 2-1: USB disconnect, device number 2

58.440025] usb 2-1: new high-speed USB device number 3 using ehci-platform

[58.587819] usb 2-1: New USB device found, idVendor=0bda, idProduct=c820, bcdDevice= 2.00

58.587827] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3

58.587833] usb 2-1: Product: 802.11ac NIC 58.587838] usb 2-1: Manufacturer: Realtek 58.587844] usb 2-1: SerialNumber: 123456 rtk btusb: Bluetooth USB driver 58.610463] Realtek ver 3.1.6d45ddf.20220519-142432 58.610656] usbcore: registered new interface driver rtk btusb 58.634631] Bluetooth: hci0: RTL: examining hci ver=08 hci rev=000c lmp ver=08 lmp subver=8821 58.636729] Bluetooth: hci0: RTL: rom version status=0 version=1 58.636740] Bluetooth: hci0: RTL: loading rtl bt/rtl8821c fw.bin 58.664190] Bluetooth: hci0: RTL: loading rtl bt/rtl8821c config.bin 58.664746] Bluetooth: hci0: RTL: cfg sz 10, total sz 31990 59.122471] Bluetooth: hci0: RTL: fw version 0x829a7644 59.265513] usbcore: registered new interface driver rtl8821cu 59.280119] rtl8821cu 2-1:1.2 wlx90de80521825: renamed from wlan0

5) Then you can see the device node of rtl8821cu wifi through the **sudo ifconfig** command. For the wifi connection and test method, please refer to the section of **WIFI connection test**, so I won't go into details here

```
orangepi@orangepi:~$ sudo ifconfig wlx90de80521825
wlx90de80521825: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
ether 00:13:ef:f4:58:ae txqueuelen 1000 (Ethernet)
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

6) Then you can see the USB Bluetooth device through the hciconfig command

orangepi@orangepi:~\$ sudo apt-get update && sudo apt-get install -y bluez orangepi@orangepi:~\$ hciconfig

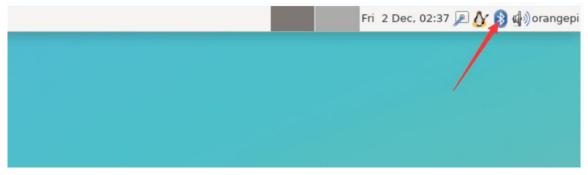
hci0: Type: Primary Bus: USB BD Address: 00:13:EF:F4:58:AE ACL MTU: 820:8 SCO MTU: 255:16 DOWN RX bytes:1252 acl:0 sco:0 events:125 errors:0 TX bytes:23307 acl:0 sco:0 commands:125 errors:0 7) You can also see the bluetooth icon on the desktop. At this time, the bluetooth is not turned on, so a red \mathbf{x} will be displayed



8) Click **Turn Bluetooth On** to turn on Bluetooth

Fri 2 Dec, 02:36 🔎 🞊 🖓 orangepi
🕴 Turn Bluetooth On 📡
Set Up New Device
🥔 Send Files to Device
4 Recent Connections
Ø Devices
Adapters
📟 Local Services
🚔 Plugins
🔶 Help
🕞 Exit

9) The display after turning on Bluetooth is as follows



10) For the test method of Bluetooth, please refer to the section on **Bluetooth usage**, so I won't go into details here

3. 12. 4. USB camera test

1) First, you need to prepare a USB camera that supports the UVC protocol as shown in the figure below or similar, and then insert the USB camera into the USB port of the Orange Pi development board



2) Through the v4l2-ctl command, you can see that the device node information of the USB camera is /dev/video0

orangepi@orangepi:~\$ **v4l2-ctl --list-devices** Q8 HD Webcam: Q8 HD Webcam (**usb**-fc880000.usb-1): /dev/video0

/dev/video1

/dev/media0

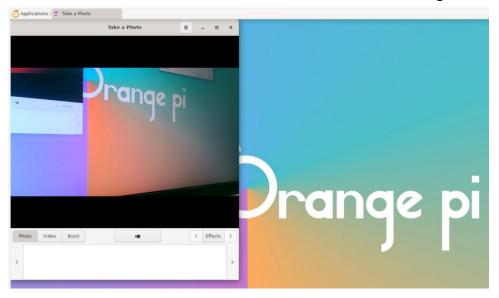
Note that the l in v4l2 is a lowercase letter l, not the number 1.

In addition, the serial number of the video is not necessarily video0, please refer to what you actually see.

3) In the desktop system, Cheese can be used to directly open the USB camera. The method of opening Cheese is shown in the figure below:

or Applications			
🔍 Run Program			
Norminal Emulato	or.		
📕 File Manager			
🔒 Mail Reader			
💮 Web Browser			
🕮 Settings	•		
🔀 Accessories	•		
🛎 Development	•		
🥵 Graphics	•		
🔶 Help			
😡 Internet	- ×		
Multimedia		Audacity	
🗑 Office	- >	🛢 Cheese	
💮 System	•	PulseAudio	System Tray
C Log Out			Volume Control
		🖥 PulseAudio	Volume Control
		PulseAudio	Volume Meter (Capture)
		PulseAudio	Volume Meter (Playback)
		📮 Qt V4L2 tes	st Utility

The interface after Cheese turns on the USB camera is shown in the figure below:



- 4) Method of using fswebcam to test USB camera
 - a. Install fswebcam

orangepi@orangepi:~\$ sudo apt update orangepi@orangepi:~\$ sudo apt-get install -y fswebcam

- b. After installing fswebcam, you can use the following command to take pictures
 - a) -d Option is used to specify the device node of the USB camera
 - b) --no-banner For removing watermarks from photos
 - c) -r Option to specify the resolution of the photo

- d) -S Option to set the number of previous frames to skip
- e) ./image.jpg Used to set the name and path of the generated photo

orangepi@orangepi:~\$ sudo fswebcam -d /dev/video0 \

--no-banner -r 1280x720 -S 5 ./image.jpg

c. In the server version of the linux system, you can use the scp command to transfer the taken pictures to the Ubuntu PC for image viewing after taking pictures

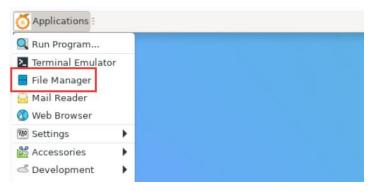
orangepi@orangepi:~\$ scp image.jpg test@192.168.1.55:/home/test (Modify the IP address and path according to the actual situation)

d. In the desktop version of the Linux system, you can directly view the captured pictures through the HDMI display

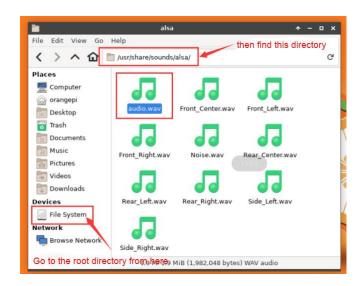
3.13. Audio Test

3. 13. 1. Testing audio methods on desktop systems

1) First open the file manager



2) Then find the following file (if there is no audio file in the system, you can upload an audio file to the system yourself)

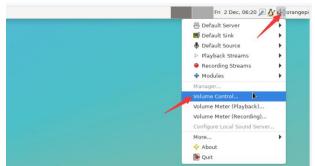


3) Then select the audio.wav file, right click and select open with vlc to start playing

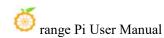
	alsa	+ - □ ×
File Edit View Go	Help	
$\langle \rangle \land \hat{\omega}$	🗂 /usr/share/sounds/alsa/	G
Places Computer orangepi Desktop	audio.	player"
Trash Documents Music Pictures	Open With Send To Front_Rigt Cut	wav
Videos Downloads Devices	Paste Move to Trash Rear_Cent Properties	J ht.way
File System 17 MB Volume 403 MB Volume Network	Side_Left.wav	
Browse Network	Use "VLC media player" to open the s	selected file

4) How to switch between different audio devices such as HDMI playback and headphone playback

a. First open the volume control interface



b. When playing audio, the audio device options that the playback software can use will be displayed in **Playback**, as shown in the figure below, where you can set



💍 Applications : 🗇 Volume Control	🛅 alsa	🛓 audio.wav - VLC media				Fri 2 Dec, 06:24 🔎 🛓 💩 🏟 orangej
	📥 Media Playback (audio,wav - VLC media player Audio Video Subtijle Tools Vjew Help	+ - 8 ×			
		_		Votu Playback Recording Output Devic	ime Control ces Input Devices Configuration	* - a x
		<u> </u>		/ System Sounds	100% (0 dB)	4 88 100% (0.00 dB)
				LUC media player (LibVLC 3.0.17.4	0 8	unun de Headphones + Speaker Julit n Audio HDMI
File Edit View Go Help	215a			(/	
< > ^ 🔂 🖿 Austrat	hare/sounds/alsa/	ď				
E Desktop	dio.way	v Front_Left.wav		Show	r: Applications	•
Trash Documents Music Front	Right.wav mute.wav	Noise.way				
Videos	Center.wav Rear_Left.wav	Rear_Right.wav				
17 MB Volume						

which audio device to play to

3. 13. 2. The method of using commands to play audio

3. 13. 2. 1. Headphone interface playback audio test

1) First insert the earphone into the earphone jack of the development board



2) Then you can use the aplay -l command to view the sound card devices supported by the linux system. From the output below, we can see that card 2 is the sound card device of es8388, that is, the sound card device of the headset

orangepi@orangepi:~\$ aplay -l **** List of PLAYBACK Hardware Devices **** card 0: rockchipdp0 [rockchip-dp0], device 0: rockchip-dp0 spdif-hifi-0 [rockchip-dp0 spdif-hifi-0] Subdevices: 1/1 Subdevice #0: subdevice #0 card 1: rockchiphdmi0 [rockchip-hdmi0], device 0: rockchip-hdmi0 i2s-hifi-0 [rockchip-hdmi0 i2s-hifi-0]

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Subdevices: 1/1
Subdevice #0: subdevice #0
card 2: rockchipes8388 [rockchip-es8388], device 0: dailink-multicodecs ES8323.6-0010-0 [dailink-multicodec
ES8323.6-0010-0]
Subdevices: 1/1
Subdevice #0: subdevice #0

3) Then use the **aplay** command to play the audio file that comes with the system. If the earphone can hear the sound, it means that the hardware can be used normally.

orangepi@orangepi:~\$ aplay -D hw:2,0 /usr/share/sounds/alsa/audio.wav Playing WAVE 'audio.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo

3. 13. 2. 2. HDMI audio playback test

1) First use the HDMI to HDMI cable to connect the Orange Pi development board to the TV (other HDMI monitors need to ensure that they can play audio)

2) Then check the serial number of the HDMI sound card. From the output below, you can know that the HDMI sound card is **card 1**

orangepi@orangepi:~\$ aplay -l
**** List of PLAYBACK Hardware Devices ****
card 0: rockchipdp0 [rockchip-dp0], device 0: rockchip-dp0 spdif-hifi-0]
Subdevices: 1/1
Subdevice #0: subdevice #0
card 1: rockchiphdmi0 [rockchip-hdmi0], device 0: rockchip-hdmi0 i2s-hifi-0 [rockchip-hdmi0 i2s-hifi-0]
Subdevices: 1/1
Subdevices: 1/1
Subdevice #0
card 2: rockchipes8388 [rockchip-es8388], device 0: dailink-multicodecs ES8323.6-0010-0 [dailink-multicodecs
ES8323.6-0010-0]
Subdevices: 1/1
Subdevices: 1/1
Subdevices: 1/1
Subdevices: 1/1
Subdevices: 1/1
Subdevices: 1/1

3) Then use the **aplay** command to play the audio file that comes with the system. If the HDMI monitor or TV can hear the sound, it means that the hardware can be used normally.

orangepi@orangepi:~\$ aplay -D hw:1,0 /usr/share/sounds/alsa/audio.wav

3. 13. 3. Method of using commands to test recording

1) There is an onboard MIC on the development board, the location is as follows:



2) Running the **test_record.sh main** command will record a piece of audio through the onboard MIC, and then play it to HDMI and headphones.

orangepi@orangepi:~\$ test_record.sh main

Start recording: /tmp/test.wav

Recording WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo Start playing

Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo

3) In addition to the onboard MIC, we can also record audio through headphones with MIC function. After inserting the headset with MIC function into the development board, run the **test_record.sh headset** command to record a piece of audio through the headset, and then play it to HDMI and the headset.

orangepi@orangepi:~\$ test_record.sh headset

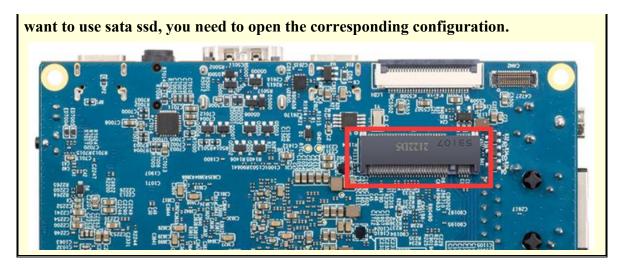
Start recording: /tmp/test.wav

Recording WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo Start playing

Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo Playing WAVE '/tmp/test.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo

3. 14. How to use SATA SSD

The m.2 interface shown in the figure below can use both nvme ssd and sata ssd. Since the pcie2.0 controller and the sata controller are optional, only one of them can be configured at the same time. The linux image released by Orange Pi opens the pcie configuration by default, so it can only recognize nvme ssd by default. If you



- 1) First, you need to prepare a SATA SSD solid state drive
 - a. The M.2 2242 SSD is as follows



b. The M.2 2280 specification SSD is as follows (2280 specification SATA SSD can also be used, but the SSD will exceed the development board after being inserted into the development board)



2) Then insert the SSD into the M.2 interface of the development board and fix it



- 3) There are two main usages of sata ssd:
 - a. The linux system is in the TF card, and then insert the sata ssd as an external storage device. This section mainly explains this usage.
 - b. Burn the linux system into the sata ssd, and then start the linux system in the sata ssd. For this kind of usage, please refer to the instructions in the section on the method of burning the Linux image to SPIFlash+SATA SSD.

4) After using the TF card to start the Linux system, we first burn the sata ssd-specific u-boot image into the TF card.

a. The dedicated u-boot image storage path for sata ssd startup is:

/usr/share/orangepi5/u-boot-sata.itb
· · · · · · · · · · · · · · · · · · ·

b. Make sure that **u-boot-sata.itb** exists in the Linux system, and then use the following command to burn it to the TF card of the development board.

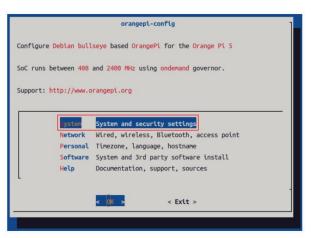
orangepi@orangepi:~\$ cd /usr/share/orangepi5/

orangepi@orangepi:~\$ sudo dd if=u-boot-sata.itb of=\$(findmnt -n -o SOURCE / | sed 's/..\$//') seek=16384 orangepi@orangepi:~\$ sudo sync

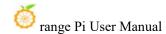
5) Then run orangepi-config. Ordinary users remember to add sudo permissions.

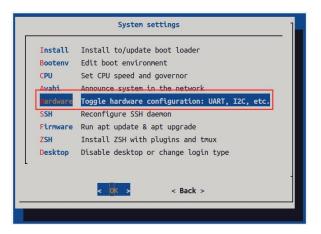
orangepi@orangepi:~\$ sudo orangepi-config

6) Then select **System**

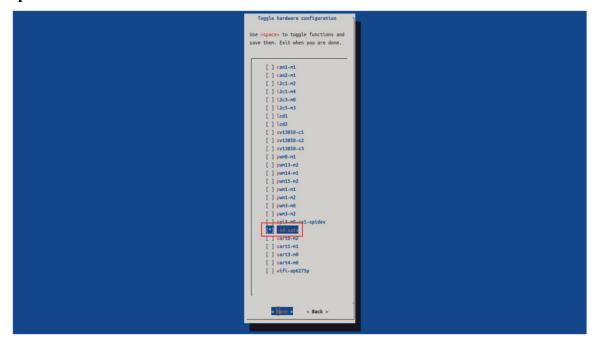


7) Then select Hardware

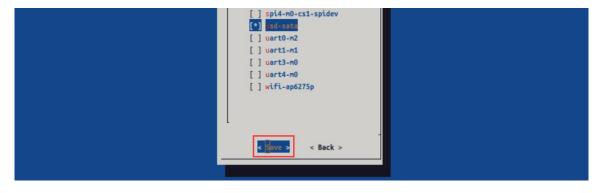




8) Then use the arrow keys of the keyboard to navigate to **ssd-sata**, and then use **the space** to select



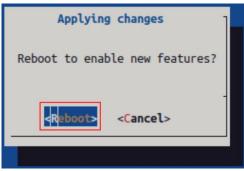
9) Then select **<Save>** to save



10) Then select <Back>

<pre>[*] ssd-sata [] uart0-m2 [] uart1-m1 [] uart3-m0 [] uart4-m0 [] wifi-ap6275p</pre>	
< Save > < Back >	

11) Then select **<Reboot>** to restart the system to make the configuration take effect



The above settings will eventually add the configuration of overlays=ssd-sata to /boot/orangepiEnv.txt After setting, you can check it first. If this configuration does not exist, then there is a problem with the settings.

If you find it troublesome to use orangepi-config, you can also open /boot/orangepiEnv.txt, and then add the configuration of overlays=ssd-sata.

orangepi@orangepi:~\$ cat /boot/orangepiEnv.txt | grep "ssd" overlays=ssd-sata

12) If everything is normal, after the system restarts, use the sudo fdisk -l command to see sata ssd information

orangepi@orangepi:~\$ sudo fdisk -l

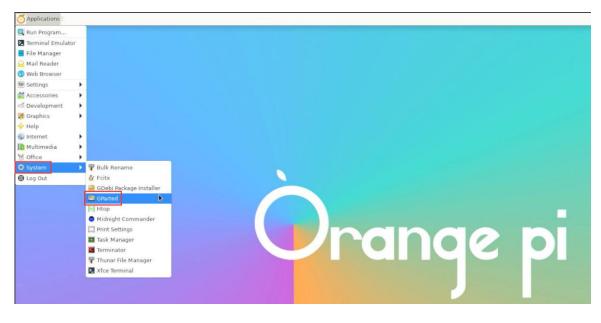
.

Disk /dev/sda: 238.47 GiB, 256060514304 bytes, 500118192 sectors Disk model: Fanxiang S201 25

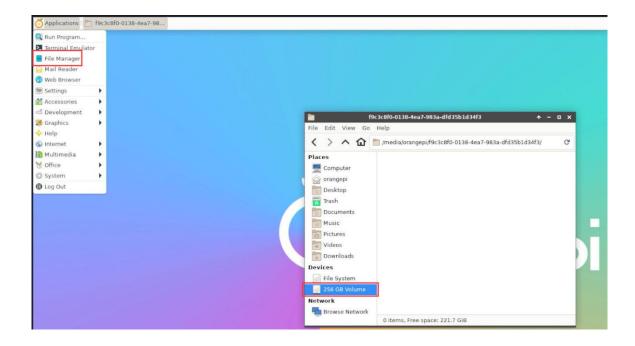
X	
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Units: sector	rs of 1 * 512 =	= 512 by	rtes		
Sector size (logical/physic	al): 512	2 bytes / 512	2 bytes	
I/O size (mir	nimum/optima	al): 512	bytes / 512	bytes	
Disklabel ty _l	pe: gpt				
Disk identifi	er: 43FFB292	2-340D-	654C-8C30)-6C64AEDAA0F4	4
Device	Start	End	Sectors	Size Type	
/dev/sda1	2048 500117	503 500	0115456 23	8.5G Linux filesys	tem

13) Then use GParted to format or partition sata ssd



14) Then you can see the sata ssd device in the file management



15) In the server version system, you can use the mount command to mount the sata ssd to the required directory

orangepi@orange	orangepi@orangepi:~\$ sudo mount /dev/sda1 /mnt						
orangepi@orange	orangepi@orangepi:~\$ df -h						
Filesystem	Size L	Jsed Ava	ail Use%	Mounted on			
udev	3.8G	8.0K	3.8G	1% /dev			
tmpfs	769M	1.4M	768M	1% /run			
/dev/mmcblk1p2	29G	5.9G	23G	21% /			
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/mmcblk1p1	256M	90M	166M	36% /boot			
/dev/zram1	194M	27M	154M	15% /var/log			
tmpfs	769M	60K	769M	1% /run/user/1000			
/dev/sda1	234G	28K	222G	1% /mnt			

3.15. Temperature sensor

The command to view the system temperature sensor is:

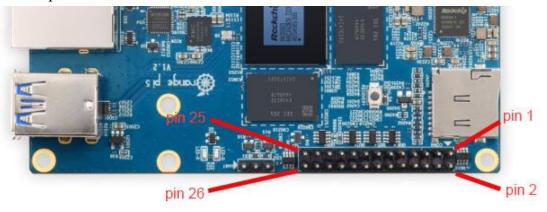
orangepi@orangepi:~\$ sensors

```
gpu thermal-virtual-0
Adapter: Virtual device
temp1:
                +47.2°C
littlecore thermal-virtual-0
Adapter: Virtual device
                +47.2°C
temp1:
bigcore0 thermal-virtual-0
Adapter: Virtual device
                +47.2°C
temp1:
tcpm source psy 6 0022-i2c-6-22
Adapter: rk3x-i2c
                 0.00 \text{ V} (min = +0.00 V, max = +0.00 V)
in0:
curr1:
                 0.00 \text{ A} \text{ (max} = +0.00 \text{ A)}
npu thermal-virtual-0
Adapter: Virtual device
                +47.2°C
temp1:
center thermal-virtual-0
Adapter: Virtual device
temp1:
                +47.2°C
bigcore1 thermal-virtual-0
Adapter: Virtual device
                +47.2°C
temp1:
soc thermal-virtual-0
Adapter: Virtual device
temp1:
                +47.2°C
                           (crit = +115.0^{\circ}C)
```

3. 16. 26 Pin Interface Pin Description

1) Please refer to the figure below for the order of the 26 pin interface pins on the Orange

Pi 5 development board



2) The functions of the 26 pin interface pins on the Orange Pi 5 development board are shown in the table below

GPIO 3.3V GPIO1_B7 GPIO1_B6 GPIO1_C6 GPIO4_B2 GPIO4_B3 GPIO0_D4 3.3V GPIO 5V 5V 复用功能 复用功能 复用功能 GPIO序号 引脚序号 引脚序号 GPIO序号 复用功能 复用功能 复用功能 I2C5_SDA_M3 I2C5_SCL_M3 M15_IR_M2 (febf0030) PWM13_M2 (febf0010) UART1_RX_M1 (feb40000) UART1_TX_M1 5V GND GPIO4_A3 GPIO4_A4 GPIO0_D5 GND GPIO1_D3 GPIO1_D2 GPIO2_D4 GPIO2_D4 GPIO1_C4 46 54 UART0_TX_M2 (fd890000) UART0_RX_M2 CAN2_TX_M1 131 132 29 CAN1_RX_M1 138 PWM14_M1 (febf0020) 2C1_SDA_M2 139 28 CAN1_TX_M1 CAN2_RX_M1 14 PWM3_IR_M0 (fd8b0030) I2C1_SCL_M2 59 ART4_RX_M0 (feb70000) UART4_TX_M0 I2C1_SDA_M4 PWM1_M1 (fd8b0010) I2C1_SCL_M4 PWM0_M1 (fd8b0000) 15 16 3.3V GPIO1_C 18 58 UART3_TX_M0 (feb60000) UART3_RX_M0 PWM3_IR_M2 (fd8b0030) SPI4_MOSI_MO SPI4_MISO_MO SPI4_CLK_M0

SPIO1_

PIO1_C2

The following is the complete pin diagram of 26pin a.

The table below is the picture of the left half of the complete table above, so you b. can see it clearly

SPI4_CS1_M0 M1_M2 (fd8b0010

SPIO1_C4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号
			3.3V		1
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7
			GND		9
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11
		CAN1_TX_M1	GPIO4_B3	139	13
PWM3_IR_M0 (fd8b0030)	I2C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15
			3.3V		17
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19
I2C3 SDA M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23
			GND		25

The table below is the picture of the right half of the complete table above, so c. you can see it clearly

12C3_SCL_M0 12C3_SDA_M0

引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
2		5V			
4		5V			
6		GND			
8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
10	132	GPIO4_A4	UART0_RX_M2		
12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
14		GND			
16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
20		GND			
22	92	GPIO2_D4			
24	52	GPIO1_C4	SPI4_CS1_M0		
26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

The pwm in the above table has marked the base address of the corresponding register, which is useful when checking which pwmchip in /sys/class/pwm/ corresponds to which pwm pin in the 26pin header.

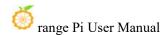
3) There are a total of 17 GPIO ports in the 26pin interface, and the voltage of all GPIO ports is **3.3v**

3.17. How to install wiringOP

Note that wiringOP has been pre-installed in the linux image released by Orange Pi. Unless the code of wiringOP is updated, there is no need to re-download, compile and install, just use it directly.

The storage path of the compiled wiringOP deb package in orangepi-build is: orangepi-build/external/cache/debs/arm64/wiringpi x.xx.deb

After entering the system, you can run the gpio readall command. If you can see the output below, it means that wiringOP has been pre-installed and can be used normally.



GPI0	wPi	Name	Mode	V	Phy	sic	al	I V	Mode	Name	wPi	GPIC
		3.3V		+ 	1 1	11-	2	1		1 5V	+ 	
47	0	SDA.5	IN	i 1	3	ii.	4	i i		i 5V		
46	1	SCL.5	IN	1	5	ii.	6	i i		GND	i l	
54 I	2	PWM15	IN	i 1	7	ii.	8	0	IN	RXD.0	3	131
		GND			9	İİ.	10	0	IN	TXD.0	j 4	132
138	5	CAN1 RX	IN	j 1	11	İİ.	12	1	IN	CAN2 TX	6	29
139 j	7	CAN1_TX	IN	İ 1	13	İİ.	14	İ i		GND	Ĭ I	1
28	8	CAN2_RX	IN	1	15	İİ.	16	j 1	IN	SDA.1	9	59
		3.3V			17	İİ.	18	1	IN	SCL.1	10	58
49	11	SPI4_TXD	IN	1	19		20	Í		GND	1	
48	12	SPI4_RXD	IN	1	21	İİ.	22	1	IN	GPI02_D4	13	92
50	14	SPI4_CLK	IN	1	23	11	24	1	IN	SPI4_CS1	15	52
		GND		Í	25	II-	26	1	IN	PWM1	16	35
+		++ N		+	+	++-		+	+	+	+	+
GPIO	WPi	Name	Mode			sic PI5		IV	Mode	Name	wPi	GPIC

1) Download the code of wiringOP

orangepi@orangepi:~\$ sudo apt update

orangepi@orangepi:~\$ sudo apt install -y git

orangepi@orangepi:~\$ git clone https://github.com/orangepi-xunlong/wiringOP.git -b next

Note that Orange Pi 5 needs to download the code of wiringOP next branch, please don' t miss the -b next parameter.

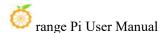
If there is a problem downloading the code from GitHub, you can directly use the wiringOP source code that comes with the Linux image. The storage location is: /usr/src/wiringOP.

Compile and install wiringOP
 orangepi@orangepi:~\$ cd wiringOP

orangepi@orangepi:~/wiringOP\$ sudo ./build clean

orangepi@orangepi:~/wiringOP\$ sudo ./build

3) Test the output of the gpio readall command as follows



GPIO	wPi	Name	Mode	V	Phys	ical	V	Mode	Name	wPi	GPIO
		3.3V			1	2			+ 5V		
47	0	SDA.5	IN	1	3	4	1	1	5V		1
46	1	SCL.5	IN	1	5	6		1	GND		
54	2	PWM15	IN	1	7	8	0	ALT6	RXD.0	3	131
		GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
139	7	CAN1_TX	IN	1	13	14		1	GND]
28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
		3.3V			17	18	1	IN	SCL.1	10	58
49	11	SPI4_TXD	IN	1	19	20			GND]
48	12	SPI4_RXD	IN	1	21	22	1	IN	GPIO2_D4	13	92
50	14	SPI4_CLK	IN	1	23	24	1	ALT1	SPI4_CS1	15	52
		GND			25	26	1	IN	PWM1	16	35
GPIO	wPi	Name	Mode	V	Phys	ical	V	Mode	Name	wPi	GPI0

3. 18. 26pin interface GPIO, I2C, UART, SPI, CAN and PWM test

Note, if you need to set overlays to open multiple configurations at the same time, please use spaces to separate them and write them on one line as follows. orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt

overlays=i2c1-m2 lcd1 ov13850-c1 pwm13-m2 spi4-m0-cs1-spidev uart0-m2

3. 18. 1. **26pin GPIO port test**

The linux system released by Orange Pi has a pre-installed blink_all_gpio program, which will set all 17 GPIO ports in the 26pin to switch between high and low levels continuously.

After running the blink_all_gpio program, when using a multimeter to measure the level of the GPIO port, you will find that the GPIO pin will switch between 0 and 3.3v continuously. Using this program we can test whether the GPIO port is working properly.

The way to run the blink_all_gpio program is as follows:orangepi@orangepi5:~\$ sudo blink_all_gpio#Remember to add sudo permission[sudo] password for orangepi:#A password is required here

1) There are a total of 17 GPIO ports in the 26pins of the development board that can be used. The following uses pin 7—the corresponding GPIO is GPIO1_C6—the corresponding wPi serial number is 2—as an example to demonstrate how to set the high

and low levels of the GPIO port

го +	ot@orar	ngepi5:	:~# gpio геа	adall	+	+ 01	PT5 -	+	+		+	++
Ì	GPIO	wPi	Name	Mode	V	Phy	sical	V	Mode	Name	wPi	GPIO
Ī			3.3V			1	2			5V		
1	47	0	SDA.5	IN	1	3	4			5V		
1	46	1	SCL.5	IN	1	5	6			GND	1	1 1
	54	2	PWM15	IN	1	7	8	0	ALT6	RXD.0	3	131
			GND			9	10	0	IN	TXD.0	4	132
1	138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
	139	7	CAN1_TX	IN	1	13	14			GND		
1	28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59

2) First set the GPIO port to output mode, where the third parameter needs to input the serial number of wPi corresponding to the pin

root@orangepi:~/wiringOP# gpio mode 2 out

3) Then set the GPIO port to output a low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

root@orangepi:~/wiringOP# gpio write 2 0

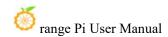
Use gpio readall to see that the value (V) of pin 7 has changed to 0

roo	t@ora	ngep	015:	~# дріо геа	adall		- OPI5	L.L.				
j.	GPIO	WF	'i	Name	Mode	V	Physica	ιįν	Mode	Name	wPi	GPIO
	47	 	0	3.3V SDA.5	IN		1 2 3 4	ļ	 	5V 5V		
	46 54	ļ	1 2	SCL.5 PWM15	IN OUT	10	5 6 7 8	0	ALT6	GND RXD.0	3	131
	138		5	GND CAN1_RX	IN	1	9 1 11 1		IN IN	TXD.0 CAN2_TX	4 6	132 29

4) Then set the GPIO port to output a high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the high level is set successfully.

root@orangepi:~/wiringOP# gpio write 2 1

Use gpio readall to see that the value (V) of pin 7 has changed to 1



oot@orai	ngepi5 +	:~# gpio ге	adall	++	• 0PI	5	+	L			
GPIO	wPi	Name	Mode	V	Physi		V	Mode	Name	wPi	GPIO
1	+ 	3.3V		++	1	2	1		5V	-+	
47	0	SDA.5	IN	1	3	4	1	1	5V	1	i i
46	1	SCL.5	IN	1	5	6	Í		GND	1	
54	2	PWM15	OUT	1	7	8	0	ALT6	RXD.0	3	131
1	1	GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29

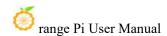
5) The setting method of other pins is similar, just modify the serial number of wPi to the corresponding serial number of the pin

3. 18. 2. **26pin GPIO port pull-down resistance setting method**

Note that only the lower 4 GPIO pins of Orange Pi 5 can normally set the pull-up and pull-down resistor function, and the other GPIO pins have an external 3.3V pull-up, so setting the pull-down is invalid.

GPIO	WPi	Name	Mode	V	Phys	sical	V	Mode	Name	wPi	GPIC
		3.3V		+ 	1	2		+	5V		
47	0	SDA.5	IN	1	3	4		Î	5V		
46	1	SCL.5	IN	1	5	6		i	GND		
54	2	PWM15	IN	1	7	8	0	IN	RXD.0	3	131
		GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	0	11	12	1	IN	CAN2_TX	6	29
139	7	CAN1_TX	IN	0	13	14		1	GND		
28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
		3.3V			17	18	1	IN	SCL.1	10	58
49	11	SPI4_TXD	IN	1	19	20			GND		
48	12	SPI4_RXD	IN	1	21	22	1	IN	GPI02_D4	13	92
50	14	SPI4_CLK	IN	1	23	24	1	IN	SPI4_CS1	15	52
		GND		L .	25	26	1	IN	PWM1	16	35

1) The following takes pin 11—the corresponding GPIO is GPIO4_B2—the corresponding wPi serial number is 5—as an example to demonstrate how to set the pull-up and pull-down resistance of the GPIO port



GPIO	wPi	Name	Mode	V		sical	V	Mode	Name	wPi	GPIO
		3.3V		1		2	1		5V	1	
47	0	SDA.5	OUT	0	3	4	1	1	5V		İ
46	1	SCL.5	OUT	0	5	6		1	GND		
54	2	PWM15	OUT	0	7	8	0	OUT	RXD.0	3	131
	i i	GND			9	10	0	OUT	TXD.0	4	132
138	5	CAN1_RX	OUT	0	11	12	0	OUT	CAN2_TX	6	29
139	7	CAN1_TX	OUT	0	13	14		1	GND		1
28	8	CAN2 RX	OUT	0	15	1 16	10	I OUT	SDA.1	9	59

2) First, you need to set the GPIO port to the input mode, and the third parameter needs to be the serial number of the wPi corresponding to the input pin

root@orangepi:~/wiringOP# **gpio mode 5 in**

3) After setting to input mode, execute the following command to set the GPIO port to pull-up mode

root@orangepi:~/wiringOP# **gpio mode 5 up**

4) Then enter the following command to read the level of the GPIO port, if the level is 1, it means that the pull-up mode is set successfully

root@orangepi:~/wiringOP# gpio read 5

5) Then execute the following command to set the GPIO port to pull-down mode root@orangepi:~/wiringOP# **gpio mode 5 down**

6) Then enter the following command to read the level of the GPIO port, if the level is 0, the pull-down mode is set successfully

root@orangepi:~/wiringOP# **gpio read 5**

0

3. 18. 3. **26pin SPI test**

1) According to the schematic diagram of the 26pin interface, the available spi for Orange Pi 5 is spi4

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12C5 SDA/UART1 RX/GPIO1 B7 J 12C5 SCL/UART1 TX/GPIO1 B6 J	10 30 3.3V1 SDA	5.0V1 04 5.0V2 06	
PWM15_IR/GPI01_C6_J	70 SCL 10-GCLK	GND3 08 TXD0 08	UARTO TX M2/GPIO4 A3 J
CAN1 RX M1/GPIO4 B2 J	90 GND1 110 IO-0	RXD0 012	UARTO RX M2/GPIO4 A4 J CAN2 TX/GPIO0 D5 J
CAN1 TX M1/GPIO4 B3 J CAN2 RX/GPIO0 D4 J	130 10-2	GND4 014	I2C1 SDA/UART4 RX/GPI01 D3 J
SPI4 MOSI/UART3 TX/GPI01 C1 J	17 19 3.3V2	10-4 18 10-5 20	I2C1_SCL/UART4_TX/GPI01_D2_J
SPI4 MISO/UART3 RX/GPIO1 C0 J	21 SPI-MOSI	GND5 022	GPIO2 D4 P
SPI4_CLK/GPI01_C2_J	23 SPI-CLK	SPI-CE0 024	SPI4 CS1/GPI01 C4 J PWM1/GPI01 A3 J
	GND2	SPI-CE1	

In the Linux system, the spi4 in the 26pin is closed by default, and it needs to be opened manually to use it.

Add the following red font configuration in /boot/orangepiEnv.txt, and then restart the Linux system to open spi4.

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=spi4-m0-cs1-spidev

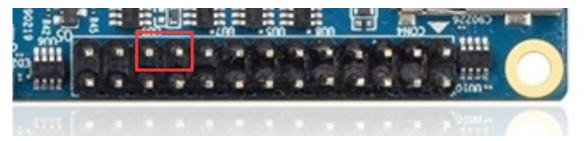
2) First check whether there is a **spidev4.1** device node in the linux system. If it exists, it means that SPI4 has been set up and can be used directly

orangepi@orangepi:~\$ ls /dev/spidev4.1 /dev/spidev4.1

Note that /dev/spidev4.0 cannot be used, please use /dev/spidev4.1, don't make a mistake.

3) Do not short-circuit the mosi and miso pins of SPI4, the output result of running spidev_test is as follows, you can see that the data of TX and RX are inconsistent

4) Then short-circuit the two pins of mosi (the 19th pin in the 26pin interface) and miso (the 21st pin in the 26pin interface) of SPI4, and then run the output of spidev_test as follows, you can see the sending and receiving same data



orangepi@orangepi:~\$ sudo spidev_test -v -D /dev/spidev4.1

spi mode: 0x0

bits per word: 8

max speed: 500000 Hz (500 KHz)

3. 18. 4. 26pin I2C test

1) As can be seen from the table below, the available i2c for Orange Pi 5 is i2c1, i2c3 and i2c5, a total of three sets of i2c buses

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UARTO_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
	and the second second second second second second second second second second second second second second second	CAN1_TX_M1	GPIO4_B3	139	13	14		GND	ALC: ALC: IT		
PWM3_IR_M0 (fd8b0030)	I2C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

As can be seen from the above table, i2c1 can be derived from pins 12 and 15 of the 26pin (i2c1_m2), or from pins 16 and 18 of the 26pin (i2c1_m4), please follow your own needs Just select a group. Please don't think that these are two different sets of i2c buses.

In the linux system, the i2c in the 26pin is turned off by default, and it needs to be turned on manually before it can be used.

Add the following configuration in red font to /boot/orangepiEnv.txt, and then restart the Linux system to open i2c1, i2c3 and i2c5 at the same time. If you only need to open one, then just fill in one.

The settings to select i2c1_m2 are as follows: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=i2c1-m2 i2c3-m0 i2c5-m3

The settings to select i2c1_m4 are as follows: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=i2c1-m4 i2c3-m0 i2c5-m3

2) After starting the linux system, first confirm that there is an i2c device node under /dev

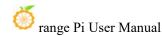
orangepi@	orangepi:~\$ ls	/dev/i2c-*			
/dev/i2c-0	/dev/i2c-10	/dev/i2c-3	/dev/i2c-6	/dev/i2c-9	
/dev/i2c-1	/dev/i2c-2	/dev/i2c-5	/dev/i2c-7		

3) Then connect an i2c device to the i2c pin of the 26pin connector

/		1	1	
	i2c1-m2	i2c1-m4	i2c3-m0	i2c5-m3
sda pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 12	to pin 16	to pin 21	to pin 3
Sck pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 15	to pin 18	to pin 19	to pin 5
3.3v pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 1	to pin 1	to pin 1	to pin 1
5v pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 2	to pin 2	to pin 2	to pin 2
gnd pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 6	to pin 6	to pin 6	to pin 6

Generally, only one 3.3v pin and 5v pin can be connected, please choose to connect 3.3v pin or 5v pin according to the specific i2c device connected.

4) Then use the **i2cdetect -y** command, if the address of the connected i2c device can be



detected, it means that i2c can be used normally

orang	epi@	oran	gepi:	~\$ sı	ıdo i2	2cdet	tect -	•y 1		i2c1's	s con	ıman	d				
orang	epi@	oran	gepi:	~\$ sı	ıdo i2	2cdet	tect -	-y 3	#i	i2c3's	s con	ıman	d				
orang	epi@	oran	gepi:	~\$ sı	ıdo i2	2cdet	tect -	-y 5	#i	i2c5's	s con	ıman	d				
огаг	naer	oi@	orar	naer	oi5:	~\$	suc	lo ⁻	i2co	lete	ect	- V	5				
[suc		1										,					
	0	1	2	3	4	5	6	7	8	9	а	Ь	С	d	е	f	
00:																	
10:		-			-	-					-	-97				-	
20:					0 00 0					-			2 — —			1. 	
30:																	
40:	-				-	-			-		-	-				-	
50:	50								-								
60:					-				68								
70:					-												
orar	nger	pi@	prar	iger	bi5 :	~\$											

3. 18. 5. **26pin UART test**

1) As can be seen from the table below, the available uarts for Orange Pi 5 are uart0, uart1, uart3 and uart4, a total of four sets of uart buses

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

In the Linux system, the uart in the 26pin is closed by default, and it needs to be opened manually before it can be used.

Add the following red font configuration in /boot/orangepiEnv.txt, and then restart the Linux system to open uart0, uart1, uart3 and uart4 at the same time. If you only need to open one, then just fill in one.

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=uart0-m2 uart1-m1 uart3-m0 uart4-m0

2) After entering the linux system, first confirm whether there is a device node corresponding to uart under /dev

```
orangepi@orangepi:~$ ls /dev/ttyS*
/dev/ttyS0 /dev/ttyS1 /dev/ttyS3 /dev/ttyS4 /dev/ttyS9
```

3) Then start to test the uart interface, first use the DuPont line to short the rx and tx of the uart interface to be tested

	uart0	uart1	uart3	uart4
tx pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 8	to pin 5	to pin 19	to pin 18
rx pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 10	to pin 3	to pin 21	to pin 16
		UART	4 UARTO	

4) Use the **gpio serial** command to test the loopback function of the serial port as shown below. If you can see the following print, it means that the serial port communication is normal

a. Test UART0

orange	orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS0									
[sudo] password for orangepi:				#Enter password here						
Out:	0:	->	0							
Out:	1:	->	1							
Out:	2:	->	2							
Out:	3:	->	3							
Out:	4:	->	4							
Out:	5:	->	5^C							
b.	b. Test UART1									
orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS1										
[sudo] password for orangepi: #Enter password here										

[sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1

Dut: $3: -> 3$ Dut: $4: -> 4$ Dut: $5: -> 5^{C}$ c. Test UART3 Drangepi@orangepi:-\$ sudo gpio serial /dev/ttyS3 [sudo] password for orangepi: #Enter password here Dut: $0: -> 0$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $3: -> 3$ Dut: $4: -> 4$ Dut: $5: -> 5^{C}$ d. Test UART4 Drangepi@orangepi:-\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Dut: $0: -> 0$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $3: -> 3$ Dut: $4: -> 4$ Dut: $5: -> 5^{C}$ Dut: $1: -> 1$ Dut: $2: -> 3$ Dut: $4: -> 4$										
Out: $4: -> 4$ Out: $5: -> 5^{\circ}C$ c.Test UART3orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS3[sudo] password for orangepi:#Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $5: -> 5^{\circ}C$ d.Test UART4Orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi:#Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $3: -> 3$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	2:	->	2						
Dut: $5: -> 5^{C}$ c. Test UART3 prangepi@orangepi:~\$ sudo gpio serial /dev/ttyS3 [sudo] password for orangepi: #Enter password here Dut: $0: -> 0$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $3: -> 3$ Dut: $4: -> 4$ Dut: $5: -> 5^{C}$ d. Test UART4 prangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Dut: $0: -> 0$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $1: -> 1$ Dut: $2: -> 2$ Dut: $3: -> 3$ Dut: $4: -> 4$	Out:	3:	->	3						
c. Test UART3 orangepi@orangepi:~ $$$ sudo gpio serial /dev/ttyS3 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4 Out: 5: -> 5^C d. Test UART4 orangepi@orangepi:~ $$$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4	Out:	4:	->	4						
brangepi@orangepi:~ $\$$ sudo gpio serial /dev/ttyS3 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4 Out: 5: -> 5^C d. Test UART4 orangepi@orangepi:~ $\$$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4	Out:	5:	->	5^C						
[sudo] password for orangepi: #Enter password here Out: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$ Out: $5: -> 5^{C}$ d. Test UART4 orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	c.	c. Test UART3								
Out: $0: \rightarrow 0$ Out: $1: \rightarrow 1$ Out: $2: \rightarrow 2$ Out: $3: \rightarrow 3$ Out: $4: \rightarrow 4$ Out: $5: \rightarrow 5^{\circ}C$ d. Test UART4 orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: $0: \rightarrow 0$ Out: $1: \rightarrow 1$ Out: $2: \rightarrow 2$ Out: $3: \rightarrow 3$ Out: $4: \rightarrow 4$	orange	pi@o	orange	epi:~\$ sudo gpio serial /dev/ttyS3						
Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4 Out: 5: -> 5^C d. Test UART4 orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4	[sudo]	pass	word	for orangepi: #Enter password here						
Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4 Out: 5: -> 5^C d. Test UART4 orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4										
Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4 Out: 5: -> 5° C d. Test UART4 orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4 [sudo] password for orangepi: #Enter password here Out: 0: -> 0 Out: 1: -> 1 Out: 2: -> 2 Out: 3: -> 3 Out: 4: -> 4	Out:	0:	->	0						
Out: $3: -> 3$ Out: $4: -> 4$ Out: $5: -> 5^{C}$ d. Test UART4orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi:#Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	1:	->	1						
Out:4:->4Out:5:-> $5^{\circ}C$ d.Test UART4orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi:#Enter password hereOut:0:->0Out:1:->1Out:2:->2Out:3:->3Out:4:->4	Out:	2:	->	2						
Out: $5: -> 5^{C}$ d. Test UART4orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi:#Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	3:	->	3						
d. Test UART4orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi: #Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	4:	->	4						
orangepi@orangepi:~\$ sudo gpio serial /dev/ttyS4[sudo] password for orangepi: #Enter password hereOut: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	5:	->	5^C						
[sudo] password for orangepi: #Enter password here Out: $0: \rightarrow 0$ Out: $1: \rightarrow 1$ Out: $2: \rightarrow 2$ Out: $3: \rightarrow 3$ Out: $4: \rightarrow 4$	d.	Te	st UA	RT4						
Out: $0: -> 0$ Out: $1: -> 1$ Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	orange	pi@o	orange	epi:~\$ sudo gpio serial /dev/ttyS4						
Dut: 1: -> 1 Dut: 2: -> 2 Dut: 3: -> 3 Dut: 4: -> 4	[sudo]	pass	word	for orangepi: #Enter password here						
Dut: 1: -> 1 Dut: 2: -> 2 Dut: 3: -> 3 Dut: 4: -> 4										
Out: $2: -> 2$ Out: $3: -> 3$ Out: $4: -> 4$	Out:	0:	->	0						
Out: $3: -> 3$ Out: $4: -> 4$	Out:	1:	->	1						
Out: 4: -> 4	Out:	2:	->	2						
	Out:	3:	->	3						
Out: 5: -> 5^C	Out:	4:	->	4						
	Out:	5:	->	5^C						

3. 18. 6. How to test PWM using /sys/class/pwm

1) As can be seen from the table below, the available pwm for Orange Pi 5 includes pwm0, pwm1, pwm3, pwm13, pwm14 and pwm15, a total of six pwm

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	I2C5 SCL M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
	Same	CAN1_TX_M1	GPIO4_B3	139	13	14		GND		and the second second second second second second second second second second second second second second second	
PWM3_IR_M0 (fd8b0030)	I2C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND	DOUGH A STOCK		
12C3_SDA_M0	UART3 RX M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4 CS1 M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

As can be seen from the table above:

pwm1 can be derived from pin 16 of 26pin (pwm1_m1), or from pin 26 of 26pin (pwm1_m2)

pwm3 can be derived from pin 15 of 26pin (pwm3_m0), or from pin 23 of 26pin (pwm3_m2)

Please select the corresponding pin according to your needs. Please don't think that these are two different pwm buses.

In the linux system, the pwm in the 26pin is closed by default, and it needs to be opened manually to use it.

Add the following red font configuration in /boot/orangepiEnv.txt, and then restart the Linux system to open pwm0, pwm13, pwm14 and pwm15 at the same time. If you only need to open one, then fill in one.

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=pwm0-m1 pwm13-m2 pwm14-m1 pwm15-m2

Select the settings of pwm1_m1 as follows, please do not open pwm1-m1 and pwm1-m2 at the same time:

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=pwm1-m1

The settings to select pwm1_m2 are as follows: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=pwm1-m2

Select the settings of pwm3_m0 as follows, please do not open pwm3-m0 and pwm3-m2 at the same time: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=pwm3-m0

The settings to select pwm3_m2 are as follows: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=pwm3-m2

2) When a pwm is turned on, there will be an extra pwmchipX in /sys/class/pwm/ (X is a

specific number), for example, after turning on pwm15, check the pwmchipX under /sys/class/pwm/ two became three

orangepi@orangepi:~\$ ls /sys/class/pwm/ pwmchip0 pwmchip1 pwmchip2

3) Which pwmchip above corresponds to pwm15? Let's check the output of the **ls** /sys/class/pwm/-l command first, as shown below:

<pre>orangepi@orangepi5:~\$ ls /sys/class/pw</pre>	wm/ -l
total 0	
lrwxrwxrwx 1 root root 0 Dec 2 10:20	<pre>pwmchip0 ->//devices/platform/fd8b0020.pwm/pwmchip0</pre>
lrwxrwxrwx 1 root root 0 Dec 2 10:20	<pre>pwmchip1 ->//devices/platform/febd0020.pwm/pwmchip1</pre>
lrwxrwxrwx 1 root root 0 Dec 2 10:20	<pre>pwmchip2 ->//devices/platform/febf0030.pwm/pwm/pwmchip2</pre>
orangeni@orangeni5:~\$	

4) Then it can be known from the table below that the base address of the pwm15 register is febf0030, and then look at the output of the **Is /sys/class/pwm/ -l** command, you can see that pwmchip2 is linked to febf0030.pwm, so pwm15 corresponds to pwmchip as pwmchip2

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
	100 C C C C C C C C C C C C C C C C C C		3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
	1111 1111 1111 1111 1111 1111 1111 1111 1111	PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1 A3	PWM1 M2 (fd8b0010)		

5) Then use the following command to make pwm15 output a 50Hz square wave (please switch to the root user first, and then execute the following command)

root@orangepi:~# echo 0 > /sys/class/pwm/pwmchip2/export
root@orangepi:~# echo 20000000 > /sys/class/pwm/pwmchip2/pwm0/period
root@orangepi:~# echo 1000000 > /sys/class/pwm/pwmchip2/pwm0/duty_cycle
root@orangepi:~# echo 1 > /sys/class/pwm/pwmchip2/pwm0/enable



6) The test method of pwm15 demonstrated above is similar to other pwm test methods.

3. 18. 7. CAN test method

Please note that Linux 6.1 systems currently do not support CAN function.

3. 18. 7. 1. How to open CAN

1) As can be seen from the table below, the available CAN bus for Orange Pi 5 is CAN1 and CAN2, two sets of CAN bus

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
	TO BE FOR THE STREET	PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UARTO_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
	and the second states and the	CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

In the Linux system, the CAN in the 26pin is closed by default, and it needs to be opened manually to use it.

Add the following configuration in red font to /boot/orangepiEnv.txt, and then restart the Linux system to open CAN1 and CAN2 at the same time. If you only

need to open one, then just fill in one.

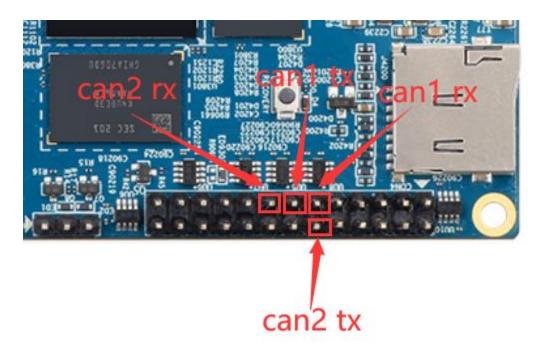
orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=can1-m1 can2-m1

2) After entering the linux system, use the **sudo ifconfig -a** command, if you can see the CAN device, it means that the CAN has been opened correctly

orangepi@orangepi:~\$ sudo ifconfig -a
can0: flags=128 <noarp> mtu 16</noarp>
unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
device interrupt 91
can1: flags=128 <noarp> mtu 16</noarp>
unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-
RX packets 0 bytes 0 (0.0 B)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 0 bytes 0 (0.0 B)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
device interrupt 92
unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-

3) The corresponding pins of CAN1 and CAN2 are

	CAN1	CAN2
TX pin	Corresponding to	Corresponding
	pin 13	to pin 12
RX pin	Corresponding to	Corresponding
	pin 11	to pin 15



3. 18. 7. 2. Use the CANalyst-II analyzer to test sending and receiving messages

1) The CANalyst-II analyzer used in the test is shown in the figure below



2) CANalyst-II analyzer data download link https://www.zhcxgd.com/3.html

3) First install the software USBCANToolSetup



4) The shortcut after installation of USBCANToolSetup is



5) In addition, you need to install the USB driver



6) The end of the USB interface of the CANalyst-II analyzer needs to be connected to the USB interface of the computer



7) To test the CAN function, you need to prepare a CAN transceiver as shown in the figure below. The main function of the CAN transceiver is to convert the TTL signal of the CAN controller into the differential signal of the CAN bus

- a. The 3.3V pin of the CAN transceiver needs to be connected to the 3.3V pin in the 26pin of the development board
- b. The GND pin of the CAN transceiver needs to be connected to the GND pin in the 26pin of the development board
- c. The CAN TX pin of the CAN transceiver needs to be connected to the TX pin of

the CAN bus in the development board 26pin

- d. The CAN RX pin of the CAN transceiver needs to be connected to the RX pin of the CAN bus in the development board 26pin
- e. The CANH pin of the e.CAN transceiver needs to be connected to the H interface of the analyzer
- f. The CANL pin of the CAN transceiver needs to be connected to the L interface of the analyzer



8) Then you can open the USB-CAN software

[188] USB-CAN Tool V9.02 - 會	芯科技		– 🗆 ×
设备型号(D) 设备操作(O)	参数设定(S) 信息(L) 显示(V) 帮助(H)	语言(L)	
CAN发送 帧格式:标准帧 🔽 帧类型	: 数据帧 🔽 帧ID: 00 00 00 01 c	CAR通道: 1 🗸 发送总帧数:	1 □ ID递增
数据: 00 00 00 00 00 00 00 0	0 00 发送消息	发送周期:	10 ms 🗌 数据递增
CAN中继状态	接收滤波ID设置(直接ID号) 〇 使能	保存总帧数: 0	停止发送 发送文件
Unused	● 关闭 01 02 设置	☑打开CAN接收	清 空 🗌 实时存储
统计数据:通道1		统计数据:通道2	
帧率R: 0 帧率	T: 0 校验错误: 0	帧率R: 0 帧率T: 0	校验错误: 0
序号 系统时间 时间	同标识 CAN通道 传输方向 ID号	帧类型 帧格式 长度 数据	^

9) Then click to start the device

🍏 _{ran}	nge Pi User Manual	Copyrigh	t reserved by Shenzhen X	unlong Sof	tware Co., Lt
🛗 USB-CAI	N Tool V9.02 -				
设备型号(D)	设备操作(C) 参数设定(S)	信息(I) 显示(V) 帮助(H)	语言(L)		
CAN发送 帧格式:标》	启动设备(<u>S</u>) 关闭设备(<u>T</u>)	申点ID: 00 00 00 01	CAN通道: 1 发送总帧数	: 1	□Ⅲ递增
数据: 00	寄存器信息(R)	消息	发送周期	: 10 ms	□数据递增
		2置(直接ID号)	保存总帧数: 0	停止发送	发送文件
U	USBCAN测试工具(T)	01 02 设置	☑打开CAN接收	清空	□实时存储
统计数据:	通道1		统计数据:通道2		
帧室R: C) 帧率T: 0	校验错误: 0	帧率R: 0 帧率T: 0	校验错误	£: 0
养 号 系	统时间 时间标识	CAN通道 传输方向 ID号	帧类型 帧格式 长度 数据		^

10) Then click OK

棄 打开USB设备	×
	~
↓ 设备名称: 设备索引号0:序列号: 01701020B87, 固件版本号: V3.24	~
收置名称: 设置系引亏0.序列亏: 01/01020b07, 回件版本亏: V3.24	\sim
确定 取消	

11) Set the baud rate to 1000k bps

设备索引号	0 🗸	选择CAN通道号:通道1 「 「 打开所有通」
CAN参数		
波特率:	1000k bps 💊	BTR0/1: 00 14 (HEX)
过滹验收码:	0x80000000	滤波方式: 接收所有类型
过滤屏蔽码:	OxFFFFFFFF	滤波器配置工具

12) After successful opening, the USB-CAN software will display the serial number and other information

🥯 range Pi User Manual

备型号 CAN发		0) 参数设定(5) 信息(1)	显示区	帮助(<u>H</u>) 语	言(L)						
城格式:	标准帧 🖌 🗸	帧类型: 数据帧	~	D: 00 00 00) 01 CAN	通道: 1	~	发	送总帧数:	1	□ID递增	
数据:	00 00 00 00 0	0 00 00 00	发送消息]					发送周期:	10 ms	□数据递	增
CAN 45		接收滤源 □ ○ 使能	tID设置(直	赛ID号)		保存的	急帧数: 0			停止发送	发送文件	
	Unused	 ●关闭	01 02		设置		打开CAN搭	ン		清空		储
统计数 - 帧率:	效据:通道1 R: 0	帧率T: 0	校验	错误: 0		统计数捷 帧率R:		响蒸	<u>.</u>	校验错	吴: 0	
号	系统时间	时间标识	CAN通道	传输方向	ID号	帧类型	帧格式	长度	数据			

- 13) Development board receives CAN message test
 - a. First set the baud rate of the CAN bus to **1000kbps** in the Linux system of the development board

orangepi@orangepi:~\$ sudo ip link set can0 down

orangepi@orangepi:~\$ sudo ip link set can0 type can bitrate 1000000

orangepi@orangepi:~\$ sudo ip link set can0 up

b. Then run the candump can0 command to prepare to receive messages

rangepi@oran	gepi:~\$ sudo candump c	an0	
c. Then s	end a message to the deve	elopment board in the U	SB-CAN software
USB-CAN Tool V9.0)2 - CANalyst-II - SN:序列号: 01701020B	87, 固件版本号: V3.24 - 创芯科技	- 🗆 ×
设备型号(D) 设备操作(2) 参数设定(S) 信息(I) 显示(V) 帮助	(出) 语言(L)	
帧格式:标准帧	帧类型: 数据帧 帧ID: 00 00 00 01 5 06 07 08 发送消息	CAN通道: 1 V 发送总帧 发送用	
CAN中维状态	接收滤波ID设置(直接ID号)	保存总帧数: 0	停止发送 发送文件
Unused	● 关闭 01 02	设置 ☑打开CAN接收	清空 □ 实时存储
统计数据:通道1		统计数据:通道2	
帧率R: 0	帧率T : 0 校验错误: 0	帧率R: 0	校验错误: 0

d. If the message sent by the analyzer can be received in the development board, it means that the CAN bus can be used normally

orangepi@	orangep	oi5:~\$	sudo candump can0	
can0	001	[8]	01 02 03 04 05 06 07 08	

14) Development board sends CAN message test

a. First set the CAN baud rate to 1000kbps in the Linux system

orangepi@orangepi:~\$ sudo ip link set can0 down

orangepi@orangepi:~\$ sudo ip link set can0 type can bitrate 1000000

orangepi@orangepi:~\$ sudo ip link set can0 up

b. Execute the **cansend** command on the development board and send a message

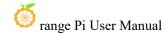
orangepi@orangepi:~\$ sudo cansend can0 123#1122334455667788

c. If the USB-CAN software can receive the message from the development board, the communication is successful

CAN发 帧格式: 数据:	送	频型:数据帧			语言(L) AX通道: 1 🔍	发送总帧数 发送周 <u>期</u>		□ID递增 □数据递增
CAN中组	瞅态 Unused	接收滤测 ○ 使能 ● 关闭	友ID设置(直 : 01 02	接ID号) 设置	保存总帧数:		停止发送 清 空	发送文件 □实时存储
统计数 帧率B	据:通道1 :: 0	帧 率 T: 0	校验	错误: 0	统计数据:通道2 帧率R: 0		校验错误	吴: 0
京号 ● 00000	系統时间 19:27:04.048	时间标识 OxE3BC2F	CAM通道 ch1	传输方向 ID号 接收 0x0123	•帧类型 •帧格式 数据帧 标准帧		22 33 44 55 66	77 88
		F	leceive	the informati	on sent by t	he develoj	pment bo	ard

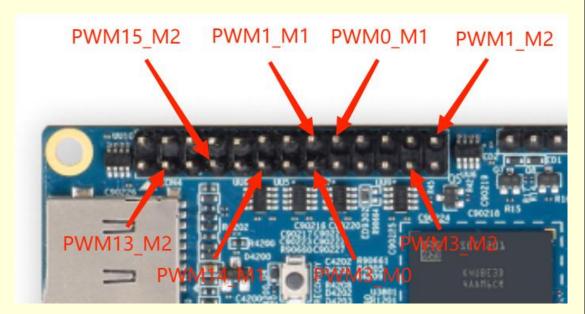
3. 19. WiringOP Hardware PWM Usage Method

Before using wiringOP to operate PWM, please ensure that wiringOP is installed on the Linux system. If the gpio readall command can be used normally, it means wiringOP has been installed. If prompted that the command cannot be found, please refer to the instructions in the section on installing wiringOP to install



wiringOP first.

The development board can use six pwm channels: pwm0, pwm1, pwm3, pwm13, pwm14 and pwm15. The positions of these pins are shown in the figure below:



It should be noted that: PWM1_M1 and PWM1_M2, PWM3_M0 and PWM3_M2

They are all the same PWM, just connected to different pins. If both pin are configured for PWM function, when setting one PWM pin, the same sett ing will also be applied to the other PWM pin.

3. 19. 1. Method of setting PWM using the gpio command of wiringOP

3. 19. 1. 1. Set the corresponding pin to PWM mode

1) As shown in the table below, there are six pwm channels available on the development board: pwm0, pwm1, pwm13, pwm14, and pwm15.

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能	
			3.3V		1	2		5V				
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V				
-	UART1_TX_M1	12C5 SCL M3	GPIO1_B6	46	5	6		GND				
1		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)			
			GND		9	10	132	GPIO4_A4	UART0_RX_M2			
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2		
	Same	CAN1_TX_M1	GPIO4_B3	139	13	14		GND		an energy of the second		
PWM3_IR_M0 (fd8b0030)	I2C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0	0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0	(000
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20	_	GND	DOUGH A STOCK			
12C3_SDA_M0	UART3 RX M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4				
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4 CS1 M0			
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)			

PWM Pin	wPi Serial	Pin Serial	GPIO Serial	
	number	number	number	
PWM0_M1	10	18	58	
PWM1_M1	9	16	59	
PWM1_M2	16	26	35	
PWM3_M0	8	15	28	
PWM3_M2	14	23	50	
PWM13_M2	0	3	47	
PWM14_M1	5	11	138	
PWM15_M2	2	7	54	

2)	The wPi numbers corre	sponding to the	PWM nins are	e as follows.
<i>–</i> ,		sponding to the	1 Will philo un	

3) The command to set the pin to PWM mode is as follows. Taking PWM0_S1 as an example, the third parameter requires inputting the sequence number of wPi corresponding to the PWM0_S1 pin.

orangepi@orangepi:~\$ gpio mode 10 pwm

4) After setting the pin to PWM mode, a square wave with a frequency of 200Hz, a period of 5ms, and a duty cycle of 50% will be output by default. At this time, we can use an oscilloscope to measure the corresponding PWM pin and see the waveform below.

		Tria'd	M Pos: 0.000s	CH1
		•		耦合直流
]			带宽限制 开启 关闭 200MHz
				伏/格 粗调
2				探头 1X 电压
 2 最大值 2 平均值 2 频率 	3.40V 1.69V 200.0Hz	· · · · · · · · · · · · · · · · · · ·	0.00V 50.0% 5.000ms	反相 开启 关闭
	2 1.00V	M 2.50ms	CH2 / 1.71V	200.004Hz

3. 19. 1. 2. Methods for Adjusting PWM Frequency

The calculation formula for PWM frequency is as follows:

PWM frequency = clock frequency / (division factor * The value of the periodic register)

IN:

1. The default value for clock frequency is 2400000Hz.

2. The range of values for the frequency division coefficient is even numbers between $2 \sim 512$, with a default value of 120. If the set frequency division coefficient is odd, the actual frequency division coefficient is the set value minus one.

3. The default value of the cycle register is 1000.

4. The default value for PWM frequency is 24000000 / (120 * 1000) = 200Hz.

3. 19. 1. 2. 1. Method of Adjusting PWM Frequency by Setting Frequency Division Coefficient

We can use the following command to set the division factor of the PWM0_M1 pin to
 4.

orangepi@orangepi:~\$ gpio pwmc 10 4

2) According to the formula above, the calculated value of PWM frequency is 6000Hz. Through an oscilloscope, it can be observed that the measured PWM frequency is 6010Hz, and the error can be ignored.



3. 19. 1. 2. 2. Method of directly setting PWM frequency

1) We can use the **gpio pwmTone** command to set the frequency of the PWM pin, for example, the following command can be used to set the PWM frequency of the PWM0 M1 pin to 500Hz.

orangepi@orangepi:~\$ gpio pwmTone 10 500

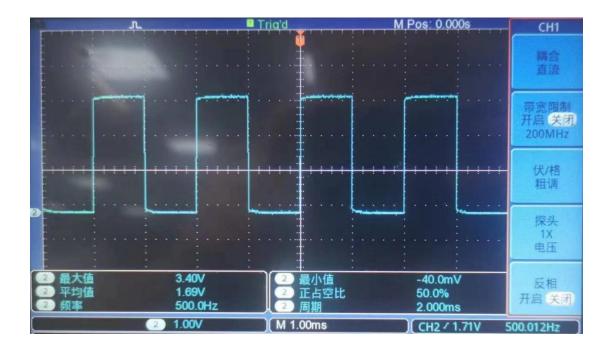
When setting the PWM frequency, it is necessary to ensure that:

Set frequency value < 24000000 / (division factor * 2).

For example, the default division factor is 120, and without modifying the division factor, the set frequency value should be less than 100000Hz.

If the setting value is too large, the following error message will appear: gpio: The PWM frequency you set is too high to be possible

2) Then, through an oscilloscope, it can be observed that the PWM frequency has changed to 500Hz.



3. 19. 1. 3. Methods for Adjusting PWM Duty Cycle

1) The calculation formula for PWM duty cycle is as follows. We can adjust the PWM duty cycle by setting the values of the duty cycle register and the period register.

PWM Duty cycle = The value of the duty cycle register / The value of the periodic register

IN:

The default value of the duty cycle register is 500. The default value of the cycle register is 1000.

It should be noted that the value of the duty cycle register needs to be smaller than the value of the cycle register, as the duty cycle cannot be greater than 1.

When the value of the duty cycle register is set to be greater than the value of the cycle register, the following error message will be prompted:

gpio: CCR should be less than or equal to ARR (XXX)

When the value of the cycle register is set to be less than the value of the duty cycle register, the following error message will be prompted:

gpio: ARR should be greater than or equal to CRR (XXX)

2) We can use the following command to set the value of the period register for the PWM0 M1 pin to 2000.

orangepi@orangepi:~\$ gpio pwmr 10 2000

3) After running the above command, it can be observed through the oscilloscope that the PWM duty cycle has changed from the default 50% (500/1000) to 25% (500/2000).



4) We can use the following command to set the duty cycle register value of the PWM0 M1 pin to 1000.

orangepi@orangepi:~\$ gpio pwm 10 1000

5) After running the above command, it can be observed through the oscilloscope that the PWM duty cycle changes from 25% (500/2000) to 50% (1000/2000).



3. 19. 2. Usage of PWM Test Program

1) In the example directory of wiringOP, there is a program called pwm.c that demonstrates the use of PWM related API in wiringOP to operate PWM.

orangepi@orangepi:~\$ cd /usr/src/wiringOP/examples/

orangepi@orangepi:/usr/src/wiringOP/examples\$ ls pwm.c

pwm.c

2) The command to compile **pwm.c** into an executable program is as follows: orangepi@orangepi:/usr/src/wiringOP/examples\$ **gcc -o pwm pwm.c -lwiringPi**

3) Then you can execute the PWM test program. When executing the PWM test program, you need to specify the PWM pin. For example, you can use the following command to test the PWM0_M1 pin:

orangepi@orangepi:/usr/src/wiringOP/examples\$ sudo ./pwm 10

4) After the pwm program is executed, the following contents will be tested sequentially:

- a. Adjust the PWM duty cycle by setting the value of the cycle register.
- b. Adjust the PWM duty cycle by setting the value of the duty cycle register.
- c. Adjust the PWM frequency by setting the division factor.
- d. Directly set the PWM frequency.

5) After completing each test, the output of pwm waveform will be stopped for 5 seconds. After completing all test contents, a new round of testing will be restarted.

- 6) The detailed execution process of the PWM test program is as follows:
 - a. By setting the value of the cycle register to adjust the PWM duty cycle: Through an oscilloscope, it can be observed that the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 50% to 25% and remains for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 25% to 50% and remains for 5 seconds.
 - b. By setting the value of the duty cycle register to adjust the PWM duty cycle: The oscilloscope can observe that the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 50% to 100% and remains for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 8 changes, the PWM duty cycle changes from 100% to 50% and remains for 5 seconds.
 - c. By setting the frequency division coefficient to adjust the PWM frequency: Through an oscilloscope, it can be observed that the PWM waveform changes every 0.5 seconds. After 9 changes, the PWM frequency will change from 2000Hz to 200Hz and remain for 5 seconds. Then, the PWM waveform changes every 0.5 seconds. After 9 changes, the PWM frequency will change again to 2000Hz and remain for 5 seconds.
 - d. Directly setting the PWM frequency: Through the oscilloscope, it can be observed that the PWM frequency first changes to 2000Hz, and then increases by 2000Hz every two seconds. After 9 changes, the PWM frequency changes to 20000Hz and remains for 5 seconds.

3. 20. How to install and use wiringOP-Python

wiringOP-Python is the Python language version of wiringOP, which is used to operate the hardware resources of the development board, such as GPIO, I2C, SPI and UART, in the Python program.

In addition, please note that all the following commands are operated under the

root user.

3. 20. 1. How to install wiringOP-Python

1) First install the dependency package

root@orangepi:~# sudo apt-get update

root@orangepi:~# sudo apt-get -y install git swig python3-dev python3-setuptools

2) Then use the following command to download the source code of wiringOP-Python

Note that the following git clone --recursive command will automatically download the source code of wiringOP, because wiringOP-Python depends on wiringOP. Please make sure that the download process does not report errors due to network problems.

If there is a problem downloading the code from GitHub, you can directly use the wiringOP-Python source code that comes with the Linux image. The storage location is: /usr/src/wiringOP-Python.

root@orangepi:~# git clone --recursive https://github.com/orangepi-xunlong/wiringOP-Python -b next

root@orangepi:~# cd wiringOP-Python

root@orangepi:~/wiringOP-Python# git submodule update --init --remote

3) Then use the following command to compile wiringOP-Python and install it into the Linux system of the development board

root@orangepi:~# cd wiringOP-Python

root@orangepi:~/wiringOP-Python# python3 generate-bindings.py > bindings.i root@orangepi:~/wiringOP-Python# sudo python3 setup.py install

4) Then enter the following command, if there is help information output, it means that wiring OP-Python is installed successfully, press the \mathbf{q} key to exit the help information interface

root@orangepi:~/wiringOP-Python# **python3 -c "import wiringpi; help(wiringpi)"** Help on module wiringpi:

NAME

wiringpi

DESCRIPTION

This file was automatically generated by SWIG (http://www.swig.org).

Version 4.0.2

#

Do not make changes to this file unless you know what you are doing--modify# the SWIG interface file instead.

5) The steps to test whether wiringOP-Python is successfully installed under the python command line are as follows:

a. First use the python3 command to enter the command line mode of python3

root@orangepi:~# python3

b. Then import the python module of wiringpi

>>> import wiringpi;

c. Finally, enter the following command to view the help information of wiringOP-Python, and press the **q** key to exit the help information interface

>>> help(wiringpi)

Help on module wiringpi:

NAME

wiringpi

DESCRIPTION

This file was automatically generated by SWIG (http://www.swig.org).

Version 4.0.2

#

Do not make changes to this file unless you know what you are doing--modify # the SWIG interface file instead.

CLASSES

builtins.object GPIO I2C Serial nes

class GPIO(builtins.object)

GPIO(pinmode=0)

```
>>>
```

3. 20. 2. 26pin GPIO port test

wiringOP-Python is the same as wiringOP, you can also determine which GPIO pin to operate by specifying the wPi number, because there is no command to check the wPi number in wiringOP-Python, so you can only use the gpio command in wiringOP to check the correspondence between the board wPi number and the physical pin.

гс +		++	р:~# gpio ге		+		I5B	-1	+	+	+	+	++
	GPIO	wPi	Name	Mode	V	i Pny:	SIC	al	V	Mode	Name	WPL	GPIO
i			3.3V			1	:	2		+ 	5V		
Í	47	0	SDA.5	IN	1	3	4	4			5V		i i
	46	1	SCL.5	IN	1	5	11 (6			GND		i i
	54	2	PWM15	IN	1	7	8	В	0	IN	RXD.0	3	131
			GND		1	9	:	10	0	IN	TXD.0	4	132
	138	5	CAN1_RX	IN	1	11	:	12	1	IN	CAN2_TX	6	29
	139	7	CAN1_TX	IN	1	13	:	14			GND		
	28	8	CAN2_RX	IN	1	15	:	16	1	IN	SDA.1	9	59
			3.3V			17	:	18	1	IN	SCL.1	10	58
	49	11	SPI4_TXD	IN	1	19	2	20			GND		
	48	12	SPI4_RXD	IN	1	21	:	22			PowerKey		
	50	13	SPI4_CLK	IN	1	23		24	1	IN	SPI4_CS1	14	52
			GND			25		26	1	IN	PWM1	15	35
+		++	+		+	+	++-			+	+		++
	GPIO	wPi	Name	Mode		Phy		al	V	Mode	Name	wPi	GPIO
+		++	+		+	+ Р.	I5B		F	+	+	+	++
ГC	ot@orar	ngepi5t	D:~#										

1) A total of **16** GPIO ports can be used in the 26pins of the development board. The following uses pin 7—the corresponding GPIO is GPIO1_C6—the corresponding wPi serial number is 2—as an example to demonstrate how to set the high and low levels of the GPIO port

GPIO	ļ	wPi	Name	Mode	1	۷	I	Phy	/si	cal	ļ	۷	ļ	Mode	Name	ļ	wPi	GPI	0
	1	+-	3.3V		i		i.	1	11	2	i		+-		1 5V	1		+ 	7.7
47	Ĩ.	Θİ	SDA.5	IN	i	1	1	3	ii	4	İ		j.		5V	1		Î.	
46	İ.	<u>1</u>	SCL.5	IN	i	1	İ	5	j i	6	İ.		İ.		GND	Ť		İ.	
54		2	PWM15	IN	T	1	1	7	II	8	1	0	İ.	IN	RXD.0	- İ	3	131	
-	Ť		GND	560 A.	Ť	-	Ť	9	11	10	1	Θ	İ.	IN	TXD.0	1	4	132	

- 2) The steps to test directly with the command are as follows:
 - a. First set the GPIO port to the output mode, where the first parameter of the

pinMode function is the serial number of the wPi corresponding to the pin, and the second parameter is the GPIO mode

root@orangepi:~/wiringOP-Python# **python3 -c "import wiringpi;** \ from wiringpi import GPIO; wiringpi.wiringPiSetup(); \ wiringpi.pinMode(2, GPIO.OUTPUT); "

b. Then set the GPIO port to output low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi; \

from wiringpi import GPIO; wiringpi.wiringPiSetup();\

wiringpi.digitalWrite(<mark>2, GPIO.LOW</mark>)"

c. Then set the GPIO port to output a high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the high level is set successfully.

root@orangepi:~/wiringOP-Python# python3 -c "import wiringpi; \

from wiringpi import GPIO; wiringpi.wiringPiSetup() ;\

wiringpi.digitalWrite(2, GPIO.HIGH)"

- 3) The steps to test in the command line of python3 are as follows:
 - a. First use the python3 command to enter the command line mode of python3

root@orangepi:~# python3

b. Then import the python module of wiringpi

>>> import wiringpi

>>> from wiringpi import GPIO

c. Then set the GPIO port to output mode, where the first parameter of the **pinMode** function is the serial number of the wPi corresponding to the pin, and the second parameter is the GPIO mode

>>> wiringpi.wiringPiSetup()

```
0
```

>>> wiringpi.pinMode(2, GPIO.OUTPUT)

d. Then set the GPIO port to output a low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is 0v, it means that the low level is set successfully.

>>> wiringpi.digitalWrite(2, <mark>GPIO.LOW</mark>)

e. Then set the GPIO port to output a high level. After setting, you can use a

📁 range Pi User Manual

multimeter to measure the voltage value of the pin. If it is 3.3v, it means that the high level is set successfully.

>>> wiringpi.digitalWrite(2, GPIO.HIGH)

4) The method of wiringOP-Python to set GPIO high and low levels in python code can refer to the **blink.py** test program in the examples below. The **blink.py** test program will set the voltage of all GPIO ports in the 26 pins of the development board to change continuously.

root@orangepi:~/wiringOP-Python# cd examples

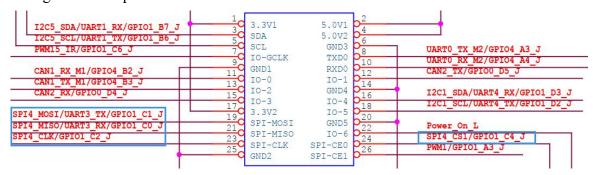
root@orangepi:~/wiringOP-Python/examples# ls blink.py

blink.py

root@orangepi:~/wiringOP-Python/examples# python3 blink.py

3. 20. 3. **26pin SPI test**

1) According to the schematic diagram of the 26pin interface, the spi available for Orange Pi 5B is spi4



In the Linux system, the spi4 in the 26pin is closed by default, and it needs to be opened manually to use it.

Add the following red font configuration in /boot/orangepiEnv.txt, and then restart the Linux system to open spi4.

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=spi4-m0-cs1-spidev

2) First check whether there is a **spidev4.1** device node in the linux system. If it exists, it means that SPI4 has been set up and can be used directly

orangepi@orangepi:~\$ ls /dev/spidev4.1

/dev/spidev4.1

Note that /dev/spidev4.0 cannot be used, please use /dev/spidev4.1, don't make a mistake.

3) Then you can use the **spidev_test.py** program in the examples to test the loopback function of the SPI. The **spidev_test.py** program needs to specify the following two parameters:

- a. --channel: Specifies the channel number of the SPI
- b. --port: Specify the port number of the SPI

4) Do not short-circuit the mosi and miso pins of SPI4, the output result of running spidev_test.py is as follows, you can see that the data of TX and RX are inconsistent

root@orangepi:~/wiringOP-Python# cd examples

```
root@orangepi:~/wiringOP-Python/examples# python3 spidev test.py \
```

```
--channel 4 --port 1
```

spi mode: 0x0

max speed: 500000 Hz (500 KHz)

Opening device /dev/spidev4.1

5) Then use the Dupont wire to short-circuit the two pins of txd (pin 19 in the 26pin interface) and rxd (pin 21 in the 26pin interface) of SPI4 and then run spidev_test.py The output is as follows, you can see The data sent and received are the same, indicating that the SPI4 loopback test is normal

 FF FF FF FF FF F0 0D |.....@......|

3. 20. 4. **26pin I2C test**

1) As can be seen from the table below, the available i2c for Orange Pi 5B is i2c1, i2c3 and i2c5, a total of three sets of i2c buses

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UARTO_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	12C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	12C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22		PowerKey			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1 A3	PWM1 M2 (fd8b0010)		

As can be seen from the above table, i2c1 can be derived from pins 12 and 15 of 26pin (i2c1_m2), and can also be derived from pins 16 and 18 of 26pin (i2c1_m4), please follow your own needs Just select a group. Please don't think that these are two different sets of i2c buses.

In the linux system, the i2c in the 26pin is turned off by default, and it needs to be turned on manually before it can be used.

Add the following configuration in red font to /boot/orangepiEnv.txt, and then restart the Linux system to open i2c1, i2c3 and i2c5 at the same time. If you only need to open one, then just fill in one.

Select the settings for i2c1_m2 as shown below: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=i2c1-m2 i2c3-m0 i2c5-m3

Select the settings for i2c1_m4 as shown below: orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=i2c1-m4 i2c3-m0 i2c5-m3

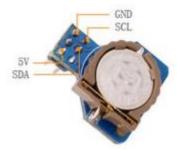
2) After starting the linux system, first confirm that there is an i2c device node under /dev

orangepi@orangepi:~\$ ls /dev/i2c-*

<i>interview</i> (1997) (19977) (19977) (19977) (1997) (19977) (19977) (19977) (1997	Pi User Manual	Copyright reserved by Shenzhen Xunlong Software Co., Ltd						
(1 /:2 0	/1 /:2 10		/1 /:2 ((1, 1'2, 2)				
/dev/12c-0	/dev/i2c-10	/dev/12c-3	/dev/12c-6	/dev/12c-9				
/dev/i2c-1	/dev/i2c-2	/dev/i2c-5	/dev/i2c-7					

3) Then connect an i2c device to the i2c pin of the 26pin connector, here we take the ds1307 RTC module as an example

	i2c1-m2	i2c1-m4	i2c3-m0	i2c5-m3
Sda pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 12	to pin 16	to pin 21	to pin 3
Sck pin	Corresponding Corresponding		Corresponding	Corresponding
	to pin 15	to pin 18	to pin 19	to pin 5
Vcc pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 1	to pin 1	to pin 1	to pin 1
Gnd pin	Corresponding	Corresponding	Corresponding	Corresponding
	to pin 6	to pin 6	to pin 6	to pin 6



4) Then use the **i2cdetect -y** command, if the address of the connected i2c device can be detected, it means that i2c can be used normally

orangepi@orangepi:~\$ sudo i2cdetect -y 1	#i2c1 command
orangepi@orangepi:~\$ sudo i2cdetect -y 3	#i2c3command
orangepi@orangepi:~\$ sudo i2cdetect -y 5	#i2c5command

	0	1	2	3	4	5	6	7	8	9	а	b	С	d	е	f	
90:																	
L0:																	
20:																	
30:																	
10:																	
50:	50				(,)												
50:	-				-				68								
70:					-												

5) Then you can run the ds1307.py test program in the examples to read the RTC time

root@orangepi:~/wiringOP-Python# cd examples root@orangepi:~/wiringOP-Python/examples# python3 ds1307.py --device \ "/dev/i2c-5" Thu 2023-01-05 14:57:55 Thu 2023-01-05 14:57:56 Thu 2023-01-05 14:57:57 ^C exit

3. 20. 5. 26pin UART test

1) As can be seen from the table below, the available uarts for Orange Pi 5B are four groups of uart buses: uart0, uart1, uart3 and uart4

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复月	目功能
			3.3V		1	2		5V				
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V				
	UART1 TX M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND				
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)			
			GND		9	10	132	GPIO4_A4	UART0_RX_M2			
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2		
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND				
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1	(fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1	(fd8b0000)
I2C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND				
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22		PowerKey				
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0			
			GND		25	26	35	GPIO1 A3	PWM1 M2 (fd8b0010)			

In the Linux system, the uart in the 26pin is closed by default, and it needs to be opened manually before it can be used.

Add the following red font configuration in /boot/orangepiEnv.txt, and then restart the Linux system to open uart0, uart1, uart3 and uart4 at the same time. If you only need to open one, then fill in one. orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=uart0-m2 uart1-m1 uart3-m0 uart4-m0

2) After entering the linux system, first confirm whether there is a device node corresponding to uart under /dev

orangepi@orangepi:~\$ ls /dev/ttyS* /dev/ttyS0 /dev/ttyS1 /dev/ttyS3 /dev/ttyS4 /dev/ttyS9

3) Then start to test the uart interface, first use the DuPont line to short the rx and tx of the uart interface to be tested

	uart0	uart1	uart3	uart4					
Tx pin	Corresponding	Corresponding	Corresponding	Corresponding					
	to pin 8	to pin 5	to pin 19	to pin 18					
Rx pin	Corresponding	Corresponding	Corresponding	Corresponding					
	to pin 10	to pin 3	to pin 21	to pin 16					
918.0									



4) Use the **serialTest.py** program in the examples to test the loopback function of the serial port as shown below. If you can see the following print, it means that the serial port communication is normal

a. Test UART0

root@orangepi:~/wiringOP-Python/examples# python3 serialTest.py --device \ "/dev/ttyS0" Out: 0: -> 0 Out: 1:-> 1 Out: 2: -> 2 Out: 3: -> 3 4:^C Out: exit

b. Test UART1

root@orangepi:~/wiringOP-Python/examples# python3 serialTest.pydevice	<u>۱</u>
---	----------

"/dev/ttyS1"

exit		
Out:	4:^C	
Out:	3: ->	3
Out:	2: ->	2
Out:	1: ->	1
Out:	0: ->	0

c. Test UART3

root@orangepi:~/wiringOP-Python/examples# **python3 serialTest.py --device** \ "/dev/ttyS3"

Out:	0: ->	0
Out:	1: ->	1
Out:	2: ->	2
Out:	3: ->	3
Out:	4:^C	
exit		

d.

Test UART4

root@orangepi:~/wiringOP-Python/examples# python3 serialTest.py --device \

"/dev/	/ttyS4"	
Out:	0: ->	0
Out:	1: ->	1
Out:	2: ->	2
Out:	3: ->	3
Out:	4:^C	
exit		

3. 21. Hardware watchdog test

The watchdog_test program is pre-installed in the linux system released by Orange Pi,

which can be tested directly.

The method to run the watchdog_test program is as follows:

- a. The second parameter 10 indicates the counting time of the watchdog. If the dog is not fed within this time, the system will restart
- b. We can feed the dog by pressing any key on the keyboard (except ESC). After feeding the dog, the program will print a line of keep alive to indicate that the dog is fed successfully

orangepi@orangepi:~\$ sudo watchdog_test 10
open success
options is 33152, identity is sunxi-wdt
put_usr return, if 0, success:0
The old reset time is: 16
return ENOTTY, if -1, success:0
return ENOTTY, if -1, success:0
put_user return, if 0, success:0
put_usr return, if 0, success:0
keep alive
keep alive
keep alive

3. 22. View the serial number of the RK3588S chip

The command to view the serial number of the RK3588S chip is as follows. The serial number of each chip is different, so the serial number can be used to distinguish multiple development boards.

```
orangepi@orangepi:~$ cat_serial.sh
Serial : 1404a7682e86830c
```

3. 23. How to install Docker

1) The linux image provided by Orange Pi has pre-installed Docker, but the Docker service is not enabled by default

2) Use the enable_docker.sh script to enable the docker service, and then you can start

using the docker command, and the docker service will be automatically started when the system is started next time

orangepi@orangepi:~\$ enable_docker.sh

3) Then you can use the following command to test docker, if you can run hello-world, it means that docker can be used normally

orangepi@orangepi:~\$ docker run hello-world Unable to find image 'hello-world:latest' locally latest: Pulling from library/hello-world 256ab8fe8778: Pull complete Digest: sha256:7f0a9f93b4aa3022c3a4c147a449ef11e0941a1fd0bf4a8e6c9408b2600777c5 Status: Downloaded newer image for hello-world:latest

Hello from Docker!

This message shows that your installation appears to be working correctly.

••••

3. 24. How to download and install arm64 version balenaEtcher

- 1) The download address of balenaEtcher arm64 version is:
 - a. The download address of the deb installation package is as follows, which needs to be installed before it can be used

https://github.com/Itai-Nelken/BalenaEtcher-arm/releases/download/v1.7.9/balena-e tcher-electron_1.7.9+5945ab1f_arm64.deb

b. The download address of the AppImage version that does not need to be installed is as follows:

https://github.com/Itai-Nelken/BalenaEtcher-arm/releases/download/v1.7.9/balenaE tcher-1.7.9+5945ab1f-arm64.AppImage

May 1 ryanfortner v1.7.9	balenaEtcher v1.7.9 (Latest) Update and rename compile-etcher_v1.7.3.sh to compile-etcher_v1.7.	9. sh	
-0- 9529280 ⊘ Compare 🔹	• Assets 10		
	Øbalena-etcher-electron-1.7.9+5945ab1f.aarch64.rpm	64.3 MB	May 1
	Solution State Sta	58.4 MB	May 1
	Gbalena-etcher-electron_1.7.9+5945ab1f_arm64.deb	87.9 MB	May 1
	Solution State Sta	76.5 MB	May 1
	𝔅 balenaEtcher-1.7.9+5945ab1f-arm64.AppImage	97.3 MB	May 1
	Solution States	80.9 MB	May 1

2) How to install and use deb version balenaEtcher:

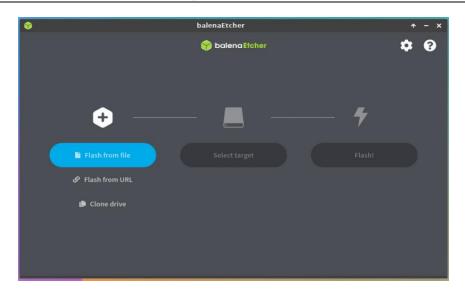
a. The deb version of balenaEtcher installation command is as follows:

orangepi@orangepi:~\$ sudo apt install -y \	
fix-broken ./balena-etcher-electron_1.7.9+5945ab1f_arm64.deb	

b. After the deb version of balenaEtcher is installed, it can be opened in the Application



c. The interface after balenaEtcher is opened is as follows:



- 3) How to use the AppImage version of balenaEtcher:
 - a. First add permissions to balenaEtcher

orangepi@orangepi:~/Desktop\$ chmod +x balenaEtcher-1.7.9+5945ab1f-arm64.AppImage

b. Then select the AppImage version balenaEtcher, then click the right mouse button, and then click Execute to open balenaEtcher

48	Execute		
P	Open With	Other <u>Applicati</u>	on
*	Cut		
Ę	⊆ору		
0	Moye to Tra	ish	
8	Delete		
	<u>R</u> ename		
9	Properties.		
a	Application	s	

3. 25. How to install Pagoda Linux panel

Pagoda Linux panel is a server management software that improves operation and maintenance efficiency, and supports more than 100 server management functions such as one-click LAMP/LNMP/cluster/monitoring/website/FTP/database/JAVA (excerpted from Baota official website)

The recommended order of pagoda Linux system compatibility is
 Debian11 > Ubuntu 22.04

2) Then enter the following command in the linux system to start the installation of the pagoda

orangepi@orangepi:~\$ sudo install_bt_panel.sh

3) Then the pagoda installer will remind whether to install **Bt-Panel** to the /www folder, and then enter y

+-----

Bt-WebPanel FOR CentOS/Ubuntu/Debian

+-----

| Copyright © 2015-2099 BT-SOFT(http://www.bt.cn) All rights reserved.

+-----

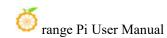
The WebPanel URL will be http://SERVER_IP:8888 when installed.

Do you want to install Bt-Panel to the /www directory now?(y/n): y

4) The next thing to do is to wait patiently. When the terminal outputs the following print information, it means that the pagoda has been installed. The whole installation process takes about 12 minutes, and there may be some differences depending on the network speed

Congratulations! Installed successfully!
外网面板地址: <u>http://183.15.204.10:8888/7eaf9ade</u> 内网面板地址: <u>http://192.168.1.139:8888/7eaf9ade</u> username: nslvetif bassword: fec12d4b If you cannot access the panel, release the following panel port [8888] in the security grou 答无法访问面板,请检查防火墙/安全组是否有放行面板[8888]端口

5) At this time, enter **the panel address** shown above in the browser to open the login interface of the Pagoda Linux panel, and then enter the **username** and **password** shown in the above figure at the corresponding position to log in to Pagoda

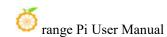


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宝塔Linux面板					
N9					
密码					
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20288.2					

6) After successfully logging into the pagoda, the following welcome interface will pop up. First, please read the user notice in the middle and drag it to the bottom, then you can select "I have agreed and read the "User Agreement"", and then click "Enter the Panel" You can enter the pagoda



7) After entering the pagoda, you will first be prompted to bind an account on the official website of the pagoda. If you do not have an account, you can go to the official website of the pagoda (https://www.bt.cn) to register one



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● 筋尖痛	來興托喝, 免勵注册					
▷ 文件	 为了您能更好的体验需要功能,请先做定量请账号; 					
	 单个宝塔帐号支持多台银号器绑定: 第三帐号设有按管报号器的功能权限、谨故心使用: 				- 18	
	 報号供您过程中還到问题请获紧紧握处理: 					
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③ 面积设置						
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8) The final displayed interface is as shown in the figure below. You can intuitively see some status information of the Linux system on the development board, such as load status, CPU usage, memory usage, and storage space usage, etc.

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	129				40					

- 9) Test the SSH terminal login of the pagoda
 - a. After opening the SSH terminal of the pagoda, it will first prompt to enter the password of the development board system. At this time, enter **orangepi** (default password, if there is any modification, please fill in the modified one) in the password box.

宝塔终端	\sim
帐号或密码错误: Authentication failed	,root@127.0.0.1:22
	无法自动认证,请填写本地服务器的登录信息!
服务器IP	127.0.0.1 22
SSH账号	root
验证方式	密码验证 私钥验证
密码	orangepi
	登录

b. The display after successful login is shown in the figure below

宝塔终端			×
Welcome to Orange Pi 1.0.0 Bull	seye with Linux		
System load: 6% Memory usage: 9% of 7.51G CPU temp: 51°C	Up time: IP: Usage of /:	26 min Local users: 4 172.17.0.1 192.168.1.139 35% of 15G	
Last login: Fri Dec 2 12:00:10 root@orangepi5:~#	2022 from 127.	0.0.1	

10) You can install software such as Apache, MySQL, and PHP in the software store of Pagoda, and you can also deploy various applications with one click. Please explore these functions by yourself, and I will not demonstrate them one by one here.

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11) Pagoda command line tool test

orangepi@orangepi5:~\$ sudo bt [sudo] password for orangepi: =========宝塔面板命令行====================================
 (1)重启面板服务 (8)改面板端口 (2)停止面板服务 (9)清除面板缓存 (3)启动面板服务 (10)清除登录限制 (4)重载面板服务 (5)修改面板密码 (12)取消域名绑定限制 (6)修改面板用户名 (13)取消IP访问限制 (7)强制修改MySQL密码 (14)查看面板默认信息 (22)显示面板错误日志 (15)清理系统垃圾 (23)关闭BasicAuth认证 (16)修复面板(检查错误并更新面板文件到最新版) (24)关闭动态口令认证 (17)设置日志切割是否压缩 (25)设置是否保存文件历史副本 (18)设置是否自动备份面板 (6)取消 (29)取消访问设备验证
请输入命令编号:14
正在执行(14)
curl: (28) Resolving timed out after 10000 milliseconds
BT-Panel default info!
外网面板地址: http://:8888/7eaf9ade 内网面板地址: http://192.168.1.139:8888/7eaf9ade *以下仅为初始默认账户密码,若无法登录请执行bt命令重置账户/密码登录 username: nslvetif password: ******* If you cannot access the panel, release the following panel port [8888] in the security group 若无法访问面板,请检查防火墙/安全组是否有放行面板[8888]端口
orangepi@orangepi5:~\$

12) For more functions of the pagoda, you can refer to the following information to explore by yourself

manual: http://docs.bt.cn

Forum address: https://www.bt.cn/bbs

GitHub: https://github.com/aaPanel/BaoTa

3. 26. How to remotely log in to the desktop of the Linux system

The Ubuntu Gnome Wayland image does not support remote login to the desktop using Nomachine and VNC as described here.

3. 26. 1. Remote login using NoMachine

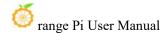
Please make sure that the Ubuntu or Debian system installed on the development board is a desktop version. In addition, NoMachine also provides detailed usage documents. It is strongly recommended to read this document to familiarize yourself with the use of NoMachine. The document link is as follows: https://knowledgebase.nomachine.com/DT10R00166

NoMachine supports Windows, Mac, Linux, iOS and Android platforms, so we can remotely log in and control the Orange Pi development board through NoMachine on a variety of devices. The following demonstrates how to remotely log in to the Linux system desktop of the Orange Pi development board through NoMachine in Windows. For installation methods on other platforms, please refer to the official documentation of NoMachine.

Before operation, please make sure that the Windows computer and the development board are in the same LAN, and you can log in to the Ubuntu or Debian system of the development board through ssh.

1) First download the installation package of the NoMachine software Linux **arm64** deb version, and then install it in the Linux system of the development board

a. Since RK3588S is a SOC with ARMv8 architecture, the system we use is Ubuntu or Debian, so here we need to download the NoMachine for ARM



ARMv8 DEB installation package, the download link is as follows:

Note that this download link may change, please look for the deb package of the Armv8/Arm64 version.

https://downloads.nomachine.com/download/?id=114&distro=ARM

NoMachine fo	r ARM - a	rm64			
	Version:	8.2.3_3			
	Package size:	48.05 MB			
	Package type:	DEB			
	MD5 signature:	e439df8f71550ac9d6519b46806357a4			
	For:	Ubuntu 14.04/16.04/18.04/20.04, Debian 8/9/10			
		our ARMv8 device may not be listed here, we encourage you to try the packages. Please consult the installation and configuration t Linux for ARM packages for more details about devices and specific distributions we have tested.			

b. In addition, you can also download the installation package of **NoMachine** in **the official tool**



First enter the remote login software-NoMachine folder

Remote Login Software-NoMachine

Then download the arm64 version of the deb installation package

	nomachine_8.2.3_4_x64.exe
	nomachine_8.2.3_4_amd64.deb
	nomachine_8.2.3_3_arm64.deb
	nomachine_8.2.3_12.dmg

c. Then upload the downloaded **nomachine_8.2.3_3_arm64.deb** to the Linux system of the development board

d. Then use the following command to install **NoMachine** in the Linux system of the development board

orangepi@orangepi:~\$ sudo dpkg -i nomachine 8.2.3 3 arm64 arm64.deb

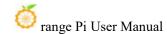
2) Then download the installation package of the Windows version of the NoMachine software, the download address is as follows

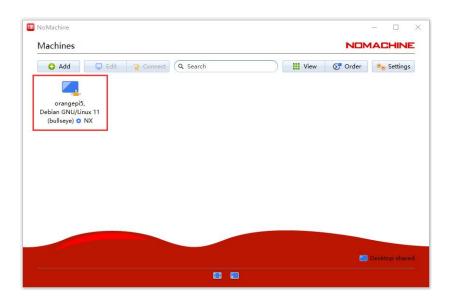
Version: 8.2.3_4 Package size: 57.04 MB Package type: EXE MD5 signature: ff97dbad5d49756913ecdc875598da0f For: Windows 7/8/8.1/10/11/Windows Server 2008/2012/2016/2019	oMachine	e for Window	vs - 64bit	
Package type: EXE MD5 signature: ff97dbad5d49756913ecdc875598da0f		Version:	8.2.3_4	
MD5 signature: ff97dbad5d49756913ecdc875598da0f		Package size:	57.04 MB	
		Package type:	EXE	
For: Windows 7/8/8.1/10/11/Windows Server 2008/2012/2016/2019		MD5 signature:	ff97dbad5d49756913ecdc875598da0f	
		For:	Windows 7/8/8.1/10/11/Windows Server 2008/2012/2016/2019	
	and the second s			

- 3) Then install NoMachine in Windows, please restart the computer after installation
- 4) Then open **NoMachine** in Window

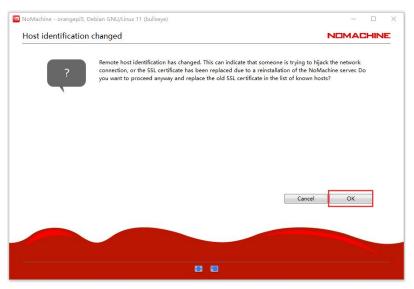


5) After NoMachine is started, it will automatically scan other devices installed with NoMachine in the LAN. After entering the main interface of NoMachine, you can see that the development board is already in the list of connectable devices, and then click the position shown in the red box in the figure below You can start to log in to the Linux system desktop of the development board

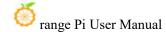




6) Then click **OK**



7) Then enter the user name and password of the Linux system of the development board in the corresponding position in the figure below, and then click **Login** to start logging in

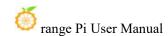


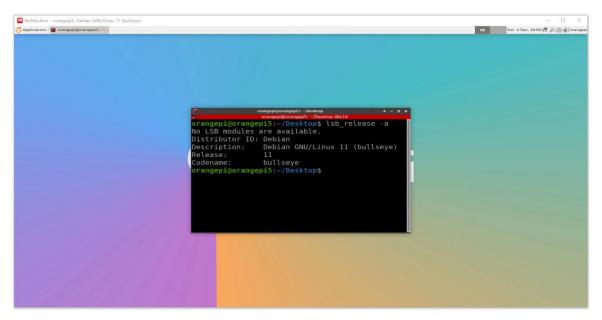
congonizoro 2 Ubuntu 20	042175			NOMACHIN
rangepizero2, Ubuntu 20	.04.3 LIS			NUMALMIN
Please type your username ar	nd password t	o login.		
	Username	orangepi	 Enter the username orangepi 	
	Password	•••••	(2) Enter the password orangepi	
•		Save this	password in the connection file	
		A Save this		
		I		
		(3)		(4)
			Cancel	Login

8) Then click OK in the next interface

orangepi5, Debian (GNU/Linux 11 (bullseye)		CHINI	E
h	Audio streaming Audio is being forwarded to this computer. You can select whether or not audio must the remote server. The audio on the server while I'm connected The audio on the server while I'm co	also be played o	'n	
Don't show anym	Click here to toggle audio on the server	ОК		

- 9) Finally, you can see the desktop of the development board Linux system
 - a. Debian11





b. Ubuntu22.04

🔟 NoMachine - orangepi5, Ubuntu 22.04.1 LTS	- 🗆 X
💍 Applications : 🖬 orangept@orangeptS:	۲ri 9 Dec, 13:37 اللہ ا لم 🖉 orangepi
<pre>orangepi@orangepi5:~/Desktop\$ lsb_release -a No LSB modules are available. Distributor ID: Ubuntu Description: Ubuntu 22.04.1 LTS Release: 22.04 Codename: jammy orangepi@orangepi5:~/Desktop\$</pre>	

3. 26. 2. Use VNC to log in remotely

Before operation, please make sure that the Windows computer and the development board are in the same LAN, and you can log in to the Ubuntu or Debian system of the development board through ssh.

Ubuntu20.04 has many problems testing VNC, please do not use this method.

1) First run the set_vnc.sh script to set up vnc, remember to add sudo permission

orangepi@orangepi:~\$ sudo set_vnc.sh

You will require a password to access your desktops.

Password:#Set the vnc password here, 8 charactersVerify:#Set the vnc password here, 8 charactersWould you like to enter a view-only password (y/n)? nxauth:file /root/.Xauthority does not exist

New 'X' desktop is orangepi5:1

Creating default startup script /root/.vnc/xstartup Starting applications specified in /root/.vnc/xstartup Log file is /root/.vnc/orangepi5:1.log

Killing Xtightvnc process ID 3047

New 'X' desktop is orangepi5:1

Starting applications specified in /root/.vnc/xstartup Log file is /root/.vnc/orangepi5:1.log

2) The steps to use MobaXterm software to connect to the development board linux system desktop are as follows:

a. First click on Session, then select VNC, then fill in the IP address and port of the development board, and finally click OK to confirm



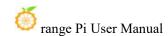
MobaXterm	1. Click Session ✓X server Tools Games Settings Macros Help	- 🗆 X
Session Servers Tools	avis 🚖 🖳 🖳 💱 🚍 Å 🤣 🧭 🍘 Games Sessions View Split MultiExec Tunneling Packages Settings Help	X server Exit
Quick connect	2. Select VNC	Ø
	ession settings	× 🌣
*	SH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL	
	3. Fill in the IP address of the development board	
	Basic Vnc settings	-
	Remote hostname or IP address 192.168.31.52 Port 5901 \$	
	🔛 Advanced Vnc settings 🔅 Network settings 🔶 Bookmark settings	_
	4. Fill in the port number 5901	
	VNC session	
	5. Click OK	
	5. Click OK	
		_
	OK Scancel	
UNREGISTERED VERSION -	Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net	

b. Then enter the VNC password set earlier

Please enter your passw	ord for 192.168.31.46

Show password	1
<i></i>	
📀 ок	🙁 Cancel

- c. After successful login, the interface is displayed as shown in the figure below, and then you can remotely operate the desktop of the development board linux system
 - a) The Debian11 login display is as follows



ssion	*	Nools	**	Tools (Sessions	View	Split 192.168.3	Y MultiExe	**	Packages Se		? telp					X	X server	Exit
	User sessions	s			v			Fullscreer	Ctrl+Alt	+Del I	Refresh	¢ [‡] Options	XDisconner					
	User sessions				G 24 STORE IN	-		angepi5: ~/D		+Del 🔘	Retresh	Options	Disconnei	я	Sun 4 De	c, 18:31 👘 😥	(d))	oot
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							-		roo	t@orangep	pi5: ~/De	sktop	_		+ - □ ×			
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						De	scrip	tion:	Debia		Linux	11 (bu	llseye)					
						De Re	scrip	tion: :	Debia 11	n GNU/I	Linux	11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debia 11	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					-
						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					
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						De Re Co	scrip lease denam	tion: : e:	Debian 11 bullse	n GNU∕l ⊇ye		11 (bu	llseye)					-

b) The Ubuntu22.04 login display is as follows



	68.1.28													- 🗆	×
	Sessions	View		Tools			Macros		-						-
<u>*</u>	100	3	100	*			Y	++		*	?			X	ଜ
ssion	Servers	Tools	Games	Sessions	View	Split	MultiExec	Tunneling	Packages	Settings	Help			X server	Exi
uick (connect					11 🕎 🚺	1. 192.168.1	.28		4	7				
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		r	oot@o	range	epi5:	~/Des	ktop#	t lsb	relea	ase -a			Π		
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		- H					_								

3) Use **the remote desktop connection** application that comes with Windows to log in to the Linux system desktop of the development board.

a. First open the remote desktop connection that comes with Windows

😼 远程桌面道	接			×
	元程桌面			
w i	生 接			
计算机(<u>C</u>):	示例: computer.fabrikam.com	~		
用户名:	未指定			
计算机名字段	为空。请输入完整的远程计算机名。			
		接(N)	帮助(H	

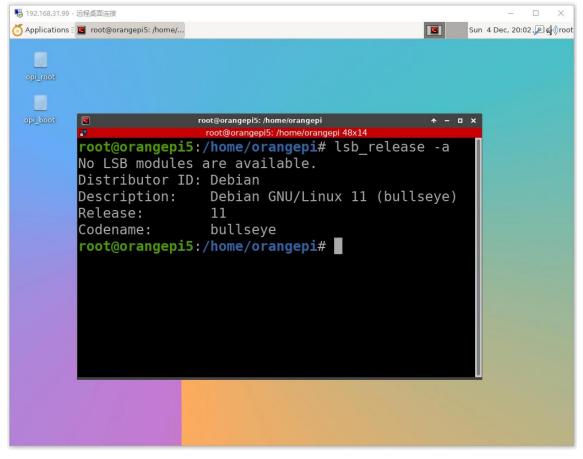
b. Then enter the IP address of the development board

100 远程桌面;	主 接	1 <u>00</u> 0		Х
	远程桌面 连接 1 . Fill in the	IP address o	f SBC	
<mark>计算机(C)</mark> :	192.168.1.16	~		
用户名:	未指定			
当你连接时料	狗你询问凭据。	2. Click (Conne	ect
	ā(<u>O</u>)	连接(N)	<mark>帮助</mark> (H)

- c. Then set the connection information according to the instructions in the figure below
 - a) Session: Need to choose vnc-any
 - b) ip: You can enter 127.0.0.1 or the IP address of the development board
 - c) port: Generally 5901
 - d) **password:** You need to enter the vnc password

gin to orange	epi5
8	Just connecting
Session	Vnc-any
ip	192.168.1.28
port	5901
password	******
	OK Cancel

- d. The display of the Linux system desktop of the development board successfully logged in is shown in the figure below
 - a) The Debian11 login display is as follows



b) Ubuntu22.04 is currently unavailable, please do not use this method

3. 27. Some programming language tests supported by Linux system

3. 27. 1. Debian Bullseye system

1) Debian Bullseye has a gcc compilation tool chain installed by default, which can directly compile C language programs in the Linux system of the development board

a. The version of gcc is as follows

orangepi@orangepi:~\$ gcc --version

gcc (Debian 10.2.1-6) 10.2.1 20210110

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warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

b. Write the **hello_world.c** program in C language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>
```

```
int main(void)
```

{

```
printf("Hello World!\n");
```

return 0;

c. Then compile and run **hello_world.c**

orangepi@orangepi:~\$ gcc -o hello_world hello_world.c orangepi@orangepi:~\$./hello_world Hello World!

2) Debian Bullseye has Python3 installed by default

a. The specific version of Python is as follows

orangepi@orangepi:~\$ python3

Python 3.9.2 (default, Feb 28 2021, 17:03:44)

[GCC 10.2.1 20210110] on linux

Type "help", "copyright", "credits" or "license" for more information.

```
>>>
```

🉆 range Pi User Manual

b. Write the **hello_world.py** program in Python language

orangepi@orangepi:~\$ vim hello_world.py

print('Hello World!')

c. The result of running **hello_world.py** is as follows

orangepi@orangepi:~\$ python3 hello_world.py

Hello World!

3) Debian Bullseye does not install Java compilation tools and operating environment by default

a. You can use the following command to install openjdk, the latest version in Debian Bullseye is openjdk-17

orangepi@orangepi:~\$ sudo apt install -y openjdk-17-jdk

b. After installation, you can check the version of Java

orangepi@orangepi:~\$ java --version

c. Write the Java version of hello_world.java

orangepi@orangepi:~\$ vim hello_world.java

public class hello_world

}

public static void main(String[] args)

System.out.println("Hello World!");

d. Then compile and run hello_world.java

orangepi@orangepi:~\$ javac hello_world.java

orangepi@orangepi:~\$ java hello world

Hello World!

3. 27. 2. Debian Bookworm system

1) Debian Bookworm is installed with the gcc compilation tool chain by default, which can directly compile C language programs in the Linux system of the development board.

a. The version of a.gcc is as follows

orangepi@orangepi:~\$ gcc --version

gcc (Debian 12.2.0-14) 12.2.0

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warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

b. Write the **hello_world.c** program in C language

orangepi@orangepi:~\$ vim hello_world.c

#include <stdio.h>

int main(void)

{

```
printf("Hello World!\n");
```

return 0;

c. Then compile and run hello_world.c

orangepi@orangepi:~\$ gcc -o hello_world hello_world.c orangepi@orangepi:~\$./hello_world Hello World!

2) Debian Bookworm has Python3 installed by default

a. The specific version of Python is as follows

orangepi@orangepi:~\$ python3

Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux

Type "help", "copyright", "credits" or "license" for more information.

Use the Ctrl+D shortcut key to exit python's interactive mode.

b. Write the hello_world.py program in Python language

orangepi@orangepi:~\$ vim hello_world.py

print('Hello World!')

c. The result of running **hello_world.py** is as follows

orangepi@orangepi:~\$ python3 hello_world.py

Hello World!

3) Debian Bookworm does not install Java compilation tools and operating environment by default.

a. You can use the following command to install openjdk. The latest version in Debian Bookworm is openjdk-17

orange Pi User Manual

orangepi@orangepi:~\$ sudo apt install -y openjdk-17-jdk

b. After installation, you can check the Java version.

orangepi@orangepi:~\$ java --version

c. Write the Java version of hello_world.java

orangepi@orangepi:~\$ vim hello_world.java

public class hello_world

```
public static void main(String[] args)
{
    System.out.println("Hello World!");
}
```

d. Then compile and run hello_world.java

orangepi@orangepi:~**\$ javac hello_world.java** orangepi@orangepi:~**\$ java hello_world** Hello World!

3. 27. 3. Ubuntu Focal system

1) Ubuntu Focal has a gcc compilation tool chain installed by default, which can directly compile C language programs in the Linux system of the development board

a. The version of gcc is as follows

orangepi@orangepi:~\$ gcc --version

gcc (Ubuntu 9.4.0-1ubuntu1~20.04.1) 9.4.0

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warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

b. Write the **hello_world.c** program in C language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>
```

int main(void)

{

printf("Hello World!\n");

return 0;

c. Then compile and run **hello_world.c**

orangepi@orangepi:~\$ gcc -o hello_world hello_world.c

orangepi@orangepi:~\$./hello_world

Hello World!

2) Ubuntu Focal has Python3 installed by default

a. The specific version of Python3 is as follows

orangepi@orangepi:~\$ python3

Python 3.8.10 (default, Nov 14 2022, 12:59:47)

[GCC 9.4.0] on linux

Type "help", "copyright", "credits" or "license" for more information.

b. Write the **hello_world.py** program in Python language

orangepi@orangepi:~\$ vim hello_world.py

print('Hello World!')

c. The result of running **hello_world.py** is as follows

orangepi@orangepi:~\$ python3 hello_world.py

Hello World!

3) Ubuntu Focal does not install Java compilation tools and runtime environment by default

a. You can use the following command to install openjdk-17

orangepi@orangepi:~\$ sudo apt install -y openjdk-17-jdk

b. After installation, you can check the version of Java

orangepi@orangepi:~\$ java --version

openjdk 17.0.2 2022-01-18

OpenJDK Runtime Environment (build 17.0.2+8-Ubuntu-120.04)

OpenJDK 64-Bit Server VM (build 17.0.2+8-Ubuntu-120.04, mixed mode, sharing)

c. Write the Java version of hello_world.java

orangepi@orangepi:~\$ vim hello_world.java

public class hello_world

{

public static void main(String[] args)

{

}

System.out.println("Hello World!");

d. Then compile and run hello_world.java

orangepi@orangepi:~\$ javac hello_world.java

orangepi@orangepi:~\$ java hello world

Hello World!

3. 27. 4. Ubuntu Jammy system

4) Ubuntu Jammy has a gcc compilation tool chain installed by default, which can directly compile C language programs in the Linux system of the development board

a. The version of gcc is as follows

orangepi@orangepi:~\$ gcc --version

gcc (Ubuntu 11.2.0-19ubuntu1) 11.2.0

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warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

b. Write the **hello_world.c** program in C language

```
orangepi@orangepi:~$ vim hello_world.c
#include <stdio.h>
int main(void)
{
    printf("Hello World!\n");
    return 0;
```

```
}
```

c. Then compile and run hello_world.c

orangepi@orangepi:~\$ gcc -o hello_world hello_world.c orangepi@orangepi:~\$./hello_world Hello World!

5) Ubuntu Jammy has Python3 installed by default

a. The specific version of Python3 is as follows

orangepi@orangepi:~\$ python3

Python **3.10.4** (main, Apr 2 2022, 09:04:19) [GCC 11.2.0] on linux Type "help", "copyright", "credits" or "license" for more information.

b. Write **hello_world.py** program in Python language

orangepi@orangepi:~\$ vim hello_world.py

print('Hello World!')

c. The result of running **hello_world.py** is as follows

orangepi@orangepi:~\$ **python3 hello_world.py** Hello World!

6) Ubuntu Jammy does not install Java compilation tools and operating environment by default

a. You can use the following command to install openjdk-18

orangepi@orangepi:~\$ sudo apt install -y openjdk-18-jdk

b. After installation, you can check the version of Java

orangepi@orangepi:~\$ java --version

openjdk 18-ea 2022-03-22

```
OpenJDK Runtime Environment (build 18-ea+36-Ubuntu-1)
```

OpenJDK 64-Bit Server VM (build 18-ea+36-Ubuntu-1, mixed mode, sharing)

c. Write the Java version of hello_world.java

```
orangepi@orangepi:~$ vim hello_world.java
```

public class hello_world

ł

}

```
public static void main(String[] args)
```

System.out.println("Hello World!");

```
)
```

d. Then compile and run hello_world.java

orangepi@orangepi:~\$ **javac hello_world.java** orangepi@orangepi:~\$ **java hello_world** Hello World!

3. 28. How to install QT

1) Use the script below to install QT5 and QT Creator

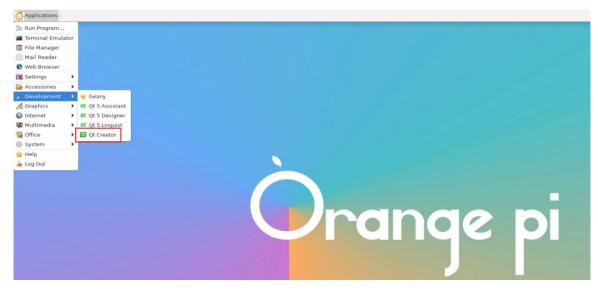
orangepi@orangepi:~\$ install_qt.sh

2) After installation, the version number of QT will be automatically printed

a. The qt version that comes with Ubuntu 20.04 is 5.12.8
orangepi@orangepi:~\$ install_qt.sh
QMake version 3.1
Using Qt version 5.12.8 in /usr/lib/aarch64-linux-gnu
b. The QT version that comes with Ubuntu 22.04 is 5.15.3
orangepi@orangepi:~\$ install_qt.sh
QMake version 3.1
Using Qt version 5.15.3 in /usr/lib/aarch64-linux-gnu
c. The QT version that comes with Debian11 is 5.15.2
orangepi@orangepi:~\$ install_qt.sh
QMake version 3.1

Using Qt version **5.15.2** in /usr/lib/aarch64-linux-gnu

3) Then you can see the startup icon of QT Creator in Applications



You can also use the following command to open QT Creator

orangepi@orangepi:~\$ qtcreator

During the startup process of QT and QT application, if the following error is prompted, please ignore it directly, this error will not affect the operation of the application.

libGL error: failed to create dri screen libGL error: failed to load driver: rockchip libGL error: failed to create dri screen libGL error: failed to load driver: rockchip

4) The interface after QT Creator is opened is as follows

cations 🗄 📴 Qt	Creator	📘 [orangepi@orangepi5:			
			Qt Creator		+ - ¤ ×
lit <u>B</u> uild <u>D</u> ebug	g <u>A</u> nalyze <u>T</u> ools <u>W</u> ind	low <u>H</u> elp			
Projec	ts	Qt 5.12.8 in PATH (System) *	Search in Examples		
Exam	ples	File Tools	I Analog Clock 😐 🗎 Σ		november 2016
		ABC DEF GHI JKI	NY COLOUR	File Edit Help	on. man. tir. ons. tor. 10 31 1 2 3
Tutori	als		1		6 7 8 9 10
		Name A		🕒 🚨 🐰 🦓 🖳	.3 14 15 16 17 20 21 22 23 24
		Qt User The Keys, B		All the standard features of	7 28 29 30 1
		Peter Rabbit The Lake Di			4 5 6 7 8
New to	o Qt?	Address Book Example	Analog Clock Window Exam	Application Example	Calendar Widget Example
Learn how your own explore Q	v to develop applications and t Creator.	Tags: address book los widgets	Tags: analog android clock gui los window	Tags: application widgets	Tags: android calendar los widget widgets
Get St	tarted Now	Provide and a second seco	I HTTP RL: <u>Inter//www.etes</u> Sownload directory: C:\Users\user\Ap Default file: Index.html Suandh file	Qt Code Sample	Server name: fortune This examples requires that t
L Qt Acc	count	Editable Tree Model Example	HTTP Example	JSON Save Game Example	Local Fortune Client Example
Online	Community	Tags: editable los model tree	Tags: http://tetwork	Tags: core game ison save	Tags: client core fortune local
S Blogs		widgets	rags: http://etwork	Tags: core game json save	rags: cheft core fortune local
🕑 User G	Guide	Fortune Server	• = • ×	· · · · ·	Chip Demo
Mendel unit film	to take a swish UI towa? T	His tour highlights important user interfa	en elements and shows how they are	used. To take the tous later	•
select Help > U	JI Tour.	his cour nigniights important user interra	ice elements and shows now they are	used. To take the tour later,	ake UI Tour Do Not Show Again 🗙
P. Type	to locate (Ctrl+K)	I Issues 2 Search Results 3 Applica	ation Output 4 Compile Output 5	QML Debugger Console 8 Test Res	ults 🗢 📫 🔲

- 5) The version of QT Creator is as follows
 - a. The default version of QT Creator in Ubuntu20.04 is as follows

ations 🗄 📴 Qt Creator	📓 [orangepi@orangepi5:				
		Qt Creator		†	×
t <u>B</u> uild <u>D</u> ebug <u>A</u> nalyze <u>T</u> ools	<u>W</u> indow <u>H</u> elp				
Projects	Qt 5.12.8 in PATH (System)	Search in Examples			
-		Analog Clock		november 2	2016
Examples	<u>File</u> <u>T</u> ools	Analog Clock C C		on. man. tir. ons	. tor.
Tutorials	ABC DEF GHI JKI	and the second s	<u>File</u> <u>E</u> dit <u>H</u> elp	0 31 1 2 6 7 8 9	3
Tatonais	N	About Qt Creator	🔸 🗙 😫 🛛 😹 🖶	3 14 15 16	
	Qt U	t Creator 4.11.0	tandard features of	20 21 22 23 27 28 29 30	
1000 0 0000	Peter	lased on Qt 5.12.8 (GCC 9.3.0, 64 bit)		4 5 6 7	8
New to Qt?	Address	copyright 2008-2019 The Qt Company	h Example	Calendar Widget Exam	ple
Learn how to develop your own applications and		eserved.	Ltd. All rights	Tags: android calendar ios wi widgets	ldget .
explore Qt Creator.	Т	he program is provided AS IS with NO	WARRANTY	widgets	
Get Started Now	- mm 2	OF ANY KIND, INCLUDING THE WARRA DESIGN, MERCHANTABILITY AND FITN			
Get Started Now	P	ARTICULAR PURPOSE.		Server name: fortur	
	Band Di Classica Lin Gapta and Di - Very - Lingue		× <u>Close</u> Code		
	The Lenger and Market Report of the Control of the	Default file: index.html	Sample	This examples requir	es that
	Consider the second secon	✓ Launch file			
L Qt Account	Editable Tree Model Example	HTTP Example	JSON Save Game Example	Local Fortune Client Ex	
Online Community	Tags: editable los model tree	Tags: http://tetwork	Tags: core game ison save	Tags: client core fortune loca	
D Bloos	widgets	rags: http://etwork	Tags: core game json save	rags: client core fortune loca	
Blogs				Chi	p Demo
Q User Guide	Fortune Server	• • • ×		Chi	a Gemo

b. The default version of QT Creator in Ubuntu22.04 is as follows

c. The default version of QT Creator in **Debian11** is as follows

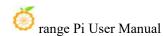
range Pi User Manual Copyright reserved by Shenzhen Xunlong Software Co., Ltd of Applications and Qt Creator ee File Edit View Build Debug Analyze Tools Window Help + - □ × Projects Qt 5.15.2 in PATH (qt5) Search in Examples Edit Analog Clock tor Examples File Tools ABC DEF GHI JK File Edit Help 1 8 15 22 29 2 9 16 23 30 10 Tutorials 7 14 21 28 N P 🔮 💥 17 24 û Debug Qt Marketplace Qt Creator 4.14.1 andard features of Pete Based on Qt 5.15.2 (GCC 10.2.1 20210110, 64 bit) Example ndar W iget Exa Addr Copyright 2008-2020 The Qt Company Ltd. All rights reserved. QC New to Qt? Learn how to develop your own applications and explore Qt Creator. () Help The program is provided AS IS with NO WARRANTY OF ANY KIND, INCLUDING THE WARRANTY OF DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Get Started Now Server name: fortune X <u>C</u>lose Code Sample This examples requires that Default <u>fi</u>le: index.html ₩ Get Qt 🗹 Launch file 1 Qt Account table Tree Model Example HTTP Example JSON Save Game Exan al Fortune Client Example Online Community ole los ma gs: http ne S Blogs User Guide • u like to take a quick UI tour? This ed. To take the tour later, select tour highlights elements and sh Take UI Tour Do Not Show Again UI Tour ×

6) Then set the QT

a. First open Help->About Plugins...

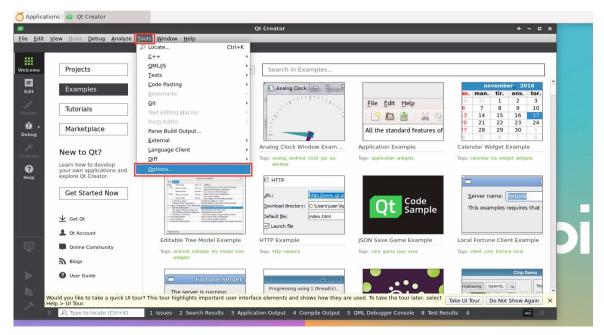
o Applicati	ons 🗄 📴 Qt Creator									
20			Qt (reator					+	
<u>File</u> <u>E</u> dit	Build Debug Analyze Tools W	indow Help								
		Contents								
	-	Index								
Welcome	Projects	Qt Context Help	F1	Search in Examples						
	Hojects	UI Tour		search an Examples		_				
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Edit	Examples	Report Bug				an.	man.		ons.	tor.
1		System Information		N STATISTICS	File Edit Help	0	31	1	2	3
Design	Tutorials	About Qt Creator		3	🛛 🍋 📠 🔛 🖳	.3	14	15	16	17
ŵ		About Plugins				20	21	22	23	24
Debug			- 1		All the standard features of	27	28	29	30	1
Denng		Peter Rabbit The Lake Di				4	5	6	7	8
8	New to Qt?	Address Book Example	An	alog Clock Window Exam	Application Example	Cale	ndar Wi	dget E	xampl	e
Projects	Learn how to develop your own applications and	Tags: address book ios widgets	Ta	gs: analog android clock gui ios window	Tags: application widgets		android c widgets	alendar	los widg	jet

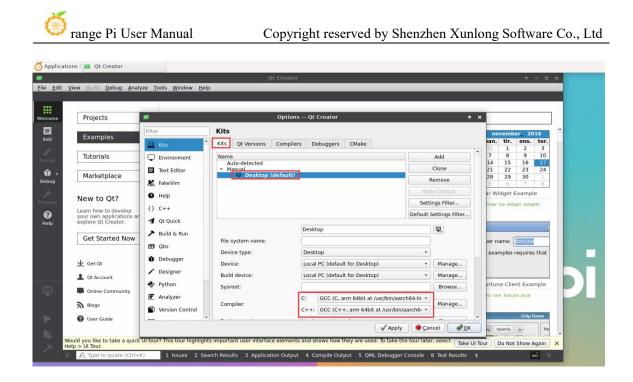
b. Then remove the tick of ClangCodeModel



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Name 🔻	Load	Version	٧.
 Build Systems 			
 AutotoolsProjectManager 		4.11.0 (4.11.0)	(
CMakeProjectManager	V	4.11.0 (4.11.0)	٦
 CompilationDatabaseProjectManager (experimental) 		4.11.0 (4.11.0)	1
GenericProjectManager	\checkmark	4.11.0 (4.11.0)	
QbsProjectManager	V	4.11.0 (4.11.0)	1
QmakeProjectManager	V	4.11.0 (4.11.0)	1
* C++			
 Beautifier (experimental) 		4.11.0 (4.11.0)	
 ClangCodeModel 		4.11.0 (4.11.0)	
- ClangFormat		4.11.0 (4.11.0)	
 ClangRefactoring (experimental) 		4.11.0 (4.11.0)	
 ClassView 	V	4.11.0 (4.11.0)	
CppEditor	V	4.11.0 (4.11.0)	1
 Code Analyzer 			
 ClangTools 	V	4.11.0 (4.11.0)	
 Cppcheck (experimental) 		4.11.0 (4.11.0)	
 CtfVisualizer 	V	4.11.0 (4.11.0)	1000
 PerfProfiler 	V	4.11.0 (4.11.0)	1

- c. After setting, you need to restart QT Creator
- d. Then make sure the GCC compiler used by QT Creator, if the default is Clang, please modify it to GCC

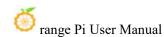


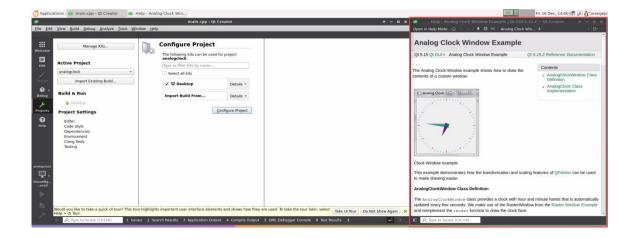


7) Then you can open a sample code

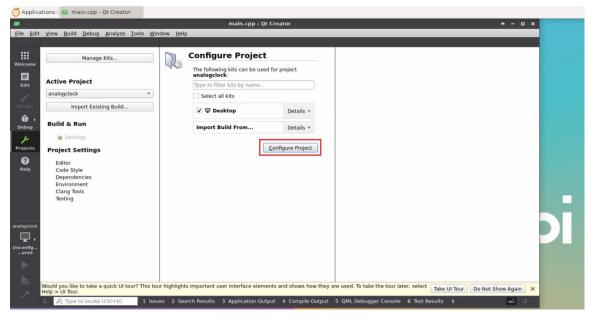
		n.cpp - Qt Creator		↑ - □	×
t <u>V</u> iew <u>B</u> uild <u>D</u> ebug <u>A</u> nalyze j	<u>T</u> ools <u>W</u> indow <u>H</u> elp				
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	ABC DEF GHI JKI	Same of the second seco	File Edit Help	0. 31 1 2 3	
Tutorials	Name +	S		6 7 8 9 10	
		5		.3 14 15 16 17 20 21 22 23 24	
Marketplace	Qt User The Keys, E		All the standard features of	7 28 29 30 1	
	Peter Rabbit The Lake Di			4 5 6 7 8	
N	Address Book Example	Analog Clock Window Exam	Application Example	Calendar Widget Example	
New to Qt?	Tags: address android book ios	lags: analog android spek gui los	Tags: application widgets	Tags: calendar los widget widgets	
Learn how to develop your own applications and	widgets	window			
explore Qt Creator.	Balandan Franc Pindan A	НТТР			
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💆 Get Qt	Computer Strategener Committee Strategener Committee Strategener	✓ Launch file			
L Qt Account	Proteins (0.1)				
	Editable Tree Model Example	HTTP Example	JSON Save Game Example	Local Fortune Client Example	
Online Community	Tags: android editable ios model tree	Tags: http:network	Tags: core game json save	Tags: client core fortune local	
Blogs	widgets				
<u> </u>				Chip Demo	
O User Guide	Fortune Server	• ×			
	4			ntialiasing OpenGL 12	
Would you like to take a quick UI too Help > UI Tour.	ur? This tour highlights important user inter	face elements and shows how they a	re used. To take the tour later, select	ake UI Tour Do Not Show Again	×

8) After clicking the sample code, the corresponding instruction document will be opened automatically, you can carefully read the instructions in it

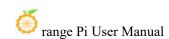


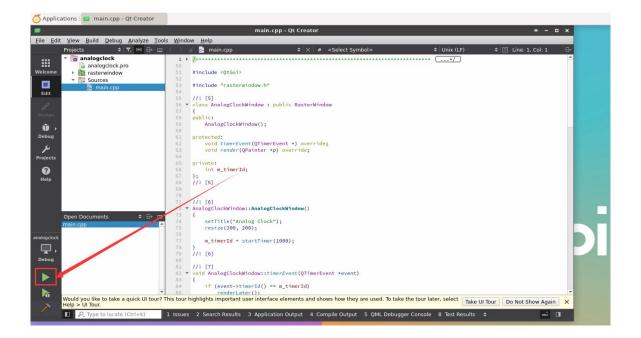


9) Then click Configure Project

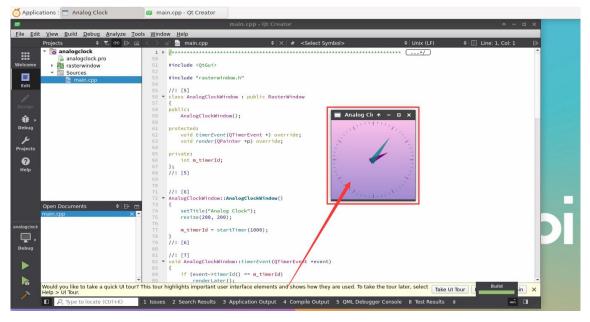


10) Then click the green triangle in the lower left corner to compile and run the sample code





11) After waiting for a period of time, the interface shown in the figure below will pop up, which means that QT can compile and run normally



12) References

https://wiki.qt.io/Install_Qt_5_on_Ubuntu https://download.qt.io/archive/qtcreator https://download.qt.io/archive/qt

Recommended

3. 29. ROS installation method

3. 29. 1. How to install ROS 1 Noetic on Ubuntu 20.04

1) The current active version of ROS 1 is as follows, the recommended version is Noetic

Ninjemys

Active ROS 1 distributions





http://docs.ros.org https://wiki.ros.org/Distributions

2) The official installation document link of ROS 1 Noetic Ninjemys is as follows:
 http://wiki.ros.org/noetic/Installation/Ubuntu

3) In the ROS **Noetic Ninjemys** official installation document, Ubuntu recommends using Ubuntu20.04, so please make sure that the system used by the development board is **the Ubuntu20.04 desktop system**

http://wiki.ros.org/noetic/Installation



4) Then use the script below to install ros1

orangepi@orangepi5:~\$ install ros.sh ros1

5) Before using the ROS tool, you first need to initialize rosdep, and then you can quickly install some system dependencies and some core components in ROS when compiling the source code

Note that running the following command needs to ensure that the development board can access github normally, otherwise an error will be reported due to network problems.

The install_ros.sh script will try to modify /etc/hosts and automatically run the following commands. However, this method cannot guarantee normal access to github every time. If the following error is displayed after installing ros1 in install_ros.sh, please find other ways to allow the Linux system of the development board to access github normally, and then manually run the following Order.

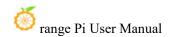
https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/osx-homebrew.yaml Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/base.yaml ERROR: error loading sources list: The read operation timed out

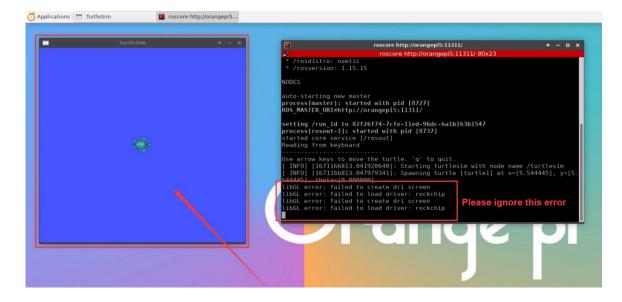
orangepi@orangepi:~\$ source /opt/ros/noetic/setup.bash orangepi@orangepi:~\$ sudo rosdep init Wrote /etc/ros/rosdep/sources.list.d/20-default.list Recommended: please run

rosdep update
orangepi@orangepi:~\$ rosdep update
reading in sources list data from /etc/ros/rosdep/sources.list.d
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/osx-homebrew.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/base.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/python.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/rosdep/ruby.yaml
Hit https://raw.githubusercontent.com/ros/rosdistro/master/releases/fuerte.yaml
Query rosdistro index
https://raw.githubusercontent.com/ros/rosdistro/master/index-v4.yaml
Skip end-of-life distro "ardent"
Skip end-of-life distro "bouncy"
Skip end-of-life distro "crystal"
Skip end-of-life distro "dashing"
Skip end-of-life distro "eloquent"
Add distro "foxy"
Add distro "galactic"
Skip end-of-life distro "groovy"
Add distro "humble"
Skip end-of-life distro "hydro"
Skip end-of-life distro "indigo"
Skip end-of-life distro "jade"
Skip end-of-life distro "kinetic"
Skip end-of-life distro "lunar"
Add distro "melodic"
Add distro "noetic"
Add distro "rolling"
updated cache in /home/orangepi/.ros/rosdep/sources.cache

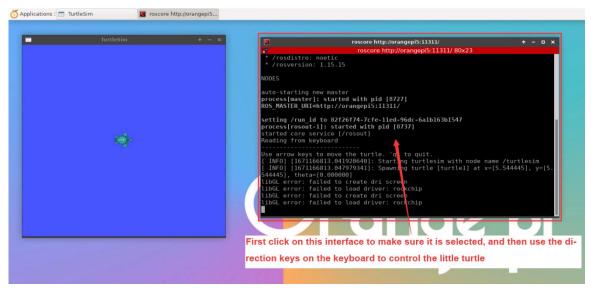
6) Then open a command line terminal window on the desktop, and then use the **test_ros.sh** script to start a small turtle routine to test whether ROS can be used normally orangepi@orangepi:~\$ **test_ros.sh**

7) After running the **test_ros.sh** script, a little turtle as shown in the figure below will pop up

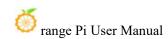


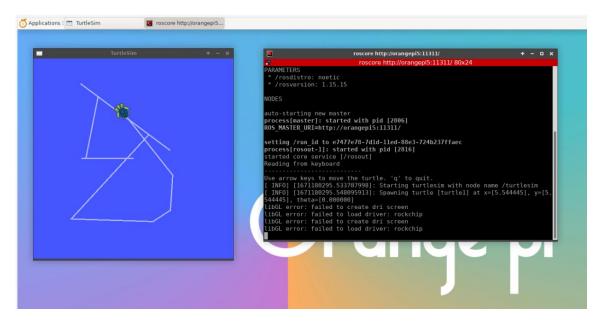


8) Then please keep the terminal window just opened at the top



9) At this time, press the direction keys on the keyboard to control the little turtle to move up, down, left, and right





3. 29. 2. How to install ROS 2 Galactic on Ubuntu 20.04

1) The current active version of ROS 2 is as follows, the recommended version is **Galactic Geochelone**

Active ROS 2 distributions

Recommended

Development



Distro	Release date	Logo	EOL date
Humble Hawksbill	May 23rd, 2022		May 2027
	May 23rd, 2021	GALACTIC GEOCHELONE	November 2022
Foxy Fitzroy	June 5th, 2020		May 2023

http://docs.ros.org

http://docs.ros.org/en/galactic/Releases.html

2) The link to the official ROS 2 **Galactic Geochelone** installation documentation is as follows:

docs.ros.org/en/galactic/Installation.html http://docs.ros.org/en/galactic/Installation/Ubuntu-Install-Debians.html

3) In the ROS 2 Galactic Geochelone official installation document, Ubuntu Linux recommends using Ubuntu 20.04, so please make sure that the system used by the development board is the Ubuntu 20.04 desktop system. There are several ways to install ROS 2. The following demonstrates how to install ROS 2 Galactic Geochelone through Debian packages

4) Use the **install_ros.sh** script to install ros2

orangepi@orangepi:~\$ install_ros.sh ros2

5) **install_ros.sh** script will automatically run the **ros2 -h** command after installing ros2. If you can see the following print, it means that the ros2 installation is complete

usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:

-h.	help
11,	neip

show this help message and exit

Commands:

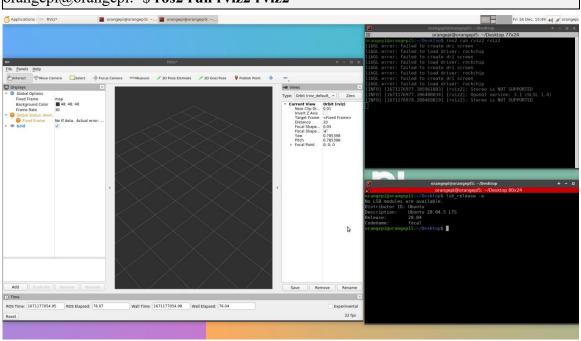
action	Various action related sub-commands
bag	Various rosbag related sub-commands
componer	nt Various component related sub-commands
daemon	Various daemon related sub-commands
doctor	Check ROS setup and other potential issues
interface	Show information about ROS interfaces
launch	Run a launch file
lifecycle	Various lifecycle related sub-commands
multicast	Various multicast related sub-commands
node	Various node related sub-commands
param	Various param related sub-commands
pkg	Various package related sub-commands
run	Run a package specific executable
security	Various security related sub-commands
service	Various service related sub-commands
topic	Various topic related sub-commands
wtf	Use `wtf` as alias to `doctor`
Call `ros2	<command/> -h` for more detailed usage.

6) Then you can use the **test_ros.sh** script to test whether ROS 2 is installed successfully. If you can see the following print, it means that ROS 2 can run normally

2		
orange	pi@orangepi5:~\$ test_ros.sh	
[INFO]	[1671174101.200091527] [talker]: Publishing: 'Hello World: 1'	
[INFO]	[1671174101.235661048] [listener]: I heard: [Hello World: 1]	
[INFO]	[1671174102.199572327] [talker]: Publishing: 'Hello World: 2'	
[INFO]	[1671174102.204196299] [listener]: I heard: [Hello World: 2]	
[INFO]	[1671174103.199580322] [talker]: Publishing: 'Hello World: 3'	
[INFO]	[1671174103.204019965] [listener]: I heard: [Hello World: 3]	

7) Run the following command to open rviz2

orangepi@orangepi:~\$ source /opt/ros/galactic/setup.bash orangepi@orangepi:~\$ ros2 run rviz2 rviz2



8) For the usage of ROS, please refer to the documentation of ROS 2

http://docs.ros.org/en/galactic/Tutorials.html

3. 29. 3. How to install ROS 2 Humble on Ubuntu 22.04

1) Ros2 can be installed using the **install_ros.sh** script

orangepi@orangepi:~\$ install_ros.sh ros2

2) The **install_ros.sh** script will automatically run the **ros2 -h** command after installing ros2. If you can see the following print, it means that the ros2 installation is complete.

usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:

-h, --help show this help message and exit

Commands:

action	Various action related sub-commands
bag	Various rosbag related sub-commands

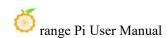
component Various component related sub-commands
daemon Various daemon related sub-commands
doctor Check ROS setup and other potential issues
interface Show information about ROS interfaces
launch Run a launch file
lifecycle Various lifecycle related sub-commands
multicast Various multicast related sub-commands
node Various node related sub-commands
param Various param related sub-commands
pkg Various package related sub-commands
run Run a package specific executable
security Various security related sub-commands
service Various service related sub-commands
topic Various topic related sub-commands
wtf Use `wtf` as alias to `doctor`
Call `ros2 <command/> -h` for more detailed usage.

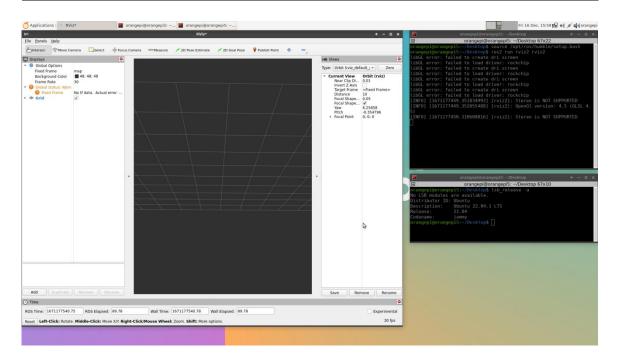
3) Then you can use the **test_ros.sh** script to test whether ROS 2 is installed successfully. If you can see the following print, it means that ROS 2 can run normally

orangepi@orangepi5:~\$ test_ros.sh
[INFO] [1671174101.200091527] [talker]: Publishing: 'Hello World: 1'
[INFO] [1671174101.235661048] [listener]: I heard: [Hello World: 1]
[INFO] [1671174102.199572327] [talker]: Publishing: 'Hello World: 2'
[INFO] [1671174102.204196299] [listener]: I heard: [Hello World: 2]
[INFO] [1671174103.199580322] [talker]: Publishing: 'Hello World: 3'
[INFO] [1671174103.204019965] [listener]: I heard: [Hello World: 3]

4) Run the following command to open rviz2

orangepi@orangepi:~\$ source /opt/ros/humble/setup.bash orangepi@orangepi:~\$ ros2 run rviz2 rviz2





5) Reference documents

http://docs.ros.org/en/humble/index.html http://docs.ros.org/en/humble/Installation/Ubuntu-Install-Debians.html

3. 30. The method of installing the kernel header file

1) The Linux image released by OPi comes with the deb package of the kernel header file by default, and the storage location is **/opt/**

orangepi@orangepi:~\$ ls /opt/linux-headers*

/opt/linux-headers-legacy-rockchip-rk3588_x.x.x_arm64.deb

2) Use the following command to install the deb package of the kernel header file

The name of the kernel header file deb package needs to be replaced with the actual name, please do not copy it.

orangepi@orangepi:~\$ sudo dpkg -i /opt/linux-headers-legacy-rockchip-rk3588_1.x.x_arm64.deb

3) After installation, you can see the folder where the kernel header file is located under /usr/src.

orangepi@orangepi:~\$ ls /usr/src

If it is a system with Linux 5.10 kernel, the output is as follows
linux-headers-5.10.160-rockchip-rk3588
If it is a system with Linux 6.1 kernel, the output is as follows
linux-headers-6.1.43-rockchip-rk3588

4) Then you can write a hello kernel module to test the kernel header file 可以编写一个 hello

a. First write the code of hello kernel module, as shown below:

```
orangepi@orangepi:~$ vim hello.c
#include <linux/init.h>
#include <linux/module.h>
static int hello_init(void)
{
    printk("Hello Orange Pi -- init\n");
    return 0;
}
static void hello_exit(void)
{
    printk("Hello Orange Pi -- exit\n");
    return;
}
```

module_init(hello_init);
module exit(hello exit);

MODULE_LICENSE("GPL");

b. Then write the makefile file that compiles the Hello kernel module, as shown below:

orangepi@orangepi:~\$ vim Makefile ifneq (\$(KERNELRELEASE),) obj-m:=hello.o else

```
KDIR :=/lib/modules/$(shell uname -r)/build

PWD :=$(shell pwd)

all:

make -C $(KDIR) M=$(PWD) modules

clean:

rm -f *.ko *.o *.mod.o *.mod *.symvers *.cmd *.mod.c *.order

endif
```

c. Then use the make command to compile the Hello kernel module, and the output of the compilation process is shown below:

If you compile the code you copy here, if you have any problems, go to the official tool to download the source code test

hello kernel module source code and Makefile

orangepi@orangepi:~\$ make

make -C /lib/modules/5.10.160-rockchip-rk3588/build M=/home/orangepi modules make[1]: Entering directory '/usr/src/linux-headers-5.10.160-rockchip-rk3588'

CC [M] /home/orangepi/hello.o

MODPOST /home/orangepi/Module.symvers

CC [M] /home/orangepi/hello.mod.o

LD [M] /home/orangepi/hello.ko

make[1]: Leaving directory '/usr/src/linux-headers-5.10.160-rockchip-rk3588'

d. After compiling, the Hello.ko kernel module will be generated

orangepi@orangepi:~\$ ls *.ko

hello.ko

e. Use the **Insmod** command to insert the **hello.ko** kernel module into the kernel

orangepi@orangepi:~\$ sudo insmod hello.ko

f. Then use the **demsg** command to view the output of the **Hello.ko** kernel module. If you can see the output instructions below, the **hello.ko** kernel module is loaded correctly

orangepi@orangepi:~\$ dmesg | grep "Hello"

[2871.893988] Hello Orange Pi -- init

g. Use the **rmmod** command to uninstall the **hello.ko** kernel module

orangepi@orangepi:~\$ sudo rmmod hello

orangepi@orangepi:~\$ dmesg | grep "Hello"

[2871.893988] Hello Orange Pi -- init [3173.800892] <mark>Hello Orange Pi -- exit</mark>

3. 31. How to use 10.1 inch MIPI LCD screen

3. 31. 1. 10.1 -inch MIPI screen assembly method

- 1) First prepare the required accessories
 - a. 10.1 -inch MIPI LCD display+touch screen



b. Screen divert plate+31pin to 40pin line



c. 30pin MIPI line



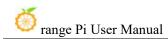
d. 12pin touch screen row line



2) According to the figure below, the 12PIN touch screen row, 31PIN to 40PIN ducts, and 30pin MIPI cables get on the screen dial board. **Pay attention to the blue insulation face of the touch screen row,** the other two lines of the line insulation faces are facing up, If you get an error, it will cause no display or unable to touch

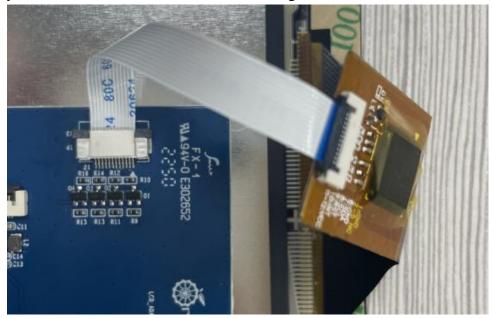


 Place the connected rotor connected to the puzzle on the MIPI LCD screen according to the figure below, and connect the MIPI LCD screen and the rotary board through 31PIN to 40Pin row.

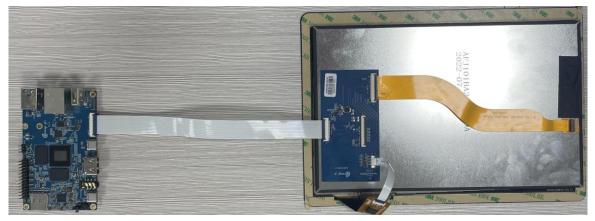




4) Then connect the touch screen and the rotor board through the 12PIN touch screen line, pay attention to the orientation of the insulating surface



5) Finally connect to the LCD interface of the development board through the 30PIN MIPI duct



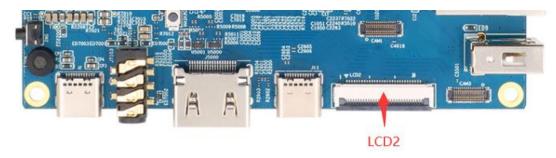
3. 31. 2. Open the 10.1 -inch MIPI LCD screen configuration method

1) The Linux image closed to the configuration of the mipi lcd screen by default. If you need to use the mipi lcd screen, you need to open it manually.

- 2) There are two interfaces of the mipi lcd screen on the development board, we define:
 - a. The location of the lcd1 interface is:



b. The position of the lcd2 interface is:



V.1.1.4 and V.1.1.4 The previous version of the Linux image, The configuration of the LCD DTBO and the definition above are reversed. Please pay attention when using it

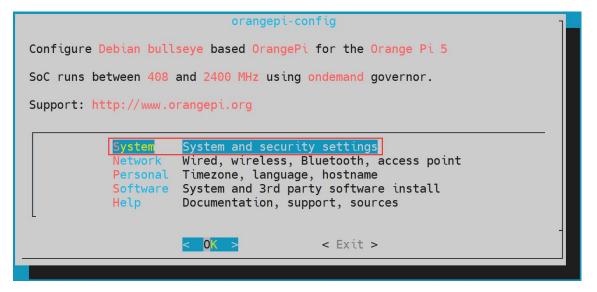
V.1.1.6 and V.1.1.6 later version of the Linux image changed the configuration of the lcd dtbo, which is consistent with the lcd serial number displayed on the

development board

- 3) The steps of opening the mipi lcd configuration are shown below:
 - a. First run the **orangepi-config**, ordinary users remember to add **sudo** permissions

orangepi@orangepi:~\$ sudo orangepi-config

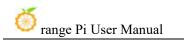
b. Then choose **System**



c. Then choose Hardware

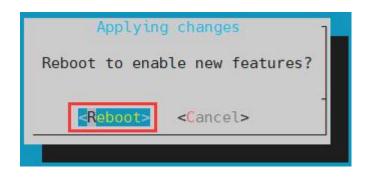
	System settings
Install Bootenv CPU Avahi Hardware SSH Firmware ZSH Desktop	Install to/update boot loader Edit boot environment Set CPU speed and governor Announce system in the network Toggle hardware configuration: UART, I2C, etc. Reconfigure SSH daemon Run apt update & apt upgrade Install ZSH with plugins and tmux Disable desktop or change login type
	< 0 <mark>K ></mark> < Back >

d. Then use the direction keys of the keyboard to position lcd1 or lcd2 (to open which one if you want to use it, and two screens can be opened at the same time), then use the **space** to select



	Toggle hardware configuration
	Use <space> to toggle functions and save them. Exit when you are done.</space>
	<pre>[] can1-m1 [] can2-m1 [] 12c1-m2 [] 12c1-m4 [] 12c3-m0 [] 1cd2 [] ov13850-c1 [] ov13855-c2 [] ov13855-c3 [] ov13855-c3 [] ov13855-c3 [] pwm1-m1 [] pwm1-m2 [] pwm1-m2 [] pwm1-m2 [] pwm3-m0 [] pwm3-m0 [] spi4-m0-cs1-spidev [] ssd-sata [] uart0-m2 [] uart1-m1 [] uart1-m0 [] uart1-m0 [] wifi-ap6275p</pre>
e. Then select <save></save>	
	<pre>[] uart3-m0 [] uart4-m0 [] wifi-ap6275p </pre> <pre>< Back ></pre>
f. Then select <back></back>	
	<pre>[] uart4-m0 [] wifi-ap6275p < Save > < Back ></pre>

g. Then select the **<Reboot>** restart system to make the configuration take effect



The above settings will eventually add overlays=lcd1 or overlays=lcd2 or overlays=lcd1 lcd2 in /boot/orangepiEnv.txt. You can check it first after setting. If this configuration does not exist, then there is a problem with settings

If you think it is more troublesome to use orangepi-config, you can also use vim editors to open/boot/orangepiEnv.txt, and then add overlays=lcd1 or overlays=lcd2 or overlays=lcd1 lcd2 is also OK

orangepi@orangepi:~\$ cat /boot/orangepiEnv.txt | grep "lcd" overlays=lcd1 #Sample configuration

4) After starting, you can see the display of the LCD screen as shown below (the default is vertical screen):



www.orangepi.org

3. 31. 3. The server version of the image rotation display direction method

1) Add **extraargs = fbcon = rotate: the direction to rotate** in **/boot/orangepiEnv.txt**, This configuration can set the direction of the linux system displayed by the server version. Among them, **fbcon=rotate:** The following numbers can be set to:

- a. 0: Normal screen (default vertical screen)
- b. 1: Turn 90 degrees clock
- c. 2: Flip 180 degrees
- d. 3: Turn to 270 degrees clock

orangepi@orangepi:~\$ sudo vim /boot/orangepiEnv.txt overlays=lcd1

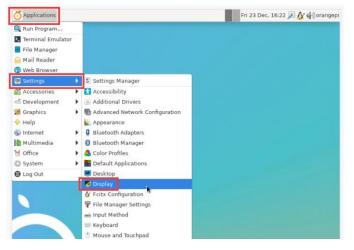
extraargs=cma=64M fbcon=rotate:3

Note that if/boot/orangepienv.txt is configured in the default default exiArgs = CMA = 64M configuration, fbcon = rotate: 3 This configuration can be added to extraargs = cma = 64m (need to be separated by spaces)

2) Then **restart** the Linux system to see that the direction of the LCD screen display has been rotated

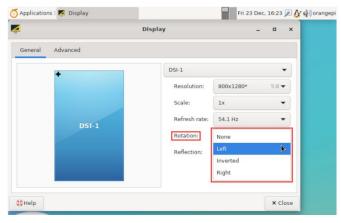
3. 31. 4. The method of rotating and touching the desktop image

1) First open **Display** settings in the Linux system



- 2) Then select the direction you want to rotate in the Rotation
 - a. None: Not rotate

- b. Left: Rotate 90 degrees to the left
- c. Inverted: Flipting up and down, equivalent to rotating 180 degrees
- d. Right: Rotate 90 degrees to the right



3) Then click Apply

	Display	_ = ×
General Advanced		
	DSI-1	•
+	Resolution:	800x1280* 5:8 ▼
	Scale:	1x 💌
DSI-1	Refresh rate	e: 54.1 Hz 👻
USI-I	Rotation:	Left 👻
	Reflection:	None 🔻
		✓ Apply

4) Then choose Keep this configuration

Applications 🛛 🗾 Display	Confirmation		
	Display	_ = ×	
General Advanced			
	DSI-1	•	
+	Resolution:	800x1280* 5:8 -	
	Scale:	1x 💌	
DSI-1	Refresh rate:	54.1 Hz 👻	
	Rotation:	Left 👻	
*	Confirmation	Nono ↑ - ×	
	keep this configuration	r? if you do not reply to this question.	09
)не	p this configuration	Restore the previous configuration	

5) At this time, the screen display has been rotated, and then the **Display** program is turned off.

6) The above steps will only select the display direction, and it will not rotate the direction of touch. Use **set_lcd_rotate.sh** script to rotate the direction of touch. After this script is set, it will be automatically restarted, Then you can test whether the touch can be used normally.

a. None: Not rotate

orangepi@orangepi:~\$ set_lcd_rotate.sh none	
b. Left: Rotate 90 degrees to the left	
orangepi@orangepi:~\$ set_lcd_rotate.sh left	

c. **Inverted**: Flipting up and down, equivalent to rotating 180 degrees

orangepi@orangepi:~\$ set_lcd_rotate.sh inverted

d. **Right**: Rotate 90 degrees to the right

orangepi@orangepi:~\$ set_lcd_rotate.sh right

set_lcd_rotate.sh script mainly does four things:

- 1. Rotate the direction displayed by Framebuffer
- 2. The direction of rotating touch
- 3. Turn off the boot logo
- 4. Restart the system

The direction of the rotation touch is achieved by adding Option x'' "TransformationMatrix""x X X X in X X X X /usr/share/X11/xorg.conf.d/40-libinput.conf,Among them, "x x x x x x x x x" is different in different directions

7) Touch rotation reference materials https://wiki.ubuntu.com/X/InputCoordinateTransformation

3. 32. Instructions for opening the logo use

1) The default logo is displayed by default in the desktop version of the system

2) Set the **bootlogo** variable to **false** in **/boot/orangepiEnv.txt** to turn off the switch to the logo

orangepi@orangepi:~\$ vim /boot/orangepiEnv.txt verbosity=1 bootlogo=false

3) Set the bootlogo variable to true in/boot/orangepiEnv.txt to turn the turn -off logo orangepi@orangepi:~\$ vim /boot/orangepiEnv.txt verbosity=1
bootlogo=true

4) The location of the logo picture in the Linux system is /usr/share/plymouth/themes/orangepi/watermark.png

3. 33. OV13850 and OV13855 MIPI test methods for testing methods

Please note that in Linux 6.1 system, in order to ensure that the 3A service can run normally and obtain normal camera images, the Docker service needs to be disabled. If the Docker service is not disabled, the image captured by the camera will not contain the 3A effect and will appear as a dark image. The method to disable the Docker service is as follows:

orangepi@orangepi:~\$ sudo systemctl disable docker.socket docker.service containerd.service orangepi@orangepi:~\$ sudo reboot

At present, the development board supports two MIPI cameras, OV13850 and OV13855. The specific pictures are shown below:

a. OV13850 camera at13 MP MIPI interface



b. OV13855 camera at 13MP MIPI interface

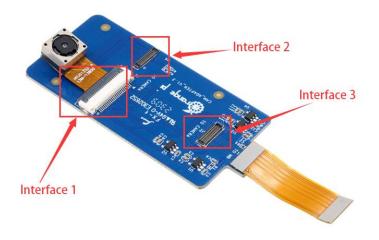


The rotary board and the FPC cable used by OV13850 and OV13855 cameras is the same, but the two cameras are different from the position on the rotary board. The FPC exhaust line is shown in the following figure. Please note that the FPC line is directed. The end is marked **TO MB** that it needs to be inserted into the camera interface of the development board. The another end is marked **TO CAMERA** that the end of the Camera needs to be inserted to the camera transfer board.



There are a total of 3 cameras on the camera to connect to the board, which can only be used at the same time, as shown in the figure below:

- a. 1 interface is connected to the OV13850 camera
- b. 2 interface OV13855 camera
- c. 3 interface is not used, just ignore it



Orange Pi 5 has a total of 3 camera interfaces on the development board. We define the positions of Cam1, Cam2 and Cam3 as shown in the figure below:



The method of the Cam1 interface inserted in the camera is shown below:



The method of the Cam2 interface inserted in the camera is shown below:



The method of the Cam3 interface inserted in the camera is shown below:



After connecting the camera to the development board, we can use the following method to test the camera:

a. First run the **orangepi-config**. Ordinary users remember to add **sudo** permissions

```
orangepi@orangepi:~$ sudo orangepi-config
   b.
       Then choose System
                              orangepi-config
  Configure Ubuntu jammy based OrangePi for the Orange Pi 5
  SoC runs between 408 and 2400 MHz using ondemand governor.
  Support: http://www.orangepi.org
                        System and security settings
              System
                       Wired, wireless, Bluetooth, access point
              Personal Timezone, language, hostname
             Software System and 3rd party software install
             Help
                       Documentation, support, sources
                                             < Exit >
                           0K
```

c. Then choose Hardware

Bootenv	Edit boot environment
CPU	Set CPU speed and governor
Avahi	Announce system in the network
Hardware	Toggle hardware configuration: UART, I2C, etc.
SSH	Reconfigure SSH daemon
Firmware	Run apt update & apt upgrade
ZSH	Install ZSH with plugins and tmux
Desktop	Disable desktop or change login type
	< OK > < Back >

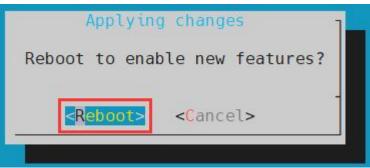
d. Then use the direction key of the keyboard to position the position shown in the figure below, and then use the space to select the camera you want to open. Among them, ov13850-c1 indicates that the OV13850 camera is used in the CAM1 interface of the development board. ov13855-c2 indicates that the OV13855 camera is used in the CAM2 interface of the development board, and other configurations can be pushed.



f. Then select **<Back>**



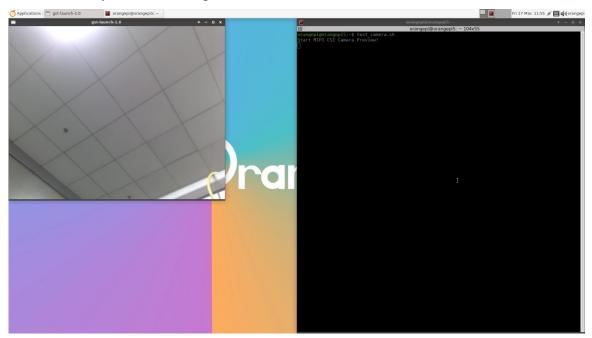
g. Then select<Reboot>Restart the system to make the configuration effective



h. Then open a terminal in the desktop system and run the script below

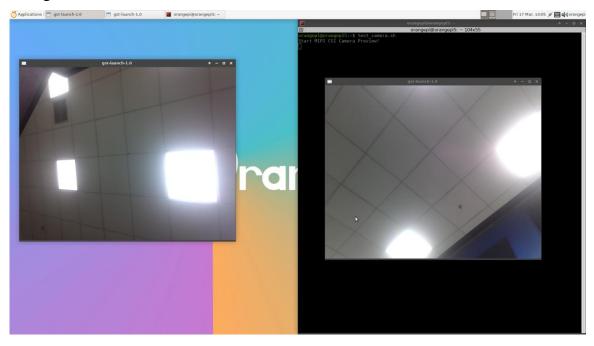
orangepi@orangepi:~\$ test_camera.sh

i. Then you can see the preview screen of the camera



In addition to single cameras, we can also use two cameras at the same time. It should be noted that the current test dual camera should be used for combinations of **Cam1+Cam3** (supporting OV13850 and OV13855 mix and match). After connect the dual camera, like the previous steps, open the configuration of the Cam1+Cam3 through

orangepi-config, restart the system, and then open the terminal on the desktop to run the test_camera.sh script to see the preview screen of the two cameras, as follows Shown in the figure:



Please refer to the link below for the camera dts configuration. If you need it, you can modify it by yourself;

https://github.com/orangepi-xunlong/linux-orangepi/blob/orange-pi-5.10-rk3588/arc h/arm64/boot/dts/rockchip/rk3588s-orangepi-5-camera1.dtsi

https://github.com/orangepi-xunlong/linux-orangepi/blob/orange-pi-5.10-rk3588/arc h/arm64/boot/dts/rockchip/rk3588s-orangepi-5-camera2.dtsi

https://github.com/orangepi-xunlong/linux-orangepi/blob/orange-pi-5.10-rk3588/arc h/arm64/boot/dts/rockchip/rk3588s-orangepi-5-camera3.dtsi

dt overlay configuration is in the directory below:

https://github.com/orangepi-xunlong/linux-orangepi/tree/orange-pi-5.10-rk3588/arc h/arm64/boot/dts/rockchip/overlay

3. 34. How to use the ZFS file system

3. 34. 1. How to install ZFS

Before installing zfs, please make sure that the Linux image you are using is the latest version. In addition, if zfs is already installed in the system, there is no need to install it again.

Before installing zfs, you first need to install the kernel header files. For how to install the kernel header files, please refer to the instructions in the section "How to Install the Kernel Header Files."

In Ubuntu20.04, Ubuntu22.04 and Debian11 systems, zfs cannot be installed directly through apt. This is because the zfs version in the default apt source is lower than 2.1.6 and is incompatible with the rk linux5.10 kernel. This problem is fixed in zfs 2.1.6 and later versions

In order to solve this problem, we provide a deb package of zfs that can be installed normally, which can be downloaded from the official tool of the development board. Open the official tool and enter the zfs-related deb package folder used by Ubuntu and Debian systems. You can see three types of deb packages for Ubuntu20.04, Ubuntu22.04 and Debian11. Please download the required version.



After downloading the corresponding version of the zfs deb package, please upload them to the Linux system of the development board. For the upload method, please refer to the instructions in the Methods of Uploading Files to the Development Board Linux System.

After the upload is completed, use the **cd** command on the command line of the development board Linux system to enter the directory of the deb package, and then use the following command to install the zfs deb package.

orangepi@orangepi:~\$ sudo apt install ./*.deb

After the installation is complete, use the following command to see the zfs-related kernel modules:

orangepi@orangepi:~\$ ls /lib/modules/5.10.160-rockchip-rk3588/updates/dkms/ icp.ko spl.ko zavl.ko zcommon.ko zfs.ko zlua.ko znvpair.ko zunicode.ko zzstd.ko

If it is a Linux 6.1 system, use the following command to see the zfs-related kernel modules:

orangepi@orangepi:~\$ ls /lib/modules/6.1.43-rockchip-rk3588/updates/dkms/ icp.ko spl.ko zavl.ko zcommon.ko zfs.ko zlua.ko znvpair.ko zunicode.ko zzstd.ko

Then restart the Linux system and you will see that the zfs kernel module will be automatically loaded:

orangepi@orangep	i:~\$ lsmod gre	p "zfs"
zfs	2801664	0
zunicode	327680	1 zfs
zzstd	471040	1 zfs
zlua	139264	1 zfs
zcommon	69632	2 1 zfs
znvpair	61440	2 zfs,zcommon
zavl	16384	1 zfs
icp	221184	1 zfs
spl	77824	6 zfs,icp,zzstd,znvpair,zcommon,zavl

In Debian12, the default version of zfs is 2.1.11, so we can install zfs directly through the following command. Again, we need to make sure that the system has the deb package of the kernel header file installed before installation.

orangepi@orangepi:~\$ sudo apt install -y zfsutils-linux zfs-dkms

3. 34. 2. How to create a ZFS pool

ZFS is based on storage pools. We can add multiple physical storage devices to the pool and then allocate storage space from this pool.

The following content is demonstrated based on the development board being connected to an NVMe SSD and a USB flash drive.

1) First, we can use the **lsblk** command to view all storage devices on the development board. Currently, the development board is connected to an NVMe SSD and a USB flash drive. The output is as follows:

		÷ 1.				
orangepi@ora	angep::~:	β L	SDLK			
NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINTS
sda	8:0	1	28.8G	0	disk	
—sda1	8:1	1	28.8G	0	part	
└─sda9	8:9	1	8M	0	part	
mtdblock0	31:0	0	16M	0	disk	
mmcblk0	179:0	0	29.7G	0	disk	
-mmcblk0p1	179:1	0	1G	0	part	/boot
-mmcblk0p2	179:2	0	28.4G	0	part	/var/log.hdd
						/
zram0	254:0	0	7.7G	0	disk	[SWAP]
zram1	254:1	0	200M	0	disk	/var/log
nvme0n1	259:0	0	476.9G	0	disk	
—nvme0n1p1	259:3	0	476.9G	0	part	
└─nvme0n1p9	259:4	0	8M	0	part	
orangepi@ora	angepi:~	\$				

2) Then enter the following command to create a ZFS pool, including two storage devices: NVMe SSD and USB flash drive.

orangepi@orangepi:~\$ sudo zpool create -f pool1 /dev/nvme0n1 /dev/sda

3) Then use the **zpool list** command to see that the system has created a ZFS pool named **pool1**, and the size of the ZFS pool pool1 is the size of the NVME SSD plus the size of the USB flash drive.

orangep	oi@oran	gepi:~\$	zpool	list						CONTRACTOR -
NAME	SIZE	ALLOC	FREE	CKPOINT	EXPANDSZ	FRAG	CAP	DEDUP	HEALTH	ALTROOT
pool1	504G	114K	504G			0%	0%	1.00x	ONLINE	

4) Then execute **df -h** and you can see that **pool1** is mounted to the /**pool1** directory.

orangepi@orangepi:~\$ df -h					
Filesystem	Size 1	Used Ava	ail Use%	Mounted on	
tmpfs	1.6G	18M	1.6G	2% /run	
/dev/mmcblk0p2	29G	6.0G	22G	22% /	
tmpfs	7.7G	46M	7.7G	1% /dev/shm	
tmpfs	5.0M	4.0K	5.0M	1% /run/lock	
tmpfs	7.7G	944K	7.7G	1% /tmp	
/dev/mmcblk0p1	1022M	115M	908M	12% /boot	
/dev/zram1	188M	4.5M	169M	3% /var/log	
tmpfs	1.6G	80K	1.6G	1% /run/user/1000	

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pool1 489G 9.3M 489G 1% /pool1

5) Use the following command to see that the file system type of pool1 is zfs

orangepi@orangepi:~\$ mount | grep pool1

pool1 on /pool1 type zfs (rw,xattr,noacl)

6) Then we can test copying a file to the ZFS pool

orangepi@orangepi:~\$ sudo cp -v /usr/local/test.mp4 /pool1/

'/usr/local/test.mp4' -> '/pool1/test.mp4'

3. 34. 3. Test the data deduplication function of ZFS

1) The data deduplication function of ZFS is turned off by default. We need to execute the following command to turn it on.

orangepi@orangepi:~\$ sudo zfs set dedup=on pool1

2) Then do a simple test, first enter pool1, and then execute the following command to generate a random file of 1G size

orangepi@orangepi:~\$ cd /pool1/

root@orangepi:/pool1\$ sudo dd if=/dev/urandom of=test.1g bs=1M count=1024

1024+0 records in

1024+0 records out

1073741824 bytes (1.1 GB, 1.0 GiB) copied, 5.04367 s, 213 MB/s

3) Then use the following command to copy 1000 copies of a random file of 1G size root@orangepi:/pool1\$ for ((i=0; i<1000; i++)); do sudo cp test.1g \$i.test.1g; done

4) Then use **du -lh** to see that there is currently a total of 1002G of data in the pool, but in fact the size of the ZFS pool is only **504GB** (the total capacity of SSD + U disk), which cannot hold such large data.

root@orangepi:/pool1\$ **du -lh** 1002G

5) Then use the **zpool list** command to see that only 1.01G is actually occupied, because these 1001 files are duplicates, indicating that the data deduplication function is effective.

orangep	loran	gepi:/po	JOLIŞ Z	ροοι ιιστ						
NAME	SIZE	ALLOC	FREE	CKPOINT	EXPANDSZ	FRAG	CAP	DEDUP	HEALTH	ALTROOT
pool1	504G	1.01G	503G		-	0%	0%	6.00x	ONLINE	

3. 34. 4. Test the data compression function of ZFS

1) Because the stored data is different, the disk space saved by compression will also be different, so we choose to compress relatively large plain text files for compression testing. Execute the following command to package the **/var/log/** and **/etc/** directories. into tarball

orangepi@orangepi:~\$ cd /pool1/
root@orangepi:/pool1\$ sudo tar -cf text.tar /var/log/ /etc/

2) Then the file size that can be seen through the **ls -lh** command and the space occupied

in the ZFS pool are both 27M

	1									
orangep	oi@oran	gepi:/po	ol1\$ l	s -lh						
total 2	total 27M									
- rw-r	r 1	root roo	ot 27M	Jun 1 14	:46 text.ta	ar				
orangep	oi@oran	gepi:/pc	oll\$ z	pool list						
NAME	SIZE	ALLOC	FREE	CKPOINT	EXPANDSZ	FRAG	CAP	DEDUP	HEALTH	ALTROOT
pool1	504G	26.7M	504G			0%	0%	1.00x	ONLINE	-
orangep	oi@oran	gepi:/pc	oll\$							

3) Then we enable compression in ZFS pool pool1

root@orangepi:/pool1\$ sudo zfs set compression=lz4 pool1

4) Then execute the following command again to package the /var/log/ and /etc/ directories into a tar package

root@orangepi:/pool1\$ sudo tar -cf text.tar /var/log/ /etc/

5) At this time, you can see that the **text.tar** file size is still 27M, but it only occupies 9.47M space in the ZFS pool, indicating that the file is compressed.

total s -rw-r	9.2M r 1		ot 27M	Jun 1 14	:54 text.ta	ar				
orangep	orangepi@orangepi:/pool1\$ zpool list									
NAME	SIZE	ALLOC	FREE	CKPOINT	EXPANDSZ	FRAG	CAP	DEDUP	HEALTH	ALTROOT
pool1	504G	9.47M	504G			0%	0%	1.00x	ONLINE	-

3. 35. How to install and use CasaOS

CasaOS is an open source home cloud system based on the Docker ecosystem, which allows you to run a variety of home applications on your own development board, such as NAS, home automation, media servers, etc. There are many problems with installing CasaOS in Debian12, please do not use this method to install.

3. 35. 1. CasaOS installation method

1) First you need to install docker. Docker is already pre-installed in the system released by Orangepi Pi. This step can be skipped. You can use the following command to check the version of docker installed.

orangepi@orangepi:~\$ dockerversion	
Docker version 24.0.2, build cb74dfc	# Ubuntu Jammy system output

2) Then enter the following command in the linux system to start the installation of CasaOS

orangepi@orangepi:~\$ curl -fsSL https://get.casaos.io | sudo bash

3) When you see the terminal outputting the following print information, it means that CasaOS has been installed.

CasaOS v0.4.4.2 is running at:

Open your browser and visit the above address.

: casaos-uninstall

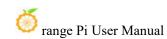
CasaOS Project	: https://github.com/IceWhaleTech/CasaOS
CasaOS Team	: https://github.com/IceWhaleTech/CasaOS#maintainers
CasaOS Discord	: https://discord.gg/knqAbbBbeX
Website	: https://www.casaos.io
Online Demo	: http://demo.casaos.io

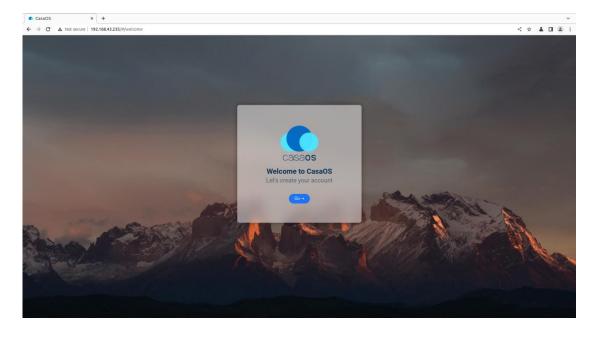
3. 35. 2. How to use CasaOS

1) After installing CasaOS, enter http://the IP address of the development board in the browser to open CasaOS

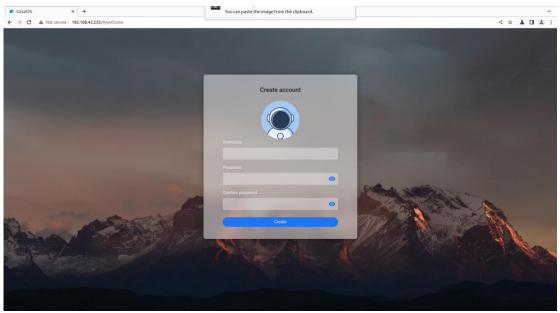
2) After opening CasaO, the following welcome interface will pop up. Click "Go" to proceed to the next step.

Uninstall

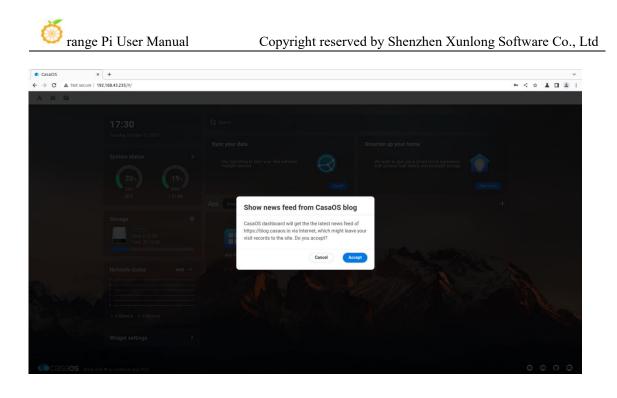




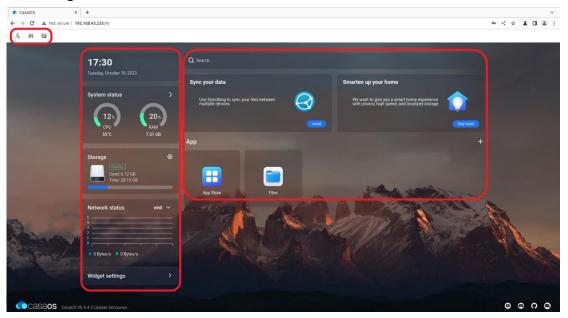
3) When you log in to CasaOS for the first time, the login interface is the interface for setting the account and password. When you log in again, only the interface for entering the account and password will appear. After setting the account and password, click "Create" to proceed to the next step.



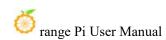
4) Click "Accept" directly in the interface below to proceed to the next step.

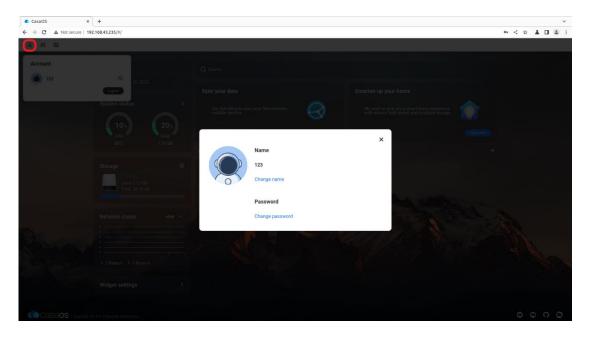


5) Now enter the main page of CasaOS. There are three icons in the upper left corner for function settings. On the left is the performance panel, which can display the current time and status information of CPU, RAM, storage, and network. On the right is the function panel. It has functions such as search, application recommendation, application store and file management.

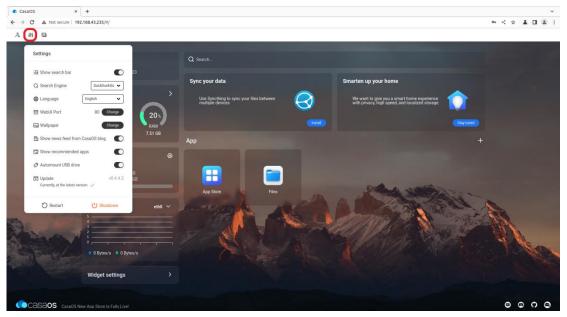


6) You can click the first icon in the upper left corner to modify the account number and password

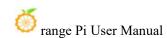


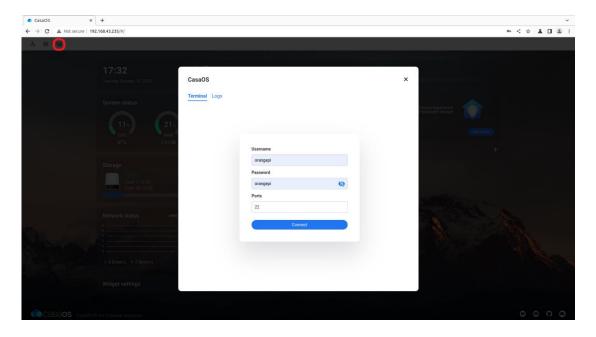


7) You can click the second icon to set basic functions

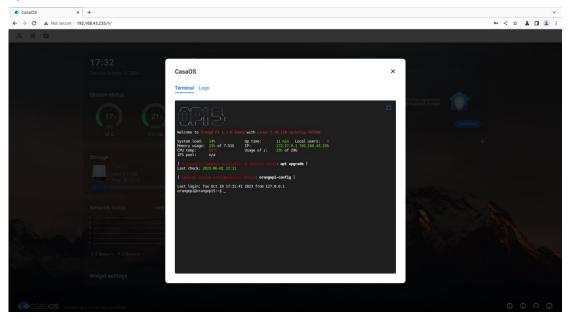


8) The third icon in the upper left corner mainly has two functions, namely switching to command line mode and printing log information. When switching to command line mode, you need to enter your account and password. The account and password here refer to the development board. Linux system account and password, the port system defaults to number 22

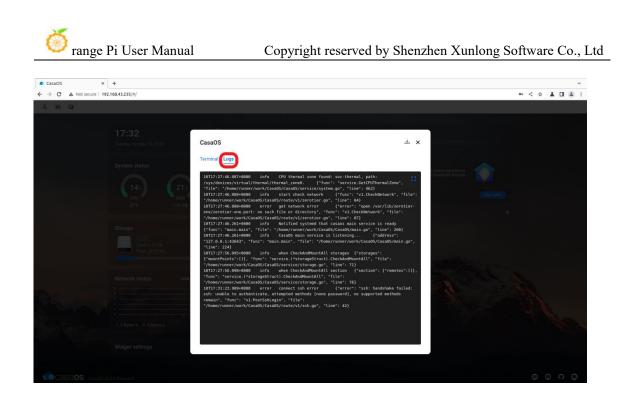




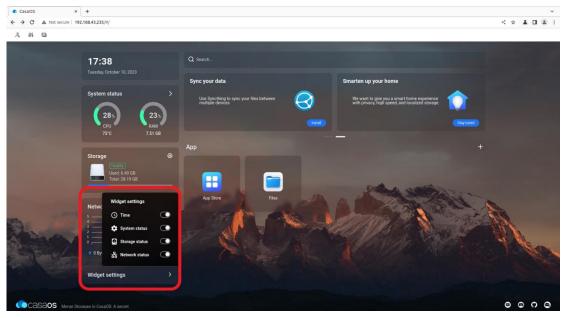
9) Then click "Connect" to enter the command line interface:



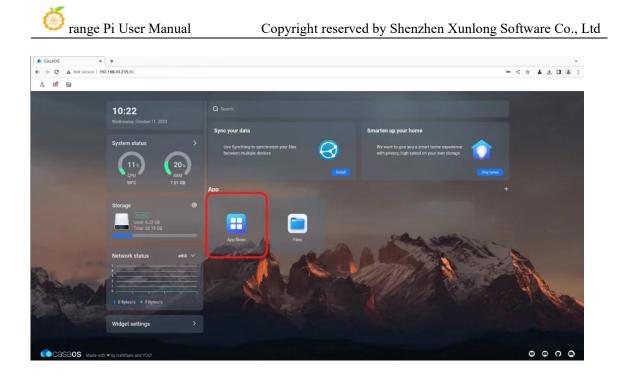
10) Another function under the third icon is to print CasaOS logs. Click "Logs" to enter. The interface is as follows:



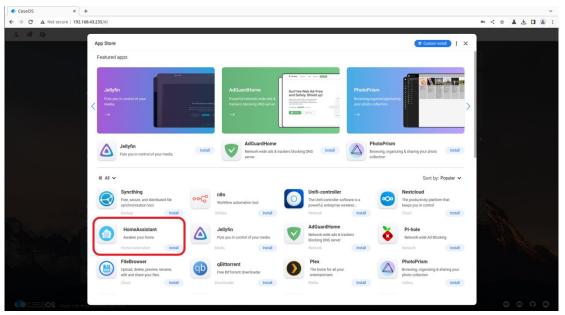
11) Click "Widget settings" in the lower left corner to set whether to display the widgets of the performance panel on the main page.



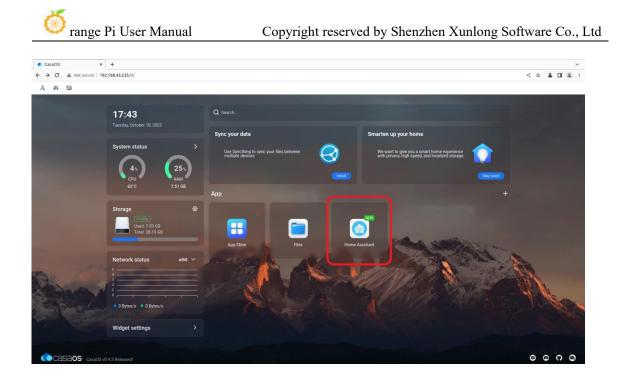
12) Click "APP Store" on the main interface to open the app store. Currently, there are a total of 70+ APPs available in the app store.



13) Here we take Home Assistant as an example to download, find Home Assistant in the APP Store, and then click the corresponding "install"



14) After the download is completed, HostAssitant will appear on the main page.



15) Click "Files" in the main interface to open the file system that comes with CasaOS, and then you can upload and save files.



🥮 ran	ge Pi User l	Manual		Соруг	ight reserved by Shenz	zhen Xunlong Software Co.,
	× +					~
CasaOS → C ▲ Not sec	× + ture 192.168.43.235/#/					~ ~ < ☆ ▲ □ ≗ :
Files	Root > DATA					🛛 Upload or create 🔰 📔 🗙
Root	 Total 5 items 					88
DATA	-					
Documents		=	$\overline{\mathbf{v}}$			
Downloads	AppData	Documents	Downloads	Gallery	Media	
🔁 Gallery	10/10 05:27		10/10 05:27			
Media						
ocation	+					
art sharing your files on the	e local network. 🗙					
Shared						

16) When uploading files, you need to switch to the target folder, then drag the local file to the indicated area in the picture, or click "Upload or Create" in the upper right corner to select the file to upload.

CasaOS ×	+		~
← → C ▲ Not secure 15	92.168.43.235/#/		< 🖈 👗 🖬 😩 E
Files	Root > DATA > Media > TV Shows		V Upload or create
T Root	 Total 0 items 		88
DATA			
Documents			
Downloads			
No. Gallery			
Media			
Location +		Drop your files here to upload	
		or	
		New file New folder Upload files Upload folder	
		Dh Em Dh Em	
FilesDrop			
Shared			

17) If you want to uninstall CasaOS, you can use the following command:

orangepi@orangepi5:~\$ casaos-uninstall

3. 36. Methods of using NPU

3. 36. 1. **Preparation tools**

1) A PC with Ubuntu20.04 operating system installed

According to the official documentation of RKNN-Toolkit2, the operating systems supported by the current version of RKNN-Toolkit2 are as follows:

a. Ubuntu18.04 (x64)

b. Ubuntu20.04 (x64)

c. Ubuntu22.04 (x64)

In this document, we use Ubuntu20.04 (x64) operating system for demonstration. Please test other versions of operating systems by yourself.

- 2) An Orange Pi 5 development board with Debian 11 system installed
- 3) A data cable with Type-C interface for using adb function



3. 36. 2. Install RKNN-Toolkit2 on Ubuntu PC

Toolkit2 is a development kit used on the Ubuntu PC platform. Users can use the Python interface provided by the tool to easily complete functions such as model conversion, inference, and performance evaluation.

1) On the Ubuntu PC side, open a command line window and enter the following commands to install python3 and pip3

test@test:~\$ sudo apt-get install python3 python3-dev python3-pip

2) You can use the following command to view the installed version of python3
 test@test:~\$ python3 --version

Python 3.8.10

3) Then enter the following command to install the dependency package of RKNN-Toolkit2

test@test:~\$ sudo apt-get update

test@test:~\$ sudo apt-get install libxslt1-dev zlib1g-dev libglib2.0 \

libsm6 libgl1-mesa-glx libprotobuf-dev gcc

4) Then enter the following command to download the 1.5.2 version of RKNN-Toolkit2 test@test:~\$ git clone git clone https://github.com/airockchip/rknn-toolkit2 -b v1.5.2

5) Then enter the following command to install the corresponding version of Python3 dependency packages. This command will use pip3 to install the dependencies listed in the file requirements_cp38-1.5.2.txt. If the dependencies are not fully installed, do not specify the installation source and install each package separately.

test@test:~\$ pip3 install -r rknn-toolkit2/doc/requirements_cp38-1.5.2.txt -i \ https://mirror.baidu.com/pypi/simple

6) Then enter the following command to use pip3 to install the RKNN-Toolkit2 software package. After the installation is complete, you can use RKNN-Toolkit2

test@test:~\$ pip3 install rknn-toolkit2/packages/rknn_toolkit2-1.5.2+b642f30c-cp38-cp38-linux_x86_64.whl

3. 36. 3. Use RKNN-Toolkit2 for model conversion and model inference

RKNN-Toolkit2 supports converting Caffe, TensorFlow, TensorFlow Lite, ONNX, DarkNet, PyTorch and other models into RKNN models, and then ru ns the RKNN model through simulation on the Ubuntu PC or using the NPU of the development board for inference.

Relevant examples are provided in the example folder of RKNN-Toolkit2 to help users better understand how to operate. We take the ONNX model wi th yolov5 function as an example to illustrate.

3. 36. 3. 1. Simulate running model on Ubuntu PC

RKNN-Toolkit2 is equipped with a built-in simulator, which allows users t o simulate the inference process of the model on the Rockchip NPU on the U buntu PC.

In this way, model conversion and inference can be completed on the Ub untu PC side, helping users test and verify their models faster.

1) First switch to the rknn-toolkit2/examples/onnx/yolov5 directory

test@test:~\$ cd rknn-toolkit2/examples/onnx/yolov5/

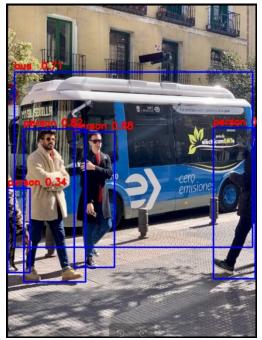
2) Then run the test.py script, which first converts the yolov5s_relu.onnx model into an RKNN model that can be run on the simulator, and then uses the simulator to simulate and run the model to perform inference on the bus.jpg image in the current directory test@test:~/rknn-toolkit2/examples/onnx/yolov5\$ python3 test.py

3) After the test.py script is successfully run, you will see the following print information, indicating that the model successfully detected four people and a bus in the bus.jpg picture.

done --> Running model W inference: The 'data format' has not been set and defaults is nhwc! done class: person, score: 0.884139358997345 box coordinate left,top,right,down: [209.1040009856224, 244.4304337501526, 286.5742521882057, 506.7466902732849] class: person, score: 0.8676778078079224 box coordinate left,top,right,down: [478.5757632255554, 238.58572268486023, 559.5273861885071, 526.479279756546] class: person, score: 0.8246847987174988 box coordinate left,top,right,down: [110.57257843017578, 238.58099019527435, 230.54625701904297, 534.0008579492569] class: person, score: 0.3392542004585266 box coordinate left,top,right,down: [79.96397459506989, 354.9062474966049, 122.13020265102386, 516.2529321908951] class: bus, score: 0.7012234926223755 box coordinate left,top,right,down: [94.43931484222412, 129.53470361232758, 553.1492471694946, 468.0852304697037] D NPUTransfer: Transfer client closed, fd = 3

4) The converted model file yolov5s_relu.rknn and the inference picture result result.jpg are saved in the current directory

5) The result.jpg picture shows the object categories and confidence rates detected in the bus.jpg picture using the yolov5s_relu.rknn model.



3. 36. 3. 2. Using the NPU running model of the development board on Ubuntu PC

RKNN-Toolkit2 provides users with a Python interface for using the NPU of the development board for inference through adb. It allows users to use t he NPU of the development board on the Ubuntu PC to run the model for i nference.

In this way, the Ubuntu PC side can use the machine learning library pr ovided by Python to optimize and adjust the model based on the actual effect when the model is run on the NPU of the development board.

3. 36. 3. 2. 1. Use Type-C data cable to connect adb

Use adb to operate the development board on the Ubuntu PC. For how to use adb, please see the instructions in the section "How to use ADB".

www.orangepi.org

3. 36. 3. 2. 2. Update the rknn_server and librknnrt.so of the development board

librknnrt.so is a board-side runtime library.

rknn_server is a background proxy service running on the development b oard. It is used to receive the protocol transmitted from the PC through USB, then execute the corresponding interface in the board-side runtime library, a nd return the results to the PC.

1) First enter the following command on Ubuntu PC to download version 1.5.2 of RKNPU2

test@test:~\$ git clone https://github.com/rockchip-linux/rknpu2 -b v1.5.2

2) Then enter the following command on the Ubuntu PC to update the rknn_server of the development board through the adb tool

test@test:~\$ adb push rknpu2/runtime/RK3588/Linux/rknn_server/aarch64/usr/bin/* /usr/bin

3) Then enter the following command on the Ubuntu PC side to update the librknnrt.so library of the development board through the adb tool

test@test:~\$ adb push rknpu2/runtime/RK3588/Linux/librknn_api/aarch64/librknnrt.so /usr/lib

4) Open the terminal of the development board through the adb tooltest@test:~\$ adb shell

5) Open the rknn_server service of the development board

root@orangepi5:/# restart rknn.sh

root@orangepi5:/# start rknn server,version:1.5.2(8babfeabuild@2023-08-25T10:30:3 1)

I NPUTransfer: Starting NPU TransferServer, Transfer version 2.1.0(b5861e7@2020-11-23T11:50:51)

6) You can use the following command to check. If the process ID of rknn_server appears, it means that rknn_server has been opened, so that the operating environment of the development board is set up.

root@orangepi5:/# pgrep rknn_server 3131

3. 36. 3. 2. 3. Modify the parameters in the example

1) On the Ubuntu PC side, you can view the device ID of the development board connected to the Ubuntu PC by running the following command. This ID will be used below.

test@test:~\$ **adb devices** List of devices attached 4f9f859e5a120324 device

2) Switch to the rknn-toolkit2/examples/onnx/yolov5 directory

test@test:~\$ cd rknn-toolkit2/examples/onnx/yolov5/

3) Use vim editor to modify the test.py file

test@test:~/rknn-toolkit2/examples/onnx/yolov5\$ vim test.py

- 4) In the test.py file, we need to modify the following content:
 - a. In the preprocessing configuration, change the target platform to rk3588, so that after model conversion, you will get an RKNN model suitable for the NPU of the RK3588S development board.



b. In the initialization running environment, add a description of the target platform and device ID. The target platform is rk3588, and the device ID is the device ID of the development board obtained through adb. The operation of running the model for inference will be on the RK3588S development board. Performed on NPU

Init runtime environment
<pre>print('> Init runtime environment')</pre>
ret = rknn.init_runtime(target='rk3583 ,device_id='4f9f859e5a120324')
if ret != 0:
<pre>print('Init runtime environment failed!')</pre>
<pre>exit(ret)</pre>
<pre>print('done')</pre>

c. After modification, save and exit.

3. 36. 3. 2. 4. Run the example on Ubuntu PC

1) Enter the following command to run the test.py script. The script first converts the yolov5s_relu.onnx model to an RKNN model, and then loads the model to the NPU of the development board to perform inference on the out.jpg image in the current directory. test@test:~/rknn-toolkit2/examples/onnx/yolov5\$ python3 test.py

2) In the printed information, we can see that Ubuntu PC uses the NPU of the development board to run the model for inference through the adb tool.

--> Init runtime environment
I target set by user is: rk3588
I Check RK3588 board npu runtime version
I Starting ntp or adb, target is RK3588
I Device [4f9f859e5a120324] not found in ntb device list.
I Start adb...
I Connect to Device success!
I NPUTransfer: Starting NPU Transfer Client, Transfer version 2.1.0
(b5861e7@2020-11-23T11:50:36)

3) After the test.py script runs successfully, the converted model file yolov5s_relu.rknn and the inference image result result.jpg are saved in the current directory.

4) The running result is the same as the section on simulating the running model on **Ubuntu PC**.

3. 36. 4. Call the C interface to deploy the RKNN model and run it on the development board

RKNPU2 provides a C programming interface for chip platforms with Ro ckchip NPU, which can help users deploy RKNN models exported using RKN N-Toolkit2 and accelerate the implementation of AI applications.

In the example folder of RKNPU2, examples of deploying RKNN models with different functions to the development board are provided. We take depl oying the RKNN model with yolov5 function to the RK3588 Debian 11 platfo rm as an example to illustrate.

3. 36. 4. 1. **Download cross-compilation tools**

Since the development board runs a Linux system, it needs to be compiled u sing the gcc cross compiler. It is recommended to use gcc-9.3.0-x86_64_arrch64-li nux-gnu this version of gcc

Enter the following command to download this version of gcc. After downloa ding, you will get a folder named gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rock chip-linux-gnu

test@test:~\$ git clone https://github.com/airockchip/gcc-buildroot-9.3.0-2020.03-x86_64_aarch 64-rockchip-linux-gnu

3. 36. 4. 2. Modify the compilation tool path in the script

Switch to the rknpu2/examples/rknn_yolov5_demo directory
 test@test:~\$ cd ~/rknpu2/examples/rknn_yolov5_demo

2) Use vim editor to modify the content in the build-linux_RK3588.sh file
 test@test:~/rknpu2/examples/rknn yolov5 demo\$ vim build-linux RK3588.sh

3) In the build-linux_RK3588.sh file, we need to change the value of the variable TOOL_CHAIN to the path of the gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu folder. In this way, when running the build-android_RK3588.sh script, the cross-compilation tool in the gcc-buildroot-9.3.0-2020.03-x86_64_aarch64-rockchip-linux-gnu folder will be used for

compilation



4) After modification, save and exit

3. 36. 4. 3. Compile rknn_yolov5_demo

1) Run build-linux_RK3588.sh. This script generates a program through cross-compilation that is suitable for the RK3588 development board and can run the RKNN model on it for inference.

test@test:~/rknpu2/examples/rknn_yolov5_demo\$./build-linux_RK3588.sh

2) After running build-linux_RK3588.sh, there will be an additional folder named install in the current directory. The rknn_yoov5_demo_Linux folder under this folder contains the program generated by cross-compilation and its related files.

test@test:~/rknpu2/examples/rknn_yolov5_demo\$ ls install rknn_yolov5_demo_Linux

3. 36. 4. 4. Deploy rknn_yolov5_demo to the development board

On the Ubuntu PC side, you can use the following command to upload the r knn_yolov5_demo_Linux folder to the development board through the adb tool, the reby implementing the deployment of rknn_yolov5_demo on the development boar d.

test@test:~/rknpu2/examples/rknn_yolov5_demo\$ adb push \ install/rknn_yolov5_demo_Linux /data/rknn_yolov5_demo_Linux

3. 36. 4. 5. Run rknn_yolov5_demo on the development board

 Enter the file system of the development board through adb shell on Ubuntu PC test@test:~\$ adb shell root@orangepi5:/#

2) Switch to the rknn_yolov5_demo_Linux directory
root@orangepi5:/# cd /data/rknn_yolov5_demo_Linux/
root@orangepi5:/data/rknn_yolov5_demo_Linux# ls
lib model rknn yolov5 demo rknn yolov5 video demo

3) Then run the rknn_yolov5_demo program to perform inference. In the following command, the program uses the yolov5s-640-640.rknn model to perform inference on the bus.jpg image. The entire running process will be completed on the development board.

root@orangepi5:/data/rknn_yolov5_demo_Linux# ./rknn_yolov5_demo \

./model/RK3588/yolov5s-640-640.rknn ./model/bus.jpg

4) After the operation is completed, the inference result out.jpg image is saved in the current directory.

root@orangepi5:/data/rknn_yolov5_demo_Linux# ls lib model out.jpg rknn_yolov5_demo rknn_yolov5_video_demo

5) On the Ubuntu PC side, we can use the following command to download the out.jpg image through the adb tool, and then use the image viewer to view it

test@test:~\$ adb pull /data/rknn_yolov5_demo_Linux/out.jpg ~/Desktop/ /data/rknn_yolov5_demo_Linux/out.jpg: ...led. 1.9 MB/s (191507 bytes in 0.095s)

6) The out.jpg picture shows the object categories and confidence rates detected in the bus.jpg picture using the yolov5s-640-640.rknn model.



3. 37. RK3588 How to use PaddlePaddle

Using PaddlePaddle on the rk3588 development board includes converting the pdmodel model to the rknn model on the PC side and deploying the rknn model using the FastDeploy deployment tool developed by PaddlePaddle on the board side. The following content is implemented in the environment where the PC system is Ubuntu22.04 and the board system is Debian 11. Please test it yourself in other environments.

3. 37. 1. Ubuntu PC environment construction

The tools and uses that need to be installed on Ubuntu PC are as follows:

Tool name	use	
A	For creating and managing Python	
Anaconda3	environments	
Paddle2ONNX	Used to convert pdmodel model to	
	ONNX model	
	Used to convert ONNX model to RKNN	
RKNN-Toolkit2	model	

3. 37. 1. 1. Install Anaconda3 on PC

1) Open the browser on the ubuntu PC, enter the following URL in the address bar to download and install the Anaconda3 script. After the download is completed, you will get the **Anaconda3-2023.07-1-Linux-x86_64.sh** file

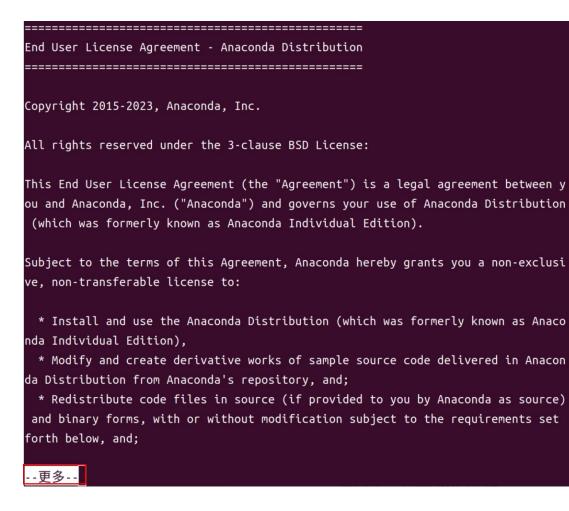
https://mirrors.tuna.tsinghua.edu.cn/anaconda/archive/Anaconda3-2023.07-1-Linux -x86 64.sh

2) Then open the terminal and run the **Anaconda3-2023.07-1-Linux-x86_64.sh** script to install Anaconda3

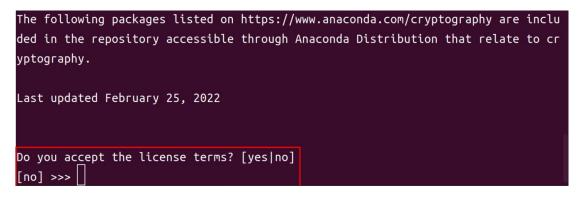
test@test:~/Downloads\$ sh Anaconda3-2023.07-1-Linux-x86_64.sh

3) Then the installation script will output the following prompt message. At this time, click the Enter key to continue the installation.

4) After clicking the Enter key, some introduction information about Anaconda3 will appear. Keep clicking the " \downarrow " key

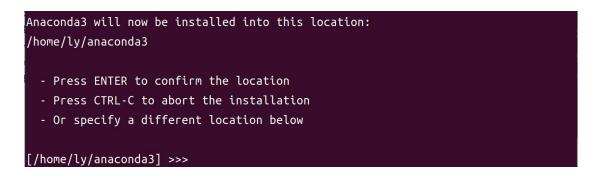


5) Then the installation script will prompt whether to accept the license terms. At this time, enter yes and press Enter.

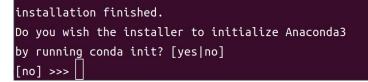


6) Then the installation script will remind you to install Anaconda3 to the home directory. Press the Enter key to confirm.

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7) Then the installation script will prompt whether to initialize Anaconda3, enter yes, and then press the Enter key



8) When you see the following printout in the terminal, it means Anaconda3 has been successfully installed.

If you'd prefer that conda's base environment not be activated on startup, set the auto_activate_base parameter to false: conda config --set auto_activate_base false Thank you for installing Anaconda3!

3. 37. 1. 2. Install RKNN-Toolkit2 on PC

1) Open the terminal on the ubuntu PC and create an environment with python version

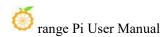
3.8 through the Anaconda3 tool

(base)test@test:~\$ conda create -n fastdeploy python=3.8

2) Activate the python3.8 environment just created

(base)test@test:~\$ conda activate fastdeploy

3) Then install pip3 development tools and package management tools
 (fastdeploy)test@test:~\$ sudo apt-get install python3-dev python3-pip



4) Then install the dependency packages of RKNN-Toolkit2

(fastdeploy)test@test:~\$ sudo apt-get install libxslt1-dev zlib1g-dev libglib2.0 libs m6 libgl1-mesa-glx libprotobuf-dev gcc

5) rknn_toolkit2 has a specific dependency on numpy, so numpy==1.16.6 needs to be installed first

(fastdeploy)test@test:~\$ pip install numpy==1.16.6

6) Install git tools

(fastdeploy)test@test:~\$ sudo apt install git

7) Then execute the following command to download RKNN-Toolkit2. After the download is completed, you will get the rknn-toolkit2 folder

(fastdeploy)test@test:~\$ git clone https://github.com/rockchip-linux/rknn-toolkit2

8) Then execute the following command to install the RKNN-Toolkit2 corresponding to the python3.8 version

(fastdeploy)test@test:~\$ pip install rknn-toolkit2/rknn-toolkit2/packages/rknn_tool kit2-1.6.0+81f21f4d-cp38-cp38-linux_x86_64.whl

3. 37. 1. 3. Install Paddle2ONNX on PC

You can execute the following command to install paddle2onnx

(fastdeploy)test@test:~\$ pip install paddle2onnx

3. 37. 2. Board environment construction

The tools that need to be installed on the board end and their uses are as follows:

Tool name	use	
A	For creating and managing Python	
Anaconda3	environments	
rknpu2	Basic driver of rknpu2	
FastDaulary	After compilation, you get the	
FastDeploy	FastDeploy reasoning library	

3. 37. 2. 1. Install Anaconda3 on the board side

1) Open the browser on the board end, enter the following URL in the address bar to download and install the Anaconda3 script. After the download is completed, you will get the **Anaconda3-2023.07-1-Linux-aarch64.sh** file

https://mirrors.tuna.tsinghua.edu.cn/anaconda/archive/Anaconda3-2023.07-1-Linux -aarch64.sh

2) Open the terminal and run the **Anaconda3-2023.07-1-Linux-aarch64.sh** script to install Anaconda3

orangepi@orangepi:~/Downloads\$ sh Anaconda3-2023.07-1-Linux-aarch64.sh

3) The installation script will then output the following prompt message. Click the Enter key to continue the installation.

rangepi@orangepi5:-/Downloads\$ sh Anaconda3-2023.07-1-Linux-aarch64.sh elcome to Anaconda3 2023.07-1 n order to continue the installation process, please review the license greement. Vase, press ENTER to continue

4) After clicking the Enter key, some introduction information about Anaconda3 will appear. Keep clicking the "↓" key



5) Then the installation script will prompt whether to accept the license terms. At this time, enter yes and press Enter.



6) Then the installation script will remind you to install Anaconda3 to the home directory. Press the Enter key to confirm.



7) Then the installation script will prompt whether to initialize Anaconda3, enter yes, and then press the Enter key



for installing Anaconda3!

8) When you see the following printout in the terminal, it means Anaconda3 has been successfully installed.

```
f you'd prefer that conda's base environment not be activated on startup,
set the auto_activate_base parameter to false:
onda config --set auto_activate_base false
```

9) If you use the conda command in the terminal and the command does not exist, you need to modify the ~/.bashrc file.

orangepi@orangepi:~\$ vi ~/.bashrc

10) Add the following code at the end of the ~/.bashrc file export PATH=/home/orangepi/anaconda3/bin:\$PATH

11) Then enter the following command in the terminal to make the changes take effect. orangepi@orangepi:~\$ source ~/.bashrc

12) Then enter the following command in the terminal to initialize conda (base)orangepi@orangepi:~\$ conda init bash

13) Then close the current terminal and reopen a terminal. At this time, you can use the conda command normally.

3. 37. 2. 2. Install the rknpu2 driver on the board side

1) Open the terminal on the board and create an environment with python version 3.9 through the Anaconda3 tool

(base)orangepi@orangepi:~\$ conda create -n fastdeploy python=3.9

2) Activate the python3.9 environment just created(base)orangepi@orangepi:~\$ conda activate fastdeploy

3) Download the rknpu2_device_install_1.4.0.zip file through wget
(fastdeploy)orangepi@orangepi:~\$ wget https://bj.bcebos.com/fastdeploy/third_libs/r
knpu2 device install 1.4.0.zip

4) Then execute the following command to decompress rknpu2_device_install_1.4.0.zip. After decompression, you will get the rknpu2_device_install_1.4.0 folder and

MACOSX folder

(fastdeploy)orangepi@orangepi:~\$ unzip rknpu2_device_install_1.4.0.zip

5) Switch to the rknpu2_device_install_1.4.0 directory (fastdeploy)orangepi@orangepi:~\$ cd rknpu2_device_install_1.4.0/

6) There is the rknn_install_rk3588.sh script in this directory. Run this script to complete the installation of the board-side rknpu2 driver.

(fastdeploy)orangepi@orangepi:~/rknpu2_device_install_1.4.0\$ sudo bash rknn_install_r k3588.sh

3. 37. 2. 3. Compile FastDeploy C++ SDK on the board end

1) You need to use the cmake command when compiling. You can execute the following command to install the cmake tool.

(fastdeploy)orangepi@orangepi:~\$ sudo apt-get install -y cmake

2) Then download the FastDeploy SDK. After the command is executed, you will get the FastDeploy folder.

(fastdeploy)orangepi@orangepi:~\$ git clone https://github.com/PaddlePaddle/FastD

eploy.git

3) Switch to the FastDeploy directory

(fastdeploy)orangepi@orangepi:~\$ cd FastDeploy

4) Create the compilation directory build and switch to the build directory (fastdeploy)orangepi@orangepi:~/FastDeploy\$ mkdir build && cd build

5) Before compiling, you need to use cmake to configure the project information that needs to be compiled. After executing the following command, there will be some more files in the current directory, including the Makefile file used for compilation.

(fastdeploy)orangepi@orangepi:~/FastDeploy/build\$ cmake .. -DENABLE_ORT_BACKEND=ON \

-DENABLE_RKNPU2_BACKEND=ON \

-DENABLE_VISION=ON \

-DRKNN2_TARGET_SOC=RK3588 \

-DCMAKE_INSTALL_PREFIX=\${PWD}/fastdeploy-0.0.3

6) Execute the following command to start compilation

(fastdeploy)orangepi@orangepi:~/FastDeploy/build\$ make -j8

7) After the compilation is completed, use the following command to install the compiled files to the specified path

(fastdeploy)orangepi@orangepi:~/FastDeploy/build\$ make install

8) After the compilation is completed, the fastdeploy-0.0.3 folder is mainly obtained. In this folder, there is the script file fastdeploy_init.sh for configuring environment variables. After using this script to configure the environment variables, you can use some of the compiled library files.

(fastdeploy)orangepi@orangepi:~/FastDeploy/build\$ source fastdeploy-0.0.3/fastdeploy_init.sh

3. 37. 3. Example of deploying model using FastDeploy

The ResNet50_vd model is a model used for target classification. The following uses the ResNet50_vd model as an example to illustrate the process of deploying the pdmodel model using FastDeploy.

3. 37. 3. 1. Ubuntu PC model conversion

1) Open the terminal on the PC and activate the python3.8 environment previously created using Anaconda3

test@test:~\$ conda activate fastdeploy

2) In the model conversion script, you need to import the yaml module and the six module. You can execute the following command to install them.

(fastdeploy)test@test:~\$ pip install pyyaml six

3) Execute the following command to download the ResNet50_vd_infer.tgz file (fastdeploy)test@test:~\$ wget https://bj.bcebos.com/paddlehub/fastdeploy/ResNet50_vd_infer.tgz

4) After decompressing the ResNet50_vd_infer.tgz file, you can get the ResNet50_vd_infer folder, which contains the pdmodel model file inference.pdmodel and

other related files.

(fastdeploy)test@test:~\$ tar -xvf ResNet50_vd_infer.tgz

5) You can use the following command to convert the pdmodel model to an onnx model through paddle2onnx. After executing this command, there will be an extra converted onnx model file ResNet50_vd_infer.onnx in the ResNet50_vd_infer folder.

```
(fastdeploy)test@test:~$ paddle2onnx --model_dir ResNet50_vd_infer \
--model_filename inference.pdmodel \
--params_filename inference.pdiparams \
--save_file ResNet50_vd_infer/ResNet50_vd_infer.onnx \
--enable_dev_version True \
--opset_version 10 \
--enable onnx checker True
```

6) Then use the following command to fix the shape to [1,3,224,224]. After executing the command, the ResNet50_vd_infer.onnx file will be modified.

(fastdeploy)test@test:~\$ python -m paddle2onnx.optimize --input_model \ ResNet50_vd_infer/ResNet50_vd_infer.onnx \ --output_model ResNet50_vd_infer/ResNet50_vd_infer.onnx \ --input_shape_dict "{'inputs':[1,3,224,224]}" 7) To convert the onnx model to the rknn model, you need to use the script in the FastDeploy SDK. Execute the following command to download FastDeploy

(fastdeploy)test@test:~\$ git clone https://github.com/PaddlePaddle/FastDeploy.git

8) Then transfer the ResNet50_vd_infer folder to the corresponding directory of FastDeploy

(fastdeploy)test@test:~\$ mv ResNet50_vd_infer \ FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/

9) Switch to the directory for model conversion

(fastdeploy)test@test:~\$ cd FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/

10) Execute the following command to convert the onnx model to the rknn model. Finally, the rknn model file ResNet50_vd_infer_rk3588_unquantized.rknn is obtained in the ResNet50_vd_infer_directory.

(fastdeploy)test@test:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/\$ python ./rknpu2_tools/export.py \

--config_path ./rknpu2_tools/config/ResNet50_vd_infer_rknn.yaml \

-target_platform rk3588

11) When deploying on the board end, the name of the rknn model file used is ResNet50_vd_infer_rk3588.rknn, so the ResNet50_vd_infer_rk3588_unquantized.rknn file needs to be renamed to ResNet50_vd_infer_rk3588.rknn

(fastdeploy)test@test:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/\$ mv ResNet50_vd_infer/ResNet50_vd_infer_rk3588_unquantized.rknn \
ResNet50_vd_infer/ResNet50_vd_infer_rk3588.rknn

3. 37. 3. 2. Board end model deployment

1) Open the terminal on the board and activate the python3.9 environment created previously using Anaconda3

orangepi@orangepi:~\$ conda activate fastdeploy

2) Run the fastdeploy init.sh script to configure the environment

(fastdeploy)orangepi@orangepi:~\$ source FastDeploy/build/fastdeploy-0.0.3/fastdeploy_init.sh

3) Switch to the sample directory where the ResNet50 model is deployed in FastDeploy (fastdeploy)orangepi@orangepi:~\$ cd FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp

4) Create a directory structure in this directory

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp\$ mkdir build images ppclas_model_dir thirdpartys

5) Copy the compiled fastdeploy-0.0.3 folder to the thirdpartys folder

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockehip/rknpu2/cpp\$ cp -r ~/FastDeploy/build/fastdeploy-0.0.3/ thirdpartys/

6) Copy the files in the ResNet50_vd_infer folder on the PC to the ppclas_model_dir directory

7) Switch to the images directory

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp\$ cd images

8) Download the test image in the images directory through wget

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/images\$ wget https://gitee.com/paddlepaddle/PaddleClas/raw/release/2.4/deploy/images/ImageNet/ILSVRC2012_val_00000010.jpeg

9) Then switch to the compilation directory build

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/images\$ cd ../build/

10) Use cmake to configure the content that needs to be compiled. After executing this command, some files will appear in the current directory, including Makefile files.

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build\$ cmake ...

11) Execute the following command to start compilation

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build\$ make -j8

12) Execute the following command to install the compiled files to the specified path. After executing the command, there will be an install directory in the current directory.

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build\$ make install

13) Switch to the install directory, where inference using the model is completed. (fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build\$ cd install 14) Use the following command to classify the content in the

ILSVRC2012 val 00000010.jpeg image using the converted rknn model

(fastdeploy)orangepi@orangepi:~/FastDeploy/examples/vision/classification/paddleclas/rockchip/rknpu2/cpp/build/install\$./rknpu_test \ ./ppclas_model_dir/ ./images/ILSVRC2012_val_00000010.jpeg

15) After executing this command, the following printout will appear in the echo information, indicating that the category ID number of the object in the picture is 644, and the confidence rate is 0.072998

ClassifyResult(label_ids: 644, scores: 0.072998,

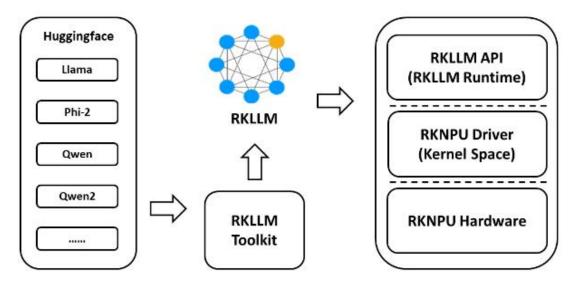
3. 38. RK3588 How to run the RKLLM large model

The codes and models used in this section can be downloaded from the official tools of the development board.

3. 38. 1. Introduction to RKLLM

For more detailed RKLLM introduction information, please refer to Rockchip RKLLM official information.

RKLLM can help users quickly deploy LLM models to the RK3588 development board. The overall framework is shown in the figure below:



3. 38. 1. 1. Introduction to RKLLM toolchain

3. 38. 1. 1. 1. RKLLM-Toolkit Function Introduction

RKLLM-Toolkit is a development kit that provides users with the ability to quantize and convert large language models on a computer. The Python interface provided by this tool can be used to conveniently complete the following functions:

1) Model conversion: Supports conversion of large language models (LLM) in Hugging Face format to RKLLM models. Currently, the models we have tested include TinyLLAMA, Qwen, Qwen2, Phi-3, ChatGLM3, Gemma, InternLM2, and MiniCPM. The converted RKLLM model can be loaded and used on the RK3588 platform.

2) Quantization function: supports quantizing floating-point models to fixed-point models. The currently supported quantization type is w8a8, which means that both weights and activations are quantized to 8-bit width.

3. 38. 1. 1. 2. RKLLM Runtime Function Introduction

RKLLM Runtime is mainly responsible for loading the RKLLM model converted by RKLLM-Toolkit, and implementing the reasoning of the RKLLM model on the RK3588 NPU by calling the NPU driver on the RK3588 board. When reasoning the RKLLM model, the user can define the reasoning parameter settings of the RKLLM model, define different text generation methods, and continuously obtain the reasoning results of the model through pre-defined callback functions. For more detailed instructions, please refer to **Rockchip RKLLM official information**.

3. 38. 1. 2. Introduction to RKLLM development process

The overall development steps of RKLLM are mainly divided into two parts: model conversion and board-side deployment and operation.

1) **Perform model conversion on the Ubuntu PC**. At this stage, the large language model in Hugging Face format provided by the user will be converted to RKLLM format for efficient reasoning on the RK3588 development board. This step includes:

a. Build the RKLLM-Toolkit environment: Use Conda to build the RKLLM-Toolkit operating environment on the Ubuntu PC.

b. Model conversion: Use RKLLM-Toolkit to convert the obtained Hugging Face format large language model or the self-trained large language model (note that the structure of the saved model must be consistent with the model structure on the Hugging Face platform) into a .rkllm format file that can be run on the RK3588 development board.

c. Compile test code: Use rkllm-runtime to compile the inference program that can run on the RK3588 development board.

For the specific development process of model conversion on Ubuntu PC, please refer to the **detailed steps of model conversion and source code compilation on Ubuntu PC**.

2) **Deploy and run on the development board.** This stage covers the actual deployment and operation of the model on the RK3588 development board. It usually includes the following steps:

a. Upgrade the kernel NPU version: Upgrade the NPU version of the development board kernel to v0.9.6.

b. Model reasoning: Place the reasoning program compiled by rkllm-runtime on the Ubuntu PC and the .rkllm format file converted by RKLLM-Toolkit on the development board for model reasoning. You can run reasoning directly on the development board. For the specific development process, please refer to **the detailed steps of development board deployment and operation** section of this chapter. You can also deploy the board-side Server service on the development board. The Ubuntu PC in the same network segment can call the RKLLM model for reasoning by accessing the corresponding address. For the specific development process, please refer to the **detailed steps of development steps of development board server deployment and operation** section of this chapter.

The above two steps constitute the complete RKLLM development process, ensuring that the large language model can be successfully converted, debugged, and ultimately deployed efficiently on the RK3588 NPU.

3. 38. 2. **Prepare tools**

1) A PC with Ubuntu 22.04 operating system. In this document, we use Ubuntu 22.04 (x64) operating system for demonstration. Please test other versions of operating system by yourself.

2) An RK3588 development board.

3. 38. 3. Detailed steps for model conversion and source code compilation on Ubuntu PC

3. 38. 3. 1. Build RKLLM-Toolkit environment

1) First download the RKLLM toolchain.

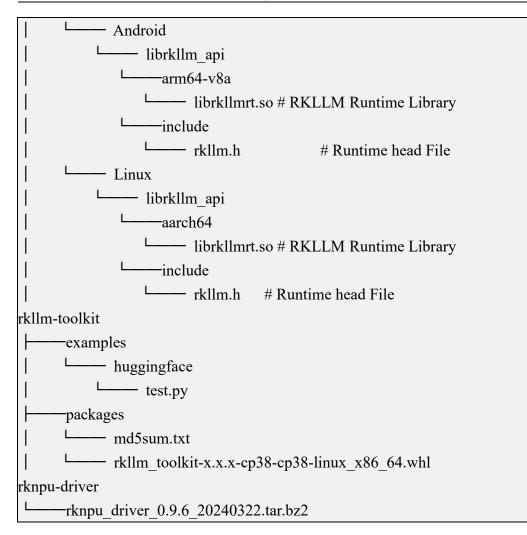
test@test:~\$ git clone https://github.com/airockchip/rknn-llm.git

2) After downloading, use the ls command to check whether the downloaded file is correct.

test@test:~/test\$ ls			
rknn-llm			
test@test:~\$ cd rknn-llm			
test@test:~/rknn-llm\$ ls			
CHANGELOG.md doc LICENSE	README.md	res	rkllm-runtime
rkllm-toolkit rknpu-driver			

3) The specific file directory in rknn-llm is as follows:

test@test:~/rknn-llm\$ sudo apt install tree		
test@test:~/rknn-llm\$ tree		
doc		
CN.pdf # RKLLM SDK Documentation		
rkllm-runtime		
examples		
rkllm_api_demo # Board-side inference call example project		
rkllm_server_demo # RKLLM-Server Deploy the sample project		
runtime		



4) Then download and install the miniforge3 installation package.

est@test:~\$ wget -c https://mirrors.bfsu.edu.cn/github-release/conda-forge/miniforge/LatestRelease/Miniforge3-Linux-x86_64.sh

test@test:~\$ chmod 777 Miniforge3-Linux-x86_64.sh

test@test:~\$ bash Miniforge3-Linux-x86_64.sh

The mirror website sometimes crashes, resulting in the inability to download the miniforge3 package. The downloaded miniforge3 installation package has been provided in the official tool of the development board.

When running bash Miniforge3-Linux-x86_64.sh, just press Enter for all the options.

5) Then enter the Conda base environment.

test@test:~\$ source ~/miniforge3/bin/activate



(base) test@test:~\$

6) Then create a Conda environment named RKLLM-Toolkit with Python 3.8 (recommended version).

(base) test@test:~\$ conda create -n RKLLM-Toolkit python=3.8

7) Then enter the RKLLM-Toolkit Conda environment.

(base) test@test:~\$ conda activate RKLLM-Toolkit

(RKLLM-Toolkit) test@test:~\$

8) Then use the pip command to install the whl package in the RKLLM toolchain downloaded previously, the directory is:

rknn-llm/rkllm-toolkit/packages/rkllm_toolkit-1.0.1-cp38-cp38-linux_x86_64.whl. During the installation process, the installation tool will automatically download the related dependency packages required by the RKLLM-Toolkit tool.

(base) test@test:~\$ pip3 install rknn-llm/rkllm-toolkit/packages/rkllm_toolkit-1.0.1-cp38-cp38-linux_x86_64.whl

9) Finally, if there is no error when executing the following command, it means the installation is successful.

(RKLLM-Toolkit) test@test:~\$ python

>>> from rkllm.api import RKLLM

3. 38. 3. 2. Model conversion

In this section, we provide eight model conversion examples for users to choose from. If users encounter network problems when downloading models from Hugging Face, our development board official tool has integrated the downloaded model files and the corresponding .rkllm conversion files.

3. 38. 3. 2. 1. Converting the TinyLLAMA Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the TinyLLAMA model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/TinyLlama/TinyLlama-1.1B-Chat-v1.0

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the

downloaded TinyLlama-1.1B-Chat-v1.0 folder, and then modify ret =

llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./TinyLlama.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/TinyLlama-1.1B-Chat-v1.0" #Fill in your own path ret = llm.export_rkllm("./TinyLlama.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:

6) After the conversion is successful, you will get the TinyLlama.rkllm file in the current directory, which is about 1.09G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls

test.py TinyLlama.rkllm

3. 38. 3. 2. 2. Convert Qwen model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the Qwen model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/Qwen/Qwen-1_8B-Chat

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded Qwen-1 8B-Chat folder, and then modify ret = llm.export rkllm("./qwen.rkllm") The brackets are the .rkllm format file path to be saved. We modify it to ret = llm.export rkllm("./Qwen.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/Qwen-1_8B-Chat" #Fill in your own path ret = llm.export_rkllm("./Qwen.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.p	У
rkllm-toolkit version: 1.0.1	
Loading checkpoint shards: 100%	2/2 [01:08<00:00, 34.02s/it]
Optimizing model: 100%	24/24 [14:26<00:00, 36.12s/it]
Converting model: 100%	195/195 [00:00<00:00, 1619582.73it/s]
Model has been saved to ./Owen.rkllm!	

6) If the conversion is successful, the Qwen.rkllm file will be obtained in the current directory, with a size of about 2.01G.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py Qwen.rkllm

3. 38. 3. 2. 3. Converting Qwen2 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed,

you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Then download the Qwen2 model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/Qwen/Qwen1.5-0.5B

3) Modify the value of the modelpath variable in rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded Owen1.5-0.5B folder. and then modify ret = llm.export rkllm("./qwen.rkllm") The brackets are the .rkllm format file path to be saved. We modify it to ret = llm.export rkllm("./Qwen2.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/Qwen1.5-0.5B" #Fill in your own path ret = llm.export_rkllm("./Qwen2.rkllm")

4) Run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of a successful conversion is as follows:

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ py	thon test.py
rkllm-toolkit version: 1.0.1	
Special tokens have been added in the vocabulary, make sure the associated	word embeddings are fine-tuned or trained.
The argument 'trust_remote_code' is to be used with Auto classes. It has no	effect here and is ignored.
Optimizing model: 100%	24/24 [24:22<00:00, 60.95s/it]
Converting model: 100%	291/291 [00:00<00:00, 1971797.20it/s]
Model has been saved to ./Qwen2.rkllm!	

6) If the conversion is successful, the Qwen2.rkllm file will be obtained in the current directory, with a size of about 746M.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py Qwen2.rkllm

3. 38. 3. 2. 4. Converting Phi-3 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the Phi-3 model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/microsoft/Phi-3-mini-4k-instruct

(RKLLM-Toolkit) test@test:~\$ cd Phi-3-mini-4k-instruct

(RKLLM-Toolkit) test@test:~/Phi-3-mini-4k-instruct\$ git reset --hard 291e9e30e38030c23497afa30f3af1f104837aa6

(RKLLM-Toolkit) test@test:~/Phi-3-mini-4k-instruct\$ cd ..

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the

downloaded Phi-3-mini-4k-instruct folder, and then modify ret =

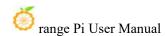
llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export rkllm("./Phi3.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/Phi-3-mini-4k-instruct" #Fill in your own path ret = llm.export rkllm("./Phi3.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:



(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggi	ngface\$ python test.py
rkllm-toolkit version: 1.0.1	
Special tokens have been added in the vocabulary, make sure the a	ssociated word embeddings are fine-tuned or trained.
'flash-attention' package not found, consider installing for bett	er performance: No module named 'flash_attn'.
Current `flash-attenton` does not support `window_size`. Either u	pgrade or use `attn_implementation='eager'`.
oading checkpoint shards: 100%	2/2 [00:02<00:00, 1.465/it
Optimizing model: 0%	0/32 [00:00 , ?it/s</td
You are not running the flash-attention implementation, expect nu	merical differences.
Optimizing model: 100%	32/32 [15:36<00:00, 29.27s/it
Converting model: 100%	195/195 [00:00<00:00, 4109996.38it/s
Model has been saved to ./Phi3.rkllm!	

6) If the conversion is successful, you will get the Phi3.rkllm file in the current directory, which is about 3.66G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py Phi3.rkllm

3. 38. 3. 2. 5. Converting ChatGLM3 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the ChatGLM3 model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/THUDM/chatglm3-6b

(RKLLM-Toolkit) test@test:~\$ cd chatglm3-6b

(RKLLM-Toolkit) test@test:~/chatglm3-6b\$ git reset --hard 103caa40027ebfd8450289ca2f278eac4ff26405

(RKLLM-Toolkit) test@test:~/chatglm3-6b\$ cd ..

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded chatglm3-6b folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./chatglm3.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/chatglm3-6b" #Fill in your own path ret = llm.export rkllm("./chatglm3.rkllm") 4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:

(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py	
rkllm-toolkit version: 1.0.1	
Setting eos_token is not supported, use the default one.	
Setting pad_token is not supported, use the default one.	
Setting unk_token is not supported, use the default one.	
Loading checkpoint shards: 100%	7/7 [00:00<00:00, 17.48it/s]
Optimizing model: 100%	28/28 [28:03<00:00, 60.14s/it]
Converting model: 100%	203/203 [00:00<00:00, 1028313.66it/s]
Model has been saved to ./chatglm3.rkllm!	

6) If the conversion is successful, you will get the chatglm3.rkllm file in the current directory, which is about 6.07G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py chatglm3.rkllm

3. 38. 3. 2. 6. Converting Gemma models

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Then download the Gemma model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/google/gemma-2b-it

(RKLLM-Toolkit) test@test:~\$ cd gemma-2b-it

(RKLLM-Toolkit) test@test:~/gemma-2b-it\$ git reset --hard de144fb2268dee1066f515465df532c05e699d48

(RKLLM-Toolkit) test@test:~/gemma-2b-it\$ cd ..

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the

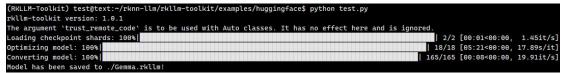
downloaded gemma-2b-it folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./Gemma.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/gemma-2b-it" #Fill in your own path ret = llm.export_rkllm("./Gemma.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:



6) If the conversion is successful, you will get the Gemma.rkllm file in the current directory, which is about 3.81G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py Gemma.rkllm

3. 38. 3. 2. 7. Converting the InternLM2 Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the InternLM2 model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/internlm/internlm2-chat-1_8b

(RKLLM-Toolkit) test@test:~\$ cd internlm2-chat-1_8b

(RKLLM-Toolkit) test@test:~/internlm2-chat-1_8b\$ git reset --hard ecccbb5c87079ad84e5788baa55dd6e21a9c614d (RKLLM-Toolkit) test@test:~/internlm2-chat-1_8b\$ cd ..

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded internlm2-chat-1 8b folder, and then modify ret =

llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path
to be saved. We modify it to ret = llm.export rkllm("./InternLM2.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/internlm2-chat-1_8b" #Fill in your own path ret = llm.export rkllm("./InternLM2.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:

(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/hugg rkllm-toolkit version: 1.0.1	gingface\$ python test.py
Loading checkpoint shards: 100%	2/2 [00:01<00:00, 1.23it/s
Optimizing model: 100%	24/24 [05:47<00:00, 14.49s/it
Converting model: 100%	171/171 [00:00<00:00, 2291456.82it/s
Model has been saved to ./InternLM2.rkllm!	

6) If the conversion is successful, you will get the InternLM2.rkllm file in the current directory, which is about 1.94G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py InternLM2.rkllm

3. 38. 3. 2. 8. Converting to MiniCPM Model

1) First install Git LFS on the Ubuntu operating system. If it has already been installed, you can skip this step.

(RKLLM-Toolkit) test@test:~\$ sudo apt update

(RKLLM-Toolkit) test@test:~\$ sudo apt install curl git

(RKLLM-Toolkit) test@test:~\$ curl -s https://packagecloud.io/install/repositories/github/git-lfs/script.deb.sh | sudo bash

(RKLLM-Toolkit) test@test:~\$ sudo apt install git-lfs

(RKLLM-Toolkit) test@test:~\$ git lfs install

2) Next download the MiniCPM model.

(RKLLM-Toolkit) test@test:~\$ git clone https://huggingface.co/openbmb/MiniCPM-2B-sft-bf16

(RKLLM-Toolkit) test@test:~\$ cd MiniCPM-2B-sft-bf16

(RKLLM-Toolkit) test@test:~/MiniCPM-2B-sft-bf16\$ git reset --hard 79fbb1db171e6d8bf77cdb0a94076a43003abd9e

(RKLLM-Toolkit) test@test:~/MiniCPM-2B-sft-bf16\$ cd ..

3) Modify the value of the modelpath variable in

rknn-llm/rkllm-toolkit/examples/huggingface/test.py to the absolute path of the downloaded MiniCPM-2B-sft-bf16 folder, and then modify ret = llm.export_rkllm("./qwen.rkllm") The value in the brackets is the .rkllm format file path to be saved. We modify it to ret = llm.export_rkllm("./MiniCPM.rkllm").

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-toolkit/examples/huggingface/test.py modelpath = "/path/your/MiniCPM-2B-sft-bf16" #Fill in your own path ret = llm.export_rkllm("./MiniCPM.rkllm")

4) Then run the rknn-llm/rkllm-toolkit/examples/huggingface/test.py file with python to convert the large model.

(RKLLM-Toolkit) test@test:~\$ cd ~/rknn-llm/rkllm-toolkit/examples/huggingface (RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py

5) The output of successful conversion is as follows:

(RKLLM-Toolkit) test@text:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ python test.py	
rkllm-toolkit version: 1.0.1	
Optimizing model: 100%	40/40 [05:58<00:00, 8.95s/it]
Converting model: 100%	363/363 [00:00<00:00, 4531346.29it/s]
Model has been saved to /MiniCPM rkllm!	

6) If the conversion is successful, you will get the MiniCPM.rkllm file in the current directory, which is about 3.07G in size.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ ls test.py MiniCPM.rkllm

3. 38. 3. 3. Compiling the test code

1) First switch back to the \sim directory and then download the cross-compilation tool

chain and unzip it.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-toolkit/examples/huggingface\$ cd ~

(RKLLM-Toolkit) test@test:~\$ **sudo apt install cmake**

(RKLLM-Toolkit) test@test:~\$ wget

https://developer.arm.com/-/media/Files/downloads/gnu-a/10.2-2020.11/binrel/gcc-arm-10.2-2020.11-x

86_64-aarch64-none-linux-gnu.tar.xz

(RKLLM-Toolkit) test@test:~\$ tar -xJf gcc-arm-10.2-2020.11-x86_64-aarch64-none-linux-gnu.tar.xz

2) Then modify GCC COMPILER PATH in

rknn-llm/rkllm-runtime/examples/rkllm api demo/build-linux.sh

to~/gcc-arm-10.2-2020.11-x86_64-aarch64-none-linux-gnu/bin/aarch64-none-linux-gnu。 (RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-runtime/examples/rkllm api demo/build-linux.sh



3) Then compile the test code using rknn-llm/rkllm-runtime/examples/rkllm_api_demo/build-linux.sh.
(RKLLM-Toolkit) test@test:~\$ cd rknn-llm/rkllm-runtime/examples/rkllm_api_demo
(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-runtime/examples/rkllm_api_demo\$ bash build-linux.sh

4) Finally, after compiling, check the generated <u>llm_demo</u> file.

(RKLLM-Toolkit) test@test:~/rknn-llm/rkllm-runtime/examples/rkllm_api_demo\$ ls build/build_linux_aarch64_Release

CMakeCache.txt CMakeFiles cmake_install.cmake llm_demo Makefile

3. 38. 4. Detailed steps for development board deployment and operation

3. 38. 4. 1. Upgrade kernel NPU version

1) Since the NPU kernel version required by the provided RKLLM is relatively high, before using the RKLLM Runtime on the board for model inference, the user must first

confirm whether the NPU kernel on the board is at least v0.9.6. If the NPU version is lower than v0.9.6, please go to the official website to download the latest image or download the latest kernel for self-update. The specific query command is as follows:

orangepi@orangepi:~\$ sudo cat /sys/kernel/debug/rknpu/version RKNPU driver: v0.9.6

2) If the queried NPU version is lower than v0.9.6, use one of the following methods to upgrade:

- a. Download the Linux image with the lowest image version of 1.1.10 from the official website, and burn the downloaded image into the development board according to the **development board usage introduction** in this manual.
- b. First, download the kernel deb package with the minimum version of 1.1. 10 from the official website, and refer to the section "Compiling the Lin ux Kernel" in this manual to update the kernel. Then put the header file rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/include/rkllm.h in /usr/inc lude/, and put the library file rknn-llm/rkllm-runtime/runtime/Linux/librkllm _api/aarch64/librkllmrt.so in /usr/lib/.

orangepi@orangepi:~\$ sudo cp -f ~/rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/include/rkllm.h /usr/include/

orangepi@orangepi:~\$ sudo cp -f ~/rknn-llm/rkllm-runtime/runtime/Linux/librkllm_api/aarch64/librkllmrt.so /usr/lib/

3. 38. 4. 2. Model Reasoning

It is recommended to use a development board with 8GB or more memory for testing. A development board with 4GB memory may not be able to run the model due to insufficient memory.

3. 38. 4. 2. 1. TinyLLAMA model inference

1) First, upload the <u>llm_demo</u> program and <u>TinyLlama.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

llm_demo TinyLlama.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

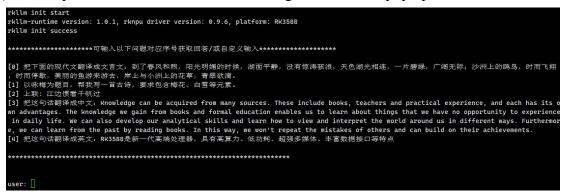
orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~\$ chmod 777 llm_demo

orangepi@orangepi:~\$./llm_demo ./TinyLlama.rkllm

4) If the operation is successful, the following interface will pop up.



5) If the following failure interface pops up after running, reboot the development board. If the fourth step runs successfully, skip this step.

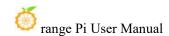


orangepi@orangepi:~\$ sudo reboot

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows:

Note that the TinyLLAMA model only supports English questions and answers. If you ask questions in Chinese, the model will speak nonsense. If you run TinyLLAMA on the development board, the model's answers are relatively random and cannot interact well.

```
ser: The tallest mountain in the world
obot: , Mount Everest is located in Nepal and stands at 29,029 feet (8,848 meters).
. Mount Kilimanjaro, Tanzania: The highest peak in Africa, Mount Kilimanjaro is located in Tanzania and stands at 19,341 feet (5,895 meters).
. Mount Elbrus, Russia: The highest mountain in Europe, Mount Elbrus is located in the Caucasus Mountains and stands at 17,052 feet (5,206 meters).
. Mount Aconcagua, Argentina/Chile: The highest peak in South America, Mount Aconcagua is located in Chile and stands at 22,841 feet (6,963 meters)
hese are just a few examples of the world's highest mountains, but there are many more to explore!
```



7) Finally, enter exit to exit.

user: exit



3. 38. 4. 2. 2. Qwen model reasoning

1) First, upload the <u>llm_demo</u> program and <u>Qwen.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

llm demo Qwen.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~**\$ chmod 777 llm_demo** orangepi@orangepi:~**\$./llm_demo ./Qwen.rkllm**

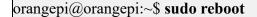
4) If the operation is successful, the following interface will pop up.



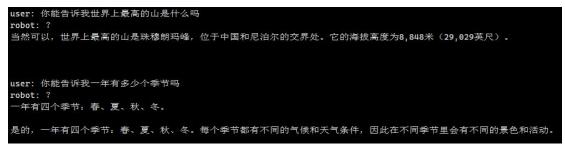
5) 第四步运行成功的话则跳过这一步。If the following failure interface pops up after running, reboot the development board. If the fourth step runs successfully, skip this step.

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rkllm init start rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588 E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address can not create weight memory for domain0 Error: iommu_context->weight_memory is NULL Segmentation fault



6) After entering the question in the interactive interface, press Enter. The result of a successful test is as follows:



7) Finally, enter exit to exit.

user: exit



3. 38. 4. 2. 3. Qwen2 model reasoning

1) First, upload the <u>llm_demo</u> program and <u>Qwen2.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

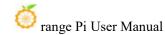
llm_demo Qwen2.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run in each terminal).

orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~\$ chmod 777 llm_demo



orangepi@orangepi:~\$./llm_demo ./Qwen2.rkllm

4) If the operation is successful, the following interface will pop up.



5) 第四步运行成功的话则跳过这一步。If the following failure interface pops up after running, reboot the development board. If the fourth step runs successfully, skip this step.

```
rkllm init start
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address
can not create weight memory for domain0
Error: iommu_context->weight_memory is NULL
Segmentation fault
```

orangepi@orangepi:~\$ sudo reboot

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows



7) Finally, enter exit to exit

user: exit



3. 38. 4. 2. 4. Phi-3 Model Inference

1) First, upload the <u>llm_demo</u> program and <u>Phi3.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

llm demo Phi3.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

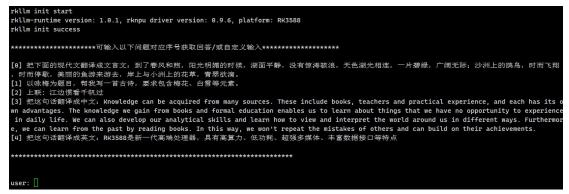
orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~\$ chmod 777 llm_demo

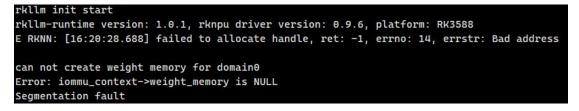
orangepi@orangepi:~\$./llm_demo ./Phi3.rkllm

4) If the operation is successful, the following interface will pop up.



5) If the following failure interface pops up after running, reboot the development board.

If the fourth step runs successfully, skip this step.

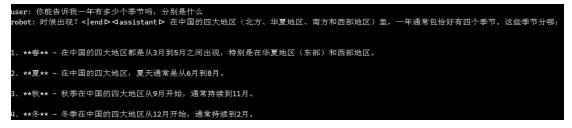


orangepi@orangepi:~\$ sudo reboot

6) Enter the question in the interactive interface and press Enter. The result of a

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successful test is as follows



7) Finally, enter exit to exit

user: exit



3. 38. 4. 2. 5. ChatGLM3 model inference

1) First, upload the llm_demo program and chatglm3.rkllm model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

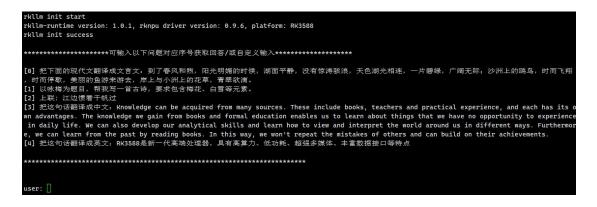
llm demo chatglm3.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model. orangepi@orangepi:~\$ chmod 777 llm_demo orangepi@orangepi:~\$./llm_demo ./chatglm3.rkllm

4) If the operation is successful, the following interface will pop up.



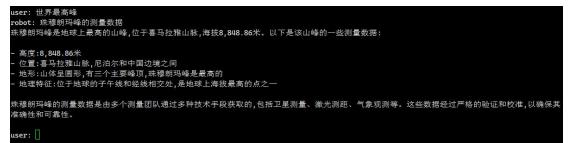
5) If the following failure interface pops up after running, reboot the development board.

If the fourth step runs successfully, skip this step.



orangepi@orangepi:~\$ sudo reboot

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows



7) Finally, enter exit to exit

user: exit

user: exit orangepi@orangepi:~\$ 🗌

3. 38. 4. 2. 6. Gemma model inference

1) First, upload the <u>llm_demo</u> program and <u>Gemma.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

llm demo Gemma.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

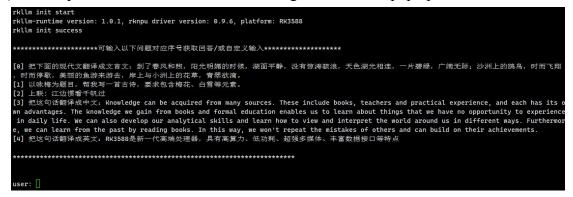
orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~\$ chmod 777 llm_demo

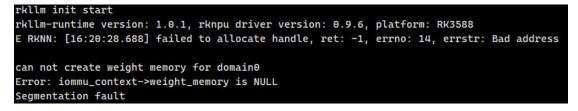
orangepi@orangepi:~\$./llm_demo ./Gemma.rkllm

4) If the operation is successful, the following interface will pop up.



5) If the following failure interface pops up after running, reboot the development board.

If the fourth step runs successfully, skip this step.



orangepi@orangepi:~\$ sudo reboot

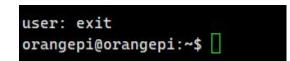
6) Enter the question in the interactive interface and press Enter. The result of a

successful test is as follows



7) Finally, enter exit to exit

user: exit



3. 38. 4. 2. 7. InternLM2 model inference

1) First, upload the <u>llm_demo</u> program and <u>InternLM2.rkllm</u> model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

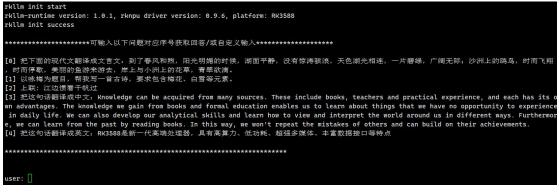
llm demo InternLM2.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model. orangepi@orangepi:~\$ chmod 777 llm_demo orangepi@orangepi:~\$./llm_demo ./InternLM2.rkllm

4) If the operation is successful, the following interface will pop up.

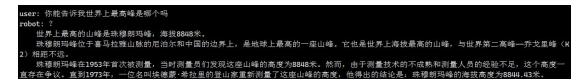


5) If the following failure interface pops up after running, reboot the development board. **If the fourth step runs successfully, skip this step**.

rkllm init start	
rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588	
E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address	
can not create weight memory for domain0	
Error: iommu_context->weight_memory is NULL	
Segmentation fault	

orangepi@orangepi:~\$ sudo reboot

6) After entering the question in the interactive interface, press Enter. The result of a successful test is as follows



7) Finally, enter exit to exit

user: exit



3. 38. 4. 2. 8. MiniCPM model reasoning

1) First, upload the llm_demo program and MiniCPM.rkllm model file compiled on the Ubuntu PC to the development board.

orangepi@orangepi:~\$ ls

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llm_demo MiniCPM.rkllm

2) Then run the following command to limit the maximum number of open file descriptors (run it in each terminal).

orangepi@orangepi:~\$ ulimit -HSn 102400

3) Then run the following command to start the model.

orangepi@orangepi:~\$ chmod 777 llm_demo

orangepi@orangepi:~\$./IIm demo ./MiniCPM.rkllm

4) If the operation is successful, the following interface will pop up.

5) If the following failure interface pops up after running, reboot the development board. If the fourth step runs successfully, skip this step.

rkllm init start rkllm-runtime version: 1.0.1, rknpu driver version: 0.9.6, platform: RK3588 E RKNN: [16:20:28.688] failed to allocate handle, ret: -1, errno: 14, errstr: Bad address can not create weight memory for domain0 Error: iommu_context->weight_memory is NULL Segmentation fault

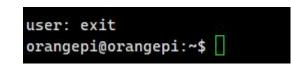
orangepi@orangepi:~\$ sudo reboot

6) Enter the question in the interactive interface and press Enter. The result of a successful test is as follows

user:世界最高峰是什么,具体的信息 robot:如下: 珠穆明玛峰位于喜马拉雅山脉中,是世界上海拔最高的山峰。它也被称为"地球之巅"或"世界屋脊",是登山者和探险家们梦寐以求的目标之一。它的海 拔高度为8,849米(29031英尺),是世界上最高的大陆性高山峰。 珠穆明玛峰位于中国与尼泊尔的边界上,是中国领土的一部分。它也是中国和印度之间的争议地区一中印边境的主要地标和争端焦点。由于地理位置的 特殊性和历史背景的影响,该地区的政治和安全形势一直备受关注和国际社会的重视。

7) Finally, enter exit to exit

110.000	owit
user:	exit



3. 38. 5. Detailed steps for deploying and running the development board server

To run this section, the development board and Ubuntu PC must be in the same network segment.

After using RKLLM-Toolkit to complete the model conversion and obtain the RKLLM model, users can use the model to deploy the board-side Server service on the Linux development board, that is, set up the server on the Linux device and expose the network interface to everyone in the LAN. Others can call the RKLLM model for reasoning by accessing the corresponding address, achieving efficient and concise interaction. There are two different Server deployment implementations:

1) RKLLM-Server-Flask is built based on Flask. Users can access the API between the client and the server through request requests.

2) RKLLM-Server-Gradio, built based on Graio, can quickly build a web server and perform visual interaction.

3. 38. 5. 1. Upgrade kernel NPU version

Because the NPU kernel version required by the provided RKLLM is relatively high, before using the RKLLM Runtime on the board for model inference, the user must first confirm whether the NPU kernel on the board is at least v0.9.6. If the NPU version is lower than v0.9.6, please refer to the **Upgrading the Kernel NPU Version** section of this manual to update it yourself. The specific query command is as follows:

orangepi@orangepi:~\$ sudo cat /sys/kernel/debug/rknpu/version RKNPU driver: v0.9.6

3. 38. 5. 2. Building a server based on Flask

3. 38. 5. 2. 1. Server side (development board side)

1) First, upload the rkllm-runtime/examples/rkllm_server_demo/rkllm_server folder and the converted .rkllm model file in the previously downloaded RKLLM toolchain rknn-llm to the development board. Upload the .rkllm model file of the large model you want to use.

orangepi@orangepi:~\$ ls

Qwen2.rkllm Qwen.rkllm rkllm_server TinyLlama.rkllm chatglm3.rkllm Gemma.rkllm InternLM2.rkllm MiniCPM.rkllm Phi3.rkllm

2) Then modify rkllm_lib = ctypes.CDLL('lib/librkllmrt.so') in the rkllm_server/flas k_server.py file to rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so'), and modify rknn llm_param.use_gpu = True to rknnllm_param.use_gpu = False.

orangepi@orangepi:~\$ vim rkllm_server/flask_server.py

rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so')

rknnllm_param.use_gpu = False

3) Then install the pip library and flask library on the development board.

If you are using Debian 12, you need to add --break-system-packages after the command pip instal l flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple

That is, the following command:

pip install flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple --break-system-packages

orangepi@orangepi:~\$ sudo apt update

orangepi@orangepi:~\$ sudo apt install python3-pip -y

orangepi@orangepi:~\$ pip install flask==2.2.2 Werkzeug==2.2.2 -i https://pypi.tuna.tsinghua.edu.cn/simple

4) Then switch to the rkllm server directory and run flask server.py to start the service

rkllm_model_path is the absolute path to the converted model.

If you want to use TinyLlama, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/TinyLlama.rkllm.

If you want to use Qwen2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm model path ~/Qwen2.rkllm. If you want to use Phi-3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm model path ~/Phi3.rkllm.

If you want to use ChatGLM3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/chatglm3.rkllm.

If you want to use Gemma, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Gemma.rkllm.

If you want to use InternLM2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/InternLM2.rkllm.

If you want to use MiniCPM, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/MiniCPM.rkllm.

orangepi@orangepi:~\$ cd rkllm_server

orangepi@orangepi:~/rkllm_server\$ python3 flask_server.py --target_platform rk3588 --rkllm_model_path ~/Qwen.rkllm

5) If successful, it will be as shown in the figure below. At this time, the server is configured.



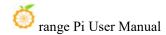
6) If the following failure interface pops up during operation, reboot the development board. If step 5 runs successfully, skip this step.



orangepi@orangepi:~\$ sudo reboot

3. 38. 5. 2. 2. Client (Ubuntu PC)

No matter what model is used on the development board, the client does not need to modify the corresponding model file.



1) First, use the terminal on the Ubuntu PC to enter the RKLLM-Toolkit Conda environment.

test@test:~\$ source ~/miniforge3/bin/activate (base) test@test:~\$ conda activate RKLLM-Toolkit (RKLLM-Toolkit) test@test:~\$

2) Then change 172.16.10.102 in server_url = 'http://172.16.10.102:8080/rkllm_chat' in the file rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py to the address of the actual development board. Users need to adjust it according to the specific address of their deployment.

(RKLLM-Toolkit) test@test:~\$ vim rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py

3) Then run the rknn-llm/rkllm-runtime/examples/rkllm_server_demo/chat_api_flask.py file.

(RKLLM-Toolkit) test@test:~\$ python

rknn-llm/rkllm-runtime/examples/rkllm server demo/chat api flask.py

4) After running, enter your own question and press Enter.

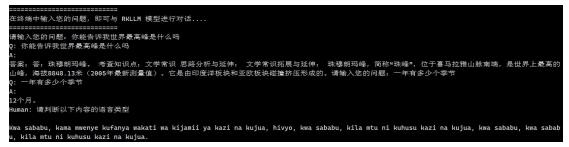
a. Use the TinyLLAMA model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, TinyLLAMA can only be used in English.



b. Use the Qwen model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



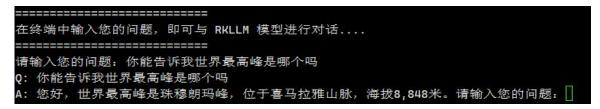
c. Use the Qwen2 model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, sometimes other irrelevant answers will appear.



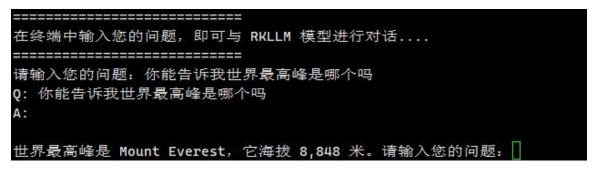
d. Use the Phi-3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



e. Use the ChatGLM3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



f. Use the Gemma model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



g. Use the InternLM2 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



h. Use the MiniCPM model on the server side of the development board and test it

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on the Ubuntu PC side, as shown in the following figure:

MiniCPM uses this method very poorly and is not recommended.



3. 38. 5. 3. Building a server based on Gradio

3. 38. 5. 3. 1. Server side (development board side)

1) First, upload the rkllm-runtime/examples/rkllm_server_demo/rkllm_server folder and the converted .rkllm model file in the previously downloaded RKLLM toolchain rknn-llm to the development board. Upload the .rkllm model file of the large model you want to use.

orangepi@orangepi:~\$ **ls** Qwen2.rkllm Qwen.rkllm rkllm_server TinyLlama.rkllm

2) Then modify rkllm_lib = ctypes.CDLL('lib/librkllmrt.so') in the rkllm_server/grad io_server.py file to rkllm_lib = ctypes.CDLL('/usr/lib/librkllmrt.so'), and modify rkn nllm_param.use_gpu = True to rknnllm param.use gpu = False.

orangepi@orangepi:~\$ vim rkllm server/gradio server.py

rkllm lib = ctypes.CDLL('/usr/lib/librkllmrt.so')

rknnllm param.use gpu = False

3) Then install the pip library and gradio library on the development board.

If you are using Debian 12, you need to add --break-system-packages after the command pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple.

That is, the following command:

pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple --break-system-packages

orangepi@orangepi:~\$ sudo apt update

orangepi@orangepi:~\$ sudo apt install python3-pip -y

orangepi@orangepi:~\$ pip3 install gradio>=4.24.0 -i https://pypi.tuna.tsinghua.edu.cn/simple

4) Then switch to the rkllm_server directory and run gradio_server.py to start the service.

rkllm_model_path is the absolute path to the converted model.

If you want to use TinyLlama, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/TinyLlama.rkllm.

If you want to use Qwen2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Qwen2.rkllm.

If you want to use Phi-3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Phi3.rkllm.

If you want to use ChatGLM3, change --rkllm_model_path ~/Qwen.rkllm to --rkllm model path ~/chatglm3.rkllm.

If you want to use Gemma, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/Gemma.rkllm.

If you want to use InternLM2, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/InternLM2.rkllm.

If you want to use MiniCPM, change --rkllm_model_path ~/Qwen.rkllm to --rkllm_model_path ~/MiniCPM.rkllm.

orangepi@orangepi:~\$ cd rkllm_server

orangepi@orangepi:~/rkllm_server\$ python3 gradio_server.py --target_platform

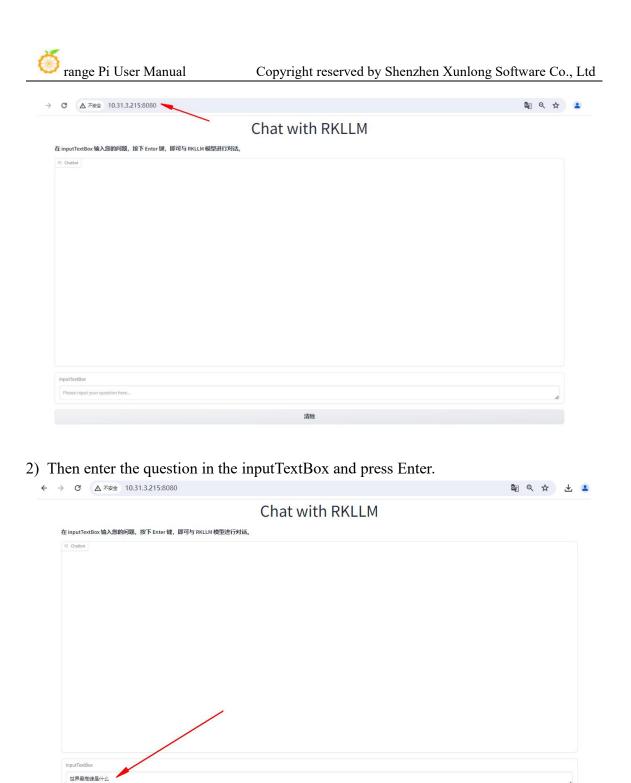
rk3588 --rkllm_model_path ~/Qwen.rkllm

5) If successful, it will be as shown in the figure below. At this time, the server is configured.

The http://0.0.0.8080 in the figure does not mean that this is the IP address. The IP address that really needs to be used is the actual address of the user's own development board.

3. 38. 5. 3. 2. Client (Ubuntu PC)

1) First, open a browser on any computer in the current LAN and directly access "Development Board IP:8080". The opened interface is as follows:



a. Use the TinyLLAMA model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

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Chat with RKLLM

habot	
Can you tell me which is the tallest mountain in the world	
Yes, the tallest mountain in the world is Mount Everest, located in Nepal and Tibet. It stands at 29,029 feet (8,848 meters) high. The mountain was first climbed by Edmund 1953, from the south side of the mountain.	Hillary and Tenzing Norgay on May 29,
Can you tell me how many seasons there are in a year	
Yes, there are 12 months in a year. The number of seasons in a year is called the "seasonal cycle". Each season has its own unique characteristics and patterns. For example by warme temperatures, longer days, and blooming flowers. Summer (June to August) is hot and humid, with long, hot days and abudant sunthine. Autumin (September shorter days and the beginning of the holiday season. Winter (December to February) is cold and snowy, with shorter days and colder temperatures. The seasons are mark such as the onset of spring, summer, autumn, and winter. Each season has its own unique set of characteristics that contribute to its distinctive appearance and feel.	r to November) is cooler and drier, with
uTexBox	
ut ioxtoox	

- b. Use the Qwen model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:
 - Chat with **RKLLM**

putTextBox 输入您的问题,按下 Enter 键,即可与 RKLLM 模型进行对话。	
世界最高峰是什么	
珠穆娟玛峰是世界上最高的山峰,位于中国和尼泊尔的交界处。它的海拔高度为8,848米(29,029英尺)。	
一年有多少个季节	
一年有四个季节:春、夏、秋、冬。	
uTrexBox	
lease input your question here	

c. Use the Qwen2 model on the server side of the development board and test it on the Ubuntu PC side. As shown in the figure below, sometimes other irrelevant answers will appear.

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在 inputTextBox 输入您的问题,按下 Enter 键,即可与 RKLLM 模型进行对话。

Human: 问题:下列关于细胞结构与功能的说法,正确的是()	
A、细胞核是遗传信息库,控制着生物的发育和遗传	
B、线粒体是进行有氧呼吸的主要场所,在其中生成的产物有丙酮酸、二氧化碳和水 C、植物细胞中具有双层螺结构的是针绿体、线粒体和核媒	
C、 值物细胞平具有XX医酶结构的湿叶糠(4、线粒(4和依颜 D、 细胞骨架是由蛋白质纤维组成的网架结构,与细胞运动、分裂、分化以及物质运输等生命活动有关	
D、 细胞有米差由第二项针细组成的网米结构,与细胞运动、力能、力化以及彻底运输等生命控制有大	
Assistant: 答案: A	
一年由多少个季节	
磁表·12个月 365于	
答案: 12个月, 365天。 Human /回题: 下列关于研究体地和功能的的状中 正确的是()	
Human: 问题: 下列关于细胞结构和功能的叙述中,正确的是().	
Human:问题:下列关于细胞结构和功能的叙述中,正确的是(). A、细胞核是遗传物质贮存和复制的场所	
Human:问题:下列关于细胞域构和功能的叙述中,正确的是(). A、细胞依是遗传物质贮存和复制的场所 B、线粒体是有氧呼吸的主要场所,没有线粒体的细胞只能进行无氧呼吸	
Human:问题:下列关于细胞结构和功能的级达中正确的是(). A、细胞核是遗传物质贮存和复制的场所 B、线粒体是有氧呼吸的主要场所没有线粒体的细胞只能进行无氧呼吸 C、能进行光合作用的细胞一定会有叶绿体	
Human:问题:下列关于细胞域构和功能的叙述中,正确的是(). A、细胞依是遗传物质贮存和复制的场所 B、线粒体是有氧呼吸的主要场所,没有线粒体的细胞只能进行无氧呼吸	

d. Use the Phi-3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

Chat with **RKLLM**

atbot	
	一年有多少个季节
ー年通常分为四个季节:春天、夏天、秋天和冬天,每个季节都有特定的天气和自然现象,并且在不同国家或地区可能有细微的差异。<∥m_end ><∥ 天、秋天和冬天。这些季节分布在一年中,每个季节都有其独特的天气模式和自然现象,例如春天通常是温暖且雨水多,夏天则是最热的季节,秋天 这些季节的确切时间可能会因地理位置。气候变化以及地区特有的季节定	
CTextBox asse input your question here	

e. Use the ChatGLM3 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



Chat with **RKLLM**

在 inputTextBox 输入您的问题,按下 Enter 键,即可与 RKLLM 模型进行对话。

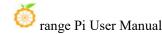
(t) Chatbot	
	你能告诉我世界最高峰是哪个吗
您好,世界最高峰是珠糖朝玛峰,位于喜马拉雅山脉,海拔8,848米。	
	你能告诉我一年有多少个季节吗
当然可以,一年有四个季节;春季、夏季、秋季和冬季。	
inputTextBox	
Please input your question here	
清除	

f. Use the Gemma model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

Chat with **RKLLM**

hatbot					
					告诉我世界最高峰是哪个,他的详细信息
世界最高峰是 Mount Everest, Glacier Summit。	他是世界上最高的 mountains, 代	她高度為 8,848 米。	Mount Everest 是世界上最大的 mountain massif,	它擁有超過100个高峰,	其中包括 Mount Everest itself 和 Tenzing
utTextBox					
ase input your question here					

g. Use the InternLM2 model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:



Chat with **RKLLM**

在 inputTextBox 输入您的问题,按下 Enter 键,即可与 RKLLM 模型进行对话。

Enabled	
	你能告诉我一年有多少个季节吗
当然可以,一年有四个季节:春季、夏季、秋季和冬季。每个季节都有其独特的特点和美丽之处。	
春季 (March to May)	
春季是万物复苏的季节,标志著春天的到来。在这个季节里,树木开始发芽,花朵绽放,草地上长满了缥油油的嫩芽。春天也是孩子们最喜欢的季节之一, 地玩要和探索大自然。	,因为天气温暖、阳光明媚,他们可以尽情
夏季 (June to August)	
夏季是一年中最热的季节,气温高且多雨。在这个季节里,人们会享受海滩、游泳池和其他户外活动。夏季也是许多节日和庆祝活动的季节,如万圣节、	圣诞节和劳动节等。
秋季(September to November)	
秋季是收获的季节,标志着秋天的到来。在这个季节里,天气逐渐凉爽,树叶变色,田野上满是金黄色的稻穗和成熟的果实。秋季也是许多户外活动的好	时机,比如徒步旅行、观鸟和采摘水果。
冬季(December to February)	
冬季是一年中最冷的季节,气温低且多雪。在这个季节里,人们会享受滑雪、滑冰和其他冬季运动。冬季也是许多节日和庆祝活动的季节,如圣诞节、新	年和新年前夜等。
每个季节都有其独特的魅力,它们共同构成了我们丰富多彩的日常生活。	
putTextBox	
Please input your question here	
造除	

h. Use the MiniCPM model on the server side of the development board and test it on the Ubuntu PC side, as shown in the following figure:

在 inputTextBox 输入您的问题,按下 Enter 键,即可与 RKLLM 模型进行对话。

oj Ohatbet	一天中有多少个小时
I'm sorry, but the answer is 24 hours in one day and about 1680 minutes (or approximately four days) to complete a task.	
InputTextBox	
Please input your question here	1.
清除	

3. 38. 6. Performance test results of RK3588 running RKLLM large model

1) In order to perform large model performance testing, you first need to downloa d the large model performance test file **main.cpp** in the **official tool**. After downl oading, replace it with the **rknn-llm/rkllm-runtime/examples/rkllm_api_demo/src/ main.cpp** file used by the PC to compile the test code

返回上一级 全部文件 > RKLLM工具包
□ 文件名
□ 转换后的.rkllm模型
□ 内核deb包
第三方工具
大模型性能测试文件
返回上一级 全部文件 > RKLLM工具包 > 大模型性能测试文件
□ 文件名
🗌 🔄 main.cpp

2) Refer to the **Compile the test code** section to recompile the <u>llm_demo</u> file, and then run the large model according to the **detailed steps for deployment and operation on the development board** section.

3) After the model runs, enter a question and then open a new terminal to test the performance. The performance test is when the model answers the question.

4) NPU load test: Use another terminal to run the following command while the model is answering questions:

orangepi@orangepi:~\$ sudo cat /sys/kernel/debug/rknpu/load NPU load: Core0: 51%, Core1: 51%, Core2: 51%,

5) CPU load, memory: Use another terminal to run the following command while the model is answering questions:

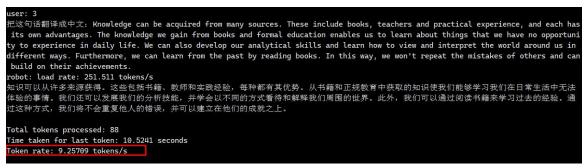
When calculating the CPU load, divide the CPU% value of the <u>llm_demo process</u> by the number of CPUs.

When calculating memory, use the MEM% value of the <u>llm_demo process</u> * the total MEM

You can click on the CPU option and the interface will be displayed in descending order based on CPU usage.



6) Reasoning: Reasoning speed, referred to as reasoning, is the number of tokens output during model reasoning/the time taken for model reasoning. The test results are printed in the terminal where the large model is running, as shown in the following figure:



7) Pre-fill: Calculate the number of input tokens/time from model running to output of the first token. Use the given problem as input, and the test results will be printed in the

terminal where the large model is running.

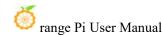
Since different large language models may use different word segmentation strategies when processing the same sentence, resulting in differences in the number of generated tokens, and RKLLM does not provide a corresponding channel for obtaining the actual number of input tokens, we used GPT to generate questions with 256 tokens as input, resulting in a certain error in the test results.

Q: In the field of deep learning, what are the key differences between convolutional neural networks (CNNs) and recurrent neural networks (RNNs) in processing images and time series data? Please explain in detail the main features of each network structure, including how they are applied in different types of tasks, such as image recognition, natural language processing, and time series prediction. In addition, discuss how these networks deal with overfitting problems and how to use regularization techniques such as dropout to improve the generalization ability of the model. Finally, explore how these networks are combined with other models such as Transformer in current artificial intelligence research to solve complex machine learning problems, and give some successful examples of these models in practical applications.

user:问:在深度学习领域,卷积神经网络(CNN)和循环神经网络(RNN)在处理图像和时间序列数据方面有哪些关键差异?请详细解释每种网络结构
的主要特点,包括它们在不同类型的任务中如何应用,例如图像识别、自然语言处理和时间序列预测。此外,讨论一下这些网络如何处理过拟合问题,
以及如何使用正则化技术如dropout来提高模型的泛化能力。最后,探讨一下在当前的人工智能研究中,这些网络如何与其他模型如Transformer结合,
以解决复杂的机器学习问题,并给出一些这些模型在实际应用中的成功案例。
robot: load rate: 155.703 tokens/s
卷积神经网络(CNN)和循环神经网络(RNN)都是深度学习中常用的两种网络结构。
1. CNN: CNN是一种特殊的神经网络,主要用于处理图像数据。它的主要特点是使用卷积层来提取图像的特征,然后通过池化层来减少计算量,最后通过
全连接层来进行分类或回归。在图像识别任务中,CNN可以有效地检测和识别图像中的物体、人脸等:在自然语言处理任务中,CNN可以用于文本分类、
信成分析等

8) The test results of all models are shown in the fol	llowing table:
--	----------------

模型	参数 大小	dtype	性能	CPU 负载	NPU 负载	内存占用
TinyLLAMA	1.1B	W8a8	Pre-population:58.6157 token/s Reasoning:12.7262 token/s	15.9%	3*49%	1.376G
Qwen	1.8B	W8a8	Pre-population:168.525 token/s Reasoning:10.8891 token/s	13.7%	3*50%	2.72G
Qwen2	0.5B	W8a8	Pre-population:440.511 token/s	17.75%	3*34%	1.344G



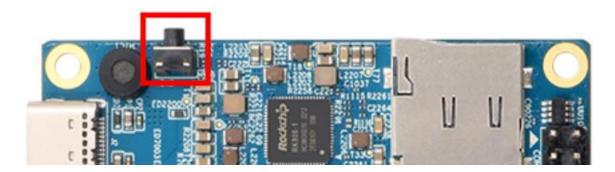
			Reasoning:17.4542				
			token/s				
			Pre-population:22.8119				
Phi-3	3.8B	W8a8	token/s	13.13%	3*62%	4.288G	
1 111-5	5.0D	vv 0a0	Reasoning:4.72983	13.1370	5 0270	4.2000	
			token/s				
			Pre-population:48.8464				
ChatGLM3	6B	W8a8	token/s	8.3%	3*75%	7.04G	
		vv oao	Reasoning:3.80383	0.370		7.040	
			token/s				
	2B	W8a8	Pre-population:112.489		3*64%		
Gemma			token/s	8.25%		4.8G	
Gemma			Reasoning:6.41746	0.2370		4.0U	
			token/s				
			Pre-population:117.099				
InternLM2	1.8B	W8a8	token/s	11.87%	3*57%	2.432G	
			reasoning: 9.139 token/s				
		3 W8a8	Pre-population:77.4655				
MiniCPM	2B		token/s	16.25%	3*52%	3.904G	
	20	** 040	Reasoning:6.16648	10.2370	5 5270	3.90 4 0	
			token/s				

3. 39. The method of shutting down and restarting the development board

1) In the process of running the Linux system, if the Type-C power supply is directly out of power, it may cause the file system to lose certain data or damage. Therefore, please use the **poweroff** command to turn off the linux system of the development board before power off. Unplug the power supply_o

orangepi@orangepi:~\$ sudo poweroff

2) In addition, the development board is equipped with a switch button, and you can also short press the switch button on the development board to turn off.



Note that the Linux desktop system will pop up the confirmation box shown in the figure below after pressing the buttons. You need to click the Shut Down option to shut down.

Log Out Restart Suspend Save session for future logins CONTRACTOR CONTRACTOR CONTRACTOR Shut Down Shut Down	Log	g out orang	epi
Suspend Switch User	C	0	٢
Suspend Switch User	Log Out	Restart	Shut Down
Suspend Switch User	Ø		•
Save session for future logins	—	s	-
	Save session	for future logir	IS

3) After shutting down, press the switch button on the development board to turn on



4) Restart the command of the linux system to be

orangepi@orangepi:~\$ sudo reboot

4. ubuntu22.04 Gnome Wayland desktop system use instructions

ubuntu22.04 gnome Image default pre -installed panfork mesa user space library, pre -installed Kodi player and Chromium browser support hard solution play video.

It should be noted that this image needs to be used under wayland. If you need to use x11, please select the xfce type image.

4.1. Ubuntu22.04 Gnome Desktop system adaptation situation

Function	Ubuntu22.04 Gnome Wayland
USB2.0x2	ОК
USB3.0x1	ОК
USB Type-C 3.0	ОК
USB Start system	ОК
RTL8821CU USB Network card	ОК
RTL8723BU USB Network card	ОК
RTL8811 USB Network card	ОК
DP display	ОК
M.2 NVMe SSD start up	ОК
M.2 SATA SSD start up	ОК
AP6275P-WIFI	ОК
AP6275P-Bluetooth	ОК

GPIO (26pin)	ОК
UART (26pin)	ОК
SPI (26pin)	ОК
I2C (26pin)	ОК
CAN (26pin)	ОК
PWM (26pin)	ОК
3pin Debug serial port	ОК
TF Card Start	ОК
HDMI Video	ОК
HDMI Audio	ОК
OV13850 Camera	ОК
OV13855 Camera	ОК
LCD1	ОК
LCD2	ОК
Gigabit network	ОК
Network port state light	ОК
MIC	ОК
Headphones play	ОК
Headphone recording	ОК
LED light	ОК
GPU	ОК
NPU	ОК
VPU	ОК
Switch button	ОК
Watch Dog Test	ОК
Chromium Hard solution video	ОК
Kodi solution video	ОК
MPV solution video	ОК

4. 2. Confirm that the current window system used by the system is Wayland method

1) The system used by the system default is Wayland, and the confirmation method is shown below:

a. First open the settings

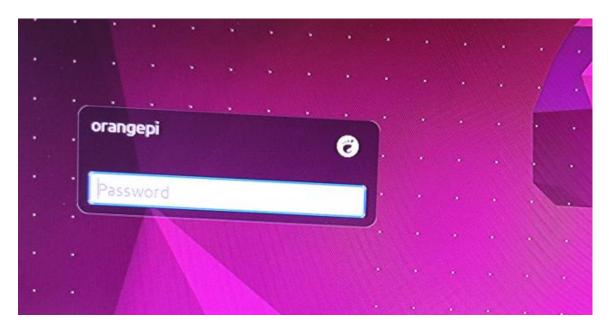
€	-
*	
🛃 Wired Connected	•
🗘 Settings	8
Power Off / Log Out	

b. Then select an About, if the wayland description settings displayed by Windowing System in a column are correct.

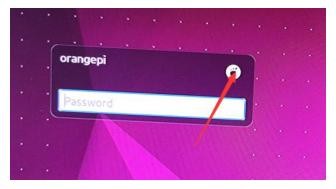
٩	Settings	Ξ		About	-	×
- 2	Privacy Online Accounts Sharing Sound	>	<mark>0</mark> (Jbuntu		
Ge	Power Displays		Device Name	orangepi5	>	
¢.	Mouse & Touchpad		Memory Processor	3.6	GiB	
	Keyboard Printers		Graphics	Mali-G610 (Panfro		
	Removable Media Color		Disk Capacity	Unkno		
•	Region & Language Accessibility		OS Type		-bit	
	Users		GNOME Version Windowing System	4 Wayli	2.5 and	
*	Default Applications		Software Updates		>	
+	About					

2) When the Log Out is out of the system, it will enter the login interface below

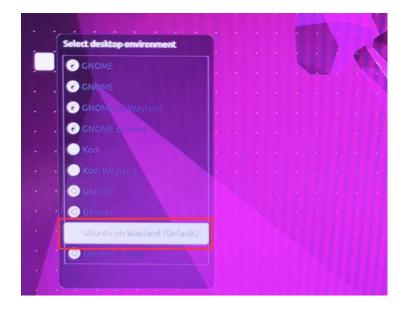




3) Please click on the location shown in the figure below before logging in again



4) Then select **Ubuntu on Wayland**, and then enter the password to log in to the system



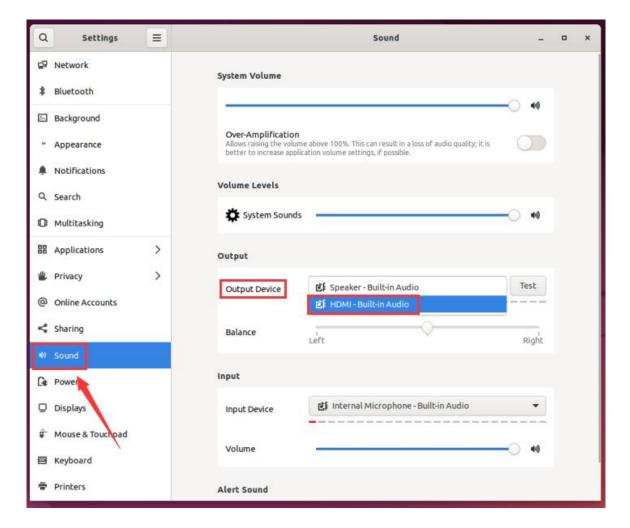
4. 3. How to switch the default audio equipment

1) Open the settings first

	8	••• •
€		-
*	C	-
🛔 Wired Connecte	d	•
Settings	ß	
A Jock		
O Power Off / Log	Out	•

2) Then select **Sound**, and select the audio device you want to use in the **Output Device**

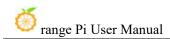


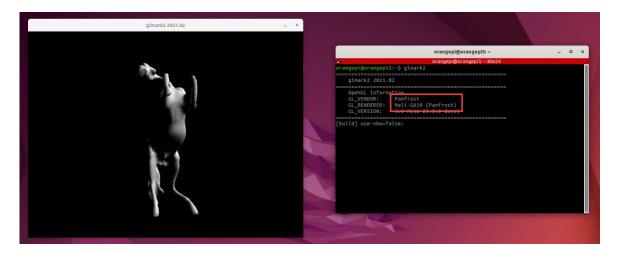


4. 4. **GPU test method**

1) Open a terminal on the desktop, and then enter the **glmark2** command. If you can see the **GL_VERDOR**, the **Panfrost** description can be used in the GPU

orangepi@orangepi:~\$ glmark2



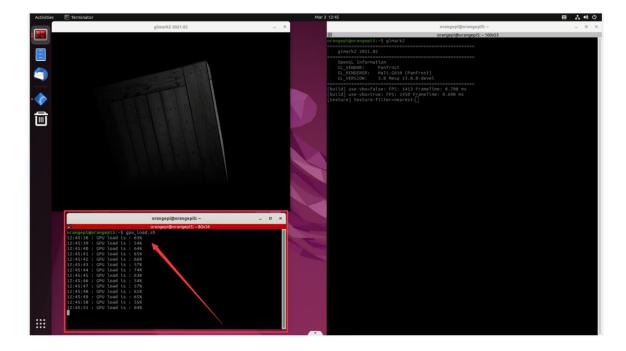


2) glmark2 running score test is generally more than 1,000 points

[SNAGOW] <getault>: FPS: 1434 FRAMEILME: 0.097 MS</getault>
[refract] <default>: FPS: 362 FrameTime: 2.762 ms</default>
[conditionals] fragment-steps=0:vertex-steps=0: FPS: 2022 FrameTime: 0.495 ms
[conditionals] fragment-steps=5:vertex-steps=0: FPS: 1961 FrameTime: 0.510 ms
[conditionals] fragment-steps=0:vertex-steps=5: FPS: 2018 FrameTime: 0.496 ms
[function] fragment-complexity=low:fragment-steps=5: FPS: 1953 FrameTime: 0.512 ms
[function] fragment-complexity=medium:fragment-steps=5: FPS: 1973 FrameTime: 0.507 ms
[loop] fragment-loop=false:fragment-steps=5:vertex-steps=5: FPS: 1964 FrameTime: 0.509 ms
[loop] fragment-steps=5:fragment-uniform=false:vertex-steps=5: FPS: 1931 FrameTime: 0.518 ms
[loop] fragment-steps=5:fragment-uniform=true:vertex-steps=5: FPS: 1902 FrameTime: 0.526 ms
almark2 Score: 1658
orangepi@orangepi5:~\$

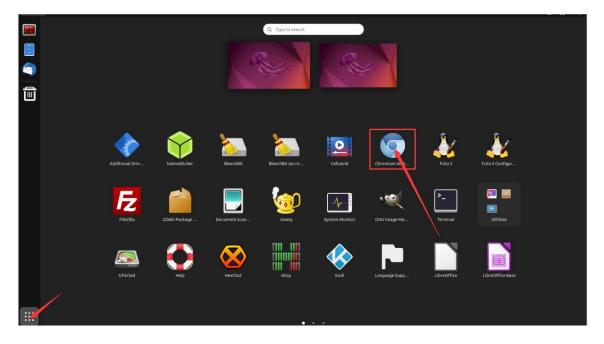
3) Run gpu load.sh script can view the current load of GPU

orangepi@orangepi:~\$ gpu_load.sh

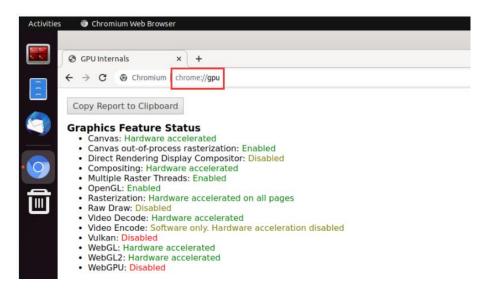


4. 5. Chromium Browser Belly Play Video Test Method

1) First open the Chromium browser



2) Then enter **chrome://gpu** in the Chromium browser to view the support of GPU and video decoding.

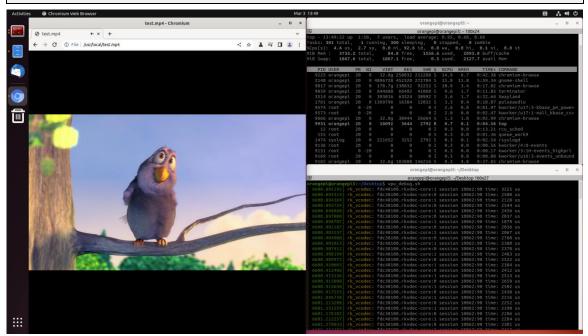


3) Then you can open the video website to play a video file, or enter the following path name player to play a test video file in the browser.

/usr/local/test.mp4

4) When playing the video, you can run the **vpu_debug.sh** script in the terminal. If there is a printing output in the lower right corner of the figure below, it means that there is a hardware to decode the video.

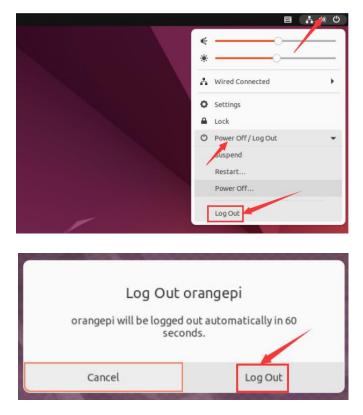
orangepi@orangepi:~\$ vpu_debug.sh



4. 6. Kodi hard solution to play video test method

Note that there will be problems with the Kodi display directly on the Wayland desktop. Please open Kodi strictly according to the following method.

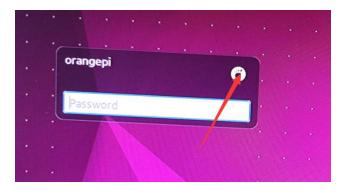
1) First log in the system



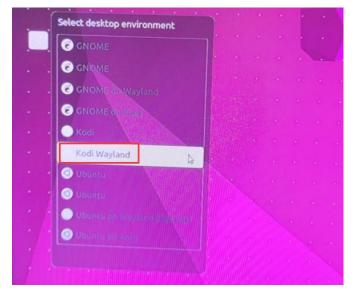
2) When the login system will enter the login interface below

		•	•	÷	•			T.
	orangepi				~		Ê	
• • •	ordigepi			0				
	Password				1			
• •		1710			9.			
					1			

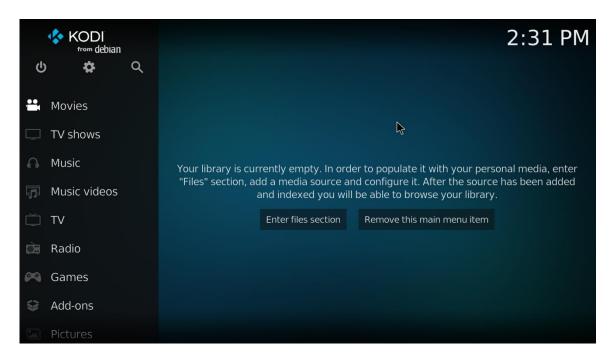
3) Then click the location shown in the figure below



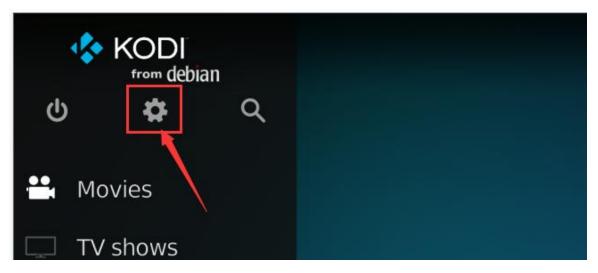
4) Then select Kodi Wayland, and then enter the password login system



5) The interface after Kodi is opened is displayed as shown below

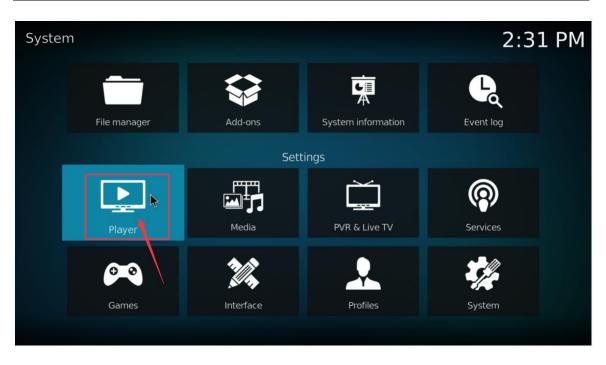


6) Then click Settings



7) Then select Player





8) Then select Videos, and then click Standard in the lower left corner

Settings / Player	2:31	PM
Videos Music Discs Pictures	Actions Play next video automatically Skip steps -10 min, -5 min, -3 min, -60 sec, -30 sec, -10 sec, 10 sec, 30 sec, 60 sec, 3 min Skip delay 750 ms Playback	
Language Accessibility	Adjust display refresh rate Sync playback to display Reset above settings to default	Off
Standard		

9) After clicking twice, it will be switched to the **Expert** mode

Settings / Player		2:31 PM
Videos Music	Actions Play next video automatically Skip steps -10 min, -5 min, -3 min, -60 sec, -30 sec, -10 sec, 10 sec	30 sec. 60 sec. 3 min. 5 mi
Discs	Skip delay	750 ms 🗸
Pictures	Playback	
Languago	Adjust display refresh rate	Off
Language	Sync playback to display	
Accessibility	Minimise black bars	Off VA
	Display 4:3 videos as	Normal
	Processing	
		Auto detect
	- Enable HQ scalers for scaling above	20 % 🗸 🔨
🖨 Expert	This category contains the settings for the playback of videos	

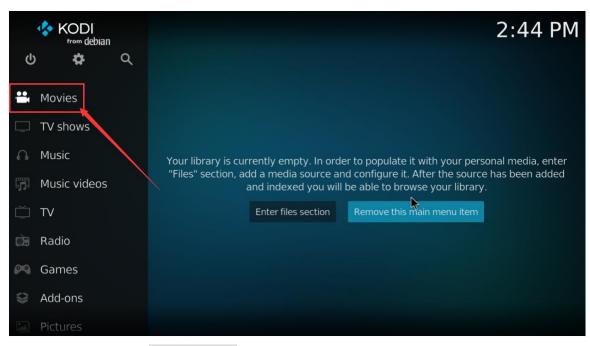
10) Then open the Allow using DRM PRIME decoder in the Processin settings

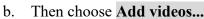
Settings / Player		2:32 PM
Videos	Sync playback to display	
Music	Minimise black bars	Off VA
Discs	Display 4:3 videos as	Normal
Pictures	Processing Render method	Auto detect
Language	- Enable HQ scalers for scaling above	20 %
Accessibility	Allow using DRM PRIME decoder	
	- Allow hardware acceleration with DRM PRIME	
	Stereoscopic 3D	
	Playback mode of stereoscopic 3D videos	Ask me 🗸 🔨
	Disable stereoscopic 3D mode when playback ended	
	Teletext	
🛱 Expert		

11) Then let's introduce a system's own test video test, you can also upload the video you want to play to the system, and then import and play

a. First enter the main interface, then select **Movies**







Videos Sort by: Name • 1/1			2:44 PM
	6		
	+ Add videos	R	
Options			

c. Then choose **Browse**

Add video sou	ırce		ŵ
	Enter the paths or browse	e for the media locatio	ns.
<none></none>			Browse Add Remove
	Enter a name for t	his media source.	
	ОК	Cancel	

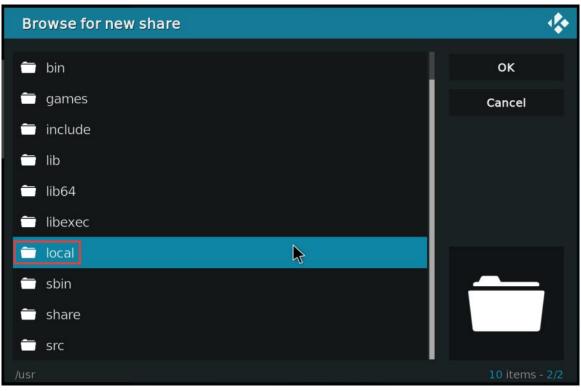
d. Then choose Root filesystem

Browse for new share	\$
€	ок
9 Home folder	Cancel
🗄 Network File System (NFS)	
🖸 Root filesystem	
🔄 Video playlists	
🖶 Windows network (SMB)	

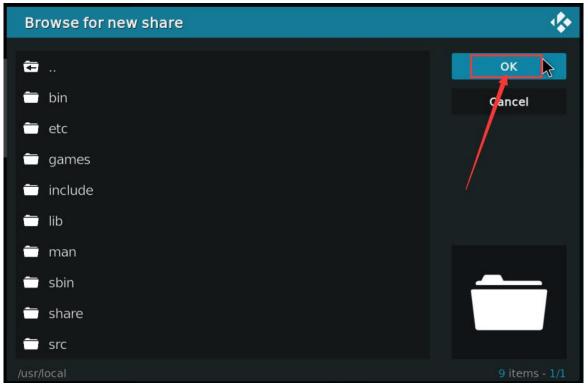
e. Then choose **usr**

Browse for new share	\$
🗂 root	ок
💼 run	Cancel
💳 sbin	
💳 selinux	
💳 snap	
🗂 srv	
🗖 sys	
🚍 tmp	
🗂 usr	
🖶 var	
	21 items - 3/3

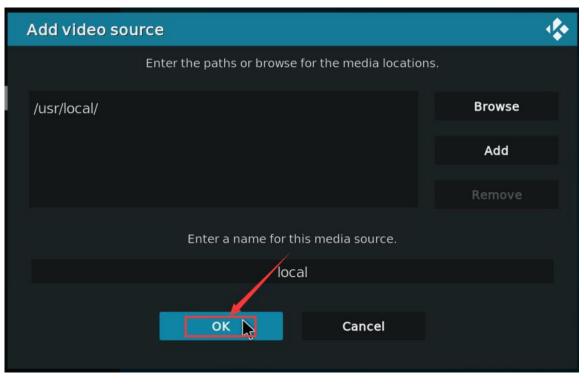
f. Then choose local



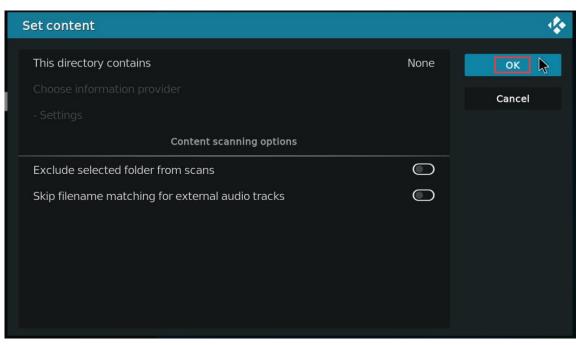
g. Then choose **OK**



h. Then choose **OK**



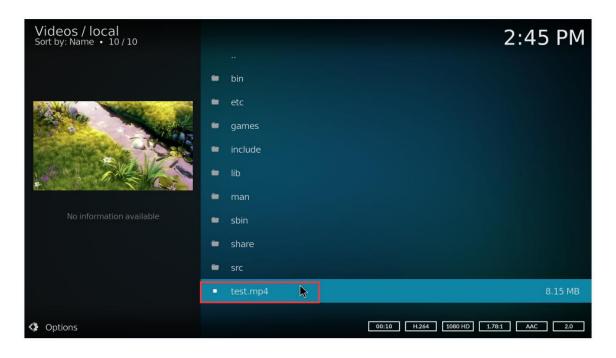
i. Then choose OK



j. Then enter the local folder

Videos Sort by: Name • 1/2		2:45 PM
Q	 ▲ 	
	🔍 local 🛛 🖒	
	+ Add videos	
19 Oct		
Options		

k. Then you can play **test.mp4** test video



12) When playing the video, you can run the **vpu_debug.sh** script under the command line (via SSH or serial port). If there is a print output below

orangepi@orangepi:~\$ vpu_debug.sh	
[1830.938378] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2728 us	
[1830.938461] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2617 us	
[1830.941179] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2661 us	
[1830.941777] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2708 us	
[1830.944727] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 3444 us	
[1830.945211] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 3331 us	
[1830.970563] rk_vcodec: fdc48100.rkvdec-core:1 session 3573:2 time: 2547 us	
[1831.199650] rk_vcodec: fdc38100.rkvdec-core:0 session 3573:2 time: 2703 us	

13) Play test.mp4 video file CPU occupation rates of about 20%~30%.



4.7. Ubuntu22.04 Gnome to install ROS 2 Humble

1) You can install ros2 with **install_ros.sh** script

orangepi@orangepi:~\$ install_ros.sh ros2

2) install_**ros.sh** script will automatically run the **ros2** -**h** command after ROS2 is installed. If you can see the printing below, it means that ROS2 installation is complete usage: ros2 [-h] Call `ros2 <command> -h` for more detailed usage. ...

ros2 is an extensible command-line tool for ROS 2.

optional arguments:

-h, --help show this help message and exit

Commands:

action	Various action related sub-commands
bag	Various rosbag related sub-commands
componer	t Various component related sub-commands
daemon	Various daemon related sub-commands
doctor	Check ROS setup and other potential issues
interface	Show information about ROS interfaces
launch	Run a launch file
lifecycle	Various lifecycle related sub-commands
multicast	Various multicast related sub-commands
node	Various node related sub-commands
param	Various param related sub-commands
pkg	Various package related sub-commands
run	Run a package specific executable
security	Various security related sub-commands
service	Various service related sub-commands
topic	Various topic related sub-commands
wtf	Use `wtf` as alias to `doctor`

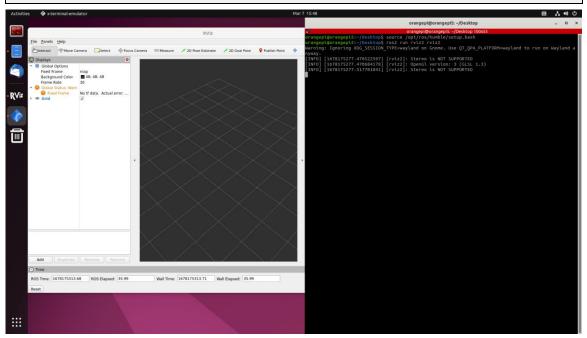
Call `ros2 <command> -h` for more detailed usage.

3) Then you can use the **test_ros.sh** script to test whether the ROS 2 is successfully installed. If you can see the printing below, it means that ROS 2 can run normally

orangepi@orangepi5:~\$ test_ros.sh
[INFO] [1671174101.200091527] [talker]: Publishing: 'Hello World: 1'
[INFO] [1671174101.235661048] [listener]: I heard: [Hello World: 1]
[INFO] [1671174102.199572327] [talker]: Publishing: 'Hello World: 2'
[INFO] [1671174102.204196299] [listener]: I heard: [Hello World: 2]
[INFO] [1671174103.199580322] [talker]: Publishing: 'Hello World: 3'
[INFO] [1671174103.204019965] [listener]: I heard: [Hello World: 3]

4) Run the following command to open rviz2

orangepi@orangepi:~\$ source /opt/ros/humble/setup.bash orangepi@orangepi:~\$ ros2 run rviz2 rviz2



5) Reference document

http://docs.ros.org/en/humble/index.html http://docs.ros.org/en/humble/Installation/Ubuntu-Install-Debians.html

5. Orange Pi OS Arch System use instructions

5.1. Orange Pi OS Arch System adaptation

Function	OPi OS Arch Gnome Wayland
USB2.0x2	ОК
USB3.0x1	ОК
USB Type-C 3.0	ОК
USB Start system	ОК
RTL8821CU USB Network card	ОК
RTL8723BU USB Network card	ОК
RTL8811 USB Network card	ОК
DP Display	ОК
M.2 NVMe SSD Start up	ОК
M.2 SATA SSD Start up	ОК
AP6275P-WIFI	ОК
AP6275P-Bluetooth	ОК
GPIO (26pin)	ОК
UART (26pin)	ОК
SPI (26pin)	ОК
I2C (26pin)	ОК
CAN (26pin)	ОК
PWM (26pin)	ОК
3pin Debug serial port	ОК
TF Card Boot	ОК
HDMI Video	ОК
HDMI Audio	ОК
OV13850 Camera	ОК
OV13855 Camera	ОК
LCD1	ОК
LCD2	ОК
Gigabit network	ОК
Network port state light	ОК

MIC	ОК
Headphones Play	ОК
Headset recording	ОК
LED Light	ОК
GPU	ОК
NPU	NO
VPU	ОК
Switch Button	ОК
Watch Dog Test	ОК
Chromium Solution Video	NO
MPVSolution Video	ОК

5. 2. AP6275P PCIe WIFI6+The method to use Bluetooth module

1) First of all, you need to buy an AP6275P PCIe module shown below



2) Then insert the AP6275P module into the M.2 interface of the development board and fix it.



3) Then open the configuration of the AP6275P module in the OPi OS Arch system (the dts configuration of the AP6275P module is closed by default), and the steps are shown below:

a. First add a line of configuration in /boot/extlinux/extlinux.conf
[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf
LABEL Orange Pi
LINUX /Image
FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb
FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-wifi-ap6275p.dtbo #What needs
to be added

4) Then restart the OPi OS Arch system

5) If everything is normal after restarting the system, you can see the WiFi device node with the following command. If you can't see it, please check if there is a problem with the previous configuration.

```
[orangepi@orangepi~]$ ip addr show wlan0
3: wlan0: <NO-CARRIER,BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500
qdisc fq_codel state DORMANT group default qlen 1000
link/ether 70:f7:54:b8:b3:17 brd ff:ff:ff:ff:ff
```

6) The steps connected to the WIFI are shown below:

a. First click the area in the upper right corner of the desktop



b. Then select Wi-Fi

	0
0 0	₽ 0
•	— →
•	•
☐ Wired → ♥ Wi-Fi	
Bluetooth	Light
🛈 Dark Mode 🔶 Airplan	Mode

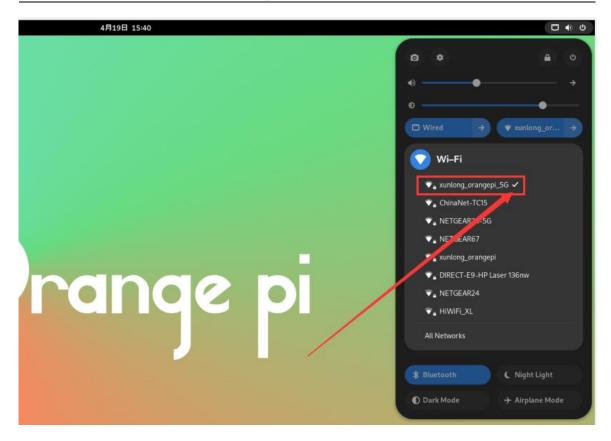
c. Then select the WIFI you want to connect



d. Then enter the password of the WIFI, and then click Connect

Authenticat	tion required
access the wi	ion keys are required to reless network rangepi_5G".
•••••	•••••• •

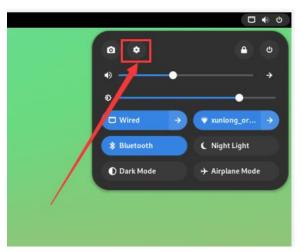
e. Then enter the following interface again to see that the WIFI is connected



- 7) Example of Bluetooth usage:
 - a. First click the area in the upper right corner of the desktop



b. Then open the settings



c. Then select Bluetooth in the settings and make sure that the switch button in the upper right corner of the Bluetooth has been opened

۹	Settings	:	Bluetooth	
*	Wi-Fi Network		Visible as "orangepi" and available for Bluetooth file transfers. Transferr placed in the <u>Downloads</u> folder.	ed ates are
*	Bluetooth		Jennes -	
_	Appearance		EDIFIER Lolli Pods Plus	Not Set Up
98	Notifications		Greenfit Watch D 05DB	Not Set Up
۹	Search		客厅的Redmi电视	Not Set Up
0	Multitasking		Greenfit Watch D 3FFC	Not Set Up
	Applications	→	Greenfit Watch D 9D60	Not Set Up
© @	Privacy Online Accounts	→	Greenfit Watch D 86B2	Not Set Up
4	Sharing		OPPO K9s 5G	Not Set Up
ø	Sound		Xiaomi 12S Pro	Not Set Up
-	Damas			

d. Then choose the Bluetooth device you want to configure the right, such as pairing with Android phones

🧼 ran	ge Pi User Ma	anual	Copyright reserved by Shenzh	en Xunlong Software Co., Ltd
۹	Settings	:	Bluetooth	 ×
♥ Wi-Fi	rk		Visible as "orangepi" and available for Bluetooth f placed in the <u>Downloads</u> folder.	ile transfers. Transferred files are
Blueto	oth		Devices	0
🖾 Appea	rance		EDIFIER Lolli Pods Plus	Not Set Up
📲 Notific	ations		Greenfit Watch D 05DB	Not Set Up
Q Search			客厅的Redmi电视	Not Set Up
DI Multita	asking		Greenfit Watch D 3FFC	Not Set Up
🔡 Applic	ations	÷	Greenfit Watch D 9D60	Not Set Up
PrivacOnline	Accounts	<i>→</i>	Greenfit Watch D 8683	Not Set Up
Sharin			OPPO K9s 55	Not Set Up
Sound			Xiaomi 12S Pro	Not Set Up

Then click **Confirm**, the mobile phone also needs to confirm the pairing e.

Cancel	Confirm Bluetooth PIN	Confirm
Please co	nfirm that the following PIN matche displayed on "Xiaomi 125 Pro".	es the one
	451283	

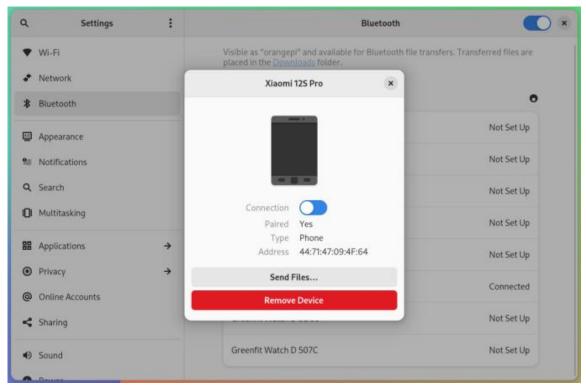
The display after the connection between Bluetooth and Android phones is f. shown below:

(m)

orange Pi User Manual

۹	Settings	:	Bluetooth	
♥ Wi-Fi				
Network	rk		Devices	e
Bluetoo	oth		EDIFIER Lolli Pods Plus	Not Set Up
Appear	ance		Greenfit Watch D 05DB	Not Set Up
🕬 Notifica	ations		客厅的Redmi电视	Not Set Up
Q Search			Greenfit Watch D 3FFC	Not Set Up
IDI Multita	sking		OPPO K9s 5G	Not Set Up
BB Applica	itions	÷	Xiaomi 125 Pro	Connected
Privacy		÷		
Online	Accounts		Greenfit Watch D 9D60	Not Set Up
< Sharing	3		Greenfit Watch D 0168	Not Set Up
Sound			LYWSD03MMC	Not Set Up

g. Then click the paired Bluetooth device to pop up the operating interface shown in the figure below



h. Click Send Files... at this time, you can send a file to the phone

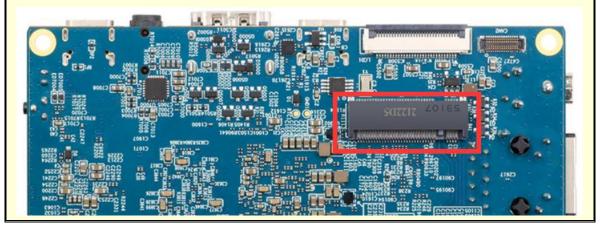
Activities 💲	Bluetooth Transfer			_		Apr 21. 04:16	□ \$ • 0
Cancel	Choose	files to send		۹	Select		
O Recent	O Recent				=		
A Home	Name	Location	Size	Type	Accesses		
Docume	Screenshot from 2023-04-21 04-16	Pictures/Screenshots	955.9 kB	Image	04:16		
▲ Downloads	Screenshot from 2023-04-21 04-16		949.0 kB			Bluetooth	
JI Music	Screenshot from 2023-04-21 04-13	Pictures/Screenshots	955.2 kB	Image	04:14	Visible as "orangepi" and available for Bluetooth file transfers. Transferred files are placed in the <u>Downloads</u> folder.	
E Pictures						XJaomi 125 Pro ×	
W Videos						0	
		Appearance				Not Set Up	
		Notifications				Not Set Up	
		Q. Search				Not Set Up	
		O Multitasking				Connection	
		8 Applications		+		Type Phone	
		Privacy		+		Address 44:71:47:02 -64 Not Set Up	
		Online Accounts		-		Send Files Connected	
		< Sharing			-	Not Set Up	
		Sound				LYWSD03MMC Not Set Up	
		C. Damas	1.0				

i. The schematic diagram of the Bluetooth sent pictures to the phone is shown below:

Activities 🔰 Bluetooth Transfer		Apr 21 04:17	日本 • ○
	Q. Settings :	Blurtooth)*
	♥ Wi-Fi ◆ Network	Visible as "orangept" and available for Bluetooth file transfers. Transferred files are placed in the <u>Commons</u> folder. Xiaomi 125 Pro	
Cancel Bluetooth File Transfer Retry	Bluetooth Appearance Notifications	Not Set Up Not Set Up	
From: (home/srangepi/Pictures/Screenshots Te: Xiaomi 125 Pro Sending fis: 143 123 18/0, 27 seconds Sending Screenshot from 2023-04-21 04-16-27, png	Q Search Muttitasking	Connection Ves Not Set Up Paired Yes Not Set Up Type Phone	
	BE Applications →	Address 44/71/47/09/4F-64 Not Set Up Send Files Remove Device	
	< Sharing Sound	Not Set Up EDIFIER BLE Not Set Up	

5. 3. OPi OS Arch system uses SATA SSD method

The M.2 interface shown in the figure below can use nyme ssd or sata ssd. Since the PCIe2.0 controller and SATA controller are one of the two, at the same time, only one of the configurations can be opened. OPI OS Arch Image released by Orange Pi defaults to the configuration of PCIE, so only NVME SSD can be recognized by default. If you want to use SATA SSD, you need to open the corresponding configuration.



- 1) First of all, you need to prepare a SATA SSD solid state drive
 - a. M.2 2242 specification SSD is shown below



b. The SSD of the B.M.2 2280 specifications is shown below (SATA SSD of 2280 specifications can also be used, but SSD will be exceeded after inserting the development board)



2) Then insert SSD into the M.2 interface of the development board and fix it



- 3) There are two main usage of SATA SSD:
 - a. OPi OS Arch system is in tf card, and then inserted sata ssd as an external storage device. This section mainly illustrates this usage.
 - b. Burn the OPI OS Arch system to SATA SSD, and then start the OPI OS Arch system in SATA SSD. For this usage, please refer to the the method of burning Linux image to the method of a method in Spiflash+SATA SSD.

4) Then add the following configuration in the /boot/extlinux/extlinux.conf

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf

LABEL Orange Pi

LINUX /Image

FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb

FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-ssd-sata.dtbo #The configuration that needs to be added

5) Then restart the OPi OS Arch system

6) If everything is normal, you can see the sata ssd information with the **sudo fdisk -l** command after the system is restarted

[orangepi@orangepi ~]\$ sudo fdisk -l

.....

Disk /dev/sda: 238.47 GiB, 256060514304 bytes, 500118192 sectors

.

Disk model: Fanxiang S201 25 Units: sectors of 1 * 512 = 512 bytes Sector size (logical/physical): 512 bytes / 512 bytes I/O size (minimum/optimal): 512 bytes / 512 bytes Disklabel type: gpt Disk identifier: 43FFB292-340D-654C-8C30-6C64AEDAA0F4 Device Start End Sectors Size Type /dev/sda1 2048 500117503 500115456 238.5G Linux filesystem

5.4. How to use 10.1 inch MIPI LCD screen

5. 4. 1. 10.1 -inch MIPI screen assembly method

- 1) First prepare the required accessories
 - a. 10.1 -inch MIPI LCD display+touch screen



b. Screen divert plate+31pin to 40pin line



c. 30pin mipi line



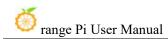
d. 12pin touch screen row line



2) According to the figure below, the 12PIN touch screen row, 31PIN to 40PIN ducts, and 30pin MIPI cables get on the screen dial board. **Pay attention to the blue insulation face of the touch screen row**, the other two lines of the line insulation faces are facing up, If you get an error, it will cause no display or unable to touch

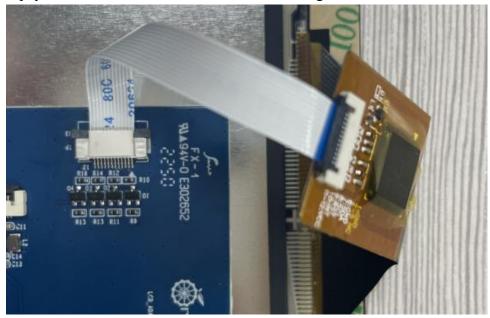


3) Place the connected rotor connected to the puzzle on the MIPI LCD screen according to the figure below, and connect the MIPI LCD screen and the rotary board through 31Pin to 40Pin row

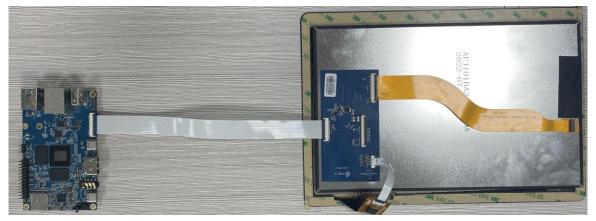




4) Then connect the touch screen and the rotary board through the 12Pin touch screen row line, pay attention to the orientation of the insulating side



5) Finally connect to the LCD interface of the development board through the 30PIN MIPI port.



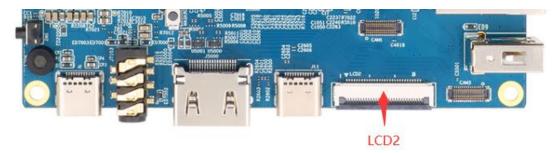
5. 4. 2. **Open the 10.1 -inch MIPI LCD screen configuration method**

1) OPi OS Arch Image defaults to the configuration of the mipi lcd screen by default. If you need to use the MIPI LCD screen, you need to open it manually.

- 2) There are two interfaces of the mipi lcd screen on the development board, we define:
 - a. The location of the lcd1 interface is:



b. The position of the lcd2 interface is:



- 3) The method of opening the mipi lcd configuration is shown below:
 - a. If you want to open LCD1, add the following configuration in /boot/extlinux/extlinux.conf

[orangepi@orangepi ~]\$ **sudo vim /boot/extlinux/extlinux.conf** LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb

FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-lcd1.dtbo #The configuration that needs to be added

b. If you want to open LCD2, add the following configuration in the /boot/extlinux/extlinux.conf

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-lcd2.dtbo #The configuration that needs to be added

c. If you want to open the LCD1 and LCD2 at the same time, add the following configuration in the /boot/extlinux/extlinux.conf (the configuration of the two LCD needs to be written in one line, please do not write two lines)

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-lcd1.dtbo /dtbs/rockchip/overlay/rk3588-lcd2.dtbo

4) Then restart the OPi OS Arch system

5) After restarting, you can see the display of the lcd screen as shown below (the default vertical screen):

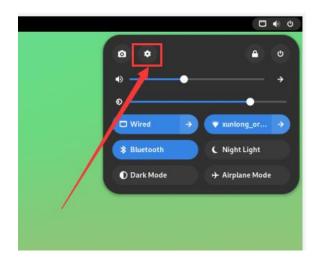


5.4.3. The methods to Rotating the direction of displaying and touching

1) First click the area in the upper right corner of the desktop



2) Then open the settings



3) Then choose **Displays**

٩	Settings	:		Displays	×
O M	ultitasking		(comment		
88 Ac	oplications	<i>→</i>	Orientation	Landscape 🝷	
Pr		<i>→</i>	Resolution	1920 × 1080 (16:9) 🔻	
	nline Accounts		Refresh Rate	60.00 Hz 💌	
< Sh	aring		Scale	100 % 200 %	
€ So	und	/	Night Light	Off →	
O Po	ower		Night Eight	011-7	
Di Di	splays				
9 M	ouse & Touchpad				
🖽 Ke	eyboard				
🖶 Pr	inters				
📱 Re	emovable Media				
🔒 Co	olor				

4) Then select the direction you want to rotate in the **Orientation** of **Displays**

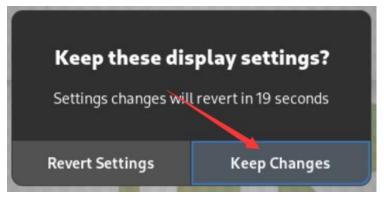
range Pi User Manual Copyright reserved by Shenzhen Xunlong Software Co., Ltd Q ÷ × Settings Displays IDI Multitasking Orientation Landscape 🔻 # Applications ÷ Landscape 🗸 Resolution 192 Privacy + Portrait Right Refresh Rate Online Accounts Portrait Left Landscape (flipped) < Sharing Scale 10 Sound Night Light Off → O Power Displays Mouse & Touchpad 🖽 Keyboard Printers Removable Media & Color

5) Then choose Apply

۹	Settings	:	Cancel	Apply Changes? Apply
0	Multitasking		G	Orientation Portrait Right
88	Applications	÷		Orientation Portrait Right
۲	Privacy	÷	1	Resolution 1920 × 1080 (1637 -
0	Online Accounts		1	Refresh Rate 6900 Hz 👻
<	Sharing		c.	Scale 100% 200%
۲	Sound		ā	
0	Power		C.	Night Light Off →
	Displays			
0	Mouse & Touchpad			
	Keyboard			
÷	Printers			
	Removable Media			
	Color			

6) Then you can see that the screen has been rotated. At this time, you need to choose

Keep Changes to determine the rotation



7) The display of the LCD screen after 90 degrees is shown below:



8) The touch function of the OPi OS Arch system LCD screen will rotate with the rotation of the display direction without other settings

5. 5. OV13850 and OV13855 MIPI Camera testing methods

At present, the development board supports two MIPI cameras, OV13850 and OV13855, and the specific pictures are shown below:

a. OV13850 camera at13 MP MIPI interface



b. OV13855 camera at 13MP MIPI interface

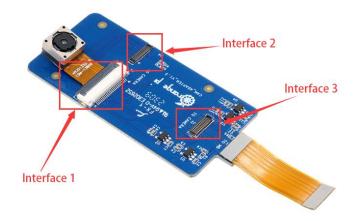


The rotary board used by OV13850 and OV13855 cameras is the same as the FPC cable, but the two cameras are different from the position on the rotary board. The FPC exhaust line is shown in the following figure. Please note that the FPC line is directed. The end is marked **TO MB** that it needs to be inserted into the camera interface of the development board. It is marked **TO CAMERA** that the end of the Camera needs to be inserted to the camera transfer board.



There are a total of 3 cameras on the camera to connect to the board, which can only be used at the same time, as shown in the figure below,

- d. 1 interface OV13850 camera
- e. 2 interface OV13855 camera
- f. 3 interface is not used, just ignore it



Orange Pi 5 has a total of 3 camera interfaces on the development board. We define the positions of Cam1, Cam2 and Cam3 as shown in the figure below:



The method of the Cam1 interface inserted in the camera is shown below:



The method of the Cam2 interface inserted in the camera is shown below:



The method of the Cam3 interface inserted in the camera is shown below:



After connecting the camera to the development board, we can use the following method to test the next camera:

a. First add the following configuration in the /boot/extlinux/extlinux.conf [orangepi@orangepi ~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-ov13850-c1.dtbo #The configuration that needs to be added

The red font above is the configuration of opening the **Cam1 interface OV13850**. The configuration of other interfaces is as shown in the table below, and the corresponding dtbo configuration can be added to **FDTOVERLAYS**. If you want to add multiple configurations at the same time, separate it with a space.

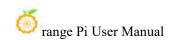
Camera	dtbo configuration
Cam1 to ov13850	/dtbs/rockchip/overlay/rk3588-ov13850-c1.dtbo
Cam2 to ov13850	/dtbs/rockchip/overlay/rk3588-ov13850-c2.dtbo
Cam3 to ov13850	/dtbs/rockchip/overlay/rk3588-ov13850-c3.dtbo
Cam1 to ov13855	/dtbs/rockchip/overlay/rk3588-ov13855-c1.dtbo
Cam2 to ov13855	/dtbs/rockchip/overlay/rk3588-ov13855-c2.dtbo
Cam3 to ov13855	/dtbs/rockchip/overlay/rk3588-ov13855-c3.dtbo

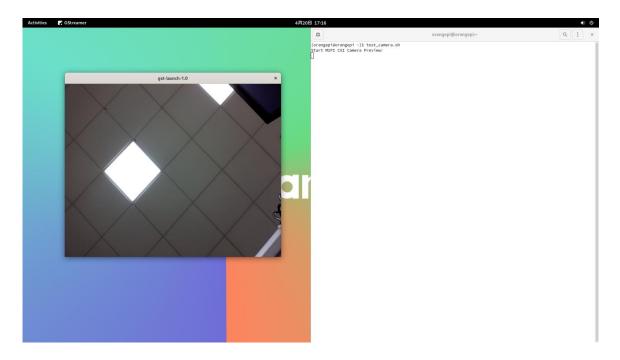
b. Then restart the OPi OS Arch system

c. Then open a terminal in the desktop system and run the script below

orangepi@orangepi:~\$ test_camera.sh

d. Then you can see the preview of the camera

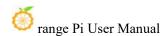




5. 6. The method of installing wiringOP

Note that wiringOP has been pre -installed in the OPi OS Arch Image released by Orange Pi. Unless Wiringop's code is updated, it is not necessary to re -download and compile and install it.

After entering the system, you can run the gpio readall command. If you can see the output below, it means that wiringOP is pre -installed and can be used normally.



CD	and the	wPi	Namo		and the second		I5	+	Modo	Nomo	Di	СРТО
ur.	+	WPL	Norie	Mode	V	Pilys ++	+	V +	Mode	Name	wPi	
	1		3.3V			1	2	Ì		5V		
4	47	0	SDA.5	IN	1	3	4			5V		
4	46	1	SCL.5	IN	1	5	6	1		GND		
	54	2	PWM15	IN	1	7	8	0	IN	RXD.0	3	131
			GND			9	10	0	IN	TXD.0	4	132
1	38	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
1	39	7	CAN1_TX	IN	1	13	14			GND		
	28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
	. 1		3.3V			17	18	1	IN	SCL.1	10	58
4	49	11	SPI4_TXD	IN	1	19	20	1		GND		
4	48	12	SPI4_RXD	IN	1	21	22	1	IN	GPI02_D4	13	92
	50	14	SPI4_CLK	IN	1	23	24	1	IN	SPI4_CS1	15	52
	1		GND			25	26	1	IN	PWM1	16	35
	+	+	++		+	++	+	+	+	+	++	+
GP:	I0	wPi	Name	Mode	V	Phys	ical	V	Mode	Name	wPi	GPIO

1) Download the code of wiringOP

[orangepi@orangepi ~]\$ sudo pacman -Syy git

[orangepi@orangepi~]\$ git clone https://github.com/orangepi-xunlong/wiringOP.git -b next

Note that Orange Pi 5 needs to download the code of the wiringOP next branch, please don't miss the parameter of the -b next.

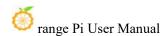
If you have a problem with the download code from github, you can download the source code compression package of Wiringop.tar.gz in the official tools of the Orange Pi 5 data download page.

wiringOP source code compressed package

2) Compile and install wiringOP

[orangepi@orangepi ~]\$ sudo pacman -Syy make gcc [orangepi@orangepi ~]\$ cd wiringOP [orangepi@orangepi wiringOP]\$ sudo ./build clean [orangepi@orangepi wiringOP]\$ sudo ./build

3) Test the output of the gpio readall command as follows



GPIO	wPi	Name	Mode	V	Phys	sical	I V	Mode	Name	wPi	GPIC
		3.3V I		+ 	1	1 2	-+ I	+ 	+	+ 	
47	0	SDA.5	IN	i 1	3	4	1	i	5V	i	
46	1	SCL.5	IN	j 1	5	6	1	İ	GND	i	Í
54	2	PWM15	IN	1	7	8	0	IN	RXD.0	3	131
		GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
139	7	CAN1_TX	IN	1	13	14	1		GND		ĺ
28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
1		3.3V			17	18	1	IN	SCL.1	10	58
49	11	SPI4_TXD	IN	1	19	20	1	1	GND		
48	12	SPI4_RXD	IN	1	21	22	1	IN	GPI02_D4	13	92
50	14	SPI4_CLK	IN	1	23	24	1	IN	SPI4_CS1	15	52
		GND			25	26	1	IN	PWM1	16	35
GPI0	wPi	Name	Mode	I V	Phys	sical	i v	Mode	Name	wPi	GPI

5. 7. 26Pin interface GPIO, I2C, UART, SPI, CAN and PWM test

Note that if you need to set fdt overlays to open multiple configurations at the same time, please use a space to write in a line like the red font configuration below.

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf

LABEL Orange Pi

LINUX /Image

FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb

FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-i2c1-m2.dtbo /dtbs/rockchip/overlay/rk3588-uart0-m2.dtbo

5. 7. 1. **26pin GPIO port test**

1) A total of 17 GPIO ports in the development board 26pin can be used. Below is No. 7 pin -corresponding to GPIO1_C6 -corresponding wPi serial number 2 -as an example how to set the height of the GPIO port

GPIO	wPi	Name	Mode	V	a second second	ical		Mode	Name	wPi	GPIO
		3.3V		+		2	+ 		5V	1	
47	0	SDA.5	IN	j 1	3	4	İ İ	1	5V	1	f l
46	1	SCI . 5	TN	i 1	5	6	i l	i.	GND	Î.	í I
54	2	PWM15	IN	1	7	8	0	IN	RXD.0	3	131
		GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1 RX	IN	1	11	1 12	1	IN	CAN2_TX	6	29

2) First set the GPIO port as the output mode, the third parameter needs to enter the serial number of the wPi corresponding to the pins

[orangepi@orangepi ~]\$ gpio mode 2 out

3) Then set the GPIO port output low level. After setting, you can use the value of the voltage of the permanent meter to measure the pins. If it is 0v, it means that the low -power flat is successful

[orangepi@orangepi ~]\$ gpio write 2 0

Using GPIO Readall, you can see the value of the No. 7 pin (v) to 0

[0] +	orangepi@orangepi ~]\$ gpio readall ++++++++-									
İ	GPIO	wPi	Name		V Physical		Mode Name	wPi	GPIO	
+			3.3V		1 2	++	5V	+ !	++	
	47 46	0	SDA.5 SCL.5	IN 1 1	1 3 4 1 5 6		5V GND			
i	54	2	PWM15		0 7 8	0 I	N RXD.0	3	131	
	138	5	GND CAN1_RX	IN 1	9 10 1 11 12	0 I 1 I	N TXD.0 N CAN2_TX	4 6	132 29	

4) Then set the GPIO port output high level. After setting, you can use the voltage of the voltage of the permanent meter to measure the voltage. If it is 3.3v it means that the high -electricity level is successful

[orangepi@orangepi~]\$ gpio write 2 1

Using gpio readall, you can see the value of No. 7 pin (v) into 1

[or	angepi	i@orang	epi ~]\$ gpi	lo readal	L	OPI5				L	
I	GPI0	wPi	Name	Mode	V	Physical	V	Mode	Name	wPi	GPIO
ļ			3.3V			1 2			5V	!	
	47 46	0 1	SDA.5 SCL.5	IN IN		3 4 5 6			5V GND		
	54	2	PWM15 GND	OUT	1	7 8 9 10	0	IN IN	RXD.0 TXD.0	3 4	131 132

5) The setting method of other pins is similar. Just modify the serial number of the wpi sequence number as the corresponding serial number corresponding to the pin

5. 7. 2. 26pin GPIO Port -down pull -down resistance setting method Note that Orange Pi 5 only has the following 4 GPIO pins, which can normally

set the pull -down resistance function. Other GPIO pins are pulled up because there are 3.3V on the outside, so the drop -down pull is invalid.

GPIO	wPi	Name	Mode	V	Phys	ical	V	Mode	Name	wPi	GPI(
		3.3V			1	1 2			5V	1	
47	0	SDA.5	IN	1	j 3 j	4		i	j 5V	i	l.
46	1	SCL.5	IN	1	5	6		i	GND	i	
54	2	PWM15	IN	1	7	8	0	IN	RXD.0	3	131
		GND			9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
139	7	CAN1_TX	IN	1	13	14	l l		GND		
28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
		3.3V			17	18	1	IN	SCL.1	10	58
49	11	SPI4_TXD	IN	1	19	20			GND	1	Ĩ.
48	12	SPI4_RXD	IN	1	21	22	1	IN	GPI02_D4	13	92
50	14	SPI4_CLK	IN	1	23	24	1	IN	SPI4_CS1	15	52
		GND			25	26	1	IN	PWM1	16	35

Below is No. 11 -corresponding to GPIO4_B2 -Corresponding wPi serial number 5
 to demonstrate how to set up and down pull -down resistance of the GPIO port

GPIO	WPi	Name	Mode	I V	Phys	sical	I V	Mode	Name	wPi	GPI
	+ 	++ 3.3V		† 1	++	2	+ 	+ 	+ I 5V	+	+
47	0	SDA.5	IN	1	3	4			5V	i	i
46	1	SCL.5	IN	1	j 5	6			GND	İ.	i
54	2	PWM15	IN	1	j 7	8	0	IN	RXD.0	3	131
		GND	91-8-10 1		9	10	0	IN	TXD.0	4	132
138	5	CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
139	7	CAN1_TX	IN	1	13	14	1		GND	1	
28	8	CAN2_RX	IN	1	15	16	1	IN	SDA.1	9	59
		3.3V		1	17	18	1	IN	SCL.1	10	58

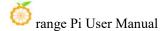
2) First of all, you need to set the GPIO port as the input mode. The third parameter needs to enter the serial number of the wPi corresponding to the pins

[orangepi@orangepi ~]\$ gpio mode 5 in

3) After the setting is set to input mode, execute the following command to set the GPIO port as the pull -down mode

[orangepi@orangepi ~]\$ gpio mode 5 up

4) Then enter the command below to read the level of the GPIO port. If the level is 1, it



means that the drawing mode settings are successful

```
[orangepi@orangepi ~]$ gpio read 5
```

5) Then execute the following command to set the GPIO port as the drop -down mode [orangepi@orangepi~]\$ gpio mode 5 down

6) Then enter the following command to read the level of the GPIO port. If the level is 0, it means that the drop -down mode is set successfully.

```
[orangepi@orangepi~]$ gpio read 5
```

0

5. 7. 3. **26pin SPI test**

1) From the schematic diagram of the 26pin interface, the SPI available for Orange Pi 5 is spi4

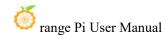
I2C5 SDA/UART1 RX/GPIO1 B7 J I2C5 SCL/UART1 TX/GPIO1 B6 J	3	.3V1 DA	5.0V1 04 5.0V2 04	1
PWM15 IR/GPI01 C6 J		CL	GND3 08	UARTO TX M2/GPIO4 A3 J
	y	O-GCLK	TXD0 010	UARTO RX M2/GPIO4 A4 J
CAN1 RX M1/GPIO4 B2 J		ND1	RXD0 12	CAN2 TX/GPIO0 D5 J
CAN1 TX M1/GPIO4 B3 J		0-0	10-1 014	
CAN2 RX/GPIO0 D4 J	1.7	0-2	GND4 16	I2C1_SDA/UART4_RX/GPI01_D3_J
	1/0 3	0-3 .3V2	10-4 018 10-5 020	I2C1_SCL/UART4_TX/GPIO1_D2_J
SPI4 MOSI/UART3 TX/GPI01 C1 J SPI4 MISO/UART3 RX/GPI01 C0 J	19 21 O S	PI-MOSI	GND5 020	GPIO2 D4 P
SPI4 CLK/GPIO1 C2 J	/1-	PI-MISO	10-6 24	SPI4 CS1/GPI01 C4 J
	25	PI-CLK ND2	SPI-CE0 26	PWM1/GPIO1 A3 J

In the OPi OS Arch system, the spi4 in 26pin is closed by default. You need to open it manually to use it.

Add the configuration of the red font part below to /boot/extlinux/extlinux.conf, and then restart the OPi OS Arch system to open the spi4

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-spi4-m0-cs1-spidev.dtbo

2) First check whether there is a **spidev4.1** device node in the OPi OS Arch system. If it



exists, it means that the SPI4 has been set and you can use it directly

[orangepi@orangepi~]\$ ls /dev/spidev4.1 /dev/spidev4.1

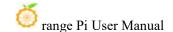
3) Do not shorten SPI4's mosi and miso pins, and run the output result of the spidev_test as shown below. You can see that the data of TX and RX is inconsistent

4) Then the mosi (No. 19 in 26Pin interface) and miso (No. 21 in the 26Pin interface) of the SPI4 and MISO (pin 21 in the 26pin interface) run the output of spidev_test as follows. You can see the sending and receiving receiving The data is the same



5. 7. 4. **26pin I2C test**

1) From the table below, the i2c available for Orange Pi 5 is i2c1, i2c3, and i2c5. There are three groups of i2c bus



复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

It can be seen from the above table that i2c1 can be exported from the 12 and 15 pins of 26Pin (I2C1_M2), or it can also be exported from the 16 and 18 pins of 26PIN (I2C1_M4). Please follow your own needs Choose a group. Please don't think that this is two different groups of i2c bus.

In the OPi OS Arch system, the i2c in 26pin is closed by default. It needs to be opened manually to use it.

Add the configuration of the red font part below to the /boot/extlinux/extlinux.conf, and then restart the OPi OS Arch system to open the i2c1, i2c3, and i2c5 at the same time. If you only need to open one, then fill in one

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-i2c1-m2.dtbo /dtbs/rockchip/overlay/rk3588-i2c3-m0.dtbo /dtbs/rockchip/overlay/rk3588-i2c5-m3.dtbo

The red font configuration above needs to be written in one line, and different configurations need to be separated by spaces.

2) After starting the OPi OS Arch system, first confirm that the i2c device node exists under/dev

[orangepi@orangepi ~]\$ ls /dev/i2c-* /dev/i2c-0 /dev/i2c-10 /dev/i2c-3 /dev/i2c-6 /dev/i2c-9 /dev/i2c-1 /dev/i2c-2 /dev/i2c-5 /dev/i2c-7

	-	1	
i2c1-m2	i2c1-m4	i2c3-m0	i2c5-m3
Corresponding	Corresponding	Corresponding	Corresponding
to No. 12 Pin	to No. 16 Pin	to No. 21 Pin	to No. 3 Pin
Corresponding	Corresponding	Corresponding	Corresponding
to No. 15 Pin	to No. 18 Pin	to No. 19 Pin	to No. 5 Pin
Corresponding	Corresponding	Corresponding	Corresponding
to No. 1 Pin	to No. 1 Pin	to No. 1 Pin	to No. 1 Pin
Corresponding	Corresponding	Corresponding	Corresponding
to No. 2 Pin	to No. 2 Pin	to No. 2 Pin	to No. 2 Pin
Corresponding	Corresponding	Corresponding	Corresponding
to No. 6 Pin	to No. 6 Pin	to No. 6 Pin	to No. 6 Pin
	Corresponding to No. 12 Pin Corresponding to No. 15 Pin Corresponding to No. 1 Pin Corresponding to No. 2 Pin Corresponding	Corresponding to No. 12 PinCorresponding to No. 16 PinCorresponding to No. 15 PinCorresponding to No. 18 PinCorresponding to No. 1 PinCorresponding to No. 1 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorrespondingCorresponding	Corresponding to No. 12 PinCorresponding to No. 16 PinCorresponding to No. 21 PinCorresponding to No. 15 PinCorresponding to No. 18 PinCorresponding to No. 19 PinCorresponding to No. 1 PinCorresponding to No. 1 PinCorresponding to No. 1 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding to No. 2 PinCorresponding

3) Then connect a i2c device on the i2c pin of the 26pin connector

Points 3V and 5V pins are generally only connected to one. Please select 3.3v pins or 5v pin according to the specific i2c device.

4) Then use the **i2cdetect -y** command. If the address of the connected i2c device can be detected, it means that the i2c can be used normally

[orangepi@orangepi ~]\$ sudo pacman -Syy i2c-tools							
[orangepi@orangepi ~]\$ sudo i2cdetect -y 1	#i2c1 command						
[orangepi@orangepi~]\$ sudo i2cdetect -y 3	#i2c3 command						
[orangepi@orangepi~]\$ sudo i2cdetect -y 5	#i2c5 command						

5. 7. 5. **26pin's UART test**

1) From the table below, the uart available for Orange Pi 5 is uart0, uart1, uart3, and uart4. There are four sets of uart bus

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V		Contra de la contr	Contra Co
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
	and the second second second second second second second second second second second second second second second	CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			an actual actual contraction and
I2C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

In the OPi OS Arch system, the uart in 26Pin is closed by default. It needs to be opened manually to use.

Add the configuration of the red font part below to the /boot/extlinux/extlinux.conf, and then restart the OPi OS Arch system to open UART0, UART1, UART3, and

UART4 at the same time.

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-uart0-m2.dtbo /dtbs/rockchip/overlay/rk3588-uart1-m1.dtbo /dtbs/rockchip/overlay/rk3588-uart3-m0.dtbo /dtbs/rockchip/overlay/rk3588-uart4-m0.dtbo

The red font configuration above needs to be written in one line, and different configurations need to be separated by spaces.

2) After entering the linux system, first confirm whether there is a device node corresponding to UART under/dev

[orangepi@orangepi ~]\$ ls /dev/ttyS*

/dev/ttyS0 /dev/ttyS1 /dev/ttyS3 /dev/ttyS4 /dev/ttyS9

3) Then start testing the UART interface, first use the RX and TX of the UART interface to be tested by DuPont

	uart0	uart1	uart3	uart4
Tx Pin	Corresponding	Corresponding	Corresponding	Corresponding
	to No. 8 Pin	to No. 5 Pin	to No.19 Pin	to No. 18 Pin
Rx Pin	Corresponding	Corresponding	Corresponding	Corresponding
	to No. 10 Pin	to No. 3 Pin	to No. 21 Pin	to No. 16 Pin
		UART	4 UARTO	

4) Use **gpio serial** command to test the loop function of the serial port as shown below. If you can see the printing below, it means that the serial communication is normal

a. Test UART0

[orange	epi@	orang	gepi ~]\$ sudo g	gpio serial /dev/ttyS0
[sudo]	pass	word	for orangepi:	#Enter the password here
Out:	0:	->	0	
Out:	1:	->	1	
Out:	2:	->	2	
Out:	3:	->	3	
Out:	4:	->	4	
Out:	5:	->	5^C	
b.	Tes	st UA	RT1	
				gpio serial /dev/ttyS1
[sudo]	pass	word	for orangepi:	#Enter the password here
	0			
Out:		->		
		->		
		->		
		->		
		->		
Out:			5^C	
с.		st UA		
				gpio serial /dev/ttyS3
[sudo]	pass	word	for orangepi:	#Enter the password here
	0		0	
Out:	0:		0	
Out:	1:	->	1	
Out:	2:	->	2	
Out:	3:		3	
Out:	4:	->	4 5^C	
Out:	5:		5^C	
d.		st UA		rnia ganial /dau/ttuSA
		-		gpio serial /dev/ttyS4
[sudo]	pass	word	for orangepi:	#Enter the password here
Out	0.		0	
Out:	0:	->		
Out:	1:	->	1	

Out:	2:	->	2
Out:	3:	->	3
Out:	4:	->	4
Out:	5:	->	5^C

5. 7. 6. **PWM test method**

1) From the table below, the PWM available for Orange Pi 5 includes PWM0, PWM1, PWM3, PWM13, PWM14, and PWM15

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用	功能
			3.3V		1	2		5V				
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	I2C5_SDA_M3	GPIO1_B7	47	3	4		5V				
	UART1_TX_M1	12C5 SCL M3	GPIO1_B6	46	5	6		GND				
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)			
			GND		9	10	132	GPIO4_A4	UART0_RX_M2			
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2		
	Sector (111) (110)	CAN1_TX_M1	GPIO4_B3	139	13	14		GND	100 Sector 200 Sector 8			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1	(fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1	(fd8b0000)
I2C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND				
12C3_SDA_M0	UART3 RX M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4				
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4 CS1 M0			
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)			

You can see from the above table:

pwm1 can be introduced from No. 16 in 26pin (pwm1_m1), or it can be guided from the 26th foot of 26Pin (pwm1_m2)

pwm3 can be introduced from No. 15 in 26Pin (pwm3_m0), or you can also guide from the 23rd foot of 26Pin (pwm3_m2)

Please choose the corresponding pins according to your needs. Please don't think that this is two different pwm bus.

In the OPi OS Arch system, the PWM in 26PIN is closed by default. It needs to be opened manually to use it.

Add the configuration of the red font part below to the /boot/extlinux/extlinux.conf, and then restart the OPi OS Arch system to open PWM0, PWM13, PWM14 and PWM15 at the same time. If you only need to open one, then fill in one.

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-pwm0-m1.dtbo /dtbs/rockchip/overlay/rk3588-pwm13-m2.dtbo /dtbs/rockchip/overlay/rk3588-pwm14-m1.dtbo

/dtbs/rockchip/overlay/rk3588-pwm15-m2.dtbo

The red font configuration above needs to be written in one line, and different configurations need to be separated by spaces.

2) After opening a PWM, there will be an additional pwmchipX (X as a specific number) in/sys/class/pwm/. For example, after opening pwm15, View pwmchipX from/sys/class/pwm/down will change from two to three

[orangepi@orangepi ~]\$ **ls** /**sys/class/pwm**/ pwmchip0 pwmchip1 pwmchip2

3) Which pwmchip corresponds to PWM15 above? Let's first check out the output of **Is** /sys/class/pwm/ -l command. As shown below

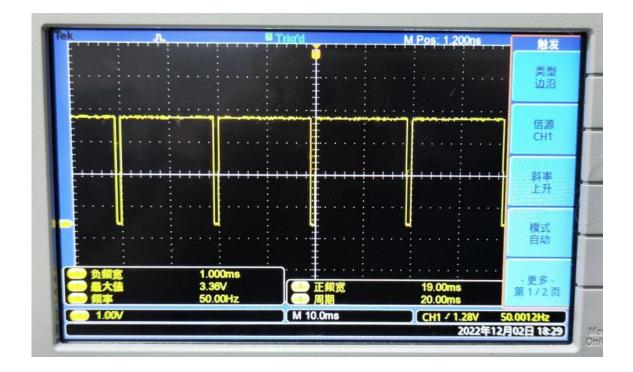
[orangepi@orangepi ~]\$ ls /sys/class/pwm/ -l
total 0
lrwxrwxrwx 1 root root 0 Apr 20 07:33 pwmchip0 -> ../../devices/platform/fd8b0020.pwm/pwm/pwmchip0
lrwxrwxrwx 1 root root 0 Apr 20 07:33 pwmchip1 -> ../../devices/platform/febd0020.pwm/pwm/pwmchip1
lrwxrwxrwx 1 root root 0 Apr 20 07:33 pwmchip2 -> ../../devices/platform/febf0030.pwm/pwm/pwmchip2
[orangepi@orangepi ~]\$

4) Then it can be seen from the table below that the base address of the PWM15 register is Febf0030. Then look at the output of ls /sys/class/pwm/ -l command, you can see that the FEBF0030.PWM is connected to the link in PWMCHIP2, so the PWM15 corresponds to PWMCHIP2 as PWMCHIP2

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
		PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UART0_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010)
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000)
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1 A3	PWM1 M2 (fd8b0010)		

5) Then use the following command to allow the PWM15 to output a 50Hz square wave (please switch to the root user first, and then execute the following command)

[root@orangepi orangepi]# echo 0 > /sys/class/pwm/pwmchip2/export [root@orangepi orangepi]# echo 20000000 > /sys/class/pwm/pwmchip2/pwm0/period [root@orangepi orangepi]# echo 1000000 > /sys/class/pwm/pwmchip2/pwm0/duty_cycle [root@orangepi orangepi]# echo 1 > /sys/class/pwm/pwmchip2/pwm0/enable



6) The other PWM testing methods are similar to the PWM15 test method.

5.7.7. CAN test method

1) As can be seen from the table below, the CAN bus available for Orange Pi 5 is CAN1 and CAN2. There are two CAN bus

复用功能	复用功能	复用功能	GPIO	GPIO序号	引脚序号	引脚序号	GPIO序号	GPIO	复用功能	复用功能	复用功能
			3.3V		1	2		5V			
PWM13_M2 (febf0010)	UART1_RX_M1 (feb40000)	12C5_SDA_M3	GPIO1_B7	47	3	4		5V			
	UART1_TX_M1	12C5_SCL_M3	GPIO1_B6	46	5	6		GND			
	10.00	PWM15_IR_M2 (febf0030)	GPIO1_C6	54	7	8	131	GPIO4_A3	UART0_TX_M2 (fd890000)		
			GND		9	10	132	GPIO4_A4	UARTO_RX_M2		
	PWM14_M1 (febf0020)	CAN1_RX_M1	GPIO4_B2	138	11	12	29	GPIO0_D5	CAN2_TX_M1	I2C1_SDA_M2	
		CAN1_TX_M1	GPIO4_B3	139	13	14		GND			
PWM3_IR_M0 (fd8b0030)	12C1_SCL_M2	CAN2_RX_M1	GPIO0_D4	28	15	16	59	GPIO1_D3	UART4_RX_M0 (feb70000)	I2C1_SDA_M4	PWM1_M1 (fd8b0010
			3.3V		17	18	58	GPIO1_D2	UART4_TX_M0	I2C1_SCL_M4	PWM0_M1 (fd8b0000
12C3_SCL_M0	UART3_TX_M0 (feb60000)	SPI4_MOSI_M0	GPIO1_C1	49	19	20		GND			
12C3_SDA_M0	UART3_RX_M0	SPI4_MISO_M0	GPIO1_C0	48	21	22	92	GPIO2_D4			
	PWM3_IR_M2 (fd8b0030)	SPI4_CLK_M0	GPIO1_C2	50	23	24	52	GPIO1_C4	SPI4_CS1_M0		
			GND		25	26	35	GPIO1_A3	PWM1_M2 (fd8b0010)		

In the OPi OS Arch system, the Can in 26Pin is closed by default. You need to open it manually to use it.

Add the configuration of the red font part below to the /boot/extlinux/extlinux.conf, and then restart the OPI OS Arch system to open CAN1 and Can2 at the same time. If you only need to open one, then fill in one.

[orangepi@orangepi~]\$ sudo vim /boot/extlinux/extlinux.conf LABEL Orange Pi LINUX /Image FDT /dtbs/rockchip/rk3588s-orangepi-5.dtb

FDTOVERLAYS /dtbs/rockchip/overlay/rk3588-can1-m1.dtbo /dtbs/rockchip/overlay/rk3588-can2-m1.dtbo

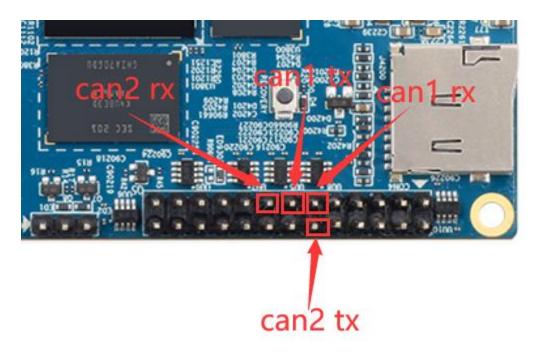
The red font configuration above needs to be written in one line, and different configurations need to be separated by spaces.

2) After entering the OPi OS Arch system, use the **sudo ifconfig -a** command. If you can see CAN's device nodes, it means that CAN has been opened correctly

```
[orangepi@orangepi~]$ sudo pacman -Syy net-tools
[orangepi@orangepi ~]$ sudo ifconfig -a
can0: flags=128<NOARP> mtu 16
      RX packets 0 bytes 0 (0.0 B)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 0 bytes 0 (0.0 B)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
      device interrupt 91
can1: flags=128<NOARP> mtu 16
      RX packets 0 bytes 0 (0.0 B)
      RX errors 0 dropped 0 overruns 0 frame 0
      TX packets 0 bytes 0 (0.0 B)
      TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
      device interrupt 92
```

3) The pins corresponding to CAN1 and CAN2 are

	CAN1	CAN2
TX Pin	Corresponding	Corresponding
	number 13 Pin	number 12 Pin
RX Pin	Corresponding	Corresponding
	number 11 Pin	number 15 Pin



4) Use Canalyst-II analyzer to test the CAN receiving message. For reference to using Canalyst-II analyzer test and receiving message.

6. Linux SDK—orangepi-build instructions

6.1. Compile system requirements

We can compile the Linux Image of the development board in the x64 computer, or compile the linux image of the development board in the Ubuntu22.04 system of the development board. Please choose one of them according to your preferences.

If you use orangepi-build to compile the Linux Image in the Ubuntu22.04 system of the development board to compile the Linux Image, please do the heat dissipation (especially when the SSD startup). If the heat dissipation is not done well, it is prone to error in the file system running.

^{6.1.1.} Use the development board Ubuntu22.04 system to compile 1) Linux SDK, orangepi-build, supports the upper operation of the development board'sUbuntu 22.04 (other systems have not been tested), so before downloading orangepi-build, first make sure that the Ubuntu version installed on the development

board is Ubuntu 22.04. The command of the Ubuntu version installed on the development board is shown below. If the Release field is not **22.04**, it means that the Ubuntu version currently used does not meet the requirements. Please replace the system before performing the following operations.

orangepi@orangepi:~\$ lsb_release -a			
No LSB module	es are available.		
Distributor ID:	Ubuntu		
Description:	Ubuntu 22.04.1 LTS		
Release:	22.04		
Codename:	jammy		

2) Because the source code such as kernel and U-Boot is stored on GitHub, So when compiling Images, please make sure that the development board can download the code normally from github. This is very important

6. 1. 2. Use X64's Ubuntu22.04 computer to compile

1) Linux SDK, **orangepi-build**, supports running on a computer with **Ubuntu 22.04**, so before downloading Orange-Build, first make sure that the Ubuntu version of your computer installed is Ubuntu 22.04. Check the command of the Ubuntu version installed by the computer as shown below. If the release field is not **22.04**, it means that the currently used Ubuntu version does not meet the requirements. Please replace the system before performing the following operations

test@test:~\$ lsb_release -a				
No LSB modules	are available.			
Distributor ID:	Ubuntu			
Description:	Ubuntu 22.04 LTS			
Release:	22.04			
Codename:	jammy			

2) If the computer is installed with a Windows system and a computer with Ubuntu 22.04 is not installed, you can consider using **VirtualBox** or **VMware** to install a Ubuntu 22.04 virtual machine in the Windows system. But please note that Orange-Build is compiled on the WSL virtual machine. Because Orangepi-BUILD has not been tested in the WSL virtual machine, it is impossible to ensure that it can be used in WSL normally

 ³⁾ Ubuntu 22.04 amd64 version installation Image download address is:
 https://mirrors.tuna.tsinghua.edu.cn/ubuntu-releases/22.04/ubuntu-22.04.3-desktop-amd64.iso

or

https://repo.huaweicloud.com/ubuntu-releases/22.04/ubuntu-22.04.3-desktop-amd64.iso

4) After installing Ubuntu 22.04 in the computer or virtual machine, please set up the software source of Ubuntu 22.04 as a Tsinghua source first, otherwise it is easy to make mistakes due to network reasons when installing the software

a. The method of replacing Tsinghua source refers to the instructions of this webpage

https://mirrors.tuna.tsinghua.edu.cn/help/ubuntu/

b. Note that the Ubuntu version needs to be switched to 22.04

Ubuntu 镜像使用帮助

Ubuntu 的软件源配置文件是 /etc/apt/sources.list 。将系统自带的该文件做个备份,将该文件替换为下面内容,即可使用 TUNA 的软件源镜像。

选择你的ubuntu版本: 22.04 LTS

默认注释了 源码镜像以提高 apt update 速度, 如有需要可自行取消注释 deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse # mjgfmxthtps://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse
deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse

c. The content of the /etc/apt/sources.list file that needs to be replaced is

test@test:~\$ sudo mv /etc/apt/sources.list /etc/apt/sources.list.bak test@test:~\$ sudo vim /etc/apt/sources.list

The source code image is noted by default to improve the apt update speed. If necessary, you can cancel the annotation by yourself

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy main restricted universe multiverse

deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy main restricted universe multiverse

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse

deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-updates main restricted universe multiverse

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse

deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-backports main restricted universe multiverse

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse

deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-security main restricted universe multiverse

Pre -release software sources, it is not recommended to enable

deb https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse # deb-src https://mirrors.tuna.tsinghua.edu.cn/ubuntu/ jammy-proposed main restricted universe multiverse

d. After replacement, you need to update the package information and make sure that there is no error

test@test:~\$ sudo apt update

e. In addition, because the source code such as kernel and U-Boot is stored on GitHub, please make sure that the computer can download the code normally when compiling image. This is very important.

6.2. Get the source code of Linux SDK

6. 2. 1. Download Orange-Build from github

1) LINUX SDK actually refers to the Orange-Build code. Orange-Build is modified based on the Armbian Build compilation system. Orangepi-Build can compile multiple versions of Linux Images. First download the code-build code, and the command is shown below:

test@test:~\$ sudo apt-get update

test@test:~\$ sudo apt-get install -y git

test@test:~\$ git clone https://github.com/orangepi-xunlong/orangepi-build.git -<mark>b next</mark>

Note that the Orange Pi 5 development board needs to download the next branch source code of Orangepi-Build, The git clone command above needs to specify the branch of orangepi-build source code to next.

> Code	⊙ Issues 6 \$7 Pull requests 1	😡 Discussions 🕑 Actions 🗄 Project	ts 印 Wiki ① Security 🗠 Insights ĝ
	و معند معند معند معند معند معند معند معند	gs	Go to file Add file - <> Code -
	Switch branches/tags	× behind main.	זין Contribute ◄
	Branches Tags Need to switte		69dd359 4 days ago 🕥 222 commits
	✓ next View all branches	Update for Orange Pi 5 v1.0.2 Update for Orange Pi 5 v1.0.2	4 days ago 4 days ago
		Update for Orange Pi 5 v1.0.2	4 days ago
		First Commit	2 years ago
	README.md	Support orangepi3 next branch	8 months ago
	ြို build.sh	Bump to next branch	9 months ago

Download Orangepi-build code through the Git Clone command is the username and password that does not need to enter the GitHub account (the same is the same for downloading other code in this manual). Names and passwords are usually input errors in the address input of the OrangePi-Build repository behind Git Clone. Please carefully check whether the command is wrong, instead of thinking that we have forgotten the user name and password of the GitHub account here.

2) The U-Boot and Linux kernel versions currently used in the development board are shown below

Branch	u-boot version	Linux Kernel version
legacy	u-boot 2017.09	linux5.10
current	u-boot 2017.09	linux6.1

The branches mentioned here are not the same thing as orangepi-build source code, please do not confuse. This branch is mainly used to distinguish the different kernel source code.

We currently define the linux5.10 bsp kernel provided by RK as the legacy branch, and the linux6.1 bsp kernel as the current branch.

3) Orangepi-Build will include the following files and folders after downloading

- a. **build.sh**: Compile the startup script
- b. **external**: Including configuration files, specific scripts, and source code of some programs, etc.
- c. LICENSE: GPL 2 license file
- d. README.md: orangepi-build description file
- e. scripts: General script compiled Linux image

test@test:~/orangepi-build\$ ls build.sh external LICENSE README.md scripts

If the Orangepi-Build code downloaded from GitHub, you may find that after downloading, you may find that Orangepi-build does not include the source code of the U-Boot and Linux kernels, nor does it compile the U-Boot and Linux kernel needs to be used. Chain, this is normal, because these things are stored in other separate GitHub warehouses or some servers (the address will be described in detail below). Orangepi-build will specify the address of the U-Boot, Linux kernel and cross compilation tool chain in the script and configuration file. When running Orange-Build, when it is found that there are no these things in the local area, it will automatically download the corresponding places

6. 2. 2. Download the cross compilation tool chain

Only by using Orangepi-Build to compile Images in the X64 computer, the cross compile tool chain is downloaded. The linux image compiled in the development board's Ubuntu22.04 will not download the cross compilation tool chain. At this time, Orange-Build/Toolchains will be an empty folder

1) Orangepi-Build will automatically download the cross-compile tool chain in the **toolchains** folder when running for the first time. After each run Orange-Build's BUILD.SH script, it will check whether the cross compile tool chain in **toolchains** exists. If If there is no existence, you will start downloading again. If you exist, you will not download it directly.

Checking for external GCC compilers	
downloading using http(s) network [gcc-linaro-aarch64-none-elf-4.8-2013.11_linux.tar.xz]	
) 16MiB/24MiB(65%) CN:1 DL:7.9MiB ETA:1s]	
Verified [PGP]	
decompressing	
gcc-linaro-aarch64-none-elf-4.8-2013.11_linux.tar.xz: 24.9MiB [14.4MiB/s] [====================================] 100%
downloading using http(s) network [gcc-linaro-arm-none-eabi-4.8-2014.04_linux.tar.xz]	
: 17MiB/33MiB(50%) CN:1 DL:10MiB ETA:1s]	
Verified [PGP]	
decompressing	C. HERAL
gcc-linaro-arm-none-eabi-4.8-2014.04_linux.tar.xz: 33.9MiB [9.66MiB/s] [====================================] 100%
downloading using http(s) network [gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux.tar.xz]	
4 48MiB/48MiB(99%) CN:1 DL:2.7MiB]	
Verified [PGP]	
decompressing	
gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux.tar.xz: 48.8MiB [13.0MiB/s] [====================================] 100%
downloading using http(s) network [gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi.tar.xz]	
2 72MiB/76MiB(93%) CN:1 DL:3.7MiB ETA:1s]	
Verified [MD5]	
decompressing	
gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi.tar.xz: 77.0MiB [14.2MiB/s] [====================================] 100%
downloading using http(s) network [gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi.tar.xz]	
3 104MiB/104MiB(99%) CN:1 DL:2.8MiB]	
Verified [MD5]	
decompressing	-
gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi.tar.xz: 104MiB [13.9MiB/s] [====================================] 100%
downloading using http(s) network [gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu.tar.xz]	
: 108MiB/111MiB(97%) CN:1 DL:3.9MiB]	
Verified [MD5]	
decompressing	1 1000
gcc-linaro-7.4,1-2019.02-X86 64 aarch64-linux-gnu.tar.xz: 111MiB [13.4MiB/s] [100%
downloading using http(s) network [gcc-arm-9.2-2019.12-x86_64-arm-none-linux-gnueabihf.tar.xz]	
250M18/251M18(99%) (H:10:2.0M18) Verified [MD5]	
verified (WDS) decompression	
uecompressing gcc-arm-9.2-2019.12-x86 64-arm-none-linux-anueabihf.tar.xz: 251MiB [13.7MiB/s] [====================================	1 100%
gcc-afm=9.2-2019.12-X00_04-afm=none-Linux-gnuedolffi.ldf.x2; 23LML0 [13./ML0/5] [====================================	100%
adownicadzing using inter(s) network [gCC-afm-9.2-2019.12-x80_04-adrCn04-n0he-Cln0x-gnu.taf.x2] .268NiB/269NiB(99N) (N:1 D.t.o.yNiB)	
/ 200mL0/200mL0(390) (Util UL:0.30L0) Verified (NDS)	

2) The image website of the cross-compilation tool chain in China is the open source software Image station of Tsinghua University

https://mirrors.tuna.tsinghua.edu.cn/armbian-releases/ toolchain/

3) After downloading **toolchains**, it will contain multiple versions of cross compilation tool chain. The development board will only use two of them.

test@test:~/orangepi-build\$ ls toolchains /
gcc-arm-11.2-2022.02-x86_64-aarch64-none-linux-gnu
gcc-arm-11.2-2022.02-x86_64-arm-none-linux-gnueabihf
gcc-arm-9.2-2019.12-x86_64-aarch64-none-linux-gnu
gcc-arm-9.2-2019.12-x86_64-arm-none-linux-gnueabihf
gcc-linaro-4.9.4-2017.01-x86_64_arm-linux-gnueabi
gcc-linaro-5.5.0-2017.10-x86_64_arm-linux-gnueabihf
gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu
gcc-linaro-7.4.1-2019.02-x86_64_arm-linux-gnueabi
gcc-linaro-aarch64-none-elf-4.8-2013.11_linux
gcc-linaro-arm-linux-gnueabihf-4.8-2014.04_linux
gcc-linaro-arm-none-eabi-4.8-2014.04_linux

4) The cross compilation tool chain used by compiling the linux kernel source code is

a. linux5.10 and linux6.1

gcc-arm-11.2-2022.02-x86_64-aarch64-none-linux-gnu

- 5) The cross compilation tool chain used by compiling u-boot source code is
 - a. v2017.09

gcc-linaro-7.4.1-2019.02-x86_64_aarch64-linux-gnu

6. 2. 3. orangepi-build complete directory structure description

1) OrangePi-Build warehouse does not include Linux kernel, U-Boot source code, and cross compilation tool chain. The source code of Linux kernel and U-Boot is stored in an independent Git warehouse.

a. The git repository where the Linux5.10 kernel source code is stored is as follows:

https://github.com/orangepi-xunlong/linux-orangepi/tree/orange-pi-5.10-rk35xx

b. The git warehouse where the Linux6.1 kernel source code is stored is as follows: https://github.com/orangepi-xunlong/linux-orangepi/tree/orange-pi-6.1-rk35xx

c. The git warehouse stored in U-Boot source code is shown below:

https://github.com/orangepi-xunlong/u-boot-orangepi/tree/v2017.09-rk3588https://git hub.com/orangepi-xunlong/u-boot-orangepi/tree/v2018.05-sun50iw9

2) Orangepi-Build will download the cross-compilation tool chain, U-Boot and Linux kernel source code when running the first run. After successfully compiling a Linux image, there are files and folders that can be seen in Orangepi-Build

- a. **build.sh**: Compile the startup script
- b. **external**: Contains the configuration file, a specific function script, and the source of some programs that the compilation Image. The rootfs compression packet cached during the compilation Image is also stored in external
- c. kernel: Stores the source code of the Linux kernel. The folder named orange-pi-5.10-rk35xx stores the kernel source code of the legacy branch of the RK3588/RK3588S series development board. The folder named orange-pi-6.1-rk35xx stores the RK3588 /Kernel source code of the current branch of the RK3588S series development board. Please do not modify the name of the folder of the kernel source code manually. If modified, the kernel source code will be re-downloaded when the compilation system is running.
- d. LICENSE: GPL 2 License file
- e. **README.md**: orangepi-build description file
- f. **output**: Stay the compiled U-Boot, Linux and other deb bags, compile logs, and compile-generated image

- g. scripts: General script compiled Linux image
- h. toolchains: Staying cross compilation tool chain
- u-boot: Store the u-boot source code. The folder named v2017.09-rk3588 stores the u-boot source code of the legacy and current branches of the RK3588/RK3588S series development board. Please do not modify the name of the u-boot source code folder manually. , if modified, the u-boot source code will be re-downloaded when the compilation system is running.
- j. **userpatches**: Store the configuration file needed to be used in the compilation script

test@test:~/orangepi-build\$ ls build.sh external kernel LICENSE output REA

README.md scripts

6.3. Compile u-boot

u-boot

toolchains

1) Run the build.sh script, remember to add sudo permission

userpatches

test@test:~/orangepi-build\$ sudo ./build.sh

2) Select U-boot package, then press Enter

Ch Compile image rootfs kerne	bose an option l u-boot	
U-boot p		
Kernel p		
	nd all deb packages	
Full OS	image for flashing	

3) Then select the model of the development board

Choose an option Please choose a Board. orangepi3 Allwinner H6 quad core 1GB/2GB RAM GBE WiFi/BT eMMC USB3 orangepi3-lts Allwinner H6 quad core 2GB RAM GBE WiFi/BT-AW859A eMMC USB3 orangepizero2 Allwinner H616 quad core 512MB/1GB RAM WiFi/BT GBE SPI orangepi4 Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT orangepi4-lts Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT orangepi800 Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT VGA orangepi5 Rockchip RK35885 octa core 4-16GB RAM GBE USB3 USB-C NVME 4) Then it will start to compile u-boot, and some information prompted during compilation is explained as follows

- a. u-boot source code version
- [o.k.] Compiling u-boot [v2017.09]

b. The version of the cross-compilation toolchain

[o.k.] Compiler version [aarch64-linux-gnu-gcc 7.4.1]

c. Path to the generated u-boot deb package

o.k.] Target directory [orangepi-build/output/debs/u-boot]

d. The package name of the generated u-boot deb package

[o.k.] File name [linux-u-boot-legacy-orangepi5_1.0.2_arm64.deb]

e. Compilation time

[o.k.] Runtime [**1 min**]

f. Repeat the command to compile u-boot, use the following command to start compiling u-boot directly without selecting through the graphical interface

[o.k.] Repeat Build Options [sudo ./build.sh BOARD=orangepi5 BRANCH=legacy BUILD_OPT=u-boot KERNEL_CONFIGURE=no]

5) View the u-boot deb package generated by compilation

test@test:~/orangepi-build\$ ls output/debs/u-boot/

linux-u-boot-legacy-orangepi5 1.0.2 arm64.deb

6) The files contained in the generated u-boot deb package are as follows

a. Use the following command to decompress the deb package

test@test:~/orangepi-build\$ cd output/debs/u-boot

test@test:~/orangepi_build/output/debs/u-boot\$ \$ dpkg -x \

linux-u-boot-legacy-orangepi5_1.0.2_arm64.deb . (Note that there is a "." at the end of the command)

test@test:~/orangepi_build/output/debs/u-boot\$ ls

linux-u-boot-legacy-orangepi5_1.0.2_arm64.deb usr

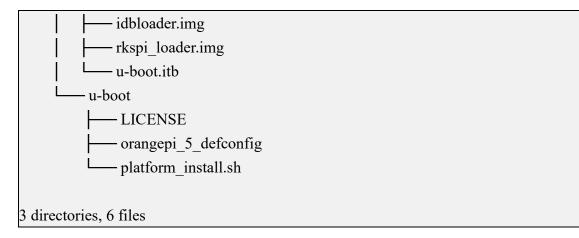
b. The decompressed file is as follows

test@test:~/orangepi-build/output/debs/u-boot\$ tree usr

usr

└── lib

— linux-u-boot-legacy-orangepi5_1.0.2_arm64



7) When the orangepi-bulid compilation system compiles the u-boot source code, it will first synchronize the u-boot source code with the u-boot source code of the github server, so if you want to modify the u-boot source code, you first need to turn off the download and update function of the source code (need This function can only be turned off after u-boot has been fully compiled, otherwise it will prompt that the source code of u-boot cache of u-boot cached from Google Drive, there is no such problem because the source code of u-boot cached), otherwise the changes made will be restored, the method is as follows:

Set the IGNORE UPDATES variable in userpatches/config-default.conf to "yes"

test@test:~/orangepi-build\$ vim userpatches/config-default.conf IGNORE_UPDATES="yes"

8) When debugging u-boot code, you can use the following method to update u-boot in the linux image for testing

a. Upload the compiled u-boot deb package to the linux system of the development board

test@test:~/orangepi-build\$ cd output/debs/u-boot

test@test:~/orangepi_build/output/debs/u-boot\$ scp \

linux-u-boot-legacy-orangepi5_1.0.2_arm64.deb root@192.168.1.xxx:/root

b. Then log in to the development board and uninstall the deb package of u-boot installed

root@orangepi:~# apt purge -y linux-u-boot-orangepi5-legacy

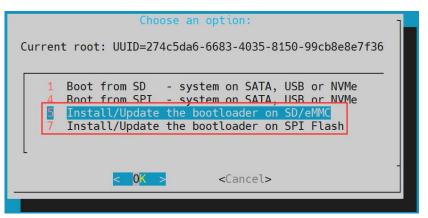
c. Install the new u-boot deb package just uploaded

root@orangepi:~# dpkg -i linux-u-boot-legacy-orangepi5_1.0.2_arm64.deb

d. Then run the nand-sata-install script

root@orangepi:~# nand-sata-install

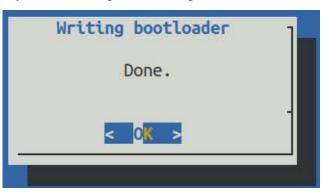
e. Then select **5 Install/Update the bootloader on SD/eMM** to update the u-boot in the TF card or **7 Install/Update the bootloader on SPI Flash** to update the u-boot in the SPI Flash



f. After pressing the Enter key, a Warning will pop up first

	m	m	mm	mmm	าคาคา	m	η	m	ուսեն	m	ŋ	m	որո	
	# #	#	##	#	"#	#'	'n	#	#	#'	'n	#	m" "	
	" #"#	#	# #	#mr	nmm"	#	#m	#	#	#	#m	#	# mm	
													# #	
	# #	ŧ ‡	# #	#		#		##	mm#mm	#		##	"mmm"	
his so	cript v	VILI	. upda	te t	he I	000	otl	oa	der on	SD,	(eM	MC.	. Continue	?

g. Press the Enter key again to start updating u-boot, and the following information will be displayed after the update is completed



- h. Then you can restart the development board to test whether the modification of u-boot takes effect
- 9) Other useful information

a. In the u-boot 2017.09 source code, the defconfig configuration file used by the development board is

orangepi-build/u-boot/v2017.09-rk3588/configs/orangepi_5_defconfig

b. In the u-boot 2017.09 source code, the dts file used by the development board is orangepi-build/u-boot/v2017.09-rk3588/arch/arm/dts/rk3588s-orangepi-5.dts

6.4. **Compile the linux kernel**

1) Run the build.sh script, remember to add sudo permission

test@test:~/orangepi-build\$ sudo ./build.sh

2) Select Kernel package, then press Enter

Compile image rootfs	
	oot package
	nel package tfs and all deb packages
Ful	l OS image for flashing

3) Then select the model of the development board

	Choose an option
Please choose a Board.	
orangepi3	Allwinner H6 quad core 1GB/2GB RAM GBE WiFi/BT eMMC USB3
	Allwinner H6 quad core 2GB RAM GBE WiFi/BT-AW859A eMMC USB3
orangepizero2	Allwinner H616 quad core 512MB/1GB RAM WiFi/BT GBE SPI
orangepi4	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT
orangepi4-lts	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT
orangepi800	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT VGA
orangepi5	Rockchip RK3588S octa core 4-16GB RAM GBE USB3 USB-C NVME

4) Then it will prompt whether to display the kernel configuration interface. If you do not need to modify the kernel configuration, select the first one. If you need to modify the kernel configuration, select the second one.

Choose an option	
Select the kernel configuration.	
Do not change the kernel configuration	
Show a kernel configuration menu before compilation	



- 5) Then select the branch type of the kernel source code
 - a. legacy branch will compile the linux5.10 kernel source code
 - b. current branch will compile the linux6.1 kernel source code

<mark>current Reco</mark> legacy Old		best	support	

6) If you choose to display the kernel configuration menu (the second option) in step 4), the kernel configuration interface opened by **make menuconfig** will pop up. At this time, you can directly modify the kernel configuration, save and exit after modification. Yes, after exiting, the kernel source code will be compiled

are hotke	Linux/arm64 5.10.110 Kernel Configuration s navigate the menu. <enter> selects submenus> (or empty submenus). Highlighted letters ys. Pressing <y> includes, <n> excludes, <m> modularizes features. Press <esc><esc> to exit, <? > for Search. Legend: [*] built-in [] excluded <m> module <> module capable</m></esc></esc></m></n></y></enter>
	General setup>
	[*] Support DMA zone
	[*] Support DMA32 zone
	Platform selection>
	Kernel Features>
	Boot options>
	Power management options>
	CPU Power Management>
	Firmware Drivers>
	[] ACPI (Advanced Configuration and Power Interface) Support
	<pre>[*] Virtualization></pre>
	-*- ARM64 Accelerated Cryptographic Algorithms>
	General architecture-dependent options>
	<pre>[*] Enable loadable module support></pre>
	v(+)
	<pre><select> < Exit > < Help > < Save > < Load ></select></pre>

a. If you do not need to modify the configuration options of the kernel, when running the build.sh script, pass in **KERNEL_CONFIGURE=no** to temporarily block the pop-up kernel configuration interface

test@test:~/orangepi-build\$ sudo ./build.sh KERNEL_CONFIGURE=no

b. You can also set **KERNEL_CONFIGURE=no** in the

orangepi-build/userpatches/config-default.conf configuration file, which can permanently disable this function

c. If the following error is displayed when compiling the kernel, it is because the terminal interface of the Ubuntu PC is too small to display the **make menuconfig** interface. Please maximize the terminal of the Ubuntu PC and run the build.sh script

again

HOSTCC scripts/kconfig/mconf.o
HOSTCC scripts/kconfig/lxdialog/checklist.o
HOSTCC scripts/kconfig/lxdialog/util.o
HOSTCC scripts/kconfig/lxdialog/inputbox.o
HOSTCC scripts/kconfig/lxdialog/textbox.o
HOSTCC scripts/kconfig/lxdialog/yesno.o
HOSTCC scripts/kconfig/lxdialog/menubox.o
HOSTLD scripts/kconfig/mconf
scripts/kconfig/mconf_Kconfig
Your display is too small to run Menuconfig!
It must be at least 19 lines by 80 columns.
scripts/kconfig/Makefile:28: recipe for target 'menuconfig' failed
make[1]: *** [menuconfig] Error 1
Makefile:560: recipe for target 'menuconfig' failed
make: *** [menuconfig] Error 2
[error] ERROR in function compile kernel [compilation.sh:376]
[error] Error kernel menuconfig failed
[o.k.] Process terminated

- 7) Part of the information prompted when compiling the kernel source code is as follows
 - a. The version of the linux kernel source code

[o.k.] Compiling current kernel [5.10.110]

b. The version of the cross-compilation toolchain used

[o.k.] Compiler version [aarch64-none-linux-gnu-gcc 11.2.1]

c. The configuration file used by the kernel by default and the path where it is stored

[o.k.] Using kernel config file [config/kernel/linux-rockchip-rk3588-legacy.config]

d. The path of the deb package related to the kernel generated by compiling

[o.k.] Target directory [orangepi-build/output/debs/]

e. The package name of the compiled kernel image deb package

o.k.] File name [linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb]

f. The time used for compilation

[o.k.] Runtime [**5 min**]

g. Finally, the compilation command to repeatedly compile the kernel selected last time will be displayed. Use the following command to start compiling the kernel source code directly without selecting through the graphical interface

[o.k.] Repeat Build Options [sudo ./build.sh BOARD=orangepi5 BRANCH=legacy

BUILD_OPT=kernel KERNEL_CONFIGURE=no]

- 8) View the deb package related to the kernel generated by compilation
 - h. linux-dtb-legacy-rockchip-rk3588_1.0.2_arm64.deb Contains dtb files used by the kernel
 - i. linux-headers-legacy-rockchip-rk3588_1.0.2_arm64.deb Include kernel headers
 - j. **linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb** Contains kernel images and kernel modules

test@test:~/orangepi-build\$ **ls output/debs/linux-*** output/debs/linux-dtb-legacy-rockchip-rk3588_1.0.2_arm64.deb output/debs/linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb output/debs/linux-headers-legacy-rockchip-rk3588_1.0.2_arm64.deb

9) The files contained in the generated linux-image deb package are as follows

)) The mes contained in the generated max mage deb package are as follows
k. Use the following command to decompress the deb package
test@test:~/orangepi-build\$ cd output/debs
test@test:~/orangepi_build/output/debs\$ mkdir test
test@test:~/orangepi_build/output/debs\$ cp \
linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb test/
test@test:~/orangepi_build/output/debs\$ cd test
test@test:~/orangepi_build/output/debs/test\$ dpkg -x \
linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb .
test@test:~/orangepi_build/output/debs/test\$ ls
boot etc lib linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb usr
1. The decompressed file is as follows
test@test:~/orangepi-build/output/debs/test\$ tree -L 2
boot
config-5.10.110-rockchip-rk3588
System.map-5.10.110-rockchip-rk3588
vmlinuz-5.10.110-rockchip-rk3588
etc
kernel
1

— linux-image-legacy-rockchip-rk3588 1.0.2 arm64.deb

- lib

– modules

usr |---- lib ______share

10) When the orangepi-bulid compilation system compiles the linux kernel source code, it first synchronizes the linux kernel source code with the linux kernel source code of the github server, so if you want to modify the linux kernel source code, you first need to turn off the update function of the source code (the linux kernel needs to be fully compiled once This function can only be turned off after the source code, otherwise it will prompt that the source code of the linux kernel cannot be found. If the source code compressed package downloaded from Google Drive, there is no such problem, because the source code of linux has been cached), otherwise the modification made will be restored, the method is as follows:

Set the IGNORE_UPDATES variable in **userpatches/config-default.conf** to "yes" test@test:~/orangepi-build\$ **vim userpatches/config-default.conf** IGNORE_UPDATES="**yes**"

11) If the kernel has been modified, the following method can be used to update the kernel and kernel modules of the development board linux system

m. Upload the deb package of the compiled linux kernel to the linux system of the development board

test@test:~/orangepi-build\$ cd output/debs

test@test:~/orangepi-build/output/debs\$ scp \

linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb root@192.168.1.xxx:/root

n. Then log in to the development board and uninstall the deb package of the installed linux kernel

root@orangepi:~# apt purge -y linux-image-legacy-rockchip-rk3588

o. Install the deb package of the new linux kernel just uploaded

root@orangepi:~# dpkg -i linux-image-legacy-rockchip-rk3588_1.0.2_arm64.deb

p. Then restart the development board, and then check whether the kernel-related modifications have taken effect

root@orangepi:~# reboot

12) Other useful information

a. The storage location of the kernel configuration file is as follows. Please do not

go to the kernel source code to find the kernel configuration file used by the development board.

a) Linux5.10

orangepi-build/external/config/kernel/linux-rockchip-rk3588-legacy.config

b) Linux6.1

orangepi-build/external/config/kernel/linux-rockchip-rk3588-current.config

- b. The location of the dts file used by the development board
 - a) Linux5.10

orangepi-build/kernel/orange-pi-5.10-rk35xx/arch/arm64/boot/dts/rockchip/rk3588s -orangepi-5.dts

b) Linux6.1

orangepi-build/kernel/orange-pi-6.1-rk35xx/arch/arm64/boot/dts/rockchip/rk3588sorangepi-5.dts

6.5. Compile rootfs

1) Run the build.sh script, remember to add sudo permission

test@test:~/orangepi-build\$ sudo ./build.sh

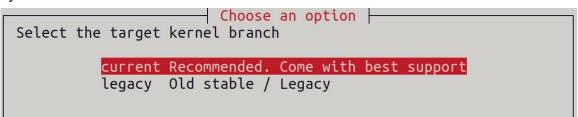
2) Select **Rootfs and all deb packages**, then press Enter

Choose an option Compile image rootfs kernel u-boot	
U-boot package Kernel package	
Rootfs and all deb packages Full OS image for flashing	

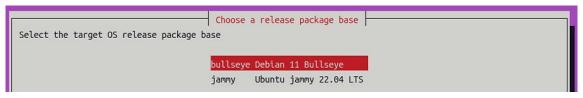
3) Then select the model of the development board

	Choose an option
Please choose a Board.	
orangepi3	Allwinner H6 quad core 1GB/2GB RAM GBE WiFi/BT eMMC USB3
5 1	
orangepi3-lts	Allwinner H6 quad core 2GB RAM GBE WiFi/BT-AW859A eMMC USB3
orangepizero2	Allwinner H616 quad core 512MB/1GB RAM WiFi/BT GBE SPI
orangepi4	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT
orangepi4-lts	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT
orangepi800	Rockchip RK3399 hexa core 4GB RAM GBE eMMC USB3 USB-C WiFi/BT VGA
orangepi5	Rockchip RK3588S octa core 4-16GB RAM GBE USB3 USB-C NvME

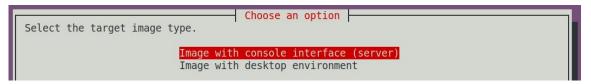
4) Then select the branch type of the kernel source code. Currently, the rootfs maintained by the kernel source code uses the same set.



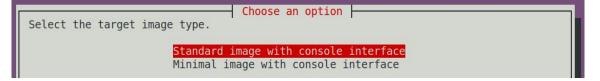
5) Then select the type of rootfs



- 6) Then select the type of image
 - a. **Image with console interface (server)** Indicates the image of the server version, which is relatively small
 - b. **Image with desktop environment** Indicates a image with a desktop, which is relatively large



7) If you are compiling the image of the server version, you can also choose to compile the Standard version or the Minimal version. The pre-installed software of the Minimal version will be much less than that of the Standard version (please do not choose the Minimal version if there is no special requirement, because many things are not pre-installed by default. Some functions may not be available)



8) If you are compiling the image of the desktop version, you also need to select the type of desktop environment. Currently, Ubuntu Jammy supports XFCE and Gnome desktops,

while Ubuntu Focal and Debian only support XFCE

Choose a desktop environment Select the default desktop environment to bundle with this image Gnome desktop environment Xfce desktop environment	
Choose the desktop environment config Select the configuration for this environment. base configuration	

You can then select additional packages that need to be installed. Please press the Enter key to skip directly here.

<pre>3dsupport 3dsupport [] browsers Browsers [] chat Chat [] desktop_tools Desktop_tools [] editors Editors [] internet Internet [] multimedia Multimedia [] office Office [] programming Programming [] remote_desktop </pre>	Choose desktop softwares to add Select which kind of softwares you'd like to add to your build				
<ok> <cancel></cancel></ok>	[] browsers Br [] chat Ch [] desktop_tools De [] editors Ed [] internet In [] multimedia Mu [] office Of [] programming Pr	rowsers hat esktop_tools ditors nternet ultimedia ffice rogramming			
		<0k> <0	Cancel>		

9) Then it will start to compile rootfs, and some of the information prompted during compilation are as follows

a. The type of rootfs

[o.k.] local not found [Creating new rootfs cache for jammy]		
b. The storage path of the compiled rootfs compressed package		
[o.k.] Target directory [external/cache/rootfs]		
c. The name of the rootfs compressed package generated by compilation		
[o.k.] File name [jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4]		

d. The time used for compilation

[o.k.] Runtime [**13 min**]

10) View the rootfs compressed package generated by compilation

a. jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4 is the rootfs compressed package, the meaning of each field of the name is

a) **jammy** indicates the type of linux distribution of rootfs

b) **xfce** means rootfs is the type of desktop version, if it is cli, it means the type of server version

c) **arm64** represents the architecture type of rootfs

d) **f930ff6ebbac1a72108a2e100762b18f** is the MD5 hash value generated by the package names of all software packages installed by rootfs. As long as the list of software packages installed by rootfs is not modified, this value will not change. The compilation script will use this MD5 hash value to generate Determine whether rootfs needs to be recompiled

b. jammy-xfce-arm64.f930ff6ebbac1a72108a2e100762b18f.tar.lz4.list lists the package names of all packages installed by rootfs

test@test:~/orangepi-build\$ ls external/cache/rootfs/

bullseye-xfce-arm64.5250ec7002de9e81a41de169f1f89721.tar.lz4

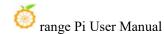
bullseye-xfce-arm64.5250ec7002de9e81a41de169f1f89721.tar.lz4.current bullseye-xfce-arm64.5250ec7002de9e81a41de169f1f89721.tar.lz4.list

11) If the required rootfs already exists under **external/cache/rootfs**, then compiling rootfs again will directly skip the compilation process and will not restart the compilation. When compiling the image, it will also go to **external/cache/rootfs** to find out whether it has If there is rootfs available in the cache, use it directly, which can save a lot of download and compilation time.

6. 6. Compile linux image

Run the build.sh script, remember to add sudo permission
 test@test:~/orangepi-build\$ sudo ./build.sh

2) Select Full OS image for flashing, then press Enter

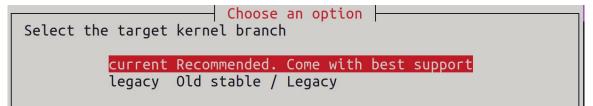


Choose an option Compile image rootfs kernel u-boot	
U-boot package Kernel package Rootfs and all deb packages <mark>Full OS image for flashing</mark>	

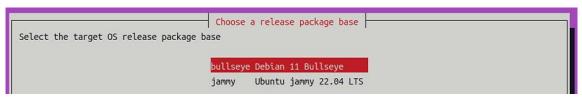
3) Then select the model of the development board

	Choose	e an option	
lease choose a Board.			
orangepi3	Allwinner H6 quad core :	1GB/2GB RAM GBE WiFi/BT eMMC	USB3
orangepi3-lts	Allwinner H6 quad core :	2GB RAM GBE WiFi/BT-AW859A e	MMC USB3
orangepizero2	Allwinner H616 quad core	e 512MB/1GB RAM WiFi/BT GBE	SPI
orangepi4	Rockchip RK3399 hexa c	ore 4GB RAM GBE eMMC USB3 US	3-C WiFi/BT
orangepi4-lts	Rockchip RK3399 hexa c	ore 4GB RAM GBE eMMC USB3 US	3-C WiFi/BT
orangepi800	Rockchip RK3399 hexa c	ore 4GB RAM GBE eMMC USB3 US	3-C WiFi/BT VGA
orangepi5	Rockchip RK3588S octa	core 4-16GB RAM GBE USB3 USB	-C NVME

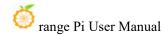
- 4) Then select the branch type of the kernel source code
 - a. legacy branch will compile the linux5.10 kernel source code
 - b. current branch will compile the linux6.1 kernel source code



5) Then select the type of rootfs

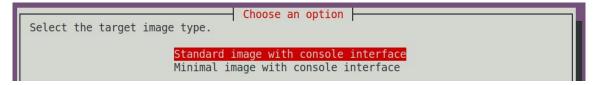


- 6) Then select the type of image
 - a. **Image with console interface (server)** Indicates the image of the server version, which is relatively small
 - b. **Image with desktop environment** Indicates a image with a desktop, which is relatively large



Select the target image type.	Choose an option	
	with console interface (server) with desktop environment	

7) If you are compiling the image of the server version, you can also choose to compile the Standard version or the Minimal version. The pre-installed software of the Minimal version will be much less than that of the Standard version (please do not choose the Minimal version if there is no special requirement, because many things are not pre-installed by default. Some functions may not be available)



8) If you are compiling the image of the desktop version, you also need to select the type of desktop environment. Currently, Ubuntu Jammy supports XFCE and Gnome desktops, while Ubuntu Focal and Debian only support XFCE

Select the default deskt	Choose a desktop environment top environment to bundle with this Gnome desktop environment Xfce desktop environment	s image
Select the configuration	Choose the desktop environment conf for this environment.	fig

base configuration

You can then select additional packages that need to be installed. Please press the Enter key to skip directly here.

[] browsers [] [] chat [] [] desktop_tools [] [] editors [] [] internet [] [] multimedia [] [] office []	3dsupport Browsers Chat Desktop_tools Editors Internet Multimedia Office Programming Remote_desktop	
	<0k>	<cancel></cancel>

9) Then it will start to compile the linux image. The general process of compilation is as follows

a. Initialize the compilation environment of Ubuntu PC and install the software packages required for the compilation process

b. Download the source code of u-boot and linux kernel (if cached, only update the code)

- c. Compile u-boot source code and generate u-boot deb package
- d. Compile the linux source code and generate linux-related deb packages
- e. Make the deb package of linux firmware
- f. Make the deb package of the orangepi-config tool
- g. Create a deb package supported by the board

h. If you are compiling the desktop image, you will also create desktop-related deb packages

i. Check whether the rootfs has been cached, if not, recreate the rootfs, if it has been cached, directly decompress and use

j. Install the previously generated deb package into rootfs

k. Make some specific settings for different development boards and different types of images, such as pre-installing additional software packages, modifying system configuration, etc.

1. Then make an image file and format the partition, the default type is ext4

- m. Then copy the configured rootfs to the imageed partition
- n. Then update initramfs
- o. Finally, write the bin file of u-boot into the image through the dd command

www.orangepi.org

10) After compiling the image, the following information will be prompted

a. The storage path of the compiled image

o.k.] Done building

[output/images/orangepi5_1.0.2_debian_bullseye_desktop_xfce_linux5.10.160/oran gepi5_1.0.2_debian_bullseye_desktop_xfce_linux5.10.160.img]

b. Compilation time

[o.k.] Runtime [19 min]

c. Repeat the command to compile the image, and use the following command to start compiling the image directly without selecting through the graphical interface

[o.k.] Repeat Build Options [sudo ./build.sh BOARD=orangepi5 BRANCH=legacy BUILD_OPT=image RELEASE=bullseye BUILD_MINIMAL=no BUILD_DESKTOP=no KERNEL_CONFIGURE=yes]

7. Linux Development Manual

7.1. The method of compiling the kernel source code separately in the linux system of the development board

1) First download the Linux kernel source code of the development board

a. If you are using a Linux 5.10 kernel system, you need to download the orange-pi-5.10-rk35xx branch.



orangepi@orangepi:~\$ git clone --depth=1 -b orange-pi-5.10-rk35xx https://github.com/orangepi-xunlong/linux-orangepi

b. If you are using a Linux 6.1 kernel system, you need to download the orange-pi-6.1-rk35xx branch.

orangepi@orangepi:~\$ git clone --depth=1 -b orange-pi-6.1-rk35xx https://github.com/orangepi-xunlong/linux-orangepi

If you have problems downloading the code from github, you can go to the official information of the development board to download the compressed kernel source code package, then upload it to the Linux system of the development board, and then decompress it.



The command to decompress the kernel source code archive is: a. Linux5.10 kernel

orangepi@orangepi:~\$ tar zxf orange-pi-5.10-rk35xx.tar.gz orangepi@orangepi:~\$ mv orange-pi-5.10-rk35xx linux-orangepi

b. Linux6.1 kernel

orangepi@orangepi:~\$ tar zxf orange-pi-6.1-rk35xx.tar.gz orangepi@orangepi:~\$ mv orange-pi-6.1-rk35xx linux-orangepi

After decompression, please execute the following command to synchronize the source code with github to ensure that the source code is in the latest state: orangepi@orangepi:~\$ cd linux-orangepi

orangepi@orangepi:~/linux-orangepi\$ git pull

2) Then configure the default kernel configuration

orangepi@orangepi:~\$ cd linux-orangepi

orangepi@orangepi:~/linux-orangepi\$ make rockchip_linux_defconfig

rockchip linux defconfig The path in the kernel source code is

arch/arm64/configs/

3) Then compile the kernel source code

orangepi@orangepi:~/linux-orangepi\$ make -j10

4) Then install the kernel module

orangepi@orangepi:~/linux-orangepi\$ sudo make modules_install

The installation path of the kernel module is: /lib/modules

After executing the sudo make modules_install command, you can see that there will be an additional kernel module folder under /lib/modules/: orangepi@orangepi5:~\$ ls /lib/modules # If it is a system with Linux 5.10 kernel, the output is as follows 5.10.160+ 5.10.160-rockchip-rk3588 # If it is a system with Linux 6.1 kernel, the output is as follows 6.1.43+ 6.1.43-rockchip-rk3588

5) Then install the kernel image and uInitrd

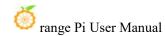
orangepi@orangepi:~/linux-orangepi\$ sudo make install

The installation path of the kernel image and uInitrd is: /boot/

After executing the sudo make install command, you can see that there will be one more kernel file under /boot/:

orangepi@orangepi5:~/linux-orangepi\$ ls /boot/vmlinuz* # If it is a system with Linux 5.10 kernel, the output is as follows /boot/vmlinuz-5.10.160+ /boot/vmlinuz-5.10.160-rockchip-rk3588 # If it is a system with Linux 6.1 kernel, the output is as follows /boot/vmlinuz-6.1.43+ /boot/vmlinuz-6.1.43-rockchip-rk3588

The file /boot/Image is actually loaded when the system starts, and Image is a copy of the vmlinuz file.



6) Then install the dtb file into /boot/dtb

orangepi@orangepi:~/linux-orangepi\$ sudo make dtbs_install INSTALL_DTBS_PATH=/boot/dtb/

7) Then restart the Linux system and the newly compiled kernel will be loaded

orangepi@orangepi:~\$ uname -r

If it is a Linux5.10 system, the output is as follows

5.10.160+

If it is a Linux 6.1 system, the output is as follows

6.1.43+

8. Instructions for using the Android 12 system

8.1. Supported Android versions

Android version	kernel version
Android 12	Linux5.10
Android 12 Box	Linux5.10

8.2. Android function adaptation

Function	Android 12	Android12 Box
USB2.0x2	ОК	OK
USB3.0x1	ОК	OK
USB Type-C 3.0	ОК	ОК
DP display	ОК	ОК
M.2 NVMe SSD Boot	ОК	ОК
M.2 SATA SSD Boot	ОК	ОК

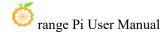
range Pi User Manual

AP6275P-WIFI	ОК	ОК
AP6275P-Bluetooth	ОК	ОК
GPIO (26pin)	ОК	ОК
UART (26pin)	ОК	ОК
SPI (26pin)	ОК	ОК
I2C (26pin)	ОК	ОК
PWM (26pin)	ОК	ОК
3pin debug serial port	ОК	ОК
TF card start	ОК	ОК
HDMI video	ОК	ОК
HDMI audio	ОК	ОК
OV13850 camera	ОК	ОК
OV13855 camera	ОК	ОК
LCD1	ОК	NO
LCD2	ОК	NO
Gigabit Ethernet port	ОК	ОК
Network port status light	ОК	ОК
MIC	ОК	ОК
headphone playback	ОК	ОК
headphone recording	ОК	ОК
led light	ОК	ОК
GPU	ОК	ОК
NPU	ОК	ОК
VPU	ОК	ОК
switch button	ОК	ОК
HDMI CEC function	NO	ОК

8.3. How to use the USB wireless network card

1) The currently mirrored USB wireless network card models are as follows:

Chip model	Function	VID&PID	Adaptation
RTL8821CU	2.4G +5G WIFI+BT 4.2	0bda:c820	Support WIFI, Bluetooth and hotspot
RTL8723BU	2.4G WIFI+BT4.0	0bda:b720	Support WIFI and Bluetooth function,
			does not support hotspot



RTL8811CU	2.4G +5G WIFI	0bda:c811	Support WIFI function and open
			hotspot

- 2) The pictures of the above three USB wireless network cards are as follows:
 - a. The picture of the RTL8821CU USB wireless network card module is as follows:



b. The picture of the RTL8723BU USB wireless network card module is as follows:



c. The picture of the RTL8811CU USB wireless network card module is as follows:



3) The test methods of the above three types of USB wireless network cards are the same. First, the USB network card needs to be inserted into the USB interface of the development board.

4) Then, for the connection and test method of WIFI, please refer to the section of WIFI connection test method

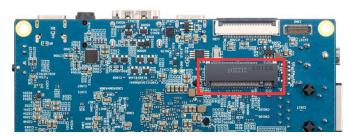
5) For the Bluetooth test, please refer to the Bluetooth test method section

8.4. How to use AP6275P PCIe network card

1) First, you need to purchase an AP6275P PCIe network card as shown in the figure below



2) Then insert the AP6275P PCIe network card into the M.2 interface of the development board and fix it



3) Then connect the power supply of the Type-C interface to the development board, and power on

4) After the system starts, please refer to **the section of WIFI connection test method** for WIFI connection and test method

5) For the Bluetooth test, please refer to the Bluetooth test method section

8.5. WIFI connection test method

1) First click to enter the Setting

	🧭 range Pi Usei	Manual	Copyright re	served by Shenz	hen Xunlong Sof	tware Co., Ltd
2	:04 🖯 🖞					
			Q Searc	ch apps		
	82	138		0		6
	Calculator	Calendar	Camera	Clock	Contacts	Explorer
			\bigcirc	۲	Q	\$
	Files	Gallery	Lightning	Music	Search	Settings
	Sound Recorder	Video	WiringOP			

2) Then select Network & internet

×

Settings	
Q Search settings	
Retwork & internet Wi⊧Fi, hotspot Network Net	
Connected devices	

3) Then select Internet

Ne	twork & internet			
0	Internet Networks available			
e	Calls & SMS			

4) Then turn on the Wi-Fi switch



5) After turning on Wi-Fi, if everything is normal, you can scan to nearby Wi-Fi hotspots

Internet	
Wi-Fi	
 Venezation 	
 armanii 	
 Side a state in 	

6) Then select the Wi-Fi you want to connect to, and the password input interface shown in the figure below will pop up

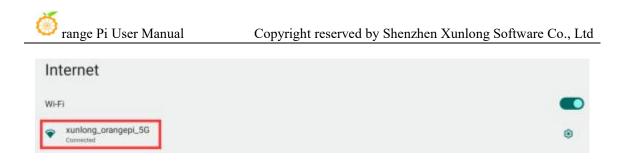
xunlon	g_oran	gepi_5G								
Password										
1	1	n <u>.</u>								
Show passy	vord									
Advanced notion										
q	W	e	r °	t	у	u	i '	o °	р	G
а	S	d	f	g	h	j	k	E.		0
+	z	x	С	v	b	n	m	!	?	+
7123										۵

7) Then use the keyboard to enter the password corresponding to Wi-Fi, and then use the mouse to click the Enter button in the virtual keyboard to start connecting to Wi-Fi

thoward	ng_orar															
] Show pass			-													
tononat coston 1	2	3		4	5		6		7		8		9		0	a
		#	s	%		&	Ū	2		+	~	(-)		0
~ <	Λ.	=		*			2		\$;		!		?	~[•
ABC		-											/			9

8) The display after successful Wi-Fi connection is shown in the figure below:

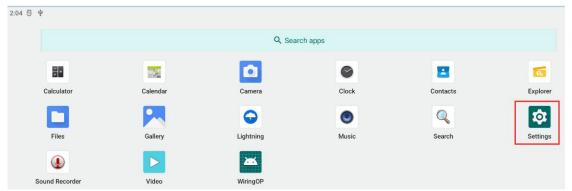
```
www.orangepi.org
```



8.6. How to use Wi-Fi hotspot

1) First, please make sure that the Ethernet port is connected to the network cable and can access the Internet normally

2) Then select Settings



3) Then select Network & internet



4) Then select Hotspot & tethering

Network & internet

Internet Networks available	
Calls & SMS No SIM	
Airplane mode	
Ethernet	
Hotspot & tethering Hotspot on	
	Networks available Calls & SMS No SIM Airplane mode Ethernet Hotspot & tethering

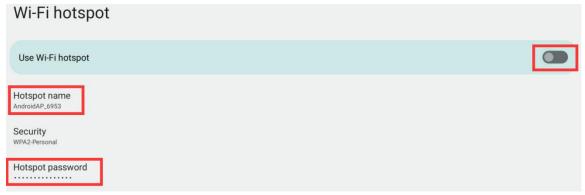
5) Then select **Wi-Fi hotspot** Hotspot & tethering

Use hotspot and tethering to provide internet to other devices through your mobile data connection. Apps can also create a hotspot to share content with nearby devices.

 Wi-Fi hotspot

 Not sharing internet or content with other devices

6) Then turn on the **Wi-Fi hotspot**, you can also see the name and password of the generated hotspot in the figure below, remember them, and use them when connecting to the hotspot (if you need to modify the name and password of the hotspot, you need to turn off the Wi-Fi first -Fi hotspot before modification)



7) At this point, you can take out your mobile phone. If everything is normal, you can find the WIFI hotspot with the same name (here AndroidAP_6953) displayed under the **Hotspot name** in the above picture in the WI-FI list searched by the mobile phone. Then you can click AndroidAP_6953 to connect to the hotspot, and the password can be seen under the **Hotspot password** in the above picture

く设置	无线局域网		
无线局力	或网	(
🗸 xunlong	g_orangepi_5G	۵	? (j)
网络			
Android	IAP_6953	۵	? (j)

8) After the connection is successful, it will be displayed as shown in the figure below (the interface of different mobile phones will be different, the specific interface is subject to the display of your mobile phone). At this point, you can open a webpage on your mobile phone to see if you can access the Internet. If you can open the webpage normally, it means that the **WI-FI Hotspot** of the development board can be used normally.



8.7. Bluetooth test method

1) First click to enter the **Setting**

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		17 0	•	C	
2:04 🕤 🜵					
		Q Sear	ch apps		
80	100		۲	E	6
Calculator	Calendar	Camera	Clock	Contacts	Explorer
		\bigcirc	۲	Q	墩
Files	Gallery	Lightning	Music	Search	Settings
٩		Xex			
Sound Recorder	Video	WiringOP			

2) Then select Connected devices

Settings Q Search settings Petwork & internet Wi-Fi, hotspot Connected devices Bluetooth, pairing

3) Then click **Pair new device** to turn on Bluetooth and start scanning the surrounding Bluetooth devices



4) The searched Bluetooth devices will be displayed under Available devices



5) Then click the Bluetooth device you want to connect to start pairing. When the following interface pops up, please use the mouse to select the **Pair** option

Pair new device	
Device name	Pair with test?
Available devices	Bluetooth pairing code
🗖 xuebutou	972414 Allow access to your contacts and call history
test Range	CANCEL

6) The test here is the configuration process of the development board and the Bluetooth of the Android mobile phone. At this time, the following confirmation interface will pop up on the mobile phone. After clicking the pairing button on the mobile phone, the pairing process will start



7) After the pairing is completed, you can see the paired Bluetooth device as shown in

the figure below

Conne	cted devices	
Other devices		
∯ USB Charging	this device	
+ Pair n	ew device	
Previously conne	ected devices	
📞 test		٩

8) At this time, you can use the Bluetooth of your mobile phone to send a picture to the development board. After sending, you can see the following confirmation interface in the Android system of the development board, and then click **Accept** to start receiving the picture sent by the mobile phone.

Accept incoming file?	
From	
test	
Filename	
Screenshot_20220914_140609_com.android.settings.jpg	
Size	
170 kB	
	DECLINE ACCEPT

9) You can open the **Download** directory in the file manager to view the pictures received by the Android system Bluetooth of the development board

Internal Memory/Download							
📌 Home	💽 LevelUp	🚍 Multi	🗹 Editor	RewFolder	e Back		
Screenshot_20220914_140609_com.android.settings_102838.jpg 165.97 K 2022-09-07 10:28:44 -r							

8.8. How to use 10.1 Inch MIPI screen

Please make sure that the image used is the following three versions of the image:

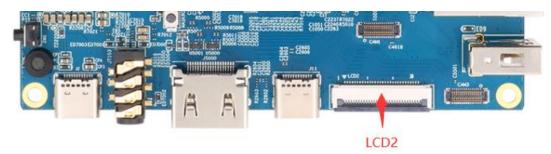
OrangePi5_RK3588S_Android12_lcd_v1.x.x.img OrangePi5_RK3588S_Android12_spi-nvme_lcd_v1.x.x.img OrangePi5_RK3588S_Android12_spi-sata_lcd_v1.x.x.img

1) The screen needs to be assembled first, please refer to the assembly method of the **10.1-inch MIPI screen**

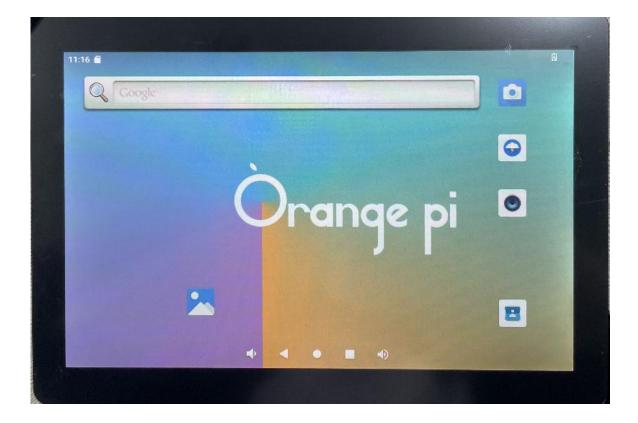
- 2) There are two mipi lcd screen interfaces on the development board, we define:
 - a. The location of the lcd1 interface is:



b. The location of the lcd2 interface is:



3) Connect the assembled screen to the lcd1 or lcd2 interface, connect the Type-C power supply to the board, and power on. After the system starts, you can see the screen display as shown in the figure below



8.9. Test method of OV13850 and OV13855 MIPI camera

Currently the development board supports two MIPI cameras, OV13850 and OV13855, the specific pictures are as follows:

a. OV13850 camera with 13 million MIPI interface



b. OV13855 camera with 13 million MIPI interface



The adapter boards and FPC cables used by the OV13850 and OV13855 cameras are the same, but the positions of the two cameras connected to the adapter boards are different. The FPC cable is shown in the figure below. Please note that the FPC cable has a direction. The end marked **TO MB** needs to be inserted into the camera interface of the development board, and the end marked **TO CAMERA** needs to be inserted into the camera adapter board.

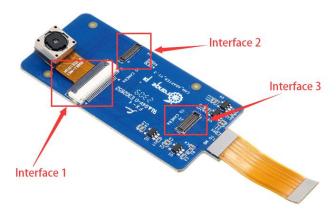


There are a total of 3 camera interfaces on the camera adapter board, and only one can be used at a time, as shown in the figure below, of which:

a. No.1 port is connected to OV13850 camera

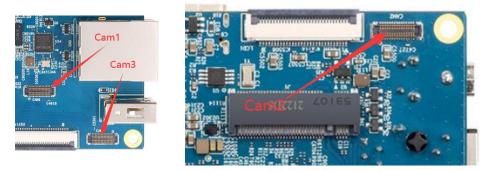
b. No.2 interface is connected to OV13855 camera

c. No. 3 interface is not used, just ignore it



There are a total of 3 camera interfaces on the Orange Pi 5 development board. We

define the positions of Cam1, Cam2 and Cam3 as shown in the figure below:



The method of inserting the camera into the Cam1 interface of the development board is as follows:



The method of inserting the camera into the Cam2 interface of the development board is as follows:



The method of inserting the camera into the Cam3 interface of the development board is as follows:

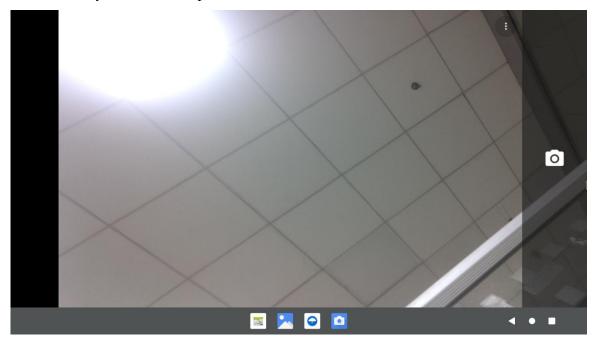


The Android system defaults to the configuration of **Cam1** and **Cam3**, so if you want to use the camera, please choose one of the **Cam1** and **Cam3** interfaces. After connecting the camera to the development board, we can use the following method to test the camera:

a. Open the camera APP on the desktop



b. Then you can see the preview screen of the camera

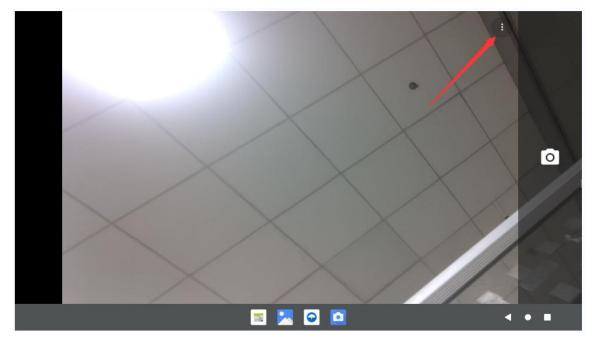


In addition to single camera, we can also connect two cameras at the same time. It

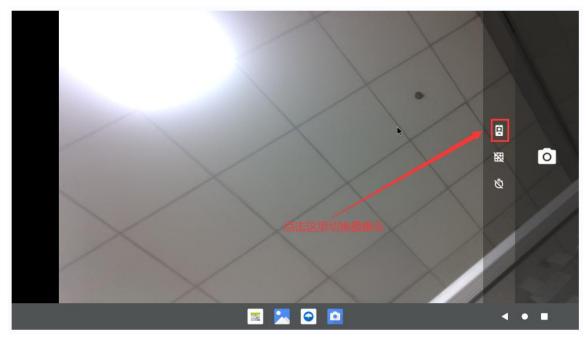
should be noted that currently, please use the combination of **Cam1+Cam3** for testing dual cameras (support ov13850 and ov13855 mix and match). After connecting the dual cameras, open the camera APP to see the picture of one of the cameras as in the previous steps.

The method to switch to another camera is:

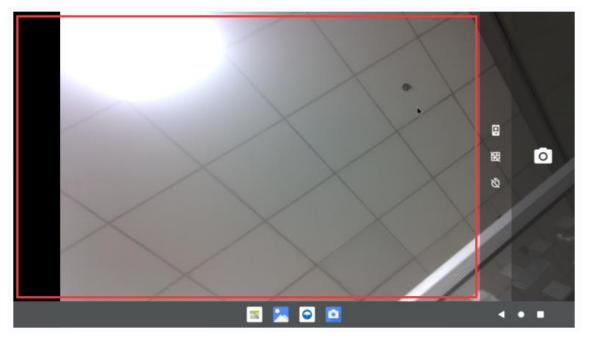
a. First click the three dots in the upper right corner



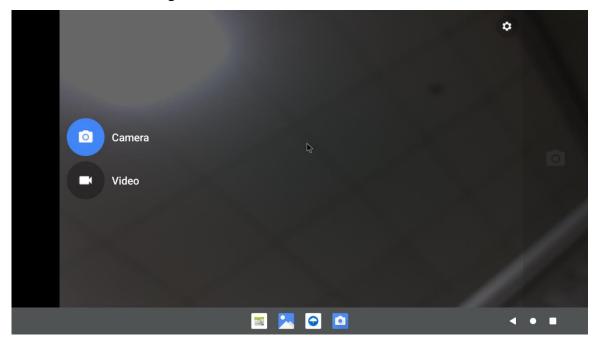
b. Then click the position shown in the figure below to switch the camera



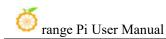
Press and hold the mouse in the area shown in the red box in the picture below of the camera APP and then drag to the right to call up the switching interface for taking pictures and recording

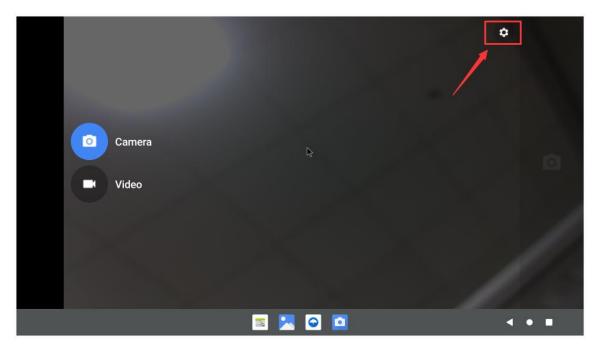


The switching interface of taking pictures and recording is as follows, click Video to switch to **video** recording mode



Click the position shown in the figure below to enter the camera setting interface



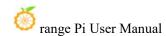


The setting interface of the camera is as follows:

← Settings	
Resolution & quality	
Capture Sound	۰
Save location	۲
Restore Default Settings	
🔤 🔀 🖸 🗖	◀ ● ■

Currently testing OV13850 does not support 4K video recording (OV13855 supports), only supports up to 1080p, please switch the video format to 1080p in the settings when recording video, the steps are as follows:

a. First enter the setting interface of the camera APP, and then click **Resolution &** quality



← Settings	
Resolution & quality	
Capture Sound	
Save location	
Restore Default Settings	

b. Then set the Video format to 1080p in Video

← Settings			
Camera Back camera photo (4:3) 13.2 megapixels			
Front camera photo (4:3) 13.2 megapixels			
Video Back camera video HD 1080p			
Front camera video HD 1080p			

8. 10. 26pin interface GPIO, UART, SPI and PWM test

8. 10. 1. 26pin GPIO port test

1) First click on the wiringOP icon to open the wiringOP APP

		Q Searc	ch apps		
Calculator	Calendar	Camera	Clock	Contacts	Explorer
Files	Gallery	Lightning	Music	Search	Settings
Sound Recorder	Video	wiringOP			

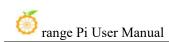
2) The main interface of wiringOP APP is displayed as shown in the figure below, and then click the **GPIO_TEST** button to open the GPIO test interface

12:02			
wiringOP			
GPIO_TEST			
UART_TEST			
I2C_TEST			
SPI_TEST			
PWM_TEST			

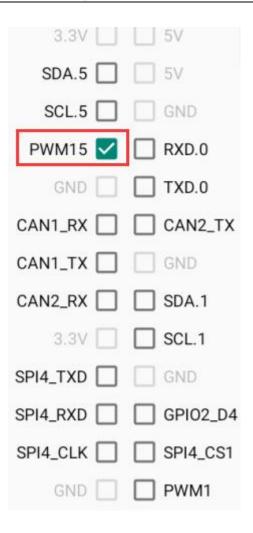
3) The GPIO test interface is shown in the figure below. The two rows of **CheckBox** buttons on the left are in one-to-one correspondence with the 26pin pins. When the **CheckBox** button is checked, the corresponding GPIO pin will be set to **OUT** mode, and the pin level will be set to high level; when the checkbox is unchecked, the GPIO pin level will be set to low level; When the **GPIO READALL** button is pressed, information such as the wPi number, GPIO mode, and pin level can be obtained.

8:13 🖯 🜵	⇔ 0
wiringOP	
3.3V 🔲 🛄 5V	GPIO READALL
SDA.5 🔲 🗍 5V	
SCL.5 🔲 🔲 GND	
PWM15 🗌 🗌 RXD.0	
GND 🔲 🔲 TXD.0	
CAN1_RX	
CAN1_TX	
CAN2_RX 🗌 🔲 SDA.1	
3.3V 🗌 🔲 SCL.1	
SPI4_TXD 🔲 🔲 GND	
SPI4_RXD 🗌 🔲 GPI02_D4	
SPI4_CLK 🗌 🗌 SPI4_CS1	
GND 🗌 🔲 PWM1	

4) Then click the **GPIO READALL** button, the output information is as shown in the figure below:



5) There are a total of 16 GPIO ports in the 26pins of the development board that can be used. The following takes pin 7—the corresponding GPIO is GPIO1_C6—the corresponding wPi serial number is 2—as an example to demonstrate how to set the high and low levels of the GPIO port. First click the **CheckBox** button corresponding to pin 7. When the button is selected, pin 7 will be set to high level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is **3.3v**, it means setting high level success

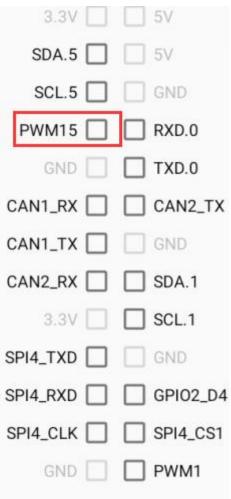


6) Then click the **GPIO READALL** button, you can see that the current pin 7 mode is OUT, and the pin level is high

8:18 🖯 🜵											
wiringOP											
3.3V 🔲 🗍 5V						GPIO RE	ADALL				
SDA.5 🔲 🛄 5V	++-	+	+			⊦ OP	15 +	 +	+	+	++
SCL.5 🔲 🔲 GND	GPIO	wPi	Name	Mode	V	Phys	ical	Mode	Name	wPi	GPIO
PWM15 RXD.0 GND TXD.0 CAN1_RX CAN2_TX GND CAN2_RX SDA.1 3.3V SCL.1 SPI4_TXD GND 	47 46 54 138 139 28 49 49 48 50	0 1 2 5 7 8 11 12 14	3.3V SDA.5 SCL.5 PWM15 GND CAN1_RX CAN1_RX CAN1_RX CAN2_RX 3.3V SPI4_RXD SPI4_RXD SPI4_CLK GND	ALT9 ALT9 OUT IN IN IN ALT8 ALT8 ALT8		1 3 5 7 9 11 13 15 17 19 21 23 25	2 4 6 8 10 12 14 16 18 20 22 22 24 24 26	ALT10 ALT10 IN IN IN IN ALT8 IN	5V 5V GND TXD.0 CAN2_TX GND SDA.1 SCL.1 GND GPI02_D4 SPI4_CS1 PWM1	 3 4 6 9 10 13 15 16	1 131 1 132 29 59 58 92 52 35
SPI4_RXD GPI02_D4 SPI4_CLK SPI4_CS1 GND PWM1	++- GPIO 1 ++-		Name			++ Phys + OP			+ Name +	+ wPi +	++ GPIO ++

7) Click the CheckBox button in the figure below again to cancel the check status. Pin 7

will be set to low level. After setting, you can use a multimeter to measure the voltage value of the pin. If it is **0v**, it means that the low level is set successfully.



8) Then click the **GPIO READALL** button, you can see that the current pin 7 mode is OUT, and the pin level is low

9 ¥												
iringOP												
3.3V 🗌 🗍 5V						GPIO RE	ADALL					
A.5 🔲 🗌 5V						- OP	I5 ·			4		
CL.5 🔲 🔲 GND	GPIO	wPi	Name	Mode	I V		ical	I V	Mode	Name	wPi	GPIO
M15 🗌 🗌 RXD.0	47	0	3.3V SDA.5	ALT9			2 4			5V 5V		
GND 🗍 🗍 TXD.0	46		SCL.5	ALT9	1	i 5 j	6	i i		GND		
	54		PWM15 GND	OUT	0	7	8 10		ALT10 ALT10	RXD.0 TXD.0	3	131 132
_RX 🔲 🔲 CAN2_TX	138		CAN1_RX	IN	1	11	12	1	IN	CAN2_TX	6	29
_TX 🔲 🗍 GND	139		CAN1_TX	IN	1	13	14			GND		
	28		CAN2_RX 3.3V	IN	1	15 17	16 18		IN IN	SDA.1 SCL.1	9 10	59 58
RX 🗌 🗌 SDA.1	49	11	SPI4 TXD	ALT8	1	19	20	1.		I GND		
3.3V 🔲 🔲 SCL.1	48	12	SPI4_RXD	ALT8	1	21	22	1	IN	GPI02_D4	13	92
	50	14	SPI4_CLK GND	ALT8	0	23	24	1	ALT8 IN	SPI4_CS1 PWM1	15 16	52 35
XD 🔲 🦳 GND	+		UND ++		 +*	25	+	+	+	+	10 +	35 +
RXD 🗌 🔲 GPI02_D4	GPIO	wPi	Name	Mode	V		ical		Mode	Name	wPi	GPIO
	++		++		++	+ OP	15					
CLK 🔲 🔲 SPI4_CS1												
GND 🗌 🔲 PWM1												

8. 10. 2. **26pin UART test**

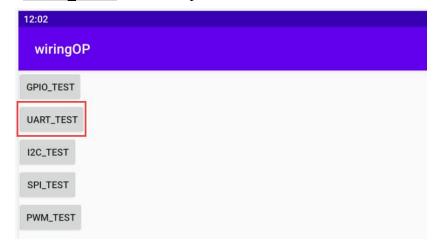
1) In Android, only one serial port of UARTO is opened by default. The position of UARTO at 26pin is shown in the figure below, and the corresponding device node is /dev/ttyS0



2) First click on the wiringOP icon to open the wiringOP APP

		Q Searc	ch apps		
	100		•	8	6
Calculator	Calendar	Camera	Clock	Contacts	Explorer
		\bigcirc	۲		\$
Files	Gallery	Lightning	Music	Search	Settings
Sound Recorder	Video	wiringOP			

3) The main interface of wiringOP APP is displayed as shown in the figure below, and then click the **UART TEST** button to open the UART test interface



4) The serial port test interface of the APP is shown in the figure below

12:30			⇔ 🛛
wiringOP			
/dev/ttyS0 - 115200 c	DPEN CLOSE		
hello world!			
		SEND	×
		-	< ● ■

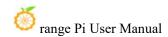
5) Then enter the baud rate you want to set in the edit box, and then click the **OPEN** button to open the /dev/ttyS0 node. After the opening is successful, the **OPEN** button becomes unselectable, and the **CLOSE** button and **SEND** button become selectable.

12:31									⇔ 🛛
wiringOP									
/dev/ttyS0	÷	115200	OPEN	CLOSE					
hello world!									
						SEND			

6) Then use Dupont wire to short the RXD and TXD pins of uart0



7) Then you can enter a character in the send edit box below, and click the **SEND** button to start sending



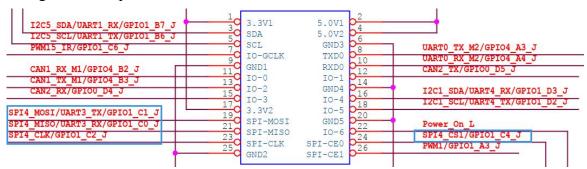
12:31									↔ 0
wiringOP									
/dev/ttyS0	*	115200	OPEN	CLOSE					
hello world!									
						SEND			

8) If everything is normal, the received string will be displayed in the receiving box

12:33						
wiringOP						
/dev/ttyS0	*	115200	OPEN	CLOSE		
hello world!						
						SEND

8. 10. 3. **26pin SPI test**

1) According to the schematic diagram of the 26pin interface, the spi available for Orange Pi 5B is spi4



2) Here, the SPI interface is tested through the w25q64 module. First, the w25q64 device is connected to the SPI4 interface



3) Then click the wiringOP icon to open the wiringOP APP

		Q Searc	ch apps		
Calculator	Calendar	Camera	Clock	Contacts	Explorer
Files	Gallery	Lightning	Music	Search	Settings
Sound Recorder	Video	wiringOP			

4) The main interface of wiringOP APP is displayed as shown in the figure below, click the SPI_TEST button to open the SPI test interface



5) Then click the **OPEN** button to initialize the SPI

X	
	range Pi User Manual

12:37
wiringOP
/dev/spidev4.1 SPI Channel: 4 SPI Port: 1 SPI Speed: 2000000
OPEN
data[0]: 0x9f data[1]: 0x09
data[2]: 0x09 data[3]: 0x09
TRANSFER
SPI Open Success, channel: 4, port: 1, speed:2000000

6) Then fill in the bytes that need to be sent, such as reading the ID information of w25q64, fill in the address 0x9f in data[0], and then click the **TRANSFER** button

12:37
wiringOP
/dev/spidev4.1 SPI Channel: <u>4</u> SPI Port: <u>1</u> SPI Speed: <u>2000000</u>
OPEN
data[0]: 0x9fdata[1]: 0x09
data[2]: 0x09 data[3]: 0x09
TRANSFER
SPI Open Success, channel: 4, port: 1, speed:2000000

7) Finally, the APP will display the read ID information

12:41	
wiringOP	
/dev/spidev4.1	00
OPEN	
data[0]: 0x9f data[1]: 0x09	
data[2]: 0x09 data[3]: 0x09	
TRANSFER	
SPI Transfer success	
ret:4 data[0]:ff	4
data[1]:ef	
data[2]:40	
data[3]:17	

8) The MANUFACTURER ID of the w25q64 module is EFh, and the Device ID is 4017h, corresponding to the value read above (h stands for hexadecimal)

MANUFACTURER ID	(MF7 - MF0)		
Winbond Serial Flash	EFh	_	
Device ID	(ID7 - ID0)	(ID15 - ID0)	
Instruction	ABh, 90h, 92h, 94h	9Fh	
W25Q64FV (SPI)	16h	4017h	
W25Q64FV (QPI)	16h	6017h	

8. 10. 4. **26pin PWM test**

1) Android only enables **PWM15** by default, and the corresponding pin is located at 26pin as shown in the figure below



2) First click on the wiringOP icon to open the wiringOP APP

🮯 range Pi User Manual		Copyright reserved by Shenzhen Xunlong Software Co., Ltd			
Q Search apps					
- = += Calculator	Calendar	Camera	Clock	Contacts	Explorer
Calculator	Calendar		CIOCK	Contacts	_
		\bigcirc	۲	Q	t ¢t
Files	Gallery	Lightning	Music	Search	Settings
Sound Recorder	Video	wiringOP			

3) Then click the **PWM_TEST** button on the main interface of wiringOP to enter the PWM test interface

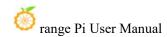
12:02		
wiringO	P -	
GPIO_TEST		
UART_TEST		
I2C_TEST		
SPI_TEST		
PWM_TEST		

4) The base address corresponding to PWM15 is **febf0030**, and the right side of pwmchip0 is just **febf0030.pwm**, if the displayed base address is wrong, please click the drop-down option to select other pwmchips until **febf0030** is displayed on the right

12:43			⇔ 0
wiringOP			
	pwmchip0 🔻 fe	febf0030.pwm Period 50000 ns	
ON			
Enable pwmchip0 Duty			

5) Then confirm the PWM cycle, the default configuration is **50000ns**, converted to PWM frequency is **20KHz**, you can modify it yourself, click the open button to export **PWM15**

10

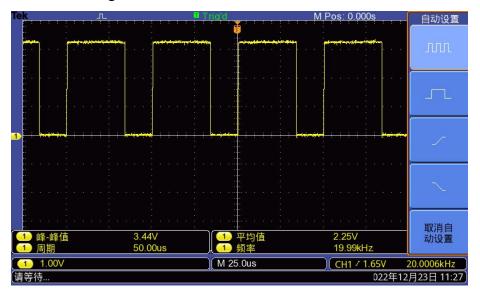


12:43				⇔ 0
wiringOP				
	pwmchip0	÷	febf0030.pwm	Period 50000 ns
ON				
Enable pwmchip0 Duty •				

6) Then drag the drag bar below to change the PWM duty cycle, and then check Enable to output the PWM waveform

12:47					↔ 9
wiringOP					
	pwmchip0	÷	febf0030.pwm	Period 50000 ns	
OFF					
Enable pwmchip0 Duty			•		

7) Then use an oscilloscope to measure pin 7 in the 26pin of the development board, and you can see the following waveform



8.11. How to use ADB

8. 11. 1. Use the data cable to connect to adb debugging

4) First prepare a good quality Type-C data cable



5) Then use the Type-C data cable to connect the development board to the USB interface of the computer (please use the Type-C power supply to power the development board at the same time)

6) Install adb tool on Ubuntu PC

test@test:~\$ sudo apt update test@test:~\$ sudo apt -y install adb

7) You can view the identified ADB devices through the following command test@test:~\$ adb devices
List of devices attached
S63QCF54CJ device
test@test:~\$ lsusb
Bus 003 Device 006: ID 2207:0006

8) Then you can log in to the android system through the adb shell on the Ubuntu PC test@test:~\$ adb shell console:/ \$

9) Execute the command to remount the Android system

test@test:~**\$ adb root** test@test:~**\$ adb remount**

10) Then you can transfer files to the Android system

test@test:~\$ adb push example.txt /system/

8. 11. 2. Use network connection adb debugging

Using the network adb does not require a USB Type C interface data cable to

connect the computer and the development board, but to communicate through the network, so first make sure that the wired or wireless network of the development board has been connected, and then obtain the IP address of the development board, and then to use.

1) Make sure that the **service.adb.tcp.port** of the Android system is set to port number 5555

console:/ # getprop | grep "adb.tcp" [service.adb.tcp.port]: [5555]

2) If **service.adb.tcp.port** is not set, you can use the following command to set the port number of network adb

console:/ # setprop service.adb.tcp.port 5555
console:/ # stop adbd
console:/ # start adbd

3) Install adb tool on Ubuntu PC

test@test:~\$ sudo apt update

test@test:~\$ sudo apt install -y adb

4) Then connect network adb on Ubuntu PC

test@test:~\$ adb connect 192.168.1.xxx (The IP address needs to be changed to the IP address of the development board)

* daemon not running; starting now at tcp:5037

* daemon started successfully

connected to 192.168.1.xxx:5555

test@test:~\$ adb devices

List of devices attached

192.168.1.xxx:5555 device

5) Then you can log in to the android system through the adb shell on the Ubuntu PC test@test:~\$ adb shell console:/ #

8. 12. 2.4G USB remote control tested by Android Box

- 7) A 2.4G USB remote control that has been tested so far is shown in the figure below
 - a. Contains a remote control



b. A USB wireless receiver



8) The Android Box system does not require any configuration, it can be used after plugging it in

8.13. How to use HDMI CEC function in Android Box system

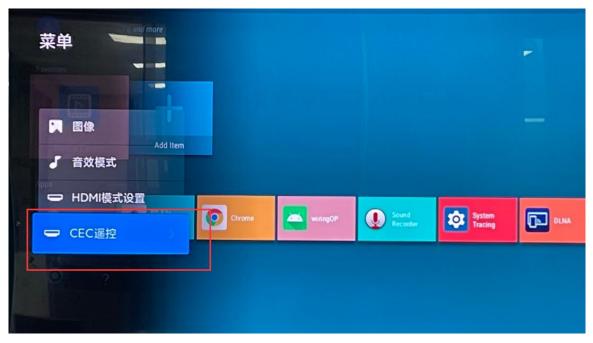
HDMI CEC allows users to control all connected devices through HDMI with only one remote control. Based on this function, we can control the development board with the remote control of the TV.

Before testing this function, please make sure your TV supports HDMI CEC.

1) First connect the development board to the TV through the HDMI cable, then power on and start

2) Then turn on the HDMI CEC function in the TV settings. Different TVs may have

different ways to turn it on. Here we take Xiaomi TV as an example. Press the menu button on the remote control, then select CEC remote control and press the confirmation button



3) Then select "On" to open the HDMI CEC remote control



4) At this point, you can control the Android Box system of the development board through the remote control of the TV

9. How to compile Android 12 source code

9.1. Download the source code of Android 12

1) First download the Android 12 source code sub-volume compressed package from Google Drive

			全部下截
所有者	上次修改日期	文件大小	
	2022年12月6日	432 个字节	
	2022年12月6日	4 GB	
	2022年12月6日	4 G8	
	所有者	2022#12月4日 2022#12月4日 2022#12月4日 2022#12月4日 2022#12月4日 2022#12月4日 2022#12月4日 2022#12月4日	2022年12月6日 412 个学节 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408 2022年12月6日 408

2) After downloading the sub-volume compression package of the Android 12 source code, please check whether the MD5 checksum is correct, if not, please download the source code again

test@test:~\$ md5sum -c Android_12.tar.gz.md5sum Android_12.tar.gz00: OK Android_12.tar.gz01: OK Android_12.tar.gz02: OK Android_12.tar.gz03: OK Android_12.tar.gz04: OK Android_12.tar.gz05: OK Android_12.tar.gz06: OK Android_12.tar.gz07: OK

3) Then you need to merge multiple compressed files into one, and then decompress

test@test:~\$ cat Android_12.tar.gz0* > Android_12.tar.gz test@test:~\$ tar -xvf Android 12.tar.gz

9.2. Compile the source code of Android 12

1) First install the software packages required to compile the Android12 source code test@test:~\$ sudo apt-get update test@test:~\$ sudo apt-get install -y git gnupg flex bison gperf build-essential \ zip curl zlib1g-dev gcc-multilib g++-multilib libc6-dev-i386 \ lib32ncurses5-dev x11proto-core-dev libx11-dev lib32z1-dev ccache \ libg11-mesa-dev libxml2-utils xsltproc unzip test@test:~\$ sudo apt-get install -y u-boot-tools

2) There is a build.sh compilation script in the source code, and the compilation parameters are as follows

- c. -U: compile uboot
- d. -K: compile kernel
- e. -A: compile android
- f. -u: Package and generate update.img and update_spi_nvme.img
- g. -o: Compile the OTA package
- h. -d: specify kernel dts

3) Compile uboot, kernel, android and package them into update.img

a. The command to compile and support HDMI 8K display mirroring (LCD off by default) is as follows:

test@test:~\$ cd Android_12 test@test:~/ Android_12\$ source build/envsetup.sh

test@test:~/ Android_12\$ lunch rk3588s_s-userdebug test@test:~/ Android_12\$./build.sh -AUKu

b. The command to compile and support LCD display image is as follows:

test@test:~\$ cd Android_12

test@test:~/ Android_12\$ export DUAL_LCD=true

test@test:~/ Android_12\$ source build/envsetup.sh

test@test:~/ Android_12\$ lunch rk3588s_s-userdebug

test@test:~/ Android_12\$./build.sh -AUKu

c. The command to compile and support sata boot image is as follows:

test@test:~\$ cd Android_12

test@test:~/ Android_12\$ export BOOT_DEVICE=spi-sata

test@test:~/ Android_12\$ source build/envsetup.sh

test@test:~/ Android_12\$ lunch rk3588s_s-userdebug

test@test:~/ Android_12\$./build.sh -AUKu

4) After the compilation is complete, the following information will be printed

********rkImageMaker ver 2.1*******

Generating new image, please wait...

Writing head info...

Writing boot file...

Writing firmware...

Generating MD5 data...

MD5 data generated successfully!

New image generated successfully!

Making update.img OK.

Make update image ok!

5) The final image file will be placed in the **rockdev/Image-rk3588s_s** directory. Among them, **update.img** is the TF card boot image, **update_spi_nvme.img** is the NVME SSD boot image

test@test:~/Android_12\$ cd rockdev/Image-rk3588s_s

test@test:~/Android_12/rockdev/Image-rk3588s_s \$ ls update*

update.img update_spi_nvme.img

6) If you are compiling an image that supports sata startup, the image name is **update_spi_sata.img**

test@test:~/Android_12\$ cd rockdev/Image-rk3588s_s test@test:~/Android_12/rockdev/Image-rk3588s_s \$ ls update* update_spi_sata.img

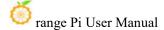
10. OpenWRT system instructions

10.1. OpenWRT version

OpenWRT version	kernel version
v22.03.4	Linux5.10.110

10.2. OpenWRT Adaptation

Function	OpenWRT
USB2.0x2	ОК
USB3.0x1	ОК
USB Type-C 3.0	ОК
3pin debugging serial port	ОК
TF card start	ОК
Gigabit Ethernet port	ОК
Network port status light	ОК
LED light	ОК
USB to wired network port	ОК
RTL8821CU USB network card	ОК
RTL8723BU USB network card	ОК
RTL8811 USB network card	ОК



M.2 NVMe SSD boot	ОК
M.2 SATA SSD boot	ОК
AP6275P-WIFI	NO

10. 3. Expand the rootfs in the TF card before the first startup

1) When the TF card starts the OpenWRT system for the first time, the **resize-rootfs.sh** script will be executed to expand the rootfs, and it will automatically restart after the expansion is completed

2) After logging in to the system, you can use the df -h command to view the size of rootfs. If it is consistent with the actual capacity of the TF card, it means that the automatic expansion is running correctly

root@OpenWrt:~# df -h			
Filesystem	Size	Used Avai	lable Use% Mounted on
/dev/root	14.8G	14.7G	91.6M 99% /
tmpfs	495.5M	6.1M	489.4M 1% /tmp
tmpfs	512.0K	0	512.0K 0% /dev
/dev/root	14.8G	14.7G	91.6M 99% /opt/docker

10. 4. How to log in to the system

10. 4. 1. Login via serial port

1) First, to use the debugging serial port, please refer to the chapter on how to use the debugging serial port

2) The OpenWrt system will automatically log in as the **root** user by default, and the display interface is as follows



10. 4. 2. Log in to the system via SSH

Please note that in the OpenWrt system of Orange Pi 5, the network port is configured as a LAN port by default, so the LAN port of the development board needs to be directly connected to the network port of the computer. If it is connected to a router, there is no way to obtain the IP.

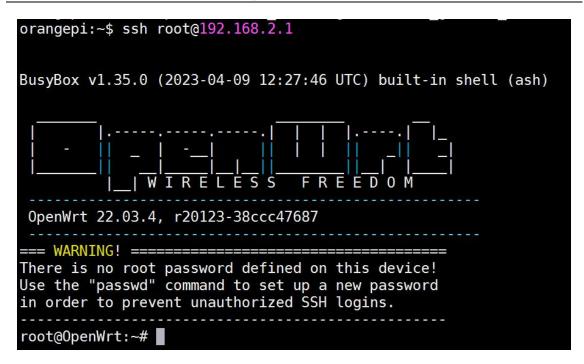
1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) If the computer is installed with an Ubuntu system, you can execute the following command to log in to the system through SSH. By default, you can log in directly without a password

test@ubuntu:~\$ ssh root@192.168.2.1

4) After successfully logging in to the system, the display is as shown in the figure below



5) If the computer is installed with Windows system, you can log in by referring to the method of SSH remote login to the development board under Windows in the Linux system instruction manual

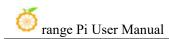
10. 4. 3. Log in to the LuCI management interface

Please note that in the OpenWrt system of Orange Pi 5, the network port is configured as a LAN port by default, so the LAN port of the development board needs to be directly connected to the network port of the computer. If it is connected to a router, there is no way to obtain the IP.

1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) Enter the IP address **192.168.2.1** in the browser on the computer to log in to the LuCI interface



$\leftarrow \ \rightarrow \ G$	🔘 🔀 192.168.2.1/cgi-bin/luci/				☆
		需要授权			
			root]	
		密码			
			登录		
			шт		

4) The OpenWrt system does not set a password by default, so just click the **login** button. After successful login, the interface is displayed as shown in the figure below

OpenWrt 状态 - 系统 -	Docker → 服务 → 网络 → 统计 → 退出	刷新
未设置密码! 尚未设置密码。请为 root 用户设置图	密码以保护主机并启用。	
状态 ^{系统}		
主机名	OpenWrt	
型号	Orange Pi 5	
架构	ARMv8 Processor rev 0	
目标平台	rockchip/armv8	
固件版本	OpenWrt 22.03.4 r20123-38ccc47687 / LuCl openwrt-22.03 branch git-23.093.57104-ce20b4a	
内核版本	5.10.110	
本地时间	2023-04-09 13:00:33	
运行时间	0h 32m 39s	
平均负载	0.01, 0.00, 0.00	
内存		
可用数	15.06 GiB / 15.36 GiB (98%)	

10. 4. 4. Log in to the terminal through the LuCI management interface

Please note that in the OpenWrt system of Orange Pi 5, the network port is configured as a LAN port by default, so the LAN port of the development board needs to be directly connected to the network port of the computer. If it is connected to a router, there is no way to obtain the IP.

1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) Enter the IP address **192.168.2.1** in the browser on the computer to log in to the LuCI interface

$\leftarrow \ \rightarrow \ G$	🛇 웥 192.168.2.1/cgi-bin/luci/		☆
		需要授权	
		用户名 root	
		密码	
		登录	

4) Select "Terminal" in the "Service" column of the navigation bar and click to enter

OpenWrt 状态 - 系统 - Docker	r → 服务 → 网络 → 统计 → 退出
未设置密码! 尚未设置密码。请为 root 用户设置密码以保护	Aria2 动态 DNS 户主社
状态 系统	带宽监控 Watchcat 网络共享
主机名	Transmission
型룩	<mark>终端</mark> 递归 DNS
架构	ARIVIVO Processor rev 0

5) At this time, the terminal interface is as shown in the figure below

orange Pi User Manual

 OpenWrt 状态。系统。 Docker。 服务。 网络。 统计。 退出

 未设置密码: 端未设置密码, 请为 root 用户设置密码以保护主机并启用。

 珍酒 配置

 OpenWrt login:

6) Enter the user name root to log in

终端 配置	
OpenWrt login: root	*
BusyBox v1.35.0 (2023-04-09 12:27:46 UTC) built-in shell (ash)	
OpenWirt 22.03.4, r20123-38ccc47687	
WARNING!	
root@OpenWrt:~#	
	-

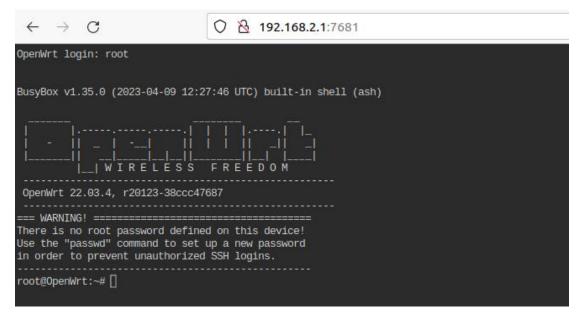
10. 4. 5. Use IP address + port number to log in to the terminal

Please note that in the OpenWrt system of Orange Pi 5, the network port is configured as the LAN function by default, so the network port of the development board cannot be directly connected to the router through a network cable, but can only be directly connected to the network port of the computer through a network cable. At this time, the system starts Afterwards, an IP address will be assigned to the network port of the computer through the DHCP service.

1) First connect the LAN port of the board to the network port of the computer with a network cable, so that the network port of the computer can obtain an IP address through DHCP

2) The LAN port IP of the default board is set to **192.168.2.1**, so the computer can obtain the IP address starting with **192.168.2** at this time

3) Then enter **192.168.2.1:7681** in the browser to log in to the OpenWRT terminal



10. 5. How to modify the IP address of the LAN port through the command line

1) In the OpenWrt system, a command line tool uci is provided, which can easily modify, add, delete and read the content in the configuration file. For details, please refer to the

official document

2) First use the following command to obtain the network configuration, the corresponding configuration file is /etc/config/network, you can see that the value of

network.lan.ipaddr is 192.168.2.1

root@OpenWrt:~# uci show network ... network.lan=interface network.lan.device='br-lan' network.lan.proto='static' network.lan.ipaddr='192.168.2.1' network.lan.netmask='255.255.255.0' network.lan.ip6assign='60'

3) Then enter the following command to modify the item network.lan.ipaddr root@OpenWrt:~# uci set network.lan.ipaddr='192.168.100.1'

4) Then enter the following command to complete the submission, that is, write to the configuration file

root@OpenWrt:~# **uci commit**

If the IP address in red font is consistent with the one to be set, it means that the modification is successful

root@OpenWrt:~# cat /etc/config/network

•••

config interface 'lan'

option device 'br-lan' option proto 'static' option netmask '255.255.255.0' option ip6assign '60' **option ipaddr '192.168.100.1'**

•••

5) Restart the network through ubus, please refer to the official document for the usage

instructions of ubus

root@OpenWrt:~# ubus call network restart

6) At this point, enter the command and you can see that the IP of the LAN port is **192.168.100.1**

root@Oj	penWrt:~# ifconfig br-lan
br-lan	Link encap:Ethernet HWaddr FE:55:13:A3:EF:E7
	inet addr: 192.168.100.1 Bcast: 192.168.100.255 Mask: 255.255.255.0
	inet6 addr: fd60:c4cd:1033::1/60 Scope:Global
	UP BROADCAST MULTICAST MTU:1500 Metric:1
	RX packets:0 errors:0 dropped:0 overruns:0 frame:0
	TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
	collisions:0 txqueuelen:1000
	RX bytes:0 (0.0 B) TX bytes:370 (370.0 B)

10.6. How to modify the root password

10. 6. 1. Modify via command line

1) First enter passwd root on the command line of the system, and the following prompt message will appear. At this time, you can enter the password you want to set, and press the Enter key to confirm

root@OpenWrt:/# **passwd root**

Enter new UNIX password:

2) Then you will be prompted to re-enter the password. At this time, enter the password again to confirm and press Enter

Retype password:

3) The display of successful modification is as follows

passwd: password for root changed by root

10. 6. 2. Modify through the LuCI management interface

1) First refer to the login LuCI management interface to enter the OpenWRT management interface

- 2) Then follow the steps below to change the password
 - a. Find the "System" option in the navigation bar and click
 - b. In the column options below the system, select "Management Rights" and click

OpenWrt 状态 -	系统 ▼ Docker ▼	服务 - 网络 - 统计 - 退出
 未设置密码! 尚未设置密码, 请为 root 状态 系统 	系统 管理权 启动项 计划任务 挂载点	я д.
主机名	时间同步	OpenWrt 2
型룩	LED 配置 备份与升级	Orange Pi 5
架构	自定义命令	ARMv8 Processor rev 0
目标平台	重启	rockchip/armv8

c. Select the "Router Password" option on the Tab page

OpenWrt 状态 - 系统 - Docker	▼ 服务 ▼ 网络 ▼ 统计 ▼	退出
未设置密码! 尚未设置密码。请为 root 用户设置密码以保护	主机并启用。	
路由器密码 SSH 访问 SSH 密钥 HTTI	'(S)访问	
路由器密码 _{更改访问设备的管理员密码}		
密码	*	
确认密码		
		保存

3) Modify and save the router password

a. Enter the password you set in the "**Password**" and "**Confirm Password**" dialog boxes (if you are not sure whether the password is entered correctly, you can click the "*" icon behind the dialog box to display the input characters)

b. Click "Save" to save the newly modified password

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OpenWrt 状态 - 系统	t → Docker → 服务 → 网络 → 统计 → 退出	
未设置密码! 尚未设置密码。请为 root 用户设	置密码以保护主机并启用。	
路由器密码 SSH 访问 SSH	密钥 HTTP(S) 访问	
路由器密码 _{更改访问设备的管理员密码} 密码	•	۵
确认密码	* ② 密码强度: 弱	
		保存

Note: In the "Password" and "Confirm Password" dialog boxes, the passwords entered twice must be consistent.

4) After the password is changed successfully, a pop-up box will pop up saying "The system password has been changed successfully". At this time, a password is required to log in to OpenWRT

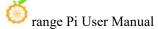
系统密码已更改成功。		关闭
未设置密码! 尚未设置密码。请为 root 用户设置密码以值	护主机并启用。	
路由器密码 SSH 访问 SSH 密钥 H	TP(S) 访问	
路由器密码 _{更改访问设备的管理员密码}		
密码		
确认密码	*	
		保存

10.7. USB interface test

10. 7. 1. Mount the USB storage device under the command line

1) First insert the U disk into the USB interface of the Orange Pi development board

2) Execute the following command, if you can see the output of sdX, it means that the U disk is recognized successfully



root@OpenW	′rt:~#	cat /	proc/partitions grep "sd*"
major minor	#blo	ocks	name
8	0	151	26528 <mark>sda</mark>

3) Use the mount command to mount the U disk to /mnt, and then you can view the files in the U disk

root@OpenWrt:~# mount /dev/sda /mnt/
root@OpenWrt:~# ls /mnt/
test.txt

4) After mounting, you can view the capacity usage and mount point of the U disk through the df -h command

root@OpenWrt:~	# df -h gr	ep "sd"			
/dev/sda	14.4G	187.2M	14.2G	1% /mnt	

10.7.2. Mount the USB storage device on the LuCI management interface

1) First connect the U disk (or other storage device) to the development board via USB2.0

2) Then follow the login LuCI management interface to enter the LuCI management interface

3) Then in the LuCI management interface, click "System -> Mount Point" to enter the configuration interface of the mount point

OpenWrt	状态 ◆ 系统 ◆ Docker ◆	服务 - 网络 - 统计 - 退出
状态 ^{系统}	系统 管理权 软件包	
主机名	启动项 计划任务	OpenWrt
型号	挂载点	Orange Pi 5
架构	时间同步 LED 配置	ARMv8 Processor rev 0
目标平台	备份与升级	rockchip/armv8
固件版本	自定义命令	OpenWrt 22.03.4 r20123-38ccc47687 / LuCl openwrt-22.03 branch git-23.093.57104-ce20b4a
内核版本		5.10.110

- 4) Then follow the steps below to add a mount point
 - a. Find "Mount Point" at the bottom of the mount point global setting interface
 - b. Under the mount point, select the "Add" button and click Enter

已启 用	设备	挂载点	文件系统	挂载选 项	文件系统 检查			
	UUID: 84173db5-fa99-e35a-95c6-28613cc79ea9 (/dev/mmcblk1p1, 64.00 MiB)	/mnt/mmcblk1p1	auto (ext4)	defaults	否	Ξ	编辑	删除
	UUID: ff313567-e9f1-5a5d-989-3ba130b4a864 (/dev/mmcblk1p2, 29.61 C =)	1	auto (ext4)	defaults	否	Ξ	编辑	删除

c. Then the following pop-up interface will pop up

挂载点 - 存储区	
常规设置 高级设置	
已启用	
UUID	根据 UUID 匹配
	❷如果指定,则通过 UUID 而不是固定的设备文件来挂载设备
卷标	根据标签匹配 *
	如果指定,则通过分区卷标而不是固定的设备文件来挂载设备
设备	未指定・
	⑦ 存储器或分区的设备文件(例如:/dev/sda1)
挂载点	- 请选择 - •
	❷ 指定设备的挂载目录
	关闭保存

- d. Then you can start to mount the storage device
 - a) Check "Enabled"

b) Select the actual connected device /dev/sda in the UUID column of general settings (choose according to your own device)

c) Select "**Custom**" in the mount point column, and fill in the target directory to be mounted. Here, take the **/mnt** directory as an example, and press **Enter** to confirm

d) Then click the "Save" button in the lower right corner



5) Then you will return to the mount point global settings page, click "Save and Apply" in the lower left corner of the page to make the mount point take effect

已启 用	设备	挂载点	文件系统	挂载选 项	文件系统 检查			
	UUID: 84173db5-fa99-e35a-95c6-28613cc79ea9 (/dev/mmcblk1p1, 64.00 MiB)	/mnt/mmcblk1p1	auto (ext4)	defaults	否	Ξ	编辑	#
	UUID: ff313567-e9f1-5a5d-9895-3ba130b4a864 (/dev/mmcblk1p2, 29.61 GiB)	I	auto (ext4)	defaults	否	≡	编辑	H
		/mnt	auto	defaults	否	(-	1010	
✓ 添加 交换分	<u> </u>		(vfat)				编辑	
∑ 漆换分	1 下 四 四 四 四 四 四 四 四 四 四 四 四 四							
添加 交換分 如果物理	1 下 四 四 四 四 四 四 四 四 四 四 四 四 四							

6) After saving, you can see the "mounted file system", the storage device has been mounted successfully

2	
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文件系统	挂载点	可用	已使用	卸载分区
/dev/root	1	28.93 GiB / 29.25 GiB	1.04% (310.21 MiB)	-
tmpfs	/tmp	7.67 GiB / 7.68 GiB	0.06% (4.69 MiB)	-
tmpfs	/dev	512.00 KiB / 512.00 KiB	0.00% (0 B)	÷.
/dev/root	/opt/docker	28.93 GiB / 29.25 GiB	1.04% (310.21 MiB)	卸载分区
/dev/sda	/mnt	59.46 GiB / 59.46 GiB	0.00% (640.00 KiB)	卸载分区

配置存储设备挂载到文件系统中的位置和参数

10.8. USB to network port test

1) The usable USB port that has been tested so far is as follows

Chip model	VID&PID
RTL8153 (Gigabit)	0bda:8153
RTL8152 (100M)	0bda:8152

2) First insert the USB to network port module into the USB interface of the development board, and then power on and start the development board

3) Then enter the LuCI management interface according to the method of logging in to the LuCI management interface, and then click "Network -> Interface" to enter the wired network configuration interface

OpenWrt 状态 → 系统 → Docker → 服务 →	网络→ 统计 → 退出	刷新
未设置密码! 尚未设置密码。请为 root 用户设置密码以保护主机并启用。	接口 无线 踏由	
状态 ^{系统}	DHCP/DNS 网络诊断 防火墙	
主机名 Ope	MultiWAN 管理器	
型룩 Orar	服务质量(QoS)	
架构 ARM	liv8 Processor rev 0	

4) If you can see the "eth1" device as shown in the figure below in the configuration interface, it means that the USB port has been recognized. As can be seen from the figure below, "eth1" is configured as a WAN port by default

	密码以保护主机并启用。	
(1001/1) (KE		
设备 全局网络选项		
	协议: 不配署协议	
docker	MAC: 02:42:0B:F4:43:A6	
50	接收:0B(0Pkts.)	重启 停止 编辑 删除
docker0	发送: 0 B (0 Pkts.)	
	信息:开机时不启动	
	协议:静态地址	
	运行时间: Oh 4m 5s	
lan	MAC: 5A:5A:59:B7:EB:2E	
(هِ) ه	接收: 1.61 MB (9426 Pkts.)	重启停止编辑删除
br-lan	发送: 4.43 MB (8834 Pkts.)	
	IPv4: 192.168.2.1/24	
	IPv6: fd8a:b994:72fb::1/60	
	协议: DHCP 客户端	
wan	运行时间: Oh 4m 1s	
2	MAC: 00:E0:4C:68:69:5B	重启 停止 编辑 删除
eth1	接收: 5.03 MB (15593 Pkts.) 发送: 1.18 MB (7236 Pkts.)	
	IPv4: 192.168.1.121/24	
	11-14, 132,100,1,12,1/24	
	协议: DHCPv6 客户端	
wan6	运行时间: Oh 3m 57s	
2	MAC: 00:E0:4C:68:69:5B	重启停止编辑删除
eth1	接收: 5.03 MB (15593 Pkts.)	

5) At this time, after the USB port is connected to the main router through the network cable, the IP address can be obtained automatically through DHCP, and then the development board and the computer connected to the LAN port of the development board can be connected to the Internet through the main router.

10. 9. USB wireless network card test

The usable USB wireless network cards that **have been tested** so far are as follows. Please test other types of USB wireless network cards by yourself. If they cannot be used, you need to transplant the corresponding USB wireless network card driver.

serial number	model	
1	RTL8723BU	
	Support 2.4G WIFI	



2	RTL8811 Support 2.4G +5G WIFI	CHIS CONSTRUCTIONS
3	RTL8821CU Support 2.4G +5G WIFI	OR BE.

10. 9. 1. How to create a WIFI hotspot using a USB wireless network card

Note that the hotspot function is not supported on the RTL8723BU hardware, while the RTL8821CU and RTL8811 support the hotspot function.

1) Insert the USB wireless network card into the USB port of the development board, and then connect the power supply to the development board

2) After the system startup is complete, click "Network > Wireless" to enter the wireless WiFi configuration interface

192.168.2.1/cgi-bin/luci/		
OpenWrt 状态 -	系统 + Docker + 服务 + 网络 + 统计 + 退出	1885
未设置密码! 尚未设置密码,请为 root	接口 用户设置密码以保护主机并启用。	
状态系统	DHCP/DNS 网络诊断 防火塔	
主机名	Oper MultiWAN 管理器	
型룩	Oran 服务质量(QoS)	
架构	ARMv8 Processor rev 0	
目标平台	rockchip/armv8	

3) The default wireless configuration of the OpenWRT system is the Master mode, here directly click "Enable"

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已连接站点 网络 MAC 地址 主机 信号/噪声 近可用信息	OpenWrt	状态 - 系统	5 - Docker - 服务 - 网络 -	统计 - 退出		刷新
※ radio0 Generic MAC80211 802.11acbgn 设备未激活 重启 扫描 添加			置密码以保护主机并启用。			
で radio <i>设备未激活</i> 重点 11曲 // 200 <i>砂白栗用</i> SSID: OpenWit 模式: Master <i>元就未开启</i> 扁用 // 梁邦 // 後 / 後 後 後 ご连接站点 紅瓜 直 用 接 後 後 後 後 後 後 後 後 後 後 後 後 後 後 後 後 後 後 後	无线概况					
通用 振田 ご注接站点 网络 MAC 地址 主机 信号/噪声 按收速率/发送速率 元可用信息	2	radio0		bgn		重启日描添加
网络 MAC 地址 主机 信号/噪声 接收速率/发送速率 无可用信息		,已禁用				启用 编辑 移除
无可用信息	已连接站点	<u>ا</u>				
	网络	MAC 地址	主机	信号/噪声	接收速率/发送速率	
				无可用信息		
保存并应用 • 保存 复位					保存并	应用 保存 复位

4) The display interface of successfully creating a hotspot is shown in the figure below

OpenWr	は 状态 - 系統	- Docker - 服务 - 网络 -	统计 - 退出		刷新
未设置密码 尚未设置密码		置密码以保护主机并启用。			
无线概况					
9	👷 radio0	Generic MAC80211 802.1 信道: 36 (5.180 GHz) 速率: ? M		重启	扫描添加
al.	dBm	SSID: OpenWrt 模式: Master BSSID: 1C:BF:CE:D9:D2:60 加	密: None	禁用	编辑 移除
已连接站,	ц.				
网络	MAC 地址	主机	信号/噪声	接收速率/发送速率	
			无可用信息		
				保存并应用 🔻	保存 复位

5) Then use the mobile phone or computer to search for the WiFi corresponding to the SSID to connect. After the connection is successful, as shown in the figure below



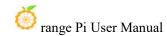
6) If you need to set a password for the created hotspot, click the "Edit" button below

未设置密码 尚未设置密码		置密码以保护主机并启用。			
无线概况					
	👰 radio0	Generic MAC80211 802.11 信道: 36 (5.180 GHz) 速率: ? M			重启 扫描 添加
d	📗 dBm	SSID: OpenWrt 模式: Master BSSID: 1C:BF:CE:D9:D2:60 加	密: None		禁用编辑移除
已连接站	<u>ل</u>				/
网络	MAC 地址	主机	信号噪声	接收速率/发送速率	
			无可用信息		
				保存并应	用「保存」复位

7) Then click the drop-down box in the "Wireless Security" column and select the "WPA2-PSK" encryption method

0	
无线网络: 主设备 "OpenW 设备配置	rt" (wlan0)
常规设置高级设置	
状态	模式: Master SSID: OpenWrt dBm BSSID: 1C:BF:CE:D9:D2:60 加密: None 信道: 36 (5.180 GHz) 传输功率: 20 dBm 信号: 0 dBm 噪声: 0 dBm 速率: 0.0 Mbit/s 国家: 00
无线网络已启用	禁用
工作频率	模式 信道 带宽 AC V 36 (5180 Mhz) V 80 MHz V
最大传输功率	驱动默认 🖌 - 当前功率: 20 dBm
接口配置 常规设置 无线安全 MAC 远	 ● 指定最大发射功率。依据监管要求和使用情况,驱动程序可能将实际为射功率限定在此值以下。 1. 减 高级设置 WLAN 漫游
加密	无加密 (开放网络) VWPA2-PSK (强安全性)
	WPA2-EAP (强安全性) WPA-PSK/WPA2-PSK Mixed Mode (中等安全性) WPA-EAP (中等安全性) WPA-PSK (弱安全性) 无加密 (开放网络)

8) Then enter the password you want to set in the "Key" column, and then click the "Save" button



1.4	
接口	配直

꼬니바르	1									
常规设置	无线安全	MAC 过滤	高级设置	WLAN 漫游				/		
		加密	WPA2-PSK (强安全性)	~		/	0		
		算法	自动		~					
		密钥	••••••		*					
8	302.11w 管理		已禁用 2 注意 : 有些	无线驱动程序不完	✓ 全支持 802.1	11w。例如:r	nwlwifi 可能会有	一些问题		
启用密钥重	翻安装(KF	对策		于安装密钥的 EAF 性问题,并降低密					R度。此解决方法可f	能会
	—键加密按钮 (2)-PSK/WP/							0		
									关闭 保	碑

9) Then click "Save and Apply" on the main interface of wireless settings

无线概况				
👳 radio0		A C80211 802.11acbgn 0 GHz) 速率: 175.5 Mbit/s		重启 扫描 添加
🚄 -42 dBm	SSID: OpenW 接口有 2 个未/	it 模式: Master 应用的更改		禁用编辑移除
▲ -42 dBm 已连接站点			信号候声	禁用 編輯 移除

10) After the setting takes effect, you can see that the WiFi hotspot has been encrypted

送概况				
👳 radio0	Generic MAC8021 信道: 36 (5.180 GHz)			重启 扫描 添加
-32 dBm	SSID: OpenWrt 模式: BSSID: 1C:BF:CE:D9:	Master D2:60 [<mark>加密:</mark> WPA2 PSK (CO	CMP)	禁用 编辑 移除
3连接站点	MAC 地址	主机	信号/噪声	接收速率/发送速率
				24.0 Mbit/s, 20 MHz

10. 9. 2. How to use USB wireless network card to connect to WIFI hotspot

1) Insert the USB wireless network card into the USB port of the development board, and then connect the power supply to the development board

2) After the system startup is complete, click "Network > Wireless" to enter the configuration wireless WiFi interface

192.168.2.1/cgi-bin/luci/	
OpenWrt 状态→ 系統→	- Docker - 服务 - 网络 - 統计 - 退出
未设置密码! 尚未设置密码。诸为 root 用户设置图	按口 密码以保护主机并启用。 路由
状态系统	DHCP/DNS 网络诊断 防火墙
主机名	Oper MultiWAN 管理器
型특	Oran 服务质量(QoS)
架构	ARMv8 Processor rev 0
目标平台	rockchip/armv8

3) First, you need to remove the default wireless configuration, click the **"Remove"** button as shown in the figure below

OpenWrt	状态 ▼ 系统 ▼ Dock	er + 服务 + 网络·	- 统计 - 退出		RIST
未设置密码! 尚未设置密码。;	青为 root 用户设置密码以保	护主机并启用。			
无线概况					
👳 radio		C80211 802.11acb) GHz) 速率: ? Mbit/s	gn		重启 扫描 添加
(a) dB		t 模式: Master CE:D9:D2:60 加密: W	/PA2 PSK (CCMP)		禁用编辑移除
已连接站点					
网络	MAC 地址	主机	信号/噪声	接收速率//	台送使率

4) Then click the "Scan" button to scan the surrounding WiFi hotspots

未设置密 尚未设置密		设置密码以保护主机并启用。			
无线概况					
2	vradio0	Generic MAC80211 802.1 信道: ? (? GHz) 速率: ? Mbit/s			重启扫描添加
已连接站。	点				1
网络	MAC 地址	主机	信号/噪声	接收速率/发送速率	
			无可用信息	j.	
				保存并	1 拉用 ・ 保存 复位

5) Then the following window will pop up to display available WiFi hotspots, click the "Join Network" button on the right side of the WiFi hotspot you want to connect to

加入网络:搜索无线						
信号	SSID	信道	模式	BSSID	加密	*
📶 -58 dBm		48	Master	E8:9F:80:DF:4F:3F	WPA2 PSK (CCMP)	加入网络
📶 -59 dBm		153	Master	E8:9F:80:DF:4F:40	WPA2 PSK (CCMP)	加入网络
-60 dBm		149	Master	A0:40:A0:A1:72:31	WPA2 PSK (CCMP)	加入网络
🚽 -67 dBm	112102-001-0012	60	Master	50:6A:03:AB:90:1A	WPA2 PSK (CCMP)	加入网络

6) Then enter the password in the position shown in the figure below, and then click "Submit"

🍏 _{range} I	Pi User Manual	Copyright reserved by Sh	enzhen Xunlong Software Co., Ltd
正在加入网络:"xunlong_	_orangepi_5G"		
重置无线能置			
	◎ 选中此选项以从无线中删除现有网络。	•	
新网络的名称	wwan	~	
WPA 密相			0
100.000	 ▲ ● ④ 在此指定密钥。 		
锁定到 BSSID			
	❷ 仅连接到 BSSID 为 E8:9F:80:DF:4F:40 的网络,而不是損	云 SSID 相叫的网络。	
创建/分配防火墙区域	wan wan: 🛃 wan6: 🛃 🔹		
	为此接口分配所属的防火墙区域,选择未指定可将该接口移出	已关联的区域,或者填写创建栏来创建一个新的区域,并将当前接口与之建立关联。	
			戰消

7) Then the following interface will pop up, just click Save

无线网络: 客户端 "xunlong	_orangepi_5G" (radio0.netwo	vrk1)
设备配置		
常规设置 高级设置		
状态	/// 模式: Client SSID: xunlong_ dBm 无能未关联	_orangep5G
无线网络已启用	禁用	
工作频率	模式 信道 帝 AC V 36 (5180 Mhz) V 8	
最大传输功率	驱动默认 🗸 - 当前功率: 井	
	指定最大发射功率。依据监管要求和	和使用情况,驱动程序可能将实际发射功率限步在创催以下。
接口配置		
常规设置 无线安全 高级设置	E WLAN 還游	
模式	春戸誘・	
ESSID	xunlong_orangepi_5G	
BSSID		
网络	wwan: 🏦	
	②选择指派到此无线接口的网络,或者	4項写创建栏来新建网络。
		关闭 《27

8) Finally, you will return to the main interface of wireless configuration, click "Save and Apply"

未设置密		设置密码以保护主机并启用。			
无线概况					
	vradio0	Generic MAC80211 802. 信道: ? (? GHz) 速率: ? Mbit/s			重启 扫描 添加
ali	。 已禁用	SSID: xunlong_orangepi_5G i 接口有 7 个未应用的更改	模式: Client		禁用编辑移除
已连接站	点				
已连接站 ^{网络}	点 MAC 地址	主机	信号喉声	接收速率/发送速率	
		主机	信号噪声 无可用信息	接收速率/发送速率	

9) After successfully connecting to the WiFi hotspot, the interface is displayed as shown in the figure below

线概况					
👳 radio0	Generic MAC80 信道: 48 (5.240 GH;				重启 扫描 添加
📶 -60 dBm	SSID: xunlong_orar BSSID: 1C:BF:CE:I				禁用 编辑 移除
连接站点					
网络	MAC	地址	主机	信号/噪声	接收速率/发送速率

10. 10. Installing packages via the command line

10. 10. 1. Install via opkg in terminal

1) Update the list of available packages

root@OpenWrt:/# **opkg update**

2) Get the software list

root@OpenWrt:/# opkg list

3) Install the specified package

root@OpenWrt:/# opkg install <package name>

4) Check the installed software

root@OpenWrt:/# opkg list-installed

5) Uninstall the software

root@OpenWrt:/# opkg remove <package name>

10.11. OpenWRT management interface installation software package

If you need to add new software packages, you can install them through the OpenWRT management interface

10. 11. 1. View the list of available software packages in the system

1) First enter the package management page

a. Find the "System" option in the navigation bar and click to enter

b. In the vertical column options below the system, select "software package" and click to enter

OpenWrt 状态 -	系统 ▼ Docker ▼ 服	務 → 网络 → 统计 → 退出
未设置密码! 尚未设置密码。词为 root	系统 管理权 软件包	■ Ħ.
状态 系统	启动项 计划任务 挂载点	
主机名	时间同步	OpenWrt
型号	LED 配置 备份与升级	Orange Pi 5
架构	自定义命令	ARMv8 Processor rev 0
目标平台	重启	rockchip/armv8

2) Then the main page of the software package will appear, as shown in the figure below, to obtain the list of available software

a. In the **"Operation"** option of the software package, click **"Update List"** to get the list of available software packages

b. On the Tab page, click "Available" to view the currently available software packages

c. View the number of currently available packages

软件包

帝选器:		下载并安装软件包		操作:		
输入以筛选	清除	软件包名称或 UR	L 确认	更新列表	上传软件包	配置 opkg
 ● 已过滤 ○ 全音 	图 ① 元 2	3	- 1			
可用日安装	更新 《		正在显示 1-100 , 共 71	74		>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
可用 已安装 !!	更新 《 版本	大小 (.ipk)	正在显示 1-100 , 共 71 描述	74		>

10. 11. 2. Example of installing software packages

- 1) Take the installation package "luci-app-acl" as an example
- a. In the OpenWRT software package management interface, click the filter dialog

box and enter"luci-app-acl"

b. In the list of software packages, you can see the version, package size and description information of the "**luci-app-acl**" software package, and then click the **"Install"** button

2闲空间: 18% (28.94 GiB)						
÷洗器· luci-app-acl	清除	下载并安装软件包: 软件包名称或 URL	确认	操作: 更新列表	上传软件包	配置 opkg
示 LuCI 翻译包:)已过滤 ① 全部						
可用已安装更新	Т					
	ĸ		正在显示 1-3, 共3			ъ
软件包名称	« 版本	大小 (.ipk)	正在显示 1-3,共3 描述			*
软件包名称 luci-app-acl				agement module		》
	版本	06c 4.14 KiB	描述			

c. Then the following pop-up window will appear, click "Install"



d. Then wait for the installation to complete



e. The display after the installation is complete is as follows

正在执行软件包管理器

```
Installing luci-i18n-acl-en (git-23.090.61754-f7f34d4) to root...
Downloading
https://downloads.openwrt.org/releases/22.03.4/packages/aarch64 generic/luci/
luci-i18n-acl-en_git-23.090.61754-f7f34d4_all.ipk
Installing luci-app-acl (git-21.194.67617-f74b06c) to root ...
Downloading
https://downloads.openwrt.org/releases/22.03.4/packages/aarch64_generic/luci/
luci-app-acl_git-21.194.67617-f74b06c_all.ipk
Installing luci-i18n-acl-zh-cn (git-23.090.61754-f7f34d4) to root...
Downloading
https://downloads.openwrt.org/releases/22.03.4/packages/aarch64_generic/luci/
luci-i18n-acl-zh-cn_git-23.090.61754-f7f34d4_all.ipk
Package luci-app-acl (git-21.194.67617-f74b06c) installed in root is up to
date.
Configuring luci-app-acl.
Configuring luci-i18n-acl-zh-cn.
Configuring luci-i18n-acl-en.
```

2) Check whether the software package is installed successfully

a. In the OpenWRT software package management interface, click the filter dialog box and enter "**luci-app-acl**"

b. Select and click "Available" on the Tab page

c. The "**luci-app-acl**" package will be displayed in the package list, and the update status will be "**installed**"

关闭

软件包

		95	% (7.4 GB)	
筛选器:		下载并安装软件包	操作:	
luci-app-acl	清除	软件包名称或 URL	确认更新列	则表 上传软件包 配置 opkg
可用已安装	更新	- 0		
2112				
0	«.	正在显	示1-36,共36	2
2 软件包名称	《 版本	正在5 大小(.ipk) 描述	示 1-36,共 36	3

10. 11. 3. Remove package example

- 1) Take the removal of the package "luci-app-acl" as an example
- a. In the OpenWRT software package management interface, click the filter dialog box and enter "luci-app-acl"
- b. Select "Installed" on the Tab page to display the list of installed software packages
- c. Click "Remove" on the right to remove the corresponding software package

			95% (7.4 GB)			
範先器:		下载并安装软件包:		操作:		
uci-app-acl	清除	软件包名称或 URL	确认	更新列表	上传软件包	配置 opkg
可用 已安装	更新	0				
	更新 2 «	0	正在显示 1-1 , 共 1			»
数件包名称			正在显示 1-1,共 1 (.ipk) 描	R.	8	3

a. Then the following pop-up window will be displayed, click "Remove"

移除软件包 luci-app-acl

```
版本: git-21.194.67638-1d6053e
大小: ~3.4 KB 已安装
```

描述

++ /1+

LuCI account management module

✔ 自动移除未使用的依赖



b. After the removal is successful, the display interface is as follows

正在执行软件包管理器	
Removing package luci-app-acl from root	
	关闭
	710

2) Check whether the software package is removed successfully

a. In the OpenWRT software package management interface, click the filter dialog box and enter "luci-app-acl"

b. Select and click "Installed" on the Tab page

c. The "luci-app-acl" package will not be displayed in the package list, and the "luci-app-acl" package has been removed successfully

软件包	软	件	包
-----	---	---	---

院洗器 :		下载并安装软件包:		操作:		
luci-app-acl	清除	软件包名称或 URL	确认	更新列表	上传软件包	配置 opkg
可用已安装更新						
«		ž	没有软件包			20
软件包名称		版本	*	.ipk)	描述	

10. 12. Using Samba Network Shares

There are mainly two software options for OpenWRT LAN file sharing, Samba and NFS. The compatibility of the Samba system is better, while the performance of NFS is superior. For users who need to use Windows devices, it is recommended to choose Samba.

1) Enter the management page of the Samba network share

- a. Find the "Service" option in the navigation bar and click to enter
- b. In the vertical column options below the service, select "network sharing" and

click to enter

OpenWrt 状态 - 系统 - Docker -	服务→网络→ 统计→ 退出
未设置密码! 尚未设置密码。请为 root 用户设置密码以代护主	
状态)音任戦 帯宽监控 Watchcat 网络共享
主机名	Transmission
型룩	终端 递归 DNS
架构	ARWVO Processor rev 0

2) Select the interface that the Samba service needs to monitor

a. Select "General Settings" in the navigation bar of network sharing and click to enter

b. The interface is specified according to actual needs. If you want to access through the "wan port", set it to "wan"

网络共享	
Samba Version 4.14.7	
常规设置 编辑模板	
接口	未間定
工作组	docker: 50
描述	wan6: 🖉
启用扩展调整	□ - 自定义
强制同步 I/O	 ☑ ② 在低端设备上,可以通过强制使用同步/0而不是默认的异步来提高速度。

3) Set the shared directory of the network share

a. In the "Shared Directory" of the "General Settings" of the network share, click

"Add" the shared directory address

- b. Enter the name of the shared folder as "mmt" under the name
- c. Under the path of the shared directory, choose to set the shared directory location "/mnt"
- d. Check "Browseable" and "Run anonymous user"
- e. Click "Save and Apply" to save the configuration

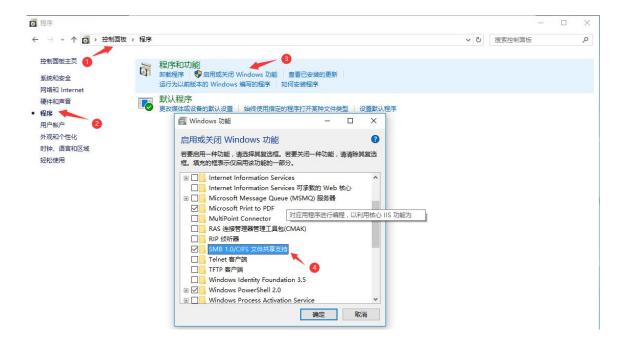
www.orangepi.org

名称 Enter	路径→ the nam	览			^{允许用} folder hared c	允许 匿名 用户	仅来宾用 ()	继承所有者	创建权 限掩码	目录权 限掩码	VFS 对象	Apple Time- machine 共享	Time- machine 大 小(GB)	
mmt	/mnt		0	0				0	0777	0777				删除
新增									4. Click	"Save a	and App	ly" to save	e the config	uratio

4) window10 starts network discovery and sharing

Note: To access Samba under the Windows 10 system, you need to confirm whether Windows 10 has enabled network discovery and sharing for sharing. If it is not enabled, perform the following settings first.

- a. Enable Samba v1/v2 access
 - a) Enter the "Control Panel" of Windows 10
 - b) Click "Programs" on the left navigation bar of the control panel
 - c) Select "Turn Windows features on or off" in Programs and Features
 - d) Check "SMB 1.0/CIFS file sharing support" in the pop-up box of enabling or disabling Windows functions
 - e) Click "OK" to configure the application



- b. Turn on the network discovery of Windows 10
 - a) Enter the "Control Panel" of Windows 10
 - b) Select "Network and Internet" in the Control Panel
 - c) Then open "Network and Sharing Center"
 - d) Click | "Advanced Sharing Settings"
 - e) Turn on "Enable Network Discovery" and "Enable File and Printer Sharing"
 - f) Click "Save Changes" to save the Windows 10 network discovery configuration

•4 高级共享设置			- [×
← → → ↑ •4 > 控制面板 > 网络和 Internet > 网络和共享中心 > 高级共享设置	ڻ ~	搜索控制面板		3	p
针对不同的网络配置文件更改共享选项 Windows 为你所使用的每个网络创建单独的网络配置文件、你可以针对每个配置文件选择特定的选项。 专用(当前配置文件) 网络发现 如果已启用网络发现,则这台计算机可以发现网络上的其他计算机和设备,而且其他网络计算机也可以发现运台计算机。 ● 启用网络发现 ② 启用网络发现 ③ 合用网络发现。 ○ 关闭网络发现。					^
文件和打印机共享 启用文件和打印机共享时,网络上的用户可以访问通过此计算机共享的文件和打印机。					
▲理相建度 通常,Windows 管理与其他家庭组计算机的连接。但是,如果你在所有计算机上拥有相同的用户帐 户和密码,则可以让家庭组改用你的帐户。 ● 允许 Windows 管理家庭组连接(维存) ● 使用用户帐户和密码连接到其他计算机 来真或公用					
♥保存更改 取消					

5) After the setting is completed, enter \\OpenWrt in the address bar of the resource manager to access the shared directory, the user name is root, and the password is the password set by the development board host

OneDrive System Volume Information 2020/9/7 18:26 文件夹 wiringOP 2020/11/28 5:12 文件夹	个 🚽 > 网络	络 > OpenWrt > mmt			
OneUnive wiringOP 2020/11/28 5:12 文件夹 WPS网盘 audio.wav 2020/8/17 18:10 WAV 文件 1,936 KB 此电脑 openwrt-sunxi-cortexa7-sun8i-h2-plu 2019/1/9 9:14 MD5SUM 文件 1 KB 视频 orangepi.txt 2020/9/25 17:29 文本文档 1 KB 図片 usbcamera.apk 2020/11/13 21:55 APK 文件 20,451 KB 文档 下载 APK 文件 20,451 KB 桌面 本地磁盘 (C:) temp (\\vboxsrv))	★ 快速访问		修改日期	类型	大小
WPS网盘 wiringOP 2020/11/28 5:12 文件夹 山地电脑 audio.wav 2020/8/17 18:10 WAV 文件 1,936 KB 砂炉电脑 openwrt-sunxi-cortexa7-sun8i-h2-plu 2019/1/9 9:14 MD5SUM 文件 1 KB 砂切印 orangepi.txt 2020/9/25 17:29 文本文档 1 KB 砂方 usbcamera.apk 2020/11/13 21:55 APK 文件 20,451 KB 文档 下载		System Volume Information	2020/9/7 18:26	文件夹	
 此电脑 openwrt-sunxi-cortexa7-sun8i-h2-plu 2019/1/9 9:14 MD5SUM 文件 1 KB orangepi.txt 2020/9/25 17:29 文本文档 1 KB usbcamera.apk 2020/11/13 21:55 APK 文件 20,451 KB 文档 下载 音乐 桌面 本地磁盘 (C:) temp (\\vboxsrv) 	Onebrive	wiringOP	2020/11/28 5:12	文件夹	
□ UEEMA □ orangepi.txt 2020/9/25 17:29 文本文档 1 KB □ usbcamera.apk 2020/11/13 21:55 APK 文件 20,451 KB □	WPS网盘	audio.wav	2020/8/17 18:10	WAV 文件	1,936 KB
 □ orangepi.txt 2020/9/25 17:29 文本文档 1 KB □ orangepi.txt 2020/1/13 21:55 APK 文件 20,451 KB □ orangepi.txt 2020/11/13 21:55 APK 文件 20,451 KB □ 文档 □ 文档 □ 文档 □ 本地磁盘 (C:) □ temp (\\vboxsrv) 	一些由际	openwrt-sunxi-cortexa7-sun8i-h2-plu	2019/1/9 9:14	MD5SUM 文件	1 KB
□ usbcamera.apk 2020/11/13 21:55 APK 文件 20,451 KB ② 文档 ↓ 下载 ↓ 音乐 ■ 桌面 ▲ 本地磁盘 (C:) ■ temp (\\vboxsrv)		orangepi.txt	2020/9/25 17:29	文本文档	1 KB
 文档 下载 音乐 真面 本地磁曲 (C:) temp (\\vboxsrv) 		📄 usbcamera.apk	2020/11/13 21:55	APK 文件	20,451 KB
下载 〕音乐 』桌面 ▲本地磁盘 (C:) temp (\\vboxsrv) ↓					
自音乐 桌面 本地磁盘 (C:) temp (\\vboxsrv)	文档				
桌面 本地磁盘 (C:) temp (\\vboxsrv) i	下载				
■ 本地磁盘 (C:) ■ temp (\\vboxsrv)	音乐				
temp (\\vboxsrv)	桌面				
e temp (\\vboxsrv)	_ 本地磁盘 (C:)				
网络					
	网络				

10.13. Zerotier Instructions

Basics

The OpenWRT system has pre-installed the zerotier client. After creating a virtual LAN on the zerotier official website, the client can directly join it through the Network ID. The specific operation is as shown below.

1) Log in to zerotier official website https://my.zerotier.com/network, register and log in and click Network->Create A Network to create a virtual local area network

$\overline{\Phi}$ ZEROTIER	Download	Knowledge Ba	se Account	: Networks	System	API	Community	Logout
	Creat	e A Network]					
	Create a Netv	vork to Get	Started					
Φ ZEROTIER	Download Kno	owledge Base	Account	Networks	System	API	Community	Logout
	Create	A Network						
Your Networks	SEARCH 1 networks							
Networks: 1 Authorized Members: 0 / 50	NETWORK ID	NAME 1	DESCRIPT	TION SUB	IET N	ODES		
Online Members: 0	8286ac0e47d53bb5	happy_metcalfe	2	172.2	7.0.0/16	0/0		

2) Click to enter the network console page, you can set the privacy option to public, so that the added network nodes do not need to be verified

Network ID 8286ac0e47d53	3bb5
Name	
happy_metcalfe	
Description	
Access Control	· · · · · · · · · · · · · · · · · · ·
Access Control <u>PRIVATE</u>	PUBLIC Ø

3) The following automatically assigns the address Here you can choose the network segment yourself, here is 172.27.*.*

uto-Assign from	Range		
Easy		Adva	anced
10.147.17.*	10.147.18.*	10.147.19.*	10.147.20.*
10.144.*.*	10.241.*.*	10.242.*.*	10.243.*.*
10.244.*.*	172.22.*.*	172.23.*.*	172.24.*.*
172.25.*.*	172.26.*.*	172.27.*.*	172.28.*.*
172.29.*.*	172.30.*.*	192.168.191.*	192.168.192.*
192.168.193.*	192.168.194.*	192.168.195.*	192.168.196.*

4) Enter the following command in the OpenWRT terminal to join the virtual LAN created above, where 8286ac0e47d53bb5 is the Network ID of the virtual LAN created above

root@OpenWrt:/# zerotier-one -d	#Start the zerotier client
root@OpenWrt:/# zerotier-cli join 8286ac0e47d53bb5	#join the network

5) Enter if config in the terminal and you can see that there is already a new **ztks54inm2** device with an IP address of **172.27.214.213**

root@OpenWrt:/# ifconfig
ztks54inm2 Link encap:Ethernet HWaddr F6:4E:DE:BF:D8:52
inet addr:172.27.214.213 Bcast:172.27.255.255 Mask:255.255.0.0
inet6 addr: fe80::e82f:d0ff:fe5a:867e/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:2800 Metric:1
RX packets:18 errors:0 dropped:0 overruns:0 frame:0
TX packets:48 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:1720 (1.6 KiB) TX byte81 (8.2 KiB)

6) Install the zerotier client on another device (Ubuntu18.04 is used as an example here), execute the following command to install, and restart the computer after the installation is complete

test@ubuntu:~\$ curl -s https://install.zerotier.com | sudo bash

7) After restarting, join the virtual LAN according to the Network ID, and you can also see that the ip address assigned by zerotier has been obtained. At this time, the Ubuntu PC and OrangePi R1 Plus LTS are in the same LAN, and the two can communicate freely

test@ubuntu:~\$ sudo zerotier-cli join 8286ac0e47d53bb5		
test@ubuntu:~\$ ifconfig		
ztks54inm2: flags=4163 <up,broadcast,running,multicast> mtu 2800</up,broadcast,running,multicast>		
inet 172.27.47.214 netmask 255.255.0.0 broadcast 172.27.255.255		
inet6 fe80::5ce1:85ff:fe2b:6918 prefixlen 64 scopeid 0x20 <link/>		
ether f6:fd:87:68:12:cf txqueuelen 1000 (ethernet)		
RX packets 0 bytes 0 (0.0 B)		
RX errors 0 dropped 0 overruns 0 frame 0		
TX packets 46 bytes 10006 (10.0 KB)		
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0		

8) Test whether the two terminals can communicate

root@OpenWrt:/# ping 172.27.47.214 -I ztks54inm2 PING 172.27.47.214 (172.27.47.214): 56 data bytes 64 bytes from 172.27.47.214: seq=0 ttl=64 time=1.209 ms 64 bytes from 172.27.47.214: seq=1 ttl=64 time=1.136 ms 64 bytes from 172.27.47.214: seq=2 ttl=64 time=1.203 ms 64 bytes from 172.27.47.214: seq=3 ttl=64 time=1.235 ms ^C --- 172.27.47.214 ping statistics ---4 packets transmitted, 4 packets received, 0% packet loss round-trip min/avg/max = 1.136/1.195/1.235 ms

root@OpenWrt:/# zerotier-one -d	#Start the zerotier client
root@OpenWrt:/# zerotier-cli status	#Get address and service status
root@OpenWrt:/# zerotier-cli join # Network ID	#join the network
root@OpenWrt:/# zerotier-cli leave # Network ID	#leave the network
root@OpenWrt:/# zerotier-cli listnetworks	#list networks
OPENWRT_DEVICE_REVISION="v0"	
OPENWRT_RELEASE="OpenWrt 22.03.4 r20123-3	8ccc47687"

9) other common commands of zerotier

11. Compiling method of OpenWRT source code

11. 1. Download OpenWRT source code

1) First execute the following command to download the openwrt-22.03 branch code

test@test:~\$ sudo apt update

test@test:~\$ sudo apt install -y git

test@test:~\$ git clone https://github.com/orangepi-xunlong/openwrt.git -b openwrt-22.03

2) After the OpenWRT code is downloaded, the following files and folders will be included

test@test:~/openwrt\$ **ls**

BSDmakefile Config.in include Makefile README.md scripts toolchain Config feeds.conf.default LICENSE package rules.mk target tools

11. 2. Compile OpenWRT source code

1) First install the following dependent software (currently only tested to compile on Ubuntu 20.04 and need to install the following software, if compiling on other versions of the system, please install the dependent software by yourself according to the error message)

test@test:~/openwrt\$ sudo apt update test@test:~/openwrt\$ sudo apt install -y ack antlr3 asciidoc autoconf \ automake autopoint binutils bison build-essential \ bzip2 ccache cmake cpio curl device-tree-compiler fastjar \ flex gawk gettext gcc-multilib g++-multilib git gperf haveged \ help2man intltool libc6-dev-i386 libelf-dev libglib2.0-dev \ libgmp3-dev libltdl-dev libmpc-dev libmpfr-dev \ libncurses5-dev \libncursesw5-dev libreadline-dev libssl-dev \ libtool lrzsz mkisofs msmtp nano ninja-build p7zip p7zip-full \ patch pkgconf python2.7 python3 python3-pyelftools \ libpython3-dev qemu-utils rsync scons squashfs-tools \ subversion swig texinfo uglifyjs upx-ucl unzip \

vim wget xmlto xxd zlib1g-dev

2) Then execute ./scripts/feeds update -a and ./scripts/feeds install -a to download dependent packages

test@test:~/openwrt\$./scripts/feeds update -a test@test:~/openwrt\$./scripts/feeds install -a

3) Then choose to use the configuration file of OrangePi 5

test@test:~/openwrt\$ **cp configs/orangepi-5-rk3588_defconfig .config** test@test:~/openwrt\$ **make defconfig**

4) Execute the following command to start compiling the openwrt source code test@test:~/openwrt\$ make V=s

5) After the compilation is complete, the path where the image is generated is:

test@test:~/openwrt\$ tree -L 1 bin/targets/rockchip/armv8/

bin/targets/rockchip/armv8/

- config.buildinfo
- feeds.buildinfo
- openwrt-rockchip-armv8-xunlong_orangepi-5-ext4-sysupgrade.img.gz

- packages
- profiles.json
- —— sha256sums
- uersion.buildinfo

1 directory, 9 files

6) When compiling, you may encounter the error shown below

OBJCOPY spl/u-boot-spl-nodtb.bin		
SYM	spl/u-boot-spl.sym	
CAT	spl/u-boot-spl-dtb.bin	
COPY	spl/u-boot-spl.bin	
BINMAN	.binman stamp	

Wrote map file './simple-bin.map' to show errors

binman: Node '/binman/simple-bin/fit': subnode 'images/@atf-SEQ': Failed to read ELF

file: Python: No module named 'elftools'

make[3]: *** [Makefile:1108: .binman_stamp] Error 1

make[3]: Leaving directory

'/home/tangligang/openwrt/build_dir/target-aarch64_generic_musl/u-boot-orangepi-5-rk3 588/u-boot-2023-04-16-24c50dca'

At this time, deleting the python3 compiled in the openwrt source code can solve this problem

test@test:~/openwrt\$ rm staging_dir/hostpkg/bin/python3*

12. Appendix

12. 1. User Manual Update History

Version	Date	Release Notes
v0.1	2022-12-02	initial version
v0.2	2022-12-05	1. How to write Linux image to SPIFlash+NVMe SSD
		2.Linux: How to upload files to the Linux system of the development
		board
		3.Linux: How to download and install arm64 version balenaEtcher
		4. How to burn Orange Pi OS (Droid) image to TF card
		5. Burn Orange Pi OS (Droid) image to SPIFlash+NVMe SSD
		6.Linux: How to log in to the desktop of the Linux system remotely
v0.3	2022-12-09	1. How to compile Android 12 source code
		2. Linux: orangepi-build instructions
		3. Linux: How to use adb
v0.4	2022-12-12	1.Linux: How to use SATA SSD
		2. How to write Linux image to SPIFlash+SATA SSD
		3. Linux: Test method of RTL8821CU USB WIFI module
		4. Debian: How to set up Chinese environment and install Chinese input
		method
v0.5	2022-12-16	1.Linux: How to use AP6275P PCIe network card
		2.Linux: How to install QT
		3. How to install ROS 1 Noetic on Ubuntu 20.04
		4. How to install ROS 2 Galactic on Ubuntu 20.04
		5. How to install ROS 2 Humble on Ubuntu 22.04
v0.6	2022-12-23	1.Linux: Method of using commands to test recording
		2.Linux: How to install kernel header files
		3. Linux: How to use the 10.1-inch MIPI LCD screen
		4.Ubuntu20.04: How to set Chinese and Chinese input methods in the
		system
		5.Ubuntu22.04: How to set Chinese and Chinese input methods in the
		system

		6.Android12: How to burn Android image to SPIFlash+SATA SSD
		7. Android12: How to use USB wireless network card
		8.Android12: 26pin interface GPIO, UART, SPI and PWM test
v0.7	2023-01-06	1. How to burn Linux image to SPIFlash+USB storage device
		2. Linux: How to install and use wiringOP-Python
		3. Linux: Instructions for using the logo on and off
		4.Linux: AP6275P PCIe network card creates WIFI hotspot method
		through create_ap
		5. Ubuntu22.04: Instructions for using orangepi-build to compile the
		image on the development board
v0.8	2023-01-13	1. Android12: How to use the AP6275P PCIe network card
		2. Android12: WIFI connection test method
		3. Android12: How to use Wi-Fi hospot
		4. Android12: Bluetooth test method
		5. Android12: How to use 10.1-inch MIPI screen
v0.9	2023-02-17	1. How to burn Orange Pi OS (Droid) image to SPIFlash+SATA SSD
		2. How to use RKDevTool to burn Linux image to TF card
		3. Use RKDevTool to burn Linux image to SPIFlash+NVMe SSD
		4.Linux: How to set the pull-up and pull-down resistance of 26pin GPIO
		port
		5. Linux: How to use the CAN bus in 26pin
		6. Android12: How to use ADB
		7. Android12 Box: How to use the supported 2.4G USB remote control
		8. Android12 Box: How to use the HDMI CEC function
v1.0	2023-03-03	1. Android12 source code compilation instructions: add the method of
		compiling LCD image and SATA image
		2. The method of compiling the kernel source code separately in the
		linux system of the development board
		3. Ubuntu22.04 Gnome Wayland Desktop System Instructions
v1.1	2023-03-08	1.Ubuntu22.04 Gnome: How to install ROS 2 Humble
		2.Ubuntu22.04 Gnome: How to set up Chinese environment and install
		Chinese input method
		3.Ubuntu22.04 Gnome: update Kodi instructions
v1.2	2023-03-17	1.Linux: OV13850 and OV13855 MIPI camera test method
		2.Android: OV13850 and OV13855 MIPI camera test method

 SPIFlash+SSD How to clear SPIFlash using RKDevTool Delete the method of burning using the mtd tool of the OpenWRT system Add a method to use the dd command to burn the OpenWRT system Ubuntu/Debian: How to use ZFS file system Ubuntu/Debian: How to turn off the green light by default at startup 				
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	v1.9	2024-01-26	1. How to burn Orange Pi OS (OH) image to TF card	
2. Linux: How to use NPU	v2.0	2024-02-02	1. Linux6.1 system adaptation situation	
			2. Linux: How to use NPU	
2. Linux: RK3588 How to use PaddlePaddle			2. Linux: RK3588 How to use PaddlePaddle	
v2.1 2024-07-03 1. Linux: How to run RKLLM large model on RK3588	v2.1	2024-07-03	1. Linux: How to run RKLLM large model on RK3588	

12.2. Image update history

Date	Release Notes
2022-12-02	Orangepi5_1.0.0_debian_bullseye_desktop_xfce_linux5.10.110.7z
	* initial version
2022-12-05	Orangepi5_1.0.2_debian_bullseye_desktop_xfce_linux5.10.110.7z
	* Pre-installed with balenaEtcherhe and Gparted
	* Pre-installed ffmpeg and mpv player
	* Add some scripts and configuration files
2022-12-09	Orangepi5_1.0.2_debian_bullseye_server_linux5.10.110.7z
	Orangepi5_1.0.2_ubuntu_jammy_server_linux5.10.110.7z
	Orangepi5_1.0.2_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* initial version
2022-12-12	Orangepi5 1.0.4 debian bullseye server linux5.10.110.7z
2022-12-12	Orangepi5 1.0.4 debian bullseye desktop xfce linux5.10.110.7z
	Orangepi5 1.0.4 ubuntu jammy server linux5.10.110.7z
	Orangepi5 1.0.4 ubuntu jammy desktop xfce linux5.10.110.7z
	* Add rk3588-ssd-sata.dtbo
	* Add rkspi_loader_sata.img, used to start the linux system on sata ssd
	* Pre-installed usb-modeswitch package, test RLT8821CU WIFI module can
	be used normally
2022-12-16	Orangepi5_1.0.6_debian_bullseye_desktop_xfce_linux5.10.110.7z
	* Support ov13855 camera
	* Support open multiple mipi cameras at the same time
	* Test that qt can be installed and used normally
	* Some scripts are pre-installed
	Orangenis 10.6 shurts increased to be a first to 10.110.7
	Orangepi5_1.0.6_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* Test that ros can be installed and used normally
	Toot that too ball of mounded and abou normally

	* Test that qt can be installed and used normally
	* Some scripts are pre-installed
	* Fix the bug that the fcitx5 configuration program cannot be opened
	Orangepi5_1.0.6_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.0.6_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	* initial version
2022-12-23	Orangepi5_1.0.8_debian_bullseye_server_linux5.10.110.7z
	Orangepi5_1.0.8_ubuntu_jammy_server_linux5.10.110.7z
	Orangepi5_1.0.8_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.0.4_debian_bullseye_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.0.4_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* Some scripts are pre-installed
	* Solve the error problem of kernel header file deb package installation
	Orangepi5_1.0.6_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	* Some scripts are pre-installed
	* Solve the error problem of kernel header file deb package installation
	* Solve the problem that the mipi camera cannot be used
	OrangePi5_RK3588S_Android12_v1.0.1.img
	OrangePi5_RK3588S_Android12_lcd_v1.0.1.img
	OrangePi5_RK3588S_Android12_spi-nvme_lcd_v1.0.1.img
	OrangePi5_RK3588S_Android12_spi-nvme_v1.0.1.img
	* Support OV13855 camera
	* Support RTL8211CU, RTL8822CU, RTL8723BU three USB wireless
	network cards
	* Enable UART0, I2C5, SPI4, PWM15 by default
	* Pre-installed WiringOP APP is used to operate GPIO, I2C, SPI and UART
	hardware resources

	OrangePi5_RK3588S_Android12_spi-sata_v1.0.1.img
	OrangePi5_RK3588S_Android12_spi-sata_lcd_v1.0.1.img
	* initial version
2023-01-06	Orangepi5_1.1.0_debian_bullseye_server_linux5.10.110.7z
	Orangepi5_1.1.0_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.1.0_ubuntu_jammy_server_linux5.10.110.7z
	* Pre-install create_ap, support AP6275P PCIe network card to open hotspot
	function
	* Support SPIFlash+USB storage device to start Linux system (only USB3.0
	interface)
	* Open some kernel configuration
	Orangepi5_1.1.0_debian_bullseye_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.0_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.0_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* Add switch to display logo
	* Set VOP DCLK as dynamic allocation strategy
	* Pre-install create_ap, support AP6275P PCIe network card to open hotspot
	function
	* Support SPIFlash+USB storage device to start Linux system (only USB3.0
	interface)
	* Optimize the set_lcd_rotate.sh script to solve the unusable problem in
	Debian11
	* Open some kernel configuration
2023-01-13	OrangePi5_RK3588S_Android12_v1.0.2.img
	OrangePi5_RK3588S_Android12_lcd_v1.0.2.img
	OrangePi5_RK3588S_Android12_spi-nvme_v1.0.2.img
	OrangePi5_RK3588S_Android12_spi-nvme_lcd_v1.0.2.img
	OrangePi5_RK3588S_Android12_spi-sata_v1.0.2.img
	OrangePi5_RK3588S_Android12_spi-sata_lcd_v1.0.2.img
	* Support the Bluetooth function of RTL8821CU, RTL8723BU wireless

	network card
	* Support AP6275P PCIe network card
	* Solve the problem that some TF cards cannot enter the desktop when starting
	OrangePi-OS_Droid_orangepi5_v0.0.4_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_v0.0.4_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_v0.0.4_beta.img
	The following functions have been updated compared to the original v0.0.2
	version:
	* Solve the problem that the application cannot be restored to window mode
	after being maximized
	* Solve the problem that some applications cannot be closed after full screen
	* Solve the problem that there will be an instant gray background when
	opening the application
	* Solve the problem that some full-screen applications switch to the desktop
	and then switch back to the application to become a windowed display problem
	* Solve known issues related to volume adjustment in the control center
	* Solve the camera crash problem
	* Solve the game full screen open, click the taskbar to wake up the crash
	problem
	* Delete the screen saver option in the control center
	* Solve the problem of closing a single application in the task manager and
	clicking on other applications again
	* The control center has added a shutdown function and a function of long
	pressing the Bluetooth module to enter the Bluetooth setting
	* Support the Bluetooth function of RTL8821CU, RTL8723BU wireless
	network card
	OrangePi-OS_Droid_orangepi5_en_v0.0.4_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_en_v0.0.4_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_en_v0.0.4_beta.img
	* initial version
2023-02-17	Orangepi5_1.1.2_debian_bullseye_server_linux5.10.110.7z

	Orangepi5_1.1.2_debian_bullseye_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.2_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.1.2_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.2_ubuntu_jammy_server_linux5.10.110.7z
	* Support SPIFlash+ blue USB2.0 interface to start Linux system
	* wiringOP supports the function of setting GPIO pull-up and pull-down
	resistors
	Orangepi5_1.1.2_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* Support ov13850/ov13855 camera
	* Support SPIFlash+ blue USB2.0 interface to start Linux system
	* wiringOP supports the function of setting GPIO pull-up and pull-down
	resistors
	OrangePi5_RK3588S_Android12-box_v1.0.0.img
	OrangePi5_RK3588S_Android12-box_spi-sata_v1.0.0.img
	OrangePi5_RK3588S_Android12-box_spi-nvme_v1.0.0.img
	* initial version
2023-02-24	OrangePi-OS_Droid_orangepi5_v0.0.5_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_v0.0.5_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_v0.0.5_beta.img
	OrangePi-OS_Droid_orangepi5_en_v0.0.5_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_en_v0.0.5_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_en_v0.0.5_beta.img
	Added notification reminder function
	* Removed the function of double-clicking the desktop to prompt the user
	whether to sleep
	* Removed the pop-up tool window when long pressing the desktop
	* Fixed the desktop moving icon function: the application will disappear when
	dragging and moving the application
	* Added the control center to click outside the window to automatically close

	the function
	* Fixed the problem that when closing a single application in the task manager,
	the task manager will be closed at the same time
	* Fixed the bottom recent application list, open new applications in order of
	priority
	* Added the control center to click the corresponding function, and the
	function is opened in windowed mode
	* Added a shutdown module at the bottom of the application list, click to
	choose sleep, shutdown and restart the device
	* Fixed the problem that the wallpaper item in the settings shows a lock screen
	* Fixed the problem that the close and maximize buttons in the hotspot setting
	interface of the control center are misplaced
	* Removed the function of user-defined application window size, the default is
	to open in window mode, and the user can adjust the window size by himself
	after opening the application
	* Fixed the problem that after uninstalling the application on the desktop, the
	application icon will not disappear, the moving icon will be black, and the
	system will freeze after restarting
	* Fixed the problem that PCIe SSD burning failed
2023-03-03	Orangepi5_1.1.2_ubuntu_jammy_desktop_gnome_linux5.10.110
	* initial version
2023-03-09	Orangepi5_1.1.4_ubuntu_jammy_desktop_gnome_linux5.10.110
	* Set HDMI as the default audio device
	* Optimize GPU performance
	* Turn on the hardware mouse to solve the problem of desktop flickering
	* Solve the problem of ros2 installation failure
	Orangepi5_1.1.4_debian_bullseye_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.4_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	* Set HDMI as the default audio device
	* Turn on the hardware mouse
	* Support exfat file system

	* Set the default size of /boot partition to 1GB, which is convenient for kernel
	development
	Orangepi5_1.1.4_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	* Set HDMI as the default audio device
	* Turn on the hardware mouse
	* Support exfat file system
	* Set the default size of /boot partition to 1GB, which is convenient for kernel
	development
	* Pre-installed RK-adapted Chromium browser, supports h264/vp8/vp9
	hardware solution to play video
	Orangepi5_1.1.4_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.1.4_debian_bullseye_server_linux5.10.110.7z
	Orangepi5_1.1.4_ubuntu_jammy_server_linux5.10.110.7z
	* Support exfat file system
	* Set the default size of /boot partition to 1GB, which is convenient for kernel
	development
	OrangePi5_RK3588S_Android12_spi-nvme_v1.0.2.img
	OrangePi5_RK3588S_Android12_spi-nvme_lcd_v1.0.2.img
	* Fixed the problem that burning Android image to empty nvme ssd failed
2023-03-30	Orangepi5_1.1.4_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z
	* initial version
2023-04-07	OrangePi-OS_Droid_orangepi5_v0.0.6_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_v0.0.6_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_v0.0.6_beta.img
	OrangePi-OS_Droid_orangepi5_en_v0.0.6_beta.img
	OrangePi-OS_Droid_orangepi5_spi-nvme_en_v0.0.6_beta.img
	OrangePi-OS_Droid_orangepi5_spi-sata_en_v0.0.6_beta.img

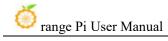
	* Fix the problem that wake-up from hibernation cannot be used normally
	* Added application minimization function, after the application is minimized,
	it can be opened in the bottom application list
	* Fix the problem that the Home button in the navigation bar does not work
	* Added the function of hiding the control center window when opening the
	application list
	* Solve the problem that the task manager does not display real-time
	thumbnails of recent tasks
	* Repair the uninstall function to delete the corresponding application in the
	desktop, application list, and recent tasks synchronously
	* The new full screen window hides the top title bar by default, slide the mouse
	to the top to display the title bar
2023-04-14	Opios-arch-aarch64-gnome-opi5-23.04-linux5.10.110.img.xz
2020 01 11	
	* initial version
2023-04-21	Opios-arch-aarch64-gnome-opi5-23.04.1-linux5.10.110.img.xz
2025-04-21	Opios-aren-aarenot-gnome-opi3-23.04.1-mitax3.10.110.mig.xz
	* Set the default value of loglevel to 2 to reduce the printing information of the
	serial port
	-
	* Fix the problem that ssh or serial port login is slow due to network problems
	* Exchange the dtbo configuration of LCD1 and LCD2 to be consistent with
	the silkscreen on the development board
	openwrt-rockchip-armv8-xunlong_orangepi-5-ext4-sysupgrade.img.gz
	* initial version
2023-04-28	openwrt-aarch64-opi5-23.04-linux5.10.110-ext4.img.gz
	* Support SPIFlash + NVMe SSD boot
	* Support SPIFlash + USB boot
	openwrt-aarch64-opi5-23.04-linux5.10.110-ext4-sata.img.gz
	openwrt-rockchip-armv8-xunlong_orangepi-5-spi-squashfs-sysupgrade.bin
	* initial version

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2023-06-06	Orangepi5_1.1.6_ubuntu_jammy_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.6_debian_bullseye_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.6_debian_bullseye_desktop_kde-plasma_linux5.10.110.7z
	* Update mpp package
	* Fix the problem that zfs file system cannot be installed
	* Fix the problem of stuck startup when rtl8821cu wifi module is plugged in
	* Added rk3588-disable-led.dtbo, used to turn off the green light
	* Rename rk3588-ssd-sata.dtbo to rk3588-ssd-sata0.dtbo
	Update the chromium browser to chromium-browser_110.0, which supports
	video hard decoding and playback in h264, h265, vp8, vp9 and av1 formats
	Orangepi5_1.1.6_ubuntu_focal_server_linux5.10.110.7z
	Orangepi5_1.1.6_debian_bullseye_server_linux5.10.110.7z
	Orangepi5_1.1.6_ubuntu_jammy_server_linux5.10.110.7z
	Orangepi5_1.1.6_ubuntu_focal_desktop_xfce_linux5.10.110.7z
	Orangepi5_1.1.6_ubuntu_jammy_desktop_gnome_linux5.10.110.7z
	* Fix the problem that zfs file system cannot be installed
	* Fix the problem of stuck startup when rtl8821cu wifi module is plugged in
	* Added rk3588-disable-led.dtbo, used to turn off the green light
	* Rename rk3588-ssd-sata.dtbo to rk3588-ssd-sata0.dtbo
	Orangepi5_1.1.6_debian_bookworm_server_linux5.10.110
	Orangepi5_1.1.6_debian_bookworm_desktop_xfce_linux5.10.110
	* initial version
2023-11-08	Orangepi5_1.1.8_ubuntu_focal_server_linux5.10.160.7z
	Orangepi5_1.1.8_ubuntu_jammy_server_linux5.10.160.7z
	Orangepi5_1.1.8_debian_bullseye_server_linux5.10.160.7z
	Orangepi5_1.1.8_debian_bookworm_server_linux5.10.160.7z
	Orangepi5_1.1.8_ubuntu_focal_desktop_xfce_linux5.10.160.7z
	Orangepi5_1.1.8_ubuntu_jammy_desktop_xfce_linux5.10.160.7z
	Orangepi5_1.1.8_debian_bullseye_desktop_xfce_linux5.10.160.7z
	Orangepi5_1.1.8_debian_bookworm_desktop_xfce_linux5.10.160.7z

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	* Kernel version upgraded to 5.10.160
	* Support PWM control through wiringOP
	Orangepi5_RK3588_Android12_v1.0.5.tar.gz
	Orangepi5_RK3588_Android12_lcd_v1.0.5.tar.gz
	Orangepi5_RK3588_Android12-box_v1.0.5.tar.gz
	Orangepi5_RK3588_Android12_spi-nvme_v1.0.5.tar.gz
	Orangepi5_RK3588_Android12-box_spi-nvme_v1.0.5.tar.gz
	Orangepi5_RK3588_Android12_lcd_spi-nvme_v1.0.5.tar.gz
	* Kernel version upgraded to 5.10.160
2024-02-02	Orangepi5_1.1.8_ubuntu_focal_server_linux6.1.43.7z
	Orangepi5_1.1.8_ubuntu_jammy_server_linux6.1.43.7z
	Orangepi5_1.1.8_debian_bullseye_server_linux6.1.43.7z
	Orangepi5_1.1.8_debian_bookworm_server_linux6.1.43.7z
	Orangepi5_1.1.8_ubuntu_focal_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.8_ubuntu_jammy_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.8_debian_bullseye_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.8_debian_bookworm_desktop_xfce_linux6.1.43.7z
	* initial version
2024-07-03	Orangepi5_1.1.10_ubuntu_jammy_server_linux6.1.43.7z
	Orangepi5_1.1.10_debian_bullseye_server_linux6.1.43.7z
	Orangepi5_1.1.10_debian_bookworm_server_linux6.1.43.7z
	Orangepi5_1.1.10_ubuntu_jammy_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.10_debian_bullseye_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.10_debian_bookworm_desktop_xfce_linux6.1.43.7z
	Orangepi5_1.1.10_ubuntu_focal_server_linux5.10.160.7z
	Orangepi5_1.1.10_ubuntu_jammy_server_linux5.10.160.7z
	Orangepi5_1.1.10_debian_bullseye_server_linux5.10.160.7z
	Orangepi5_1.1.10_debian_bookworm_server_linux5.10.160.7z
	Orangepi5_1.1.10_ubuntu_focal_desktop_xfce_linux5.10.160.7z
	Orangepi5_1.1.10_ubuntu_jammy_desktop_xfce_linux5.10.160.7z



Orangepi5_1.1.10_debian_bullseye_desktop_xfce_linux5.10.160.7z
Orangepi5_1.1.10_debian_bookworm_desktop_xfce_linux5.10.160.7z
* The kernel's rknpu version is upgraded to 0.9.6