

Idea3588 Linux6.1 User Manual

V5.0



Boardcon Embedded Design

Overview

The content of this document is intended solely for the Idea3588 development board, aiming to help users quickly understand, apply, and test the Idea3588 development board.

System Support

Development Board	Debian12	Buildroot
CM3588_V2.0	Y	Y
IDEA3588_V4		

Revision History

Version	Date	Author	Revision History
V2.0	2024-12-20	Liu Yuan	Update Debian12 and Buildroot (rkr4)
V3.0	2025-03-07	Liu Yuan	Update Debian12, Buildroot (rkr5)
V4.0	2025-09-17	Liu Yuan	Update Debian12 and Buildroot (rkr6.1)
V5.0	2026-06-04	Xue Junchao	Update Debian12 and Buildroot (rkr7)

Disclaimer

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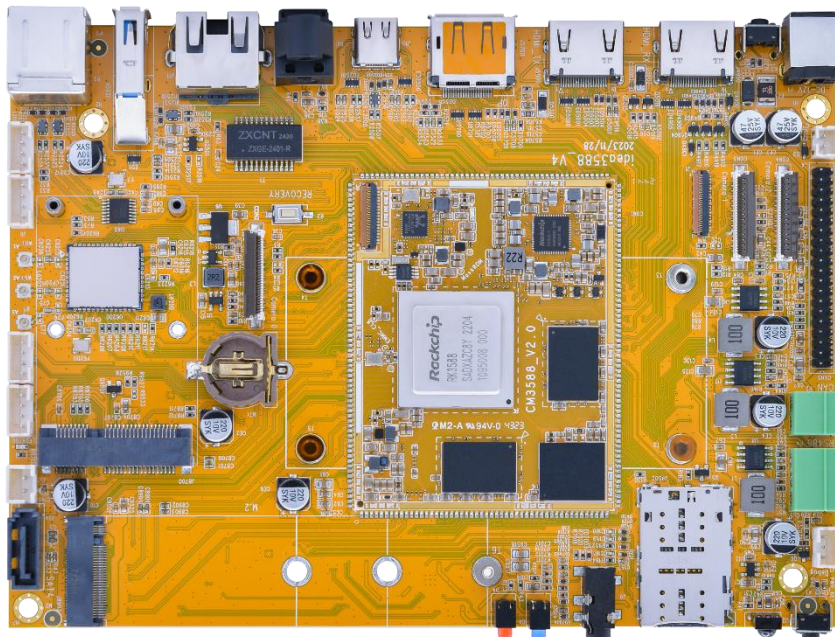
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1.Introduction

1.1 Overview

The idea3588 CPU integrates quad-core Cortex-A76 and quad-core Cortex-A55 with separately NEON coprocessor, NPU computing power up to 6TOPs, enable various AI scenarios, it can process up to 8K video encoding and decoding, ultra-high definition rendering, with super image processing capability and powerful network communication function, 48MP ISP, supporting multi-camera input, Which is suitable for ARM-based PC and edge computing devices, personal mobile Internet devices and other digital multimedia applications.



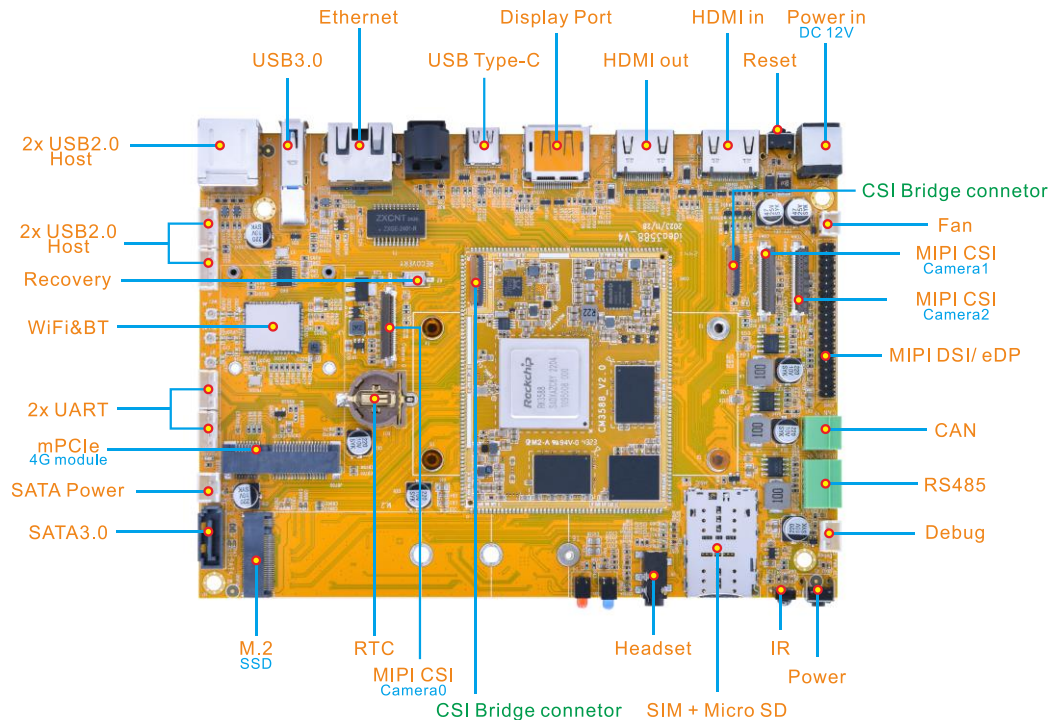
1.2 Product Parameters

Basic Parameters	
SOC	RK3588
CPU	• Octa-core 64-bit architecture: Quad-core Cortex-A76 + Quad-core Cortex-A55

GPU		• ARM Mali-G610 MC4 • OpenGL ES 1.1/2.0/3.1/3.2 • Vulkan 1.1, 1.2 • OpenCL 1.1, 1.2, 2.0 • Embedded high performance 2D image acceleration module
NPU		• Up to 6 TOPS AI computing power • Supports int4, int8, int16, FP16, BF16, TF32 operation
Video	Decoder	• Support 8K@60fps H.265/VP9 video decoding • Support 8K@30fps H.264 video decoding • Support 4K@60fps AV1 video decoding • Support 1080P@60fps MPEG-2/MPEG-1/VC-1/VP8 video decoding
	Encoder	• Support H.264/H.265 video encoding, up to 8K@30fps
RAM		8GB LPDDR4
ROM		32GB eMMC
Support system		Android, Debian, Buildroot
Hardware Parameters		
Extended Storage		• Support 1x M.2 PCIe3.0 SSD • Support 1xSATA3.0 • Support 1x MicroSD Card
Display		• Support 1x HDMI2.1 TX, up to 7680x4320@60fps • Support 1xDP1.4, up to 7680x4320@30fps • Support 1xeDP, up to 4K@60fps • Support 1x HDMI RX, up to 4K@60fps
Audio		• Support 1x HDMI TX/RX audio output • Support 1x DP audio output • Support 1x Headphone output/input

USB	• Support 1xUSB3.0 • Support 4xUSB2.0 • Support 1x USB3.1 Type-C (ADB/USB3.0/DP)
Network	• Support 1x Gigabit Ethernet • Support 1x WIFI/BT module • Support 1x 4G module
Camera	• Support 3xCamera
Peripheral communication	• Support 1xCAN • Support 1xRS485 • Support 2xUART
Other parameters	Support 1xDebug, 1xIR, 1xRTC, 1xFan
Electrical Parameters	
Power supply input voltage	12V/3A
RTC input voltage	3V/0.6uA
Operating temperature	0~70°
Storage temperature	-40~85°
Structural Parameters	
Core board dimensions	67mm x 53mm
Motherboard dimensions	165mm x 120mm

1.3 Hardware Interface Introduction



Interface parameters	
Power in	12V DC power input interface
Reset	Reset key
HDMI_IN	HDMI RX interface
HDMI_OUT	HDMI2.1 TX interface
Display_Port	DP interface
USB Type-C	USB Type-C interface, OTG download interface
Ethernet	Gigabit Ethernet RJ45 interface
USB3.0	USB3.0 Host interface
2XUSB2.0 Host(1)	Dual-layer USB2.0 HOST interface
2XUSB2.0 Host(2)	USB expansion interface
Recover	Recovery key
WIFI&BT	WIFI&Bluetooth module

2XUART	• UART0, TTL level interface • UART3, TTL level interface
PCIe2.0 4G model	4G model interface
SATA_Power	SATA Power interface, 5V
SATA3.0	SATA3.0 interface
M.2_PCl3.0	M.2 PCIe3.0 SSD interface
RTC	RTC coin cell connector
MIPI_CSI0	Camera0 interface
CSI Bridge connector	CSI Bridge connector, must be connected when using the camera
Audio I/O	Earphone output/input
Nano SIM + Micro SD	All-in-one card holder
IR	infrared receiver
Power	Power key
Debug	debug the serial port
RS485	RS485 communication interface
CAN	CAN communication interface
MIPI_DSI/eDP	DSI/eDP display interface
MIPI_DPHY1	MIPI DPHY1 interface
MIPI_CSI1	Camera1 interface
Fan	Fan interface, 12V
CSI Bridge connector	CSI Bridge connector, must be connected when using the camera

2. Install Drivers and Tool

To download firmware and debug in the terminal, the following drivers and software need to be installed (for Windows computers):

Number	Driver name	Driver	Use
1	RK Driver Assitant	DriverInstall.exe	OTG USB driver installation assitant
2	CH9102x	SETUP.EXE	Serial port debugging driver
3	Serial Terminal Tool	SecureCRT.exe	Debugging tool

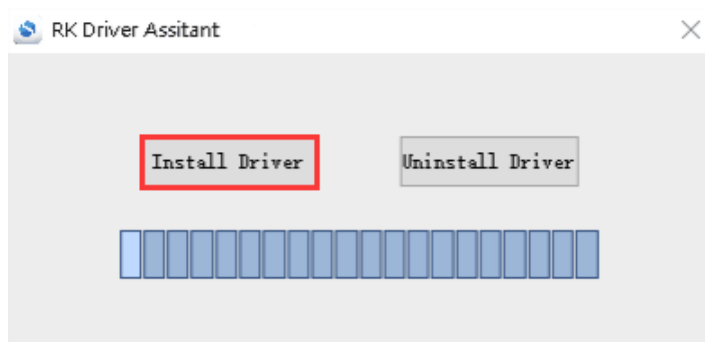
2.1 Install RK Driver Assitant

Step 1: Open [DriverAssitant_v5.1.1/DriverInstall.exe](#).

Step 2: To avoid driver conflicts, click “**Uninstall Driver**” to uninstall the driver.

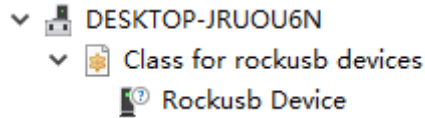


Step 3: Click button “**Install Driver**” to install.

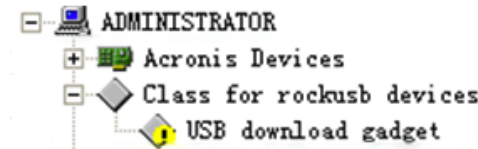


Step 4: After the installation is complete, connect the board and PC with Type_C USB cable and press the **Recovery** key and hold then power the board, the following information is displayed in the Computer **Device Manager**, indicating that the USB

driver was successfully installed.

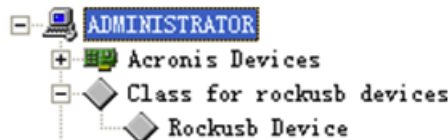


Step 5: If the following device information appears in the **Device Manager** after the operation in Step 4, user need to proceed to the next step.



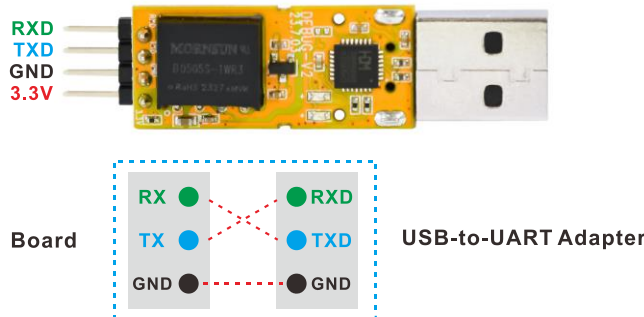
Step 6: The WINDOW will pop up found New Hardware Wizard dialog box, choose to install from the specified location, and then select: *DriverAssitant_y5.1.1/ADBDriver*.

Step 7: After the installation is completed, the following device information can be seen in the Computer **Device Manager**.



2.2 Install CH9102X Driver

2.2.1 How to Connect the Serial Port Tool



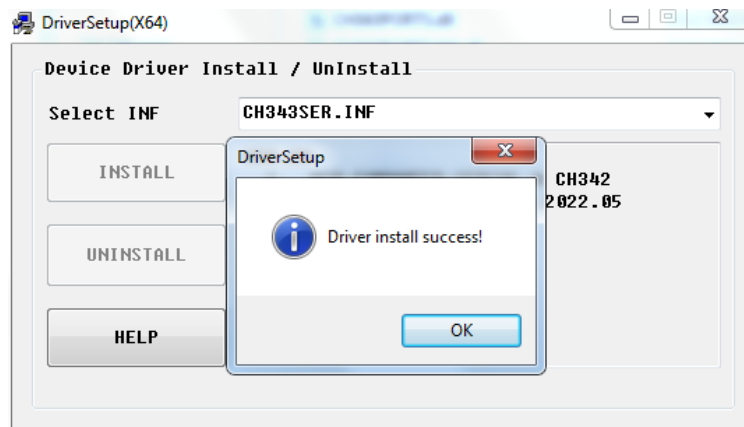
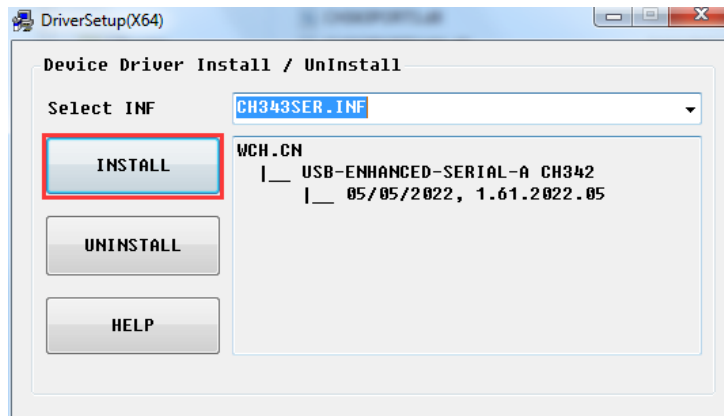
Pin	Connection Description
RXD	Receive, connect to TX pin of the board.
TXD	Transmit, connect to RX pin of the board.
GND	Ground, connect to GND pin of the board.
3V3	No need to connect.

2.2.2 Install Driver

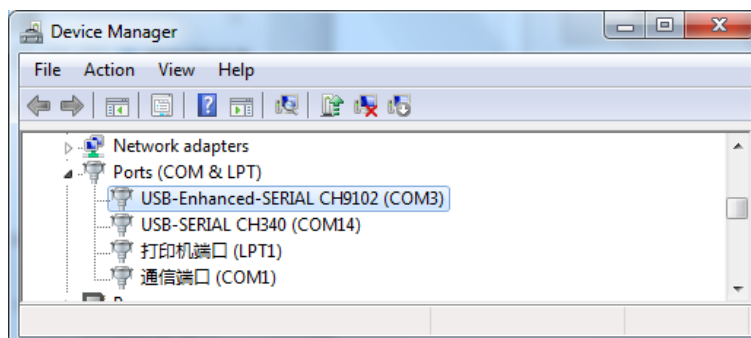
Step 1: Plug the CH9102X Module to the PC

Step 2: Unzip *CH343SER.ZIP* on Windows.

Step 3: Select and install the corresponding *SETUP.EXE* according to the computer properties.



Step 4: After the installation is completed, the device will be listed under **Device Manager** ports with unique serial port assigned.

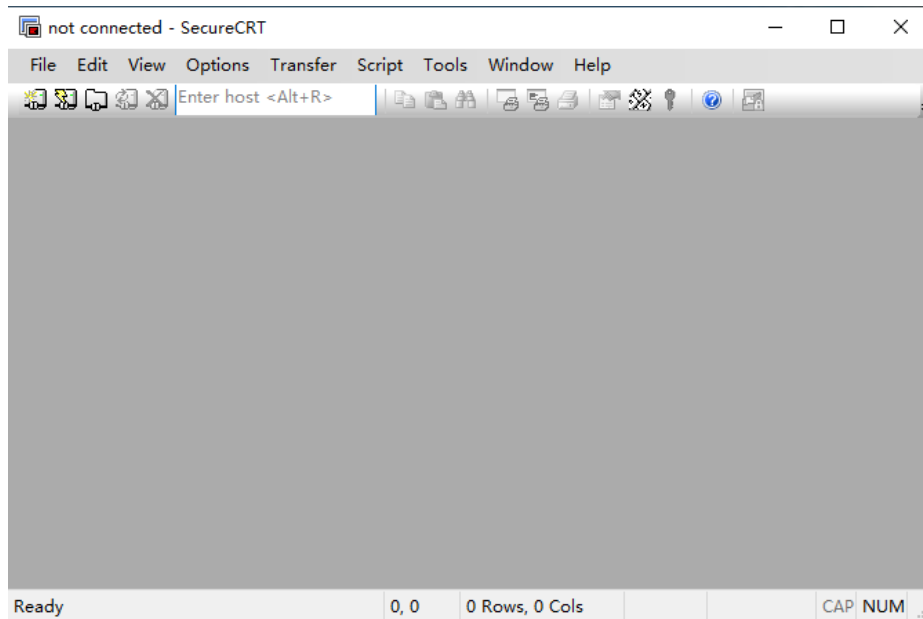


2.3 Install Serial Terminal Tool

The serial terminal SecureCRT is used for debugging in Windows. It can be used directly after decompression.

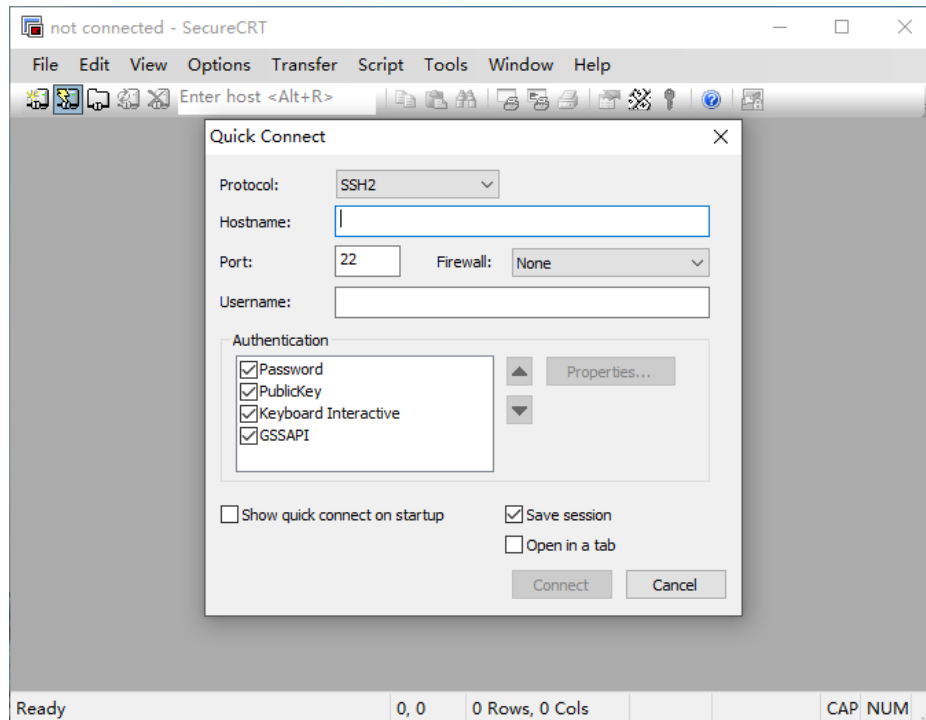
Step 1: Unzip *Platform/SecureCRT.rar* on PC.

Step 2: Click *SecureCRT/SecureCRT.exe* open the SecureCRT.

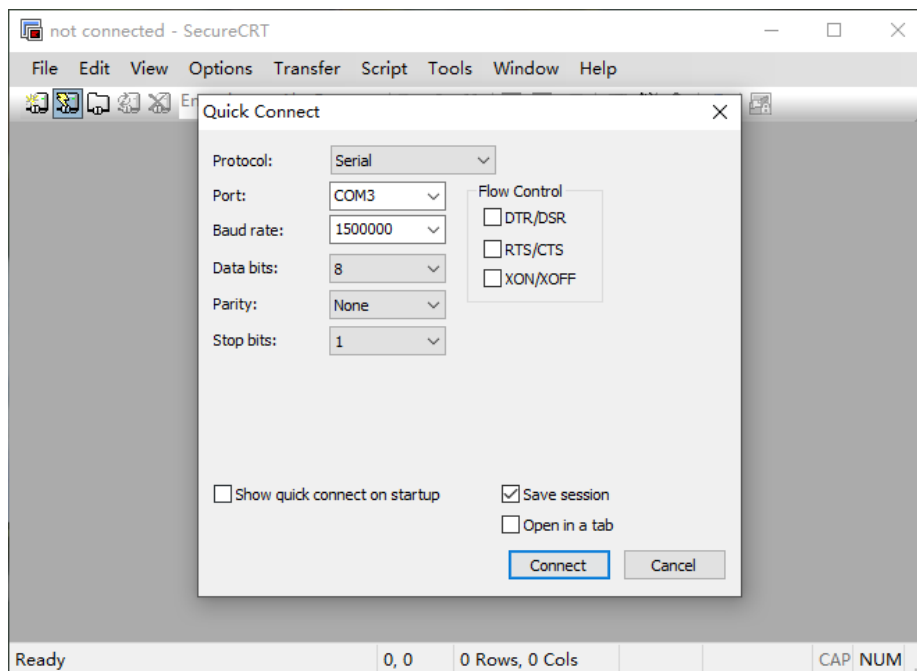


Step 3: Confirm that the CH9102X driver has been installed and the CH9102X module is connecting to the PC.

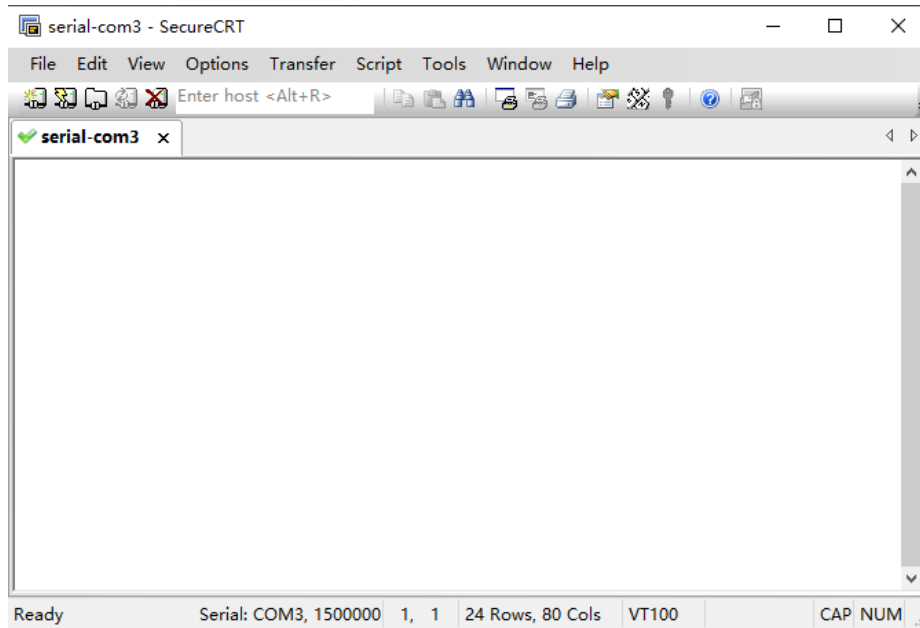
Step 4: Click the “**Quick Connect**” button to go to the Quick Connect configuration screen.



Step 5: Configure as shown in the following figure.



Step 6: After clicking “**Connect**” button, the terminal serial interface will be successfully accessed.



3. Upgrade Introduction

3.1 Upgrade Mode

The firmware can be upgraded via USB cable in two modes:

1. Loader Mode:

The standard mode used for firmware upgrades.

2. MaskRom Mode:

A last-resort mode used when the device is bricked. Entering MaskRom mode requires hardware manipulation, which involves certain risks. It should only be attempted if Loader mode is unavailable.

• Prerequisite

Before upgrading the firmware via USB cable, ensure that the necessary drivers are installed. For installation instructions, refer to the section [Install RK Driver Assistant](#).

3.1.1 How to Enter Loader Mode

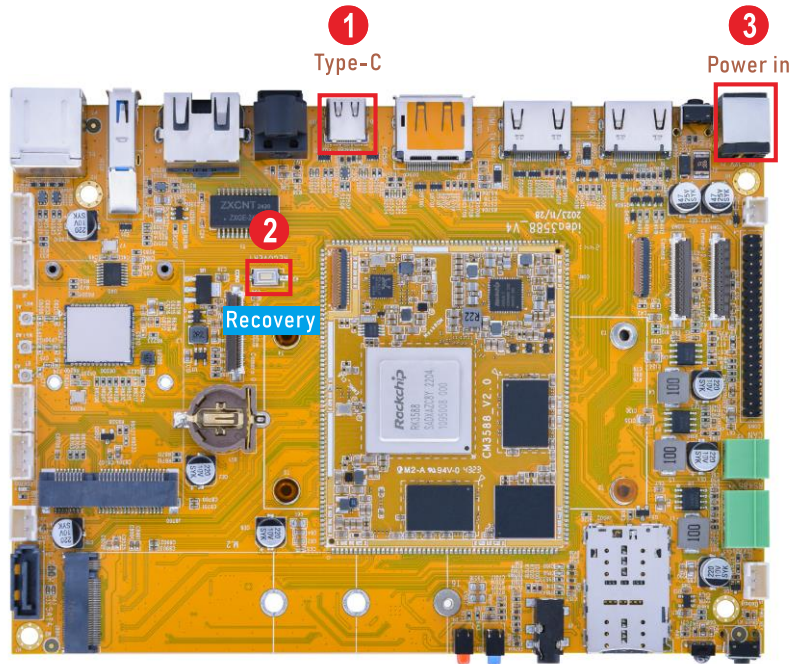
3.1.1.1 Hardware

Step 1: Disconnect the power adapter.

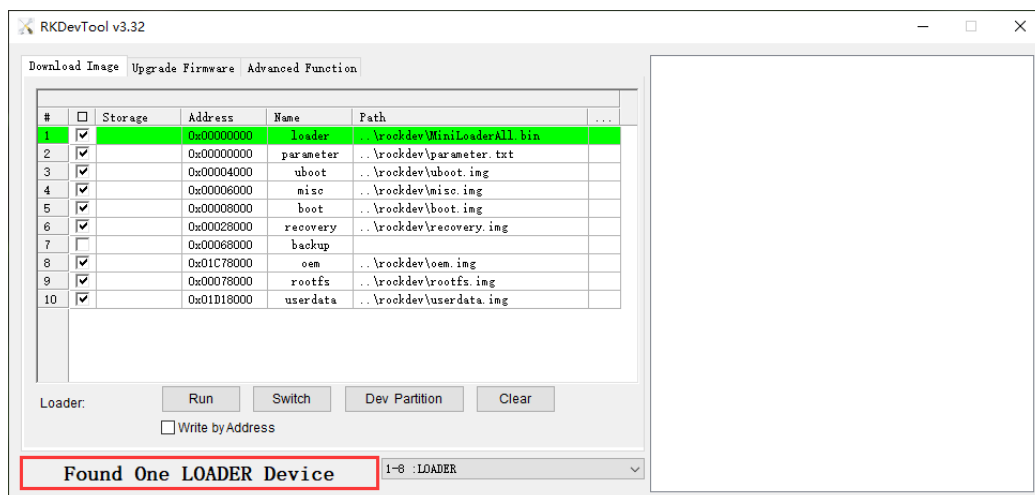
Step 2: Connect one end of the Type_C cable to the host and the other end to the development board.

Step 3: Press and hold the **Recovery** button on the board

Step 4: Connect the power supply.



Step 5: After a few seconds, release the **Recovery** button when the flashing tool shows “**Found one LOADER Device**”.



3.1.1.2 Software

After connecting the Type_C USB cable, execute the following command in the serial debug terminal or adb shell.

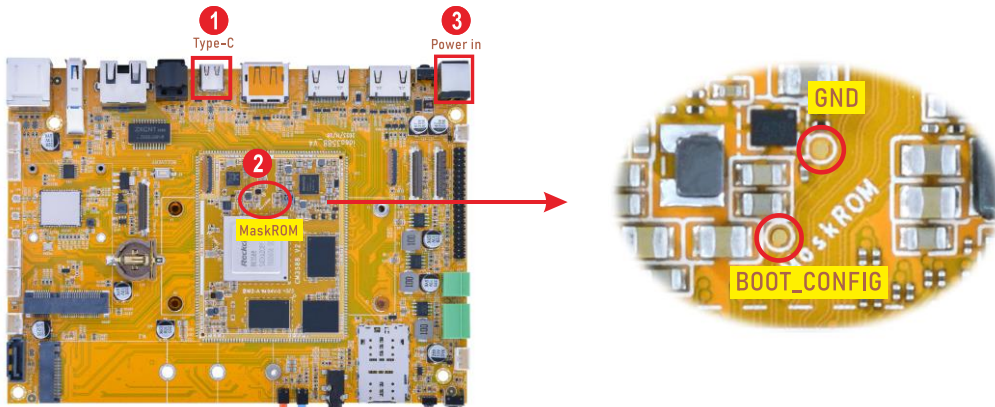
```
# reboot loader
```

3.1.2 How to Enter MaskRom Mode

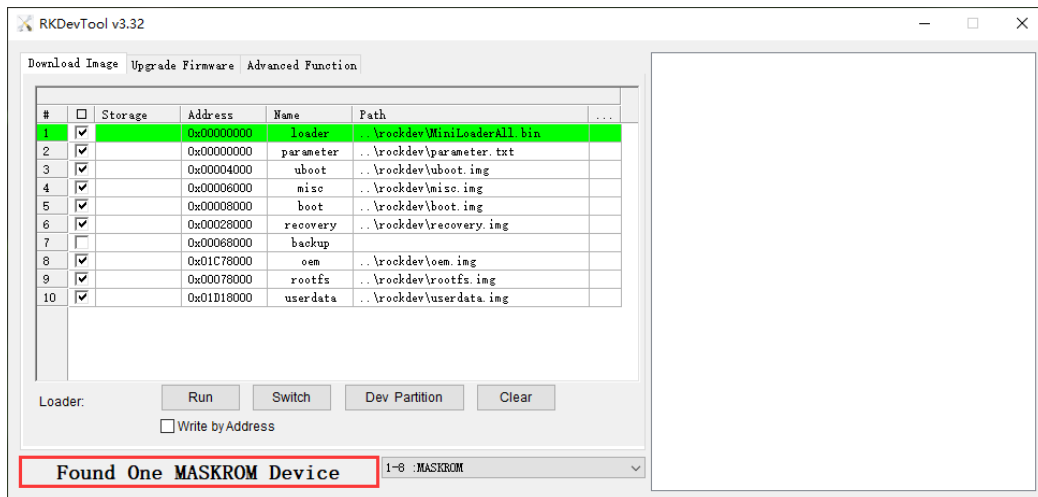
Step 1: Disconnect the power adapter.

Step 2: Connect one end of the Type_C cable to the host and the other end to the development board.

Step 3: Use tweezers to short the two test points on the CM3588.



Step 4: After connecting the power cable, the device will enter MaskRom mode.



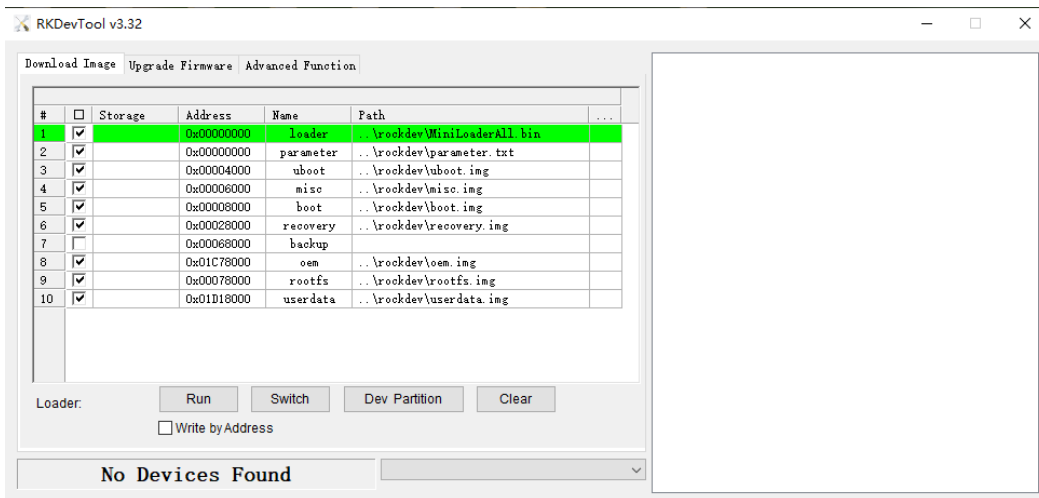
3.2 Firmware Flashing

Environment: Windows OS (Operating System).

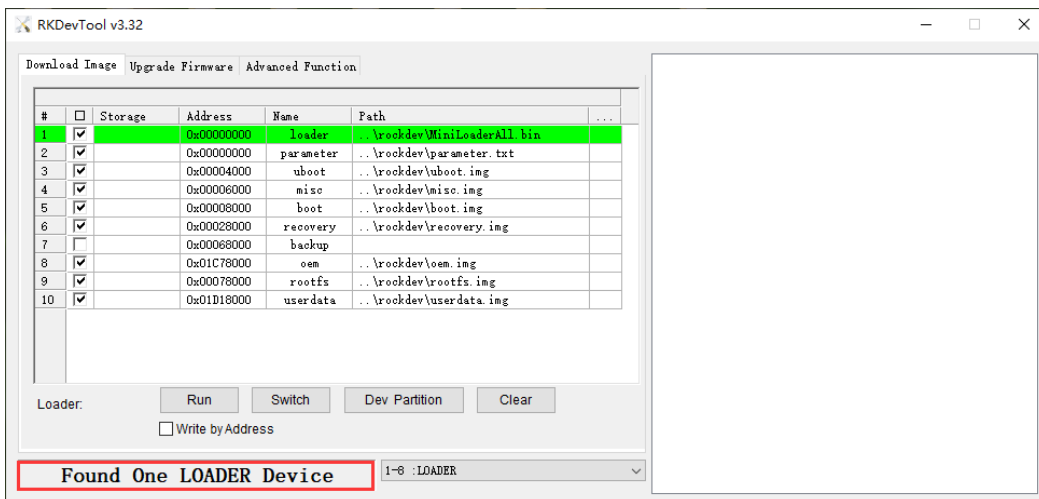
3.2.1 Flash Full Firmware Image

Step 1: Unzip *RKDevTool.rar* on Windows.

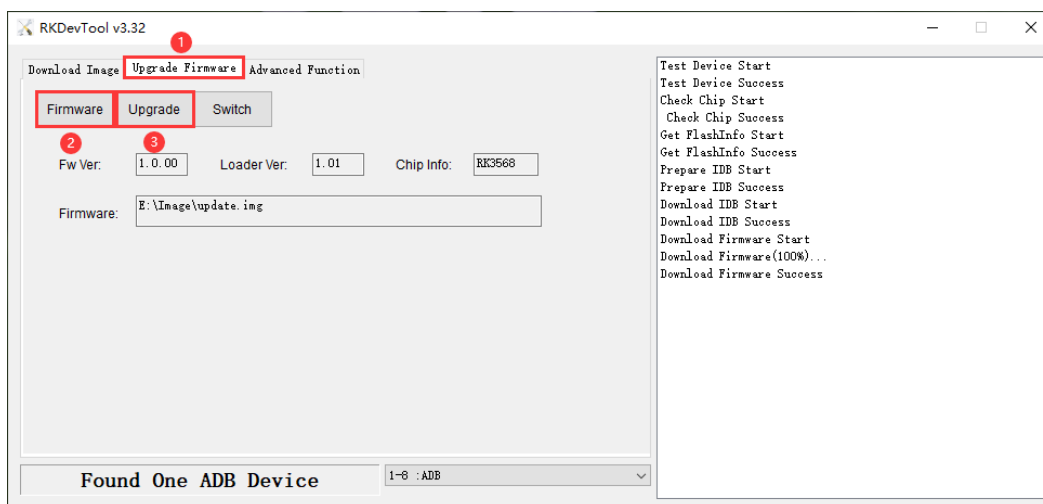
Step 2: Open *RKDevTool\RKDevTool_Release\RKDevTool.exe*.



Step 3: Switch to loader mode. ([How to Enter Loader Mode](#))



Step 4: Click **Upgrade Firmware** -> **Firmware**, select **update.img**, then click **Upgrade** to flash.



After the flashing is complete, the board will automatically reboot.

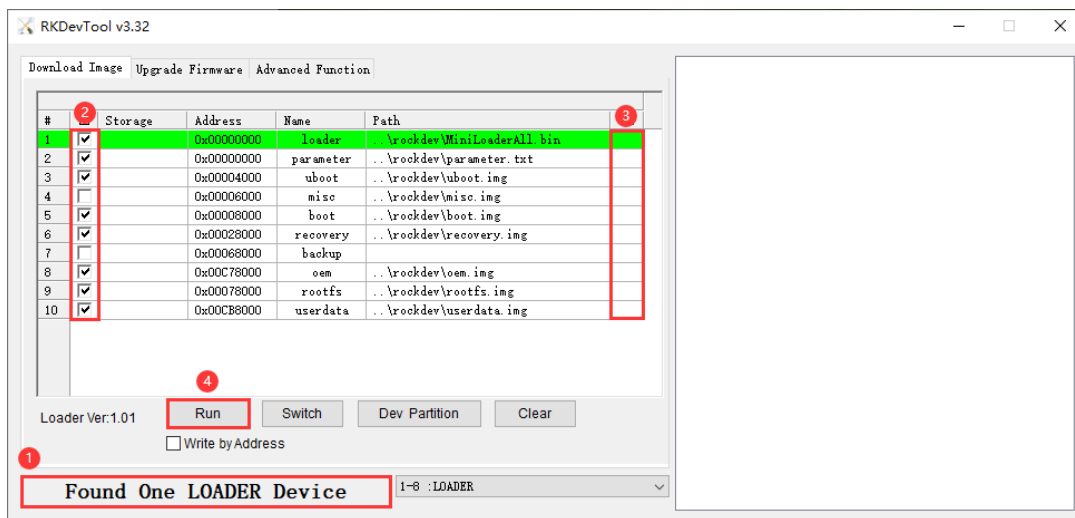
3.2.2 Flash Separate Partition Images

Step 1: Switch to **Loader mode**.

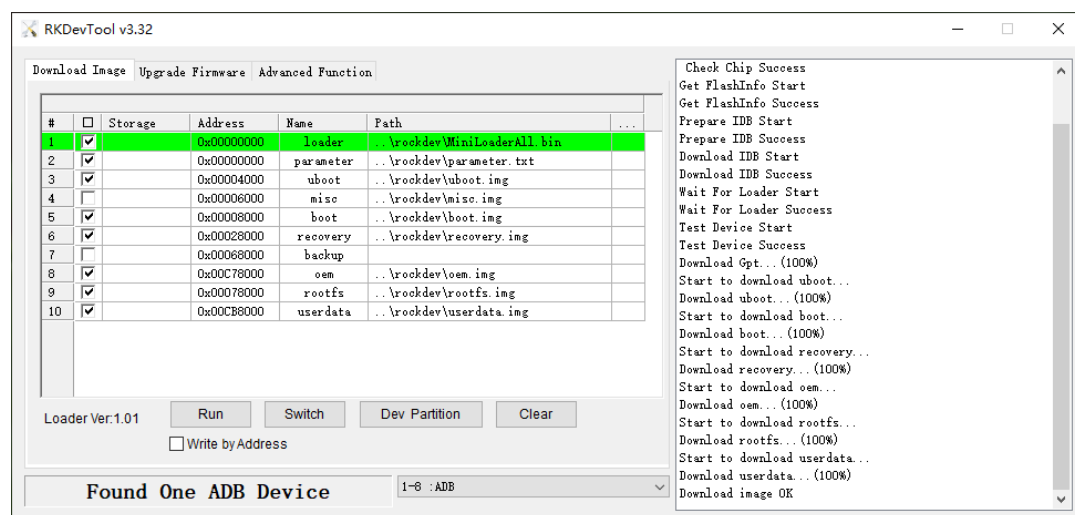
Step 2: Check the partitions to be flashed, multiple partitions can be selected.

Step 3: Ensure the image file path is correct. If necessary, click the blank cell next to the path to reselect it.

Step 4: Click the **Run** button to flash the image.



After the flashing is complete, the board will automatically reboot.



Note

① Without burning the **parameter.txt** file, please check the **"Write by Address"** checkbox, otherwise the flashing may fail with the **"Image is larger than partition size"** error.

4. Development Environment

4.1 Preparing the Development Environment

It is recommended to use Ubuntu 22.04 or higher version for compilation. If you encounter an error during compilation, user can check the error message and install the corresponding software packages accordingly. Other Linux versions may need to adjust the software package accordingly. In addition to the system requirements, there are other hardware and software requirements.

Hardware requirements	Software requirements
64-bit system, hard disk space should be greater than 150G. If you do multiple builds, you will need more hard drive space.	Ubuntu 22.04

4.2 Installing Libraries and Toolkits

The contents of this directory only provide the software package installation commands that are needed to build the compiled SDK environment. Please install other tools such as samba and ssh yourself.

PC OS	Network	Permission
Ubuntu 22.04	online	root

To install the required tools, execute the following commands:

```
$ sudo apt-get install git ssh make gcc libssl-dev liblz4-tool libmpc-dev
$ sudo apt-get install expect g++ patchelf chrpath gawk texinfo chrpath diffstat
$ sudo apt-get install binfmt-support live-build bison flex fakeroot libgmp-dev
$ sudo apt-get install cmake gcc-multilib g++-multilib unzip device-tree-compiler
$ sudo apt-get install ncurses-dev libgucharmap-2-90-dev bzip2 expat gpgv2
$ sudo apt-get install cpp-aarch64-linux-gnu g++-aarch64-linux-gnu
$ sudo apt install python2 python-is-python3
```

5.Compile Source

Step 1: Unzip the Source

To extract the source files, execute the following commands:

```
$ tar xvf rk3588-linux6.1-rkr7.tar.bz2
$ cd rk3588-linux6.1-rkr7
```

Step 2: Configure the Compiled Board

To configure the board, execute:

```
$ ./build.sh lunch
```

After executing **./build.sh lunch**, the system will list available defconfig files. Select the 3th option: **3. boardcon_idea3588_defconfig**, this configuration ensures hardware compatibility with the Idea3588 development board. Using other options may cause kernel mismatches and prevent proper booting.

```
xuejunchao@boardcon:~/3588/rk3588-linux6.1-rkr7$ ./build.sh lunch
Log colors: message notice warning error fatal

Log saved at /home/xuejunchao/3588/rk3588-linux6.1-rkr7/output/sessions/2026-06-04_14-25-56
Pick a defconfig:

1. rockchip_defconfig
2. boardcon_em3588_defconfig
3. boardcon_idea3588_defconfig
4. boardcon_sbc3588_defconfig
5. rockchip_rk3588_evb10_v10_defconfig
6. rockchip_rk3588_evb1_lp4_v10_amp_defconfig
7. rockchip_rk3588_evb1_lp4_v10_defconfig
8. rockchip_rk3588_evb1_lp4_v10_mcu_defconfig
9. rockchip_rk3588_evb7_v11_defconfig
10. rockchip_rk3588_ipc_evb1_v10_defconfig
11. rockchip_rk3588_ipc_evb7_lp4_v11_defconfig
12. rockchip_rk3588_multi_ipc_evb1_v10_defconfig
13. rockchip_rk3588s_evb1_lp4x_v10_defconfig
Which would you like? [1]: 3
Switching to defconfig:
/home/xuejunchao/3588/rk3588-linux6.1-rkr7/device/rockchip/.chip/boardcon_idea3588_defconfig
#
# configuration written to /home/xuejunchao/3588/rk3588-linux6.1-rkr7/output/.config
#
Using last kernel version(6.1)
```

Step 3: Compile U-Boot

To compile uboot, execute the following command:

```
$ ./build.sh uboot
```

Step 4: Compile Kernel

To compile kernel, execute the following command:

```
$ ./build.sh kernel
```

Step 5: Compile Recovery

To compile recovery, execute the following command:

```
$ ./build.sh recovery
```

Step 6: Compile rootfs

(1) Compile Debian12 (Permission: root)

To compile debian12, execute the following command:

```
$ sudo ./build.sh debian
```

After compilation, a **linaro-rootfs.img** is generated in the *debian/* directory.

Note: Related dependencies must be installed beforehand.

```
$ cd debian
$ sudo apt-get install binfmt-support qemu-user-static live-build
$ sudo dpkg -i ubuntu-build-service/packages/*
$ sudo apt-get install -f
```

(2) Compile Buildroot

To compile buildroot, execute the following command:

```
$ ./build.sh buildroot
```

Step 7: Generate and Check Firmwares

To generate firmware, execute the following command:

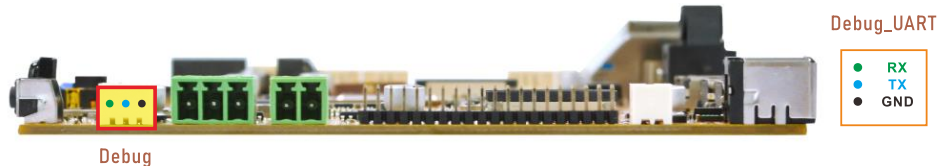
```
$ ./build.sh firmware
```

Images and **update.img** are generated in *rockdev/* directory.

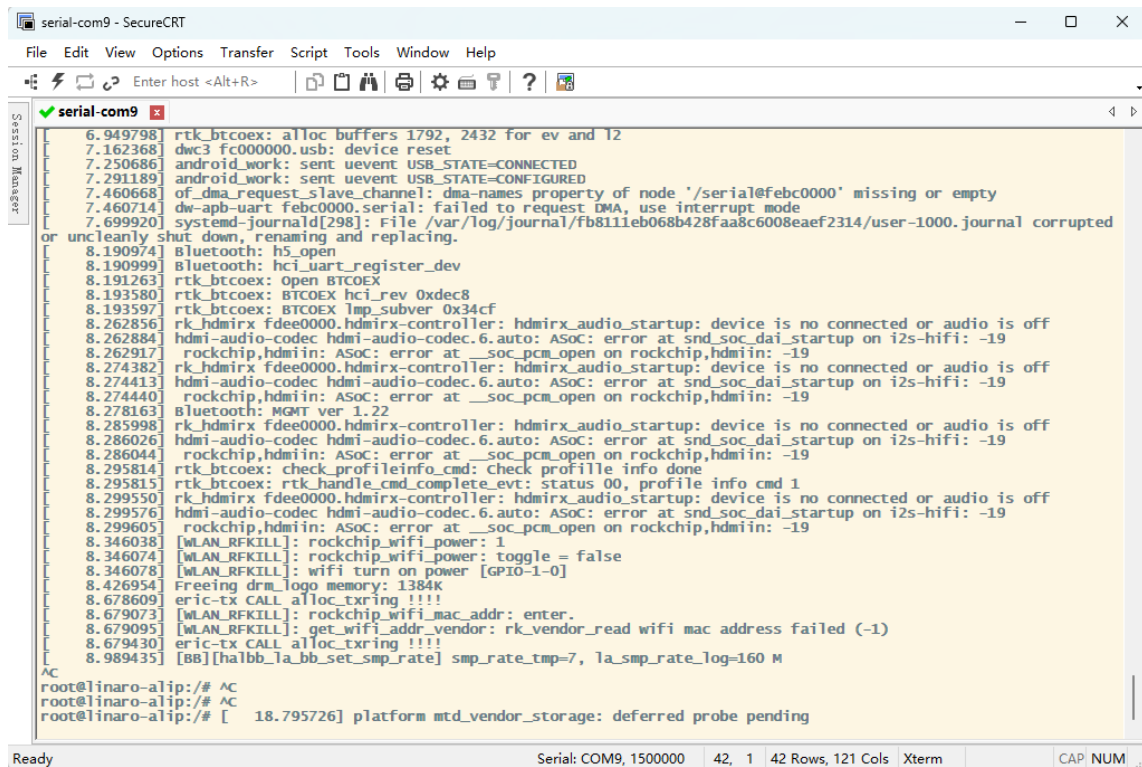
6. Debian12 Test

Account: [linaro](#)
 Password: [linaro](#)

6.1 Serial Terminal



Connect the board and PC with USB Serial cable, then power on, the terminal will output boot information. The default baudrate is 1500000.



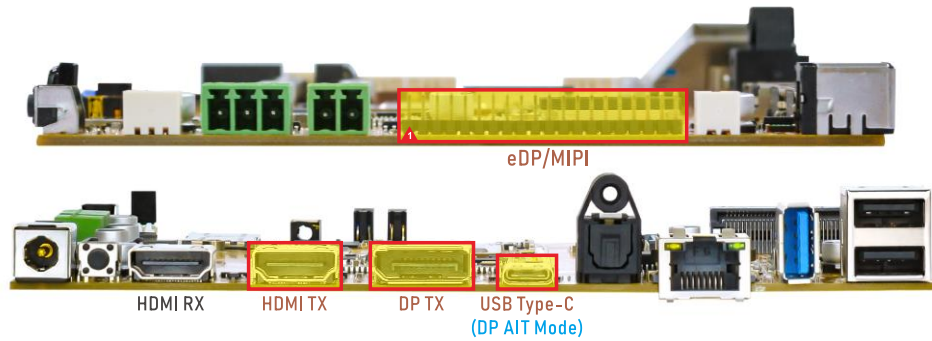
```

6.949798 rtk_btcoex: alloc buffers 1792, 2432 for ev and l2
7.162368 dwc3_fc000000.usb: device reset
7.250686 android_work: sent uevent USB_STATE=CONNECTED
7.291189 android_work: sent uevent USB_STATE=CONFIGURED
7.460668 of_dma_request_slave_channel: dma-names property of node '/serial@febc0000' missing or empty
7.460714 dw-apb-uart febc0000.serial: failed to request DMA, use interrupt mode
7.699920 systemd-journald[298]: File /var/log/journal/fb8111eb068b428faa8c6008eaeef2314/user-1000.journal corrupted
or uncleanly shut down, renaming and replacing.
8.190974 Bluetooth: h5_open
8.190999 Bluetooth: hci_uart_register_dev
8.191263 rtk_btcoex: Open BTCOEEX
8.193580 rtk_btcoex: BTCOEEX hci_rev 0xdec8
8.193597 rtk_btcoex: BTCOEEX lmp_subver 0x34cf
8.262856 rk_hdmirx_fdee0000.hdmirx-controller: hdmirx_audio_startup: device is no connected or audio is off
8.262884 hdmirx-audio-codec hdmirx-audio-codec.6.auto: ASOC: error at snd_soc_dai_startup on i2s-hifi: -19
8.262917 rockchip,hdmirx: ASOC: error at __soc_pcm_open on rockchip,hdmirx: -19
8.274382 rk_hdmirx_fdee0000.hdmirx-controller: hdmirx_audio_startup: device is no connected or audio is off
8.274413 hdmirx-audio-codec hdmirx-audio-codec.6.auto: ASOC: error at snd_soc_dai_startup on i2s-hifi: -19
8.274440 rockchip,hdmirx: ASOC: error at __soc_pcm_open on rockchip,hdmirx: -19
8.278163 Bluetooth: MGMT ver 1.22
8.285998 rk_hdmirx_fdee0000.hdmirx-controller: hdmirx_audio_startup: device is no connected or audio is off
8.286026 hdmirx-audio-codec hdmirx-audio-codec.6.auto: ASOC: error at snd_soc_dai_startup on i2s-hifi: -19
8.286044 rockchip,hdmirx: ASOC: error at __soc_pcm_open on rockchip,hdmirx: -19
8.295814 rtk_btcoex: check_profileinfo_cmd: check profile info done
8.295815 rtk_btcoex: rtk_handle_cmd_complete_evt: status 00, profile info cmd 1
8.295550 rk_hdmirx_fdee0000.hdmirx-controller: hdmirx_audio_startup: device is no connected or audio is off
8.295576 hdmirx-audio-codec hdmirx-audio-codec.6.auto: ASOC: error at snd_soc_dai_startup on i2s-hifi: -19
8.299605 rockchip,hdmirx: ASOC: error at __soc_pcm_open on rockchip,hdmirx: -19
8.346038 [WLAN_RFKILL]: rockchip_wifi_power: 1
8.346074 [WLAN_RFKILL]: rockchip_wifi_power: toggle = false
8.346078 [WLAN_RFKILL]: wifi turn on power [GPIO-1-0]
8.426954 Freeing drm_logo memory: 1384K
8.678609 eric-tx CALL alloc_txring !!!!
8.679073 [WLAN_RFKILL]: rockchip_wifi_mac_addr: enter.
8.679095 [WLAN_RFKILL]: get_wifi_addr_vendor: rk_vendor_read wifi mac address failed (-1)
8.679430 eric-tx CALL alloc_txring !!!!
8.989435 [BB][halbb_la_bb_set_smp_rate] smp_rate_tmp=7, la_smp_rate_log=160 M

AC
root@linaro-alip:/# AC
root@linaro-alip:/# AC
root@linaro-alip:/# [ 18.795726] platform mtd_vendor_storage: deferred probe pending
  
```

6.2 Display

The Idea3588 supports triple independent displays, with default support for HDMI, eDP, and DP TX interfaces, and also supports asynchronous display.



The display effect diagram is as follows:



Note

- ① DP TX and DP AIT mode interface share the VP resources and cannot be used simultaneously.
- ② DP AIT mode does not support logo display.

6.3 HDMI RX



After connecting the HDMI OUT port of the source device to the HDMI IN port of the Idea3588, execute the following commands to start the preview.

- **View the HDMI RX video node:**

```
# grep -H hdmirx /sys/class/video4linux/video*/name
```

```
root@linaro-alip:/# grep -H hdmirx /sys/class/video4linux/video*/name  
/sys/class/video4linux/video40/name:stream_hdmirx
```

- **Check supported resolutions and formats:**

```
# v4l2-ctl -d /dev/video40 --all
```

```

root@linaro-alip:/# v4l2-ctl -d /dev/video40 --all
Driver Info:
  Driver name      : rk_hdmirx
  Card type        : rk_hdmirx
  Bus info         : fdee0000.hdmirx-controller
  Driver version   : 6.1.141
  Capabilities     : 0x84201000
                    Video Capture Multiplanar
                    Streaming
                    Extended Pix Format
                    Device Capabilities
  Device Caps      : 0x04201000
                    Video Capture Multiplanar
                    Streaming
                    Extended Pix Format

Priority: 2
DV timings:
  Active width: 1920
  Active height: 1080
  Total width: 2200
  Total height: 1125
  Frame format: progressive
  Polarities: -vsync -hsync
  Pixelclock: 148500000 Hz (60.00 frames per second)
  Horizontal frontporch: 88
  Horizontal sync: 44
  Horizontal backporch: 148
  Vertical frontporch: 4
  Vertical sync: 5
  Vertical backporch: 36
  Standards:
  Flags:
DV timings capabilities:
  Minimum Width: 640
  Maximum Width: 4096
  Minimum Height: 480
  Maximum Height: 2160
  Minimum PClock: 20000000
  Maximum PClock: 600000000
  Standards: CTA-861
  Capabilities: Interlaced, Progressive
Format Video Capture Multiplanar:
  Width/Height      : 1920/1080
  Pixel Format       : 'NV24' (Y/UV 4:4:4)
  Field              : None
  Number of planes   : 1
  Flags              : premultiplied-alpha, 0x000000fe
  Colorspace         : Default
  Transfer Function   : Unknown (0x000000b8)
  YCbCr/HSV Encoding: xvYCC 601
  Quantization       : Limited Range
  Plane 0            :
                    Bytes per Line : 1920
                    Size Image      : 6220800

User Controls
      audio_sampling_rate 0x00981a80 (int) : min=0 max=768000 step=1 default=0 value=44100
flags=read-only, volatile
      audio_present 0x00981a81 (bool) : default=0 value=0 flags=read-only, volatile

Digital Video Controls
      power_present 0x00a00964 (bitmask): max=0x00000001 default=0x00000000 value=1
flags=read-only

```

• Video Preview:

```

# gst-launch-1.0 v4l2src device=/dev/video40 !
video/x-raw,format=NV24,width=1920,height=1080 ! videoconvert !
video/x-raw,format=I420 ! xvimagesink sync=false

```

```
root@linaro-alip:/# gst-launch-1.0 v4l2src device=/dev/video40 !
video/x-raw,format=NV24,width=1920,height=1080 ! videoconvert ! video/x-raw,format=I420 ! xvimagesink
sync=false
[ 115.856734] dw9714 2-000c: cmd 0x80685600 not supported
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
[ 115.936373] fdee0000.hdmirx-controller: hdmirx_start_streaming: delay_line:720
Redistribute latency...
[ 117.124995] fdee0000.hdmirx-controller: rcv frames
0:00:04.4 / 99:99:99.
```

- **Capture Audio from DP Output:**

```
# gst-launch-1.0 alsasrc device=hw:rockchipdmiin,0 ! audioconvert ! audioresample !
queue ! alsasink device=hw:rockchipdp1
```

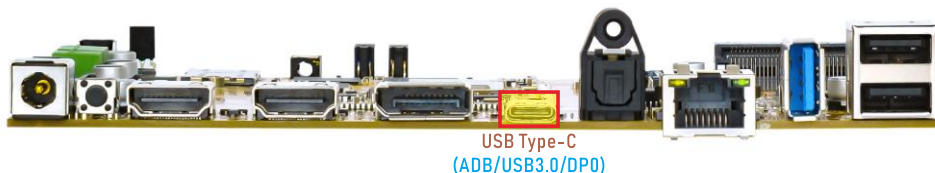
```
root@linaro-alip:/# gst-launch-1.0 alsasrc device=hw:rockchipdmiin,0 ! audioconvert ! audioresample ! queue !
alsasink device=hw:rockchipdp1
Setting pipeline to PAUSED ...-1.0 alsasrc device=hw:rockchipdmiin,0 ! audioconvert ! audioresample ! queue !
alsasink device=hw:rockchipdp1
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstAudioSrcClock
Redistribute latency...
Redistribute latency...
Redistribute latency...
0:00:05.4 / 99:99:99.
```

Parameter Description:

```
Audio Output:
* device=hw:rockchipes8388 /* Headset audio output */
* device=hw:rockchipdmi0 /* HDMI TX audio output */
* device=hw:rockchipdp0 /* DP AIT mode audio output */
* device=hw:rockchipdp1 /* DP TX audio output */

v4l2-ctl:
* v4l2-ctl -d /dev/video40 --get-fmt-video /* Get current video format */
* v4l2-ctl -d /dev/video40 --query-dv-timings /* Query supported DV timings */
* v4l2-ctl -d /dev/video40 --get-dv-timings /* Get current DV timing */
* v4l2-ctl -d /dev/video40 -D /* Display device information */
```

6.4 USB Type-C



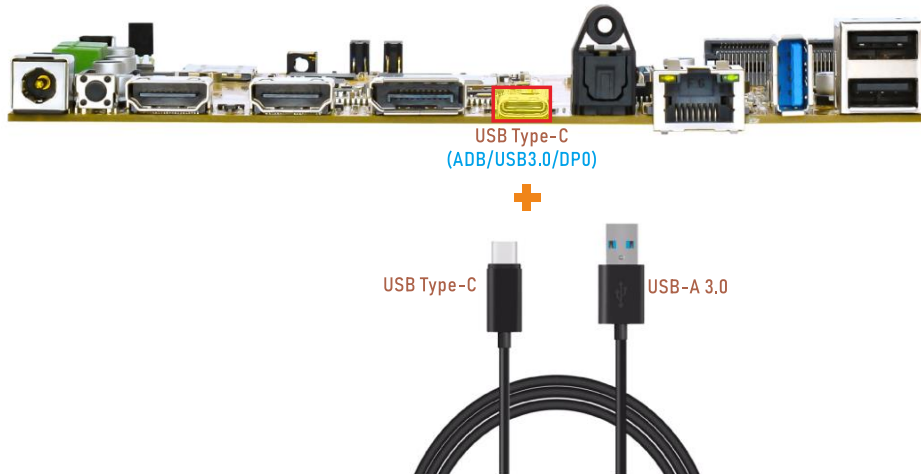
Features Supported by the Type-C Interface:

- **Reversible Design:** Allows insertion in either orientation for user convenience.
- **Data Transmission Roles:** Supports flexible designation of host and device roles.

- **Multiple Protocol Support:** Compatible with USB 3.0 and DisplayPort, enabling high-speed data transmission.

6.4.1 ADB

Step 1: Connect the board and PC host with Type-C cable.

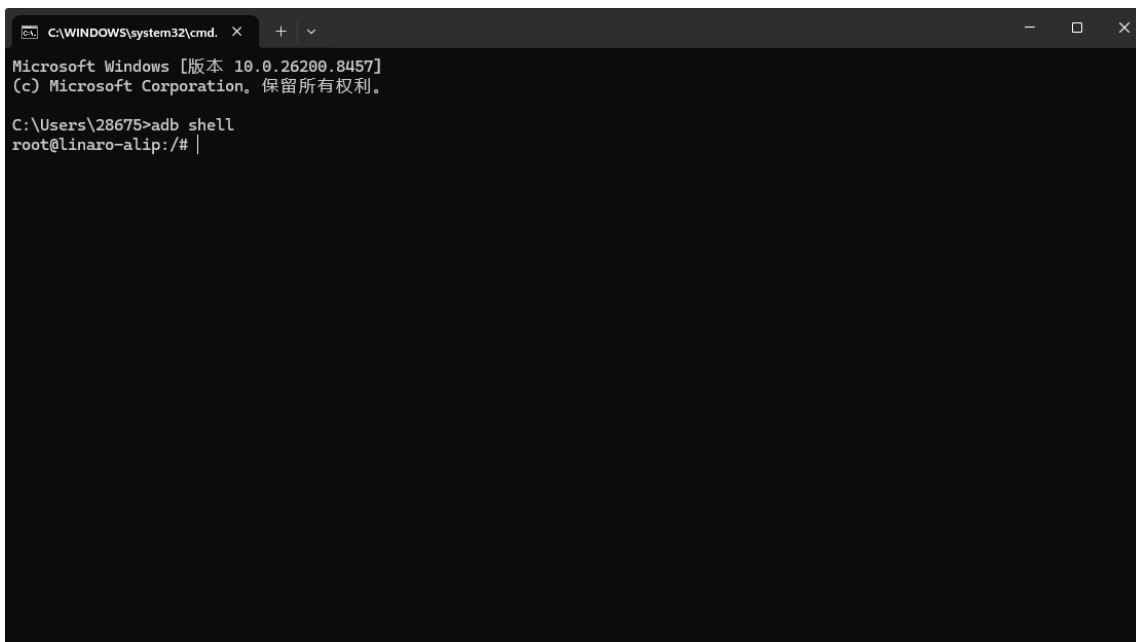


Step 2: Install ADB driver on Windows system.

Step 3: Press **Windows + R** to open the Run program. Type “cmd” and press Enter.

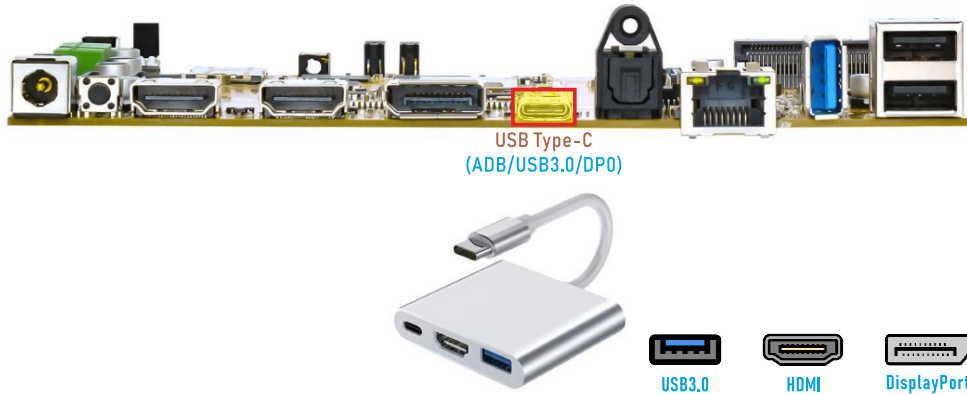
Step 4: Execute the following command to enable ADB.

```
# adb shell
```



6.4.2 Type-C to USB3.0

Step 1: Connect the Type-C to USB3.0 converter to the Type-C port of the development board, and then insert the USB3.0 flash drive into the USB3.0 port of the docking station.

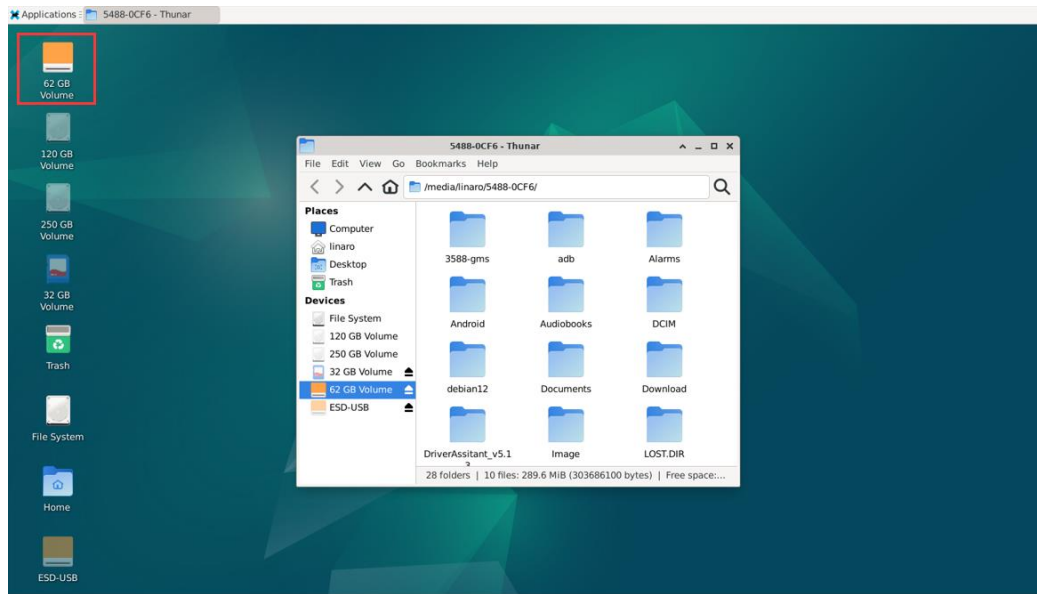


The serial port of the terminal will display the following message, indicating that the USB3.0 device is successfully recognized.

```
root@linaro-alip:/# [ 129.552267] dwc3 fc000000.usb: request 00000000252d83d1 was not queued to ep0out
[ 129.553631] android_work: did not send uevent (0 0 0000000000000000)
[ 129.659271] xhci-hcd xhci-hcd.13.auto: xHCI Host Controller
[ 129.659614] xhci-hcd xhci-hcd.13.auto: new USB bus registered, assigned bus number 8
[ 129.659764] xhci-hcd xhci-hcd.13.auto: hcc params 0x0220fe64 hci version 0x110 quirks 0x0000808002010010
[ 129.659800] xhci-hcd xhci-hcd.13.auto: irq 71, io mem 0xfc000000
[ 129.659915] xhci-hcd xhci-hcd.13.auto: xHCI Host Controller
[ 129.660236] xhci-hcd xhci-hcd.13.auto: new USB bus registered, assigned bus number 9
[ 129.660250] xhci-hcd xhci-hcd.13.auto: Host supports USB 3.0 SuperSpeed
[ 129.660355] usb usb8: New USB device found, idVendor=1d6b, idProduct=0002, bcdDevice= 6.01
[ 129.660367] usb usb8: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 129.660377] usb usb8: Product: xHCI Host Controller
[ 129.660386] usb usb8: Manufacturer: Linux 6.1.84 xhci-hcd
[ 129.660395] usb usb8: SerialNumber: xhci-hcd.13.auto
[ 129.660936] hub 8-0:1.0: USB hub found
[ 129.660962] hub 8-0:1.0: 1 port detected
[ 129.661194] usb usb9: We don't know the algorithms for LPM for this host, disabling LPM.
[ 129.661257] usb usb9: New USB device found, idVendor=1d6b, idProduct=0003, bcdDevice= 6.01
[ 129.661268] usb usb9: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 129.661277] usb usb9: Product: xHCI Host Controller
[ 129.661285] usb usb9: Manufacturer: Linux 6.1.84 xhci-hcd
[ 129.661294] usb usb9: SerialNumber: xhci-hcd.13.auto
[ 129.661684] hub 9-0:1.0: USB hub found
[ 129.661706] hub 9-0:1.0: 1 port detected
[ 129.995418] usb 9-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 130.026189] usb 9-1: New USB device found, idVendor=0dd8, idProduct=3b00, bcdDevice= 0.02
[ 130.026217] usb 9-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 130.026228] usb 9-1: Product: OnlyDisk
[ 130.026237] usb 9-1: Manufacturer: Netac
[ 130.026246] usb 9-1: SerialNumber: 0A6544CD10427AB2
[ 130.028505] usb-storage 9-1:1.0: USB Mass Storage device detected
[ 130.029653] scsi host1: usb-storage 9-1:1.0
[ 131.173600] scsi 1:0:0:0: Direct-Access Netac OnlyDisk 8.01 PQ: 0 ANSI: 6
[ 131.180010] sd 1:0:0:0: [sdb] 121610240 512-byte logical blocks: (62.3 GB/58.0 GiB)
[ 131.180855] sd 1:0:0:0: [sdb] Write Protect is off
[ 131.181226] sd 1:0:0:0: [sdb] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 131.188030] sdb: sdb1
[ 131.188483] sd 1:0:0:0: [sdb] Attached SCSI removable disk
```

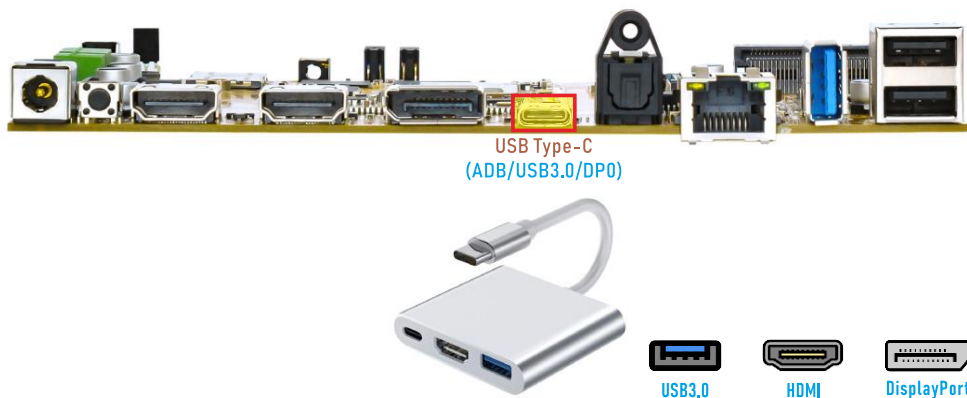
Step 2: After inserting the USB3.0 flash drive, if it is recognized successfully, an icon will appear on the desktop. Users need to click the icon in order to access the files on the

USB3.0 flash drive.



6.4.3 DP Alt Mode

DisplayPort Alternate Mode (DP Alt Mode) is a technology that facilitates the transmission of DisplayPort video signals through a USB Type-C interface. It enables devices to output video and audio via a USB-C connection without requiring a dedicated DisplayPort connector. This allows users to connect a display using a single USB-C port while transmitting video, audio, and additional data.



Currently, Boardcon has conducted the following output tests:

- **Type-C to HDMI:** Supports 3840x2160p60 resolution.
- **Type-C to DisplayPort (DP):** Supports 3840x2160p60 resolution.



6.5 Ethernet

Step 1: Connect the network cable to the Ethernet port.



According to the log, it can be seen that the Gigabit Ethernet recognition is successful.

```
root@linaro-alip:/# [ 25.032312] rk_gmac-dwmac fe1c0000.ethernet end1: Link is Up - 1Gbps/Full - flow control rx/tx
[ 25.032455] IPv6: ADDRCONF(NETDEV_CHANGE): end1: link becomes ready
```

Step 2: View network interface information.

```
# ifconfig end1
```

```
root@linaro-alip:/# ifconfig end1
end1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.114 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::b809:8ba1:7a0c:4602 prefixlen 64 scopeid 0x20<link>
    ether 8a:64:ef:69:ea:d3 txqueuelen 1000 (Ethernet)
    RX packets 251 bytes 32328 (31.5 KiB)
    RX errors 0 dropped 8 overruns 0 frame 0
    TX packets 144 bytes 13026 (12.7 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
    device interrupt 69
```

Step 3: Network connection test.

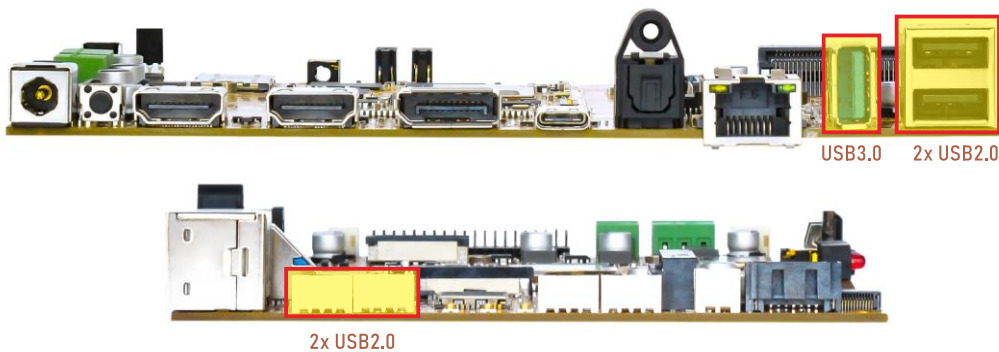
```
# ping -I end1 www.armdesigner.com
```

```

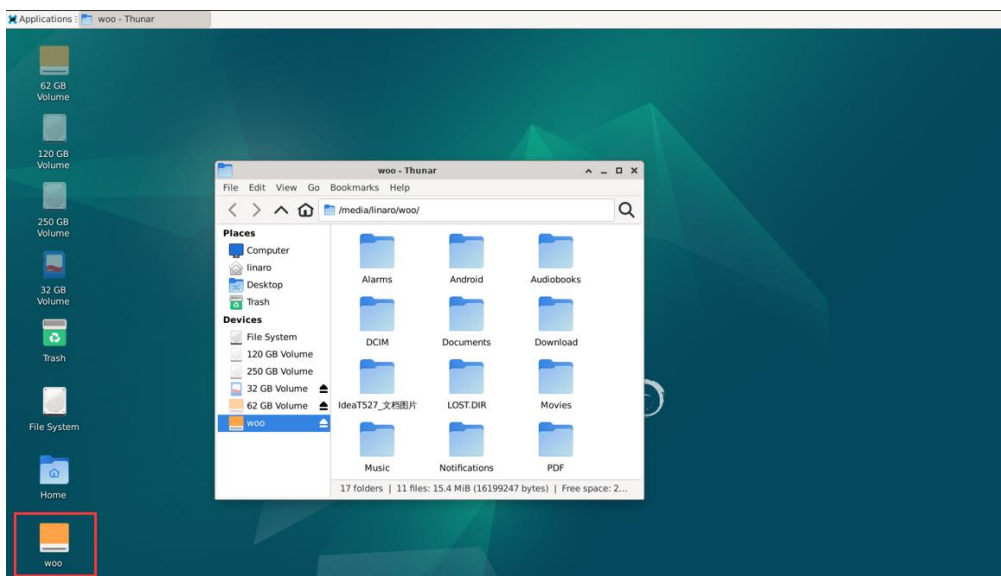
root@linaro-alip:/# ping -I end1 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.114 end1: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=48 time=180 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=48 time=180 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=8 ttl=48 time=180 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=9 ttl=48 time=185 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=10 ttl=48 time=179 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=11 ttl=48 time=180 ms
^C
--- www.armdesigner.com ping statistics ---
12 packets transmitted, 11 received, 8.33333% packet loss, time 11009ms
rtt min/avg/max/mdev = 179.233/180.087/185.473/1.725 ms
  
```

6.6 USB Host

The USB host can be used to connect devices such as USB mouse, USB keyboards, USB flash drives, and other USB peripherals.



After connecting the USB flash drive, if the device is successfully recognized, an icon will appear on the desktop. Users need to click the icon in order to access the files on the device.



The user can identify whether the mounted flash drive is USB 2.0 or USB 3.0 from the debug log.

- USB2.0 print information in **high-speed** mode.

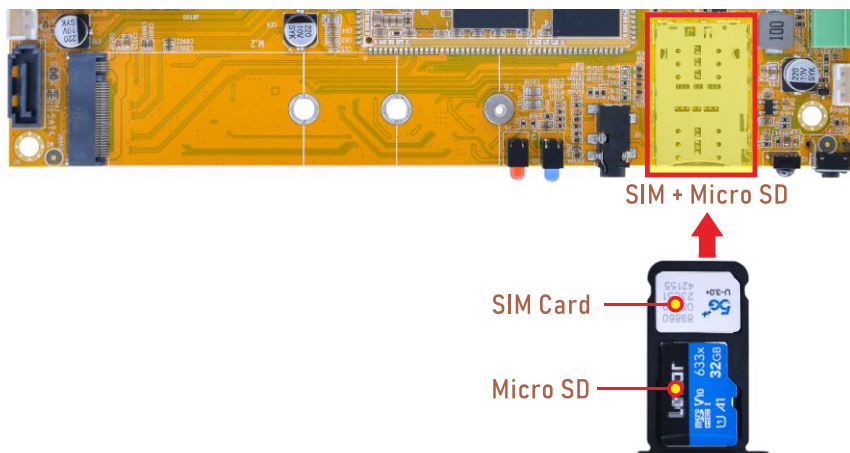
```
root@linaro-alip:/# [ 140.487516] usb 3-1.4: new high-speed USB device number 5 using xhci-hcd
[ 140.641006] usb 3-1.4: New USB device found, idVendor=0dd8, idProduct=3b00, bcdDevice= 0.02
[ 140.641046] usb 3-1.4: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 140.641063] usb 3-1.4: Product: OnlyDisk
[ 140.641075] usb 3-1.4: Manufacturer: Netac
[ 140.641087] usb 3-1.4: SerialNumber: EDD6D7C3ADB1480A
[ 140.642933] usb-storage 3-1.4:1.0: USB Mass Storage device detected
[ 140.643671] scsi host2: usb-storage 3-1.4:1.0
[ 141.693527] scsi 2:0:0:0: Direct-Access    Netac    OnlyDisk        8.01 PQ: 0 ANSI: 6
[ 141.700001] sd 2:0:0:0: [sdc] 60825600 512-byte logical blocks: (31.1 GB/29.0 GiB)
[ 141.700661] sd 2:0:0:0: [sdc] Write Protect is off
[ 141.701129] sd 2:0:0:0: [sdc] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 141.708229]   sdc: sdc1 sdc2
[ 141.708953] sd 2:0:0:0: [sdc] Attached SCSI removable disk
```

- USB3.0 print information in **SuperSpeed** mode.

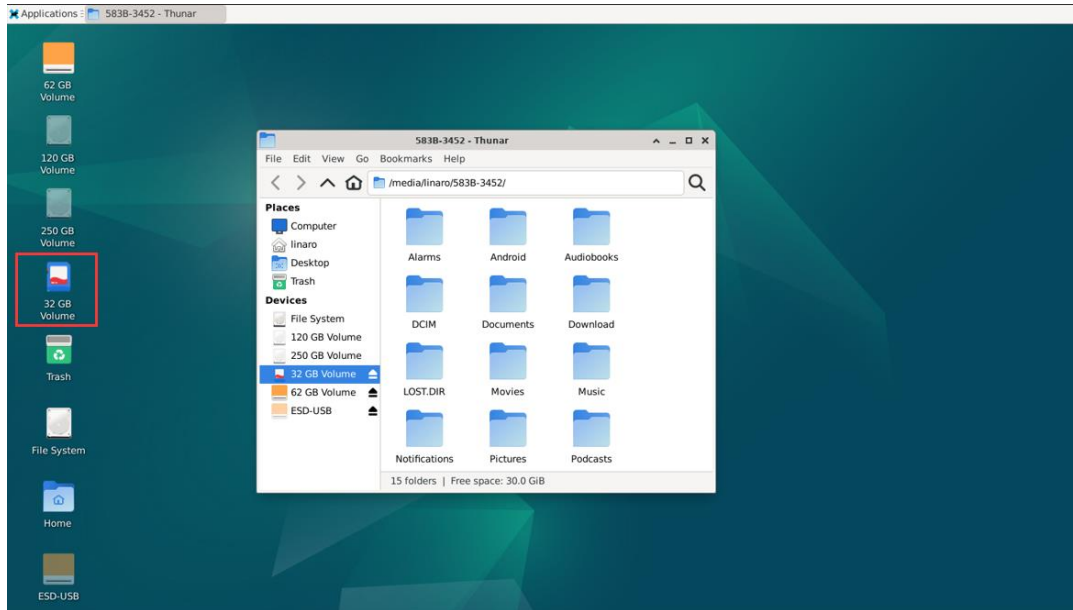
```
root@linaro-alip:/# [ 101.420059] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 101.450692] usb 2-1: New USB device found, idVendor=0dd8, idProduct=3b00, bcdDevice= 0.02
[ 101.450721] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 101.450732] usb 2-1: Product: OnlyDisk
[ 101.450741] usb 2-1: Manufacturer: Netac
[ 101.450749] usb 2-1: SerialNumber: 0A6544CD10427AB2
[ 101.452230] usb-storage 2-1:1.0: USB Mass Storage device detected
[ 101.453129] scsi host1: usb-storage 2-1:1.0
[ 102.598813] scsi 1:0:0:0: Direct-Access    Netac    OnlyDisk        8.01 PQ: 0 ANSI: 6
[ 102.605168] sd 1:0:0:0: [sdb] 121610240 512-byte logical blocks: (62.3 GB/58.0 GiB)
[ 102.605892] sd 1:0:0:0: [sdb] Write Protect is off
[ 102.606448] sd 1:0:0:0: [sdb] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 102.614922]   sdb: sdb1
[ 102.615644] sd 1:0:0:0: [sdb] Attached SCSI removable disk
```

6.7 SD Card

Step 1: Insert the micro SD card into the card slot.

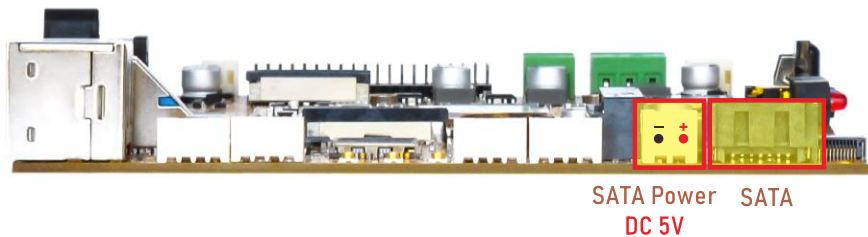


Step 2: After inserting the SD card, if it is recognized successfully, an icon will appear on the desktop. Users need to click the icon in order to access the SD card.

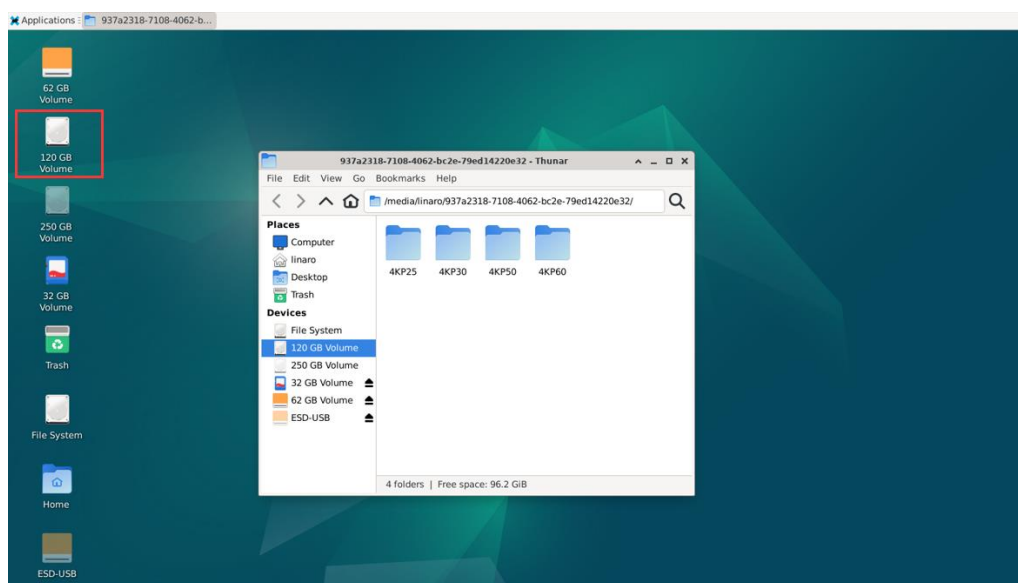


6.8 SATA

Step 1: Connect the sata and sata power, then power on.



Step 2: If the SATA device is successfully recognized, an icon will appear on the desktop. Users can click the icon to access the SATA device.



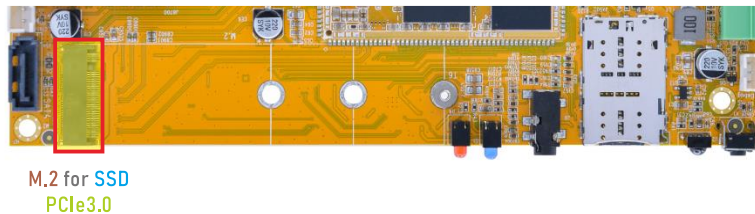
Note: The SATA on Debian 12 only supports the ext4 format. If devices that are not in

ext4 format, the user can choose to format them on the board. After formatting, **the files on the device will be permanently lost**, so please proceed with caution.

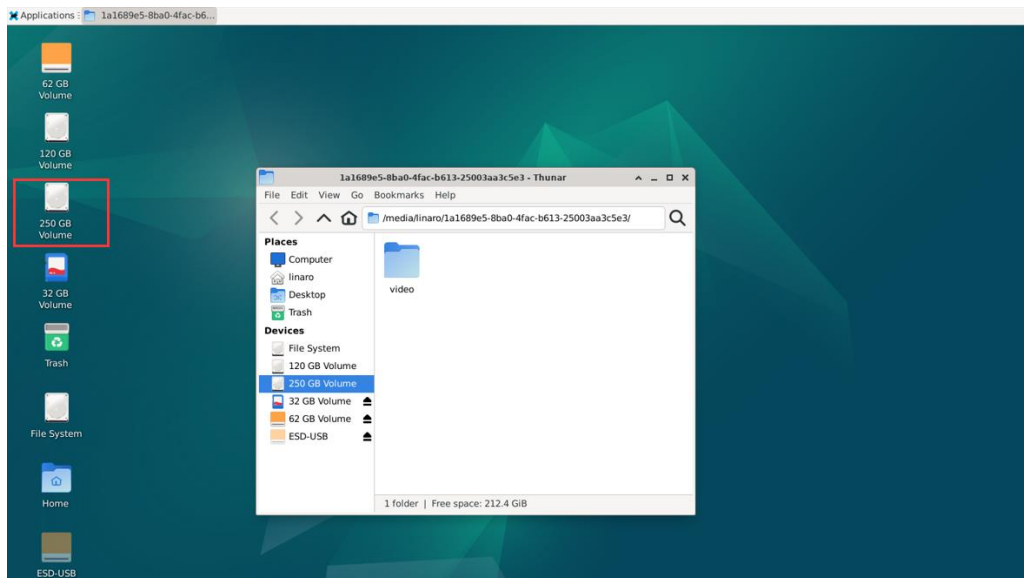
```
# mke2fs -t ext4 /dev/sda1
```

6.9 M.2 NVME SSD

Step 1: Connect the SSD, then power on.



Step 2: If the SSD device is successfully recognized, an icon will appear on the desktop. Users can click the icon to access the SSD device.

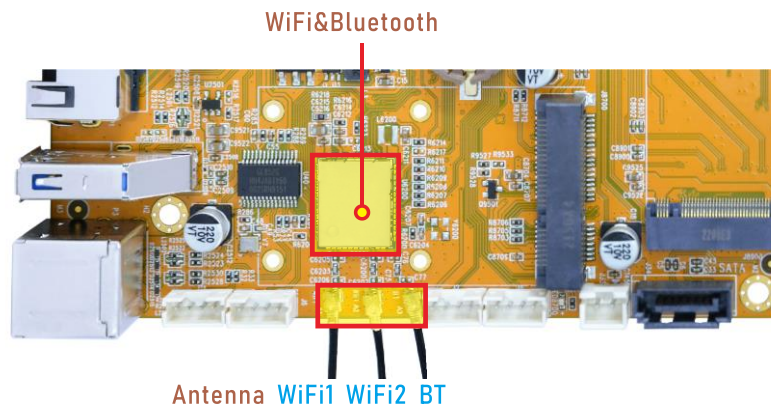


Note: The SSD on Debian 12 only supports the ext4 format. If devices that are not in ext4 format, the user can choose to format them on the board. After formatting, **the files on the device will be permanently lost**, so please proceed with caution.

```
# mke2fs -t ext4 /dev/nvme0n1
```

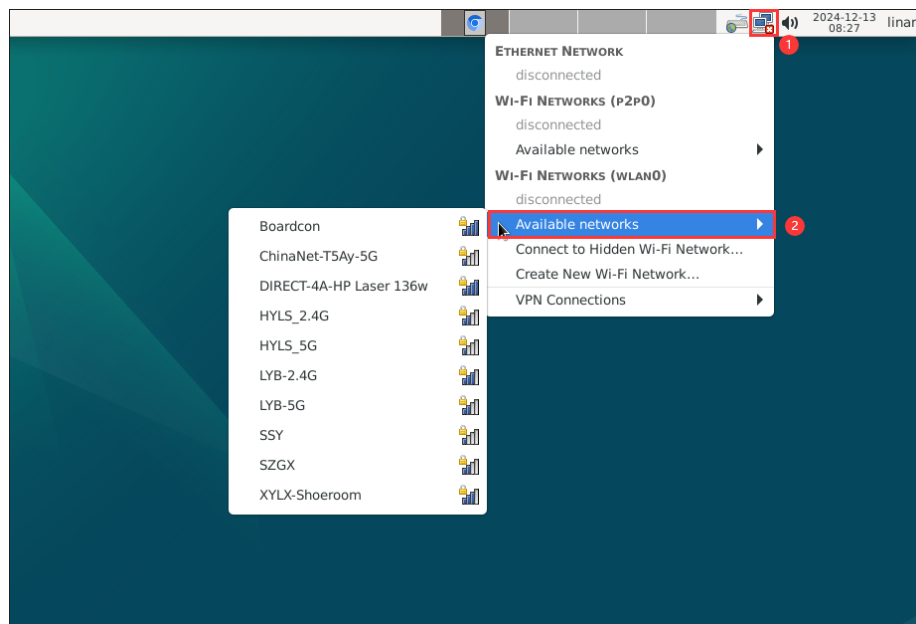
6.10 WiFi & Bluetooth

To use Wi-Fi and Bluetooth functions properly, the antenna needs to be connected.



6.10.1 WiFi

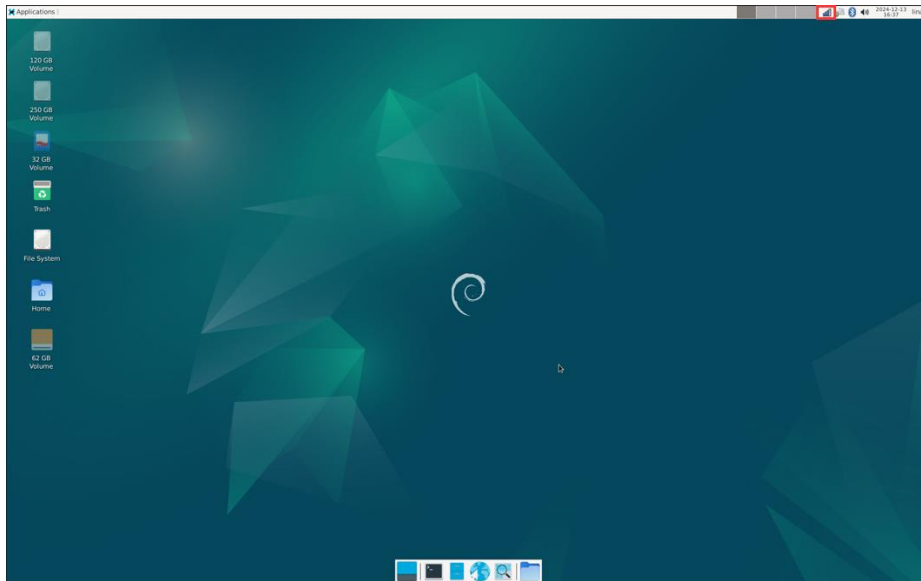
Step 1: Click the network icon in the top right corner of the interface, then select the "Available Networks" option to view the list of available hotspots.



Step 2: Select the SSID from the list of available networks and enter the password.



Step 3: After the WiFi successfully connects to the hotspot, the system will display the corresponding connection status icon in the top right corner.



Step 4: Users can test network connectivity using the desktop's built-in browser or verify it through the following command method.

(1) View network interface information.

```
# ifconfig wlan0
```

```
root@linaro-alip:/# ifconfig wlan0
wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.192 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::16a8:c071:497f:f33c prefixlen 64 scopeid 0x20<link>
    ether cc:64:1a:32:8b:90 txqueuelen 1000 (Ethernet)
    RX packets 153 bytes 21550 (21.0 KiB)
    RX errors 0 dropped 9 overruns 0 frame 0
    TX packets 132 bytes 10692 (10.4 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

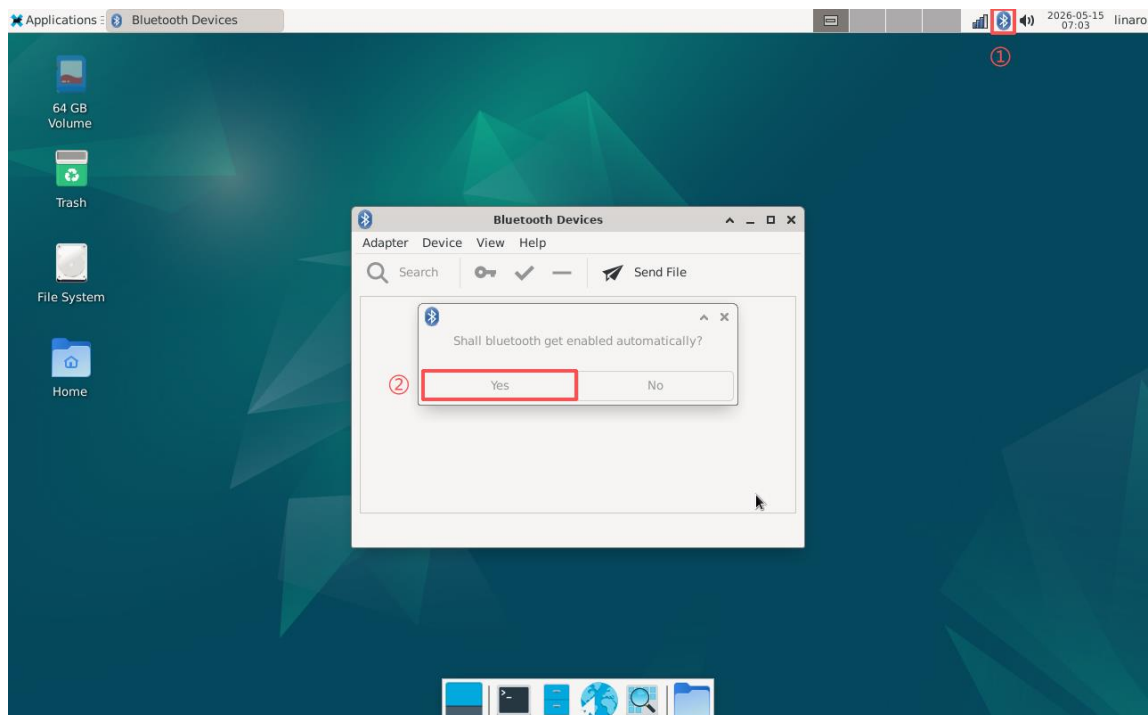
(2) Network connection test.

```
# ping -I wlan0 www.armdesigner.com
```

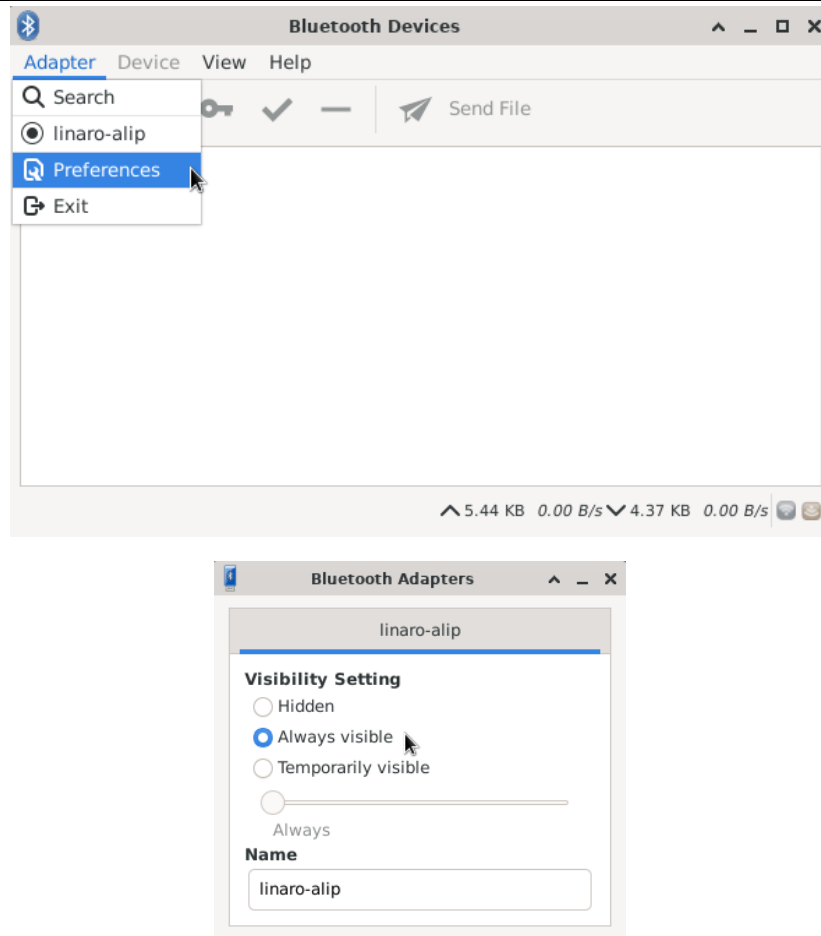
```
root@linaro-alip:/# ping -I wlan0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.192 wlan0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=48 time=184 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=48 time=204 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=48 time=193 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=48 time=185 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=48 time=181 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=48 time=200 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=48 time=214 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=8 ttl=48 time=199 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=9 ttl=48 time=195 ms
^C
--- www.armdesigner.com ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 801ms
rtt min/avg/max/mdev = 180.972/194.843/213.738/9.965 ms
```

6.10.2 Bluetooth

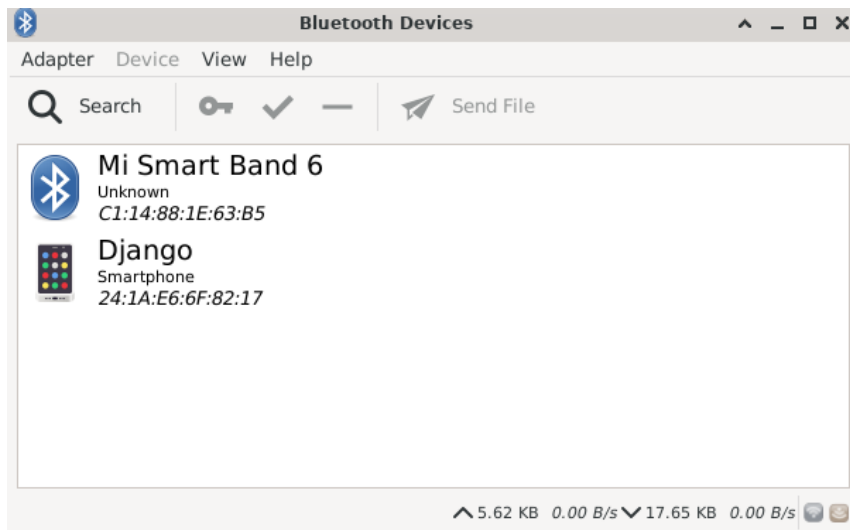
Step 1: Click the Bluetooth icon in the top right corner of the desktop.



Step 2: The Bluetooth device name is hidden by default. Set it to be visible by clicking **Adapter -> Preferences -> Always visible**.



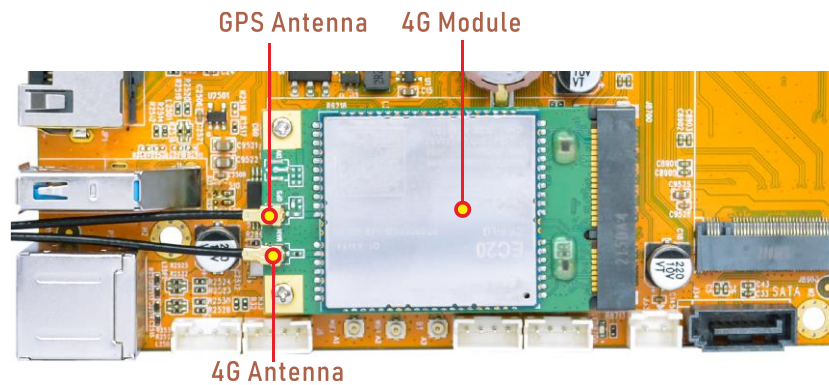
Step 3: Click Search to start searching and select the available device in the list to pair.



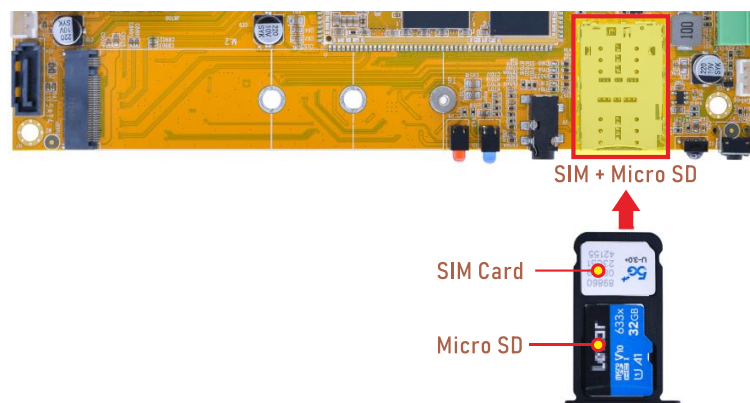
After successful configuration, Bluetooth devices can communicate with each other directly.

6.11 4G&GPS

Step 1: Insert 4G module to PCIe socket (4G model: EC20), and connect antenna.



Step 2: Connect antenna and insert SIM card.



Step 3: Power on.

6.11.1 4G Test

Step 1: Initiate the PPP connection.

```
# pppd call quectel-ppp &
```

```

root@linaro-alip:/# pppd call quectel-ppp &
[1] 2340
root@linaro-alip:/# pppd options in effect:
debug          # (from /etc/ppp/peers/quectel-ppp)
nodetach       # (from /etc/ppp/peers/quectel-ppp)
dump          # (from /etc/ppp/peers/quectel-ppp)
noauth        # (from /etc/ppp/peers/quectel-ppp)
user test     # (from /etc/ppp/peers/quectel-ppp)
password ????? # (from /etc/ppp/peers/quectel-ppp)
remotename 3gppp # (from /etc/ppp/peers/quectel-ppp)
/dev/ttyUSB3 # (from /etc/ppp/peers/quectel-ppp)
115200      # (from /etc/ppp/peers/quectel-ppp)
lock        # (from /etc/ppp/peers/quectel-ppp)
connect chat -s -v -f /etc/ppp/peers/quectel-chat-connect # (from /etc/ppp/peers/quectel-ppp)
disconnect chat -s -v -f /etc/ppp/peers/quectel-chat-disconnect # (from /etc/ppp/peers/quectel-ppp)
nocrtscts   # (from /etc/ppp/peers/quectel-ppp)
modem       # (from /etc/ppp/peers/quectel-ppp)
asynmap 0   # (from /etc/ppp/options)
lcp-echo-failure 4 # (from /etc/ppp/options)
lcp-echo-interval 30 # (from /etc/ppp/options)
hide-password # (from /etc/ppp/peers/quectel-ppp)
novj        # (from /etc/ppp/peers/quectel-ppp)
novjccomp   # (from /etc/ppp/peers/quectel-ppp)
ipcp-accept-local # (from /etc/ppp/peers/quectel-ppp)
ipcp-accept-remote # (from /etc/ppp/peers/quectel-ppp)
ipparam 3gppp # (from /etc/ppp/peers/quectel-ppp)
noipdefault # (from /etc/ppp/peers/quectel-ppp)
ipcp-max-failure 30 # (from /etc/ppp/peers/quectel-ppp)
defaultroute # (from /etc/ppp/peers/quectel-ppp)
usepeerdns  # (from /etc/ppp/peers/quectel-ppp)
noccpx      # (from /etc/ppp/peers/quectel-ppp)
noipx       # (from /etc/ppp/options)
abort on (BUSY)
abort on (NO CARRIER)
abort on (NO DIALTONE)
abort on (ERROR)
abort on (NO ANSWER)
timeout set to 30 seconds
send (AT^M)
expect (OK)
AT^M^M
OK
-- got it

send (ATE0^M)
expect (OK)
^M

```

Step 2: Check the status of the network interfaces.

```
# ifconfig ppp0
```

```

root@linaro-alip:/# ifconfig ppp0
ppp0: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST> mtu 1500
    inet 10.69.44.54 netmask 255.255.255.255 destination 10.64.64.64
    ppp txqueuelen 3 (Point-to-Point Protocol)
    RX packets 4 bytes 52 (52.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 11 bytes 156 (156.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```

Step 3: Test the PPP connection.

```
# ping -I ppp0 www.armdesigner.com
```

```

root@linaro-alip:/# ping -I ppp0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 10.69.44.54 ppp0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=46 time=477 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=46 time=443 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=46 time=394 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=46 time=360 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=46 time=311 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=46 time=269 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=46 time=550 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=8 ttl=46 time=508 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=9 ttl=46 time=468 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=10 ttl=46 time=426 ms
^C
--- www.armdesigner.com ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9011ms
rtt min/avg/max/mdev = 269.450/420.566/550.441/83.508 ms

```

6.11.2 GPS Test

Step 1: Enable GPS functionality.

```
# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
```

Step 2: Read GPS data.

```
# cat /dev/ttyUSB1
```

```

root@linaro-alip:/# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
root@linaro-alip:/#
root@linaro-alip:/# cat /dev/ttyUSB1
$GPVTG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

$GPGGA,,,,,0,,,,,,*66

$GPRMC,,V,,,,,,,,,N,V*29

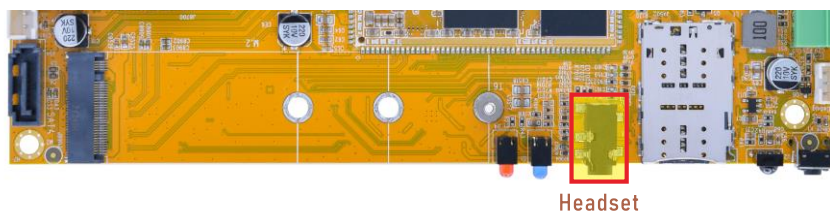
$GPVTG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

```

6.12 Headset

Step 1: Plug the headset into the headset jack.



Step 2: View sound card.

```
# cat /proc/asound/cards
```

```
root@linaro-alip:/# cat /proc/asound/cards
0 [rockchiphdmiin ]: rockchip_hdmiin - rockchip_hdmiin
rockchip_hdmiin
1 [rockchip-es8388 ]: rockchip-es8388 - rockchip-es8388
rockchip-es8388
2 [rockchiphdmi0 ]: rockchip-hdmi0 - rockchip-hdmi0
rockchip-hdmi0
3 [rockchipdp0 ]: rockchip-dp0 - rockchip-dp0
rockchip-dp0
4 [rockchipdp1 ]: rockchip-dp1 - rockchip-dp1
rockchip-dp1
```

Step 3: Headset recording.

```
# arecord -Dhw:1,0 -f cd record.wav
```

```
root@linaro-alip:/# arecord -Dhw:1,0 -f cd record.wav
Recording WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Step 4: Headset play audio.

```
# aplay -Dhw:1,0 record.wav
```

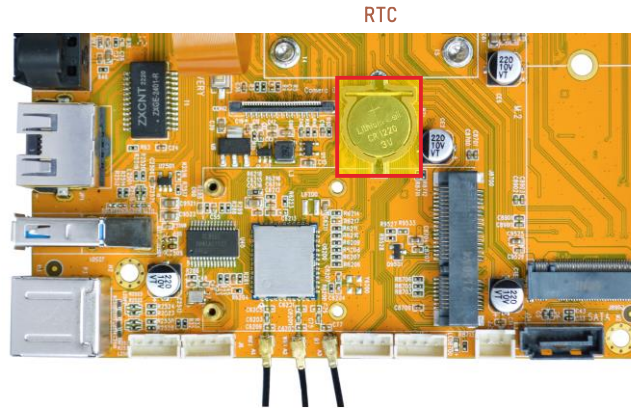
```
root@linaro-alip:/# aplay -Dhw:1,0 record.wav
Playing WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Supplementary instructions on audio output:

```
# aplay -Dhw:1,0 record.wav // Headset audio output
# aplay -Dhw:2,0 record.wav // HDMI TX audio output
# aplay -Dhw:3,0 record.wav // DP AIT mode audio output
# aplay -Dhw:4,0 record.wav // DP TX audio output
```

6.13 RTC

Step 1: Install the coin cell battery.



Step 2: Set the system time.

```
# date -s "2026-12-11 19:00:00"
```

Step 3: Write the system time to the hardware clock.

```
# hwclock -w
```

Step 4: Display the current hardware clock time.

```
# hwclock
```

```
root@linaro-alip:/# date -s "2026-12-11 19:00:00"
Fri Dec 11 07:00:00 PM UTC 2026
root@linaro-alip:/# hwclock -w
root@linaro-alip:/# hwclock
2026-12-11 19:00:02.944664+00:00
root@linaro-alip:/# hwclock
2026-12-11 19:00:10.666488+00:00
```

Step 5: Power off, after a period of time to turn on the power again, check whether the time is saved.

```
root@linaro-alip:/# hwclock
2026-12-11 19:01:17.479482+00:00
root@linaro-alip:/# hwclock
2026-12-11 19:01:21.293676+00:00
root@linaro-alip:/# hwclock
2026-12-11 19:01:23.555443+00:00
```

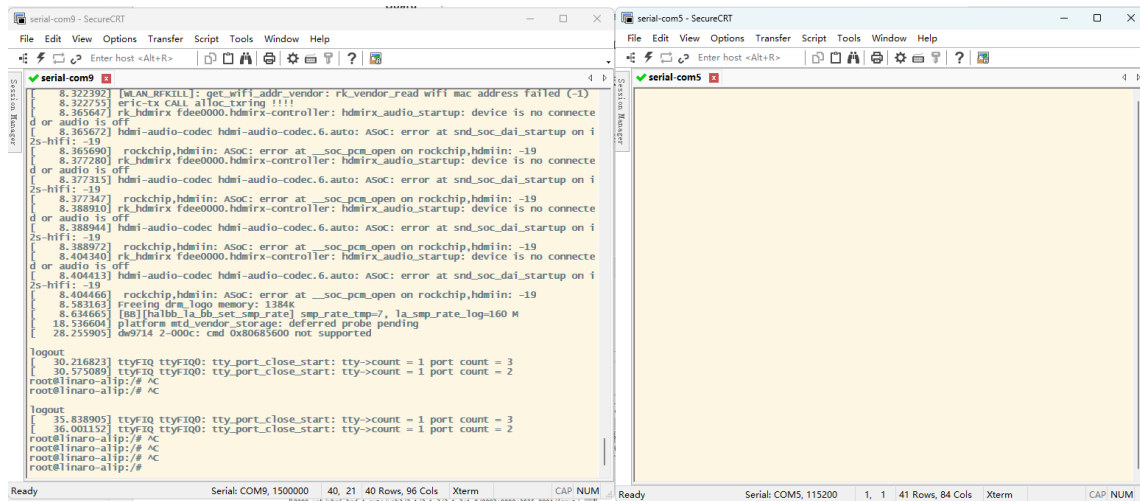
6.14 RS485



Step 1: As shown in the diagram, connect the RS485 test tool to the development board.

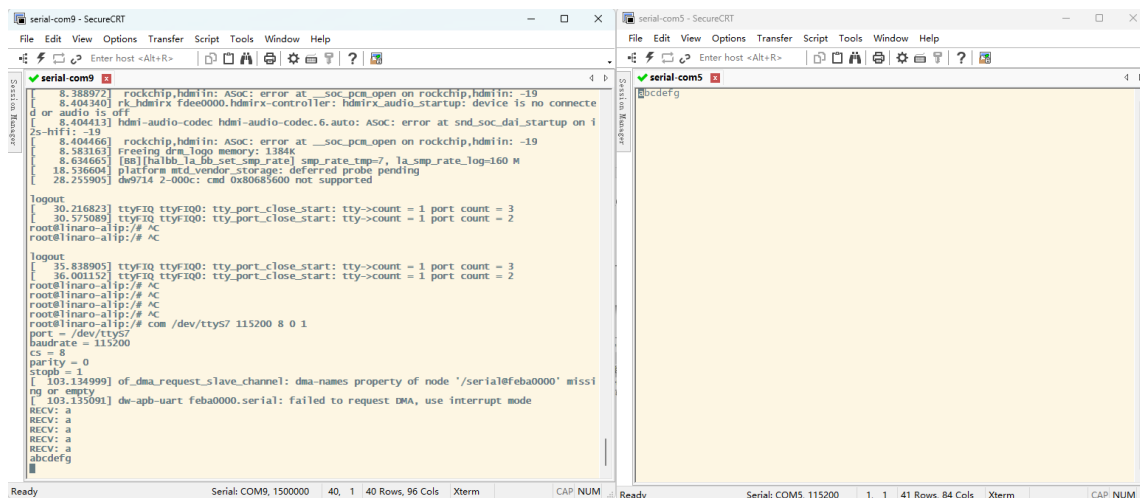


Step 2: Open the corresponding serial terminal, set the baud rate of the board to 1500000, and set the baud rate of the RS485 test tool to 115200.



Step 3: Execute the following command on the board to test the RS485 transmission and reception functionality.

```
# com /dev/ttyS7 115200 8 0 1
```



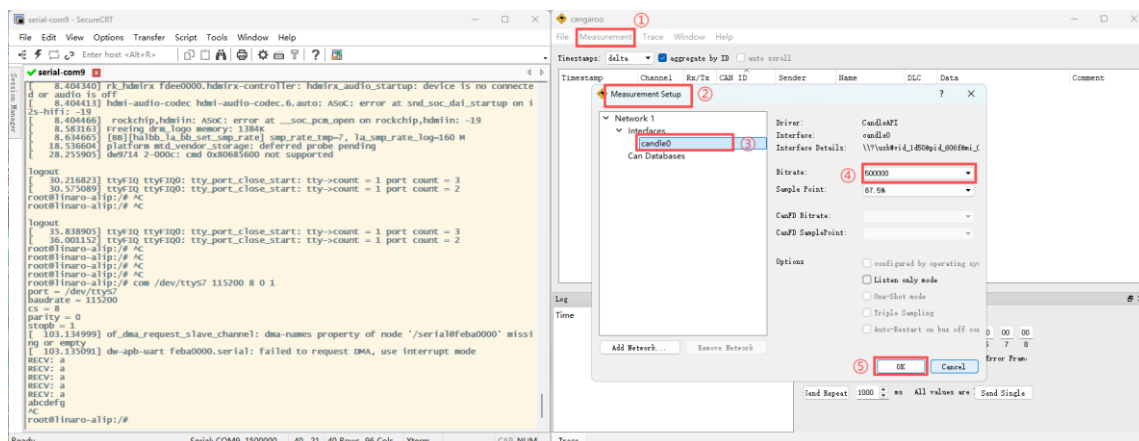
6.15 CAN



Step 1: Connect the CAN test tool to the board as shown in the diagram below.



Step 2: Open the CAN test software and set the baud rate to 500000.



Step 3: Configure and activate the CAN network, setting the bitrate to 500000.

```
# ip link set can0 down
# ip link set can0 type can bitrate 500000
# ip link set can0 up
```

The screenshot displays a Kali Linux desktop environment with two active windows. The left window, titled "serial-com9 - SecureCRT", shows a serial console session. The output indicates a login attempt on a device named "feba0000" with a baud rate of 115200. The session shows a "ttyf100" prompt and a "root@linaro-alip:/" prompt. The right window, titled "cangaroo", shows a network packet capture analysis in Wireshark. The selected packet is an ARP request from 192.168.1.10 to 192.168.1.1. The packet details show the Ethernet II frame, Internet Protocol Version 4, and ARP request fields.

Step 4: Configure CAN as the receiver.

```
# candump can0
```

The image displays two side-by-side terminal windows. The left window, titled 'serial-comb - SecureCRT', shows the output of a serial console connection to a device. The output includes kernel boot messages such as 'read strings', 'device reset', 'DMA-names property of node "/>

Step 5: Configure CAN as the sender.

```
# cansend can0 123#DEADBEEF
```

6.16 UART

Step 1: Short circuit RX and TX pins of UART.



Step 2: UART0 test.

```
# com /dev/ttyS0 115200 8 0 1
```

```
root@linaro-alip:/# com /dev/ttyS0 115200 8 0 1
port = /dev/ttyS0
baudrate = 115200
cs = 8
parity = 0
stopb = 1
vvvvvvvvvvvvvvvvvvvv
RECV: vvvvvvvvvvvvvvvvvvvvv
uuuuuuuuuuuuuuuuuuuu
RECV: uuuuuuuuuuuuuuuuuuu
ooythj1111
RECV: ooythj1111
.....
RECV: .....
```

Step 3: UART3 test.

```
# com /dev/ttyS3 115200 8 0 1
```

```
root@linaro-alip:/# com /dev/ttyS3 115200 8 0 1
port = /dev/ttyS3
baudrate = 115200
cs = 8
parity = 0
stopb = 1
xxxxxxxxxxxxxx
RECV: xxxxxxxxxxxxxxxxx
0000000000000000
RECV: 0000000000000000
pppppppppp4444
RECV: pppppppppp4444
hhh.....
RECV: hhh.....
```

6.17 IR



Step 1: Open IR debugging print.

```
# echo 1 > /sys/module/rockchip_pwm_remotectl/parameters/code_print
```

This enables the driver to print the decoded IR key values to the kernel log.

Step 2: Press buttons on the remote control

Point the remote control at the IR receiver and press any button. Messages appear in the log, for example:

```
root@linaro-alip:/# echo 1 > /sys/module/rockchip_pwm_remotectl/parameters/code_print
root@linaro-alip:/# [ 786.800756] USERCODE=0x1818
[ 786.827915] RMC_GETDATA=98
[ 787.449207] USERCODE=0x1818
[ 787.476380] RMC_GETDATA=9a
[ 787.896997] USERCODE=0x1818
[ 787.924225] RMC_GETDATA=9b
[ 788.397386] USERCODE=0x1818
[ 788.424515] RMC_GETDATA=99
[ 788.861160] USERCODE=0x1818
[ 788.888342] RMC_GETDATA=e6
[ 789.509201] USERCODE=0x1818
[ 789.536331] RMC_GETDATA=e5
[ 789.820960] USERCODE=0x1818
[ 789.848096] RMC_GETDATA=e4
```

Parameter Description:

```
* USERCODE=0x1818    /* User code of the remote control (vendor/device
                      identifier), usually fixed for the same remote */
* RMC_GETDATA=98     /* Scancode of the remote control button (specific key
                      value), needs to be mapped to Linux KEY_xxx */
```

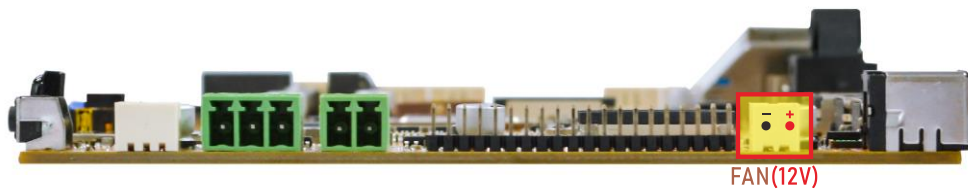
Step 3: Configure key values in the device tree (DTS)

Insert the values obtained in **Step 2** into the remotectl-pwm node of the DTS file. File path: `kernel-6.1\arch\arm64\boot\dts\rockchip\idea3588\idea3588.dtsi`

```
&pwm15 {
    compatible = "rockchip,remotectl-pwm";
    pinctrl-names = "default";
    pinctrl-0 = <&pwm15m1_pins>; /* PWM15 Pin Configuration */
    remote_pwm_id = <15>; /* PWM controller ID */
    handle_cpu_id = <1>;
    remote_support_psci = <0>;
    status = "okay";
    ir_key1 {
        rockchip,usercode = <0x4040>;
        rockchip,key_table =
            <0xf2KEY_REPLY>,
            .....
    };

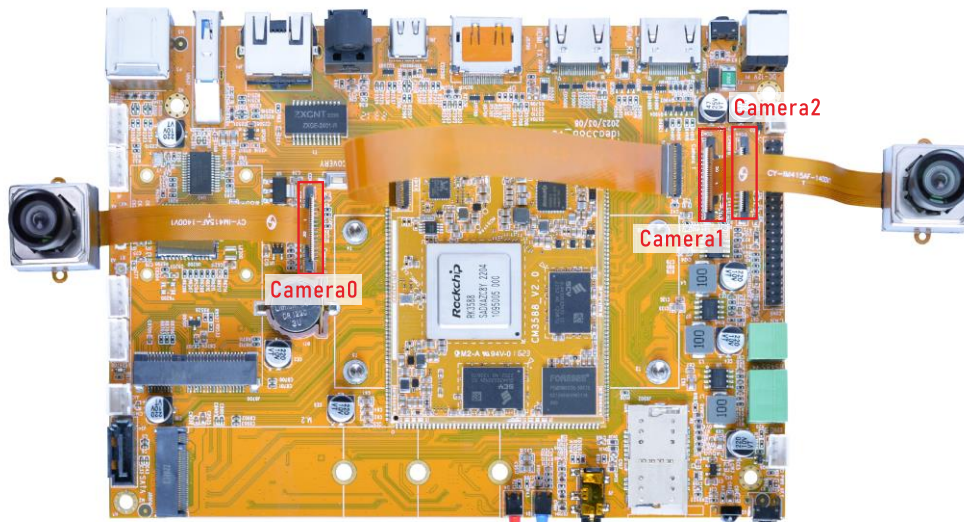
    ir_key2 {
        rockchip,usercode = <0x1818>;
        rockchip,key_table =
            <0x98 KEY_HOME>,
            <0x99 KEY_BACK>,
            <0x9a KEY_MENU>,
            <0x4d KEY_REPLY>,
            <0xe6 KEY_UP>,
            <0xe4 KEY_DOWN>,
            <0xe7 KEY_LEFT>,
            <0xe5 KEY_RIGHT>,
            .....
    };
};
```

6.18 Fan



12v long supply output.

6.19 Camera



6.19.1 Camera Interface

6.19.1.1 Camera Interface Supported Modes

The Idea3588 provides three Camera interfaces: camera0, camera1, and camera2. These interfaces support the following usage modes:

- Use any single interface (camera0, camera1, or camera2).
- Use camera0 and camera1 simultaneously.
- Use camera1 and camera2 simultaneously.

6.19.1.2 Camera Interface Configuration

The usage modes are controlled by software configuration. The specific settings can be found in the following configuration file:

kernel-6.1/arch/arm64/boot/dts/rockchip/boardcon-idea3588-linux.dts

- By default, camera0 and camera1 are used simultaneously.

```
#include "idea3588/idea3588-imx415-dphy0.dtsi" // camera0
#include "idea3588/idea3588-imx415-dphy1.dtsi" // camera1
//#include "idea3588/idea3588-imx415-dcphy1.dtsi" // camera2
```

- Camera1 and camera2 can also be used simultaneously.

```
//#include "idea3588/idea3588-imx415-dphy0.dtsi" // camera0
#include "idea3588/idea3588-imx415-dphy1.dtsi" // camera1
#include "idea3588/idea3588-imx415-dcphy1.dtsi" // camera2
```

- Single camera usage is supported (using camera0 as an example).

```
#include "idea3588/idea3588-imx415-dphy0.dtsi" // camera0
//#include "idea3588/idea3588-imx415-dphy1.dtsi" // camera1
//#include "idea3588/idea3588-imx415-dcphy1.dtsi" // camera2
```

Note

- ① The provided **update.img** supports enabling **camera0** and **camera1** simultaneously.
- ② The provided **boot.img** supports enabling **camera1** and **camera2** simultaneously.
- ③ For other modes, manual modification of the DTS configuration and recompilation of the image are required.
- ④ When using dual-camera mode, ensure that both cameras are connected to the hardware. Otherwise, **rkisp_3A_server** initialization may fail, leading to preview issues.

6.19.2 Camera Test

Step 1: View the video device.

```
# grep "" /sys/class/video4linux/v*/name | grep mainpath
# grep "" /sys/class/video4linux/v*/name | grep selfpath
```

```
root@linaro-alip:/# grep "" /sys/class/video4linux/v*/name | grep mainpath
/sys/class/video4linux/video22/name:rkisp_mainpath
/sys/class/video4linux/video31/name:rkisp_mainpath
root@linaro-alip:/# grep "" /sys/class/video4linux/v*/name | grep selfpath
/sys/class/video4linux/video23/name:rkisp_selfpath
/sys/class/video4linux/video32/name:rkisp_selfpath
```

- **Camera0** corresponds to the device node **/dev/video22** or **/dev/video23**.
- **Camera1** corresponds to the device node **/dev/video31** or **/dev/video32**.
- The following test uses Camera0 as an example.

Step 2: Preview camera.

```
# gst-launch-1.0 v4l2src device=/dev/video22 !
video/x-raw,format=NV12,width=1920,height=1080, framerate=30/1 ! xvimagesink
```

```

root@linaro-alip:/# gst-launch-1.0 v4l2src device=/dev/video22 !
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! xvimagesink
[ 2349.442009] dw9714 2-000c: cmd 0x80685600 not supported
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! xvimagesink
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
[ 2350.059901] rkisp_hw fdc00000.rkisp: set isp clk = 396000000Hz
[ 2350.083376] rkisp rkisp0-vir2: first params buf queue
[ 2350.084050] rkCIF-mipi-lvds2: stream[0] start streaming
[ 2350.085731] rkCIF-mipi-lvds2: Allocate dummy buffer, size: 0x01028000
[ 2350.085827] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 00000000d3769089, sd_name:rockchip-csi2-dphy0
[ 2350.085834] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 2350.085857] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 2350.085883] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 2350.085889] imx415 2-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
Redistribute latency...
0:01:06.9 / 99:99:99.

```

Step 3: Record the video.

```

# gst-launch-1.0 v4l2src device=/dev/video23 num-buffers=100 ! \
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! \
videoconvert ! mpph264enc ! h264parse ! mp4mux ! \
filesink location=/tmp/h264.mp4

```

```

root@linaro-alip:/# gst-launch-1.0 v4l2src device=/dev/video23 num-buffers=100 ! \
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! \um-buffers=100 ! \
videoconvert ! mpph264enc ! h264parse ! mp4mux ! \merate=30/1 ! \
filesink location=/tmp/h264.mp44parse ! mp4mux ! \
[ 2509.664649] dw9714 2-000c: cmd 0x80685600 not supported
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
[ 2510.305779] rkisp_hw fdc00000.rkisp: set isp clk = 396000000Hz
[ 2510.341314] rkisp rkisp0-vir2: first params buf queue
[ 2510.343540] rkCIF-mipi-lvds2: stream[0] start streaming
[ 2510.346431] rkCIF-mipi-lvds2: Allocate dummy buffer, size: 0x01028000
[ 2510.346500] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 00000000d3769089, sd_name:rockchip-csi2-dphy0
[ 2510.346505] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 2510.346524] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 2510.346547] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 2510.346552] imx415 2-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
Redistribute latency...
Redistribute latency...
0:00:01.7 / 99:99:99.

```

Step 4: Take photos.

```

# gst-launch-1.0 -v v4l2src device=/dev/video22 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \
multifilesink location=/tmp/test%05d.jpg

```

```

root@linaro-alip:/# gst-launch-1.0 -v v4l2src device=/dev/video22 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \22 num-buffers=10 ! \
multifilesink location=/tmp/test%05d.jpgt=1080 ! mppjpegenc ! \
[ 2575.805196] dw9714 2-000c: cmd 0x80685600 not supported
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
/GstPipeline:pipeline0/GstV4l2Src:v4l2src0: crop-bounds = < (int)0, (int)0, (int)3840, (int)2160 >
/GstPipeline:pipeline0/GstV4l2Src:v4l2src0.GstPad:src: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, framerate=(fraction)120/1, interlace-mode=(string)progressive,
colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstCapsFilter:capsfilter0.GstPad:src: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, framerate=(fraction)120/1, interlace-mode=(string)progressive,
colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstMppJpegEnc:mppjpegenc0.GstPad:src: caps = image/jpeg, width=(int)1920,
height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstMultiFileSink:multifilesink0.GstPad:sink: caps = image/jpeg, width=(int)1920,
height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstMppJpegEnc:mppjpegenc0.GstPad:sink: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, framerate=(fraction)120/1, interlace-mode=(string)progressive,
colorimetry=(string)1:3:5:1
[ 2576.400451] rkisp_hw fdcb0000.rkisp: set isp clk = 396000000Hz
/GstPipeline:pipeline0/GstCapsFilter:capsfilter0.GstPad:sink: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, framerate=(fraction)120/1, interlace-mode=(string)progressive,
colorimetry=(string)1:3:5:1
[ 2576.429902] rkisp rkisp0-vir2: first params buf queue
  
```

6.20 Video Playback

(1) The directory for the built-in video testing scripts in the system: */rockchip-test/video*

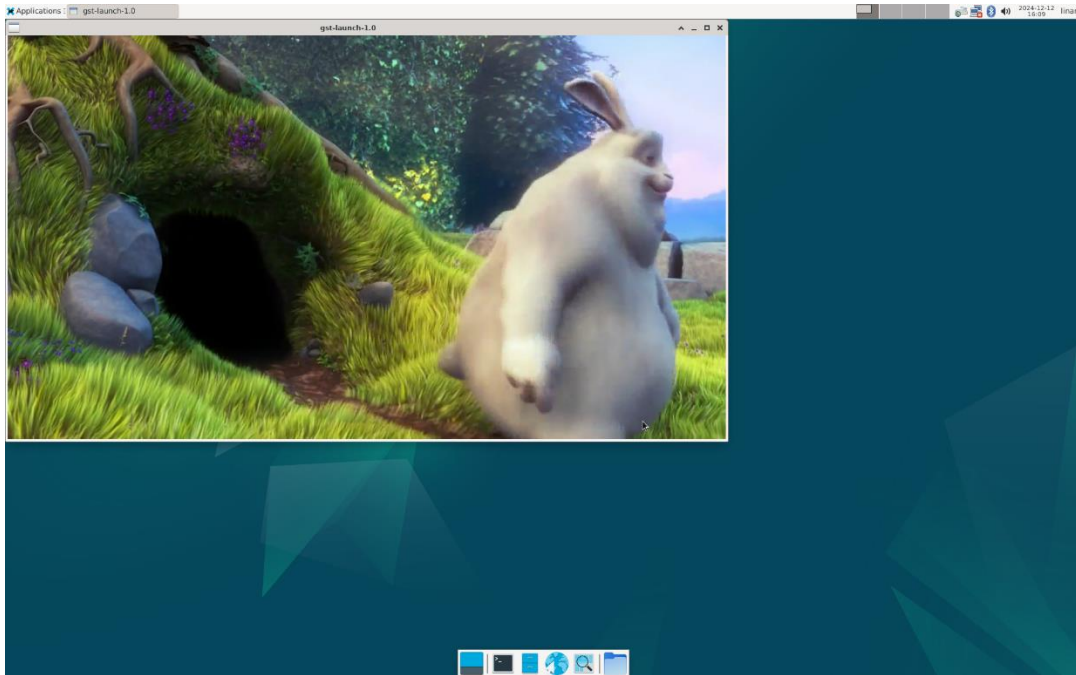
```

root@linaro-alip:/# ls /rockchip-test/video/
test_dec-gst.sh      test_enc-gst.sh      test_gst_video_maxfps.sh
test_dec-mpv.sh      test_gst_multivideo.sh  video_stresstest.sh
test_dec-parole.sh   test_gst_video.sh      video_test.sh
test_dec-qt.sh       test_gst_video_fps.sh
  
```

Simply execute the script.

```

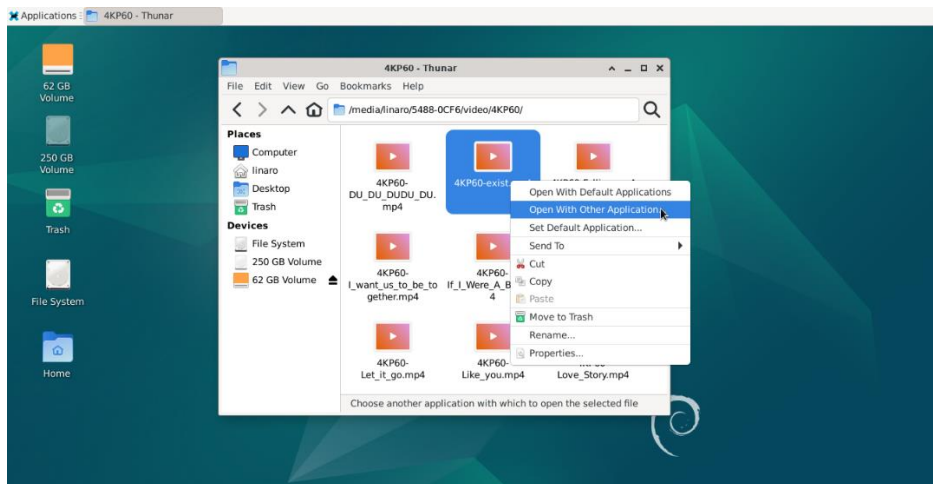
root@linaro-alip:/rockchip-test/video# ./test_gst_video.sh
Setting pipeline to PAUSED ...
Pipeline is PREROLLING ...
Redistribute latency...
mpp[4383]: mpp_info: mpp version: 48962a10 author: Hongjin Li    2024-09-19 fix[avsd]: Fix attach dev error
issue
mpp[4383]: mpp_info: mpp version: 48962a10 author: Hongjin Li    2024-09-19 fix[avsd]: Fix attach dev error
issue
mpp[4383]: mpp_info: mpp version: 48962a10 author: Hongjin Li    2024-09-19 fix[avsd]: Fix attach dev error
issue
mpp[4383]: mpp_info: mpp version: 48962a10 author: Hongjin Li    2024-09-19 fix[avsd]: Fix attach dev error
issue
mpp[4383]: mpp_info: mpp version: 48962a10 author: Hongjin Li    2024-09-19 fix[avsd]: Fix attach dev error
issue
Redistribute latency...
mpp[4383]: h264d_api: is_avcC=1
Pipeline is PREROLLED ...
Prerolled, waiting for async message to finish...
Setting pipeline to PLAYING ...
Redistribute latency...
New clock: GstSystemClock
0:00:06.6 / 0:00:29.5 (22.7 %)
  
```



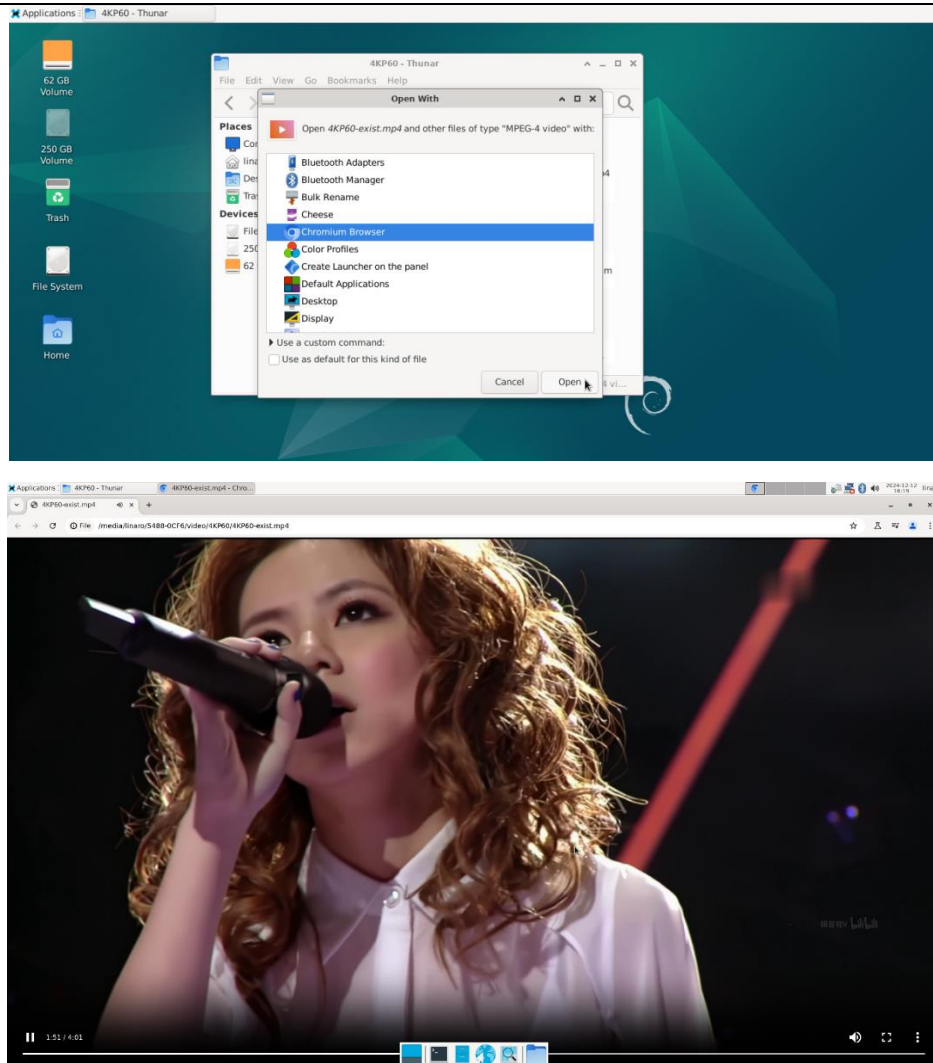
(2) Play the video using Google Chrome.

- Google Chrome supports video playback up to 4K at 60Hz, with support for the following decoding formats: VP8, H.264, H.265, VP9, and AV1.
- However, it is only compatible with certain H.265 video files.

Step 1: Select the video file, right-click, and choose “**Open With Other Application...**”.



Step 2: Find **Chromium Browser** in the list, select it, and click “**Open**” to play the video file.



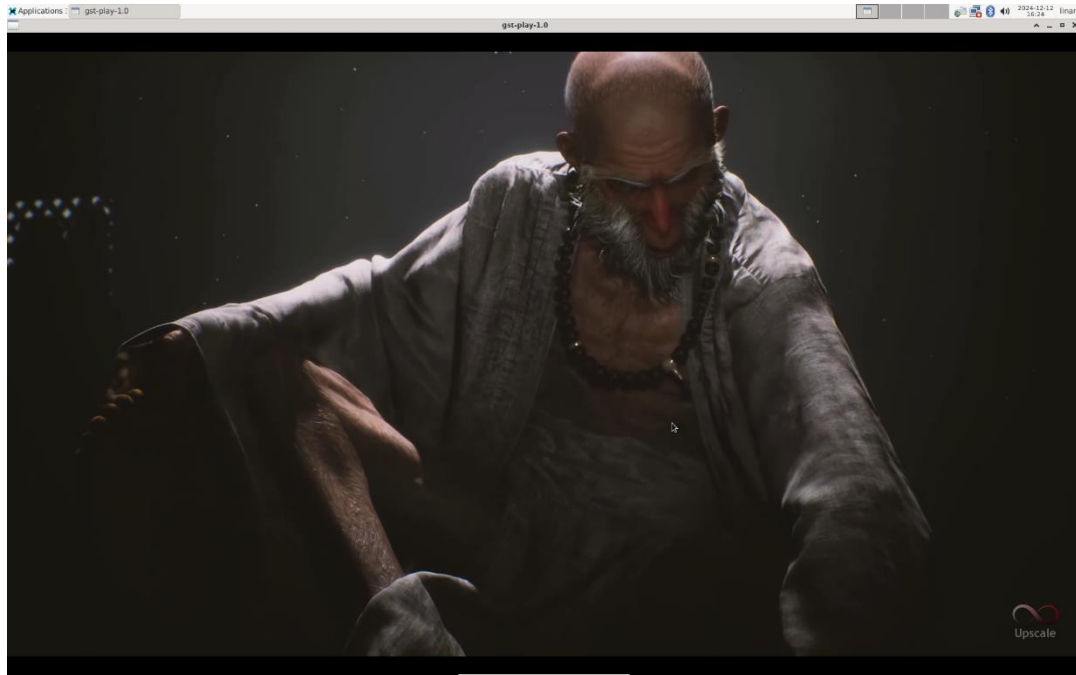
(3) Use the `gst-play-1.0` command to play the video.

```
# gst-play-1.0 --videosink=xvimagesink
/media/linaro/5488-0CF6/video/8KP30/H265_8KP30-2.mp4 --audiosink="alsasink
device=hw:1,0"
```

Command explanation:

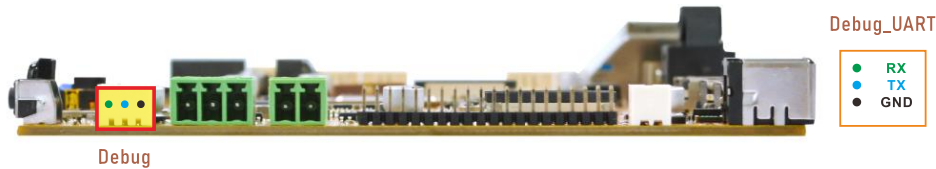
- `/media/linaro/5488-0CF6/video/8KP30/H265_8KP30-2.mp4`: The media file path to be played.
- `--audiosink="alsasink device=hw:1,0"`: Specifies the audio output device as `hw:1,0`.

```
root@linaro-alip:/# gst-play-1.0 --videosink=xvimagesink
/media/linaro/5488-0CF6/video/8KP30/H265_8KP30-2.mp4 --audiosink="alsasink device=hw:1,0"
Press 'k' to see a list of keyboard shortcuts.
Now playing /media/linaro/5488-0CF6/video/8KP30/H265_8KP30-2.mp4
Redistribute latency...
Redistribute latency...
Redistribute latency...
Redistribute latency...
Redistribute latency...
0:01:35.0 / 0:13:10.5
```

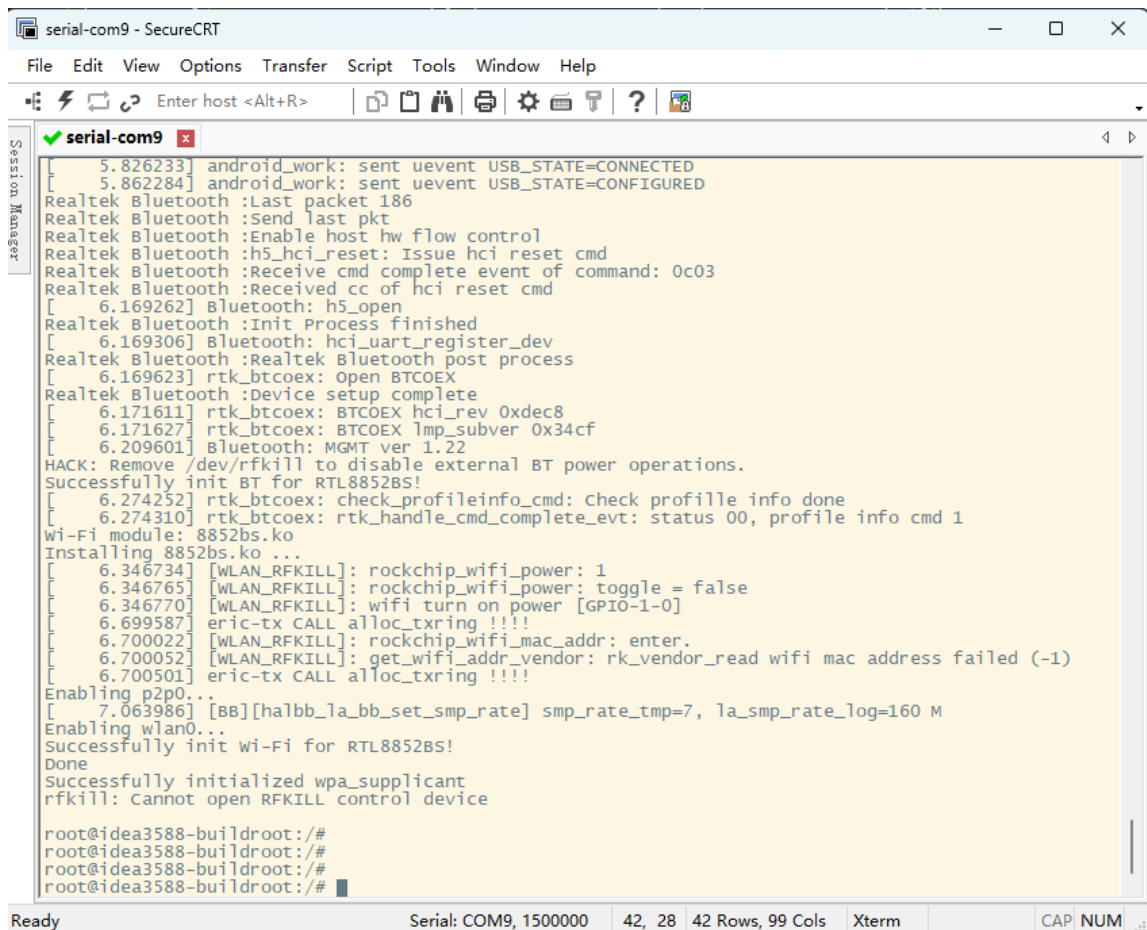


7. Buildroot Test

7.1 Serial Terminal



Connect the board and PC with USB Serial cable, then power on, the terminal will output boot information. The default baudrate is 1500000.



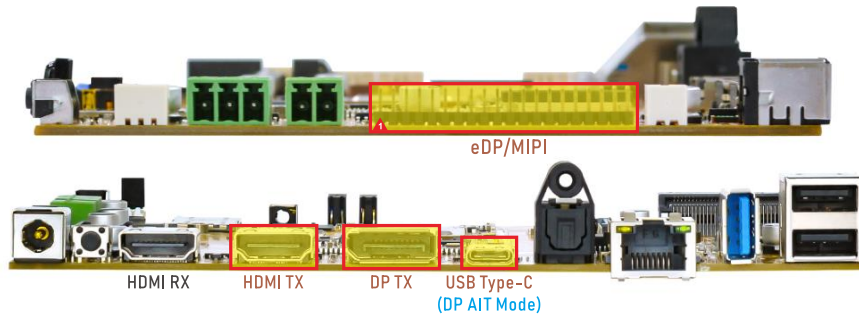
```

serial-com9 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
serial-com9
[ 5.826233] android_work: sent uevent USB_STATE=CONNECTED
[ 5.862284] android_work: sent uevent USB_STATE=CONFIGURED
Realtek Bluetooth :Last packet 186
Realtek Bluetooth :Send last pkt
Realtek Bluetooth :Enable host hw flow control
Realtek Bluetooth :h5_hci_reset: Issue hci reset cmd
Realtek Bluetooth :Receive cmd complete event of command: 0c03
Realtek Bluetooth :Received cc of hci reset cmd
[ 6.169262] Bluetooth: h5_open
Realtek Bluetooth :Init Process finished
[ 6.169306] Bluetooth: hci_uart_register_dev
Realtek Bluetooth :Realtek Bluetooth post process
[ 6.169623] rtk_btcoex: open BTcoEX
Realtek Bluetooth :Device setup complete
[ 6.171611] rtk_btcoex: BTcoEX hci_rev 0xdec8
[ 6.171627] rtk_btcoex: BTcoEX lmp_subver 0x34cf
[ 6.209601] Bluetooth: MGMT ver 1.22
HACK: Remove /dev/rfkill to disable external BT power operations.
Successfully init BT for RTL8852BS!
[ 6.274252] rtk_btcoex: check_profileinfo_cmd: check profile info done
[ 6.274310] rtk_btcoex: rtk_handle_cmd_complete_evt: status 00, profile info cmd 1
Wi-Fi module: 8852bs.ko
Installing 8852bs.ko ...
[ 6.346734] [WLAN_RFKILL]: rockchip_wifi_power: 1
[ 6.346765] [WLAN_RFKILL]: rockchip_wifi_power: toggle = false
[ 6.346770] [WLAN_RFKILL]: wifi turn on power [GPIO-1-0]
[ 6.699587] eric-tx CALL alloc_txring !!!!
[ 6.700022] [WLAN_RFKILL]: rockchip_wifi_mac_addr: enter.
[ 6.700052] [WLAN_RFKILL]: get_wifi_addr_vendor: rk_vendor_read wifi mac address failed (-1)
[ 6.700501] eric-tx CALL alloc_txring !!!!
Enabling p2p0...
[ 7.063986] [BB][halbb_la_bb_set_smp_rate] smp_rate_tmp=7, la_smp_rate_log=160 M
Enabling wlan0...
Successfully init wi-Fi for RTL8852BS!
Done
Successfully initialized wpa_supplicant
rfkill: Cannot open RFKILL control device

root@idea3588-buildroot:/#
root@idea3588-buildroot:/#
root@idea3588-buildroot:/#
root@idea3588-buildroot:/#
  
```

7.2 Display

The Idea3588 supports triple independent displays, with default support for HDMI, eDP, and DP TX interfaces, and also supports synchronized display.



The display effect diagram is as follows:



Note

- (1) DP TX and DP AIT mode interface share the VP resources and cannot be used simultaneously.
- (2) DP AIT mode does not support logo display.

7.3 HDMI RX



After connecting the HDMI OUT port of the source device to the HDMI IN port of the Idea3588, execute the following commands to start the preview.

- **View the HDMI RX video node:**



```
# grep -H hdmirx /sys/class/video4linux/video*/name
```

```
root@idea3588-buildroot:/# grep -H hdmirx /sys/class/video4linux/video*/name
/sys/class/video4linux/video0/name:stream_hdmirx
```

- **Check supported resolutions and formats:**

```
# v4l2-ctl -d /dev/video0 --all
```



```
root@idea3588-buildroot:/# v4l2-ctl -d /dev/video0 --all
Driver Info:
  Driver name      : rk_hdmirx
  Card type        : rk_hdmirx
  Bus info         : fdee0000.hdmirx-controller
  Driver version   : 6.1.141
  Capabilities     : 0x84201000
                    Video Capture Multiplanar
                    Streaming
                    Extended Pix Format
                    Device Capabilities
  Device Caps      : 0x04201000
                    Video Capture Multiplanar
                    Streaming
                    Extended Pix Format
Priority: 2
DV timings:
  Active width: 1920
  Active height: 1080
  Total width: 2200
  Total height: 1125
  Frame format: progressive
  Polarities: -vsync -hsync
  Pixelclock: 148500000 Hz (60.00 frames per second)
  Horizontal frontporch: 88
  Horizontal sync: 44
  Horizontal backporch: 148
  Vertical frontporch: 4
  Vertical sync: 5
  Vertical backporch: 36
  Standards:
  Flags:
DV timings capabilities:
  Minimum Width: 640
  Maximum Width: 4096
  Minimum Height: 480
  Maximum Height: 2160
  Minimum PClock: 20000000
  Maximum PClock: 600000000
  Standards: CTA-861
  Capabilities: Interlaced, Progressive
Format Video Capture Multiplanar:
  Width/Height      : 1920/1080
  Pixel Format       : 'NV24' (Y/UV 4:4:4)
  Field              : None
  Number of planes   : 1
  Flags              : premultiplied-alpha, set-csc, 0x000000fc
  Colourspace        : Rec. 709
  Transfer Function   : Unknown (0x000000b8)
  YCbCr/HSV Encoding: xvYCC 709
  Quantization       : Limited Range
  Plane 0
    Bytes per Line   : 1920
    Size Image        : 6220800
User Controls
  audio_sampling_rate 0x00981a80 (int) : min=0 max=768000 step=1 default=0 value=44100
  flags=read-only, volatile
  audio_present 0x00981a81 (bool) : default=0 value=1 flags=read-only, volatile
Digital Video Controls
  power_present 0x00a00964 (bitmask): max=0x00000001 default=0x00000000 value=1
  flags=read-only
```

• Video Preview:

HDMI input source: rk3568

```
# gst-launch-1.0 v4l2src device=/dev/video0 ! videoconvert ! waylandsink
```

```
root@idea3588-buildroot:/# gst-launch-1.0 v4l2src device=/dev/video0 ! videoconvert ! waylandsink
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
Redistribute latency...
0:00:04.0 / 99:99:99.
```

HDMI input source: rk3588

```
# gst-launch-1.0 v4l2src device=/dev/video0 !
video/x-raw,format=NV24,width=1920,height=1080 ! videoconvert !
video/x-raw,format=I420 ! waylandsink sync=false
```

```
root@idea3588-buildroot:/# gst-launch-1.0 v4l2src device=/dev/video0 !
video/x-raw,format=NV24,width=1920,height=1080 ! videoconvert ! video/x-raw,format=I420 ! waylandsink
sync=false
mpp[2186]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2186]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2186]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2186]: mpp_info: mpp version: unknown mpp version for missing VCS info
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
Redistribute latency...
0:00:03.8 / 99:99:99.
```

- **Capture Audio from DP Output:**

```
# gst-launch-1.0 alsasrc device=hw:rockchipdmiin,0 ! audioconvert ! audioresample !
queue ! alsasink device=hw:rockchipdp1
```

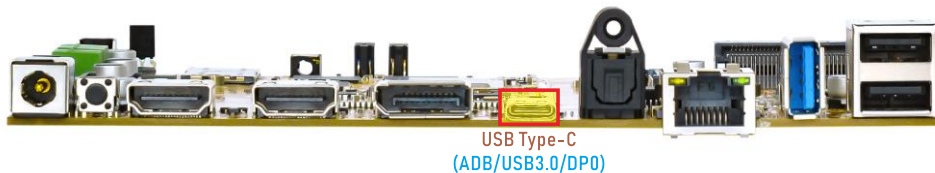
```
root@idea3588-buildroot:/#
udioconvert ! audioresample ! queue ! alsasink device=hw:rockchipdp1hdmiiin,0 ! au
Setting pipeline to PAUSED ...
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstAudioSrcClock
Redistribute latency...
Redistribute latency...
Redistribute latency...
0:00:20.3 / 99:99:99.
```

Parameter Description:

```
Audio Output:
* device=hw:rockchip8388 /* Headset audio output */
* device=hw:rockchipdmi0 /* HDMI TX audio output */
* device=hw:rockchipdp0 /* DP AIT mode audio output */
* device=hw:rockchipdp1 /* DP TX audio output */

v4l2-ctl:
* v4l2-ctl -d /dev/video0 --get-fmt-video /* Get current video format */
* v4l2-ctl -d /dev/video0 --query-dv-timings /* Query supported DV timings */
* v4l2-ctl -d /dev/video0 --get-dv-timings /* Get current DV timing */
* v4l2-ctl -d /dev/video0 -D /* Display device information */
```

7.4 USB Type-C

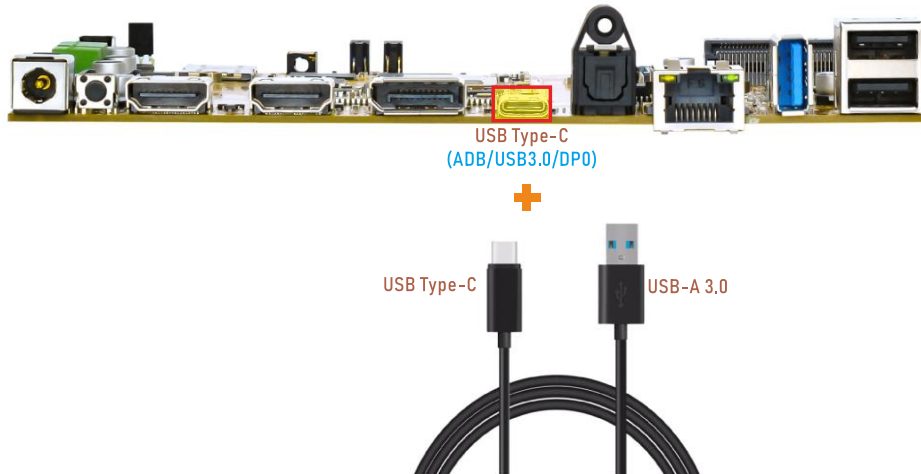


Features Supported by the Type-C Interface:

- **Reversible Design:** Allows insertion in either orientation for user convenience.
- **Data Transmission Roles:** Supports flexible designation of host and device roles.
- **Multiple Protocol Support:** Compatible with USB 3.0 and DisplayPort, enabling high-speed data transmission.

7.4.1 ADB

Step 1: Connect the board and PC host with Type-C cable.

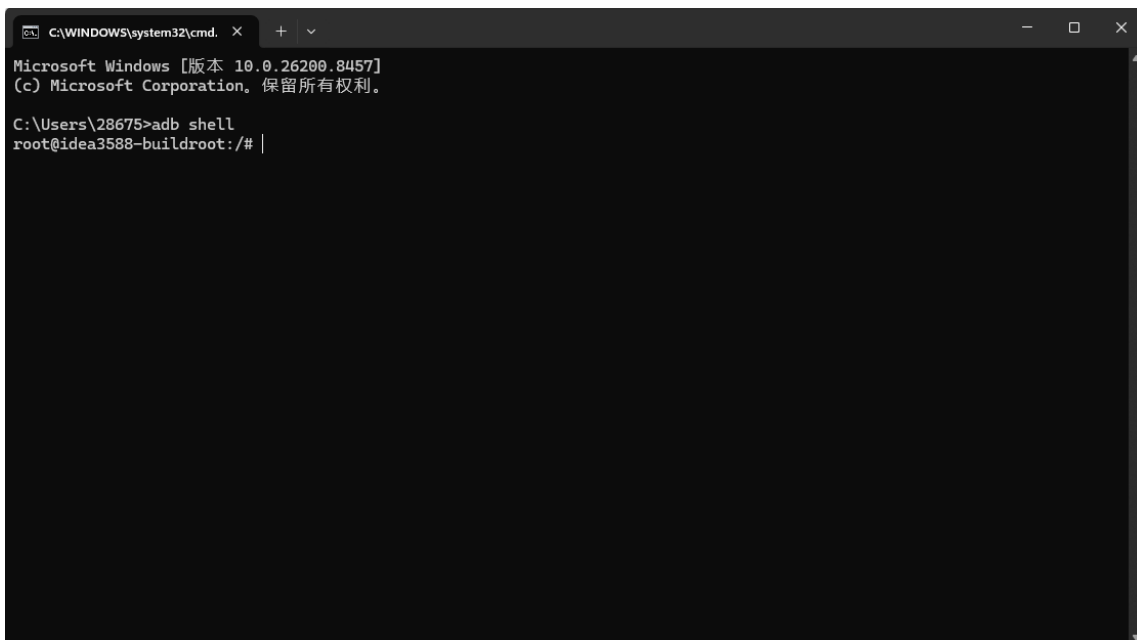


Step 2: Install ADB driver on Windows system.

Step 3: Press **Windows + R** to open the Run program. Type “cmd” and press Enter.

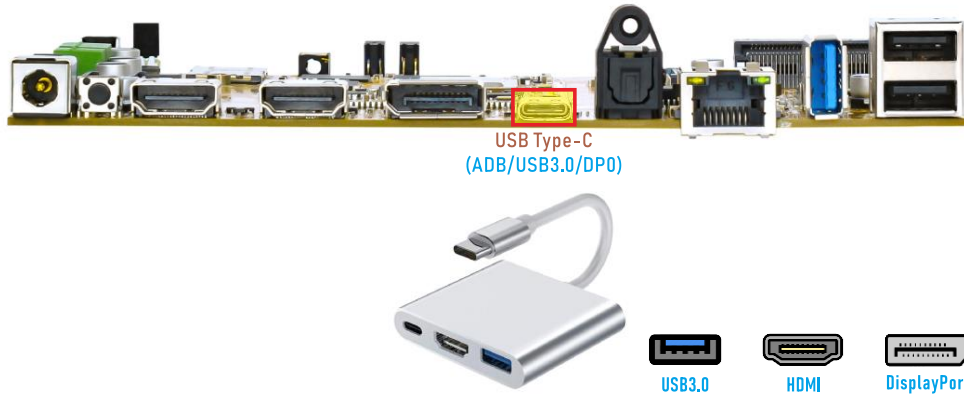
Step 4: Execute the following command to enable ADB.

```
# adb shell
```



7.4.2 Type-C to USB3.0

Step 1: Connect the Type-C to USB3.0 converter to the Type-C port of the development board, and then insert the USB3.0 flash drive into the USB3.0 port of the docking station.



The serial port of the terminal will display the following message, indicating that the USB3.0 device is successfully recognized.

```

root@idea3588-buildroot:/# [ 204.930522] dwc3 fc000000.usb: request 0000000053e30a3c was not queued to ep0out
[ 204.930885] android_work: did not send uevent (0 0 0000000000000000)
[ 205.036615] xhci-hcd xhci-hcd.14.auto: xHCI Host Controller
[ 205.036718] xhci-hcd xhci-hcd.14.auto: new USB bus registered, assigned bus number 8
[ 205.036801] xhci-hcd xhci-hcd.14.auto: hcc params 0x0220fe64 hci version 0x110 quirks 0x0002008002010010
[ 205.036817] xhci-hcd xhci-hcd.14.auto: irq 75, io mem 0xfc000000
[ 205.036876] xhci-hcd xhci-hcd.14.auto: xHCI Host Controller
[ 205.036949] xhci-hcd xhci-hcd.14.auto: new USB bus registered, assigned bus number 9
[ 205.036955] xhci-hcd xhci-hcd.14.auto: Host supports USB 3.0 SuperSpeed
[ 205.037006] usb usb8: New USB device found, idVendor=1d6b, idProduct=0002, bcdDevice= 6.01
[ 205.037012] usb usb8: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 205.037016] usb usb8: Product: xHCI Host Controller
[ 205.037020] usb usb8: Manufacturer: Linux 6.1.118 xhci-hcd
[ 205.037025] usb usb8: SerialNumber: xhci-hcd.14.auto
[ 205.037219] hub 8-0:1.0: USB hub found
[ 205.037233] hub 8-0:1.0: 1 port detected
[ 205.037350] usb usb9: We don't know the algorithms for LPM for this host, disabling LPM.
[ 205.037380] usb usb9: New USB device found, idVendor=1d6b, idProduct=0003, bcdDevice= 6.01
[ 205.037385] usb usb9: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 205.037389] usb usb9: Product: xHCI Host Controller
[ 205.037393] usb usb9: Manufacturer: Linux 6.1.118 xhci-hcd
[ 205.037397] usb usb9: SerialNumber: xhci-hcd.14.auto
[ 205.037634] hub 9-0:1.0: USB hub found
[ 205.037650] hub 9-0:1.0: 1 port detected
[ 205.872608] usb 9-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 205.892817] usb 9-1: LPM exit latency is zeroed, disabling LPM.
[ 205.893267] usb 9-1: New USB device found, idVendor=346d, idProduct=5678, bcdDevice= 3.20
[ 205.893275] usb 9-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 205.893280] usb 9-1: Product: HIKSEMI
[ 205.893284] usb 9-1: Manufacturer:
[ 205.893288] usb 9-1: SerialNumber: FC015D057334E
[ 205.893843] usb-storage 9-1:1.0: USB Mass Storage device detected
[ 205.894331] scsi host2: usb-storage 9-1:1.0
[ 206.900974] scsi 2:0:0:0: Direct-Access HIKSEMI 3.20 PQ: 0 ANSI: 4
[ 206.902520] sd 2:0:0:0: [sdc] 245760000 512-byte logical blocks: (126 GB/117 GiB)
[ 206.902706] sd 2:0:0:0: [sdc] Write Protect is off
[ 206.902862] sd 2:0:0:0: [sdc] No Caching mode page found
[ 206.902870] sd 2:0:0:0: [sdc] Assuming drive cache: write through
[ 206.905188] sdc: sdc1
[ 206.905505] sd 2:0:0:0: [sdc] Attached SCSI removable disk
[ 207.052407] FAT-fs (sdc1): utf8 is not a recommended IO charset for FAT filesystems, filesystem will be case
sensitive!
[ 207.055633] FAT-fs (sdc1): Volume was not properly unmounted. Some data may be corrupt. Please run fsck.

```

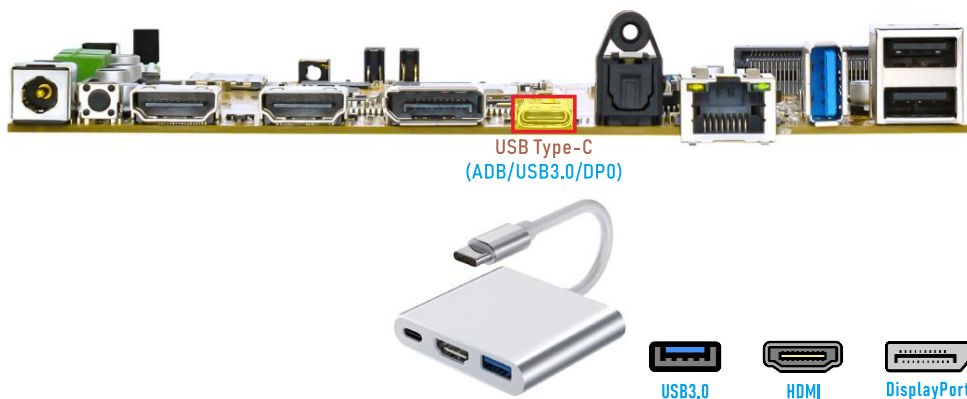
Step 2: After inserting the USB 3.0 flash drive, the system will automatically mount the device. Use the following command to check the directory information of the automatically mounted device:

```
# df -h
```

```
root@idea3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   792M   13G   6% /
devtmpfs        3.8G   8.0K   3.8G   1% /dev
tmpfs           3.9G   440K   3.9G   1% /run
tmpfs           3.9G   240K   3.9G   1% /var/log
tmpfs           3.9G    0     3.9G   0% /dev/shm
tmpfs           3.9G   140K   3.9G   1% /tmp
/dev/mmcblk0p8   15G   400K   15G   1% /userdata
/dev/mmcblk0p7  124M   5.3M  115M   5% /oem
/dev/sda1        62M    15M   47M  24% /mnt/udisk
```

7.4.3 DP Alt Mode

DisplayPort Alternate Mode (DP Alt Mode) is a technology that facilitates the transmission of DisplayPort video signals through a USB Type-C interface. It enables devices to output video and audio via a USB-C connection without requiring a dedicated DisplayPort connector. This allows users to connect a display using a single USB-C port while transmitting video, audio, and additional data.



Currently, Boardcon has conducted the following output tests:

- **Type-C to HDMI:** Supports 3840x2160p60 resolution.
- **Type-C to DisplayPort (DP):** Supports 3840x2160p60 resolution.



7.5 Ethernet

Step 1: Connect the network cable to the Ethernet port.



According to the log, it can be seen that the Gigabit Ethernet recognition is successful.

```
root@idea3588-buildroot:/# [ 292.088371] rk_gmac-dwmac fe1c0000.ethernet eth0: Link is Up - 1Gbps/Full - flow control rx/tx
[ 292.088515] IPv6: ADDRCONF(NETDEV_CHANGE): eth0: link becomes ready
```

Step 2: View network interface information.

```
# ifconfig eth0
```

```
root@idea3588-buildroot:/# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 22:5F:F9:59:2B:D0
          inet addr:192.168.0.248  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::c552:1d18:c472:d407/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:65 errors:0 dropped:6 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5567 (5.4 KiB)  TX bytes:1340 (1.3 KiB)
          Interrupt:73
```

Step 3: Network connection test.

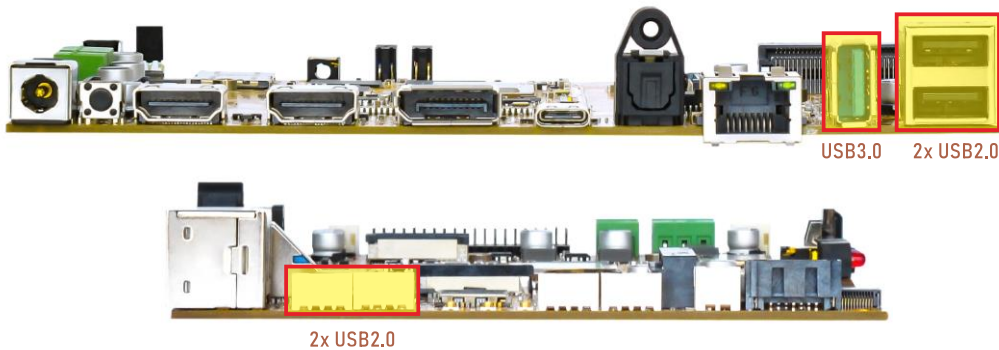
```
# ping -I eth0 www.armdesigner.com
```

```

root@idea3588-buildroot:/# ping -I eth0 www.armdesigner.com
PING d3dsoj86mhwkk6.cloudfront.net (13.249.126.17) from 192.168.0.248 eth0: 56(84) bytes of data.
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=1 ttl=246 time=169 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=3 ttl=246 time=171 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=4 ttl=246 time=164 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=5 ttl=246 time=173 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=6 ttl=246 time=173 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=7 ttl=246 time=168 ms
64 bytes from www.armdesigner.com (13.249.126.17): icmp_seq=8 ttl=246 time=164 ms
^C
--- d3dsoj86mhwkk6.cloudfront.net ping statistics ---
8 packets transmitted, 7 received, 12.5% packet loss, time 7037ms
rtt min/avg/max/mdev = 164.370/168.980/173.363/3.398 ms
  
```

7.6 USB Host

The USB host can be used to connect devices such as USB mouse, USB keyboards, USB flash drives, and other USB peripherals.



After connecting the USB flash drive, it will be automatically mounted. The user can identify whether the mounted flash drive is USB 2.0 or USB 3.0 from the debug log.

- USB2.0 print information in **high-speed** mode.

```

root@idea3588-buildroot:/# [ 41.378439] usb 3-1.3: new high-speed USB device number 3 using xhci-hcd
[ 41.489503] usb 3-1.3: New USB device found, idVendor=346d, idProduct=5678, bcdDevice= 3.20
[ 41.489548] usb 3-1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 41.489564] usb 3-1.3: Product: HIKSEMI
[ 41.489576] usb 3-1.3: Manufacturer:
[ 41.489588] usb 3-1.3: SerialNumber: FC082FA00CF4E
[ 41.490669] usb-storage 3-1.3:1.0: USB Mass Storage device detected
[ 41.493822] scsi host1: usb-storage 3-1.3:1.0
[ 42.614711] scsi 1:0:0:0: Direct-Access HIKSEMI 3.20 PQ: 0 ANSI: 4
[ 42.616974] sd 1:0:0:0: [sdb] 245760000 512-byte logical blocks: (126 GB/117 GiB)
[ 42.617523] sd 1:0:0:0: [sdb] Write Protect is off
[ 42.618116] sd 1:0:0:0: [sdb] No Caching mode page found
[ 42.618132] sd 1:0:0:0: [sdb] Assuming drive cache: write through
[ 42.622260] sdb: sdb1
[ 42.622711] sd 1:0:0:0: [sdb] Attached SCSI removable disk
  
```

- USB3.0 print information in **SuperSpeed** mode.

```

root@idea3588-buildroot:/# [ 84.052596] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 84.083452] usb 2-1: New USB device found, idVendor=0dd8, idProduct=3b00, bcdDevice= 0.02
[ 84.083534] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 84.083568] usb 2-1: Product: OnlyDisk
[ 84.083595] usb 2-1: Manufacturer: Netac
[ 84.083622] usb 2-1: SerialNumber: C0E8BFA3EC38F796
[ 84.086246] usb-storage 2-1:1.0: USB Mass Storage device detected
[ 84.087561] scsi host2: usb-storage 2-1:1.0
[ 85.700538] scsi 2:0:0:0: Direct-Access Netac OnlyDisk 8.01 PQ: 0 ANSI: 6
[ 85.704211] sd 2:0:0:0: [sdc] 121610240 512-byte logical blocks: (62.3 GB/58.0 GiB)
[ 85.704801] sd 2:0:0:0: [sdc] Write Protect is off
[ 85.705299] sd 2:0:0:0: [sdc] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 85.710489] sdc: sdc1
[ 85.710754] sd 2:0:0:0: [sdc] Attached SCSI removable disk
  
```

Execute the following command to view the path where the device is mounted:

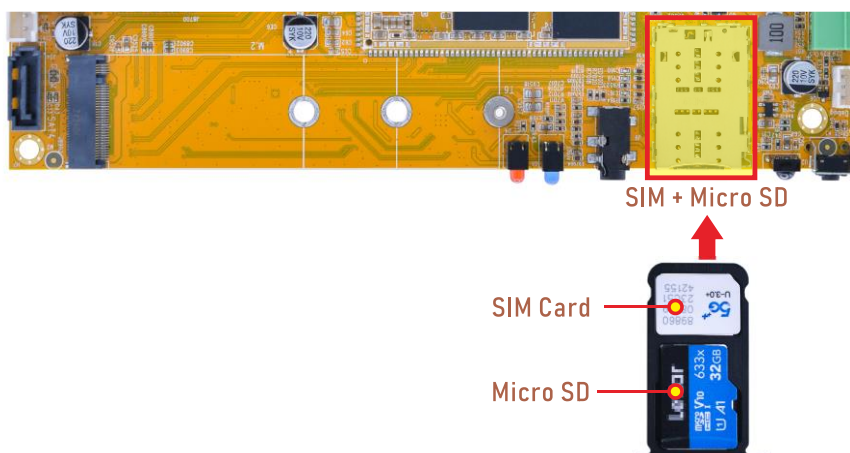
```
# df -h
```

```

root@idea3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   735M   13G   6% /
devtmpfs         3.8G   8.0K   3.8G   1% /dev
tmpfs            3.9G   140K   3.9G   1% /tmp
tmpfs            3.9G   664K   3.9G   1% /run
tmpfs            3.9G   240K   3.9G   1% /var/log
tmpfs            3.9G   0       3.9G   0% /dev/shm
/dev/mmcblk0p7   123M   12M   109M  10% /oem
/dev/mmcblk0p8   15G   436K   15G   1% /userdata
/dev/nvme0n1p1   233G   640K   233G   1% /mnt/storage
/dev/sda1        120G   1.7M   120G   1% /media/storage1
/dev/mmcblk1p1   120G   74M   120G   1% /mnt/sdcard
/dev/sdb1        118G   62G   56G   53% /mnt/udisk
/dev/sdc1         58G   34G   25G   59% /media/udisk1
  
```

7.7 SD Card

Step 1: Insert the micro SD card into the card slot.



Step 2: The system will automatically mount it, view the device mount path.

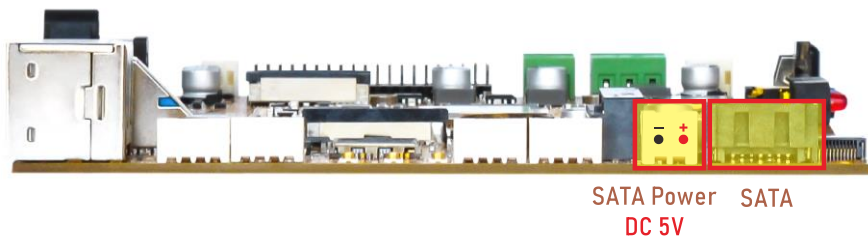
```
# df -h
```

```

root@idea3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   735M   13G   6% /
devtmpfs        3.8G   8.0K   3.8G   1% /dev
tmpfs           3.9G  140K   3.9G   1% /tmp
tmpfs           3.9G   664K   3.9G   1% /run
tmpfs           3.9G  240K   3.9G   1% /var/log
tmpfs           3.9G   0     3.9G   0% /dev/shm
/dev/mmcblk0p7  123M   12M   109M  10% /oem
/dev/mmcblk0p8   15G   436K   15G   1% /userdata
/dev/nvme0n1p1  233G   640K   233G   1% /mnt/storage
/dev/sda1       120G   1.7M   120G   1% /media/storage1
/dev/mmcblk1p1  120G   74M   120G   1% /mnt/sdcard
  
```

7.8 SATA

Step 1: Connect the sata and sata power, then power on.



Step 2: The system will automatically mount it, view the device mount path.

```
# df -h
```

```

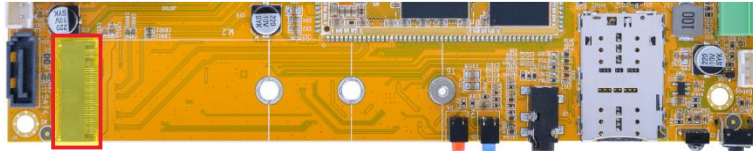
root@idea3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   735M   13G   6% /
devtmpfs        3.8G   8.0K   3.8G   1% /dev
tmpfs           3.9G  140K   3.9G   1% /tmp
tmpfs           3.9G   664K   3.9G   1% /run
tmpfs           3.9G  240K   3.9G   1% /var/log
tmpfs           3.9G   0     3.9G   0% /dev/shm
/dev/mmcblk0p7  123M   12M   109M  10% /oem
/dev/mmcblk0p8   15G   436K   15G   1% /userdata
/dev/nvme0n1p1  233G   640K   233G   1% /mnt/storage
/dev/sda1       120G   1.7M   120G   1% /media/storage1
/dev/mmcblk1p1  120G   74M   120G   1% /mnt/sdcard
  
```

Note: The SATA on buildroot only supports the ext4 format. If devices that are not in ext4 format, the user can choose to format them on the board. After formatting, **the files on the device will be permanently lost**, so please proceed with caution.

```
# mke2fs -t ext4 /dev/sda1
```

7.9 M.2 NVME SSD

Step 1: Connect the SSD, then power on.



M.2 for SSD
PCIe3.0

Step 2: The system will automatically mount it, view the device mount path.

```
# df -h
```

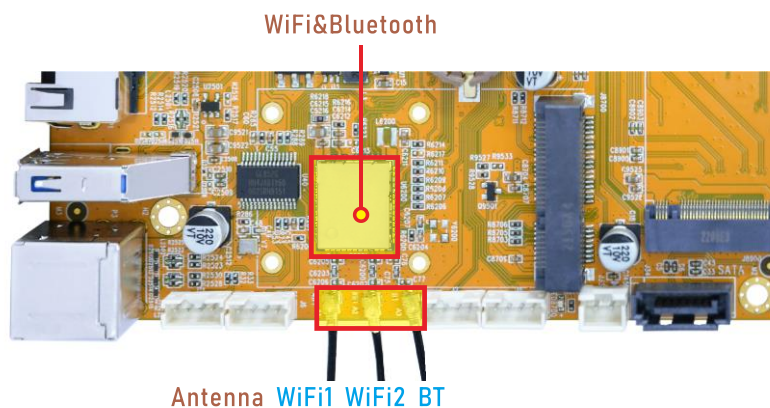
```
root@idea3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   735M   13G   6% /
devtmpfs         3.8G   8.0K   3.8G   1% /dev
tmpfs            3.9G   140K   3.9G   1% /tmp
tmpfs            3.9G   664K   3.9G   1% /run
tmpfs            3.9G   240K   3.9G   1% /var/log
tmpfs            3.9G    0     3.9G   0% /dev/shm
/dev/mmcblk0p7   123M   12M   109M  10% /oem
/dev/mmcblk0p8   15G   436K   15G   1% /userdata
/dev/nvme0n1p1  233G   640K  233G   1% /mnt/storage
/dev/sda1        120G   1.7M  120G   1% /media/storage1
/dev/mmcblk1p1   120G    74M  120G   1% /mnt/sdcard
```

Note: The SSD on buildroot only supports the ext4 format. If devices that are not in ext4 format, the user can choose to format them on the board. After formatting, **the files on the device will be permanently lost**, so please proceed with caution.

```
# mke2fs -t ext4 /dev/nvme0n1p1
```

7.10 WiFi & Bluetooth

To use Wi-Fi and Bluetooth functions properly, the antenna needs to be connected.



7.10.1 WiFi

Step 1: View the device information.

```
# ifconfig wlan0
```

```
root@idea3588-buildroot:/# ifconfig wlan0
wlan0      Link encap:Ethernet  HWaddr CC:64:1A:32:8B:90
UP BROADCAST MULTICAST  MTU:1500  Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

Step 2: Scan for available WiFi hotspots.

```
# iwlist wlan0 scan
```

```
root@idea3588-buildroot:/# iwlist wlan0 scan
wlan0      Scan completed :
Cell 01 - Address: B4:F1:8C:6D:D1:24
            ESSID:"Boardcon"
            Protocol:IEEE 802.11bgn
            Mode:Master
            Frequency:2.412 GHz (Channel 1)
            Encryption key:on
            Bit Rates:780 Mb/s
            Extra:wpa_ie=dd1a0050f20101000050f20202000050f2040050f20201000050f202
            IE: WPA Version 1
               Group Cipher : TKIP
               Pairwise Ciphers (2) : CCMP TKIP
               Authentication Suites (1) : PSK
            Extra:
            IE: IEEE 802.11i/WPA2 Version 1
               Group Cipher : TKIP
               Pairwise Ciphers (2) : CCMP TKIP
               Authentication Suites (1) : PSK
            IE: Unknown:
DD910050F204104A0001101044000102103B00010310470010123456789ABCDEF01234B4F18C6DD124102100194875617765692054
656368E6F6C6F677920436F2E2C4C74641023000B576972656C657373204150102400033132331042000531323334351054000800
000050F2040001101100095443373130322D3130100800020780103C0001011049000600372A000120
            Quality=69/100  Signal level=69/100
```

Step 3: Connect to the hotspot.

```
# wifi-connect.sh SSID PSK
```

```
root@idea3588-buildroot:/# wifi-connect.sh Boardcon Boardcon434123
connect to WiFi ssid: Boardcon, Passwd: Boardcon434123
Successfully initialized wpa_supplicant
rfkill: Cannot open RFKILL control device
root@idea3588-buildroot:/# [ 382.759173] IPv6: ADDRCONF(NETDEV_CHANGE): wlan0: link becomes ready
```

Step 4: View the network interface status.

```
# ifconfig wlan0
```

```
root@idea3588-buildroot:/# ifconfig wlan0
wlan0      Link encap:Ethernet  HWaddr CC:64:1A:32:8B:90
           inet addr:192.168.0.95  Bcast:192.168.0.255  Mask:255.255.255.0
           inet6 addr: fe80::135c:137c:887e:4807/64  Scope:Link
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:212 errors:0 dropped:42 overruns:0 frame:0
           TX packets:18 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:25658 (25.0 KiB)  TX bytes:1836 (1.7 KiB)
```

Step 5: Test the WiFi network.

```
# ping -I wlan0 www.armdesigner.com
```

```
root@idea3588-buildroot:/# ping -I wlan0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.95 wlan0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=50 time=429 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=50 time=198 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=50 time=189 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=50 time=225 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=50 time=212 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=50 time=231 ms
^C
--- www.armdesigner.com ping statistics ---
7 packets transmitted, 6 received, 14.2857% packet loss, time 6008ms
rtt min/avg/max/mdev = 188.904/247.353/428.838/82.431 ms
```

7.10.2 Bluetooth

By default, Bluetooth is configured to work as a Bluetooth speaker.

Follow the steps below to pair and connect a device:

Step 1: Start the Bluetooth control tool

```
# bluetoothctl
```

```
root@idea3588-buildroot:/# hciconfig hci0 piscan
root@idea3588-buildroot:/# bluetoothctl
hci0 new_settings: powered connectable discoverable bondable ssp br/edr le secure-conn
Agent registered
[CHG] Controller 54:78:C9:88:AC:7B Pairable: yes
[bluetooth]#
```

Step 2: Scan for nearby Bluetooth devices.

Turn scanning on, then off after discovering devices (otherwise it will keep searching and refreshing).

```
[bluetooth]# scan on
[bluetooth]# scan off
```

```
[bluetooth]# scan on
SetDiscoveryFilter success
hci0 type 7 discovering on
Discovery started
[CHG] Controller 54:78:C9:88:AC:7B Discovering: yes
[NEW] Device 61:BC:6D:4C:39:F3 NZbI73aR101JD/BBPtMyHLHK0
[NEW] Device 5F:8C:21:57:FE:9A NZtaGS/Q6h4/TAenEAuCVvg5M
[NEW] Device 63:DF:D5:2F:60:3A 63-DF-D5-2F-60-3A
[NEW] Device 53:FB:97:21:75:F0 53-FB-97-21-75-F0
[CHG] Device 61:BC:6D:4C:39:F3 RSSI: 0xfffffff8 (-72)
[NEW] Device 51:2E:A7:D1:19:DE 51-2E-A7-D1-19-DE
[NEW] Device 15:4F:84:FB:20:8E 15-4F-84-FB-20-8E
[NEW] Device 50:8A:06:FA:35:A5 TY
[NEW] Device 67:94:69:60:89:9E 67-94-69-60-89-9E
[NEW] Device C1:14:88:1E:63:B5 Mi Smart Band 6
[NEW] Device A8:35:12:9A:EB:4D liuy
hci0 type 7 discovering off
[bluetooth]# scan off
[CHG] Device A8:35:12:9A:EB:4D RSSI is nil
[CHG] Device C1:14:88:1E:63:B5 RSSI is nil
[CHG] Device 67:94:69:60:89:9E TxPower is nil
[CHG] Device 51:2E:A7:D1:19:DE TxPower is nil
[CHG] Device 51:2E:A7:D1:19:DE RSSI is nil
[CHG] Device 53:FB:97:21:75:F0 TxPower is nil
[CHG] Device 5F:8C:21:57:FE:9A TxPower is nil
[CHG] Device 73:E8:A7:24:D4:EA TxPower is nil
[CHG] Device 73:E8:A7:24:D4:EA RSSI is nil
[CHG] Device 4C:3F:66:E0:55:7E TxPower is nil
[CHG] Device 66:09:E0:27:5F:87 TxPower is nil
[CHG] Device 61:23:F4:C9:CE:EA TxPower is nil
[CHG] Device 61:23:F4:C9:CE:EA RSSI is nil
[CHG] Device 6E:AA:58:3A:84:51 TxPower is nil
[CHG] Device 6E:AA:58:3A:84:51 RSSI is nil
[CHG] Device 61:BC:6D:4C:39:F3 TxPower is nil
[CHG] Device 61:BC:6D:4C:39:F3 RSSI is nil
[CHG] Controller 54:78:C9:88:AC:7B Discovering: no
Discovery stopped
```

Step 3: List available devices

```
[bluetooth]# devices
```

```
[bluetooth]# devices
Device 61:BC:6D:4C:39:F3 NZbI73aR101JD/BBPtMyHLHK0
Device 6E:AA:58:3A:84:51 6E-AA-58-3A-84-51
Device 61:23:F4:C9:CE:EA 61-23-F4-C9-CE-EA
Device 5E:16:F2:ED:94:B2 5E-16-F2-ED-94-B2
Device 66:09:E0:27:5F:87 66-09-E0-27-5F-87
Device 68:DE:82:7A:1E:5F 68-DE-82-7A-1E-5F
Device 64:E9:73:33:1B:32 64-E9-73-33-1B-32
Device 42:2F:13:61:20:18 42-2F-13-61-20-18
Device 4C:3F:66:E0:55:7E 4C-3F-66-E0-55-7E
Device 73:E8:A7:24:D4:EA 73-E8-A7-24-D4-EA
Device 69:88:E2:AF:C7:DE 69-88-E2-AF-C7-DE
Device 5F:8C:21:57:FE:9A NZtaGS/Q6h4/TAenEAuCVvg5M
Device 63:DF:D5:2F:60:3A 63-DF-D5-2F-60-3A
Device 53:FB:97:21:75:F0 53-FB-97-21-75-F0
Device 51:2E:A7:D1:19:DE 51-2E-A7-D1-19-DE
Device 15:4F:84:FB:20:8E 15-4F-84-FB-20-8E
Device 50:8A:06:FA:35:A5 TY
Device 67:94:69:60:89:9E 67-94-69-60-89-9E
Device C1:14:88:1E:63:B5 Mi Smart Band 6
Device A8:35:12:9A:EB:4D liuy
```

Step 4: Pair with a device

Replace the MAC address with the one of your target device.

```
[bluetooth]# pair A8:35:12:9A:EB:4D
```

```
[bluetooth]# pair A8:35:12:9A:EB:4D
Attempting to pair with A8:35:12:9A:EB:4D
hci0 device_flags_changed: A8:35:12:9A:EB:4D (BR/EDR)
      supp: 0x00000000 curr: 0x00000000
[CHG] Device A8:35:12:9A:EB:4D Connected: yes
Request confirmation
[agent] Confirm passkey 349129 (yes/no): yes
hci0 new_link_key A8:35:12:9A:EB:4D type 0x08 pin_len 0 store_hint 1
[CHG] Device A8:35:12:9A:EB:4D Bonded: yes
[CHG] Device A8:35:12:9A:EB:4D Modalias: bluetooth:v010Fp107Ed1436
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000046a-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001105-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000110a-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000110c-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001112-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001115-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001116-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000111f-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000112f-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001132-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001200-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001800-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 00001801-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 0000fe35-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIs: 11c8b310-80e4-4276-afc0-f81590b2177f
[CHG] Device A8:35:12:9A:EB:4D UUIs: 8ce255c0-200a-11e0-ac64-0800200c9a66
[CHG] Device A8:35:12:9A:EB:4D UUIs: 9664aa26-d76c-43ad-9775-d310f253a408
[CHG] Device A8:35:12:9A:EB:4D ServicesResolved: yes
[CHG] Device A8:35:12:9A:EB:4D Paired: yes
Pairing successful
```

Step 5: Trust the device (to avoid having to pair again each time)

```
[bluetooth]# trust A8:35:12:9A:EB:4D
```

```
[bluetooth]# trust A8:35:12:9A:EB:4D
[CHG] Device A8:35:12:9A:EB:4D Trusted: yes
Changing A8:35:12:9A:EB:4D trust succeeded
```

Step 6: Connect to the paired device

```
[bluetooth]# connect A8:35:12:9A:EB:4D
```

```
[bluetooth]# connect A8:35:12:9A:EB:4D
Attempting to connect to A8:35:12:9A:EB:4D
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
[CHG] Device A8:35:12:9A:EB:4D Connected: yes
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 11
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
[NEW] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep1
[NEW] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep2
[NEW] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep3
[NEW] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep4
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
[NEW] Transport /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep1/fd1
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
Connection successful
```

Step 7: Remove a paired device (unpair)

```
[bluetooth]# remove A8:35:12:9A:EB:4D
```

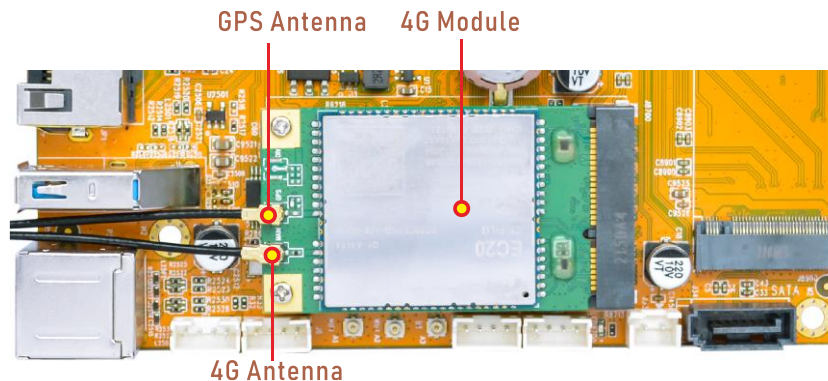
```
[liuy]# remove A8:35:12:9A:EB:4D
[DEL] Player /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/player0 [default]
[liuy]# [12:36:13.082] event9 - liuy (AVRCP): device removed
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
[DEL] Transport /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep1/fd1
[DEL] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep1
[DEL] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep2
[DEL] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep3
[DEL] Endpoint /org/bluez/hci0/dev_A8_35_12_9A_EB_4D/sep4
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR connected eir_len 5
hci0 A8:35:12:9A:EB:4D type BR/EDR disconnected with reason 2
[CHG] Device A8:35:12:9A:EB:4D ServicesResolved: no
Device has been removed
[CHG] Device A8:35:12:9A:EB:4D Connected: no
[DEL] Device A8:35:12:9A:EB:4D liuy
[bluetooth]#
```

Bluetoothctl Common Commands:

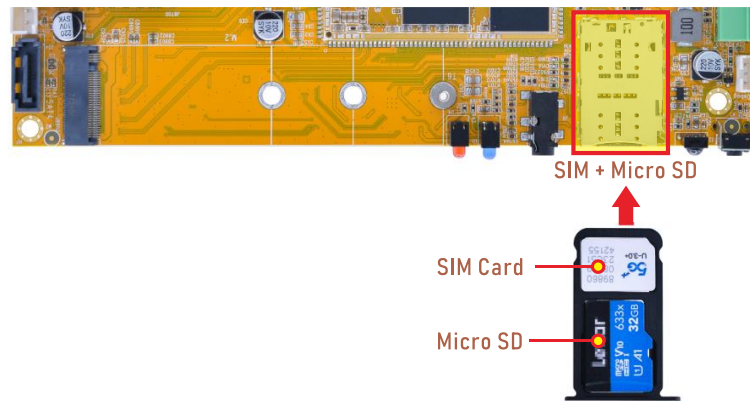
```
# bluetoothctl                                /* Start bluetoothctl interactive tool */
[bluetooth]# scan on                          /* Enable scanning for nearby devices */
[bluetooth]# scan off                         /* Disable scanning, stop refreshing */
[bluetooth]# devices                          /* Show discovered devices with MAC addresses */
[bluetooth]# pair XX:XX:XX:XX:XX:XX           /* Pair with specified device */
[bluetooth]# trust XX:XX:XX:XX:XX:XX          /* Trust device for auto-connect */
[bluetooth]# connect XX:XX:XX:XX:XX:XX        /* Connect to paired device */
[bluetooth]# disconnect XX:XX:XX:XX:XX:XX     /* Disconnect from device */
[bluetooth]# remove XX:XX:XX:XX:XX:XX         /* Remove (unpair) device */
[bluetooth]# paired-devices                   /* List previously paired devices */
[bluetooth]# list                             /* Show local Bluetooth adapters */
[bluetooth]# discoverable on                  /* Make device discoverable */
[bluetooth]# discoverable off                 /* Make device non-discoverable */
[bluetooth]# exit                             /* Exit bluetoothctl */
```

7.11 4G&GPS

Step 1: Insert 4G module to PCIe socket (4G model: EC20), and connect antenna.



Step 2: Connect antenna and insert SIM card.



Step 3: Power on.

7.11.1 4G Test

Step 1: Initiate the PPP connection.

```
# mkdir -p var/run/pppd/lock  
# pppd call quectel-ppp &
```



```
root@idea3588-buildroot:/# mkdir -p var/run/pppd/lock
root@idea3588-buildroot:/# pppd call quectel-ppp &
[1] 2255
root@idea3588-buildroot:/# pppd options in effect:
debug          # (from /etc/ppp/peers/quectel-ppp)
nodetach        # (from /etc/ppp/peers/quectel-ppp)
dump           # (from /etc/ppp/peers/quectel-ppp)
noauth         # (from /etc/ppp/peers/quectel-ppp)
user test      # (from /etc/ppp/peers/quectel-ppp)
password ????? # (from /etc/ppp/peers/quectel-ppp)
remotename 3gppp # (from /etc/ppp/peers/quectel-ppp)
/dev/ttyUSB_4G # (from /etc/ppp/peers/quectel-ppp)
115200       # (from /etc/ppp/peers/quectel-ppp)
lock         # (from /etc/ppp/peers/quectel-ppp)
connect chat -s -v -f /etc/ppp/peers/quectel-chat-connect # (from /etc/ppp/peers/quectel-ppp)
disconnect chat -s -v -f /etc/ppp/peers/quectel-chat-disconnect # (from /etc/ppp/peers/quectel-ppp)
noctrlscts    # (from /etc/ppp/peers/quectel-ppp)
modem         # (from /etc/ppp/peers/quectel-ppp)
hide-password # (from /etc/ppp/peers/quectel-ppp)
novj          # (from /etc/ppp/peers/quectel-ppp)
novjccomp     # (from /etc/ppp/peers/quectel-ppp)
ipcp-accept-local # (from /etc/ppp/peers/quectel-ppp)
ipcp-accept-remote # (from /etc/ppp/peers/quectel-ppp)
ipparam 3gppp # (from /etc/ppp/peers/quectel-ppp)
noipdefault   # (from /etc/ppp/peers/quectel-ppp)
ipcp-max-failure 30 # (from /etc/ppp/peers/quectel-ppp)
defaultroute  # (from /etc/ppp/peers/quectel-ppp)
usepeerdns    # (from /etc/ppp/peers/quectel-ppp)
noccip        # (from /etc/ppp/peers/quectel-ppp)
abort on (BUSY)
abort on (NO CARRIER)
abort on (NO DIALTONE)
abort on (ERROR)
abort on (NO ANSWER)
timeout set to 30 seconds
send (AT^M)
expect (OK)
AT^M^M
OK
-- got it

send (ATE0^M)
expect (OK)
^M
ATE0^M^M
OK
-- got it

send (ATI;+CSUB;+CSQ;+CPIN?;+COPS?;+CGREG?;&D2^M)
expect (OK)
^M
^M
Quectel^M
EC25^M
Revision: EC25EUXGAR08A17M1G^M
^M
SubEdition: V01^M
```

Step 2: Check the status of the network interfaces.

```
# ifconfig ppp0
```

```
root@idea3588-buildroot:/# ifconfig ppp0
ppp0      Link encap:Point-to-Point Protocol
          inet addr:10.39.113.32 P-t-P:10.64.64.64 Mask:255.255.255
          UP POINTOPOINT RUNNING NOARP MULTICAST MTU:1500 Metric:1
          RX packets:4 errors:0 dropped:0 overruns:0 frame:0
          TX packets:14 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3
          RX bytes:52 (52.0 B) TX bytes:198 (198.0 B)
```

Step 3: Test the PPP connection.

```
# ping -I ppp0 www.armdesigner.com
```

```
root@idea3588-buildroot:/# ping -I ppp0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 10.39.113.32 ppp0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=45 time=240 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=45 time=505 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=45 time=459 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=45 time=1165 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=45 time=276 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=45 time=717 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=45 time=277 ms
^C
--- www.armdesigner.com ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6029ms
rtt min/avg/max/mdev = 239.836/519.770/1165.123/306.178 ms, pipe 2
```

7.11.2 GPS Test

Step 1: Enable GPS functionality.

```
# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
```

Step 2: Read GPS data.

```
# cat /dev/ttyUSB1
```

```
root@idea3588-buildroot:/# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
root@idea3588-buildroot:/# cat /dev/ttyUSB1
$GPVTDG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

$GPGGA,,,,,0,,,,,,*66

$GPRMC,,V,,,,,,,,,N,V*29

$GPVTDG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

$GPGGA,,,,,0,,,,,,*66

$GPRMC,,V,,,,,,,,,N,V*29

$GPVTDG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

$GPGGA,,,,,0,,,,,,*66

$GPRMC,,V,,,,,,,,,N,V*29

$GPVTDG,,T,,M,,N,,K,N*2C

$GPGSA,A,1,,,,,,,,,,,,,*32

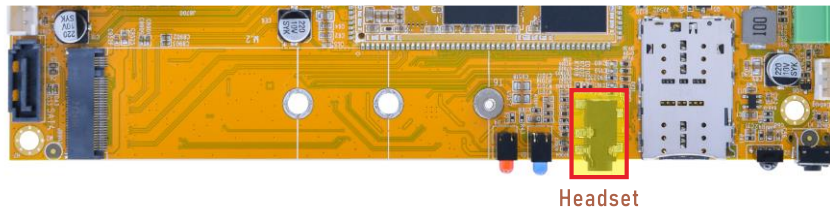
$GPGGA,,,,,0,,,,,,*66

$GPRMC,,V,,,,,,,,,N,V*29

$GPVTDG,,T,,M,,N,,K,N*2C
```

7.12 Headset

Step 1: Plug the headset into the headset jack and connect the speaker.



Step 2: View sound card.

```
# cat /proc/asound/cards
```

```
root@idea3588-buildroot:/# cat /proc/asound/cards
0 [rockchiphdmiin ]: rockchip_hdmiin - rockchip_hdmiin
rockchip_hdmiin
1 [rockchipes8388 ]: rockchip-es8388 - rockchip-es8388
rockchip-es8388
2 [rockchiphdmi0 ]: rockchip-hdmi0 - rockchip-hdmi0
rockchip-hdmi0
3 [rockchipdp0 ]: rockchip-dp0 - rockchip-dp0
rockchip-dp0
4 [rockchipdp1 ]: rockchip-dp1 - rockchip-dp1
rockchip-dp1
```

Step 3: Headset recording.

```
# arecord -Dhw:1,0 -f cd record.wav
```

```
root@idea3588-buildroot:/# arecord -Dhw:1,0 -f cd record.wav
Recording WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Step 4: Headset play audio.

```
# aplay -Dhw:1,0 record.wav
```

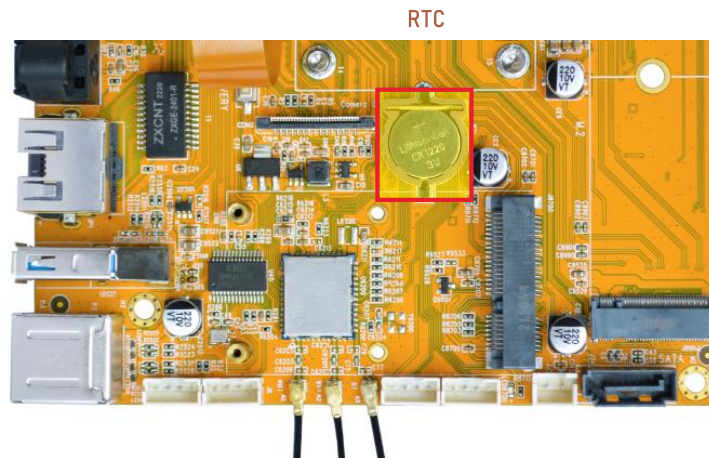
```
root@idea3588-buildroot:/# aplay -Dhw:1,0 record.wav
Playing WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Supplementary instructions on audio output:

```
# aplay -Dhw:1,0 record.wav // Headset audio output
# aplay -Dhw:2,0 record.wav // HDMI TX audio output
# aplay -Dhw:3,0 record.wav // DP AIT mode audio output
# aplay -Dhw:4,0 record.wav // DP TX audio output
```

7.13 RTC

Step 1: Install the coin cell battery.



Step 2: Set the system time.

```
# date -s "2025-07-22 18:49:00"
```

Step 3: Write the system time to the hardware clock.

```
# hwclock -w
```

Step 4: Display the current hardware clock time.

```
# hwclock
```

```
root@idea3588-buildroot:/# date -s "2025-07-22 18:49:00"
Tue Jul 22 18:49:00 UTC 2025
root@idea3588-buildroot:/# hwclock -w
root@idea3588-buildroot:/# hwclock
Tue Jul 22 18:49:06 2025  0.000000 seconds
root@idea3588-buildroot:/# hwclock
Tue Jul 22 18:49:31 2025  0.000000 seconds
```

Step 5: Power off, after a period of time to turn on the power again, check whether the time is saved.

```
root@idea3588-buildroot:/# hwclock
Tue Jul 22 19:28:28 2025  0.000000 seconds
root@idea3588-buildroot:/# hwclock
Tue Jul 22 19:29:59 2025  0.000000 seconds
root@idea3588-buildroot:/# hwclock
Tue Jul 22 19:30:13 2025  0.000000 seconds
root@idea3588-buildroot:/# hwclock
Tue Jul 22 19:30:45 2025  0.000000 seconds
```

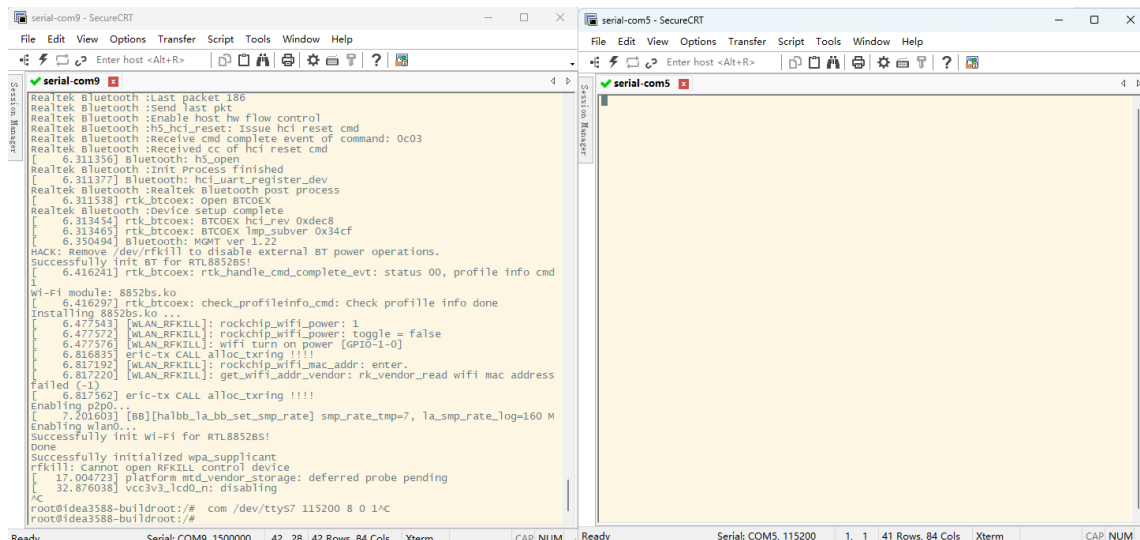
7.14 RS485



Step 1: As shown in the diagram, connect the RS485 test tool to the development board.

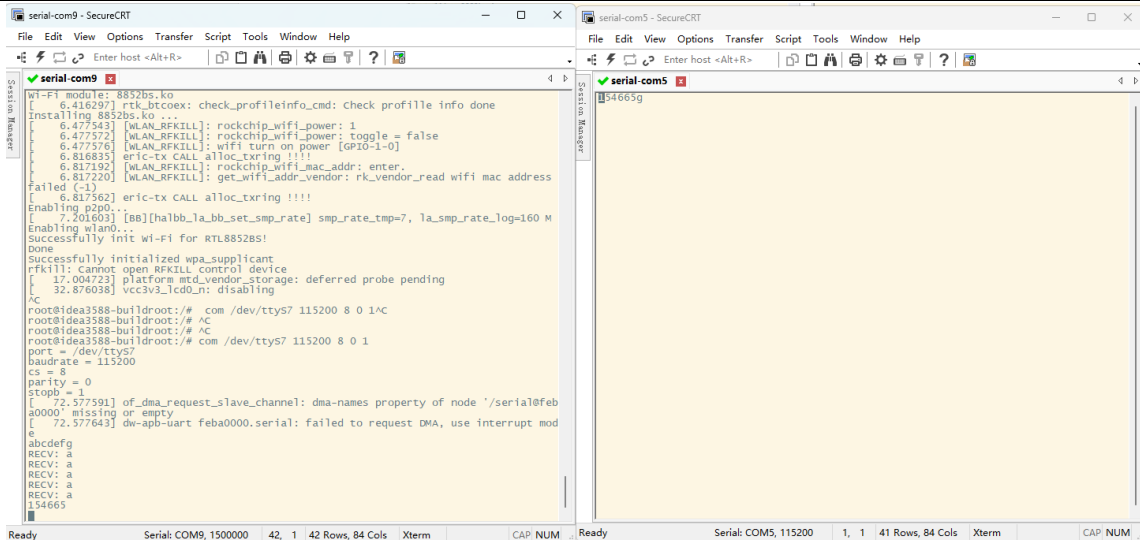


Step 2: Open the corresponding serial terminal, set the baud rate of the board to 1500000, and set the baud rate of the RS485 test tool to 115200.

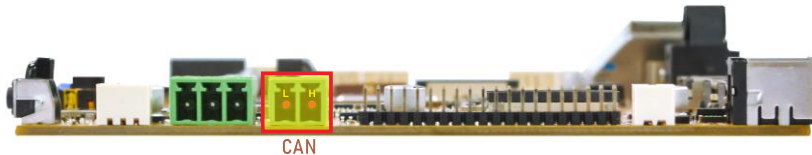


Step 3: Execute the following command on the board to test the RS485 transmission and reception functionality.

```
# com /dev/ttyS7 115200 8 0 1
```



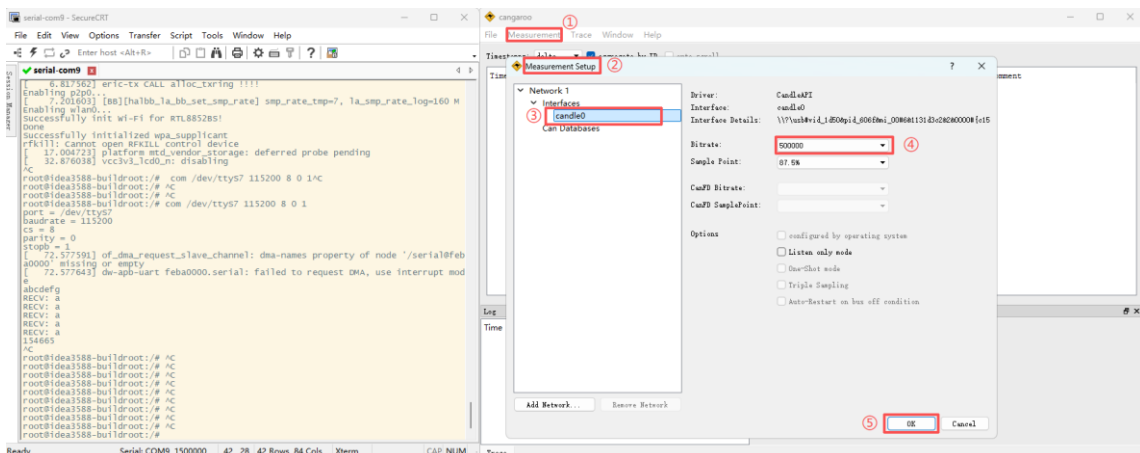
7.15 CAN



Step 1: Connect the CAN test tool to the board as shown in the diagram below.

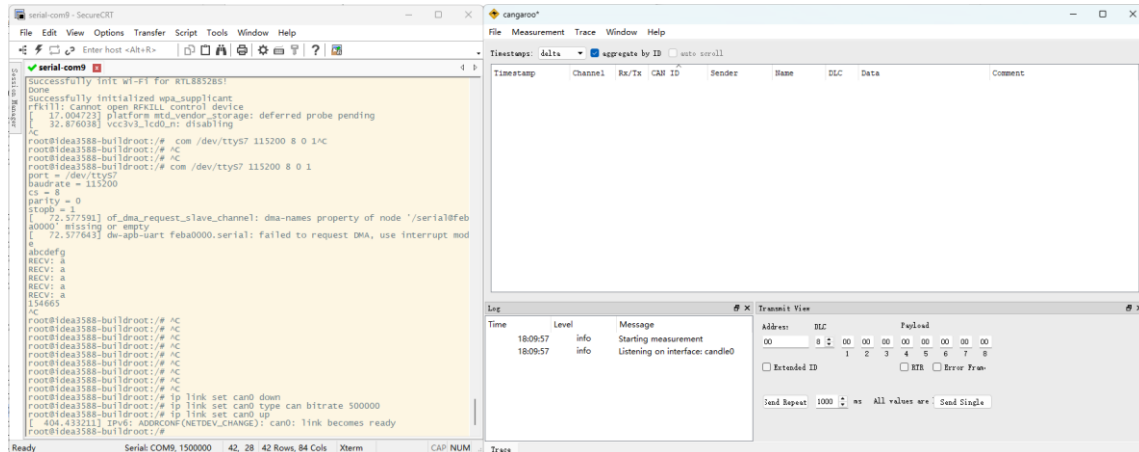


Step 2: Open the CAN test software and set the baud rate to 500000.



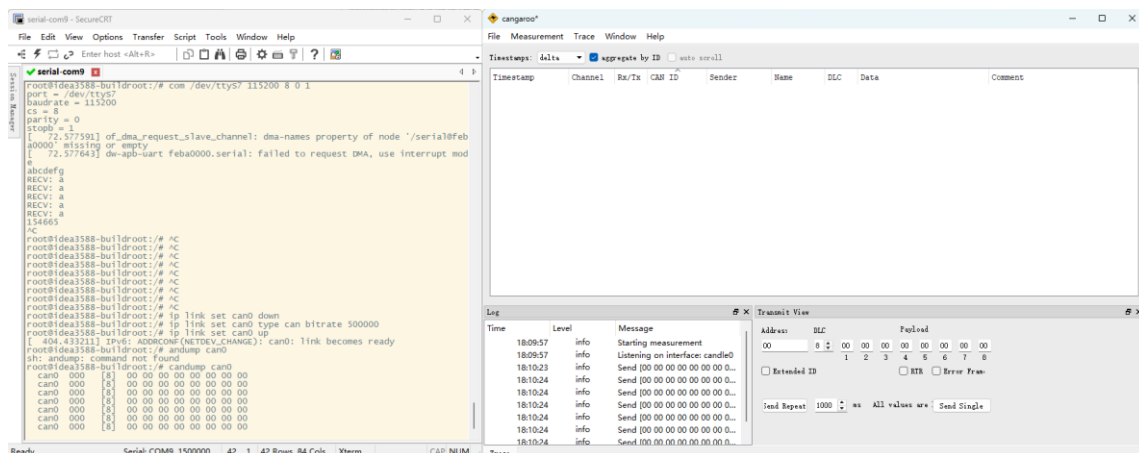
Step 3: Configure and activate the CAN network, setting the bitrate to 500000.

```
# ip link set can0 down
# ip link set can0 type can bitrate 500000
# ip link set can0 up
```



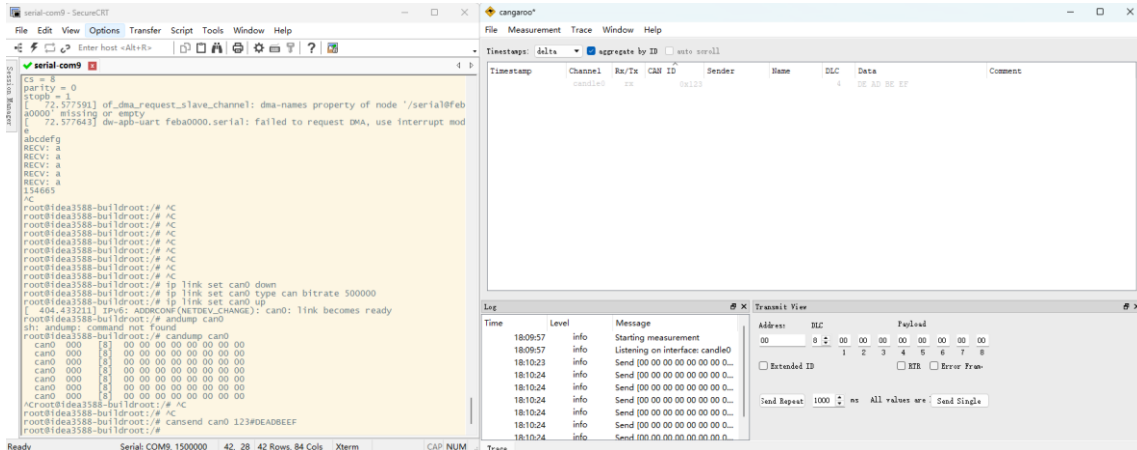
Step 4: Configure CAN as the receiver.

```
# candump can0
```



Step 5: Configure CAN as the sender.

```
# cansend can0 123#DEADBEEF
```



7.16 UART

Step 1: Short circuit RX and TX pins of UART.



Step 2: UART0 test.

```
# com /dev/ttyS0 115200 8 0 1
```

```
root@idea3588-buildroot:/# com /dev/ttyS0 115200 8 0 1
port = /dev/ttyS0
baudrate = 115200
cs = 8
parity = 0
stopb = 1
klklklklklklklkl
RECV: klklklklklklklkl
88888888
RECV: 88888888
oooooooooiuy
RECV: ooooooooooiuy
565322o
RECV: 565322o
```

Step 3: UART3 test.

```
# com /dev/ttyS3 115200 8 0 1
```

```

root@idea3588-buildroot:/# com /dev/ttyS3 115200 8 0 1
port = /dev/ttyS3
baudrate = 115200
cs = 8
parity = 0
stopb = 1
yuyuyuyu
RECV: yuyuyuyu
5656565
RECV: 5656565
yuyuyuyu
RECV: yuyuyuyu
pppp
RECV: pppp
  
```

7.17 IR



Step 1: Open IR debugging print.

```
# echo 1 > /sys/module/rockchip_pwm_remotectl/parameters/code_print
```

This enables the driver to print the decoded IR key values to the kernel log.

Step 2: Press buttons on the remote control

Point the remote control at the IR receiver and press any button. Messages appear in the log, for example:

```

s/code_print8-buildroot:/# echo 1 > /sys/module/rockchip_pwm_remotectl/parameters
root@idea3588-buildroot:/# [ 586.842747] USERCODE=0x1818
[ 586.869909] RMC_GETDATA=98
[ 587.242269] USERCODE=0x1818
[ 587.269402] RMC_GETDATA=98
[ 587.998014] USERCODE=0x1818
[ 588.025185] RMC_GETDATA=9a
[ 588.334528] USERCODE=0x1818
[ 588.361663] RMC_GETDATA=99
[ 588.662441] USERCODE=0x1818
[ 588.689601] RMC_GETDATA=9b
[ 589.134181] USERCODE=0x1818
[ 589.161335] RMC_GETDATA=e6
[ 589.411375] USERCODE=0x1818
[ 589.438508] RMC_GETDATA=e4
[ 589.693809] USERCODE=0x1818
[ 589.720948] RMC_GETDATA=e5
[ 589.982959] USERCODE=0x1818
[ 590.010067] RMC_GETDATA=e7
  
```

Parameter Description:

```

* USERCODE=0x1818    /*User code of the remote control (vendor/device
                      identifier), usually fixed for the same remote */
* RMC_GETDATA=98     /* Scancode of the remote control button (specific key
                      value), needs to be mapped to Linux KEY_xxx */
  
```

Step 3: Configure key values in the device tree (DTS)

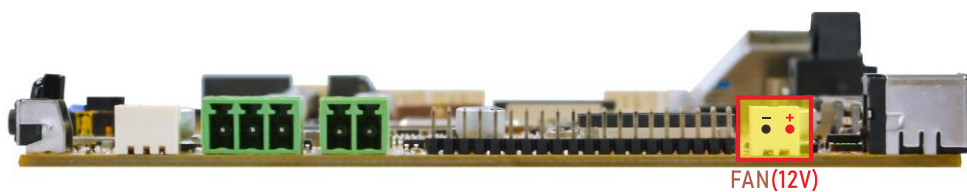
Insert the values obtained in **Step 2** into the remotectl-pwm node of the DTS file. File

path: `kernel-6.1\arch\arm64\boot\dts\rockchip\idea3588\idea3588.dtsi`

```
&pwm15 {
    compatible = "rockchip,remotectl-pwm";
    pinctrl-names = "default";
    pinctrl-0 = <&pwm15m1_pins>; /* PWM15 Pin Configuration */
    remote_pwm_id = <15>; /* PWM controller ID */
    handle_cpu_id = <1>;
    remote_support_psci = <0>;
    status = "okay";
    ir_key1 {
        rockchip,usercode = <0x4040>;
        rockchip,key_table =
            <0xf2KEY_REPLY>,
            .....
    };

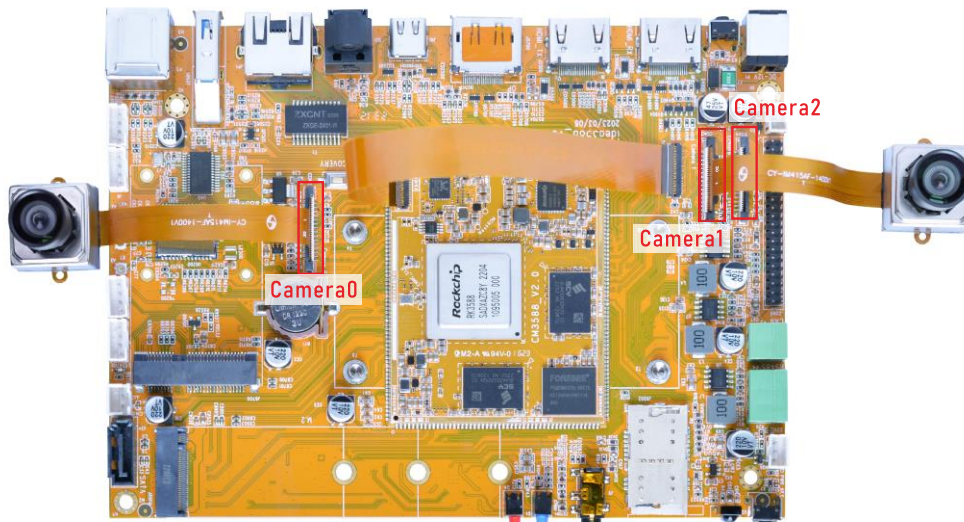
    ir_key2 {
        rockchip,usercode = <0x1818>;
        rockchip,key_table =
            <0x98 KEY_HOME>,
            <0x99 KEY_BACK>,
            <0x9a KEY_MENU>,
            <0x4d KEY_REPLY>,
            <0xe6 KEY_UP>,
            <0xe4 KEY_DOWN>,
            <0xe7 KEY_LEFT>,
            <0xe5 KEY_RIGHT>,
            .....
    };
};
```

7.18 Fan



12v long supply output.

7.19 Camera



7.19.1 Camera Interface

7.19.1.1 Camera Interface Supported Modes

The Idea3588 provides three Camera interfaces: camera0, camera1, and camera2. These interfaces support the following usage modes:

- Use any single interface (camera0, camera1, or camera2).
- Use camera0 and camera1 simultaneously.
- Use camera1 and camera2 simultaneously.

7.19.1.2 Camera Interface Configuration

The usage modes are controlled by software configuration. The specific settings can be found in the following configuration file:

kernel-6.1/arch/arm64/boot/dts/rockchip/boardcon-idea3588-linux.dts

- By default, camera0 and camera1 are used simultaneously.

```
#include "Boardcon-imx415-dphy0.dtsi" // camera0
#include "Boardcon-imx415-dphy1.dtsi" // camera1
//#include "Boardcon-imx415-dcphy1.dtsi" // camera2
```

- Camera1 and camera2 can also be used simultaneously.

```
//#include "Boardcon-imx415-dphy0.dtsi" // camera0
#include "Boardcon-imx415-dphy1.dtsi" // camera1
#include "Boardcon-imx415-dcphy1.dtsi" // camera2
```

- Single camera usage is supported (using camera0 as an example).

```
#include "Boardcon-imx415-dphy0.dtsi" // camera0
//#include "Boardcon-imx415-dphy1.dtsi" // camera1
//#include "Boardcon-imx415-dcphy1.dtsi" // camera2
```

Note

- ① The provided **update.img** supports enabling **camera0** and **camera1** simultaneously.
- ② The provided **boot.img** supports enabling **camera1** and **camera2** simultaneously.
- ③ For other modes, manual modification of the DTS configuration and recompilation of the image are required.
- ④ When using dual-camera mode, ensure that both cameras are connected to the hardware. Otherwise, **rkisp_3A_server** initialization may fail, leading to preview issues.

7.19.2 Camera Test

Step 1: View the video device.

```
# grep "" /sys/class/video4linux/v*/name | grep mainpath
# grep "" /sys/class/video4linux/v*/name | grep selfpath
```

```
hoot@idea3588-buildroot:/# grep "" /sys/class/video4linux/v*/name | grep mainpath
/sys/class/video4linux/video22/name:rkisp_mainpath
/sys/class/video4linux/video31/name:rkisp_mainpath
root@idea3588-buildroot:/#
hoot@idea3588-buildroot:/# grep "" /sys/class/video4linux/v*/name | grep selfpath
/sys/class/video4linux/video23/name:rkisp_selfpath
/sys/class/video4linux/video32/name:rkisp_selfpath
```

- **Camera0** corresponds to the device node **/dev/video22** or **/dev/video23**.
- **Camera1** corresponds to the device node **/dev/video31** or **/dev/video32**.
- The following test uses Camera0 as an example.

Step 2: Preview camera.

```
# gst-launch-1.0 v4l2src device=/dev/video22 !
video/x-raw,format=NV12,width=1920,height=1080, framerate=30/1 ! waylandsink
```

```
root@idea3588-buildroot:/# ^C
raw,format=NV12,width=1920,height=1080,framerate=30/1 ! waylandsink2 ! video/x-r
Setting pipeline to PAUSED ...
Using mplane plugin for capture
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
[ 109.807534] rkisp_hw fdc00000.rkisp: set isp clk = 396000000Hz
[ 109.828298] rkisp rkisp0-vir2: first params buf queue
[ 109.829179] rkCIF-mipi-lvds2: stream[0] start streaming
[ 109.832443] rkCIF-mipi-lvds2: Allocate dummy buffer, size: 0x01028000
[ 109.832675] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 000000007524cd37, sd_name:rockchip-csi2-dphy0
[ 109.832691] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 109.832727] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 109.832766] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 109.832780] imx415 2-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 109.947656] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 109.980951] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
Redistribute latency...
0:00:05.6 / 99:99:99.
```

Step 3: Record the video.

```
# gst-launch-1.0 v4l2src device=/dev/video23 num-buffers=100 ! \
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! \
videoconvert ! mpph264enc ! h264parse ! mp4mux ! \
filesink location=/tmp/h264.mp4
```

```

root@idea3588-buildroot:/# ^C
s=100 ! \3588-buildroot:/# gst-launch-1.0 v4l2src device=/dev/video23 num-buffers
> video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! \
> videoconvert ! mpph264enc ! h264parse ! mp4mux ! \
> filesink location=/tmp/h264.mp4
mpp[2329]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2329]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2329]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2329]: mpp_info: mpp version: unknown mpp version for missing VCS info
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[2329]: mpp_info: mpp version: unknown mpp version for missing VCS info
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
mpp[2329]: mpp_enc: set prep cfg w:h [1920:1080] stride [1920:1088] fmt 0 rotate 0 mirror 0
mpp[2329]: mpp_enc: set rc cbr bps [7776000:8262000:7290000] fps [30:1:fix] - [30:1:fix] gop 30
mpp[2329]: mpp_enc: mode cbr bps [7290000:7776000:8262000] fps fix [30/1] -> fix [30/1] gop i [30] v [0]
[ 130.524725] rkisp_hw fdc00000.rkisp: set isp clk = 396000000Hz
[ 130.564126] rkisp rkisp0-vir2: first params buf queue
[ 130.565154] rkCIF-mipi-lvds2: stream[0] start streaming
[ 130.568752] rkCIF-mipi-lvds2: Allocate dummy buffer, size: 0x01028000
[ 130.569028] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 000000007524cd37, sd_name:rockchip-csi2-dphy0
[ 130.569047] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 130.569089] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 130.569131] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 130.569146] imx415 2-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 130.686976] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 130.720178] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 130.736075] devfreq fdbd0000.rkvenc-core: Couldn't update frequency transition information.
Redistribute latency...
Redistribute latency...
Got EOS from element "pipeline0".
Execution ended after 0:00:03.540221585
Setting pipeline to NULL ...
Freeing pipeline ...
[ 134.060850] rkCIF-mipi-lvds2: stream[0] start stopping, total mode 0x1, cur 0x1
root@idea3588-buildroot:/# [ 134.119946] rockchip-mipi-csi2 mipi2-csi2: stream off, src_sd: 000000007524cd37,
sd_name:rockchip-csi2-dphy0
[ 134.120037] rockchip-mipi-csi2 mipi2-csi2: stream OFF
[ 134.120084] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream_stop stream stop, dphy0
[ 134.120122] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:0, dphy0, ret 0
[ 134.120177] imx415 2-0036: s_stream: 0. 3864x2192, hdr: 0, bpp: 10
[ 134.135352] rkCIF-mipi-lvds2: stream[0] stopping finished, dma_en 0x0

```

Step 4: Take photos.

```

# gst-launch-1.0 -v v4l2src device=/dev/video22 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \
multifilesink location=/tmp/test%05d.jpg

```

```

fers=10 ! \88-buildroot:/# gst-launch-1.0 -v v4l2src device=/dev/video22 num-buff
> video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \
> multifilesink location=/tmp/test%05d.jpg
mpp[2347]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2347]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2347]: mpp_info: mpp version: unknown mpp version for missing VCS info
mpp[2347]: mpp_info: mpp version: unknown mpp version for missing VCS info
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[2347]: mpp_info: mpp version: unknown mpp version for missing VCS info
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
/GstPipeline:pipeline0/GstV4l2Src:v4l2src0: crop-bounds = < (int)0, (int)0, (int)3840, (int)2160 >
/GstPipeline:pipeline0/GstV4l2Src:v4l2src0.GstPad:src: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstCapsFilter:capfilter0.GstPad:src: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
[ 154.387606] rkisp_hw fdc00000.rkisp: set isp clk = 396000000Hz
mpp[2347]: mpp_enc: set prep cfg w:h [1920:1080] stride [1920:1088] fmt 0 rotate 0 mirror 0
mpp[2347]: mpp_enc: set rc cbr bps [31104000:33048000:29160000] fps [120:1:fix] - [120:1:fix] gop 120
mpp[2347]: mpp_enc: set jpeg qfactor [80:1:99]
/GstPipeline:pipeline0/GstMppJpegEnc:mppjpegenc0.GstPad:src: caps = image/jpeg, width=(int)1920,
height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstMultiFileSink:multifilesink0.GstPad:sink: caps = image/jpeg, width=(int)1920,
height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstMppJpegEnc:mppjpegenc0.GstPad:sink: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
/GstPipeline:pipeline0/GstCapsFilter:capfilter0.GstPad:sink: caps = video/x-raw, format=(string)NV12,
width=(int)1920, height=(int)1080, pixel-aspect-ratio=(fraction)1/1, framerate=(fraction)120/1,
interlace-mode=(string)progressive, colorimetry=(string)1:3:5:1
[ 154.416866] rkisp rkisp0-vir2: first params buf queue
[ 154.417832] rkCIF-mipi-lvds2: stream[0] start streaming
[ 154.420904] rkCIF-mipi-lvds2: Allocate dummy buffer, size: 0x01028000
[ 154.421182] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 000000007524cd37, sd_name:rockchip-csi2-dphy0
[ 154.421199] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 154.421235] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 154.421274] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 154.421288] imx415 2-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 154.533228] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 154.566449] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
Redistribute latency...
Got EOS from element "pipeline0".
Execution ended after 0:00:00.524487500
Setting pipeline to NULL ...
Freeing pipeline ...
[ 154.940510] rkCIF-mipi-lvds2: stream[0] start stopping, total mode 0x1, cur 0x1
root@idea3588-buildroot:/# [ 154.999531] rockchip-mipi-csi2 mipi2-csi2: stream off, src_sd: 000000007524cd37,
sd_name:rockchip-csi2-dphy0
[ 154.999628] rockchip-mipi-csi2 mipi2-csi2: stream OFF
[ 154.999742] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream_stop stream stop, dphy0
[ 154.999781] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:0, dphy0, ret 0
[ 154.999835] imx415 2-0036: s_stream: 0. 3864x2192, hdr: 0, bpp: 10
[ 155.019117] rkCIF-mipi-lvds2: stream[0] stopping finished, dma_en 0x0

```

7.20 Video Playback

(1) The directory for the built-in video testing scripts in the system: `/rockchip-test/video`

```

root@idea3588-buildroot:/# ls /rockchip-test/video/
test_gst_multivideo.sh    test_gst_video_fps.sh    video_test.sh
test_gst_video.sh        test_gst_video_maxfps.sh
test_gst_video_benchmark.sh  video_stresstest.sh

```

Simply execute the script.

```

root@idea3588-buildroot:/# /rockchip-test/video/test_gst_video.sh
Setting pipeline to PAUSED ...
Pipeline is PREROLLING ...
Redistribute latency...
mpp[1897]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log (llog)
function
mpp[1897]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log (llog)
function
mpp[1897]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log (llog)
function
mpp[1897]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log (llog)
function
mpp[1897]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log (llog)
function
Redistribute latency...
mpp[1897]: h264d_api: is_avc=1
Pipeline is PREROLLED ...
Prerolled, waiting for async message to finish...
Setting pipeline to PLAYING ...
Redistribute latency...
New clock: GstSystemClock
0:00:02.6 / 0:00:29.5 (9.1 %)
  
```

(2) Play the video using Google Chrome.

- Google Chrome supports video playback up to 4K at 60Hz, with support for the following decoding formats: VP8, H.264, H.265, VP9, and AV1.
- However, it is only compatible with certain H.265 video files.

Execute the following command to play the video using Google Chrome:

```
# chromium /media/udisk1/video/4KP60/4KP60-exist.mp4
```

Command explanation:

- **chromium**: Launches the Chromium browser.
- **/media/udisk1/video/4KP60/4KP60-exist.mp4**: The media file path to be played.

```

root@idea3588-buildroot:/# chromium /media/udisk1/video/4KP60/4KP60-exist.mp4
[2057:2076:0722/195216.573036:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.573375:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.573426:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.573466:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.573502:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.NameHasOwner: object_path= /org/freedesktop/DBus: unknown error type:
[2057:2076:0722/195216.584858:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.606971:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2076:0722/195216.607032:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.NameHasOwner: object_path= /org/freedesktop/DBus: unknown error type:

(process:2057): Glib-GIO-CRITICAL **: 19:52:16.623: g_settings_schema_source_lookup: assertion 'source !=
NULL' failed
[2057:2072:0722/195216.623678:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2075:0722/195216.623705:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2057:0722/195216.686288:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.NameHasOwner: object_path= /org/freedesktop/DBus: unknown error type:
[2057:2057:0722/195216.690965:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.NameHasOwner: object_path= /org/freedesktop/DBus: unknown error type:
[2057:2057:0722/195216.690992:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.NameHasOwner: object_path= /org/freedesktop/DBus: unknown error type:
[2057:2072:0722/195216.691089:ERROR:bus.cc(407)] Failed to connect to the bus: Could not parse server address:
Unknown address type (examples of valid types are "tcp" and on UNIX "unix")
[2057:2138:0722/195216.702105:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.DBus.Properties.Get: object_path= /org/freedesktop/UPower:
org.freedesktop.DBus.Error.ServiceUnknown: The name org.freedesktop.UPower was not provided by any .service
files
[2057:2138:0722/195216.702522:ERROR:object_proxy.cc(576)] Failed to call method:
org.freedesktop.UPower.GetDisplayDevice: object_path= /org/freedesktop/UPower:
org.freedesktop.DBus.Error.ServiceUnknown: The name org.freedesktop.UPower was not provided by any .service
files
  
```

(3) Use the `gst-play-1.0` command to play the video.

```
# gst-play-1.0 --videosink="waylandsink fullscreen=true"  
/media/udisk1/video/8KP30/8KP30-2.mp4 --audiosink="alsasink device=hw:2,0"
```

Command explanation:

- `/media/udisk1/video/8KP30/8KP30-2.mp4`: The media file path to be played.
- `--audiosink="alsasink device=hw:2,0"`: Specifies the audio output device as hw:2,0.

```
root@idea3588-buildroot:/#  
" /media/udisk1/video/8KP30/8KP30-2.mp4 --audiosink="alsasink device=hw:2,0"true"  
Press 'k' to see a list of keyboard shortcuts.  
Now playing /media/udisk1/video/8KP30/8KP30-2.mp4  
Redistribute latency...  
Redistribute latency...  
mpp[2179]: mpp_info: mpp version: 870c02ce author: Herman Chen 2025-06-20 feat[mpp_log]: Add long log (llog)  
function  
mpp[2179]: mpp_info: mpp version: 870c02ce author: Herman Chen 2025-06-20 feat[mpp_log]: Add long log (llog)  
function  
mpp[2179]: mpp_info: mpp version: 870c02ce author: Herman Chen 2025-06-20 feat[mpp_log]: Add long log (llog)  
function  
mpp[2179]: mpp_info: mpp version: 870c02ce author: Herman Chen 2025-06-20 feat[mpp_log]: Add long log (llog)  
function  
mpp[2179]: mpp_info: mpp version: 870c02ce author: Herman Chen 2025-06-20 feat[mpp_log]: Add long log (llog)  
function  
Redistribute latency...  
Redistribute latency...  
mpp[2179]: H265D_PARSER: extradata is encoded as hvcc format  
Redistribute latency...  
0:00:11.6 / 0:13:10.5
```