

SBC3588 Linux6.1 User Manual

V3.0



Boardcon Embedded Design

Overview

The content of this document is intended solely for the SBC3588 development board, aiming to help users quickly understand, apply, and test the SBC3588 development board.

System Support

Development Board	Debian12	Buildroot
SBC3588 V2 CM3588 V2.0	Y	Y

Revision History

Version	Date	Author	Revision History
V2.0	2025-08-28	Liu Yuan	Update Linux6.1 rkr6
V3.0	2026-06-04	Xue Junchao	Update Linux6.1 rkr7

Disclaimer

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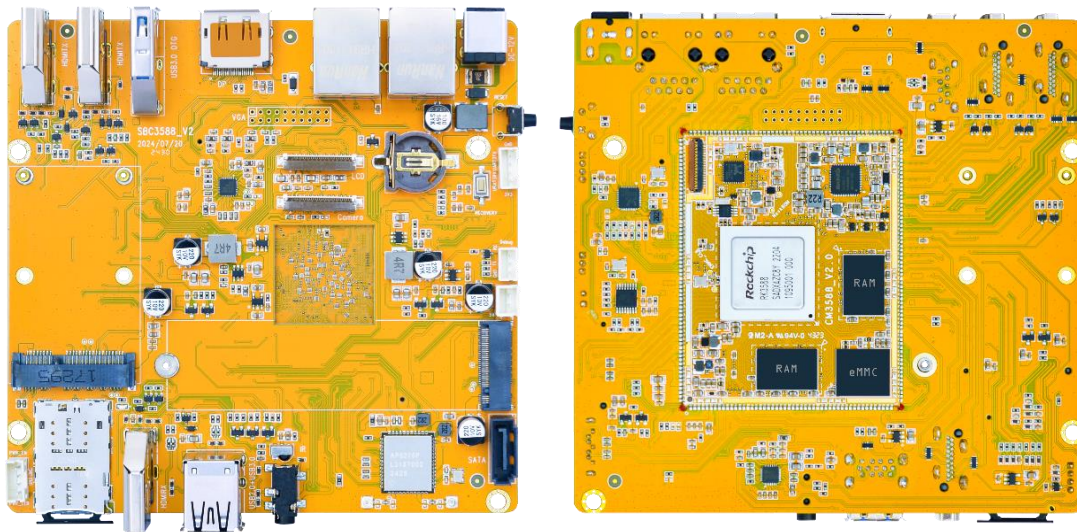
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1.Introduction

1.1 Overview

The SBC3588 is a high-performance, low-power processor platform built on an octa-core 64-bit architecture, featuring four Cortex-A76 and four Cortex-A55 cores. It integrates a powerful NPU with up to 6 TOPS computing power, supports 8K video encoding and decoding, and includes advanced image processing capabilities with a 48MP ISP. The SBC3588 provides extensive multimedia support, flexible display interfaces, rich peripheral connectivity, and high-speed communication interfaces, making it ideal for edge computing, intelligent vision systems, industrial control, and other embedded AI applications.



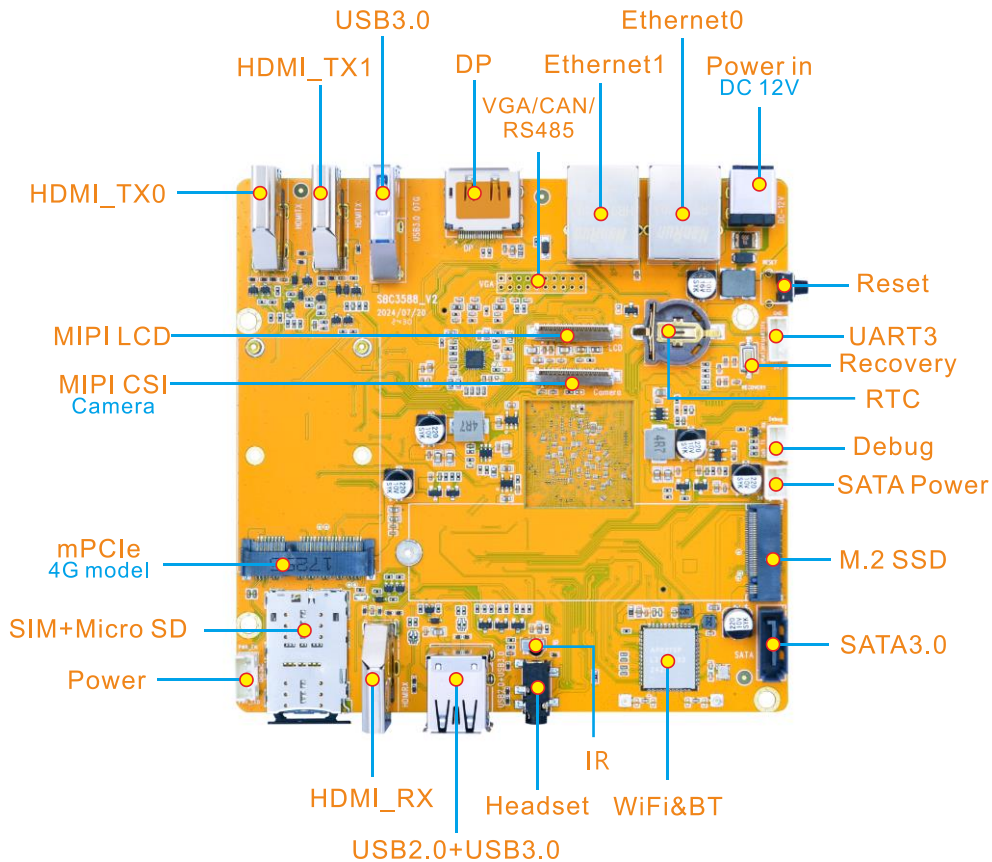
1.2 Product Parameters

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 1.1/2.0/3.2 • Vulkan 1.2 • OpenCL 2.2 • 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/AVS2 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 LPDDR4X
ROM		32GB eMMC
Support system		Android, Debian, Buildroot
Hardware Parameters		
Extended Storage		• Support 1x M.2 PCIe3.0 SSD • Support 1x SATA3.0 • Support 1x MicroSD Card
Display		• Support 2x HDMI2.1 TX, up to 7680x4320@60fps • Support 1x DP TX 1.4a, up to 7680x4320@30fps • Support 1x MIPI DSI, up to 4K@60fps • Support 1x VGA
Audio		• Support 2x HDMI TX audio output • Support 1x DP audio output • Support 1x Headset output/input • Support 1x HDMI RX audio input

USB	• Support 2x USB3.0 (1x OTG) • Support 1x USB2.0
Network	• Support 2x Gigabit Ethernet • Support 1x WIFI/BT module • Support 1x 4G module
Camera	• Support 1x MIPI Camera
Peripheral communication	• Support 1x CAN • Support 1x RS485 • Support 1x RS232
Other parameters	Support 1xDebug, 1xRTC, 1xIR
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	125mm x 121.7mm

1.3 Hardware Interface Introduction



Interface parameters	
Power in DC 12V	12V DC power input interface
Ethernet0	Gigabit Ethernet0 RJ45 interface
Ethernet1	Gigabit Ethernet1 RJ45 interface
VGA/CAN/RS485	VGA display / CAN / RS485 interface
DP	DP display interface
USB3.0	USB3.0 OTG interface
HDMI_TX1	HDMI TX1 interface
HDMI_TX0	HDMI TX0 interface
MIPI LCD	MIPI display interface
MIPI CSI Camera	MIPI camera interface

mPCIe 4G module	4G model interface
SIM + Mirco SD	All-in-one card holder
Power	Sleep/Wake GPIO control interface
HDMI_RX	HDMI RX interface
USB2.0 + USB3.0	Dual-layer USB HOST interface
Headset	Headset output/input interface
IR	Infrared receiver
WIFI&BT	WIFI&Bluetooth module
SATA	SATA3.0 interface
M.2 SSD	PCIe M.2 SSD interface
SATA Power	SATA Power interface, 5V
Debug	Debug the serial port
RTC	RTC coin cell connector
Recovery	Recovery key
UART3	UART3 serial interface
Reset	Reset key

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

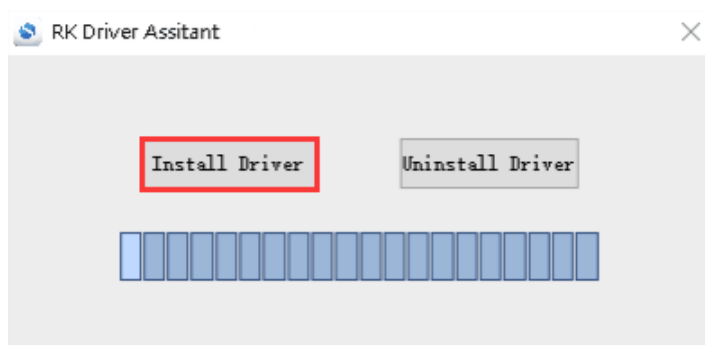
2.1 Install RK Driver Assitant

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

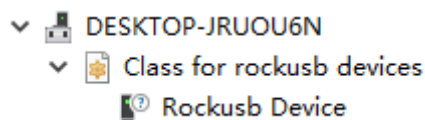
Step 2: To avoid driver conflicts, click “**Uninstall Driver**” to uninstall the driver.



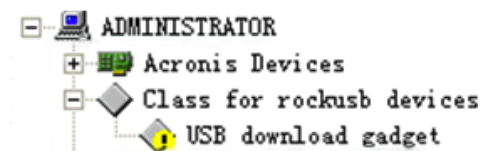
Step 3: Click button “**Install Driver**” to install.



Step 4: After the installation is complete, connect the board and PC with Type_A 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.

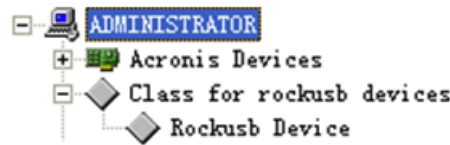


Step 5: If the following device information appears in the **Device Manager** after the operation in Step 4, user need to proceed to the next step.



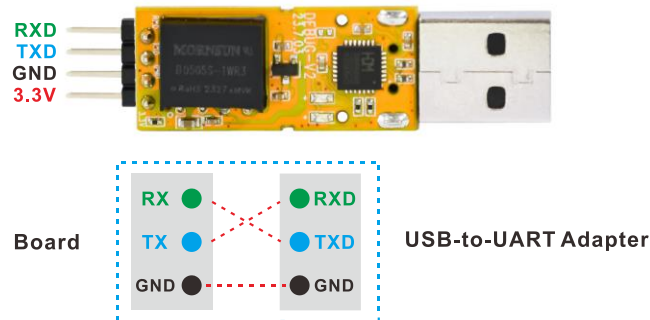
Step 6: The WINDOW will pop up found New Hardware Wizard dialog box, choose to install from the specified location, and then select: [DriverAssitant_y5.1.1/ADBDriver](#).

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



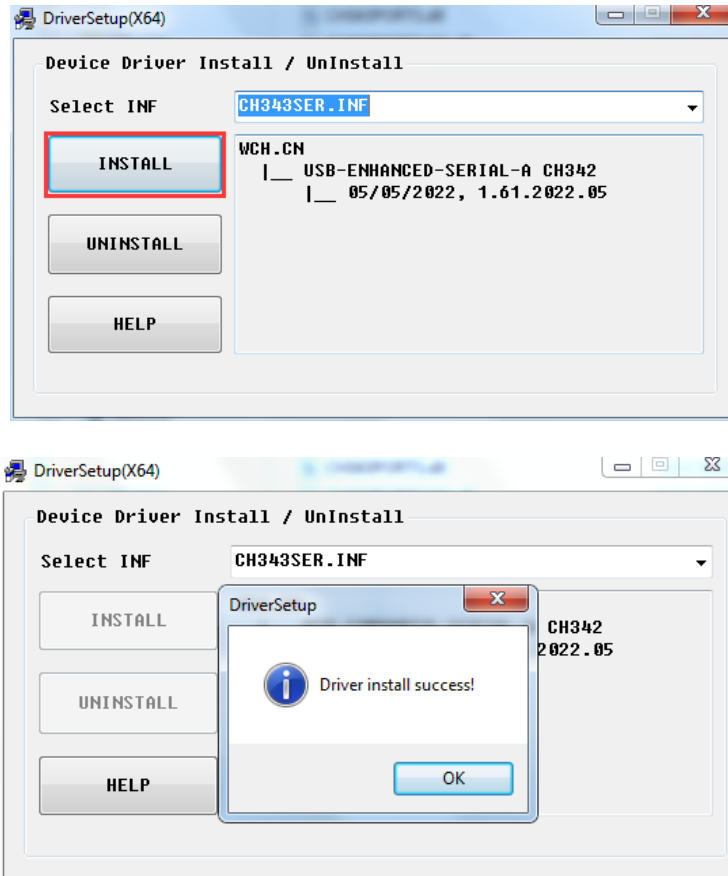
Pin	Connection Description
RXD	Receive, connect to TX pin of the board.
TXD	Transmit, connect to RX pin of the board.
GND	Ground, connect to GND pin of the board.
3V3	No need to connect.

2.2.2 Install Driver

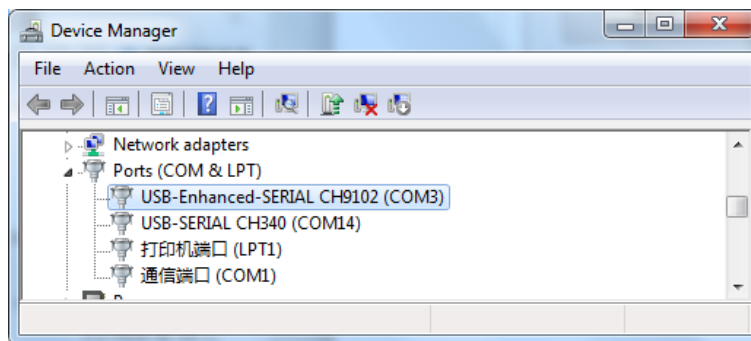
Step 1: Plug the CH9102X Module to the PC

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.

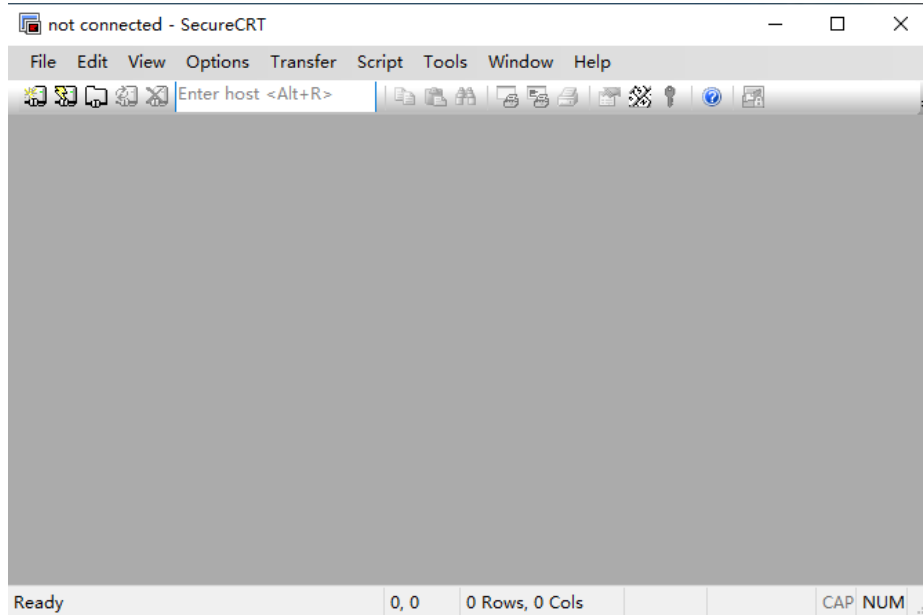


2.3 Install Serial Terminal Tool

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

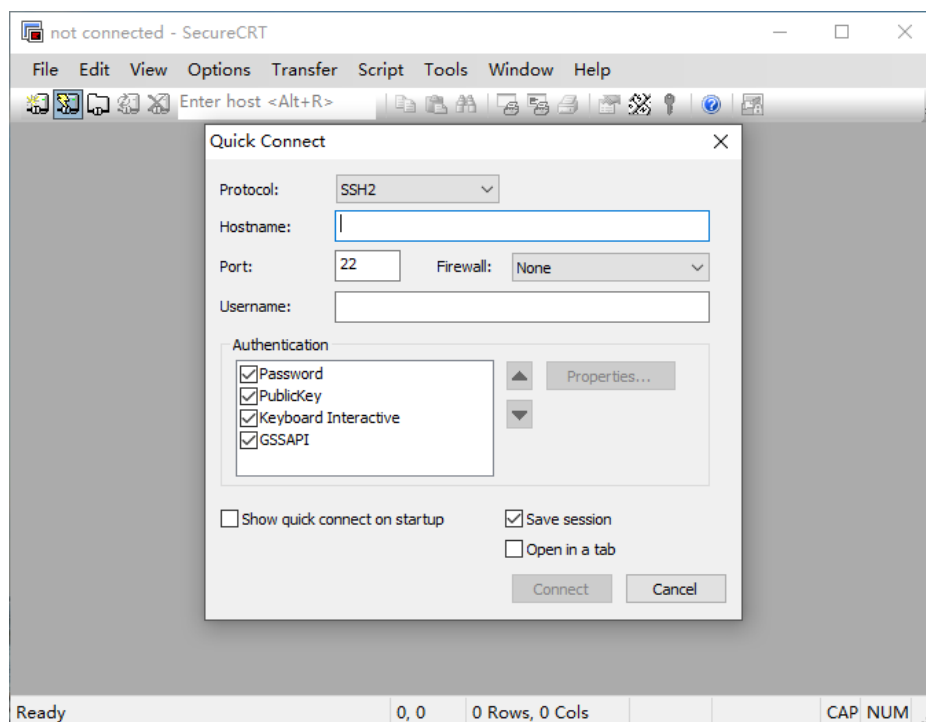
Step 1: Unzip *Platform/SecureCRT.rar* on PC.

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

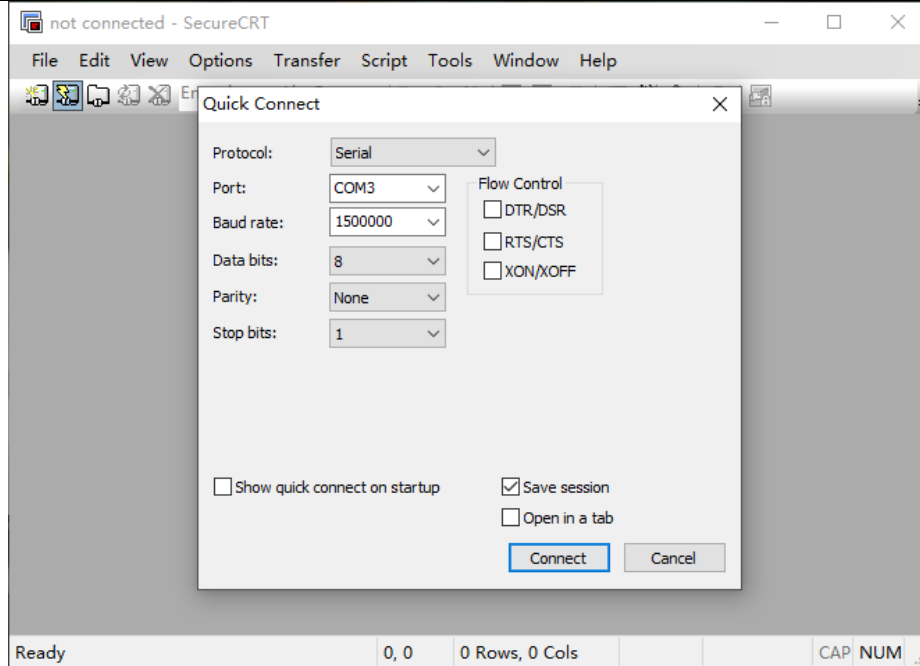


Step 3: Confirm that the CH9102X driver has been installed and the CH9102X module is connecting to the PC.

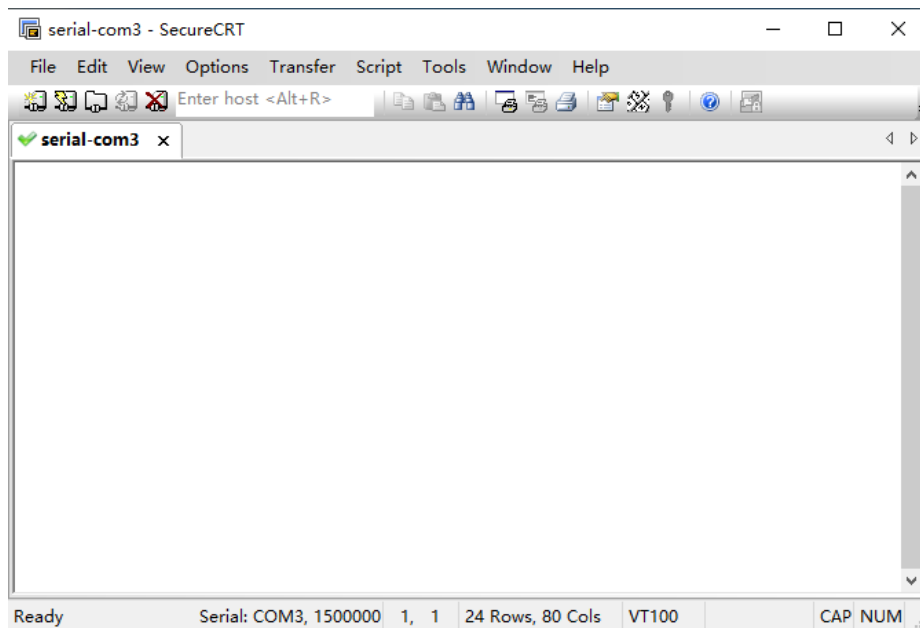
Step 4: Click the “**Quick Connect**” button to go to the Quick Connect configuration screen.



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

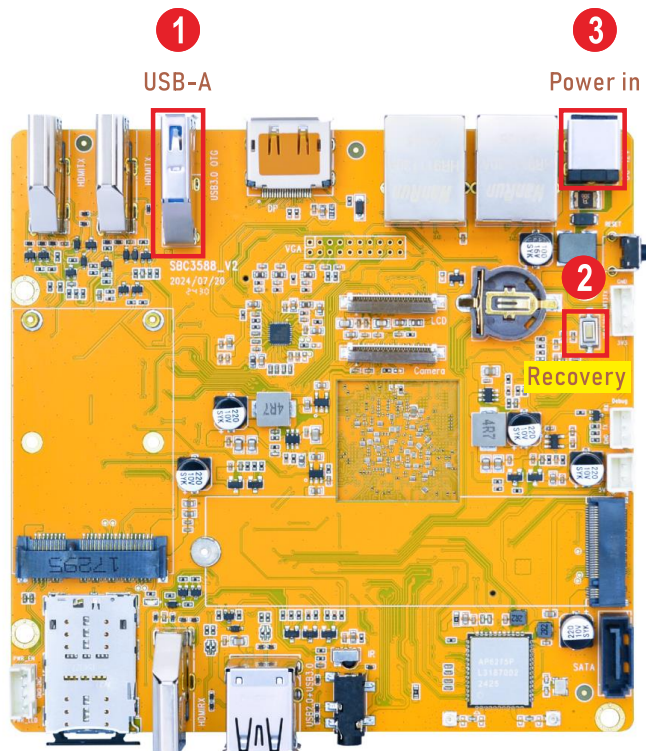
3.1.1.1 Hardware

Step 1: Disconnect the power adapter.

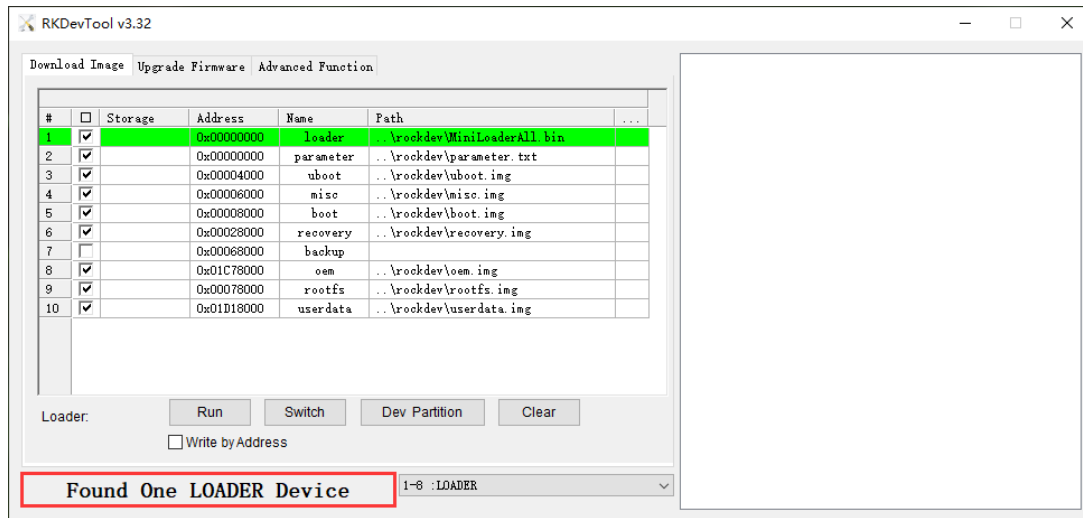
Step 2: Connect one end of the Type_A cable to the host and the other end to the development board.

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_A USB cable, execute the following command in the serial debug terminal or adb shell.

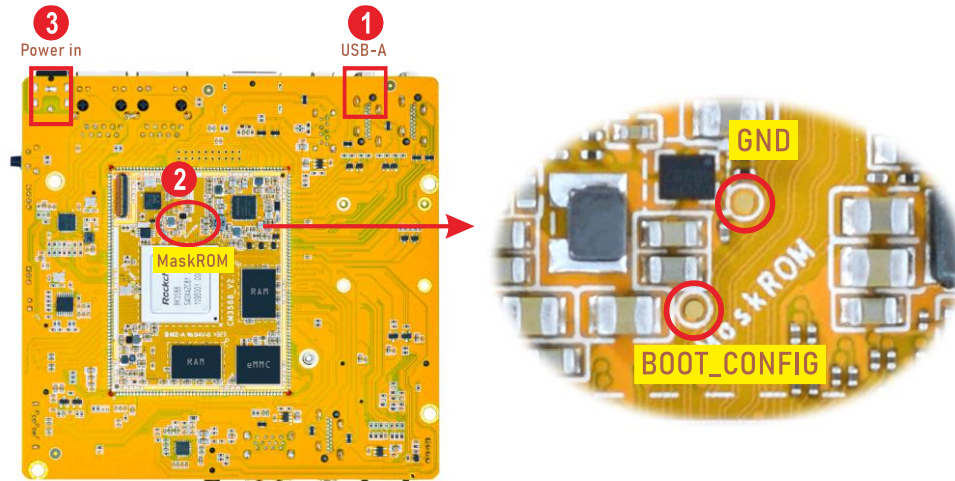
```
# reboot loader
```

3.1.2 How to Enter MaskRom Mode

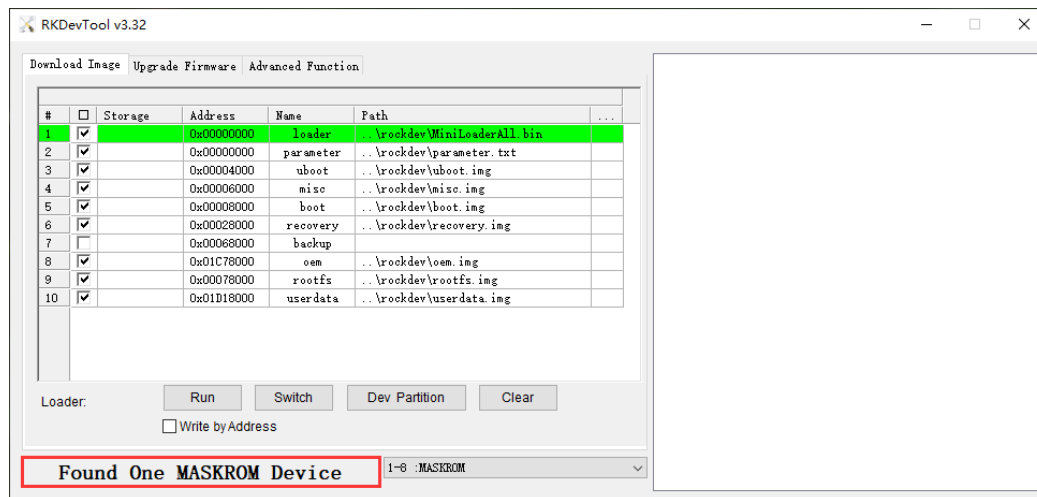
Step 1: Disconnect the power adapter.

Step 2: Connect one end of the Type_A 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.



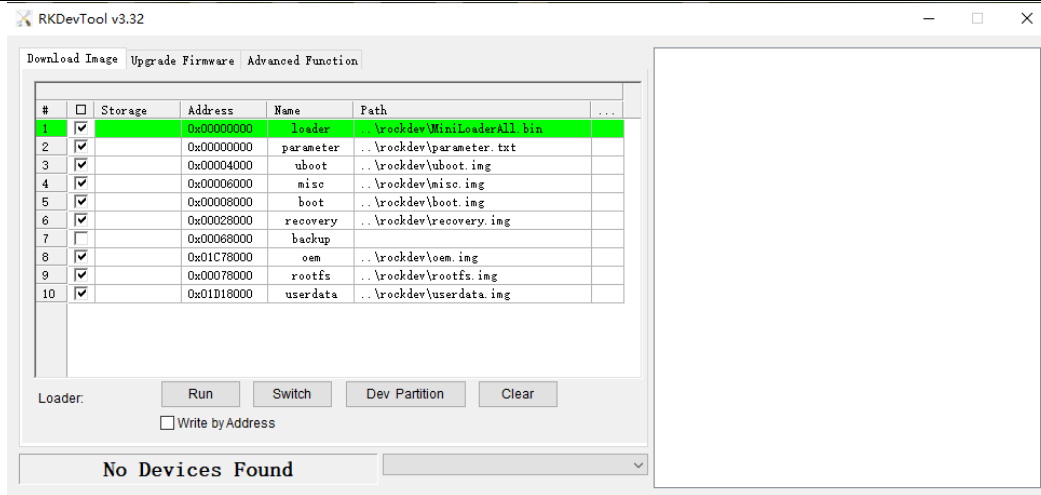
3.2 Firmware Flashing

Environment: Windows OS (Operating System).

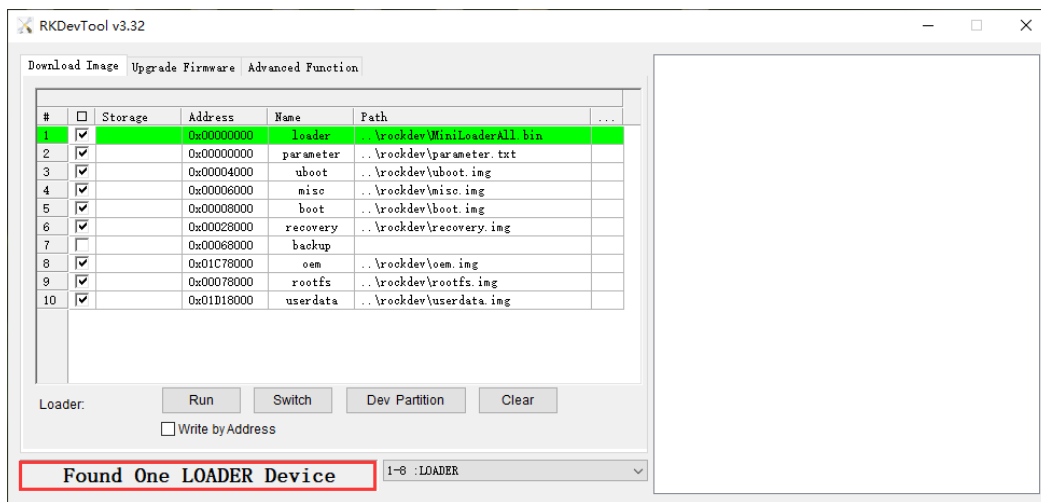
3.2.1 Flash Full Firmware Image

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

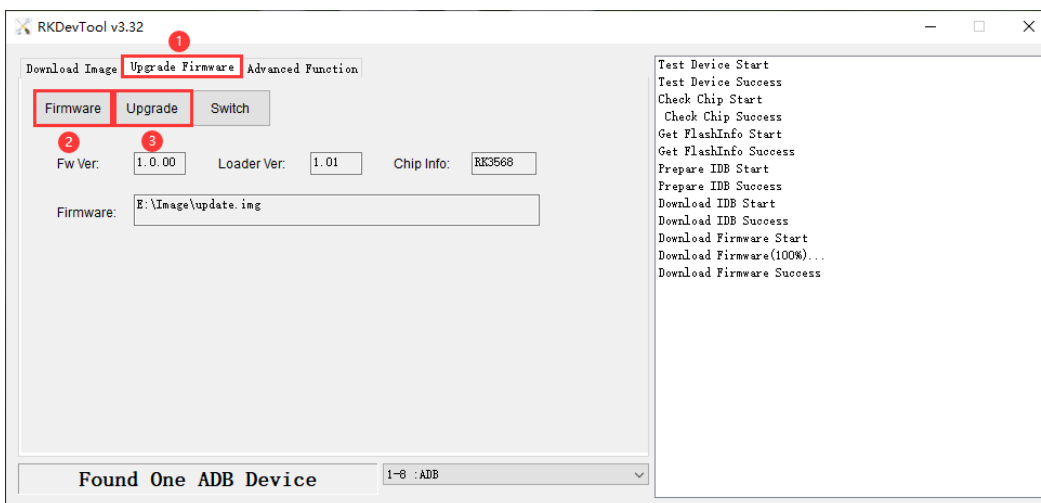
Step 2: Open *RKDevTool\RKDevTool_Release\RKDevTool.exe*.



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.

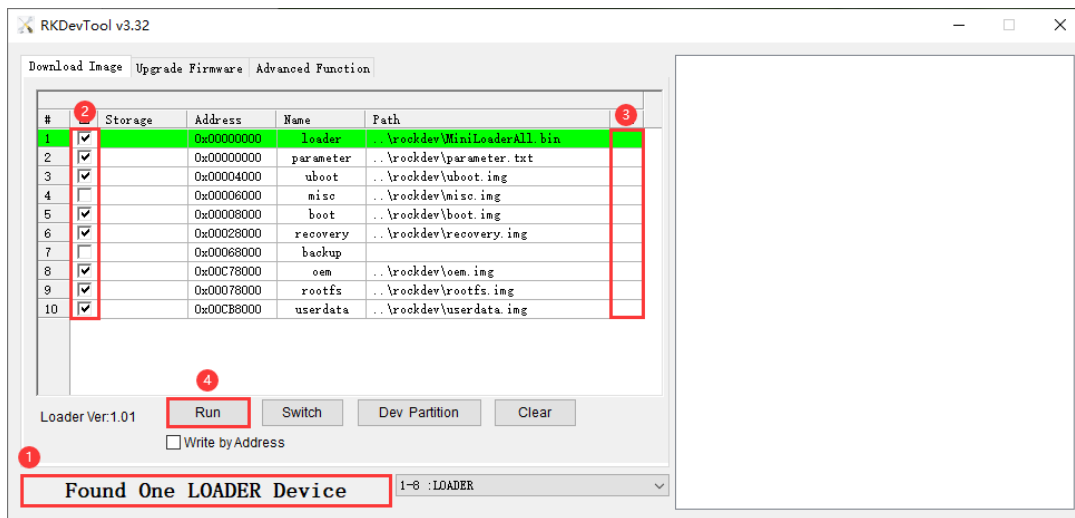
3.2.2 Flash Separate Partition Images

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

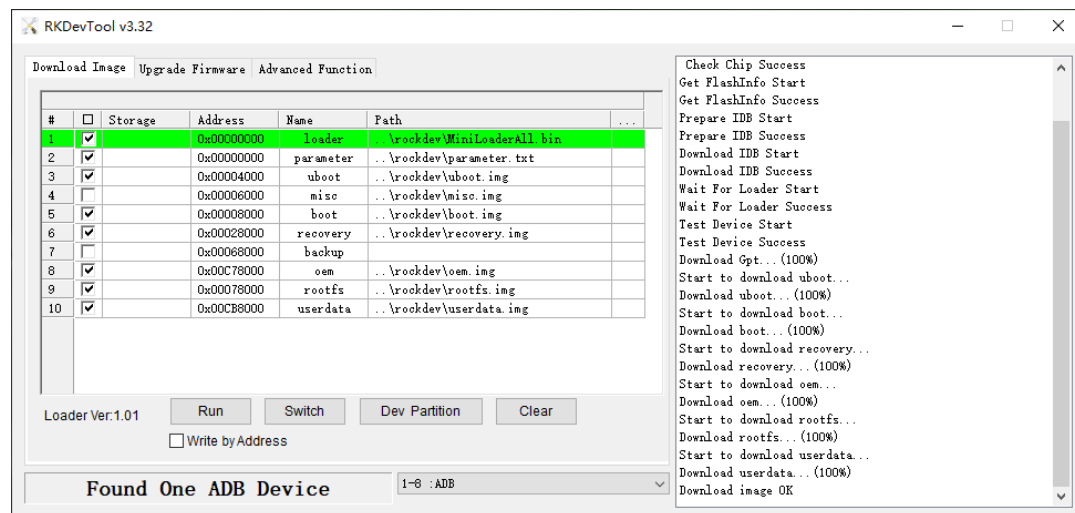
Step 2: Check the partitions to be flashed, multiple partitions can be selected.

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.



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 200G. 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 4th option: **4. boardcon_sbc3588_defconfig**, this configuration ensures hardware compatibility with the sbc3588 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_18-08-10
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]: 4
Switching to defconfig: /home/xuejunchao/3588/rk3588-linux6.1-
rkr7/device/rockchip/.chip/boardcon_sbc3588_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
```

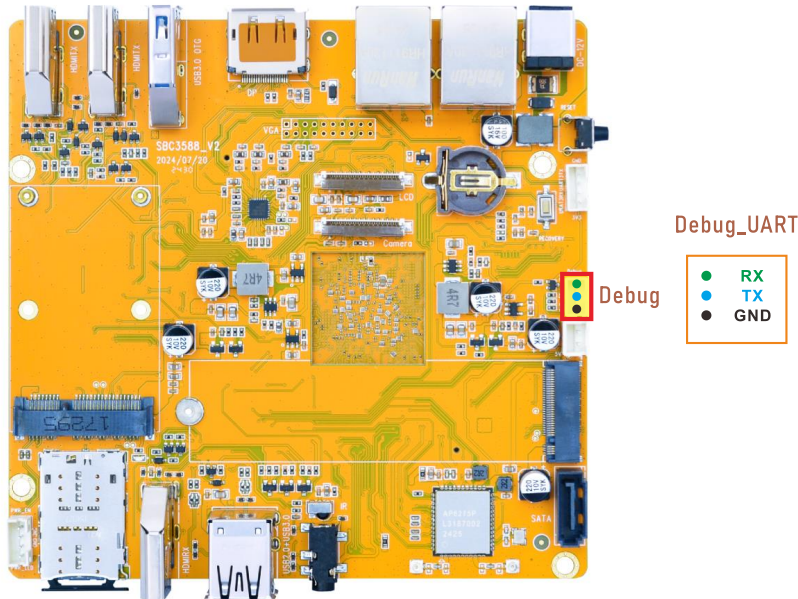
Images and **update.img** are generated in *rockdev/* directory.

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.

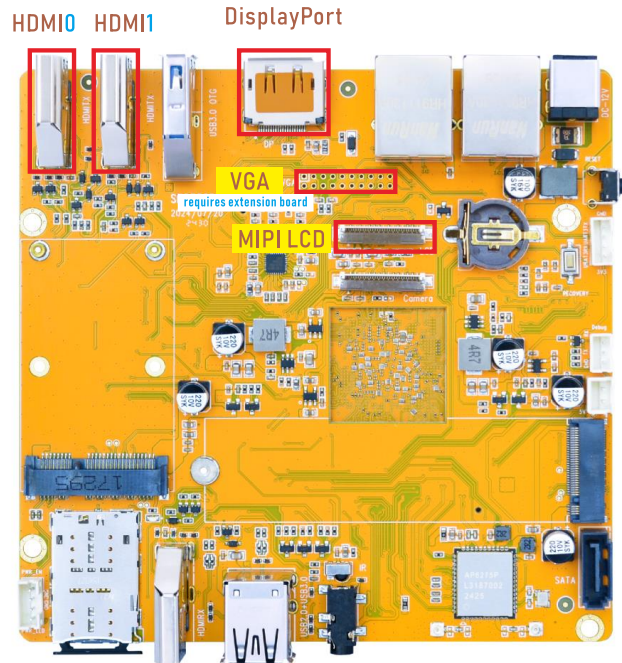
```

serial-com4 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
serial-com4
11.966046 [dhd] [wlan1] dhd_static_if_open : Exit ret=0
11.966057 [dhd] dhd_static_if_open : mutex is released.
11.966545 [dhd] dhd_pri_open : no mutex held
11.966567 [dhd] dhd_pri_open : set mutex lock
11.966578 [dhd] [wlan0] dhd_open : Primary net_device is already up
11.966589 [dhd] [wlan0] dhd_pri_open : tx queue started
11.966688 [dhd] [wlan0] custom_xps_map_set : Done. mapping cpu
11.966697 [dhd] dhd_pri_open : mutex is released.
11.982796 [dhd] CFG80211-ERROR) wl_cfg80211_flush_pmksa : Not supporting Flushing pmklist on vi
rtual interfaces than primary interface, primary_dev wlan0 dev wlan1
12.000737 [dhd] P2P interface registered
12.015856 [dhd] CFGP2P-ERROR) wl_cfgp2p_set_discovery : p2p_disc 1 error -16
12.015874 [dhd] CFGP2P-ERROR) wl_cfgp2p_init_discovery : set discover error
12.021329 [dhd] CFGP2P-ERROR) wl_cfgp2p_enable_discovery : init discovery error -16
12.021339 [dhd] CFGP2P-ERROR) wl_cfgp2p_disable_discovery : do nothing, not initialized
12.027811 [dhd] CFGP2P-ERROR) wl_cfgp2p_start_p2p_device : P2P enable discovery failed, ret=-16
12.028388 [dhd] CFGP2P-ERROR) wl_cfgp2p_disable_discovery : do nothing, not initialized
12.028953 [dhd] CFGP2P-ERROR) wl_cfgp2p_del_p2p_disc_if : P2P interface unregistered

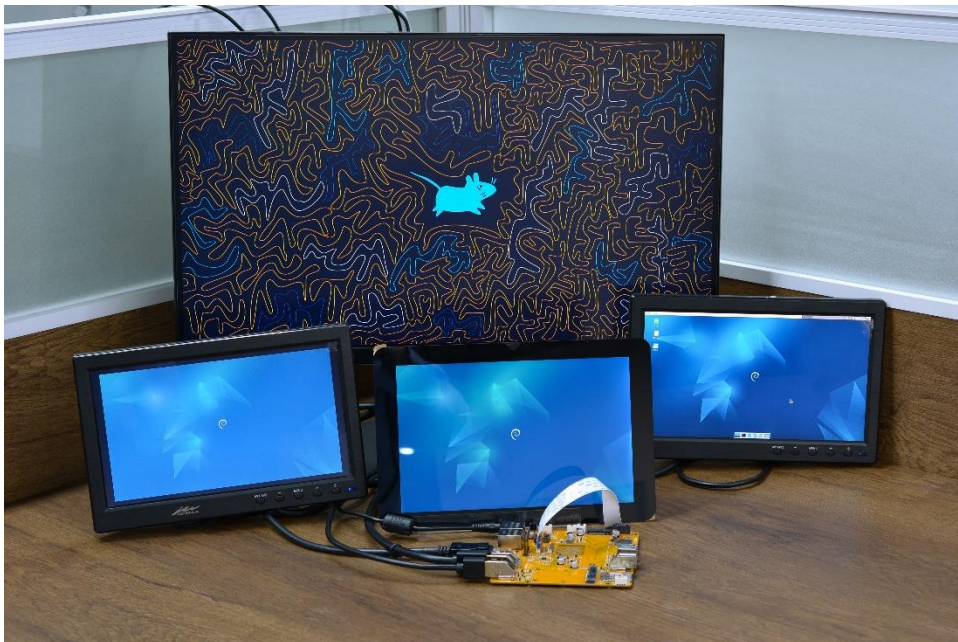
root@linaro-alip:/#
root@linaro-alip:/#
root@linaro-alip:/#
root@linaro-alip:/#
Copy the selection and put it on the Clipboard  Serial: COM4, 1500000  23, 21  23 Rows, 100 Cols  Xterm  CAP NUM
  
```

6.2 Display

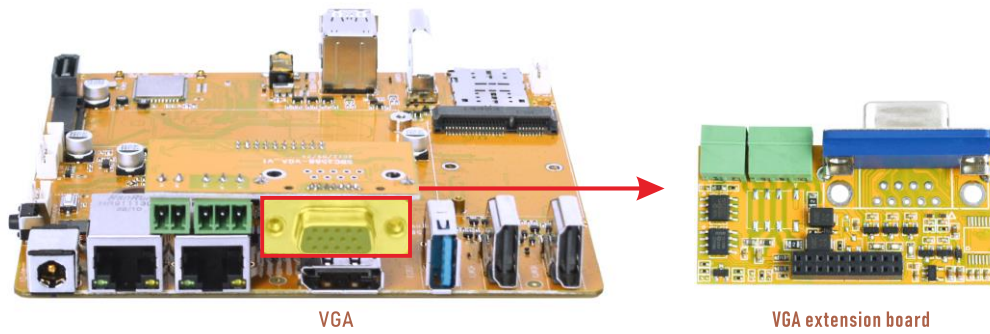
The SBC3588 supports quad independent display output on the default Debian12 image, with interfaces including HDMI0, HDMI1, DP/VGA (selectable), and MIPI DSI.



The display effect diagram is as follows:



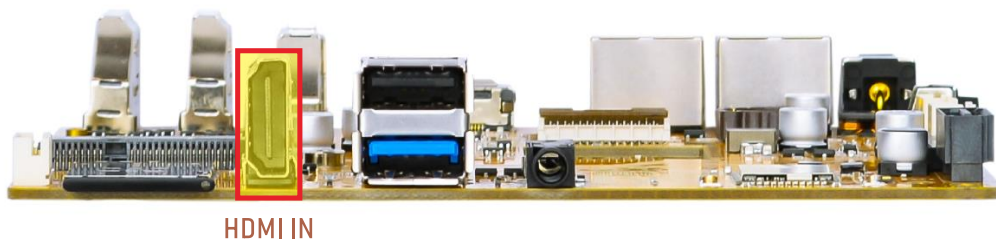
Note: DP and VGA share the same VOP and cannot be used simultaneously with different display timings—only one output will be active at a time.



Preview effect:



6.3 HDMI RX



After connecting the HDMI OUT port of the source device to the HDMI IN port of the SBC3588, 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/video20/name:stream_hdmirx
```

- Check supported resolutions and formats:

```
# v4l2-ctl -d /dev/video20 --all
```

```
root@linaro-alip:/# v4l2-ctl -d /dev/video20 --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
  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=0 flags=read-only, volatile
Digital Video Controls
  power_present 0x00a00964 (bitmask): max=0x00000001 default=0x00000000 value=1 flags=read-only
```

• Video Preview:

If NV24 is supported:

```
# gst-launch-1.0 v4l2src device=/dev/video20 ! 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/video20 ! video/x-raw,format=NV24,width=1920,height=1080 ! videoconvert ! video/x-raw,format=I420 ! xvimagesink sync=false
[ 2072.732397] dw9714 3-000c: 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
[ 2072.837439] fdee0000.hdmirx-controller: hdmirx_start_streaming: delay_line:720
Redistribute latency...
[ 2074.536655] fdee0000.hdmirx-controller: rcv frames
0:00:02.3 / 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:

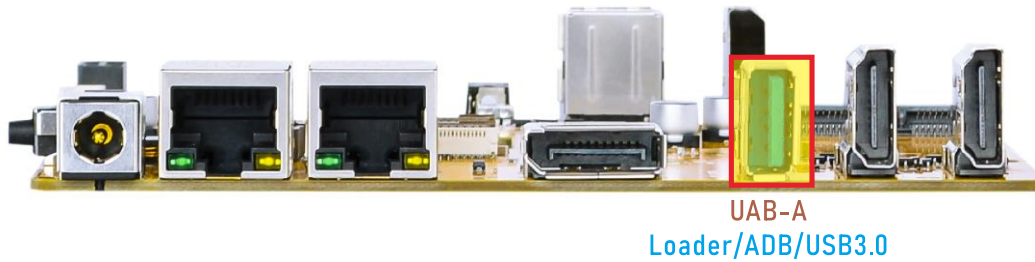
```
Audio Output:
* device=hw:rockchipes8388 /* Headset audio output */
* device=hw:rockchipdmi0 /* HDMI TX0 audio output */
* device=hw:rockchipdmi1 /* HDMI TX1 audio output */
* device=hw:rockchipdp1 /* DP TX audio output */

v4l2-ctl:
* v4l2-ctl -d /dev/video20 --get-fmt-video /* Get current video format */
* v4l2-ctl -d /dev/video20 --query-dv-timings /* Query supported DV timings */
* v4l2-ctl -d /dev/video20 --get-dv-timings /* Get current DV timing */
* v4l2-ctl -d /dev/video20 -D /* Display device information */
```

6.4 USB

6.4.1 USB OTG

Default mode on boot: Device mode, functioning as a USB device for ADB debugging and file transfer.



6.4.1.1 Host mode

In this mode, the board functions as a USB host, allowing connection to:

- USB keyboard
- USB mouse
- USB flash drive

To switch to host mode, execute the following command:

```
# echo host > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-  
phy@0/otg_mode
```

```

root@linaro-alip:/# echo host > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-phy@0/otg_mode
[ 31.929307] dwc3 f000000.usb: request 00000000748085a3 was not queued to ep0outde
[ 31.929703] android_work: did not send uevent (0 0 0000000000000000)
[ 31.977587] read descriptors
[ 31.977642] read strings
[ 32.041439] xhci-hcd xhci-hcd.16.auto: xHCI Host Controller
[ 32.041570] xhci-hcd xhci-hcd.16.auto: new USB bus registered, assigned bus number 8
[ 32.041671] xhci-hcd xhci-hcd.16.auto: hcc params 0x0220fe64 hci version 0x110 quirks 0x0002008002010010
[ 32.041697] xhci-hcd xhci-hcd.16.auto: irq 84, io mem 0xfc000000
[ 32.041781] xhci-hcd xhci-hcd.16.auto: xHCI Host Controller
[ 32.041842] xhci-hcd xhci-hcd.16.auto: new USB bus registered, assigned bus number 9
[ 32.041850] xhci-hcd xhci-hcd.16.auto: Host supports USB 3.0 SuperSpeed
[ 32.041917] usb usb8: New USB device found, idVendor=1d6b, idProduct=0002, bcdDevice= 6.01
[ 32.041923] usb usb8: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 32.041928] usb usb8: Product: xHCI Host Controller
[ 32.041934] usb usb8: Manufacturer: Linux 6.1.141 xhci-hcd
[ 32.041938] usb usb8: SerialNumber: xhci-hcd.16.auto
[ 32.042131] hub 8-0:1.0: USB hub found
[ 32.042145] hub 8-0:1.0: 1 port detected
[ 32.042291] usb usb9: We don't know the algorithms for LPM for this host, disabling LPM.
[ 32.042324] usb usb9: New USB device found, idVendor=1d6b, idProduct=0003, bcdDevice= 6.01
[ 32.042330] usb usb9: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 32.042335] usb usb9: Product: xHCI Host Controller
[ 32.042340] usb usb9: Manufacturer: Linux 6.1.141 xhci-hcd
[ 32.042344] usb usb9: SerialNumber: xhci-hcd.16.auto
[ 32.042482] hub 9-0:1.0: USB hub found
[ 32.042496] hub 9-0:1.0: 1 port detected
[ 32.297066] usb 8-1: new high-speed USB device number 2 using xhci-hcd
[ 32.447037] usb 8-1: New USB device found, idVendor=abcd, idProduct=1234, bcdDevice= 1.00
[ 32.447080] usb 8-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 32.447097] usb 8-1: Product: UDisk
[ 32.447111] usb 8-1: Manufacturer: General
[ 32.447123] usb 8-1: SerialNumber: 1
[ 32.448268] usb-storage 8-1:1.0: USB Mass Storage device detected
[ 32.449346] scsi host1: usb-storage 8-1:1.0
[ 33.029608] read descriptors
[ 33.029647] read strings
[ 33.453835] scsi 1:0:0:0: Direct-Access    General UDisk          5.00 PQ: 0 ANSI: 2
[ 33.455394] sd 1:0:0:0: [sda] 129088 512-byte logical blocks: (66.1 MB/63.0 MiB)
[ 33.455394] sd 1:0:0:0: [sda] 129088 512-byte logical blocks: (66.1 MB/63.0 MiB)

```

6.4.1.2 Device mode

To switch back to Device mode, execute the following command:

```
# echo peripheral > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-phy@0/otg_mode
```

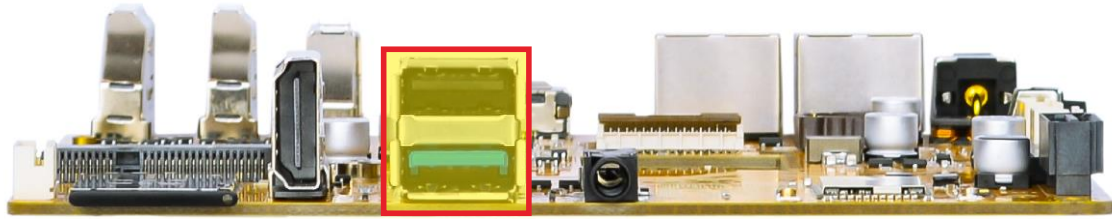
```

root@linaro-alip:/# echo peripheral > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-phy@0/otg_mode
[ 89.865854] usb 8-1: USB disconnect, device number 2
[ 89.866901] device offline error, dev sda, sector 2049 op 0x1:(WRITE) flags 0x100000 phys_seg 1 prio class 2
[ 89.866940] Buffer I/O error on dev sda1, logical block 1, lost async page write
[ 89.867623] xhci-hcd xhci-hcd.16.auto: remove, state 4
[ 89.867659] usb usb9: USB disconnect, device number 1
[ 89.868343] xhci-hcd xhci-hcd.16.auto: USB bus 9 deregistered
[ 89.868637] xhci-hcd xhci-hcd.16.auto: remove, state 1
[ 89.868656] usb usb8: USB disconnect, device number 1
[ 89.946804] xhci-hcd xhci-hcd.16.auto: USB bus 8 deregistered
[ 91.335393] read descriptors
[ 91.335428] read strings
[ 91.515633] android_work: did not send uevent (0 0 0000000000000000)

```

6.4.2 USB Host

The USB host interface provides connectivity for standard peripherals, including USB keyboards, mice, flash drives, and other USB-compatible devices.



USB2.0 (up)
 USB3.0 (down)

USB version identification based on kernel log output:

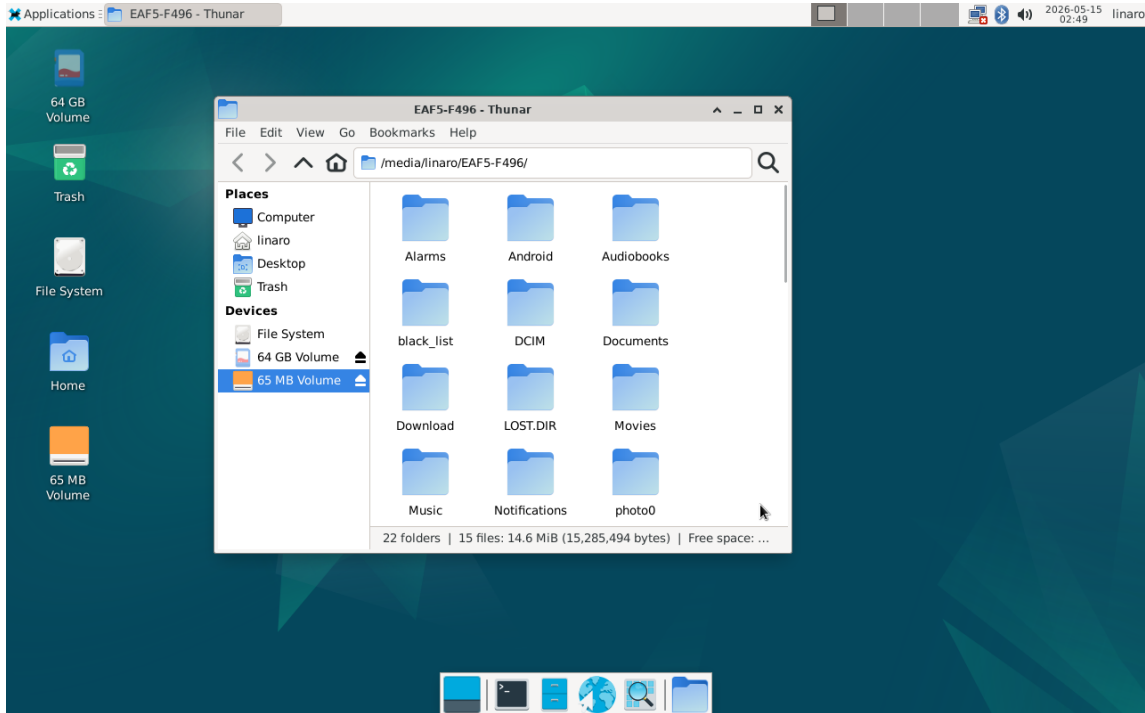
- **USB 2.0:** Displays as high-speed.

```
root@linaro-alip:/# [ 475.128435] usb 3-1: new high-speed USB device number 2 using xhci-hcd
[ 475.277788] usb 3-1: New USB device found, idVendor=21c4, idProduct=0cc7, bcdDevice= 1.00
[ 475.277828] usb 3-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 475.277845] usb 3-1: Product: USB Flash Drive
[ 475.277859] usb 3-1: Manufacturer: Lexar
[ 475.277871] usb 3-1: SerialNumber: 0410280000031D7
[ 475.279415] usb-storage 3-1:1.0: USB Mass Storage device detected
[ 475.280863] scsi host1: usb-storage 3-1:1.0
[ 476.298448] scsi 1:0:0:0: Direct-Access Lexar USB Flash Drive 1.00 PQ: 0 ANSI: 4
[ 476.302087] sd 1:0:0:0: [sdb] 120861886 512-byte logical blocks: (61.9 GB/57.6 GiB)
[ 476.302771] sd 1:0:0:0: [sdb] Write Protect is off
[ 476.303737] sd 1:0:0:0: [sdb] No Caching mode page found
[ 476.303773] sd 1:0:0:0: [sdb] Assuming drive cache: write through
[ 476.310443] sdb: sdb1
[ 476.310848] sd 1:0:0:0: [sdb] Attached SCSI removable disk
```

- **USB 3.0:** Displays as SuperSpeed.

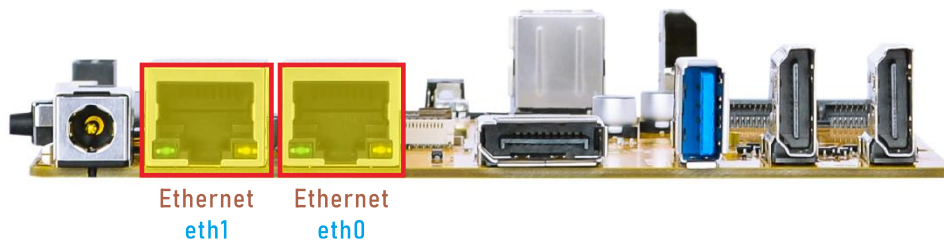
```
[ 517.376969] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 517.407690] usb 2-1: New USB device found, idVendor=0dd8, idProduct=3b00, bcdDevice= 0.02
[ 517.407716] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 517.407730] usb 2-1: Product: OnlyDisk
[ 517.407740] usb 2-1: Manufacturer: Netac
[ 517.407748] usb 2-1: SerialNumber: C0E8BFA3EC38F796
[ 517.409410] usb-storage 2-1:1.0: USB Mass Storage device detected
[ 517.410881] scsi host2: usb-storage 2-1:1.0
[ 518.676704] scsi 2:0:0:0: Direct-Access Netac OnlyDisk 8.01 PQ: 0 ANSI: 6
[ 518.683041] sd 2:0:0:0: [sdc] 121610240 512-byte logical blocks: (62.3 GB/58.0 GiB)
[ 518.683549] sd 2:0:0:0: [sdc] Write Protect is off
[ 518.683734] sd 2:0:0:0: [sdc] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 518.690522] sdc: sdc1
[ 518.690847] sd 2:0:0:0: [sdc] Attached SCSI removable disk
```

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.



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:/# [ 29.778221] rk_gmac-dwmac fe1b0000.ethernet end0: Link is Up - 1Gbps/Full - flow control rx/tx
[ 29.778235] IPv6: ADDRCONF(NETDEV_CHANGE): end0: link becomes ready
[ 36.018129] rk_gmac-dwmac fe1c0000.ethernet end1: Link is Up - 1Gbps/Full - flow control rx/tx
[ 36.018197] IPv6: ADDRCONF(NETDEV_CHANGE): end1: link becomes ready
```

Step 2: View network interface information.

```
# ifconfig
```

```
root@linaro-alip:~# ifconfig
end0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.81 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::5b4b:7f1d:986a:52ab prefixlen 64 scopeid 0x20<link>
    ether ba:43:fc:c9:26:0a txqueuelen 1000 (Ethernet)
    RX packets 189 bytes 19028 (18.5 KiB)
    RX errors 0 dropped 20 overruns 0 frame 0
    TX packets 116 bytes 10382 (10.1 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
    device interrupt 77

end1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.52 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::958c:25e1:7fd0:c6a4 prefixlen 64 scopeid 0x20<link>
    ether be:43:fc:c9:26:0a txqueuelen 1000 (Ethernet)
    RX packets 75 bytes 7358 (7.1 KiB)
    RX errors 0 dropped 15 overruns 0 frame 0
    TX packets 13 bytes 1432 (1.3 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
    device interrupt 75
```

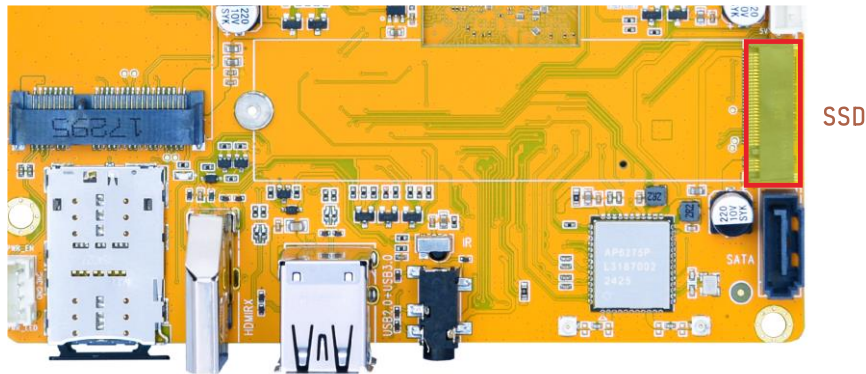
Step 3: Network connection test.

```
# ping -I end0 www.armdesigner.com
# ping -I end1 www.armdesigner.com
```

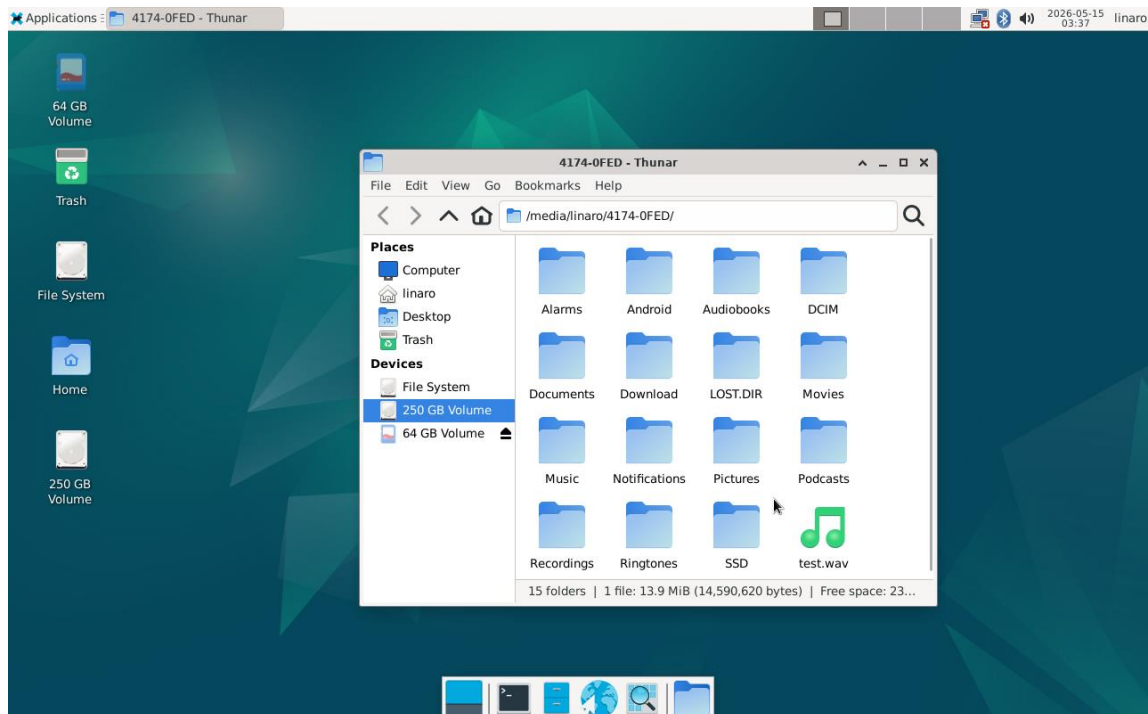
```
root@linaro-alip:~# ping -I end0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.81 end0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=50 time=172 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=50 time=173 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=50 time=171 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=50 time=172 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=50 time=173 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=50 time=173 ms
^C
--- www.armdesigner.com ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5002ms
rtt min/avg/max/mdev = 171.337/172.318/173.101/0.683 ms
root@linaro-alip:~# ping -I end1 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.52 end1: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=50 time=172 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=50 time=172 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=50 time=172 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=50 time=171 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=50 time=171 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=50 time=172 ms
^C
--- www.armdesigner.com ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6009ms
rtt min/avg/max/mdev = 171.436/172.255/175.085/1.179 ms
```

6.6 PCIe M.2 SSD

Step 1: Insert the M.2 SSD into the M.2 card slot, then power on the device.



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.

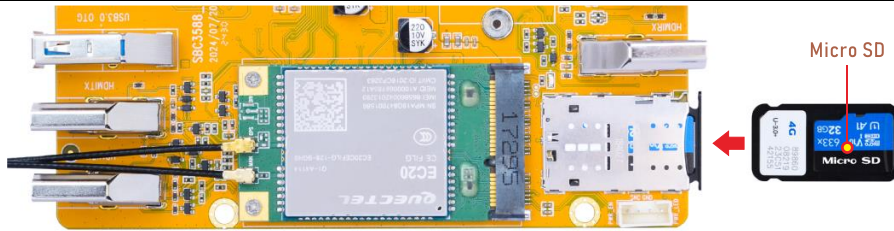


Note: The SSD on buildroot only supports the ext4 format. If devices that are not in ext4 format, the user can choose to format them on the board. After formatting, **the files on the device will be permanently lost**, so please proceed with caution.

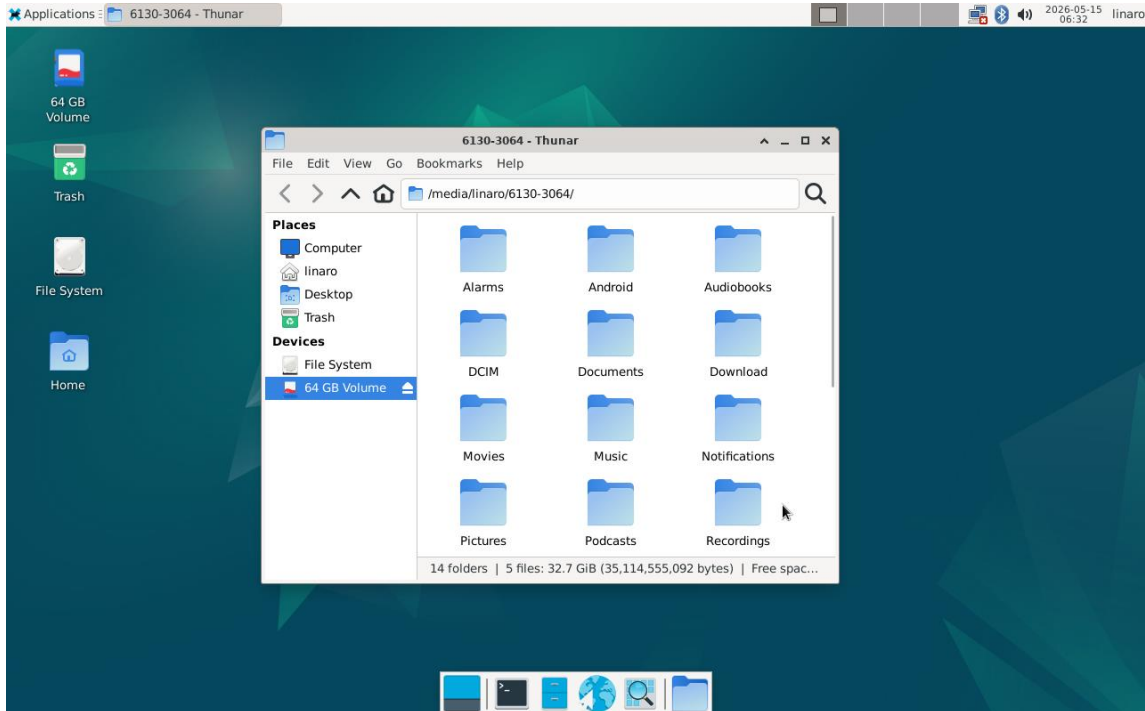
```
# mke2fs -t ext4 /dev/nvme0n1p1
```

6.7 SD Card

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

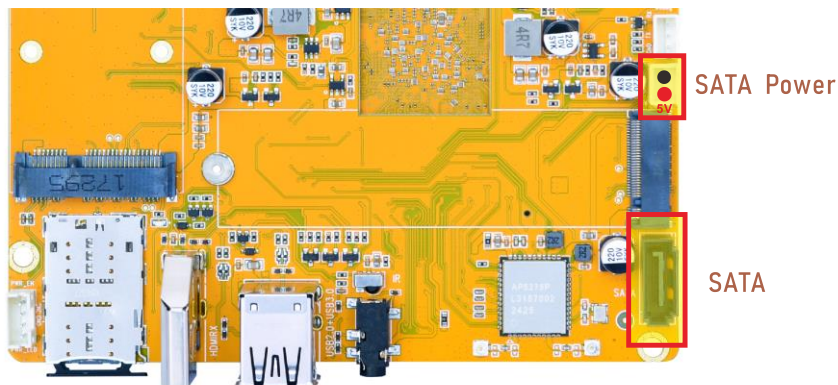


Step 2: After inserting the SD card, if it is recognized successfully, an icon will appear on the desktop. Users need to click the icon in order to access the SD card.



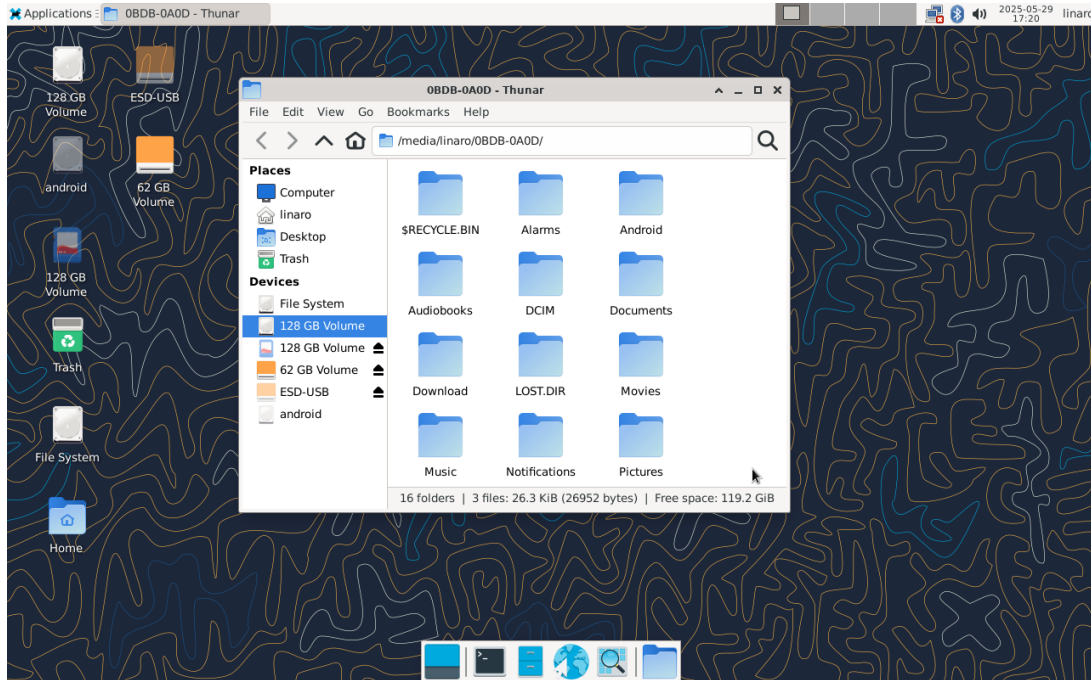
6.8 SATA

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 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
```

6.9 WiFi & Bluetooth

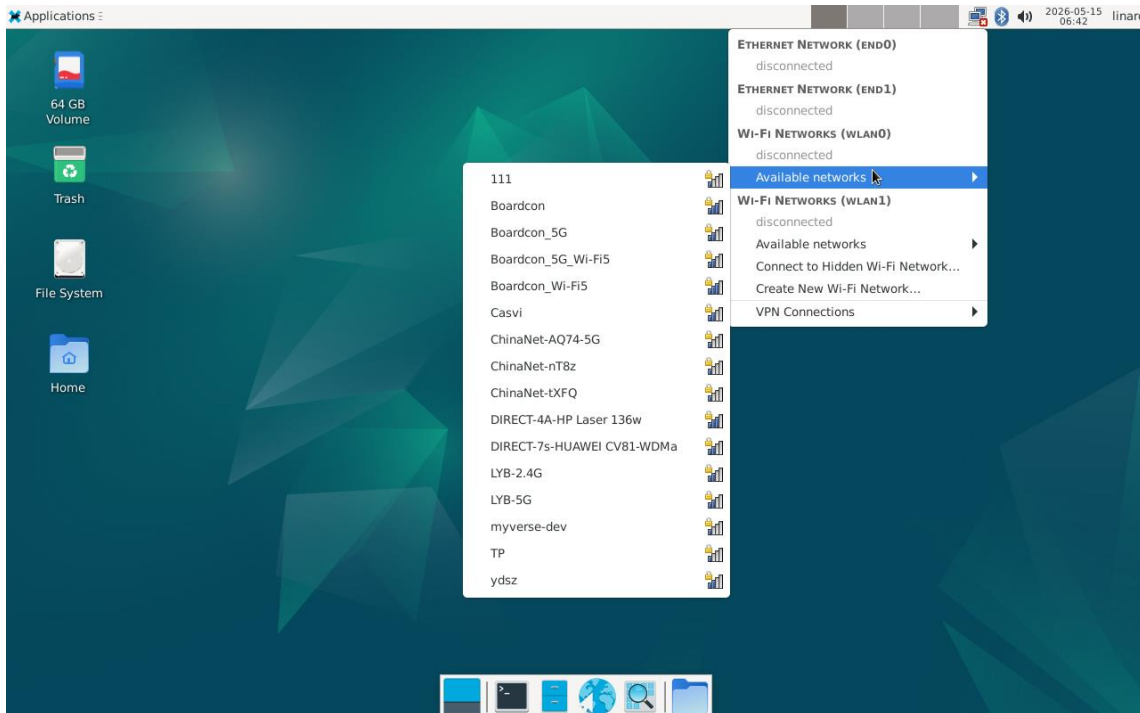
To use Wi-Fi and Bluetooth functions properly, the antenna needs to be connected.



6.9.1 WiF

Step 1: Click the network icon in the top right corner of the interface, then select the

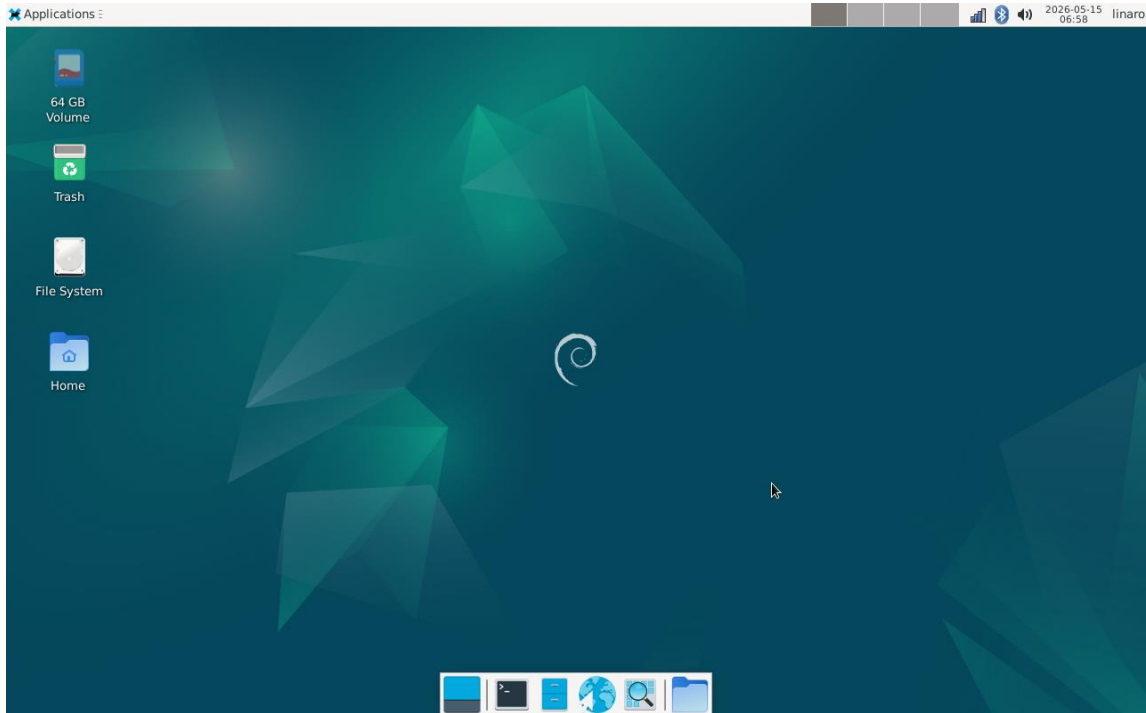
"Available Networks" option to view the list of available hotspots.



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 192.168.0.31 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::f786:af6b:bfca:bcf8 prefixlen 64 scopeid 0x20<link>
    ether 54:78:c9:88:4b:20 txqueuelen 1000 (Ethernet)
    RX packets 676 bytes 66204 (64.6 KiB)
    RX errors 0 dropped 68 overruns 0 frame 0
    TX packets 111 bytes 9794 (9.5 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

(2) Network connection test.

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

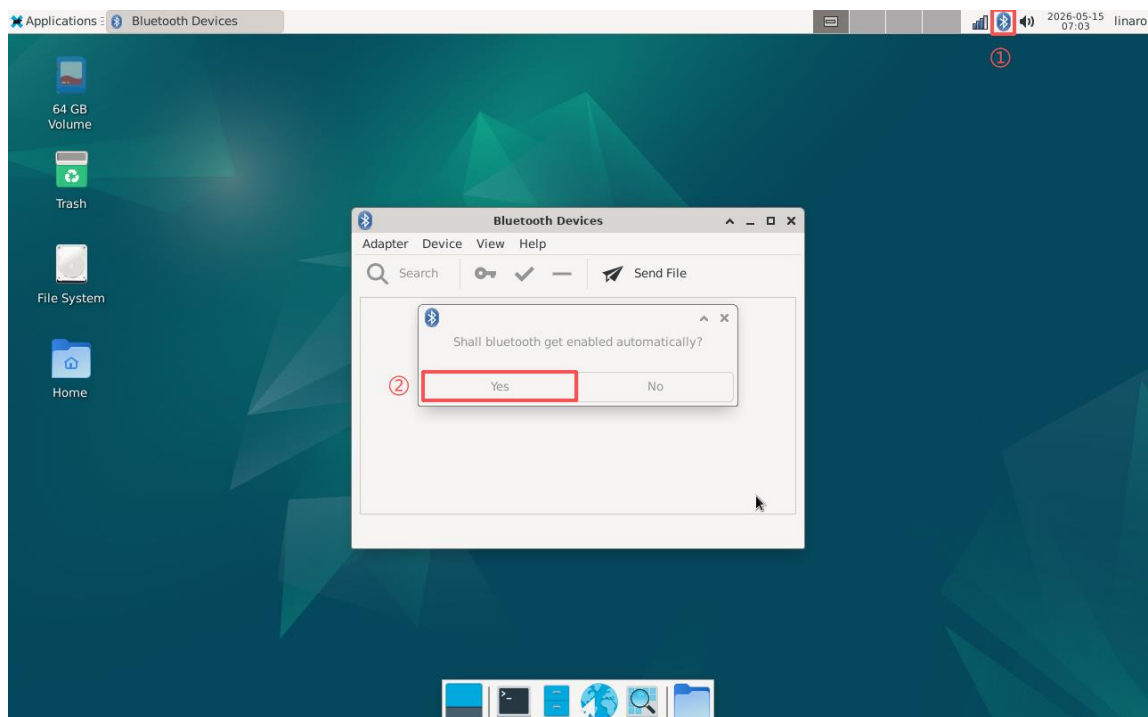
```

root@linaro-alip:~# ping -I wlan0 www.armdesigner.com
PING d3dsoj86mhwk6.cloudfront.net (13.32.99.68) from 192.168.0.31 wlan0: 56(84) bytes of data.
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=2 ttl=246 time=1654 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=3 ttl=246 time=632 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=4 ttl=246 time=256 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=5 ttl=246 time=225 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=6 ttl=246 time=206 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=7 ttl=246 time=223 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=10 ttl=246 time=231 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=11 ttl=246 time=235 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=12 ttl=246 time=210 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=14 ttl=246 time=265 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=15 ttl=246 time=210 ms
^C64 bytes from 13.32.99.68: icmp_seq=16 ttl=246 time=537 ms

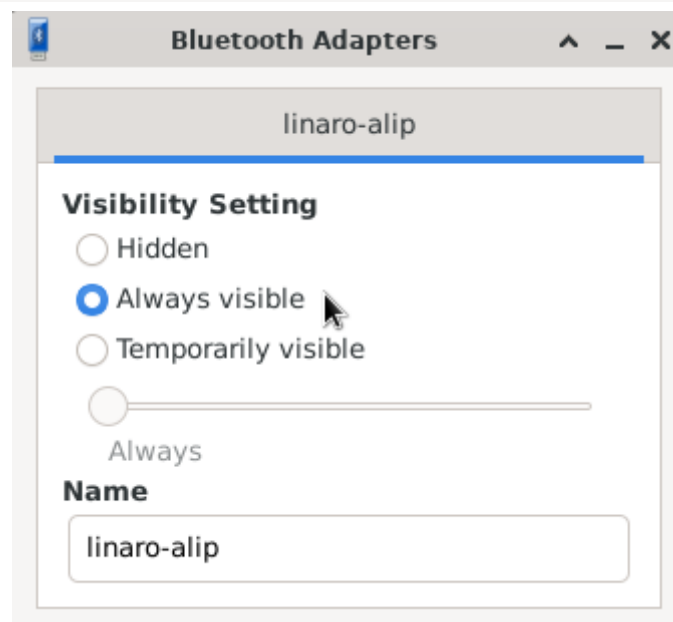
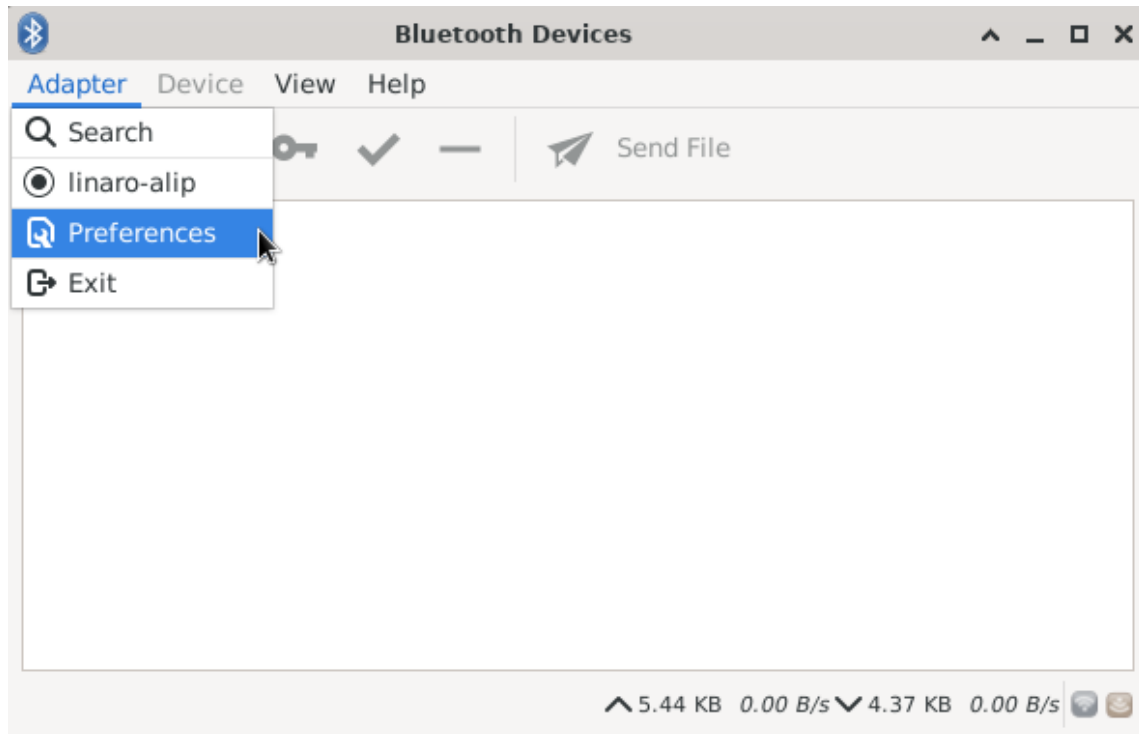
--- d3dsoj86mhwk6.cloudfront.net ping statistics ---
16 packets transmitted, 12 received, 25% packet loss, time 3706lms
rtt min/avg/max/mdev = 205.556/407.022/1654.486/399.223 ms, pipe 2
  
```

6.9.2 Bluetooth

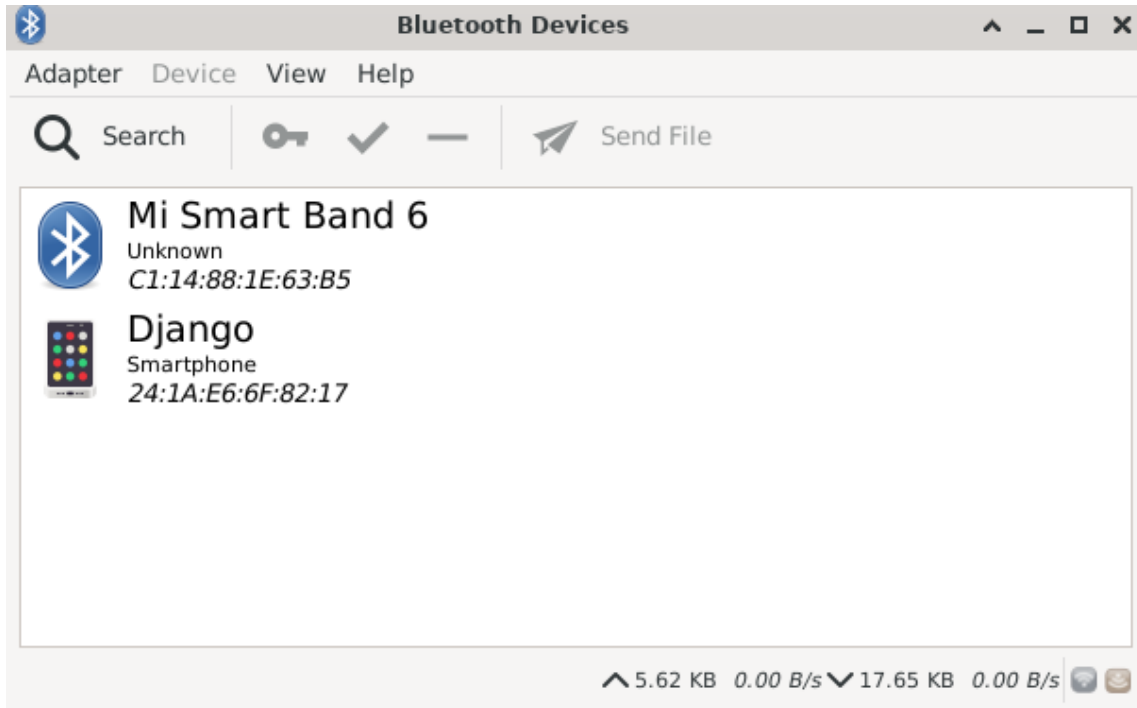
Step 1: Click the Bluetooth icon in the top right corner of the desktop.



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.



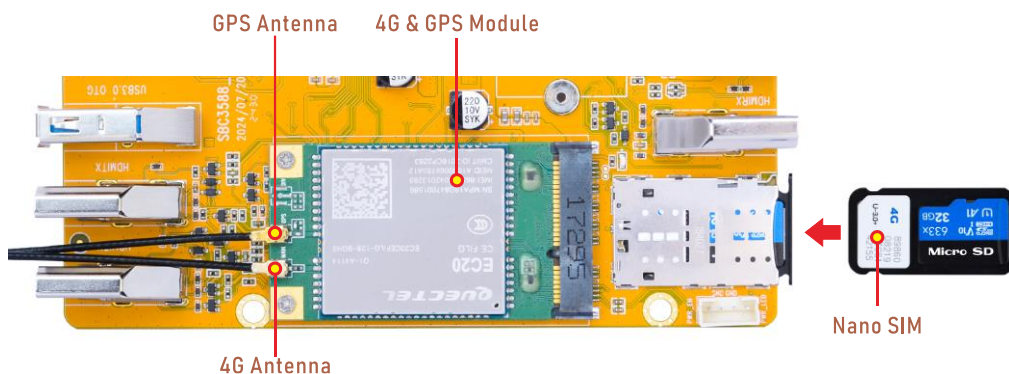
After successful configuration, Bluetooth devices can communicate with each other directly.

6.10 4G & GPS

Step 1: Insert 4G module to PCIe socket (4G model: EC20/EC25).

Step 2: Connect antenna and insert SIM card.

Step 3: Power on.



6.10.1 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 3gpp # (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)
noctrlcts     # (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)
noccp         # (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 10.23.177.106 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 14 bytes 198 (198.0 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 d3dsoj86mhwkk6.cloudfront.net (13.32.99.68) from 10.23.177.106 ppp0: 56(84) bytes of data.
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=1 ttl=245 time=549 ms
64 bytes from 13.32.99.68: icmp_seq=2 ttl=245 time=334 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=3 ttl=245 time=613 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=4 ttl=245 time=489 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=5 ttl=245 time=448 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=6 ttl=245 time=729 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=7 ttl=245 time=318 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=8 ttl=245 time=908 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=9 ttl=245 time=556 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=49 ttl=245 time=543 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=50 ttl=245 time=504 ms
64 bytes from server-13-32-99-68.fra60.r.cloudfront.net (13.32.99.68): icmp_seq=51 ttl=245 time=402 ms
^C64 bytes from 13.32.99.68: icmp_seq=52 ttl=245 time=356 ms

--- d3dsoj86mhwkk6.cloudfront.net ping statistics ---
52 packets transmitted, 48 received, 7.69231% packet loss, time 186610ms
rtt min/avg/max/mdev = 211.714/560.935/1249.981/260.434 ms, pipe 2
  
```

6.10.2 GPS Test

Step 1: Enable GPS functionality.

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

Step 2: Read GPS data.

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

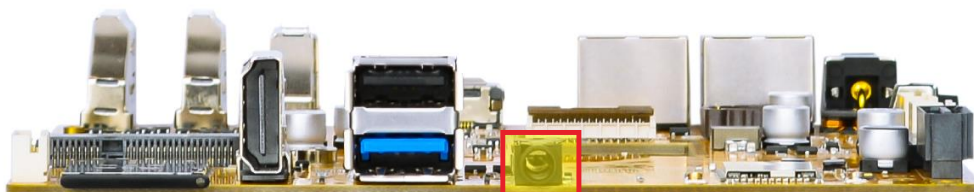
```

root@linaro-alip:/# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
root@linaro-alip:/#
root@linaro-alip:/# cat /dev/ttyUSB1
$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
  
```

6.11 Headset

Step 1: Plug the headset into the headset jack.



Headset

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 [rockchiphdmi1 ]: rockchip-hdmi1 - rockchip-hdmi1
rockchip-hdmi1
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
```

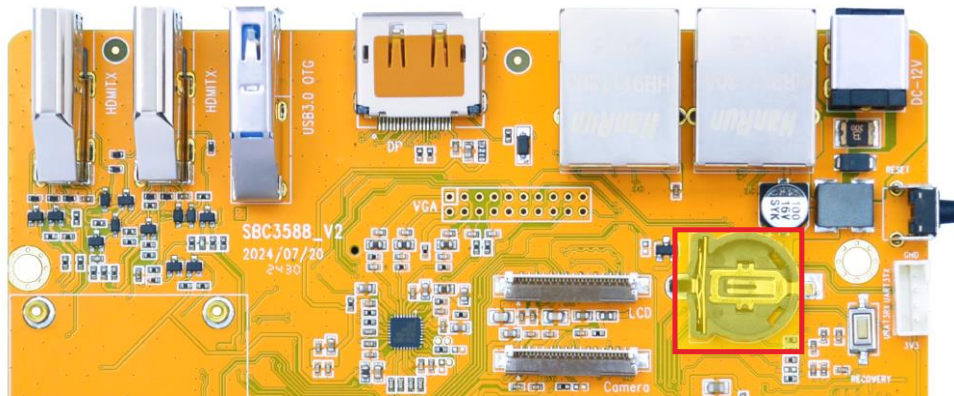
```
root@linaro-alip:/# aplay -Dhw:1,0 record.wav
Playing WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Supplementary instructions on audio output:

```
# aplay -Dhw:1,0 record.wav // Headset audio output
# aplay -Dhw:2,0 record.wav // HDMI TX0 audio output
# aplay -Dhw:3,0 record.wav // HDMI TX1 audio output
# aplay -Dhw:4,0 record.wav // DP TX audio output
```

6.12 RTC

Step 1: Install the coin cell battery.



RTC

Step 2: Set the system time.

```
# date -s "2025-08-25 10:33:00"
```

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

```
# hwclock -w
```

Step 4: Display the current hardware clock time.

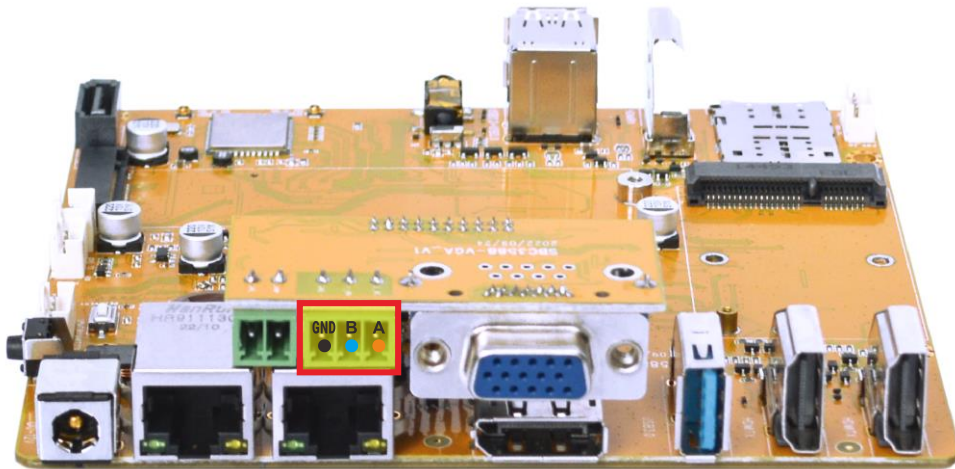
```
# hwclock
```

```
root@linaro-alip:/# date -s "2025-08-25 10:33:00"
Mon Aug 25 10:33:00 UTC 2025
root@linaro-alip:/# hwclock -w
root@linaro-alip:/# hwclock
2025-08-25 10:33:10.847368+00:00
root@linaro-alip:/# hwclock
2025-08-25 10:33:23.686632+00:00
root@linaro-alip:/# hwclock
2025-08-25 10:34:03.179098+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 -w
root@linaro-alip:/# hwclock
2025-08-25 11:30:05.361323+00:00
root@linaro-alip:/# hwclock
2025-08-25 11:30:33.360222+00:00
root@linaro-alip:/# hwclock
2025-08-25 11:31:12.209036+00:00
```

6.13 RS485

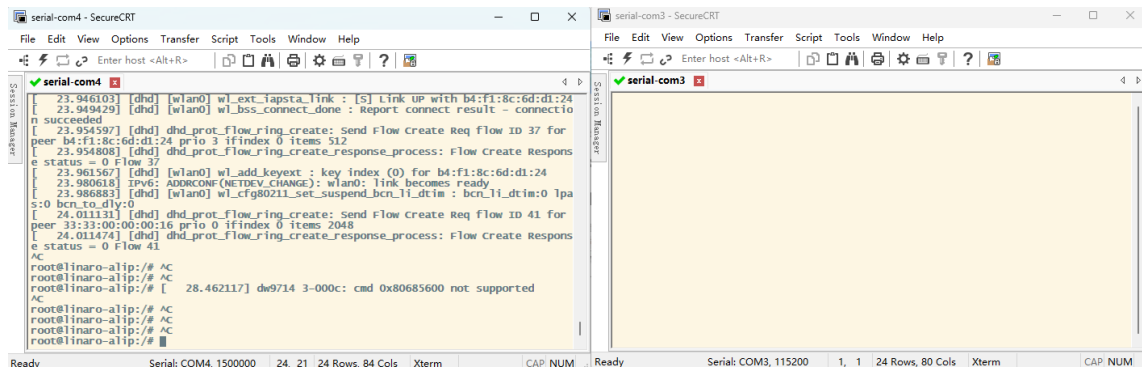


RS485

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

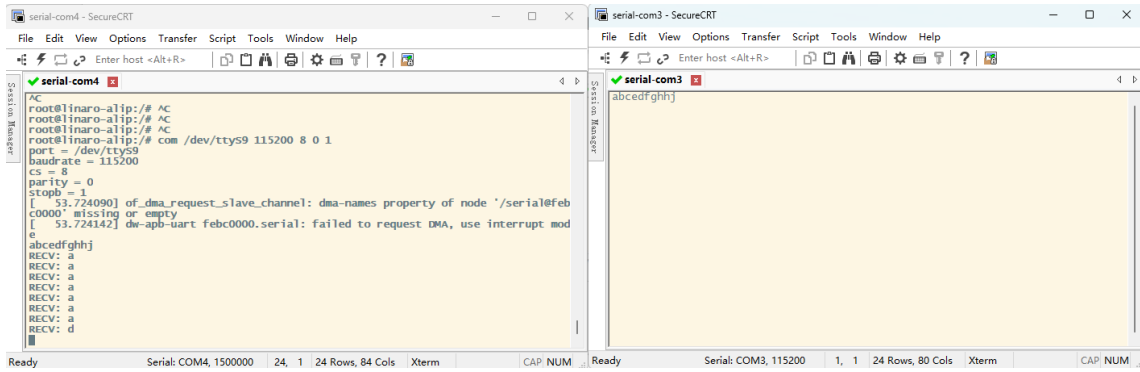


Step 2: Open the corresponding serial terminal, set the baud rate of the board to 1500000, and set the baud rate of the RS485 test tool to 115200.

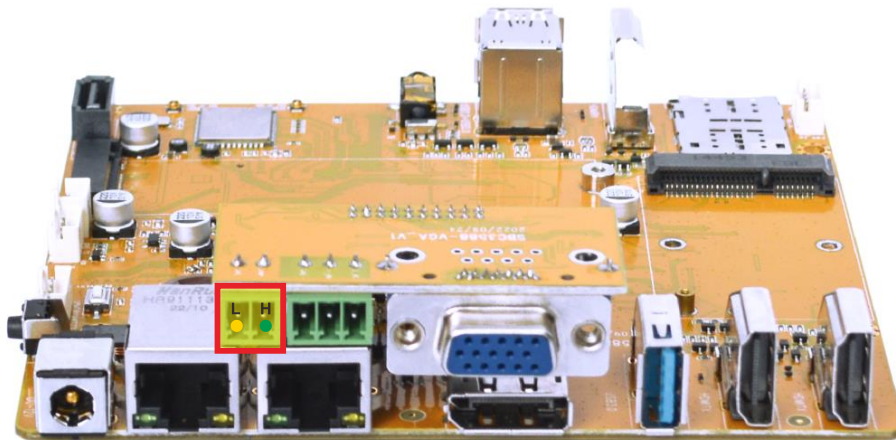


Step 3: Execute the following command on the board to test the RS485 transmission and reception functionality.

```
# com /dev/ttyS9 115200 8 0 1
```

6.14 CAN

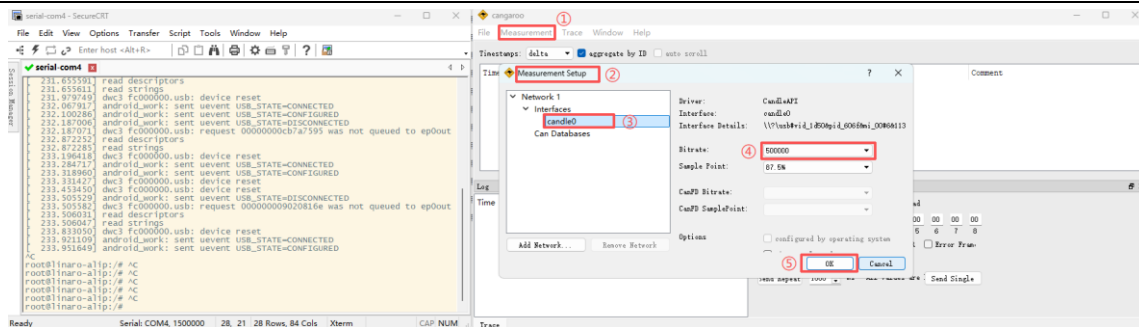


CAN

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

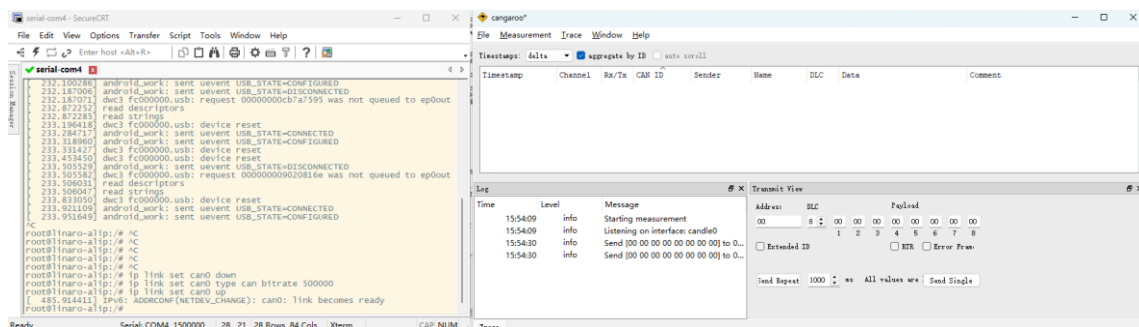


Step 2: Open the CAN test software and set the baud rate to 500000.



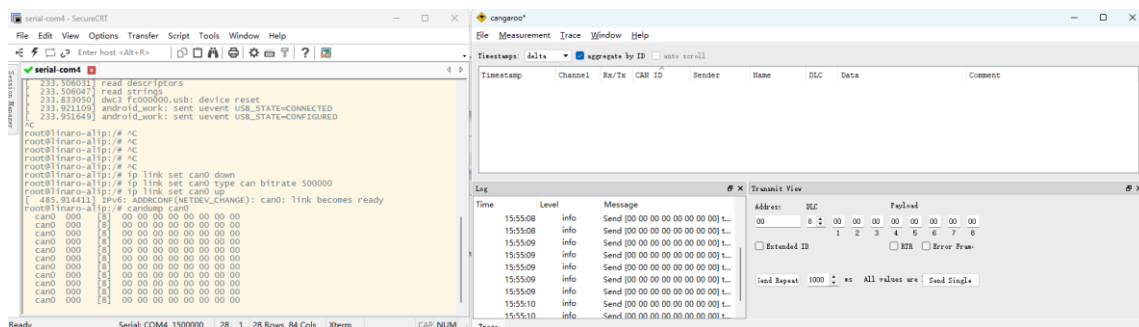
Step 3: Configure and activate the CAN network, setting the bitrate to 500000.

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



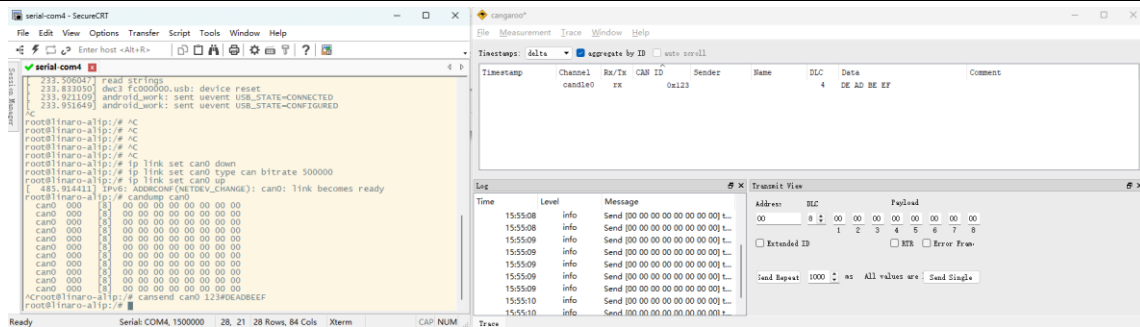
Step 4: Configure CAN as the receiver.

```
# candump can0
```



Step 5: Configure CAN as the sender.

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



6.15 RS232

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



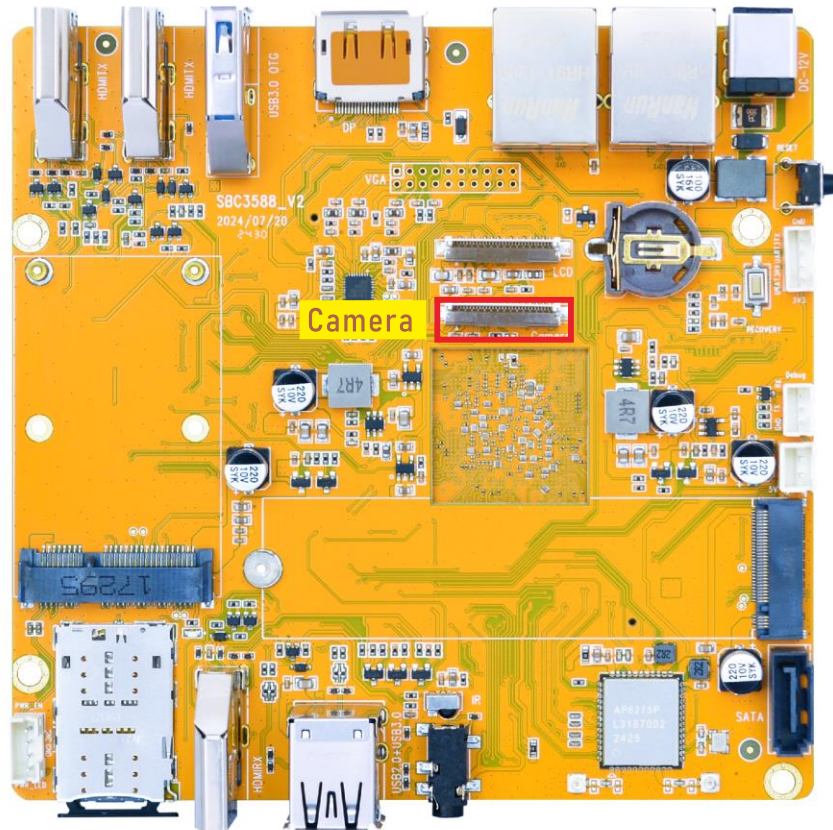
Step 2: RS232 test.

```
# 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
asdasdasd
RECV: asdasdasd
aaaaaaaaa1111
RECV: aaaaaaaaa1111
111111
RECV: 111111
```

6.16 Camera

Step 1: Connect the camera (IMX415), and then power on the board.



Step 2: 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/video11/name:rkisp_mainpath
root@linaro-alip:/# grep "" /sys/class/video4linux/v*/name | grep selfpath
/sys/class/video4linux/video12/name:rkisp_selfpath
```

Step 3: Preview camera.

```
# gst-launch-1.0 v4l2src device=/dev/video11 ! video/x-raw,format=NV12,width=1920,height=1080, framerate=30/1 ! xvimagesink
```

```

root@linaro-alip:/#
root@linaro-alip:/# gst-launch-1.0 v4l2src device=/dev/video11 ! video/x-
raw,format=NV12,width=1920,height=1080,framerate=30/1 ! xvimagesink
mpp[3337]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro0, framerate=30/1 ! xvimagesink
mpp[3337]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3337]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3337]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
[ 627.138631] dw9714 3-000c: cmd 0x80685600 not supported
[ 627.603624] dw9714 3-000c: 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
[ 627.710721] rkisp_hw fdc00000.rkisp: set isp clk = 594000000Hz
[ 627.729084] rkCIF-mipi-lvds2: stream[0] start streaming
[ 627.729393] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 00000000eebc10a4, sd_name:rockchip-csi2-
dphy0
[ 627.729414] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 627.729454] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 627.729498] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 627.729515] imx415 3-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 627.838624] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 627.872022] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
Redistribute latency...
0:00:04.9 / 99:99:99.

```

Step 3: Record the video.

```

# gst-launch-1.0 v4l2src device=/dev/video11 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/video11 num-buffers=100 ! \
video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! \m-buffers=100 ! \
videoconvert ! mpph264enc ! h264parse ! mp4mux ! \merate=30/1 ! \
filesink location=/tmp/h264.mp44parse ! mp4mux ! \
[ 665.859489] dw9714 3-000c: cmd 0x80685600 not supported
mpp[3433]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3433]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3433]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3433]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[3433]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
mpp[3433]: mpp_enc: MPP_ENC_SET_RC_CFG bps 7776000 [7290000 : 8262000] fps [30:30] gop 30
mpp[3433]: h264e_api_v2: MPP_ENC_SET_PREP_CFG w:h [1920:1080] stride [1920:1088]
mpp[3433]: mpp_enc: mode cbr bps [7290000:7776000:8262000] fps fix [30/1] -> fix [30/1] gop i [30] v [0]
[ 665.879202] rkisp_hw fdcb0000.rkisp: set isp clk = 594000000Hz
[ 665.899762] rkisp rkisp0-vir0: first params buf queue
[ 665.900576] rkCIF-mipi-lvds2: stream[0] start streaming
[ 665.900911] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 0000000eebc10a4, sd_name:rockchip-csi2-
dphy0
[ 665.900933] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 665.900975] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 665.901025] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 665.901043] imx415 3-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 666.022225] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 666.044917] devfreq fdbd0000.rkvenc-core: Couldn't update frequency transition information.
[ 666.055487] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
Redistribute latency...
Redistribute latency...
Got EOS from element "pipeline0".
Execution ended after 0:00:05.111628420
Setting pipeline to NULL ...
[ 671.006501] rkCIF-mipi-lvds2: stream[0] start stopping, total mode 0x2, cur 0x2
[ 671.021028] rockchip-mipi-csi2 mipi2-csi2: stream off, src_sd: 0000000eebc10a4, sd_name:rockchip-csi2-
dphy0
[ 671.021065] rockchip-mipi-csi2 mipi2-csi2: stream OFF
[ 671.021091] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream_stop stream stop, dphy0
[ 671.021109] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:0, dphy0, ret 0
[ 671.021135] imx415 3-0036: s_stream: 0. 3864x2192, hdr: 0, bpp: 10
[ 671.021754] rkCIF-mipi-lvds2: stream[0] stopping finished, dma_en 0x0
Freeing pipeline ...

```

Step 4: Take photos.

```

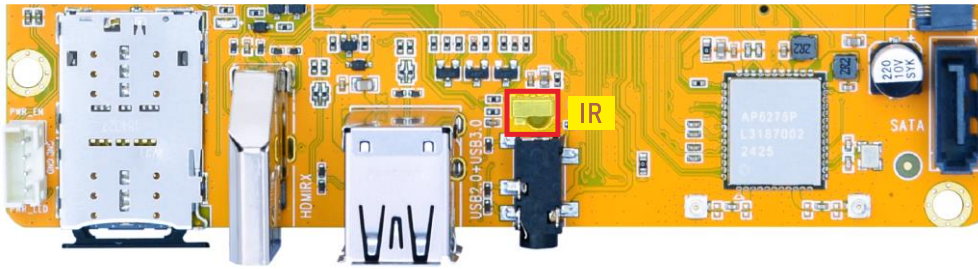
# gst-launch-1.0 -v v4l2src device=/dev/video11 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \
multifilesink location=/tmp/test%05d.jpg

```



```
root@linaro-alip:/# gst-launch-1.0 -v v4l2src device=/dev/video11 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \11 num-buffers=10 ! \
multifilesink location=/tmp/test%05d.jpgt=1080 ! mppjpegenc ! \
[ 717.514140] dw9714 3-000c: cmd 0x80685600 not supported
mpp[3476]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3476]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3476]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3476]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[3476]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
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
mpp[3476]: mpp_enc: MPP_ENC_SET_RC_CFG bps 31104000 [29160000 : 33048000] fps [120:120] gop 120
/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
[ 717.534409] rkisp_hw fdc00000.rkisp: set isp clk = 594000000Hz
/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
[ 717.562409] rkisp rkisp0-vir0: first params buf queue
[ 717.563277] rkCIF-mipi-lvds2: stream[0] start streaming
[ 717.563930] rockchip-mipi-csi2 mipi2-csi2: stream on, src_sd: 00000000eebc10a4, sd_name:rockchip-csi2-
dphy0
[ 717.563993] rockchip-mipi-csi2 mipi2-csi2: stream ON
[ 717.564073] rockchip-csi2-dphy0: dphy0, data_rate_mbps 892
[ 717.564148] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:1, dphy0, ret 0
[ 717.564187] imx415 3-0036: s_stream: 1. 3864x2192, hdr: 0, bpp: 10
[ 717.677576] rkCIF-mipi-lvds2: Warning: vblank need >= 1000us if isp work in online, cur 859 us
[ 717.710904] 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 0:00:00.620212584
Setting pipeline to NULL ...
[ 718.161668] rkCIF-mipi-lvds2: stream[0] start stopping, total mode 0x2, cur 0x2
[ 718.176334] rockchip-mipi-csi2 mipi2-csi2: stream off, src_sd: 00000000eebc10a4, sd_name:rockchip-csi2-
dphy0
[ 718.176369] rockchip-mipi-csi2 mipi2-csi2: stream OFF
[ 718.176394] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream_stop stream stop, dphy0
[ 718.176412] rockchip-csi2-dphy csi2-dphy0: csi2_dphy_s_stream stream on:0, dphy0, ret 0
[ 718.176436] imx415 3-0036: s_stream: 0. 3864x2192, hdr: 0, bpp: 10
[ 718.177101] rkCIF-mipi-lvds2: stream[0] stopping finished, dma_en 0x0
Freeing pipeline ...
```


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/sbc3588/sbc3588.dtsi`


```
&pwm15 {
    compatible = "rockchip,remotectl-pwm";
    pinctrl-names = "default";
    pinctrl-0 = <&pwm15m1_pins>;
    remote_pwm_id = <15>;
    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 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.

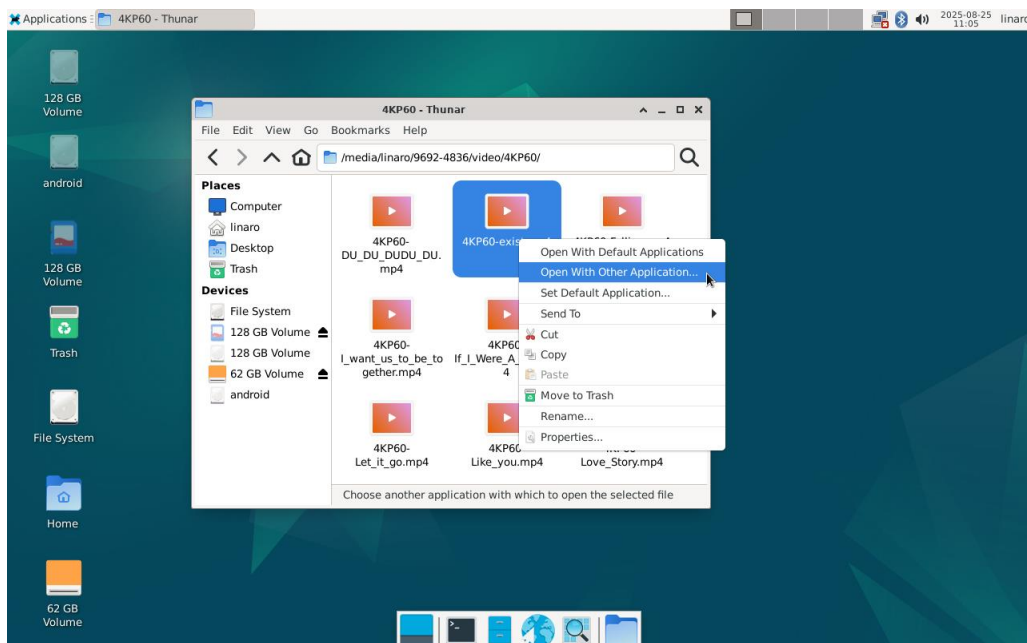
```
root@linaro-alip:/# /rockchip-test/video/test_gst_video.sh
[ 125.336230] dw9714 3-000c: cmd 0x80685600 not supported
Setting pipeline to PAUSED ...
Pipeline is PREROLLING ...
Redistribute latency...
mpp[3998]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3998]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3998]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3998]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[3998]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
Redistribute latency...
mpp[3998]: h264d_api: is_avcC=1
Pipeline is PREROLLED ...0 %
Prerolled, waiting for async message to finish...
Setting pipeline to PLAYING ...
Redistribute latency...
New clock: GstSystemClock
[ 140.635708] exFAT-fs (sdb1): Volume was not properly unmounted. Some data may be corrupt. Please run
fsck.
Got EOS from element "pipeline0".
Execution ended after 0:00:29.567359556
Setting pipeline to NULL ...
Freeing pipeline ...
```



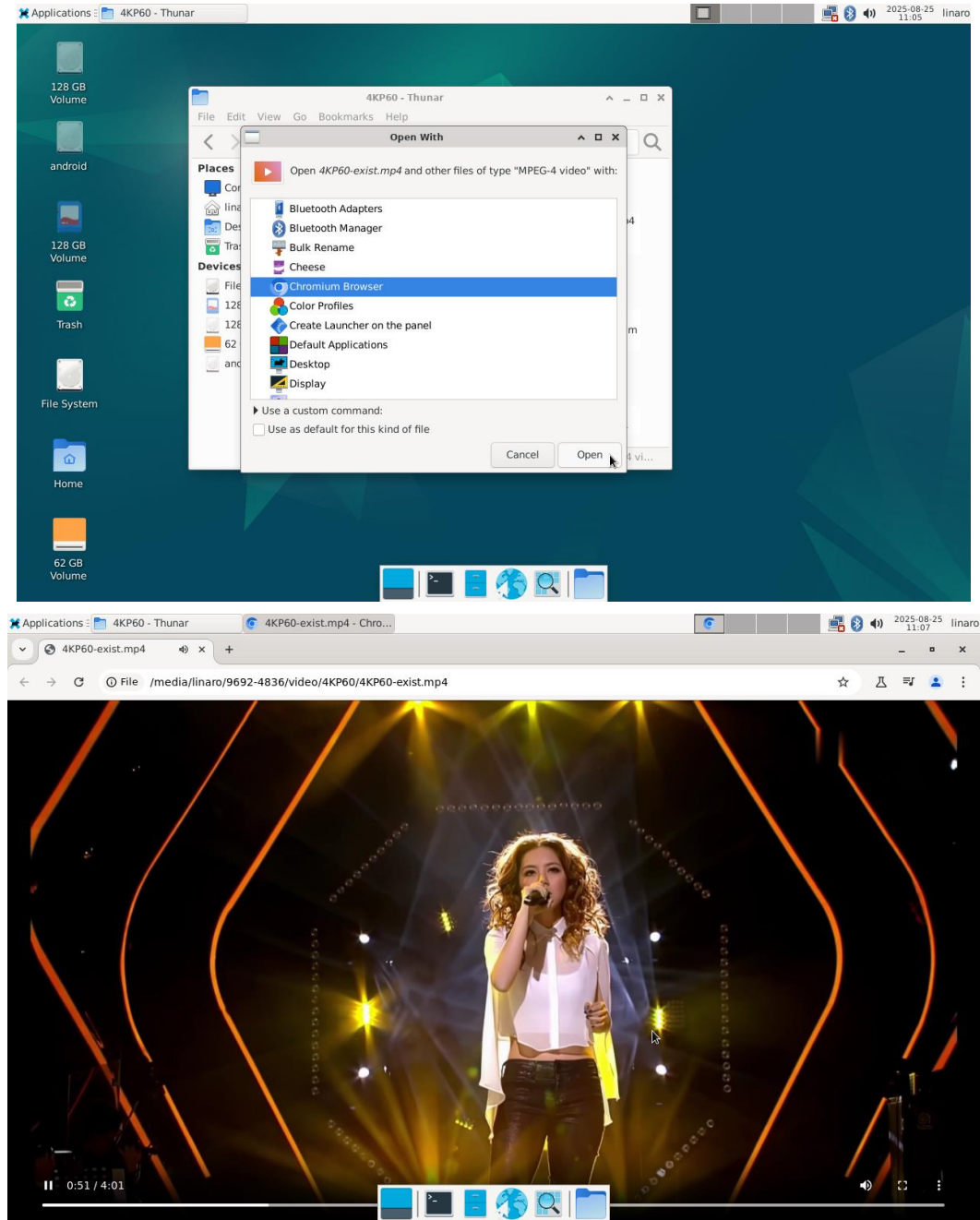
(2) Play the video using Google Chrome.

- 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.



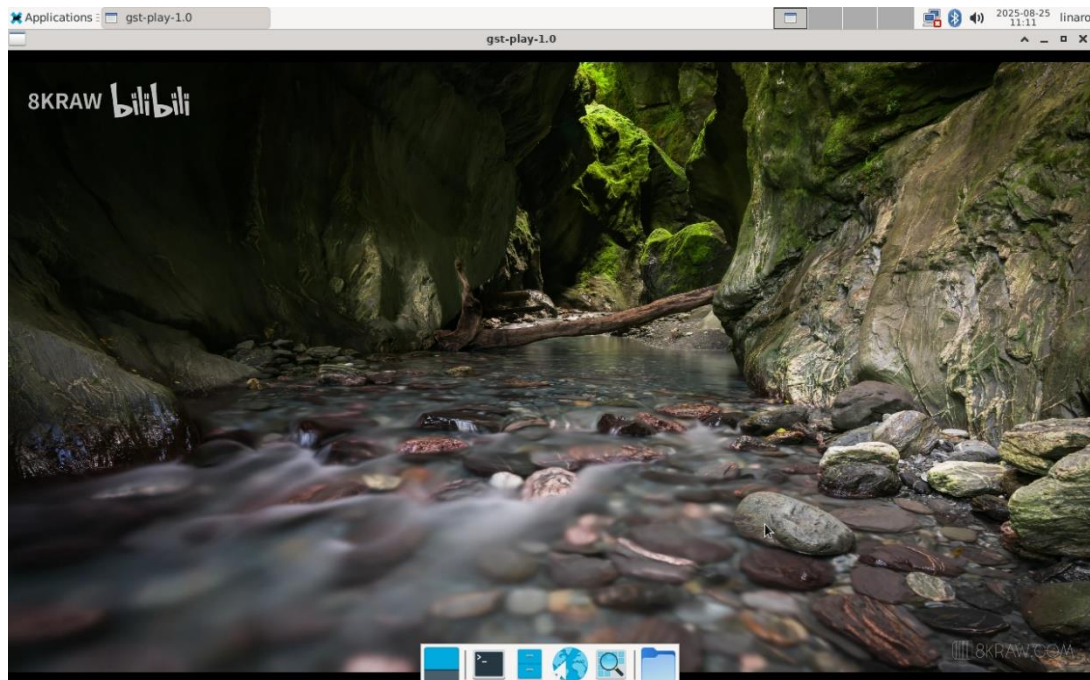
(3) Use the `gst-play-1.0` command to play the video.

```
# gst-play-1.0 --videosink=xvimagesink /media/linaro/9692-4836/video/8KP30/8KP30-3.mp4 --audiosink="alsasink device=hw:1,0"
```

Command explanation:

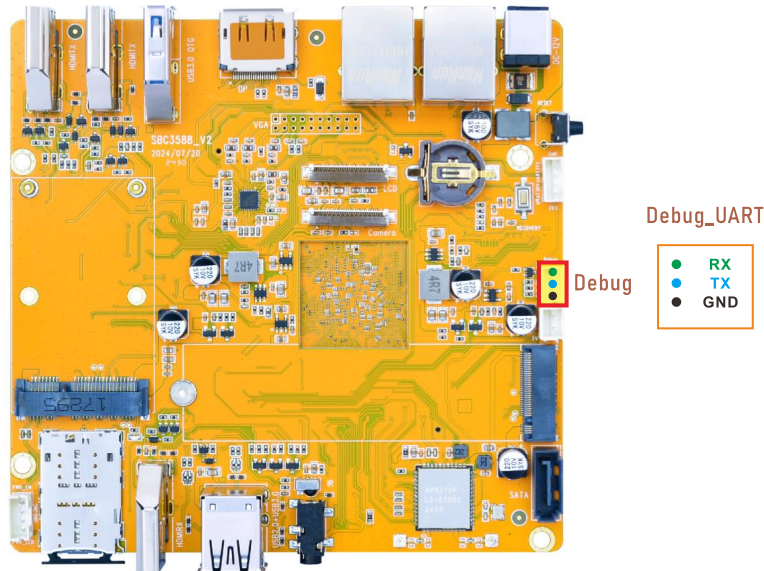
- `/media/linaro/9692-4836/video/8KP30/8KP30-3.mp4`: The media file path to be played.
- `--audiosink="alsasink device=hw:1,0"`: Specifies the audio output device as `hw:1,0`.

```
root@linaro-alip:/# gst-play-1.0 --videosink=xvimagesink /media/linaro/9692-4836/video/8KP30/8KP30-3.mp4 -
-audiosink="alsasink--audiosink="alsasink device=hw:1,0"
Press 'k' to see a list of keyboard shortcuts.
Now playing /media/linaro/9692-4836/video/8KP30/8KP30-3.mp4
Redistribute latency...
mpp[5077]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[5077]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[5077]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[5077]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
mpp[5077]: mpp_info: mpp version: ebb49879 author: Herman Chen 2025-05-29 fix[kmpp_obj]: Update helper
macro
Redistribute latency...
mpp[5077]: H265D_PARSER: extradata is encoded as hvCC format
Redistribute latency...
Redistribute latency...
Redistribute latency...
0:00:43.0 / 0:05:27.8
```



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.

```

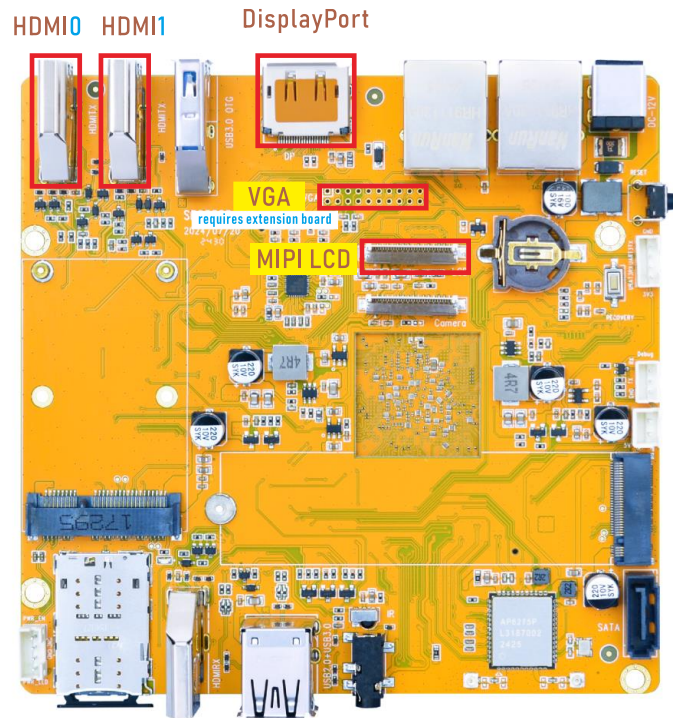
serial-com4 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>

[ 8.522071] [dhd] dhd_pri_open : no mutex held
Enabling wlan1..
[ 8.522092] [dhd] dhd_pri_open : set mutex lock
[ 8.522103] [dhd] [wlan0] dhd_open : Primary net_device is already up
[ 8.522114] [dhd] [wlan0] dhd_pri_open : tx queue started
[ 8.522243] [dhd] [wlan0] custom_xps_map_set : Done. mapping cpu
[ 8.522253] [dhd] dhd_pri_open : mutex is released.
Successfully init wi-fi for AP6275P!
Done
rfkill: Cannot open RFKILL control device
[ 8.555726] [dhd] P2P interface registered
n180211: kernel reports: Registration to specific type not supported
rfkill: Cannot get wiphy information
[ 8.583267] [dhd] CFGP2P-ERROR wl_cfgp2p_init_discovery : p2p_disc 1 error -16
[ 8.583298] [dhd] CFGP2P-ERROR wl_cfgp2p_set_discovery : set discover error
[ 8.589628] [dhd] CFGP2P-ERROR wl_cfgp2p_enable_discovery : init discovery error -16
[ 8.589653] [dhd] CFGP2P-ERROR wl_cfgp2p_disable_discovery : do nothing, not initialized
[ 8.595538] [dhd] CFGP2P-ERROR wl_cfgp2p_start_p2p_device : P2P enable discovery failed, ret=-16
n180211: Could not set interface 'p2p-dev-wlan0' UP
[ 8.596288] [dhd] CFGP2P-ERROR wl_cfgp2p_disable_discovery : do nothing, not initialized
n180211: deinit ifname=p2p-dev-wlan0 disabled_11b_rates=0
[ 8.596961] [dhd] CFGP2P-ERROR wl_cfgp2p_del_p2p_disc_if : P2P interface unregistered
p2p-dev-wlan0: Failed to initialize driver interface
p2p-dev-wlan0: CTRL-EVENT-DSCP-POLICY clear_all
P2P: Failed to enable P2P Device interface
AC
root@sbc3588-buildroot:/# ^C
root@sbc3588-buildroot:/# ^C
root@sbc3588-buildroot:/# ^C
root@sbc3588-buildroot:/# [ 17.785210] platform mtd_vendor_storage: deferred probe pending
[ 17.785299] platform dp0-sound: deferred probe pending
  
```

Ready Serial: COM4, 1500000 32, 1 32 Rows, 107 Cols Xterm CAP NUM

7.2 Display

The SBC3588 supports quad independent display output on the default Buildroot image, with interfaces including HDMI0, HDMI1, DP/VGA (selectable), and MIPI DSI.

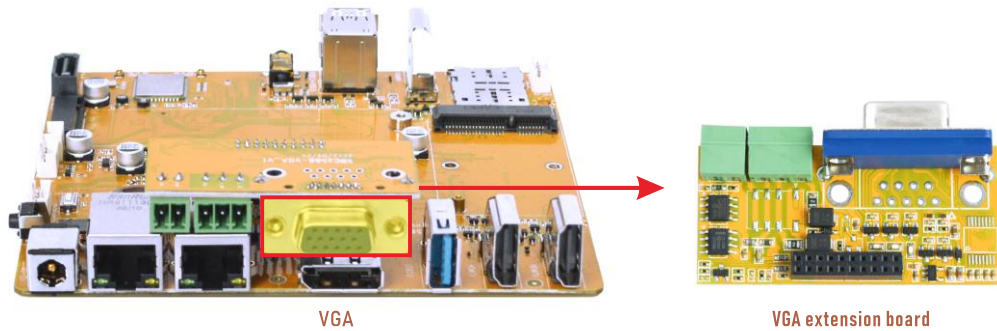


The display effect diagram is as follows:



Note: DP and VGA share the same VOP and cannot be used simultaneously with

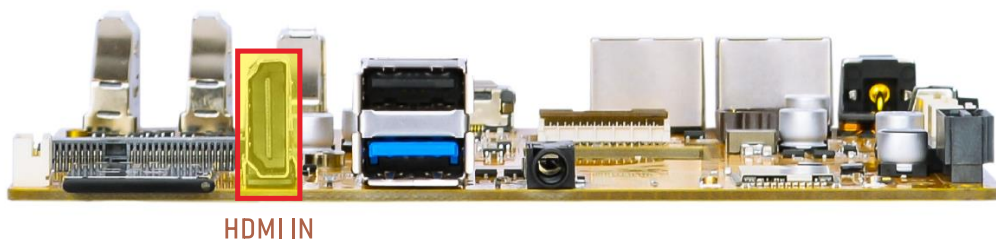
different display timings—only one output will be active at a time.



Preview effect:



7.3 HDMI RX



After connecting the HDMI OUT port of the source device to the HDMI IN port of the SBC3588, execute the following commands to start the preview.

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


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

```
root@sbc3588-buildroot:/# grep -H hdmirx /sys/class/video4linux/video*/name
/sys/class/video4linux/video20/name:stream_hdmirx
```

- **Video Preview:**

HDMI input source: rk3568

```
# gst-launch-1.0 v4l2src device=/dev/video20 ! videoconvert ! waylandsink
```

```
root@sbc3588-buildroot:/#
vert ! waylandsinkdroot:/# gst-launch-1.0 v4l2src device=/dev/video20 ! videoconv
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
[ 3079.928025] fdee0000.hdmirx-controller: hdmirx_start_streaming: delay_line:720
Redistribute latency...
[ 3080.593755] fdee0000.hdmirx-controller: rcv frames
0:00:43.2 / 99:99:99.
```

HDMI input source: rk3588

```
# gst-launch-1.0 v4l2src device=/dev/video20 ! video/x-
raw,format=NV24,width=1920,height=1080 ! videoconvert ! video/x-raw,format=I420 !
waylandsink sync=false
```

```
root@sbc3588-buildroot:/#
waylandsink sync=false20,height=1080 ! videoconvert ! video/x-raw,format=I420 !
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
[ 658.459766] fdee0000.hdmirx-controller: hdmirx_start_streaming: delay_line:720
Redistribute latency...
[ 661.020339] fdee0000.hdmirx-controller: rcv frames
0:00:08.8 / 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@sb3588-buildroot:/#
diodconvert ! audioresample ! queue ! alsasink device=hw:rockchipdp1hdmi0 ! aud
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...
0:00:01.8 / 99:99:99.
```

Parameter Description:

```
Audio Output:
* device=hw:rockchipes8388 /* Headset audio output */
* device=hw:rockchipdmi0 /* HDMI TX0 audio output */
* device=hw:rockchipdmi1 /* HDMI TX1 audio output */
* device=hw:rockchipdp1 /* DP TX audio output */

v4l2-ctl:
* v4l2-ctl -d /dev/video20 --get-fmt-video /* Get current video format */
* v4l2-ctl -d /dev/video20 --query-dv-timings /* Query supported DV timings */
* v4l2-ctl -d /dev/video20 --get-dv-timings /* Get current DV timing */
* v4l2-ctl -d /dev/video20 -D /* Display device information */
```

7.4 USB

7.4.1 USB OTG

Default mode on boot: Device mode, functioning as a USB device for ADB debugging and file transfer.



7.4.1.1 Host mode

In this mode, the board functions as a USB host, allowing connection to:

- USB keyboard
- USB mouse
- USB flash drive

To switch to host mode, execute the following command:

```
# echo host > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-
phy@0/otg_mode
```

```
root@sbc3588-buildroot:/# [ 51.708850] dwc3 fc000000.usb: request 0000000096c18dc9 was not queued to
ep0out
[ 51.708964] android_work: sent uevent USB_STATE=DISCONNECTED
[ 51.817929] xhci-hcd xhci-hcd.16.auto: xHCI Host Controller
[ 51.818168] xhci-hcd xhci-hcd.16.auto: new USB bus registered, assigned bus number 8
[ 51.818315] xhci-hcd xhci-hcd.16.auto: hcc params 0x0220fe64 hci version 0x110 quirks 0x0002008002010010
[ 51.818362] xhci-hcd xhci-hcd.16.auto: irq 84, io mem 0xfc000000
[ 51.818499] xhci-hcd xhci-hcd.16.auto: xHCI Host Controller
[ 51.818625] xhci-hcd xhci-hcd.16.auto: new USB bus registered, assigned bus number 9
[ 51.818644] xhci-hcd xhci-hcd.16.auto: Host supports USB 3.0 SuperSpeed
[ 51.818785] usb usb8: New USB device found, idVendor=1d6b, idProduct=0002, bcdDevice= 6.01
[ 51.818804] usb usb8: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 51.818818] usb usb8: Product: xHCI Host Controller
[ 51.818831] usb usb8: Manufacturer: Linux 6.1.141 xhci-hcd
[ 51.818844] usb usb8: SerialNumber: xhci-hcd.16.auto
[ 51.819260] hub 8-0:1.0: USB hub found
[ 51.819295] hub 8-0:1.0: 1 port detected
[ 51.819638] usb usb9: We don't know the algorithms for LPM for this host, disabling LPM.
[ 51.819731] usb usb9: New USB device found, idVendor=1d6b, idProduct=0003, bcdDevice= 6.01
[ 51.819748] usb usb9: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 51.819761] usb usb9: Product: xHCI Host Controller
[ 51.819772] usb usb9: Manufacturer: Linux 6.1.141 xhci-hcd
[ 51.819783] usb usb9: SerialNumber: xhci-hcd.16.auto
[ 51.820139] hub 9-0:1.0: USB hub found
[ 51.820172] hub 9-0:1.0: 1 port detected
[ 51.873570] read descriptors
[ 51.873642] read strings
root@sbc3588-buildroot:/# [ 64.085773] usb 9-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 64.118917] usb 9-1: New USB device found, idVendor=0951, idProduct=1666, bcdDevice= 0.01
[ 64.118967] usb 9-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 64.118983] usb 9-1: Product: DataTraveler 3.0
[ 64.118997] usb 9-1: Manufacturer: Kingston
[ 64.119010] usb 9-1: SerialNumber: E0D55EA57425F740385A009C
[ 64.207260] usb-storage 9-1:1.0: USB Mass Storage device detected
[ 64.208497] scsi host1: usb-storage 9-1:1.0
[ 65.235483] scsi 1:0:0:0: Direct-Access Kingston DataTraveler 3.0 PQ: 0 ANSI: 6
[ 65.239662] sd 1:0:0:0: [sda] 120845300 512-byte logical blocks: (61.9 GB/57.6 GiB)
[ 65.240057] sd 1:0:0:0: [sda] Write Protect is off
[ 65.240421] sd 1:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[ 65.245138] sda: sda1
[ 65.245557] sd 1:0:0:0: [sda] Attached SCSI removable disk
[ 65.361699] FAT-fs (sda1): utf8 is not a recommended IO charset for FAT filesystems, filesystem will be
case sensitive!
[ 65.363485] FAT-fs (sda1): Volume was not properly unmounted. Some data may be corrupt. Please run fsck.
```

7.4.1.2 Device mode

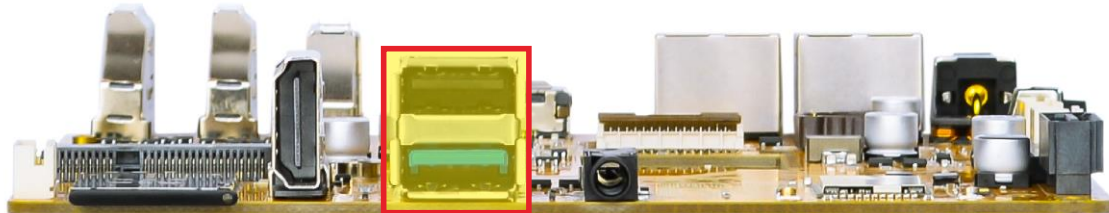
To switch back to Device mode, execute the following command:

```
# echo peripheral > /sys/devices/platform/fd5d0000.syscon/fd5d0000.syscon:usb2-
phy@0/otg_mode
```

```
root@sbc3588-buildroot:/# [ 81.418012] xhci-hcd xhci-hcd.16.auto: remove, state 4
[ 81.418070] usb usb9: USB disconnect, device number 1
[ 81.418831] xhci-hcd xhci-hcd.16.auto: USB bus 9 deregistered
[ 81.419041] xhci-hcd xhci-hcd.16.auto: remove, state 4
[ 81.419058] usb usb8: USB disconnect, device number 1
[ 81.419878] xhci-hcd xhci-hcd.16.auto: USB bus 8 deregistered
root@sbc3588-buildroot:/# [ 82.671644] read descriptors
[ 82.671695] read strings
[ 82.879345] android_work: did not send uevent (0 0 0000000000000000)
[ 86.741275] phy phy-fd5d0000.syscon:usb2-phy@0.0: charger = USB_SDP_CHARGER
[ 86.951458] dwc3 fc000000.usb: device reset
[ 87.039221] android_work: sent uevent USB_STATE=CONNECTED
[ 87.076732] android work: sent uevent USB_STATE=CONFIGURED
```

7.4.2 USB Host

The USB host interface provides connectivity for standard peripherals, including USB keyboards, mice, flash drives, and other USB-compatible devices.



USB2.0 (up)
 USB3.0 (down)

USB version identification based on kernel log output:

- **USB 2.0:** Displays as high-speed.

```
root@sbc3588-buildroot:/# [ 41.439060] usb 3-1: new high-speed USB device number 6 using xhci-hcd
[ 41.588897] usb 3-1: New USB device found, idVendor=346d, idProduct=5678, bcdDevice= 2.00
[ 41.588947] usb 3-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 41.588964] usb 3-1: Product: HIKSEMI
[ 41.588976] usb 3-1: SerialNumber: FC0767D6251F4
[ 41.590141] usb-storage 3-1:1.0: USB Mass Storage device detected
[ 41.591155] usb-storage 3-1:1.0: Quirks match for vid 346d pid 5678: 520
[ 41.591448] scsi host1: usb-storage 3-1:1.0
[ 42.612774] scsi 1:0:0:0: Direct-Access HIKSEMI 3.00 PQ: 0 ANSI: 4
[ 42.618360] sd 1:0:0:0: [sda] 122880000 512-byte logical blocks: (62.9 GB/58.6 GiB)
[ 42.619090] sd 1:0:0:0: [sda] Write Protect is off
[ 42.619655] sd 1:0:0:0: [sda] No Caching mode page found
[ 42.619693] sd 1:0:0:0: [sda] Assuming drive cache: write through
[ 42.624876] sda: sda1
[ 42.625209] sd 1:0:0:0: [sda] Attached SCSI removable disk
```

- **USB 3.0:** Displays as SuperSpeed.

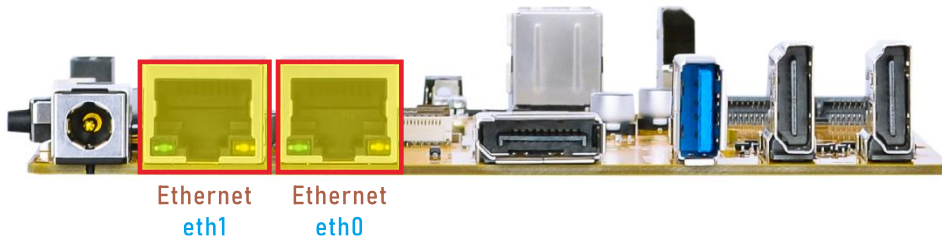
```
root@sbc3588-buildroot:/# [ 74.679109] usb 2-1: new SuperSpeed USB device number 2 using xhci-hcd
[ 74.700171] usb 2-1: LPM exit latency is zeroed, disabling LPM.
[ 74.701063] usb 2-1: New USB device found, idVendor=346d, idProduct=5678, bcdDevice= 2.00
[ 74.701108] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 74.701125] usb 2-1: Product: HIKSEMI
[ 74.701138] usb 2-1: SerialNumber: FC0767D6251F4
[ 74.702225] usb-storage 2-1:1.0: USB Mass Storage device detected
[ 74.703164] usb-storage 2-1:1.0: Quirks match for vid 346d pid 5678: 420
[ 74.703599] scsi host1: usb-storage 2-1:1.0
[ 75.732341] scsi 1:0:0:0: Direct-Access HIKSEMI 3.00 PQ: 0 ANSI: 4
[ 75.736414] sd 1:0:0:0: [sda] 122880000 512-byte logical blocks: (62.9 GB/58.6 GiB)
[ 75.737001] sd 1:0:0:0: [sda] Write Protect is off
[ 75.737516] sd 1:0:0:0: [sda] No Caching mode page found
[ 75.737554] sd 1:0:0:0: [sda] Assuming drive cache: write through
```

After connecting the USB flash drive, it will be automatically mounted. Execute the following command to view the path where the device is mounted:

```
root@sbc3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   719M   13G   6% /
devtmpfs        3.8G   8.0K   3.8G   1% /dev
tmpfs           3.9G  140K   3.9G   1% /tmp
tmpfs           3.9G  528K   3.9G   1% /run
tmpfs           3.9G  268K   3.9G   1% /var/log
tmpfs           3.9G   0     3.9G   0% /dev/shm
/dev/mmcblk0p7  123M   12M   111M  10% /oem
/dev/mmcblk0p8   15G   320K   15G   1% /userdata
/dev/sda1        59G   2.6G   57G   5% /mnt/udisk
/dev/sdb1        58G   11G   47G  19% /media/udisk1
```

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@sbc3588-buildroot:/# [ 73.265079] rk_gmac-dwmac fe1c0000.ethernet eth0: Link is Up - 1Gbps/Full -
flow control rx/tx
[12041.510098] IPv6: ADDRCONF(NETDEV_CHANGE): eth0: link becomes ready
[12047.782104] rk_gmac-dwmac fe1b0000.ethernet eth1: Link is Up - 1Gbps/Full - flow control rx/tx
[12047.782285] IPv6: ADDRCONF(NETDEV_CHANGE): eth1: link becomes ready
```

Step 2: View network interface information.

```
# ifconfig
```

```
root@sbc3588-buildroot:/# ifconfig
eth0      Link encap:Ethernet HWaddr BE:43:FC:C9:26:0A
          inet addr:192.168.0.52 Bcast:192.168.0.255 Mask:255.255.255.0
          inet6 addr: fe80::2cc2:fd93:fc9b:b576/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:297 errors:0 dropped:31 overruns:0 frame:0
          TX packets:11 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:31520 (30.7 KiB) TX bytes:1410 (1.3 KiB)
          Interrupt:75

eth1      Link encap:Ethernet HWaddr BA:43:FC:C9:26:0A
          inet addr:192.168.0.81 Bcast:192.168.0.255 Mask:255.255.255.0
          inet6 addr: fe80::3a3a:38c0:faac:bd4c/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
          RX packets:214 errors:0 dropped:26 overruns:0 frame:0
          TX packets:11 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:22318 (21.7 KiB) TX bytes:1410 (1.3 KiB)
          Interrupt:77
```

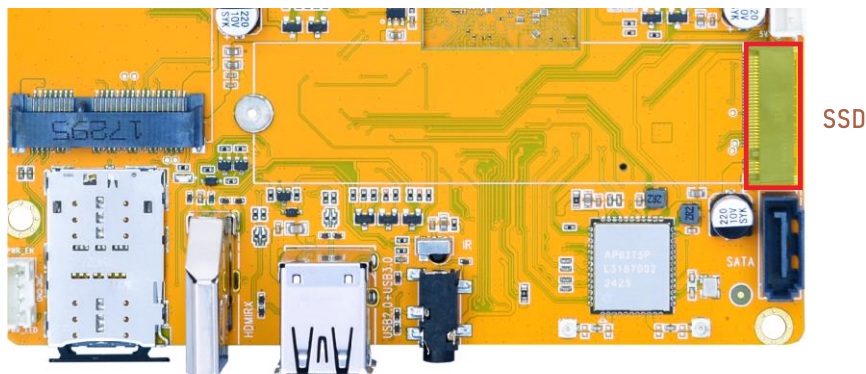
Step 3: Network connection test.

```
# ping -I eth0 www.armdesigner.com
# ping -I eth1 www.armdesigner.com
```

```
root@sbc3588-buildroot:/# ping -I eth0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.52 eth0: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=50 time=180 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=50 time=175 ms
^C
--- www.armdesigner.com ping statistics ---
7 packets transmitted, 6 received, 14.2857% packet loss, time 6010ms
rtt min/avg/max/mdev = 174.689/175.955/180.485/2.034 ms
root@sbc3588-buildroot:/#
root@sbc3588-buildroot:/# ping -I eth1 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 192.168.0.81 eth1: 56(84) bytes of data.
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=1 ttl=50 time=214 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=50 time=175 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=50 time=175 ms
^C
--- www.armdesigner.com ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5002ms
rtt min/avg/max/mdev = 174.698/181.423/214.048/14.591 ms
```

7.6 PCIe M.2 SSD

Step 1: Insert the M.2 SSD into the M.2 card slot, then power on the device.



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

```
# df -h
```

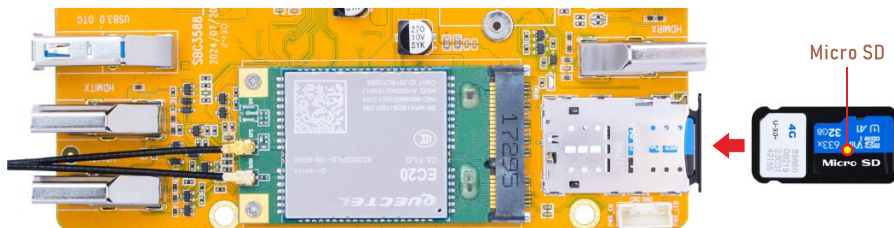
```
root@sbc3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   739M   13G   6% /
devtmpfs         3.8G   8.0K   3.8G   1% /dev
tmpfs            3.9G  140K   3.9G   1% /tmp
tmpfs            3.9G   640K   3.9G   1% /run
tmpfs            3.9G   328K   3.9G   1% /var/log
tmpfs            3.9G    0     3.9G   0% /dev/shm
/dev/mmcblk0p7   123M   12M   111M  10% /oem
/dev/mmcblk0p8    15G   320K   15G   1% /userdata
/dev/sda1        120G   2.4M  120G   1% /mnt/storage
/dev/nvme0n1p1   233G   13M   233G   1% /media/storage1
/dev/mmcblk1p1   120G   85M   119G   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
```

7.7 SD Card

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



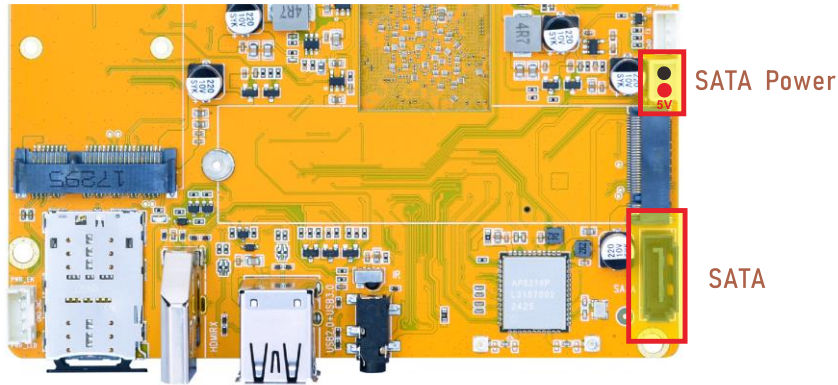
Step 2: The system will automatically mount it, view the device mount path.

```
# df -h
```

```
root@sbc3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   761M   13G   6% /
devtmpfs         3.8G   8.0K   3.8G   1% /dev
tmpfs            3.9G   524K   3.9G   1% /run
tmpfs            3.9G   316K   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   320K   15G   1% /userdata
/dev/mmcblk0p7   124M    5.3M   118M   5% /oem
/dev/mmcblk1p1    60G   659M   59G   2% /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@sbc3588-buildroot:/# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/root        14G   739M   13G   6% /
devtmpfs         3.8G   8.0K   3.8G   1% /dev
tmpfs            3.9G   140K   3.9G   1% /tmp
tmpfs            3.9G   640K   3.9G   1% /run
tmpfs            3.9G   328K   3.9G   1% /var/log
tmpfs            3.9G    0   3.9G   0% /dev/shm
/dev/mmcblk0p7   123M    12M   111M  10% /oem
/dev/mmcblk0p8   15G   320K    15G   1% /userdata
/dev/sda1        120G   2.4M   120G   1% /mnt/storage
/dev/nvme0n1p1   233G    13M   233G   1% /media/storage1
/dev/mmcblk1p1   120G    85M   119G   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 WiFi & Bluetooth

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



7.9.1 WiFi

Step 1: View the device information.

```
# ifconfig wlan0
```

```
root@sb3588-buildroot:/# ifconfig wlan0
wlan0    Link encap:Ethernet HWaddr 54:78:C9:88:4B:20
          inet6 addr: fe80::3fef:48fe:16f9:301c/64 Scope:Link
          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@sb3588-buildroot:/# iwlist wlan0 scan
[12860.455023] [dhd] [wlan0] wl_escan_set_scan : LEGACY_SCAN
[12862.229482] [dhd] [wlan0] IAPSTA-ERROR) wl_ext_in4way_sync_sta : escan busy
wlan0    Scan completed :
          Cell 01 - Address: 9C:A6:15:10:DA:C5
                   ESSID:"datang"
                   Mode:Managed
                   Frequency=2.412 GHz (Channel 1)
                   Quality=2/5  Signal level:-74 dBm  Noise level:-86 dBm
                   IE: IEEE 802.11i/WPA2 Version 1
                        Group Cipher : TKIP
                        Pairwise Ciphers (2) : CCMP TKIP
                        Authentication Suites (1) : PSK
                   IE: WPA Version 1
                        Group Cipher : TKIP
                        Pairwise Ciphers (2) : CCMP TKIP
                        Authentication Suites (1) : PSK
                   Encryption key:on
                   Bit Rates:1 Mb/s; 2 Mb/s; 5.5 Mb/s; 11 Mb/s; 54 Mb/s
                        48 Mb/s; 36 Mb/s; 24 Mb/s; 18 Mb/s; 12 Mb/s
                        9 Mb/s; 6 Mb/s
          Cell 02 - Address: D8:FE:42:CE:EE:D3
                   ESSID:"DIRECT-Jw-HUAWEI CV81-WDMa"
                   Mode:Managed
                   Frequency=2.432 GHz (Channel 5)
                   Quality=2/5  Signal level:-76 dBm  Noise level:-86 dBm
                   IE: IEEE 802.11i/WPA2 Version 1
                        Group Cipher : CCMP
                        Pairwise Ciphers (1) : CCMP
                        Authentication Suites (1) : PSK
                   IE: Unknown:
DD7F0050F204104A0001101044000102103B00010310470010146518B467FA5D3B9B0B2F36A43EB66010210009686973696C69636F
6E1023000120102400012010420001201054000800030050F20400051011001C4449524543542D48554157454920435638312D5744
4D612D313031301008000200001049000600372A000120
                   Encryption key:on
                   Bit Rates:6 Mb/s; 9 Mb/s; 12 Mb/s; 18 Mb/s; 24 Mb/s
                        36 Mb/s; 48 Mb/s; 54 Mb/s
          Cell 03 - Address: B4:F1:8C:FD:D1:29
                   ESSID:"Boardcon_Wi-Fi5"
                   Mode:Managed
                   Frequency=2.437 GHz (Channel 6)
```

Step 3: Connect to the hotspot.

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

```

root@sb3588-buildroot:/# wifi-connect.sh Boardcon_5G Boardcon43435656
connect to WiFi ssid: Boardcon_5G, Passwd: Boardcon43435656
Successfully initialized wpa_supplicant
rfkill: Cannot open RFKILL control device
[ 198.932023] [dhd] P2P interface registered
nl80211: kernel reports: Registration to specific type not supported
rfkill: Cannot get wiphy information
[ 198.946285] [dhd] CFGP2P-ERROR) wl_cfgp2p_set_discovery : p2p_disc 1 error -16
[ 198.946313] [dhd] CFGP2P-ERROR) wl_cfgp2p_init_discovery : set discover error
[ 198.951842] [dhd] CFGP2P-ERROR) wl_cfgp2p_enable_discovery : init discovery error -16
[ 198.951861] [dhd] CFGP2P-ERROR) wl_cfgp2p_disable_discovery : do nothing, not initialized
[ 198.956785] [dhd] CFGP2P-ERROR) wl_cfgp2p_start_p2p_device : P2P enable discovery failed, ret=-16
nl80211: Could not set interface 'p2p-dev-wlan0' UP
[ 198.957281] [dhd] CFGP2P-ERROR) wl_cfgp2p_disable_discovery : do nothing, not initialized
nl80211: deinit ifname=p2p-dev-wlan0 disabled_11b_rates=0
[ 198.957558] [dhd] CFGP2P-ERROR) wl_cfgp2p_del_p2p_disc_if : P2P interface unregistered
p2p-dev-wlan0: Failed to initialize driver interface
p2p-dev-wlan0: CTRL-EVENT-DSCP-POLICY clear_all
P2P: Failed to enable P2P Device interface
root@sb3588-buildroot:/# [ 201.718430] [dhd] [wlan0] wl_ext_set_chanspec : channel 5g-44(0xe22a 80MHz)
[ 201.720164] [dhd] [wlan0] wl_conn_debug_info : Connecting with b4:f1:8c:6d:d1:28 ssid "Boardcon_5G",
len (11), channel=5g-44(chan_cnt=1), sec=wpa2/psk/mfpn/tkip/aes, rssi=-62
[ 201.831807] [dhd] dhd_update_interface_flow_info: ifindex:0 previous role:0 new role:0
[ 201.831889] [dhd] dhd_update_multicast_flow_rings: ifindex 0
[ 201.838474] [dhd] [wlan0] wl_iw_event : Link UP with b4:f1:8c:6d:d1:28
[ 201.838568] [dhd] [wlan0] wl_ext_iapsta_link : [S] Link UP with b4:f1:8c:6d:d1:28
[ 201.842545] [dhd] [wlan0] wl_bss_connect_done : Report connect result - connection succeeded
[ 201.846694] [dhd] dhd_prot_flow_ring_create: Send Flow Create Req flow ID 37 for peer b4:f1:8c:6d:d1:28
prio 3 ifindex 0 items 512
[ 201.846939] [dhd] dhd_prot_flow_ring_create_response_process: Flow Create Response status = 0 Flow 37
[ 201.853291] [dhd] [wlan0] wl_add_keyext : key index (0) for b4:f1:8c:6d:d1:28
[ 201.874983] [dhd] [wlan0] wl_cfg80211_set_suspend_bcn_li_dtim : bcn_li_dtim:0 lpas:0 bcn_to_dly:0
[ 201.886542] [dhd] dhd_prot_flow_ring_create: Send Flow Create Req flow ID 41 for peer 33:33:00:00:00:16
prio 0 ifindex 0 items 2048
[ 201.886824] [dhd] dhd_prot_flow_ring_create_response_process: Flow Create Response status = 0 Flow 41

```

Step 4: View the network interface status.

```
# ifconfig wlan0
```

```

root@sb3588-buildroot:/# ifconfig wlan0
wlan0      Link encap:Ethernet  HWaddr 54:78:C9:88:4B:20
          inet addr:192.168.0.23  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::4479:cea2:d463:947d/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:210 errors:0 dropped:24 overruns:0 frame:0
          TX packets:30 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:15899 (15.5 KiB)  TX bytes:3032 (2.9 KiB)

```

Step 5: Test the WiFi network.

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

```

root@sb3588-buildroot:/# ping -I wlan0 www.armdesigner.com
PING d3soj86mhkk6.cloudfront.net (108.138.246.80) from 192.168.0.23 wlan0: 56(84) bytes of data.
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=1 ttl=246 time=160 ms
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=2 ttl=246 time=165 ms
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=3 ttl=246 time=161 ms
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=4 ttl=246 time=160 ms
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=5 ttl=246 time=163 ms
64 bytes from www.armdesigner.com (108.138.246.80): icmp_seq=6 ttl=246 time=160 ms
^C
--- d3soj86mhkk6.cloudfront.net ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 159.684/161.398/164.828/2.002 ms

```

7.9.2 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@sbc3588-buildroot:/# hciconfig hci0 piscan
root@sbc3588-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: 0xfffffb8 (-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 NZbI73aRl01JD/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:A4: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 UUIDs: 0000046a-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001105-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 0000110a-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 0000110c-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001112-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001115-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001116-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 0000111f-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 0000112f-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001132-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001200-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001800-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 00001801-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 0000fe35-0000-1000-8000-00805f9b34fb
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 11c8b310-80e4-4276-afc0-f81590b2177f
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 8ce255c0-200a-11e0-ac64-0800200c9a66
[CHG] Device A8:35:12:9A:EB:4D UUIDs: 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:

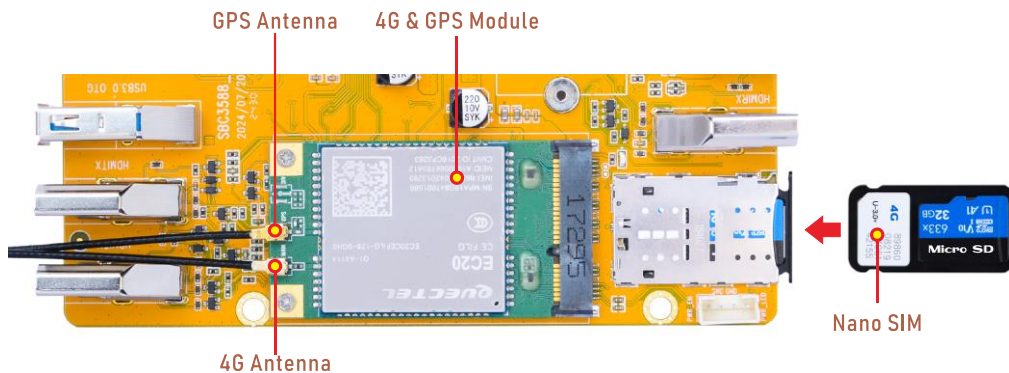
```
# bluetoothctl                                /* Start bluetoothctl interactive tool */
[bluetooth]# scan on                          /* Enable scanning for nearby devices */
[bluetooth]# scan off                        /* Disable scanning, stop refreshing */
[bluetooth]# devices                         /* 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 */
```

7.10 4G & GPS

Step 1: Insert 4G module to PCIe socket (4G model: EC20/EC25).

Step 2: Connect antenna and insert SIM card.

Step 3: Power on.



7.10.1 4G Test

Step 1: Initiate the PPP connection.

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




```
root@sbc3588-buildroot:/# mkdir -p var/run/pppd/lock
root@sbc3588-buildroot:/# pppd call quectel-ppp &
[1] 1783
root@sbc3588-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)
nocrtscts    # (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@sbc3588-buildroot:/# ifconfig ppp0
ppp0      Link encap:Point-to-Point Protocol
          inet addr:10.35.149.100 P-t-P:10.64.64.64 Mask:255.255.255.255
          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@sb3588-buildroot:/# ping -I ppp0 www.armdesigner.com
PING www.armdesigner.com (67.222.54.196) from 10.35.149.100 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=272 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=2 ttl=45 time=552 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=3 ttl=45 time=513 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=4 ttl=45 time=472 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=5 ttl=45 time=431 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=6 ttl=45 time=392 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=7 ttl=45 time=351 ms
64 bytes from 67-222-54-196.unifiedlayer.com (67.222.54.196): icmp_seq=8 ttl=45 time=311 ms
^C
--- www.armdesigner.com ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7001ms
rtt min/avg/max/mdev = 272.199/411.664/551.715/91.895 ms
```

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@sb3588-buildroot:/# echo -e "AT+QGPS=1\r\n" > /dev/ttyUSB2
root@sb3588-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

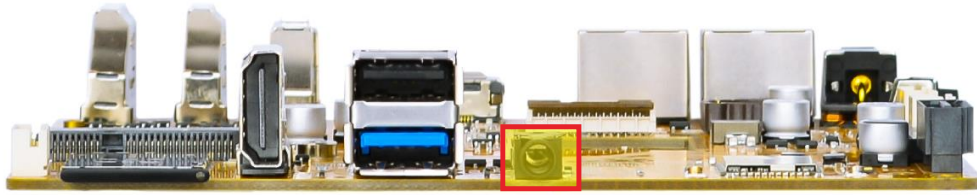
$GPVTDG,,T,,M,,N,,K,N*2C

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

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

7.11 Headset

Step 1: Plug the headset into the headset jack.



Headset

Step 2: View sound card.

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

```
root@sbc3588-buildroot:/# 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 [rockchiphdmi1 ]: rockchip-hdmi1 - rockchip-hdmi1
rockchip-hdmi1
4 [rockchipdp1 ]: rockchip-dp1 - rockchip-dp1
rockchip-dp1
```

Step 3: Headset recording.

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

```
root@sbc3588-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
```

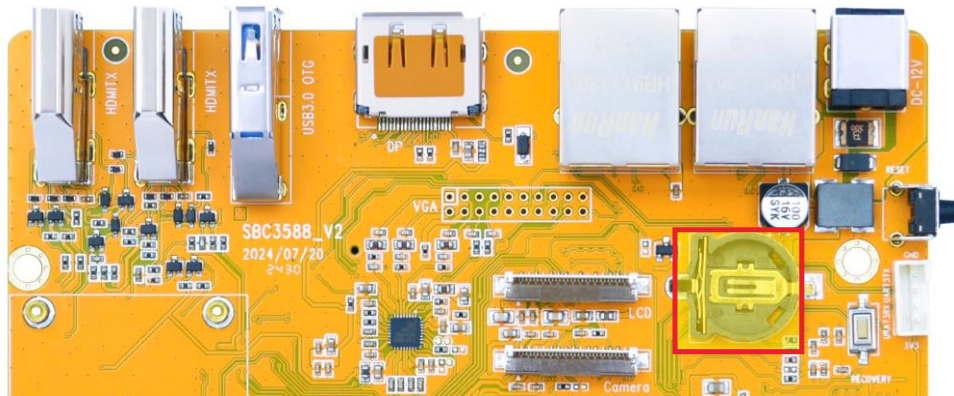
```
root@sbc3588-buildroot:/# aplay -Dhw:1,0 record.wav
Playing WAVE 'record.wav' : Signed 16 bit Little Endian, Rate 44100 Hz, Stereo
```

Supplementary instructions on audio output:

```
# aplay -Dhw:1,0 record.wav // Headset audio output
# aplay -Dhw:2,0 record.wav // HDMI TX0 audio output
# aplay -Dhw:3,0 record.wav // HDMI TX1 audio output
# aplay -Dhw:4,0 record.wav // DP TX audio output
```

7.12 RTC

Step 1: Install the coin cell battery.



RTC

Step 2: Set the system time.

```
# date -s "2025-08-26 10:38:00"
```

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

```
# hwclock -w
```

Step 4: Display the current hardware clock time.

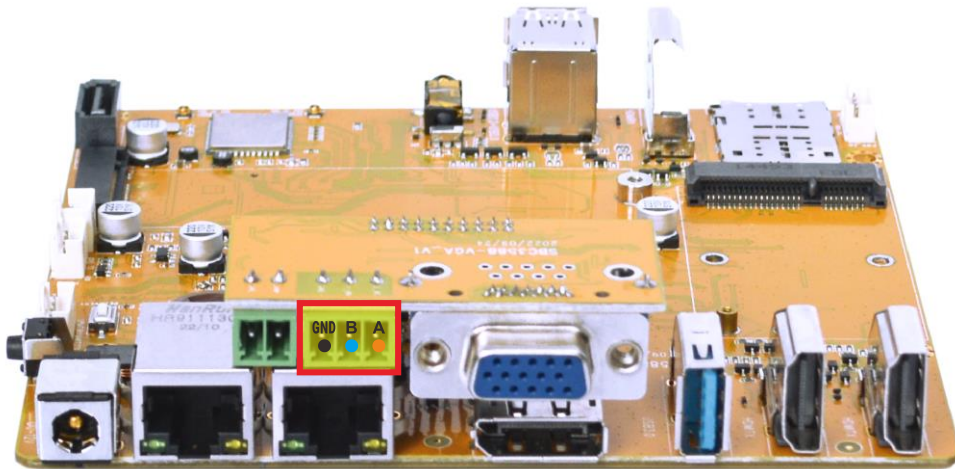
```
# hwclock
```

```
root@sbc3588-buildroot:/# date -s "2025-08-26 10:38:00"
Tue Aug 26 10:38:00 UTC 2025
root@sbc3588-buildroot:/# hwclock -w
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 10:38:09 2025  0.000000 seconds
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 10:38:53 2025  0.000000 seconds
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 10:39:07 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@sbc3588-buildroot:/# hwclock
Tue Aug 26 11:39:34 2025  0.000000 seconds
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 11:41:38 2025  0.000000 seconds
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 11:41:53 2025  0.000000 seconds
root@sbc3588-buildroot:/# hwclock
Tue Aug 26 11:42:01 2025  0.000000 seconds
```

7.13 RS485

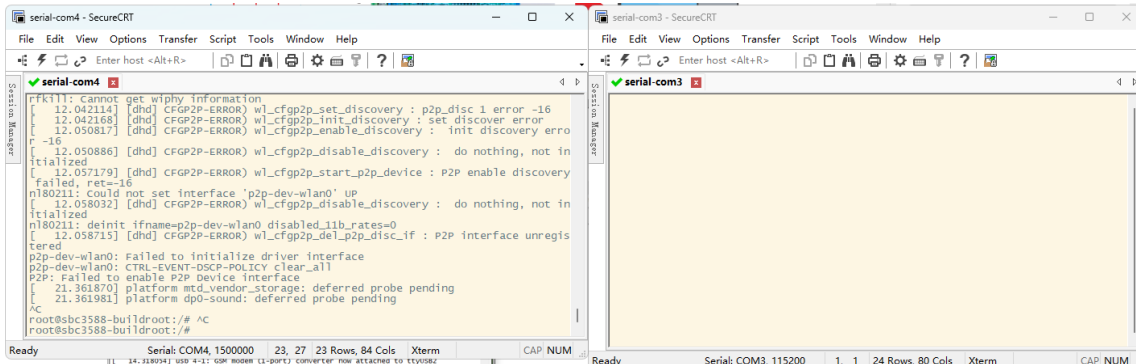


RS485

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

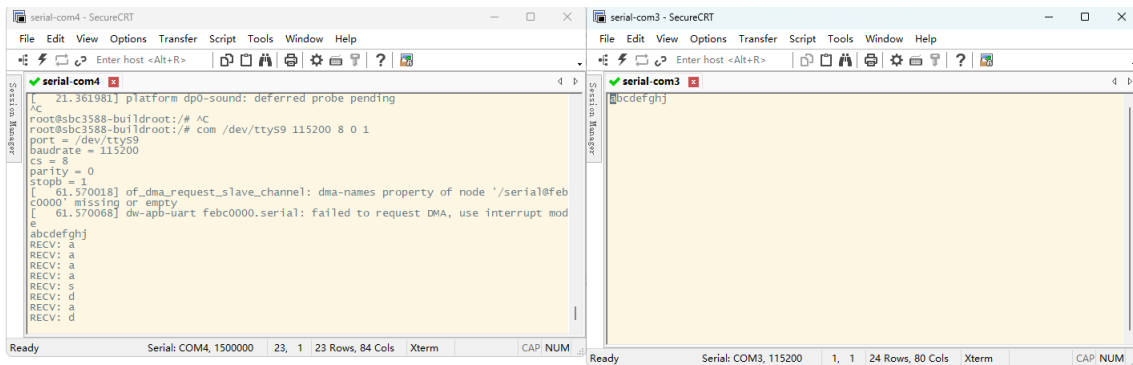


Step 2: Open the corresponding serial terminal, set the baud rate of the board to 1500000, and set the baud rate of the RS485 test tool to 115200.

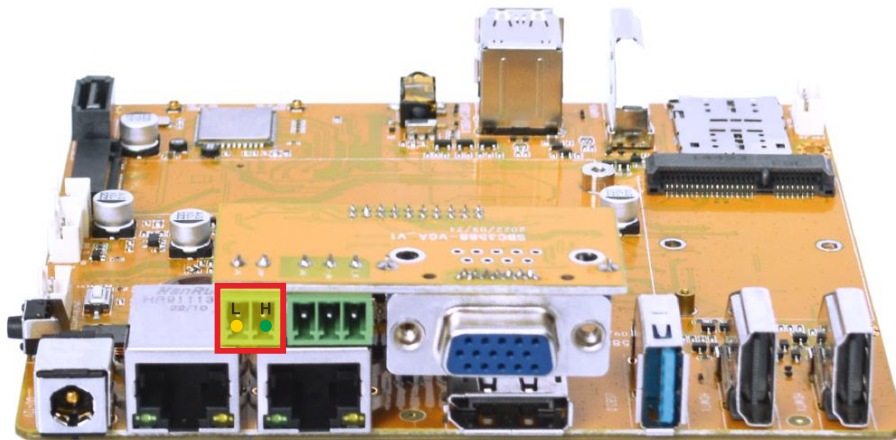


Step 3: Execute the following command on the board to test the RS485 transmission and reception functionality.

```
# com /dev/ttyS9 115200 8 0 1
```



7.14 CAN

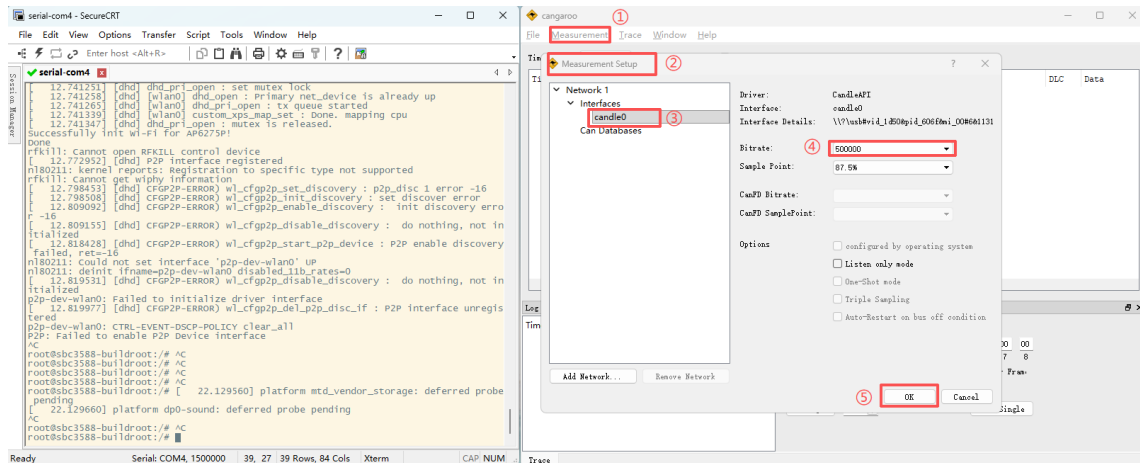


CAN

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

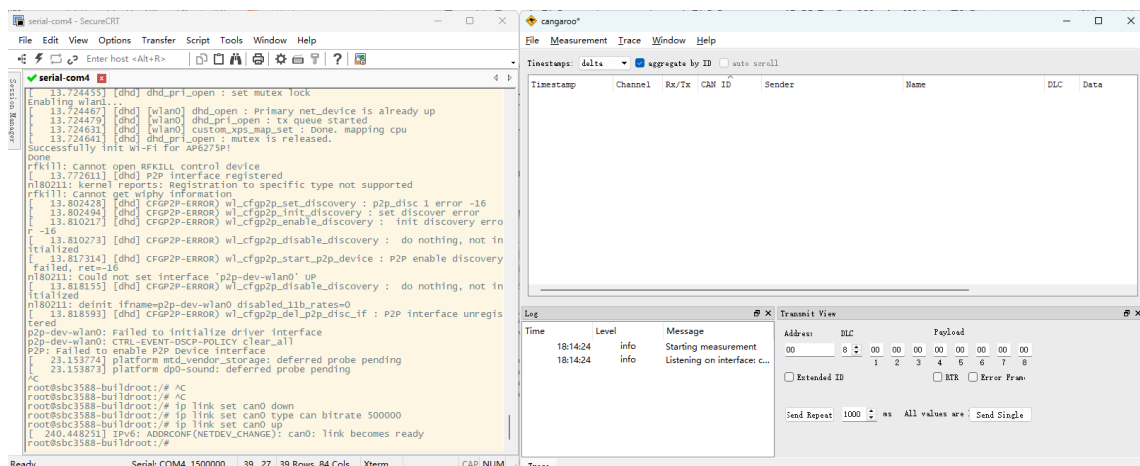


Step 2: Open the CAN test software and set the baud rate to 500000.



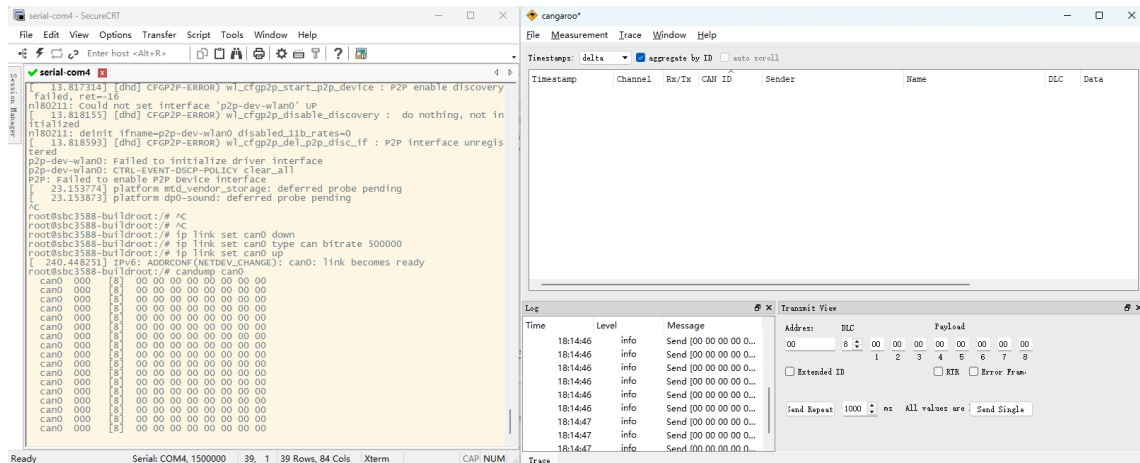
Step 3: Configure and activate the CAN network, setting the bitrate to 500000.

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



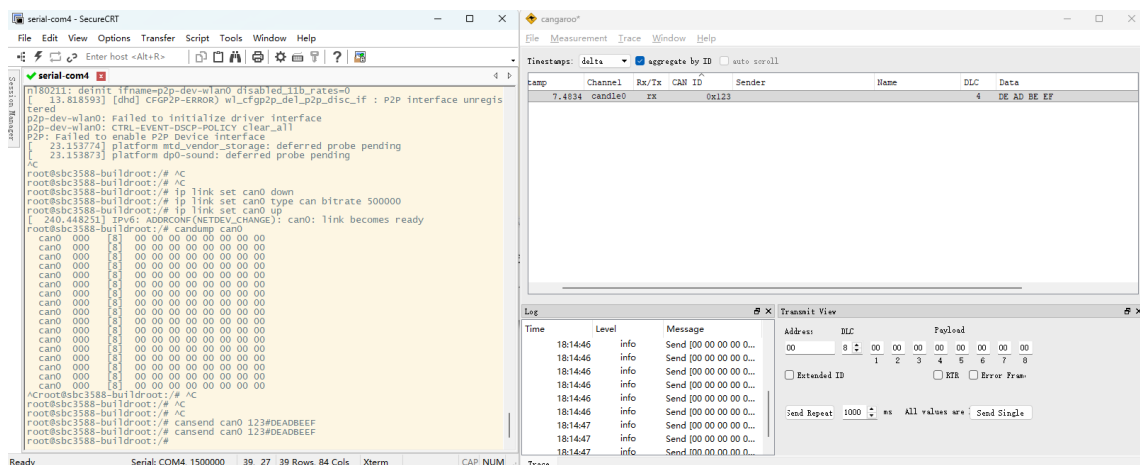
Step 4: Configure CAN as the receiver.

```
# candump can0
```

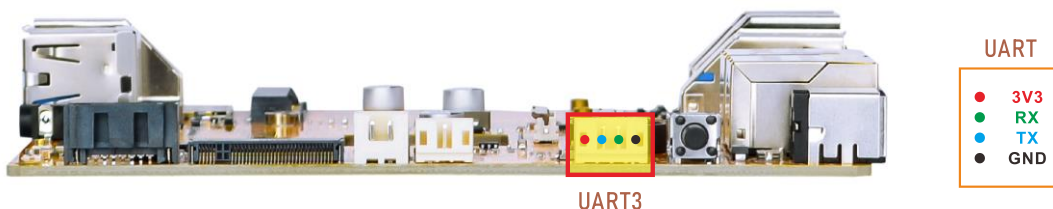
Step 5: Configure CAN as the sender.

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



7.15 RS232

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



Step 2: RS232 test.

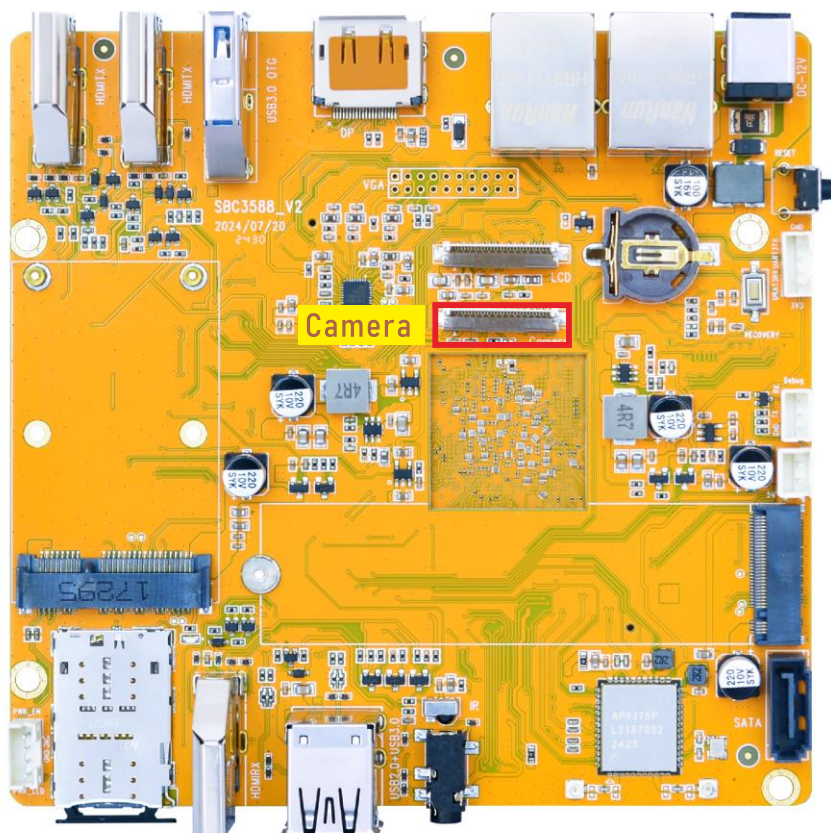
```
# com /dev/ttyS3 115200 8 0 1
```

```

root@sbc3588-buildroot:/# com /dev/ttyS3 115200 8 0 1
port = /dev/ttyS3
baudrate = 115200
cs = 8
parity = 0
stopb = 1
56565656
RECV: 56565656
opopopo
RECV: opopopo
yyyyy
RECV: yyyyy
00000000
RECV: 00000000
  
```

7.16 Camera

Step 1: Connect the camera (IMX415), and then power on the board.



Step 2: View the video device.

```

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

```

root@sbc3588-buildroot:/# grep "" /sys/class/video4linux/v*/name | grep mainpath
/sys/class/video4linux/video11/name:rkisp_mainpath4linux/v*/name | grep mainpath
root@sbc3588-buildroot:/# grep "" /sys/class/video4linux/v*/name | grep selfpath
/sys/class/video4linux/video12/name:rkisp_selfpath4linux/v*/name | grep selfpath
  
```

Step 3: Preview camera.

```
# gst-launch-1.0 v4l2src device=/dev/video11 ! video/x-raw,format=NV12,width=1920,height=1080, framerate=30/1 ! waylandsink
```

```
root@sbc3588-buildroot:/# gst-launch-1.0 v4l2src device=/dev/video11 ! video/x-raw,format=NV12,width=1920,height=1080, framerate=30/1 ! 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...
0:00:02.9 / 99:99:99.
```

Step 3: Record the video.

```
# gst-launch-1.0 v4l2src device=/dev/video11 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@sbc3588-buildroot:/# gst-launch-1.0 v4l2src device=/dev/video11 num-buffers=100 ! video/x-raw,format=NV12,width=1920,height=1080,framerate=30/1 ! videoconvert ! mpph264enc ! h264parse ! mp4mux ! filesink location=/tmp/h264.mp4
mpp[2145]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2145]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2145]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2145]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[2145]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
Pipeline is live and does not need PREROLL ...
Pipeline is PREROLLED ...
Setting pipeline to PLAYING ...
New clock: GstSystemClock
mpp[2145]: mpp_enc: set prep cfg w:h [1920:1080] stride [1920:1088] fmt 0 rotate 0 mirror 0
mpp[2145]: mpp_enc: set rc cbr bps [7776000:8262000:7290000] fps [30:1:fix] - [30:1:fix] gop 30
mpp[2145]: mpp_enc: mode cbr bps [7290000:7776000:8262000] fps fix [30/1] -> fix [30/1] gop i [30] v [0]
Redistribute latency...
Redistribute latency...
Got EOS from element "pipeline0".
Execution ended after 0:00:05.088083628
Setting pipeline to NULL ...
Freeing pipeline ...
```

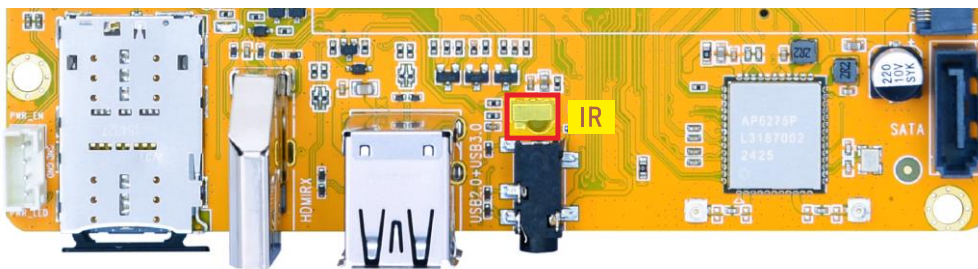
Step 4: Take photos.

```
# gst-launch-1.0 -v v4l2src device=/dev/video11 num-buffers=10 ! \
video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! \
multifilesink location=/tmp/test%05d.jpg
```

```

root@sbc3588-buildroot:/# gst-launch-1.0 -v v4l2src device=/dev/video11 num-buffers=10 ! video/x-raw,format=NV12,width=1920,height=1080 ! mppjpegenc ! multifilesink location=/tmp/test%05d.jpg
mpp[2162]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2162]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2162]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
mpp[2162]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
Setting pipeline to PAUSED ...
Using mplane plugin for capture
mpp[2162]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and poc setup overflow
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
mpp[2162]: mpp_enc: set prep cfg w:h [1920:1080] stride [1920:1088] fmt 0 rotate 0 mirror 0
mpp[2162]: mpp_enc: set rc cbr bps [31104000:33048000:29160000] fps [120:1:fix] - [120:1:fix] gop 120
mpp[2162]: 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
Redistribute latency...
Got EOS from element "pipeline0".
Execution ended after 0:00:00.596206834
Setting pipeline to NULL ...
Freeing pipeline ...
  
```

7.17 IR



Step 1: Enable IR debug prints

```
# 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:

```
/code_print8-buildroot:/# echo 1 > /sys/module/rockchip_pwm_remotectl/parameters/
root@sbc3588-buildroot:/# [ 1007.461148] USERCODE=0x1818
[ 1007.488280] RMC_GETDATA=98
[ 1008.120600] USERCODE=0x1818
[ 1008.147760] RMC_GETDATA=99
[ 1008.629423] USERCODE=0x1818
[ 1008.656626] RMC_GETDATA=9a
[ 1009.074212] USERCODE=0x5818
[ 1009.153936] RMC_GETDATA=4d
[ 1010.212954] USERCODE=0x1818
[ 1010.240138] RMC_GETDATA=e6
[ 1011.180754] USERCODE=0x1818
[ 1011.207891] RMC_GETDATA=e4
[ 1012.860955] USERCODE=0x1818
[ 1012.888114] RMC_GETDATA=e7
[ 1013.308965] USERCODE=0x1818
[ 1013.336124] RMC_GETDATA=e5
```

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/sbc3588/sbc3588.dtsi`

```
&pwm15 {
    compatible = "rockchip,remotectl-pwm";
    pinctrl-names = "default";
    pinctrl-0 = <&pwm15m1_pins>;
    remote_pwm_id = <15>;
    handle_cpu_id = <1>;
    remote_support_psci = <0>;
    status = "okay";

    ir_key1 {
        rockchip,usercode = <0x4040>;
        rockchip,key_table =
            <0xf2KEY_REPLY>,
            .....
    };

    r_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 Video Playback

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

```
root@sb3588-buildroot:/# ls /rockchip-test/video/
test_gst_multivideo.sh  test_gst_video_benchmark.sh  test_gst_video_maxfps.sh  video_test.sh
test_gst_video.sh      test_gst_video_fps.sh        video_stresstest.sh
```

Simply execute the script.

```
root@sb3588-buildroot:/# /rockchip-test/video/test_gst_video.sh
mpp[5335]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5335]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5335]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5335]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
Setting pipeline to PAUSED ...
Pipeline is PREROLLING ...
Redistribute latency...
mpp[5334]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5334]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5334]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5334]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
mpp[5334]: mpp_info: mpp version: 958803d7 author: Herman Chen 2026-02-26 fix[h265d_rkv]: Fix rkv ref and
poc setup overflow
Redistribute latency...
mpp[5334]: h264d api: is_avcC=1
Pipeline is PREROLLED ...
Prerolled, waiting for async message to finish...
Setting pipeline to PLAYING ...
Redistribute latency...
New clock: GstSystemClock
0:00:12.4 / 0:00:29.5 (42.0 %)
```

(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 /mnt/udisk/video/4KP60/4KP60-exist.mp4
```

Command explanation:

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

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

```
# gst-play-1.0 --videosink="waylandsink fullscreen=true"
/mnt/udisk/video/8KP30/8KP30-3.mp4 --audiosink="alsasink device=hw:4,0"
```

Command explanation:

- `/mnt/udisk/video/8KP30/8KP30-3.mp4`: The media file path to be played.
- `--audiosink="alsasink device=hw:4,0"`: Specifies the audio output device as hw:4,0.

```
root@sb3588-buildroot:/#
/mnt/udisk/video/8KP30/8KP30-3.mp4 --audiosink="alsasink device=hw:4,0"en=true
Press 'k' to see a list of keyboard shortcuts.
Now playing /mnt/udisk/video/8KP30/8KP30-3.mp4
Redistribute latency...
Redistribute latency...
mpp[2078]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log
(llog) function
mpp[2078]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log
(llog) function
mpp[2078]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log
(llog) function
mpp[2078]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log
(llog) function
mpp[2078]: mpp_info: mpp version: 870c02ce author: Herman Chen    2025-06-20 feat[mpp_log]: Add long log
(llog) function
Redistribute latency...
Redistribute latency...
mpp[2078]: H265D_PARSER: extradata is encoded as hvcC format
Redistribute latency...
0:00:02.4 / 0:05:27.8
```