Thundercomm

Empowering Every IoT Device with Our Technology

Thundercomm TurboX C865C Development Kit Linux Android

Software User Manual

Rev. V1.2.1

May 23, 2022

DN: tc-rla-2312.1

Revision History

Revision	Date	Description
1.0	Jul 09, 2021	Initial release
1.1	Dec 10, 2021	• Update industrial temperature range supported by QCS8250 from "–30 °C to +105 °C" to "–20°C to +96°C" in Chapter 1. Product Overview. • Replace all illustrations based on V02 IO board. • Update 3.5. NVME SSD slot. • Update 3.8. Ethernet connector. • Update 3.12.2. Three-camera concurrency mode. • Add new sections: ▫ 3.12.3. C-phy Camera ▫ 3.14. Digital microphone arrays
1.2	Feb 17, 2022	Add a note in 3.16. Video encoding/decoding via OpenMAX.
1.2.1	May 23, 2022	• Change operating temperature from -20℃ ~ 70℃ to 25℃ ~ 75℃ in Table 1-2. • Add Appendix 1. Compliance and Certificate Information.

Table List

About This Document

- Illustrations in this documentation might look different from your product.
- Depending on the model, some optional accessories, features, and software programs might not be available on your device.
- Depending on the version of operating systems and programs, some user interface instructions might not be applicable to your device.
- Documentation content is subject to change without notice. Thundercomm makes constant improvements on the documentation of the products, including this guidebook.
- Function declarations, function names, type declarations, attributes, and code samples appear in a different format, for example, `cp armcc armcpp`.
- Code variables appear in angle brackets, for example, `<number>`.
- Button, tool, and key names appear in bold font, for example, click **Save** or press **Enter**.
- Commands to be entered appear in a different font, on the host computer use $ as shell prompt, while on the target device use # as shell prompt, for example,

```
$ adb devices
# logcat
```

- Part of the code that does not contain instructions appear in a different format, for example,

```
SUBSYSTEM=="usb", ATTR{idVendor}=="18d1", MODE="0777", GROUP="adm"
```

- Folders and files are formatted in italic, for example, *turbox_flash_flat.sh*.

Table of Contents

Chapter 1. Product Overview

Thundercomm TurboX C865C Development Kit is based on the TurboX C865C Platform that facilitates accelerated development of innovative, power-efficient, high computing robots and drones for enterprise, industrial, and professional service applications.

➲ **NOTE:** "TurboX" referred to herein is the English text of our registered trademark TURBOX.

At the heart of the kit is the QCS8250 processor. Customized for robotics applications, this processor offers powerful heterogeneous computing architecture that delivers 15 Tera Operations Per Second of compute. It also offers incredible ML (Machine Learning) accuracy, a powerful ISP (Image Signal Processor) with support for seven concurrent cameras, a dedicated computer vision engine for EVA (Enhanced Video Analytics), as well as the new HTA (Hexagon™ Tensor Accelerator). Its fifth-generation Qualcomm® AI Engine powers inferencing and accuracy with the dedicated HTA. QCS8250 can support an industrial temperature range of –20°C to +96°C, with long life support.

The QCS8250 processor and TurboX C865C platform cater to a wide range of applications, such as AMR (autonomous mobile robots), inventory robots, retail robots, pick-sort-place robots, cleaning robots, first mile robots, last mile delivery robots, and delivery drones, prosumer and commercial drones, industrial and manufacturing robots, healthcare robots, defense robots, etc.

TurboX C865C Platform offers flexible options for development and commercialization in terms of development board offerings for prototyping, off-the-shelf SOM (System-on-module) solutions, and flexibility for chip-on-board designs.

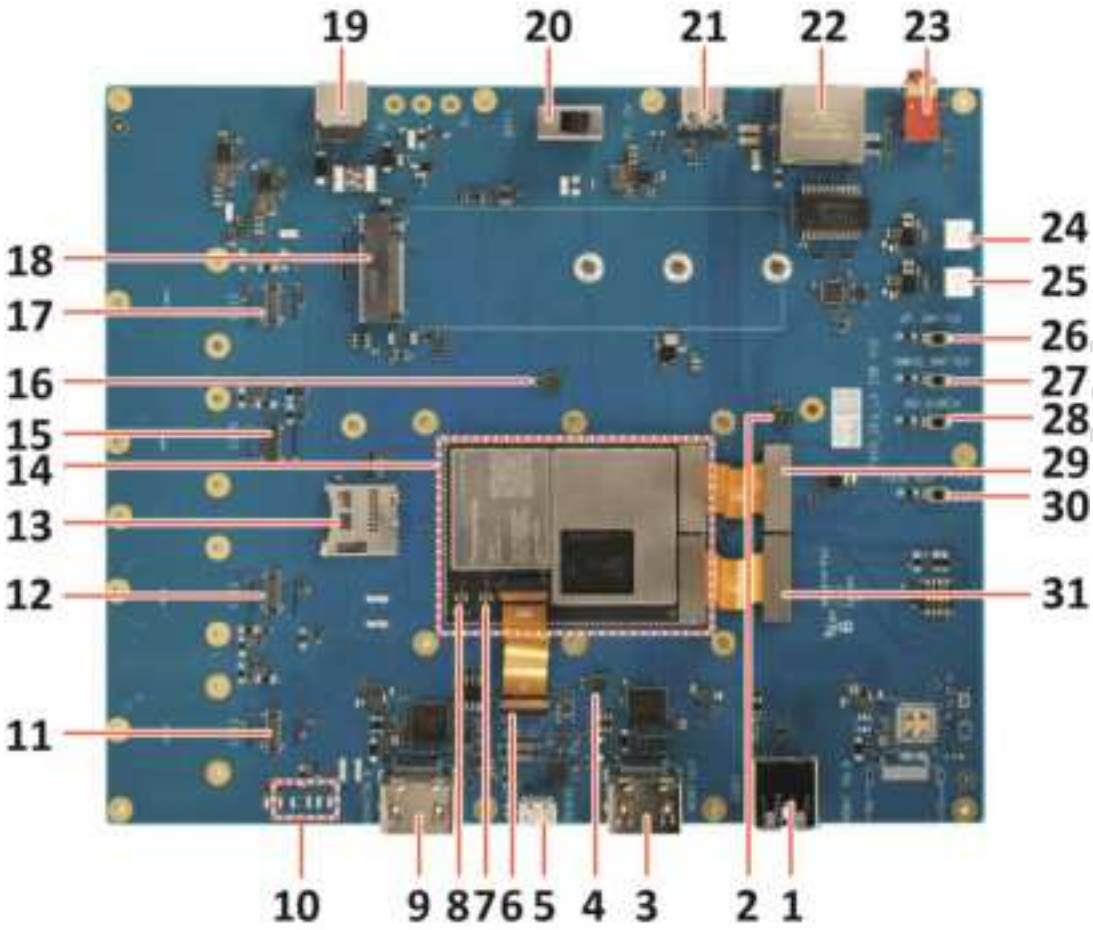

Figure 1-1.TurboX C865C Development Kit Top View

Table 1-1. Interface list

1. Type-A USB 3.0 connector	17. Camera connector 1
2. Digital microphone 3	18. NVME SSD slot
3. HDMI OUT connector	19. DC IN connector
4. Digital microphone 1	20. Power switch
5. UART debug connector	21. Type-C USB 3.0 connector
6. ZIF FPC	22. Ethernet connector
7. BT/Wi-Fi antenna slot 1	23. Audio line-in connector
8. BT/Wi-Fi antenna slot 2	24. Left-channel speaker connector
9. HDMI IN connector	25. Right-channel speaker connector
10. LEDs	26. Volume up button
11. Camera connector 3	27. Volume down button
12. Camera connector 2	28. Power on button
13. SD card slot	29. Board to board connector 1 (FPC)
14. SOM plate	30. Force_USB_boot button
15. Camera connector 0	31. Board to board connector 2 (FPC)
16. Digital microphone 2	-

1.1. Features and specifications

Table 1-2. Features and specifications

Category	Description
System	TurboX C865C SOM
Camera interface	• Panorama - 3 x IMX577 • Samsuang – 1 x S5KGW1SP03 • 1 x HDMI IN • 1 x UVC camera
Display feature	• DP • HDMI OUT • Wi-Fi display
Audio interface	• 1 x audio line-in • 2 x speaker • 3 x DMIC
General interface on mother board	• 1 x Type-C USB 3.0 • 1 x Type-A USB 3.0 • 1 x Micro USB (for debug) • 1 x SD card • 1 x GbE Ethernet • 1 x NVME SSD • 6 x LED • 4 x button (Volume up, Volume down, Force_USB_boot, Power on)
Power supply	• 12V DC in jack • Battery connection
Operating environment	• Operating temperature: -25℃ ~ 75℃ • Operating humidity: 5%~95%, non-condensing
Dimensions	• 36.5 x 52 x 4.55 mm
OS support	• Android

1.2. Product diagram

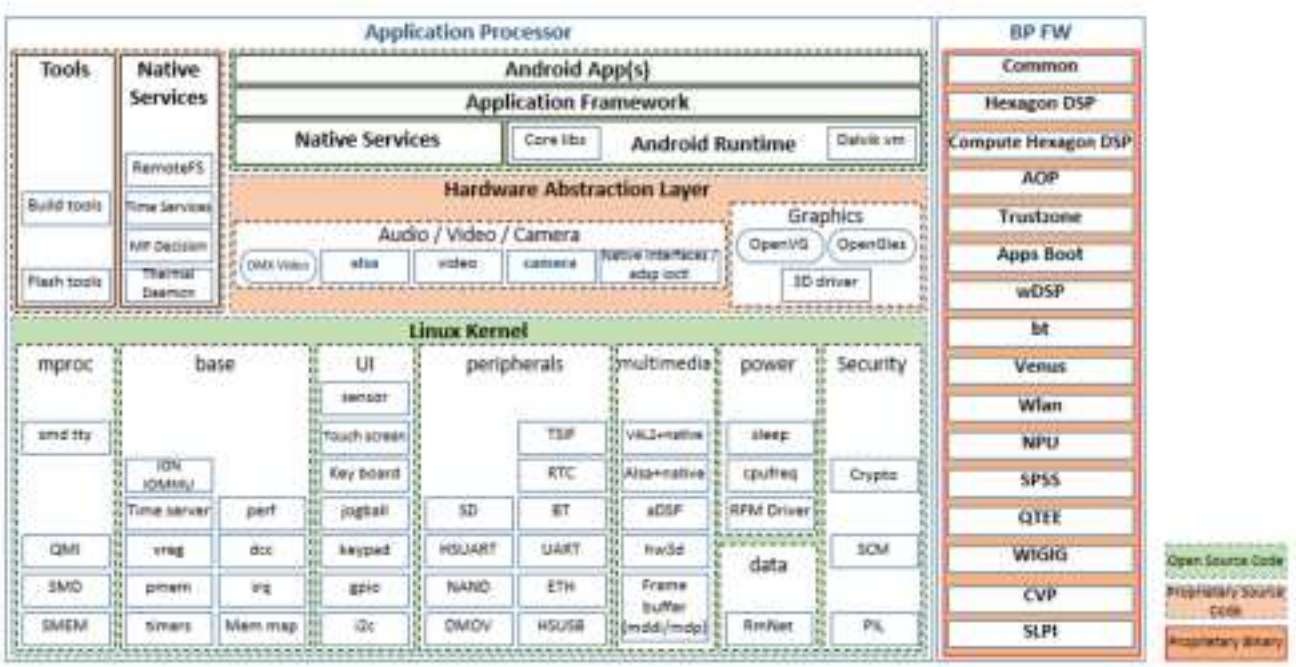

Figure 1-2.Block Diagram

Chapter 2. Firmware Programming

Refer to *TurboX C865C DK Software Release Notes*.

Chapter 3. Function Verification Test

This chapter introduces detailed testing steps for various functions.

3.1. UART debug connector

Step 1. Connect the device to your computer via **UART debug connector** (No. 5 in Figure 1-1).

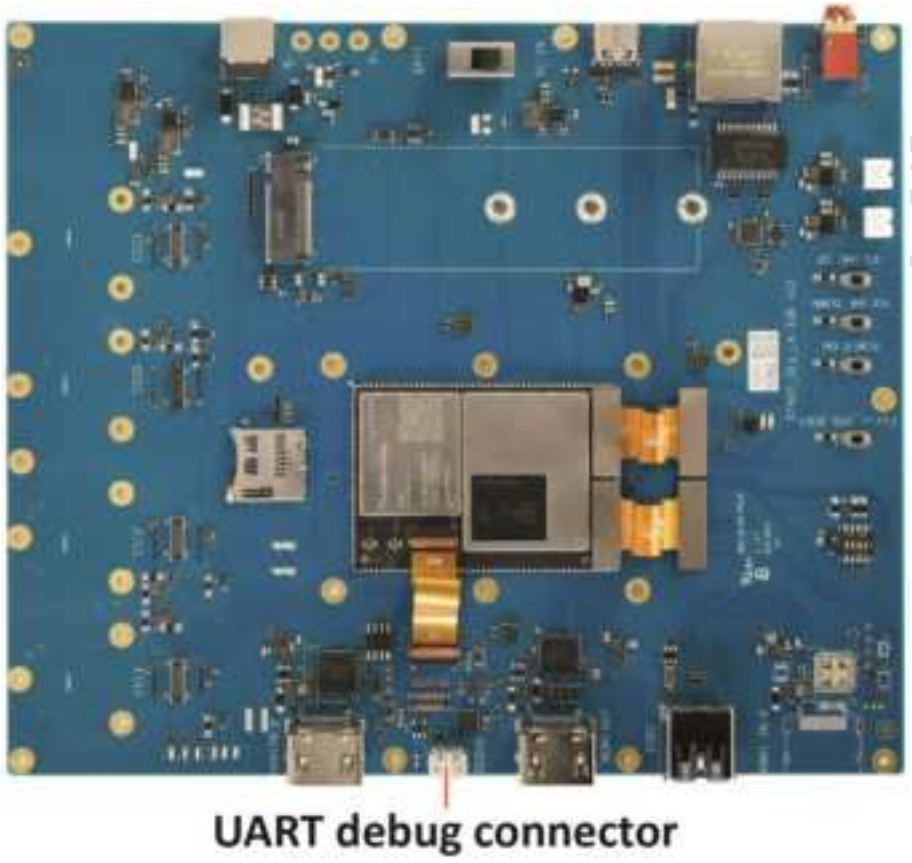

Figure 3-1. UART Debug Connector

Step 2. Select your desired UART tool, for example, **Minicom**.

A new serial port will be added to your computer after the device is connected. Select the new serial port and configure it to 115200 8N1. Refer to Figure 3-2:

Figure 3-2. Minicom 2.7 Configuration

Step 3. Turn the **Power switch** (No. 20 in Figure 1-1) to DC IN position to boot up the system and check the following log output.

```
Format:
Log Type - Time(microsec) - Message - Optional Info Log Type: B - Since Boot(Power
On Reset), D - Delta, S - Statistic
S - QC_IMAGE_VERSION_STRING=BOOT.XF.3.2-00313-SM8250-1
S - IMAGE_VARIANT_STRING=Soc8250LAA
```

```
S - OEM_IMAGE_VERSION_STRING=b7400b83815c
S - Boot Interface: UFS S - Secure Boot: Off S - Boot Config @ 0x00786070 =
0x00000001 S - JTAG ID @ 0x00786130 = 0x200c30e1
S - OEM ID @ 0x00786138 = 0x00000000
S - Serial Number @ 0x00786134 = 0xedb84c66
S - OEM Config Row 0 @ 0x007841e0 = 0x0000000000000000
S - OEM Config Row 1 @ 0x007841e8 = 0x0000000000000000
S - Feature Config Row 0 @ 0x007841f8 = 0x0040200000000420
S - Feature Config Row 1 @ 0x00784200 = 0xc000000000000000
S - Core 0 Frequency, 1516 MHz
S - PBL Patch Ver: 4
S - PBL freq: 600 MHZ
……
console:/ $
```

3.2. LED

Locate the LEDs on the board. Refer to Figure 3-3.

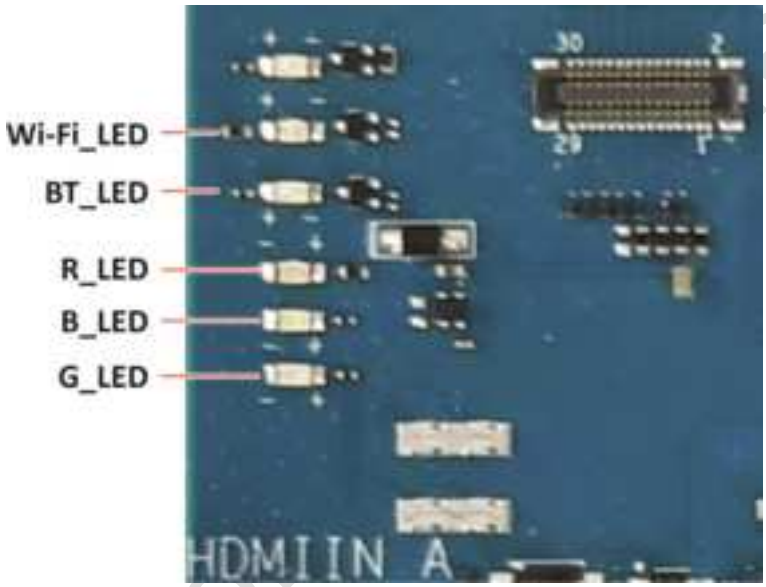

Figure 3-3. LED Layout

Run the commands below on your host to test LEDs.

```
$ adb root
$ adb shell
```

- RED_LED

```
# echo 255 > /sys/class/leds/red/brightness      // Turn on the red led
# echo 0 > /sys/class/leds/red/brightness        // Turn off the red led
```

- BLUE_LED

```
# echo 255 > /sys/class/leds/blue/brightness          // Turn on the blue led
# echo 0 > /sys/class/leds/blue/brightness       // Turn off the blue led
```

- GREEN_LED

```
# echo 255 > /sys/class/leds/green/brightness          // Turn on the green led
# echo 0 > /sys/class/leds/green/brightness      // Turn off the green led
```

- Wi-Fi_LED

```
# echo 255 > /sys/class/leds/led_wifi/brightness      // Turn on the WIFI led
# echo 0 > /sys/class/leds/led_wifi/brightness        // Turn off the WIFI led
```

- BT_LED

```
# echo 255 > /sys/class/leds/led_bt/brightness        // Turn on the BT led
# echo 0 > /sys/class/leds/led_bt/brightness          // Turn off the BT led
```

3.3. Button

Locate the buttons on the board. Refer to Figure 3-4.

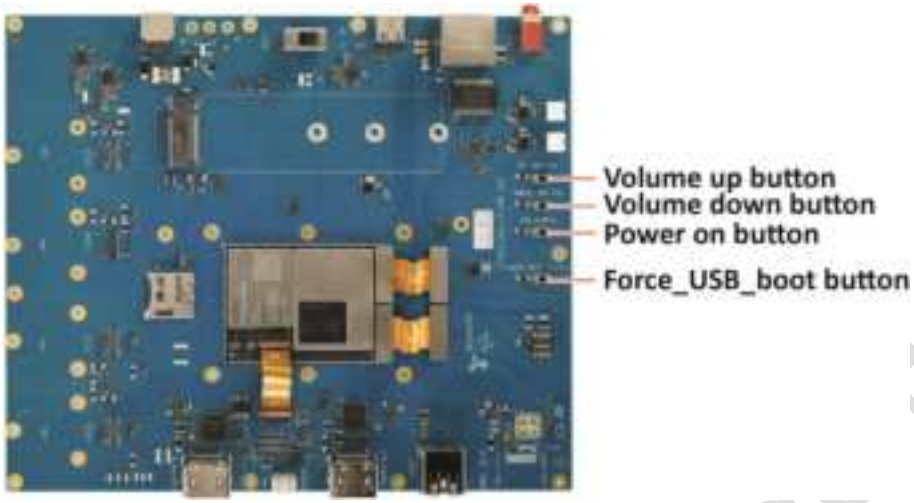

Figure 3-4. Buttons

Table 3-1. Button specifications

Button	Device node
Volume up	/dev/input/event2
Volume down	/dev/input/event0
Power	/dev/input/event0
Force_USB_boot	-

➲ **NOTE**: **Force_USB_BOOT** is used to force the system to enter EDL (Emergency Download) mode.

Execute the following commands and then press any button for more information:

```
$ adb root
$ adb shell
# getevent
add device 1: /dev/input/event5
  name:     "kona-mtp-snd-card Button Jack"
add device 2: /dev/input/event4
  name:     "kona-mtp-snd-card Headset Jack"
add device 3: /dev/input/event2
  name:     "qti-haptics"
add device 4: /dev/input/event0
  name:     "qpnp_pon"
add device 5: /dev/input/event3
  name:     "gpio-keys"
/dev/input/event2: 0001 0073 00000001
/dev/input/event2: 0000 0000 00000000
/dev/input/event2: 0001 0073 00000000
/dev/input/event2: 0000 0000 00000000
/dev/input/event0: 0001 0072 00000001
/dev/input/event0: 0000 0000 00000000
/dev/input/event0: 0001 0072 00000000
/dev/input/event0: 0000 0000 00000000
/dev/input/event0: 0001 0074 00000001
/dev/input/event0: 0000 0000 00000000
/dev/input/event0: 0001 0074 00000000
/dev/input/event0: 0000 0000 00000000
```

3.4. SD card slot

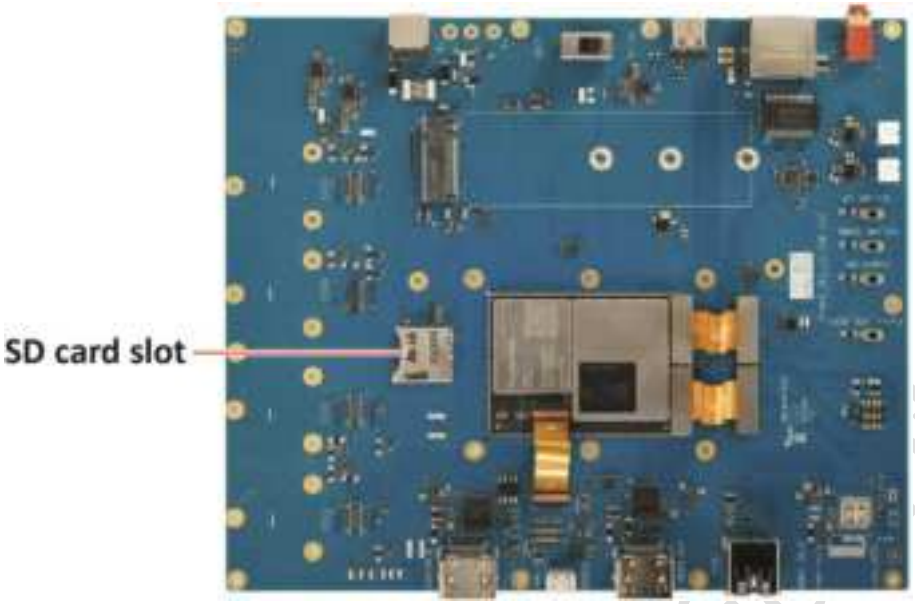

Figure 3-5. SD Card Slot

Step 1. SD card slot is hot-swappable. When inserted to the board (No. 13 in Figure 1-1), SD card will automatically mount to a temporary file, for example: */mnt/media_rw/6B8E-1AF0*, in */mnt/media_rw*.

Step 2. Run the following commands to test read and write speed of the SD card.

```
$ adb root
$ adb shell
# dd if=/dev/urandom of=/mnt/media_rw/6B8E-1AF0/test.txt bs=30M count=2 conv=fsync
2+0 records in
2+0 records out
62914560 bytes (60.0MB) copied, 6.366916 seconds, 9.4MB/s
# echo 3 >/proc/sys/vm/drop_caches
# dd if=/mnt/media_rw/6B8E-1AF0/test.txt of=/dev/null
122880+0 records in
122880+0 records out
62914560 bytes (60.0MB) copied, 0.092965 seconds, 645.4MB/s
```

3.5. NVME SSD slot

Follow the steps below to test the NVME SSD function.

Step 1. Insert NVME SSD to the drive slot on DK board. Refer to Figure 3-6.

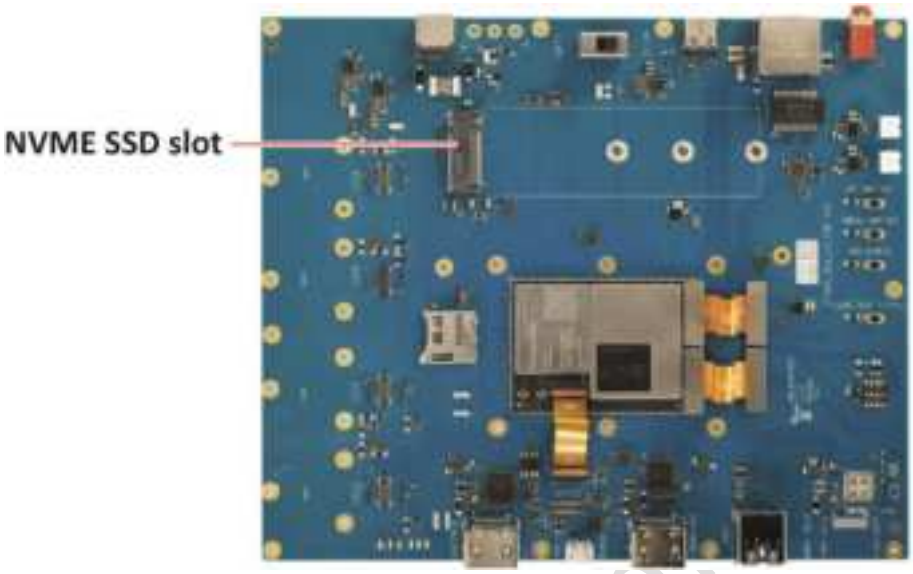

Figure 3-6. NVME SSD Connection

➲ **NOTE:** Connect the SSD to the board via the NVME SSD connector.

Step 2. Install the test tools tiotest and push the tool to the device.

```
$ adb root
$ adb push tiotest /data/
# adb shell chmod 755 /data/tiotest
```

Step 3. Run the following commands to test read and write speed of NVME SSD.

```
$ adb shell
# cd /data/
# mkdir nvme
# mount /dev/block/nvme0n1 /data/nvme
# ./tiotest  -t 8 -d /data/nvme -f 1024 -k 1 -k 3 -L

Tiotest results for 8 concurrent io threads:
,---------------------------------------------------------------------------.
| Item                 | Time     | Rate           |  IOPS   | Usr CPU  | Sys CPU  |
+----------------------+----------+----------------+---------+----------+----------+
| Write     8192 MBs |    7.4 s | 1104.758 MB/s |         |   6.9 %  | 205.0 %  |
| Read      8192 MBs |    5.3 s | 1558.557 MB/s |         |   7.5 %  | 138.1 %  |
+----------------------+----------+----------------+---------+----------+----------+
```

3.6. Type-C USB 3.0 connector

Step 1.The board shall detect an external hub once connected by a Type-C OTG cable.

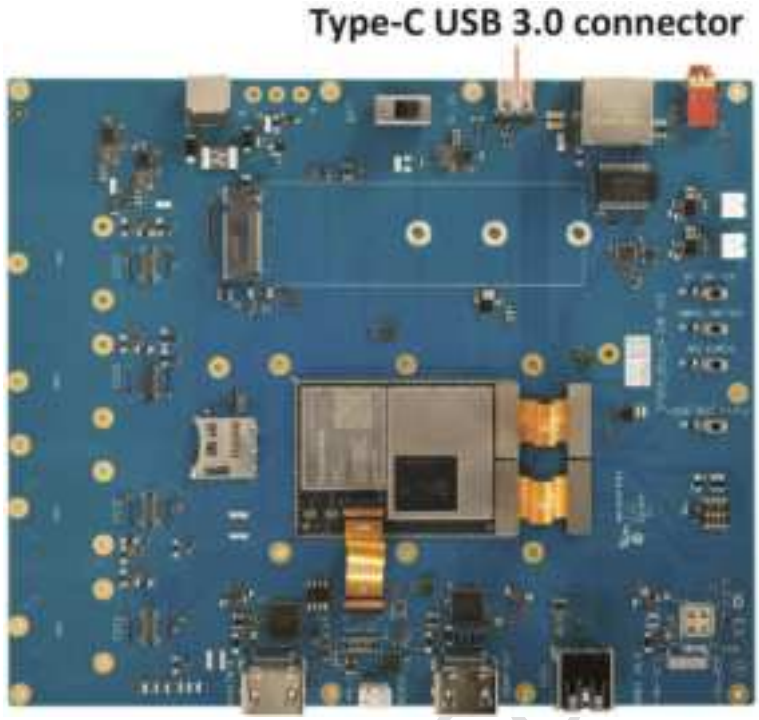

Figure 3-7. Type-C USB 3.0 Connector

Step 2.Insert a USB device to the USB port on the OTG cable and input `dmesg | grep usb` on UART terminal for detailed information.

```
# dmesg | grep usb
[  119.228633] usb 4-1: Product: USB3.1 Hub
[  119.228640] usb 4-1: Manufacturer: GenesysLogic
[  119.748986] usb 4-1.2: new SuperSpeed Gen 1 USB device number 3 using xhci-hcd
[  119.778398] usb 4-1.2: New USB device found, idVendor=0951, idProduct=1666,
bcdDevice= 0.01
[  119.778408] usb 4-1.2: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  119.778415] usb 4-1.2: Product: DataTraveler 3.0
[  119.778422] usb 4-1.2: Manufacturer: Kingston
[  119.778429] usb 4-1.2: SerialNumber: E0D55EA574F1F440F901CB02
[  119.787853] usb-storage 4-1.2:1.0: USB Mass Storage device detected
[  119.789037] scsi host1: usb-storage 4-1.2:1.0
```

Step 3.Open **Files** APP on the Android screen and click the **Recent** button to check the connected USB device in the drop-down list.

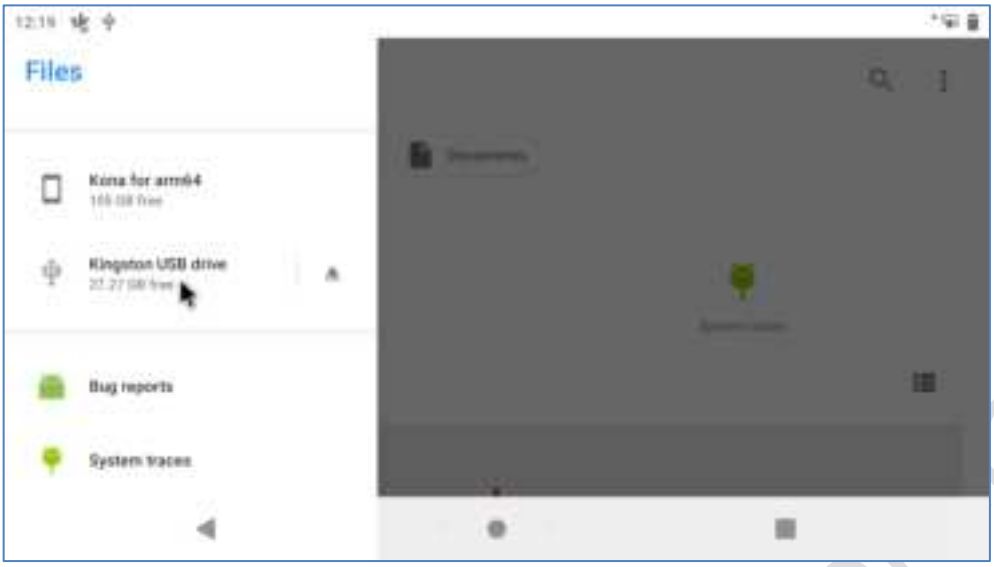

Figure 3-8. Android Screen

3.7. Type-A USB 3.0 connector

Step 1.Insert a USB device to **Type-A USB 3.0 connector** (No. 1 in Figure 1-1) on the board.

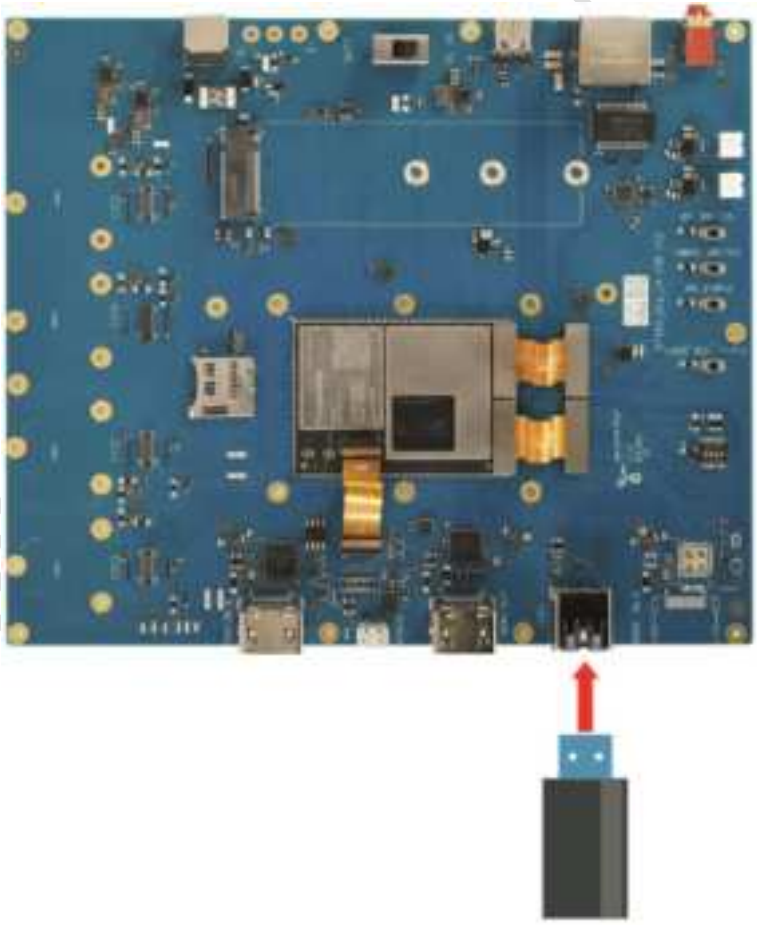

Figure 3-9. Type-A USB 3.0 Connector

Step 2.For more information on the USB device, input **# dmesg**, refer to the corresponding log output below

```
[ 2045.486868] usb 1-1: USB disconnect, device number 2
[ 2046.825339] msm-dwc3 a800000.ssusb: DWC3 in low power mode
[ 2054.361235] msm-dwc3 a800000.ssusb: DWC3 exited from low power mode
[ 2054.605392] usb 2-1: new SuperSpeed Gen 1 USB device number 2 using xhci-hcd
[ 2054.635864] usb 2-1: New USB device found, idVendor=0951, idProduct=1666,
bcdDevice= 0.01
[ 2054.635880] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 2054.635889] usb 2-1: Product: DataTraveler 3.0
[ 2054.635896] usb 2-1: Manufacturer: Kingston
[ 2054.635903] usb 2-1: SerialNumber: E0D55EA574F1F440F901CB02
[ 2054.651707] usb-storage 2-1:1.0: USB Mass Storage device detected
[ 2054.652615] scsi host1: usb-storage 2-1:1.0
```

Step 3.Open **Files** APP on the Android screen and click the **Recent** button to check the connected USB device in the drop-down list.

Figure 3-10.Android Screen

3.8. Ethernet connector

Follow the steps below to test the Ethernet function.

Step 1.Connect the board to a local network via an Ethernet cable. Refer to Figure 3-11.

Figure 3-11.Connect Ethernet Cable

Step 2.Confirm the connection setup with an IP obtained.

```
# ifconfig eth0
eth0      Link encap:Ethernet  HWaddr 00:0e:c6:81:79:01  Driver ax88179_178a
          inet addr:10.0.36.42  Bcast:10.0.36.255  Mask:255.255.255.0
          inet6 addr: fe80::d050:90cf:afb8:6d01/64 Scope: Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:144 errors:0 dropped:0 overruns:0 frame:0
          TX packets:72 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:12348 TX bytes:9714
```

Step 3.Perform a ping test:

```
# ping www.thundercomm.com
PING nm.aicdn.com (223.85.20.156) 56(84) bytes of data.
64 bytes from 223.85.20.156: icmp_seq=1 ttl=45 time=39.2 ms
64 bytes from 223.85.20.156: icmp_seq=2 ttl=45 time=39.3 ms
64 bytes from 223.85.20.156: icmp_seq=3 ttl=45 time=39.6 ms
64 bytes from 223.85.20.156: icmp_seq=4 ttl=45 time=39.1 ms
64 bytes from 223.85.20.156: icmp_seq=5 ttl=45 time=40.4 ms
64 bytes from 223.85.20.156: icmp_seq=6 ttl=45 time=39.4 ms
```

3.9. Wi-Fi

3.9.1. Wi-Fi network connection

Step 1.Connect your antennas to the board. Refer to Figure 3-12.

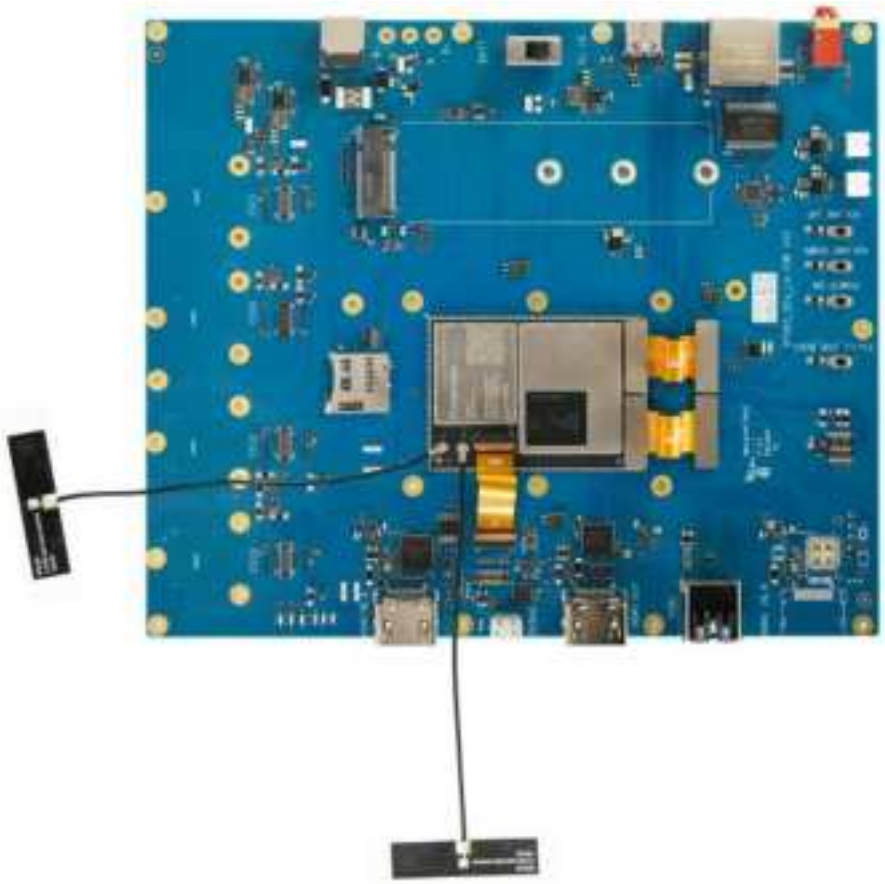

Figure 3-12. Wi-Fi Network Connection

Step 2.Swipe downwards shortly from the top edge of your screen to enter **Quick Settings** bar.

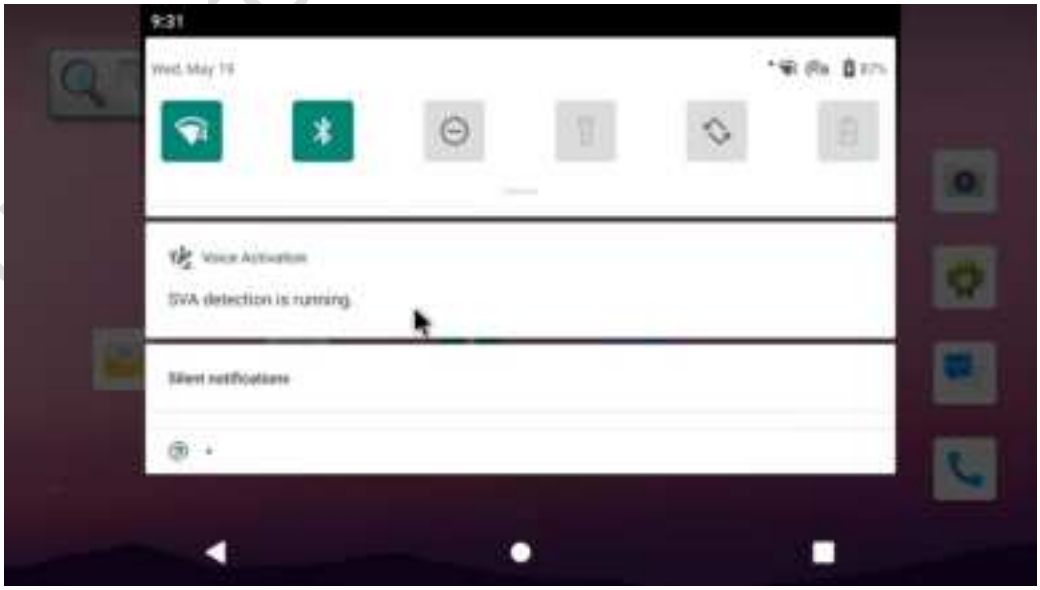

Figure 3-13. Quick Settings

Step 3.Tap the **Wi-Fi** connection icon to turn on the Wi-Fi connection function.

Step 4. Hold the icon to enter the network list.

Step 5. Tap your desired network and enter the password (Networks that require password have a lock icon marked).

Step 6. Confirm connection with an IP obtained.

```
# ifconfig wlan0
wlan0     Link encap:Ethernet  HWaddr 12:d9:8d:c8:77:e7  Driver cnss_pci
          inet addr:192.168.1.107  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::74a8:fe06:9ecf:2c1a/64 Scope: Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:531 errors:0 dropped:2 overruns:0 frame:0
          TX packets:4319 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:3000
          RX bytes:72338 TX bytes:335787
```

Step 7. Perform a ping test.

```
# ping www.thundercomm.com
PING nm.aicdn.com (223.85.20.156) 56(84) bytes of data.
64 bytes from 223.85.20.156: icmp_seq=1 ttl=45 time=39.2 ms
64 bytes from 223.85.20.156: icmp_seq=2 ttl=45 time=39.3 ms
64 bytes from 223.85.20.156: icmp_seq=3 ttl=45 time=39.6 ms
```

3.9.2. Hotspot setup

Step 1. Enter Wi-Fi hotspot page: **Settings** → **Network & internet** → **Hotspot & tethering** → **Wi-Fi hotspot**.

Step 2. Tap **OFF** icon  to enable Wi-Fi hotspot.

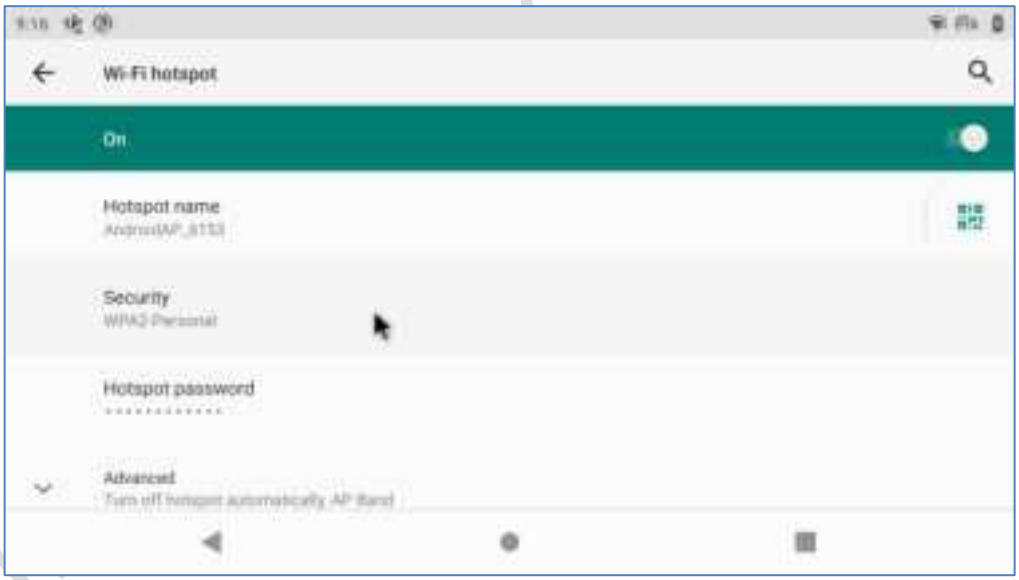

Figure 3-14. Hotspot Setup

Then you can edit the setup as required.

Step 3. Connect your phone to the Wi-Fi network you have set up.

3.10. Bluetooth

Step 1.Swipe downwards shortly from the top edge of your screen to enter **Quick Settings** bar.

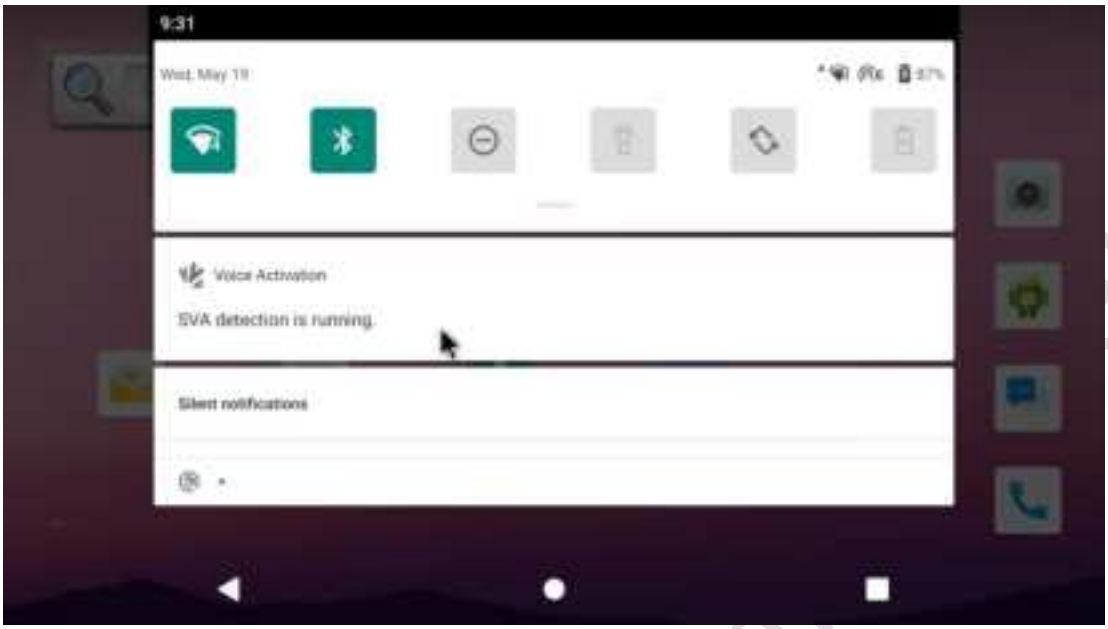

Figure 3-15.Quick Settings

Step 2.Tap Bluetooth icon to turn on Bluetooth connection function.

Step 3.Hold the icon to enter Bluetooth setting interface.

Step 4.Tap **Pair new device** to search for the Bluetooth-enabled device around.

➲ **NOTE**: If you cannot find **Pair new device** option, check the Bluetooth list under **Available devices,** or tap **More**/ to refresh.

Step 5.Tap the Bluetooth name to pair the Bluetooth-enabled device with your device.

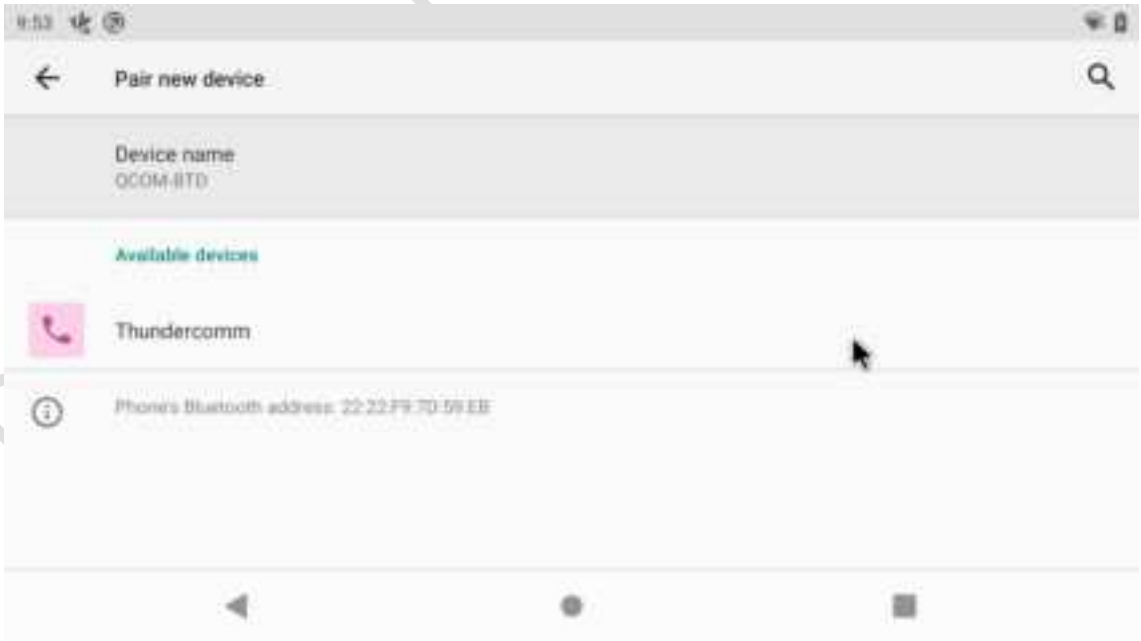

Figure 3-16.Pair Bluetooth-enabled Device

3.11. Display interface

C865C display system supports DP and HDMI interfaces.

➲ **NOTE:** The system goes into Sleep Mode after about one minute of non-use. To activate it, press the **Power on button**. (No. 28 in Figure 1-1).

3.11.1. DP interface

Step 1. Connect the monitor to the board by a USB Type-C to DP cable through **Type-C USB 3.0 Connector** (No. 21 in Figure 1-1).

Step 2. DP driver will automatically match monitor resolution display.

3.11.2. HDMI interface

Two types of resolution are available for HDMI: 1080P60FPS (default) and 4K60FPS.

Step 1. Connect the monitor to the board by a HDMI cable through the **HDMI OUT Connector** (No. 3 in Figure 1-1).

Step 2. After connecting the HDMI cable, the display will display automatically.

Step 3. Switch HDMI resolution.

- **Switching HDMI resolution from 4K to 1080P**:

```
$ adb reboot bootloader
$ fastboot oem select-display-panel dsi_ext_bridge_1080p
$ fastboot reboot
```

- **Switching HDMI resolution from 1080P to 4K:**

```
$ adb reboot bootloader
$ fastboot oem select-display-panel dsi_ext_bridge_4k
$ fastboot reboot
```

3.11.3. Secondary display control via Android presentation

Step 1. Connect two monitors to the board by a USB Type-C to DP cable and an HDMI cable respectively.

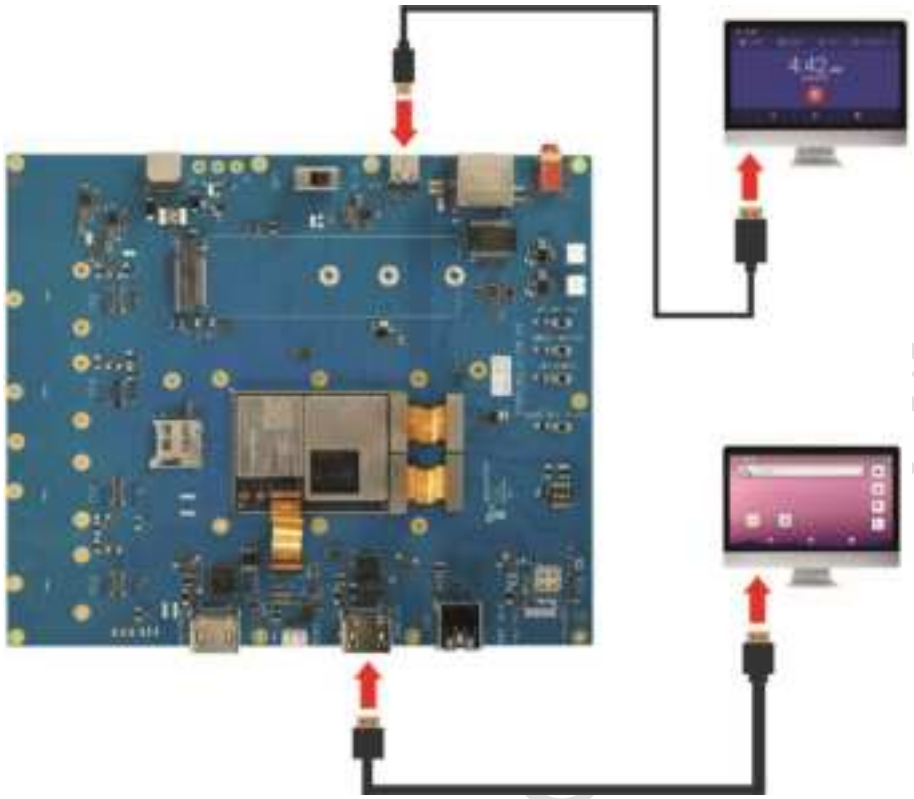

Figure 3-17.Secondary display control via Android presentation

Step 2. By default, DP and HDMI display the same content. To make them display different contents, execute the following commands in the UART debug port.

- **Disable debug log**

```
# su
# sysctl kernel.printk="2 6 1 7"
```

- **View connected monitor ID**

```
# dumpsys SurfaceFlinger | grep pnpId
Display 23367303159971588 (HWC display 1): port=4 pnpId=TXD displayName="HDMI"
Display 19260656133175937 (HWC display 0): port=129 pnpId=QCM displayName="ext video mod"
```

- **Select monitor to run app**

```
# am start -n com.android.deskclock/.DeskClock --display 1
```

3.11.4. Wi-Fi projection

Prerequisite: Make sure SOM and the projector are connected to the same Wi-Fi hotspot.

Step 1. Connect the board with a mouse via **Type A USB 3.0 connector** (No.1 in Figure 1-1).

Step 2. Select **Settings → Connected devices → Connection preferences → Cast** on the screen.

Step 3. Click the menu button and activate the "Enable wireless display" checkbox. Then your PC will appear in the list if the **Connect APP** is opened. Click the name of the PC in the list to enable projection.

Figure 3-18. Enable Wireless Display

➲ **Note:** When you are using a laptop with Win 10 OS to project your display, make sure you have opened **Miracast** by selecting **Start** → **Settings** → **System** → **Projecting to this PC**.

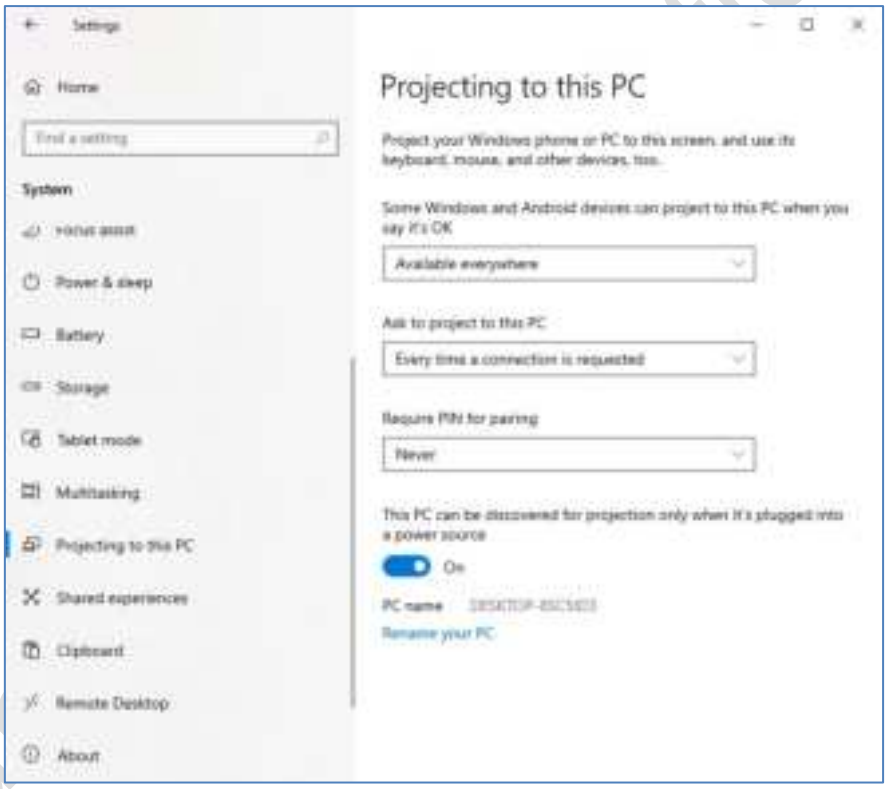

Figure 3-19. Open Miracast

3.12. Camera

3.12.1. Main camera (IMX577)

Step 1.Install camera modules to the board.

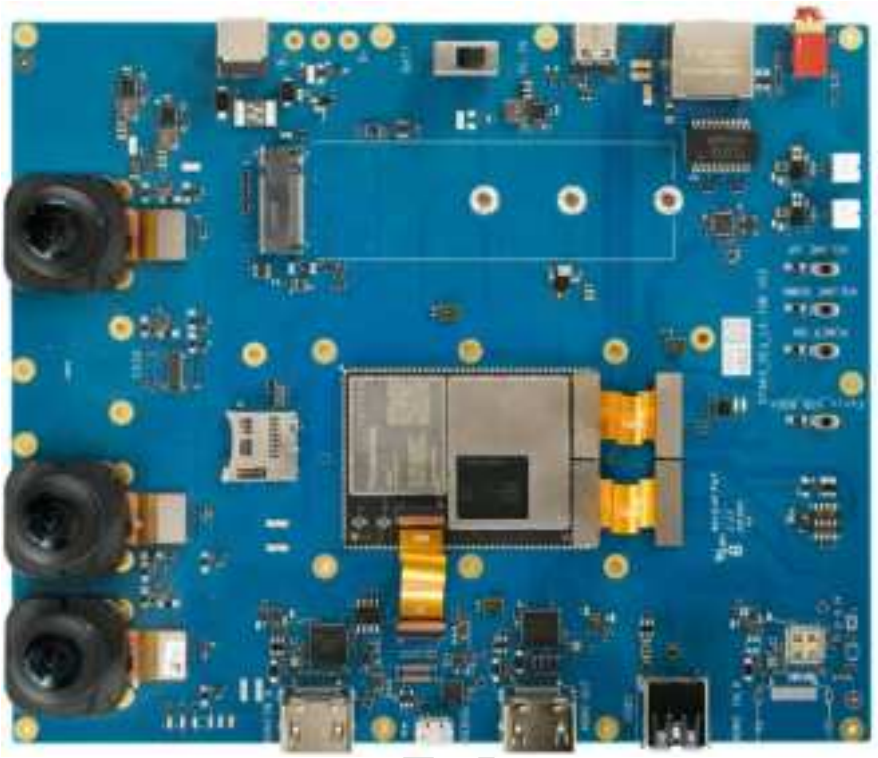

Figure 3-20.Connect Cameras

Step 2.Boot up your system, then open the **Snapdragon Camera** app to take picture or record video .

Figure 3-21.Camera/Video

➲ **NOTE:**

- Default rear camera: camera0; default front camera: camera3.
- Follow the steps below to switch the front/rear camera:

a) Click the **Setting** icon at the upper right corner of home screen of **Snapdragon Camera** app and click **Version Info** for 10 times to open **DEVELOPER OPTIONS** of **Snapdragon Camera** app.

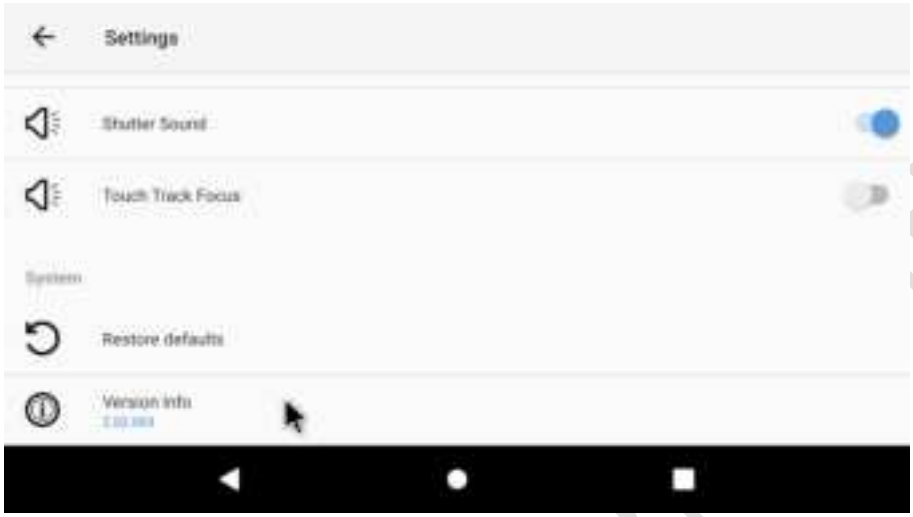

Figure 3-22.Settings Screen

b) Click **Version Info** for 10 times to return to the home screen of **Snapdragon Camera** app, then click the **Settings** icon again and select **Switch camera by id** to configure the default camera.

3.12.2. Three-camera concurrency mode

Step 1.Download ThundersoftMultiCamera.apk and install it to SOM.

```
$ adb root
$ adb install ThundersoftMultiCamera.apk
```

Step 2.Configure the permission of ThundersoftMultiCamera.apk.

a) Select **Settings** → **Apps&notifications** → **ThundersoftMultiCamera** → **Permissions**.

b) Click **Camera** or **Storage** in Figure 3-27 to perform permission.

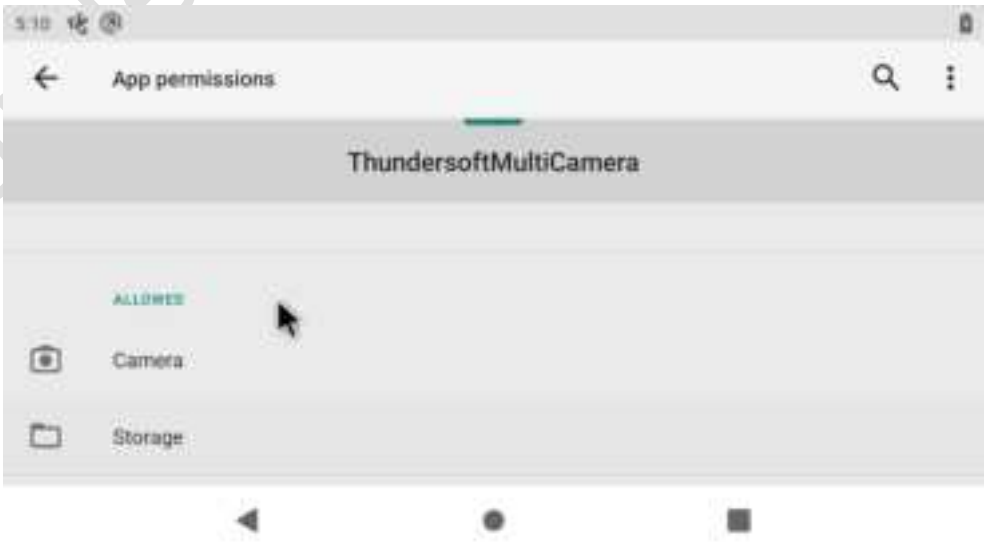

Figure 3-23.App Permissions

Step 3.Open the **ThundersoftMultiCamera** app and click **START** to display camera pictures.

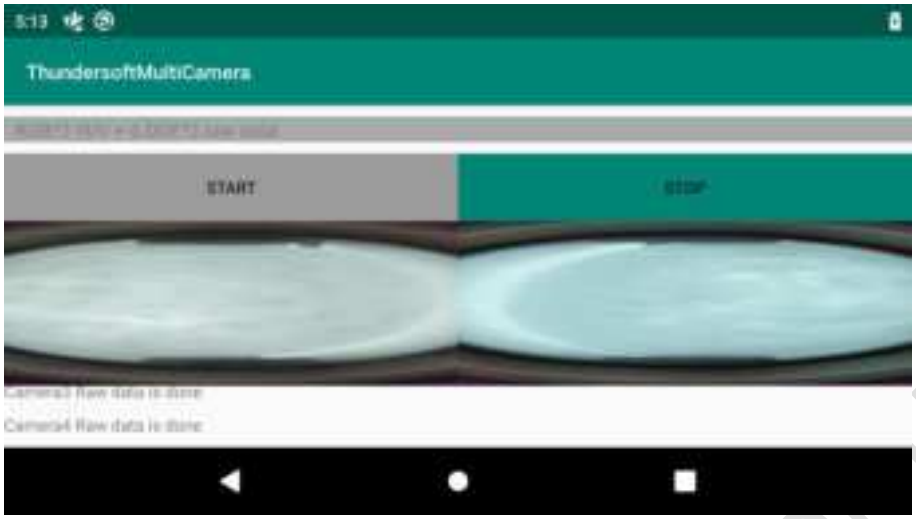

Figure 3-24.ThundersoftMultiCamera App

Step 4.To check the other two camera pictures, run the following commands on the terminal.

```
$ adb root
$ adb shell
# cd /data/user/0/com.thundercomm.thundersoftmulticamera/files/rawdata
# ls
```

3.12.3. C-phy Camera

Step 1.Install camera modules to the board.

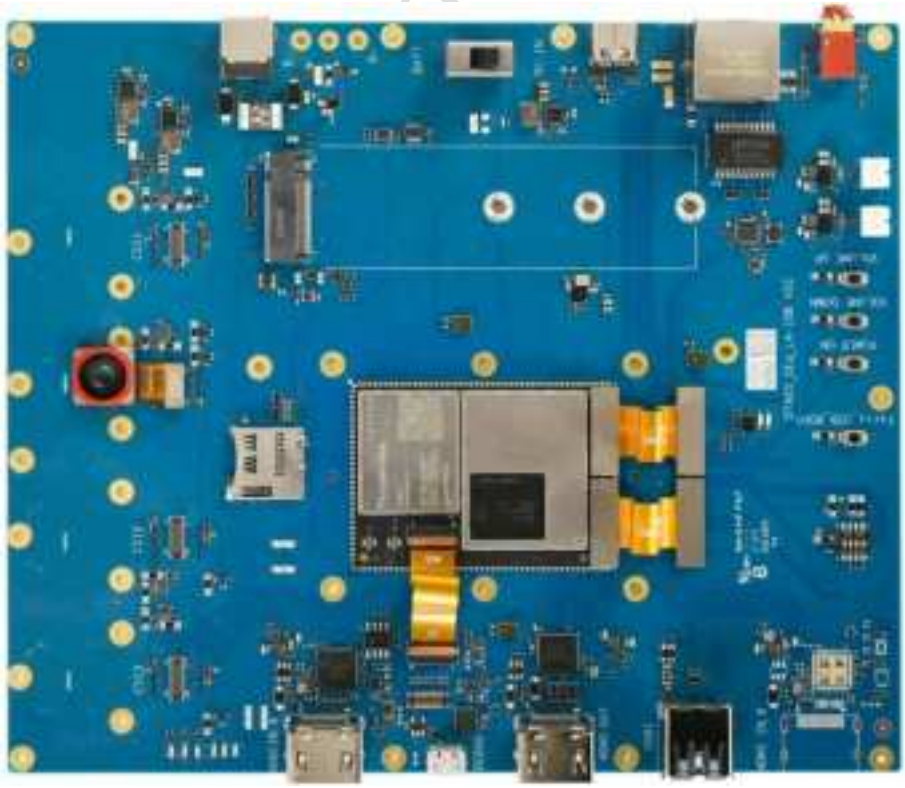

Figure 3-25.C-phy Camera Connection

Step 2. Boot up your system, then open the Snapdragon Camera app to take picture or record video .

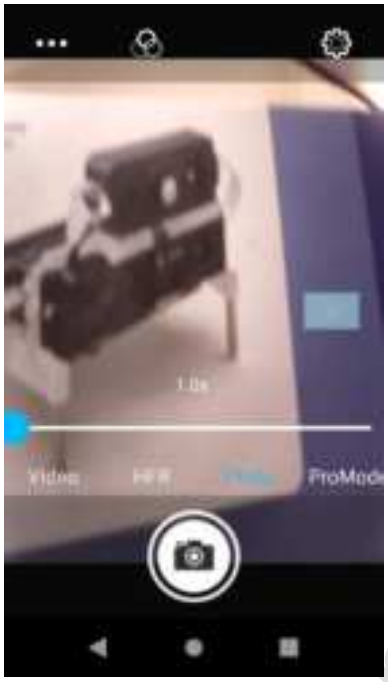

Figure 3-26. Camera App

3.12.4. HDMI IN

➲ **NOTE**: Do not connect any camera before testing the HDMI IN function.

Step 1. Configure permission of **CameraRAW**.

a) Select **Settings** → **Apps&notifications** → **CameraRAW** → **Permissions**.

b) Click **Camera** or **Storage** to perform permission.

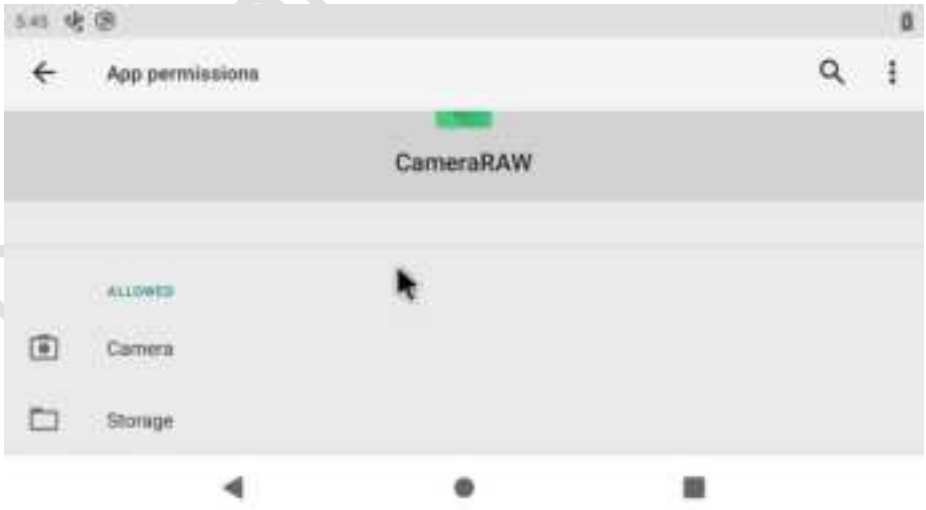

Figure 3-27. App Permissions

Step 2. Connect your computer to the board via the **HDMI IN connector** (No. 9 in Figure 1-1) with an HDMI cable.

Step 3. Open the **CameraRAW** app to display camera pictures.

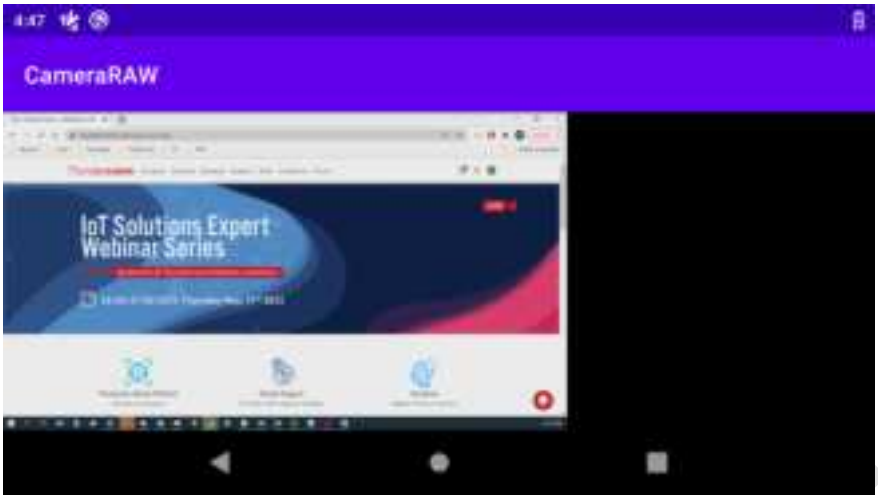

Figure 3-28. HDMI In Display Preview

3.12.5. UVC host

Step 1. Download the USB camera app usbcamera.apk and install it to SOM.

```
$ adb root
$ adb install com-shenyaocn-android-usbcamera.apk
```

Step 2. Connect the USB camera to the board through **Type-A USB 3.0 connector** (No. 1 in Figure 1-1).

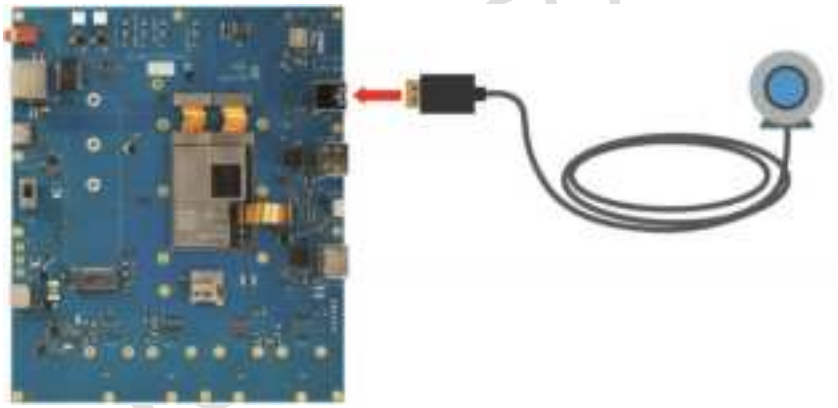

Figure 3-29. USB Camera

Step 3. Open the **USB Camera** app.

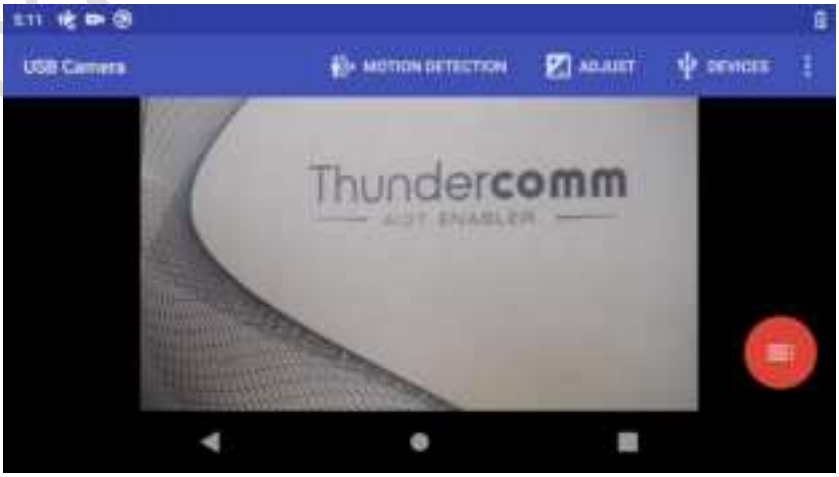

Figure 3-30. USB Camera Screen

3.13. Speaker

Step 1.Connect speakers to the board.

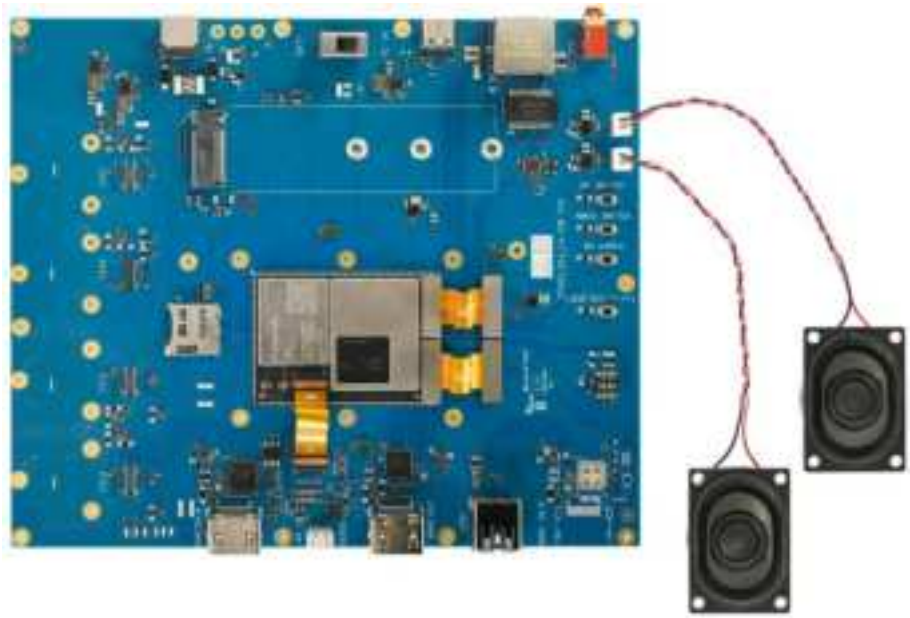

Figure 3-31.Connect Speakers

Step 2.Push an .mp3 file to your device.

```
$ adb root
$ adb push test.mp3 /storage/emulated/0/Music
```

Step 3.Find *test.mp3* in the **Files** app and double-click **Play**, then sound will come out from the speaker.

Figure 3-32.Speaker

3.14. Digital microphone arrays

There are all together three microphones on the board. Refer to Figure 3-33 to locate the microphones.

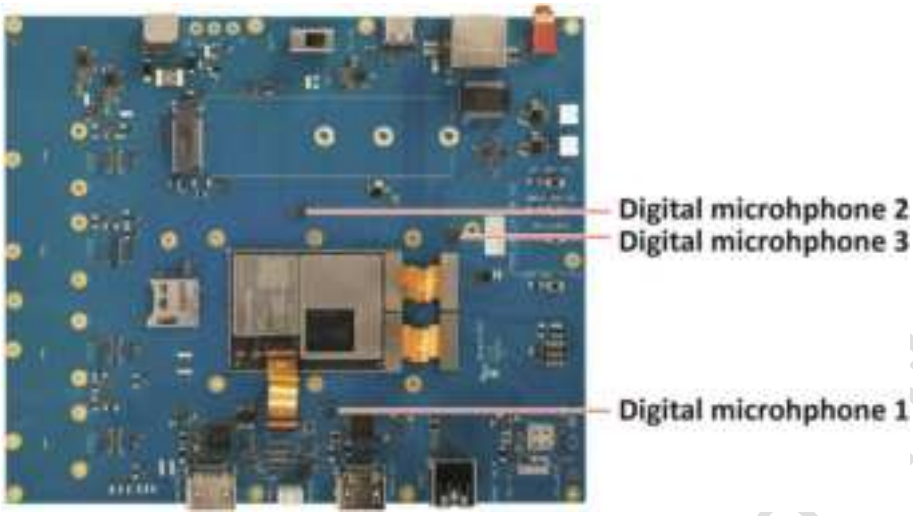

Figure 3-33. Digital Microphone Arrays

Step 1. Pre-set all microphones' configuration.

```
tinymix 'WSA_CDC_DMA_RX_0 Channels' 'Two'
tinymix 'WSA RX0 MUX' 'AIF1_PB'
tinymix 'WSA RX1 MUX' 'AIF1_PB'
tinymix 'WSA_RX0 INP0' 'RX0'
tinymix 'WSA_RX1 INP0' 'RX1'
tinymix 'WSA_COMP1 Switch' 1
tinymix 'WSA_COMP2 Switch' 1
tinymix 'SpkrLeft COMP Switch' 1
tinymix 'SpkrLeft BOOST Switch' 1
tinymix 'SpkrLeft VISENSE Switch' 1
tinymix 'SpkrLeft SWR DAC_Port Switch' 1
tinymix 'SpkrRight COMP Switch' 1
tinymix 'SpkrRight BOOST Switch' 1
tinymix 'SpkrRight VISENSE Switch' 1
tinymix 'SpkrRight SWR DAC_Port Switch' 1
tinymix 'WSA_RX0 Digital Volume' 68
tinymix 'WSA_RX1 Digital Volume' 68
tinymix 'WSA_CDC_DMA_RX_0 Audio Mixer MultiMedia1' 1
```

Step 2. Enable the microphone (DMIC0) on Main IO Board.

```
tinymix 'TX DEC0 MUX' 'MSM_DMIC'
tinymix 'TX DMIC MUX0' 'DMIC0'
tinymix 'TX_CDC_DMA_TX_3 Channels' 'One'
tinymix 'TX_CDC_DMA_TX_3 SampleRate' 'KHZ_48'
tinymix 'TX_CDC_DMA_TX_3 Format' 'S16_LE'
tinymix 'TX_AIF1_CAP Mixer DEC0' 1
tinymix 'TX_DEC0 Volume' 102
tinymix 'MultiMedia1 Mixer TX_CDC_DMA_TX_3' 1
tinycap /data/dmic0.wav c 1 r 48000 b 16 T 10
```

Disable the microphone.

```
tinymix 'TX DMIC MUX0' 'ZERO'
tinymix 'TX_AIF1_CAP Mixer DEC0' 0
```

Step 3.Enable the microphone (DMIC1) on Main IO Board.

```
tinymix 'TX DEC2 MUX' 'MSM_DMIC'
tinymix 'TX DMIC MUX2' 'DMIC1'
tinymix 'TX_CDC_DMA_TX_3 Channels' 'One'
tinymix 'TX_CDC_DMA_TX_3 SampleRate' 'KHZ_48'
tinymix 'TX_CDC_DMA_TX_3 Format' 'S16_LE'
tinymix 'TX_AIF1_CAP Mixer DEC2' 1
tinymix 'TX_DEC2 Volume' 102
tinymix 'MultiMedia1 Mixer TX_CDC_DMA_TX_3' 1
tinycap /data/dmic1.wav c 1 r 48000 b 16 T 10
```

Disabled the microphone.

```
tinymix 'TX DMIC MUX2' 'ZERO'
tinymix 'TX_AIF1_CAP Mixer DEC2' 0
```

Step 4.Enable the microphone (DMIC2) on Main IO Board.

```
tinymix 'TX DEC2 MUX' 'MSM_DMIC'
tinymix 'TX DMIC MUX2' 'DMIC3'
tinymix 'TX_CDC_DMA_TX_3 Channels' 'One'
tinymix 'TX_CDC_DMA_TX_3 SampleRate' 'KHZ_48'
tinymix 'TX_CDC_DMA_TX_3 Format' 'S16_LE'
tinymix 'TX_AIF1_CAP Mixer DEC2' 1
tinymix 'TX_DEC2 Volume' 102
tinymix 'MultiMedia1 Mixer TX_CDC_DMA_TX_3' 1
tinycap /data/dmic3.wav c 1 r 48000 b 16 T 10
```

Disabled the microphone.

```
tinymix 'TX DMIC MUX2' 'ZERO'
tinymix 'TX_AIF1_CAP Mixer DEC2' 0
```

3.15. Line-in

Step 1.Connect the device to the board with a line-in cable.

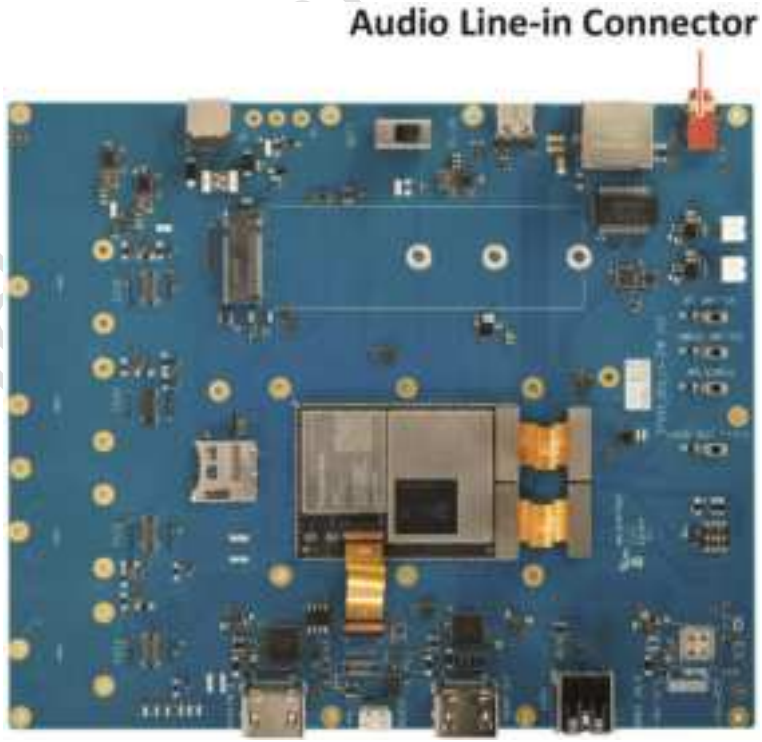

Figure 3-34.Audio Line-in Connection

Step 2. Run the following commands to record the sound.

```
$ adb root
$ adb shell
# tinymix 'TX DEC0 MUX' 'SWR_MIC'
# tinymix 'TX DEC1 MUX' 'SWR_MIC'
# tinymix 'TX SMIC MUX0' 'ADC2'
# tinymix 'TX SMIC MUX1' 'ADC3'
# tinymix "TX_CDC_DMA_TX_3 Channels" Two
# tinymix 'TX_CDC_DMA_TX_3 SampleRate' 'KHZ_48'
# tinymix 'TX_CDC_DMA_TX_3 Format' 'S16_LE'
# tinymix 'TX_AIF1_CAP Mixer DEC1' 1
# tinymix 'TX_AIF1_CAP Mixer DEC0' 1
# tinymix 'TX2 MODE' 'ADC_NORMAL'
# tinymix 'TX3 MODE' 'ADC_NORMAL'
# tinymix 'ADC3 Volume' 64
# tinymix 'ADC4 Volume' 64
# tinymix 'TX_DEC0 Volume' 84
# tinymix 'TX_DEC1 Volume' 84
# tinymix 'MultiMedia1 Mixer TX_CDC_DMA_TX_3' 1
# tinymix 'ADC3_MIXER Switch' 1
# tinymix 'HDR34 MUX' 'NO_HDR34'
# tinymix 'ADC4_MIXER Switch' 1
# tinymix 'ADC3 MUX' 'INP4'
# tinymix 'ADC4 MUX' 'INP5'
# tinycap /data/amic.wav -c 1 -r 48000 -b 16
```

Step 3. Play the recording file.

```
$ adb root
$ adb pull /data/amic.wav .
```

3.16. Video encoding/decoding via OpenMAX

Step 1. Download the test file:

- 3840_2160.yuv
- H264_3840_2160_60fps

Step 2. Check the mm-vidc-omx-test environment:

```
$ adb root
$ adb shell
# mm-vidc-omx-test
VT_CONSOLE main::108 Usage: mm-vidc-omx-test <MasterConfg.xml path> <input.xml>
```

Step 3. *MasterConfig.xml* configuration.

Configure the macro environment, mainly used to set the input and output video path.

```
<xml>
<InputFileRoot>/data/input/</InputFileRoot>
<OutputFileRoot>/data/output/</OutputFileRoot>
</xml>
```

Step 4. Configure the corresponding directory and upload the config file.

```
$ adb root
$ adb shell mkdir /data/input /data/output
$ adb push MasterConfig.xml /data
$ adb push 3840_2160.yuv /data/input
$ adb push H264_3840_2160_60fps /data/input
```

- **Encode**
  - Feature description

Table 3-2. Feature description

Refer to the following **OpenMAX** parameters.

Recode	Encode
CompressionFormat	VIDEO_CodingAVC VIDEO_CodingHEVC VIDEO_CodingVP8 VIDEO_CodingMPEG4 VIDEO_CodingH263 VIDEO_CodingVC1RCV VIDEO_CodingVC1 VIDEO_CodingDIVX VIDEO_CodingMPEG2 VIDEO_CodingVP9 VIDEO_CodingTME
ProfileIDC	VIDEO_AVCProfileBaseline, VIDEO_AVCProfileConstrainedBaseline, VIDEO_AVCProfileMain, VIDEO_AVCProfileHigh, VIDEO_AVCProfileConstrainedHigh, VIDEO_HEVCProfileMain, VIDEO_HEVCProfileMainStillPic, VIDEO_HEVCProfileMain10, VIDEO_HEVCProfileMain10HDR10, VIDEO_MPEG4ProfileSimple, VIDEO_MPEG4ProfileAdvancedSimple, VIDEO_H263ProfileSimple, VP8_MAIN, VIDEO_TMEProfile0, VIDEO_TMEProfile1, VIDEO_TMEProfile2, VIDEO_TMEProfile3
Resolution	SourceWidth SourceHigh
eControlRate	RC_OFF VBR_VFR VBR_CFR CBR_VFR CBR_CFR MBR_CFR MBR_VFR
FPSNumerator	0FPS/60FPS

- *SampleEncode.xml*

  The Encode property is configured, and you need to configure the properties and corresponding values in the specification.

```
<xml>
 <EncodeSession>
      <TestCaseID>Encoder_H264_3840_2160_60fps</TestCaseID>
      <CompressionFormat>VIDEO_CodingAVC</CompressionFormat>
      <ProfileIDC>VIDEO_AVCProfileMain</ProfileIDC>
      <SourceHeight>2160</SourceHeight>
      <SourceWidth>3840</SourceWidth>
      <OutputHeight>2160</OutputHeight>
      <OutputWidth>3840</OutputWidth>
      <FPSDenominator>1</FPSDenominator>
      <FPSNumerator>60</FPSNumerator>
      <Bitrate>1000000000</Bitrate>
      <InputFile>3840_2160.yuv</InputFile>
      <nFramesToParse>36000</nFramesToParse>
      <nBframes>0</nBframes>
      <nPframes>29</nPframes>
      <eControlRate>VBR_CFR</eControlRate>
 </EncodeSession>
</xml>
```

- Encode commands:

```
$ adb root
$ adb push SampleEncode.xml /data
$ adb shell
# mm-vidc-omx-test /data/ /data/SampleEncode.xml
```

- Encode output file check:

```
$ adb root
$ adb pull /data/output/Encoder_H264_3840_2160_60fps .
```

H264/H265 output tool: PotPlayer 64 bit

- **Decode**

- *SampleDecode.xml:*

The decode property is configured, and you need to configure the properties and corresponding values in the specification.

```
<xml>
 <DecodeSession>
      <TestCaseID>Decoder_HEVC_3840_2160_60fps</TestCaseID>
      <CompressionFormat>VIDEO_CodingAVC</CompressionFormat>
      <InputFile>H264_3840_2160_60fps</InputFile>
      <session_mode>dec</session_mode>
      <SinkType>FILE</SinkType>
      <PlaybackMode>1</PlaybackMode>
      <SourceHeight>2160</SourceHeight>
      <SourceWidth>3840</SourceWidth>
      <OutputHeight>2160</OutputHeight>
      <OutputWidth>3840</OutputWidth>
 </DecodeSession>
</xml>
```

- Decode command:

```
$ adb root
$ adb push SampleDecode.xml /data
$ adb shell
# mm-vidc-omx-test /data/ /data/SampleDecode.xml
```

- Decode video check:

```
$ adb root
$ adb pull /data/output/.yuv  3840_2160_60fps.yuv
```

➲ **NOTE**: The file generated by decoding is named ".yuv". To check this file, run the following command:

```
ls -al /data/output/.yuv"
```

With the YUV player, the format is set to NV12.

Appendix 1. Compliance and Certificate Information

FCC statements:

The device for operation in the band 5150–5350 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

Federal Communication Commission (FCC) Radiation Exposure Statement

When using the product, maintain a distance of 20cm from the body to ensure compliance with RF exposure requirements.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio

communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

CE statements:

Do not use the module in the environment at too high or too low temperature, never expose the module under strong sunshine or too wet environment.

RF exposure information: The Maximum Permissible Exposure (MPE) level has been calculated based on a distance of d=20 cm between the device and the human body. To maintain compliance with RF exposure requirement, use product that maintain a 20cm distance between the device and human body.

EU Regulatory Conformance

Hereby, Thundercomm Technology Co., Ltd declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

The device for operation in the band 5150–5350 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

	AT	BE	BG	CH	CY	CY	DE	DK
	EE	EL	ES	FI	FR	HR	HU	IE
	IS	IT	LI	LT	LU	LV	MT	NL
	PL	PT	RO	SE	SI	SK	TR	UK(NI)

Frequency bands and power

	Bands	Operation Frequency	Max.Power
Bluetooth	2.4GHz	2402-2480 MHz	EIRP 9.54 dBm
Wi-Fi	2.4GHz	2412-2472MHz	EIRP 19.9 dBm
	5GHz	5180-5240MHz	EIRP 19.66dBm
		5260-5320MHz	EIRP 19.54 dBm
		5500-5700MHz	EIRP 19.94 dBm
		5745-5825MHz	EIRP 13.25 dBm

Manufacturer: Thundercomm Technology Co., Ltd

Manufacturer Address: Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China.

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