

# ***RK3399Pro EVB User Guide***

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# Preface

## Overview

This document mainly describes RK3399Pro EVB single board basic function and hardware characteristics, multi-function hardware configuration and software debugging operation method, aiming to help developers to use RK3399Pro EVB more quickly and correctly, and familiar with RK3399Pro chip solution.

## Product version

The corresponding product version of the document is as below:

Product name	Product version
RK3399Pro EVB	RK_EVB_RK3399PRO_LP3S178P332SD8_V12_20190215_RZF

## Applicable object

This document is mainly suitable for below engineers:

- Field application engineers
- Single board hardware development engineers
- Embedded software development engineers
- Test engineers

## Revision History

The revision history accumulates instructions for each update of the document and the latest version contains updates of all previous versions.

Revision Date	Version No.	Author	Revision Description
2019-04-30	V1.0	Linus.Lin	Initial Release

## Acronym

Acronym includes the abbreviations of commonly used phrases in this document.

DDR	Double Data Rate	双倍速率同步动态随机存储器
eMMC	Embedded Multi Media Card	内嵌式多媒体存储卡
EVB	Evaluation Board	评估板
I <sup>2</sup> C	Inter-Integrated Circuit	内部整合电路(两线式串行通讯总线)
JTAG	Joint Test Action Group	联合测试行为组织定义的一种国际标准测试协议 (IEEE 1149.1兼容)
LDO	Low Drop Out Linear Regulator	低压差线性稳压器
LVDS	Low-Voltage Differential Signaling	低电压差分信号
MIPI	Mobile Industry Processor Interface	移动产业处理器接口
PMIC	Power Management IC	电源管理芯片
PMU	Power Management Unit	电源管理单元
RK	Rockchip Electronics Co.,Ltd.	瑞芯微电子股份有限公司
SD Card	Secure Digital Memory Card	安全数码卡
SDIO	Secure Digital Input and Output	安全数字输入输出接口
SDMMC	Secure Digital Multi Media Card	安全数字多媒体存储卡
TF Card	Micro SD Card (Trans-flash Card)	外置记忆卡
USB	Universal Serial Bus	通用串行总线

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# 1. Overview

## 1.1 EVB introduction

RK3399Pro EVB is the hardware development board integrated with reference design, chip debugging and testing, and chip verification for RK3399Pro multimedia processing chip (hereinafter referred to as RK3399Pro chip). It is used to demo RK3399Pro powerful multimedia interfaces and rich peripheral interfaces, and also provide RK3399Pro based hardware reference design for customers, so that customers can finish the product hardware development without modification or only simply modify the module circuit of the reference design. RK3399Pro EVB supports SDK development of RK3399Pro chip, application software development and running and so on. Considering the different usage environment and chip full function verification, the interfaces are complete and the design is relatively complex.

RK3399Pro EVB can be used as a basic developing system by connecting with PC via USB cable, or to implement more complete developing system or demo environment by connecting with below devices or components:

- Power supply
- EDP panel
- TF Card memory device
- Earphone or speaker box
- Camera module

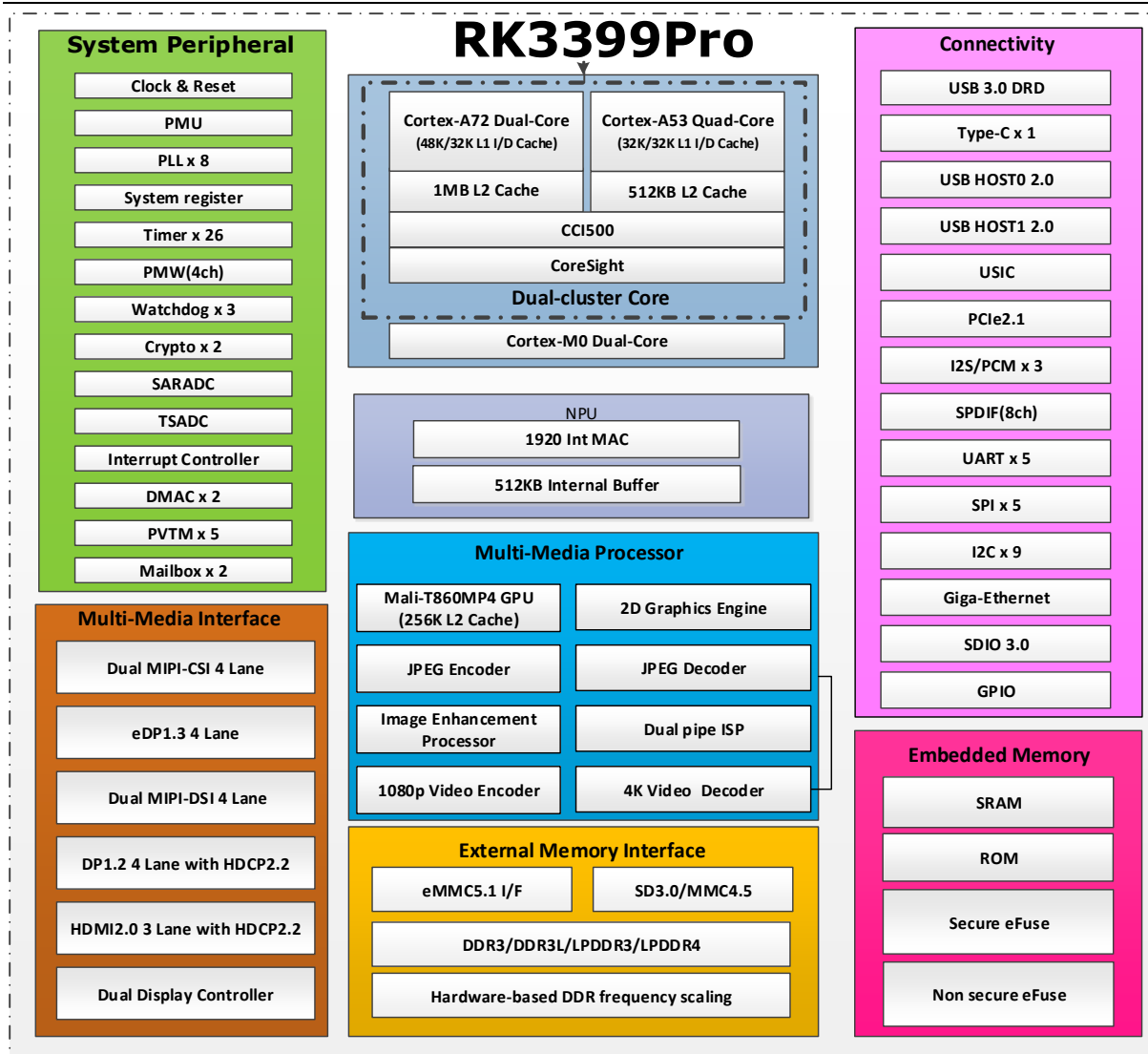


Figure 1-1 RK3399Pro Chip architecture

## 1.2 EVB Block Diagram

The EVB block diagram lets developers to have an intuitive understanding of the architecture and principle of the whole system: the whole system is powered by power adapter or battery, and debugging through UART serial port or JTAG interface to verify each function module. The EVB has most interfaces, and is equipped with Camera, WI-FI/BT module, USB OTG, TF card, audio interface, video interface, and can meet the different applications requirements in most cases, which is benefit for the deep development of the chip solution and rapid productization.

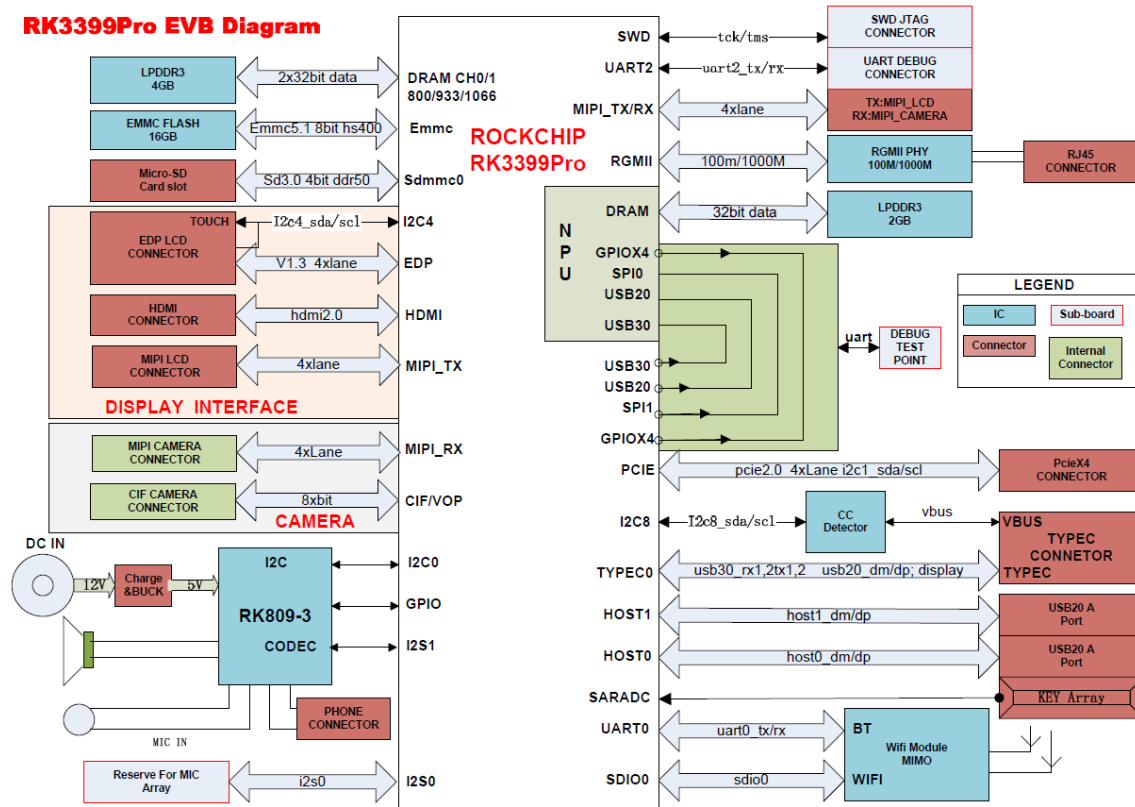


Figure 1-2 EVB Block Diagram

### 1.3 Function overview

RK3399Pro EVB includes the following features:

- BQ25703 charge controller
- RK809-3 power management IC
- CPU 2x32bit LPDDR3, total size 4GByte
- NPU 1x32bit LPDDR3, total size 2GByte
- 8bit eMMC Flash, total size 16GByte
- TF Card: support external storage card
- USB Type-A Port: support USB2.0 devices
- USB Type-C Port(J2600):used for image download and ADB debug
- USB Type-C Port(J9702):reserve for EVB reboot test
- USB Micro-B Port: used for UART Debug
- USB Mini Port: used for power consumption test
- System button: Power, Reset, Menu, Esc, VOL+, VOL-, Home and Maskrom
- SDIO Wi-Fi (AP6398S) :support 802.11 ac/a/b/g/n and BT5.0
- Audio out: support earphone, speaker
- Audio in: support microphone recording
- Gigabit Ethernet

- HDMI output
- Infrared remote reception
- Sensor: G-sensor+Gyroscope MPU6500、Compass AK8963C
- CIF Camera:IMX323,2M pixel
- MIPI Camera:OV5695,5M pixel
- PCIe x4 slot:
- Extended interface includes: JTAG

Function module layout as below:

TOP Layer:

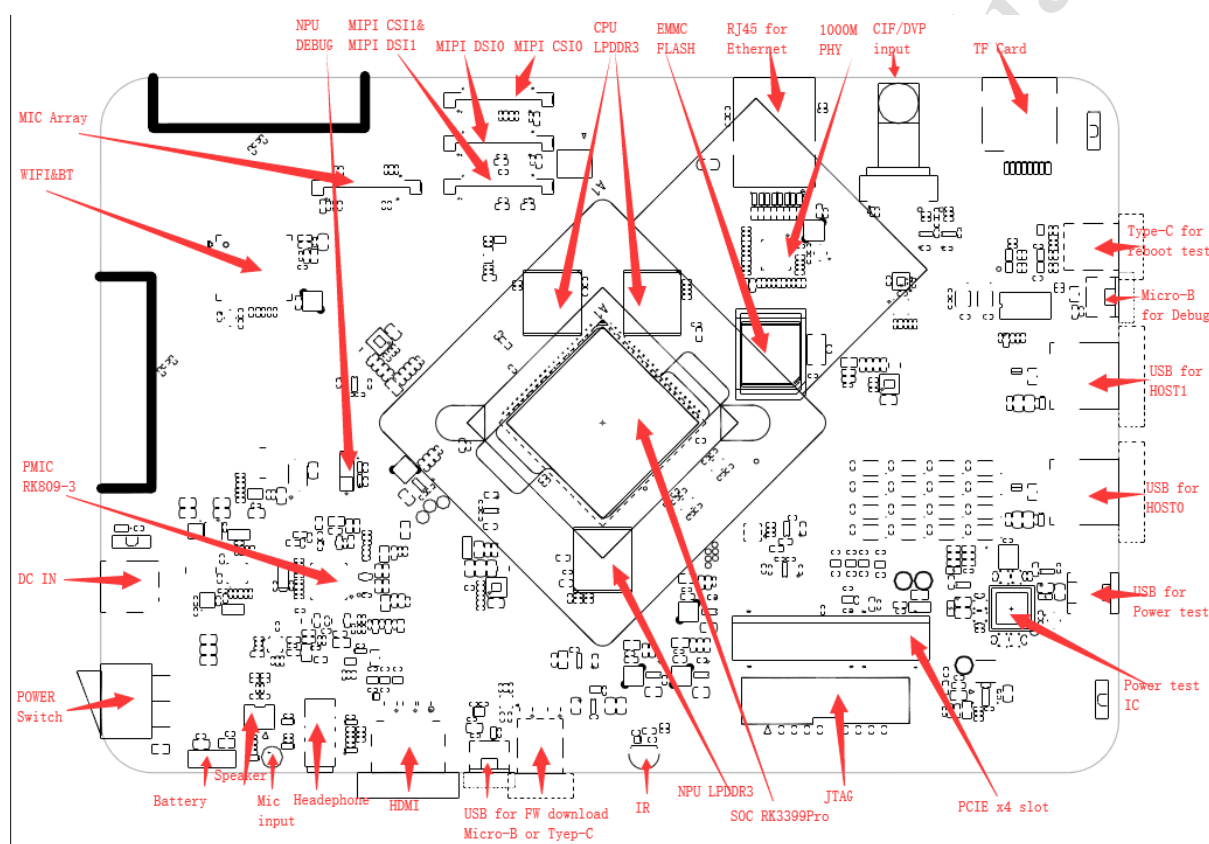


Figure 1-3 EVB interfaces and module location

## 1.4 EVB default flashing function

The EVB that user gets already has the firmware burned. All the functions covered by default are listed below:

Table 1-1 EVB function table

Item.	Function Part	Requirement
1	BQ25703	2-cell battery normal charging and discharging
2	PMIC RK809-3	Output of each power supply is normal, accurate battery volume detection
3	CPU DDR LPDDR3	Can recognize total size 4GByte
4	NPU DDR LPDDR3	Can recognize total size 2GByte
5	eMMC Flash	Can normally recognize 16GByte
8	USB Type-A Port	Can recognize device, and function normally
7	USB Type-C Port	Can recognize ADB device, can download images
6	USB Micro-B Port	Serial port input and output normally
9	TF Card	Normal recognition TF Card
10	Audio codec	Earphone and speakers function normal, and switching between them is normally
11	G-Sensor+ Gyroscope	MPU6050 function normally
12	Compass	AK8963C function normally
13	KEY BAORD	All the buttons function normally
14	WI-FI/BT	AP6398S module functions normally
15	MIPI/CIF Camera	Camera works normally, MIPI camera input by default
16	eDP panel	Screen image displays normally
18	HDMI Port	HDMI image outputs normally
18	Ethernet	Network connection normally
12	Standby and wake up	Can standby and wake up system normally

## 1.5 EVB component

RK3399Pro EVB includes the following components:

- RK3399Pro EVB
- DC adapter: input 100V AC~240V AC,50Hz, output DC12V/2A
- Panel: 9.7 inch eDP panel, 2048x1536 resolution

## 2.EVB hardware introduction

### 2.1 Physical View

EVB physical picture



Figure 2-1 EVB physical front view

The PCB physical picture of RK3399Pro EVB is shown as below:



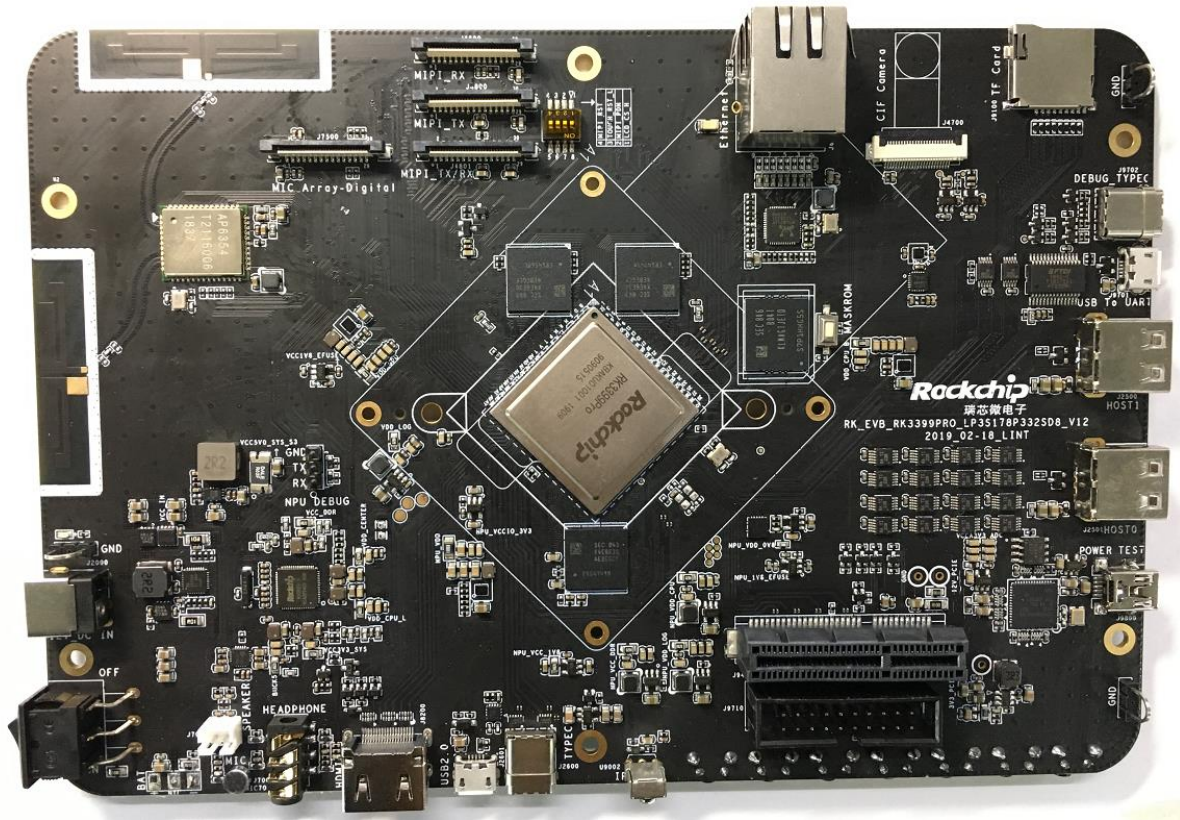


Figure 2-2 EVB PCB physical front view

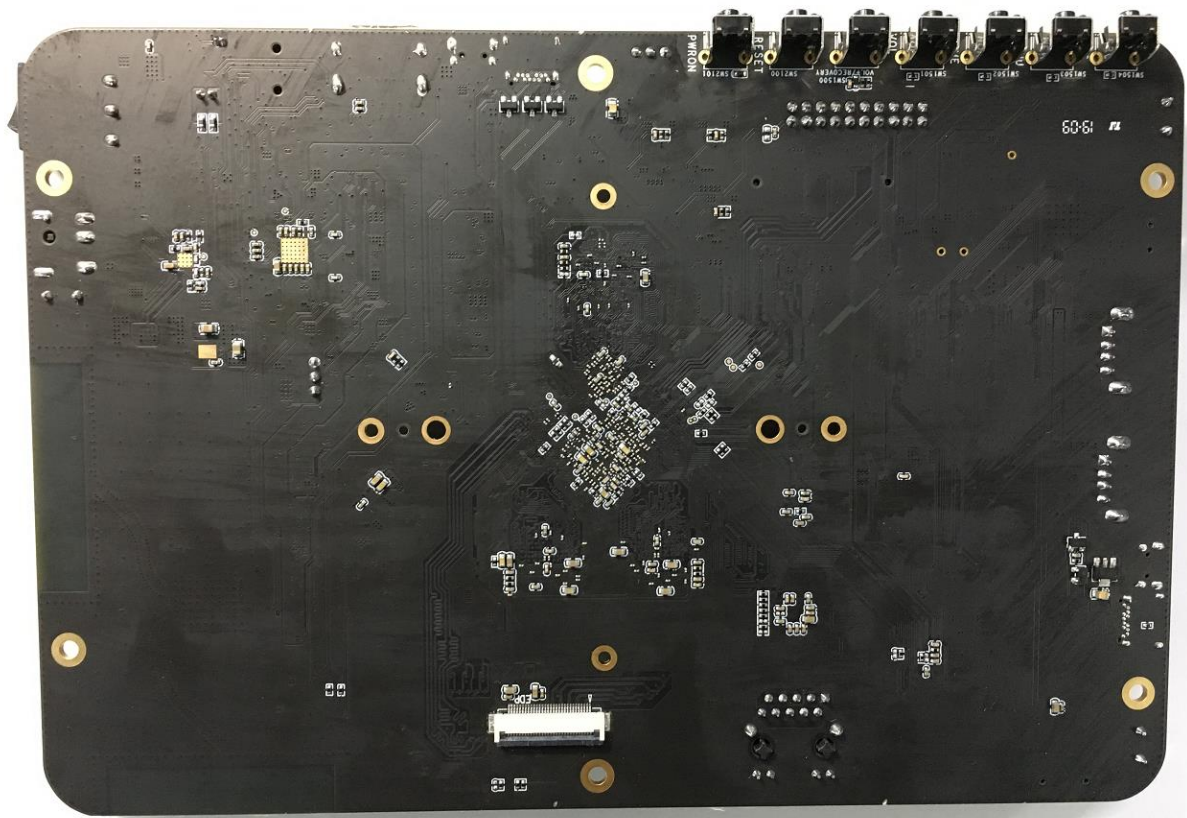


Figure 2-3 EVB PCB physical back view



## 2.2 Power Block Diagram

RK3399Pro EVB uses PMIC of RK809-3. The power block diagram is as below:

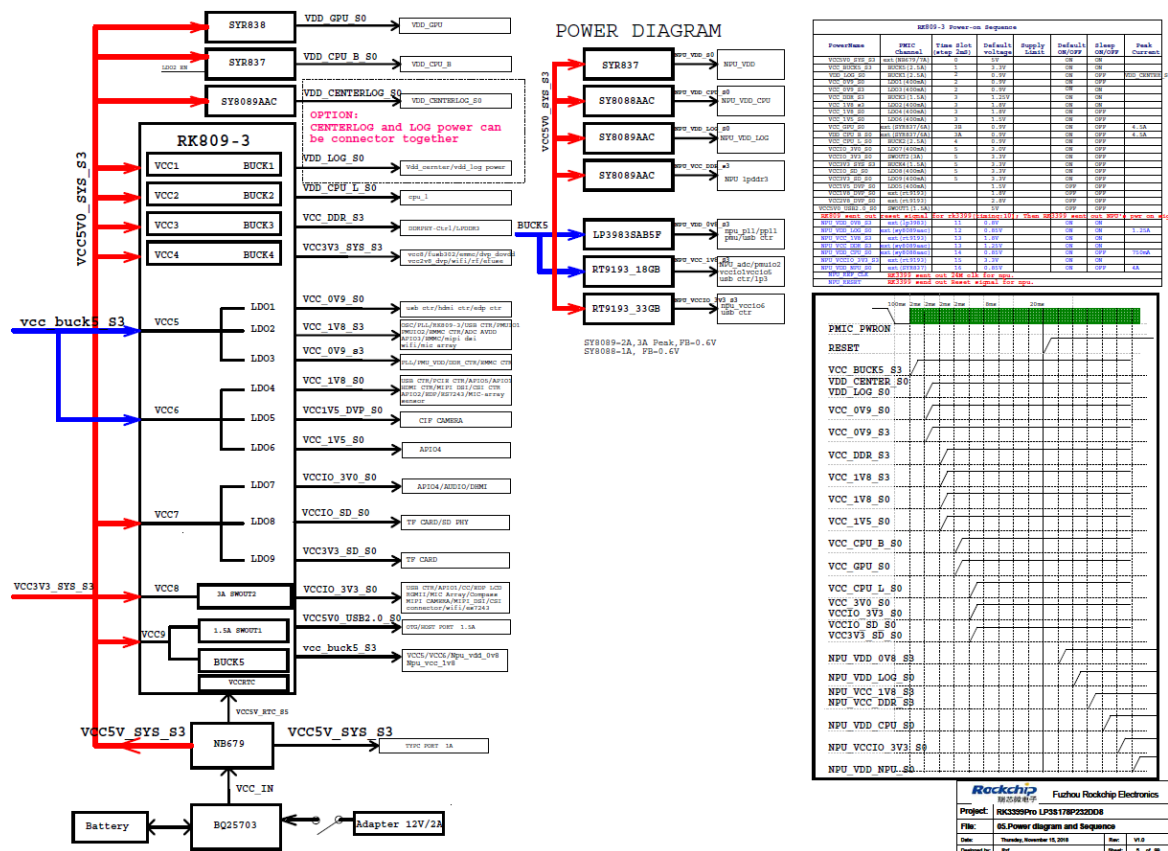


Figure 2-4 EVB power block diagram

## 2.3 I<sup>2</sup>C address

I<sup>2</sup>C address (7bit) configurations of RK3399Pro EVB are shown as below table:

Table 2-1 EVB I<sup>2</sup>C address table

	Device	Address
I <sup>2</sup> C0	RK809-3	0x20
	BQ25703	0x6a
	TCS4525	0x40
	TCS4526	0x41
I <sup>2</sup> C1	MPU6500	0x34
	AK8963C	0x0d
	OV5695	0x36
	IMX323	0x1a
	ES7243	0x22
I <sup>2</sup> C2	GSL1680	0x40

I <sup>2</sup> C3	HDMI	
I <sup>2</sup> C8	FUSB302B	0x44,0x46

**Note: when using the extension board, need to ensure that the I<sup>2</sup>C address not conflict with the I<sup>2</sup>C address of the EVB.**

## 2.4 Reference design of the EVB

Please contact with RK FAE to get the reference design of RK3399Pro EVB. The latest version is as follows:

《RK\_EVB\_RK3399Pro\_LP3S178P332SD8\_V12\_20190215\_RZF.dsn》

《RK\_EVB\_RK3399Pro\_LP3S178P332SD8\_v12\_20190218\_final\_lint.brd》

## 3.EVB module description

### 3.1 Power input

The 12V power supply input by the DC adapter can be controlled ON/OFF by the boat switch. The power input was step-down to system power VCC\_IN by charge IC. After the power supply is step-down to VCC5V0\_SYS\_S3 by DC-DC BUCK NB679GD, it will provide input for PMIC, and then PMIC outputs multiple power supplies for EVB.

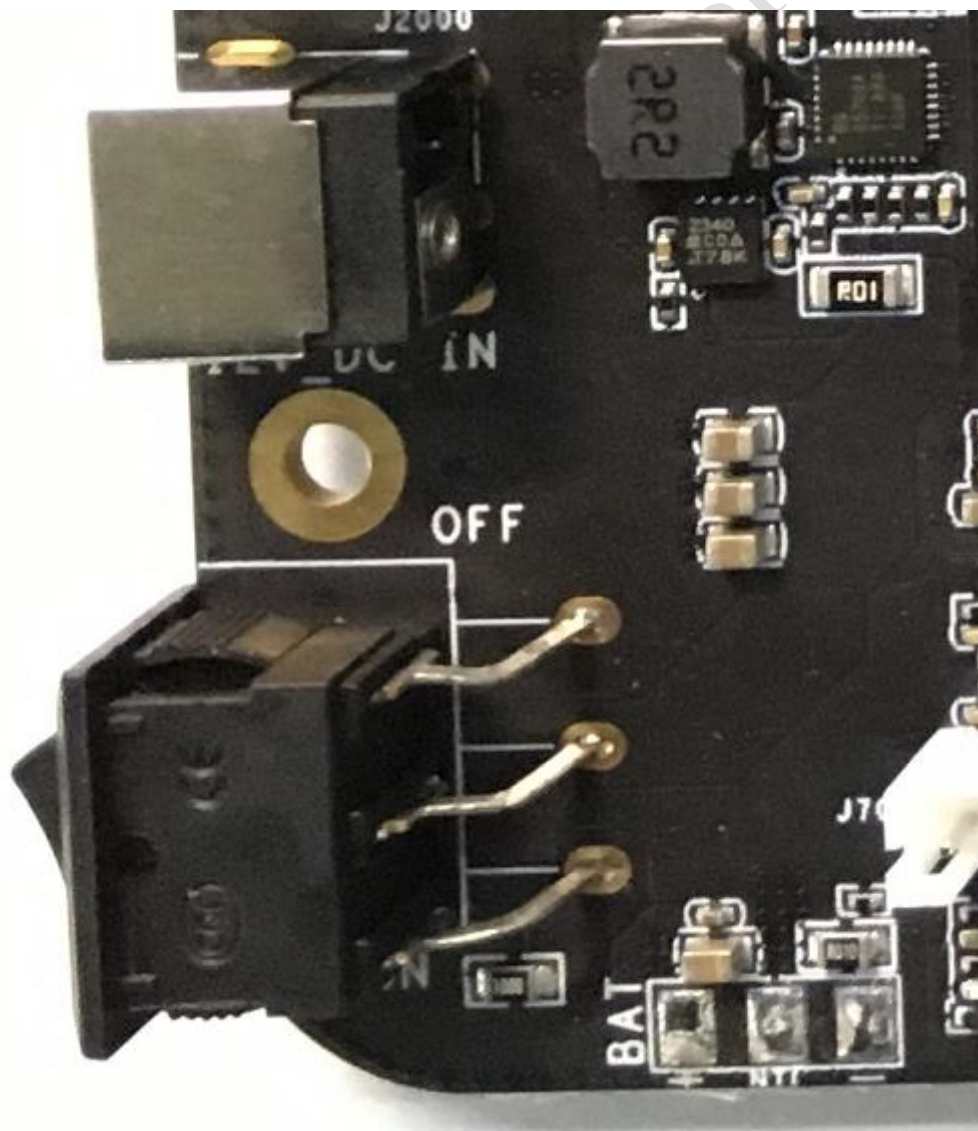


Figure 3-1 EVB power input

## 3.2 Memory

### 3.2.1 EMMC

1. The default eMMC FLASH size of the EVB is 16GByte.
2. There is Update button next to Flash, which is marked as "MASKROM" on the main board, in order to upgrade images of the EVB conveniently. Connect USB, press and hold the button, EVB power on or reset, and then the system will enter MaskRom mode for image download.

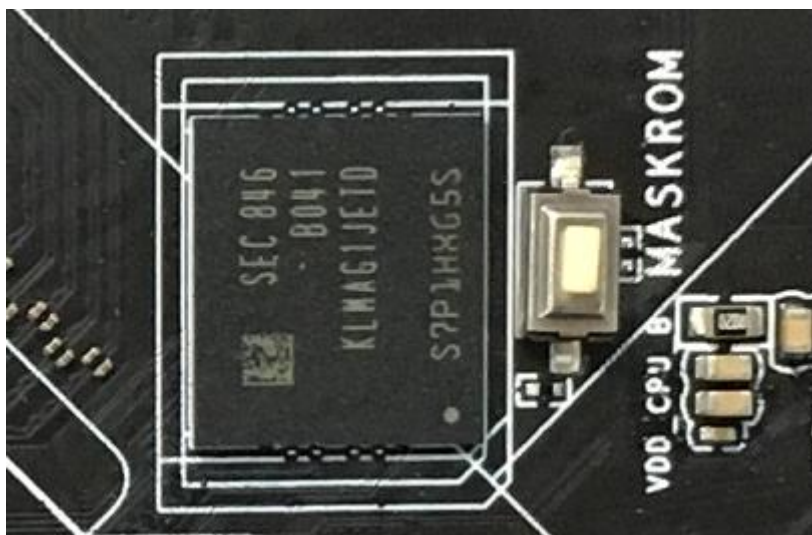


Figure 3-2 EVB eMMC Flash

### 3.2.2 DDR

The CPU DDR controller of RK3399Pro supports dual-channel 32bit DDR, NPU DDR controller supports single 32bit DDR. All use LPDDR3, and total size is 4+2GByte.

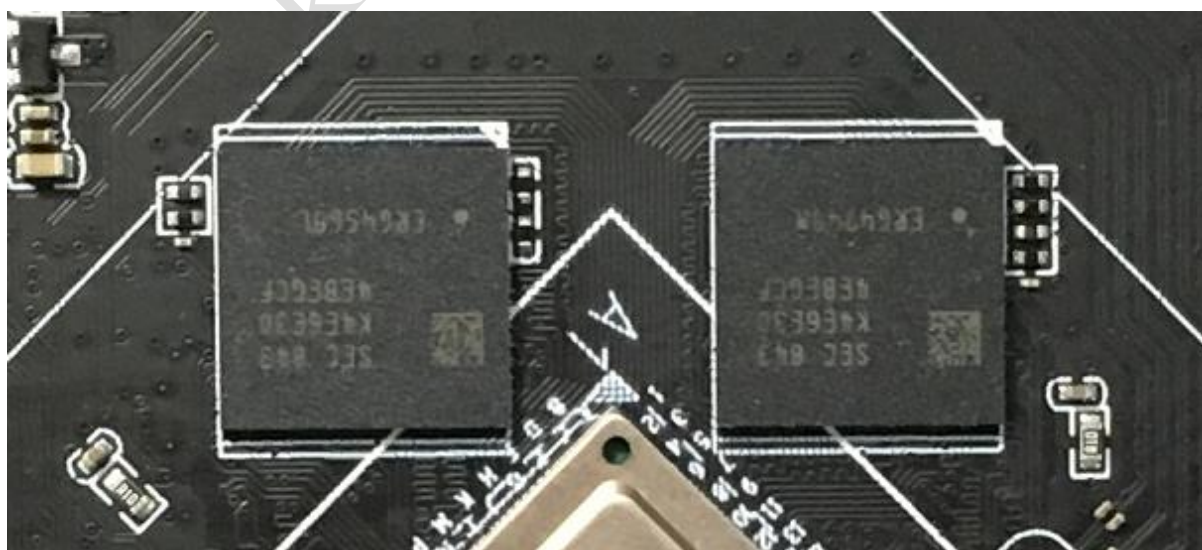


Figure 3-3 CPU LPDDR3



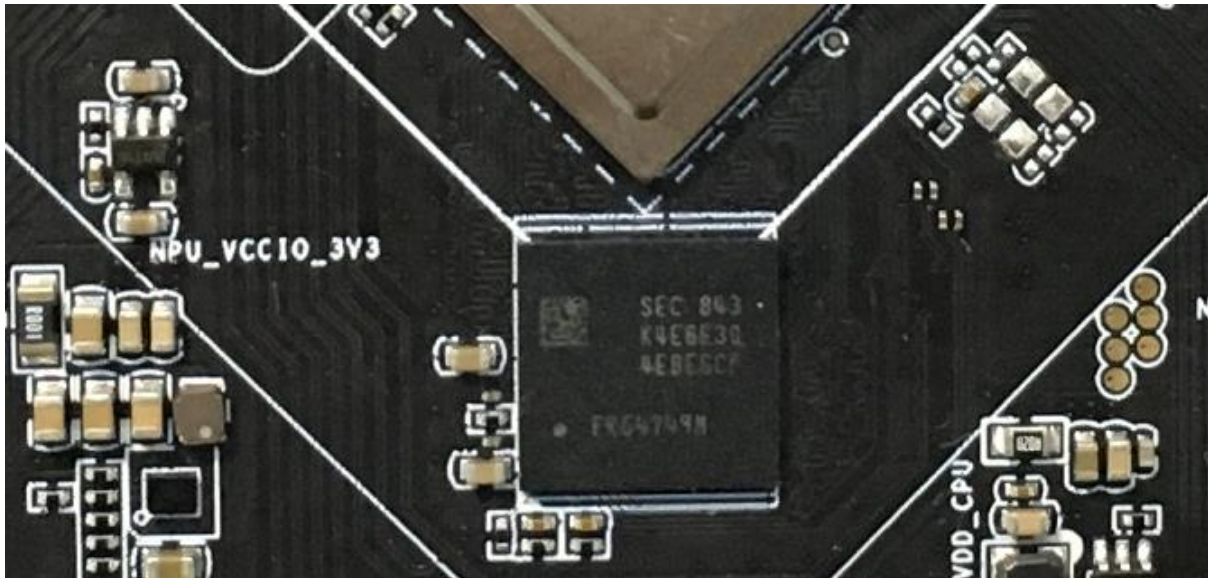


Figure 3-4 NPU LPDDR3

### 3.3 Button input

1. The EVB provides button application, uses RK3399Pro ADC\_IN2 as detection input, and supports 10bit resolution.
2. ADC power supply is provided by VCC\_1V8, and the corresponding key value can be calculated according to the resistance parameter in Figure 3-5.
3. The EVB defines several commonly used function buttons: VOL+/VOL-/MENU/ESC/HOME.
4. Connect USB, press and hold VOL+/Recovery then power on (or reset), enter into Rockusb(Recovery) mode for image download.

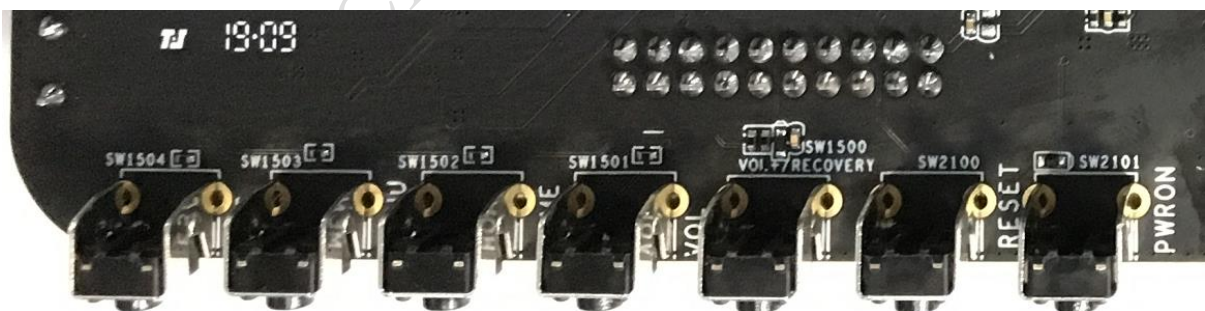


Figure 3-5 EVB buttons

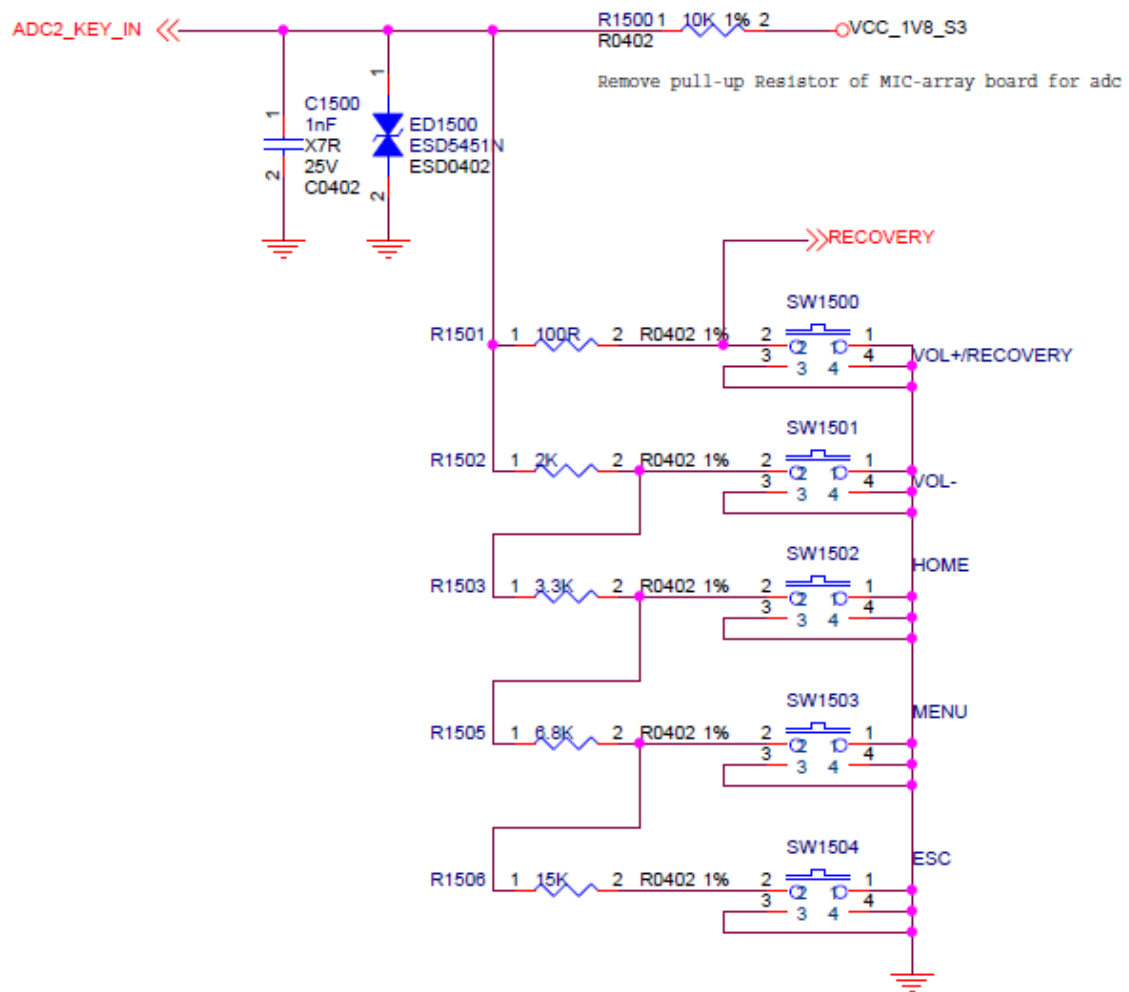


Figure 3-6 EVB button design

### 3.4 Sensor

The sensor used on the EVB is MPU6500 which is six-axis sensor. It can support acceleration and gyroscope detection as shown below:

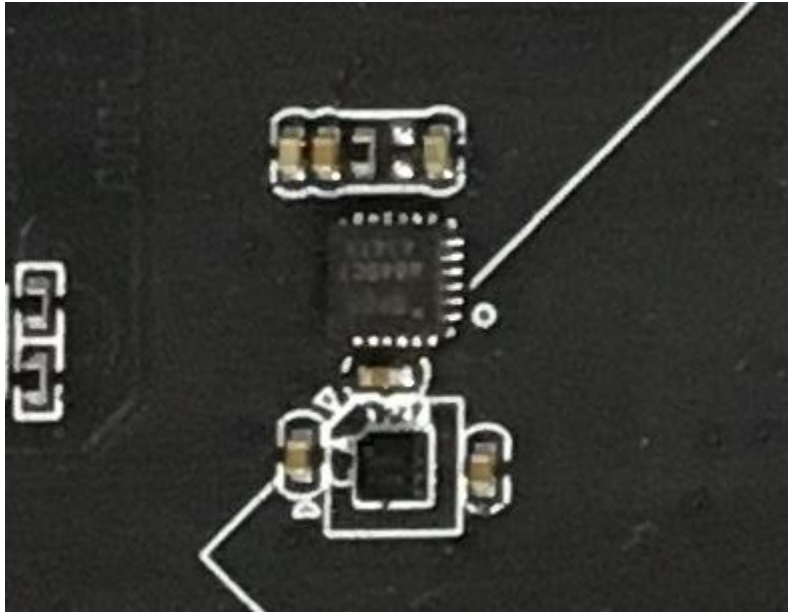


Figure 3-7 EVB sensor

### 3.5 Compass

The electronic compass used on the EVB is AK8963C, which is communicating with SoC via I<sup>2</sup>C. The location is shown as below.

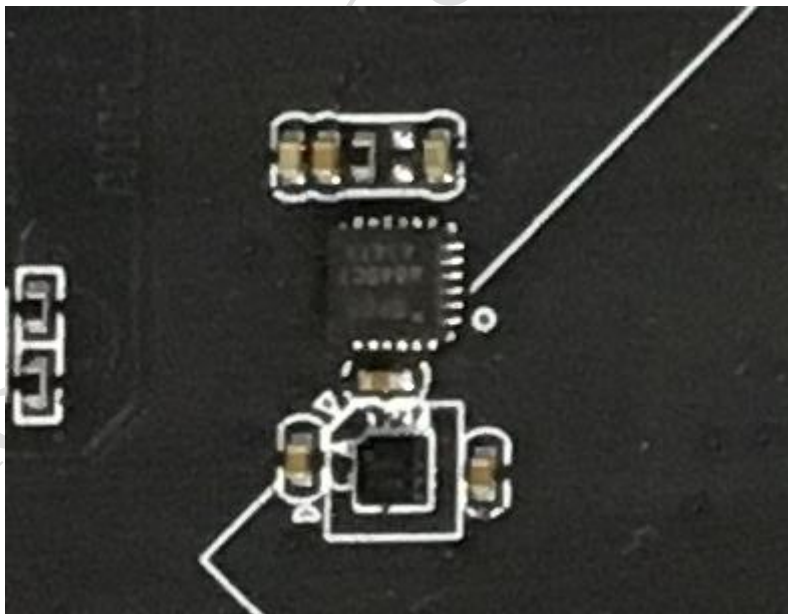


Figure 3-8 EVB compass

### 3.6 Audio input and output

The EVB audio uses the embedded Codec of RK809-1, equipped with ES7243 as ADC Loopback. It has the following features:

- Embedded Charge Pump, support stereo earphone output without capacitive

coupling.

- Embedded Class-D amplifier, can drive 1.3W/8ohm speaker output, and have over-current protection.
- Microphone supports single-end/differential input mode.

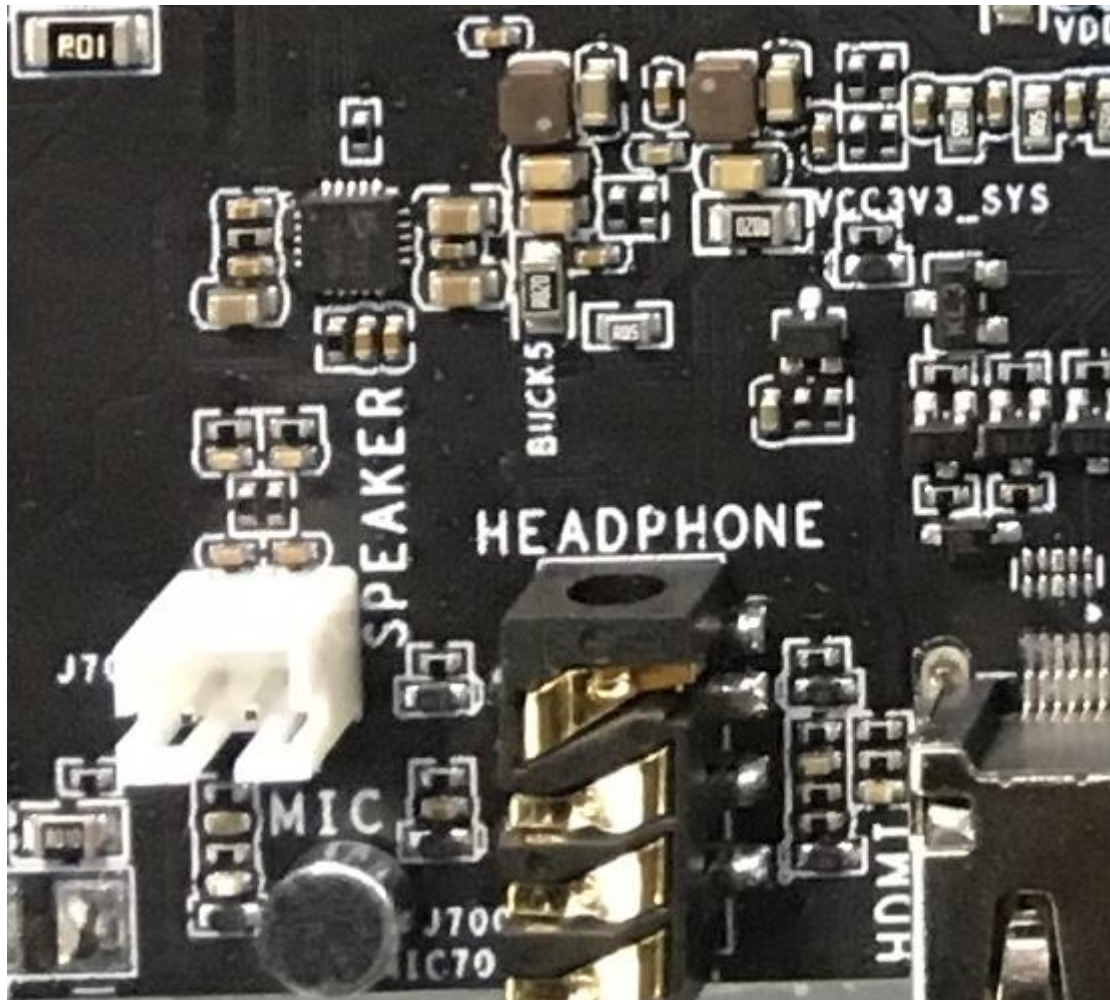


Figure 3-9 EVB audio input and output

### 3.7 USB Micro-B&USB Type-C Port

The USB Type-C port J2600 of the EVB is the image download port. In order to facilitate the use of customers, the EVB also reserves USB Micro-B port J2601, customers can use this port without additional purchase of cables.



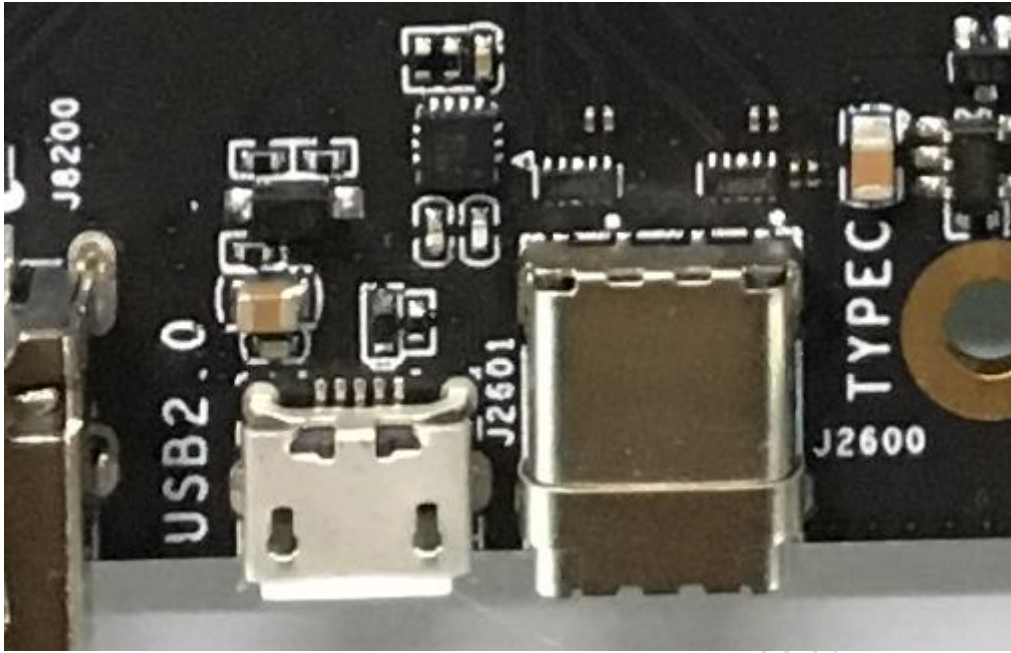


Figure 3-10 EVB USB port

### 3.8 TF Card connector

The EVB has TF card interface as shown below. It can supports SDMMC 2.0/3.0, and the data bus width is 4bits.

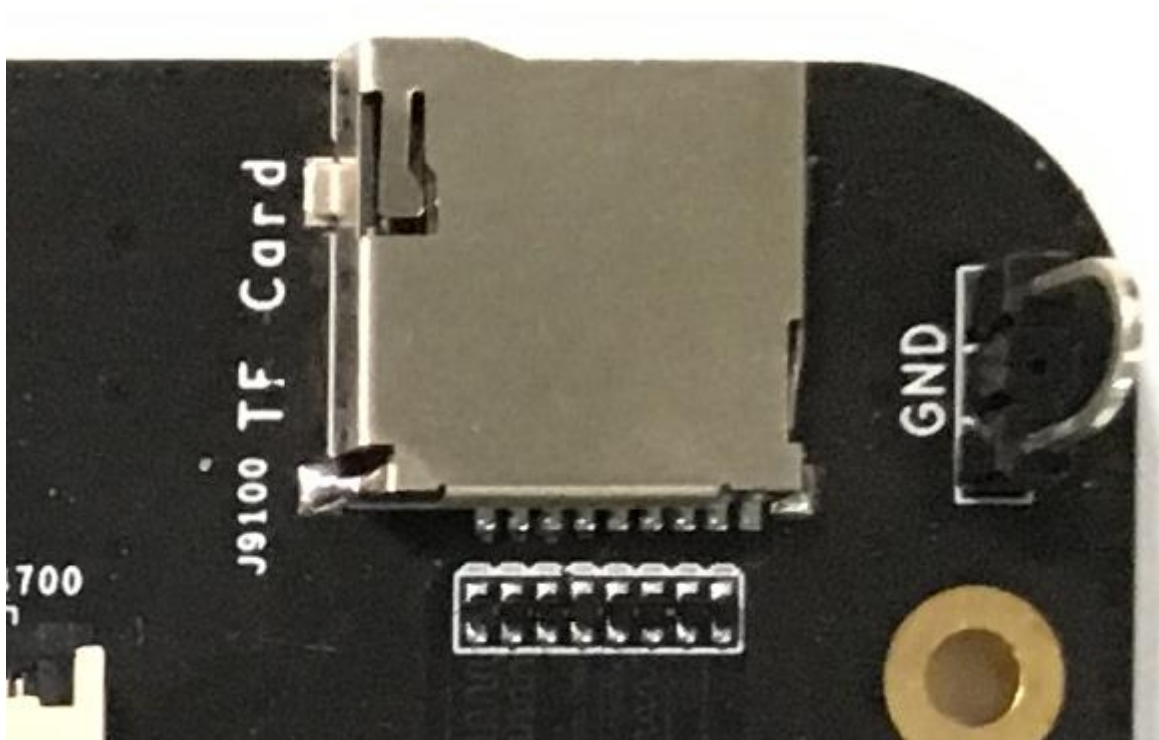


Figure 3-11 EVB TF card connector

### 3.9 Camera connector

The camera connector of the EVB supports MIPI-CSI and DVP camera modules. The connector is shown as Figure 3-12. When using camera, please pay attention to voltage matching, otherwise it will cause camera work abnormally or fail to work.

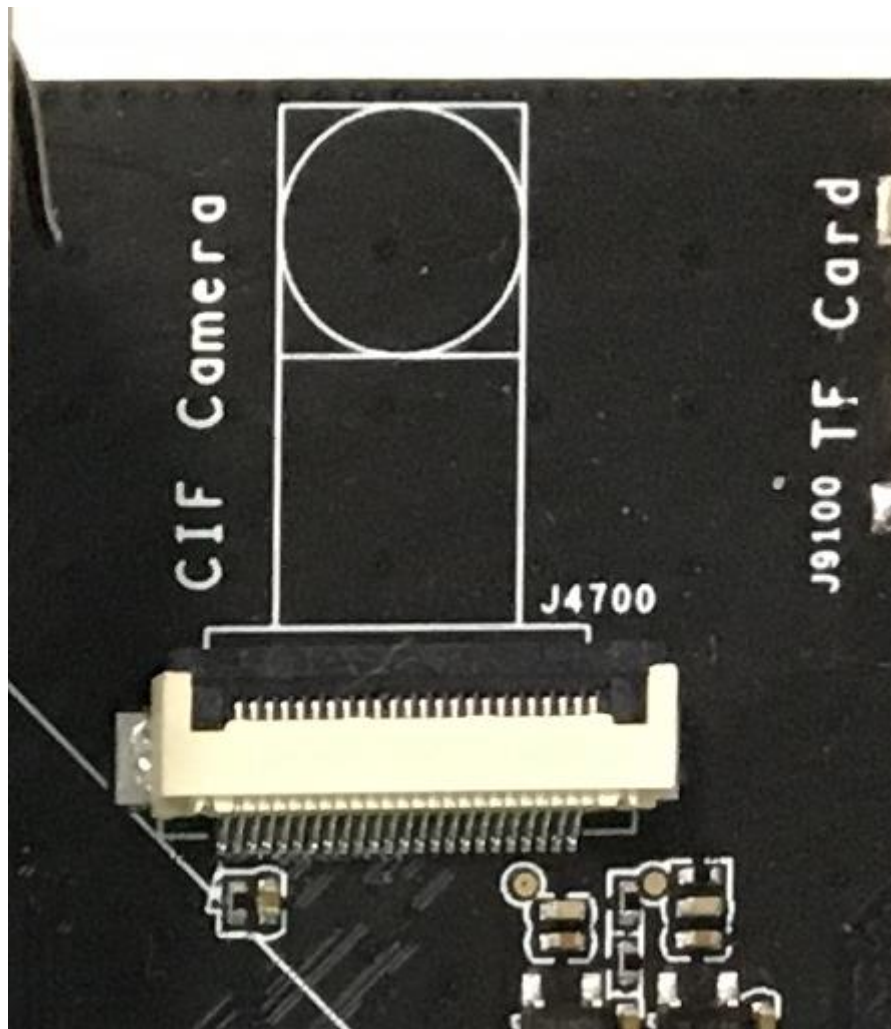


Figure 3-12 EVB DVP camera connector



Figure 3-13 EVB MIPI camera connector

Table 3-1 MIPI Camera net name and SoC pin name

MIPI Camera connector pin No.	MIPI Camera connector pin net name	SoC pin name
1	GND	GND
2	MIPI_D3N	MIPI_RX0_D3N
3	MIPI_D3P	MIPI_RX0_D3P
4	GND	GND
5	MIPI_D2N	MIPI_RX0_D2N
6	MIPI_D2P	MIPI_RX0_D2P
7	GND	GND
8	MIPI_CLKN	MIPI_RX0_CLKN
9	MIPI_CLKP	MIPI_RX0_CLKP
10	GND	GND
11	MIPI_D1N	MIPI_RX0_D1N
12	MIPI_D1P	MIPI_RX0_D1P
13	GND	GND
14	MIPI_D0N	MIPI_RX0_D0N
15	MIPI_D0P	MIPI_RX0_D0P
16	GND	GND
17	NC1	N/A
18	MIPI_MCLK0	CIF_CLKOUTA
19	VCC_IO	VCCIO_3V3_S0
20	NC2	N/A
21	MIPI_PDN	GPIO4_D4
22	NC3	N/A
23	I2C1_SCL_1V8	I2C1_SCL/GPIO4_A2_u
24	I2C1_SDA_1V8	I2C1_SDA/GPIO4_A3_u
25	NC4	N/A
26	MIPI_RST	GPI4_D2
27	GND6	GND
28	VCC_SYS_0	VCC5V0_SYS_S3
29	VCC_SYS_1	VCC5V0_SYS_S3
30	VCC_SYS_2	VCC5V0_SYS_S3

Table 3-2 DVP Camera net name and SoC pin name

DVP Camera connector pin No.	DVP Camera connector pin net name	SoC pin name
1	DVP_PDN1_H_1V8	GPIO4_D4
2	GND	GND
3	I2C1_SDA_1V8	I2C1_SDA/GPIO4_A3_u
4	VCC2V8_DVP	N/A
5	I2C1_SCL_1V8	I2C1_SCL/GPIO4_A2_u
6	CIF_RST	N/A
7	CIF_VSYNC	CIF_VSYNC/GPIO2_B0
8	DVP_PDN0_H	GPIO2_B4
9	CIF_HREF	CIF_HREF/GPIO2_B1
10	DVP_DVDD	N/A
11	DVP_DOVDD	VCCIO3
12	CIF_D7	CIF_D7/GPIO2_A7
13	CIF_CLKOUT	CIF_CLKO/GPIO2_B3
14	CIF_D6	CIF_D6/GPIO2_A6
15	GND	GND

16	CIF_D5	CIF_D5/GPIO2_A5
17	CIF_CLK_IN	CIF_CLKI/GPIO2_B2
18	CIF_D4	CIF_D4/GPIO2_A4
19	CIF_D0	CIF_D0/GPIO2_A0
20	CIF_D3	CIF_D3/GPIO2_A3
21	CIF_D1	CIF_D0/GPIO2_A1
22	CIF_D2	CIF_D2/GPIO2_A2
23	NC	N/A
24	NC	N/A

### 3.10 WI-FI/BT module

The WI-FI/BT module of the EVB is Taiwan AMPAK AP6398S module as shown in Figure 3-14. It has the following features:

- Support WI-FI (802.11 ac/a/b/g/n), BT5.0 function.
- BT data is transmitted through UART.
- BT voice is transmitted through PCM.
- WI-FI data supports 4bits SDIO 3.0.

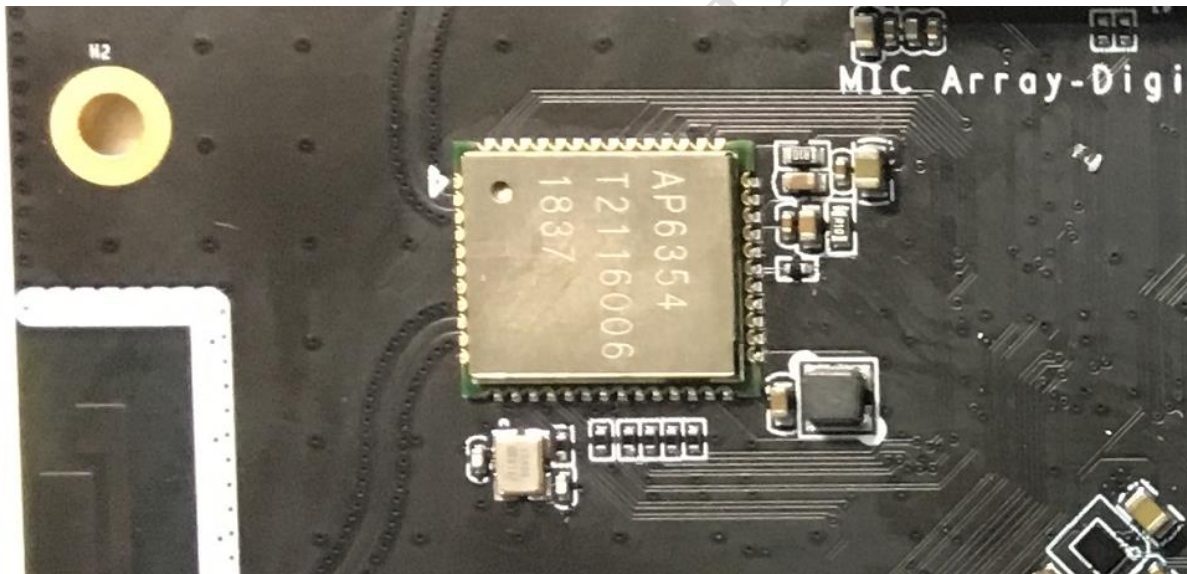


Figure 3-14 EVB WI-FI/BT module

### 3.11 LCM MIPI connector

The MIPI panel output of the EVB is shown as below:





Figure 3-15 EVB MIPI LCM

### 3.12 LCM EDP connector

The EVB default uses EDP panel as shown below.

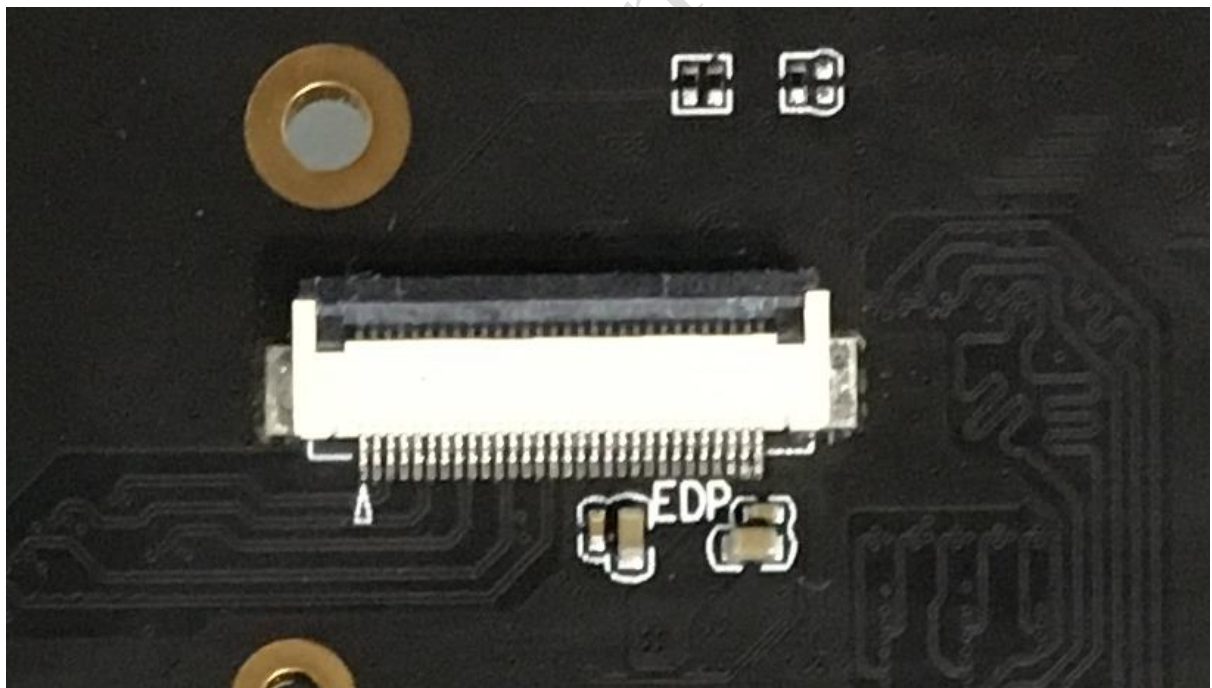


Figure 3-16 EVB EDP LCM

### 3.13 UART Debug connector

The EVB provides serial port for debugging. FT232RL highly integrated FT232-USB interface conversion chip is used as following.



Figure 3-17 EVB UART debug port (USB Micro-B)

### 3.14 JTAG Debug connector

The EVB uses standard 20pin JTAG debug connector as shown below, which is convenient for customers to do the debugging and development through it.



Figure 3-18 EVB JTAG debug connector

### 3.15 PCIe x4 slot

The EVB reserves standard PCIe x4 slot as shown below, which is convenient for customers to debug PCIe device.

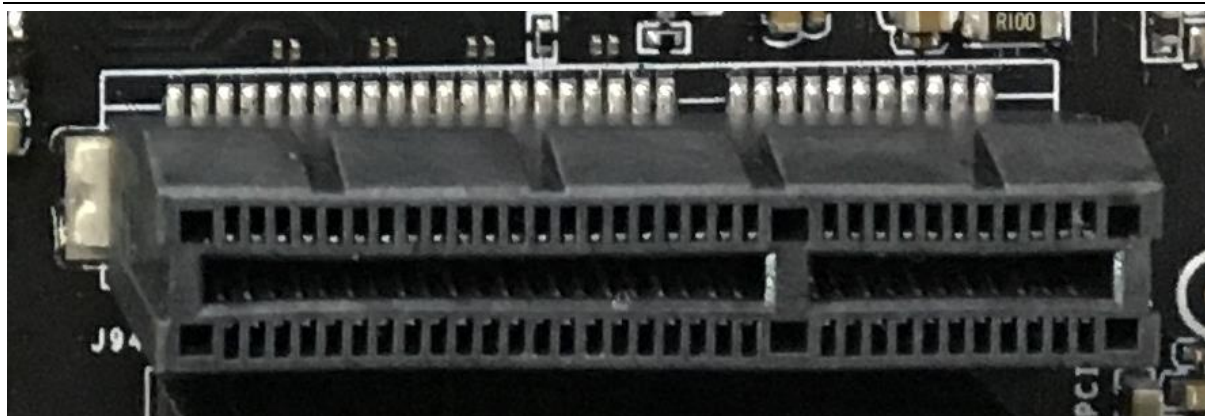


Figure 3-19 EVB PCIe x4 slot

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## 4.EVB usage

### 4.1 EVB power on/off and standby

EVB power on and power off method is described as below.

#### 4.1.1 Power on:

- If use DC 12V for power supply, turn on the power switch, short press power button over 0.5s, and then EVB will power on.
- If use 1-cell Li-battery for power supply, short press power button over 0.5s, and then EVB will power on.

#### 4.1.2 Power off:

Long press Power button for over 2s, and click power off on the display panel.

#### 4.1.3 Abnormal power off:

- If use 1-cell Li-battery for power supply, in abnormal case, long press Power button for over 8s can force to power off, or press Reset button to reset EVB.
- If use DC 12V for power supply, in abnormal case, except the above method, turn off the power switch also can power off the power of the EVB.

#### 4.1.4 Standby:

In desk or application case, press Power button, the system will enter standby mode. If not connecting with USB, without any operation, the system will enter into deep sleep after a while.

### 4.2 USB driver installation

EVB needs to install USB driver before image download, driver upgrading and ADB debug. The driver tool path is:

Open "DriverInstall.exe" in the directory of SDK\RKTools\windows\Release\_DriverAssitant, click "driver install", and then waiting for it prompts "install driver successfully". If there is old driver installed, please click "driver uninstall", and re-in



stall the driver.

The driver only supports Windows currently.

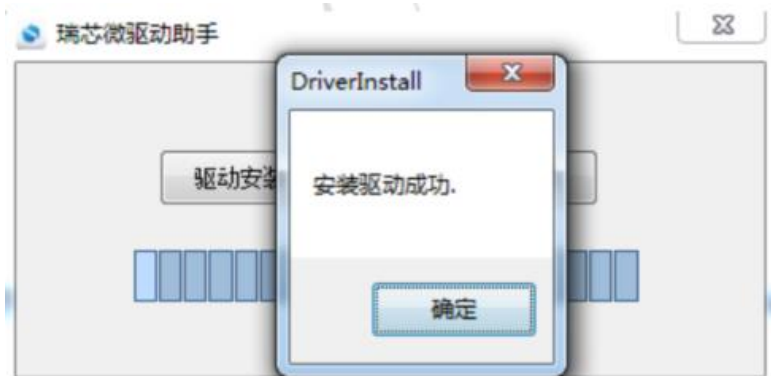


Figure 4-1 Driver install successfully

## 4.3 EVB image download

RK3399Pro EVB has two kinds of image download methods.

### 4.3.1 Maskrom download mode

The basic principle is to short connect FLASH\_D0 with GND before the system is power on, to make Flash fail to load, and then enter into Maskrom state. It is applicable for the case when download the wrong bootloader image so that the system cannot be power on normally.

The detailed steps are as below:

- Connect USB to PC, press and hold the Maskrom button of the EVB.
- Supply 12V for EVB, and turn on the switch. If it is already power on, please press the reset button.
- Wait for a while, the development tool will display "find a Maskrom device". Need to note that in Maskrom mode the corresponding miniLoader should be selected for upgrading.
- Select the corresponding image files.
- Click execute to enter the upgrading state, there is the progress bar in the right box of the tool to display the download and verification status.

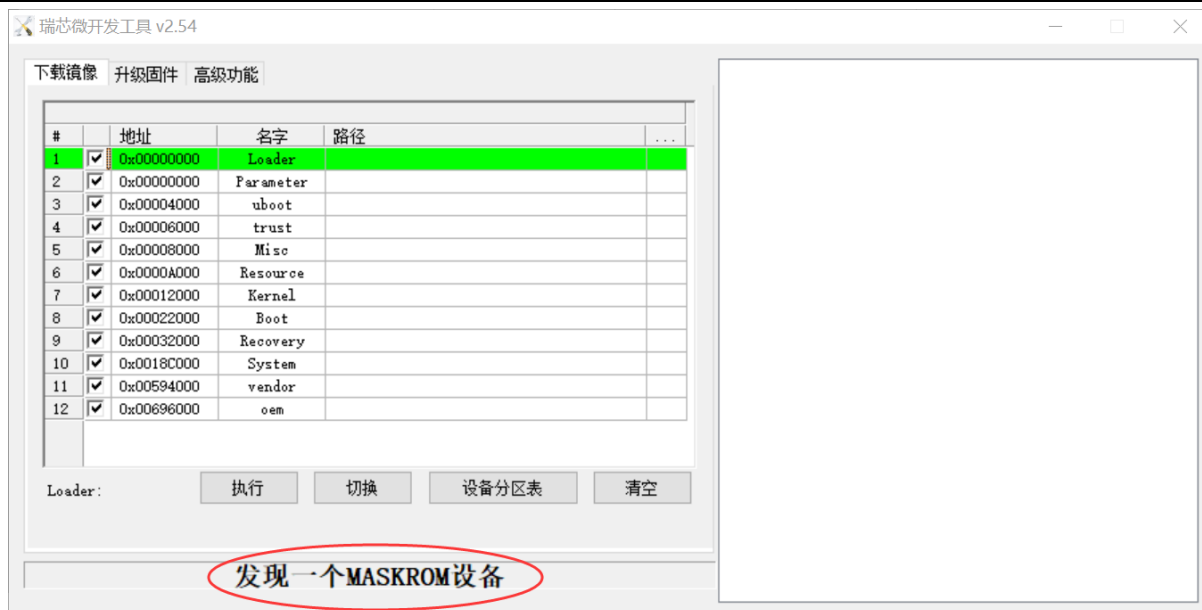


Figure 4-2 Maskrom download mode

### 4.3.2 Loader download mode

The basic principle is to ensure ADC2\_KEY\_IN is low level before the system is power on or reset, and the system will enter into recovery state after power on or reset. It is applicable for updating some part or whole of the image in normal.

The detailed steps are as below:

- Connect USB to PC, press and hold the Vol+/RECOVER button of the EVB.
- Supply 12V for EVB, and turn on the switch. If it is already power on, please press the reset button.
- Wait for a while, the development tool will display "find a Loader device".  
Need to note that in Loader mode there is no need to download the whole image, you can select the image file to be updated.
- Select the corresponding image file.
- Click execute to enter the upgrading state, there is the progress bar in the right box of the tool to display the download and verification status.

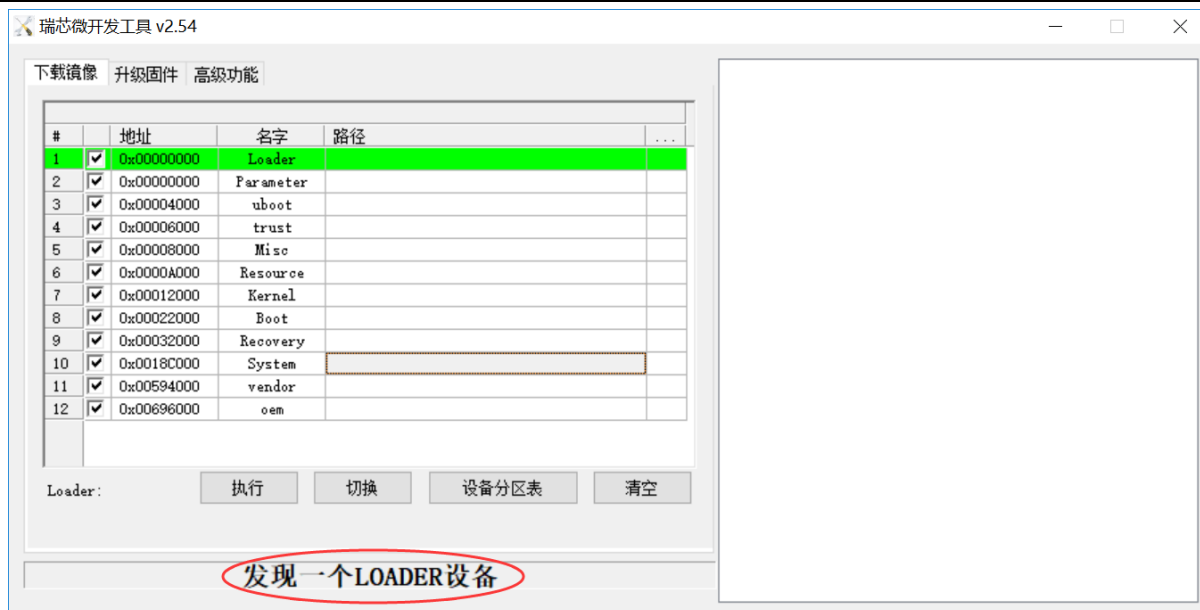


Figure 4-3 Loader download mode

## 4.4 Serial port debug

### 4.4.1 Connect serial port

Connect USB Debug port of EVB to PC, and obtain current comm port number in the device manager of PC.

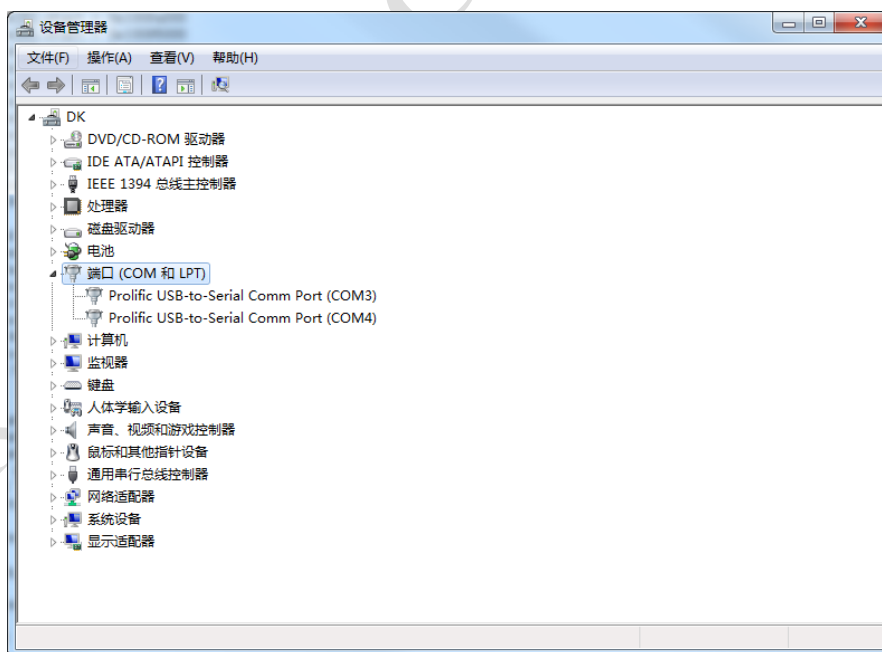


Figure 4-4 Obtain current comm port number

Open serial port tool "SecureCRT", click "quick connection" button.

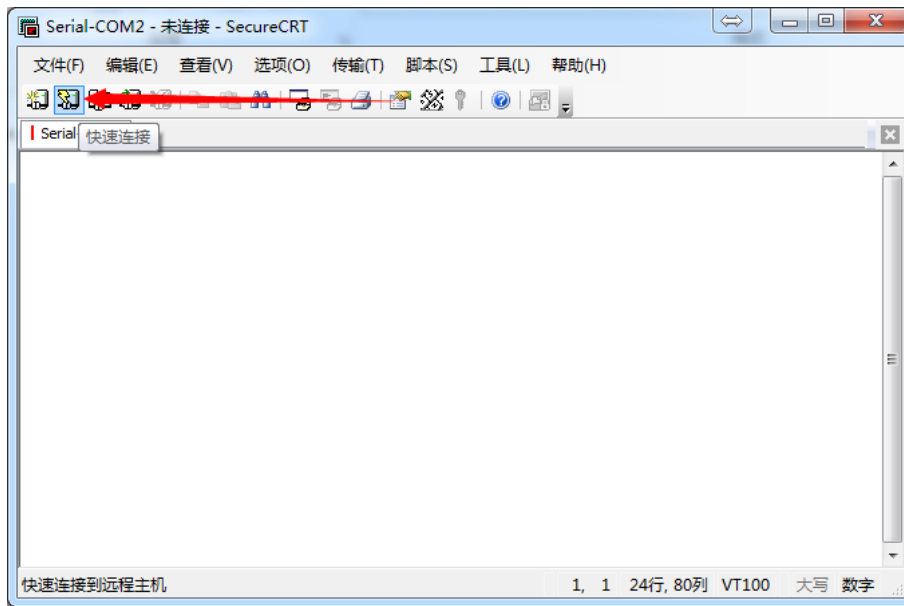


Figure 4-5 SecureCRT windows

Configure the serial port, the port selects the port number connected with the EVB, baud rate selects 1.5M, flow control RTS/CTS doesn't need to select.

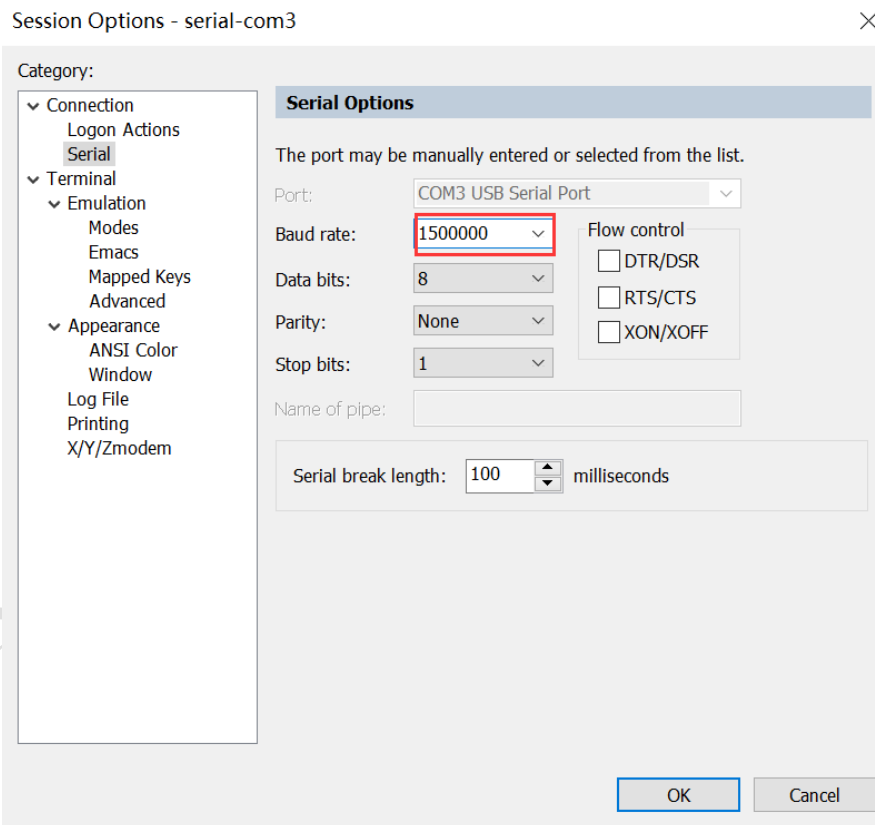


Figure 4-6 Configure serial port information

Click connection, and then it will connect the device normally. Configure session option to make debugging convenient, click "Session Option" of the tool bar, it can save more log information if Scrollback buffer is set with bigger value.

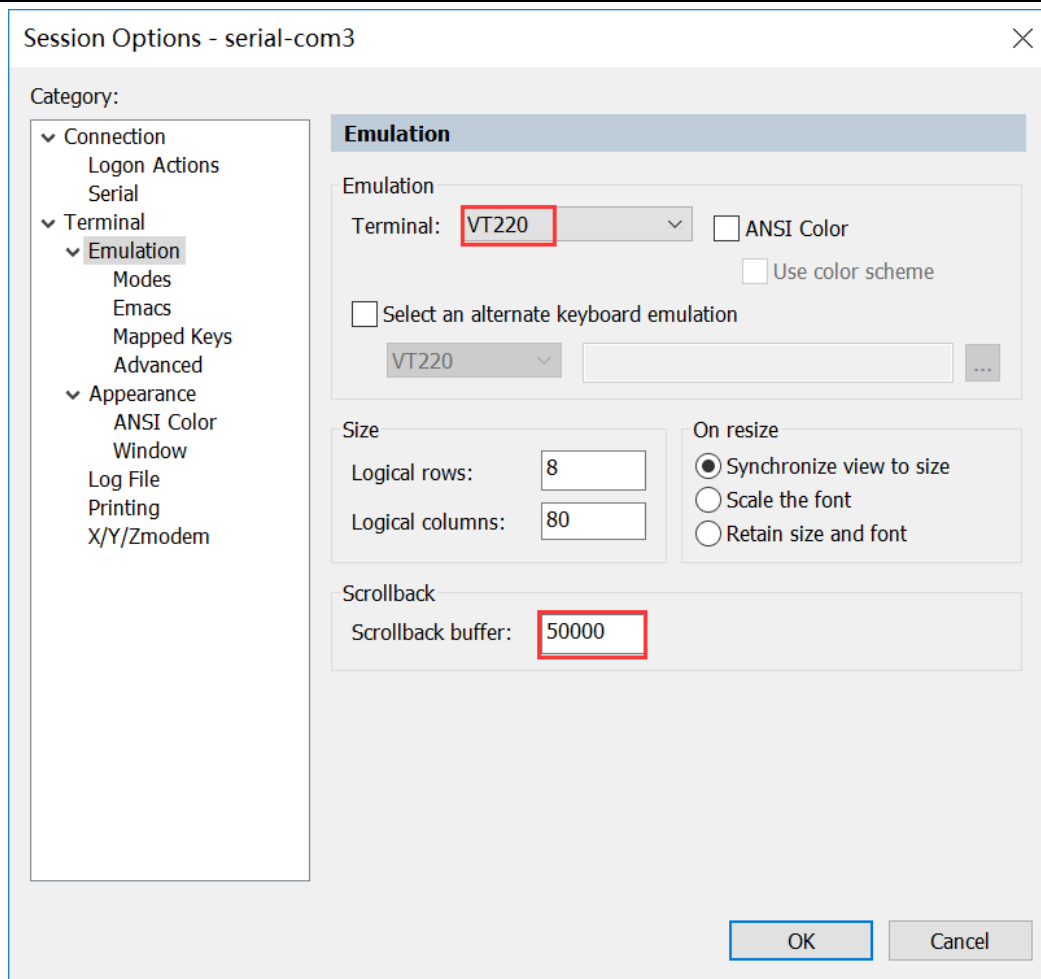


Figure 4-7 Configure serial port tool option

#### 4.4.2 ADB debug

The ADB connection steps are as follows:

- Make sure the driver is installed successfully, and PC connects with USB port of the development board.
- The EVB is power on, enter the system setting option, select "developer options", and select "USB debugging".
- In PC side, click "start---run", input "cmd", enter the directory of adb.exe tool, input "adb devices", it means the connection is normal if can inquire the connected device.
- Input "adb shell", and enter ADB debug mode.

run - adb shell

```
F:\RK\Driver\adb tools>adb shell
rk3326:/ $
rk3326:/ $ su
su
rk3326:/ #
rk3326:/ #
rk3326:/ #
```

Figure 4-8 ADB connects normally

## 5. Notice

### 5.1 Notice

RK3399Pro EVB is suitable for lab or engineering development environment.

Please read below notices before operation:

- Under no circumstance can the panel interface of the EVB and the expansion board be hot-plugged.
- Before unpacking and installing the EVB board, please take the necessary anti-static measures to avoid the damage to the hardware of the EVB board caused by ESD.
- Please hold the edge of the EVB board, and do not touch the exposed metal part of the EVB board, so as to avoid the electrostatic damage to the components of the EVB board.
- Please place RK3399Pro EVB board on the dry surface to keep them away from heat source, electromagnetic interference source and radiation source, electromagnetic radiation sensitive equipment (such as medical equipment) and so on.