Rockchip
瑞芯微电子

Rockchip RK3399 User Manual for Industrial EVB

Release Version:V1.1

Date:2020.03.20

Preface

Overview

This document mainly describes RK3399 IND EVB basic functions and hardware characteristics, multifunctional hardware configuration and the debugging method of software, aiming to help developers to use RK3399 Evaluation board more quickly and correctly, and familiar with RK3399 SOC solution.

Product Version

The corresponding product version of the document is as below:

Product Name	Product Version
IND EVB	RK_IND_EVB_RK3399_LP4D200P232SD8_V12_20200109
eDP panel (iPADmini2 Resolution 1536 x 2048)	RK_EVB_ExtBoard_eDPDisplay_V10_20171013

Applicable Object

This document is mainly suitable for below engineers:

- Field application engineer
- Single board hardware development engineer
- Software development engineer
- Test engineer

Revision History

The revision history accumulates instructions for each update of the document.

Version	Author	Revision Date	Revision Description	Remark
V1.0	Pan Leng	2019-11-29	Initial Release	
V1.1	Pan Leng	2020-03-20	Modify the power of USB controller and the allocation of I2S	

Acronym

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

Acronym	English Description	Chinese Description
eDP	Embedded Display Port	嵌入式数码音视讯传输接口
HDMI	High Definition Multimedia Interface	高清晰度多媒体接口
I^2C	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
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
SPDIF	Sony/Philips Digital Interface Format	SONY、PHILIPS 数字音频接口
TF Card	Micro SD Card(Trans-flash Card)	外置记忆卡
USB	Universal Serial Bus	通用串行总线
TYPE-C	Universal Serial Bus TYPE-C	通用串行总线
USB 3.0	Universal Serial Bus	通用串行总线
PCIE	Peripheral Component Interconnect Express	外围组件快速互连

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1.1 RK3399 chip overview

RK3399 is a low power and high performance processor based on Big-Little architecture, which includes dual-core ARM cortex–A72 and quad-core ARM cortex-A53, can be applied to computer, tablet, personal mobile internet, digital multimedia equipment, server and AI products.

It can support multi-format video decoder including H.264/H.265/VP9 up to 4Kx2K@60fps, especially H.264/H.265 10bits encoding, H.264/MVC/VP8 1080p@30fps decoding, and high quality JPEG encoder/decoder and pre-processing and post-processing of special image. Embedded 3D GPU makes RK3399 completely compatible with OpenGL ES1.1/2.0/3.0/3.1, OpenCL and DirectX 11.1.

RK3399 has high performance dual channel external memory interface, to ensure the memory bandwidths for system running with high capacity and stability. It supports DDR3, DDR3L, LPDDR3, LPDDR4 and other memory types.

1.2 RK3399 chip block diagram

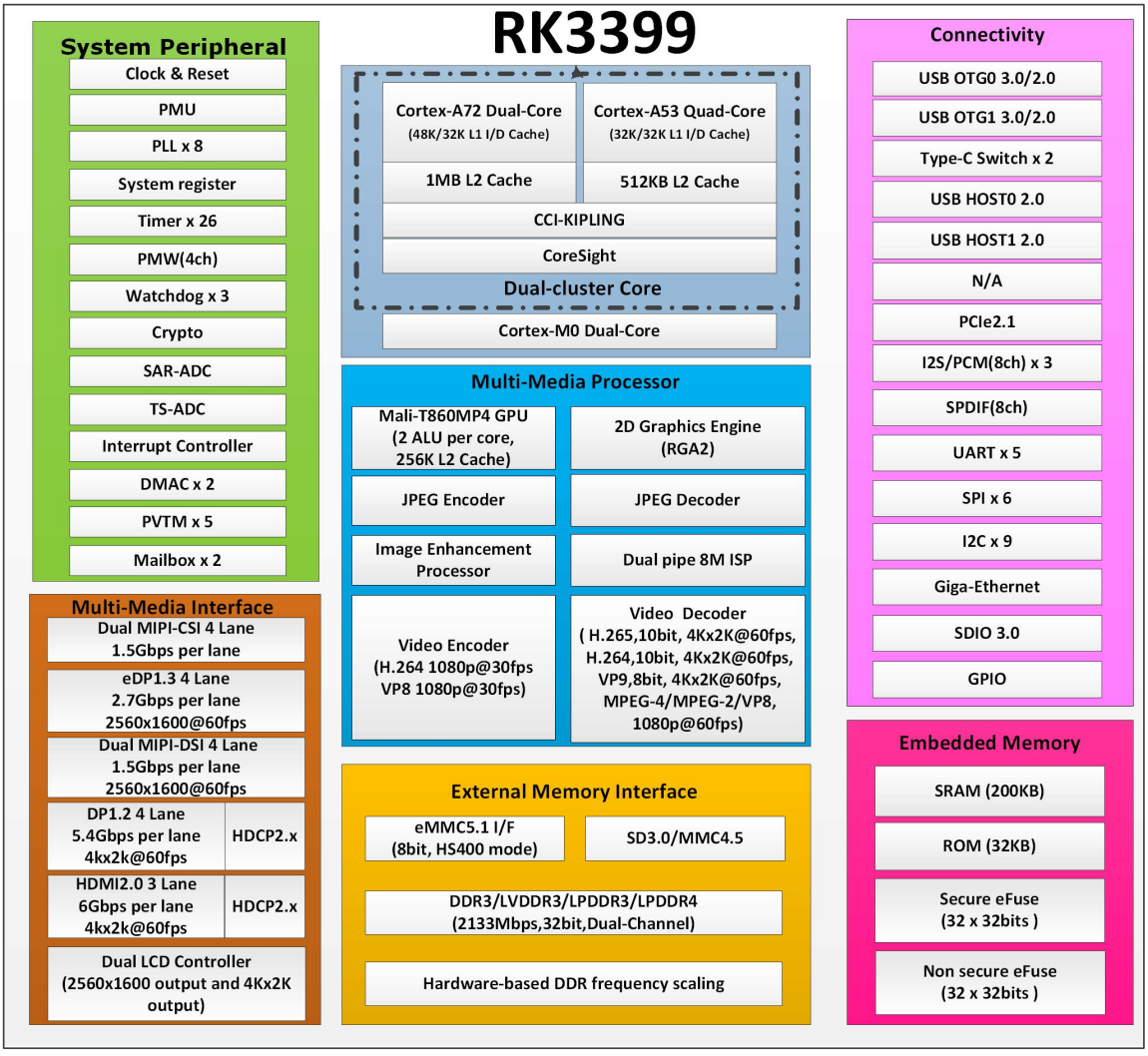

Figure 1- 1 RK3399 chip block diagram

1.3 IND EVB system block diagram

1.3.1 RK3399 IND EVB system block diagram

RK3399 IND EVB system uses RK3399 as the core chip of the system, PMIC RK809 as the power management chip, with peripheral BUCK and LDO power chip, LPDDR4, eMMC and peripheral function devices to integrate a stable production solution. The detailed block diagram is as below:

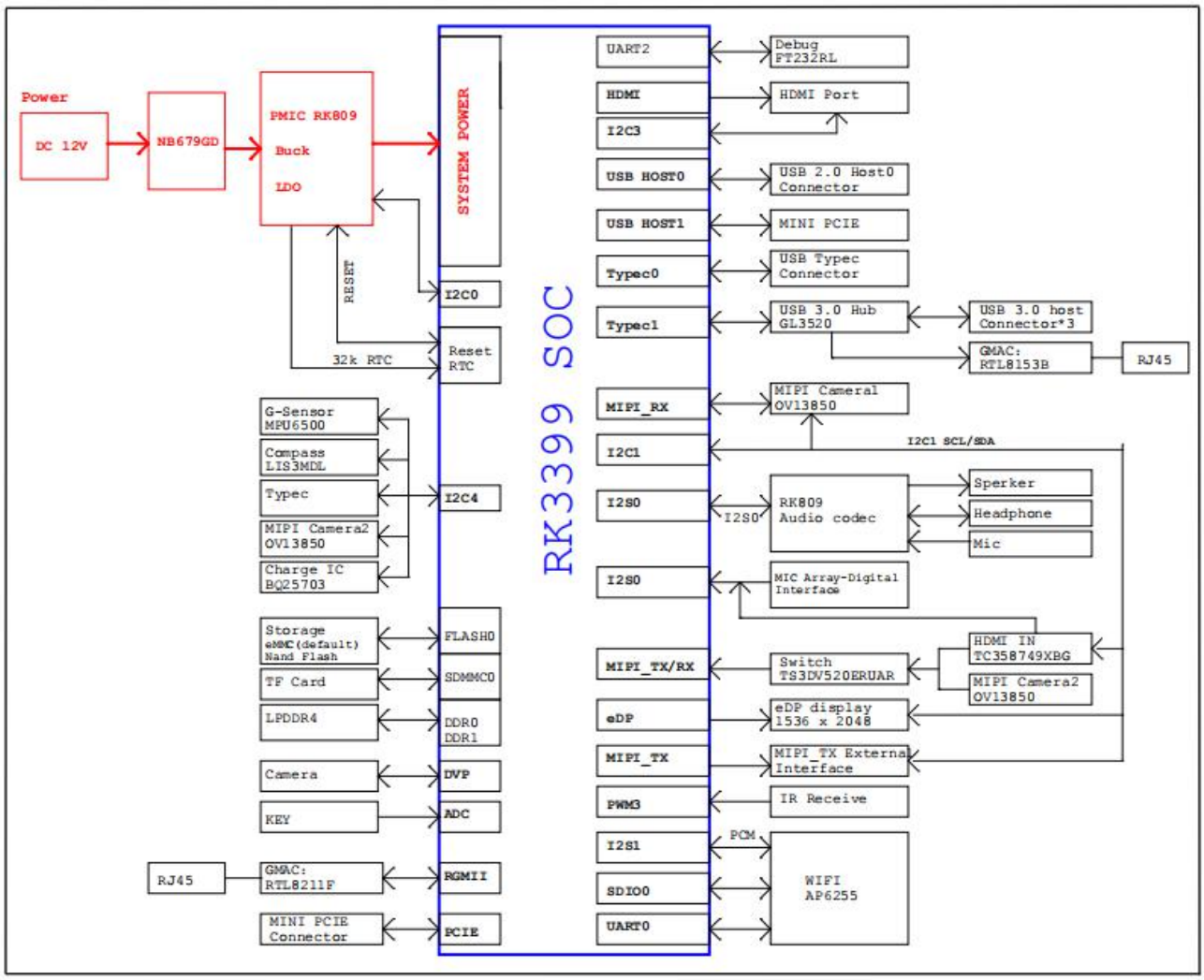

Figure 1- 2 RK3399 IND EVB system block diagram

1.3.2 Function overview

RK3399 IND EVB includes the following functions:

- ✧ Three kinds of MIPI channel: MIPI TX externally connected to MIPI panel, MIPI_RX externally connected to MIPI camera, MIPI_TX/RX with MIPI_TX externally connected to dual MIPI camera or connected to HDMI_IN interface.
- ✧ GPIO/SPI/I2C/UART interface: the same interface sequence definition as Raspberry Pi, provide rich low-speed extension interface for users, convenient for module debugging.
- ✧ MIC Array interface: I2S Signal, users can externally connect MIC array board, currently there is no corresponding conversion board available, users need to design by themselves.
- ✧ TF Card: It can externally connect TF card, extending the system memory capacity.
- ✧ USB 3.0 HOST: It can connect mouse, U disk, USB HUB and other devices.
- ✧ USB 2.0 HOST: It can connect mouse, U disk, USB HUB and other devices.

- ✧ RS485: support to externally connect the bus devices which conform to RS485 standard.
- ✧ CIF: support to externally connect the bus camera module with standard DVP interface.
- ✧ eDP 1.3 (4 lanes with 10.8Gbps): externally connect eDP panel, the system display screen.
- ✧ TOUCH: the touch IC type is GSL3673.
- ✧ HDMI OUT: support output up to 4K@60Hz.
- ✧ System Key: including Power key, system power on/off, sleep/resume, VOL+/Recovery key, system Loader upgrade, VOL- key, Reset key, Maskrom key.
- ✧ Ethernet: support 100M and 1000M Ethernet.
- ✧ USB3.0 to Ethernet: support 100M and 1000M Ethernet.
- ✧ Audio interface: support speaker, headphone output and single/multi MIC audio recording.
- ✧ HDMI IN: external HDMI TO MIPI_CSI conversion IC. The signal path is: conversion IC to receive HDMI signal, process and analyze, then output MIPI_CSI signal to RK3399 for processing, and then display through RK3399 display interface eDP or HDMI OUT.
- ✧ SDIO WIFI (1x1 wifi&4.1 BT): WIFI type is AP6255, external antenna with SMA interface, support wireless internet function.
- ✧ MINI PCIE interface: support 4G module, allow users to debug PCIE SATA devices.
- ✧ IR Receive: IR remote controller input.
- ✧ UART Debug: used to check LOG information for user debugging.
- ✧ Sensor: including multiple sensor devices such as Gyroscope, G-sensor, Compass.
- ✧ USB TYPEC0 interface: the channel to upgrade system image.

1.3.3 PCB function interface:

IND EVB function	
LPDDR4 (2x32bit total size 4G)	YES
EMMC（total size 16G）	YES
TF Card	YES
HDMI IN	YES
System Key	YES
SPDIF OUT	YES
SDIO WIFI（1x1 WIFI&4.1 BT）	YES
Mini PCIE Interface	YES
HDMI OUT	YES
MIC IN	YES
SPK OUT	YES
Gyroscope+ G-sensor（MPU6500）	YES
RS485	YES
Compass（AK8963C）	YES
eDP out（1536x204）	YES
MIPI_TX interface	YES
MIPI_RX interface	YES
MIPI_TX/RX interface	YES
UART Debug	YES
MIC Array Interface	YES
IR Receive	YES
Raspberry Pi compatible Interface &CIF	YES
USB2.0 Host(1 Port)	YES
USB3.0 Host(3 Port)	YES
USB Type-C0	YES
RGMII 10M/100M/1000M	YES
USB3.0 to Ethernet	YES

Table 1- 1 PCB function interface introduction

Note: YES means the function interface available on pcb.

1.3.4 Function module layout:

IND EVB function interface layout:

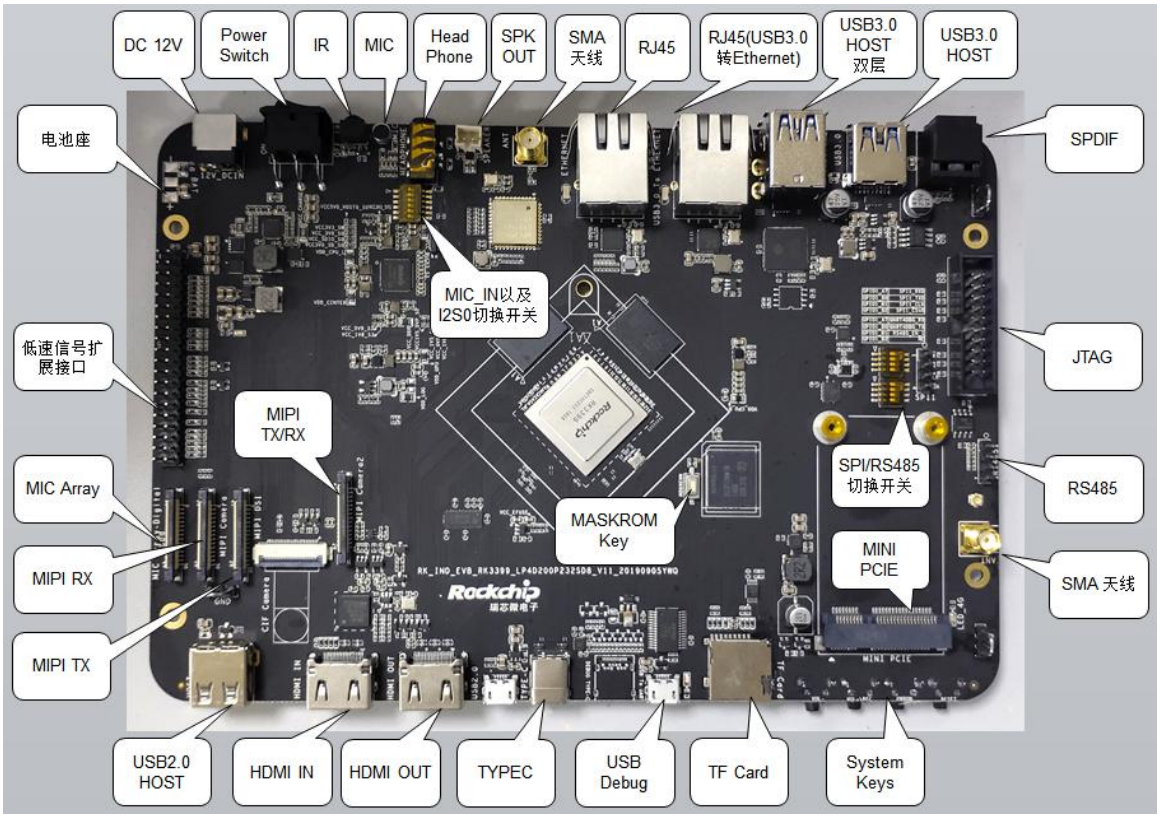

Figure 1- 3 IND EVB function interface picture

1.4 IND EVB development board component

IND EVB has the following two configurations for different users:

1. Open source user & development enthusiast: IND EVB.
2. Tablet & VR user: IND EVB, eDP panel (iPADmini2 resolution 1536 x 2048).

The standard power spec of the two configurations: input 100V AC~240V AC, 50Hz, output 12V DC, 2A.

1.5 IND EVB power on/off and standby

IND EVB power on and power off method is described as below:

1．Power on method:

Use DC 12V as power supply, turn on the power switch, and it will power on.

Use two batteries as power supply, need to press and hold Power button for 2s to power on.

2．Power off method:

Long press Power button for 6 seconds, and the system will shut down. If DV 12V adapter is connected, it will reboot, which is normal.

3．Standby method:

Press Power button, and the system will enter standby mode. If not connecting with USB OTG, without any other operation (such as key operation), and software also does not have wake_lock source, the system will enter deep sleep mode from standby mode after 3s around.

1.6 IND EVB driver upgrading

1.6.1 USB driver installation

IND EVB needs to install the driver first before upgrading the driver. The tool path is:

Open “DriverInstall.exe” in the directory of SDK\RKTools\windows\Release_DriverAssitant, click “driver install”, and then waiting for it prompts “driver install successfully”.

Basically, the driver file could support all current operation systems.

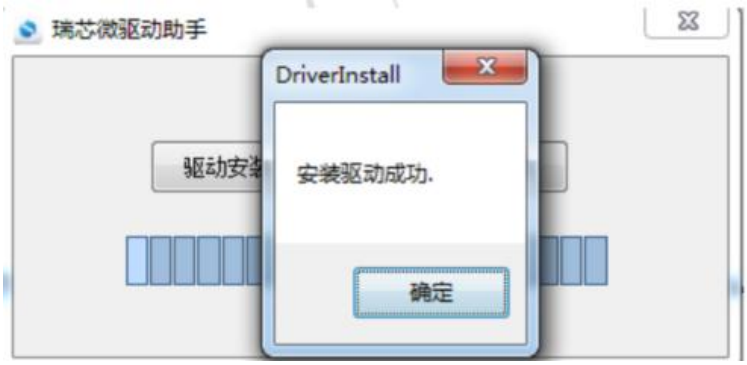

Figure 1- 4 Driver install successfully

1.6.2 Driver upgrading method

RK3399 IND EVB driver upgrading has two methods:

Entering Maskrom to upgrade:

Short connect EMMC_CLKO to GND before the system is powered up, to make eMMC fail to load, and then enter Maskrom state.

The detailed steps are as below:

1. Connect USB OTG to PC, press and hold Maskrom button on the main board.

2. Supply 12V for EVB, press reset button if it is already powered up.

3. Wait for a while, the flashing tool will display “find a Maskrom device”, and then release Maskrom button. Need to note that in Maskrom mode the corresponding Loader should be selected at the same time for upgrading.

4. Select Loader, Parameter, Misc, Kernel, Resource, System and other files accordingly in the flashing tool.

5. Click execute button to enter upgrading state. There is the progress bar in the right box of the tool to display the download and verification status.

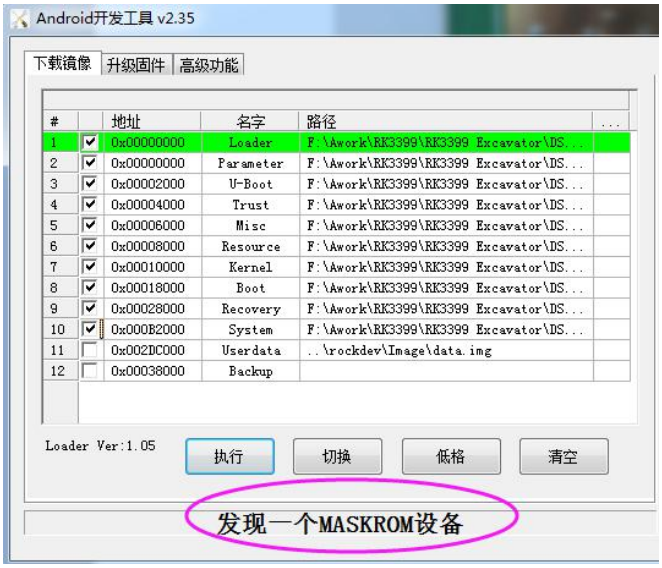

Figure 1- 5 Tool display after entering Maskrom flashing mode

Entering Loader to upgrade:

Ensure ADKEY_IN is low level before the system is powered up and the system will enter Loader mode.

The detailed steps are as below:

1. Connect USB OTG to PC, press and hold the Vol+/RECOVER button on the main board.
2. Supply 12V for EVB, Press the reset button if it is already powered up.
3. Wait for a while, the flashing tool will display “find a Loader device”, release Vol+/RECOVER button.
4. Select Loader, Parameter, Misc, Kernel, Resource, System and other files accordingly in the flashing tool.
5. Click execute button to enter the upgrading state. There is the progress bar in the right box of the tool to display the download and verification status.

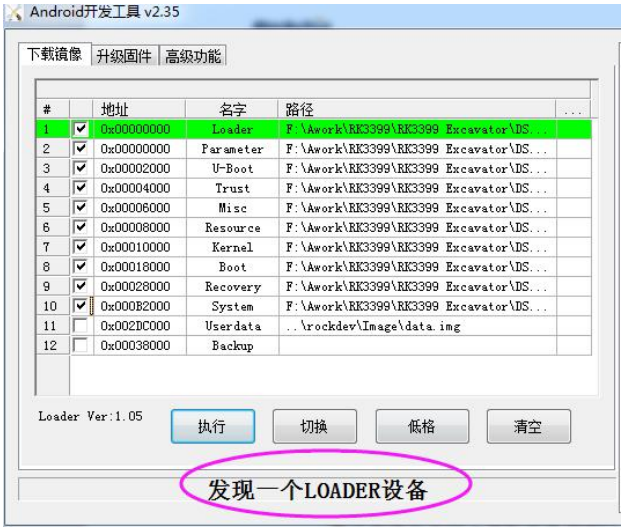

Figure 1- 6 Tool display after entering Loader flashing mode

1.7 Serial port debugging

1.7.1 SecureCRT serial port tool

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

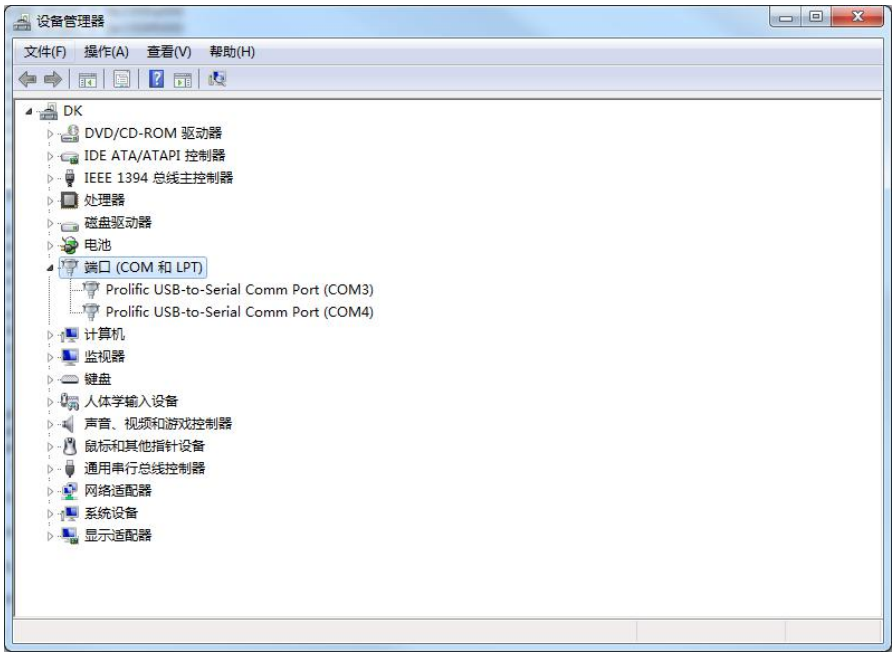

Figure 1- 7 Obtain COM number of current port

Open serial port tool “SecureCRT” and click “quick connection” button.

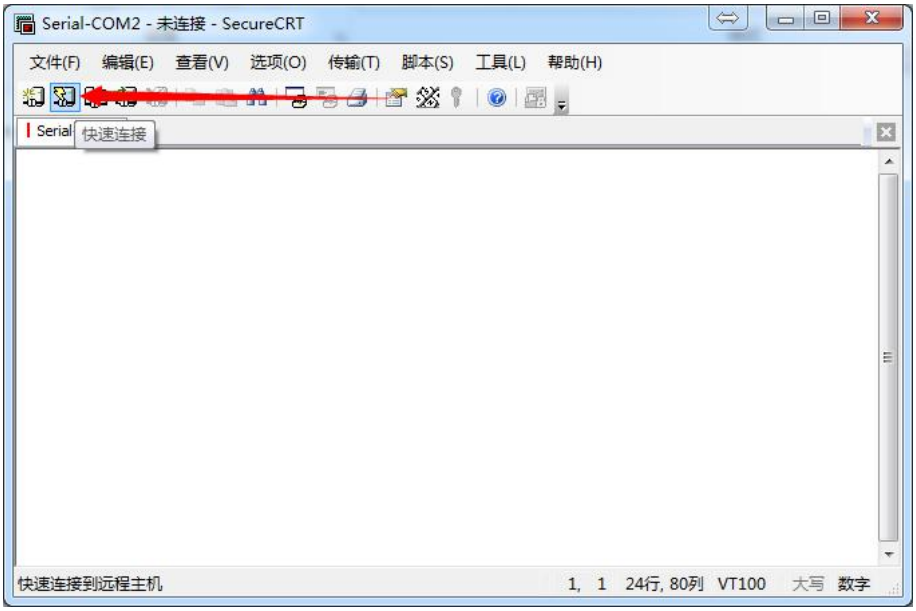

Figure 1- 8 Serial port tool SecureCRT interface

Configuring the serial port, the port selects the port number connected with the development board (no need to select the flow control RTS/CTS). RK3399 supports 1.5M baud rate and needs to change 115200 to 1.5M

Figure 1- 9 Configuring serial port

Clicking connection, and then it will connect to the device normally. Configuring session option to make debugging convenient, click “Session Option” of the tool bar, it can save more log information if rollback buffer is set as bigger value.

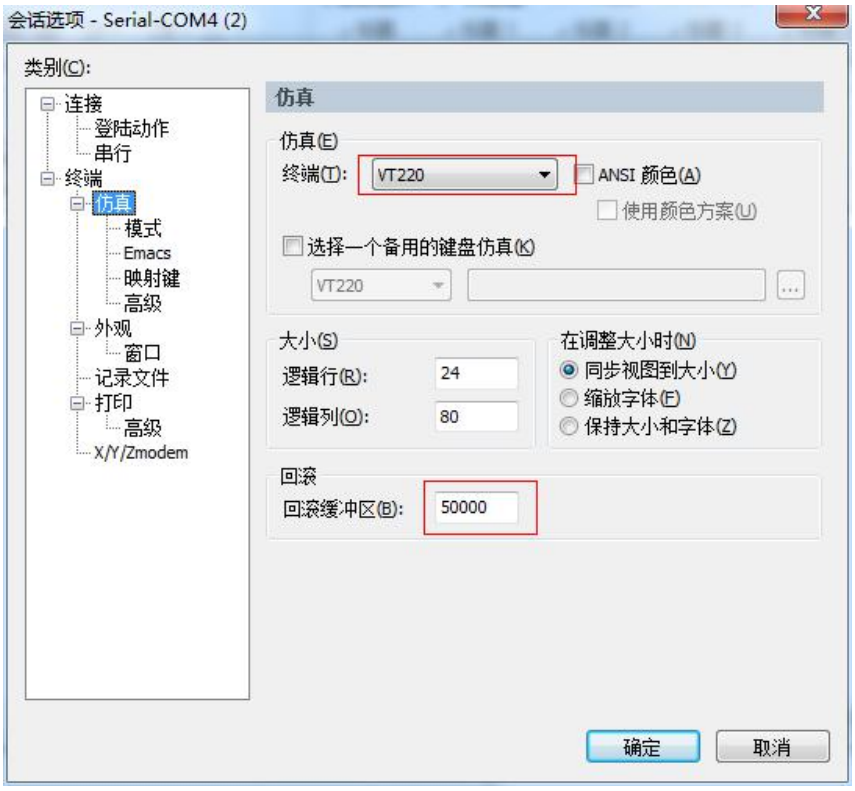

Figure 1- 10 Configuring serial port tool

1.7.2 ADB debugging

1. Make sure the driver is installed successfully, and PC connects with USB OTG port of the development board.

2. The development board is powered up, enter the system, then enter setting, select “developer options”, and select “USB debugging”. If for BOX, also need to select setting-USB-Connect to PC.

3.In PC side, start---run---cmd, enter the directory of adb.exe tool, input “adb devices”, it means the connection is normal if the connected device can be inquired.

4. Input “adb shell”, to enter ADB debugging.

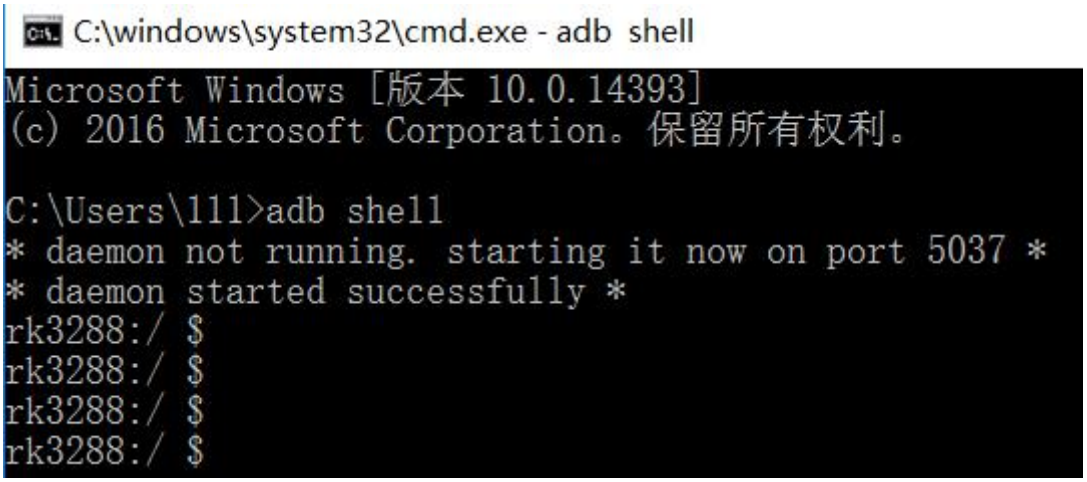

Figure 1- 11 ADB connect normally

2 IND EVB Hardware Introduction

The 7.85 inch eDP panel and the touch board is precisely and firmly glued together with the aluminum alloy frame, and the positioning column is used to firmly combine eDP panel and the main board. The physical and assembling pictures are shown as below:

2.1 Overall effect picture

2.1.1 IND EVB main board:

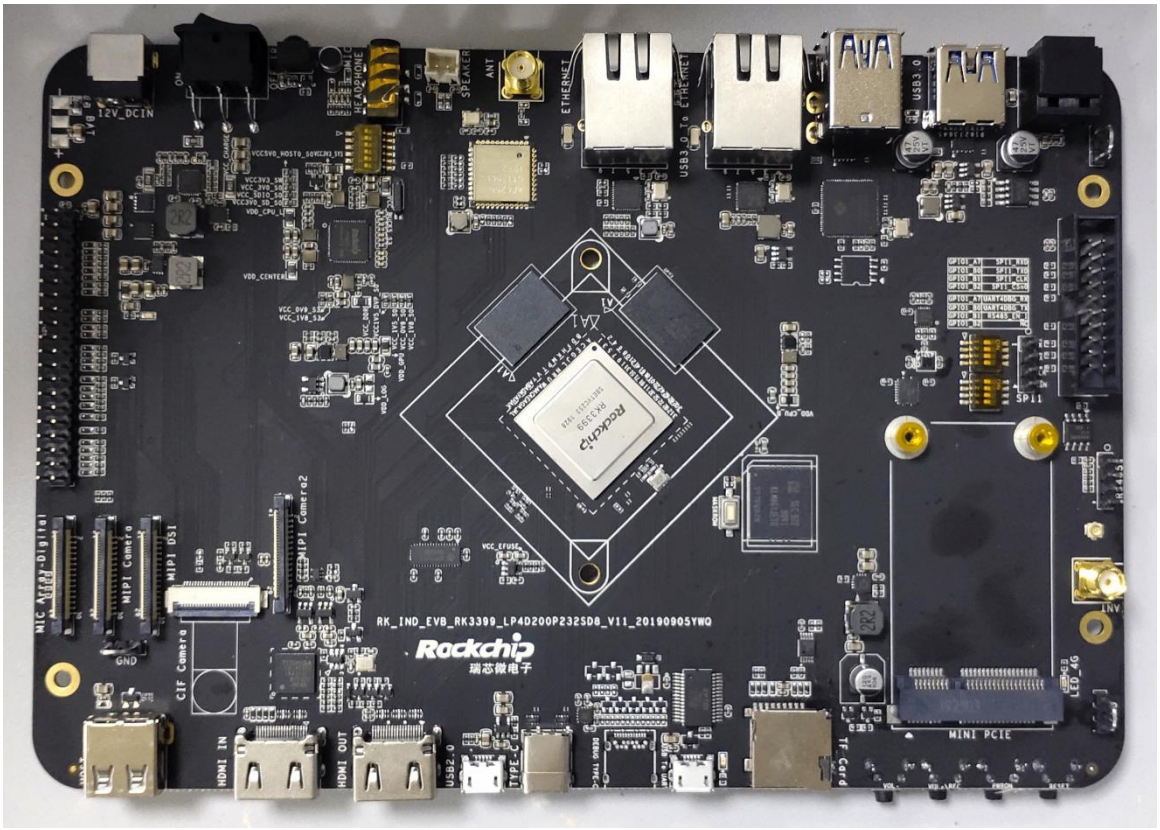

Figure 2- 1 Front view of IND EVB main board

2.1.2 eDP panel picture

Both eDP panel and touch board are connected to the conversion board. The conversion board includes all the circuits required for panel and touch board working. The conversion board connects with the main board using 30PIN FPC cable.

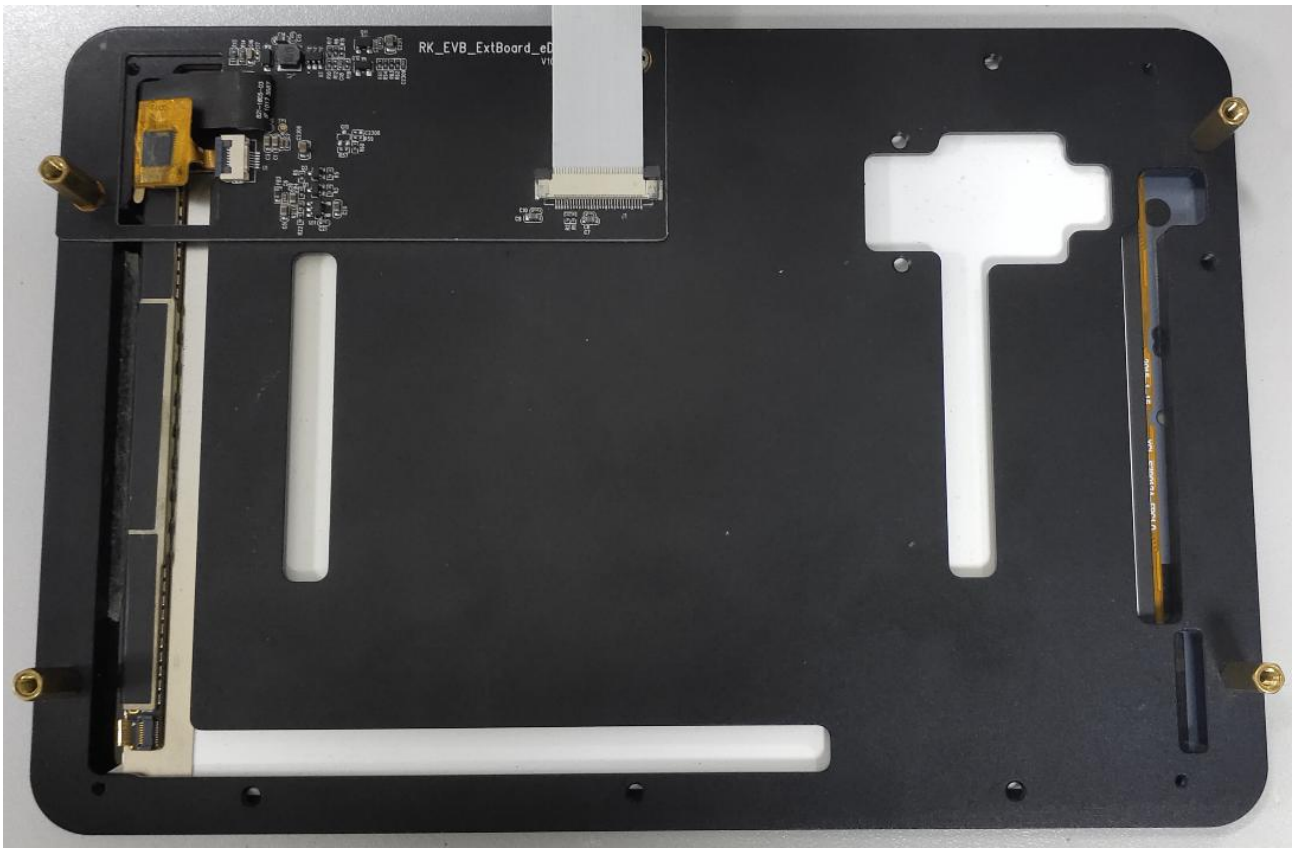

Figure 2- 2 eDP panel overall picture

2.1.3 IND EVB assembled picture

IND EVB development board has two PCBA: IND EVB, eDP panel (resolution 1536 x 2048). The physically, assembled picture is as below:

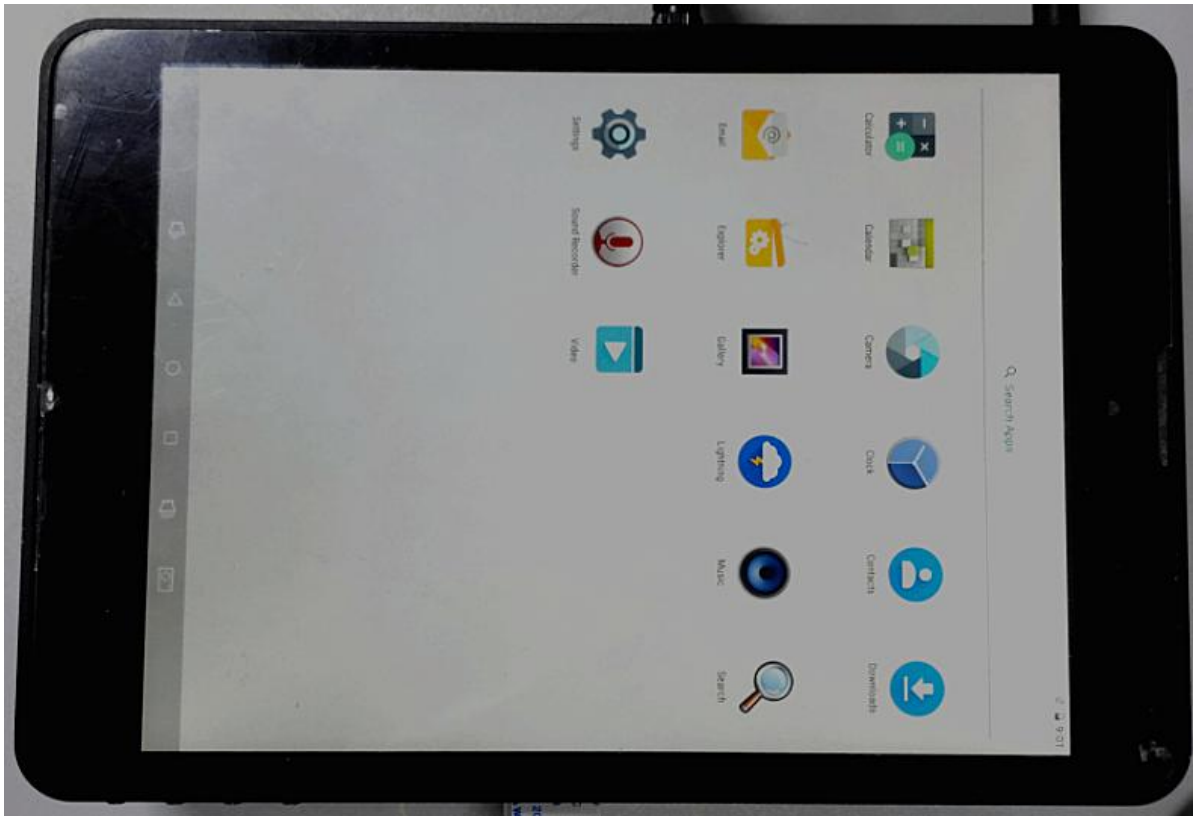

Figure 2- 3 Overall picture of IND EVB assembled completely

2.2 I2C address

This development board reserves many peripheral interfaces and the user may refer to I2C channel reuse when debugging I2C peripherals, so we list the I2C address and level value corresponding to the components of current development board to avoid the address conflict and level mismatch.

I2C channel	device	I2Caddress	Power domain
I2C0	RK809-3	0X20	1.8V
I2C0	TCS4525	0X1C	1.8V
I2C0	TCS4526	0X10	1.8V
I2C1	TC358749XBG	0X1F	1.8V
I2C1	GLS3673(Touch IC)	0X40	1.8V
I2C4	FUSB302MPX(CC IC)	0X44	1.8V
I2C4	MPU6500	0X68	1.8V
I2C4	AK8963C	0X0D	1.8V
I2C4	BQ25703	0X6B	1.8V

Table 2- 1 the table of the peripheral address and IO level loaded by I2C channel

Note: when using the extension board, need to make sure that I²C address of the extension board must not conflict with I²C address of the development board.

2.3 Extension connector information

During the practical use, the user may build extension board. This development board supports the following connector types:

J4600, J4601, J5100, J7500 are 0.5mm vertical double-row 30PIN, with size as below:

P数	A	B	C	D	P数	A	B	C	D
4	1.500	2.570	8.400	4.650	35	17.000	18.070	23.900	5.150
5	2.000	3.070	8.900	4.650	36	17.500	18.570	24.400	5.150
6	2.500	3.570	9.400	4.650	37	18.000	19.070	24.900	5.150
7	3.000	4.070	9.900	4.650	38	18.500	19.570	25.400	5.150
8	3.500	4.570	10.400	4.650	39	19.000	20.070	25.900	5.150
9	4.000	5.070	10.900	4.650	40	19.500	20.570	26.400	5.150
10	4.500	5.570	11.400	4.650	41	20.000	21.070	26.900	5.150
11	5.000	6.070	11.900	4.650	42	20.500	21.570	27.400	5.150
12	5.500	6.570	12.400	4.650	43	21.000	22.070	27.900	5.150
13	6.000	7.070	12.900	4.650	44	21.500	22.570	28.400	5.150
14	6.500	7.570	13.400	4.650	45	22.000	23.070	28.900	5.150
15	7.000	8.070	13.900	4.650	46	22.500	23.570	29.400	5.150
16	7.500	8.570	14.400	4.650	47	23.000	24.070	29.900	5.150
17	8.000	9.070	14.900	4.650	48	23.500	24.570	30.400	5.150
18	8.500	9.570	15.400	4.650	49	24.000	25.070	30.900	5.150
19	9.000	10.070	15.900	4.650	50	24.500	25.570	31.400	5.150
20	9.500	10.570	16.400	4.650	51	25.000	26.070	31.900	5.150
21	10.000	11.070	16.900	4.650	52	25.500	26.570	32.400	5.150
22	10.500	11.570	17.400	4.650	53	26.000	27.070	32.900	5.150
23	11.000	12.070	17.900	4.650	54	26.500	27.570	33.400	5.150
24	11.500	12.570	18.400	4.650	55	27.000	28.070	33.900	5.150
25	12.000	13.070	18.900	4.650	56	27.500	28.570	34.400	5.150
26	12.500	13.570	19.400	4.650	57	28.000	29.070	34.900	5.150
27	13.000	14.070	19.900	4.650	58	28.500	29.570	35.400	5.150
28	13.500	14.570	20.400	4.650	59	29.000	30.070	35.900	5.150
29	14.000	15.070	20.900	4.650	60	29.500	30.570	36.400	5.150
30	14.500	15.570	21.400	5.150	61	30.000	31.070	36.900	5.150
31	15.000	16.070	21.900	5.150	62	30.500	31.570	37.400	5.150
32	15.500	16.570	22.400	5.150	63	31.000	32.070	37.900	5.150
33	16.000	17.070	22.900	5.150	64	31.500	32.570	38.400	5.150
34	16.500	17.570	23.400	5.150					

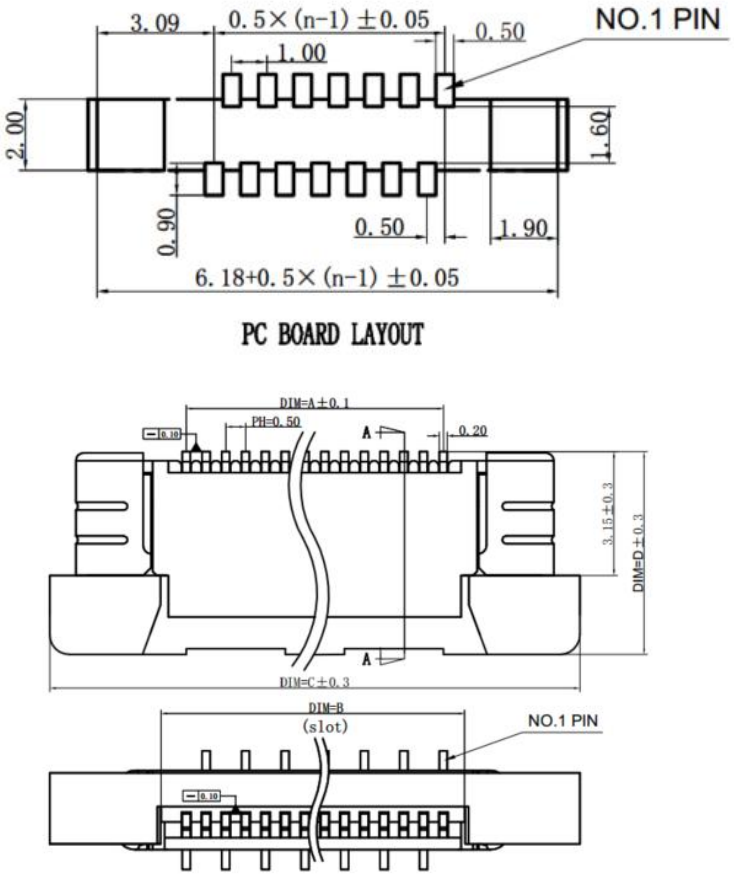

Figure 2- 4 PCB package with interval 0.5mm vertical double-row 30PIN

2.4 Reference design of the development board

The corresponding reference design PCB version information of the development board is as below:

1、IND EVB：

RK_IND_EVB_RK3399_LP4D200P232SD8_V12_20200109.DSN

RK_IND_EVB_RK3399_LP4D200P232SD8_V12_20200109.brd

2、eDP Display：

RK_EVB_ExtBoard_eDPDisplay_V10_20171013.DSN

RK_EVB_ExtBoard_eDPDisplay_V10_20171013.PCB

3 Main Board Introduction

3.1 Power input

1. The system power VCC_SYS is obtained after charging IC processing with 12V/2A power input by the power adapter, and then VCC_SYS is provided to RK809-3, multi-channel DCDC, LDO, and FET switch to output groups of voltage for system usage.

2. Two-battery power supply, input from VBAT interface, obtain VCC_SYS voltage after switching the circuit through charging IC, VCC_SYS is provided to RK809-3, multi-channel DCDC, LDO, FET switch to output groups of voltage for system usage.

The input port of the power adapter, charging IC and Buck convertor:

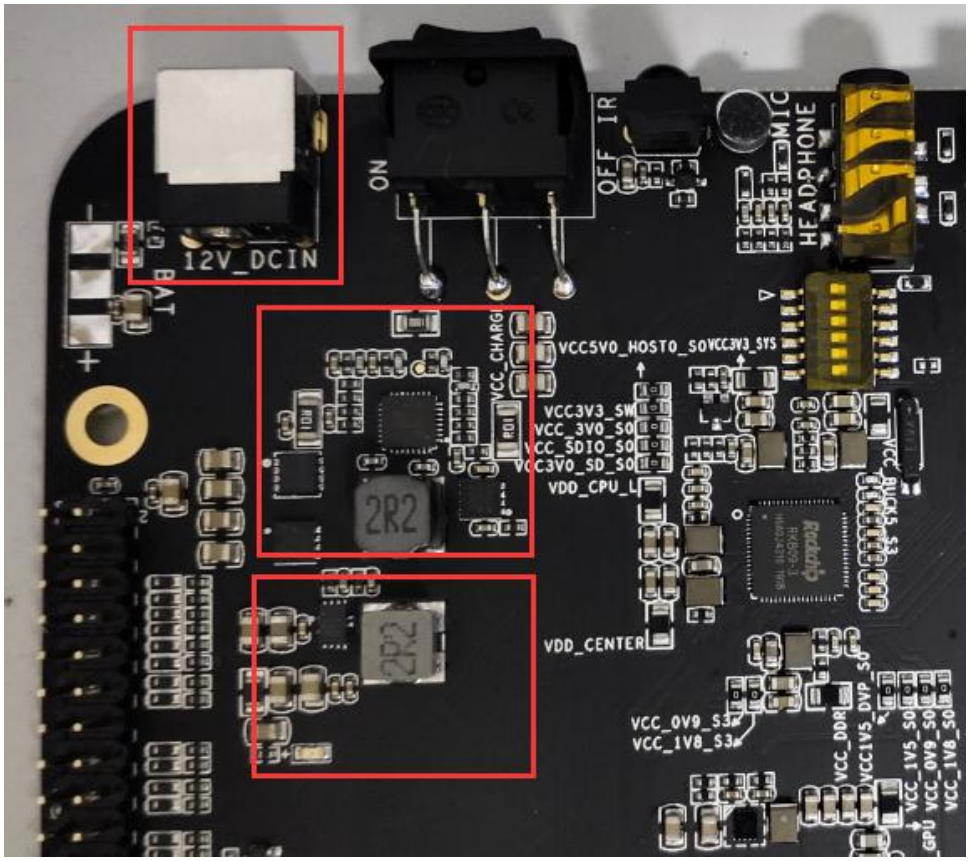

Figure 3- 1 Charging IC, Buck convertor and DC12 input

Two-battery input port:

Figure 3- 2 Two-battery input

3.2 Memory

3.2.1 EMMC：

1. The memory type of the development board is eMMC FLASH, and the default capacity is 16G.

2. There is Maskrom button on IND EVB which is convenient for the development board to enter Maskrom to upgrade image.

3.2.2 DDR

DDR uses 2x32bit LPDDR4, total size 4G.

EMMC&LPDDR4：

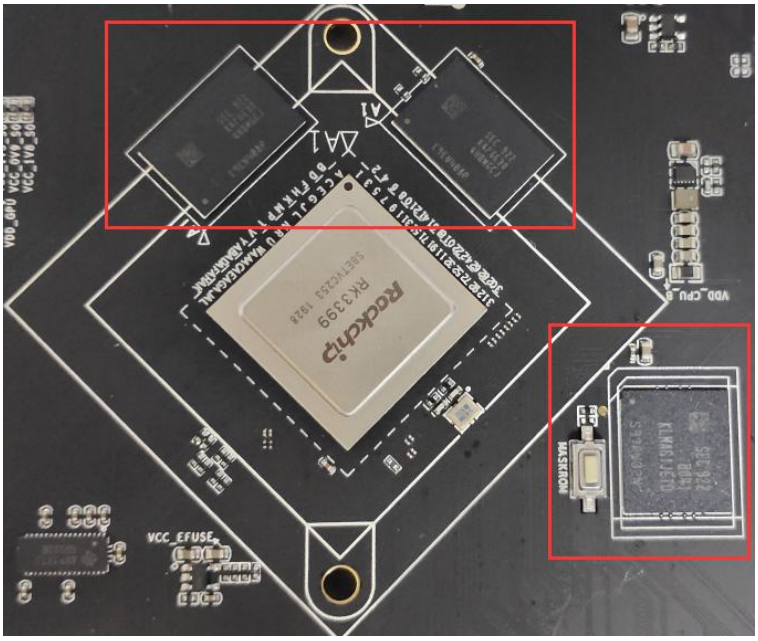

Figure 3- 3 LPDDR4 and EMMC

IND EVB Maskrom button:

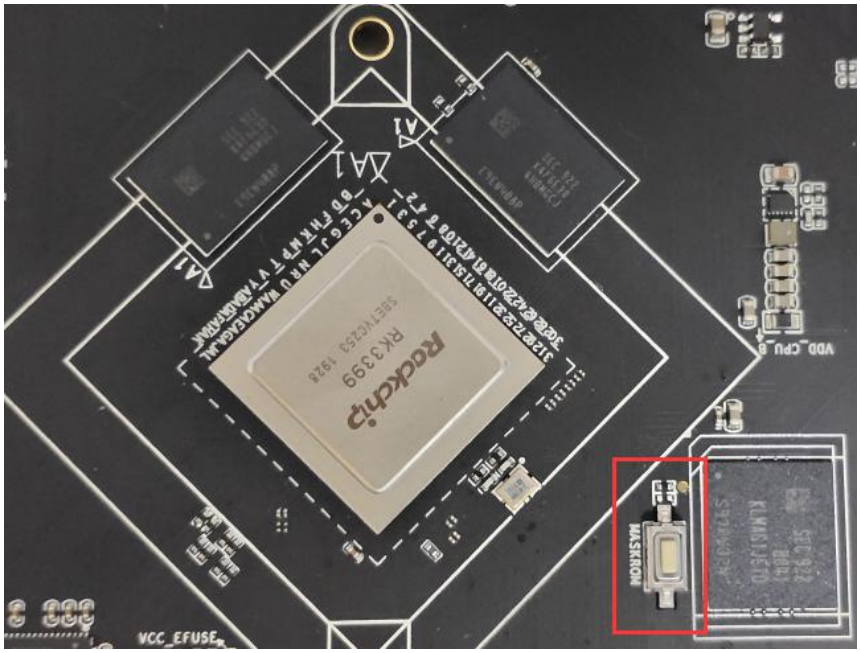

Figure 3- 4 the button to enter Maskrom flashing mode

3.3 Button input

1. The development board provides ADC detection for button group application, uses RK3399 ADC_IN1 as the detection port, and supports 10bit resolution.
2. The development board defines several commonly used buttons: VOL+/ VOL-/ POWER_KEY/RESET.
3. VOL+ and Recovery are reused.

The button location:

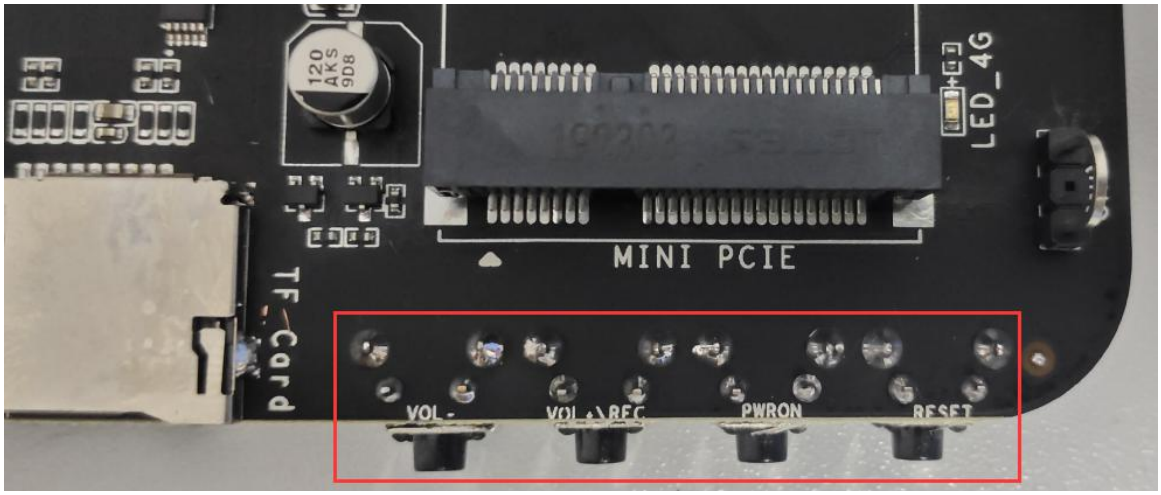

Figure 3- 5 System buttons

3.4 Infrared receiver

The development board uses small infrared receiver, commonly used type FT-009 serial, central frequency 38kHz.

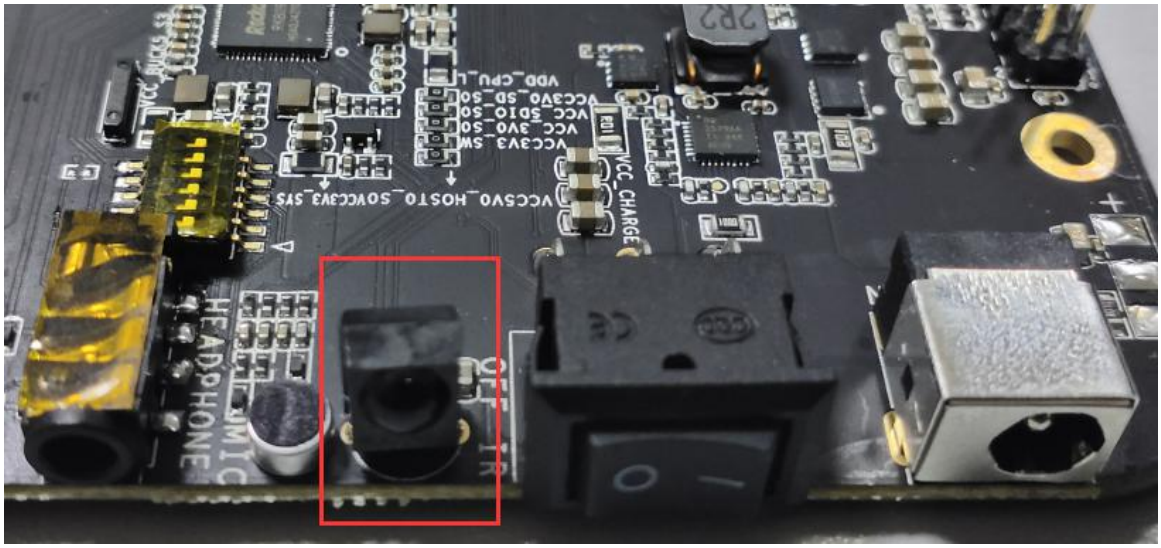

Figure 3- 6 IR receiver

3.5 Gravity sensor

The gravity acceleration sensor used on the development board is a two-in-one sensor MPU6500 with 3-axis digital accelerator and 3-axis gyroscope, communicating with SoC through I^2C.

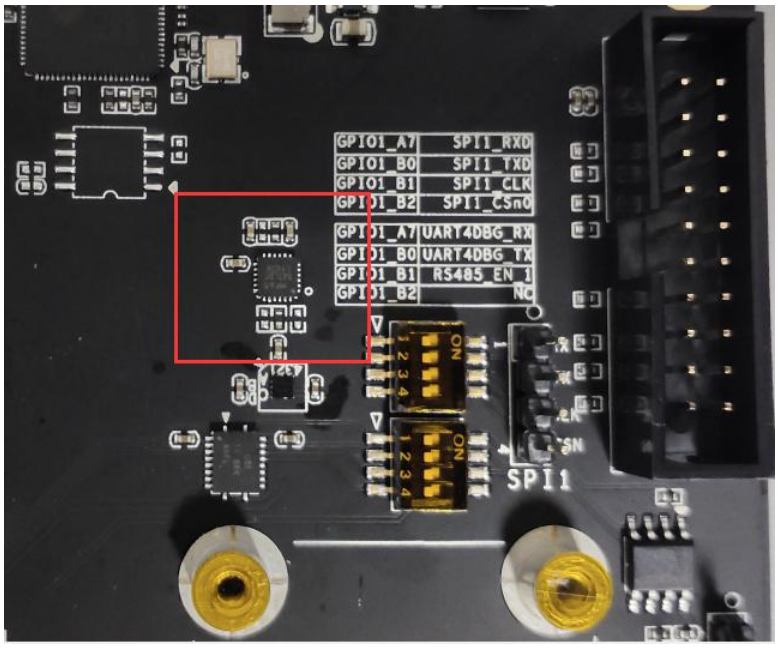

Figure 3- 7 Gravity sensor MPU6500

3.6 RS485

The RS485 bus uses the MAX3485E and communicates with SoC through the UART4 serial port, the external 4 PINS 2.54mm male connector is reserved for debugging.

The UART4 serial port and SPI1 are reused, switching the functions through dial switch. When the S1803 is on, the S1802 is off, it will enable the RS485; When the S1802 is on, the S1803 is off, it will enable the SPI. (RS485 function is enabled by default, and the SPI function can be manually configured if required)

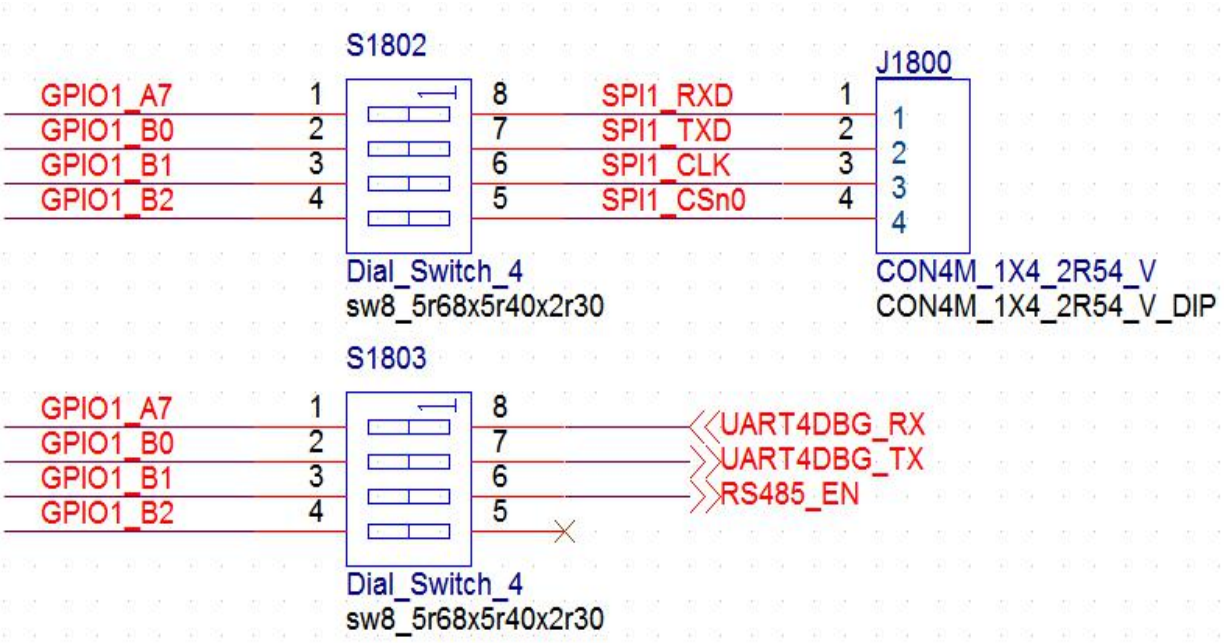

Figure 3- 8 the switch between RS485 and SPI1

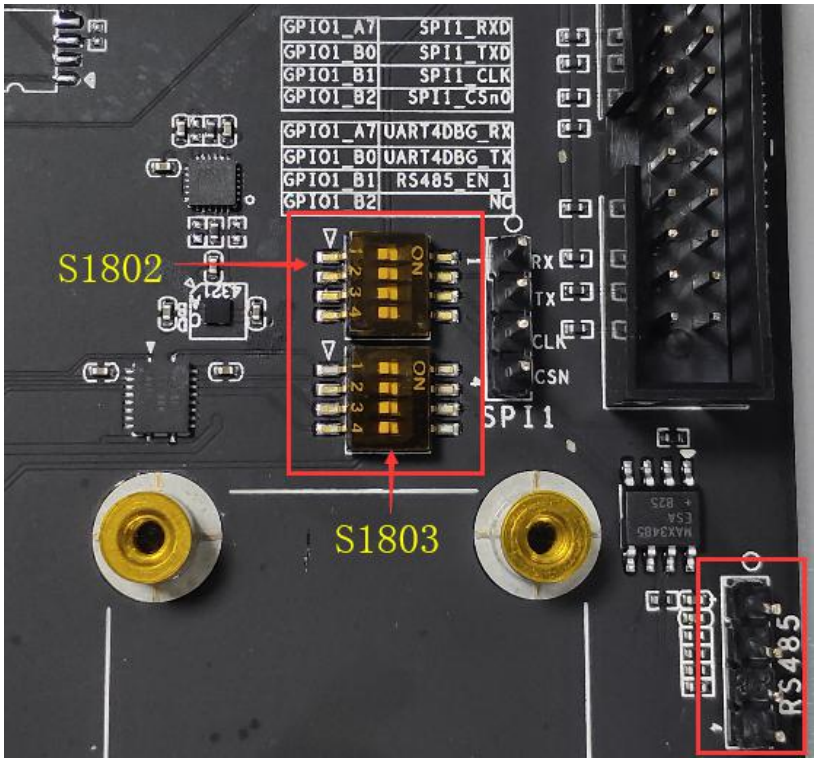

Figure 3- 9 RS485 interface

3.7 Compass

The compass used on the development board is AK8963C, communicating with SoC through I²C.

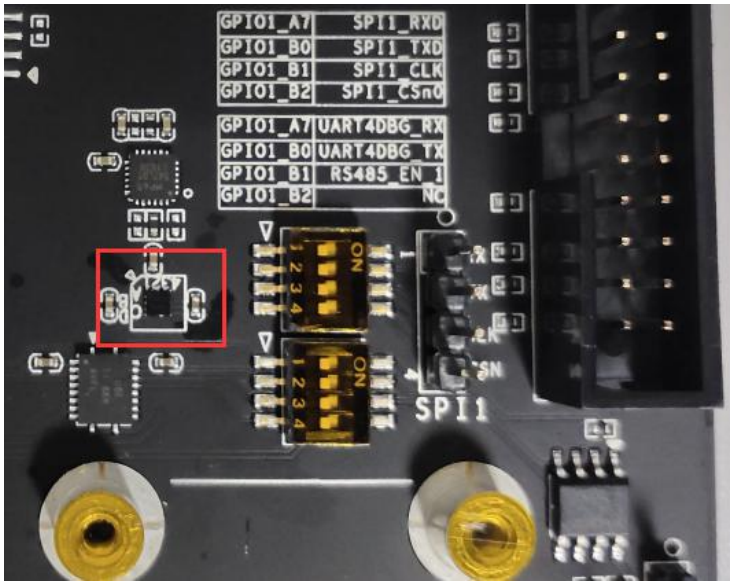

Figure 3- 10 compass AK8963C

3.8 Video output interface

The development board supports multiple video output interfaces:

- eDP output
- Single MIPI output

The interface uses the vertical connector with interval 0.5mm. The connector in the picture 3-11 from top to bottom corresponds to the signal sequence in Table 3-1:

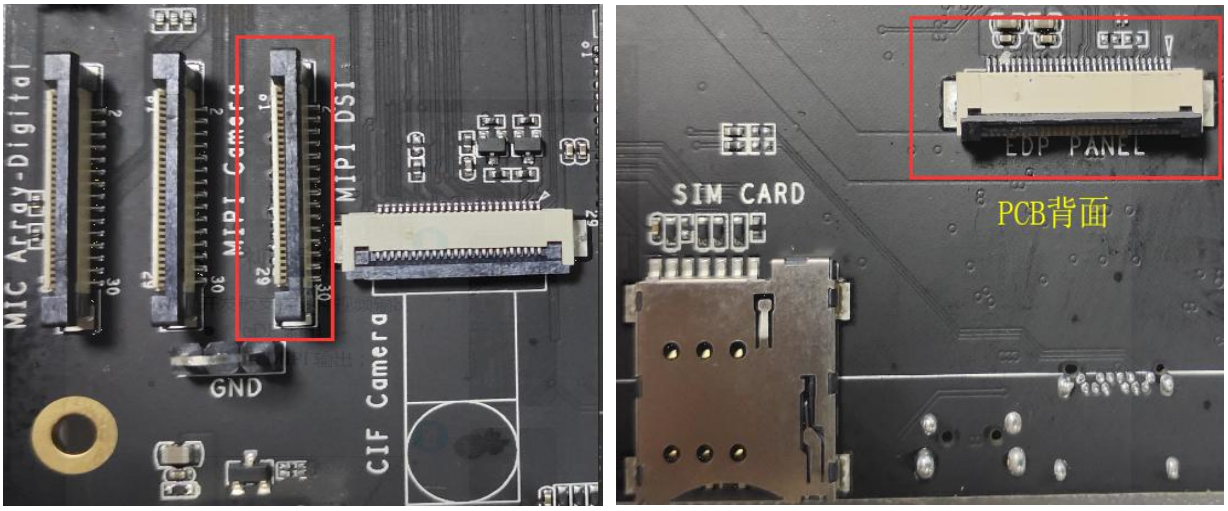

Figure 3- 11 Video output interface

The signal sequence of MIPI_TX is as below:

1	GND	
2		MIPI_TX0_D3N
3	MIPI_TX0_D3P	
4		GND
5	MIPI_TX0_D2N	
6		MIPI_TX0_D2P
7	GND	
8		MIPI_TX0_CLKN
9	MIPI_TX0_CLKP	
10		GND
11	MIPI_TX0_D1N	
12		MIPI_TX0_D1P
13	GND	
14		MIPI_TX0_D0N
15	MIPI_TX0_D0P	
16		GND
17	LCD_BL_PWM	
18		NC
19	VCC3V3_SW	
20		LCD_RST_H
21		
22		LED_EN_H
23	I2C1_SCL	
24		ISC1_SDA
25	TOUCH_INT_L	
26		TOUCH_RST_L
27	GND	
28		VCC5V0_SYS
29	VCC5V0_SYS	
30		VCC5V0_SYS

Table 3- 1 MIPI_TX signal definition

The signal sequence of eDP is as below:

1	GND	
2		EDP_TX0N
3	EDP_TX0P	
4		GND
5	EDP_TX1N	
6		EDP_TX1P
7	GND	
8		EDP_AUXN
9	EDP_AUXP	
10		GND
11	EDP_TX2N	
12		EDP_TX2P
13	GND	
14		EDP_TX3N
15	EDP_TX3P	
16		GND
17	LCD_BL_PWM	
18		GND
19	VCC3V3_SW	
20		LCD_RST_H
21		
22		LED_EN_H
23	I2C1_SCL	
24		ISC1_SDA
25	TOUCH_INT_L	
26		TOUCH_RST_L
27	GND	
28		VCC5V0_SYS
29	VCC5V0_SYS	
30		VCC5V0_SYS

Table 3- 2 eDP signal definition

3.9 HDMI output

The development board supports the latest HDMI 2.0 protocol and the output connector uses Type-A interface.

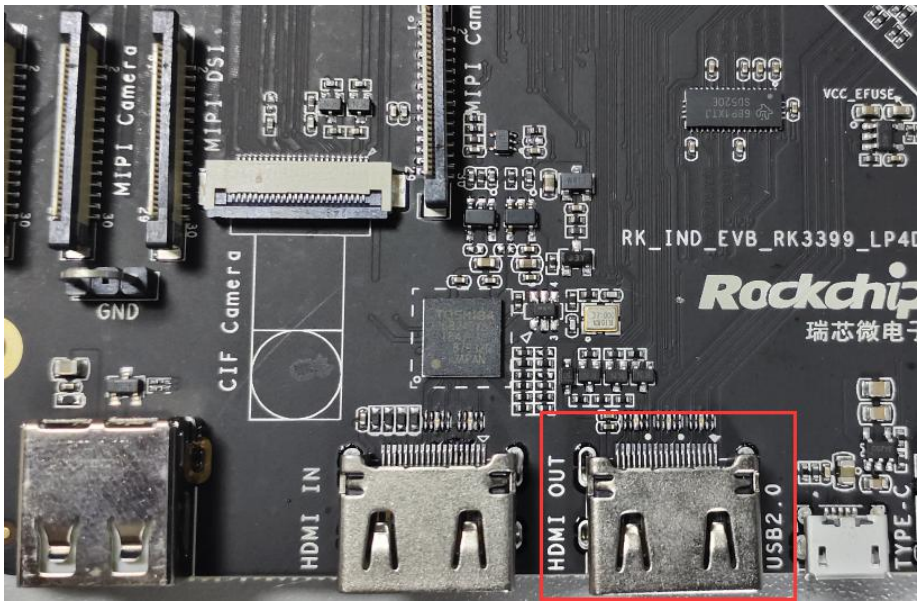

Figure 3- 12 HDMI OUT output

3.10 HDMI input

External HDMI TO MIPI_CSI conversion IC TC358749XBG is used to convert the HDMI signal to RK3399 MIPI_TX/RX and then display through RK3399 display interface eDP or HDMI OUT.

The HDMI IN port and MIPI Camera2 share the MIPI_TX/RX, switching the function through dial switch. The default configuration is MIPI Camera2 function.

When the cable is connected to HDMI IN interface, the VCC5V0_HDMIIN signal is pulled up to 5V, then the dial switch will automatically switch to HDMI IN function. After the cable is unplugged, the VCC5V0_HDMIIN signal is 0V and it will pull down the SEL pin, then it will automatically switch to the MIPI Camera2 function.

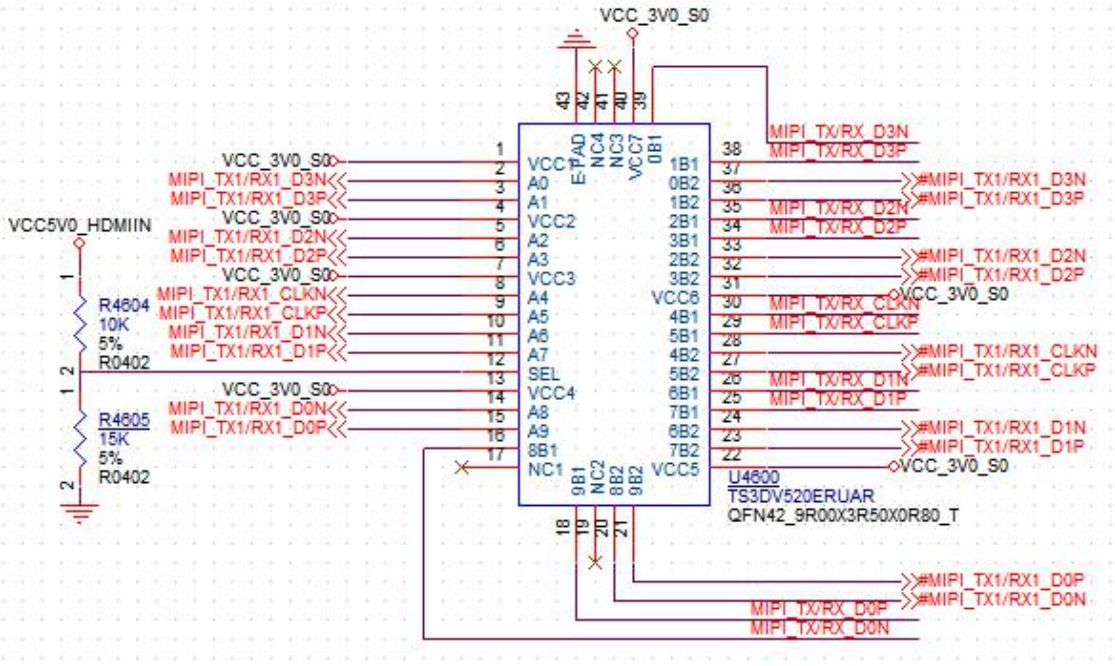

Figure 3- 13 the switch between HDMI IN and MIPI CSI2

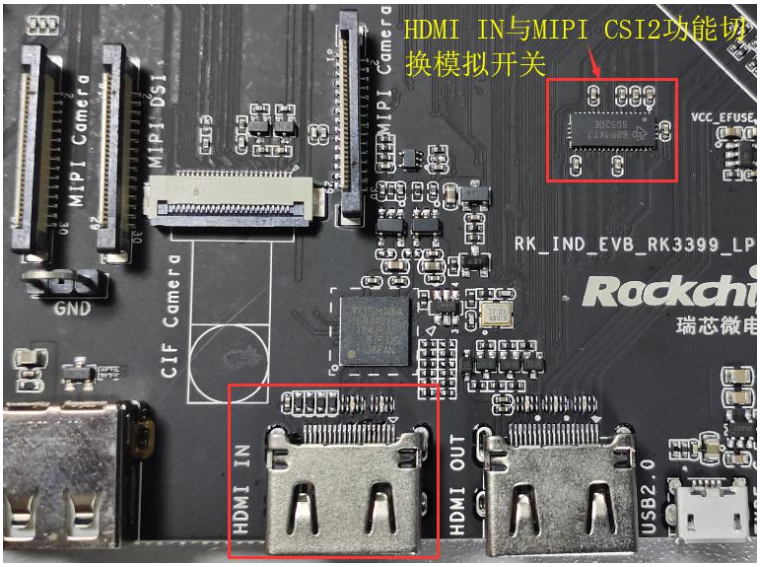

Figure 3- 14 HDMI IN

3.11 Audio input/output

The audio codec used on the development board is integrated in RK809_3, with the following features:

- 24bits high-performance DAC decoder and Head-Phone output.
- 1.3W Class-D amplifier.
- 24bits high-performance ADC encoder and built-in MIC/PGA.

The single MIC, headphone and MIC Array share the MIC IN interface in RK809-3, so only one can be enabled at the same time and need to switch the function through dial switch. When the switch three and the switch four are on, the switch one and the switch two are off, it will enable the external signal MIC and headphone; When the switch one and the switch two are on, the switch three and the switch four are off, it will enable the loopback on MIC Array. (By default, the signal MIC and headphone are enabled. The external MIC Array can be manually configured if required)

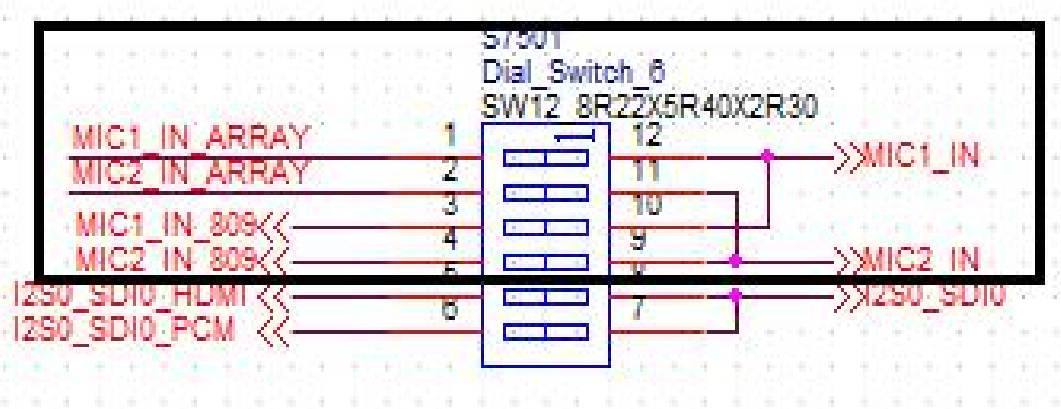

Figure 3- 15 the switch between the single MIC and MIC Array

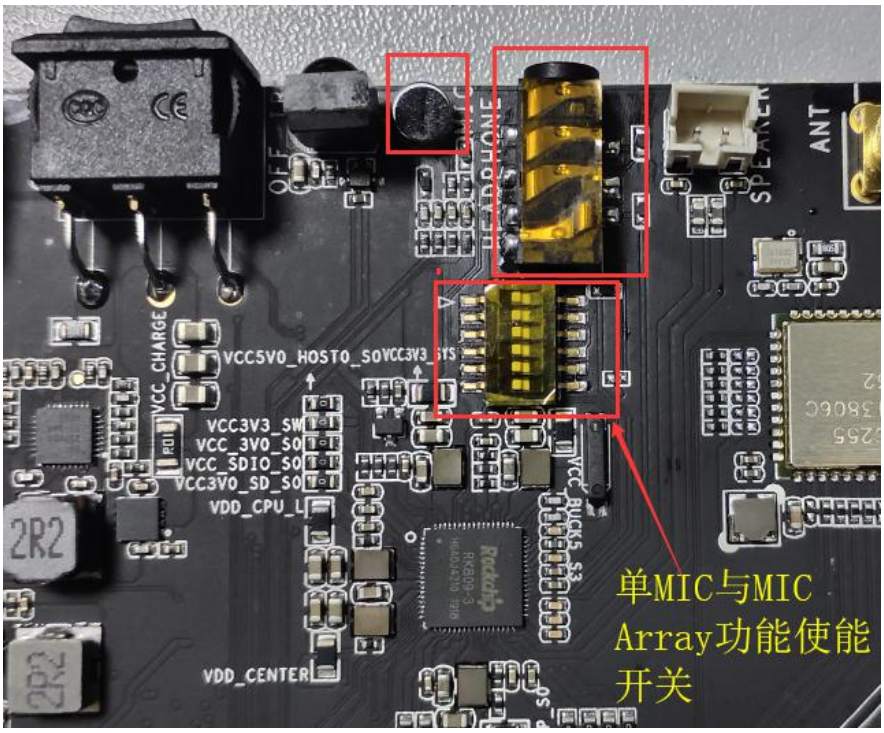

Figure 3- 16 audio output and single MIC input interface

3.12 SPDIF output

The development board supports SONY, PHILIPS digital audio interface output and the transmission hardware interface uses optical fiber mode.

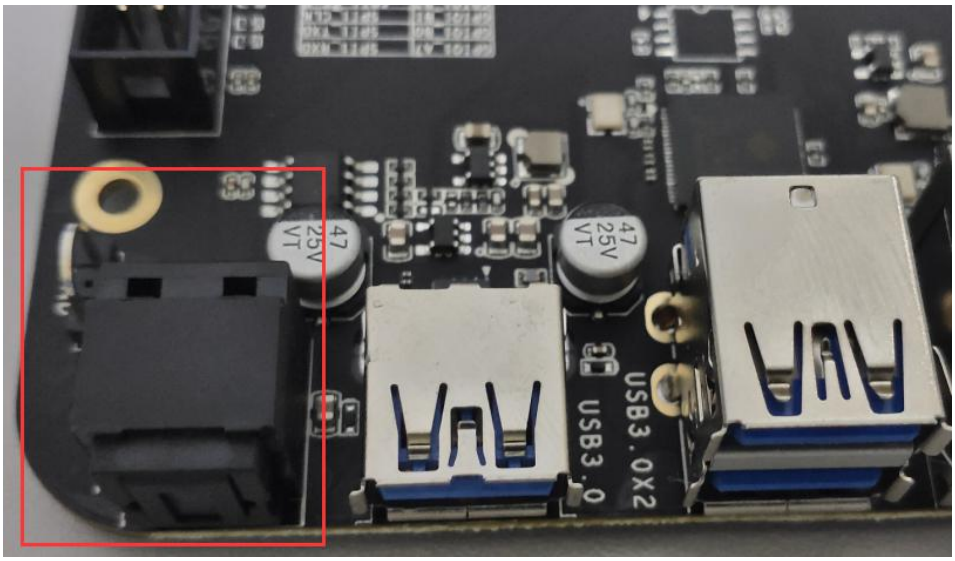

Figure 3- 17 SPDIF output interface

3.13 USB OTG/HOST interface

The development board has USB OTG and USB HOST interfaces:

- IND EVB connects USB HOST0 to SoC, supporting USB2.0 HOST(one Port)

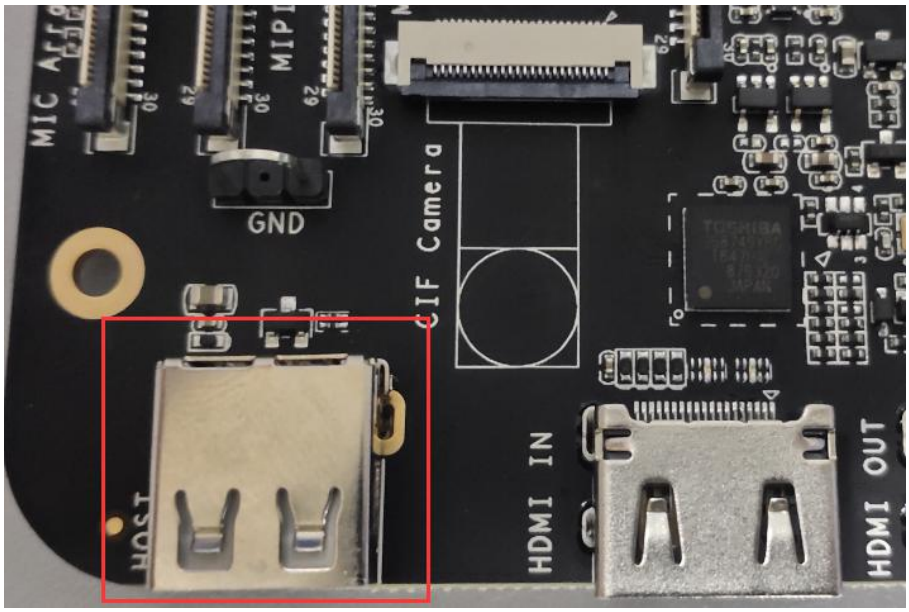

Figure 3- 18 USB2.0 HOST interface

- IND EVB connects USB HOST 3.0 interface to DP/DM of TYPE-C1 of SoC, using USB 3.0 Standard-A type interface and backward-compatible with USB 2.0 protocol. External USB3.0 HUB is integrated, supporting three USB HOST 3.0 interfaces.

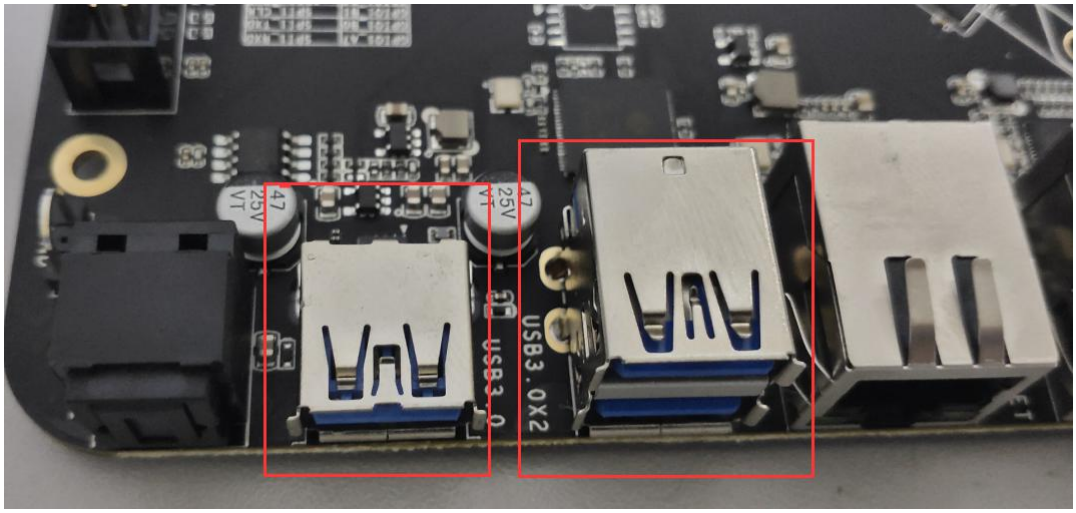

Figure 3- 19 USB3.0 HOST interface

- The other USB2.0 interface is connected to the HOST1 of SoC and is used to debug 4G module.
- TYPE-C interface supported by RK3399, supports full function TYPE-C protocol, and can output DP signal to display on DP monitor.

A USB20 Micro OTG socket is reserved which closed to the TYPE-C interface. The ID is internal pulled up and is configured to the Device mode by default.

The signal sequence of TYPE-C interface:

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	VBUS	CC1	D+	D−	SBU1	VBUS	RX2−	RX2+	GND
GND	RX1+	RX1−	VBUS	SBU2	D−	D+	CC2	VBUS	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Table 3- 3 USB TYPEC signal sequence

The location of TYPE-C connector corresponding to DP signal is as below:

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	DP3+	DP3−	Vbus	CC1	D+	D−	auxN	Vbus	DP1−	DP1+	GND
GND	DP2+	DP2−	Vbus	auxP	D−	D+	CC2	Vbus	DP0−	DP0+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

Table 3- 4 USB TYPEC corresponding to DP output signal

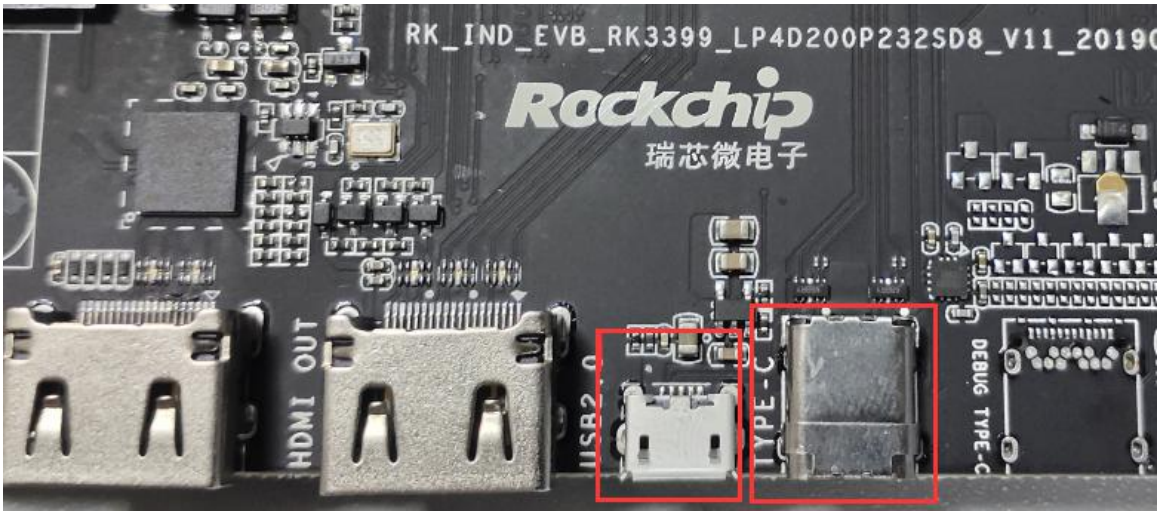

Figure 3- 20 USB TYPEC interface and USB20 Micro OTG interface

3.14 Ethernet

The development board reserves two RJ45 interfaces, which can provide dual Gigabit Ethernet connection function.

Selecting RTL8211F-CG which is integrated in RK3399 as PHY, with the following features:

- Compatible with IEEE802.3 standard, support full duplex and half duplex mode, and support cross detection and self-adaption.
- Support 10/100/1000M data rate.
- The interface uses RJ45 interface with indicator light and isolation transformer.

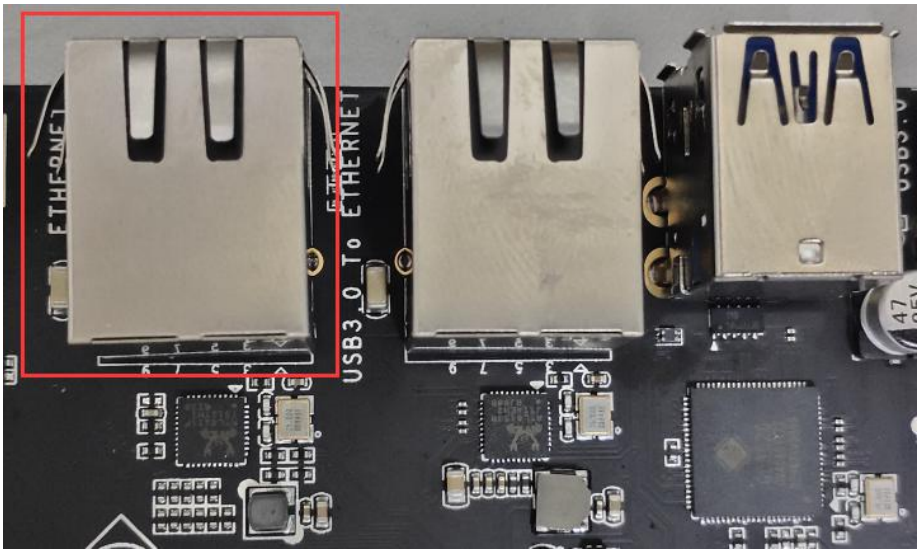

Figure 3- 21 RJ45 interface

The other RJ45 interface which transfers the USB3.0 to Ethernet selects RTL8153B-VB-CG as PHY.

The features are as follows:

- Compatible with IEEE802.3 standard, support full duplex and half duplex operation, and support cross detection and self-adaption.
- Support 10/100/1000M data rate.
- The interface uses RJ45 interface with indicator light and isolation transformer.
- By default, the interface is disabled in software configuration, and needs to upgrade the firmware if want to enable it.

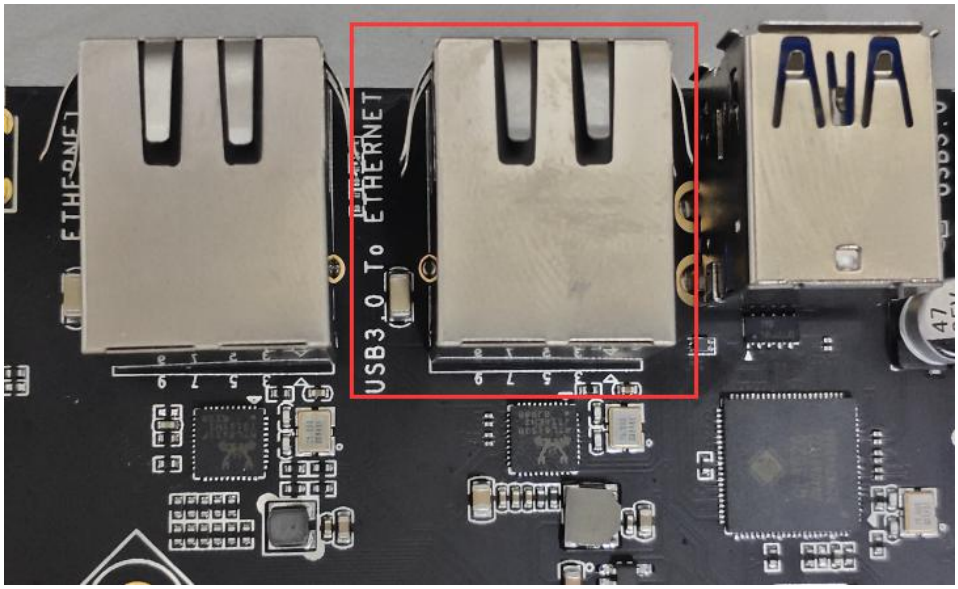

Figure 3- 22 RJ45 interface

3.15 TF/SD Card interface

TF/SD cards uses RK3399 SDMMC0 interface, data bus width is 4bits, and supports SDMMC 3.0 protocol.

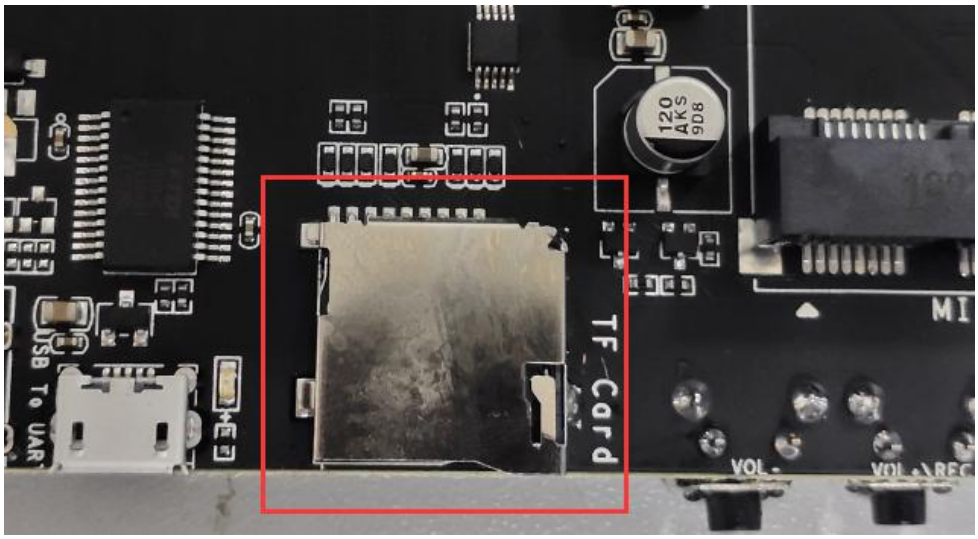

Figure 3- 23 TF card interface

3.16 GPIO/I2C/SPI/CIF extension port

IND EVB extends multiple channels of I2C, SPI, UART and other low-speed control signals, which is convenient for users to debug peripherals. Meanwhile, RK3399 CIF signal is reused with this interface, and users can use conversion board to debug CIF Camera.

The signal definition and sequence of the interface are the same as that of Raspberry Pi.

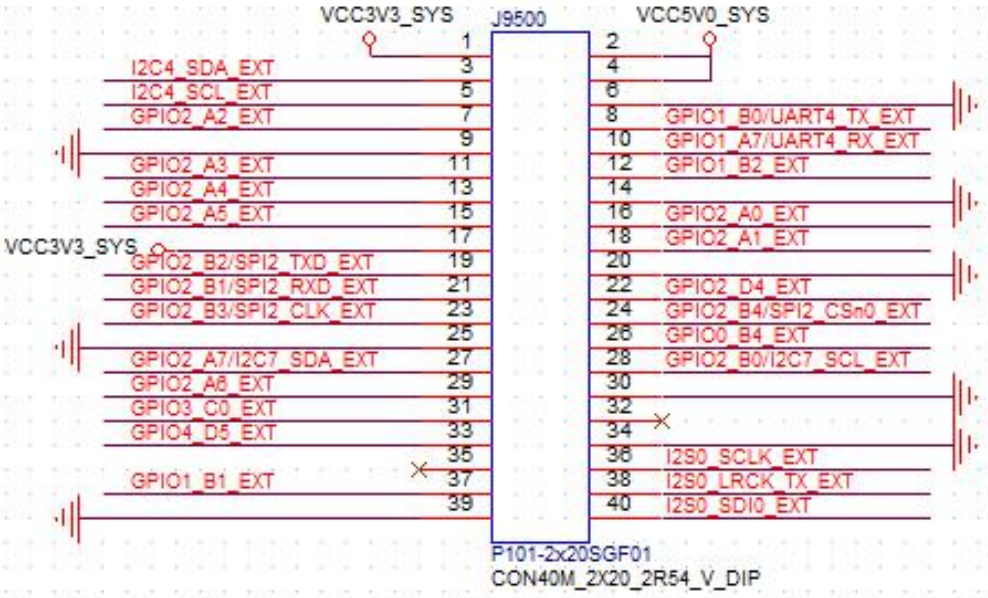

Figure 3- 24 GPIO/I2C/SPI/CIF interface signal

The corresponding table of I2C/SPI/CIF/GPIO reused interface:

Func1	**Func2**	**Func3**
GPIO2_A0/CIF_D0		I2C2_SDA
GPIO2_A1/CIF_D1		I2C2_SCL
GPIO2_A7/CIF_D7		I2C7_SDA
GPIO2_B0/CIF_VSYNC		I2C7_SCL
GPIO2_B1/CIF_HERF	SPI2_RXD	I2C6_SDA
GPIO2_B2/CIF_CLKI	SPI2_TXD	I2C6_SCL
GPIO2_B3/CIF_CLKO	SPI2_CLK	
GPIO2_B4/DVP_PDN0_H	SPI2_CSN	

Table 3- 5 Signal reuse relationship

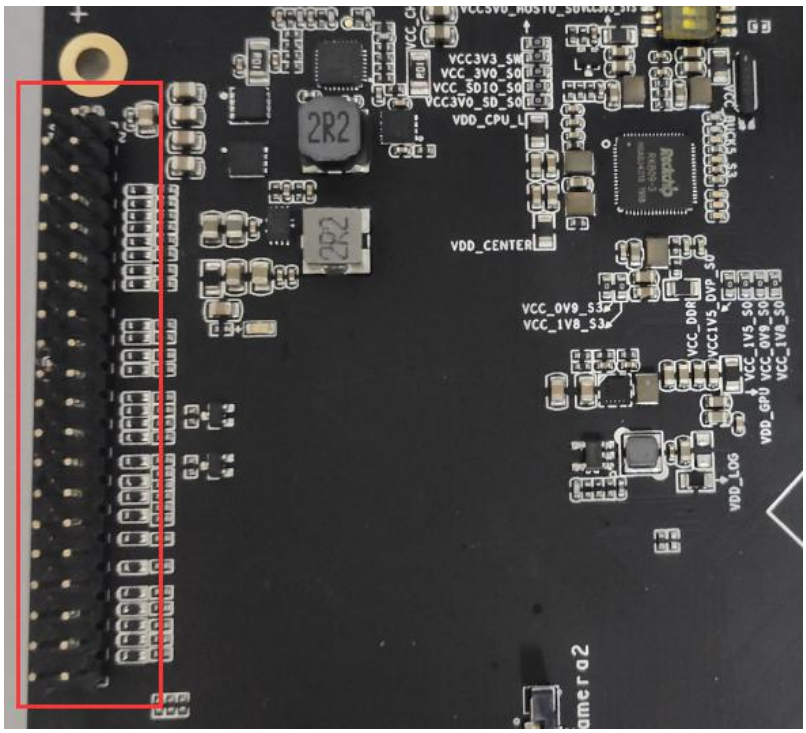

Figure 3- 25 Low-speed signal interface location on IND EVB

In order to check related signals, the signal sequence corresponding to PCB interface is shown as below picture:

Left/up	Right/down
VCC3V3_SYS	VCC5V0_SYS
I2C4_SDA_EXT	VCC5V0_SYS
I2C4_SCL_EXT	GND
GPIO2_A2_EXT	GPIO1_ B0/UART4_TX_EXT
GND	GPIO1_ A7/UART4_RX_EXT
GPIO2_ A3_EXT	GPIO1_ B2_EXT
GPIO2_ A4_EXT	GND
GPIO2_ A5_EXT	**GPIO2_ A0_EXT**
VCC3V3_SYS	**GPIO2_ A1_EXT**
GPIO2_B2/SPI2_TXD_EXT	GND
GPIO2_B1/SPI2_RXD_EXT	GPIO2_ D4_EXT
GPIO2_B3/SPI2_CLK_EXT	**GPIO2_B4/SPI2_CSn0_EXT**
GND	GPIO0_B4 _EXT
GPIO2_A7/I2C7_SDA_EXT	**GPIO2_B0/I2C7_SCL_EXT**
GPIO2_A6_EXT	GND
GPIO3_C0_EXT	NC
GPIO4_D5_EXT	GND
NC	I2S0_SCLK_EXT
GPIO1_B1_EXT	I2S0_LRCK_TX_EXT
GND	I2S0_SDI0_EXT

Table 3- 6 GPIO/I2C/SPI/CIF signal definition

The method to use Camera function:

The items marked in bold include D0~D7, CIF_CLKO/CLKI, CIF_HREF/VSYNC and CIF_PDN, 13 signals in total. These signals are reused by RK3399 CIF, so it can also be used as CIF to connect camera.

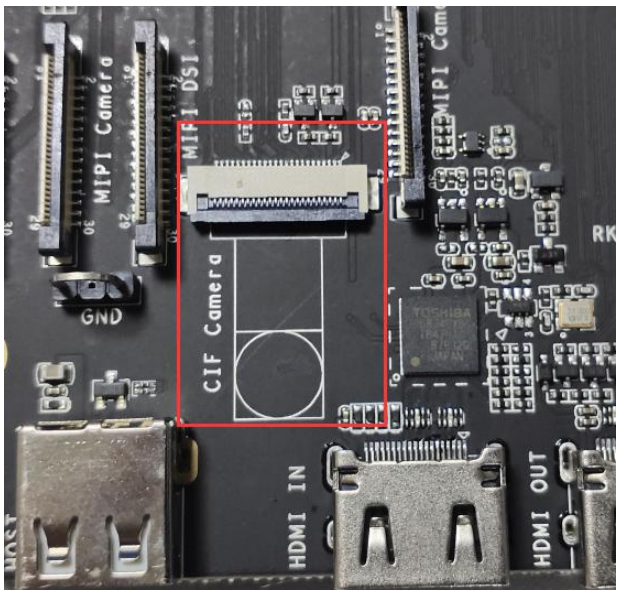

Figure 3- 26 CIF interface

3.17 WIFI+BT module

The WIFI+BT module used on the development board is Taiwan AMPAK AP6255, with the following features:

- Support WIFI (2.4G and 5G，802.11 ac), BT4.1 function, external antenna with SMA interface.
- BT data uses UART communication.
- BT voice is connected to PCM interface of SoC (I2S1 channel).
- WIFI data uses 4bits SDIO data bus.

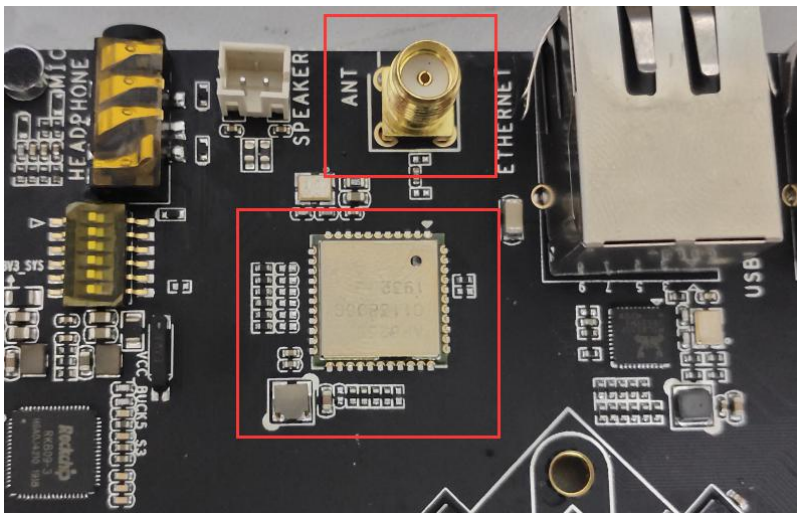

Figure 3- 27 WIFI/BT and antenna with SMA interface

3.18 UART Debugging port

The development board provides serial port for development debugging, connected to Uart2 by default. The board uses FT232RL as UART to USB conversion chip and supports baud rate 1.5M.

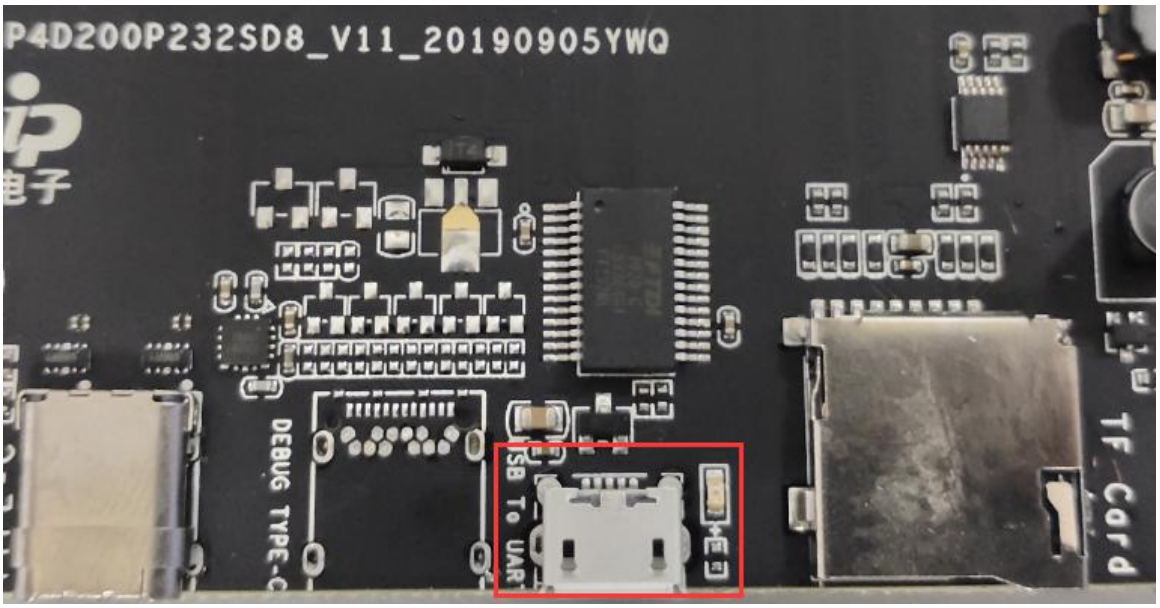

Figure 3- 28 USB Debug interface

3.19 MIC Array

It requires special MIC array small board to use this function. Users can design the signal sequence of the connector by themselves:

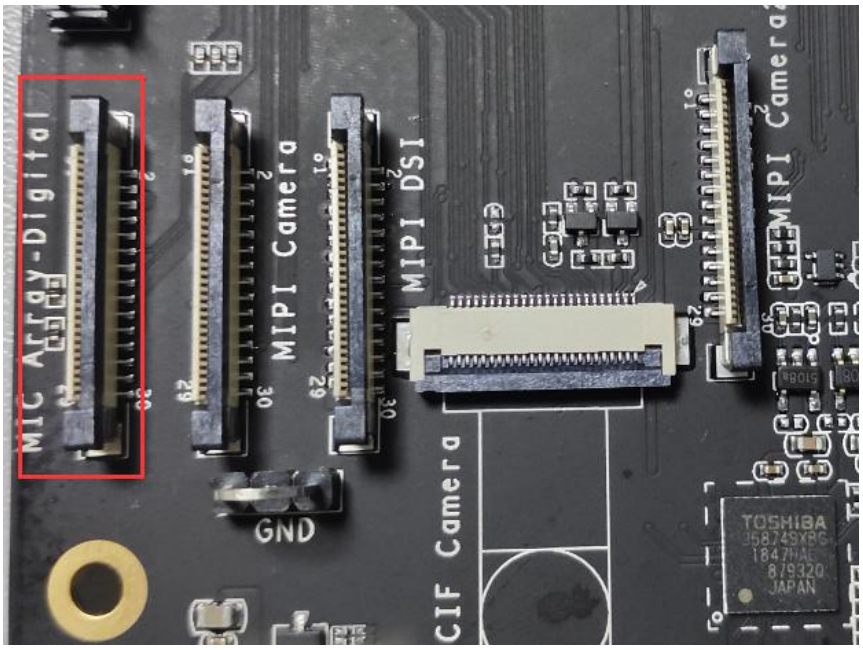

Figure 3- 29 MIC Array

The signals corresponding to the PCB location are as below:

Left/down	**Right/up**
VCC5V0_SYS	VCC5V0_SYS
VCC3V3_SW	GND
ADC_IN0	VCC_1V8_S0
GND	ADKEY_IN
GND	NC
GND	I2S0_CLK
GND	NC
GND	I2S0_LRCK_TX
GND	NC
NC	NC
NC	NC
I2S0_SDI1	I2S0_SDI2
I2S0_SDI3	NC
GND	GPIO_B4/MIC_LED_EN_H
I2C4_SDA	I2C4_SCL

Table 3- 7 MIC ARRAY signal sequence definition

The single MIC, headphone and MIC Array share the MIC IN interface in RK809-3, so only one can be enabled at the same time and need to switch the function through dial switch.

When the switch one and the switch two are on, the switch three and the switch four are off, it will enable the loopback on MIC Array; When the switch three and the switch four are on, the switch one and the switch two are off, it will enable the signal MIC and headphone. The switch is as shown as the figure 3-30. (The signal MIC and headphone are enabled by default, and the MIC Array can be manually configured if required)

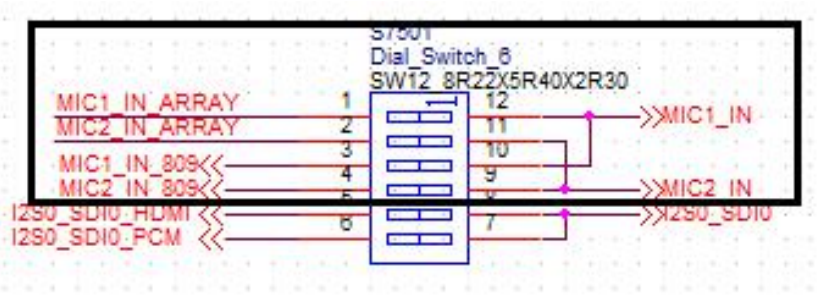

Figure 3- 30 the switch between the single MIC and MIC Array

3.20 MINI PCIE interface

RK3399 has a Mini PCIE interface which follows the PCI Express Mini Card 1.2 protocol.

- Duplex mode: Root Complex(RC) and End Point(EP).
- The link supports up 1 lane data interface, two-way communication mode.
- Support USB2.0 protocol.
- Support 100MHz differential signal output.

The development board uses standard Mini PCIE splint-type connector and the external PCIE board card can be connected to IND EVB from the side for PCIE communication. The 4G module RK serial RM310 can be allocated to communicate with SoC through USB HOST1 port. Meanwhile externally connect the SIM card and SMA 4G antenna can be installed to achieve the internet.

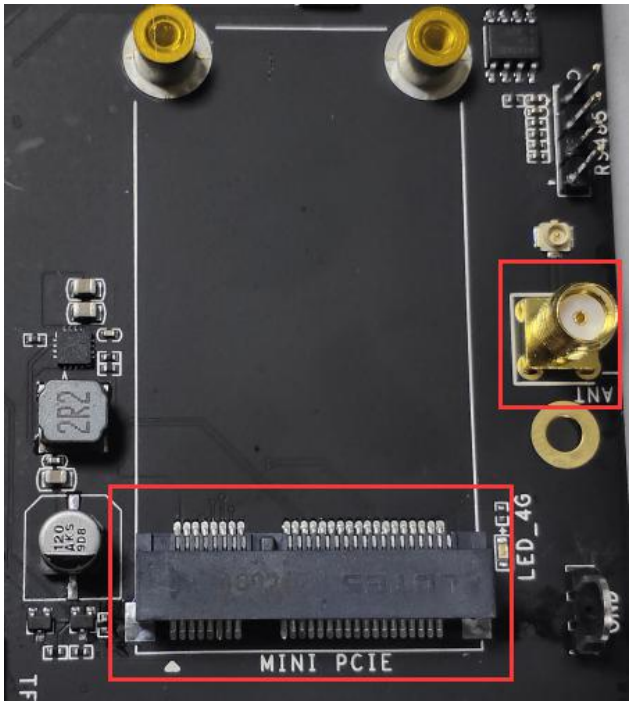

Figure 3- 31 Mini PCIE connector

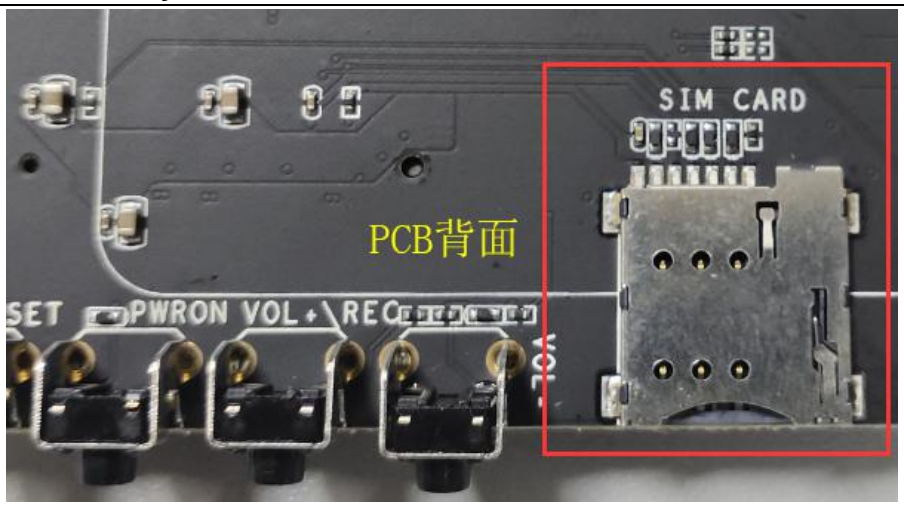

Figure 3- 32 SIM card slot

3.21 4G LTE Wireless Module RM310 (Optional)

RM310 is a MMMB module which contains FDD-LTE, TDD-LTE, WCDMA, GSM, and is also compatible with 2G, 3G network. ALL of them can be customized according to the project to ensure the flexibility.

- Support LTE Cat.4, with max downstream rate:150Mbps, and max upstream rate:50Mbps.
- Integrate multiple standard industrial interfaces, including USB2.0 high-speed interface, UART interface, PCM interface (Optional) etc.
- Support multi-platform, such as Windows XP/7/8/8.1/10/Vista、Linux、Android etc.
- Support differential signal output up to 100MHz.

The RM310 uses standard Mini PCIE splint-type connector to connect with IND EVB board. The RM310 communicates with SoC through USB HOST1 port. Externally connect the SMA antenna, can achieve the data transmission.

Figure 3- 33 4G module and antenna with SMA interface

3.22 MIPI Camera

IND EVB supports to externally connect MIPI Camera extension board for pre-evaluation of the project. Our company has the corresponding extension board, with camera type ov13850, for usage.

The interfaces on IND EVB main board are as below. The extension board can be connected to MIPI_RX or MIPI_TX/RX. Just need to select the corresponding software driver (the driver is configured as MIPI_RX channel by default).

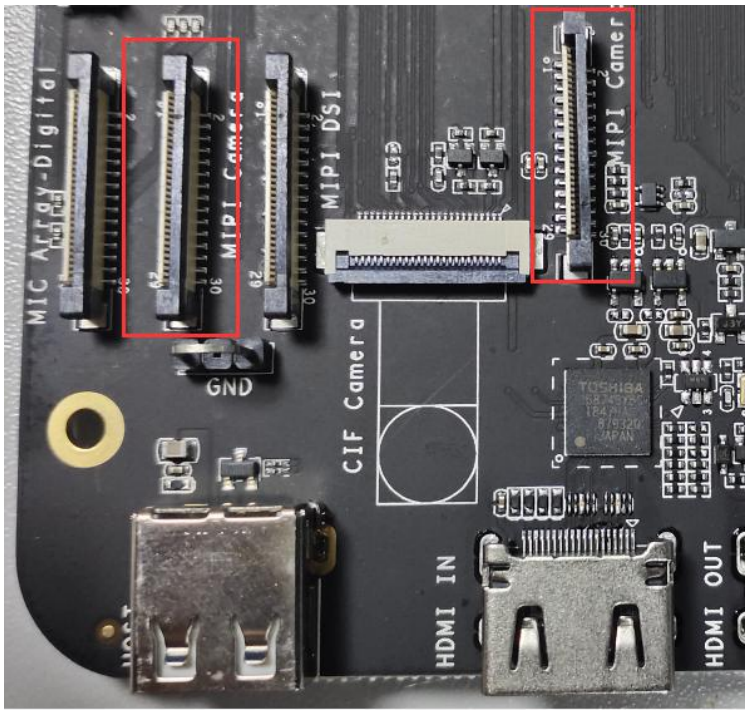

Figure 3- 34 MIPI_RX and MIPI_RX/RX interface

We design the conversion board for OV4689 and OV13850, and the conversion board is connected with IND EVB through 30 PIN FPC cable with 30PIN interval 0.5mm. The corresponding interfaces are as below:

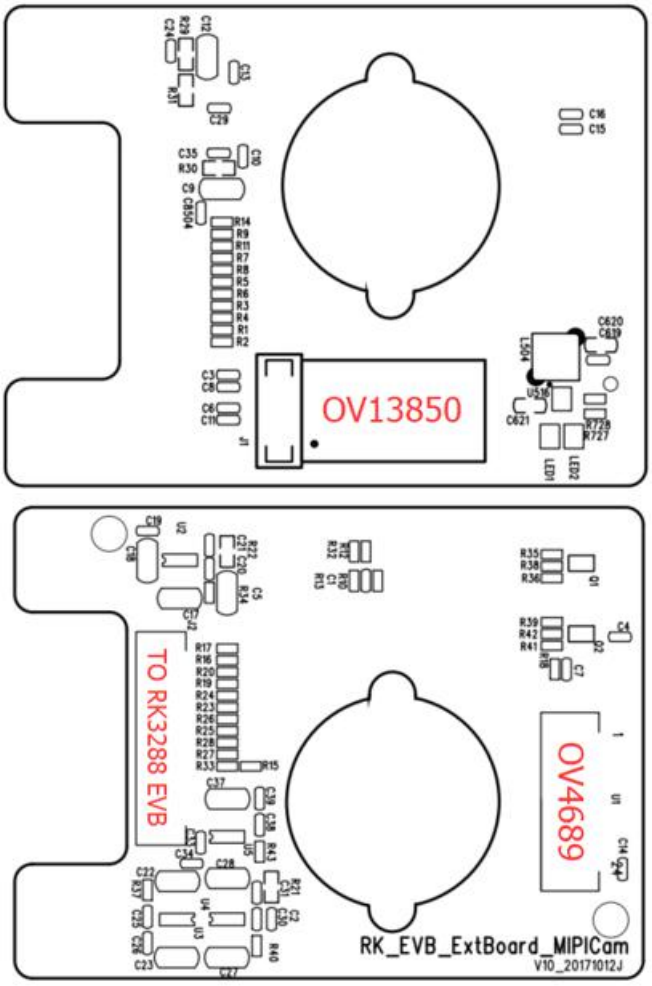

Figure 3- 35 camera conversion board connector

Connect camera extension board with IND EVB:

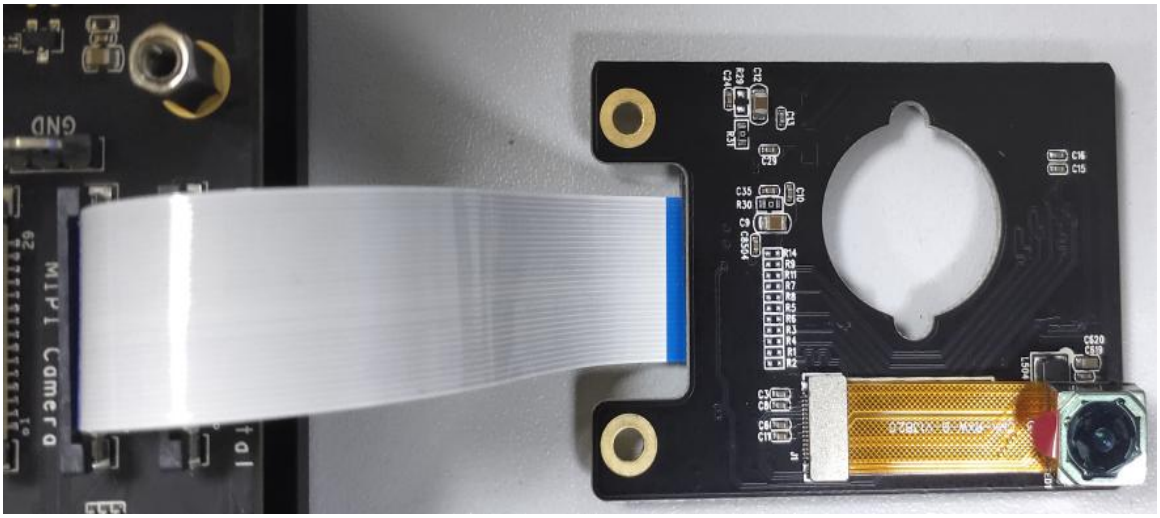

Figure 3- 36 camera conversion board

MIPI_RX connector signals corresponding to the silk-print 1, 2, 29, 30 are as below:

1	GND	
2		MIPI_RX0_D3N
3	MIPI_RX0_D3P	
4		GND
5	MIPI_RX0_D2N	
6		MIPI_RX0_D2P
7	GND	
8		MIPI_RX0_CLKN
9	MIPI_RX0_CLKP	
10		GND
11	MIPI_RX0_D1N	
12		MIPI_RX0_D1P
13	GND	
14		MIPI_RX0_D0N
15	MIPI_RX0_D0P	
16		GND
17	NC	
18		MIPI_MCLK_CAM1
19	VCC3V3_SW	
20		NC
21	MIPI_PDN_CAM1	
22		NC
23	I2C1_SCL	
24		I2C1_SDA
25	NC	
26		MIPI_RST_CAM1
27	GND	
28		VCC5V0_SYS
29	VCC5V0_SYS	
30		VCC5V0_SYS

Table 3- 8 MIPI RX signal definition

MIPI_TX/RX connector signals corresponding to the silk-print are as below:

1	GND	
2		MIPI_TX/RX_D3N
3	MIPI_TX/RX_D3P	
4		GND
5	MIPI_TX/RX_D2N	
6		MIPI_TX/RX_D2P
7	GND	
8		MIPI_TX/RX_CLKN
9	MIPI_TX/RX_CLKP	
10		GND
11	MIPI_TX/RX_D1N	
12		MIPI_TX/RX_D1P
13	GND	
14		MIPI_TX/RX_D0N
15	MIPI_TX/RX_D0P	
16		GND
17	NC	
18		MIPI_MCLK_CAM2
19	VCC3V3_SW	
20		NC
21	MIPI_PDN_CAM2	
22		NC
23	I2C4_SCL	
24		I2C4_SDA
25	NC	
26		MIPI_RST_CAM2
27	GND	
28		VCC5V0_SYS
29	VCC5V0_SYS	
30		VCC5V0_SYS

Table 3- 9 MIPI_TX/RX signal definition

Camera specification：

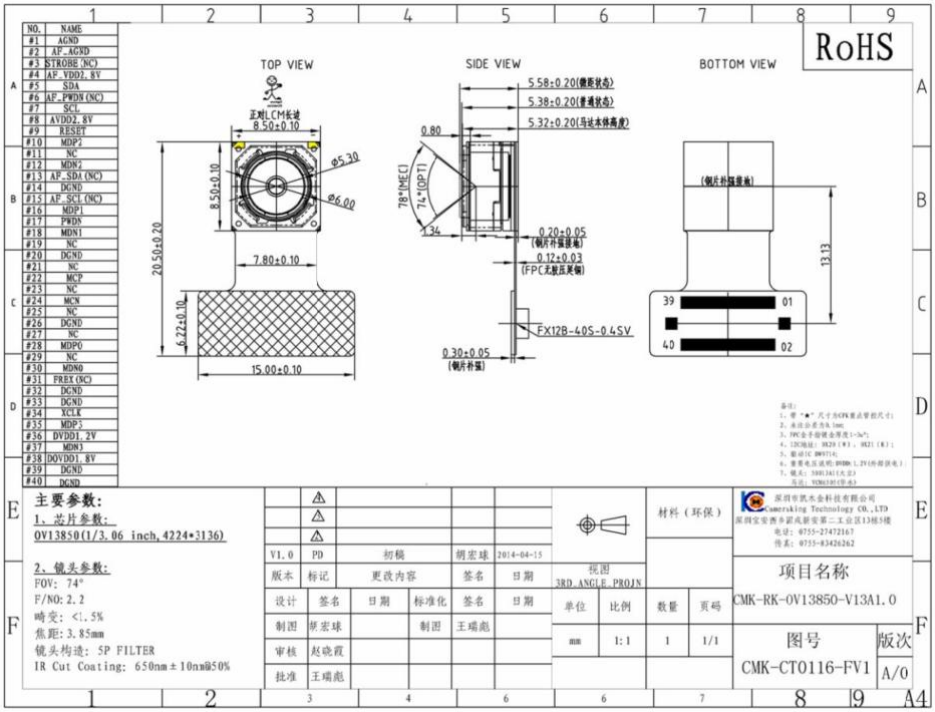

Figure 3- 37 Camera specification

OV13850 MIPI_RX Signals			
1	AGND	**21**	NC
2	AF_AGND	**22**	MCP
3	STROBE(NC)	**23**	NC
4	AF_VDD2.8V	**24**	MCN
5	SDA	**25**	NC
6	AF_PWDN(NC)	**26**	DGND
7	SCL	**27**	NC
8	AVDD2.8V	**28**	MDP0
9	RESET	**29**	NC
10	MDP2	**30**	MDN0
11	NC	**31**	FRBX(NC)
12	MDN2	**32**	DGND
13	AF_SDA(NC)	**33**	DGND
14	DGND	**34**	XCLK
15	AF_SCL(NC)	**35**	MDP3
16	MDP1	**36**	DVDD1.2V
17	PWDN	**37**	MDN3
18	MDN1	**38**	DOVDD1.8V
19	NC	**39**	DGND
20	DGND	**40**	DGND

Table 3- 10 OV13850 camera pin definition

4 Notice

4.1 Notice

RK3399 IND EVB is suitable for lab or engineering development environment. Please read the following notices carefully before operation:

- ✧ Under no circumstance can the power board, the panel interface and the extension board of the development board be hot-plugged.
- ✧ Before unpacking and installing the development board, please take the necessary anti-static measures to avoid the damage to the hardware of the development board caused by ESD.
- ✧ Please hold the edge of the development board, do not touch the exposed metal part of the development board, so as to avoid the electrostatic damage to the components of the development board.
- ✧ Please place the development board on the dry plane 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.