UG1002
EV721FA0 Evaluation Board User Guide

This document describes the evaluation board supported SM721FA0 modules.

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USING THIS DOCUMENT

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

Contents

1 Overview

1.1 Introduction

The evaluation board (EVB) supported SM721FA0 modules is designed to provide users with flexible function demonstration and usage evaluation. It builds the minimum system including power supply and clock, and provides various circuits such as Wi-Fi, A2C, USB, SDIO, GPIO, etc. Users can configure the functions freely by using the Software Development Kit (SDK) and related tools provided by REALTEK.

1.2 Features

The EVB includes the following features:

- SM721FA0 module SMT supported, the main chip on the module can be RTL8721FAM, RTL8711FAM, RTL8721FAF or RTL8711FAF.
- Supports for ARM's SWD and SEGGER J-Link protocol options
- 5V DC power supply through USB socket
- Buttons for chip reset and UART download
- Wi-Fi 2.4G&5G and Bluetooth supported from SM721FC0 module
- SDIO, A2C, USB, RMII, Cap-touch, DMIC interfaces and related on-board circuits
- User LED circuits

2 Quick Start

2.1 Power

The EVB can be powered by connecting a USB cable between PC and board in both USB-C sockets on the EVB.

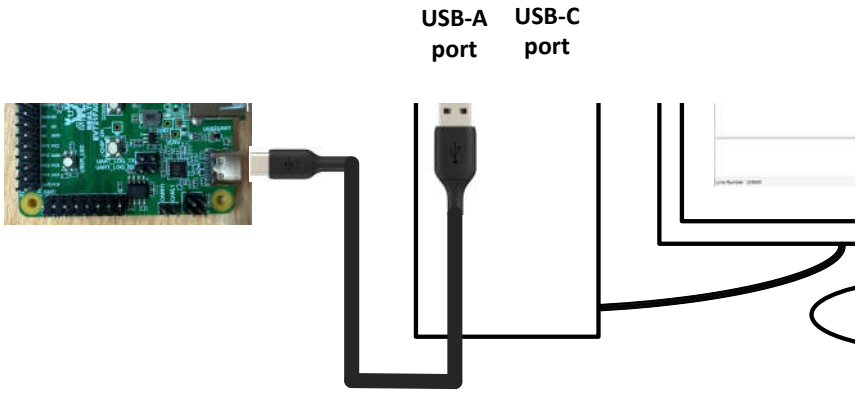


Figure 2-1 EV721FA0 EVB power supply schematic

2.2 FLASH Download

Users are allowed to download their own bin files into the flash through USB-to-UART function on the EVB.

NOTE

Please refer to the flash programming tool user guide(https://aiot.realmcu.com/en/latest/rst_tools/image_tool/index.html) for detailed instructions before downloading bin files into the flash.

2.3 Log

LOGUART is an important way for users to interact with the chip. Users can judge the working status of the code and perform online operations through the log transferred by the serial port.
The default transmission formats and transfer speed of LOGUART are: 8bits data, no parity bit, 1stop bit and 1.5Mbps respectively.

NOTE

- *The EVB has integrated a USB to UART IC on board so that the LOGUART function can be available only through a regular USB-A/USB-C to USB-C cable.*
- *If users want to use their own USB to UART module，please refer to section 4.3.1.*
- *Users can freely use any serial tool to communicate between PC and the chip on the SM721FA0 module. But if the software configuration enables AGG, users must use trace tool provided by REALTEK. If Trace Tool provided by REALTEK is chosen, please refer to the log tool user guide (https://aiot.realmcu.com/en/latest/rst_tools/trace_tool/index.html) for detailed instructions.*

2.4 Functions

The EVB supported SM721FA0 module provides many functions for users to use freely. When users want to use a specific function, please follow the steps:

(1) Confirm whether the function circuit or interface is supported directly on the EVB or not, please refer to Figure 3-1 & Figure 3-2.
(2) If the function circuit or interface is supported directly on the EVB, like User LED, RMII, USB, SDIO etc. Please refer to chapter 4 Basic Usage for information of the function.
(3) If the function circuit or interface is not supported directly on the EVB, like PWM, I2C, SPI etc., users need to connect the EVB to external

device through the pin headers and Dupont lines. Please confirm the pins to be used for the function through PINMUX document and find the location of the pin headers according to Figure 3 4 and Table 3 1.

3 PCB Layout

3.1 Component Distribution

The EVB is a four-layer PCB board, with a size of 65mm*56mm, and a positioning hole diameter of 2.7mm.

3.1.1 Top Layer

The top layer of the EVB is illustrated in Figure 3-1.

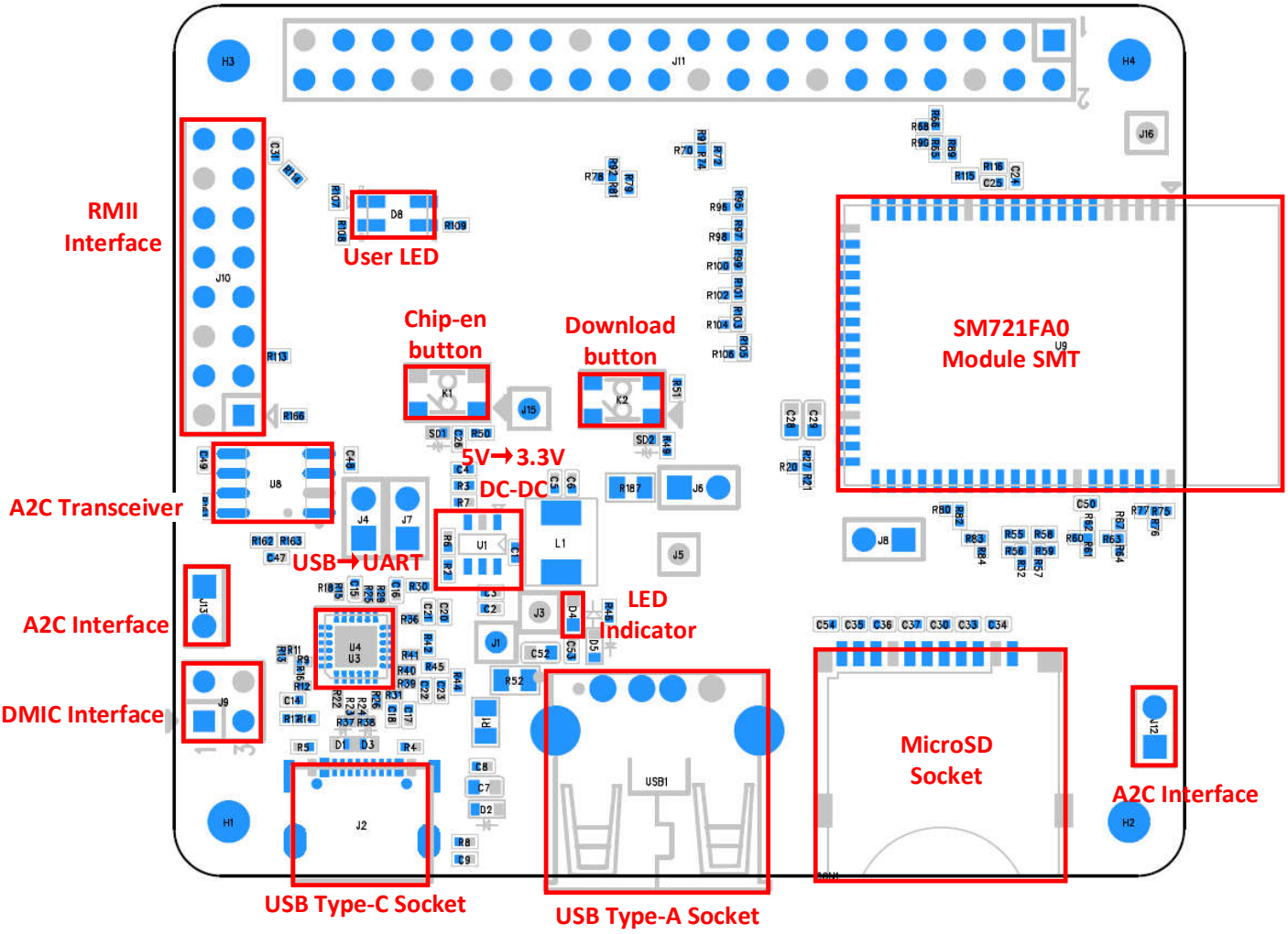


Figure 3-1 EV721FA0 EVB – top layer

3.1.2 Bottom Layer

The bottom layer of the EVB is illustrated in Figure 3-2.

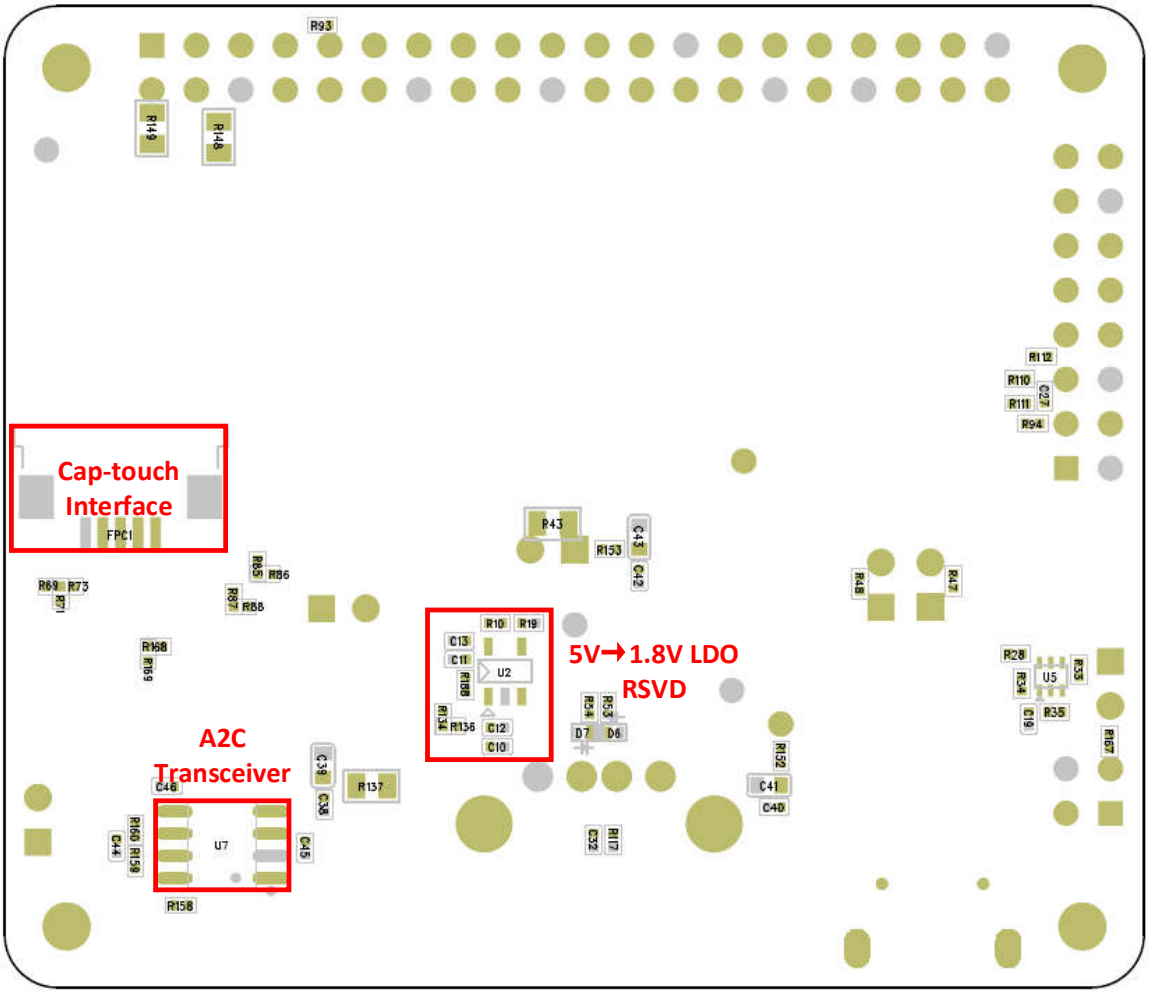


Figure 3-2 EV721FA0 EVB – bottom layer

3.2 External Module and Chips

3.2.1 SM721FA0 Module

SM721FA0 module as shown in Figure 3-3 could be placed on the EVB. The SM721FA0 module is a two-layer PCB board, with a size of 18mm*28mm.

The main chip on the module can be RTL8721FAM, RTL8711FAM, RTL8721FAF or RTL8711FAF.

For RF function, users could use Wi-Fi 2.4G/5G and Bluetooth (BT) function. PCB antenna is designed on the module board. Users can use onboard antenna or external antenna through IPEX connector.

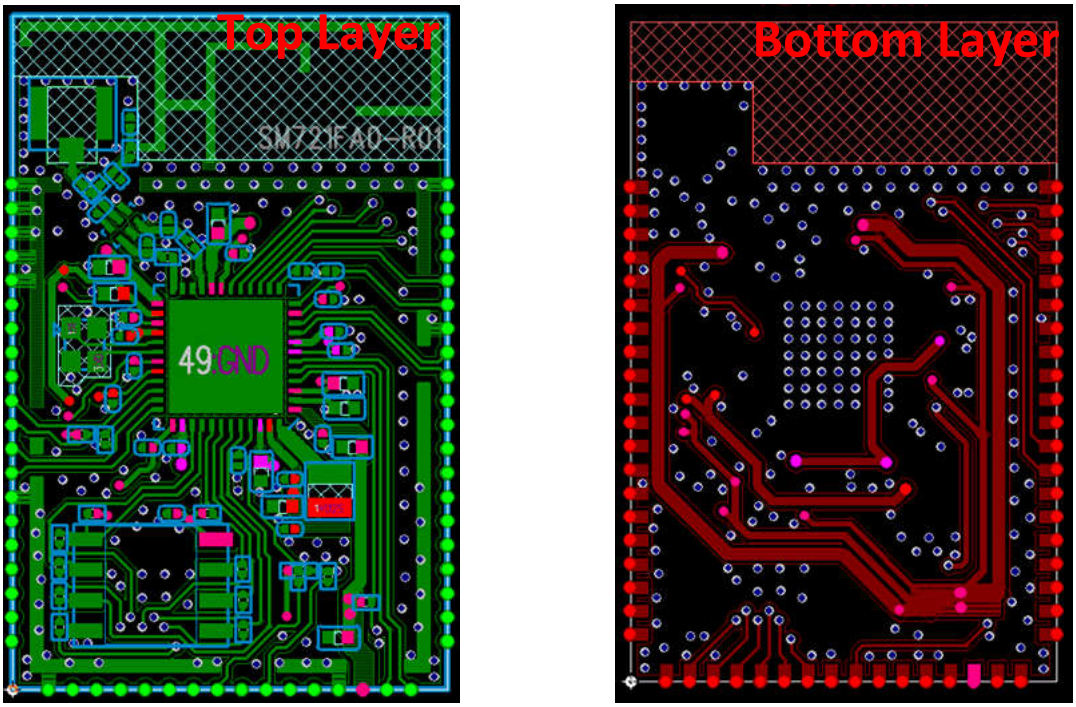


Figure 3-3 SM721FA0 module

3.2.2 USB to UART converter

PL2303GC of Prolific is used as a USB to UART converter. A USB-A/USB-C to USB-C cable can be used to connect the PC to the EVB and communicate with the chip on the SM721FA0 module.

3.2.3 A2C Transceiver

The TJA1042T/3 A2C transceiver of NXP provides an interface between the A2C controller of the main chip on the module and the physical two-wire A2C bus on the EVB.

3.3 Connectors

Multiple connectors are provided on the EVB for the expansion of different functions of the chip. The positions of different connectors on the EVB are shown in the figures below.

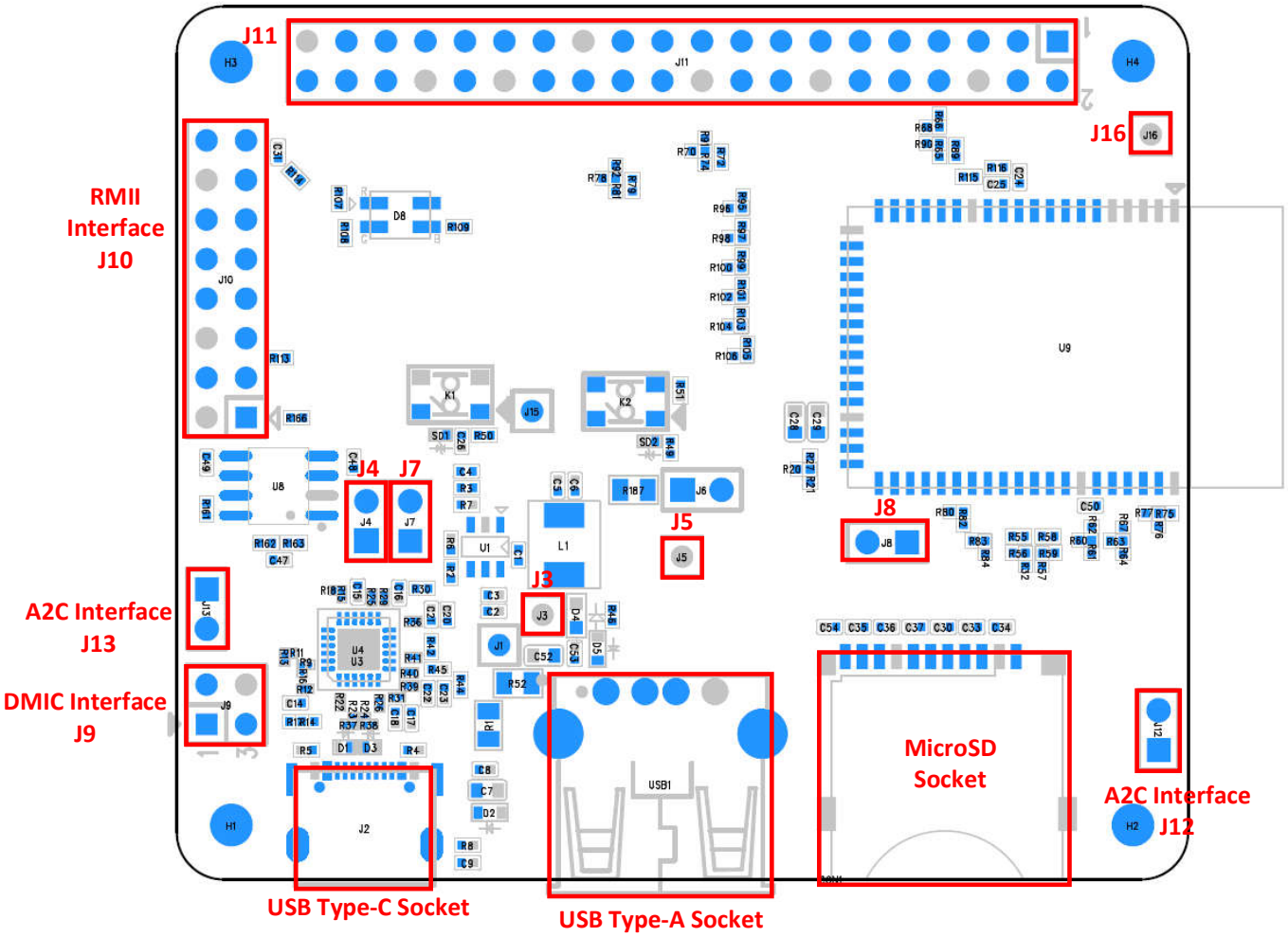


Figure 3-4 Connector top location diagram

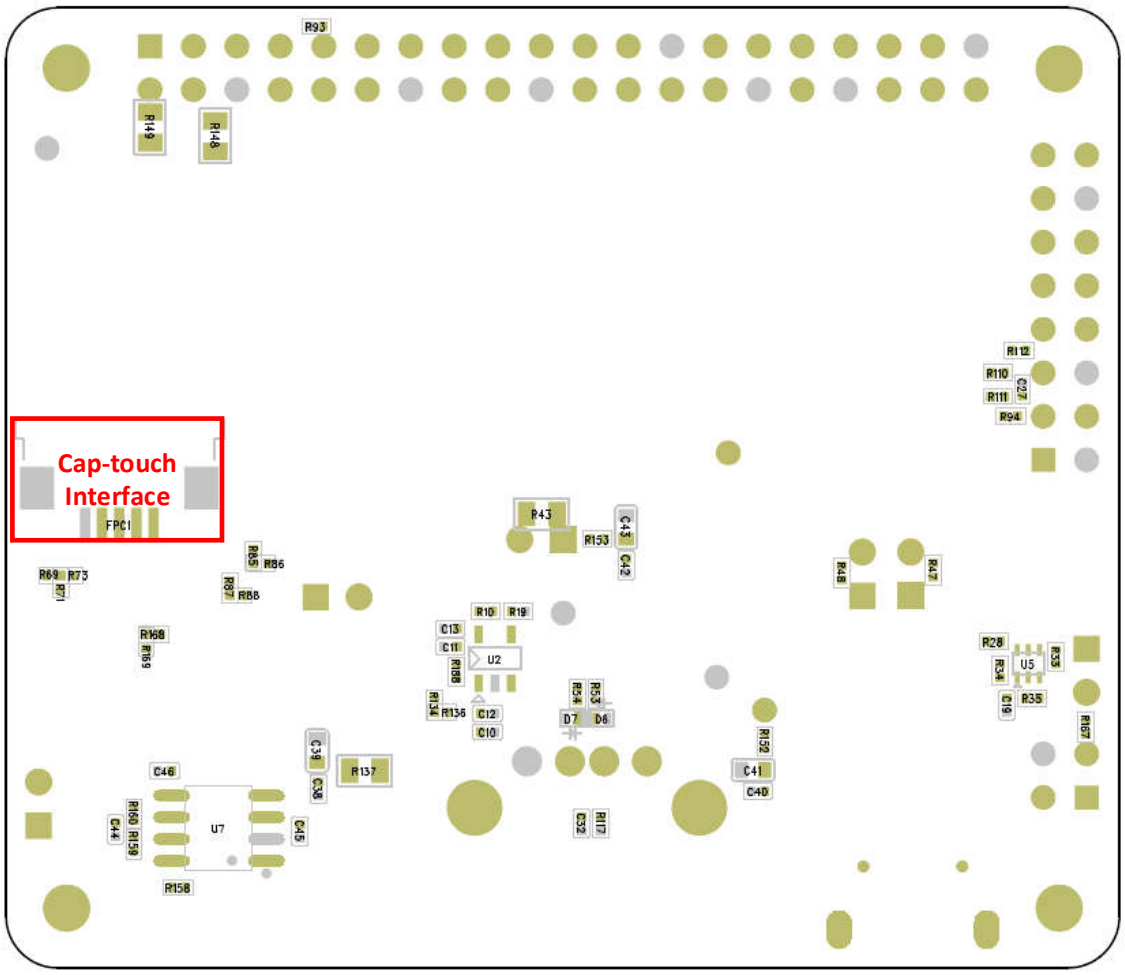


Figure 3-5 Connector bottom location diagram

3.3.1 Pin Headers

The pin multiplexing and description of each connector is listed in Table 3-1.

Table 3-1 EV721FA0 EVB - pin headers

Header name	Pin number	Symbol	Description
J11	1	VDD33V	3.3V voltage supplied by 5V-to-3.3V DC-DC converter through R148 0 ohm resistor.
	2	VDD5V	5V voltage supplied by USB interface through R149 0 ohm resistor.
	3	PA26	Used as GPIO or other functions connected to PA26 of the module through R87 0 ohm resistor.
	4	VD5V	5V voltage supplied by USB interface.
	5	PA25	Used as GPIO or other functions connected to PA25 of the module through R85 0 ohm resistor.
	6	GND	Ground.
	7	NC	-
	8	NC	-
	9	GND	Ground
	10	PA3	Used as GPIO or other functions connected to PA3 of the module through R27 0 ohm resistor.
	11	NC	-
	12	PA_0	Used as GPIO or other functions connected to PA0 of the module directly.
	13	PA21	Used as GPIO or other functions connected to PA21 of the module through R75 0 ohm resistor.
	14	GND	Ground.

	15	PA18	Used as GPIO or other functions connected to PA18 of the module through R60 0 ohm resistor.
	16	PA19	Used as GPIO or other functions connected to PA19 of the module through R63 0 ohm resistor.
	17	VDD33V	3.3V voltage supplied by 5V-to-3.3V DC-DC converter through R148 0 ohm resistor.
	18	PA5	Used as GPIO or other functions connected to PA5 of the module through R58 0 ohm(default NC) resistor.
	19	PB17	Used as GPIO or other functions connected to PB17 of the module through R66 0 ohm resistor.
	20	GND	Ground.
	21	PB18	Used as GPIO or other functions connected to PB18 of the module through R91 & R116 0 ohm resistors.
	22	PA20	Used as GPIO or other functions connected to PA20 of the module through R69 0 ohm resistor.
	23	PB19	Used as GPIO or other functions connected to PB19 of the module through R92 & R115 0 ohm resistors.
	24	NC	-
	25	GND	Ground
	26	NC	-
	27	NC	-
	28	NC	-
	29	NC	-
	30	GND	Ground.
	31	PC3	Used as GPIO or other functions connected to PC3 of the module through R97 0 ohm resistor.
	32	PC2	Used as GPIO or other functions connected to PC2 of the module through R95 0 ohm resistor.
	33	PC4	Used as GPIO or other functions connected to PC4 of the module through R99 0 ohm resistor.
	34	GND	Ground
	35	PC6	Used as GPIO or other functions connected to PC6 of the module through R103 0 ohm resistor.
	36	PC5	Used as GPIO or other functions connected to PC5 of the module through R101 0 ohm resistor.
	37	PA4	Used as GPIO or other functions connected to PA4 of the module through R550 ohm(default NC) resistor.
	38	PC7	Used as GPIO or other functions connected to PC7 of the module through R105 0 ohm resistor.
	39	GND	Ground.
	40	PC_8	Used as GPIO or other functions connected to PC8 of the module through R63 0 ohm resistor directly.
J10	1	VD33V	3.3V voltage supplied by 5V-to-3.3V DC-DC converter through R166 0 ohm resistor.
	2	GND	Ground.
	3	RMII_TXD0	Used as RMII TXD0 signal connected to PC4 of the module through R100 0 ohm (default NC) resistor.
	4	RMII_REF_CLK	Used as RMII_REF_CLK signal connected to PB18 of the module through R70 0 ohm (default NC) and R116 0 ohm resistors.
	5	RMII_TXD1	Used as RMII TXD1 signal connected to PC3 of the module through R98 0 ohm (default NC) resistor.
	6	GND	Ground.
	7	RMII_TXEN	Used as RMII TXEN signal connected to PC2 of the module through R96 0 ohm (default NC) resistor.
	8	RMII_RXD1	Used as RMII RXD1 signal connected to PC6 of the module through R104 0 ohm (default NC) resistor.
	9	PHY_RSTB	Used as PHY_RSTB signal connected to PA3 of the module through R20 0 ohm (default NC) resistor.
	10	RMII_RXD0	Used as RMII RXD0 signal connected to PC7 of the module through R106 0 ohm (default NC) resistor.
	11	RMII_RXERR	Used as RMII RXERR signal connected to PB17 of the module through R68 0 ohm (default NC) resistor.

	12	RMII_CRS_DV	Used as RMII_CRS_DV signal connected to PC5 of the module through R102 0 ohm (default NC) resistor.
	13	RMII_MDC	Used as RMII_MDC signal connected to PA25 of the module through R80 0 ohm (default NC) resistor.
	14	GND	Ground.
	15	RMII_MDIO	Used as RMII_MDIO signal connected to PA26 of the module through R83 0 ohm (default NC) resistor.
	16	EXT_CLK_OUT	Used as EXT_CLK_OUT signal connected to PB19 of the module through R78 0 ohm (default NC) and R115 0 ohm resistors.
J3	1	GND	Ground.
J4	1	USB2UART_TX	Log UART TX signal of PL2303G4FIG7P2 RS232.
	2	UART_LOG_RX	Default LOGUART RX function of RTL8721FLM.
J5	1	GND	Ground.
J7	1	USB2UART_RX	Log UART RX signal of PL2303G4FIG7P2 RS232.
	2	UART_LOG_TX	Default LOGUART TX function of RTL8721FLM.
J13	1	C_H1	Used as A2C high signal connected to TJA1042T/3 A2C transceiver.
	2	C_L1	Used as A2C low signal connected to TJA1042T/3 A2C transceiver.
J12	1	C_H0	Used as A2C high signal connected to TJA1042T/3 A2C transceiver.
	2	C_L0	Used as A2C low signal connected to TJA1042T/3 A2C transceiver.
J9	1	DMIC_CLK/PB17	Used as DMIC clock or GPIO connected to PB17 of RTL8721FLM through R90 0 ohm(default NC) resistor.
	2	VD33_DMIC	3.3V power for DMIC through R167 0 ohm resistor.
	3	DMIC_DATA/PB18	Used as DMIC data or GPIO connected to PB18 of RTL8721FLM through R74 0 ohm (default NC) and R116 0 ohm resistors.
J8	1	PA_25	Used for user LED connected to PA25 of the module directly.
	2	LED_G	LED green signal connected to user LED through R108 470 ohm resistor.

NOTE

1.If the main chip on the SM721FA0 module is RTL8721FAM or RTL8711FAM. PC2, PC3, PC4, PC5, PC6, PC7 are connected to external flash by default and cannot be used as GPIO or other functions through the pin header on the EVB.
2.If the main chip on the SM721FA0 module is RTL8721FAM or RTL8711FAM. PA0 is used as power pins by default and cannot be used as GPIO or other functions through the pin header on the EVB.
3. PC8 are used as power pin and cannot be used as GPIO or other functions through the pin header on the EVB.
4. Not all pins are connected to the pin headers by default. If the following pins (PA4, PA5) need to be used on the pin headers, please refer to Table 3-2 to determine the hardware changes that need to be made on the EVB board. In addition, please refer to Figure 3-1 and Figure 3-2 for the specific location of the components that need to be adjusted on the board.

Table 3-2 Circuit modification instructions of GPIO

Pin name	Resistors need to be soldered	Resistors need to be removed	Note
PA4	R55 (0 ohm)	R32 (0 ohm)	After R32 or R57 is removed, the USB type-A socket on board cannot be used.
PA5	R58 (0 ohm)	R57 (0 ohm)	

3.3.2 USB-C Socket

A standard USB-C socket is provided on the EVB. Users can use a USB-A/USB-C to USB-C cable to connect between PC and EVB for both power supply and LOGUART function.

Figure 3-6 USB-A to USB-C cable

Figure 3-7 USB-C to USB-C cable

3.3.3 USB-A Socket

A standard USB-A socket is provided on the EVB. Users can connect an external U disk through the USB-A socket or use a USB-A/USB-C to USB-A cable to connect between PC and EVB.

Figure 3-8 USB-A to USB-A cable

3.3.4 IPEX

IPEX is reserved for Wi-Fi and Bluetooth on the EVB. The IPEX female connector can be connected to an external antenna or an instrument to measure the RF characteristics.
Figure 3- shows the size of IPEX female connector. Pay attention to the size matching of the adapter when using it.

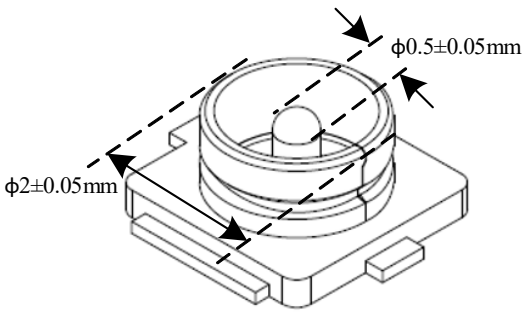


Figure 3-9 Size of IPEX female connector

3.3.5 Cap-touch Interface

A Cap-touch interface is provided on the EVB for extended use connected to a touch daughter board through FPC.

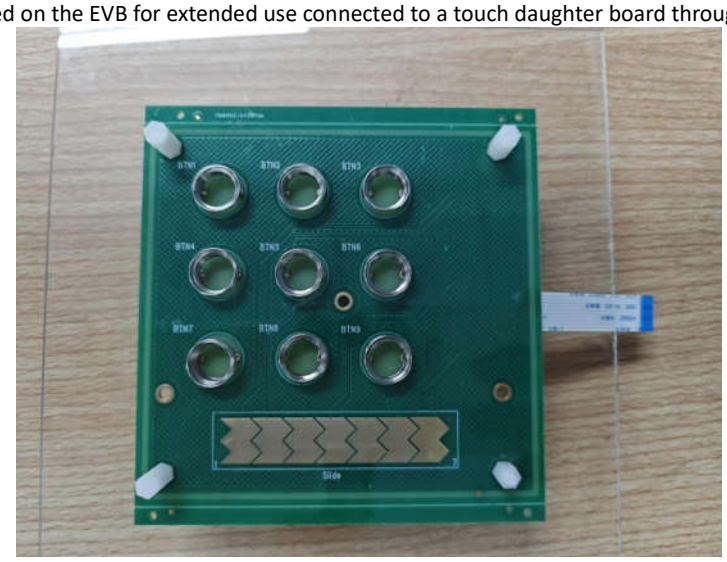


Figure 3-10 Touch daughter board

3.3.6 RMII Interface

A RMII interface is provided on the EVB which can be connected to RMII daughter board.

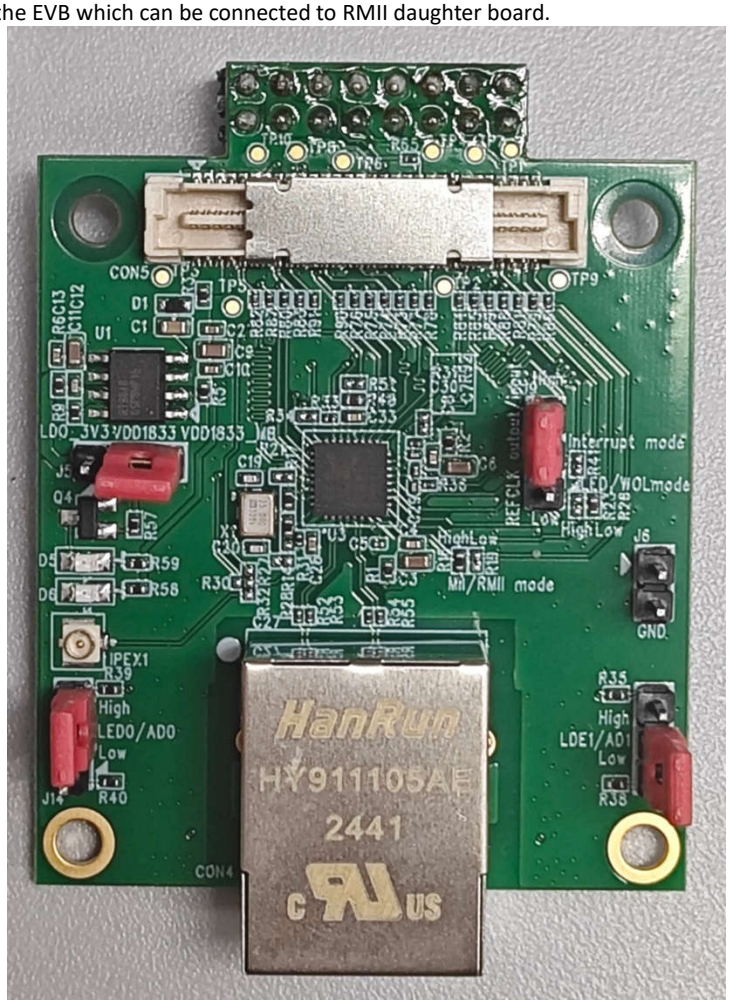


Figure 3-10 RMII daughter board

3.3.7 MicroSD Socket

A microSD socket is provided on the EVB which can be connected to microSD card directly or SDIO daughter board.

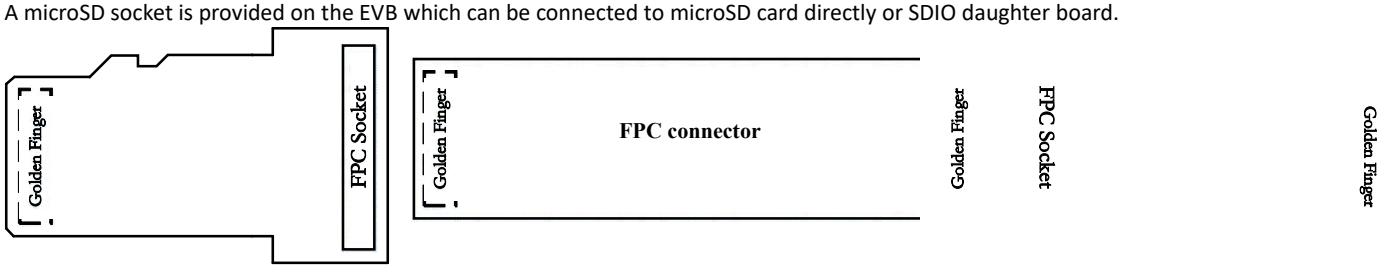


Figure 3-11 SDIO daughter board

3.3.8 DMIC Interface

Please refer to the sector 3.3.1 for the description of pin header J9. The EVB can collect sound data through external DMIC daughter board.

Figure 3-11 DMIC daughter board

3.3.9 A2C Interface

Please refer to the sector 3.3.1 for the description of pin headers J12 and J13.

4 Basic Usage

4.1 Power Supply

The maximum power consumption of the EVB is 3.3V, 600mA.

4.1.1 USB Power

- The EV721FA0 EVB can be 5V DC powered by connecting PC or adaptor to the USB-C socket. Users can use the LOGUART function through the USB-C socket at the same time.
- The EV721FA0 EVB can be 5V DC powered by connecting PC or adaptor to the USB-A socket.

4.1.2 SDIO Power

The EV721FA0 EVB can be 3.3V DC powered by SDIO host through the VCC pin of microSD socket.

4.1.3 Raspberry Pi Power

The EV721FA0 EVB can be 3.3V DC and 5V DC powered by the Raspberry Pi through the 40 pin header on the EVB. Please refer to the sector 4.14 for the method and operation when the EVB is powered by the Raspberry Pi.

4.1.4 LED Indicators

A single color LED is used to indicate whether 3.3V power supply of the SM721FA0 module is available. Please refer to Figure 3-1 for the location of LED.

4.2 Reset

When the power supply is stable, the chip on the SM721FA0 module can be reset by pressing and releasing the CHIP_EN button on the EVB, or powering the EVB off and then powering on. Please refer to Figure 3-1 for the location of the CHIP_EN button.

4.3 Communication

4.3.1 LOGUART

The EV721FA0 EVB integrates a USB to UART chip so users can simply use a USB-A/USB-C to USB-C cable to connect EVB and PC. After that, users can communicate with the chip on the module through any serial tool on the PC.
Before using the serial tool, users should follow the below steps:
(1) Select the correct serial port.
(2) Configure the transmission baud rate and frame format.
(3) Open the serial port to interact with the EVB.
Users also can use their own UART communication module instead of the integrated USB to UART chip on the EVB. Users should follow the following steps:
(1) Remove the R47 0 ohm and R48 0 ohm resistors to disconnect the connection between the integrated USB to UART chip and the chip on the SM721FA0 module.
(2) Refer to the figure 4-1 and find the Location of LOGUART function on EVB. The default LOGUART function is distributed on PA2 (UART_LOG_RXD) and PB20 (UART_LOG_TXD).
(3) Connect EVB and external UART communication module through four DuPont lines including TXD, RXD, ground and power (Power is optional).

NOTE

The default transmission baud rate of LOGUART is 1.5Mbps

Figure 4-1 Location of LOGUART function on EVB

Take Trace Tool provided by REALTEK as an example, after the configurations above, the log window of the Trace Tool will display the data received/transmitted by PC and parse it into ASCII characters. Each line will display the time of receiving/transmitting this log.
Please refer to the application note (AN1000) for more detailed information.

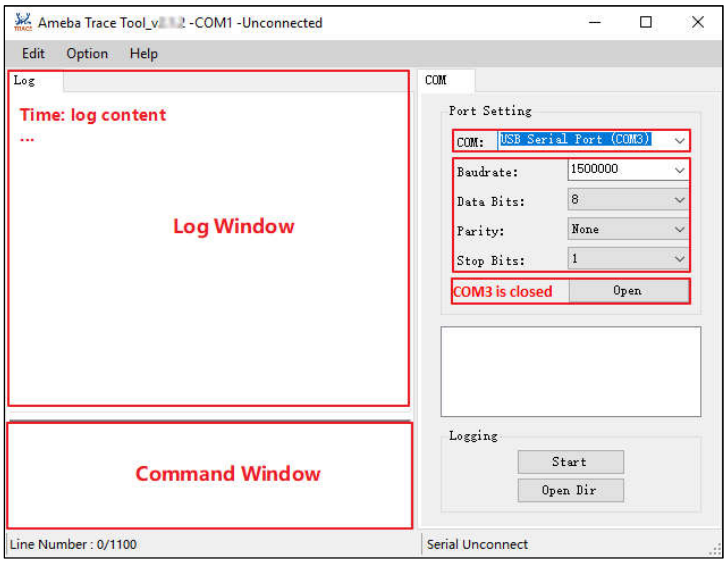


Figure 4-2 Trace Tool UI

4.3.2 SWD

The EV721FA0 EVB supports 2-pins serial-wire debug (SWD) interface for users to access ARM Cortex®-M core integrated in the chip on the SM721FA0 module. For more information, please refer to ARM Debug Interface v6 Architecture Specification.
The default SWD function is distributed on PA18 (SWD_CLK) and PA19 (SWD_DAT).

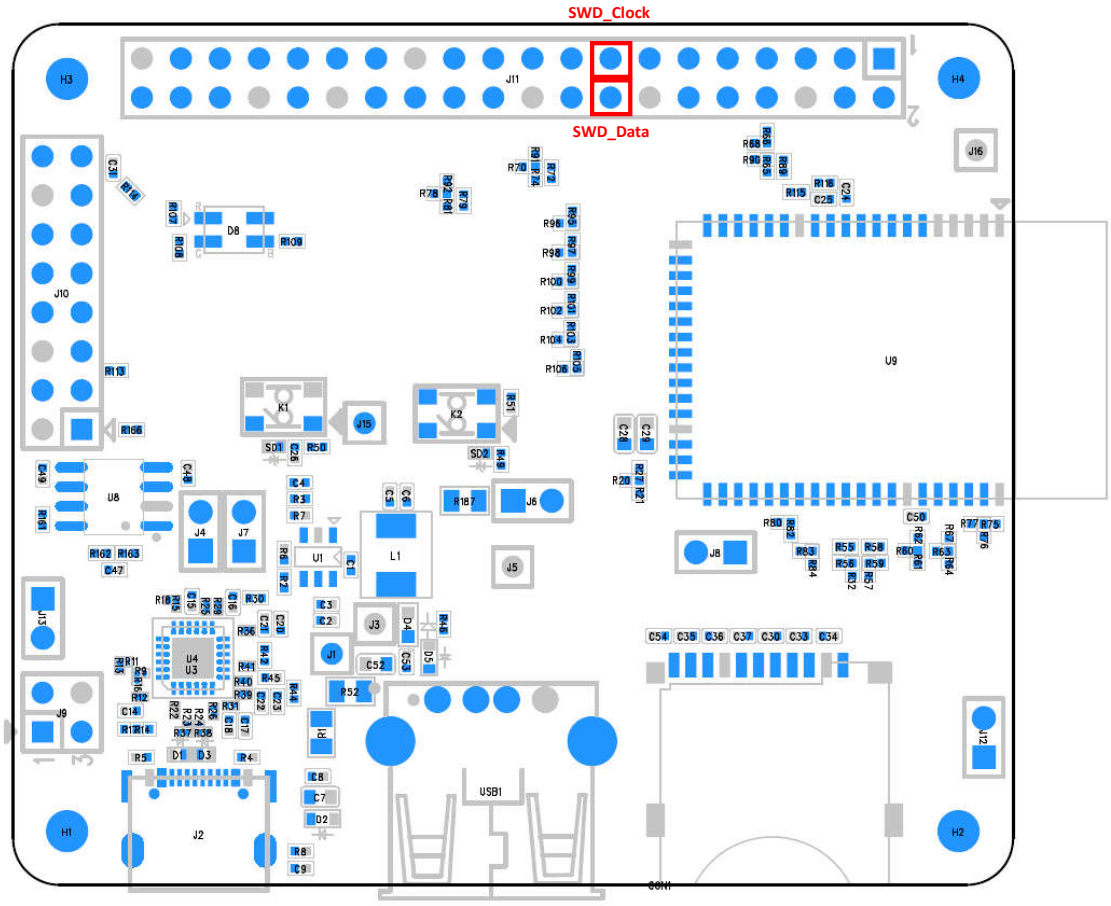


Figure 4-3 Location of SWD function on EVB

4.4 Wi-Fi

The main chip on the SM721FA0 module supports up to Wi-Fi 802.11ax protocol, both PCB and external antenna (Bluetooth and WiFi share the antenna through time-division multiplexing).

4.5 Bluetooth

The main chip on the SM721FA0 module supports Bluetooth protocol 5.0, both PCB and external antenna (Bluetooth and WiFi share the antenna through time-division multiplexing).

4.6 Cap Touch

4.6.1 Overview of Daughter Board

Capacitive touch sensors detect touch events by changing capacitance when a finger touches them. The EVB connects to the Daughter Board via a flexible printed circuit board (FPC). This daughterboard includes nine spring-loaded buttons and a set of flat slider buttons. These two share some channels, which are selected using a resistor (co-lay) on the back panel.

4.6.2 Component Specifications of Daughter Board

- 10-pin FPC connector, 1mm pitch, with a flap attached at the bottom.
- Some packaged ICs only have 5-pin connectors. In these cases, a 5-pin flexible cable is required to connect to the 10-pin daughterboard. The connection should be aligned with the end of the 10-pin connector printed with "BTN9" on the daughterboard.
- Button daughterboard: A double-layer board with nine spring-loaded buttons and a set of seven-button sliders. The back of the board has an FPC connector.
- The upper insulating cover for the buttons (including the spring-loaded buttons) is made of acrylic, 2mm thick.

4.6.3 Instructions of Daughter Board

- Select spring buttons or sliders for the co-lay resistors on the back of the daughterboard PCB;
- Select Cap-touch for the co-lay resistors on the EVB PCB;
- Cover the front of the daughterboard with an acrylic sheet. If you select a spring button, press the acrylic sheet on top of the spring, and the spring and the acrylic sheet must be in contact;
- Connect the FPC interfaces of the two PCBs through a flexible cable and confirm the connection reliability;
- Connect the EVB power supply, burn the program, and confirm that the boot is successful;
- Run the Cap-touch application or debugger;
- Perform touch actions on the acrylic sheet on the front of the daughterboard and observe the touch effect.

NOTE

1. Please be noted that the FPC cable should be carefully inserted into the connector to avoid damage to the golden finger.

2. If users want to use cap-touch interface (refer to chapter 3.3.5) on the EVB, please make the modifications in the Table 4-1. In addition, please refer to Figure 3-1 and *Figure 3-2 for the specific location of the components that need to be adjusted on the board.*

Table 4-1 Circuit modification instructions of Cap-Touch

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
FPC1_2	TOUCH8	R77(0 ohm)	R75(0 ohm)	If touch channel8 is used, the SD_D3 of SDIO cannot work.
FPC1_3	TOUCH0	R73(0 ohm)	R69(0 ohm)	If touch channel0 is used, the SD_D1 of SDIO cannot work.
FPC1_4	TOUCH1	R67(0 ohm)	R63(0 ohm)	If touch channel1 is used, the SD_CMD of SDIO cannot work.
FPC1_5	TOUCH2	R62(0 ohm)	R60(0 ohm)	If touch channel2 is used, the SD_CLK of SDIO cannot work.

4.7 USB

The USB Type-A interface on the EVB supports up to USB protocol 2.0.

4.8 SDIO

Both RTL8721FAM and RTL8721FAF on the SM721FA0 module support up to SDIO specification version 2.0.
If RTL8721FAM or RTL8721FAF is used as a SDIO host on the EVB，the microSD socket can be connected to a standard microSD card or connected to a SDIO device with microSD socket through a SDIO daughter board (Refer to Figure 4-9) provided by Realtek. In addition, if users want RTL8721FAM or RTL8721FAF to communicate with eMMC chip， users can choose to remove the microSD socket on the EVB and solder the EMMC module provided by Realtek.

Figure 4-4 MicroSD Card

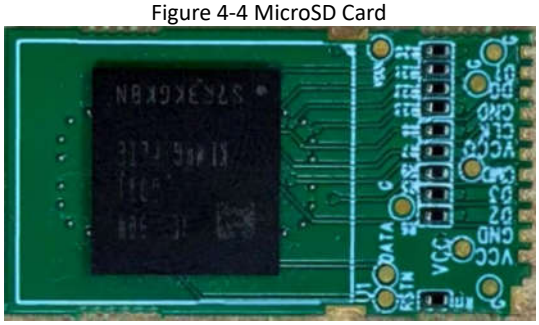


Figure 4-5 eMMC Module

If RTL8721FAM or RTL8721FAF is used as a SDIO device on the EVB， users can refer to the following application scenarios:
1. Connected to another EVB which used as SDIO host.

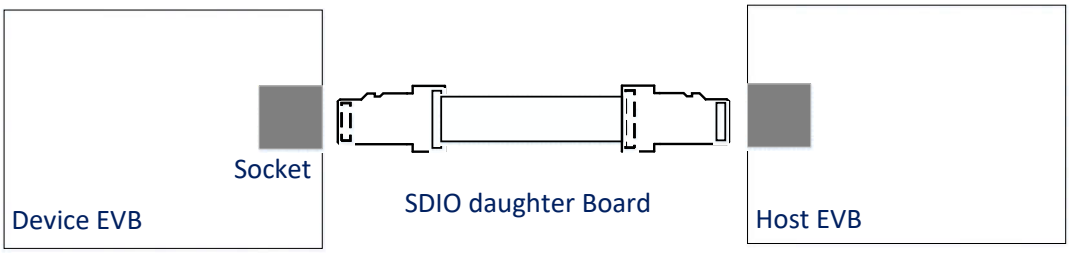


Figure 4-6 EVB connected to another EVB

2. When connected to a PC with standard SD socket, it is necessary to use a SDIO daughter board with a MicroSD to standard SD adaptor.

Figure 4-7 EVB connected to PC

3. EVB is used as a device connected to other host controller platforms, such as STM32 platform. Users can select the above two methods based on the SD socket type on the host controller platform.

NOTE

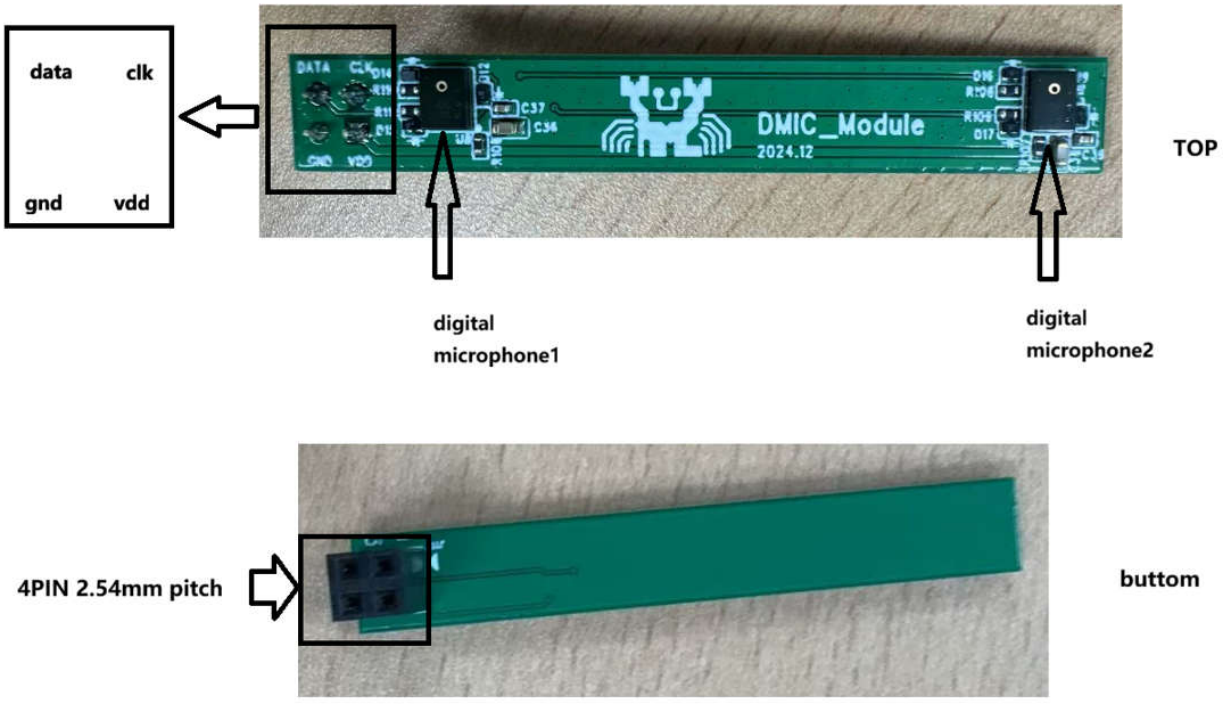
1.If users want to use MicroSD socket (refer to chapter 3.3.7) on the EVB and related SDIO daughter board provided by REALTEK, please make the modifications in the Table 4-2. In addition, please refer to Figure 3-1 and *Figure 3-2 for the specific location of the components that need to be adjusted on the board.*

Table 4-2 Circuit modification instructions of SDIO

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
CON1-1	SDIO_D2	R56 (0 ohm)	R32 (0 ohm)	If R32 is removed, the USB type-A interface on the EVB cannot be used.
CON1-2	SDIO_D3	R76 (0 ohm)	R75 (0 ohm)	If SDIO_D3 is used, the cap touch channel8 cannot work.
CON1-3	SDIO_CMD	R64 (0 ohm)	R63 (0 ohm)	If SDIO_CMD is used, the cap touch channel1 cannot work.
CON1-5	SDIO_CLK	R61 (0 ohm)	R60 (0 ohm)	If SDIO_CLK is used, the cap touch channel2 cannot work.
CON1-7	SDIO_D0	R59 (0 ohm)	R57 (0 ohm)	If R57 is removed, the USB type-A interface on the EVB cannot be used.
CON1-8	SDIO_D1	R71 (0 ohm)	R69 (0 ohm)	If SDIO_D1 is used, the cap touch channel0 cannot work.
CON1-9	SDIO_CD	R79 (0 ohm)	R92 (0 ohm)	If SDIO_CD is used, the EXT_CLK_OUT and A2C STB1 cannot work.

4.9 Microphone

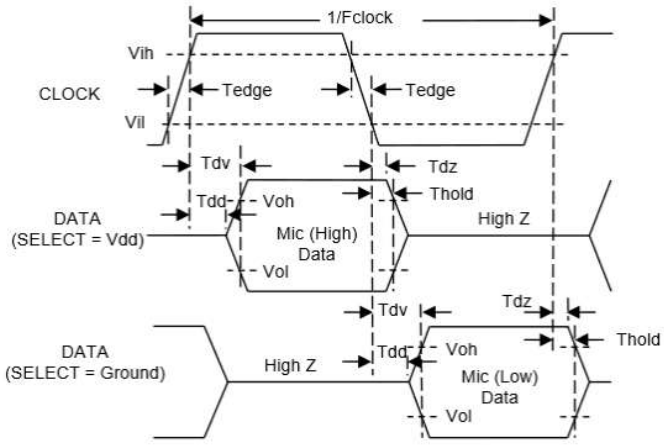
4.9.1 Overview of Daughter Board



S

Figure 4-8 digital microphone board

The digital microphone board contains two digital microphones and related circuit components, a 4-pin socket, and the digital microphone uses WMM7040DTHN0. The timing is as follows: digital microphone1 select=vdd，digital microphone2 select=gnd



Timing Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Comments
Low to High Threshold	Vl-h	0.65*VDD		VDD+0.3	V	
High to Low Threshold	Vh-l	-0.3		0.35*VDD	V	
DATA into Hi Z Time	Tdz	0		20	ns	RL=1MΩ，CL=12pF
DATA Valid Time	Tdv	24	36	48	ns	RL=1MΩ，CL=12pF
Clock Jitter				0.5	ns	Period jitter in RMS
Clock Duty Cycle		40	50	60	%	
Clock Frequency		350	2400	4800	KHZ	

Figure 4-9 digital microphone timing

4.9.2 Digital microphone schematic

Digital microphone 1 corresponds to U8, digital microphone 2 corresponds to U9, and the chip pins L/R correspond to SELECT in Figure 4-10.

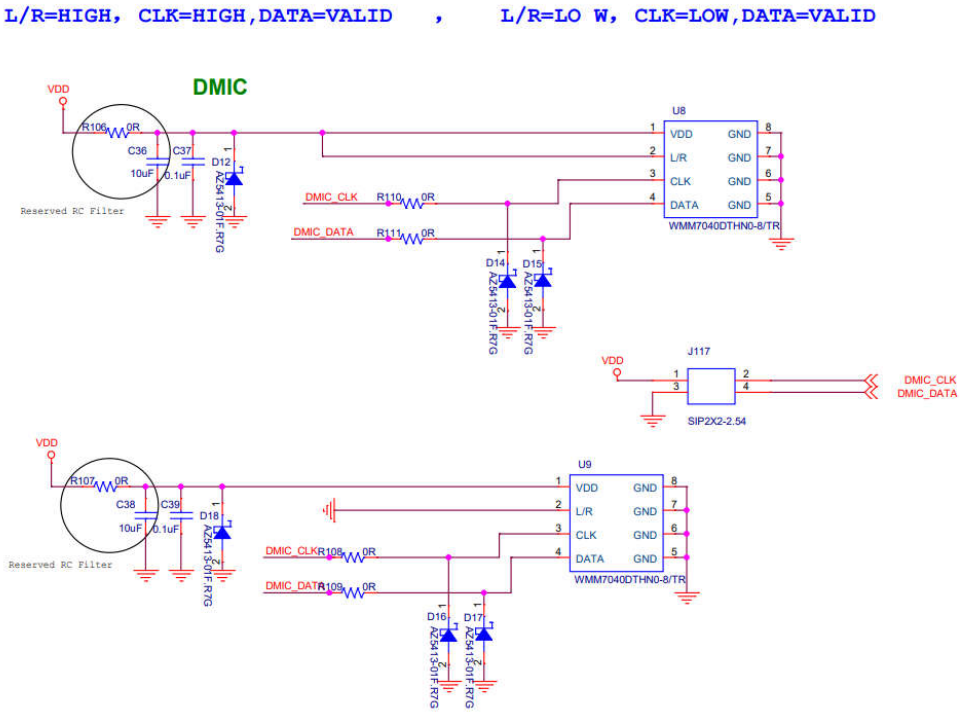


Figure 4-10 digital microphone schematic

4.9.3 Component Specifications of Daughter Board

- Socket: 4-pin 2.54mm pitch female socket.
- Digital microphone daughterboard: double-layer board.
- Digital microphone: WMM7040DTHN0.

4.9.4 Instructions of Daughter Board

- When plugging the digital microphone daughterboard into the motherboard, make sure to follow the order of the socket pins.
- It is recommended that the power supply VDD of the daughterboard be in the same power domain as the data and clk pins.
- Keep the pickup area of the digital microphone away from dust and water stains. Do not blow the microphone with a temperature gun, and do not touch the microphone with cleaning water, alcohol, etc.

NOTE

1. Digital microphone datasheet：WMM7040DTHN0 datasheet。

2. If users want to connect the EVB to external DMIC through J9 pin header (refer to chapter 3.3.1), please make the modifications in the Table 4-3. In addition, please refer to Figure 3-1 and *Figure 3-2 for the specific location of the components that need to be adjusted on the board.*

Table 4-3 Circuit modification instructions of DMIC

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
J19-1	DMIC_CLK	R90 (0 ohm)	R66 (0 ohm)	If DMIC_CLK is used, the RMII RXERR, A2C TX1 and LED_B cannot work.
J19-2	VD33_DMIC	R167 (0 ohm)	-	
J19-3	DMIC_DATA	R74 (0 ohm)	R91 (0 ohm)	If DMIC_DATA is used, the RMII REF_CLK and A2C RX1 cannot work.

4.10 RMII

The main chip on the EVB supports single-port 10/100Mbps Ethernet. Users can connect the EVB to external RMII daughter board through RMII interface (refer to chapter 3.3.6).

4.10.1 Overview of Daughter Board

The RMII daughter board designed for RMII verification based on RTK EVB, utilizing the RTL8201F RMII PHY chip by default. it can support multiple clock sources and directions for REFCLK with different configurations:

- Supports onboard XTAL for the PHY clock.
- Supports external source clock for the PHY clock.
- Support external source clock from EVB for the PHY clock:
- Support REFCLK output mode: REFCLK from PHY to MAC.
- Support REFCLK input mode: REFCLK from MAC to PHY.

4.10.2 Description of Daughter Board

Refer to the Figure 4-11, which includes:

- RMII interface, clock source (from EVB), VCC (from EVB), GND.
- Power select: Default connection is to the right side,：
- Left side ：3.3V from LDO
  Right side：3.3V from EVB.
- REFCLK select: REFCLK direction selection
- Upper side for REFCLK input mode;
- Down side for REFCLK output mode.
- If REFCLK direction is set in the image, selection on the RMII Daughter board can be omitted.
- PHYADDR select- AD0
- PHYADDR select- AD1

- Address selection based on image configuration.
- Jumper: upper side for High, down side for Low.
- In the Figure setting, default PHY address is 01.
- RJ45 interface

Figure 4-11 RMII daughter board

4.10.3 Clock option

The section introduces the selection of different PHY source clock options.
The schematic diagram of the clock options is shown in Figure 4-12.。

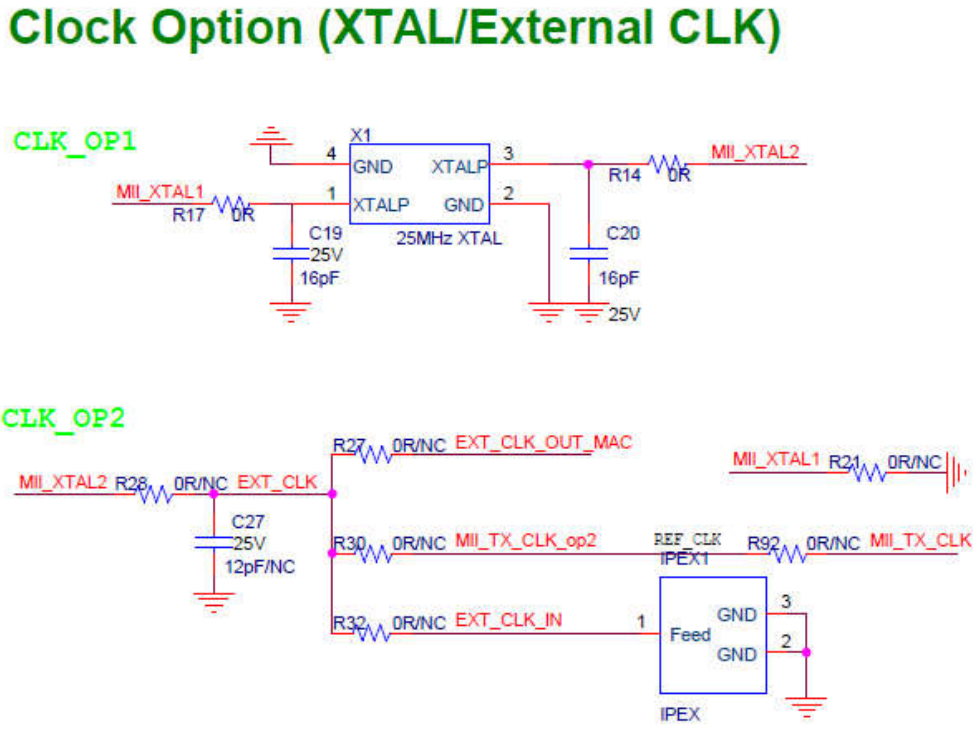


Figure 4-12 RMII clock option schematic

- SYSCLK from XTAL： XTAL(default onboard), add R17/R14 （components in the red diagram，0ohm）； Remove R21（components in the yellow diagram）

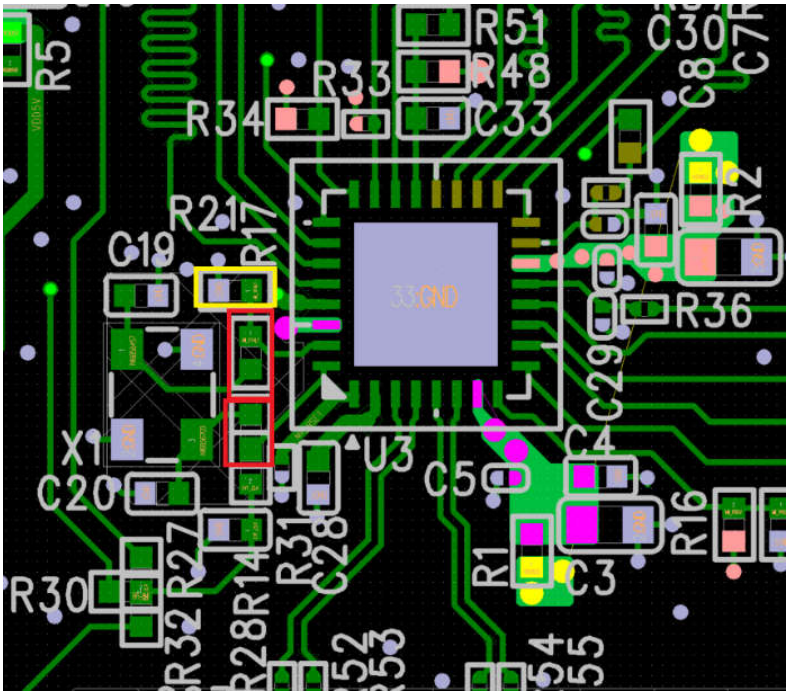


Figure 4-13 PHY sysclk from XTAL

- SYSCLK from EXT_CLK： add R28/R21/R32 （components in the red diagram，0 ohm）, add C27(component in the blue diagram，12pF); Remove R17/R14（components in the yellow diagram）, remove XTAL , and input the Clock from IPEX1

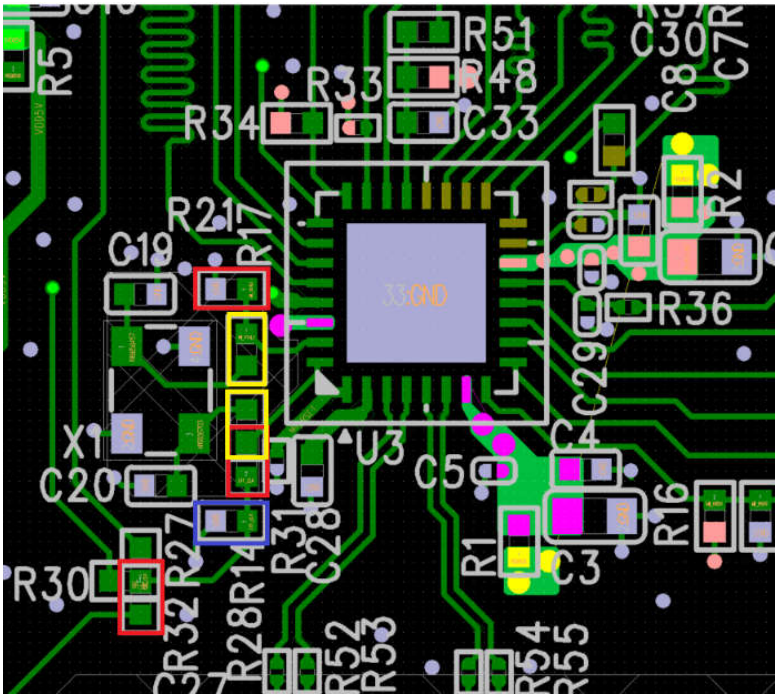


Figure 4-14 PHY source clock from external clock

- SYSCLK from MAC_CLK(from EVB)： add R27/R21/R32 （components in the red diagram, 0 ohm）, add C27(components in the blue diagram，12pF); Remove R17/R14（components in the yellow diagram）, remove XTAL

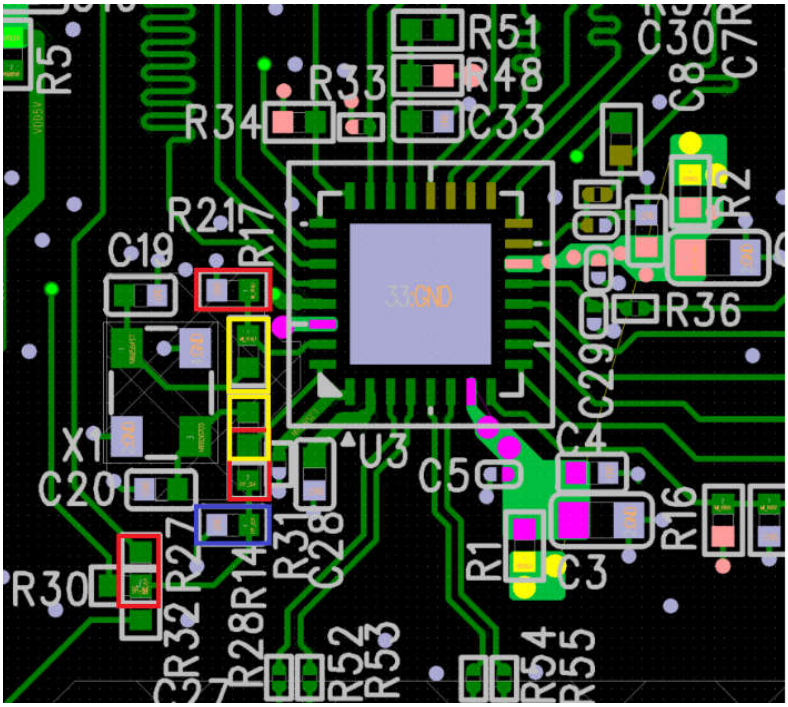


Figure 4-15 PHY source clock from EVB

4.11 A2C

The main chip on the EVB has two independent A2C modules, so the EVB provides two A2C transceivers (U7&U8, *refer to chapter 3.1.1*) and two pin headers (J12&J13, *refer to chapter 3.3.1*) for users to connect external A2C device.

NOTE

If users want to the A2C circuit on the EVB, please make the modifications in the Table 4-3. In addition, please refer to Figure 3-1 and *Figure 3-2 for the specific location of the components that need to be adjusted on the board.*

Table 4-3 Circuit modification instructions of A2C

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
U7_8	A2C_STB0	R21(0 ohm)	R27(0 ohm)	If A2C_STB0 is used, the PHY_RSTB of RMII cannot work.
U8_8	A2C_STB1	R81(0 ohm)	R92(0 ohm)	If A2C_STB1 is used, the SD_CD of SDIO and EXT_CLK_OUT cannot work.
U7_4	A2C_RX0	R84(0 ohm)	R87(0 ohm)	If A2C_RX0 is used, the RMII_MDIO and LED_R cannot work.
U8_1	A2C_TX0	R82(0 ohm)	R85(0 ohm)	If A2C_TX0 is used, the RMII_MDC and LED_G cannot work.
U7_4	A2C_RX1	R72(0 ohm)	R91(0 ohm)	If A2C_RX1 is used, the REF_CLK of RMII and DMIC_DATA cannot work.
U8_1	A2C_TX1	R89(0 ohm)	R66(0 ohm)	If A2C_TX1 is used, the RXERR of RMII, DMIC_CLK and LED_B cannot work.

4.12 User LED

A RGB LED and related driving circuit are provided on the EVB for free use. Users can set related pins to GPIO output mode and drive pins to low which connected to the LEDR/LEDG/LEDB ports to control the LED to emit red/green/blue colors of light. For further use, users can set

related pins of the chip on the module to PWM function to obtain more display color combinations.

NOTE

If users want to use USER LED circuit on the EVB, please solder on R65, R86 and R88 of 0 ohm resistors.

4.13 Other IO Function

The EVB has many other functions such as SPI, I2C, I2S, PWM, etc., which can be expanded and used through the pins drawn by the connector. Please refer to the content in Section 3.2.1 for the pins led out through the connector.

4.14 Compatible with Raspberry Pi

The signal of 40 pin header on the EVB is compatible with Raspberry Pi 4 and Raspberry Pi 3.5. If users need to connect the EVB to the Raspberry Pi, users should remove the 40 pin header on the top layer of the EVB and then solder the 40 pin receptacle on the bottom layer of EVB.

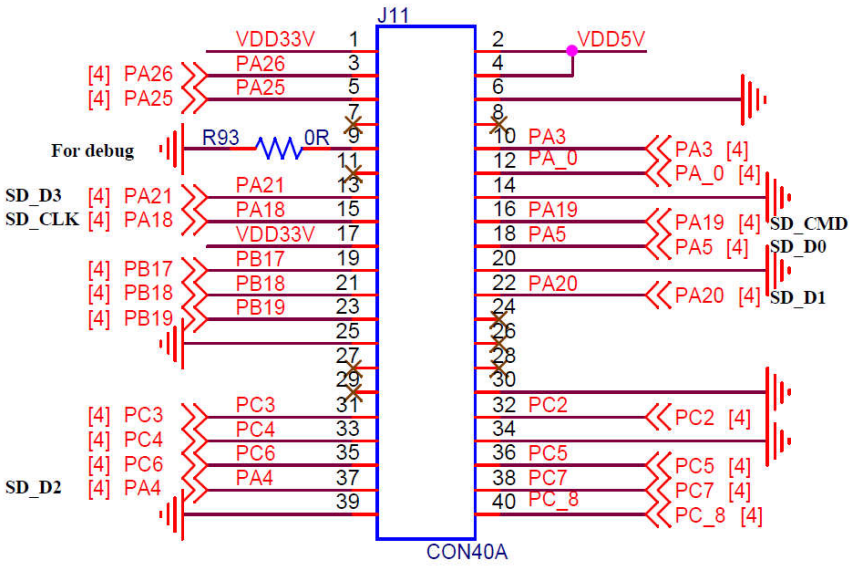


Figure 4-8 The 40 pin header on the EVB

Remove 40 pin header **Solder 40 pin receptacle** **Connected to Raspberry Pi**

Figure 4-9 The operation of connecting EVB to Raspberry Pi

Before connecting the EVB to the Raspberry Pi and powering on the entire system, users need to make some circuit modifications to the EVB.

- If the entire system is powered through the USB 5V (USB type-C on Raspberry Pi 4 and USB Micro-B on Raspberry Pi 3.5) on the Raspberry Pi. To avoid power conflicts, EVB cannot be powered on by any other source. If users need to debug the IC through the USB-C (USB→UART) interface on the EVB, it is necessary to remove the resistor R1 and R187 from the top layer of the EVB.

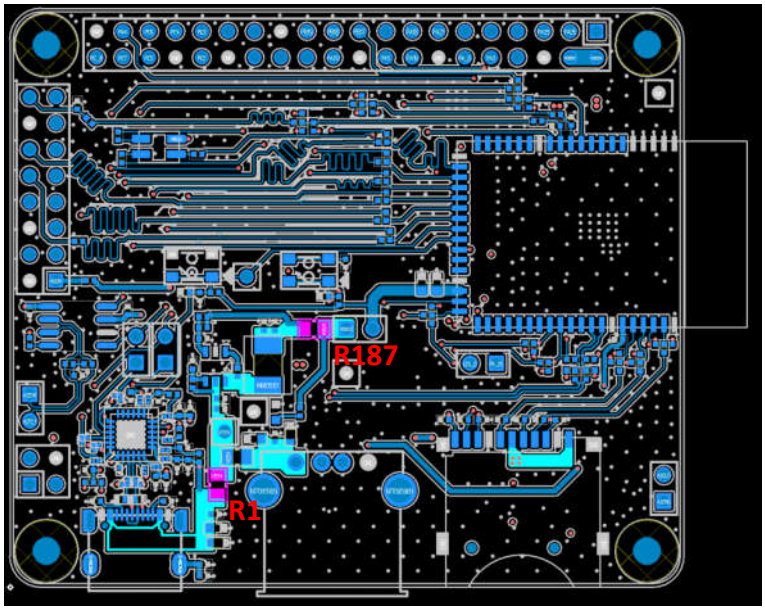


Figure 4-10 Location of resistors to be removed on EVB

Figure 4-11 Power supply method of the system

- If the entire system is powered through the USB-C 5V on the EVB. To avoid power conflicts, Raspberry Pi cannot be powered on by any other source and it is necessary to remove the resistor R148 from the bottom layer of the EVB. Users also can debug the IC on the EVB through the USB-C (USB→UART) interface on the EVB.

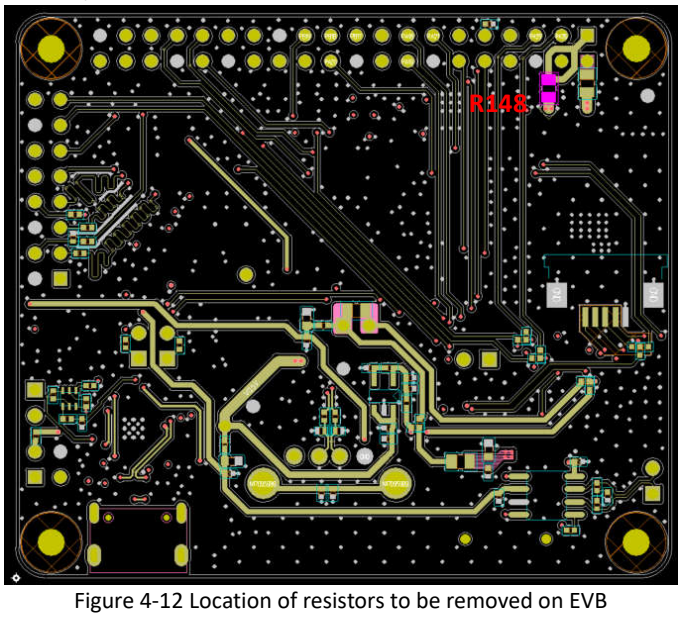


Figure 4-12 Location of resistors to be removed on EVB

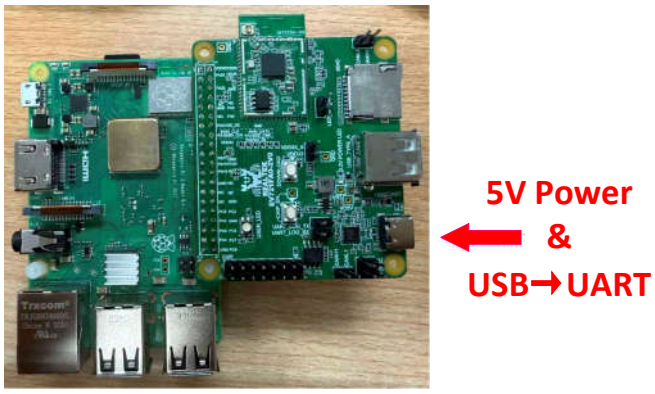


Figure 4-13 Power supply method of the system

Revision History

Date	Version	Description
2025-09-20	v1.0	Initial release