UG1002
EV721D00 Evaluation Board User Guide

This document describes the evaluation board supported SM721DA0&SM721DC0 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 SM721DA0&SM721DC0 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, Audio, OSPI, 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:

- SM721DA0 module SMT supported
- SM721DC0 module SMT supported
- Supports for ARM's SWD and SEGGER J-Link protocol options
- 5V DC power supply through USB-C socket
- Buttons for chip reset and UART download
- Wi-Fi 2.4G supported from module
- SDIO, OSPI, USB, Cap-touch interfaces and related on-board circuits
- Audio circuits of DMIC and power amplifier for speaker.
- 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.

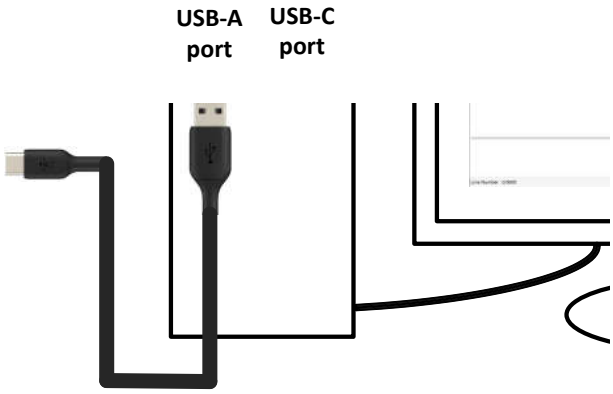

Figure 2-1 EV721D00 EVB power supply schematic

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

Before downloading bin files into the flash, please refer to the application note (AN1000) for detailed instructions.

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 SM721DA0&SM721DC0 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 application note (AN1000) for detailed instructions.*

2.4 Functions

The EVB supported SM721DA0&SM721DC0 module provides many functions for users to use freely. When users want to use a specific function, please follow the following steps:

(1) If the function supported directly on board, just use the resource on board, like User LED, Digital MIC function etc.
(2) If the function needs external sub-board to support, confirm the available pin for the function and hardware configuration of the EVB through reference design documents.
(3) Connect EVB and external sub-board directly or through DuPont lines.

3 PCB Layout

3.1 Component Distribution

The EVB is a four-layer PCB board, with a size of 65mm*30mm, and a positioning hole diameter of 3.2mm.

3.1.1 Top Layer

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

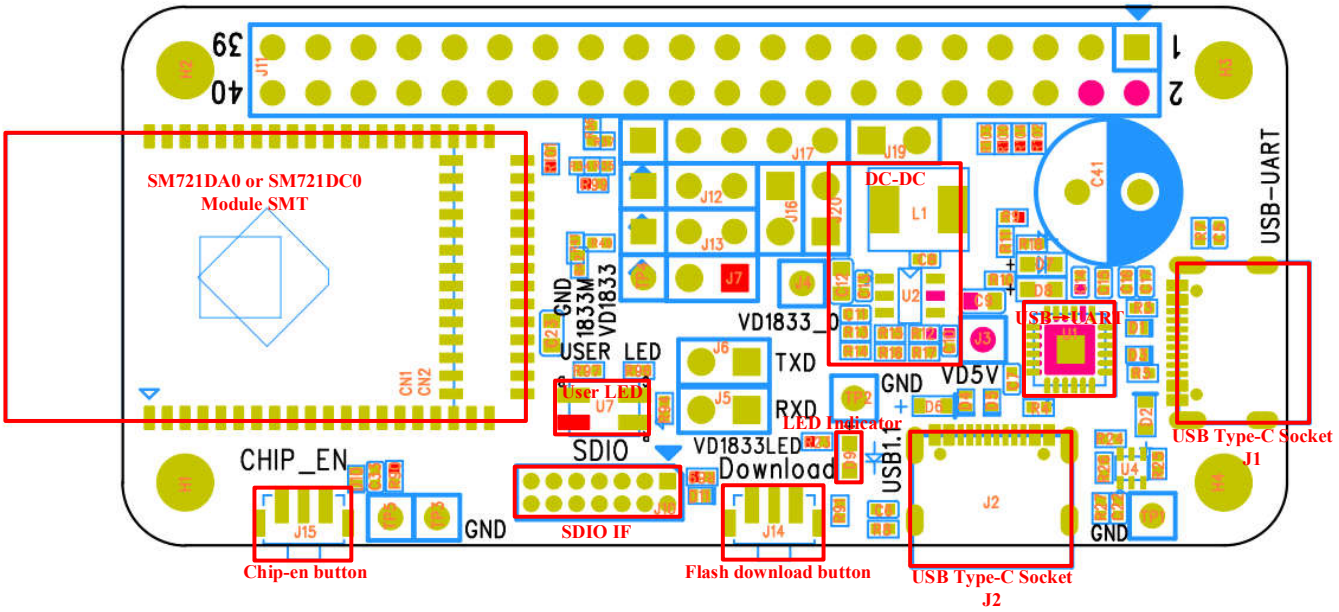

Figure 3-1 EV721D00 EVB – top layer

3.1.2 Bottom Layer

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

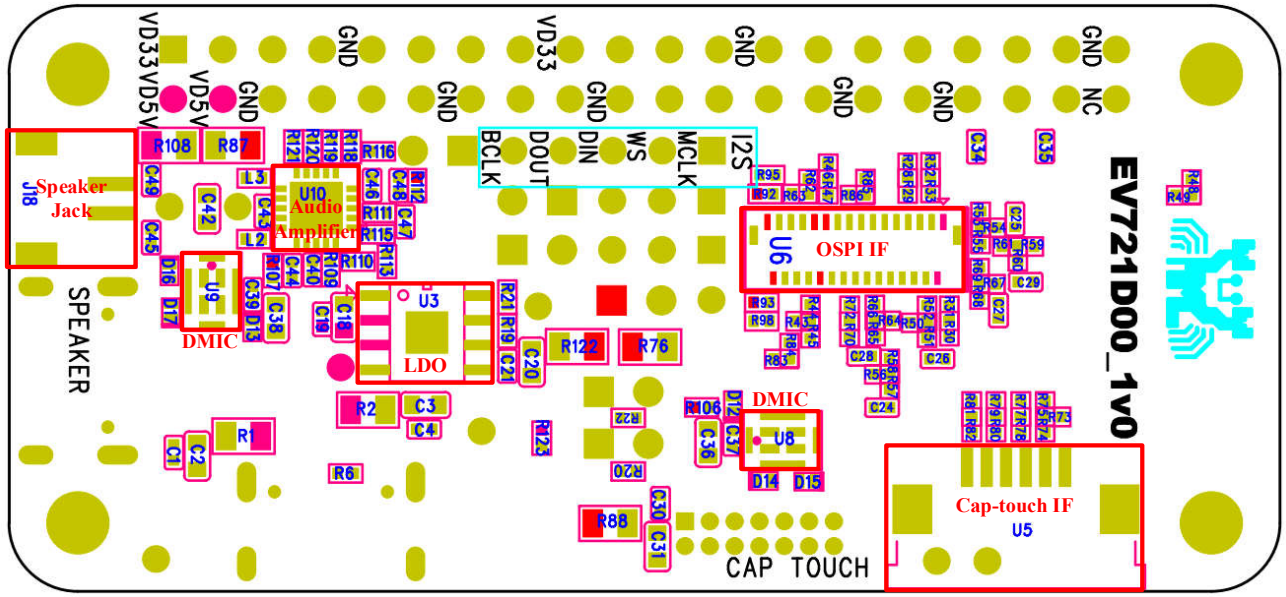

Figure 3-2 EV721D00 EVB – bottom layer

3.2 Main Parts

3.2.1 SM721DA0&SM721DC0 Module

Both of SM721DA0 module and SM721DC0 module as shown in Figure 3-3 could be placed on the EVB. The SM721DA0 module is a four-layer PCB board, with a size of 16mm*25mm. The SM721DC0 module is a four-layer PCB board, with a size of 16mm*29mm.

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 antennas or external antennas through IPEX connector.

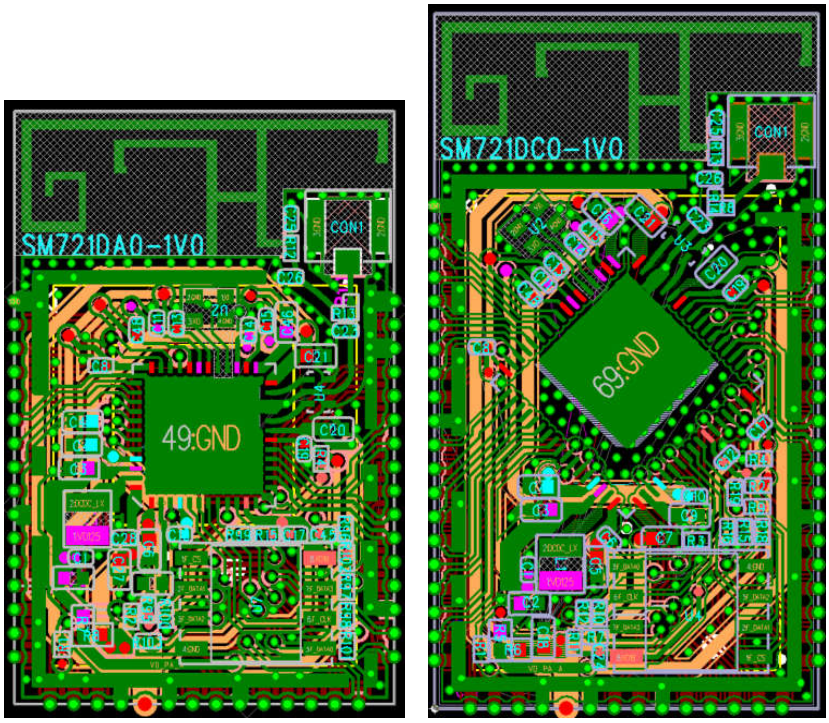

Figure 3-3 SM721DA0 and SM721DC0 module

3.2.2 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.

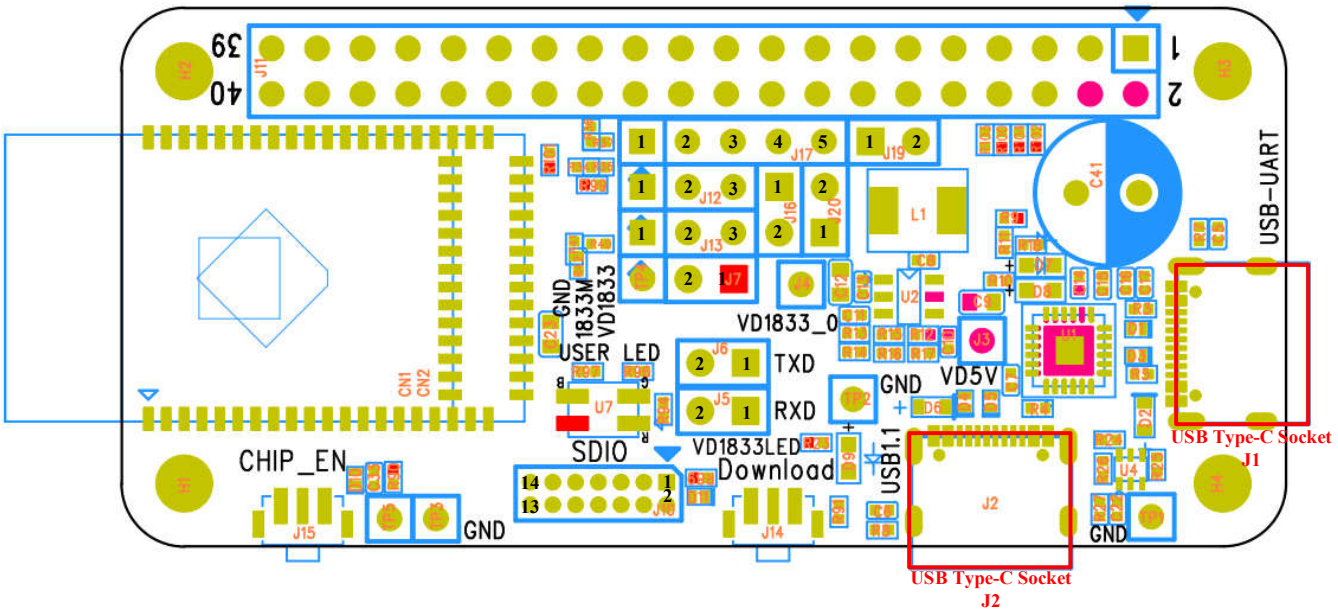

Figure 3-4 Connector top location diagram

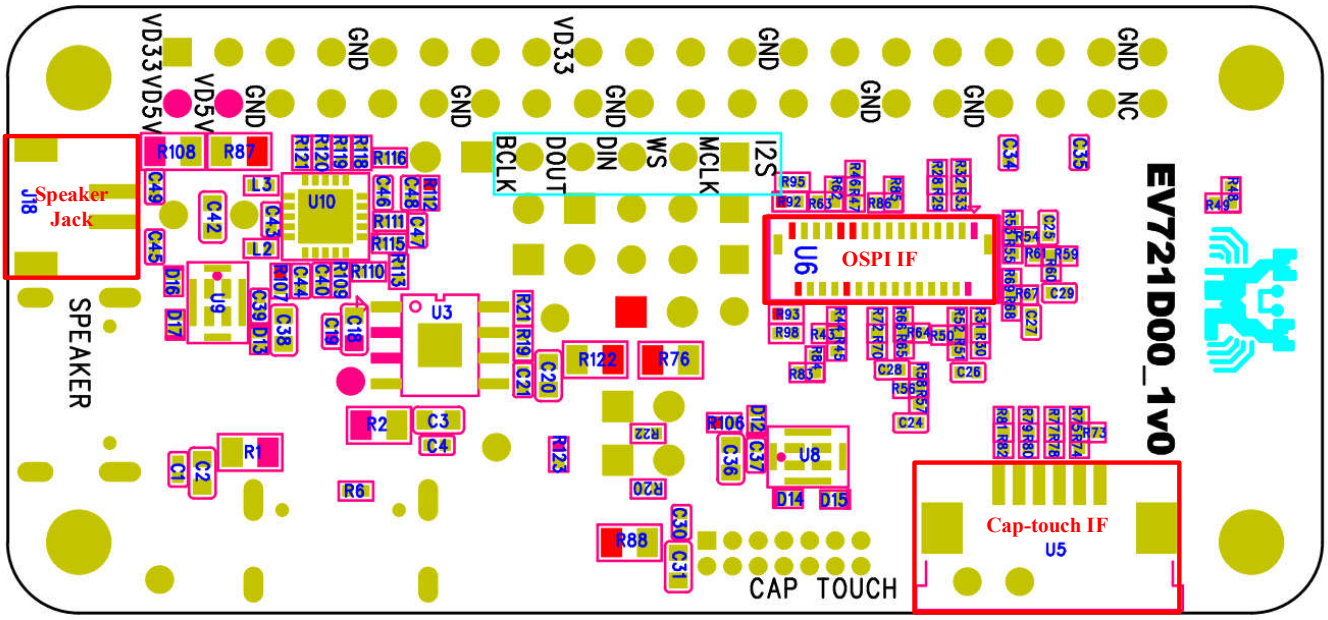

Figure 3-5 Connector bottom location diagram

3.2.3 Pin Headers

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

Table 3-1 EV721D00 EVB - pin headers

Designator	Pin number	Symbol	Description
J11	1	VD33	3.3V voltage supplied by 5V-to-3.3V or 1.8V DC-DC converter through R125 0 ohm resistor.
	2	VD5V	5V voltage supplied by USB interface.
	3	PB30	Used as GPIO or other functions connected to PB30 of the module directly.
	4	VD5V	5V voltage supplied by USB interface.
	5	PB31	Used as GPIO or other functions connected to PB31 of the module directly.
	6	GND	Ground.
	7	PA12	Used as GPIO or other functions connected to PB30 of the module directly.
	8	PB_2	Used as GPIO or other functions connected to PB2/PA13 of the module through R46

			0 ohm resistor.(PB2 is connected to the chip on SM721DC0 module, PA13 is connected to the chip on SM721DA0 module)
	9	GND	Ground
	10	PB_3	Used as GPIO or other functions connected to PB3/PA27 of the module through R48 0 ohm resistor. (PB3 is connected to the chip on SM721DC0 module, PA27 is connected to the chip on SM721DA0 module)
	11	PA_28	Used as GPIO or other functions connected to PA28 of the module through R34 0 ohm (default NC) resistor.
	12	PB_15	Used as GPIO or other functions connected to PB15/PA8 of the module through R70 0 ohm resistor. (PB15 is connected to the chip on SM721DC0 module, PA8 is connected to the chip on SM721DA0 module)
	13	PB7_SDIO_D3	Used as SDIO data signal or other functions connected to PB7/PB17 of the module through R53 0 ohm resistor. (PB7 is connected to the chip on SM721DC0 module, PB17 is connected to the chip on SM721DA0 module)
	14	GND	Ground.
	15	PB9_SDIO_CLK	Used as SDIO clock signal or other functions connected to PB9/PB19 of the module through R59 0 ohm resistor. (PB9 is connected to the chip on SM721DC0 module, PB19 is connected to the chip on SM721DA0 module)
	16	PB8_SDIO_CMD	Used as SDIO command signal or other functions connected to PB8/PB18 of the module through R56 0 ohm resistor. (PB8 is connected to the chip on SM721DC0 module, PB18 is connected to the chip on SM721DA0 module)
	17	VD33	3.3V voltage supplied by 5V-to-3.3V DC-DC converter.
	18	PB13_SDIO_D0	Used as SDIO data signal or other functions connected to PB13/PB20 of the module through R64 0 ohm resistor. (PB13 is connected to the chip on SM721DC0 module, PB20 is connected to the chip on SM721DA0 module)
	19	PA23	Used as GPIO or other functions connected to PA23 of the module directly.
	20	GND	Ground.
	21	PA_20	Used as GPIO or other functions connected to PA20/PA16 of the module through R30 0 ohm resistor. (PA20 is connected to the chip on SM721DC0 module, PA16 is connected to the chip on SM721DA0 module)
	22	PB14_SDIO_D1	Used as SDIO data signal or other functions connected to PB14/PB21 of the module through R67 0 ohm resistor. (PB14 is connected to the chip on SM721DC0 module, PB21 is connected to the chip on SM721DA0 module)
	23	PA_30	Used as GPIO or other functions connected to PA30/PA14 of the module directly.
	24	PA_21	Used as GPIO or other functions connected to PA21/PA17 of the module through R32 0 ohm resistor.
	25	GND	Ground
	26	PA22	Used as GPIO or other functions connected to PA22/PA18 of the module directly.
	27	PB_0	Used as GPIO or other functions connected to PB0/PA30 of the module through R40 0 ohm resistor.
	28	PB_1	Used as GPIO or other functions connected to PB1/PA31 of the module through R43 0 ohm resistor.
	29	PA_29	Used as GPIO or other functions connected to PA29 of the module through R36 0 ohm (default NC) resistor.
	30	GND	Ground.
	31	PB_18	Used as GPIO or other functions connected to PB18 of the module through R79 0 ohm resistor.
	32	PB_21	Used as GPIO or other functions connected to PB21 of the module through R83 0 ohm resistor.
	33	PB_19	Used as GPIO or other functions connected to PB19 of the module through R81 0 ohm resistor.
	34	GND	Ground
	35	PB20	Used as GPIO or other functions connected to PB20 of the module directly.
	36	PB22	Used as GPIO or other functions connected to PB22 of the module directly.
	37	PB6_SDIO_D2	Used as SDIO data signal or other functions connected to PB6/PA26 of the module through R50 0 ohm resistor.
	38	PA8	Used as GPIO or other functions connected to PA8 of the module directly.
	39	GND	Ground.
	40	NC	-
J10	1	VCC_SDIO	Powered by SDIO host through R119 0 ohm resistor.

	2	GND	Ground.
	3	GND	Ground.
	4	SDIO_D1	Used as SDIO data signal connected to PB14/PB21 of the module through R68 0 ohm (default NC) resistor.
	5	SDIO_CMD	Used as SDIO command signal connected to PB8/PB18 of the module through R57 0 ohm (default NC) resistor.
	6	GND	Ground.
	7	GND	Ground.
	8	SDIO_D0	Used as SDIO data signal connected to PB13/PB20 of the module through R65 0 ohm (default NC) resistor.
	9	SDIO_D3	Used as SDIO data signal connected to PB7/PB17 of the module through R54 0 ohm (default NC) resistor.
	10	GND	Ground.
	11	GND	Ground.
	12	SDIO_CLK	Used as SDIO clock signal connected to PB9/PB19 of the module through R60 0 ohm (default NC) resistor.
	13	SDIO_D2	Used as SDIO data signal connected to PB6/PA26 of the module through R51 0 ohm (default NC) resistor.
	14	GND	Ground.
J20	1	PB_10	Used as GPIO or other functions connected to PB10 of the module through R62 0 ohm resistor.
	2	PB_16	Used as GPIO or other functions connected to PB16 of the module through R73 0 ohm resistor.
J13	1	PA13	Used as GPIO or other functions connected to PA13 of the module directly.
	2	PA14	Used as GPIO or other functions connected to PA14 of the module directly.
	3	PA15	Used as GPIO or other functions connected to PA15 of the module directly.
J12	1	PA16	Used as GPIO or other functions connected to PA16 of the module directly.
	2	PA17	Used as GPIO or other functions connected to PA17 of the module directly.
	3	PA18	Used as GPIO or other functions connected to PA18 of the module directly.
J16	1	PA26	Used as GPIO or other functions connected to PA26 of the module directly.
	2	PA27	Used as GPIO or other functions connected to PA27 of the module directly.
J19	1	PA_31	Used as GPIO or other functions connected to PA31 of the module directly.
	2	PB_17	Used as GPIO or other functions connected to PB17 of the module through R77 0 ohm resistor.
J17	1	PA_19	Used as I2S MCLK or other functions connected to PA19 of the module through R28 0 ohm resistor.
	2	PA_20	Used as I2S WS or other functions connected to PA20/PA16 of the module through R30 0 ohm resistor.
	3	PA_21	Used as I2S DIN or other functions connected to PA21/PA17 of the module through R32 0 ohm resistor.
	4	PA22	Used as I2S DOUT or other functions connected to PA22/PA18 of the module directly.
	5	PA23	Used as I2S BCLK or other functions connected to PA23/PA15 of the module directly.
J3	1	VD5V	5V voltage supplied by USB interface.
J4	1	VD1833_0	3.3V or 1.8V voltage output through 5V-to-3.3V or 1.8V DC-DC converter
J5	1	UART_LOG_RX	LOG UART RX signal connected to the USB to UART chip on EVB
	2	PB4_UART_LOG_RXD	LOG UART RX signal connected to PB4 of the module
J6	1	UART_LOG_TX	LOG UART TX signal connected to the USB to UART chip on EVB
	2	PB5_UART_LOG_RXD	LOG UART TX signal connected to PB4 of the module
J7	1	VD1833	3.3V or 1.8V voltage supplied by 5V-to-3.3V or 1.8V DC-DC converter through R125 0 ohm resistor.
	2	VD1833_M	3.3V or 1.8V voltage provided for the module.

NOTE

Not all GPIOs are connected to the pin headers. If the following GPIOs(PA28, PA29) need to be used on the pin headers, please refer to Table xx 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.

Pin name	Resistors need to be soldered	Resistors need to be removed	Note
PA28	R34 (0 ohm)	R35 (0 ohm)	After R35/R37 is removed, the USB circuits (J2)on board cannot be used.
PA29	R36 (0 ohm)	R37 (0 ohm)	

3.2.4 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 SM721DA0 or SM721DC0 module.

3.2.5 Microphone

There are two digital microphone chips on the EVB. Refer to Figure 3-1 for the location on the EVB.

The model number of DMIC is 3SM222FMT1KA, and the typical parameters are:

- Sensitivity: -26dB ±1dB @ 94dB SPL 1kHz
- Signal-to-noise ratio (SNR): 60dBA
- Input clock frequency range:1-3.25MHz

3.2.6 Audio Amplifier

REALTEK's high performance mono class-D audio amplifier (ALC1019) is used as the driver of external speakers. It can deliver 3W/CH output power into 4Ω speaker impedance with 5V power supply at the condition of THD+N=10%.

3.2.7 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

3.2.8 OSPI Display Interface

EVB has an OSPI Display interface integrated with touch I2C interface, which can be connected with a display panel through FPC.

- The OSPI display interface consists of a clock line (SPI_CLK), a chip select line (SPI_CS), a data/command switching line (SPI_DCX) and 8

data lines (SPI_D0-SPI_D7). In addition, there are IM0/1, RESET, BLEN, 1.8V/3.3V power supply (VD1833), and 5V power supply (VDD5) for extended use.

- The touch function (TP_SCL, TP_SDA, TP_INT and TP_RST) interacts with the chip on the module through I2C protocol.

The features of OSPI display interface are as followed:

- Max 50MHz clock rate.
- Support SPI, dual SPI, Quad SPI and Octal SPI
- Support SPI mode 0 and mode 3
- Support SDR and DDR mode

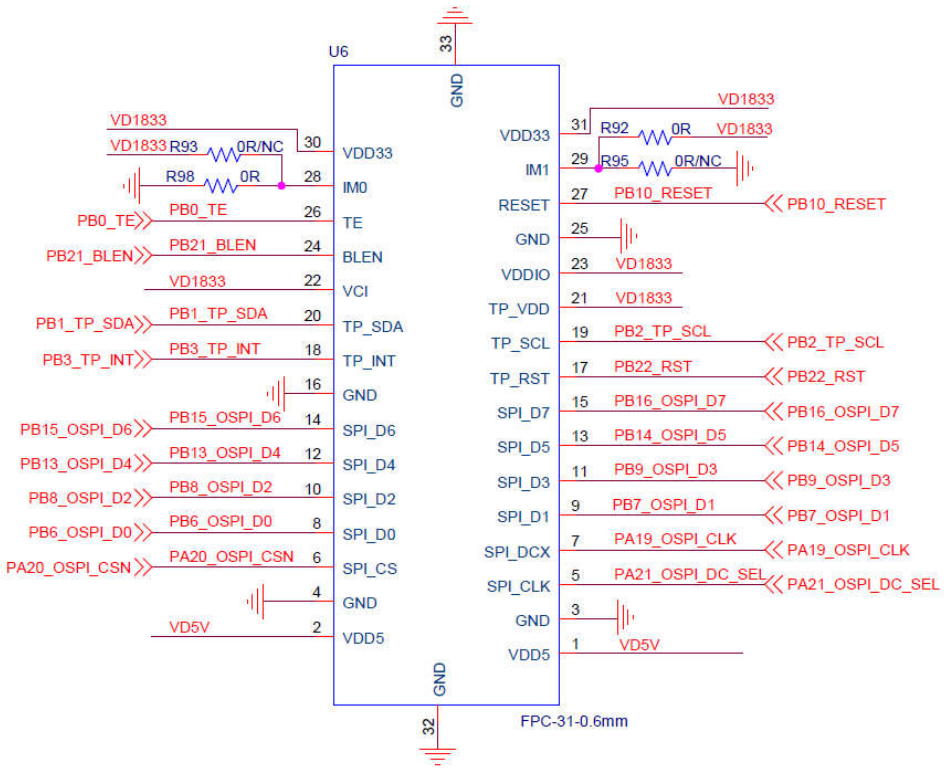

Figure 3-8 FPC signal distribution of display and touch interface

NOTE

If users need to connect the OSPI Display interface with a display panel through FPC, the cable should be carefully inserted into the connector to avoid damage to the golden finger.

3.2.9 Cap-touch Interface

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

3.2.10 Speaker Jack

The speaker jack provided on the EVB is a 2-pin jack with a spacing of 1.5mm, connected with the P/N output of the power amplifier.

3.2.11 SDIO Interface

A SDIO interface is provided on the EV721D00 EVB which can be connected to a SDIO daughter board provided by Realtek. The golden fingers of the daughter board can be inserted into the SDIO host like a PC for communication

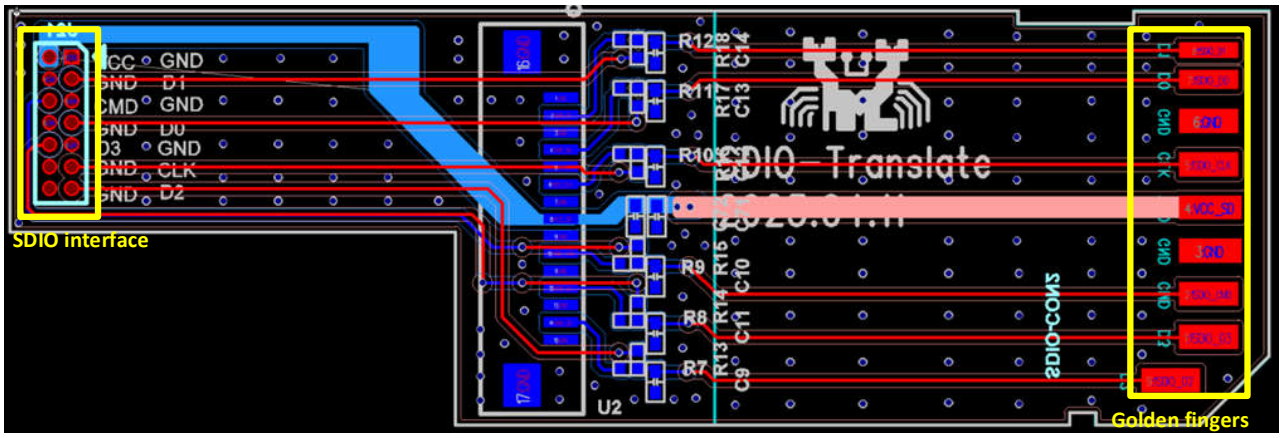

Figure 3-9 SDIO daughter board

4 Basic Usage

4.1 Power Supply

4.1.1 USB Power

The EV721D00 EVB can be powered by connecting PC or adaptor to either of the two USB-C sockets.

NOTE

- *The maximum theoretical power supply capacity of general USB-A 2.0 port is 500mA which is enough for the EVB without Audio function under operation. If Audio function is needed, please use a USB-C to USB-C cable and make sure the power source is enough for the consumption of EVB.*
- *If users want to drive a speaker of greater power through ALC1019, please refer to the section 3.2.6 for detailed usage.*

4.1.2 LED Indicators

A single color LED is used to indicate whether 3.3V or 1.8V power supply of the SM721DA0 or SM721DC0 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 SM721DA0 or SM721DC0 module can be reset by pressing and releasing the CHIP_EN button on the EVB, or powering the EVB off and then powering on.

The CHIP_EN button on the EVB is J15.

4.3 Communication

4.3.1 LOGUART

The EV721D00 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 below steps:
(1) Remove the R20 and R22 0 ohm resistor to disconnect the connection between the integrated USB to UART chip and the chip on the

SM721DA0 or SM721DC0 module.

(2) Refer to the figure 4-1 and find the Location of LOGUART function on EVB. The default LOGUART function is distributed on PB4 (UART_LOG_RXD) and PB5 (UART_LOG_RXD).

(3) Connect EVB and external UART communication module through four DuPont lines including TXD, RXD, ground and power (Power is optional).

Please refer to the application note (AN1000) for more detailed information.

NOTE

The default transmission baud rate of LOGUART is 1.5Mbps

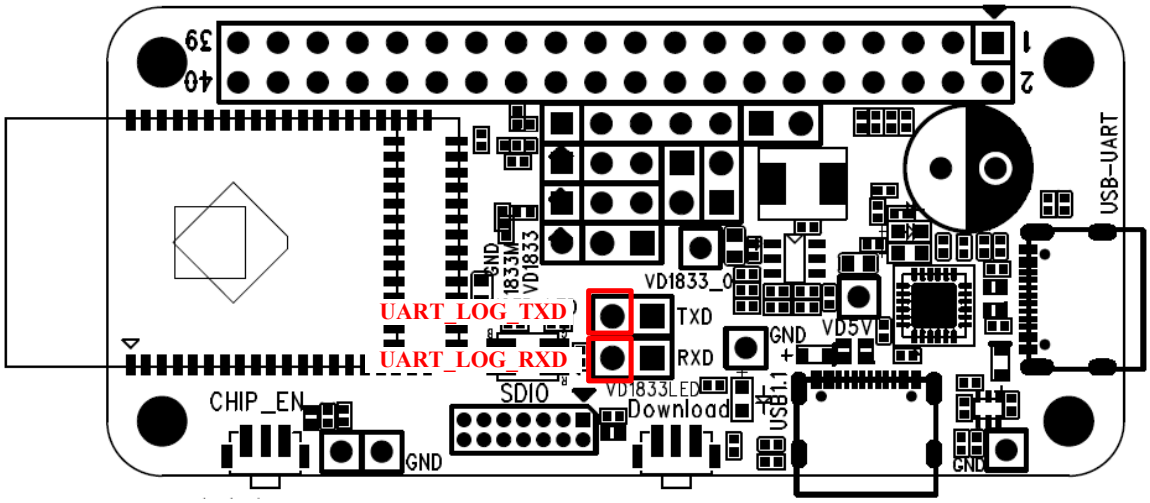

Figure 4-1 Location of SWD function on EVB

4.3.2 SWD

The EV721D00 EVB supports 2-pins serial-wire debug (SWD) interface for users to access ARM Cortex®-M core integrated in the chip on the SM721DA0 or SM721DC0 module. For more information, please refer to ARM Debug Interface v6 Architecture Specification.
The default SWD function is distributed on PA30 (SWD_CLK) and PA31 (SWD_DAT).

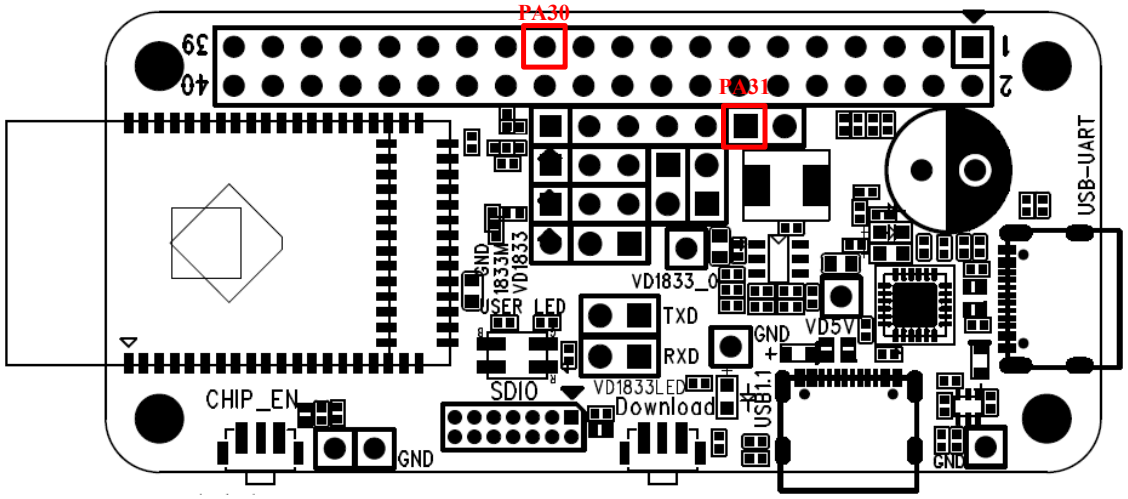

Figure 4-2 Location of SWD function on EVB

4.4 Wi-Fi

The chip on the SM721DA0 or SM721DC0 module supports up to Wi-Fi 802.11n protocol and external antenna.

4.5 Bluetooth

The chip on the SM721DA0 or SM721DC0 module supports Bluetooth protocol 5.0 and external antenna.

4.6 Cap Touch

The EVB supports 4 channels of cap touch application. Users can connect cap touch sub-board through the FPC 6-pins connector (U5) on the EVB. Please be noted that the FPC cable should be carefully inserted into the connector to avoid damage to the golden finger.
The PINs shown in the Figure 4-4 are used as GPIO by default. If users want to apply cap-touch function, please change the hardware configurations following below instructions:

- R73, R77, R79, R81 removed;
- Place R74, R78, R80, R82 of 560Ω resistors（default 0R/NC）on the board.

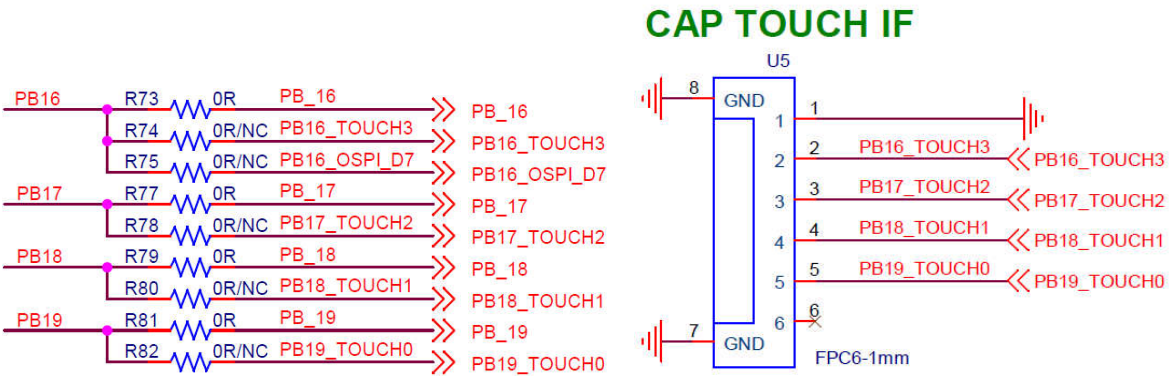

Figure 4-3 Hardware configuration of the cap touch

4.7 USB

The USB Type-C interface J1 on the EVB supports up to USB protocol 2.0.

4.8 SDIO

The EVB supports up to SDIO card specification version 2.0.

NOTE

If users want to use SDIO interface (refer to chapter 3.2.11) on the EVB and related SDIO daughter board provided by REALTEK, 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 SDIO

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
J10-4	SDIO_D1	R68 (0 ohm)	R67 (0 ohm)	
J10-5	SDIO_CMD	R57 (0 ohm)	R56 (0 ohm)	
J10-8	SDIO_D0	R65 (0 ohm)	R64 (0 ohm)	
J10-9	SDIO_D3	R54 (0 ohm)	R53 (0 ohm)	
J10-12	SDIO_CLK	R60 (0 ohm)	R59 (0 ohm)	
J10-13	SDIO_D2	R51 (0 ohm)	R50 (0 ohm)	

4.9 OSPI

The EVB supports OSPI Display Interface which includes one clock line and eight data lines.

NOTE

If users want to use OSPI interface (refer to chapter 3.2.8) on the EVB, 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 OSPI

Pin name	Function name	Resistors need to be soldered	Resistors need to be removed	Note
U6-5	OSPI_DC_SEL	R33 (0 ohm)	R32 (0 ohm)	
U6-6	OSPI_CSN	R31 (0 ohm)	R30 (0 ohm)	
U6-7	OSPI_CLK	R29 (0 ohm)	R28 (0 ohm)	
U6-8	OSPI_D0	R52 (0 ohm)	R50 (0 ohm)	
U6-9	OSPI_D1	R55(0 ohm)	R53 (0 ohm)	
U6-10	OSPI_D2	R58 (0 ohm)	R56 (0 ohm)	
U6-11	OSPI_D3	R61 (0 ohm)	R59 (0 ohm)	
U6-12	OSPI_D4	R66 (0 ohm)	R64 (0 ohm)	
U6-13	OSPI_D5	R69 (0 ohm)	R67 (0 ohm)	
U6-14	OSPI_D6	R72 (0 ohm)	R70 (0 ohm)	
U6-15	OSPI_D7	R75 (0 ohm)	R73 (0 ohm)	
U6-17	TP_RST	R86 (0 ohm)	R85 (0 ohm)	
U6-18	TP_INT	R49 (0 ohm)	R48 (0 ohm)	
U6-19	TP_SCL	R47 (0 ohm)	R46 (0 ohm)	
U6-20	TP_SDA	R44 (0 ohm)	R43 (0 ohm)	
U6-24	BLEN	R84 (0 ohm)	R83 (0 ohm)	
U6-26	TE	R41 (0 ohm)	R40 (0 ohm)	
U6-27	RESET	R63 (0 ohm)	R62 (0 ohm)	

4.10 Microphone

The EVB can collect sound data through DMIC.

4.11 Speaker

The EVB can directly drive 4Ω impedance speaker with maximum power of 3W/CH through ALC1019.

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 R94, R96 and R97 of at least 470 ohm resistors (Used as current limit resistors to prevent LED from being damaged).

4.13 IO

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 3.2.2 for the pins led out through the connector.

NOTE

For all the contents above, please refer to the datasheet (DS1001 or DS1002) for more detailed information.

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.

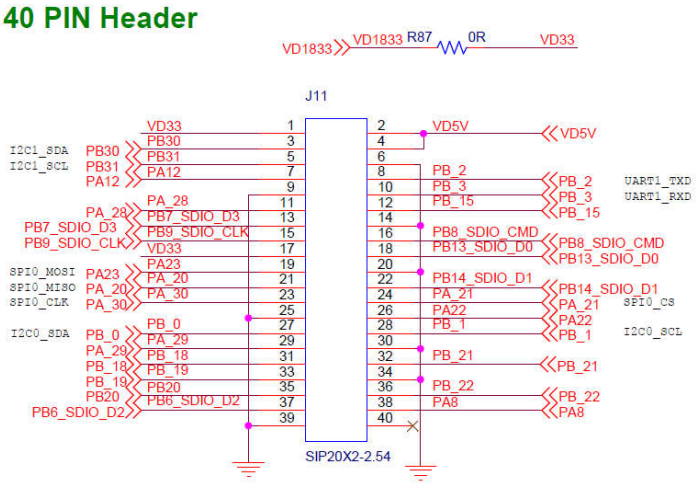

Figure 4-4 The 40 pin header on the EVB

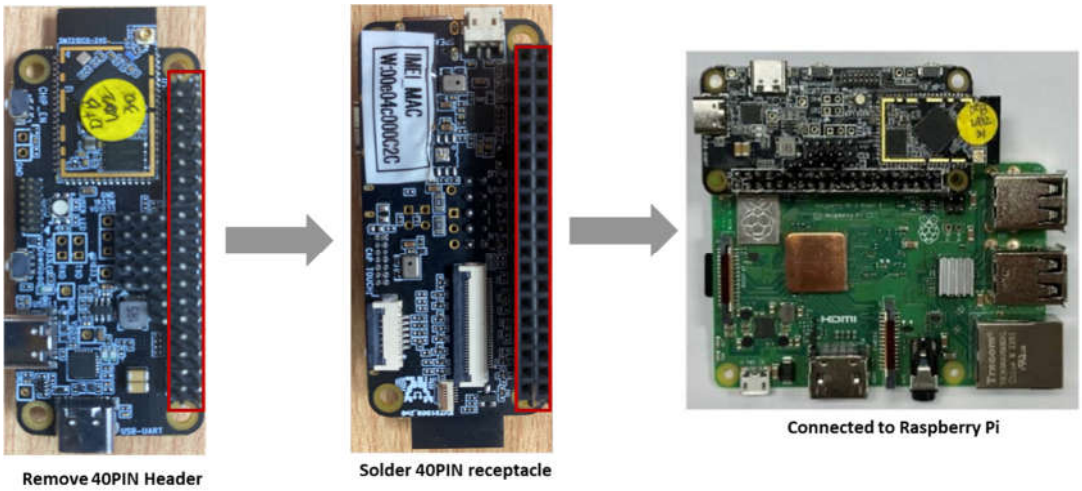

Figure 4-5 The operation of connecting EVB to Raspberry Pi

After connecting the EVB to the Raspberry Pi, the entire system needs to be powered on.

- If the EVB preforms as the slave, the system should be 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, it is necessary to remove the two resistors (R1 and R122) from the bottom layer of the EVB. Users can debug the IC on the EVB through the USB-C (USB→UART) interface on the EVB.

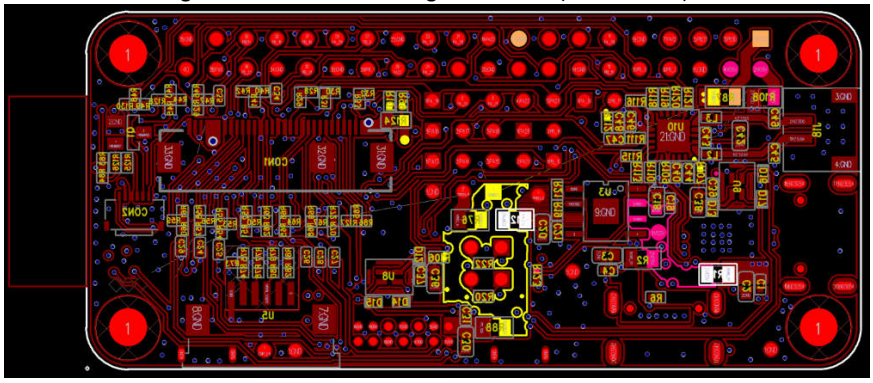

Figure 4-6 Location of resistors to be removed on EVB

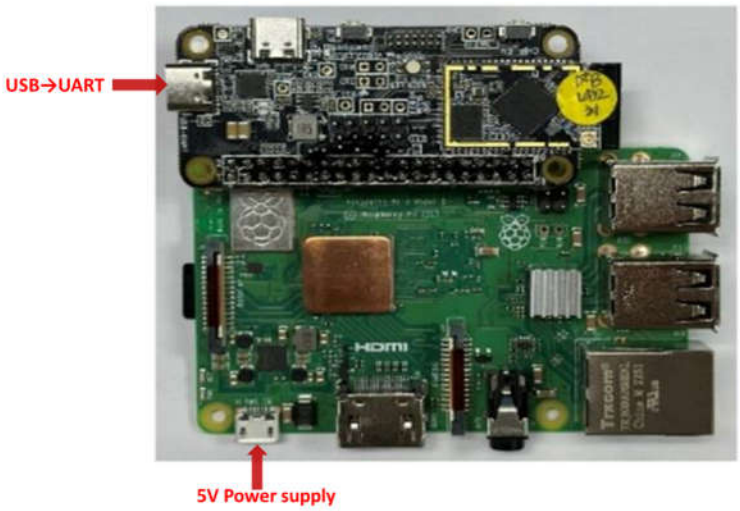

Figure 4-7 Power supply method of the system when EVB preforms as slave

- If the EVB preforms as the master, the system should be powered through the USB-C 5V on the EVB. Users also can debug the IC on the EVB through the USB-C (USB→UART) interface on the EVB.

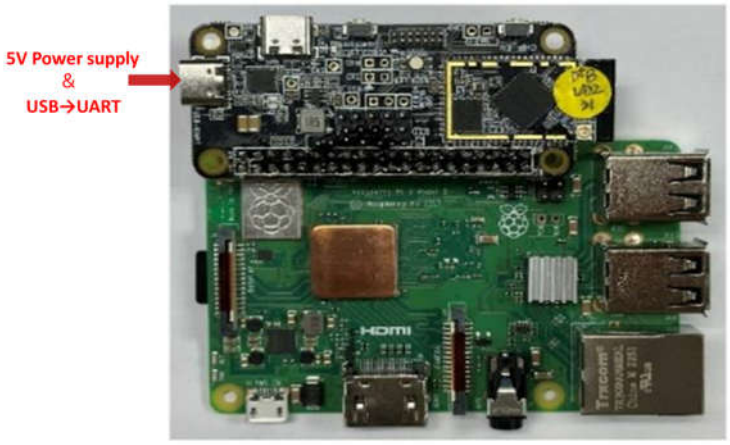

Figure 4-8 Power supply method of the system when EVB preforms as master

Revision History

Date	Version	Description
2023-10-20	v1.0	Initial release
2023-12-05	v1.1	1. Correct some mistakes 2. Add contents in 3.2.3 , 4.8 and 4.9.
2024-09-18	V1.2	Add sector 4.14