

M.2 EVB User Guide

LTE Module Series

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Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:

Quectel Wireless Solutions Co., Ltd.

7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local office. For more information, please visit:

<http://quectel.com/support/sales.htm>

For technical support, or to report documentation errors, please visit:

<http://quectel.com/support/technical.htm>

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About the Document

History

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1 Introduction

This document describes how to use the M.2 EVB (Evaluation Board). It is an assistant tool for engineers to develop and test Quectel EM05 and EM06 modules, which are designed in M.2 form factor.

1.1. Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating EM05 and EM06 modules. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for customers' failure to comply with these precautions.



Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the aircraft.



Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.



Cellular terminals or mobiles operating over radio signals and cellular network cannot be guaranteed to connect in all possible conditions (for example, with unpaid bills or with an invalid (U)SIM card). When emergent help is needed in such conditions, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength.



The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.



In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.

2 General Overview

Quectel supplies M.2 EVB for designers to develop applications based on Quectel EM05 and EM06 modules. The EVB can test all functionalities of these modules.

2.1. Key Features

The following table describes the detailed features of M.2 EVB.

Table 1: Key Features of M.2 EVB

Features	Implementation
Power Supply	DC power supply: 4.5V~5.5V, typically: 5.0V VBAT: 3.7V
M.2 Interface	Standard PCI Express M.2 interface
USB Interfaces	USB Type-C Support USB 2.0 & USB 3.0
Audio Interface	<ul style="list-style-type: none"> ● One digital audio codec board interface Support TI TLV320AIC3104 codec board ● Two analog interfaces used for earphone and handset
(U)SIM Interfaces	Support (U)SIM card: 3.0V and 1.8V Include USIM1 and USIM2 interfaces Support Dual SIM Single Standby*
Switches and Button	Switches: Power Switch (S101), PWRKEY (S103) and Switch between EM05 and EM06 modules (S701) Button: RESET (S102)
Signal Indication	3 LEDs are available for signal indication
Physical Characteristics	Size: 122.0mm × 100.0mm

2.2. Interface Overview

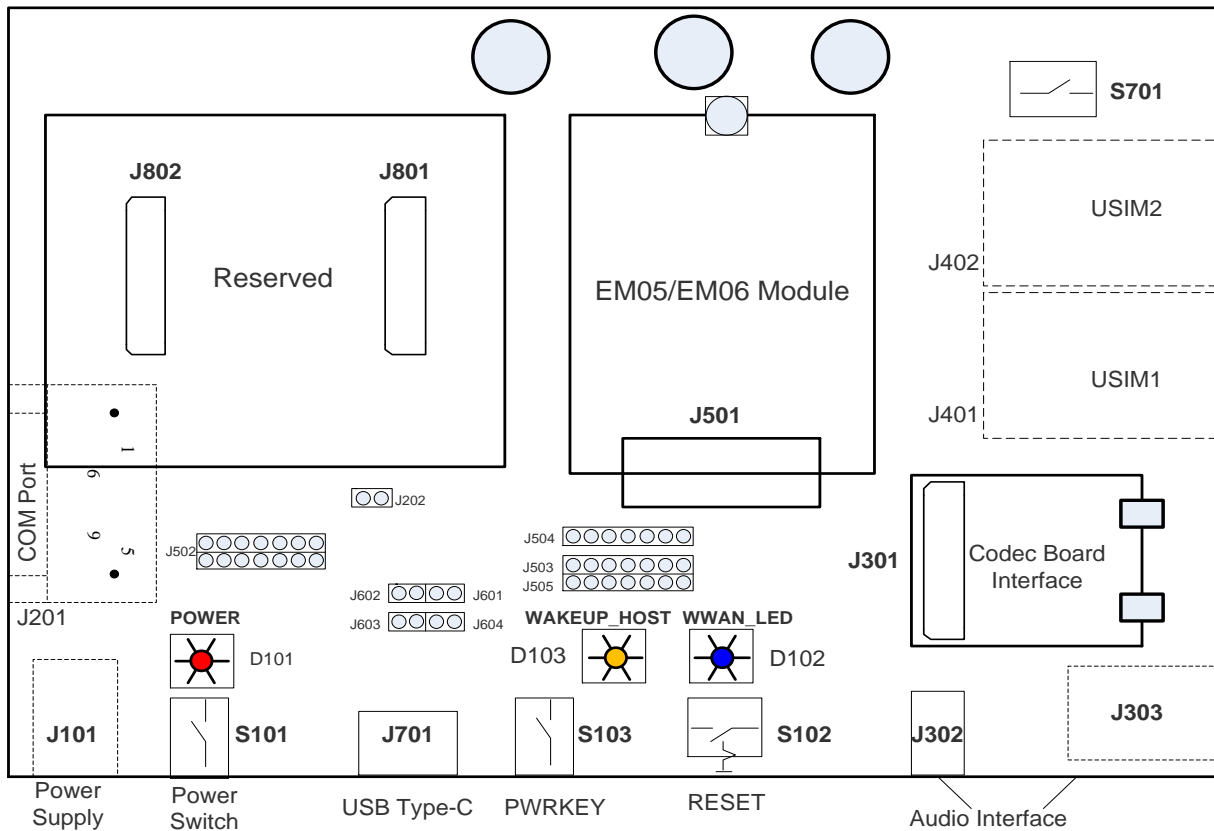


Figure 1: M.2 EVB Interface Overview

Table 2: Interfaces of M.2 EVB

Interface	Reference No.	Description
Power Supply	J101 (bottom side)	The power jack on the EVB. Typical supply voltage: +5V
	J701	USB Type-C interface Typical supply voltage: +5V
Power Switch	S101	Power ON/OFF control
PWRKEY	S103	Turn on/off the module
RESET	S102	Reset button (push button) Used to reset the module
USB Type-C	J701	USB device interface Can also be used to supply power for the EVB

Audio	J302	Used for earphone Used to test the analog audio function of the module
	J303 (bottom side)	Used for handset Used to test the analog audio function of the module
	J301	Codec board interface
(U)SIM	J401 (bottom side)	(U)SIM card connector 1
	J402 (bottom side)	(U)SIM card connector 2 (Not applicable to EM05 module)
COM Port	J201 (bottom side)	Debug UART port (only for internal debugging by Quectel)
Status Indication LEDs	D101, D102, D103	D101 (Power ON/OFF indicator) is used to indicate power ON/OFF status of the EVB D102 is used to indicate whether RF is capable of transmitting D103 is used to indicate a URC reporting which could wake up the module
M.2	J501	M.2 standard connector for the module
Switches	S701	Switch for controlling EM05 or EM06 module
Connectors	J501	J501 is M.2 module connector
	J801, J802	J801 and J802 are reserved for future use
Test points	J202, J502-J505, J601-J604	Test pins

2.3. Top and Bottom Views of M.2 EVB

The top and bottom views of the M.2 EVB are shown as following figures.

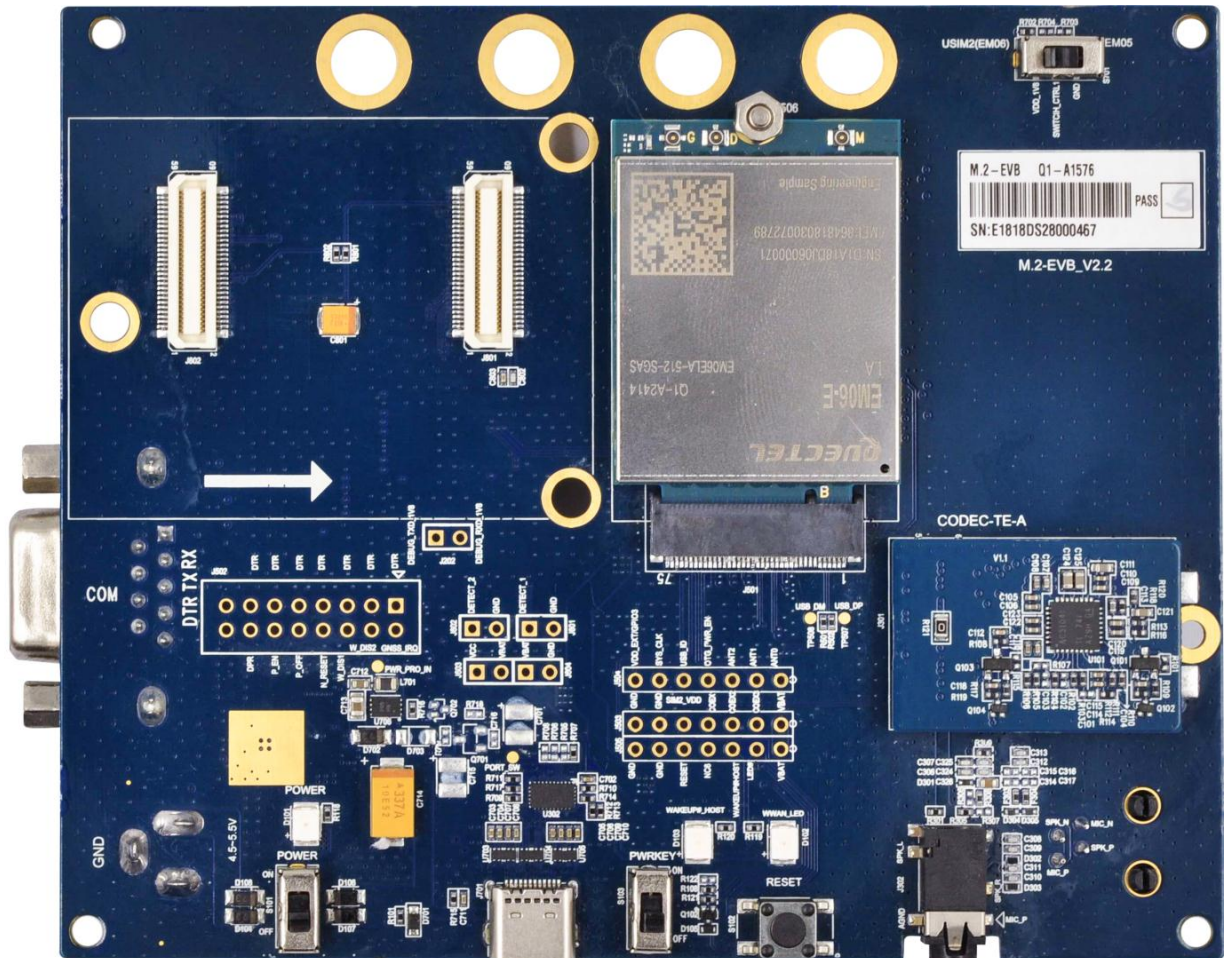


Figure 2: M.2 EVB Top View

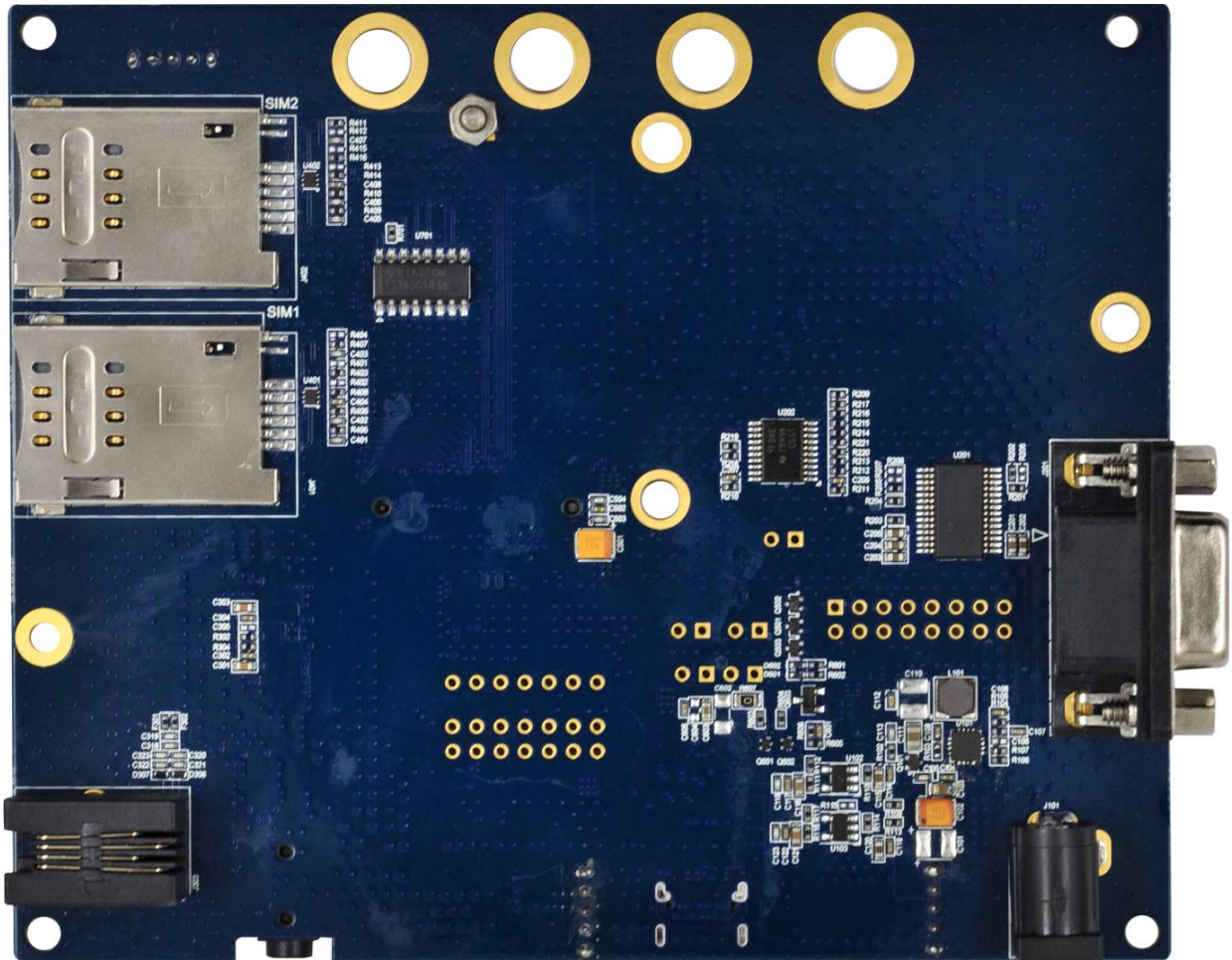


Figure 3: M.2 EVB Bottom View

2.4. EVB Kit Accessories

All accessories of the M.2 EVB kit are listed as below.



Figure 4: M.2 EVB Kit Accessories

Table 3: Accessories List

Items	Description	Quantity
Cables	USB type-C cable	1
	USB to UART converter cable	1
	RF cables	3
Antennas	Main antennas	2
	GNSS antenna (passive)	1
Audio	Earphone	1
Disks	USB 2.0 to RS-232 driver and USB driver disk	2
Codec Board	TLV320AIC3104 codec board	1
Others	Bolts and coupling nuts for assembling EVB	4 for each type

Instruction Sheet	A sheet of paper giving instructions for EVB connection, details of EVB accessories, etc.	1
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NOTE

The main antenna can also be used for diversity reception.

3 EVB Kit Accessories Assembly

The following figure shows the EVB kit accessories assembly.



Figure 5: M.2 EVB Kit Accessories Assembly

4 Application Interfaces

This chapter describes the hardware interfaces of M.2 EVB, shown as follows:

- Power interface
- M.2 interface
- USB interface
- Audio interfaces
- (U)SIM interface

It also provides information about button, switches, status indication LEDs and test points to help customers use the M.2 EVB.

4.1. Power Interface (J101/J701)

The M.2 EVB can be powered by an external power adapter through connecting with the power jack (J101) or USB receptacle (J701) on the EVB. The power adapter connects to a step-down converter which can provide the supply voltage (VBAT) required for operating the EVB and the module.

The following two figures show the simplified power supply schematic and the power interface of the M.2 EVB.

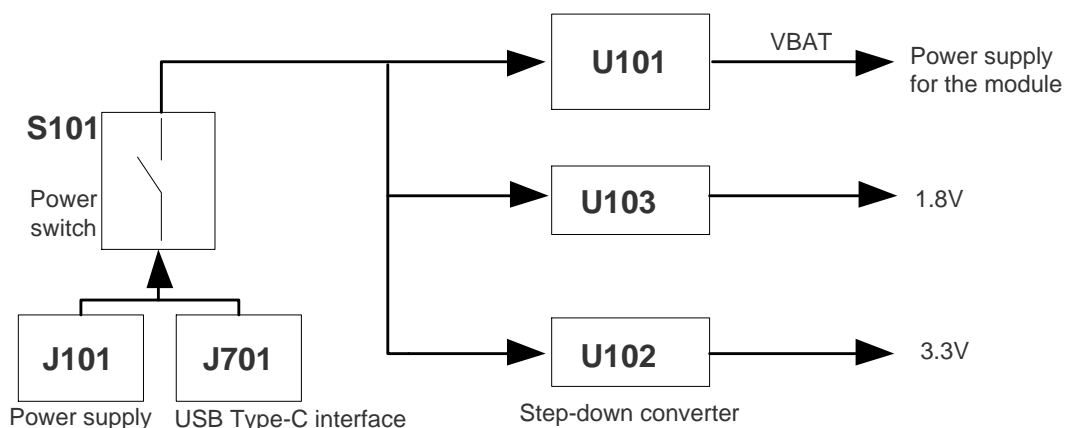


Figure 6: Power Supply for M.2 EVB

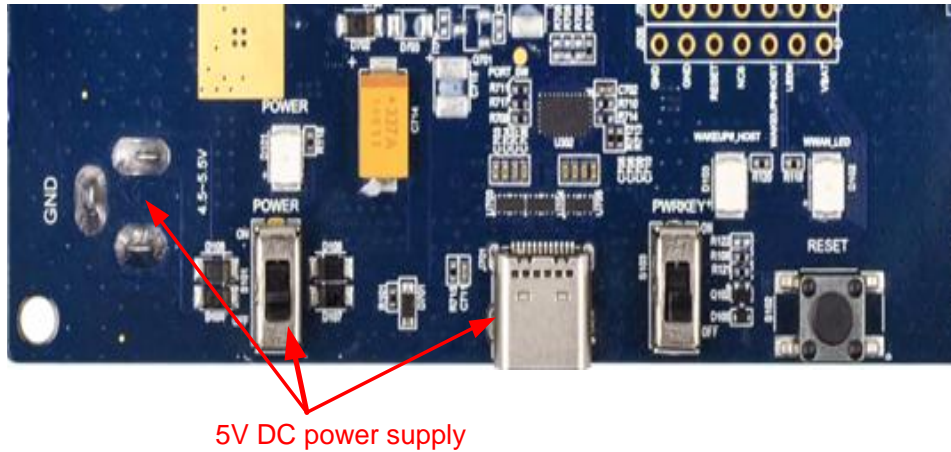


Figure 7: Power Interface

Before connecting the power supply, customers have to select a proper DC power adapter to supply power for the M.2 EVB, and the power plug design of the adapter is shown as below.

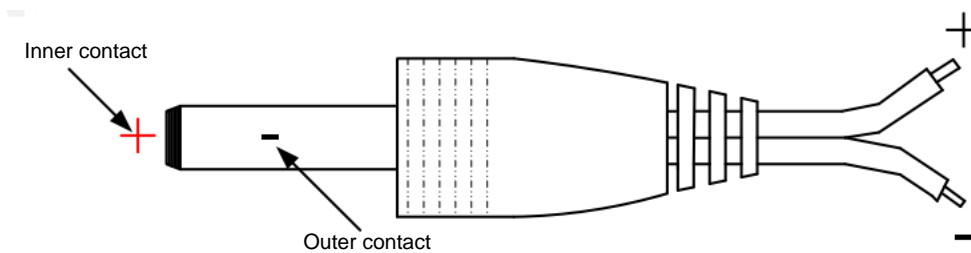


Figure 8: Power Plug Design

4.2. M.2 Interface (J501)

The M.2 interface is designed to accommodate the EM05 and EM06 modules. The module is connected to the EVB via BTB connectors J501. The interface allows customers to easily test the functionalities of EM05 and EM06 modules or develop applications based on the module.

The following figure shows the connection between the module and the EVB

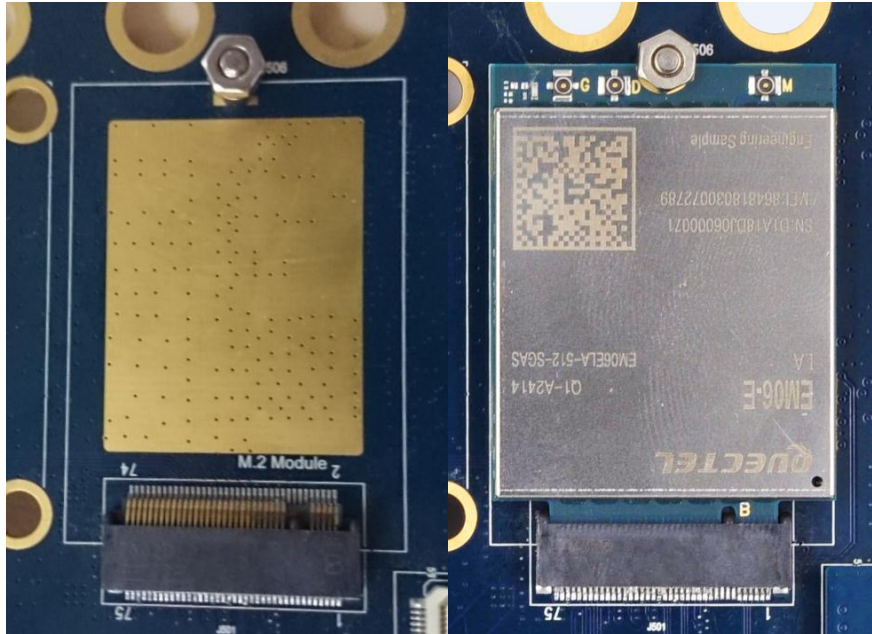


Figure 9: Connection between the Module and EVB

4.3. USB Interface (J701)

The USB interface of EM05 complies with USB 2.0 specification, and that of EM06 complies with USB 2.0 and USB 3.0 specifications. USB 3.0 supports super speed (5Gbps) mode, and USB 2.0 supports high speed (480 Mbps) and full speed (12 Mbps) modes. The USB interface is used for AT command communication, data transmission, GNSS NMEA output, software debugging, firmware upgrade and voice over USB*¹).

The M.2 EVB provides a USB Type-C interface J701 for connection with a host device. The USB data lines D+ and D- are connected directly to the EM06 module. The CC1 and CC2 lines can be used for Type-C configuration channel signals. The VBUS lines can be used for USB connection detection and EVB power supply.

Table 4: Pin Assignment of J701

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

The following figure is a reference circuit design for the USB Type-C device interface.

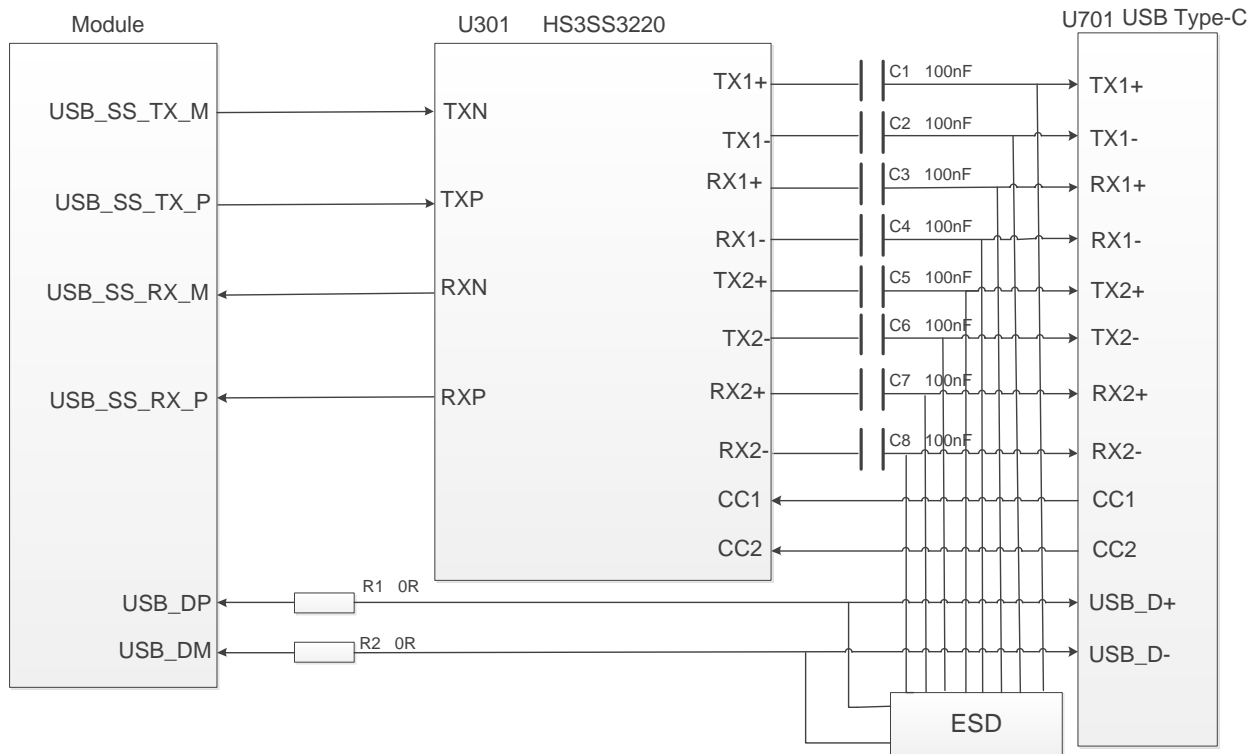


Figure 10: USB Type-C Interface Circuit

NOTE

1. "*" means under development.
2. ¹⁾ The USB interface of EM05 does not support voice over USB function.

4.4. Audio Interfaces (J301/J302/J303)

Quectel M.2 EVB provides one digital audio codec board interface (PCM) J301 and two analog audio interfaces J302 and J303. This chapter gives a detailed introduction on these audio interfaces.

4.4.1. Digital Audio Codec Board Interface (J301)

The M.2 EVB supports the external digital audio codec of TLV320AIC3104. The codec circuit is assembled on an independent small board which can be interconnected with EVB by the BTB connector J301.

The following figures show a reference design for the connection between digital audio codec board and the EVB.

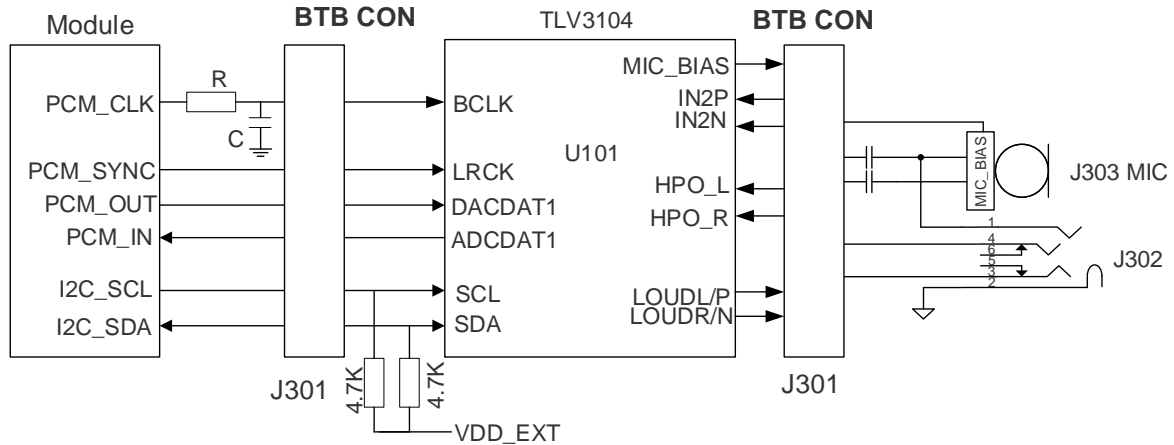


Figure 11: Reference Design for Connection between Codec Board and EVB

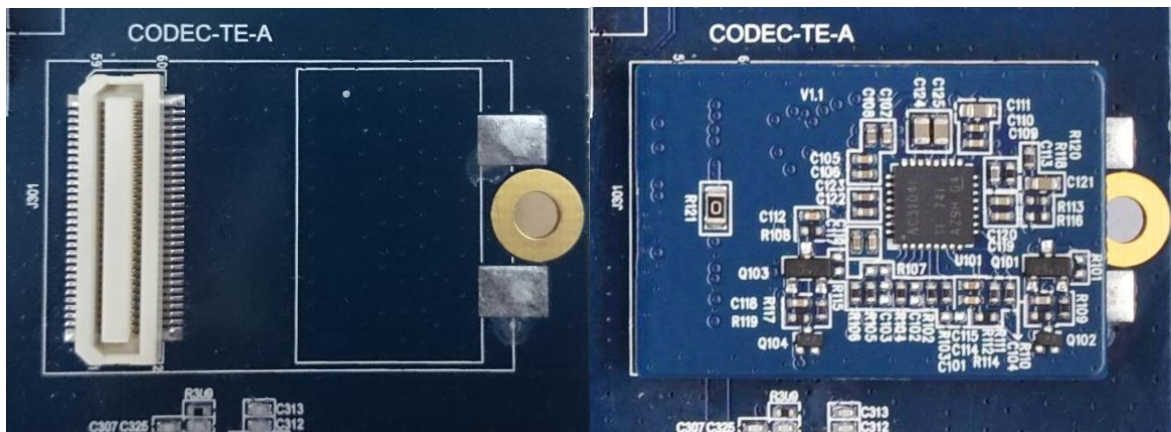


Figure 12: Connection between Codec Board and EVB

4.4.2. Earphone Interface (J302)

Audio interface J302 is designed for earphones. A reference circuit design for the interface is shown as following figure.

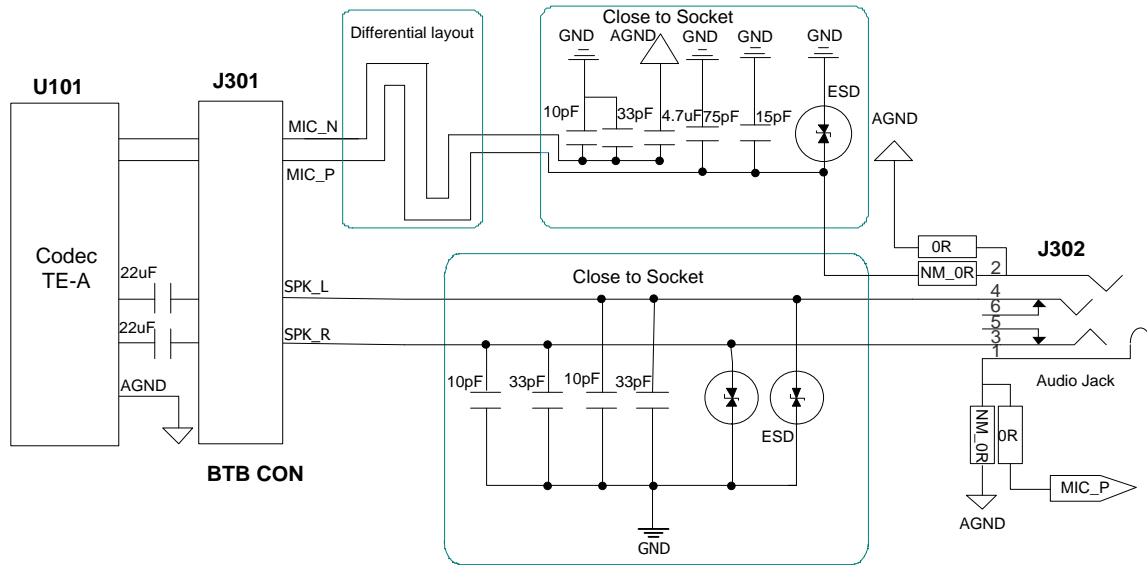


Figure 13: Reference Circuit Design for Earphone Interface J302

The figure and table below illustrate the pin assignment and definition of earphone interface J302.

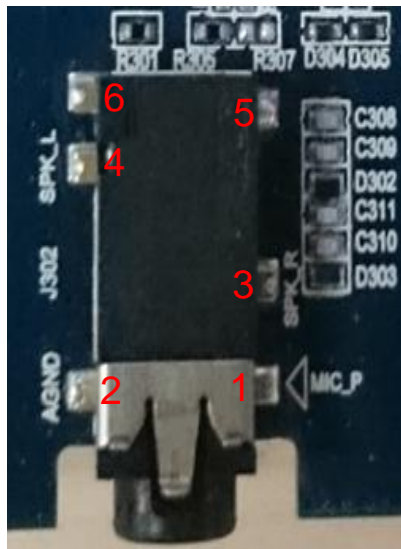


Figure 14: Pin Assignment of J302

Table 5: Pin Definition of J302

Pin No.	Pin Name	Description
1	MIC_P	Microphone input-positive

2	AGND	Dedicated GND for audio
3	SPK_R	Right channel of stereo audio output
4	SPK_L	Left channel of stereo audio output
5, 6	NC	Not connected

The following figure shows the sketch design of audio plug which suits for the audio jack on M.2 EVB.

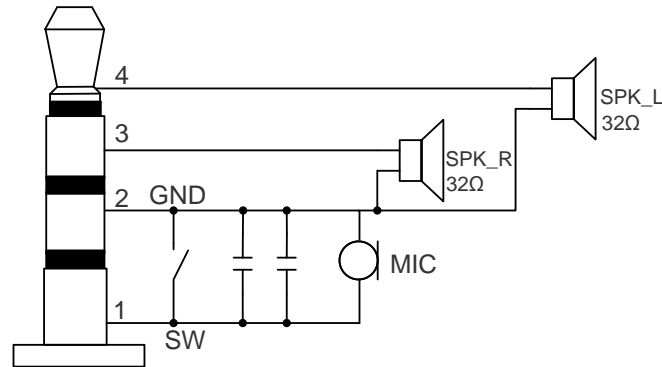


Figure 15: Sketch of Audio Plug

4.4.3. Handset Interface (J303)

Audio interface J303 is designed for handsets. A reference circuit design for handset interfaces J303 is shown below.

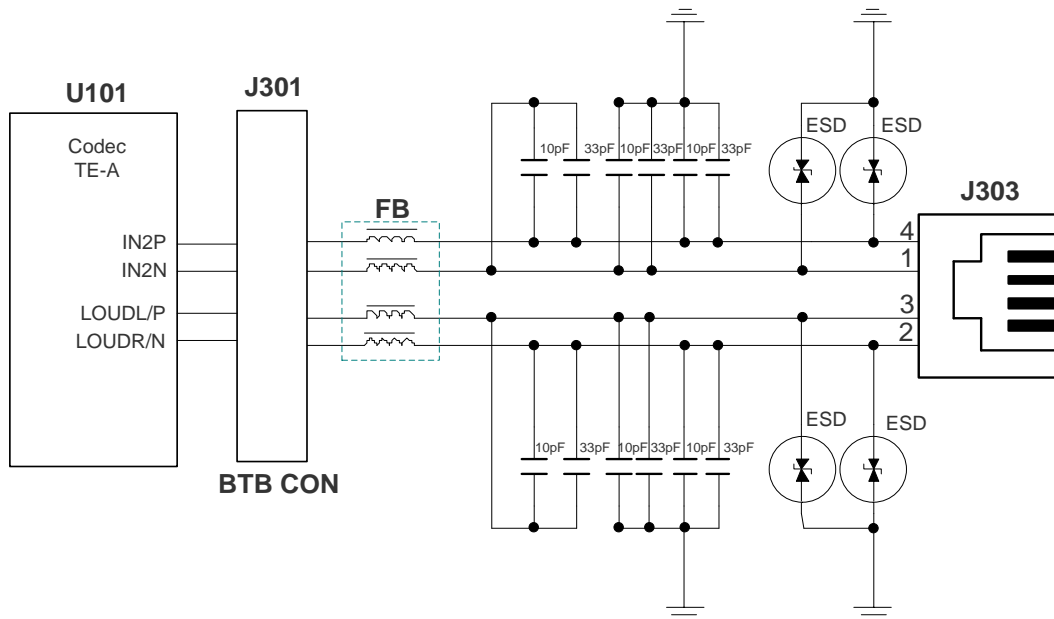


Figure 16: Reference Circuit Design for Handset Interface J303

The figure and table below illustrate the pin assignment and definition of handset interface J303.

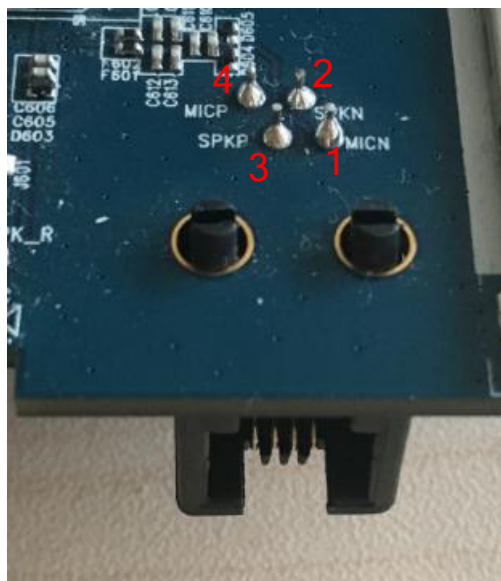


Figure 17: Pin Assignment of J303

Table 6: Pin Definition of J303

Pin No.	Pin Name	Function
1	MICN	Negative microphone input
2	SPKN	Negative loudspeaker output
3	SPKP	Positive loudspeaker output
4	MICP	Positive microphone input

4.5. (U)SIM Interfaces (J401/J402)

The M.2 EVB has two 8-pin push-push type (U)SIM card (3.0V or 1.8V) connector J401 and J402. Both of them can be used for EM06 module, and EM06 supports Dual SIM Single Standby* function. The J402 is not applicable for EM05 module. The following figure shows the pin assignment and definition of J401/J402.

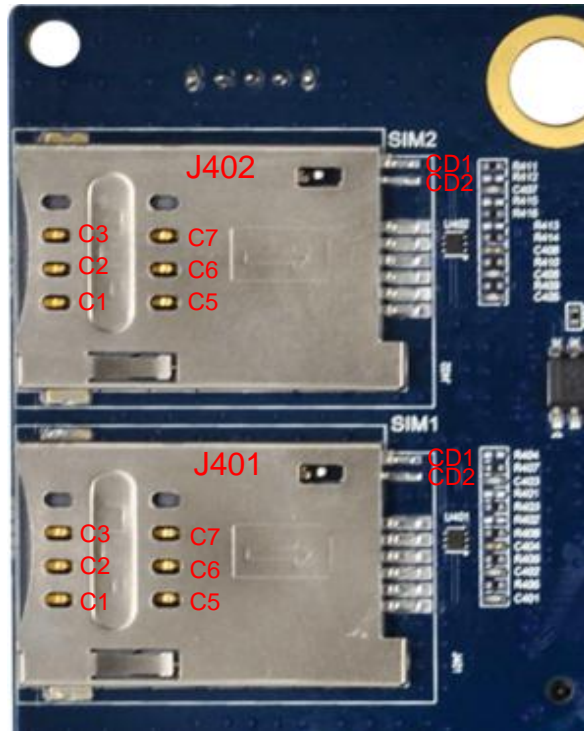


Figure 18: Pin Assignments of J401/J402

Table 7: Pin Assignments of J401/J402

Pin No.	Signal Name	I/O	Description
C1	SIM_VDD	PO	(U)SIM card power supply, provided by M.2 EVB
C2	SIM_RST	DO	(U)SIM card reset
C3	SIM_CLK	DO	(U)SIM card clock
C5	GND	/	Ground
C6	VPP	/	Not connected
C7	SIM_DATA	I/O	Data line, bi-directional
CD1	/	/	(U)SIM card insertion detection
CD2	SIM_PRESENCE	I/O	(U)SIM card insertion detection When the (U)SIM card is present, it is at high level (pulled up to 1.8V). When the (U)SIM card is absent, it is at low level.

4.6. Switches and Button

The M.2 EVB includes three switches S101/S103/S701 and a button S102, as shown in the following figure.

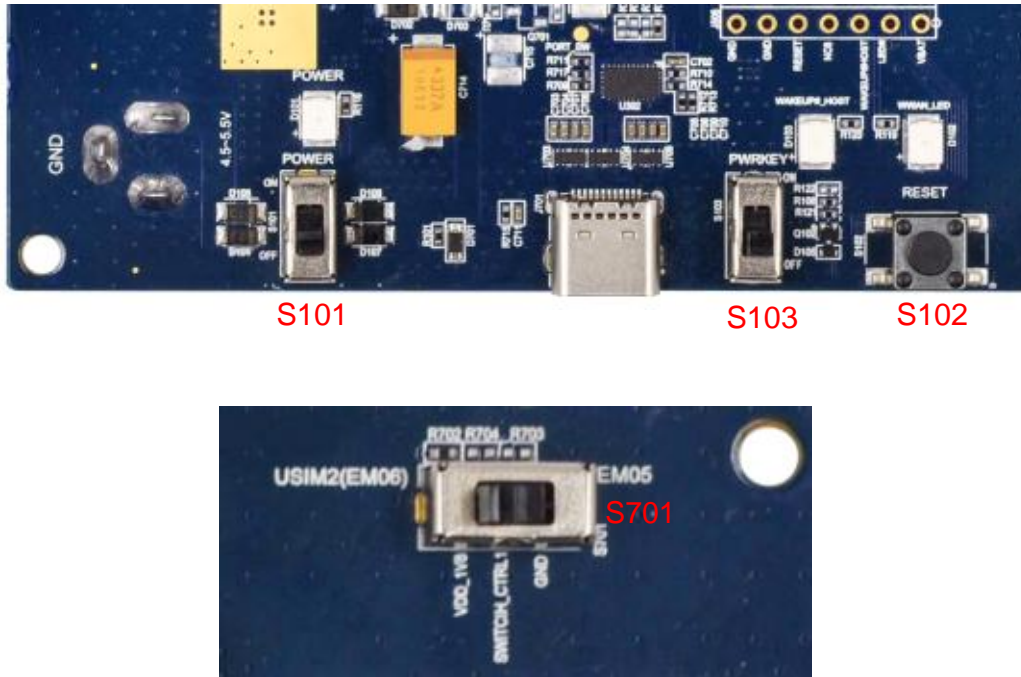


Figure 19: Switches and Button

Table 8: Description of the Switches and Button

Reference No.	Description
S701	Used to switch between EM05 and EM06 modules
S101	Power ON/OFF control
S103	Used to turn on/off the module
S102	Used to reset the module

4.7. Status Indication LEDs

The M.2 EVB includes three status indication LEDs (D101, D102 and D103). The following figure shows the location of these LED indicators.

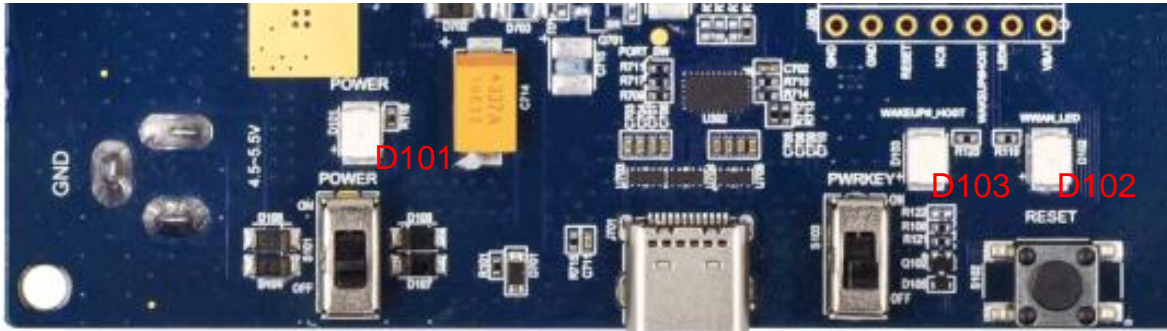


Figure 20: Status Indicators

Table 9: Description of Status Indicators

Reference No.	Description
D101	Power ON/OFF indicator indicating the power supply status of the EVB Bright: the module is powered on Extinct: the power is powered off
D103	Operation status indicator for the module When a URC returns, a 1s low level pulse will be outputted Used to indicate a URC reporting which could wake up the module Bright: A call, SMS message or data is coming, the module is woken up Extinct: the module is in idle or sleep mode
D102	RF status indicator for the module Bright: RF function is enabled Extinct: RF function is disabled

4.8. Test Points

The M.2 EVB provides a series of test points. They can help customers to obtain the corresponding waveform of some signals. The following figures and tables show test points J502, J503, J504, J505, J202, J601, J602, J603 and J604.

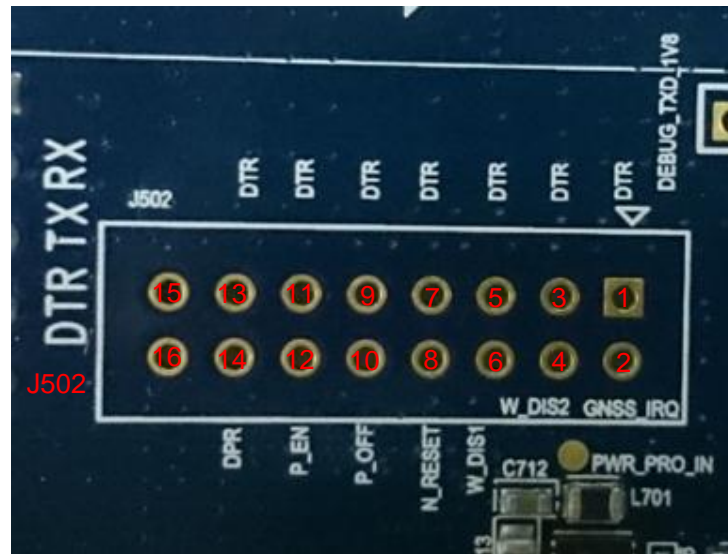


Figure 21: Test Point J502

Table 10: Pin Definition of J502

Pin No.	Pin Name	Description
1	DTR	Data terminal ready test pin
2	GNSS_IRQ	GNSS_IRQ test pin
3	DTR	Data terminal ready test pin
4	W_DIS2	GPS control test pin
5	DTR	Data terminal ready test pin
6	W_DIS1	Airplane mode control test pin
7	DTR	Data terminal ready test pin
8	N_RESET	Module reset test pin
9	DTR	Data terminal ready test pin
10	P_OFF	A signal control to power on/off the module
11	DTR	Data terminal ready test pin
12	P_EN	Module power supply enable pin

13	DTR	Data terminal ready test pin
14	DPR	Dynamic power control test pin
15	/	Not connected
16	/	Not connected

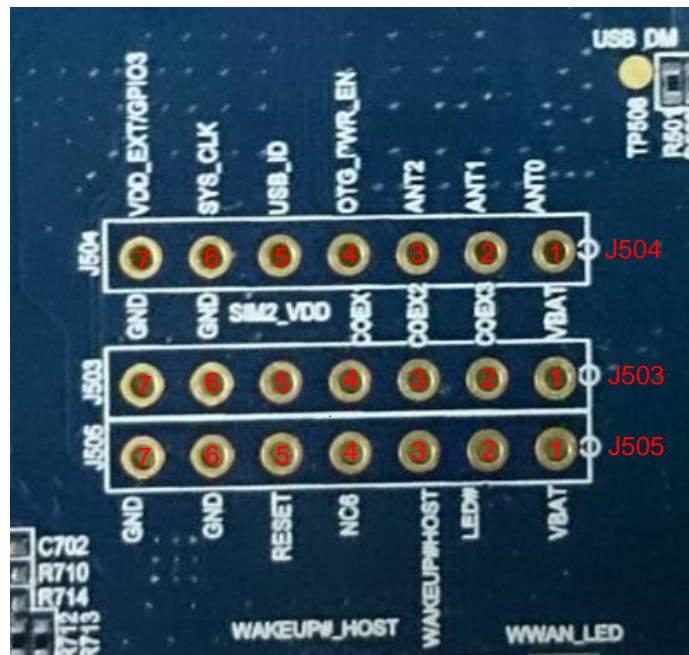


Figure 22: Test Points J503, J504 and J505

Table 11: Pin Definition of J503

Pin No.	Pin Name	Description
1	VBAT	Module power supply test pin
2	COEX3	Connected directly to pin 60 of EM06 module
3	COEX2	Connected directly to pin 62 of EM06 module
4	COEX1	Connected directly to pin 64 of EM06 module
5	SIM2_VDD	Power supply for (U)SIM2 card test pin
6	GND	Ground

7	GND	Ground
---	-----	--------

Table 12: Pin Definition of J504

Pin No.	Pin Name	Description
1	ANT0	Tunable antenna control
2	ANT1	Tunable antenna control
3	ANT2	Tunable antenna control
4	OTG_PWR_EN	USB power supply enable pin
5	USB_ID	USB_ID test pin
6	SYS_CLK	PCM interface clock signal test pin
7	VDD_EXT/GPIO3	Tunable antenna control

Table 13: Pin Definition of J505

Pin No.	Pin Name	Description
1	VBAT	Module power supply test pin
2	LED#	WWAN status indicators test pin
3	WAKEUP#HOST	A signal to wake up the host
4	NC6	Not connected
5	RESET	System reset test pin
6	GND	Ground
7	GND	Ground

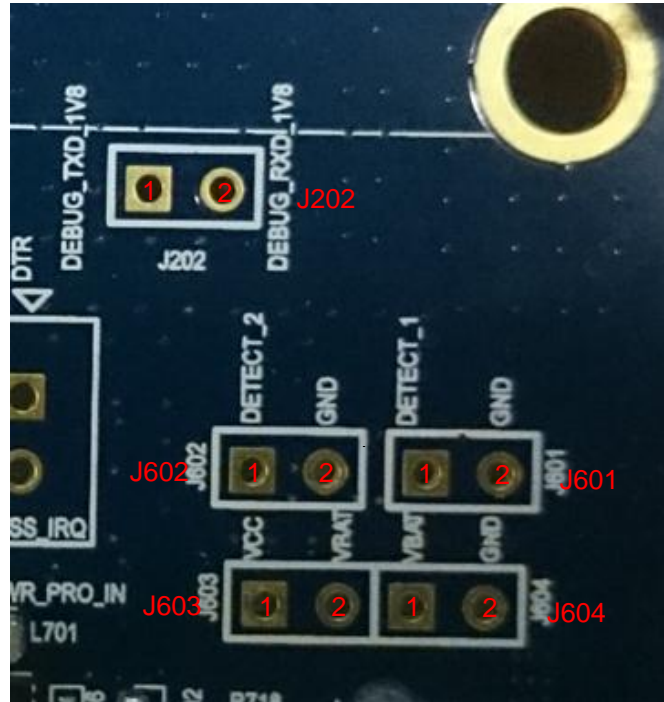


Figure 23: Test Points J202, J601, J602, J603 and J604

Table 14: Pin Definition of J202

Pin No.	Pin Name	Description
1	DEBUG_TXD_1V8	DEBUG_TXD_1V8 test pin
2	DEBUG_RXD_1V8	DEBUG_RXD_1V8 test pin

Table 15: Pin Definition of J601

Pin No.	Pin Name	Description
1	DETECT_1	Module insertion detection pin
2	GND	Ground

Table 16: Pin Definition of J602

Pin No.	Pin Name	Description
1	DETECT_2	Module insertion detection pin
2	GND	Ground

Table 17: Pin Definition of J603

Pin No.	Pin Name	Description
1	VCC	Module power supply test pin
2	VBAT	Module power supply test pin

Table 18: Pin Definition of J604

Pin No.	Pin Name	Description
1	VBAT	Module power supply test pin
2	GND	Ground

5 Operation Procedures Illustration

This chapter introduces how to use the M.2 EVB for testing and evaluation of Quectel EM05 and EM06 modules.

5.1. Power on the Module

1. Connect the module to the EVB. Insert the module into the connectors (J501) on EVB, and then fix the other end of the module with screws.
2. Insert a (U)SIM card into the (U)SIM card connector on EVB and connect the antennas to the module.
3. Connect the EVB to a 5V power adapter or connect the EVB to PC via USB Type-C cable.
4. Switch S101 (Power Switch) to **ON** state, then the D101 (Power ON/OFF indicator) will light up, which indicates that the power supply for the EVB is ready. In such case, switch S103 (PWRKEY) to **ON** state, the module will be powered on automatically and then D102 (WWAN_LED) will be light up when RF function is enabled.

Table 19: Indication of D101, D102 and D103

Reference Number	State	Description
D101	Always ON	VBAT ON
	Always OFF	VBAT OFF
D102	Always ON	RF function is enabled
	Always OFF	RF function is disabled
D103	Always ON	A call, SMS message or data is coming, the module is woken up
	Always OFF	The module is in idle or sleep mode

5.2. Communication via USB Type-C Interface

1. Power on the module according to the procedure mentioned in **Chapter 5.1**.
2. Connect the EVB and the PC with USB cable through USB Type-C interface, and then run the driver disk on PC to install the USB driver. For details about USB driver installation, please refer to **document [1]**.



Figure 24: USB Ports

3. Install and then use the QCOM tool provided by Quectel to realize communication between the module and the PC. The following figure shows the COM Port Setting field on QCOM: select correct “**COM Port**” (USB AT Port which is shown in above figure) and set correct “**Baudrate**” (such as 115200bps). For more details about QCOM tool usage and configuration, please refer to **document [4]**.

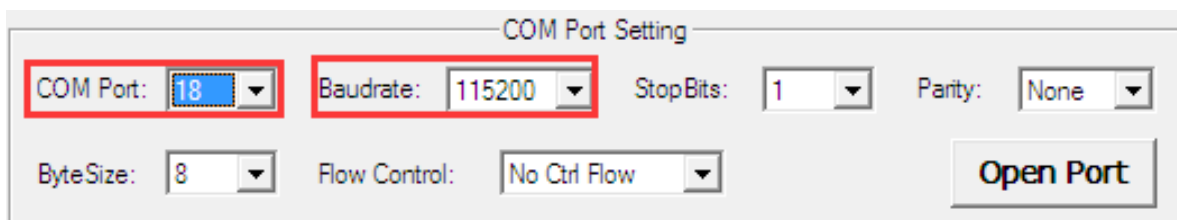


Figure 25: COM Port Setting Field on QCOM (USB AT Port Connection)

5.3. Firmware Upgrade

The firmware of the module is upgraded via USB port by default. Please follow the procedures below to upgrade the firmware.

1. Install and open the firmware upgrade tool QFlash on PC, and then power on the module according to the procedure mentioned in **Chapter 5.1**.
2. Click the “**COM Port**” dropdown list and select the USB DM port.

3. Click the “**Load FW Files**” button to choose the firmware package.
4. Click the “**Start**” button to upgrade the firmware.

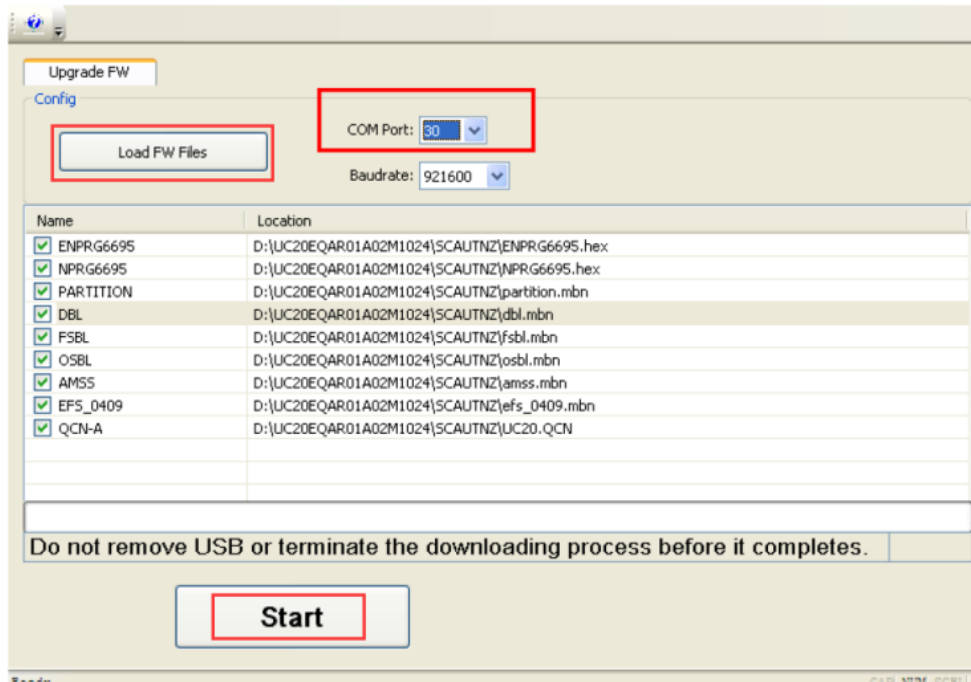


Figure 26: Configurations for Firmware Upgrade

For more details about QFlash tool usage and configuration, please refer to **document [5]**.

5.4. Reset the Module

The emergency reset option is only used in case of emergency. For example, the software does not respond for more than 5s due to some serious problems.

Press the button S102 (RESET) for 250ms~600ms for EM06 module or 150ms~460ms for EM05 module, then release it to reset the module. However, this operation may cause the loss of information stored in the memory as the reset module has been initialized.

NOTE

The time for pressing the RESET button cannot exceed the maximum values, otherwise the module will be powered off.

5.5. Power off the Module

There are two ways to power off the module.

- Hardware shutdown: Switch the S103 to **OFF** state, the module will be powered off.
- Software shutdown: Turn off the module using **AT+QPOWD** command.

NOTE

Please refer to *document [2]* for details about **AT+QPOWD** command.

5.6. Test Current Consumption

The M.2 EVB can also be used to test the current consumption of the module after making the following modifications.

1. Remove R607.

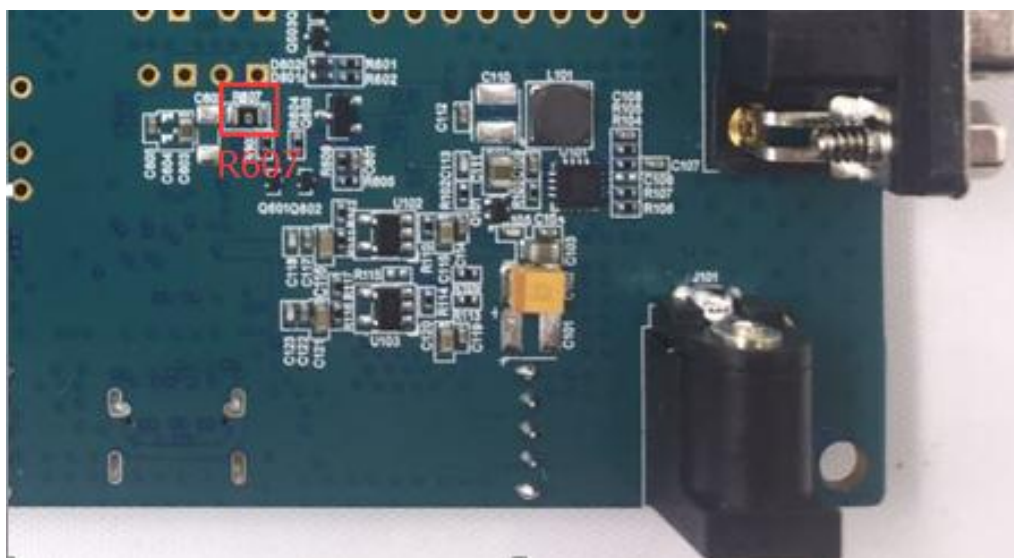


Figure 27: Location of R607

Connect an external power supply to J603 or J604 (either of them) to supply power for the module independently.

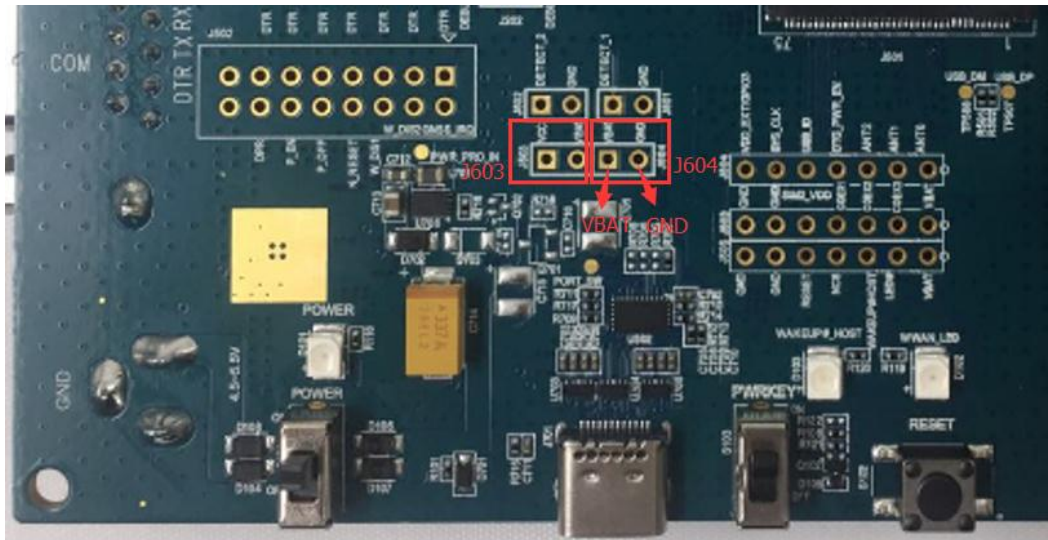


Figure 28: Location of J603 and J604

2. Power on the module according to the procedure mentioned in **Chapter 5.1** and then test the current consumption of the module.

6 Appendix A References

Table 20: Related Documents

SN	Document Name	Remark
[1]	Quectel_LTE_Windows_USB_Drivers_Installation_Guide	Install USB drivers for M.2 module on Windows system
[2]	Quectel_xx_AT_Commands_Manual	Respective AT commands manual for EM05 and EM06 modules
[3]	Quectel_xx_Hardware_Design	Respective hardware design for EM05 and EM06 modules
[4]	Quectel_QCOM_User_Guide	User guide for QCOM tool
[5]	Quectel_QFlash_User_Guide	User guide for QFlash tool

Table 21: Terms and Abbreviations

Abbreviation	Description
COM	Cluster Communication Port
DC	Direct Current
DO	Digital Output
GND	Ground
I/O	Input/Output
LED	Light Emitting Diode
PO	Power Output
(U)SIM	(Universal) Mobile Telecommunication System
VBAT	Voltage of Battery