5G EVB User Guide

5G/LTE-A Module Series

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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 the module. Manufacturers of the cellular terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

	Full attention must be paid 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 there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an 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 signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. 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. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.
	The cellular terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other cellular terminals. Areas with explosive or potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

Version	Date	Author	Description
-	2020-05-25	Iverson CHENG	Creation of the document
1.0	2020-05-25	Iverson CHENG	First official release
1.1	2020-05-26	Iverson CHENG	Updated the firmware upgrade tool in Chapter 4.3 to QFlash.
1.2	2021-05-08	Besson RONG	1. Chapter 2: Updated the descriptions of interfaces/ switches/ buttons in Table 2; updated the top and bottom view for component placement (Figure 1 and Figure 2), and the interface table (Table 3); updated the accessories of the EVB (Table 4). 2. Chapter 3: Updated the interface reference designators and corresponding figures according to the EVB upgrade. 3. Chapter 4.3.1: Updated the emergency download procedure. 4. Chapter 4.4: Updated the period of pressing RESET button for the module reset.

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1 Introduction

This user guide describes detailed information about the usage of the EVB (Evaluation Board) for Quectel 5G RG50xQ series and LTE-A EG512R-EA modules. The EVB is an auxiliary tool for engineers to develop and test these modules.

1.1. Applicable Modules

Quectel 5G EVB is applicable to the following modules:

Table 1: Applicable Modules

Module Series	Models
5G	RG50xQ Series: RG500Q Series/ RG502Q-EA
LTE-A	EG512R-EA

2 General Overview

Quectel supplies 5G EVB for engineers to develop applications based on Quectel 5G and LTE-A EG512R-EA modules. This EVB can be used to test basic functionalities of these modules.

2.1. Key Features

The following table describes the detailed features of 5G EVB.

Table 2: Key Features

Features	Implementation
Power Supply	DC power supply: 4.5–5.5 V Typical: +5 V/ 3 A
Module TE-A Interface	Quectel 5G RG50xQ Series and LTE-A EG512R-EA modules supported
PHY TE-A Interface	PHY AR8035 supported
Wi-Fi TE-A Interface	Reserved
AP TE-A Interface	Reserved
SD Card Interface	SD card connector
(U)SIM Card Interface	Dual (U)SIM card supported: 1.8 V and 2.95 V
Audio Interfaces	● 1 digital audio codec board interface: Supporting ALC5616-TE-A and TLV320AIC3104-TE-A codec boards ● 2 analog audio interfaces: Used for loudspeaker and earphone
UART Interface	**COM1 (J2002):** ● Main UART ● For data communication ● Default baud rate: 115200 bps **COM2 (J2003):** ● Debug UART ● For debugging

	• Default baud rate: 115200 bps
USB Interface	• USB Type C interface • USB 3.0 and USB 2.0 supported
PCIe to USB Interface	Reserved
Signal Indication	5 LEDs are available for signal indication
Button and Switches	• PWRKEY (S0202) • RESET (S0201) • USB_BOOT (S0203) • PCIe Configuration Switch (S1501) • Power Switch (S0301) • SDIO Configuration Switch (S2501) • RGMII Configuration Switch (S1801/S1802) • Codec Configuration Switch (S2801)
Physical Characteristics	Size: 235 mm × 190 mm
Antenna	12 antenna interfaces

2.2. Component Placement of 5G EVB

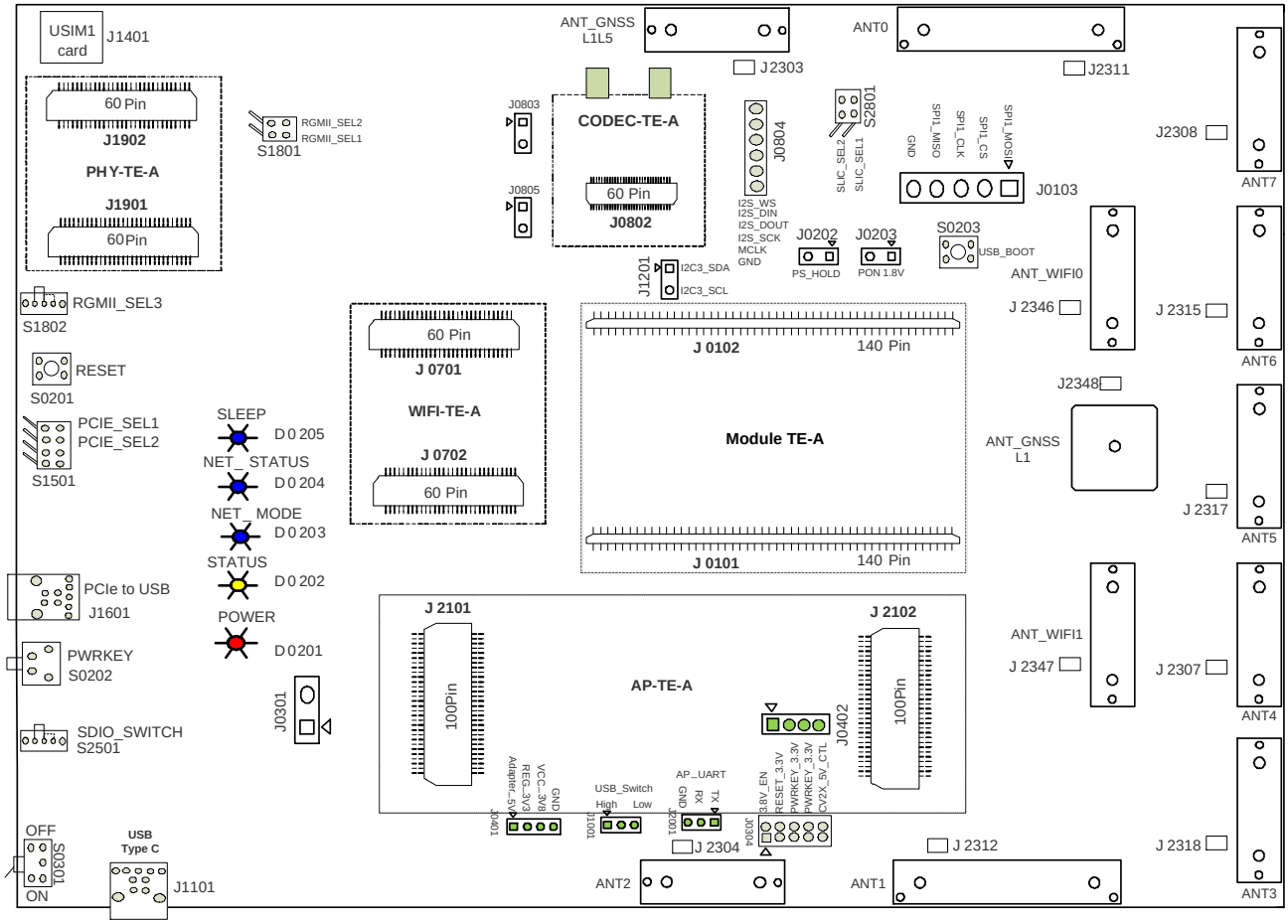

Figure 1: Top View for Component Placement of the EVB

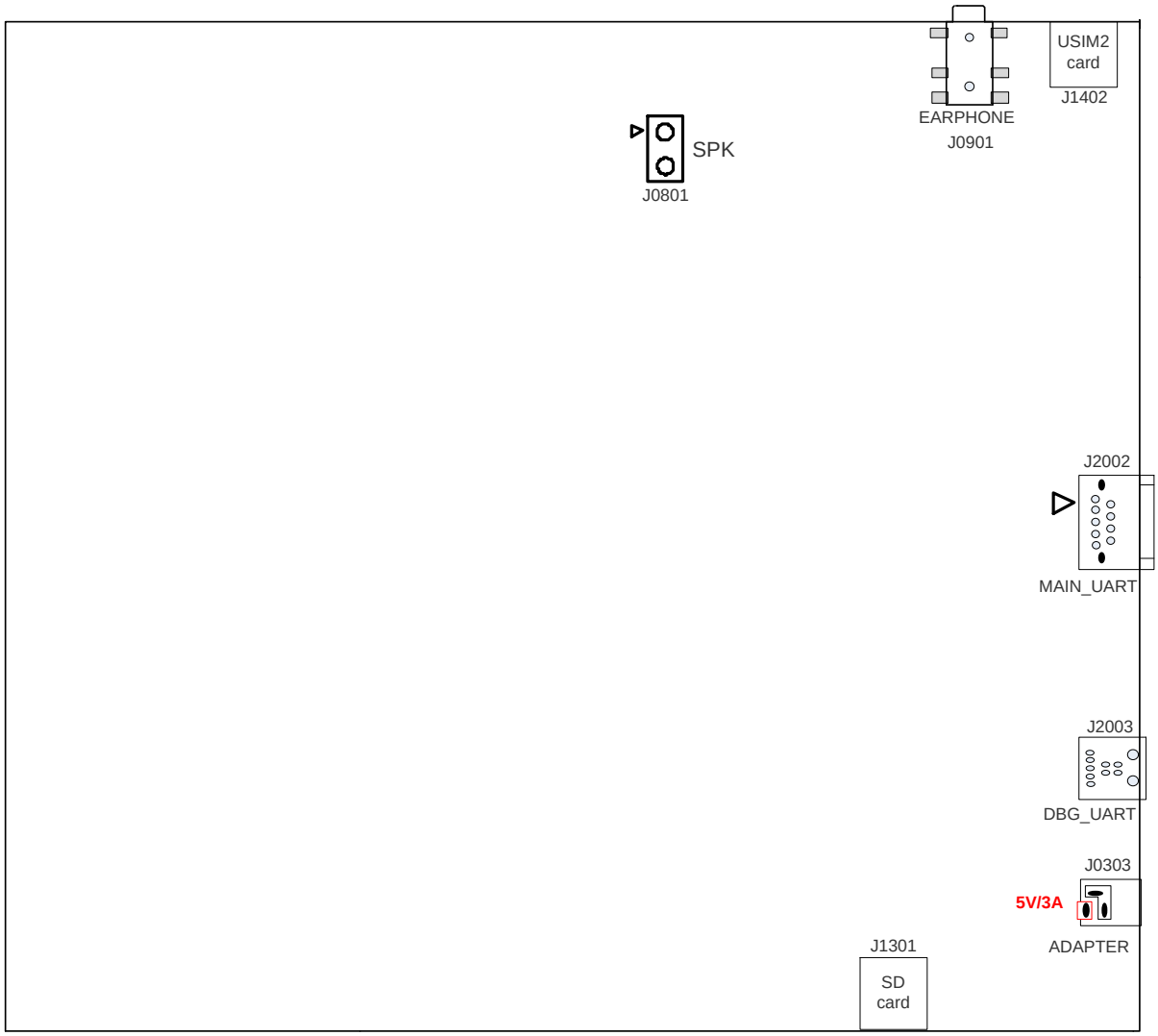

Figure 2: Bottom View for Component Placement of the EVB

Table 3: Components & Interfaces of 5G EVB

Interface	Reference Designator	Description
Power Supply	J0303	The power jack on the EVB Typical supply voltage: +5 V/ 3 A
Power Switch	S0301	VBAT ON/OFF control
PWRKEY	S0202	Power key (push button) Used to turn on/off the module
PON	J0203	Auto-power on control
USB_BOOT	S0203	Emergency download
RESET	S0201	Reset button (push button)

		Used to reset the module
USB	J1101	USB Type C interface
PCIe to USB	J1601	PCIe to USB interface, not supported by default
PCIe Configuration Switch	S1501	Used to configure the module communication with different devices via PCIe signals
SDIO Configuration Switch	S2501	Used to switch between SD card and eMMC
RGMII Configuration Switch	S1801, S1802	Used for RGMII configuration
Codec Configuration Switch	S2801	Used for codec configuration
Audio	J0802	Codec board TE-A connector
	J0801	Designed for loudspeakers
	J0901	Audio jack for earphone
(U)SIM	J1401	(U)SIM1 card connector
	J1402	(U)SIM2 card connector
SD Card	J1301	SD card connector
Main UART	J2002	MAIN_UART port for data communication
Debug UART	J2003	DBG_UART port for debugging
Status Indicator	D0201	Power supply on/off indicator, indicating whether the module's power supply is on or off.
	D0202	Module operation status indicator, indicating whether the module is powered on.
	D0203	Net mode indicator, indicating NET_MODE status of the module.
	D0204	Net status indicator, indicating NET_STATUS status of the module.
	D0205	Sleep status indicator, indicating SLEEP status of the module.
Module TE-A	J0101, J0102	Module TE-A connectors
PHY TE-A	J1901, J1902	PHY TE-A connectors
Wi-Fi TE-A	J0701, J0702	Wi-Fi TE-A connectors
AP TE-A	J2101, J2102	AP TE-A connectors

Antenna	J2303, J2304, J2307, J2308, J2311, J2312, J2315, J2317, J2318, J2346, J2347, J2348	Antenna connectors

2.3. Top and Bottom Views of 5G EVB

The following figures shows the top and bottom views of the 5G EVB.

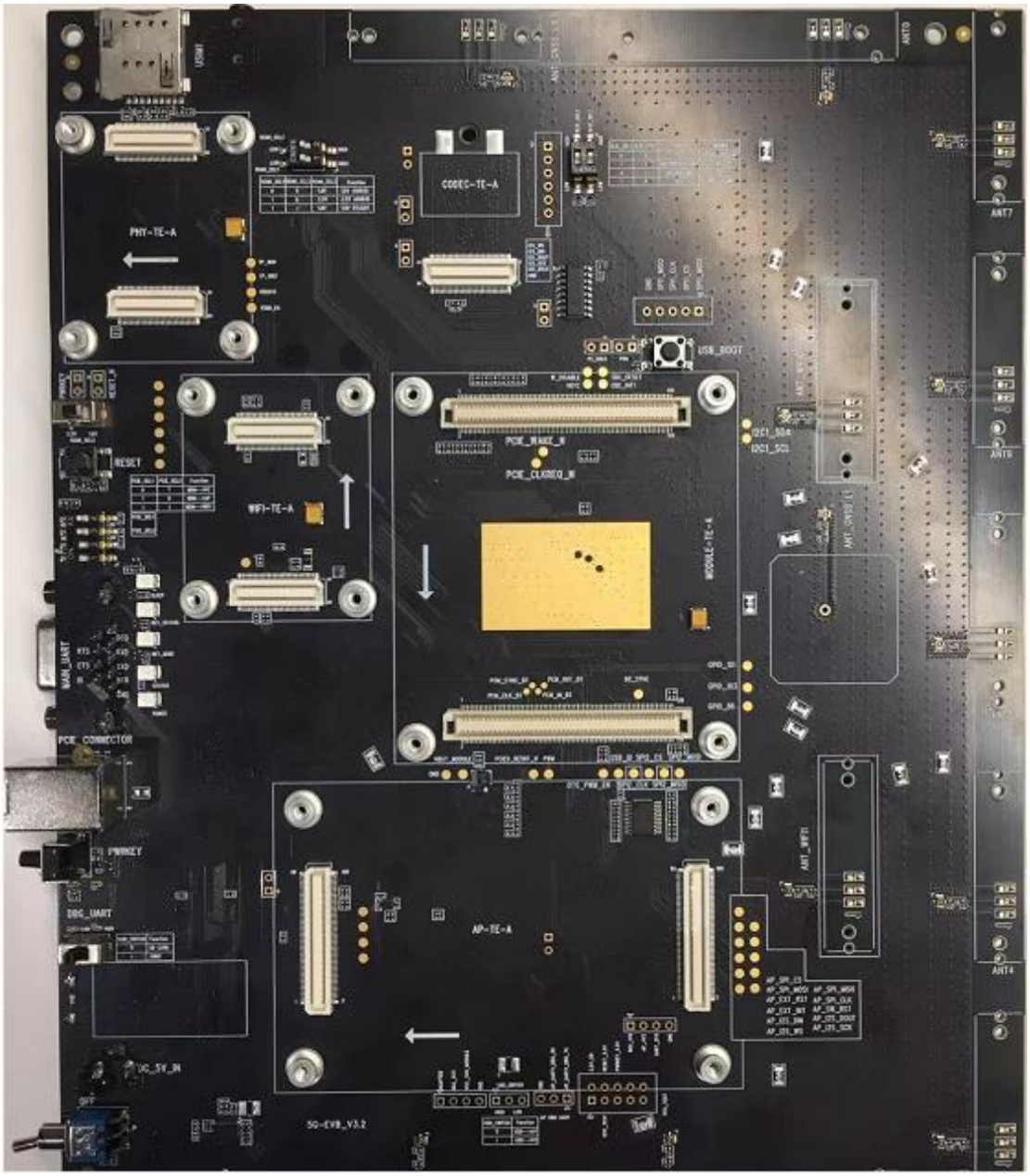

Figure 3: 5G EVB Top View

Figure 4: 5G EVB Bottom View

2.4. List of Accessories

All accessories of the 5G EVB kit are listed below.

Table 4: Accessories List

Items	Description	Quantity (pcs)
Cables	USB to RS-232 converter cable	1
	USB Type A converter B cable	1
	USB Type-C cable	1
	RF cables	9
Antennas	Wi-Fi antenna	2
	RF antennas	8
	GNSS antenna (passive)	2
Audio	Earphone	1
USB Driver	Including module's related documents, tools & drivers etc.	1
Codec TE-A	ALC5616, TLV320AIC3104	2
PHY TE-A	PHY AR8035	1
Screws	Used to fasten TE-As on the EVB	8
Instruction Sheet	A sheet of paper giving instructions for EVB connection, details of EVB accessories, etc.	1
PCIe to USB adapter	PCIe signal is transferred through USB 3.0 connector, not used by default.	1
Bolts and Nuts	Bolts and nuts for assembling the EVB	4 pairs
Power Adapter	+5 V/ 3 A power adapter	1

3 Interface Application

This chapter describes the hardware interfaces of the 5G EVB, as listed below:

- Power supply
- Module TE-A interface
- PHY TE-A interface
- USB interface
- Audio interfaces
  - Digital Audio Codec Board Connector
  - Analog Audio Interfaces
    - Loudspeaker Interface
    - Earphone Interface
- (U)SIM interfaces
- UART interfaces
- SD card interface
- PCIe to USB interface
- Switches and buttons
- Status indicators
- Wi-Fi interface
- Antenna Interfaces

It also provides information about the buttons, switches, status indication LEDs and test points to help developers use the EVB.

3.1. Power Supply (J0303)

The 5G EVB can be powered by an external power adapter through the power jack (J0303).

The following two figures manifest a simplified power supply block diagram and the power interface of 5G EVB.

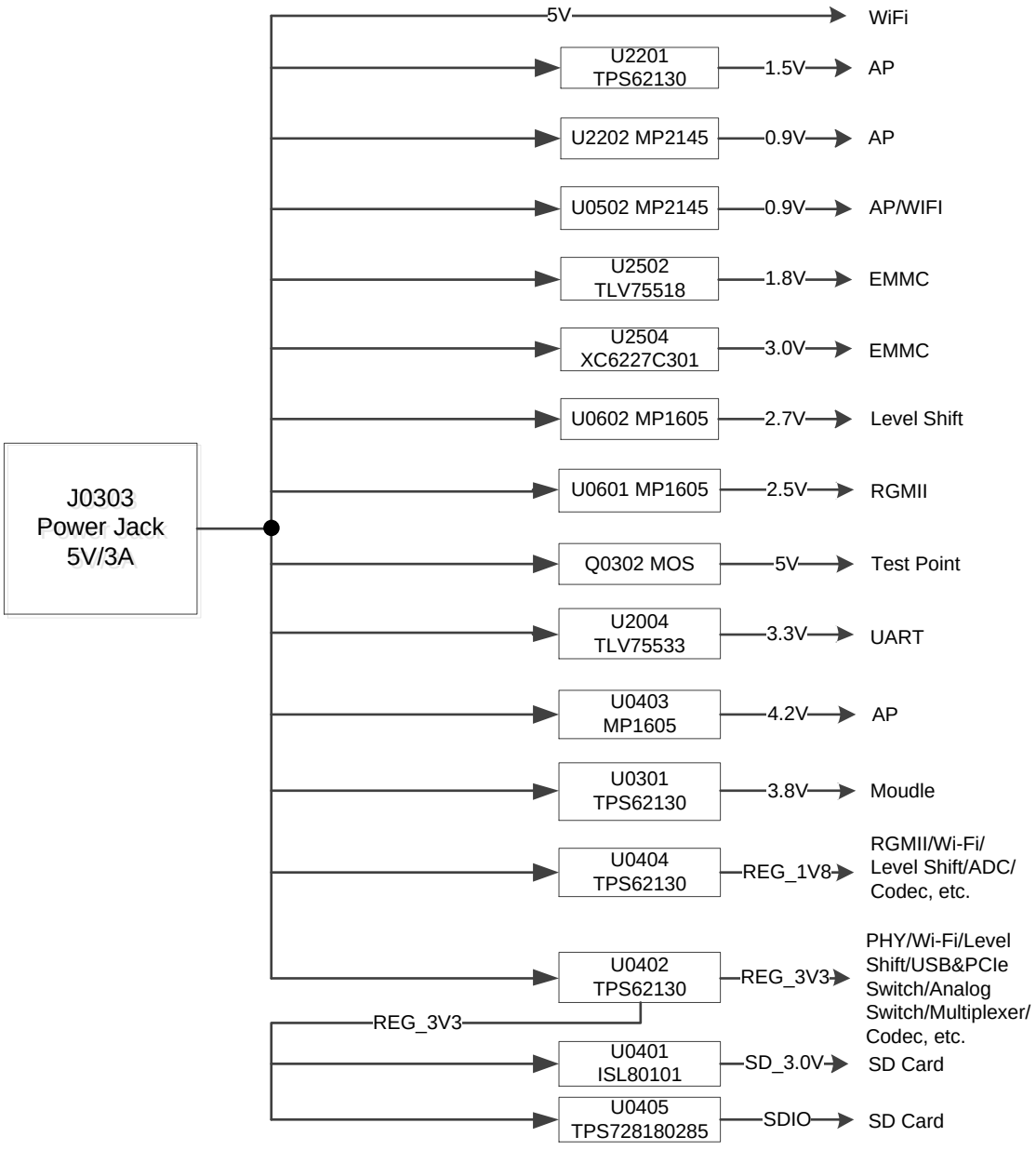

Figure 5: Block Diagram of the EVB Power Supply

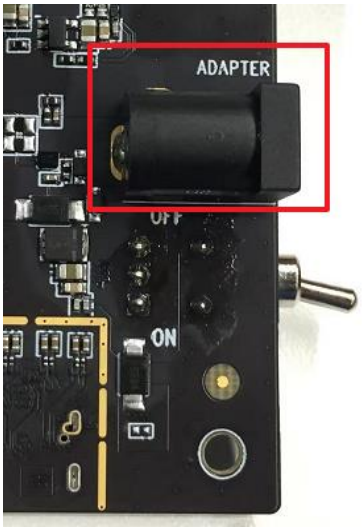

Figure 6: EVB Power Supply Interface

3.2. Module TE-A Interface (J0101/J0102)

Module TE-A interface is designed to accommodate the TE-A of the modules. The TE-A is mounted onto and connected to the EVB via BTB connectors J0101 and J0102. The developer will be able to test the functionalities of the modules easily (insert as indicated by the arrow to prevent reverse insertion).

The following figure displays the connection between the module TE-A and the EVB.

Figure 7: Connection Between the Module TE-A and the EVB

3.3. PHY TE-A Interface (J1901/J1902)

The PHY TE-A interface is designed to accommodate the PHY TE-A (PHY8035-TE-A). The PHY TE-A is mounted onto and connected to the EVB via BTB connectors J1901 and J1902 (insert as indicated by the arrow to prevent reverse insertion).

The following two figures displays the connection between PHY8035-TE-A and EVB.

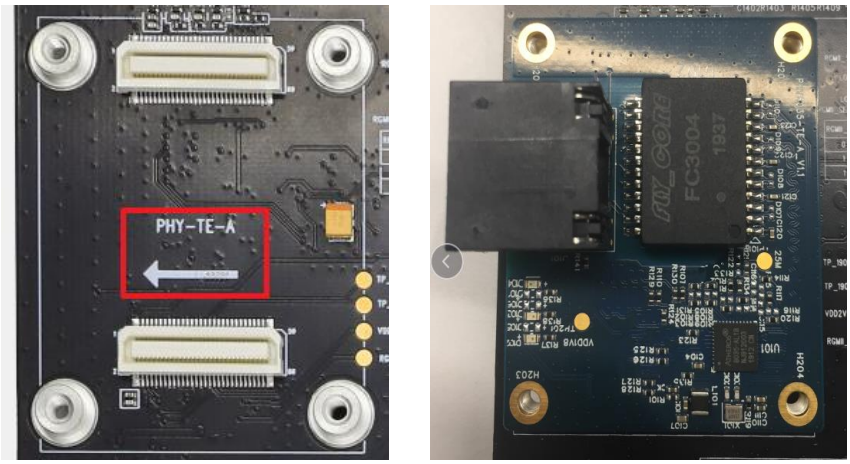

Figure 8: Connection Between PHY8035-TE-A and the EVB

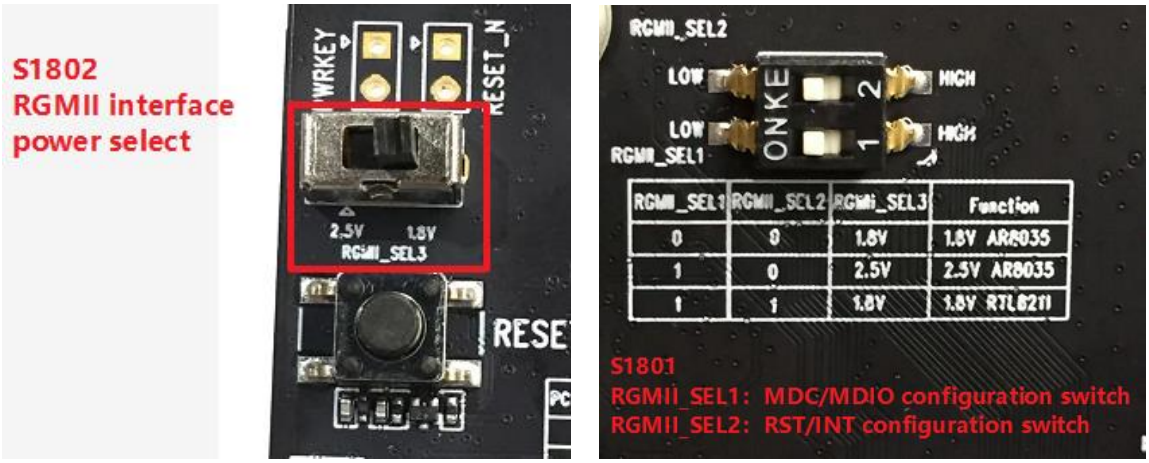

Figure 9: S1801/S1802 Switch

Table 5: PHY8035-TE-A Configuration Switch

RGMII_SEL1	RGMII_SEL2	RGMII_SEL3	Function
Low	Low	1.8 V	1.8 V AR8035
High	Low	2.5 V	2.5 V AR8035
High	High	-	1.8 V RTL8211

3.4. USB Interface (J1101)

A USB Type C connector, which complies with USB 3.0/3.1 and USB 2.0 standard, is provided. This USB interface is used for AT command communication, data transmission and firmware upgrade.

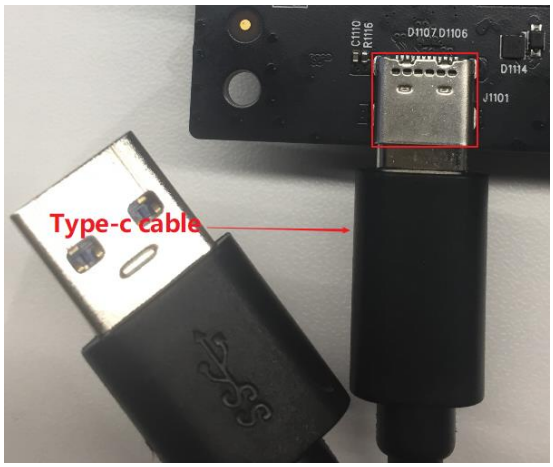

Figure 10: USB Interface Connection

3.5. Audio Interface (J0802/J0901/J0801)

Quectel 5G EVB provides one digital audio codec board interface (I2S) J0802 and two analog audio interfaces J0901 and J0801.

3.5.1. Digital Audio Codec Board Connector (J0802)

The 5G EVB supports two different kinds of external digital audio codec TE-As named ALC5616 and TLV320AIC3104. The codec circuit is assembled on an independent small board which can be interconnected with the EVB by the BTB connector J0802.

Codecs can be selected according to specific application demands, the following figures show the connection between digital audio codec TE-A and the EVB.

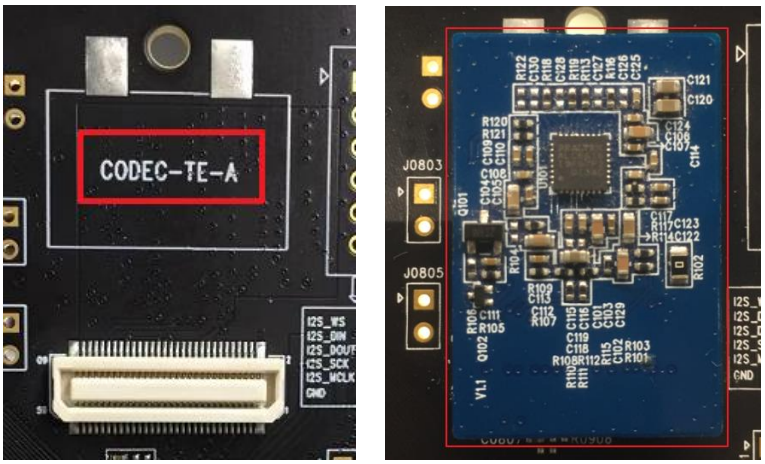

Figure 11: Connection Between Codec TE-A and the EVB

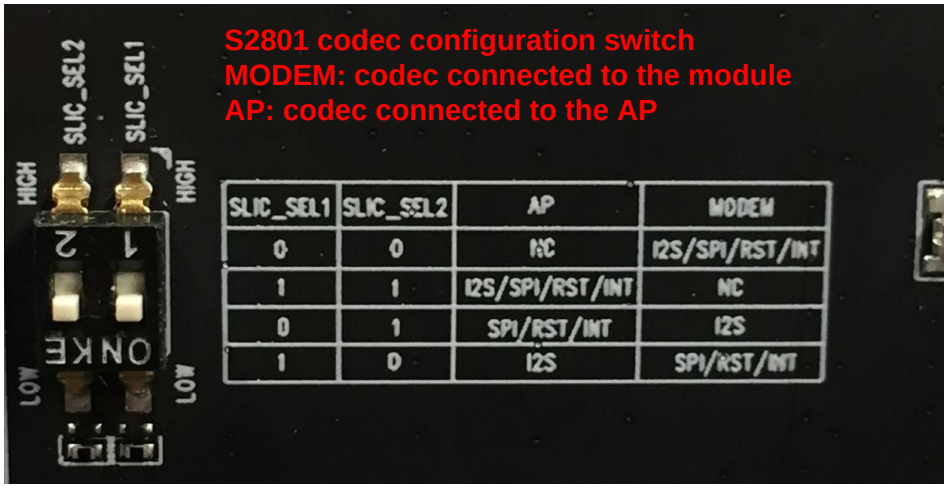

Figure 12: S2801 Switch

Table 6: Codec TE-A Configuration Switch

SLIC_SEL1	SLIC_SEL2	AP	MODEM
Low	Low	NC	I2S/SPI/RST/INT
High	High	I2S/SPI/RST/INT	NC
Low	High	SPI/RST/INT	I2S
High	Low	I2S	SPI/RST/INT

3.5.2. Analog Audio Interfaces (J0801/J0901)

3.5.2.1. Loudspeaker Interface (J0801)

Audio interface J0801 is designed for loudspeakers and the following figure shows a reference design of loudspeaker with an external audio amplifier.

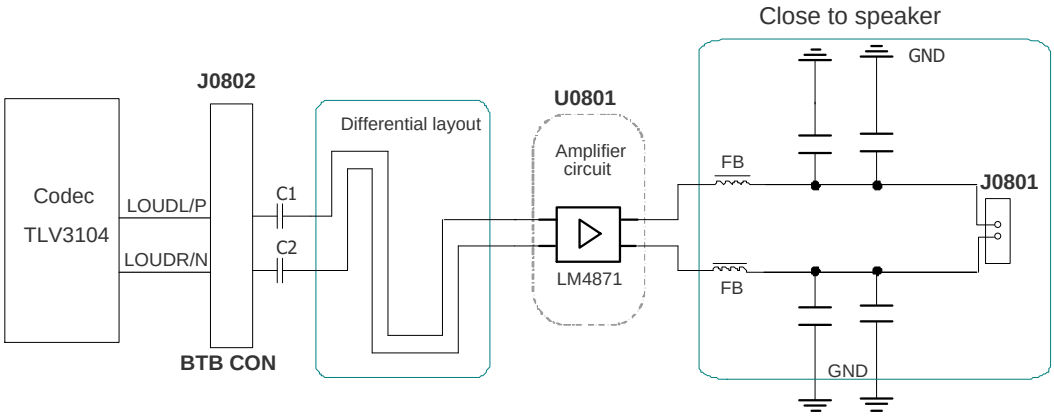

Figure 13: Reference Circuit Design for Loudspeaker Interface J0801

3.5.2.2. Earphone Interface (J0901)

Audio interface J0901 is designed for earphone. A reference circuit design is shown by the following figure.

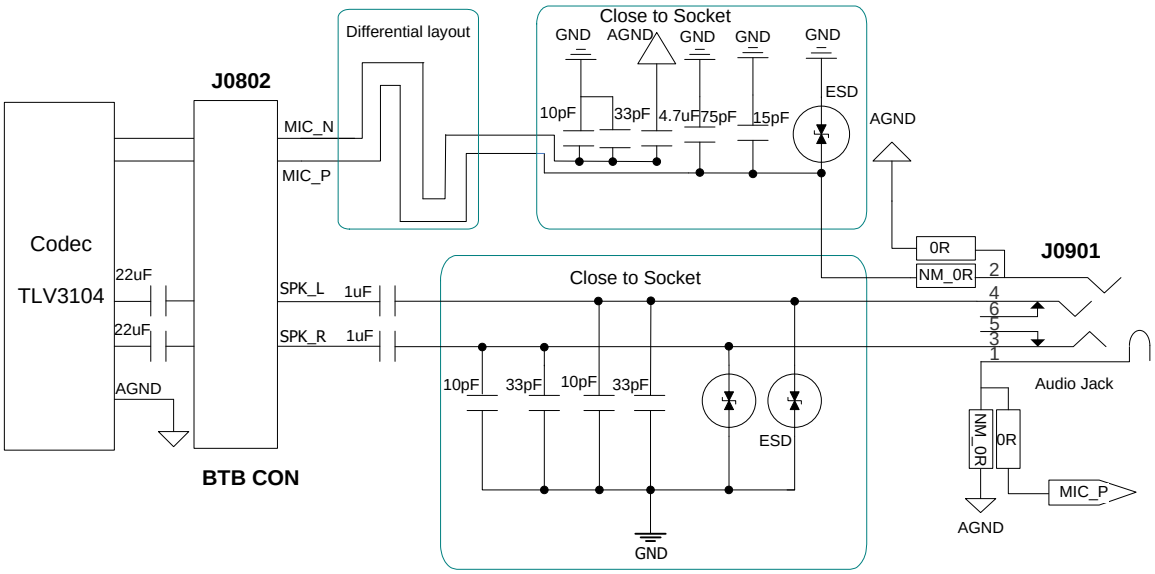

Figure 14: Reference Circuit Design for Earphone Interface J0901

The figure and table below illustrates the pin assignment and pin definition of earphone connector J0901.

Figure 15: Pin Assignment of J0901

Table 7: Pin Definition of J0901

Pin No.	Pin Name	Description
1	MIC	Microphone input
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 a schematic of audio plug which suits the audio jack on 5G EVB.

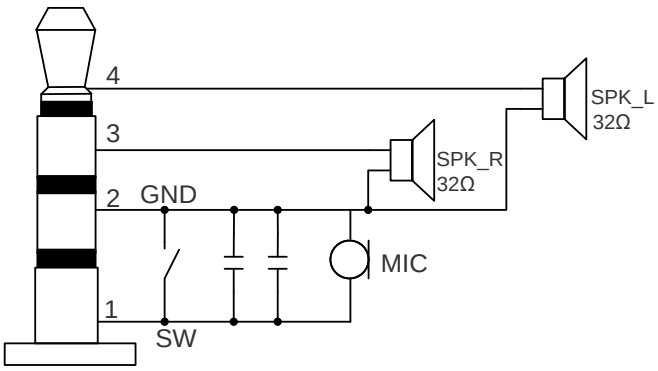

Figure 16: Schematic of Audio Plug

3.6. (U)SIM Card Interfaces (J1401/J1402)

The 5G EVB has two 8-pin push-push type (U)SIM card (1.8/2.95 V) connectors J1401 and J1402. The following figure shows a simplified connector schematic for J1401 and J1402.

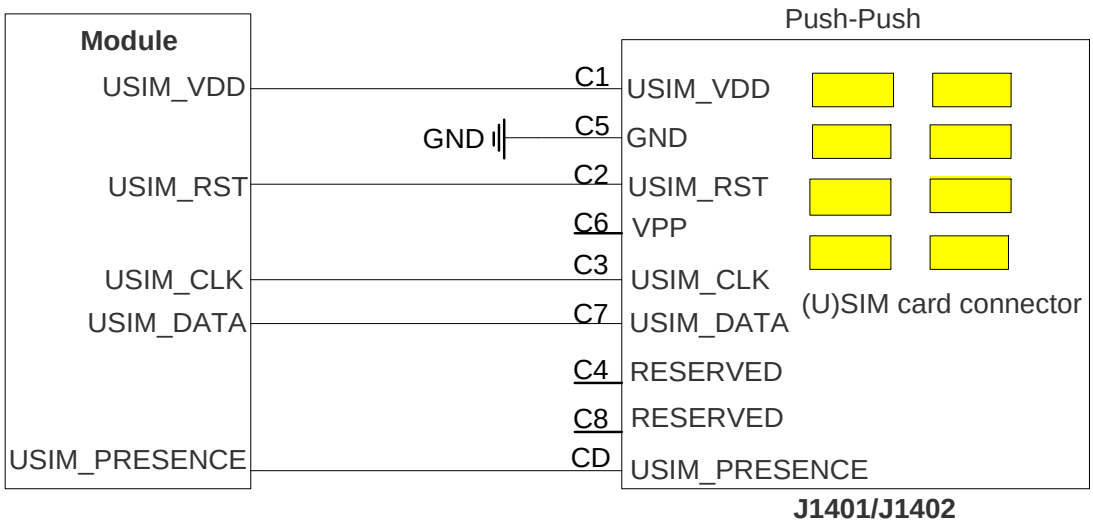

Figure 17: Simplified Connector Schematic for (U)SIM Card Connectors

The figure and table below illustrate the pin assignment and definition of (U)SIM card connector J1401. J1402 is similar to J1401.

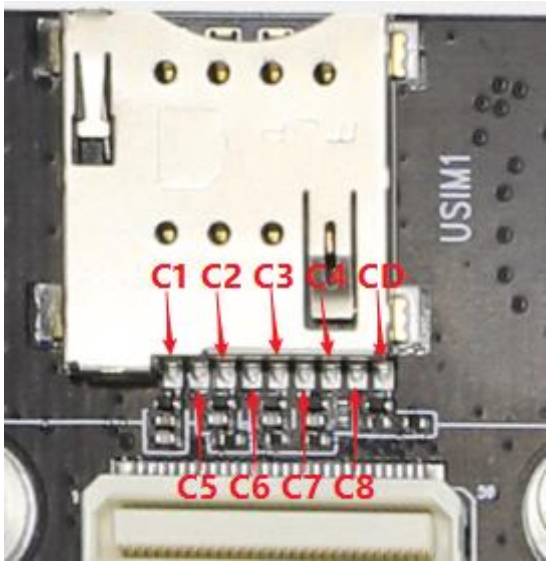

Figure 18: Pin Assignment of (U)SIM Card Connector J1401

Table 8: Pin Definition of J1401

Pin No.	Pin Name	I/O	Function
C1	USIM_VDD	PO	U(SIM) card power supply, provided by module
C2	USIM_RST	DO	U(SIM) card reset
C3	USIM_CLK	DO	U(SIM) card clock
C4	RESERVED	-	Not connected
C5	GND	-	Ground
C6	VPP	-	Not connected
C7	USIM_DATA	I/O	Data line, bi-directional
C8	RESERVED	-	Not connected
CD	USIM_PRESENCE	DI	U(SIM) card insertion detection.

3.7. SD Card Interface (J1301)

The 5G EVB provides an SDIO interface, which can be used for connecting SD card. The following figure shows the simplified interface schematic for J1301.

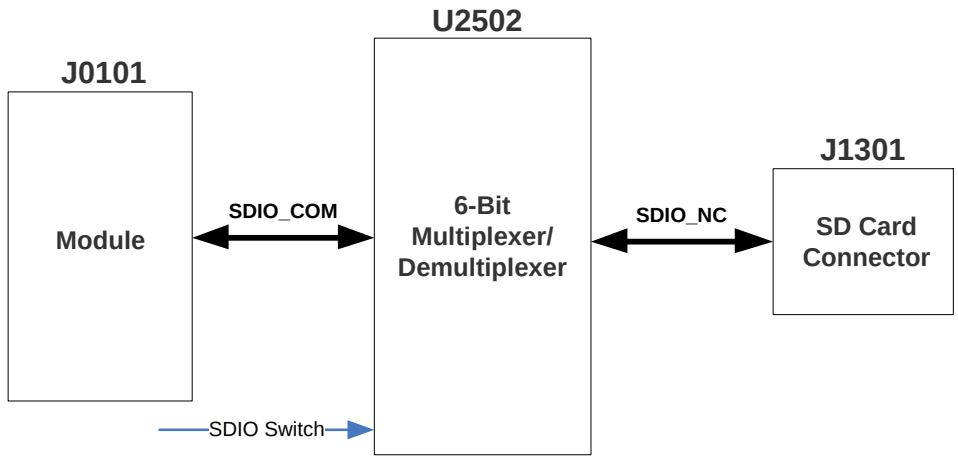

Figure 19: Simplified Interface Schematic for J1301

If SD card function is intended to be used, please switch the SDIO Switch to low level illustrated in the figure and table below, a standard SD card can be inserted into J1301. Which supports micro SD card

of maximal 32 GB. With the SD card interface, customers can easily enhance the memory capacity of modules.

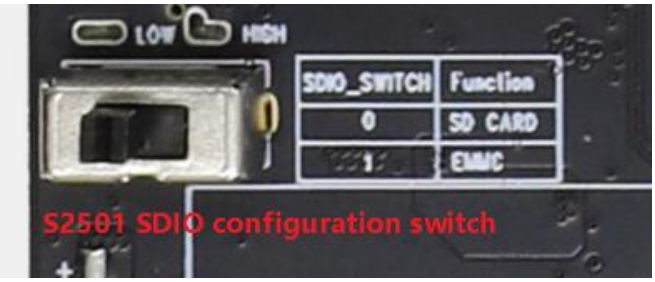

Figure 20: S2501 Switch

Table 9: SDIO Switch Function

SDIO Switch	Function
Low	Enable SD card function
High	Enable eMMC function [1)]

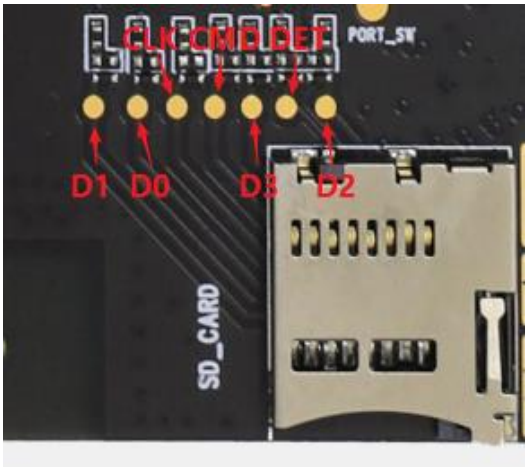

Figure 21: Pin Assignment of SD Card Connector J1301

NOTE

[1)] eMMC is not supported for RG50xQ series and EG512R-EA.

3.8. UART Interfaces (J2002/J2003)

The 5G EVB supports two UART interfaces: main UART J2002 and debug UART J2003, supporting baud rate of 115200 bps by default.

The main UART interface is used for communication between the module and the host application.

The debug UART interface is used for Linux console and log output.

The following figure shows a block diagram of UART interfaces of the EVB.

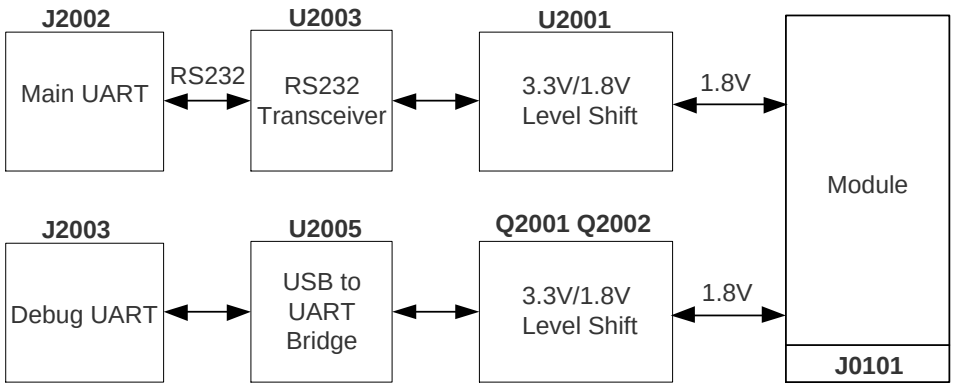

Figure 22: UART Block Diagram

3.9. PCIe to USB Interface (J1601)

The 5G EVB reserves a PCIe 3.0 signal over USB interface for developers' testing, and this function is not enabled by default. Please refer to the following block diagram.

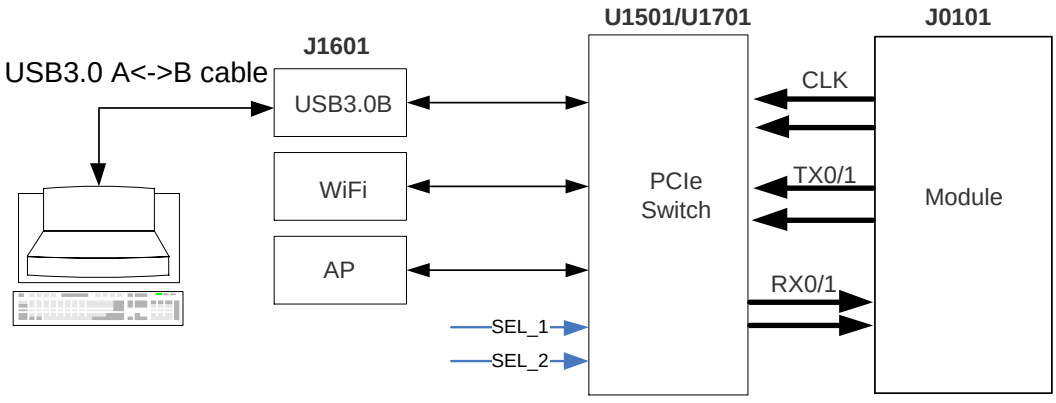

Figure 23: PCIe Block Diagram

Figure 24: S1501 Switch

Table 10: PCIe Connection Truth Table

PCIE_SEL1	PCIE_SEL2	Function
0	1	Module → PC
1	0	Module → AP
1	1	Module → Wi-Fi

3.10. Switches and Buttons

The 5G EVB includes six switches (S0301, S1501, S1801, S1802, S2501 and S2801) and three buttons (S0201, S0202 and S0203), as shown in the following figures.

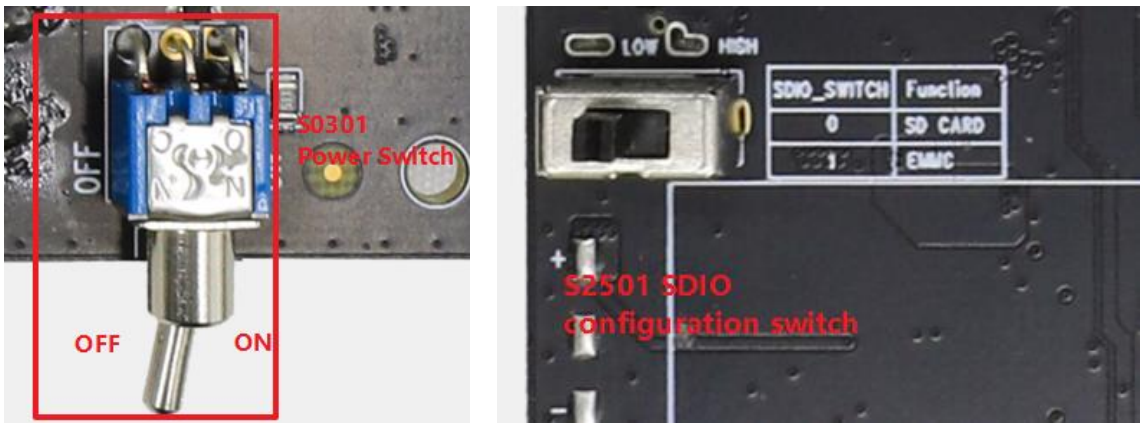

Figure 25: Power Switch and S2501 Switch

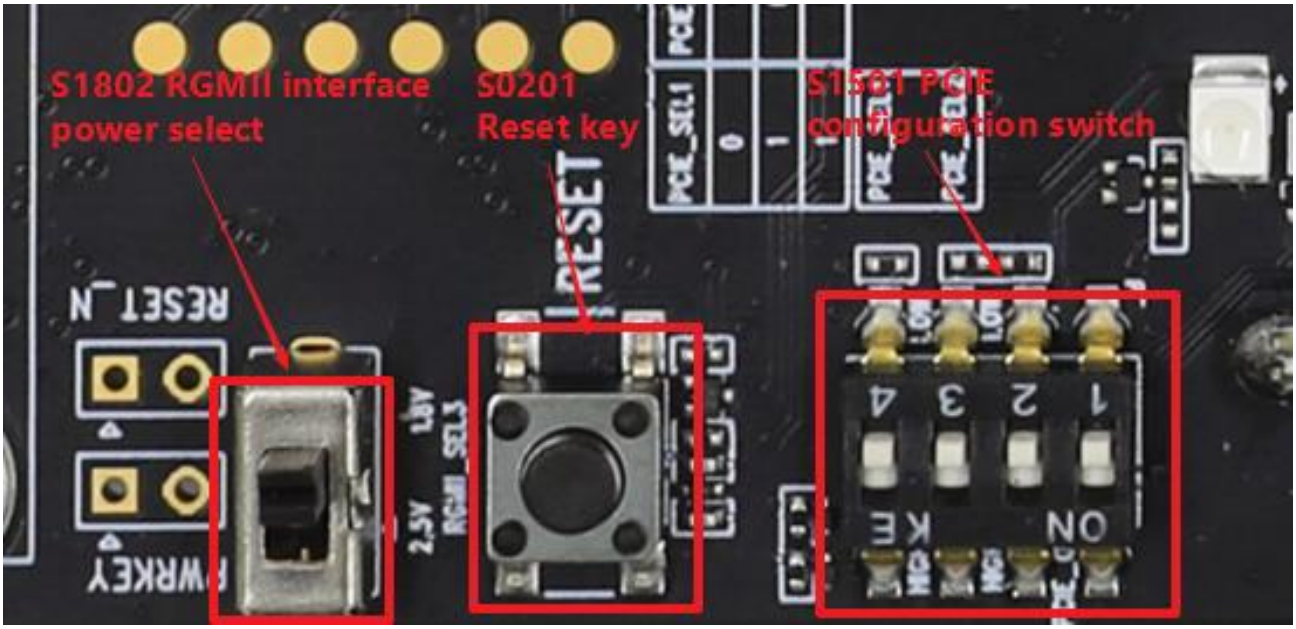

Figure 26: S1802/S1501 Switch and S0201 Button

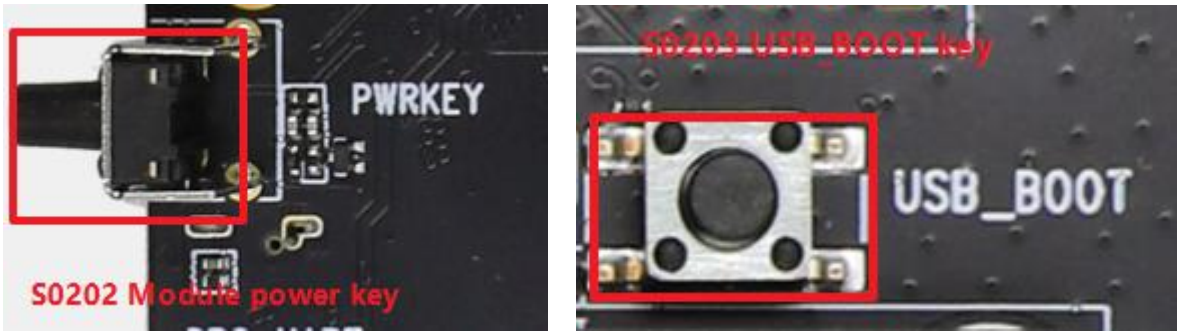

Figure 27: S0202/S0203 Button

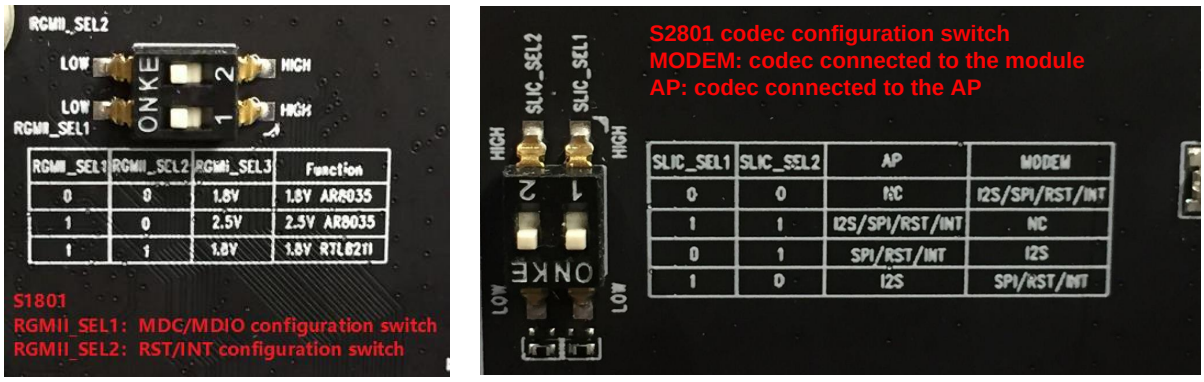

Figure 28: S1801/S2801 Switch

Table 11: Description of Switches and Buttons

Interface	Reference Designator	Description
Power Switch	S0301	VBAT ON/OFF control
PWRKEY	S0202	Power key used to turn on/off the module.
PCIe Configuration	S1501	PCIe configuration switch. Refer to ***Chapter 3.9***
RESET	S0201	Reset button used to reset the module.
USB_BOOT	S0203	Emergency download control.
RGMII Configuration	S1801, S1802	RGMII configuration switch. Refer to ***Chapter 3.3***
SDIO Configuration	S2501	SDIO configuration switch. Refer to ***Chapter 3.7***
Codec Configuration	S2801	Codec configuration switch. Refer to ***Chapter 3.5***

3.11. Status Indicators (D0201/D0202/D0203/D0204/D0205)

There are five status indication LEDs on the EVB. The following figure manifests the positions of these LED indicators.

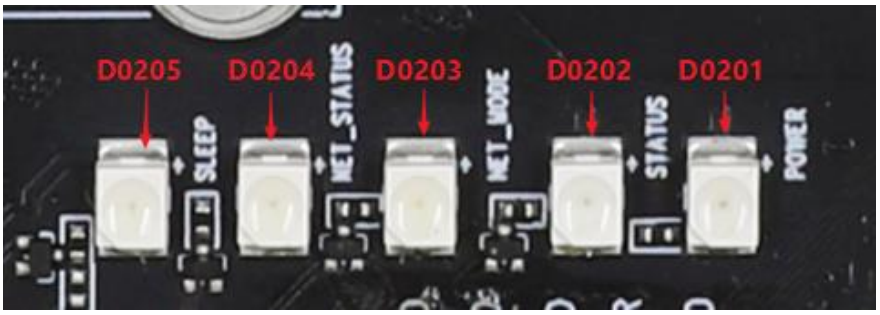

Figure 29: Status Indicator

Table 12: Description of Status Indication LEDs

Reference Designator	Description
D0201	Indicates whether the power supply for module is ready. On: VBAT ON Off: VBAT OFF

D0202	Indicates the operation status of the module. On: the module is powered on Off: the module is powered off
D0203	Indicate the module's NET_MODE status.
D0204	Indicate the module's NET_STATUS status.
D0205	Indicate the module's SLEEP status.

3.12. Wi-Fi Interfaces (J0701/J0702)

The Wi-Fi TE-A interface is designed to accommodate the TE-A of Wi-Fi modules (paired with FG50V). The TE-A is connected to the EVB via BTB connectors J0701 and J0702. The interface allows customers to test the Wi-Fi function of the module or to develop applications with Wi-Fi function easily.

The following two figures show the connection between FG50V-TE-A and EVB.

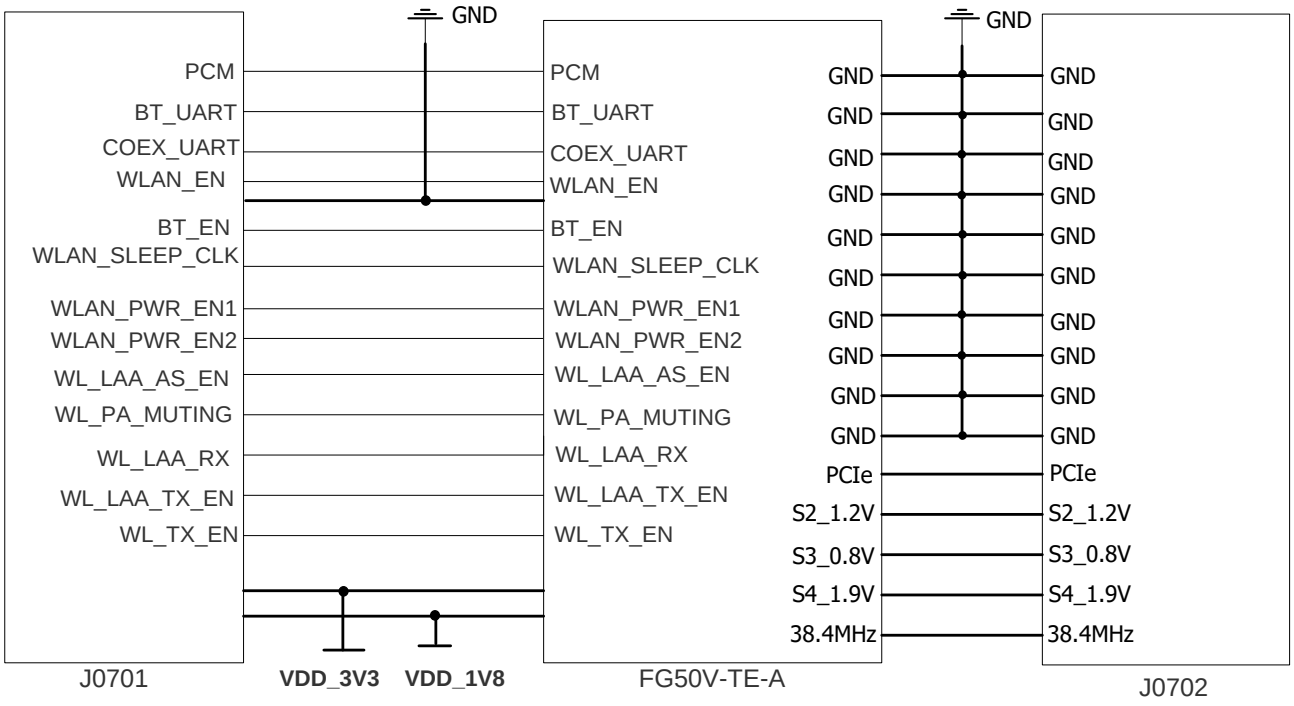

Figure 30: Simplified FG50V-TE-A Interface Schematic

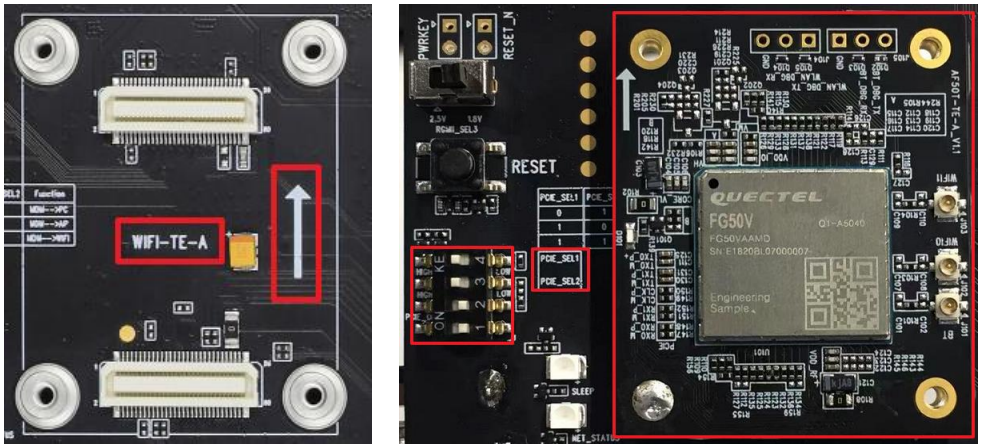

Figure 31: Connection Between FG50V-TE-A and the EVB

3.13. Antenna Interfaces

The 5G EVB includes twelve antenna interfaces. The following figure shows the assembly of these antenna interfaces.

Figure 32: Antenna Interfaces

4 EVB Operation Procedures

This chapter introduces how to use the 5G EVB for testing and evaluation of Quectel modules.

4.1. Turn on the Module

1. Connect the module TE-A to the EVB via connectors J0101 and J0102.
2. Insert a (U)SIM card into the USIM1 card connector on EVB.
3. Use RF cable to connect the module TE-A to the EVB, and connect antennas to the EVB.
4. Connect the EVB to a 5 V/ 3 A power, then switch S0301 to ON. Then D0201 (ON/OFF indicator of the module's power supply) will light up.
5. Press the S0202 (PWRKEY) for at least 500ms, then the module will be powered on and D0202 (operation indicator of the module) will light up.

4.2. Communication via USB

1. Power on the module according to the procedure in ***Chapter 4.1***.
2. Connect the EVB and a PC with USB cable through USB Type-C interface, and then run the driver disk on the PC to install the USB driver. For details about USB driver installation, please refer to ***document [1]***. The USB port numbers can be viewed in Device Manager of the PC when the USB driver is installed, as shown below.

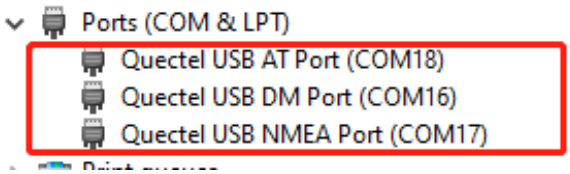

Figure 33: USB Ports

3. Install and then use QCOM provided by Quectel to realize the communication between the module and the PC.

The following figure shows the COM Port Setting of QCOM: select the correct "**COM Port**" (USB AT Port, which is shown in figure above) and set correct "**Baudrate**" (e.g. 115200 bps). For more details about QCOM usage and configuration, please refer to ***document [2]***.

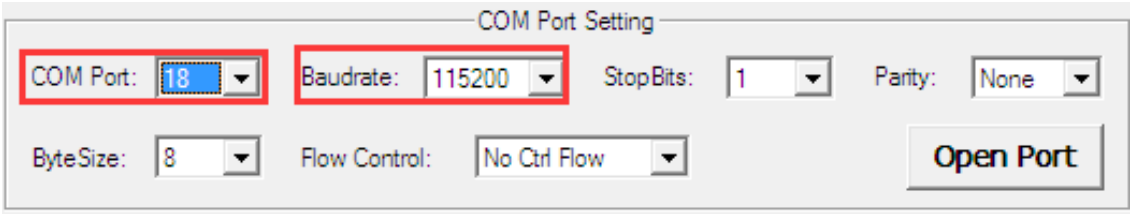

Figure 34: COM Port Setting Field on QCOM (USB AT Port Connection)

4.3. Firmware Upgrade

Firmware of the module is upgraded via USB port by default, and there are two methods for the upgrade: emergency download and normal download. Please refer to the following procedures to upgrade firmware through the EVB.

4.3.1. Emergency Download

1. Install the firmware upgrade tool QFlash on PC.
2. Connect the EVB and the PC through USB Type-C cable.
3. Press the USB_BOOT button (S0203).
4. Insert the DC power adapter and power on the module.
5. Upgrade the firmware with QFlash. Please refer to *Quectel_QFlash_User_Guide* for details about the use of QFlash.

4.3.2. Normal Download

1. Turn on the module according to the procedure in ***Chapter 4.1***.

2. Wait for the USB port to be found in Device Manage of the PC.

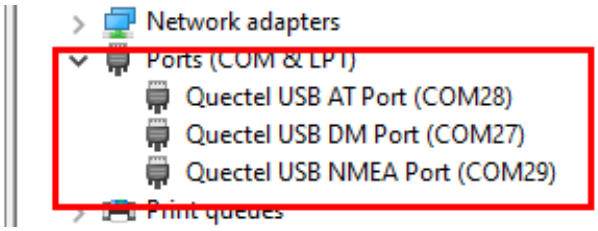

Figure 35: USB Port in PC Device Manage

3. Open QFlash and upgrade the firmware. Please refer to *Quctel_QFlash_User_Guide* for the detailed procedure.

4.4. Reset the Module

The reset option is only used in case of abnormality. For example, the software fails to respond for more than 5 seconds due to some serious problems.

Long press the button S0201 (RESET) for more than 8 seconds, and then release it to reset the module.

4.5. Turn off the Module

There are two methods to turn off the module.

- Turn off the module with AT command **AT+QPOWD**. This is a safer method. The module will log off from the network and save data before shutdown.
- Turn off the module with PWRKEY button (S0301). Long press PWRKEY for at least 800 ms, then the module will be powered off.

5 Appendix A References

Table 13: Related Documents

SN	Document Name	Remark
[1]	Quectel_LTE&5G_Windows_USB_Driver_ Installation _Guide	The installation guide of Windows USB drivers for Quectel LTE and 5G modules
[2]	Quectel_QCOM_User_Guide	The user guide of QCOM
[3]	Quectel_QFlash_User_Guide	The user guide of QFlash

Table 14: Terms and Abbreviations

Abbreviation	Description
AGND	Analog Ground
BTB	Board to Board
COM	Cluster Communication Port
DC	Direct Current
DI	Digital Input
DO	Digital Output
eMMC	embedded Multi-Media Card
EVB	Evaluation Board
GND	Ground
GNSS	Global Navigation Satellite System
I/O	Input/Output
LED	Light Emitting Diode

MIC	Microphone
NC	Not Connected
PC	Private Computer
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PHY	Physical Layer
PO	Power Output
RF	Radio Frequency
SD	Secure Digital
SIM	Subscriber Identity Module
UART	Universal Asynchronous Receiver & Transmitter
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module