PCIe Card EVB
User Guide

LTE-A&5G Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2020-09-15	Archibald JIANG	Initial
1.1	2020-12-26	Archibald JIANG	1. Deleted the EM161R-GL in Table 1. 2. Added the switch S104 in Chapter 2.1, Chapter 2.2 and Chapter 4.6. 3. Updated Figures 1, 4, 6, 8, 15, 16, 19, and 31.

Contents

Table Index

Figure Index

1 Introduction

This document introduces Quectel evaluation board for PCIe cards, the assistant tool for engineers to develop and test Quectel modules, and how to use it.

Table 1: Applicable Modules

Module Series	Applicable Modules
LTE-Advanced	EM120R-GL/ EM121R-GL/ EM160R-GL
5G	RM500Q Series/ RM510Q-GL

NOTE

Quectel modules listed above may include multiple models. Please refer to the corresponding module Specifications for more specific information.

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 Quectel modules. 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 emergent 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 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 mobile phone or other cellular terminals. Areas with potentially explosive atmospheres include fueling 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.

2 General Overview

Quectel supplies PCIe Card EVB to engineers to help with the application development. This chapter offers an overview of this EVB.

2.1. Key Features

The following table describes the detailed features of PCIe Card EVB.

Table 2: Key Features of PCIe Card EVB

Features	Description
M.2 Interface	Standard PCI Express M.2 interface
(U)SIM Interfaces	Support (U)SIM card insertion detection Support (U)SIM card: 3.0/1.8 V
UART Interface	UART interface for debugging purpose
USB Interface	USB Type-B (USB 2.0 and USB 3.0)
Status Indication	2 LEDs available for signal indication
Switches and Button	Switches: Power Switch (S103), PWRKEY (S101), PCIe/USB Switch* (S104) Button: RESET (S102)
Physical Characteristics	Size: 101.8 mm × 112.0 mm

NOTE

"*" means under development. Currently the PCIe/USB Switch does not work no matter to which side the switch is switched.

2.2. Interface Overview

Figure 1: Overview of PCIe Card EVB Interface

Table 3: Component Functions of PCIe Card EVB

Functions	Reference No.	Description
Power Supply [1]	J801	The power jack on the EVB Typical supply voltage: +5 V
	J401	USB Type-B interface Typical supply voltage: +5 V

	J803	External power supply Typical supply voltage: +3.7 V
	J501	PCIe card interface Typical supply voltage: +3.3 V
Power Switch	S103	VCC ON/OFF control
PWRKEY	S101	Power key Turn on/off the module
RESET	S102	Reset button (push button) Reset the module
PCIe/USB Switch*	S104	PCIe/USB interface Switch
USB Type-B	J401	USB device interface Supply power for the EVB
(U)SIM1	J301	(U)SIM card connector 1
(U)SIM2	J302	(U)SIM card connector 2
UART	J601	Debug UART port
Status Indicators	D101	Indicate power ON/OFF status of the EVB
	D102	Indicate whether RF function is enabled or not
Connectors	J101	M.2 standard connector for the module
	J501	PCIe Card connector for the EVB
Test Points	J102, J103, J602, J603, J802	Test pins

NOTES

1. [1] The power supply information in the table above is for the module. Refer to **Chapter 4.1** for detailed information about the power supply,
2. "*" means under development. Currently the PCIe/USB Switch does not work no matter to which side the switch is switched.
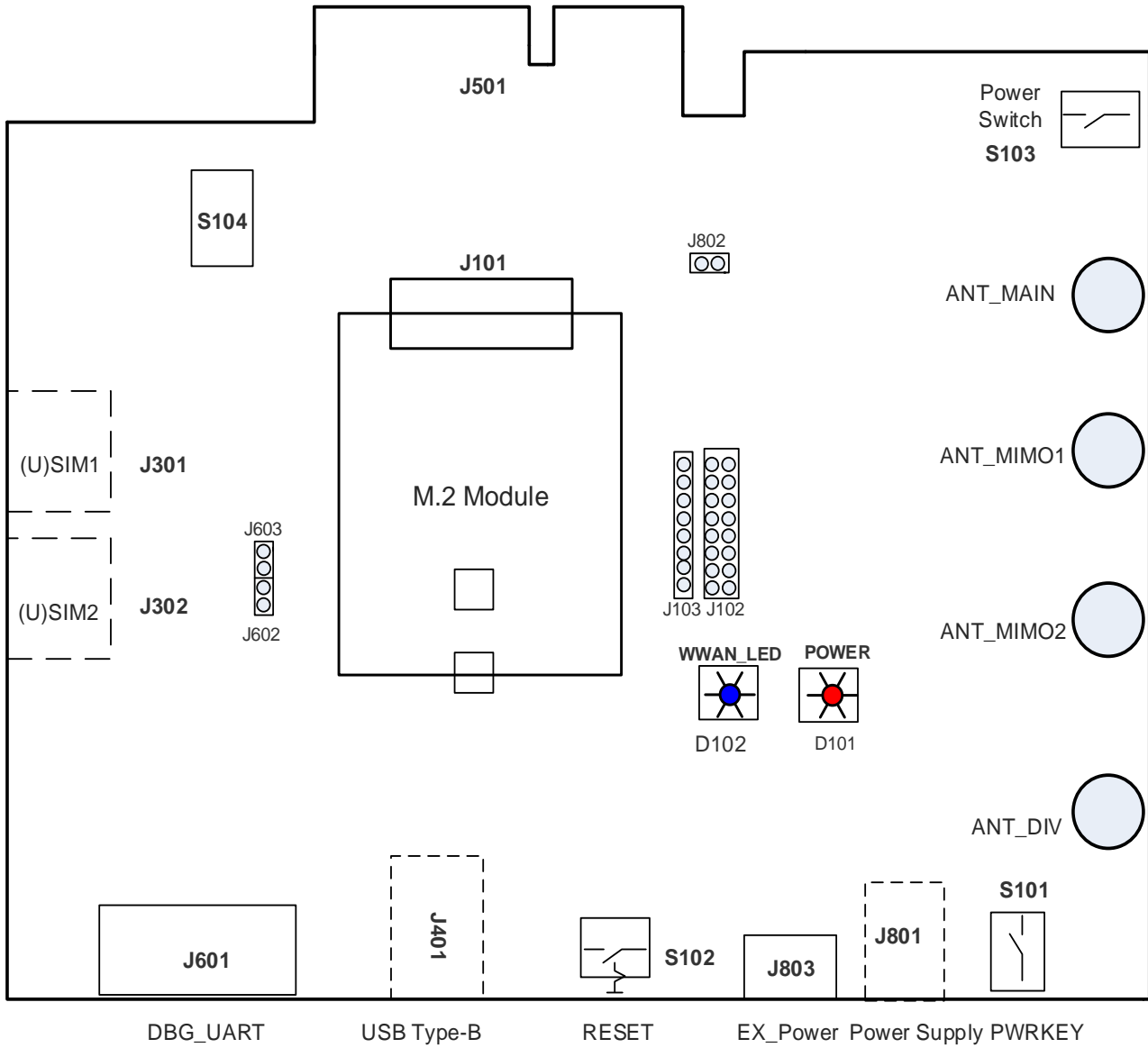
2.3. Top View of PCIe Card EVB

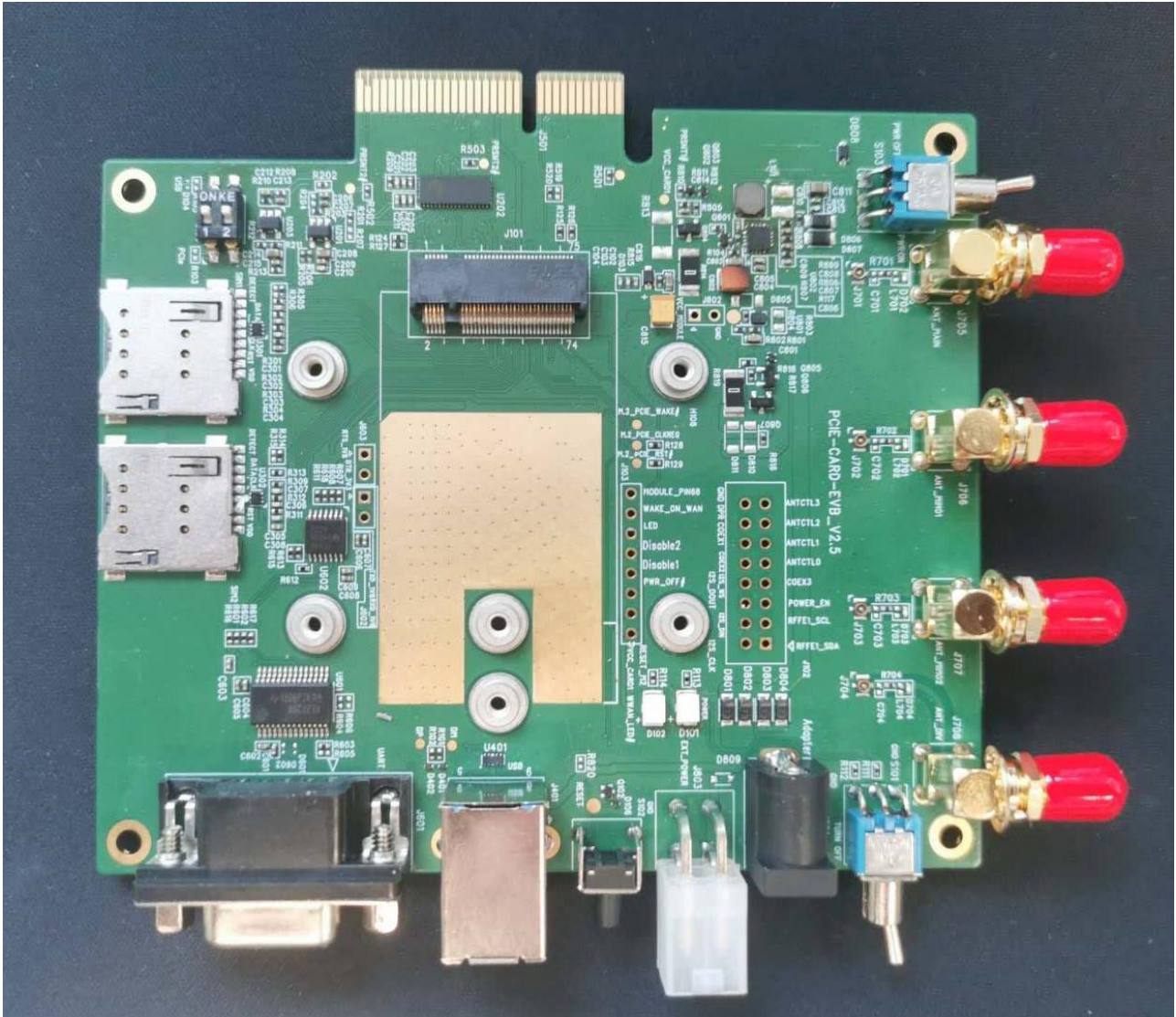The top view of the PCIe Card EVB is shown below.

Figure 2: PCIe Card EVB Top View

2.4. EVB Kit Accessories

All accessories of the PCIe Card EVB kit are listed as below.

Figure 3: EVB Kit Accessories

Table 4: Accessories List

Items	Description	Quantity
Cables	USB to UART converter cable	1
	USB Type-B cable	1
	RF cables	4
Antennas	Antennas	4

Driver disk	- USB 2.0 to RS-232 driver - USB driver - QUD driver and UDE driver - Related tools for modules	1
Silicone soft pad	Thermal conductive gasket	1
Others	Bolts and nuts for EVB assembling	4 + 4 for the EVB, 6 for the module and heat sink
Instruction sheet	One-sheet instruction manual for the EVB connection, details of EVB accessories, etc.	1
Heat sink	Heat sink above the module	1
Power adapter	Power adapter 5 V/ 3 A	1
Adapter plug	Adapter plug type BS	1
	Adapter plug type EU	1
	Adapter plug type US	1
	Adapter plug type CN	1

NOTE

The four antennas are identical and each of them can be used for main, diversity and GNSS reception.

3 EVB and Accessories Assembly

The following figure shows the assembly of the EVB and its accessories.

Figure 4: PCIe Card EVB and Accessories Assembly

4 Interface Application

This chapter describes the following hardware interfaces, as well as the switches, button, status indicators and test points, of the PCIe Card EVB:

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

4.1. Power Supply (J801/J401/J803/J501)

The PCIe Card EVB can be powered by an external power adapter through the power jack (J801) or USB Type-B receptacle (J401) on the EVB. The power adapter is designed to be connected to a step-down converter that converts the supplied voltage into proper voltage (VCC) for the module.

The power can also be supplied by inserting the EVB J501 into PCIe Card slot of the desktop computer.

The module can be directly powered by an external power source through connecting with the power jack (J803), and this type of power supply is generally used for current consumption test.

The following two figures show the simplified power supply block diagram and the power interface of Quectel PCIe Card EVB.
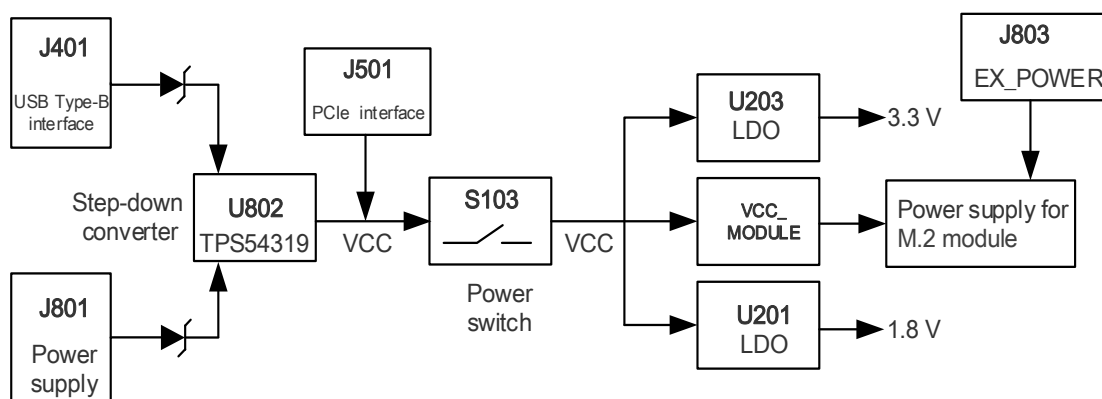

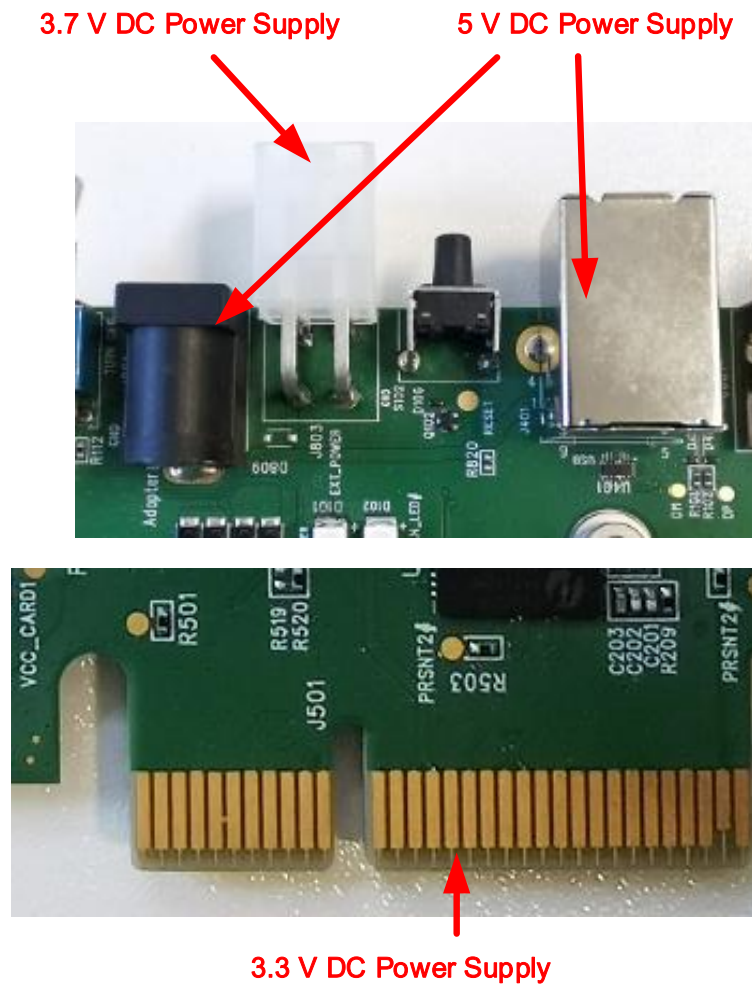**Figure 5: EVB Power Supply Block Diagram**

3.7 V DC Power Supply   5 V DC Power Supply

3.3 V DC Power Supply

Figure 6: EVB Power Supply Interface

When using the power jack for power supply, the power plug design of the adapter is shown as below.
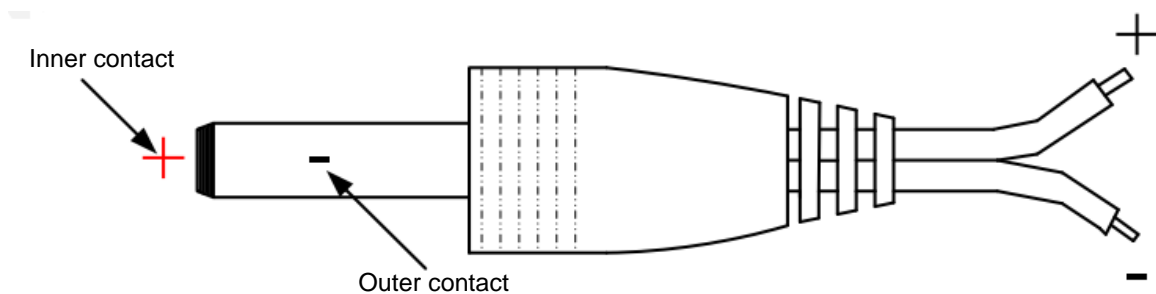

Inner contact

Outer contact

Figure 7: Power Plug Design

4.2. M.2 Interface (J101)

The M.2 interface is designed to accommodate the modules. The module is connected to the EVB via BTB connector J101. This interface allows customers to easily test functionalities of the module or develop applications based on the module.

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

Figure 8: Connection between the Module and the EVB

4.3. USB Interface (J401)

The PCIe Card EVB provides a USB Type-B receptacle J401 for the connection with a host device. The VBUS lines can be used for USB connection detection and EVB power supply.

Figure 9: Pin Assignment of J401
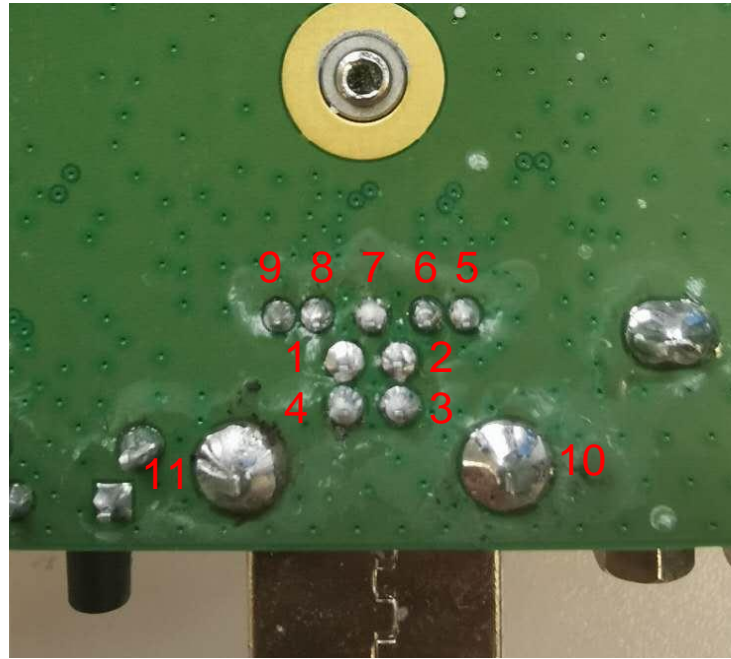
Table 5: Pin Assignment of J401

Pin No.	1	2	3	4	5	6	7	8	9	10	11
Pin Name	VBUS	USB_DM	USB_DP	GND	TX-	TX+	GND	RX-	RX+	GND	GND

The following figure shows the connection of the module and the USB Type-B receptacle.
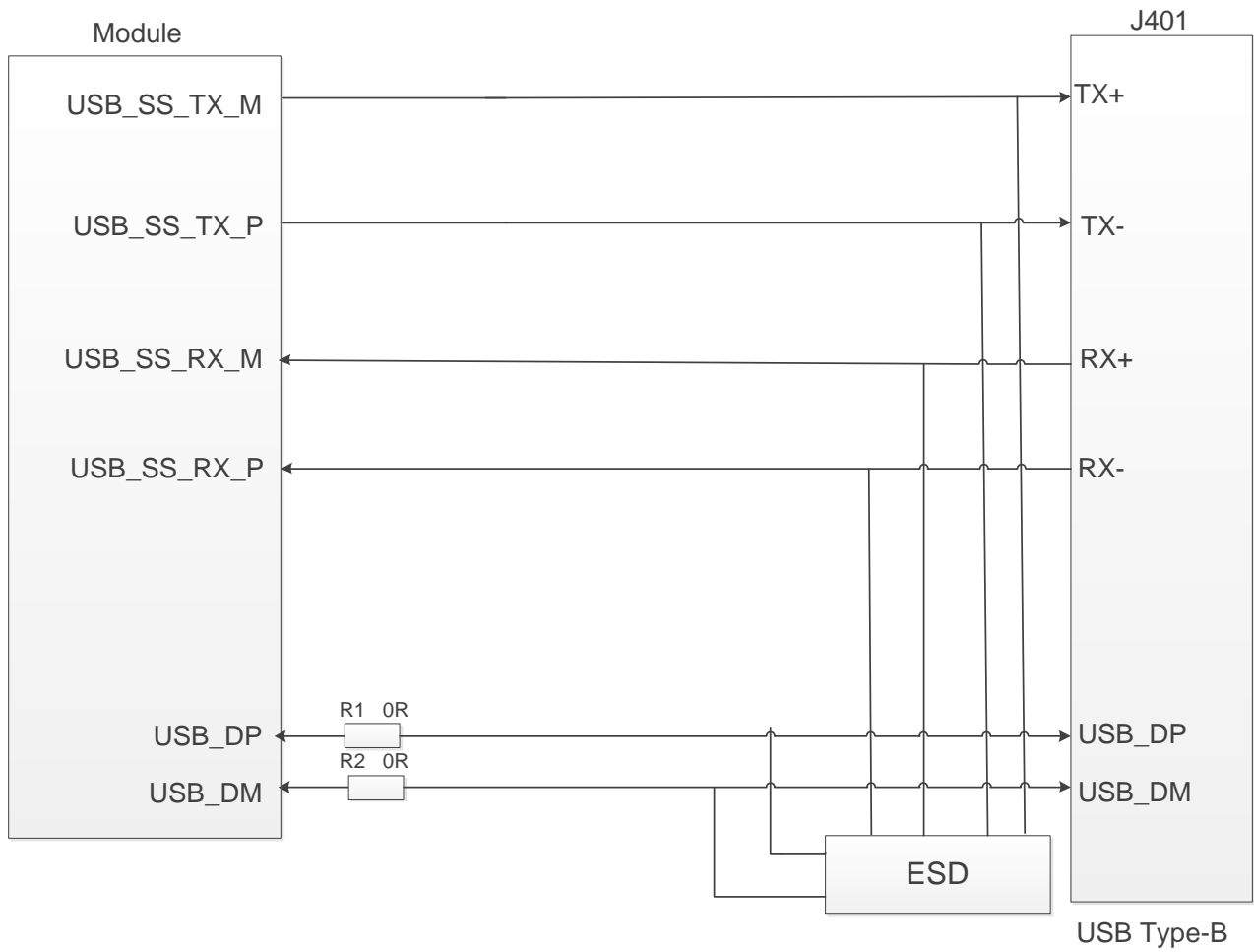

Figure 10: Diagram for Module and USB Type-B Receptacle Connection

4.4. (U)SIM Interfaces (J301/J302)

The PCIe Card EVB has two 8-pin push-push type Micro (U)SIM card (3.0/1.8 V) connectors J301 and J302. Both of them can be used for the modules. The following figure shows the pin assignment and definition of J301 and J302.
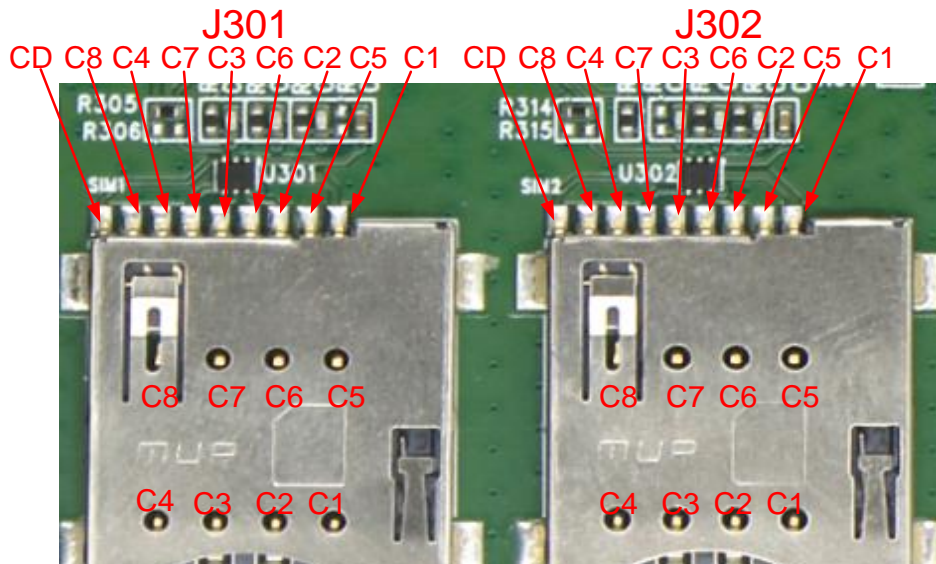

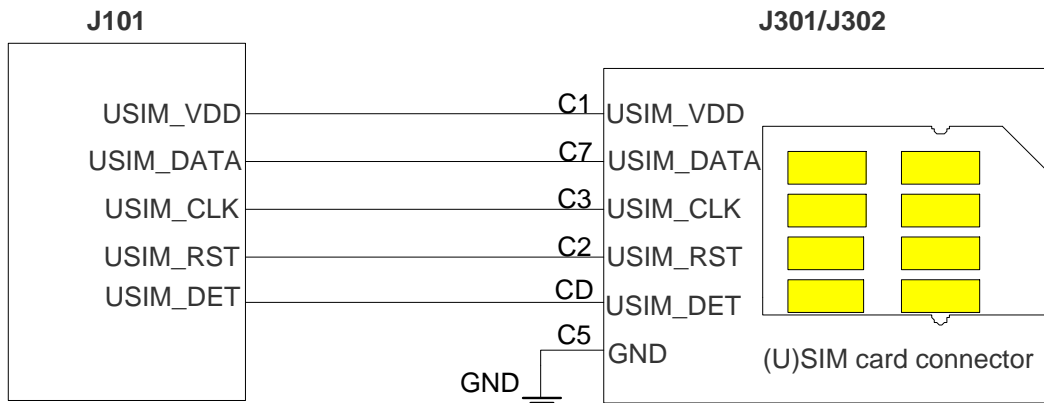**Figure 11: Pin Assignment of J301 and J302**

Figure 12: Simplified Interface Schematic for (U)SIM Card Connector

Table 6: Pin Definition of J301/302

Pin No.	Pin Name	I/O	Description
C1	USIM_VDD	PO	(U)SIM card power supply, provided by PCIe Card EVB

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	IO	(U)SIM card data
C8	RESERVED	/	Not connected
CD	USIM_DET	DI	(U)SIM card insertion detection

4.5. UART Interface (J601)

The PCIe Card EVB offers a UART interface: debug UART port J601. This UART interface supports 115200 bps baud rate by default and can be used for Linux console and log output.

The following figure shows the block diagram of UART on PCIe Card EVB.
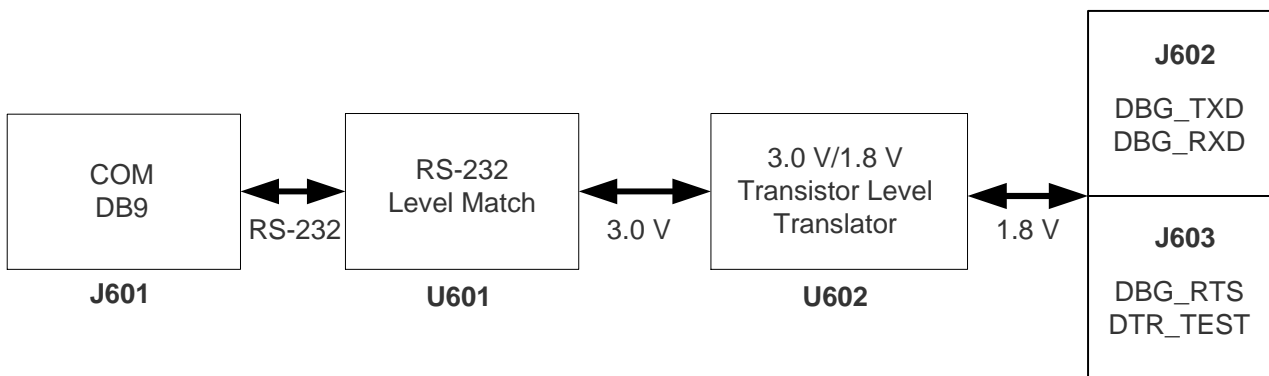

Figure 13: UART Block Diagram

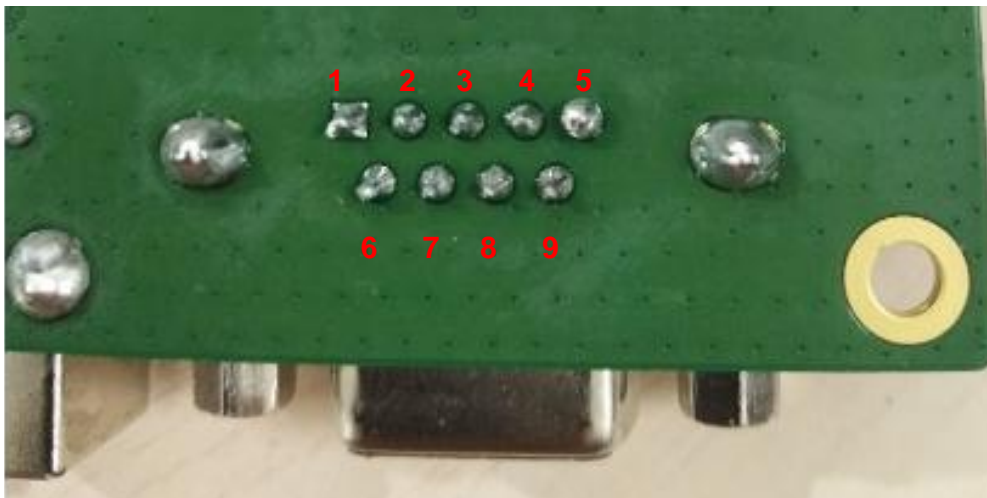The figure and table below illustrate the pin assignment and pin definition of J601.

Figure 14: Pin Assignment of J601

Table 7: Pin Definition of J601

Pin No.	Pin Name	I/O	Description
1	NC	/	Not connected
2	DBG_TXD	DO	Debug UART transmit
3	DBG_RXD	DI	Debug UART receive
4	DTR_TEST	DI	Data terminal ready
5	GND	/	GND
6	NC	/	Not connected
7	DBG_RTS	DI	Request to send
8	NC	/	Not connected
9	NC	/	Not connected

4.6. Switches and Button (S101/S102/S103/S104*)

The PCIe Card EVB includes two power switches (S101 and S103), a reset button (S102), and a PCIe/USB switch (S104)*, as shown in the following figures.
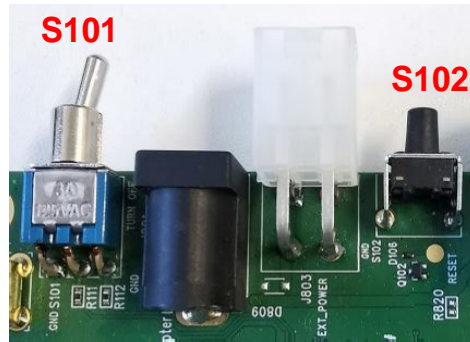

Figure 15: Switch S101 and Button S102

Figure 16: Switch S103

Table 8: Description of Switches and Button

Reference No.	Function	Description
S101	PWRKEY	Used to turn on/off the module
S102	RESET	Used to reset the module
S103	Power Switch	Power ON/OFF control
S104*	PCIe/USB Switch	PCIe/USB interface Switch

NOTE

"*" means under development. Currently the PCIe/USB Switch does not work no matter to which side the switch is switched.

4.7. Status Indicators (D101/D102)

The PCIe Card EVB provides two status indication LEDs (D101 and D102). The following figure shows the location of these LED indicators.
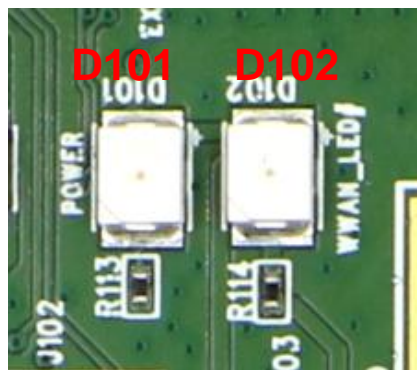

Figure 17: Status Indicators

Table 9: Description of Status Indicators

Reference No.	Description
D101	Power ON/OFF indicator indicating the power supply status of the EVB Light on: the module is powered on; Light off: the power is powered off.
D102	RF status indicator for the module Light on: RF function is enabled; Light off: RF function is disabled.

4.8. Test Points (J102/J103/J602/J603/J802)

The PCIe Card EVB provides test points which help customers obtain the corresponding waveforms of some signals. The following figures show the test points of J102, J103, J602, J603 and J802.
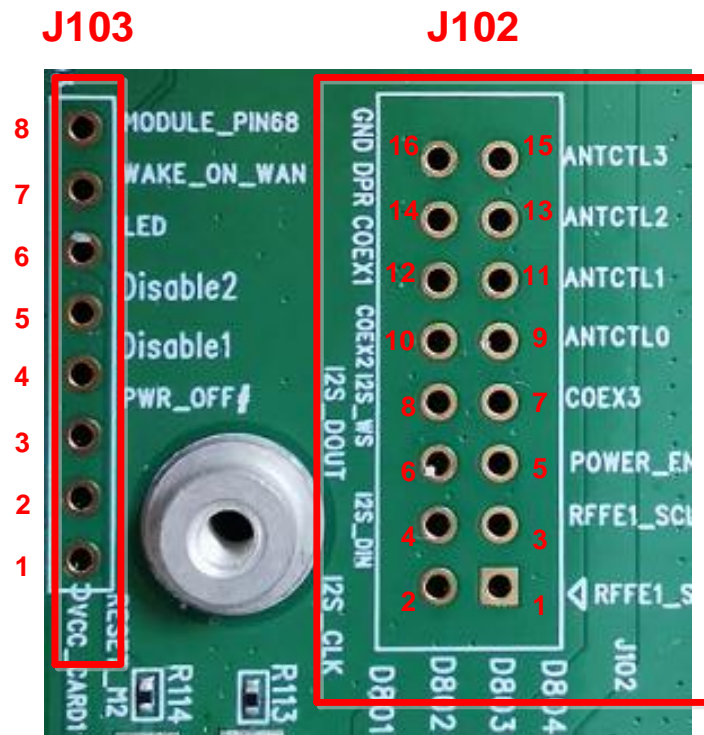
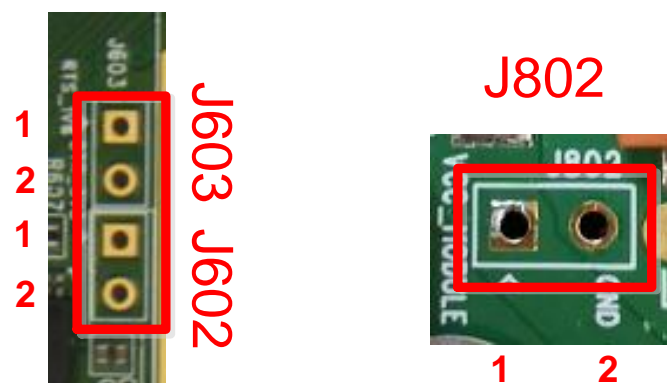

Figure 18: Test Points of J102 and J103

Figure 19: Test Points of J602 J603 and J802

Table 10: Pin Definition of J102, J103, J602, J603 and J802

J102			27 / 38
Pin No.	Pin Name	Module Pin No.	Description
1	RFFE1_SDA	58	RFFE data
2	I2S_CLK	20	Connected directly to I2S_CLK of the module
3	RFFE1_SCL	56	RFFE clock
4	I2S_DIN	22	Connected directly to I2S_IN of the module
5	POWER_EN	NA	VCC enable pin
6	I2S_DOUT	24	Connected directly to I2S_DOUT of the module
7	COEX3	60	COEX3
8	I2S_WS	28	Connected directly to I2S_WS of the module
9	ANTCTL0	59	Antenna tuner control
10	COEX2	62	COEX UART transmit
11	ANTCTL1	61	Antenna tuner control
12	COEX1	64	COEX UART receive
13	ANTCTL2	63	Antenna tuner control
14	DPR	25	Dynamic power reduction
15	ANTCTL3	65	Antenna tuner control
16	GND	3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73, 76, 79	Ground
J103			
Pin No.	Pin Name	Module Pin No.	Description
1	VCC_CARD	NA	EVB power supply
2	RESET	NA	Module reset control
3	PWR_OFF#	6	Turn on/off the module
4	DISABLE1	8	Airplane mode control
5	DISABLE2	26	GNSS enable control

6	LED	10	WWAN status indicators test point
7	WAKE_ON_WAN	23	Wake up the host
8	MODULE_PIN68	68	Module pin 68

J602			
Pin No.	**Pin Name**	**Module Pin No.**	**Description**
1	TXD_1V8	NA	TXD_1V8
2	RXD_1V8	NA	RXD_1V8

J603			
Pin No.	**Pin Name**	**Module Pin No.**	**Description**
1	RTS_1V8	NA	Connected directly to the voltage translator
2	DTR_3V3	NA	Data terminal ready

J802			
Pin No.	**Pin Name**	**Module Pin No.**	**Description**
1	VCC_MODULE	2, 4, 7, 72, 74	Module power supply
2	GND	3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73, 76, 79	Ground

5 Operation Procedures Illustration

This chapter introduces how to use the PCIe Card EVB for testing and evaluation of the module.

5.1. Power on the Module

1. Connect the module to the EVB. Insert the module into the BTB connector (J101) on the EVB, and then fix the module with screws.

2. Insert a (U)SIM card into the (U)SIM card connector on the EVB and connect the antennas to the module.

3. Connect the EVB to a 5.0 V power adapter, or connect the EVB to a PC by using a USB Type-B cable, or insert the EVB into the PCIe card slot of the desktop computer.

4. Switch S103 (Power Switch) to ON state, and then the D101 (Power ON/OFF indicator) will light up, which indicates that the power supply for the EVB is ready. In this case, switch S101 (PWRKEY) to ON state, the module will be powered on automatically, and D102 will light up when RF function is enabled.

The following table shows the module status indicated by D101 and D102.

Table 11: Indication of D101 and D102

Reference No.	State	Description
D101	Always ON	VCC ON
	Always OFF	VCC OFF
D102	Always ON	RF function is enabled
	Always OFF	RF function is disabled

5.2. Communication

5.2.1. Communication via USB Type-B 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-B 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 20: USB Ports

3. Install and then use the QCOM provided by Quectel to realize communication between the module and the PC. The following figure shows the settings for COM Port on QCOM: select the correct "**COM Port**" (USB AT Port which is shown in the figure above) and set the correct "**Baudrate**" (such as 115200 bps). For more details about QCOM usage and configuration, please refer to *document [2]*.
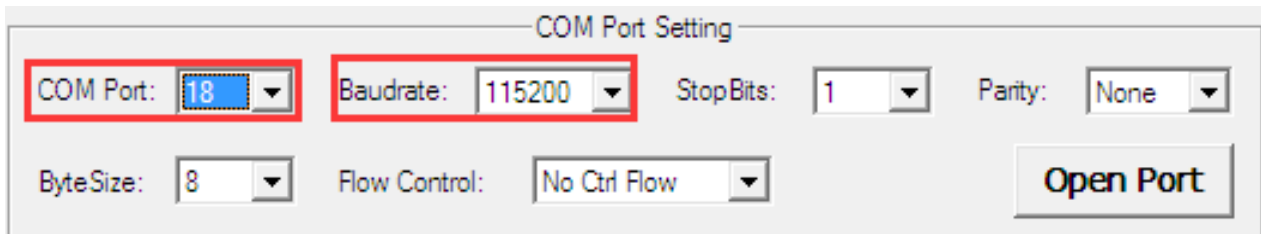
Figure 21: COM Port Setting Field on QCOM (USB AT Port Connection)

5.2.2. Communication Via PCIe Interface

1. Insert the EVB into the PCIe card slot of the desktop computer, as shown in the figure below. Then power on the module according to the procedure mentioned in *Chapter 5.1*. Please notice that when the EVB is inserted into the PCIe card slot of the desktop computer, do not power the EVB through other power supply interfaces.
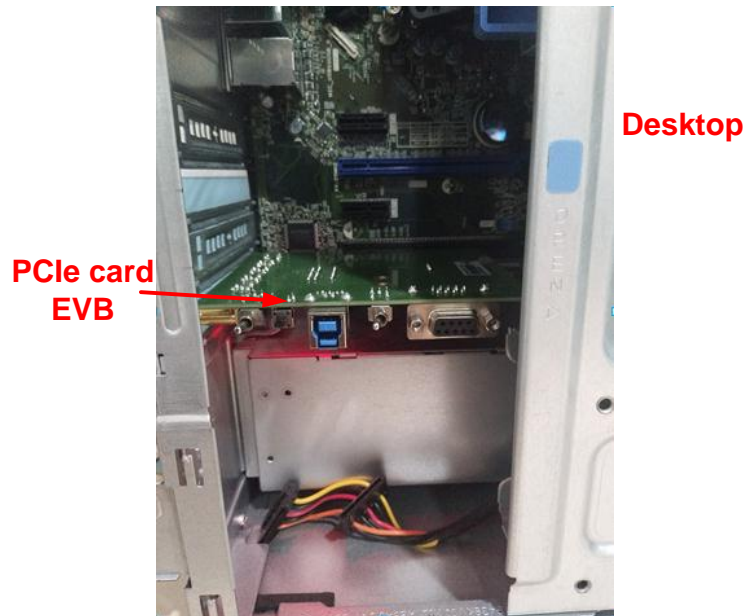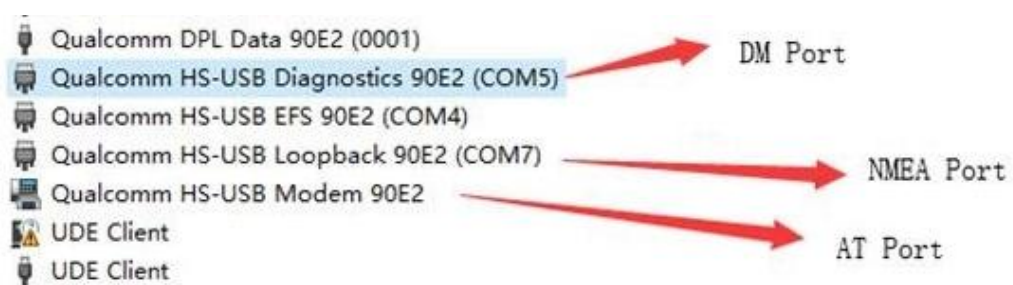

Figure 22: EVB and Desktop Computer Connection via PCIe Interface

2. Run the driver disk on PC to install the UDE driver and QUD driver.

Figure 23: PCIe Ports

3. Install and then use QCOM provided by Quectel to realize communication between the module and the PC. The following figure shows the settings for COM Port on QCOM: select the correct "**COM Port**" (AT Port shown in the above figure) and set the correct "**Baudrate**" (such as 115200 bps). For more details about QCOM usage and configuration, please refer to *document [2]*.
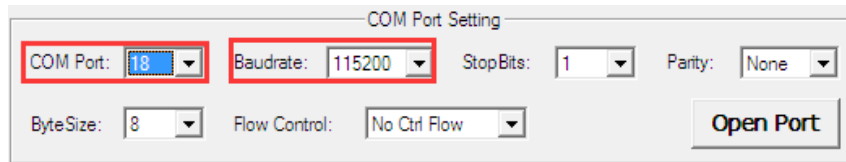
Figure 24: COM Port Setting Field on QCOM (AT Port Connection)

5.3. Firmware Upgrade

5.3.1. USB Firmware Upgrade via USB

The firmware of the module is upgraded via USB port by default, please follow the procedures below to upgrade the firmware with the tool QFlash.

1. Install and open the firmware upgrade tool QFlash on PC and then power on the module according to the procedures in *Chapter 5.1*.

2. Click "**COM Port**" dropdown list and select the USB DM port.

3. Click "**Load FW Files**" button to choose the firmware package.

4. Click "**Start**" button to start upgrading the firmware.
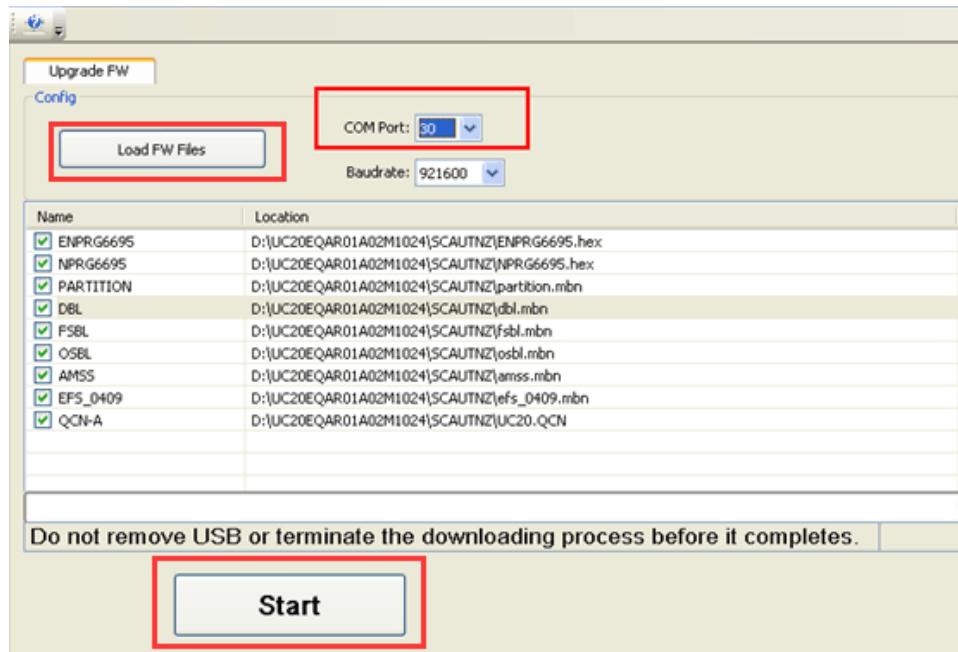
Figure 25: Configurations for Firmware Upgrade

For more details about QFlash usage and configuration, please refer to *document [3]*.

5.3.2. Firmware Upgrade via PCIe

To upgrade the firmware of the module via PCIe port, please follow the procedures below.

1. Use QCOM to open Diagnostic Port (COM5), and then check "**HEX String**", sending HEX array:
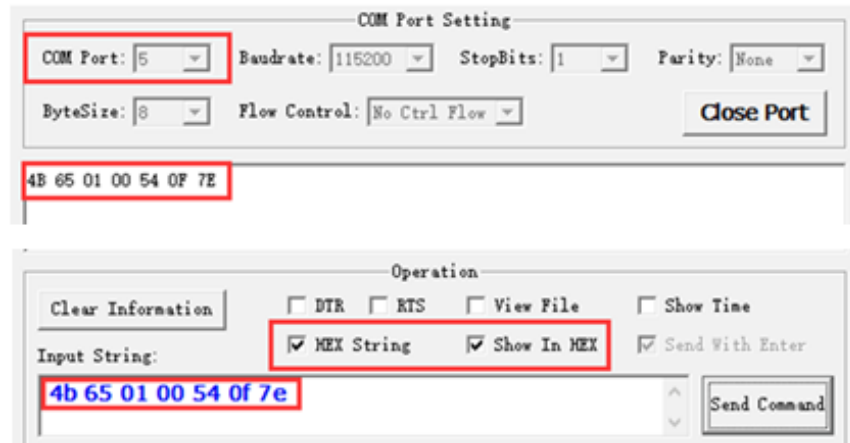**0x4b, 0x65, 0x01, 0x00, 0x54, 0x0f, 0x7e**.

Figure 26: First Step of Firmware Upgrade via PCIe

2. After the above command is executed, the port shown in the following figure will show up in the Device Manger. Right click this node and select Disable. After this device node is disabled, right click it again and select Enable.
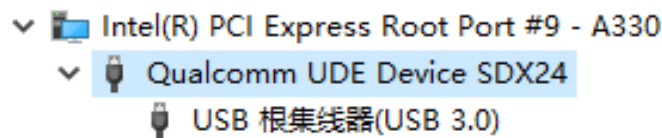

Figure 27: Second Step of Firmware Upgrade via PCIe

3. Open *cmd.exe* (Command Prompt) with administrator authority, then, switch to the firehose directory of the version upgrade file. Execute **QBHiServer.exe** to download **prog_firehose_sdx24.mbn**.

Figure 28: Third Step of Firmware Upgrade via PCIe

4. After the above command is executed, the EDL port will show up after seconds.
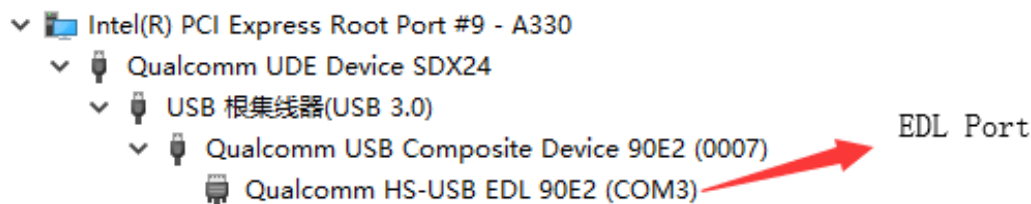

Figure 29: Fourth Step of Firmware Upgrade via PCIe

5. Directly call **Qfirehoese.exe** in CMD to execute command:

Qfirehose.exe -f FW_PATH -p \\.\COM3 -v 1

*   FW_Path: the root directory of the version, that is, the parent directory of *update*.
*   COM3: EDL Port.

Waiting for about 30 seconds, and the module will start to work.

5.4. Reset the Module

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

Press the button S102 (RESET) for 250–600 ms and then release it to reset the module. However, this operation may cause the loss of information stored in the memory as the module will be reinitialized after the reset.

NOTE

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

5.5. Power off the Module

There are two methods to power off the module.

- Hardware shutdown: switch the S101 to OFF state and the module will be powered off.
- Software shutdown: turn off the module by using **AT+QPOWD** command.

NOTE

Please refer to AT Commands Manuals of corresponding modules for details about the **AT+QPOWD** command.

5.6. Current Consumption Test

The PCIe Card EVB can also be used to test the current consumption of the module after modifications as follows:
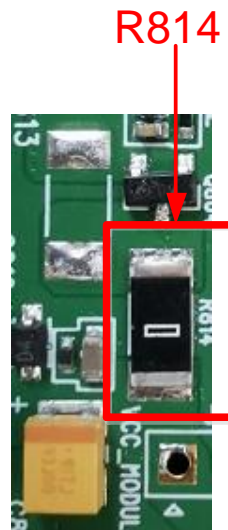
1. Remove R814.

Figure 30: Location of R814

2. Connect an external power supply to J803 to power the module independently.
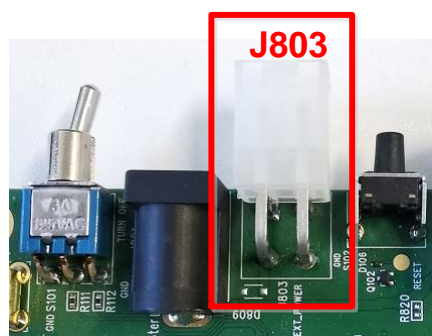

Figure 31: Location of J803

3. Power on the module according to the procedure mentioned in *Chapter 5.1* and then test the current consumption according to specific demand.

6 **Appendix References**

Table 12: Related Documents

SN	Document Name	Remark
[1]	Quectel_LTE&5G_Windows_USB_Drivers_Installation_ Guide	Install USB drivers for M.2 module on Windows system
[2]	Quectel_QCOM_User_Guide	User guide for QCOM tool
[3]	Quectel_QFlash_User_Guide	User guide for QFlash tool

Table 13: Terms and Abbreviations

Abbreviation	Description
AGND	Analog Ground
BTB	Board to Board
COM	Communication Port
DC	Direct Current
DI	Digital Input
DO	Digital Output
EVB	Evaluation Board
GND	Ground
GNSS	Global Navigation Satellite System
I/O	Input/Output
LED	Light Emitting Diode
LTE	Long Term Evolution

NC	Not Connected
PC	Personal Computer
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PO	Power Output
RF	Radio Frequency
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module