

# 5G-mmWave EVB

# User Guide

**5G Module Series**

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**Quectel Wireless Solutions Co., Ltd.**

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: [info@quectel.com](mailto:info@quectel.com)

**Or our local offices. For more information, please visit:**

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

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## 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 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 fueling 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
-	2021-06-23	Neeson ZHANG/ Jumping HE	Creation of the document
1.0	2021-07-25	Kingson ZHANG/ Jumping HE	First official release
1.1	2022-12-14	Wynna SHU/ Summer SUN	<ol style="list-style-type: none"> <li>1. Added an applicable module RM530N-GL and QTM545 mmWave antenna module;</li> <li>2. Added U1001 and its description (Table 2);</li> <li>3. Updated description of connector J2000 (Table 2, Chapter 3.2);</li> <li>4. Updated descriptions of connectors J1800 and J1801 (Table 2);</li> <li>5. Added information of test points (Chapter 2.1 &amp; 3.10);</li> <li>6. Added mmWave pinboard view and placement (Chapter 2.2);</li> <li>7. Added accessory list of RM530N-GL 5G-mmWave EVB kit (Table 5);</li> <li>8. Added figure of Sub-6 GHz antenna interfaces (Figure 13);</li> <li>9. Updated 5G-mmWave EVB assembly (Chapter 3.11);</li> <li>10. Added operation procedures for turning off the module (Chapter 4.2);</li> <li>11. Added operation procedures about communication via USB (Chapter 4.3).</li> </ol>

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# 1 Introduction

This user guide describes the application details of 5G-mmWave EVB (evaluation board), which is an assistant tool for engineers to develop applications and test basic functionalities of the Quectel module.

## 1.1. Applicable Modules

For details about the modules that this EVB applies to, see **document [1]**.

## 1.2. Special Mark

**Table 1: Special Mark**

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, it indicates that the function, feature, interface, pin, AT command, or argument is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.

# 2 General Overview

Quectel supplies 5G-mmWave EVB for engineers to develop applications. This EVB can be used to test basic functionalities of RM510Q-GL with QTM525 (mmWave antenna module) or RA510T series (antenna carrier boards) and RM530N-GL with QTM545 ((mmWave antenna module).

## 2.1. EVB Views and Component Placement

The size of 5G-mmWave EVB is 146 mm x 168 mm, and the top and bottom views are shown as below:

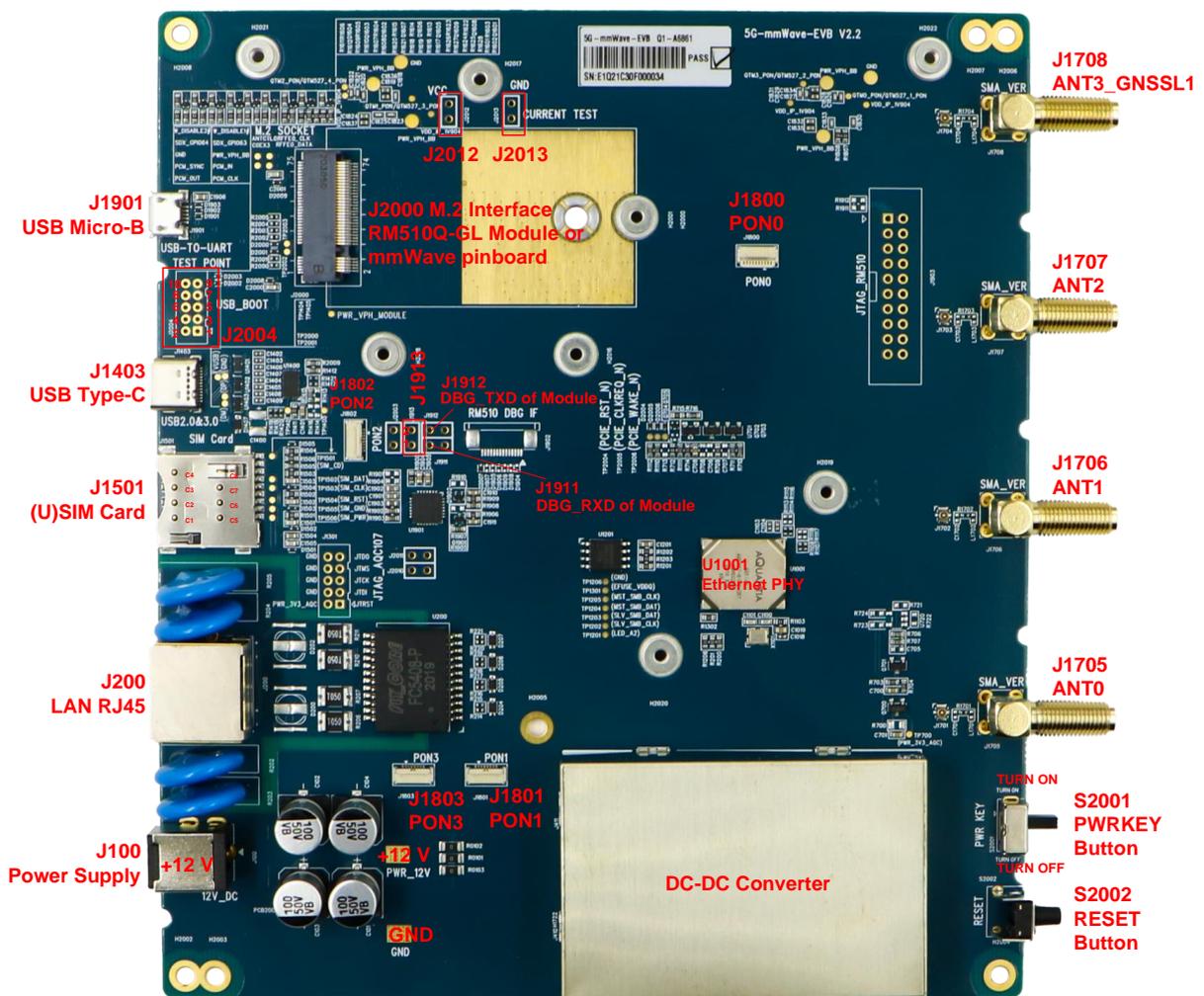


Figure 1: Top View for Component Placement of the EVB

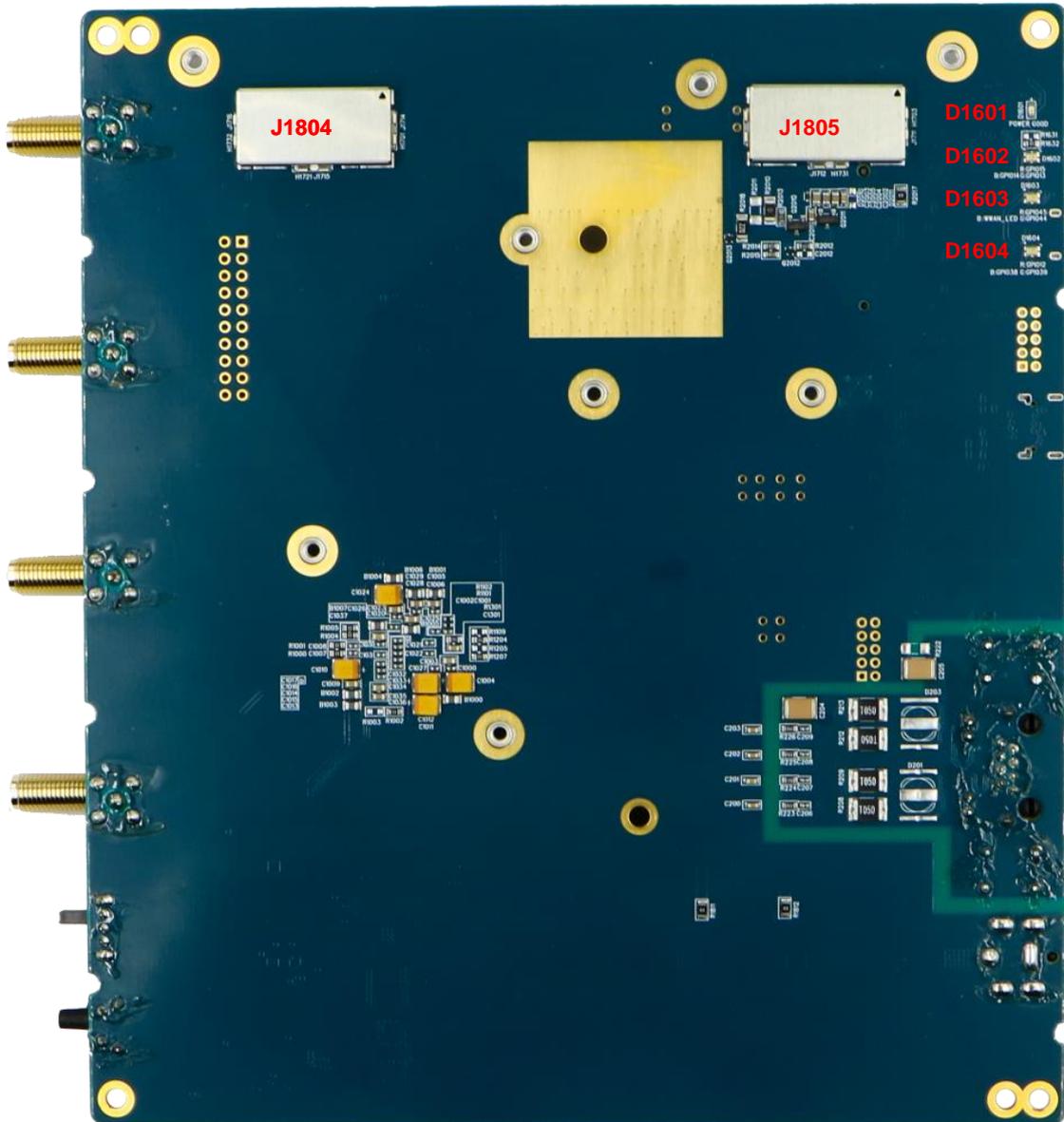


Figure 2: Bottom View for Component Placement of the EVB

Table 2: Key Components and Features of 5G-mmWave EVB

Function	RefDes	Description
Power Supply <sup>1</sup>	J100	Power jack on the EVB; Typical power supply: +12 V / 2 A (using QTM525) or +12 V / 8 A (using RA510T series) or +12 V / 2 A (using QTM545).
USB Type-C Interface	J1403	Used for USB 2.0 & 3.1 communication

<sup>1</sup> The detailed information of power supply about turning on the modules, see **Chapter 4.1**.

USB-to-UART	J1901, J1911, J1912	J1901 is used to convert debug UART to USB 2.0 signal; J1911 and J1912 are used to connect the module's test points DBG_RXD and DBG_TXD to the EVB.
(U)SIM Card Interface	J1501	Supports (U)SIM card insertion detection; Supports (U)SIM card: Class B (3.0 V) and Class C (1.8 V).
LAN Interface	J200	Connect to PC with LAN cable
Buttons	S2001	PWRKEY button (push button) Turn ON/OFF the module
	S2002	RESET button (push button) Reset the module
Ethernet PHY	U1001	Ethernet controller with PCIe interface
Status Indicators <sup>2</sup>	D1601	Power supply ON/OFF indicator
	D1602*	5G signal strength indicator
	D1603*	Module status indicator
	D1604*	Proximity alarm
Connectors	J2000	Standard PCI Express M.2 interface for mmWave pinboard or RM510Q-GL module
	J1800, J1801	BTB connectors for QTM545 and QTM525 power supply and control signals; Each connector has one control signal (PON).
	J1802, J1803	BTB connectors for QTM525 power supply and control signals; Each connector has one control signal (PON).
	J1804, J1805	BTB connectors for RA510T series power supply and control signals; Each connector has two control signals (PON).
	J1705	ANT0 antenna interface
	J1706	ANT1 antenna interface
	J1707	ANT2 antenna interface
	J1708	ANT3_GNSS1 antenna interface
Test Points	J2012, J2013, J2004, J1913	Test points

<sup>2</sup> D1602, D1603 and D1604 are all RGB (tri-color) LEDs.

## 2.2. mmWave Pinboard View and Placement

The mmWave pinboard is used to carry RM530N-GL module, while RM510Q-GL module does not need this board. The physical picture is as follows:

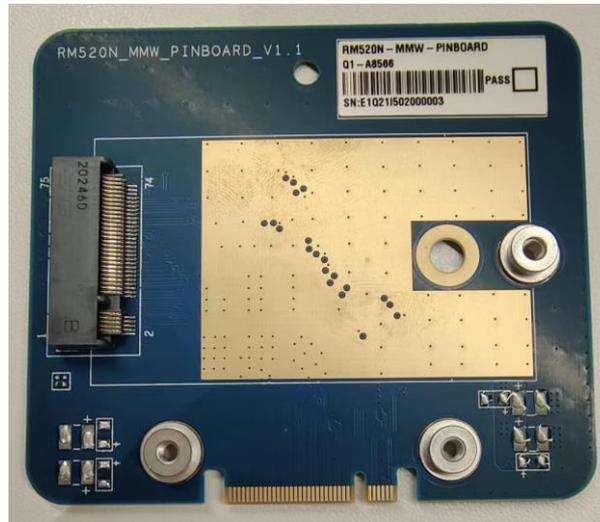


Figure 3: Top View of mmWave Pinboard

## 2.3. List of Accessories

All accessories of the 5G-mmWave EVB kits are listed below:

Table 3: Accessory List of RM510Q-GL 5G-mmWave EVB Kit (High-Power Solution)

Items	Description	Quantity (pcs)
Cables	10 gigabit Ethernet cable	1
	USB Micro-B cable	1
	USB Type-C cable	1
	RF mmWave cables	8
	Sub-6 GHz RF cables	4
Memory	8 GB U-disk	1

Antennas	Sub-6 GHz antennas	4
Silicone Thermal Pads	Thermal conductive pads	4
Instruction Sheet	A sheet of paper giving instructions for EVB connection, details of EVB accessories, etc.	1
Screws	Screws SC-PB3X6-1N	4
	Screws SC-PM2.5X5-2L	2
Power Adapter	+12 V/ 8 A power adapter	1
FPC	The FPC transmits power and control signal from the EVB to RA510T series	2

**Table 4: Accessory List of RM510Q-GL 5G-mmWave-LP EVB Kit (Low-Power Solution)**

Items	Description	Quantity (pcs)
Cables	10 gigabit Ethernet cable	1
	USB Micro-B cable	1
	USB Type-C cable	1
	RF mmWave cables	8
	Sub-6 GHz RF cables	4
Memory	8 GB U-disk	1
Antennas	Sub-6 GHz antennas	4
Silicone thermal pads	Thermal conductive pads	5
Instruction sheet	A sheet of paper giving instructions for EVB connection, details of EVB accessories, etc.	1
Screws	Screws SC-PM2.5X10-2L	3
	Screws SC-PM2.5X5-2L	2
Power adapter	+12 V/ 2 A power adapter	1
QTM525 power supply cable	Used to connect QTM525 power supply to J1800/J1801/J1802/J1803 on the EVB	4
Heatsink	Heatsink AL6063T5 Black Anodized 60 mm x 60 mm H: 30 mm	1

**Table 5: Accessory List of RM530N-GL 5G-mmWave EVB Kit**

Items	Description	Quantity (pcs)
Cables	10 gigabit Ethernet cable	1
	USB Micro-B cable	1
	USB Type-C cable	1
	RF mmWave cables	2
	Sub-6 GHz RF cables	4
Memory	8 GB U-disk	1
Antennas	Sub-6 GHz antennas	4
Silicone thermal pads	Thermal conductive pads	5
Instruction sheet	A sheet of paper giving instructions for EVB connection, details of EVB accessories, etc.	1
Screws	Screws SC-PM2.5X10-2L	3
	Screws SC-PM2.5X5-2L	2
Power adapter	+12 V/ 2 A power adapter	1
QTM545 power supply cable	Used to connect QTM545 power supply to J1800/J1801 on the EVB	2
Heatsink	Heatsink AL6063T5 Black Anodized 60 mm × 60 mm H: 30 mm	1
Antenna modules	QTM545 mmWave Antenna Modules	2

## 2.4. 5G-mmWave EVB Assembly

The assembly procedures of the EVB kit are different. For RM510Q-GL 5G-mmWave-LP EVB kit (low-power solution), see **document [3]**. For RM510Q-GL 5G-mmWave-EVB kit (high-power solution), see **document [4]**. For RM530N-GL 5G-mmWave EVB kit, see **document [5]**.

### NOTE

- Each of the four Sub-6 GHz antennas can be used for main/diversity transmission and GNSS reception.

2. All EVB kits do not contain Quectel 5G M.2 modules. For RM510Q-GL 5G-mmWave EVB kit high-power/low-power solution, mmWave antenna module QTM525 and antenna carrier boards RA510T series are not included.

# 3 Interface Application

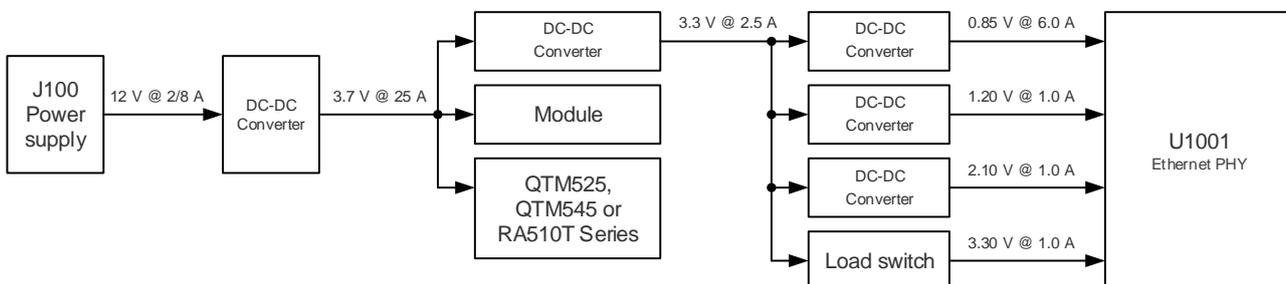
This chapter describes the following hardware interfaces and components of the 5G-mmWave EVB:

- Power supply
- M.2 interface
- USB Type-C interface
- USB-to-UART interface
- (U)SIM card interface
- LAN interface
- Status Indicators
- Sub-6 GHz antenna interfaces
- PWRKEY and RESET Buttons
- Test points

## 3.1. Power Supply (J100)

The 5G-mmWave EVB can be powered by an external power adapter through the power jack (J100) on the EVB. The power adapter is designed to be connected to a step-down converter, which converts the supplied voltage into proper voltage (VCC) for the module.

The following two figures show the simplified power-supply block diagram and the power supply interface of the 5G-mmWave EVB.



**Figure 4: EVB Power Supply Block Diagram**

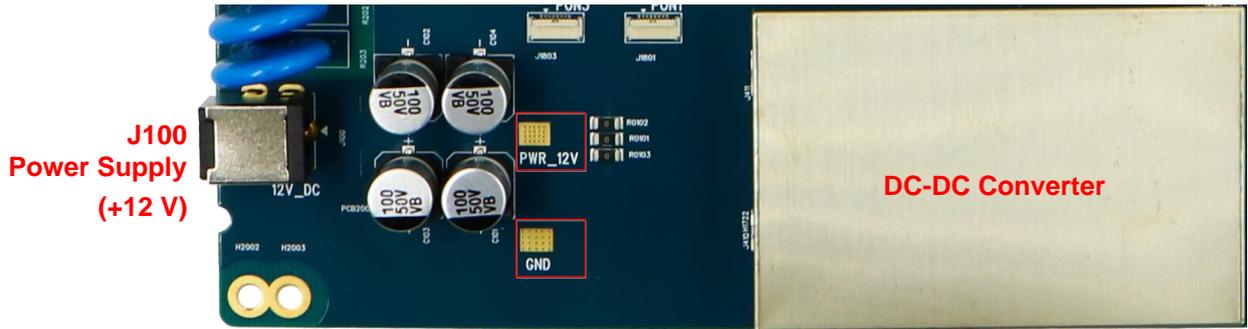


Figure 5: EVB Power Supply Interface

### 3.2. M.2 Interface (J2000)

The M.2 interface (J2000) is designed to accommodate the applicable modules (RM510Q-GL and RM530N-GL). This interface is used to test functionalities of the applicable modules or to develop applications based on the modules.

The following figure shows USB-to-UART interface (J1901), USB 2.0/3.1 Type-C interface (J1403), and the connection between the module and the EVB. J2000 is used for the installation of RM510Q-GL or mmWave pinboard carrying with RM530N-GL.

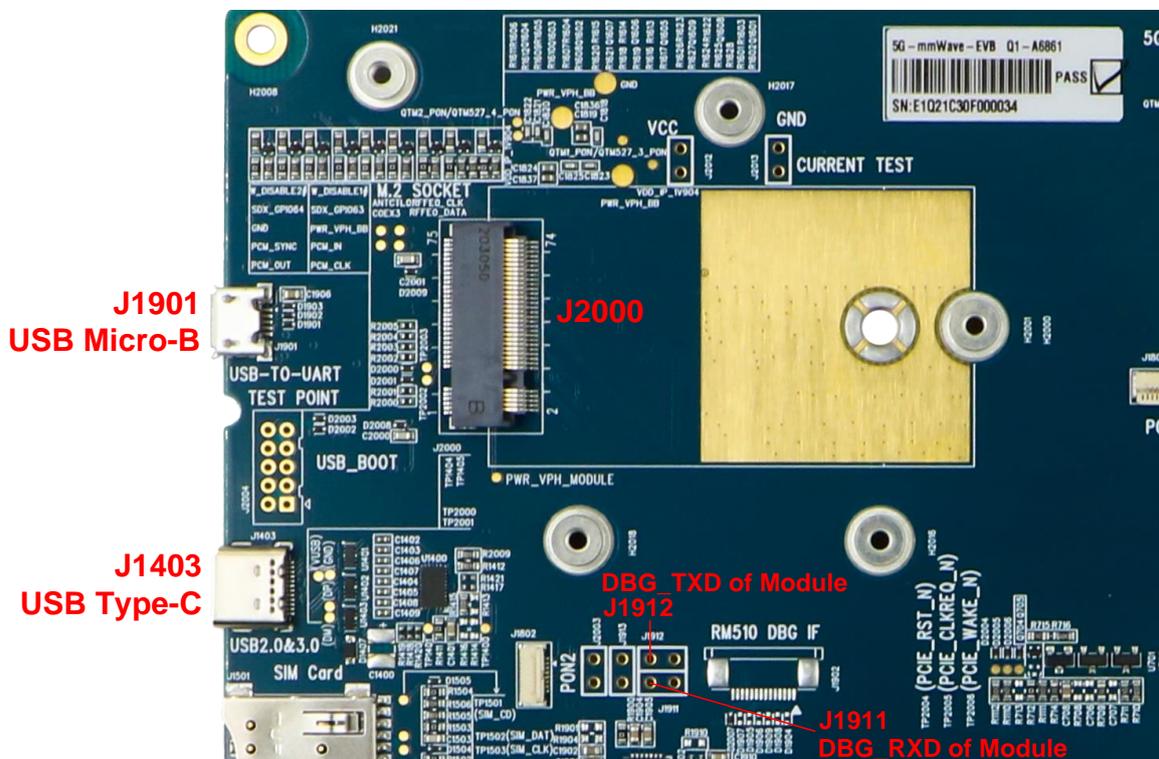
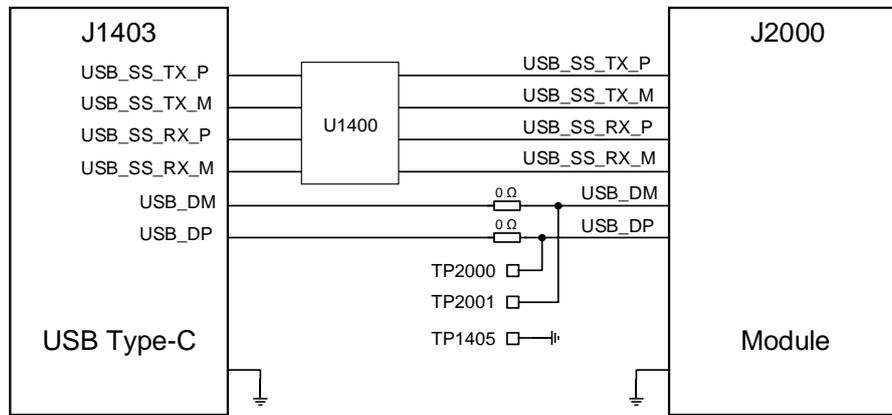


Figure 6: Connection Between Module and EVB

### 3.3. USB Type-C Interface (J1403)

The 5G-mmWave EVB provides a USB 2.0/3.1 Type-C interface (J1403) for connection with a host device, as shown in **Figure 6** and **Figure 7**.



**Figure 7: Connection Between Module and USB Type-C Interface**

### 3.4. USB-to-UART Interface (J1901)

The 5G-mmWave EVB provides a USB-to-UART interface (J1901). This interface is used for Linux console and converting log UART signal to USB 2.0 signal for debugging.

Before using the USB-to-UART interface, DBG\_TXD and DBG\_RXD test points of the modules, as shown in the following figures, should be connected to the corresponding positions of J1911 and J1912 on the EVB respectively, as shown in **Figure 6**.

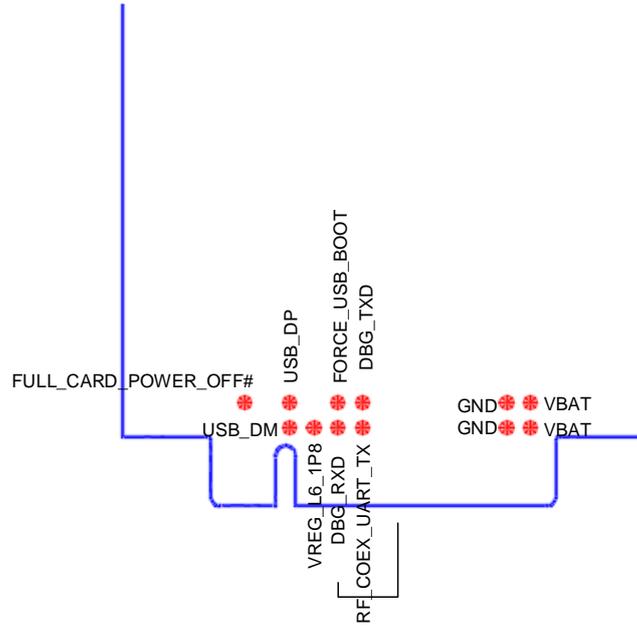


Figure 8: DBG\_TXD and DBG\_RXD Test Points of RM510Q-GL

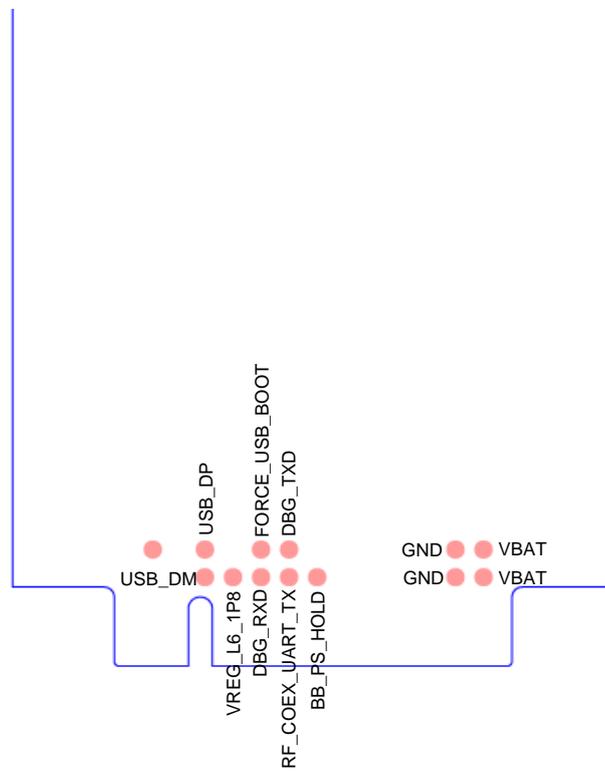


Figure 9: DBG\_TXD and DBG\_RXD Test Points of RM530N-GL



### 3.7. Status Indicators (D1601/D1602\*/D1603\*/D1604\*)

The 5G-mmWave EVB provides four status indication LEDs (D1601/D1602\*/D1603\*/D1604\*) on the bottom side. The following figure shows the location of these LED indicators.



Figure 12: Status Indicators

Table 6: Description of Status Indicators

RefDes	Description
D1601	Power supply ON/OFF indicator indicating the power supply status of the module. <b>Light on:</b> the module is turned on. <b>Light off:</b> the module is turned off.
D1602*	This RGB LED indicates different 5G signal strength.
D1603*	This RGB LED indicates different system status.
D1604*	This RGB LED is used as proximity alarm.

### 3.8. Sub-6 GHz Antenna Interfaces (J1705/J1706/J1707/J1708)

The four antennas (J1705/J1706/J1707/J1708) provided in the EVB kits are the same. They support 600–6000 MHz and can be randomly connected to the four antenna interfaces on the EVB.

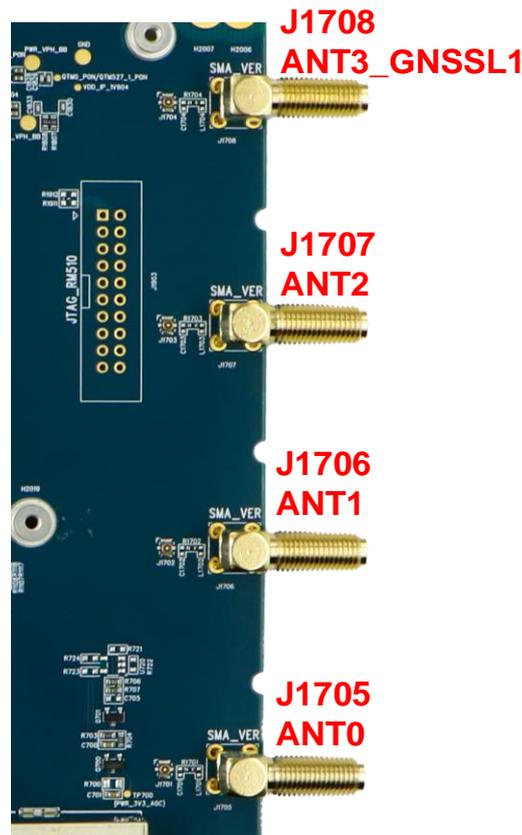


Figure 13: Sub-6 GHz Antenna Interfaces

### 3.9. PWRKEY and RESET Buttons (S2001/S2002)



Figure 14: Buttons (S2001 and S2002)

Table 7: Description of Buttons

Function	RefDes	Description
PWRKEY	S2001	Used to turn ON/OFF the module
RESET	S2002	Used to reset the module

### 3.10. Test Points (J2012/J2013/J2004/1913)

The 5G-mmWave EVB provides test points which help you obtain the corresponding waveforms of some signals. The following figure shows the details of all test points.

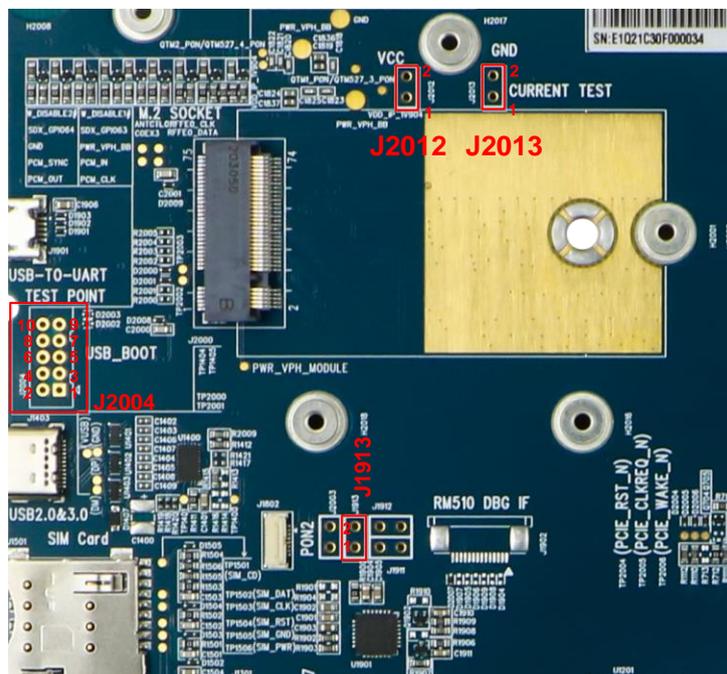


Figure 15: Test Points of J2012, J2013, J2004, and J1913

Table 8: Pin Definition of Test Points

J2012			
Pin No.	Pin Name	Module Pin No.	Description
1	VCC	2, 4, 70, 72, 74	Module's power supply test point

2	VCC	2, 4, 70, 72, 74	Module's power supply test point
<b>J2013</b>			
Pin No.	Pin Name	Module Pin No.	Description
1	GND	-	Ground
2	GND	-	Ground
<b>J2004</b>			
Pin No.	Pin Name	Module Pin No.	Description
1	PCM_CLK	20	Connect to module's pin 20
2	PCM_OUT	24	Connect to module's pin 24
3	PCM_IN	22	Connect to module's pin 22
4	PCM_SYNC	28	Connect to module's pin 28
5	PWR_VPH_BB	2, 4, 70, 72, 74	Module's power supply test point
6	GND	-	Ground
7	SDX_GPIO63	38	Connect to module's pin 38
8	SDX_GPIO64	68	Connect to module's pin 68
9	W_DISABLE1#	8	W_DISABLE1# test point
10	W_DISABLE2#	26	W_DISABLE2# test point
<b>J1913</b>			
Pin No.	Pin Name	Module Pin No.	Description
1	VDDIO_1V8	65	Connect to module's pin 65
2	GND	-	Ground

# 4 Operation Procedures

This chapter introduces how to use the 5G-mmWave EVB for testing and evaluation of applicable modules. Before the procedures below, ensure modules and the EVB are correctly assembled.

## 4.1. Turn On the Module

1. Insert a (U)SIM card into the (U)SIM card interface (J1501) on the EVB and connect the antennas to the module;
2. Connect the LAN interface (J200) and the PC with a LAN cable;
3. Connect the EVB power jack (J100) to power supply through the +12 V/ 2 A or +12 V/ 8 A power adapter;
4. Switch PWRKEY (S2001) to the “**TURN ON**” side, the module and the EVB will be turned on. And then the power supply ON/OFF indicator LED (D1601) will light up, which indicates that the power supply for the whole EVB is ready.

### NOTE

1. If the PWRKEY has been switched to “**TURN ON**” side before the power supply is connected, the module and the EVB will turn on automatically when the power adapter is connected.
2. The turn-on should be performed only after the EVB assembling is completed to avoid any possible damage.

## 4.2. Turn Off the Module

There are two methods to turn off the module.

1. Turn off the module with **AT+QPOWD**. This is a safer method. The module will log off from the network and save data before shutdown.
2. Turn off the module with PWRKEY button (S2001) switching to “**TURN OFF**” side.

### 4.3. Communication Via USB

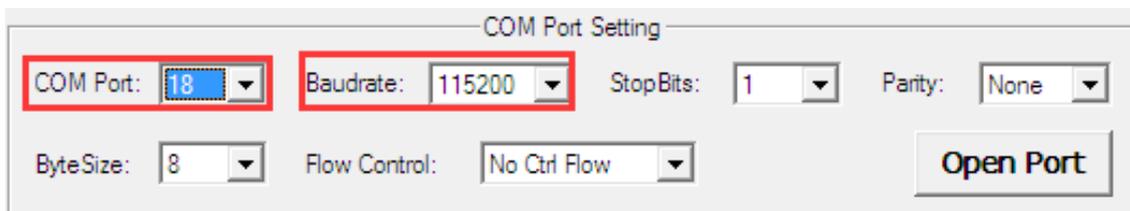
1. Turn on the module according to the procedures in **Chapter 4.1**.
2. Connect the EVB and a PC with USB cable through USB Type-C interface, and then run the driver disk on the PC to install the USB driver. The USB port numbers can be viewed in Device Manager of the PC when the USB driver is installed, as shown below.



**Figure 16: 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, see **document [6]**.

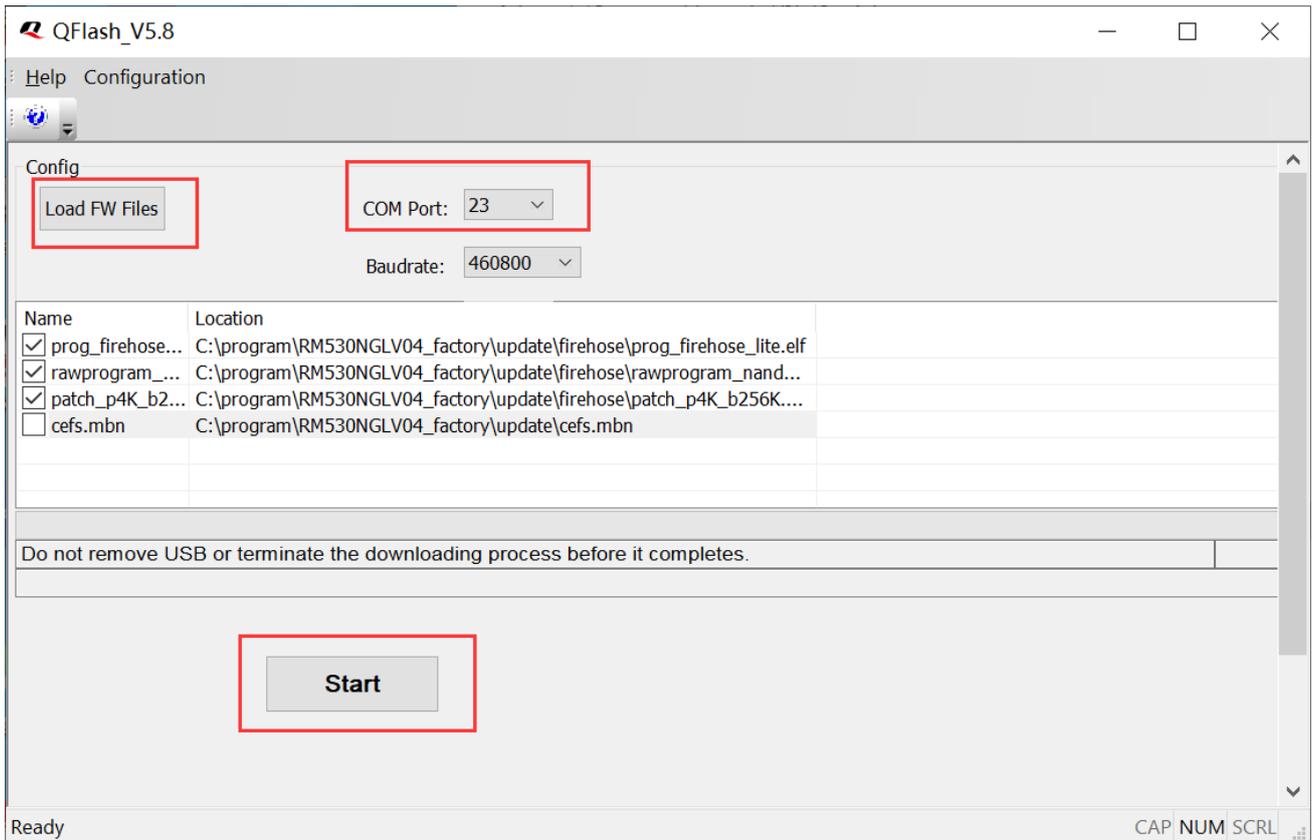


**Figure 17: COM Port Setting Field on QCOM (USB AT Port Connection)**

### 4.4. Firmware Upgrade via USB

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

1. Install and open the firmware upgrade tool QFlash on the PC and then turn on the module according to the procedures in **Chapter 4.1**;
2. Select the USB DM port in the “**COM Port**” dropdown list;
3. Click the “**Load FW Files**” button to choose the target firmware package;
4. Click the “**Start**” button to upgrade the firmware.



**Figure 18: Configurations for Firmware Upgrade**

For more details about usage and configuration of the QFlash, see **document [7]**.

### 4.5. Reset the Module

Reset is only used in case of emergency or abnormality. For example, the software fails to respond for more than 5 s due to serious problems.

Press the RESET button (S2002) for 200–700 ms, and then release it to reset the module. Note that this operation may cause loss of information in the memory as the module will be initialized after the resetting.

# 5 Appendix References

**Table 9: Related Documents**

Document Name
[1] Quectel_List_of_EVB_Applicable_Modules
[2] Quectel_RG520N&RG52xF&RG530F&RM520N&RM530N_Series_AT_Commands_Manual
[3] Quectel_RM510Q-GL+QTM525+5G-mmWave-LP_EVB_Kit_Assembly_Instruction
[4] Quectel_RM510Q-GL+RA510T+5G-mmWave-EVB_Kit_Assembly_Instruction
[5] Quectel_RM530N-GL+QTM545+5G-mmWave_EVB_Kit_Assembly_Instruction
[6] Quectel_QCOM_User_Guide
[7] Quectel_QFlash_User_Guide

**Table 10: Terms and Abbreviations**

Abbreviation	Description
BTB	Board to Board
COM	Cluster Communication Port
DC	Direct Current
DI	Digital Input
DO	Digital Output
EVB	Evaluation Board
FPC	Flexible Printed Circuit
GND	Ground
GNSS	Global Navigation Satellite System

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I/O	Input/Output
LED	Light Emitting Diode
LAN	Local Area Network
LP	Low-Power
mmWave	Millimeter-Wave
PC	Personal Computer
PCIe	Peripheral Component Interconnect Express
RC	Root Complex
RefDes	Reference Designator
RF	Radio Frequency
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module

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