RG65xE&RG650V&RM551E Series

RF Application Note

5G Products

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About the Document

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-	2024-04-15	Kevin Li	Creation of the document
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1 Introduction

This document introduces how to use related AT commands, including RF FTM, RX chain controlling, power backoff, 8RX, mmWave and other related AT commands on Quectel 5G RG650E series, RG651E-NA, RG650V series and RM551E-GL modules.

1.1. Applicable Modules

Table 1: Applicable Modules

Module Family	Module
RG65xE	RG650E Series
	RG651E-NA
-	RG650V Series
-	RM551E-GL

2 Description of AT Commands

2.1. AT Command Introduction

2.1.1. Definitions

- **<CR>** Carriage return character.
- **<LF>** Line feed character.
- **<...>** Parameter name. Angle brackets do not appear on the command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on the command line. When an optional parameter is not given in a command, the new value equals to its previous value or the default settings, unless otherwise specified.
- **Underline** Default setting of a parameter.

2.1.2. AT Command Syntax

All command lines must start with **AT** or **at** and end with **<CR>**. Information responses and result codes always start and end with a carriage return character and a line feed character: **<CR><LF><response><CR><LF>**. In tables presenting commands and responses throughout this document, only the commands and responses are presented, and **<CR>** and **<LF>** are deliberately omitted.

Table 2: Types of AT Commands

Command Type	Syntax	Description
Test Command	**AT+<cmd>=?**	Test the existence of the corresponding command and return information about the type, value, or range of its parameter.
Read Command	**AT+<cmd>?**	Check the current parameter value of the corresponding command.
Write Command	**AT+<cmd>=<p1>[,<p2>[,<p3>[...]]]**	Set user-definable parameter value.
Execution Command	**AT+<cmd>**	Return a specific information parameter or perform a specific action.

2.2. Declaration of AT Command Examples

The AT command examples in this document are provided to help you learn about the use of the AT commands introduced herein. The examples, however, should not be taken as Quectel's recommendations or suggestions about how to design a program flow or what status to set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there is a correlation among these examples, or that they should be executed in a given sequence. The URLs, domain names, IP addresses, usernames/accounts, and passwords (if any) in the AT command examples are provided for illustrative and explanatory purposes only, and they should be modified to reflect your actual usage and specific needs.

3 Description of RF AT Commands

3.1. RF FTM Related AT Commands

3.1.1. AT+QFTMMODE Query/Set FTM Mode

This command queries or sets FTM mode.

AT+QFTMMODE Query/Set FTM Mode	
Test Command **AT+QFTMMODE=?**	Response **+QFTMMODE: (**list of supported **<mode>**s**)** **OK**
Read Command **AT+QFTMMODE?**	Response **+QFTMMODE: <mode>** **OK**
Write Command **AT+QFTMMODE=<mode>**	Response **OK** Or **ERROR**
Maximum Response Time	150 ms
Characteristics	This command takes effect immediately. The configuration is not saved.

Parameter

<mode>	Integer type. RF test mode. 0 Online mode 1 FTM mode

3.1.2. AT+QRFTESTEX RX/TX Test in FTM for WCDMA/LTE/NR5G

This command performs RX/TX tests in FTM for WCDMA/LTE/NR5G Sub-6 GHz.

AT+QRFTESTEX RX/TX Test in FTM for WCDMA/LTE/NR5G	
Test Command **AT+QRFTESTEX=?**	Response **+QRFTESTEX: <tech>,"rx",<band>,<chain_idx>,<expected_rxagc_dbm10>,<rx_enable>,<rx_channel>** **+QRFTESTEX: <tech>,"tx",<band>,<tx_index>,<tx_power_dbm10>,<tx_enable>,<tx_channel>** **OK**
Write Command **AT+QRFTESTEX=<tech>,"rx",<band>,<chain_idx>,<expected_rxagc_dbm10>,<rx_enable>,<rx_channel>**	Response **+QRFTESTEX: <RX_AGC>** **OK** If there is any error: **ERROR**
Write Command **AT+QRFTESTEX=<tech>,"tx",<band>,<tx_index>,<tx_power_dbm10>,<tx_enable>,<tx_channel>**	Response **OK** Or **ERROR**
Maximum Response Time	150 ms
Characteristics	This command takes effect immediately; The configurations are not saved.

Parameter

<tech>	String type. Network mode. "NR5G" NR5G Sub-6 GHz "LTE" LTE "WCDMA" WCDMA
<band>	Integer type. NR5G Sub-6 GHz/LTE/WCDMA band. 1 NR5G Sub-6 GHz n1/LTE B1/WCDMA B1 2 NR5G Sub-6 GHz n2/LTE B2/WCDMA B2 3 NR5G Sub-6 GHz n3/LTE B3/WCDMA B3 ..... 28 NR5G Sub-6 GHz n28/LTE B28/WCDMA B28 .....
<chain_idx>	Integer type. Specify the RX chain for testing. WCDMA bands only support testing RX0 and RX1. And only the bands that support 8RX

	can test RX4–7. 0 RX0 1 RX1 2 RX2 3 RX3 4 RX4 5 RX5 6 RX6 7 RX7
<expected_rxagc_dbm10>	Integer type. The expected received signal strength. Unit: 0.1 dBm. It is generally equal to test equipment signal strength in dBm × 10. For example, if the signal strength set by the test equipment is -60 dBm, then this parameter is set to -600.
<rx_enable>	Integer type. Enable/disable RX test. 0 Disable 1 Enable
<rx_channel>	Integer type. RX channel. See ***Chapter 5*** for details.
<RX_AGC>	Float type. The actual received signal strength. Unit: dBm.
<tx_index>	Integer type. Specify the TX chain for testing. **LTE/WCDMA:** 0 TX0 **NR5G Sub-6 GHz:** 0 TX0 1 TX1
<tx_power_dbm10>	Integer type. The expected TX power. Unit: 0.1 dBm. For example, if the expected TX power value is 20 dBm, then this parameter is set to 200。
<tx_enable>	Integer type. Enable/disable TX test. 0 Disable 1 Enable
<tx_channel>	Integer type. TX channel. See ***Chapter 5*** for details.

NOTE

1. Before executing **AT+QRFTESTEX** for RX/TX tests under WCDMA/LTE/NR5G Sub-6 GHz, you need to execute **AT+QFTMMODE=1** to enter into FTM mode; after the test, you need to execute **AT+QFTMMODE=0** to exit FTM mode and switch to online mode.
2. After each RX/TX test of a specific network mode (WCDMA/LTE/NR5G Sub-6 GHz) is performed, it is recommended to reboot the module before performing the RX/TX test of another network mode.
3. After each RX/TX chain is tested, the next RX/TX test can be performed after the former RX/TX test is disabled.
4. During the RX/TX test, the frequency and other parameters that need to be set on the test equipment should be calculated according to the channel information. See ***Chapter 5*** for the range

of RX channel and TX channel.

5. When testing in LTE mode, the BW that needs to be set on the test equipment is 10 MHz.
6. When testing in NR5G Sub-6 GHz mode, if necessary, the band, BW and SCS mapping tables that need to be set on the simulator are as follows:

Band	BW（MHz）	SCS（KHz）
n1	20	15
n2	20	15
n3	20	15
n5	20	15
n7	20	15
n8	20	15
n12	10	15
n13	10	15
n14	10	15
n18	10	15
n20	20	15
n25	20	15
n26	10	15
n28	10	15
n29	10	15
n30	10	15
n34	10	30
n38	20	30
n39	20	30
n40	20	30
n41	20	30

n46	20	30
n48	20	30
n50	20	30
n51	5	15
n53	10	30
n66	20	15
n70	10	15
n71	20	15
n74	20	15
n75	20	15
n76	5	15
n77	100	30
n78	100	30
n79	100	30

7. Try not to insert a (U)SIM card during RX/TX tests.
8. RX/TX tests in FTM only verify whether the antenna path is normal, and cannot be used as a test for the module performance.
9. AT commands introduced in this chapter is only suitable for verification and not for stress tests due to the instability of these commands in stress testing.
10. During RX tests, the tested chain is recommended to be carried out in the order of RX0, RX1, RX2 and RX3.
11. For the specific bands that support 8RX, please refer to the relevant module's hardware design manual.

Example

```
//Test command
AT+QFTMMODE=?
+QFTMMODE: (0,1)

OK
AT+QRFTESTEX=?
AT+QRFTESTEX=<tech>,"rx",<band>,<chain_idx>,<expected_rxagc_dbm10>,<rx_enable>,<rx_ch
```

```
annel>
AT+QRFTESTEX=<tech>,"tx",<band>,<tx_index>,<tx_power_dbm10>,<tx_enable>,<tx_channel>

OK
//Perform TX/RX tests in LTE mode.
AT+QFTMMODE=1                                   //Enter FTM mode.
OK
AT+QRFTESTEX="LTE","rx",3,0,-600,1,1575         //Enable RX test.
+QRFTESTEX: -60.9

OK
AT+QRFTESTEX="LTE","rx",3,0,-600,0,1575         //Disable RX test.
OK
AT+QRFTESTEX="LTE","tx",3,0,200,1,19575         //Enable TX test.
OK
AT+QRFTESTEX="LTE","tx",3,0,200,0,19575         //Disable TX test.
OK
AT+QFTMMODE=0                                   //Exit FTM mode.
OK
//Perform TX/RX tests in NR5G mode after the module is rebooted.
AT+QFTMMODE=1                                   //Enter FTM mode.
OK
AT+QRFTESTEX="NR5G","rx",41,0,-600,1,518598     //Enable RX test.
+ QRFTESTEX: -91.3

OK
AT+QRFTESTEX="NR5G","rx",41,0,-600,0,518598     //Disable RX test.
OK
AT+QRFTESTEX="NR5G","tx",41,0,200,1,518598      //Enable TX test.
OK
AT+QRFTESTEX="NR5G","tx",41,0,200,0,518598      //Disable TX test.
OK
AT+QFTMMODE=0                                   //Exit FTM mode.
OK
//Perform TX/RX test in WCDMA mode after the module is rebooted.
AT+QFTMMODE=1                                   //Enter FTM mode.
OK
AT+QRFTESTEX="WCDMA","rx",1,0,-600,1,10700      //Enable RX test.
+QRFTESTEX: -94.7

OK
AT+QRFTESTEX="WCDMA","rx",1,0,-600,0,10700      //Disable RX test.
OK
AT+QRFTESTEX="WCDMA","tx",1,0,200,1,9750        //Enable TX test.
```

```
OK
AT+QRFTESTEX="WCDMA","tx",1,0,200,0,9750          //Disable TX test.
OK
AT+QFTMMODE=0                                     //Exit FTM mode.
OK
```

3.1.3. AT+QTXFTMEX Extend TX Functionality in FTM Mode

This command extends TX functionality in FTM mode, and supports TX test on Power Class 2/Power Class 3 for NR5G Sub-6 and LTE bands and supports TX test on Power Class 1.5 for part of NR5G Sub-6 GHz bands. To perform TX test on Power Class 1.5, the optional parameters of the Write Command should be omitted.

AT+QTXFTMEX Extend TX Functionality in FTM Mode	
Test Command **AT+QTXFTMEX=?**	Response **+QTXFTMEX: <tech>,<tx_enable>,<band>,<tx_power_dbm10>,<pwr_class>,<channel>,<bandwidth>,<tx_index>,<tx_waveform>,<tx_modulation>,<rb_start>,<rb_count>,<nr_scs>,<duty_cycle>** **OK**
Write Command **AT+QTXFTMEX=<tech>,<tx_enable>,<band>,<tx_power_dbm10>,<pwr_class>,<channel>,<bandwidth>[,<tx_index>,<tx_waveform>,<tx_modulation>,<rb_start>,<rb_count>[,<nr_scs>,<duty_cycle>]]**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	This command takes effect immediately. The configurations are not saved.

Parameter

<tech>	String type. Network mode. "NR5G" NR5G Sub-6 GHz "LTE" LTE
<tx_enable>	Integer type. Enable or disable TX test. 0 Disable 1 Enable
<band>	Integer type. NR5G Sub-6 GHz/LTE band. See ***Chapter 5*** for details. 1 NR5G Sub-6 GHz n1/LTE B1

2	NR5G Sub-6 GHz n2/LTE B2
3	NR5G Sub-6 GHz n3/LTE B3
…	
28	NR5G Sub-6 GHz n28/LTE B28
…	

<tx_power_dbm10> Integer type. The expected TX power. Unit: 0.1 dBm.

<pwr_class> Integer type. The level of the output power. In NR5G Sub-6 GHz, the module supports testing Power Class 2/3/1.5. In LTE, the module only supports testing Power Class 2/3.

0	Power Class 1 (Reserved)
1	Power Class 2
2	Power Class 3
3	Power Class 4 (Reserved)
4	Power Class 1.5
5	Power Class 5 (Reserved)

<channel> Integer type. TX channel. See ***Chapter 5*** for details.

<bandwidth> Integer type. Bandwidth.

NR5G Sub-6 GHz:

1	5 MHz
2	10 MHz
3	15 MHz
4	20 MHz
5	25 MHz
6	30 MHz
7	40 MHz
8	50 MHz
9	60 MHz
10	80 MHz
11	90 MHz
12	100 MHz

LTE:

0	1.4 MHz
1	3 MHz
2	5 MHz
3	10 MHz
4	15 MHz
5	20 MHz
6	40 MHz

<tx_index> Integer type. Specify the TX chain on TX test. This parameter is optional while it is specified only when **<pwr_class>** is 1 or 2 (that is Power Class 2/3). This parameter and other optional parameters are omitted when **<pwr_class>** is 4 (that is Power Class 1.5), which indicates TX0 and TX1 are tested synchronously.

	0 TX0 1 TX1 (Not supported under LTE network)
<tx_waveform>	Integer type. Uplink waveform. **NR5G Sub-6 GHz:** 1 CW 10 PUSCH 11 PUSCH_DFT_S **LTE:** 0 CW 1 PUSCH 2 PUCCH
<tx_modulation>	Integer type. Modulation type of the uplink signal. **NR5G Sub-6 GHz:** 0 QPSK 1 QAM_16 2 QAM_64 3 QAM_256 4 BPSK **LTE:** 0 QPSK 1 QAM_16 2 QAM_64 3 QAM_256
<rb_start>	Integer type. RB (Resource Block) starting offset. The minimum value is 0, and the maximum value is the maximum number of RBs minus 1. The maximum number of RBs supported by NR5G Sub-6 GHz is 273. The maximum RB supported by LTE is 100.
<rb_count>	Integer type. The number of RBs. The minimum value is 1, and the maximum value is the maximum number of RBs minus RB starting offset.
<nr_scs>	Integer type. Sub Carrier Spacing for NR5G Sub-6 GHz. This parameter needs to be configured only when testing NR5G Sub-6 GHz, and is not required for LTE testing. Default value: 30000. Unit: Hz. Example: If the test is conducted with a sub carrier spacing of 15 kHz, set this parameter to 15000. If this parameter is omitted, the default sub carrier spacing of 30 kHz will be used for testing.
<duty_cycle>	Integer type. Uplink signal duty cycle. 0 50% 1 20% 2 25% 3 40%

NOTE

1. For specific NR5G Sub-6 GHz bands that support TX test on Power Class 1.5 and Power Class 2, please see the document of the hardware design or contact Quectel Technical Supports.
2. When a TX chain is tested, the corresponding TX test needs to be disabled first before the next TX chain is tested.
3. Try not to insert a (U)SIM card during TX test.
4. It is recommended to refer to3GPP for RB configuration, otherwise there will be deviations in the TX power obtained.

Example

```
//In NR5G
//Perform TX test on Power Class 1.5.
AT+QFTMMODE=1                                   //Enter FTM mode.
OK
AT+QTXFTMEX="NR5G",1,41,260,4,518598,12         //Perform a TX test on n41, 100 MHz bandwidth,
                                                and PC1.5, with TX0 and TX1 output TX power
                                                set to 26 dBm.
OK
AT+QTXFTMEX="NR5G",0,41,260,4,518598,12         //Disable TX test.
OK
//Perform TX test on PC2.
AT+QTXFTMEX="NR5G",1,78,260,1,623334,12,0,10,0,137,68,30000,1   //Perform a TX test on n78,
                                                                100 MHz bandwidth, and
                                                                PC2, with TX0 output TX
                                                                power set to 26 dBm and a
                                                                duty cycle of 20%.
OK
AT+QTXFTMEX="NR5G",0,78,260,1,623334,12,0,10,0,137,68,30000,1   //Disable TX test.
OK
//Perform TX test on PC3.
AT+QTXFTMEX="NR5G",1,78,230,2,623334,12,0,10,2,137,68,30000,1   //Perform a TX test on n78,
                                                                100 MHz bandwidth, and
                                                                PC3, with TX0 output TX
                                                                power set to 23 dBm and a
                                                                duty cycle of 20%.
OK
AT+QTXFTMEX="NR5G",0,78,230,2,623334,12,0,10,0,137,68,30000,1   //Disable TX test.
OK
AT+QFTMMODE=0                                   //Exit FTM mode.
OK

//In LTE
```

```
//Perform TX test on PC2.
AT+QFTMMODE=1                                   //Enter FTM mode.
OK
AT+QTXFTMEX="LTE",1,40,260,1,39150,5,0,1,0,1,1  //Perform a TX test on B40, 20 MHz
                                                bandwidth and PC2, with TX0 output
                                                TX power set to 26 dBm.
OK
AT+QTXFTMEX="LTE",0,40,260,1,39150,5,0,1,0,1,1  //Disable TX test.
OK
AT+QFTMMODE=0                                   //Exit FTM mode.
OK
```

3.2. RX Chain Controlling Related AT Commands

The AT commands introduced in this chapter are used to enable the RX chain to perform sensitivity measurements on the simulator. Meanwhile please not be used in real network.

3.2.1. AT+QCFG="div_test_mode" Initialize RX Chain State in LTE Mode

This command initializes RX chain state in LTE mode.

AT+QCFG="div_test_mode" Initialize RX Chain State in LTE Mode	
Test Command **AT+QCFG=?**	Response **...** **+QCFG: "div_test_mode",(**list of supported **<state>**s**)** **...** **OK**
Write Command **AT+QCFG="div_test_mode"[,<state>]**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration is not saved.

Parameter

<state>	Integer type. Whether to initialize RX chain state in LTE mode 0 Current working state

1	Initialization state

NOTE

1. This command is only applicable for LTE.
2. Before you execute this command, the LTE registration state must be switched to idle state; it is forbidden to execute this command in the connected state (see ***Chapter 3.2.4.1*** for details).
3. This command does not support querying current configurations and **<state>** cannot be switched from 1 to 0 in this command. If it is necessary to release the RX chain lock and restore the module to its current working state, simply reboot the module.

Example

```
AT+QCFG="div_test_mode",1      //Initialize RX chain state in LTE mode.
OK
```

3.2.2. AT+QCFG="diversity/config" Enable Single RX Chain

This command enables the single RX chain.

AT+QCFG="diversity/config" Enable Single RX Chain	
Test Command **AT+QCFG=?**	Response **...** **+QCFG: "diversity/config",(**list of supported **<tech>**s**),(**list of supported **<RX_chain>**s**),(**list of supported **<CC_ID>**s**)** **...** **OK**
Write Command **AT+QCFG="diversity/config",<tech>,<RX_chain>,<CC_ID>**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configurations are not saved.

Parameter

<mode>	Integer type. Network mode. 0 LTE 1 NR5G

<RX_chain>	Integer type. Enable a specific RX chain. Only the bands that support 8RX can be used for enabling RX0~RX7, and the rest of the bands that support 4MIMO can only be used for enabling RX0~RX3. 1 RX0 2 RX1 3 RX2 4 RX3 5 RX4 6 RX5 7 RX6 8 RX7
<CC_ID>	Integer type. Primary component carrier (PCC). This parameter can only be set to 0.

NOTE

1. In LTE mode, this command must be executed in the connected state, while in NR5G, this command must be executed in FTM (see ***Chapter 3.2.4.2*** for details).
2. This command does not support querying current configurations.

Example

```
AT+QCFG="diversity/config",0,1,0        //Enable RX0 only.
OK
AT+QCFG="diversity/config",0,2,0        //Enable RX1 only.
OK
AT+QCFG="diversity/config",0,3,0        /Enable RX2 only.
OK
AT+QCFG="diversity/config",0,4,0        //Enable RX3 only.
OK
```

3.2.3. Environment Setup

Before using AT commands to perform the single RX chain controlling, it is recommended to calibrate the device first. During the single RX chain controlling, you need to use a power splitter. The environment is set up as follows:

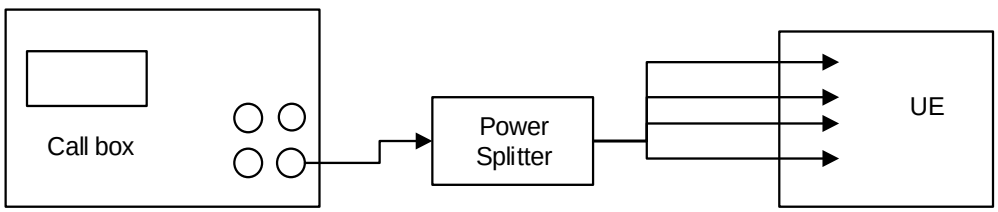

Figure 1: Environment Setup

3.2.4. Operation Steps

3.2.4.1. In LTE

Connect all antennas of the module to CMW500 through the power splitter. Uncheck "**Keep RRC Connection**" on CMW500, as shown in the figure below.

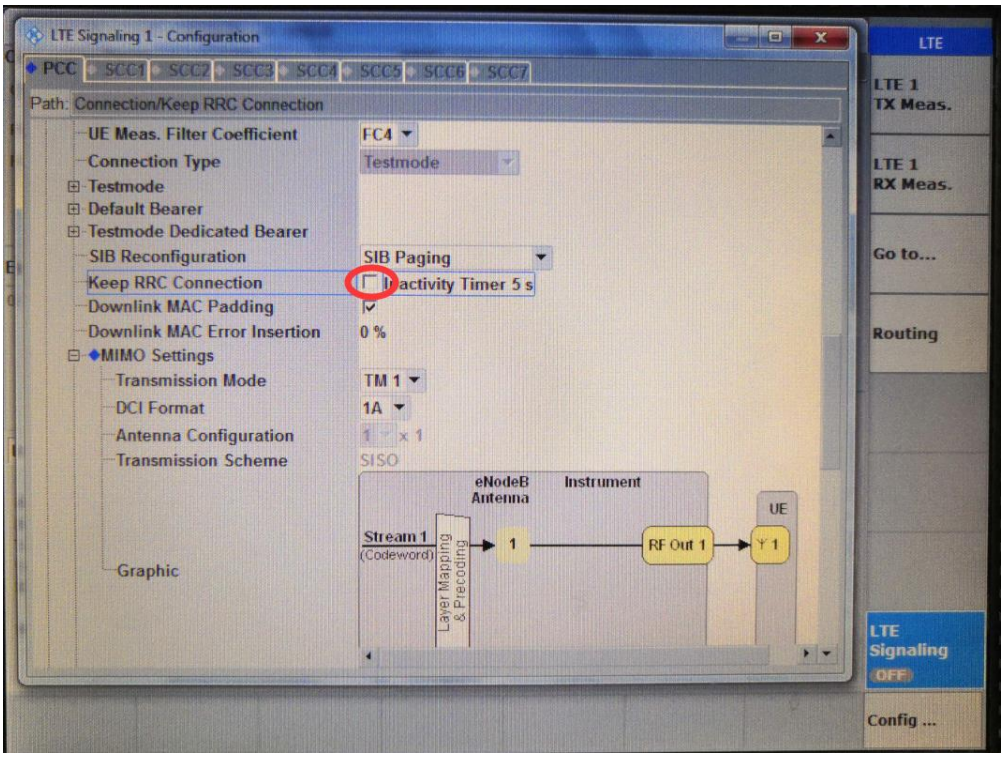

Figure 2: Uncheck "Keep RRC Connection"

And then execute **AT+QCFG="div_test_mode",1**. After this command is executed successfully, press the button "**Connect**" on CMW500 to manually connect to the network.

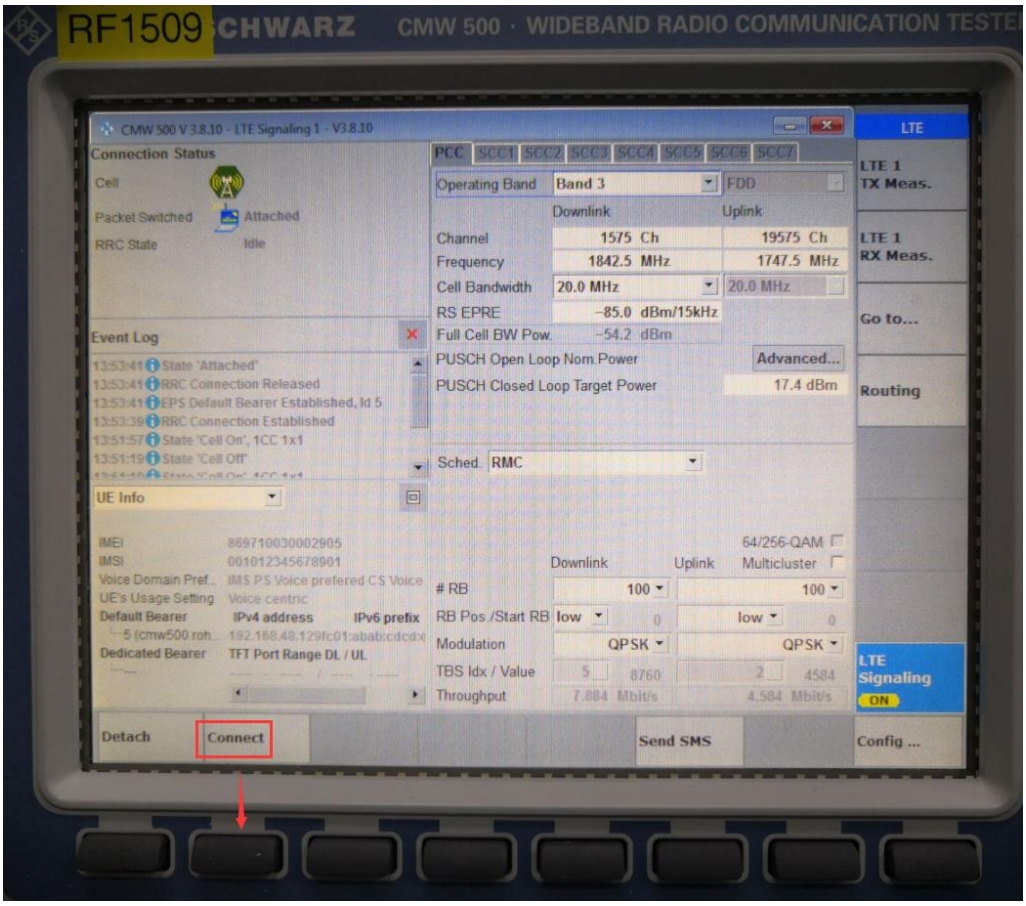

Figure 3: Connect to the Network

After network connection is successful, execute the following commands to enable the single RX chain. Then you can confirm whether the RX chain is enabled through **AT+QRSRP?**. If the return value is -80, it indicates the RX chain is enabled successfully; if the return value is -32768 or -140, it indicates the RX chain fails to be enabled, as shown below.

```
AT+QCFG="div_test_mode",1                  //Initialize RX chain state in LTE mode.
OK
AT+QCFG="diversity/config",0,1,0           //Enable RX0 only.
OK
AT+QCFG="diversity/config",0,2,0           //Enable RX1 only.
OK
AT+QCFG="diversity/config",0,3,0           //Enable RX2 only .
OK
AT+QCFG="diversity/config",0,4,0           //Enable RX3 only .
OK
AT+QRSRP?                                  //Query RSRP.
+QRSRP: -32768,-32768,-32768,-80,LTE       //RX3 is enabled.

OK
```

NOTE

1. If you switch to another channel or band, please enable the RX chain again after the module reconnected to the network. Rebooting the module will cause the single RX chain to be invalid.
2. After the RX chain is enabled in LTE mode, the order of the return values of **AT+QRSRP?** is the same as the order of the RX chains. For more details about **AT+QRSRP?**, see ***document [1]***.

3.2.4.2. In NR5G

Connect all antennas of the module to 5G call box through the power splitter and make the module enter FTM with **AT+QFTMMODE=1** (see ***Chapter 3.1.1*** for details).The module goes offline after entering FTM.

```
AT+QFTMMODE=1                       //Enter FTM
OK
//Enable the single RX chain
AT+QCFG="diversity/config",1,1,0    //Enable RX0 only.
OK
AT+QCFG="diversity/config",1,2,0    //Enable RX1 only.
OK
AT+QCFG="diversity/config",1,3,0    //Enable RX2 only.
OK
AT+QCFG="diversity/config",1,4,0    //Enable RX3 only.
OK
//Switch to online mode.
AT+QFTMMODE=0
OK
AT+QRSRP?                           //Query RSRP.
+QRSRP: -80,-140,-140,-140,NR5G     //RX3 is enabled.

OK
```

After switching to online mode, the module is connected to 5G network automatically. At this time, you can confirm whether the RX chain is enabled through **AT+QRSRP?**.

NOTE

1. If you switch to another channel or band, the single RX chain feature still takes effect. Rebooting the module will cause the single RX chain to be invalid.
2. After the RX chain is enabled in NR5G, the first value returned by executing **AT+QRSRP?** determines whether this RX chain is enabled, and the other three values are invalid. If the first value is -80, this RX chain is enabled successfully; if the first value is -32768 or -140, this RX chain

fails to be enabled.

3.3. Power Backoff Related AT Commands

3.3.1. AT+QSAR Enable/Disable SAR Power Backoff

This command enables or disables SAR power backoff. This command is applicable to legacy SAR and smart transmit.

AT+QSAR Enable/Disable SAR Power Backoff	
Test Command **AT+QSAR=?**	Response **+QSAR: (**list of supported **<level>s),(**list of supported **<saved>**s**)** **OK**
Read Command **AT+QSAR?**	Response **+QSAR: <level>** **OK**
Write Command **AT+QSAR=<level>[,<saved>]**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. **<saved>** determines whether the configuration is saved to NVM.

Parameter

<level>	Integer type.	
	0	Disable SAR power backoff.
	1–20	SAR power backoff level which corresponds to Index 1–20
<saved>	Integer type.	Whether to save the configuration to NVM.
	0	Not save
	1	Save. The configuration is still valid after the module is rebooted.

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with

a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QSAR=?                 //Test command
+QSAR: (0-20),(0,1)

OK
AT+QSAR?                  //Read command
+QSAR: 2

OK
AT+QSAR=2,1               //Set SAR power backoff level to index 2 and save the configuration to NVM.
OK
```

3.3.2. AT+QMTPLCFG Set Maximum TX Power for WCDMA/LTE/NR5G Band

This command sets the maximum TX power for WCDMA/LTE/NR5G band.

AT+QMTPLCFG Set Maximum TX Power for WCDMA/LTE/NR5G Band	
Test Command **AT+QMTPLCFG=?**	Response **+QMTPLCFG: (**list of supported **<tech>**s**),(**list of supported **<enable>**s**),(**list of supported **<mtpl_adjust>**s**)** **OK** If there is any error: **ERROR**
Write Command **AT+QMTPLCFG=<tech>,<enable>,<mtpl_adjust>**	Response **OK** Or **ERROR**

Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configurations are not saved.

Parameter

<tech>	Integer type. Network mode. 0 WCDMA 1 LTE 2 NR5G
<enable>	Integer type. Disable/Enable power back-off. 0 Disable 1 Enable
<mtpl_adjust>	Integer type. The maximum TX power value to be set, which is only valid when **<enable>** is 1. This value needs to be set to a multiple of 10. Range: -440–290. Unit: 0.1 dBm.

NOTE

1. This command sets the maximum TX power value for different network modes, regardless of specific bands.
2. This command does not support querying the current configuration.

Example

```
AT+QMTPLCFG=?
+QMTPLCFG: (0-2),(0,1),(-440-290)

OK
AT+QMTPLCFG=1,1,200          //Enable power backoff function and set the maximum TX power value to 20 dBm for LTE band.
OK
```

3.3.3. AT+QXQCN Activate XQCN File Configured in Firmware

Test Command queries a list of XQCN files configured in the firmware; Read Command queries the XQCN file activated in firmware; Write Command activates the XQCN file configured in firmware. Power parameters are stored in XQCN file.

AT+QXQCN Activate XQCN File Configured in Firmware	
Test Command **AT+QXQCN=?**	Response **+QXQCN: <fileID>,<file_name>,<groupID>**

	… **OK**
Read Command **AT+QXQCN?**	Response **+QXQCN: <fileID>[,<file_name>,<groupID>** **[…]]** **OK**
Write Command **AT+QXQCN=<fileID>[,<groupID>]**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	This command takes effect after the module is rebooted. The configurations are saved automatically.

Parameter

<fileID>	Integer type. XQCN file ID. 0 is the default value, indicating that the XQCN file configured in firmware is not activated.
<file_name>	String type without double quotes. XQCN file name.
<groupID>	Integer type. XQCN group ID. Range: 1–8. Default value: 1.

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QXQCN?            //Query the current configuration.
+QXQCN: 0

OK
AT+QXQCN=1,1         //Activate the XQCN file in the firmware where <fileID> is 1 and <groupID> is 1.
OK
AT+QXQCN=3,2         //Activate the XQCN file in the firmware where <fileID> is 3 and <groupID> is 2.
OK
AT+QXQCN=?           //Query a list of XQCN files configured in the firmware.
+QXQCN: 1,RG650VEU_grp1qcn_20230210,1
+QXQCN: 3,RG650VEU_grp2qcn_20230610,2

OK
```

3.4. 8RX Related AT Commands

3.4.1. AT+Q8RX Enable/Disable 8RX

This command enables or disables 8RX.

AT+Q8RX Enable/Disable 8RX	
Test Command **AT+Q8RX=?**	Response **+Q8RX: (**list of supported **<8RX_enable>**s**)** **OK**
Read Command **AT+Q8RX?**	Response **+Q8RX: <8RX_enable>** **OK** If there is any error: **ERROR**
Write Command **AT+Q8RX=<8RX_enable>**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration is saved automatically.

Parameter

<8RX_enable>	Integer type. Enable/Disable 8RX. 0 Disable 1 Enable

NOTE

In order to prolong the lifespan of the eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+Q8RX=?
+Q8RX: (0,1)

OK
AT+Q8RX?
+Q8RX: 1

OK
AT+Q8RX=0
OK
//Reboot the module
AT+Q8RX?
+8RX: 0

OK
```

3.5. AT+QCMWSCAN Query Hardware Physical Device Information

This command queries hardware physical device information. If the returned **<device_status>** is "MISSING_FATAL", it indicates that the device under test is offline, that is the device is missing.

AT+QCMWSCAN Query Hardware Physical Device Information	
Test Command **AT+QCMWSCAN=?**	Response **OK**
Read Command **AT+QCMWSCAN?**	Response **+QCMWSCAN: <hardwareID>,<feature_setID>,<RFC_CMW_initial_status>** **+QCMWSCAN: <deviceID>,<manufactID>,<productID>,<device_status>** **[+QCMWSCAN: <deviceID>,<manufactID>,<productID>,<device_status>** **…]** **OK**
Maximum Response Time	300 ms
Characteristic	-

Parameter

<hardwareID>	Integer type. Hardware ID.
<feature_setID>	Integer type. Feature setting ID.
<RFC_CMW_initial_status>	Integer type. Initial status of RFC and CMW. 2 Successful 3 Failed
<deviceID>	String type. Device ID.
<manufactID>	Integer type in hexadecimal. Manufacturer ID.
<productID>	Integer type in hexadecimal. Product ID.
<device_status>	String type. Device status. "PRESNET" Online "MISSING_FATAL" Offline

Example

```
AT+QCMWSCAN=?
OK
AT+QCMWSCAN?
+QCMWSCAN: 896,0,2
```

```
+QCMWSCAN: 0,0X42E,0X1FDA,"PRESENT"
+QCMWSCAN: 1,0X42E,0X678,"PRESENT"
+QCMWSCAN: 2,0X42E,0X3FA,"PRESENT"
+QCMWSCAN: 3,0X42E,0XE24,"PRESENT"
+QCMWSCAN: 4,0X42E,0X678,"PRESENT"
+QCMWSCAN: 5,0X42E,0X3FA,"PRESENT"
+QCMWSCAN: 6,0X42E,0XE22,"PRESENT"
+QCMWSCAN: 7,0X42E,0X35C,"PRESENT"
+QCMWSCAN: 8,0X702,0XE4,"PRESENT"
+QCMWSCAN: 9,0X728,0X120,"PRESENT"
+QCMWSCAN: 10,0X702,0XB0,"PRESENT"
+QCMWSCAN: 11,0X702,0X190,"PRESENT"
+QCMWSCAN: 12,0X702,0X190,"PRESENT"
+QCMWSCAN: 13,0X360,0X4ECA,"PRESENT"
+QCMWSCAN: 14,0X42E,0X83A,"PRESENT"
+QCMWSCAN: 15,0X42E,0X1020,"PRESENT"
+QCMWSCAN: 16,0X42E,0X4BA,"PRESENT"
+QCMWSCAN: 17,0X702,0X190,"PRESENT"
+QCMWSCAN: 18,0X702,0XE4,"PRESENT"
+QCMWSCAN: 19,0X728,0X120,"PRESENT"
+QCMWSCAN: 20,0X42E,0X1428,"PRESENT"
+QCMWSCAN: 21,0X42E,0X1028,"PRESENT"
+QCMWSCAN: 22,0X42E,0X4BA,"PRESENT"
+QCMWSCAN: 23,0X42E,0X4C6,"PRESENT"
+QCMWSCAN: 24,0X702,0XE4,"PRESENT"
+QCMWSCAN: 25,0X42E,0X4C0,"PRESENT"
+QCMWSCAN: 26,0X702,0XEA,"PRESENT"
+QCMWSCAN: 27,0X702,0XAA,"PRESENT"

OK
```

3.6. AT+QRFCALIBRATE Query Factory Calibration Status

This command queries the factory calibration status to check whether the factory calibration information exists.

AT+QRFCALIBRATE Query Factory Calibration Status	
Test Command **AT+QRFCALIBRATE=?**	Response **+QRFCALIBRATE: (**list of supported **<value>**s**)** **OK**

Read Command **AT+QRFCALIBRATE?**	Response **+QRFCALIBRATE: <value>** **OK**
Maximum Response Time	300 ms
Characteristic	-

Parameter

<value> Integer type. Factory calibration status.

0 The module is not calibrated by the factory or the factory calibration information is erased.

1 The module is calibrated by the factory.

NOTE

The command does not support querying whether the calibration information that is not calibrated by the factory exists.

Example

```
AT+QRFCALIBRATE=?                  //Test Command
+QRFCALIBRATE: (0,1)

OK
AT+QRFCALIBRATE?                   //Query whether the module is calibrated by the factory.
+QRFCALIBRATE: 0                   //The module is not calibrated by the factory or the calibration
                                    information is erased.

OK
```

3.7. AT+QSRS Enable/Disable SRS Antenna Switch Feature

This command enables or disables SRS antenna switch feature.

AT+QSRS Enable /Disable SRS Antenna Switch Feature	
Test Command **AT+QSRS=?**	Response **+QSRS: (**list of supported **<NR_enable>**s**),(**list of supported **<MRDC_enable>**s**)**

	OK
Read Command **AT+QSRS?**	Response **+QSRS: <NR_enable>,<MRDC_enable>** **OK** If there is any error: **ERROR**
Write Command **AT+QSRS=<NR_enable>,<MRDC_enable>**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristic	The command takes effect after the module is rebooted. The configurations are saved automatically.

Parameter

<NR_enable>	Integer type. Enable or disable SRS antenna switch feature in SA mode. 0 Disable 1 Enable
<MRDC_enable>	Integer type. Enable or disable SRS antenna switch feature in NSA mode. 0 Disable 1 Enable

NOTE

1. This command only controls the SRS antenna switch feature. If you do not use the Write Command to set the parameter values, you cannot use the Read Command to query the initial status of SRS antenna switch feature.
2. In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configurations, there is no need to use **AT+QEFSSYNC=1** for immediate saving. If performing related functions that depend on the modified NV configurations, first check with an AT

command whether the read NV configuration is the expected modified configuration. If it is not, modify it using the AT command.

Example

```
AT+QSRS=?                   //Test Command.
+QSRS: (0,1),(0,1)

OK
AT+QSRS=0,0                 //Disable SRS antenna switch feature in NA and NSA modes.
OK
AT+QSRS?                    //Query the status of SRS antenna switch feature.
+QSRS:0,0

OK
```

3.8. AT+QPC1DOT5 Enable or Disable Power Class 1.5

This command enables or disables Power Class 1.5.

AT+QPC1DOT5 Enable or Disable Power Class 1.5	
Test Command **AT+QPC1DOT5=?**	Response **+QPC1DOT5: (**list of supported **<enable>**s**)** **OK**
Read Command **AT+QPC1DOT5?**	Response **+QPC1DOT5: <enable>** **OK** If there is any error: **ERROR**
Write Command **AT+QPC1DOT5=<enable>**	Response **OK** Or **ERROR**
Maximum Response Time	150 ms
Characteristics	The command takes effect after the module is rebooted. The configuration is saved automatically.

Parameter

<enable>	Integer type. Enable or disable Power Class 1.5.	
	0	Disable
	1	Enable

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QPC1DOT5=?          //Test Command
+QPC1DOT5: (0,1)

OK
AT+QPC1DOT5?           //Query whether the PC1.5 is enabled or not.
+QPC1DOT5: 0

OK
AT+QPC1DOT5=1          //Enable PC1.5.
OK
AT+QPC1DOT5=0          //Disable PC1.5.
OK
AT+QPC1DOT5?           //Query whether the PC1.5 is enabled or not.
+QPC1DOT5: 0

OK
```

3.9. AT+QASDIV Enable or Disable ASDIV Feature

This command enables or disables ASDIV feature.

AT+QASDIV Enable or Disable ASDIV Feature	
Test Command **AT+QASDIV=?**	Response **+QASDIV: (**list of supported **<enable>**s**)** **OK**
Read Command **AT+QASDIV?**	Response **+QASDIV: <enable>** **OK** If there is any error: **ERROR**
Write Command **AT+QASDIV=<enable>**	Response **OK** Or **ERROR**
Maximum Response Time	150 ms
Characteristics	The command takes effect after the module is rebooted. The configuration is saved automatically.

Parameter

<enable>	Integer type. Enable or disable ASDIV feature. 0 Disable 1 Enable

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For

non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QASDIV=?                 //Test Command
+QASDIV: (0,1)

OK
AT+QASDIV?                  //Query whether ASDIV feature is enabled or not..
+QASDIV: 0                  //ASDIV feature is disabled.

OK
AT+QASDIV=1                 //Enable ASDIV feature.
OK
AT+QASDIV=0                 //Disable ASDIV feature.
OK
AT+QASDIV?                  //Query whether ASDIV feature is enabled or not.
+QASDIV: 0

OK
```

3.10. AT+QNRULMIMO Enable or Disable NR5G Uplink MIMO Feature

This command enables or disables NR5G uplink MIMO feature.

AT+QNRULMIMO Enable or Disable NR5G Uplink MIMO Feature	
Test Command **AT+QNRULMIMO=?**	Response **+QNRULMIMO: (**list of supported **<enable>**s**)** **OK**
Read Command **AT+QNRULMIMO?**	Response **+QNRULMIMO: <enable>** **OK** If there is any error:

	ERROR
Write Command **AT+QNRULMIMO=<enable>**	Response **OK** Or **ERROR**
Maximum Response Time	150 ms
Characteristics	The command takes effect after the module is rebooted. The configuration is saved automatically.

Parameter

<enable>	Integer type. Enable or disable NR5G uplink MIMO feature.	
	0	Disable
	1	Enable

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QNRULMIMO=?          //Test Command
+QNRULMIMO: (0,1)

OK
AT+QNRULMIMO?           //Query whether NR5G uplink MIMO feature is enabled or not.
+QNRULMIMO: 1           //NR5G uplink MIMO feature is disabled.

OK
```

```
AT+QNRULMIMO=0          //Disable NR5G uplink MIMO feature.
OK
AT+QNRULMIMO?           //Query whether NR5G uplink MIMO feature is enabled or not.
+QNRULMIMO: 0

OK
```

3.11. mmWave Related AT Commands

NOTE

mmWave and other related AT commands are only applicable to RG651E-NA and RM551E-GL modules.

3.11.1. AT+QMMWENABLE Enable/Disable mmWave

This command enables or disables mmWave.

AT+QMMWENABLE Enable/Disable mmWave	
Test Command **AT+QMMWENABLE=?**	Response **+QMMWENABLE: (**list of supported **<status>**s**)** **OK**
Read Command **AT+QMMWENABLE?**	Response **+QMMWENABLE: <status>** **OK**
Write Command **AT+QMMWENABLE=<status>**	Response **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration is saved automatically.

Parameter

<status>	Integer type. Enable/disable mmWave. 0 Disable 1 Enable

NOTE

In order to prolong the lifespan of the module eMMC, chip manufacturers have implemented a mechanism where writing NV data to the EFS partition is delayed by 90 seconds before saving. This indicates that the NV configuration modified by an AT command will be saved to the EFS partition with a delay of 90 seconds after successful execution. When modifying NV configurations with an AT command, if a sudden power failure occurs, the modified NV configuration will fail to save, and the modifications will be invalid. To save the critical NV configuration immediately, please execute **AT+QEFSSYNC=1** to forcibly save it (For details about AT command, see ***document [1]***). Please note that, to prolong the lifespan of the eMMC storage, frequent execution of **AT+QEFSSYNC=1** to immediately save non-critical NV configurations and repeated modifications are not recommended. For non-critical NV configuration items, it is not necessary to immediately execute the **AT+QEFSSYNC=1** command to save changes after modification. However, if the execution of subsequent functions depends on the correctness of this configuration, it is recommended to read and verify whether the NV configuration value has been updated to the expected value via the corresponding AT command before proceeding. If the read value does not match the expected value, please modify the configuration again.

Example

```
AT+QMMWENABLE=?
+QMMWENABLE: (0,1)

OK
AT+QMMWENABLE=1
OK
//Reboot the module
AT+QMMWENABLE?
+QMMWENABLE: 1

OK
```

3.11.2. AT+QMMWSCAN Query mmWave Antenna Information

This command queries mmWave antenna information. If the returned **<device_status>** is "MISSING_FATAL", it indicates that the device under test is offline, that is the device is missing.

AT+QMMWSCAN Query mmWave Antenna Information	
Test Command **AT+QMMWSCAN=?**	Response **OK**
Read Command **AT+QMMWSCAN?**	Response **+QMMWSCAN: <deviceID>,<manufactID><productID>,<device_status>**

	[+QMMWSCAN: <deviceID>,<manufactID>,<productID>,<device_status> **…]** **OK** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	-

Parameter

<deviceID>	Integer type. Device ID.	
<manufactID>	Integer type in hexadecimal. Manufacturer ID.	
<productID>	Integer type in hexadecimal. Product ID.	
<device_status>	String type. Device status.	
	"PRESNET"	Online
	"MISSING_FATAL"	Offline (mmWave is unavailable)
	"MISSING_NON_FATAL"	Non-fatal offline (mmWave is still available)

Example

```
AT+QMMWSCAN=?
OK
AT+QMMWSCAN?                    //Query mmWave antenna information.
+QMMWSCAN: 0,0x1fe,0xa4c,PRESENT
+QMMWSCAN: 1,0x42e,0x1d6,PRESENT
+QMMWSCAN: 2,0x42e,0x1d6,PRESENT
+QMMWSCAN: 3,0x42e,0x1d6,PRESENT
+QMMWSCAN: 4,0x42e,0x1d6,PRESENT
+QMMWSCAN: 5,0x42e,0x1d6,PRESENT
+QMMWSCAN: 6,0x42e,0x1d6,PRESENT
+QMMWSCAN: 7,0x42e,0x1d6,PRESENT
+QMMWSCAN: 8,0x42e,0x1d6,PRESENT
+QMMWSCAN: 9,0x42e,0x7e,PRESENT
+QMMWSCAN: 10,0x42e,0x7e,PRESENT
+QMMWSCAN: 11,0x42e,0x7e,PRESENT
+QMMWSCAN: 12,0x42e,0x7e,PRESENT
+QMMWSCAN: 13,0x42e,0x7e,PRESENT
+QMMWSCAN: 14,0x42e,0x7e,PRESENT
+QMMWSCAN: 15,0x42e,0x7e,PRESENT
```

```
+QMMWSCAN: 16,0x42e,0x7e,PRESENT

OK
```

3.11.3. AT+QRFTESTMMW mmWave TX/RX Test in FTM

This command performs mmWave TX/RX tests in FTM.

AT+QRFTESTMMW mmWave TX/RX Test in FTM	
Test Command **AT+QRFTESTMMW=?**	Response **+QRFTESTMMW: "tx",<moduleID>,<band>,<TX_RGI>** **+QRFTESTMMW: "rx",<moduleID>,<band>** **+QRFTESTMMW: "mode",(**list of supported **<mode>**s**)** **OK**
Write Command **AT+QRFTESTMMW="mode",<mode>**	Response **OK** Or **ERROR**
Write Command **AT+QRFTESTMMW="tx",<moduleID>,<band>,<TX_RGI>**	Response **OK** Or **ERROR**
Write Command **AT+QRFTESTMMW="rx",<moduleID>,<band>**	Response **+QRFTESTMMW: <RX_AGC>** **OK** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configurations are not saved.

Parameter

<mode>	Integer type. Enter/Exit FTM. 0 Exit FTM 1 Enter FTM
<moduleID>	Integer type. Antenna ID. 0 QTM565 0

	1 QTM565 1 2 QTM565 2 3 QTM565 3 10 QTM567
<band>	Integer type. mmWave band. 257 n257 258 n258 260 n260 261 n261
<TX_RGI>	Integer type. The TX power index. See ***Table 3*** and ***Table 4*** for the correspondance between **<TX_RGI>** and the output TX power value. The maximum value is 50.
<RX_AGC>	Float type. The actual received signal strength. Unit: dBm.

Table 3: Correspondence Between <TX_RGI> of mmWave Antenna QTM565 and TX Power

<TX_RGI>	TX Power (+/- 1 dBm)
30	2
40	11
50	18

Table 4: Correspondence Between <TX_RGI> of mmWave Antenna 2 x QTM567 and TX Power

<TX_RGI>	TX Power (+/- 1 dBm)
20	10
30	23
40	31
50	40

NOTE

When testing the QTM567 TX functionality, all QTM567 mmWave antennas will be enabled.

Example

```
AT+QRFTESTMMW="mode",1                    //Enter FTM
OK
```

```
AT+QRFTESTMMW="tx",1,261,50          //mmWave TX Test in FTM
OK
AT+QRFTESTMMW="rx",1,261             //mmWave RX Test in FTM
+QRFTESTMMW: -49.3

OK
AT+QRFTESTMMW="mode",0               //Exit FTM
OK
```

4 Appendix A References

Table 5: Terms and Abbreviations

Document Name
[1] Quectel_RG65xE&RG650V&RM551E_Series_AT_Commands_Manual

Table 6: Terms and Abbreviations

Abbreviation	Description
ASDIV	Antenna Switch Diversity
BW	Bandwidth
CA	Carrier Aggregation
CDMA	Code Division Multiple Access
DRX	Discontinuous Reception
eMMC	Embedded Multimedia Card
FTM	Factory Test Mode
GSM	Global System for Mobile Communications
HDR	High Data Rate
ID	Identifier
LTE	Long Term Evolution
mmWave	Millimeter Wave
NSA	Non-Standalone
PC	Power Class

PCC	Primary Component Carrier
PRX	Primary Receive
RB	Resource Block
RF	Radio Frequency
RX	Receive
SA	Standalone
SAR	Specific Absorption Rate
SCS	Sub Carrier Spacing
SRS	Sounding Reference Signal
TA	Terminal Adapter
TX	Transmit
TDS	Time Division-Synchronous Code Division Multiple Access
UE	User Equipment
WCDMA	Wideband Code Division Multiple Access

5 Appendix B Channel Distribution

Table 7: Channel Distribution of WCDMA Bands

Network Mode	Band	Range of RX Channels			Range of TX Channels		
		Min	Mid	Max	Min	Mid	Max
WCDMA	B1	10562	10700	10838	9612	9750	9888
	B2	9662	9800	9938	9262	9400	9538
	B3	1162	1338	1513	937	1113	1288
	B4	1537	1638	1738	1312	1413	1513
	B5	4357	4408	4458	4132	4183	4233
	B8	2937	3013	3088	2712	2788	2863
	B9	9237	9312	9387	8762	8837	8912
	B11	3712	3750	3787	3487	3525	3562
	B19	712	738	763	312	338	363

Table 8: Channel Distribution of LTE Bands

Network Mode	Band	Range of RX Channels			Range of TX Channels		
		Min	Mid	Max	Min	Mid	Max
LTE	B1	0	300	599	18000	18300	18599
	B2	600	900	1199	18600	18900	19199
	B3	1200	1575	1949	19200	19575	19949
	B4	1950	2175	2399	19950	20175	20399
	B5	2400	2525	2649	20400	20525	20649

B7	2750	3100	3449	20750	21100	21449
B8	3450	3625	3799	21450	21625	21799
B9	3800	3975	4149	21800	21975	22149
B10	4150	4450	4749	22150	22450	22749
B11	4750	4850	4949	22750	22850	22949
B12	5010	5095	5179	23010	23095	23179
B13	5180	5230	5279	23180	23230	23279
B14	5280	5330	5379	23280	23330	23379
B17	5730	5790	5849	23730	23790	23849
B18	5850	5925	5999	23850	23925	23999
B19	6000	6075	6149	24000	24075	24149
B20	6150	6300	6449	24150	24300	24449
B21	6450	6525	6599	24450	24525	24599
B22	6600	7000	7399	24600	25000	25399
B23	7500	7600	7699	25500	25600	25699
B24	7700	7870	8039	25700	25870	26039
B25	8040	8365	8689	26040	26365	26689
B26	8690	8865	9039	26690	26865	27039
B27	9040	9125	9209	27040	27125	27209
B28	9210	9435	9659	27210	27435	27659
B29	9660	9715	9769	-	-	-
B30	9770	9820	9869	27660	27710	27759
B31	9870	9895	9919	27760	27785	27809
B32	9920	10140	10359	-	-	-
B33	36000	36100	36199	36000	36100	36199

	B34	36200	36275	36349	36200	36275	36349
	B35	36350	36650	36949	36350	36650	36949
	B36	36950	37250	37549	36950	37250	37549
	B37	37550	37650	37749	37550	37650	37749
	B38	37750	38000	38249	37750	38000	38249
	B39	38250	38450	38649	38250	38450	38649
	B40	38650	39150	39649	38650	39150	39649
	B41	39650	40620	41589	39650	40620	41589
	B42	41590	42590	43589	41590	42590	43589
	B43	43590	44590	45589	43590	44590	45589
	B46	46790	50665	54539	46790	50665	54539
	B47	54540	54890	55239	54540	54890	55239
	B48	55240	55990	56739	55240	55990	56739
	B66	66436	66886	67335	131972	132322	132671
	B70	68336	68461	68585	132972	133047	133121
	B71	68586	68761	68935	133122	133297	133471

Table 9: Channel Distribution of NR5G Bands

Network Mode	Band	Range of RX Channels			Range of TX Channels		
		Min	Mid	Max	Min	Mid	Max
NR5G	n1	422000	428000	434000	384000	390000	396000
	n2	386000	392000	398000	370000	376000	382000
	n3	361000	368500	376000	342000	349500	357000
	n5	173800	176300	178800	164800	167300	169800
	n7	524000	531000	538000	500000	507000	514000
	n8	185000	188500	192000	176000	179500	183000

n12	145800	147500	149200	139800	141500	143200
n13	149200	150200	151200	155400	156400	157400
n14	151600	152600	153600	157600	158600	159600
n18	172000	173500	175000	163000	164500	166000
n20	158200	161200	164200	166400	169400	172400
n25	386000	392500	399000	370000	376500	383000
n26	171800	175300	178800	162800	166300	169800
n28	152600	156100	159600	141600	145100	148600
n29	143400	144500	145600	-	-	-
n30	470000	471000	472000	461000	462000	463000
n34	402000	403500	405000	402000	403500	405000
n38	514000	519000	524000	514000	519000	524000
n39	376000	380000	384000	376000	380000	384000
n40	460000	470000	480000	460000	470000	480000
n41	499200	518598	537999	499200	518598	537999
n46	743333	769167	795000	743333	769167	795000
n48	636668	641668	646666	636668	641668	646666
n50	286400	294900	303400	286400	294900	303400
n66	422000	431000	440000	342000	349000	356000
n70	399000	401500	404000	339000	340500	342000
n71	123400	126900	130400	132600	136100	139600
n75	286400	294900	303400	-	-	-
n76	285400	285900	286400	-	-	-
n77	620000	650000	680000	620000	650000	680000
n78	620000	636666	653333	620000	636666	653333
n79	693334	713334	733333	693334	713334	733333