RGx00U&RM500U Series
RF FTM Application Note

5G Module Series

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About the Document

Revision History

Version	Date	Author	Description
-	2023-10-11	Lenz ZHANG	Creation of the document
1.0	2023-11-09	Lenz ZHANG	First official release

Contents

Table Index

1 Introduction

The document describes the AT commands that are used to test the receiving and transmitting performance of Quectel 5G RG200U series, RG500U series and RM500U series modules in FTM (Factory Test Mode), to facilitate RF calibration.

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 command line.
- **[...]**   Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on command line. When an optional parameter is omitted, the new value equals its previous value or its default setting, unless otherwise specified.
- <u>**Underline**</u>   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 1: Type of AT Commands and Responses

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 how to use 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.

2.3. Description of RF FTM AT Commands

2.3.1. AT+QRFTEST   RF Test in FTM Under WCDMA/LTE/5G

AT+QRFTEST RF Test in FTM Under WCDMA/LTE/5G	
Test Command **AT+QRFTEST=?**	Response **+QRFTEST: "rx",<type>,<band>,<bw>,<channel>,<chain_idx>,<expected_rxagc>** **+QRFTEST: "tx",<type>,<band>,<bw>,<channel>,<TX_enable>,<TX_power>** **+QRFTEST: "mode",(list of supported <mode>s)** **OK**
Write Command Query/Set FTM **AT+QRFTEST="mode"[,<mode>]**	Response If the optional parameter is omitted, query the current setting: **+QRFTEST: <mode>** **OK** If the optional parameter is specified, set FTM mode: **OK** If there is any error: **ERROR**
Write Command RX test in FTM **AT+QRFTEST="rx",<type>,<band>,<bw>,<channel>,<chain_idx>,<expected_rxagc>**	Response **+QRFTEST: rssi[0] = <RSSI0>, rssi[1] = <RSSI1>, rssi[2] = -<RSSI2>, rssi[3] = <RSSI3>** **OK** If there is any error: **ERROR**
Write Command	Response

TX test in FTM **AT+QRFTEST="tx",<type>,<band>, <bw>,<channel>,<TX_enable>,<TX_ power>[,<ant_number>]**	**OK** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	This command takes effect immediately. The configurations are not saved.

Parameter

<mode>	Integer type. RF test mode.
	0 Online mode
	1 FTM
<type>	Integer type. WCDMA/LTE/5G configuration.
	0 WCDMA
	1 LTE
	2 5G
<band>	Integer type. WCDMA/LTE/5G Band.
	1 5G n1/LTE B1/WCDMA B1
	2 5G n2/LTE B2/WCDMA B2
	3 5G n3/LTE B3/WCDMA B3
	4 LTE B4/WCDMA B4
	5 5G n5/LTE B5/WCDMA B5
	6 LTE B6/WCDMA B6
	7 5G n7/LTE B7/WCDMA B7
	8 5G n8/LTE B8/WCDMA B8
	9 LTE B9/WCDMA B9
	10 LTE B10/WCDMA B10
	11 LTE B11/WCDMA B11
	……
	19 LTE B19/WCDMA B19
	20 5G n20/LTE B20
	28 5G n28/LTE B28
	……
<bw>	Integer type. WCDMA/LTE/5G bandwidth. Unit: MHz.
	0 1.4
	1 3
	2 5
	3 10
	4 15
	5 20
	6 40 (Applicable to 5G only)
	8 80 (Applicable to 5G only)

	10　100 (Applicable to 5G only)
<channel>	Integer type. RX/TX channel. See *table 2*, *table 3* and *table 4* for details.
<chain_idx>	Integer type. Receiving antenna index. (Not supported currently)
	0　PRX
	1　DRX
<expected_rxagc>	Integer type. Expected value of Rx AGC. The value of this parameter should be set to the signal strength sent on the radio communication tester. Unit: dBm. (Currently not supported)
<RSSIn>	Integer type. RSSI value of antenna.
<TX_enable>	Integer type. Enable/disable TX.
	0　　Disable
	1　　Enable
<TX_power>	Integer type. Transceiver output gain. This parameter has a positive correlation with the actual TX power. Unit: dBm. It is recommended to set it to 23.
<ant_number>	Integer type. Antenna configuration. This parameter is only configured in the 5G network and is omitted in the LTE and WCDMA networks.
	0　　Primary antenna
	1　　Secondary antenna

NOTE

1. For network modes and corresponding bands, see *table 2*, *table 3* and *table 4*.
2. After each RX/TX test of a network mode (5G/LTE/WCDMA), execute **AT+QRFTEST="mode",0** to exit FTM, then execute **AT+QRFTEST="mode",1** to reenter FTM before RX/TX testing of the next network mode.
3. When performing TX test in FTM, if you need to switch bands, first set **<TX_enable>** to 0 to disable the TX test, and then reconfigure the parameters.
4. The RSSI values returned by different modules correspond to different antenna ports. For the relationship between RSSI values and corresponding antenna ports, please refer to the relevant module's hardware design manual.
5. The demo test data for RX/TX tests can be obtained by contacting Quectel Technical Support.

Table 2: RX/TX Channel Distribution of 5G Bands

5G bands	RX channel Range Minimum–Maximum	TX channel Range Minimum–Maximum
n1	422000–434000	384000–396000
n2	386000–398000	370000–382000
n3	361000–376000	342000–357000
n5	173800–178800	164800–169800

n7	524000–538000	500000–514000
n8	185000–192000	176000–183000
n20	158200–164200	166400–172400
n28	151600–160600	140600–149600
n38	514000–524000	514000–524000
n41	499200–537999	499200–537999
n50	286400–303400	286400–303400
n51	285400–286400	285400–286400
n66	422000–440000	342000–356000
n70	399000–404000	339000–342000
n71	123400–130400	132600–139600
n74	295000–303600	285400–294000
n75	286400–303400	-
n76	285400–286400	-
n77	620000–680000	620000–680000
n78	620000–653333	620000–653333
n79	693334–733333	693334–733333

Table 3: RX/TX Channel Distribution of LTE Bands

LTE bands	RX channel Range Minimum–Default–Maximum	TX channel Range Minimum–Default–Maximum
LTE B1	0–300–599	18000–18300–18599
LTE B2	600–900–1199	18600–18900–19199
LTE B3	1200–1575–1949	19200–19575–19949
LTE B4	1950–2175–2399	19950–20175–20339
LTE B5	2400–2525–2649	20400–20525–20649

LTE B6	2650–2700–2749	20650–20700–20749
LTE B7	2750–3100–3449	20750–21100–21449
LTE B8	3450–3625–3799	21450–21625–21799
LTE B9	3800–3975–4149	21800–21975–22149
LTE B10	4150–4450–4749	22150–22450–22749
LTE B11	4750–4850–4949	22750–22850–22949
LTE B12	5000–5095–5179	23000–23095–23179
LTE B13	5180–5230–5279	23180–23230–23279
LTE B14	5280–5330–5379	23280–23330–23379
LTE B17	5730–5790–5849	23730–23790–23849
LTE B18	5850–5925–5999	23850–23925–23999
LTE B19	6000–6075–6149	24000–24075–24149
LTE B20	6150–6300–6449	24150–24300–24449
LTE B21	6450–6525–6599	24450–24525–24599
LTE B22	6600–7000–7399	24600–25000–25399
LTE B23	7500–7600–7699	25500–25600–25699
LTE B24	7700–7870–8039	25700–25870–26039
LTE B25	8040–8365–8689	26040–26365–26689
LTE B26	8690–8865–9039	26690–26865–27039
LTE B27	9040–9125–9209	27040–27125–27209
LTE B28	9210–9435–9659	27210–27435–27659
LTE B29	9660–9715–9769	27660–27710–27759
LTE B30	9770–9820–9869	27760–27785–27809
LTE B31	9870–9895–9919	25700–25870–26039
LTE B32	9920–10140–10359	-

LTE B33	36000–36100–36199	36000–36100–36199
LTE B34	36200–36275–36349	36200–36275–36349
LTE B35	36350–36650–36949	36350–36650–36949
LTE B36	36950–37250–37549	36950–37250–37549
LTE B37	37550–37650–37749	37550–37650–37749
LTE B38	37750–38000–38249	37750–38000–38249
LTE B39	38250–38450–38649	38250–38450–38649
LTE B40	38650–39150–39649	38650–39150–39649
LTE B41	39650–40620–41589	39650–40620–41589
LTE B42	41590–42590–43589	41590–42590–43589
LTE B43	43590–44590–45589	43590–44590–45589
LTE B46	46790–50665–54539	46790–50665–54539
LTE B47	54540–54885–55239	54540–54885–55239
LTE B48	55240–55940–56739	55240–55940–56739
LTE B66	66436–66886–67335	131972–132322–132671
LTE B71	68586–68761–68935	133122–133297–133471

Table 4: RX/TX Channel Distribution of WCDMA Bands

WCDMA bands	RX channel Range Minimum–Default–Maximum	TX channel Range Minimum–Default–Maximum
WCDMA B1	10562–10700–10838	9612–9750–9888
WCDMA B2	9662–9800–9938	9262–9400–9538
WCDMA B3	1162–1338–1513	937–1112–1288
WCDMA B4	1537–1638–1738	1312–1412–1513
WCDMA B5	4357–4408–4458	4132–4182–4233
WCDMA B6	4387–4400–4413	4162–4175–4188

WCDMA B7	2237–2400–2563	2012–2175–2338
WCDMA B8	2937–3012–3088	2712–2788–2863
WCDMA B9	9237–9312–9387	8762–8837–8912
WCDMA B10	3112–3250–3388	2887–3025–3163
WCDMA B11	3712–3762–3812	3487–3537–3587
WCDMA B19	712–738–763	312–338–363

2.3.2. CMW500 Configuration for RX Test

Signal sources which emit continuous waves can be used as the downlink CW signals. If you use the CMW500 to test the receiving performance, the following settings can be applied:

Figure 1: CMW500 Configuration
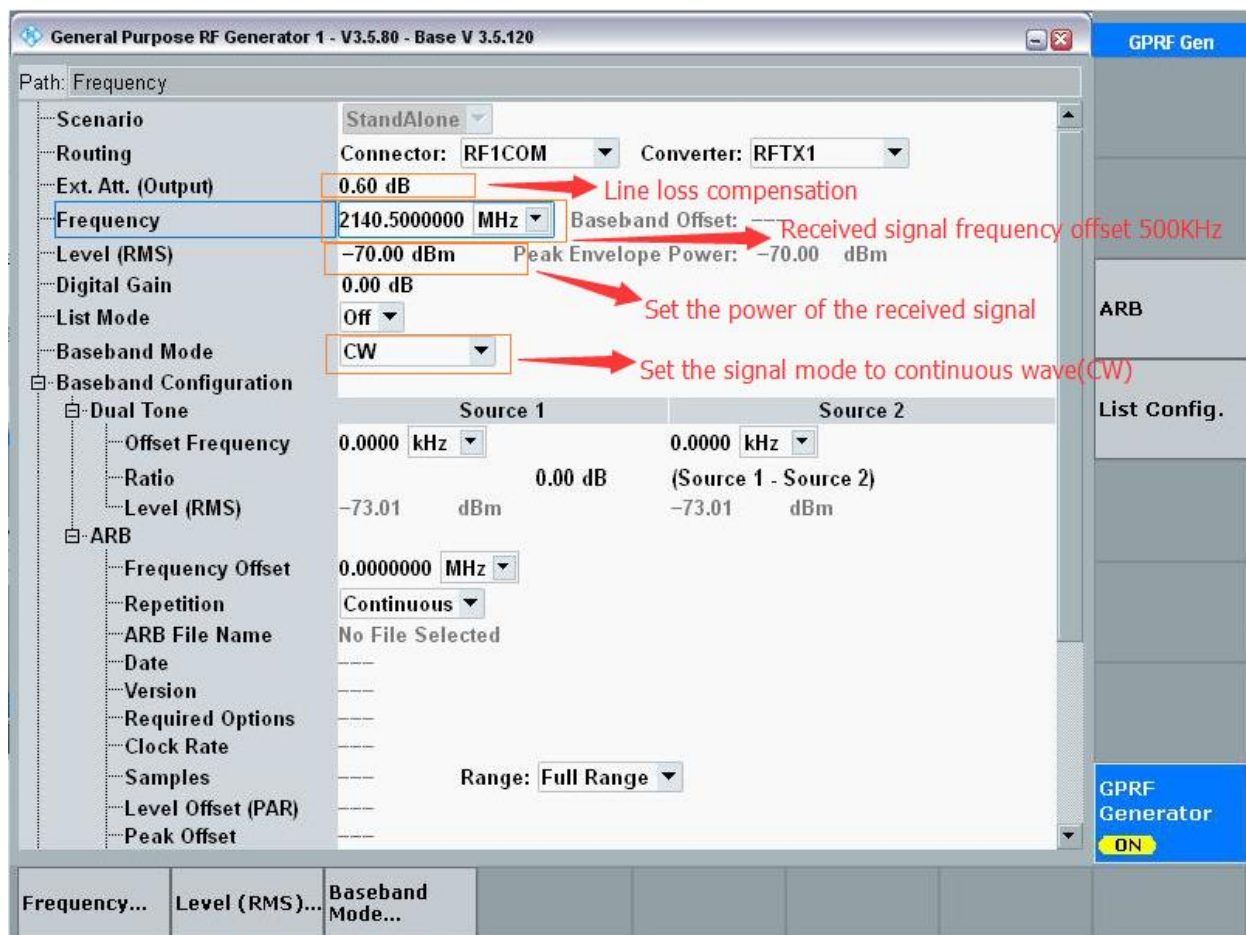
3 Example

```
AT+QRFTEST=?
+QRFTEST: "rx",<type>,<band>,<bw>,<channel>,<chain_idx>,<expected_rxagc>
+QRFTEST: "tx",<type>,<band>,<bw>,<channel>,<TX_enable>,<TX_power>
+QRFTEST: "mode",(0,1)

OK
//RX Test in FTM
AT+QRFTEST="mode"                       //Query the RF test mode
+QRFTEST: 0

OK
AT+QRFTEST="mode",1                     //Enter FTM
OK
AT+QRFTEST="rx",1,41,3,40620,0,-600     //Perform RX test for LTE B41
+QRFTEST: rssi[0] = -17608, rssi[1] = -8901, rssi[2] = -120, rssi[3] = -120
OK
AT+QRFTEST="mode",0                     //Exit FTM
OK
//TX test in FTM
AT+QRFTEST="mode"                       //Query the RF test mode
+QRFTEST: 0

OK
AT+QRFTEST="mode",1                     //Enter FTM
OK
AT+QRFTEST="tx",1,41,3,40620,1,23       //Perform TX test for LTE B41
OK
AT+QRFTEST="tx",1,41,3,40620,0,23       //Disable TX test of LTE B41
OK

AT+QRFTEST="tx",1,20,3,24300,1,23       //Perform TX test for LTE B20
OK
AT+QRFTEST="tx",1,20,3,24300,0,23       //Disable TX test of LTE B20
OK
AT+QRFTEST="mode",0                     //Exit FTM
OK
AT+QRFTEST="mode"                       //Query the RF test mode
```

```
+QRFTEST: 0

OK
AT+QRFTEST="mode",1              //Enter FTM
OK
AT+QRFTEST="tx",2,41,6,518601,1,23,0    //Perform TX test for 5G n41 primary antenna
OK
AT+QRFTEST="tx",2,41,6,518601,0,23,0    //Disable TX test of 5G n41 primary antenna
OK


AT+QRFTEST="tx",2,41,6,518601,1,23,1    //Perform TX test for 5G n41 secondary antenna
OK
AT+QRFTEST="tx",2,41,6,518601,0,23,1    //Disable TX test of 5G n41 secondary antenna
OK
AT+QRFTEST="mode",0              //Exit FTM
OK
```

4 **Appendix**

Table 5: Terms and Abbreviations

Abbreviation	Description
AGC	Automatic Gain Control
CW	Continuous Wave
DRX	Discontinuous Reception
FTM	Factory Test Mode
LTE	Long Term Evolution
PRX	Primary Receive
RF	Radio Frequency
RSSI	Received Signal Strength Indication
RX	Receive
TX	Transmit
WCDMA	Wideband Code Division Multiple Access