BG95&BG77&BG600L Series

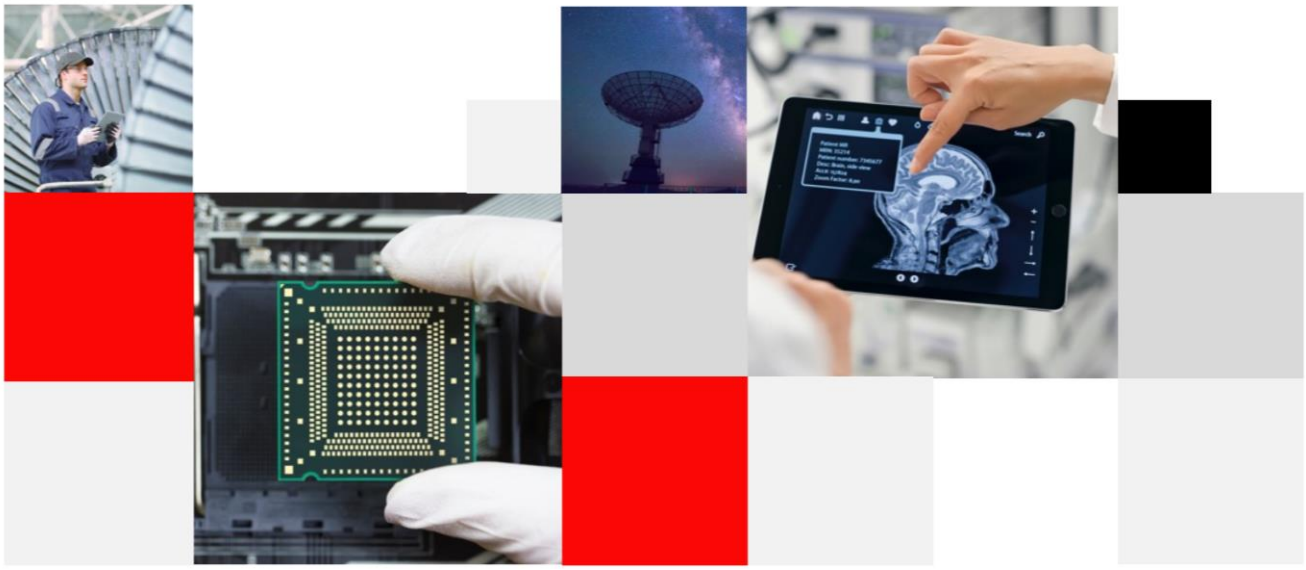
QuecCell Application Note

LPWA Module Series

Version: 1.0

Date: 2021-03-30

Status: Released



Build a Smarter World

Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:

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

Or our local office. For more information, please visit:
http://www.quectel.com/support/sales.htm.

For technical support, or to report documentation errors, please visit:
http://www.quectel.com/support/technical.htm
Or email to support@quectel.com.

General Notes

Quectel offers the information as a service to its customers. The information provided is based upon customers' requirements. Quectel makes every effort to ensure the quality of the information it makes available. Quectel does not make any warranty as to the information contained herein, and does not accept any liability for any injury, loss or damage of any kind incurred by use of or reliance upon the information. All information supplied herein is subject to change without prior notice.

Disclaimer

While Quectel has made efforts to ensure that the functions and features under development are free from errors, it is possible that these functions and features could contain errors, inaccuracies and omissions. Unless otherwise provided by valid agreement, Quectel makes no warranties of any kind, implied or express, with respect to the use of features and functions under development. To the maximum extent permitted by law, Quectel excludes all liability for any loss or damage suffered in connection with the use of the functions and features under development, regardless of whether such loss or damage may have been foreseeable.

Duty of Confidentiality

The Receiving Party shall keep confidential all documentation and information provided by Quectel, except when the specific permission has been granted by Quectel. The Receiving Party shall not access or use Quectel's documentation and information for any purpose except as expressly provided herein. Furthermore, the Receiving Party shall not disclose any of the Quectel's documentation and information to any third party without the prior written consent by Quectel. For any noncompliance to the above requirements, unauthorized use, or other illegal or malicious use of the documentation and information, Quectel will reserve the right to take legal action.

Copyright

About the Document

Revision History

Version	Date	Author	Description
-	2021-02-10	Lane HAO	Creation of the document
1.0	2021-03-30	Lane HAO	First official release

Contents

About the Document **3**
Contents **4**
Table Index **5**

1 Introduction **6**

2 Description of AT Commands **7**
2.1. AT Command Introduction 7
2.1.1. Definitions 7
2.1.2. AT Command Syntax 7
2.2. Declaration of AT Command Examples 8
2.3. AT+QENG Query Serving Cell and Neighbour Cell Information 8
2.4. AT+QCELLSCAN Scan Cell Information 13

3 Appendix A References **16**

Table Index

Table 1: Applicable Modules 6
Table 2: Types of AT Commands 7
Table 3: Related Documents 16
Table 4: Terms and Abbreviations 16

1 Introduction

This document presents the description of cell scanning command for the following Quectel LPWA modules.

Table 1: Applicable Modules

Module Series	Model	Description
BG95	BG95-M1	Cat M1 only
	BG95-M2	Cat M1/Cat NB2
	BG95-M3	Cat M1/Cat NB2/EGPRS
	BG95-M4	Cat M1/Cat NB2, 450 MHz Supported
	BG95-M5	Cat M1/Cat NB2/EGPRS, Power Class 3
	BG95-M6	Cat M1/Cat NB2, Power Class 3
	BG95-MF	Cat M1/Cat NB2, Wi-Fi Positioning
BG77	BG77	Cat M1/Cat NB2
BG600L	BG600L-M3	Cat M1/Cat NB2/EGPRS

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 corresponding Write Command and return information about the type, value, or range of its parameter.
Read Command	**AT+<cmd>?**	Check the current parameter value of a corresponding Write 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 familiarize with AT commands and learn how to use them. The examples, however, should not be taken as Quectel's recommendation or suggestions about how you should design a program flow or what status you should set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there exists a correlation among these examples and that they should be executed in a given sequence.

2.3. AT+QENG Query Serving Cell and Neighbour Cell Information

The command reports the information of serving cells and neighbour cells.

AT+QENG Query Serving Cell and Neighbour Cell Information	
Test Command **AT+QENG=?**	Response **+QENG:** (list of supported **<cell_type>**s) **OK**
Write Command Query the information of serving cell **AT+QENG="servingcell"**	Response In the case of GSM mode: **+QENG: "servingcell",<state>[,<RAT>,<MCC>,<MNC>,<LAC>,<cellID>,<bsic>,<ARFCN>,<band>,<RxLev>,<txp>,<rla>,<DRX>,<c1>,<c2>,<GPRS>,<tch>,<ts>,<ta>,<MAIO>,<HSN>,<rxlevsub>,<rxlevfull>,<rxqualsub>,<rxqualfull>,<voicecodec>]** **OK** In the case of LTE Cat M1/Cat NB2 mode: **+QENG: "servingcell",<state>[,<RAT>,<is_tdd>,<MCC>,<MNC>,<cellID>,<PCI>,<EARFCN>,<freq_band_ind>,<UL_bandwidth>,<DL_bandwidth>,<TAC>,<RSRP>,<RSRQ>,<RSSI>,<SINR>,<srxlev>]** **OK**
Write Command Query the information of neighbour cells: **AT+QENG="neighbourcell"**	Response In the case of GSM mode: **[+QENG: "neighbourcell",<RAT>,<MCC>,<MNC>,<LAC>,<cellID>,<bsic>,<ARFCN>,<RxLev>,<c1>,<c2>,<c31>,<c32>** **[…]]**

	OK In the case of LTE Cat M1/Cat NB2 mode: **[+QENG: "neighbourcell intra",<RAT>,<EARFCN>,<PCI>,<RSRQ>,<RSRP>,<RSSI>,<SINR>,<srxlev>,<cell_resel_priority>,<s_non_intra_search>,<thresh_serving_low>,<s_intra_search>** **[…]]** **[+QENG: "neighbourcell inter",<RAT>,<EARFCN>,<PCI>,<RSRQ>,<RSRP>,<RSSI>,<SINR>,<srxlev>,<threshX_low>,<threshX_high>,<cell_resel_priority>** **[…]]** **OK**
Maximum Response Time	300 ms
Characteristics	\

Parameter

<cell_type>	String type. Type of the cell, of which the information can be queried. "servingcell" Serving cell "neighbourcell" Neighbour cell
<state>	String type. UE state. "SEARCH" UE is searching but could not (yet) find a suitable cell "LIMSRV" UE is camping on a cell but has not registered on the network "NOCONN" UE has camped on a cell and registered on the network, but it is in the idle mode "CONNECT" UE has camped on a cell and registered on the network, and a call is in progress
<RAT>	String type. Radio access technologies. "GSM" GSM "eMTC" LTE Cat M1 "NBIoT" LTE Cat NB2
<MCC>	Integer type. A three-digit value indicating mobile country code (the first part of the PLMN code).
<MNC>	Integer type. A two-digit value indicating the mobile network code (the second part of the PLMN code).
<LAC>	Two-byte location area code, in hexadecimal format (e.g., 00C1 equals 193 in decimal), of the cell that was scanned. Range: 0–0xFFFF.
<cellID>	Hexadecimal format. 16-bit (GSM) or 28-bit (LTE) cell ID. Range: 0–0xFFFFFFF.
<bsic>	Integer type. Base station identification code. Range: 0–63.
<ARFCN>	Integer type. ARFCN of the cell that was scanned. Range: 0–1023.

<band>	Integer type. The current GSM band. 0 DCS1800 1 PCS1900 2 EGSM900 3 GSM850
<RxLev>	Integer type. The Rx level value for base station selection that is mapped from the measured signal level (see *3GPP 45.008*). Range: 0–63. Subtracting 111 from the Rx level value, a dBm value will be got.
<txp>	Integer type. The maximum Tx power level an MS may use when accessing the system. Range: 0–31.
<rla>	Integer type. The minimum received signal level at the MS required for access to the system. Range: 0–63.
<DRX>	Integer type. Discontinuous reception cycle. Unit: second.
<c1>	Integer type. Path loss criterion used for cell selection and reselection.
<c2>	Integer type. Cell reselection criterion.
<GPRS>	Integer type. Whether the current cell supports GPRS. 0 Not support 1 Support
<tch>	String or integer type. Displays ‘h’ in hopping; displays the current ARFCN in voice call.
<ts>	Integer type. Timeslot number in voice call. Range: 0–7.
<ta>	Integer type. Timing advance in voice call. Range: 0–63.
<MAIO>	Integer type. Mobile allocation index offset in voice call. Range: 0–63.
<HSN>	Integer type. Hopping sequence number in voice call. Range: 0–63.
<rxqualsub>	Integer type. Rx quality (sub) in voice call. Range: 0–7.
<rxqualfull>	Integer type. Rx quality (full) in voice call. Range: 0–7.
<rxlevsub>	Integer type. Rx level (sub) in voice call. Range: 0–63.
<rxlevfull>	Integer type. Rx level (full) in voice call. Range: 0–63.
<voicecodec>	String format. Speech coding modes during a voice call. "HR" Half rate "FR" Full rate "EFR" Enhanced full rate "AMR" Adaptive multi-rate "AMRHR" AMR half rate "AMRFR" AMR full rate "AMRWB" AMR wide band
<is_tdd>	String type. LTE network mode. "FDD" LTE-FDD
<PCI>	Integer type. Physical cell identity.
<EARFCN>	Integer type. E-UTRA absolute radio frequency channel number.
<freq_band_ind>	Integer type. E-UTRA frequency bands (see *3GPP 36.101*).
<UL_bandwidth>	Integer type. UL bandwidth. 0 1.4 MHz 1 3 MHz 2 5 MHz

	3	10 MHz
	4	15 MHz
	5	20 MHz
<DL_bandwidth>	Integer type. DL bandwidth.	
	0	1.4 MHz
	1	3 MHz
	2	5 MHz
	3	10 MHz
	4	15 MHz
	5	20 MHz
<TAC>	Tracking area code in hexadecimal format (see *3GPP 23.003 subclause 19.4.2.3*).	
<RSRP>	Reference signal received power (see *3GPP 36.214 subclause 5.1.1*). Unit: dBm.	
<RSRQ>	Reference signal received quality (see *3GPP 36.214 subclause 5.1.3*). Unit: dB.	
<RSSI>	Integer type. The received signal strength indication. Unit: dBm.	
<SINR>	Integer type. A converted value of SINR. The actual SINR = (1/5) × <SINR> - 20. Range: 0–250 (that is, the actual SINR ranges between -20 dB and 30 dB). .	
<srxlev>	Integer type. Cell selection Rx level value (in dB) (see *3GPP 36.304*).	
<c31>	Integer type. The signal level threshold criterion for hierarchical cell structures (HCS). The parameter is used to determine whether prioritised hierarchical GPRS and LSA cell re-selection shall apply.	
<c32>	Integer type. The cell ranking criterion which is used to select cells among those with the same priority.	
<cell_resel_priority>	Integer type. Cell reselection priority. Range: 0–7.	
<s_non_intra_search>	Integer type. Threshold to control non-intra frequency searches.	
<thresh_serving_low>	Integer type. The threshold of **<srxlev>** (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.	
<s_intra_search>	Integer type. Threshold to control intra-frequency searches.	
<threshX_low>	Integer type. To be referenced when reselection. The suitable Rx level value of an evaluated lower priority cell must be greater than this value.	
<threshX_high>	Integer type. To be referenced when reselection. The suitable Rx level value of an evaluated higher priority cell must be greater than this value.	

Example

```
AT+QENG="servingcell"
+QENG: "servingcell","SEARCH"

OK

//If the module registers on GSM network.
AT+QENG="servingcell"
+QENG: "servingcell","NOCONN","GSM",460,00,550B,D89,35,59,,-48,255,255,0,55,165,1,,,,,,,,,

OK
```

```
//If the module registers on NB-IoT network.
AT+QENG="servingcell"
+QENG:  "servingcell","NOCONN","NBIoT","FDD",460,11,DDA1451,280,2506,5,0,0,69C9,-84,-17,-67,
8,44

OK

//If the module registers on eMTC network.
AT+QENG="servingcell"
+QENG:  "servingcell","NOCONN","eMTC","FDD",460,11,690843E,314,1850,3,5,5,691D,-105,-14,-77,
11,22

OK

//If the module registers on GSM network.
AT+QENG="neighbourcell"
+QENG: "neighbourcell","GSM",460,00,550B,D8A,41,63,-72,31,141,0,0
+QENG: "neighbourcell","GSM",460,00,550B,D58,58,57,-65,38,148,0,0
+QENG: "neighbourcell","GSM",460,00,550B,6395,11,64,-66,37,147,0,0
+QENG: "neighbourcell","GSM",460,00,550B,3C94,43,62,-70,33,143,0,0

OK

//If the module registers on NB-IoT network.
AT+QENG="neighbourcell"
+QENG: "neighbourcell intra","NBIoT",2506,224,-12,-81,-68,0,59,0,50,0,50
+QENG: "neighbourcell intra","NBIoT",2506,280,-14,-81,-67,0,47,0,50,0,50
+QENG: "neighbourcell intra","NBIoT",2506,281,-15,-81,-66,0,58,0,50,0,50

OK

//If the module registers on eMTC network.
AT+QENG="neighbourcell"
+QENG: "neighbourcell intra","eMTC",1850,314,-15,-107,-78,0,21,7,20,10,58
+QENG: "neighbourcell intra","eMTC",1850,312,-16,-106,-81,0,21,7,20,10,58
+QENG: "neighbourcell intra","eMTC",1850,319,-20,-112,-83,0,15,7,20,10,58

OK
```

2.4. AT+QCELLSCAN Scan Cell Information

The command returns the information of all cells existing in the coverage area of the network that the module registers on.

AT+QCELLSCAN Scan Cell Information	
Test Command **AT+QCELLSCAN=?**	Response **+QCELLSCAN: (**list of supported **<RAT>**s**),(**range of **<timeout>)** **OK**
Write Command **AT+QCELLSCAN=<RAT>[,<timeout>]**	Response If **<RAT>**=1 (in the GSM network): **OK** **+QCELLSCAN: <cell_num>** **+QCELLSCAN: "GSM",<MCC>,<MNC>,<LAC>,<cellID>,<bsic>,<RxLev>** **[...]** If **<RAT>**=8 (in the eMTC network): **OK** **+QCELLSCAN: <cell_num>** **+QCELLSCAN: "eMTC",<MCC>,<MNC>,<TAC>,<EARFCN>,<PCI>,<cellID>,<RSRP>,<RSRQ>,<RSSI>** **[...]** If **<RAT>**=9 (in the NB-IoT network): **OK** **+QCELLSCAN: <cell_num>** **+QCELLSCAN: "NBIoT",<MCC>,<MNC>,<TAC>,<EARFCN>,<PCI>,<cellID>,<RSRP>,<RSRQ>,<RSSI>** **[...]** If there is a timeout error or any other error:

	+QCELLSCAN: <err> Or **ERROR**
Maximum Response Time	Depending on the network environment.
Characteristics	The command takes effect immediately. The configuration is not saved.

Parameter

<RAT>	Integer type. The access technology of the serving cell. 1 GSM network 8 eMTC network 9 NB-IoT network
<timeout>	Integer type. The timeout value for the cell-scanning. Range: 5–65535. Default value: 120. Unit: second.
<cell_num>	Integer type. Number of cells scanned.
<MCC>	Integer type. A three-digit value indicating mobile country code.
<MNC>	Integer type. A two-digit value indicating the mobile network code.
<LAC>	Two-byte location area code in hexadecimal format.
<cellID>	Cell ID in hexadecimal format.
<bsic>	Integer type. Base station identification code. Range: 0–63.
<RxLev>	Integer type. The Rx level value for base station selection that is mapped from the measured signal level (see *3GPP 45.008*). Range: 0–63. Subtracting 111 from the Rx level value, a dBm value will be got.
<TAC>	Tracking area code in hexadecimal format.
<EARFCN>	Integer type. E-UTRA absolute radio frequency channel number.
<PCI>	Integer type. Physical cell identity.
<RSRP>	Reference signal received power (see *3GPP 36.214 subclause 5.1.1*). Unit: dBm.
<RSRQ>	Reference signal received quality (see *3GPP 36.214 subclause 5.1.3*). Unit: dB.
<RSSI>	Integer type. The received signal strength indication. Unit: dBm.
<err>	Integer type. -1 Cell scanning failure

NOTE

When **<timeout>** reaches, cell scanning will be aborted but the response cannot be returned immediately unless no cell has been scanned before.

Example

```
//If the module registers on GSM network.
AT+QCELLSCAN=1
OK
```

```
+QCELLSCAN: 3

+QCELLSCAN: "GSM",460,00,550B,34B8,63,58

+QCELLSCAN: "GSM",460,00,550B,D89,34,44

+QCELLSCAN: "GSM",460,00,550B,3C94,26,38

//If the module registers on eMTC network.
AT+QCELLSCAN=8
OK

+QCELLSCAN: 2

+QCELLSCAN: "eMTC",460,11,1,73A,314,690843E,-103,-12,-77

+QCELLSCAN: "eMTC",460,11,691D,1850,312,6908430,-108,-17,-77

//If the module registers on NB-IoT network.
AT+QCELLSCAN=9
OK

+QCELLSCAN: 2

+QCELLSCAN: "NBIoT",460,00,2,E9A,471,84958B2,-73,-11,-62

+QCELLSCAN: "NBIoT",460,00,4C10,3736,121,5C4EF33,-85,-10,-75
```

3 Appendix A References

Table 3: Related Documents

SN	Document Name	Description
[1]	3GPP TS 45.008	3rd Generation Partnership Project; Technical Specification Group Radio Access Network; GSM/EDGE Radio subsystem link control
[2]	Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual	AT Commands Manual of BG95 Series, BG77 and BG600L-M3 Modules

Table 4: Terms and Abbreviations

Abbreviation	Description
3GPP	3rd Generation Partnership Project
ARFCN	Absolute Radio Frequency Channel Number
DCS	Digital Cellular System
DL	Downlink
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
EGPRS	Enhanced General Packet Radio Service
eMTC	enhanced Machine-Type Communication
E-UTRA	Evolved Universal Terrestrial Radio Access
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
ID	Identifier

LTE	Long-Term Evolution
LPWA	Low-Power Wide-Area
LSA	Local Service Area
MS	Mobile Station
NB-IoT	Narrowband Internet of Things
PCS	Personal Communication Service
PLMN	Public Land Mobile Network
RAT	Radio Access Technology
Rx	Receive
SINR	Signal To Interference Plus Noise Ratio
TA	Terminal Adapter
TDD	Time Division Duplex
Tx	Transmit
UE	User Equipment
UL	Uplink
URC	Unsolicited Result Code
UTRA-ARFCN	UTRA Absolute Radio Frequency Channel Number