

BG95&BG77&BG600L Series

QuecLocator Application Note

LPWA Module Series

Version: 1.0

Date: 2021-02-19

Status: Released



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About the Document

Revision History

Version	Date	Author	Description
-	2020-12-01	Sherlock ZHAO	Creation of the document
1.0	2021-02-19	Sherlock ZHAO	First official release

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1 Introduction

QuecLocator[®] is an efficient location technology developed by Quectel. It complements the performance of GNSS positioning by integrating information of mobile network cells and/or Wi-Fi access points (APs), particularly in signal-challenging environments, such as urban canyon environment, indoor areas, and enclosed park facilities, or when GNSS signals are jammed or intermittent. For more details, visit https://iot.quectel.com/doc_getStart.html#QuecLocator.

1.1. Applicable Modules

This manual is applicable to BG95 series, BG77 and BG600L-M3 modules, as listed in the table below.

Among all the modules listed, currently only the BG95-MF module has a built-in Wi-Fi chip, which does not support Wi-Fi connection but can actively scan for the nearby access points for Wi-Fi positioning. For the modules without such a Wi-Fi chip, to use Wi-Fi positioning, you have to manually input MAC addresses.

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

1.2. 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 QuecLocator[®] Authentication

To use the QuecLocator service, an authorization token is needed for identity authentication. The auth token remains valid after module rebooting or power-off. It is needed to execute **AT+QLBSCFG="token"** to confirm whether a token has already been configured when you use the service for the first time; if not, please input one. The concrete steps are illustrated in the figure below.

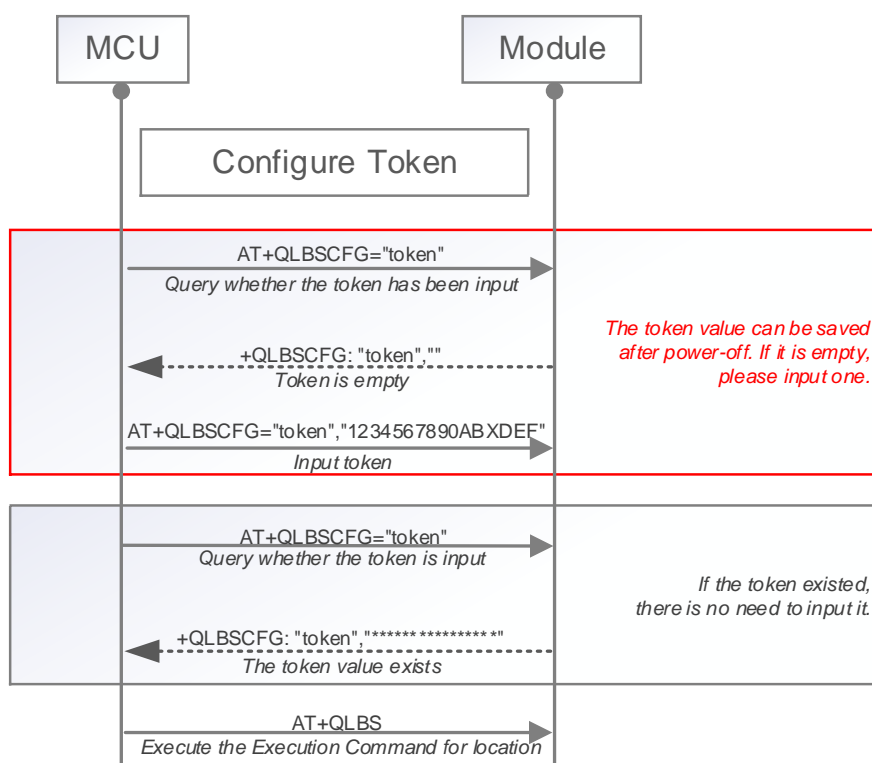


Figure 1: QuecLocator Auth Token Configuration

NOTE

Please consult Quectel Technical Supports to apply for the token value.

3 QuecLocator[®] Related AT Commands

3.1. AT Command Syntax

3.1.1. 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 not given, the new value equals to its previous value or its default setting, unless otherwise specified.
- **Underline** Default setting of a parameter.

3.1.2. 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>**. Throughout this document, only the commands and responses are presented, while carriage return and line feed characters are deliberately omitted.

Table 2: Type of AT Commands

Command Type	Syntax	Description
Test Command	AT+<cmd>=?	Test the existence of corresponding Write Command and to give 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.

3.2. Description of QuecLocator Related AT Commands

3.2.1. AT+QWIFI Turn On/Off Wi-Fi

This command turns on/off the Wi-Fi function of the BG95-MF module and scans for nearby access points (APs). From the response of **AT+QWIFI=2**, you can get an idea about whether Wi-Fi positioning can function in the hybrid positioning. This command applies only to the BG95-MF module.

AT+QWIFI Turn On/Off Wi-Fi	
Test Command AT+QWIFI=?	Response +QWIFI: (range of supported <mode> s) OK
Read Command AT+QWIFI?	Response +QWIFI: <status> OK
Write Command AT+QWIFI=<mode>	Response If <mode> is 0 or 1, turn on/off Wi-Fi: OK If <mode> is 2, scan for information of APs nearby: [+QWIFI: (<SSID>,<rssi>,<AP_MAC>)] [...] OK If there is any error: ERROR
Maximum Response Time	/
Characteristics	The command takes effect immediately. The configurations will not be saved.

Parameter

<status>	Integer type. Wi-Fi state. 0 Off state 1 On state
<mode>	Integer type. Wi-Fi operating mode. 0 Turn off Wi-Fi 1 Turn on Wi-Fi 2 Scan for information of nearby APs

<SSID>	String type. Service set identifier. Maximum length: 32 bytes.
<rsst>	Integer type. Received signal strength indicator.
<AP_MAC>	String type. The Wi-Fi MAC address of a nearby Wi-Fi AP. 6 bytes in hexadecimal separated by ":".

Example

```

AT+QWIFI=1 //Turn on Wi-Fi function
OK
AT+QWIFI=2 //Scan for nearby Wi-Fi APs
+QWIFI: ("Quectel-Hf",-84,"44:00:4d:d4:24:00")
+QWIFI: ("Quectel-Customer",-86,"44:00:4d:d4:24:01")
+QWIFI: ("Quectel-Customer",-87,"1c:20:db:8d:d5:81")
+QWIFI: ("Quectel-Hf",-87,"1c:20:db:8d:d5:80")

OK
AT+QWIFI=0 //Turn off Wi-Fi function
OK

```

3.2.2. AT+QLBSCFG Configure Parameters of QuecLocator

AT+QLBSCFG Configure Parameters of QuecLocator

Test Command	Response
AT+QLBSCFG=?	+QLBSCFG: "asynch",(list of supported <asynch_mode>s) +QLBSCFG: "timeout",(range of supported <response_time>s) +QLBSCFG: "server",<server_name> +QLBSCFG: "token",<token_value> +QLBSCFG: "timeupdate",(list of supported <update_mode>s) +QLBSCFG: "withtime",(list of supported <time_mode>s) +QLBSCFG: "latorder",(list of supported <order_mode>s) +QLBSCFG: "scanband",(list of supported <scan_mode>s), (list of supported <scan_band>s) +QLBSCFG: "singlecell",(list of supported <singlecell_mode>s) +QLBSCFG: "wifiloc",(list of supported <wifiloc_mode>s) OK
Read Command AT+QLBSCFG?	Response +QLBSCFG: "asynch",<asynch_mode> +QLBSCFG: "timeout",<response_time> +QLBSCFG: "server",<server_name>

	<p>+QLBSCFG: "token",<token_value> +QLBSCFG: "timeupdate",<update_mode> +QLBSCFG: "withtime",<time_mode> +QLBSCFG: "latorder",<order_mode> +QLBSCFG: "scanband",<scan_mode>[,<scan_band>] +QLBSCFG: "singlecell",<singlecell_mode> +QLBSCFG: "wifiloc",<wifiloc_mode></p> <p>OK</p>
<p>Write Command AT+QLBSCFG="asynch"[,<asynch_mode>]</p>	<p>Response</p> <p>If the optional parameter is omitted, query the current setting: +QLBSCFG: "asynch",<asynch_mode></p> <p>OK</p> <p>If the optional parameter is specified, configure the execution mode of AT+QLBS: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="timeout"[,<response_time>]</p>	<p>Response</p> <p>If the optional parameter is omitted, query the current setting: +QLBSCFG: "timeout",<response_time></p> <p>OK</p> <p>If the optional parameter is specified, configure the maximum response time of AT+QLBS: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="server"[,<server_name>]</p>	<p>Response</p> <p>If the optional parameter is omitted, query the current setting: +QLBSCFG: "server",<server_name></p> <p>OK</p> <p>If the optional parameter is specified, configure the domain/IP address and port of the server that provides the positioning service: OK</p>

	<p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="token"[,<token_value>]</p>	<p>Response</p> <p>If the optional parameter is omitted, and the <token_value> has been configured, query the current setting: +QLBSCFG: "token", "*****"</p> <p>OK</p> <p>If the optional parameter is omitted, and the <token_value> has not been configured, query the current setting: +QLBSCFG: "token", ""</p> <p>OK</p> <p>If the optional parameter is specified, configure the token value for server authentication: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="timeupdate"[,<update_mode>]</p>	<p>Response</p> <p>If the optional parameter is omitted, query the current setting: +QLBSCFG: "timeupdate",<update_mode></p> <p>OK</p> <p>If the optional parameter is specified, configure whether to update to the RTC the time acquired at accessing the server that provides the positioning service: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="withtime"[,<time_mode>]</p>	<p>Response</p> <p>If the optional parameter is omitted, query the current setting: +QLBSCFG: "withtime",<time_mode></p> <p>OK</p> <p>If the optional parameter is specified, configure whether to output <time> in the response of AT+QLBS: OK</p>

	<p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="latorder"[,<order_mode>]</p>	<p>Response If the optional parameter is omitted, query the current setting: +QLBSCFG: "latorder",<order_mode></p> <p>OK</p> <p>If the optional parameter is specified, configure the output order of latitude and longitude of the location fixed: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="scanband"[,<scan_mode>,<scan_band>]</p>	<p>Response If the optional parameters are omitted, query the current settings: +QLBSCFG: "scanband",<scan_mode>,<scan_band></p> <p>OK</p> <p>If any of the optional parameters is specified, configure the scan mode and the eMTC frequency band to be scanned. <scan_band> can be specified only when <scan_mode>=1: OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="singlecell"[,<singlecell_mode>]</p>	<p>Response If the optional parameter is omitted, query the current setting: +QLBSCFG: "singlecell",<singlecell_mode></p> <p>OK</p> <p>If the optional parameter is specified, enable or disable cellular positioning (positioning based on cell ID with algorithm): OK</p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
<p>Write Command AT+QLBSCFG="wifiloc"[,<wifiloc_mode>]</p>	<p>Response If the optional parameter is omitted, query the current setting: +QLBSCFG: "wifiloc",<wifiloc_mode></p>

	<p>OK</p> <p>If the optional parameter is specified, enable ¹⁾ or disable the hybrid positioning mode (Cellular + Wi-Fi):</p> <p>OK</p> <p>If there is an error related to ME functionality:</p> <p>+CME ERROR: <err></p>
Maximum Response Time	300 ms
Characteristics	<p>The commands take effect immediately.</p> <p>The configurations will not be saved except those of <asynch_mode> and <token_value>.</p>

Parameter

<asynch_mode>	<p>Integer type. The command execution mode of AT+QLBS. The response of the command varies in format to different modes.</p> <p>0 Synchronous mode</p> <p>1 Asynchronous mode</p>
<response_time>	<p>Integer type. The maximum response time of AT+QLBS. If there is no response from the server within <response_time>, the command times out.</p> <p>Range: 10–120. Default: 60. Unit: second.</p>
<server_name>	<p>String type. The domain/IP address and the port of the server. The format is "domain/IP address:port" (e.g. "www.queclocator.com:80"). The range of the port is 1–65535. The default server is "www.queclocator.com:80".</p>
<token_value>	<p>String type. Value of the authentication token. Length: 16 bytes.</p>
<update_mode>	<p>Integer type. Whether to update to the RTC the time acquired at accessing the server that provides the positioning service.</p> <p>0 Do not update the time to RTC</p> <p>1 Update the time to RTC</p>
<time_mode>	<p>Integer type. Whether to output <time> in the response of AT+QLBS.</p> <p>0 Do not output time</p> <p>1 Output time</p>
<order_mode>	<p>Integer type. Set the output order of latitude and longitude of the location fixed.</p> <p>0 Longitude output before latitude like this: +QLBS: <loc_result>,<longitude>,<latitude>[,<time>]</p> <p>1 Latitude output before longitude like this: +QLBS: <loc_result>,<latitude>,<longitude>[,<time>]</p> <p>See Chapter 3.2.3 for details of the parameters.</p>
<scan_mode>	<p>Integer type. Scan mode.</p> <p>0 Scan the current attached band</p> <p>1 Scan full bands or a fixed band</p>
<scan_band>	<p>A hexadecimal value that specifies the eMTC frequency band to be scanned. For</p>

example, if it is set to 0x40000000, the band LTE B31 will be scanned. This parameter can be configured only when **<scan_mode>=1**.

0x1 (BAND_PREF_LTE_BAND1)	LTE B1
0x2 (BAND_PREF_LTE_BAND2)	LTE B2
0x4 (BAND_PREF_LTE_BAND3)	LTE B3
0x8 (BAND_PREF_LTE_BAND4)	LTE B4
0x10 (BAND_PREF_LTE_BAND5)	LTE B5
0x80 (BAND_PREF_LTE_BAND8)	LTE B8
0x800 (BAND_PREF_LTE_BAND12)	LTE B12
0x1000 (BAND_PREF_LTE_BAND13)	LTE B13
0x20000 (BAND_PREF_LTE_BAND18)	LTE B18
0x40000 (BAND_PREF_LTE_BAND19)	LTE B19
0x80000 (BAND_PREF_LTE_BAND20)	LTE B20
0x1000000 (BAND_PREF_LTE_BAND25)	LTE B25
0x2000000 (BAND_PREF_LTE_BAND26)	LTE B26
0x4000000 (BAND_PREF_LTE_BAND27)	LTE B27
0x8000000 (BAND_PREF_LTE_BAND28)	LTE B28
0x40000000 (BAND_PREF_LTE_BAND31)	LTE B31
0x200000000000000000 (BAND_PREF_LTE_BAND66)	LTE B66
0x800000000000000000 (BAND_PREF_LTE_BAND72)	LTE B72
0x1000000000000000000 (BAND_PREF_LTE_BAND73)	LTE B73
0x10000000000000000000 (BAND_PREF_LTE_BAND85)	LTE B85

<singlecell_mode> Integer type. Enable or disable cellular positioning.

0 Disable
1 Enable

<wifiloc_mode> Integer type. Enable or disable hybrid positioning (Cellular + Wi-Fi):

0 Disable
1 Enable

NOTES

- Usually, the parameter **<server_name>** does not need to be configured. The default address is www.queclocator.com with the default port of 80. When it is needed, the server domain/IP address and port can be changed with this command.
- In LTE Cat M1 network, **AT+QLBS** only supports asynchronous return mode.
- The **<token_value>** is used for server authentication and should be applied for from Quectel in advance.
- The **<scan_mode>** is only used in LTE Cat M1 network. The default band is the band to which the module has attached. If **<scan_mode>=1**, **AT+QLBS** is executed to scan full bands and you need to wait for more than 1 minute for the URC response.
- When you configure **<scan_band>**, make sure the band specified is supported by the current operator of the module. Otherwise, the module cannot get cell information of the band.
- ¹⁾ **AT+QLBSCFG="wifiloc"** is applicable to the BG95-MF module only.
- If **<wifiloc_mode>** is configured to 1, the module performs hybrid positioning. If no Wi-Fi AP

information is found, the module performs cellular positioning.

8. The B31, B72 and B73 bands are only supported by the BG95-M4 module.

3.2.3. AT+QLBS Get Location Information by QuecLocator

AT+QLBS Get Location Information by QuecLocator	
Test Command AT+QLBS=?	Response OK
Execution Command AT+QLBS	<p>Response</p> <p>If the module is in synchronous (<asynch_mode>=0) mode and the positioning succeeds: +QLBS: <loc_result>,<latitude>,<longitude>[,<time>]</p> <p>OK</p> <p>If the module is in synchronous mode and the positioning fails: +QLBS: <loc_result></p> <p>OK</p> <p>If the module is in asynchronous mode (<asynch_mode>=1) and the positioning succeeds: OK</p> <p>+QLBS: <loc_result>,<latitude>,<longitude>[,<time>]</p> <p>If the module is in asynchronous mode and the positioning fails: OK</p> <p>+QLBS: <loc_result></p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
Write Command ¹⁾ AT+QLBS=<MAC_num>,<AP_MAC1>,<rsssi1>,<AP_MAC2>,<rsssi2>[,...]	<p>Response</p> <p>If the module is in synchronous mode and the positioning succeeds: +QLBS: <loc_result>,<latitude>,<longitude>[,<time>]</p> <p>OK</p>

	<p>If the module is in synchronous mode and the positioning fails: +QLBS: <loc_result></p> <p>OK</p> <p>If the module is in asynchronous mode and the positioning succeeds: OK</p> <p>+QLBS: <loc_result>,<latitude>,<longitude>[,<time>]</p> <p>If the module is in asynchronous mode and the positioning fails: OK</p> <p>+QLBS: <loc_result></p> <p>If there is an error related to ME functionality: +CME ERROR: <err></p>
Maximum Response Time	Depends on the <response_time> in AT+QLBSCFG="timeout",<response_time> .
Characteristics	The command takes effect immediately. The configurations will not be saved.

Parameter

<MAC_num>	Integer type. The number of inputted Wi-Fi MAC addresses. Range: 2–6.
<AP_MACX>	String type. Wi-Fi MAC addresses of nearby Wi-Fi APs.
<rsiX>	Integer type. Received signal strength indicator. The value should be less than zero.
<latitude>	Float type. The latitude of the location information. This value is accurate to six decimal places, and the range is from -90.000000 to 90.000000.
<longitude>	Float type. The longitude of the location information. This value is accurate to six decimal places, and the range is from -180.000000 to 180.000000.
<time>	String type. The date and time obtained from HTTP header.
<loc_result>	Integer type. The positioning result. If the positioning is successful, it is 0. If the positioning fails, it is <err> . See Chapter 5 for descriptions of error codes (<err>).

NOTE

¹⁾ QuecLocator supports Wi-Fi positioning. When the module cannot scan for the information of its surrounding Wi-Fi APs, such information can be inputted manually with this command.

4 Example

```
//Activate network first, then make configurations and get locations referring to the steps below.
AT+QLBSCFG="token" //Query the token value for authentication required
                    //by QuecLocator server. Now, it is empty and
                    //needs to be configured.

+QLBSCFG: "token", ""

OK
AT+QLBSCFG="token", "1234567890ABCDEF" //Input the token value for authentication required
                                        //by QuecLocator server.

OK
AT+QLBSCFG="token" //Query the token value for authentication required
                   //by QuecLocator server.

+QLBSCFG: "token", "*****"

OK
AT+QLBSCFG="latorder", 1 //Configure the location output format into:
                        //+QLBS: <loc_result>,<latitude>,<longitude>

OK
AT+QLBSCFG="asynch", 1 //Configure to execute AT+QLBS command in
                       //asynchronous mode.

OK
AT+QLBS //Start cellular positioning.

OK

+QLBS: 0,31.847649,117.200134
AT+QLBS=5, "44:6a:2e:11:d7:d1", -30, "44:6a:2e:11:d7:c2", -39, "44:6a:2e:11:d6:e1", -59, "44:6a:2e:11:
d6:e2", -76, "44:6a:2e:11:d6:e0", -81 //Input MAC addresses manually to start Wi-Fi
                                     //positioning.

OK

+QLBS: 0,31.846893,117.198166
AT+QLBSCFG="wifiloc", 1 //Enable hybrid positioning.

OK
AT+QLBS //Start hybrid positioning.

OK

+QLBS: 0,31.846893,117.198166
```

5 Summary of Error Codes

Table 3: Summary of Error Codes

Code of <err>	Description of Error Codes
10000	Positioning fails.
10001	IMEI number is illegal.
10002	The token does not exist.
10003	The number of devices using the same token exceeds the limit.
10004	The times of positioning initiated by the same device in one day exceeds the limit.
10005	The total times of positioning using the same token exceeds the limit.
10006	The token is expired.
10007	The IMEI number is not accepted by the server.
10008	The times of positioning using the same token within one day exceeds the limit.
10009	The frequency of positioning using the same token exceeds the limit.

NOTE

QuecLocator uses HTTP protocol. If there is any HTTP error code returned, please refer to *Quectel_BG95&BG77_HTTP(S)_Application_Note* for the description of the error code.

6 Appendix A Reference

Table 4: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
eMTC	Enhanced Machine Type of Communication
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communication
HTTP	Hyper Text Transfer Protocol
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
LPWA	Low-Power Wide-Area (Network)
MAC	Media Access Control Address
MCU	Microcontroller Unit
RTC	Real Time Clock
URC	Unsolicited Result Code
Wi-Fi	Wireless-Fidelity