BG95&BG77&BG600L Series
GNSS Application Note

LPWA Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2019-11-29	Matt YE/ Alfred LI	Initial
1.1	2020-07-17	Matt YE	1. Added an applicable module BG600L-M3. 2. Added the description of GNSS and WWAN coexistence management (Chapter 1.3). 3. Added AT command syntax (Chapter 2.1). 4. Added AT+QGPSCFG="qzssnmeatype" (Chapter 2.2.1.8). 5. Extended AT+QGPSCFG="priority" to enable saving of priority configuration (Chapter 2.2.1.11). 6. Added AT+QCFGEXT and its example (Chapter 2.2.6 and Chapter 3.4). 7. Added FAQ (Chapter 5).
1.2	2020-10-23	Matt YE/ Alfred LI/ Mac ZHU	1. Added introduction of gpsOneXTRA feature (Chapter 1.4). 2. Added the following AT commands (Chapter 2.2.1) AT+QGPSCFG="xtrafilesize", AT+QGPSCFG="xtra_info", AT+QGPSCFG="gpsdop", AT+QGPSCFG="estimation_error", AT+QGPSCFG="nmea_epe", AT+QGPSCFG="xtra_apn", AT+QGPSCFG="xtra_download", AT+QGPSCFG="test_mode". 3. Added notes for AT+QGPSCFG="priority" (Chapter 2.2.1.11). 4. Supported to return URC +QGPSURC: "XTRA_DL",<DL_err> indicating whether XTRA file is downloaded successfully after GNSS is turned on (Chapter 2.2.2) 5. Modified <mode> and <para> of AT+QGPSLOC (Chapter 2.2.4).

			6. Added AT+QGPSXTRA (Chapter 2.2.7). 7. Added AT+QGPSXTRATIME (Chapter 2.2.8). 8. Added AT+QGPSXTRADATA (Chapter 2.2.9). 9. Added AT+QGPSDEL (Chapter 2.2.10). 10. Updated the example about positioning information acquiring (Chapter 3.2). 11. Added examples of gpsOneXTRA feature (Chapter 3.5). 12. Updated error code table (Chapter 6).
1.3	2022-02-25	Kayn SHAO	1. Added the following AT commands (Chapter 2.3.1). AT+QGPSCFG="xtra_autodownload". AT+QGPSCFG="xtra_ntp" 2. Involved AT+QGPSCFG="xtra_autodownload",1 in XTRA file downloading and XTRA operating procedures (Chapters 1.4.3 and 1.4.4). 3. Added a note to give details if <GNSS_config>=5 when configuring supported GNSS constellations (Chapter 2.3.1.2). 4. Updated the supported NMEA sentence types for QZSS (Chapter 2.3.1.8). 5. Changed the default value of AT+QGPSCFG="test_mode" (Chapter 2.3.1.20)

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1 Introduction

Quectel BG95 series, BG77 and BG600L-M3 modules integrate the XTRA (i.e., gpsOneXTRA) feature with the multi-GNSS engine, which supports GPS, BeiDou, Galileo, GLONASS and QZSS systems. The GNSS engine can receive simultaneous signals from maximum two constellations (GPS and another constellation) at any given time. Therefore, it is suitable for various applications requiring accurate positioning at the lowest cost, or position tracking without network assistance.

The modules are based on a cost-optimized architecture in which WWAN (LTE Cat-M1, LTE Cat-NB2 and GSM) and GNSS Rx chains share certain hardware blocks. However, the modules do not support concurrent operation of WWAN and GNSS.

The solution adopted in the modules is a form of coarse time-division multiplexing (TDM) between WWAN and GNSS Rx chains. Given the relaxed latency requirements of most LPWA applications, time-division sharing of resources can be made largely transparent to applications.

1.1. Applicable Modules

Table 1: Applicable Modules

Module Series	Model	Description
BG95 Series	BG95-M1	Cat-M1
	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

NOTE

Hereinafter, BG95 series shall be collectively referred to as BG95 unless otherwise specified.

1.2. Supported NMEA Sentence Types

The default NMEA sentences of the modules are compliant with the NMEA 0183 version 4.10 standard except for talker ID of RMC, GGA and VTG sentences, which use Qualcomm-specific standards. Each satellite system uses distinct prefixes, so as to easily distinguish NMEA sentences of different satellite systems, as is illustrated below.

GPS sentences have the prefix "GP":

- GPGGA - Global positioning system fix data, such as time and position.
- GPRMC - Recommended minimum specific GNSS data
- GPGSV - GNSS satellites in view (number of satellites in view, satellite ID numbers, etc.).
- GPGSA - GNSS DOP and active satellites
- GPVTG - Course over ground and ground speed

GLONASS sentences have the prefixes "GL" and "GN":

- GLGSV - GNSS satellites in view (number of satellites in view, satellite ID numbers, etc.).
- GNGSA - GNSS DOP and active satellites

For Galileo sentences, the prefixes are "GA" and "GN":

- GAGSV - GNSS satellites in view (number of satellites in view, satellite ID numbers, etc.).
- GNGSA - GNSS DOP and active satellites

For BeiDou sentences, the prefix is "PQ":

- PQGSV - GNSS satellites in view (number of satellites in view, satellite ID numbers, etc.).
- PQGSA - GNSS DOP and active satellites

QZSS sentences also start with the prefix "PQ":

- PQGSV - GNSS satellites in view (number of satellites in view, satellite ID numbers, etc.).
- PQGSA - GNSS DOP and active satellites

1.3. GNSS and WWAN Coexistence Management

As GNSS and WWAN cannot work simultaneously, either WWAN or GNSS takes priority during implementation. By default, the modules are configured into the GNSS priority mode, which can be switched to the WWAN priority mode with **AT+QGPSCFG="priority"**. The command takes effect immediately. For more details, see ***Chapter 2.3.1.11***.

1.3.1. WWAN Priority Mode

In the WWAN priority mode, GNSS positioning request succeeds only when RRC is released and WWAN enters an idle sleep. Features of WWAN priority mode include:

- Data service works well all the time (No WWAN page is missed)
- RRC connection is not impacted by GNSS operation
- GNSS session is deferred to the time when the UE goes to the eDRX state[1)]

For LPWA applications, the duration for WWAN in the active status is fairly short. Therefore, GNSS has an opportunity to get a position fix.

NOTE

1. [1)] The eDRX cycle must be configured sufficiently long. In the WWAN priority mode, if the eDRX Sleep Cycle is shorter than the ***t*** + ***t1***, the GNSS is not able to get a position fix. For more details, see ***Chapter 1.3.6***.
2. When the eDRX Sleep Cycle is less than ***t*** + ***t1*** or eDRX is not supported, it is recommended to set the modules into the GNSS priority mode.
3. When switching from the WWAN priority mode to the GNSS priority mode, the modules take about 1 second (in the open sky, see ***Chapter 1.3.3***) for GNSS to get a position fix (if GNSS has got a position fix before).

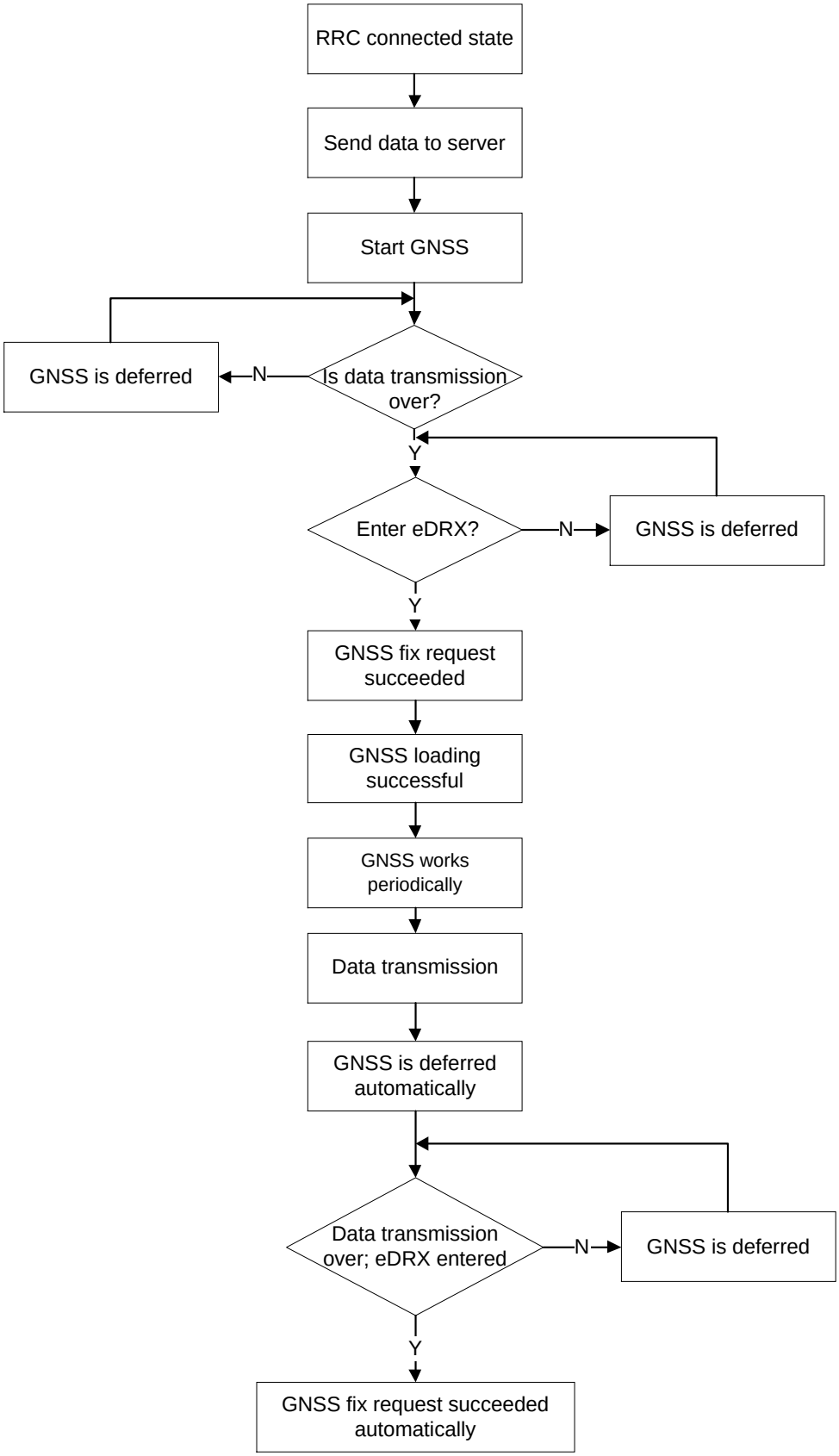

Figure 1: GNSS and WWAN Coexistence Management (WWAN Priority Mode)

1.3.2. GNSS Priority Mode

In the GNSS priority mode, GNSS positioning request succeeds in all WWAN states:

- **When UE is in the RRC connected state:**

  The UE locally releases the RRC connection and initiates the GNSS session. After the GNSS session is completed, if there is WWAN data to be sent, the RRC connection will be initiated again.

- **When UE is in the eDRX state:**

  The UE may miss pages sent on the paging channel while the GNSS session is still active.

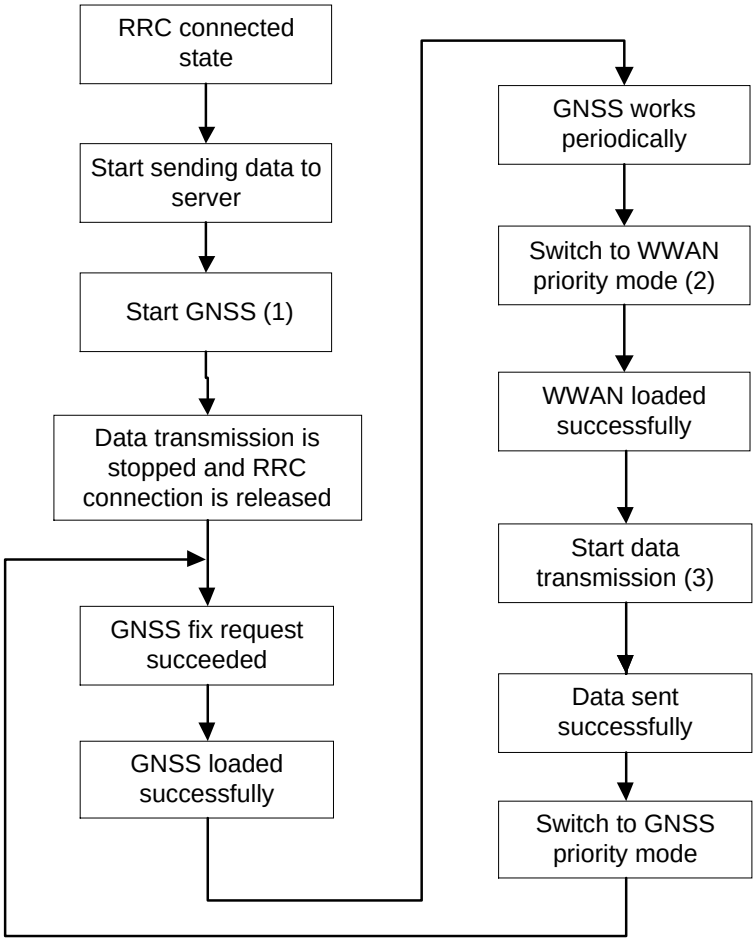

Figure 2: GNSS and WWAN Coexistence Management (GNSS Priority Mode)

NOTE

1. GNSS starts working as soon as the GNSS is started.
2. After switching to the WWAN priority mode, the GNSS is stopped automatically. In such a case, the

power consumption is the same as when the GNSS is stopped with **AT+QGPSEND**.
3. It is recommended to delay 0.5 seconds before transmitting data as this is the time that the module needs to switch from the GNSS to the WWAN priority mode (see ***Chapter 1.3.3)***.
4. The priority of the following operations/procedures is higher than that of GNSS/WWAN:
   - Power-off/Power Saving Mode
   - PS detaching

1.3.3. WWAN and GNSS Switching Delays

The following table summarizes the average delays captured for different RATs. All tests were executed in the open sky, with the transmission of 500-byte data as an example. The presented average delays are provided for illustration purposes only and should be taken with caution.

- **Test Environment**

GNSS CNR = 45 dB
LTE-M RSRP = -71 dBm
SINR = 21.4 dB
NB-IoT RSRP = -87 dBm
SINR = 15 dB
GSM RSSI = -48 dBm

- **Test Steps**

Load WWAN → Unload WWAN → Load GNSS → Get a position fix → Unload GNSS → Load WWAN → Transfer WWAN data.

Table 2: Average Delays Captured for Different RATs (Unit: s)

Network Type	LTE-M	NB-IoT	GSM
Load WWAN	0.251	0.177	0.259
Unload WWAN	0.153	0.087	0.339
Load GNSS	0.208	0.216	0.197
Unload GNSS	0.116	0.112	0.105
Delay Between “Switching to WWAN Priority Mode” and “Start Sending Data” [1)]	0.5	0.5	0.5
Time to Transfer WWAN Data (the delay for setting up and closing the connection is not taken into account) [2)]	1.0	4.5	3.6

Delay Between “Switching to the GNSS Priority Mode” and “Getting GNSS Started”	0	0	0
GNSS Fix with/without XTRA [3)]	1/1	1/1	1/1

NOTE

1. Above mentioned “Load” and “Unload” mean loading/unloading WWAN/GNSS protocol stack.
2. [1)] When the WWAN is loaded successfully (you can query it via **AT+QGPSCFG="priority"**), the data can be sent.
3. [2)] The time used to transfer WWAN data varies depending on the coverage level and the data amount. In this example, 500-byte data were transferred.
4. [3)] The TTFF is about 10/30 seconds (with/without XTRA under the open sky, respectively) after a cold start. The data listed in the table above are the positioning time within 2 hours after a hot start.

1.3.4. GNSS/WWAN Priority and PSM

In the GNSS priority mode, PSM cannot be configured when GNSS is active. However, it can be configured before starting GNSS. After PSM is configured successfully, the modules are able to enter PSM even when GNSS is active.

In the WWAN priority mode, the modules are able to configure and enter PSM regardless of whether GNSS is active or not.

For the actual scenario with PSM, see ***Chapter 4.1***.

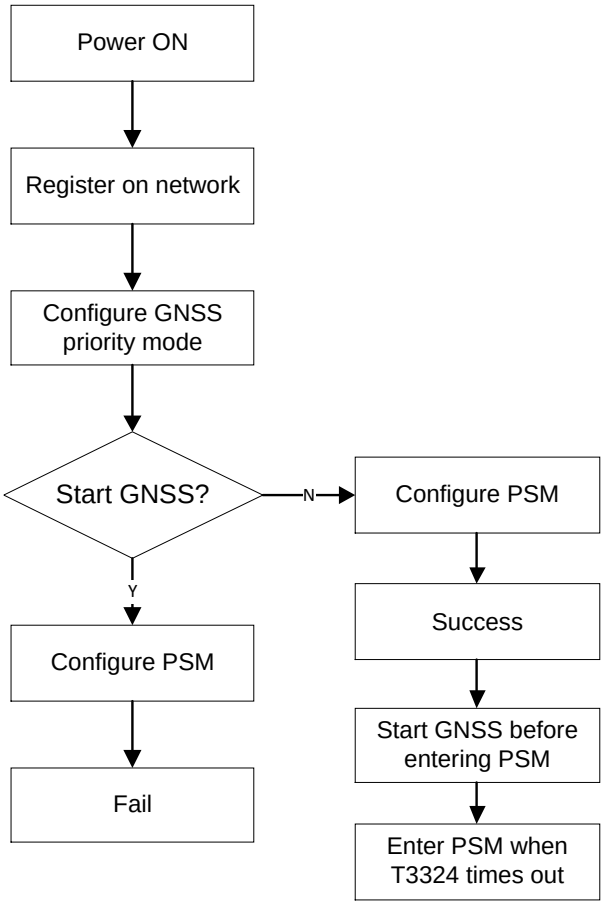

Figure 3: Configure PSM in GNSS Priority Mode

1.3.5. GNSS/WWAN Priority and eDRX

The eDRX can be configured in the GNSS priority mode when GNSS is turned off. However, the eDRX cannot be configured in GNSS priority mode when GNSS is active. In such a case, the modules cannot enter eDRX even if it has been configured successfully before starting GNSS.

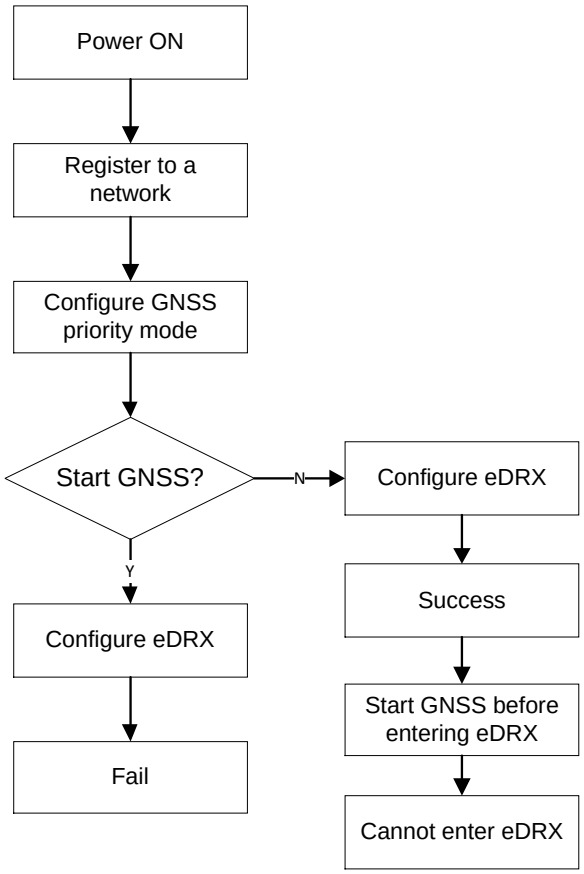

Figure 4: Configure eDRX in GNSS Priority Mode

In WWAN priority mode, the modules are able to configure and enter eDRX regardless of whether GNSS is active or not.

1.3.6. Minimum eDRX Cycle Recommendation in WWAN Priority Mode

Assuming that a GNSS fix on average takes a maximum of ***t*** seconds:

t1 = GNSS Unloading Time + WWAN Loading Time + Page Accepting Wake-up Time

From test observations, ***t1*** ≈ 1.5 seconds.

The recommended minimum eDRX Sleep Cycle should be > (***t*** + ***t1***) seconds.

eDRX Sleep Cycle = eDRX Cycle - PTW

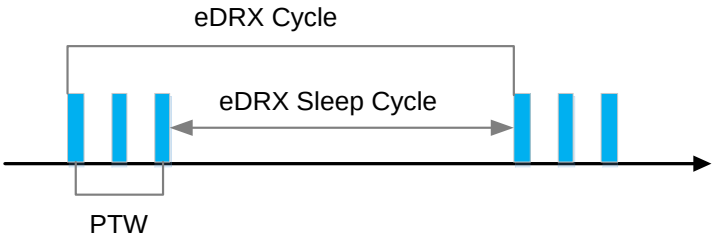

Figure 5: eDRX Diagram

Table 3: Recommended Minimum eDRX Cycle in WWAN Priority Mode (Unit: s)

Network Type	LTE-M	NB-IoT	GSM
Common eDRX Cycles	5.12 10.24 20.48 40.96 61.44 81.92 … 10485.76	20.48 40.96 61.44 163.84 …	eDRX not supported
Recommended Minimum eDRX Cycle (Cold start with XTRA)	10.24 (PTW = 1.28)	20.48 (PTW ≤ 10.24)	/
Recommended Minimum eDRX Cycle (Cold start without XTRA)	61.44 (PTW ≤ 20.48)	61.44 (PTW ≤ 20.48)	/

NOTE

1. The recommended minimum eDRX cycle is based on strong signal conditions. It is necessary to extend the eDRX Sleep Cycle in weak signal conditions.
2. The minimum eDRX Sleep Cycle must be greater than 8/40 seconds (cold start with/without XTRA respectively).

1.4. XTRA Feature

The XTRA technology enhances GNSS performance and provides simplified GNSS assistance delivery, including ephemeris, almanac, ionosphere, UTC, health and coarse time assistance for GNSS engine. After activating XTRA, the TTFF (Time to First Fix) can be reduced to about 10 seconds under the open sky.

1.4.1. XTRA Configuration Items

Select the XTRA file with 1, 3, or 7-day validity via **AT+QGPSCFG="xtrafilesize"**. With the constellations enabled on the device, the XTRA files are divided into 4 types: GPS + QZSS, GPS + GLONASS, GPS + Galileo, and GPS + BeiDou. The XTRA file size is shown in the following table.

Table 4: XTRA File Size

File Type & Duration (Validity)	7-Day File (kB)	3-Day File (kB)	1-Day File (kB)
GPS + QZSS	16.1	9.7	6.5
GPS + GLONASS	24.5	14.7	9.7
GPS + BeiDou	23.9	14.6	9.9
GPS + Galileo	25.8	15.2	9.9

NOTE

The sizes listed in the table above are for illustrative purposes only.

1.4.2. XTRA Time Source

The XTRA time format is UTC time. The modules support the following 4 ways to obtain UTC time:

- Inject time manually
- Synchronize NITZ time
- Synchronize GPS time
- Synchronize NTP time

The XTRA time is used to check the XTRA file validity and to inject ephemeris data at the current time to GNSS engine. Unless you inject the time manually, the XTRA time is injected automatically before injecting XTRA data. A device starts to first synchronize NITZ time. If NITZ time is not available, the device will then synchronize GPS time. Lastly, if both NITZ and GPS time are not available, the device will try to obtain NTP time.

NOTE

The NTP time server is *time.xtracloud.net*. When obtaining NTP time, the module starts a timer of 35 seconds. If the NTP time is not obtained within 35 seconds, the XTRA technology is not available and the module starts GNSS without XTRA.

1.4.3. Downloading XTRA File

1.4.3.1. XTRA File Downloading Initiation

The XTRA files are located on XTRA servers that are not configurable. To download XTRA file, the data service and the XTRA feature have to be enabled.

There are two ways to trigger XTRA file downloading:

- Execute **AT+QGPSCFG="xtra_download",1**
- Start GNSS [1)] with **AT+QGPSCFG="xtra_autodownload",1**

When XTRA file downloading is triggered, the module starts a 35-second timer. If no XTRA file is downloaded within 35 seconds, the XTRA technology is not available and the module starts GNSS without XTRA.

NOTE

1. [1)] To trigger automatic XTRA file downloading when starting GNSS, make sure the feature is enabled with **AT+QGPSCFG="xtra_autodownload",1** before starting GNSS.
2. If the XTRA file is downloaded via **AT+QGPSCFG="xtra_download",1** successfully, starting GNSS with **AT+QGPSCFG="xtra_autodownload",1** will not trigger downloading of the XTRA file again. If no valid XTRA file is available, starting GNSS with **AT+QGPSCFG="xtra_autodownload",1** triggers automatic XTRA file downloading.
3. If the network is unavailable when starting GNSS, the module skips XTRA file downloading and starts GNSS without XTRA.
4. The module checks XTRA file validity before downloading. If the existing XTRA file is expired, the module downloads the new XTRA file and then reports the URC **+QGPSURC: "XTRA_DL",<DL_err>** indicating the result of XTRA file downloading.

   <DL_err> Integer type. Downloading process result.
   - 0 XTRA file downloaded successfully
   - -1 Downloading failed

1.4.3.2. Validity Checking

When XTRA file downloading is triggered, the module checks the validity of the existing XTRA file. If the existing XTRA file is valid, the module stops downloading the new XTRA file. You can check the validity of the existing XTRA file manually by executing **AT+QGPSCFG="xtra_info"** (see ***Chapter 2.3.1.13***) or **AT+QGPSXTRADATA?** (see ***Chapter 2.3.9***).

1.4.3.3. Downloading Process

After XTRA file downloading is triggered automatically by starting GNSS with **AT+QGPSCFG="xtra_autodownload",1** or manually with **AT+QGPSCFG="xtra_download",1**, the module downloads the XTRA file with 3-day validity [1] by default and then injects the downloaded XTRA file into the GNSS engine. The XTRA file downloading process is shown as follows:

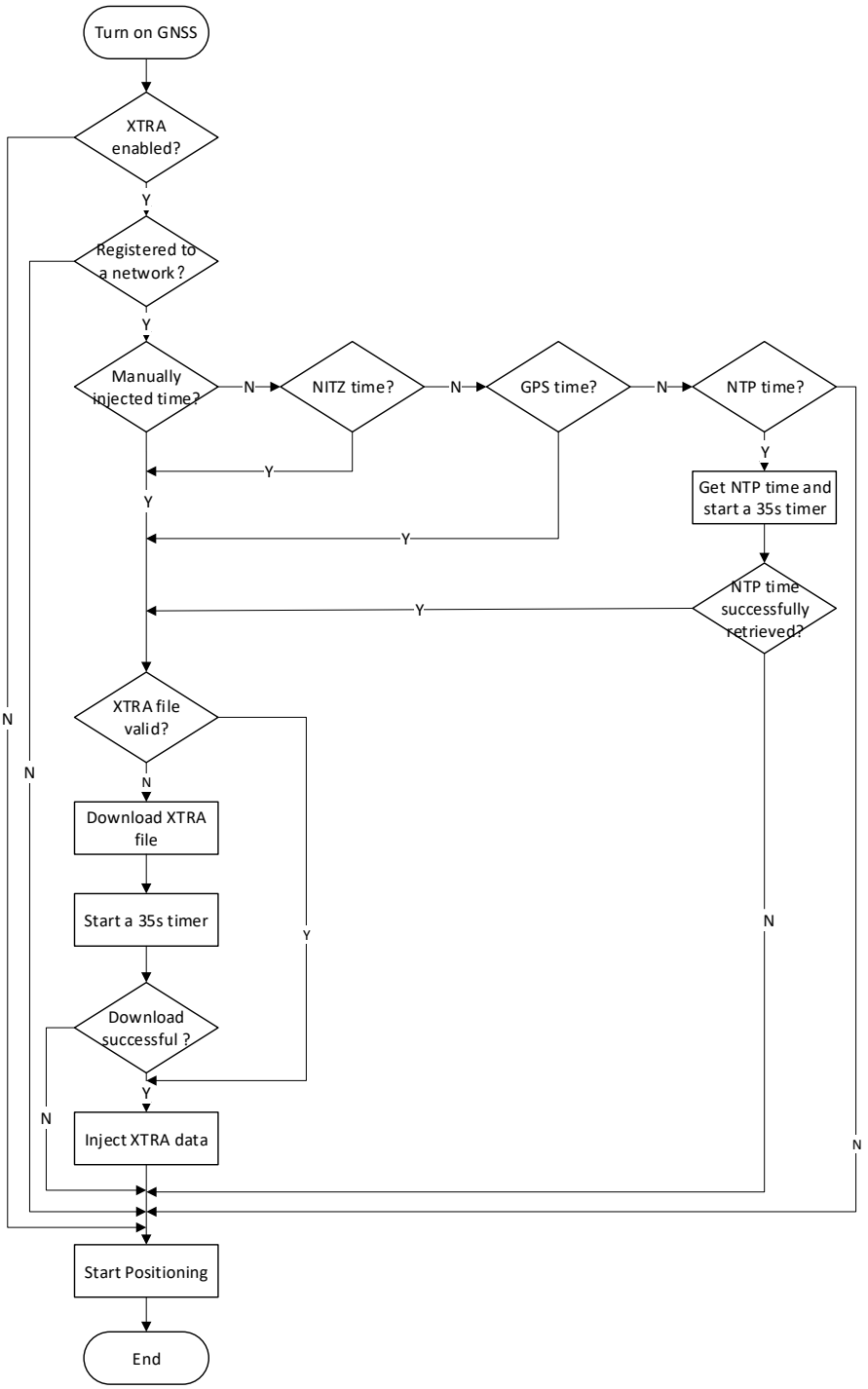

Figure 6: XTRA File Downloading Process

NOTE

[1] You can change the validity of the XTRA file via **AT+QGPSCFG="xtrafilesize"**. For more information, see ***Chapter 2.3.1.12***.

1.4.3.4. URLs for Downloading XTRA File Through MCU or Browser

You can manually download the XTRA file through the following URLs. Note that a special User-Agent used by HTTP protocol is needed to download the XTRA file. The special User-Agent string allows the devices to be recognized and grouped by the XTRA server.

User-Agent:
TX/9205/65536/-/-/MDM9205/-/QCX3/-/-/-/-/-/46/46/-/2.5/0/NA/0

GPS + QZSS:
7-day file:
http://iot1.xtracloud.net/xtra3gj.bin
http://iot2.xtracloud.net/xtra3gj.bin
http://iot3.xtracloud.net/xtra3gj.bin

3-day file:
http://iot1.xtracloud.net/xtra3gj_72h.bin
http://iot2.xtracloud.net/xtra3gj_72h.bin
http://iot3.xtracloud.net/xtra3gj_72h.bin

1-day file:
http://iot1.xtracloud.net/xtra3gj_24h.bin
http://iot2.xtracloud.net/xtra3gj_24h.bin
http://iot3.xtracloud.net/xtra3gj_24h.bin

GPS + GLONASS:
7-day file:
http://iot1.xtracloud.net/xtra3gr.bin
http://iot2.xtracloud.net/xtra3gr.bin
http://iot3.xtracloud.net/xtra3gr.bin

3-day file:
http://iot1.xtracloud.net/xtra3gr_72h.bin
http://iot2.xtracloud.net/xtra3gr_72h.bin
http://iot3.xtracloud.net/xtra3gr_72h.bin

1-day file:
http://iot1.xtracloud.net/xtra3gr_24h.bin

http://iot2.xtracloud.net/xtra3gr_24h.bin
http://iot3.xtracloud.net/xtra3gr_24h.bin

GPS + Galileo:
7-day file:
http://iot1.xtracloud.net/xtra3ge.bin
http://iot2.xtracloud.net/xtra3ge.bin
http://iot3.xtracloud.net/xtra3ge.bin

3-day file:
http://iot1.xtracloud.net/xtra3ge_72h.bin
http://iot2.xtracloud.net/xtra3ge_72h.bin
http://iot3.xtracloud.net/xtra3ge_72h.bin

1-day file:
http://iot1.xtracloud.net/xtra3ge_24h.bin
http://iot2.xtracloud.net/xtra3ge_24h.bin
http://iot3.xtracloud.net/xtra3ge_24h.bin

GPS + BeiDou:
7-day file:
http://iot1.xtracloud.net/xtra3gc.bin
http://iot2.xtracloud.net/xtra3gc.bin
http://iot3.xtracloud.net/xtra3gc.bin

3-day file:
http://iot1.xtracloud.net/xtra3gc_72h.bin
http://iot2.xtracloud.net/xtra3gc_72h.bin
http://iot3.xtracloud.net/xtra3gc_72h.bin

1-day file:
http://iot1.xtracloud.net/xtra3gc_24h.bin
http://iot2.xtracloud.net/xtra3gc_24h.bin
http://iot3.xtracloud.net/xtra3gc_24h.bin

1.4.4. XTRA Operating Procedures

The XTRA file needs to be updated regularly. When triggering new XTRA file downloading with **AT+QGPSCFG="xtra_download",1** or by starting GNSS with **AT+QGPSCFG="xtra_autodownload",1**, the module checks the validity of the existing XTRA file. In that case, if the existing XTRA file has expired, the new XTRA file is downloaded and injected automatically. If, however, the XTRA file is downloaded manually through MCU or browser, then you need to manually inject the new XTRA file into the GNSS engine before starting GNSS.

1.4.4.1. XTRA File Downloading Triggered with AT+QGPSCFG="xtra_download",1

Step 1: Enable the XTRA feature via **AT+QGPSXTRA=1** and then restart the module to activate the features.
Step 2: Check the network registration status via **AT+CGEG?** or **AT+CEREG?** before triggering the XTRA file downloading.
Step 3: Configure APN via **AT+QGPSCFG="xtra_apn"**. This step is optional.
Step 4: Check XTRA time via **AT+QGPSXTRATIME?**. If there is no XTRA time, inject XTRA time manually.
Step 5: Execute **AT+QGPSCFG="xtra_download",1** to trigger XTRA file downloading.
Step 6: Start GNSS via **AT+QGPS=1**.

For more detailed information about **AT+CGEG?** or **AT+CEREG?**, see ***document [1]***.

1.4.4.2. Automatic XTRA File Downloading by Starting GNSS

Step 1: Enable the XTRA feature via **AT+QGPSXTRA=1** and enable automatic XTRA file downloading upon GNSS starting via **AT+QGPSCFG="xtra_autodownload",1**. Then restart the module to activate the features.
Step 2: Check the network registration status via **AT+CGEG?** or **AT+CEREG?** before triggering the XTRA file downloading.
Step 3: Configure APN via **AT+QGPSCFG="xtra_apn"**. This step is optional.
Step 4: Check XTRA time via **AT+QGPSXTRATIME?**. If there is no XTRA time, inject XTRA time manually.
Step 5: Start GNSS via **AT+QGPS=1** to trigger automatic downloading of XTRA file.

For more detailed information about **AT+CGEG?** or **AT+CEREG?**, see ***document [1]***.

1.4.4.3. XTRA File Downloading Through MCU or Browser

Step 1: Enable the XTRA feature via **AT+QGPSXTRA** and then restart the module to activate the feature.
Step 2: Query and confirm the validity of the existing XTRA file via **AT+QGPSXTRADATA?**. If the existing XTRA file has expired, perform ***Steps 3***–***7***; if the XTRA file is valid, perform ***Steps 5*** and ***7***.
Step 3: Download the XTRA file to the module via URLs listed in ***Chapter 1.4.3.4***.
Step 4: Store the downloaded XTRA file to UFS or EUFS via **AT+QFUPL**, see ***document [2]***.
Step 5: Check XTRA time via **AT+QGPSXTRATIME?**. If there is no XTRA time, inject XTRA time manually.
Step 6: Inject the downloaded XTRA file into GNSS engine via **AT+QGPSXTRADATA**.
Step 7: Start GNSS via **AT+QGPS=1**.

2 Description of GNSS 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 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 4: 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.

2.3. AT Command Description

2.3.1. AT+QGPSCFG Configure GNSS

This command queries and configures various GNSS settings, including the NMEA output port and output types of NMEA sentences.

AT+QGPSCFG Configure GNSS	
Test Command **AT+QGPSCFG=?**	Response: **+QGPSCFG: "outport",(**list of supported **<outport>**s**),(**list of supported **<baud_rate>**s**)** **+QGPSCFG: "gnssconfig",(**range of supported **<GNSS_config>**s**)** **+QGPSCFG: "nmeafmt",(**list of supported **<NMEA_fmt_config>**s**)** **+QGPSCFG: "gpsnmeatype",(**range of supported **<GPS_NMEA_type>**s**)** **+QGPSCFG: "glonassnmeatype",(**range of supported **<GLONASS_NMEA_type>**s**)** **+QGPSCFG: "galileonmeatype",(**range of supported **<Galileo_NMEA_type>**s**)** **+QGPSCFG: "beidounmeatype",(**range of supported **<BeiDou_NMEA_type>**s**)** **+QGPSCFG: "qzssnmeatype",(**range of supported **<QZSS_NMEA_type>**s**)** **+QGPSCFG: "nmeasrc",(**list of supported **<NMEA_src>**s**)** **+QGPSCFG: "autogps",(**list of supported **<autoGPS>**s**)** **+QGPSCFG: "priority",(**list of supported **<priority_type>**s**),(**list of supported **<save>**s**)** **+QGPSCFG: "xtrafilesize",(**list of supported **<type>**s**)** **+QGPSCFG: "xtra_info"** **+QGPSCFG: "gpsdop"** **+QGPSCFG: "nmea_epe",(**list of supported **<NMEA_EPE>**s**)** **+QGPSCFG: "estimation_error"** **+QGPSCFG: "xtra_apn",(**list of supported **<IP_type>**s**),<APN>**

	+QGPSCFG: "xtra_download",(list of supported **<type>**s**)** **+QGPSCFG: "xtra_autodownload",(**list of supported **<mode>**s**)** **+QGPSCFG: "test_mode",(**list of supported **<mode>**s**)** **+QGPSCFG: "xtra_ntp",(**list of supported **<mode>**s**)** **OK**
Characteristics	/

2.3.1.1. AT+QGPSCFG="outport" Configure NMEA Output Port

This command queries and configures the NMEA output port and the port baud rate.

AT+QGPSCFG="outport" Configure NMEA Output Port	
Write Command **AT+QGPSCFG="outport"[,<outport>[,<baud_rate>]]**	Response If the optional parameters are omitted, query the current setting. **+QGPSCFG: "outport",<outport>[,<baud_rate>]** **OK** If any of the optional parameters is specified, set the NMEA output port and the port baud rate when **<outport>** is "uartnmea" or "auxnmea". **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<outport>	String type. NMEA output port. "none" Close NMEA sentence output "usbnmea" Output via USB NMEA port "uartnmea" Output via GNSS UART port "auxnmea" Output via debug UART port
<baud_rate>	Integer type. Baud rate of GNSS UART and debug UART port. Unit: bps. 4800 9600 19200

	38400 57600 115200 230400 460800 921600
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. The **<baud_rate>** is available only when **<outport>** is "uartnmea" or "auxnmea".
2. When **<baud_rate>** is 4800 or 9600, data loss may occur if a large amount of NMEA sentences are output.

2.3.1.2. AT+QGPSCFG="gnssconfig" Configure Supported GNSS Constellations

This command queries and configures the supported GNSS constellations of the module.

AT+QGPSCFG="gnssconfig"	**Configure Supported GNSS Constellations**
Write Command **AT+QGPSCFG="gnssconfig"[,<GNSS_config>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "gnssconfig",<GNSS_config>** **OK** If the optional parameter is specified, configure the supported GNSS constellations. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<GNSS_config>	Integer type. Supported GNSS constellation. 1 GPS + GLONASS 2 GPS + BeiDou 3 GPS + Galileo

	4	GPS + QZSS
	5	Variable. One of the options (1–4) is selected based on MCC of the camped network.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.	

NOTE

If **<GNSS_config>**=5, the constellation is selected based on Mobile Country Code (MCC) of camped network:

MCC	Constellations
United States/Russia/Default	GPS + GLONASS
Europe and relevant regions	GPS + Galileo
China	GPS + BeiDou
Japan and relevant regions	GPS + QZSS

2.3.1.3. AT+QGPSCFG="nmeafmt" Configure NMEA Protocol Standard

This command queries and configures the protocol standard of NMEA sentences.

AT+QGPSCFG="nmeafmt" Configure NMEA Protocol Standard	
Write Command **AT+QGPSCFG="nmeafmt"[,<NMEA_fmt_config>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "nmeafmt",<NMEA_fmt_config>** **OK** If the optional parameter is specified, set the NMEA protocol standard. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<NMEA_fmt_config>	Integer type. NMEA protocol standards. 0 NMEA output sentences conform to Qualcomm standards. 1 NMEA output sentences conform to the NMEA 0183 version 4.10.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

For details of NMEA sentences in Qualcomm standards, please refer to ***Chapter 1.2***. NMEA sentences in Qualcomm standards and that in NMEA 0183 version 4.10 standard differ from each other only in the talker ID of RMC, GGA and VTG sentences.

2.3.1.4. AT+QGPSCFG="gpsnmeatype" Configure Output Type of GPS NMEA Sentences

This command queries and configures the output type of GPS NMEA sentences.

AT+QGPSCFG="gpsnmeatype"	**Configure Output Type of GPS NMEA Sentences**
Write Command **AT+QGPSCFG="gpsnmeatype"[,<GPS_NMEA_type>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "gpsnmeatype",<GPS_NMEA_type>** **OK** If the optional parameter is specified, set the output type of GPS NMEA sentences. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<GPS_NMEA_type>	Integer type. Output type of GPS NMEA sentences by ORed. Range: 0–31. 0 Disable 1 GGA 2 RMC 4 GSV

	8 GSA 16 VTG 31 All of the above five types
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.5. AT+QGPSCFG="glonassnmeatype" Configure Output Type of GLONASS NMEA Sentences

This command queries and configures the output type of GLONASS NMEA sentences.

AT+QGPSCFG="glonassnmeatype" Configure Output Type of GLONASS NMEA Sentences	
Write Command **AT+QGPSCFG="glonassnmeatype"[, <GLONASS_NMEA_type>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "glonassnmeatype",<GLONASS_NMEA_type>** **OK** If the optional parameter is specified, set the output type of GLONASS NMEA sentences. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<GLONASS_NMEA_type>	Integer type. Output type of GLONASS NMEA sentences by ORed. Range: 0–3. 0 Disable 1 GSV 2 GSA 3 GSV + GSA
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.6. AT+QGPSCFG="galileonmeatype" Configure Output Type of Galileo NMEA Sentences

This command queries and configures the output type of Galileo NMEA sentences.

AT+QGPSCFG="galileonmeatype" Configure Output Type of Galileo NMEA Sentences	
Write Command **AT+QGPSCFG="galileonmeatype"[,<Galileo_NMEA_type>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "galileonmeatype",<Galileo_NMEA_type>** **OK** If the optional parameter is specified, set the output type of Galileo NMEA sentences. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<Galileo_NMEA_type>	Integer type. Output type of Galileo NMEA sentences by ORed. Range: 0–3. 0 Disable 1 GSV 2 GSA 3 GSV + GSA
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.7. AT+QGPSCFG="beidounmeatype" Configure Output Type of BeiDou NMEA Sentences

This command queries and configures the output type of BeiDou NMEA sentences.

AT+QGPSCFG="beidounmeatype" Configure Output Type of BeiDou NMEA Sentences	
Write Command **AT+QGPSCFG="beidounmeatype"[,<BeiDou_NMEA_type>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "beidounmeatype",<BeiDou_NMEA_type>** **OK**

	If the optional parameter is specified, set the output type of BeiDou NMEA sentences. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<BeiDou_NMEA_type>	Integer type. Output type of BeiDou NMEA sentences by ORed. Range: 0–3. 0 Disable 1 GSA 2 GSV 3 GSA + GSV
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.8. AT+QGPSCFG="qzssnmeatype" Configure Output Type of QZSS NMEA Sentences

This command queries and configures the output type of QZSS NMEA sentences.

AT+QGPSCFG="qzssnmeatype"	Configure Output Type of QZSS NMEA Sentences
Write Command **AT+QGPSCFG="qzssnmeatype"[,<QZSS_NMEA_type>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "qzssnmeatype",<QZSS_NMEA_type>** **OK** If the optional parameter is specified, set the output type of QZSS NMEA sentences. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<QZSS_NMEA_type>	Integer type. Output type of QZSS NMEA sentences by ORed. Range: 0–3. 0 Disable 1 GSA 2 GSV 3 GSA + GSV
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.9. AT+QGPSCFG="nmeasrc" Enable/Disable Acquisition of NMEA Sentences via AT+QGPSGNMEA

This command enables/disables the acquisition of NMEA sentences via **AT+QGPSGNMEA** and queries the current settings.

AT+QGPSCFG="nmeasrc" Enable/Disable Acquisition of NMEA Sentences via AT+QGPSGNMEA	
Write Command **AT+QGPSCFG="nmeasrc"[,<NMEA_src>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "nmeasrc",<NMEA_src>** **OK** If the optional parameter is specified, set whether to enable the acquisition of NMEA sentences via **AT+QGPSGNMEA**. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<NMEA_src>	Integer type. Sets whether to acquire the original NMEA sentences via **AT+QGPSGNMEA**. 0 Disable 1 Enable
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.10. AT+QGPSCFG="autogps" Enable/Disable GNSS to Run Automatically

This command enables/disables the automatic running of GNSS after the module is powered on, or queries the current settings.

AT+QGPSCFG="autogps" Enable/Disable GNSS to Run Automatically	
Write Command **AT+QGPSCFG="autogps"[,<autoGPS>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "autogps",<autoGPS>** **OK** If the optional parameter is specified, enable/disable the automatic running of GNSS. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<autoGPS>	Integer type. Enable/disable GNSS to run automatically after the module is powered on. 0 Disable GNSS to run automatically 1 Enable GNSS to run automatically
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. GNSS runs automatically with a high positioning accuracy and 1 Hz fix rate.
2. After enabling this function, the module may fail to register to a network, since the module cannot search the network when GNSS is active and in high priority.

2.3.1.11. AT+QGPSCFG="priority" Set GNSS or WWAN Priority Mode

This command sets the GNSS or WWAN priority mode or queries the current settings.

AT+QGPSCFG="priority" Set GNSS or WWAN Priority Mode	
Write Command **AT+QGPSCFG="priority"[,<priority_type>[,<save>]]**	Response If the optional parameters are omitted, query the current setting. **+QGPSCFG: "priority",<priority_type>,<state>** **OK** If any of the optional parameters is specified, set the GNSS or priority mode. **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. Whether to save the configuration is decided by **<save>**.

Parameter

<priority_type>	Integer type. Switch between GNSS and WWAN priority mode. 0 GNSS priority mode 1 WWAN priority mode
<save>	Integer type. Choose whether to save the configuration to NVRAM. 0 Do not save to NVRAM 1 Save to NVRAM
<state>	Integer type. GNSS/WWAN state. 0 WWAN/GNSS in unloaded state 1 WWAN in pending state 2 GNSS in pending state 3 WWAN in loaded state 4 GNSS in loaded state
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. The data service can be used only when the **<state>** is 3, while GNSS can work only when the **<state>** is 4.

2. If GNSS is not active, **<state>** should always be 3; when GNSS is active, **<state>** changes to 4.

2.3.1.12. AT+QGPSCFG="xtrafilesize" Select XTRA File to be Downloaded

This command selects the XTRA file to be downloaded.

AT+QGPSCFG="xtrafilesize" Select XTRA File to be Downloaded	
Write Command **AT+QGPSCFG="xtrafilesize"[,<type>]**	Response If the optional parameter is omitted, the command queries the current setting. **+QGPSCFG: "xtrafilesize",<type>** **OK** If the optional parameter is specified, the command selects the XTRA file to be downloaded: **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module reboots. The configuration is saved automatically.

Parameter

<type>	Integer type. XTRA file type. 1 Download the XTRA file with 1-day validity 3 Download the XTRA file with 3-day validity 7 Download the XTRA file with 7-day validity
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.13. AT+QGPSCFG="xtra_info" Query the Existing XTRA File Information

This command queries the existing XTRA file information. You can use the command to manually check the validity of the XTRA file.

AT+QGPSCFG="xtra_info"	Query the Existing XTRA File Information
Write Command **AT+QGPSCFG="xtra_info"**	Response **+QGPSCFG: "xtra_info",<left_time>,<date>** **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<left_time>	Integer type. Remaining validity term of the XTRA file. Range: 0–168. Unit: hour.
<date>	Integer type. Validity start date of the XTRA file in the UTC format. Format: "YYYY/MM/DD,hh:mm:ss".
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.14. AT+QGPSCFG="gpsdop" Query GNSS DOP Value

This command queries GNSS DOP value.

AT+QGPSCFG="gpsdop"	Query GNSS DOP value
Write Command **AT+QGPSCFG="gpsdop"**	Response **+QGPSCFG: "gpsdop",<PDOP>,<HDOP>,<VDOP>** **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	//

Parameter

<PDOP>	Float type. Position Dilution of Precision.
<HDOP>	Float type. Horizontal Dilution of Precision.
<VDOP>	Float type. Vertical Dilution of Precision.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.15. AT+QGPSCFG="estimation_error" Get Estimation Error

This command retrieves the estimation error.

AT+QGPSCFG="estimation_error" Get Estimation Error	
Write Command **AT+QGPSCFG="estimation_error"**	Response **+QGPSCFG: "estimation_error",<hori_unc>,<vert_unc>,<speed_unc>,<head_unc>** **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<hori_unc>	Float type. Horizontal estimated position error. Unit: meter.
<vert_unc>	Float type. Vertical estimated position error. Unit: meter.
<speed_unc>	Float type. Horizontal estimated velocity error. Unit: m/s.
<head_unc>	Float type. Estimated heading error. Unit: degree.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.16. AT+QGPSCFG="nmea_epe" Enable/Disable the Output of EPE NMEA Sentences

This command enables or disables the output of EPE NMEA sentences which includes the GNSS receiver's estimated accuracy.

AT+QGPSCFG="nmea_epe" Enable/Disable the Output of EPE NMEA Sentences	
Write Command **AT+QGPSCFG="nmea_epe"[,<NMEA_EPE>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "nmea_epe",<NMEA_EPE>** **OK** If the optional parameter is specified, enable or disable the NMEA message output of the receiver's estimated accuracy. **OK** If there is any error related to ME functionality:

	+CME ERROR: <errcode>
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<NMEA_EPE>	Integer type. Enable/disable the output of EPE NMEA sentences. 0 Disable 1 Enable. Sentence format: **$PQEPE,<timestamp>,<status>,<HDOP>,<hori_unc>,<vert_unc>,<speed_unc>,<head_unc>*<checksum>**
<timestamp>	String type. UTC time. Format: "hhmmss.ss".
<status>	String type. Indication of data validity. A Valid V Invalid
<HDOP>	Float type. Horizontal dilution of precision.
<hori_unc>	Float type. Horizontal estimated position error. Unit: meter.
<vert_unc>	Float type. Vertical estimated position error. Unit: meter.
<speed_unc>	Float type. Horizontal estimated velocity error. Unit: m/s.
<head_unc>	Float type. Estimated heading error. Unit: degree.
<checksum>	Hexadecimal type. The checksum is the XOR of all bytes between “$” and “*” (not including the delimiters themselves).
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.17. AT+QGPSCFG="xtra_apn" Configure APN Settings of XTRA File

This command configures APN settings of the XTRA file.

AT+QGPSCFG="xtra_apn" Configure APN Settings of XTRA File	
Write Command **AT+QGPSCFG="xtra_apn"[,<IP_type>,<APN>]**	Response If the optional parameters are omitted, query the current setting. **+QGPSCFG: "xtra_apn",<IP_type>,<APN>** **OK** If the optional parameters are specified, configure the APN settings of the XTRA file. **OK** If there is any error related to ME functionality:

	+CME ERROR: <errcode>
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will be saved automatically.

Parameter

<IP_type>	Integer type. IP family type. 0 IPv4 1 IPv6
<APN>	String type. Access point name.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

There is no need to configure the APN again if the APN settings of the XTRA file have already been configured via **AT+CGDCONT**.

2.3.1.18. AT+QGPSCFG="xtra_download" Trigger XTRA File Downloading

This command triggers XTRA file downloading.

AT+QGPSCFG="xtra_download"	Trigger XTRA File Downloading
Write Command **AT+QGPSCFG="xtra_download",<type>**	Response **OK** **+QGPSURC: "XTRA_DL",<DL_err>** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately.

Parameter

<type>	Integer type. Operation mode. 1 Trigger XTRA file downloading.
<DL_err>	Integer type. The result of the download process. 0 XTRA file downloaded successfully.

	-1 Downloading failed
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.19. AT+QGPSCFG="xtra_autodownload" Enable/Disable Automatic Downloading of XTRA File

This command enables or disables the automatic downloading of XTRA file upon GNSS starting.

AT+QGPSCFG="xtra_autodownload" Enable/Disable Automatic Downloading of XTRA File	
Write Command **AT+QGPSCFG="xtra_autodownload"[,<mode>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "xtra_autodownload",<mode>** **OK** If the optional parameter is specified, enable or disable the automatic downloading of XTRA file. **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<mode>	Enable/disable automatic downloading of XTRA file upon GNSS starting. 0 Disable 1 Enable
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.1.20. AT+QGPSCFG="test_mode" Enable/Disable XTRA Test Mode

This command enables/disables the XTRA test mode.

AT+QGPSCFG="test_mode"	Enable/Disable XTRA Test Mode
Write Command **AT+QGPSCFG="test_mode"[,<mode>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "test_mode",<mode>** **OK** If the optional parameter is specified, enable or disable the XTRA test mode. **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<mode>	Integer type. Enable/disable the XTRA test mode. 0 Disable 1 Enable
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. When the XTRA test mode is enabled, the number of XTRA file downloading attempt is unlimited.
2. The XTRA test mode is typically used when you test GNSS cold start performance with the XTRA feature enabled.

2.3.1.21. AT+QGPSCFG="xtra_ntp" Enable/Disable Time Synchronization from NTP Server

This command enables or disables the time synchronization from NTP server after downloading the XTRA file.

AT+QGPSCFG="xtra_ntp"	Enable/Disable Time Synchronization from NTP Server
Write Command **AT+QGPSCFG="xtra_ntp"[,<mode>]**	Response If the optional parameter is omitted, query the current setting. **+QGPSCFG: "xtra_ntp",<mode>**

	OK If the optional parameter is specified, enable or disable time synchronization from NTP server after downloading the XTRA file. **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<mode>	Integer type. Enable/disable time synchronization from NTP server after downloading the XTRA file. 0 Disable 1 Enable
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. This configuration takes effect for both manual and automatic downloading of XTRA file.
2. Before XTRA file downloading, you can execute **AT+QGPSCFG="xtra_ntp"** to enable time synchronization with NTP server. If the file downloading failed due to network or other reasons, GNSS will start positioning after about 35 s.

2.3.2. AT+QGPS Turn on GNSS

This command turns on the GNSS function. When **<fix_count>** is 0, the GNSS continuously gets a position fix and is always on. In that case, you can turn off the GNSS with the **AT+QGPSEND**. If **<fix_count>** is not zero, the GNSS is turned off automatically when **<fix_count>** reaches the specified value.

AT+QGPS Turn on GNSS	
Test Command **AT+QGPS=?**	Response **+QGPS: (**list of supported **<GNSS_mode>**s**)[,(**range of supported **<accuracy>**s**)[,(**range of supported **<fix_count>**s**)[,(**list of supported **<fix_rate>**s**)[,(**range of supported **<HEPE>**s**)]]]]** **OK**

Read Command **AT+QGPS?**	Response **+QGPS: <GNSS_state>** **OK**
Write Command **AT+QGPS=<GNSS_mode>[,<accuracy>[,<fix_count>[,<fix_rate>[,<HEPE>]]]]**	Response **OK** **[+QGPSURC: "XTRA_DL",<DL_err>]** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<GNSS_state>	Integer type. GNSS state. 0 GNSS OFF 1 GNSS ON
<GNSS_mode>	Integer type. GNSS working mode. 1 Stand-alone mode
<accuracy>	Integer type. The desired level of accuracy acceptable for fix computation. 1 Low Accuracy (1000 m) 2 Medium Accuracy (500 m) 3 High Accuracy (50 m)
<fix_count>	Integer type. Number of positioning or continuous positioning attempts. Range: 0–1000. Default value: 0. 0 indicates continuous positioning. Other values indicate the number of positioning attempts. When the value reaches the specified number of attempts, the GNSS will be stopped.
<fix_rate>	The interval between the first- and second-time positioning. Unit: second. If **<fix_rate>** < 1, it is a float type. Available options: 0.1 0.2 0.5 If **<fix_rate>** ≥ 1, it is an integer type. Range: 1–65535. Default value: 1.
<HEPE>	Integer type. Accuracy threshold. GNSS NMEA sentences will not be outputted if the accuracy is less than **<HEPE>**. 0 means disable this function. Range: 0–1000. Default value: 0. Unit: meter.
<DL_err>	Integer type. The result of XTRA file downloading. 0 XTRA file downloaded successfully

	-1 Downloading failed
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

1. XTRA file downloading is triggered only when XTRA feature is enabled and the XTRA file has expired.
2. Configure **<HEPE>** cautiously, because the higher the requested accuracy, the longer the TTFF or the more difficult the positioning. It is recommended to disable accuracy threshold.

2.3.3. AT+QGPSEND Turn off GNSS

This command turns off GNSS. It is used when GNSS is turned on and continuously fixes position (**<fix_count>** is 0). In such a case, GNSS can be turned off with **AT+QGPSEND**.

You do not need to use this command when **<fix_count>** is not zero, as GNSS is turned off automatically when **<fix_count>** reaches the specified value.

AT+QGPSEND Turn off GNSS	
Test Command **AT+QGPSEND=?**	Response **OK**
Execution Command **AT+QGPSEND**	Response **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.4. AT+QGPSLOC Acquire Positioning Information

This command acquires positioning information. Before executing the command, GNSS must be turned on via **AT+QGPS**.

AT+QGPSLOC Acquire Positioning Information	
Test Command **AT+QGPSLOC=?**	Response **+QGPSLOC: (**range of supported **<mode>**s**)[,(**range of supported **<para>**s**)]** **OK**
Write Command **AT+QGPSLOC=<mode>[,<para>]**	Response **+QGPSLOC: <UTC>,<latitude>,<longitude>,<HDOP>,<altitude>,<fix>,<COG>,<spkm>,<spkn>,<date>,<nsat>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Read Command **AT+QGPSLOC?**	Response Return the positioning information with **<latitude>,<longitude>** in format: ddmm.mmmmN/S,dddmm.mmmmE/W: **+QGPSLOC: <UTC>,<latitude>,<longitude>,<HDOP>,<altitude>,<fix>,<COG>,<spkm>,<spkn>,<date>,<nsat>** **OK**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<mode>	Integer type. Latitude and longitude display format. If **<mode>** ≤ 2, the timer periodically queries and reports. In this case, the command has to be executed only after getting the position fix. 0 **<latitude>,<longitude>** format: ddmm.mmmmN/S,dddmm.mmmmE/W 1 **<latitude>,<longitude>** format: ddmm.mmmmmm,N/S,dddmm.mmmmmm,E/W 2 **<latitude>,<longitude>** format: (-)dd.ddddd,(-)ddd.ddddd If **<mode>** ≥ 3, the positioning information is reported according to the frequency of RMC NMEA sentences. There is no restriction regarding command execution — the command can be executed at any time. 3 **<latitude>,<longitude>** format: ddmm.mmmmN/S,dddmm.mmmmE/W 4 **<latitude>,<longitude>** format: ddmm.mmmmmm,N/S,dddmm.mmmmmm,E/W 5 **<latitude>,<longitude>** format: (-)dd.ddddd,(-)ddd.ddddd
<para>	Integer type. If **<mode>** <=2, the parameter specifies the time when the queried results are reported.

	Range: 0–3600. Default value: 0. Unit: second. 0 Disable reporting. If **<mode>** >=3, the parameter specifies the reporting mode of the positioning information. Range: 0–2. 0 Disable reporting 1 Report once only when the fix status is changed: from “not fixed” to “fixed”, or vice versa. 2 Always report. Report according to the output frequency of NMEA sentences.
<UTC>	String type. Current UTC time. Format: hhmmss.sss (Quoted from GPGGA sentence).
<latitude>	Float type. Latitude. If **<mode>** is 0 or 3: Format: ddmm.mmmmN/S (Quoted from GPGGA sentence) dd 00–89 (Unit: degree) mm.mmmm 00.0000–59.9999 (Unit: minute) N/S North latitude / South latitude If **<mode>** is 1 or 4: Format: ddmm.mmmmmm,N/S (Quoted from GPGGA sentence) dd 00–89 (Unit: degree) mm.mmmmmm 00.000000–59.999999 (Unit: minute) N/S North latitude/South latitude If **<mode>** is 2 or 5: Format: (-)dd.ddddd (Quoted from GPGGA sentence) dd.ddddd -89.99999 to 89.99999 (Unit: degree) - South latitude
<longitude>	Float type. Longitude. If **<mode>** is 0 or 3: Format: dddmm.mmmmE/W (Quoted from GPGGA sentence) ddd 000–179 (Unit: degree) mm.mmmm 00.0000–59.9999 (minute) E/W East longitude / West longitude If **<mode>** is 1 or 4: Format: dddmm.mmmmmm,E/W (Quoted from GPGGA sentence) ddd 000–179 (Unit: degree) mm.mmmmmm 00.000000–59.999999 (Unit: minute) E/W East longitude / West longitude If **<mode>** is 2 or 5: Format: (-)dd.ddddd (Quoted from GPGGA sentence) dd.ddddd -179.99999 to 179.99999 (Unit: degree) - West longitude
<HDOP>	Float type. Horizontal precision. Range: 0.5–99.9 (Quoted from GPGGA sentence).
<altitude>	Float type. The altitude of the antenna away from the sea level, accurate to one decimal place. Unit: meter. (Quoted from GPGGA sentence)
<fix>	Integer type. GNSS positioning mode (Quoted from GNGSA/GPGSA sentence).

	2 2D positioning 3 3D positioning
<COG>	String type. Course Over Ground based on true north. Format: ddd.mm (Quoted from GPVTG sentence). ddd 000–359 (Unit: degree) mm 00–59 (Unit: minute)
<spkm>	Float type. Speed over ground. Format: xxxx.x. Unit: Km/h. Accurate to one decimal place (Quoted from GPVTG sentence).
<spkn>	Float type. Speed over ground. Format: xxxx.x. Unit: knots. Accurate to one decimal place (Quoted from GPVTG sentence).
<date>	String type. UTC time when fixing position. Format: ddmmyy (Quoted from GPRMC sentence).
<nsat>	Integer type. Number of satellites. Range: 00–12 (Quoted from GPGGA sentence).
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

The response of **AT+QGPSLOC?** is the same as that of **AT+QGPSLOC=0**.

2.3.5. AT+QGPSGNMEA Acquire NMEA Sentences

This command acquires NMEA sentences. Before using this command, turn on the GNSS via **AT+QGPS**, and set **<NMEA_src>** of **AT+QGPSCFG="nmeasrc"** to 1.

The sentence output can also be disabled via **AT+QGPSCFG="gpsnmeatype",0**, **AT+QGPSCFG="glonassnmeatype",0**, **AT+QGPSCFG="galileonmeatype",0** and **AT+QGPSCFG="beidounmeatype",0**.

AT+QGPSGNMEA Acquire NMEA Sentences	
Test Command **AT+QGPSGNMEA=?**	Response **+QGPSGNMEA: (**list of supported **<NMEA_sentence>**s**)** **OK**
Write Command Acquire GGA sentences **AT+QGPSGNMEA="GGA"**	Response **+QGPSGNMEA: <GGA_sentence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**

Write Command Acquire RMC sentences **AT+QGPSGNMEA="RMC"**	Response **+QGPSGNMEA: <RMC_sentence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Write Command Acquire GSV sentences **AT+QGPSGNMEA="GSV"**	Response **+QGPSGNMEA: <GSV_sentence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Write Command Acquire GSA sentences **AT+QGPSGNMEA="GSA"**	Response **+QGPSGNMEA: <GSA_sentence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Write Command Acquire VTG sentences **AT+QGPSGNMEA="VTG"**	Response **+QGPSGNMEA: <VTG_sentence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<GGA_sentence>	GGA sentences.
<RMC_sentence>	RMC sentences.
<GSV_sentence>	GSV sentences.
<GSA_sentence>	GSA sentences.
<VTG_sentence>	VTG sentences.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.6. AT+QCFGEXT Query and Configure Extended Settings

This command queries and configures various extended settings of the module.

AT+QCFGEXT Query and Configure Extended Settings	
Test Command **AT+QCFGEXT=?**	Response **+QCFGEXT: "addgeo",<geoid>,<mode>,<shape>,<lat1>,<lon1>,<lat2>[,<lon2>[,<lat3>,<lon3>[,<lat4>,<lon4>]]]** **+QCFGEXT: "deletegeo",<geoid>** **+QCFGEXT: "querygeo",<geoid>** **OK**
Maximum Response Time	300 ms
Characteristics	/

2.3.6.1. AT+QCFGEXT="addgeo" Add a Geo-fence

This command adds a geo-fence or queries the current settings.

AT+QCFGEXT="addgeo" Add a Geo-fence	
Write Command **AT+QCFGEXT="addgeo",[<geoid>,[<mode>,<shape>,<lat1>,<lon1>,<lat2>,[<lon2>,[<lat3>,<lon3>[,<lat4>,<lon4>]]]]]**	Response If all optional parameters are omitted, query the current settings of all geo-fences that have been added. **[+QCFGEXT: "addgeo",<geoid>,<mode>,<shape>,<lat1>,<lon1>,<lat2>,[<lon2>,[<lat3>,<lon3>[,<lat4>,<lon4>]]]** **…** **+QCFGEXT: "addgeo",<geoid>,<mode>,<shape>,<lat1>,<lon1>,<lat2>,[<lon2>,[<lat3>,<lon3>[,<lat4>,<lon4>]]]]** **OK** If the optional parameters after **<geoid>** are omitted, query the current setting of the specified geo-fence. **+QCFGEXT: "addgeo",<geoid>,<mode>,<shape>,<lat1>,<lon1>,<lat2>,[<lon2>,[<lat3>,<lon3>[,<lat4>,<lon4>]]]** **OK** If **<shape>**=0, the command adds a circular geo-fence and the parameters after **<lat2>** must be omitted. **OK** If **<shape>**=1, the command adds a circular geo-fence and the parameters after **<lon2>** must be omitted. **OK**

	If **<shape>**=2, the command adds a triangular geo-fence and the parameters after **<lon3>** must be omitted. **OK** If **<shape>**=3, the command adds a quadrangle geo-fence. All parameters must be specified. **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<geoid> Integer type. Geo-fence ID. Range: 0–9.

<mode> Integer type. URC report mode.

0 Disable URC to be reported when entering or leaving the geo-fence
1 Enable URC to be reported when entering the geo-fence
2 Enable URC to be reported when leaving the geo-fence
3 Enable URC to be reported when entering or leaving the geo-fence

The URC is shown as below:

+QIND: "GEOFENCE",<ID>,<action>,<time>,<latitude>,<longitude>,<altitude>,<course>,<speed>,<PDOP>,<HDOP>,<VDOP>

URC parameters:

<ID> The ID of geo-fence that is to be entered or left.

<action> The current action of the module.
1 Entering the geo-fence
2 Leaving the geo-fence

<time> The UTC time when entering or leaving the geo-fence.
Format: yyyy-MM-dd hh:mm:ss

<latitude> The latitude of module when entering or leaving the geo-fence.
Unit: degree.

<longitude> The longitude of module when entering or leaving the geo-fence.
Unit: degree.
Format: ±ddd.dddddd. Range: -180.000000 to 180.000000.

<altitude> Mean sea level altitude. Unit: meter.

<course> Course over ground, relative to true north. Unit: degree.

<speed> Speed over ground. Unit: m/s.

<PDOP> Position dilution of precision.

	<HDOP> Horizontal dilution of precision. **<VDOP>** Vertical dilution of precision.
<shape>	Integer type. Geo-fence shape. 0 Circularity with center and radius 1 Circularity with center and one point on the circle 2 Triangle 3 Quadrangle
<lat1>	The latitude of a point that is defined as the center of the geo-fence circular region or the first point. Unit: degree. Format: ±dd.dddddd. Range: -90.000000 to 90.000000.
<lon1>	The longitude of a point that is defined as the center of the geo-fence circular region or the first point. Unit: degree. Format: ±ddd.dddddd. Range: -180.000000 to 180.000000.
<lat2>	When **<shape>** is 0, this parameter is a radius. Range: 0–6000000. Unit: meter. When **<shape>** is not 0, this parameter is a latitude. Unit: degree. Format: ±dd.dddddd. Range: -90.000000 to 90.000000. If **<shape>** is 0, the parameters after **<lat2>** must be omitted.
<lon2>	The longitude of the second point. Unit: degree. Format: ±ddd.dddddd. Range: -180.000000 to 180.000000. If **<shape>** is 1, the parameters after **<lon2>** must be omitted.
<lat3>	The latitude of the third point. Unit: degree. Format: ±dd.dddddd. Range: -90.000000 to 90.000000.
<lon3>	The longitude of the third point. Unit: degree. Format: ±ddd.dddddd. Range: -180.000000 to 180.000000. If **<shape>** is 2, the parameters after **<lon3>** must be omitted.
<lat4>	The latitude of the fourth point. Unit: degree. Format: ±dd.dddddd. Range: -90.000000 to 90.000000.
<lon4>	The longitude of the fourth point. Unit: degree. Format: ±ddd.dddddd. Range: -180.000000 to 180.000000.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.6.2. AT+QCFGEXT="deletegeo" Delete a Geo-fence

This command deletes a geo-fence.

AT+QCFGEXT="deletegeo" Delete a Geo-fence	
Write Command **AT+QCFGEXT="deletegeo",<geoid>**	Response **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms

Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<geoid>	Integer type. Geo-fence ID. Range: 0–10. 10 means deleting all geo-fences.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.6.3. AT+QCFGEXT="querygeo" Query the Position with Respect to Geo-Fence

This command queries the position with respect to the geo-fence.

AT+QCFGEXT="querygeo" Query the Position with Respect to Geo-Fence	
Write Command **AT+QCFGEXT="querygeo",<geoid>**	Response: **+QCFGEXT: "querygeo",<geoid>,<pos_wrt_geofence>** **OK** If there is any error related to the ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<geoid>	Integer type. Geo-fence ID. Range: 0–9.
<pos_wrt_geofence>	Integer type. Position with respect to the geo-fence. 0 Position unknown 1 Position is inside the geo-fence 2 Position is outside the geo-fence
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.7. AT+QGPSXTRA Enable/Disable XTRA Function

This command enables/disables XTRA function.

AT+QGPSXTRA Enable/Disable XTRA Function	
Test Command **AT+QGPSXTRA=?**	Response **+QGPSXTRA: (**list of supported **<XTRA_enable>**s**)**

	OK
Read Command **AT+QGPSXTRA?**	Response **+QGPSXTRA: <XTRA_enable>** **OK**
Write Command **AT+QGPSXTRA=<XTRA_enable>**	Response **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect after the module is rebooted. The configuration will be saved automatically.

Parameter

<XTRA_enable>	Integer type. Enable/disable XTRA feature. 0 Disable 1 Enable
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

2.3.8. AT+QGPSXTRATIME Inject XTRA Time

This command injects XTRA time to GNSS engine when the module cannot synchronize time from network. Before using this command, enable XTRA feature via **AT+QGPSXTRA=1**.

AT+QGPSXTRATIME Inject XTRA Time	
Test Command **AT+QGPSXTRATIME=?**	Response **+QGPSXTRATIME: 0,<XTRA_time>,(**list of supported **<UTC>**s**),0,<uncrtn>** **OK**
Read Command **AT+QGPSXTRATIME?**	Response **+QGPSXTRATIME: <inject_time>** **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Write Command **AT+QGPSXTRATIME=<op>,<XTRA_time>[,<UTC>[,<reserved>,<uncrtn>]]**	Response **OK**

	If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	/

Parameter

<inject_time>	String type. Injected UTC time. Format: "YYYY/MM/DD,hh:mm:ss". e.g. "2020/04/03,15:34:50". If the queried **<inject_time>** is empty, it means XTRA time has not been injected yet.
<op>	Integer type. Operation type. 0 Inject XTRA time
<XTRA_time>	String type. Current UTC time to be injected. Format: "YYYY/MM/DD,hh:mm:ss". e.g. "2020/04/03,15:34:50".
<UTC>	Integer type. The type of time. 0 Reserved 1 UTC time
<reserved>	Reserved. Always 0.
<uncrtn>	Integer type. Uncertainty of time. Range: 1–3600000. Default value: 3500. Unit: millisecond. If this parameter is omitted or less than 3.5 seconds, it will be counted as 3.5 seconds.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

The module synchronizes time from network by NITZ automatically and supports querying the injected time via **AT+QGPSXTRATIME?**. If the XTRA time is not injected, you can inject it manually with this command.

2.3.9. AT+QGPSXTRADATA Inject XTRA File

This command injects XTRA data file to GNSS engine. It is used when you are manually downloading XTRA file through MCU or a browser. Before running this command, you must enable XTRA feature, store the valid XTRA file into UFS or EUFS of the module, and inject XTRA time to GNSS engine. The XTRA file stored in UFS or EUFS can be deleted after injecting the XTRA file into GNSS engine. **AT+QGPSXTRADATA?** returns the injecting result, so the command can be used to check the validity of the XTRA file.

AT+QGPSXTRADATA Inject XTRA File	
Test Command **AT+QGPSXTRADATA=?**	Response **+QGPSXTRADATA: <XTRA_data_filename>**

	OK
Read Command **AT+QGPSXTRADATA?**	Response **+QGPSXTRADATA: <XTRA_data_durtime>,<injected_datatime>** **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Write Command **AT+QGPSXTRADATA=<XTRA_data_filename>**	Response **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<XTRA_data_filename>	String type. Filename of the XTRA file, e.g. "UFS:xtra3grc.bin" or "EUFS:xtra3grc.bin".
<XTRA_data_durtime>	Integer type. Validity period of the injected XTRA file. Unit: minute. 1440 For 1-day XTRA file 4320 For 3-day XTRA file 10080 For 7-day XTRA file
<injected_datatime>	String type. The starting time of the XTRA file's validity. Format: "YYYY/MM/DD,hh:mm:ss", e.g. "2020/07/20,06:00:00".
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

The XTRA file expires after the validity period is over: **<injected_datatime>** + **<XTRA_data_durtime>**.

2.3.10. AT+QGPSDEL Delete Assistance Data

This command deletes assistance data so as to perform cold start, hot start and warm start of GNSS. The command can only be executed when GNSS is turned off. After deleting the assistance data via this command, cold start of GNSS can be enforced via **AT+QGPS**. Hot/warm start can also be performed if the corresponding conditions are satisfied.

AT+QGPSDEL Delete Assistance Data	
Test Command **AT+QGPSDEL=?**	Response **+QGPSDEL: (**range of supported **<delete_type>)** **OK**
Write Command **AT+QGPSDEL=<delete_type>**	Response **OK** If there is any error related to ME functionality: **+CME ERROR: <errcode>**
The maximum response time	1 s
Characteristics	The command takes effect immediately. The configuration will not be saved.

Parameter

<delete_type>	Integer type. The type of GNSS assistance data to be deleted. 0 Delete all assistance data include XTRA data. Enforce cold start after starting GNSS. 1 Do not delete any data. After starting GNSS, perform hot start if conditions are met. 2 Delete some related data. After starting GNSS, perform warm start if conditions are met.
<errcode>	Integer type. Error code of an operation. See ***Chapter 6*** for details.

NOTE

When performing a cold start, the XTRA file is deleted and cannot be downloaded again for the next 24 hours. You can execute **AT+QGPSCFG="test_mode",1** to remove the download limitation. For more information, see ***Chapter 2.3.1.20***.

3 Examples

3.1. Turn on/off GNSS

Default arguments are used in this example to turn on GNSS. After turning on GNSS, NMEA sentences will be output from "usbnmea" port by default, and GNSS can be turned off via **AT+QGPSEND**.

```
AT+QGPS=1                    //Turn on GNSS.
OK

//After turning on GNSS, NMEA sentences will be output from "usbnmea" port by default.
AT+QGPSLOC?                  //Obtain positioning information.
+QGPSLOC: 130618.000,3150.8076N,11711.9039E,0.8,89.5,2,0.00,0.0,0.0,110919,12

OK
AT+QGPSEND                   //Turn off GNSS.
OK
```

3.2. Acquire Positioning Information

In the following example, you can see how to acquire the positioning information via **AT+QGPSLOC** after the GNSS has been turned on and the position fix obtained.

```
AT+QGPS=1                    //Turn on GNSS.
OK
AT+QGPSLOC?
+CME ERROR: 516              //Not fixed
AT+QGPSLOC?                  //Obtain positioning information.
+QGPSLOC: 130618.000,3150.8076N,11711.9039E,0.8,89.5,2,0.00,0.0,0.0,110919,12

OK
AT+QGPSLOC=0                 //Set the latitude and longitude display format to
                             ddmm.mmmmN/S,dddmm.mmmmE/W
+QGPSLOC: 131050.000,3150.8069N,11711.9032E,1.2,90.7,3,0.00,0.0,0.0,110919,08
```

```
OK
AT+QGPSLOC=1              //Set the latitude and longitude display format to
                          ddmm.mmmmmm,N/S,dddmm.mmmmmm,E/W
+QGPSLOC: 131117.000,3150.806972,N,11711.903278,E,1.3,90.6,3,0.00,0.0,0.0,110919,07

OK
AT+QGPSLOC=2              //Set the latitude and longitude display format to
                          (-)dd.ddddd,(-)ddd.ddddd
+QGPSLOC: 131140.000,31.84678,117.19838,1.3,90.5,3,0.00,0.0,0.0,110919,07

OK
AT+QGPSLOC=2,1            //Obtain positioning information and enable periodical location report.
+QGPSLOC: 131305.000,31.84678,117.19838,1.8,89.9,3,0.00,0.0,0.0,110919,07

OK

+QGPSLOC: 131306.000,31.84678,117.19838,1.0,89.9,3,0.00,0.0,0.0,110919,08

+QGPSLOC: 131307.000,31.84678,117.19838,1.0,89.9,3,0.00,0.0,0.0,110919,08

+QGPSLOC: 131308.000,31.84678,117.19838,0.9,89.9,3,0.00,0.0,0.0,110919,08

AT+QGPSLOC=2,0            //Obtain positioning information and disable periodical location report.
+QGPSLOC: 131431.000,31.84678,117.19838,0.9,89.7,3,0.00,0.0,0.0,110919,09

OK
AT+QGPSLOC=4,1            //Set position reporting when the positioning status has changed.
OK

//Not fixing → fixing
+QGPSLOC:052943.000,3149.314079,N,11706.979269,E,0.8,128.7,3,0.00,0.0,0.0,080720,07

//Fixing → not fixing
+QGPSLOC: ,,,,,,,,,,

AT+QGPSLOC=4,2            //Set the reporting location information according to the reporting
                          frequency of NMEA sentences
+QGPSLOC: 053018.000,3149.309670,N,11706.977340,E,0.8,136.6,3,1.47,2.2,1.2,080720,07

+QGPSLOC: 053019.000,3149.309125,N,11706.978666,E,0.7,136.0,3,0.00,0.0,0.0,080720,08

+QGPSLOC: 053020.000,3149.309125,N,11706.978666,E,0.7,136.0,3,0.00,0.0,0.0,080720,08
```

```
AT+QGPSLOC=4,0              //Disable location report.
OK
```

3.3. Query Satellite System

```
AT+QGPSCFG="gnssconfig"     //Query enabled satellite systems
+QGPSCFG: "gnssconfig",1    //GPS and GLONASS are enabled.

OK
AT+QGPS=1                   //Turn on GNSS.
OK
AT+QGPSGNMEA="GSV"
//GPS GSV sentences
+QGPSGNMEA: $GPGSV,4,1,14,02,68,055,16,04,00,000,31,05,64,314,26,07,08,070,18,1*6D
+QGPSGNMEA: $GPGSV,4,2,14,09,04,037,30,12,11,228,36,15,16,207,20,19,11,155,14,1*6B
+QGPSGNMEA: $GPGSV,4,3,14,25,09,269,20,29,27,316,32,06,26,101,,13,41,177,,1*68
+QGPSGNMEA: $GPGSV,4,4,14,17,00,000,,30,10,091,,1*6D
//GLONASS GSV sentences
+QGPSGNMEA: $GLGSV,2,1,05,22,32,332,26,20,25,136,13,21,78,073,18,07,57,243,21,1*78
+QGPSGNMEA: $GLGSV,2,2,05,08,10,224,,1*40

OK
AT+QGPSCFG="gnssconfig",2   //Enable GPS and BeiDou.
OK

//Restarts the module.
RDY

APP RDY
AT+QGPSCFG="gnssconfig"     //Query enabled satellite systems.
+QGPSCFG: "gnssconfig",2    //GPS and BeiDou are enabled.

OK
AT+QGPS=1                   //Turn on GNSS.
OK
AT+QGPSGNMEA="GSV"
//GPS GSV sentences
+QGPSGNMEA: $GPGSV,3,1,11,02,64,089,36,04,00,000,39,05,63,346,45,06,21,113,27,1*6F
+QGPSGNMEA: $GPGSV,3,2,11,07,09,059,45,12,02,218,33,15,29,211,30,25,04,257,27,1*64
+QGPSGNMEA: $GPGSV,3,3,11,29,37,307,41,30,16,090,29,13,57,173,,1*59
//BeiDou GSV sentence
+QGPSGNMEA: $PQGSV,1,1,03,13,65,343,34,14,72,329,26,21,08,052,42,1*45
```

```
OK
```

3.4. Implement Geo-Fence Function

```
AT+QCFGEXT="addgeo",0,3,0,31.826,117.2168,100      //Add a circular geo-fence 0.
OK
AT+QCFGEXT="addgeo",0                              //Query the setting of circular geo-fence 0.
+QCFGEXT: "addgeo",0,3,0,31.826000,117.216800,100.0

OK
AT+QCFGEXT="addgeo",7,1,3,31.833348,117.212909,31.826453,117.213248,31.82873,117.222093,
31.833502,117.2208623                              //Add a quadrangle geo-fence 7.
OK
AT+QCFGEXT="addgeo",7                              //Query the settings of geo-fence 7.
+QCFGEXT:
"addgeo",7,1,3,31.833348,117.212909,31.826453,117.213248,31.828730,117.222093,31.833502,117.
220862

OK
AT+QCFGEXT="deletegeo",7                           //Delete geo-fence 7.
OK
AT+QGPS=1                                          //Turn on the GNSS engine.
OK
AT+QCFGEXT="querygeo",0                  //Query the position with respect to geo-fence 0.
+QCFGEXT: "querygeo",0,1                 //The current position is inside the geo-fence 0.

OK

//When entering the geo-fence 0, this URC is reported.
+QIND: "GEOFENCE",0,1,2017/08/25 08:35:53,31.825179,117.217127,34.0,0.2,13.8,1.1,0.7,0.8
//When leaving the geo-fence 0, this URC is reported.
+QIND: "GEOFENCE",0,2,2017/08/25 08:36:07,31.826951,117.217071,38.0,359.0,13.4,0.9,0.6,0.6
```

3.5. Procedure to Use XTRA Feature

There are three ways to download XTRA files:

a) Via **AT+QGPSCFG="xtra_download",1**
b) By starting GNSS
c) Manual download through MCU or browser

3.5.1. XTRA File Downloading Triggered with AT+QGPSCFG="xtra_download",1

```
AT+QGPSXTRA=1                  //Enable XTRA and then restart the module to activate the feature.
OK
AT+CEREG?                      //Check the network status.
+CEREG: 0,1

OK
AT+QGPSXTRATIME?               //Check XTRA time. Inject XTRA time if it is not available.
+QGPSXTRATIME: "2020/07/20,02:34:47"

OK
AT+QGPSCFG="xtra_info"         //Check whether the existing XTRA file has expired.
+QGPSCFG: "xtra_info",0, "2020/07/16,06:00:00"      //XTRA file is expired.

OK
AT+QGPSCFG="xtra_download",1   //Trigger XTRA file downloading.
OK

+QGPSURC: "XTRA_DL",0          //The XTRA file is successfully downloaded.
AT+QGPSXTRADATA?               //Check the validity of the existing XTRA file.
+QGPSXTRADATA: 4320,"2020/07/20,06:00:00"

OK
AT+QGPS=1                      //Start GNSS with XTRA.
OK
```

3.5.2. Automatic XTRA File Downloading by Starting GNSS

```
AT+QGPSXTRA=1                          //Enable XTRA feature.
OK
AT+QGPSCFG="xtra_autodownload",1       //Enable automatic XTRA file downloading upon GNSS
                                       starting.
```

```
OK
AT+CEREG?                                   //Check the network status.
+CEREG: 0,1

OK
AT+QGPSXTRATIME?                  //Check XTRA time. Inject XTRA time if it is not available.
+QGPSXTRATIME: "2020/07/20,02:34:47"

OK
AT+QGPSCFG="xtra_info"      //Check whether the existing XTRA file has expired.
+QGPSCFG: "xtra_info",0, "2020/07/16,06:00:00"      //XTRA file has expired.

OK
AT+QGPS=1                          //Start GNSS to trigger automatic downloading of XTRA file.
OK

+QGPSURC: "XTRA_DL",0

AT+QGPSXTRADATA?          //Check the validity of the existing XTRA file.
+QGPSXTRADATA: 4320,"2020/07/20,06:00:00"      //The XTRA file expires on 2020/07/23,06:00:00.

OK
```

3.5.3. XTRA File Downloading Through MCU or Browser

```
AT+QGPSXTRA=1                     //Enable XTRA and then restart the module to activate the feature.
OK

//Download the XTRA file to PC (or MCU) from the URLs listed in Chapter 1.4.3.4.
AT+QFUPL="UFS:xtra3gr.bin",24376     //Select the XTRA file and upload it to the module's UFS or
                                     EUFS via QCOM. For more details about this command,
                                     see document [2]. For more details about QCOM tool
                                     use and configuration, see document [7].
OK
AT+QGPSXTRATIME?                     //Check XTRA time.
+QGPSXTRATIME: ""                    //There is no XTRA time, so you need to inject it manually.

OK
AT+QGPSXTRATIME=0,"2020/07/20,07:31:54"      //Inject XTRA time.
OK
AT+QGPSXTRADATA="UFS:xtra3gr.bin"            //Inject the XTRA file.
OK
AT+QGPSXTRADATA?                             //Check the validity of the existing XTRA file.
```

```
+QGPSXTRADATA: 168,"2020/07/20,06:00:00"

OK
AT+QFDEL="UFS:xtra3gr.bin"          //Delete the XTRA file from UFS to save memory.
                                    This step is optional.
OK
AT+QGPS=1                           //Start GNSS with XTRA.
OK
```

4 Use Cases

Considering the complexity of GNSS feature of the modules and the fact that those use cases listed below cannot cover all tracking applications and extreme cases, we strongly suggest that you provide the specific application cases to Quectel Technical Support team for a review via support@quectel.com or http://e-service.quectel.com.

4.1. PSM Enabled

The recommended procedure for using the PSM is given below. For more information on PSM implementation, see ***document [6]***.

1. Power on the module and then register to a network
2. Configure PSM (such as T3412 = 6 hours, T3324 = 10 minutes)
3. Wake up from PSM
4. Set the module into the GNSS priority mode
5. Turn on GNSS and get a position fix
6. Switch to the WWAN priority mode
7. Report positioning information and other data to the server
8. Enter PSM
9. Repeat 3-8

4.2. Recommended Mode: WWAN Priority Mode

The WWAN priority mode is recommended when there is a high demand for data transmission services. Before using the WWAN priority mode, make sure that both conditions are satisfied:

- The eDRX is used, and the eDRX cycle is longer than TTFF
- There is a low demand for GNSS positioning

The recommended procedure for using the WWAN priority mode:

1. Configure the eDRX cycle that is sufficiently longer than TTFF [1)]
2. Wake up from the sleep mode
3. Turn on GNSS (GNSS session may be deferred to eDRX)

4. Obtain the GNSS positioning information
5. Turn off GNSS or switch to the WWAN priority mode[2]
6. Report position information to the server
7. Return to the sleep mode
8. Repeat 2-7

NOTE

1. [1)] For details of TTFF values, refer to the corresponding hardware design manuals.
2. Step 5 is optional, as it depends on the practical applications and the current consumption requirements.

4.3. Recommended Mode: GNSS Priority Mode

The GNSS priority mode is recommended when there is high demand for GNSS positioning and low demand for data transmission.

The recommended procedure for using the GNSS priority mode:

1. Wake up from the sleep mode
2. Turn on GNSS (GNSS session starts immediately)
3. Collect data from sensors and obtain the GNSS positioning information
4. Turn off GNSS or switch to WWAN priority mode
5. Report sensor data and positioning information to the server
6. Return to sleep mode
7. Repeat 1–6

NOTE

It will take at least 44.5 seconds for one cycle if you transfer 500 bytes of data: TCP connect time (8 s) + Time used to send 500 bytes of data (4.5 s) + TCP close time (10 s) + GNSS fix time (30 s) + delay time (2 s). If XTRA is enabled, this time can be reduced to 24.5 s.

4.4. Limitations of GNSS

There may be limitations on reporting positioning and sensor data in applications where the reporting is performed following the steps below. A success of the query on step 7 cannot be guaranteed every time, because the page may be lost when GNSS is in active status with GNSS priority. In addition, obtaining a position on time cannot be guaranteed either if WWAN is preferential. In these cases, it is recommended

to select a solution where GNSS and WWAN could work simultaneously, either Quectel BG96 module, or Quectel BG95/BG77/BG600L-M3 module with an external GNSS module.

Procedure

1. Wake up from sleep mode
2. Turn on GNSS (GNSS session started immediately)
3. Collect data from sensors and obtain the GNSS positioning information
4. Turn off GNSS or switch to WWAN priority mode
5. Report sensor data and positioning information to server
6. Return to sleep mode
7. The sensor data and positioning information may be queried from the network side anytime during Steps 2–5
8. Repeat Steps 1–7.

5 FAQ

1. **Q:** Why cannot the module register to a network when the GNSS auto-start feature is enabled with **AT+QGPSCFG="autogps",1**?

   A: If your module is in the GNSS priority mode, If GNSS starts automatically when the module powers up, the module will fail to register on network. Please configure the module into WWAN priority mode if GNSS auto-start feature is needed.

2. **Q:** When GNSS is active and in high priority, the module can detach from the network after executing **AT+CFUN=0**, but why cannot it register to the network after executing **AT+CFUN=1**?

   A: Network detachment has higher priority than GNSS/WWAN, so the module can detach from the network even if the module is in the GNSS priority mode. However, network attachment does not have the same priority as network detachment, so the module cannot register to the network when the module is in the GNSS priority mode.

3. **Q:** Why reporting sensor data and positioning information sometimes does not work?

   A: Reporting sensor data and positioning information cannot be guaranteed every time because the page may be lost when GNSS is in the active status with GNSS priority. Additionally, getting position on time cannot be guaranteed either if WWAN is preferential. In these cases, it is recommended to select a solution where GNSS and WWAN could work simultaneously, either Quectel BG96 module, or Quectel BG95/BG77/BG600L module with an external GNSS module.

6 Summary of Error Codes

The **<errcode>** indicates an error related to the GNSS operation. The details about **<errcode>** are described in the following table.

Table 5: Summary of Error Codes

<errcode>	Description
501	Invalid parameter
502	Operation not supported
503	GNSS subsystem busy
504	Session is ongoing
505	Session not active
506	Operation timeout
507	Function not enabled
508	Time information error
509	XTRA not enabled
512	Validity time is out of range
513	Internal resource error
514	GNSS locked
515	End by E911
516	No fix
517	Geo-fence ID does not exist
518	Sync time failed
519	XTRA file does not exist

520	XTRA file on downloading
521	XTRA file is valid
522	GNSS is working
523	Time injection error
524	XTRA file is invalid
549	Unknown error

7 Appendix References

Table 6: Related Documents

Document Name
[1] Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual
[2] Quectel_BG95&BG77&BG600L_Series_FILE_Application_Note
[3] Quectel_BG95_Series_Hardware_Design
[4] Quectel_BG77_Hardware_Design
[5] Quectel_BG600L-M3_Hardware_Design
[6] Quectel_BG95&BG77&BG600L_Series_PSM_Application_Note
[7] Quectel_QCOM_User_Guide

Table 7: Terms and Abbreviations

Abbreviation	Description
APN	Access Point Name
BeiDou	BeiDou Navigation Satellite System
CNR	Carrier-to-Noise Ratio
DOP	Dilution of Precision
eDRX	Extended Discontinuous Reception
EGPRS	Enhanced General Packet Radio Service
EPE	Estimated Position Error
EUFS	Extended User File Storage
FAQ	Frequently Asked Questions

Galileo	Galileo Satellite Navigation System (EU)
GGA	Global Positioning System Fix Data
GLONASS	Global Navigation Satellite System (Russian)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	GNSS DOP and Active Satellites
GSM	Global System for Mobile Communications
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
ID	Identifier
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
LPWA	Low-Power Wide Area
LTE	Long Term Evolution
LTE-M	LTE Machine-to-Machine Communications
MCC	Mobile Country Code
MCU	Microcontroller Unit/Microprogrammed Control Unit
ME	Mobile Equipment
MO	Mobile Originated
NB-IoT	Narrowband Internet of Things
NITZ	Network Identity and Time Zone
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
NTP	Network Time Protocol
NVRAM	Non-Volatile Random-Access Memory
PS	Packet Switch

PSM	Power Saving Mode
PTW	Paging Time Window
QZSS	Quasi-Zenith Satellite System
RAT	Radio Access Technology
RMC	Recommended Minimum Specific GNSS Data
RRC	Radio Resource Control
RSRP	Reference Signal Received Power
RSSI	Received Signal Strength Indicator
Rx	Receive
TCP	Transmission Control Protocol
TDM	Time-Division Multiplexing
TTFF	Time to First Fix
UART	Universal Asynchronous Receiver/Transmitter
UE	User Equipment
UFS	User File Storage
URL	Uniform Resource Locator
USB	Universal Serial Bus
UTC	Universal Time Coordinated
VTG	Course over Ground and Ground Speed
Wi-Fi	Wireless Fidelity
WWAN	Wireless Wide Area Network
XOR	Exclusive OR
XTRA	Auxiliary Positioning Technology Provided by Qualcomm