LG69T (AS) GNSS Protocol Specification

GNSS Module Series

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About the Document

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-	2021-07-01	Creation of the document
1.0	2022-02-21	First official release
1.1	2023-01-09	1. Updated PQTMVERNO message (*Chapter 2.2.11*). 2. Added the PQTMSVINSTATUS and PQTMCFGMSGRATE messages (*Chapters 2.2.12* and *2.2.13*). 3. Added RTCM-1005 message into supported RTCM3 messages (*Table 3*).

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1 Introduction

Quectel LG69T (AS) GNSS module supports GPS, Galileo, BDS and QZSS constellations. Concurrent tracking of GPS L1 C/A, GPS L5, Galileo E1, Galileo E5a, BDS B1, BDS B2a, QZSS L1 and QZSS L5 frequency bands enables fast and accurate acquisition and makes this module an ideal solution for a base station and for generating RTK corrections.

This document describes the software commands necessary to control and modify the module configuration. The software commands are NMEA proprietary commands defined by Quectel (PQTM commands). To report GNSS information, the module supports outputting messages in NMEA 0183 protocol and RTCM protocol format.

LG69T (AS) GNSS module supports the following protocols:

Table 1: Supported Protocols

Protocol	Type
NMEA 0183 V4.11	Input/output, ASCII, proprietary
RTCM 10403.3	Output, binary, standard

NOTE

Quectel assumes no responsibility if commands other than the ones listed herein are used.

2 NMEA Protocol

2.1. Structure of NMEA Protocol Messages

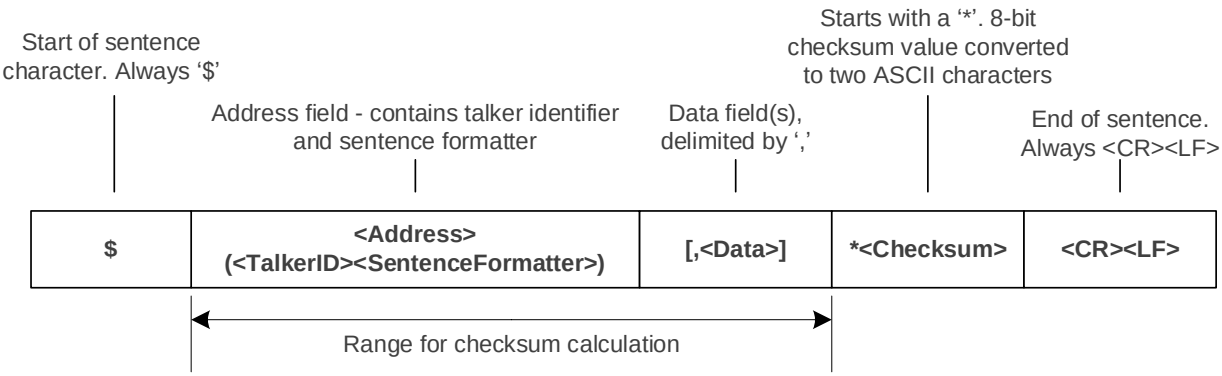


Figure 1: Structure of NMEA Protocol Messages

Table 2: Structure of NMEA Protocol Messages

Field	Description
$	Start of the sentence (Hex 0x24).
<Address>	**In Proprietary Messages:** In NMEA proprietary messages, this field consists of the proprietary character **P** followed by a three-character Manufacturer's Mnemonic Code, used to identify the TALKER issuing a proprietary sentence, and any additional characters as required.
<Data>	Data fields, delimited by data field delimiter **','**. Variable length (depending on the NMEA message type).
<Checksum>	Checksum field follows the checksum delimiter character *****. Checksum is the 8-bit exclusive OR of all characters in the sentence, including ',' field delimiter, between but not including the **$** and the ***** delimiters.
<CR><LF>	End of the sentence (Hex 0x0D 0x0A).

2.2. PQTM Messages

This chapter explains the **PQTM** messages (proprietary NMEA messages defined by Quectel) supported by LG69T (AS).

2.2.1. PQTMSRR

Executes a system reset.

Type:

Command

Synopsis:

```
$PQTMSRR*<Checksum><CR><LF>
```

Parameter:

None

Result:

GNSS firmware is rebooted and no message is sent as a response.

Example:

```
$PQTMSRR*4B
```

2.2.2. PQTMCFGPORT

Sets a communication port or gets a communication port configuration.

Type:

Set/Get

Synopsis:

```
$PQTMCFGPORT,<RW>,<PortType>,<ProtocolType>{,<Par1>,<Par2>,…,<ParN>}*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<RW>	Decimal, 1 digit	-	Read or write port configuration: 0 = Read current configuration 1 = Configure the communication port
<PortType>	Decimal, 1 digit	-	Port type: 0 = UART 1 1 = UART 2
<ProtocolType>	Decimal	-	Protocol type: Bit 0 = NMEA command input Bit 1 = NMEA message output Bit 2 = RTCM output
<ParN>	-	-	**<ParN>** content depends on port type (**<PortType>**). If the port is the UART port, **<ParN>** is the baud rate configuration. For more details, see *Chapter 2.2.2.1 UART Configuration (<PortType> = 0 or 1).*

NOTE

If the default value is not given for any parameter in a Set command, you can query it with the corresponding Get command provided that the default setting has not been changed by Set command. If the default setting had been changed by Set command, contact Quectel Technical Support (support@quectel.com) to get the default setting if necessary.

2.2.2.1. UART Configuration (<PortType> = 0 or 1)

Sets the UART port baud rate.

Type:

Set

Synopsis:

```
$PQTMCFGPORT,<RW>,<PortType>,<ProtocolType>{,<BaudRate>}*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<BaudRate>	Decimal	bps	UART port baud rate. Supported baud rates: 115200 230400 460800 921600

Example:

```
//Read UART 1 port baud rate:
$PQTMCFGPORT,0,0*43
$PQTMPORT,0,0,3,460800*38

//Configure UART 1 port baud rate:
$PQTMCFGPORT,1,0,1,460800*79
$PQTMCFGPORTOK*47
```

NOTE

If **<RW>** = 0, the parameters after **<PortType>** will be omitted. If **<RW>** = 1, the parameters after **<PortType>** shall be specified.

2.2.3. PQTMSETRECVMODE

Sets the receiver mode. The base station must work in static mode. It can enter static mode via Survey-in mode or Fixed mode.

Survey-in mode (**<Mode>** = 1) determines the receiver's position by calculating a weighted mean of all valid 3D position solutions. User can set **<Duration>** value to define the minimum observation time regardless of the actual number of fixes used for position estimation.

In Fixed mode (**<Mode>** = 2), the user manually enters receiver position coordinates. Any error in base station position translates directly into rover position error.

Type:

Set

Synopsis:

```
$PQTMSETRECVMODE,<Mode>,<Duration>,<AntHeight>,<ECEF_X>,<ECEF_Y>,<ECEF_Z>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	Receiver mode. 0 = None 1 = Survey-in 2 = Fixed with ECEF coordinate
<Duration>	Numeric	Second	Survey-in minimum duration. Range: 0–60000.
<AntHeight>	Numeric	Meter	Antenna height. Range: 0–6.5535.
<ECEF_X>	Numeric	Meter	WGS84 ECEF X coordinate of ARP position.
<ECEF_Y>	Numeric	Meter	WGS84 ECEF Y coordinate of ARP position.
<ECEF_Z>	Numeric	Meter	WGS84 ECEF Z coordinate of ARP position.

Example:

```
$PQTMSETRECVMODE,1,90,0,0,0,0*63
$PQTMSETRECVMODEOK*5F
```

2.2.4. PQTMGETRECVMODE

Inquires the receiver mode.

Type:

Get

Synopsis:

```
$PQTMGETRECVMODE*<Checksum><CR><LF>
```

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMRECVMODE,<Mode>,<Duration>,<AntHeight>,<ECEF_X>,<ECEF_Y>,<ECEF_Z>*<Checksum><CR><LF>
```

The parameters included in the result above are listed below:

Field	Format	Unit	Description
<Mode>	Numeric	-	Receiver mode. 0 = None 1 = Survey-in 2 = Fixed with ECEF coordinate
<Duration>	Numeric	Second	Survey-in minimum duration. Range: 0–60000.
<AntHeight>	Numeric	Meter	Antenna height. Range: 0–6.5535.
<ECEF_X>	Numeric	Meter	WGS84 ECEF X coordinate of ARP position.
<ECEF_Y>	Numeric	Meter	WGS84 ECEF Y coordinate of ARP position.
<ECEF_Z>	Numeric	Meter	WGS84 ECEF Z coordinate of ARP position.

- If failed, the module returns:

```
$PQTMRECVMODEERROR*41
```

Example:

```
$PQTMGETRECVMODE*4F
$PQTMRECVMODE,1,90,0.0000,0.0000,0.0000,0.0000*21
```

2.2.5. PQTMSETMSMMODE

Sets the RTCM MSM message type.

Type:

Set

Synopsis:

```
$PQTMSETMSMMODE,<Mode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	MSM message type. 4 = MSM4 7 = MSM7

Example:

```
$PQTMSETMSMMODE,4*12
$PQTMSETMSMMODEOK*0E
```

2.2.6. PQTMGETMSMMODE

Inquires the RTCM MSM message type.

Type:

Get

Synopsis:

```
$PQTMGETMSMMODE*<Checksum><CR><LF>
```

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMMSMMODE,<Mode>*<Checksum><CR><LF>
```

The parameter included in the result above is listed below:

Field	Format	Unit	Description
<Mode>	Numeric	-	MSM message type. 4 = MSM4 7 = MSM7

- If failed, the module returns:

```
$PQTMGETMSMMODEERROR*46
```

Example:

```
$PQTMGETMSMMODE*1E
$PQTMMSMMODE,4*50
```

2.2.7. PQTMSETCONSTMASK

Sets the GNSS constellation bit mask.

Type:

Set

Synopsis:

```
$PQTMSETCONSTMASK,<Mask>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mask>	Numeric	-	GNSS constellation bit mask. This parameter is in decimal format. Bit 0 = GPS Bit 2 = Galileo Bit 3 = BDS Bit 4 = QZSS

Result:

- If successful, the module returns:

```
$PQTMSETCONSTMASKOK*0F
```

- If failed, the module returns:

```
$PQTMSETCONSTMASKERROR*53
```

Example:

```
$PQTMSETCONSTMASK,29*2C
$PQTMSETCONSTMASKOK*0F
```

2.2.8. PQTMGETCONSTMASK

Inquires the GNSS constellation bit mask.

Type:

Get

Synopsis:

```
$PQTMGETCONSTMASK*<Checksum><CR><LF>
```

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMCONSTMASK,<Mask>*<Checksum><CR><LF>
```

The parameter included in the result above is listed below:

Field	Format	Unit	Description
<Mask>	Numeric	-	GNSS constellation bit mask. Bit 0 = GPS Bit 2 = Galileo Bit 3 = BDS Bit 4 = QZSS

- If failed, the module returns:

```
$PQTMGETCONSTMASKERROR*47
```

Example:

```
$PQTMGETCONSTMASK*1F
$PQTMCONSTMASK,29*6E
```

2.2.9. PQTMSAVEPAR

Saves configurations of GNSS commands to NVM.

Type:

Command

Synopsis:

```
$PQTMSAVEPAR*<Checksum><CR><LF>
```

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMSAVEPAROK*5E
```

- If failed, the module returns:

```
$PQTMSAVEPARERROR*02
```

Example:

```
$PQTMSAVEPAR*5A
$PQTMSAVEPAROK*5E
```

2.2.10. PQTMRESTOREPAR

Restores all configurations to default values.

Type:

Command

Synopsis:

```
$PQTMRESTOREPAR*<Checksum><CR><LF>
```

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMRESTOREPAROK*17
```

- If failed, the module returns:

```
$PQTMRESTOREPARERROR*4B
```

Example:

```
$PQTMRESTOREPAR*13
$PQTMRESTOREPAROK*17
```

2.2.11. PQTMVERNO

Queries the firmware version.

Type:

Command

Synopsis:

```
$PQTMVERNO*<Checksum><CR><LF>
```

Parameter:

None

Result:

Firmware version string is returned.

Example:

```
$PQTMVERNO*58
$PQTMVERNO,LG69TASNR01A02,2021/12/30,17:38:07*63
```

2.2.12. PQTMSVINSTATUS

Output the survey-in status.

Type:

Output

Synopsis:

```
$PQTMSVINSTATUS,<MsgVer>,<TOW>,<Valid>,<Res0>,<Res1>,<Obs>,<CfgDur>,<MeanX>,<MeanY>,<MeanZ>,<Res2>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MsgVer>	Numeric	-	Message version. 1 = Version 1 (Always 1 for this message version.)
<TOW>	Numeric	Millisecond	GPS time of week.
<Valid>	Numeric	-	Survey-in position validity flag. 0 = Invalid

Field	Format	Unit	Description
			1 = In-progress 2 = Valid
<Res0>	Numeric	-	Reserved. Always 0.
<Res1>	Numeric	-	Reserved. Always 0.
<Obs>	Numeric	-	Number of position observations used during survey-in.
<CfgDur>	Numeric	Second	Configuration of duration.
<MeanX>	Numeric, n.xxxx	Meter	Current survey-in mean position ECEF X coordinate.
<MeanY>	Numeric, n.xxxx	Meter	Current survey-in mean position ECEF Y coordinate.
<MeanZ>	Numeric, n.xxxx	Meter	Current survey-in mean position ECEF Z coordinate.
<Res2>	-	-	Reserved. This field is always empty.

Example:

```
$PQTMSVINSTATUS,1,301386000,1,0,0,7,60000,-2472445.1423,4828301.6489,3343727.6841,*24
```

2.2.13. PQTMCFGMSGRATE

Sets/gets the message output rate on the current port.

Type:

Set/Get

Synopsis:

```
//Set the output rate:
$PQTMCFGMSGRATE,W,<MsgName/MsgID>,<Rate>[,<MsgVer>]*<Checksum><CR><LF>
//Get the output rate:
$PQTMCFGMSGRATE,R,<MsgName/MsgID>[,<MsgVer>]*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MsgName/MsgID>	String/Hex	-	Message name/ID. This command can only be used to set/get the message output rate listed below. Proprietary NMEA message: PQTMSVINSTATUS Standard RTCM3 message: RTCM3-1005, RTCM3-1006, RTCM3-1019, RTCM3-1042, RTCM3-1044, RTCM3-1046, RTCM3-1077, RTCM3-1097, RTCM3-1117, RTCM3-1127.
<Rate>	Numeric	-	Message output rate. 0 = Not output 1 = Output once every position fix
<MsgVer>	Numeric	-	Message version. Optional.

NOTE

1. When set or get the output rate of **$PQTMSVINSTATUS**, **<MsgVer>** should be configured to specify the message version, otherwise an error will be returned.
2. When set or get the output rate of standard RTCM3 message, **<MsgVer>** is omitted.

Result:

- If successful, the module returns:

```
//Set:
$PQTMCFGMSGRATE,OK*29
//Get:
$PQTMCFGMSGRATE,OK,<MsgName/MsgID>,<Rate>[,<MsgVer>]*<Checksum><CR><LF>
```

- If failed, the module returns:

```
$PQTMCFGMSGRATE,ERROR,<ErrCode>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<ErrCode>	Numeric	-	Error code. 1 = Invalid parameter(s). 2 = Execute failed.

Example:

```
//Set the output rate of $PQTMSVINSTATUS (version 1) message:
$PQTMCFGMSGRATE,W,PQTMSVINSTATUS,1,1*58
$PQTMCFGMSGRATE,OK*29

//Get the output rate of $PQTMSVINSTATUS (version 1) message:
$PQTMCFGMSGRATE,R,PQTMSVINSTATUS,1*40
$PQTMCFGMSGRATE,OK,PQTMSVINSTATUS,1,1* 0B

//Set the output rate of RTCM3-1046 message:
$PQTMCFGMSGRATE,W,RTCM3-1046,1*5E
$PQTMCFGMSGRATE,OK*29

//Get the output rate of RTCM3-1006 message:
$PQTMCFGMSGRATE,R,RTCM3-1006*42
$PQTMCFGMSGRATE,OK, RTCM3-1006,1*29
```

3 RTCM Protocol

The LG69T (AS) module supports the RTCM protocol, which is in accordance with *RTCM Standard 10403.3 Differential GNSS (Global Navigation Satellite Systems) Services - Version 3.* This protocol is used for transferring GNSS raw measurement data and is available from https://www.rtcm.org/.

Table 3: Supported RTCM3 Messages

Message Type	Mode	Description
1005	Output	Stationary RTK Reference Station ARP
1006	Output	Stationary RTK Reference Station ARP with Antenna Height
1019	Output	GPS Ephemerides
1042	Output	BDS Satellite Ephemeris Data
1044	Output	QZSS Ephemerides
1046	Output	Galileo I/NAV Satellite Ephemeris Data
1074	Output	GPS MSM4
1077	Output	GPS MSM7
1094	Output	Galileo MSM4
1097	Output	Galileo MSM7
1114	Output	QZSS MSM4
1117	Output	QZSS MSM7
1124	Output	BDS MSM4
1127	Output	BDS MSM7

4 Appendix A References

Table 4: Terms and Abbreviations

Abbreviation	Description
ARP	Antenna Reference Point
BDS	BDS Navigation Satellite System
ECEF	Earth-Centered, Earth-Fixed
Galileo	Galileo Satellite Navigation System (EU)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MSM	Multiple Signal Messages
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
QZSS	Quasi-Zenith Satellite System
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
UART	Universal Asynchronous Receiver/Transmitter
UTC	Universal Time Coordinated
WGS84	World Geodetic System 1984

5 Appendix B Special Characters

Table 5: Special Characters

Special Character	Definition
<...>	Parameter name. Angle brackets do not appear in the message.
[...]	Optional field of a message. Square brackets do not appear in the message.
{…}	Repeated field of a message. Curly brackets do not appear in the message.
Underline	Default setting of a parameter.