

L76-LB GNSS

Protocol Specification

GNSS Module Series

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About the Document

History

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1 Introduction

L76-LB is a GNSS module capable of accessing GPS and BeiDou systems. It only supports GPS and GPS+BeiDou modes.

The module supports autonomous GNSS C/A, SBAS function (including WAAS, EGNOS, MSAS and GAGAN) and AGPS (EASY™ function). It can be used in positioning, navigation and other industries.

This document mainly describes NMEA packet protocols supported by L76-LB. The module supports NMEA 0183 standard commands. MTK NMEA extended packet is also enabled to control and configure the module.

And the module supports SDK commands developed by Quectel. At present the SDK commands contain **\$PQGLP**, **\$PQBAUD**, **\$PQ1PPS**, **\$PQEPE** and so on. For more informations about SDK commands, please refer to **document [1]**.

2 Standard NMEA Packet Protocol

L76-LB supports NMEA 0183 standard messages. The following table shows the structure of a NMEA 0183 standard message.

Table 1: Structure of NMEA Message

Filed	Length (Bytes)	Description
\$	1	Each NMEA message starts with '\$'
Talker ID	1~2	Talker IDs can be 'GN' when the message ID is RMC, VTG, GGA or GLL. Talker IDs can be 'GP' and 'BD' when the message ID is GSA or GSV.
NMEA Message ID	3	NMEA message ID
Data Field	Variable, depends on the NMEA message type	Data fields, delimited by comma ','
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between '\$' and '*'
<CR><LF>	2	Each NMEA message ends with 'CR' and 'LF'

NOTE

L76-LB GNSS module supports GPS + BeiDou system by default, and it can output the following six types of NMEA messages: RMC, VTG, GGA, GSA, GSV and GLL.

2.1. GNRMC

RMC, Recommended Minimum Position Data (including position, velocity and time).

Example:

```
$GNRMC,021618.000,A,3150.7827,N,11711.8695,E,0.14,181.50,030119,,,A*76<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
GNRMC	Message ID
UTC Time	Time in 'hhmmss.sss' format
Data Validity	'V'=Invalid 'A'=Valid
Latitude	Latitude in 'ddmm.mmmm' format (degrees and minutes)
N/S	'N'=North 'S'=South
Longitude	Longitude in 'dddmm.mmmm' format (degrees and minutes)
E/W	'E'=East 'W'=West
Speed	Speed over ground in knots
COG	Course over ground in degree
Date	Date in 'ddmmyy' format
Magnetic Variation	Magnetic variation in degree, not being output
E/W	Magnetic variation E/W indicator, not being output
Positioning Mode	'N'=No fix 'A'=Autonomous GNSS fix 'D'=Differential GNSS fix
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

2.2. GNVTG

VTG, Track Made Good and Ground Speed.

Example:

```
$GNVTG,148.76,T,,M,0.21,N,0.39,K,A*26<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
GNVTG	Message ID
COG(T)	Course over ground (true) in degree
T	Fixed field, true
COG(M)	Course over ground (magnetic), not being output
M	Fixed field, magnetic
Speed	Speed over ground in knots
N	Fixed field, knots
Speed	Speed over ground in km/h
K	Fixed field, km/h
Positioning Mode	'N'=No fix 'A'=Autonomous GNSS fix 'D'=Differential GNSS fix
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

2.3. GNGGA

GGA, Global Positioning System Fix Data, is the essential fix data which provides 3D location and accuracy data.

Example:

```
$GNGGA,032843.000,3150.7957,N,11711.8668,E,1,10,2.09,80.3,M,0.0,M,,*71<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
GNGGA	Message ID
UTC Time	Time in 'hhmmss.sss' format
Latitude	Latitude in 'ddmm.mmmm' format (degrees and minutes)
N/S	'N'=North 'S'=South
Longitude	Longitude in 'dddmm.mmmm' format (degrees and minutes)
E/W	'E'=East 'W'=West
Fix Status	'0'=Invalid '1'=GNSS fix '2'=DGPS fix
Number of SV	Number of satellites being used (0~24)
HDOP	Horizontal dilution of precision
Altitude	Altitude in meters according to WGS84 ellipsoid
M	Fixed field, meter
Geoid Separation	Height of Geoid (means sea level) above WGS84 ellipsoid, meter
M	Fixed field, meter
DGPS Age	Age of DGPS data in seconds, empty if DGPS is not used
DGPS Station ID	Empty if DGPS is not used
*	End character of data field
Checksum	Hexadecimal checksum

<CR><LF> Each NMEA message ends with 'CR' and 'LF'

2.4. --GSA

GSA, GNSS DOP and Active Satellites, which provides details on the fix and includes the number of satellites being used in the current solution and the DOP. At most the first 12 satellite IDs are output.

Example:

```
$GPGSA,A,3,20,13,12,15,10,32,24,,,,,,,,,2.48,2.18,1.18*0E<CR><LF>
```

```
$BDGSA,A,3,14,06,09,,,,,,,,,2.48,2.18,1.18*14<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
--GSA	Message ID
Mode	Auto selection of 2D or 3D fix 'M'=Manual, forced to switch 2D/3D mode 'A'=Allowed to automatically switch 2D/3D mode
Fix Status	'1'=No fix '2'=2D fix '3'=3D fix
Satellite Used 1	Satellite used on channel 1
Satellite Used 2	Satellite used on channel 2
Satellite Used 3	Satellite used on channel 3
Satellite Used 4	Satellite used on channel 4
Satellite Used 5	Satellite used on channel 5
Satellite Used 6	Satellite used on channel 6
Satellite Used 7	Satellite used on channel 7
Satellite Used 8	Satellite used on channel 8
Satellite Used 9	Satellite used on channel 9
Satellite Used 10	Satellite used on channel 10
Satellite Used 11	Satellite used on channel 11

Satellite Used 12	Satellite used on channel 12
PDOP	Position dilution of precision
HDOP	Horizontal dilution of precision
VDOP	Vertical dilution of precision
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

2.5. --GSV

GSV, GNSS Satellites in View. One GSV sentence can only provide data for at most 4 satellites, so several sentences might be required for full information. Since GSV includes satellites that are not used as part of the solution, GSV sentence contains more satellites than GGA does.

Example:

```
$GPGSV,4,1,14,24,69,062,39,193,69,095,,20,61,325,43,194,56,121,*7D<CR><LF>
$GPGSV,4,2,14,21,49,229,20,15,40,054,44,10,33,317,43,12,17,136,24*7A<CR><LF>
$GPGSV,4,3,14,32,15,268,44,195,07,168,,13,06,062,27,25,06,167,*43<CR><LF>
$GPGSV,4,4,14,14,01,258,,46,,, *45<CR><LF>
$BDGSV,3,1,12,06,64,356,39,14,64,358,41,09,54,305,38,03,51,192,*63<CR><LF>
$BDGSV,3,2,12,01,44,143,,13,41,216,17,02,39,232,,04,30,120,*66<CR><LF>
$BDGSV,3,3,12,07,26,165,23,05,19,253,,11,12,228,,10,09,187,*6F<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
--GSV	Message ID
Number of Message	Number of messages
Sequence Number	Sequence number of this entry
Satellites in View	Total satellites in view
Satellite ID 1	Satellite ID
Elevation 1	Elevation in degree (0~90)
Azimuth 1	Azimuth in degree (0~359)

SNR 1	Signal to noise ratio in dBHz (0~99), empty if not tracking
Satellite ID 2	Satellite ID
Elevation 2	Elevation in degree (0~90)
Azimuth 2	Azimuth in degree (0~359)
SNR 2	Signal to noise ratio in dBHz (0~99), empty if not tracking
Satellite ID 3	Satellite ID
Elevation 3	Elevation in degree (0~90)
Azimuth 3	Azimuth in degree (0~359)
SNR 3	Signal to noise ratio in dBHz (0~99), empty if not tracking
Satellite ID 4	Satellite ID
Elevation 4	Elevation in degree (0~90)
Azimuth 4	Azimuth in degree (0~359)
SNR 4	Signal to noise ratio in dBHz (0~99), empty if not tracking
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

2.6. GNGLL

GLL, Geographic Latitude and Longitude, which contains position information, time of position fix and status.

Example:

```
$GNGLL,3150.7957,N,11711.8668,E,033640.000,A,A*49<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
GNGLL	Message ID
Latitude	Latitude in 'ddmm.mmmm' format (degrees and minutes)
N/S	'N'=North 'S'=South

Longitude	Longitude in 'dddmm.mmmm' format (degrees and minutes)
E/W	'E'=East 'W'=West
UTC Time	Time in 'hhmmss.sss' format
Data Validity	'V'=Invalid 'A'=Valid
Positioning Mode	'N'=No fix 'A'=Autonomous GNSS fix 'D'=Differential GNSS fix
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3 MTK NMEA Packet Protocol

This chapter introduces the MTK NMEA packet protocol, which is a set of extension messages of the standard NMEA packet protocol. These messages are used to control and configure L76-LB GNSS module. The following table shows the structure of an MTK NMEA packet.

Table 2: Structure of an MTK NMEA Packet

Filed		Length (Bytes)	Description
\$		1	Each NMEA message starts with '\$'
Talker ID		1	'P' for proprietary message
NMEA	Data type	3	Always 'MTK' to indicate MTK proprietary message
Data Filed	Packet type	3	Packet type, from '000' to '999'
	Packet data	Variable, depend on the packet type	Data fields, delimited by comma ','
*		1	End character of data field
Checksum		2	A hexadecimal number calculated by exclusive OR of all characters between '\$' and '*'
<CR><LF>		2	Each NMEA message ends with 'CR' and 'LF'

3.1. Packet Type: 010 PMTK_SYS_MSG

This message is used to automatically output system messages through L76-LB module.

Data Field:

None

Example:

```
$PMTK010,1*2E<CR><LF>
```

Field	Description
-------	-------------

\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	010
Message	System message '0'=Unknown '1'=Startup '2'=Notification for the host aiding EPO '3'=Notification for the transition to normal mode is successfully done
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.2. Packet Type: 011 PMTK_TXT_MSG

This message is used to automatically output system messages through L76-LB module.

Data Field:

None

Example:

\$PMTK011,MTKGPS*08<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	011
Message	MTKGPS
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.3. Packet Type: 001 PMTK_ACK

Acknowledgement of PMTK command. In order to inform the sender whether the receiver has received the packet, an acknowledgement packet PMTK_ACK should be returned.

Some commands will cause the GNSS module to restart or change the baud rate. There is no PMTK_ACK for those commands as listed below.

- PMTK_CMD_HOT_START
- PMTK_CMD_WARM_START
- PMTK_CMD_COLD_START
- PMTK_CMD_FULL_COLD_START
- PMTK_SET_NMEA_BAUDRATE

Data Field:

\$PMTK001,Cmd,Flag

Example:

\$PMTK001,869,3*37<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	001
Cmd	The packet type that the acknowledge responds
Flag	'0'=Invalid packet '1'=Unsupported packet type '2'=Valid packet, but action failed '3'=Valid packet, and action succeeded
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.4. Packet Type: 101 PMTK_CMD_HOT_START

This message is used to perform hot start on L76-LB module (use all available data in the NVM). Normally hot start means the GNSS module was powered down less than 3 hours (RTC must be alive) and its ephemeris is still valid. As there is no need for downloading ephemeris, it's the fastest startup method.

Data Field: None Example: \$PMTK101*32<CR><LF>	
Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	101
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.5. Packet Type: 102 PMTK_CMD_WARM_START

This message is used to perform warm start on L76-LB module. Warm start means the GNSS module has approximate information of time, position and coarse data on satellite positions. But it needs to download ephemeris until it can get a fix. Using this message will force a warm restart on the module without using the ephemeris data in NVM.

Data Field: None Example: \$PMTK102*31<CR><LF>	
Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	102

*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.6. Packet Type: 103 PMTK_CMD_COLD_START

This message is used to perform cold start on L76-LB module. Using this message will force a cold restart on the module without using any prior location information, including time, position, almanacs and ephemeris data.

Data Field: None	
Example: \$PMTK103*30<CR><LF>	
Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	103
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.7. Packet Type: 104 PMTK_CMD_FULL_COLD_START

This message is essentially a cold restart, and it additionally clears system and user configurations at restart. That is, reset L76-LB module to the factory setting. Full cold start means the module has no information on last location. It needs to search the full time and frequency space, and also all possible satellite numbers before it can get a fix.

Data Field:
None
Example:
\$PMTK104*37<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	104
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.8. Packet Type: 161 PMTK_CMD_STANDBY_MODE

This message is used to make the L76-LB module enter standby mode for power saving.

Data Field:
\$PMTK161,Type
Example:
\$PMTK161,0*28<CR><LF>
Response:
\$PMTK001,161,3*36<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	161
Type	'0'=Standby mode
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.9. Packet Type: 183 PMTK_LOCUS_QUERY_STATUS

This message is used to query LOCUS logging status.

Data Field:

None

Example:

```
$PMTK183*38<CR><LF>
```

Response:

```
$PMTK001,183,3*3A<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	183
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

Return:

Example:

```
$PMTKLOG,456,0,b,31,2,0,0,0,3769,46*2A<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	LOG
Serial#	Logging serial number: 0~65535
Type	Logging type 0: Overlap, 1: Fullstop
Mode	Logging mode
Content	Logging contents of configuration
Interval	Logging interval setting (valid when interval mode is selected)

Distance	Logging distance setting (valid when distance mode is selected)
Speed	Logging speed setting (valid when speed mode is selected)
Status	Logging status 1: Stop logging, 0: Logging
Number	Logging number of data record
Percent	Used percentage of logging life (0%~100%)
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.10. Packet Type: 184 PMTK_LOCUS_ERASE_FLASH

This message is used to erase logger flash.

Data Field:
\$PMTK184,Type
Example:
\$PMTK184,1*22<CR><LF>
Response:
\$PMTK001,184,3*3D<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	184
Type	'1'=Erase all logger internal flash data
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.11. Packet Type: 185 PMTK_LOCUS_STOP_LOGGER

This message is used to stop or start logging data.

Data Field:

\$PMTK185,Status

Example:

\$PMTK185,1*23<CR><LF>

Response:

\$PMTK001,185,3*3C<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	185
Status	'0'=Start logging '1'=Stop logging
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.12. Packet Type: 622 PMTK_Q_LOCUS_DATA

This message is used to dump LOCUS flash data.

Data Field:

\$PMTK622,Type

Example:

\$PMTK622,1*29<CR><LF>

Response:

\$PMTK001,622,3*36<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message

Packet Type	622
Type	'1'=Dump current sector's LOCUS flash data
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.13. Packet Type: 220 PMTK_SET_POS_FIX

This message is used to set position fix interval.

Data Field:
\$PMTK220,Interval
Example:
\$PMTK220,1000*1F<CR><LF>
Response:
\$PMTK001,220,3*30<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	220
Interval	Position fix interval (Unit: msec). Range: 100~10000
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.14. Packet Type: 223 PMTK_SET_AL_DEE_CFG

This message is used to config DEE.

Data Field:
\$PMTK223,SV,SNR,Extension Threshold,Extension Gap
Example:
\$PMTK223,1,30,180000,60000*3C<CR><LF>
Response:
\$PMTK001,223,3*33<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	223
SV	Required number of SV which satisfy the SNR condition to trigger dynamic ephemeris extension. Range: 1~4 (Default value: 1)
SNR	SV signal SNR criterial used to trigger dynamic ephemeris extension. Range: 25~30 (Default value: 30)
Extension Threshold	Time duration of dynamic ephemeris extension. (Unit: msec) Range: 40000~180000 (Default value: 180000)
Extension Gap	The limitation of the interval between neighboring DEE intervals. (Unit: msec) Range: 0~3600000 (Default value: 60000)
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.15. Packet Type: 225 PMTK_SET_PERIODIC_MODE

This message is used to enter periodic mode for power saving.

Data Field:
\$PMTK225,Type,Run Time,Sleep Time,Second Run Time,Second Sleep Time
Example:
\$PMTK225,8*23<CR><LF>
Response:
\$PMTK001,225,3*35<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	225
Type	'0'=Back to normal mode '1'=Periodic backup mode '2'=Periodic standby mode '4'=Perpetual backup mode '8'=AlwaysLocate™ standby mode '9'=AlwaysLocate™ backup mode
Run Time	'0': Disable >='1000': Enable. Range: 1000~518400000
Sleep Time	Range: 1000~518400000
Second Run Time	'0': Disable >='1000': Enable. Range: 1000~518400000
Second Sleep Time	Range: 1000~518400000
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

NOTE

The unit of run time or sleep time is msec. The second run time should be longer than the first run time when the first run time is a non-zero value.

3.16. Packet Type: 251 PMTK_SET_NMEA_BAUDRATE

This message is used to set the baud rate of NMEA port. The setting will be back to default value in the condition: Full cold start command is issued.

Data Field:

\$PMTK251,Baudrate

Example:

\$PMTK251,38400*27<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	251
Baudrate	Baud rate setting: 9600 - default setting 4800 9600 14400 19200 38400 57600 115200
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.17. Packet Type: 255 PMTK_SET_SYNC_PPS_NMEA

This message is used to enable or disable the function of fixing NMEA output time behind PPS (Default: disabled).

Data Field:

\$PMTK255,Enable

Example:

\$PMTK255,0*2C<CR><LF>

Response:
\$PMTK001,255,3*32<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	255
Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.18. Packet Type: 256 PMTK_SET_TIMING_PRODUCT

This message is used to enable or disable timing product mode (Default: disabled).

Data Field:
\$PMTK256,Enable
Example:
\$PMTK256,0*2F<CR><LF>
Response:
\$PMTK001,256,3*31<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	256
Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.19. Packet Type: 285 PMTK_SET_PPS_CONFIG

This message is used to set PPS type.

Data Field:
\$PMTK285,Type,PPSPulseWidth
Example:
\$PMTK285,4,100*38<CR><LF>
Response:
\$PMTK001,285,3*3F<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	285
Type	'0'=Disable '1'=After the first fix '2'=3D fix only '3'=2D/3D fix only '4'=Always
PPSPulseWidth	2~998 (Unit: ms)
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.20. Packet Type: 286 PMTK_SET_AIC_ENABLED

This message is used to enable or disable AIC function. It is suggested to set cold start command first and then PMTK command.

Data Field:
\$PMTK286,Enable
Example:
\$PMTK286,0*22<CR><LF>
Response:
\$PMTK001,286,3*3C<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	286
Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.21. Packet Type: 300 PMTK_API_SET_FIX_CTL

This message is used to control the rate of position fixing activity.

Data Field:
\$PMTK300,Fix Interval,0,0,0,0
Example:
\$PMTK300,1000,0,0,0,0*1C<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	300
Fix Interval	Position fix interval (Unit: msec). Must be greater than 100.
Reserved	0
Reserved	0
Reserved	0
Reserved	0
*	End character of data field

Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.22. Packet Type: 301 PMTK_API_SET_DGPS_MODE

This message is used to configure the source mode of DGPS correction data.

Data Field:
\$PMTK301,Mode
Example:
\$PMTK301,2*2E<CR><LF>
Response:
\$PMTK001,301,3*32<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	301
Mode	DGPS data source mode. '0'=No DGPS source '1'=RTCM '2'=SBAS (Include WAAS/EGNOS/GAGAN/MSAS)
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.23. Packet Type: 306 PMTK_API_SET_MIN_SNR

This message is used to set the minimum SNR of satellites being used. If the minimum SNR threshold value is set, the module would not use the satellite whose SNR is smaller than it.

Data Field:
\$PMTK306,MIN_SNR
Example:
\$PMTK306,15*1F<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	306
MIN_SNR	Minimum SNR threshold of used satellites. Valid range: 9~37
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.24. Packet Type: 311 PMTK_API_SET_ELEV_MASK

This message is used to set satellite elevation mask.

Data Field:
\$PMTK311,Satellite Elevation Mask
Example:
\$PMTK311,5*28<CR><LF>
Response:
\$PMTK001,311,3*33<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	311
Satellite Elevation Mask	Range: 0~90 (Unit: degree)
*	End character of data field
Checksum	Hexadecimal checksum

<CR><LF>

Each NMEA message ends with 'CR' and 'LF'

NOTE

The satellite elevation mask is recommended to be no more than 10 degrees. As with the increase of satellite elevation mask, the number of satellites involved in positioning will decrease.

3.25. Packet Type: 313 PMTK_API_SET_SBAS_ENABLED

This message is used to enable or disable searching an SBAS satellite. SBAS supports wide-area or regional augmentation through geostationary satellite broadcast messages. The geostationary satellite broadcasts GNSS integrity and correction data with the assistance of multiple ground stations which are located at accurately-surveyed points.

Data Field:

\$PMTK313,Enable

Example:

\$PMTK313,1*2E<CR><LF>

Response:

\$PMTK001,313,3*31<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	313
Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.26. Packet Type: 314 PMTK_API_SET_NMEA_OUTPUT

This message is used to set NMEA sentence output frequencies. There are totally 19 data fields that present output frequencies for the 19 supported NMEA sentences individually.

Supported Frequency Settings:

- 0 - Disabled or not supported sentence
- 1 - Output once every one position fix
- 2 - Output once every two position fixes
- 3 - Output once every three position fixes
- 4 - Output once every four position fixes
- 5 - Output once every five position fixes

Data Field:

None

Example:

The module only outputs RMC once every one position fix.

```
$PMTK314,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
```

Response:

```
$PMTK001,314,3*36<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	314
0 GLL	GLL interval - Geographic position - latitude longitude
1 RMC	RMC interval - Recommended minimum specific GNSS sentence
2 VTG	VTG interval - Course over ground and ground speed
3 GGA	GGA interval - GPS fix data
4 GSA	GSA interval - GNSS DOPS and active satellites
5 GSV	GSV interval - GNSS satellites in view
6 GRS	GRS interval - GNSS range residuals
7 GST	GST interval - GNSS pseudorange error statistics
8 Reserved	Always 0

9 Reserved	Always 0
10 Reserved	Always 0
11 Reserved	Always 0
12 Reserved	Always 0
13 Reserved	Always 0
14 Reserved	Always 0
15 Reserved	Always 0
16 Reserved	Always 0
17 ZDA	ZDA interval - Time and date
18 MCHN	PMTKCHN interval - GNSS channel status
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

To restore the system default setting, the following message can be used:

Example:

```
$PMTK314,-1*04<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	314
Restore	Always -1
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.27. Packet Type: 351 PMTK_API_SET_SUPPORT_QZSS_NMEA

The command allows users to enable or disable QZSS NMEA format. QZSS NMEA format is disabled by default.

Data Field:
\$PMTK351,QZSS_Enable
Example:
\$PMTK351,1*28<CR><LF>
Response:
\$PMTK001,351,3*37<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	351
QZSS_Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.28. Packet Type: 352 PMTK_API_SET_STOP_QZSS

This command is used to enable or disable QZSS function. QZSS function is enabled by default.

Data Field:
\$PMTK352,QZSS_Enable
Example:
\$PMTK352,0*2A<CR><LF>
Response:
\$PMTK001,352,3*34<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'

PMTK	MTK proprietary message
Packet Type	352
QZSS_Enable	'0'=Enable '1'=Disable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.29. Packet Type: 353 PMTK_API_SET_GNSS_SEARCH_MODE

This command is used to configure the receiver to start searching satellite system.

Data Field:
\$PMTK353,GPS_Enable,0,0,0,BEIDOU_Enable
Example:
\$PMTK353,1,0,0,0,1*2B<CR><LF>: Search GPS+BeiDou
Response:
\$PMTK001,353,3,1,0,0,0,1,49*08<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	353
GPS_Enable	'0'=Disable (DO NOT search GPS satellites) '1'or non-ZERO: search GPS satellites
Reserved	Keep as '0'
Reserved	Keep as '0'
Reserved	Keep as '0'
BEIDOU_Enable	'0'=Disable '1'or non-ZERO: search BeiDou satellites
*	End character of data field
Checksum	Hexadecimal checksum

<CR><LF>

Each NMEA message ends with 'CR' and 'LF'

3.30. Packet Type: 386 PMTK_API_SET_STATIC_NAV_THD

This message is used to set the speed threshold for static navigation. If the actual speed is below the threshold, output position will remain the same and output speed will be zero. If threshold value is set to 0, this function is disabled.

Data Field:

\$PMTK386,Speed_threshold

Example:

\$PMTK386,0.3*3E<CR><LF>

Response:

\$PMTK001,386,3*3D<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	386
Speed_threshold	0~2 (Unit: m/s)
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.31. Packet Type: 400 PMTK_API_Q_FIX_CTL

This message is used to query the rate of position fixing activity.

Please refer to **PMTK_API_SET_FIX_CTL** for setting the rate and **PMTK_DT_FIX_CTL** for the result of the query.

Data Field:
None
Example:
\$PMTK400*36<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	400
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.32. Packet Type: 401 PMTK_API_Q_DGPS_MODE

This message is used to query the setting of DGPS mode.

Please refer to **PMTK_API_SET_DGPS_MODE** for setting the DGPS mode and **PMTK_DT_DGPS_MODE** for the result of the query.

Data Field:
None
Example:
\$PMTK401*37<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	401
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.33. Packet Type: 413 PMTK_API_Q_SBAS_ENABLED

This message is used to query the setting of SBAS.

Please refer to **PMTK_API_SET_SBAS_ENABLE** for SBAS setting and **PMTK_DT_SBAS_ENABLED** for the result of the query.

Data Field:

None

Example:

\$PMTK413*34<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	413
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.34. Packet Type: 414 PMTK_API_Q_NMEA_OUTPUT

This message is used to query the current NMEA sentence output frequencies.

Please refer to **PMTK_API_SET_NMEA_OUTPUT** for the frequencies setting and **PMTK_DT_NMEA_OUTPUT** for the result of the query.

Data Field:

None

Example:

\$PMTK414*33<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'

PMTK	MTK proprietary message
Packet Type	414
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.35. Packet Type: 458 PMTK_API_GET_POS_XYZ

This message is used to return the WGS84 ECEF XYZ Cartesian position vector (metres) with an estimated 1-sigma accuracy.

Data Field: None Example: \$PMTK458*3B<CR><LF>	
Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	458
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.36. Packet Type: 461 PMTK_API_GET_VEL_XYZ

This message is used to return the WGS84 ECEF XYZ Cartesian velocity vector (m/s) with an estimated 1-sigma accuracy.

Data Field:
None
Example:
\$PMTK461*31<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	461
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.37. Packet Type: 605 PMTK_Q_RELEASE

This message is used to query the firmware release information.

Please refer to **PMTK_DT_RELEASE** for the result of the query.

Data Field:
None
Example:
\$PMTK605*31<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	605
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.38. Packet Type: 500 PMTK_DT_FIX_CTL

This message is the response to PMTK_API_Q_FIX_CTL.

Data Field:

\$PMTK500,Fix Interval,0,0,0,0

Example:

\$PMTK500,1000,0,0,0,0*1A<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	500
Fix Interval	Position fix interval (msec). Range: 100~10000
Reserved	Always 0
Reserved	Always 0
Reserved	Always 0
Reserved	Always 0
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.39. Packet Type: 501 PMTK_DT_DGPS_MODE

This message is the response to PMTK_API_Q_DGPS_MODE.

Data Field:

\$PMTK501,Mode

Example:

\$PMTK501,1*2B<CR><LF>

Field	Description
-------	-------------

\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	501
Mode	DGPS data source mode '0'=No DGPS source '1'=RTCM '2'=SBAS
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.40. Packet Type: 513 PMTK_DT_SBAS_ENABLED

This message is the response to PMTK_API_Q_SBAS_ENABLED.

Data Field:
\$PMTK513,Enable
Example:
\$PMTK513,1*28<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	513
Enable	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.41. Packet Type: 514 PMTK_DT_NMEA_OUTPUT

This message is the response to PMTK_API_Q_NMEA_OUTPUT.

Data Field:

None

Example:

```
$PMTK514,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0*2E<CR><LF>
```

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	514
0 GLL	GLL interval - Geographic position - latitude longitude
1 RMC	RMC interval - Recommended minimum specific GNSS sentence
2 VTG	VTG interval - Course over ground and ground speed
3 GGA	GGA interval - GPS fix data
4 GSA	GSA interval - GNSS DOPS and active satellites
5 GSV	GSV interval - GNSS satellites in view
6 Reserved	GRS interval - GNSS range residuals
7 Reserved	GST interval - GNSS pseudorange error statistics
8 Reserved	
9 Reserved	
10 Reserved	
11 Reserved	
12 Reserved	
13 Reserved	
14 Reserved	
15 Reserved	

16	Reserved	
17	ZDA	ZDA interval - Time and date
18	Reserved	PMTKCHN interval - GNSS channel status
*		End character of data field
	Checksum	Hexadecimal checksum
	<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.42. Packet Type: 705 PMTK_DT_RELEASE

This message is the response to PMTK_Q_RELEASE.

Data Field:

\$PMTK705,Release string,Build ID,Product Model,SDK Version

Example:

\$PMTK705,AXN_3.10_3333_12102201,0000,QUECTEL-L76LB,*18<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	705
Release String	Firmware release name and version 3318: Mcore_x.x 3329: AXN_x.x 3339: AXN_x.x 3333: AXN_x.x 3337: AXN_x.x
Build ID	Build ID set in CoreBuilder for firmware version control
Product Model	Product model set in CoreBuilder for product identification
SDK Version	Showing SDK version if the firmware is used for SDK
*	End character of data field
Checksum	Hexadecimal checksum

<CR><LF>

Each NMEA message ends with 'CR' and 'LF'

3.43. Packet Type: 838 PMTK_TEST_ANTI_SPOOFING

This message is used to enable or disable jamming detection function.

Data Field:

\$PMTK838,CmdType

Example:

\$PMTK838,1*2C<CR><LF>

Response:

\$PMTK001,838,3,1*2E<CR><LF>

Return:

\$PMTKSPF,1*5A => No jamming, healthy status (status 1).

\$PMTKSPF,2*59 => Warning status (status 2).

\$PMTKSPF,3*58 => Critical status (status 3).

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	838
CmdType	'0'=Disable jamming detection function '1'=Enable jamming detection function
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

NOTE

After jamming detection is enabled, the module starts to detect whether there is jamming.

1. If there is no jamming, "\$PMTKSPF,1*5A" will be reported to indicate healthy status (status 1).
2. If there is continuous jamming, then the module status will change from 1 to 2 and finally 3.
 - In the case of not being positioned: after jamming detection is enabled, the module status will be 1 at the very beginning, and then change to 2 when jamming is detected. During the process, the module will attempt to fix position. If it still fails in positioning after 200s, the module status will change to 3 finally.

- In the case of being positioned: after jamming detection is enabled, the module status will be 1 at the very beginning. When jamming is detected, the module status will change to 2 and then 3 consecutively.

3.44. Packet Type: 869 PMTK_EASY_ENABLE

This message is used to enable or disable EASY™ function, and it can also be used to query whether EASY™ is enabled or disabled.

Data Field:
\$PMTK869,CmdType[,Enabled]
Example:
\$PMTK869,1,1*35<CR><LF>
Response:
\$PMTK001,869,3*37<CR><LF>

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	869
CmdType	'0'=Query '1'=Set '2'=Result for query operation
Enabled (optional)	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

NOTES

1. If EASY™ is disabled, the receiver returns:
\$PMTK869,2,0,0*2B<CR><LF>
2. If EASY™ is enabled and is not finished yet, the receiver may return:
\$PMTK869,2,1,0*2A<CR><LF>
3. If EASY™ is enabled and is finished after 1 day, the receiver may return:

\$PMTK869,2,1,1*2B<CR><LF>

4. If EASY™ is enabled and is finished after 2 days, the receiver may return:

\$PMTK869,2,1,2*28<CR><LF>

5. If EASY™ is enabled and is finished after 3 days, the receiver may return:

\$PMTK869,2,1,3*29<CR><LF>

3.45. Packet Type: 875 PMTK_PMTKLSC_STN_OUTPUT

PMTKLSC sentence is the leap second indicate statement. This message is used to enable or disable PMTKLSC sentence output, and it can also be used to query whether PMTKLSC sentence output is enabled or disabled.

Data Field:

\$PMTK875,CmdType[,Enabled]

Example:

\$PMTK875,1,1*38<CR><LF>: Enable PMTKLSC and PMTKLSCB sentence output

Response:

\$PMTKLSC,Parameter1,Parameter2,Parameter3*CS

\$PMTKLSCB,Parameter1,Parameter2,Parameter3*CS

Where Parameter1: current leap second

Parameter2: leap indicator, 1 means updated from broadcast data

Parameter3: next leap second

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	875
CmdType	'0'=Query '1'=Set '2'=Result for query operation
Enabled (optional)	'0'=Disable '1'=Enable
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

3.46. Packet Type: 886 PMTK_FR_MODE

This message is used to set navigation mode.

Data Field:
\$PMTK886,CmdType
Example:
\$PMTK886,3*2B<CR><LF>
Response:
\$PMTK001,886,3*36

Field	Description
\$	Each NMEA message starts with '\$'
PMTK	MTK proprietary message
Packet Type	886
CmdType	'0'=Normal Mode: For general purpose '1'=Fitness Mode: For running and walking purpose that the low-speed (<5m/s) movement will have more effect on the position calculation. '2'=Aviation Mode: For high-dynamic purpose that the large-acceleration movement will have more effect on the position calculation. '3'=Balloon Mode: For high-altitude balloon purpose that the vertical movement will have more effect on the position calculation. '4'=Stationary Mode: For stationary applications that zero dynamics is assumed.
*	End character of data field
Checksum	Hexadecimal checksum
<CR><LF>	Each NMEA message ends with 'CR' and 'LF'

NOTE

Each mode has its altitude limitation. Please choose the appropriate mode base on the table below. If the test scenario exceeds the limitation, the position calculation will be incorrect.

Mode	Altitude Limitation
Normal Mode	10000m

Fitness Mode	10000m
Aviation Mode	10000m
Stationary Mode	10000m
Balloon Mode	80000m

4 Default Configurations

Table 3: Default Configurations

Item	Default
NMEA Port Baud Rate	9600bps
Datum	WGS84
Rate of Position Fixing	1Hz
DGPS Mode	SBAS
SBAS Enable	Enabled
NMEA Output Messages	GGA, RMC, GSA, GSV, VTG and GLL
AIC	Enabled
EASY™	Enabled

5 Appendix A References

Table 4: Related Documents

SN	Document Name	Remark
[1]	Quectel_GNSS_SDK_Commands_Manual	GNSS SDK Commands Manual
[2]	Quectel_L76-LB_Hardware_Design	L76-LB Hardware Design
[3]	Quectel_L76-LB_EVB_User Guide	L76-LB EVB User Guide
[4]	Quectel_L76-LB_Reference_Design	L76-LB Reference Design

Table 5: Terms and Abbreviations

Abbreviation	Description
AGPS	Assisted Global Positioning System
AIC	Active Interference Cancellation
CS	Commercial Sample
DEE	Dynamic Ephemeris Extension
DOP	Dilution of Precision
DGPS	Differential Global Positioning System
GGA	NMEA: Global Positioning System Fix Data
GLL	NMEA: Geographic Latitude and Longitude
GLONASS	Global Navigation Satellite System (The Russian GNSS)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	NMEA: GNSS DOP and Active Satellites

GSV	NMEA: GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
NMEA	National Marine Electronics Association
NVM	Non-volatile Memory
PDOP	Position Dilution of Precision
PPS	Pulse Per Second
PMTK	Private Protocol of MTK
QZSS	Quasi-Zenith Satellite System
RMC	NMEA: Recommended Minimum Position Data
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite-Based Augmentation System
SNR	Signal-to-noise Ratio
SV	Satellites in View
UTC	Universal Time Coordinated
VDOP	Vertical Dilution of Precision
VTG	NMEA: Track Made Good and Ground Speed
WAAS	Wide Area Augmentation System
