LC29H Series&LC79H (AL)
GNSS Protocol Specification

GNSS Module Series

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About the Document

Document Information	
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Revision History

Version	Date	Description
-	2021-03-18	Creation of the document
1.0	2021-08-19	First official release
1.1	2022-08-26	Numerous changes were made to this document. It should be read in its entirety.
1.2	2023-06-20	1. Updated applicable variant LC79H series to LC79H (AL). 2. Added the table of supported protocols (*Table 1*). 3. Added Sample Code for NMEA Checksum (*Chapter 2.1*). 4. Updated the note on <NumSatUsed> in GGA message (*Chapter 2.2.2*). 5. Updated the note for GSA message (*Chapter 2.2.4*). 6. Added a note about calculation of range residual in GRS message (*Chapter 2.2.8*). 7. Added PQTM messages (*Chapter 2.3*). 8. Updated the example and notes for Packet Type 066 message (*Chapter 2.4.15*). 9. Added a table about altitude and speed ranges of navigation modes for Packet Type 080 message (*Chapter 2.4.23*). 10. Updated the descriptions of <NavMode> for Packet Type 080 and Packet Type 081 messages (*Chapters 2.4.23* and *2.4.24*). 11. Updated the notes of LC29H (BA, CA, DA) supporting the Packet Type

Version	Date	Description
		410 and 411 messages (*Chapters 2.4.35* and *2.4.36*).

Contents

Table Index

1 Introduction

Quectel LC29H series and LC79H (AL) GNSS modules support GPS, GLONASS, Galileo, BDS and QZSS constellations. Concurrent tracking of GPS L1 C/A, GLONASS L1, Galileo E1, BDS B1I, QZSS L1 C/A, GPS L5, Galileo E5a, BDS B2a and QZSS L5 frequency bands provides fast and accurate acquisition and makes these modules ideal solutions for positioning and navigation in various vertical markets.

This document describes the software commands that are needed to control and modify the module configuration. The software commands are NMEA proprietary commands defined by the chipset supplier (PAIR/PQTM messages). To report GNSS information, the modules support output messages in NMEA 0183 standard protocol format and RTCM protocol format.

The LC29H series and LC79H (AL) GNSS modules support the following protocols:

Table 1: Supported Protocols

Protocol	Type
NMEA 0183 V3.01/V4.10	Output, ASCII, standard
	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.

1.1. Applicable Modules

Table 2: Applicable Modules

Module Series	Model
LC29H	LC29H (AA)
	LC29H (BA)
	LC29H (CA)
	LC29H (DA)
	LC29H (EA)
LC79H	LC79H (AL)

2 NMEA Protocol

2.1. Structure of NMEA Protocol Messages

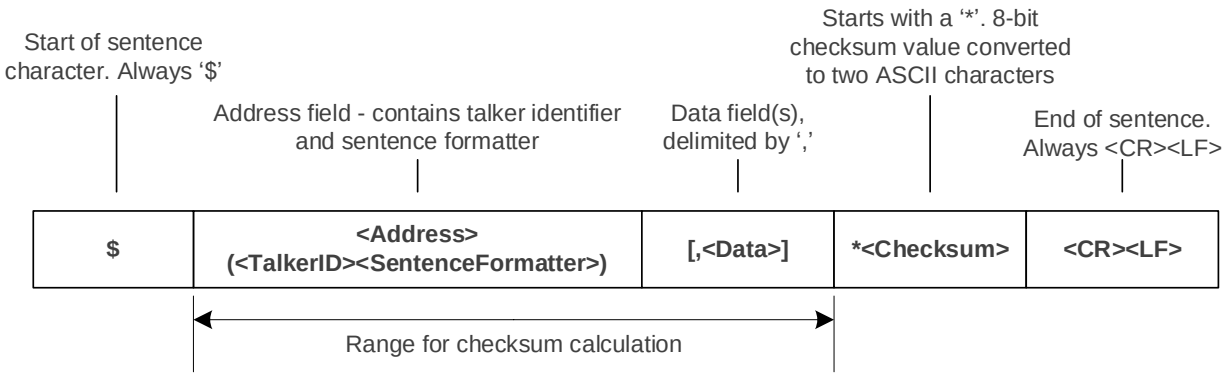

Figure 1: Structure of NMEA Protocol Messages

Table 3: Structure of NMEA Protocol Messages

Field	Description
$	Start of the sentence (Hex 0x24).
<Address>	**In Standard Messages:** In standard messages, this field consists of a two-character talker identifier (TalkerID) and a three-character sentence formatter (SentenceFormatter). The talker identifier identifies the type of talker. For more information on the TalkerID, see *Table 4: NMEA Talker ID*. The sentence formatter identifies the data type and the string format of the successive fields. **In Proprietary Messages:** In 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.

Field	Description
<Data>	Data fields, delimited by the 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 **‘,’** the field delimiter, between but not including the **$** and the ***** delimiters.
<CR><LF>	End of sentence (Hex 0x0D 0x0A).

Table 4: NMEA Talker ID

GNSS Constellation Configuration	TalkerID (NMEA 0183 V3.01)	TalkerID (NMEA 0183 V4.10)
GPS	GP	GP
GLONASS	GL	GL
Galileo	GA	GA
BDS	GB	GB
QZSS	GP	GP
Combination of Multiple Satellite Systems	GN	GN

NOTE

The TalkerID of QZSS in NMEA 0183 V4.10 is GQ for LC29H (BA, CA, DA, EA).

NMEA Checksum Sample Code:

```
// pData  is the data array whose checksum needs to be calculated:

unsigned char Ql_Check_XOR(const unsigned char *pData, unsigned int Length)
{
    unsigned char result = 0;
    unsigned int i = 0;

    if((NULL == pData) || (Length < 1))
    {
        return 0;
    }
```

```
    for(i = 0; i < Length; i++)
    {
        result ^= *(pData + i);
    }

    return result;
}
```

2.2. Standard Messages

This chapter explains the standard NMEA 0183 V3.01 and NMEA 0183 V4.10 messages supported by the modules.

2.2.1. RMC

Recommended Minimum Specific GNSS Data. Time, date, position, course, and speed data provided by a GNSS receiver.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>RMC,<UTC>,<Status>,<Lat>,<N/S>,<Lon>,<E/W>,<SOG>,<COG>,<Date>,<MagVar>,<MagVarDir>,<ModeInd>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>RMC,<UTC>,<Status>,<Lat>,<N/S>,<Lon>,<E/W>,<SOG>,<COG>,<Date>,<MagVar>,<MagVarDir>,<ModeInd>,<NavStatus>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
RMC	String, 3 characters	-	RMC	Recommended Minimum Specific GNSS Data.

Field	Format	Unit	Example	Description
<UTC>	hhmmss.sss	-	093316.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Status>	Character	-	A	Positioning system status. A = Data valid V = Navigation receiver warning
<Lat>	ddmm.mmmmmm	-	3149.332558	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes (variable length) Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	North-south direction. N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.912570	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes (variable length) Note that this field is empty in case of an invalid value.
<E/W>	Character	-	E	East-west direction. E = East W = West Note that this field is empty in case of an invalid value.
<SOG>	Numeric	Knot	0.00	Speed over ground. Variable length. Note that this field is empty in case of an invalid value.
<COG>	Numeric	Degree	237.67	Course over ground. Variable length. Maximum value: 359.99. Note that this field is empty in case of an invalid value.
<Date>	ddmmyy	-	140122	Date. dd: Day of month mm: Month

Field	Format	Unit	Example	Description
				yy: Year
<MagVar>	-	-	-	Magnetic variation. Not supported.
<MagVarDir>	-	-	-	Direction of magnetic variation. Not supported.
<ModeInd>	Character	-	A	Mode indicator. A = Autonomous mode. Satellite system used in non-differential mode in position fix. D = Differential mode. Satellite system used in differential mode in position fix. Corrections from ground stations or Satellite Based Augmentation System (SBAS). E = Estimated (dead reckoning) mode. F = Float RTK. Satellite system used in RTK mode with floating integers. M = Manual input mode. N = No fix. Satellite system not used in position fix, or fix not valid. R = Real Time Kinematic (RTK). Satellite system used in RTK mode with fixed integers.
<NavStatus>	Character	-	V	Navigational status. Not supported. Always “V” (Invalid. The device cannot provide navigational status indication). Please note that this parameter is only available in messages in line with NMEA 0183 V4.10 and above.
<Checksum>	Hexadecimal	-	0B	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNRMC,093423.000,A,3149.332006,N,11706.913200,E,0.01,0.00,140122,,,A*79
```

NMEA 0183 V4.10 example:

```
$GNRMC,093316.000,A,3149.332558,N,11706.912570,E,0.00,237.67,140122,,,A,V*0B
```

2.2.2. GGA

Global Positioning System Fix Data. Time, position, and fix-related data for a GNSS receiver.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GGA,<UTC>,<Lat>,<N/S>,<Lon>,<E/W>,<Quality>,<NumSatUsed>,<HDOP>,<Alt>,M,<Sep>,M,<DiffAge>,<DiffStation>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GGA,<UTC>,<Lat>,<N/S>,<Lon>,<E/W>,<Quality>,<NumSatUsed>,<HDOP>,<Alt>,M,<Sep>,M,<DiffAge>,<DiffStation>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
GGA	String, 3 characters	-	GGA	Global Positioning System Fix Data.
<UTC>	hhmmss.sss	-	093316.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Lat>	ddmm.mmmmmm	-	3149.332558	Latitude. dd: Degrees (00–90) mm: Minutes (00–59)

Field	Format	Unit	Example	Description
				mmmmmm: Decimal fraction of minutes (variable length) Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	North-south direction. N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.912570	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes (variable length) Note that this field is empty in case of an invalid value.
<E/W>	Character	-	E	East-west direction. E = East W = West Note that this field is empty in case of an invalid value.
<Quality>	Numeric, 1 digit	-	1	GPS quality indicator. 0 = Fix not available or invalid 1 = GPS SPS Mode, fix valid 2 = Differential GPS, SPS Mode, or Satellite Based Augmentation. System (SBAS), fix valid 3 = GPS PPS Mode, fix valid 4 = Real Time Kinematic (RTK) System used in RTK mode with fixed integers 5 = Float RTK. Satellite system used in RTK mode, floating integers. 6 = Estimated (dead reckoning) mode
<NumSatUsed>	Numeric, 2 digits	-	28	Number of satellites in use.
<HDOP>	Numeric	-	0.67	Horizontal dilution of precision. Variable length. Range: 0.00–100.00. Note that this field is empty in case

Field	Format	Unit	Example	Description
				of an invalid value.
<Alt>	Numeric	Meter	54.481	Altitude above mean-sea-level (geoid). Variable length. Note that this field is empty in case of an invalid value.
M	Character	-	M	Unit of <Alt>. "M" = Meter.
<Sep>	Numeric	Meter	-0.337	Geoid separation (the difference between the earth ellipsoid surface and the mean-sea-level (geoid) surface defined by the reference datum used in the position solution). Variable length. Note that this field is empty in case of an invalid value.
M	Character	-	M	Unit of <Sep>. "M" = Meter.
<DiffAge>	-	-	-	Differential GPS data age. Not supported.
<DiffStation>	-	-	-	Differential reference station ID. Not supported.
<Checksum>	Hexadecimal	-	*5D	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNGGA,093423.000,3149.332006,N,11706.913200,E,1,22,0.75,45.346,M,-0.337,M,,*56
```

NMEA 0183 V4.10 example:

```
$GNGGA,093316.000,3149.332558,N,11706.912570,E,1,28,0.67,54.481,M,-0.337,M,,*5D
```

NOTE

1. The NMEA 0183 specification indicates that **GGA** messages are GPS specific. However, when the receiver is configured for multi-constellations, the content of **GGA** messages will be generated from the multi-constellation solution.
2. For **<NumSatUsed>**:
   1) According to the NMEA 0183 specification, the number of satellites in use is between 00 and 12. However, in the multi-constellation solution, the number of satellites in use may exceed 12.
   2) Only for LC29H (AA) and LC79H (AL), the <NumSatUsed> in GGA will be increased by 1 if single-band signal (either L1 or L5) is being used or 2 if both L1 and L5 signals of the same satellite are used. For LC29H (BA, CA, DA, EA), the <NumSatUsed> in GGA will be increased by 1 when single-band or dual-band signals of the same satellite are used.

2.2.3. GSV

GNSS Satellites in View. The GSV sentence provides the number of satellites in view (SV), satellite ID numbers, elevation, azimuth, and SNR value, and it contains maximum four satellites per transmission. Therefore, it may take several sentences to get complete information. The total number of sentences being transmitted and the sentence number are indicated in the first two data fields.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GSV,<TotalNumSen>,<SenNum>,<TotalNumSat>{,<SatID>,<SatElev>,<SatAz>,<SatCN0>}*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GSV,<TotalNumSen>,<SenNum>,<TotalNumSat>{,<SatID>,<SatElev>,<SatAz>,<SatCN0>},<SignalID>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GP	Talker identifier. See *Table 4: NMEA Talker ID*.
GSV	String, 3 characters	-	GSV	GNSS Satellites in View.

Field	Format	Unit	Example	Description
<TotalNumSen>	Numeric	-	3	Total number of sentences. Range: 1–9.
<SenNum>	Numeric	-	1	Sentence number. Range: 1–**<TotalNumSen>**.
<TotalNumSat>	Numeric	-	11	Total number of satellites in view.
Start of repeat block. Repeat times: 1–4.				
<SatID>	Numeric	-	08	Satellite ID. See *Table 11: GNSS Satellites (NMEA) Numbering*.
<SatElev>	Numeric	Degree	76	Satellite elevation. Range: 00–90.
<SatAz>	Numeric	Degree	353	Satellite azimuth, with true north as the reference plane. Range: 000–359.
<SatCN0>	Numeric	dB-Hz	46	Satellite C/N_0. Range 00–99. Null when not tracking.
End of repeat block.				
<SignalID>	Numeric	-	1	GNSS signal ID. See *Table 11: GNSS Satellites (NMEA) Numbering*. Please note that this parameter is only available in messages in line with NMEA 0183 V4.10 or higher.
<Checksum>	Hexadecimal	-	*5C	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GPGSV,3,1,12,08,75,355,46,195,68,113,44,194,64,081,42,199,51,162,36*47
$GPGSV,3,2,12,27,45,037,44,21,44,156,43,16,30,072,39,30,18,317,38*72
$GPGSV,3,3,12,03,,,19,04,,,37,09,,,40,07,,,43*7C
$GPGSV,2,1,08,08,75,355,38,195,68,113,38,194,64,081,38,199,51,162,38*4C
$GPGSV,2,2,08,27,45,037,38,30,18,317,31,04,,,29,09,,,32*70
$GLGSV,1,1,04,86,63,182,32,85,59,041,42,76,36,333,41,66,07,278,*6A
$GAGSV,1,1,00*68
$GAGSV,1,1,00*68
$GBGSV,3,1,12,29,82,083,41,07,64,319,41,09,54,220,40,36,47,113,45*66
$GBGSV,3,2,12,06,45,201,39,39,34,192,40,01,,,38,30,,,40*69
$GBGSV,3,3,12,16,,,41,05,,,31,02,,,36,13,,,35*6E
```

```
$GBGSV,1,1,04,29,82,083,36,36,47,113,36,39,34,192,32,30,,,28*5F
```

NMEA 0183 V4.10 example:

```
$GPGSV,3,1,11,08,76,353,46,195,68,113,44,194,64,080,42,199,51,162,37,1*5C
$GPGSV,3,2,11,27,45,037,43,07,44,315,43,21,43,156,44,16,30,071,39,1*6B
$GPGSV,3,3,11,09,28,244,40,04,20,206,37,30,,,38,1*6F
$GPGSV,2,1,08,08,76,353,35,195,68,113,34,194,64,080,33,199,51,162,34,8*5A
$GPGSV,2,2,08,27,45,037,33,09,28,244,28,04,20,206,26,30,,,27,8*5E
$GLGSV,1,1,03,85,59,042,41,76,35,333,40,66,07,279,32,1*43
$GAGSV,1,1,00,7*73
$GAGSV,1,1,00,1*75
$GBGSV,4,1,13,07,64,319,41,40,61,345,43,36,47,113,43,06,45,201,40,1*7E
$GBGSV,4,2,13,16,41,195,41,35,40,213,45,26,17,313,39,56,,,19,1*49
$GBGSV,4,3,13,57,,,37,01,,,39,02,,,36,60,,,40,1*7B
$GBGSV,4,4,13,03,,,40,1*73
$GBGSV,1,1,04,40,61,345,32,36,47,113,32,35,40,213,29,26,17,313,23,5*79
```

NOTE

GN cannot be used for **GSV** sentences. If satellites of multiple constellations are in view, **GSV** sentences are output with the corresponding talker ID for each constellation, respectively.

2.2.4. GSA

GNSS DOP and Active Satellites. GNSS receiver operating mode, satellites used in the navigation solution reported by the **GGA** sentence, and DOP values.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GSA,<Mode>,<FixMode>{,<SatID>},<PDOP>,<HDOP>,<VDOP>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GSA,<Mode>,<FixMode>{,<SatID>},<PDOP>,<HDOP>,<VDOP><SystemID>*<Checksum>
<CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
GSA	String, 3 characters	-	GSA	GNSS DOP and Active Satellites.
<Mode>	Character	-	A	Selection of 2D or 3D fix: M = Manual, forced to operate in 2D or 3D mode. A = Automatic, allowed to automatically switch to 2D/3D.
<FixMode>	Numeric	-	3	Fix mode. 1 = Fix not available 2 = 2D 3 = 3D
Start of repeat block. Repeat times: 12.				
<SatID>	Numeric	-	08	ID numbers of satellites used in solution. See *Table 11: GNSS Satellites (NMEA) Numbering*. Note that this field is empty in case of an invalid value.
End of repeat block.				
<PDOP>	Numeric	-	1.03	Position dilution of precision. Maximum value: 99.99. Note that this field is empty in case of an invalid value.
<HDOP>	Numeric	-	0.67	Horizontal dilution of precision. Maximum value: 99.99. Note that this field is empty in case of an invalid value.
<VDOP>	Numeric	-	0.78	Vertical dilution of precision. Maximum value: 99.99. Note that this field is empty in case of an invalid value.
<SystemID>	Numeric	-	1	GNSS system ID. See *Table 11: GNSS Satellites (NMEA) Numbering*. Please note that this parameter is only available in messages in line with NMEA

Field	Format	Unit	Example	Description
				0183 V4.10 or higher.
<Checksum>	Hexadecimal	-	*3E	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GPGSA,A,3,08,195,194,199,27,21,16,30,,,,,1.09,0.75,0.79*3C
$GLGSA,A,3,86,85,76,,,,,,,,,1.09,0.75,0.79*18
$GAGSA,A,3,,,,,,,,,,,,,1.09,0.75,0.79*17
$GBGSA,A,3,07,09,36,06,39,,,,,,,,1.09,0.75,0.79*13
```

NMEA 0183 V4.10 example:

```
$GNGSA,A,3,08,195,194,199,27,07,21,16,09,04,,,1.03,0.67,0.78,1*3E
$GNGSA,A,3,85,76,66,,,,,,,,,,1.03,0.67,0.78,2*02
$GNGSA,A,3,,,,,,,,,,,,,1.03,0.67,0.78,3*0F
$GNGSA,A,3,07,40,36,06,16,35,26,,,,,,1.03,0.67,0.78,4*0D
```

NOTE

If less than 12 satellites are used for navigation, the remaining **<SatID>** fields are left empty. If more than 12 satellites are used for navigation, only the IDs of the first 12 are output.

2.2.5. VTG

Course Over Ground & Ground Speed. The actual course and speed relative to the ground.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>VTG,<COGT>,T,<COGM>,M,<SOGN>,N,<SOGK>,K,<ModeInd>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>VTG,<COGT>,T,<COGM>,M,<SOGN>,N,<SOGK>,K,<ModeInd>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
VTG	String, 3 characters	-	VTG	Course Over Ground & Ground Speed.
<COGT>	Numeric	Degrees	237.67	Course over ground, in true north direction. Note that this field is empty in case of an invalid value.
T	Character	-	T	Fixed field: true.
<COGM>	Numeric	Degrees	-	Course over ground (magnetic). Not supported.
M	Character	-	M	Fixed field: magnetic.
<SOGN>	Numeric	Knots	0.00	Speed over ground in knots. Variable length. Note that this field is empty in case of an invalid value.
N	Character	-	N	Fixed field: knot.
<SOGK>	Numeric	km/h	0.00	Speed over ground in kilometers per hour. Variable length. Note that this field is empty in case of an invalid value.
K	Character	-	K	Fixed field: kilometers per hour.
<ModeInd>	Character	-	A	Mode indicator. A = Autonomous mode. Satellite system used in non-differential mode in position fix. D = Differential mode. Satellite system used in differential mode in position fix. Corrections from ground stations or Satellite Based Augmentation System (SBAS). E = Estimated (dead reckoning) mode. M = Manual input mode. N = Data not valid.
<Checksum>	Hexadecimal	-	*24	Checksum

Field	Format	Unit	Example	Description
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNVTG,0.00,T,,M,0.01,N,0.02,K,A*20
```

NMEA 0183 V4.10 example:

```
$GNVTG,237.67,T,,M,0.00,N,0.00,K,A*24
```

2.2.6. GLL

Geographic Position – Latitude/Longitude. Latitude and longitude of the GNSS receiver position, the time of position fix and status.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GLL,<Lat>,<N/S>,<Lon>,<E/W>,<UTC>,<Status>,<ModeInd>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GLL,<Lat>,<N/S>,<Lon>,<E/W>,<UTC>,<Status>,<ModeInd>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	-	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
GLL	String, 3 characters	-	GLL	Geographic Position – Latitude/Longitude.
<Lat>	ddmm.mmmmmm	-	3149.332558	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes

Field	Format	Unit	Example	Description
				(variable length) Note that this field is empty in case of an invalid value.
<N/S>	Character	-	N	North-south direction. N = North S = South Note that this field is empty in case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.912570	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes (variable length) Note that this field is empty in case of an invalid value.
<E/W>	Character	-	E	East-west direction. E = East W = West Note that this field is empty in case of an invalid value.
<UTC>	hhmmss.sss	-	093316.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Status>	Character	-	A	Positioning system status. A = Data valid V = Data not valid
<ModeInd>	Character	-	A	Mode indicator. A = Autonomous mode. Satellite system used in non-differential mode in position fix. D = Differential mode. Satellite system used in differential mode in position fix. Corrections from ground stations or Satellite Based Augmentation System (SBAS). E = Estimated (dead reckoning) mode. M = Manual input mode. N = Data not valid.
<Checksum>	Hexadecimal	-	*45	Checksum

Field	Format	Unit	Example	Description
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNGLL,3149.332006,N,11706.913200,E,093423.000,A,A*4B
```

NMEA 0183 V4.10 example:

```
$GNGLL,3149.332558,N,11706.912570,E,093316.000,A,A*45
```

2.2.7. ZDA

Time & Date. UTC, day, month, year and local time zone.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>ZDA,<UTC>,<Day>,<Month>,<Year>,<LocalHour>,<LocalMin>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>ZDA,<UTC>,<Day>,<Month>,<Year>,<LocalHour>,<LocalMin>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
ZDA	String, 3 characters	-	ZDA	Time & Date. UTC, day, month, year and local time zone.
<UTC>	hhmmss.sss	-	093316.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds

Field	Format	Unit	Example	Description
<Day>	Numeric	-	14	Day of month. Range: 01–31.
<Month>	Numeric	-	01	Month. Range: 01–12.
<Year>	Numeric	-	2022	Year.
<LocalHour>	Numeric	-	-	Local zone hours, 00 to ±13 hours. Not supported.
<LocalMin>	Numeric	-	-	Local zone minutes, 00 to 59 minutes. Not supported.
<Checksum>	Hexadecimal	-	*40	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNZDA,093423.000,14,01,2022,,*41
```

NMEA 0183 V4.10 example:

```
$GNZDA,093316.000,14,01,2022,,*40
```

NOTE

ZDA message is not supported on LC29H (BA, CA, DA, EA).

2.2.8. GRS

GNSS range residuals. This sentence supports Receiver Autonomous Integrity Monitoring (RAIM). Range residuals can be computed in two ways for this process. The basic measurement integration cycle of most navigation filters generates a set of residuals and uses these to update the position state of the receiver.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GRS,<UTC>,<Mode>{,<Resi>}*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GRS,<UTC>,<Mode>{,<Resi>},<SystemID>,<SignalID>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
GRS	String, 3 characters	-	GRS	GNSS range residuals.
<UTC>	hhmmss.sss	-	061549.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Mode>	Numeric	-	1	Computation method used. 0 = Residuals were used to calculate the position given in the matching GGA or GNS sentence. 1 = Residuals were recomputed after the GGA or GNS position was computed.
Start of repeat block. Repeat time: 12.				
<Resi>	Numeric	m	6.2	Range residuals for SVs used in navigation. Range: -999 to 999. Note that this field is empty in case of an invalid value.

Field	Format	Unit	Example	Description
End of repeat block.				
<SystemID>	Numeric	-	1	GNSS system ID. See *Table 11: GNSS Satellites (NMEA) Numbering*. Please note that this parameter is only available in messages in line with NMEA 0183 V4.10 or higher.
<SignalID>	Numeric	-	1	GNSS signal ID. See *Table 11: GNSS Satellites (NMEA) Numbering*. Please note that this parameter is only available in messages in line with NMEA 0183 V4.10 or higher.
<Checksum>	Hexadecimal	-	*6F	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNGRS,072520.000,1,-4.5,-133,-6.9,2.3,-4.3,-144,-4.9,-4.4,-2.2,-131,-76.7,-3.3*61
$GNGRS,072520.000,1,-4.5,,,,-4.3,,,-4.4,,,,-3.3*64
$GNGRS,072520.000,1,-2.3,0.3,-2.0,,,,,,,,*4C
$GNGRS,072520.000,1,-3.9,-4.6,3.0,-15.1,0.7,,,,,,,*58
$GNGRS,072520.000,1,-3.9,-4.6,3.0,-15.1,0.7,,,,,,,*58
$GNGRS,072520.000,1,-4.1,0.3,-0.2,6.1,-4.3,3.8,-0.2,-10.3,-6.6,1.8,12.2,-15.5*79
$GNGRS,072520.000,1,6.5,-6.3,1.9,-4.1,-141,0.5,,,,,,*5B
$GNGRS,072520.000,1,-4.1,0.3,-0.2,,,,-0.2,,-6.6,,12.2,*55
$GNGRS,072520.000,1,,,1.9,,,0.5,,,,,,*6F
```

NMEA 0183 V4.10 example:

```
$GNGRS,061549.000,1,6.2,-7.5,0.4,-0.7,0.8,-8.6,4.0,4.1,7.7,7.2,2.0,-6.3,1,1*6F
$GNGRS,061549.000,1,-4.8,5.2,-82.4,1.7,,,,,,,,,1,1*5C
$GNGRS,061549.000,1,6.2,-7.5,,,0.8,-8.6,,4.1,,,,,1,8*4D
$GNGRS,061549.000,1,-4.8,5.2,,,,,,,,,,,1,8*40
$GNGRS,061549.000,1,-2.5,11.2,-16.4,-1.5,,,,,,,,,2,1*43
$GNGRS,061549.000,1,-9.8,8.0,8.0,74.7,-16.2,-6.2,-101,,,,,,3,7*5F
$GNGRS,061549.000,1,-9.8,8.0,8.0,74.7,-16.2,-6.2,,,,,,,3,1*44
$GNGRS,061549.000,1,-0.6,-2.0,-6.4,1.0,12.7,7.8,-18.0,3.3,-5.3,16.5,-7.6,-91.2,4,1*4D
$GNGRS,061549.000,1,-3.8,5.9,-0.4,1.1,-107,-5.2,,,,,,,4,1*76
$GNGRS,061549.000,1,-0.6,-2.0,-6.4,,,,,3.3,,,,,4,5*45
```

```
$GNGRS,061549.000,1,-3.8,5.9,-0.4,1.1,,,,,,,,,4,5*6D
```

NOTE

1. **GRS** is not supported on LC29H (BA, CA, DA, EA).
2. The satellite order in a **GRS** sentence should match the order of satellite ID numbers in a **GSA** sentence. If the range residual exceeds ±99.9 meters, then the decimal part is dropped, resulting in an integer.
3. The calculation method is: Range Residual = Calculated Range - Measured Range.
4. If less than 12 satellites are used for navigation, the remaining **<Resi>** fields are left empty. If more than 12 satellites are used, multiple **GRS** sentences containing all **<Resi>** fields will be output.

2.2.9. GST

GNSS Pseudorange Error Statistics. This sentence supports Receiver Autonomous Integrity Monitoring (RAIM). Pseudorange measurement error statistics can be translated in the position domain in order to give statistical measures of the quality of the position solution.

Type:

Output

Synopsis:

NMEA 0183 V3.01 format:

```
$<TalkerID>GST,<UTC>,<RMS_D>,<MajorD>,<MinorD>,<Orient>,<LatD>,<LonD>,<AltD>*<Checksum><CR><LF>
```

NMEA 0183 V4.10 format (default):

```
$<TalkerID>GST,<UTC>,<RMS_D>,<MajorD>,<MinorD>,<Orient>,<LatD>,<LonD>,<AltD>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Example	Description
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 4: NMEA Talker ID*.
GST	String, 3 characters	-	GST	GNSS Pseudorange Error Statistics.
<UTC>	hhmmss.sss	-	061549.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59)

Field	Format	Unit	Example	Description
				ss: Seconds (00–59) sss: Decimal fraction of seconds
<RMS_D>	Numeric	Meter	8.2	RMS value of the standard deviation of the range inputs to the navigation process.
<MajorD>	Numeric	Meter	2.6	Standard deviation of semi-major axis of error ellipse.
<MinorD>	Numeric	Meter	2.4	Standard deviation of semi-minor axis of error ellipse.
<Orient>	Numeric	Degree	74.7	Orientation of semi-major axis of error ellipse.
<LatD>	Numeric	Meter	2.4	Standard deviation of latitude error.
<LonD>	Numeric	Meter	2.6	Standard deviation of longitude error.
<AltD>	Numeric	Meter	8.5	Standard deviation of altitude error.
<Checksum>	Hexadecimal	-	*45	Checksum.
<CR><LF>	Character	-	-	Carriage return and line feed.

Example:

NMEA 0183 V3.01 example:

```
$GNGST,072520.000,6.5,2.9,2.3,98.2,2.3,2.9,11.2*79
```

NMEA 0183 V4.10 example:

```
$GNGST,061549.000,8.2,2.6,2.4,74.7,2.4,2.6,8.5*45
```

NOTE

GST is not supported on LC29H (BA, CA, DA, EA).

2.3. PQTM Messages

This chapter explains the **PQTM** messages (proprietary NMEA messages defined by Quectel) supported by LC29H series and LC79H (AL) GNSS modules.

Table 5: Error Codes

Field	Format	Unit	Description
<ErrCode>	Numeric	-	Error code. 1 = Invaild parameters. 2 = Execution failed.

2.3.1. PQTMVERNO

Queries the firmware version information.

Type:

Command

Synopsis:

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

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMVERNO,<VerStr>,<BuildDate>,<BuildTime>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<VerStr>	String	-	Version string.
<BuildDate>	yyyy/mm/dd	-	Firmware build date.
<BuildTime>	hh:mm:ss	-	Firmware build time.

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
$PQTMVERNO*58
$PQTMVERNO,LC29HAANR01A04S,2022/11/04,16:39:48*34
```

2.3.2. PQTMSAVEPAR

Saves the configurations set via **PQTM** commands into NVM.

Type:

Command

Synopsis:

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

Parameter:

None

Result:

- If successful, the module returns:

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

- If failed, the module returns:

```
$PQTMSAVEPAR,ERROR,<ErrCode>*<Checksum>
```

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
$PQTMSAVEPAR*5A
$PQTMSAVEPAR,OK*72
```

2.3.3. PQTMRESTOREPAR

Restores all parameters set via **$PQTM** commands to default values. Reset the module after executing this command

Type:

Command

Synopsis:

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

Parameter:

None

Result:

- If successful, the module returns:

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

- If failed, the module returns:

```
$PQTMRESTOREPAR,ERROR,<ErrCode>*<Checksum>
```

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
$PQTMRESTOREPAR*13
$PQTMRESTOREPAR,OK*3B
```

2.3.4. PQTMEPE

Outputs the estimated positioning error.

Type:

Output

Synopsis:

```
$PQTMEPE,<MsgVer>,<EPE_North>,<EPE_East>,<EPE_Down>,<EPE_2D>,<EPE_3D>*<Checksum>
<CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MsgVer>	Numeric	-	Message version. 2 = Version 2 (Always 2 for this version.)
<EPE_North>	Numeric	Meter	Estimated north error.
<EPE_East>	Numeric	Meter	Estimated east error.
<EPE_Down>	Numeric	Meter	Estimated down error.
<EPE_2D>	Numeric	Meter	Estimated 2D position error.
<EPE_3D>	Numeric	Meter	Estimated 3D position error.

Example:

```
$PQTMEPE,2,3.393,3.476,12.713,4.857,13.609*5D
```

NOTE

LC29H (EA) does not support this message.

2.3.5. PQTMCFGMSGRATE

Configures the message output rate on the current port.

Type:

Set/Get

Synopsis:

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

Parameter:

Field	Format	Unit	Description
<MsgName>	String	-	Configuration message name. See *Table 6: Supported Messages* for details.

Field	Format	Unit	Description
<Rate>	Numeric	-	Message output rate. 0 = Output disabled. N = Output once every N position fix(es). Range of N see *Table 6: Supported Messages* for details.
<MsgVer>	Numeric	-	Message version. Optional. This field can be omitted when the configuration message is standard NMEA 0183 message.

Result:

- If successful, the module returns:

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

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
//Set the output rate of $PQTMGEOFENCESTATUS message to once every position fix:
$PQTMCFGMSGRATE,W,PQTMGEOFENCESTATUS,1,1*5C
$PQTMCFGMSGRATE,OK*29

//Get the output rate of $PQTMGEOFENCESTATUS message:
$PQTMCFGMSGRATE,R,PQTMGEOFENCESTATUS,1*44
$PQTMCFGMSGRATE,OK,PQTMGEOFENCESTATUS,1,1*0F

//Set the output rate of $PQTMEPE message to once every position fix:
$PQTMCFGMSGRATE,W,PQTMEPE,1,2*1D
$PQTMCFGMSGRATE,OK*29

//Get the output rate of $PQTMEPE message:
$PQTMCFGMSGRATE,R,PQTMEPE,2*05
$PQTMCFGMSGRATE,OK,PQTMEPE,1,2*4E
```

Table 6: Supported Messages

Message Name	Message Output Rate Range (N)
$PQTMSVINSTATUS	1–20
$PQTMGEOFENCESTATUS	1–20
$PQTMEPE	1–20
$PQTMPVT	1

NOTE

1. If the configuration message is a **$PQTM** message, use **<MsgVer>** field to specify the message version, otherwise an error will be returned.
2. This command will take effect after sending **$PQTMSAVEPAR*5A** and resetting the module.
3. 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 the Set command. If the default setting had been changed by the Set command, contact Quectel Technical Support (support@quectel.com) to get the default setting, if necessary.

2.3.6. PQTMCFGGEOFENCE

Configures geofence feature.

Type:

Set/Get

Synopsis:

```
//Set:
$PQTMCFGGEOFENCE,W,<Index>,<Status>,<Reserved>,<Shape>,<Lat0>,<Lon0>,<Lat1/Radius>[,<Lon1>,<Lat2>,<Lon2>,<Lat3>,<Lon3>]*<Checksum><CR><LF>
//Get:
$PQTMCFGGEOFENCE,R,<Index>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Index>	Numeric	-	Geofence index. Range: 0–3.
<Status>	Numeric	-	Geofence function status.

Field	Format	Unit	Description
			0 = Disabled 1 = Enabled
<Reserved>	Numeric	-	Always 0.
<Shape>	Numeric	-	Geofence shape. 0 = Circle defined by the center and the radius 1 = Circle defined by the center and a point on the circle 2 = Triangle 3 = Quadrangle (such as square, rectangle, trapezium.)
<Lat0>	Numeric	Degree	The latitude of the first point.
<Lon0>	Numeric	Degree	The longitude of the first point.
<Lat1/Radius>	Numeric	Degree/Meter	If the geofence shape is a circle with a certain radius, this value will be the radius of the circle, otherwise, this value will be the latitude of the second point.
<Lon1>	Numeric	Degree	The longitude of the second point.
<Lat2>	Numeric	Degree	The latitude of the third point.
<Lon2>	Numeric	Degree	The longitude of the third point.
<Lat3>	Numeric	Degree	The latitude of the fourth point.
<Lon3>	Numeric	Degree	The longitude of the fourth point.

Result:

- If successful, the module returns:

```
//Response to Set command:
$PQTMCFGGEOFENCE,OK*<Checksum><CR><LF>
//Response to Get command:
$PQTMCFGGEOFENCE,OK,<Index>,<Status>,<Reserved>,<Shape>,<Lat0>,<Lon0>,<Lat1/Radius>[,<Lon1>,<Lat2>,<Lon2>,<Lat3>,<Lon3>]*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
//Set:
$PQTMCFGGEOFENCE,W,0,1,0,0,31.451248,117.451245,100.5*18
$PQTMCFGGEOFENCE,OK*74

//Get:
$PQTMCFGGEOFENCE,R,0*3E
$PQTMCFGGEOFENCE,OK,0,1,0,0,31.451248,117.451245,100.500000*7B
```

NOTE

1. This command is supported on LC29H (AA, EA) and LC79H (AL).
2. This command will take effect after sending **$PQTMSAVEPAR*5A** and resetting the module.

2.3.7. PQTMGEOFENCESTATUS

Outputs the geofences status.

Type:

Output

Synopsis:

```
$PQTMGEOFENCESTATUS,<MsgVer>,<Time>{,<StateN>}*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MsgVer>	Numeric	-	Message version. 1 = Version 1 (Always 1 for this version.)
<Time>	hhmmss.sss	-	UTC time.
Start of repeat block. Repeat times: 4.			
<StateN>	Numeric	-	Geofence N state. Range of N: 0–3. 0 = Unknow 1 = Inside 2 = Outside
End of repeat block.			

Example:

```
$PQTMGEOFENCESTATUS,1,093444.000,2,0,0,0*29
```

2.3.8. PQTMCFGSVIN

Configures the survey-in feature.

In order to operate as a base station, the module external antenna should be mounted on a fix point. The antenna accurate coordinate location can be acquired through a self-survey process. The Survey-in mode (**<Mode>** = 1) determines the receiver's position by building a weighted mean of all valid 3D positioning solutions. You can set values of **<MinDur>** and **<3D_AccLimit>** to define the minimum observation time and 3D position standard deviation used for the position estimation. The Fixed mode (**<Mode>** = 2) requires user to manually enter the receiver position coordinates. Any error in the base station position will translate directly into rover position error.

Type:

Set/Get

Synopsis:

```
//Set:
$PQTMCFGSVIN,W,<Mode>,<MinDur>,<3D_AccLimit>,<ECEF_X>,<ECEF_Y>,<ECEF_Z>*<Checksum><CR><LF>
//Get:
$PQTMCFGSVIN,R*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	Configure the receiver mode. 0 = Disable 1 = Survey-in mode 2 = Fixed mode (ARP position is given in ECEF.)
<MinDur>	Numeric	-	Survey-in minimum duration of fixed times. Range: 0–86400.
<3D_AccLimit>	Numeric	Meter	Limit the 3D position accuracy in survey-in mode. When this field is 0, it means no limit on 3D position accuracy.
<ECEF_X>	Numeric	Meter	WGS84 ECEF X coordinate.
<ECEF_Y>	Numeric	Meter	WGS84 ECEF Y coordinate.

Field	Format	Unit	Description
<ECEF_Z>	Numeric	Meter	WGS84 ECEF Z coordinate.

Result:

- If successful, the module returns:

```
//Response to Set command:
$PQTMCFGSVIN,OK*<Checksum><CR><LF>
//Response to Get command:
$PQTMCFGSVIN,OK,<Mode>,<MinDur>,<3D_AccLimit>,<ECEF_X>,<ECEF_Y>,<ECEF_Z>*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
//Set:
$PQTMCFGSVIN,W,2,0,0,-2472446.4619,4828304.1363,3343730.2653*2A
$PQTMCFGSVIN,OK*70

//Get:
$PQTMCFGSVIN,R*26
$PQTMCFGSVIN,OK,2,0,0.0,-2472446.4619,4828304.1363,3343730.2653*67
```

NOTE

1. This command is supported on LC29H (DA, EA).
2. This command will take effect after sending **$PQTMSAVEPAR*5A** and resetting the module.

2.3.9. PQTMSVINSTATUS

Outputs the survey-in status.

Type:

Output

Synopsis:

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

Parameter:

Field	Format	Unit	Description
<MsgVer>	Numeric	-	Message version. 1 = Version 1 (Always 1 for this version.)
<TOW>	Numeric	Millisecond	GPS time of week.
<Valid>	Numeric	-	Survey-in position validity flag. 0 = Invalid 1 = In-progress 2 = Valid
<Res0>	Numeric	-	Reserved.
<Res1>	Numeric	-	Reserved.
<Obs>	Numeric	-	Number of position observations used during survey-in.
<CfgDur>	Numeric	-	Duration configured via the **<MinDur>** field of **$PQTMCFGSVIN** command.
<MeanX>	Numeric	Meter	Current survey-in mean position along X axis of ECEF coordinate system.
<MeanY>	Numeric	Meter	Current survey-in mean position along Y axis of ECEF coordinate system.
<MeanZ>	Numeric	Meter	Current survey-in mean position along Z axis of ECEF coordinate system.
<MeanAcc>	Numeric	Meter	Current survey-in mean position accuracy.

Example:

```
$PQTMSVINSTATUS,1,2241,1,,01,538,43200,-2472436.0802,4828383.0026,3343698.4839,9.5*38
```

NOTE

This command is supported on LC29H (DA, EA).

2.3.10. PQTMGNSSSTART

Starts GNSS engine.

Type:

Command

Synopsis:

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

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMGNSSSTART,OK*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
$PQTMGNSSSTART*51
$PQTMGNSSSTART,OK*79
```

NOTE

This command is only supported on LC29HCANR01A08S_DTB2 and LC29HCANR01A05S_DSA2 and their higher versions. Contact Quectel Technical Support for details about the software versions.

2.3.11. PQTMGNSSSTOP

Stops GNSS engine.

Type:

Command

Synopsis:

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

Parameter:

None

Result:

- If successful, the module returns:

```
$PQTMGNSSSTOP,OK*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
$PQTMGNSSSTOP*09
$PQTMGNSSSTOP,OK*21
```

NOTE

1. This command is only used to stop GNSS engine, the DR engine keep working if it is enabled.
2. This command is only supported on LC29HCANR01A08S_DTB2 and LC29HCANR01A05S_DSA2 and their higher versions. Contact Quectel Technical Support for details about the software versions.

2.3.12. PQTMPVT

Outputs the PVT (GNSS only) result.

Type:

Output

Synopsis:

```
$PQTMPVT,<MsgVer>,<TOW>,<Date>,<Time>,<Res>,<FixMode>,<NumSatUsed>,<LeapS>,<Lat>,<Lon>,<Alt>,<Sep>,<VelN>,<VelE>,<VelD>,<Spd>,<Heading>,<HDOP>,<PDOP>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MsgVer>	Numeric	-	Message version. 1 = Version 1 (Always 1 for this version.)
<TOW>	Numeric	Millisecond	Time of week.
<Date>	YYYYMMDD	-	UTC date. YYYY: Year MM: Month DD: Day of month
<Time>	hhmmss.sss	-	UTC time. hh: Hour (00–23) mm: Minute (00–59) ss: Second (00–59) sss: Decimal fraction of second
<Res>	Numeric	-	Reserved.
<FixMode>	Numeric	-	Fix mode. 0 = No fix. 1 = Reserved. 2 = 2D fix. 3 = 3D fix.
<NumSatUsed>	Numeric	-	Number of satellites in use.
<LeapS>	Numeric	Second	Leap seconds. Note that this field is empty in case of an invalid value.
<Lat>	Numeric	Degree	Latitude. Note that this field is empty in case of an invalid value.

Field	Format	Unit	Description
<Lon>	Numeric	Degree	Longitude. Note that this field is empty in case of an invalid value.
<Alt>	Numeric	Meter	Altitude above mean-sea-level. Note that this field is empty in case of an invalid value.
<Sep>	Numeric	Meter	Geoidal separation (the difference between the WGS84 earth ellipsoid surface and the mean-sea-level surface). Note that this field is empty in case of an invalid value.
<VelN>	Numeric	m/s	North velocity. Note that this field is empty in case of an invalid value.
<VelE>	Numeric	m/s	East velocity. Note that this field is empty in case of an invalid value.
<VelD>	Numeric	m/s	Down velocity. Note that this field is empty in case of an invalid value.
<Spd>	Numeric	m/s	Ground speed. Note that this field is empty in case of an invalid value.
<Heading>	Numeric	Degree	Heading. Note that this field is empty in case of an invalid value. Range: 0.00–360.00.
<HDOP>	Numeric	-	Horizontal dilution of precision. Note that the value is 99.99 in case of an invalid value.
<PDOP>	Numeric	-	Position (3D) dilution of precision. Note that the value is 99.99 in case of an invalid value.

Example:

```
//No fix:
$PQTMPVT,1,1000,20221225,163355.000,,0,00,,,,,,,,,,99.99,99.99*79

//3D fix:
$PQTMPVT,1,31075000,20221225,083737.000,,3,09,18,31.12738291,117.26372910,34.212,5.267,3.212,2.928,0.238,4.346,34.12,2.16,4.38*51
```

NOTE

This message is supported on LC29H (BA, CA). The message output rate only supports 1 Hz.

2.3.13. PQTMCFGNMEADP

Configures the decimal places of NMEA messages.

Type:

Set/Get

Synopsis:

```
//Set:
$PQTMCFGNMEADP,W,<UTC_DP>,<POS_DP>,<ALT_DP>,<DOP_DP>,<SPD_DP>,<COG_DP>*<Checksum><CR><LF>
//Get:
$PQTMCFGNMEADP,R*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<UTC_DP>	Numeric	-	Configure the number of decimal places for UTC seconds in NMEA standard messages. Range: 0–3. (Default: 3) 0 = No fractional part.
<POS_DP>	Numeric	-	Configure the number of decimal places for latitude and longitude in NMEA standard messages. Range: 0–8. (Default: 6) 0 = No fractional part.
<ALT_DP>	Numeric	-	Configure the number of decimal places for altitude and geoidal separation in NMEA standard

Field	Format	Unit	Description
			messages. Range: 0–3. (Default: 2) 0 = No fractional part.
<DOP_DP>	Numeric	-	Configure the number of decimal places for DOP in NMEA standard messages. Range: 0–3. (Default: 2) 0 = No fractional part.
<SPD_DP>	Numeric	-	Configure the number of decimal places for speed in NMEA standard messages. Range: 0–3. (Default: 3) 0 = No fractional part.
<COG_DP>	Numeric	-	Configure the number of decimal places for COG in NMEA standard messages. Range: 0–3. (Default: 2) 0 = No fractional part.

Result:

- If successful, the module returns:

```
//Response to Set command:
$PQTMCFGNMEADP,OK*<Checksum><CR><LF>
//Response to Get command:
$PQTMCFGNMEADP,OK,<UTC_DP>,<POS_DP>,<ALT_DP>,<DOP_DP>,<SPD_DP>,<COG_DP>*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
//Set:
$PQTMCFGNMEADP,W,3,6,1,2,3,2*35
$PQTMCFGNMEADP,OK*61

//Get:
$PQTMCFGNMEADP,R*37
$PQTMCFGNMEADP,OK,3,6,1,2,3,2*66
```

NOTE

1. This command will take effect after sending **$PQTMSAVEPAR*5A** and resetting the module.
2. This command is supported on LC29H (BA, CA, DA, EA).

2.3.14. PQTMCFGRCVRMODE

Configures the receiver working mode.

Type:

Set/Get

Synopsis:

```
//Set:
$PQTMCFGRCVRMODE,W,<Mode>*<Checksum><CR><LF>
//Get:
$PQTMCFGRCVRMODE,R*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	Receiver working mode 0 = Unknown. 1 = Rover. When set the module to this mode, the receiver will restore to default NMEA messages output state. 2 = Base station. When set the module to this mode, the receiver will automatically disable NMEA messages output and enable RTCM MSM4, 1005 messages output.

Result:

- If successful, the module returns:

```
//Response to Set command:
$PQTMCFGRCVRMODE,OK*<Checksum><CR><LF>
//Response to Get command:
$PQTMCFGRCVRMODE,OK,<Mode>*<Checksum><CR><LF>
```

- If failed, the module returns:

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

For details about **<ErrCode>**, see *Table 5: Error Codes*.

Example:

```
//Set:
$PQTMCFGRCVRMODE,W,2*29
$PQTMCFGRCVRMODE,OK*64
```

```
//Get:
$PQTMCFGRCVRMODE,R*32
$PQTMCFGRCVRMODE,OK,2*7A
```

NOTE

This command is only supported on LC29H (DA, EA).

2.4. PAIR Messages

This chapter explains **PAIR** messages (proprietary NMEA messages defined by the chipset supplier) supported by LC29H series and LC79H (AL) GNSS modules.

PAIR Message Format:

```
$PAIR<PacketType>[,<Data>]<Checksum><CR><LF>
```

Packet Type: Three-byte character string, from 000 to 999. An identifier for each PAIR message.
Data: This field can be omitted, or multiple fields can be delimited by a data field delimiter **‘,’**. Different commands correspond to different data. See the specific values below.

2.4.1. Packet Type: 001 PAIR_ACK

Acknowledges a PAIR command. An acknowledgement packet **$PAIR001** is returned to inform the sender that the receiver has received the packet.

Type:

Output

Synopsis:

```
$PAIR001,<CommandID>,<Result>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<CommandID>	Numeric	-	Type of command/packet to be acknowledged.
<Result>	Numeric	-	Result. 0 = Command has been successfully sent.

Field	Format	Unit	Description
			1 = Command is being processed. Please wait for the result. 2 = Command sending failed. 3 = <CommandID> is not supported 4 = Command parameter error. Out of range/Some parameters were lost/Checksum error. 5 = MNL service is busy. You can try again soon.

Example:

```
$PAIR001,004,0*3F
```

2.4.2. Packet Type: 002 PAIR_GNSS_SUBSYS_POWER_ON

Powers on the GNSS system, including DSP, RF, PE and clock.

Type:

Command

Synopsis:

```
$PAIR002*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR002*38
$PAIR001,002,1*38
$PAIR001,002,0*39
```

2.4.3. Packet Type: 003 PAIR_GNSS_SUBSYS_POWER_OFF

Powers off the GNSS system, including DSP, RF, PE and clock.

Type:

Command

Synopsis:

```
$PAIR003*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR003*39
$PAIR001,003,1*39
$PAIR001,003,0*38
```

NOTE

1. If the module receives **$PAIR382,1*2E** before **$PAIR003*39**, and **$PAIR001,382,0*32** is returned correctly, then it can still receive other commands. Otherwise, any other commands will not be received.
2. For software versions supporting I2C communication, the module can still receive commands after sending **$PAIR003*39**.

2.4.4. Packet Type: 004 PAIR_GNSS_SUBSYS_HOT_START

Performs a hot start (uses all available data in the NVRAM). Normally a hot start means that the GNSS module has been powered down for less than 2 hours (RTC must be alive) and its ephemeris is still valid. Therefore, there is no need to download an ephemeris again upon a hot start, thus making this startup method the fastest.

Type:

Command

Synopsis:

```
$PAIR004*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR004*3E
$PAIR001,004,0*3F
```

2.4.5. Packet Type: 005 PAIR_GNSS_SUBSYS_WARM_START

Performs a warm start. A warm start means that the GNSS module remembers only rough time, position, and almanac data, and thus needs to download an ephemeris before it can fix a position.

Type:

Command

Synopsis:

```
$PAIR005*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR005*3F
$PAIR001,005,0*3E
```

2.4.6. Packet Type: 006 PAIR_GNSS_SUBSYS_COLD_START

Performs a cold start, which means that there is no location information stored in the receiver, including time, position, almanacs and ephemeris data.

Type:

Command

Synopsis:

```
$PAIR006*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR006*3C
$PAIR001,006,0*3D
```

2.4.7. Packet Type: 007 PAIR_GNSS_SUBSYS_FULL_COLD_START

Performs a cold start and clears system and user configurations at the start, i.e., resets the module to its factory settings. Upon a full cold start, the module loses all data on the previous position. Therefore, it needs to search over the full frequency spectrum for all visible satellites before it can fix a position.

Type:

Command

Synopsis:

```
$PAIR007*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR007*3D
$PAIR001,007,0*3C
```

2.4.8. Packet Type: 010 PAIR_REQUEST_AIDING

Notifies the expiration of GNSS aiding data stored in the module. This message is automatically output when the module powers on.

Type:

Output

Synopsis:

```
$PAIR010,<Type>,<GNSS_System>,<WN>,<TOW>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Type>	Numeric	-	Type of data to be updated. 0 = EPO data 1 = Time 2 = Location
<GNSS_System>	Numeric	-	Type of required GNSS data. 0 = GPS data 1 = GLONASS data 2 = Galileo data 3 = BDS data 4 = QZSS data
<WN>	Numeric	Week	Week Number (accommodating roll-over).
<TOW>	Numeric	Second	Time of Week.

Example:

```
$PAIR010,0,0,2044,369413*33
```

NOTE

The GNSS system outputs this message automatically. Do not send **$PAIR010** manually.

2.4.9. Packet Type: 050 PAIR_COMMON_SET_FIX_RATE

Sets position fix interval.

Type:

Set

Synopsis:

```
$PAIR050,<Time>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Time>	Numeric	Millisecond	Position fix interval. Range: 100–1000. Default value: 1000.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR050,1000*12
$PAIR001,050,0*3E
```

NOTE

1. 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 the Set command. If the default setting had been changed by the Set command, contact Quectel Technical Support (support@quectel.com) for the default setting.
2. If the set frequency is greater than 1 Hz, only **RMC**, **GGA** and **GNS** massages will be output at the set frequency, whereas **GSA** and **GSV** messages are kept output at 1 Hz. Other NMEA messages will not be output.
3. For LC29H (BA) with LC29HBANR01A01S_CSA4 or higher software versions, LC29H (CA) with LC29HCANR01A01S_DSA4 or higher software versions, as well as LC29H (EA) modules:
   3) **<Time>** can be set only to 100 or 1000.

4) **$PAIR050** will take effect after you reboot the module.

4. **$PAIR050** is not supported on LC29H (BA) with LC29HBANR01A01S_CSA2 or higher software versions, LC29H (CA) with LC29HCANR01A01S_DSA2 or LC29HCANR01A01S_DTB2 or their higher versions, as well as LC29H (DA) modules.

2.4.10. Packet Type: 051 PAIR_COMMON_GET_FIX_RATE

Gets the position fix interval.

Type:

Get

Synopsis:

```
$PAIR051*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR051,<Time>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Time>	Numeric	Millisecond	Position fix interval. Range: 100–1000. Default value: 1000.

Example:

```
$PAIR051*3E
$PAIR001,051,0*3F
$PAIR051,1000*13
```

NOTE

This command is not supported on LC29H (BA) with LC29HBANR01A01S_CSA2 or higher software versions, LC29H (CA) with LC29HCANR01A01S_DSA2 or LC29HCANR01A01S_DTB2 or their higher

versions, as well as LC29H (DA) modules.

2.4.11. Packet Type: 058 PAIR_COMMON_SET_MIN_SNR

Sets the minimum SNR of satellites in use. If the minimum SNR threshold is set, the module will not use the satellites with SNR below the threshold.

Type:

Set

Synopsis:

```
$PAIR058,<MIN_SNR>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<MIN_SNR>	Numeric	dB	Minimum SNR threshold of satellites in use. Range: 9–37. Default value: 9.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR058,15*1F
$PAIR001,058,0*36
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.12. Packet Type: 059 PAIR_COMMON_GET_MIN_SNR

Gets the minimum SNR of satellites in use.

Type:

Get

Synopsis:

```
$PAIR059*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR059,<MIN_SNR>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<MIN_SNR>	Numeric	dB	Minimum SNR threshold of satellites in use. Range: 9–37. Default value: 9.

Example:

```
$PAIR059*36
$PAIR001,059,0*37
$PAIR059,15*1E
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.13. Packet Type: 062 PAIR_COMMON_SET_NMEA_OUTPUT_RATE

Sets the output rate of standard NMEA messages of each type.

Type:

Set

Synopsis:

```
$PAIR062,<Type>,<OutputRate>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Type>	Numeric	-	Type of standard NMEA sentence. -1 = Reset the output rates of all types of sentences to default values 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA 3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG 6 = NMEA_SEN_ZDA 7 = NMEA_SEN_GRS 8 = NMEA_SEN_GST
<OutputRate>	Numeric	-	Message output rate setting. 0 = Disable sentence output N = Output message once every N position fix(es) Range of N: 0–20. Default value: 1.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR062,0,3*3D
$PAIR001,062,0*3F
```

NOTE

1. LC29H (BA, CA, DA, EA) only supports setting **<Type>** to 0–5.
2. LC29H (BA, CA, DA, EA) only supports setting **<OutputRate>** to 0 or 1.

3. **GGA**, **GLL**, **GSA**, **GSV**, **RMC** and **VTG** messages are output by default.

2.4.14. Packet Type: 063 PAIR_COMMON_GET_NMEA_OUTPUT_RATE

Gets the output rate of standard NMEA messages of each type.

Type:

Get

Synopsis:

```
$PAIR063,<Type>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Type>	Numeric	-	Type of standard NMEA sentence. -1 = Return the output rates of all types of standard NMEA sentences 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA 3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG 6 = NMEA_SEN_ZDA 7 = NMEA_SEN_GRS 8 = NMEA_SEN_GST

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR063,<Type>,<OutputRate>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<Type>	Numeric	-	Type of standard NMEA sentence. 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA

Field	Format	Unit	Description
			3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG 6 = NMEA_SEN_ZDA 7 = NMEA_SEN_GRS 8 = NMEA_SEN_GST
<OutputRate>	Numeric	-	Message output rate setting. 0 = Disabled or not supported. N = Output message once every N position fix(es) Range of N: 1–20.

Example:

```
$PAIR063,0*23
$PAIR001,063,0*3E
$PAIR063,0,3*3C
```

NOTE

LC29H (BA, CA, DA, EA) only supports setting **<Type>** to 0–5.

2.4.15. Packet Type: 066 PAIR_COMMON_SET_GNSS_SEARCH_MODE

Sets the GNSS search mode. The setting is valid when the NVRAM data are valid.

Type:

Set

Synopsis:

```
$PAIR066,<GPS_Enabled>,<GLONASS_Enabled>,<Galileo_Enabled>,<BDS_Enabled>,<QZSS_Enabled>,<Reserved>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<GPS_Enabled>	Numeric	-	0 = Disable (Do not search for GPS satellites) 1 = Search for GPS satellites
<GLONASS_Enabled>	Numeric	-	0 = Disable (Do not search for GLONASS satellites) 1 = Search for GLONASS satellites

Field	Format	Unit	Description
<Galileo_Enabled>	Numeric	-	0 = Disable (Do not search for Galileo satellites) 1 = Search for Galileo satellites
<BDS_Enabled>	Numeric	-	0 = Disable (Do not search for BDS satellites) 1 = Search for BDS satellites
<QZSS_Enabled>	Numeric	-	0 = Disable (Do not search for QZSS satellites) 1 = Search for QZSS satellites
<Reserved>	Numeric	-	Always "0"

Result:

Returns **$PAIR001** message.

Example:

```
//Switching between dual-band constellation combinations. Switch to GPS + Galileo + BDS:
$PAIR066,1,0,1,1,0,0*3B
$PAIR001,066,0*3B

//Switching between single-band constellation combinations. Switch to GPS:
$PAIR066,1,0,0,0,0,0*3B
$PAIR001,066,0*3B

//Switch from single-band GPS to dual-band GPS + GLONASS + Galileo + BDS constellation combination:
$PAIR066,1,1,1,1,0,0*3A
$PAIR001,066,0*3B
$PAIR382,1*2E
$PAIR001,382,0*32
$PAIR003*39
$PAIR001,003,0*38
$PAIR104,1*22
$PAIR001,104,0*3E
$PAIR002*38
$PAIR001,002,0*39

//Switch from dual-band GPS + GLONASS + Galileo + BDS to single-band GPS constellation combination:
$PAIR382,1*2E
$PAIR001,382,0*32
$PAIR003*39
$PAIR001,003,0*38
$PAIR104,0*23
$PAIR001,104,0*3E
```

$PAIR002*38
$PAIR001,002,0*39
$PAIR066,1,0,0,0,0,0*3B
$PAIR001,066,0*3B

NOTE

1. QZSS is always enabled by default.
2. Supported GNSS search modes (L1):
   - GPS L1 C/A
   - GPS L1 C/A + QZSS L1 C/A
   - GPS L1 C/A + GLONASS L1
   - GPS L1 C/A + GLONASS L1 + QZSS L1 C/A
   - GPS L1 C/A + BDS B1I
   - GPS L1 C/A + BDS B1I + QZSS L1 C/A
   - GPS L1 C/A + Galileo E1
   - GPS L1 C/A + Galileo E1 + QZSS L1 C/A
   - GPS L1 C/A + GLONASS L1 + Galileo E1 + BDS B1I
   - GPS L1 C/A + GLONASS L1 + Galileo E1 + BDS B1I + QZSS L1 C/A
3. Supported GNSS search modes (L1 + L5):
   - GPS L1 C/A, GPS L5 + Galileo E1, Galileo E5a + BDS B1I, BDS B2a
   - GPS L1 C/A, GPS L5 + Galileo E1, Galileo E5a + BDS B1I, BDS B2a + QZSS L1 C/A, QZSS L5
   - GPS L1 C/A, GPS L5 + GLONASS L1 + Galileo E1, Galileo E5a + BDS B1I, BDS B2a
   - GPS L1 C/A, GPS L5 + GLONASS L1 + Galileo E1, Galileo E5a + BDS B1I, BDS B2a + QZSS L1 C/A, QZSS L5
4. This command is not supported on LC29H (BA, CA, DA, EA).
5. If you need to switch from single-band mode to dual-band mode, you must first switch to the constellation combination that supports by both single and dual bands, then send **$PAIR104** command before sending **$PAIR066**.

2.4.16. Packet Type: 067 PAIR_COMMON_GET_GNSS_SEARCH_MODE

Gets the GNSS search mode.

Type:

Get

Synopsis:

$PAIR067*<Checksum><CR><LF>

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR067,<GPS_Enabled>,<GLONASS_Enabled>,<Galileo_Enabled>,<BDS_Enabled>,<QZSS_Enabled>,<Reserved>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<GPS_Enabled>	Numeric	-	0 = Disabled (DO NOT search for GPS satellites) 1 = Search for GPS satellites
<GLONASS_Enabled>	Numeric	-	0 = Disabled (DO NOT search for GLONASS satellites) 1 = Search for GLONASS satellites
<Galileo_Enabled>	Numeric	-	0 = Disabled (DO NOT search for Galileo satellites) 1 = Search for Galileo satellites
<BDS_Enabled>	Numeric	-	0 = Disabled (DO NOT search for BDS satellites) 1 = Search for BDS satellites
<QZSS_Enabled>	Numeric	-	0 = Disabled (DO NOT search for QZSS satellites) 1 or other non-zero values = Search for QZSS satellites
<Reserved>	Numeric	-	Always “0”.

Example:

```
$PAIR067*3B
$PAIR001,067,0*3A
$PAIR067,1,1,1,1,1,0*3A
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.17. Packet Type: 070 PAIR_COMMON_SET_STATIC_THRESHOLD

Sets the static navigation speed threshold. If the actual speed is below the threshold, the output position remains unchanged and the output speed is 0. If the threshold value is set to 0, this function is disabled.

Type:

Set

Synopsis:

```
$PAIR070,<SpeedThreshold>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<SpeedThreshold>	Numeric	dm/s	Speed threshold. Range: 0–20. Default value: 0.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR070,4*25
$PAIR001,070,0*3C
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.18. Packet Type: 071 PAIR_COMMON_GET_STATIC_THRESHOLD

Gets the static navigation speed threshold.

Type:

Get

Synopsis:

```
$PAIR071*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR071,<SpeedThreshold>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<SpeedThreshold>	Numeric	m/s	Static navigation speed threshold. Range: 0–2. Default value: 0.

Example:

```
$PAIR071*3C
$PAIR001,071,0*3D
$PAIR071,0.4*3A
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.19. Packet Type: 072 PAIR_COMMON_SET_ELEV_MASK

Sets the satellite elevation mask.

Type:

Set

Synopsis:

```
$PAIR072,<Degree>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Degree>	Numeric	Degree	Satellite elevation mask. Range: -90 to 90. Default value: 5.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR072,5*26
$PAIR001,072,0*3E
```

NOTE

1. The satellites below the elevation mask are not used for positioning.
2. This command is not supported on LC29H (BA, CA, DA, EA).

2.4.20. Packet Type: 073 PAIR_COMMON_GET_ELEV_MASK

Gets satellite elevation mask.

Type:

Get

Synopsis

```
$PAIR073*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR073,<Degree>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Degree>	Numeric	Degree	Satellite elevation mask Range: -90 to 90.

Example:

```
$PAIR073*3E
$PAIR001,073,0*3F
$PAIR073,5*27
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.21. Packet Type: 074 PAIR_COMMON_SET_AIC_ENABLE

Enables/disables the active interference cancellation (AIC) function. For details about AIC function, see *documents [1]* and *[2] hardware designs*.

Type:

Set

Synopsis

```
$PAIR074,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Enable/disable AIC function. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR074,1*24
$PAIR001,074,0*38
```

2.4.22. Packet Type: 075 PAIR_COMMON_GET_AIC_STATUS

Queries the status of active interference cancellation (AIC) function.

Type:

Get

Synopsis

```
$PAIR075*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR075,<Status>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Status>	Numeric	-	Status of AIC function. 0 = Disabled 1 = Enabled

Example:

```
$PAIR075*38
$PAIR001,075,0*39
$PAIR075,1*25
```

2.4.23. Packet Type: 080 PAIR_COMMON_SET_NAVIGATION_MODE

Sets navigation mode.

Type:

Set

Synopsis:

```
$PAIR080,<NavMode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<NavMode>	Numeric	-	Navigation mode. 0 = Normal mode. This mode is a basic mode. It is applied to most of scenarios. (for example, driving scenario). 1 = Fitness mode. For running and walking activities, the low-speed (< 5 m/s) movement will have a greater effect on the position calculation. It reduces measurement noise caused by arm movement and optimizes the navigation performance in low-speed scenarios. 2 = Reserved. 3 = Reserved. 4 = Stationary mode. For stationary applications where zero dynamics is assumed. 5 = Drone mode. Used for drone applications with equivalent dynamics range and vertical acceleration at different flight phases (for example, hovering, cruising). 6 = Reserved. 7 = Swimming mode. This mode is designed for swimming activities. It reduces measurement noise caused by specific arm movement and improves the positioning capability after the module is out of water. It also smooths the trajectory and improves the accuracy in distance calculation. 8 = Reserved. 9 = Bike mode. For sharing bike applications.

Table 7: Altitude and Speed Ranges of Navigation Modes

Mode	Max Altitude (m)	Max Speed (m/s)
Normal	10000	100
Fitness	10000	30
Stationary	10000	10
Drone	10000	30
Swimming	10000	10
Bike	10000	30

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR080,1*2F
$PAIR001,080,0*33
```

2.4.24. Packet Type: 081 PAIR_COMMON_GET_NAVIGATION_MODE

Queries navigation mode.

Type:

Get

Synopsis:

```
$PAIR081*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR081,<NavMode>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<NavMode>	Numeric	-	Navigation mode. 0 = Normal mode. This mode is a basic mode. It is applied to most of scenarios. (for example, driving scenario). 1 = Fitness mode. For running and walking activities, the low-speed (< 5 m/s) movement will have a greater effect on the position calculation. It reduces measurement noise caused by arm movement and optimizes the navigation performance in low-speed scenarios. 2 = Reserved. 3 = Reserved. 4 = Stationary mode. For stationary applications where zero dynamics is assumed. 5 = Drone mode. Used for drone applications with equivalent dynamics range and vertical acceleration at different flight phases (for example, hovering, cruising). 6 = Reserved. 7 = Swimming mode. This mode is designed for swimming activity. It reduces measurement noise caused by specific arm movement and improves the positioning capability after the module is out of water. It also smooths the trajectory and improves the accuracy of distance calculation. 8 = Reserved. 9 = Bike mode. For sharing bike applications.

Example:

```
$PAIR081*33
$PAIR001,081,0*32
$PAIR081,0*2F
```

2.4.25. Packet Type: 086 PAIR_COMMON_SET_DEBUGLOG_OUTPUT

Enables/disables debug log output in binary format.

Type:

Set

Synopsis

```
$PAIR086,<Status>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Status>	Numeric	-	Debug log output setting. 0 = Disable 1 = Enable with full debug log output 2 = Enable with lite debug log output

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR086,1*29
$PAIR001,086,0*35
```

2.4.26. Packet Type: 087 PAIR_COMMON_GET_DEBUGLOG_OUTPUT

Queries the debug log output setting.

Type:

Get

Synopsis

```
$PAIR087*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR087,<Status>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Status>	Numeric	-	Debug log output setting. 0 = Disabled 1 = Enabled with full debug log output 2 = Enabled with lite debug log output

Example:

```
$PAIR087*35
$PAIR001,087,0*34
$PAIR087,0*29
```

2.4.27. Packet Type: 100 PAIR_COMMON_SET_NMEA_OUTPUT_MODE

Sets output mode of standard NMEA sentences.

Type:

Set

Synopsis:

```
$PAIR100,<NMEA_Mode>,<Res>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<NMEA_Mode>	Numeric	-	Output mode of standard NMEA sentences. 0 = Disabled 1 = ASCII NMEA 0183 V4.10 output enabled 2 = ASCII NMEA 0183 V3.01 output enabled
<Res>	Numeric	-	Reserved. Default value: 0.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR100,1,0*3A
$PAIR001,100,0*3A
```

NOTE

For LC29H (BA, CA, DA, EA), standard NMEA sentences are output in NMEA 0183 V4.10 format and this command is not supported.

2.4.28. Packet Type: 101 PAIR_COMMON_GET_NMEA_OUTPUT_MODE

Queries output mode of standard NMEA sentences.

Type:

Get

Synopsis:

```
$PAIR101*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR101,<NMEA_Mode>,<Res>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<NMEA_Mode>	Numeric	-	Output mode of standard NMEA sentences. 0 = Disabled 1 = ASCII NMEA 0183 V4.10 output enabled 2 = ASCII NMEA 0183 V3.01 output enabled
<Res>	Numeric	-	Reserved. Default value: 0.

Example:

```
$PAIR101*3A
$PAIR001,101,0*3B
$PAIR101,1,0*3B
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.29. Packet Type: 104 PAIR_COMMON_SET_DUAL_BAND

Enables/disables the Dual Band feature only when the GNSS system is powered off.

Type:

Set

Synopsis:

```
$PAIR104,<DualBandEnabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<DualBandEnabled>	Numeric	-	Enable/disable the Dual Band feature. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR104,0*23
$PAIR001,104,0*3E
```

NOTE

1. This command is not supported on LC29H (BA, CA, DA, EA).
2. Before setting the Dual Band feature by **$PAIR104**, send **$PAIR382,1*2E** and **$PAIR003*39** in sequence to power off the GNSS system. After the Dual Band feature has been set, send **$PAIR002*38** to power on the module.

2.4.30. Packet Type: 105 PAIR_COMMON_GET_DUAL_BAND

Queries whether the Dual Band feature is enabled or disabled.

Type:

Get

Synopsis:

```
$PAIR105*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR105,<Enabled>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Status of the Dual Band feature. 0 = Disabled 1 = Enabled

Example:

```
$PAIR105*3E
$PAIR001,105,0*3F
$PAIR105,1*23
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.31. Packet Type: 382 PAIR_TEST_LOCK_SYSTEM_SLEEP

Enables/disables the locking of Sleep mode. The CPU core will lock into the power off mode after the command is sent.

Type:

Set

Synopsis:

```
$PAIR382,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Sleep mode locking setting. 0 = Disabled 1 = Enabled

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR382,1*2E
$PAIR001,382,0*32
```

NOTE

1. This configuration will not be saved in the flash or RTC RAM. Please send this command every time after the GNSS subsystem or main power reboots.
2. The module can still receive commands if it receives **$PAIR382,1*2E** before **$PAIR003*39** and **$PAIR001,382,0*32** is returned correctly. Otherwise, any other commands cannot be received.

2.4.32. Packet Type: 391 PAIR_TEST_JAMMING_DETECT

Enables/disables jamming detection. Jamming status messages will be returned when jamming detection is enabled.

Type:

Set/Output

Synopsis:

```
$PAIR391,<CmdType>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<CmdType>	Numeric	-	Enable/disable jamming detection. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message and enable **$PAIRSPF** message output periodically (at 1 Hz).

Query result message format:

```
$PAIRSPF,<Status>*<Checksum><CR><LF>
$PAIRSPF5,<Status>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Status>	Numeric	-	Jamming status. 0 = Unknown status 1 = No jamming, good status 2 = Warning status 3 = Critical status

Example:

```
$PAIR391,1*2C
$PAIR001,391,0*30
//Unknown status:
$PAIRSPF,0*53
$PAIRSPF5,0*66
```

```
//Good status:
$PAIRSPF,1*52
$PAIRSPF5,1*67
//Warning status:
$PAIRSPF,2*51
$PAIRSPF5,2*64
//Critical status:
$PAIRSPF,3*50
$PAIRSPF5,3*65
```

NOTE

1. The **$PAIRSPF,<Status>*<Checksum><CR><LF>** sentence indicates L1 jamming status.
2. The **$PAIRSPF5,<Status>*<Checksum><CR><LF>** sentence indicates L5 jamming status. This message will not be output when only L1 band signals are received and tracked.
3. The module starts jamming detection once the feature is enabled.
   - If there is no jamming, **$PAIRSPF,1*52**, or **$PAIRSPF,1*52** and **$PAIRSPF5,1*62**, will be reported to indicate good status (**<Status>** = 1).
   - In case of continuous jamming, the jamming status will change from 1 to 2 and finally to 3.
     1) When no position fix has been completed: module status is 1 right after the jamming detection is enabled, and then changes to 2 when jamming is detected. During this process, the module keeps attempting to get a fix; if the anti-jamming repair fails, the jamming status changes to 3 at last.
     2) After a successful position fix: jamming status is 1 right after jamming detection is enabled, and changes to 2 and 3 consecutively when jamming is detected.

2.4.33. Packet Type: 400 PAIR_DGPS_SET_MODE

Sets the DGPS correction data source.

Type:

Set

Synopsis:

```
$PAIR400,<Mode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	DGPS data source. 0 = No DGPS data source 1 = RTCM 2 = SBAS (including WAAS/EGNOS/GAGAN/MSAS)

Result:

Retuns **$PAIR001** message.

Example:

```
$PAIR400,2*20
$PAIR001,400,0*3F
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.34. Packet Type: 401 PAIR_DGPS_GET_MODE

Queries the DGPS correction data source.

Type:

Get

Synopsis:

```
$PAIR401*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR401,<Mode>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Mode>	Numeric	-	DGPS data source. 0 = No DGPS data source 1 = RTCM 2 = SBAS (including WAAS/EGNOS/GAGAN/MSAS)

Example:

```
$PAIR401*3F
$PAIR001,401,0*3E
$PAIR401,2*21
```

NOTE

This command is not supported on LC29H (BA, CA, DA, EA).

2.4.35. Packet Type: 410 PAIR_SBAS_ENABLE

Enables/disables SBAS satellite search. SBAS supports wide-area or regional augmentation through geostationary satellite broadcast messages. The geostationary satellites broadcast GNSS integrity and correction data with the assistance of multiple ground stations that are located at accurately-surveyed points.

Type:

Set

Synopsis

```
$PAIR410,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Enable or disable the search of SBAS satellites. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR410,1*22
$PAIR001,410,0*3E
```

NOTE

1. When the navigation mode is Fitness or Swimming mode (see command **$PAIR080**), SBAS is not supported.
2. LC29H (EA) does not support this command as the module does not support the SBAS feature.
3. For LC29H (BA), this command is supported on LC29HBANR11A02S_CSA2, LC29HBANR11A02_CSA4 and higher versions.
4. For LC29H (CA), this command is supported on LC29HCANR11A01S_DTB2, LC29HCANR11A01S_DSA2, LC29HCANR11A02S_DSA4 and higher versions.
5. For LC29H (DA), this command is supported on LC29HDANR11A01S_RSA and higher versions.

2.4.36. Packet Type: 411 PAIR_SBAS_GET_STATUS

Queries the status of SBAS satellite search.

Type:

Get

Synopsis

```
$PAIR411*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR411,<Enabled>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Status of SBAS satellite search. 0 = Disabled 1 = Enabled

Example:

```
$PAIR411*3E
$PAIR001,411,0*3F
$PAIR411,1*23
```

NOTE

1. When the navigation mode is Fitness or Swimming mode (see command **$PAIR080**), SBAS is not supported.
2. LC29H (EA) does not support this command since the module does not support the SBAS feature.
3. For LC29H (BA), this command is supported on LC29HBANR11A02S_CSA2, LC29HBANR11A02_CSA4 and higher versions.
4. For LC29H (CA), this command is supported on LC29HCANR11A01S_DTB2, LC29HCANR11A01S_DSA2, LC29HCANR11A02S_DSA4 and higher versions.
5. For LC29H (DA), this command is supported on LC29HDANR11A01S_RSA and higher versions.

2.4.37. Packet Type: 432 PAIR_RTCM_SET_OUTPUT_MODE

Sets RTCM output mode.

Type:

Set

Synopsis

```
$PAIR432,<Mode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	RTCM output mode setting. -1 = Disable outputting RTCM 0 = Enable output RTCM3 with message type MSM4 1 = Enable output RTCM3 with message type MSM7

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR432,1*22
$PAIR001,432,0*3E
```

2.4.38. Packet Type: 433 PAIR_RTCM_GET_OUTPUT_MODE

Queries RTCM output mode.

Type:

Get

Synopsis

```
$PAIR433*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR433,<Mode>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Mode>	Numeric	-	RTCM output mode setting. -1 = Outputting RTCM disabled 0 = Outputting RTCM3 with message type MSM4 enabled 1 = Outputting RTCM3 with message type MSM7 enabled

Example:

```
$PAIR433*3E
$PAIR001,433,0*3F
$PAIR433,-1*0E
```

2.4.39. Packet Type: 434 PAIR_RTCM_SET_OUTPUT_ANT_PNT

Enables/disables outputting stationary antenna reference point in RTCM format.

Type:

Set

Synopsis

```
$PAIR434,<Enable>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enable>	Numeric	-	Enable/disable outputting outputting stationary antenna reference point (message type 1005). 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR434,1*24
$PAIR001,434,0*38
```

2.4.40. Packet Type: 435 PAIR_RTCM_GET_OUTPUT_ANT_PNT

Queries the setting of outputting stationary antenna reference point in RTCM format.

Type:

Get

Synopsis

```
$PAIR435*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR435,<Enable>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enable>	Numeric	-	Status of outputting stationary antenna reference point (message type 1005). 0 = Disabled 1 = Enabled

Example:

```
$PAIR435*38
$PAIR001,435,0*39
$PAIR435,1*25
```

2.4.41. Packet Type: 436 PAIR_RTCM_SET_OUTPUT_EPHEMERIS

Enables/disables outputting satellite ephemeris in RTCM format.

Type:

Set

Synopsis

```
$PAIR436,<Enable>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enable>	Numeric	-	Enable/disable outputting satellite ephemeris. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR436,1*26
$PAIR001,436,0*3A
```

2.4.42. Packet Type: 437 PAIR_RTCM_GET_OUTPUT_EPHEMERIS

Queries the status of satellite ephemeris in RTCM format.

Type:

Get

Synopsis

```
$PAIR437*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

```
$PAIR437,<Enable>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enable>	Numeric	-	Status of outputting satellite ephemeris. 0 = Disabled 1 = Enabled

Example:

```
$PAIR437*3A
$PAIR001,437,0*3B
$PAIR437,1*27
```

2.4.43. Packet Type: 490 PAIR_EASY_ENABLE

Enables/disables EASY function.

Type:

Set

Synopsis:

```
$PAIR490,<Enabled>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EASY function setting. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR490,1*2A
$PAIR001,490,0*36
```

NOTE

Since EASY feature is not supported on LC29H (BA, CA, DA, EA), this command is not supported either.

2.4.44. Packet Type: 491 PAIR_EASY_GET_STATUS

Queries the status of EASY function.

Type:

Get

Synopsis:

```
$PAIR491*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message and the query result.

Query result message format:

$PAIR491,<Enabled>,<Status>*<Checksum><CR><LF>

Parameters included in the result:

Field	Format	Unit	Description
<Enabled>	Numeric	-	EASY function setting. 0 = Disabled 1 = Enabled
<Status>	Numeric	-	EASY data extension status. 0 = Not finished 1 = 1-day extension finished 2 = 2-day extension finished 3 = 3-day extension finished

Example:

```
$PAIR491*36
$PAIR001,491,0*37
$PAIR491,1,0*37
```

NOTE

1. If EASY function is disabled, only the **<Enabled>** value will be returned after executing this command.
2. This command is not supported on LC29H (BA, CA, DA, EA).

2.4.45. Packet Type: 511 PAIR_NVRAM_SAVE_NAVIGATION_DATA

Saves current navigation data from RTC RAM to flash.

Type:

Command

Synopsis

```
$PAIR511*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
//In case the position fix rate is 1 Hz.
$PAIR511*3F
$PAIR001,511,0*3E

//In case the position fix rate is greater than 1 Hz.
$PAIR382,1*2E
$PAIR001,382,0*32
$PAIR003*39
$PAIR001,003,0*38
$PAIR511*3F
$PAIR001,511,0*3E
$PAIR002*38
$PAIR001,002,0*39
```

NOTE

1. If the backup domain cannot be powered after the power supply of the module is cut off, this command needs to be sent every time the parameters are modified.
2. In case the position fix rate is greater than 1 Hz, power off the GNSS system with **$PAIR382,1*2E** and **$PAIR003*39** in sequence before sending this command. After sending **$PAIR511*3F**, send **$PAIR002*38** to re-power the module. This limitation does not apply to fix rate below 1 Hz.

2.4.46. Packet Type: 513 PAIR_NVRAM_SAVE_SETTING

Saves the current configurations from RTC RAM to flash.

Type:

Command

Synopsis:

```
$PAIR513*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
//In case the position fix rate is 1 Hz.
$PAIR513*3D
$PAIR001,513,0*3C

//In case the position fix rate is greater than 1 Hz.
$PAIR382,1*2E
$PAIR001,382,0*32
$PAIR003*39
$PAIR001,003,0*38
$PAIR513*3D
$PAIR001,513,0*3C
$PAIR002*38
$PAIR001,002,0*39
```

NOTE

1. If the backup domain cannot be powered after the power supply of the module is cut off, this command needs to be sent every time the parameters are modified.
2. In case the position fix rate is greater than 1 Hz, power off the GNSS system with **$PAIR382,1*2E** and **$PAIR003*39** in sequence before sending this command. After sending **$PAIR513*3D**, send **$PAIR002*38** to re-power the module. This limitation does not apply to fix rate below 1 Hz.

2.4.47. Packet Type: 650 PAIR_LOW_POWER_ENTRY_RTC_MODE

Shuts down the GNSS system, except the clock. The CPU core will be set to the Backup mode after the command is sent, in which it cannot receive any commands. For details about Backup mode, see *documents [1]* and *[2] hardware designs*.

Type:

Set

Synopsis:

```
$PAIR650,<Second>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Second>	Numeric	Second	Time to stay in Backup mode before exiting. Range: 0 and 10–62208000 (2 years); 0 means entering the Backup mode without any timer.

Result:

- If there is no error, the **$PAIR001** and **$PAIR650** messages will be returned. The module will be set to Backup mode and cannot receive any commands.
- In case of any command parameter error, only the **$PAIR001** message will be returned.

Example:

```
$PAIR650,0*25
$PAIR001,650,0*38
$PAIR650,0*25
```

NOTE

Refer to *documents [1]* and *[2] hardware designs* for details about entering/exiting the Backup mode.

2.4.48. Packet Type: 690 PAIR_PERIODIC_SET_MODE

Sets Periodic Power Saving mode configurations.

Type:

Set

Synopsis:

```
$PAIR690,<Mode>,<FirstRun>,<FirstSleep>,<SecondRun>,<SecondSleep>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	State of Periodic Power Saving mode. 0 = Disabled 1 = Smart periodic mode enabled 2 = Strict periodic mode enabled
<FirstRun>	Numeric	Second	Run time. Range: 3–518400.
<FirstSleep>	Numeric	Second	Sleep time. Range: 3–518400.
<SecondRun>	Numeric	Second	Second run time. Range: 0 or 3–518400.
<SecondSleep>	Numeric	Second	Second sleep time. Range: 0 or 3–518400.

Result:

Returns a **$PAIR001** message.

Example:

```
$PAIR690,1,21,39,48,72*28
$PAIR001,690,0*34
```

NOTE

1. **<FirstRun>:** Interval in seconds after exiting the Sleep mode and getting a new position fix.
2. **<FirstSleep>:** Duration in seconds for staying in the Sleep mode after getting a fix (or attempting to get a fix).
3. **<SecondRun>:** GNSS module will use “second run time” instead of “first run time” setting when there is no signal. The second run time can be “0” only when the second sleep time is “0”.
4. **<SecondSleep>:** GNSS module will use “second sleep time” instead of “first sleep time” setting when there is no signal. The second sleep time can be “0” only when the second run time is “0”.

2.4.49. Packet Type: 691 PAIR_PERIODIC_GET_MODE

Queries Periodic Power Saving Mode configurations.

Type:

Get

Synopsis:

```
$PAIR691*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns a **$PAIR001** message and the query result.

Query result message format:

```
$PAIR691,<Mode>,<FirstRun>,<FirstSleep>,<SecondRun>,<SecondSleep>*<Checksum><CR><LF>
```

Parameters included in the result:

Field	Format	Unit	Description
<Mode>	Numeric	-	State of Periodic Power Saving mode. 0 = Disabled 1 = Smart periodic mode enabled 2 = Strict periodic mode enabled
<FirstRun>	Numeric	Second	Run time. Range: 3–518400.
<FirstSleep>	Numeric	Second	Sleep time. Range: 3–518400.
<SecondRun>	Numeric	Second	Second run time. Range: 0 or 3–518400.
<SecondSleep>	Numeric	Second	Second sleep time. Range: 0 or 3–518400.

Example:

```
$PAIR691*34
$PAIR001,691,1*34
$PAIR001,691,0*35
$PAIR691,0,3,12,18,72*14
```

2.4.50. Packet Type: 752 PAIR_PPS_SET_CONFIG_CMD

Sets PPS configurations.

Type:

Set

Synopsis:

```
$PAIR752,<PPSType>,<PPSPulseWidth>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<PPSType>	Numeric	-	PPS pulse type. 0 = Disable 1 = After the first fix 2 = 3D fix only 3 = 2D/3D fix only 4 = Always
<PPSPulseWidth>	Numeric	Millisecond	PPS Pulse Width. Range: 1–999. Default value: 100.

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR752,2,100*39
$PAIR001,752,0*3B
```

2.4.51. Packet Type: 830 PAIR_RAW_ENABLE

Enables/disables outputting binary raw measurement.

Type:

Set

Synopsis:

```
$PAIR830,<Enable>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Enable>	Numeric	-	Raw measurement output setting. 0 = Disabled 1 = Raw measurement 2 = Raw measurement + SV information + PVT (including time offset data between GPS and GLONASS/Galileo/BDS)

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR830,1*2C
$PAIR001,830,0*30
```

2.4.52. Packet Type: 831 PAIR_RAW_GET_STATUS

Gets the binary raw measurement output setting.

Type:

Get

Synopsis:

```
$PAIR831*<Checksum><CR><LF>
```

Parameter:

None

Result:

Returns **$PAIR001** and the query result.

Query result message format:

```
$PAIR831,<Enable>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enable>	Numeric	-	Raw measurement output setting. 0 = Disabled 1 = Raw measurement 2 = Raw measurement + SV information + PVT (including time offset data between GPS and GLONASS/Galileo/BDS)

Example:

```
$PAIR831*30
$PAIR001,831,0*31
$PAIR831,1*2D
```

2.4.53. Packet Type: 864 PAIR_IO_SET_BAUDRATE

Sets the baud rate of UART interface.

Type:

Set

Synopsis:

```
$PAIR864,<PortType>,<PortIndex>,<Baudrate>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<PortType>	Numeric	-	Hardware port type. 0 = UART
<PortIndex>	Numeric	-	Hardware port index. 0 = UART1
<Baudrate>	Numeric	bps	Baud rate. 4800 9600 19200 38400 57600 115200 230400 460800

Field	Format	Unit	Description
			921600 3000000

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR864,0,0,115200*1B
$PAIR001,864,0*31
```

NOTE

1. The module must be rebooted after changing the port baud rate, and the change will take effect after the reboot.
2. On LC29H series and LC79H (AL) modules, messages may be lost when the output baud rate is lower than 115200 bps.

2.4.54. Packet Type: 865 PAIR_IO_GET_BAUDRATE

Gets the baud rate of the UART interface.

Type:

Get

Synopsis:

```
$PAIR865,<PortType>,<PortIndex>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<PortType>	Numeric	-	Hardware port type. 0 = UART
<PortIndex>	Numeric	-	Hardware port index. 0 = UART1

Result:

Returns **$PAIR001** and the query result.

Query result message format:

```
$PAIR865,<Baudrate>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Baudrate>	Numeric	bps	Baud rate. 4800 9600 19200 38400 57600 115200 230400 460800 921600 3000000

Example:

```
$PAIR865,0,0*31
$PAIR001,865,0*30
$PAIR865,115200*1A
```

2.4.55. Packet Type: 866 PAIR_IO_SET_FLOW_CONTROL

Sets UART flow control.

Type:

Set

Synopsis:

```
$PAIR866,<PortType>,<PortIndex>,<FlowControl>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<PortType>	Numeric	-	Hardware port type. 0 = UART
<PortIndex>	Numeric	-	Hardware port index. 0 = UART1

Field	Format	Unit	Description
<FlowControl>	Numeric	-	Flow control setting. 0 = Flow control disabled 1 = Software flow control enabled 2 = Hardware flow control enabled

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR866,0,0,1*2F
$PAIR001,866,0*33
```

NOTE

The module must be rebooted after changing the port baud rate, and the change will take effect after the reboot.

2.4.56. Packet Type: 867 PAIR_IO_GET_FLOW_CONTROL

Gets UART flow control setting.

Type:

Get

Synopsis:

```
$PAIR867,<PortType>,<PortIndex>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<PortType>	Numeric	-	Hardware port type. 0 = UART
<PortIndex>	Numeric	-	Hardware port index. 0 = UART1

Result:

Returns **$PAIR001** and the query result.

Query result message format:

```
$PAIR867,<FlowControl>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<FlowControl>	Numeric	-	Flow control setting. 0 = Flow control disabled 1 = Software flow control enabled 2 = Hardware flow control enabled

Example:

```
$PAIR867,0,0*33
$PAIR001,867,0*32
$PAIR867,0*2F
```

3 RTCM Protocol

The LC29H series and LC79H (AL) modules support 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 to transfer GNSS raw measurement data and is available from https://www.rtcm.org/.

Table 8: Supported RTCM3 Messages

Message Type	Mode	Message Name
1005	Output	Stationary RTK Reference Station ARP.
1019	Output	GPS Ephemerides.
1020	Output	GLONASS 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.
1084	Output	GLONASS MSM4.
1087	Output	GLONASS 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.

NOTE

1. The **$PAIR432** command can enable/disable MSM4/MSM7 (1074, 1077, 1084, 1087, 1094, 1097,1114, 1117, 1124 and 1127) messages if the corresponding constellation is enabled.
2. The **$PAIR434** command can enable/disable Stationary RTK Reference Station ARP (1005) message.
3. The **$PAIR436** command can enable/disable ephemeris (1019, 1020, 1042, 1044 and 1046) messages if the corresponding constellation is enabled.

4 Appendix A References

Table 9: Related Documents

Document Name
[1] Quectel_LC29H_Series_Hardware_Design
[2] Quectel_LC79H(AL)_Hardware_Design

Table 10: Terms and Abbreviations

Abbreviation	Description
2D	2 Dimension
3D	3 Dimension
ACK	Acknowledgement
AIC	Active Interference Cancellation
ARP	Antenna Reference Point
BDS	BeiDou Navigation Satellite System
DGPS	Differential Global Positioning System
DOP	Dilution of Precision
DSP	Digital Signal Processing
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
GAGAN	GPS-aided GEO Augmented Navigation
Galileo	Galileo Satellite Navigation System (EU)
GGA	Global Positioning System Fix Data

Abbreviation	Description
GLL	Geographic Position – Latitude/Longitude
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS	GNSS Range Residuals
GSA	GNSS DOP and Active Satellites
GST	GNSS Pseudorange Error Statistics
GSV	GNSS Satellites in View
RMS	Root Mean Square
HDOP	Horizontal Dilution of Precision
ID	Identifier
MNL	MTK Navigation Lib
MSAS	Multi-functional Satellite Augmentation System
NMEA	NMEA (National Marine Electronics Association) 0183 Interface Standard
NVRAM	Non-Volatile Random Access Memory
PAIR	Proprietary Protocol of MTK
PDOP	Position Dilution of Precision
PE	Positioning Engine
PPS	Pulse Per Second
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
RMC	Recommended Minimum Specific GNSS Data
RTC	Real-time Clock
RTK	Real Time Kinematic
SBAS	Satellite-Based Augmentation System

Abbreviation	Description
SNR	Signal-to-noise Ratio
SV	Satellites in View
PVT	Position, Velocity, and Timing
UART	Universal Asynchronous Receiver/Transmitter
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VTG	Course Over Ground and Ground Speed
WAAS	Wide Area Augmentation System
ZDA	Time & Date
ECEF	Earth Centered Earth Fixed

5 Appendix B GNSS Numbering

Table 11: GNSS Satellites (NMEA) Numbering

GNSS Type	System ID	Satellite ID	Signal ID
GPS	1	1–32 33–51 for SBAS	1 = L1 C/A 8 = L5
GLONASS	2	65–88	1 = L1
Galileo	3	1–36	1 = E5a 7 = E1
BDS	4	1–63	1 = B1I 5 = B2a
QZSS	5	193–199	1 = L1 C/A 8 = L5

NOTE

1. QZSS System ID is 1 for LC29H (AA) and LC79H (AL) modules.
2. QZSS Satellite ID numbers range from 1 to 10 for LC29H (BA, CA, DA, EA).

6 Appendix C Special Characters

Table 12: 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.