L89 R2.0 GNSS Protocol Specification

GNSS Module Series

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About the Document

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1 Introduction

Quectel L89 R2.0 GNSS module supports GPS, Galileo, GLONASS, BDS, QZSS and NavIC (IRNSS) constellations. Concurrent tracking of GPS L1 C/A, GLONASS L1, Galileo E1, BDS B1I, QZSS L1 C/A and NavIC (IRNSS) L5 frequency bands provides fast and accurate acquisition and makes this module the ideal positioning and navigation solution in various vertical markets.

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

NOTE

1. Quectel assumes no responsibility if commands other than the ones listed herein are used.
2. QZSS satellite reporting is enabled by default and it is always switchable.
3. GLONASS L1 and BDS B1I are supported by L89 (HA) with L89HANR01A06S or higher versions and L89 (HB) with L89HBNR01A01S or higher versions.

2 NMEA Protocol

2.1. Structure of NMEA Protocol Messages

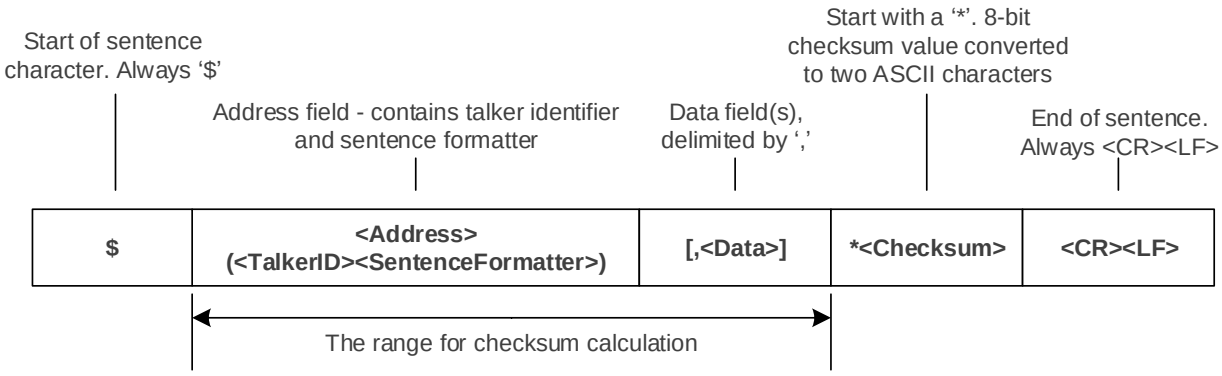

Figure 1: Structure of NMEA Protocol Messages

Table 1: 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 2: 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 data field delimiter **‘,’**. Variable length (depends 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 the sentence (Hex 0x0D 0x0A).

Table 2: NMEA Talker ID

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

Sample Code for NMEA Checksum:

```
// pData  is the data array of which the 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 module, and the standard NMEA 0183 V4.10 messages is supported by default.

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 2: NMEA Talker ID*.
RMC	String, 3 characters	-	RMC	Recommended Minimum Specific GNSS Data
<UTC>	hhmmss.sss	-	073925.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59)

Field	Format	Unit	Example	Description
				sss: Decimal fraction of seconds
<Status>	Character	-	A	Positioning system status. A = Data valid V = Navigation receiver warning
<Lat>	ddmm.mmmmmm	-	3149.333680	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes 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	-	11706.947520	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes 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	0.08	Speed over ground. Variable length. Note that this field is empty in case of an invalid value.
<COG>	Numeric	Degree	0.00	Course over ground. Variable length. Maximum value: 359.9. Note that this field is empty in case of an invalid value.
<Date>	ddmmyy	-	230222	Date. dd: Day of month mm: Month yy: Year
<MagVar>	-	-	-	Magnetic variation. Not supported.

Field	Format	Unit	Example	Description
<MagVarDir>	-	-	-	Direction of magnetic variation. Not supported.
<ModeInd>	Character	-	D	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). Please note that this parameter is only available in NMEA V4.10 or higher.
<Checksum>	Hexadecimal	-	*00	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNRMC,073551.000,A,3149.333056,N,11706.945606,E,0.00,0.00,230222,,,A*70
```

NMEA 0183 V4.10 Example:

```
$GNRMC,073925.000,A,3149.333680,N,11706.947520,E,0.08,0.00,230222,,,D,V*00
```

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 2: NMEA Talker ID*.
GGA	String, 3 characters	-	GGA	Global Positioning System Fix Data.
<UTC>	hhmmss.sss	-	073925.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Lat>	ddmm.mmmmmm	-	3149.333680	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes 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

Field	Format	Unit	Example	Description
				case of an invalid value.
<Lon>	dddmm.mmmmmm	-	11706.947520	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes 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	-	2	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> [1)]	Numeric, 2 digits	-	39	Number of satellites in use.
<HDOP>	Numeric	-	0.46	Horizontal dilution of precision. Note that this field is empty in case of an invalid value.
<Alt>	Numeric	Meter	62.014	Altitude above mean-sea-level (geoid). Note that this field is empty in case of an invalid value.
M	Character	-	M	Unit of <Alt>. “M” = meter.
<Sep>	Numeric	Meter	-0.334	Geoid separation (the difference between the earth ellipsoid surface and the mean-sea-level

Field	Format	Unit	Example	Description
				(geoid) surface defined by the reference datum used in the position solution). 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	-	*55	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNGGA,073551.000,3149.333056,N,11706.945606,E,1,36,0.52,62.883,M,-0.335,M,,*5C
```

NMEA 0183 V4.10 Example:

```
$GNGGA,073925.000,3149.333680,N,11706.947520,E,2,39,0.46,62.014,M,-0.334,M,,*55
```

NOTE

1. The NMEA 0183 specification indicates that the **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. [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.

2.2.3. GSV

GNSS Satellites in View. The GSV sentence provides the number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value, and 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 2: NMEA Talker ID*.
GSV	String, 3 characters	-	GSV	GNSS Satellites in View
<TotalNumSen>	Numeric	-	5	Total number of sentences. Range: 1–9.
<SenNum>	Numeric	-	1	Sentence number. Range: 1–**<TotalNumSen>**.
<TotalNumSat>	Numeric	-	17	Total number of satellites in view.
Start of repeat block. Repeat times: 1–4.				
<SatID>	Numeric	-	195	Satellite ID. See *Table 5: GNSS Numbering*.
<SatElev>	Numeric	Degree	70	Satellite elevation. Range: 00–90.
<SatAz>	Numeric	Degree	093	Satellite azimuth, with true north as the reference plane. Range: 000–359.
<SatCN0>	Numeric	dB-Hz	41	Satellite C/N_0. Range: 00–99. Null when not tracking.
End of repeat block.				
<SignalID>	Numeric	-	1	GNSS Signal ID. See *Table 5: GNSS Numbering*. Please note that this parameter is only available in NMEA V4.10 or higher.
<Checksum>	Hexadecimal	-	*61	Checksum

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

NMEA 0183 V3.01 Example:

```
$GPGSV,5,1,17,195,70,095,44,194,64,093,38,21,63,128,40,07,61,295,49*78
$GPGSV,5,2,17,08,58,024,47,199,51,162,39,01,40,174,44,30,35,312,45*41
$GPGSV,5,3,17,27,26,046,42,16,18,091,22,196,16,157,38,09,15,226,37*44
$GPGSV,5,4,17,14,10,296,41,49,05,262,,04,05,194,34,17,03,239,28*71
$GPGSV,5,5,17,193,03,160,36*75
$GAGSV,2,1,08,01,63,055,46,33,57,170,45,26,55,065,45,31,40,318,44*6A
$GAGSV,2,2,08,04,12,230,23,09,11,281,37,12,11,201,24,13,08,035,33*6B
$GIGSV,2,1,05,04,83,208,39,03,36,231,34,02,24,279,32,07,,,37*52
$GIGSV,2,2,05,05,,,29*6B
```

NMEA 0183 V4.10 Example:

```
$GPGSV,5,1,17,195,70,093,41,21,64,125,40,194,64,095,37,07,62,292,49,1*61
$GPGSV,5,2,17,08,57,025,48,199,51,162,38,45,45,219,39,01,41,174,45,1*58
$GPGSV,5,3,17,30,38,310,44,27,25,046,41,16,17,092,23,196,16,157,,1*5A
$GPGSV,5,4,17,09,14,225,29,14,10,297,,04,04,193,30,193,03,159,36,1*51
$GPGSV,5,5,17,17,03,240,33,1*51
$GAGSV,3,1,09,01,63,060,46,33,58,170,46,26,54,062,44,31,41,319,45,7*7D
$GAGSV,3,2,09,21,22,103,24,12,13,201,22,04,11,229,28,09,11,279,37,7*78
$GAGSV,3,3,09,13,06,035,36,7*4D
$GIGSV,1,1,04,04,83,206,28,03,36,231,19,02,24,280,,07,,,27,1*4A
```

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** or **GNS** 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 2: 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 2D/3D.
<FixMode>	Numeric	-	3	Fix mode. 1 = Fix not available 2 = 2D fix 3 = 3D fix
Start of repeat block. Repeat times: 12.				
<SatID>	Numeric	-	195	ID numbers of satellites used in solution. See *Table 5: GNSS Numbering*. Note that this field is empty in case of an invalid value.
End of repeat block.				
<PDOP>	Numeric	-	0.70	Position dilution of precision. Maximum value: 99.99. Note that this field is empty in case of an invalid value.
<HDOP>	Numeric	-	0.46	Horizontal dilution of precision. Maximum value: 99.99. Note that this field is empty in case of an invalid value.

Field	Format	Unit	Example	Description
<VDOP>	Numeric	-	0.53	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 5: GNSS Numbering*. Please note that this parameter is only available in NMEA 4.10 or higher.
<Checksum>	Hexadecimal	-	*37	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GPGSA,A,3,195,194,21,07,08,199,01,30,27,09,14,04,0.84,0.52,0.66*3A
$GAGSA,A,3,01,33,26,31,04,09,12,13,,,,,0.84,0.52,0.66*13
$GIGSA,A,3,04,03,02,,,,,,,,,,0.84,0.52,0.66*15
```

NMEA 0183 V4.10 Example:

```
$GNGSA,A,3,195,21,194,07,08,199,01,30,27,16,09,,0.70,0.46,0.53,1*37
$GNGSA,A,3,01,33,26,31,12,04,09,13,,,,,0.70,0.46,0.53,3*0B
$GNGSA,A,3,04,03,,,,,,,,,,,0.70,0.46,0.53,6*02
```

NOTE

If less than 12 satellites are used for navigation, the remaining **<SatID>** fields are left empty. If more than 12 satellites are used, multiple **GSA** sentences containing all satellite IDs will be 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 2: NMEA Talker ID*.
VTG	String, 3 characters	-	VTG	Course Over Ground & Ground Speed.
<COGT>	Numeric	Degrees	0.00	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	0.08	Speed over ground in knots. Note that this field is empty in case of an invalid value.
N	Character	-	N	Fixed field: knot.
<SOGK>	Numeric	km/h	0.14	Speed over ground in kilometers per hour. Note that this field is empty in case of an invalid value.
K	Character	-	K	Fixed field: kilometers per hour.
<ModeInd>	Character	-	D	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

Field	Format	Unit	Example	Description
<Checksum>	Hexadecimal	-	*2B	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNVTG,0.00,T,,M,0.00,N,0.01,K,A*22
```

NMEA 0183 V4.10 Example:

```
$GNVTG,0.00,T,,M,0.08,N,0.14,K,D*2B
```

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
$	Character	-	$	Each NMEA message starts with **$**.
<TalkerID>	String, 2 characters	-	GN	Talker identifier. See *Table 2: NMEA Talker ID*.
GLL	String, 3 characters	-	GLL	Geographic Position – Latitude/Longitude
<Lat>	ddmm.mmmmmm	-	3149.333680	Latitude. dd: Degrees (00–90) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes.

Field	Format	Unit	Example	Description
				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	-	11706.947520	Longitude. ddd: Degrees (000–180) mm: Minutes (00–59) mmmmmm: Decimal fraction of minutes. 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	-	073925.000	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	-	D	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	-	*46	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed

NMEA 0183 V3.01 Example:

```
$GNGLL,3149.333056,N,11706.945606,E,073551.000,A,A*44
```

NMEA 0183 V4.10 Example:

```
$GNGLL,3149.333680,N,11706.947520,E,073925.000,A,D*46
```

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 2: NMEA Talker ID*.
ZDA	String, 3 characters	-	ZDA	Time & Date. UTC, day, month, year and local time zone.
<UTC>	hhmmss.sss	-	081531.000	Position fix UTC. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59) sss: Decimal fraction of seconds
<Day>	Numeric	-	25	Day of month. Range: 01–31.
<Month>	Numeric	-	08	Month. Range: 01–12.
<Year>	Numeric	-	2022	Year.

Field	Format	Unit	Example	Description
<LocalHour>	Numeric	-	-	Local zone hours, 00 to ±13 hours. Not supported.
<LocalMin>	Numeric	-	-	Local zone minutes, 00 to 59 minutes. Not supported.
<Checksum>	Hexadecimal	-	*4B	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNZDA,082250.000,25,08,2022,,*48
```

NMEA 0183 V4.10 Example:

```
$GNZDA,081531.000,25,08,2022,,*4B
```

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 2: NMEA Talker ID*.

Field	Format	Unit	Example	Description
GRS	String, 3 characters	-	GRS	GNSS range residuals.
<UTC>	hhmmss.sss	-	081531.000	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	-0.8	Range residuals for SVs used in navigation. Range: -999 to 999. Note that this field is empty in case of an invalid value.
End of repeat block.				
<SystemID>	Numeric	-	1	GNSS system ID. See *Table 5: GNSS Numbering*. Please note that this parameter is only available in NMEA 0183 V4.10 or higher.
<SignalID>	Numeric	-	1	GNSS signal ID. See *Table 5: GNSS Numbering*. Please note that this parameter is only available in NMEA 0183 V4.10 or higher.
<Checksum>	Hexadecimal	-	*4C	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNGRS,082250.000,1,-9.8,-9.3,-6.7,,,,,,,,*64
$GNGRS,082250.000,1,-10.9,-15.0,-8.1,-8.2,-11.3,,,,,,,*52
$GNGRS,082250.000,1,-1.0,,,,,,,,,,*6F
```

NMEA 0183 V4.10 Example:

```
$GNGRS,081531.000,1,-0.8,2.5,0.4,1.7,2.0,1.3,4.1,2.5,,,,,1,1*4C
$GNGRS,081531.000,1,1.2,2.7,-0.2,1.1,5.7,,,,,,,,3,7*6F
```

```
$GNGRS,081531.000,1,-1.9,20.4,,,,,,,,,,6,1*7A
```

NOTE

1. The SV order matches the order of the satellite ID numbers in **GSA** sentence. If the range residual exceeds +99.9 meters, then the decimal part is dropped, resulting in an integer. The maximum value for **<Resi>** is +999.
2. If less than 12 satellites are used for navigation, the remaining **<Resi>**s are left empty. If more than 12 satellites are used, multiple **GRS** sentences containing all **<Resi>**s 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 2: NMEA Talker ID*.
GST	String, 3 characters	-	GST	GNSS pseudorange error statistics.
<UTC>	hhmmss.sss	-	081531.000	UTC time of the **GGA** fix associated with this sentence. hh: Hours (00–23) mm: Minutes (00–59) ss: Seconds (00–59)

Field	Format	Unit	Example	Description
				sss: Decimal fraction of seconds
<RMS_D>	Numeric	Meter	3.5	RMS value of the standard deviation of the range inputs to the navigation process.
<MajorD>	Numeric	Meter	4.3	Standard deviation of semi-major axis of error ellipse.
<MinorD>	Numeric	Meter	2.5	Standard deviation of semi-minor axis of error ellipse.
<Orient>	Numeric	Degree	148.7	Orientation of semi-major axis of error ellipse.
<LatD>	Numeric	Meter	3.9	Standard deviation of latitude error.
<LonD>	Numeric	Meter	3.1	Standard deviation of longitude error.
<AltD>	Numeric	Meter	11.4	Standard deviation of altitude error.
<Checksum>	Hexadecimal	-	*47	Checksum
<CR><LF>	Character	-	-	Carriage return and line feed.

NMEA 0183 V3.01 Example:

```
$GNGST,082250.000,5.7,6.9,2.0,143.2,5.7,4.5,18.0*45
```

NMEA 0183 V4.10 Example:

```
$GNGST,081531.000,3.5,4.3,2.5,148.7,3.9,3.1,11.4*47
```

2.3. PQTM Messages

This chapter explains the PQTM messages (proprietary NMEA messages defined by Quectel) supported by the module.

2.3.1. PQTMANTENNASTATUS

Outputs antenna status.

Type:

Output

Synopsis:

```
$PQTMANTENNASTATUS,<Status>,<Mode>,<Power>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Status>	Numeric	-	Antenna status. 0 = Normal 1 = Open circuit 2 = Short-circuited
<Mode>	Numeric	-	Antenna operation mode. 0 = Automatic 1 = Internal antenna (patch antenna) 2 = External antenna
<Power>	Numeric	-	External antenna power status. 0 = Power off 1 = Power on

Example:

```
$PQTMANTENNASTATUS,0,0,0*4F
```

2.3.2. PQTMCFGANTENNA

Sets/gets antenna operation mode.

Type:

Set/Get

Synopsis:

```
$PQTMCFGANTENNA,<R/W>,<Mode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<R/W>	Numeric	-	Read/write configuration. 0 = Read 1 = Write
<Mode>	Numeric	-	Antenna operation mode. 0 = Automatic 1 = Internal antenna (patch antenna)

2 = External antenna

Example:

```
//Set antenna to automatic mode:
$PQTMCFGANTENNA,1,0*04
//Response:
$PQTMCFGANTENNAOK*1

//Get antenna operation mode:
$PQTMCFGANTENNA,0*19
//Response:
$PQTMCFGANTENNA,0,0*5
```

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 if the default setting has not been changed. If the default setting had been changed with the Set command, contact Quectel Technical Support (support@quectel.com) for the default setting.
2. **<Mode>** should be omitted in the command if **<R/W>** is 0.

2.3.3. 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>
```

- If failed, the module returns:

```
$PQTMVERNO,ERROR,<ErrCode>*<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.
<ErrCode>	Numeric	-	Error code. 1 = Invalid parameters

Example:

```
$PQTMVERNO*58
$PQTMVERNO,L89HANR01A06S,2022/07/28,18:27:04*3E
```

2.3.4. PQTMVER

Outputs the firmware version information once after each boot-up.

Type:

Output

Synopsis:

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

Parameter:

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

Example:

```
//L89(HA)
$PQTMVER,MODULE_L89HANR01A06S,2022/07/28,18:27:04*7A
```

NOTE

This response message will automatically be output from the module on power-up or after a deliberate reset via an external reset pin or reset triggered by an internal watchdog on the module.

2.4. PAIR Messages

This chapter explains PAIR messages (proprietary NMEA messages defined by the chipset supplier). "**P**" means proprietary message, "**AIR**" means the command defined by the chipset supplier.

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	-	0 = Command has been successfully sent. 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:

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

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
```

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) with its ephemeris still valid. Therefore, there is no need to download the ephemeris data 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 the ephemeris data 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 no location information is stored in the receiver, including time, position, and 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 **<Time>** is set to be less than 1000 ms (i.e., frequency greater than 1 Hz), only **RMC**, **GGA** and **PQTMANTENNASTATUS** are output at the set frequency, while other NMEA sentences are output at 1 Hz.
2. The module has been supporting this command since L89HANR01A05S or L89HBNR01A01S version.

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
```

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
```

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
```

2.4.13. Packet Type: 062 PAIR_COMMON_SET_NMEA_OUTPUT_RATE

Sets the output rate of standard NMEA sentences 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 = Disabled or not supported N = Output message once every N position fix(es) Range of N: 1–20. Default value: 1.

Result:

Returns **$PAIR001** message.

Example:

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

2.4.14. Packet Type: 063 PAIR_COMMON_GET_NMEA_OUTPUT_RATE

Gets the output rate of standard NMEA sentences 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 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
```

2.4.15. Packet Type: 066 PAIR_COMMON_SET_GNSS_SEARCH_MODE

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

Type:

Set

Synopsis:

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

Parameter:

Packet Data	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
<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
<NavIC_Enabled>	Numeric	-	0 = Disable (DO NOT search for NavIC (IRNSS) satellites) 1 = Enable (Search for NavIC (IRNSS) satellites)

Result:

Returns **$PAIR001** message.

Example:

```
//Search for GPS satellites only:
$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:
   - GPS only
   - NavIC (IRNSS) only
   - GPS +QZSS
   - GPS + Galileo + NavIC (IRNSS)
   - GPS + Galileo + NavIC (IRNSS) + QZSS
   - GPS + Galileo + GLONASS + BDS
   - GPS + Galileo + GLONASS + BDS + QZSS
   - GPS + Galileo + GLONASS + BDS + NavIC (IRNSS)
   - GPS + Galileo + GLONASS + BDS + NavIC (IRNSS) + QZSS
3. The module has been supporting GLONASS and BDS constellations since L89HANR01A06S or L89HBNR01A01S version.

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>,<NavIC_Enabled>*<Checksum><CR><LF>
```

Parameter included in the result:

Packet Data	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
<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
<NavIC_Enabled>	Numeric	-	0 = Disable (DO NOT search for NavIC (IRNSS) satellites) 1 = Search for NavIC (IRNSS) satellites

Example:

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

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
```

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	dm/s	Speed threshold. Range: 0–20. Default value: 0.

Example:

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

2.4.19. Packet Type: 072 PAIR_COMMON_SET_ELEV_MASK

Sets 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

The satellites below the elevation mask are not used for positioning.

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
```

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 *document [1] hardware design*.

Type:

Set

Synopsis:

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

Parameter:

Field	Format	Unit	Description
<Enabled>	Numeric	-	Enable/Disable AIC feature. 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: 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
```

2.4.24. 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
```

2.4.25. Packet Type: 098 PAIR_COMMON_SET_NMEA_POS_DECIMAL_PRECISION

Sets the coordinate precision, i.e., the decimal places in the output coordinates.

Type:

Set

Synopsis:

```
$PAIR098,<Mode>*<Checksum><CR><LF>
```

Parameter:

Field	Format	Unit	Description
<Mode>	Numeric	-	Coordinate precision mode. 0 = Latitude, Longitude: 4; Altitude: 1 1 = Latitude, Longitude: 5; Altitude: 2 2 = Latitude, Longitude: 6; Altitude: 3 3 = Latitude, Longitude: 7; Altitude: 3

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR098,2*25
$PAIR001,098,0*3A
```

2.4.26. Packet Type: 099 PAIR_COMMON_GET_NMEA_POS_DECIMAL_PRECISION

Gets the coordinate precision.

Type:

Get

Synopsis:

```
$PAIR099*<Checksum><CR><LF>
```

Parameter:

None

Result:

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

Query result message format:

```
$PAIR099,<Mode>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Mode>	Numeric	-	Coordinate precision mode. 0 = Latitude, Longitude: 4; Altitude: 1 1 = Latitude, Longitude: 5; Altitude: 2 2 = Latitude, Longitude: 6; Altitude: 3 3 = Latitude, Longitude: 7; Altitude: 3

Example:

```
$PAIR099*3A
$PAIR001,099,0*3B
$PAIR099,2*24
```

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
```

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>
```

Parameter 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
```

2.4.29. Packet Type: 391 PAIR_TEST_JAMMING_DETECT

Enables/disables jamming detection. Jamming status messages will be returned if 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 **$PAIR001** message and enables periodic output of **$PAIRSPF** message (at 1 Hz).

Query result message format:

```
$PAIRSPF,<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
//Good  status:
$PAIRSPF,1*52
//Warning  status:
$PAIRSPF,2*51
//Critical  status:
$PAIRSPF,3*50
```

NOTE

The module starts jamming detection once the function is enabled.

1) If there is no jamming, **$PAIRSPF,1*52** will be reported to indicate good status (**<Status>** = 1).
2) If there is continuous jamming, the jamming status will change from 1 to 2 and finally to 3.
   - If there is no position fix: module status is 1, once 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.
   - After a successful position fix: jamming status is 1, once jamming detection is enabled, and changes to 2 and 3 consecutively when jamming is detected.

2.4.30. 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 source 1 = RTCM 2 = SBAS (including WAAS/EGNOS/GAGAN/MSAS)

Result:

Returns **$PAIR001** message.

Example:

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

2.4.31. 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 source 1 = RTCM 2 = SBAS (including WAAS/EGNOS/GAGAN/MSAS)

Example:

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

2.4.32. Packet Type: 410 PAIR_SBAS_ENABLE

Enables/disables SBAS satellite searching. 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/disable SBAS satellite searching. 0 = Disable 1 = Enable

Result:

Returns **$PAIR001** message.

Example:

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

2.4.33. Packet Type: 411 PAIR_SBAS_GET_STATUS

Queries the status of SBAS satellite searching.

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 searching. 0 = Disabled 1 = Enabled

Example:

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

2.4.34. Packet Type: 490 PAIR_EASY_ENABLE

Enables/disables EASY function.

Type:

Set

Synopsis:

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

Parameter:

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

Result:

Returns **$PAIR001** message.

Example:

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

2.4.35. Packet Type: 491 PAIR_EASY_GET_STATUS

Gets 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,<Enable>,<Status>*<Checksum><CR><LF>
```

Parameter included in the result:

Field	Format	Unit	Description
<Enable>	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

If EASY function is disabled, only the **<Enable>** value will be returned after executing this command.

2.4.36. 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:

```
$PAIR511*3F
$PAIR001,511,1*3F
$PAIR001,511,0*3E
```

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. If the position fix rate is greater than 1 Hz, power off the GNSS system with **$PAIR003*39** before sending this command. After sending the **$PAIR511*3F**, send **$PAIR002*38** to re-power the module. This limitation does not apply to fix rate below 1 Hz.

2.4.37. Packet Type: 513 PAIR_NVM_SAVE_SETTING

Saves the current configuration from RTC RAM to flash.

Type:

Command

Synopsis:

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

Parameter:

None

Result:

Returns **$PAIR001** message.

Example:

```
$PAIR513*3D
$PAIR001,513,0*3C
```

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 **$PAIR003*39** before sending this command. After sending **$PAIR513*3D**, send **$PAIR002*38** to re-power the module.

This limitation does not apply to fix rates below 1 Hz.

2.4.38. Packet Type: 650 PAIR_LOW_POWER_ENTER_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 *document [1] hardware design*.

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 module will be set to Backup mode in which it cannot receive any commands.
- In case of any command parameter error, the **$PAIR001** message will be returned.

Example:

```
$PAIR650,1*24
$PAIR001,650,4*3C
```

NOTE

1. Refer to *document [1] hardware design* for details about entering/exiting the Backup mode.
2. For L89 (HB), pull WAKEUP high for at least 10 ms within 5 s after the VCC power supply is restored to exit the Backup mode; otherwise the module will restart.

2.4.39. 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 position fix 2 = 3D position fix only 3 = 2D/3D position 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
```

2.4.40. 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	-	HW Port Type. 0 = UART
<PortIndex>	Numeric	-	HW Port Index. 0 = UART0
<BaudRate>	Numeric	bps	Baud rate value. 4800 9600 19200 38400 57600 115200 230400 460800 921600

Result:

Returns **$PAIR001** message.

Example:

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

NOTE

For the configuration to take effect reboot the module after changing the port baud rate.

2.4.41. Packet Type: 865 PAIR_IO_GET_BAUDRATE

Gets the baud rate of UART interface.

Type:

Get

Synopsis:

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

Parameter:

Field	Format	Unit	Description
<PortType>	Numeric	-	HW Port Type. 0 = UART
<PortIndex>	Numeric	-	HW Port Index. 0 = UART0

Result:

Returns **$PAIR001** message 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 value. 4800 9600 19200 38400 57600 115200 230400 460800 921600

Example:

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

3 Appendix A References

Table 3: Related Document

Document Name
[1] Quectel_L89_R2.0_Hardware Design

Table 4: Terms and Abbreviations

Abbreviation	Description
2D	2 Dimension
3D	3 Dimension
ACK	Acknowledgement
AIC	Active Interference Cancellation
ASCII	American Standard Code for Information Interchange
BDS	BeiDou Navigation Satellite System
C/N_0	Carrier-to-Noise-Density Ratio
COG	Course over Ground
COGM	Course over Ground (in Magnetic North Course Direction)
COGT	Course over Ground (in True North Course Direction)
DGPS	Differential Global Positioning System
DOP	Dilution of Precision
DSP	Digital Signal Processing
EASY	Embedded Assist System
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
GLL	Geographic Position-Latitude and 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
HDOP	Horizontal Dilution of Precision
HW	Hardware
IRNSS/NavIC	Indian Regional Navigation Satellite System
MNL	MTK Navigation Lib
MSAS	Multi-functional Satellite Augmentation System (Japan)
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
RAM	Random Access Memory
RMC	Recommended Minimum Specific GNSS Data

RTC	Real-Time Clock
RTK	Real-Time Kinematic
SBAS	Satellite-Based Augmentation System
SNR	Signal-to-Noise Ratio
SV	Satellites in View
UART	Universal Asynchronous Receiver/Transmitter
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VTG	Course Over Ground & Ground Speed
WAAS	Wide Area Augmentation System
ZDA	Time & Date

4 Appendix B GNSS Numbering

Table 5: GNSS Numbering

GNSS Type	System ID	Satellite ID	Signal ID
GPS	1	1–32	1 = L1 C/A
GLONASS	2	65–88	1 = L1
Galileo	3	1–36	7 = E1
BDS	4	1–63	1 = B1I
QZSS	5	193–199	1 = L1 C/A
NavIC (IRNSS)	6	1–14	1 = L5
SBAS	-	33–51	-

5 Appendix C Special Characters

Table 6: 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.