L89 R2.0 GNSS Protocol Specification

GNSS Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2019-04-29	Ai HONG	Initial

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1 Introduction

Quectel L89 R2.0 GNSS module supports GPS, GALILEO, QZSS and NAVIC (also known as IRNSS) constellations, and the default constellation is GPS + GALILEO + NAVIC. Also, they support autonomous GNSS C/A code, SBAS function (including WAAS, EGNOS, MSAS and GAGAN) and AGPS (EASY™ function). It can be used for positioning and navigation in many vertical markets.

This document describes the NMEA messages supported by L89 R2.0 module, including NMEA standard messages which are defined in the NMEA 0183 standard and NMEA proprietary messages which are defined by MTK.

NOTE

Please use the commands listed in this document. Quectel assumes no responsibility for other commands that are not listed/mentioned within this document.

2 NMEA Protocol

2.1. NMEA Portocol Structure

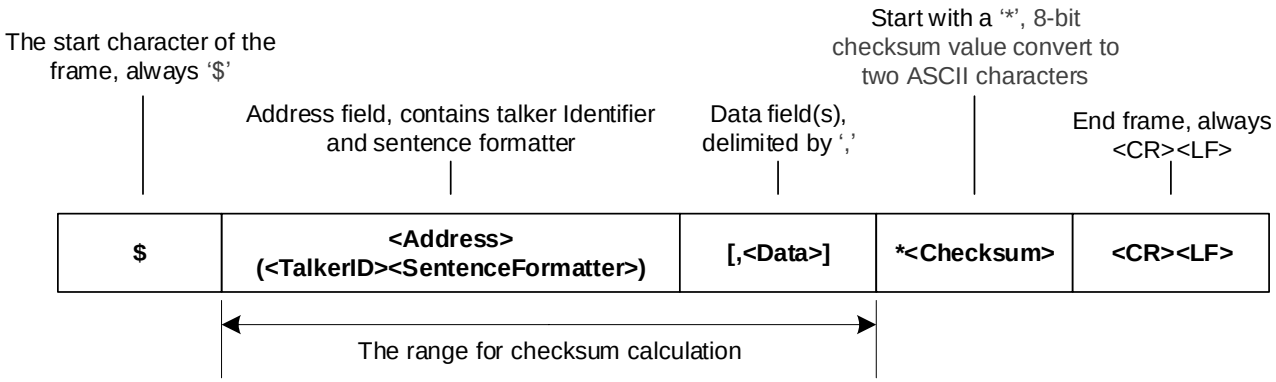

Figure 1: Structure of NMEA protocol message

$	Each NMEA message starts with $.
Address	This field contains TalkerID and SentenceFormatter. For the TalkerID, see table below; the SentenceFormatter is used to define the format and the type of data.
Data	These fields in approved sentences follows a "," delimiter with variable length.
Checksum	The checksum is the 8-bit exclusive OR of all characters in the sentence, including delimiters, between but not including the $ and *.
<CR><LF>	All NMEA messages end with <CR><LF> (Hex 0x0D 0x0A) characters.

Table 1: NMEA TalkerID

GNSS Constellation Configuration	TalkerID
Galileo	GA
NavIC (IRNSS)	GI
GPS	GP
QZSS	GP

Combination of multiple satellite systems.	GN

2.2. List of NMEA Standard Message

L89 R2.0 module supports output messages defined in NMEA 0183 standard (NMEA standard messages). It by default output of the following NMEA standard messages.

Table 2: List of Supported NMEA Standard Messages

Syntax	Default	Type	Description
$--RMC	ON	Output	Recommended minimum specific GNSS data
$--VTG	ON	Output	Course over ground and ground speed
$--GGA	ON	Output	Global positioning system fix data
$--GSA	ON	Output	GNSS DOP and active satellites
$--GSV	ON	Output	GNSS satellites in view
$--GLL	ON	Output	Geographic position - latitude and longitude

2.3. NMEA Standard Messages

2.3.1. RMC

RMC, Recommended Minimum Specific GNSS Data. This sentence is transmitted at intervals not exceeding 2 seconds. All data fields must be provided, and null fields can be used only when the data is temporarily unavailable.

Format:

Format for NMEA 0183 Rev 3.01:
$--RMC,<UTC Time>,<Data Validity>,<Latitude>,<N/S>,<Longitude>,<E/W>,<Speed>,<COG>,<Date>,<Magnetic Variation>,<E/W>,<Positioning Mode>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--RMC,<UTC Time>,<Data Validity>,<Latitude>,<N/S>,<Longitude>,<E/W>,<Speed>,<COG>,<Date>,<Magnetic Variation>,<E/W>,<Positioning Mode>,<Navigational status>*<Checksum><CR><LF>

Parameter:

Field	Description
UTC Time	UTC of position fix in hhmmss.sss format
Data Validity	V = Invalid A = Valid
Latitude	Latitude in ddmm.mmmmmm format (degrees and minutes)
N/S	Latitude direction: N = North S = South
Longitude	Longitude in dddmm.mmmmmm format (degrees and minutes)
E/W	Longitude direction: E = East W = West
Speed	Speed over ground in knots.
COG	Course over ground in degrees.
Date	Date in ddmmyy format
Magnetic Variation	Magnetic variation in degrees (will not be output)
E/W	Magnetic variation E/W indicator (will not be output)
Positioning Mode	Positioning system mode indicator: N = Not fixed A = Autonomous mode D = Differential mode
Navigational status	Navigational status: S = Safe C = Caution U = Unsafe V = Navigational status not valid, equipment is not providing navigational status indication (This parameter is exclusive to NMEA 4.10)

Example:

Example for NMEA 0183 Rev 3.01:
$GNRMC,114736.000,A,3149.288062,N,11706.924786,E,0.00,0.00,160420,,,A*79
Example for NMEA 0183 Rev 4.10:
$GNRMC,114736.000,A,3149.288062,N,11706.924786,E,0.00,0.00,160420,,,A,V*03

2.3.2. VTG

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

Format:

Format for NMEA 0183 Rev 3.01:
$--VTG,<COG(T)>,<T>,<COG(M)>,<M>,<Speed>,<N>,<Speed>,K,<Positioning Mode>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--VTG,<COG(T)>,<T>,<COG(M)>,<M>,<Speed>,<N>,<Speed>,K,<Positioning Mode>*<Checksum><CR><LF>

Parameter:

Field	Description
COG(T)	True course over ground in degrees
T	True (fixed field)
COG(M)	Magnetic course over ground (will not be output)
M	Magnetic (fixed field)
Speed	Speed over ground in knots
N	Knots (fixed field)
Speed	Speed over ground in km/h
K	km/h (fixed field)
Positioning Mode	Positioning system mode indicator: N = Not fixed A = Autonomous mode D = Differential mode

Example:

$GPVTG,183.85,T,,M,0.00,N,0.00,K,A*3A<CR><LF>

2.3.3. GGA

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

Format:

Format for NMEA 0183 Rev 3.01:
$--GGA,<UTC Time>,<Latitude>,<N/S>,<Longitude>,<E/W>,<Fix Status>,<Number of satellites in use>,<HDOP>,<Altitude>,<M>,<Geoid Separation>,<M>,<DGPS Age>,<DGPS Station ID>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--GGA,<UTC Time>,<Latitude>,<N/S>,<Longitude>,<E/W>,<Fix Status>,<Number of satellites in use>,<HDOP>,<Altitude>,<M>,<Geoid Separation>,<M>,<DGPS Age>,<DGPS Station ID>*<Checksum><CR><LF>

Parameter:

Field	Description
UTC Time	UTC of position fix in hhmmss.sss format
Latitude	Latitude in ddmm.mmmmmm format (degrees and minutes)
N/S	Latitude direction: N = North S = South
Longitude	Longitude in dddmm.mmmmmm format (degrees and minutes)
E/W	Longitude direction: E = East W = West
Fix Status	0 = Invalid 1 = GNSS fix 2 = DGPS fix
Number of satellites in use	Number of satellites being used. Range: 0–12.
HDOP	Horizontal dilution of precision
Altitude	Height above mean sea level in meters
M	Meter (fixed filed)
Geoid Separation	Geoidal separation in meters
M	Meter (fixed filed)

DGPS Age	Age of DGPS data in seconds. Empty if DGPS is not used
DGPS Station ID	DGPS station ID Empty if DGPS is not used

Example:

```
$GPGGA,140145.000,3150.863861,N,11711.928739,E,1,11,0.79,175.165,M,0.009,M,,*53<CR><LF>
```

2.3.4. GSA

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

Format:

Format for NMEA 0183 Rev 3.01:
$--GSA,<Mode>,<CurrentMode>,<SatPRN1>,...,<SatPRNN>,<PDOP>,<HDOP>,<VDOP>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--GSA,<Mode>,<CurrentMode>,<SatPRN1>,...,<SatPRNN>,<PDOP>,<HDOP>,<VDOP>,<System ID>*<checksum><CR><LF>

Parameter:

Field	Description
Mode	Auto selection of 2D or 3D fix M = Manual, forced to switch 2D/3D mode A = Allowed to automatically switch 2D/3D mode
CurrentMode	1 = No fix 2 = 2D fix 3 = 3D fix
SatPRN1	ID number of the satellite used in solution
SatPRNN	ID number of the satellite used in solution. Range of N: 1–12.
PDOP	Position dilution of precision
HDOP	Horizontal dilution of precision
VDOP	Vertical dilution of precision
System ID	GNSS System ID: 1 = GPS

	3 = GALILEO 5 = QZSS 6= NAVIC(IRNSS) (This parameter is exclusive to NMEA 4.10)

Example:

Example for NMEA 0183 Rev 3.01:
$GNGSA,A,3,23,03,22,09,01,19,17,06,31,11,,,1.1,0.6,0.9*23<CR><LF>
Example for NMEA 0183 Rev 4.10:
$GNGSA,A,3,23,03,22,09,01,19,17,06,31,11,,,1.1,0.6,0.9,1*3E<CR><LF>

2.3.5. GSV

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

Format:

Format for NMEA 0183 Rev 3.01:
$--GSV,<Number of Message>,<Sequence Number>,<Satellites in View>,<Satellite ID x>,<Elevation x>,<Azimuth x>,<SNR x>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--GSV,<Number of Message>,<Sequence Number>,<Satellites in View>,<Satellite ID x>,<Elevation x>,<Azimuth x>,<SNR x>,<Signal ID>*<Checksum><CR><LF>

Parameter:

Field	Description
Number of Message	Number of messages
Sequence Number	Sequence number of this entry
Satellites in View	Total satellites in view
Satellite ID x	Satellite ID, Range of x: 1–4.
Elevation x	Elevation in degree. Range: 0–90, empty if no value. Range of x: 1–4.
Azimuth x	Azimuth in degree. Range: 0–359, empty if no value. Range of x: 1–4.
SNR x	Signal to noise ratio in dBHz. Range: 0–99, empty if not tracking. Range of x: 1–4.

Signal ID	Signal ID: GPS Systerm: 1 = L1(C/A) GALILEO Systerm: 7 = L1-BC IRNSS Systerm: 1 = L5-SPS (This parameter is exclusive to NMEA 4.10)

Example:

Example for NMEA 0183 Rev 3.01:
$GPGSV,3,1,12,02,04,037,,05,27,125,44,06,78,051,23,07,83,021,30*7C
$GPGSV,4,1,16,17,65,026,,195,65,084,20,19,56,340,,28,55,180,33*45
Example for NMEA 0183 Rev 4.10:
$GPGSV,4,1,16,17,65,026,,195,65,084,20,19,56,340,,28,55,180,33,1*58
$GPGSV,4,2,16,06,50,281,14,193,46,133,23,41,37,232,31,03,32,047,17,1*56
$GPGSV,4,3,16,199,24,153,,02,22,263,21,194,21,172,36,09,12,131,30,1*66
$GPGSV,4,4,16,04,12,098,28,22,09,041,,01,02,060,,24,02,294,,1*6D
$GAGSV,2,1,08,12,52,310,,33,47,039,07,31,46,214,29,24,41,290,11,7*74
$GAGSV,2,2,08,11,11,270,,01,10,171,35,26,06,071,,25,04,327,,7*7E
$GIGSV,2,1,07,05,62,199,30,07,48,159,34,04,43,191,35,03,36,231,35,1*77
$GIGSV,2,2,07,02,28,270,,09,04,234,38,01,,,37,1*71

2.3.6. GLL

GLL, Geographic Position – Latitude/Longitude. Latitude and longitude of vessel position, time of position fix and status.

Format:

Format for NMEA 0183 Rev 3.01:
$--GLL,<Latitude>,<N/S>,<Longitude>,<E/W>,<UTC Time>,<Data Validity>,<Positioning Mode>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10 (default):
$--GLL,<Latitude>,<N/S>,<Longitude>,<E/W>,<UTC Time>,<Data Validity>,<Positioning Mode>*<Checksum><CR><LF>

Parameter:

Field	Description
Latitude	Latitude in ddmm.mmmmmm format (degrees and minutes)

N/S	Latitude direction: N = North S = South
Longitude	Longitude in dddmm.mmmmmm format (degrees and minutes)
E/W	Longitude direction: E = East W= West
UTC Time	UTC of position fix in hhmmss.sss format
Data Validity	V = Invalid A = Valid
Positioning Mode	N = Not fixed A = Autonomous GNSS fix D = Differential GNSS fix

Example:

Example for NMEA 0183 Rev 4.10:
GPS+GALILEO+IRNSS mode:
$GNGLL,3149.251540,N,11706.946578,E,131018.000,A,A*45<CR><LF>

2.4. PAIR Message

These messages are defined by Airoha.

2.4.1. List of Supported PAIR Message

The table below summarizes all PAIR commands supported by L89 R2.0.

Table 3: List of Supported PAIR Messages

Syntax	Default	Type	Description
010 PAIR_AIDING_REQUEST	/	Output	Request reference data.
001 PAIR_ACK	/	Output	Acknowledgement of PAIR command
004 PAIR_HOT_START	/	Input	Perform hot start on the module
005 PAIR_WARM_START	/	Input	Perform warm start on the module

006 PAIR_COLD_START	/	Input	Perform cold start on the module
007 PAIR_FULL_COLD_START	/	Input	Perform cold restart on the module
161 PAIR_CMD_STANDBY_MODE*	/	/	Force the module to enter into standby mode.
820 PAIR_LOCUS_SET_STATUS*	/	Input	Stop or start LOCUS logging data
821 PAIR_LOCUS_GET_STATUS*	/	Input	Query LOCUS logging status
824 PAIR_LOCUS_CLEAR*	/	Input	Erase LOCUS logger flash
826 PAIR_LOCUS_GET_DATA*	/	Input	Dump LOCUS flash data
050 PAIR_SET_FIX_RATE	/	Input	Set position fix interval
051 PAIR_GET_FIX_RATE	/	Input	Get position fix interval.
690 PAIR_PERIODIC_MODE_SET_STATUS	/	Input	Make the module enter periodic mode for power saving
864 PAIR_IO_SET_BAUDRATE	/	Input	Set the baud rate of NMEA port
865 PAIR_IO_GET_BAUDRATE	/	Input	Get the current UART configuration
751 PAIR_PPS_SET_SYNC_NMEA*	/	Input	Enable or disable the function of fixing NMEA output time behind PPS
752 PAIR_PPS_SET_CONFIG_CMD*	/	Input	Set PPS type
074 PAIR_SET_AIC_STATUS	/	Input	Enable or disable AIC function
400 PAIR_DGPS_SET_MODE	/	Input	Set the source mode of DGPS correction data
401 PAIR_DGPS_GET_MODE	/	Input	Query the setting of DGPS mode
058 PAIR_SET_MIN_SNR	/	Input	Set the minimum SNR of satellites being used
072 PAIR_SET_ELEV_MASK	/	Input	Set satellite elevation mask
073 PAIR_GET_ELEV_MASK	/	Input	Get satellite elevation mask
410 PAIR_SBAS_SET_STATUS	/	Input	Enable or disable searching an SBAS satellite
411 PAIR_SBAS_GET_STATUS	/	Input	Query the status of SBAS to whether it is enabled.
062 PAIR_SET_NMEA_OUTPUT_RATE	/	Input	Set NMEA sentence output frequencies
063 PAIR_GET_NMEA_OUTPUT_RATE	/	Input	Query the current NMEA sentence output frequencies

351 PAIR_API_SET_SUPPORT_QZSS_NMEA*	/	/	/
066 PAIR_SET_GNSS_STATUS	/	Input	Configure the module to start searching satellite system
070 PAIR_SET_STATIC_LIMIT	/	Input	Set the speed threshold for static navigation
020 PAIR_GET_VERSION	/	Input	Query the firmware release information
391 PAIR_TEST_JAMMING_DETECTION	/	Input	Enable or disable jamming detection function
490 PAIR_EASY_SET_STATUS	/	Input	Enable or disable EASY™ function
491 PAIR_EASY_GET_STATUS	/	Input	Query whether EASY is enabled or disabled.
080 PAIR_SET_NAVIGATION_MODE	/	Input	Set the navigation mode
513 PAIR_NVRAM_SAVE_SETTING	/	Input	Save the current configuration

NOTE

"*" means under development.

2.4.2. Packet Type: 010 PAIR_AIDING_REQUEST

This is a system message that will be automatically output when the module is powered up.

Format:

```
$PAIR010,<Type>,<GNSS_System>,<Week_Number>,<Time_of_Week>*<Checksum><CR><LF>
```

Parameter:

Packet Data	Description
Type	The data type. 0 = Need to update EPO data 1 = Need to update the time 2 = Need to update the location
GNSS_System	The GNSS system type is needed. 0 = Need GPS data 2 = Need GALILEO data 4 = Need QZSS data

Week_Number	Week Number.
Time_of_Week	Time of Week.

Example：

```
$PAIR010,0,0,2044,369413*33<CR><LF>
```

2.4.3. Packet Type: 001 PAIR_ACK

Acknowledgement of a PAIR command. In order to inform the sender whether the receiver has received the packet, an acknowledgement packet PAIR_ACK would be returned.

Format:

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

Parameter:

Packet Data	Description
Command_ID	The command / packet type that the acknowledgement responds.
Result	0 = The command was successfully sent 1 = The command is processing. You must wait for the result 2 = Sending the command failed 3 = This command ID is not supported 4 = Command parameter error 5 = MNL service is busy

Example：

```
$PAIR001,002,0*39<CR><LF>
```

2.4.4. Packet Type: 004 PAIR_HOT_START

This message is used to perform a hot start on the module (use all available data in the NVM). Normally a hot start means the GNSS module is powered down less than 2 hours (RTC must be alive) and its ephemeris is still valid. As there is no need for downloading ephemeris, it is the fastest startup method.

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR004*3E<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,004,0*3F<CR><LF>
```

2.4.5. Packet Type: 005 PAIR_WARM_START

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

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR005*3F<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,005,0*3E<CR><LF>
```

2.4.6. Packet Type: 006 PAIR_COLD_START

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

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR006*3C<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,006,0*3D<CR><LF>
```

2.4.7. Packet Type: 007 PAIR_FULL_COLD_START

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

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR007*3D<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,007,0*3C<CR><LF>
```

2.4.8. Packet Type: 161 PAIR_CMD_STANDBY_MODE*

This message is under development.

2.4.9. Packet Type: 820 PAIR_LOCUS_SET_STATUS*

This message is under development.

2.4.10. Packet Type: 821 PAIR_LOCUS_GET_STATUS*

This message is under development.

2.4.11. Packet Type: 824 PAIR_LOCUS_CLEAR*

This message is under development.

2.4.12. Packet Type: 826 PAIR_LOCUS_GET_DATA*

This message is under development.

2.4.13. Packet Type: 050 PAIR_SET_FIX_RATE

This message is used to set position fix interval. ULP mode only support 1 hz.

Format:

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

Parameter:

Packet Data	Description
time	Position fix interval. Range: 1000–10000, unit: millisecond.

Example：

```
$PAIR050,3000*10<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,050,0*3E<CR><LF>

2.4.14. Packet Type: 051 PAIR_GET_FIX_RATE

This message is used to query the position fix interval.

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR051*3E<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,051,0*3F<CR><LF>

Response:

Format: $PAIR051,<time>*CS<CR><LF> Example: $PAIR051,3000*11<CR><LF>	
Packet Data	**Description**
time	Position fix interval. Range: 1000–10000, unit: millisecond. For time = 1000 ms, position fix interval is as setting value (time). For 1000 ms < time <= 10000 ms, position fix interval will be rounded to integral sec (1000 ms, 2000 ms, ..., 10000 ms).

2.4.15. Packet Type: 690 PAIR_PERIODIC_MODE_SET_STATUS

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

Format:

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

Parameter:

Packet Data	Description
Type	0 = Back to normal mode 1 = Smart periodic mode 2 = Periodic standby mode
FirstRun	0 = Disable 1–518400 = Run time in second
FirstSleep	Range: 1–518400 Unit: second
SecondRun	0 = Disable 1–518400 = Second run time in second
SecondSleep	Range: 1–518400 Unit: millisecond

Example：

$PAIR690,1,21,39,48,72*28<CR><LF>

Acknowledgement:

Format:

$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,690,0*34<CR><LF>

NOTE

The second run time should be longer than the first run time when the first run time is a non-zero value.

2.4.16. Packet Type: 864 PAIR_IO_SET_BAUDRATE

This message is used to set the baud rate of NMEA port.

Format:

$PAIR864,<Port_Type>,<Port_Index>,<Baudrate>*<Checksum><CR><LF>

Parameter:

Packet Data	Description
Port_Type	HW Port Type 0 = UART
Port_Index	HW Port Index 0 = UART0 1 = UART1 2 = UART2
Baudrate	Baud rate (bps): 9600 (default) 4800 9600 19200 38400 57600 115200

Example：

$PAIR864,0,0,115200*1B<CR><LF>

NOTE

The configuration made by this message will take effect after rebooting and be saved automatically without executing the message $PAIR513.

2.4.17. Packet Type: 865 PAIR_IO_GET_BAUDRATE

This message is used to get the current UART configuration.

Format:

$PAIR865,<Port_Type>,<Port_Index>*<Checksum><CR><LF>

Parameter:

Packet Data	Description
Port_Type	HW Port 0 = UART
Port_Index	HW Port Index 0 = UART0 1 = UART1 2 = UART2

Example：

$PAIR865,0,0*31<CR><LF>

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,865,0*30<CR><LF>

Response:

Format:
$PAIR865,<Baudrate>*CS<CR><LF>
Example:
$PAIR865,115200*1A<CR><LF>

Packet Data	Description

Baudrate	Baud rate (bps): 9600 (default) 4800 9600 19200 38400 57600 115200

2.4.18. Packet Type: 751 PAIR_PPS_SET_SYNC_NMEA*

This message is under development.

2.4.19. Packet Type: 752 PAIR_PPS_SET_CONFIG_CMD*

This message is under development.

2.4.20. Packet Type: 074 PAIR_SET_AIC_STATUS

This message is used to enable or disable AIC function. It is recommended to set the cold start command first and then send this command.

Format:

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

Parameter:

Packet Data	Description
Enabled	0 = Disable 1 = Enable (default)

Example：

```
$PAIR074,1*24<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,074,0*38<CR><LF>
```

2.4.21. Packet Type: 400 PAIR_DGPS_SET_MODE

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

Format:

```
$PMTK400,<Mode>*<Checksum><CR><LF>
```

Parameter:

Packet Data	Description
Mode	DGPS data source mode. 0 = No DGPS source 1 = RTCM 2 = SBAS (Includes WAAS/EGNOS/GAGAN/MSAS)

Example：

```
$PAIR400,2*20<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,400,0*3F<CR><LF>
```

2.4.22. Packet Type: 401 PAIR_DGPS_GET_MODE

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

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR401*3F<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,401,0*3E<CR><LF>

Response:

Format:
$PAIR401,<Mode>*CS<CR><LF>
Example:
$PAIR401,2*21<CR><LF>

Packet Data	Description
Mode	DGPS data source mode. 0 = No DGPS source 1 = RTCM 2 = SBAS (Includes WAAS / EGNOS / GAGAN / MSAS)

2.4.23. Packet Type: 058 PAIR_SET_MIN_SNR

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

Format:

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

Parameter:

Packet Data	Description
MIN_SNR	Minimum SNR threshold of satellites being used. Range: 9–37, default value: 9.

Example：

```
$PAIR058,15*1F<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,058,0*36<CR><LF>
```

2.4.24. Packet Type: 072 PAIR_SET_ELEV_MASK

This message is used to set satellite elevation mask.

Format:

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

Parameter:

Packet Data	Description
Degree	Range: -90–90, default value: 5, unit: degree.

Example：

```
$PAIR072,5*26<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,072,0*3E<CR><LF>
```

NOTE

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

2.4.25. Packet Type: 073 PAIR_GET_ELEV_MASK

This message is used to get satellite elevation mask.

Format:

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

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR073*3E<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,073,0*3F<CR><LF>

Response:

Format:
$PAIR073,<Degree>*<Checksum><CR><LF>
Example:
$PAIR073,5*27<CR><LF>

Packet Data	Description
Degree	Range: -90–90, default value: 5, unit: degree.

2.4.26. Packet Type: 410 PAIR_SBAS_SET_STATUS

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

Format:

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

Parameter:

Packet Data	Description
Enabled	0 = Disable 1 = Enable (default)

Example：

```
$PAIR410,1*22<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,410,0*3E<CR><LF>
```

2.4.27. Packet Type: 411 PAIR_SBAS_GET_STATUS

This message is used to query the setting of SBAS.

Format:

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

Parameter:

Packet Data	Description
None	/

Example:

```
$PAIR411*3E<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,411,0*3F<CR><LF>
```

Response:

```
Format:
$PAIR411,<Enabled>*CS<CR><LF>
Example:
$PAIR411,2*21<CR><LF>
```

Packet Data	Description
Enabled	SBAS Status

	0 = Disable 1 = Enable

2.4.28. Packet Type: 062 PAIR_SET_NMEA_OUTPUT_RATE

This message is used to set NMEA sentence output frequencies.

Format:

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

Parameter:

Packet Data	Description
Type	NMEA sentence type: -1 = Reset all sentence to default value 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA 3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG
Output_Rate	RMC sentence output frequency: 0 = Disabled or not supported sentence n = Output once every n position fix. Range of n: 1–5, default value: 1.

Example：

```
$PAIR062,0,3*3D<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,062,0*3F<CR><LF>
```

The following message can be used to restore the system default settings.

```
Format:
$PAIR062,<Restore>*<Checksum><CR><LF>
Example:
$PAIR062,-1*0E<CR><LF>
```

Packet Data	Description
Restore	Always -1.

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,062,0*3F<CR><LF>

2.4.29. Packet Type: 063 PAIR_GET_NMEA_OUTPUT_RATE

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

Format:

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

Parameter:

Packet Data	Description
Type	NMEA sentence type: -1 = Reset all sentence to default value 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA 3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG

Example：

$PAIR063,0*23<CR><LF>

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,063,0*3E<CR><LF>

Response:

Format: $PAIR063,<Type>,<Output_Rate>*CS<CR><LF> Example: $PAIR063,0,3*3C <CR><LF>	
Packet Data	**Description**
Type	NMEA sentence type: 0 = NMEA_SEN_GGA 1 = NMEA_SEN_GLL 2 = NMEA_SEN_GSA 3 = NMEA_SEN_GSV 4 = NMEA_SEN_RMC 5 = NMEA_SEN_VTG
Output_Rate	RMC sentence output frequency: 0 = Disabled or not supported sentence n = Output once every n position fix. Range of n: 1–5, default value: 1.

2.4.30. Packet Type: 351 PAIR_API_SET_SUPPORT_QZSS_NMEA*

This message is under development.

2.4.31. Packet Type: 066 PAIR_SET_GNSS_STATUS

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

Format:

$PAIR066,<GPS_Enabled>,0,<GALILEO_Enabled>,0,<QZSS_Enabled>,<NAVIC_Enabled>*<Checksum><CR><LF>

Parameter:

Packet Data	Description
GPS_Enabled	0 = Disable (DO NOT search GPS satellites) 1 or other non-zero values = Search GPS satellites
Reserved	Keep as 0
GALILEO_Enabled	0 = Disable (DO NOT search GALILEO satellites) 1 or other non-zero values = Search GALILEO satellites
Reserved	Keep as 0

QZSS_Enabled	0 = Disable (DO NOT search QZSS satellites) 1 or other non-zero values = Search QZSS satellites
NAVIC_Enabled	0 = Disable (DO NOT search IRNSS satellites) 1 or other non-zero values = Search INRSS satellites

Example：

```
Example:
Search GPS Only:
$PAIR066,1,0,0,0,0,0*3B<CR><LF>
Search GPS+GELILEO+NAVIC:
$PAIR066,1,0,1,0,0,1*3B<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,066,0*3B<CR><LF>
```

NOTE

L89 R2.0 is capable of accessing GPS, GALILEO and IRNSS systems. Either of the following two options are supported:

- IRNSS only
- GPS + GALILEO + IRNSS (default)

2.4.32. Packet Type: 070 PAIR_SET_STATIC_LIMIT

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

Format:

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

Parameter:

Packet Data	Description
Speed_threshold	Range: 0–2, unit: m/s.

Example：

```
$PAIR070,0.4*3B<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,070,0*3C<CR><LF>

2.4.33. Packet Type: 020 PAIR_GET_VERSION

This message is used to query the firmware release information.

Format:

```
$PAIR020*<Checksum><CR><LF>
```

Parameter:

Packet Data	Description
None	/

Example：

```
$PAIR020*38<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,020,0*39<CR><LF>

Response:

Format:
$PAIR020,<Project Version>,<Frequency>,<SW package>,<Service version>,<Service build time>,<DSP L1 rom version>,<DSP L1 ram version>,<DSP L5 rom version>,<DSP L5 ram version>,<Kernel version>,<Kernel build time>,<KF version>,<KF build time>,<RTK version>,<RTK build time>*<Checksum><CR><LF>
Example:
$PAIR020,AG3335M_V1.0.0.ER5_20200416,S,I,1003931,2003132012,a272,0,,,3aae182,2003132006,

062ab13,2003132011,,*28

Packet Data	Description
Project Version	<Project_board>_<SDK version>_<SDK Build time>
Frequency	Frequency: S = Single D = Dual
SW package	SW package: N = Normal W = Raw T = Timing R = RTK I = NAVIC
Service version	mnl_service version in 7 characters.
Service build time	mnl_service library build time, format is yyMMDDhhmm.
DSP L1 rom version	Null before first power on.
DSP L1 ram version	Null before first power on.
DSP L5 rom version	Null for L1 only project. Null before first power on.
DSP L5 ram version	Null for L1 only project. Null before first power on.
Kernel version	mnl_kernel version in 7 characters.
Kernel build time	mnl_kernel library build time, format is yyMMDDhhmm.
KF version	mnl_kf version in 7 characters.
KF build time	mnl_kf library build time, format is yyMMDDhhmm.
RTK version	RTK version in 7 characters Null for not RTK project.
RTK build time	RTK library build time. Null for not RTK project.

2.4.34. Packet Type: 391 PAIR_TEST_JAMMING_DETECTION

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

Format:

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

Parameter:

Packet Data	Description
CmdType	0 = Disable jamming detection function (default) 1 = Enable jamming detection function

Example：

```
$PAIR391,1*2C<CR><LF>
```

Acknowledgement:

Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,391,0*30<CR><LF>

Response:

Format:
$PAIRSPF,<Status>*<Checksum><CR><LF>
Example:
Healthy status:
$PAIRSPF,1*52<CR><LF>
Warning status:
$PAIRSPF,2*51<CR><LF>
Critical status:
$PAIRSPF,3*50<CR><LF>

Packet Data	Description
Status	1 = No jamming, healthy status 2 = Warning status 3 = Critical status

NOTE

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

1. If there is no jamming, $PAIRSPF,1*52 will be reported to indicate healthy status (status 1).
2. If there is continuous jamming, then the module status will change from 1 to 2 and finally 3.
   - In the case of not being positioned: after jamming detection is enabled, the module status will be 1 at the very beginning, and then change to 2 when jamming is detected. During the process, the module will attempt to fix position. If it still fails in positioning after 200s, the module status will change to 3 finally.

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

2.4.35. Packet Type: 490 PAIR_EASY_SET_STATUS

This message is used to enable or disable EASY™ function.

Format:

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

Parameter:

Packet Data	Description
Enabled	0 = Disable 1 = Enable (default)

Example:

```
$PAIR490,1*2A<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,490,0<CR><LF>
```

2.4.36. Packet Type: 491 PAIR_EASY_GET_STATUS

This message is used to query whether the EASY™ function is enabled or disabled.

Format:

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

Parameter:

Packet Data	Description
NONE	/

Example：

```
$PAIR491*36<CR><LF>
```

.

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,491,0*37<CR><LF>
```

Response:

```
Format:
$PAIR491,<Enable>,<Status>*<Checksum><CR><LF>
Example:
$PAIR491,1,0*37<CR><LF>
```

Packet Data	Description
Enable	Enable or Disable 0 = Disable 1 = Enable
Status	0 = Not finished 1 = Finished 1-day extension 0 = Finished 2-day extension 1 = Finished 3-day extension

NOTE

If EASY™ function is not enabled, only the <Enable> value will be returned after executing this command.

2.4.37. Packet Type: 080 PAIR_SET_NAVIGATION_MODE

This message is used to set the navigation mode.

Format:

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

Parameter:

Packet Data	Description
CmdType	0 = Normal Mode. For general purposes.

	1 = Fitness Mode. For running and walking purposes that the low-speed (< 5 m/s) movement will have more effect on the position calculation. 2 = Aviation Mode. For high-dynamic purposes that the large-acceleration movement will have more effect on the position calculation. 3 = Balloon Mode. For high-altitude balloon purposes that the vertical movement will have more effect on the position calculation. 4 = Stationary Mode. For stationary applications that zero dynamics is assumed. 7 = Swimming Mode. For swimming purpose so that it smooths the trajectory and improves the accuracy of distance calculation

Example：

```
$PAIR080,1*2F<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
Example:
$PAIR001,080,0*33<CR><LF>
```

2.4.38. Packet Type: 513 PAIR_NVRAM_SAVE_SETTING

This message is used to save the current configuration to file system.

Format:

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

Parameter:

Packet Data	Description
NONE	/

Example：

```
$PAIR513*3D<CR><LF>
```

Acknowledgement:

```
Format:
$PAIR001,<Command_ID>,<Result>*<Checksum><CR><LF>
```

Example:
$PAIR001,513,0*3C<CR><LF>

NOTE

Need to send this command every time after modifying any parameters, if the HW not keep RTC power.

2.5. PQTM Message

These messages are defined by Quectel.

2.5.1. PQTMANTENNASTATUS

This message is showed statue of antenna.

Format:

$PQTMANTENNASTATUS,<status>,<mode_ind>,<power_ind>*<Checksum><CR><LF>

Parameter:

Packet Data	Description
status	0 = Normal 1 = Open circuit 2 = Short
mode_ind	0 = Auto mode 1 = Internal mode 2 = External mode
power_ind	0 = Power off 1 = Power on

Example：

$PQTMCFGANTENNA,1,0*04

2.5.2. PQTMCFGANTENNA

This message is used to config of antenna

Format:

```
$PQTMCFGANTENNA,<r/w>,<mode>*<Checksum><CR><LF>
```

Parameter:

Packet Data	Description
r/w	0 = Read configuration 1 = Set configuration
mode	0 = Auto mode 1 = Internal mode 2 = External mode

Example：

```
//Configure antenna mode to auto mode
$PQTMCFGANTENNA,1,0*04

Response:
$PQTMCFGANTENNA,W,0*62

//Get antenna mode
$PQTMCFGANTENNA,0*19

Response:
$PQTMCFGANTENNA,0,0*5
```

NOTE

<mode> should be omitted in the command if <r/w> is 0.

3 Default Configurations

Table 4: Default Configurations

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

4 Appendix A References

Table 5: Related Documents

SN	Document Name	Remark
[1]	Quectel_L89H_Hardware_Design	L89 R2.0 Hardware Design

Table 6: Terms and Abbreviations

Abbreviation	Description
AGPS	Assisted Global Positioning System
AIC	Active Interference Cancellation
DEE	Dynamic Ephemeris Extension
DOP	Dilution of Precision
DGPS	Differential Global Positioning System
EASY™	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
GALILEO	Galileo satellite navigation system
GAGAN	GPS-aided GEO Augmented Navigation
GGA	NMEA: Global Positioning System Fix Data
GLL	NMEA: Geographic Position – Latitude/Longitude
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	NMEA: GNSS DOP and Active Satellites
GSV	NMEA: GNSS Satellites in View
HDOP	Horizontal Dilution of Precision

HW	Hardware
IRNSS/NAVIC	Indian Regional Navigation Satellite System
MNL	MTK Navigation Lib
MSAS	Multi-functional Satellite Augmentation System
NMEA	National Marine Electronics Association
NVM	Non-volatile Memory
PDOP	Position Dilution of Precision
PPS	Pulse Per Second
PMTK	Proprietary Protocol of MTK
QZSS	Quasi-Zenith Satellite System
RMC	NMEA: Recommended Minimum Specific GNSS Data
RTC	Real-time Clock
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite-Based Augmentation System
SNR	Signal-to-noise Ratio
SV	Satellites in View
TXT	Text transmission showing antenna status
UART	Universal Asynchronous Receiver/Transmitter
ULP	Ultra Low Power
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VTG	NMEA: Course Over Ground and Ground Speed
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984