L89 GNSS Protocol Specification

GNSS Module Series

Rev. L89_GNSS_Protocol_Specification_V1.2

Date: 2020-03-18

Status: Released

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About the Document

Revision History

Version	Date	Author	Description
1.0	2019-04-16	Jenn XIANG	Initial
1.1	2019-08-28	Berton PENG	Updated the descriptions of the following commands: ● $PSTMCOLD ● $PSTMSETANTSENSMANUAL ● $PSTMANTENNASTATUS
1.2	2020-03-18	Berton PENG	1. Added descriptions for $PSTMPPS commands so as to clarify the function of each command. 2. Updated the description of the following commands: ● $PSTMSETANTSENSMANUAL ● $PSTMCFGMSGL ● $PSTMCFGAJM ● $PSTMCFGPORT 3. Added the commands listed below: ● $PSTMCFGTDATA ● $PSTMGETPAR ● $PSTMPPSDATA ● $PSTMSBAS

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1 Introduction

L89 GNSS module supports GPS, GLONASS, BeiDou, Galileo, QZSS and IRNSS constellations and provides fast and accurate acquisition. The module supports autonomous GNSS C/A code and SBAS functions. It can be used for positioning and navigation in many vertical markets.

This document describes the software commands used for controlling the L89 module. The module supports output messages at NMEA 0183 standard protocol format and ST proprietary protocol messages (in NMEA format) to report GNSS information. It also supports module control and configuration through ST proprietary commands (PSTM commands).

NOTE

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

2 Commands

2.1. List of NMEA Proprietary Commands

The table below lists the NMEA proprietary commands.

Table 1: Summary of NMEA Proprietary Commands

Syntax	Description
$PSTMINITGPS	Initialize the position and time of GNSS receiver
$PSTMINITTIME	Initialize the time of GNSS receiver
$PSTMCLREPHS	Clear all ephemerides
$PSTMDUMPEPHEMS	Dump ephemeris data
$PSTMCLRALMS	Erase Almanac files
$PSTMDUMPALMANAC	Dump Almanac data
$PSTMCOLD	Perform cold start
$PSTMWARM	Perform warm start
$PSTMHOT	Perform hot start
$PSTMSRR	Reset system
$PSTMSBASONOFF	Enable/disable SBAS activity
$PSTMSBASSERVICE	Set SBAS service
$PSTMGETRTCTIME	Get current RTC time
$PSTMSETCONSTMASK	Set GNSS constellation mask
$PSTMPPS	Manage command interface for pulse per second

$PSTMFORCESTANDBY	Force the platform to enter into standby mode
$PSTMGEOFENCEREQ	Request internal geo-fence subsystem status
$PSTMODOSTART	Enable and reset odometer subsystem
$PSTMODOSTOP	Stop odometer subsystem
$PSTMODOREQ	Request odometer subsystem status
$PSTMODORESET	Reset odometer subsystem
$PSTMCFGCONST	Configure constellation
$PSTMCFGPORT	Configure char port
$PSTMCFGTDATA	Configure date and time related parameters
$PSTMCFGMSGL	Configure message list
$PSTMCFGAGPS	Configure assisted GNSS
$ PSTMCFGAJM	Configure anti-jamming
$PSTMCFGODO	Configure odometer
$PSTMCFGGEOFENCE	Configure geo-fencing
$PSTMCFGGEOCIR	Configure geo-fencing circle
$PSTMSETTHTRK	Set track threshold
$PSTMSETTHPOS	Set position threshold
$PSTMSETANTSENSOPMODE	Set antenna sensing operating mode
$PSTMSETANTSENSMANUAL	Control antenna state manually
$PSTMGETPAR	Get software version
$PSTMSAVEPAR	Save the current configuration data blocks into the backup memory
$PSTMRESTOREPAR	Restore the factory default settings

2.2. Structure of NMEA Proprietary Commands

Table 2: Structure of NMEA Proprietary Commands

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

2.3. GNSS Commands

2.3.1. $PSTMINITGPS

Initialize the position and time of GNSS receiver using UTC format. It must be issued after a cold reset else the command fails. The date information which includes parameters Day, Month and Year must be after January 2018.

Synopsis:

```
$PSTMINITGPS,<Lat>,<LatRef>,<Lon>,<LonRef>,<Alt>,<Day>,<Month>,<Year>,<Hour>,<Minute>,<Second>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
Lat	DDMM.MMM	Latitude (Degree-Minute.Minute decimals)
LatRef	N or S	Latitude direction (north or south)

Lon	DDDMM.MMM	Longitude (Degree-Minute.Minute decimals)
LonRef	E or W	Longitude direction (east or west)
Alt	dddd – Decimal, 4 digits	Altitude in meters (-1500 to 100000)
Day	dd – Decimal, 2 digits	Day of month (01 to 31)
Month	mm – Decimal, 2 digits	Month (01 to 12)
Year	YYYY – Decimal, 4 digits	Year (2018- …)
Hour	HH – Decimal, 2 digits	Hour (00 to 23)
Minute	MM – Decimal, 2 digits	Minute (00 to 59)
Second	SS – Decimal, 2 digits	Second (00 to 59)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the position and time of the GNSS receiver will be initialized and the returned message will be:

  ```
  $PSTMINITGPSOK*<checksum><CR><LF>
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMINITGPSERROR*<checksum><CR><LF>
  ```

Example:

```
$PSTMINITGPS,4811.365,N,01164.123,E,0530,23,02,2018,09,44,12
```

NOTES

1. The error between input time and real time should be less than 3 seconds.
   GNSS time = UTC time + Leap second. In 2019, Leap second = 18 s.
2. The error between input position and real position should be less than 30 kilometers.
3. The string ***<checksum>*** is optional when inputting commands.

2.3.2. $PSTMINITTIME

Initialize the time of GNSS receiver using UTC format. The date issued with parameters Day, Month and Year must be after January 2018.

Synopsis:

```
$PSTMINITTIME,<Day>,<Month>,<Year>,<Hour>,<Minute>,<Second>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
Day	dd – Decimal, 2 digits	Day of month (01 to 31)
Month	mm – Decimal, 2 digits	Month (01 to 12)
Year	YYYY – Decimal, 4 digits	Year (2018- …)
Hour	HH – Decimal, 2 digits	Hour (00 to 23)
Minute	MM – Decimal, 2 digits	Minute (00 to 59)
Second	SS – Decimal, 2 digits	Second (00 to 59)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the time of GNSS receiver will be initialized and the returned message will be:

  ```
  $PSTMINITTIMEOK*<checksum><CR><LF>
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMINITTIMEERROR*<checksum><CR><LF>
  ```

Example:

```
$PSTMINITTIME,23,02,2018,09,44,12
```

NOTE

The error between input time and real time should be less than 3 seconds.
GNSS time = UTC time + Leap second. In 2019, Leap second = 18 s.

2.3.3. $PSTMCLREPHS

Clear all ephemerides. This command will erase all ephemerides that are stored in the NVM backup memory.

Synopsis:

```
$PSTMCLREPHS*<checksum><CR><LF>
```

Arguments:

None.

Results:

- All ephemerides, stored in the NVM backup memory (backup SRAM or Flash), will be deleted.
- No message will be sent as reply.

Example:

```
$PSTMCLREPHS
```

2.3.4. $PSTMDUMPEPHEMS

Dump the ephemeris data stored in the backup memory.

Synopsis:

```
$PSTMDUMPEPHEMS*<checksum><CR><LF>
```

Arguments:

None.

Result:

```
$PSTMEPHEM,<sat_id>,<N>,<byte1>…<byteN>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number
N	Decimal, 1 digit	Number of the ephemeris data bytes
byte1	Hexadecimal, 2 digits	First byte of the ephemeris data
byteN	Hexadecimal, 2 digits	Last byte of the ephemeris data
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

The data from byte1 to byteN are the dump of structures that contain all the information of the ephemeris.

Ephemeris data format varies according to different constellations. Please check the tables below for details.

Table 3: Ephemeris Data Format for GPS Constellation

Bits	Structure Member	Description
16	week	Week number of the issue of data
16	toe	Time of week for ephemeris epoch
16	toc	Time of week for clock epoch
8	iode1	Issue of data 1
8	iode2	Issue of data 2
10	iodc	Issue of data clock
14	i_dot	Rate of inclination angle
8	reserved	-
24	omega_dot	Rate of right ascension
8	reserved	Must be 0
16	crs	Amplitude of the sine harmonic correction to the orbit radius
16	crc	Amplitude of the cosine harmonic correction to the orbit radius
16	cus	Amplitude of the sine harmonic correction to the argument of latitude
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude
16	cis	Amplitude of the sine harmonic correction to the angle of inclination
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination
16	motion_difference	Mean motion difference from computed value
16	reserved	Must be 0
32	inclination	Inclination angle at reference time
32	e	Eccentricity
32	root_A	Square root of major axis

32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
8	time_group_delay	Estimated group delay differential
8	af2	Second order clock correction
16	af1	First order clock correction
22	af0	Constant clock correction
1	reserved	Reserved for use by GNSS library. Must be 1.
1	reserved	Reserved for use by GNSS library. Must be 1.
1	reserved	Reserved for use by GNSS library. Must be 1.
1	available	Contain 1 if ephemeris is available, 0 if not
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	reserved	Must be 0
4	accuracy	Accuracy

Table 4: Ephemeris Data Format for GLONASS Constellation

Bits	Structure Member	Description
16	week	Week number of the issue of data
16	toe	Time of week for ephemeris epoch
4	toe_lsb	Time of week for ephemeris epoch (LSB)
11	NA	Calendar day number within the four-year period since the beginning of last leap year (almanac)
7	tb	Time of ephemeris index
2	M	Type of satellite 00 = GLONASS 01 = GLONASS-M
2	P1	Time interval between two adjacent tb parameters
1	P3	Number of satellites for which almanac is transmitted within this frame

		0 = 4 1 = 5
1	P2	Flag of oddness (1) or evenness (0) of the value of tb
1	P4	Flag to show that ephemeris parameters are present
1	KP	Notification on forthcoming leap second correction of UTC
1	reserved	-
27	xn	Satellite PZ-90 x coordinate at epoch tb
5	xn_dot_dot	Satellite PZ-90 x velocity at epoch tb
24	xn_dot	Satellite PZ-90 x acceleration component at epoch tb
5	n	Slot number (1 to 24)
3	Bn	Healthy flags
27	yn	Satellite PZ-90 y coordinate at epoch tb
5	yn_dot_dot	Satellite PZ-90 y acceleration component at epoch tb
24	yn_dot	Satellite PZ-90 y velocity at epoch tb
8	age_h	Age of predicted ephemeris (Unit: hours)
27	zn	Satellite PZ-90 z coordinate at epoch tb
5	zn_dot_dot	Satellite PZ-90 z acceleration component at epoch tb
24	zn_dot	Satellite PZ-90 z velocity at epoch tb
8	reserved	Must be 0
11	gamma_n	Satellite clock frequency drift at epoch tb
5	E_n	Age of the ephemeris information
4	freq_id	Frequency ID
12	reversed	-
22	tau_n	Satellite clock correction at epoch tb
10	reserved	Must be 0
32	tau_c	GLONASS to UTC(SU) time correction
22	tau_GPS	GLONASS to GPS system time correction

10	reserved	-
11	NT	Calendar day number of ephemeris within the four-year period since the beginning of last leap year
5	N4	Four-year interval number starting from 1996
12	tk	Satellite time referenced to the beginning of the frame
4	FT	Predicted satellite user range accuracy at time tb
32	reserved	-
5	m_available	Must be 0x1F
1	nvm_reliable	Must be 1
26	spare	-
25	reserved	-
1	available	Contain 1 if ephemeris is available, 0 if not
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	reserved	Must be 0
4	reserved	-

Table 5: Ephemeris Data Format for Galileo Constellation

Bits	Structure Member	Description
16	week	Week number of the issue of data
16	toe	Time of week for ephemeris epoch
2	reserved	-
16	toc	Time of week for clock epoch
10	iod_nav	Issue of data
8	SISA	Signal in space accuracy
10	reserved	Must be 0
10	BGD_E1_E5a	E1-E5a broadcast group delay
10	BGD_E1_E5b	E1-E5b broadcast group delay

2	E1BHS	E1-B signal health status
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity
32	root_a	Square root of major axis
32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
14	i_dot	Rate of inclination angle
1	available	Contain 1 if ephemeris is available, 0 if not
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
16	motion_difference	Mean motion difference from computed value
16	crs	Amplitude of the sine harmonic correction to the orbit radius
16	crc	Amplitude of the cosine harmonic correction to the orbit radius
16	cus	Amplitude of the sine harmonic correction to the argument of latitude
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude
16	cis	Amplitude of the sine harmonic correction to the angle of inclination
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination
24	omega_dot	Rate of right ascension
6	SVID	Satellite identification
1	E1BDVS	E1-B data validity status
1	reserved	Must be 0
8	reserved	Must be 0
16	reserved	Must be 0
6	af2	Second order clock correction
21	af1	First order clock correction

5	word_available	Must be 0x1F
31	af0	Constant clock correction
1	reserved	-
6	reserved	Must be 0
26	reserved	Reserved for use by GNSS library. Must be 1.
1	reserved	Must be 0

Table 6: Ephemeris Data Format for BeiDou Constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity
32	root_a	Square root of major axis
32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension
8	A0	Ionospheric delay model parameter α0
24	af0	Constant clock correction
8	A1	Ionospheric delay model parameter α1
20	sow	Seconds of week
11	af2	Second order clock correction
1	is_geo	1 for geostationary satellites, otherwise 0
22	af1	First order clock correction

10	subframe_avail	Must be 0x3FF
16	motion_difference	Mean motion difference from computed value
8	A2	Ionospheric delay model parameter α2
8	A3	Ionospheric delay model parameter α3
18	crs	Amplitude of the sine harmonic correction to the orbit radius
8	B2	Ionospheric delay model parameter β2
4	urai	User range accuracy index
2	reserved	Must be 0
18	crc	Amplitude of the cosine harmonic correction to the orbit radius
8	B3	Ionospheric delay model parameter β3
5	aodc	Issue of data, clock
1	spare	-
18	cus	Amplitude of the sine harmonic correction to the argument of latitude
14	i_dot	Rate of inclination angle
18	cuc	Amplitude of the cosine harmonic correction to the argument of latitude
8	B0	Ionospheric delay model parameter β0
6	spare	-
18	cis	Amplitude of the sine harmonic correction to the angle of inclination
8	B1	Ionospheric delay model parameter β1
6	reserved	Must be 0
18	cic	Amplitude of the cosine harmonic correction to the angle of inclination
1	nvm_reliable	Must be 1
11	reserved	Must be 0
2	spare	-
17	toc	Time of week for clock epoch

13	week	Week number of the issue of data
1	available	Contain 1 if ephemeris is available, 0 if not
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy

Table 7: Ephemeris Data Format for IRNSS Constellation

Bits	Structure Member	Description
16	toe	Ephemeris reference time
16	toc	Time of clock
32	mean_anomaly	Mean anomaly at reference time
32	eccentricity	Eccentricity
32	root_a	Square root of the semi-major axis
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
32	inclination	Inclination angle at reference time
22	omega_dot	Rate of right ascension
10	reserved	-
16	af1	Clock coefficients af1
15	cuc	Amplitude of the cosine harmonic correction term to the argument of latitude
1	L5_flag	Signal health flag
14	i_dot	Rate of inclination angle
2	spare1	-
15	cus	Amplitude of the sine harmonic correction term to the argument of latitude
1	s_flag	Signal health flag
22	af0	Clock coefficients af0
8	af2	Clock coefficients af2

2	spare2	-
22	difference	Mean motion difference from computed value
10	WN	Week number
4	URA	User range accuracy
8	t_gd	Total group delay
8	IODEC	Issue of data for ephemeris and clock
12	spare3	-
15	crc	Amplitude of the cosine harmonic correction term to the orbit radius
15	crs	Amplitude of the sine harmonic correction term to the orbit radius
2	spare5	-
10	reserved	-
6	reserved	-
1	reserved	-
1	Available	Contain 1 if ephemeris is available, 0 if not
1	Health	Contain 1 if the satellite is unhealthy, 0 if healthy
2	subframe_avail	Must be 0x3
1	nvm_reliable	Must be 1
10	spare6	-

Example:

```
$PSTMDUMPEPHEMS
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400fbff33420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ffcaff1937000033515726556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00b8ffd037000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff6c00f72e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

2.3.5. $PSTMCLRALMS

Erase the Almanac files stored in the NVM backup memory.

Synopsis:

```
$PSTMCLRALMS*<checksum><CR><LF>
```

Arguments:

None.

Results:

- The Almanac files, stored in the NVM backup memory, will be deleted.
- No message will be sent as reply.

Example:

```
$PSTMCLRALMS
```

2.3.6. $PSTMDUMPALMANAC

Dump Almanac data. This command dumps the Almanacs files stored in the backup memory.

Synopsis:

```
$PSTMDUMPALMANAC*<checksum><CR><LF>
```

Arguments:

None.

Result:

```
$PSTMDUMPALMANAC,<sat_id>,<N>,<byte1>…<byteN>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number
N	Decimal, 1 digit	Number of the almanac data bytes
byte1	Hexadecimal, 2 digits	First byte of the almanac data
byteN	Hexadecimal, 2 digits	Last byte of the almanac data

checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

The data from byte1 to byteN are the dump of structures that contain all the information of the Almanac. Almanac data format varies according to different constellations. For more details, please check the tables below.

Table 8: Almanac Data Format for GPS Constellation

Bits	Structure Member	Description
8	satid	Satellite number
16	week	Week number for the epoch
8	toa	Reference time almanac
16	e	Eccentricity
16	delta_i	Rate of inclination angle
16	omega_dot	Rate of right ascension
24	root_A	Square root of semi-major axis
24	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
24	perigee	Argument of perigee
24	mean_anomaly	Mean anomaly at reference time
11	af0	Constant clock correction
11	af1	First order clock correction
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	available	Contain 1 if almanac is available, 0 if not

Table 9: Almanac Data Format for GLONASS Constellation

Bits	Structure Member	Description
8	satid	Satellite number
16	week	Week number for the epoch

8	toa	Reference time almanac
5	n_A	Slot number (1 to 24)
5	H_n_A	Carrier frequency channel number
2	M_n_A	Type of satellite 00 = GLONASS 01 = GLONASS-M
10	tau_n_A	Satellite clock correction
15	epsilon_n_A	Eccentricity
21	t_lambda_n_A	Time of the first ascending node passage
21	lambda_n_A	Longitude of ascending node of orbit plane at almanac epoch
18	delta_i_n_A	Inclination angle correction to nominal value
7	delta_T_n_dot_A	Draconian period rate of change
22	delta_T_n_A	Draconian period correction
16	omega_n_A	Argument of perigee
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	available	Contain 1 if Almanac is available, 0 if not
32	Tau_c	-
11	NA	-
5	N4	-
16	Spare	-

Table 10: Almanac Data Format for Galileo Constellation

Bits	Structure Member	Description
16	satid	Satellite number
6	svid	Space vehicle identificator
16	week	Week number for the epoch
20	toa	Reference time almanac

13	delta_a	Delta of semi-major axis
11	e	Eccentricity
16	perigee	Argument of perigee
11	delta_i	Rate of inclination angle
16	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
11	omega_dot	Rate of right ascension
16	mean_anomaly	Mean anomaly at reference time
16	af0	Constant clock correction
13	af1	First order clock correction
2	E5b_HS	E5 signal health status
2	E1B_HS	E1-B signal health status
4	ioda_1	Issue of data almanac 1
4	ioda_2	Issue of data almanac 2
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
2	reserved	Reserved for use by GNSS library
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	available	Contain 1 if almanac is available, 0 if not

Table 11: Almanac Data Format for BeiDou Constellation

Bits	Structure Member	Description
8	prn	PRN number of the corresponding almanac data
16	week	Almanac reference week number
8	toa	Almanac reference time
17	eccentricity	Eccentricity
11	af0	Satellite clock time bias correction coefficient

1	is_geo	Satellite orbit type
1	WNa_valid	-
2	spare0	-
17	omega_dot	Rate of right ascension
11	af1	Satellite clock time drift correction coefficient
4	spare1	-
24	root_a	Square root of semi-major axis
8	spare2	-
24	omega_zero	Longitude of ascending node of orbital plane at weekly epoch
8	spare3	-
24	perigee	Argument of perigee
8	spare4	-
24	mean_anomaly	Mean anomaly at reference time
8	spare5	-
16	delta_i	Correction of inclination angle at reference time
1	health	Satellite health information
1	available	Contain 1 if almanac is available, 0 if not
8	last_received_toa	-
6	spare6	-

Table 12: Almanac Data Format for IRNSS Constellation

Bits	Structure Member	Description
10	WNa	Week number for almanac
16	toa	Almanac reference time
6	prn_al	PRN ID for almanac

16	eccentricity	Eccentricity
16	omega_dot	Rate of right ascension
24	inclination	Inclination
8	ISC	Inter signal correction
24	root_a	Square root of the semi-major axis
8	spare0	-
24	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
6	spare	-
2	spare1	-
24	perigee	Argument of perigee
6	prn	PRN ID
2	spare2	-
24	mean_anomaly	Mean anomaly at reference time
8	spare3	-
11	af0	Clock bias A0
11	af1	Clock bias A1
1	health	Contain 1 if the satellite is unhealthy, 0 if healthy
1	available	Contain 1 if almanac is available, 0 if not
8	spare4	-

Example:

```
$PSTMDUMPALMANAC
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034024200b4ffff00*1a
$PSTMALMANAC,2,32,021a0690944b78fe37fd0800770da141ef0c5b0060487700989bd800d8088000*1a
$PSTMALMANAC,3,32,031a06904f68a2f540fd0800f60ca141922a2c003cae27009496cf00020a8000*15
$PSTMALMANAC,4,32,041a0690a94aeffd36fd0800390ca141afc95b00de7a1700dfc74e004ddebf00*13
$PSTMALMANAC,5,32,051a0690940eee0b5efd0800900ca141582b8600d3000b0060641200e40f8000*14
```

2.3.7. $PSTMCOLD

Perform a cold start.

Synopsis:

```
$PSTMCOLD*<checksum><CR><LF>
```

Arguments:

None

Result:

Cold start initialization and GNSS engine restart [1].

Example:

```
$PSTMCOLD
```

NOTE

[1] It is not a system reboot.

2.3.8. $PSTMWARM

Perform a warm start.

Synopsis:

```
$PSTMWARM*<checksum><CR><LF>
```

Arguments:

None.

Result:

Warm start initialization and GNSS engine restart [1].

Example:

```
$PSTMWARM
```

NOTE

1) It is not a system reboot.

2.3.9. $PSTMHOT

Perform a hot start.

Synopsis:

```
$PSTMHOT*<checksum><CR><LF>
```

Arguments:

None.

Result:

GNSS engine restart 1).

Example:

```
$PSTMHOT
```

NOTE

1) It is not a system reboot.

2.3.10. $PSTMSRR

Execute a system reset. The GNSS firmware is rebooted.

Synopsis:

```
$PSTMSRR*<checksum><CR><LF>
```

Arguments:

None.

Results:

- The GNSS firmware will be rebooted.
- No message will be sent as reply.

Example:

```
$PSTMSRR
```

2.3.11. $PSTMSBASONOFF

Suspend or resume the SBAS software execution. The SBAS is active by default. If SBAS has been suspended, it will not be reported in the GSV sentences even when it is in view.

Synopsis:

```
$PSTMSBASONOFF*<checksum><CR><LF>
```

Arguments:

None.

Result:

If SBAS is active, it will be suspended. If it has been suspended, it will return to active.

Example:

```
$PSTMSBASONOFF
```

2.3.12. $PSTMSBASSERVICE

Change the SBAS service.

Synopsis:

```
$PSTMSBASSERVICE,<service>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
service	Integer	SBAS service: 0 = WAAS 1 = EGNOS 2 = MSAS 3 = GAGAN 4 = SDCM 7 = OFF 15 = Auto (default)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and * characters

Results:

- If there are no errors, the returned message will be:

  ```
  $PSTMSBASSERVICEOK*<checksum><CR><LF>
  ```

  If service is 0, 1, 2, 3 or 4, the SBAS engine will track all the SBAS satellites which correspond to the specified service.

  If service is 7, no SBAS satellites will be tracked.

  If service is 15, the SBAS engine will automatically select an appropriate SBAS service based on the computed user location.

- In case of any error, the returned message will be:

  ```
  $PSTMSBASSERVICEERROR*<checksum><CR><LF>
  ```

Example:

```
$PSTMSBASSERVICE,15
```

2.3.13. $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

```
$PSTMGETRTCTIME*<checksum><CR><LF>
```

Arguments:

None.

Results:

The system will provide the RTC data and status:

```
$PSTMGETRTCTIME,<time>,<date>,<rtc_status>,<time_validity>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
time	hhmmss.sss	Current time read from RTC
date	ddmmyy	Current date read from RTC

rtc_status	Decimal, 1 digit	Status: 0 = RTC_STATUS_INVALID 1 = RTC_STATUS_STORED 2 = RTC_STATUS_APPROXIMATE
time_validity	Decimal, 1 digit	Validity: 0 = NO_TIME 1 = FLASH_TIME 2 = USER_TIME 3 = USER_RTC_TIME 4 = RTC_TIME 5 = RTC_TIME_ACCURATE 6 = APPROX_TIME 8 = ACCURATE_TIME 9 = POSITION_TIME 10 = EPHEMERIS_TIME
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Example:

```
$PSTMGETRTCTIME
```

2.3.14. $PSTMSETCONSTMASK

Set the GNSS constellation mask. It allows GNSS constellation switching during run time. In case of reset, constellation mask is restored back to the default value.

Synopsis:

```
$PSTMSETCONSTMASK,<constellation_mask>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
constellation_mask	Decimal, 1 to 9999	It is a bit mask. Each bit will enable/disable a specific constellation independent to the others: bit 0: Enabling/disabling GPS constellation bit 1: Enabling/disabling GLONASS constellation bit 2: Enabling/disabling QZSS constellation bit 3: Enabling/disabling Galileo constellation bit 7: Enabling/disabling BeiDou constellation bit 10: Enabling/disabling IRNSS constellation
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMSETCONSTMASKOK,<constellation_mask>*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMSETCONSTMASKERROR*<checksum><CR><LF>

Examples:

- Enable GPS only:

  $PSTMSETCONSTMASK,1

- Enable GLONASS only:

  $PSTMSETCONSTMASK,2

- Enable GPS and GLONASS:

  $PSTMSETCONSTMASK,3

- Enable IRNSS:

  $PSTMSETCONSTMASK,1024

2.3.15. $PSTMPPS

This command modifies various parameters related to the 1PPS feature. The setting will be restored back to the default values after reset.

Synopsis:

$PSTMPPS,<cmd_mode>,<cmd_type>,<par_1>,…,<par_N>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
cmd_mode	Decimal, 1 digit	Select the command operation mode: 1 = GET operation (to get data from PPS manager) 2 = SET operation (to set data into PPS manager)
cmd_type	Decimal	Command type: 1 = PPS_IF_ON_OFF_CMD 2 = PPS_IF_OUT_MODE_CMD 4 = PPS_IF_PULSE_DELAY_CMD

			5 = PPS_IF_PULSE_DURATION_CMD 6 = PPS_IF_PULSE_POLARITY_CMD 7 = PPS_IF_PULSE_DATA_CMD 8 = PPS_IF_FIX_CONDITION_CMD 9 = PPS_IF_SAT_TRHESHOLD_CMD 10 = PPS_IF_ELEVATION_MASK_CMD 11 = PPS_IF_COSTELLATION_MASK_CMD 12 = PPS_IF_TIMING_DATA_CMD 13 = PPS_IF_POSITION_HOLD_DATA_CMD 14 = PPS_IF_AUTO_HOLD_SAMPLES_CMD 15 = PPS_IF_TRAIM_CMD 16 = PPS_IF_TRAIM_USED_CMD 17 = PPS_IF_TRAIM_RES_CMD 18 = PPS_IF_TRAIM_REMOVED_CMD 19 = PPS_IF_REFERENCE_TIME_CMD 20 = PPS_IF_CONSTELLATION_RF_DELAY_CMD
par_1 … par_N			Parameter list is determined by the command type. Please check the sub-chapters below for details.
checksum	Hexadecimal, digits	2	Checksum of the message bytes between but not including the **$** and ***** characters

Result:

According to the operation mode and the command type, the configuration is set or can be retrieved from the PPS manager.

2.3.15.1. Set PPS Data: PPS_IF_ON_OFF_CMD

This command is used to enable/disable PPS feature.

Synopsis:

```
$PSTMPPS,2,1,<on_off>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = PPS disabled 1 = PPS enabled (default)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.2. Set PPS Data: PPS_IF_OUT_MODE_CMD

This command is used to set PPS output mode.

Synopsis:

```
$PSTMPPS,2,2,<out_mode>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated (default) 1 = PPS generated on even seconds 2 = PPS generated on odd seconds
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.3. Set PPS Data: PPS_IF_PULSE_DELAY_CMD

This command is used to set pulse delay time caused by transmission in the cable.

Synopsis:

```
$PSTMPPS,2,4,<pulse_delay>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay. Unit: ns. The default value is 0.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.4. Set PPS Data: PPS_IF_PULSE_DURATION_CMD

This command is used to set pulse duration.

Synopsis:

```
$PSTMPPS,2,5,<pulse_duration>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
pulse_duration	Double	Pulse duration. Unit: s. The default value is 0.500000.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.5. Set PPS Data: PPS_IF_PULSE_POLARITY_CMD

This command is used to set pulse polarity.

Synopsis:

```
$PSTMPPS,2,6,<pulse_polarity>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
pulse_polarity	Decimal, 1 digit	0 = not inverted (default) 1 = inverted
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.6. Set PPS Data: PPS_IF_PULSE_DATA_CMD

This command is used to set pulse data into PPS manager.

Synopsis:

```
$PSTMPPS,2,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_duration>,<pulse_polarity>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated (default) 1 = PPS generated on even seconds 2 = PPS generated on odd seconds
reference_time	Decimal, 1 digit	0 = UTC (default) 1 = GPS_UTC

		2 = GLONASS_UTC 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS
pulse_delay	Decimal	Pulse delay. Unit: ns. The default value is 0.
pulse_duration	Double	Pulse duration. Unit: s. The default value is 0.500000.
pulse_polarity	Decimal, 1 digit	0 = not inverted (default) 1 = inverted
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.7. Set PPS Data: PPS_IF_FIX_CONDITION_CMD

This command is used to set PPS fix condition.

Synopsis:

```
$PSTMPPS,2,8,<fix_condition>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = No fix (default) 2 = 2D fix 3 = 3D fix
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.8. Set PPS Data: PPS_IF_SAT_TRHESHOLD_CMD

This command is used to set minimum number of satellites for the PPS generation.

Synopsis:

```
$PSTMPPS,2,9,<sat_th>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
sat_th	Decimal	Minimum number of satellites for the PPS generation.

		The default value is 0.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.9. Set PPS Data: PPS_IF_ELEVATION_MASK_CMD

This command is used to set minimum satellite elevation mask for satellite usage in timing filtering.

Synopsis:

```
$PSTMPPS,2,10,<elevation_mask>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
elevation_mask	Decimal	Minimum satellite elevation mask for satellite usage in timing filtering. The default value is 0.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.10. Set PPS Data: PPS_IF_COSTELLATION_MASK_CMD

This command is used to set satellite constellation selection for usage in timing filtering.

Synopsis:

```
$PSTMPPS,2,11,<constellation_mask>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit 0 = GPS bit 1 = GLONASS bit 3 = Galileo bit 7 = BeiDou The default value is 0. **NOTES:** This parameter enables the usage of mixed

		constellations satellites in the timing filtering. If bit0 is enabled, GPS satellites are used to correct the GLONASS reference time together with GLONASS satellites. If bit1 is enabled, GLONASS satellites are used to correct the GPS reference time together with the GPS satellites. When constellation mask is zero (default), only GPS satellites are used to correct the GPS reference time and only GLONASS satellites are used to correct the GLONASS reference time. Same description is valid also for GPS and BeiDou constellations enabling/disabling bit0 and bit7.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Example:

Enable GPS only (bit 0):

```
$PSTMPPS,2,11,1
```

2.3.15.11. Set PPS Data: PPS_IF_TIMING_DATA_CMD

This command is used to set timing data into PPS manager.

Synopsis:

```
$PSTMPPS,2,12,<fix_condition>,<sat_th>,<elevation_mask>,<constellation_mask>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = No fix (default) 2 = 2D fix 3 = 3D fix
sat_th	Decimal	Minimum number of satellites for the PPS generation. The default value is 0.
elevation_mask	Decimal	Minimum satellite elevation mask for satellite usage in timing filtering. The default value is 0.
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. The default value is 0. bit 0 = GPS

		bit 1 = GLONASS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.12. Set PPS Data: PPS_IF_POSITION_HOLD_DATA_CMD

This command is used to enable/disable position hold in PPS feature.

Synopsis:

```
$PSTMPPS,2,13,<on_off>,<lat>,<lat_dir>,<lon>,<lon_dir>,<h_msl>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = Position hold disabled (default) 1 = Position hold enabled
lat	DDMM.MMMMM	Latitude in position hold mode
lat_dir	N or S	North or south direction
lon	DDDMM.MMMMM	Longitude in position hold mode
lon_dir	E or W	East or west direction
h_msl	Double	Mean sea level altitude in position hold mode
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.13. Set PPS Data: PPS_IF_AUTO_HOLD_SAMPLES_CMD

This command is used to set the number of position samples for the auto position algorithm.

Synopsis:

```
$PSTMPPS,2,14,<auto_ph_samples>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
auto_ph_samples	Decimal, 1 digit	Number of position samples for the auto position algorithm.

		If the number of samples is set to 0, the auto position hold feature is disabled. The position average evaluation is restarted every time the command is executed.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.14. Set PPS Data: PPS_IF_TRAIM_CMD

This command is used to enable/disable TRAIM algorithm.

Synopsis:

```
$PSTMPPS,2,15,<on_off>,<alarm>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = TRAIM disabled 1 = TRAIM enabled (default)
alarm	Double	TRAIM alarm. Unit: s. Scientific notation is allowed.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Example:

Set the module to auto position hold mode:

```
$PSTMPPS,2,10,10   //Satellites with elevation angle below 10° are not involved in 1PPS timing
$PSTMPPS,2,11,1    //Set GPS satellite to participate in 1PPS timing
$PSTMPPS,2,19,1    //Set the GPS satellite UTC time as the 1PPS timing reference time
$PSTMPPS,2,14,3600
//Set the module to automatically calculate the position hold reference parameter after 3600 times positioning. The module will set the position hold reference position by itself after sending the command an hour later (3600 s).
$PSTMPPS,2,8,1     //Set the module to continuously output 1PPS when location lose lock.
//Wait for 1 hour.
$PSTMPPS,2,4,-10   //Execute this command to calibrate the 1PPS time error by comparing with the reference 1PPS output when the module 1PPS delays 10 ns compared to the reference time. Because the loss of RF link is existed objectively.
```

2.3.15.15. Set PPS Data: PPS_IF_REFERENCE_TIME_CMD

This command is used to set PPS reference time.

Synopsis:

```
$PSTMPPS,2,19,<reference_time>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
reference_time	Decimal, 1 digit	0 = UTC (default) 1 = GPS_UTC 2 = GLONASS_UTC. 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS 5 = COMPASS_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST **NOTES:** UTC_SU is the Soviet Union UTC derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. If the software is configured to work in GLONASS only mode, UTC_SU is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.16. Set PPS Data: PPS_IF_CONSTELLATION_RF_DELAY_CMD

This command sets pulse delay time caused by satellite RF signal transmission.

Synopsis:

```
$PSTMPPS,2,20,<sat_type><time_delay>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
sat_type	Decimal	Satellite constellation type: 0 = GPS 1 = GLONASS 3 = Galileo 7 = Compass
time_delay	Decimal	Time delay. Unit: ns.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.17. Get PPS Data: PPS_IF_PULSE_DATA_CMD

This command is used to get pulse information from PPS manager.

Synopsis:

```
$PSTMPPS,1,7*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_duration>,<pulse_polarity>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated 1 = PPS generated on even seconds 2 = PPS generated on odd seconds
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS 5 = COMPASS_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST

		NOTES: UTC_SU is the Soviet Union UTC derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. If the software is configured to work in GLONASS only mode, UTC_SU is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
pulse_delay	Decimal	Pulse delay. Unit: ns.
pulse_duration	Double	Pulse duration. Unit: s.
pulse_polarity	Decimal, 1 digit	0 = not inverted 1 = inverted
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.18. Get PPS Data: PPS_IF_TIMING_DATA_CMD

This command is used to get time information from PPS manager.

Synopsis:

```
$PSTMPPS,1,12*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,12,<fix_condition>,<sat_th>,<elevation_mask>,<constellation_mask>,<gps_rf_delay>,<glonass_rf_delay>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = No fix 2 = 2D fix 3 = 3D fix
sat_th	Decimal	Minimum number of satellites for the PPS generation
elevation_mask	Decimal	Minimum satellite elevation for satellite usage in timing filtering
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing

		filtering. bit0 = GPS bit1 = GLONASS bit7 = BeiDou
gps_rf_delay	Decimal	GPS path RF delay. Unit: ns.
glonass_rf_delay	Decimal	GLONASS path RF delay. Unit: ns.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.19. Get PPS Data: PPS_IF_POSITION_HOLD_DATA_CMD

This command is used to get position hold information from PPS manager. In position hold mode, the timing service is still available when there is only one visible satellite.

Synopsis:

```
$PSTMPPS,1,13*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,13,<on_off>,<lat>,<lat_dir>,<lon>,<lon_dir>,<h_msl>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = position hold disabled 1 = position hold enabled
lat	DDMM.MMMMM	Position hold position latitude
lat_dir	N or S	North or south direction
lon	DDDMM.MMMMM	Position hold position longitude
lon_dir	E or W	East or west direction
h_msl	Double	Position hold mean sea level altitude
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.20. Get PPS Data: PPS_IF_TRAIM_CMD

This command is used to get TRAIM related information from PPS manager. TRAIM is a timing calibration algorithm.

Synopsis:

```
$PSTMPPS,1,15*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,15,<TRAIM_enabled>,<TRAIM_solution>,<ave_error>,<used_sats>,<removed_sats>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
TRAIM_enabled	Decimal, 1 digit	TRAIM on/off status: 0 = off 1 = on
TRAIM_solution	Decimal, 1 digit	TRAIM algorithm status: 0 = under alarm 1 = over alarm 2 = unknown
ave_error	Decimal	Average time error. Unit: ns.
used_sats	Decimal	Number of satellites used for timing correction
removed_sats	Decimal	Number of satellites removed by the timing correction
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.21. Get PPS Data: PPS_IF_TRAIM_USED_CMD

This command is used to get satellites used in TRAIM algorithm from PPS manager.

Synopsis:

```
$PSTMPPS,1,16*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,16,<TRAIM_enabled>,<used_sats>,<sat1>,...,<satN>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
TRAIM_enabled	Decimal, 1 digit	TRAIM on/off status: 0 = off 1 = on
used_sats	Decimal	Number of satellites used for timing correction
sat1...satN	Decimal	List of satellites IDs
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.22. Get PPS Data: PPS_IF_TRAIM_RES_CMD

This command is used to get satellite residuals in TRAIM algorithm from PPS manager. Each residual is corresponding to the satellite in the used satellite list at the same message position.

Synopsis:

```
$PSTMPPS,1,17*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,17,<TRAIM_enabled>,<used_sats>,<res1>,…,<resN>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
TRAIM_enabled	Decimal, 1 digit	TRAIM on/off status: 0 = off 1 = on
used_sats	Decimal	Number of satellites used for timing correction
res1...resN	Decimal	List of satellites residuals. Unit: ns. Each residual corresponds to the satellite in the used satellite list at the same message position
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.15.23. Get PPS Data: PPS_IF_TRAIM_REMOVED_CMD

This command is used to get removed satellites in TRAIM algorithm from PPS manager.

Synopsis:

```
$PSTMPPS,1,18*<checksum><CR><LF>
```

Result:

```
$PSTMPPS,1,18,<TRAIM_enabled>,<rem_sats>,<sat1>,...,<satN>*<checksum><CR><LF>
```

The parameters included in the result above are listed below:

Parameter	Format	Description
TRAIM_enabled	Decimal, 1 digit	TRAIM on/off status: 0 = off 1 = on
rem_sats	Decimal	Number of satellites removed by timing correction
sat1...satN	Decimal	List of satellites IDs
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

2.3.16. $PSTMFORCESTANDBY

Force the module into standby mode.

Synopsis:

```
$PSTMFORCESTANDBY,<duration>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
Duration	Decimal, 5 digits	Duration of the standby time in seconds. Range: 0-99999. When set to 0, the module remains in standby mode until it is awakened by driving WAKE_UP pin to high voltage level.
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  ```
  $PSTMFORCESTANDBYOK*<checksum><CR><LF>
  ```

- In case of errors, the returned message will be:

```
$PSTMFORCESTANDBYERROR*<checksum><CR><LF>
```

2.3.17. $PSTMGEOFENCEREQ

This command forces the GNSS receiver to send a **$PSTMGEOFENCE** message to query internal geo-fence subsystem status.

The geofence must be enabled otherwise the request will be rejected with an error. To enable the geofence, it is required a change in firmware configuration which can be done also through the command **$PSTMCFGGEOFENCE**.

Synopsis:

```
$PSTMGEOFENCEREQ*<checksum><CR><LF>
```

Arguments:

None.

Results:

- If there are no errors, the following message will be returned. For more details, please refer to ***Chapter 3.2.2.2***.

```
$PSTMGEOFENCESTATUS,<timestamp>,<datestamp>,<status_1>,<status_2>,…,<status_x>*<checksum><CR><LF>
```

- In case of errors, the returned message will be:

```
$PSTMGEOFENCEREQERROR*<checksum><CR><LF>
```

2.3.18. $PSTMODOSTART

Enable and reset the odometer subsystem, which calculates the ground distance from the current resolved position.

The odometer must be enabled otherwise the request will be rejected with an error. It can be enabled through command **$PSTMCFGODO**.

Synopsis:

```
$PSTMODOSTART*<checksum><CR><LF>
```

Arguments:

None.

Results:

- If there are no errors, the returned message will be:

  $PSTMODOSTARTOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMODOSTARTERROR*<checksum><CR><LF>

2.3.19. $PSTMODOSTOP

Stop the odometer subsystem.

The odometer must be enabled otherwise the request will be rejected with an error. It can be enabled through the software command **$PSTMCFGODO**.

Synopsis:

$PSTMODOSTOP*<checksum><CR><LF>

Arguments:

None.

Results:

- If there are no errors, the returned message will be:

  $PSTMODOSTOPOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMODOSTOPERROR*<checksum><CR><LF>

2.3.20. $PSTMODOREQ

Request the odometer status.

The odometer must be enabled otherwise the request will be rejected with an error. It can be enabled through the software command **$PSTMCFGODO**.

Synopsis:

```
$PSTMODOREQ*<checksum><CR><LF>
```

Arguments:

None.

Results:

- If there are no errors, the returned message will be:

  ```
  $PSTMODO
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMODOREQERROR*<checksum><CR><LF>
  ```

2.3.21. $PSTMCFGCONST

This command configures the satellite constellation. The changes take places on run time and will be saved only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGCONST,<gps>,<glonass>,<galileo>,<qzss>,<beidou>,<irnss>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
gps	Unsigned	GPS constellation status: 0 = constellation off 1 = constellation being tracked 2 = constellation tracked and used in positioning
glonass	Unsigned	GLONASS constellation status: 0 = constellation off 1 = constellation being tracked 2 = constellation tracked and used in positioning
galileo	Unsigned	Galileo constellation status: 0 = constellation off 1 = constellation being tracked 2 = constellation tracked and used in positioning
qzss	Unsigned	QZSS constellation status: 0 = constellation off 1 = constellation being tracked

		2 = constellation tracked and used in positioning
beidou	Unsigned	BeiDou constellation status: 0 = constellation off 1 = constellation being tracked 2 = constellation tracked and used in positioning
irnss	Unsigned	IRNSS constellation status: 0 = constellation off 1 = constellation being tracked 2 = constellation tracked and used in positioning
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

```
$PSTMCFGCONFOK*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMCFGCONFERROR*<checksum><CR><LF>
```

NOTES

1. L89 GNSS module supports GPS, GLONASS, BeiDou, Galileo, QZSS and IRNSS constellations which cannot be enabled at the same time. Any constellation can be enabled as a standalone satellite navigation system.
2. The default constellation combination of L89 is: GPS + Galileo + IRNSS.

2.3.22. $PSTMODORESET

This command resets the odometer subsystem.

The odometer must be enabled otherwise the request will be rejected with an error. It can be enabled through the software command **$PSTMCFGODO**.

Synopsis:

```
$PSTMODORESET,<odo_mask>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
odo_mask	Decimal	The odometers to be reset: 0 = none 1 = Odo-A 2 = Odo-B 3 = Odo-A and Odo-B 4 = Odo-Tot 5 = Odo-A and Odo-Tot 6 = Odo-B and Odo-Tot 7 = Odo-A, Odo-B and Odo-Tot
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMODORESETOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMODORESETERROR*<checksum><CR><LF>

2.3.23. $PSTMCFGPORT

Configure a general-purpose port for NMEA, STBIN, DEBUG or RTCM. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

$PSTMCFGPORT,<port_type>,<protocol_type>,<port_numb>,<baud_rate>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
port_type	Decimal, 1 digit	Select the port type: 0 = UART
protocol_type	Decimal, 1 digit	Select the protocol type: 0 = NMEA
port_numb	From 0 to 255	UART GPIO ID (Linearly addressed) **NOTE:** No NMEA sentence will be output if configuration of

		this parameter is incorrect. Only by re-flashing firmware can this issue be resolved. An example of obtaining current NMEA port number is as follows: Command: **$PSTMGETPAR,1101<CR><LF>** Response: **$PSTMSETPAR,1101,0x01*53<CR><LF>** According to the response, the current NMEA port number is 1. Set the baud rate of NMEA port 1 to 115200 bps: **$PSTMCFGPORT,0,0,1,115200<CR><LF>** **$PSTMSAVEPAR<CR><LF>** **$PSTMSRR<CR><LF>**
baud_rate	Integer	Baud rate of the port. Allowed values are: 9600 115200 230400 460800 921600 **NOTE:** If the baud rate exceeds 230400 bps, it is recommended to increase the CPU frequency by the following commands to avoid data loss: **$PSTMSETPAR,1130,0x00<CR><LF>** **$PSTMSAVEPAR<CR><LF>** **$PSTMSRR<CR><LF>**
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMCFGPORTOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMCFGPORTERROR*<checksum><CR><LF>

2.3.24. $PSTMCFGTDATA

This command configures date and time related parameters. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGTDATA,<gps_min_week>,<gps_max_week>,<fix_rate>,<utcdelta>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
gps_min_week	Unsigned	GPS minimum week number. The default value is 1964.
gps_max_week	Unsigned	GPS maximum week number. The default value is 3443.
fix_rate	Double	Fix rate. Unit: second. The default value is 1.
utcdelta	Unsigned	UTC delta time
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there is no error, the following confirmation message will be returned:

  ```
  $PSTMCFGTDATAOK*<checksum><CR><LF>
  ```

- If there is any error, the following message will be returned:

  ```
  $PSTMCFGTDATAERROR*<checksum><CR><LF>
  ```

Example:

```
//Configure the output frequency of NMEA standard messages to 10 Hz
$PSTMSETPAR,1130,0x00<CR><LF>
//Increase CPU frequency before using the 460800 bps baud rate
$PSTMCFGPORT,0,0,1,460800<CR><LF>                    //Configure baud rate to 460800 bps
$PSTMCFGTDATA,1964,3443,0.1,00000012<CR><LF>         //Configure output frequency to 10 Hz
$PSTMCFGMSGL,1,1,0x00180056,0x7ec20010<CR><LF> //Set NMEA message list 1 as the output list
$PSTMSAVEPAR<CR><LF>                                 //Save the current configurations
$PSTMSRR<CR><LF>                                     //Reset the module
```

For details of other parameters in $PSTMCFGPORT and $PSTMCFGMSGL, please refer to corresponding chapters.

2.3.25. $PSTMCFGMSGL

This command configures the message list. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

$PSTMCFGMSGL,<listid>,<rate>,<listlow>,<listhigh>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA message list 0 1 = NMEA message list 1 (dedicated for NMEA standard messages output frequency ≥ 2 Hz)
rate	From 0 to 255	Message list rate scaler
listlow	Hexadecimal, 8 digits	Low 32 bits. **NOTE:** CDB-ID 201 represents this low 32 bits of extended 64 bits NMEA message list. The command to get the current configuration is as follows: **$PSTMGETPAR,1201<CR><LF>** Response: **$PSTMSETPAR,1201,0x00180056*5B<CR><LF>**
listhigh	Hexadecimal, 8 digits	High 32 bits. **NOTE:** CDB-ID 228 represents this high 32 bits of extended 64 bits NMEA message list. The command to get configuration value is as follows: **$PSTMGETPAR,1228<CR><LF>** Response: **$PSTMSETPAR,1228,0x7ec22000*5B<CR><LF>**
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

NOTE

For each bit, 0 means the feature is disabled, while 1 means the feature is enabled.

Table 13: NMEA Message List

Bit	Bitmask (32 bits)	Function
Low 32 bits		
0	0x1	$GPGNS message
1	0x2	$GPGGA message
2	0x4	$GPGSA message
3	0x8	$GPGST message
4	0x10	$GPVTG message
5	0x20	Reserved
6	0x40	$GPRMC message
7	0x80	Reserved
8	0x100	Reserved
9	0x200	Reserved
10	0x400	Reserved
11	0x800	Reserved
12	0x1000	Reserved
13	0x2000	Reserved
14	0x4000	Reserved
15	0x8000	Reserved
16	0x10000	Reserved
17	0x20000	$PSTMSBAS Message
18	0x40000	Reserved
19	0x80000	$GPGSV message
20	0x100000	$GPGLL message
21	0x200000	$PSTMPPSDATA Message
22	0x400000	Reserved

23	0x800000	Reserved
24	0x1000000	$GPZDA message
25	0x2000000	Reserved
26	0x4000000	Reserved
27	0x8000000	Reserved
28	0x10000000	Reserved
29	0x20000000	Reserved
30	0x40000000	Reserved
31	0x80000000	Reserved
High 32 bits		
32	0x1	Reserved
33	0x2	Reserved
34	0x4	Reserved
35	0x8	Reserved
36	0x10	$PSTMANTENNASTATUS message
37	0x20	Reserved
38	0x40	Reserved
39	0x80	$GPDTM message
40	0x100	Reserved
41	0x200	Reserved
42	0x400	Reserved
43	0x800	Reserved
44	0x1000	Reserved
45	0x2000	$GPGBS message
46	0x4000	Reserved
47	0x8000	Reserved

48	0x10000	Reserved
49	0x20000	Reserved
50	0x40000	$PSTMODO message
51	0x80000	$PSTMGEOFENCESTATUS message
52	0x100000	Reserved
53	0x200000	Reserved
54	0x400000	Reserved
55	0x800000	Reserved
56	0x1000000	Reserved
57	0x2000000	Reserved
58	0x4000000	Reserved
59	0x8000000	Reserved
60	0x10000000	Reserved
61	0x20000000	Reserved
62	0x40000000	Reserved
63	0x80000000	$GARLM message

Results:

- If there are no errors, the returned message will be:

  $PSTMCFGMSGLOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMCFGMSGLERROR*<checksum><CR><LF>

Example:

```
//Disable the output of RMC sentence.
$PSTMGETPAR,1201<CR><LF>                    //Input
$PSTMSETPAR,1201,0x00180056*5B<CR><LF>      //Response
$PSTMGETPAR,1228<CR><LF>                    //Input
$PSTMSETPAR,1228,0x7ec22000*5B<CR><LF>      //Response
//The bitmask of $GPRMC message is 0x40, low 32 bits. Then, 0x00180056 – 0x40 = 0x00180016.
```

```
$PSTMCFGMSGL,0,1,00180016,7ec22000<CR><LF>    //Configure
$PSTMSAVEPAR<CR><LF>                          //Save
$PSTMSRR<CR><LF>                              //Reset
```

2.3.26. $PSTMCFGAGPS

Configures the Assisted GPS. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGAGPS,<en_agps>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
en_agps	Decimal	Enable/disable AGPS engine 0 = AGPS disabled (default) 1 = AGPS enabled
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  ```
  $PSTMCFGAGPSOK*<checksum><CR><LF>
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMCFGAGPSERROR*<checksum><CR><LF>
  ```

2.3.27. $PSTMCFGAJM*

Configure the anti-jamming algorithm. The anti-jamming algorithm protects receivers from interference and intentional jamming. If anti-jamming algorithm is disabled, the module will lose fix quickly when facing narrowband interference. After enabled, when the module encounters narrowband interference, only the C/No slightly reduces and the module can maintain positioning status. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGAJM,<gpsmode>,<glonassmode>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
gpsmode	Decimal, 1 digit	Notch filter on GPS path: 0 = disable 1 = normal mode 2 = auto mode (default)
glonassmode	Decimal, 1 digit	Notch filter on GLONASS path: 0 = disable 1 = normal mode 2 = auto mode (default)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

```
$PSTMCFGAJMOK*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMCFGAJMERROR*<checksum><CR><LF>
```

NOTE

"*" means under development.

2.3.28. $PSTMCFGODO

Configure the odometer. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGODO,<en>,<auto>,<enmsg>,<alarm>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
en	Decimal, 1 digit	Enable/disable the odometer: 0 = odometer disabled (default) 1 = odometer enabled

auto	Decimal, 1 digit	Enable/disable the auto-start (e.g. odometer is automatically started on start-up and no **$PSTMODOSTART** command is required): 0 = auto-start disabled (default) 1 = auto-start enabled
enmsg	Decimal, 1 digit	Enable/disable odometer related periodic messages: 0 = periodic message disabled (default) 1 = periodic message enabled
alarm	Decimal, 0 – 65535	Distance travelled between two NMEA messages. The range is 0-65535 and the default value is 1000. Unit: meter.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

```
$PSTMCFGODOOK*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMCFGODOERROR*<checksum><CR><LF>
```

Example:

```
$PSTMCFGODO,1,0,0,0        //Enable odometer feature
$PSTMSAVEPAR               //Save
$PSTMSRR                   //Reset
$PSTMODOSTART              //Start odometer
$PSTMODOSTOP               //Stop odometer
$PSTMODOREQ                //Inquiry odometer
$PSTMODORESET              //Reset odometer
```

2.3.29. $PSTMCFGGEOFENCE

This command enables/disables the geo-fencing feature, and selects the tolerance. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGGEOFENCE,<en>,<tol>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
en	Decimal, 1 digit	Enable/disable the geo fencing: 0 = geo-fencing disabled (default) 1 = geo-fencing enabled
tol	Decimal, 1 digit	Tolerance: 0 = No tolerance 1 = Geofencing status probability is 68% (default) 2 = Geofencing status probability is 95% 3 = Geofencing status probability is 99%
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

```
$PSTMCFGGEOFENCEOK*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMCFGGEOFENCEERROR*<checksum><CR><LF>
```

Example:

```
$PSTMCFGGEOFENCE,1,1          //Enable the geo-fencing feature
$PSTMCFGGEOCIR,1,1,31.839225,117.21645277777777,200
                              //Set the geo-fencing circle parameters
$PSTMSAVEPAR                  //Save
$PSTMSRR                      //Reset
$PSTMGEOFENCEREQ              //Inquiry the status
$PSTMGEOFENCESTATUS,022026,20190402,1,1,1,1,0,0,0,0*00
                              //Response: the current position is outside of the circle.
```

2.3.30. $PSTMCFGGEOCIR

Configure geo-fencing circle parameters. The changes will take place only by issuing a **$PSTMSAVEPAR** command and rebooting (e.g. issuing **$PSTMSRR**). Once saved, the configurations are permanent and remain applied even after a power cycle.

Synopsis:

```
$PSTMCFGGEOCIR,<circleid>,<en>,<lat>,<lon>,<rad>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
circleid	Decimal, 1 digit	Geo-fencing circle ID From 0 to 4
en	Boolean	Enable/disable the circle 0 = disable 1 = enable
lat	Double	The corresponding circle latitude
lon	Double	The corresponding circle longitude
rad	Double	The corresponding circle radius
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMCFGGEOCIROK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMCFGGEOCIRERROR*<checksum><CR><LF>

2.3.31. $PSTMSETTHTRK

Configure the C/No and elevation mask thresholds for tracking. This command changes these parameters at run-time and no reset is required. In case of reset, tracking C/No threshold and elevation mask angle are restored back to default values.

Synopsis:

$PSTMSETTHTRK,<C/No>,<el>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
C/No	Decimal	Tracking C/No threshold. Unit: dB. The default value is 7.
el	Double	Tracking elevation mask angle. Unit: degree. The default value is 5.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMSETTHTRKOK*<checksum><CR><LF>

- In case of any error, the returned message will be:

  $PSTMSETTHTRKERROR*<checksum><CR><LF>

2.3.32. $PSTMSETTHPOS

Configure the C/No threshold and elevation mask angle for positioning. This command changes these parameters at run-time and no reset is required. In case of reset, positioning C/No threshold and elevation mask angle are restored back to the default values.

Synopsis:

$PSTMSETTHPOS,<C/No>,<el>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
C/No	Decimal	Positioning C/No threshold as dB. The default value is 15.
el	Double	Positioning elevation mask angle as degree. The default value is 5.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  $PSTMSETTHTRKOK*<checksum><CR><LF>

- In case of error, this error message is returned:

  $PSTMSETTHTRKERROR*<checksum><CR><LF>

2.3.33. $PSTMSETANTSENSOPMODE

Set antenna sensing operating mode: auto or manual. The changes will take effect at runtime and restore back to default configurations after reset.

Synopsis:

```
$PSTMSETANTSENSOPMODE,<operating_mode>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
operating_mode	Decimal, 1 digit	Select the antenna sensing operating mode: 0 = auto (default) 1 = manual
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- If there are no errors, the returned message will be:

  ```
  $PSTMSETANTSENSOPMODEOK*<checksum><CR><LF>
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMSETANTSENSOPMODEERROR*<checksum><CR><LF>
  ```

2.3.34. $PSTMSETANTSENSMANUAL

Force antenna power switching, antenna RF path switching, antenna status message, and set the antenna detection process to active/stop. The command can be used only when the antenna operating mode is set to manual. The changes will take effect at runtime and restore back to default configurations after reset.

Synopsis:

```
$PSTMSETANTSENSMANUAL,<pwr_switch>,<rf_path>,<get_update>,<start_stop>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
pwr_switch	Decimal, 1 digit	Switch on/off the antenna power supply 0 = do nothing 1 = switch on the antenna power supply 2 = switch off the antenna power supply
rf_path	Decimal, 1 digit	Force the switching of antenna RF path 0 = do nothing 1 = switch to external antenna

		2 = switch to internal antenna
get_update	Decimal, 1 digit	Force the $PSTMANTENNASTATUS message to be sent once: 0 = do not send message 1 = manual mode
start_stop	Decimal, 1 digit	Force start or stop of antenna detection process: 0 = start antenna detection 1 = stop antenna detection
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

Results:

- In case of no errors, the following corresponding messages will be returned:

  If get_update is 0:

  ```
  $PSTMSETANTSENSMANUALOK*<checksum><CR><LF>
  ```

  If get_update is 1:

  ```
  $PSTMSETANTSENSMANUALOK*<checksum><CR><LF>
  $PSTMANTENNASTATUS,<ant_status>,<op_mode>,<rf_path>,<pwr_switch>*<checksum><CR><LF>
  ```

- In case of errors (including auto antenna operating mode), the returned message will be:

  ```
  $PSTMSETANTSENSMANUALERROR*<checksum><CR><LF>
  ```

2.4. System Commands

The GNSS software utilizes a "Configuration Data Block" in which parameters used for receiver configuration are grouped.

2.4.1. $PSTMGETPAR

This command gets the software version information.

Synopsis:

```
$PSTMGETPAR,1500*<checksum><CR><LF>
```

Arguments:

None.

Results:

- In case of no errors, the version information is returned:

```
$PSTMSETPAR,1500,<version info>*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMGETPARERROR*<checksum><CR><LF>
```

Example:

```
$PSTMGETPAR,1500                    //Input
$PSTMSETPAR,1500,L89NR01A06V01*5F   //Response
```

2.4.2. $PSTMSAVEPAR

This command saves the current configuration data block into the backup memory.

Synopsis:

```
$PSTMSAVEPAR*<checksum><CR><LF>
```

Arguments:

None.

Results:

- In case of no errors, the current configuration data block, including changed parameters, will be stored into the backup memory (NVM) and the returned message will be:

```
$PSTMSAVEPAROK*<checksum><CR><LF>
```

- In case of any error, the returned message will be:

```
$PSTMSAVEPARERROR*<checksum><CR><LF>
```

Example:

```
$PSTMSAVEPAR
```

2.4.3. $PSTMRESTOREPAR

This command restores the factory default settings. The configuration data block stored in NVM, if present, will be invalidated. Any changed parameter will be lost.

Synopsis:

```
$PSTMRESTOREPAR*<checksum><CR><LF>
```

Arguments:

None.

Results:

- If there are no errors, the factory default settings will be restored and the configuration block in the backup memory will be lost. A system reboot is needed to complete the factory reset restoring to get the system working with default settings. In such a case, the returned message will be:

  ```
  $PSTMRESTOREPAROK*<checksum><CR><LF>
  ```

- In case of any error, the returned message will be:

  ```
  $PSTMRESTOREPARERROR*<checksum><CR><LF>
  ```

Example:

```
$PSTMRESTOREPAR
```

3 Messages

3.1. NMEA Standard Messages

This chapter introduces the NMEA standard messages supported by L89 module.

3.1.1. List of NMEA Standard Messages

L89 module supports output of the following six types of NMEA standard messages by default.

Table 14: List of NMEA Standard Messages

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

3.1.2. NMEA Standard Messages Specification

These messages are defined within the NMEA 0183 specification. The structure of NMEA messages is shown as below.

Table 15: Structure of NMEA Standard Message

Filed	Length (Bytes)	Description
$	1	Each NMEA message starts with **$**
Talker ID	2	GP: If the system works in GPS only mode GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode
NMEA Message ID	3	NMEA message ID
Data Field	Variable, depend on the NMEA message type	Data fields, delimited by comma (**,**)
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.1. $--RMC

RMC, Recommended Minimum Specific GNSS Data. Time, date, position, course and speed data provided by a GNSS navigation receiver. All data fields must be provided, and null fields can be used only while the data is temporarily unavailable.

Format for NMEA 0183 Rev 3.01 (Default):
$GPRMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/W>,<Speed>,<Trackgood>,<Date>,<MagVar>,<MagVarDir>,<mode>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$<TalkerID>RMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/W>,<Speed>,<Trackgood>,<Date>,<MagVar>,<MagVarDir>,<mode>,<Nav_status>*<checksum><CR><LF>
Example for NMEA 0183 Rev 3.01 (Default):
$GPRMC,091241.000,A,3150.79761,N,11711.92397,E,0.0,351.6,130619,,,A*64
Example for NMEA 0183 Rev 4.10:
$GNRMC,202340.000,A,4045.53297,N,01447.20361,E,0.2,0.0,291117,,,A,C*18

Field	Format	Description
$	Char	Each NMEA message starts with **$**

TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (fixed two digits) mm: minutes (fixed two digits) ss: seconds (fixed two digits) .sss: decimal fraction of seconds (variable) Please note that decimal fraction assumes nonzero values when the fix rate is bigger than 1 Hz. And for Rev 4.10, this field is empty in case of invalid value.
Status	A or V	V = Invalid A = Valid
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (fixed two digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable) Please note that for Rev 4.10, this field is empty in case of invalid value.
N/S	N or S	Latitude direction: N = North S = South Please note that for Rev 4.10, this field is empty in case of invalid value.
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (fixed three digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable) Please note that for Rev 4.10, this field is empty in case of invalid value.
E/W	E or W	Longitude direction: E = East W = West Please note that for Rev 4.10, this field is empty in case of invalid value.
Speed	x.x, variable length field	Speed over ground in knots

Trackgood	x.x, variable length field	Course made good, max. 999.9
Date	Decimal, 6 digits	Date in format ddmmyy
MagVar	Decimal, 4 digits	Magnetic variation in degree, not being output
MagVarDir	E or W	Magnetic variation E or W indicator, not being output
Mode	D, A, N or E	Positioning system Mode Indicator: D = Differential mode A = Autonomous mode N = data not valid E = Estimated (dead reckoning) mode
Nav_status	S, C, U or V	Navigational status indicator: S = Safe C = Caution U = Unsafe V = Not valid
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.2. $--VTG

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

Format for NMEA 0183 Rev 3.01 (Default):
$GPVTG,<TMGT>,T,<TMGM>,M,<SoGN>,N,<SoGK>,K,D*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$<TalkerID>VTG,<TMGT>,T,<TMGM>,M,<SoGN>,N,<SoGK>,K,D*<checksum><CR><LF>
Example:
$GPVTG,73.2,T,,M,0.2,N,0.4,K,D*50

Field	Format	Description
$	Char	Each NMEA message starts with **$**
TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode

		IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode
TMGT	ddd.d in degrees	Track in reference to “true” earth poles
T		Indicate “terrestrial”
TMGM	ddd.d in degrees	Track in reference to “magnetic” earth poles
M		Indicate “magnetic”
SoGN	ddd.d in knots	Speed over ground in knots
N		Indicate “knots”
SoGK	ddd.d in km/h	Speed over ground in kilometers per hour
K		Indicate “kilometers”
D	Char	Mode indicator: A = Autonomous mode D = Differential mode E = Estimated mode
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.3. $--GGA

GGA, Global Positioning System Fix Data.

Format for NMEA 0183 Rev 3.01 (Default):
$GPGGA,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,<HDOP>,<Alt>,<AltVal>,<GeoSep>,<GeoVal>,<DGPSAge>,<DGPSRef>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$<TalkerID>GGA,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,<HDOP>,<Alt>,<AltVal>,<GeoSep>,<GeoVal>,<DGPSAge>,<DGPSRef>*<checksum><CR><LF>
Example:
$GPGGA,183417.000,04814.03970,N,01128.52205,E,0,00,99.0,495.53,M,47.6,M,,*53

Field	Format	Description
$	Char	Each NMEA message starts with **$**
TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode

		GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (fixed two digits) mm: minutes (fixed two digits) ss: seconds (fixed two digits) .sss: decimal fraction of seconds (variable) Please note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz. For Rev 4.10, this field is empty in case of invalid value.
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (fixed two digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable) Please note that for Rev 4.10, this field is empty in case of invalid value.
N/S	N or S	Latitude direction: North or South Please note that for Rev 4.10, this field is empty in case of invalid value.
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (fixed three digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable) Please note that for Rev 4.10, this field is empty in case of invalid value.
E/W	E or W	Longitude direction: East or West Please note that for Rev 4.10, this field is empty in case of invalid value.
GPSQual	Decimal, 1digit	0 = Fix not available or invalid 1 = GPS, SPS Mode, fix valid 2 = Differential GPS, SPS Mode, fix valid 6 = Estimated (dead reckoning) mode
Sats	Decimal, 2 digits	Satellites in use, for example, 08
HDOP	x.x, variable length field	Horizontal dilution of precision. Max: 99.0
Alt	x.x, variable length field	Height above mean sea level. Max: 100000.0 m
AltVal	M	Reference unit for altitude (M = meters)

GeoSep	x.x, variable length field	Geoidal separation (M = meters)
GeoVal	M	Reference unit for GeoSep (M = meters)
DGPSAge	Empty	Not supported
DGPSRef	Empty	Not supported
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.4. $--GSA

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.

In case of multi-constellation mode, the talker ID is always GN. If NMEA is set as Rev 3.01, it is possible to force the talker ID as GN.

When NMEA is set as Rev 4.10, the talker ID could not be forced and is managed internally to be compliant with the standard. For information about available values of Talker ID, please check the following parameter table.

Format for NMEA 0183 Rev 3.01 (Default):
$--GSA,<Mode>,<CurrentMode>,<SatPRN1>,...,<SatPRNN>,<PDOP>,<HDOP>,<VDOP>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$<TalkerID>GSA,<Mode>,<CurrentMode>,<SatPRN1>,...,<SatPRNN>,<PDOP>,<HDOP>,<VDOP>,<SystemID>*<checksum><CR><LF>
Example for NMEA 0183 Rev 3.01 (Default):
$GPGSA,A,3,05,21,07,24,30,16,12,,,,,,2.4,1.9,1.5*38
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
$GNGSA,A,3,67,66,81,65,88,75,82,74,,,,, 1.1,0.6,0.9,2*3D
$GNGSA,A,3,03,05,22,08,30,16,12,,,,,, 1.1,0.6,0.9,3*32

Field	Format	Description
$	Char	Each NMEA message starts with **$**
TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode

		GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode.
Mode	1 character	M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to automatically switch 2D/3D
CurrentMode	Decimal, 1 digit	1 = Fix not available 2 = 2D 3 = 3D
SatPRN (1 to 12)	Decimal, 2 or 3 digits	Satellites list used for positioning
PDOP	x.x, variable length field	Position dilution of precision. Max: 99.0
HDOP	x.x, variable length field	Horizontal dilution of precision. Max: 99.0
VDOP	x.x, variable length field	Vertical dilution of precision. Max: 99.0
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = Galileo 4 = BeiDou 5 = QZSS 6 = IRNSS
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.5. $--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.

If multiple GPS, GLONASS, Galileo, etc. satellites are in view, use separate GSV sentences with talker ID

GP to show the GPS satellites in view and talker GL to show the GLONASS satellites in view and talker GA to show the Galileo satellites in view, etc. When more than ranging signal is used per satellite, also use separate GSV sentences with a Signal ID corresponding to the ranging signal.

The GN identifier shall not be used with this sentence.

Format for NMEA 0183 Rev 3.01 (Default):
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1C/No>,…,<Sat4PRN>,<Sat4Elev>,<Sat4Azim>,<Sat4C/No>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1C/No>,…,<Sat4PRN>,<Sat4Elev>,<Sat4Azim>,<Sat4C/No>,<SignalID>*<checksum><CR><LF>
Example for NMEA 0183 Rev 3.01 (Default):
$GPGSV,3,1,12,02,04,037,,05,27,125,44,06,78,051,23,07,83,021,30*7C
$GPGSV,3,2,12,10,16,067,30,12,11,119,36,16,24,301,41,21,44,175,50*73
$GPGSV,3,3,12,23,06,326,28,24,61,118,40,30,45,122,43,31,52,253,37*7C
$IRGSV,2,1,07,802,65,274,28,803,57,167,16,804,48,094,24,806,33,248,27*73
$IRGSV,2,2,07,807,24,110,26,809,22,206,24,805,22,136,,,,,*75
Example for NMEA 0183 Rev 4.10:
$GPGSV,3,1,11,02,67,018,44,05,65,296,27,06,39,086,46,13,29,181,32,1*62
$GPGSV,3,2,11,19,23,152,18,29,19,321,24,12,19,244,,09,17,042,36,1*63
$GPGSV,3,3,11,25,13,281,24,17,06,151,25,30,06,107,32,,,,,1*5C
$GLGSV,2,1,06,85,72,023,47,70,72,002,42,71,48,227,,84,35,125,21,1*73
$GLGSV,2,2,06,86,22,330,22,69,16,031,38,,,,,,,,1*71

Field	Format	Description
$	Char	Each NMEA message starts with **$**
TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode
GSVAmount	Decimal, 1 digit	Total amount of GSV messages. Max: 8
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total number of satellites in view. Max: 32
SatxPRN	Decimal, 2 digits	Satellites list used for positioning
SatxElev	Decimal, 2 digits	Elevation of satellite x in degree, 0-90

SatxAzim	Decimal, 3 digits	Azimuth of satellite x in degree, ref. "North", 000 to 359
SatxC/No	Decimal, 2 digits	Carrier to noise ratio for satellite x in dB, 00 - 99
SignalID	Decimal, 1 digit	An identifier to indicate the signal in use. Currently it is 1 for GPS and GLONASS, 2 for BeiDou and QZSS, 6 for Galileo
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.1.2.6. $--GLL

GLL, Geographic Position – Latitude and Longitude.

Format for NMEA 0183 Rev 3.01 (Default):
$GPGLL,<Lat>,<N/S>,<Long>,<E/W>,<Timestamp>,<Status>,<mode indicator>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$<TalkerID>GLL,<Lat>,<N/S>,<Long>,<E/W>,<Timestamp>,<Status>,<mode indicator>*<checksum><CR><LF>
Example:
$GPGLL,4055.04673,N,01416.54941,E,110505.000,A,A*54

Field	Format	Description
$	Char	Each NMEA message starts with **$**
TalkerID	String, 2 characters	The talker ID (fixed two characters): GP: If the system works in GPS only mode GL: If the system works in GLONASS only mode GA: If the system works in Galileo only mode BD: If the system works in BeiDou only mode QZ: If the system works in QZSS only mode IR: If the system works in IRNSS only mode GN: If the system works in multi-constellation mode.
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (fixed two digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable)

		Please note that for Rev 4.10, this field is empty in case of invalid value.
N / S	N or S	Latitude direction: N = north S = south Please note that for Rev 4.10, this field is empty in case of invalid value.
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (fixed three digits) MM: Minutes (fixed two digits) .MMMMM: Decimal fraction of minutes (variable) Please note that for Rev 4.10, this field is empty in case of invalid value.
E / W	E or W	Longitude direction: E = east W = west Please note that for Rev 4.10, this field is empty in case of invalid value.
Timestamp	hhmmss.sss	UTC time of GGL sample .sss is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Status	A or V	Validity of data: A = valid V = invalid
Mode indicator	D, A, N or E	Positioning system mode indicator: D = Differential mode A = Autonomous mode N = data not valid E = Estimated (dead reckoning) mode
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between **$** and *****
<CR><LF>	2	Each NMEA message ends with **<CR><LF>**

3.2. NMEA Proprietary Messages

This chapter introduces the NMEA proprietary messages supported by L89 module.

3.2.1. List of NMEA Proprietary Messages

Table 16: List of NMEA Proprietary Messages

Syntax	Default	Description
$PSTMANTENNASTATUS	ON	Report the status of the antenna
$PSTMGEOFENCESTATUS	OFF	Report the status of the geo-fence
$PSTMODO	OFF	Report the values of the odometer
$PSTMPPSDATA	OFF	Report the pulse per second data
$PSTMSBAS	OFF	Report SBAS satellite data

3.2.2. NMEA Proprietary Messages Specification

3.2.2.1. $PSTMANTENNASTATUS

Report the status of the antenna (working normally, open or short). It reports also information on antenna detection operating mode as well as the information on which antenna is being used (external or internal).

Synopsis:

$PSTMANTENNASTATUS,<ant_status>,<op_mode>,<rf_path>,<pwr_switch>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
ant_status	Decimal, 1 digit	External antenna status: 0 = normal 1 = open circuit 2 = short-circuited
op_mode	Decimal, 1 digit	Operating mode 0 = Auto - the antenna is managed automatically by the software logic 1 = Manual - the antenna ON-OFF or RF switching is controlled by commands
rf_path	Decimal, 1 digit	Current RF path: 0 = external antenna 1 = internal antenna
pwr_switch	Decimal, 1 digit	Current antenna power status:

		0 = antenna power is on 1 = antenna power is off
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

3.2.2.2. $PSTMGEOFENCESTATUS

This message is sent from GNSS receiver to the host as response to **$PSTMGEOFENCEREQ**. Geo-fencing reports a bitmap against which circle is raising the alarm.

Synopsis:

```
$PSTMGEOFENCESTATUS,<timestamp>,<datestamp>,<status_1>,<status_2>,…,<status_x>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
timestamp	Decimal, 6 digits	Hour (2 digits) Minute (2 digits) Seconds (2 digits)
datestamp	Decimal, 8 digits	Year (4 digits) Month (2 digits) Day (2 digits)
status_x	Decimal, 1 digit	Geo-fencing status for each circle where: 0 = status unknown 1 = the current position is outside the circle 2 = the current position on circle boundary 3 = the current position is inside the circle
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

3.2.2.3. $PSTMODO

The message is sent from GNSS receiver to the host periodically if odometer subsystem is enabled and related messages are in the message list.

Synopsis:

```
$PSTMODO,<timestamp>,<date-stamp>,<odo-A>,<odo-B>,<odo-pon>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
Timestamp	Decimal, 6 digits	Hour (2 digits) Minute (2 digits) Seconds (2 digits)
date-stamp	Decimal, 8 digits	Year (4 digits) Month (2 digits) Day (2 digits)
odo-A	Unsigned	Odometer A value
odo-B	Unsigned	Odometer B value
odo-pon	Unsigned	Odometer PON value
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and ***** characters

3.2.2.4. $PSTMPPSDATA

This message is used to report the PPS data.

Synopsis:

$PSTMPPSDATA,<on_off>,<pps_valid>,<synch_valid>,<out_mode>,<ref_time>,<ref_constellation>,<pulse_duration>,<pulse_delay>,<gps_delay>,<glo_delay>,<bei_delay>,<gal_delay>,<inverted_polarity>,<fix_cond>,<sat_th>,<elev_mask>,<const_mask>,<ref_sec>,<fix_status>,<used_sats>,<gps_utc_delta_s>,<gps_utc_delta_ns>,<glonass_utc_delta_ns>,<galileo_utc_delta_ns>,<quantization_error>,<pps_clock_freq>,<tcxo_clock_freq>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
on_off	Decimal, 1 digit	PPS signal on/off status: 0 = off 1 = on
pps_valid	Decimal, 1 digit	Global PPS validity flag 0 = PPS not valid 1 = PPS valid
synch_valid	Decimal, 1 digit	PPS synchronization validity 0 = not valid 1 = valid
out_mode	Decimal, 1 digit	0 = PPS_OUT_MODE_ALWAYS

		1 = PPS_OUT_MODE_ON_EVEN_SECONDS 2 = PPS_OUT_MODE_ON_ODD_SECONDS
ref_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS **NOTES:** UTC_SU is the Soviet Union UTC derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. If the software is configured to work in GLONASS only mode, UTC_SU is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
ref_constellation	Decimal, 1 digit	0 = GPS 1 = GLONASS/BeiDou **NOTE:** The reference constellation reports which reference time has been used for the PPS generation.
pulse_duration	Double	Pulse duration. Unit: s.
pulse_delay	Decimal	Pulse delay. Unit: ns.
gps_delay	Decimal	GPS path RF delay. Unit: ns.
glo_delay	Decimal	GLONASS path RF delay. Unit: ns.
bei_delay	Decimal	BeiDou path RF delay. Unit: ns. **NOTE:** This parameter is always zero if BeiDou constellation is not supported by the hardware platform.
gal_delay	Decimal	Galileo path RF delay. Unit: ns.
inverted_polarity	Decimal, 1 digit	Pulse polarity inversion: 0 = not inverted 1 = inverted
fix_cond	Decimal, 1 digit	Selected GNSS fix condition for PPS signal generation: 1 = No fix

		2 = 2D fix 3 = 3D fix
sat_th	Decimal	Selected minimum number of satellites for PPS signal generation.
elev_mask	Decimal	Selected minimum satellite elevation mask for time correction.
const_mask	Decimal	Selected constellations for time correction.
ref_sec	Decimal, 2 digits	Second at which the reported PPS data is applied. According to the reference time configuration it could be a UTC or a GPS or a GLONASS or a BeiDou time second.
fix_status	Decimal, 1 digit	GNSS position fix status when the time has been corrected.
used_sats	Decimal	Used satellites for time correction.
gps_utc_delta_s	Decimal	UTC leap seconds. Unit: s.
gps_utc_delta_ns	Decimal	UTC – GPS delta time. Unit: ns.
glonass_utc_delta_ns	Decimal	UTC – GLONASS delta time. Unit: ns.
galileo_utc_delat_ns	Decimal	UTC – GALILEO delta time. Unit: ns.
quantization_error	Double (scientific notation format)	Quantization error. Unit: s.
pps_clock_freq	Double, 2 fractional digits	PPS clock frequency. Unit: Hz.
tcxo_clock_freq	Double, 2 fractional digits	TCXO clock frequency. Unit: Hz.
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and * characters

3.2.2.5. $PSTMSBAS

This message reports SBAS satellite data.

Synopsis:

```
$PSTMSBAS,<Status>,<SatTrk>,<SatID>,<Elev>,<Azim>,<Sig>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
Status	Decimal, 1 digit	SBAS status

		0 = no SBAS used 1 = SBAS used
SatTrk	Decimal, 1 digit	SBAS satellite tracked or not 0 = SBAS satellite not tracked 1 = SBAS satellite tracked, and decoding is ongoing 2 = SBAS satellite tracked and decoded. Differential mode ON.
SatID	Decimal, 3 digits	SBAS satellite ID
Elev	Decimal, 2 digits	SBAS satellite elevation. Unit: degree.
Azim	Decimal, 3 digits	SBAS satellite azimuth. Unit: degrees.
Sig	Decimal, 2 digits	SBAS satellite signal strength (C/No). Unit: dB.
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the **$** and * characters

Example:

```
$PSTMSBAS,1,1,129,45,141,20*14
$PSTMSBAS,1,1,137,42,135,23*1C
```

4 Default Configurations

Table 17: Default Configurations

Item	Default
NMEA port baud rate	9600bps
Datum	WGS84
Rate of position fixing	1Hz
DGPS mode	On
NMEA output messages	RMC, VTG, GGA, GSA, GSV and GLL
GNSS Configuration	GPS + Galileo + IRNSS

5 Appendix A References

Table 18: Related Documents

SN	Document Name	Remark
[1]	Quectel_L89_Hardware_Design	L89 Hardware Design
[2]	Quectel_L89_Reference_Design	L89 Reference Design

Table 19: Terms and Abbreviations

Abbreviation	Description
CDB	Configuration Data Block
DGPS	Differential Global Positioning System
EGNOS	European Geostationary Navigation Overlay Service
GAGAN	GPS-aided GEO Augmented Navigation
GGA	Global Positioning System Fix Data
GLL	Geographic Position – Latitude and Longitude
GLONASS	Global Navigation Satellite System (The Russian GNSS)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSA	GNSS DOP and Active Satellites
GST	Galileo System Time
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
IRNSS	Indian Regional Navigation Satellite System

MSAS	Multi-functional Satellite Augmentation System
NMEA	National Marine Electronics Association
NVM	Non-volatile Memory
PDOP	Position Dilution of Precision
PPS	Pulse Per Second
PRN	Pseudo Random Noise
QZSS	Quasi-Zenith Satellite System
RMC	Recommended Minimum Specific GNSS Data
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite-based Augmentation System
SDCM	System of Differential Correction and Monitoring
SPS	Standard Positioning Service
TRAIM	Timing Receiver Autonomous Integrity Monitoring
UTC	Universal Time Coordinated
VDOP	Vertical Dilution of Precision
VTG	Course Over Ground & Ground Speed
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984