L89 GNSS

Protocol Specification

GNSS Module Series

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About the Document

History

Revision	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

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Table Index

1 Introduction

L89 GNSS module supports GPS, GLONASS, BeiDou, Galileo, QZSS and IRNSS constellations and features accurate acquisition. The module supports autonomous GNSS C/A and SBAS functions. It can be used in the positioning, navigation and other industries.

This document describes the software aspects of L89. The module supports output of NMEA 0183 standard messages and ST proprietary protocol messages to report GNSS information. Also it supports module control and configuration through ST proprietary commands (PSTM commands).

2 Commands

2.1. List of NMEA Proprietary Commands

The table below summarizes the NMEA proprietary commands.

Table 1: Summary of NMEA Proprietary Commands

Syntax	Description
$PSTMINITGPS	Initialize GNSS receiver’s position and time
$PSTMINITTIME	Initialize GNSS receiver’s time
$PSTMCLREPHS	Clear all ephemeris
$PSTMDUMPEPHEMS	Dump ephemeris data
$PSTMCLRALMS	Clear all almanacs
$PSTMDUMPALMANAC	Dump almanacs 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
$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

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	Always ‘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’ and ‘LF’

2.3. GNSS Commands

2.3.1. $PSTMINITGPS

Initialize GNSS receiver’s position and time using UTC format. This command must be issued after a cold reset or the command fails. The date issued with parameters Day, Month and Year must be later than 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:

- In case of no errors, the GNSS receiver’s position and time will be initialized:

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

- In case of errors, the error message is returned:

```
$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. And the error between input position and real position should be less than 30 kilometers.
2. The string “*<checksum>“ is optional when users input commands.

2.3.2. $PSTMINITTIME

Initialize GNSS receiver’s time using UTC format. The date issued with parameters Day, Month and Year must be later than 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:

- The time will be initialized.
- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

```
$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.

2.3.3. $PSTMCLREPHS

Clear all ephemerides. This command erases all the ephemerides 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

Send out all ephemerides 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:

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…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 (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 all the almanacs stored in the NVM backup memory.

Synopsis:

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

Arguments:

None.

Results:

- All almanacs, 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. It sends out all almanacs 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:

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. Please check the tables below for details.

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…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/resume the SBAS software execution.

Synopsis:

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

Arguments:

None.

Result:

- If SBAS is running, it will be suspended; if it has been suspended, it will start to run.

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

Results:

- The SBAS engine will put in tracker all the satellites which correspond to the specified service.
- With SBAS service OFF, no satellites are put in tracker.
- With SBAS AUTO, the SBAS engine automatically selects the appropriate SBAS service based on the computed user position latitude and longitude.
- In case of no errors, the following message is returned:

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

- In case of errors, the following message is returned:

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

Example:

```
$PSTMSBASSERVICE,15
```

2.3.13. $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

- System will send RTC data and status.

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

The parameters included in the result above are listed:

Parameter	Format	Description
time	hhmmss.mms	Current time read on RTC
date	ddmmyy	Current date read on 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 at run-time. In case of reset, constellation mask is restored to the default value.

Synopsis:

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

Arguments:

Parameter	Format	Description
constellation_mask	1 - 9999	It is a bit mask, each bit of which enables/disables a specific constellation independently by 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:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

Examples:

Enabling GPS only:

```
$PSTMSETCONSTMASK,1
```

Enabling GLONASS only:

```
$PSTMSETCONSTMASK,2
```

Enabling GPS and GLONASS:

```
$PSTMSETCONSTMASK,3
```

Enabling IRNSS:

```
$PSTMSETCONSTMASK,1024
```

2.3.15. $PSTMPPS

Allow interfacing all parameters for Pulse Per Second management. This is a parametric command.

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	1 = PPS_IF_ON_OFF_CMD 2 = PPS_IF_OUT_MODE_CMD 3 = PPS_IF_REFERENCE_CONSTELLATION_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 tables below for details.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Result:
According to the operation mode and the command type, data is set into or is retrieved from the PPS manager.

2.3.15.1. Getting PPS Data (cmd_mode = 1)

- **PPS_IF_PULSE_DATA_CMD**

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

Reply:

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

The parameters included in the reply above are listed:

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 [ns]
pulse_duration	Double	Pulse duration [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

- **PPS_IF_TIMING_DATA_CMD**

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

Reply:

```
$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 reply above are listed:

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 [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_POSITION_HOLD_DATA_CMD**

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

Reply:

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

The parameters included in the reply above are listed:

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

- **PPS_IF_TRAIM_CMD**

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

Reply:

$PSTMPPS,1,15,<traim_enabled>,<traim_solution>,<ave_error>,<used_sats>,<removed_sats>*<checksum><CR><LF>

The parameters included in the reply above are listed:

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 [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

- **PPS_IF_TRAIM_USED_CMD**

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

Reply:

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

The parameters included in the reply above are listed:

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

- **PPS_IF_TRAIM_RES_CMD**

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

Reply:

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

The parameters included in the reply above are listed:

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 [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

- **PPS_IF_TRAIM_REMOVED_CMD**

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

Reply:

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

The parameters included in the reply above are listed:

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

2.3.15.2. Setting PPS Data (cmd_mode = 2)

- **PPS_IF_ON_OFF_CMD**

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

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

- **PPS_IF_OUT_MODE_CMD**

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

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated 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

- **PPS_IF_REFERENCE_TIME_CMD**

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

Parameter	Format	Description
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.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_PULSE_DELAY_CMD**

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

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay [ns]
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_CONSTELLATION_RF_DELAY_CMD**

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

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

- **PPS_IF_PULSE_DURATION_CMD**

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

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_PULSE_POLARITY_CMD**

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

Parameter	Format	Description
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

- **PPS_IF_PULSE_DATA_CMD**

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

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
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [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

- **PPS_IF_FIX_CONDITION_CMD**

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

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

- **PPS_IF_SAT_TRHESHOLD_CMD**

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

Parameter	Format	Description
sat_th	Decimal	Minimum number of satellites for the PPS generation
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_ELEVATION_MASK_CMD**

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

Parameter	Format	Description
elevation_mask	Decimal	Minimum satellite elevation for satellite usage in timing filtering
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

- **PPS_IF_CONSTELLATION_MASK_CMD**

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

Parameter	Format	Description
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS bit7 = BeiDou 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

- **PPS_IF_TIMING_DATA_CMD**

$PSTMPPS,2,12,<fix_condition>,<sat_th>,<elevation_mask>,<constellation_mask>*<checksum><cr><lf>

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

- **PPS_IF_POSITION_HOLD_DATA_CMD**

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

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

- **PPS_IF_AUTO_HOLD_SAMPLES_CMD**

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

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 be “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

- **PPS_IF_TRAIM_CMD**

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

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = TRAIM disabled 1 = TRAIM enabled
alarm	Double	TRAIM alarm [s] - scientific notation is allowed
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

2.3.16. $PSTMFORCESTANDBY

Force the module to enter standby mode.

Synopsis:

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

Arguments:

Parameter	Format	Description
duration	Decimal, 5 digits	Duration of the standby time in seconds
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.17. $PSTMGEOFENCEREQ

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

Synopsis:

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

Arguments:

None.

Results:

- In case of no errors, the GNSS receiver replies with the **$PSTMGEOFENCESTATUS** message.
- In case of errors, the error message is returned:

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

2.3.18. $PSTMODOSTART

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

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

$PSTMCFGODO.

Synopsis:

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

Arguments:

None.

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.19. $PSTMODOSTOP

Stop the odometer subsystem.

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

Synopsis:

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

Arguments:

None.

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.20. $PSTMODOREQ

Request the odometer status.

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

Synopsis:

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

Arguments:

None.

Results:

- In case of no errors, the following message is returned:

```
$PSTMODO
```

- In case of errors, the error message is returned:

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

2.3.21. $PSTMCFGCONST

Configure constellation.

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 tracked 2 = constellation tracked and used in positioning
glonass	Unsigned	GLONASS constellation status: 0 = constellation off 1 = constellation tracked 2 = constellation tracked and used in positioning
galileo	Unsigned	Galileo constellation status: 0 = constellation off 1 = constellation tracked 2 = constellation tracked and used in positioning
qzss	Unsigned	QZSS constellation status: 0 = constellation off 1 = constellation tracked 2 = constellation tracked and used in positioning
beidou	Unsigned	BeiDou constellation status: 0 = constellation off 1 = constellation tracked 2 = constellation tracked and used in positioning
irnss	Unsigned	IRNSS constellation status: 0 = constellation off

		1 = constellation 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:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.22. $PSTMODORESET

Reset the odometer subsystem.

The odometer must be enabled otherwise the request will be rejected with error. To enable the odometer, it is required a change in firmware configuration which can be done also through the 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:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.23. $PSTMCFGPORT

Configure a general-purpose port for NMEA, STBIN, DEBUG or RTCM purpose.

Synopsis:

$PSTMCFGPORT,<port_type>,<protocol_type>,<par_1>,<par_2>,…,<par_N>*<checksum><CR><LF>

Arguments:

Parameter	Format	Description
port_type	Decimal, 1 digit	Select the port type: 0 = UART 1 = I2C
protocol_type	Decimal, 1 digit	Select the protocol type: 0 = NMEA
par_1 … par_N	Integer	Parameter list is determined by the command type. Please check the tables below for details.
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.23.1. Parameters when port_type is UART

Parameter	Format	Description
portnumb	From 0 to 255	UART GPIO ID (Linearly addressed)
baudrate	Integer	Baud rate of the port. Allowed values are: 9600bps, 115200bps, 230400bps, 460800bps, 921600bps
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

2.3.23.2. Parameters when port_type is I2C

Parameter	Format	Description
slaveaddr	Hexadecimal, 2 bytes	I2C slave address
mode	Decimal, 1 digit	0 = speed mode STANDARD 1 = speed mode FAST 2 = speed mode HS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

2.3.24. $PSTMCFGMSGL

Configure the message list.

Synopsis:

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

Arguments:

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA list 0
rate	From 0 to 255	Message list rate scaler
listlow	Hexadecimal, 8 digits	Low 32 bits
listhigh	Hexadecimal, 8 digits	High 32 bits
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	Reserved
18	0x40000	Reserved
19	0x80000	$GPGSV message
20	0x100000	$GPGLL message
21	0x200000	Reserved
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:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.25. $PSTMCFGAGPS

Configure the Assisted GPS.

Synopsis:

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

Arguments:

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

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.26. $PSTMCFGAJM

Configure the anti-jamming algorithm.

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
glonassmode	Decimal, 1 digit	Notch filter on GLONASS path: 0 = disable 1 = normal mode 2 = auto mode
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.27. $PSTMCFGODO

Configure the odometer.

Synopsis:

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

Arguments:

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

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.28. $PSTMCFGGEOFENCE

Configure the geo-fencing feature enabling circles and choose the tolerance.

Synopsis:

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

Arguments:

Parameter	Format	Description
en	Decimal, 1 digit	Enable/disable the geo fencing: 0 = geo-fencing disabled 1 = geo-fencing enabled
tol	Decimal, 1 digit	Tolerance: 0 = none 1 = level 1 2 = level 2 3 = level 3
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.29. $PSTMCFGGEOCIR

Configure a geo-fencing circle.

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:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.30. $PSTMSETTHTRK

Configure the CN0 and elevation mask angle thresholds for tracking. This command changes these parameters at run-time and no reset is required. In case of reset, tracking CN0 and elevation mask angle are restored to default values.

Synopsis:

```
$PSTMSETTHTRK,<cn0>,<el>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
cn0	Decimal	Tracking CN0 threshold [dB]
el	Double	Tracking elevation mask angle [degree]
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.31. $PSTMSETTHPOS

Configure the CN0 and elevation mask angle thresholds for positioning. This command changes these parameters at run-time and no reset is required. In case of reset, positioning CN0 and elevation mask angle are restored to the default values.

Synopsis:

```
$PSTMSETTHPOS,<cn0>,<el>*<checksum><CR><LF>
```

Arguments:

Parameter	Format	Description
cn0	Decimal	Positioning CN0 threshold as dB
el	Double	Positioning elevation mask angle as degree
checksum	Hexadecimal, 2 digits	Checksum of the message bytes between but not including the “$” and “*” characters

Results:

- In case of no errors, the following message is returned:

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

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

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

2.3.32. $PSTMSETANTSENSOPMODE

Set antenna sensing operating mode: auto or manual.

Synopsis:

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

Arguments:

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

Results:

- In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

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

2.3.33. $PSTMSETANTSENSMANUAL

Force antenna power switching, antenna RF path switching, antenna status message, and set the antenna detection process to active/stop. It can be used only when the antenna operating mode is set to manual.

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 = antenna power OFF 1 = antenna power ON
rf_path	Decimal, 1 digit	Force the switching of antenna RF path: 0 = switch to internal antenna 1 = switch to external 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 corresponding messages are 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 error message is returned:

```
$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. $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

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

Arguments:

None.

Results:

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

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

- In case of errors, the error message is returned:

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

Example:

```
$PSTMSAVEPAR
```

2.4.2. $PSTMRESTOREPAR

Restore the factory setting parameters. 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:

- The factory setting parameters 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 ad to get system working with default setting.
  In case of no errors, the following message is returned:

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

- In case of errors, the error message is returned:

```
$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

Table 14: List of NMEA Standard Messages

Syntax	Default	Description
$--RMC	ON	NMEA: Recommended minimum specific GNSS data
$--VTG	ON	NMEA: Course over ground and 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/longitude

3.1.2. NMEA Standard Messages Specification

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

Table 15: Structure of NMEA Standard Message

Filed	Length (Bytes)	Description
$	1	Each NMEA message starts with ‘$’
Talker ID	1~2	GP: If system works in GPS only mode GL: If system works in GLONASS only mode

		GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If 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’ and ‘lf’

NOTE

The default output message of L89 module has the following six sentences: RMC, VTG, GGA, GSA, GSV and GLL.

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, null fields used only when 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 system works in GPS only mode

		GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If 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 length) Please note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. 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’ and ‘lf’

3.1.2.2. $--VTG

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

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 system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If 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' and 'lf'

3.1.2.3. $--GGA

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

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 system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode

		QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If 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 length) Please note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. 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 Pleae 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:

		100000.0m
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’ and ‘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. Please check the following parameter table for information about Talker ID available values.

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 '$'
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If system works in multi-constellation mode.
Mode	1 character	M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to automatically switch 2D/3D
CurrentMode	Decimal, 1 digit	1 = Fix not available 2 = 2D 3 = 3D
SatPRN (1 to 12)	Decimal, 2 or 3 digits	Satellites list used for positioning
PDOP	x.x, variable length field	Position dilution of precision, max: 99.0
HDOP	x.x, variable length field	Horizontal dilution of precision, max: 99.0
VDOP	x.x, variable length field	Vertical dilution of precision, max: 99.0
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = Galileo 4 = BeiDou 5 = QZSS 6 = IRNSS
*	1	End character of data field
Checksum	2	A hexadecimal number calculated by exclusive OR of all characters between '$' and '*'
<CR><LF>	2	Each NMEA message ends with 'cr' and '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>,<Sat1CN0>,…,<Sat4PRN>,<Sat4Elev>,<Sat4Azim>,<Sat4CN0>*<checksum><CR><LF>
Format for NMEA 0183 Rev 4.10:
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1CN0>,…,<Sat4PRN>,<Sat4Elev>,<Sat4Azim>,<Sat4CN0>,<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
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 system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If system works in multi-constellation 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 … 359
SatxCN0	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' and 'lf'

3.1.2.6. $--GLL

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

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 system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in Galileo only mode BD: If system works in BeiDou only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode GN: If 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: 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.
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’ and ‘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

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 info on which antenna is active (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	Antenna status: 0 = normal 1 = open 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 = current position is outside the circle 2 = current position on circle boundary 3 = 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

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
DGPS	Differential Global Positioning System
EGNOS	European Geostationary Navigation Overlay Service
GAGAN	GPS-aided GEO Augmented Navigation
GGA	NMEA: Global Positioning System Fix Data
GLL	NMEA: Geographic Position – Latitude/Longitude
GLONASS	Global Navigation Satellite System (The Russian GNSS)
GNSS	Global Navigation Satellite System
GPS	Global Navigation Satellite System
GSA	NMEA: GNSS DOP and Active Satellites
GST	Galileo System Time
GSV	NMEA: 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	NMEA: 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
UTC	Universal Time Coordinated
VDOP	Vertical Dilution of Precision
VTG	NMEA: Course Over Ground & Ground Speed
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984