1 Introduction

The purpose of this document is to provide an overview of the various NMEA commands and messages for the STMicroelectronics´ GNSS Systems. This document is relevant for the following Baseband Processors and related GNSS software products. Any other specific constraints related to version of products and software are specified inside the document.

Device Type	Binary Image Version	SDK Version
STA 8088	3.1.18 or later	1.7.4 or later
STA 8088	3.5.4 or later	2.2.1 or later
STA 8089/90	4.5.4 or later	2.2.1 or later

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None

3 Document Management

3.1 Revision History

Rev	Date	Author	Notes
1.3	2006-10-25	A. Di Girolamo	Doc.Name: "GPS NMEA Commands"
2.3	2009-02-23	F. Henkel	Extended with NMEA Messages and reworked
2.4	2009-07-06	F. Henkel	Added "$PSTMKFCOV"
2.5	2009-07-07	F. Henkel	Added $GPGGA5 Message, Minor Changes in Descriptions and formatting
2.6	2009-07-15	F. Henkel	Correction of $GPGSA Fix Status
2.7	2009-07-21	F. Henkel	Correction of $PSTMSBAS Example, Removed "Draft"
2.8	2009-10-12	A. Di Girolamo	Added $PSTMAGPS. Added Footnotes. Removed $PSTMFDAONOFF, replaced by $PSTMGETALGO and $PSTMSETALGO. Changed bitmask for $PSTMKFCOV. Document review.
2.9	2010-01-27	A. Di Girolamo	STA205x Configuration Review Added Configuration for STA206x families
2.10	2010-04-02	A. Di Girolamo	Document Layout Review. Added Default Settings Configuration.
2.11	2010-09-10	F. Henkel	Added $PSTMCOLD Parameters
3.0	2011-04-07	F. Boggia	New layout
3.1	2011-04-11	A. Di Girolamo	Document review Initial draft release Updated to GNSS library 7.1.1.15
3.2	2011-06-17	A. Di Girolamo	Added new software configuration features introduced on rel. 7.1.6.25
3.3	2011-08-08	A. Cascella	Added new command to select local geodetic datum
3.4	2011-09-06	A. Di Girolamo	Added additional PPS configuration parameters. Added DEBUG ON/OFF command. Fixed $PSTMAGPS age and satid evaluation.

3.5	2011-12-23	A.Di Girolamo	Added additional configuration parameters introduced in SW 7.1.11.34
3.7	2012-02-27	A.Di Girolamo	Removed the firmware configuration section. It has been moved on separate document. Added commands and messages for the Position Hold management. Added command for GNSS constellation setting. Added CPU usage NMEA output message. Added command to perform a system reset. Added NMEA message for Notch Filter status. Removed $PSTMSBASCOR message.
3.7.1	2012-04-05	A. Occhipinti	Added commands to read/write/erase user SQI memory area.
3.8	2012-03-20	A.Di Girolamo	Added command interface for PPS setting.
3.9	2012-04-03	A.Di Girolamo	Added new PPS commands and out messages.
3.10	2012-04-13	A.Di Girolamo	New PPS command plus additional parameters in the PSTMPPSDATA message.
3.11	2012-06-19	A.Di Girolamo	Added parameters to the $PSTMPPSDATA message.
3.12	2012-07-19	A.Di Girolamo	Extended the PPS synchronization modes. Document review.
3.13	2012-10-24	A.Di Girolamo	Added new proprietary output message for noise floor raw estimation. $PSTMGETSWVER review.
3.14	2013-01-25	G. De Angelis	Added $GPGST and $GPZDA standard messages. Updated timestamp field on some old messages.
3.15	2013-02-08	G. De Angelis	Added parameter to the $PSTMTG message.
3.16	2013-03-08	M. Frazzetto	Added $PSTMADCSTART and $PSTMADCREAD commands

3.17	2013-04-08	A. Di Girolamo	Added $GNGNS message Added return message to the GPSSUSPEND command. Added HW version string in $PSTMGETSWVER command Added response on $PSTMINITGPS command Added $PSTMINITTIME command Added $PSTMLOWPOWERDATA proprietary message.
3.18	2013-05-14	A.Di Girolamo	Removed "*" from $PSTMSETPAR and $PSTMGETPAR syntax documentation
3.19	2013-07-15	M. Frazzetto	Added $PSTMADCDATA proprietary message Added Antenna Status proprietary messages: $PSTMANTENNASTATUS Added optional parameter to $PSTMADCSTART command
	17/07/2013	A.Di Girolamo	Added command for adaptive low power operating modes settings Extended the adaptive low power output NMEA message Fixed mistakes in GGA message description
3.20	18/11/2013	A.Di Girolamo	Added $PSTMPV and $PSTMUTC proprietary messages
3.21	03/12/2013	M.Renna	Added Kalman Filter configuration in TG message Corrected Description of the AltVal, GeoSep and GeoVal fields in GPGGA description
	10/01/2014	A.Di Girolamo	Changed titles in document header/footer Fixed mistakes in GSV, PSTMPV and PPS_IF descriptions Used 64bits for message list descriptions Added $PSTMCRCCHECK command Added $PSTMBIN command Added $PSTMNMEAREQUEST command
3.22	14/02/2014	A.Di Girolamo	Added STA8089/90 platforms Extended support for Galileo and BeiDou in GSV and GSA messages.
3.23	03/03/2014	A.Occhipinti	Added missing CPU time in $PSTMTIM message description.
	04/03/2014	A.Di Girolamo	Added footnotes about HW/SW restrictions on supported constellations.

3.24	17/12/2014	Antonio Furno	General review. PSTMG extended with new values. Added ephemerid and almanac descriptions.
3.25	22/4/2015	Antonio Furno	Added Mode indicator parameter in PSTMVTG
3.26	30/07/2015	A.Di Girolamo	Added DTM message Added Appendix A reporting the supported Datum table Updated disclaimer Added PSTMFORCESTANDBY command
3.27	29/10/2015	A.Furno, J. Philippe	Added PSTMIONOPARAMS, PSTMGALILEOGGTO, PSTMGALILEODUMPGGTO, GPGBS message
3.28	15/12/2015	A. Furno	Added STA8090 signature in PSTMGETSWVER Added more info to GSV PSTMSETCONSTMASK updated
3.29	29/03/2016	F. Deruy, J. Philippe, J. Durand , A.Di Girolamo	Added type 11 for SWCFG in PSTMGETSWVER Added PSTMGNSSINV command Update of $PSTMLOWPOWERONOFF and $PSTMLOWPOWERDATA commands. Addition of $PSTMSTANDBYENABLE. Added $PSTMPVRAW message Removed obsolete command $PSTM2DFIXONOFF
3.30	14/7/2016	J. Durand Antonio Furno	Added restrictions to STA8089/STA8090 in low power messages.
			$PSTMLOWPOWERONOFF update Removal of $PSTMSTANDBYENABLE
			$PSTMNOTCH and $PSTMNOTCHSTATUS updated
			Added mode indicator to GLL and RMC commands
3.31	28/11/2016	A.Di Girolamo A. Cascella	Added $PSTMFEDATA message Updated $--GNS message

Table 1: Revision history

3.2 Acronyms and definitions

Keyword	Definition
Accuracy	Deviation of a GPS-based calculated position from the true position
ADC	Analogue to Digital Converter
Almanac	Contains the information about all available satellites , their orbit data and time of their clocks.
ANF	Adaptive Notch Filter
Azim	Azimuth - Angular distance from a reference
Bank Swap	Exchanging two memory banks for storage of data
BAUD rate	Transmission Rate Measure for the effective transmission of data content. (may differ from Bits/sec).
BEIDOU	China's regional navigation satellite system
Checksum	Calculated from the transmitted characters of a message by "ex-OR"ing the 8 bit character values including delimiters (without checksum).
CN0	Carrier to Noise Ratio - Identifies the quality of a received signal
Cold Start	Start Condition for a GPS system having no position nor time. Almanac and Ephemeris is not available, too.
BeiDou	China's global navigation satellite system (also known as Beidou-2, BD2)
Dead Reckoning	Sensor based process to determine the movement of a mobile unit, utilizing Gyro, Odometer and Wheel Pulses.
Delimiter (within NMEA 0183)	ASCII "$" to indicate Address Field ASCII "," to indicate Data Field ASCII "*" to indicate Checksum Field
DGPS	Differential GPS - GPS Augmentation System providing the accurate location of a Reference Station to reduce system errors.
EGNOS	European Geostationary Navigation Overlay System
Elev	Elevation - Angle between a high level or non-earth bound point and the horizontal plane of the viewer.
Ephemeris	Ephemeris Data is transmitted by each satellite and contains current and predicted satellite position.
FDA	Failure Detection Algorithm - Specific Algorithm to detect failures in position calculation
FDE	False Detection Exclusion

GALILEO	Europe’s global navigation satellite system
GDOP	Geometric Dilution Of Position - Quality value representing all geometry based error factors in a system.
GNSS	Global Navigation Satellite System - Satellite based system to calculate the position of the receiver on the earth surface.
GPS	Global Positioning System - United States Satellite Navigation System
GPS Library	STMicroelectronics C-Library containing all GPS relevant Functions
Gyro	Gyroscope - Sensor to determine rotational movements
HDOP	Horizontal Dilution Of Precision - Quality value representing all 2D plane geometry based error factors in a system.
Hot Start	Start Condition for a GPS System having position, time, Almanac and Ephemeris already available. High time accuracy is required.
Lat	Lattitude - Angular difference of a given position to the Equator. Values include 0°-90° either North or South
Lat-Ref	Lattitude Reference - Reference if a Latitude value is North or South
Long	Longitude - Angular difference to a “reference” Longitude indicated as “000”. Values include 0°… 180° either West or East.
Long-Ref	Longitude Reference - Reference if a Longitude value is East or West of the “000” Meridian.
NMEA	National Marine Electronics Association - United States Standards Organisation For Marine Equipment
NMEA 0183	National Marine Electronics Association - Standard for Interfacing Marine Electronics Devices
NVM	Non Volatile Memory - Any type of memory that conserves data in the absence of regular supply voltage (includes battery buffered memories)
Proprietary Message	Messages within the scope of NMEA0183 which are not standardized. They start with $P and a 3 character identifier.
PRN	Pseudo Random Number - Satellite Specific 1023 Bit Number used for Spread Spectrum Modulation
RAIM	Receiver Autonomous Integrity Monitoring
RF	Radio Frequency - High Frequency for Reception with a RF-Receiver
RS232	IEEE Standard - Physical Layer Standard for Data Transmission

Sat-ID	Satellite Identifier - Satellite specific Number used to generate the corresponding PRN code
SBAS	Satellite Based Augmentation System - GPS enhancement system based on geostationary satellites.
Static Position Filtering	Algorithm to detect that the GPS receiver doesn´t move and position output is kept stable.
UTC	Universal Time Coordinated
WAAS	Wide Area Augmentation System - American GPS Augmentation System delivering accurate Ionosphere Data
Warm Start	Start Condition for a GPS system having current Almanac, position and time availability. Ephemeris are not available. Time needs to be available with reasonable accuracy (some seconds).
2D Fix	Fix based on the use of 3 satellites
3D Fix	Fix based on the use of 4 satellites

Table 2. Acronyms

3.3 Reference Documents

None

4 Communication Interface

Communication between a host processor and the ST GNSS System can be established in different ways, depending on the implementation of the Baseband Processor as a stand-alone unit or as an integrated subsystem on a “System on Chip”.

For simplicity reasons this document will refer to “Stand-alone Processors” only and the interface described in the examples is a UART.

All information contained in this document is related to the “NMEA port” of the Baseband Processor. STMicroelectronics GNSS Systems may contain an additional “Debug port” but the data exchanged on the “Debug Port” is not within the scope of this document.

4.1 Commands

A Command is a defined Data Packet which is sent from a host processor to the GPS-Baseband Controller in order to control the GPS system behaviour. The regular structure of a command is:

```
command-ID, <parameters> <cr><lf>
```

In order to receive the commands the GNSS receiver is connected to the PC via the NMEA port (make sure that the serial cable is the right one, sometimes it is necessary to use a cross-cable). The user interaction can be achieved through the use of a PC terminal emulator that is connected to the appropriate COM port with settings of:

- 115200 Baud
- 0 Parity Bits
- 1 Stop Bit
- 8 Data Bits

The NMEA baud rate at 115200 is the default value, automatically set at the system start-up. It can be modified at system runtime using the appropriate command.

The simplest way to send a command to the device is to write the command string in a text file and send it using the “send file” capability of the terminal emulator. For this reason, it is required that the terminal emulator (or production test program) running on the PC is capable of sending text files down the RS232 link to the GNSS receiver.

Once the command is executed the device reply with messages according to what specify in this document, after the message the command is sent back to the host as final confirmation of the execution. This functionality can be configured accordingly to what specified in the Firmware Configuration document.

4.2 Messages

A Message is a defined set of data sent from the GNSS System to a host processor using the same interface which is used to transfer commands to the system. Messages may not be enabled by default but can be switched on and off using a command at run-time. The basic structure of a message is:

```
message-ID, <parameters> <cr><lf>
```

There are two basic sets of messages implemented.

4.2.1 Standard NMEA Messages

Standard NMEA Messages are defined in the “NMEA 0183” Standard, issued from the “National Marine Electronics Association”. The latest issue is Rev. 3.1 dated January 2002. NMEA0183 refers to it as Sentences (single line message) and Messages (multiple line messages).

To get an overview on the standard NMEA messages supported by ST´s GPS Systems please refer to 7.1 “Standard NMEA Messages” in this document.

Standard NMEA messages start the “message-ID” with:

```
$<Talker ID>
```

Supported talker IDs[1] are: “GP”, “GL”, “GA”, “BD”, “QZ” and “GN” for standard NMEA sentences.

4.2.2 Proprietary Messages

The STMicroelectronics GPS System can provide additional messages with more detailed data content. This is required to transmit GPS and System information content which is not defined in the NMEA standard output.

Proprietary Messages from STMicroelectronics start with:

```
$PSTM…
```

To get an overview on the proprietary messages defined by STMicroelectronics please refer to chapter 4.2 in this document.

[1] The set of supported talker IDs depends by supported constellations. It is strictly related to the hardware platform and software revision.

5 Commands[2]

5.1 Software Command List:

The table below summarizes all the commands supported by the ST NMEA layer:

Syntax	Description
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITFRQ	Initialize centre frequency
$PSTMSETRANGE	Set the frequency range for satellite searching
$PSTMCLREPHS	Clear all ephemeris
$PSTMDUMPEPHEMS	Dump Ephemeris data
$PSTMEPHEM	Load Ephemeris data
$PSTMCLRALMS	Clear all almanacs
$PSTMDUMPALMANAC	Dump Almanacs data
$PSTMALMANAC	Load Almanacs data
$PSTMCOLD	Perform COLD start
$PSTMWARM	Perform WARM start
$PSTMHOT	Perform HOT start
$PSTMNMEAONOFF	Toggle ON/OFF the NMEA output
$PSTMDEBUGONOFF	Toggle ON/OFF the DEBUG output
$PSTMSRR	System Reset
$PSTMGPSRESET	Reset the GPS engine
$PSTMGPSSUSPEND	Suspend GPS engine
$PSTMGPSRESTART	Restart GPS engine
$PSTMGNSSINV	Invalidate the GNSS fix status
$PSTMTIMEINV	Invalidate the GPS time

[2] If not explicitly declared, all modifications of the status of the parameters, are not saved in the backup memory. For this reason, any changes of the parameters are replaced by previous values after system reset or system power cycling.

$PSTMGETSWVER	Provide the GPS library version string.
$PSTMNVMSWAP[3]	Execute a bank swap on the NVM GPS backup memory
$PSTMSBASONOFF	Enable/Disable the SBAS activity
$PSTMSBASSAT	Set the SBAS satellite's ID
$PSTMRFTESTON	Enable the RF test mode
$PSTMRFTESTOFF	Disable the RF test mode
$PSTMGETALGO	Get FDE algorithm ON/OFF status
$PSTMSETALGO	Set FDE algorithm ON/OFF status
$PSTMGETRTCTIME	Get the current RTC time.
$PSTMSELECTDATUM	Set a geodetic local datum different from WGS84
$PSTMDATUMSETPARAM	Set parameters to local geodetic to WGS84 datum transformations
$PSTMENABLEPOSITIONHOLD	Set status and position for the Position Hold feature.
$PSTMSETCONSTMASK	Set GNSS constellation mask.
$PSTMNOTCH	Set the ANF operation mode.
$PSTMPPS	Command interface for Pulse Per Second management.
$PSTMADCSTART	Start and Configure ADC
$PSTMADCREAD	Read ADC channels data
$PSTMSETPAR	Set System Parameter in the configuration data block.
$PSTMGETPAR	Get System Parameter from configuration data block.
$PSTMSAVEPAR	Save System Parameters in the GNSS backup memory.
$PSTMRESTOREPAR	Restore System Parameters (Factory Settings).

Warning: The $PSTMSETPAR command allows the direct modification of the system parameters. Wrong Settings may degrade the GNSS system performance or even stop the system from working

[3] This command is supported only by platforms or system configurations where the GNSS backup memory is based on Flash NOR or SQI memories.

5.2 NMEA commands

5.2.1 $PSTMINITGPS

Initialize GPS position and time using UTC format. This command must be issued after a cold reset or it fails. The date issued with parameters Day, Month and Year must be later than January 2015, this threshold can be changed using the configuration options (see STA80xx Firmware Configuration document).

Synopsis:

```
$PSTMINITGPS,<Lat>,<LatRef>,<Lon>,<LonRef>,<Alt>,<Day>,<Month>,
   <Year>,<Hour>,<Minute>,<Second><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 (2015 - …)
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)

Results:

- The position and time will be initialized
- The following message will be output on NMEA communication channel:

```
$PSTMINITGPSOK<cr><lf>       if success
$PSTMINITGPSERROR<cr><lf>    if no success
```

Example:

```
$PSTMINITGPS,4811.365,N,01164.123,E,0530,23,02,2015,09,44,12
```

5.2.2 $PSTMINITTIME

Initialize GPS time using UTC format. The date issued with parameters Day, Month and Year must be later than January 2015, this threshold can be changed using the configuration options (see STA80xx Firmware Configuration document).

Synopsis:

```
$PSTMINITTIME,<Day>,<Month>,<Year>,<Hour>,<Minute>,<Second><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 (2015 - …)
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)

Results:

- The position and time will be initialized
- The following message will be output on NMEA communication channel:

```
$PSTMINITTIMEOK<cr><lf>            if success
$PSTMINITTIMEERROR<cr><lf>         if no success
```

Example:

```
$PSTMINITTIME,23,02,2015,09,44,12
```

5.2.3 $PSTMINITFRQ

Initialize the centre frequency. This command can be used to set the local oscillator frequency offset.

Synopsis:

```
$PSTMINITFRQ,<offset><cr><lf>
```

Arguments:

Parameter	Format	Description
offset	Decimal, 6 digits	Frequency offset in Hz

Results:

- The centre frequency will be initialized

Example:

```
$PSTMINITFRQ,-47000
```

5.2.4 $PSTMSETRANGE

Set the frequency range for satellite searching. The “min.” and “max.” values are used as offsets versus the centre frequency.

Synopsis:

```
$PSTMSETRANGE,<min>,<max><cr><lf>
```

Arguments:

Parameter	Format	Description
min	Decimal, 6 digits	Lower limit range in Hz
max	Decimal, 6 digits	Upper limit range in Hz

Results:

- The following message will be output on NMEA communication channel:

```
$PSTMSETRANGEOK<cr><lf>            if success
$PSTMSETRANGEERROR<cr><lf>         if no success
```

Example:

```
   $PSTMSETRANGE,-57000,-37000
```

5.2.5 $PSTMCLREPHS

Clear all ephemeris. This command erases all the ephemeris stored in the NVM backup memory.

Synopsis:

```
$PSTMCLREPHS<cr><lf>
```

Arguments:

None.

Results:

- All ephemeris, stored in the non-volatile backup memory (either Backup-SRAM or Flash), will be deleted.
- No message will be sent as reply.

Example:

```
$PSTMCLREPHS
```

5.2.6 $PSTMDUMPEPHEMS

This command sends out all ephemeris stored in the backup memory.

Synopsis:

```
$PSTMDUMPEPHEMS<cr><lf>
```

Arguments:

None.

Results:

```
$PSTMEPHEM,<sat_id>,<N>,<byte1>,…..,<byteN>*<checksum><cr><lf>
```

Where:

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 without *<checksum><cr><lf> characters.

The N Bytes that are in the message are the dump of a structures that contain all the information of the ephemeris. Data are stored in this structure according to the following table if the data are for GPS:

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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

1	reserved	Must be 0.
4	accuracy	Accuracy

For GLONASS the table is:

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 (LBS).
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.
2	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	reserved	
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	Contains 1 if ephemeris is available, 0 if not.
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy.
1	reserved	Must be 0.
4	reserved	

For Galileo the data are decoded according to the following table:

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
14	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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 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.

For BEIDOU:

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 α_0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter α_1
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 α_2
8	A3	Ionospheric Delay Model Parameter α_3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter β_2
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 β_3
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 β_0
6	spare	

18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter β_1
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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

Example:

```
$PSTMDUMPEPHEMS

$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400
fbff33420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ff
c616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ff
caff1937000033515726556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00
f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00
b8ffd037000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ff
ea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff
6c00f72e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300
c4a0c203*52
```

5.2.7 $PSTMEPHEM

This command allows the user to load the ephemeris data into backup memory.

Synopsis:

```
$PSTMEPHEM,<sat_id>,<N>,<byte1>,…..,<byteN>*<checksum><cr><lf>
```

Arguments:

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 without *<checksum><cr><lf> characters.

The N Bytes that are in the parameters are the dump of a structures that contain all the information of the ephemeris. Data are stored in this structure according to the following table if the data are for GPS:

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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	reserved	Must be 0.
4	accuracy	Accuracy

For GLONASS the following table must be used:

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 (LBS).
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.
2	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	reserved	
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	Contains 1 if ephemeris is available, 0 if not.
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy.
1	reserved	Must be 0.
4	reserved	

For Galileo:

Bits	*Structure Member*	*Description*
16	week	Week number of the Issue of Data
14	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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 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.

For BEIDOU

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 α_0
24	af0	Constant clock correction.

8	A1	Ionospheric Delay Model Parameter α_1
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 α_2
8	A3	Ionospheric Delay Model Parameter α_3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter β_2
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 β_3
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 β_0
6	spare	
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter β_1
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	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

Results:

- The ephemeris will be stored into backup RAM
- No message will be sent as reply.

Example:

```
$PSTMEPHEM,12,64,0f06bc34bc3437373790f40045a7ff00fcf5d522480b4bf71b0
0fbff8931000096126f271f869101c3870ca107afce79a763e13e360a1ce8e700310
0380ff903*36
```

5.2.8 $PSTMCLRALMS

This command erases all the almanacs stored in the NVM backup memory.

Synopsis:

```
$PSTMCLRALMS<cr><lf>
```

Arguments:

None.

Results:

- All almanacs, stored in the non-volatile backup memory, will be deleted.
- No message will be sent as reply.

Example:

```
$PSTMCLRALMS
```

5.2.9 $PSTMDUMPALMANAC

Dump Almanac data. This command sends out all almanacs stored in the backup memory.

Synopsis:

```
$PSTMDUMPALMANAC <cr><lf>
```

Arguments:

None.

Results:

```
$PSTMDUMPALMANAC,<sat_id>,<N>,<byte1>,,<byteN>*<checksum><cr><lf>
```

Where:

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 without *<checksum><cr><lf> characters.

The N Bytes that are in the message are the dump of a structures that contain all the information of the almanac. Data are stored in this structure according to the following table if the data are for GPS:

Bits	Structure Member	Description
8	satid	The satellite number
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.

For GLONASS the table is the following:

Bits	Structure Member	Description
8	satid	The satellite number.
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.
32	Tau_c	
11	NA	

5	N4	
16	Spare	

The almanac of Galileo must be decoded using the following table:

Bits	Structure Member	Description
16	satid	The satellite number
6	svid	Space Vehicle Identificator
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
2	reserved	Reserved for use by GNSS library
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	available	Contains 1 if almanac is available 0 if not.

Example:

```
$PSTMDUMPALMANAC

$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034
024200b4ffff00*1a
```

```
$PSTMALMANAC,2,32,021a0690944b78fe37fd0800770da141ef0c5b006048770098
9bd800d8088000*1a
$PSTMALMANAC,3,32,031a06904f68a2f540fd0800f60ca141922a2c003cae270094
96cf00020a8000*15
$PSTMALMANAC,4,32,041a0690a94aeffd36fd0800390ca141afc95b00de7a1700df
c74e004ddebf00*13
$PSTMALMANAC,5,32,051a0690940eee0b5efd0800900ca141582b8600d3000b0060
641200e40f8000*14
```

5.2.10 $PSTMALMANAC

Load Almanacs data. This command allows the user to load the almanacs data into backup memory.

Synopsis:

```
$PSTMALMANAC,<sat_id>,<N>,<byte1>,…..,<byteN>*<checksum><cr><lf>
```

Arguments:

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 without *<checksum><cr><lf> characters.

The N Bytes that are in the parameters are the dump of a structures that contain all the information of the almanac. Data are stored in this structure according to the following table if the data are for GPS:

Bits	Structure Member	Description
8	satid	The satellite number
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.

For GLONASS the table is the following:

Bits	Structure Member	Description
8	satid	The satellite number.
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.
32	Tau_c	
11	NA	
5	N4	
16	Spare	

For Galileo the following table:

Bits	Structure Member	Description
16	satid	The satellite number
6	svid	Space Vehicle Identificator
16	week	The 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	Contains 1 if the satellite is unhealthy 0 if healthy.
2	reserved	Reserved for use by GNSS library
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	available	Contains 1 if almanac is available 0 if not.

Results:

- The almanac will stored into backup memory
- No message will be sent as reply.

Example:

```
$PSTMALMANAC,12,32,0c1a06907c1a971160fd0800fa0da141ae9f0600d912e9007
5669700490f8000*75
```

5.2.11 $PSTMCOLD

Perform a COLD start.

Synopsis:

```
$PSTMCOLD, < Mask ><cr><lf>
```

Arguments:

Parameter	Format	Description
Mask	Integer	Optional parameter to invalidate time, position, ephemeris and almanac : 0x1 – clear almanac 0x2 – clear ephemeris 0x4 – clear position 0x8 – clear time

Results:

- Coldstart initialization and system restart[4].
- If Mask parameter is used, only the selected GPS data is invalidated for this actual Coldstart. Multiple selects are supported (i.e. 0xD).
- If Mask parameter is not used, default is 0xE (clear ephemeris, time and position).

Example:

```
$PSTMCOLD,6
```

[4] The GPS engine will be reset. It is not a system reboot.

5.2.12 $PSTMWARM

Perform a WARM start.

Synopsis:

```
$PSTMWARM<cr><lf>
```

Arguments:

None.

Results:

- Warm start initialization and system restart[5].

Example:

```
$PSTMWARM
```

[5] The GPS engine will be reset. It is not a system reboot.

5.2.13 $PSTMHOT

Perform an HOT start.

Synopsis:

```
$PSTMHOT<cr><lf>
```

Arguments:

None.

Results:

- The system restart[6].

Example:

```
$PSTMHOT
```

[6] The GPS engine will be reset. It is not a system reboot.

5.2.14 $PSTMNMEAONOFF

Toggle NMEA output. This command switches ON or OFF the output NMEA messages.

Synopsis:

```
$PSTMNMEAONOFF,<on_off><cr><lf>
```

Arguments:

Parameter	Format	Description
on_off[7]	Integer	0 = NMEA output is turned OFF 1 = NMEA output is turned ON

Results:

- If the NMEA output message is running, sending "$PSTMNMEAONOFF,0" the NMEA output is stopped.
- If the NMEA output message is OFF, sending "$PSTMNMEAONOFF,1" the NMEA output is started.
- Sending "$PSTMNMEAONOFF,1" while NMEA is running or sending "$PSTMNMEAONOFF,0" while NMEA is stopped the command is rejected with no effects.

Example:

```
$PSTMNMEAONOFF,0
```

[7] The "on_off" input parameter has been added starting from SW re. 7.1.9.29. For backward compatibility the old command syntax is still supported: sending $PSTMNMEAONOFF with no input parameter the NMEA ON/OFF status is toggled.

5.2.15 $PSTMDEBUGONOFF

Toggle DEBUG output. This command switches ON or OFF the output DEBUG sentences.

Synopsis:

```
$PSTMDEBUGONOFF,<on_off><cr><lf>
```

Arguments:

Parameter	Format	Description
on_off	Integer	0 = DEBUG output is turned OFF 1 = DEBUG output is turned ON

Results:

- If the DEBUG output message is running, sending “$PSTMDEBUGONOFF,0” the DEBUG output is stopped.
- If the DEBUG output message is OFF, sending “$PSTMDEBUGONOFF,1” the DEBUG output is started.
- Sending “$PSTMDEBUGONOFF,1” while DEBUG is running or sending “$PSTMDEBUGONOFF,0” while DEBUG is stopped the command is rejected with no effects.

Example:

```
$PSTMDEBUGONOFF,0
```

5.2.16 $PSTMSRR

Executes a system reset. The GNSS firmware is rebooted.

Synopsis:

```
$PSTMSRR<cr><lf>
```

Arguments:

None.

Results:

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

Example:

```
$PSTMSRR
```

5.2.17 $PSTMGPSRESET

Reset the GPS receiver engine.

Synopsis:

```
$PSTMGPSRESET<cr><lf>
```

Arguments:

None.

Results:

- The GPS receiver engine will be reset
- No message will be sent as reply.

Note: using this command the GPS module won't reboot.

Example:

```
$PSTMGPSRESET
```

5.2.18 $PSTMGPSSUSPEND

Suspend the GPS receiver engine.

Synopsis:

```
$PSTMGPSSUSPEND<cr><lf>
```

Arguments:

None.

Results:

```
$PSTMGPSSUSPENDED<cr><lf>
```

- The GPS receiver engine will be suspended

Example:

```
$PSTMGPSSUSPEND
```

5.2.19 $PSTMGPSRESTART

Restart the GPS receiver engine.

Synopsis:

```
PSTMGPSRESTART<cr><lf>
```

Arguments:

None.

Results:

- The GPS receiver engine will be restarted
- No message will be sent as reply.

Example:

```
$PSTMGPSRESTART
```

5.2.20 $PSTMGNSSINV

Invalidate the GNSS Fix Status.

Synopsis:

```
$PSTMGNSSINV,<invalid>,<cr><lf>
```

Arguments:

Parameter	Format	Description
invalid	Integer	Invalid flag allowing to change the GNSS Fix status 1: GNSS Fix status is set to NO_FIX 0: GNSS Fix Status unchanged

Results:

- $PSTMGNSSINV,1 invalidates the GNSS Fix Status. A NO FIX status is so simulated.
- $PSTMGNSSINV,0 allows to restore the real GNSS Fix status.

Example:

```
$PSTMGNSSINV,1
```

5.2.21 $PSTMTIMEINV

Invalidate the Real Time Clock (RTC).

Synopsis:

```
$PSTMTIMEINV<cr><lf>
```

Arguments:

None.

Results:

- The RTC time will be invalidated.

Example:

```
$PSTMTIMEINV
```

5.2.22 $PSTMGETSWVER

Get the version string of the libraries embedded in the software application.

Synopsis:

```
$PSTMGETSWVER,<id><cr><lf>
```

Arguments:

Parameter	Format	Description
id	Integer	Depending on the value of the <lib_id> parameter, the following version numbering is delivered by the command: 0 = GNSS Library Version 1 = OS20 Version 2 = SDK App Version 4 = WAAS Version 6 = Binary Image Version 7 = STA8088 HW version 11 = SW configuration ID 254 = configuration data block 255 = all versions strings (as reported at the NMEA startup).

Results:

```
$PSTMVER,<Lib>_<Ver>_<Type><cr><lf>
```

Where:

Parameter	Format	Description
Lib	Text, fixed	Text String identifying the Library that the command is requiring the version: GNSSLIB if type = 0 OS20LIB if type = 1 GPSAPP if type = 2 WAASLIB if type = 4 BINIMG if type = 6 SWCFG if type = 11
Ver	x.x.x.x	GNSS Library Version: example 7.1.1.15
Type	ARM, GNU	Compiler Type: ARM or GNU

Example:

```
$PSTMGETSWVER,0
```

Note1: if any id is passed as parameter to the command, its output act as in the id = 0 case

Note2: when id is 255 consecutive messages are sent reporting the library version string on each line following the above message syntax.

Note3: when id is 254 the entire configuration block is printed on several lines using the following syntax:

```
$PSTMSWCONFIG,<config_source>,<msg_n>,<msg_tot><data>*<checksum><cr>
<lf>
```

Parameter	Format	Description
config_source	Decimal, 1 digit	Configuration block data source: 1 = Current Configuration (RAM) 2 = Default Configuration (ROM) 3 = Saved Configuration (FLASH)
msg_n	Decimal, 1 digit	Current message number
msg_tot	Decimal, 1 digit	Total number of messages
data	String	64 Bytes per line printing each byte in HEX format.

Note 4: The HW version has the following syntax:

```
$PSTMVER,STA80XX_<HW_SIGNATURE_STRING><cr><lf>
```

HW_SIGNATURE_STRING	STA8088 HW
0x2229D041	BB Mask
0x3229D041	BC Mask

HW_SIGNATURE_STRING	STA8089 and STA8090 HW
0x1222BC043	AA Mask
0x2222BC043	AB Mask

0x3222BC043	BA Mask
0x4222BC043	BB Mask
0x5222BC043	BC Mask
0x6222BC043	BD Mask

5.2.23 $PSTMNVMSWAP[8]

Execute a bank swap on the NVM GPS backup memory.

Synopsis:

```
$PSTMNVMSWAP<cr><lf>
```

Arguments:

None.

Results:

- The non-volatile backup memory banks will be swapped

Example:

```
$PSTMNVMSWAP
```

[8] This command is supported only by platforms or software configurations where the backup memory is based on Flash NOR or SQI memories.

5.2.24 $PSTMSBASONOFF

Suspend / resume the SBAS software execution.

Synopsis:

```
$PSTMSBASONOFF<cr><lf
```

Arguments:

None.

Results:

- If SBAS was running it will be suspended, if it was suspended it will start to run.

Example:

```
$PSTMSBASONOFF
```

5.2.25 $PSTMSBASSAT

Change the SBAS satellite.

Synopsis:

```
$PSTMSBASSAT,<prn><cr><lf
```

Arguments:

Parameter	Format	Description
prn	Decimal, 3 digit	Satellite PRN (Range: from 120 to 138 and 0)

Results:

- If the SBAS satellite is available in the above range, the software starts tracking. If the parameter is zero, the system automatically searches for the SBAS satellite available in the user region.

Example:

```
$PSTMSBASSAT,128
```

5.2.26 $PSTMRFTESTON

Enable the RF test mode for production line tests.

Synopsis:

```
$PSTMRFTESTON,<sat_id>,<cr><lf>
```

Arguments:

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number

Results:

- The GPS engine will restart in the RF test modality. This RF test forces the GPS acquiring process only on the provided satellite's id. It could be useful to reduce the RF testing time in the production line where generally a single channel simulator is present

Example:

```
$PSTMRFTESTON,24
```

5.2.27 $PSTMRFTESTOFF

Disable the RF test mode for production line tests.

Synopsis:

```
$PSTMRFTESTOFF <cr><lf>
```

Arguments:

None.

Results:

- The RF test modality will be disabled and the GPS engine will be restarted.

Note: the RF test mode can be disabled also resetting the GPS module.

Example:

```
$PSTMRFTESTOFF
```

5.2.28 $PSTMGETALGO

Get False Detection and Exclusion (FDE) algorithm ON/OFF status.

Synopsis:

```
$PSTMGETALGO,<algo_type><cr><lf>
```

Arguments:

Parameter	Format	Description
algo_type	Decimal, 1 digit	1 = FDE algorithm on/off status is returned.

Results:

- If success the following message is sent:

```
$PSTMGETALGOOK,<algo_type>,<algo_status>*<checksum><cr><lf>
```

Parameter	Format	Description
algo_type	Decimal, 1 digit	1 = FDE algorithm on/off status is returned.
algo_status	Decimal, 1 digit	0 = the algorithm is disabled. 1 = the algorithm is enabled.

- In case of error the following message will be sent:

```
$PSTMGETALGOERROR*<checksum><cr><lf>
```

Example:

```
$PSTMGETALGO,1
```

5.2.29 $PSTMSETALGO

Set False Detection and Exclusion (FDE) algorithm ON/OFF status.

Synopsis:

```
$PSTMSETALGO,<algo_type>,<algo_status><cr><lf>
```

Arguments:

Parameter	Format	Description
algo_type	Decimal, 1 digit	1 = FDE algorithm on/off status is returned.
algo_status	Decimal, 1 digit	0 = the algorithm is disabled. 1 = the algorithm is enabled.

Results:

- If success the following message is sent:

```
$PSTMSETALGOOK,<algo_type>,<algo_status>*<checksum><cr><lf>
```

Parameter	Format	Description
algo_type	Decimal, 1 digit	1 = FDE algorithm on/off status is returned.
algo_status	Decimal, 1 digit	0 = the algorithm is disabled. 1 = the algorithm is enabled.

- In case of error the following message will be sent:

```
$PSTMSETALGOERROR*<checksum><cr><lf>
```

Example:

```
$PSTMSETALGO,1,0
```

5.2.30 $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

```
$PSTMGETRTCTIME<cr><lf>
```

Arguments:

None.

Results:

- System will send RTC Data and Status.

```
$PSTMGETRTCTIME,<time>,<date>,<rtc_status>,<time_validity>*<checksum
><cr><lf>
```

Where:

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 7 - POSITION_TIME 8 - EPHEMERIS_TIME
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMGETRTCTIME
```

5.2.31 $PSTMDATUMSELECT

Set a local geodetic datum different from WGS84 (default).

Synopsis:

```
$PSTMDATUMSELECT,<datum_type><cr><lf>
```

Arguments:

Parameter	Format	Description
datum_type	Integer	The following datum are selectable: 0 : WGS84 1: TOKYO MEAN 2: OSGB

Results:

- If success the following message is sent:

```
$PSTMDATUMSELECTOK,<datum_type>*<checksum><cr><lf>
```

Parameter	Format	Description
datum_type	Integer	0 : WGS84 1: TOKYO MEAN 2: OSGB

- In case of error the following message will be sent:

```
$PSTMSELECTDATUMERROR*<checksum><cr><lf>
```

Example:

```
$PSTMSELETDATUM,1
```

5.2.32 $PSTMDATUMSETPARAM

Set parameters to local geodetic to WGS84 datum transformations.

Synopsis:

```
$PSTMDATUMSETPARAM,<d_x>,<d_y>,<d_z>,<d_a>,<d_f><cr><lf>
```

Arguments:

Parameter	Format	Description
d_x d_y d_z	Decimal	shifts between centres of the local geodetic datum and WGS84 Ellipsoid
d_a	Decimal	differences between the semi-major axis of the local geodetic datum ellipsoid and the WGS 84 ellipsoid, respectively (WGS 84 minus Local)
d_f	Decimal	differences between flattening of the local geodetic datum ellipsoid and the WGS 84 ellipsoid, respectively (WGS 84 minus Local)

Results:

- If success the following message is sent:

```
$PSTMDATUMSETPARAMOK*<checksum><cr><lf>
```

- In case of error the following message will be sent:

```
$PSTMDATUMSETPARAMERROR*<checksum><cr><lf>
```

Example:

```
$PSTMDATUMSETPARAM,-375,111,-431,-573.60, -0.000011960023
```

5.2.33 $PSTMENABLEPOSITIONHOLD

Enable/disable and set position for the Position Hold feature.

Synopsis:

```
$PSTMENABLEPOSITIONHOLD,<on_off>,<Lat>,<LatRef>,<Lon>,<LonRef>,<Alt>
<cr><lf>
```

Arguments:

Parameter	Format	Description
on_off	Decimal, 1 digit	Set the position hold enable/disable status: 0: disabled. 1: enabled.
Lat	DDMM.MMMMM	Latitude (Degree-Minute.Minute decimals)
LatRef	'N' or 'S'	Latitude direction (North or South)
Lon	DDDMM.MMMMM	Longitude (Degree-Minute.Minute decimals)
LonRef	'E' or 'W'	Longitude Direction (East or West)
Alt[9]	dddddd.dddd	Altitude in meters (-1500 to 100000)

Results:

- If success the following message is sent:

  If on_off = 1

```
$PSTMPOSITIONHOLDENABLED*<checksum><cr><lf>
```

  If on_off = 0

```
$PSTMPOSITIONHOLDDISABLED*<checksum><cr><lf>
```

- In case of error the following message will be sent:

[9] The altitude value must be reported without any geoid correction. It means that if the altitude value is retrieved by the $GPGGA message it must be added to the geoid correction before using it in the $PSTMENABLEPOSITIONHOLD command. This limitation may be removed in the future releases.

```
$PSTMENABLEPOSITIONHOLDERROR*<checksum><cr><lf>
```

Example:

```
$PSTMENABLEPOSITIONHOLD,1,4811.365,N,01164.123,E,0530.0
```

5.2.34 $PSTMSETCONSTMASK

Set the GNSS constellation mask. It allows switching the GNSS constellation at run-time.

Synopsis:

```
$PSTMSETCONSTMASK,<constellation_mask><cr><lf>
```

Arguments:

Parameter	Format	Description
constellation_mask	Decimal, 1 digit	It is a bit mask where each bit enable/disable a specific constellation independently by the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling bit 3: GALILELO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling

Results:

- If success the following message is sent:

```
$PSTMSETCONSTMASKOK,<constellation_mask>*<checksum><cr><lf>
```

- In case of error the following message will be sent:

```
$PSTMSETCONSTMASKERROR*<checksum><cr><lf>
```

Examples:

Enabling GPS only:

```
$PSTMSETCONSTMASK,1
```

Enabling GLONASS only:

```
$PSTMSETCONSTMASK,2
```

Enabling GPS and GLONASS:

```
$PSTMSETCONSTMASK,3
```

5.2.35 $PSTMNOTCH

This command set the Adaptive Notch Filter (ANF) operation mode

Synopsis:

```
$PSTMNOTCH,<Sat_type>,<Mode>,<Frequency>,<kbw_gross>,<kbw_fine>,<threshold><cr><lf>
```

Arguments:

Parameter	Format	Description
Sat_type	Decimal, 1 digits [Mandatory]	Sat type ANF path [0 -> GPS; 1->GLONASS]
Mode	Decimal, 1 digits [Mandatory]	ANF operation mode [0, disable, 1always on, 2 Auto (suggested)]
Frequency	Decimal, 8 digits [Optional]	IF Frequency, at which Notch search starts 0-8MHz range GPS / 0-16MHz Range Glonass path.
kbw_gross	Decimal, 1 digit [Optional]	Scan Speed [4,5,6 are supported values, the bigger the slower]. 5 is defauly
kbw_fine	Decimal, 1 digit [Optional]	Bandwidth Removed [4,5,6 are supported values, the smaller the bigger]. 6 is default
threshold	Decimal, 5 digits [Optional]	Detection threshold to lock the Notch at a given frequency [Default values *3010 (GPS)/ 3556(GLONASS)*]

The command can be issued in the following form:

Standard configuration (2 parameters only)

[$PSTMNOTCH,sat_type,mode]

Enhanced configuration (3 parameters)

[$PSTMNOTCH, sat_type, mode, frequency] that accepts more the frequency parameter to start search for RFI.

Full configuration (6 parameters)

[$PSTMNOTCH, Sat_type,Mode,Frequency,kbw_gross,kbw_fine,threshold]

That allows completely tuning filter behaviour (speed / bandwidth / detection threshold)

Other configurations, with a different number of parameters and/or values out of specs are not supported and can result in not predictable behaviours.

Results:

- This command set the ANF operation mode.

Example:

Standard Configuration

```
$PSTMNOTCH,0,0          [GPS path, ANF disabled]

$PSTMNOTCH,0,1          [GPS path, ANF set in always ON mode]
[For Int. usage only]

$PSTMNOTCH,0,2
[GPS path, auto insertion mode, Initial Scan Frequency is set @
4f0][Default]

$PSTMNOTCH,1,0          [GLONASS path, ANF disabled]

$PSTMNOTCH,1,1          [GLONASS path, always ON mode]
[For Int.usage only]

$PSTMNOTCH,1,2
[GLONASS path, auto insertion mode, Initial Scan Frequency is set @ 8f0]
[Default]
```

Extra supported Usages

```
$PSTMNOTCH,0,2,frequency
[GPS path, auto insertion mode, Initial Frequency is frequency (Hz)]

$PSTMNOTCH,1,2,frequency
[GLONASS path, auto insertion mode, Initial Frequency is frequency (Hz)]

$PSTMNOTCH,0,2,frequency, kbw_gross, kbw_fine, threshold

[GPS path, auto insertion mode, Initial Scan Frequency (Hz), kbw_gross,
kbw_fine, threshold]

$PSTMNOTCH,1,2,frequency, kbw_gross, kbw_fine, threshold
[GLONASS path, auto insertion mode, Initial Frequency (Hz), kbw_gross,
kbw_fine, threshold]
```

Usage Note:

By Default the

- **$PSTMNOTCH,0,2** command (Notch enabled in Auto mode on GPS branch) corresponds to the explicit
  - *PSTMNOTCH,0,2,4092000,5,6, 3010*
- **$PSTMNOTCH,1,2** command (Notch enabled in Auto mode on Glonass Branch) corresponds to the explicit
  - *PSTMNOTCH,1,2, 8184000,5,6, 3556*

5.2.36 $PSTMSQISET

Sets 8 consecutive words into the SQI Data Storage Area starting from the specified address.

Synopsis:

```
$PSTMSQISET,<offset>,<word1>,…,<word8><cr><lf>
```

Arguments:

Parameter	Format	Description
offset	HexDecimal, 4 digits	Offset from the base address of the chosen sector
word1	Hexadecimal, 8 digits	32 bits-wide word
word8	Hexadecimal, 8 digits	32 bits-wide word

Results:

- if success the following message is sent

```
$PSTMSQISETOK,<dest_addr>*<checksum><cr><lf>
```

- in case of error the following message will be sent

```
$PSTMSQISETERROR*<checksum><cr><lf>.
```

Example:

```
$PSTMSQISET,0xa0,0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88
the following 8 bytes (0x11, 0x22, 0x33, 0x44, 0x55, 0x66, 0x77, 0x88) are consecutively written in the SQI Data Storage Area, starting from offset 0xa0 (i.e. at address 0x300F00a0)
```

5.2.37 $PSTMSQIGET

Starting from the specified address, it gets 8 consecutive words from the SQI Data Storage Area.

Synopsis:

```
$PSTMSQIGET,<offset><cr><lf>
```

Arguments:

Parameter	Format	Description
offset	Hexadecimal, 4 digits	Offset from the base address of the chosen sector

Results:

- if success the following message is sent

```
$PSTMSQIGETOK,<dest_addr>,<word1>,….,<word8>*<checksum><cr><lf>
```

- in case of error the following message will be sent

```
$PSTMSQIGETERROR*<checksum><cr><lf>
```

Example:

```
$PSTMSQIGET,0xa0
The following NMEA command gets the 8 consecutive words contained in the SQI Data Storage starting from offset 0xa0 (i.e. starting from destination address 0x300F00a0)
```

5.2.38 $PSTMSQIERASE

This NMEA command erases the ector (64kbytes wide) of the SQI Data Storage Area from 0x300F0000 to 0x300FFFFF.

Synopsis:

```
$PSTMSQIERASE<cr><lf>
```

Arguments:

None.

Results:

- if success the following message is sent

```
$PSTMSQIERASEOK<cr><lf>
```

- in case of error the following message will be sent

```
$PSTMSQIERASEERROR<cr><lf>
```

Example:

```
$PSTMSQIERASE
fhe following NMEA command erases all the information inside the SQI Data
Storage Area (from 0x300F0000 to 0x300FFFFF)
```

5.2.39 $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><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 digit	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		Parameters list according to the command type specification (see below).

5.2.39.1 Getting PPS Data (cmd_mode = 1)

PPS_IF_PULSE_DATA_CMD

```
$PSTMPPS,1,7<cr><lf>
```

Replay:

```
$PSTMPPS,1,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_durati
on>,<pulse_polarity><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 NOTES: UTC(SU) is the Soviet Union UTC, it is 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.

PPS_IF_TIMING_DATA_CMD

```
$PSTMPPS,1,12<cr><lf>
```

Replay:

```
$PSTMPPS,1,12,<fix_condition>,<sat_th>,<elevation_mask>,<constellati
on_mask>,<gps_rf_delay>,<glonass_rf_delay><cr><lf>
```

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = NOFIX. 2 = 2DFIX. 3 = 3DFIX.
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
gps_rf_delay	Decimal	GPS path RF delay [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]

PPS_IF_POSITION_HOLD_DATA_CMD

```
$PSTMPPS,1,13,<on_off>,<lat>,<lat_dir>,<lon>,<lon_dir>,<h_msl><cr><l
f>
```

Replay:

```
$PSTMPPS,1,13<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 see level altitude.

PPS_IF_TRAIM_CMD

```
$PSTMPPS,1,15<cr><lf>
```

Replay:

```
$PSTMPPS,1,15,<traim_enabled>,<traim_solution>,<ave_error>
,<used_sats>,<removed_sats><cr><lf>
```

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 satellite used for timing correction.
removed_sats	Decimal	Number of satellites removed by the timing correction.

PPS_IF_TRAIM_USED_CMD

```
$PSTMPPS,1,16<cr><lf>
```

Replay:

```
$PSTMPPS,1,16,<traim_enabled>,<used_sats>,<sat1>,..,<satN><cr><lf>
```

Parameter	Format	Description
traim_enabled	Decimal, 1 digit	TRAIM ON/OFF status 0 = OFF 1 = ON
used_sats	Decimal	Number of satellite used for timing correction.
sat1..satN	Decimal	List of satellites IDs

PPS_IF_TRAIM_RES_CMD

```
$PSTMPPS,1,17<cr><lf>
```

Replay:

```
$PSTMPPS,1,17,<traim_enabled>,<used_sats>,<res1>,..,<resN><cr><lf>
```

Parameter	Format	Description
traim_enabled	Decimal, 1 digit	TRAIM ON/OFF status 0 = OFF 1 = ON
used_sats	Decimal	Number of satellite used for timing correction.
res1..resN	Decimal	List of satellites residuals [ns]. Each residual corresponds to the satellite in the used sat list at the same message position.

PPS_IF_TRAIM_REMOVED_CMD

```
$PSTMPPS,1,18<cr><lf>
```

Replay:

```
$PSTMPPS,1,18,<traim_enabled>,<rem_sats>,<sat1>,..,<satN><cr><lf>
```

Parameter	Format	Description
traim_enabled	Decimal, 1 digit	TRAIM ON/OFF status 0 = OFF 1 = ON
rem_sats	Decimal	Number of satellite removed by timing correction.
sat1..satN	Decimal	List of satellites IDs

5.2.39.2 Setting PPS Data (cmd_mode = 2)

PPS_IF_ON_OFF_CMD

```
$PSTMPPS,2,1,<on_off><cr><lf>
```

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = PPS disabled. 1 = PPS enabled.

PPS_IF_OUT_MODE_CMD

```
$PSTMPPS,2,2,<out_mode><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.

PPS_IF_REFERENCE_TIME_CMD

```
$PSTMPPS,2,19,<reference_time><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 NOTES: UTC(SU) is the Soviet Union UTC, it is 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.

PPS_IF_PULSE_DELAY_CMD

```
$PSTMPPS,2,4,<pulse_delay><cr><lf>
```

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay [ns]

PPS_IF_CONSTELLATION_RF_DELAY_CMD

```
$PSTMPPS,2,20,<sat_type><time_delay><cr><lf>
```

Parameter	Format	Description
sat_type	Decimal	Satellite constellation type: 0 = GPS 1 = GLONASS
time_delay	Decimal	Time delay [ns]

PPS_IF_PULSE_DURATION_CMD

```
$PSTMPPS,2,5,<pulse_duration><cr><lf>
```

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]

PPS_IF_PULSE_POLARITY_CMD

```
$PSTMPPS,2,6,<pulse_polarity><cr><lf>
```

Parameter	Format	Description
pulse_polarity	Decimal, 1 digit	0 = not inverted. 1 = inverted.

PPS_IF_PULSE_DATA_CMD

```
$PSTMPPS,2,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_durati
on>,<pulse_polarity><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.

PPS_IF_FIX_CONDITION_CMD

```
$PSTMPPS,2,8,<fix_condition><cr><lf>
```

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = NOFIX. 2 = 2DFIX. 3 = 3DFIX.

PPS_IF_SAT_TRHESHOLD_CMD

```
$PSTMPPS,2,9,<sat_th><cr><lf>
```

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

PPS_IF_ELEVATION_MASK_CMD

```
$PSTMPPS,2,10,<elevation_mask><cr><lf>
```

Parameter	Format	Description
elevation_mask	Decimal	Minimum satellite elevation for satellite usage in timing filtering.

PPS_IF_COSTELLATION_MASK_CMD

```
$PSTMPPS,2,11,<constellation_mask><cr><lf>
```

Parameter	Format	Description
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS 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 sats are used to correct the GPS reference time and only GLONASS sats are used to correct the GLONASS reference time.

PPS_IF_TIMING_DATA_CMD

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

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = NOFIX. 2 = 2DFIX. 3 = 3DFIX.
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

PPS_IF_POSITION_HOLD_DATA_CMD

```
$PSTMPPS,2,13,<on_off>,<lat>,<lat_dir>,<lon>,<lon_dir>,<h_msl><cr><l
f>
```

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 see level altitude.

PPS_IF_AUTO_HOLD_SAMPLES_CMD

```
$PSTMPPS,2,14,<auto_ph_samples><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 “0” the auto position hold feature is disabled. The position average evaluation is restarted every time the command is executed.

PPS_IF_TRAIM_CMD

```
$PSTMPPS,2,15,<on_off>,<alarm><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

Results:

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

5.2.40 $PSTMADCSTART

Start the ADC. It enables the peripheral clock, configures the ADC wrapper registers and creates the handlers for each channel not masked.

This command has to be used only one time, if the command is executed more than one time it doesn't have any effect on the system.

Synopsis:

```
$PSTMADCSTART,<sel_line>,<adc_functional_mode><cr><lf>
```

Arguments:

Parameter	Format	Description
Sel_line	Decimal	It is a select line mask. This value sets the *sel* field of the ADC configiguration register that controls which channels are masked. Allowed values: 0: 8 channels available (no channel masked) 1: 4 channels available (AIN0, AIN2, AIN4, AIN6; the other analogue data input are masked) 3: 2 channels available (AIN0, AIN4, others channels are masked) 7: 1 channel available (AIN0; all the others channels are masked)
adc_functional_mode	Decimal	It allows selecting ADC operating mode: 0: NO INTERRUPT mode 1: INTERRUPT mode It is an optional parameter. If not present by default the ADC operating mode will be NO INTERRUPT.

Results:

- If success the following message is sent:

```
$PSTMADCSTARTOK*<checksum><cr><lf>
```

- In case of error the following message will be sent:

```
$PSTMADCSTARTERROR*<checksum><cr><lf>
```

Examples:

To observe all eight possible channels in NO INTERRUPT ADC operating mode:

```
$PSTMADCSTART,0
```

To observe only the channels AIN0, AIN2, AIN4 and AIN6 in NO INTERRUPT ADC operating mode:

```
$PSTMADCSTART,1
```

To observe only the channels AIN0 and AIN4 in NO INTERRUPT ADC operating mode:

```
$PSTMADCSTART,3
```

To observe only one channel AIN0 in NO INTERRUPT ADC operating mode:

```
$PSTMADCSTART,7
```

To observe all eight possible channels in INTERRUPT ADC functional mode:

```
$PSTMADCSTART,0,1
```

To observe only one channel AIN0 in NO INTERRUPT ADC operating mode:

```
$PSTMADCSTART,7,0
```

5.2.41 $PSTMADCREAD

This NMEA command reads from the buffer the converted analogue input specified as parameter.

This command has to be used only after ADC is started, if the command is executed more than one time the system returns an error message. It is important that the selector line has the same value passed in the STARTADC NMEA command.

Synopsis:

```
$PSTMADCREAD,<sel_line>,<ain><cr><lf>
```

Arguments:

Parameter	Format	Description
Sel_line	Decimal, 1 digit	It is a select line mask. This value sets the *sel* field of the ADC cfg register that controls which channels are masked: 0: 8 channels available (no channel masked) 1: 4 channels available (AIN0, AIN2, AIN4, AIN6; the other analog data input are masked) 3: 2 channels available (AIN0, AIN4, others channels are masked) 7: 1 channel available (AIN0; all the others channels are masked). This value must have the same value passed as parameter in the ADCSTART NMEA command
ain	Decimal, 1 digit	Channel to be read. It has to be compatible to the sel_line value: 0,…,7 if sel_line = 0; 0, 2, 4, 6 if sel_line = 1; 0, 4 if sel_line = 3; 0 if sel_line = 7

Results:

- If success the following message is sent:

```
$PSTMADCREADOK,<ain>,<data_read>*<checksum><cr><lf>
```

Where:

Parameter	Format	Description
ain	Decimal, 1 digit	Channel to be read

Data_read	Decimal, 1 digit	Data read from the buffer

- In case of error the following message will be sent:

```
$PSTMADCREADERROR*<checksum><cr><lf>
```

Examples:

All the eight possible channels are available and the channel to be read is AIN5:

```
$PSTMADCREAD,0,5
```

Only AIN0, AIN2, AIN4 and AIN6 channels are available and the one to be read is AIN2:

```
$PSTMADCREAD,1,2
```

Only the channels AIN0 and AIN4 are available and the channel to be read is AIN4:

```
$PSTMADCREAD,3,4
```

Only one channel is available AIN0:

```
$PSTMADCREAD,7,0
```

Result Example for the last case:

```
$PSTMADCREAD,0,760*4f
```

5.2.42 $PSTMLOWPOWERONOFF

Allow setting the low power algorithm parameters at run-time.

NOTE: The periodic mode settings are only valid for STA8089/STA8090.

Synopsis:

```
$PSTMLOWPOWERONOFF <low power enable/disable>, <constellation mask>,
<EHPE threshold>, <Max tracked sats>, <Switch constellation features
>, <Duty Cycle enable/disable>, <Duty Cycle ms signal off>,
<Periodic mode>, <Fix period>, <Number of fix>, <Ephemeris refresh>,
<RTC refresh>, <No Fix timeout>, <No Fix timeout Off
duration><cr><lf>
```

Arguments:

Parameter	Format	Description
low power enable/disable	Decimal, 1 digit	General Low Power features Enable/Disable 0: OFF, 1: ON
Adaptive mode settings		
Constellation mask	Decimal, 1 digit	It is a bit mask where each bit enable/disable a specific constellation independently by the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling
EHPE threshold	Decimal, 3 digits	EHPE average threshold [m]
Max tracked sats	Decimal, 2 digits	first N satellites (with higher elevation) used for the position calculation (Active channel management) in LOW POWER STATE
Switch constellation features	Decimal, 1 digit	Switch constellation features (enable it only for GNSS constellation case)
Cyclic mode settings		
Duty Cycle enable/disable	Decimal, 1 digit	Duty Cycle features enable/disable
Duty Cycle ms signal off	Decimal, 3 digits	Estimated Horizontal Position Error Average

Periodic mode settings		
Periodic mode	Decimal, 1 digit	Setup Active or Standby periodic mode 0: OFF 1: Active Periodic mode 3: Standby Periodic mode
FixPeriod	Decimal, 5 digits	Interval between two fixes [s]
FixOnTime	Decimal, 2 digits	Number of fixes reported for each interval
Ephemeris refresh	Decimal, 1 digit	Enable/Disable the refresh of ephemeris data 0: OFF, 1: ON
RTC calibration	Decimal, 1 digit	Enable/Disable the RTC calibration 0: OFF, 1: ON
NoFixCnt	Decimal, 2 digits	Time to declare fix loss [s] in HOT conditions
NoFixOff	Decimal, 2 digits	Period of off period after a fix loss [s]

Results:

- If the command is executed with success the following message is sent:

```
$PSTMLOWPOWERON,<EHPE threshold>, <Max tracked sats>, <Switch constellation features >, <Duty Cycle enable/disable>, <Duty Cycle ms signal off>*<checksum><cr><lf>
```

Arguments:

Same description as reported in previous table.

5.2.43 $PSTMCRCCHECK

Evaluates the Cyclic Redundancy Check (CRC-32bits) of the GNSS firmware and boot code memory areas and compare it with the factory stored CRC value.

Synopsis:

```
$PSTMCRCCHECK,<type>,<par1>,<par2>,<par3><cr><lf>
```

Arguments:

Parameter	Format	Description

type	Decimal, 1 digit	Command configuration bitmask. Bit0: defines the meaning of input parameters (par1, par2 and par3) - 0 = input parameters represent the memory addresses where the value is stored. - 1 = input parameters represent the value for the CRC evaluation and compare. Bit1: indicates if boot code should be included or not in the CRC evaluation. - 0 = boot code is included - 1 = boot code is excluded by CRC evaluation. Bit2: defines the response message format. - 0 = short response message - 1 = detailed response message
par1	Hexadecimal, 1 Digit	GNSS firmware base address (it could be an address or a value according to bit0 of first parameter)
par2	Hexadecimal, 1 Digit	GNSS firmware size (it could be an address or a value according to bit0 of first parameter)
par3	Hexadecimal, 1 Digit	GNSS firmware stored CRC (it could be an address or a value according to bit0 of first parameter)

Results:

```
$PSTMCRCCHECK,<result>,<code_add>,<code_len>,<code_eval_crc>,<code_stored_crc>,<boot_add>,<boot_len>,<boot_eval_crc>,<boot_stored_crc>*<checksum><cr><lf>
```

Parameter	Format	Description
result	Decimal, 1 Digit	CRC compare result: 0 = FAILED 1 = PASSED
code_add	Hexadecimal, 1 Digit	GNSS firmware base address
code_len	Hexadecimal, 1 Digit	GNSS firmware size
code_eval_crc	Hexadecimal, 1 Digit	GNSS firmware evaluated CRC
code_stored_crc	Hexadecimal, 1 Digit	GNSS firmware stored CRC

boot_add	Hexadecimal, 1 Digit	BOOT code base address
boot_len	Hexadecimal, 1 Digit	BOOT code size
boot_eval_crc	Hexadecimal, 1 Digit	BOOT code evaluated CRC
boot_stored_crc	Hexadecimal, 1 Digit	BOOT code stored CRC

NOTE1: all input parameters are optional. If command is sent with no input parameters the CRC evaluation and comparison is performed including the boot code area and using the default hard coded location to retrieve base address, size and stored CRC. In such case the command response will be:

```
$PSTMCRCCHECK,<result>*<checksum><cr><lf>
```

NOTE2: response message may include or not details about boot code area according to bit1 status of first input parameter.

5.2.44 $PSTMSTBIN

Switch NMEA port in/out interface to ST binary protocol (STBIN).

Synopsis:

```
$PSTMSTBIN<cr><lf>
```

Arguments:

None.

Results:

The NMEA port can send messages and receive commands according to the STBIN protocol.

NOTE: to be used the STBIN needs to be enabled and configured (see firmware configuration documentation for details).

5.2.45 $PSTMNMEAREQUEST

Send a set of NMEA messages according to the input message list as specified in the FW Configuration document.

Synopsis:

```
$PSTMNMEAREQUEST,<msglist_l>,<msglist_h><cr><lf>
```

Arguments:

Parameter	Format	Description
msglist_l	Hexadecimal, 1 Digit	First 32 bits of 64 bits message list (low). Each bit is used to enable/disable a specific message. 0 = disabled 1 = enabled
msglist_h	Hexadecimal, 1 Digit	Second 32 bits of 64 bits message list (high). Each bit is used to enable/disable a specific message. 0 = disabled 1 = enabled

Results:

A set of NMEA messages is sent according to the input message list.

NOTE: the order of NMEA messages in the message list is the same as for the periodic NMEA output messages.

5.2.46 $PSTMFORCESTANDBY

Force the platform to go in standby mode.

NOTE: This command is not implemented in 3.7.x version of the software.

Synopsis:

```
$PSTMFORCESTANDBY,<duration><cr><lf>
```

Arguments:

Parameter	Format	Description
duration	Decimal, 5 digits	Duration of the standby time in seconds

Results:

- If the command is executed with success the following message is sent:

```
$PSTMFORCESTANDBYOK*<checksum><cr><lf>
```

- In case of errors, the error message is returned

```
$ PSTMFORCESTANDBYERROR*<checksum><cr><lf>
```

Arguments:

Same description as reported in previous table.

5.2.47 $PSTMIONOPARAMS

Uploads a specific iono packet into the receiver NVM. The uploaded iono packet will be retained until a new iono packet for the same constellation is successfully uploaded or downloaded from the navigation message.

NOTE: This command is not implemented in 3.x.y version of the software.

Synopsis:

```
$PSTMIONOPARAMS,<sat_type=0>,1,<A0>,<A1>,<A2>,<A3>,<B0>,<B1>,<B2>,<B3>,
<cr><lf>

$PSTMIONOPARAMS,<sat_type=1>,1,<ai0>,<ai1>,<ai2>,<Region1>,<Region2>,<R
egion3>,<Region4>,<Region5>,<cr><lf>
```

Arguments:

Parameter	Format	Description
sat_type	Decimal, 1 digits	1 is for GPS 3 is for Galileo 7 for BeiDou
A0,A1,A2,A3	Decimal, 3 digits	These parameters are used only if sat_type=1 or 7 Iono parameters, raw integer values as from Navigation Messages.
B0,B1,B2,B3	Decimal, 3 digits	These parameters are used only if sat_type=1 or 7 Iono parameters, raw integer values as from Navigation Messages.
ai0,ai1,ai2	Decimal, 3 digits	These parameters are used only if sat_type=3 Iono parameters, raw integer values as from Navigation Messages.
Region1,Region2,Region3,Region4,Region5	Binary	These parameters are used only if sat_type=3 Galileo iono regions

5.2.48 $PSTMGALILEOGGTO

This command programs the Galileo broadcast GGTO.

NOTE: This command is not implemented in 3.x.y version of the software.

Synopsis:

```
$PSTMGALILEOGGTO <brd>,<WN0G>,<t0G>,<A0G>,<A1G>,<validity>*
<checksum><cr><lf>
```

Arguments:

Parameter	Format	Description
brd	Decimal, 1 digits	1=broadcast GGTO
WN0G	Decimal, 3 digits	Value for WN0G
t0G	Decimal, 5 digits	Value for t0G
A0G	Decimal, 5 digits	Value for A0G
A1G	Decimal, 5 digits	Value for A1G
validity	binary	0=not valid, 1=valid

5.2.49 $PSTMGALILEODUMPGGTO

This command dumps the broadcast GGTO.

NOTE: This command is not implemented in 3.x.y version of the software.

Synopsis:

```
$PSTMGALILEODUMPGGTO<cr><lf>
```

Results:

- If the command is executed with success the following message is sent:

```
$PSTMGALILEOGGTO <brd>,<WN0G>,<t0G>,<A0G>,<A1G>,<validity>*
<checksum><cr><lf>
```

Parameter	Format	Description
brd	Decimal, 1 digits	1=broadcast GGTO
WN0G	Decimal, 3 digits	Value for WN0G
t0G	Decimal, 5 digits	Value for t0G
A0G	Decimal, 5 digits	Value for A0G
A1G	Decimal, 5 digits	Value for A1G
validity	binary	0=not valid, 1=valid

5.2.50 $PSTMSBASMCH

SBAS multi-channel management.

Synopsis:

$PSTMSBASMCH,<function>,<channel>,<prn>,<status><cr><lf>

Arguments:

5.3 System Configuration Commands

The GNSS Software utilizes a “Configuration Data Block” that holds the working parameters for the system. The parameters can be set, read or store (in NVM) using the system configuration commands: `$PSTMSETPAR`, `$PSTMGETPAR` and `$PSTMSAVEPAR`. There is also a command to restore the factory setting parameters: `$PSTMRESTOREPAR`.

At run-time it could be possible to have up to three different configuration blocks:

- Current configuration: it is placed in RAM memory and it includes the current configuration of each parameter. This configuration block can be modified with the `$PSTMSETPAR` command. The `$PSTMSAVEPAR` command stores the current configuration data block into the NVM memory. At startup the current configuration block is loaded from NVM (if a stored data block is available) or it is loaded from default one embedded in the code (factory settings).

- Default configuration: it is generally placed in the flash/rom memory. It includes the factory setting for each parameter. This configuration is used at system startup if there is no configuration data into the NVM memory.

- NVM stored configuration: it is available in the NVM backup memory as soon as the `$PSTMSAVEPAR` command is executed. It includes all parameters modified and stored by the user. At system startup the SW configuration managements checks if a valid configuration block is available in the NVM backup memory. In case the stored configuration is available, it will be used for system configuration. If not available the default setting will be used.

Note: Other “Configuration Data Block” parameters not documented in this manual must be considered as reserved and must not be modified. Modifying any other parameter intentionally or unintentionally may stop the system from working and/or degrade the system performance.

5.3.1 $PSTMSETPAR

This command sets the defined parameter (indicated by “ID”) to the value provided as “param_value” in the commands parameter.

Synopsis:

```
$PSTMSETPAR,<ConfigBlock><ID>,<param_value>[,<mode>]<cr><lf>
```

Arguments:

Parameter	Format	Description
ConfigBlock	Decimal,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block as described in FW Configuration document)
param_value	1 up to 80 bytes	Parameter to be set, see “Allowed values” as described in FW Configuration document.
mode	Decimal, 1 digit	This parameter is optional. It allows to perform bit-to-bit “OR” or “AND” operations between the selected parameter in the configuration block and the param_value in input. It has the following meaning: 0: the parameter in the configuration block is overwritten by the param_value. This is the default action as in the case mode is omitted. 1: the parameter in the configuration block is the result of bit-to-bit “OR” between old value and the param_value.This is useful for bit mask setting. 2: the parameter in the configuration block is the result of bit-to-bit “AND” between old value and NOT(param_value). This is useful for bit mask resettimg.

Results:

- The parameter indicated by the ID value is set according to the parameters included in param_value. In case of no errors, the following message is returned

```
$PSTMSETPAROK ,<ConfigBlock><ID>*<checksum><cr><lf>
```

- In case of errors, the error message is returned

```
$PSTMSETPARERROR*<checksum><cr><lf>
```

Where:

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block as described in FW Configuration document)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

Issuing the command:

```
$PSTMSETPAR,1121,10
```

You could have this answer:

```
$PSTMSETPAROK,1121*
```

Note: The configuration block parameter is ignored by the "SET" command because only the current configuration, stored in the RAM memory, can be written. It is used only to keep same syntax as for the "GET" command. The configuration block stored in NVM will be overwritten by current configuration after the $PSTMSAVEPAR command.

Note: There is no comma and no space between ConfigBlock and ID parameters.

Note: The input param_value must be expressed in hexadecimal format without "0x" prefix for any integer value except DOP configuration. It must be decimal for any not integer value and DOP setting.

5.3.2 $PSTMGETPAR

This command reads the defined parameter (indicated by “ID”) from the “Configuration Data Block” and returns it as a specific message.

Synopsis:

```
$PSTMGETPAR,<ConfigBlock><ID><cr><lf>
```

Arguments:

Parameter	Format	Description
ConfigBlock	Decima1, 1 digit	Indicates one of configuration blocks: 1 = Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)

Results:

- In case of no errors, the selected parameter ID value is returned in the following message

```
$PSTMSETPAR,<ConfigBlock><ID>,<value>*<checksum><cr><lf>
```

- In case of errors, the error message is returned

```
$PSTMGETPARERROR*<checksum><cr><lf>
```

Where:

Parameter	Format	Description
ConfigBlock	Decima1, 1 digit	Indicates one of configuration blocks: 1 = Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see, Configuration Data Block)
value	Hexadecimal or Decimal	The value of returned parameter. According to the parameter type it could be expressed in hexadecimal format (in case parameter is integer) or decimal format (in case the parameter is floating).

checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

Issuing the command:

```
$PSTMGETPAR,1403
```

You could have this answer:

```
$PSTMSET,1403,15,12,12,18*<checksum><cr><lf>
```

Note: there is no comma and no space between `ConfigBlock` and `ID` parameters.

Note: In case of no errors the answer is deliberately `$PSTMSET` and not `$PSTMGET`.

Note: if the parameter ID is "000" all the configuration block is printed out using one message for each parameter. The message syntax is the same as reported above.

5.3.3 $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

```
$PSTMSAVEPAR<cr><lf>
```

Arguments:

None.

Results:

- The current configuration data block, including changed parameters, will be stored into the backup memory (NVM).

  If there are no error the following message is returned

```
$PSTMSAVEPAROK
```

  In case of errors, the error message is returned

```
$PSTMSAVEPARERROR
```

Note: the factory setting parameters can be restored using the $PSTMRESTOREPAR command.

Example:

```
$PSTMSAVEPAR
```

5.3.4 $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<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.

  If there are no error the following message is returned

```
$PSTMRESTOREPAROK
```

  In case of errors, the error message is returned

```
$PSTMRESTOREPARERROR
```

Example:

```
$PSTMRESTOREPAR
```

6 Messages

This section contains both the standard NMEA messages and the proprietary messages delivered from any ST-GPS system. Additionally it contains messages which result from a specific command input.

6.1 Standard NMEA messages list

Syntax	Default	Description
$--GNS	ON	NMEA: Global Position System Fix Data
$GPGGA	ON	NMEA: Global Position System Fix Data
$GPGLL	OFF	NMEA: Geographic Position Latitude/Longitude
$--GSA	ON	NMEA: GPS DOP and Active Satellites. “GP”, “GL” and “GN” talker ID are supported according to the software configuration.
$--GSV	ON	NMEA: GPS Satellites in View. “GP”, “GL” and “GN” talker ID are supported according to the software configuration.
$GPRMC	ON	NMEA: Recommended Minimum Specific GNSS Data
$GPVTG	OFF	NMEA: Track made good and ground speed
$GPZDA	OFF	NMEA: Time and Date
$GPGST	ON	NMEA: GNSS Pseudorange Noise Statistics
$--DTM	OFF	NMEA: Local datum offsets from reference

6.2 ST NMEA messages list

Syntax	Default	Description
$PSTMDIFF	OFF	ST: Differential Correction Data
$PSTMPRES	OFF	ST: Position Residuals
$PSTMVRES	OFF	ST: Velocity Residuals
$PSTMPA	OFF	ST: Position Algorithm
$PSTMRF	OFF	ST: Radio Frequency
$PSTMSAT	OFF	ST: Satellite Information
$PSTMSBAS	ON	ST: Augmentation System

$PSTMSBASCORR	OFF	ST: Satellite Correction Data
$PSTMTIM	OFF	ST: System Time
$PSTMTG	OFF	ST: Time and Number of used Satellites
$PSTMTS	OFF	ST: Tracked Satellite Data
$PSTMKFCOV	OFF	ST: Standard Deviation and Covariance
$PSTMAGPS[10]	OFF	ST: STAGPS predicted ephemeris information
$PSTMNOTCHSTATUS	OFF	ST: Reports the Notch filter status.
$PSTMCPU	ON	ST: Reports the CPU usage and CPU speed setting.
$PSTMPOSNHOLD	OFF	ST: Reports the status and position of Position Hold.
$PSTMPPSDATA	OFF	ST: Reports the Pulse Per Second data.
$PSTMTRAIMSTATUS	OFF	ST: Reports the TRAIM status data.
$PSTMTRAIMUSED	OFF	ST: Reports the satellites used for timing correction.
$PSTMTRAIMRES	OFF	ST: Reports the residuals for used satellites.
$PSTMTRAIMREMOVED	OFF	ST: Reports the satellites removed by timing correction algorithm.
$PSTMLOWPOWERDATA	OFF	ST: Reports the status of low power algorithm
$PSTMGALILEOGGTO	OFF	ST: Reports the Galileo broadcast GGTO

6.3 Commands answers messages list

Syntax	Default	Description
$PSTMALMANAC	Reply	ST: Dump Almanac <Data>
$PSTMEPH	Reply	ST: Dump Ephemeris <Data>
$PSTMGETRTCTIME	Reply	ST: Get Real Time Clock Time
$PSTMSETRANGEERROR	Reply	ST: Error Message: Range set = failed
$PSTMSETRANGEOK	Reply	ST: Acknowledge Range set = OK
$PSTMVER	Reply	ST: Output Version String

[10] This message is available only if the STAGPS is supported.

6.4 Standard NMEA messages specification

This messages are defined within the “NMEA 0183” Specification.

6.4.1 $GPGGA

Global Positioning System Fixed data

NMEA message list bitmask (64 bits): 0000 0000 0000 0002

Format:

```
$GPGGA,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,<HDOP>,
   <Alt>,<AltVal>,<GeoSep>,<GeoVal>,<DGPSAge>,<DGPSRef>,
   <checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 “.sss” is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat	DDMM.MMMMM	Latitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
GPSQual	Decimal, 1digit	0 = invalid 1 = GPS 2 = DGPS 6 = estimated (dead reckoning) mode
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above mean sea level, max: 100000m
AltVal	“M”	Reference Unit for Altitude (“M” = meters)
GeoSep	Decimal, 4 digits	Geoidal Separation measure in “M” = meters

GeoVal	“M”	Reference Unit for GeoSep (“M” = meters)
DGPSAge	Empty	Not supported
DGPSRef	Empty	Not supported
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGGA,183417.000,04814.03970,N,01128.52205,E,0,00,99.0,495.53,M,47.
6,M,,*53
```

6.4.2 $GPGLL

Geographic Positioning Latitude / Longitude

Format:

```
$GPGLL,<Lat>,<N/S>,<Long>,<E/W>,<Timestamp>,<Status>,<mode
indicator>,<checksum><cr><lf>
```

Parameter	Format	Description
Lat	DDMM.MMMMM	Latitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Latitude Direction: North or South
Long	DDMM.MMMMM	Longitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Longitude Direction: East or West
Timestamp	hhmmss.sss	UTC Time of GGL Sample, example: 160836 “.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
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGLL,4055.04673,N,01416.54941,E,110505.000,A,A*54
```

6.4.3 $--GSA

GNSS DOP and Active Satellites. The talker ID for this NMEA message depends on the enabled constellation as follows:

- "GP" if only GPS constellation is enabled.
- "GL" if only GLONASS constellation is enabled.
- "GA" if only GALILEO constellation is enabled[11].
- "BD" if only BEIDOU constellation is enabled[12].
- "GN" if more than one constellation is enabled to be used in the positioning solution. This talker ID is used even if it is forced to be used in the configuration block (see Application ON/OFF parameter Bit 20).

Satellites from different constellations are sent on separate messages.

Format:

```
$--GSA,<Mode>,<CurrentMode>,[<SatPRN1>],...,[<SatPRNN>],
   <PDOP>,<HDOP>,<VDOP>,
   <checksum><cr><lf>
```

Parameter	Format	Description
Mode	"M" or "A"	Operating Mode: M = Manual, A = Auto (2D/3D)
CurrentMode	Decimal, 1 digit	Current Mode: 1 = no fix available 2 = 2D 3 = 3D
SatPRN1...N	Decimal, 2 digits	Satellites list used in position fix (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, max: 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, max: 99.0
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

[11] Only on platforms that support Galileo constellations

[12] Only on platforms supporting Beidou constellation

Example:

```
$GPGSA,A,3,05,21,07,24,30,16,12,,,,,,2.4,1.9,1.5*38
```

6.4.4 $--GSV

GNSS Satellites in View. The talker ID for this NMEA message depends on the enabled constellation as follows:

- "GP" is used only for GPS satellites. A set of $GPGSV messages is sent to report all GPS satellites.
- "GL" is used only for GLONASS satellites. A set of $GLGSV messages is sent to report all GLONASS satellites.
- "GA" is used only for GALILEO satellites[13]. A set of $GAGSV messages is sent to report all GPS satellites.
- "BD" is used only for BEIDOU satellites[14]. A set of $BDGSV messages is sent to report all GPS satellites.
- "QZ" is used only for QZSS satellites. A set of $QZGSV messages is sent to report all QZSS satellites.
- "GN" if enabled in the configuration block (see Application ON/OFF parameter Bit 21) to report all satellites for all enabled constellation. A single set of $GNGSV messages is sent to report all satellites. In such case the number of GSV messages could be bigger than 4.

Format:

```
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,
   [<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1C/N0>],
   ...
   [<SatNPRN>,<SatNElev>,<SatNAzim>,<SatNC/N0>],
   <checksum><cr><lf>
```

N max 4

Parameter	Format	Description
GSVAmount	Decimal, 1 digit	Total amount of GSV messages, max. 3
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 12

[13] If the HW platform and/or firmware revision supports Galileo constellation.

[14] It the HW platform and/or firmware revision supports BeiDou constellation.

SatxPRN	Decimal, 2 digits / 3 digits	1 … 32 PRN Number of satellite x for GPS 33 .. 51 NMEA ID of SBAS 65 … 92 PRN Number of satellite x for GLONASS 141 … 172 PRN Number of satellite x for BAIDEU 183 … 197 PRN Number of satellite x for QZSS 293 … 297 PRN Number of satellite x for QZSS 301 … 330 PRN Number of satellite x for GALILEO
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
SatxC/N0	Decimal, 2 digits	Carrier to Noise Ratio for satellite x in dB, 00 … 99
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$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
```

Note: Due to the fact that sometimes more than to 12 Satellites may be in view, this message can be repeated up to 4 times containing 4 different Satellites per message. `GSVAmount` reports the total number of GSV messages to be transmitted, while `GSVNumber` reports the actual number of the current message frame.

6.4.5 $GPRMC

Recommended Minimum Specific GPS/Transit data. Time, date, position and speed data provided by the GNSS receiver. This sentence is transmitted at intervals not exceeding 2 seconds and is always accompanied by RMB when destination waypoint is active.

Format:

```
$GPRMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/W>,<Speed>,
   <Trackgood>,<Date>,<MagVar>,<MagVarDir>,<mode indicator>
   <checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Status	"A" or "V"	Receiver warning: "A" = valid, "V" = Warning NOTE: "V" is reported in NO FIX conditions and "A" is reported in 2D and 3D fix conditions.
Lat	DDMM.MMMMM	Latitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	"N" or "S"	Latitude Direction: North or South
Long	DDMM.MMMMM	Longitude in Degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	"E" or "W"	Longitude Direction: East or West
Speed	ddd.d	Speed over ground in knots
Trackgood	Decimal, 4 digits	Course made good, max. 999.9
Date	Decimal, 6 digits	Date of Fix : ddmmyyyy
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	"E" or "W"	Magnetic Variation Direction
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

checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPRMC,183417.000,V,4814.040,N,01128.522,E,0.0,0.0,170907,0.0,W*6C
```

6.4.6 $GPVTG

Course over grounf and ground speed, this message provides the actual corse and speed relative to ground.

Format:

```
$GPVTG,<TMGT>,T,<TMGM>,M,<SoGN>,N,<SoGK>,K,D*<checksum><cr><lf>
```

Parameter	Format	Description
TMGT	ddd.d in degrees	Track in reference to “true” earth poles
T		Indicates “terrestrial”
TMGM	ddd.d in degrees	Track in reference to “magnetic” earth poles
M		Indicates “magnetic”
SoGN	ddd.d in knots	Speed over Ground in knots
N		Indicates “knots”
SoGK	ddd.d in km/h	Speed over Ground in kilometers per hour
K		Indicates “kilometres”
D	char	Mode indicator: A = Autonoumus mode D= Differential mode E= Estimated mode
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$GPVTG,73.2,T,,M,0.2,N,0.4,K,D*50
```

6.4.7 $GPZDA

UTC, day, month and year.

Format:

```
$GPZDA,<Timestamp>,<Day>,<Month>,<Year>,00,00,<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Day	Decimal, 2 digits	Day of month (01 to 31)
Month	Decimal, 2 digits	Month (01 to 12)
Year	Decimal, 4 digits	Year (1994 - …)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPZDA,110505.00,25,01,2013,00,00*60
```

6.4.8 $GPGST

Global Positioning System Pseudorange Noise Statistics

Format:

```
$GPGST,<Timestamp>,<EHPE>,<Semi-major Dev>,<Semi-minor Dev>,<Semi-
major Angle>,<Lat Err Dev>,<Lon Err Dev>,<Alt Err Dev>,
<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
EHPE	dd.d in m	Equivalent Horizontal Position Error
Semi-major Dev	dd.d in m	Standard deviation (meters) of semi-major axis of error ellipse
Semi-minor Dev	dd.d in m	Standard deviation (meters) of semi-minor axis of error ellipse
Semi-major Angle	dd.d in degree	Orientation of semi-major axis of error ellipse (true north degrees)
Lat Err Dev	dd.d in m	Standard deviation (meters) of latitude error
Lon Err Dev	dd.d in m	Standard deviation (meters) of longitude error
Alt Err Dev	dd.d in m	Standard deviation (meters) of altitude error
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGST,101429.000,0.0,3.5,3.1,89.4,3.2,3.4,3.4*58
```

6.4.1 $GPGBS

GNSS Satellite Fault Detection

NMEA message list bitmask (64 bits): 0000 2000 0000 0000

Format:

```
$GPGBS,<Timestamp>,<Lat Err Dev>,<Lon Err Dev>,<Alt Err
Dev>,<SatPRN>,<Prob>,<res>,<Std dev>,<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat Err Dev	dd.d in m	Standard deviation (meters) of latitude error
Lon Err Dev	dd.d in m	Standard deviation (meters) of longitude error
Alt Err Dev	dd.d in m	Standard deviation (meters) of altitude error
SatPRN	Decimal, 2 digits	PRN Number of most likely failed satellite. This satellite is excluded by RAIM or FDE algorithm.
Prob	Empty	Probability of missed detection for most likely failed satellite Not supported
res	dd.d in m	Range residual of most likely failed satellite
Std dev	Empty	Standard Deviation of bias estimate Not supported
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGBS,033037.000,10.7,12.0,14.1,08,,-51.7,*7C
```

6.4.2 $--GNS

Fix data for single or combined satellite navigation system (GNSS).

The talker ID for this NMEA message depends on the enabled constellation as follows:

- “GP” if only GPS constellation is enabled.
- “GL” if only GLONASS constellation is enabled.
- “GA” if only GALILEO constellation is enabled.
- “BD” if only BEIDOU constellation is enabled.
- “QZ” if only QZSS constellation is enabled.
- “GN” if at least two constellations are enabled. This talker ID is used even if it is forced to be used in the configuration block (see Application ON/OFF parameter Bit 20).

Format:

```
$--GNS,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual><GLNQual>,
<Sats>,<HDOP>,<AltVal>,<GEOVal>,<DGPSAge>,<DGPSRef>,
<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 “.sss” is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat	DDMM.MMMMM	Lat in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
GPS Mode Indicator	Char	N = NO Fix A = Autonomous D = Differential GPS E = Estimated (dead reckoning mode)

Glonass Mode Indicator	Char	N = NO Fix A = Autonomous D = Differential Glonass E = Estimated (dead reckoning mode)
Galileo Mode Indicator	Char	N = NO Fix A = Autonomous D = Differential Glonass E = Estimated (dead reckoning mode)
QZSS Mode Indicator	Char	N = NO Fix A = Autonomous D = Differential Glonass E = Estimated (dead reckoning mode)
Beidou Mode Indicator	Char	N = NO Fix A = Autonomous D = Differential Glonass E = Estimated (dead reckoning mode)
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above WGS84 Elipsoid, max: 100000m
GEOSep	Decimal, 4 digits	Geoidal separation, meter
DGNSSAge	Empty field	Not supported
DGNSSRef	Empty field	Not supported
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Note: In case of single constellation setup the mode indicator consists in one character and the information about the constellation is given by talker id

Example:

```
$GNGNS,091233.000,4055.04824,N,01416.55600,E,AAANN,19,0.7,0078.1,42.
9,,*17

$GPGNS,083423.000,4055.04781,N,01416.55528,E,A,10,0.9,0092.0,42.9,,*
06
```

6.4.3 $--DTM

Local geodetic datum and datum offsets from a reference datum. This sentence is used to define the datum to which a position location, and geographic locations in subsequent sentences, is referenced. If enabled, this message is sent for every position fix as first NMEA message in the list.

Format:

```
$--DTM,<Local_datum_code>,<local_datum_code_id>,<Lat_offset>,<N/S>,
<Long_offest>,<E/W>,<Alt_offset><Reference_datum_code><checksum><cr>
<lf>
```

Parameter	Format	Description
Local_datum_code	ccc	Local datum code (three characters): W84 = WGS84 P90 = PZ90 999 = User Defined Datum IHO = Datum reported in the International Hydrographic Organization Publication S-60 Appendices B and C. Note: all supported datum are listed in the Appendix A at the end of this document.
local_datum_code_id	ddd	In case the local datum code is W84 or 999 (User Defined) this field is left empty. In all other cases this field reports the local datum code ID (three numeric digits) as reported in Appendix A at the end of this document. The local datum code ID is the same number used to identify the datum code in the firmware configuration (CDB-ID)
Lat_offset	mmm.mmmmm	Latitude offset in minutes
N/S	“N” or “S”	Lat Direction: North or South
Long_offest	mmm.mmmmm	Longitude offset in minutes
E/W	“E” or “W”	Long Direction: East or West
Alt_offset	aaa.aaaaaa	Altitude offset in meters
Reference_datum_code	ccc	Reference datum code (three characters): W84 = WGS84

Examples:

```
$GPDTM,W84,,000.00000,N,000.00000,E,0.000000,W84*5F

$GPDTM,P90,253,000.00005,S,000.00266,E,0.000000,W84*73

$GPDTM,999,,000.18907,N,000.05146,W,0.000000,W84*2E

$GPDTM,IHO,037,000.11581,N,000.01822,W,0.000000,W84*69
```

6.5 ST NMEA messages specification

In order to provide further data and information from the GPS system, which are not provided by the standard NMEA messages, STMicroelectronics provides “proprietary messages”. Any proprietary message on the NMEA port starts with “$Pxxxx…” and the following three letter indicate that it is a ST proprietary message ($PSTMxxx…)

There are two sorts of “proprietary messages” within a ST-GPS system. They are either send repeatedly with a defined or definable reporting rate or they are send only once as a reaction to a command.

6.5.1 $PSTMRF

Provides “satellite signal data” for each tracked satellite. Single message contains the relevant fields for 3 satellites. For all satellites the message is repeated with the data of the other satellites.

Format:

```
$PSTMRF,<MessgAmount>,<MessgIndex>,<used_sats>,
   [<Sat1ID>,<Sat1PhN>,<Sat1Freq>,<Sat1CN0>],
   ...
   [<SatNID>,<SatNPhN>,<SatNFreq>,<SatNCN0>],
   <checksum><cr><lf>
```

N max 3

Parameter	Format	Description
MessgAmount	Decimal, 1 digit	Number of consecutive $PSTMRF messages
MessgIndex	Decimal, 1 digit	Current number in the sequence of messages
used_sats	Decimal, 2 digits	Number of satellites used in the fix
SatxID	Decimal, 2 digits	Satellite x Number (PRN)
SatxPhN	Decimal, 5 digits	Satellite x Phase Noise
SatxFreq	Decimal, 6 digits	Satellite x Frequency
SatxCN0	Decimal, 2 digits	Satellite x Carrier to Noise Ratio (in dB)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

6.5.2 $PSTMTESTRF

Specific message containing information on just one satellite for RF testing purposes.

Format:

```
$PSTMTESTRF,<Sat-ID>,<Sat-Freq>,<Sat-PhN><Sat-
CN0>,<checksum><cr><lf>
```

Parameter	Format	Description
Sat-ID	Decimal, 2 digits	Satellite Number (PRN)
Sat-Freq	Decimal, 5 digits	Satellite Frequency
Sat-PhN	Decimal, 5 digits	Satellite Phase Noise
Sat-CN0	Decimal, 2 digits	Satellite Carrier to Noise Ratio (in dB)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

6.5.3 $PSTMTG

Time and Satellites Information

Format:

```
$PSTMTG,<Week>,<TOW>,<TotSat>,<CPUTime><Timevalid><NCO>
<kf_config_status><constellation_mask><time_best_sat_type><time_mast
er_sat_type><time_aux_sat_type><time_master_week_n><time_master_tow>
<time_master_validity><time_aux_week_n><time_aux_tow><time_aux_valid
ity><cr><lf>
```

Parameter	Format	Description
Week	Decimal, 4 digits	Week Number
TOW	Decimal, 10 digits	Time of Week
Tot-Sat	Decimal, 2 digits	Total Number of satellites used for fix
CPU-Time	Decimal, 10 digits	CPU Time
Timevalid	Decimal, 2 digits	0 = no time 1 = time read from flash 2 = time set by user 3 = time set user RTC 4 = RTC time 5 = RTC time, accurate 6 = time approximate 7 = “not used” 8 = time accurate 9 = position time 10 = Ephemeris time
NCO	Decimal, 9 digits	NCO value

<table>
<tr><td>kf_config_status</td><td>Hexadecimal, 2 digits</td><td>Kalman Filter Configuration
For each bit:
• 0 means feature disabled
• 1 means feature enabled
<table><tr><th>Bit</th><th>Configuration</th></tr><tr><td>0</td><td>Walking mode ON</td></tr><tr><td>1</td><td>Stop Detection ON</td></tr><tr><td>2</td><td>Frequency Ramp On (only Xtal mode)</td></tr><tr><td>3</td><td>Velocity estimator model:
• 1 means MULTIPLE MODEL
• 0 means SINGLE MODEL</td></tr><tr><td>4</td><td>Velocity estimator filter:
• 1 means SLOW
• 0 means FAST</td></tr><tr><td>5</td><td>FDE Status ON</td></tr></table></td></tr>
<tr><td>constellation_mask</td><td>Decimal, 3 digits max</td><td>It is a bit mask where each bit enable/disable a specific constellation independently by the others:
bit 0: GPS constellation enabling/disabling
bit 1: GLONASS constellation enabling/disabling
bit 2: QZSS constellation enabling/disabling
bit 3: GALILELO constellation enabling/disabling
bit 7: BAIDEU constellation enabling/disabling</td></tr>
<tr><td>time_best_sat_type</td><td>Decimal</td><td>selected best time satellite type</td></tr>
<tr><td>time_master_sat_type</td><td>Decimal</td><td>master time satellite type</td></tr>
<tr><td>time_aux_sat_type</td><td>Decimal</td><td>auxiliary time satellite type</td></tr>
<tr><td>time_master_week_n</td><td>Decimal</td><td>master time week number</td></tr>
<tr><td>time_master_tow</td><td>Floating</td><td>master time TOW</td></tr>
</table>

time_master_validity	Decimal	master week number time validity
time_aux_week_n	Decimal	auxiliary time
time_aux_tow	Floating	auxiliary time TOW
time_aux_validity	Decimal	auxiliary time validity

6.5.4 $PSTMTS

This message is repeated for each satellite tracked and used for the calculation of a fix

Format:

```
$PSTMTS,<dsp-dat>,<SatID>,<PsR>,<Freq>,<plf>,<CN0>,<ttim>,<Satdat>,
   <Satx>,<Saty>,<Satz>,<Velx>,<Vely>,<Velz>,<src>,<ac>,
   <difdat>,<drc>,<drrc><predavl>,<predage>,<predeph>,<predtd>,
   <cr><lf>
```

Parameter	Format	Description
dsp-dat	Decimal, 1 digit	DSP data available: 0 = satellite not tracked 1 = satellite tracked
Sat-ID	Decimal, 2 digits	Satellite Number (PRN)
PsR	Decimal, 10 digits	Pseudo range
Freq	Decimal, 8 digits	Satellite tracking frequency offset
Plf	Decimal, 1 digit	Preamble Lock Flag 0 = Navigation data stream preamble not locked 1 = Navigation data stream preamble locked
CN0	Decimal, 3 digits	Satellite Carrier to Noise Ratio (in dB)
Ttim	Decimal, 6 digits	Track Time of Satellite (in seconds)
Satdat	Decimal, 1 digit	Satellite Data available Flag 0 = Sat. Ephemeris not available or unhealthy Sat. 1 = Sat. Ephemeris available and healthy Satellite
Satx	Decimal, 10 digits	Satellite Position , X-Coordinate
Saty	Decimal, 10 digits	Satellite Position , Y-Coordinate
Satz	Decimal, 10 digits	Satellite Position , Z-Coordinate
Velx	Decimal, 8 digits	Satellite Velocity , X-Coordinate
Vely	Decimal, 8 digits	Satellite Velocity , Y-Coordinate
Velz	Decimal, 8 digits	Satellite Velocity , Z-Coordinate
Src	Decimal, 6 Digits	Satellite Range Correction

Ac	Decimal, 3 Digits	Atmospheric Correction
Difdat	Decimal, 1 digit	Differential Data available Flag 0 = Differential Corrections not available 1 = Differential Corrections available
Drc	Decimal, 3 digits	Differential Range Correction (from DGPS Station)
Drrc	Decimal, 3 digits	Differential Range Rate Correction (from DGPS Stat.)
predavl	Decimal, 1 digit	Prediction available Flag 0 = Predicted Ephemeris not available 1 = Predicted Ephemeris available
predage	Decimal, 1 digit	Age of predicted Ephemeris (in hours)
predeph	Decimal, 1 digit	Number of satellites ussed for prediction (1 or 2)
predtd	Decimal, 1 digit	Time distance of Ephemeris calculated from 2 Sats. Only valid if <pred-eph> = 2

Note: <pred-xxx> fields are only included within the message if the AGPS software module has been included.

Example:

```
$PSTMTS,1,05,15748178.41,30992.22,1,44,306150,1,16278399.26,20504574
.30,4653136.69,38.03,703.04,-3046.01,141169.29,11.45,1,-12.75,0.00,
$PSTMTS,1,31,14242886.83,-28462.15,1,37,304775,1,20641723.13,
-8713847.54,14517949.66,1788.86,311.39,-2382.23,1804.01,7.09,1,
-5.74,0.00,
$PSTMTS,1,21,14885540.17,-25018.74,1,50,301653,1,25482227.75,
6629457.30,5528104.33,-699.61,220.74,2983.68,23248.85,8.12,1,
-2.84,0.00,
$PSTMTS,1,07,13337296.04,-27966.11,1,31,296621,1,15777659.46,
4155044.35,21301094.71,-1287.52,2301.27,509.20,-15394.31,5.65,1,
-3.83,0.00,
$PSTMTS,1,06,1216319.39,-28367.75,0,23,40492,1,14595868.85,
6511991.60,21397698.91,-1394.03,2294.91,251.81,70766.81,5.72,1,
-3.28,0.00,
$PSTMTS,1,24,13629659.89,-27176.62,1,40,298187,1,17698708.17,
12886703.95,15024752.78,-1901.12,-1.00,2298.33,11530.25,6.39,1,
-9.27,0.00,
$PSTMTS,1,30,14421546.48,-30401.97,1,44,298264,1,17539544.73,
16864817.03,10440026.12,394.97,1346.12,-2741.16,14708.79,7.87,1,
-9.96,0.00,
$PSTMTS,1,16,16177492.44,-24593.30,1,40,298572,1,6202032.13,
-17659074.51,18852818.90,1139.40,2098.88,1613.11,35896.88,12.03,1,
-4.54,0.00,
$PSTMTS,1,10,16728325.63,-26663.46,1,30,124750,1,-2057875.88,
```

```
21248945.17,15476302.66,-1018.51,-1731.48,2256.47,
-32564.02,15.33,1,-12.86,0.00,
$PSTMTS,1,12,17539958.05,-31018.23,1,35,10528,1,11788804.59,
23841922.01,245355.77,-236.27,137.48,-3173.58,-103404.01,20.66,1,
-19.21,0.00,
$PSTMTS,1,23,17770191.78,-27801.14,1,28,196026,1,-6131001.55,
-15740405.01,20363733.86,1549.10,-2097.11,-1173.09,89981.45,
27.98,0,0.00,0.00,
```

6.5.5 $PSTMPA

Position Algorithm

Format:

```
$PSTMPA,<PosA>,<Dur><cr><lf>
```

Parameter	Format	Description
PosA	Char, 2	Position Algorithm Indicator Empty = none LS = LMS KF = Kalman Filter
Dur	Decimal, 3 digits	Time period in which the position has been stationary (count in seconds)

Example:

```
$PSTMPA,KF,433
$PSTMPA,  ,00
```

6.5.6 $PSTMSAT

This message is repeated for each satellite tracked and used for the calculation of a fix. The information contained in this message is a subset of the `$PSTMTS` message.

Format:

```
$PSTMSAT,<SatID>,<PsR>,<Freq>,<Satx>,<Saty>,<Satz><cr><lf>
```

Parameter	Format	Description
`SatID`	Decimal, 2 digits	Satellite Number (PRN)
`PsR`	Decimal, 10 digits	Pseudo Range
`Freq`	Decimal, 8 digits	Tracking Frequency of Satellite
`Satx`	Decimal, 10 digits	Satellite Position, X-Coordinate
`Saty`	Decimal, 10 digits	Satellite Position, Y-Coordinate
`Satz`	Decimal, 10 digits	Satellite Position, Z-Coordinate

6.5.7 $PSTMPRES

Position Residual

NOTE: $PSTMPRES and $PSTMVRES are always enabled together.

Format:

```
$PSTMPRES,<RMSpos>,<res1>,...,<resN>*<checksum><cr><lf>
```

N = number of tracked satellites

Parameter	Format	Description
RMSpos	dd.d	position “rms” residual for the fix
resx	dd.d	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)
*	Fixed Character	Delimiter of datafield
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMPRES,8.1,-0.2,-0.2,-0.1,-0.3,-0.3,-0.4,,,,,,,*2D
$PSTMPRES,0.0,,,,,,,,,,,,,*20
```

6.5.8 $PSTMVRES

Velocity Residual

NOTE: $PSTMPRES and $PSTMVRES are always enabled together.

Format:

```
$PSTMPRES,<RMSvel>,<vres1>,...,<vresN>*<checksum><cr><lf>
```

N = number of tracked satellites

Parameter	Format	Description
RMSvel	dd.d	velocity “rms” residual for the fix
vresx	dd.d	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)
*	Fixed Character	Delimiter of datafield
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMVRES,0.0,0.0,0.0,0.0,,,,,,,,,,*26
```

6.5.9 $PSTMNOISE

This message contains the raw noise floor estimation for GPS and GLONASS

Format:

```
$PSTMNOISE,<GPS_raw_NF>,<GLONASS_raw_NF>*<checksum><cr><lf>
```

Parameter	Format	Description
GPS_raw_NF	integer	Noise floor raw estimation for GPS.
GLONASS_raw_NF	integer	Noise floor raw estimation for GLONASS.

6.5.10 $PSTMCPU

This message contains the real time CPU usage and the CPU speed setting.

Format:

```
$PSTMCPU,<CPU_Usage>,<PLL_ON_OFF>,<CPU_Speed>*<checksum><cr><lf>
```

Parameter	Format	Description
CPU_Usage	ddd.dd	CPU usage %
PLL_ON_OFF	Decimal, 1 digit	PLL enabling/disabling status: 0: PLL disabled 1: PLL enabled
CPU_Speed	Decimal, 1 digit	CPU clock frequency: 52, 104, 156, 208 MHz.

6.5.11 $PSTMPPSDATA

Reports the Pulse Per Second data

Format:

```
$PSTMPPSDATA,<on_off>,<pps_valid>,<synch_valid>,<out_mode>,<ref_time
>,<ref_constellation>,<pulse_duration>,<pulse_delay>,<gps_delay>,<gl
o_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>,<quantization_error>,<pps_clock_fre
q>,<tcxo_clock_freq>*<checksum><cr><lf>
```

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, it is 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 NOTE: the reference constellation reports which reference time has been used for the PPS generation.
pulse_duration	Double	Pulse duration [s]
pulse_delay	Decimal	Pulse delay [ns]

gps_delay	Decimal	GPS path RF delay [ns]
glonass_delay	Decimal	GLONASS path RF delay [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 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 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 [s]
gps_utc_delta_ns	Decimal	UTC – GPS delta time [ns]
glonass_utc_delta_ns	Decimal	UTC – GLONASS delta time [ns]
quantization_error	Double (scientific notation format)	Quantization error [s].
pps_clock_freq	Double, 2 fractional digits	PPS clock frequency [Hz]
tcxo_clock_freq	Double, 2 fractional digits	TCXO clock frequency [Hz]

6.5.12 $PSTMPOSHOLD

Reports the Position Hold status and position.

Format:

```
$PSTMPOSHOLD,<on_off>,<Lat>,<N/S>,<Long>,<E/W>,<Alt>*<checksum><cr><lf>
```

Parameter	Format	Description
On_off	Decimal, 1 digit	Position Hold enabling/disabling status 0: disabled 1: enabled
Lat	DDMM.MMMMM	Lat in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
Alt	Decimal, 8 digits	Height above WGS84 Elipsoid, max: 100000

6.5.13 $PSTMTRAIMSTATUS

Reports the TRAIM algorithm status.

NOTE: All TRAIM related messages are enabled/disabled all together by the same mask.

Format:

```
$PSTMTRAIMSTATUS,<on_off>,<traim_solution>,<alarm>,<ave_error>
,<used_sats>,<removed_sats>,<ref_second>*<checksum><cr><lf>
```

Parameter	Format	Description
on_off	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
alarm	Decimal	Time error threshold [ns]
ave_error	Decimal	Average time error [ns]
used_sats	Decimal	Number of used satellites.
removed_sats	Decimal	Number of removed satellites.
ref_second	Decimal	Second at which the PPS signal is generated based on reported TRAIM status.

6.5.14 $PSTMTRAIMUSED

Reports the satellite used for timing correction.

NOTE: All TRAIM related messages are enabled/disabled all together by the same mask.

Format:

```
$PSTMTRAIMUSED,<on_off>,<used_sats>,<sat1>,…,<satN>*<checksum><cr><l
f>
```

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
used_sats	Decimal	Number of used satellites.
Sat1..satN	Decimal	Used satellites list.

6.5.15 $PSTMTRAIMRES

Reports the time error residuals for satellites used for timing correction.

NOTE: All TRAIM related messages are enabled/disabled all together by the same mask.

Format:

```
$PSTMTRAIMRES,<on_off>,<used_sats>,<res1>,…,<resN>*<checksum><cr><lf
>
```

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
used_sats	Decimal	Number of used satellites.
res1..resN	Decimal	Time error residuals for satellites reported in the TRAIMUSED message. Each residual refer to the satellite in the same message position.

6.5.16 $PSTMTRAIMREMOVED

Reports the satellite removed by the timing correction algorithm.

NOTE: All TRAIM related messages are enabled/disabled all together by the same mask.

Format:

```
$PSTMTRAIMUSED,<on_off>,<removed_sats>,<sat1>,…,<satN>*<checksum><cr
><lf>
```

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
removed_sats	Decimal	Number of removed satellites.
Sat1..satN	Decimal	Removed satellites list.

6.5.17 $PSTMKFCOV

This message contains the Standard Deviations for position and velocity and their split into north, east and vertical components.

Format:

```
$PSTMKFCOV,<PosStd>,<PosNcov>,<PosEcov>,<PosVcov>,
   <VelStd>,<VelNcov><VelEcov>,<VelVcov>
   <cr><lf>
```

Parameter	Format	Description
PosStd	ddd.d	Standard Deviation of Position in meters
PosNcov	ddd.d	Covariance (North/South) in m² (from Kalman Filter)
PosEcov	ddd.d	Covariance (East/West) in m² (from Kalman Filter)
PosVcov	ddd.d	Covariance (Vertical) in m² (from Kalman Filter)
VelStd	ddd.d	Standard Deviation of Velocity in meter/second
VelNcov	ddd.d	Covariance (North/South) in m²/s (from Kalman Filter)
VelEcov	ddd.d	Covariance (East/West) in m²/s (from Kalman Filter)
VelVcov	ddd.d	Covariance (Vertical) in m²/s (from Kalman Filter)

Example:

```
$PSTMKFCOV,8.7,50.9,25.4,150.7,0.4,0.1,0.0,0.2*49
```

6.5.18 $PSTMAGPS[15]

This message has the same syntax of standard NMEA GSA message. It provides dynamically standard GSA data or STAGPS related information according to the status of predicted ephemeris for each satellite. To send out different types of information for each satellite, an integer number is sent in the message fields instead of the satellite PRN ID; it should be decoded to get all the message info. If a satellite is not using a predicted ephemeris its PRN id is reported as in the standard GSA message case (the integer number will be identical to the satellite PRN ID – see formula below when AGE is 0). If a satellite is using a predicted ephemeris a number which is related to sat PRN and predicted ephemeris age is reported instead of simple PRN id. It is generated using the formula: satID + 32 * STAGPS_AGE_DAYS where STAGPS_AGE_DAYS is the number of days from current time back to the most recent ephemeris used for STAGPS predictions.

- STAGPS_AGE_DAYS = 1: most recent ephemeris has been downloaded from 0 up to 24 hours in the past.
- STAGPS_AGE_DAYS = 2: most recent ephemeris has been downloaded from 24 up to 48 hours in the past.
- STAGPS_AGE_DAYS = 3: most recent ephemeris has been downloaded from 48 up to 72 hours in the past.

This message could be used to replace the standard GSA in all devices where STAGPS is enabled.

Format:

```
$PSTMAGPS,<Mode>,<CurrentMode>,[<SatPRN1>],...,[<SatPRNN>],
   <PDOP>,<HDOP>,<VDOP>,
   <checksum><cr><lf>
```

Parameter	Format	Description
Mode	“M” or “A”	Operating Mode: M = Manual, A = Auto (2D/3D)
CurrentMode	Decimal, 1 digit	Current Mode: 1 = no fix available 2 = 2D 3 = 3D
SatPRN1...N	Decimal, 2 digits	Satellites list used in position fix (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, max: 99.0

[15] This message is supported only if the STAGPS is supported by the used platform.

HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, max: 99.0
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMAGPS,A,3,05,85,103,24,30,48,12,,,,,,2.4,1.9,1.5*38
```

The example above should be read in the following way:

- Satellites 5, 24, 30, 12 don't have predicted ephemeris (they are reported as in the case of standard GSA message – basically all satellites reported with a number less or equal 32 have no predicted ephemeris).
- Satellite 21 has a predicted ephemeris 2 days old.
- Satellite 7 has predicted ephemeris 3 days old.
- Satellite 16 has predicted ephemeris 1 day old.

Here are two simple decoding functions to get satellite ID and ages:

```
Age = (int)((<reported number> - 1) / 32)
Satid = <reported number> - 32 * Age
```

6.5.19 $PSTMAGLO[16]

This message has the same syntax of standard NMEA GSA message. Each parameter in the satellites PRN fields is an integer number that reports the satellite PRN and, in case a satellite is using a predicted ephemeris, it reports also the age of predicted ephemeris available for that satellite. They are generated using the formula: satID + 32 * STAGPS_AGE_DAYS where STAGPS_AGE_DAYS is the number of days from current time back to the most recent ephemeris used for STAGPS predictions. If a satellite has no predicted ephemeris (STAGPS_AGE_DAYS = 0) the satellite parameter, reported in the sentence, is exactly the satellite PRN.

- STAGPS_AGE_DAYS = 1: most recent ephemeris has been downloaded from 0 up to 24 hours in the past.
- STAGPS_AGE_DAYS = 2: most recent ephemeris has been downloaded from 24 up to 48 hours in the past.
- STAGPS_AGE_DAYS = 3: most recent ephemeris has been downloaded from 48 up to 72 hours in the past.
- STAGPS_AGE_DAYS = 4: most recent ephemeris has been downloaded from 72 up to 96 hours in the past.
- STAGPS_AGE_DAYS = 5: most recent ephemeris has been downloaded from 96 up to 120 hours in the past.

This message could be used to replace the standard GSA in all devices where STAGPS is enabled. It allows, decoding a single sentence, to show on the screen satellite bars coloured with different colours according to each ephemeris prediction age. Of course, if STAGPS is not enabled, it will behave in the same way of NMEA GSA sentence.

Format:

```
$PSTMAGLO,<Mode>,<CurrentMode>,[<SatPRN1>],...,[<SatPRNN>],
   <PDOP>,<HDOP>,<VDOP>,
   <checksum><cr><lf>
```

Parameter	Format	Description
Mode	“M” or “A”	Operating Mode: M = Manual, A = Auto (2D/3D)
CurrentMode	Decimal, 1 digit	Current Mode: 1 = no fix available 2 = 2D 3 = 3D

[16] This message is supported only if the STAGPS is supported by the used platform.

SatPRN1...N	Decimal, 2 digits	Satellites list used in position fix (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, max: 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, max: 99.0
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMAGLO,A,3,84,109,196,78,71,,,,,,,,2.4,1.9,1.5*66
```

The example above should be read in the following way:

- Satellites 84, 78, 71 don't have predicted ephemeris (they are reported as in the case of standard GSA message – basically all satellites reported with a number between 65 and 92 have no predicted ephemeris).
- Satellite 77 has a predicted ephemeris 1 days old (109 is reported in the sentence above).
- Satellite 68 has predicted ephemeris 4 days old (196 is reported in the sentence above).

Here are two simple decoding functions to get satellite ID and ages:

```
Age = (int)((<reported number> - 65) / 32)
Satid = <reported number> - 32 * Age
```

Note:

This message works for GLONASS satellites only.

If no GLONASS satellites are available this message will be not displayed.

6.5.20 $PSTMTIM

Time Validity.

Format:

```
$PSTMTIM,<Tvalid>,<curr-CPU-Time><cr><lf>
```

Parameter	Format	Description
Tvalid	ASCII	"RTC" = time read from RTC "VALID" = time downloaded from satellite or corrected using position "INVALID" = time is not valid
curr-CPU-Time	Decimal	Current CPU Time, i.e. the number of ticks since the system started to run

6.5.21 $PSTMDIFF

Time Validity.

Format:

```
$PSTMDIFF,<ListSize>,<NCS>,
   [<Sat1ID>,<Corr1Avl>,]
   ...
   [<SatNID>,<CorrNAvl>,]
   *<checksum><cr><lf>
```

N = number of tracked satellites

Parameter	Format	Description
ListSize	Decimal, 2 digits	Amount of visible satellites in this message (n)
NCS	Decimal, 2 digits	Number of corrected satellites
SatxID	Decimal, 2 digits	Satellite x ID (PRN)
CorrxAvl	Decimal	Correction available for Satellite x
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

6.5.22 $PSTMSBAS

SBAS Satellite Data.

Format:

```
$PSTMSBAS,<Status>,<SatTrk>,<SatID>,<Elev>,<Azim>,<Sig>,*
   <checksum><cr><lf>
```

N = number of tracked satellites

Parameter	Format	Description
Status	Decimal, 1 digit	SBAS Status 0 = no SBAS used 1 = SBAS used
SatTrk	Decimal, 1 digit	SBAS Satellite tracked 0 = SBAS Satellite not tracked 1 = SBAS Satellite tracked, 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 (in degrees)
Azim	Decimal, 3 digits	SBAS Satellite Azimuth (in degrees)
Sig	Decimal, 2 digits	SBAS Satellite Signal Strength CN0 (in dB)
*	Fixed Character	Delimiter for data field
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMSBAS,1,0,124,65,090,00*09
```

6.5.23 $PSTMNOTCHSTATUS

This message provide information on the Adaptive Notch Filter (ANF) status.

Synopsis:

```
$PSTMNOTCHSTATUS,<kfreq_now_Hz_gps>,<lock_en_gps>,<pwr_gps>,
<ovfs_gps>,<mode_gps>,<kfreq_now_Hz_gln>,<lock_en_gln>,<pwr_gln>,
<ovfs_gln>,<mode_gln><cr><lf>
```

Arguments:

Parameter	Format	Description
kfreq_now_Hz_gps	Decimal, 7 digits	Notch frequency estimation actual value [Hz] (GPS path)
lock_en_gps	Decimal, 1 digits	Frequency lock flag (GPS path)
pwr_gps	Decimal, 5 digits	Band Pass Filter internal power estimation (GPS path) [dimensionless quantity]
ovfs_gps	Decimal, 4 digits	Internal mask output as: 1000 * Notch_Removing_jammer (1/0,TRUE/FALSE) + overflow flags status (3 digits). E.g: “1000” means Block enabled, with no internal overflows detected
mode_gps	Decimal, 1 digits	ANF mode operation (GPS path) [0 → ANF disabled; 1 → Always ON(Internal Use only); 2 → Auto insertion mode (suggested);]
kfreq_now_Hz_gln	Decimal, 7 digits	Notch frequency estimation actual value [Hz] (GLONASS path)
lock_en_gln	Decimal, 1 digits	Frequency lock flag (GLONASS path)
pwr_gln	Decimal, 24 digits	Band Pass Filter internal power estimation (GLONASS path) [dimensionless quantity]
ovfs_gln	Decimal, 4 digits	Internal mask output as: 1000 * Notch_Removing_jammer (1/0,TRUE/FALSE) + overflow flags status (3 digits). E.g: “1000” means Block enabled, with no internal overflows detected

mode_gln	Decimal, 1 digits	ANF mode operation (GLONASS path) [0 → ANF disabled; 1 → Always ON (Internal Use only); 2 → Auto insertion mode(suggested);]

Results:

- This message provides the ANF status.
- When ANF is disabled all parameters are set to zero
- Frequency / Power values are meaningful only when Notch is locked

6.5.24 $PSTMLOWPOWERDATA

Reports the status of adaptive low power algorithm.

Format:

```
$PSTMLOWPOWERDATA,<low power state>,<steady state>,<reserved>,
<reserved>,<ehpe>,<reserved>,<ehpe_average>,<reserved>, <reserved>,<
eph const mask>,<switch constellation>,<duty cycle enable>,<duty
cycle ms off>,<duty cycle state><cr><lf>
```

Parameter	Format	Description
low power state	Decimal, 1 digits	Low power state indicator: [0 → FULL CONST; 1 → LOW POWER STATE; 2 → EPH REFRESH]
steady state	Decimal, 1 digits	Steady state reached indicator
reserved		
reserved		
ehpe	dd.d [m]	Estimated Horizontal Position Error [m]
reserved		
ehpe_average	dd.d [m]	Estimated Horizontal Position Error Average [m]
reserved		
reserved		
eph const mask	Decimal, 2 digits	Bitfield of completed ephemeris download

switch constellation	Decimal, 1 digits	Switch constellation features indicator
duty cycle enable	Decimal, 1 digits	Duty cycle enable indicator
duty cycle ms off	Decimal, 3 digits	Duty cycle ms signal off
duty cycle state	Decimal, 1 digits	Duty cycle state indicator

Results:

- This message provides the adaptive low power status. In the case of dynamic low power disabled all parameters are set to zero.

6.5.25 $PSTMADCDATA

Reports the ADC channels data read.

Format:

```
$PSTMADCDATA,<ADC1>,<ADC2>,<ADC3>,<ADC4>,<ADC5>,<ADC6>,<ADC7>,<ADC8>
*<checksum><cr><lf>
```

Parameter	Format	Description
ADC*i*	Decimal	ADC data read for the channel *i* Values between 0 and 1023

Results:

- If this message is enabled it provides the ADC channels values read.

Example:

```
$PSTMADCDATA,754,862,0,754,13,754,754,81*4B
```

```
$PSTMADCDATA,793,,,,0,,,59*4D
```

NOTE: this message is not supported in the standard NMEA message list. It is automatically enabled when the antenna sensing feature is enabled (see firmware configuration for details on how to enable/disable the feature).

6.5.26 $PSTMANTENNASTATUS

This message reports the status of the antenna (working normally, open or short).

Format:

```
$PSTMANTENNASTATUS,<status>*<checksum><cr><lf>
```

Parameter	Format	Description
status	Decimal	Antenna Status 0 = Antenna NORMAL 1 = Antenna OPEN 2 = Antenna SHORT

Results:

- If this message is enabled it provides the antenna status.

NOTE: this message is not supported in the standard NMEA message list. It is automatically enabled when the antenna sensing feature is enabled (see firmware configuration for details on how to enable/disable the feature).

6.5.28 $PSTMPV

Provides position (Latitude, Longitude, Height), velocity (North, East, Vertical) and root square of covariance matrix values for position and velocity,

Format:

```
$PSTMPV,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<Alt>,<AltVal>,<Vel_N>,
<Vel_E>,<Vel_V>,<P_cov_N>,<P_cov_NE>,<P_cov_NV>,<P_cov_E>,<P_cov_EV>
,<P_cov_V>,<V_cov_N>,<V_cov_NE>,<V_cov_NV>,<V_cov_E>,<V_cov_EV>,<V_c
ov_V>*<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat	DDMM.MMMMM	Lat in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	"N" or "S"	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	"E" or "W"	Long Direction: East or West
Alt	Decimal, 6 digits	Height above mean sea level, max: 100000m
Alt-Val	"M"	Height measure in "M" = meters
Vel_N	ddd.d	Velocity North component [m/s]
Vel_E	ddd.d	Velocity East component [m/s]
Vel_V	ddd.d	Velocity Vertical component [m/s]
P_cov_N	ddd.d	Position North covariance [m]
P_cov_NE	ddd.d	Position North-East covariance [m]
P_cov_NV	ddd.d	Position North-Vertical covariance [m]
P_cov_E	ddd.d	Position East covariance [m]
P_cov_EV	ddd.d	Position East-Vertical covariance [m]
P_cov_V	ddd.d	Position Vertical covariance [m]

V_cov_N	ddd.d	Velocity North covariance [m/s]
V_cov_NE	ddd.d	Velocity North-East covariance [m/s]
V_cov_NV	ddd.d	Velocity North-Vertical covariance [m/s]
V_cov_E	ddd.d	Velocity East covariance [m/s]
V_cov_EV	ddd.d	Velocity East-Vertical covariance [m/s]
V_cov_V	ddd.d	Velocity Vertical covariance [m/s]
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMPV,160635.000,4055.10928,N,01416.56027,E,026.96,M,0.2,0.0,0.1,2
2.6,12.8,5.8,17.2,10.9,18.8,5.5,4.1,1.7,4.6,0.0,2.7*70
```

6.5.29 $PSTMPVRAW

Provides not filtered position (Latitude, Longitude, Height), not filtered velocity (North, East, Vertical) and LMS fix related info

Format:

```
$PSTMPVRAW,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,<HDOP>,<Alt>,<AltVal>,<GeoSep>,<GeoVal>,<Vel_N>,<Vel_E>,<Vel_V>*<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 “.sss” is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat	DDMM.MMMMM	Lat in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
GPSQual	Decimal, 1digit	0 = invalid 1 = GPS 2 = DGPS
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above mean sea level, max: 100000m
AltVal	“M”	Reference Unit for Altitude (“M” = meters)
GeoSep	Decimal, 4 digits	Geoidal Separation measure in “M” = meters
GeoVal	“M”	Reference Unit for GeoSep (“M” = meters)
Vel_N	ddd.d	Velocity North component [m/s]
Vel_E	ddd.d	Velocity East component [m/s]
Vel_V	ddd.d	Velocity Vertical component [m/s]

Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMPVRAW,144056.000,5131.12414,N,00005.31484,W,2,09,1.2,043.31,M,4
7.0,M,-0.6,0.1,0.6*58
```

6.5.30 $PSTMPVQ

Provides position and velocity processing noise matrix values.

Format:

```
$PSTMPVQ,<P_Q_N>,<P_Q_E>,<P_Q_V>,<Q_CLKO>,<Q_GLPD>,<V_Q_N>,<V_Q_E>,<
V_Q_V>,<Q_CLKD>,<reserved><*<checksum><cr><lf>
```

Parameter	Format	Description
P_Q_N	ddd.d	Position North processing noise [m]
P_Q_E	ddd.d	Position East processing noise [m]
P_Q_V	ddd.d	Position Vertical processing noise [m]
Q_CLKO	ddd.d	Clock offset processing noise [m]
Q_GLPD	ddd.d	Glonass path delay [m]
V_Q_N	ddd.d	Velocity North processing noise [m/s]
V_Q_E	ddd.d	Velocity East processing noise [m/s]
V_Q_V	ddd.d	Velocity Vertical processing noise [m/s]
Q_CLKD	ddd.d	Clock drift processing noise [m/s]
reserved	-	Reserved for future use
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMPVQ,0.0,0.0,0.0,0.0,4.0,3.0,3.0,0.0,3.0,0.0*4A
```

6.5.31 $PSTMUTC

This message reports the UTC time, date and time offset parameters.

Format:

```
$PSTMUTC,<utc_time>,<utc_date>,<utc_timestamp>,<utc_offset>,<utc_off
set_validity>*<checksum><cr><lf>
```

Parameter	Format	Description
utc_time	hhmmss.sss	UTC Time of Fix, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
utc_date	ddmmyyyy	Date of Fix : ddmmyyyy
utc_timestamp	Decimal	UTC time expressed as number of seconds since January 6th 1980
utc_offset	Decimal, 2 digits	UTC to GPS time offset [s]
utc_offset_validity	Decimal, 1 digit	UTC to GPS time offset validity 0 = NOT Valid 1 = Read From NVM 2 = Valid (downloaded from sky)

Example:

```
$PSTMUTC,161344.000,19062012,1024157624,15,2*52
```

6.5.32 $PSTMFEDATA

This message reports the current values of all RF front-end registers.

Format:

```
$PSTMFEDATA,<R0>,<R1>,<R2>,…,<R22>,<R23>,<R24>*<checksum><cr><lf>
```

Parameter	Format	Description
From R0 up to R22	Hexadecimal, 2 digits	Reserved
R23	Hexadecimal, 2 digits	Automatic gain control register for GPS+GALILEO RF path
R24	Hexadecimal, 2 digits	Automatic gain control register for GLONASS or BEIDOU RF path

Example:

```
$PSTMFEDATA,ff,ff,3c,6f,9d,78,b7,90,00,00,00,9a,28,f0,3f,30,e0,1a,28
,e0,7f,30,40,3a,3a*75
```

6.6 Commands answers messages specification

6.6.1 $PSTMALMANAC

Almanac Data Dump. This message is sent as a reply to a `$PSTMDUMPALMANAC` command.

Format:

```
$PSTMALMANAC,<SatID>,<DataSize>,<HexData>*<checksum><cr><lf>
```

Parameter	Format	Description
`SatID`	Decimal, 2 digits	Satellite Number (PRN)
`DataSize`	Decimal, 2 digits	Number of bytes contained in the “Hex-Data” field
`HexData`	Hexadecimal, n-times 2 digits	Almanac Data in Hex-Format
`checksum`	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034
024200b4ffff00*1a
```

6.6.2 $PSTMEPH

Ephemeris Data Dump. This message is sent as a reply to a `$PSTMDUMPEPHEMS` command.

Format:

```
$PSTMEPHEM,<SatID>,<DataSize>,<HexData>*<checksum><cr><lf>
```

Parameter	Format	Description
`SatID`	Decimal, 2 digits	Satellite Number (PRN)
`DataSize`	Decimal, 2 digits	Number of bytes contained in the “Hex-Data” field
`HexData`	Hexadecimal, n-times 2 digits	Ephemeris Data in Hex-Format
`checksum`	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400
fbff33420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ff
c616fe03*57
```

7 Almanacs and Ephemeris Management

Please note that in order for new almanacs and ephemeris data to be stored correctly it is essential that the baud rate is at a maximum of 115200 baud. A higher baud rate will cause the stored data to be corrupted so, it is recommended to use the command to change the port baud rate before start the following procedures.

7.1 Using the Assist Commands to Obtain Almanac and Ephemeris Data from a Reference GPS Receiver

The following steps may be used to obtain Ephemeris and Almanac data from the GPS receiver. In order for useful data to be obtained it is best that the GPS receiver has been running long enough to receive a full set of Ephemeris and Almanac data from the satellites.

Note: the Ephemeris data must be less than one hour old, while Almanac can tolerate some days/weeks delay between collection and use.

To ensure the validity of the ephemeris and almanac data it is advisable to clear the Ephemeris and Almanac data stored in the flash of the receiver. This may be done by sending the commands `$PSTMCLREPHS` and `$PSTMCLRALMS`. Once this has been done it will be necessary to wait for the reference receiver to receive up to date Ephemeris and Almanac data from the satellites, before issuing the dump commands.

It is also useful to save commandsin various text files that may be transmitted over the connection by the terminal emulator. This example makes use of the following files:

- SUSPEND.txt
- RESUME.txt
- DUMPEPHEMS.txt
- DUMPALMANAC.txt

.

Step 1

Ensure that the connection is working and that the user can see NMEA data displayed on their terminal emulator.

Step 2

Ensure that the terminal emulator is logging its input to a text file e.g. log.txt.

Step 3

Before downloading the Almanac and Ephemeris data from the reference receiver, it is advisable to clear any existing Almanac and Ephemeris data from its memory and waiting until a full set of Ephemeris and Almanac data has been received from the satellites. This will ensure the validity of the data downloaded from the reference GPS receiver. This can be achieved by sending the `$PSTMCLREPHS` and the `$PSTMCLRALMS` commands.

Step 4

Send the file SUSPEND.txt to the target. The user will notice that the target appears to have stopped working. This is because the GPS library has been suspended.

Note: Steps 5 and 6 are separate operations and may be carried out individually or together depending on the needs of the user.

Step 5

Send the file `DUMPEPHEMS.txt` to the target. The user will notice that the Ephemeris data is displayed on the terminal emulator (as shown below). Note that if no data is displayed then there is no Ephemeris data in the flash.

```
$PSTMEPHEM,1,64,42056a626a6281818170100009a9ff00cb05e920580e65052f00
ecff212c00000ced2b287d1021031f5b0da1b0eabad3c9277301316763b9f9001100
9184c003*59
$PSTMEPHEM,2,64,4205706270629898984 1f60034a3ff0017014e23c90ad20095ff
feff40360000e59fd126b3f39f04ddda0ca160ecc10ed28dacaa512bc74edb000300
e21eff03*09
$PSTMEPHEM,5,64,4205706270626f6f6fd1f600fea6ff0076f8491883120ff9c5ff
f0ff5b36000089e92c26d3a6700364ca0da109f24862068422525c188929f700f201
032bc703*5b
$PSTMEPHEM,6,64,4205706270627d7d7d800800a4a6ff007506cf18ee1178050a00
200053370000a4b113261c5b240333740da1b1d91e956051cf7e3f6ed4b3f6000400
6fa5db03*00
$PSTMEPHEM,14,64,420570627062c5c5c5e10e007ea9ff0064058520a30ea604160
00200772c000024c01b28451e1f01c49f0ca10aeb5ff83bcf570002bc35acec00040
0a632ff03*6b
$PSTMEPHEM,21,64,4205706270622121 2188f9009da5ff00e7004622cd0aba00d9f
f9efffd3500001a618a2634ba500506010ea1e9f9fa926c745cac2cc31f84e700200
044a6c403*3c
$PSTMEPHEM,25,64,42056c626c62b2b2b20c04008ca5ff0007fc3b250b0820fd5b0
0290079370000ada6bd26d78f350664e90ca176ebc4a6c5e0fd26c93f03c6f000070
04d12c003*3d
$PSTMEPHEM,30,64,420570627062b0b0b091f800caa6ff00cff8e2179e1355f999f
fc0ff553500003f077326f97e6c04c8140da10c14be42db05f853b7a66b34ef005e0
09ff7cd03*3e
```

Step 6

Send the file `DUMPALMANAC.txt` to the target. As in the previous step the user will notice that the Almanac data is displayed on the terminal emulator (as shown below). Note that if no data is displayed then there is no Almanac data in the flash.

```
$PSTMALMANAC,1,32,0142056314325b1c5efd0140020da14009730160ad61b900ca
ffe12011088020*1d
$PSTMALMANAC,2,32,02420563034ab50634fd01406c0ca1402eacaa6047c64e005b
741c20e4078020*15
$PSTMALMANAC,3,32,03420563483df0f537fd0140bb0ca140807d7c60237f19000a
3ef92030088020*1c
$PSTMALMANAC,4,32,04420563f93a700633fd0140450da140447bab606fd202008e
c97f201e208020*1a
```

```
$PSTMALMANAC,5,32,054205630d3765fc3ffd0140500da14033225260f08929006c
f96f20e6808020*19
$PSTMALMANAC,6,32,064205634532d6fa3ffd0140fc0ca14018cf7e600cd4b30037
d0a22075038020*49
$PSTMALMANAC,7,32,07420563f56cd9fb3ffd0140d20da1402eb77d6082d2b7003b
dcfa2099218020*13
$PSTMALMANAC,8,32,08420563ee4e011242fd0140190da14072452c609b4a6900fb
e2a620d0078020*1b
$PSTMALMANAC,9,32,09420563588ed00938fd0140cf0ca1406728296083eb3000c2
729720f1078020*44
$PSTMALMANAC,10,32,0a420563ed35ee155ffd0140ac0da140f82cd6609c7a0e004
eb22a204c008020*76
$PSTMALMANAC,11,32,0b420563fc2632e406fd0140fc0ca1403c39a56064700a006
08bbe2023098020*7b
$PSTMALMANAC,13,32,0d4205632315171f64fd0140ca0ca140d1d4006012ed2d00d
0a1242016088020*2c
$PSTMALMANAC,14,32,0e420563f711581b5efd0140480ca140b2570060bd35ac002
a110620e6078020*20
$PSTMALMANAC,15,32,0f420563f14a070b3bfd0140780ba1400dc3ad60b14366000
ce9a92017128020*2f
$PSTMALMANAC,16,32,10420563c917770c58fd0140550ca140199f55601c2bd800a
2196b200d008020*24
$PSTMALMANAC,17,32,114205630c0d1a0c54fd0140430ca140aeef7f6043406d000
8044920c427c020*79
$PSTMALMANAC,18,32,12420563c0367d0b50fd0140b30ca140c130d76094349100f
755672031ffbf20*25
$PSTMALMANAC,19,32,13420563b01ad60a51fd01409a0da140d1628260fc19c500a
7d23520e4078020*72
$PSTMALMANAC,20,32,14420563e0133f0b4efd0140830ca140db0ad560ed613a00a
1365a20d3078020*7c
$PSTMALMANAC,21,32,154205630955410230fd0140880da1400d5cac60921f84007
faca02095088020*29
$PSTMALMANAC,22,32,164205631029da094efd0140140da140808ad7608e4abf00d
bfc212032088020*27
$PSTMALMANAC,23,32,174205630f23bf0f51fd0140a50ca140a0f0ff60905c61001
72d0720aff8bf20*7d
$PSTMALMANAC,24,32,184205634b4a1f0d3ffd01404d0da1400ec6ac604db9d4000
6aac7203c088020*2c
$PSTMALMANAC,25,32,19420563596376052ffd0140760ca1408bfd26603c01c600e
9d9b42002008020*28
$PSTMALMANAC,26,32,1a420563fd87eb1d61fd0140bc0ca140e5e2006013041e001
389e320f7ffbf20*22
$PSTMALMANAC,27,32,1b4205630e9e660834fd0140720da140313f28606565ae002
a2d772016008020*7b
$PSTMALMANAC,28,32,1c4205631756300b57fd0000dc0ca1402f06562082c6a1205
0f344002a008000*25
$PSTMALMANAC,29,32,1d4205638f49d21b60fd0140090da1407880ff60c018d5000
095352095298020*73
```

```
$PSTMALMANAC,30,32,1e420563ca46c70045fd0140a00ca140baf75360466c3400e
26e5020bf198020*28
```

Step 7

To resume the GPS library operation send the file `RESUME.txt`.

Step 8

The Almanac and Ephemeris data should now be saved the log file. These can be extracted for loading to a new target GPS receiver by copying the `$PSTMALMANAC` and `$PSTMEPHEM` lines into a new file, ensuring that there is no wrapping of lines introduced by the editor.

7.2 Using the Assist Commands to Load Almanacs and Ephemeris Data into a Target Receiver

The following steps may be used to load Ephemeris and Almanac data to the GPS receiver. All the explanations in this chapter are related to a system that includes Flash Memory for data storage, it will however also work in a system with battery backup to retain data in an embedded SRAM. All data storage management is supported by ST´s GPS Library.

Ephemeris data must be less than one hour old, while Almanac can tolerate some days/weeks delay between collection and use.

Data within the GPS receiver is stored in a double buffered arrangement controlled by NVM management software. The double buffering makes use of two banks of flash to store data. This means that if new data is being written to the flash and fails for whatever reason, the previous version of the data can be recovered to ensure that the receiver software can continue to function.

The mechanism that is employed to achieve this double buffering results in the following effect. Assuming that 4 almanac entries are already existing in the NVM flash and that user wants to download a complete almanac to the receiver. When the NVM management software detects that a version of the data it is trying to write already exists then it will copy everything from one bank to the other before swapping banks. It will then continue writing to the new bank until it the same condition arises. Then it will copy everything to the other bank and swap banks again.

In order to prevent the multiple copying and swapping of banks it is better to ensure that the NVM area of flash is clear of Almanac and Ephemeris data before loading new Ephemeris and Almanac data to the receiver. In a production environment it should be the case that there is no Ephemeris and Almanac data in the flash. However if the Almanac and Ephemeris data is being loaded in the field it is important to clear any existing data using the `$PSTMCLREPHS` and `$PSTMCLRALMS` commands.

It is useful that the commands have been saved in various text files that may be transmitted over the connection by the terminal emulator.

This example makes use of the following files:

- SUSPEND.txt
- RESUME.txt

- LOADEPHEMS.txt
- LOADALMANAC.txt

Step 1

Ensure that the connection is working and that the user can see NMEA data displayed on their terminal emulator.

Step 2

Before loading the receiver with new Almanac and Ephemeris data it is necessary to clear any existing Almanac and Ephemeris data from its memory. If this is not done the receiver will make a copy of the data already within its memory before loading the new data into memory. This will result in twice as many erase and write operations occurring on the flash memory of the receiver. This can be achieved by sending the `$PSTMCLREPHS` and the `$PSTMCLRALMS` commands.

Step 3

Send the file `SUSPEND.txt` to the target. The user will notice that the target appears to have stopped working. This is because the GPS library has been suspended.

Note: Steps 4 and 5 are separate operations and may be carried out individually or together depending on what user needs..

Step 4

Send the file `LOADEPHEMS.txt` to the target. This will load the ephemeris data into the target flash. If the user wishes to verify that the ephemeris data has been downloaded they can do so by issuing a hot start command (`$PSTMHOT`). Note that it is important that they resume the operation of the GPS library before issuing the hot start command otherwise the hot start command will fail. This is possible via the `$PSTMRESUME` command.

Step 5

Send the file LOADALMANAC.txt to the target. This will load the almanac data into the target flash.

Step 6

To resume the GPS library operation send the file `RESUME.txt`.

In order to use these commands to truly assist a GPS receiver in a cold start scenario, it is also necessary to issue position and time information using the $PSTMINITGPS command before loading the Almanac and Ephemeris data. It is important that the time in this case corresponds to the Ephemeris and Almanac data otherwise the receiver will reject the data as being invalid.

8 Summary of text files used in the examples

8.1 File: SUSPEND.txt

```
$PSTMSUSPEND
```

8.2 File: RESUME.txt

```
$PSTMRESUME
```

8.3 File: DUMPEPHEMS.txt

```
$PSTMNMEAONOFF
$PSTMDUMPALMANAC
```

8.4 File: DUMPALMANAC.txt

```
$PSTMNMEAONOFF
$PSTMDUMPALMANAC
```

8.5 File: LOADALMANAC.txt

```
$PSTMALMANAC,1,32,0142056314325b1c5efd0140020da14009730160ad61b900ca
ffe12011088020*1d
$PSTMALMANAC,2,32,02420563034ab50634fd01406c0ca1402eacaa6047c64e005b
741c20e4078020*15
$PSTMALMANAC,3,32,03420563483df0f537fd0140bb0ca140807d7c60237f19000a
3ef92030088020*1c
$PSTMALMANAC,4,32,04420563f93a700633fd0140450da140447bab606fd202008e
c97f201e208020*1a
$PSTMALMANAC,5,32,054205630d3765fc3ffd0140500da14033225260f08929006c
f96f20e6808020*19
$PSTMALMANAC,6,32,064205634532d6fa3ffd0140fc0ca14018cf7e600cd4b30037
d0a22075038020*49
$PSTMALMANAC,7,32,07420563f56cd9fb3ffd0140d20da1402eb77d6082d2b7003b
dcfa2099218020*13
$PSTMALMANAC,8,32,08420563ee4e011242fd0140190da14072452c609b4a6900fb
e2a620d0078020*1b
$PSTMALMANAC,9,32,09420563588ed00938fd0140cf0ca1406728296083eb3000c2
729720f1078020*44
$PSTMALMANAC,10,32,0a420563ed35ee155ffd0140ac0da140f82cd6609c7a0e004
eb22a204c008020*76
$PSTMALMANAC,11,32,0b420563fc2632e406fd0140fc0ca1403c39a56064700a006
08bbe2023098020*7b
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1365a20d3078020*7c
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faca02095088020*29
$PSTMALMANAC,22,32,164205631029da094efd0140140da140808ad7608e4abf00d
bfc212032088020*27
$PSTMALMANAC,23,32,174205630f23bf0f51fd0140a50ca140a0f0ff60905c61001
72d0720aff8bf20*7d
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6aac7203c088020*2c
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8.6 File: LOADEPHEMS.txt

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032bc703*5b
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```

9 Appendix

A. Local Geodetic Datum Tables

AFRICA			
REGION		CODE	CDB-ID VALUE
ADINDAN			
	MeanSolution(Ethiopia-Sudan)	ADI-M	0
	BurkinaFaso	ADI-E	1
	Cameroon	ADI-F	2
	Ethiopia	ADI-A	3
	Mali	ADI-C	4
	Senegal	ADI-D	5
	Sudan	ADI-B	6
AFGOOYE			
	Somalia	AFG	7
ARC_1950			
	Mean_Solution	ARF-M	8
	Botswana	ARF-A	9
	Burundi	ARF-H	10
	Lesotho	ARF-B	11
	Malawi	ARF-C	12
	Swaziland	ARF-D	13
	Zaire	ARF-E	14
	Zambia	ARF-F	15
	Zimbabwe	ARF-G	16
ARC_1960			
	Mean_Solution	ARS-M	17
	Kenya	ARS-A	18
	Tanzania	ARS-B	19
AYABELLE_LIGHTHOUSE			
	Djibouti	PHA	20
BISSAU			
	Guinea-Bissau	BID	21
CAPE			
	South_Africa	CAP	22
CARTHAGE			
	Tunisia	CGE	23

DABOLA			
	Guinea	DAL	24
EUROPEAN_1950			
	Egypt	EUR-F	73
	Tunisia	EUR-T	83
LEIGON			
	Ghana	LEH	25
LIBERIA_1964			
	Liberia	LIB	26
MASSAWA			
	Eritrea(Ethiopia)	MAS	27
MERCHICH			
	Morocco	MER	28
MINNA			
	Cameroon	MIN-A	29
	Nigeria	MIN-B	30
M'PORALOKO			
	Gabon	MPO	31
NORTH_SAHARA_1959			
	Algeria	NSD	32
OLD_EGYPTIAN_1907			
	Egypt	OEG	33
POINT_58			
	Mean_Solution (BurkinaFaso-Niger)	PTB	34
POINTE_NOIRE_1948			
	Congo	PTN	35
SCHWARZECK			
	Namibia	SCK	36
SIERRA_LEONE_1960			
	SierraLeone	SRL	37
VOIROL_1960			
	Algeria	VOR	38

ASIA		
REGION	**CODE**	**CDB-ID VALUE**
AIN_EL_ABD_1970		
Bahrain_Island	AIN-A	39
Saudi_Arabia	AIN-B	40

DJAKARTA(BATAVIA)			
	Sumatra(Indonesia)	BAT	41
EUROPEAN_1950			
	Iran	EUR-H	77
HONG_KONG_1963			
	Hong_Kong	HKD	42
HU-TZU-SHAN			
	Taiwan	HTN	43
INDIAN			
	Bangladesh	IND-B	44
	India-Nepal	IND-I	45
INDIAN_1954			
	Thailand	INF-A	46
INDIAN_1960			
	Vietnam(near_16DegNorth)	ING-A	47
	ConSonIsland(Vietnam)	ING-B	48
INDIAN_1975			
	Thailand	INH-A	49
	Thailand	INH-A1	50
INDONESIAN_1974			
	Indonesia	IDN	51
KANDAWALA			
	SriLanka	KAN	52
KERTAU_1948			
	WestMalaysia-Singapore	KEA	53
KOREAN_1995			
	SouthKorea	KGS	54
NAHRWAN			
	MasirahIsland(Oman)	NAH-A	55
	UnitedArabEmirates	NAH-B	56
	SaudiArabia	NAH-C	57
OMAN			
	Oman	FAH	58
QATAR_NATIONAL			
	Qatar	QAT	59
SOUTH_ASIA			
	Singapore	SOA	60
TIMBALAI_1948			
	Brunei-East_Malaysia	TIL	61
TOKYO			
	MeanSolution	TOY-M	62

	Japan	TOY-A	63
	Okinawa	TOY-C	64
	South Korea	TOY-B	65
	South Korea	TOY-B1	66

AUSTRALIA			
	REGION	**CODE**	**CDB-ID VALUE**
AUSTRALIAN_1966			
	Australia-Tasmania	AUA	67
AUSTRALIAN_1984			
	Australia-Tasmania	AUG	68

EUROPE			
	REGION	**CODE**	**CDB-ID VALUE**
CO-ORDINATE SYSTEM 1937 OF ESTONIA			
	Estonia	EST	69
EUROPEAN_1950			
	MeanSolution	EUR-M	70
	WesternEurope	EUR-A	71
	Cyprus	EUR-E	72
	Egypt	EUR-F	73
	England,ChannelIslands,Scotland,ShetlandIslands	EUR-G	74
	England,Ireland,Scotland,ShetlandIslands	EUR-K	75
	Greece	EUR-B	76
	Iran	EUR-H	77
	ItalySardinia	EUR-I	78
	ItalySicily	EUR-J	79
	Malta	EUR-L	80
	Norway,Finland	EUR-C	81
	Portugal,Spain	EUR-D	82
	Tunisia	EUR-T	83
EUROPEAN_1979			
	MeanSolution	EUS	84
HJORSEY_1955			
	Iceland	HJO	85
IRELAND_1965			

	Ireland	IRL	86
ORDNANCE SURVEY OF GREAT BRITAIN 1936			
	MeanSolution	OGB-M	87
	England	OGB-A	88
	England,IsleOfMan,Wales	OGB-B	89
	Scotland,ShetlandIslands	OGB-C	90
	Wales	OGB-D	91
ROME_1940			
	Sardinia	MOD	92
S-42(PULKOVO_1942)			
	Hungary	SPK-A	93
	Poland	SPK-B	94
	Czechoslovakia*	SPK-C	95
	Latvia	SPK-D	96
	Kazakhstan	SPK-E	97
	Albania	SPK-F	98
	Romania	SPK-G	99
S-JTSK			
	Czechoslovakia	CCD	100

NORTH AMERICA

REGION		CODE	CDB-ID VALUE
CAPE_CANAVERAL			
	MeanSolution(Florida,Bahamas)	CAC	101
NORTH AMERICAN 1927			
	MeanSolution	NAS-C	102
	WesternUnitedStates	NAS-B	103
	EasternUnitedStates	NAS-A	104
	Alaska(ExcludingAleutianIslands)	NAS-D	105
	AleutianIslands(East180°W)	NAS-V	106
	AleutianIslands(West180°W)	NAS-W	107
	Bahamas(Excluding San Salvador Island)	NAS-Q	108
	SanSalvadorIsland	NAS-R	109
	CanadaMeanSolution(Including Newfoundland)	NAS-E	110
	Alberta,BritishColumbia	NAS-F	111
	EasternCanada	NAS-G	112
	Manitoba,Ontario	NAS-H	113

	NorthwestTerritories,Saskatchewan	NAS-I	114
	Yukon	NAS-J	115
	CanalZone	NAS-O	116
	Caribbean	NAS-P	117
	CentralMerica	NAS-N	118
	Cuba	NAS-T	119
	Greenland	NAS-U	120
	Mexico	NAS-L	121
NORTH AMERICAN 1983			
	Alaska(ExcludingAleutianIslands)	NAR-A	122
	AleutianIslands	NAR-E	123
	Canada	NAR-B	124
	CONUS	NAR-C	125
	Hawaii	NAR-H	126
	Mexico,CentralAmerica	NAR-D	127

SOUTH AMERICA			
	REGION	**CODE**	**CDB-ID VALUE**
BOGOTA OBSERVATORY			
	Colombia	BOO	128
CAMPO NCHAUSPE 1969			
	Argentina	CAI	129
CHUA ASTRO			
	Paraguay	CHU	130
CORREGO ALEGRE			
	Brazil	COA	131
PROVISIONAL SOUTH AMERICAN 1956			
	MeanSolution	PRP-M	132
	Bolivia	PRP-A	133
	Northern Chile(near 19°S)	PRP-B	134
	Southern Chile(near 43°S)	PRP-C	135
	Colombia	PRP-D	136
	Ecuador	PRP-E	137
	Guyana	PRP-F	138
	Peru	PRP-G	139
	Venezuela	PRP-H	140
PROVISIONAL SOUTH CHILEAN			

	Southern Chile(near 53°S)	HIT	141
SOUTH AMERICAN 1969			
	MeanSolution	SAN-M	142
	Argentina	SAN-A	143
	Bolivia	SAN-B	144
	Brazil	SAN-C	145
	Chile	SAN-D	146
	Colombia	SAN-E	147
	Ecuador (Excluding Galapagos Islands)	SAN-F	148
	Baltra,Galapagos Islands	SAN-J	149
	Guyana	SAN-G	150
	Paraguay	SAN-H	151
	Peru	SAN-I	152
	Trinidad and Tobago	SAN-K	153
	Venezuela	SAN-L	154
SOUTH AMERICAN GEOCENTRIC REFERENCE SYSTEM(SIRGAS)			
	South America	SIR	155
ZANDERIJ			
	Suriname	ZAN	156

ATLANTIC OCEAN

REGION		CODE	CDB-ID VALUE
ANTIGUA ISLAND ASTRO 1943			
	Antigua,Leeward Islands	AIA	157
ASCENSION ISLAND 1958			
	Ascension Island	ASC	158
ASTRO DOS 71/4			
	St.Helena Island	SHB	159
BERMUDA 1957			
	Bermuda Islands	BER	160
CAPE CANAVERAL			
	Mean Solution (Bahamas and Florida)	CAC	101
DECEPTION ISLAND			
	Deception Islandand Antarctica	DID	161
FORT THOMAS 1955			
	Nevis, St.Kitts and Leeward Islands	FOT	162
GRACIOSA BASE SW 1948			
	Faial, Graciosa, Pico, SaoJorge and Terceira Islands (Azores)	GRA	163

HJORSEY 1955			
	Iceland	HJO	85
ISTS 061 ASTRO 1968			
	South Georgia Island	ISG	164
L.C. 5 ASTRO 1961			
	Cayman Brac Island	LCF	165
MONTSERRAT ISLAND ASTRO 1958			
	Montserrat and Leeward Islands	ASM	166
NAPARIMA,BWI			
	Trinidad and Tobago	NAP	167
OBSERVATORIO METEOROLOGICO 1939			
	Corvo and Flores Islands (Azores)	FLO	168
PICO DE LAS NIEVES			
	Canary Islands	PLN	169
PORTO SANTO 1936			
	Porto Santo and Madeira Islands	POS	170
PUERTO RICO			
	Puerto Rico and Virgin Islands	PUR	171
QORNOQ			
	South Greenland	QUO	172
SAO BRAZ			
	Sao Miguel and Santa Maria Islands (Azores)	SAO	173
SAPPER HILL 1943			
	East Falkland Island	SAP	174
SELVAGEM GRANDE 1938			
	Salvage Islands	SGM	175
TRISTAN ASTRO 1968			
	Tristan da Cunha	TDC	176

INDIAN OCEAN		
REGION	**CODE**	**CDB-ID VALUE**
ANNA 1 ASTRO 1965		
Cocos Islands	ANO	177
GAN 1970		
Republic of Maldives	GAA	178
ISTS 073 ASTRO 1969		
Diego Garcia	IST	179
KERGUELEN ISLAND 1949		

	Kerguelen Island	KEG	180
MAHE 1971			
	Mahe Island	MIK	181
REUNION			
	Mascarene Islands	REU	182

PACIFIC OCEAN			
REGION		**CODE**	**CDB-ID VALUE**
AMERICAN SAMOA 1962			
	American Samoa Islands	AMA	183
ASTRO BEACON "E" 1945			
	Iwo Jima	ATF	184
ASTRO TERN ISLAND (FRIG) 1961			
	Tern Island	TRN	185
ASTRONOMICAL STATION 1952			
	Marcus Island	ASQ	186
BELLEVUE (IGN)			
	Efate and Erromango Islands	IBE	187
CANTON ASTRO 1966			
	Phoenix Islands	CAO	188
CHATHAM ISLAND ASTRO 1971			
	Chatham Island (New Zealand)	CHI	189
DOS 1968			
	Gizo Island (New Georgia Islands)	GIZ	190
EASTER ISLAND 1967			
	Easter Island	EAS	191
GEODETIC DATUM 1949			
	New Zealand	GEO	192
GUAM 1963			
	Guam	GUA	193
GUX I ASTRO			
	Guadalcanal Island	DOB	194
INDONESIAN 1974			
	Indonesia	IDN	51
JOHNSTON ISLAND 1961			
	Johnston Island	JOH	195
KUSAIE ASTRO 1951			
	CarolineIslands, Fed.States of Micronesia	KUS	196

LUZON			
	Philippines (Excluding Mindanao Island)	LUZ-A	197
	Mindanao Island	LUZ-B	198
MIDWAY ASTRO 1961			
	Midway Islands	MID_A	199
	Midway Islands	MID_B	200
OLD_HAWAIIAN			
	Mean Solution	OHA-M	201
	Hawaii	OHA-A	202
	Kauai	OHA-B	203
	Maui	OHA-C	204
	Oahu	OHA-D	205
OLD HAWAIIAN			
	Mean Solution	OHI-M	206
	Hawaii	OHI-A	207
	Kauai	OHI-B	208
	Maui	OHI-C	209
	Oahu	OHI-D	210
PITCAIRN ASTRO 1967			
	Pitcairn Island	PIT	211
SANTO (DOS) 1965			
	Espirito Santo Island	SAE	212
VITI LEVU 1916			
	VitiLevuIsland (Fiji Islands)	MVS	213
WAKE-ENIWETOK 1960			
	Marshall Islands	ENW	214
WAKE ISLAND ASTRO 1952			
	Wake Atoll	WAK	215

Non-Satellite Derived Transformation Parameter

REGION		CODE	CDB-ID VALUE
BUKIT RIMPAH			
	Bangka and Belitung Islands (Indonesia)	BUR	216
CAMP AREA ASTRO			
	Camp McMurdo Area, Antarctica	CAZ	217
EUROPEAN 1950			
	Iraq, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia, Syria	EUR-S	218
GUNUNG SEGARA			

	Kalimantam (Indonesia)	GSE	219
HERAT NORTH			
	Afghanistan	HEN	220
HERMANNSKOGEL			
	Slovenia, Croatia, Bosnia and Herzegovina, Serbia	HER	221
INDIAN			
	Pakistan	IND_P	222
PULKOVO 1942			
	Russia	PUK	223
TANANARIVE OBSERVATORY 1925			
	Madagascar	TAN	224
VOIROL 1874			
	Tunisia, Algeria	VOI	225
YACARE			
	Uruguay	YAC	226

Terrestrial Reference Systems			
		CODE	**CDB-ID VALUE**
GLONASS			
	PZ90.2	PZ90_2	227
	PZ90.11	PZ90_11	254

10 Disclaimer