Teseo-LIV3 GNSS Module - Software manual

Introduction

The Teseo-LIV3 module family is an easy to use Global Navigation Satellite System (GNSS) stand-alone modules, embedding Teseo single die stand-alone positioning receiver IC working on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

The modules are designed for top performance in a minimal space and it has been optimized for cost sensitive applications without quality compromise. It allows, at competitive costs, an easy integration and migration from existing designs of products such as trackers, telematics, portable, tablets, marine and sports accessories.

Within its compact size, Teseo-LIV3 is offering superior accuracy thanks to the on board Temperature Compensated Crystal Oscillator (TCXO) and a reduced Time To First Fix (TTFF) relying on its dedicated Real Time Clock (RTC) oscillator.

The devices are offered with a complete GNSS firmware which performs all GNSS operations including acquisition, tracking and navigation and data output with no need of external memories.

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.

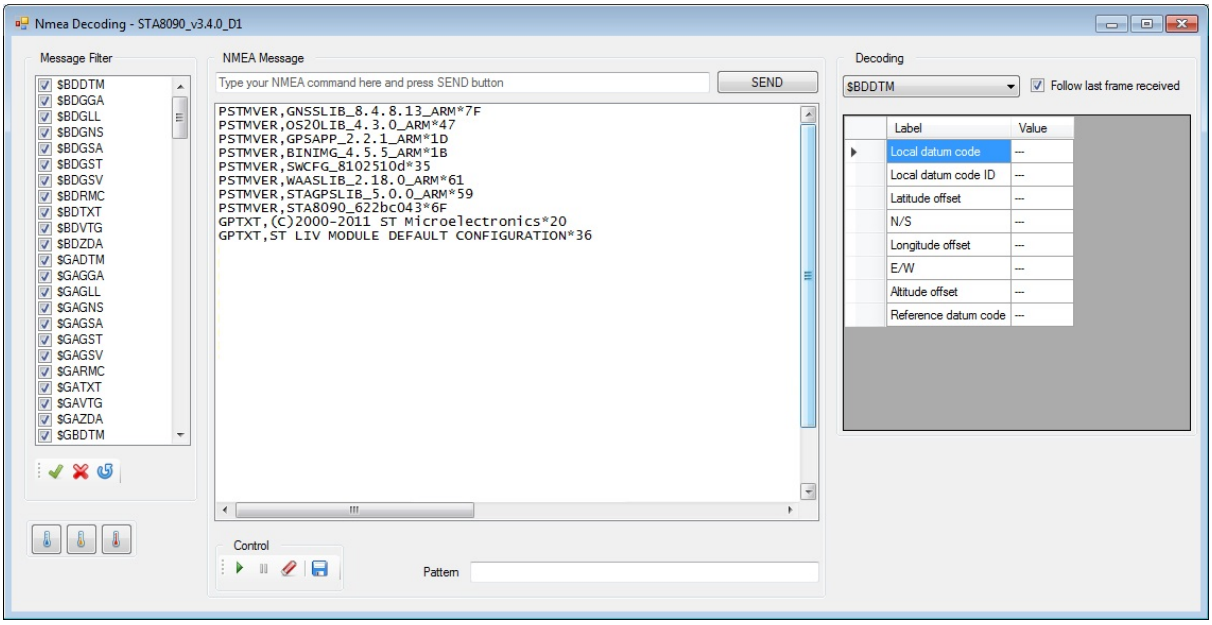
GNSS Teseo III supported devices:

- Teseo-LIV3F
- Teseo-LIV3FL

1 Firmware version

The firmware version defines which set of messages the receivers is able to manage.
The command `[$PSTMGETSWVER]` returns the firmware and all software versions in string format.
While booting Teseo Module reports on the serial port the current configuration as showed in the Figure 1:

Figure 1. Teseo Module booting message from UART



Each entry of Table 1 identifies a specific Teseo Module firmware subsystem version.

Table 1. Teseo Module firmware subsystem version

Entry	Description
PSTMVER,GNSSLIB_8.4.8.13_ARM*7F	GNSS Library Version
PSTMVER,OS20LIB_4.3.0_ARM*47	OS20 Version
PSTMVER,GPSAPP_2.2.1_ARM*1D	GPS App Version
PSTMVER,BINIMG_4.5.5_ARM*1B	Binary Image Version
PSTMVER,SWCFG_8102510d*35	Sw configuration Version
PSTMVER,WAASLIB_2.18.0_ARM*61	WAAS Library Version
PSTMVER,STAGPSLIB_5.0.0_ARM*59	AGPS Library Version
PSTMVER,STA8090_622bc043*6F	Chip Version
GPTXT,(C)2000-2011 ST Microelectronics*20	Log message
GPTXT,ST LIV MODULE DEFAULT CONFIGURATION*36	Log message

The Binary Image Version covers all the firmware subsystem, therefore on every firmware subsystem update the Binary Image Version updates as well.

1.1 Firmware update algorithm protocol

Teseo Module supports the firmware upgrade.

Both the Host and Teseo Module have to follow a well-defined protocol.

Caution: take care that during the whole firmware upgrade procedure the Voltage VCC and VCC_IO must remain applied and stable; a power outage, during the firmware upgrade procedure, could force Teseo Module in an unrecoverable state.

Firmware upgrade has a preliminary phase to synchronize the Host and the Teseo Module.

Just after the synchronization with the device, the Host must send the binary image options. These options are packed inside a structure; below there's the description and the specific values:

```
struct ImageOptions
{
unsigned char reserved_0;
unsigned char reserved_1;
unsigned char chunk_size;
unsigned char reserved_2;
unsigned int firmwareSize;
unsigned int firmwareCRC;
unsigned int reserved_3;
unsigned int reserved_4;
} img_option = {
  .reserved_0 = 1,
  .reserved_1= 0,
  .chunk_size = <CHUNK_SIZE>,
  .reserved_2= 1,
  .firmwareSize = <FIRMWARE_SIZE>,
  .firmwareCRC = <FIRMWARE_CRC>,
  .reserved_3 = 0x00100000,
  .reserved_4 = 0x00100000,
};
```

The Host has to specify the chunk size, the firmware size and the firmware CRC in the related fields.

The chunk size can be selected setting the .chunk_size field in the struct ImageOptions; chunk size selection is described in the Table 2:

Table 2. Chunk_size bit field description

Chunk-size bit field	Description
[7:4]	Reserved must be zero
[3:0]	Set the chunk size value: 0: 16 Kbytes; 1: 1 Kbytes; 2: 2 Kbytes; 3: 3 Kbytes; 4: 4 Kbytes; 5: 5 Kbytes; 6: 6 Kbytes; 7: 7 Kbytes; 8: 8 Kbytes; 9: 9 Kbytes; 0: 10 Kbytes; 11: 11 Kbytes; 12: 12 Kbytes; 13: 13 Kbytes; 14: 14 Kbytes;

Chunk-size bit field	Description
	15: 15 Kbytes;

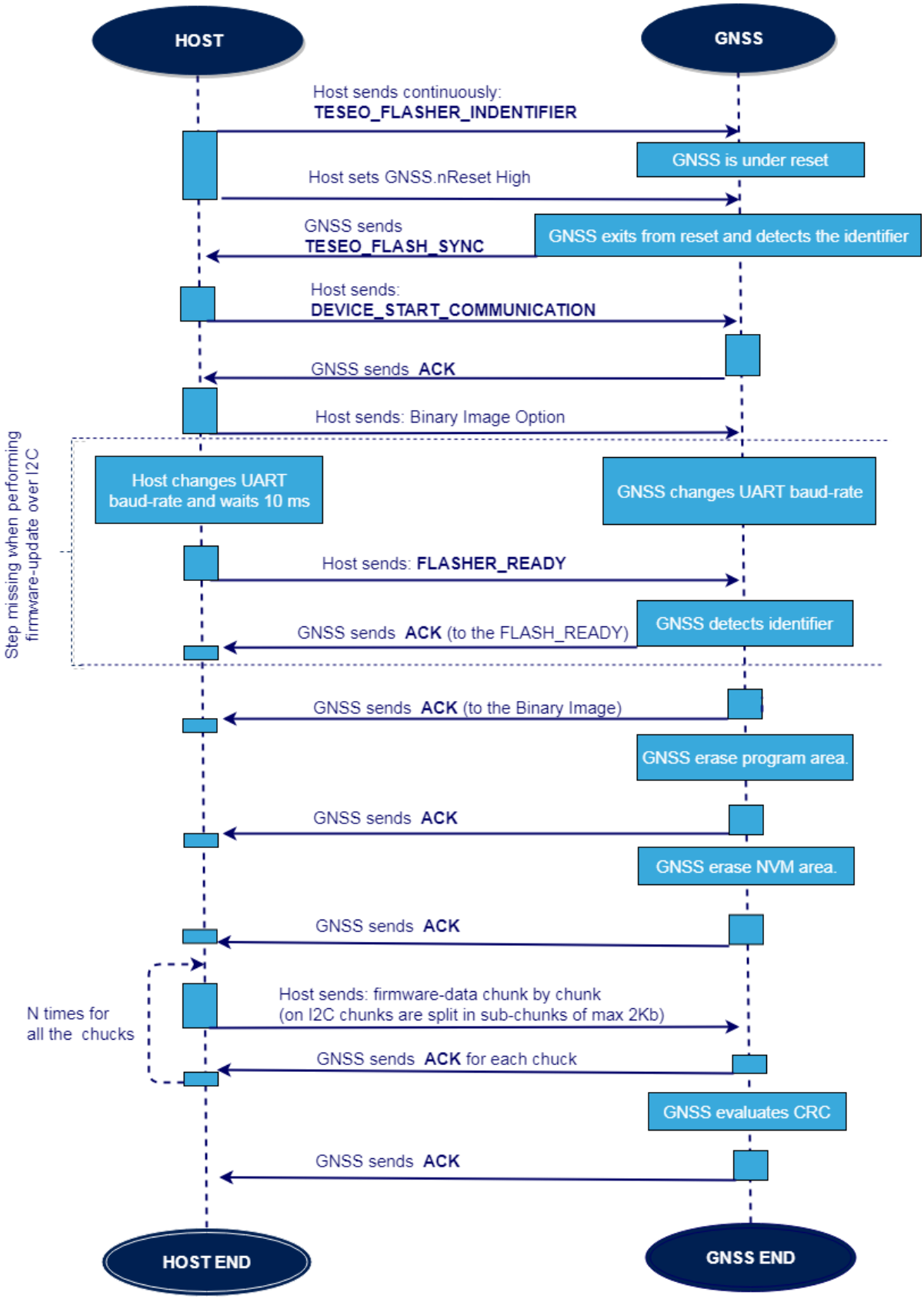
While sending the firmware, data host has to split the binary image in a N chunks with the selected chunk-size (in the ImageOptions structure); last chunk size must be equal to the remaining bytes number.

Each data chunk will be acknowledged with "ACK" response from Teseo Module.

When all the chunks are sent, Teseo Module performs a CRC error check on the image data received by the Host; if the check is passed an "ACK" response is sent back to the Host and the new downloaded firmware is validated. Otherwise if the check failed a "NAK" response is sent. In both cases Teseo Module device resets itself.

The firmware upgrade procedure is shown in Figure 2.

Figure 2. **Teseo Module firmware upgrade procedure**



Firmware upgrade procedure, on Teseo Module, uses the following constants:

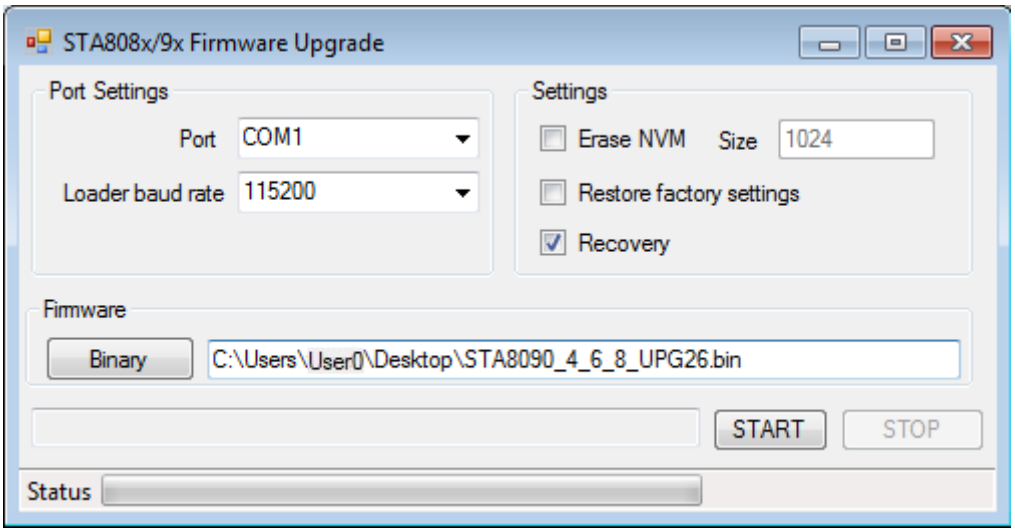
Table 3. Firmware upgrade constants

Constants	Value
TESEO_FLASHER_IDENTIFIER	0xBCD501F4
TESEO_FLASHER_SYNC	0x83984073
DEVICE_START_COMMUNICATION	0xA3
FLASHER_READY	0x4A
ACK	0xCC

1.2 Firmware update software tool

Teseo Module firmware update is supported through the ST Firmware Upgrade tool.

Figure 3. Firmware Upgrade tool



ST Firmware Upgrade tool is provided with the ST Teseo Suite Light program.

When the user wants to update the Teseo Module, Teseo Module must be powered and under reset; the user must configure the tool, select binary image and start firmware upgrade process. Only when the process has started, user must take Teseo Module out of reset.

1.2.1 Port settings option

When user clicks on UART mode button all COM ports available on your PC will be listed in the Output port box; also, two boxes for the baud rate selection are now selectable.

- **NMEA baud rate**: this is the UART baud rate used to send the FW Upgrade command and start the update process. When "Auto" is selected, the tool tries to automatically detect the baud rate of the select port and use it to send the command;
- **Baud rate**: this is the UART baud rate used to download the new firmware.
- **Output port**: COM port used to update the firmware;

USB mode is related to other ST-GNSS solution and it doesn't have to be enabled in case of Teseo Module.

1.2.2 Firmware options

- **Erase NVM**: check this flag if you want to erase ST proprietary NVM during firmware upgrade process. If this flag is checked, the size of NVM can be entered using the related text box. Value is expressed in KB. The default value is 1024;
- **Program only**: check this flag if you don't want to erase program memory before writing new firmware.
- **Dump**: not available;
- **Recovery**: check this flag if you want to update the Teseo Module;

On this window there are two boxes where information about firmware size and CRC code is displayed; these fields are read-only. After configuring all options, the load button can be pushed in order to upload the firmware binary image

1.2.3 Upgrade process

When all preliminary steps described above are completed, the firmware upgrade process can be executed by clicking on Start button. A progress bar will be displayed in the status bar. The update process can be stopped by clicking on Stop button.

When upgrade has finished a confirmation message is displayed. If the process failed or was stopped by the user, no backup firmware can be executed; the only way to re-install a working firmware is to reset the hardware and start a new upgrade process.

2 Receiver Description

2.1 GPS/Galileo/GLONASS/BeiDou Base Band (G3BB+) processor

Teseo Module integrates G3BB+ proprietary IP, which is the ST last generation high-sensitivity Baseband processor fully compliant with GPS, Galileo, GLONASS and BeiDou systems.

The baseband receives, from the embedded RF Front-End, two separate IF signals coded in sign-magnitude digital format on 3 bits and the related clocks. The Galileo/GPS (GALGPS) and GLONASS/BeiDou (GNSCOM) signals at the base band inputs are centered on 4.092 MHz, 8.57 MHz and 10.23 MHz.

The baseband processes the two IF signals performing data codification, sample rate conversion and final frequency conversion to zero IF before acquisition and tracking correlations.

The baseband processor has the capability of acquiring and tracking the Galileo, GPS, GLONASS and BeiDou signals in a simultaneous or single way, or a combination of three, being GLONASS and BeiDou mutually exclusive.

2.2 Receiver Configuration

The Teseo Module binary image supports the firmware configuration facility. It allows changing some application parameters in order to address most of the specific HW constraints and/or the final product functionality requirements.

The firmware configuration management supports the "Factory Setting", embedded in the binary code, and the "Customized Setting", stored in the GNSS backup memory (NVM). The "Factory Setting" can be changed and saved at run-time using specific NMEA commands.

Teseo Module binary image software is released with the ST defined default setting (Factory Setting).

2.2.1 Configuration Concept

All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

Default setting of configuration data block is hard coded into the binary image file.

When the system is running, 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. At start-up, the current configuration block is loaded from NVM (if a stored data block is available) or it is loaded from the 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. It includes all parameters modified and stored by the user. At system startup the SW configuration management 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.

The receiver always uses only the Current Configuration.

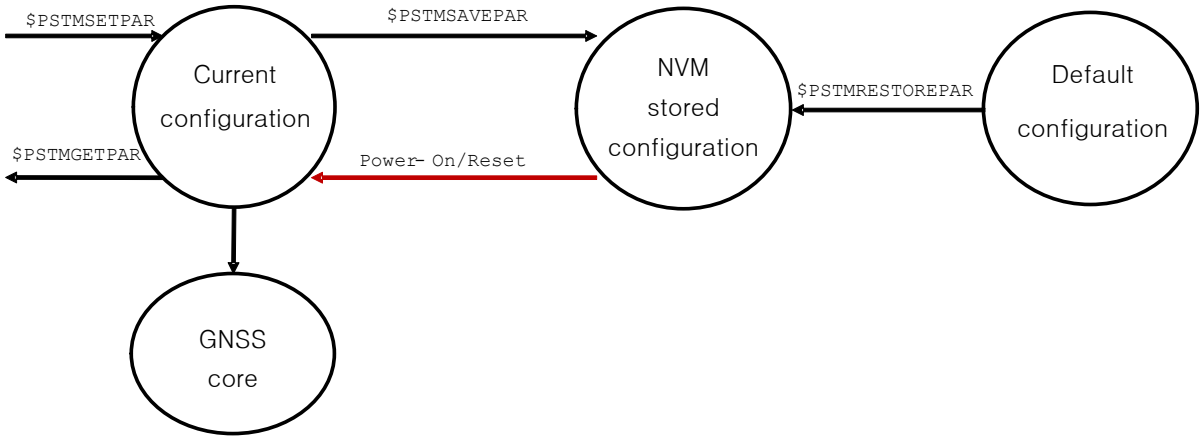
Current Configuration will be lost when there is:

- a power cycle
- a hardware reset
- a software reset

The Current Configuration can be made permanent (stored in a non-volatile memory) by saving it to the "NVM stored configuration".

On NMEA protocol the run-time configuration parameters can be read, changed and stored (in NVM) using the system configuration commands: $PSTMSETPAR, $PSTMGETPAR and $PSTMSAVEPAR. There is also a command to restore the factory setting parameters: $PSTMRESTOREPAR.

Figure 4. **Custom Configuration using NMEA Protocol**



For example if the UART baud rate would change, the following commands should be sent by the Host:

1. `$PSTMSETPAR,3102,0x9`
2. `$PSTMSAVEPAR`
3. `$PSTMSRR`

Where:

1. `$PSTMSETPAR` changes the UART's baudrate;
2. `$PSTMSAVEPAR` saves the whole configuration;
3. `$PSTMSRR` restarts the Teseo Module to guarantee that the change made is effective;

2.2.2 Configuration Data Blocks (CDB)

The configuration is divided into several sub-sections.

The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

Table 4. **Configuration Data Block List**

ID	Parameter Name	Size Bytes	Default(1)	Description
102	NMEA Port Baudrate	1	0x5	Set NMEA Baudrate
125	Notch Filter Setting	1	0x0C	Enable or disable the Notch Filter usage
128	Differential Source Type	1	0x03	Allow setting the number of decimal digits for the position data in the NMEA messages
129	GLONASS Satellite ID Type	1	0x01	Allow setting the GLONASS satellite ID type used in the GSV and GSA messages the satellite ID is based on frequency the satellite ID is based on slot number.
135	SBAS Default PRN	1	0x7C	Set the SBAS default PRN
197	PPS Clock	1	0x20	Allow setting the PPS clock. For accurate timing application, 64 is mandatory.
199	Local geodetic datum	1	0xFF	Set the local geodetic datum to be used in position reporting over the NMEA messages. Not valid number (e.g. 255) means default datum which is WSG84.
200	Application ON/OFF	4	0x1963965C	Activates/Deactivates GNSS application features
201	NMEA Port Msg-List 0 (LOW)	4	0x00980056	Set NMEA Message List over UART(32 bits low)

ID	Parameter Name	Size Bytes	Default[1]	Description
205	Position Data Time Delay [ms]	4	0x50	Set the time delay between the measurements (on UTC second) and the position data delivery.[2]
213	PPS operating mode setting 1	4	0x0	Allow setting different operating modes for the PPS signal generation
214	PPS operating mode setting 2	4	0x0	Allow setting different operating modes for the PPS signal generation
215	Position hold auto survey samples	4	0x0	Sets the number of position samples to be captured before entering in the position hold mode. If it is set to 0, the auto survey is disabled.
227	Application ON/OFF 2	4	0x0000040D	Activates/Deactivates GNSS application features
228	NMEA Port Msg-List 0 (HIGH)	4	0x0	Set NMEA Message List over UART (32 bits high)
231	NMEA Message List over I2C (LOW)	4	0x00980056	Allow enabling/disabling each NMEA message in the message list over I2C The message list over I2C is a 64-bits bitmap; CDB-ID 231 represents the first 32 bits (low bits)
232	NMEA Message List over I2C (HIGH)	4	0x0	Allow enabling/disabling each NMEA message in the message list over I2C The message list over I2C is a 64-bits bitmap; CDB-ID 232 represents the second 32 bits (high bits)
237	Default GPS MIN-MAX week number	4	0x0CE4071D	Set default MIN-MAX range for GPS week number.[3]
238	Default UTC delta time	4	0x11	Default value of GPS time to UTC delta time in seconds (leap second)
257	Periodic operating mode setting 1	4	0x02000A0C	Configure the periodic low power mode.
263	I2C slave configuration	4		I2C configuration: [31:16]: Speed; Speed Standard; Speed Fast Speed HS; [15:6]: Slave address; [5:2]: reserved; [1:0]: I2C enable: NMEA over I2C OFF NMEA over I2C ON
301	PPS Pulse Duration	8	0.5	PPS pulse width. It is the time distance (in seconds) from PPS rising edge and next PPS falling edge.
302	PPS Delay Correction	8	0x0	PPS time delay correction n seconds. It allows to compensate any delay introduced on PPS signal by RF chain.
303	GNSS FIX Rate	8	1	Set the GNSS FIX rate period in seconds

1. *Values compliant with the Default Teseo Module default configuration v. 0.02.*
2. *To reduce the jittering of the NMEA message list 2 data delivery, the messages are sent over the uart port after a fixed delay from the measurement time. This delay can be configured to achieve the best jitter reduction at different CPU speed setting.*
3. *Min week number is used for correct GPS week number decoding. Max week number is used for GPS week validity check.*

2.2.3 Firmware configuration commands

To simplify the Teseo Module module configuration, Teseo Module supports firmware configuration commands which are able to setup more than one CBD-ID with a single command.

Teseo Module supports the following configuration commands:

Table 5. NMEA configuration commands

Name	Command description
$PSTMCFGPORT	Char Port Configuration
$PSTMCFGCLKS	Clock Mode and Speed Configuration
$PSTMCFGMSGL	Message List Configuration
$PSTMCFGTHGNSS	Configure the GNSS algorithm threshold
$PSTMCFGTDATA	Time and Data Related Configuration
$PSTMCFGCONST	Constellation Related Configuration
$PSTMCFGSBAS	SBAS Algorithm Configuration
$PSTMCFGPPSGEN	PPS General Configuration
$PSTMCFGPPSPUL	PPS Pulse Related Configuration
$PSTMCFGPPSSAT	PPS Satellite Related Configuration
$PSTMCFGPOSHOLD	Position Hold Configuration
$PSTMCFGTRAIM	PPS Traim Configuration
$PSTMCFGSATCOMP	PPS Satellite Compensation Configuration
$PSTMCFGLPA	Low Power Algorithm Configuration
$PSTMCFGAGPS	Assisted GNSS Configuration
$PSTMCFGAJM	Anti-Jamming Configuration
$PSTMCFGODO	Odometer Configuration
$PSTMCFGLOG	Logger Configuration
$PSTMCFGGEOFENCE	Geofencing Configuration

Take care that all the firmware configuration commands reported in Table 5 operate only on the 'Current configuration'; this means that the Host configuration procedure has to be completed sending a '`$PSTMSAVEPAR`' command to save in the 'NVM' the provided configuration.

2.3 Communication channels

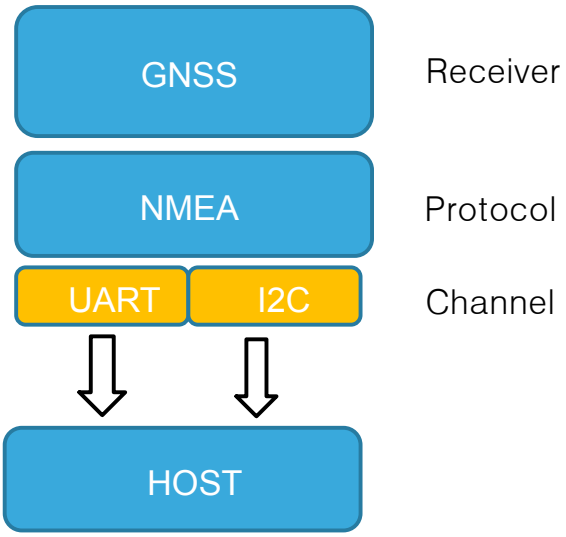
On the Teseo Module the NMEA Protocol is communication channel independent.

Users can select the channel based on their needs.

Teseo Module receiver supports the following communication channels:

- UART channel;
- I2C channel (from release 4.6.8);

Figure 5. **Teseo Module protocol routing over the available ports**



2.3.1 Communication over UART Port

Teseo Module receiver and Host are connected by serial port. Communication parameters are the following:

- 8 data bits
- No parity
- 1 stop bit
- 9600 bauds

In both directions, communication is based on the frames described in next sections.

From Teseo Module receiver to Host frames can be:

- Unsolicited: For instance, periodical frame reporting position
- Data Responses: Teseo Module Receiver returns data requested by Host
- ACK: in case no data need to be returned to Host (e.g. on a reset request), simple ACK is sent
- NACK: if request contains wrong parameters, NACK is returned to Host.

From Host to Teseo Module receiver frames can be:

- Read Requests;
- Write reset, initialization Requests

2.3.2 Communication over I2C Port

I2C is a two-wire communication interface invented by Philips Semiconductor.

Unlike all other interfaces, I2C is not able to communicate in full-duplex mode; it uses only two bidirectional open-drain lines, Serial Data Line (SDA) and Serial Clock Line (SCL), pulled up with resistors.

Teseo Module always acts as slave and it cannot initiate data on the bus; Host has to periodically pull the receiver to check about data availability. Default I2C slave address is 0x3A.

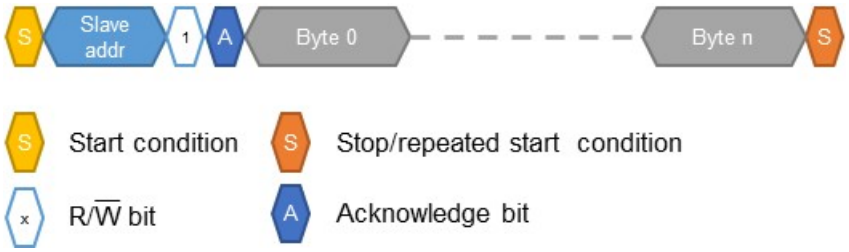
The CDB that can be used to configure I2C specific parameters is CDB 263

2.3.2.1 I2C Read Access

When the Host wants to read NMEA sentences from I2C, it must start a read operation over I2C, providing configured slave address.

After the acknowledge bit, a stream of bytes will be sent by Teseo Module up to the stop/repeated start condition.

Figure 6. **I2C Read operation description**



The format of the bytes is ASCII. When Teseo Module does not have any character to send, a dummy 0xFF byte is sent.

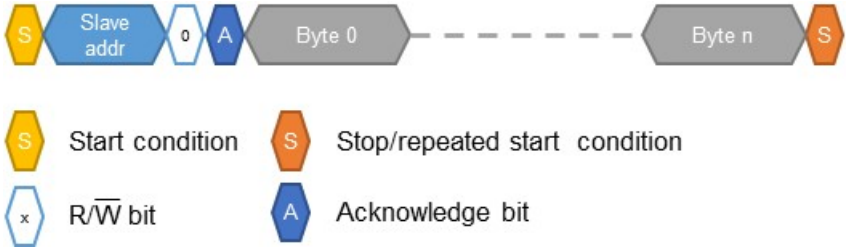
The Host can parse the data received as defined in ST GNSS NMEA specification and commands document.

2.3.2.2 *I2C Write Access*

When the Host wants to send commands to Teseo Module through I2C, it must start a write operation over I2C, providing configured slave address.

After the acknowledge bit, Teseo Module will receive any character coming from the Host up to the stop/repeated start condition.

Figure 7. **I2C Write operation description**



The format of the commands is defined in ST GNSS NMEA specification and commands document.

2.3.2.3 *I2C Register description*

On I2C communication channel Teseo Module allows 256 addressable registers.

Each register is 32bits wide and it can be addressed to support read or write operations.

On write operation:

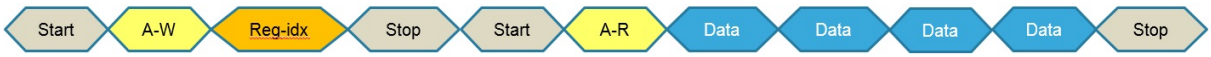
- the first data byte is the register index while the following bytes are the register value;
- every write operation with less than 5 bytes is discarded;
- write operation with more than 5 bytes all the extra bytes not required are discarded;

Figure 8. **I2C register write operation**

On read operation:

- the register index is the last one indexed in a write operation;
- GNSS will send the 4 bytes register values;
- If the Host doesn't close the i2c-read-transaction after 4 bytes, extra bytes will be filled with 0x0 (zero) by the Teseo Module;

Figure 9. **I2C register read operation**



Teseo Module doesn't support auto-increment register index, this means, each register has to be addressed by the Host to access.

Registers from 0x0 to 0xFE are currently reserved for future use, every read or write operation on these registers can provide unpredictable operation on Teseo Module.

Teseo Module has a special register, the register 0xFF reports, as it is, the NMEA stream where the Host can perform read and write operations as a standard UART port.

On PowerOrReset the default register index value is 0xFF in this way every Host can read the NMEA stream directly just raising a simple i2c-read-operation on Teseo Module.

Table 6. I2C registers map

Register id	Operation	Size	Description
0x00	-	32 bits	Reserved
\xc9	-	-	-
0xFE	-	-	Reserved
0xFF	R/W	No-Limit	NMEA stream

3 Protocol Specification

The receivers come with a highly flexible communication interface.

Teseo Module supports the following protocols:

- NMEA Protocol based on NMEA 0183 Version 3.1;
- RTCM protocol based on RTCM Version 2.3

3.1 NMEA Protocol

NMEA messages sent by the Teseo Module are based on NMEA 0183 Version 3.1.

NMEA (National Marine Electronics Association) is a non-profit association of manufacturers, distributors, dealers, educational institutions, and others interested in peripheral marine electronics occupations. The NMEA 0183 standard defines an electrical interface and data protocol for communications between marine instrumentation.

3.1.1 Communication Interface

Communication between a Host processor and the Teseo Module 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.

3.1.2 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 behavior. The regular structure of a command is:

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

Once the command is executed the device replies with messages according to what specified in this document, after the message the command is sent back to the Host as a final confirmation of the execution. This functionality can be configured according to what specified in Receiver Configuration.

3.1.2.1 ST NMEA command list

Table 7. ST NMEA command list

Syntax	Description
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITTIME	Initialize GPS time using UTC format
$PSTMINITFRQ	Initialize center 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

Syntax	Description
$PSTMWARM	Perform WARM start
$PSTMHOT	Perform HOT start
$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
$PSTMSBASONOFF	Enable/Disable the SBAS activity
$PSTMSBASSAT	Set the SBAS satellite's ID
$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
$PSTMSETCONSTMASK	Set GNSS constellation mask
$PSTMNOTCH	Set the ANF operation mode
$PSTMPPS	Command interface for pulse Per second management
$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)
$PSTMNMEAREQUEST	Send a set of NMEA messages according to the input message list

3.1.3 Messages

A Message is a defined set of data sent from the Teseo Module 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>*<checksum><cr><lf>
```

There are two basic sets of message implemented.

3.1.3.1 Standard NMEA messages list

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).

Standard NMEA messages start the "message-ID" with:

```
$<Talker ID>
```

Supported talker IDs are:

Table 8. Standard NMEA message

Syntax	Default	Description
$--GNS	ON	NMEA: global position system FIX data
$GPGGA	ON	NMEA: global position system FIX data
$GPGLL	ON	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	ON	NMEA: track made good and ground speed
$GPZDA	OFF	NMEA: time and date
$GPGST	OFF	NMEA: GNSS pseudorange noise statistics
$--DTM	OFF	NMEA: local datum offsets from reference

3.1.3.2 *Proprietary ST NMEA Messages List*

The Teseo Module 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
```

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

Table 9. Proprietary ST NMEA Message

Syntax	Default	Description
$PSTMDIFF	OFF	ST: Differential Correction Data
$PSTMPRES	OFF	ST: Position Residuals
$PSTMVRES	OFF	ST: Velocity Residuals
$PSTMPA	OFF	ST: Position Algorithm
$PSTMSAT	OFF	ST: Satellite Information
$PSTMSBAS	OFF	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
$PSTMAGPS10	OFF	ST: STAGPS predicted ephemeris information
$PSTMNOTCHSTATUS	OFF	ST: Reports the Notch filter status.
$PSTMCPU	OFF	ST: Reports the CPU usage and CPU speed setting.
$PSTMPPSDATA	OFF	ST: Reports the Pulse Per Second data.
$PSTMTRAIMSTATUS	OFF	ST: Reports the TRAIM status data.

Syntax	Default	Description
$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

3.2 RTCM Protocol

RTCM (Radio Technical Commission for Maritime Services) is an international standards organization. RTCM protocol is a unidirectional protocol to supply, to Teseo Module, real-time differential correction data.

Teseo Module is compliant with RTCM 2.3 and it supports the following messages:

Table 10. RTCM message type supported

Message Type	Description
1	Differential GPS Corrections
9	GPS Partial Correction Set
31	Differential GLONASS Corrections
34	GLONASS Partial Correction Set

On Teseo Module RTCM doesn't need any configuration; when enabled the RTCM input stream is parsed and used in the DGPS algorithm.

The RTCM protocol can be enabled/disabled on CDB-ID 200.

4 Assisted GNSS

GNSS Teseo Module needs accurate satellite position data from at least 4 satellites to produce a position fix (FIX).

Accurate satellite data -ephemeris data- is valid for 4hrs only for GPS and 30 min only for GLONASS.

After that time a Teseo Module must download new ephemeris data.

Ephemeris download can take from dozens of seconds to several minutes, hours or can fail.

Assisted-GNSS is a mechanism to provide ephemeris assistance from external source, this reduces considerably the time to get a FIX especially in critical environments when the ephemeris download time could be very long.

ST GNSS Teseo Module binary image supports three types of Assisted GNSS:

- ST - AGNSS
- Predictive AGNSS
- RealTime GNSS

4.1 ST - AGNSS

The STAGNSS library is able to provide predicted ephemerides to the ST GNSS Teseo Module in a time frame less than the usual time (about 30 seconds) needed to download real ephemeris from the sky. This reduces considerably the time to get a FIX especially in critical environments when the ephemeris download time could be very long.

STAGNSS autonomous solution works using the past real ephemeris (downloaded from the sky and stored in its internal database) to extrapolate the parameter of future ephemeris (up to 5 days of prediction). For these reasons, the STAGNSS autonomous performances (in terms of position accuracy using predicted ephemeris) are strictly dependent on the real ephemeris database content. In normal usage of STAGNSS autonomous, the system automatically uploads the real ephemeris into its database as soon as new ephemerides are downloaded from the sky. This means that the global content of the real ephemeris input database is determined by the history of device running periods in the past.

STAGNSS subsystem supports the following NMEA interface with the Host.

Table 11. ST-AGNSS NMEA interface

Syntax	Description
$PSTMSTAGPSONOFF	Turns ON/OFF the STAGPS\xaa engine
$PSTMSTAGPSINVALIDATE	Clears data stored in the STAGPS\xaa internal database
$PSTMGETAGPSSTATUS	Returns the status of the STAGPS\xaa internal processing
$PSTMSTAGPSSETCONSTMASK	Switches among the ST-AGNSS constellation.
$PSTMAGPS	Message with the same syntax as standard NMEA GSA Message
$PSTMAGLO	Message with the same syntax as standard NMEA GSA Message
$PSTMPOLSTARTED	Message in response to $PSTMSTAGPSONOFF
$PSTMPOLSUSPENDED	Message in response to $PSTMSTAGPSONOFF

4.2 Predictive AGNSS

ST-AGNSS when used in systems with network data access is able to provide full-constellation long-term prediction taking advantage of an assistance server.

Server based assistance is done by ST-AGNSS using GPStream technology from RxNetworks. This unique solution combines the advantage of universal assistance data protocol with lightweight data access, by needing only about 8 KB bi-weekly data transfers to maintain fast and accurate GPS performance. Starting from this downloaded payload called "seed". ST-AGNSS is capable of generating at the client satellite orbit predictions for up to 14 days, with very high accuracy, for the complete GPS constellation and GLONASS constellation.

A unique feature of ST-AGNSS is the dual-mode ability to seamlessly fall back from the

14-day server-based prediction to 5-day autonomous prediction capability, which

self-sustains on the field depending on usage patterns. This is very useful to keep quality of the GPS experience, should a connected device lose its ability to contact the server for coverage or roaming issues or any other wireless connectivity problem.

While autonomous ST-AGNSS is completely transparent to the host device, the sever-based (Predictive AGNSS) version should be downloaded from the server and passed to the GNSS device. The method to achieve this, is discussed in the following subsections.

PGPS server should be accessed in the following ways:

- Host generates HTTP request string
- HTTP Request made from Host to RxNetworks
- Seed data packet returned to the Host
- Seed data sent to ST GNSS device
- ST GNSS device expands seed data into flash database
- Predicted ephemeris data available now and in future 14 days

4.2.1 PGPS server access

4.2.1.1 The HTTP Request URL

To download a PGPS seed from the server, the application will need to format a HTTP request. Refer to the Application Note "AN5160: RxNetworks Assisted GNSS Server Interface Specification" to access the RxNetwork Service.

4.2.2 Password generation

As mentioned in the previous section, in order to access the RxNetwork servers, the user has to provide a set of parameters which are used in generating the HTTP request.

Predictive AGNSS and RealTime AGNSS uses the same password generator and the same NMEA commands as described in Password generation.

4.2.3 Predictive AGNSS Seed Transmission

Moreover, before sending the binary seed for each constellation, it must be divided into blocks.

The first block for each constellation is 171-bit long. It has to be transferred through the $PSTMSTAGPSSEEDBEGIN command.

Just after the $PSTMSTAGPSSEEDBEGIN command, the list of the satellites block types for that constellation has to be sent using the $PSTMSTAGPSBLKTYPE command.

In the case of the GLONASS constellation, also the slot frequency channels list must be sent after the $PSTMSTAGPSBLKTYPE command. It can be done using the $PSTMSTAGPSSLOTFRQ command.

Then the remaining part of the seed must be divided into 155 byte blocks (called packets) and must be sent using the $PSTMSTAGPSSEEDPKT command. All the packets for the constellation specified in the previous $PSTMSTAGPSSEEDBEGIN command must be sent before issuing the $PSTMSTAGPSSEEDBEGIN command again for a different constellation.

When all the first blocks and all subsequent packets have been sent for all the available constellations, then the $PSTMSTAGPSSEEDPROP command must be issued to signal the end of the seed and to start the propagation.

The seed propagation is a time consuming operation. The propagation status can be checked in the message $PSTMAGPSSTATUS in response to $PSTMGETAGPSSTATUS command; the message $PSTMAGPSSTATUS reports the propagation status. When the returned status field is equal zero the propagation is completed.

4.3 RealTime AGNSS

The Real-Time AGNSS is able to provide the approximate current time, the ephemerides, the almanacs and optionally the approximate position to the GNSS engine in a time frame less than the usual time (about 30 seconds) needed to download real ephemeris from the sky. This reduces considerably the time to get fixed especially in critical environments when the ephemeris download time could be very long.

Real-time AGNSS requires a network connection to download assistance data from the server. Assistance data include the current time (if not available, for instance, from RTC), the ephemerides, the almanacs and optionally the rough position.

All the assistance data can be injected into the device backup memory using a few NMEA commands.

Once those data have been downloaded from the server, refer to the guidelines reported in the Application Note "AN5160: RxNetworks Assisted GNSS Server Interface Specification" to access the RxNetwork Service. The first thing to do is to inject the current time into the device (if the device has no RTC, or if it is set to a wrong time). This can be done either using the $PSTMINITTIME command or, if also the approximate position is available, then both current time and position can be injected using the $PSTMINITGPS command.

Then the ephemerides can be injected into the device using the $PSTMEPHEM command for each satellite (between two consecutive commands there must be at least a 20 millisecond delay).

Then the almanacs can be injected into the device using the $PSTMALMANAC command for each satellite (between two consecutive commands there must be at least a 20 millisecond delay).

Now the device will be capable of achieving the fix very quickly, if enough satellites are in view.

4.3.1 Password generation

As mentioned in the previous section, in order to access the RxNetworks servers, the user has to provide a set of parameters which are used in generating the HTTP request. These parameters are used to generate a password string (up to 41 characters in length) that is required by the HTTP request string.

GNSS device provides the $PSTMSTAGPS8PASSGEN NMEA command that performs the password generation. The user must supply three parameters to this command that it will be used to generate a unique password.

In order to generate the password the user must pass the following parameters:

- The vendor id string
- The current time expressed as GPS seconds (i.e., the number of seconds since midnight 06-Jan-1980)

The vendor id and device id strings will be provided by RxNetworks. The current time will be calculated by the software creating the HTTP request string.

4.3.2 Real-time assistance data uploading procedure

The real-time AGNSS performances depend on the availability of a network connection in order to download assistance data, which include:

- the current time (if not available, from instance, from RTC)
- the ephemerides
- the almanacs
- the rough position (optional)

Once those data have been downloaded from the server, the first thing to do is to inject the current time into the device (if the device has no RTC, or if it is set to a wrong time). This can be done either using the $PSTMINITTIME command or, if also the approximate position is available, then both current time and position can be injected using the $PSTMINITGPS command.

Then the ephemerides can be injected into the device using the $PSTMEPHEM command for each satellite (between two consecutive commands there must be at least a 20 millisecond delay).

Then the almanacs can be injected into the device using the $PSTMALMANAC command for each satellite (between two consecutive commands there must be at least a 20 millisecond delay).

Now the device will be capable of achieving the fix very quickly, if enough satellites are in view.

5 Data logging

Data logging allows the GNSS Teseo Module to save locally to the flash the resolved GNSS position to be retrieved on demand from the host.

GNSS Teseo Module supports only one datalog at a time.

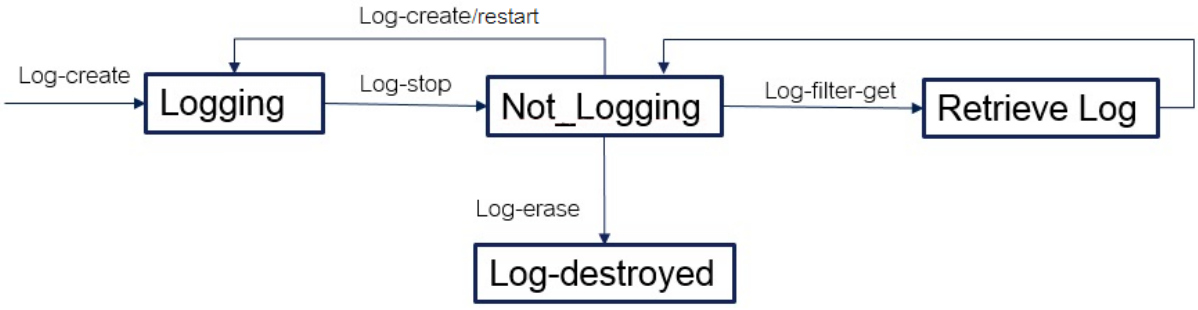
Datalogging can be enabled, disabled and erased. Datalogging is supported over NMEA using runtime commands.

Datalogging subsystem supports both:

- Circular buffer
- Standard buffer

The finite state machine of each log is showed in the following image.

Figure 10. Data-logging finite state machine



Each log is:

- Created and enabled with a create command
- Restarted with a start command
- Disabled with a disable command
- Erased with an erase command

While the data-logging is disabled but not erased the log can be queried.

The recorded data is configurable when the log is created, there are mandatory fields and other fields which can be logged or not; the mandatory fields are: Index-log (a counter from zero) Longitude, Latitude, Time and Data.

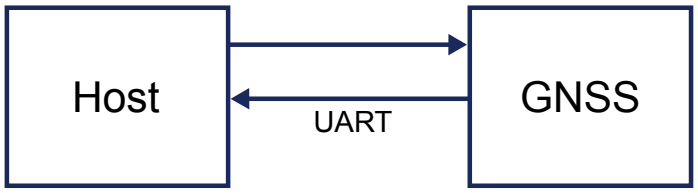
Data-logging support three types of data logged, during the log creating the data-type has to be defined and it will be used for all the life-time of the log.

Each type has a different size and different data logged. All the data logged types have: timestamp, latitude and longitude while other fields depend on the type; details in Table 12.

Table 12. Data-log types description

Type	Size	Altitude	Odometer	Geo	Quality	Qual_idx	Fix	Speed
1	12	-	-	X	-	X	X	-
2	16	X	-	X	X	-	X	X
3	20	X	X	X	X	-	X	X

Figure 11. **Scenario-1 supported on data-logging**

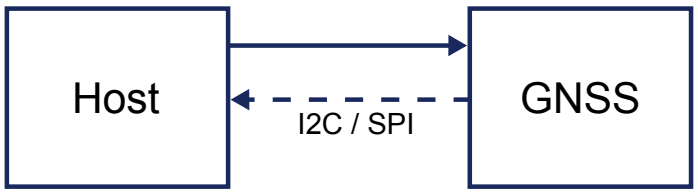


In case of **Scenario 1,** GNSS Teseo Module cannot raise an interrupt to the host, but if $PSTMLOGSTATUS message is enabled in the message-list the GNSS Teseo Module can send the $PSTMLOGSTATUS message autonomously to the host (currently supported only in case of buffer full) through the UART port, in this manner the host does not need polling the GNSS Teseo Module raising $PSTMLOGREQSTATUS commands.

When the host receives the $PSTMLOGSTATUS message, it is aware of internal datalog status.

The other datalog commands are raised by the host to manage, configure and query the log.

Figure 12. **Scenario-2 supported on data-logging**



In case of **Scenario 2,** GNSS Teseo Module cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command $PSTMLOGSTATUS to the GNSS Teseo Module with a bus-specific-write operation followed by a bus-specific-read operation where the host will read $PSTMLOGSTATUS message posted by the ST GNSS Teseo Module.

6 Geofencing

Geofence feature allows the GNSS Teseo Module to raise an alarm when the resolved GNSS position is close to a specific circle, entering or exiting from a circle.

GNSS Teseo Module supports at least 8 circular areas where 4 circular areas are configurable in the firmware.

Geofencing alarm can be notified over:

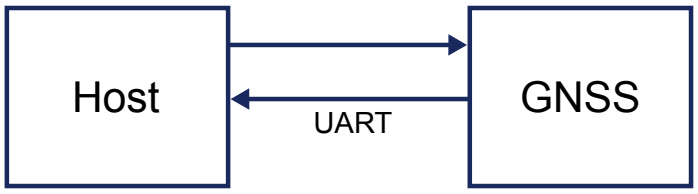
- NMEA message

ST GNSS Teseo Module supports the Geofencing features over NMEA.

Geofencing can be configured and enabled in the firmware configurator (via CDB-ID) or using the specific geofencing configuration command.

Geofence system support the following two scenarios.

Figure 13. Scenario-1 supported on Geofencing

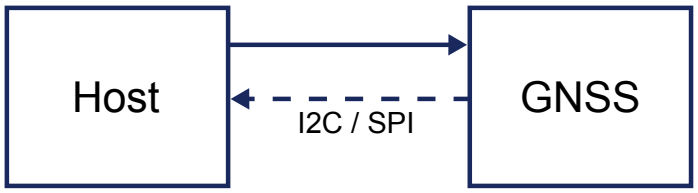


In case of **Scenario 1**, GNSS Teseo Module cannot raise an interrupt to the host but if $PSTMGEOFENCESTATUS message is enabled in the message-list the GNSS Teseo Module can send the $PSTMGEOFENCESTATUS message autonomously to the host through the UART port, in this manner host doesn't need polling the GNSS Teseo Module raising $PSTMGEOFENCEREQ commands.

When the host receives the $PSTMGEOFENCESTATUS message it is aware of Geofence internal status.

The other datalog commands are raised by the host to manage, configure and query the log.

Figure 14. Scenario-2 supported on Geofencing



In case of **Scenario 2,** GNSS Teseo Module cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command $PSTMGEOFENCEREQ to the GNSS Teseo Module with a bus-specific-write operation followed by a bus-specific-read operation where the host will read $PSTMGEOFENCESTATUS message posted by the GNSS Teseo Module.

7 Odometer

ST GNSS Teseo Module supports Odometer feature.

Odometer provides information on the traveled distance using only positioning information.

Odometer cannot be configured in the firmware configurator datablock. This means it has to be configured and managed using specific odometer commands during the runtime.

Odometer subsystem has only 2 states:

- Odometer activated
- Odometer reset

While activated the odometer reports the ground distance from the last reset.

Odometer can be configured and enabled in the firmware configurator (via CDB-ID).

Odometer traveled distance is reset in case of:

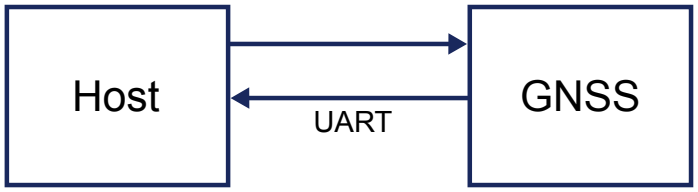
- Power off/on
- Entering/Exiting from Reset and/or Standby

Odometer is also able to raise an alarm when a programmed distance is reached. Odometer alarm can be notified over:

- NMEA message

Odometer system supports the following two scenarios.

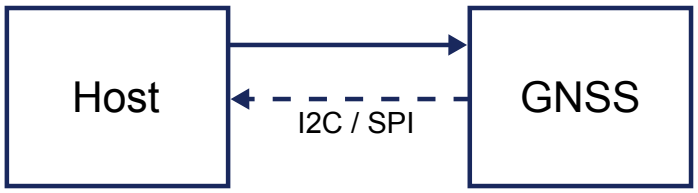
Figure 15. Scenario-1 supported on Odometer



In case of Scenario 1, GNSS Teseo Module cannot raise an interrupt to the host but if $PSTMODO message is enabled in the message-list the GNSS Teseo Module can send the $PSTMODO message autonomously to the host through the UART port, in this manner host doesn't need polling the GNSS Teseo Module raising $PSTMODOREQ commands.

When the host receives the $PSTMODO message it is aware of internal odometer status.

Figure 16. Scenario-2 supported on Odometer



In case of Scenario 2, GNSS Teseo Module cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command $PSTMODOREQ to the GNSS Teseo Module with a bus-specific-write operation followed by a bus-specific-read operation where the host will read $PSTMODO message posted by the GNSS Teseo Module.

8 Communication interface

Communication between a host processor and the ST GNSS Teseo Module 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 Teseo Module may contain an additional "Debug port" but the data exchanged on the "Debug Port" is not within the scope of this document.

8.1 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>*<checksum><cr><lf>`

In order to receive the commands, the GNSS Teseo Module 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 in Table 13.

Table 13. Default UART port configuration

Baudrate	Parity bits	Stop Bit	Data bits
9600	0	1	8

The NMEA default value baud rate is 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 Teseo Module.

Once the command is executed, the device replies with messages according to what specified 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 according to what specified in the Firmware Configuration document.

8.2 Messages

A Message is a defined set of data sent from the GNSS Teseo Module 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>*<checksum><cr><lf>`

There are two basic sets of message implemented.

8.2.1 Standard NMEA messages

Standard NMEA Messages are defined in the "NMEA 0183" Standard, issued by the "National Marine Electronics Association".

To get an overview on the supported by ST's GNSS Teseo Module please refer to Standard NMEA messages specification.

Standard NMEA messages start the "message-ID" with:

`$<TalkerID>`

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

8.2.2 Proprietary messages

The STMicroelectronics GNSS Teseo Module can provide additional messages with more detailed data content. This is required to transmit GNSS 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 ST NMEA messages specification.

9 Low power modes

The Low Power Management library implements different modes including the functionalities below:

- Adaptive Low Power mode:
  - Change the constellation used by the system (dynamic constellation switch)
  - Update the number of GPS satellites used (active channel management)
- Cyclic Low Power mode:
  - Change the duty cycle of every channel
- Active and Standby Periodic Low Power mode:
  - Report a fix at a given periodicity
  - Autonomous periodic ephemeris refresh
  - RTC calibration capability
  - Optional use of STAGPS\xaa (Standby mode only)
  - Different hardware power state between fixes are possible
- Fix on demand Low Power mode (Standby mode only):
  - Report a fix on demand triggered by a hardware pin
  - Autonomous periodic ephemeris refresh
  - RTC calibration capability

Adaptive and cyclic modes can be mixed together. They are designed to save power while limiting the degradation of the sensitivity and accuracy. List of satellites and reception duration can be adjusted as long as the estimated error is above a threshold.

Adaptive and Cyclic modes cannot be mixed with the Periodic mode.

The periodic mode saves power when a fix is needed more than every 5 seconds and when accuracy degradation is acceptable. Two cases are depicted, corresponding to different hardware states between the fix activities. There is the active case and the standby case (maximum power saving). The usage of ST-AGNSS feature allows to reduce the energy spent in the ephemeris refresh periods.

The choice between the different modes is driven by the required fix periodicity.

Table 14. Suggested power mode against the fix periodicity

Fix periodicity	Appropriate mode
0.1 s-1 s	None
1 s-10 s	Adaptive and Cyclic modes
5 s-24 H	Standby Periodic mode + optional ST-AGNSS
Asynchronous	Fix On Demand

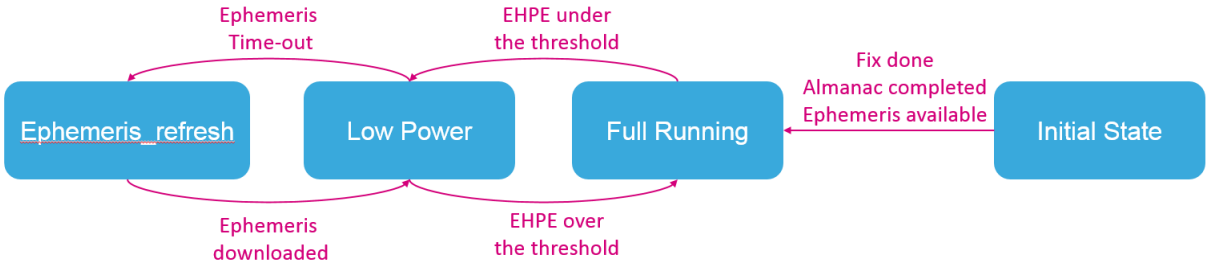
9.1 Adaptive and Cyclic mode state diagram

The library, using the Estimated Horizontal Position Error (EHPE), implements a dynamic constellation switch, in this way the device is able to optimize the usage of multi-constellation satellites allowing the customer to select the proper compromise between accuracy performance and power consumption.

EHPE is a measure of the error in a GNSS position on the horizontal plane. This value can be monitored in the NMEA sentences **$GPGST**.

Figure 17 is the algorithm's state diagram.

Figure 17. **Adaptive and Cyclic mode state diagram**



The Adaptive and Cyclic Low Power algorithm is scheduled every second.

Initial state is achieved only after the steady state is reached. The steady state in GNSS mode is a particular condition in which the software turns off the acquisition engine.

This condition is reached when all the following conditions are true:

- The system is in Position Accurate condition (position fix available)
- Ephemeris available (4 for GPS, 4 for GLONASS)
- Almanac completely downloaded

Generally at first start up (Full Cold Mode) this condition, in full sky is reached in 12.5 minutes.

Diagram explanations in the table below:

Table 15. **Adaptive and Cyclic finite state machine descriptions**

State	Description	Next State
INITIAL_STATE		FULL_CONST only when all the three conditions are taken: • position fix available • almanac completely downloaded • ephemeris available (4 for GPS, 4 for GLONASS);
FULL_CONST	• All the GNSS constellations enabled in the firmware-configuration are active during the runtime • System fully running.	LOW_POWER_STATE only if EHPE average is less than EHPE threshold (good sky condition)
LOW_POWER	• Only one GNSS constellation is enabled available (Adaptive constellation ON/OFF) • Only the first N GPS/GLONASS satellites (with higher elevation) are used for the position calculation (Adaptive tracked satellites) • Duty cycle for every channels enabled and Base-Band enabled (if configured) • Turn-on the ephemeris-refresh timer	FULL_CONST only if EHPE average is greater than EHPE threshold (bad sky condition) EPHEMERIS_REFRESH only if the ephemeris-refresh timeout fires (30 minutes timeout)
EPHEMERIS_REFRESH	• Turn on all constellation to download the updated ephemeris-data	LOW_POWER_STATE only when the ephemeris are downloaded

The Adaptive low power management can operate even in the case in which the constellation enabled is GPS only and GLONASS only. In this case, the low power state only consists in reducing the GPS/GLONASS used satellites.

Table 16. **Adaptive low power mode**

	Low power mode	Features
1	Dynamic Constellation ON/OFF	Constellation switch (GPS only enabled) based on estimated EHPE / Duty Cycle enable / ephemeris refresh / ability to reduce the tracked satellites (better elevation) / ability to disable the duty cycle based on estimated EHPE

	Low power mode	Features
2	Dynamic Constellation ON/OFF (standard mode)	Constellation switch (GPS only enabled) based on estimated EHPE / ephemeris refresh / ability to reduce the tracked satellites (better elevation)
3	Only Duty Cycle mode	Duty Cycle enable / ephemeris refresh / ability to disable the duty cycle based on estimated EHPE
4	Duty Cycle mode with reduced satellites (better elevation)	Duty Cycle enable / ephemeris refresh / ability to disable the duty cycle based on estimated EHPE / ability to reduce the tracked satellites

9.2 Periodic mode

The periodic mode has different settings to control the FIX reporting, and other settings to control the low power hardware state.

The periodic mode can have two different hardware states between FIX activities:

- Wait For Interrupt state used in Active Periodic mode, where the system clock is set to the RING oscillator (a low power oscillator)
- Standby state used in Standby Periodic mode, where only Always ON domain is alive

Although the Wait For Interrupt hardware state ensure continuity of software execution and maintain data, the Standby hardware state is a reset and ARM Core state and on-board memories except backup RAM are lost.

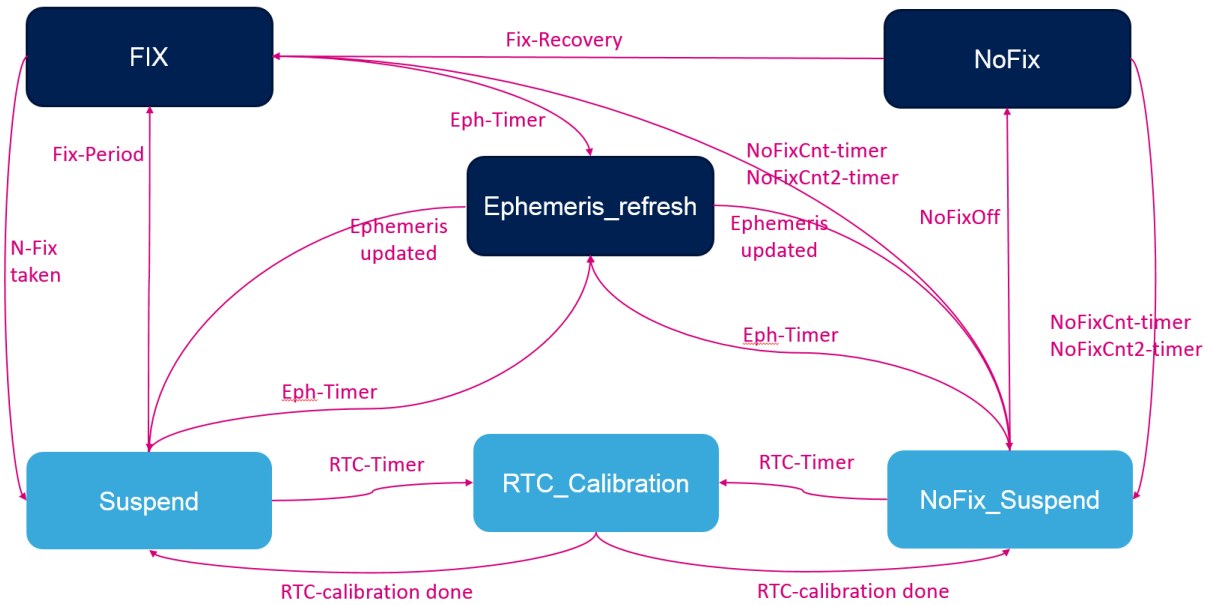
9.2.1 State machine

The periodic mode has basically two parts in its state machine – one to handle the fix (left) and one to handle the case of no fix (right). The transition between both in case of fix loss or recovery is done according to the steady state condition. The steady state is the combination of the following information:

- The system is in Position Accurate condition (position fix available)
- Ephemeris available (5 each activated constellations)
- Almanac, Ephemeris or Health information collected for all satellites

Generally, at first start up (Full Cold Mode) this condition, in full sky is reached in 12.5 minutes for GPS constellation.

Figure 18. Low power periodic mode State Diagram



Here are details about the different states in the following table.

Table 17. Periodic Standby Finite States description

State	Description	Next State
SUSPEND	GNSS system sleeping. CPU in idle. System running at low frequency. Three timers running: • FixPeriod timer • EphRefresh timer • RTC_clb timer	FIX when FixPeriod timer fires
		EPH_REFRESH when EphRefresh timer fires (32 minutes timer)
		RTC_CALIB when RTC_clb timer fires (5 minutes timer)
FIX	GNSS system running to acquire a series of N fixes. CPU running Three timers running: • NoFixCnt timer • NoFixCnt2 timer • EphRefresh timer	SUSPEND when the N fixes are acquired
		NOFIX_SUS when the N fixes serie can not be completed and NoFixCnt timers fire (in HOT conditions)
		NOFIX_SUS when the N fixes serie can not be completed and NoFixCnt2 timer fire (in NOT-HOT conditions)
		EPH_REFRESH when EphRefresh timer fires (32 minutes timer)
EPH_REFRESH	GNSS system running for 40/60s to download new ephemeris. CPU running Two timers running: • NoFixCnt timer • NoFixCnt2 timer	SUSPEND when ephemeris download completes
		NOFIX_SUS when ephemeris download doesn't complete and NoFixCnt timers fire (in HOT conditions)
		NOFIX_SUS when ephemeris download doesn't complete and NoFixCnt2 timer fire (in NOT-HOT conditions)
NOFIX_SUS	GNSS system sleeping due to No satellites signal or no fix acquired CPU in idle. System running at low frequency. Three timers running: • EphRefresh timer • NoFixCnt timer • NoFixCnt2 timer	EPH_REFRESH when EphRefresh timer fires (32 minutes timer)
		NOFIX when NoFixCnt timer fires (in HOT conditions)
		NOFIX when NoFixCnt2 timer fires (in NOT-HOT conditions)
NOFIX	GNSS system running but unable to acquire a fix. Two timers running: • NoFixCnt timer • NoFixCnt2 timer	FIX if a fix is acquired
		NOFIX_SUS when fix is not acquired and NoFixCnt timer fires (in HOT conditions)
		NOFIX_SUS when fix is not acquired and NoFixCnt2 timer fires (in NOT-HOT conditions)
RTC Calibration	GNSS system sleeping. CPU running for rtc_calibration; calibration is performed at higher frequency settings	SUSPEND when calibration completes

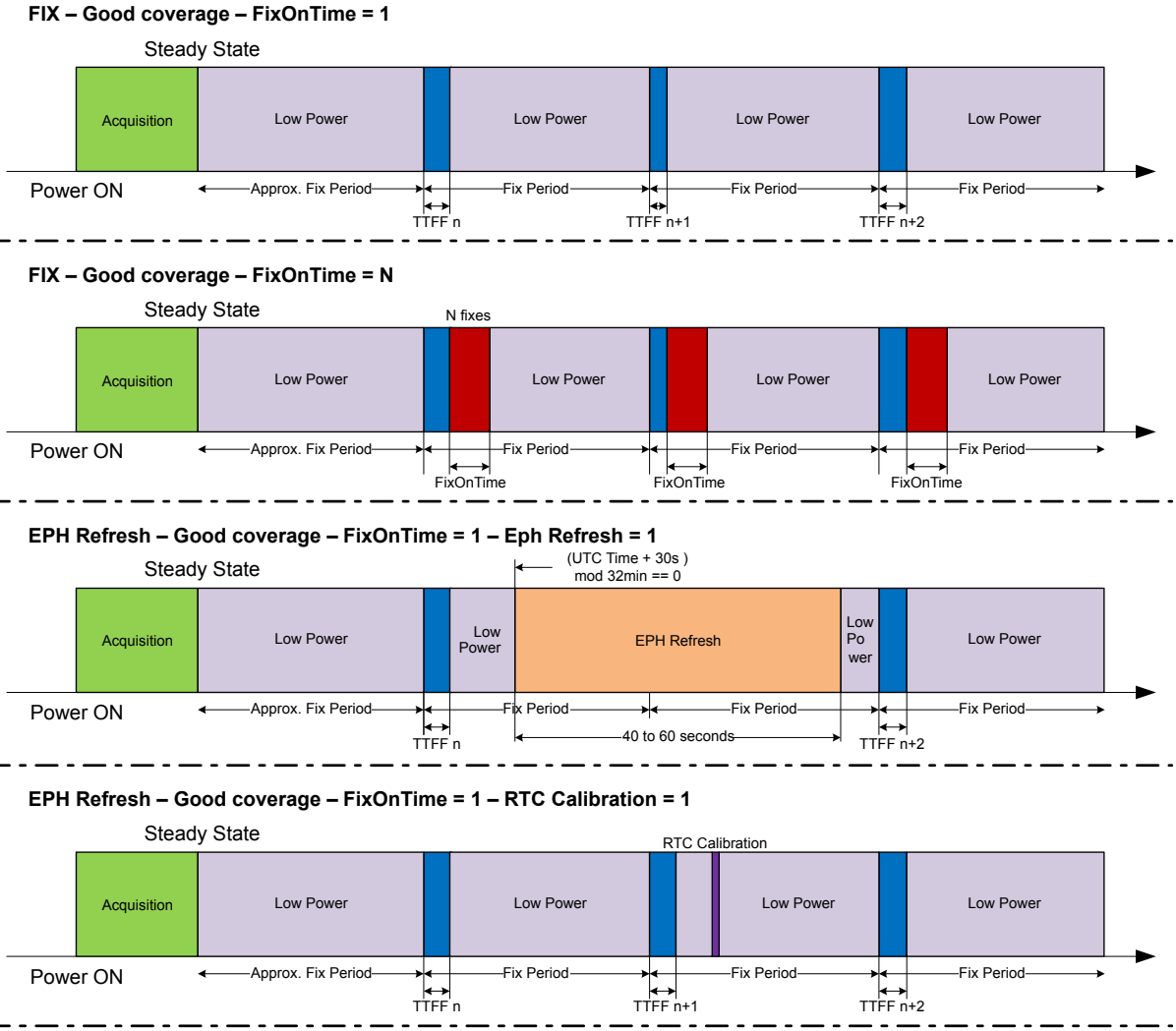
The two states concerned by the low power hardware states are SUSPEND and NOFIX_SUS. The RTC Calibration state occurs while the GNSS Lib is suspended, but it is executed anyway at high frequency (48f0 or 192f0 according to frequency settings).

NoFixCnt is used in HOT conditions (Number of ephemeris and RTC are OK), while NoFixCnt2 is used in non-HOT conditions (start-up cases, obsolete ephemeris\xc9). Their values are related to the expected sensitivity supported by the platform in bad RF conditions. Lower values give worst sensitivity.

The EPH_REFRESH state aims at downloading ephemeris and almanacs before they become obsolete to ensure a certain level of fix accuracy. It is done approximately every 30 minutes, during 40 to 60 seconds. When the STAGPS\xaa feature is set and the GNSS Teseo has downloaded an ephemeris for each satellite of the constellation, the STAGPS\xaa ephemeris predictions can replace real ephemeris and the ephemeris refresh interval is extended to about 10 hours and lasts 66 seconds.

9.2.2 Good GNSS coverage sequences

Figure 19. Gnss good coverage sequences



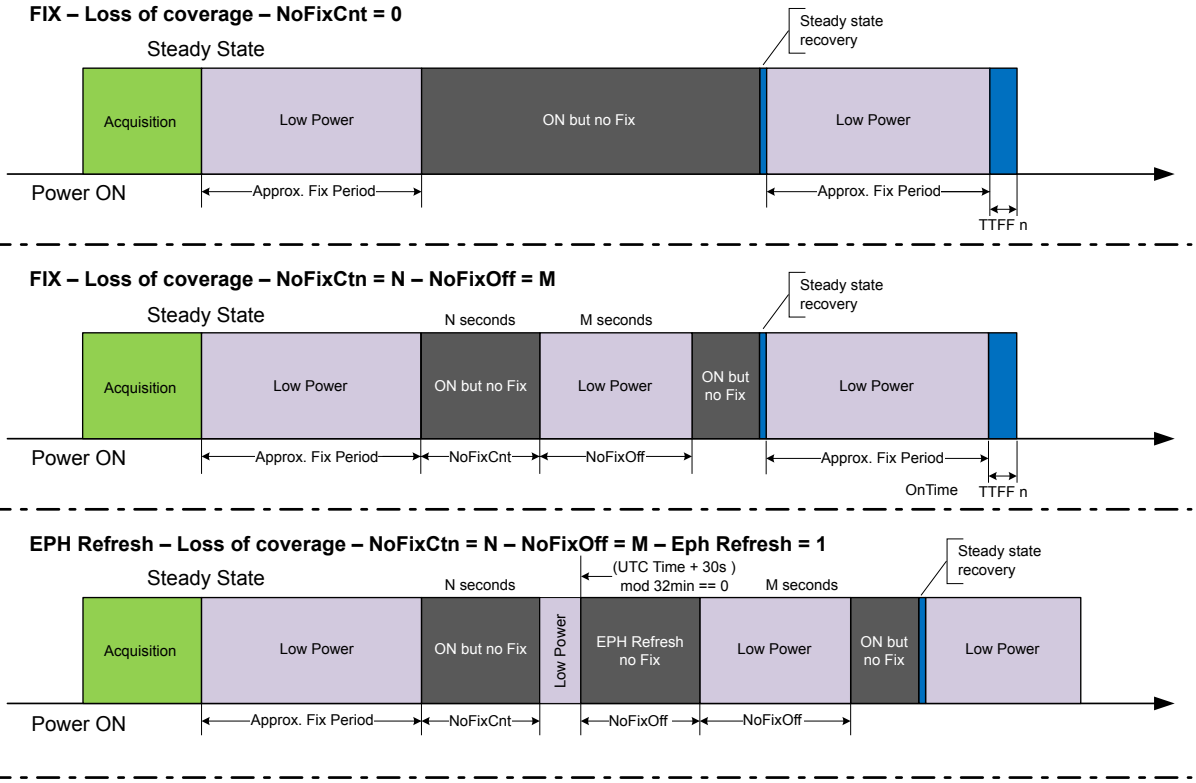
All sequences begin with an acquisition phase where all visible satellite ephemeris and almanacs are downloaded. The position of the first fix after the first Low Power period is approximate, but all the next periods are regularly placed every "Fix Period".

Sequence 3: Example of an ephemeris download period among the fixes.

Sequence 4: Example of the RTC calibration among the fixes.

9.2.3 Poor GNSS coverage sequences

Figure 20. **GNSS poor coverage sequences**



In all sequences, the acquisition phase is ok and all ephemeris and almanacs are downloaded. The steady state is entered, but a loss of coverage occurs during the Low Power period.

Sequence 1: NoFixCnt = 0 means we don't alternate fix activities and low power periods. On the GNSS activation, the loss of coverage is detected and the GNSS will remain active until the recovery of the fix.

Sequence 2: As NoFixCnt is different from 0, the GNSS solution will remain active during N seconds and go back to low power state during M seconds. It will alternate this way until the fix is recovered.

Sequence 3: Despite the loss of coverage, the GNSS solution will try to decode the satellites when the ephemeris refresh activity is due. Instead of lasting 40 to 60s, the trial period will be only N seconds.

10 Commands

ST NMEA proprietary command can modify the internal Teseo Module status, 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 the previous values after system reset or system power cycling.

10.1 Software command list

The Table 18 summarizes all the commands supported by the ST NMEA layer.

Table 18. NMEA command list

Syntax	Description
GNSS management commands	
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITTIME	Initialize time only
$PSTMINITFRQ	Initialize center 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
$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
$PSTMGETSWVER	Provide the GPS library version string
$PSTMSBASONOFF	Enable/Disable the SBAS activity
$PSTMSBASSERVICE	Set the SBAS service
$PSTMSBASSAT	Set the SBAS satellite's ID
$PSTMSBASM	Send a SBAS frame
$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
$PSTMDATUMSELECT	Set a geodetic local datum different from WGS84

Syntax	Description
$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
$PSTMLOWPOWERONOFF	Allow setting the low power algorithm parameters at run-time
$PSTMNMEAREQUEST	Send a set of NMEA messages according to the input message list as specified in the FW Configuration document
$PSTMFORCESTANDBY	Force the platform to go in standby mode
$PSTMIONOPARAMS	Uploads a specific iono packet into the Teseo NVM
$PSTMGALILEOGGTO	This command programs the Galileo broadcast GGTO
$PSTMGALILEODUMPGGTO	This command dumps the broadcast GGTO
$PSTMSETTHTRK	Configures the CN0 and Angle Elevation Mask thresholds for tracking
$PSTMSETTHPOS	Configures the CN0 and Angle Elevation Mask thresholds for positioning
Configuration commands	
$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)
$PSTMCFGPORT	Char Port Configuration
$PSTMCFGMSGL	Message List Configuration
$PSTMCFGGNSS	GNSS Algorithm Configuration
$PSTMCFGSBAS	SBAS Algorithm Configuration
$PSTMCFGPPSGEN	PPS General Configuration
$PSTMCFGPPSSAT	PPS Satellite Related Configuration
$PSTMCFGPPSPUL	PPS Pulse Related Configuration
$PSTMCFGPOSHOLD	Configure the Position hold
$PSTMCFGTRAIM	Traim Configuration
$PSTMCFGSATCOMP	Configure the PPS with general settings
$PSTMCFGLPA	Configure the Low Power Algorithm
$PSTMCFGAGPS	Assisted GNSS Configuration
$PSTMCFGAJM	Anti-Jamming Configuration
$PSTMCFGODO	Odometer Configuration
$PSTMCFGLOG	Logger Configuration
$PSTMCFGGEOFENCE	Geofencing Configuration
$PSTMCFGGEOCIR	Geofencing Circle Configuration
$PSTMCFGCONST	Allow enable/disable all the GNSS constellations
Datalogging commands	
$PSTMLOGCREATE	Creates and enable a new data log
$PSTMLOGSTART	Starts or restarts the current the data logging
$PSTMLOGSTOP	Stops the data logging

Syntax	Description
$PSTMLOGERASE	Erases the data log
$PSTMLOGREQSTATUS	To get information about the datalog subsystem
$PSTMLOGREQQUERY	Triggers a query request to the ST GNSS Teseo
Geofence Commands	
$PSTMGEOFENCECFG	Configures the Geofence subsystem
$PSTMGEOFENCEREQ	To know internal Geofence subsystem status
Odomenter commands	
$PSTMODOSTART	Enables and resets the Odometer subsystem
$PSTMODOSTOP	Stops the Odometer subsystem
$PSTMODORESET	Resets the Odometer subsystem
Autonomous AGNSS	
$PSTMSTAGPSONOFF	The command turns ON/OFF the STAGPS\xaa engine
$PSTMSTAGPSINVALIDATE	The command clears data stored in the STAGPS\xaa internal database
$PSTMGETAGPSSTATUS	The command returns the status of the STAGPS\xaa internal processing
$PSTMSTAGPSSETCONSTMASK	The command sets the ST-AGNSS constellation mask
Predictive AGNSS commands	
$PSTMSTAGPSSEEDBEGIN	The PGPS seed first block is sent via NMEA, for each constellation
$PSTMSTAGPSBLKTYPE	Send the list of all block types (in satellite number order) for the current constellation
$PSTMSTAGPSSLOTFRQ	Send the list of all slot frequency channels (in satellite slot number order) for the GLONASS constellation
$PSTMSTAGPSSEEDPKT	Send the PGPS seed via NMEA divided in separate packets
$PSTMSTAGPSSEEDPROP	Start the propagation of the seed
Real Time AGNSS commands	
$PSTMSTAGPS8PASSGEN	Request the generation of a password to access the Real-Time AGPS server to the device

Caution: 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.

10.2 ST NMEA command specification

10.2.1 $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.

Synopsis:

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

Arguments:

Table 19. $PSTMINITGPS field description

Parameter	Format	Description
Lat	DDMM.MMM	Latitude (Degree-Minute.Minute decimals)

Parameter	Format	Description
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 - \xc9)
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
- In case of no errors, the $PSTMINITGPSOK message is returned
- In case of errors, the error message $PSTMINITGPSERROR is returned

Example:

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

10.2.2 $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.

Synopsis:

```
$PSTMINITTIME,<Day>,<Month>,<Year>,<Hour>,<Minute>,<Second>*<checksum><cr><lf>
```

Arguments:

Table 20. $PSTMINITTIME field description

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 - \xc9)
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
- In case of no errors, the $PSTMINITTIMEOK message is returned
- In case of errors, the error message $PSTMINITTIMEERROR is returned

Example:

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

10.2.3 $PSTMINITFRQ

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

Synopsis:

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

Arguments:

Table 21. $PSTMINITFRQ field description

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

Results:

- The center frequency will be initialized

Example:

```
$PSTMINITFRQ,-47000*<checksum><cr><lf>
```

10.2.4 $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>*<checksum><cr><lf>
```

Arguments:

Table 22. $PSTMSETRANGE field description

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

Results:

- In case of no errors, the $PSTMSETRANGEOK message is returned
- In case of errors, the error message $PSTMSETRANGEERROR is returned

Example:

```
$PSTMSETRANGE,-57000,-37000*<checksum><cr><lf>
```

10.2.5 $PSTMCLREPHS

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

Synopsis:

```
$PSTMCLREPHS*<checksum><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 a reply.

Example:

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

10.2.6 $PSTMDUMPEPHEMS

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

Synopsis:

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

Arguments:

None.

Results:

- GNSS replies with the $PSTMEPHEM messages

Example:

```
$PSTMDUMPEPHEMS
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400fbff33420000ee632f27698ef
001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ffcaff1937000033515726556ba
9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00b8ffd037000020b84e26b5138
b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff6c00f72e00005131d827592b9
50a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

10.2.7 $PSTMEPHEM

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

If more than one $PSTMEPHEM command needs to be issued, between two consecutive commands there must be at least a 20 ms delay.

Synopsis:

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

Arguments:

Table 23. $PSTMEPHEM field description

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

The N Bytes that are in the parameters are the dump of structures that contain all the information of the ephemeris.

Data format is constellation dependent.

Table 24. $PSTMEPHEM field description for GPS constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch

Bits	Structure Member	Description
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

Table 25. $PSTMEPHEM field description for GLONASS constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch
4	toe_lsb	Time of week for ephemeris epoch (LBS)
11	NA	Calendar day number within the four-year period since the beginning of last leap year (almanac)

Bits	Structure Member	Description
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\xc9 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

Bits	Structure Member	Description
1	RESERVED	Must be 0
4	RESERVED	

Table 26. $PSTMEPHEM field description for Galileo constellation

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

Bits	Structure Member	Description
31	af0	Constant clock correction
1	RESERVED	
6	RESERVED	Must be 0
26	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	Must be 0

Table 27. $PSTMEPHEM field description for BEIDOU constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity
32	root_a	Square root of major axis
32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension.
8	A0	Ionospheric Delay Model Parameter 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

Bits	Structure Member	Description
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.
- In case of no errors, the $STMEPHEMOK message is returned.
- In case of errors, the error message $PSTMEPHEMERROR is returned.

Example:

```
$PSTMEPHEM,12,64,0f06bc34bc3437373790f40045a7ff00fcf5d522480b4bf71b00fbff8931000096126f271f869101c3870ca107afce79a763e13e360a1ce8e7003100380ff903*36
```

10.2.8 $PSTMCLRALMS

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

10.2.9 $PSTMDUMPALMANAC

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

Synopsis:

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

Arguments:

None.

Results:

- GNSS replies with the $PSTMALMANAC messages

Example:

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

10.2.10 $PSTMALMANAC

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

If more than one $PSTMALMANAC command needs to be issued, between two consecutive commands there must be at least a 20 ms delay.

Synopsis:

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

Arguments:

Table 28. $PSTMALMANAC field description

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 structure that contains all the information of the almanac.

Data format is constellation dependent.

Table 29. $PSTMALMANAC field description for GPS constellation

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.

Bits	Structure Member	Description
1	available	Contains 1 if almanac is available 0 if not.

Table 30. $PSTMALMANAC field description for GLONASS constellation

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\xc9 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	

Table 31. $PSTMALMANAC field description for Galileo constellation

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.

Bits	Structure Member	Description
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 be stored into backup memory.
- In case of no errors, the $PSTMALMANACOK message is returned.
- In case of errors, the error message $PSTMALMANACERROR is returned.

Example:

```
$PSTMALMANAC,12,32,0c1a06907c1a971160fd0800fa0da141ae9f0600d912e90075669700490f8000*75
```

10.2.11 $PSTMCOLD

Perform a COLD start.

Synopsis:

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

Arguments:

Table 32. $PSTMCOLD field description

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(1).
- 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).

1. *The GPS engine will be reset. It is not a system reboot.*

Example:

```
$PSTMCOLD,6
```

10.2.12 $PSTMWARM

Perform a WARM start.

Synopsis:

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

Arguments:

None.

Results:

- Warm start initialization and system restart(1).

1. *The GPS engine will be reset. It is not a system reboot.*

Example:

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

10.2.13 $PSTMHOT

Perform a HOT start.

Synopsis:

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

Arguments:

None.

Results:

- The system restarts(1).

1. *The GPS engine will be reset. It is not a system reboot.*

Example:

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

10.2.14 $PSTMSRR

Executes a system reset. The GNSS firmware is rebooted.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

10.2.15 $PSTMGPSRESET

Reset the GNSS Teseo engine.

Synopsis:

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

Arguments:
None.
Results:
- The GNSS Teseo engine will be reset
- No message will be sent as a reply

Note: Using this command the GNSS module won't reboot.

Example:

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

10.2.16 $PSTMGPSSUSPEND

Suspend the GNSS Teseo engine.
Synopsis:

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

Arguments:
None.
Results:
- The $PSTMGPSSUSPENDED message will be sent when GNSS Teseo Module engine is suspended

Example:

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

10.2.17 $PSTMGPSRESTART

Restart the GNSS Teseo engine.
Synopsis:

```
PSTMGPSRESTART*<checksum><cr><lf>
```

Arguments:
None.
Results:
- The GNSS Teseo engine will be restarted
- No message will be sent as a reply

Example:

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

10.2.18 $PSTMGNSSINV

Invalidate the GNSS Fix Status.
Synopsis:

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

Arguments:

Table 33. **$PSTMGNSSINV field description**

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*<checksum><cr><lf>
```

10.2.19 $PSTMTIMEINV

Invalidate the Real Time Clock (RTC).

Synopsis:

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

Arguments:

None.

Results:

- The RTC time will be invalidated.

Example:

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

10.2.20 $PSTMGETSWVER

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

Synopsis:

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

Arguments:

Table 34. **$PSTMGETSWVER field description**

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 6 = Binary Image Version 7 = STA8088 HW version 11 = SW configuration ID 12 = Product ID 254 = configuration data block 255 = all versions strings (as reported at the NMEA startup).

Results:

- GNSS replies with $PSTMVER message

10.2.21 $PSTMSBASONOFF

Suspend / resume the SBAS software execution.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

10.2.22 $PSTMSBASSERVICE

Change the SBAS service.

Synopsis:

```
$PSTMSBASSERVICE,<service>*<checksum><cr><lf>
```

Arguments:

Table 35. $PSTMBASSERVICE field description

Parameter	Format	Description
service	Integer	SBAS service 0 = WAAS 1 = EGNOS 2 = MSAS 3 = GAGAN 4 = SDCM 7 = OFF 15 = AUTO

Results:

- The SBAS engine will put in tracker all the satellites which correspond to the specified service.
- With SBAS service OFF, no satellites are put in tracker. In that case, SBAS frames are to be provided to the SBAS engine through the $PSTMSBASM command
- With SBAS AUTO, the SBAS engines automatically selects the appropriate SBAS service based on the computed user position latitude and longitude.
- In case of no errors, the $PSTMSBASSERVICEOK message is returned
- In case of errors, the error message $PSTMSBASSERVICEERROR is returned

Example:

```
$PSTMSBASSERVICE,15*<checksum><cr><lf>
```

10.2.23 $PSTMSBASSAT

Change the SBAS satellite.

Synopsis:

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

Arguments:

Table 36. $PSTMSBASSAT field description

Parameter	Format	Description
prn	Decimal, 3 digit	Satellite PRN (Range: from 120 to 140)

Results:

- Kept for compatibility. Set SBAS service AUTO
- The preferred NMEA command is $PSTMSBASSERVICE

Example:

```
$PSTMSBASSAT,120*<checksum><cr><lf>
```

10.2.24 $PSTMSBASM

Send a SBAS frame to the SBAS engine.

Synopsis:

```
$PSTMSBASM,<prn><sbas_frame>*<checksum><cr><lf>
```

Arguments:

Table 37. $PSTMSBASM field description

Parameter	Format	Description
prn	Decimal, 3 digits	Satellite PRN (Range: from 120 to 140)
sbas_frame	Hexadecimal, 64 digits	SBAS frame (250 bits + 6 padding)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Results:

- Sends the SBAS frame to the SBAS engine.
- The SBAS service has to be set to OFF before sending SBAS frames so that no SBAS satellites are put in tracking.
- In case of no errors, the $PSTMSBASMOK message is returned
- In case of errors, the error message $PSTMSBASMERROR is returned

Example:

```
$PSTMSBASM,123,536A481B40D8063829C12E08704B82DFFDFFEFFF7FFBFFDFFEF06E8037EFB440*6D
```

10.2.25 $PSTMRFTESTON

Enable the RF test mode for production line tests.

Synopsis:

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

Arguments:

Table 38. **$PSTMRFTESTON field description**

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 to acquire the 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*<checksum><cr><lf>
```

10.2.26 $PSTMRFTESTOFF

Disable the RF test mode for production line tests.

Synopsis:

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

Arguments:

None.

Results:

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

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

Example:

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

10.2.27 $PSTMGETALGO

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

Synopsis:

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

Arguments:

Table 39. **$PSTMGETALGO field description**

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

Results:

- In case of no errors, the $PSTMGETALGOOK message is returned
- In case of errors, the error message $PSTMGETALGOERROR is returned

Example:

```
$PSTMGETALGO,1*<checksum><cr><lf>
```

10.2.28 $PSTMSETALGO

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

Synopsis:

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

Arguments:

Table 40. $PSTMSETALGO field description

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:

- In case of no errors, the $PSTMSETALGOOK message is returned
- In case of errors, the error message $PSTMSETALGOERROR is returned

Example:

```
$PSTMSETALGO,1,0*<checksum><cr><lf>
```

10.2.29 $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

- System will send $PSTMGETRTCTIME message

Example:

```
$PSTMGETRTCTIME
```

10.2.30 $PSTMDATUMSELECT

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

Synopsis:

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

Arguments:

Table 41. $PSTMDATUMSELECT field description

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

Results:

- In case of no errors, the $PSTMDATUMSELECTOK message is returned
- In case of errors, the error message $PSTMDATUMSELECTERROR is returned

Example:

```
$PSTMSELETDATUM,1*<checksum><cr><lf>
```

10.2.31 $PSTMDATUMSETPARAM

Set parameters to local geodetic to WGS84 datum transformations.

Synopsis:

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

Arguments:

Table 42. $PSTMDATUMSETPARAM field description

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:

- In case of no errors, the $PSTMDATUMSETPARAMOK message is returned
- In case of errors, the error message $PSTMDATUMSETPARAMERROR is returned

Example:

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

10.2.32 $PSTMENABLEPOSITIONHOLD

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

Synopsis:

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

Arguments:

Table 43. $PSTMENABLEPOSITIONHOLD field description

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(1)	dddddd.dddd	Altitude in meters (-1500 to 100000)

1. *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.*

Results:

- In case of no errors, and position hold is enabled the $PSTMPOSITIONHOLDENABLED message is returned
- In case of no errors, and position hold is disabled the $PSTMPOSITIONHOLDDISABLED message is returned
- In case of error the error message $PSTMENABLEPOSITIONHOLDERROR is sent

Example:

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

10.2.33 $PSTMSETCONSTMASK

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

Synopsis:

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

Arguments:

Table 44. $PSTMSETCONSTMASK field description

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:

- In case of no errors, the $PSTMSETCONSTMASKOK message is returned
- In case of errors, the error message $PSTMSETCONSTMASKERROR is returned

Examples:

Enabling GPS only:

```
$PSTMSETCONSTMASK,1*<checksum><cr><lf>
```

Enabling GLONASS only:

```
$PSTMSETCONSTMASK,2*<checksum><cr><lf>
```

Enabling GPS and GLONASS:

```
$PSTMSETCONSTMASK,3*<checksum><cr><lf>
```

10.2.34 $PSTMNOTCH

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

Synopsis:

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

Arguments:

Table 45. $PSTMNOTCH field description

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 default
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>*<checksum><cr><lf>`

Enhanced configuration (3 parameters):

`$PSTMNOTCH,<sat_type>,<mode>,<frequency>*<checksum><cr><lf>`

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*<checksum><cr><lf>`

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 unpredictable behaviours.

Results:

- This command sets 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
```

10.2.35 $PSTMPPS

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

Synopsis:

```
$PSTMPPS,<cmd_mode>,<cmd_type>,<par_1>,...,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 46. $PSTMPPS field description

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

Parameter	Format	Description
		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 \xc9 par_N		Parameters list according to the command type specification (see below).

10.2.35.1 *PPS Get PPS_IF_PULSE_DATA_CMD*

Synopsis:

```
$PSTMPPS,1,7
```

10.2.35.2 *PPS Get PPS_IF_TIMING_DATA_CMD*

Synopsis:

```
$PSTMPPS,1,12
```

10.2.35.3 *PPS Get PPS_IF_POSITION_HOLD_DATA_CMD*

Synopsis:

```
$PSTMPPS,1,13
```

10.2.35.4 *PPS Get PPS_IF_TRAIM_CMD*

Synopsis:

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

10.2.35.5 *PPS Get PPS_IF_TRAIM_USED_CMD*

Synopsis:

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

10.2.35.6 *PPS Get PPS_IF_TRAIM_RES_CMD*

Synopsis:

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

10.2.35.7 *PPS Get PPS_IF_TRAIM_REMOVED_CMD*

Synopsis:

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

10.2.35.8 *PPS Set PPS_IF_ON_OFF_CMD*

Synopsis:

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

Arguments:

Table 47. **$PSTMPPS field description on PPS_IF_ON_OFF_CMD**

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

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.

10.2.35.9 *PPS Set PPS_IF_OUT_MODE_CMD*

Synopsis:

```
$PSTMPPS,2,2,<out_mode>*<checksum><cr><lf>
```

Arguments:

Table 48. **$PSTMPPS field description on PPS_IF_OUT_MODE_CMD**

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated. 1 = PPS generated on even seconds. 2 = PPS generated on odd seconds.

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.

10.2.35.10 *PPS Set PPS_IF_REFERENCE_TIME_CMD*

Synopsis:

```
$PSTMPPS,2,19,<reference_time>*<checksum><cr><lf>
```

Arguments:

Table 49. **$PSTMPPS field description on PPS_IF_REFERENCE_TIME_CMD**

Parameters	Format	Description
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC 3 = UTC_SU(1) 4 = GPS_UTC_FROM_GLONASS(2) 5 =BEIDOU_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST

1. *UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.*
2. *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.*

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.

10.2.35.11 *PPS Set PPS_IF_PULSE_DELAY_CMD*

Synopsis:

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

Arguments:

Table 50. $PSTMPPS field description on PPS_IF_PULSE_DELAY_CMD

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay [ns]

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.

10.2.35.12 *PPS Set PPS_IF_CONSTELLATION_RF_DELAY_CMD*

Synopsis:

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

Arguments:

Table 51. $PSTMPPS field description on PPS_IF_CONSTELLATION_RF_DELAY_CMD

Parameter	Format	Description
sat_type	Decimal	Satellite constellation type: 0 = GPS 1 = GLONASS 3 = Galileo 7 = BEIDOU
time_delay	Decimal	Time delay [ns]

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.

10.2.35.13 *PPS Set PPS_IF_PULSE_DURATION_CMD*

Synopsis:

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

Arguments:

Table 52. $PSTMPPS field description on PPS_IF_PULSE_DURATION_CMD

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]

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.

10.2.35.14 *PPS Set PPS_IF_PULSE_POLARITY_CMD*

Synopsis:

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

Arguments:

Table 53. $PSTMPPS field description on PPS_IF_PULSE_POLAROTY_CMD

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

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.

10.2.35.15 *PPS Set PPS_IF_PULSE_DATA_CMD*

Synopsis:

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

Arguments:

Table 54. $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD

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(1) 4 = GPS_UTC_FROM_GLONASS(2) 5 = BEIDOU_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = not inverted. 1 = inverted.

1. *UTC(SU) is the Soviet Union UTC. It is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.*

2. *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.*

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.

10.2.35.16 *PPS Set PPS_IF_FIX_CONDITION_CMD*

Synopsis:

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

Arguments:

Table 55. $PSTMPPS field description on PPS_IF_FIX_CONDITION_CMD

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

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.

10.2.35.17 *PPS Set PPS_IF_SAT_TRHESHOLD_CMD*

Synopsis:

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

Arguments:

Table 56. $PSTMPPS field description on PPS_IF_SAT_TRHESHOLD_CMD

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

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.

10.2.35.18 *PPS Set PPS_IF_ELEVATION_MASK_CMD*

Synopsis:

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

Arguments:

Table 57. $PSTMPPS field description on PPS_IF_ELEVATION_MASK_CMD

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

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.

10.2.35.19 *PPS Set PPS_IF_CONSTELLATION_MASK_CMD*

Synopsis:

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

Arguments:

Table 58. $PSTMPPS field description on PPS_IF_CONSTELLATION_MASK_CMD

Parameter	Format	Description
constellation_mask(1)	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS bit7 = BEIDOU

1. *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. Same description is valid also for GPS and Beidou constellations enabling/disabling bit0 and bit7.*

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.

10.2.35.20 *PPS Set PPS_IF_TIMING_DATA_CMD*

Synopsis:

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

Arguments:

Table 59. $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD

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 bit7 = BEIDOU
gps_rf_delay	Decimal	GPS path RF delay [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]

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.

10.2.35.21 PPS Set PPS_IF_POSITION_HOLD_DATA_CMD

Synopsis:

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

Arguments:

Table 60. $PSTMPPS field description on PPS_IF_POSITION_HOLD_DATA_CMD

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.

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.

10.2.35.22 PPS Set PPS_IF_AUTO_HOLD_SAMPLES_CMD

Synopsis:

```
$PSTMPPS,2,14,<auto_ph_samples>*<checksum><cr><lf>
```

Arguments:

Table 61. $PSTMPPS field description on PPS_IF_AUTO_HOLD_SAMPLES_CMD

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.

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.

10.2.35.23 PPS Set PPS_IF_TRAIM_CMD

Synopsis:

```
$PSTMPPS,2,15,<on_off>,<alarm>*<checksum><cr><lf>
```

Arguments:

Table 62. $PSTMPPS field description on PPS_IF_TRAIM_CMD

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

Parameter	Format	Description
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.

10.2.36 $PSTMLOWPOWERONOFF

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

Synopsis:

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

Synopsys to Disable Low Power mode:

```
$PSTMLOWPOWERONOFF,0,<constellation mask>*<checksum><cr><lf>
```

Synopsys to Enable Adaptive/Cycling Mode:

```
$PSTMLOWPOWERONOFF,1,<constellation mask>,<EHPE threshold>,<Max tracked sats>,<Switch constellation features >,<DutyCycle enable/disable>,<Duty Cycle fix period>,0,0,0,0,0,0,0*<checksum><cr><lf>
```

Synopsys to Enable Periodic Mode:

```
$PSTMLOWPOWERONOFF,1,0,0,0,0,0,0,<Periodic mode>, <Fixperiod>,<Number of fix>,<Ephemeris refresh>,<RTC refresh>,<No Fix timeout>,<No Fix timeout Off duration>*<checksum><cr><lf>
```

Arguments:

Table 63. $PSTMLOWPOWERONOFF field description

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, 3 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: GALILEO constellation enabling/disabling bit 7: BEIDOU 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	Enable/Disable the Cyclic mode

Parameter	Format	Description
		0: OFF, 1: ON This parameter can only be enabled if "Periodic mode" parameter is 0
Duty Cycle fix period	Decimal, 1 digits	Time between 2 fixes Typical value: 1, 3, 5 The receiver provide a fix every fix period
Periodic mode settings		
Periodic mode	Decimal, 1 digit	Setup Active or Standby periodic mode 0: OFF 3: Standby Periodic mode
FixPeriod	Decimal, 5 digits	Interval between two fixes [s]. 0 means no periodic fix is required.
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]. 0 means the counter is not active. The fix retry will be based on FixPeriod.

Results:

- In case of no errors, the $PSTMLOWPOWERON message is returned.
- In case of errors, the $PSTMLOWPOWERERROR error message is returned

10.2.37 $PSTMSTANDBYENABLE

When the Periodic mode is configured with $PSTMLOWPOWERONOFF, this command allows/disallows the Teseo to go in Standby mode between the fixes.

Synopsis:

```
$PSTMSTANDBYENABLE,<checksum><cr><lf>
```

Synopsis with Argument:

```
$PSTMSTANDBYENABLE,<on_off>*<checksum><cr><lf>
```

Arguments:

Table 64. $PSTMSTANDBYENABLE command field description

Parameter	Format	Description
Without parameter		Request the internal status
on_off	Decimal, 1 digits	Set the standby enable status 0: Active Periodic mode 1: Periodic mode, standby allowed

Result without parameter:

- The $PSTMSTANDBYENABLE message is sent back to report the internal status

Result with parameter:

- In case of no errors, the not found$PSTMSTANDBYENABLEOK message is returned

- In case of errors, the error message $PSTMSTANDBYENABLEERROR is returned

10.2.38 $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>*<checksum><cr><lf>
```

Arguments:

Table 65. $PSTMNMEAREQUEST field description

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.

10.2.39 $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>*<checksum><cr><lf>
```

Arguments:

Table 66. $PSTMFORCESTANDBY field description

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

Results:

- In case of no errors, the $PSTMFORCESTANDBYOK message is returned
- In case of errors, the error message $PSTMFORCESTANDBYERROR is returned

10.2.40 $PSTMIONOPARAMS

Uploads a specific iono packet into the Teseo 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: when sat_type = 0

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

Synopsis: when sat_type = 1

```
$PSTMIONOPARAMS,<sat_type=1>,1,<ai0>,<ai1>,<ai2>,<Region1>,<Region2>,<Region3>,<Region4>,<Reg
ion5>*<checksum><cr><lf>
```

Arguments:

Table 67. $PSTMIONOPARAMS field description

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

10.2.41 $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:

Table 68. $PSTMGALILEOGGTO field description

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

10.2.42 $PSTMGALILEODUMPGGTO

This command dumps the broadcast GGTO.

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

Synopsis:

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

Arguments:

No arguments.

Results:

- If the command is executed with $PSTMGALILEODUMPGGTO, message is sent

10.2.43 $PSTMSETTHTRK

Configures the CN0 and Angle Elevation Mask thresholds for tracking. This command changes these parameters at run-time and no reset is required. In case of reset tracking CN0 and Angle Elevation Mask are restored to default value.

Synopsis:

```
$PSTMSETTHTRK,<cn0>,<el>*<checksum><cr><lf>
```

Arguments:

Table 69. $PSTMCFGSETTHTRK field description

Parameter	Format	Description
cn0	Decimal	Tracking CN0 threshold as dB
el	Double	Tracking elevation mask angle as degree

Results:

- In case of no errors, the $PSTMSETTHTRKOK message is returned
- In case of errors, the error message $PSTMSETTHTRKERROR is returned

10.2.44 $PSTMSETTHPOS

Configures the CN0 and Angle Elevation Mask thresholds for positioning. This command changes these parameters at run-time and no reset is required. In case of reset positioning CN0 and Angle Elevation Mask are restored to default value.

Synopsis:

```
$PSTMSETTHPOS,<cn0>,<el>*<checksum><cr><lf>
```

Arguments:

Table 70. $PSTMCFGSETTHPOS field description

Parameter	Format	Description
cn0	Decimal	Positioning CN0 threshold as dB
el	Double	Positioning elevation mask angle as degree

Results:

- In case of no errors, the $PSTMSETTHPOSOK message is returned
- In case of errors, the error message $PSTMSETTHPOSERROR is returned

10.2.45 $PSTMGETUCODE

This command reads the unique code from the secondary boot flash memory partition.

Synopsis:

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

Arguments:

None

Results:

- In case of no error the $PSTMGETUCODEOK message is sent
- In case of error the $PSTMGETUCODEERROR message is sent

10.3 ST 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 stored (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 the 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 the 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 management 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.

10.3.1 $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>]*<checksum><cr><lf>
```

Arguments:

Table 71. $PSTMSETPAR field description

Parameter	Format	Description
ConfigBlock	Decimal,1 digit	Indicates one of the 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.

Parameter	Format	Description
		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:

- In case of no errors, the $PSTMSETPAROK message is returned
- In case of errors, the error message $PSTMSETPARERROR is returned

Example:

Issuing the command:

```
$PSTMSETPAR,1121,10*<checksum><cr><lf>
```

You could have this answer:

```
$PSTMSETPAROK,1121*<checksum><cr><lf>
```

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 the same syntax as for the "GET" command. The configuration block stored in NVM will be overwritten by the current configuration after the $PSTMSAVEPAR command.

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

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.

10.3.2 $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>*<checksum><cr><lf>
```

Arguments:

Table 72. $PSTMGETPAR field description

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, $PSTMSETPAR message is sent
- In case of errors, the error message $PSTMGETPARERROR is returned

Example:

Issuing the command:

```
$PSTMGETPAR,1403*<checksum><cr><lf>
```

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.

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

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.

10.3.3 $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

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

Arguments:

None.

Results:

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

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

Example:

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

10.3.4 $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*<checksum><cr><lf>
```

Arguments:

None.

Results:

- The factory setting parameters will be restored and the configuration block in the backup memory will be lost. A system reboot is needed to complete the factory reset restoring and to get system working with default setting.
- In case of no errors, the $PSTMRESTOREPAROK message is returned
- In case of errors, the error message $PSTMRESTOREPARERROR is returned

Example:

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

10.3.5 $PSTMCFGPORT

Configure a general-purpose port for NMEA purpose.

Synopsis:

```
$PSTMCFGPORT,<port_type>,<protocol_type>,<par_1>,<par_2>,\xc9 ,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 73. **$PSTMCFGPORT field description**

Parameter	Format	Description
port_type	Decimal, 1 Digit	Select the port type: 0 = UART 1 = I2C
protocol_type	Decimal, 1 Digit	Select the protocol type: 0 = NMEA
par_1 \xc9 par_N	Integer	Parameters list according to the command type Specification (see below).

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGPORTOK message is returned
- In case of errors, the error message $PSTMCFGPORTERROR is returned

10.3.6 $PSTMCFGPORT on UART

Arguments:

Table 74. **$PSTMCFGPORT field description when port_type is UART**

Parameter	Format	Description
portnumb	From 0 to 255	UART GPIO ID (Linearly addressed)
baudrate	Integer	The port baud rate. Allowed values are: 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400, 57600, 115200, 230400, 460800, 921600

10.3.7 $PSTMCFGPORT on I^2C

Arguments:

Table 75. **$PSTMCFGPORT field description when port_type is I^2C**

Parameter	Format	Description
slaveaddr	Hexadecimal, 2Bytes	The I^2C slave address

Parameter	Format	Description
mode	Decimal, 1 digit	0 = Speed mode STANDARD 1 = Speed mode FAST 2 = Speed mode HS

10.3.8 $PSTMCFGMSGL

Configure the Message List.

Synopsis:

`$PSTMCFGMSGL,<listid>,<rate>,<listlow>,<listhigh>*<checksum><cr><lf>`

Arguments:

Table 76. $PSTMCFGMSGL field description

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA on UART 3 = NMEA on I2C
rate	From 0 to 255	Message list rate scaler
listlow	Hexadecimal, 8 digits	Please refer to CDB 201 table in case of NMEA
listhigh	Hexadecimal, 8 digits	Please refer to CDB 228 table in case of NMEA

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGMSGLOK message is returned
- In case of errors, the error message $PSTMCFGMSGLERROR is returned

10.3.9 $PSTMCFGGNSS

Configure the GNSS Algorithm.

Synopsis:

`$PSTMCFGGNSS,<trkcn0>,<poscn0>,<trkmskang>,<posmskang>,<NCOcntr>,<NCOmin>,<NCOmax>*<checksum><cr><lf>`

Arguments:

Table 77. $PSTMCFGGNSS field description

Parameter	Format	Description
trkcn0	From 0 to 255	Minimum CN0 [dB] at which satellite can be tracked
poscn0	From 0 to 255	Minimum CN0 [dB] at which satellite can be tracked for positioning solution
trkmskang	From 0 to 255	Minimum elevation angle at which satellite can be tracked
posmskang	From 0 to 255	Minimum elevation angle at which satellite can be tracked for positioning solution
NCOcntr	From 0 to 255	NCO center value
NCOmin	From 0 to 255	NCO range minimum value
NCOmax	From 0 to 255	NCO range maximum value

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned

- In case of no errors, the $PSTMCFGGNSSOK message is returned
- In case of errors, the error message $PSTMCFGGNSSERROR is returned

10.3.10 $PSTMCFGSBAS

Configure the SBAS Algorithm.

Synopsis:

```
$PSTMCFGSBAS,<enengine>,<enreport>,<enautosearch>,<numofsats>,<sat_1prnid>,<sat_1long>,<sat_1longsens>,<sat_1sbasserv>,<sat_1default>,...,>,<sat_Mprnid>,<sat_Mlong>,<sat_Mlongsens>,<sat_Msbasserv>,<sat_Mdefault>,<par_1>,<par_2>,...,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 78. $PSTMCFGSBAS field description

Parameter	Format	Description
enengine	Decimal, 1 digit	Enable SBAS engine switch: 0 = Disabled 1 = Enabled
enreport	Decimal, 1 digit	Enable satellite report in GSV message: 0 = Disabled 1 = Enabled
enautosearch	Decimal, 1 digit	Enable autosearch switch: 0 = Disabled 1 = Enabled
autosearchmask	Hexadecimal, 8 digits	Allow enabling/disabling the SBAS satellites to be searched by the auto search procedure
dectimeout	From 0 to 255	The time the autosearch waits to try to decode the current PRN.(1)
diftimeout	From 0 to 255	The time the autosearch waits before changing the prn when the current SBAS sat is not more decoded.(1)
nextsattimeout	From 0 to 255	The time the autosearch waits to try to acquire and tracking new SBAS satellite using the searching channel.(1)
nextsesstimeout	From 0 to 255	The time the autosearch waits before starting a new searching session using the searching channel.(1)
numofsats (N)	From 0 to 255	Number of SBAS satellites.(1)
satN_prnid	Integer	SBAS PRN configuration for satellite 1
satN_long	From 0 to 255	Longitude for satellite 1
satN_longsens	Decimal, 1 digit	Longitude sense for satellite 1 0 = EAST 1 = WEST
satN_sbasserv	Decimal, 1 digit	SBAS service for satellite 1 0 = WAAS 1 = EGNOS 2 = MSAS 3 = GAGAN
satN_default	Decimal, 1 digit	Select if satellite 1 is default or not 0 = Not default

Parameter	Format	Description
		1 = Default

1. *Expressed in seconds. This value is ignored if enautosearch is 0*

Note: The last 5 parameters will be repeated N times, where N is the number of satellites the user has chosen.

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGSBASOK message is returned
- In case of errors, the error message $PSTMCFGSBASERROR is returned

Parameters when auto-search is enabled:

Table 79. $PSTMCFGSBAS field description when auto-search is enabled

Parameter	Format	Description
Satellite-Enable-mask	Integer	Enable/disable satellites to be searched by the autosearch procedure.
Autosearch-decoding-timeout	Integer	Set the timeout the autosearch waits to try to decode the current PRN
Autosearch-differentialtimeout	Integer	Set the timeout the autosearch waits before changing the PRN when the current SBAS satellite is no more decoded
Autosearch-searching-timeout-next-satellite	Integer	Set the timeout the auto-search waits to try to acquire and tracking new SBAS satellite using the searching channel
Autosearch-searching-timeout-next-session	Integer	Set the timeout the auto-search waits before starting a new searching session using the searching channel

10.3.11 $PSTMCFGPPSGEN

Configure the PPS with general settings.

Synopsis:

```
$PSTMCFGPPSGEN,<enpps>,<genmode>,<ppsclock>,<reftime>*<checksum><cr><lf>
```

Arguments:

Table 80. $PSTMCFGPPSGEN field description

Parameter	Format	Description
enpps	Decimal, 1 digit	Enable PPS engine switch 0 = Disabled 1 = Enabled
genmode	Decimal, 1 digit	Generation mode 0 = Every second 1 = Even seconds 2 = Odd seconds
ppsclock	Decimal, 1 digit	PPS clock 0 = 16 MHz

Parameter	Format	Description
		1 = 32 MHz 2 = 64 MHz
reftime	Decimal, 1 digit	Reference time 0 = UTC 1 = GPS time 2 = GLONASS time 3 = UTC (SU) 4 = GPS time from GLONASS time reference

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGPPSGENOK message is returned
- In case of errors, the error message $PSTMCFGPPSGENERROR is returned

10.3.12 $PSTMCFGPPSSAT

Configure the PPS with satellite related configurations settings.

Synopsis:

```
$PSTMCFGPPSSAT,<enmix>,<fixcond>,<minsatnum>,<satelevmask>*<checksum><cr><lf>
```

Arguments:

Table 81. $PSTMCFGPPSSAT field description

Parameter	Format	Description
enmix	Decimal, 1 digit	Enable Mixing 0 = Disabled 1 = GPS satellite enabled for GLONASS correction 2 = GLONASS satellite enabled for GPS correction
fixcond	Decimal, 1 digit	Fix condition 0 = No fix 1 = 2D fix 2 = 3D fix
minsatnum	From 0 to 255	Minimum number of satellites used for timing correction
satelevmask	From 0 to 255	Satellite elevation mask for time correction. It is the minimum satellite elevation angle to use the satellite for time correction

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGPPSSATOK message is returned
- In case of errors, the error message $PSTMCFGPPSSATERROR is returned

10.3.13 $PSTMCFGPPSPUL

Configure the PPS with pulse related settings.

Synopsis:

```
$PSTMCFGPPSPUL,<enpolinv>,<pulsedur>,<delcorr>*<checksum><cr><lf>
```

Arguments:

Table 82. $PSTMCFGPPSPUL field description

Parameter	Format	Description
enpolinv	Decimal, 1 digit	Enable polarity inversion switch 0 = Disabled 1 = Enabled
pulsedur	Double	Allow setting the pulse duration of the PPS signal
delcorr	Double	Allow setting a time correction to compensate any delay introduced on the Pulse Per Second (PPS) signal by cables and/or RF chain

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGPPSPULOK message is returned
- In case of errors, the error message $PSTMCFGPPSPULERROR is returned

10.3.14 $PSTMCFGPOSHOLD

Configure the Position hold.

Synopsis:

```
$PSTMCFGPOSHOLD,<poshold>,<poshlat>,<poshlon>,<poshhei>*<checksum><cr><lf>
```

Arguments:

Table 83. $PSTMCFGPOSHOLD field description

Parameter	Format	Description
poshold	Decimal, 1 digit	Enable position hold switch 0 = Disabled 1 = Enabled Next parameter will be ignored when poshold is Disabled.
poshlat	Double	Set the position hold latitude
poshlon	Double	Set the position hold longitude
poshhei	Double	Set the position hold height

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGPOSHOLDOK message is returned
- In case of errors, the error message $PSTMCFGPOSHOLDERROR is returned

10.3.15 $PSTMCFGTRAIM

Configure the PPS with general settings.

Synopsis:

```
$PSTMCFGTRAIM,<entraim>,<threshold>*<checksum><cr><lf>
```

Arguments:

Table 84. $PSTMCFGTRAIM field description

Parameter	Format	Description
entraim	Decimal, 1 digit	Enable TRAIM switch 0 = Disabled 1 = Enabled
threshold	Double	Time error threshold for the satellites exclusion in the TRAIM algorithm

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGTRAIMOK message is returned
- In case of errors, the error message $PSTMCFGTRAIMERROR is returned

10.3.16 $PSTMCFGSATCOMP

Configure the PPS with general settings.

Synopsis:

```
$PSTMCFGSATCOMP,<numofcomp>,<pathid1>,<comp1>,<pathid2>,<comp2>*<checksum><cr><lf>
```

Arguments:

Table 85. $PSTMCFGSATCOMP field description

Parameter	Format	Description
numofcomp	Decimal	Number of RF path to compensate. Note that this affect next parameters. Next fields will be repeated "numofcomp" times
pathid	Decimal,1 Digit	Select the ID of the RF path to compensate 0 = GPS 1 = GLONASS
comp	Double	Time compensation value

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGSATCOMPOK message is returned
- In case of errors, the error message $PSTMCFGSATCOMERROR is returned

10.3.17 $PSTMCFGLPA

Configure the Low Power Algorithm.

Synopsis:

```
$PSTMCFGLPA,<en_lpa>,<feat>,<fix_period>,<fix_on_time>,<no_fix_cnt>,<no_fix_cnt2>,<no_fix_off
>,<adaptive_feat>,<adaptive_duty_cicle>,<ehpe_th>,<num_of_sat>,<duty_off>,<const_type>*<check
sum><cr><lf>
```

Arguments:

Table 86. **$PSTMCFGLPA field description**

Parameter	Format	Description
en_lpa	unsigned, 1 bytes	Enable Low Power Algorithm 0 = LPA Disabled 1 = LPA Enabled.
feat	unsigned, 1 bytes	Low Power Algorithm feature 0 = Periodic mode disabled 1 = Active Periodic mode 2 = RESERVED 3 = Standby Periodic mode
fix_period	From 0 to 86400	Fix period in seconds. 0 means the Fix will be given only on WAKEUP pin activation. Value 0 is only valid in Standby Periodic mode. Default is 10.
fix_on_time	unsigned, 2 bytes	Number of fix reported every Fix wakeup. Default is 1
no_fix_cnt	unsigned, 2 bytes	Number of no-fixes in hot conditions, before to signal a fix loss event. Default is 8
no_fix_cnt2	unsigned, 2 bytes	Number of no-fixes in non-hot conditions, before signaling a fix loss event. Default is 60
no_fix_off	unsigned, 2 bytes	Off duration time after a fix loss event. Default is 180
adaptive_feat	unsigned, 1 bytes	Enable disable adaptive multi-constellation algorithm. 0 = Adaptive Algorithm Disabled 1 = Adaptive Algorithm Enabled Default is 0
adaptive_duty_cicle	unsigned, 1 bytes	Enable disable trimming of correlation time for each cycle. 0 = Adaptive Duty Cycle Disabled 1 = Adaptive Duty Cycle Enabled Default is 0
ehpe_th	unsigned, 1 bytes	EHPE average threshold. Default is 15
num_of_sat	unsigned, 1 bytes 0 to 32	Number of satellite used in Adaptive mode (first N with higher elevation) Default is 9
duty_off	unsigned, 2 bytes 100 to 740	Duty cycle OFF period length in ms; Default is 700
const_type	unsigned, 1 bytes	RESERVED, set it as 0

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGLPAOK message is returned
- In case of errors, the error message $PSTMCFGLPAERROR is returned

10.3.18 $PSTMCFGAGPS

Configure the Assisted GPS.

Synopsis:

```
$PSTMCFGAGPS,<en_agps>*<checksum><cr><lf>
```

Arguments:

Table 87. $PSTMCFGAGPS field description

Parameter	Format	Description
en_agps	Decimal	Enable/Disable AGPS engine 0 = AGPS Disables 1 = AGPS Enabled

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGAGPSOK message is returned
- In case of errors, the error message $PSTMCFGAGPSERROR is returned

10.3.19 $PSTMCFGAJM

Configure the Anti-Jamming Algorithm.

Synopsis:

```
$PSTMCFGAJM,<gpsmode>,<glonassmode>*<checksum><cr><lf>
```

Arguments:

Table 88. $PSTMCFGAJM field description

Parameter	Format	Description
gpsmode	Decimal, 1 digit	Notch filter on GPS path: 0 = Disable 1 = Normal Mode 2 = Auto Mode
glonassmode	Decimal, 1 digit	Notch filter on GLONASS path: 0 = Disable 1 = Normal Mode 2 = Auto Mode

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGAJMOK message is returned
- In case of errors, the error message $PSTMCFGAJMERROR is returned

10.3.20 $PSTMCFGODO

Configure the Odometer.

This command is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMCFGODO,<en>,<enmsg>,<alarm>*<checksum><cr><lf>
```

Arguments:

Table 89. **$PSTMCFGODO field description**

Parameter	Format	Description
en	Decimal, 1 digit	Enable/Disable the odometer: 0 = Odometer disabled 1 = Odometer enabled
enmsg	Decimal, 1 digit	Enable/Disable odometer related periodic messages: 0 = Periodic message disabled 1 = Periodic message enabled
alarm	0 to 65535	Distance travelled between two NMEA messages

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGODOOK message is returned
- In case of errors, the error message $PSTMCFGODOERROR is returned

10.3.21 $PSTMCFGLOG

Configure the Data Logging.

This command is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMCFGLOG,<en>,<circ>,<rectype>,<oneshot>,<rate>,<speed>,<dist>*<checksum><cr><lf>
```

Arguments:

Table 90. **$PSTMCFGLOG field description**

Parameter	Format	Description
en	Decimal, 1 digit	Enable/Disable the log: 0 = Data-logging disabled 1 = Data-logging enabled
circ	Decimal, 1 digit	Enable/Disable circular mode: 0 = Circular mode disabled 1 = Circular mode enabled
rectype	Decimal, 1 digit	Record type 1 = Type 1 2 = Type 2 3 = Type 3
oneshot	Decimal, 1 digit	Enable/Disable one shot mode: 0 = One shot mode disabled 1 = One shot mode enabled
rate	0 to 255	Time interval in seconds between two consecutive logged records
speed	0 to 255	Minimum speed threshold (record is logged if the speed is above the threshold – 0 means the threshold is not used)
dist	0 to 65535	Distance threshold (record is logged if the distance from previous record is bigger than threshold – 0 means not used)

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGLOGOK message is returned
- In case of errors, the error message $PSTMCFGLOGERROR is returned

10.3.22 $PSTMCFGGEOFENCE

Allows to configure Geofencing feature enabling circles and choosing tolerance.

This command is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMCFGGEOFENCE,<en>,<tol>*<checksum><cr><lf>
```

Arguments:

Table 91. $PSTMCFGGEOFENCE field description

Parameter	Format	Description
en	Decimal, 1 digit	Enable/Disable the geofencing: 0 = Geo fencing disabled 1 = Geo fencing enabled
tol	Decimal, 1 digit	Tolerance: 0 = none 1 = level 1 2 = level 2 3 = level 3

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGGEOFENCEOK message is returned
- In case of errors, the error message $PSTMCFGGEOFENCEERROR is returned

10.3.23 $PSTMCFGGEOCIR

Allows to configure a circle of geofencing feature.

This command is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMCFGGEOCIR,<circleid>,<en>,<lat>,<lon>,<rad>*<checksum><cr><lf>
```

Arguments:

Table 92. $PSTMCFGGEOCIR field description

Parameter	Format	Description
circleid	Decimal, 1 digit	The circle ID From 0 to 7
en	Boolean	Enable disable the circle 0 = Disable, 1 = Enable
lat	Double	N-th circle latitude

Parameter	Format	Description
lon	Double	N-th circle longitude
rad	Double	N-th circle radius

Results:

- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the $PSTMCFGGEOCIROK message is returned
- In case of errors, the error message $PSTMCFGGEOCIRERROR is returned

10.3.24 $PSTMCFGCONST

Allow enable/disable all the GNSS constellations.

Synopsis:

```
$PSTMCFGCONST,<gps>,<glonass>,<galileo>,<qzss>,<beidou>*<checksumn><cr><lf>
```

Arguments:

Table 93. $PSTMCFGCONST field description

Parameter	Format	Description
Gps	Decimal, 1 digit	Allowed values: Constellation disabled Constellation satellites only tracked Satellites constellation used in position evaluation
Gloanss	Decimal, 1 digit	Allowed values: Constellation disabled Constellation satellites only tracked Satellites constellation used in position evaluation
Galileo	Decimal, 1 digit	Allowed values: Constellation disabled Constellation satellites only tracked Satellites constellation used in position evaluation
Qzss	Decimal, 1 digit	Allowed values: Constellation disabled Constellation satellites only tracked Satellites constellation used in position evaluation
Beidou	Decimal, 1 digit	Allowed values: Constellation disabled Constellation satellites only tracked Satellites constellation used in position evaluation

Results:

- One or more parameters of swconfig are set according to the command parameters
- In case of no errors, the $PSTMCFGCONSTOK message is returned
- In case of errors, the $PSTMCFGCONSTERROR error message is returned

10.3.25 $PSTMCFGTHGNSS

Configures threshold related to GNSS algorithm.

Synopsis:

```
$PSTMCFGTHGNSS,<trkcn0>,<poscn0>,<trkmaskangle>,<posmaskangle>*<checksum><cr><lf>
```

Arguments:

Table 94. $PSTMCFGTHGNSS field description

Parameter	Format	Description
trkcn0	Unsigned	Minimum CN0 for tracking purposes
poscn0	Unsigned	Minimum CN0 for positioning purposes
trkmaskangle	Unsigned	Minimum angle for tracking purposes
posmaskangle	Unsigned	Minimum angle for positioning purposes

Results:

- If the command syntax is correct and parameters are correctly set, the device returns the $PSTMCFGTHGNSSOK confirmation message
- In case of errors, the error message $PSTMCFGTHGNSSERROR is returned

10.3.26 $PSTMCFGTDATA

Configures data and time related parameters.

Synopsis:

```
$PSTMCFGTDATA,<gpsminweek>,<gps_max_week>,<fix_rate>,<utcdelta>*<checksum><cr><lf>
```

Arguments:

Table 95. $PSTMCFGTDATA field description

Parameter	Format	Description
gpsminweek	Unsigned	GPS minimum week number
gpsmaxweek	Unsigned	GPS maximum week number
fix_rate	Double	Fix rate
utc_delta	Unsigned	UTC delta time

Results:

- If the command syntax is correct and parameters are correctly set, the device returns the $PSTMCFGTDATAOK confirmation message
- In case of errors, the $PSTMCFGTDATAERROR message, is returned

10.4 Datalogging NMEA commands

10.4.1 $PSTMLOGCREATE

This command creates and enables a new data log. In case a log is already there, this command erases the previous one.

Synopsis:

```
$PSTMLOGCREATE,<cfg>,<min-rate>,<min-speed>,<min-position>,<log-mask>*<checksum><cr><lf>
```

Arguments:

Table 96. $PSTMLOGCREATE field description

Parameter	Format	Description
cfg	Hexadecimal, 3 Digits	[1:1]: enable buffer-full GPIO alarm; [0:0]: enable-circular-buffer;
min-rate(1)	Unsigned	The rate to records a new entry
min-speed(2)	Unsigned	If the current speed is greater than the threshold then the position is logged (0 = not set)
min-position(3)	Unsigned	If the 3D position difference is greater than the threshold then the position is logged (0 = not set)
log-mask	Decimal, 1 digit	Which dataset is logged? See Table 12

1. *In LowPower mode `min-rate`, are not used. Entry-rate is the same as periodic-mode-rate.*
2. *In LowPower mode `min-speed`, are not used. Entry-rate is the same as periodic-mode-rate.*
3. *In LowPower mode `min-position`, are not used. Entry-rate is the same as periodic +-mode-rate.*

Results:

- In case of no errors, the $PSTMLOGCREATEOK message is returned
- In case of errors, the error message $PSTMLOGCREATEERROR is returned

10.4.2 $PSTMLOGSTART

This command starts or restarts the current the data logging.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the $PSTMLOGSTARTOK message is returned
- In case of errors, the error message $PSTMLOGSTARTERROR is returned

10.4.3 $PSTMLOGSTOP

This command stops the data logging.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the $PSTMLOGSTOPOK message is returned
- In case of errors, the error message $PSTMLOGSTOPERROR is returned

10.4.4 $PSTMLOGERASE

This command erases the data log.

Synopsis:

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

Arguments:
No arguments
Results:

- In case of no errors, the $PSTMLOGERASEOK message is returned
- In case of errors, the error message $PSTMLOGERASEERROR is returned

10.4.5 $PSTMLOGREQSTATUS

Raised from the host to get information about the datalog subsystem.
Synopsis:

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

Arguments:
No arguments
Results:

- If logger has been created this replies with the message $PSTMLOGSTATUS
- Otherwise, the error message $PSTMLOGSTATUSERROR is returned

10.4.6 $PSTMLOGREQQUERY

This command triggers a query to fetch the data-log entries.
Host can specify the number of entries and from which entry the ST GNSS has to begin sending data.
This command is implemented and supported only in Binary Image 4.5.8 and later.
Synopsis:

```
$PSTMLOGREQQUERY,<start-timestamp>,<start-datestamp>,<numb-of-entries>*<checksum><cr><lf>
```

Arguments:

Table 97. $PSTMLOGREQQUERY field description

Parameter	Format	Description
start-timestamp	Decimal, 6 Digits	The initial timestamp as hhmmss
start-datestamp	Decimal, 8 Digits	The initial date stamp as yyyyMMdd
numb-of-entries	Unsigned	Number of entries to print out

Results:

- In case of no errors the message $PSTMLOGQUERY is sent
- In case of errors, the error message $PSTMLOGQUERYERROR is returned

10.5 Geofencing NMEA commands

10.5.1 $PSTMGEOFENCECFG

This command configures the Geofence subsystem.
Each $PSTMGEOFENCECFG command can configure only one circle, if more circles are needed the Host has to raise more $PSTMGEOFENCECFG commands.
Synopsis:

```
$PSTMGEOFENCECFG,<id>,<en>,<tol>,<lat>,<lon>,<rad>*<checksum><cr><lf>
```

Arguments:

Table 98. **$PSTMGEOFENCECFG field description**

Parameter	Format	Description
id	Decimal, 1 digit	Circle identifier
en	Decimal, 1 digit	Circle enabler: 0 = Circle not valid 1 = Circle enabled
tol	Decimal, 1 digit	Sigma tolerance 1 = 68% 2 = 95% 3 = 99%
lat	Double	Latitude as Decimal Degrees
lon	Double	Longitude as Decimal Degrees
rad	Double	Radius as meters

Results:

- In case of no errors, the $PSTMGEOFENCECFGOK message is returned
- In case of errors, the error message $PSTMGEOFENCECFGERROR is returned

10.5.2 $PSTMGEOFENCEREQ

This command forces the GNSS Teseo Module to send a $PSTMGEOFENCESTATUS message to acknowledge the internal Geofence subsystem status.

Synopsis:

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

Arguments:

No Arguments

Results:

- In case of no errors, the Teseo Module replies with the $PSTMGEOFENCESTATUS message
- In case of errors, the error message $PSTMGEOFENCEREQERROR is returned

10.6 Odometer NMEA commands

10.6.1 $PSTMODOSTART

This command enables and resets the Odometer subsystem which begins evaluating the ground distance from the current resolved position.

Synopsis:

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

Arguments:

No arguments.

Results:

- In case of no errors, the $PSTMODOSTARTOK message is returned
- In case of errors, the error message $PSTMODOSTARTERROR is returned

10.6.2 $PSTMODOSTOP

This command stops the Odometer subsystem.

Synopsis:

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

Arguments:
No arguments
Results:

- In case of no errors, the $PSTMODOSTOPOK message is returned
- In case of errors, the error message $PSTMODOSTOPERROR is returned

10.6.3 $PSTMODORESET

This command resets the Odometer subsystem.
Synopsis:

```
$PSTMODORESET,<odo_mask>*<checksum><cr><lf>
```

Arguments:

Table 99. $PSTMODORESET field description

Parameter	Format	Description
odo_mask	Decimal	The odometers to be reset: 0 = none 1 = Odo-A 2 = Odo-B 3 = Odo-A and Odo-B 4 = Odo-Tot 5 = Odo-A and Odo-Tot 6 = Odo-B and Odo-Tot 7 = Odo-A, Odo-B and Odo-Tot

Results:

- In case of no errors, the $PSTMODORESETOK message is returned
- In case of errors, the error message $PSTMODORESETERROR is returned

10.6.4 $PSTMODOREQ

This command requires the Odometer status.
The Odometer must be enabled otherwise the request will be rejected with error.
Synopsis:

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

Arguments:
No arguments
Results:

- In case of no errors, this replies with a $PSTMODOmessage.
- In case of errors, the error message $PSTMODOREQERRORis returned

10.7 Autonomous AGNSS NMEA commands

10.7.1 $PSTMSTAGPSONOFF

The command turns ON/OFF the STAGPS\xaa engine; it affects both autonomous and server based solutions.

Synopsis:

```
$PSTMSTAGPSONOFF,<param>*<checksum><cr><lf>
```

Arguments:

Table 100. $PSTMSTAGPSPONOFF field description

Parameter	Format	Description
param	Decimal, 1 digits	ON/OFF status: 0: the STAGPS\xaa engine is suspended. 1: the STAGPS\xaa engine is started

Results:

According to the command parameter, the STAGPS\xaa engine is started or suspended. One of the following messages is sent:

- $PSTMPOLSTARTED if the engine has been started
- $PSTMPOLSUSPENDED if the engine has been suspended
- $PSTMPOLONOFFERROR in case of error

10.7.2 $PSTMSTAGPSINVALIDATE

The command clears data stored in the STAGPS\xaa internal database. The input parameter allows selection of the data to be cleared.

Synopsis:

```
$PSTMSTAGPSINVALIDATE,<param>*<checksum><cr><lf>
```

Arguments:

Table 101. $PSTMSTAGPSINVALIDATE field description

Parameter	Format	Description
param	Decimal, 3 digits	Selects which database should be erased: 1: Clear the real ephemeris database (only autonomous). 2: Clear the satellite seeds database (autonomous and server based) 4: Clear the satellite polys database (autonomous and server based) 7: Clear all databases

Results:

According to the command parameter, the internal STAGPS\xaa databases will be erased.

The input parameter should be considered as a mask where the first three bits select the database to be cleared (e.g. using 3 as input parameter the real ephemeris and seed databases will be cleared).

When operation is complete, STAGPS subsystem sends a message:

- $PSTMSTAGPSINVALIDATEOK in case of success
- $PSTMSTAGPSINVALIDATEERROR in case of errors

10.7.3 $PSTMGETAGPSSTATUS

The command returns the status of the STAGPS\xaa internal processing.

Synopsis:

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

Arguments:

None

Results:

The system sends back the STAGPS\xaa status in the $PSTMAGPSSTATUS message.

10.7.4 $PSTMSTAGPSSETCONSTMASK

The command sets the ST-AGNSS constellation mask. It allows switching the ST-AGNSS constellation at run-time. All previous ST-AGNSS data will be erased

Synopsis:

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

Arguments:

Table 102. $PSTMSTAGPSSETCONSTMASK field description

Parameter	Format	Description
Constellation_mask	Decimal, 1 digits	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 3: GALILEO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling

Results:

According to the command parameter, one of the following messages is sent:

- $PSTMSTAGPSSETCONSTMASKOK in case of success
- $PSTMSTAGPSSETCONSTMASKERROR in case of error

Note: GALILEO and BEIDOU support is still experimental and should not be used in production environment.

10.8 Predictive AGNSS NMEA commands

10.8.1 $PSTMSTAGPSSEEDBEGIN

The PGPS seed first block is sent via NMEA, for each constellation. After the command has been issued for a constellation, all the packets for that constellation must be sent. The command must be re-issued before transferring the seed first block and packets for a different constellation.

The seed first block is made up of the first 171 bits of the seed string for each constellation, padded with five 0 bits at the end to reach the length of 176 bits (i.e. 22 bytes). They are the first 171 bits of the binary seed for each constellation.

Synopsis:

$PSTMSTAGPSSEEDBEGIN,<Constellation>,<Leap seconds>,<Next Leap Time>,<Next Leap>,<Ref Time>,<T0>,<T1>,<T2>,<GNSS to ID>,<Week Number>,<Delta T>,<Seed 1st block String>*<checksum><cr><lf>

Arguments:

Results:

- In case of no errors the message $PSTMSTAGPSSEEDBEGINOK is returned
- In case of error the device returns the error message $PSTMSTAGPSSEEDBEGINERROR

10.8.2 $PSTMSTAGPSBLKTYPE

Send the list of all block types (in satellite number order) for the current constellation. If a particular satellite is missing, then "0" should be sent as block number for that satellite.

Synopsis:

`$PSTMSTAGPSBLKTYPE,<Block Type #1>,...,<Block Type #n>` *<checksum><cr><lf>

Arguments:

Table 103. $PSTMSTAGPSBLKTYPE field description

Parameter	Description
<Block Type #1>	Satellite block type for satellite #1, otherwise 0
…	
<Block Type #i>	Satellite block type for satellite #i, otherwise 0
…	
<Block Type #n>	Satellite block type for satellite #n, otherwise 0

Results:

- If the block types list has been correctly received then the device returns the message $PSTMSTAGPSBLKTYPEOK
- In case of error the device returns the error message $PSTMSTAGPSBLKTYPEERROR

10.8.3 $PSTMSTAGPSSLOTFRQ

Send the list of all slot frequency channels (in satellite slot number order) for the GLONASS constellation. If a particular satellite is missing, then "-128" should be sent as slot frequency for that satellite. This command should be issued for the GLONASS constellation only.

Synopsis:

$PSTMSTAGPSSLOTFRQ,<Slot freq #1>,...,<Slot freq #24>*<checksum><cr><lf>

Arguments:

Table 104. $PSTMSTAGPSSLOTFRQ field description

Parameter	Description
<Slot freq. #1>	GLONASS frequency slot for satellite #1, otherwise 0
…	
<Slot freq. #i>	GLONASS frequency slot for satellite #i, otherwise 0
…	
<Slot freq. #24>	GLONASS frequency slot for satellite #24, otherwise 0

Results:

- If the slot frequencies list has been correctly received then the device returns the message $PSTMSTAGPSSLOTFRQOK
- In case of error the device returns the error message $PSTMSTAGPSSLOTFRQERROR

10.8.4 $PSTMSTAGPSSEEDPKT

Send the PGPS seed via NMEA divided in separate packets. The packets can be obtained by dropping the first 171 bits of the binary seed and then dividing the remaining part into 155 byte blocks. The command should be issued for each block.

Synopsis:

$PSTMSTAGPSSEEDPKT,<Seed Packet String>*<checksum><cr><lf>

Arguments:

Table 105. **$PSTMSTAGPSSEEDPKT field description**

Parameter	Description
<Seed Packet String>	155 Byte seed string (each byte is coded on 2 ASCII chars so this field will be 310 ASCII chars)

Results:

- If the seed packet has been correctly received then the device returns the message $PSTMSTAGPSSEEDPKTOK
- In case of error the device returns the error message $PSTMSTAGPSSEEDPKTERROR

10.8.5 $PSTMSTAGPSSEEDPROP

After all first blocks and packets for all available constellations have been sent, this command must be issued to start the propagation of the seed.

Synopsis:

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

Arguments:

None.

Results:

After the command the device returns the message $PSTMSTAGPSSEEDPROPOK

10.9 Real Time AGNSS NMEA commands

10.9.1 $PSTMSTAGPS8PASSGEN

Request the generation of a password to access the Real-Time AGPS server to the device.

Synopsis:

```
$PSTMSTAGPS8PASSGEN,<time>,<VendorID>,<ModelID>*<checksum><cr><lf>
```

Arguments:

Table 106. **$PSTMSTAGPS8PASSGEN field description**

Parameter	Description
<time>	GPS time in seconds (i.e.: the current time expressed in the number of seconds since midnight 06-Jan-1980).
<VendorID>	Unique Vendor ID
<ModelID>	Model identifier

Results:

ST GNSS Teseo Module returns the password in the message $PSTMSTAGPS8PASSRTN.

11 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.

11.1 Standard NMEA messages list

Table 107. 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

11.2 ST NMEA messages list

Table 108. 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
$PSTMSBASM	OFF	ST; Augmentation System Message
$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(1)	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.

Syntax	Default	Description
$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

1. *This message is available only if the STAGPS is supported.*

11.3 Preliminary notes about satellites' PRN ranges

The satellite PRN is an ID used to identify satellites. In NMEA 0183 Rev 3.1, PRN was not described for new constellation.

Table 109. Satellite PRNs for each NMEA version

	GPS	SBAS	GLONASS	BAIDEU	QZSS	GALILEO
NMEA 3.10	from 1 to 32	from 33 to 51	from 65 to 92	from 141 to 172	from 183 to 197	from 301 to 330

11.4 Standard NMEA messages specification

These messages are defined within the "NMEA 0183" Specification.

11.4.1 $--GGA

Global Positioning System Fixed data

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

Synopsis for NMEA 0183 Rev. 3.1 (Default):

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

Synopsis for NMEA 0183 Rev. 4.10:

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

Arguments:

Table 110. $--GGA message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multiconstellation mode.

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
N/S	"N" or "S"	Latitude direction: North or South Note that for Rev 4.10 this field is empty in case of invalid value
Long	DDMM.MMMMM	Longitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
E/W	"E" or "W"	Longitude direction: East or West
GPSQual	Decimal, 1digit	0 = Fix not available or invalid 1 = GPS, SPS Mode, fix valid 2 = Differential GPS, SPS Mode, fix valid 6 = Estimated (dead reckoning) mode
Sats	Decimal, 2 digits	Satellites in use: 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
```

11.4.2 $--GLL

Geographic Positioning Latitude / Longitude

NMEA message list bitmask (64 bits): 0000 0000 0010 0000

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 111. $--GLL message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
N/S	"N" or "S"	Latitude direction: North or South
Long	DDMM.MMMMM	Longitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
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
```

11.4.3 $--GSA

GNSS DOP and Active Satellites. Satellites from different constellations are sent on separate messages.
In case of multi-constellation mode, the talker ID is always GN.
NMEA message list bitmask (64 bits): 0000 0000 0000 0004

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 112. $--GSA message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
CurrentMode	Decimal, 1 digit	Current Mode: 1 = Fix not available or invalid 2 = GPS, SPS Mode, fix valid 3 = Differential GPS, SPS Mode, fix valid
SatPRN(1 to 12)	Decimal, 2 or 3 digits	Satellites list used for positioning. See Section 11.3 for more info about available values.
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
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BEIDOU 5 = QZSS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNGSA,A,3,23,03,22,09,01,19,17,06,31,11,,,1.1,0.6,0.9,1*3E
```

```
$GNGSA,A,3,67,66,81,65,88,75,82,74,,,,, 1.1,0.6,0.9,2*3D
```

```
$GNGSA,A,3,03,05,22,08,30,16,12,,,,,, 1.1,0.6,0.9,3*32
```

11.4.4 $--GSV

GNSS Satellites in View.

Usually GSV messages are organized per constellation and each message carries information about up to 4 satellites in view. Thus, in certain cases, to describe all the satellites in view from a constellation more than a message is needed. This set of message is printed once per each constellation with talker ID related to described constellation.

NMEA message list bitmask (64 bits): 0000 0000 0008 0000

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1CN0>,\xc9 ,<Sat
4PRN>,<Sat4Elev>,<Sat4Azim>,<Sat4CN0>*<checksum><cr><lf>
```

Synopsis for NMEA 0183 Rev 4.10:

```
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1CN0>,…,<Sat4PRN
>,<Sat4Elev>,<Sat4Azim>,<Sat4CN0>,<SignalID>*<checksum><cr><lf>
```

Arguments:

Table 113. $--GSV message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
GSVAmount	Decimal, 1 digit	Total amount of GSV messages
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 32
SatxPRN	Decimal, 2 digits	Satellites list used for positioning.
SatxElev	Decimal, 2 digits	Elevation of satellite x in Degree, 0 \xc9 90
SatxAzim	Decimal, 3 digits	Azimuth of satellite x in degree, ref. "North", 000 \xc9 359
SatxCN0	Decimal, 2 digits	Carrier to Noise Ratio for satellite x in dB, 00 \xc9 99
SignalID	Decimal, 1 digits	An identifier to indicate the signal in use. Currently it is 1 for GPS, GLONASS, 2 for BEIDOU and QZSS 6 for GALILEO
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

```
$GPGSV,3,1,12,02,04,037,,05,27,125,44,06,78,051,23,07,83,021,30*7C
```

```
$GPGSV,3,2,12,10,16,067,30,12,11,119,36,16,24,301,41,21,44,175,50*73
```

```
$GPGSV,3,3,12,23,06,326,28,24,61,118,40,30,45,122,43,31,52,253,37*7C
```

Example for NMEA 0183 Rev 4.10:

```
$GPGSV,3,1,09,30,68,039,49,05,61,266,50,28,52,137,47,07,38,052,48,01*5C
```

```
$GPGSV,3,2,09,13,37,301,45,09,17,105,43,15,07,297,40,08,06,056,41,01*56
```

```
$GPGSV,3,3,09,20,,,41,,,,,,,,,,,,01*5A
```

```
$GLGSV,2,1,06,68,86,031,43,78,78,013,46,79,51,226,43,69,33,325,38,01*43
```

```
$GLGSV,2,2,06,67,33,139,41,77,26,035,36,,,,,,,,,01*46
```

```
$GAGSV,2,1,05,08,76,129,44,02,65,057,46,30,56,205,45,07,48,311,44,06*4F
```

```
$GAGSV,2,2,05,03,22,129,40,,,,,,,,,,,,06*7D
```

11.4.5 $--RMC

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

- NMEA message list bitmask (64 bits): 0000 0000 0000 0040

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>RMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/
W>,<Speed>,<Trackgood>,<Date>,<MagVar>,<MagVarDir>,<mode>,<Nav_status>*<checksum><cr><lf>
```

Arguments:

Table 114. $--RMC message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
Status	"A" or "V"	Teseo warning: "A" = valid, "V" = Warning Note that "V" is reported in NO FIX conditions and "A" is reported in 2D and 3D fix conditions.
Lat	DDDMM.MMMMM	Latitude as degrees: DDD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)

Parameter	Format	Description
N/S	"N" or "S"	Latitude direction: North or South
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
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: ddmmyy
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	"E" or "W"	Magnetic Variation Direction
Mode	"D", "A", "N" or "E"	Positioning system Mode Indicator: "D" = Differential mode "A" = Autonomous mode "N" = data not valid "E" = Estimated (dead reckoning) mode
Nav_status	"S", "C", "U" or "V"	Navigational status indicator: "S" = Safe "C" = Caution "U" = Unsafe "V" = Not valid
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNRMC,,V,,,,,,,,,,N,V*37
```

```
or
```

```
$GNRMC,202340.000,A,4045.53297,N,01447.20361,E,0.2,0.0,291117,,,A,C*18
```

11.4.6 $--VTG

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

- NMEA message list bitmask (64 bits): 0000 0000 0000 0010

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 115. **$--VTG message field description**

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
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 = Autonomous 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
```

11.4.7 $--ZDA

- UTC, day, month and year.
- NMEA message list bitmask (64 bits): 0000 0000 0100 0000

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>ZDA,<Timestamp>,<Day>,<Month>,<Year>,,*<checksum><cr><lf>
```

Arguments:

Table 116. **$--ZDA message field description**

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode

Parameter	Format	Description
		QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
Day	Decimal, 2 digits	Day of month (01 to 31)
Month	Decimal, 2 digits	Month (01 to 12)
Year	Decimal, 4 digits	Year (1994 - \xc9)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNZDA,204409.000,29,11,2017,,*4C
```

11.4.8 $--GST

- Global Positioning System Pseudorange Noise Statistics.
- NMEA message list bitmask (64 bits): 0000 0000 0000 0008

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$GPGST,<Timestamp>,<EHPE>,<Semi-major>,<Semi-minor>,<Angle>,<LatErr>,<LonErr>,<Alt Err
Dev>*<checksum><cr><lf>
```

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>GST,<Timestamp>,<EHPE>,<Semi-major>,<Semi-minor>,<Angle>,<LatErr>,<LonErr>,<Alt
Err Dev>*<checksum><cr><lf>
```

Arguments:

Table 117. $--GST message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits)

Parameter	Format	Description
		ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
EHPE	dd.d in m	Equivalent Horizontal Position Error
Semi-major	dd.d in m	Standard deviation (meters) of semi-major axis of error ellipse
Semi-minor	dd.d in m	Standard deviation (meters) of semi-minor axis of error ellipse
Angle	dd.d in degree	Orientation of semi-major axis of error ellipse (true north degrees)
LatErr	dd.d in m	Standard deviation (meters) of latitude error
LonErr	dd.d in m	Standard deviation (meters) of longitude error
AltErr	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 for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNGST,205512.000,16.5,5.6,4.5,0.8,5.0,5.0,6.7*41
```

or

```
$GAGST,,,,,,,,*46
```

11.4.9 $--GBS

GNSS Satellite Fault Detection

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$GPGBS,<Timestamp>,<LatErr>,<LonErr>,<AltErr>,<SatPRN>,<Prob>,<Res>,<StdDev>*<checksum><cr><l
f>
```

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>GBS,<Timestamp>,<LatErr>,<LonErr>,<AltErr>,<SatPRN>,<Prob>,<Res>,<StdDev>,<SystemI
D>,<SignalID>*<checksum><cr><lf>
```

Arguments:

Table 118. $--GBS message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample:

Parameter	Format	Description
		hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
LatErr	dd.d in m	Standard deviation (meters) of latitude error
LonErr	dd.d in m	Standard deviation (meters) of longitude error
AltErr	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
StdDev	Empty	Standard Deviation of bias estimate Not supported
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BEIDOU 5 = QZSS
SignalID	Decimal, 1 digits	An identifier to indicate the signal in use. Currently it is 1 for GPS, GLONASS, 2 for BEIDOU and QZSS 6 for GALILEO
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNGBS,211120.000,7.6,9.6,10.8,,,,,,*59
```

11.4.10 $--GNS

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

NMEA message list bitmask (64 bits): 0000 0000 0000 0001

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$<TalkerID>GNS,<Timestamp>,<Lat>,<N/S>,<Long>,<E/
W>,<Mode>,<Sats>,<HDOP>,<AltVal>,<GEOVal>,<DGPSAge>,<DGPSRef>*<checksum><cr><lf>
```

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>GNS,<Timestamp>,<Lat>,<N/S>,<Long>,<E/
W>,<Mode>,<Sats>,<HDOP>,<AltVal>,<GEOVal>,<DGPSAge>,<DGPSRef>*<checksum><cr><lf>
```

Arguments:

Table 119. $--GNS message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz.
Lat	DDDMM.MMMMM	Latitude as degrees: DDD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
N/S	"N" or "S"	Latitude direction: North or South
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable)
E/W	"E" or "W"	Longitude direction: East or West
Mode Indicator	Char or String	In case of single constellation this is a character which can assume these values: N = NO Fix A = Autonomous D = Differential GPS E = Estimated (dead reckoning mode) In multi-constellation mode this is a 5 letter string where each letter is the mode indicator of each constellation in this order: GPS, GLONASS, GALILEO, BEIDOU, QZSS
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 for NMEA 0183 Rev 3.1 (Default):

```
$GNGNS,091233.000,4055.04824,N,01416.55600,E,AAANN,19,0.7,0078.1,42.9,,*17
```

or

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

Example for NMEA 0183 Rev 4.10:

```
$GPGNS,211803.000,4045.53340,N,01447.19988,E,A,04,2.2,0240.1,42.0,,*08
```

or

```
$GAGNS,,,,,,N,00,99.0,0282.1,0.0,,*35
```

11.4.11 $--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.

NMEA message list bitmask (64 bits): 0000 0080 0000 0000

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 120. $--DTM message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Local_datum_code(1)	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.
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

Parameter	Format	Description
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

1. *All supported datum are listed in the Appendix A at the end of this document.*

Example for NMEA 0183 Rev 3.1 (Default):

```
$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
```

Example for NMEA 0183 Rev 4.10:

```
$GNDTM,W84,,2445.54843,N,887.20838,E,0.000000,W84*7E
```

11.5 ST NMEA messages specification

In order to provide further data and information from the ST GNSS receiver, which are not provided by the standard NMEA messages, STMicroelectronics provides "proprietary messages". Any proprietary message on the NMEA port starts with "$PSTM\xc9 " where "STM" indicates that it is a ST proprietary message ($PSTMxxx\xc9)

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

11.5.1 $PSTMINITGPSOK

Message sent in response to command $PSTMINITGPS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.5.2 $PSTMINITGPSERROR

Message sent in response to command $PSTMINITGPS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.3 $PSTMINITTIMEOK

Message sent in response to command $PSTMINITTIME

Synopsis:

```
$PSTMINITTIME OK*<checksum><cr><lf>
```

Arguments:
None.
Results:
Message sent in case of successful operation.

11.5.4 $PSTMINITTIMEERROR

Message sent in response to command $PSTMINITTIME
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.5.5 $PSTMSETRANGEOK

Message sent in response to command $PSTMSETRANGE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.5.6 $PSTMSETRANGEERROR

Message sent in response to command $PSTMSETRANGE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.5.7 $PSTMSBASSERVICEOK

Message sent in response to command $PSTMSBASSERVICE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.5.8 $PSTMSBASSERVICEERROR

Message sent in response to command $PSTMSBASSERVICE

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.9 $PSTMSBASMOK

Message sent in response to command $PSTMSBASM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.5.10 $PSTMSBASMERROR

Message sent in response to command $PSTMSBASM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.11 $PSTMGETALGOOK

Message sent in response to command $PSTMGETALGO.

Synopsis:

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

Arguments:

Table 121. $PSTMGETALGOOK field description

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:

Message sent in case of successful operation.

11.5.12 $PSTMGETALGOERROR

Message sent in response to command $PSTMGETALGO.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.13 $PSTMSETALGOOK

Message sent in response to command $PSTMGETALGO.

Synopsis:

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

Arguments:

Table 122. $PSTMSETALGOOK field description

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:

Message sent in case of successful operation.

11.5.14 $PSTMSETALGOERROR

Message sent in response to command $PSTMSETALGO.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.15 $PSTMGETRTCTIME

Message sent in response to command $PSTMGETRTCTIME.

Synopsis:

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

Arguments:

Table 123. $PSTMGETRTCTIME message field description

Parameter	Format	Description
time	hhmmss.mms	Current time read on RTC.

Parameter	Format	Description
date	ddmmyy	Current date read on RTC.
rtc_status	Decimal, 1 digit	Status: 0 - RTC_STATUS_INVALID 1 - RTC_STATUS_STORED 2 - RTC_STATUS_APPROXIMATE
time_validity	Decimal, 1 digit	Validity: 0 - NO_TIME 1 - FLASH_TIME 2 - USER_TIME 3 - USER_RTC_TIME 4 - RTC_TIME 5 - RTC_TIME_ACCURATE 6 - APPROX_TIME 8 - ACCURATE_TIME 9 - POSITION_TIME 10 - EPHEMERIS_TIME

Results:
None.

11.5.16 $PSTMDATUMSELECTOK

Message sent in response to command $PSTMDATUMSELECT.
Synopsis:

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

Arguments:

Table 124. $PSTMDATUMSELECTOK field description

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

Results:
None

11.5.17 $PSTMDATUMSELECTERROR

Message sent in response to command $PSTMDATUMSELECT
Synopsis:

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

Arguments:
None
Result:
None

11.5.18 $PSTMDATUMSETPARAMOK

Message sent in response to command $PSTMDATUMSETPARAM

Synopsis:

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

Arguments:

None

Result:

Message sent in case of successful operation.

11.5.19 $PSTMDATUMSETPARAMERROR

Message sent in response to command $PSTMDATUMSETPARAM

Synopsis:

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

Arguments:

None

Result:

None

11.5.20 $PSTMPOSITIONHOLDENABLED

Message sent in response to command $PSTMENABLEPOSITIONHOLD

Synopsis:

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

Arguments:

None

Results:

None

11.5.21 $PSTMPOSITIONHOLDDISABLED

Message sent in response to command $PSTMENABLEPOSITIONHOLD.

Synopsis:

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

Arguments:

None

Results:

None

11.5.22 $PSTMENABLEPOSITIONHOLDERROR

Message sent in response to command $PSTMENABLEPOSITIONHOLD

Synopsis:

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

Arguments:

None

Results:

None

11.5.23 $PSTMSETCONSTMASKOK

Message sent in response to command $PSTMSETCONSTMASK

Synopsis:

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

Arguments:

Table 125. $PSTMSETCONSTMASKOK message field description

Parameter	Format	Description
constellation_mask	Decimal, 1 digit	It is a bit mask where each bit enables/disables a specific constellation independently of 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:

Message sent in case of successful operation.

11.5.24 $PSTMSETCONSTMASKERROR

Message sent in response to command $PSTMSETCONSTMASK

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.25 $PSTMPPS

Message sent in response to command $PSTMPPS

Synopsis:

```
$PSTMPPS,1,<cmd_type>,<par_1>,\xc9 ,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 126. $PSTMPPS field description

Parameter	Format	Description
1	Decimal, 1 digit	1 = GET operation (to get data from 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

Parameter	Format	Description
		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 \xc9 par_N		Parameters list according to the command type specification (see below).

11.5.25.1 *PPS Get PPS_IF_PULSE_DATA_CMD*

Synopsis:

```
$PSTMPPS,1,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_duration>,<pulse_polarity>*<checksum><cr><lf>
```

Arguments:

Table 127. $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD

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(1) 4 = GPS_UTC_FROM_GLONASS(2) 5 =BEIDOU_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = Not inverted. 1 = Inverted.

1. *UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.*
2. *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.*

11.5.25.2 *PPS Get PPS_IF_TIMING_DATA_CMD*

Synopsis:

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

Arguments:

Table 128. $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD

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 bit3 = BEIDOU bit7 = Galileo
gps_rf_delay	Decimal	GPS path RF delay [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]

11.5.25.3 *PPS Get PPS_IF_POSITION_HOLD_DATA_CMD*

Synopsis:

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

Arguments:

Table 129. $PSTMPPS field description on PPS_IF_POSITION_HOLD_DATA_CMD

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.

11.5.25.4 *PPS Get PPS_IF_TRAIM_CMD*

Synopsis:

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

Arguments:

Table 130. $PSTMPPS field description on PPS_IF_TRAIM_CMD

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.

11.5.25.5 *PPS Get PPS_IF_TRAIM_USED_CMD*

Synopsis:

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

Arguments:

Table 131. $PSTMPPS field description on PPS_IF_TRAIM_USED_CMD

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

11.5.25.6 *PPS Get PPS_IF_TRAIM_RES_CMD*

Synopsis:

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

Arguments:

Table 132. $PSTMPPS field description on PPS_IF_TRAIM_RES_CMD

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].

Parameter	Format	Description
		Each residual corresponds to the satellite in the used sat list at the same message position.

11.5.25.7 *PPS Get PPS_IF_TRAIM_REMOVED_CMD*

Synopsis:

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

Arguments:

Table 133. $PSTMPPS field description on PPS_IF_TRAIM_REMOVED_CMD

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

11.5.26 $PSTMPPSERROR

Message sent in response to command $PSTMPPS

Synopsis:

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

Arguments:

None

Results:

Message is sent in case of errors

11.5.27 $PSTMFORCESTANDBYOK

Message sent in response to command $PSTMFORCESTANDBY

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

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of successful operation.

11.5.28 $PSTMFORCESTANDBYERROR

Message sent in response to command $PSTMFORCESTANDBY

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

Synopsis:

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

Arguments:

No arguments

Results:
Message is sent in case of error

11.5.29 $PSTMGALILEODUMPGGTO

Message sent in response to command $PSTMGALILEODUMPGGTO
Synopsis:

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

Arguments:

Table 134. $PSTMGALILEODUMPGGTO message field description

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

Results:
No result

11.5.30 $PSTMSETTHTRKOK

Message sent in response to command $PSTMSETTHTRK
Synopsis:

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

Arguments:
No argument
Results:
Message is sent in case of successful operation.

11.5.31 $PSTMSETTHTRKERROR

Message sent in response to command $PSTMSETTHTRK
Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of error

11.5.32 $PSTMSETTHPOSOK

Message sent in response to command $PSTMSETTHPOS
Synopsis:

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

Arguments:
No arguments
Results:
Message is sent in case of successful operation.

11.5.33 $PSTMSETTHPOSERROR

Message sent in response to command $PSTMSETTHPOS
Synopsis:

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

Arguments:
No arguments
Results:
Message sent in case of errors

11.5.34 $PSTMVER

Message sent in response to command $PSTMGETSWVER
Synopsis:

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

Arguments:

Table 135. $PSTMVER field specification

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 BINIMG if type = 6 SWCFG if type = 11 PID if type = 12
Ver	x.x.x.x	GNSS Library Version: example 7.1.1.15
Type	ARM, GNU	Compiler Type: ARM or GNU

Example:

```
$PSTMGETSWVER,0*<checksum><cr><lf>
```

Note: If any id is passed as parameter to the command, its output acts as in the id = 0 case
When id is 255 consecutive messages are sent reporting the library version string on each line following the above message syntax.
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>
```

Arguments:

Table 136. **$PSTMSWCONFIG field specification**

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: The HW version has the following syntax:

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

Table 137. **HW_SIGNATURE_STRING description**

HW_SIGNATURE_STRING	STA8088 HW
0x2229D041	BB Mask
0x3229D041	BC Mask
HW_SIGNATURE_STRING	STA8089 and STA8090 HW
0x122BC043	AA Mask
0x222BC043	AB Mask
0x322BC043	BA Mask
0x422BC043	BB Mask
0x522BC043	BC Mask
0x622BC043	BD Mask

11.5.35 $PSTMRF

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

Synopsis:

```
$PSTMRF,<MessgAmount>,<MessgIndex>,<used_sats>, [<Sat1ID>,<Sat1PhN>,<Sat1Freq>,<Sat1CN0>],
[<Sat2ID>,<Sat2PhN>,<Sat2Freq>,<Sat2CN0>], [<Sat3ID>,<Sat3PhN>,<Sat3Freq>,<Sat3CN0>],
*<checksum><cr><lf>
```

Arguments:

Table 138. **$PSTMRF message field description**

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

Parameter	Format	Description
SatxCN0	Decimal, 2 digits	Satellite x Carrier to Noise Ratio (in dB)

Results:
None

11.5.36 $PSTMTESTRF

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

Synopsis:

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

Arguments:

Table 139. $PSTMTESTRF message field description

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)

Results:
None

11.5.37 $PSTMTG (Teseo-LIV3F)

Time and Satellites Information

Synopsis:

```
$PSTMTG,<Week>,<TOW>,<TotSat>,<CPUTime><Timevalid><NCO><kf_config_status><constellation_mask>
<time_best_sat_type><time_master_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_validity>*
```

Arguments:

Table 140. $PSTMTG message field description

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"

Parameter	Format	Description
		8 = time accurate 9 = position time 10 = Ephemeris time
NCO	Decimal, 9 digits	NCO value
kf_config_status	Hexadecimal, 2 digits	Kalman Filter Configuration For each bit: • 0 means feature disabled • 1 means feature enabled See Table 141
constellation_mask	Decimal, 3 digits max	It is a bit mask where each bit enables/disables a specific constellation independently of 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
time_best_sat_type	Decimal	Selected best time satellite type
time_master_sat_type	Decimal	Master time satellite type
time_aux_sat_type	Decimal	Auxiliary time satellite type
time_master_week_n	Decimal	Master time week number
time_master_tow	Floating	Master time TOW
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

Table 141. $PSTMTG Kalman Filter Configuration

Bit	Configuration
0	Walking mode ON
1	Stop Detection ON
2	Frequency Ramp On (only Xtal mode)
3	Velocity estimator model: • 1 means MULTIPLE MODEL • 0 means SINGLE MODEL
4	Velocity estimator filter: • 1 means SLOW • 0 means FAST
5	FDE Status ON

Results:
None

11.5.38 $PSTMTS (Teseo-LIV3F)

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

Synopsis:

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

Arguments:

Table 142. $PSTMTS message field description

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 used 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.

Results:

None

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,-699.61,22
0.74,2983.68,23248.85,8.12,1,-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,-1394.03,22
94.91,251.81,70766.81,5.72,1,-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,-30401.97,1,44,298264,1,17539544.73,16864817.03,10440026.12,394.97,1
346.12,-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,
```

11.5.39 $PSTMTG (Teseo-LIV3FL)

Time and satellites information

Synopsis:

```
$PSTMTG,<Week>,<TOW>,<TotSat>,<CPUTime><Timevalid><NCO><config_status>,
<tow_delta>,<req_tow_delta>,<cpu_time_p>,<req_cpu_time>,
<constellation_mask>,<time_best_sat_type>,<time_master_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_validity>*<checksum><cr><lf>
```

Arguments:

Table 143. $PSTMTG (CP binary) message field description

Parameter	Format	Description
Week	Decimal, 4 digits	Week number

<table>
<tr><th>Parameter</th><th>Format</th><th colspan="2">Description</th></tr>
<tr><td>TOW</td><td>Decimal, 12 digits</td><td colspan="2">Time of week</td></tr>
<tr><td>Tot-Sat</td><td>Decimal, 2 digits</td><td colspan="2">Total number of satellites used for fix</td></tr>
<tr><td>CPU-Time</td><td>Decimal, 10 digits</td><td colspan="2">CPU time</td></tr>
<tr><td>Timevalid</td><td>Decimal, 2 digits</td><td colspan="2">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</td></tr>
<tr><td>NCO</td><td>Decimal, 9 digits</td><td colspan="2">NCO value
If clock steering is enabled this value shall be used in the Doppler calculation (instead of the nominal values).</td></tr>
<tr><td rowspan="10">Config_status</td><td rowspan="10">Hexadecimal, 4 digits</td><td colspan="2">Kalman filter configuration</td></tr>
<tr><td>Bit</td><td>Configuration</td></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>
<tr><td>[7 : 6]</td><td>Reserved</td></tr>
<tr><td>[11 : 8]</td><td>Front end frequency:
• means 48 MHz
• means 26 MHz</td></tr>
<tr><td>[15 : 12]</td><td>$PSTMTG and $PSTMTS version and clock sterring indicator</td></tr>
<tr><td>tow_delta</td><td>Floating</td><td colspan="2">Measurement TOW propagation</td></tr>
<tr><td>req_tow_delta</td><td>Floating</td><td colspan="2">Requested meas. TOW propagation</td></tr>
<tr><td>cpu_time_p</td><td>Decimal</td><td colspan="2">Propagated meas. CPU time</td></tr>
<tr><td>req_cpu_time</td><td>Decimal</td><td colspan="2">Requested meas. CPU time</td></tr>
<tr><td>constellation_mask</td><td>Decimal, 3 digits max</td><td colspan="2">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</td></tr>
</table>

Parameter	Format	Description
		bit 7: BAIDEU constellation enabling/disabling
time_best_sat_type	Decimal	Selected best time satellite type
time_master_sat_type	Decimal	Master time satellite type
time_aux_sat_type	Decimal	Auxiliary time satellite type
time_master_week_n	Decimal	Master time week number
time_master_tow	Floating	Master time TOW
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

Time of week (TOW) pre-processing

The actual TOW measure (*TOW**) can be calculated from the *TOW* and *tow_delta* fields of the $PSTMTG message in the following way:

TOW*=TOW+tow_delta/C

Where C is the speed of light in vacuum (299,792,458 m/s).

Results:

None

11.5.40 $PSTMTS (Teseo-LIV3FL)

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

Synopsis:

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

Arguments:

Table 144. $PSTMTS (CP) message field description

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		
cp	Floating	Carrier phase measurement (cycles)		
flags	Decimal, 1 digit	**Bits**	**Values**	**Descriptions**
		[0]	• 1: locked • 0: unlocked	Preamble-locked
		[1]	• 1: valid	Multi-path indicator validity

Parameter	Format	Description		
			• 0: invalid	
		[3 : 2]	• 0: no MP • 1: • 2: • 3: strong MP	Multi-path strength
		[4]	• 0: normal • 1: inverted	Polarity
		[5]	• 1: valid • 0: invalid	Carrier phase validity
		[6]	• 0 = unknown • 1 = solved	Half cycle ambiguity
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		
Rrc	Floating	Range rate correction		
Pr_delta	Floating	Pseudorange propagation		
Cp_delta	Floating	Carrier Phase propagation		
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 station)		
codeNoise	Integer	Moving average of the code-loop discriminator error in arbitrary units. Typical abs < 2000.		
phaseNoise	Integer	Moving average of the error used to update the carrier loop in arbitrary units. Typical range from 1 to 10 k		
Cycle_slip_cnt	Integer	Total cycle slip counter		

Parameter	Format	Description
Glonass_slot	Integer	GLONASS satellite slot number (from 1 to 24), if available; otherwise 0

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

Pseudo range pre-processing

The actual pseudo range measure (*PR**) can be calculated from the *PsR* and *pr_delta* fields of the $PSTMTS message in the following way:

PR*=PsR+pr_delta

Carrier phase pre-processing

The actual carrier phase measure (CP*) can be calculated from the cp and cp_delta fields of the $PSTMTS message in the following way:

CP*=-(cp+cp_delta)

Doppler pre-processing

The actual Doppler measure (*D**) can be calculated from the *Freq* field of the $PSTMTS message and from *Front end frequency* bit in the *config_status* field of the $PSTMTG message the in the following way:

$D^*=Freq-clock_{GPS}$

Where clockGPS can be obtained from the following table:

Table 145. F.E. frequency bit meaning

Front end frequency bit	clockGPS
0 (= 26 MHz)	-47122.395833492279 Hz
1 (= 48 MHz)	-40526.315789699554 Hz

When clock steering is active (bit 3 in the version field of the TG sentence set to '1'), then the rate of the fundamental time frame used to trigger the measurement epochs is adjusted (steered), such that no millisecond jump will happen in the observables. This rate is reported in the NCO field of the $PSTMTG sentence and can be used as an accurate value of $\boldsymbol{clock_{GPS}}$.

The BeiDou signals on Teseo III are received with inverted spectrum. For this reason, carrier phase and Doppler must be sign-inverted. The formulas to compute the Doppler and the corrected carrier phase for a BeiDou satellite shall be modified as follows (B1 = 1561.098 MHz, L1 = 1575.42 MHz):

$D^*=-(Freq+clock_{GPS}*B1/L1)$

CP=+(cp+cp_delta)*

GLONASS Sat-ID

The index for GLONASS frequency channels is function of the SV identifier Sat-ID (which is reported in measurement $PSTMTS message). It can be determined using the following lookup table.

Table 146. GLONASS Sat ID vs frequency channel ID (K) association

K	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Id	65	66	67	68	69	10	71	72	73	74	75	76	77	78
Id	19	80	81	82	83	84	85	86	87	88	89	90	91	92

BeiDou Sat-ID

When the satellite ID reported on $PSTMTS message is included in the range from 141 to 170, then that sentence refers to a BeiDou satellite. In that case the BeiDou PRN numbers can be determined by subtracting 140 to the satellite ID got from the $PSTMTS sentence.

Results:

None

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,
```

11.5.41 $PSTMPA

Position Algorithm

Synopsis:

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

Arguments:

Table 147. $PSTMPA message field description

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)

Results:

None

Example:

```
$PSTMPA,KF,433*<checksum><cr><lf>$PSTMPA,  ,00*<checksum><cr><lf>
```

11.5.42 $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.

Synopsis:

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

Arguments:

Table 148. $PSTMSAT message field description

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

Results:
None

11.5.43 $PSTMPRES

Position Residual

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

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 149. $PSTMPRES message field description

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)

Results:
None

Example:

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

```
$PSTMPRES,0.0,,,,,,,,,,,,,*20
```

11.5.44 $PSTMVRES

Velocity Residual

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

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 150. **$PSTMVRES message field description**

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)

Results:

None

Example:

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

11.5.45 $PSTMNOISE

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

Synopsis:

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

Arguments:

Table 151. **$PSTMNOISE message field description**

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

Results:

None

11.5.46 $PSTMCPU

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

Synopsis:

```
$PSTMCPU,<CPU_Usage>,-1,<CPU_Speed>*<checksum><cr><lf>
```

Arguments:

Table 152. **$PSTMCPU message field description**

Parameter	Format	Description
CPU_Usage	ddd.dd	CPU usage %
CPU_Speed	Decimal, 1 digit	CPU clock frequency: 52, 104, 156, 208 MHz.

Results:

None

11.5.47 $PSTMPPSDATA

Reports the Pulse Per Second data

Synopsis:

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

Arguments:

Table 153. **$PSTMPPSDATA message field description**

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(1) 4 = GPS_UTC_FROM_GLONASS(2)
ref_constellation(3)	Decimal, 1 digit	0 = GPS 1 = GLONASS
pulse_duration	Double	Pulse duration [s]
pulse_delay	Decimal	Pulse delay [ns]
gps_delay	Decimal	GPS path RF delay [ns]
glo_delay	Decimal	GLONASS path RF delay [ns]
bei_delay(4)	Decimal	BEIDOU path RF delay [ns]
gal_delay	Decimal	GALILEO 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

Parameter	Format	Description
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]
galileo_utc_delat_ns	Decimal	UTC – GALILEO 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]

1. *UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.*
2. *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.*
3. *The reference constellation reports which reference time has been used for the PPS generation.*
4. *This parameter is always zero if Beidou constellation is not supported by the hardware platform.*

Results:
None

11.5.48 $PSTMPOSHOLD

Reports the Position Hold status and position.

Synopsis:

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

Arguments:

Table 154. $PSTMPOSHOLD message field description

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:

Parameter	Format	Description
		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

Results:
None

11.5.49 $PSTMTRAIMSTATUS

Reports the TRAIM algorithm status.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 155. $PSTMTRAIMSTATUS message field description

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.

Results:
None

11.5.50 $PSTMTRAIMUSED

Reports the satellite used for timing correction.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

```
$PSTMTRAIMUSED,<on_off>,<used_sats>,<sat1>,...,<satN>*<checksum><cr><lf>
```

Arguments:

Table 156. **$PSTMTRAIMUSED message field description**

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.

11.5.51 $PSTMTRAIMRES

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

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 157. **$PSTMTRAIMRES message field description**

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 refers to the satellite in the same message position.

11.5.52 $PSTMTRAIMREMOVED

Reports the satellite removed by the timing correction algorithm.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 158. **$PSTMTRAIMREMOVED message field description**

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.

11.5.53 $PSTMKFCOV

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

Synopsis:

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

Arguments:

Table 159. $PSTMKFCOV message field description

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
```

11.5.54 $PSTMTIM

Time Validity.

Synopsis:

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

Arguments:

Table 160. $PSTMTIM message field description

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

11.5.55 $PSTMDIFF

Time Validity.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 161. **$PSTMDIFF message field description**

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

11.5.56 $PSTMSBAS

SBAS Satellite Data.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 162. **$PSTMSBAS message field description**

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)

Example:

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

11.5.57 $PSTMSBASM

SBAS Frame.

Synopsis:

```
$PSTMSBASM,<prn><sbas_frame>*<checksum><cr><lf>
```

Arguments:

Table 163. **$PSTMSBASM message field description**

Parameter	Format	Description
prn	Decimal, 3 digits	Satellite PRN (Range: from 120 to 140)
sbas_frame	Hexadecimal, 64 digits	SBAS frame (250 bits + 6 padding)

Example:

```
$PSTMSBASM,123,536A481B40D8063829C12E08704B82DFFDFFEFFF7FFBFFDFFEF06E8037EFB440*6D
```

11.5.58 $PSTMNOTCHSTATUS

This message provides 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>*<checksum><cr><lf>
```

Arguments:

Table 164. $PSTMNOTCHSTATUS message field description

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

11.5.59 $PSTMLOWPOWERDATA

Reports the status of adaptive low power algorithm.

Synopsis:

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

Arguments:

Table 165. $PSTMLOWPOWERDATA message field description

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.

11.5.60 $PSTMSTANDBYENABLE

Message sent in response to command $PSTMSTANDBYENABLEnot found.

Synopsis:

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

Arguments:

Table 166. $PSTMSTANDBYENABLE message field description

Parameter	Format	Description
status	Decimal, 1 digits	Set the standby enable status 0: Active Periodic mode 1: Periodic mode, standby allowed

Results:

- Message sent in case of successful operation.

11.5.61 $PSTMSTANDBYENABLEOK

Message sent in response to command $PSTMSTANDBYENABLE

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.5.62 $PSTMSTANDBYENABLEERROR

Message sent in response to command $PSTMSTANDBYENABLE

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.63 $PSTMPV

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

Synopsis:

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

Arguments:

Table 167. $PSTMPV message field description

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]

Parameter	Format	Description
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]

Example:

```
$PSTMPV,160635.000,4055.10928,N,01416.56027,E,026.96,M,0.2,0.0,0.1,22.6,12.8,5.8,17.2,10.9,18
.8,5.5,4.1,1.7,4.6,0.0,2.7*70
```

11.5.64 $PSTMPVRAW

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

Synopsis:

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

Arguments:

Table 168. $PSTMPVRAW message field description

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

Parameter	Format	Description
		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]

Example:

```
$PSTMPVRAW,144056.000,5131.12414,N,00005.31484,W,2,09,1.2,043.31,M,47.0,M,-0.6,0.1,0.6*58
```

11.5.65 $PSTMPVQ

Provides position and velocity processing noise matrix values.

Synopsis:

```
$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>
```

Arguments:

Table 169. $PSTMPVQ message field description

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

Example:

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

11.5.66 $PSTMUTC

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

Synopsis:

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

Arguments:

Table 170. $PSTMUTC message field description

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
```

11.5.67 $PSTMNAVM

Navigation Data Frame.

Synopsis:

```
$PSTMNAVM,<msg_id>,<prn>,<nav_frame>*<checksum><cr><lf>
```

Arguments:

Table 171. $PSTMNAVM message field description

Parameter	Format	Description
msg_id	Decimal, 1 digits	Message ID (GPS = 0, GLONASS = 1, GALILEO = 3, BEIDOU = 7)
prn	Decimal, 3 digits	Satellite PRN (Range: depending on the constellation)
nav_frame	Hexadecimal, up to 80 digits	Navigation data frame (length: depending on the constellation)

Details:

The navigation frame parameter depends on the constellation. The following table describes its meaning (see each constellation ICD document for details):

Table 172. Navigation frame data types

Constellation	Type	Length (bits)	Length (bytes)	Note
GPS	Sub-frame	300	40 (10 words)	For each 32 bit word 30 bits are used (the 2 msb are ignored)
GLONASS	1 or 2 strings	85 or 170 (85+85)	11 or 22 (11+11 bytes)	One string for each message for strings from 1 to 5. Two strings for each message for strings from 6 to 15.

Constellation	Type	Length (bits)	Length (bytes)	Note
				For the first byte of each string the 3 msb are ignored and the 4th is always zero. The payload is 84 bits long
GALILEO	payload	128	16 (4 words)	Each message contains the payload from I/NAV message (see Note for details)
BEIDOU	Sub-frame	300	40 (10 words)	For each 32 bit word 30 bits are used (the 2 msb are ignored)

Note: In the above table, "word" means a 32-bit little endian encoded word, while "msb" means most significant bit(s). It means that, in a little endian architecture system, the navigation frame (converted to binary format) can be directly copied into a C 32 bit unsigned integer words array. In other words:

- *For GPS, the navigation frame can be copied into a C language variable defined according to the following type definition:*

```
typedef tU32 gps_subframe_t [10];
```

- *For GLONASS, the navigation frame can be copied into a C language variable defined according to the following type definition:*

```
typedef tU08 glo_subframe_t [22];
```

Note: For strings for #1 to #5 just the first 11 bytes will be used, while for strings from #6 to #15 all 22 bytes will be used by storing two consecutive strings (e.g. strings #7 and #6). In this latter case the first sting (e.g. string #n) will be stored in the second part of the array (i.e. from byte #12 to #22), and the second string (e.g. string #n+1) will be stored in the first part of the array (i.e. from byte #1 to #11).

- *For GALILEO, the navigation frame can be copied in a C language variable defined according to the following type definition:*

```
typedef tU32  gal_subframe_t  [4];
```

Note: The GALILEO navigation frame contains the message payload, encoded according to the following Table 173.

Table 173. Galileo payload, 128[bit], 32-bit packing

BIT PACKING																															
	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Data k 0-31 (112 bit)																															
1	Data k 32-63 (112 bit)																															
2	Data k 64-95 (112 bit)																															
3	Data k 96-111 (112 bit)																Data j (16 bit)														

For BEIDOU, the navigation frame can be copied in a C language variable defined according to the following type definition:

```
typedef tU32  bds_subframe_t  [10];
```

where tU32 is a 32 bit unsigned integer type and tU08 is a 8 bit unsigned integer type.

Example:

```
$PSTMNAVM,0,4,00AFC32268A9BD26337FF43AC40B60D1B8B80018C8EE0B0330BDA238AF711D185E1000C088790781*23
```

11.5.68 $PSTMEPHEM

Ephemeris Data Dump.

This message is sent as a reply to a $PSTMDUMPEPHEMS command.

Synopsis:

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

Arguments:

Table 174. $PSTMEPHEM message field description

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

The N Bytes that are in the message are the dump of a structure that contains all the information of the ephemeris.

Data formats are constellation dependant.

Table 175. $PSTMEPHEM message field description for GPS constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch
16	toc	Time of week for clock epoch
8	iode1	Issue of data 1
8	iode2	Issue of data 2
10	iodc	Issue of data clock
14	i_dot	Rate of inclination angle
8	RESERVED	
24	omega_dot	Rate of right ascension
8	RESERVED	Must be 0
16	crs	Amplitude of the sine harmonic correction to the orbit radius
16	crc	Amplitude of the cosine harmonic correction to the orbit radius
16	cus	Amplitude of the sine harmonic correction to the argument of latitude
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude
16	cis	Amplitude of the sine harmonic correction to the angle of inclination
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination
16	motion_difference	Mean motion difference from computed value
16	RESERVED	Must be 0
32	inclination	Inclination angle at reference time
32	e	Eccentricity
32	root_A	Square root of major axis
32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
8	time_group_delay	Estimated group delay differential
8	af2	Second order clock correction

Bits	Structure Member	Description
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

Table 176. $PSTMEPHEM message field description for GLONASS constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch
4	toe_lsb	Time of week for ephemeris epoch (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\xc9 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

Bits	Structure Member	Description
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	

Table 177. $PSTMEPHEM message field description for Galileo constellation

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

Bits	Structure Member	Description
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

Table 178. $PSTMEPHEM message field description for BEIDOU constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity
32	root_a	Square root of major axis
32	mean_anomaly	Mean anomaly at reference time
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch
32	perigee	Argument of perigee
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension
8	A0	Ionospheric Delay Model Parameter α_0
24	af0	Constant clock correction
8	A1	Ionospheric Delay Model Parameter α_1
20	sow	Seconds of week

Bits	Structure Member	Description
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

11.5.69 $PSTMALMANAC

Almanac Data Dump.

This message is sent as a reply to a $PSTMDUMPALMANAC command.

Synopsis:

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

Arguments:

Table 179. $PSTMALMANAC message field description

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

The N Bytes that are in the message are the dump of a structure that contains all the information of the almanac. Data formats is constellation dependent

Table 180. $PSTMALMANAC message field description for GPS constellation

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.

Table 181. $PSTMALMANAC field description for GLONASS constellation

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\xc9 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.

Bits	Structure Member	Description
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	

Table 182. $PSTMALMANAC field description for Galileo constellation

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.

11.5.70 $PSTMGPSSUSPENDED

Message sent in response to command $PSTMGPSSUSPEND

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.71 $PSTMUSEDSATS

This message reports the number of used satellites for each constellation.
NMEA message list bitmask (64 bits): 0000 0040 0000 0000
Synopsis:

```
$PSTMUSEDSATS,<GPS_n>,<GLONASS_n>,<GALILEO_n>,<BEIDOU_n>,<QZSS_n>*<checksum><cr><lf>
```

Arguments:

Table 183. $PSTMUSEDSATS message field description

Parameter	Format	Description
GPS_n	Decimal, 2 digits	Number of used satellites of the GPS constellation
GLONASS_n	Decimal, 2 digits	Number of used satellites of the GLONASS constellation
GALILEO_n	Decimal, 2 digits	Number of used satellites of the GALILEO constellation
BEIDOU_n	Decimal, 2 digits	Number of used satellites of the BEIDOU constellation
QZSS_n	Decimal, 2 digits	Number of used satellites of the QZSS constellation

Results:
None.
Example:

```
$PSTMUSEDSATS,08,07,00,00,00*2B
```

11.5.72 $PSTMGETUCODEOK

Message sent in response to command $PSTMGETUCODE
Synopsis:

```
$PSTMGETUCODEOK,<unique_code>*<checksum><cr><lf>
```

Arguments:

Table 184. $PSTMGETUCODEOK message field description

Parameter	Format	Description
unique_code	Char, 32 bytes	The Unique ID written in the secondary boots

Results:
Message sent in case of successful operation.

11.5.73 $PSTMGETUCODEERROR

Message sent in response to command $PSTMGETUCODE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.5.74 $PSTMEPHEMOK

Message sent in response to command $PSTMEPHEM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.5.75 $PSTMEPHEMERROR

Message sent in response to command $PSTMEPHEM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.5.76 $PSTMALMANACOK

Message sent in response to command $PSTMALMANAC

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.5.77 $PSTMALMANACERROR

Message sent in response to command $PSTMALMANAC

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of errors.

11.5.78 $PSTMLOWPOWERON

Message sent in response of command $PSTMLOWPOWERONOFF

Synopsis:

```
$PSTMLOWPOWERON,<EHPE_threshold>,<Max_tracked_sats>,<Switch_constellation_features>,<Duty_Cycle_enable>,<Duty_Cycle_fix_period>,<Periodic_mode>,<Fix_period>,<Number_of_fix>,<Ephemeris_refresh>,<RTC_refresh>,<No_Fix_timeout>,<No_Fix_timeout_Off_duration>*<checksum><cr><lf>
```

Arguments:

Table 185. **$PSTMLOWPOWERON message field description**

Parameter	Format	Description
Adaptive mode settings		
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 digits	Switch constellation features (enable it only for GNSS constellation case)
Cyclic mode settings		
Duty Cycle enable/disable	Decimal, 1 digits	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:
Message sent in case of succesfull operation.

11.5.79 $PSTMLOWPOWERERROR

Message sent in response to command $PSTMLOWPOWERONOFF
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of errors.

11.6 ST system configuration messages

11.6.1 $PSTMSETPAROK

Message sent in response to command $PSTMSETPAR
Synopsis:

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

Arguments:

Table 186. **$PSTMSETPAROK message field description**

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of the 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)

Results:
Message sent in case of successful operation.

11.6.2 $PSTMSETPARERROR

Message sent in response to command $PSTMSETPAR
Synopsis:

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

Argument:
No argument
Results:
Message sent in case of error.

11.6.3 $PSTMRESTOREPAROK

Message sent in response to command $PSTMRESTOREPAR
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.4 $PSTMRESTOREPARERROR

Message sent in response to command $PSTMRESTOREPAR
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.5 $PSTMSAVEPAROK

Message sent in response to command $PSTMSAVEPAR
Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.6 $PSTMSAVEPARERROR

Message sent in response to command $PSTMSAVEPAR

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.7 $PSTMSETPAR

Message sent in response to command $PSTMGETPAR

Synopsis:

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

Arguments:

Table 187. $PSTMSETPAR message field description

Parameter	Format	Description
ConfigBlock	Decima1, 1 digit	Indicates one of the 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).

11.6.8 $PSTMGETPARERROR

Message sent in response to command $PSTMGETPAR.

Synopsis:

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

Arguments:

No aruments

Results:

- In case of errors, the error message is returned

11.6.9 $PSTMCFGPORTOK

Message sent in response to command $PSTMCFGPORT

Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.10 $PSTMCFGPORTERROR

Message sent in response to command $PSTMCFGPORT
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.11 $PSTMCFGMSGLOK

Message sent in response to command $PSTMCFGMSGL
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.12 $PSTMCFGMSGLERROR

Message sent in response to command $PSTMCFGMSGL
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.13 $PSTMCFGGNSSOK

Message sent in response to command $PSTMCFGGNSS
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.14 $PSTMCFGGNSSERROR

Message sent in response to command $PSTMCFGGNSS

Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.15 $PSTMCFGSBASOK

Message sent in response to command $PSTMCFGSBAS
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.16 $PSTMCFGSBASERROR

Message sent in response to command $PSTMCFGSBAS
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.17 $PSTMCFGPPSGENOK

Message sent in response to command $PSTMCFGPPSGEN
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.18 $PSTMCFGPPSGENERROR

Message sent in response to command $PSTMCFGPPSGEN
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.19 $PSTMCFGPPSSATOK

Message sent in response to command $PSTMCFGPPSSAT

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.20 $PSTMCFGPPSSATERROR

Message sent in response to command $PSTMCFGPPSSAT

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.21 $PSTMCFGPPSPULOK

Message sent in response to command $PSTMCFGPPSPUL

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.22 $PSTMCFGPPSPULERROR

Message sent in response to command $PSTMCFGPPSPUL

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.23 $PSTMCFGPOSHOLDOK

Message sent in response to command $PSTMCFGPOSHOLD

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.24 $PSTMCFGPOSHOLDERROR

Message sent in response to command $PSTMCFGPOSHOLD

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.25 $PSTMCFGTRAIMOK

Message sent in response to command $PSTMCFGTRAIM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.26 $PSTMCFGTRAIMERROR

Message sent in response to command $PSTMCFGTRAIM

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.27 $PSTMCFGSATCOMPOK

Message sent in response to command $PSTMCFGSATCOMP

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.28 $PSTMCFGSATCOMERROR

Message sent in response to command $PSTMCFGSATCOMP

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.29 $PSTMCFGLPAOK

Message sent in response to command $PSTMCFGLPA

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.30 $PSTMCFGLPAERROR

Message sent in response to command $PSTMCFGLPA

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.31 $PSTMCFGAGPSOK

Message sent in response to command $PSTMCFGAGPS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.32 $PSTMCFGAGPSERROR

Message sent in response to command $PSTMCFGAGPS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.33 $PSTMCFGAJMOK

Message sent in response to command $PSTMCFGAJM

Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.34 $PSTMCFGAJMERROR

Message sent in response to command $PSTMCFGAJM
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.35 $PSTMCFGODOOK

Message sent in response to command $PSTMCFGODO
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.36 $PSTMCFGODOERROR

Message sent in response to command $PSTMCFGODO
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.37 $PSTMCFGLOGOK

Message sent in response to command $PSTMCFGLOG
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.38 $PSTMCFGLOGERROR

Message sent in response to command $PSTMCFGLOG

Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.39 $PSTMCFGGEOFENCEOK

Message sent in response to command $PSTMCFGGEOFENCE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.40 $PSTMCFGGEOFENCEERROR

Message sent in response to command $PSTMCFGGEOFENCE
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.41 $PSTMCFGGEOCIROK

Message sent in response to command $PSTMCFGGEOCIR
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of successful operation.

11.6.42 $PSTMCFGGEOCIRERROR

Message sent in response to command $PSTMCFGGEOCIR
Synopsis:

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

Arguments:
None.
Results:
Message sent in case of error.

11.6.43 $PSTMCFGGNSSOK

Message sent in response to command $PSTMCFGGNSS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.44 $PSTMCFGGNSSERROR

Message sent in response to command $PSTMCFGGNSS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.45 $PSTMCFGCONSTOK

Message sent in response to command $PSTMCFGCONST

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.46 $PSTMCFGCONSTERROR

Message sent in response to command $PSTMCFGCONST

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.47 $PSTMCFGTHGNSSOK

Message sent in response to command $PSTMCFGTHGNSS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

11.6.48 $PSTMCFGTHGNSSERROR

Message sent in response to command $PSTMCFGTHGNSS

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

11.6.49 $PSTMCFGTDATAOK

Message sent in response to command $PSTMCFGTDATA

Synopsis:

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

Arguments:

None.

Results:

"Message sent in case of successful operation.

11.6.50 $PSTMCFGTDATAERROR

Message sent in response to command $PSTMCFGTDATA

Synopsis:

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

Arguments:

None.

Results:

"Message sent in case of error.

11.7 Datalogging NMEA messages

11.7.1 $PSTMLOGCREATEOK

Message sent in response to command $PSTMLOGCREATE

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.7.2 $PSTMLOGCREATEERROR

Message sent in response to command $PSTMLOGCREATE

Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of error.

11.7.3 $PSTMLOGSTARTOK

Message sent in response to command $PSTMLOGSTART
Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of successful operation.

11.7.4 $PSTMLOGSTARTERROR

Message sent in response to command $PSTMLOGSTART
Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of error.

11.7.5 $PSTMLOGSTOPOK

Message sent in response to command $PSTMLOGSTOP
Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of successful operation.

11.7.6 $PSTMLOGSTOPERROR

Message sent in response to command $PSTMLOGSTOP
Synopsis:

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

Arguments:
No argument
Results:
Message sent in case of error.

11.7.7 $PSTMLOGERASEOK

Message sent in response to command $PSTMLOGERASE

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.7.8 $PSTMLOGERASEERROR

Message sent in response to command $PSTMLOGERASE

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.7.9 $PSTMLOGSTATUS

Message sent by the GNSS Teseo Module in response to $PSTMLOGREQSTATUS the internal data log subsystem state.

This message is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMLOGSTATUS,<time-first-entry>,<data-first-entry>,<time-last-entry>,<data-last-
entry>,<used>,<bufer-status>,<free-entries>*<checksum><cr><lf>
```

Arguments:

Table 188. $PSTMLOGSTATUS message field description

Parameter	Format	Description
time-first-entry	Decimal, 6 Digits	The first entry timestamp as hhmmss
data-first-entry	Decimal, 8 Digits	The first entry date stamp as yyyyMMdd
time-last-entry	Decimal, 6 Digits	The last entry timestamp as hhmmss
data-last-entry	Decimal, 8 Digits	The last entry date stamp as yyyyMMdd
used	Unsigned	Used entries
buffer-status	Decimal, 1 Digit	Status of data buffer: 0 = non full 1 = full
free-entries	Unsigned	Remaing free entries

11.7.10 $PSTMLOGSTATUSERROR

Message sent in response to command $PSTMLOGREQSTATUS

Synopsis:

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

Arguments:

No argument

Results:
Message sent in case of error.

11.7.11 $PSTMLOGQUERY

This messages is sent by the ST GNSS Teseo Module in response to a query command $PSTMLOGREQQUERY.
GNSS Teseo sends a message for each entry in the log compliant to the query raised by the host.
This message is implemented and supported only in Binary Image 4.5.8 and later.
Synopsis:

```
$PSTMLOGQUERY,<status-bitmap>,<log-mask>,<timestamp>,<date-
stamp>,<altitude>,<odometer>,<geo>,<quality>,<qual-idx>,<fix>,<speed>*<checksum><cr><lf>
```

Arguments:

Table 189. $PSTMLOGQUERY message field description

Parameter	Format	Description
status-bitmap	Decimal	[1]: DataValid (DV) [0]: EndOfData (EOD)
log-mask	Decimal, 1 digit	Which dataset is logged
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
date-stamp	Decimal, 8 digits	Year (4 digit) Month (2 digit) Day (2 digit)
fix	Decimal, 1 digit	Fix status where: 1 = NO_FIX 2 = FIX_2D 3 = FIX 3D
quality	Unsigned	Estimation of accuracy (ehpe) expressed in meters. Note that in case of log-mask type = 1 this quality is expressed as IDx where 0 = (quality > 50) 1 = (quality > 40) 2 = (quality > 30) 3 = (quality > 20) 4 = (quality > 15) 5 = (quality > 10) 6 = (quality > 5) 7 = (quality > 2)
geo	Decimal, 1 digit	Geo fencing status where: 0 = Status unknown 1 = Current position is outside the circle 2 = Current position on circle boundary 3 = Current position is inside the circle
lat	Double	Current latitude

Parameter	Format	Description
lon	Double	Current longitude
alt	Double	Current altitude. It depends on log-mask. If disabled this value will be always zero. See Table 12 for more details
speed	Double	Current speed. It depends on log-mask. If disabled this value will be always zero. See Table 12 for more details
odo	Double	Current odometer data. It depends on log-mask. If disabled this value will be always zero. See Table 12 for more details

In the $PSTMLOGREQQUERY the bit-fields:

- Status-bitmap.EndOfData (EOD) notifies no more data have to be sent by the GNSS Teseo;
- Status-bitmap.DataValid (DV) notifies the data in the message is valid or not;

Using the EOD and the DV bit-fields the GNSS Teseo Module can notify all the possible cases:[DV=0, EOD=0]: Out-Of-Spec GNSS Teseo cannot send message with this configuration;

[DV=0, EOD=1]: GNSS Teseo has no more data to send; this message can be:

- the last one in a valid sequence of data-log;
- the first one if the host raised a not valid request (ie.start_index out of the log range);
- No data in the log;
- [DV=1, EOD=0]: the message contains a valid data and the GNSS has to send other datas;
- [DV=1, EOD=1]: the message contains a valid data and the GNSS has no more data to send;

If the message $PSTMLOGREQQUERY has the Status-bitmap.DV=0 the remaining fields could not be sent at all by the GNSS Teseo.

If the Host raises one of the commands, $PSTMLOGCREATE, $PSTMLOGERASE, $PSTMLOGREQQUERY, while the GNSS Teseo has pending $PSTMLOGQUERY messages to be sent (in response to a previous $PSTMLOGQUERY), in this case the GNSS Teseo discards the pending $PSTMLOGQUERY messages.

11.7.12 $PSTMLOGQUERYERROR

Message sent in response to command $PSTMLOGREQQUERY

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.8 Geofencing NMEA messages

11.8.1 $PSTMGEOFENCECFGOK

Message sent in response to command $PSTMGEOFENCECFG

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.8.2 $PSTMGEOFENCECFGERROR

Message sent in response to command $PSTMGEOFENCECFG

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.8.3 $PSTMGEOFENCESTATUS

This message is sent from GNSS Teseo to the host as a response to $PSTMGEOFENCEREQ.

Geofence reports a bitmap against which circle is raising the alarm.

Synopsis:

```
$PSTMGEOFENCESTATUS,<timestamp>,<datestamp>,<status_1>,<status_2>,\xc9 ,<status_x>*<checksum>
<cr><lf>
```

Arguments:

Table 190. $PSTMGEOFENCESTATUS message field description

Parameter	Format	Description
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
datestamp	Decimal, 8 digits	Year (4 digit); Month (2 digit); Day (2 digit)
status_x	Decimal, 1 digit	Geo fencing status for each circle where: 0 = Status unknown 1 = Current position is outside the circle 2 = Current position on circle boundary 3 = Current position is inside the circle

11.8.4 $PSTMGEOFENCEREQERROR

Message sent in response to command $PSTMGEOFENCEREQ

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.9 Odometer NMEA messages

11.9.1 $PSTMODOSTARTOK

Message sent in response to command $PSTMODOSTART

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.9.2 $PSTMODOSTARTERROR

Message sent in response to command $PSTMODOSTART

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.9.3 $PSTMODOSTOPOK

Message sent in response to command $PSTMODOSTOP

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.9.4 $PSTMODOSTOPERROR

Message sent in response to command $PSTMODOSTOP.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.9.5 $PSTMODORESETOK

Message sent in response to command $PSTMODORESET.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

11.9.6 $PSTMODORESETERROR

Message sent in response to command $PSTMODORESET.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

11.9.7 $PSTMODO

This message is sent from GNSS Teseo Module to the host periodically if Odometer subsystem is enabled and the related messages are in the message list.

Synopsis:

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

Arguments:

Table 191. $PSTMODO message field description

Parameter	Format	Description
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
date-stamp	Decimal, 8 digits	Year (4 digit); Month (2 digit); Day (2 digit)
odo-A	Unsigned	Odometer A value
odo-B	Unsigned	Odometer B value
odo-pon	Unsigned	Odometer PON value

11.9.8 $PSTMODOREQERROR

Message sent in response to command $PSTMODOREQ.

Synopsis:

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

Arguments:

None

Result:

Message sent in case of error.

11.10 Autonomous AGNSS NMEA messages

11.10.1 $PSTMPOLSTARTED

Message sent in response to command $PSTMSTAGPSONOFF.

Synopsis:

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

Arguments:

None

Results:

Message sent if the engine has been started

11.10.2 $PSTMPOLSUSPENDED

Message sent in response to command $PSTMSTAGPSONOFF.

Synopsis:

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

Arguments:

None

Results:

Message sent if the engine has been suspended

11.10.3 $PSTMPOLONOFFERROR

Message sent in response to command $PSTMSTAGPSONOFF.

Synopsis:

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

Arguments:

None

Results:

Message sent in case of error

11.10.4 $PSTMSTAGPSINVALIDATEOK

Message sent in response to command $PSTMSTAGPSINVALIDATE.

Synopsis:

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

Arguments:

None

Results:

Message sent in case of successful operation.

11.10.5 $PSTMSTAGPSINVALIDATEERROR

Message sent in response to command $PSTMSTAGPSINVALIDATE.

Synopsis:

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

Arguments:

None

Results:

Message sent in case of error

11.10.6 $PSTMAGPSSTATUS

Message sent in response to command $PSTMGETAGPSSTATUS.

Synopsis:

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

Arguments:

Table 192. $PSTMAGPSSSTATUS message field description

Parameter	Format	Description
status	Decimal, 1 digits	0 = the STAGPS\xaa processing is completed. Any number different from zero on means that the STAGPS\xaa processing is ongoing and so the ephemeris prediction data has not been completely generated.

Results:

Message returns the AGPS status.

11.10.7 $PSTMSTAGPSSETCONSTMASKOK

Message sent in response to command $PSTMSTAGPSSETCONSTMASK.

Synopsis:

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

Arguments:

Table 193. $PSTMSTAGPSSETCONSTMASKOK message field description

Parameter	Format	Description
Constellation_mask	Decimal, 1 digits	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 3: GALILEO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling

Results:

Message sent in case of successful operation

11.10.8 $PSTMSTAGPSSETCONSTMASKERROR

Message sent in response to command $PSTMSTAGPSSETCONSTMASK

Synopsis:

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

Arguments:

None

Results:

Message sent in case of error.

11.10.9 $PSTMAGPS

This message has the same syntax as the 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 also reports 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.

Table 194. $PSTMAGPS ephemeris aging description

STAGPS_AGE_DAYS	Ephemeris aging description
1	Latest ephemeris has been downloaded from 0 up to 24 hours in the past
2	Latest ephemeris has been downloaded from 24 up to 48 hours in the past
3	Latest ephemeris has been downloaded from 48 up to 72 hours in the past
4	Latest ephemeris has been downloaded from 72 up to 96 hours in the past
5	Latest 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. If STAGPS is not enabled, it behaves in the same way as NMEA GSA message.

NMEA message list bitmask: 0x10000000 – This message is not enabled by default

Synopsis:

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

Arguments:

Table 195. $PSTMAGPS message field description

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 FIX 3 = 3D FIX
SatPRN1...N	Decimal, 2 digits	Satellites list used in position FIX (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, from 0.0 to 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, from 0.0 to 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, from 0.0 to 99.0

11.10.10 $PSTMAGLO

This message has the same syntax as 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 also reports 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.

Table 196. **$PSTMAGLO ephemeris aging description**

STAGPS_AGE_DAYS	Ephemeris aging description
1	Latest ephemeris has been downloaded from 0 up to 24 hours in the past
2	Latest ephemeris has been downloaded from 24 up to 48 hours in the past
3	Latest ephemeris has been downloaded from 48 up to 72 hours in the past
4	Latest ephemeris has been downloaded from 72 up to 96 hours in the past
5	Latest 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. If STAGPS is not enabled, it behaves in the same way as NMEA GSA message.

NMEA message list bitmask: 0x10000000 – This message is not enabled by default

Synopsis:

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

Arguments:

Table 197. **$PSTMAGLO message field description**

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 FIX 3 = 3D FIX
SatPRN1...N	Decimal, 2 digits	Satellites list used in position FIX (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, from 0.0 to 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, from 0.0 to 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, from 0.0 to 99.0

11.11 Predictive AGNSS NMEA messages

11.11.1 $PSTMSTAGPSSEEDBEGINOK

Message sent in response to command $PSTMSTAGPSSEEDBEGIN

Synopsis:

$PSTMSTAGPSSEEDBEGINOK*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of successful operation.

11.11.2 $PSTMSTAGPSSEEDBEGINERROR

Message sent in response to command $PSTMSTAGPSSEEDBEGIN

Synopsis:

$PSTMSTAGPSSEEDBEGINERROR*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of error.

11.11.3 $PSTMSTAGPSBLKTYPEOK

Message sent in response to command $PSTMSTAGPSBLKTYPE

Synopsis:

$PSTMSTAGPSBLKTYPEOK*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of successful operation.

11.11.4 $PSTMSTAGPSBLKTYPEERROR

Message sent in response to command $PSTMSTAGPSBLKTYPE

Synopsis:

$PSTMSTAGPSBLKTYPEERROR*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of error.

11.11.5 $PSTMSTAGPSSLOTFRQOK

Message sent in response to command $PSTMSTAGPSSLOTFRQ

Synopsis:

$PSTMSTAGPSSLOTFRQOK*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of successful operation.

11.11.6 $PSTMSTAGPSSLOTFRQERROR

Message sent in response to command $PSTMSTAGPSSLOTFRQ

Synopsis:

$PSTMSTAGPSSLOTFRQERROR*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of error

11.11.7 $PSTMSTAGPSSEEDPKTOK

Message sent in response to command $PSTMSTAGPSSEEDPKT

Synopsis:

$PSTMSTAGPSSEEDPKTOK*<checksum><cr><lf>

Arguments:

None.

Results:

Message sent in case of successful operation.

11.11.8 $PSTMSTAGPSSEEDPKTERROR

Message sent in response to command $PSTMSTAGPSSEEDPKT

Synopsis:
$PSTMSTAGPSSEEDPKTERROR*<checksum><cr><lf>
Arguments:
None.
Results:
Message sent in case of error

11.11.9 $PSTMSTAGPSSEEDPROPOK

Message sent in response to command $PSTMSTAGPSSEEDPROP
Synopsis:
$PSTMSTAGPSSEEDPROPOK*<checksum><cr><lf>
Arguments:
None.
Results:
Message sent in case of successful operation.

11.12 Real Time AGNSS NMEA messages

11.12.1 $PSTMSTAGPS8PASSRTN

Message sent in response to command $PSTMSTAGPS8PASSGEN.
Synopsis:

```
$PSTMSTAGPS8PASSRTN,<DevID>,<Password>*<checksum><cr><lf>
```

Arguments:

Table 198. $PSTMSTAGPS8PASSRTN message field description

Parameter	Description
<DevID>	Unique Device ID
<Password>	41-character ASCII password.

Results:
None

12 Firmware Configuration Data Block (CDB)

All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

The table below includes all parameters which can be changed to apply a different configuration to the firmware.

The IDs not reported in the table should be considered as RESERVED and must be left untouched to avoid unexpected system behaviors.

Table 199. Configuration data block list

ID	Parameter name	Size bytes	Allowed values	Default	Description
102	NMEA Port Baudrate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set NMEA Baudrate
104	GNSS Mask Angle	1	0 \xc9 . 45	5	Set the GNSS Mask Angle for low Satellite Elevation
105	GNSS Tracking Threshold [dB]	1	9...40	10	Set the satellites tracking threshold
120	Cold Start Type	1	0xF = clear Almanach, Ephem, Time &Position 0xE = clear Ephemeris, Time, Position	0xE	Set the cold start type with selective data erase
121	NMEA Decimal Digits for Speed and Course values	1	First nibble: 0x1...0x8 Second nibble: 0x1...0x8	0x11	Allow setting the number of decimal digits for the speed and course data in the NMEA messages.
125	Notch Filter Setting	1	0x0...0xF	0x0	Enable or disable the Notch Filter usage
127	NMEA Decimal Digits	1	First nibble: 0x1...0x8 Second nibble: 0x1...0x8	0x55	Allow setting the number of decimal digits for the position data in the NMEA messages.
128	Differential Source Type	1	0...3	0x3	Allow selecting the differential mode source type.
129	GLONASS Satellite ID Type	1	0...1	0x1	Allow setting the GLONASS satellite ID type used in the GSV and GSA messages. 0x0 – the satellite ID is based on frequency

ID	Parameter name	Size bytes	Allowed values	Default	Description
					0x1 – the satellite ID is based on slot number.
131	NMEA Talker ID	1	'P', 'L', 'N'	'P'	Allow setting the second character of the NMEA talker ID.
132	GNSS positioning CN0 Threshold [dB]	1	9...40	15	Set the satellites CN0 threshold for the positioning stage
135	SBAS Default Service	1	0...15	15	Set the SBAS default Service
From 141 To 189 Odd IDs	RF front-end data register value	1	Any RF front-end supported values (see front-end reference manual)	0xFF	The value to be applied to the front-end register pointed by the previous address and operation parameter (e.g. 141 reports the value to be applied to the address reported on 140)
190	NMEA Msg-List 0 output rate scaling factor.	1	1...255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
198	GNSS Mask Angle Positioning	1	0 \xc9 . 45	1	Set the GNSS Mask Angle for positioning algorithm. Satellites with elevation below the mask angle are not used in the position solution.
199	Local geodetic datum	1	0...215	255	Set the local geodetic datum to be used in position reporting over the NMEA messages. Not valid number (e.g. 255) means default datum which is WSG84.
200	Application ON/OFF	4	0x2 = GPS_2D_FIX_ENABLE 0x4 = SBAS_ENABLE 0x8 = SBAS_SAT_ON_GSV_MSG_ENABLE 0x10 = STAGPS_ENABLE 0x20 = 2.5_PPM_TCXO_ENABLE 0x40 = RESERVED 0x80 = QZSS_DISTRIBUTED_ACQ_MODE_ENABLE 0x200 = CONFIG_TXT_HEADER_EN. 0x400 = ST_HEADERS_ENABLE 0x800 = RTCM_ENABLE 0x1000 = FDE_ENABLE 0x4000 = WALKING_MODE_ENABLE 0x8000 = STOP_DETECTION_ENABLE 0x10000 = GPS_ENABLE	0x09419644	Activates/Deactivates GNSS application features

ID	Parameter name	Size bytes	Allowed values	Default	Description
			0x20000 = GLONASS_ENABLE 0x40000 = QZSS_ENABLE 0x80000 = NMEA_GNGSV_ENABLE 0x100000 = NMEA_GNGSA_ENABLE 0x200000 = GLONASS_USE_ENABLE 0x400000 = GPS_USE_ENABLE 0x800000 = QZSS_USE_ENABLE 0x1000000 = PPS_ENABLE 0x2000000 = PPS_POLARITY_INVERSION 0x4000000 = POSITION_HOLD_ENABLE 0x8000000 = TIMING_TRAIM_ON_OFF 0x10000000 = RESERVED 0x20000000 = HIGH_DYNAMICS_ON_OFF 0x40000000 = NMEA_RAW_ON_OFF 0x80000000 = LOW_POWER_ON_OFF		
201	NMEA Port Msg-List 0 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x288435F	Set NMEA Message List 0 (32 bits low)
202	NCO Range max.	4	-132000 to 132000	0x0	Set NCO range max. value in Hz
203	NCO Range min.	4	-132000 to 132000	0x0	Set NCO range min. value in Hz
204	NCO Center	4	-132000 to 132000	0x0	Set NCO center frequency Offset in Hz
205	Position Data Time Delay [ms](1)	4	0..(fix rate time period)	80 ms	Set the time delay between the measurements (on UTC second) and the position data delivery.
213	PPS operating mode setting 1	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation. (see details in the corresponding section)
214	PPS operating mode setting 2	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation (see details in the corresponding section)
215	Position hold auto survey samples.	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Sets the number of position samples to be captured before entering in the position hold mode. If it is set to 0, the auto survey is disabled.
218	SBAS satellite parameters	4	-	0xFFFFFFFF	Allow setting parameters (PRN, longitude and service) for new SBAS satellites not supported by the was library. Not valid value (e.g. 0xFFFFFFFF) means not used.

ID	Parameter name	Size bytes	Allowed values	Default	Description
219	SBAS satellite parameters	4	-	0xFFFFFFFF	Allow setting parameters (PRN, longitude and service) for new SBAS satellites not supported by the was library. Not valid value (e.g. 0xFFFFFFFF) means not used
220	Adaptive Low Power operating mode setting 1	4	-	15 m,10s, 10s, 180s	Allow setting the operative mode for low power algorithm.
221	Adaptive Low Power operating mode setting 2	4	-	4,60s,9, 31min	Allow setting the operative mode for low power algorithm.
222	LMS operating mode setting 1	4	-	1,0,0,,50m, 50m,	Allow setting parameters for the LMS algorithm
223	LMS operating mode setting 2	4	-	5,3,-223m	Allow setting parameters for the LMS algorithm
224	Adaptive Low Power operating mode setting 3	4	-	1,1,740ms	Allow setting the operative mode for low power algorithm.
227	Application ON/OFF 2	4	0x1 = NMEA_COMMAND_ECO_ENABLE 0x2 = NMEA_TTFF_MESSAGE_ENABLE 0x4 = FEW_SATS_POS_ESTIMATION_ENABLE 0x8 = RESERVED 0x20 = NMEA_IN_OUT_INTERFACE_SELECT 0x40 = GALILEO_ENABLE 0x80 = GALILEO_USAGE_ENABLE 0x100 = BEIDOU_ENABLE 0x200 = BEIDOU_USAGE_ENABLE 0x800 = RTC_USAGE_DISABLING 0x1000 = FAST_SATELLITE_DROP_ENABLE 0x2000 = RESERVED 0x4000 = EXCLUDED_SATS_REPORTING_ENABLE	0x345	Activates/Deactivates GNSS application features
228	NMEA Port Msg-List 0 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x2000	Set NMEA Message List 0 (32 bits high)
231	NMEA on I2C Port Msg-List 0 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on I2C port Message List 0 (32 bits low)
232	NMEA on I2C Port Msg-List 0 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on I2C port Message List 0 (32 bits high)
237	Default GPS MIN-MAX week number(2)	4	MIN: 0x0000 to 0xFFFF - MAX: 0x0000 to 0xFFFF	MIN = 1821 MAX = 3300	Set default MIN-MAX range for GPS week number.
238	Default UTC delta time	4	0x0000.0000 to 0xFFFF.FFFF	16	Default value of GPS time to UTC delta time in seconds (leap second)
260	WLS configuration params	4	-	0x00190A00	WLS algorithm configuration params
261	Dynamic modes configurations	4	0,1,3	0	Allow setting the dynamic mode for the satellite tracking engine.

ID	Parameter name	Size bytes	Allowed values	Default	Description
263	Nmea over serial configuration	4		0xE80	Allow configuring parameters for nmea over serial feature
264	Data logger Configuration 0	4	0x0000.0000 to 0xFFFF.FFFF	0x10180000	Data logger configuration field 0. Configures the memory base address for the data logger data structure
265	Data logger Configuration 1	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	Data logger configuration field 1. Specify the maximum space available for data logger data structure
266	Data logger Configuration 2	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	Data logger configuration field 2
267	Data logger Configuration 3	4	0x0000.0000 to 0xFFFF.FFFF	0x0000010E	Data logger configuration field 3
268	Geofencing Configuration 0	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Geofencing configuration field 0
270	Odometer Configuration	4	0x0000.0000 to 0xFFFF.FFFF	0x03E80000	Odometer configuration field
272	GNSS Integrity	4	0x0..0x3	0x0	Enabling/disabling position and time integrity feature
301	PPS Pulse Duration	8	<= 1.0 seconds	0.5	PPS pulse width. It is the time distance (in seconds) from PPS rising edge and next PPS falling edge.
302	PPS Delay Correction	8	< 1.0 seconds	0.0	PPS time delay correction n seconds. It allows to compensate any delay introduced on PPS signal by RF chain.
303	GNSS Fix Rate(3)	8	> 0.1 seconds	1.0	Set the GNSS fix rate period in seconds.
304	Position Hold Latitude [deg]	8	From -90.0 to 90.0	40.91747	Set the position hold latitude.
305	Position Hold Longitude [deg]	8	From -180.0 to 180.0	14.27586	Set the position hold longitude.
306	Position Hold Altitude [m]	8	From -1500 to 100000	88.43307	Set the position hold altitude.
307	GPS RF delay correction	8		718E-9	Time delay compensation for the GPS RF path.
308	GLONASS RF delay correction	8		-420E-9	Time delay compensation for the GLONASS RF path.
309	TRAIM alarm threshold	8		15ns	Time error threshold for the satellites exclusion in the TRAIM algorithm.
310	BEIDOU RF delay correction	8		100E-9	Time delay compensation for the BEIDOU RF path.
311	GALILEO RF delay correction	8		718E-9	Time delay compensation for the GALILEO RF path.
314	Geofencing Circle 0 Latitude	8		41.11473	Allows to set up the geofencing circle number 0 by choosing its latitude as a double precision floating number

ID	Parameter name	Size bytes	Allowed values	Default	Description
315	Geofencing Circle 0 Longitude	8		13.88093	Allows to set up the geofencing circle number 0 by choosing its longitude as a double precision floating number
316	Geofencing Circle 0 Radius	8		10.0	Allows to set up the geofencing circle number 0 by choosing its radius in meters as a double precision floating number
317	Geofencing Circle 1 Latitude	8		41.12148	Allows to set up the geofencing circle number 1 by choosing its latitude as a double precision floating number
318	Geofencing Circle 1 Longitude	8		13.87146	Allows to set up the geofencing circle number 1 by choosing its longitude as a double precision floating number
319	Geofencing Circle 1 Radius	8		10.0	Allows to set up the geofencing circle number 1 by choosing its radius in meters as a double precision floating number
320	Geofencing Circle 2 Latitude	8		41.24341	Allows to set up the geofencing circle number 2 by choosing its latitude as a double precision floating number
321	Geofencing Circle 2 Longitude	8		13.77443	Allows to set up the geofencing circle number 2 by choosing its longitude as a double precision floating number
322	Geofencing Circle 2 Radius	8		10.0	Allows to set up the geofencing circle number 2 by choosing its radius in meters as a double precision floating number
323	Geofencing Circle 3 Latitude	8		41.24328	Allows to set up the geofencing circle number 3 by choosing its latitude as a double precision floating number
324	Geofencing Circle 3 Longitude	8		13.77424	Allows to set up the geofencing circle number 3 by choosing its longitude as a double precision floating number
325	Geofencing Circle 3 Radius	8		10.0	Allows to set up the geofencing circle number 3 by choosing its radius in meters as a double precision floating number

1. *To reduce the jittering of the NMEA message list 2 data delivery, the messages are sent over the uart port after a fixed delay from the measurement time. This delay can be configured to achieve the best jitter reduction at different CPU speed setting.*
2. *Min week number is used for correct GPS week number decoding. Max week number is used for GPS week validity check.*
3. *High fix rates may require a different setting (e.g. 208MHz) of the CPU speed.*

12.1 CDB-ID 102 – NMEA port baudrate setting

Allow setting the baudrate for the NMEA port number. The translation table in Table 200.

Table 200. **CDB-ID 102 field description**

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

System reboot needed to have new setting in use.

12.2 CDB-ID 104 – Mask angle setting

Allow setting the minimum elevation angle at which a satellite can be tracked. Satellite with elevation below the mask angle cannot be tracked.

System reboot needed to have new setting in use.

12.3 CDB-ID 105 – GNSS tracking threshold

Allow setting the minimum CN0 [dB] at which a satellite can be tracked. Satellite with CN0 below the configured threshold cannot be tracked.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

12.4 CDB-ID 120 – Cold start setting

Allow setting the data to be cleared during the COLD start command execution. This parameter is a bitmask where bit=1 indicates the data to be cleared.

Table 201. **CDB-ID 120 field description**

Bit	Bitmask	Description
0	0x1	Clear almanacs
1	0x2	Clear ephemeris
2	0x4	Clear position
3	0x8	Clear time

Any bitmask combination is allowed, the default one is 0xE.

This setting is in place as soon as the $PSTMSETPAR is performed.

12.5 CDB-ID 121 – Number of decimal digits for speed and course data in NMEA messages

Allow setting the number of decimal digits for the speed and course data in NMEA messages. It affects both RMC and VTG messages

It is possible to set a different number of decimal digits.

Table 202. CDB-ID 121 field description

Bit	Values	Description
From B0 to B3	From 1 up to 5	Allow setting the number of decimal digits for speed value in RMC and VTG massages
From B4 to B7	From 1 up to 5	Allow setting the number of decimal digits for course value in RMC and VTG messages.

12.6 CDB-ID 125 – Notch filter setting

Allow setting the Notch filter usage on GPS RF path, GLONASS RF path or both GPS and GLONASS RF paths. The notch filter can be enabled and inserted in the RF path (normal mode – see b0, b1 below) or the notch filter can be enabled but inserted only if locked on a jammer (auto-insertion mode – see b2, b3 below).

Table 203. CDB-ID 125 field description

Bitmask	Description
b0...b3 = 0x00	Notch Filter is disabled on both GPS and GLONASS paths
b0	Enable/disable notch filter on GPS path (normal mode).
b1	Enable/disable notch filter on GLONASS path (normal mode).
b2	Enable/disable notch filter on GPS path in auto-insertion mode.
b3	Enable/disable notch filter on GLONASS path in auto-insertion mode.

12.7 CDB-ID 127 – Number of decimal digits in NMEA position messages

Allow setting the number of decimal digits for the NMEA position messages.

It is possible to set a different number of decimal digits for GGA and for both RMC and GLL messages.

Table 204. CDB-ID 127 field description

Bit	Values	Description
From B0 to B3	From 1 up to 5	Allow setting the number of decimal digits for the RMC and GLL massages
From B4 to B7	From 1 up to 5	Allow setting the number of decimal digits for the GGA massage.

12.8 CDB-ID 128 – Differential Source Type

Allow selecting the differential mode source type.

Table 205. CDB-ID 128 field description

Value	Description
0x0 - NONE	No differential source.
0x1 - SBAS	SBAS is the source for differential correction.
0x2 - RTCM	RTCM is the source for differential corrections.

Value	Description
0x3 - AUTO	RTCM (if available) or SBAS (if available) is the source for differential corrections.

12.9 CDB-ID 129 – GLONASS Satellite ID Type

Allow selecting between two different ways to report the GLONASS satellites ID in the GSV and GSA messages.

Table 206. CDB-ID 129 field description

Value	Description
0x0	GLONASS satellite ID based on the satellite frequency. If lowest frequency is marked with freq_ID = 1 and highest frequency is marked with freq_ID = 14, the satellite IDs are reported, starting from lowest frequency as 64+freq_ID. Satellites from 79 up to 92 are the antipodal of satellites from 65 up to 78 (they are received at the same frequency).
0x1	GLONASS satellite ID based on the satellite slot (reported in almanacs and ephemeris data). The satellite IDs are reported as 64+slot_number. The slot number is in the range from 1 up to 24.

12.10 CDB-ID 130 – CPU clock speed

Allow setting the CPU clock speed.

Table 207. CDB-ID 130 field description

Bit	Values	Description
From B0 to B3	0 = 192f0 1 = TCXO 2 = RTC 3 = RING Oscillator	Allow setting the CPU clock source
From B4 to B6	0 = 1 1 = 2 3 = 4	Allow setting the CPU clock divisor factor
B7		RESERVED

Examples:

- 0x00 sets the CPU speed at 192f0 MHz
- 0x10 sets the CPU speed at 96f0 MHz
- 0x20 sets the CPU speed at 64f0 MHz
- 0x30 sets the CPU speed at 48f0 MHz

12.11 CDB-ID 131 – NMEA Talker ID

Allow setting the second character of the NMEA talker ID for the GGA, RMC, VTG, GLL NMEA sentences. The talked ID for GSV and GSA is managed in a different way (see CDB-ID 200, bits 19 and 20).

12.12 CDB-ID 132 – GNSS Positioning CN0 threshold

Allow setting the minimum CN0 [dB] at which a satellite can be used in the position solution. Satellites with CN0 below the configured threshold are not used in the position evaluation.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

12.13 CDB-ID 135 – SBAS default service

Allow setting the default service for the SBAS library.

System reboot needed to have new setting in use.

Note: For compatibility, a default SBAS PRN can also be set. In that case the SBAS AUTO service will be used.

12.14 CDB-ID 190 - CDB-ID 201 - CDB-ID 228 - NMEA on UART message list parameters

CDB-ID 201 and CDB-ID 228 allow enabling/disabling each NMEA message in the message list 0. CDB-ID 201 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 228 for the second 32 bits (high bits) of the 64 bits message list.

CDB-ID 190 allows setting the message list output rate for the message list 0. It is a scaling factor referred to the selected fix rate. The default value is 1 and this means that the messages are sent out on every fix. Setting the scaling factor to "N" means that the corresponding message list is sent out every "N" fixes.

Note: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate feature is not required.

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 208. CDB-ID 201 - CDB-ID 228 fields description

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

	Bit[1]	Bitmask (32 bits)	Function
Low 32 bits	22	0x400000	RESERVED
	23	0x800000	$PSTMCPU Message
	24	0x1000000	$GPZDA Message
	25	0x2000000	$PSTMTRAIMSTATUS Message
	26	0x4000000	$PSTMPOSHOLD Message
	27	0x8000000	$PSTMKFCOV Message
	28	0x10000000	$PSTMAGPS Message
	29	0x20000000	$PSTMLOWPOWERDATA Message
	30	0x40000000	$PSTMNOTCHSTATUS
	31	0x80000000	$PSTMTM Message
High 32 bits	32	0x1	$PSTMPV Message
	33	0x2	$PSTMPVQ Message
	34	0x4	$PSTMUTC Message
	35	0x8	$PSTMADCDATA Message
	36	0x10	RESERVED
	37	0x20	RESERVED
	38	0x40	$PSTMUSEDSATS
	39	0x80	$GPDTM Message
	40	0x100	$PSTMEPHEM Message
	41	0x200	$PSTMALMANAC Message
	42	0x400	$PSTMIONOPARAMS Message
	43	0x800	RESERVED
	44	0x1000	$PSTMBIASDATA Message
	45	0x2000	$GPGBS Message
	46	0x4000	$PSTMPVRAW Message
	47	0x8000	RESERVED
	48	0x10000	$PSTMFEDATA Message
	49	0x20000	RESERVED
	50	0x40000	$PSTMODO Message
	51	0x80000	$PSTMGEOFENCESTATUS Message
	52	0x100000	$PSTMLOGSTATUS Message
	53	0x200000	$PSTMGNSSINTEGRITY Message
	54	0x400000	RESERVED
	55	0x800000	RESERVED
	56	0x1000000	RESERVED
	57	0x2000000	RESERVED
	58	0x4000000	RESERVED
	59	0x8000000	RESERVED
	60	0x10000000	RESERVED
	61	0x20000000	RESERVED

	Bit[1]	Bitmask (32 bits)	Function
High 32 bits	62	0x40000000	RESERVED
	63	0x80000000	$--RLM Message

1. *The Bit-Value indicates the bit position, thus multiple choices are possible.*

Note: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate feature is not required.

12.15 CDB-ID 197 – PPS clock

Allow setting the PPS clock frequency. For accurate timing application 64MHz is mandatory.

Table 209. CDB-ID 197 field description

Values	Description
16	Sets PPS clock to 16MHz
32	Sets PPS clock to 32MHz
64	Sets PPS clock to 64MHz

12.16 CDB-ID 198 – GNSS Mask angle positioning

Set the GNSS Mask Angle for positioning algorithm. Satellites with elevation below the mask angle are not used in the position solution.

12.17 CDB-ID 199 – Local geodetic datum selection

Set the local geodetic datum to be used when position data is reported over the NMEA messages. See Appendix A for the list of all supported datum. In the last column of the tables, it is reported the number to be used for the CDB-ID configuration according to the selected datum.

12.18 CDB-ID 200 - CDB-ID 227 - Application ON/OFF

Allow enabling/disabling different features in the GNSS library.

All features are mapped in a 64-bit bitmap with one bit for each feature; CDB-ID 200 represents the first 32 bits (low 32 bits) and CDB-227 represents the second 32 bits (high 32 bits).

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 210. CDB-ID 200 field description

Bit[1]	Bitmask	Function	Description
0	0x1	RESERVED	
1	0x2	RESERVED	
2	0x4	SBAS (WAAS / EGNOS) augmentation system	Enable/disable the SBAS engine. When enabled, the SBAS engine starts searching for SBAS satellites at system startup.
3	0x8	Enabling SBAS satellite reporting in the GSV messages	If enabled the SBAS satellite is reported in the GSV messages. The SBAS satellite ID, reported in the GSV messages, is in the range from 33 to 51 according to the NMEA specifications

Bit[1]	Bitmask	Function	Description
4	0x10	STAGPS enable	Enable/disable the STAGPS functionality. During STAGPS processing a high CPU load is required, for best performances it is suggested to increase the CPU frequency when the STAGPS is enabled. The server based assisted GPS (PGPS) is included in the STAGPS software. It is enabled/disabled if the STAGPS functionality is enabled/disabled.
5	0x20	2.5ppm TCXO support enable	Enable/disable support for TCXO with 2.5ppm accuracy
6	0x40	RESERVED	
7	0x80	QZSS distributed acquisition mode enable	Enable/disable the distributed acquisition operative mode for the QZSS constellation. When distributed acquisition mode for QZSS is enabled, the acquisition stage usage is widespread along the time in order to mitigate the current consumption spikes required by the acquisition engine.
9	0x200	RESERVED	
10	0x400	RESERVED	
11	0x800	RTCM enable	Enable/disable the RTCM data processing.
12	0x1000	FDE Algorithm	Enable/disable the False Detection and Exclusion algorithm.
14	0x4000	Walking Mode Algorithm	Enable/disable the Walking Mode algorithm.
15	0x8000	Stop Detection Algorithm	Enable/disable the Stop Detection algorithm.
16	0x10000	GPS constellation enable[2]	Enable/disable the GPS constellation. When this bit is enabled GPS satellites are enabled to be tracked and used for positioning. This bit setting affects also the talker ID of GSV and GSA NMEA messages. If only the GPS constellation is enabled the NMEA talker ID for GSV and GSA is "GP". If GLONASS constellation is also enabled "GP" is used for GPS related GSV messages while "GN" is used for the GSA messages.
17	0x20000	GLONASS constellation enable[2]	Enable/disable the GLONASS constellation. When this bit is enabled GLONASS satellites are enabled to be tracked. To be used for positioning also the Bit 21 should be enabled. This bit setting affects also the talker ID of GSV and GSA NMEA messages. If only the GLONASS constellation is enabled the NMEA talker ID for GSV and GSA is "GL". If GPS constellation is also enabled "GL" is used for GLONASS related GSV messages while "GN" is used for the GSA messages
18	0x40000	QZSS constellation enable[2]	Enable/disable the QZSS constellation. When this bit is enabled QZSS satellites are enabled to be tracked and used for positioning
19	0x80000	NMEA GNGSV enable	Enable/disable the "GN" talker ID for GSV messages reporting satellite for all constellations. When this bit is enabled, only the talker ID "GN" is used for GSV messages.
20	0x100000	NMEA GNGSA enable	Enable/disable the "GN" talker ID for GSA messages reporting satellite for all constellations. When this bit is enabled, only the talker ID "GN" is used for GSA messages.
21	0x200000	GLONAS usage for positioning enable	Enable/disable the usage of GLONASS satellite for the GNSS position fix. If this bit is disabled and GLONASS constellation is enabled, the GLONASS satellites are only tracked.
22	0x400000	GPS usage for positioning enable	Enable/disable the usage of GPS satellite for the GNSS position fix. If this bit is disabled and GPS constellation is enabled, the GPS satellites are only tracked
23	0x800000	QZSS usage for positioning enable	Enables/disables the usage of QZSS satellites for the GNSS position fix. If this bit is disabled and QZSS constellation is enabled, the QZSS satellites are only tracked.
24	0x1000000	PPS enabling	Enables/disables the PPS generation on the PPS pin.
25	0x2000000	PPS polarity inversion	Enables/disables the PPS signal polarity inversion. If polarity inversion is disabled (Bit25 = 0) the PPS signal has the rising edge on the PPS event. If polarity inversion is enabled (Bit25 = 1) the PPS signal has a falling edge on the PPS event.
26	0x4000000	Position Hold enable	Enables/disables the Position Hold functionality (timing applications).
27	0x8000000	TRAIM algorithm enable	Enables/disables the TRAIM algorithm (timing applications).
28	0x10000000	RESERVED	
29	0x20000000	RESERVED	
30	0x40000000	RESERVED	

Bit[1]	Bitmask	Function	Description
31	0x80000000	Low power algorithm enable	Enables/disables the low power management features

1. *The Bit-Value indicates the bit position (starting from 0 as the least significant bit), thus multiple choices are possible.*
2. *Multi-constellation firmware supports the following constellations: GPS, GALILEO, GLONASS, BEIDOU and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+GALILEO+QZSS+GLONASS), (GPS+GALILEO+QZSS+BEIDOU) and (GLONASS+BEIDOU). Any constellation can be enabled as standalone satellite navigation system.*

Table 211. CDB-ID 227 field description

Bit[1]	Bitmask	Function	Description
1	0x1	NMEA commands eco enable	Enable/disable the command eco on the NMEA port
2	0x2	NMEA Time To First Fix enable	Enable/disable the Time To First Fix message on the NMEA port. If enabled, the TTFF message is sent only one time as soon as the GNSS position fix is achieved.
3	0x4	Few satellites position estimation enable	Enable/disable the position estimation algorithm when tracked satellites are less than 3.
4	0x8	RESERVED	
5	0x10	Return Link Message enable	Enable/disable the Return Link Message on the NMEA port
6	0x20	RESERVED	
7	0x40	Galileo constellation enable	Enable/disable the Galileo constellation. When this bit is enabled Galileo satellites are enabled to be tracked and used for positioning
8	0x80	Galileo usage for positioning enable	Enable/disable the usage of Galileo satellite for the GNSS position fix. If this bit is disabled and Galileo constellation is enabled, the Galileo satellites are only tracked.
9	0x100	BEIDOU constellation enable[2]	Enable/disable the BEIDOU constellation. When this bit is enabled BEIDOU satellites are enabled to be tracked and used for positioning.
10	0x200	BEIDOU usage for positioning enable	Enable/disable the usage of BEIDOU satellite for the GNSS position fix. If this bit is disabled and BEIDOU constellation is enabled, the BEIDOU satellites are only tracked.
11	0x400	RESERVED	
12	0x800	RTC usage disabling	Enable/disable the usage of RTC from the GNSS engine. It is recommended to have RTC usage disabled (Bit12 set to 1) is the RTC crystal is not mounted.
13	0x1000	Fast Satellite Drop feature enable	Enable/disable the Fast Satellite Drop feature. When fast satellite drop is enabled, the GNSS software reports NO FIX status immediately after the tunnel entrance; the position update is no more propagated for some seconds inside the tunnel.
14	0x2000	RESERVED	
15	0x4000	Excluded satellites reporting enable	Enable/disable the excluded satellites reporting in the GGA, GSA, GNS and PSTMTG nmea messages. If this bit is enabled, satellites excluded by positioning stage due to RAIM or FDE algorithms, are included in the number of used satellites (present in the GGA, GNS and PSTMG messages) and their satellites IDs are included in the list of used satellite (present in the GSA message). This bit is disabled by default.
16	0x8000	RESERVED	
17	0x10000	RESERVED	
18	0x20000	RESERVED	
19	0x40000	RESERVED	
20	0x80000	RESERVED	
21	0x100000	RESERVED	
22	0x200000	RESERVED	

Bit[1]	Bitmask	Function	Description
23	0x400000	RESERVED	
24	0x800000	RESERVED	
25	0x1000000	RESERVED	
26	0x2000000	RESERVED	
27	0x4000000	RTC calibration enable	Enable/disable the RTC calibration feature. When enabled the RTC counter is calibrated using the accurate GNSS internal time reference.

1. *The Bit-Value indicates the bit position (starting from 0 as the least significant bit), thus multiple choices are possible.*
2. *Multi-constellation firmware supports the following constellations: GPS, GALILEO, GLONASS, BEIDOU and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+GALILEO+QZSS+GLONASS), (GPS+GALILEO+QZSS+BEIDOU). Any constellation can be enabled as standalone satellite navigation system.*

Note: If the STAGPS feature is not required (bit 4) and it is disabled, it is strongly suggested to clear all the STAGPS data from the NVM memory. This can be done via NMEA sending the "$PSTMSTAGPSINVALIDATE,7" command. If the NVM was empty (e.g. the STAGPS has been never enabled or the NVM has been completely erased before) the invalidate command is not required.

When GPS and GLONASS constellations are enabled, the GSV messages are sent in two separate sets: one with "GP" as talker ID and one with "GL".

Only "GN" is supported as talker ID for QZSS GSV and GSA messages.

In this case the GSV messages are sent in a single set reporting satellites for all enabled constellations.

12.19 CDB-ID 202 – NCO range max value

Allow setting the upper limit for the NCO search range.

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

12.20 CDB-ID 203 – NCO range min value

Allow setting the lower limit for the NCO search range.

STA8090 supports different TCXO frequencies:

- 26 MHz
- 48 MHz
- 55 MHz

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

12.21 CDB-ID 204 – NCO centre value

Allow setting the NCO centre frequency.

STA8090 supports different TCXO frequencies:

- 26 MHz
- 48 MHz
- 55 MHz

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

12.22 CDB-ID 213 – PPS operating mode setting 1

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table.

Table 212. CDB-ID 213 field description

Bits	Values	Description
From B0 to B3	0 = on every second 1 = on even seconds 2 = on odd seconds	PPS generation mode
From B4 to B7	0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU(1) 4 = GPS_UTC_FROM_GLONASS(2)	Reference time on which the PPS signal is synchronized.
From B8 to B11	1 = NO FIX 2 = 2D FIX 3 = 3D FIX	GNSS fix condition for PPS signal generation. NO FIX: PPS signal is present even in GNSS NO fix conditions. 2D FIX: the PPS is present if the GNSS is at least in 2D fix condition. 3D FIX: the PPS is present only if the GNSS is in 3D fix conditions.
From B16 to B23	0...24	Minimum number of satellites used for timing correction. PPS signal is generated if the number of satellites used for time correction is bigger the minimum number. This parameter should be set to 0 is the threshold is not used.
From B24 to B31	0...90	Satellite elevation mask for time correction. It is the minimum satellite elevation angle to use the satellite for time correction. If this parameter is set to 0 there is no satellites filtering based on the elevation.

1. *UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.*
2. *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*

12.23 CDB-ID 214 – PPS operating mode setting 2

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table:

Table 213. CDB-ID 214 field description

Bits	Values	Description
From B0 to B7	0 = mixing constellation disabled 1 = GPS sats are enabled for GLONASS time correction. 2 = GLONASS sats are enabled for GPS time correction.	Enable/disable mixing constellations for time correction.

Bits	Values	Description
	B7 = BEIDOU constellation	

Mixing constellations for time correction means that satellites from one constellation are used to correct the reference time for other constellations.

For example if GPS time is selected for PPS signal generation and B1 (or B7) is enabled, also Glonass satellites (or Beidou satellites) are used to correct the GPS reference time. If Glonass time is selected for PPS signal generation and B0 is enabled, also GPS satellites are used to correct the Glonass reference time.

12.24 CDB-ID 215 – Position hold auto survey samples

Sets the number of position samples to be captured before entering in the position hold mode. The auto survey procedure is disabled if the number of samples is set to 0.

12.25 CDB-ID 218 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 214. CDB-ID 218 field description

Bits	Values	Description
From B0 to B7	From 120 to 138	SBAS PRN
From B8 to B15	From 0 to 180	Satellite longitude in degree
B16	0: EAST 1: WEST	Longitude sense
From B17:B18	0: WAAS 1: EGNOS 2: MSAS 3:GAGAN	The SBAS service

12.26 CDB-ID 219 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 215. CDB-ID 219 field description

Bits	Values	Description
From B0 to B7	From 120 to 138	SBAS PRN
From B8 to B15	From 0 to 180	Satellite longitude in degree
B16	0: EAST 1: WEST	Longitude sense
From B17:B18	0: WAAS 1: EGNOS 2: MSAS 3:GAGAN	The SBAS service

12.27 CDB-ID 220 – Adaptive and Cyclic operating mode setting 1

Configure the cyclic low power mode. This parameter includes different fields as reported in Table 216.

Table 216. **CDB-ID 220 field description**

Bits	Values	Description
B0	0	Adaptive mode enable/disable
B1	0/1	Duty cycle enable/disable
From B2 to B3	0	Reserved
From B4 to B11	0...255	EHPE average threshold [m]
From B12 to B19	0...32	First N satellites (with higher elevation) used for the position calculation (Active channel management) in LOW POWER STATE
From B20 to B31	1, 3, 5	Duty cycle fix period [s]

12.28 CDB-ID 222 – LMS operating mode setting 1

Table 217. **CDB-ID 222 field description**

Bits	Values	Description
B0	0/1	2D Fix: 1: enable 0: disable
B1	0/1	HDOP product in range error metric: 1: enable 0: disable
B2	0/1	GLONASS path delay lock: 1: enable 0: disable
From B8 to B15	0...255	Position residual threshold [m]
From B16 to B23	0...255	Position residual threshold after RAIM [m]

12.29 CDB-ID 223 – LMS operating mode setting 2

Table 218. **CDB-ID 223 field description**

Bits	Values	Description
From B0 to B7	0...255	Minimum number of satellites in GNSS mode
From B8 to B15	0...255	Minimum number of satellites in single constellation mode
From B16 to B31	-32768...32767	Initial GLONASS path delay [dm]. (It is expressed in 2-complements on 16 bits)

12.30 CDB-ID 231 – CDB-ID 232 - NMEA on I2C Port Message List

Allow enabling/disabling each NMEA message in the message list 0 used for sending messages over the I2C port. CDB-ID 231 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 232 for the second 32 bits (high bits) of the 64 bits message list. The message list configuration is done in the same way as for the NMEA message list 0 (see CDB-ID 201 and CDB-ID 228 for details). See CDB-ID 201 also for supported message list table.

12.31 CDB-ID 237 – Default GPS MIN-MAX week number

Allow setting of minimum and maximum GPS week number.

Minimum week number is used for correct GPS week decoding. The GNSS software is able to decode correctly the GPS week number for a number of 1024 weeks (about 20 years) starting from a minimum week number.

Note: The minimum week number should be moved ahead along years to guarantee at least 20 years of correct week decoding in the future.

Maximum week number is used for GPS week validity check. It must be set at least 1024 weeks ahead to the minimum week number.

Note: As soon as the max week number is reached, the GNSS software is no more able to validate the time and so it is no more able to achieve the GNSS position fix.

Table 219. CDB-ID 237 field description

Bits	Values	Description
From B0 to B15	0...65535	GPS minimum week number
From B16 to B31	0...65535	GPS maximum week number

12.32 CDB-ID 238 – Default UTC delta time

Allow setting the default value for the GPS time to UTC delta time seconds (leap seconds). This parameter is used by the GNSS software only is the UTC backup data is not available in the backup memory (e.g. first startup after production or in case of backup memory content lost occurrence).

12.33 CDB-ID 257 – Periodic operating mode setting 1

Configure the periodic low power mode. This CBD has to be combined with CBD-258.This parameter includes different fields as reported in the following table:

Table 220. CDB-ID 257 field description

Bits	Values	Description
From B0 to B7	0/1 for each feature	Periodic feature set Enable/Disable: B0-B1: 00: Periodic mode OFF 01: Active Periodic mode 11: Standby Periodic mode B2: Ephemeris refresh required B3: RTC calibration required B4: FixOnDemand by WakeUp pin enable - must have B0-B1=11. B5 to B7 are reserved for further usage.
From B8 to B24	0...86400	FixPeriod [s]. 0 means no periodic fix is required.
From B25 to B31	1...127	FixOnTime - Number of fix to report every fix wakeup – used for FixOnDemand and Periodic mode.

12.34 CDB-ID 258 – periodic operating mode setting 2

Configure the periodic low power mode. This CBD has to be combined with CBD-257.This parameter includes different fields as reported in the following table:

Table 221. **CDB-ID 258 field description**

Bits	Values	Description
From B0 to B7	0...255	NoFixCnt [s] - Time to declare fix loss in HOT conditions.
From B8 to B19	0...4095.	NoFixOff [s] - Off duration time after a fix loss event. 0 means the counter is not active. The fix retry will be based on FixPeriod.
From B20 to B28	0...300	NoFixCnt2 [s] – Time to declare fix loss in non-HOT conditions – startup case, obsolete ephemeris.

12.35 CDB-ID 260 – WLS algorithm configuration

Allow to configure the WLS algorithm implemented in the positioning stage.

Table 222. **CDB-ID 260 field description**

Bits	Values	Description
B0	0...1	Enable/Disable the WLS algorithm usage in the positioning stage. 0 = disabled 1= enabled
B1...B7	xxx	Not used
B8...B15	1...100	Parameter1 multiplied by 10. Parameter1 is a coefficient to change the measurements weighting in the position filter. Allowed values are from 0.1 to 10.0 (suggested value is 1.0) means high acceptance of satellites measurements in the position filter. 10.0 means low acceptance of satellites measurements in the position filter.
B16...B23	10...100	Parameter2 multiplied by 10. Parameter2 is a coefficient to change the measurements acceptance threshold. Allowed values are from 1.0 to 10.0 (suggested value is 2.5) means strong satellite exclusions by FDE (high false alarm rate). 10.0 means relaxed satellites exclusions by FDE.

12.36 CDB-ID 266 – Data logger Configuration 2

Data logger configuration field 2.

Table 223. **CDB-ID 266 field description**

Bits	Values	Description	Default
Bit 0	0...1	0 = Data logger disabled on boot 1 = Data logger enabled on boot	0
Bit 1	0...1	0 = Circular buffer disabled 1 = Circular buffer enabled	0x1
Bit 2-4	0..3	0 = RESERVED 1 = Log type 1 2 = Log type 2 3 = Log type 3	0x11
Bit 5	0...	0 = One shot mode disabled 1 = One shot mode enabled	0

Bits	Values	Description	Default
Bit 6	0...1	0 = Auto start mode disabled 1 = Auto start mode enabled	0
Bit 7-15	1...255	RESERVED	0
Bit 16-23	0...255	0	0
Bit 24-31	-	RESERVED	0

12.37 CDB-ID 267 – Data logger Configuration 3

Data logger configuration field 3.

Table 224. CDB-ID 267 field description

Bits	Values	Description	Default
Bit 24-31	-	RESERVED	0
Bit 0-23	0..65535	Minimal distance between to logs expressed in meters	0

12.38 CDB-ID 268 – Geofencing Configuration 0

Geofencing configuration field 0.

Table 225. CDB-ID 268 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Geofencing disabled on boot 1 = Geofencing enabled on boot	0
Bit 1-2	0...3	Geofencing tolerance: 0 = No tolerance 1 = Geofencing status probability is 68% 2 = Geofencing status probability is 95% 3 = Geofencing status probability is 99%	0x1
Bit 3	0...1	0 = Autostart disabled 1 = Autostart enabled	0
Bit 4-7	-	RESERVED	0x1
Bit 8	0...1	0 = Circle 0 disabled 1 = Circle 0 enabled	0x1
Bit 9	0...1	0 = Circle 1 disabled 1 = Circle 1 enabled	0x1
Bit 10	0...1	0 = Circle 2 disabled 1 = Circle 2 enabled	0x1
Bit 11	0...1	0 = Circle 3 disabled 1 = Circle 3 enabled	0x1
Bit 12-31	-	RESERVED	0

12.39 CDB-ID 270 – Odometer Configuration

Odometer configuration field. This configuration is supported only in Binary Image 4.5.8 and later.

Table 226. CDB-ID 270 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Odometer disabled on boot 1 = Odometer enabled on boot	0
Bit 1	0...1	0 = Odometer related NMEA messages disabled 1 = Odometer related NMEA messages enabled	0
Bit 2	0...1	0 = Odometer does not starts to record on boot 1 = Odometer automatically starts to record on boot	0
Bit 3-15	-	RESERVED	0
Bit 16-31	0...1	Distance in meter to trigger the alarm	0x03E8

12.40 CDB-ID 272 – GNSS integrity check configuration

Position and time integrity check enabling/disabling.

Table 227. CDB-ID 271 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Position integrity check disabled 1 = Position integrity check enabled	0
Bit 1	0...1	0 = Time integrity check disabled 1 = Time integrity check enabled	0

12.41 CDB-ID 301 – PPS Pulse Duration

Allow setting the pulse duration of the PPS signal. The pulse duration is intended to be the time distance between the PPS rising edge and the next falling edge if polarity inversion is disabled or the time distance between falling and rising edge if polarity inversion is enabled.

12.42 CDB-ID 302 – PPS Delay Correction

Allow setting a time correction to compensate any delay introduced on the Pulse per Second (PPS) signal by cables and/or RF chain.

12.43 CDB-ID 303 – GNSS fix rate

Allow setting the GNSS library fix rate. It is the time period between two consecutive position fix evaluations.

System reboot needed to have new setting in use.

12.44 CDB-ID 304 – Position Hold Latitude

Allow setting the latitude [degrees] for the position hold mode

Note: To be used the position hold functionality must be enabled, see CDB-ID 200 for details.

System reboot needed to have new setting in use.

12.45 CDB-ID 305 – Position Hold Longitude

Allow setting the longitude [degrees] for the position hold mode

Note: To be used the position hold functionality must be enabled: see CDB-ID 200 for details.

System reboot needed to have new setting in use.

12.46 CDB-ID 306 – Position Hold Altitude

Allow setting the altitude [m] for the position hold mode

Note: To be used the position hold functionality must be enabled: see CDB-ID 200 for details.

Note: The altitude to be configured in this parameter mustn't be compensated with the geoid correction. If the altitude value is retrieved by the $GPGGA NMEA message, it must be added to the geoid correction (reported in the same $GPGGA message) before setting it in the CDB-ID 306 parameter.

System reboot needed to have new setting in use.

12.47 CDB-ID 307 – GPS RF delay correction

Allow setting the RF time delay for the GPS signal path. The RF compensation for GPS is independent of the PPS clock setting. The value calibrated for the ST reference design is 713E-9 s.

12.48 CDB-ID 308 – GLONASS RF delay correction

Allow setting the RF time delay for the GLONAS signal path. The RF compensation for GLONASS depends on the PPS clock setting (see CDB-ID). Here are the values calibrated for the ST reference design.

Table 228. CDB-ID 308 field description

PPS Clock Setting	GLONASS RF Correction
32 MHz	-
64 MHz	-

Note: If the PPS clock setting is changed in the configuration block, also the GLONASS RF delay correction must be changed accordingly. For accurate timing applications it is strongly recommended to set PPS clock to 64 MHz.

12.49 CDB-ID 309 – TRAIM alarm threshold

Allow setting the time error threshold for satellites removal in the TRAIM algorithm. Satellites which have a time error bigger than the TRAIM threshold are not used for time correction. The TRAIM threshold is also used to rise the TRAIM alarm if the time correction error is bigger than it.

12.50 CDB-ID 310 – BEIDOU RF delay correction

Allow setting the RF time delay for BEIDOU signal path.

12.51 CDB-ID 311 – GALILEO RF delay correction

Allow setting the RF time delay for GALILEO signal path.

12.52 CDB-ID 314 – CDB-ID 315 – CDB-ID 316 – Geofencing Circle 0

Allows to set up the geofencing circle number 0 parameters.

Table 229. **Geofencing circle 0 field description**

CDB-ID	Type value	Description
314	double precision floating number	Circle latitude
315	double precision floating number	Circle longitude
316	double precision floating number	Circle radius in meters

12.53 CDB-ID 317 – CDB-ID 318 - CDB-ID 319 - Geofencing Circle 1

Allows to set up the geofencing circle number 1 parameters.

Table 230. **Geofencing circle 1 field description**

CDB-ID	Type value	Description
317	Double precision floating number	Circle latitude
318	Double precision floating number	Circle longitude
319	Double precision floating number	Circle radius in meters

12.54 CDB-ID 320 – CDB-ID 321 – CDB-ID 322 – Geofencing Circle 2

Allows to set up the geofencing circle number 2 parameters

Table 231. **Geofencing circle 2 field description**

CDB-ID	Type value	Description
320	Double precision floating number	Circle latitude
321	Double precision floating number	Circle longitude
322	Double precision floating number	Circle radius in meters

12.55 CDB-ID 323 – CDB-ID 324 – CDB-ID 325 – Geofencing Circle 3

Allows to set up the geofencing circle number 3 parameters

Table 232. **Geofencing circle 3 field description**

CDB-ID	Type value	Description
323	double precision floating number	Circle latitude
324	double precision floating number	Circle longitude
325	double precision floating number	Circle radius in meters

12.56 CDB-ID 400 – Default 2D DOP

Allow setting the default value for the 2D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

12.57 CDB-ID 401 – Default 3D DOP

Allow setting the default value for the 3D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

12.58 CDB-ID 402 – Startup 2D DOP

Allow setting the startup value for the 2D DOP. This value is used during the GNSS startup phase as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

12.59 CDB-ID 403 – Startup 3D DOP

Allow setting the startup value for the 3D DOP. This value is used during the GNSS startup phase as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

12.60 CDB-ID 500 – Text message

Allow setting a text message which is sent (if enabled – see bit9 of CDB-ID 200 parameter) at startup over the NMEA port. The user is free to use this text as product name or as specific configuration marker.

System reboot needed to have new setting in use.

Appendix A Acronyms and definitions

Table 233 lists the acronyms and definitions used in this document.

Table 233. 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 excluding delimiters $ and *
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 Teseo 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.
IMU	Inertial Measurement Unit

Keyword	Definition
Lat	Latitude - Angular difference of a given position to the Equator. Values include 0° -90° either North or South
Lat-Ref	Latitude Reference - Reference if a Latitude value is North or South
Long	Longitude - Angular difference to a "reference" Longitude indicated as "000". Values include 0° \xc9 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 Organization 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	Teseo Autonomous Integrity Monitoring
RF	Radio Frequency - High Frequency for Reception with a RF-Teseo
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.
SPS	Standard Positioning Service
Static Position Filtering	Algorithm to detect that the GPS Teseo 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

A.1 Local geodetic datum tables

Table 234. Africa geodetic datum

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

AFRICA		
REGION	CODE	CDB-ID VALUE
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

AFRICA		
REGION	CODE	CDB-ID VALUE
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

Table 235. Asia geodetic datum

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

ASIA		
REGION	CODE	CDB-ID VALUE
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

Table 236. Australia geodetic datum

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

Table 237. **Europe geodetic datum**

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

EUROPE		
REGION	CODE	CDB-ID VALUE
S-JTSK		
Czechoslovakia	CCD	100

Table 238. North America geodetic datum

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
CentralAmerica	NAS-N	118
Cuba	NAS-T	119
Greenland	NAS-U	120
Mexico	NAS-L	121
NORTH AMERICAN 1983		
Alaska (ExcludingAleutianIslands)	NAR-A	122
Aleutian Islands	NAR-E	123
Canada	NAR-B	124
CONUS	NAR-C	125
Hawaii	NAR-H	126
Mexico,Central America	NAR-D	127

Table 239. South America geodetic datum

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

Table 240. **Atlantic Ocean geodetic datum**

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 Island and 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

ATLANTIC OCEAN		
REGION	CODE	CDB-ID VALUE
SAPPER HILL 1943		
East Falkland Island	SAP	174
SELVAGEM GRANDE 1938		
Salvage Islands	SGM	175
TRISTAN ASTRO 1968		
Tristan da Cunha	TDC	176

Table 241. Indian Ocean geodetic datum

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

Table 242. Pacific Ocean geodetic datum

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

PACIFIC OCEAN		
REGION	CODE	CDB-ID VALUE
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

PACIFIC OCEAN		
REGION	CODE	CDB-ID VALUE
VITI LEVU 1916		
VitiLevuIsland (Fiji Islands)	MVS	213
WAKE-ENIWETOK 1960		
Marshall Islands	ENW	214
WAKE ISLAND ASTRO 1952		
Wake Atoll	WAK	215

Table 243. Non-Satellite Derived Transformation Parameter geodetic datum

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
EUROPEAN1950		
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

Table 244. Terrestrial Reference Systems geodetic datum

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

Appendix B RxNetworks Teseo-LIV3 credential

The table below reports the Teseo-LIV3 credential to access the RxNetworks AGNSS Web Server.

Credential access has to be used as described in the 'AN5160: RxNetworks Assisted GNSS Server Interface Specification'

Table 245. Teseo-LIV3 credential access on RxNetworks Assisted GNSS Server

String	Value
Server address	stm.api.location.io:80
<cld>	ZYDLLXxEH94dEeX2
<mld>	MYST

Revision history

Table 246. **Document revision history**

Date	Revision	Changes
16-May-2018	1	Initial release.
03-Oct-2018	2	Following are the changes: not found: Updated the table. NMEA command list: Updated the "Predictive AGNSS commands" list. $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD: Updated the description of "reference_time" paramater. $PSTMPPS field description on PPS_IF_CONSTELLATION_MASK_CMD: Updated the description of "constellation_mask" paramater. PPS Set PPS_IF_TIMING_DATA_CMD: Updated the "Synopsis". $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD: Updated the table. $PSTMLOWPOWERONOFF: Updated the "Synopsis". Updated the "Results" $PSTMLOWPOWERONOFF field description: Updated the table. $PSTMCFGTHGNSS and $PSTMCFGTDATA: Added the sections. $--GSV message field description: Updated the table. not found: Added the section. $PSTMGETRTCTIME message field description: Updated the description of "time_validity" parameter. $PSTMUSEDSATS: Added the section. $PSTMCFGTHGNSSOK, $PSTMCFGTHGNSSERROR, $PSTMCFGTDATAOK, and $PSTMCFGTDATAERROR: Added the sections. CDB-ID 201 - CDB-ID 228 fields description: Replaced the function of bit 38 from "RESERVED" to "$PSTMUSEDSATS" and function of bit 63 from "RESERVED" to "$--RLM" CDB-ID 214 – PPS operating mode setting 2: Added text "Mixing constellations for....." CDB-ID 214 field description: In the "Values" column, added "B7 = BEIDOU constellation" CDB-ID 220 – Adaptive and Cyclic operating mode setting 1: Updated the text. CDB-ID 220 field description: Updated the table. CDB-ID 257 field description: Updated the table. CDB-ID 258 field description: Updated the description of "From B8 to B19" bits. not found: Added text "Be careful, the voltage...." not found, CDB-ID 266 field description, CDB-ID 268 field description, and CDB-ID 270 field description: Updated the tables.
05-Mar-2019	3	Updated LowPower description Updated Data logging Updated Geofencing Updated Adaptive and Cyclic mode state diagram Added Adaptive and Cyclic finite state machine descriptions

Date	Revision	Changes
05-Mar-2019	3 (cont'd)	Updated Low power periodic mode State Diagram Added Periodic Standby Finite States description Updated ST NMEA command list Updated Odometer Updated Adaptive and Cyclic mode state diagram Added Adaptive and Cyclic finite state machine descriptions Updated Low power periodic mode State Diagram Added Periodic Standby Finite States description Removed $PSTMSETUCODE Updated $PSTMCFGMSGL field description Added CDB-ID 130 – CPU clock speed Removed $PSTMSETUCODEOK Removed "Almanacs and Ephemeris Management" and "Summary of text files used in the examples" chapters. UpdatedTeseo-LIV3 credential access on RxNetworks Assisted GNSS Server
17-Dec-2019	4	Updated: Introduction Section 10 Commands and some TESEO commands Section 11 Messages and some NMEA messages Added: Section 4.3.2 Real-time assistance data uploading procedure Section 11.3 Preliminary notes about satellites' PRN ranges Section 11.5.75 $PSTMEPHEMERROR Section 11.5.76 $PSTMALMANACOK Section 11.5.77 $PSTMALMANACERROR Section 11.5.78 $PSTMLOWPOWERON Section 11.5.79 $PSTMLOWPOWERERROR Removed: CDB-ID 195 - USB Data Terminal Equipment feature Minor text changes.
29-Nov-2021	5	Updated the introduction in cover page. Replaced in all the document "Teseo-LIV3F" with "Teseo Module". Added Section 11.5.39 $PSTMTG (Teseo-LIV3FL) and Section 11.5.40 $PSTMTS (Teseo-LIV3FL) Minor text changes.

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