UM2229
User manual

Teseo-LIV3F GNSS Module - Software Manual

Introduction

The Teseo-LIV3F module is an easy to use Global Navigation Satellite System (GNSS) stand-alone module, embedding Teseo single die stand-alone positioning receiver IC working on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

The module is 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 9.7x10.1 mm compact size, Teseo-LIV3F is offering superior accuracy thanks to the on board 26 MHz Temperature Compensated Crystal Oscillator (TCXO) and a reduced Time To First Fix (TTFF) relying on its dedicated 32 KHz Real Time Clock (RTC) oscillator.

The device is 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.

Contents

List of tables

List of figures

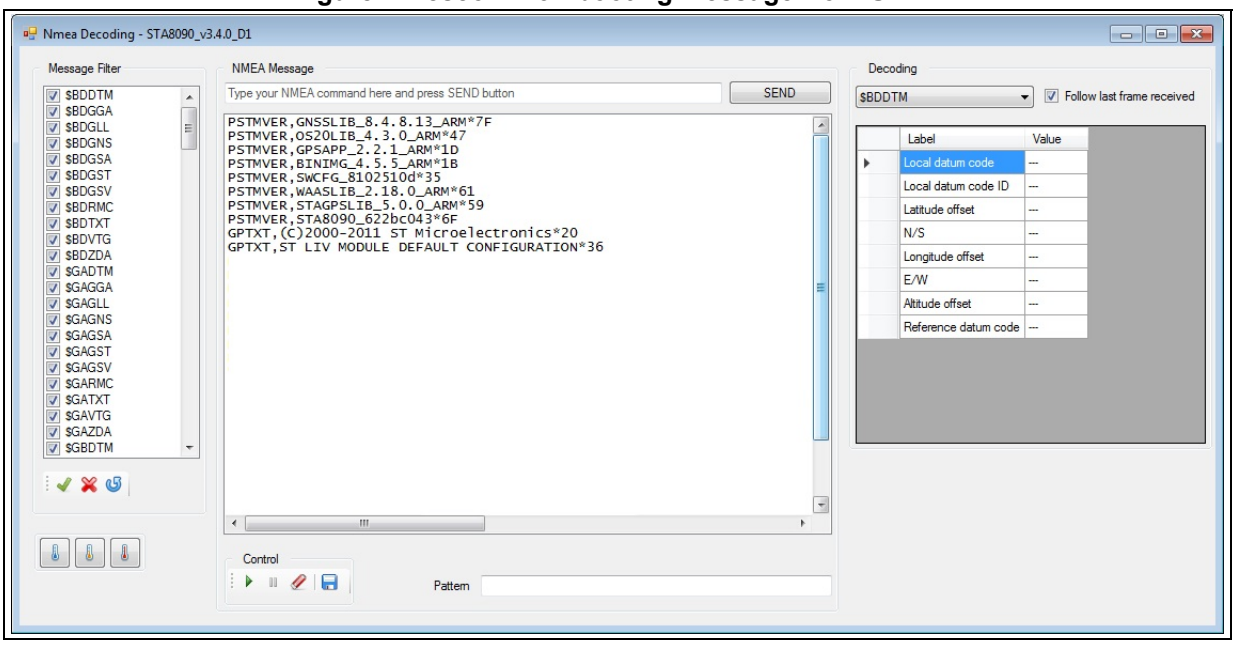
1 Firmware version

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-LIV3F reports on the serial port the current configuration as showed in the *Figure 1*:

Figure 1. Teseo-LIV3F booting message from UART



Each entry of *Table 1* identifies a specific Teseo-LIV3F firmware subsystem version.

Table 1. Teseo-LIV3F 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-LIV3F supports the firmware upgrade.

Both the Host and Teseo-LIV3F 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-LIV3F in an unrecoverable state.

Firmware upgrade has a preliminary phase to synchronize the Host and the Teseo-LIV3F.

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; 15: : 15 Kbytes;

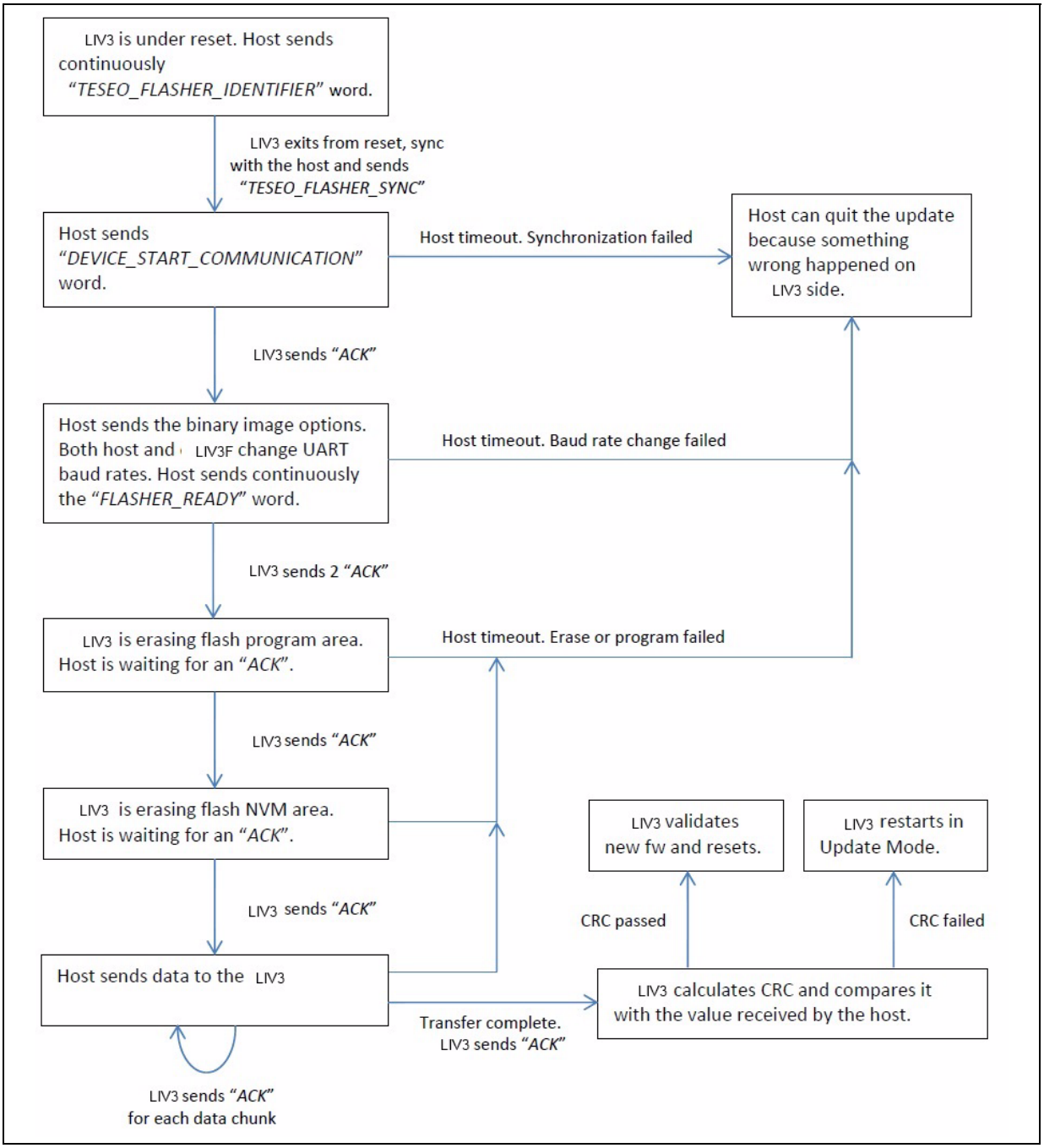
While sending the firmware, data host has to split the binary image in a N chunks with the selected chunk-size (in the ImageOptions structure); last chunk size must be equal to the remaining bytes number.

Each data chunk will be acknowledged with "ACK" response from Teseo-LIV3F.

When all the chunks are sent, Teseo-LIV3F 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-LIV3F device resets itself.

The firmware upgrade procedure is shown in *Figure 2*.

Figure 2. Teseo-LIV3F firmware upgrade procedure



Firmware upgrade procedure, on Teseo-LIV3F, uses the following constants:

Table 3. Firmware upgrade constants

Constants	Value
TESEO_FLASHER_IDENTIFIER	0xBCD501F4
TESEO_FLASHER_SYNC	0x83984073

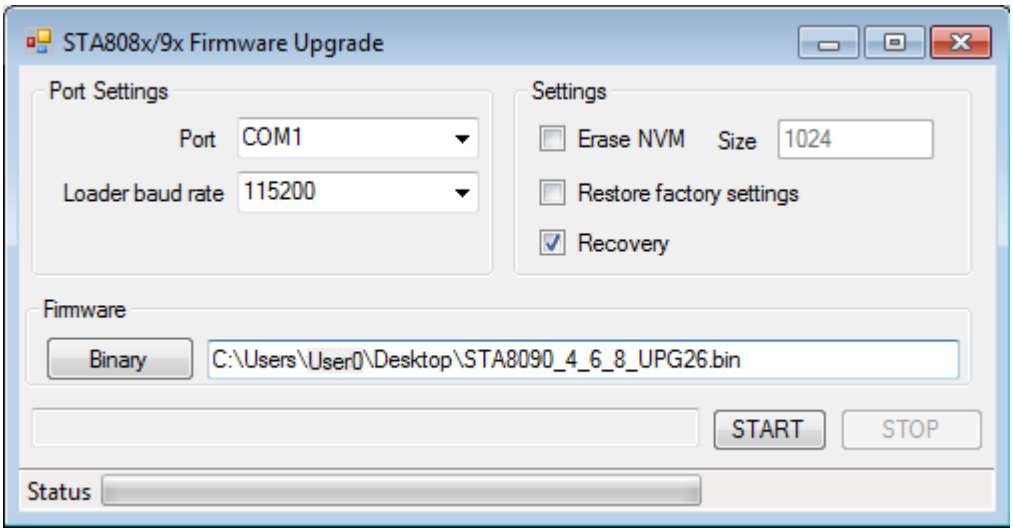
Table 3. Firmware upgrade constants (continued)

Constants	Value
DEVICE_START_COMMUNICATION	0xA3
FLASHER_READY	0x4A
ACK	0xCC

1.2 Firmware update software tool

Teseo-LIV3F 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-LIV3F, Teseo-LIV3F 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-LIV3F 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-LIV3F.

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-LIV3F;

On this windows 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-LIV3F 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-LIV3F 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-LIV3F 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.

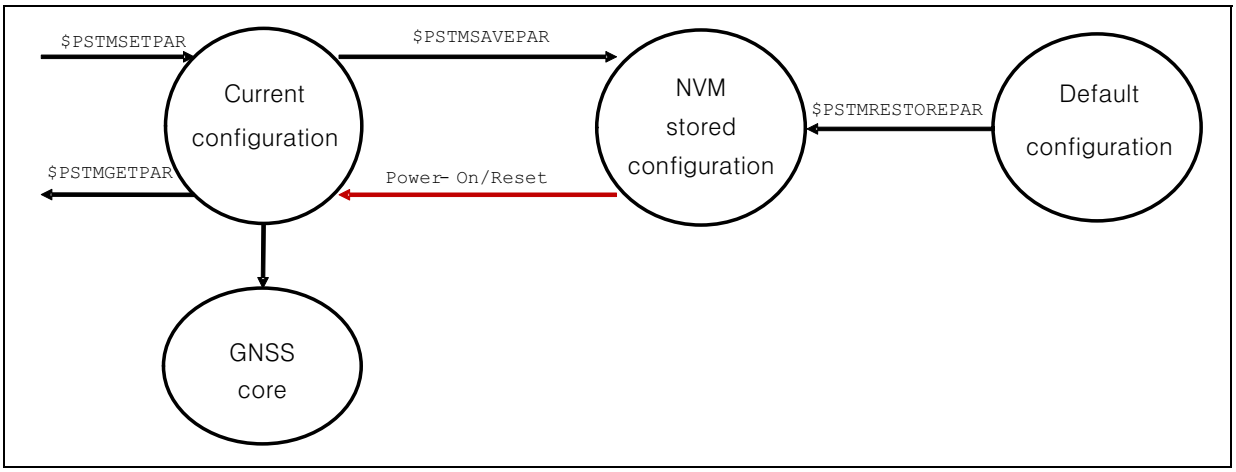
Current Configuration will be lost when there is:

- 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 whould be changed 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-LIV3F to guarantee that the change made are effectives;

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)
205	Position Data Time Delay [ms]	4	0x50	Set the time delay between the measurements (on UTC second) and the position data delivery. NOTE: 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.
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

Table 4. Configuration Data Block List (continued)

ID	Parameter Name	Size Bytes	Default(1)	Description
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. NOTE: Min week number is used for correct GPS week number decoding. Max week number is used for GPS week validity check.
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-LIV3F *default configuration v. 0.02*.

2.2.3 Firmware configuration commands

To simplify the Teseo-LIV3F module configuration, Teseo-LIV3F supports *firmware configuration commands* which are able to setup more than one CBD-ID with a single command.

Teseo-LIV3F 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

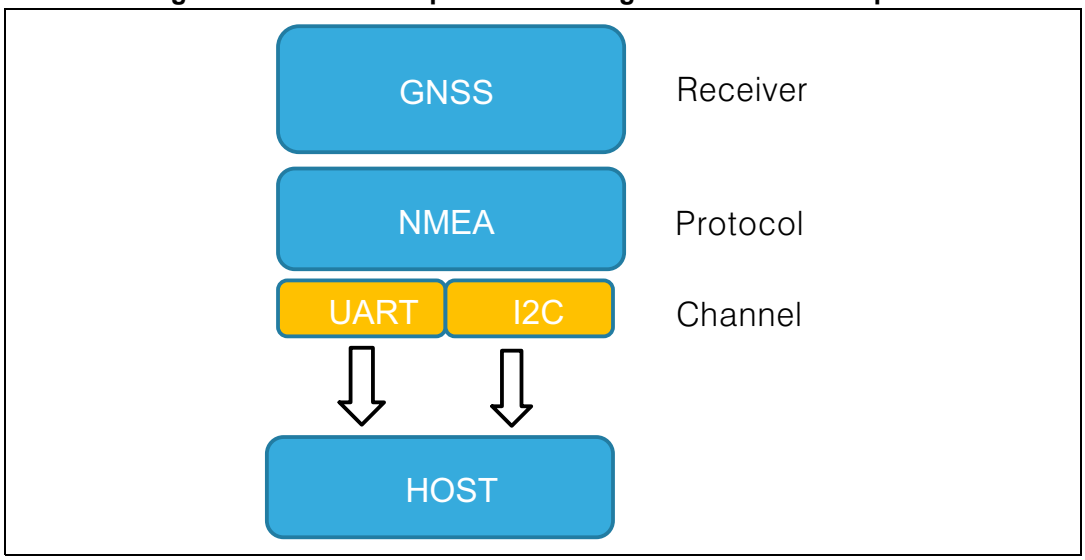
On the Teseo-LIV3F the *NMEA Protocol* is communication channel independent.

Users can select the channel based on their needs.

Teseo-LIV3F receiver supports the following communication channels:

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

Figure 5. Teseo-LIV3F protocol routing over the available ports



2.3.1 Communication over UART Port

Teseo-LIV3F 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-LIV3F receiver to Host frames can be:

- *Unsolicited*: For instance, periodical frame reporting position
- *Data Responses*: Teseo-LIV3F 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-LIV3F 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-LIV3F 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.

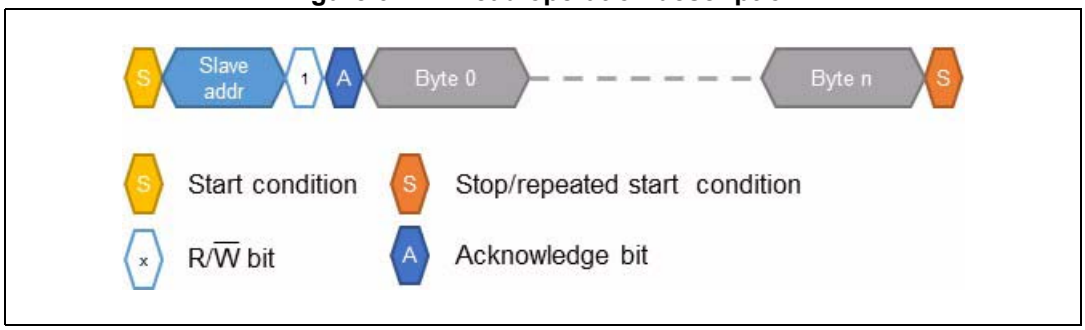
The CDB that can be used to configure I2C specific parameters is CDB 263

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-LIV3F up to the stop/repeated start condition.

Figure 6. I2C Read operation description



The format of the bytes is ASCII. When Teseo-LIV3F does not have any character to send, a dummy 0xFF byte is sent.

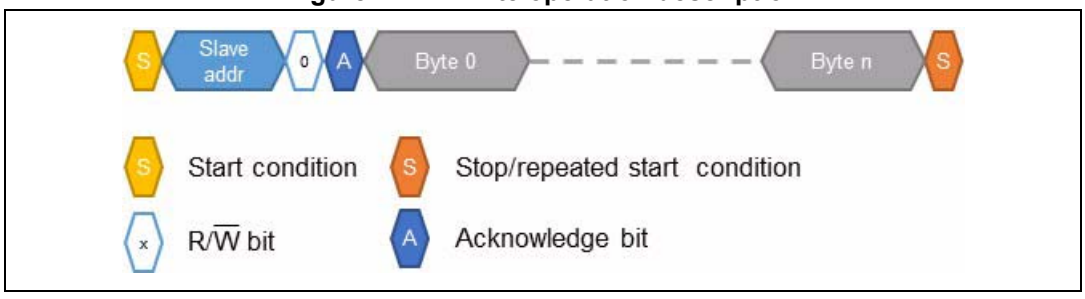
The Host can parse the data received as defined in ST GNSS NMEA specification and commands document.

2.3.2.2 I2C Write Access

When the Host wants to send commands to Teseo-LIV3F through I2C, it must start a write operation over I2C, providing configured slave address.

After the acknowledge bit, Teseo-LIV3F 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-LIV3F allows 256 addressable registers.

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

On write opertation:

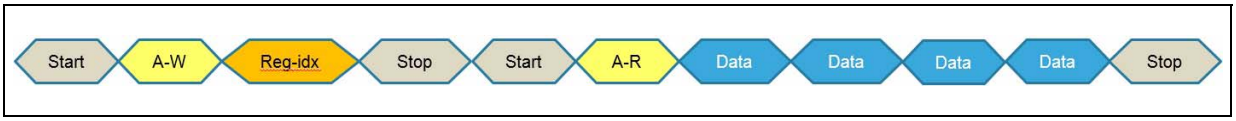
- the first data byte is the register index while the following bytes are the register value;
- every write operation with less than 5 bytes is discarded;
- write operation with more than 5 bytes all the extra bytes not required are discarded;

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-LIV3F;

Figure 9. I2C register read operation



Teseo-LIV3F 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-LIV3F.

Teseo-LIV3F 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-LIV3F.

Table 6. I2C registers map

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

3 Protocol Specification

The receivers come with a highly flexible communication interface.

Teseo-LIV3F supports the following protocols:

- NMEA Protocol based on NMEA 0183 Version 4.0;
- RTCM protocol based on RTCM Version 2.3

3.1 NMEA Protocol

NMEA messages sent by the Teseo-LIV3F 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-LIV3F 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 *Section 2.2: 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

Table 7. ST NMEA Command List (continued)

Syntax	Description
$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
$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-LIV3F 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 messages 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-LIV3F 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

Table 9. Proprietary ST NMEA Message (continued)

Syntax	Default	Description
$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.
$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 an unidirectional protocol to supply, to Teseo-LIV3F, real-time differential correction data.

Teseo-LIV3F 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-LIV3F 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

Teseo-LIV3F 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 GLONASS.

After that time a receiver must download new ephemeris data.

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

Assisted-AGNSS 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.

Teseo-LIV3F supports two types of Assisted GPS.

4.1 ST-AGNSS

The STAGNSS™ library is able to provide predicted ephemerides 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 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 commands raised by the Host:

Table 11. STAGNSS NMEA commands

Syntax	Description
`$PSTMSTAGPSONOFF`	Turns ON/OFF the STAGPS™ engine
`$PSTMSTAGPSINVALIDATE`	Clears data stored in the STAGPS™ internal database
`$PSTMGETAGPSSTATUS`	Returns the status of the STAGPS™ internal processing.
`$PSTMSTAGPSSETCONSTMASK`	Switches among the ST-AGNSS constellation.

Teseo-LIV3F receivers can send the following ST-AGNSS:

Table 12. ST-AGNSS NMEA messages

Syntax	Description
$PSTMAGPS	Message with the same syntax as standard NMEA GSA message
$PSTMAGLO	Message with the same syntax as standard NMEA GSA message
$PSTMSTAGPSONOFF	Turn ON/OFF the STAGPS™ engine
$PSTMPOLSTARTED	Message in response to PSTMSTAGPSONOFF
$PSTMPOLSUSPENDED	Message in response to PSTMSTAGPSONOFF
$PSTMPOLONOFFERROR	Message in response to PSTMSTAGPSONOFF
$PSTMSTAGPSINVALIDATEOK	Message in response to PSTMSTAGPSINVALIDATE
$PSTMSTAGPSINVALIDATEERROR	Message in response to PSTMSTAGPSINVALIDATE
$PSTMAGPSSTATUS	Message in response to PSTMGETAGPSSTATUS

4.2 Predicted - 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 8KB 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.

While autonomous ST-AGNSS™ is completely transparent to the Host device, the sever-based (P-AGNSS) version needs that a seed should be downloaded from the server and passed to the GNSS device

A unique feature of ST-AGNSS™ is the dual-mode ability to seamless fall back from the 14-days server-based prediction to 5-days autonomous prediction capability which self-sustains on the field depending on usage patterns.

PGPS server should be accessed as follows:

- Host generates HTTP request string
- HTTP Request made from Host to RXN
- 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.

This takes the form of a URL as follows:

```
http://{server address}:{port number}/{request string}
```

The server address and port number strings correspond to the particular server being used to download the seed from. These values are managed by RxNetworks. The request string consists of some key-value pairs that provide the server with some further information related to the download request. The following example illustrates the request string:

```
/grnserver/RXNPredictedData?seedAge=0&version=5&mask=1073741824&cId={vendo
r-id}&mID={mid}&un={device-id}&pw={password}&seedType={seed-
type}&constType=3
```

As it can be seen the request string consists of some directories (`/grnserver/RXNPredictedData`), the '?' indicates that the request is a HTTP GET request, and the rest of the request string consists of key value pairs (of the form &key=value). The keys of interest are detailed in the following table:

Table 13. PGPS server request field description

Key	Value
seedAge	This key is used to specify the GPS time of the seed to download.
cId	This key is used to specify the vendor id string. This is a unique string issued by RXN identifying the product vendor. In the case of ST at present this is "Rom20Bub78".
mID	This key is used to specify the mid string which seems to identify the product. In the case of ST at present this is "TODO".
un	This key specifies the customer's device id string. Again this is a unique id string agreed with RXN. For the development server this is set as "00-24-D6-30-A5-1F". For production this will contain a specific customer and unit value.
pw	This key specifies an automatically generated password. This password is generated by passing certain parameters into the GNSS device, which then uses those parameters to generate a password string. This is explained further in the next section.
seedType	This key identifies the type of PGPS seed to download. At the moment this is fixed as 14 (as 14 day models are available at the moment).

4.2.1.2 Password Generation

As mentioned in the previous section, in order to access the RXN servers, the user will be given a set of parameters that 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 a NMEA command that performs the password generation. The user must supply three parameters to this command that will be used to generate a unique password.

In order to generate the password the user must pass in 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 has been provided by RX Networks. The current time will need to be calculated by the software creating the HTTP request string.

4.2.1.3 Server Access

In order to access to the RXN servers, for Teseo-LIV3F the following id strings have been assigned:

Table 14. Rx Network Server access ID strings

String	Value
Server address	stm-1.pgps.gpstream.net:9280 stm-2.pgps.gpstream.net:9280 stm-3.pgps.gpstream.net:9280
Vendor Id	Rom20Bub78
mId	TODO

4.2.1.4 Seed structure

The 'version=5' request corresponds to PGPS 7.x seeds.

The PGPS 7 seed has the following structure:

```
<RXN mask="1073741824" version="5">
<GPS>[Navstar seed body in binary format]</GPS>
<GLO>[Glonass seed body in binary format ]</GLO>
</RXN>
```

The seed body in binary format consists of a seed header followed by up to 56 single satellite data blocks.

In the header some general information is stored, including:

- the seed initial time t0 (starting at bit #25 and 32 bits long);
- the seed current time (starting at bit #57 and 32 bits long);
- the seed protocol version (starting at bit #9 and 8 bits long);
- the seed propagator version (starting at bit #17 and 8 bits long),;
- the seed tauGPS (starting at bit #89 and 32 bits long);
- the seed tauDot (starting at bit #121 and 32 bits long)
- the number of single satellite data blocks stored in the seed (starting at bit #233 and 6 bits long).

The seed body starts at bit #239. It contains the single satellite data blocks (which are long 1167 bits each) which have to be transferred to the device through NMEA command described in the following pages.

The first 6 bits of the single satellite data block contain the satellite ID for that block (the satellite ID is equal to PRN minus 1 for GPS and the slot number minus 1 for GLONASS - for instance GPS satellite ID 5 means GPS PRN #6 or GLONASS satellite ID 11 means GLONASS slot number 12).

Each single satellite data block should be extracted from the seed and passed to the device using the NMEA commands described in the following paragraphs.

4.3 Real time - AGNSS

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.

4.3.1 Real time - AGNSS Procedure

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 `$PSTMINITTIME` command or the `$PSTMINITGPS` command, if also the approximate position is available, injecting both current time and position.

Then the ephemerids 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 Teseo-LIV3F receiver to save locally on the flash the resolved GNSS position to be retrieved on demand from the Host.

Teseo-LIV3F receiver supports only one datalog at a time.

Datalogging can be enabled, disabled and erased using runtime commands.

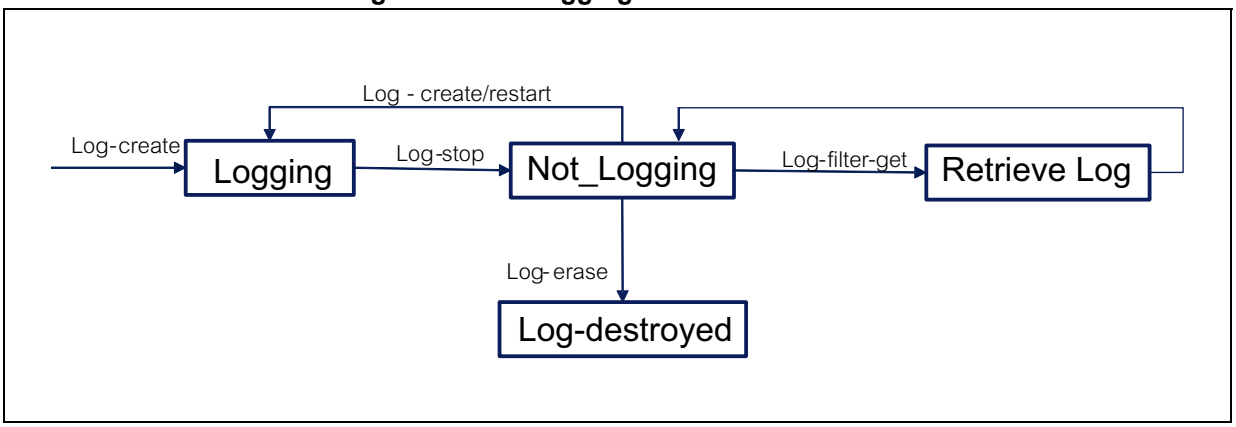
Datalogging subsystem supports both:

- Circular buffer;
- Standard buffer;

In case of standard buffer the datalogging system can also raise an alarm to the Host in case of buffer full using a NMEA message.

The *Figure 10* shows the finite state machine of each log.

Figure 10. Datalogging 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 datalogging 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; the optional fields depend on the *datalog types*;

Datalog system supports 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: an index-log (a counter from zero), timestamp, latitude and longitude while other fields depend on the type; in details:

Table 15. Field description in the Datalogging types

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

Datalogging subsystem supports the following commands raised by the Host:

- `PSTMLOGCREATE`
- `PSTMLOGSTART`
- `PSTMLOGSTOP`
- `PSTMLOGERASE`
- `PSTMLOGREQSTATUS`
- `PSTMLOGREQQUERY`

Teseo-LIV3F receivers can send the following message in response to a command:

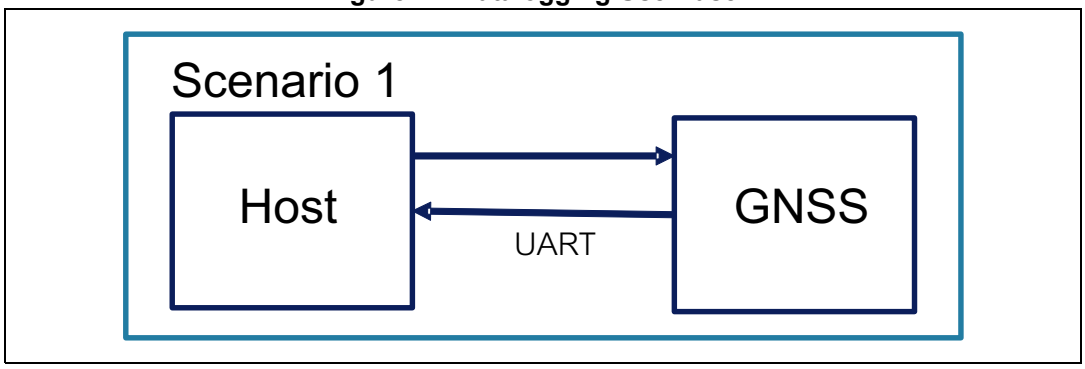
- `PSTMLOGSTATUS`
- `PSTMLOGQUERY`

Teseo-LIV3F receivers can send autonomously the following message (if enabled in the message list):

- `PSTMLOGSTATUS`

Datalogging system supports the following two scenarios.

Figure 11. Datalogging Use Case 1

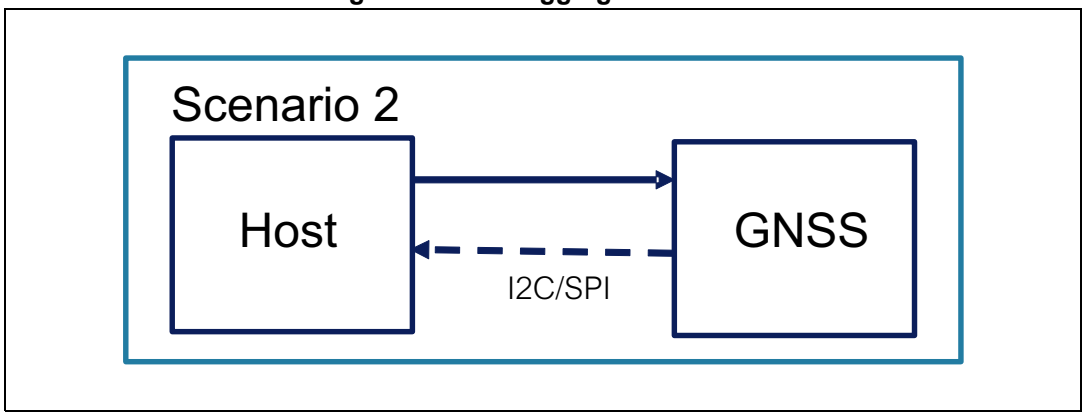


In case of **Scenario 1** Teseo-LIV3F receiver can autonomously raise a `PSTMLOGSTATUS` message to the Host (if `PSTMLOGSTATUS` message is enabled in the message-list) to notify log buffer full) trough the UART port, in this manner the Host doesn't need polling the Teseo-LIV3F receiver raising `PSTMLOGREQSTATUS` commands.

When the Host receives the `PSTMLOGSTATUS` message it's aware of internal datalog status.

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

Figure 12. Datalogging Use Case 2



In case of **Scenario 2** Teseo-LIV3F receiver cannot autonomously raise message to the Host. In this scenario, periodically, the Host has to send the command `PSTMLOGREQSTATUS` to Teseo-LIV3F receiver with a bus-specific-write operation followed by a bus-specific-read operation where the Host will read `PSTMLOGSTATUS` message posted by the Teseo-LIV3F receiver.

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

Table 16. CDB-ID

CDB-ID	Fields	Default-value	Description
266	Config-0	—	Datalogging configuration-0: [23:16]: minimal speed to log a data; [15:8]: minimal rate to log a data; [4:2]: data logging type; [1:1]: Enable circular buffer; [0:0]: Enable Datalogging on boot;
267	Config-1	—	Datalogging configuration-1: [15:0]: minimal distance to log a data;

6 Geofencing

Geofence feature allows the Teseo-LIV3F receiver to raise a NMEA message when the resolved GNSS position is close to or entering or exiting from a specific circle.

Teseo-LIV3F receiver supports at least 8 circular areas where 4 circular areas are configurable in the firmware.

Geofencing features and alarm are notified over NMEA message.

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

Geofencing subsystem supports the following commands raised by the Host:

- `PSTMGEOFENCECFG`
- `PSTMGEOFENCEREQ`

Teseo-LIV3F receivers can send the following message in response to a command:

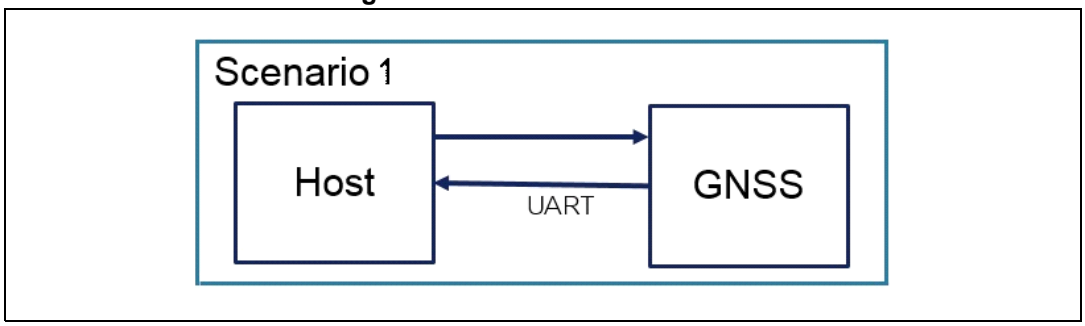
- `PSTMGEOFENCE`

Teseo-LIV3F receivers can send autonomously the following message (if enabled in the message list):

- `PSTMGEOFENCE`

Geofence system supports the following two scenarios.

Figure 13. Geofence uses case 1

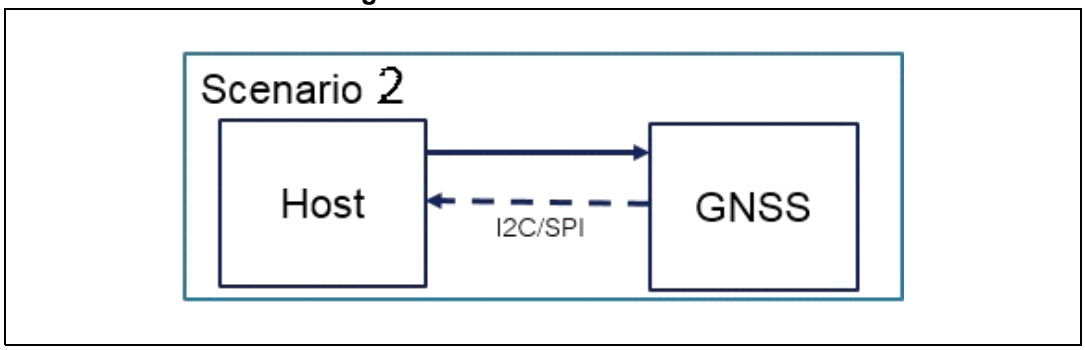


In case of **Scenario 1** Teseo-LIV3F receiver can raise autonomously `PSTMGEOFENCE` NMEA message to the Host trough the UART port, in this manner the Host doesn't need polling the Teseo-LIV3F receiver raising `PSTMGEOFENCEREQ` commands.

When the Host receives the `PSTMGEOFENCE` message it's aware of geofence internal status.

The other geofence commands are raised by the Host to manage, configure and query the log.

Figure 14. Geofence uses case 2



In case of **Scenario 2** Teseo-LIV3F receiver cannot raise autonomously message to the Host. In this scenario, periodically, the Host has to send the commad `PSTMGEOFENCEREQ` to the Teseo-LIV3F receiver with a bus-specific-write operation followed by a bus-specific-read operation where the Host will read `PSTMGEOFENCE` message posted by the Teseo-LIV3F receiver.

7 Odometer

ST Teseo-LIV3F receiver supports Odometer feature.

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

Odometer subsystem has only 2 states:

- Odometer activated;
- Odometer reseted;

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 reseted 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 subsystem supports the following commands raised by the Host:

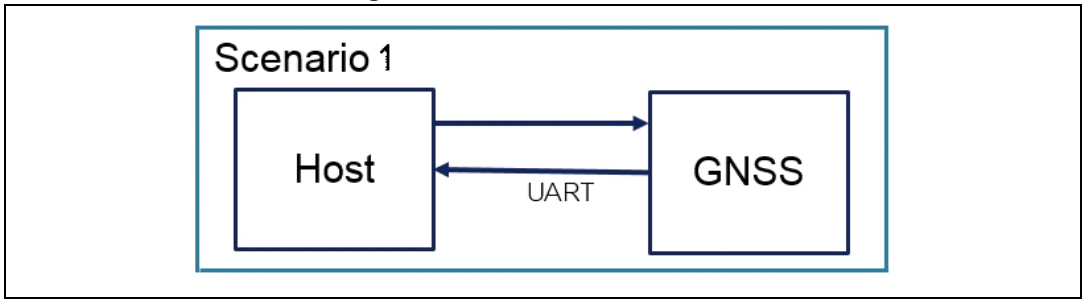
- `PSTMODOSTART;`
- `PSTMODOSTOP;`
- `PSTMODORESET;`

Teseo-LIV3F receivers can send autonomously the following message (if enabled in the message list):

- `PSTMODO`

Odometer system supports the following two scenarios.

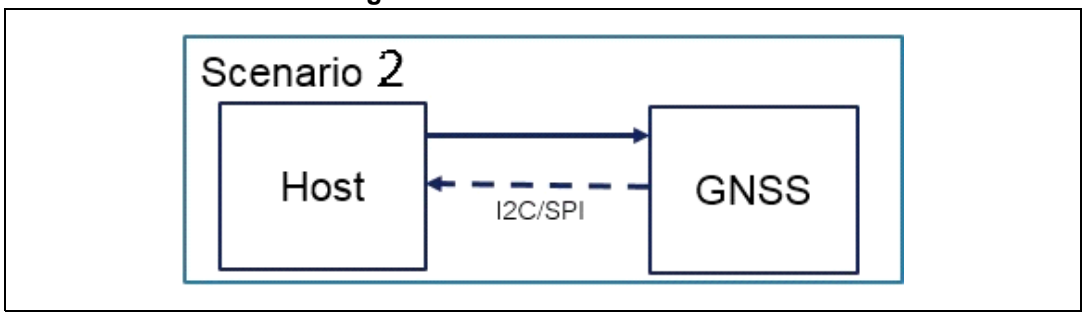
Figure 15. Odometer use case 1



In case of **Scenario 1** Teseo-LIV3F receiver can autonomously raise a `PSTMODO` NMEA message to the Host trough the UART port (if `PSTMODO` message is enabled in the message-list).

When the Host receives the `PSTMODO` message it's aware of internal datalog status.

Figure 16. Odometer use case 2



In case of **Scenario 2** Teseo-LIV3F receiver cannot raise autonomously NMEA message to the Host. In this scenario, periodically, the Host has to send the command `$PSTMNMEAREQUEST` to the Teseo-LIV3F receiver with a bus-specific-write operation followed by a bus-specific-read operation where the Host will read a `PSTMODO` message posted by the Teseo-LIV3F receiver.

8 Adaptive Low Power Modes

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

Active and Standby Periodic Low Power mode:

- Report a FIX at a given periodicity
- Autonomous periodic ephemeris refresh
- RTC calibration capability

The periodic mode saves power when a FIX is needed with periodicity greater than 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 choice between the different modes is driven by the required FIX periodicity.

Table 17. Low power mode supported

Fix Periodicity	Appropriate mode
0.1s-1s	None
5s – 24H	Standby Periodic mode

8.1 Periodic Modes

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 (WFI) 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

The WFI hardware state ensures continuity of software execution and maintains data; the Standby hardware state is a reset, where CPU register states and on-board memories (except backup RAM) are lost.

8.2 State Machine

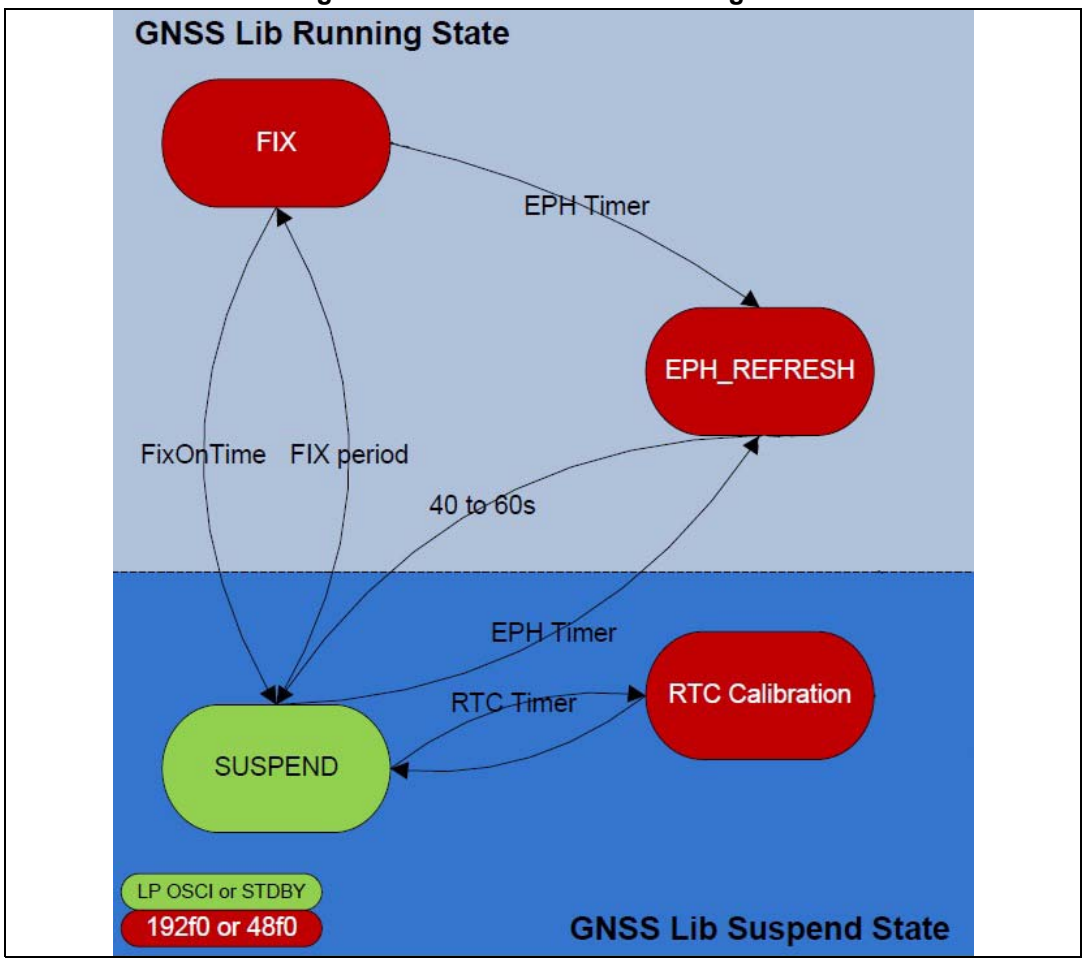
The periodic mode has basically two parts in its state machine. The transitions between both parts in case of FIX loss or recovery is done according to the steady state condition.

The steady state is the combination of the following information:

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

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

Figure 17. Periodic Mode State Diagram



Here are the details about the different states:

- *SUSPEND*: The GNSS Lib has previously managed to report a FIX, steady state has been reached, so the *SUSPEND* state can be entered. Three timers are run: FixPeriod for next FIX occurrence, EPH refresh and RTC calibration. Expiration of the first two timers can trigger a transition to FIX or EPH_REFRESH states, while the RTC calibration is done in suspended mode.
- *FIX*: A new FIX or a series of N fixes are expected. Go back to *SUSPEND* as soon as 1 or N fixes are reported. If the GNSS FIX can't be calculated during 8, a transition to *SUSPEND*, a suspended state, is triggered. If the ephemeris refresh timer occurs during the FIX calculation, a transition to EPH_REFRESH occurs and GNSS signal is decoded during 40 to 60s.
- *EPH_REFRESH*: Period where ephemeris are downloaded. The transition to this state occurs every 32 minutes, for 40 to 60 seconds, according to the completeness of ephemeris download;
- *RTC Calibration*: When configured in the settings, a RTC calibration is done on the first transition to *SUSPEND* state, and regularly reconfirmed every 5 minutes.

The state *SUSPEND* concerns a low power hardware state. The *RTC Calibration* state occurs while the GNSS Lib is suspended, but is executed anyway at high frequency (48f0 or 192f0 according to frequency settings).

The *ephemeris refresh* is done every 32 minutes, this delay allows the almanac refresh along several ephemeris refresh periods.

8.3 Control Interface

Low power mode can be configured through the:

- CDB-ID 200 - Application ON/OFF bit 32;
- CDB-ID 257 – Periodic operating mode setting 1;

During the runtime the `$PSTMLOWPOWERONOFF` commands (NMEA protocol) can be triggered by the Host.

9 Configuration and command specification

9.1 Configuration Data Block IDs

9.1.1 CDB-ID 102 – NMEA port baud rate setting

It allows setting the baud rate for the NMEA port number. The translation table is reported below.

Table 18. NMEA port baud rate setting

Parameter Value	Baud rate
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

A system reboot is needed to have new setting in use.

9.1.2 CDB-ID 125 – Notch Filter Setting

It allows setting the Notch filter usage on GPS RF path, GLONASS RF path or both GPS and GLONASS RF paths.

Table 19. Notch Filter setting

Bitmask	Description
b0	Enable/disable notch filter on GPS path (normal mode).
b1	Enable/disable notch filter on GLONASS path (normal mode).
b2	Reserved - Must be 1
b3	Reserved - Must be 1

9.1.3 CDB-ID 128 – Differential Source Type

It allows selecting the differential mode source type.

Table 20. Differential Source setting

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.
0x3 - AUTO	RTCM (if available) or SBAS (if available) is the source for differential corrections.

9.1.4 CDB-ID 129 – GLONASS Satellite ID Type

It allows selecting between two different ways to report the GLONASS satellites ID in the GSV and GSA messages.

Table 21. GLONASS ID Type setting

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.

9.1.5 CDB-ID 135 – SBAS default PRN

It allows setting the default PRN for the SBAS library.

A system reboot is needed to have new setting in use.

9.1.6 CDB-ID 197 – PPS Clock

It allows setting the PPS clock frequency. For accurate timing application 64MHz is mandatory.

Table 22. PPS Clock setting

Value	Description
16	Sets PPS clock to 16MHz
32	Sets PPS clock to 32MHz
64	Sets PPS clock to 64MHz

9.1.7 CDB-ID 199 – Local Geodetic Datum Selection

It sets the local geodetic datum to be used when position data is reported over the NMEA messages. *Appendix A: Local Geodetic Datum Tables* specifies the CDB-ID required value for all supported datum.

9.1.8 CDB-ID 200 - CDB-ID 227 Application ON/OFF

It allows enabling/disabling different features in the GNSS library.

Features are mapped in a 64 bits 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 32bits).

For each bit:

- 0 means feature disabled;
- 1 means feature enabled.

Low 32bits are described in the following table:

Table 23. Application feature description

Bit1	Bitmask	Function
32 bits low		
0	0x1	Reserved – MUST Be 0
1	0x2	Reserved – MUST Be 0
2	0x4	SBAS (WAAS / EGNOS) augmentation system
3	0x8	Reserved – MUST Be 1
4	0x10	STAGPS enable
5	0x20	Reserved – MUST Be 0
6	0x40	Reserved – MUST Be 1
7	0x80	QZSS distributed acquisition mode enable
9	0x200	Reserved – MUST Be 1
10	0x400	Reserved – MUST Be 1
11	0x800	RTCM enable
12	0x1000	Reserved – MUST Be 1
14	0x4000	Reserved – MUST Be 0
15	0x8000	Stop Detection Algorithm
16	0x10000	GPS constellation enable2
17	0x20000	GLONASS constellation enable3
18	0x40000	QZSS constellation enable4
19	0x80000	Reserved – MUST Be 0
20	0x100000	Reserved – MUST Be 0
21	0x200000	GLONAS usage for positioning enable
22	0x400000	GPS usage for positioning enable

Table 23. Application feature description (continued)

Bit1	Bitmask	Function
23	0x800000	QZSS usage for positioning enable
24	0x1000000	PPS enabling
25	0x2000000	PPS polarity inversion
26	0x4000000	Reserved – MUST Be 0
27	0x8000000	TRAIM algorithm enable
28	0x10000000	Reserved – MUST Be 1
29	0x20000000	Reserved – MUST Be 0
30	0x40000000	Reserved – MUST Be 0
31	0x80000000	Reserved – MUST Be 0
32 bits high		
32	0x1	Reserved – MUST Be 1
33	0x2	Reserved – MUST Be 0
34	0x4	Reserved – MUST Be 1
35	0x8	STBIN in/out enable
36	0x10	Reserved
37	0x20	Reserved – MUST Be 0
38	0x40	Galileo constellation enable
39	0x80	Galileo usage for positioning enable
40	0x100	Beidou constellation enable8
41	0x200	Beidou usage for positioning enable
42	0x400	Reserved
43	0x800	Reserved – MUST Be 0
44	0x1000	Reserved – MUST Be 0
45	0x2000	Reserved
46	0x4000	Excluded satellites reporting enable

9.1.9 CDB-ID 201 – CDB-ID 228 NMEA Message List over UART (LOW and HIGH)

It allows enabling/disabling each NMEA message in the message list over UART.

The message list over UART is a 64bits bitmap; CDB-ID 201 represents the first 32 bits (low bits) while CDB-ID 228 represents the second 32 bits (high bits).

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 24. NMEA message list description

Bit	Bitmask (32 bits)	Function
32 bits low		
0	0x1	$GPGNS Message
1	0x2	$GPGGA Message
2	0x4	$GPGSA Message
3	0x8	$GPGST Message
4	0x10	$GPVTG Message
5	0x20	Reserved
6	0x40	$GPRMC Message
7	0x80	$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	Reserved
19	0x80000	$GPGSV Message
20	0x100000	$GPGLL Message
21	0x200000	$PSTMPPSDATA Message
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	Reserved
31	0x80000000	$PSTMTM Message
32 bits high		
32	0x1	$PSTMPV Message

Table 24. NMEA message list description (continued)

Bit	Bitmask (32 bits)	Function
33	0x2	$PSTMPVQ Message
34	0x4	$PSTMUTC Message
35	0x8	Reserved
36	0x10	$PSTMANTENNASTATUS Message
37	0x20	Reserved
38	0x40	Reserved
39	0x80	$GPDTM Message
40	0x100	$PSTMEPHEM Message
41	0x200	$PSTMALMANAC Message
42	0x400	Reserved
43	0x800	Reserved
44	0x1000	$PSTMBIASDATA Message
45	0x2000	$GPGBS Message
46	0x4000	Reserved
47	0x8000	Reserved
48	0x10000	Reserved
49	0x20000	Reserved
50	0x40000	Reserved
51	0x80000	Reserved
52	0x100000	Reserved
53	0x200000	Reserved
54	0x400000	Reserved
55	0x800000	Reserved
56	0x1000000	Reserved
57	0x2000000	Reserved
58	0x4000000	Reserved
59	0x8000000	Reserved
60	0x10000000	Reserved
61	0x20000000	Reserved
62	0x40000000	Reserved
63	0x80000000	Reserved

9.1.10 CDB-ID 205 – Position Data Time Delay

It allows setting the time delay [ms] between the measurements (on the UTC second) and the GNSS position data delivery. This parameter should never be bigger than the time period of the configured FIX rate.

If “0” is used, the time delay is set in accordance with the CPU speed:

- 50ms if CPU is running @ 208MHz
- 500ms if CPU is running @ 52MHz

A system reboot is needed to have new setting in use.

9.1.11 CDB-ID 213 – PPS operating mode setting 1

It allows 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 25. CDB-ID 213 field description

Bits	Values	Description
From B0 to B3	0on every second 1on even seconds 2on odd seconds	PPS generation mode
From B4 to B7	0UTC 1GPS Time 2GLONASS Time 3UTC(SU) 4GPS Time (From Glonass Time Reference)	Reference time on which the PPS signal is synchronized.
From B8 to B11	1NO FIX 2D FIX 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	Minimun number of satellites used for timing correction. PPS signal is generated if the number of satellites used for time correction is bigger than 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.

9.1.12 CDB-ID 214 – PPS operating mode setting 2

It allows 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 26. CBD-ID 214 field description

Bits	Values	Description
From B0 to B7	1 mixing constellation disabled 2 GPS sats are enabled for GLONASS time correction. 3 GLONASS sats are enabled for GPS time correction.	Enable/disable mixing constellations for time correction.

9.1.13 CDB-ID 215 – Position hold auto survey samples

It 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.

9.1.14 CDB-ID 231 - CDB-ID 232 NMEA Message List over I2C (LOW and HIGH)

It allows 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) while CDB-ID 232 represents the second 32 bits (high bits).

For each bit:

- 0 means feature disabled;
- 1 means feature enabled;

Bits description is the same as CDB-ID 201 and CDB-ID 228 of NMEA Message List over UART

9.1.15 CDB-ID 237 – Default GPS MIN-MAX week number

It allows setting of the minimum and the 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 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 FIX.

Table 27. CBD-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

9.1.16 CDB-ID 238 – Default UTC delta time

It allows setting the default value for the GPS time to UTC delta time seconds (leap seconds). This parameter is used by the GNSS software only if 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).

9.1.17 CDB-ID 257 – Periodic operating mode setting 1

It configures 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 28. CBD-ID 257 field description

Bits	Values	Description
From B0 to B7	0/1 for each feature	Periodic feature set Enable/Disable: B0: Periodic mode B1: Standby state allowed B2: Ephemeris refresh required B3: RTC calibration required B4 to B7 are reserved for further usage.
From B8 to B24	0..86400	FixPeriod [s]. 0 means the FIX will be given only on WAKEUP pin activation.
From B25 to B31	1..127	FixOnTime - Number of FIX to report every FIX periodicity [s].

9.1.18 CDB-ID 263 – I2C slave configuration

It allows setting the I2C configuration when acting as I2C slave device.

Table 29. I2C slave configuration

Bits	Values	Description
From B0 to B1	1	Reserved
From B2 to B5	-	Reserved
From B6 to B15	0x3A	I2C slave address
From B16 to B31	0	Reserved

9.1.19 CDB-ID 301 – PPS Pulse Duration

It allows 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.

9.1.20 CDB-ID 302 – PPS Delay Correction

It allows setting a time correction to compensate any delay introduced on the Pulse Per Second (PPS) signal by cables and/or RF chain.

9.1.21 CDB-ID 303 – GNSS FIX rate

It allows setting the GNSS library FIX rate. It is the time period between two consecutive position FIX evaluations.

A system reboot is needed to have new setting in use.

9.2 NMEA Protocol

9.2.1 Standard NMEA Messages List

9.2.1.1 $GPGGA

Global Positioning System Fixed data

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

Format:

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

Table 30. GPGGA 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	Latitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
GPSQual	Decimal, 1digit	0 = invalid 1 = GPS 2 = DGPS
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 (“M” = meters)
GeoVal	“M”	Reference Unit for GeoSep (“M” = meters)

Table 30. GPGGA field description (continued)

Parameter	Format	Description
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
```

9.2.1.2 $GPGLL

Geographic Positioning Latitude / Longitude

Format:

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

Table 31. GPGLL field description

Parameter	Format	Description
Lat	DDMM.MMMMM	Latitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	“N” or “S”	Latitude Direction: North or South
Long	DDMM.MMMMM	Longitude in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Longitude Direction: East or West
Timestamp	hhmmss.sss	UTC Time of GGL Sample, Example: 160836 “.sss” is the fraction of seconds; it assumes non zero values when the FIX rate is bigger than 1Hz.
Status	“A” or “V”	Validity of Data: “A” = valid, “V” = invalid
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
```

9.2.1.3 $--GSA

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

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

Satellites from different constellations are sent on separate messages.

Format:

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

Table 32. GSA 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 mode; 2: 2D mode; 3: 3D mode;
SatPRN1...N	Decimal, 2 digits	Satellites list used in position FIX (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, max: 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, max: 99.0
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

9.2.1.4 $--GSV

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

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

Format:

```
$--GSV,<GSVAmount>,<GSVNumber>,<TotSats>,
[<Sat1PRN>,<Sat1Elev>,<Sat1Azim>,<Sat1C/N0>],
...
[<SatNPRN>,<SatNElev>,<SatNAzim>,<SatNC/N0>]*<checksum><cr><lf>
N max 4
```

Table 33. GSV field description

Parameter	Format	Description
GSVAmount	Decimal, 1 digit	Total amount of GSV messages, max. 3
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 12
SatxPRN	Decimal, 2 digits / 3 digits	1 … 32 PRN Number of satellite x for GPS 33 .. 51 NMEA ID of SBAS 65 … 92 PRN Number of satellite x for GLONASS 141 … 172 PRN Number of satellite x for BAIDEU 183 … 197 PRN Number of satellite x for QZSS 293 … 297 PRN Number of satellite x for QZSS 301 … 330 PRN Number of satellite x for GALILEO
SatxElev	Decimal, 2 digits	Elevation of satellite x in Degree, 0 … 90
SatxAzim	Decimal, 3 digits	Azimuth of satellite x in degree, ref. “North”, 000 … 359
SatxC/N0	Decimal, 2 digits	Carrier to Noise Ratio for satellite x in dB, 00 … 99
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGSV,3,1,12,02,04,037,,05,27,125,44,06,78,051,23,07,83,021,30*7C
$GPGSV,3,2,12,10,16,067,30,12,11,119,36,16,24,301,41,21,44,175,50*73
$GPGSV,3,3,12,23,06,326,28,24,61,118,40,30,45,122,43,31,52,253,37*7C
```

9.2.1.5 $GPRMC

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

Format:

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

Table 34. GPRMC 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.
Status	“A” or “V”	Receiver warning: “A” = valid, “V” = Warning NOTE: “V” is reported in NO FIX conditions and “A” is reported in 2D and 3D FIX conditions.
Lat	DDMM.MMMMM	Latitude in degree: DD: Degree MM: Minutes .MMMMM: parts Minutes
N/S	“N” or “S”	Latitude Direction: North or South
Long	DDMM.MMMMM	Longitude in Degree: DD: Degree MM: Minutes .MMMMM: parts Minutes
E/W	“E” or “W”	Longitude Direction: East or West
Speed	ddd.d	Speed over ground in knots
Trackgood	Decimal, 4 digits	Course made good, max. 999.9
Date	Decimal, 6 digits	Date of FIX : ddmmyyyy
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	“E” or “W”	Magnetic Variation Direction
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

9.2.1.6 $GPVTG

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

Format:

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

Table 35. GPVTG field description

Parameter	Format	Description
TMGT	ddd.d	Track in reference to “true” earth poles in degrees
T		Indicates “terrestrial”
TMGM	ddd.d	Track in reference to “magnetic” earth poles in degrees
M		Indicates “magnetic”
SoGN	ddd.d	Speed over Ground in knots
N		Indicates “knots”
SoGK	ddd.d	Speed over Ground in kilometers per hour
K		Indicates “kilometers”
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
```

9.2.1.7 $GPZDA

UTC, day, month and year.

Format:

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

Table 36. GPZDA 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.
Day	Decimal, 2 digits	Day of month (01 to 31)
Month	Decimal, 2 digits	Month (01 to 12)

Table 36. GPZDA field description (continued)

Parameter	Format	Description
Year	Decimal, 4 digits	Year (1994 - …)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

9.2.1.8 $GPGST

Global Positioning System Pseudorange Noise Statistics

Format:

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

Table 37. GPGST 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.
EHPE	dd.d	Equivalent Horizontal Position Error in m
Semi-major Dev	dd.d	Standard deviation (meters) of semi-major axis of error ellipse in m
Semi-minor Dev	dd.d	Standard deviation (meters) of semi-minor axis of error ellipse in m
Semi-major Angle	dd.d	Orientation of semi-major axis of error ellipse (true north degrees) in degree
Lat Err Dev	dd.d	Standard deviation (meters) of latitude error in m
Lon Err Dev	dd.d	Standard deviation (meters) of longitude error in m
Alt Err Dev	dd.d	Standard deviation (meters) of altitude error in m
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

9.2.1.9 $GPGBS

GNSS Satellite Fault Detection

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

Format:

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

Table 38. GPGBS 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 1 Hz.
Lat Err Dev	dd.d	Standard deviation (meters) of latitude error in m
Lon Err Dev	dd.d	Standard deviation (meters) of longitude error in m
Alt Err Dev	dd.d	Standard deviation (meters) of altitude error in m
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	Range residual of most likely failed satellite in m
Std dev	Empty	Standard Deviation of bias estimate Not supported
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

9.2.1.10 $--GNS

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

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

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

Satellites from different constellations are sent on separate messages.

Format:

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

Table 39. GNS 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
GPS Mode Indicator	Char	N = NO FIX A = Autonomous D = Differential GPS
Glonass Mode Indicator	Char	N = NO FIX A = Autonomous D = Differential Glonass
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.

Example:

```
$GNGSN,090025.000,4055.04798,N,01416.55234,E,AA,19,0.6,0088.1,43.0,,*5F
```

9.2.1.11 $--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, are referenced. If enabled, this message is sent for every position FIX as first NMEA message in the list.

Format:

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

Table 40. DTM field description

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

Example:

```
$GPDTM,W84,,000.00000,N,000.00000,E,0.000000,W84*5F
$GPDTM,P90,253,000.00005,S,000.00266,E,0.000000,W84*73
$GPDTM,999,,000.18907,N,000.05146,W,0.000000,W84*2E
$GPDTM,IHO,037,000.11581,N,000.01822,W,0.000000,W84*69
```

9.2.2 Proprietary ST NMEA Message List

9.2.2.1 $PSTMCPU

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

Format:

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

Table 41. PSTMCPU field description

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

9.2.2.2 $PSTMPPSDATA

It reports the Pulse Per Second data

Format:

```
$PSTMPPSDATA,<on_off>,<pps_valid>,<synch_valid>,<out_mode>,<ref_time>,<ref
_constellation>,<pulse_duration>,<pulse_delay>,<gps_delay>,<glo_delay>,<in
verted_polarity>,<fix_cond>,<sat_th>,<elev_mask>,<const_mask>,<ref_sec>,<f
ix_status>,<used_sats>,<gps_utc_delta_s>,<gps_utc_delta_ns>,<glonass_utc_d
elta_ns>,<quantization_error>,<pps_clock_freq>,<tcxo_clock_freq>*<checksum
><cr><lf>
```

Table 42. PSTMPPSDATA 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 4 GPS_UTC_FROM_GLONASS
ref_constellation	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]
glonass_delay	Decimal	GLONASS path RF delay [ns]
inverted_polarity	Decimal, 1 digit	Pulse polarity inversion: 0 not inverted 1 inverted
fix_cond	Decimal, 1 digit	Selected GNSS FIX condition for PPS signal generation: 0 NO_FIX 1 D_FIX 2 3D_FIX
sat_th	Decimal	Selected minimum number of satellites for PPS signal generation.
elev_mask	Decimal	Selected minimum satellite elevation for time correction.

Table 42. PSTMPPSDATA field description (continued)

Parameter	Format	Description
const_mask	Decimal	Selected constellations for time correction.
ref_sec	Decimal, 2 digits	Second at which the reported PPS data is applied. According to the reference time configuration it could be a UTC or a GPS or a GLONASS time second.
fix_status	Decimal, 1 digit	GNSS position FIX status when the time has been corrected.
used_sats	Decimal	Used satellites for time correction.
gps_utc_delta_s	Decimal	UTC leap seconds [s]
gps_utc_delta_ns	Decimal	UTC – GPS delta time [ns]
glonass_utc_delta_ns	Decimal	UTC – GLONASS delta time [ns]
quantization_error	Double (scientific notation format)	Quantization error [s].
pps_clock_freq	Double, 2 fractional digits	PPS clock frequency [Hz]
tcxo_clock_freq	Double, 2 fractional digits	TCXO clock frequency [Hz]

9.2.2.3 $PSTMLOWPOWERDATA

It reports the status of adaptive low power algorithm.

Format:

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

Table 43. PSTMLOWPOWERDATA 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	Estimated Horizontal Position Error [m]
reserved	—	—
ehpe_average	dd.d	Estimated Horizontal Position Error Average [m]

Table 43. PSTMLOWPOWERDATA field description (continued)

Parameter	Format	Description
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

9.2.2.4 $PSTMALMANAC

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

Format:

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

Table 44. PSTMALMANAC field description

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

Example:

```
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034024200
b4ffff00*1a
```

9.2.2.5 $PSTMEPH

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

Format:

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

Table 45. PSTMEPH field description

Parameter	Format	Description
SatID	Decimal, 2 digits	Satellite Number (PRN)
DataSize	Decimal, 2 digits	Number of bytes contained in the “Hex-Data” field

Table 45. PSTMEPH field description (continued)

Parameter	Format	Description
HexData	Hexadecimal, n-times 2 digits	Ephemeris Data in Hex-Format
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

```
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400fbff33
420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
```

9.2.3 Proprietary ST NMEA Command List

9.2.3.1 $PSTMINITGPS

The command initializes 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 46. PSTMINITGPS field description

Parameter	Format	Description
Lat	DDMM.MMM	Latitude (Degree-Minute.Minute decimals)
LatRef	‘N’ or ‘S’	Latitude direction (North or South)
Lon	DDDMM.MMM	Longitude (Degree-Minute.Minute decimals)
LonRef	‘E’ or ‘W’	Longitude Direction (East or West)
Alt	dddd – Decimal,4 digits	Altitude in meters (-1500 to 100000)
Day	dd – Decimal, 2 digits	Day of month (01 to 31)
Month	mm – Decimal, 2 digits	Month (01 to 12)
Year	YYYY – Decimal, 4 digits	Year (2015 - …)
Hour	HH – Decimal, 2 digits	Hour (00 to 23)
Minute	MM – Decimal, 2 digits	Minute (00 to 59)
Second	SS – Decimal, 2 digits	Second (00 to 59)

Results:

- The position and time will be initialized
- The following message will be sent as output on NMEA communication channel:
  - `$PSTMINITGPSOK<cr><lf>` if successful
  - `$PSTMINITGPSERROR<cr><lf>`if unsuccessful

Example:

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

9.2.3.2 $PSTMINITTIME

The command initializes 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 47. 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 - …)
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 time will be initialized
- The following message will be output on NMEA communication channel:
  - `$PSTMINITTIMEOK<cr><lf>` if success
  - `$PSTMINITTIMEERROR<cr><lf>`if no success

Example:

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

9.2.3.3 $PSTMINITFRQ

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

Synopsis:

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

Arguments:

Table 48. PSTMINITFRQ field description

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

Results:

- The centre frequency will be initialized

Example:

```
$PSTMINITFRQ,-47000
```

9.2.3.4 $PSTMSETRANGE

The command sets 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 49. 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:

- The following message will be output on NMEA communication channel:
  - `$PSTMSETRANGEOK<cr><lf>`if success
  - `$PSTMSETRANGEERROR<cr><lf>`if no success

Example:

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

9.2.3.5 $PSTMCLREPHS

The command clears 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
```

9.2.3.6 $PSTMDUMPEPHEMS

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

Synopsis:

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

Arguments:

None.

Results:

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

Where:

Table 50. PSTMDUMPEPHEMS 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
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

The N Bytes that are in the message are the dump of a structure that contains all the information of the ephemeris. Data are stored in this structure according to the following tables.

If the data are for GPS:

Table 51. GPS ephemeris field description

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.

Table 51. GPS ephemeris field description (continued)

Bits	Structure Member	Description
16	cis	Amplitude of the sine harmonic correction to the angle of inclination.
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
16	motion_difference	Mean motion difference from computed value
16	Reserved	Must be 0.
32	inclination	Inclination angle at reference time
32	e	Eccentricity.
32	root_A	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
8	time_group_delay	Estimated group delay differential.
8	af2	Second order clock correction.
16	af1	First order clock correction.
22	af0	Constant clock correction.
1	reserved	Reserved for use by GNSS library – must be 1
1	reserved	Reserved for use by GNSS library – must be 1
1	reserved	Reserved for use by GNSS library – must be 1
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	reserved	Must be 0.
4	Accuracy	Accuracy

For GLONASS the table is:

Table 52. GLONASS ephemeris field description

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.

Table 52. GLONASS ephemeris field description (continued)

Bits	Structure Member	Description
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 Means 4; 1 Means 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	Reserverd	—
27	Xn	Satellite PZ-90 x coordinate at epoch tb.
5	xn_dot_dot	Satellite PZ-90 x velocity at epoch tb.
24	xn_dot	Satellite PZ-90 x acceleration component at epoch tb.
5	N	Slot number (1…24).
3	Bn	Healthy flags.
27	Yn	Satellite PZ-90 y coordinate at epoch tb.
5	yn_dot_dot	Satellite PZ-90 y acceleration component at epoch tb.
24	yn_dot	Satellite PZ-90 y velocity at epoch tb.
8	age_h	Age of predicted ephemeris (hours)
27	zn	Satellite PZ-90 z coordinate at epoch tb.
5	zn_dot_dot	Satellite PZ-90 z acceleration component at epoch tb.
24	zn_dot	Satellite PZ-90 z velocity at epoch tb.
8	Reserved	Must be 0.
11	gamma_n	Satellite clock frequency drift at epoch tb.
5	E_n	Age of the ephemeris information.
4	freq_id	Frequency ID
12	reserved	—
22	tau_n	Satellite clock correction at epoch tb.
10	reserved	Must be 0.
32	tau_c	GLONASS to UTC(SU) time correction.
22	tau_GPS	GLONASS to GPS system time correction.
10	reserved	—
11	NT	Calendar day number of ephemeris within the four-year period since the beginning of last leap year.

Table 52. GLONASS ephemeris field description (continued)

Bits	Structure Member	Description
5	N4	Four-year interval number starting from 1996.
12	Tk	Satellite time referenced to the beginning of the frame.
4	FT	Predicted satellite user range accuracy at time tb
32	reserved	—
5	m_available	Must be 0x1F
1	nvm_reliable	Must be 1.
26	spare	—
25	reserved	—
1	available	Contains 1 if ephemeris is available, 0 if not.
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy.
1	reserved	Must be 0.
4	reserved	—

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

Table 53. Galileo ephemeris field description

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.

Table 53. Galileo ephemeris field description (continued)

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.

For BEIDOU:

Table 54. BEIDOU ephemeris field description

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.

Table 54. BEIDOU ephemeris field description (continued)

Bits	Structure Member	Description
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 0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter 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 2
8	A3	Ionospheric Delay Model Parameter 3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter 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 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 0
6	spare	—
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.

Table 54. BEIDOU ephemeris field description (continued)

Bits	Structure Member	Description
8	B1	Ionospheric Delay Model Parameter 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	helth	Contains 1 if the satellite is unhealthy, 0 if healthy

Example:

```
$PSTMDUMPEPHEMS
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400fbff33
420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ffcaff19
37000033515726556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00b8ffd0
37000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff6c00f7
2e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

9.2.3.7 $PSTMEPHEM

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

Synopsis:

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

Arguments:

Table 55. STMEPHEM 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
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 ephemeris. Data are stored in this structure according to the following tables.

If the data are for GPS:

Table 56. GPS Load ephemeris field description

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch
16	toc	Time of week for clock epoch
8	iode1	Issue of data 1
8	iode2	Issue of data 2
10	Iodc	Issue of data clock
14	I_dot	Rate of inclination angle.
8	Reserved	—
24	omega_dot	Rate of right ascension.
8	Reserved	Must be 0.
16	crs	Amplitude of the sine harmonic correction to the orbit radius.
16	crc	Amplitude of the cosine harmonic correction to the orbit radius.
16	cus	Amplitude of the sine harmonic correction to the argument of latitude.
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
16	cis	Amplitude of the sine harmonic correction to the angle of inclination.
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
16	motion_difference	Mean motion difference from computed value
16	reserved	Must be 0.
32	inclination	Inclination angle at reference time
32	e	Eccentricity.
32	root_A	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
8	time_group_delay	Estimated group delay differential.
8	af2	Second order clock correction.
16	af1	First order clock correction.
22	af0	Constant clock correction.

Table 56. GPS Load ephemeris field description (continued)

Bits	Structure Member	Description
1	reserved	Reserved for use by GNSS library – must be 1
1	reserved	Reserved for use by GNSS library – must be 1
1	reserved	Reserved for use by GNSS library – must be 1
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	reserved	Must be 0.
4	accuracy	Accuracy

For GLONASS the following table must be used:

Table 57. GLONASS Load ephemeris field description

Bits	Structure Member	Description
16	week	Week number of the Issue of Data.
16	toe	Time of week for ephemeris epoch.
4	toe_lsb	Time of week for ephemeris epoch (LBS).
11	NA	Calendar day number within the four-year period since the beginning of last leap year (almanac).
7	tb	Time of ephemeris index.
2	M	Type of satellite 00=GLONASS 01=GLONASS-M .
2	P1	Time interval between two adjacent tb parameters.
1	P3	Number of satellites for which almanac is transmitted within this frame 0=4 1=5.
1	P2	Flag of oddness ("1") or evenness ("0") of the value of tb
1	P4	Flag to show that ephemeris parameters are present.
2	KP	Notification on forthcoming leap second correction of UTC
1	Reserved	—
27	xn	Satellite PZ-90 x coordinate at epoch tb.
5	xn_dot_dot	Satellite PZ-90 x velocity at epoch tb.
24	xn_dot	Satellite PZ-90 x acceleration component at epoch tb.
5	n	Slot number (1…24).
3	Bn	Healthy flags.
27	yn	Satellite PZ-90 y coordinate at epoch tb.
5	yn_dot_dot	Satellite PZ-90 y acceleration component at epoch tb.
24	yn_dot	Satellite PZ-90 y velocity at epoch tb.
8	age_h	Age of predicted ephemeris (hours)
27	zn	Satellite PZ-90 z coordinate at epoch tb.

Table 57. GLONASS Load ephemeris field description (continued)

Bits	Structure Member	Description
5	zn_dot_dot	Satellite PZ-90 z acceleration component at epoch tb.
24	zn_dot	Satellite PZ-90 z velocity at epoch tb.
8	reserved	Must be 0.
11	gamma_n	Satellite clock frequency drift at epoch tb.
5	E_n	Age of the ephemeris information.
4	freq_id	Frequency ID
12	reserved	—
22	tau_n	Satellite clock correction at epoch tb.
10	reserved	Must be 0.
32	tau_c	GLONASS to UTC(SU) time correction.
22	tau_GPS	GLONASS to GPS system time correction.
10	reserved	—
11	NT	Calendar day number of ephemeris within the four-year period since the beginning of last leap year.
5	N4	Four-year interval number starting from 1996.
12	tk	Satellite time referenced to the beginning of the frame.
4	FT	Predicted satellite user range accuracy at time tb
32	reserved	—
5	m_available	Must be 0x1F
1	nvm_reliable	Must be 1.
26	spare	—
25	reserved	—
1	available	Contains 1 if ephemeris is available, 0 if not.
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy.
1	reserved	Must be 0.
4	reserved	—

For Galileo:

Table 58. Galileo Load ephemeris field description

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

Table 58. Galileo Load ephemeris field description (continued)

Bits	Structure Member	Description
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.

Table 58. Galileo Load ephemeris field description (continued)

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.

For BEIDOU:

Table 59. Beidou Load ephemeris field description

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 0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter 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 2
8	A3	Ionospheric Delay Model Parameter 3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter 2
4	urai	User range accuracy index

Table 59. Beidou Load ephemeris field description (continued)

Bits	Structure Member	Description
2	reserved	Must be 0.
18	crc	Amplitude of the cosine harmonic correction to the orbit radius.
8	B3	Ionospheric Delay Model Parameter 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 0
6	spare	—
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter 1
6	reserved	Must be 0.
18	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
1	nvm_reliable	Must be 1.
11	reserved	Must be 0.
2	spare	—
17	toc	Time of week for clock epoch
13	week	Week number of the Issue of Data
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

Results:

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

Example:

```
$PSTMEPHEM,12,64,0f06bc34bc3437373790f40045a7ff00fcf5d522480b4bf71b00fbff8
931000096126f271f869101c3870ca107afce79a763e13e360a1ce8e7003100380ff903*36
```

9.2.3.8 $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
```

9.2.3.9 $PSTMDUMPALMANAC

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

Synopsis:

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

Arguments:

None.

Results:

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

Where:

Table 60. PSTMDUMPALMANAC 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 message are the dump of a structure that contains all the information of the almanac. Data are stored in this structure according to the following tables.

If the data are for GPS:

Table 61. GPS Dump Almanac field description

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.

Table 61. GPS Dump Almanac field description (continued)

Bits	Structure Member	Description
16	omega_dot	Rate of right ascension.
24	root_A	Square root of semi-major axis.
24	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
24	perigee	Argument of perigee.
24	mean_anomaly	Mean anomaly at reference time.
11	af0	Constant clock correction.
11	af1	First order clock correction.
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.

For GLONASS the table is the following:

Table 62. GLONASS Dump Almanac field description

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

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

Table 63. Galileo Dump Almanac field description

Bits	Structure Member	Description
16	satid	The satellite number
6	svid	Space Vehicle Identificator
16	week	The week number for the epoch
20	toa	Reference time almanac.
13	delta_a	Delta of semi-major axis.
11	e	Eccentricity.
16	perigee	Argument of perigee.
11	delta_i	Rate of inclination angle.
16	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
11	omega_dot	Rate of right ascension.
16	mean_anomaly	Mean anomaly at reference time.
16	af0	Constant clock correction.
13	af1	First order clock correction.
2	E5b_HS	E5 Signal Health Status
2	E1B_HS	E1-B Signal Health Status
4	ioda_1	Issue of data Almanac 1
4	ioda_2	Issue of data Almanac 2
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.
2	reserved	Reserved for use by GNSS library
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	available	Contains 1 if almanac is available 0 if not.

Example:

```
$PSTMDUMPALMANAC
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034024200
b4ffff00*1a
$PSTMALMANAC,2,32,021a0690944b78fe37fd0800770da141ef0c5b0060487700989bd800
d8088000*1a
$PSTMALMANAC,3,32,031a06904f68a2f540fd0800f60ca141922a2c003cae27009496cf00
020a8000*15
$PSTMALMANAC,4,32,041a0690a94aeffd36fd0800390ca141afc95b00de7a1700dfc74e00
4ddebf00*13
$PSTMALMANAC,5,32,051a0690940eee0b5efd0800900ca141582b8600d3000b0060641200
e40f8000*14
```

9.2.3.10 $PSTMALMANAC

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

Synopsis:

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

Arguments:

Table 64. 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 are stored in this structure according to the following tables.

If the data are for GPS:

Table 65. GPS Load almanac field description

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

For GLONASS the table is the following:

Table 66. Glonass Load almanac field description

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

For Galileo the following table:

Table 67. Galileo Load almanac field description

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.

Table 67. Galileo Load almanac field description (continued)

Bits	Structure Member	Description
16	mean_anomaly	Mean anomaly at reference time.
16	af0	Constant clock correction.
13	af1	First order clock correction.
2	E5b_HS	E5 Signal Health Status
2	E1B_HS	E1-B Signal Health Status
4	ioda_1	Issue of data Almanac 1
4	ioda_2	Issue of data Almanac 2
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.
2	reserved	Reserved for use by GNSS library
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	available	Contains 1 if almanac is available 0 if not.

Results:

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

Example:

```
$PSTMALMANAC,12,32,0c1a06907c1a971160fd0800fa0da141ae9f0600d912e9007566970
0490f8000*75
```

9.2.3.11 $PSTMCOLD

The command performs a COLD start.

Synopsis:

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

Arguments:

Table 68. 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.
- If `Mask` parameter is used, only the selected GPS data is invalidated for this actual Coldstart. Multiple selects are supported (i.e. 0xD).
- If `Mask` parameter is not used, default is 0xE (clear ephemeris, time and position).

Example:

```
$PSTMCOLD,6
```

9.2.3.12 $PSTMWARM

The command performs a WARM start.

Synopsis:

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

Arguments:

None.

Results:

- Warm start initialization and system restart.

Example:

```
$PSTMWARM
```

9.2.3.13 $PSTMHOT

The command performs an HOT start.

Synopsis:

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

Arguments:

None.

Results:

- The system restart.

Example:

```
$PSTMHOT
```

9.2.3.14 $PSTMSRR

The command 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
```

9.2.3.15 $PSTMGPSRESET

The command resets the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

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

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

Example:

```
$PSTMGPSRESET
```

9.2.3.16 $PSTMGPSSUSPEND

The command suspends the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

- The GPS receiver engine will be suspended

Example:

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

9.2.3.17 $PSTMGPSRESTART

The command restarts the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

9.2.3.18 $PSTMGNSSINV

The command invalidates the GNSS FIX Status.

Synopsis:

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

Arguments:

Table 69. 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
```

9.2.3.19 $PSTMTIMEINV

The command invalidates the Real Time Clock (RTC).

Synopsis:

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

Arguments:

None.

Results:

- The RTC time will be invalidated.

Example:

```
$PSTMTIMEINV
```

9.2.3.20 $PSTMSBASONOFF

The command suspends / resumes 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
```

9.2.3.21 $PSTMSBASSAT

The command changes the SBAS satellite.

Synopsis:

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

Arguments:

Table 70. PSTMSBASSAT field description

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

Results:

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

Example:

```
$PSTMSBASSAT,128
```

9.2.3.22 $PSTMGETRTCTIME

The command gets the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

- System will send RTC Data and Status.

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

Where:

Table 71. PSTMGETRTCTIME field description

Parameter	Format	Description
time	hhmmss.mms	Current time read on RTC.
date	ddmmyy	Current date read on RTC.
rtc_status	Decimal, 1 digit	Status: 0 RTC_STATUS_INVALID 1 RTC_STATUS_STORED 2 RTC_STATUS_APPROXIMATE

Table 71. PSTMGETRTCTIME field description (continued)

Parameter	Format	Description
time_validity	Decimal, 1 digit	Validity: 0 NO_TIME 1 FLASH_TIME 2 USER_TIME 3 USER_RTC_TIME 4 RTC_TIME 5 RTC_TIME_ACCURATE 6 APPROX_TIME 7 POSITION_TIME 8 EPHEMERIS_TIME
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMGETRTCTIME
```

9.2.3.23 $PSTMDATUMSELECT

The command sets a local geodetic datum different from WGS84 (default).

Synopsis:

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

Arguments

Table 72. PSTMDATUSELECT field description

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

Results:

- If successful the following message is sent:

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

Table 73. PSTMDATUMSELECTOK field description

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

In case of error the following message will be sent:

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

Example:

```
$PSTMSELETDATUM,1
```

9.2.3.24 $PSTMDATUMSETPARAM

It sets 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 74. 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:

- If successful the following message is sent:

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

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

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

Example:

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

9.2.3.25 $PSTMSETCONSTMASK

The command sets the GNSS constellation mask. It allows switching the GNSS constellation at run-time.

Synopsis:

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

Arguments:

Table 75. 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: BAIDEU constellation enabling/disabling

Results:

- If successful the following message is sent:

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

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

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

Example:

Enabling GPS only:

```
$PSTMSETCONSTMASK,1
```

Enabling GLONASS only:

```
$PSTMSETCONSTMASK,2
```

Enabling GPS and GLONASS:

```
$PSTMSETCONSTMASK,3
```

9.2.3.26 $PSTMLOWPOWERONOFF

A Command is defined to control the low power status. The table below summarizes the command supported by the ST NMEA layer.

Synopsis:

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

Arguments:

Table 76. PSTMLOWPOWERONOFF field description

Parameter	Format	Description
low power enable/disable	Decimal, 1 digit	General Low Power features Enable/Disable 0: OFF, 1: ON
Reserved settings		
Constellation mask	Decimal, 3 digits	It is a bit mask where each bit enable/disable a specific constellation independently by the others: bit 0: GPS constellation enabling/disabling; bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling
EHPE threshold	Decimal, 3 digits	Reserved
Max tracked sats	Decimal, 2 digits	Reserved
Switch constellation features	Decimal, 1 digit	Reserved, must be 0
Reserved settings		
Duty Cycle enable/disable	Decimal, 1 digit	Reserved, must be 0
Duty Cycle signal off	Decimal, 3 digits	Reserved

Table 76. PSTMLOWPOWERONOFF field description (continued)

Parameter	Format	Description
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]

Parameter “low power enable/disable” must be set to “Enable” to have any of the low power features to be active.

9.2.3.27 $PSTMPPS

The command allows 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 77. PSTMPPS field description

Parameter	Format	Description
cmd_mode	Decimal, 1 digit	Select the command operation mode: 1 GET operation; 2 SET operation;
cmd_type	Decimal, 1 digit	1 PPS_IF_ON_OFF_CMD 2 PPS_IF_OUT_MODE_CMD 3 PPS_IF_REFERENCE_CONSTELLATION_CMD 4 PPS_IF_PULSE_DELAY_CMD 5 PPS_IF_PULSE_DURATION_CMD 6 PPS_IF_PULSE_POLARITY_CMD 7 PPS_IF_PULSE_DATA_CMD 8 PPS_IF_FIX_CONDITION_CMD 9 PPS_IF_SAT_TRHESHOLD_CMD 10 PPS_IF_ELEVATION_MASK_CMD 11 PPS_IF_COSTELLATION_MASK_CMD 12 PPS_IF_TIMING_DATA_CMD 13 PPS_IF_POSITION_HOLD_DATA_CMD 14 PPS_IF_AUTO_HOLD_SAMPLES_CMD 15 PPS_IF_TRAIM_CMD 16 PPS_IF_TRAIM_USED_CMD 17 PPS_IF_TRAIM_RES_CMD 18 PPS_IF_TRAIM_REMOVED_CMD 19 PPS_IF_REFERENCE_TIME_CMD 20 PPS_IF_CONSTELLATION_RF_DELAY_CMD
par_1 … par_N	—	Parameters list according to the command type specification (see below).

9.2.3.27.1 Setting PPS On/Off (cmd_mode = 2; cmd_type = *PPS_IF_ON_OFF_CMD)*

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

Table 78. PSTMPPS On/Off field description

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

9.2.3.27.2 Setting PPS Duration (cmd_mode = 2; cmd_type = *PPS_IF_PULSE_DURATION_CMD*)

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

Table 79. PSTMPPS Duration field description

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]

9.2.3.27.3 Setting PPS Traim (cmd_mode = 2; cmd_type = PPS_IF_TRAIM_CMD)

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

Table 80. PSTMPPS Traim field description

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM disabled. TRAIM enabled.
alarm	Double	TRAIM alarm [s] – scientific notation is allowed

9.2.3.28 $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 81. PSTMSETPAR field description

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

Results:

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

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

- In case of errors, the error message is returned

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

Where:

Table 82. PSTMSETPAROK field description

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 0 Current Configuration, 1 Default Configuration, 2 NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier Configuration Data Block
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

Issuing the command:

`$PSTMSETPAR,1121,10`

You could have this answer:

`$PSTMSETPAROK,1121*`

9.2.3.29 $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 83. PSTMGETPAR field description

Parameter	Format	Description
ConfigBlock	Decima1,1 digit	Indicates one of configuration blocks: 0 Current Configuration, 1 Default Configuration, 2 NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier Configuration Data Block

Results:

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

  `$PSTMSETPAR,<ConfigBlock><ID>,<value>*<checksum><cr><lf>`
- in case of errors, the error message is returned

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

9.2.3.30 $PSTMSAVEPAR

The command saves 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).
- If there are no errors the following message is returned

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

  `$PSTMSAVEPARERROR`

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

Example:

`$PSTMSAVEPAR`

9.2.3.31 $PSTMRESTOREPAR

The command restores 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 the default setting.
- If there are no errors, the following message is returned

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

  `$PSTMRESTOREPARERROR`

Example:

`$PSTMRESTOREPAR`

9.2.3.32 $PSTMNMEAREQUEST

Synopsis:

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

Arguments:

Table 84. PSTMNMEAREQUEST field description

Parameter	Format	Description
msglist_l	Hexadecimal, 8 Digit	First 32 bits of 64 bits message list (low). Each bit is used to enable/disable a specific message. disabled enabled
msglist_h	Hexadecimal, 8 Digit	First 32 bits of 64 bits message list (low). Each bit is used to enable/disable a specific message. disabled enabled

Results:

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

9.2.4 Proprietary ST NMEA Configuration Command List

9.2.4.1 $PSTMCFGPORT – Char Port Configuration

The command configures a general-purpose port for NMEA purpose.

Synopsis:

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

Arguments:

Table 85. 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 … 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 `$PSTMCFGPORTOK` message is returned
- In case of errors, the `$PSTMCFGPORTERROR` message is returned

9.2.4.1.1 Parameters when port_type is UART

Table 86. PSTMCFGPORT UART field description

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 87. Modified CDB-IDs on PSTMCFGPORT UART command

CDB_ID	NAME
102	NMEA_PORT_BAUDRATE_ID

9.2.4.1.2 Parameters when port_type is I2C

Table 88. PSTMCFGPORT I2C field description

Parameter	Format	Description
slaveaddr	Hexadecimal, 2Bytes	The I2C slave address

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 89. Modified CDB-IDs on PSTMCFGPORT I2C command

CDB_ID	NAME
263	NMEA_OVER_SERIAL_ID

9.2.4.2 $PSTMCFGCLKS – Clock Mode and Speed Configuration

The command configures a clock source.

Synopsis:

`$PSTMCFGCLKS,<clkid>,<clksrc>,<clkdiv>*<checksum><cr><lf>`

Arguments:

Table 90. PSTMCFGCLKS field description

Parameter	Format	Description
Clkid	Decimal, 1 digit	Clock identifier: 0 = CPU-clk
Clksrc	Decimal, 1 digit	Clock source selector: 1 = TCXO
clkdiv	Decimal, 1 digit	Clock divider: 0 = DIV 1 1 = DIV 2 2 = DIV 3 3 = DIV 4

Results:

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 91. CDB-IDs on PSTMCFGCLKS command

CDB_ID	NAME
130	CPU_CLOCK_SPEED

9.2.4.3 $PSTMCFGMSGL – Message List Configuration

The command configures the Message List.

Synopsis:

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

Arguments:

Table 92. PSTMCFGMSGL field description

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA list 0 1 = NMEA list 1
rate	From 0 to 255	Message list rate scaler

Table 92. PSTMCFGMSGL field description (continued)

Parameter	Format	Description
listlow	Hexadecimal, 8 digits	Please refer to CDB 201 table
listhigh	Hexadecimal, 8 digits	Please refer to CDB 228 table

Results:

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 93. Modified CDB-IDs on PSTMCFGMSGL command

CDB_ID	NAME
190	DEFAULT_MSGLIST_SCALING_ID
201	NMEA_PORT_MSGLIST_L_ID
228	NMEA_PORT_MSGLIST_H_ID
191	DEFAULT_MSGLIST_SCALING1_ID
210	NMEA_PORT_MSGLIST1_L_ID
229	NMEA_PORT_MSGLIST1_H_ID

9.2.4.4 $PSTMCFGSBAS – SBAS Algorithm Configuration

The command configures the SBAS Algorithm.

Synopsis:

```
$PSTMCFGSBAS,<enengine>,<enreport>,<enautosearch>,<numofsats>,<sat_1prnid>
,<sat_1long>,<sat_1longsens>,<sat_1sbasserv>,<sat_1default>,…,>,<sat_Mprni
d>,<sat_Mlong>,<sat_Mlongsens>,<sat_Msbasserv>,<sat_Mdefault>,<par_1>,<par
_2>,…,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 94. 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

Table 94. PSTMCFGSBAS field description (continued)

Parameter	Format	Description
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 Note: expressed in seconds. This value is ignored if `enautosearch` is `0`
diftimeout	From 0 to 255	The time the autosearch waits before to change the prn when the current SBAS sat is not more decoded Note: expressed in seconds. This value is ignored if `enautosearch` is `0`
nextsattimeout	From 0 to 255	The time the autosearch waits to try to acquire and tracking new SBAS satellite using the searching channel Note: expressed in seconds. This value is ignored if `enautosearch` is `0`
nextsesstimeout	From 0 to 255	The time the autosearch waits before to start a new searching session using the searching channel Note: expressed in seconds. This value is ignored if `enautosearch` is `0`
numofsats (N)	From 0 to 255	Number of SBAS satellites. Note that following configuration settings will be repeated “numofsat” times
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 1 = Default

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 `$PSTMCFGSBASOK` message is returned
  - In case of errors, the `$PSTMCFGSBASERROR` message is returned

Parameters when auto-search is enabled

Table 95. PSTMCFGSBAS field description on enabled auto-search

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 to change 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 to start a new searching session using the searching channel

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 96. Modified CDB-IDs on PSTMCFGSBAS command

CDB_ID	NAME
200	APP_ON_OFF_ID
212	SBAS_SATELLITES_ENABLE_MASK_ID
217	SBAS_AUTO_SEARCH_TIMEOUT_2_ID
218	SBAS_SATELLITE_PARAM_1_ID
219	SBAS_SATELLITE_PARAM_2_ID
135	SBAS_PRN_ID

9.2.4.4.1 Parameters when auto-search is disabled

There are no additional parameters when auto-search is disabled.

Modified CDB-IDs:

Table 97. Modified CDB-IDs on PSTMCFGSBAS with enabled auto-search command

CDB_ID	NAME
200	APP_ON_OFF_ID

9.2.4.5 $PSTMCFGPPSGEN – PPS General Configuration

The command configures the PPS with general settings.

Synopsis:

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

Arguments:

Table 98. 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 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 `$PSTMCFGPPSGENOK` message is returned
  - In case of errors, the `$PSTMCFGPPSGENERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 99. Modified CDB-IDs on PSTMCFGPPSGEN command

CDB_ID	NAME
200	APP_ON_OFF_ID
213	PPS_OPERATING_MODE_SETTING_1_ID
197	PPS_CLOCK_SETTING_ID

9.2.4.6 $PSTMCFGPPSPUL – PPS Pulse Related Configuration

The command configures the PPS with pulse related settings.

Synopsis:

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

Arguments:

Table 100. 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 `$PSTMCFGPPSPULOK` message is returned
  - In case of errors, the `$PSTMCFGPPSPULERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 101. Modified CDB-IDs on PSTMCFGPPSPUL command

CDB_ID	NAME
200	APP_ON_OFF_ID
302	RF_TIME_CORRECTION_ID
301	PPS_PULSE_DURATION_ID

9.2.4.7 $PSTMCFGPPSSAT – PPS Satellite Related Configuration

The command configures the PPS with satellite related configurations settings.

Synopsis:

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

Arguments:

Table 102. 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 $`PSTMCFGPPSSATOK` message is returned
  - In case of errors, the $`PSTMCFGPPSSATERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 103. Modified CDB-IDs on PSTMCFGPPSSAT command

CDB_ID	NAME
214	PPS_OPERATING_MODE_SETTING_2_ID
213	PPS_OPERATING_MODE_SETTING_1_ID

9.2.4.8 $PSTMCFGPOSHOLD – Position Hold Configuration

The command configures the Position hold.

Synopsis:

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

Arguments:

Table 104. 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 `$PSTMCFGPOSHOLDOK` message is returned
  - In case of errors, the `$PSTMCFGPOSHOLDERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 105. Modified CDB-IDs on PSTMCFGPOSHOLD command

CDB_ID	NAME
200	APP_ON_OFF_ID
306	POSITION_HOLD_HEIGHT_ID
304	POSITION_HOLD_LAT_ID
305	POSITION_HOLD_LON_ID

9.2.4.8.1 $PSTMCFGTRAIM – PPS Traim Configuration

The command configures the PPS with general settings.

Synopsis:

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

Arguments:

Table 106. 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

Result:

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 107. Modified CDB-IDs on PSTMCFGTRAIM command

CDB_ID	NAME
200	APP_ON_OFF_ID
309	TIMING_TRAIM_ALARM_ID

9.2.4.8.2 $PSTMCFGSATCOMP – PPS Satellite Compensation Configuration

The command configures the PPS with general settings.

Synopsis:

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

Arguments:

Table 108. 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

Result:

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 109. Modified CDB-IDs on PSTMCFGTRAIM command

CDB_ID	NAME
307	GPS_RF_TIME_CORRECTION_ID
308	GLONASS_RF_TIME_CORRECTION_ID

9.2.4.9 $PSTMCFGLPA – Low Power Algorithm Configuration

The command configures 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>*<checksum><cr><lf>
```

Arguments:

Table 110. 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 = Periodic mode active 3 = Periodic mode standby
fix_period	unsigned, 2 bytes	Time in s between two starts of FIX activity 0 to select Always Hot mode;
fix_on_time	unsigned, 2 bytes	Number of FIX reported each FIX Period;
no_fix_cnt	unsigned, 2 bytes	Number of no-fixes in hot conditions, before to signal a FIX loss event
no_fix_cnt2	unsigned, 2 bytes	Number of no-fixes in non-hot conditions, before to signal a FIX loss event
no_fix_off	unsigned, 2 bytes	Off duration time after a FIX loss event
adaptive_feat	unsigned, 1 bytes	Enable disable adaptive multi-constellation algorithm. 0 = Adaptive Algorithm Disabled 1 = Adaptive Algorithm Enabled
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
ehpe_th	unsigned, 1 bytes	EHPE average threshold.
num_of_sat	unsigned, 1 bytes 0 to 32	Number of satellite used in Adaptive mode (first N with higher elevation)
duty_off	unsigned, 2 bytes 100 to 740	Duty cycle OFF period length in ms;
const_type	unsigned, 1 bytes	Reserved, set it as 0

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 111. Modified CDB-IDs on PSTMCFGLPA command

CDB_ID	NAME
200	APP_ON_OFF_ID
220	LOW_POWER_CFG_PARAMS_1_ID
257	LOW_POWER_CFG_PARAMS_4_ID
258	LOW_POWER_CFG_PARAMS_5_ID

9.2.4.10 $PSTMCFGAGPS – Assisted GNSS Configuration

The command configures the Assisted GPS.

Synopsis:

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

Arguments:

Table 112. 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 `$PSTMCAGPSOK` message is returned
  - In case of errors, the `$PSTMCFGAGPSERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 113. Modified CDB-IDs on PSTMCFGAGPS command

CDB_ID	NAME
200	APP_ON_OFF_ID

9.2.4.11 $PSTMCFGAJM – Anti-Jamming Configuration

The command configures the Anti-Jamming Algorithm.

Synopsis:

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

Arguments:

Table 114. 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 `$PSTMCFGAJMOK` message is returned
  - In case of errors, the `$PSTMCFGAJMERROR` message is returned

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 115. Modified CDB-IDs on PSTMCFGAJM command

CDB_ID	NAME
125	NOTCH_FILTER_CFG_ID

9.2.4.12 $PSTMCFGODO – Odometer Configuration

The command configures the Odometer.

Synopsis:

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

Arguments:

Table 116. PSTMCFGODO field description

Parameter	Format	Description
en	Decimal, 1 digit	Enable/Disable the odometer: 0 = Odometer disabled 1 = Odometer enabled

Table 116. PSTMCFGODO field description (continued)

Parameter	Format	Description
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 `$PSTMCFGODOOK` message is returned;
  - In case of errors, the `$PSTMCFGODOERROR` message is returned;

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 117. Modified CDB-IDs on PSTMCFGODO command

CDB_ID	NAME
270	ODOMETER_CFG0_ID

9.2.4.13 $PSTMCFGLOG – Logger Configuration

The command configures the Odometer.

Synopsis:

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

Arguments:

Table 118. PSTMCFGLOG field description

Parameter	Format	Description
en	Decimal, 1 digit	Enable/Disable the log: 0 = Odometer disabled 1 = Odometer 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

Table 118. PSTMCFGLOG field description (continued)

Parameter	Format	Description
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 `$PSTMCFGLOGOK` message is returned;
  - In case of errors, the `$PSTMCFGLOGERROR` message is returned;

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 119. CBD-IDs on PSTMCFGLOG

CDB_ID	NAME
266	LOGGER_CFG2_ID
267	LOGGER_CFG3_ID

9.2.4.14 $PSTMCFGGEOFENCE – Geofencing Configuration

Synopsis:

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

Arguments:

Table 120. PSTMCFGGEOFENCE field description

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

Results:

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

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 121. Modified CDB-IDs on PSTMCFGGEOFENCE command

CDB_ID	NAME
268	GEOFENCING_CFG0_ID

9.2.4.15 $PSTMCFGGEOCIR – Geofencing Configuration

Synopsis:

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

Arguments:

Table 122. PSTMCFGGEOCIR field description

Parameter	Format	Description
circleid	Decimal, 1 digit	The circle ID From 0 to 4
en	Boolean	Enable disable the circle 0 = Disable, 1 = Enable
lat	Double	N-th circle latitude
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 `$PSTMCFGGEOCIROK` message is returned;
  - In case of errors, the `$PSTMCFGGEOCIRERROR` message is returned;

Modified CDB-IDs:

The following sw config parameters could be involved depending on NMEA command parameters.

Table 123. Modified CDB-IDs on PSTMCFGGEOCIR command

CDB_ID	NAME
268	GEOFENCING_CFG0_ID
314	GEOFENCING_P0_LAT_ID
315	GEOFENCING_P0_LON_ID
316	GEOFENCING_P0_RAD_ID
317	GEOFENCING_P1_LAT_ID
318	GEOFENCING_P1_LON_ID
319	GEOFENCING_P1_RAD_ID
320	GEOFENCING_P2_LAT_ID
321	GEOFENCING_P2_LON_ID
322	GEOFENCING_P2_RAD_ID
323	GEOFENCING_P3_LAT_ID
324	GEOFENCING_P3_LON_ID
325	GEOFENCING_P3_RAD_ID

9.2.4.16 $PSTMCFGTHGNSS – GNSS Algorithm Configuration

The command configures the GNSS Algorithm

Synopsis

`$PSTMCFGTHGNSS,<trkcn0>,<poscn0>,<trkmskang>,<posmskang><cr><lf>`

Arguments

Table 124. PSTMCFGTHGNSS 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

Table 124. PSTMCFGTHGNSS field description (continued)

Parameter	Format	Description
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

Results

One or more parameters of swconfig are set according to the command parameters.

- In case of no errors, the `$PSTMCFGTHGNSSOK` message is returned
- In case of errors, the `$PSTMCFGTHGNSSERROR` message is returned

Modified CBD-IDs:

The following sw config parameters could be involved depending on NMEA command parameters

Table 125. Modified CBD-IDs on PSTMCFGTHGNSS command

CBD-ID	NAME
105	GPS_TRACKING_TH_ID
104	GPS_MASK_ANGLE_ID
132	GNSS_POSITIONING_THRESHOLD_ID
198	GPS_MASK_ANGLE_POSITIONING_ID

9.2.4.17 $PSTMCFGCONST – Constellation related Configuration

The command configures the time and data related parameters.

Synopsis:

```
$PSTMCFGTDATA,<gps-setup>,<glonass-setup>,<galileo-setup>,<qzss-
setup>,<beidu-setup><cr><lf>
```

Arguments:

Table 126. PSTMCFGCONST field description

Parameter	Format	Description
gps-setup	Decimal 1 digit	Setup of GPS constellation 0 = Disabled 1 = Used for tracking only 2 = Used for tracking and positioning
glonass-setup	Decimal 1 digit	Setup of GLONASS constellation 0 = Disabled 1 = Used for tracking only 2 = Used for tracking and positioning

Table 126. PSTMCFGCONST field description (continued)

Parameter	Format	Description
galileo-setup	Decimal 1 digit	Setup of Galileo constellation 0 = Disabled 1 = Used for tracking only 2 = Used for tracking and positioning
qzss-setup	Decimal 1 digit	Setup of QZSS constellation 0 = Disabled 1 = Used for tracking only 2 = Used for tracking and positioning
beidou-setup	Decimal 1 digit	Setup of Beidou constellation 0 = Disabled 1 = Used for tracking only 2 = Used for tracking and positioning

Results

One or more parameters of swconfig are set according to the command parameters.

- In case of no errors, the `$PSTMCFGTDATAOK` message is returned
- In case of errors, this `$PSTMCFGTDATAERROR` message is returned

Modified CBD-IDs:

The following sw config parameters could be involved depending on NMEA command parameters

Table 127. Modified CBD-IDs on PSTMCFGCONST command

CBD-ID	NAME
200	APP_ON_OFF_ID
227	APP_ON_OFF_2_ID

9.2.5 Proprietary ST NMEA Configuration Message List

9.2.5.1 $PSTMCFGPORTOK

Message sent in response to `$PSTMCFGPORT:`

Synopsis:

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

Result:

Port configuration done.

9.2.5.2 $PSTMCFGPORTERROR

Message sent in response to `$PSTMCFGPORT:`

Synopsis:

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

Result:

Port configuration not done.

9.2.5.3 $PSTMCFGCLKSOK

Message sent in response to `$PSTMCFGCLKS`:

Synopsis:

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

Result:

Message sent in case of errors

9.2.5.4 $PSTMCFGCLKSERROR

Message sent in response to `$PSTMCFGCLKS`:

Synopsis:

`$PSTMCFGCLKSERROR`

Result:

Message sent in case of errors

9.2.5.5 $PSTMCFGMSGLOK

Message sent in response to `$PSTMCFGMSGL`:

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.6 $PSTMCFGMSGLERROR

Message sent in response to `$PSTMCFGMSGL`:

Synopsis:

`$PSTMCFGMSGLERROR`

Result:

Message sent in case of errors.

9.2.5.7 $PSTMCFGSBASOK

Message sent in response to `$PSTMCFGSBAS`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.8 $PSTMCFGSBASERROR

Message sent in response to `$PSTMCFGSBAS`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.9 $PSTMCFGPPSGENOK

Message sent in response to `$PSTMCFGPPSGEN`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.10 $PSTMCFGPPSGENERROR

Message sent in response to `$PSTMCFGPPSGEN`

SynopsisSynopsis:

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

Result:

Message sent in case of errors.

9.2.5.11 $PSTMCFGPPSPULOK

Message sent in response to `$PSTMCFGPPSPUL`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.12 $PSTMCFGPPSPULERROR

Message sent in response to `$PSTMCFGPPSPUL`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.13 $PSTMCFGPPSSATOK

Message sent in response to `$PSTMCFGPPSSAT`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.14 $PSTMCFGPPSSATERROR

Message sent in response to `$PSTMCFGPPSSAT`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.15 $PSTMCFGPOSHOLDOK

Message sent in response to `$PSTMCFGPOSHOLD`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.16 $PSTMCFGPOSHOLDERROR

Message sent in response to `$PSTMCFGPOSHOLD`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.17 $PSTMCFGTRAIMOK

Message sent in response to `$PSTMCFGTRAIM`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.18 $PSTMCFGTRAIMERROR

Message sent in response to `$PSTMCFGTRAIM`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.19 $PSTMCFGSATCOMPOK

Message sent in response to `$PSTMCFGSATCOMP`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.20 $PSTMCFGSATCOMPERROR

Message sent in response to `$PSTMCFGSATCOMP`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.21 $PSTMCFGLPAOK

Message sent in response to `$PSTMCFGLPA`.

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.22 $PSTMCFGLPAERROR

Message sent in response to `$PSTMCFGLPA`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.23 $PSTMCAGPSOK

Message sent in response to `$PSTMCFGAGPS`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.24 $PSTMCFGAGPSERROR

Message sent in response to `$PSTMCFGAGPS`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.25 $PSTMCFGAJMOK

Message sent in response to `$PSTMCFGAJM`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.26 $PSTMCFGAJMERROR

Message sent in response to `$PSTMCFGAJM`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.27 $PSTMCFGODOOK

Message sent in response to `$PSTMCFGODO`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.28 $PSTMCFGODOERROR

Message sent in response to `$PSTMCFGODO`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.29 $PSTMCFGLOGOK

Message sent in response to `$PSTMCFGLOG`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.30 $PSTMCFGLOGERROR

Message sent in response to `$PSTMCFGLOG`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.31 $PSTMCFGGEOFENCEOK

Message sent in response to `$PSTMCFGGEOFENCE`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.32 $PSTMCFGGEOFENCEERROR

Message sent in response to `$PSTMCFGGEOFENCE`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.33 $PSTMCFGGEOCIROK

Message sent in response to `$PSTMCFGGEOCIR`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.34 $PSTMCFGGEOCIRERROR

Message sent in response to `$PSTMCFGGEOFENCE`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.5.35 $PSTMCFGTHGNSSOK

Message sent in response to `$PSTMCFGTHGNSS`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.36 $PSTMCFGTHGNSSERROR

Message sent in response to `$PSTMCFGTHGNSS`

Synopsis

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

Result:

Message sent in case of errors.

9.2.5.37 $PSTMCFGCONSTOK

Message sent in response to `$PSTMCFGCONST`

Synopsis:

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

Result:

Message sent in case of no errors.

9.2.5.38 $ PSTMCFGCONSTERROR

Message sent in response to `$PSTMCFGCONST`

Synopsis:

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

Result:

Message sent in case of errors.

9.2.6 ST AGPS NMEA Commands

9.2.6.1 $PSTMSTAGPSONOFF

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

Synopsis:

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

Arguments:

Table 128. PSTMSTAGPSONOFF field description

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

Results:

According to the command parameter, the STAGPS™ 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

9.2.6.2 $PSTMSTAGPSINVALIDATE

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

Synopsis:

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

Arguments:

Table 129. PSTMSTAGPSINVALIDATE field description

Parameter	Format	Description
param	Decimal, 1 digitChar	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™ 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).

At the end of operation STAGPS subsystem sends the message end of a successful invalidation process the message:

- `$PSTMSTAGPSINVALIDATEOK` in case of successful;
- `$PSTMSTAGPSINVALIDATEERROR` in case of errors;

9.2.6.3 $PSTMGETAGPSSTATUS

The command returns the status of the STAGPS™ internal processing.

Synopsis:

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

Results:

- The system sends back the STAGPS™ status in the `PSTMAGPSSTATUS` message.

9.2.6.4 $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

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

Table 130. PSTMSTAGPSSETCONSTMASK 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 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.

9.2.7 ST AGPS NMEA Messages

9.2.7.1 $PSTMPOLSTARTED

Message sent in response to command `PSTMSTAGPSONOFF`.

Synopsis:

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

Result:

if the engine has been started

9.2.7.2 $PSTMPOLSUSPENDED

Message sent in response to command `PSTMSTAGPSONOFF`

Synopsis:

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

Result:

if the engine has been suspended

9.2.7.3 $PSTMPOLONOFFERROR

Message sent in response to command `PSTMSTAGPSONOFF`

Synopsis:

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

Result:

Message send in case of error.

9.2.7.4 $PSTMSTAGPSINVALIDATEOK

Message sent in response to command `PSTMSTAGPSINVALIDATE`

Synopsis:

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

Result:

Message sent in case of successful operation;

9.2.7.5 $PSTMSTAGPSINVALIDATEERROR

Message sent in response to commands `PSTMSTAGPSINVALIDATE`

Synopsis:

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

Result:

Message sent in case of error;

9.2.7.6 $PSTMAGPSSTATUS

Message sent in response to commands `PSTMGETAGPSSTATUS`

Synopsis::

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

Arguments:

Table 131. PSTMAGPSSTATUS field description

Parameter	Format	Description
status	Decimal, 1 digit	0 = the STAGPS™ processing is completed. Any number different from zero on means that the STAGPS™ processing is ongoing and so the ephemeris prediction data has been not completely generated.

9.2.7.7 $PSTMSTAGPSSETCONSTMASKOK

Message sent in response to commands `PSTMSTAGPSSETCONSTMASK`

Synopsis:

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

Arguments:

Table 132. PSTMSTAGPSSETCONSTMASKOK 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 3: GALILEO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling

Result:

Message send in case of success.

9.2.7.8 $PSTMSTAGPSSETCONSTMASKERROR

Message sent in response to commands `PSTMSTAGPSSETCONSTMASK`

Synopsis:

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

Result:

Message send in case of error

9.2.7.9 $PSTMAGPS

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.

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

This message could be used to replace the standard GSA in all devices where STAGPS is enabled. 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, it should be enabled by adding it in the NMEA message list.

Synopsis:

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

Table 133. PSTMAGPS 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
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

The example above should be read as follows:

- Satellites 5, 24, 30, 12 don’t have predicted ephemeris (they are reported as in the case of standard GSA message – basically all satellites reported with a number less than or equal to 32 have no predicted ephemeris).
- Satellite 21 has a predicted ephemeris 2 days old (85 is reported in the sentence above).
- Satellite 7 has predicted ephemeris 3 days old (103 is reported in the sentence above).
- Satellite 16 has predicted ephemeris 1 day old (48 is reported in the sentence above).

Note: This message works for GPS satellites only. If no GPS satellites are available this message will be not displayed.

9.2.7.10 $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.

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

This message could be used to replace the standard GSA in all devices where STAGPS is enabled. If STAGPS is not enabled, it behaves in the same way as NMEA GSA sentence.

NMEA message list bitmask: 0x10000000 – This message is not enabled by default, it should be enabled by adding it in the NMEA message list.

Synopsis:

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

Table 134. PSTMAGLO 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
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

The example above should be read as follows:

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

Note: This message works for GLONASS satellites only.If no GLONASS satellites are available this message will be not displayed.

9.2.8 P-AGPS NMEA Commands

9.2.8.1 $PSTMSTAGPSPASSGEN

The command requests the generation of a password to access the PGPS server to the device.

Synopsis:

```
$PSTMSTAGPSPASSGEN,<time>,<Ven ID>*<checksum><cr><lf>
```

Arguments:

Table 135. PSTMSTAGPSPASSGEN field description

Parameter	Description
<time>	GPS time in seconds.
<Vendor ID>	Unique Vendor ID

Results:

Teseo-LIV3F returns the password in the message `PSTMSTAGPSPASSRTN`

9.2.8.2 $PSTMSTAGPSSATSEED

The command sends the PGPS seed via NMEA divided in separate sequential packets.

It is possible to choose the constellation seed to be sent (GPS only, or GLONASS only or GPS and GLONASS). If full seed is required to be sent via NMEA command it will be divided in 32 plus 24 packets.

Host must send, for GPS constellation, 32 seed packets (one for each Sat ID) in ascending order (from Sat ID = 1 to Sat ID = 32). For GLONASS constellation the Host has to send 24 seed packets (one for each prn id) in ascending order (from PRN ID 65 to 92).

If there is no seed packet for the corresponding Sat ID the seed string will be “00” (just one byte coded with 2 ASCII chars).

Synopsis:

```
$PSTMSTAGPSSATSEED,<Sat ID>,<Seed t0>,<Seed t curr>,<Seed TauGPS>,<Seed
TauGPS Dot>,<GPS UTC Offset>,<Seed String>*<checksum><cr><lf>
```

Arguments:

Table 136. PSTMSTAGPSSATSEED field description

Parameter	Description
<Sat ID>	1 to 32 satellite ID for GPS and 65 to 92 for GLONASS (first GPS sats are sent and then GLO sats).
<Seed t0>	Seed initial time in GPS seconds
<Seed t curr>	Seed current time in GPS seconds
<Seed TauGPS>	Seed Tau GPS

Table 136. PSTMSTAGPSSATSEED field description (continued)

Parameter	Description
<Seed TauGPS Dot>	Seed Tau GPS Dot
<GPS UTC offset>	Leap seconds
<Seed String>	146 Byte ASCII seed string (each byte is coded on 2 ASCII chars so this field will be 292 ASCII chars) or “00” (1 byte / 2 ASCII chars) if there is no seed for that Sat ID

Results:

- In case the seed packet has been correctly received the device returns:
  `$PSTMSTAGPSSATSEEDOK`
- In case of error the device returns:
  `$PSTMSTAGPSSATSEEDERROR`

9.2.8.3 $PSTMSTAGPSSATSEEDNEXT

The command checks the current seed transmission status from the Host.

Synopsis:

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

Results:

Teseo-LIV3F sent a message `PSTMSTAGPSSATSEEDNEXT` as a response.

9.2.9 P-AGPS NMEA Messages

9.2.9.1 $PSTMSTAGPSPASSRTN

Message sent in response to command `PSTMSTAGPSPASSGEN`

Synopsis:

```
$PSTMSTAGPSPASSRTN,<Dev ID>,<Password>*<checksum><cr><lf>
```

Arguments:

Table 137. PSTMSTAGPSPASSRTN field description

Parameter	Description
<Dev ID>	Unique Device ID
<Password>	41-character ASCII password.

9.2.9.2 $PSTMSTAGPSSATSEEDOK

Message sent in response to command `PSTMSTAGPSSATSEED`

Synopsis:

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

Results:

Message sent in case of success.

9.2.9.3 $PSTMSTAGPSSATSEEDERROR

Message sent in response to command `PSTMSTAGPSSATSEED`

Synopsis:

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

Results:

Message sent in case of error.

9.2.9.4 $PSTMSTAGPSSATSEEDNEXT

Message sent in response to command `$PSTMSTAGPSSATSEEDNEXT`

Synopsis:

```
$PSTMSTAGPSSATSEEDNEXT,<N>*<checksum><cr><lf>
```

Arguments:

Table 138. PSTMSTAGPSSATSEEDNEXT field description

Parameter	Description
<N>	The next Sat ID to enter.

9.2.10 RT-AGPS NMEA Commands

9.2.10.1 $PSTMSTAGPS8PASSGEN

The command requests the generation of a password to access the RT server to the device.

Synopsis:

```
$PSTMSTAGPS8PASSGEN,<time>,<Ven ID>,<Mod ID>*<checksum><cr><lf>
```

Arguments:

Table 139. PSTMSTAGPS8PASSGEN field description

Parameter	Format	Description
<time>	Decimal	GPS time in seconds.
<Vendor ID>	Character string	Unique Vendor ID (“fUhcD7797AfVqvQ” for STMicroelectronics)
<Model ID>	Character string	Device Model ID

Results:

The 44 characters base64 password returned in the following `PSTMSTAGPS8PASSGEN` message

9.2.11 RT-AGPS NMEA Messages

9.2.11.1 $PSTMSTAGPSPASSGEN

Message sent in response to commands `PSTMSTAGPSPASSGEN`

Synopsis:

```
$PSTMSTAGPSPASSRTN,<Device ID>,<Password>*<checksum><cr><lf>
```

Arguments:

Table 140. PSTMSTAGPSPASSGEN field description

Parameter	Description
<Device ID>	Unique device ID (24 character string)
<Password>	44-character Base64 password.

9.2.12 Datalogging command list

9.2.12.1 $PSTMLOGCREATE

This command creates and enables a new datalog `<cr><lf>*<checksum>`. 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 141. PSTMLOGCREATE field description

Parameter	Format	Description
Cfg	Hexadecimal, 3 Digits	[1:1]: enable buffer-full 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	1 decimal digit	Which datas are logged

1. In LowPower mode min-rate is not used. Entry-rate is the same as periorid-mode-rate;
2. In LowPower mode min-speed is not used. Entry-rate is the same as periorid-mode-rate;
3. In LowPower mode min-position is not used. Entry-rate is the same as periorid-mode-rate;

Results:

- In case of no errors, the following message is returned
  `$PSTMLOGCREATEOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMLOGCREATEERROR*<checksum><cr><lf>`

9.2.12.2 $PSTMLOGSTART

This command starts or restarts the current datalogging.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the following message is returned
  `$PSTMLOGCREATEOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMLOGCREATEERROR*<checksum><cr><lf>`

9.2.12.3 $PSTMLOGSTOP:

This command stops the datalogging.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the following message is returned
  `$PSTMLOGSTOPOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMLOGSTOPERROR*<checksum><cr><lf>`

9.2.12.4 $PSTMLOGERASE:

This command erases the datalog.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the following message is returned
  `$PSTMLOGERASEOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMLOGERASEERROR*<checksum><cr><lf>`

9.2.12.5 $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, Teseo-LIV3F replies with the message
  `$PSTMLOGSTATUS`
- Otherwise, this error message is returned
  `$PSTMLOGREQSTATUSERROR*<checksum><cr><lf>`

9.2.12.6 $PSTMLOGSTATUS

The message sent by the Teseo-LIV3F receiver in response to a `PSTMLOGGETSTATUS`. It reports the internal datalog subsystem state.

Synopsis:

```
$PSTMLOGSTATUS,<time-first-entry>,<data-first-entry>,<time-last-entry>,
<data-last-entry>,<latitude>,<used>,<buffer-status>,<free-entries>,
<longitude>*<checksum><cr><lf>
```

Arguments:

Table 142. PSTMLOGSTATUS field description

Parameter	Format	Description
time-first-entry	6 dec. digit	The first entry timestamp as hhmmss
data-first-entry	8 dec. digit	The first entry date stamp as yyyyMMdd
time-last-entry	6 dec. digit	The last entry timestamp as hhmmss
data-last-entry	8 dec. digit	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	Remaining free entries

9.2.12.7 $PSTMLOGREQQUERY

This command triggers a query request to the ST Teseo-LIV3F receiver.

The Host can specify:

- The maximum number of required entries
- The initial time stamp from which the entries have to be fetched.

Synopsis:

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

Arguments:

Table 143. 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:

- If logger has been created, Teseo-LIV3F replies with the message `$PSTMLOGQUERY`
- In case of errors, this error message is returned

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

9.2.12.8 $PSTMLOGQUERY

This messages is sent by the Teseo-LIV3F in response to a query command.

Teseo-LIV3F receiver sends a message for each entry in the log compliant to the query raised by the Host.

In the `PSTMLOGQUERY` the bit-fields:

- `Status-bitmap.EndOfData (EOD)` notifies no more data have to be sent by the Teseo-LIV3F;
- `Status-bitmap.DataValid (DV)` notifies the data in the message is valid or not;

Using the EOD and the DV bit-fields the Teseo-LIV3F receivers can notify all the possible cases:

- `[DV=0, EOD=0]`: Out-Of-Spec Teseo-LIV3F cannot send message with this configuration;
- `[DV=0, EOD=1]`: Teseo-LIV3F 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 Teseo-LIV3F has to send other datas;
- `[DV=1, EOD=1]`: the message contains a valid data and the Teseo-LIV3F has no more data to send;

If the message PSTMLOGQUERY has the Status-bitmap.DV=0 Teseo-LIV3F could not send the remaining data.

If the Host raises one of the commands PSTMLOGCREATE, PSTMLOGERASE, PSTMLOGREQUERY, while the Teseo-LIV3F has pending PSTMLOGQUERY messages to be sent (in response to a previous PSTMLOGREQUERY) , in this case the Teseo-LIV3F discards the pending PSTMLOGQUERY messages.

Synopsis:

```
$PSTMLOGQUERY,<status-bitmap>,<log-mask>,<timestamp>,<date-stamp>,
<dateset>*<checksum><cr><lf>
```

Arguments:

Table 144. PSTMLOGQUERY field description

Parameter	Format	Description
Status-bitmap	Decimal	[1]: DataValid (DV) [0]: EndOfData (EOD)
Id-entry	—	—
Time	6, decimal digit	Hour (2 digit) Minut (2 digit) Seconds (2 digit)
Data	8, decimal digit	Year (4 digit); Month (2 digit); Day (2 digit)
Latitude	—	—
Longitude	—	—
Altitude	—	Present only if enabled in the LogCreation;
Odometer	—	Present only if enabled in the LogCreation; (if odometer subsystem is not enabled this field is equal to zero);
Nr-Sat	—	Present only if enabled in the LogCreation;
FixType	—	Present only if enabled in the LogCreation;

9.2.13 Geofencing command list

9.2.13.1 $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 145. PSTMGEOFENCECFG field description

Parameter	Format	Description
Id	1 decimal digit	Digit which circle is configured
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	Float	Latitude
Lon	Float	Longitude
Rad	Float	Radius

Results:

- In case of no errors, the following message is returned
  `$PSTMGEOFENCECFGOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMGEOFENCECFGERROR*<checksum><cr><lf>`

9.2.13.2 $PSTMGEOFENCEREQ

This command forces the Teseo-LIV3F receiver to reply with a `PSTMGEOFENCE` message reporting internal Geofence subsystem status.

Synopsis:

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

Arguments:

No Arguments

Results:

- In case of no errors, the Teseo-LIV3F replies with the `$PSTMGEOFENCE` message
- In case of errors, this error message is returned
  `$PSTMGEOFENCEREQERROR*<checksum><cr><lf>`

9.2.13.3 $PSTMGEOFENCE

This message is sent from Teseo-LIV3F receiver to the Host when a Geofence alarm is raised.

Geofence reports a bitmap against which circle is raising the alarm.

Format:

`$PSTMGEOFENCE,<timestamp>,<id>,<lat>,<lon>,<rad>,<dist>,<sigma>,<curr-status>*<checksum><cr><lf>`

Table 146. PSTMGEOFENCE field description

Parameter	Format	Description
timestamp	Hex, 1 digits	A bitmap to notify which circle is raising the alarm a bit set as high means that corresponding circle is raising an alarm.
id	Decimal	Circle identifier
lat	Float	Latitude
lon	Float	Longitude
rad	Float	Radius
dist	Float	Distance from circle
sigma	Float	Sigma tolerance
curr-status	Decimal, 1 Digit	Current status: 0 = Status unknown 1 = Current position is outside the circle 2 = Current position on circle boundary 3 = Current position is inside the circle

CDB-ID:

Table 147. Geofence CDB-IDs

CDB-ID	Fields	Description
268	Config	[11:11]: Enable circle-3; [10:10]: Enable circle-2; [9:9]: Enable circle-1; [8:8]: Enable circle-0; [2:1]: Tolerance; [0:0]: Enable Geofence on boot
269	Config-1	Reserved
314	Circle-0: Latitude	Set the circle-0 latitude
315	Circle-0: Longitude	Set the circle-0 longitude
316	Circle-0: Radius	Set the circle-0 radius
317	Circle-1: Latitude	Set the circle-1 latitude
318	Circle-1: Longitude	Set the circle-1 longitude
319	Circle-1: Radius	Set the circle-1 radius
320	Circle-2: Latitude	Set the circle-2 latitude
321	Circle-2: Longitude	Set the circle-2 longitude
322	Circle-2: Radius	Set the circle-2 radius
323	Circle-3: Latitude	Set the circle-3 latitude
324	Circle-3: Longitude	Set the circle-3 longitude
325	Circle-3: Radius	Set the circle-3 radius

9.2.14 Odometer command list

9.2.14.1 $PSTMODOSTART

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

Synopsis:

```
$PSTMODOSTART,<Alarm-Distance>*<checksum><cr><lf>
```

Arguments:

Table 148. PSTMODOSTART field description

Parameter	Format	Description
Alarm-Distance	8 hex digit	Set the Alarm-distance (zero means alarm disabled)

Results:

- In case of no errors, the following message is returned
  `$PSTMODOSTARTOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMODOSTARTERROR*<checksum><cr><lf>`

9.2.14.2 $PSTMODOSTOP

This command stops the Odometer subsystem.

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, the following message is returned
  `$PSTMODOSTOPOK*<checksum><cr><lf>`
- In case of errors, this error message is returned
  `$PSTMODOSTOPERROR*<checksum><cr><lf>`

9.2.14.3 $PSTMODOREQ

This command requests the Odometer subsystem status.

Synopsis:

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

Arguments:

No arguments

9.2.14.4 $PSTMODO

This message is sent from Teseo-LIV3F to the Host periodically if Odometer subsystem is enabled and related messages are in the message list

Synopsis:

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

Arguments:

Table 149. PSTMODO 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
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Appendix A Local Geodetic Datum Tables

Table 150. Africa Local Geodetic Datum

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

Table 150. Africa Local Geodetic Datum (continued)

REGION	CODE	CDB-ID Value
DABOLA		
Guinea	DAL	24
EUROPEAN_1950		
Egypt	EUR-F	73
Tunisia	EUR-T	83
LEIGON		
Ghana	LEH	25
LIBERIA_1964		
Liberia	LIB	26
MASSAWA		
Eritrea (Ethiopia)	MAS	27
MERCHICH		
Morocco	MER	28
MINNA		
Cameroon	MIN-A	29
Nigeria	MIN-B	30
M'PORALOKO		
Gabon	MPO	31
NOTRTH_SAHARA_1959		
Algeria	NSD	32
OLD_EGYPTIAN_1909		
Egypt	OEG	33
POINT_58		
Mean Solution (Burkina Faso-Niger)	PTB	34
POINTE_NOIRE_1948		
Congo	PTN	35
SCHWARZECK		
Namibia	SCK	36
SIERRA_LEONE_1960		
Sierra Leone	SRL	37
VOIROL_1960		
Algeria	VOR	38

Table 151. Asia Local Geodetic Datum

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
ConSon Island (Vietnam)	ING-B	48
INDIAN_1975		
Thailand	INH-A	49
Thailand	INH-A1	50
INDONESIAN_1974		
Indonesia	IDN	51
KANDAWALA		
SriLanka	KAN	52
KERTAU_1948		
West Malaysia-Singapore	KEA	53
KOREAN_1995		
South Korea	KGS	54
NAHRWAN		
Masirah Island (Oman)	NAH-A	55
United Arab Emirates	NAH-B	56
Saudi Arabia	NAH-C	57
OMAN		

Table 151. Asia Local Geodetic Datum (continued)

REGION	CODE	CDB-ID VALUE
OMAN	FAH	58
QATAR_NATIONAL		
Qatar	QAT	59
SOUTH_ASIA		
Singapore	SOA	60
TIMBALAI_1948		
Brunei-East-Malaysia	TIL	61
TOKYO		
Mean Solution	TOY-M	62
Japan	TOY-A	63
Okinawa	TOY-C	64
South Korea	TOY-B	65
South Korea	TOY-B1	66

Table 152. Australia Local Geodetic Datum

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

Table 153. Europe Local Geodetic Datum

REGION	CODE	CDB-ID VALUE
CO-ORDINATE SYSTEM 1937 OF ESTONIA		
Estonia	EST	69
EUROPEAN_1950		
Mean Solution	EUR-M	70
Western Europe	EUR-A	71
Cyprus	EUR-E	72
Egypt	EUR-F	73
England, Channel Islands, Scotland, Shetland Islands	EUR-G	74
England, Ireland, Scotland, Shetland Islands	EUR-K	75
Greece	EUR-B	76

Table 153. Europe Local Geodetic Datum (continued)

REGION	CODE	CDB-ID VALUE
Iran	EUR-H	77
Italy Sardinia	EUR-I	78
Italy Sicily	EUR-J	79
Malta	EUR-L	80
Norway, Finland	EUR-C	81
Portugal, Spain	EUR-D	82
Tunisia	EUR-T	83
EUROPEAN_1979		
Mean Solution	EUS	84
HJORSEY_1955		
Iceland	HJO	85
IRELAND_1965		
Ireland	IRL	86
ORDNANCE SURVEY OF GREAT BRITAIN 1936		
Mean Solution	OGB-M	87
England	OGB-A	88
England, Isle Of Man, Wales	OGB-B	89
Scotland, Shetland Islands	OGB-C	90
Wales	OGB-D	91
ROME_1940		
Sardinia	MOD	92
S-42(PULKOVO_1942)		
Hungary	SPK-A	93
Poland	SPK-B	94
Czechoslovakia	SPK-C	95
Latvia	SPK-D	96
Kazakhstan	SPK-E	97
Albania	SPK-F	98
Romania	SPK-G	99
S-JTSK		
Czechoslovakia	CCD	100

Table 154. North America Local Geodetic Datum

REGION	CODE	CDB-ID VALUE
CAPE_CANAVERAL		
Mean Solution (Florida, Bahamas)	CAC	101
NORTH AMERICAN 1927		
Mean Solution	NAS-C	102
Western United States	NAS-B	103
Eastern United States	NAS-A	104
Alaska (Excluding Aleutian Islands)	NAS-D	105
AleutianIslands(East180°W)	NAS-V	106
AleutianIslands(West180°W)	NAS-W	107
Bahamas (Excluding San Salvador Island)	NAS-Q	108
San Salvador Island	NAS-R	109
Canada Mean Solution (Including Newfoundland)	NAS-E	110
Alberta, British Columbia	NAS-F	111
Eastern Canada	NAS-G	112
Manitoba, Ontario	NAS-H	113
Northwest Territories, Saskatchewan	NAS-I	114
Yukon	NAS-J	115
Canal Zone	NAS-O	116
Caribbean	NAS-P	117
Central America	NAS-N	118
Cuba	NAS-T	119
Greenland	NAS-U	120
Mexico	NAS-L	121
NORTH AMERICAN 1983		
Alaska (Excluding Aleutian Islands)	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 155. South America Local Geodetic Datum

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		
Mean Solution	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

Table 155. South America Local Geodetic Datum (continued)

REGION	CODE	CDB-ID VALUE
SOUTH AMERICAN GEOCENTRIC REFERENCE SYSTEM(SIRGAS)		
South America	SIR	155
ZANDERIJ		
Suriname	ZAN	156

Table 156. Atlantic Ocean Local Geodetic Datum

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

Table 156. Atlantic Ocean Local Geodetic Datum (continued)

REGION	CODE	CDB-ID VALUE
OBSERVATORIO METEOROLOGICO 1939		
Corvo and Flores Islands (Azores)	FLO	168
PICO DE LAS NIEVES		
Canary Islands	PLN	169
PORTO SANTO 1936		
Porto Santo and Madeira Islands	POS	170
PUERTO RICO		
Puerto Rico and Virgin Islands	PUR	171
QORNOQ		
South Greenland	QUO	172
SAO BRAZ		
Sao Miguel and Santa Maria Islands (Azores)	SAO	173
SAPPER HILL 1943		
East Falkland Island	SAP	174
SELVAGEM GRANDE 1938		
Salvage Islands	SGM	175
TRISTAN ASTRO 1968		
Tristan da Cunha	TDC	176

Table 157. Indian Ocean Local Geodetic Datum

REGION	CODE	CDB-ID VALUE
ANNA 1 ASTRO 1965		
Coco 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 158. Pacific Ocean Local Geodetic Datum

REGION	CODE	CDB-ID VALUE
AMERICAN SAMOA 1962		
American Samoa Islands	AMA	183
ASTRO BEACON “E” 1945		
Iwo Jima	ATF	184
ASTRO TERN ISLAND (FRIG) 1961		
Tern Island	TRN	185
ASTRONOMICAL STATION 1952		
Marcus Island	ASQ	186
BELLEVUE (IGN)		
Efate and Erromango Islands	IBE	187
CANTON ASTRO 1966		
Phoenix Islands	CAO	188
CHATHAM ISLAND ASTRO 1971		
Chatham Island (New Zealand)	CHI	189
DOS 1968		
Gizo Island (New Georgia Islands)	GIZ	190
EASTER ISLAND 1967		
Easter Island	EAS	191
GEODETIC DATUM 1949		
New Zealand	GEO	192
GUAM 1963		
Guam	GUA	193
GUX I ASTRO		
Guadalcanal Island	DOB	194
INDONESIAN 1974		
Indonesia	IDN	51
JOHNSTON ISLAND 1961		
Johnston Islands	JOH	195
KUSAIE ASTRO 1951		
Caroline Islands, Fed.States of Micronesia	KUS	196
LUZON		
Philippines (Excluding Mindanao Island)	LUZ-A	197
Mindanao Island	LUZ-B	198

Table 158. Pacific Ocean Local Geodetic Datum (continued)

REGION	CODE	CDB-ID VALUE
MIDWAY ASTRO 1961		
Midway Islands	MID_A	199
Midway Islands	MID_B	200
OLD_HAWAIIAN - CLARKE 1866		
Mean Solution	OHA-M	201
Hawaii	OHA-A	202
Kauai	OHA-B	203
Maui	OHA-C	204
Oahu	OHA-D	205
OLD HAWAIIAN - INTERNATIONAL 1924		
Mean Solution	OHI-M	206
Hawaii	OHI-A	207
Kauai	OHI-B	208
Maui	OHI-C	209
Oahu	OHI-D	210
PITCAIRN ASTRO 1967		
Pitcairn Island	PIT	211
SANTO (DOS) 1965		
Espirito Santo Island	SAE	212
VITI LEVU 1916		
Viti Levu Island (Fiji Islands)	MVS	213
WAKE-ENIWETOK 1960		
Marshall Islands	ENW	214
WAKE ISLAND ASTRO 1952		
Wake Atoll	WAK	215

Table 159. Non-Satellite Derived Transformation Parameter

REGION	CODE	CDB-ID VALUE
BUKIT RIMPAH		
Bangka and Belitung Islands (Indonesia)	BUR	216
CAMP AREA ASTRO		
Camp McMurdo Area, Antarctica	CAZ	217
EUROPEAN 1950		

Table 159. Non-Satellite Derived Transformation Parameter (continued)

REGION	CODE	CDB-ID VALUE
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 160. Terrestrial Reference Systems

	CODE	CDB-ID VALUE
GLONASS		
PZ90.2	PZ90_2	227

Appendix B Acronyms and definitions

Table 161. Acronyms and definitions

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

Table 161. Acronyms and definitions (continued)

Keyword	Definition
HDOP	Horizontal Dilution Of Precision - Quality value representing all 2D plane geometry based error factors in a system.
Hot Start	Start Condition for a GPS System having position, time, Almanac and Ephemeris already available. High time accuracy is required.
Lat	Lattitude - Angular difference of a given position to the Equator. Values include 0°-90° either North or South
Lat-Ref	Lattitude Reference - Reference if a Latitude value is North or South
Long	Longitude - Angular difference to a “reference” Longitude indicated as “000”. Values include 0°… 180° either West or East.
Long-Ref	Longitude Reference - Reference if a Longitude value is East or West of the “000” Meridian.
NMEA	National Marine Electronics Association - United States Standards 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	Receiver Autonomous Integrity Monitoring
RF	Radio Frequency - High Frequency for Reception with a RF-Receiver
RS232	IEEE Standard - Physical Layer Standard for Data Transmission
Sat-ID	Satellite Identifier - Satellite specific Number used to generate the corresponding PRN code
SBAS	Satellite Based Augmentation System - GPS enhancement system based on geostationary satellites.
Static Position Filtering	Algorithm to detect that the GPS receiver doesn´t move and position output is kept stable.
UTC	Universal Time Coordinated
WAAS	Wide Area Augmentation System - American GPS Augmentation System delivering accurate Ionosphere Data
Warm Start	Start Condition for a GPS system having current Almanac, position and time availability. Ephemeris are not available. Time needs to be available with reasonable accuracy (some seconds).
2D FIX	FIX based on the use of 3 satellites
3D FIX	FIX based on the use of 4 satellites

Revision history

Table 162. Document revision history

Date	Revision	Changes
01-Sep-2017	1	Initial release
04-Oct-2017	2	Removed "ST Restricted" watermark.