UM2399
User manual

ST Teseo III binary image - User manual

Introduction

ST Teseo III Binary Image is the official binary software used on several ST Teseo III GNSS Systems.

This document is relevant for the following Baseband Processors and related GNSS software products. Any other specific constraints related to version of products and software are specified inside the document.

Table 1. ST GNSS Teseo III supported devices

Device Type	Binary Image Version
STA8088xx/STA8089xx/STA8090xx	4.5.12 or later

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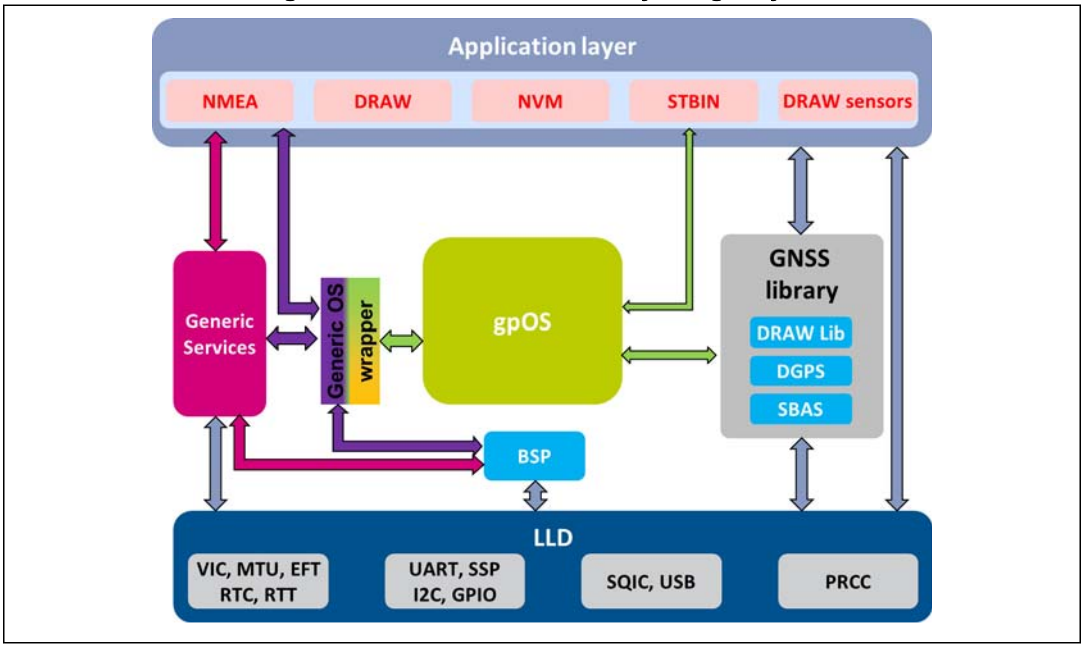
1 GNSS Binary introduction

The GNSS Teseo III Binary Image is the pre-built software running a ST Teseo III GNSS Receiver able to provide a complete PVT platform solution on ST Teseo III chip.

The GNSS Binary image is composed by different parts as shown in *Figure 1: GNSS Teseo III Binary image layout*.

Figure 1. GNSS Teseo III Binary image layout



1.1 GNSS binary components description

Table 2. GNSS binary components description

Component	Description
LLD	Low Level Driver layer which provides access to any HW peripheral register
BSP	Board Support Package for the Operating System. It represents the hardware abstraction layer for the Operating System. It has the same version number as the OS20.
OS20	ST proprietary Operating System. It has its own version number
Generic Services	OS services to support the usage of main HW peripherals. It has its own version number
GNSS Library	The core of the GNSS software. It includes all the routines to acquire, track and make positioning of a multi-constellation receiver. It also includes algorithms for accurate timing application. The GNSS library has its own version number
RTC	The module for the Real Time Clock management. It has the same version number as the GNSS library
NVM	The manager of the GNSS backup memory. It includes the file system for the GNSS sensible data storage. It has the same version number as the GNSS library.

Table 2. GNSS binary components description (continued)

Component	Description
SBAS	The Satellite Based Augmentation System. It includes the modules for SBAS data decoding and satellites corrections extrapolation. It has its own version number.
DGPS	The Differential GPS library. It supports RTCM-SC104 specifications. It has its own version number.
STAGPS™	The Self Trained Assisted GPS. It is the ST library for the ephemeris prediction. The STAGPS software includes the PGPS functionality for Server based Assisted GPS. It has its own version number.
DRAW LIB	The Dead Reckoning core library. It has its own version number.
DRAW Sensors	The sensors interface for the DRAW software. It shares the same version number as the DRAW library.
Application	The application layer. It includes the output messages according to the NMEA-183 specification and the input commands to control the system functionality. It has its own version number.
Debug	It is part of the application blocks. It is responsible for the debug messages handling. It shares the same version number as the application layer.
SW Config	The software configuration block. It implements the configuration facility supported by the STA8089-90 Binary Image. It shares the same version number as the application layer.

1.2 GNSS binary memory layout

The STA8089-90 Binary Image is designed to work with the SQI Flash memory and the STA8089-90 internal TCM memories (256 KB). No external RAM is required.

The memory layout at run-time is reported in the *Table 3*.

Table 3. GNSS binary image memory layout

	Memory area	Reserved size	Address	
Boot Code Area	Boot Code	64 KB	Start Address	0x10000000
			End Address	0x1000FFF0
	Boot Code Base Address Offset (CRC Evaluation)		Start Address	0x1000FFF4
			End Address	0x1000FFF7
	Boot Code Size (CRC Evaluation)		Start Address	0x1000FFF8
			End Address	0x1000FFFB
	Boot Code CRC		Start Address	0x1000FFFC
			End Address	0x1000FFFF

Table 3. GNSS binary image memory layout (continued)

	Memory area	Reserved size	Address	
GNSS Code Area	GNSS Code Validity Key Area	960 KB	Start Address	0x10010000
			End Address	0x10010003
	GNSS Code Area Base Address Offset (CRC Evaluation)		Start Address	0x10010004
			End Address	0x10010007
	GNSS Code Area Size (CRC Evaluation)		Start Address	0x10010008
			End Address	0x1001000B
	GNSS Code Area CRC		Start Address	0x1001000C
			End Address	0x1001000F
	GNSS Code Area		Start Address	0x10010010
			End Address	0x100FEFFF
	Saved Software Configuration Area		Start Address	0x100FF000
			End Address	0x100FFFFF
NVM Area	NVM Bank1	256 KB	Start Address	0x10100000
			End Address	0x1013FFFF
	NVM Bank2	256 KB	Start Address	0x10140000
			End Address	0x1017FFFF

The SQI flash memory is used as load and execution region for most of the software code. The real-time routines and non-constant data are stored in the ITCM and DTCM memories at run-time.

The first 64 KB of the SQI memory is reserved for the boot code. It is used to support the GNSS firmware upgrade functionality. At the end of the 64 KB boot code memory area, three parameters are stored (last three 32bits words): the code base offset, size and CRC. Code base offset and size are needed for CRC evaluation.

Starting at offset of 0x10000 (at the beginning of the first flash sector of the GNSS firmware area) four parameters are stored: Validity Key Area, GNSS firmware base address offset, GNSS firmware size and factory evaluated CRC code. Firmware base address and size are needed for the CRC evaluation.

The GNSS firmware starts with an offset of 0x1000D from the SQI memory base address.

The GNSS backup memory (NVM) is placed in two sectors of the same SQI memory. The base address of the NVM area has an offset of 0x180000 from the beginning of the SQI memory.

2 GNSS binary configuration

2.1 Binary configuration

The ST GNSS Teseo III 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.

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

2.1.1 Configuration concept

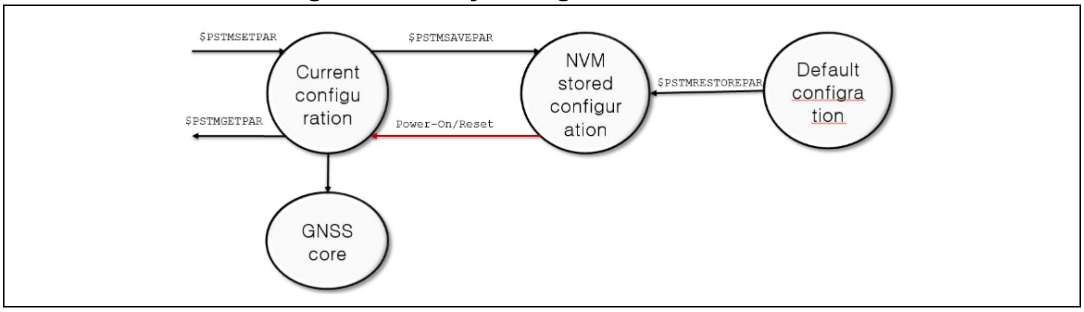
All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

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 as shown in *Figure 2: Binary configuration data block*:

- *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.

Figure 2. Binary configuration data block



Teseo III 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*

For example if the UART baud rate would 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 ST GNSS Teseo III Receiver to guarantee that the changes made are effective

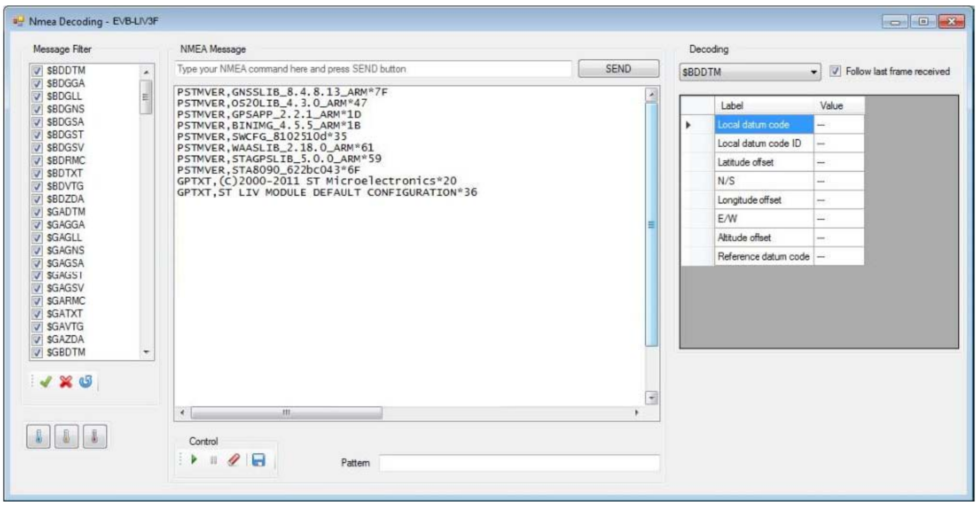
2.2 Binary version

The binary firmware version defines which set of messages the Teseo III is able to manage.

The command *$PSTMGETSWVER* returns the firmware and all software versions in string format.

While booting the ST GNSS Teseo III reports on the serial port the current configuration as showed in *Figure 3: ST GNSS booting message from UART*.

Figure 3. ST GNSS booting message from UART



Each entry of *Table 4: ST GNSS binary firmware subsystem version* identifies a specific binary firmware subsystem version.

Table 4. ST GNSS binary 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.

2.3 Firmware update algorithm protocol

ST GNSS Binary firmware supports the firmware upgrade on field.

Two variants of firmware update are supported:

- Firmware update over NMEA command
- Firmware update on Reset

2.3.1 Firmware update over NMEA command

The firmware update procedure over NMEA command can be triggered using the commands *$PSTMFMWUPGRADE*.

As soon as ST GNSS Teseo III device receives the FW Update command, GNSS firmware resets the hardware and enters in FW Update mode. Now the software running on the host can start to synchronize with ST GNSS Teseo III device. In this phase the host sends continuously *TESEO_FLASHER_IDENTIFIER* word; at the same time it checks for a response from ST GNSS Teseo III. In order to complete the synchronization phase, ST GNSS Teseo III device sends back the *TESEO_FLASHER_SYNC* word.

Host software can use a timeout of 3 seconds; if no response is received in this time interval, host software can return with timeout error.

As soon as host receives *TESEO_FLASHER_SYNC* word, it sends *DEVICE_START_COMMUNICATION* word and wait for *ACK* from ST GNSS Teseo.

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:

```
struct ImageOptions {
      unsigned char eraseNVM;
      unsigned char programOnly;
      unsigned char chunk_size;
      unsigned char baudRate;
      int firmwareSize;
      unsigned int firmwareCRC;
      unsigned int nvmAddressOffset;
      unsigned int nvmSize;
};
```

Where:

- **eraseNVM**: if true, the NMV flash memory area will be erased during update; the host software must wait for an *ACK* response from ST GNSS Teseo **III** device as confirmation that flash NVM area has been erased
- **programOnly**: if true, firmware will be flashed without erasing flash memory area
- **reserved**: must be 0; the host software must wait for an “*ACK*” response from ST GNSS Teseo **III** device as confirmation that flash program area has been erased
- **baudRate**: this is the new UART baud rate used to download the firmware. See *Table 5: Chunk_size bit field description* for the supported values
- **firmwareSize**: this is the byte size of firmware binary image
- **firmwareCRC**: this is the CRC32 code calculated first on the image file size field and then over the entire firmware image payload
- **nvmAddressOffset**: set to *NVM_FLASH_OFFSET*
- **nvmSize**: set to *NVM_FLASH_ERASE_SIZE*

Table 5. 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;

Following the binary image options, the host can send data to update the firmware inside ST GNSS Teseo III device flash. The software running on the host must split the binary image data into *n* chunks (the chuck size has been specified in the binary image option); last chunk size must be equal to the remaining bytes number. Each data chunk will be acknowledged with *ACK* response from ST GNSS Teseo III.

When the last chunk has been received by ST GNSS Teseo III, bootloader software 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 ST GNSS Teseo III device resets itself.

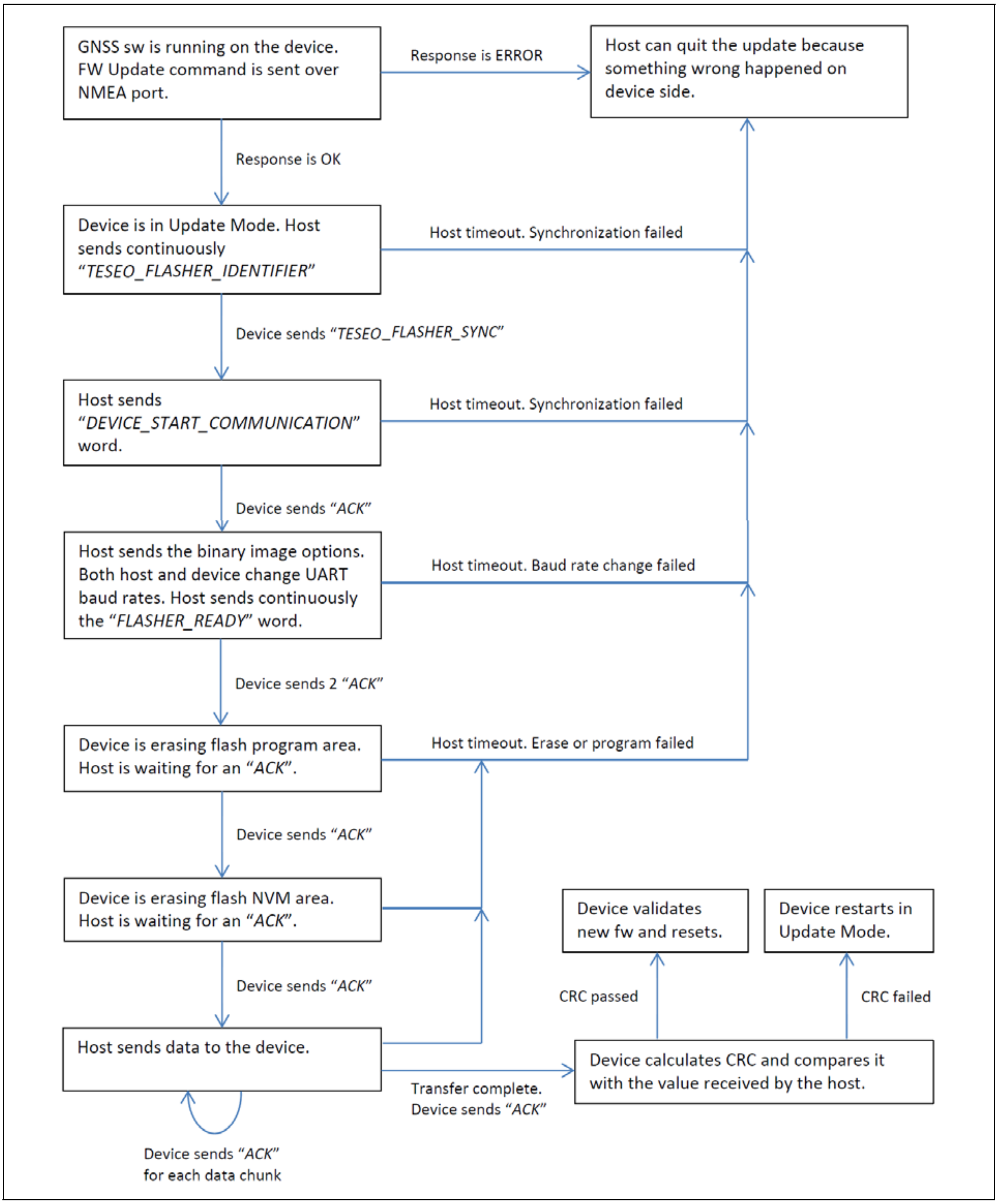
On firmware update over NMEA commands all constants value are reported in *Table 6: Firmware upgrade over NMEA constants*:

Table 6. Firmware upgrade over NMEA constants

Constants	Value
TESEO_FLASHER_IDENTIFIER	0xBCD501F4
TESEO_FLASHER_SYNC	0x83984073
DEVICE_START_COMMUNICATION	0xA3
FLASHER_READY	0x4A
ACK	0xCC
NAK	0xDD
NVM_FLASH_OFFSET	0x00100000
NVM_FLASH_ERASE_SIZE	0x00100000

The whole procedure is shown in *Figure 4: Firmware update algorithm over NMEA*.

Figure 4. Firmware update algorithm over NMEA

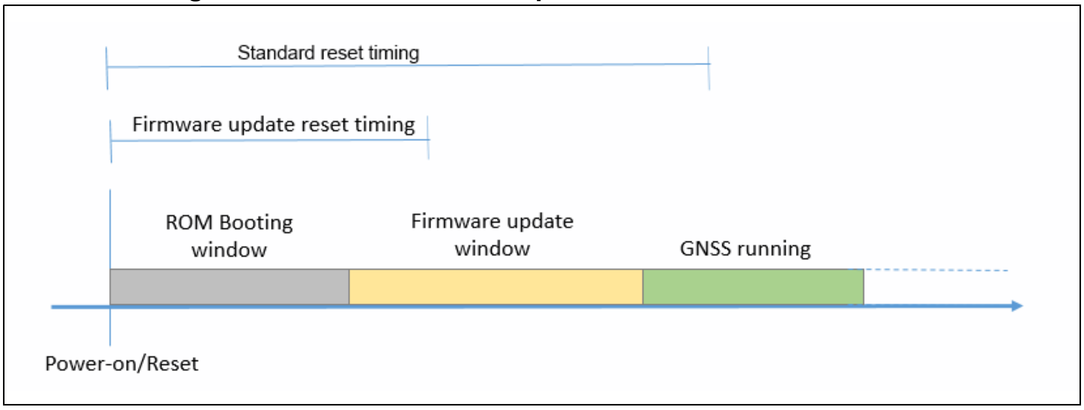


2.3.2 Firmware update on reset

The firmware update procedure on Reset can be triggered from the host only on a Power-On/Reset (POR); after a POR, ST GNSS Teseo III executes sequentially three actions as in *Figure 5: ST GNSS Teseo III operation from Power-On/Reset*:

1. ST GNSS Teseo III initializes itself (ROM booting windows)
2. ST GNSS Teseo III enters (Firmware update windows) in polling mode on all the port interfaces to check if the host triggers a firmware update procedure
3. If the timeout in step 2 fires, the ST GNSS Teseo III will enter in the GNSS normal mode; while if in step 2 a request-firmware-update is detected, on an interface port, the ST GNSS Teseo III will enter in firmware update mode

Figure 5. ST GNSS Teseo III operation from Power-On/Reset



Host has to manage two kinds of reset depending on the elapse time the host has to wait from POR to operate with ST GNSS Teseo III:

- **Standard Reset**: this is a normal reset required when the host wants ST GNSS Teseo III resetted and again up and running, in this case the host has to wait from PoR 500 ms before it can operate with ST GNSS Teseo. No commands has to be sent on the ST GNSS Teseo III's interface until the *Standard-reset-timing* elapses.
- **Firmware Update Reset**: this is the reset required when the host triggers a firmware update procedure, in this case the host has to wait from PoR 100 ms (ROM booting windows) and during the Firmware update windows it has to send the request firmware command

Both the Host and ST GNSS Teseo III have to follow a well-defined protocol.

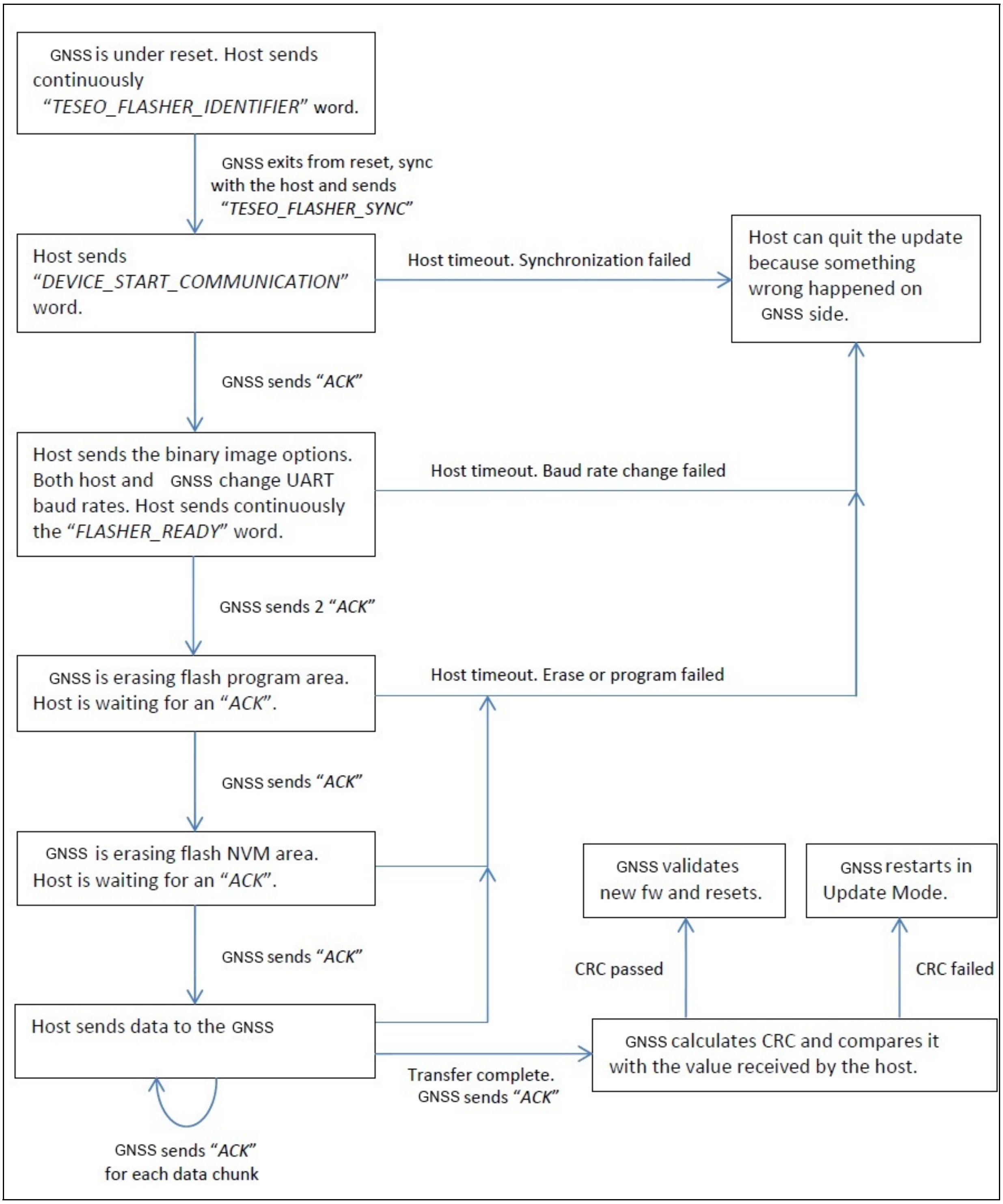
Caution: Take care that during the whole firmware upgrade procedure the Voltage VCC and VCC_IO must remain applied and stable; a power outage, during the firmware upgrade procedure, could force the ST GNSS Teseo III in an unrecoverable state.

Firmware upgrade has a preliminary phase to synchronize the Host and the ST GNSS Teseo III.

Just after the synchronization with the device, the Host must send the binary image options (the same as firmware update over NMEA).

The firmware upgrade procedure on Reset is shown in *Figure 6: ST GNSS firmware upgrade procedure on Reset*.

Figure 6. ST GNSS firmware upgrade procedure on Reset



Firmware upgrade on reset procedure, on ST GNSS Teseo III, uses the constants in *Table 7: Firmware upgrade on reset constants*.

Table 7. Firmware upgrade on reset constants

Constants	Value
TESEO_FLASHER_IDENTIFIER	0xBCD501F4
TESEO_FLASHER_SYNC	0x83984073
DEVICE_START_COMMUNICATION	0xA3
FLASHER_READY	0x4A
ACK	0xCC
NAK	0xDD
NVM_FLASH_OFFSET	0x00100000
NVM_FLASH_ERASE_SIZE	0x00100000

3 Assisted GNSS

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

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

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

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

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

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

- ST - AGNSS
- Predictive AGNSS
- RealTime GNSS

3.1 ST - AGNSS

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

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

STAGNSS subsystem supports the following NMEA interface with the Host.

Table 8. ST-AGNSS NMEA interface

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.
$PSTMAGPS	Message with the same syntax as standard NMEA GSA Message
$PSTMAGLO	Message with the same syntax as standard NMEA GSA Message
$PSTMPOLSTARTED	Message in response to $PSTMSTAGPSONOFF
$PSTMPOLSUSPENDED	Message in response to $PSTMSTAGPSONOFF

3.2 Predictive AGNSS

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

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

A unique feature of ST-AGNSS is the dual-mode ability to seamlessly fall back from the 14-day server-based prediction to 5-day autonomous prediction capability, which self-sustains on the field depending on usage patterns. This is very useful to keep quality of the GPS experience, should a connected device looses its ability to contact the server for coverage or roaming issues or any other wireless connectivity problem.

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

PGPS server should be accessed in the following ways:

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

3.2.1 PGPS server access

3.2.1.1 The HTTP Request URL

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

3.2.2 Password generation

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

Predictive AGNSS and RealTime AGNSS uses the same password generator and the same NMEA commands as described in *Section 3.3.1*.

3.2.3 Predictive AGNSS Seed Transmission

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

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

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

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

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

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

The seed propagation is a time consuming operation. The propagation status can be checked in the message *$PSTMAGPSSTATUS* in response of *$PSTMGETAGPSSTATUS* command); the message *$PSTMAGPSSTATUS* reports the propagation status when equal zero the propagation completed.

3.3 RealTime AGNSS

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

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

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

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

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

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

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

3.3.1 Password generation

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

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

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

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

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

3.3.2 Real-time assistance data uploading procedure

to download assistance data, which include:

1. the current time (if not available, from instance, from RTC),
2. the ephemerides,
3. the almanacs
4. the rough position (optional)

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

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

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

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

4 Data logging

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

GNSS Teseo III supports only one datalog at a time.

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

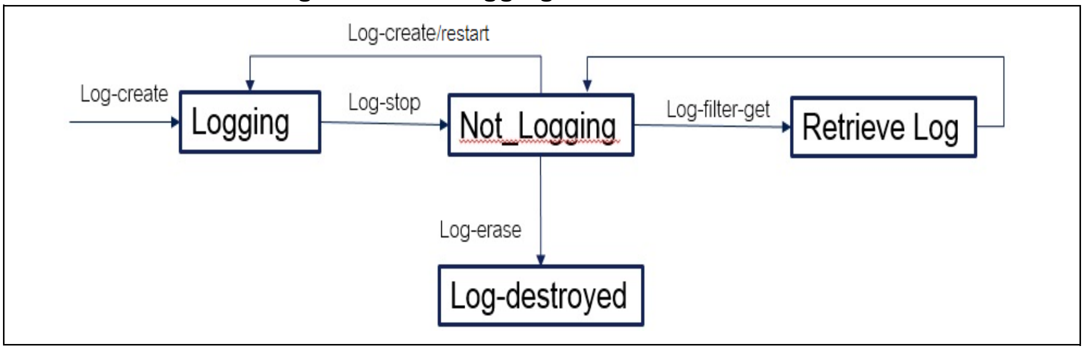
Datalogging subsystem supports both:

- Circular buffer
- Standard buffer

In case of standard buffer the datalogging system can also raise an alarm to the host in case of buffer full using configurable GPIO (Datalogging and Geofencing can share the same GPIO alarm).

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

Figure 7. Data-logging finite state machine



Each log is:

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

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

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

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

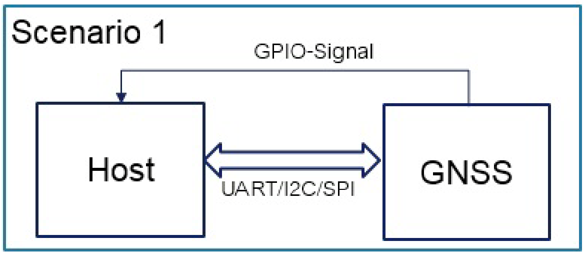
Each type has a different size and different data logged. All the data logged types have: timestamp, latitude and longitude while other fields depend on the type; details in *Table 9: Data-log types description*.

Table 9. Data-log types description

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

Data-logging system supports the following three scenarios.

Figure 8. Scenario-1 supported on data-logging



In case of **Scenario 1,** GNSS Teseo III is able to raise an interrupt to the host to notify it requires attention by the host (currently supported only in case of datalog-buffer full).

GNSS Teseo III do not raise any message autonomously.

On detection of GPIO-Datalog interrupts from the host:

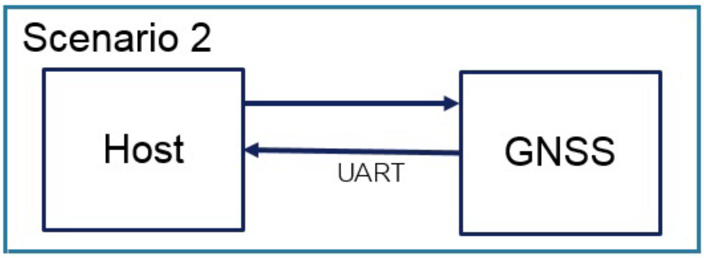
Host has to send the *$PSTMLOGREQSTATUS* command

- On *$PSTMLOGREQSTATUS*:

1. GNSS Teseo deasserts the GPIO-Datalog signal
2. GNSS Teseo will reply with a *$PSTMLOGREQSTATUS* message through the communication channel

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

Figure 9. Scenario-2 supported on data-logging

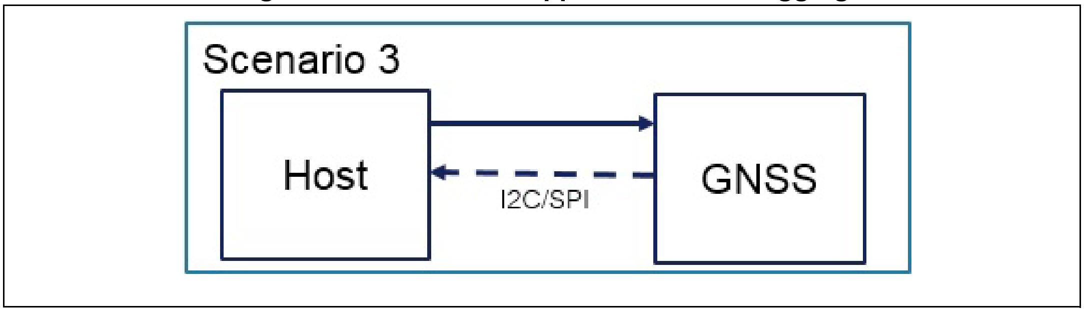


In case of **Scenario 2,** GNSS Teseo III cannot raise an interrupt to the host, but if *$PSTMLOGSTATUS* message is enabled in the message-list the GNSS Teseo III can send the *$PSTMLOGSTATUS* message autonomously to the host (currently supported only in case of buffer full) through the UART port, in this manner the host does not need polling the GNSS Teseo III raising *$PSTMLOGREQSTATUS* commands.

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

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

Figure 10. Scenario-3 supported on data-logging



In case of **Scenario 3,** GNSS Teseo III cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command *$PSTMLOGSTATUS* to the GNSS Teseo III with a bus-specific-write operation followed by a bus-specific-read operation where the host will read *$PSTMLOGSTATUS* message posted by the ST GNSS Teseo III.

5 Geofencing

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

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

Geofencing alarm can be notified over:

- NMEA message
- GPIO

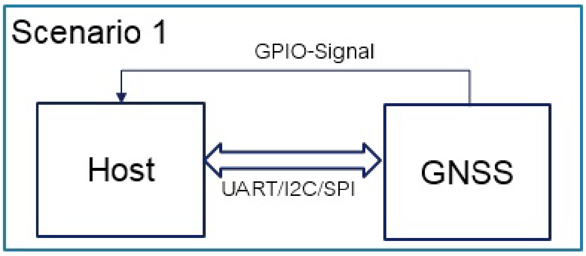
ST GNSS Teseo III supports the Geofencing features over NMEA.

In case of geofencing alarm over GPIO, user can specify which GPIO is used to notify geofencing alarm; the selected GPIO will be triggered when geofencing alarm is raised (Datalogging and Geofencing can share the same GPIO alarm).

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

Geofence system support the following three scenarios.

Figure 11. Scenario-1 supported on Geofencing



In case of **Scenario 1,** GNSS Teseo III is able to raise an interrupt to the host to notify it requires attention by the host.

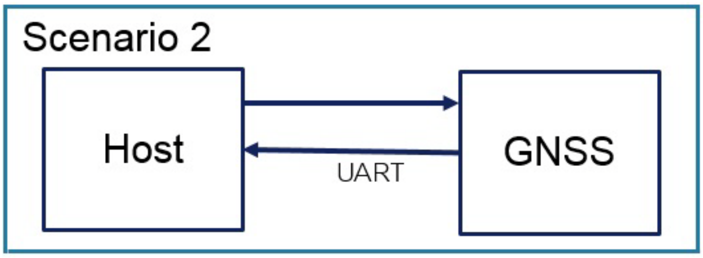
GNSS Teseo III need not raise any message autonomously.

On detection of GPIO-Geofence interrupt from the host:

- Host has to send the *$PSTMGEOFENCEREQ* command;
- On *$PSTMGEOFENCEREQ*:

1. GNSS Teseo III deasserts the GPIO-Geofence signal
2. GNSS Teseo III will reply with a *$PSTMGEOFENCESTATUS* message through the communication channel

Figure 12. Scenario-2 supported on Geofencing

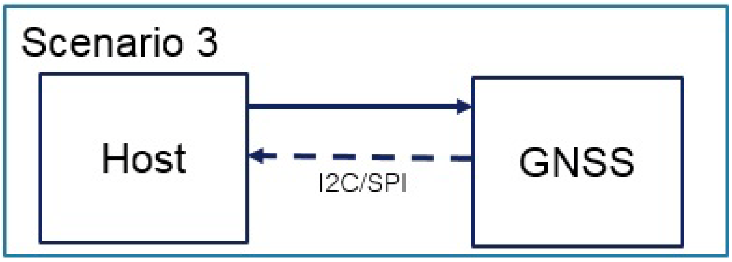


In case of **Scenario 2**, GNSS Teseo III cannot raise an interrupt to the host but if *$PSTMGEOFENCESTATUS* message is enabled in the message-list the GNSS Teseo III can send the *$PSTMGEOFENCESTATUS* message autonomously to the host through the UART port, in this manner host doesn't need polling the GNSS Teseo III raising *$PSTMGEOFENCEREQ* commands.

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

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

Figure 13. Scenario-3 supported on Geofencing



In case of **Scenario 3,** GNSS Teseo III cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command *$PSTMGEOFENCEREQ* to the GNSS Teseo III with a bus-specific-write operation followed by a bus-specific-read operation where the host will read *$PSTMGEOFENCESTATUS* message posted by the GNSS Teseo III.

6 Odometer

ST GNSS Teseo III supports Odometer feature.

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

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

Odometer subsystem has only 2 states:

- Odometer activated
- Odometer reset

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

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

Odometer traveled distance is reset in case of:

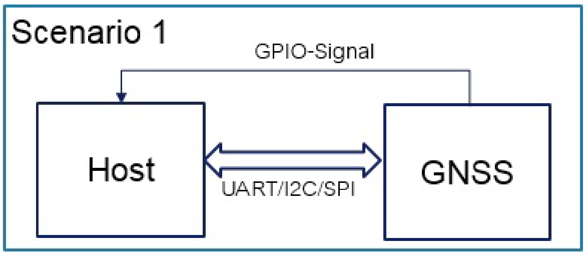
- Power off/on
- Entering/Exiting from Reset and/or Standby

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

- NMEA message
- GPIO

Odometer system supports the following three scenarios.

Figure 14. Scenario-1 supported on Odometer



In case of **Scenario 1,** GNSS Teseo III is able to raise an interrupt to the host to notify it requires attention by the host.

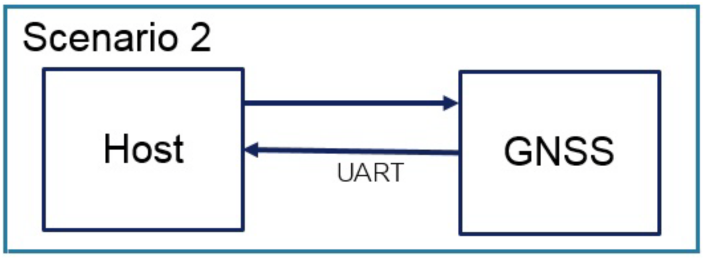
GNSS Teseo III need not raise any message autonomously.

On detection of GPIO-Odometer interrupts from the host:

- Host has to send the $PSTMODOREQ command
- On $PSTMODOREQ:

1. GNSS Teseo III deasserts the GPIO-Odometer signal
2. GNSS Teseo III will reply with a $PSTMGEOFENCESTATUS message through the communication channel

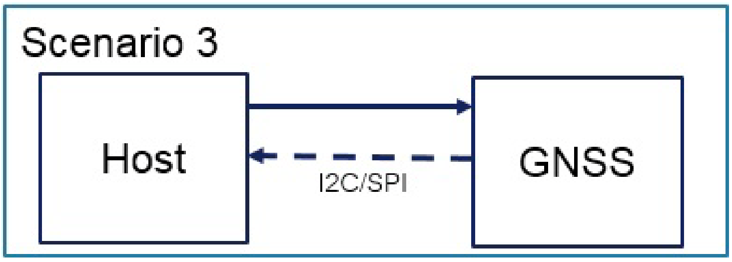
Figure 15. Scenario-2 supported on Odometer



In case of Scenario 2, GNSS Teseo III cannot raise an interrupt to the host but if *$PSTMODO* message is enabled in the message-list the GNSS Teseo III can send the *$PSTMODO* message autonomously to the host through the UART port, in this manner host doesn't need polling the GNSS Teseo III raising *$PSTMODOREQ* commands.

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

Figure 16. Scenario-3 supported on Odometer



In case of Scenario 3, GNSS Teseo III cannot raise interrupt to the host nor send message autonomously. In this scenario, periodically, the host has to send the command *$PSTMODOREQ* to the GNSS Teseo III with a bus-specific-write operation followed by a bus-specific-read operation where the host will read *$PSTMODO* message posted by the GNSS Teseo III.

7 Communication interface

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

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

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

7.1 Commands

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

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

In order to receive the commands, the GNSS Teseo III is connected to the PC via the NMEA port (make sure that the serial cable is the right one, sometimes it is necessary to use a cross-cable). The user interaction can be achieved through the use of a PC terminal emulator that is connected to the appropriate COM port with settings in *Table 10: Default UART port configuration*.

Table 10. Default UART port configuration

Baudrate	Parity bits	Stop Bit	Data bits
115200	0	1	8

The NMEA default value baud rate is automatically set at the system start-up.

It can be modified at system runtime using the appropriate command.

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

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

7.2 Messages

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

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

There are two basic sets of message implemented.

7.2.1 Standard NMEA messages

Standard NMEA Messages are defined in the “NMEA 0183” Standard, issued from the “National Marine Electronics Association”. The latest issue is Rev. 4.10 dated August 2012. NMEA0183 refers to it as Sentences (single line message) and Messages (multiple line messages).

By default, Standard NMEA Messages are compliant with the “NMEA 0183” Standard Rev. 3.1 dated January 2002. Anyway, it is possible to change their format to be compliant with Rev. 4.10, issued from the “National Marine Electronics Association” in the August 2012.To change NMEA format refer to *Section 12.3: Changing standard NMEA messages format*.

To get an overview on the supported by ST’s GNSS Teseo III please refer to *Section 12.5: Standard NMEA messages specification*.

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

`$<TalkerID>`

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

7.2.2 Proprietary messages

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

Proprietary Messages from STMicroelectronics start with:

`$PSTM...`

To get an overview on the proprietary messages defined by STMicroelectronics please refer to *Section 12.5.12: $--RLM*.

a. The set of supported talker IDs depends on the supported constellations. It is strictly related to the hardware platform and software revision.

8 Low power modes

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

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

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

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

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

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

Table 11. Suggested power mode against the fix periodicity

Fix periodicity	Appropriate mode
0.1 s-1 s	None
1 s-10 s	Adaptive and Cyclic modes
5 s-24 H (Binary + SDK)	Standby Periodic mode + optional STAGPS™
Asynchronous	Fix On Demand

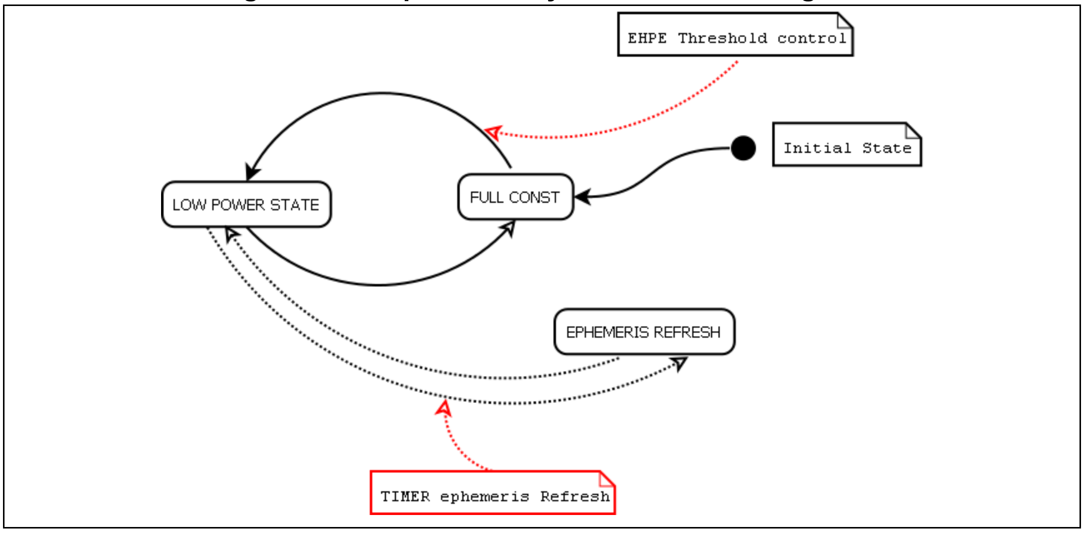
8.1 Adaptive and Cyclic mode state diagram

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

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

Figure 17 is the algorithm's state diagram.

Figure 17. Adaptive and Cyclic mode state diagram



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

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

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

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

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

Diagram explanations:

- FULL CONST:
  – Full constellations available (Standard operation mode) (all constellation available, if enabled)
  – Changes state and goes into LOW POWER STATE only if EHPE average is less than EHPE threshold (good sky condition)
- LOW POWER STATE:
  – Low power state, only a GNSS constellation is available (Dynamic constellation ON/OFF) and only first N GPS/GLONASS satellites (with higher elevation) are

used for the position calculation (Active channel management), duty cycle for every channels enabled.
  - Start the monitoring and counting for GLONASS/GPS ephemeris refresh every 30 minutes
  - Change the state and goes into FULL CONST only if EHPE average is greater than EHPE threshold (bad sky condition)
- EPHEMERIS REFRESH:
  - Turn on all constellation until the GLONASS/GPS ephemeris are available

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

Table 12. Adaptive low power mode

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

8.2 Periodic mode

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

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

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

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

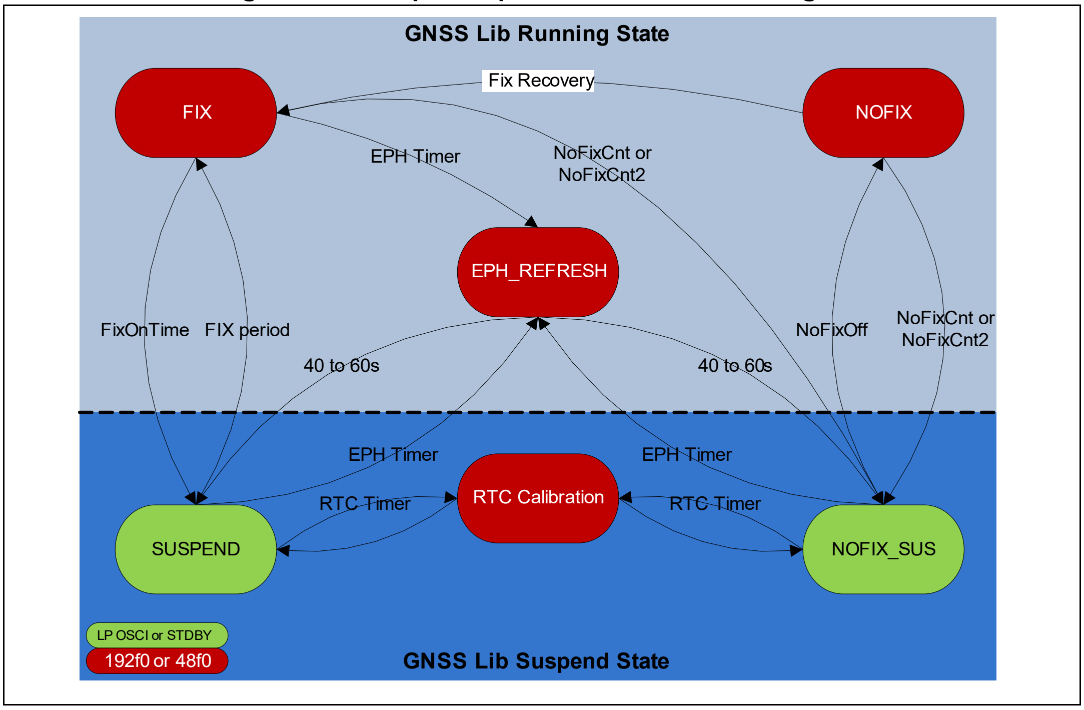
8.2.1 State machine

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

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

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

Figure 18. Low power periodic mode State Diagram



Here are details about the different states:

- *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 cannot be calculated during NoFixCnt or NoFixCnt2 seconds (difference between both timers explained below), a transition to NOFIX_SUS, a suspended state, is triggered. If the ephemeris refresh timer occurs during the fix calculation, a transition to EPH_REFRESH occurs.
- *EPH_REFRESH*: Period where ephemeris are downloaded. If the signal is lost during NoFixCnt or NoFixCnt2 seconds, a transition to NOFIX_SUS is triggered, otherwise it goes to SUSPEND.
- *NOFIX_SUS*: Suspended state, but coming from a signal loss transition. Periodicities are different from normal FIX condition to avoid losing too much energy in poor signal

situation. Ephemeris download are anyway tried, so a transition to EPH_REFRESH can occur. A transition to NOFIX state occurs when NoFixOff timer occurs.

- *NOFIX*: The GNSS Lib wait for the configured number of seconds that the GNSS signal is recovered. If so, a transition to FIX state occurs. If not, the lib goes back to NOFIX_SUS.
- *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.

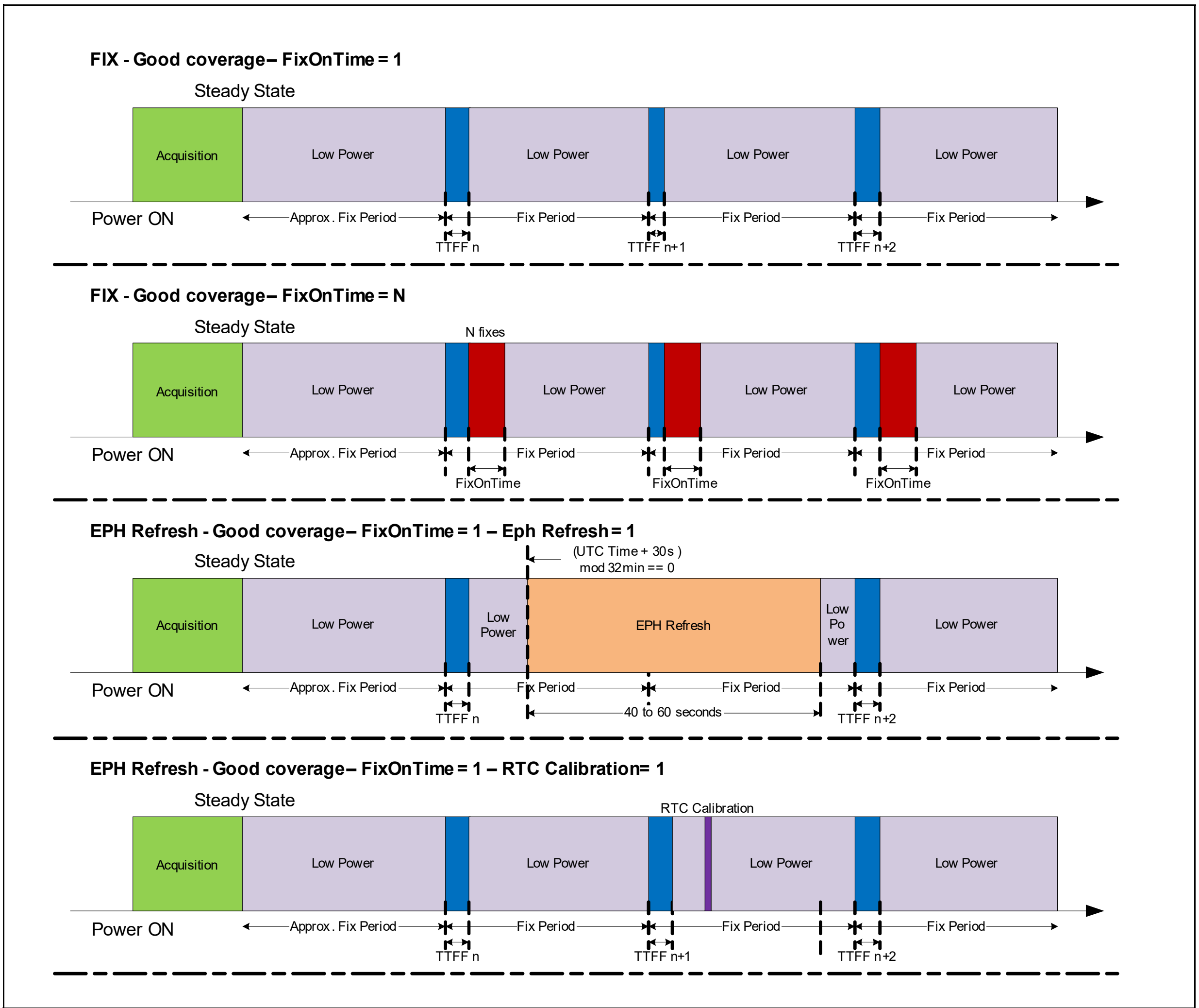
The two states concerned by the low power hardware states are SUSPEND and NOFIX_SUS. The RTC Calibration state occurs while the GNSS Lib is suspended, but it is executed anyway at high frequency (48f0 or 192f0 according to frequency settings).

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

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

8.2.2 Good GNSS coverage sequences

Figure 19. Gnss good coverage sequences



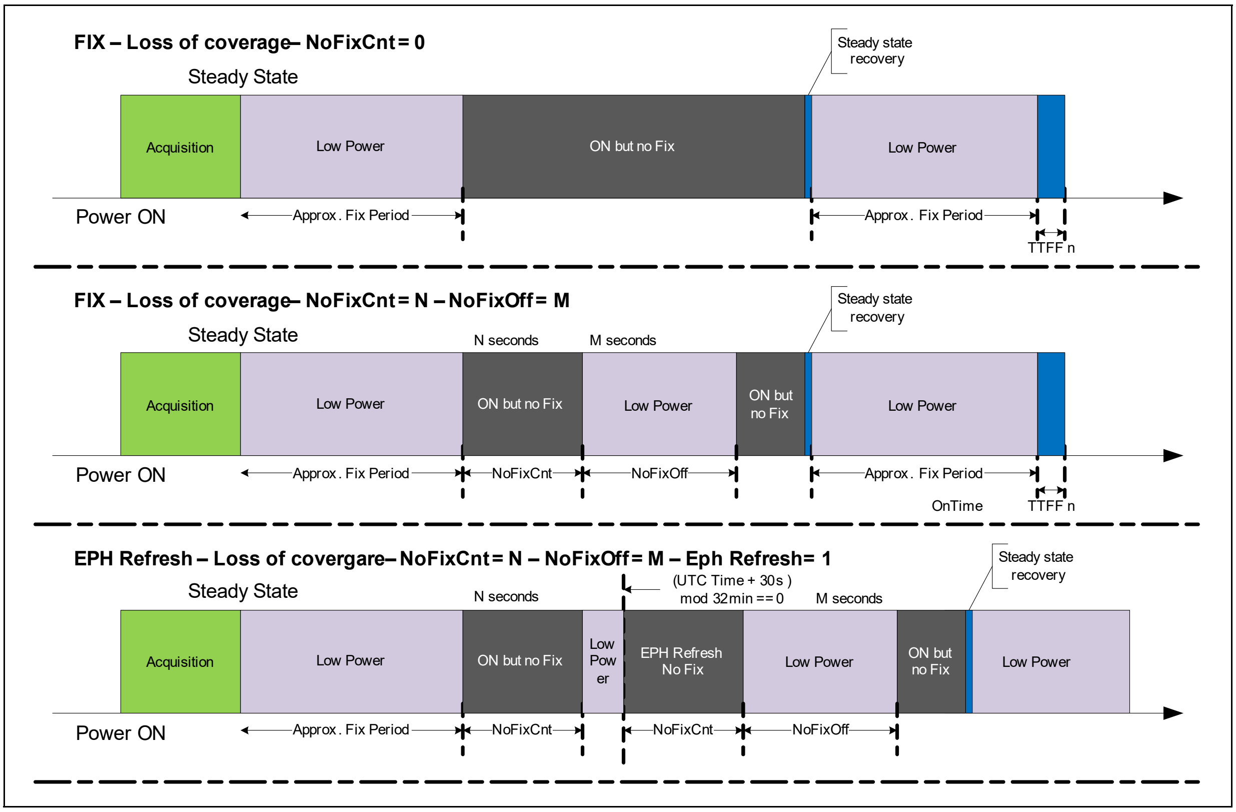
All sequences begin with an acquisition phase where all visible satellite ephemeris and almanacs are downloaded. The position of the first fix after the first Low Power period is approximate, but all the next periods are regularly placed every “Fix Period”.

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

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

8.2.3 Poor GNSS coverage sequences

Figure 20. Gnss poor coverage sequences



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

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

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

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

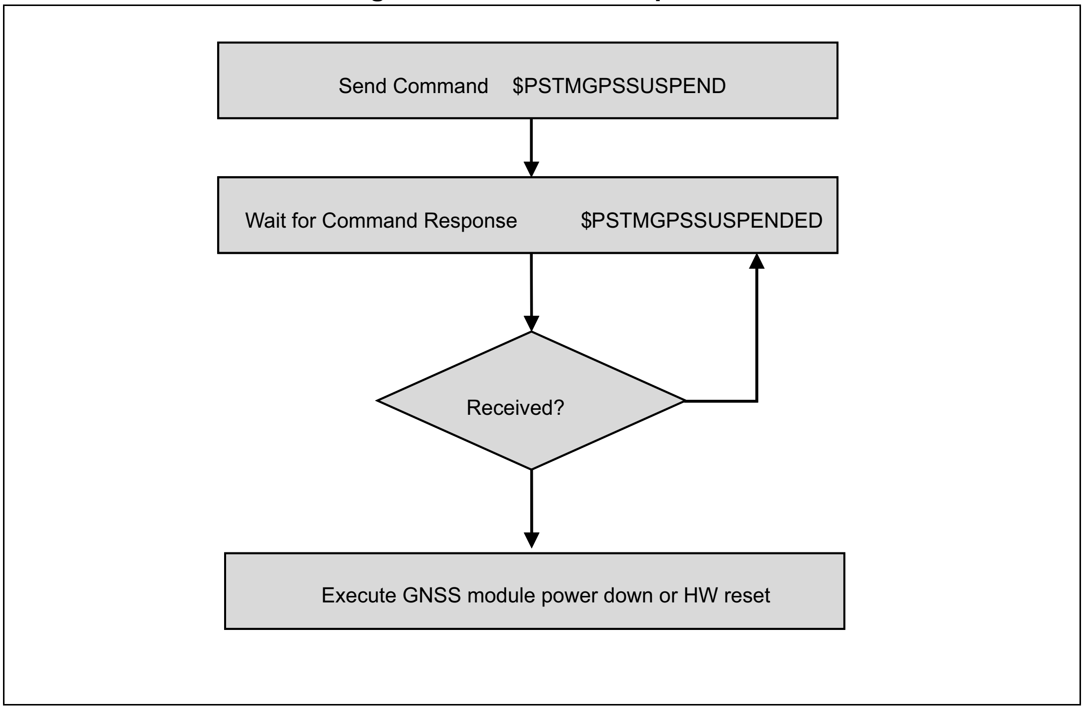
8.3 Shutdown

Safer shutdown procedure avoiding interrupted NVM driver operations can be implemented using the NMEA command *$PSTMGPSSUSPEND*.

When the GNSS Teseo III shutdown procedure is completed the ST GNSS Teseo III replies with a NMEA message *$PSTMGPSSUSPEND*.

When the NMEA message *$PSTMGPSSUSPEND* is received the ST GNSS Teseo III can be switched-OFF.

Figure 21. Shutdown sequence



9 Antenna detection

The Antenna Detection allows to recognize the presence of an external active antenna sensing the current provided to it by the ST Teseo III chipset.

According to the antenna status, the module is able to autonomously take an action switching on/off the antenna power as well as re-routing the RF paths.

The Antenna Detection requires a custom design of the board which has to provide some dedicated lines for the sensing plus optionally a dedicated line to manage the antenna power switch and up to two lines to manages the RF paths.

9.1 Sensing types

The Antenna Detection feature is mainly based on the capability to sense the antenna. The solution provides many sensing methods which are fully configurable at configuration time. Acting on Firmware Configuration, the customer can choose between three antenna sensing types at configuration time acting on CDB-ID 226.

Available sensing types are:

- RF type, where the sensing is performed through the internal RF frontend.
- ADC type, where the sensing is performed reading two ADC analog inputs.
- GPIO type, where the sensing is performed through the GPIO. This typology requires two lines.

Each typology requires a rearrangement of the external circuitry in order to achieve a proper antenna sensing. Some reference designs for each typology will be proposed in the chapter Implementation.

Anyway, each sensing typology requires at least two lines for sensing:

- the RF type requires two lines from the antenna external circuitry to the SENSE1_3V3, SENSE2 pins of the ST Teseo III (as shown in Figure 7: RF sense principle schematic).
- the ADC type, requires two lines from the antenna external circuitry to two Analog Inputs of the ST Teseo III (e.g. AIN0 and AIN1). The two Analog Inputs can be changed at configuration time.
- the GPIO type, from the antenna external circuitry to two GPIOs of the ST Teseo III which would be configured as Input by the module. The two GPIO pins can be selected at configuration time acting on CDB-ID 242, CDB-ID 243 and CDB-ID 244.

As result of the sensing process, the Antenna Detection module will output the external antenna status. The external antenna could lay in three different states:

- Normal condition, i.e. when the external antenna is connected operating in nominal condition
- Open condition, i.e. when the external antenna is disconnected and the ST Teseo III chipset is unable to detect a load.
- Short condition, i.e. when the external antenna exhibit the behavior of a short circuit: this is usually symptom of a malfunction.

The antenna status is printed out through the NMEA as a parameter of the message *$PSTMANTENNASTATUS* .

This message can be printed out periodically if the Bit 2 of the CDB-ID 226 is high or only on status change if the Bit 2 of the *CDB-ID 226* is low. It is important to notice that the message would be visible only by adding it to the current NMEA message list (see *CDB-ID 228*).

9.2 External antenna power management

The Antenna Detection is able to manage external antenna power and automatically switch off the antenna power in case of malfunction (i.e. when the antenna sensing process reports a Short condition).

This feature requires a specific design of the external circuitry and a dedicated GPIO which shall be allocated to the Antenna Detection module. This pin would be automatically configured as output.

The user can select any of the available GPIO pin for this purpose at configuration time acting on *CDB-ID 242*, *CDB-ID 243* and *CDB-ID 244*.

To proper configure the feature, aside the hardware design, the user has to specify which GPIO of the ST Teseo III shall act as power switch (*CDB-ID 242* Bits 0-7), the mode of this GPIO (*CDB-ID 243* Bits 0-1) and the active level of power switch (*CDB-ID 244* Bit 0).

Since certain external circuity are not designed to support the power management, this feature can be enabled/disabled at configuration time acting on Bit 3 of *CDB-ID 226*. When the antenna power is not switchable (i.e. Bit 3 of *CDB-ID 226* masked to 0) all the fields of *CDB-ID 242*, *CDB-ID 243* and *CDB-ID 244* related to power switch are ignored and the Antenna Detection does not take any action related to antenna power.

9.3 Antenna RF path management

The Antenna Detection can manage those ST Teseo III based boards equipped with both a small board-mounted Internal Antenna and a SMA connector that allow to plug an External Active Antenna to ensure better performances.

Subsequently to the antenna sensing process, the Antenna Detection module is able to automatically switch to the Internal Antenna when it detects a Short Condition or an Open Condition.

ST Teseo III is single-band multi-constellation positioning solution able to operate in L1 band only. Anyway this solution can be extended by adding an STA5635 external front-end able to operate in L5 band. This cost effective solution (ST Teseo III + STA5635) is thus able to operate in dual band.

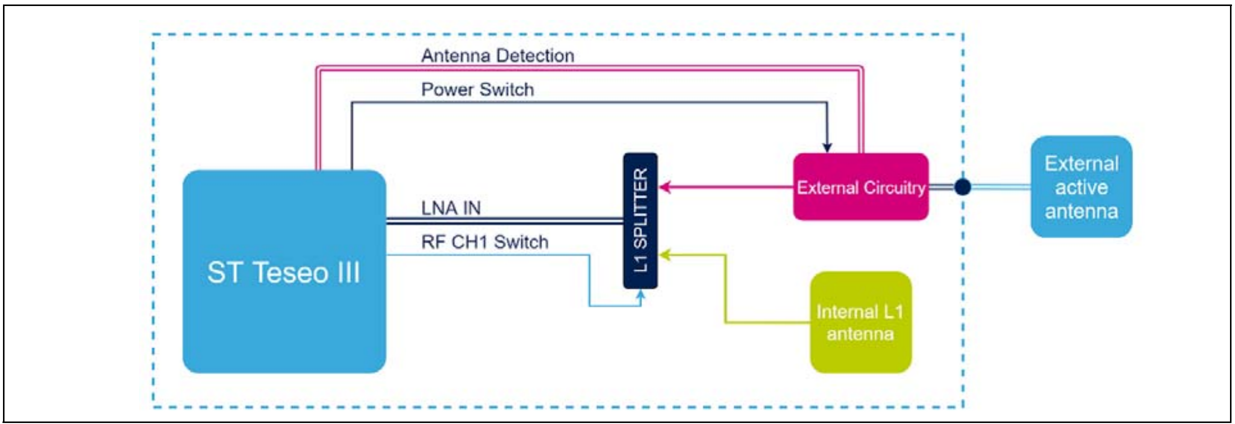
This basically means that, in a general purpose scenario, there could be two RF paths. Consequently, the hardware design could provide till two RF path splitter. As the Antenna Detection shall be able to manage this case, this requires deleted two number of dedicated GPIO which shall be allocated to this module.

Since certain external circuity are not designed to support the RF path management at all, this feature can be enabled/disabled at configuration time acting on Bit 3 of *CDB-ID 243*. It is also possible to select between the single band and the dual band scenario acting on Bits 4-5 in the *CDB-ID 243*. The dual band solution is not available if sensing type is GPIO.

9.3.1 Single band solution

This scenario is the most common and a related block diagram is provided in

Figure 22. Single frequency block diagram



The GPIO used to manage the L1 splitter is labeled as RF CH1 Switch and the user can assign any of the available GPIO of the ST Teseo III for this purpose.

This can be done selecting an ID (CDB-ID 242 Bits 13-8), the mode of this GPIO (CDB-ID 243 Bits 8-9) and the active level of this switch (CDB-ID 244 Bit 8).

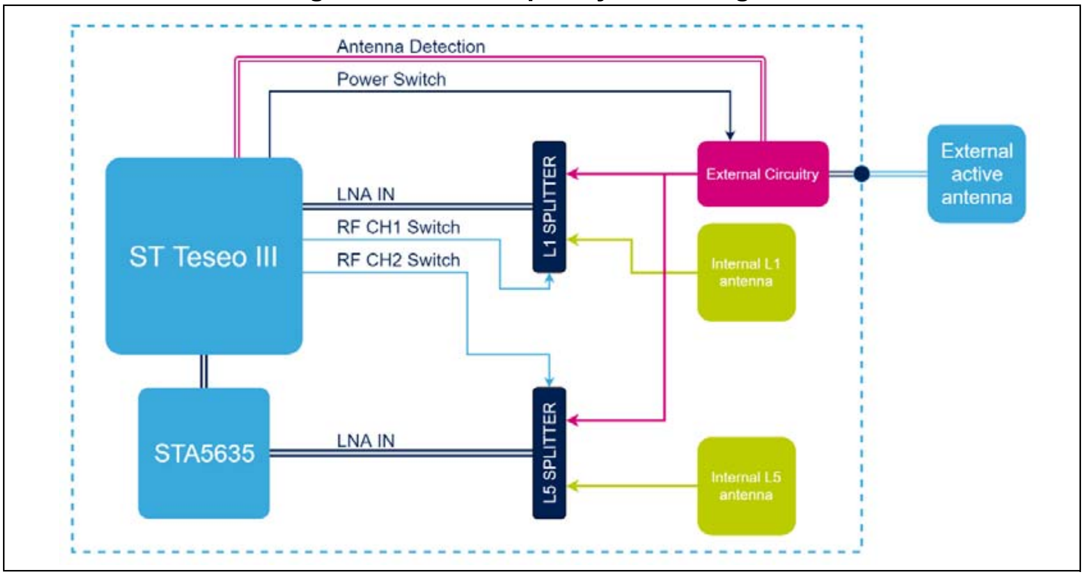
When the antenna RF is not switchable (i.e. Bit 3 of CDB-ID 243 masked to 0) all the fields of CDB-ID 242, CDB-ID 243 and CDB-ID 244 related to RF switch are ignored and the Antenna Detection does not take any action related to RF switch.

9.3.2 Dual band solution

This solution could be considered an extension of the Single band scenario. A block diagram of such solution is reported in *Figure 23*.

In comparison to the Single band scenario, here we have an additional GPIO used to manage the L5 splitter (i.e. RF CH2 Switch). The user can assign any of the available GPIO of the ST Teseo III for this purpose selecting an ID (CDB-ID 242 Bits 21-16), the mode of this GPIO (CDB-ID 243 Bits 17-16) and the active level of this switch (CDB-ID 244 Bit 16).

Figure 23. Dual frequency block diagram



Note: *The dual band solution is not available when sensing type is GPIO.*

9.4 Software implementation

The Antenna Detection is a complex software module which relies on external hardware board. Its behavior can be conditioned through the CDB-ID and it is possible to interact with it at runtime through the NMEA protocol.

The Firmware configuration impact this module at a very early stage as it conditions how ST GNSS Library initialize the module and its dependencies. This piece of software is completely described in *Figure 24*.

Looking at this figure it is possible to notice that all the interaction with Firmware Configuration are marked in pink, all the conditional branches in azure and the interaction with Antenna Detection module in green.

We can also notice that if sensing type is set to OFF (i.e. Bit 1-0 in CDB-ID 226 equal to zero) the whole initialization process would be skipped. When the Antenna Detection module is not initialized it is not possible to use those NMEA command that would interact with the module at run time. In other words, this means that issuing the commands *$PSTMSETANTSENSOPMODE* or *$PSTMSETANTSENSMANUAL* we would receive respectively *$PSTMSETANTSENSOPMODEERROR* and *$PSTMSETANTSENSMANUAL* as reply from the ST GNSS Library.

It would be anyway possible to reconfigure the module using $PSTMCFG like commands but the changes would take place only after a power cycle (e.g. pushing the ST Teseo III reset button or issuing a $PSTMSRR command).

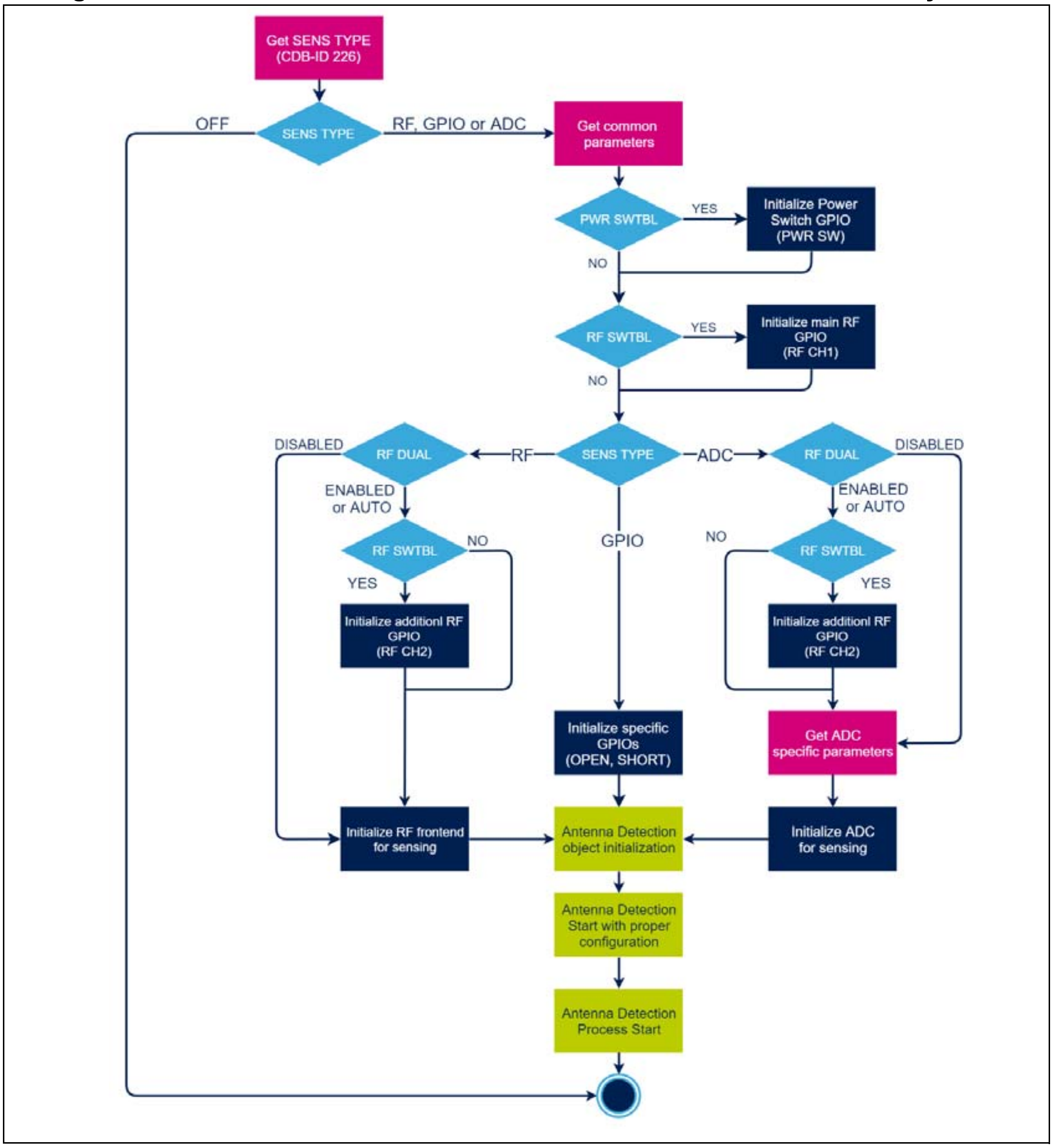
When the module has not power switch capability (i.e. Bit 3 in CDB-ID 226 equal to zero) there is no Power Switch initialization. This basically means that all the field related to Power Switch in CDB-ID 242, CDB-ID 243 and CDB-ID 244 are ignored. This guarantees that there would be no GPIO misconfiguration when Power Switch is not provided in the Hardware design.

Similarly, when the module has not RF switch capability (i.e. Bit 3 in CDB-ID 243 equal to zero) there is no RF CH1 nor RF CH2 switches initialization. Again, in this case, all the field related to RF CH1 and RF CH2 switches in CDB-ID 242, CDB-ID 243 and CDB-ID 244 are ignored. Furthermore, RF CH2 switch make sense only if sensing type is not GPIO and RF DUAL is enabled or auto (i.e. Bits 4:5 in CDB-ID 243 equal to one or two).

Depending on the sensing type, all the Antenna Detection module dependencies are initialized at application level, thus when Antenna Detection is started and its process launched all the peripheral required for this purpose are ready to use.

When launched the Antenna Detection process will be executed with the same cadency of the NMEA process which by default is equal to 1 Hz.

Figure 24. Initialization of Antenna Detection module at ST GNSS Library level

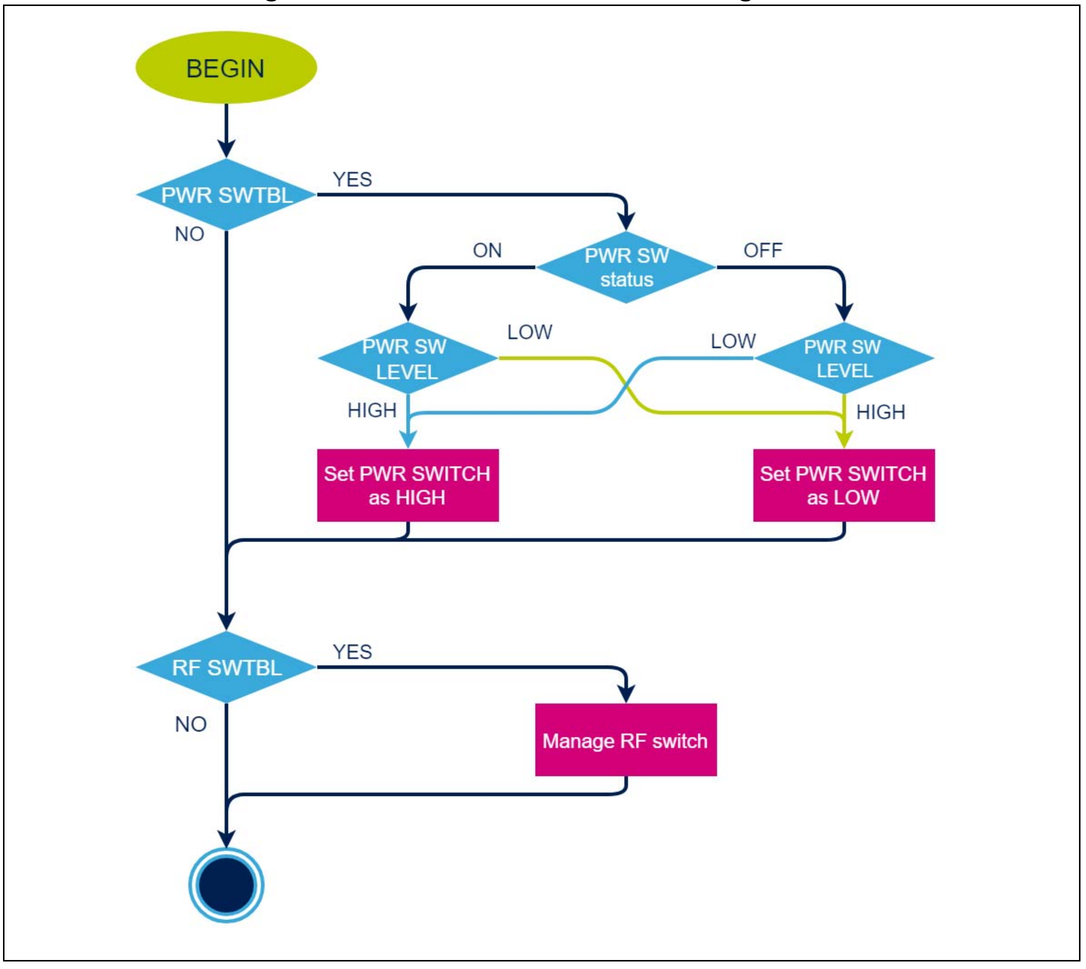


9.4.1 The first configuration

Once that parameters are extracted from the firmware configuration and that dependencies are configured the Antenna Detection module can be started and configured for its normal activities. Looking back to Figure 3 this happens in the green block described as "Antenna Detection Start with proper configuration".

This block can be zoomed in to see what happens inside as shown in *Figure 25*.

Figure 25. Antenna Detection first configuration

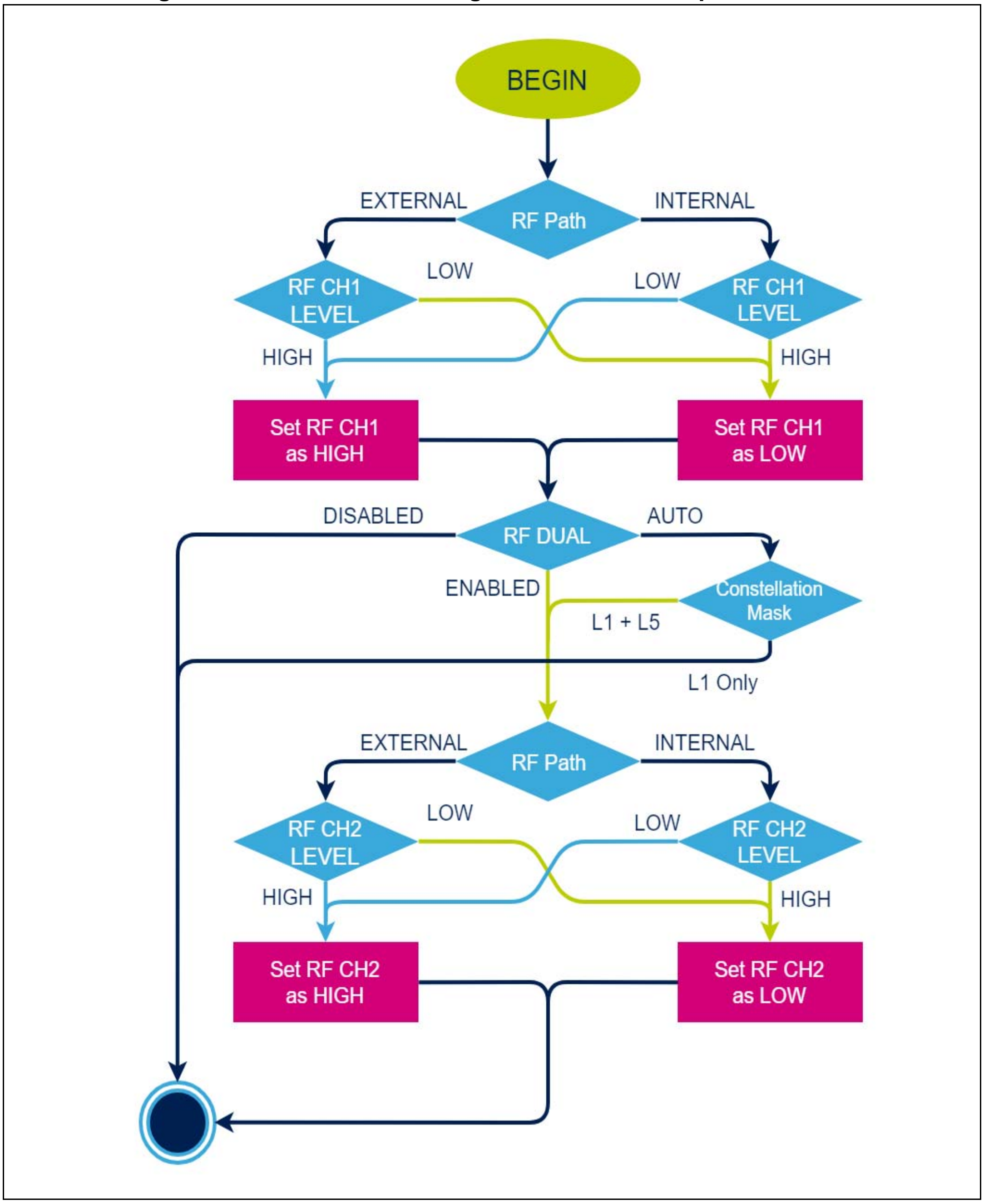


Looking at this figure it is possible to notice that all the actions that involve GPIO are highlighted in pink. Moreover, when the antenna power is not switchable (i.e. Bit 3 of CDB-ID 226 masked to 0), no action related to antenna power is taken.

The block "Manage RF switch" is the the one that drives the switch of the RF channels. The behavior of this block is described in *Figure 26*. The RF management is directly impacted by RF dual and, in automatic mode, by the Satellite constellation mask.

Note that by design, it is not possible to drive the two channels on different antennas. In other words, if the chosen RF path is INTERNAL both RF CH1 and RF CH2 would be re-routed on the Internal Antenna. Similarly, if the chosen RF path is EXTERNAL both RF CH1 and RF CH2 would be re-routed on the External Antenna. Note also that if when the RF path is not switchable (i.e. Bit 3 of CDB-ID 243 masked to 0) the flow of *Figure 26* would never be executed and no action on RF CH1/RF CH 2 would be taken.

Figure 26. RF switches management Software implementation



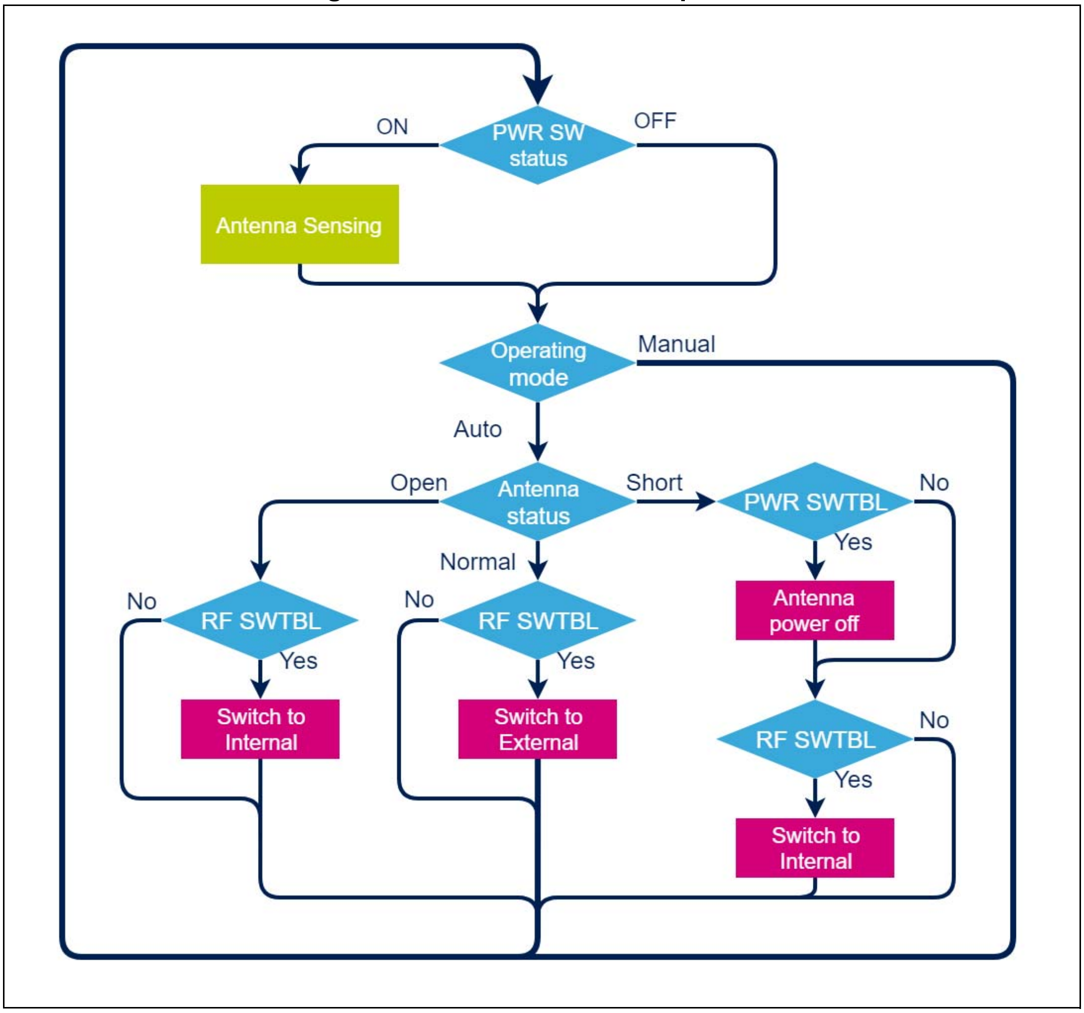
9.4.2 The main process

Once the Antenna Detection module have been initialized and configured, it can execute its normal activity. These activities are executed periodically, thus they can be considered like a process, an ongoing task, executed with a certain cadency.

Looking at *Figure 24* it is possible to notice that the ST GNSS Library launches this process after the Antenna Detection first configuration. When launched it will be executed with the same cadency of the NMEA task which by default is equal to 1 Hz.

The purpose of the Antenna Detection process is to sense the external antenna and take an action based on the module current configuration. Such activity can be resumed in a flowchart shown in *Figure 27*.

Figure 27. Antenna Detection process



Looking at this diagram it is possible to notice that when antenna is not powered on there is no chance to perform the Antenna Sensing. This is quite normal because the working principle of the sensing procedure is to measure in different ways the current drawn by the external antenna.

Note: If the external Antenna is not powered on, the sensing operation is skipped. By default, when the hardware has not the power switch capability, it is expected that the external antenna is always powered.

Note: If the Antenna Detection operating mode is manual the process would not take any action on Power Switch nor RF path. It is possible to switch operating mode at runtime through the command $PSTMSETANTSENSOPMODE.

9.5 Hardware reference design

In the *Figure 27* we have described the working flow of the Antenna Detection main process where the Antenna Sensing operation has been shown as a green box with no reference to the sensing type.

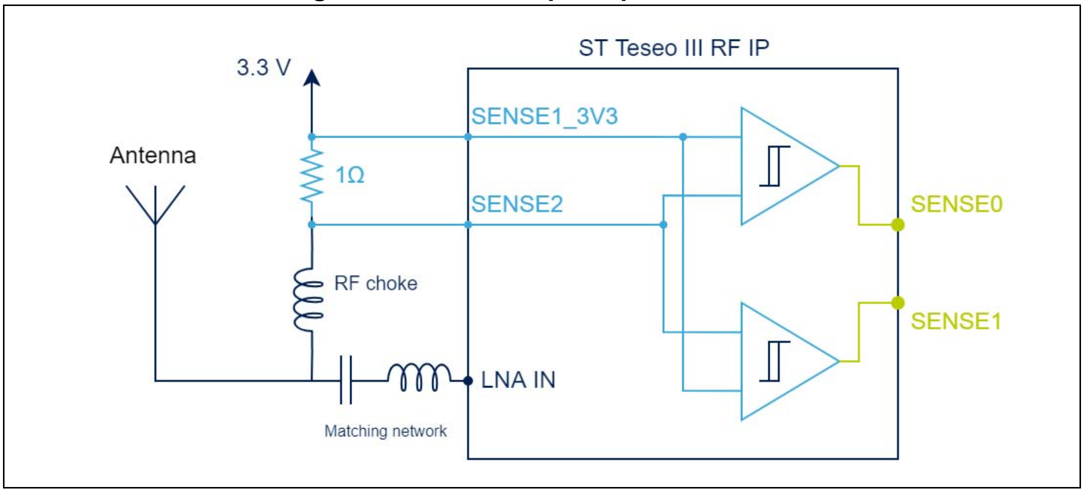
The antenna sensing has actually something different and its complexity as well as its software behavior depends strictly on the sensing type. In this chapter we are going to describe how it works in each case providing some hardware reference designs.

9.5.1 RF sensing type

9.5.1.1 Working principle

When sensing type is RF, the sensing is performed by the RF IP of the ST Teseo III chipset. This IP embeds two small-hysteresis comparators as shown in *Figure 28*.

Figure 28. RF sense principle schematic



The output of the comparison process is collected in sampled in hardware and used to update two bit fields in a ST Teseo III register. The Antenna Detection module can thus access this register and read for SENSE0 and SENSE1.

According to the value of these bits the module is able to establish the antenna status:

- Open condition, i.e. when SENSE0 and SENSE1 are both low.
- Normal condition, i.e. i.e. when SENSE0 is high and SENSE1 is low
- Short condition, i.e. when SENSE0 and SENSE1 are both high.

Due to the hysteresis, the thresholds are slightly different when the current sunk by the antenna is rising and when is falling. These thresholds are defined by the silicon process and cannot be configured. They have been designed starting from the following specification:

- Active antenna
- Antenna power supply equal to 3.3 V
- Typical current absorption about 30 mA
- Typical probe resistor 1Ω

If the antenna in use has a different current absorption, it is possible to rescale the probe resistor to make the sensing work properly.

Indeed, the comparators have been designed for a typical voltage drop across the sensing resistor equal to

$$V_{SENSE} = = I_{ANT.}R_{SENSE} = 30mA.1\Omega = 30mV$$

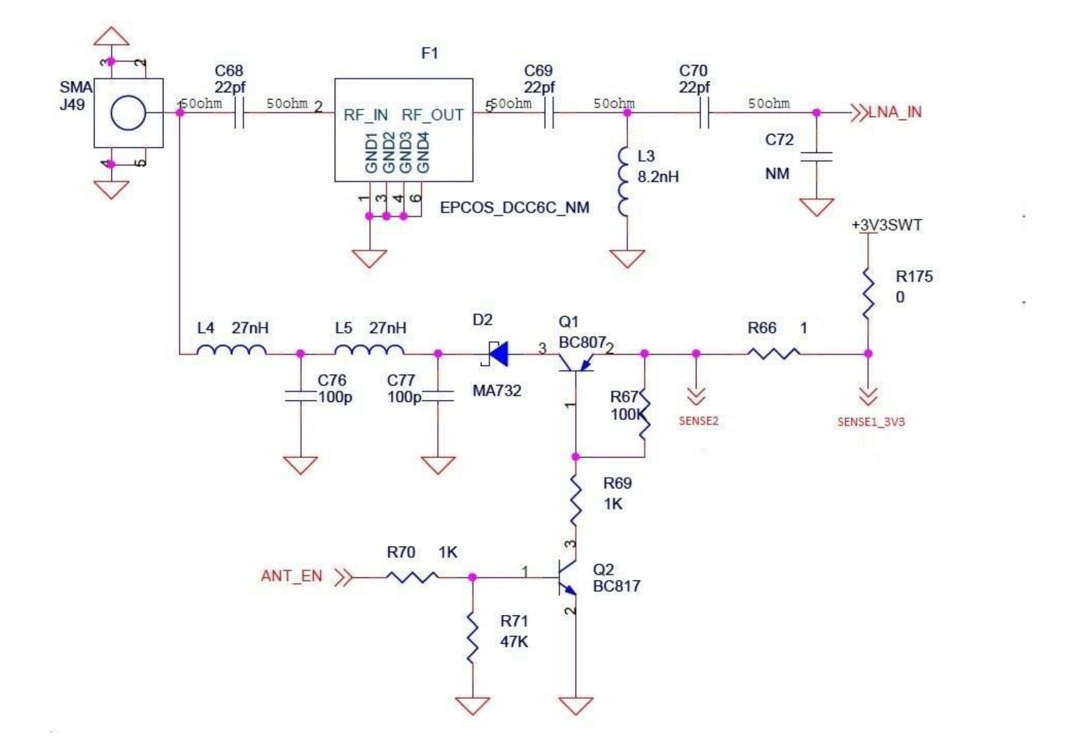
Reversing this simple equation, it is possible to compute a new resistor value starting from the expected antenna current absorption. For instance, let us consider an antenna which current absorption is 10 mA. In this case the resistor probe should be

$$R_{SENSE} = V_{SENSE}I_{ANT} = 30mV10mA = 3\Omega$$

Note: The RF sensing type is not supported on STA8089xx as the SENSE1_3V3 and SENSE2 pins are not available.

9.5.1.2 Reference hardware design

Figure 29. RF hardware reference design



In *Figure 28* a reference design of the antenna external circuitry for RF sensing type. In this design the ANT_EN label represents the Antenna Power Switch which could be connected to a GPIO of the ST Teseo III chipset providing thus the antenna power switch capability.

9.5.2 ADC sensing type

9.5.2.1 Working principle

When sensing type is ADC, the ST Teseo III chipset samples the voltage drop across a sense resistor. The differential measurement can be done using two channel of the ADC peripheral of the ST Teseo III properly connected to the terminals of the sense resistor. The difference is then computed in software and compared to two thresholds.

- If the voltage drop is greater than the higher threshold, there is a big current absorption and thus the antenna is in short condition.
- If the voltage drop is smaller than the lower threshold, there is no current absorption and thus the antenna is in open condition.
- If the voltage drop lays between the two thresholds, the antenna is in normal condition.

To guarantee flexibility, the antenna detection allows to configure these thresholds at configuration level through two bit fields of the CDB-ID 226 (i.e MAX THR and MIN THR). The thresholds are expressed in millivolts.

It is also possible to choose the ADC clock divider (i.e. CLK DIV in CDB-ID 226) and the ADC input mask (i.e Bits 7-0 in CDB-ID 252)

9.5.2.2 How to choose the thresholds

The antenna detection will work properly only if the thresholds are defined properly. To make things clearer we are going to introduce an example about how to properly choose the thresholds.

Let also consider that

- The maximum ADC input voltage for the ST Teseo III 1.4 V

Then let us assume that

- The antenna is supplied with 3.3 V
- The sensing resistor is 10 ?
- The normal current absorption of the antenna is in range 15 to 50 mA
- To avoid ADC saturation, voltage on the terminal of the resistor has been attenuated of a factor equal to 3.3/1.4 V/V

With these considerations the normal voltage drop across the sense resistor can be computed as

$$V_{SENSE} = I_{ANT} . R_{SENSE}$$

Although we have

$$150mV \le V_{SENSEnormal} \le 500mV$$

Due to the voltage attenuation these thresholds shall be divided by a factor equal to the attenuation (i.e. 3.3/1.4 V/V). Thus the scaled thresholds would be

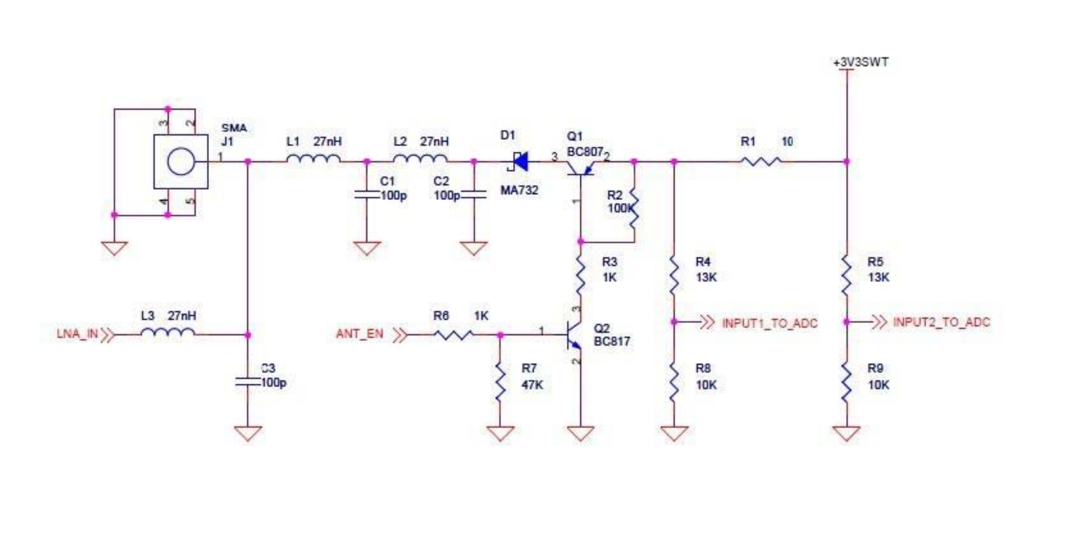
$$63.6mV \le V_{SENSEscalednormal} \le 212.12mV$$

9.5.2.3 Reference design

A possible reference design for this solution is shown in *Figure 9*.

In this design the ANT_EN label represents the Antenna Power Switch which could be connected to a GPIO of the ST Teseo III chipset providing thus the antenna power switch capability.

Figure 30. ADC hardware reference design



9.5.3 GPIO sensing type

When sensing type is GPIO, the sensing is performed using two GPIOs of the ST Teseo III chipset as input. These two pins labeled as GPIO_OPEN and GPIO_SHORT are fully configurable at configuration level. A principle schematic of such circuit is shown in *Figure 31*.

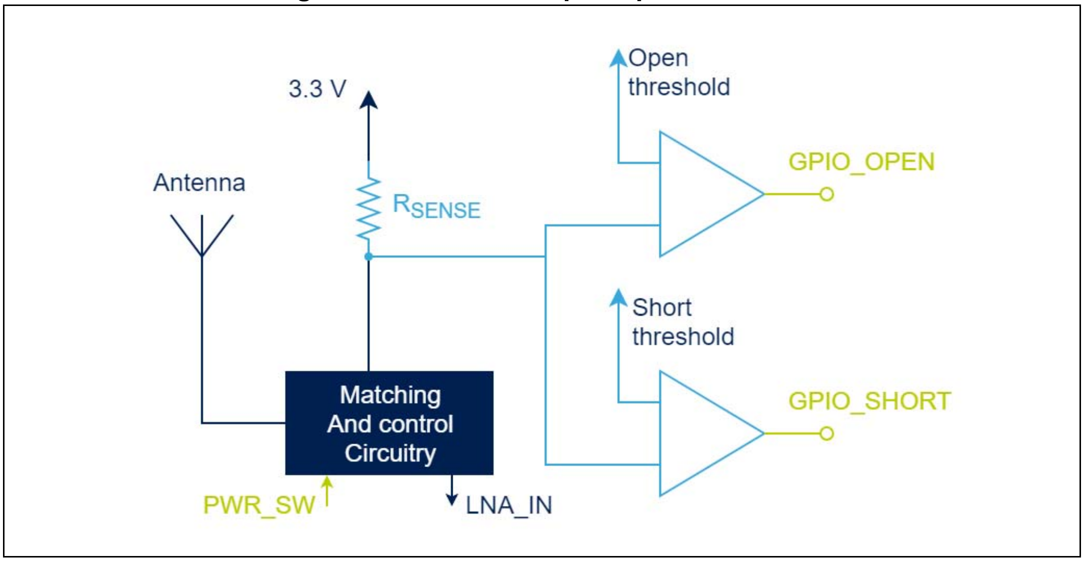
In the example shown in *Figure 31* there are two comparator that measures the Antenna current absorption through a RSENSE. To make things clearer, let us assume that the nominal current absorption of the antenna is 30 mA and that RSENSE value is 1Ω. Let us assume then that open threshold is 3.290 V and that short threshold is 3.250 V.

In such scenario, in normal condition, the expected voltage drop across the RSENSE would be 30 mV. Considering the chosen thresholds, we can have 3 conditions:

- the drop is less than 10 mV (i.e. Open is high and Short low). This represents the Open condition.
- the drop is more than 50 mV (i.e. Open is low and Short high). This represents the Short condition.
- the drop is in range 10mV, 50mV (i.e. both Open and Short are low) This represents the Normal condition.

As shown, such sensing type relies on the design of external circuitry which should be designed to provide proper digital signal according to the Antenna specifications thus it is not possible to provide a reference design a priori.

Figure 31. GPIO sense principle schematic



Such sensing type could be also used with external IC like a current limit Switches. These ICs usually are provided with some output pins that signal if there is a load presence or if there is a short condition.

The Antenna Detection module allows to choose the Active level for both GPIO_SHORT and GPIO_OPEN through the CDB-ID 244. This provide enough flexibility to cover all these use cases.

Note: The GPIO_SHORT and GPIO_OPEN pin would be automatically configured as Input at start up when sensing type is GPIO.

Note: GPIO sensing type allows to manage the antenna Power Switch and the RF path but does not work in RF dual mode. When sensing type is configured as GPIO the bit fields related to RF_CH2 are used to configure the GPIO_SHORT pin (see Firmware Configuration bitfield descriptions for more).

9.6 Event driven IOs

The Antenna Detection module is able to trigger events when certain conditions are matched. These events are captured processed by the ST GNSS Library allowing to toggle some GPIO.

There are two events related to the Antenna Detection module:

- The Antenna Status change
- The Antenna Switch

9.6.1 Antenna status change

This event is triggered by the Antenna Detection module as result of the sensing process. More precisely it is triggered only whereas the antenna status has changed.

The ST GNSS Library reacts to the event signaling and changing the status of a GPIO labeled as ANT_STA.

The GPIO identifier, as well as its mode and its active level are fully configurable by acting on CDB-ID 283.

Note: The antenna status change event can be disabled assigning the disable value to the related GPIO identifier (i.e. Bits 23-16 equal to 0xFF in CDB-ID 283).

If the event is not disabled, at start up, the ST GNSS Library will configure the GPIO according to the configuration. When the event is triggered the GPIO will be driven at its active level (i.e. Bit 28 in CDB-ID 283) if the Antenna is in *Normal condition* or at its inactive level if the Antenna is in *Open or Short condition*.

9.6.2 Antenna RF switch

This event is triggered by the Antenna Detection module as result of the RF path switch.

The ST GNSS Library reacts to the event signaling changing the status of a GPIO labeled as ANT_SWI.

The GPIO identifier, as well as its mode and its active level are fully configurable by acting on CDB-ID 283.

Note: The antenna switch event can be disabled assigning the disable value to the related GPIO identifier (i.e. Bits 7-0 equal to 0xFF in CDB-ID 283)

If the event is not disabled, at start up, the ST GNSS Library will configure the GPIO according to the configuration. When the event is triggered the GPIO will be driven at its active level (i.e. Bit 28 in CDB-ID 283) if the RF path is rerouted on External Antenna or at its inactive level if the RF path is rerouted on Internal Antenna.

10 Low Latency Interface

Low Latency Inteface (LLI) implements a different mode of sending PVT data via.

If LLI is disabled, when the new FIX is computed the GNSS-lib generates a FIX-Event and on that the NMEA process generates the message (i.e.: $xxGGA) with the PVT data and sends it to UART. This processing leads to delay and jittering in the output messages.

If the LLI mode is enabled, the PVT data are interpolated by propagating the latest PTV values up to the UTC timestamp of the NMEA message and then sent regularly without waiting for the fix event. Propagation is carried out using a faster algorithm therefore there is no jittering.

The propagation mode is always the same: hypothesis of uniform rectilinear motion starting from the last known point.

LLI can be enabled/disabled in the Application-CDB, moreover LLI rate can be configured in the CDB-ID 300 - Low Latency Interface rate

LLI is supported only on the message-list-2.

11 Commands

ST NMEA proprietary command can modify the internal Teseo III status, if not explicitly declared, all modifications of the parameters status, are not saved in the backup memory. For this reason, any changes of the parameters are replaced by the previous values after system reset or system power cycling.

11.1 Software command list

The *Table 13: NMEA command list* summarizes all the commands supported by the ST NMEA layer.

Table 13. NMEA command list

Syntax	Description
GNSS management commands	
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITTIME	Initialize time only
$PSTMINITFRQ	Initialize center frequency
$PSTMSETRANGE	Set the frequency range for satellite searching
$PSTMCLREPHS	Clear all ephemeris
$PSTMDUMPEPHEMS	Dump Ephemeris data
$PSTMEPHEM	Load Ephemeris data
$PSTMCLRALMS	Clear all almanacs
$PSTMDUMPALMANAC	Dump Almanacs data
$PSTMALMANAC	Load Almanacs data
$PSTMCOLD	Perform COLD start
$PSTMWARM	Perform WARM start
$PSTMHOT	Perform HOT start
$PSTMNMEAONOFF	Toggle ON/OFF the NMEA output
$PSTMDEBUGONOFF	Toggle ON/OFF the DEBUG output
$PSTMSRR	System Reset
$PSTMGPSRESET	Reset the GPS engine
$PSTMGPSSUSPEND	Suspend GPS engine
$PSTMGPSRESTART	Restart GPS engine
$PSTMGNSSINV	Invalidate the GNSS fix status
$PSTMTIMEINV	Invalidate the GPS time
$PSTMGETSWVER	Provide the GPS library version string.
$PSTMNVMSWAP(1)	Execute a bank swap on the NVM GPS backup memory

Table 13. NMEA command list (continued)

Syntax	Description
$PSTMSBASONOFF	Enable/Disable the SBAS activity
$PSTMSBASSERVICE	Set the SBAS service
$PSTMSBASSAT	Set the SBAS satellite's ID
$PSTMSBASM	Send a SBAS frame
$PSTMRFTESTON	Enable the RF test mode
$PSTMRFTESTOFF	Disable the RF test mode
$PSTMGETALGO	Get FDE algorithm ON/OFF status
$PSTMSETALGO	Set FDE algorithm ON/OFF status
$PSTMGETRTCTIME	Get the current RTC time.
$PSTMDATUMSELECT	Set a geodetic local datum different from WGS84
$PSTMDATUMSETPARAM	Set parameters to local geodetic to WGS84 datum transformations
$PSTMENABLEPOSITIONHOLD	Set status and position for the Position Hold feature.
$PSTMSETCONSTMASK	Set GNSS constellation mask.
$PSTMNOTCH	Set the ANF operation mode.
$PSTMSQISET	
$PSTMSQIGET	
$PSTMSQIERASE	
$PSTMPPS	Command interface for Pulse Per Second management.
$PSTMADCSTART	Start and Configure ADC
$PSTMADCREAD	Read ADC channels data
$PSTMLOWPOWERONOFF	
$PSTMCRCCHECK	
$PSTMSTBIN	
$PSTMNMEAREQUEST	
$PSTMFORCESTANDBY	
$PSTMIONOPARAMS	
$PSTMGALILEOGGTO	
$PSTMGALILEODUMPGGTO	
$PSTMSETTHTRK	
$PSTMSETTHPOS	
$PSTMGETFLASHTYPE	
$PSTMGETFLASHTYPE	
$PSTMFMWUPGRADE	
Configuration commands	
$PSTMSETPAR	Set System Parameter in the configuration data block.

Table 13. NMEA command list (continued)

Syntax	Description
$PSTMGETPAR	Get System Parameter from configuration data block.
$PSTMSAVEPAR	Save System Parameters in the GNSS backup memory.
$PSTMRESTOREPAR	Restore System Parameters (Factory Settings).
$PSTMCFGPORT	Char Port Configuration
$PSTMCFGANTSENS	Antenna Sensing Configuration
$PSTMCFGCLKS	Clock Mode and Speed Configuration
$PSTMCFGMSGL	Message List Configuration
$PSTMCFGGNSS	GNSS Algorithm Configuration
$PSTMCFGSBAS	SBAS Algorithm Configuration
$PSTMCFGPPSGEN	PPS General Configuration
$PSTMCFGPPSSAT	PPS Satellite Related Configuration
$PSTMCFGPPSPUL	PPS Pulse Related Configuration
$PSTMCFGPOSHOLD	
$PSTMCFGTRAIM	Traim Configuration
$PSTMCFGSATCOMP	
$PSTMCFGLPA	
$PSTMCFGLPS	Low Power State Configuration
$PSTMCFGAGPS	Assisted GNSS Configuration
$PSTMCFGAJM	Anti-Jamming Configuration
$PSTMCFGODO	Odometer Configuration
$PSTMCFGLOG	Logger Configuration
$PSTMCFGGEOFENCE	Geofencing Configuration
$PSTMCFGGEOCIR	Geofencing Circle Configuration
$PSTMCFGCONST	
Datalogging commands	
$PSTMLOGCREATE	Creates and enable a new data log
$PSTMLOGSTART	Starts or restarts the current the data logging
$PSTMLOGSTOP	Stops the data logging
$PSTMLOGERASE	Erases the data log.
$PSTMLOGREQSTATUS	To get information about the datalog subsystem
$PSTMLOGREQQUERY	Triggers a query request to the ST GNSS Teseo
Geofence Commands	
$PSTMGEOFENCECFG	Configures the Geofence subsystem
$PSTMGEOFENCEREQ	To know internal Geofence subsystem status
Odomenter commands	

Table 13. NMEA command list (continued)

Syntax	Description
$PSTMODOSTART	Enables and resets the Odometer subsystem
$PSTMODOSTOP	Stops the Odometer subsystem
$PSTMODORESET	Resets the Odometer subsystem
Autonomous AGNSS	
$PSTMSTAGPSONOFF	
$PSTMSTAGPSINVALIDATE	
$PSTMGETAGPSSTATUS	
$PSTMSTAGPSSETCONSTMASK	
Predictive AGNSS commands	
$PSTMSTAGPSSEEDBEGIN	
$PSTMSTAGPSBLKTYPE	
$PSTMSTAGPSSLOTFRQ	
$PSTMSTAGPSSEEDPKT	
$PSTMSTAGPSSEEDPROP	
Real Time AGNSS commands	
$PSTMSTAGPS8PASSGEN	

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

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

11.2 ST NMEA command specification

11.2.1 $PSTMINITGPS

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

Synopsis:

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

Arguments:

Table 14. $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
- In case of no errors, the *$PSTMINITGPSOK* message is returned
- In case of errors, the error message *$PSTMINITGPSERROR* is returned

Example:

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

11.2.2 $PSTMINITTIME

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

Synopsis:

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

Arguments:

Table 15. $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 position and time will be initialized
- In case of no errors, the *$PSTMINITTIMEOK* message is returned
- In case of errors, the error message *$PSTMINITTIMEERROR* is returned

Example:

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

11.2.3 $PSTMINITFRQ

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

Synopsis:

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

Arguments:

Table 16. $PSTMINITFRQ field description

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

Results:

- The center frequency will be initialized

Example:

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

11.2.4 $PSTMSETRANGE

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

Synopsis:

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

Arguments:

Table 17. $PSTMSETRANGE field description

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

Results:

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

Example:

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

11.2.5 $PSTMCLREPHS

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

11.2.6 $PSTMDUMPEPHEMS

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

Synopsis:

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

Arguments:

None.

Results:

- GNSS replies with the *$PSTMEPHEM* messages

Example:

```
$PSTMDUMPEPHEMS
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400fbff33
420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ffcaff19
370000335157265556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00b8ffd0
37000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff6c00f7
2e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

11.2.7 $PSTMEPHEM

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

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

Synopsis:

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

Arguments:

Table 18. $PSTMEPHEM field description

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

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

Data format is constellation dependent.

Table 19. $PSTMEPHEM field description for GPS constellation

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

Table 19. $PSTMEPHEM field description for GPS constellation (continued)

Bits	Structure Member	Description
8	time_group_delay	Estimated group delay differential.
8	af2	Second order clock correction.
16	af1	First order clock correction.
22	af0	Constant clock correction.
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	RESERVED	Must be 0.
4	accuracy	Accuracy

Table 20. $PSTMEPHEM field description for GLONASS constellation

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

Table 20. $PSTMEPHEM field description for GLONASS constellation (continued)

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

Table 21. $PSTMEPHEM field description for Galileo constellation

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

Table 21. $PSTMEPHEM field description for Galileo constellation (continued)

Bits	Structure Member	Description
16	toc	Time of week for clock epoch
10	iod_nav	Issue of data
8	SISA	Signal In Space Accuracy
10	RESERVED	Must be 0.
10	BGD_E1_E5a	E1-E5a Broadcast Group Delay
10	BGD_E1_E5b	E1-E5b Broadcast Group Delay
2	E1BHS	E1-B Signal Health Status
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
14	i_dot	Rate of inclination angle.
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
16	motion_difference	Mean motion difference from computed value
16	crs	Amplitude of the sine harmonic correction to the orbit radius.
16	crc	Amplitude of the cosine harmonic correction to the orbit radius.
16	cus	Amplitude of the sine harmonic correction to the argument of latitude.
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
16	cis	Amplitude of the sine harmonic correction to the angle of inclination.
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
24	omega_dot	Rate of right ascension.
6	SVID	Satellite Identification.
1	E1BDVS	E1-B Data Validity Status
1	RESERVED	Must be 0.
8	RESERVED	Must be 0.
16	RESERVED	Must be 0.
6	af2	Second order clock correction.
21	af1	First order clock correction.
5	word_available	Must be 0x1F.
31	af0	Constant clock correction.
1	RESERVED	
6	RESERVED	Must be 0

Table 21. $PSTMEPHEM field description for Galileo constellation (continued)

Bits	Structure Member	Description
26	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	Must be 0.

Table 22. $PSTMEPHEM field description for BEIDOU constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential.
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension.
8	A0	Ionospheric Delay Model Parameter α_0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter α_1
20	sow	Seconds of week
11	af2	Second order clock correction.
1	is_geo	1 for Geostationary satellites, otherwise 0
22	af1	First order clock correction.
10	subframe_avail	Must be 0x3FF.
16	motion_difference	Mean motion difference from computed value
8	A2	Ionospheric Delay Model Parameter α_2
8	A3	Ionospheric Delay Model Parameter α_3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter β_2
4	urai	User range accuracy index
2	RESERVED	Must be 0.
18	crc	Amplitude of the cosine harmonic correction to the orbit radius.
8	B3	Ionospheric Delay Model Parameter β_3
5	aodc	Issue of data, clock
1	spare	
18	cus	Amplitude of the sine harmonic correction to the argument of latitude.

Table 22. $PSTMEPHEM field description for BEIDOU constellation (continued)

Bits	Structure Member	Description
14	i_dot	Rate of inclination angle.
18	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
8	B0	Ionospheric Delay Model Parameter β_0
6	spare	
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter β_1
6	RESERVED	Must be 0.
18	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
1	nvm_reliable	Must be 1.
11	RESERVED	Must be 0.
2	spare	
17	toc	Time of week for clock epoch
13	week	Week number of the Issue of Data
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

Table 23. $PSTMEPHEM field description for IRNSS constellation

Bits	Structure Member	Description
16	toe	Ephemeris Reference time
16	toc	Time of clock,
32	mean_anomaly	Mean Anomaly at Reference Time
32	eccentricity	Eccentricity
32	root_a	Square Root of the Semi-Major Axis
32	omega_zero	Longitude of Ascending Node of Orbit Plane at Weekly Epoch
32	perigee	Argument of Perigee
32	inclination	Inclination Angle at Reference Time
22	omega_dot	Rate of Right Ascension
10	reserved	
16	af1	Clock coefficients af1
15	cuc	Amplitude of the Cosine Harmonic Correction term to the Argument of Latitude
1	L5_flag	Signal Health Flag
14	i_dot	Rate of Inclination Angle
2	spare1	

Table 23. $PSTMEPHEM field description for IRNSS constellation (continued)

Bits	Structure Member	Description
15	cus	Amplitude of the Sine Harmonic Correction term to the Argument of Latitude
1	S_flag	Signal Health Flag
22	af0	Clock coefficients af0
8	af2	Clock coefficients af2
2	spare2	
22	difference	Mean Motion difference from computed value
10	WN	Week number
4	URA	User Range Accuracy
8	t_gd	Total Group Delay
8	IODEC	Issue of Data for Ephemeris and Clock
12	spare3	
15	crc	Amplitude of the Cosine Harmonic Correction term to the Orbit Radius
15	crs	Amplitude of the Sine Harmonic Correction term to the Orbit Radius
2	spare5	
10	reserved	
6	reserved	
1	reserved	
1	Available	Contains 1 if ephemeris is available, 0 if not
1	Health	Contains 1 if the satellite is unhealthy, 0 if healthy
2	subframe_avail	Must be 0x3
1	nvm_reliable	Must be 1.
10	spare6	

Results:
- The ephemeris will be stored into backup RAM
- In case of no errors, the *$PSTMEPHEMOK* message is returned
- In case of errors, the error message *$PSTMEPHEMERROR* is returned

Example:

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

11.2.8 $PSTMCLRALMS

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

11.2.9 $PSTMDUMPALMANAC

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

Synopsis:

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

Arguments:

None.

Results:

- GNSS replies with the *$PSTMALMANAC* messages

Example:

```
$PSTMDUMPALMANAC
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034024200
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
```

11.2.10 $PSTMALMANAC

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

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

Synopsis:

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

Arguments:

Table 24. $PSTMALMANAC field description

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number
N	Decimal, 1 digit	Number of the almanac data bytes
byte1	Hexadecimal, 2 digits	First byte of the almanac data
byteN	Hexadecimal, 2 digits	Last byte of the almanac data
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

The N Bytes that are in the parameters are the dump of a structure that contains all the information of the almanac.

Data format is constellation dependent.

Table 25. $PSTMALMANAC field description for GPS constellation

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

Table 26. $PSTMALMANAC field description for GLONASS constellation

Bits	Structure Member	Description
8	satid	The satellite number.
16	week	The week number for the epoch.
8	toa	Reference time almanac.
5	n_A	Slot number (1…24).
5	H_n_A	Carrier frequency channel number.
2	M_n_A	Type of satellite 00=GLONASS 01=GLONASS-M.

Table 26. $PSTMALMANAC field description for GLONASS constellation (continued)

Bits	Structure Member	Description
10	tau_n_A	Satellite clock correction.
15	epsilon_n_A	Eccentricity.
21	t_lambda_n_A	Time of the first ascending node passage.
21	lambda_n_A	Longitude of ascending node of orbit plane at almanac epoch.
18	delta_i_n_A	Inclination angle correction to nominal value.
7	delta_T_n_dot_A	Draconian period rate of change.
22	delta_T_n_A	Draconian period correction.
16	omega_n_A	Argument of perigee.
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.
32	Tau_c	
11	NA	
5	N4	
16	Spare	

Table 27. $PSTMALMANAC field description for Galileo constellation

Bits	Structure Member	Description
16	satid	The satellite number
6	svid	Space Vehicle Identificator
16	week	The week number for the epoch
20	toa	Reference time almanac.
13	delta_a	Delta of semi-major axis.
11	e	Eccentricity.
16	perigee	Argument of perigee.
11	delta_i	Rate of inclination angle.
16	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
11	omega_dot	Rate of right ascension.
16	mean_anomaly	Mean anomaly at reference time.
16	af0	Constant clock correction.
13	af1	First order clock correction.
2	E5b_HS	E5 Signal Health Status
2	E1B_HS	E1-B Signal Health Status
4	ioda_1	Issue of data Almanac 1
4	ioda_2	Issue of data Almanac 2
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.

Table 27. $PSTMALMANAC field description for Galileo constellation (continued)

Bits	Structure Member	Description
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.

Table 28. $PSTMALMANAC field description for IRNSS constellation

Bits	Structure Member	Description
10	WNa	Week number for almanac
16	toa	Almanac Reference time
6	prn_al	PRN ID for Almanac
16	eccentricity	Eccentricity
16	omega_dot	Rate of Right Ascension
24	inclination	Inclination
8	ISC	Inter Signal Correction
24	root_a	Square Root of the Semi-Major Axis
8	spare0	
24	omega_zero	Longitude of Ascending Node of Orbit Plane at Weekly Epoch
6	spare	
2	spare1	
24	perigee	Argument of perigee
6	prn	PRN ID
2	spare2	
24	mean_anomaly	Mean Anomaly at Reference Time
8	spare3	
11	af0	Clock bias A0
11	af1	Clock drift A1
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	available	Contains 1 if almanac is available 0 if not.
8	spare4	

Results:
- The almanac will be stored into backup memory
- In case of no errors, the *$PSTMALMANACOK* message is returned
- In case of errors, the error message *$PSTMALMANACERROR* is returned

Example:

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

11.2.11 $PSTMCOLD

Perform a COLD start.

Synopsis:

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

Arguments:

Table 29. $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[b].
- 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`

11.2.12 $PSTMWARM

Perform a WARM start.

Synopsis:

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

Arguments:

None.

Results:

- Warm start initialization and system restart[b].

Example:

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

11.2.13 $PSTMHOT

Perform a HOT start.

Synopsis:

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

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

Arguments:

None.

Results:

- The system restarts[c].

Example:

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

11.2.14 $PSTMNMEAONOFF

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

Synopsis:

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

Arguments:

Table 30. $PSTMNMEAONOFF field description

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

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

Results:

- NMEA output message is started or stopped according to the ‘`on_off`’ field value.

Example:

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

11.2.15 $PSTMDEBUGONOFF

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

Synopsis:

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

Arguments:

Table 31. $PSTMDEBUGONOFF field description

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

Results:

- Debug output message is started or stopped according to the ‘`on_off`’ field value.

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

Example:

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

11.2.16 $PSTMSRR

Executes a system reset. The GNSS firmware is rebooted.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

11.2.17 $PSTMGPSRESET

Reset the GPS Teseo engine.

Synopsis:

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

Arguments:

None.

Results:

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

Note: Using this command the GPS module won’t reboot.

Example:

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

11.2.18 $PSTMGPSSUSPEND

Suspend the GNSS Teseo engine.

Synopsis:

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

Arguments:

None.

Results:

- The $PSTMGPSSUSPENDED message will be sent when GNSS Teseo III engine is suspended

Example:

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

11.2.19 $PSTMGPSRESTART

Restart the GNSS Teseo engine.

Synopsis:

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

Arguments:

None.

Results:

- The GNSS Teseo engine will be restarted
- No message will be sent as a reply

Example:

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

11.2.20 $PSTMGNSSINV

Invalidate the GNSS Fix Status.

Synopsis:

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

Arguments:

Table 32. $PSTMGNSSINV field description

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

Results:

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

Example:

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

11.2.21 $PSTMTIMEINV

Invalidate the Real Time Clock (RTC).

Synopsis:

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

Arguments:

None.

Results:

- The RTC time will be invalidated.

Example:

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

11.2.22 $PSTMGETSWVER

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

Synopsis:

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

Arguments:

Table 33. $PSTMGETSWVER field description

Parameter	Format	Description
id	Integer	Depending on the value of the <lib_id> parameter, the following version numbering is delivered by the command: 0 = GNSS Library Version 1 = OS20 Version 2 = SDK App Version 6 = Binary Image Version 7 = STA8088 HW version 11 = SW configuration ID 12 = Product ID 254 = configuration data block 255 = all versions strings (as reported at the NMEA startup).

Results:

- GNSS replies with *$PSTMVER* message

11.2.23 $PSTMNVMSWAP[(d)]

Execute a bank swap on the NVM GPS backup memory.

Synopsis:

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

Arguments:

None.

Results:

- The non-volatile backup memory banks will be swapped

Example:

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

11.2.24 $PSTMSBASONOFF

Suspend / resume the SBAS software execution.

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

11.2.25 $PSTMSBASSERVICE

Change the SBAS service.

Synopsis:

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

Arguments:

Table 34. $PSTMBASSERVICE field description

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

Results:

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

Example:

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

11.2.26 $PSTMSBASSAT

Change the SBAS satellite.

Synopsis:

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

Arguments:

Table 35. $PSTMSBASSAT field description

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

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

Example:

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

11.2.27 $PSTMSBASM

Send a SBAS frame to the SBAS engine.

Synopsis:

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

Arguments:

Table 36. $PSTMSBASM field description

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

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

Example:

```
$PSTMSBASM,123,536A481B40D8063829C12E08704B82DFFDFFEFFF7FFBFFDFFEF06E8037E
FB440*6D
```

11.2.28 $PSTMRFTESTON

Enable the RF test mode for production line tests.

Synopsis:

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

Arguments:

Table 37. $PSTMRFTESTON field description

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number

Results:

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

Example:

```
$PSTMRFTESTON,24*<checksum><cr><lf>
```

11.2.29 $PSTMRFTESTOFF

Disable the RF test mode for production line tests.

Synopsis:

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

Arguments:

None.

Results:

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

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

Example:

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

11.2.30 $PSTMGETALGO

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

Synopsis:

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

Arguments:

Table 38. $PSTMGETALGO field description

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

Results:

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

Example:

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

11.2.31 $PSTMSETALGO

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

Synopsis:

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

Arguments:

Table 39. $PSTMSETALGO field description

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

Results:

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

Example:

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

11.2.32 $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

- System will send *$PSTMRTCTIME* message

Example:

```
$PSTMGETRTCTIME
```

11.2.33 $PSTMDATUMSELECT

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

Synopsis:

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

Arguments:

Table 40. $PSTMDATUMSELECT field description

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

Results:

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

Example:

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

11.2.34 $PSTMDATUMSETPARAM

Set parameters to local geodetic to WGS84 datum transformations.

Synopsis:

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

Arguments:

Table 41. $PSTMDATUMSETPARAM field description

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

Results:

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

Example:

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

11.2.35 $PSTMENABLEPOSITIONHOLD

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

Synopsis:

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

Arguments:

Table 42. $PSTMENABLEPOSITIONHOLD field description

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

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

Results:

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

Example:

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

11.2.36 $PSTMSETCONSTMASK

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

Synopsis:

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

Arguments:

Table 43. $PSTMSETCONSTMASK field description

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

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

Examples:

Enabling GPS only:

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

Enabling GLONASS only:

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

Enabling GPS and GLONASS:

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

11.2.37 $PSTMNOTCH

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

Synopsis:

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

Arguments:

Table 44. $PSTMNOTCH field description

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

The command can be issued in the following form:

Standard configuration (2 parameters only):

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

Enhanced configuration (3 parameters):

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

that accepts more the frequency parameter to start search for RFI.

Full configuration (6 parameters):

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

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

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

Results:

- This command set the ANF operation mode.

Example:

Standard Configuration

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

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

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

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

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

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

Extra supported Usages

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

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

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

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

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

Usage Note:

By Default the

- $PSTMNOTCH,0,2 command (Notch enabled in Auto mode on GPS branch) corresponds to the explicit

```
PSTMNOTCH,0,2,4092000,5,6, 3010
```

- $PSTMNOTCH,1,2 command (Notch enabled in Auto mode on Glonass Branch) corresponds to the explicit

```
PSTMNOTCH,1,2, 8184000,5,6, 3556
```

11.2.38 $PSTMSQISET

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

Synopsis:

```
$PSTMSQISET,<offset>,<word1>,...,<word8>*<checksum><cr><lf>
```

Arguments:

Table 45. $PSTMSQISET field description

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

Results:

- In case of no errors, the *$PSTMSQISETOK* message is returned
- In case of errors, the error message *$PSTMSQISETERROR* is returned

Example:

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

11.2.39 $PSTMSQIGET

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

Synopsis:

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

Arguments:

Table 46. $PSTMSQIGET field description

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

Results:

- In case of no errors, the *$PSTMSQIGETOK* message is returned
- In case of errors, the error message *$PSTMSQIGETERROR* is returned

Example:

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

```
$PSTMSQIGET,0xa0
```

11.2.40 $PSTMSQIERASE

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

Synopsis:

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

Arguments:

None.

Results:

- In case of no errors, the *$PSTMSQIERASEOK* message is returned
- In case of errors, the error message *$PSTMSQIERASEERROR* is returned

Example:

The following NMEA command erases all the information inside the SQI Data Storage Area (from 0x300F0000 to 0x300FFFFF)

```
$PSTMSQIERASE
```

11.2.41 $PSTMPPS

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

Synopsis:

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

Arguments:

Table 47. $PSTMPPS field description

Parameter	Format	Description
cmd_mode	Decimal, 1 digit	Select the command operation mode: 1 = GET operation (to get data from PPS manager) 2 = SET operation (to set data into PPS manager)
cmd_type	Decimal, 1 digit	1 = PPS_IF_ON_OFF_CMD 2 = PPS_IF_OUT_MODE_CMD 3 = PPS_IF_REFERENCE_CONSTELLATION_CMD 4 = PPS_IF_PULSE_DELAY_CMD 5 = PPS_IF_PULSE_DURATION_CMD 6 = PPS_IF_PULSE_POLARITY_CMD 7 = PPS_IF_PULSE_DATA_CMD 8 = PPS_IF_FIX_CONDITION_CMD 9 = PPS_IF_SAT_TRHESHOLD_CMD 10 = PPS_IF_ELEVATION_MASK_CMD 11 = PPS_IF_COSTELLATION_MASK_CMD 12 = PPS_IF_TIMING_DATA_CMD 13 = PPS_IF_POSITION_HOLD_DATA_CMD 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).

11.2.41.1 PPS Get PPS_IF_PULSE_DATA_CMD

Synopsis:

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

11.2.41.2 PPS Get PPS_IF_TIMING_DATA_CMD

Synopsis:

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

11.2.41.3 PPS Get PPS_IF_POSITION_HOLD_DATA_CMD

Synopsis:

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

11.2.41.4 PPS Get PPS_IF_TRAIM_CMD

Synopsis:

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

11.2.41.5 PPS Get PPS_IF_TRAIM_USED_CMD

Synopsis:

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

11.2.41.6 PPS Get PPS_IF_TRAIM_RES_CMD

Synopsis:

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

11.2.41.7 PPS Get PPS_IF_TRAIM_REMOVED_CMD

Synopsis:

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

11.2.41.8 PPS Set PPS_IF_ON_OFF_CMD

Synopsis:

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

Arguments:

Table 48. $PSTMPPS field description on PPS_IF_ON_OFF_CMD

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

Results:

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

11.2.41.9 PPS Set PPS_IF_OUT_MODE_CMD

Synopsis:

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

Arguments:

Table 49. $PSTMPPS field description on PPS_IF_OUT_MODE_CMD

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

Results:

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

11.2.41.10 PPS Set PPS_IF_REFERENCE_TIME_CMD

Synopsis:

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

Arguments:

Table 50. $PSTMPPS field description on PPS_IF_REFERENCE_TIME_CMD

Parameters	Format	Description
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS 5 =BeiDou_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST **Note:** UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. If the software is configured to work in GLONASS only mode, UTC(SU) is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.

Results:

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

11.2.41.11 PPS Set PPS_IF_PULSE_DELAY_CMD

Synopsis:

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

Arguments:

Table 51. $PSTMPPS field description on PPS_IF_PULSE_DELAY_CMD

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay [ns]

Results:

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

11.2.41.12 PPS Set PPS_IF_CONSTELLATION_RF_DELAY_CMD

Synopsis:

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

Arguments:

Table 52. $PSTMPPS field description on PPS_IF_CONSTELLATION_RF_DELAY_CMD

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

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

11.2.41.13 PPS Set PPS_IF_PULSE_DURATION_CMD

Synopsis:

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

Arguments:

Table 53. $PSTMPPS field description on PPS_IF_PULSE_DURATION_CMD

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]

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

11.2.41.14 PPS Set PPS_IF_PULSE_POLARITY_CMD

Synopsis:

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

Arguments:

Table 54. $PSTMPPS field description on PPS_IF_PULSE_POLAROTY_CMD

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

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

11.2.41.15 PPS Set PPS_IF_PULSE_DATA_CMD

Synopsis:

```
$PSTMPPS,2,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_duration>,<p
ulse_polarity>*<checksum><cr><lf>
```

Arguments:

Table 55. $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated. 1 = PPS generated on even seconds. 2 = PPS generated on odd seconds.
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC 3 = UTC_SU(1) 4 = GPS_UTC_FROM_GLONASS(2) 5 = BeiDou_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = not inverted. 1 = inverted.

1. UTC(SU) is the Soviet Union UTC. It is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.
2. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites.
If the software is configured to work in GLONASS only mode, UTC(SU) is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.

Results:

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

11.2.41.16 PPS Set PPS_IF_FIX_CONDITION_CMD

Synopsis:

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

Arguments:

Table 56. $PSTMPPS field description on PPS_IF_FIX_CONDITION_CMD

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

Results:

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

11.2.41.17 PPS Set PPS_IF_SAT_TRHESHOLD_CMD

Synopsis:

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

Arguments:

Table 57. $PSTMPPS field description on PPS_IF_SAT_TRHESHOLD_CMD

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

Results:

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

11.2.41.18 PPS Set PPS_IF_ELEVATION_MASK_CMD

Synopsis:

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

Arguments:

Table 58. $PSTMPPS field description on PPS_IF_ELEVATION_MASK_CMD

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

Results:

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

11.2.41.19 PPS Set PPS_IF_CONSTELLATION_MASK_CMD

Synopsis:

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

Arguments:

Table 59. $PSTMPPS field description on PPS_IF_CONSTELLATION_MASK_CMD

Parameter	Format	Description
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS bit7 = BEIDOU **Note:** This parameter enables the usage of mixed constellations satellites in the timing filtering. If bit0 is enabled GPS satellites are used to correct the GLONASS reference time together with GLONASS satellites. If bit1 is enabled, GLONASS satellites are used to correct the GPS reference time together with the GPS satellites. When constellation mask is zero (default) only GPS sats are used to correct the GPS reference time and only GLONASS sats are used to correct the GLONASS reference time. Same description is valid also for GPS and Beidou constellations enabling/disabling bit0 and bit7.

Results:

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

11.2.41.20 PPS Set PPS_IF_TIMING_DATA_CMD

Synopsis:

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

Arguments:

Table 60. $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = NOFIX. 2 = 2DFIX. 3 = 3DFIX.
sat_th	Decimal	Minimum number of satellites for the PPS generation.
elevation_mask	Decimal	Minimum satellite elevation for satellite usage in timing filtering.
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS bit7 = BEIDOU

Table 60. $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD

Parameter	Format	Description
gps_rf_delay	Decimal	GPS path RF delay [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]

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

11.2.41.21 PPS Set PPS_IF_POSITION_HOLD_DATA_CMD

Synopsis:

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

Arguments:

Table 61. $PSTMPPS field description on PPS_IF_POSITION_HOLD_DATA_CMD

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = Position Hold disabled. 1 = Position Hold enabled.
lat	DDmm.mmmmm	Position Hold position latitude.
lat_dir	“N” or “S”	North or South direction.
lon	DDDmm.mmmmm	Position Hold position longitude.
lon_dir	“E” or “W”	East or West direction.
h_msl	Double	Position Hold mean see level altitude.

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

11.2.41.22 PPS Set PPS_IF_AUTO_HOLD_SAMPLES_CMD

Synopsis:

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

Arguments:

Table 62. $PSTMPPS field description on PPS_IF_AUTO_HOLD_SAMPLES_CMD

Parameter	Format	Description
auto_ph_samples	Decimal, 1 digit	Number of position samples for the auto position algorithm. If the number of samples is set to “0” the auto position hold feature is disabled. The position average evaluation is restarted every time the command is executed.

Results:

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

11.2.41.23 PPS Set PPS_IF_TRAIM_CMD

Synopsis:

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

Arguments:

Table 63. $PSTMPPS field description on PPS_IF_TRAIM_CMD

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = TRAIM disabled. 1 = TRAIM enabled.
alarm	Double	TRAIM alarm [s] – scientific notation is allowed

Results:

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

11.2.42 $PSTMADCSTART

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

This command has to be used only once, if the command is executed more than once, it does not have any effect on the system.

Synopsis:

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

Arguments:

Table 64. $PSTMADCSTART field description

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

Results:

- In case of no errors, the *$PSTMADCSTARTOK* message is returned
- In case of errors, the error message *$PSTMADCSTARTERROR* is returned

Examples:

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

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

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

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

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

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

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

```
$PSTMADCSTART,7*<checksum><cr><lf>
```

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

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

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

```
$PSTMADCSTART,7,0*<checksum><cr><lf>
```

11.2.43 $PSTMADCREAD

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

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

Synopsis:

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

Arguments:

Table 65. $PSTMADCREAD field description

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

Results:

- In case of no errors, the *$PSTMADCREADOK* message is returned
- In case of errors, the error message *$PSTMADCREADERROR* is returned

Examples:

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

```
$PSTMADCREAD,0,5*<checksum><cr><lf>
```

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

```
$PSTMADCREAD,1,2*<checksum><cr><lf>
```

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

```
$PSTMADCREAD,3,4*<checksum><cr><lf>
```

Only one channel is available AIN0:

```
$PSTMADCREAD,7,0*<checksum><cr><lf>
```

Result Example for the last case:

```
$PSTMADCREAD,0,760*4f*<checksum><cr><lf>
```

11.2.44 $PSTMLOWPOWERONOFF

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

Synopsis:

```
$PSTMLOWPOWERONOFF,<low power enable/disable>,<constellation mask>,
```

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

Arguments:

Table 66. $PSTMLOWPOWERONOFF field description

Parameter	Format	Description
Low power enable/disable	Decimal, 1 digit	General Low Power features Enable/Disable 0: OFF, 1: ON
Adaptive mode settings		
Constellation mask	Decimal, 3 digit	It is a bit mask where each bit enable/disable a specific constellation independently by the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling bit 3: GALILEO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling
EHPE threshold	Decimal, 3 digits	Reserved, must be 0
Max tracked sats	Decimal, 2 digits	Reserved, must be 32
Switch constellation features	Decimal, 1 digit	Reserved, must be 0
Cyclic mode settings		
Duty Cycle enable/disable	Decimal, 1 digit	Enable/Disable the Cyclic mode 0: OFF, 1: ON This parameter can only be enabled if “Periodic mode” parameter is 0
Duty Cycle fix period	Decimal, 1 digits	Time between 2 fixes Typical value: 1, 3, 5 The receiver provide a fix every fix period
Periodic mode settings		
Periodic mode	Decimal, 1 digit	Setup Active or Standby periodic mode 0: OFF 1: Active Periodic mode 3: Standby Periodic mode 7: Standby Periodic mode and FixOnDemand triggered by WakeUp pin. This parameter can only be different from 0 if “Duty Cycle enable/disable” parameter is 0.
FixPeriod	Decimal, 5 digits	Interval between two fixes [s]. 0 means no periodic fix is required.
FixOnTime	Decimal, 2 digits	Number of fixes reported for each interval

Table 66. $PSTMLOWPOWERONOFF field description (continued)

Parameter	Format	Description
Ephemeris refresh	Decimal, 1 digit	Enable/Disable the refresh of ephemeris data 0: OFF, 1: ON
RTC calibration	Decimal, 1 digit	Enable/Disable the RTC calibration 0: OFF, 1: ON
NoFixCnt	Decimal, 2 digits	Time to declare fix loss [s] in HOT conditions
NoFixOff	Decimal, 2 digits	Period of off period after a fix loss [s]. 0 means the counter is not active. The fix retry will be based on FixPeriod.

Results:

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

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

Arguments:

Same description as reported in the previous table.

11.2.45 $PSTMSTANDBYENABLE

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

Synopsis:

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

Synopsis with Argument:

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

Arguments:

Table 67. $PSTMSTANDBYENABLE command field description

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

Result without parameter:

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

Result with parameter:

- In case of no errors, the *$PSTMSTANDBYENABLEOK* message is returned
- In case of errors, the error message *$PSTMSTANDBYENABLEERROR* is returned

11.2.46 $PSTMCRCCHECK

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

Synopsis:

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

Arguments:

Table 68. $PSTMCRCCHECK command field description

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

Results:

- The *$PSTMCRCCHECK* message is returned

Examples:

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

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

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

11.2.47 $PSTMSTBIN

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

Synopsis:

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

Arguments:

None.

Results:

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

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

11.2.48 $PSTMNMEAREQUEST

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

Synopsis:

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

Arguments:

Table 69. $PSTMNMEAREQUEST field description

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

Results:

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

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

11.2.49 $PSTMFORCESTANDBY

Force the platform to go in standby mode.

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

Synopsis:

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

Arguments:

Table 70. $PSTMFORCESTANDBY field description

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

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

11.2.50 $PSTMIONOPARAMS

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

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

Synopsis: when sat_type = 0

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

Synopsis: when sat_type = 1

```
$PSTMIONOPARAMS,<sat_type=1>,1,<ai0>,<ai1>,<ai2>,<Region1>,<Region2>,<Region3>,<Region4>,<Region5>*<checksum><cr><lf>
```

Arguments:

Table 71. $PSTMIONOPARAMS field description

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

11.2.51 $PSTMGALILEOGGTO

This command programs the Galileo broadcast GGTO.

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

Synopsis:

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

Arguments:

Table 72. $PSTMGALILEOGGTO field description

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

11.2.52 $PSTMGALILEODUMPGGTO

This command dumps the broadcast GGTO.

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

Synopsis:

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

Arguments:

No arguments.

Results:

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

11.2.53 $PSTMSETTHTRK

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

Synopsis:

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

Arguments:

Table 73. $PSTMCFGSETTHTRK field description

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

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

11.2.54 $PSTMSETTHPOS

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

Synopsis:

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

Arguments:

Table 74. $PSTMCFGSETTHPOS field description

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

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

11.2.55 $PSTMGETFLASHTYPE

Returns the type of the flash memory in use.

Synopsis:

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

Arguments:

None

Results:
- In case of no error the *$PSTMGETFLASHTYPE* message is sent
- In case of error the *$PSTMGETFLASHTYPEERROR* message is sent

11.2.56 $PSTMFMWUPGRADE

This command starts the Firmware Update procedure over NMEA.

Synopsis:

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

Arguments:

None

Results:

- In case of no error the *$PSTMFWUPGRADEOK* message is sent
- In case of error the *$PSTMFWUPGRADEERROR* message is sent

11.2.57 $PSTMSETUCODE

This command writes a unique code in the secondary boot flash memory partition.

The unique code can be written only once.

Synopsis:

`$PSTMSETUCODE,<unique_code>*<checksum><cr><lf>`

Arguments:

Table 75. $PSTMSETUCODE field description

Parameter	Format	Description
unique_code	Char, 32 bytes	The unique code string

Results:

- In case of no error the *$PSTMSETUCODEOK* message is sent
- In case of error the *$PSTMSETUCODEERROR* message is sent

11.2.58 $PSTMGETUCODE

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

Synopsis:

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

Arguments:

None

Results:

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

11.2.59 $PSTMSETANTSENSOPMODE

This command is used to change the Antenna Detection operating mode at run time.

This can be used to switch in manual mode to take direct action on antenna power as well as RF path. This command can be even use to switch back to automatic mode after a manual service or an anomalous condition.

Synopsis:

`$PSTMSETANTSENSOPMODE,<operating_mode><checksum><cr><lf>`

Arguments:

Table 76. $PSTMSETANTSENSOPMODE field description

Parameter	Format	Description
operating_mode	Decimal, 1 Digit	Current Antenna Detection operating mode 0 = Automatic mode 1 = Manual mode

Results:

- Antenna Sensing operating mode is set according to the command parameter. In case of no errors, the *$PSTMSETANTSENSOPMODEOK* message is returned
- In case of errors, this *$PSTMSETANTSENSOPMODEERROR* error message is returned

11.2.60 $PSTMSETANTSENSMANUAL

This command is used to act manually on the Antenna Detection at run time.

This can be used to manually force antenna power on/off, to force RF, to request the Antenna Status as well as resuming the antenna sensing process.

Note: Before to issue this command, Antenna Detection operating mode shall be switched to manual (for more info see $PSTMSETANTSENSOPMODEOK)

Synopsis:

```
$PSTMSETANTSENSMANUAL,<pwr_switch>,<rf_path>,<get_update>,<start_stop>*<ch
ecksum><cr><lf>
```

Arguments:

Table 77. $PSTMSETANTSENSMANUAL field description

Parameter	Format	Description
pwr_switch	Decimal, 1 Digit	Forces antenna power switch 0 = Antenna power off 1 = Antenna power on
rf_path	Decimal, 1 digit	Forces antenna RF path 0 = Switches on internal antenna 1 = Switches on external antenna
get_update	Decimal, 1 digit	Forces the Antenna Status message once 0 = Do not 1 = Manual mode
start_stop	Decimal, 1 digit	Force start or stop of Antenna Detection process 0 = Antenna Detection process set to active 1 = Antenna Detection process set to stop

Results:

- In case of no errors the *$PSTMSETANTSENSOPMODEOK* message is returned and if get_update is 1, the *$PSTMANTENNASTATUS* message is sent.
- In case of errors, the *$PSTMSETANTSENSOPMODEERROR* error message is returned.

11.3 ST system configuration commands

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

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

- Current configuration: it is placed in the RAM memory and it includes the current configuration of each parameter. This configuration block can be modified with the $PSTMSETPAR command. The $PSTMSAVEPAR command stores the current configuration data block into the NVM memory. At startup the current configuration block is loaded from NVM (if a stored data block is available) or it is loaded from the default one embedded in the code (factory settings).
- Default configuration: it is generally placed in the flash/rom memory. It includes the factory setting for each parameter. This configuration is used at system startup if there is no configuration data into the NVM memory.
- NVM stored configuration: it is available in the NVM backup memory as soon as the *$PSTMSAVEPAR* command is executed. It includes all parameters modified and stored by the user. At system startup the SW configuration management checks if a valid configuration block is available in the NVM backup memory. In case the stored configuration is available, it will be used for system configuration. If not available the default setting will be used.

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

11.3.1 $PSTMSETPAR

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

Synopsis:

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

Arguments:

Table 78. $PSTMSETPAR field description

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

Table 78. $PSTMSETPAR field description (continued)

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

Results:

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

Example:

Issuing the command:

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

You could have this answer:

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

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

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

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

11.3.2 $PSTMGETPAR

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

Synopsis:

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

Arguments:

Table 79. $PSTMGETPAR field description

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

Results:

- In case of no errors, *$PSTMSETPAR* message is sent
- In case of errors, the error message *$PSTMGETPARERROR* is returned

Example:

Issuing the command:

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

You could have this answer:

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

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

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

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

11.3.3 $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

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

Arguments:

None.

Results:

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

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

Example:

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

11.3.4 $PSTMRESTOREPAR

Restore the factory setting parameters. The configuration data block stored in NVM, if present, will be invalidated. Any changed parameter will be lost.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

11.3.5 $PSTMCFGPORT

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

Synopsis:

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

Arguments:

Table 80. $PSTMCFGPORT field description

Parameter	Format	Description
port_type	Decimal, 1 Digit	Select the port type: 0 = UART 1 = I2C 2 = SPI 3 = USB
protocol_type	Decimal, 1 Digit	Select the protocol type: 0 = NMEA 1 = STBin 2 = Debug 3 = RTCM
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 following message is returned
- In case of no errors, the *$PSTMCFGPORTOK* message is returned
- In case of errors, the error message *$PSTMCFGPORTERROR* is returned

11.3.6 $PSTMCFGPORT on UART

Arguments:

Table 81. $PSTMCFGPORT field description when port_type is UART

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

11.3.7 $PSTMCFGPORT on I2C

Arguments:

Table 82. $PSTMCFGPORT field description when port_type is I2C

Parameter	Format	Description
slaveaddr	Hexadecimal, 2Bytes	The I2C slave address
mode	Decimal, 1 digit	0 = Speed mode STANDARD 1 = Speed mode FAST 2 = Speed mode HS

11.3.8 $PSTMCFGPORT on SPI

Still unused, placeholder for future development.

11.3.9 $PSTMCFGPORT on USB

Arguments:

Table 83. $PSTMCFGPORT field description when port_type is USB

Parameter	Format	Description
dtefeat	Decimal, 1 digit	0 = Data Terminal Equipment is disabled. 1 = Data Terminal Equipment is enabled.
detfeat	Decimal, 1 digit	0 = Detect feature is disabled. 1 = Detect feature is enabled.
detgpioid	From 0 to 255	Detect GPIO ID (Linearly addressed)
detgpiocfg	Decimal, 1 digit	Detect GPIO configuration. Allowed values are: 0 = Default 1 = Alternate A 2 = Alternate B 3 = Alternate C

11.3.10 $PSTMCFGANTSENS

Configure the Antenna Sensing.

Synopsis:

```
$PSTMCFGANTSENS,<sens_type>,<periodicmsg>,<switchcap>,<switchgpioid
>,<switchgpiocfg>,<par_1>,<par_2>,...,<par_N>*<checksum><cr><lf>
```

Arguments:

Table 84. $PSTMCFGANTSENS field description

Parameter	Format	Description
sens_type	Decimal, 1 Digit	Select the port type: 0 = OFF 1 = RF 2 = ADC 3 = GPIO
periodicmsg	Decimal, 1 digit	0 = Periodic antenna related messages are disabled. 1 = Periodic antenna related messages are enabled.
switchcap	Decimal, 1 digit	0 = Antenna switching is disabled. 1 = Antenna switching is enabled.
switchgpioid	From 0 to 255	ANT_SWITCH_CTRL port ID (Linearly addressed): currently unused.
switchgpiocfg	Decimal, 1 digit	ANT_SWITCH_CTRL configuration: 0 = Default, 1 = Alternate A 2 = Alternate B 3 = Alternate C
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 following message is returned
- In case of no errors, the *$PSTMCFGANTSENSOK* message is returned
- In case of errors, the error message *$PSTMCFGANTSENSERROR* is returned

11.3.11 $PSTMCFGANTSENS on RF

No additional parameters are required when sensing type is RF.

11.3.12 $PSTMCFGANTSENS on ADC

Arguments:

Table 85. $PSTMCFGANTSENS field description on sensing on ADC

Parameter	Format	Description
chid	Any combination with two bits high	ADC channel input mask. The bit position represents the ADC channel. The selected channel must have the corresponding bit enabled in the mask. Any combination of couples of channels is allowed only for STA8090EXG. For all other packages default value, must be used: 0x3.
clkdiv	From 0 to 255	Clk divisor factor to configure ADC sampling rate.
min_thr	Integer < 63	Minimum Threshold value (mV).
max_thr	Integer > 210	Maximum Threshold value (mV).

11.3.13 $PSTMCFGANTSENS on GPIO

Arguments:

Table 86. $PSTMCFGANTSENS field description on sensing on GPIO

Parameter	Format	Description
digon_gpio_id	From 0 to 255	ANT_DIG_ON port ID (Linearly addressed): currently unused.
digon_gpio_cfg	Decimal, 1 digit	ANT_DIG_ON port configuration: 0 = Default, 1 = Alternate A 2 = Alternate B 3 = Alternate C
dig_short_gpio_id	From 0 to 255	EXT_ANT_DIG_SHORT port ID (Linearly addressed): currently unused.
dig_short_gpio_cfg	Decimal, 1 digit	EXT_ANT_DIG_SHORT port configuration: 0 = Default, 1= Alternate A 2 = Alternate B 3 = Alternate C
dig_open_gpio_id	From 0 to 255	EXT_ANT_DIG_OPEN port ID (Linearly addressed): currently unused.
dig_open_gpio_cfg	Decimal, 1 digit	EXT_ANT_DIG_OPEN port configuration: 0 = Default, 1 = Alternate A 2 = Alternate B 3 = Alternate C

11.3.14 $PSTMCFGANTSENS on OFF

Arguments:

No arguments

11.3.15 $PSTMCFGCLKS

Configure a clock source.

Synopsis:

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

Arguments:

Table 87. $PSTMCFGCLKS field description

Parameter	Format	Description
clkid	Decimal, 1 digit	Clock identifier: 0 = CPU-clk … open to future development
clksrc	Decimal, 1 digit	Clock source selector: 0 = 192f0 1 = TCXO 2 = RTC 3 = RING Oscillator
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 following message is returned
- In case of no errors, the *$PSTMCFGCLKSOK* message is returned
- In case of errors, the error message *$PSTMCFGCLKSERROR* is returned

11.3.16 $PSTMCFGMSGL

Configure the Message List.

Synopsis:

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

Arguments:

Table 88. $PSTMCFGMSGL field description

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA list 0 1 = NMEA list 1 2 = NMEA list 2 3 = NMEA on Debug list 0 4 = NMEA on Debug list 1 5 = NMEA on Debug list 2 6 = STBin
rate	From 0 to 255	Message list rate scaler
listlow	Hexadecimal, 8 digits	Please refer to CDB 201 table in case of NMEA or 240 in case of STBin
listhigh	Hexadecimal, 8 digits	Please refer to CDB 228 table in case of NMEA or 241 in case of STBin

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

11.3.17 $PSTMCFGGNSS

Configure the GNSS Algorithm.

Synopsis:

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

Arguments:

Table 89. $PSTMCFGGNSS field description

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

Table 89. $PSTMCFGGNSS field description (continued)

Parameter	Format	Description
NCOmin	From 0 to 255	NCO range minimum value
NCOmax	From 0 to 255	NCO range maximum value

Results:

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

11.3.18 $PSTMCFGSBAS

Configure the SBAS Algorithm.

Synopsis:

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

Arguments:

Table 90. $PSTMCFGSBAS field description

Parameter	Format	Description
enengine	Decimal, 1 digit	Enable SBAS engine switch: 0 = Disabled 1 = Enabled
enreport	Decimal, 1 digit	Enable satellite report in GSV message: 0 = Disabled 1 = Enabled
enautosearch	Decimal, 1 digit	Enable autosearch switch: 0 = Disabled 1 = Enabled
autosearchmask	Hexadecimal, 8 digits	Allow enabling/disabling the SBAS satellites to be searched by the auto search procedure
dectimeout	From 0 to 255	The time the autosearch waits to try to decode the current PRN Note: expressed in seconds. This value is ignored if `enautosearch is 0`

Table 90. $PSTMCFGSBAS field description (continued)

Parameter	Format	Description
diftimeout	From 0 to 255	The time the autosearch waits before changing 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 starting 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 following message is returned
- In case of no errors, the *$PSTMCFGSBASOK* message is returned
- In case of errors, the error message *$PSTMCFGSBASERROR* is returned

Parameters when auto-search is enabled.

Table 91. $PSTMCFGSBAS field description when auto-search is enabled

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

11.3.19 $PSTMCFGPPSGEN

Configure the PPS with general settings.

Synopsis:

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

Arguments:

Table 92. $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 following message is returned
- In case of no errors, the *$PSTMCFGPPSGENOK* message is returned
- In case of errors, the error message *$PSTMCFGPPSGENERROR* is returned

11.3.20 $PSTMCFGPPSSAT

Configure the PPS with satellite related configurations settings.

Synopsis:

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

Arguments:

Table 93. $PSTMCFGPPSSAT field description

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

Results:

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

11.3.21 $PSTMCFGPPSPUL

Configure the PPS with pulse related settings.

Synopsis:

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

Arguments:

Table 94. $PSTMCFGPPSPUL field description

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

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

11.3.22 $PSTMCFGPOSHOLD

Configure the Position hold.

Synopsis:

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

Arguments:

Table 95. $PSTMCFGPOSHOLD field description

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

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

11.3.23 $PSTMCFGTRAIM

Configure the PPS with general settings.

Synopsis:

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

Arguments:

Table 96. $PSTMCFGTRAIM field description

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

Results:

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

11.3.24 $PSTMCFGSATCOMP

Configure the PPS with general settings.

Synopsis:

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

Arguments:

Table 97. $PSTMCFGSATCOMP field description

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

Results:

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

11.3.25 $PSTMCFGLPA

Configure the Low Power Algorithm.

Synopsis:

```
$PSTMCFGLPA,<en_lpa>,<feat>,<fix_period>,<fix_on_time>,<no_fix_cnt>,<no_fi
x_cnt2>,<no_fix_off>,<adaptive_feat>,<adaptive_duty_cicle>,<ehpe_th>,<num_
of_sat>,<duty_off>,<const_type>*<checksum><cr><lf>
```

Arguments:

Table 98. $PSTMCFGLPA field description

Parameter	Format	Description
en_lpa	unsigned, 1 bytes	Enable Low Power Algorithm 0 = LPA Disabled 1 = LPA Enabled.
feat	unsigned, 1 bytes	Low Power Algorithm feature 0 = Periodic mode disabled 1 = Active Periodic mode 2 = RESERVED 3 = Standby Periodic mode
fix_period	From 0 to 86400	Fix period in seconds. 0 means the Fix will be given only on WAKEUP pin activation. Value 0 is only valid in Standby Periodic mode. Default is 10.
fix_on_time	unsigned, 2 bytes	Number of fix reported every Fix wakeup. Default is 1
no_fix_cnt	unsigned, 2 bytes	Number of no-fixes in hot conditions, before to signal a fix loss event. Default is 8
no_fix_cnt2	unsigned, 2 bytes	Number of no-fixes in non-hot conditions, before signaling a fix loss event. Default is 60
no_fix_off	unsigned, 2 bytes	Off duration time after a fix loss event. Default is 180
adaptive_feat	unsigned, 1 bytes	Enable disable adaptive multi-constellation algorithm. 0 = Adaptive Algorithm Disabled 1 = Adaptive Algorithm Enabled Default is 0

Table 98. $PSTMCFGLPA field description (continued)

Parameter	Format	Description
adaptive_duty_cicle	unsigned, 1 bytes	Enable disable trimming of correlation time for each cycle. 0 = Adaptive Duty Cycle Disabled 1 = Adaptive Duty Cycle Enabled Default is 0
ehpe_th	unsigned, 1 bytes	EHPE average threshold. Default is 15
num_of_sat	unsigned, 1 bytes 0 to 32	Number of satellite used in Adaptive mode (first N with higher elevation) Default is 9
duty_off	unsigned, 2 bytes 100 to 740	Duty cycle OFF period length in ms; Default is 700
const_type	unsigned, 1 bytes	RESERVED, set it as 0

Results:

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

11.3.26 $PSTMCFGLPS

Configure each pair PowerDomain-PowerState the system has to support.

Synopsis:

```
$PSTMCFGLPS,<numoflps>,<pd1>,<ps1>,<voltage1>,<pd2>,<ps2>,<voltage2>,...*<
checksum><cr><lf>
```

Arguments:

Table 99. $PSTMCFGLPS field description

Parameter	Format	Description
numoflps	Decimal	The number of pair Power State – Power Domain to be configured. Note that next parameters will be repeated ‘numodlps’ times.
pd	Decimal, 1 digit	The Power Domain ID to configure: 0 = SMPS 1 = LDO1 2 = LDO2 3 = BKLDO

Table 99. $PSTMCFGLPS field description (continued)

Parameter	Format	Description
ps	Decimal, 1 digit	The Power State to configure 0 = Low Frequency; 1 = High Frequency
voltage	Decimal, 1 digit	The pair voltage value which will be set 0 = OFF 1 = 1.0 V (means 1.8V if LDO is configured as 1.8 V, means ON if domain has ON/OFF only) 2 = 1.1 V (means 1.8V if LDO is configured as 1.8 V. RESERVED if domain has ON/OFF only) 3 = 1.2 V (means 1.8V if LDO is configured as 1.8 V. RESERVED if domain has ON/OFF only)

Results:
- One or more parameters of swconfig are set according to the command parameters. In case of no errors, the following message is returned
- In case of no errors, the *$PSTMCFGLPSOK* message is returned
- In case of errors, the error message *$PSTMCFGLPSERROR* is returned

11.3.27 $PSTMCFGAGPS

Configure the Assisted GPS.

Synopsis:

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

Arguments:

Table 100. $PSTMCFGAGPS field description

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

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

11.3.28 $PSTMCFGAJM

Configure the Anti-Jamming Algorithm.

Synopsis:

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

Arguments:

Table 101. $PSTMCFGAJM field description

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

Results:

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

11.3.29 $PSTMCFGODO

Configure the Odometer.

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

Synopsis:

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

Arguments:

Table 102. $PSTMCFGODO field description

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

Results:

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

11.3.30 $PSTMCFGLOG

Configure the Data Logging.

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

Synopsis:

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

Arguments:

Table 103. $PSTMCFGLOG field description

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

Results:

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

11.3.31 $PSTMCFGGEOFENCE

Allows to configure Geofencing feature enabling circles and choosing tolerance.

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

Synopsis:

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

Arguments:

Table 104. $PSTMCFGGEOFENCE field description

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

Results:

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

11.3.32 $PSTMCFGGEOCIR

Allows to configure a circle of geofencing feature.

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

Synopsis:

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

Arguments:

Table 105. $PSTMCFGGEOCIR field description

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

Table 105. $PSTMCFGGEOCIR field description

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

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

11.3.33 $PSTMCFGCONST

Allow enable/disable all the GNSS constellations.

Synopsis:

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

Arguments:

Table 106. $PSTMCFGCONST field description

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

Results:

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

11.3.34 $PSTMCFGTHGNSS

Configures threshold related to GNSS algorithm.

Synopsis:

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

Arguments:

Table 107. $PSTMCFGTHGNSS field description

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

Results:

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

11.3.35 $PSTMCFGTDATA

Configures data and time related parameters.

Synopsis:

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

Arguments:

Table 108. $PSTMCFGTDATA field description

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

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

11.3.36 $PSTMCFGASIOS

This command is used to configure all the IOs related to Antenna Detection feature at once.

The command accepts 6, 9 or 12 parameters otherwise it returns error.

Synopsis:

```
$PSTMCFGASIOS,<pwr_id>,<pwr_mode>,<pwr_level>,<rf_ch1_id>,<rf_ch1_m
ode>,<rf_ch1_level>,<rf_ch2_short_id>,<rf_ch2_short_mode>,<rf_ch2_s
hort_level>,<open_id>,<open_mode>,<open_level>*<checksum><cr><lf>
```

Arguments:

Table 109. $PSTMCFGAIOS field description

Parameter	Format	Description
pwr_id	Decimal	Antenna power switch identifier -1 = Unchanged 0…63 = Valid ID
pwr_mode	Decimal	Antenna power switch mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3
rf_ch1_id	Decimal	RF path channel 1 switch identifier -1 = Unchanged 0…63 = Valid ID
rf_ch1_mode	Decimal	RF path channel 1 switch mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3
rf_ch1_level	Decimal	RF path channel 1 switch active level -1 = Unchanged 0 = Low 1 = High
rf_ch2_short_id	Decimal	RF path channel 2 switch or GPIO short identifier -1 = Unchanged 0…63 = Valid ID

Table 109. $PSTMCFGAIOS field description (continued)

Parameter	Format	Description
rf_ch2_short_mode	Decimal	RF path channel 2 switch or GPIO short mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3
rf_ch2_short_level	Decimal	RF path channel 2 switch or GPIO short active level -1 = Unchanged 0 = Low 1 = High
open_id	Decimal	GPIO open identifier -1 = Unchanged 0…63 = Valid ID
open_mode	Decimal	GPIO open mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3
open_level	Decimal	GPIO open active level -1 = Unchanged 0= Low 1 = High

Results:

- In case of no errors the message *$PSTMCFGASIOSOK* is returned
- In case of errors, the error message *$PSTMCFGASIOSERROR* is returned

11.3.37 $PSTMCFGASPARAMS

This command is used to configure all the parameters related to Antenna Detection feature at once.

This command acts on CDB-ID 226, CDB-ID 243, CDB-ID 244 and CDB-ID 252. The changes will take places only issuing a $PSTMSAVEPAR command and rebooting the ST Teseo III (e.g. issuing $PSTMSRR). Once saved, configurations are permanent and remain applied even after a power cycle.

T*he command accepts 8 or 12 parameters otherwise it returns error.*

Synopsis:

```
$PSTMCFGASPARAMS,<sens_type>,<per_msg>,<pwr_swtbl>,<pwr_switch>,<rf_swtbl>,<rf_dual>,<rf_path>,<op_mode>,<adc_ch_mask>,<adc_clk_div>,<adc_min_th>,<adc_max_th>*<checksum><cr><lf>
```

Arguments:

Table 110. $PSTMCFGASPARAMS field description

Parameter	Format	Description
sens_type	Decimal	Antenna Detection sensing type -1 = Unchanged 0 = Off 1 = RF type 2 = ADC type 3 = GPIO type
per_msg	Decimal	Antenna status periodic message -1 = Unchanged 0 = Periodic message disabled 1 = Periodic message enabled
pwr_swtbl	Decimal	Antenna Detection power switch capability -1 = Unchanged 0 = HW do not has power switch capability 1 = HW has power switch capability
pwr_switch	Decimal	Antenna initial power switch status -1 = Unchanged 0 = Antenna power is ON 1 = Antenna power is OFF
rf_swtbl	Decimal	Antenna Detection RF switch capability -1 = Unchanged 0 = HW do not has RF switch capability 1 = HW has RF switch capability
rf_dual	Decimal	Antenna RF dual mode -1 = Unchanged 0 = Single mode 1 = Dual mode 2 = Auto
rf_path	Decimal	Antenna initial RF path -1 = Unchanged 0 = External antenna 1 = Internal antenna
op_mode	Decimal	Antenna Detection initial operating mode -1 = Unchanged 0 = Automatic mode 1 = Manual mode
adc_ch_mask	Decimal	ADC channel used by Antenna Detection -1 = Unchanged 0…255 = Accepted values

Table 110. $PSTMCFGASPARAMS field description (continued)

Parameter	Format	Description
adc_clk_div	Decimal	ADC clock divider -1 = Unchanged 0 = Invalid 1…255 = Accepted values
adc_min_th	Decimal	ADC minimum threshold -1 = Unchanged 0…1023 = Accepted values
adc_max_th	Decimal	ADC maximum threshold -1 = Unchanged 0…1023 = Accepted values

For additional detail about arguments see CDB-ID 226, CDB-ID 243, CDB-ID 244 and CDB-ID 252.

Results:

- In case of no errors the message *$PSTMCFGASPARAMSOK* is returned
- In case of errors, the error message *$PSTMCFGASPARAMSERROR* is returned

11.3.38 $PSTMCFGASEVENTS

This command is used to configure all the events related to Antenna Detection feature at once.

This command acts on CDB-ID 283. The changes will take places only issuing a $PSTMSAVEPAR command and rebooting (e.g. issuing $PSTMSRR). Once saved, configurations are permanent and remains applied even after a power cycle.

Synopsis:

```
$PSTMCFGASEVENTS,<ant_swi_id>,<ant_swi_mode>,<ant_swi_level,<ant_st
a_id>,<ant_sta_mode>,<ant_sta_level>,<*<checksum><cr><lf>
```

Arguments

Table 111. $PSTMCFGASEVENTS field description

Parameter	Format	Description
ant_swi_id	Decimal	Antenna switch event GPIO identifier -1 = Unchanged 0…63 = Valid ID 255 = Event disabled
ant_swi_mode	Decimal	Antenna switch event GPIO mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3

Table 111. $PSTMCFGASEVENTS field description (continued)

Parameter	Format	Description
ant_swi_level	Decimal	Antenna switch event GPIO active level -1 = Unchanged 0 = Low 1 = High
ant_sta_id	Decimal	Antenna status change event GPIO identifier -1 = Unchanged 0…63 = Valid ID 255 = Event disabled
ant_sta_mode	Decimal	Antenna status change event GPIO mode -1 = Unchanged 0 = Alternative function 0 1 = Alternative function 1 2 = Alternative function 2 3 = Alternative function 3
ant_sta_level	Decimal	Antenna status change event GPIO active level -1 = Unchanged 0 = Low 1 = High

Results:
- In case of no errors the message *$PSTMCFGASEVENTSOK* is returned
- In case of errors, the error message *$PSTMCFGASEVENTSERROR* is returned

11.4 Datalogging NMEA commands

11.4.1 $PSTMLOGCREATE

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

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

Synopsis:

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

Arguments:

Table 112. $PSTMLOGCREATE field description

Parameter	Format	Description
cfg	Hexadecimal, 3 Digits	[24: 8]: gpio_id; [7:6]: gpio_af; [3:2]: … [1:1]: enable buffer-full GPIO alarm; [0:0]: enable-circular-buffer;
min-rate(1)	Unsigned	The rate to records a new entry
min-speed(2)	Unsigned	If the current speed is greater than the threshold then the position is logged (0 = not set)
min-position(3)	Unsigned	If the 3D position difference is greater than the threshold then the position is logged (0 = not set)
log-mask	Decimal, 1 digit	Which dataset is logged? See *Table 9: Data-log types description*

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

Results:

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

11.4.2 $PSTMLOGSTART

This command starts or restarts the current data logging.

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

Synopsis:

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

Arguments:

No arguments

Results:

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

11.4.3 $PSTMLOGSTOP

This command stops the data logging.

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

Synopsis:

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

Arguments:

No arguments

Results:

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

11.4.4 $PSTMLOGERASE

This command erases the data log.

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

Synopsis:

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

Arguments:

No arguments

Results:

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

11.4.5 $PSTMLOGREQSTATUS

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

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

Synopsis:

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

Arguments:

No arguments

Results:

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

11.4.6 $PSTMLOGREQQUERY

This command triggers a query to fetch the data-log entries.

Host can specify the number of entries and from which entry the ST GNSS has to begin sending data.

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

Synopsis:

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

Arguments:

Table 113. $PSTMLOGREQQUERY field description

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

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

11.5 Geofencing NMEA commands

11.5.1 $PSTMGEOFENCECFG

This command configures the Geofence subsystem.

Each $PSTMGEOFENCECFG command can configure only one circle, if more circles are needed the Host has to raise more $PSTMGEOFENCECFG commands.

Geofencing subsystem is able to manage only one GPIO, therefore when more than a circle is configured to trigger a GPIO alarm, all the configurations have to specify the same GPIO with the same GPIO configuration.

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

Synopsis:

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

Arguments:

Table 114. $PSTMGEOFENCECFG field description

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

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

11.5.2 $PSTMGEOFENCEREQ

This command forces the GNSS Teseo III to send a *$PSTMGEOFENCESTATUS* message to know the internal Geofence subsystem status.

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

Synopsis:

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

Arguments:

No Arguments

Results:
- In case of no errors, the Teseo III replies with the *$PSTMGEOFENCESTATUS* message
- In case of errors, the error message *$PSTMGEOFENCEREQERROR* is returned

11.6 Odometer NMEA commands

11.6.1 $PSTMODOSTART

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

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

Synopsis:

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

Arguments:

No arguments.

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

11.6.2 $PSTMODOSTOP

This command stops the Odometer subsystem.

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

Synopsis:

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

Arguments:

No arguments

Results:

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

11.6.3 $PSTMODORESET

This command resets the Odometer subsystem.

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

Synopsis:

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

Arguments:

Table 115. $PSTMODORESET field description

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

Results:

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

11.6.4 $PSTMODOREQ

This command requires the Odometer status.

The Odometer must be enabled otherwise the request will be rejected with error.

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

Synopsis:

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

Arguments:

No arguments

Results:

- In case of no errors, this replies with a *$PSTMODO* message.
- In case of errors, the error message *$PSTMODOREQERROR* is returned

11.7 Autonomous AGNSS NMEA commands

11.7.1 $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 116. $PSTMSTAGPSPONOFF field description

Parameter	Format	Description
param	Decimal, 1 digits	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

11.7.2 $PSTMSTAGPSINVALIDATE

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

Synopsis:

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

Arguments:

Table 117. $PSTMSTAGPSINVALIDATE field description

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

Results:

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

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

When operation is complete, STAGPS subsystem sends a message:

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

11.7.3 $PSTMGETAGPSSTATUS

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

Synopsis:

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

Arguments:

None

Results:

The system sends back the STAGPS™ status in the *$PSTMAGPSSTATUS* message.

11.7.4 $PSTMSTAGPSSETCONSTMASK

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

Synopsis:

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

Arguments:

Table 118. $PSTMSTAGPSSETCONSTMASK field description

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

Results:

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

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

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

11.8 Predictive AGNSS NMEA commands

11.8.1 $PSTMSTAGPSSEEDBEGIN

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

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

Synopsis:

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

Arguments:

Table 119. $PSTMSTAGPSSEEDBEGIN field description

Parameter	Description
<Constellation>	1 = GPS 2 = GLONASS 3 = GALILEO 4 = BEIDOU
<Leap seconds>	Current number of leap seconds
<Next Leap Time>	Next GPS time for leap seconds change
<Next Leap>	Next number of leap seconds
<Ref Time>	sGANSS Time Model Reference Time
<T0>	sT_{A0}
<T1>	sT_{A1}
<T2>	sT_{A2}
<GNSS to ID>	GNSS to ID
<Week Number>	Week number
<DeltaT>	Delta T (BEIDOU only)
<Seed 1st block string>	22 Byte seed first block string (each byte is coded on 2 ASCII chars so this field will be 44 ASCII chars)

Results:

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

11.8.2 $PSTMSTAGPSBLKTYPE

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

Synopsis:

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

Arguments:

Table 120. $PSTMSTAGPSBLKTYPE field description

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

Results:

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

11.8.3 $PSTMSTAGPSSLOTFRQ

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

Synopsis:

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

Arguments:

Table 121. $PSTMSTAGPSSLOTFRQ field description

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

Results:

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

11.8.4 $PSTMSTAGPSSEEDPKT

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

Synopsis:

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

Arguments:

Table 122. $PSTMSTAGPSSEEDPKT field description

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

Results:

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

11.8.5 $PSTMSTAGPSSEEDPROP

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

Synopsis:

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

Arguments:

None.

Results:

After the command the device returns the message *$PSTMSTAGPSSEEDPROPOK*

11.9 Real Time AGNSS NMEA commands

11.9.1 $PSTMSTAGPS8PASSGEN

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

Synopsis:

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

Arguments:

Table 123. $PSTMSTAGPS8PASSGEN field description

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

Results:

ST GNSS Teseo III returns the password in the message *$PSTMSTAGPS8PASSRTN*.

12 Messages

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

12.1 Standard NMEA messages list

Table 124. Standard NMEA messages list

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

12.2 ST NMEA messages list

Table 125. ST NMEA messages list

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

Table 125. ST NMEA messages list (continued)

Syntax	Default	Description
$PSTMTG	OFF	ST: Time and Number of used Satellites
$PSTMTS	OFF	ST: Tracked Satellite Data
$PSTMKFCOV	OFF	ST: Standard Deviation and Covariance
$PSTMAGPS[(1)]	OFF	ST: STAGPS predicted ephemeris information
$PSTMNOTCHSTATUS	OFF	ST: Reports the Notch filter status.
$PSTMCPU	ON	ST: Reports the CPU usage and CPU speed setting.
$PSTMPOSNHOLD	OFF	ST: Reports the status and position of Position Hold.
$PSTMPPSDATA	OFF	ST: Reports the Pulse Per Second data.
$PSTMTRAIMSTATUS	OFF	ST: Reports the TRAIM status data.
$PSTMTRAIMUSED	OFF	ST: Reports the satellites used for timing correction.
$PSTMTRAIMRES	OFF	ST: Reports the residuals for used satellites.
$PSTMTRAIMREMOVED	OFF	ST: Reports the satellites removed by timing correction algorithm.
$PSTMLOWPOWERDATA	OFF	ST: Reports the status of low power algorithm
$PSTMGALILEOGGTO	OFF	ST: Reports the Galileo broadcast GGTO

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

12.3 Changing standard NMEA messages format

By default, Standard NMEA Messages are compliant with the “NMEA 0183” Standard Rev. 3.1 dated January 2002. To change format to Rev. 4.10, issued from the “National Marine Electronics Association” in the August 2012 some system configuration commands should be issued.
It is required to change the value of Configuration Data Block 122 from the default value to “4”.

```
$PSTMSETPAR,1122,4
$PSTMSAVEPAR
$PSTMSRR
```

It is possible to go back to default configuration restoring parameters or setting CDB 122 as 0xC

```
$PSTMSETPAR,1122,C
$PSTMSAVEPAR
$PSTMSRR
```

12.4 Preliminary notes about satellites’ PRN ranges

The satellite PRN is an ID used to identify satellites. In NMEA 0183 Rev 3.1, PRN was not described for new constellation. Starting from Rev 4.10 more constraints about this info have been added. Thus, PRN ranges depend on the NMEA revision in use.

Table 126. Satellite PRNs for each NMEA version

	GPS	SBAS	GLONASS	BAIDEU	QZSS	GALILEO
NMEA 3.10	from 1 to 32	from 33 to 51	from 65 to 92	from 141 to 172	from 183 to 197	from 301 to 330
NMEA 4.10	from 1 to 32	from 33 to 64	from 65 to 99	from 1 to 32	from 1 to 32	from 1 to 36

12.5 Standard NMEA messages specification

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

12.5.1 $--GGA

Global Positioning System Fixed data

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 127. $--GGA message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode. GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1 Hz. Note that for Rev 4.10 this field is empty in case of invalid value

Table 127. $--GGA message field description (continued)

Parameter	Format	Description
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
N/S	“N” or “S”	Latitude direction: North or South Note that for Rev 4.10 this field is empty in case of invalid value
Long	DDDMM.MMMMM	Longitude as degrees: DDD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
E/W	“E” or “W”	Longitude direction: East or West Note that for Rev 4.10 this field is empty in case of invalid value
GPSQual	Decimal, 1digit	0 = Fix not available or invalid 1 = GPS, SPS Mode, fix valid 2 = Differential GPS, SPS Mode, fix valid 6 = Estimated (dead reckoning) mode
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	x.x, variable length field	Horizontal Dilution of Precision, max: 99.0
Alt	x.x, variable length field	Height above mean sea level, max: 100000m
AltVal	“M”	Reference Unit for Altitude (“M” = meters)
GeoSep	Decimal, 4 digits	Geoidal Separation measure in “M” = meters
GeoVal	“M”	Reference Unit for GeoSep (“M” = meters)
DGPSAge	Empty	Not supported
DGPSRef	Empty	Not supported
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGGA,183417.000,04814.03970,N,01128.52205,E,0,00,99.0,495.53,M,47.6,M*53
```

12.5.2 $--GLL

Geographic Positioning Latitude / Longitude

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 128. $--GLL message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
N/S	"N" or "S"	Latitude direction: North or South Note that for Rev 4.10 this field is empty in case of invalid value
Long	DDMM.MMMMM	Longitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
E/W	"E" or "W"	Longitude direction: East or West Note that for Rev 4.10 this field is empty in case of invalid value
Timestamp	hhmmss.sss	UTC Time of GGL Sample, example: 160836 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Status	"A" or "V"	Validity of Data "A" = valid, "V" = invalid
Mode indicator	"D", "A", "N" or "E"	Positioning system Mode Indicator: "D" = Differential mode "A" = Autonomous mode "N" = data not valid "E" = Estimated (dead reckoning) mode
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

12.5.3 $--GSA

GNSS DOP and Active Satellites. Satellites from different constellations are sent on separate messages.

In case of multi-constellation mode, the talker ID is always GN. If NMEA is set as Rev 3.1, it is possible to force the talker ID as GN also acting on CDB-ID 200.

When NMEA is set as Rev 4.10 (see *Section 12.3*) the talker ID could not be forced and is managed internally to be compliant with the standard.

NMEA message list bitmask (64 bits): 0000 0000 0000 0004

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 129. $--GSA message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Mode	1 character	M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to automatically switch 2d/3D
CurrentMode	Decimal, 1 digit	Current Mode: 1 = Fix not available or invalid 2 = GPS, SPS Mode, fix valid 3 = Differential GPS, SPS Mode, fix valid
SatPRN(1 to 12)	Decimal, 2 or 3 digits	Satellites list used for positioning. See Chapter *12.4* for more info about available values.
PDOP	.x, variable length field	Position Dilution of Precision, max: 99.0
HDOP	x.x, variable length field	Horizontal Dilution of Precision, max: 99.0
VDOP	x.x, variable length field	Vertical Dilution of Precision, max: 99.0

Table 129. $--GSA message field description (continued)

Parameter	Format	Description
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BEIDOU 5 = QZSS 6 = IRNSS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNGSA,A,3,23,03,22,09,01,19,17,06,31,11,,,1.1,0.6,0.9,1*3E
$GNGSA,A,3,67,66,81,65,88,75,82,74,,,,, 1.1,0.6,0.9,2*3D
$GNGSA,A,3,03,05,22,08,30,16,12,,,,,, 1.1,0.6,0.9,3*32
```

12.5.4 $--GSV

GNSS Satellites in View.

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

Prior to NMEA Revision 3.1 it is possible to force the “GN” talker ID acting on CDB-ID 200 Bit 19. In such case a single set of messages is sent.

With NMEA Rev 4.10 the “GN” talker ID is forbidden in order to be compliant with the standard. Thus the module will print a set of messages for each constellation.

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 130. $--GSV message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
GSVAmount	Decimal, 1 digit	Total amount of GSV messages, max. 8
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 32
SatxPRN	Decimal, 2 digits	Satellites list used for positioning. See *Section 12.4* for more info about available values.

Table 130. $--GSV message field description (continued)

Parameter	Format	Description
SatxElev	Decimal, 2 digits	Elevation of satellite x in Degree, 0 … 90
SatxAzim	Decimal, 3 digits	Azimuth of satellite x in degree, ref. “North”, 000 … 359
SatxCN0	Decimal, 2 digits	Carrier to Noise Ratio for satellite x in dB, 00 … 99
SignalID	Decimal, 1 digits	An identifier to indicate the signal in use. Currently it is 1 for GPS, GLONASS, 2 for BEIDOU, QZSS, 6 for GALILEO 7 for IRNSS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GPGSV,3,1,09,30,68,039,49,05,61,266,50,28,52,137,47,07,38,052,48,01*5C
$GPGSV,3,2,09,13,37,301,45,09,17,105,43,15,07,297,40,08,06,056,41,01*56
$GPGSV,3,3,09,20,,,41,,,,,,,,,,,,,01*5A
$GLGSV,2,1,06,68,86,031,43,78,78,013,46,79,51,226,43,69,33,325,38,01*43
$GLGSV,2,2,06,67,33,139,41,77,26,035,36,,,,,,,,,01*46
$GAGSV,2,1,05,08,76,129,44,02,65,057,46,30,56,205,45,07,48,311,44,06*4F
$GAGSV,2,2,05,03,22,129,40,,,,,,,,,,,,,06*7D
```

12.5.5 $--RMC

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

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 131. $--RMC message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode IR: If system works in IRNSS only mode. GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. Note that for Rev 4.10 this field is empty in case of invalid value
Status	“A” or “V”	Teseo 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 as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
N/S	“N” or “S”	Latitude direction: North or South Note that for Rev 4.10 this field is empty in case of invalid value
Long	DDDMM.MMMMM	Longitude as degrees: DD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
E/W	“E” or “W”	Longitude direction: East or West Note that for Rev 4.10 this field is empty in case of invalid value
Speed	x.x, variable length field	Speed over ground in knots
Trackgood	x.x, variable length field	Course made good, max. 999.9
Date	Decimal, 6 digits	Date of Fix: ddmmyy

Table 131. $--RMC message field description (continued)

Parameter	Format	Description
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	“E” or “W”	Magnetic Variation Direction
Mode	“D”, “A”, “N” or “E”	Positioning system Mode Indicator: “D” = Differential mode “A” = Autonomous mode “N” = data not valid “E” = Estimated (dead reckoning) mode
Nav_status	“S”, “C”, “U” or “V”	Navigational status indicator: “S” = Safe “C” = Caution “U” = Unsafe “V” = Not valid
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

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

or

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

12.5.6 $--VTG

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

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 132. $--VTG message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
TMGT	ddd.d in degrees	Track in reference to “true” earth poles
T		Indicates “terrestrial”
TMGM	ddd.d in degrees	Track in reference to “magnetic” earth poles
M		Indicates “magnetic”
SoGN	ddd.d in knots	Speed over Ground in knots
N		Indicates “knots”
SoGK	ddd.d in km/h	Speed over Ground in kilometers per hour
K		Indicates “kilometres”
D	char	Mode indicator: A = Autonomous mode D= Differential mode E= Estimated mode
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

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

12.5.7 $--ZDA

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 133. $--ZDA message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. Note that for Rev 4.10 this field is empty in case of invalid value
Day	Decimal, 2 digits	Day of month (01 to 31)
Month	Decimal, 2 digits	Month (01 to 12)
Year	Decimal, 4 digits	Year (1994 - …)
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

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

12.5.8 $--GST

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 134. $--GST message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. Note that for Rev 4.10 this field is empty in case of invalid value
EHPE	dd.d in m	Equivalent Horizontal Position Error
Semi-major	dd.d in m	Standard deviation (meters) of semi-major axis of error ellipse
Semi-minor	dd.d in m	Standard deviation (meters) of semi-minor axis of error ellipse
Angle	dd.d in degree	Orientation of semi-major axis of error ellipse (true north degrees)
LatErr	dd.d in m	Standard deviation (meters) of latitude error
LonErr	dd.d in m	Standard deviation (meters) of longitude error
AltErr	dd.d in m	Standard deviation (meters) of altitude error
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

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

or

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

12.5.9 $--GBS

GNSS Satellite Fault Detection

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$GPGBS,<Timestamp>,<LatErr>,<LonErr>,<AltErr>,<SatPRN>,<Prob>,
```

```
<Res>,<StdDev>*<checksum><cr><lf>
```

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 135. $--GBS message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. Note that for Rev 4.10 this field is empty in case of invalid value
LatErr	dd.d in m	Standard deviation (meters) of latitude error
LonErr	dd.d in m	Standard deviation (meters) of longitude error
AltErr	dd.d in m	Standard deviation (meters) of altitude error
SatPRN	Decimal, 2 digits	PRN Number of most likely failed satellite. This satellite is excluded by RAIM or FDE algorithm.
Prob	Empty	Probability of missed detection for most likely failed satellite Not supported
Res	dd.d in m	Range residual of most likely failed satellite
StdDev	Empty	Standard Deviation of bias estimate Not supported
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = GALILEO 4 = BEIDOU 5 = QZSS
SignalID	Decimal, 1 digits	An identifier to indicate the signal in use. Currently it is 1 for GPS, GLONASS, 2 for BEIDOU and QZSS 6 for GALILEO
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

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

12.5.10 $--GNS

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

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 136. $--GNS message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Timestamp	hhmmss.sss	UTC Time of GPS Sample: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .sss: decimal fraction of seconds (Variable length) Note that decimal fraction assumes non zero values when the fix rate is bigger than 1Hz. Note that for Rev 4.10 this field is empty in case of invalid value
Lat	DDMM.MMMMM	Latitude as degrees: DD: Degree (Fixed two digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
N/S	“N” or “S”	Latitude direction: North or South Note that for Rev 4.10 this field is empty in case of invalid value

Table 136. $--GNS message field description (continued)

Parameter	Format	Description
Long	DDDMM.MMMMM	Longitude as degrees: DD: Degree (Fixed three digits) MM: Minutes (Fixed two digits) .MMMMM: Decimal fraction of minutes (Variable) Note that for Rev 4.10 this field is empty in case of invalid value
E/W	“E” or “W”	Longitude direction: East or West Note that for Rev 4.10 this field is empty in case of invalid value
Mode Indicator	Char or String	In case of single constellation this is a character which can assume these values: N = NO Fix A = Autonomous D = Differential GPS E = Estimated (dead reckoning mode) In multi-constellation mode this is a 5 letter string where each letter is the mode indicator of each constellation in this order: GPS, GLONASS, GALILEO, BEIDOU, QZSS
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above WGS84 Elipsoid, max: 100000m
GEOSep	Decimal, 4 digits	Geoidal separation, meter
DGNSSAge	Empty field	Not supported
DGNSSRef	Empty field	Not supported
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

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

Example for NMEA 0183 Rev 3.1 (Default):

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

or

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

Example for NMEA 0183 Rev 4.10:

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

Or

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

12.5.11 $--DTM

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

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

Synopsis for NMEA 0183 Rev 3.1 (Default):

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

Synopsis for NMEA 0183 Rev 4.10:

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

Arguments:

Table 137. $--DTM message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If system works in GPS only mode GL: If system works in GLONASS only mode GA: If system works in GALILEO only mode BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
Local_datum_code	ccc	Local datum code (three characters): W84 = WGS84 P90 = PZ90 999 = User Defined Datum IHO = Datum reported in the International Hydrographic Organization Publication S-60 Appendices B and C. Note: all supported datum are listed in the Appendix A at the end of this document.
local_datum_code_id	ddd	In case the local datum code is W84 or 999 (User Defined) this field is left empty. In all other cases this field reports the local datum code ID (three numeric digits) as reported in Appendix A at the end of this document. The local datum code ID is the same number used to identify the datum code in the firmware configuration (CDB-ID)
Lat_offset	mmm.mmmmm	Latitude offset in minutes
N/S	“N” or “S”	Lat Direction: North or South
Long_offest	mmm.mmmmm	Longitude offset in minutes
E/W	“E” or “W”	Long Direction: East or West

Table 137. $--DTM message field description (continued)

Parameter	Format	Description
Alt_offset	aaa.aaaaaa	Altitude offset in meters
Reference_datum_code	ccc	Reference datum code (three characters): W84 = WGS84

Example for NMEA 0183 Rev 3.1 (Default):

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

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

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

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

Example for NMEA 0183 Rev 4.10:

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

12.5.12 $--RLM

Return Link Message data.

NMEA message list bitmask (64 bits): 8000 0000 0000 0000.

Synopsis for NMEA 0183 Rev 3.1 (Default):

```
$<TalkerID>RLM,<BeaconID>,<TimeOfReception>,<MessageCode>,<MessageBody>
*<checksum><cr><lf>
```

Synopsis for NMEA 0183 Rev 4.10:

```
$<TalkerID>RLM,<BeaconID>,<TimeOfReception>,<MessageCode>,<MessageBody>*
<checksum><cr><lf>
```

Arguments:

Table 138. $--RLM message field description

Parameter	Format	Description
TalkerID	String, 2 characters	The talker ID (Fixed two characters). GP: If the RLM has been received on a GPS satellite GL: If the RLM has been received on a GLO satellite GA: If the RLM has been received on a GAL satellite BD: If the RLM has been received on a BDS satellite QZ: If the RLM has been received on a QZS satellite IR: If system works in IRNSS only mode. **Note:** Currently only GALILEO supports RLM
BeaconID	Hexadecimal, 15 digits	Beacon intended to receive the message
TimeOfReception	hhmmss.ss	UTC Time of RLM (time of reception of the last 20 bit packet of the RLM: hh: hours (Fixed two digits) mm: minutes (Fixed two digits) ss: seconds (Fixed two digits) .ss: decimal fraction of seconds (Fixed two digits)
MessageCode	Hexadecimal, 1 digit	Type of RLM Message Service 0 = Reserved 1 = Acknowledgment Service RLM 2 = Command Service RLM 3 = Message Service RLM 4-E = Reserved F = Test Service RLM
MessageBody	Hexadecimal, up to 24 digits	Variable field length encapsulating the data parameters into hexadecimal format. GALILEO Short Message: 4 hexadecimal digits GALILEO Long Message: 24 hexadecimal digits

Results:

None.

Example:

```
GALILEO Short RLM
$GARLM,A5A5A123213C3C3,220151.00,1,CAFE*0E

GALILEO Long RLM
$GARLM,00CAFE11DECAF00,221909.00,1,1F0F1ABCDE2F0F2123453F0F*0C
```

12.6 ST NMEA messages specification

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

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

12.6.1 $PSTMINITGPSOK

Message sent in response to command *$PSTMINITGPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.2 $PSTMINITGPSERROR

Message sent in response to command *$PSTMINITGPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.3 $PSTMINITTIMEOK

Message sent in response to command *$PSTMINITTIME*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.4 $PSTMINITTIMEERROR

Message sent in response to command *$PSTMINITTIME*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.5 $PSTMSETRANGEOK

Message sent in response to command *$PSTMSETRANGE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.6 $PSTMSETRANGEERROR

Message sent in response to command *$PSTMSETRANGE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.7 $PSTMSBASSERVICEOK

Message sent in response to command *$PSTMSBASSERVICE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.8 $PSTMSBASSERVICEERROR

Message sent in response to command *$PSTMSBASSERVICE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.9 $PSTMSBASMOK

Message sent in response to command *$PSTMSBASM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.10 $PSTMSBASMERROR

Message sent in response to command *$PSTMSBASM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.11 $PSTMGETALGOOK

Message sent in response to command *$PSTMGETALGO*.

Synopsis:

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

Arguments:

Table 139. $PSTMGETALGOOK field description

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

Results:

Message sent in case of successful operation.

12.6.12 $PSTMGETALGOERROR

Message sent in response to command *$PSTMGETALGO*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.13 $PSTMSETALGOOK

Message sent in response to command *$PSTMGETALGO*.

Synopsis:

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

Arguments:

Table 140. $PSTMSETALGOOK field description

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

Results:

Message sent in case of successful operation.

12.6.14 $PSTMSETALGOERROR

Message sent in response to command *$PSTMSETALGO*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.15 $PSTMRTCTIME

Message sent in response to command *$PSTMGETRTCTIME*.

Synopsis:

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

Arguments:

Table 141. $PSTMGETRTCTIME message 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
time_validity	Decimal, 1 digit	Validity: 0 - NO_TIME 1 - FLASH_TIME 2 – TOW_TIME 3 - USER_TIME 4 - USER_RTC_TIME 5 - RTC_TIME 6 - RTC_TIME_ACCURATE 7 - APPROX_TIME 8 - ACCURATE_TIME 9 - POSITION_TIME 10 - EPHEMERIS_TIME

Results:

None.

12.6.16 $PSTMDATUMSELECTOK

Message sent in response to command *$PSTMDATUMSELECT*.

Synopsis:

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

Arguments:

Table 142. $PSTMDATUMSELECTOK field description

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

Results:

None

12.6.17 $PSTMDATUMSELECTERROR

Message sent in response to command *$PSTMDATUMSELECT*

Synopsis:

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

Arguments:

None

Result:

None

12.6.18 $PSTMDATUMSETPARAMOK

Message sent in response to command *$PSTMDATUMSETPARAM*

Synopsis:

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

Arguments:

None

Result:

Message sent in case of successful operation.

12.6.19 $PSTMDATUMSETPARAMERROR

Message sent in response to command *$PSTMDATUMSETPARAM*

Synopsis:

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

Arguments:

None

Result:

None

12.6.20 $PSTMPOSITIONHOLDENABLED

Message sent in response to command *$PSTMENABLEPOSITIONHOLD*

Synopsis:

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

Arguments:

None

Results:

None

12.6.21 $PSTMPOSITIONHOLDDISABLED

Message sent in response to command *$PSTMENABLEPOSITIONHOLD*.

Synopsis:

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

Arguments:

None

Results:

None

12.6.22 $PSTMENABLEPOSITIONHOLDERROR

Message sent in response to command *$PSTMENABLEPOSITIONHOLD*

Synopsis:

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

Arguments:

None

Results:

None

12.6.23 $PSTMSETCONSTMASKOK

Message sent in response to command *$PSTMSETCONSTMASK*

Synopsis:

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

Arguments:

Table 143. $PSTMSETCONSTMASKOK message field description

Parameter	Format	Description
constellation_mask	Decimal, 1 - 9999	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling bit 3: GALILELO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling bit 10: IRNSS constellation enabling/disabling

Results:

Message sent in case of successful operation.

12.6.24 $PSTMSETCONSTMASKERROR

Message sent in response to command *$PSTMSETCONSTMASK*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.25 $PSTMSQISETOK

Message sent in response to command *$PSTMSQISET*

Synopsis:

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

Arguments:

Table 144. $PSTMSQISETOK message field description

Parameter	Format	Description
dest_addr	HexDecimal, 4 digits	

Results:

Message sent in case of successful operation.

12.6.26 $PSTMSQISETERROR

Message sent in response to command *$PSTMSQISET*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of error

12.6.27 $PSTMSQIGETOK

Message sent in response to command *$PSTMSQIGET*

Synopsis:

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

Arguments:

Table 145. $PSTMSQIGEOK message field description

Parameter	Format	Description
dest_addr	Hexadecimal, 4 digits	Offset from the base address of the chosen sector
Word-N	Hexadecimal, 4 digits	N-th word values read from SQI

Results:

Message sent in case of successful operation.

12.6.28 $PSTMSQIGETERROR

Message sent in response to command *$PSTMSQIGET*

Synopsis:

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

Arguments:

No arguments

Results:

Message sent in case of error

12.6.29 $PSTMSQIERASEOK

Message sent in response to command *$PSTMSQIERASE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.30 $PSTMSQIERASEERROR

Message sent in response to command *$PSTMSQIERASE*

Synopsis:

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

Arguments:

None.

Results:

Message is sent in case of errors

12.6.31 $PSTMPPS

Message sent in response to command *$PSTMPPS*

Synopsis:

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

Arguments:

Table 146. $PSTMPPS field description

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

12.6.31.1 PPS Get PPS_IF_PULSE_DATA_CMD

Synopsis:

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

Arguments:

Table 147. $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated. 1 = PPS generated on even seconds. 2 = PPS generated on odd seconds.
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC. 2 = GLONASS_UTC. 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS 5 =BeiDou_UTC 6 = UTC_NTSC 7 = GST 8 = UTC_GST 9 = GPS_FROM_GST **Note:** UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites.GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites.If the software is configured to work in GLONASS only mode, UTC(SU) is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = Not inverted. 1 = Inverted.

12.6.31.2 PPS Get PPS_IF_TIMING_DATA_CMD

Synopsis:

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

Arguments:

Table 148. $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD

Parameter	Format	Description
fix_condition	Decimal, 1 digit	1 = NOFIX. 2 = 2DFIX. 3 = 3DFIX.
sat_th	Decimal	Minimum number of satellites for the PPS generation.
elevation_mask	Decimal	Minimum satellite elevation for satellite usage in timing filtering.
constellation_mask	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS bit3 = BeiDou bit7 = Galileo
gps_rf_delay	Decimal	GPS path RF delay [ns]
glonass_rf_delay	Decimal	GLONASS path RF delay [ns]

12.6.31.3 PPS Get PPS_IF_POSITION_HOLD_DATA_CMD

Synopsis:

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

Arguments:

Table 149. $PSTMPPS field description on PPS_IF_POSITION_HOLD_DATA_CMD

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = Position Hold disabled. 1 = Position Hold enabled.
lat	DDmm.mmmmm	Position Hold position latitude.
lat_dir	“N” or “S”	North or South direction.
lon	DDDmm.mmmmm	Position Hold position longitude.
lon_dir	“E” or “W”	East or West direction.
h_msl	Double	Position Hold mean see level altitude.

12.6.31.4 PPS Get PPS_IF_TRAIM_CMD

Synopsis:

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

Arguments:

Table 150. $PSTMPPS field description on PPS_IF_TRAIM_CMD

Parameter	Format	Description
traim_enabled	Decimal, 1 digit	TRAIM ON/OFF status 0 = OFF 1 = ON
traim_solution	Decimal, 1 digit	TRAIM Algorithm status: 0 = UNDER Alarm 1 = OVER Alarm 2 = UNKNOWN
ave_error	Decimal	Average time error [ns]
used_sats	Decimal	Number of satellite used for timing correction.
removed_sats	Decimal	Number of satellites removed by the timing correction.

12.6.31.5 PPS Get PPS_IF_TRAIM_USED_CMD

Synopsis:

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

Arguments:

Table 151. $PSTMPPS field description on PPS_IF_TRAIM_USED_CMD

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

12.6.31.6 PPS Get PPS_IF_TRAIM_RES_CMD

Synopsis:

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

Arguments:

Table 152. $PSTMPPS field description on PPS_IF_TRAIM_RES_CMD

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

12.6.31.7 PPS Get PPS_IF_TRAIM_REMOVED_CMD

Synopsis:

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

Arguments:

Table 153. $PSTMPPS field description on PPS_IF_TRAIM_REMOVED_CMD

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

12.6.32 $PSTMPPSERROR

Message sent in response to command *$PSTMPPS*

Synopsis:

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

Arguments:

None

Results:

Message is sent in case of errors

12.6.33 $PSTMADCSTARTOK

Message sent in response to command *$PSTMADCSTART*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of successful operation.

12.6.34 $PSTMADCSTARTERROR

Message sent in response to command *$PSTMADCSTART*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of errors

12.6.35 $PSTMADCREADOK

Message sent in response to command *$PSTMADCREAD*

Synopsis:

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

Arguments:

Table 154. $PSTMADCREADOK message field description

Parameter	Format	Description
ain	Decimal, 1 digit	Channel to be read
Data_read	Decimal, 1 digit	Data read from the buffer

Results:

Message is sent in case of successful operation.

12.6.36 $PSTMADCREADERROR

Message sent in response to command *$PSTMADCREAD*

Synopsis:

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

Arguments:

No Arguments

Results:

Message will be sent in case of error

12.6.37 $PSTMCRCCHECK

Message sent in response to command *$PSTMCRCCHECK*

Synopsis:

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

Arguments:

Table 155. $PSTMCRCCHECK message field description

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

Results:

None

12.6.38 $PSTMFORCESTANDBYOK

Message sent in response to command *$PSTMFORCESTANDBY*

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

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of successful operation.

12.6.39 $PSTMFORCESTANDBYERROR

Message sent in response to command *$PSTMFORCESTANDBY*

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

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of error

12.6.40 $PSTMGALILEODUMPGGTO

Message sent in response to command *$PSTMGALILEODUMPGGTO*

Synopsis:

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

Arguments:

Table 156. $PSTMGALILEODUMPGGTO message field description

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

Results:

No result

12.6.41 $PSTMSETTHTRKOK

Message sent in response to command *$PSTMSETTHTRK*

Synopsis:

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

Arguments:

No argument

Results:

Message is sent in case of successful operation.

12.6.42 $PSTMSETTHTRKERROR

Message sent in response to command *$PSTMSETTHTRK*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error

12.6.43 $PSTMSETTHPOSOK

Message sent in response to command *$PSTMSETTHPOS*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of successful operation.

12.6.44 $PSTMSETTHPOSERROR

Message sent in response to command *$PSTMSETTHPOS*

Synopsis:

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

Arguments:

No arguments

Results:

Message sent in case of errors

12.6.45 $PSTMIMUSELFTESTCMDOK

Message sent in response to command *$PSTMGETFLASHTYPE*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of successful operation.

12.6.46 $PSTMIMUSELFTESTCMDERROR

Message sent in response to command *$PSTMGETFLASHTYPE*

Synopsis:

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

Arguments:

No arguments

Results:

Message sent if self-test command is not supported by the mounted IMU or is not supported by the FW (sensor layer not present in FW).

12.6.47 $PSTMGETFLASHTYPE

Message sent in response to command *$PSTMGETFLASHTYPE*

Synopsis:

```
$PSTMGETFLASHTYPE,<idx>*<checksum><cr><lf>
```

Arguments:

Table 157. $PSTMGETFLASHTYPE message field description

Parameter	Format	Description
idx	Decimal,2 digit	Memory type index: 0: Macronix U type 1: Winbond W25QxxxFV/DW/DV/BV Where xxx<256 2: Micron 3: - 4: Spansion 5: MACRONIX R type 6: ISSI LQ type 7: MACRONIX L type 8: MACRONIX V type 9: ISSI LP type

Results:

None.

12.6.48 $PSTMGETFLASHTYPEERROR

Message sent in response to command *$PSTMGETFLASHTYPE*

Synopsis:

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

Arguments:

No arguments

Results:

None.

12.6.49 $PSTMFWUPGRADEOK

Message sent in response to command *$PSTMFMWUPGRADE*

Synopsis:

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

Arguments:

None.

Results:

Message is sent in case of successful operation.

12.6.50 $PSTMFWUPGRADEERROR

Message sent in response to command *$PSTMFMWUPGRADE*

Synopsis:

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

Arguments:

None

Results:

Message sent in case of error

12.6.51 $PSTMVER

Message sent in response to command *$PSTMGETSWVER*

Synopsis:

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

Arguments:

Table 158. $PSTMVER field specification

Parameter	Format	Description
Lib	Text, fixed	Text String identifying the Library that the command is requiring the version: GNSSLIB if type = 0 OS20LIB if type = 1 GPSAPP if type = 2 BINIMG if type = 6 SWCFG if type = 11 PID if type = 12
Ver	x.x.x.x	GNSS Library Version: example 7.1.1.15
Type	ARM, GNU	Compiler Type: ARM or GNU

Example:

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

Note: If any id is passed as parameter to the command, its output acts as in the id = 0 case

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

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

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

Note: Note: Starting from STA8090 Binary Image v4.5.7 and v4.7.7 the text size of BINIMG has a maximum value. The version string of BINIMG is now managed with a constant vector of 32 chars which is always filled up to the max size with NULL chars (0x0). The BINIMG version string has the following format:

Note: "BINIMG_" + <fw version> + "_ARM"

That is 32 bytes in size (including "BINIMG_ and _ARM strings). The <fw version> string is not fixed in size, it depends on the number of digits used in the version string. Having a fixed maximum size, always filled with NULL chars, is it possible for customers to implement a smart parser that it is able to get and decode any version string.

Arguments:

Table 159. $PSTMSWCONFIG field specification

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

Note: The HW version has the following syntax:

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

Table 160. HW_SIGNATURE_STRING description

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

12.6.52 $PSTMRF

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

Synopsis:

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

Arguments:

Table 161. $PSTMRF message field description

Parameter	Format	Description
MessgAmount	Decimal, 1 digit	Number of consecutive $PSTMRF messages
MessgIndex	Decimal, 1 digit	Current number in the sequence of messages
used_sats	Decimal, 2 digits	Number of satellites used in the fix
SatxID	Decimal, 2 digits	Satellite x Number (PRN)
SatxPhN	Decimal, 5 digits	Satellite x Phase Noise
SatxFreq	Decimal, 6 digits	Satellite x Frequency
SatxCN0	Decimal, 2 digits	Satellite x Carrier to Noise Ratio (in dB)

Results:

None

12.6.53 $PSTMTESTRF

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

Synopsis:

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

Arguments:

Table 162. $PSTMTESTRF message field description

Parameter	Format	Description
Sat-ID	Decimal, 2 digits	Satellite Number (PRN)
Sat-Freq	Decimal, 5 digits	Satellite Frequency
Sat-PhN	Decimal, 5 digits	Satellite Phase Noise
Sat-CN0	Decimal, 2 digits	Satellite Carrier to Noise Ratio (in dB)

Results:

None

12.6.54 $PSTMTG

Time and Satellites Information

Synopsis:

```
$PSTMTG,<Week>,<TOW>,<TotSat>,<CPUTime><Timevalid><NCO>
<kf_config_status><constellation_mask><time_best_sat_type><time_master_sat
_type><time_aux_sat_type><time_master_week_n><time_master_tow><time_master
_validity><time_aux_week_n><time_aux_tow><time_aux_validity>*
```

Arguments:

Table 163. $PSTMTG message field description

Parameter	Format	Description
Week	Decimal, 4 digits	Week Number
TOW	Decimal, 10 digits	Time of Week
Tot-Sat	Decimal, 2 digits	Total Number of satellites used for fix
CPU-Time	Decimal, 10 digits	CPU Time
Timevalid	Decimal, 2 digits	0 = no time 1 = time read from flash 2 = time set by user 3 = time set user RTC 4 = RTC time 5 = RTC time, accurate 6 = time approximate 7 = “not used” 8 = time accurate 9 = position time 10 = Ephemeris time
NCO	Decimal, 9 digits	NCO value
kf_config_status	Hexadecimal, 2 digits	Kalman Filter Configuration For each bit: – 0 means feature disabled – 1 means feature enabled See *Table 164*
constellation_mask	Decimal, 3 digits max	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling bit 3: GALILELO constellation enabling/disabling bit 7: BAIDEU constellation enabling/disabling
time_best_sat_type	Decimal	Selected best time satellite type

Table 163. $PSTMTG message field description (continued)

Parameter	Format	Description
time_master_sat_type	Decimal	Master time satellite type
time_aux_sat_type	Decimal	Auxiliary time satellite type
time_master_week_n	Decimal	Master time week number
time_master_tow	Floating	Master time TOW
time_master_validity	Decimal	Master week number time validity
time_aux_week_n	Decimal	Auxiliary time
time_aux_tow	Floating	Auxiliary time TOW
time_aux_validity	Decimal	Auxiliary time validity

Table 164. $PSTMTG Kalman Filter Configuration

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

Results:

None

12.6.55 $PSTMTS

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

Synopsis:

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

Arguments:

Table 165. $PSTMTS message field description

Parameter	Format	Description
dsp-dat	Decimal, 1 digit	DSP data available: 0 = satellite not tracked 1 = satellite tracked
Sat-ID	Decimal, 2 digits	Satellite Number (PRN)
PsR	Decimal, 10 digits	Pseudo range
Freq	Decimal, 8 digits	Satellite tracking frequency offset
Plf	Decimal, 1 digit	Preamble Lock Flag 0 = Navigation data stream preamble not locked 1 = Navigation data stream preamble locked
CN0	Decimal, 3 digits	Satellite Carrier to Noise Ratio (in dB)
Ttim	Decimal, 6 digits	Track Time of Satellite (in seconds)
Satdat	Decimal, 1 digit	Satellite Data available Flag 0 = Sat. Ephemeris not available or unhealthy Sat. 1 = Sat. Ephemeris available and healthy Satellite
Satx	Decimal, 10 digits	Satellite Position, X-Coordinate
Saty	Decimal, 10 digits	Satellite Position, Y-Coordinate
Satz	Decimal, 10 digits	Satellite Position, Z-Coordinate
Velx	Decimal, 8 digits	Satellite Velocity, X-Coordinate
Vely	Decimal, 8 digits	Satellite Velocity, Y-Coordinate
Velz	Decimal, 8 digits	Satellite Velocity, Z-Coordinate
Src	Decimal, 6 Digits	Satellite Range Correction
Ac	Decimal, 3 Digits	Atmospheric Correction
Difdat	Decimal, 1 digit	Differential Data available Flag 0 = Differential Corrections not available 1 = Differential Corrections available
Drc	Decimal, 3 digits	Differential Range Correction (from DGPS Station)
Drrc	Decimal, 3 digits	Differential Range Rate Correction (from DGPS Stat.)
predavl	Decimal, 1 digit	Prediction available Flag 0 = Predicted Ephemeris not available 1 = Predicted Ephemeris available
predage	Decimal, 1 digit	Age of predicted Ephemeris (in hours)
predeph	Decimal, 1 digit	Number of satellites used for prediction (1 or 2)
predtd	Decimal, 1 digit	Time distance of Ephemeris calculated from 2 Sats. Only valid if <pred-eph> = 2

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

Results:

None

Example:

```
$PSTMTS,1,05,15748178.41,30992.22,1,44,306150,1,16278399.26,20504574.30,46
53136.69,38.03,703.04,-3046.01,141169.29,11.45,1,-12.75,0.00,
$PSTMTS,1,31,14242886.83,-28462.15,1,37,304775,1,20641723.13,
-8713847.54,14517949.66,1788.86,311.39,-2382.23,1804.01,7.09,1,
-5.74,0.00,
$PSTMTS,1,21,14885540.17,-25018.74,1,50,301653,1,25482227.75,
6629457.30,5528104.33,-699.61,220.74,2983.68,23248.85,8.12,1,
-2.84,0.00,
$PSTMTS,1,07,13337296.04,-27966.11,1,31,296621,1,15777659.46,
4155044.35,21301094.71,-1287.52,2301.27,509.20,-15394.31,5.65,1,
-3.83,0.00,
$PSTMTS,1,06,1216319.39,-28367.75,0,23,40492,1,14595868.85,
6511991.60,21397698.91,-1394.03,2294.91,251.81,70766.81,5.72,1,
-3.28,0.00,
$PSTMTS,1,24,13629659.89,-27176.62,1,40,298187,1,17698708.17,
12886703.95,15024752.78,-1901.12,-1.00,2298.33,11530.25,6.39,1,
-9.27,0.00,
$PSTMTS,1,30,14421546.48,-30401.97,1,44,298264,1,17539544.73,
16864817.03,10440026.12,394.97,1346.12,-2741.16,14708.79,7.87,1,
-9.96,0.00,
$PSTMTS,1,16,16177492.44,-24593.30,1,40,298572,1,6202032.13,
-17659074.51,18852818.90,1139.40,2098.88,1613.11,35896.88,12.03,1,
-4.54,0.00,
$PSTMTS,1,10,16728325.63,-26663.46,1,30,124750,1,-2057875.88,
21248945.17,15476302.66,-1018.51,-1731.48,2256.47,
-32564.02,15.33,1,-12.86,0.00,
$PSTMTS,1,12,17539958.05,-31018.23,1,35,10528,1,11788804.59,
23841922.01,245355.77,-236.27,137.48,-3173.58,-103404.01,20.66,1,
-19.21,0.00,
$PSTMTS,1,23,17770191.78,-27801.14,1,28,196026,1,-6131001.55,
-15740405.01,20363733.86,1549.10,-2097.11,-1173.09,89981.45,
27.98,0,0.00,0.00,
```

12.6.56 $PSTMTG (Carrier Phase binary)

Time and Satellites Information

Synopsis:

```
$PSTMTG,<Week>,<TOW>,<TotSat>,<CPUTime><Timevalid><NCO><config_status>,
<tow_delta>,<req_tow_delta>,<cpu_time_p>,<req_cpu_time>,
```

```
<constellation_mask>,<time_best_sat_type>,<time_master_sat_type>,<time_aux
_sat_type>,<time_master_week_n>,<time_master_tow>,
<time_master_validity>,<time_aux_week_n>,<time_aux_tow>,
<time_aux_validity>*<checksum><cr><lf>
```

Arguments:

Table 166. $PSTMTG (CP binary) message field description

Parameter	Format	Description
Week	Decimal, 4 digits	Week Number
TOW	Decimal, 12 digits	Time of Week
Tot-Sat	Decimal, 2 digits	Total Number of satellites used for fix
CPU-Time	Decimal, 10 digits	CPU Time
Timevalid	Decimal, 2 digits	0 = no time 1 = time read from flash 2 = time set by user 3 = time set user RTC 4 = RTC time 5 = RTC time, accurate 6 = time approximate 7 = “not used” 8 = time accurate 9 = position time 10 = Ephemeris time
NCO	Decimal, 9 digits	NCO value If clock steering is enabled this value shall be used in the Doppler calculation (instead of the nominal values).
Config_status	Hexadecimal, 4 digits	Kalman Filter Configuration For each bit: – 0 means feature disabled – 1 means feature enabled see *Table 167*
tow_delta	Floating	Measurement TOW propagation
req_tow_delta	Floating	Requested meas. TOW propagation
cpu_time_p	Decimal	Propagated meas. CPU time
req_cpu_time	Decimal	Requested meas. CPU time

Table 166. $PSTMTG (CP binary) message field description (continued)

Parameter	Format	Description
constellation_mask	Decimal, 3 digits max	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
time_best_sat_type	Decimal	selected best time satellite type
time_master_sat_type	Decimal	master time satellite type
time_aux_sat_type	Decimal	auxiliary time satellite type
time_master_week_n	Decimal	master time week number
time_master_tow	Floating	master time TOW
time_master_validity	Decimal	master week number time validity
time_aux_week_n	Decimal	auxiliary time
time_aux_tow	Floating	auxiliary time TOW
time_aux_validity	Decimal	auxiliary time validity

Table 167. Kalman Filter Configuration

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

Table 167. Kalman Filter Configuration (continued)

Bit	Configuration
[3 : 0]	Front end frequency: – Means 48MHz – Means 26 MHz
[7 : 4]	$PSTMTG and $PSTMTS version and clock sterring indicator

Time of week (TOW) pre-processing

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

$$\mathrm{TOW^*} = \mathrm{TOW} + \mathrm{tow\_delta}/\mathrm{C}$$

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

Results:

None.

12.6.57 $PSTMTS (Carrier Phase binary)

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

Synopsis:

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

Arguments:

Table 168. $PSTMTS (CP) message field description

Parameter	Format	Description
dsp-dat	Decimal, 1 digit	DSP data available: 0 = satellite not tracked 1 = satellite tracked
Sat-ID	Decimal, 2 digits	Satellite Number (PRN)
PsR	Decimal, 10 digits	Pseudo range
Freq	Decimal, 8 digits	Satellite tracking frequency offset
cp	Floating	Carrier phase measurement (cycles)
flags	Decimal, 1 digit	See *Table 169*

Table 168. $PSTMTS (CP) message field description (continued)

Parameter	Format	Description
CN0	Decimal, 3 digits	Satellite Carrier to Noise Ratio (in dB)
Ttim	Decimal, 6 digits	Track Time of Satellite (in seconds)
Satdat	Decimal, 1 digit	Satellite Data available Flag 0 = Sat. Ephemeris not available or unhealthy Sat. 1 = Sat. Ephemeris available and healthy Satellite
Satx	Decimal, 10 digits	Satellite Position , X-Coordinate
Saty	Decimal, 10 digits	Satellite Position , Y-Coordinate
Satz	Decimal, 10 digits	Satellite Position , Z-Coordinate
Velx	Decimal, 8 digits	Satellite Velocity , X-Coordinate
Vely	Decimal, 8 digits	Satellite Velocity , Y-Coordinate
Velz	Decimal, 8 digits	Satellite Velocity , Z-Coordinate
Src	Decimal, 6 Digits	Satellite Range Correction
Ac	Decimal, 3 Digits	Atmospheric Correction
Rrc	Floating	Range Rate Correction
Pr_delta	Floating	Pseudorange propagation
Cp_delta	Floating	Carrier Phase propagation
Difdat	Decimal, 1 digit	Differential Data available Flag 0 = Differential Corrections not available 1 = Differential Corrections available
Drc	Decimal, 3 digits	Differential Range Correction (from DGPS Station)
Drrc	Decimal, 3 digits	Differential Range Rate Correction (from DGPS Stat)
codeNoise	Integer	Moving average of the code-loop discriminator error in arbitrary units. Typical abs <2000.
phaseNoise	Integer	Moving average of the error used to update the carrier loop in arbitrary units. Typical range 1-10k
Cycle_slip_cnt	Integer	Total Cycle Slip Counter
Glonass_slot	Integer	GLONASS satellite slot number (1 to 24), if available; otherwise 0

Table 169. $PSTMTS Flags bits description

bits	values	descriptions
[0]	1: locked 0: unlocked	Preamble-Locked
[1]	1: valid 0: invalid	Multi-path indicator validity

Table 169. $PSTMTS Flags bits description (continued)

bits	values	descriptions
[3:2]	0: no MP 1: 2: 3: strong MP	Multi-path strength
[4]	0: Normal 1: Inverted	Polarity
[5]	1: valid 0: invalid	Carrier Phase validity
[6]	0 = unknown 1 = solved	Half Cycle Ambiguity

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

Pseudo range pre-processing

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

$$PR^* = PsR + pr\_delta$$

Carrier phase pre-processing

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

$$CP^* = -(cp + cp\_delta)$$

Doppler pre-processing

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

$$D^* = Freq - clockGPS$$

Where clockGPS can be obtained from the following table:

Table 170. F.E. frequency bit meaning

***Front end frequency* bit**	**clock$_{GPS}$**
0 (= 26 MHz)	-47122.395833492279 Hz
1 (= 48 MHz)	-40526.315789699554 Hz

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

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

$$D^* = -(Freq + clockGPS*B1/L1)$$

$$CP^* = +(cp + cp\_delta)$$

GLONASS Sat-ID

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

Table 171. GLONASS Sat ID vs. Frequency Channel ID (K) Association

K	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
Id	65	66	67	68	69	10	71	72	73	74	75	76	77	78
Id	19	80	81	82	83	84	85	86	87	88	89	90	91	92

BeiDou Sat-ID

When the satellite ID reported on $PSTMTS message is included in the range 141 to 170, then that sentence refers to a BeiDou satellite. In that case the BeiDou PRN numbers can be determined by subtracting 140 to the satellite ID got from the $PSTMTS sentence.

Results:

None.

Example:

```
$PSTMTS,1,05,15748178.41,30992.22,1,44,306150,1,16278399.26,20504574.30,46
53136.69,38.03,703.04,-3046.01,141169.29,11.45,1,-12.75,0.00,
$PSTMTS,1,31,14242886.83,-28462.15,1,37,304775,1,20641723.13,
-8713847.54,14517949.66,1788.86,311.39,-2382.23,1804.01,7.09,1,
-5.74,0.00,
$PSTMTS,1,21,14885540.17,-25018.74,1,50,301653,1,25482227.75,
6629457.30,5528104.33,-699.61,220.74,2983.68,23248.85,8.12,1,
-2.84,0.00,
$PSTMTS,1,07,13337296.04,-27966.11,1,31,296621,1,15777659.46,
4155044.35,21301094.71,-1287.52,2301.27,509.20,-15394.31,5.65,1,
-3.83,0.00,
$PSTMTS,1,06,1216319.39,-28367.75,0,23,40492,1,14595868.85,
6511991.60,21397698.91,-1394.03,2294.91,251.81,70766.81,5.72,1,
-3.28,0.00,
$PSTMTS,1,24,13629659.89,-27176.62,1,40,298187,1,17698708.17,
12886703.95,15024752.78,-1901.12,-1.00,2298.33,11530.25,6.39,1,
-9.27,0.00,
$PSTMTS,1,30,14421546.48,-30401.97,1,44,298264,1,17539544.73,
16864817.03,10440026.12,394.97,1346.12,-2741.16,14708.79,7.87,1,
-9.96,0.00,
$PSTMTS,1,16,16177492.44,-24593.30,1,40,298572,1,6202032.13,
-17659074.51,18852818.90,1139.40,2098.88,1613.11,35896.88,12.03,1,
-4.54,0.00,
$PSTMTS,1,10,16728325.63,-26663.46,1,30,124750,1,-2057875.88,
21248945.17,15476302.66,-1018.51,-1731.48,2256.47,
-32564.02,15.33,1,-12.86,0.00,
$PSTMTS,1,12,17539958.05,-31018.23,1,35,10528,1,11788804.59,
23841922.01,245355.77,-236.27,137.48,-3173.58,-103404.01,20.66,1,
-19.21,0.00,
$PSTMTS,1,23,17770191.78,-27801.14,1,28,196026,1,-6131001.55,
-15740405.01,20363733.86,1549.10,-2097.11,-1173.09,89981.45,
```

```
27.98,0,0.00,0.00,
```

12.6.58 $PSTMPA

Position Algorithm

Synopsis:

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

Arguments:

Table 172. $PSTMPA message field description

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

Results:

None

Example:

```
$PSTMPA,KF,433*<checksum><cr><lf>
$PSTMPA,  ,00*<checksum><cr><lf>
```

12.6.59 $PSTMSAT

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

Synopsis:

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

Arguments:

Table 173. $PSTMSAT message field description

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

Results:

None

12.6.60 $PSTMPRES

Position Residual

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

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 174. $PSTMPRES message field description

Parameter	Format	Description
RMSpos	dd.d	position “rms” residual for the fix
resx	dd.d	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)

Results:

None

Example:

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

12.6.61 $PSTMVRES

Velocity Residual

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

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 175. $PSTMVRES message field description

Parameter	Format	Description
RMSvel	dd.d	velocity “rms” residual for the fix
vresx	dd.d	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)

Results:

None

Example:

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

12.6.62 $PSTMNOISE

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

Synopsis:

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

Arguments:

Table 176. $PSTMNOISE message field description

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

Results:

None

12.6.63 $PSTMCPU

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

Synopsis:

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

Arguments:

Table 177. $PSTMCPU message 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 -1: Not supported
CPU_Speed	Decimal, 1 digit	CPU clock frequency for STA8089-90: 49, 98, 196 MHz

Results:

None

12.6.64 $PSTMPPSDATA

Reports the Pulse Per Second data

Synopsis:

```
$PSTMPPSDATA,<on_off>,<pps_valid>,<synch_valid>,<out_mode>,<ref_time>,<ref
_constellation>,<pulse_duration>,<pulse_delay>,<gps_delay>,<glo_delay>,<be
i_delay>,<gal_delay>,<inverted_polarity>,<fix_cond>,<sat_th>,<elev_mask>,<
```

```
const_mask>,<ref_sec>,<fix_status>,<used_sats>,<gps_utc_delta_s>,<gps_utc_
delta_ns>,<glonass_utc_delta_ns>,<galileo_utc_delta_ns>,<quantization_erro
r>,<pps_clock_freq>,<tcxo_clock_freq>*<checksum><cr><lf>
```

Arguments:

Table 178. $PSTMPPSDATA message field description

Parameter	Format	Description
on_off	Decimal, 1 digit	PPS signal ON/OFF status 0: OFF 1: ON
pps_valid	Decimal, 1 digit	Global PPS validity flag 0: PPS not valid 1: PPS valid
synch_valid	Decimal, 1 digit	PPS synchronization validity 0: Not Valid 1: Valid
out_mode	Decimal, 1 digit	0 = PPS_OUT_MODE_ALWAYS 1 = PPS_OUT_MODE_ON_EVEN_SECONDS 2 = PPS_OUT_MODE_ON_ODD_SECONDS
ref_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS **Note:** UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. If the software is configured to work in GLONASS only mode, UTC(SU) is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
ref_constellation	Decimal, 1 digit	0 = GPS 1 = GLONASS **Note:** The reference constellation reports which reference time has been used for the PPS generation.
pulse_duration	Double	Pulse duration [s]
pulse_delay	Decimal	Pulse delay [ns]
gps_delay	Decimal	GPS path RF delay [ns]
glo_delay	Decimal	GLONASS path RF delay [ns]

Table 178. $PSTMPPSDATA message field description (continued)

Parameter	Format	Description
bei_delay	Decimal	BEIDOU path RF delay [ns] **Note:** This parameter is always zero if Beidou constellation is not supported by the hardware platform.
gal_delay	Decimal	GALILEO path RF delay [ns]
inverted_polarity	Decimal, 1 digit	Pulse polarity inversion: 0 = not inverted 1 = inverted
fix_cond	Decimal, 1 digit	Selected GNSS fix condition for PPS signal generation: 1 = NO_FIX 2 = 2D_FIX 3 = 3D_FIX
sat_th	Decimal	Selected minimum number of satellites for PPS signal generation.
elev_mask	Decimal	Selected minimum satellite elevation for time correction.
const_mask	Decimal	Selected constellations for time correction.
ref_sec	Decimal, 2 digits	Second at which the reported PPS data is applied. According to the reference time configuration it could be a UTC or a GPS or a GLONASS time second.
fix_status	Decimal, 1 digit	GNSS position fix status when the time has been corrected.
used_sats	Decimal	Used satellites for time correction.
gps_utc_delta_s	Decimal	UTC leap seconds [s]
gps_utc_delta_ns	Decimal	UTC – GPS delta time [ns]
glonass_utc_delta_ns	Decimal	UTC – GLONASS delta time [ns]
galileo_utc_delat_ns	Decimal	UTC – GALILEO delta time [ns]
quantization_error	Double (scientific notation format)	Quantization error [s].
pps_clock_freq	Double, 2 fractional digits	PPS clock frequency [Hz]
tcxo_clock_freq	Double, 2 fractional digits	TCXO clock frequency [Hz]

Results:

None

12.6.65 $PSTMPOSHOLD

Reports the Position Hold status and position.

Synopsis:

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

Arguments:

Table 179. $PSTMPOSHOLD message field description

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

Results:

None

12.6.66 $PSTMTRAIMSTATUS

Reports the TRAIM algorithm status.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 180. $PSTMTRAIMSTATUS message field description

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
traim_solution	Decimal, 1 digit	TRAIM algorithm status: 0 = UNDER Alarm 1 = OVER Alarm 2 = UNKNOWN

Table 180. $PSTMTRAIMSTATUS message field description (continued)

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

Results:

None

12.6.67 $PSTMTRAIMUSED

Reports the satellite used for timing correction.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

```
$PSTMTRAIMUSED,<on_off>,<used_sats>,<sat1>,...,<satN>*<checksum><cr><lf>
```

Arguments:

Table 181. $PSTMTRAIMUSED message field description

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

12.6.68 $PSTMTRAIMRES

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

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 182. $PSTMTRAIMRES message field description

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

12.6.69 $PSTMTRAIMREMOVED

Reports the satellite removed by the timing correction algorithm.

Note: All TRAIM related messages are enabled/disabled altogether by the same mask.

Synopsis:

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

Arguments:

Table 183. $PSTMTRAIMREMOVED message field description

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

12.6.70 $PSTMKFCOV

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

Synopsis:

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

Arguments:

Table 184. $PSTMKFCOV message field description

Parameter	Format	Description
PosStd	ddd.d	Standard Deviation of Position in meters
PosNcov	ddd.d	Covariance (North/South) in m^2 (from Kalman Filter)
PosEcov	ddd.d	Covariance (East/West) in m^2 (from Kalman Filter)
PosVcov	ddd.d	Covariance (Vertical) in m^2 (from Kalman Filter)

Table 184. $PSTMKFCOV message field description

Parameter	Format	Description
VelStd	ddd.d	Standard Deviation of Velocity in meter/second
VelNcov	ddd.d	Covariance (North/South) in m^2/s (from Kalman Filter)
VelEcov	ddd.d	Covariance (East/West) in m^2/s (from Kalman Filter)
VelVcov	ddd.d	Covariance (Vertical) in m^2/s (from Kalman Filter)

Example:

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

12.6.71 $PSTMTIM

Time Validity.

Synopsis:

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

Arguments:

Table 185. $PSTMTIM message field description

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

12.6.72 $PSTMDIFF

Time Validity.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 186. $PSTMDIFF message field description

Parameter	Format	Description
ListSize	Decimal, 2 digits	Amount of visible satellites in this message (n)
NCS	Decimal, 2 digits	Number of corrected satellites

Table 186. $PSTMDIFF message field description

Parameter	Format	Description
SatxID	Decimal, 2 digits	Satellite x ID (PRN)
CorrxAvl	Decimal	Correction available for Satellite x

12.6.73 $PSTMSBAS

SBAS Satellite Data.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 187. $PSTMSBAS message field description

Parameter	Format	Description
Status	Decimal, 1 digit	SBAS Status 0 = no SBAS used 1 = SBAS used
SatTrk	Decimal, 1 digit	SBAS Satellite tracked 0 = SBAS Satellite not tracked 1 = SBAS Satellite tracked, decoding is ongoing 2 = SBAS Satellite tracked and decoded. Differential Mode ON
SatID	Decimal, 3 digits	SBAS Satellite ID
Elev	Decimal, 2 digits	SBAS Satellite Elevation (in degrees)
Azim	Decimal, 3 digits	SBAS Satellite Azimuth (in degrees)
Sig	Decimal, 2 digits	SBAS Satellite Signal Strength CN0 (in dB)

Example:

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

12.6.74 $PSTMSBASM

SBAS Frame.

Synopsis:

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

Arguments:

Table 188. $PSTMSBASM message field description

Parameter	Format	Description
prn	Decimal, 3 digits	Satellite PRN (Range: from 120 to 140)
sbas_frame	Hexadecimal, 64 digits	SBAS frame (250 bits + 6 padding)

Example:

```
$PSTMSBASM,123,536A481B40D8063829C12E08704B82DFFDFFEFFF7FFBFFDFFEF06E8037E
FB440*6D
```

12.6.75 $PSTMNOTCHSTATUS

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

Synopsis:

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

Arguments:

Table 189. $PSTMNOTCHSTATUS message field description

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

Table 189. $PSTMNOTCHSTATUS message field description

Parameter	Format	Description
ovfs_gln	Decimal, 4 digits	Internal mask output as: 1000 * Notch_Removing_jammer (1/0,TRUE/FALSE) + overflow flags status (3 digits). E.g: “1000” means Block enabled, with no internal overflows detected
mode_gln	Decimal, 1 digits	ANF mode operation (GLONASS path) [0 → ANF disabled; 1 → Always ON (Internal Use only); 2 → Auto insertion mode(suggested);]

Results:

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

12.6.76 $PSTMLOWPOWERDATA

Reports the status of adaptive low power algorithm.

Synopsis:

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

Arguments:

Table 190. $PSTMLOWPOWERDATA message field description

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

Table 190. $PSTMLOWPOWERDATA message field description

Parameter	Format	Description
eph const mask	Decimal, 2 digits	Bitfield of completed ephemeris download
switch constellation	Decimal, 1 digits	Switch constellation features indicator
duty cycle enable	Decimal, 1 digits	Duty cycle enable indicator
duty cycle ms off	Decimal, 3 digits	Duty cycle ms signal off
duty cycle state	Decimal, 1 digits	Duty cycle state indicator

Results:

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

12.6.77 $PSTMSTANDBYENABLE

Message sent in response of command *$PSTMSTANDBYENABLE*.

Synopsis:

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

Arguments:

Table 191. $PSTMSTANDBYENABLE message field description

Parameter	Format	Description
status	Decimal, 1 digits	Set the standby enable status 0: Active Periodic mode 1: Periodic mode, standby allowed

Results:

- Message sent in case of successful operation.

12.6.78 $PSTMSTANDBYENABLEOK

Message sent in response to command *$PSTMSTANDBYENABLE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.79 $PSTMSTANDBYENABLEERROR

Message sent in response to command *$PSTMSTANDBYENABLE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.80 $PSTMADCDATA

Reports the ADC channels data read.

Synopsis:

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

Arguments:

Table 192. $PSTMADCDATA message field description

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

Results:

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

Example:

```
$PSTMADCDATA,754,862,0,754,13,754,754,81*4B
$PSTMADCDATA,793,,,,0,,,59*4D
```

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

12.6.81 $PSTMANTENNASTATUS

This message reports most relevant information about the Antenna Detection module. It is printed asynchronously when the antenna status changes.

Synopsis:

```
$PSTMANTENNASTATUS,<ant_status>,<op_mode>,<rf_path>,<pwr_switch>*<checksum
><cr><lf>
```

Arguments:

Table 193. $PSTMANTENNASTATUS message field description

Parameter	Format	Description
ant_status	Decimal Current	antenna status 0 = Normal condition 1 = Open condition 2 = Short condition
op_mode	Decimal	Current antenna detection operating mode 0 = Automatic mode 1 = Manual mode
rf_path	Decimal	Current RF path 0 = External antenna 1 = Internal antenna
pwr_switch	Decimal	Current antenna power status 0 = Antenna power is on 1 = Antenna power is off

Results:

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

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

12.6.82 $PSTMPV

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

Synopsis:

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

Arguments:

Table 194. $PSTMPV message field description

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC Time of GPS Sample, example: 160836.000 ".sss" is the fraction of seconds; it assumes non zero values when the fix rate is bigger than 1Hz.
Lat	DDMM.MMMMM	Lat in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
N/S	"N" or "S"	Lat Direction: North or South

Table 194. $PSTMPV message field description (continued)

Parameter	Format	Description
Long	DDMM.MMMMM	Long in degree: DD: Degree MM: Minutes .MMMMM: partsMinutes
E/W	“E” or “W”	Long Direction: East or West
Alt	Decimal, 6 digits	Height above mean sea level, max: 100000m
Alt-Val	“M”	Height measure in “M” = meters
Vel_N	ddd.d	Velocity North component [m/s]
Vel_E	ddd.d	Velocity East component [m/s]
Vel_V	ddd.d	Velocity Vertical component [m/s]
P_cov_N	ddd.d	Position North covariance [m]
P_cov_NE	ddd.d	Position North-East covariance [m]
P_cov_NV	ddd.d	Position North-Vertical covariance [m]
P_cov_E	ddd.d	Position East covariance [m]
P_cov_EV	ddd.d	Position East-Vertical covariance [m]
P_cov_V	ddd.d	Position Vertical covariance [m]
V_cov_N	ddd.d	Velocity North covariance [m/s]
V_cov_NE	ddd.d	Velocity North-East covariance [m/s]
V_cov_NV	ddd.d	Velocity North-Vertical covariance [m/s]
V_cov_E	ddd.d	Velocity East covariance [m/s]
V_cov_EV	ddd.d	Velocity East-Vertical covariance [m/s]
V_cov_V	ddd.d	Velocity Vertical covariance [m/s]

Example:

```
$PSTMPV,160635.000,4055.10928,N,01416.56027,E,026.96,M,0.2,0.0,0.1,22.6,12
.8,5.8,17.2,10.9,18.8,5.5,4.1,1.7,4.6,0.0,2.7*70
```

12.6.83 $PSTMPVRAW

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

Synopsis:

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

Arguments:

Table 195. $PSTMPVRAW message field description

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

Example:

```
$PSTMPVRAW,144056.000,5131.12414,N,00005.31484,W,2,09,1.2,043.31,M,47.0,M,
-0.6,0.1,0.6*58
```

12.6.84 $PSTMPVQ

Provides position and velocity processing noise matrix values.

Synopsis:

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

Arguments:

Table 196. $PSTMPVQ message field description

Parameter	Format	Description
P_Q_N	ddd.d	Position North processing noise [m]
P_Q_E	ddd.d	Position East processing noise [m]
P_Q_V	ddd.d	Position Vertical processing noise [m]
Q_CLKO	ddd.d	Clock offset processing noise [m]
Q_GLPD	ddd.d	Glonass path delay [m]
V_Q_N	ddd.d	Velocity North processing noise [m/s]
V_Q_E	ddd.d	Velocity East processing noise [m/s]
V_Q_V	ddd.d	Velocity Vertical processing noise [m/s]
Q_CLKD	ddd.d	Clock drift processing noise [m/s]
RESERVED	-	RESERVED for future use

Example:

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

12.6.85 $PSTMUTC

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

Synopsis:

```
$PSTMUTC,<utc_time>,<utc_date>,<utc_timestamp>,<gps_utc_leap>,<gps_utc_val
idity>,<glonass_utc_leap>,<glonass_utc_validity>,<beidou_utc_leap>,<beidou
_utc_validity>*<checksum><cr><lf>
```

Arguments:

Table 197. $PSTMUTC message field description

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

Table 197. $PSTMUTC message field description (continued)

Parameter	Format	Description
beidou_utc_leap	Decimal, 2 digits	UTC to GPS time offset [s]
beidou_utc_validity	Decimal, 1 digit	UTC to GPS time offset validity 0 = NOT Valid 1 = Read From NVM 2 = Valid (downloaded from sky)

Example:

```
$PSTMUTC,012358.000,02122015,1133054638,16,2,00,2,02,2*58
```

12.6.86 $PSTMFEDATA

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

Synopsis:

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

Arguments:

Table 198. $PSTMFEDATA message field description

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

Example:

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

12.6.87 $PSTMERRORMSG

This message reports an error, its location as well as additional (and optional) parameters helpful to understand the error cause.

Synopsis:

```
$PSTMERRORMSG,<error_code>,<param1>,...,<param6>*<checksum><cr><lf>
```

Arguments:

Table 199. $PSTMERRORMSG message field description

Parameter	Format	Description
error_code	Hexadecimal, 8 digits	Indicates where the error comes from.
Param1 up to param6	Hexadecimal, 8 digits	Optional parameters used to understand the error. There can be 0 additional parameter.

Example:

```
$PSTMERRORMSG,01900001,11111111,11111111,cccccccc,0000dddd,eeeeeeee*26
$PSTMERRORMSG,01920003*2E
```

12.6.88 $PSTMGNSSINTEGRITY

This message is sent from GNSS Teseo to the host periodically it is enabled in the message list.

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

Synopsis:

```
$PSTMGNSSINTEGRITY,<type>,<pos_const_mask>,<pos_err_AtoB>,<pos_err_AtoC>,<
pos_err_BtoC>,<time_const_mask>,<time_err_AtoB>,<time_err_AtoC>,<time_err_
BtoC>*<checksum><cr><lf>
```

Arguments:

Table 200. $PSTMGNSSINTEGRITY message field description

Parameter	Format	Description
type	Decimal	Integrity message type (currently always 0)
pos_const_mask	Decimal	Position related constellation mask
pos_err_AtoB	Double	Position error of second active constellation in comparison to the first one as meters
pos_err_AtoC	Double	Position error of third active constellation in comparison to the first one as meters
pos_err_BtoC	Double	Position error of third active constellation in comparison to the second one as meters
time_const_mask	Decimal	Time related constellation mask
time_err_AtoB	Double	Time error of second active constellation in comparison to the first one as nanoseconds
time_err_AtoC	Double	Time error of third active constellation in comparison to the first one as nanoseconds
time_err_BtoC	Double	Time error of third active constellation in comparison to the second one as nanoseconds

12.6.89 $PSTMNAVM

Navigation Data Frame.

Synopsis:

```
$PSTMNAVM,<msg_id>,<prn>,<nav_frame>*<checksum><cr><lf>
```

Arguments:

Table 201. $PSTMNAVM message field description

Parameter	Format	Description
msg_id	Decimal, 1 digits	Message ID (GPS = 0, GLONASS = 1, GALILEO = 3, BEIDOU = 7)
prn	Decimal, 3 digits	Satellite PRN (Range: depending on the constellation)
nav_frame	Hexadecimal, up to 80 digits	Navigation data frame (length: depending on the constellation)

Details:

The navigation frame parameter depends on the constellation. The following table describes its meaning (see each constellation ICD document for details):

Table 202. Navigation frame data types

Constellation	Type	Length (bits)	Length (bytes)	Note
GPS	Sub-frame	300	40 (10 words)	For each 32 bit word 30 bits are used (the 2 msb are ignored)
GLONASS	1 or 2 strings	85 or 170 (85+85)	11 or 22 (11+11 bytes)	One string for each message for strings from 1 to 5. Two strings for each message for strings from 6 to 15. For the first byte of each string the 3 msb are ignored and the 4^{th} is always zero. The payload is 84 bits long
GALILEO	payload	128	16 (4 words)	Each message contains the payload from I/NAV message (see Note for details)
BEIDOU	Sub-frame	300	40 (10 words)	For each 32 bit word 30 bits are used (the 2 msb are ignored)

Note: In the above table, "word" means a 32-bit little endian encoded word, while "msb" means most significant bit(s).
It means that, in a little endian architecture system, the navigation frame (converted to binary format) can be directly copied into a C 32 bit unsigned integer words array. In other words:

- For GPS, the navigation frame can be copied into a C language variable defined according to the following type definition:

```
typedef tU32  gps_subframe_t  [10];
```

- For GLONASS, the navigation frame can be copied into a C language variable defined according to the following type definition:

```
typedef tU08  glo_subframe_t  [22];
```

Note: For strings for #1 to #5 just the first 11 bytes will be used, while for strings from #6 to #15 all 22 bytes will be used by storing two consecutive strings (e.g. strings #7 and #6). In this latter case the first sting (e.g. string #n) will be stored in the second part of the array (i.e. from byte #12 to #22), and the second string (e.g. string #n+1) will be stored in the first part of the array (i.e. from byte #1 to #11).

- For GALILEO, the navigation frame can be copied in a C language variable defined according to the following type definition:

```
typedef tU32  gal_subframe_t  [4];
```

Note: The GALILEO navigation frame contains the message payload, encoded according to the following figure.

Figure 32. Galileo payload, 128[bit], 32-bit packing

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Data k 0-31 (112 bit)																															
1	Data k 32-63 (112 bit)																															
2	Data k 64-95 (112 bit)																															
3	Data k 96-111 (112 bit)																Data j (16 bit)															

For BEIDOU, the navigation frame can be copied in a C language variable defined according to the following type definition:

```
typedef tU32  bds_subframe_t  [10];
```

where *tU32* is a 32 bit unsigned integer type and *tU08* is a 8 bit unsigned integer type.

Example:

```
$PSTMNAVM,0,4,00AFC32268A9BD26337FF43AC40B60D1B8B80018C8EE0B0330BDA238AF71
1D185E1000C088790781*23
```

12.6.90 $PSTMEPHEM

Ephemeris Data Dump.

This message is sent as a reply to a *$PSTMDUMPEPHEMS* command.

Synopsis:

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

Arguments:

Table 203. $PSTMEPHEM message field description

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

The N Bytes that are in the message are the dump of a structure that contains all the information of the ephemeris.

Data formats are constellation dependant.

Table 204. $PSTMEPHEM message field description for GPS constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
16	toe	Time of week for ephemeris epoch
16	toc	Time of week for clock epoch
8	iode1	Issue of data 1

Table 204. $PSTMEPHEM message field description for GPS constellation (continued)

Bits	Structure Member	Description
8	iode2	Issue of data 2
10	iodc	Issue of data clock
14	i_dot	Rate of inclination angle.
8	RESERVED	
24	omega_dot	Rate of right ascension.
8	RESERVED	Must be 0.
16	crs	Amplitude of the sine harmonic correction to the orbit radius.
16	crc	Amplitude of the cosine harmonic correction to the orbit radius.
16	cus	Amplitude of the sine harmonic correction to the argument of latitude.
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
16	cis	Amplitude of the sine harmonic correction to the angle of inclination.
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
16	motion_difference	Mean motion difference from computed value
16	RESERVED	Must be 0.
32	inclination	Inclination angle at reference time
32	e	Eccentricity.
32	root_A	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
8	time_group_delay	Estimated group delay differential.
8	af2	Second order clock correction.
16	af1	First order clock correction.
22	af0	Constant clock correction.
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	RESERVED for use by GNSS library – must be 1
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
1	RESERVED	Must be 0.
4	accuracy	Accuracy

Table 205. $PSTMEPHEM message field description for GLONASS constellation

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

Table 205. $PSTMEPHEM message field description for GLONASS constellation (continued)

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

Table 206. $PSTMEPHEM message field description for Galileo constellation

Bits	Structure Member	Description
16	week	Week number of the Issue of Data
14	toe	Time of week for ephemeris epoch
2	RESERVED	
16	toc	Time of week for clock epoch
10	iod_nav	Issue of data
8	SISA	Signal In Space Accuracy
10	RESERVED	Must be 0.
10	BGD_E1_E5a	E1-E5a Broadcast Group Delay
10	BGD_E1_E5b	E1-E5b Broadcast Group Delay
2	E1BHS	E1-B Signal Health Status
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.

Table 206. $PSTMEPHEM message field description for Galileo constellation (continued)

Bits	Structure Member	Description
14	i_dot	Rate of inclination angle.
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy
16	motion_difference	Mean motion difference from computed value
16	crs	Amplitude of the sine harmonic correction to the orbit radius.
16	crc	Amplitude of the cosine harmonic correction to the orbit radius.
16	cus	Amplitude of the sine harmonic correction to the argument of latitude.
16	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
16	cis	Amplitude of the sine harmonic correction to the angle of inclination.
16	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
24	omega_dot	Rate of right ascension.
6	SVID	Satellite Identification.
1	E1BDVS	E1-B Data Validity Status
1	RESERVED	Must be 0.
8	RESERVED	Must be 0.
16	RESERVED	Must be 0.
6	af2	Second order clock correction.
21	af1	First order clock correction.
5	word_available	Must be 0x1F.
31	af0	Constant clock correction.
1	RESERVED	
6	RESERVED	Must be 0
26	RESERVED	RESERVED for use by GNSS library – must be 1
1	RESERVED	Must be 0.

Table 207. $PSTMEPHEM message field description for BEIDOU constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential.

Table 207. $PSTMEPHEM message field description for BEIDOU constellation (continued)

Bits	Structure Member	Description
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension.
8	A0	Ionospheric Delay Model Parameter α_0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter α_1
20	sow	Seconds of week
11	af2	Second order clock correction.
1	is_geo	1 for Geostationary satellites, otherwise 0
22	af1	First order clock correction.
10	subframe_avail	Must be 0x3FF.
16	motion_difference	Mean motion difference from computed value
8	A2	Ionospheric Delay Model Parameter α_2
8	A3	Ionospheric Delay Model Parameter α_3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter β_2
4	urai	User range accuracy index
2	RESERVED	Must be 0.
18	crc	Amplitude of the cosine harmonic correction to the orbit radius.
8	B3	Ionospheric Delay Model Parameter β_3
5	aodc	Issue of data, clock
1	spare	
18	cus	Amplitude of the sine harmonic correction to the argument of latitude.
14	i_dot	Rate of inclination angle.
18	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
8	B0	Ionospheric Delay Model Parameter β_0
6	spare	
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter β_1
6	RESERVED	Must be 0.
18	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
1	nvm_reliable	Must be 1.
11	RESERVED	Must be 0.
2	spare	
17	toc	Time of week for clock epoch
13	week	Week number of the Issue of Data

Table 207. $PSTMEPHEM message field description for BEIDOU constellation (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

12.6.91 $PSTMALMANAC

Almanac Data Dump.

This message is sent as a reply to a *$PSTMDUMPALMANAC* command.

Synopsis:

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

Arguments:

Table 208. $PSTMALMANAC message field description

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

The N Bytes that are in the message are the dump of a structure that contains all the information of the almanac.

Data formats is constellation dependent

Table 209. $PSTMALMANAC message field description for GPS constellation

Bits	Structure Member	Description
8	satid	The satellite number
16	week	The week number for the epoch
8	toa	Reference time almanac.
16	e	Eccentricity.
16	delta_i	Rate of inclination angle.
16	omega_dot	Rate of right ascension.
24	root_A	Square root of semi-major axis.
24	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
24	perigee	Argument of perigee.
24	mean_anomaly	Mean anomaly at reference time.
11	af0	Constant clock correction.
11	af1	First order clock correction.

Table 209. $PSTMALMANAC message field description for GPS constellation

Bits	Structure Member	Description
1	health	Contains 1 if the satellite is unhealthy 0 if healthy.
1	available	Contains 1 if almanac is available 0 if not.

Table 210. $PSTMALMANAC field description for GLONASS constellation

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

Table 211. $PSTMALMANAC field description for Galileo constellation

Bits	Structure Member	Description
16	satid	The satellite number
6	svid	Space Vehicle Identificator
16	week	The week number for the epoch
20	toa	Reference time almanac.
13	delta_a	Delta of semi-major axis.
11	e	Eccentricity.

Table 211. $PSTMALMANAC field description for Galileo constellation (continued)

Bits	Structure Member	Description
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.

12.6.92 $PSTMGPSSUSPENDED

Message sent in response to command *$PSTMGPSSUSPEND*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.93 PSTMUSEDSATS

This message reports the number of used satellites for each constellation.

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

Synopsis:

```
$PSTMUSEDSATS,<GPS_n>,<GLONASS_n>,<GALILEO_n>,<BEIDOU_n>,<QZSS_n>*<checksu
m><cr><lf>
```

Arguments:

Table 212. $PSTMUSEDSATS message field description

Parameter	Format	Description
GPS_n	Decimal, 2 digits	Number of used satellites of the GPS constellation
GLONASS_n	Decimal, 2 digits	Number of used satellites of the GLONASS constellation
GALILEO_n	Decimal, 2 digits	Number of used satellites of the GALILEO constellation
BEIDOU_n	Decimal, 2 digits	Number of used satellites of the BEIDOU constellation
QZSS_n	Decimal, 2 digits	Number of used satellites of the QZSS constellation

Results:

None.

Example:

`$PSTMUSEDSATS,08,07,00,00,00*2B`

12.6.94 $PSTMSETUCODEOK

Message sent in response to command *$PSTMSETUCODE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.95 $PSTMSETUCODEERROR

Message sent in response to command *$PSTMSETUCODE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.96 $PSTMGETUCODEOK

Message sent in response to command *$PSTMGETUCODE*

Synopsis:

```
$PSTMGETUCODEOK,<unique_code>*<checksum><cr><lf>
```

Arguments:

Table 213. $PSTMGETUCODEOK message field description

Parameter	Format	Description
unique_code	Char, 32 bytes	The Unique ID written in the secondary boots

Results:

Message sent in case of successful operation.

12.6.97 $PSTMGETUCODEERROR

Message sent in response to command *$PSTMGETUCODE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.98 $PSTMEPHEMOK

Message sent in response of command *$PSTMEPHEM*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.99 $PSTMEPHEMERROR

Message sent in response of command *$PSTMEPHEM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of errors.

12.6.100 $PSTMALMANACOK

Message sent in response of command *$PSTMALMANAC*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.101 $PSTMALMANACERROR

Message sent in response of command *$PSTMALMANAC*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of errors.

12.6.102 $PSTMSETANTSENSOPMODEOK

Message sent in response to command *$PSTMSETANTSENSOPMODE*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

12.6.103 $PSTMSETANTSENSOPMODEERROR

Message sent in response to command *$PSTMSETANTSENSOPMODE*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.104 $PSTMSETANTSENSMANUAL

Message sent in response to command *$PSTMSETANTSENSMANUAL*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.6.105 $PSTMSETANTSENSMANUALERROR

Message sent in response to command *$PSTMSETANTSENSMANUAL*.

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

12.7 ST system configuration messages

12.7.1 $PSTMSETPAROK

Message sent in response to command *$PSTMSETPAR*

Synopsis:

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

Arguments:

Table 214. $PSTMSETPAROK message field description

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

Results:

Message sent in case of successful operation.

12.7.2 $PSTMSETPARERROR

Message sent in response to command *$PSTMSETPAR*

Synopsis:

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

Argument:

No argument

Results:

Message sent in case of error.

12.7.3 $PSTMRESTOREPAROK

Message sent in response to command *$PSTMRESTOREPAR*

Synopsis:

`$PSTMRESTOREPAROK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.4 $PSTMRESTOREPARERROR

Message sent in response to command *$PSTMRESTOREPAR*

Synopsis:

`$PSTMRESTOREPARERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.5 $PSTMSAVEPAROK

Message sent in response to command *$PSTMSAVEPAR*

Synopsis:

`$PSTMSAVEPAROK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.6 $PSTMSAVEPARERROR

Message sent in response to command *$PSTMSAVEPAR*

Synopsis:

```
$PSTMSAVEPARERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.7 $PSTMSETPAR

Message sent in response to command *$PSTMGETPAR*

Synopsis:

```
$PSTMSETPAR,<ConfigBlock><ID>,<value>*<checksum><cr><lf>
```

Arguments:

Table 215. $PSTMSETPAR message field description

Parameter	Format	Description
ConfigBlock	Decima1, 1 digit	Indicates one of the configuration blocks: 1 = Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see Configuration Data Block)
value	Hexadecimal or Decimal	The value of returned parameter. According to the parameter type it could be expressed in hexadecimal format (in case parameter is integer) or decimal format (in case the parameter is floating).

12.7.8 $PSTMGETPARERROR

Message sent in response to command *$PSTMGETPAR*.

Synopsis:

```
$PSTMGETPARERROR*<checksum><cr><lf>
```

Arguments:

No aruments

Results:

- In case of errors, the error message is returned

12.7.9 $PSTMCFGPORTOK

Message sent in response to command *$PSTMCFGPORT*

Synopsis:

```
$PSTMCFGPORTOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.10 $PSTMCFGPORTERROR

Message sent in response to command *$PSTMCFGPORT*

Synopsis:

```
$PSTMCFGPORTERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.11 $PSTMCFGANTSENSOK

Message sent in response to command *$PSTMCFGANTSENS*

Synopsis:

```
$PSTMCFGANTSENSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.12 $PSTMCFGANTSENSERROR

Message sent in response to command *$PSTMCFGANTSENS*

Synopsis:

```
$PSTMCFGANTSENSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.13 $PSTMCFGCLKSOK

Message sent in response to command *$PSTMCFGCLKS*

Synopsis:

```
$PSTMCFGCLKSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.14 $PSTMCFGCLKSERROR

Message sent in response to command *$PSTMCFGCLKS*

Synopsis:

```
$PSTMCFCLKSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.15 $PSTMCFGMSGLOK

Message sent in response to command *$PSTMCFGMSGL*

Synopsis:

```
$PSTMCFGMSGLOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.16 $PSTMCFGMSGLERROR

Message sent in response to command *$PSTMCFGMSGL*

Synopsis:

```
$PSTMCFGMSGLERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.17 $PSTMCFGGNSSOK

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

```
$PSTMCFGGNSSOKOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.18 $PSTMCFGGNSSERROR

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

```
$PSTMCFGGNSSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.19 $PSTMCFGSBASOK

Message sent in response to command *$PSTMCFGSBAS*

Synopsis:

```
$PSTMCFGSBASOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.20 $PSTMCFGSBASERROR

Message sent in response to command *$PSTMCFGSBAS*

Synopsis:

```
$PSTMCFGSBASERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.21 $PSTMCFGPPSGENOK

Message sent in response to command *$PSTMCFGPPSGEN*

Synopsis:

```
$PSTMCFGPPSGENOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.22 $PSTMCFGPPSGENERROR

Message sent in response to command *$PSTMCFGPPSGEN*

Synopsis:

```
$PSTMCFGPPSGENERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.23 $PSTMCFGPPSSATOK

Message sent in response to command *$PSTMCFGPPSSAT*

Synopsis:

```
$PSTMCFGPPSSATOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.24 $PSTMCFGPPSSATERROR

Message sent in response to command *$PSTMCFGPPSSAT*

Synopsis:

```
$PSTMCFGPPSSATERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.25 $PSTMCFGPPSPULOK

Message sent in response to command *$PSTMCFGPPSPUL*

Synopsis:

```
$PSTMCFGPPSPULOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.26 $PSTMCFGPPSPULERROR

Message sent in response to command *$PSTMCFGPPSPUL*

Synopsis:

`$PSTMCFGPPSPULERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.27 $PSTMCFGPOSHOLDOK

Message sent in response to command *$PSTMCFGPOSHOLD*

Synopsis:

`$PSTMCFGPOSHOLDOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.28 $PSTMCFGPOSHOLDERROR

Message sent in response to command *$PSTMCFGPOSHOLD*

Synopsis:

`$PSTMCFGPOSHOLDERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.29 $PSTMCFGTRAIMOK

Message sent in response to command *$PSTMCFGTRAIM*

Synopsis:

`$PSTMCFGTRAIMOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.30 $PSTMCFGTRAIMERROR

Message sent in response to command *$PSTMCFGTRAIM*

Synopsis:

```
$PSTMCFGTRAIMERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.31 $PSTMCFGSATCOMPOK

Message sent in response to command *$PSTMCFGSATCOMP*

Synopsis:

```
$PSTMCFGSATCOMPOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.32 $PSTMCFGSATCOMERROR

Message sent in response to command *$PSTMCFGSATCOMP*

Synopsis:

```
$PSTMCFGSATCOMPERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.33 $PSTMCFGLPAOK

Message sent in response to command *$PSTMCFGLPA*

Synopsis:

```
$PSTMCFGLPAOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.34 $PSTMCFGLPAERROR

Message sent in response to command *$PSTMCFGLPA*

Synopsis:

```
$PSTMCFGLPAERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.35 $PSTMCFGLPSOK

Message sent in response to command *$PSTMCFGLPS*

Synopsis:

```
$PSTMCFGLPSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.36 $PSTMCFGLPSERROR

Message sent in response to command *$PSTMCFGLPS*

Synopsis:

```
$PSTMCFGLPSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.37 $PSTMCFGAGPSOK

Message sent in response to command *$PSTMCFGAGPS*

Synopsis:

```
$PSTMCFGAGPSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.38 $PSTMCFGAGPSERROR

Message sent in response to command *$PSTMCFGAGPS*

Synopsis:

`$PSTMCFGAGPSERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.39 $PSTMCFGAJMOK

Message sent in response to command *$PSTMCFGAJM*

Synopsis:

`$PSTMCFGAJMOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.40 $PSTMCFGAJMERROR

Message sent in response to command *$PSTMCFGAJM*

Synopsis:

`$PSTMCFGAJMERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.41 $PSTMCFGODOOK

Message sent in response to command *$PSTMCFGODO*

Synopsis:

`$PSTMCFGODOOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.42 $PSTMCFGODOERROR

Message sent in response to command *$PSTMCFGODO*

Synopsis:

```
$PSTMCFGODOERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.43 $PSTMCFGLOGOK

Message sent in response to command *$PSTMCFGLOG*

Synopsis:

```
$PSTMCFGLOGOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.44 $PSTMCFGLOGERROR

Message sent in response to command *$PSTMCFGLOG*

Synopsis:

```
$PSTMCFGLOGERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.45 $PSTMCFGGEOFENCEOK

Message sent in response to command *$PSTMCFGGEOFENCE*

Synopsis:

```
$PSTMCFGGEOFENCEOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.46 $PSTMCFGGEOFENCEERROR

Message sent in response to command *$PSTMCFGGEOFENCE*

Synopsis:

`$PSTMCFGGEOFENCEERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.47 $PSTMCFGGEOCIROK

Message sent in response to command *$PSTMCFGGEOCIR*

Synopsis:

`$PSTMCFGGEOCIROK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.48 $PSTMCFGGEOCIRERROR

Message sent in response to command *$PSTMCFGGEOCIR*

Synopsis:

`$PSTMCFGGEOCIRERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.49 $PSTMCFGGNSSOK

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

`$PSTMCFGGNSSOKOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.50 $PSTMCFGGNSSERROR

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

`$PSTMCFGGNSSERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.51 $PSTMCFGCONSTOK

Message sent in response to command *$PSTMCFGCONST*

Synopsis:

`$PSTMCFGCONSTOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.52 $PSTMCFGCONSTERROR

Message sent in response to command *$PSTMCFGCONST*

Synopsis:

`$PSTMCFGCONSTERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.7.53 $PSTMCFGTHGNSSOK

Message sent in response to command *$PSTMCFGTHGNSS*

Synopsis:

`$PSTMCFGTHGNSSOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.54 $PSTMCFGTHGNSSERROR

Message sent in response to command *$PSTMCFGTHGNSS*

Synopsis:

```
$PSTMCFGTDATAOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.55 $PSTMCFGTDATAOK

Message sent in response to command *$PSTMCFGTDATA*

Synopsis:

```
$PSTMCFGTDATAOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

"Message sent in case of successful operation.

12.7.56 $PSTMCFGTDATAERROR

Message sent in response to command *$PSTMCFGTDATA*

Synopsis:

```
$PSTMCFGTDATAERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

"Message sent in case of error.

12.7.57 $PSTMCFGASIOSOK

Message sent in response to command *$PSTMCFGASIOS*

Synopsis:

```
$PSTMCFGASIOSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation

12.7.58 $PSTMCFGASIOSERROR

Message sent in response to command *$PSTMCFGASIOS*

Synopsis:

```
$PSTMCFGASIOSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.59 $PSTMCFGASPARAMSOK

Message sent in response to command *$PSTMCFGASPARAMS*

Synopsis:

```
$PSTMCFGASPARAMSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.60 $PSTMCFGASPARAMSERROR

Message sent in response to command *$PSTMCFGASPARAMS*

Synopsis:

```
$PSTMCFGASPARAMSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.7.61 $PSTMCFGASEVENTSOK

Message sent in response to command *$PSTMCFGASEVENTS*

Synopsis:

```
$PSTMCFGASEVENTSOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.7.62 $PSTMCFGASEVENTSERROR

Message sent in response to command *$PSTMCFGASEVENTS*

Synopsis:

```
$PSTMCFGASEVENTSERROR*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of error.

12.8 Datalogging NMEA messages

12.8.1 $PSTMLOGCREATEOK

Message sent in response to command *$PSTMLOGCREATE*

Synopsis:

```
$PSTMLOGCREATEOK*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.8.2 $PSTMLOGCREATEERROR

Message sent in response to command *$PSTMLOGCREATE*

Synopsis:

```
$PSTMLOGCREATEERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.8.3 $PSTMLOGSTARTOK

Message sent in response to command *$PSTMLOGSTART*

Synopsis:

```
$PSTMLOGSTARTOK*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.8.4 $PSTMLOGSTARTERROR

Message sent in response to command *$PSTMLOGSTART*

Synopsis:

`$PSTMLOGSTARTERROR*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of error.

12.8.5 $PSTMLOGSTOPOK

Message sent in response to command *$PSTMLOGSTOP*

Synopsis:

`$PSTMLOGSTOPOK*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.8.6 $PSTMLOGSTOPERROR

Message sent in response to command *$PSTMLOGSTOP*

Synopsis:

`$PSTMLOGSTOPERROR*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of error.

12.8.7 $PSTMLOGERASEOK

Message sent in response to command *$PSTMLOGERASE*

Synopsis:

`$PSTMLOGERASEPOK*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.8.8 $PSTMLOGERASEERROR

Message sent in response to command *$PSTMLOGERASE*

Synopsis:

```
$PSTMLOGERASEERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.8.9 $PSTMLOGSTATUS

Message sent by the GNSS Teseo III in response to *$PSTMLOGREQSTATUS* the internal data log subsystem state.

This message is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMLOGSTATUS,<time-first-entry>,<data-first-entry>,<time-last-
entry>,<data-last-entry>,<used>,<bufer-status>,<free-
entries>*<checksum><cr><lf>
```

Arguments:

Table 216. $PSTMLOGSTATUS message field description

Parameter	Format	Description
time-first-entry	Decimal, 6 Digits	The first entry timestamp as hhmmss
data-first-entry	Decimal, 8 Digits	The first entry date stamp as yyyyMMdd
time-last-entry	Decimal, 6 Digits	The last entry timestamp as hhmmss
data-last-entry	Decimal, 8 Digits	The last entry date stamp as yyyyMMdd
used	Unsigned	Used entries
buffer-status	Decimal, 1 Digit	Status of data buffer: 0 = non full 1 = full
free-entries	Unsigned	Remaing free entries

12.8.10 $PSTMLOGSTATUSERROR

Message sent in response to command *$PSTMLOGREQSTATUS*

Synopsis:

```
$PSTMLOGREQSTATUSERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.8.11 $PSTMLOGQUERY

This messages is sent by the ST GNSS Teseo III in response to a query command *$PSTMLOGREQQUERY*.

GNSS Teseo sends a message for each entry in the log compliant to the query raised by the host.

This message is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMLOGQUERY,<status-bitmap>,<log-mask>,<timestamp>,<date-
stamp>,<altitude>,<odometer>,<geo>,<quality>,<qual-
idx>,<fix>,<speed>*<checksum><cr><lf>
```

Arguments:

Table 217. $PSTMLOGQUERY message field description

Parameter	Format	Description
status-bitmap	Decimal	[1]: DataValid (DV) [0]: EndOfData (EOD)
log-mask	Decimal, 1 digit	Which dataset is logged
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
date-stamp	Decimal, 8 digits	Year (4 digit); Month (2 digit); Day (2 digit)
fix	Decimal, 1 digit	Fix status where: 1 = NO_FIX, 2 = FIX_2D, 3 = FIX 3D.

Table 217. $PSTMLOGQUERY message field description (continued)

Parameter	Format	Description
quality	Unsigned	Estimation of accuracy (ehpe) expressed in meters. Note that in case of log-mask type = 1 this quality is expressed as IDx where 0 = (quality > 50), 1 = (quality > 40), 2 = (quality > 30), 3 = (quality > 20), 4 = (quality > 15), 5 = (quality > 10), 6 = (quality > 5), 7 = (quality > 2).
geo	Decimal, 1 digit	Geo fencing status where: 0 = Status unknown 1 = Current position is outside the circle 2 = Current position on circle boundary 3 = Current position is inside the circle
lat	Double	Current latitude.
lon	Double	Current longitude.
alt	Double	Current altitude. It depends on log-mask. If disabled this value will be always zero. See *Table 9* for more details.
speed	Double	Current speed. It depends on log-mask. If disabled this value will be always zero. See *Table 9* for more details.
odo	Double	Current odometer data. It depends on log-mask. If disabled this value will be always zero. See *Table 9* for more details.

In the $PSTMLOGREQQUERY the bit-fields:

- `Status-bitmap.EndOfData` (EOD) notifies no more data have to be sent by the GNSS Teseo;
- `Status-bitmap.DataValid` (DV) notifies the data in the message is valid or not;

Using the EOD and the DV bit-fields the GNSS Teseo III can notify all the possible cases:`[DV=0, EOD=0]:` Out-Of-Spec GNSS Teseo cannot send message with this configuration;

[DV=0, EOD=1]: GNSS Teseo has no more data to send; this message can be:

- the last one in a valid sequence of data-log;
- the first one if the host raised a not valid request (ie.start_index out of the log range);
- No data in the log;
- [DV=1, EOD=0]: the message contains a valid data and the GNSS has to send other datas;
- [DV=1, EOD=1]: the message contains a valid data and the GNSS has no more data to send;

If the message $PSTMLOGREQQUERY has the `Status-bitmap.DV=0` the remaining fields could not be sent at all by the GNSS Teseo.

If the Host raises one of the commands, $PSTMLOGCREATE, $PSTMLOGERASE, $PSTMLOGREQQUERY, while the GNSS Teseo has pending $PSTMLOGQUERY messages to be sent (in response to a previous $PSTMLOGQUERY), in this case the GNSS Teseo discards the pending $PSTMLOGQUERY messages.

12.8.12 $PSTMLOGQUERYERROR

Message sent in response to command *$PSTMLOGREQQUERY*

Synopsis:

```
$PSTMLOGCREATEERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.9 Geofencing NMEA messages

12.9.1 $PSTMGEOFENCECFGOK

Message sent in response to command *$PSTMGEOFENCECFG*

Synopsis:

```
$PSTMGEOFENCECFGOK*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.9.2 $PSTMGEOFENCECFGERROR

Message sent in response to command *$PSTMGEOFENCECFG*

Synopsis:

```
$PSTMGEOFENCECFGERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.9.3 $PSTMGEOFENCESTATUS

This message is sent from GNSS Teseo to the host as a response to *$PSTMGEOFENCEREQ*.

Geofence reports a bitmap against which circle is raising the alarm.

This message is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMGEOFENCESTATUS,<timestamp>,<datestamp>,<status_1>,<status_2>,…,<status_x>*<checksum><cr><lf>
```

Arguments:

Table 218. $PSTMGEOFENCESTATUS message field description

Parameter	Format	Description
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
datestamp	Decimal, 8 digits	Year (4 digit); Month (2 digit); Day (2 digit)
status_x	Decimal, 1 digit	Geo fencing status for each circle where: 0 = Status unknown 1 = Current position is outside the circle 2 = Current position on circle boundary 3 = Current position is inside the circle

12.9.4 $PSTMGEOFENCEREQERROR

Message sent in response to command *$PSTMGEOFENCEREQ*

Synopsis:

```
$PSTMGEOFENCEREQERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.10 Odometer NMEA messages

12.10.1 $PSTMODOSTARTOK

Message sent in response to command *$PSTMODOSTART*

Synopsis:

`$PSTMSTARTOK*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.10.2 $PSTMODOSTARTERROR

Message sent in response to command *$PSTMODOSTART*

Synopsis:

`$PSTMSTARTERROR*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of error.

12.10.3 $PSTMODOSTOPOK

Message sent in response to command *$PSTMODOSTOP*

Synopsis:

`$PSTMSTOPOK*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.10.4 $PSTMODOSTOPERROR

Message sent in response to command *$PSTMODOSTOP*.

Synopsis:

`$PSTMSTOPERROR*<checksum><cr><lf>`

Arguments:

No argument

Results:

Message sent in case of error.

12.10.5 $PSTMODORESETOK

Message sent in response to command *$PSTMODORESET*.

Synopsis:

```
$PSTMRESETOK*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of successful operation.

12.10.6 $PSTMODORESETERROR

Message sent in response to command *$PSTMODORESET*.

Synopsis:

```
$PSTMRESETERROR*<checksum><cr><lf>
```

Arguments:

No argument

Results:

Message sent in case of error.

12.10.7 $PSTMODO

This message is sent from GNSS Teseo III to the host periodically if Odometer subsystem is enabled and the related messages are in the message list.

This message is implemented and supported only in Binary Image 4.5.8 and later.

Synopsis:

```
$PSTMODO,<timestamp>,<date-stamp>,<odo-A>,<odo-B>,<odo-
pon>*<checksum><cr><lf>
```

Arguments:

Table 219. $PSTMODO message field description

Parameter	Format	Description
timestamp	Decimal, 6 digits	Hour (2 digit) Minute (2 digit) Seconds (2 digit)
date-stamp	Decimal, 8 digits	Year (4 digit); Month (2 digit); Day (2 digit)
odo-A	Unsigned	Odometer A value
odo-B	Unsigned	Odometer B value
odo-pon	Unsigned	Odometer PON value

12.10.8 $PSTMODOREQERROR

Message sent in response to command *$PSTMODOREQ*.

Synopsis:

`$PSTMODOREQERROR*<checksum><cr><lf>`

Arguments:

None

Result:

Message sent in case of error.

12.11 Autonomous AGNSS NMEA messages

12.11.1 $PSTMPOLSTARTED

Message sent in response to command *$PSTMSTAGPSONOFF*.

Synopsis:

`$PSTMPOLSTARTED*<checksum><cr><lf>`

Arguments:

None

Results:

Message sent if the engine has been started

12.11.2 $PSTMPOLSUSPENDED

Message sent in response to command *$PSTMSTAGPSONOFF*.

Synopsis:

`$PSTMTPOLSUSPENDED*<checksum><cr><lf>`

Arguments:

None

Results:

Message sent if the engine has been suspended

12.11.3 $PSTMPOLONOFFERROR

Message sent in response to command *$PSTMSTAGPSONOFF*.

Synopsis:

`$PSTMTPOLONOFFERROR*<checksum><cr><lf>`

Arguments:

None

Results:

Message sent in case of error

12.11.4 $PSTMSTAGPSINVALIDATEOK

Message sent in response to command *$PSTMSTAGPSINVALIDATE*.

Synopsis:

```
$PSTMSTAGPSINVALIDATEOK*<checksum><cr><lf>
```

Arguments:

None

Results:

Message sent in case of successful operation.

12.11.5 $PSTMSTAGPSINVALIDATEERROR

Message sent in response to command *$PSTMSTAGPSINVALIDATE*.

Synopsis:

```
$PSTMSTAGPSINVALIDATEERROR*<checksum><cr><lf>
```

Arguments:

None

Results:

Message sent in case of error

12.11.6 $PSTMAGPSSTATUS

Message sent in response to command *$PSTMGETAGPSSTATUS*.

Synopsis:

```
$PSTMGETAGPSSTATUS,<status>*<checksum><cr><lf>
```

Arguments:

Table 220. $PSTMAGPSSSTATUS message field description

Parameter	Format	Description
status	Decimal, 1 digits	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 not been completely generated.

Results:

Message returns the AGPS status.

12.11.7 $PSTMSTAGPSSETCONSTMASKOK

Message sent in response to command *$PSTMSTAGPSSETCONSTMASK*.

Synopsis:

```
$PSTMSTAGPSSETCONSTMASKOK,<constellation_mask>*<checksum><cr><lf>
```

Arguments:

Table 221. $PSTMSTAGPSSETCONSTMASKOK message field description

Parameter	Format	Description
Constellation_mask	Decimal, 1 digits	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 3: GALILEO constellation enabling/disabling bit 7: BEIDOU constellation enabling/disabling

Results:

Message sent in case of successful operation

12.11.8 $PSTMSTAGPSSETCONSTMASKERROR

Message sent in response to command *$PSTMSTAGPSSETCONSTMASK*

Synopsis:

```
$PSTMSTAGPSSETCONSTMASKERROR*<checksum><cr><lf>
```

Arguments:

None

Results:

Message sent in case of error.

12.11.9 $PSTMAGPS

This message has the same syntax as the standard NMEA GSA message. Each parameter in the satellites PRN fields is an integer number that reports the satellite PRN and, in case a satellite is using a predicted ephemeris, it also reports the age of predicted ephemeris available for that satellite.

They are generated using the formula:

satID + 32 * STAGPS_AGE_DAYS

where STAGPS_AGE_DAYS is the number of days from current time back to the most recent ephemeris used for STAGPS predictions. If a satellite has no predicted ephemeris (STAGPS_AGE_DAYS = 0) the satellite parameter, reported in the sentence, is exactly the satellite PRN.

Table 222. $PSTMAGPS ephemeris aging description

STAGPS_AGE_DAYS	Ephemeris aging description
1	Latest ephemeris has been downloaded from 0 up to 24 hours in the past
2	Latest ephemeris has been downloaded from 24 up to 48 hours in the past
3	Latest ephemeris has been downloaded from 48 up to 72 hours in the past

Table 222. $PSTMAGPS ephemeris aging description

STAGPS_AGE_DAYS	Ephemeris aging description
4	Latest ephemeris has been downloaded from 72 up to 96 hours in the past
5	Latest ephemeris has been downloaded from 96 up to 120 hours in the past

This message could be used to replace the standard GSA in all devices where STAGPS is enabled. If STAGPS is not enabled, it behaves in the same way as NMEA GSA message.

NMEA message list bitmask: 0x10000000 – This message is not enabled by default

Synopsis:

```
$PSTMAGPS,<Mode>,<CurrentMode>,[<SatPRN1>],...,[<SatPRNN>],<PDOP>,<
HDOP>,<VDOP>*<checksum><cr><lf>
```

Arguments:

Table 223. $PSTMAGPS message field description

Parameter	Format	Description
Mode	“M” or “A”	Operating Mode: M = Manual, A = Auto (2D/3D)
CurrentMode	Decimal, 1 digit	Current Mode: 1 = no FIX available 2 = 2D FIX 3 = 3D FIX
SatPRN1...N	Decimal, 2 digits	Satellites list used in position FIX (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, from 0.0 to 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, from 0.0 to 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, from 0.0 to 99.0

12.11.10 $PSTMAGLO

This message has the same syntax as standard NMEA GSA message. Each parameter in the satellites PRN fields is an integer number that reports the satellite PRN and, in case a satellite is using a predicted ephemeris, it also reports the age of predicted ephemeris available for that satellite. They are generated using the formula:

satID + 32 * STAGPS_AGE_DAYS

where STAGPS_AGE_DAYS is the number of days from current time back to the most recent ephemeris used for STAGPS predictions. If a satellite has no predicted ephemeris (STAGPS_AGE_DAYS = 0) the satellite parameter, reported in the sentence, is exactly the satellite PRN.

Table 224. $PSTMAGLO ephemeris aging description

STAGPS_AGE_DAYS	Ephemeris aging description
1	Latest ephemeris has been downloaded from 0 up to 24 hours in the past
2	Latest ephemeris has been downloaded from 24 up to 48 hours in the past

Table 224. $PSTMAGLO ephemeris aging description

STAGPS_AGE_DAYS	Ephemeris aging description
3	Latest ephemeris has been downloaded from 48 up to 72 hours in the past
4	Latest ephemeris has been downloaded from 72 up to 96 hours in the past
5	Latest ephemeris has been downloaded from 96 up to 120 hours in the past

This message could be used to replace the standard GSA in all devices where STAGPS is enabled. If STAGPS is not enabled, it behaves in the same way as NMEA GSA message.

NMEA message list bitmask: 0x10000000 – This message is not enabled by default

Synopsis:

```
$PSTMAGLO,<Mode>,<CurrentMode>,[<SatPRN1>],...,[<SatPRNN>],<PDOP>,<
HDOP>,<VDOP>*<checksum><cr><lf>
```

Arguments:

Table 225. $PSTMAGLO message field description

Parameter	Format	Description
Mode	“M” or “A”	Operating Mode: M = Manual, A = Auto (2D/3D)
CurrentMode	Decimal, 1 digit	Current Mode: 1 = no FIX available 2 = 2D FIX 3 = 3D FIX
SatPRN1...N	Decimal, 2 digits	Satellites list used in position FIX (max N 12)
PDOP	Decimal, 3 digits	Position Dilution of Precision, from 0.0 to 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, from 0.0 to 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, from 0.0 to 99.0

12.12 Predictive AGNSS NMEA messages

12.12.1 $PSTMSTAGPSSEEDBEGINOK

Message sent in response to command *$PSTMSTAGPSSEEDBEGIN*

Synopsis:

```
$PSTMSTAGPSSEEDBEGINOK*<checksum><cr><lf>
```

Arguments:

None.

Results:

Message sent in case of successful operation.

12.12.2 $PSTMSTAGPSSEEDBEGINERROR

Message sent in response to command *$PSTMSTAGPSSEEDBEGIN*

Synopsis:

`$PSTMSTAGPSSEEDBEGINERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.12.3 $PSTMSTAGPSBLKTYPEOK

Message sent in response to command *$PSTMSTAGPSBLKTYPE*

Synopsis:

`$PSTMSTAGPSBLKTYPEOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.12.4 $PSTMSTAGPSBLKTYPEERROR

Message sent in response to command *$PSTMSTAGPSBLKTYPE*

Synopsis:

`$PSTMSTAGPSBLKTYPEERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error.

12.12.5 $PSTMSTAGPSSLOTFRQOK

Message sent in response to command *$PSTMSTAGPSSLOTFRQ*

Synopsis:

`$PSTMSTAGPSSLOTFRQOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.12.6 $PSTMSTAGPSSLOTFRQERROR

Message sent in response to command *$PSTMSTAGPSSLOTFRQ*

Synopsis:

`$PSTMSTAGPSSLOTFRQERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error

12.12.7 $PSTMSTAGPSSEEDPKTOK

Message sent in response to command *$PSTMSTAGPSSEEDPKT*

Synopsis:

`$PSTMSTAGPSSEEDPKTOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.12.8 $PSTMSTAGPSSEEDPKTERROR

Message sent in response to command *$PSTMSTAGPSSEEDPKT*

Synopsis:

`$PSTMSTAGPSSEEDPKTERROR*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of error

12.12.9 $PSTMSTAGPSSEEDPROPOK

Message sent in response to command *$PSTMSTAGPSSEEDPROP*

Synopsis:

`$PSTMSTAGPSSEEDPROPOK*<checksum><cr><lf>`

Arguments:

None.

Results:

Message sent in case of successful operation.

12.13 Real Time AGNSS NMEA messages

12.13.1 $PSTMSTAGPS8PASSRTN

Message sent in response to command *$PSTMSTAGPS8PASSGEN*.

Synopsis:

```
$PSTMSTAGPS8PASSRTN,<DevID>,<Password>*<checksum><cr><lf>
```

Arguments:

Table 226. $PSTMSTAGPS8PASSRTN message field description

Parameter	Description
<DevID>	Unique Device ID
<Password>	41-character ASCII password.

Results:

None

13 Firmware Configuration Data Block (CDB)

All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

The table below includes all parameters which can be changed to apply a different configuration to the firmware.

The IDs not reported in the table should be considered as RESERVED and must be left untouched to avoid unexpected system behaviors.

Table 227. Configuration data block list

ID	Parameter name	Size bytes	Allowed values	Default	Description
100	Debug Port Number	1	0...2	0	Set debug port number
101	NMEA Port Number	1	0...2	2	Set NMEA port number
102	NMEA Port Baudrate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set NMEA Baudrate
103	GPS Debug Mode	1	0x00 = Debug Mode ON 0x01 = Debug Mode OFF 0x10 = Debug OUT ON + NMEA IN 0x11 = Debug OUT OFF + NMEA IN 0xA0 = Debug OUT ON + NMEA OUT 0xA1 = Debug OUT OFF + NMEA OUT 0xB0 = Debug OUT ON + NMEA IN/OUT 0xB1 = Debug OUT OFF + NMEA IN/OUT	0	Debug port IN/OUT configuration. Extended debug mode configuration allows having on the debug port the NMEA messages and/or the NMEA input commands. **Note:** Bit7 and bit5 must be enabled to have the NMEA messages over debug port.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
104	GNSS Mask Angle	1	0 …. 45	5	Set the GNSS Mask Angle for low Satellite Elevation
105	GNSS Tracking Threshold [dB]	1	9...40	10	Set the satellites tracking threshold
106	Debug Port Baudrate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set Debug Baudrate
120	Cold Start Type	1	0xF = clear Almanach, Ephem, Time &Position 0xE = clear Ephemeris, Time, Position	0xE	Set the cold start type with selective data erase
121	NMEA Decimal Digits for Speed and Course values	1	First nibble: 0x1...0x8 Second nibble: 0x1...0x8	0x11	Allow setting the number of decimal digits for the speed and course data in the NMEA messages.
124	NMEA and Debug Output Redirection	1	0x11 = NMEA and Debug over UART 0x21 = NMEA over USB and Debug over UART 0x12 = NMEA over UART and Debug over USB 0x44 = NMEA and Debug over SD card 0x81 = NMEA over I2C and Debug over UART 0x18 = NMEA over UART and Debug over I2C	0x11	Configure the output method for NMEA and Debug messages (over UART, USB or SD card)
125	Notch Filter Setting	1	0x0...0xF	0x0	Enable or disable the Notch Filter usage

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
126	HW CONFIG	1	0...1	1	Select the HW configuration: 0: SOC 1: SAL
127	NMEA Decimal Digits	1	First nibble: 0x1...0x8 Second nibble: 0x1...0x8	0x55	Allow setting the number of decimal digits for the position data in the NMEA messages.
128	Differential Source Type	1	0...3	0x3	Allow selecting the differential mode source type.
129	GLONASS Satellite ID Type	1	0...1	0x1	Allow setting the GLONASS satellite ID type used in the GSV and GSA messages. 0x0 – the satellite ID is based on frequency 0x1 – the satellite ID is based on slot number.
130	CPU clock speed	1	0x00, 0x10, 0x20, 0x30, 0x02	0x30	Allow setting the CPU clock source and speed.
131	NMEA Talker ID	1	‘P’, ‘L’, ‘N’	‘P’	Allow setting the second character of the NMEA talker ID.
132	GNSS positioning CN0 Threshold [dB]	1	9...40	15	Set the satellites CN0 threshold for the positioning stage
134	Configuration Version ID	1	0...255	0	Allow setting a version number for the specific configuration
135	SBAS Default Service	1	0...15	15	Set the SBAS default Service
138	RTCM Port Number	1	0...2	0	Set the serial port number for the RTCM input.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
139	RTCM Port Baud rate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set the baudrate for the RTCM input serial port.
From 140 To 188 Even IDs	RF front-end address register and operation	1	b0...b5 = address (from 0 to 24) b6...b7= operation (00b or 01b or 10b)	0xFF = Don't Touch	Set the address and the operation to be performed on the corresponding RF front end register. The address is reported in the first 6 bits. The operation is reported in the last 2 bits. Any address from 0 to 24 is allowed. Supported operations are: b6...b7 = 00b: overwrite register with provided value b6...b7 = 01b: Perform OR operation between register and provided value b6...b7 = 11b: Perform AND operation between register and provided value. Provided value is the value reported in the next parameter (e.g. 140 reports the address and operation for the value reported on 141) **Note:** Using 0xFF for this parameter means don't touch the front-end register. If the front-end registers configuration is not needed, all parameters from 140 to 188 (even IDs) should be set to 0xFF. This is the default value of standard ST image.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
From 141 To 189 Odd IDs	RF front-end data register value	1	Any RF front-end supported values (see front-end reference manual)	0xFF	The value to be applied to the front-end register pointed by the previous address and operation parameter (e.g. 141 reports the value to be applied to the address reported on 140)
190	NMEA Msg-List 0 output rate scaling factor.	1	1...255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
191	NMEA Msg-List 1 output rate scaling factor.	1	1...255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
192	NMEA Msg-List 2 output rate scaling factor.	1	1...255	1	Message list output rate scaling factor referred to the fix rate. Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
193	USB Detect feature	1	0...1	0	Enable or disable the USB detect feature
194	USB Detect GPIO pin configuration	1	GPIO pin number (from 0 to 63)	0	Configure GPIO pin used for USB detect feature
195	USB Data Terminal Equipment feature	1	0...1	1	Enable or disable the USB Data Terminal Equipment feature
197	PPS Clock	1	16,32,48,64	32	Allow setting the PPS clock. For accurate timing application, 64 is mandatory.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
198	GNSS Mask Angle Positioning	1	0 …. 45	1	Set the GNSS Mask Angle for positioning algorithm. Satellites with elevation below the mask angle are not used in the position solution.
199	Local geodetic datum	1	0...215	255	Set the local geodetic datum to be used in position reporting over the NMEA messages. Not valid number (e.g. 255) means default datum which is WSG84.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
200	Application ON/OFF	4	0x2 = GPS_2D_FIX_ENABLE 0x4 = SBAS_ENABLE 0x8 = SBAS_SAT_ON_GSV_MSG_ENABLE 0x10 = STAGPS_ENABLE 0x20 = 2.5_PPM_TCXO_ENABLE 0x40 = NMEA_v301_ENABLE 0x80 = QZSS_DISTRIBUTED_ACQ_MODE_ENABLE 0x200 = CONFIG_TXT_HEADER_EN. 0x400 = ST_HEADERS_ENABLE 0x800 = RTCM_ENABLE 0x1000 = FDE_ENABLE 0x4000 = WALKING_MODE_ENABLE 0x8000 = STOP_DETECTION_ENABLE 0x10000 = GPS_ENABLE 0x20000 = GLONASS_ENABLE 0x40000 = QZSS_ENABLE 0x80000 = NMEA_GNGSV_ENABLE 0x100000 = NMEA_GNGSA_ENABLE 0x200000 = GLONASS_USE_ENABLE 0x400000 = GPS_USE_ENABLE 0x800000 = QZSS_USE_ENABLE 0x1000000 = PPS_ENABLE 0x2000000 = PPS_POLARITY_INVERSION 0x4000000 = POSITION_HOLD_ENABLE 0x8000000 = TIMING_TRAIM_ON_OFF 0x10000000 = RESERVED 0x20000000 = HIGH_DYNAMICS_ON_OFF 0x40000000 = NMEA_RAW_ON_OFF 0x80000000 = LOW_POWER_ON_OFF	0x09419644	Activates/Deactivates GNSS application features

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
201	NMEA Port Msg-List 0 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x288435F	Set NMEA Message List 0 (32 bits low)
202	NCO Range max.	4	-132000 to 132000	0x0	Set NCO range max. value in Hz
203	NCO Range min.	4	-132000 to 132000	0x0	Set NCO range min. value in Hz
204	NCO Center	4	-132000 to 132000	0x0	Set NCO center frequency Offset in Hz
205	Position Data Time Delay [ms]	4	0..(fix rate time period)	80 ms	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.
206	GPIO Port0 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port0
207	GPIO Port0 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port0
208	GPIO Port1 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port1
209	GPIO Port1 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port1
210	NMEA Port Msg-List 1 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 1 (32 bits low)
211	NMEA Port Msg-List 2 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 2 (32 bits low)
213	PPS operating mode setting 1	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation. (see details in the corresponding section)
214	PPS operating mode setting 2	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation (see details in the corresponding section)

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
215	Position hold auto survey samples.	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Sets the number of position samples to be captured before entering in the position hold mode. If it is set to 0, the auto survey is disabled.
218	SBAS satellite parameters	4	-	0xFFFF FFFF	Allow setting parameters (PRN, longitude and service) for new SBAS satellites not supported by the was library. Not valid value (e.g. 0xFFFFFFFF) means not used.
219	SBAS satellite parameters	4	-	0xFFFF FFFF	Allow setting parameters (PRN, longitude and service) for new SBAS satellites not supported by the was library. Not valid value (e.g. 0xFFFFFFFF) means not used
220	Adaptive Low Power operating mode setting 1	4	-	15 m,10 s, 10s, 180s	Allow setting the operative mode for low power algorithm.
221	Adaptive Low Power operating mode setting 2	4	-	4,60s,9, 31min	Allow setting the operative mode for low power algorithm.
222	LMS operating mode setting 1	4	-	1,0,0,,50 m, 50m,	Allow setting parameters for the LMS algorithm
223	LMS operating mode setting 2	4	-	5,3,-223m	Allow setting parameters for the LMS algorithm
224	Adaptive Low Power operating mode setting 3	4		1,1,740 ms	Allow setting the operative mode for low power algorithm.
225	ADC channel read configuration parameters	4	-	0x3FE	Allow setting parameters for configuration of ADC channels reading
226	Antenna Sensing configuration parameters	4	-	0x7D096 010	Allow setting parameters for configuration of Antenna Sensing feature

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
227	Application ON/OFF 2	4	0x1 = NMEA_COMMAND_ECO_ENABLE 0x2 = NMEA_TTFF_MESSAGE_ENABLE 0x4 = FEW_SATS_POS_ESTIMATION_ENABLE 0x8 = STBIN_IN_OUT_ENABLE 0x20 = NMEA_IN_OUT_INTERFACE_SELECT 0x40 = GALILEO_ENABLE 0x80 = GALILEO_USAGE_ENABLE 0x100 = BeiDou_ENABLE 0x200 = BeiDou_USAGE_ENABLE 0x800 = RTC_USAGE_DISABLING 0x1000 = FAST_SATELLITE_DROP_ENABLE 0x2000 = RESERVED 0x4000 = EXCLUDED_SATS_REPORTING_ENABLE	0x345	Activates/Deactivates GNSS application features
228	NMEA Port Msg-List 0 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x2000	Set NMEA Message List 0 (32 bits high)
229	NMEA Port Msg-List 1 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 1 (32 bits high)
230	NMEA Port Msg-List 2 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 2 (32 bits high)
231	NMEA on Debug Port Msg-List 0 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 0 (32 bits low)
232	NMEA on Debug Port Msg-List 0 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 0 (32 bits high)

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
233	NMEA on Debug Port Msg-List 1 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 1 (32 bits low)
234	NMEA on Debug Port Msg-List 1 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 1 (32 bits high)
235	NMEA on Debug Port Msg-List 2 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 2 (32 bits low)
236	NMEA on Debug Port Msg-List 2 (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA on Debug port Message List 2 (32 bits high)
237	Default GPS MIN-MAX week number	4	MIN: 0x0000 to 0xFFFF - MAX: 0x0000 to 0xFFFF	MIN = 1821 MAX = 3300	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	0x0000.0000 to 0xFFFF.FFFF	16	Default value of GPS time to UTC delta time in seconds (leap second)
240	STBIN Msg-List (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x1FF	Set STBIN Message List (32 bits low)
241	STBIN Msg-List (HIGH)	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set STBIN Message List (32 bits high)
245	TCXO Frequency	4	0x0, 0xA, 0xB	0x0	Select the TCXO frequency among the supported ones. (NOTE: supported frequencies are 26MHz, 48MHz and 55MHz)
249	Flash Protection Setting 1	4	-	0x1	Flash Protection enabling/disabling
250	Flash Protection Setting 2	4	-	0x8000000	Flash sectors to be protected / auto-protection feature enabling/disabling
253	GPIO Port0 Mode AFSLA	4	0x0000.0000 to 0xFFFF.FFFF	0xFFF7C3F0	AFSLA register configuration for GPIO Port0
254	GPIO Port0 Mode AFSLB	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	AFSLB register configuration for GPIO Port0
255	GPIO Port1 Mode AFSLA	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	AFSLA register configuration for GPIO Port1

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
256	GPIO Port1 Mode AFSLB	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	AFSLB register configuration for GPIO Port1
257	Low Power Setting	4	0x0, 0x1	0x1	Allow configuration of low power functionalities
260	WLS configuration params	4	-	0x00190A00	WLS algorithm configuration params
261	Dynamic modes configurations	4	0,1,3	0	Allow setting the dynamic mode for the satellite tracking engine.
263	Nmea over serial configuration	4		0xE80	Allow configuring parameters for nmea over serial feature
264	Data logger Configuration 0	4	0x0000.0000 to 0xFFFF.FFFF	0x10180000	Data logger configuration field 0. Configures the memory base address for the data logger data structure
265	Data logger Configuration 1	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	Data logger configuration field 1. Specify the maximum space available for data logger data structure
266	Data logger Configuration 2	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	Data logger configuration field 2
267	Data logger Configuration 3	4	0x0000.0000 to 0xFFFF.FFFF	0x0000010E	Data logger configuration field 3
268	Geofencing Configuration 0	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Geofencing configuration field 0
270	Odometer Configuration	4	0x0000.0000 to 0xFFFF.FFFF	0x03E80000	Odometer configuration field
272	GNSS Integrity	4	0x0..0x3	0x0	Enabling/disabling position and time integrity feature
301	PPS Pulse Duration	8	<= 1.0 seconds	0.5	PPS pulse width. It is the time distance (in seconds) from PPS rising edge and next PPS falling edge.
302	PPS Delay Correction	8	< 1.0 seconds	0.0	PPS time delay correction n seconds. It allows to compensate any delay introduced on PPS signal by RF chain.

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
303	GNSS Fix Rate	8	> 0.1 seconds	1.0	Set the GNSS fix rate period in seconds. NOTE: high fix rates may require a different setting (e.g. 208MHz) of the CPU speed.
304	Position Hold Latitude [deg]	8	From -90.0 to 90.0	40.9174 7	Set the position hold latitude.
305	Position Hold Longitude [deg]	8	From -180.0 to 180.0	14.2758 6	Set the position hold longitude.
306	Position Hold Altitude [m]	8	From -1500 to 100000	88.4330 7	Set the position hold altitude.
307	GPS RF delay correction	8		718E-9	Time delay compensation for the GPS RF path.
308	GLONASS RF delay correction	8		-420E-9	Time delay compensation for the GLONASS RF path.
309	TRAIM alarm threshold	8		15ns	Time error threshold for the satellites exclusion in the TRAIM algorithm.
310	BeiDou RF delay correction	8		100E-9	Time delay compensation for the BeiDou RF path.
311	GALILEO RF delay correction	8		718E-9	Time delay compensation for the GALILEO RF path.
314	Geofencing Circle 0 Latitude	8		41.1147 3	Allows to set up the geofencing circle number 0 by choosing its latitude as a double precision floating number
315	Geofencing Circle 0 Longitude	8		13.8809 3	Allows to set up the geofencing circle number 0 by choosing its longitude as a double precision floating number
316	Geofencing Circle 0 Radius	8		10.0	Allows to set up the geofencing circle number 0 by choosing its radius in meters as a double precision floating number
317	Geofencing Circle 1 Latitude	8		41.1214 8	Allows to set up the geofencing circle number 1 by choosing its latitude as a double precision floating number

Table 227. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
318	Geofencing Circle 1 Longitude	8		13.87146	Allows to set up the geofencing circle number 1 by choosing its longitude as a double precision floating number
319	Geofencing Circle 1 Radius	8		10.0	Allows to set up the geofencing circle number 1 by choosing its radius in meters as a double precision floating number
320	Geofencing Circle 2 Latitude	8		41.24341	Allows to set up the geofencing circle number 2 by choosing its latitude as a double precision floating number
321	Geofencing Circle 2 Longitude	8		13.77443	Allows to set up the geofencing circle number 2 by choosing its longitude as a double precision floating number
322	Geofencing Circle 2 Radius	8		10.0	Allows to set up the geofencing circle number 2 by choosing its radius in meters as a double precision floating number
323	Geofencing Circle 3 Latitude	8		41.24328	Allows to set up the geofencing circle number 3 by choosing its latitude as a double precision floating number
324	Geofencing Circle 3 Longitude	8		13.77424	Allows to set up the geofencing circle number 3 by choosing its longitude as a double precision floating number
325	Geofencing Circle 3 Radius	8		10.0	Allows to set up the geofencing circle number 3 by choosing its radius in meters as a double precision floating number

13.1 CDB-ID 100 – Debug port setting

Allow setting the debug port number.

System reboot needed to have new setting in use.

13.2 CDB-ID 101 – NMEA port setting

Allow setting the NMEA port number.

System reboot needed to have new setting in use.

13.3 CDB-ID 102 – NMEA port baudrate setting

Allow setting the baudrate for the NMEA port number. The translation table in *Table 228: CDB-ID 102 field description*.

Table 228. CDB-ID 102 field description

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

System reboot needed to have new setting in use.

13.4 CDB-ID 103 – Debug mode setting

Allow setting the debug port operational modes.

Table 229. CDB-ID 103 field description

Bit	Bitmask	Description
0	0x1	Debug messages ON/OFF – 0 = ON – 1 = OFF
1	0x2	Not Used
2	0x4	Not Used
3	0x8	Not Used
4	0x10	NMEA Input on debug port enabling/disabling – 0 = disabled – 1 = enabled

Table 229. CDB-ID 103 field description (continued)

Bit	Bitmask	Description
5	0x20	NMEA Output on debug port enabling/disabling – 0 = disabled – 1 = enabled **Note:** This bit is used only when bit7 is enabled.
6	0x40	NMEA Output enabling/disabling – 0 = disabled – 1 = enabled **Note:** This bit is used only when bit7 is enabled.
7	0x80	Dual NMEA Output enabling/disabling – 0 = disabled – 1 = enabled **Note:** This bit is used to enable/disable the dual NMEA port feature. It must be enabled to have NMEA messages over debug port.

Any combination of bits in the bitmask is allowed. When debug is configured to be OFF and both NMEA IN and OUT are disabled, the debug port pins are in high impedance mode.

Example: setting 0x01 the debug port pins are in high impedance mode.

System reboot needed to have new setting in use.

13.5 CDB-ID 104 – Mask angle setting

Allow setting the minimum elevation angle at which a satellite can be tracked. Satellite with elevation below the mask angle cannot be tracked.

System reboot needed to have new setting in use.

13.6 CDB-ID 105 – GNSS tracking threshold

Allow setting the minimum CN0 [dB] at which a satellite can be tracked. Satellite with CN0 below the configured threshold cannot be tracked.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

13.7 CDB-ID 106 – DEBUG port baudrate setting

Allow setting the baudrate for the DEBUG port number. The translation table in *Table 230: CDB-ID 106 field description*.

Table 230. CDB-ID 106 field description

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud

Table 230. CDB-ID 106 field description (continued)

Parameter Value	Baudrate
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

System reboot needed to have new setting in use.

13.8 CDB-ID 120 – Cold start setting

Allow setting the data to be cleared during the COLD start command execution. This parameter is a bitmask where bit=1 indicates the data to be cleared.

Table 231. CDB-ID 120 field description

Bit	Bitmask	Description
0	0x1	Clear almanacs
1	0x2	Clear ephemeris
2	0x4	Clear position
3	0x8	Clear time

Any bitmask combination is allowed, the default one is 0xE.

This setting is in place as soon as the `$PSTMSETPAR` is performed.

13.9 CDB-ID 121 – Number of decimal digits for speed and course data in NMEA messages

Allow setting the number of decimal digits for the speed and course data in NMEA messages. It affects both RMC and VTG messages

It is possible to set a different number of decimal digits.

Table 232. CDB-ID 121 field description

Bit	Values	Description
From B0 to B3	From 1 up to 5	Allow setting the number of decimal digits for speed value in RMC and VTG massages
From B4 to B7	From 1 up to 5	Allow setting the number of decimal digits for course value in RMC and VTG messages.

13.10 CDB-ID 122 – NMEA format configuration

Allow setting the change format of NMEA.

Note that NMEA format configuration changes the default value of this parameter the Bit 6 of CDB-ID 200 – Application ON/OFF is bypassed.

The default value of this parameter is 0x0C.

In case of wrong configuration NMEA is configured as 3.01 like.

Table 233. CDB-ID 122 field description

Bit	Values	Description
From B0 to B3	Hexadecimal	Changes the NMEA format 0x01 = NMEA is 3.00 like 0x02 = NMEA is 3.01 like 0x04 = NMEA is 4.10 like 0x0C = Depends on Bit 6 of CDB-ID 200

13.11 CDB-ID 124 – NMEA and debug output redirection

Allow setting the output channel for NMEA and Debug messages. Supported channels are UART, USB and SD card. UART is the default channel. If the SD card is selected for NMEA and Debug output but the SD card is not present in the slot, the system switch automatically to the UART mode. NMEA and Debug output cannot be redirected to USB together.

This parameter is made by two bit masks (4 bits each one):

Table 234. CDB-ID 124 field description

Bit	Bitmask	Description
From B0 to B3	0x01=enable/disable UART output 0x02=enable/disable USB output 0x04=enable/disable SD output 0x08=enable/disable I2C output	Bit mask for Debug output configuration (only one bit can be enabled at the same time in the bitmask)
From B4 to B7	0x10=enable/disable UART output 0x20=enable/disable USB output 0x40=enable/disable SD output 0x80=enable/disable I2C output	Bit mask for NMEA output configuration (only one bit can be enabled at the same time in the bitmask)

Note: USB output works only with TCXO 48Mhz.

Note: ST provides a specific USB driver that can be found in the standard installation pack inside the folder \drivers\usb.

13.12 CDB-ID 125 – Notch filter setting

Allow setting the Notch filter usage on GPS RF path, GLONASS RF path or both GPS and GLONASS RF paths. The notch filter can be enabled and inserted in the RF path (normal mode – see b0, b1 below) or the notch filter can be enabled but inserted only if locked on a jammer (auto-insertion mode – see b2, b3 below).

Table 235. CDB-ID 125 field description

Bitmask	Description
b0...b3 = 0x00	Notch Filter is disabled on both GPS and GLONASS paths
b0	Enable/disable notch filter on GPS path (normal mode).
b1	Enable/disable notch filter on GLONASS path (normal mode).
b2	Enable/disable notch filter on GPS path in auto-insertion mode.
b3	Enable/disable notch filter on GLONASS path in auto-insertion mode.

13.13 CDB-ID 126 – HW Config

Allow setting the HW configuration (SOC=0 or SAL=1). It is currently used for PPS signal configuration.

13.14 CDB-ID 127 – Number of decimal digits in NMEA position messages

Allow setting the number of decimal digits for the NMEA position messages.

It is possible to set a different number of decimal digits for GGA and for both RMC and GLL messages.

Table 236. CDB-ID 127 field description

Bit	Values	Description
From B0 to B3	From 1 up to 5	Allow setting the number of decimal digits for the RMC and GLL massages
From B4 to B7	From 1 up to 5	Allow setting the number of decimal digits for the GGA massage.

13.15 CDB-ID 128 – Differential Source Type

Allow selecting the differential mode source type.

Table 237. CDB-ID 128 field description

Value	Description
0x0 - NONE	No differential source.
0x1 - SBAS	SBAS is the source for differential correction.
0x2 - RTCM	RTCM is the source for differential corrections.
0x3 - AUTO	RTCM (if available) or SBAS (if available) is the source for differential corrections.

13.16 CDB-ID 129 – GLONASS Satellite ID Type

Allow selecting between two different ways to report the GLONASS satellites ID in the GSV and GSA messages.

Table 238. CDB-ID 129 field description

Value	Description
0x0	GLONASS satellite ID based on the satellite frequency. If lowest frequency is marked with freq_ID = 1 and highest frequency is marked with freq_ID = 14, the satellite IDs are reported, starting from lowest frequency as 64+freq_ID. Satellites from 79 up to 92 are the antipodal of satellites from 65 up to 78 (they are received at the same frequency).
0x1	GLONASS satellite ID based on the satellite slot (reported in almanacs and ephemeris data). The satellite IDs are reported as 64+slot_number. The slot number is in the range from 1 up to 24.

13.17 CDB-ID 130 – CPU clock speed

Allow setting the CPU clock speed.

Table 239. CDB-ID 130 field description

Bit	Values	Description
From B0 to B3	0 = 192f0 1 = TCXO 2 = RTC 3 = RING Oscillator	Allow setting the CPU clock source
From B4 to B6	0 = 1 1 = 2 3 = 4	Allow setting the CPU clock divisor factor
B7		RESERVED

Examples:

- 0x00 sets the CPU speed at 192f0 MHz
- 0x10 sets the CPU speed at 96f0 MHz
- 0x20 sets the CPU speed at 64f0 MHz
- 0x30 sets the CPU speed at 48f0 MHz

13.18 CDB-ID 131 – NMEA Talker ID

Allow setting the second character of the NMEA talker ID for the GGA, RMC, VTG, GLL NMEA sentences. The talked ID for GSV and GSA is managed in a different way (see CDB-ID 200, bits 19 and 20).

13.19 CDB-ID 132 – GNSS Positioning CN0 threshold

Allow setting the minimum CN0 [dB] at which a satellite can be used in the position solution. Satellites with CN0 below the configured threshold are not used in the position evaluation.

A GNSS engine reset (suspend/restart) is needed to have this setting in place.

13.20 CDB-ID 134 – Configuration version ID

Allow setting a version identification number for the configuration data block. This parameter has two main purposes:

- Mark a specific configuration data block with a unique identifier which is readable at the application level using the command interface
- Replace any saved configuration data with the default setting configuration if the version number of the default setting is different from the version number of the saved data block. Example: the GNSS module is flashed with a firmware which has an embedded default setting marked as version 1. The user changes some parameter and saves the new configuration. The module is then updated with a firmware which has the configuration version marked as version 2. At the first startup the saved configuration (version 1) is automatically cleared and the version 2 configuration is applied to the GNSS software.

13.21 CDB-ID 135 – SBAS default service

Allow setting the default service for the SBAS library.

System reboot needed to have new setting in use.

Note: For compatibility, a default SBAS PRN can also be set. In that case the SBAS AUTO service will be used.

13.22 CDB-ID 138 – RTCM port setting

Allow setting the RTCM port number.

Note: The RTCM feature is supported on all serial ports. It can be configured also to work on the same serial port already used for NMEA or Debug messages.

System reboot needed to have new setting in use.

13.23 CDB-ID 139 – RTCM port baudrate setting

Allow setting the baudrate for the RTCM port number. The translation table in *Table 240: CDB-ID 139 field description*.

Table 240. CDB-ID 139 field description

Parameter Value	Baudrate
0x0	300 baud
0x1	600 baud
0x2	1200 baud
0x3	2400 baud
0x4	4800 baud
0x5	9600 baud
0x 6	14400 baud
0x 7	19200 baud
0x 8	38400 baud
0x 9	57600 baud
0xA	115200 baud
0xB	230400 baud
0xC	460800 baud
0xD	921600 baud

System reboot needed to have new setting in use.

13.24 CDB-ID From 140 to 189 – GNSS RF front-end configuration

Allow setting the GNSS RF front-end register. By default the front-end registers don't need to be configured. If a specific configuration is required it can be achieved by setting in the proper way the configuration parameters in the range from 140 to 189.

Even IDs (e.g. 140, 142, …, 188) are used to set the address at which the value (reported in the next odd ID parameter) is applied. Together with the address (first 6 bits of parameter) there is the operation to perform (last 2 bits).

Allowed addresses are from 0 to 24 (see front-end specs).

Supported operations are:

- 00b: overwrite the register with provided value.
- 01b: execute "OR" operation between register content and provided value.
- 10b: execute "AND" operation between register content and provided value.

Odd IDs (e.g. 141, 143, …, 189) are the values to be applied (according to the operation) to the address reported on the previous even ID. For example the value in the parameter ID 141 is applied to the address in the parameter 140 etc.

Examples

Param 140=0x81 and Param 141=0x55: the front-end register at 0x1 address is updated with the result of bit-to-bit AND operation between the register content and 0x55 value.

Param 140=0x44 and Param 141=0x55: the front-end register at 0x4 address is updated with the result of bit-to-bit OR operation between the register content and 0x55 value.

Param 140=0x08 and Param 141=0x55: the front-end register at 0x8 address is overwritten with 0x55 value.

Note: 0xFF value in the address IDs is used to skip the parameter without applying any configuration to the front-end registers. The default setting in the ST binary image is all addresses parameters set to 0xFF.

13.25 CDB-ID 190 - CDB-ID 201 - CDB-ID 228 - NMEA message list 0 parameters

CDB-ID 201 and CDB-ID 228 allow enabling/disabling each NMEA message in the message list 0. CDB-ID 201 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 228 for the second 32 bits (high bits) of the 64 bits message list.

CDB-ID 190 allows setting the message list output rate for the message list 0. It is a scaling factor referred to the selected fix rate. The default value is 1 and this means that the messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

Note: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate feature is not required.

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 241. CDB-ID 201 - CDB-ID 228 fields description

	Bit[(1)]	Bitmask (32 bits)	Function
Low 32 bits	0	0x1	$GPGNS Message
	1	0x2	$GPGGA Message
	2	0x4	$GPGSA Message
	3	0x8	$GPGST Message
	4	0x10	$GPVTG Message
	5	0x20	$PSTMNOISE Message
	6	0x40	$GPRMC Message
	7	0x80	$PSTMRF Message
	8	0x100	$PSTMTG Message
	9	0x200	$PSTMTS Message
	10	0x400	$PSTMPA Message
	11	0x800	$PSTMSAT Message
	12	0x1000	$PSTMRES Message
	13	0x2000	$PSTMTIM Message
	14	0x4000	$PSTMWAAS Message
	15	0x8000	$PSTMDIFF Message
	16	0x10000	$PSTMCORR Message
	17	0x20000	$PSTMSBAS Message
	18	0x40000	$PSTMTESTRF Message
	19	0x80000	$GPGSV Message
	20	0x100000	$GPGLL Message
	21	0x200000	$PSTMPPSDATA Message
	22	0x400000	RESERVED
	23	0x800000	$PSTMCPU Message
	24	0x1000000	$GPZDA Message
	25	0x2000000	$PSTMTRAIMSTATUS Message
	26	0x4000000	$PSTMPOSHOLD Message
	27	0x8000000	$PSTMKFCOV Message
	28	0x10000000	$PSTMAGPS Message
	29	0x20000000	$PSTMLOWPOWERDATA Message
	30	0x40000000	$PSTMNOTCHSTATUS
	31	0x80000000	$PSTMTM Message

Table 241. CDB-ID 201 - CDB-ID 228 fields description (continued)

	Bit[(1)]	Bitmask (32 bits)	Function
High 32 bits	32	0x1	$PSTMPV Message
	33	0x2	$PSTMPVQ Message
	34	0x4	$PSTMUTC Message
	35	0x8	$PSTMADCDATA Message
	36	0x10	$PSTMANTENNASTATUS Message
	37	0x20	RESERVED
	38	0x40	$PSTMUSEDSATS
	39	0x80	$GPDTM Message
	40	0x100	$PSTMEPHEM Message
	41	0x200	$PSTMALMANAC Message
	42	0x400	$PSTMIONOPARAMS Message
	43	0x800	RESERVED
	44	0x1000	$PSTMBIASDATA Message
	45	0x2000	$GPGBS Message
	46	0x4000	$PSTMPVRAW Message
	47	0x8000	RESERVED
	48	0x10000	$PSTMFEDATA Message
	49	0x20000	RESERVED
	50	0x40000	$PSTMODO Message
	51	0x80000	$PSTMGEOFENCESTATUS Message
	52	0x100000	$PSTMLOGSTATUS Message
	53	0x200000	$PSTMGNSSINTEGRITY Message
	54	0x400000	RESERVED for DRAW (see DRAW documentation)
	55	0x800000	RESERVED for DRAW (see DRAW documentation)
	56	0x1000000	RESERVED for DRAW (see DRAW documentation)
	57	0x2000000	RESERVED for DRAW (see DRAW documentation)
	58	0x4000000	RESERVED for DRAW (see DRAW documentation)
	59	0x8000000	RESERVED for DRAW (see DRAW documentation)
	60	0x10000000	RESERVED for DRAW (see DRAW documentation)
	61	0x20000000	RESERVED for DRAW (see DRAW documentation)
	62	0x40000000	RESERVED for DRAW (see DRAW documentation)
	63	0x80000000	$--RLM Message

1. The Bit-Value indicates the bit position, thus multiple choices are possible.

Note: The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate feature is not required.

13.26 CDB-ID 191 - CDB-ID 210 - CDB-ID 229 - NMEA message list 1 parameters

CDB-ID 210 and CDB 229 allow enabling/disabling each NMEA message in the message list 2. CDB-ID 210 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list, CDB-ID 220 represents the second 32 bits (high bits) of the extended 64 bits NMEA message list.

CDB-ID 191 allows setting the message list 1 output rate. It is a scaling factor referred to the selected fix rate. The default value is 1 and it means that messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

Table 242. NMEA message list 1 CDB-IDs

CDB-ID	Description
191	Message list 1 - Output rate scaling factor
210	Message list 1 - Low bitmap mask
229	Message list 1 - High bitmap mask

13.27 CDB-ID 192 - CDB-ID 211 - CDB-ID 230 - NMEA message list 2 parameters

CDB-ID 211 and CDB 230 allow enabling/disabling each NMEA message in the message list 2. CDB-ID 211 represents first 32 bits (low bits) of extended 64 bits NMEA message list. See CDB-ID 230 for second 32 bits (high bits) of 64 bits message list. The message list configuration is done in the same way as for the message list 0.

If not used the message list must be set to “0”

CDB-ID 230 allows setting the message list output rate for the message list 2. It is a scaling factor referred to the selected fix rate. The default value is 1 and it means that messages are sent out on every fix. Setting the scaling factor to “N” means that the corresponding message list is sent out every “N” fixes.

Table 243. NMEA message list 2 CDB-IDs

CDB-ID	Description
192	Message list 2 - Output rate scaling factor
211	Message list 2 - Low bitmap mask
230	Message list 2 - High bitmap mask

Note: The message list 2 is RESERVED for those messages which need to be sent at high rate (e.g. 10 Hz) and/or require accurate message output timing (low jitter). If high rate messages or low jitter are not required, this message list should not be used.

13.28 CDB-ID 193 - USB Detect feature

Enable or disable the USB detect feature. When enabled the USB VCOM is open only if detect pin is high. Look at the next CDB to see how to configure and detect the GPIO pin.

Note: As soon as the USB is recognized the PLL is automatically enabled if not done before by configuration.

13.29 CDB-ID 194 - USB detect GPIO pin configuration

Allow setting of USB detect GPIO pin.

Table 244. CDB-ID 194 field description

Bit	Values	Description
From B0 to B7	From 0 to 63	GPIO pin number

CDB-ID 195 - USB Data Terminal Equipment feature

Enable or disable the USB Data Terminal Equipment feature. When enabled, the data (NMEA or Debug depending on CDB-ID 124 configuration) are sent over USB VCOM only when DTE is present. This signal corresponds to RS-232 signal DTR. When this feature is enabled, the host must open the VCOM enabling DTR mode.

13.30 CDB-ID 197 – PPS clock

Allow setting the PPS clock frequency. For accurate timing application 64MHz is mandatory.

Table 245. CDB-ID 197 field description

Values	Description
16	Sets PPS clock to 16MHz
32	Sets PPS clock to 32MHz
64	Sets PPS clock to 64MHz

13.31 CDB-ID 198 – GNSS Mask angle positioning

Set the GNSS Mask Angle for positioning algorithm. Satellites with elevation below the mask angle are not used in the position solution.

13.32 CDB-ID 199 – Local geodetic datum selection

Set the local geodetic datum to be used when position data is reported over the NMEA messages. See Appendix A for the list of all supported datum. In the last column of the tables, it is reported the number to be used for the CDB-ID configuration according to the selected datum.

13.33 CDB-ID 200 - CDB-ID 227 - Application ON/OFF

Allow enabling/disabling different features in the GNSS library.

All features are mapped in a 64-bit bitmap with one bit for each feature; CDB-ID 200 represents the first 32 bits (low 32 bits) and CDB-227 represents the second 32 bits (high 32 bits).

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 246. CDB-ID 200 field description

Bit(1)	Bitmask	Function	Description
0	0x1	RESERVED	
1	0x2	RESERVED	
2	0x4	SBAS (WAAS / EGNOS) augmentation system	Enable/disable the SBAS engine. When enabled, the SBAS engine starts searching for SBAS satellites at system startup.
3	0x8	Enabling SBAS satellite reporting in the GSV messages	If enabled the SBAS satellite is reported in the GSV messages. The SBAS satellite ID, reported in the GSV messages, is in the range from 33 to 51 according to the NMEA specifications
4	0x10	STAGPS enable	Enable/disable the STAGPS functionality. During STAGPS processing a high CPU load is required, for best performances it is suggested to increase the CPU frequency when the STAGPS is enabled. The server based assisted GPS (PGPS) is included in the STAGPS software. It is enabled/disabled if the STAGPS functionality is enabled/disabled.
5	0x20	2.5ppm TCXO support enable	Enable/disable support for TCXO with 2.5ppm accuracy
6	0x40	NMEA v301 support enable	Enable/disable the NMEA v3.01 support. To support the NMEA v3.01 standard some new values have been reported in the –RMC, --VTG and –GLL NMEA messages. This feature is enabled by default. To ensure full compatibility with the previous releases, the old NMEA format can be restored disabling this feature
7	0x80	QZSS distributed acquisition mode enable	Enable/disable the distributed acquisition operative mode for the QZSS constellation. When distributed acquisition mode for QZSS is enabled, the acquisition stage usage is widespread along the time in order to mitigate the current consumption spikes required by the acquisition engine.
9	0x200	Send “config text” in the “Header Message” at start up	Enable/disable sending the configured text on the NMEA port at startup.
10	0x400	Send standard ST NMEA Headers	Enable/disable sending the ST standard headers on the NMEA port at startup.

Table 246. CDB-ID 200 field description (continued)

Bit[(1)]	Bitmask	Function	Description
11	0x800	RTCM enable	Enable/disable the RTCM data processing.
12	0x1000	FDE Algorithm	Enable/disable the False Detection and Exclusion algorithm.
14	0x4000	Walking Mode Algorithm	Enable/disable the Walking Mode algorithm.
15	0x8000	Stop Detection Algorithm	Enable/disable the Stop Detection algorithm.
16	0x10000	GPS constellation enable[(2)]	Enable/disable the GPS constellation. When this bit is enabled GPS satellites are enabled to be tracked and used for positioning. This bit setting affects also the talker ID of GSV and GSA NMEA messages. If only the GPS constellation is enabled the NMEA talker ID for GSV and GSA is “GP”. If GLONASS constellation is also enabled “GP” is used for GPS related GSV messages while “GN” is used for the GSA messages.
17	0x20000	GLONASS constellation enable[(2)]	Enable/disable the GLONASS constellation. When this bit is enabled GLONASS satellites are enabled to be tracked. To be used for positioning also the Bit 21 should be enabled. This bit setting affects also the talker ID of GSV and GSA NMEA messages. If only the GLONASS constellation is enabled the NMEA talker ID for GSV and GSA is “GL”. If GPS constellation is also enabled “GL” is used for GLONASS related GSV messages while “GN” is used for the GSA messages
18	0x40000	QZSS constellation enable[(2)]	Enable/disable the QZSS constellation. When this bit is enabled QZSS satellites are enabled to be tracked and used for positioning
19	0x80000	NMEA GNGSV enable	Enable/disable the “GN” talker ID for GSV messages reporting satellite for all constellations. When this bit is enabled, only the talker ID “GN” is used for GSV messages.
20	0x100000	NMEA GNGSA enable	Enable/disable the “GN” talker ID for GSA messages reporting satellite for all constellations. When this bit is enabled, only the talker ID “GN” is used for GSA messages.
21	0x200000	GLONAS usage for positioning enable	Enable/disable the usage of GLONASS satellite for the GNSS position fix. If this bit is disabled and GLONASS constellation is enabled, the GLONASS satellites are only tracked.
22	0x400000	GPS usage for positioning enable	Enable/disable the usage of GPS satellite for the GNSS position fix. If this bit is disabled and GPS constellation is enabled, the GPS satellites are only tracked

Table 246. CDB-ID 200 field description (continued)

Bit[1]	Bitmask	Function	Description
23	0x800000	QZSS usage for positioning enable	Enables/disables the usage of QZSS satellites for the GNSS position fix. If this bit is disabled and QZSS constellation is enabled, the QZSS satellites are only tracked.
24	0x1000000	PPS enabling	Enables/disables the PPS generation on the PPS pin.
25	0x2000000	PPS polarity inversion	Enables/disables the PPS signal polarity inversion. If polarity inversion is disabled (Bit25 = 0) the PPS signal has the rising edge on the PPS event. If polarity inversion is enabled (Bit25 = 1) the PPS signal has a falling edge on the PPS event.
26	0x4000000	Position Hold enable	Enables/disables the Position Hold functionality (timing applications).
27	0x8000000	TRAIM algorithm enable	Enables/disables the TRAIM algorithm (timing applications).
28	0x10000000	RESERVED	
29	0x20000000	High dynamics enable.	Enables/disables the high dynamics functionality. This feature increases the sample rate of the DSP measurements. It is required when high fix rate (> 5 Hz) is selected
30	0x40000000	ST NMEA DSP raw messages enable	Enables/disables the DSP raw messages over the NMEA port. They are proprietary messages which reports info from DSP stage.
31	0x80000000	Low power algorithm enable	Enables/disables the low power management features

1. The Bit-Value indicates the bit position (starting from 0 as the least significant bit), thus multiple choices are possible.

2. Multi-constellation firmware supports the following constellations: GPS, GALILEO, GLONASS, BeiDou and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+GALILEO+QZSS+GLONASS), (GPS+GALILEO+QZSS+BeiDou) and (GLONASS+BeiDou). Any constellation can be enabled as standalone satellite navigation system.

Table 247. CDB-ID 227 field description

Bit[1]	Bitmask	Function	Description
1	0x1	NMEA commands eco enable	Enable/disable the command eco on the NMEA port
2	0x2	NMEA Time To First Fix enable	Enable/disable the Time To First Fix message on the NMEA port. If enabled, the TTFF message is sent only one time as soon as the GNSS position fix is achieved.
3	0x4	Few satellites position estimation enable	Enable/disable the position estimation algorithm when tracked satellites are less than 3.
4	0x8	STBIN in/out enable	Enable/disable the STBIN in/out communication protocol.

Table 247. CDB-ID 227 field description (continued)

Bit[1]	Bitmask	Function	Description
5	0x10	Navigation message and Return Link message enable	Enable/Disable the Navigation message and Return Link message.
6	0x20	NMEA in/out interface selection	Select the communication interface to be used over the NMEA port at startup: 0 = NMEA in/out interface 1 = STBIN in/out interface
7	0x40	Galileo constellation enable[2]	Enable/disable the Galileo constellation. When this bit is enabled Galileo satellites are enabled to be tracked and used for positioning
8	0x80	Galileo usage for positioning enable	Enable/disable the usage of Galileo satellite for the GNSS position fix. If this bit is disabled and Galileo constellation is enabled, the Galileo satellites are only tracked.
9	0x100	BeiDou constellation enable[2]	Enable/disable the BeiDou constellation. When this bit is enabled BeiDou satellites are enabled to be tracked and used for positioning.
10	0x200	BeiDou usage for positioning enable	Enable/disable the usage of BeiDou satellite for the GNSS position fix. If this bit is disabled and BeiDou constellation is enabled, the BeiDou satellites are only tracked.
11	0x400	RESERVED	
12	0x800	RTC usage disabling	Enable/disable the usage of RTC from the GNSS engine. It is recommended to have RTC usage disabled (Bit12 set to 1) is the RTC crystal is not mounted.
13	0x1000	Fast Satellite Drop feature enable	Enable/disable the Fast Satellite Drop feature. When fast satellite drop is enabled, the GNSS software reports NO FIX status immediately after the tunnel entrance; the position update is no more propagated for some seconds inside the tunnel.
14	0x2000	RESERVED	
15	0x4000	Excluded satellites reporting enable	Enable/disable the excluded satellites reporting in the GGA, GSA, GNS and PSTMTG nmea messages. If this bit is enabled, satellites excluded by positioning stage due to RAIM or FDE algorithms, are included in the number of used satellites (present in the GGA, GNS and PSTMG messages) and their satellites IDs are included in the list of used satellite (present in the GSA message). This bit is disabled by default.
16	0x8000	RESERVED	
17	0x10000	RESERVED	
18	0x20000	RTCM3 enable message	Enable RTCM3 message
19	0x40000	RESERVED	

Table 247. CDB-ID 227 field description (continued)

Bit[1]	Bitmask	Function	Description
20	0x80000	RESERVED	
21	0x100000	RESERVED	
22	0x200000	External RTC oscillator enable	Enable/disable the usage on an external oscillator for the RTC peripheral. When enabled the internal oscillator is not used and the RTC clock must be fed from the xtal_in pin
23	0x400000	RESERVED	
24	0x800000	RESERVED	
25	0x1000000	RESERVED	
26	0x2000000	RESERVED	
27	0x4000000	RTC calibration enable	Enable/disable the RTC calibration feature. When enabled the RTC counter is calibrated using the accurate GNSS internal time reference.
28	0x8000000	IRNSS constellation enable	IRNSS constellation enable
29	0x10000000	IRNSS positioning enable	IRNSS usage for positioning enable
30	0x20000000	STA5635 support switch	
31	0x40000000	LLI interface Enable	Enable disable the LLI interface
32	0x80000000	Min week handler switch	

1. The Bit-Value indicates the bit position (starting from 0 as the least significant bit), thus multiple choices are possible.
2. Multi-constellation firmware supports the following constellations: GPS, GALILEO, GLONASS, BeiDou and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+GALILEO+QZSS+GLONASS), (GPS+GALILEO+QZSS+BeiDou). Any constellation can be enabled as standalone satellite navigation system.

Note: If the STAGPS feature is not required (bit 4) and it is disabled, it is strongly suggested to clear all the STAGPS data from the NVM memory. This can be done via NMEA sending the "$PSTMSTAGPSINVALIDATE,7" command. If the NVM was empty (e.g. the STAGPS has been never enabled or the NVM has been completely erased before) the invalidate command is not required.

When GPS and GLONASS constellations are enabled, the GSV messages are sent in two separate sets: one with "GP" as talker ID and one with "GL".

Only "GN" is supported as talker ID for QZSS GSV and GSA messages.

In this case the GSV messages are sent in a single set reporting satellites for all enabled constellations.

13.34 CDB-ID 202 – NCO range max value

Allow setting the upper limit for the NCO search range.

STA8090 supports different TCXO frequencies:

- 26 MHz
- 48 MHz
- 55 MHz

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

13.35 CDB-ID 203 – NCO range min value

Allow setting the lower limit for the NCO search range.

STA8090 supports different TCXO frequencies:

- 26 MHz
- 48 MHz
- 55 MHz

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

13.36 CDB-ID 204 – NCO centre value

Allow setting the NCO centre frequency.

STA8090 supports different TCXO frequencies:

- 26 MHz
- 48 MHz
- 55 MHz

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

13.37 CDB-ID 205 – Position data time delay

Allow 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:

- 50 ms if CPU is running @ 208 MHz
- 500 ms if CPU is running @ 52 MHz

System reboot needed to have new setting in use.

13.38 CDB-ID From 206 to 209 – GPIO High/Low Status Setting

Allow setting the High/Low status for each GPIO.

Parameters 206 and 207 refer to the GPIO port 0; parameters 208 and 209 refer to GPIO port 1. Each parameter is a 32-bit mask representing the 32 pins of the GPIO port (bit 0 corresponds to PIN0 and bit31 corresponds to PIN31).

For each pin three configurations are possible: DO_NOT_TOUCH, SET_HIGH and SET_LOW. Each configuration is achieved setting in the proper way the bits corresponding to the same pin in the two configurations bit mask of the same port.

Table 248. CDB-ID 206-209 field description

Port CFG0 Bit	Port CFG1 Bit	Description
0	0	SET_LOW: GPIO pin is configured as output and set to LOW state.
1	1	SET_HIGH: GPIO pin is configured as output and set to HIGH state.
0	1	DO_NOT_TOUCH: the pin is left unchanged
1	0	DO_NOT_TOUCH: the pin is left unchanged

Examples:

Param 206=0xFFFFFFFE and Param 207=0x08000000 GPIO Port0 pin 0 is set to LOW and GPIO Port0 pin 27 is set to HIGH. All other GPIO Port0 pins are left unchanged.

Param 208=0x7FFFFFFF and Param 209=0x00000004 GPIO Port1 pin 2 is set to HIGH and GPIO Port1 pin 31 is set to LOW. All other GPIO Port1 pins are left unchanged.

13.39 CDB-ID 213 – PPS operating mode setting 1

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table.

Table 249. CDB-ID 213 field description

Bits	Values	Description
From B0 to B3	0 = on every second 1 = on even seconds 2 = on odd seconds	PPS generation mode
From B4 to B7	0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS	Reference time on which the PPS signal is synchronized. **Note:** – UTC(SU) is the Soviet Union UTC, it is derived from GLONASS time applying the UTC delta time downloaded from GLONASS satellites. – GPS_UTC_FROM_GLONASS is the GPS time derived from GLONASS time applying the GPS delta time downloaded from GLONASS satellites. – If the software is configured to work in GLONASS only mode, UTC(SU) is identical to UTC and GPS_UTC_FROM_GLONASS is identical to GPS_UTC.
From B8 to B11	1 = NO FIX 2 = 2D FIX 3 = 3D FIX	GNSS fix condition for PPS signal generation. NO FIX: PPS signal is present even in GNSS NO fix conditions. 2D FIX: the PPS is present if the GNSS is at least in 2D fix condition. 3D FIX: the PPS is present only if the GNSS is in 3D fix conditions.
From B16 to B23	0...24	Minimum number of satellites used for timing correction. PPS signal is generated if the number of satellites used for time correction is bigger the minimum number. This parameter should be set to 0 is the threshold is not used.
From B24 to B31	0...90	Satellite elevation mask for time correction. It is the minimum satellite elevation angle to use the satellite for time correction. If this parameter is set to 0 there is no satellites filtering based on the elevation.

13.40 CDB-ID 214 – PPS operating mode setting 2

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table:

Table 250. CDB-ID 214 field description

Bits	Values	Description
From B0 to B7	0 = mixing constellation disabled 1 = GPS sats are enabled for GLONASS time correction. 2 = GLONASS sats are enabled for GPS time correction. B7 = BEIDOU constellation	Enable/disable mixing constellations for time correction.

Mixing constellations for time correction means that satellites from one constellation are used to correct the reference time for other constellations.

For example if GPS time is selected for PPS signal generation and B1 (or B7) is enabled, also Glonass satellites (or Beidou satellites) are used to correct the GPS reference time. If Glonass time is selected for PPS signal generation and B0 is enabled, also GPS satellites are used to correct the Glonass reference time.

13.41 CDB-ID 215 – Position hold auto survey samples

Sets the number of position samples to be captured before entering in the position hold mode. The auto survey procedure is disabled if the number of samples is set to 0.

13.42 CDB-ID 218 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 251. CDB-ID 218 field description

Bits	Values	Description
From B0 to B7	From 120 to 138	SBAS PRN
From B8 to B15	From 0 to 180	Satellite longitude in degree
B16	0: EAST 1: WEST	Longitude sense
From B17:B18	0: WAAS 1: EGNOS 2: MSAS 3:GAGAN	The SBAS service

13.43 CDB-ID 219 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 252. CDB-ID 219 field description

Bits	Values	Description
From B0 to B7	From 120 to 138	SBAS PRN
From B8 to B15	From 0 to 180	Satellite longitude in degree
B16	0: EAST 1: WEST	Longitude sense
From B17:B18	0: WAAS 1: EGNOS 2: MSAS 3:GAGAN	The SBAS service

13.44 CDB-ID 220 – Adaptive and Cyclic operating mode setting 1

Configure the cyclic low power mode. This parameter includes different fields as reported in *Table 253*.

Table 253. CDB-ID 220 field description

Bits	Values	Description
B0	0	Adaptive mode enable/disable
B1	0/1	Duty cycle enable/disable
From B2 to B3	0	Reserved
From B4 to B11	0...255	EHPE average threshold [m]
From B12 to B19	0...32	First N satellites (with higher elevation) used for the position calculation (Active channel management) in LOW POWER STATE
From B20 to B31	1, 3, 5	Duty cycle fix period [s]

13.45 CDB-ID 221 – Low Power operating mode setting

Low Power management:

Table 254. CDB-ID 221 field description

Bits	Values	Description
From B0 to B31		RESERVED

13.46 CDB-ID 222 – LMS operating mode setting 1

Table 255. CDB-ID 222 field description

Bits	Values	Description
B0	0/1	2D Fix enable/disable: – 0: disable – 1: enable
B1	0/1	HDOP product in range error metric enable/disable: – 0: disable – 1: enable
B2	0/1	GLONASS path delay lock enable/disable: – 0: disable – 1: enable
From B8 to B15	0...255	Position residual threshold [m]
From B16 to B23	0...255	Position residual threshold after RAIM [m]

13.47 CDB-ID 223 – LMS operating mode setting 2

Table 256. CDB-ID 223 field description

Bits	Values	Description
From B0 to B7	0...255	Minimum number of satellites in GNSS mode
From B8 to B15	0...255	Minimum number of satellites in single constellation mode
From B16 to B31	-32768...32767	Initial GLONASS path delay [dm]. (It is expressed in 2-complements on 16 bits)

13.48 CDB-ID 224 – Low power operating mode setting

Low Power management

Table 257. CDB-ID 224 field description

Bits	Values	Description
From B0 to B31		RESERVED

13.49 CDB-ID 225 – ADC channels read parameters

This parameter allows configuring different parameters for the ADC channels reading. This parameter includes different fields as reported in the following table where the description of the ADC channel reading configuration parameters is reported:

Table 258. CDB-ID 225 field description

Bits	Values	Description
B0	0 = OFF 1 = ON	ADC channels data reading OFF (default mode)/ON
From B1 to B8	1...255	Channel Mask
From B9 to B16	0...255	Clk divisor factor to configure ADC sampling rate

13.50 CDB-ID 226 – Antenna Sensing parameters

This parameter allows configuring different parameters for the Antenna Sensing feature. This parameter includes different fields as reported in the following table where the description of the Antenna Sensing configuration parameters is reported:

Table 259. CDB-ID 226 field description

Bits	Values	Description
From B0 to B1	0...1	0 = Antenna Sensing OFF (default value) 1 = Antenna Sensing RF mode ON 2 = Antenna Sensing ADC mode ON 3 = Antenna Sensing GPIO mode ON
Bit2	0...1	Periodic antenna status NMEA message reporting (if disabled the antenna status is reported on status change event) 0 = disabled 1 = enabled
Bit3	0...1	Antenna switching capability: 0 = disabled 1 = enabled
From B4 to B11	0...255	ADC clock divider for sampling rate. This field is completely ignored when Antenna sensing type is different from ADC. In ADC mode this cannot be 0.
From B12 to B21	< 63	ADC minimum threshold value (mV).
From B22 to B31	> 210	ADC maximum threshold value (mV)

The thresholds values have to be tuned according to the specific Antenna Sensing application implementation. The default values reported in the table above are dimensioned assuming an antenna powered with 3.3 V and with a partitioned maximum input voltage to ADC of 1.4 V.

13.51 CDB-ID 231 – CDB-ID 232 - NMEA on Debug Port Message List 0

Allow enabling/disabling each NMEA message in the message list 0 used for sending messages over the debug port. CDB-ID 231 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 232 for the second 32 bits (high bits) of the 64 bits message list. The message list configuration is done in the same way as for the NMEA message list 0 (see CDB-ID 201 and CDB-ID 228 for details). See CDB-ID 201 also for supported message list table.

If not used the message list must be set to “0” (both CDB-ID 231 and CDB-ID 232 must be set to 0). It must be set to “0” also when the dual NMEA port feature is disabled (see CDB-ID 103 for details on enabling/disabling dual NMEA port).

13.52 CDB-ID 233 – CDB-ID 234 - NMEA on Debug Port Message List 1

Allow enabling/disabling each NMEA message in the message list 1 used for sending messages over the debug port. CDB-ID 233 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 234 for the second 32 bits (high bits) of the 64 bits message list. The message list configuration is done in the same way as for the NMEA message list 0 (see CDB-ID 201 and CDB-ID 228 for details). See CDB-ID 201 also for supported message list table.

If not used the message list must be set to “0” (both CDB-ID 233 and CDB-ID 234 must be set to 0). It must be set to “0” also when the dual NMEA port feature is disabled (see CDB-ID 103 for details on enabling/disabling dual NMEA port).

13.53 CDB-ID 235 – CDB-ID 236 - NMEA on Debug Port Message List 2

Allow enabling/disabling each NMEA message in the message list 2 used for sending messages over the debug port. CDB-ID 235 represents the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 236 for the second 32 bits (high bits) of the 64 bits message list. The message list configuration is done in the same way as for the NMEA message list 0 (see CDB-ID 201 and CDB-ID 228 for details). See CDB-ID 201 also for supported message list table.

If not used the message list must be set to “0” (both CDB-ID 235 and CDB-ID 236 must be set to 0). It must be set to “0” also when the dual NMEA port feature is disabled (see CDB-ID 103 for details on enabling/disabling dual NMEA port).

Note: The message list 2 is RESERVED for those messages which need to be sent at high rate (e.g. 10Hz) and/or require accurate message output timing (low jitter). If high rate messages or low jitter are not required, this message list should not be used.

13.54 CDB-ID 237 – Default GPS MIN-MAX week number

Allow setting of minimum and maximum GPS week number.

Minimum week number is used for correct GPS week decoding. The GNSS software is able to decode correctly the GPS week number for a number of 1024 weeks (about 20 years) starting from a minimum week number.

Note: The minimum week number should be moved ahead along years to guarantee at least 20 years of correct week decoding in the future.

Maximum week number is used for GPS week validity check. It must be set at least 1024 weeks ahead to the minimum week number.

Note: As soon as the max week number is reached, the GNSS software is no more able to validate the time and so it is no more able to achieve the GNSS position fix.

Table 260. CDB-ID 237 field description

Bits	Values	Description
From B0 to B15	0...65535	GPS minimum week number
From B16 to B31	0...65535	GPS maximum week number

13.55 CDB-ID 238 – Default UTC delta time

Allow setting the default value for the GPS time to UTC delta time seconds (leap seconds). This parameter is used by the GNSS software only is the UTC backup data is not available in the backup memory (e.g. first startup after production or in case of backup memory content lost occurrence).

13.56 CDB-ID 240 – CDB-ID 241 – STBIN Msg-List

Allow enabling/disabling each STBIN message in the binary protocol message list. CDB-ID 240 represents the first 32 bits (low bits) of the extended 64 bits STBIN message list. See CDB-ID 241 for the second 32 bits (high bits) of the 64 bits message list.

For each bit:

- 0 means feature disabled
- 1 means feature enabled

Table 261. CDB-ID 240 field description

	Bit(1)	Bitmask (32 bits)	Function
Low 32 bits	0	0x1	ECEF Position Information
	1	0x2	LLH Position Information
	2	0x4	Fix Status Information
	3	0x8	DOP Information
	4	0x10	ECEF Velocity Information
	5	0x20	NEU Velocity Information
	6	0x40	GNSS Time Information
	7	0x80	UTC Time Information
	8	0x100	SV Information
	9	0x200	DGPS Information
	10	0x400	DGPS Information Per Satellite
	11	0x800	Position Residuals
	12	0x1000	Velocity Residuals
	13	0x2000	Satellite Fix Information
	14	0x4000	Fix Information
	15	0x8000	Positioning Algorithm Information
	16	0x10000	Satellites RF Data
	17	0x20000	Position and Velocity Covariance
	18	0x40000	Position Accuracy Data
	19	0x80000	PPS Data
	20	0x100000	Position Hold Data
	21	0x200000	TRAIM Data
	22	0x400000	Low Power Management Information
	23	0x800000	CPU Information
	24	0x1000000	Notch Filter Status Data
	25	0x2000000	Not Used
	26	0x4000000	Not Used
	27	0x8000000	Not Used
	28	0x10000000	Not Used
	29	0x20000000	Not Used
	30	0x40000000	Not Used
	31	0x80000000	Not Used

1. The Bit-Value indicates the bit position, thus multiple choices are possible.

Table 262. CDB-ID 241 field description

	Bit[(1)]	Bitmask (32 bits)	Function
High 32 bits	32	0x1	Not Used
	33	0x2	Not Used
	34	0x4	Not Used
	35	0x8	Not Used
	36	0x10	Not Used
	37	0x20	Not Used
	38	0x40	Not Used
	39	0x80	Not Used
	40	0x100	STAGPS GPS Prediction Information
	41	0x200	STAGPS LONASS Prediction Information
	42	0x400	Not Used
	43	0x800	Not Used
	44	0x1000	Not Used
	45	0x2000	Not Used
	46	0x4000	Not Used
	47	0x8000	Not Used
	48	0x10000	SBAS Satellite Data
	49	0x20000	SBAS Corrections Data
	50	0x40000	Not Used
	51	0x80000	Not Used
	52	0x100000	Not Used
	53	0x200000	Not Used
	54	0x400000	Not Used
	55	0x800000	RF Test Data
	56	0x1000000	Not Used
	57	0x2000000	Not Used
	58	0x4000000	Not Used
	59	0x8000000	Not Used
	60	0x10000000	Not Used
	61	0x20000000	Not Used
	62	0x40000000	Not Used
	63	0x80000000	Not Used

1. The Bit-Value indicates the bit position, thus multiple choices are possible.

13.57 CDB-ID 242 – Antenna Sensing via GPIO setting 1

Allow GPIO pin configuration for the antenna detection and control signals.

Table 263. CDB-ID 242 field description

Bits	Values	Description
[5 : 0]	0 ... 63	This field represent the identifier of the ST Teseo III GPIO used to drive the external antenna power switch. The ID shall be in range 0 to 63. Note: This bit field is completely ignored if **PWR_SWTBL** in *CDB-ID 226* is set to zero.
[7 : 6]		Reserved, must be kept at reset value.
[13 : 8]	0 ... 63	This field represent the identifier of the ST Teseo III GPIO used to drive the channel 1 of RF path (i.e. L1 RF path). The ID shall be in range 0 to 63. Note: This bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero.
[15 : 14]		Reserved, must be kept at reset value.
[21 : 16]	0 ... 63	If sensing type is ADC or RF, this field represent the identifier of the ST Teseo III GPIO used to drive the channel 2 of RF path (i.e. L5 RF path). If sensing type is GPIO, this field represent the identifier of the ST Teseo III GPIO used to detect the *short condition*. Note: if sensing type is ADC or RF, this bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero or **RF DUAL** in *CDB-ID 243* is set to zero.
[23 : 22]		Reserved, must be kept at reset value
[29 : 24]	0 to 63	**GPIO OPEN ID[5:0]:** GPIO open identifier. The meaning of this field depends on **SENS TYPE** in *CDB-ID 226*. If sensing type is ADC or RF, this field is ignored. If sensing type is GPIO, this field represent the identifier of the ST Teseo III GPIO used to detect the *open condition*.
[31 : 30]		Reserved, must be kept at reset value

13.58 CDB-ID 243 – Antenna Sensing via GPIO setting 2

Allow GPIO mode configuration for the antenna detection and control signals.

Table 264. CDB-ID 243 field description

Bits	Values	Description
[1 : 0]	0 ... 3	This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **PWR SWITCH ID** in *CDB-ID 242*. 0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2
[2]		Reserved, must be kept at reset value
[3]	0 ... 1	**RF SWTBL:** Antenna detection RF switch capability This bit specifies if external circuitry is able to manage the antenna RF switch. 0: Hardware has not RF switch capability. 1: Hardware has RF switch capability.
[5 : 4]	0 ... 3	**RF DUAL:** Antenna RF dual mode. This bit specifies if the hardware is dual band or single band. 0: Single mode. The hardware has not dual frequency capability. 1: Dual mode. The hardware has dual frequency capability. 2: Auto. The hardware single/dual frequency capability is automatically detected from the constellation mask. Note: This bit field is completely ignored if **RF SWTBL** is set to zero.
[7 : 6]		Reserved, must be kept at reset value
[9 : 8]	0 ... 3	**RF CH1 MODE:** Antenna RF path CH1 mode. This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **RF CH1 ID** in *CDB-ID 242*. 0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2 3: Alternative function 3 Note: This bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero.
[15 : 10]		Reserved, must be kept at reset value

Table 264. CDB-ID 243 field description (continued)

Bits	Values	Description
[17 : 16]	0 ... 3	**RF CH2/GPIO SHORT MODE[1:0]:** Antenna RF path CH2 or GPIO short mode. This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **RF CH2/GPIO SHORT ID** in *CDB-ID 242*. 0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2 3: Alternative function 3 Note: The meaning of this field depends on **SENS TYPE** in *CDB-ID 226*. Note: if sensing type is ADC or RF, this bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero or **RF DUAL** in *CDB-ID 243* is set to zero.
[23 : 18]		Reserved, must be kept at reset value
[25 : 24]	0 ... 1	**GPIO OPEN MODE:** GPIO open mode. This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **GPIO OPEN ID** in *CDB-ID 242*. 0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2 3: Alternative function 3 The meaning of this field depends on **SENS TYPE** in *CDB-ID 226*. If sensing type is ADC or RF, this field is ignored.
[31 : 26]		Reserved, must be kept at reset value

13.59 CDB-ID 244 – Antenna Sensing via GPIO setting 3

Allow setting the active levels for the antenna detection and control signals

Table 265. CDB-ID 244 field description

Bits	Values	Description
[0]	0 ... 1	**PWR SWITCH LEVEL:** Antenna power switch active level. This bit represents the active level of power switch i.e. that logic level that turns on the antenna power. 0: Active level is low 1: Active level is high
[1]	0 ... 1	**OP MODE:** Antenna Detection initial operating mode. This bit defines the operating mode of Antenna Detection at startup 0: Automatic mode 1: Manual mode
[2]	0 ... 1	**RF PATH:** Antenna Detection initial RF path. This bit defines the RF path at startup 0: RF path routed on external antenna 1: RF path routed on internal antenna Note: This bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero.
[3]	0 ... 1	**PWR SW:** Antenna Detection initial power switch status. This bit defines the status of Antenna Power switch at startup 0: Antenna power is ON 1: Antenna power is OFF Note: This bit field is completely ignored if **PWR SWTBL** in *CDB-ID 226* is set to zero.
[7 : 4]		Reserved, must be kept at reset value
[8]	0 ... 1	**RF CH1 LEVEL:** Antenna RF path CH1 active level. This bit represents the active level of RF CH1 (L1 RF path) i.e. that logic level that switches the RF CH1 on external antenna. 0: Active level is low 1: Active level is high
[15 : 9]		Reserved, must be kept at reset value

Table 265. CDB-ID 244 field description (continued)

Bits	Values	Description
[16]	0 ... 1	**RF CH2/GPIO SHORT LEVEL:** Antenna RF path CH2 or GPIO short active level. The meaning of this field depends on **SENS TYPE** in *CDB-ID 226*. If sensing type is ADC or RF, this bit represents the active level of RF CH2 (L5 RF path) i.e. that logic level that switches the RF CH2 on external antenna. If sensing type is GPIO, this field represent the active level of GPIO short i.e. that logic level in which that line is when a *short condition* occurs. 0: Active level is low 1: Active level is high Note: if sensing type is ADC or RF, this bit field is completely ignored if **RF SWTBL** in *CDB-ID 243* is set to zero or **RF DUAL** in *CDB-ID 243* is set to zero.
[23 : 17]		Reserved, must be kept at reset value
[24]	0 ... 1	**GPIO OPEN LEVEL:** GPIO open active level. This field represent the active level of GPIO short i.e. that logic level in which that line is when an *open condition* occurs. This bit field is ignored whereas sensing type is ADC or RF. 0: Active level is low 1: Active level is high
[31 : 25]		Reserved, must be kept at reset value

13.60 CDB-ID 245 – TCXO frequency

Allow selecting the TCXO frequency in the set of supported frequencies.

Table 266. CDB-ID 245 field description

Value	TCXO Frequency
0x00	26 MHz
0x0A	48 MHz
0x0B	55 MHz

Note: This parameter allows setting the TCXO frequency only for the GNSS firmware. It doesn’t configure the BOOT firmware which is present at the beginning of flash memory and which is used to perform the firmware upgrade procedure. The proper BOOT code must be flashed into the device to ensure the firmware upgrade functionality with the TCXO frequency in use.

Note: 55 MHz TCXO is supported to avoid RF interferer injection from GNSS subsystem into FW radio frequency band. This configuration should be used when an RF coupling is possible *between GNSS and Radio. To guarantee no interferer injected into the radio subsystem, also the CPU speed (see parameter CDB-ID 130) must be set to 55 MHz.*

13.61 CDB-ID 249 – Flash Protection Setting 1

Allow enabling/disabling the flash write protection feature.

Note: This parameter can only be changed in the factory setting (e.g. changing firmware configuration before flashing with fwconfig.exe tool). The parameter setting by commands is no more supported. If the command interface is used to change the value of this parameter, the new configuration doesn't take effect even after the system reboot.

Table 267. CDB-ID 249 field description

Bits	Values	Description
B0	0...1	0: Flash protection feature disabled 1: Flash protection feature enabled

13.62 CDB-ID 250 – Flash Protection Setting 2

Allow setting the flash sectors to be write protected.

Note: This parameter can only be changed in the factory setting (e.g. changing firmware configuration before flashing with fwconfig.exe tool). The parameter setting by commands is no more supported. If the command interface is used to change the value of this parameter, the new configuration doesn't take effect even after the system reboot.

Table 268. CDB-ID 250 field description

Bits	Values	Description
B0..B30	0x0...0x7FFFFFFF	The word programmed inside the flash memory control registers to select the set of sectors to be protected. It could be different for different memory vendors (see the application note for details). The memory area which is protected by the flash protection feature is the code area. Sectors used by NVM must not be protected. Default setting is 0x0 because the auto-configuration mode is enabled.
B31	0,1	Flash memory auto-protection feature enabling/disabling 0 = disabled 1 = enabled NOTE: when enabled the value configured in B0..B30 is not used. B31 is set to 1 by default.

In case of Teseo III, the part number with embedded SQI follows the *Table 269: CDB-ID 250 configuration in case of embedded SQI*.

Table 269. CDB-ID 250 configuration in case of embedded SQI

Embedded SQI	CDB-ID 250 SPM_CONFIGURATION
STA8089Fxx	0x0A
STA8090Fxx	0x0A
STA8090F4xx	0x15

While in case of external SQI flash the *Table 270: Embedded SQI flash memory supported on Teseo III* must be followed.

Table 270. Embedded SQI flash memory supported on Teseo III

External SQI		CDB-ID 250 SPM_CONFIGURATION
Vendor	p/n	
Macronix	MX25U1635E MX25U1635F	0x0A
Winbond	W25QxxFV/DW/DV Where xx<64	0x0D
Winbond	W25QxxJV Where xx<64	0x0D
Winbond	W25Q64FV	0x0C
Winbond	W25Q64JV	0x0C
Winbond	W25Q128FV	0x0B
Winbond	W25Q128JV	0x0B
Winbond	W25Q256FV/JV	0x15
Micron	N25Q032A N25Q064A	0x0D
Spansion	S25FL116K S25FL132K	0x0D
Spansion	S25FL164K	0x0C
Macronix	MX25R1635F MX25R3235F	0x15
Macronix	MX25V1635F	0x15
Macronix	MX25L3233F	0x15
ISSI	IS25LQ0xxB	0x0A
ISSI	IS25LP016D IS25WP016D	0x0A

13.63 CDB-ID 252 – Antenna sensing ADC inputs configuration

Allow setting the ADC inputs for the antenna sensing feature.

Table 271. CDB-ID 252 field description

Bits	Values	Description
B0...B7	Any combination with two bits high	**ADC CHANNELS[7:0]:** ADC channel used by Antenna Detection. This field represent the bitmask of ADC channels used by Antenna Detection when sensing type is ADC. Note: This bit field is completely ignored if **SENS TYPE** in CDB-ID 226 is different from 2 (i.e. ADC sensing type). *Note: The number of selected channels must be equal to 2.*

The configurability of ADC input is allowed only for STA8090EXG. For other packages the default ADC input configuration must be used. Default ADC input values are: AIN0 and AIN1.

13.64 CDB-ID From 253 to 256 – GPIO Pin Mode Setting

Allow setting the pin mode required by the GPIO function. These settings are used together with parameters from CDB-ID 206 to 209. The default values should be OK and don’t require to be changed when parameters from 206 to 209 are configured. Anyway this type of configuration has been added to give flexibility in case a different silicon cut reports a different pin mode setting for the GPIO functionality.

Parameters 253 and 254 refer to the GPIO port 0; parameters 255 and 256 refer to GPIO port 1. Each parameter is a 32-bit mask representing the 32 pins of the GPIO port (bit 0 corresponds to PIN0 and bit31 corresponds to PIN31).

These parameters have the same meaning as the AFSLA and AFSLB registers, described in the STA8090 datasheet, they allow setting the alternate functions (NONE, A, B and C) for each pin.

13.65 CDB-ID 257 – Periodic operating mode setting 1

Configure the periodic low power mode. This CBD has to be combined with CBD-258.This parameter includes different fields as reported in the following table:

Table 272. CDB-ID 257 field description

Bits	Values	Description
From B0 to B7	0/1 for each feature	Periodic feature set Enable/Disable: B0-B1: 00: Periodic mode OFF 01: Active Periodic mode 11: Standby Periodic mode B2: Ephemeris refresh required B3: RTC calibration required B4: FixOnDemand by WakeUp pin enable - must have B0-B1=11. B5 to B7 are reserved for further usage.
From B8 to B24	0...86400	FixPeriod [s]. 0 means no periodic fix is required.
From B25 to B31	1...127	FixOnTime - Number of fix to report every fix wakeup – used for FixOnDemand and Periodic mode.

13.66 CDB-ID 258 – periodic operating mode setting 2

Configure the periodic low power mode. This CBD has to be combined with CBD-257.This parameter includes different fields as reported in the following table:

Table 273. CDB-ID 258 field description

Bits	Values	Description
From B0 to B7	0...255	NoFixCnt [s] - Time to declare fix loss in HOT conditions.
From B8 to B19	0...4095.	NoFixOff [s] - Off duration time after a fix loss event. 0 means the counter is not active. The fix retry will be based on FixPeriod.
From B20 to B28	0...300	NoFixCnt2 [s] – Time to declare fix loss in non-HOT conditions – startup case, obsolete ephemeris.

13.67 CDB-ID 259 – Low Power Mode HW Setting

Describe the state of each power supplies in the TESEO. The TESEO has a Backup LDO, LDO1, LDO2 and SMPS. Two different states are possible, the High and the Low frequency states, basically related to the TCXO ON or OFF state. The value 0 means OFF, any other values represent a voltage (1.0V 1.1V or 1.2V) or an ON state. The different frequency states are obtained by configuring the periodic mode. High frequency is used when the GNSS Library is active, the low frequency is used when the GNSS Library is inactive. During standby state, only the backup LDO is ON.
Be careful, the voltage source of LDO1 is common to SMPS. If both are ON with a given voltage, the SMPS one will be applied.

Table 274. CDB-ID 259 field description

Bits	Values	Description
B0-B1	0,1	Enable/disable the stop mode functionality of the backup LDO during High frequency periods. If stop mode functionality is enabled, the power consumption in standby mode is reduced. 0 = stop mode disabled 1= stop mode enabled
B2-B3	0,1	Enable/disable the stop mode functionality of the backup LDO during Low frequency periods. If stop mode functionality is enabled, the power consumption in standby mode is reduced. 0 = stop mode disabled 1= stop mode enabled
B4-B5	0,1,2,3	LDO1 status during High frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V. If the LDO1 is configured in 1.8 V, any value different from 0 means ON.
B6-B7	0,1,2,3	LDO1 status during Low frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V. If the LDO1 is configured in 1.8 V, any value different from 0 means ON.
B8-B9	0,1,2,3	LDO2 status during High frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V.
B10-B11	0,1,2,3	LDO2 status during Low frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V.
B12-B13	0,1,2,3	SMPS status during High frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V.
B14-B15	0,1,2,3	SMPS status during Low frequency mode 0 = OFF, 1 = 1.0 V, 2 = 1.1 V, 3 = 1.2 V.

13.68 CDB-ID 260 – WLS algorithm configuration

Allow to configure the WLS algorithm implemented in the positioning stage.

Table 275. CDB-ID 260 field description

Bits	Values	Description
B0	0...1	Enable/Disable the WLS algorithm usage in the positioning stage. 0 = disabled 1= enabled
B1...B7	xxx	Not used

Table 275. CDB-ID 260 field description (continued)

Bits	Values	Description
B8...B15	1...100	Parameter1 multiplied by 10. Parameter1 is a coefficient to change the measurements weighting in the position filter. Allowed values are from 0.1 to 10.0 (suggested value is 1.0) means high acceptance of satellites measurements in the position filter. 10.0 means low acceptance of satellites measurements in the position filter.
B16...B23	10...100	Parameter2 multiplied by 10. Parameter2 is a coefficient to change the measurements acceptance threshold. Allowed values are from 1.0 to 10.0 (suggested value is 2.5) means strong satellite exclusions by FDE (high false alarm rate). 10.0 means relaxed satellites exclusions by FDE.

13.69 CDB-ID 261 – Dynamic modes configuration

Allow to configure the supported dynamic modes for the satellites tracking engine. This configuration replaces the old high/low dynamic setting in the CDB-ID 200 bit mask 0x20000000.

Note: The old High/Low setting is still operative for backward compatibility reasons. To use CDB-ID 261 the CDB-ID 200 bit mask 0x20000000 must be set to 0.

Table 276. CDB-ID 261 field description

Bits	Values	Description
B0..B3	0,1,3	Dynamic mode selection. 0 = Low Dynamic 1= High Dynamic 2= RESERVED 3 = Auto Dynamic

13.70 CDB-ID 262 – HW Shutdown GPIO configuration

This parameter allows to select and configure the GPIO to be used for the HW shutdown feature.

Table 277. CDB-ID 262 field description

Bits	Values	Description
B0	0 = OFF 1 = ON	HW shutdown feature enabling/disabling
From B1 to B2	0,1,2	Edge configuration: 0= rising edge 1=falling edge 2=rising and falling edges
From B3 to B7	-	RESERVED
From B8 to B13	0...63	GPIO ID
From B8 to B13	0,1,2,3	Pin alternate function configuration: 0=None 1=Alternate A 2=Alternate B 3=Alternate C
From B14 to B31	-	RESERVED

13.71 CDB-ID 263 – NMEA over Serial Configuration

Allow configuring the Nmea over serial feature. This Configuration ID allows switching on the feature and configuring the serial peripheral. Only Nmea over I2C is available: it is possible to configure the slave address, different baud rates and I2C pins different from the default ones.

Table 278. CDB-ID 263 field description

Bits	Values	Description	Default
Bit 0-1	0..3	0 = NMEA over I2C OFF 1 = NMEA over I2C ON	0
Bit 2-5	-	RESERVED	0
Bit 6-15	0...0x3F	Slave address	0x3A
Bit 16-23	0...2	0 = Speed mode STANDARD 1 = Speed mode FAST 2 = Speed mode HS	0

Table 278. CDB-ID 263 field description (continued)

Bits	Values	Description	Default
Bit 24-27	0...4	0 = I2C_SD as P0.9 default pin 1 = I2C_SD as P0.20 2 = I2C_SD as P0.28 3 = I2C_SD as USP_DM 4 = I2C_SD as P0.6	0
Bit 28-31	0...3	0 = I2C_CLK as P0.8 default pin 1 = I2C_CLK as P0.7 2 = I2C_CLK as P0.29 3 = I2C_SD as USP_DP	0

13.72 CDB-ID 264 – Data logger Configuration 0

Data logger configuration field 0. Configures the memory base address for the data logger data structure. This configuration is supported only in Binary Image 4.5.8 and later.

Table 279. CDB-ID 264 field description

Bits	Values	Description	Default
Bit 0-31	-	Specify the base address where the log is created	0x10180000

13.73 CDB-ID 265 – Data logger Configuration 1

Data logger configuration field 1. Specify the maximum space available for data logger data structure. This configuration is supported only in Binary Image 4.5.8 and later.

Table 280. CDB-ID 265 field description

Bits	Values	Description	Default
Bit 0-31	0...3	Specify the maximum space available for the log	0x80000

13.74 CDB-ID 266 – Data logger Configuration 2

Data logger configuration field 2. This configuration is supported only in Binary Image 4.5.8 and later.

Table 281. CDB-ID 266 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Data logger disabled on boot 1 = Data logger enabled on boot	0
Bit 1	0...1	0 = Circular buffer disabled 1 = Circular buffer enabled	0x1
Bit 2-4	0..3	0 = RESERVED 1 = Log type 1 2 = Log type 2 3 = Log type 3	0x11
Bit 5	0...	0 = One shot mode disabled 1 = One shot mode enabled	0
Bit 6	0...1	0 = Auto start mode disabled 1 = Auto start mode enabled	0
Bit 7-15	1...255	RESERVED	0
Bit 16-23	0...255	0	0
Bit 24-31	-	RESERVED	0

13.75 CDB-ID 267 – Data logger Configuration 3

Data logger configuration field 3. This configuration is supported only in Binary Image 4.5.8 and later.

Table 282. CDB-ID 267 field description

Bits	Values	Description	Default
Bit 24-31	-	RESERVED	0
Bit 0-23	0..65535	Minimal distance between to logs expressed in meters	0

13.76 CDB-ID 268 – Geofencing Configuration 0

Geofencing configuration field 0. This configuration is supported only in Binary Image 4.5.8 and later.

Table 283. CDB-ID 268 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Geofencing disabled on boot 1 = Geofencing enabled on boot	0
Bit 1-2	0...3	Geofencing tolerance: 0 = No tolerance 1 = Geofencing status probability is 68% 2 = Geofencing status probability is 95% 3 = Geofencing status probability is 99%	0x1
Bit 3	0...1	0 = Autostart disabled 1 = Autostart enabled	0
Bit 4-7	-	RESERVED	0x1
Bit 8	0...1	0 = Circle 0 disabled 1 = Circle 0 enabled	0x1
Bit 9	0...1	0 = Circle 1 disabled 1 = Circle 1 enabled	0x1
Bit 10	0...1	0 = Circle 2 disabled 1 = Circle 2 enabled	0x1
Bit 11	0...1	0 = Circle 3 disabled 1 = Circle 3 enabled	0x1
Bit 12-31	-	RESERVED	0

13.77 CDB-ID 270 – Odometer Configuration

Odometer configuration field. This configuration is supported only in Binary Image 4.5.8 and later.

Table 284. CDB-ID 270 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Odometer disabled on boot 1 = Odometer enabled on boot	0
Bit 1	0...1	0 = Odometer related NMEA messages disabled 1 = Odometer related NMEA messages enabled	0
Bit 2	0...1	0 = Odometer does not starts to record on boot 1 = Odometer automatically starts to record on boot	0
Bit 3-15	-	RESERVED	0
Bit 16-31	0...1	Distance in meter to trigger the alarm	0x03E8

13.78 CDB-ID 272 – GNSS integrity check configuration

Position and time integrity check enabling/disabling.

Table 285. CDB-ID 271 field description

Bits	Values	Description	Default
Bit 0	0...1	0 = Position integrity check disabled 1 = Position integrity check enabled	0
Bit 1	0...1	0 = Time integrity check disabled 1 = Time integrity check enabled	0

13.79 CDB-ID 283 - I/O events configuration 4

Reset value: 0x00FF00FF

This parameter allows configuring I/O related to Antenna Switch and Antenna Status change events.

Table 286. CDB-ID 283 bit fields description

Bits	Values	Description
[7 : 0]	0..63: Allowed values. 64…254: reserved. 255: Event disabled	**ANT SWI ID:** Antenna switch event GPIO identifier This field represent the identifier of the ST Teseo III GPIO associated to the Antenna Switch event.
[9 : 8]	0 ... 3	**ANT SWI MODE [1:0]:** Antenna switch event GPIO mode This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **ANT SWI ID**. 0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2 3: Alternative function 3
[11 : 10]		Reserved, must be kept at reset value
[12]	0 ... 1	**ANT SWI LEVEL:** Antenna switch event GPIO active level. This bit represents the active level of Antenna Switch event i.e. the logic level the software will apply to associated GPIO when antenna path is external. 0: Active level is low 1: Active level is high
[15 : 13]		Reserved, must be kept at reset value

Table 286. CDB-ID 283 bit fields description

Bits	Values	Description
[23 : 16]	0..63: Allowed values. 64…254: reserved. 255: Event disabled.	**ANT STA ID [7:0]:** Antenna status change event GPIO identifier This field represent the identifier of the ST Teseo III GPIO associated to the Antenna Status change event.
[25 : 24]	0: Alternative function 0 (default) 1: Alternative function 1 2: Alternative function 2 3: Alternative function 3	**ANT STA MODE [1:0]:** Antenna status change event GPIO mode. This field represent the Alternative function required to have the GPIO functionality on the ST Teseo III pin identified with **ANT STA ID**.
[27 : 26]		Reserved, must be kept at reset value.
[28]	0: Active level is low 1: Active level is high	**ANT STA LEVEL:** Antenna status change event GPIO active level. This bit represents the active level of Antenna Status change event i.e. the logic level the software will apply to associated GPIO when antenna is in *normal condition*.
[31 : 29]		Reserved, must be kept at reset value.

13.80 CDB-ID 300 - Low Latency Interface rate

Allow setting the Low Latency Interface rate. It is the time period between two consecutive NMEA message (only working on message-list-2).

System reboot needed to have new setting in use.

13.81 CDB-ID 301 – PPS Pulse Duration

Allow setting the Low Latency Interface rate. It is the time period between two consecutive NMEA message (only working on message-list-2).

System reboot needed to have new setting in use.

13.82 CDB-ID 301 – PPS Pulse Duration

Allow setting the pulse duration of the PPS signal. The pulse duration is intended to be the time distance between the PPS rising edge and the next falling edge if polarity inversion is disabled or the time distance between falling and rising edge if polarity inversion is enabled.

13.83 CDB-ID 302 – PPS Delay Correction

Allow setting a time correction to compensate any delay introduced on the Pulse per Second (PPS) signal by cables and/or RF chain.

13.84 CDB-ID 303 – GNSS fix rate

Allow setting the GNSS library fix rate. It is the time period between two consecutive position fix evaluations.

System reboot needed to have new setting in use.

13.85 CDB-ID 304 – Position Hold Latitude

Allow setting the latitude [degrees] for the position hold mode

Note: To be used the position hold functionality must be enabled, see CDB-ID 200 for details.

System reboot needed to have new setting in use.

13.86 CDB-ID 305 – Position Hold Longitude

Allow setting the longitude [degrees] for the position hold mode

Note: To be used the position hold functionality must be enabled, see CDB-ID 200 for details).

System reboot needed to have new setting in use.

13.87 CDB-ID 306 – Position Hold Altitude

Allow setting the altitude [m] for the position hold mode (NOTE: to be used the position hold functionality must be enabled, see CDB-ID 200 for details).

Note: The altitude to be configured in this parameter mustn't be compensated with the geoid correction. If the altitude value is retrieved by the $GPGGA NMEA message, it must be added to the geoid correction (reported in the same $GPGGA message) before setting it in the CDB-ID 306 parameter.

System reboot needed to have new setting in use.

13.88 CDB-ID 307 – GPS RF delay correction

Allow setting the RF time delay for the GPS signal path. The RF compensation for GPS is independent of the PPS clock setting. The value calibrated for the ST reference design is 713E-9 s.

13.89 CDB-ID 308 – GLONASS RF delay correction

Allow setting the RF time delay for the GLONAS signal path. The RF compensation for GLONASS depends on the PPS clock setting (see CDB-ID). Here are the values calibrated for the ST reference design.

Table 287. CDB-ID 308 field description

PPS Clock Setting	GLONASS RF Correction
32 MHz	-
64 MHz	-

Note: If the PPS clock setting is changed in the configuration block, also the GLONASS RF delay correction must be changed accordingly. For accurate timing applications it is strongly recommended to set PPS clock to 64 MHz.

13.90 CDB-ID 309 – TRAIM alarm threshold

Allow setting the time error threshold for satellites removal in the TRAIM algorithm. Satellites which have a time error bigger than the TRAIM threshold are not used for time correction. The TRAIM threshold is also used to rise the TRAIM alarm if the time correction error is bigger than it.

13.91 CDB-ID 310 – BeiDou RF delay correction

Allow setting the RF time delay for BeiDou signal path.

13.92 CDB-ID 311 – GALILEO RF delay correction

Allow setting the RF time delay for GALILEO signal path.

13.93 CDB-ID 314 – CDB-ID 315 – CDB-ID 316 – Geofencing Circle 0

Allows to set up the geofencing circle number 0 parameters.

Table 288. Geofencing circle 0 field description

CDB-ID	Type value	Description
314	double precision floating number	Circle latitude
315	double precision floating number	Circle longitude
316	double precision floating number	Circle radius in meters

This configuration is supported only in Binary Image 4.5.8 and later.

13.94 CDB-ID 317 – CDB-ID 318 - CDB-ID 319 - Geofencing Circle 1

Allows to set up the geofencing circle number 1 parameters.

Table 289. Geofencing circle 1 field description

CDB-ID	Type value	Description
317	Double precision floating number	Circle latitude
318	Double precision floating number	Circle longitude
319	Double precision floating number	Circle radius in meters

This configuration is supported only in Binary Image 4.5.8 and later.

13.95 CDB-ID 320 – CDB-ID 321 – CDB-ID 322 – Geofencing Circle 2

Allows to set up the geofencing circle number 2 parameters

Table 290. Geofencing circle 2 field description

CDB-ID	Type value	Description
320	Double precision floating number	Circle latitude
321	Double precision floating number	Circle longitude
322	Double precision floating number	Circle radius in meters

This configuration is supported only in Binary Image 4.5.8 and later.

CDB-ID 323 – CDB-ID 324 – CDB-ID 325 – Geofencing Circle 3

Allows to set up the geofencing circle number 3 parameters

Table 291. Geofencing circle 3 field description

CDB-ID	Type value	Description
323	double precision floating number	Circle latitude
324	double precision floating number	Circle longitude
325	double precision floating number	Circle radius in meters

This configuration is supported only in Binary Image 4.5.8 and later.

13.96 CDB-ID 400 – Default 2D DOP

Allow setting the default value for the 2D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

13.97 CDB-ID 401 – Default 3D DOP

Allow setting the default value for the 3D DOP. This value is used at run-time, after the GNSS startup phase, as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

13.98 CDB-ID 402 – Startup 2D DOP

Allow setting the startup value for the 2D DOP. This value is used during the GNSS startup phase as a threshold for the 2D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

13.99 CDB-ID 403 – Startup 3D DOP

Allow setting the startup value for the 3D DOP. This value is used during the GNSS startup phase as a threshold for the 3D fix validation. DOP below this threshold will be considered valid for position fixing.

System reboot needed to have new setting in use.

13.100 CDB-ID 500 – Text message

Allow setting a text message which is sent (if enabled – see bit9 of CDB-ID 200 parameter) at startup over the NMEA port. The user is free to use this text as product name or as specific configuration marker.

System reboot needed to have new setting in use.

Appendix A Acronyms and definitions

Table 292 lists the acronyms and definitions used in this document.

Table 292. Acronyms and definitions

Keyword	Definition
Accuracy	Deviation of a GPS-based calculated position from the true position
ADC	Analogue to Digital Converter
Almanac	Contains the information about all available satellites, their orbit data and time of their clocks.
ANF	Adaptive Notch Filter
Azim	Azimuth - Angular distance from a reference
Bank Swap	Exchanging two memory banks for storage of data
BAUD rate	Transmission Rate Measure for the effective transmission of data content. (may differ from Bits/sec).
BEIDOU	China’s regional navigation satellite system
Checksum	Calculated from the transmitted characters of a message by “ex-OR”ing the 8 bit character values excluding delimiters $ and *
CN0	Carrier to Noise Ratio - Identifies the quality of a received signal
Cold Start	Start Condition for a GPS system having no position nor time. Almanac and Ephemeris is not available, too.
BeiDou	China’s global navigation satellite system (also known as Beidou-2, BD2)
Dead Reckoning	Sensor based process to determine the movement of a mobile unit, utilizing Gyro, Odometer and Wheel Pulses.
Delimiter (within NMEA 0183)	ASCII “$” to indicate Address Field ASCII “,” to indicate Data Field ASCII “*” to indicate Checksum Field
DGPS	Differential GPS - GPS Augmentation System providing the accurate location of a Reference Station to reduce system errors.
EGNOS	European Geostationary Navigation Overlay System
Elev	Elevation - Angle between a high level or non-earth bound point and the horizontal plane of the viewer.
Ephemeris	Ephemeris Data is transmitted by each satellite and contains current and predicted satellite position.
FDA	Failure Detection Algorithm - Specific Algorithm to detect failures in position calculation
FDE	False Detection Exclusion
GALILEO	Europe’s global navigation satellite system
GDOP	Geometric Dilution Of Position - Quality value representing all geometry based error factors in a system.
IRNSS	Indian Regional Navigational Satellite System

Table 292. Acronyms and definitions (continued)

Keyword	Definition
GNSS	Global Navigation Satellite System - Satellite based system to calculate the position of the Teseo on the earth surface.
GPS	Global Positioning System - United States Satellite Navigation System
GPS Library	STMicroelectronics C-Library containing all GPS relevant Functions
Gyro	Gyroscope - Sensor to determine rotational movements
HDOP	Horizontal Dilution Of Precision - Quality value representing all 2D plane geometry based error factors in a system.
Hot Start	Start Condition for a GPS System having position, time, Almanac and Ephemeris already available. High time accuracy is required.
IMU	Inertial Measurement Unit
Lat	Latitude - Angular difference of a given position to the Equator. Values include 0°-90° either North or South
Lat-Ref	Latitude Reference - Reference if a Latitude value is North or South
Long	Longitude - Angular difference to a “reference” Longitude indicated as “000”. Values include 0°… 180° either West or East.
Long-Ref	Longitude Reference - Reference if a Longitude value is East or West of the “000” Meridian.
NMEA	National Marine Electronics Association - United States Standards Organization For Marine Equipment
NMEA 0183	National Marine Electronics Association - Standard for Interfacing Marine Electronics Devices
NVM	Non Volatile Memory - Any type of memory that conserves data in the absence of regular supply voltage (includes battery buffered memories)
Proprietary Message	Messages within the scope of NMEA0183 which are not standardized. They start with $P and a 3 character identifier.
PRN	Pseudo Random Number - Satellite Specific 1023 Bit Number used for Spread Spectrum Modulation
RAIM	Teseo Autonomous Integrity Monitoring
RF	Radio Frequency - High Frequency for Reception with a RF-Teseo
RS232	IEEE Standard - Physical Layer Standard for Data Transmission
Sat-ID	Satellite Identifier - Satellite specific Number used to generate the corresponding PRN code
SBAS	Satellite Based Augmentation System - GPS enhancement system based on geostationary satellites.
SPS	Standard Positioning Service
Static Position Filtering	Algorithm to detect that the GPS Teseo doesn't move and position output is kept stable.
UTC	Universal Time Coordinated
WAAS	Wide Area Augmentation System - American GPS Augmentation System delivering accurate Ionosphere Data

Table 292. Acronyms and definitions (continued)

Keyword	Definition
Warm Start	Start Condition for a GPS system having current Almanac, position and time availability. Ephemeris are not available. Time needs to be available with reasonable accuracy (some seconds).
2D Fix	Fix based on the use of 3 satellites
3D Fix	Fix based on the use of 4 satellites

A.1 Local geodetic datum tables

Table 293. Africa geodetic datum

AFRICA			
REGION		CODE	CDB-ID VALUE
ADINDAN			
	MeanSolution (Ethiopia-Sudan)	ADI-M	0
	BurkinaFaso	ADI-E	1
	Cameroon	ADI-F	2
	Ethiopia	ADI-A	3
	Mali	ADI-C	4
	Senegal	ADI-D	5
	Sudan	ADI-B	6
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			

Table 293. Africa geodetic datum (continued)

AFRICA			
REGION		CODE	CDB-ID VALUE
	Mean_Solution	ARS-M	17
	Kenya	ARS-A	18
	Tanzania	ARS-B	19
AYABELLE_LIGHTHOUSE			
	Djibouti	PHA	20
BISSAU			
	Guinea-Bissau	BID	21
CAPE			
	South_Africa	CAP	22
CARTHAGE			
	Tunisia	CGE	23
DABOLA			
	Guinea	DAL	24
EUROPEAN_1950			
	Egypt	EUR-F	73
	Tunisia	EUR-T	83
LEIGON			
	Ghana	LEH	25
LIBERIA_1964			
	Liberia	LIB	26
MASSAWA			
	Eritrea (Ethiopia)	MAS	27
MERCHICH			
	Morocco	MER	28
MINNA			
	Cameroon	MIN-A	29
	Nigeria	MIN-B	30
M'PORALOKO			

Table 293. Africa geodetic datum (continued)

AFRICA			
REGION		CODE	CDB-ID VALUE
	Gabon	MPO	31
NORTH_SAHARA_1959			
	Algeria	NSD	32
OLD_EGYPTIAN_1907			
	Egypt	OEG	33
POINT_58			
	Mean_Solution (BurkinaFaso-Niger)	PTB	34
POINTE_NOIRE_1948			
	Congo	PTN	35
SCHWARZECK			
	Namibia	SCK	36
SIERRA_LEONE_1960			
	SierraLeone	SRL	37
VOIROL_1960			
	Algeria	VOR	38

Table 294. Asia geodetic datum

ASIA			
REGION		CODE	CDB-ID VALUE
AIN_EL_ABD_1970			
	Bahrain_Island	AIN-A	39
	Saudi_Arabia	AIN-B	40
DJAKARTA(BATAVIA)			
	Sumatra (Indonesia)	BAT	41
EUROPEAN_1950			
	Iran	EUR-H	77

Table 294. Asia geodetic datum (continued)

ASIA			
REGION		CODE	CDB-ID VALUE
HONG_KONG_1963			
	Hong_Kong	HKD	42
HU-TZU-SHAN			
	Taiwan	HTN	43
INDIAN			
	Bangladesh	IND-B	44
	India-Nepal	IND-I	45
INDIAN_1954			
	Thailand	INF-A	46
INDIAN_1960			
	Vietnam (near_16DegNorth)	ING-A	47
	ConSonIsland (Vietnam)	ING-B	48
INDIAN_1975			
	Thailand	INH-A	49
	Thailand	INH-A1	50
INDONESIAN_1974			
	Indonesia	IDN	51
KANDAWALA			
	SriLanka	KAN	52
KERTAU_1948			
	WestMalaysia-Singapore	KEA	53
KOREAN_1995			
	SouthKorea	KGS	54
NAHRWAN			
	MasirahIsland (Oman)	NAH-A	55
	UnitedArabEmirates	NAH-B	56
	SaudiArabia	NAH-C	57
OMAN			

Table 294. Asia geodetic datum (continued)

ASIA			
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			
	MeanSolution	TOY-M	62
	Japan	TOY-A	63
	Okinawa	TOY-C	64
	South Korea	TOY-B	65
	South Korea	TOY-B1	66

Table 295. Australia geodetic datum

AUSTRALIA			
REGION		CODE	CDB-ID VALUE
AUSTRALIAN_1966			
	Australia-Tasmania	AUA	67
AUSTRALIAN_1984			
	Australia-Tasmania	AUG	68

Table 296. Europe geodetic datum

EUROPE			
REGION		CODE	CDB-ID VALUE
CO-ORDINATE SYSTEM 1937 OF ESTONIA			
	Estonia	EST	69
EUROPEAN_1950			
	MeanSolution	EUR-M	70
	WesternEurope	EUR-A	71
	Cyprus	EUR-E	72
	Egypt	EUR-F	73
	England, ChannelIslands, Scotland, ShetlandIslands	EUR-G	74
	England, Ireland, Scotland, ShetlandIslands	EUR-K	75
	Greece	EUR-B	76
	Iran	EUR-H	77
	ItalySardinia	EUR-I	78
	ItalySicily	EUR-J	79
	Malta	EUR-L	80
	Norway, Finland	EUR-C	81
	Portugal, Spain	EUR-D	82
	Tunisia	EUR-T	83
EUROPEAN_1979			
	MeanSolution	EUS	84
HJORSEY_1955			
	Iceland	HJO	85
IRELAND_1965			
	Ireland	IRL	86
ORDNANCE SURVEY OF GREAT BRITAIN 1936			
	MeanSolution	OGB-M	87
	England	OGB-A	88
	England, IsleOfMan, Wales	OGB-B	89
	Scotland, ShetlandIslands	OGB-C	90
	Wales	OGB-D	91

Table 296. Europe geodetic datum (continued)

EUROPE			
REGION		CODE	CDB-ID VALUE
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 297. North America geodetic datum

NORTH AMERICA			
REGION		CODE	CDB-ID VALUE
CAPE_CANAVERAL			
	MeanSolution (Florida, Bahamas)	CAC	101
NORTH AMERICAN 1927			
	MeanSolution	NAS-C	102
	WesternUnitedStates	NAS-B	103
	EasternUnitedStates	NAS-A	104
	Alaska (ExcludingAleutianIslands)	NAS-D	105
	AleutianIslands(East180°W)	NAS-V	106
	AleutianIslands(West180°W)	NAS-W	107
	Bahamas (Excluding San Salvador Island)	NAS-Q	108

Table 297. North America geodetic datum (continued)

NORTH AMERICA			
REGION		CODE	CDB-ID VALUE
	SanSalvadorIsland	NAS-R	109
	CanadaMeanSolution(Including Newfoundland)	NAS-E	110
	Alberta, BritishColumbia	NAS-F	111
	EasternCanada	NAS-G	112
	Manitoba, Ontario	NAS-H	113
	NorthwestTerritories, Saskatchewan	NAS-I	114
	Yukon	NAS-J	115
	CanalZone	NAS-O	116
	Caribbean	NAS-P	117
	CentralAmerica	NAS-N	118
	Cuba	NAS-T	119
	Greenland	NAS-U	120
	Mexico	NAS-L	121
NORTH AMERICAN 1983			
	Alaska (ExcludingAleutianIslands)	NAR-A	122
	Aleutian Islands	NAR-E	123
	Canada	NAR-B	124
	CONUS	NAR-C	125
	Hawaii	NAR-H	126
	Mexico,Central America	NAR-D	127

Table 298. South America geodetic datum

SOUTH AMERICA			
REGION		CODE	CDB-ID VALUE
BOGOTA OBSERVATORY			
	Colombia	BOO	128

Table 298. South America geodetic datum (continued)

SOUTH AMERICA			
REGION		CODE	CDB-ID VALUE
CAMPO NCHAUSPE 1969			
	Argentina	CAI	129
CHUA ASTRO			
	Paraguay	CHU	130
CORREGO ALEGRE			
	Brazil	COA	131
PROVISIONAL SOUTH AMERICAN 1956			
	MeanSolution	PRP-M	132
	Bolivia	PRP-A	133
	Northern Chile (near 19°S)	PRP-B	134
	Southern Chile (near 43°S)	PRP-C	135
	Colombia	PRP-D	136
	Ecuador	PRP-E	137
	Guyana	PRP-F	138
	Peru	PRP-G	139
	Venezuela	PRP-H	140
PROVISIONAL SOUTH CHILEAN			
	Southern Chile (near 53°S)	HIT	141
SOUTH AMERICAN 1969			
	MeanSolution	SAN-M	142
	Argentina	SAN-A	143
	Bolivia	SAN-B	144
	Brazil	SAN-C	145
	Chile	SAN-D	146
	Colombia	SAN-E	147
	Ecuador (Excluding Galapagos Islands)	SAN-F	148
	Baltra, Galapagos Islands	SAN-J	149
	Guyana	SAN-G	150

Table 298. South America geodetic datum (continued)

SOUTH AMERICA			
REGION		CODE	CDB-ID VALUE
	Paraguay	SAN-H	151
	Peru	SAN-I	152
	Trinidad and Tobago	SAN-K	153
	Venezuela	SAN-L	154
SOUTH AMERICAN GEOCENTRIC REFERENCE SYSTEM(SIRGAS)			
	South America	SIR	155
ZANDERIJ			
	Suriname	ZAN	156

Table 299. Atlantic Ocean geodetic datum

ATLANTIC OCEAN			
REGION		CODE	CDB-ID VALUE
ANTIGUA ISLAND ASTRO 1943			
	Antigua, Leeward Islands	AIA	157
ASCENSION ISLAND 1958			
	Ascension Island	ASC	158
ASTRO DOS 71/4			
	St.Helena Island	SHB	159
BERMUDA 1957			
	Bermuda Islands	BER	160
CAPE CANAVERAL			
	Mean Solution (Bahamas and Florida)	CAC	101
DECEPTION ISLAND			
	Deception Island and Antarctica	DID	161
FORT THOMAS 1955			
	Nevis, St.Kitts and Leeward Islands	FOT	162

Table 299. Atlantic Ocean geodetic datum (continued)

ATLANTIC OCEAN			
REGION		CODE	CDB-ID VALUE
GRACIOSA BASE SW 1948			
	Faial, Graciosa, Pico, SaoJorge and Terceira Islands (Azores)	GRA	163
HJORSEY 1955			
	Iceland	HJO	85
ISTS 061 ASTRO 1968			
	South Georgia Island	ISG	164
L.C. 5 ASTRO 1961			
	Cayman Brac Island	LCF	165
MONTSERRAT ISLAND ASTRO 1958			
	Montserrat and Leeward Islands	ASM	166
NAPARIMA,BWI			
	Trinidad and Tobago	NAP	167
OBSERVATORIO METEOROLOGICO 1939			
	Corvo and Flores Islands (Azores)	FLO	168
PICO DE LAS NIEVES			
	Canary Islands	PLN	169
PORTO SANTO 1936			
	Porto Santo and Madeira Islands	POS	170
PUERTO RICO			
	Puerto Rico and Virgin Islands	PUR	171
QORNOQ			
	South Greenland	QUO	172
SAO BRAZ			
	Sao Miguel and Santa Maria Islands (Azores)	SAO	173
SAPPER HILL 1943			
	East Falkland Island	SAP	174
SELVAGEM GRANDE 1938			

Table 299. Atlantic Ocean geodetic datum (continued)

ATLANTIC OCEAN			
REGION		CODE	CDB-ID VALUE
	Salvage Islands	SGM	175
TRISTAN ASTRO 1968			
	Tristan da Cunha	TDC	176

Table 300. Indian Ocean geodetic datum

INDIAN OCEAN			
REGION		CODE	CDB-ID VALUE
ANNA 1 ASTRO 1965			
	Cocos Islands	ANO	177
GAN 1970			
	Republic of Maldives	GAA	178
ISTS 073 ASTRO 1969			
	Diego Garcia	IST	179
KERGUELEN ISLAND 1949			
	Kerguelen Island	KEG	180
MAHE 1971			
	Mahe Island	MIK	181
REUNION			
	Mascarene Islands	REU	182

Table 301. Pacific Ocean geodetic datum

PACIFIC OCEAN			
REGION		CODE	CDB-ID VALUE
AMERICAN SAMOA 1962			
	American Samoa Islands	AMA	183
ASTRO BEACON “E” 1945			
	Iwo Jima	ATF	184
ASTRO TERN ISLAND (FRIG) 1961			
	Tern Island	TRN	185
ASTRONOMICAL STATION 1952			
	Marcus Island	ASQ	186
BELLEVUE (IGN)			
	Efate and Erromango Islands	IBE	187
CANTON ASTRO 1966			
	Phoenix Islands	CAO	188
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			

Table 301. Pacific Ocean geodetic datum (continued)

PACIFIC OCEAN			
REGION		CODE	CDB-ID VALUE
	Johnston Island	JOH	195
KUSAIE ASTRO 1951			
	CarolineIslands, Fed.States of Micronesia	KUS	196
LUZON			
	Philippines (Excluding Mindanao Island)	LUZ-A	197
	Mindanao Island	LUZ-B	198
MIDWAY ASTRO 1961			
	Midway Islands	MID_A	199
	Midway Islands	MID_B	200
OLD_HAWAIIAN			
	Mean Solution	OHA-M	201
	Hawaii	OHA-A	202
	Kauai	OHA-B	203
	Maui	OHA-C	204
	Oahu	OHA-D	205
OLD HAWAIIAN			
	Mean Solution	OHI-M	206
	Hawaii	OHI-A	207
	Kauai	OHI-B	208
	Maui	OHI-C	209
	Oahu	OHI-D	210
PITCAIRN ASTRO 1967			
	Pitcairn Island	PIT	211
SANTO (DOS) 1965			
	Espirito Santo Island	SAE	212
VITI LEVU 1916			
	VitiLevuIsland (Fiji Islands)	MVS	213

Table 301. Pacific Ocean geodetic datum (continued)

PACIFIC OCEAN			
REGION		CODE	CDB-ID VALUE
WAKE-ENIWETOK 1960			
	Marshall Islands	ENW	214
WAKE ISLAND ASTRO 1952			
	Wake Atoll	WAK	215

Table 302. Non-Satellite Derived Transformation Parameter geodetic datum

Non-Satellite Derived Transformation Parameter			
REGION		CODE	CDB-ID VALUE
BUKIT RIMPAH			
	Bangka and Belitung Islands (Indonesia)	BUR	216
CAMP AREA ASTRO			
	Camp McMurdo Area, Antarctica	CAZ	217
EUROPEAN 1950			
	Iraq, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia, Syria	EUR-S	218
GUNUNG SEGARA			
	Kalimantam (Indonesia)	GSE	219
HERAT NORTH			
	Afghanistan	HEN	220
HERMANNSKOGEL			
	Slovenia, Croatia, Bosnia and Herzegovina, Serbia	HER	221
INDIAN			
	Pakistan	IND_P	222
PULKOVO 1942			
	Russia	PUK	223
TANANARIVE OBSERVATORY 1925			
	Madagascar	TAN	224

Table 302. Non-Satellite Derived Transformation Parameter geodetic datum (continued)

Non-Satellite Derived Transformation Parameter			
REGION		CODE	CDB-ID VALUE
VOIROL 1874			
	Tunisia, Algeria	VOI	225
YACARE			
	Uruguay	YAC	226

Table 303. Terrestrial Reference Systems geodetic datum

Terrestrial Reference Systems			
		CODE	CDB-ID VALUE
GLONASS			
	PZ90.2	PZ90_2	227
	PZ90.11	PZ90_11	254

Revision history

Table 304. Document revision history

Date	Revision	Changes
16-May-2018	1	Initial release.
03-Oct-2018	2	Following are the changes: *Table 1: ST GNSS Teseo III supported devices*: Updated the table. *Table 13: NMEA command list* : Updated the “Predictive AGNSS commands” list. *Table 55: $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD*: Updated the description of “reference_time” paramater. *Table 59: $PSTMPPS field description on PPS_IF_CONSTELLATION_MASK_CMD*: Updated the description of “constellation_mask” paramater. *Section 11.2.41.20: PPS Set PPS_IF_TIMING_DATA_CMD*: Updated the “Synopsis”. *Table 60: $PSTMPPS field description on PPS_IF_TIMING_DATA_CMD*: Updated the table. *Section 11.2.44: $PSTMLOWPOWERONOFF*: Updated the “Synopsis”. Updated the “Results” *Table 66: $PSTMLOWPOWERONOFF field description*: Updated the table. *Section 11.3.34: $PSTMCFGTHGNSS* and *Section 11.3.35: $PSTMCFGTDATA*: Added the sections. *Table 130: $--GSV message field description* : Updated the table. *Section 12.5.12: $--RLM*: Added the section.

Table 304. Document revision history (continued)

Date	Revision	Changes
03-Oct-2018	2 (cont'd)	*Table 141: $PSTMGETRTCTIME message field description* : Updated the description of "time_validity" parameter. *Section 12.6.93: PSTMUSEDSATS*: Added the section. *Section 12.7.53: $PSTMCFGTHGNSSOK*, *Section 12.7.54: $PSTMCFGTHGNSSERROR*, *Section 12.7.55: $PSTMCFGTDATAOK*, and *Section 12.7.56: $PSTMCFGTDATAERROR*: Added the sections. *Table 241: CDB-ID 201 - CDB-ID 228 fields description*: Replaced the function of bit 38 from "RESERVED" to "$PSTMUSEDSATS" and function of bit 63 from "RESERVED" to "$--RLM" *Section 13.40: CDB-ID 214 – PPS operating mode setting 2*: Added text "Mixing constellations for....." *Table 250: CDB-ID 214 field description*: In the "Values" column, added "B7 = BEIDOU constellation" *Section 13.44: CDB-ID 220 – Adaptive and Cyclic operating mode setting 1*: Updated the text. *Table 253: CDB-ID 220 field description*: Updated the table. *Table 272: CDB-ID 257 field description*: Updated the table. *Table 273: CDB-ID 258 field description*: Updated the description of "From B8 to B19" bits. *Section 13.67: CDB-ID 259 – Low Power Mode HW Setting*: Added text "Be careful, the voltage...." *Table 274: CDB-ID 259 field description*, *Table 281: CDB-ID 266 field description*, *Table 283: CDB-ID 268 field description*, and *Table 284: CDB-ID 270 field description*: Updated the tables.

Table 304. Document revision history (continued)

Date	Revision	Changes
11-Dec-2018	3	Updated *Chapter 8* and *Section 8.1*. Updated *Table 66: $PSTMLOWPOWERONOFF field description*. Added *Section 11.2.45: $PSTMSTANDBYENABLE*, *Section 11.2.57: $PSTMSETUCODE*, *Section 11.2.58: $PSTMGETUCODE* Updated *Section 11.9.1: $PSTMSTAGPS8PASSGEN* Added *Section 12.6.32: $PSTMPPSERROR*, *Section 12.6.77: $PSTMSTANDBYENABLE*, *Section 12.6.78: $PSTMSTANDBYENABLEOK*, *Section 12.6.79: $PSTMSTANDBYENABLEERROR*, *Section 12.6.94: $PSTMSETUCODEOK*, *Section 12.6.95: $PSTMSETUCODEERROR*, *Section 12.6.96: $PSTMGETUCODEOK* and *Section 12.6.97: $PSTMGETUCODEERROR*. Updated *Table 249: CDB-ID 213 field description*.

Table 304. Document revision history (continued)

Date	Revision	Changes
16-Sep-2019	4	Updated *Section 3.2.3: Predictive AGNSS Seed Transmission*. Added *Section 3.3: RealTime AGNSS*. Added *Section 3.3.2: Real-time assistance data uploading procedure*. Updated *Section 11.2.7: $PSTMEPHEM*. Updated *Section 11.2.10: $PSTMALMANAC* Updated *Table 50: $PSTMPPS field description on PPS_IF_REFERENCE_TIME_CMD* Updated *Table 52: $PSTMPPS field description on PPS_IF_CONSTELLATION_RF_DELAY_CMD* Updated *Table 55: $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD* Updated *Table 66: $PSTMLOWPOWERONOFF field description* Add *Section 11.2.59: $PSTMSETANTSENSOPMODE* Add *Section 11.2.60: $PSTMSETANTSENSMANUAL* Add *Section 11.2.60: $PSTMSETANTSENSMANUAL* Add *Section 11.3.36: $PSTMCFGASIOS* Add *Section 11.3.37: $PSTMCFGASPARAMS* Add *Section 11.3.38: $PSTMCFGASEVENTS* Updated *Section 11.6.4: $PSTMODOREQ* Updated *Table 117: $PSTMSTAGPSINVALIDATE field description* Updated *Table 127: $--GGA message field description* Updated *Table 129: $--GSA message field description* Updated *Table 130: $--GSV message field description* Updated *Table 131: $--RMC message field description* Updated *Table 136: $--GNS message field description* Updated *Table 138: $--RLM message field description* Updated *Table 141: $PSTMGETRTCTIME message field description* Updated *Table 143: $PSTMSETCONSTMASKOK message field description* Updated *Table 146: $PSTMPPS field description* Updated *Table 147: $PSTMPPS field description on PPS_IF_PULSE_DATA_CMD* Updated *Section 12.6.51: $PSTMVER* Updated *Table 177: $PSTMCPU message field description* Updated *Section 12.6.81: $PSTMANTENNASTATUS* Updated *Table 193: $PSTMANTENNASTATUS message field description* Updated *Section 12.6.85: $PSTMUTC* Updated *Table 197: $PSTMUTC message field description*

Table 304. Document revision history (continued)

Date	Revision	Changes
16-Sep-2019	4 (cont)	Added *Section 12.6.98: $PSTMEPHEMOK* Added *Section 12.6.99: $PSTMEPHEMERROR* Added *Section 12.6.100: $PSTMALMANACOK* Added *Section 12.6.101: $PSTMALMANACERROR* Added *Section 12.6.102: $PSTMSETANTSENSOPMODEOK* Added *Section 12.6.103: $PSTMSETANTSENSOPMODEERROR* Added *Section 12.6.104: $PSTMSETANTSENSMANUAL* Added *Section 12.6.105: $PSTMSETANTSENSMANUALERROR* Added *Section 12.7.57: $PSTMCFGASIOSOK* Added *Section 12.7.58: $PSTMCFGASIOSERROR* Added *Section 12.7.59: $PSTMCFGASPARAMSOK* Added *Section 12.7.60: $PSTMCFGASPARAMSERROR* Added *Section 12.7.61: $PSTMCFGASEVENTSOK* Added *Section 12.7.62: $PSTMCFGASEVENTSERROR* Updated *Table 227: Configuration data block list* Updated *Section 13.24: CDB-ID From 140 to 189 – GNSS RF front-end configuration* Updated *Table 246: CDB-ID 200 field description* Updated *Table 247: CDB-ID 227 field description* Updated *Table 255: CDB-ID 222 field description* Updated *Section 13.91: CDB-ID 310 – BeiDou RF delay correction* Deleted Section 13. Updated *Table 292: Acronyms and definitions*
05-May-2020	5	Added *Section 12.6.56: $PSTMTG (Carrier Phase binary)* Updated *Table 247: CDB-ID 227 field description* Added *Section 13.80: CDB-ID 300 - Low Latency Interface rate* Added *Section 13.81: CDB-ID 301 – PPS Pulse Duration*