UM2523
User manual

ST Teseo III ROM binary image - User manual

Introduction

ST Teseo III ROM binary image is the official binary software used on several ST Teseo III ROM 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 ROM supported devices

Device type
Teseo-LIV3R
STA8090WGR
STA8089GR

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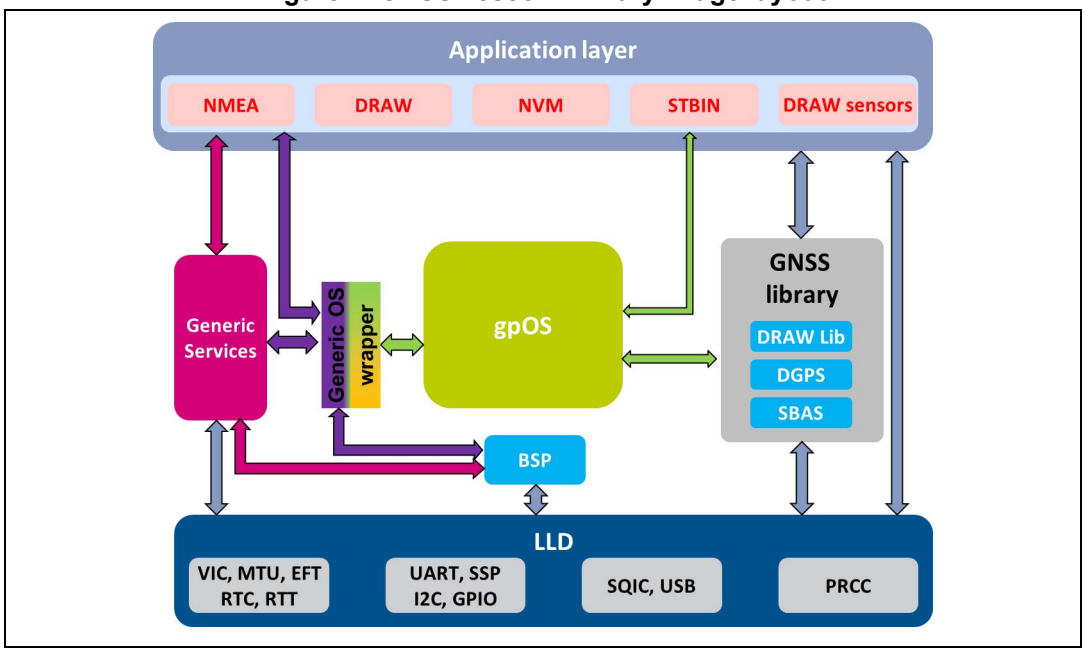
1 GNSS ROM Binary introduction

The GNSS Teseo III ROM Binary Image is the pre-built software running an ST Teseo III ROM 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 ROM binary components description

Table 2. GNSS ROM 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 ROM 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.
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.
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.

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

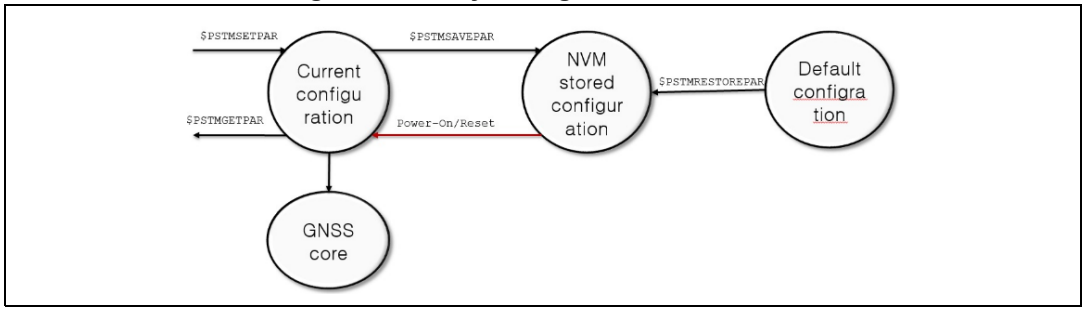
All configuration parameters are grouped in a data block. Each field is addressed by a unique ID. The IDs are made by three digits: the most significant one represents the parameter type and the others are used to identify different parameters of the same type.

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

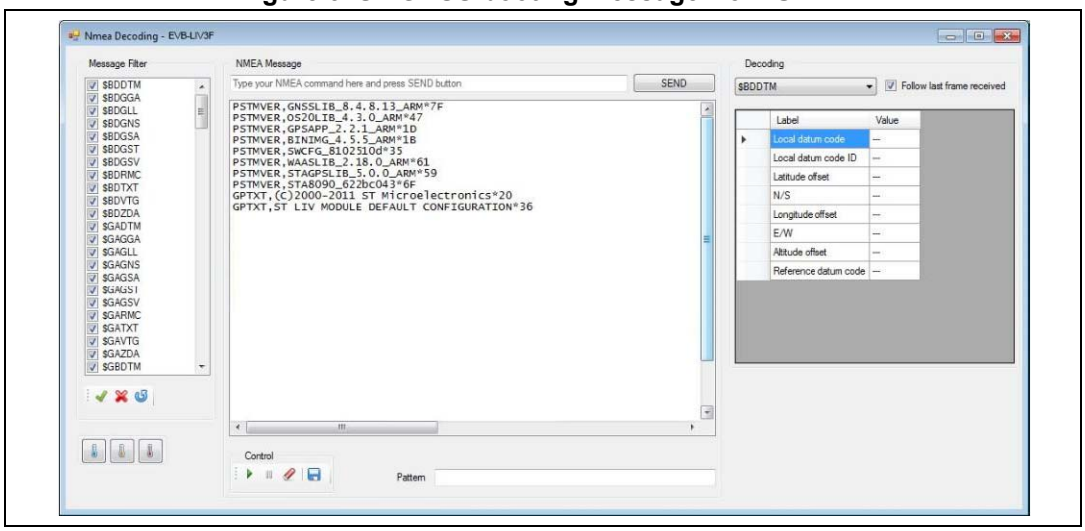
2.2 Binary version

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 3: ST GNSS binary firmware subsystem version* identifies a specific binary firmware subsystem version.

Table 3. 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.

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 ROM binary image supports one type of Assisted GNSS:

- RealTime GNSS

3.1 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.

3.1.1 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 will be used to generate a unique password.

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

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

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

4 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:

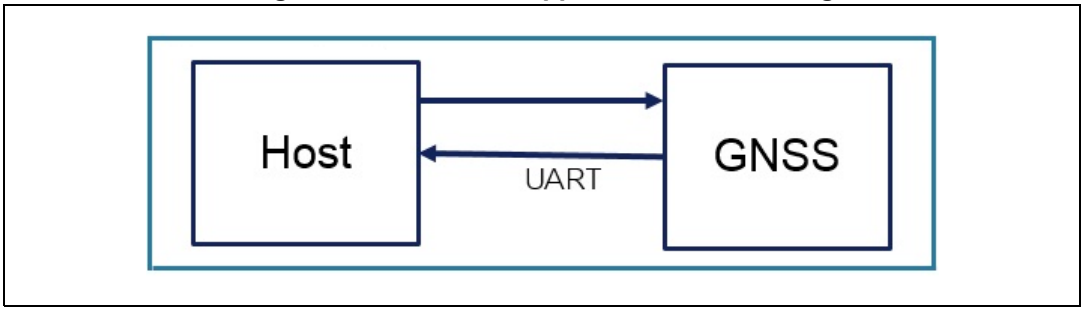
- NMEA message

ST GNSS Teseo III supports the Geofencing features over NMEA.

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

Geofence system support the following two scenarios.

Figure 4. Scenario-1 supported on Geofencing

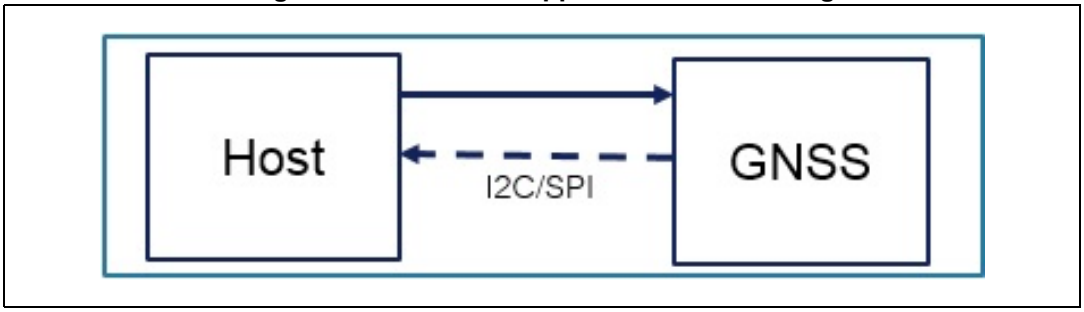


In case of **Scenario 1**, GNSS Teseo III cannot raise an interrupt to the host but if *$PSTMGEOFENCESTATUS* message is enabled in the message-list the GNSS Teseo III can send the *$PSTMGEOFENCESTATUS* message autonomously to the host through the UART port, in this manner host doesn't need polling the 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 5. Scenario-2 supported on Geofencing



In case of **Scenario 2,** 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.

5 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:

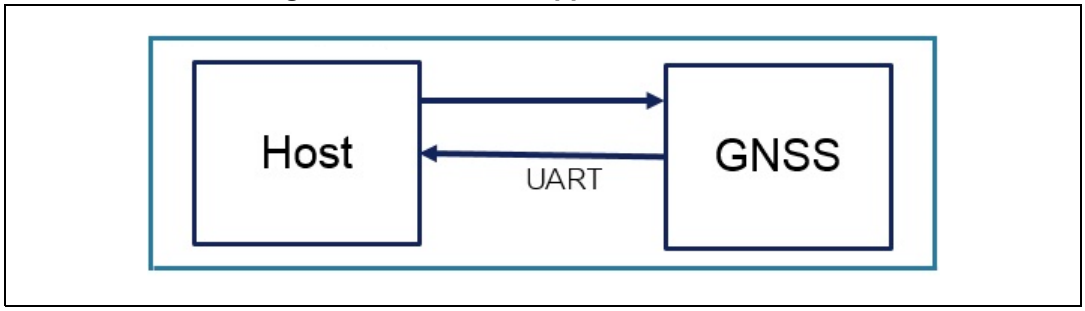
- Power off/on
- Entering/Exiting from Reset and/or Standby

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

- NMEA message

Odometer system supports the following two scenarios.

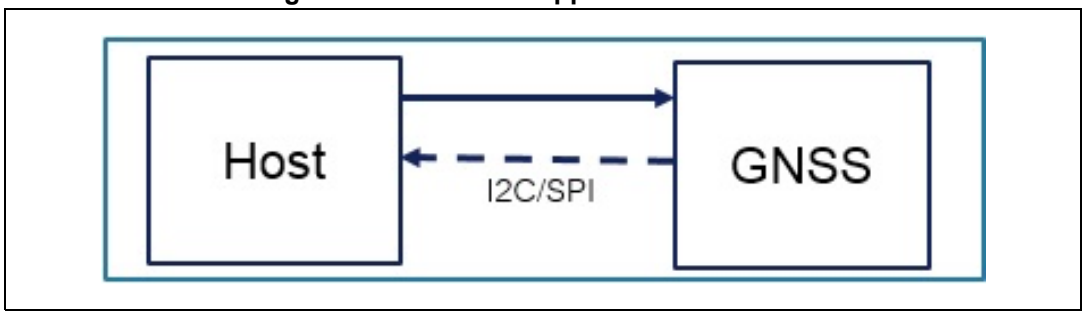
Figure 6. Scenario-1 supported on Odometer



In case of **Scenario 1**, 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 7. Scenario-2 supported on Odometer



In case of **Scenario 2**, 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.

6 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.

6.1 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 4: Default UART port configuration*.

Table 4. Default UART port configuration

Baudrate	Parity bits	Stop Bit	Data bits
9600	0	1	8

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

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

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

6.2 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.

6.2.1 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 10.3: Changing standard NMEA messages format*.

To get an overview on the supported by ST’s GNSS Teseo III please refer to *Section 10.5: 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.

6.2.2 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 10.6: ST NMEA messages specification*.

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

7 Low power modes

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

- Active and Standby Periodic Low Power mode:
  - Report a fix at a given periodicity
  - Autonomous periodic ephemeris refresh
  - RTC calibration capability
  - Optional use of STAGPS™ (Standby mode only)
  - Different hardware power states between fixes are possible
- Fix on demand Low Power mode (Standby mode only):
  - Report a fix on demand triggered by a hardware pin
  - Autonomous periodic ephemeris refresh
  - RTC calibration capability

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 5. Suggested power mode against the fix periodicity

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

7.1 Mode maturity

Table 6. Feature maturity

Feature	Maturity level
Active Periodic mode	Validated (GPS Only)
Standby Periodic mode	Validated (GPS Only)
Standby Periodic mode w/ STAGPS™	Validated (GPS Only)
Fix On Demand mode (STANDBY)	Validated (GPS Only)

7.2 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 ensures 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.

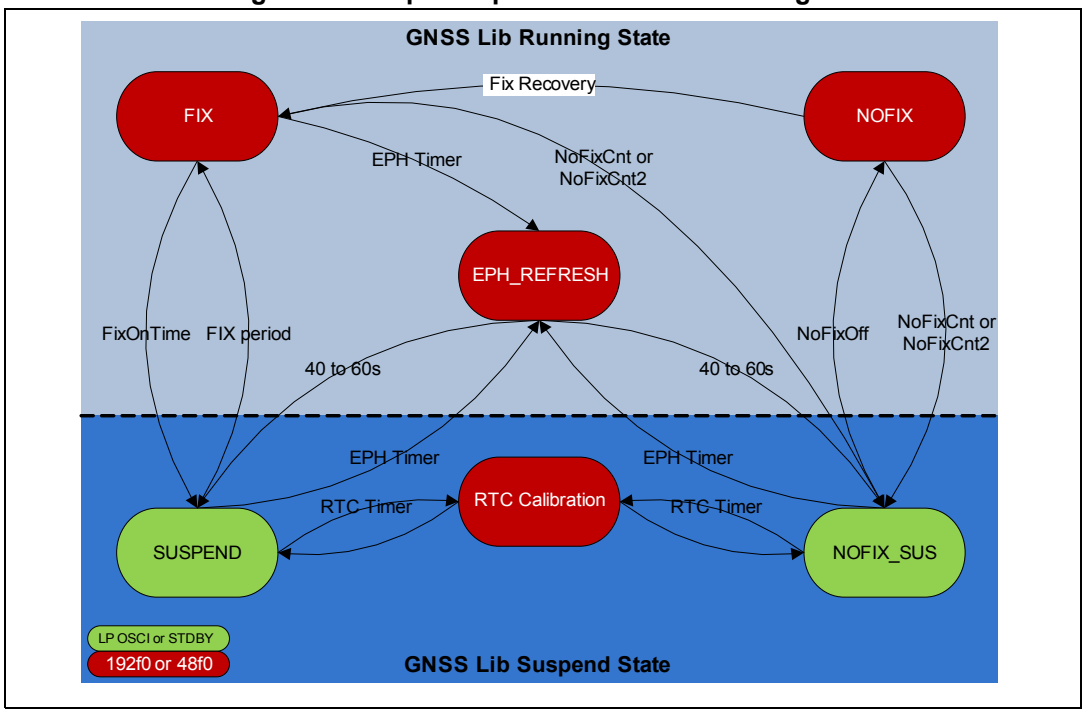
7.2.1 State machine

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 8. 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 is 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.

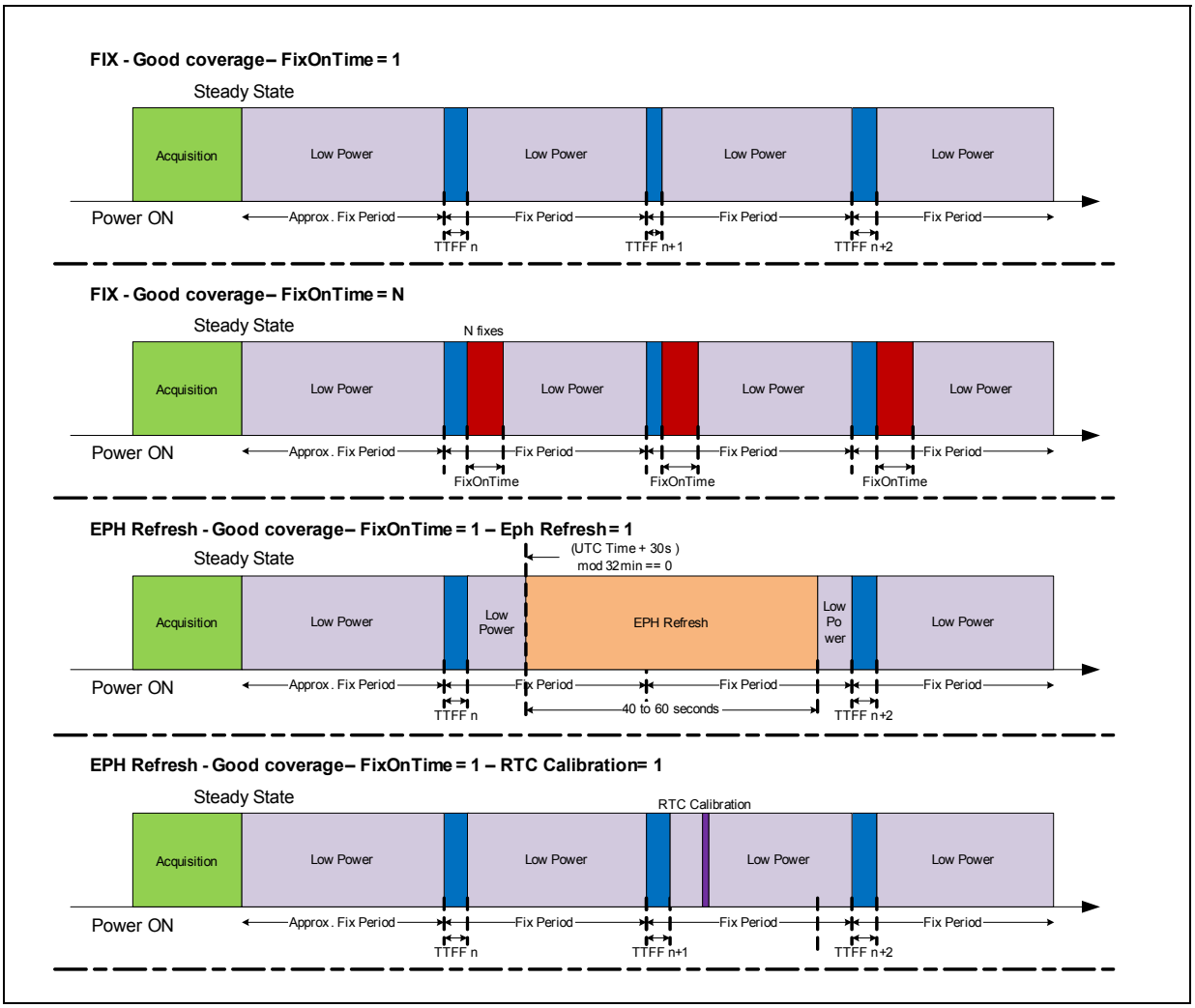
The two states concerned by the low power hardware states are SUSPEND and NOFIX_SUS. The RTC Calibration state occurs while the GNSS Lib is suspended, but it is executed anyway at high frequency (48f0 or 192f0 according to frequency settings).

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.

7.2.2 Good GNSS coverage sequences

Figure 9. GNSS good coverage sequences



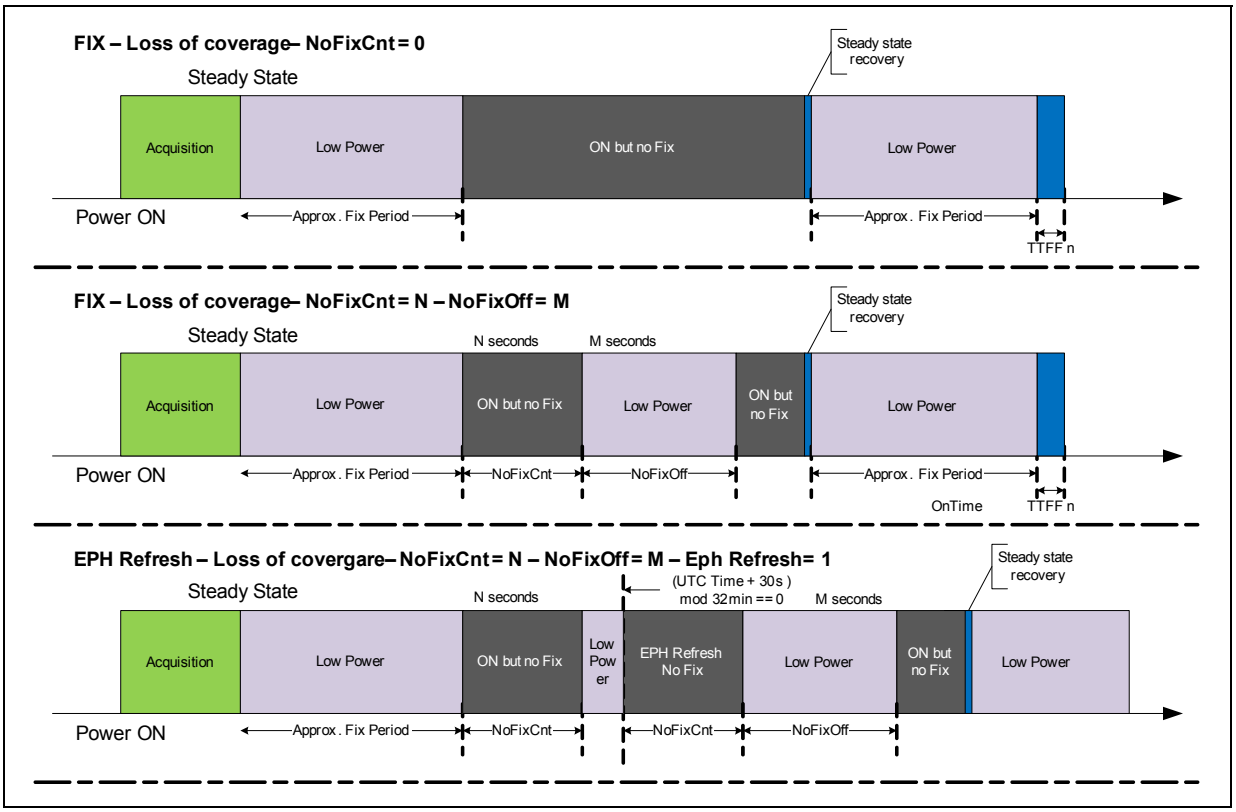
All sequences begin with an acquisition phase where all visible satellite ephemeris and almanacs are downloaded. The position of the first fix after the first Low Power period is approximate, but all the next periods are regularly placed every “Fix Period”.

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

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

7.2.3 Poor GNSS coverage sequences

Figure 10. 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.

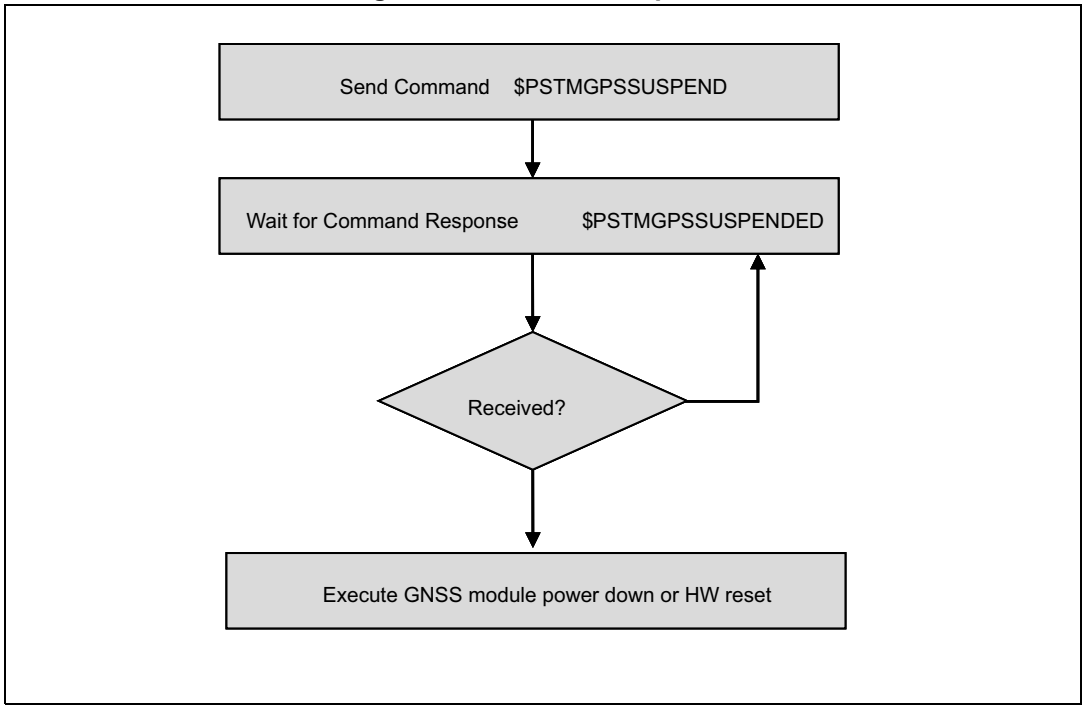
7.3 Shutdown

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 11. Shutdown sequence



8 Antenna detection

ST GNSS Teseo III binary image supports Antenna Detection algorithm.

Two different implementations of Antenna Detection are available on ST GNSS Receiver:

1. Antenna Detection Algorithm

   Two possibilities are implemented and provided. At configuration time the customer can choose which of the two, ADC or GPIO implementation:

   a) ADC implementation
   For this implementation periodic reading of two ADC analog inputs is performed, by default AIN1 and AIN5 channels, in order to execute a differential measurement and to compare it with a minimum and a maximum threshold.

   b) GPIO implementation
   Four GPIOs signals are used to detect if the external antenna is working correctly, if it is open or if there is a short. This software implementation allows handling GPIOs signals to switch off the external antenna if it is not connected or it is not properly working.

   As a result, both algorithms produce a NMEA message reporting if the antenna is working properly or, otherwise, if it is open or it is shorted.

2. ADC Channels Reading

   This possibility provides a periodic NMEA message giving information about the read values of the required ADC input channels. The user may choose the channels to read as well as the ADC sampling rate.

8.1 Antenna detection algorithm

The Antenna Detection algorithm is a configurable software allowing the customer to check the external antenna status. This feature can be enabled in two options, ADC mode or GPIO mode. Both implementations continuously check and update the antenna status. The software can be configured to generate a periodic NMEA message reporting the external antenna status or to send an NMEA message that reports the antenna status only when a change occurs.

Another configurable parameter can be used to enable or not the switch OFF of the external antenna in case it is not connected or if a short is detected. This option is possible only for the GPIO mode; otherwise, for ADC mode no switch off feature is provided. When the Antenna Switch Off feature is enabled, the reading of the signals (GPIOs signals) to detect and update the external antenna status is performed only if the antenna works correctly as expected, otherwise no operation is executed by the algorithm.

The antenna sensing algorithm checks, at NMEA message rate, if the antenna is correctly connected and detected or, otherwise, it is open or there is a short.

A NMEA sentence *$PSTMANTENNASTATUS* reports the status of the Antenna:

- NORMAL
- OPEN
- SHORT

8.1.1 Antenna detection algorithm: ADC implementation

Antenna detection algorithm in ADC mode is a configurable feature, if enabled in the firmware configuration, when ST GNSS Teseo III is powered on and the GNSS software starts, the ADC peripheral is configured and the ADC conversion started.

The following parameters can be configured:

- The ADC inputs to read from for the Antenna detection calculations
- The ADC sampling rate
- The values of the minimum and maximum thresholds.

At NMEA message output rate (by default 1 Hz) the Antenna Sensing software, enabled as ADC mode, reads the analog inputs, INPUT1 and INPUT2, to a specific ADC converter input port (by default AIN1 and AIN5, but this analog inputs can be configured differently by the user) in order to measure the current flowing through R1 (10 Ω) resistor. The software performs the differential measurement of the read voltages at the ends of R1 and update the Antenna Status.

If the differential voltage is between 150 mV (default minimum value of the threshold) and 500 mV (default maximum value of the threshold), the algorithm assumes that the antenna is working properly. In this case the default thresholds values are based on the assumption of a current consumption of the antenna between 15 mA and 50 mA. If the differential measurement is less than 150 mV then the antenna is not detected (open) otherwise, if the differential measurement of voltage is greater than 500 mV, then the antenna is considered shorted. Both the thresholds (minimum and maximum) may be configured with different values according to customers' needs and implementation.

It is important to consider that the thresholds have to be configured taking into account that the voltage at ADC input doesn't have to exceed 1.4 V (to avoid saturation). Assuming the power to the antenna is V_{ANT} and the voltage that the customer would like to have at ADC input is V_{ADCIN} (max value 1.4 V), the threshold minimum value, $THRSHOLD_{MIN}$, has to be properly scaled in order to have the right threshold to be considered for the comparison:

$$THRSCALED_{MIN} = (THRSHOLD_{MIN} * V_{ADCIN}) / V_{ANT}$$

and the same for the threshold maximum value:

$$THRSCALED_{MAX} = (THRSHOLD_{MAX} * V_{ADCIN}) / V_{ANT}$$

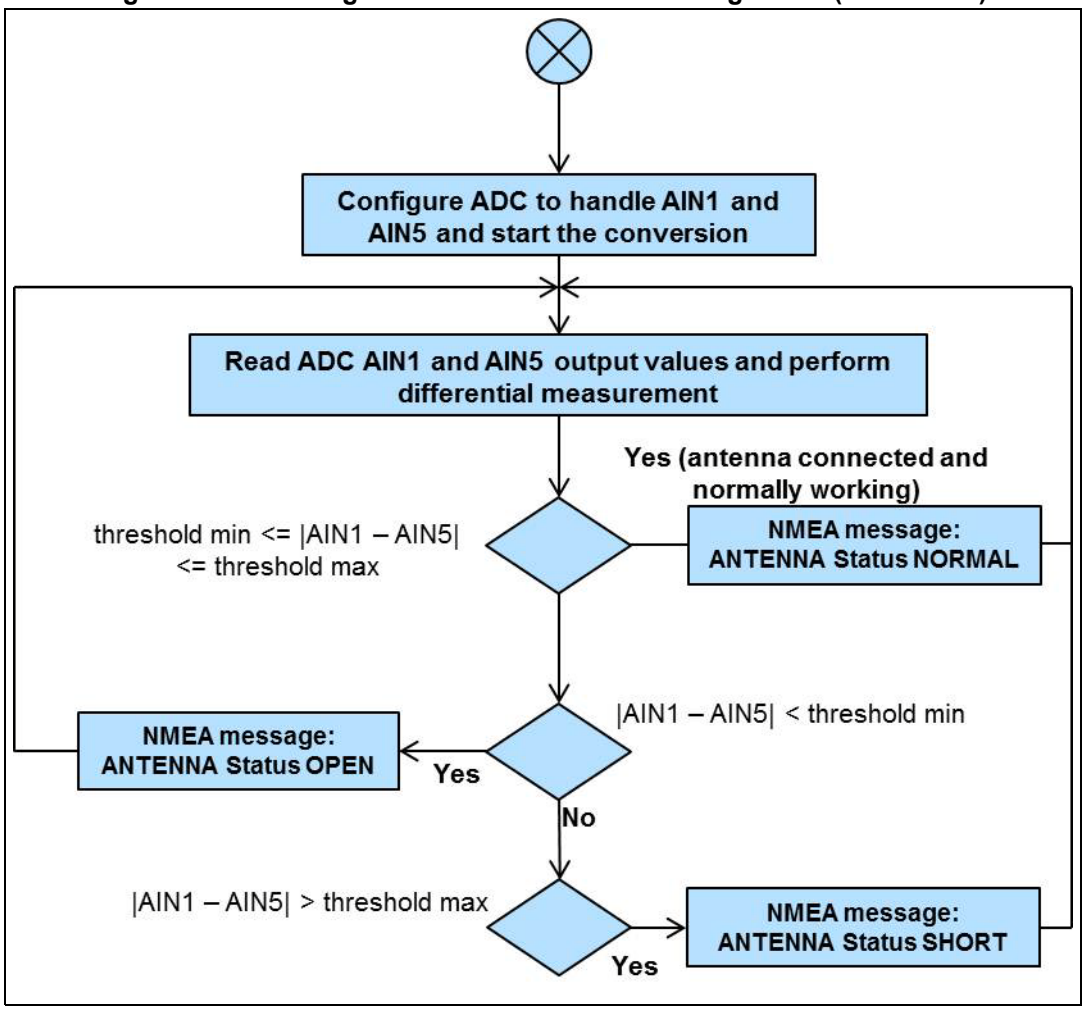
In ST GNSS Teseo III system there are:

$V_{ADCIN} = 1.4V$ and $V_{ANT} = 3.3V$ so that

$THRSCALED_{MIN} \sim= 63$ and $THRSCALED_{MAX} \sim= 210$ as default values.

The *Figure 12: Flow Diagram for Antenna Detection Algorithm (ADC mode)* shows the flow diagram for Antenna Detection algorithm in ADC mode. In the *Figure 12* the default ADC input has been considered, the user can configure different inputs for the Antenna Sensing.

Figure 12. Flow Diagram for Antenna Detection Algorithm (ADC mode)



Note: When Antenna Status detected is OPEN or SHORT only the NMEA warning output message is sent. The customer antenna sensing application on top, based on the received information, may set GPIO in order to switch off the power to the antenna. It means that, when ADC mode is enabled, the switch off of the external antenna MUST be DISABLED. The ADC inputs reported in the flow diagram are default values. The customer can choose different ADC inputs.

8.1.2 Antenna detection algorithm: GPIO implementation

Antenna detection algorithm in GPIO mode, needs four GPIOs, two inputs and two outputs to be working. Each GPIO is configurable (IDs, operating control mode and active-level). If enabled in the firmware configuration, when ST GNSS Teseo III is powered on and the GNSS software starts, the configured Antenna Detection GPIOs are configured in the platform.

The control mode is configurable, the GPIOs direction is fixed:

- ANT_DIG_ON: output from ST GNSS Teseo to enable normal operating for antenna diagnosis device and the reading of GPIO SHORT and OPEN signals in input
- ANT_SWITCH_CTRL: output from ST GNSS Teseo to manage the power to external antenna
- EXT_ANT_DIG_SHORT: input to ST GNSS Teseo to detect if there is a short
- EXT_ANT_DIG_OPEN: input to ST GNSS Teseo to detect if the external antenna is open

If the antenna switching is enabled the software sets the pin state for the output GPIOs according to the active level configured by the user. This allows enabling the reading of the OPEN and SHORT pin input signals and the power to external antenna.

When the Antenna Sensing software is enabled in GPIO mode, it reads the EXT_ANT_DIG_SHORT and the EXT_ANT_DIG_OPEN pins level at NMEA-message-output-rate (by default 1 Hz).

If these levels are different respect to the active levels configured, the algorithm assumes that the antenna is working properly. If the SHORT or OPEN signals levels are detected equal to the active levels configured by the user, the algorithm assumes that the external antenna is respectively shorted or not connected.

Summarizing the Antenna Detection (GPIO mode) with Switch OFF mode enabled:

Step 1: Insert External Antenna

Step 2: GPIO settings: ST GNSS Teseo drives ANT_DIG_ON and ANT_SWITCH_CTRL to enable normal operating mode for Antenna Diagnosis device and to enable power to External Antenna

Step 3: Read Output Ant Diagnosis Device condition: ST GNSS Teseo reads GPIO input signals EXT_ANT_DIG_SHORT and EXT_ANT_DIG_OPEN

Step 4: Check EXTERNAL ANT Condition:

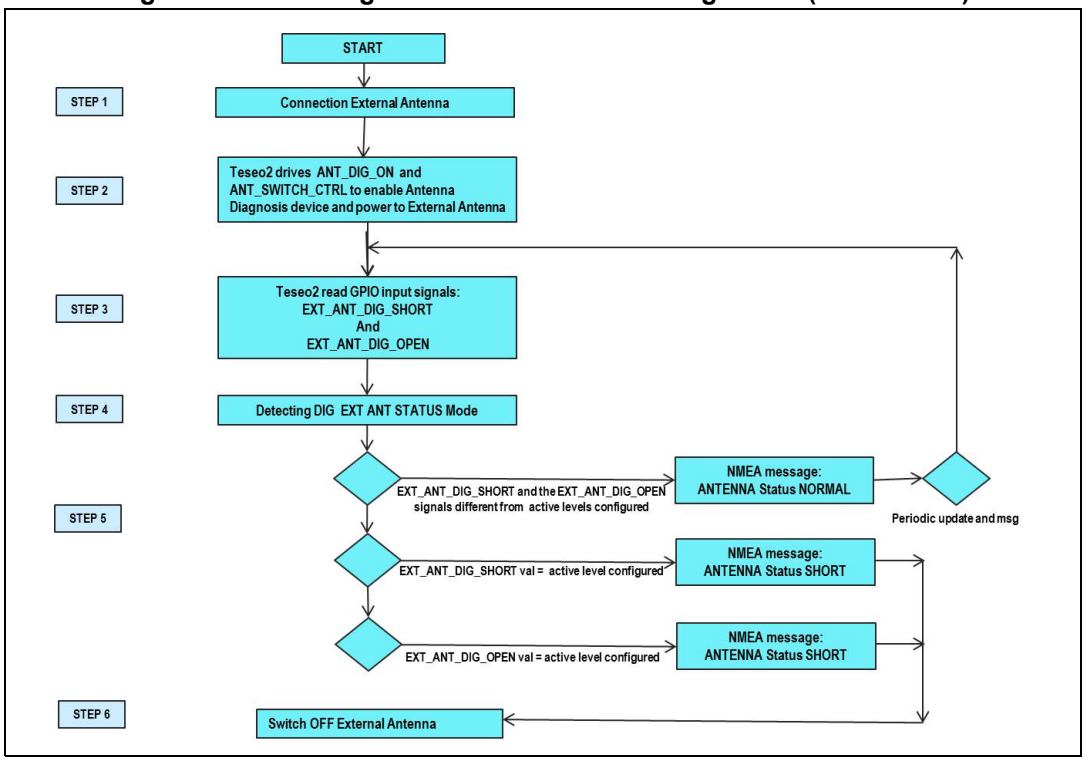
1. EXT_ANT_DIG_SHORT and the EXT_ANT_DIG_OPEN pin levels are both different from active levels configured: External Antenna connected and working normally
2. EXT_ANT_DIG_OPEN value is equal to the active level configured: External Antenna OPEN
3. EXT_ANT_DIG_SHORT value is equal to the active level configured: External Antenna Short

Step 5: Report Antenna Status on *$PSTMANTENNASTATUS* NMEA message

Step 6: Switch OFF External Antenna: if an OPEN or SHORT condition is detected on the External Antenna, Teseo2 drives ANT_DIG_ON and ANT_SWITCH_CTRL GPIOs to manage the switch off of the antenna.

The *Figure 13: Flow Diagram Antenna Detection Algorithm (GPIO mode)* shows the flow diagram for Antenna Detection algorithm (GPIO mode).

Figure 13. Flow Diagram Antenna Detection Algorithm (GPIO mode)



8.2 ADC channels reading

To check the status of the antenna another possible method is to read directly via ADC the input channel data reporting the voltage value drop on the resistor.

Based on the device selected among those of ST GNSS Teseo family, via NMEA there is a possibility to read all the ADC channels. This feature may be enabled or not and gives the user the possibility to configure the channels mask (in order to choose the required ADC inputs to read) and the ADC sampling rate (by default the ADC sampling rate is 13 MHz). Following the *$PSTMADCDATA* NMEA message reports the ADC channels data read.

These values represent the converted voltages values of the ADC channels. They must be converted in Volts to be compared to the thresholds.

The formula that must be used to convert the raw data from the ADC to a value in Volt is:

ADC_out[V] = ADC_out_read * 1.4/1023.

Example:

Considering that the antenna voltage is 3.3 V the maximum input voltage to ADC after partitioning should not exceed 1.4 V, so a scaling factor has to be considered for this purpose. In our system it has 1.4/3.3 = 0.42

ADC1 = 1.4 Volt read in ADC channels with the value AIN1 ~= 1000

If the Voltage Drop on the resistor in series to the antenna power is 250 mV (25 mA *10 Ω) on the ADC2 channel the read value is:

ADC2 = 1.28 Volt-> read in ADC channel reported AIN2 ~= 935

9 Commands

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

9.1 Software command list

The *Table 7: NMEA command list* summarizes all the commands supported by the ST NMEA layer.

Table 7. 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
$PSTMNMEAONOFF,0<checksum><cr><lf>*	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 7. 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
$PSTMSETCONSTMASK	Set GNSS constellation mask.
$PSTMNOTCH	Set the ANF operation mode.
$PSTMADCSTART	Start and Configure ADC
$PSTMADCREAD	Read ADC channels data
$PSTMLOWPOWERONOFF	
$PSTMCRCCHECK	
$PSTMNMEAREQUEST	
$PSTMFORCESTANDBY	
$PSTMIONOPARAMS	
$PSTMSETTHTRK	
$PSTMSETTHPOS	
Configuration commands	
$PSTMSETPAR	Set System Parameter in the configuration data block.
$PSTMGETPAR	Get System Parameter from configuration data block.
$PSTMSAVEPAR	Save System Parameters in the GNSS backup memory.
$PSTMRESTOREPAR	Restore System Parameters (Factory Settings).
$PSTMCFGPORT	Char Port Configuration
$PSTMCFGANTSENS	Antenna Sensing Configuration
$PSTMCFGCLKS	Clock Mode and Speed Configuration
$PSTMCFGMSGL	Message List Configuration
$PSTMCFGGNSS	GNSS Algorithm Configuration
$PSTMCFGSBAS	SBAS Algorithm Configuration
$PSTMCFGLPA	
$PSTMCFGLPS	Low Power State Configuration

Table 7. NMEA command list (continued)

Syntax	Description
$PSTMCFGAJM	Anti-Jamming Configuration
$PSTMCFGODO	Odometer Configuration
$PSTMCFGGEOFENCE	Geofencing Configuration
$PSTMCFGGEOCIR	Geofencing Circle Configuration
$PSTMCFGCONST	
Geofence Commands	
$PSTMGEOFENCECFG	Configures the Geofence subsystem
$PSTMGEOFENCEREQ	To know internal Geofence subsystem status
Odomenter commands	
$PSTMODOSTART	Enables and resets the Odometer subsystem
$PSTMODOSTOP	Stops the Odometer subsystem
$PSTMODORESET	Resets the Odometer subsystem
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**

9.2 ST NMEA command specification

9.2.1 $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 8. $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
```

9.2.2 $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 9. $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
```

9.2.3 $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 10. $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>
```

9.2.4 $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 11. $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>
```

9.2.5 $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>
```

9.2.6 $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
37000033515726556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00b8ffd0
37000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff6c00f7
2e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

9.2.7 $PSTMEPHEM

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

Synopsis:

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

Arguments:

Table 12. $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 13. $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 13. $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 14. $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 14. $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 15. $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.

Table 15. $PSTMEPHEM field description for BEIDOU constellation (continued)

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

Table 15. $PSTMEPHEM field description for BEIDOU constellation (continued)

Bits	Structure Member	Description
1	nvm_reliable	Must be 1.
11	RESERVED	Must be 0.
2	spare	
17	toc	Time of week for clock epoch
13	week	Week number of the Issue of Data
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

Results:

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

Example:

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

9.2.8 $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>
```

9.2.9 $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
```

9.2.10 $PSTMALMANAC

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

Synopsis:

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

Arguments:

Table 16. $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 17. $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.

Table 17. $PSTMALMANAC field description for GPS constellation (continued)

Bits	Structure Member	Description
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 18. $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	

Results:

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

Example:

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

9.2.11 $PSTMCOLD

Perform a COLD start.

Synopsis:

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

Arguments:

Table 19. $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
```

9.2.12 $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>
```

9.2.13 $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>
```

9.2.14 $PSTMNMEAONOFF

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

Synopsis:

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

Arguments:

Table 20. $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>
```

9.2.15 $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>
```

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

9.2.16 $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>
```

9.2.17 $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>
```

9.2.18 $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>
```

9.2.19 $PSTMGNSSINV

Invalidate the GNSS Fix Status.

Synopsis:

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

Arguments:

Table 21. $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>
```

9.2.20 $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>
```

9.2.21 $PSTMGETSWVER

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

Synopsis:

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

Arguments:

Table 22. $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

9.2.22 $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>
```

9.2.23 $PSTMSBASONOFF

Suspend / resume the SBAS software execution.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

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

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

9.2.24 $PSTMSBASSERVICE

Change the SBAS service.

Synopsis:

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

Arguments:

Table 23. $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 *$PSTMSBASM* command
- With SBAS AUTO, the SBAS engines automatically select the appropriate SBAS service based on the computed user position latitude and longitude.
- In case of no errors, the *$PSTMSBASSERVICEOK* message is returned
- In case of errors, the error message *$PSTMSBASSERVICEERROR* is returned

Example:

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

9.2.25 $PSTMSBASSAT

Change the SBAS satellite.

Synopsis:

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

Arguments:

Table 24. $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>
```

9.2.26 $PSTMSBASM

Send a SBAS frame to the SBAS engine.

Synopsis:

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

Arguments:

Table 25. $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
```

9.2.27 $PSTMRFTESTON

Enable the RF test mode for production line tests.

Synopsis:

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

Arguments:

Table 26. $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>
```

9.2.28 $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>
```

9.2.29 $PSTMGETALGO

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

Synopsis:

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

Arguments:

Table 27. $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>
```

9.2.30 $PSTMSETALGO

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

Synopsis:

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

Arguments:

Table 28. $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>
```

9.2.31 $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

- System will send *$PSTMGETRTCTIME* message

Example:

```
$PSTMGETRTCTIME
```

9.2.32 $PSTMDATUMSELECT

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

Synopsis:

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

Arguments:

Table 29. $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>
```

9.2.33 $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 30. $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
```

9.2.34 $PSTMSETCONSTMASK

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

Synopsis:

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

Arguments:

Table 31. $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: Reserved 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>
```

9.2.35 $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 32. $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>
```

to specify from which frequency begins searching for RFI..

Full configuration (6 parameters):

```
$PSTMNOTCH,Sat_type,Mode,Frequency,kbw_gross,kbw_fine,threshold*<ch
ecksum><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
```

9.2.36 $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 33. $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>
```

9.2.37 $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 34. $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>
```

9.2.38 $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 35. $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, 1 digit	Reserved, must be 1
EHPE threshold	Decimal, 3 digits	Reserved, must be 0
Max tracked sats	Decimal, 2 digits	Reserved, must be 0
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		

Table 35. $PSTMLOWPOWERONOFF field description (continued)

Parameter	Format	Description
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
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.

9.2.39 $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 36. $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.

9.2.40 $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 37. $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.

9.2.41 $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 38. $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

9.2.42 $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 39. $PSTMIONOPARAMS field description

Parameter	Format	Description
sat_type	Decimal, 1 digits	1 is for GPS 3 is Reserved 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	Reserved

9.2.43 $PSTMSETTHTRK

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

Synopsis:

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

Arguments:

Table 40. $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

9.2.44 $PSTMSETTHPOS

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

Synopsis:

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

Arguments:

Table 41. $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

9.3 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.

9.3.1 $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 42. $PSTMSETPAR field description

Parameter	Format	Description
ConfigBlock	Decimal,1 digit	Indicates one of the configuration blocks: 1=Current Configuration, 2 = Default Configuration, 3 = NVM Stored configuration.
ID	Decimal, 3 digits	ID - Identifier (see Configuration Data Block as described in FW Configuration document)
param_value	1 up to 80 bytes	Parameter to be set, see “Allowed values” as described in FW Configuration document.
mode	Decimal, 1 digit	This parameter is optional. It allows to perform bit-to-bit “OR” or “AND” operations between the selected parameter in the configuration block and the `param_value` in input. It has the following meaning: 0: the parameter in the configuration block is overwritten by the `param_value`. This is the default action as in the case `mode` is omitted. 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.

9.3.2 $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 43. $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.

9.3.3 $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>
```

9.3.4 $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>
```

9.3.5 $PSTMCFGPORT

Configure a general-purpose port for NMEA or RTCM purpose.

Synopsis:

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

Arguments:

Table 44. $PSTMCFGPORT field description

Parameter	Format	Description
port_type	Decimal, 1 Digit	Select the port type: 0 = UART 1 = I2C
protocol_type	Decimal, 1 Digit	Select the protocol type: 0 = NMEA 1 = Reserved 2 = Reserved 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

9.3.6 $PSTMCFGPORT on UART

Arguments:

Table 45. $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

9.3.7 $PSTMCFGPORT on I2C

Arguments:

Table 46. $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

9.3.8 $PSTMCFGANTSENS

Configure the Antenna Sensing.

Synopsis:

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

Arguments:

Table 47. $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

9.3.9 $PSTMCFGANTSENS on RF

No additional parameters are required when sensing type is RF.

9.3.10 $PSTMCFGANTSENS on ADC

Arguments:

Table 48. $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).

9.3.11 $PSTMCFGANTSENS on GPIO

Arguments:

Table 49. $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.

Table 49. $PSTMCFGANTSENS field description on sensing on GPIO (continued)

Parameter	Format	Description
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

9.3.12 $PSTMCFGANTSENS on OFF

Arguments:

No arguments

9.3.13 $PSTMCFGCLKS

Configure a clock source.

Synopsis:

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

Arguments:

Table 50. $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

9.3.14 $PSTMCFGMSGL

Configure the Message List.

Synopsis:

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

Arguments:

Table 51. $PSTMCFGMSGL field description

Parameter	Format	Description
listid	Decimal, 1 digit	List selector: 0 = NMEA list 0 1 = NMEA list 1 2 = NMEA list 2
rate	From 0 to 255	Message list rate scaler
listlow	Hexadecimal, 8 digits	Please refer to CDB 201 table in case of NMEA
listhigh	Hexadecimal, 8 digits	Please refer to CDB 228 table in case of NMEA

Results:

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

9.3.15 $PSTMCFGGNSS

Configure the GNSS Algorithm.

Synopsis:

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

Arguments:

Table 52. $PSTMCFGGNSS field description

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

Results:

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

9.3.16 $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 53. $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

Table 53. $PSTMCFGSBAS field description (continued)

Parameter	Format	Description
autosearchmask	Hexadecimal, 8 digits	Allow enabling/disabling the SBAS satellites to be searched by the auto search procedure
dectimeout	From 0 to 255	The time the autosearch waits to try to decode the current PRN Note: expressed in seconds. This value is ignored if `enautosearch` is `0`
diftimeout	From 0 to 255	The time the autosearch waits before 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 54. $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

9.3.17 $PSTMCFGLPA

Configure the Low Power Algorithm.

Synopsis:

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

Arguments:

Table 55. $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

Table 55. $PSTMCFGLPA field description (continued)

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

Results:

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

9.3.18 $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 56. $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
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

9.3.19 $PSTMCFGAJM

Configure the Anti-Jamming Algorithm.

Synopsis:

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

Arguments:

Table 57. $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

9.3.20 $PSTMCFGODO

Configure the Odometer.

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

Synopsis:

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

Arguments:

Table 58. $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

9.3.21 $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 59. $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

9.3.22 $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 60. $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 60. $PSTMCFGGEOCIR field description (continued)

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

9.3.23 $PSTMCFGCONST

Allow enable/disable all the GNSS constellations.

Synopsis:

```
$PSTMCFGCONST,<gps>,<glonass>,0,<qzss>,<beidou<*<checksumn><cr><lf>
```

Arguments:

Table 61. $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
Reserved	Decimal, 1 digit	Reserved must be zero
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

9.3.24 $PSTMCFGTHGNSS

Configures threshold related to GNSS algorithm.

Synopsis:

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

Arguments:

Table 62. $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

9.3.25 $PSTMCFGTDATA

Configures data and time related parameters.

Synopsis:

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

Arguments:

Table 63. $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

9.4 Geofencing NMEA commands

9.4.1 $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 64. $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

9.4.2 $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

9.5 Odometer NMEA commands

9.5.1 $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

9.5.2 $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

9.5.3 $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 65. $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

9.5.4 $PSTMODOREQ

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

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

9.6 Real Time AGNSS NMEA commands

9.6.1 $PSTMSTAGPS8PASSGEN

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

Synopsis:

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

Arguments:

Table 66. $PSTMSTAGPS8PASSGEN field description

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

Results:

ST GNSS Teseo III returns the password in the message *$PSTMSTAGPS8PASSRTN*.

10 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.

10.1 Standard NMEA messages list

Table 67. 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

10.2 ST NMEA messages list

Table 68. 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 68. 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
$PSTMNOTCHSTATUS	OFF	ST: Reports the Notch filter status.
$PSTMCPU	ON	ST: Reports the CPU usage and CPU speed setting.
$PSTMPPSDATA	OFF	ST: Reports the Pulse Per Second 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

10.3 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
```

10.4 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 NMEA revision in use.

Table 69. 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

10.5 Standard NMEA messages specification

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

10.5.1 $--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 70. $--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: Reserved 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 70. $--GGA message field description (continued)

Parameter	Format	Description
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
GPSQual	Decimal, 1digit	0 = Fix not available or invalid 1 = GPS, SPS Mode, fix valid 2 = Differential GPS, SPS Mode, fix valid 6 = Estimated (dead reckoning) mode
Sats	Decimal, 2 digits	Satellites in use: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above mean sea level, max: 100000m
AltVal	“M”	Reference Unit for Altitude (“M” = meters)
GeoSep	Decimal, 4 digits	Geoidal Separation measure in “M” = meters
GeoVal	“M”	Reference Unit for GeoSep (“M” = meters)
DGPSAge	Empty	Not supported
DGPSRef	Empty	Not supported
Checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGGA,183417.000,04814.03970,N,01128.52205,E,0,00,99.0,495.53,M,47.6,M*53
```

10.5.2 $--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 71. $--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: Reserved 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
```

10.5.3 $--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. (See STA8089-90 Firmware Configuration document).

When NMEA is set as Rev 4.10 (See chapter 6.4 in this document) the talker ID could not be forced and is managed internally to be compliant with the standard. See parameter table for info about Talker ID available values.

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 72. $--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: Reserved BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
CurrentMode	Decimal, 1 digit	Current Mode: 1 = Fix not available or invalid 2 = GPS, SPS Mode, fix valid 3 = Differential GPS, SPS Mode, fix valid
SatPRN(1 to 12)	Decimal, 2 or 3 digits	Satellites list used for positioning. See Chapter 6.5 for more info about available values.
PDOP	Decimal, 3 digits	Position Dilution of Precision, max: 99.0
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
VDOP	Decimal, 3 digits	Vertical Dilution of Precision, max: 99.0
SystemID	Hexadecimal, 1 digit	The system ID of this message: 1 = GPS 2 = GLONASS 3 = Reserved 4 = BEIDOU 5 = QZSS
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GNGSA,A,3,23,03,22,09,01,19,17,06,31,11,,,1.1,0.6,0.9,1*3E
$GNGSA,A,3,67,66,81,65,88,75,82,74,,,,, 1.1,0.6,0.9,2*3D
$GNGSA,A,3,03,05,22,08,30,16,12,,,,,, 1.1,0.6,0.9,3*32
```

10.5.4 $--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 73. $--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: Reserved BD: If system works in BEIDOU only mode QZ: If system works in QZSS only mode GN: If system works in multi-constellation mode.
GSVAmount	Decimal, 1 digit	Total amount of GSV messages
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 32
SatxPRN	Decimal, 2 digits	Satellites list used for positioning. See *Section 10.4* for more info about available values.

Table 73. $--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 and QZSS 6 for GALILEO
checksum	Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example for NMEA 0183 Rev 3.1 (Default):

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

Example for NMEA 0183 Rev 4.10:

```
$GPGSV,3,1,09,30,68,039,49,05,61,266,50,28,52,137,47,07,38,052,48,01*5C
$GPGSV,3,2,09,13,37,301,45,09,17,105,43,15,07,297,40,08,06,056,41,01*56
$GPGSV,3,3,09,20,,,41,,,,,,,,,,,,01*5A
$GLGSV,2,1,06,68,86,031,43,78,78,013,46,79,51,226,43,69,33,325,38,01*43
$GLGSV,2,2,06,67,33,139,41,77,26,035,36,,,,,,,,,01*46
$GAGSV,2,1,05,08,76,129,44,02,65,057,46,30,56,205,45,07,48,311,44,06*4F
$GAGSV,2,2,05,03,22,129,40,,,,,,,,,,,,06*7D
```

10.5.5 $--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 74. $--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: Reserved 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
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	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
Speed	ddd.d	Speed over ground in knots
Trackgood	Decimal, 4 digits	Course made good, max. 999.9
Date	Decimal, 6 digits	Date of Fix: ddmmyyyy
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	“E” or “W”	Magnetic Variation Direction

Table 74. $--RMC message field description (continued)

Parameter	Format	Description
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
```

10.5.6 $--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 75. $--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: Reserved 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

Table 75. $--VTG message field description (continued)

Parameter	Format	Description
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
```

10.5.7 $--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 76. $--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: Reserved 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
```

10.5.8 $--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 77. $--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: Reserved 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
```

10.5.9 $--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 78. $--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: Reserved 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 = Reserved 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
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
```

10.5.10 $--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 79. $--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: Reserved 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 79. $--GNS message field description (continued)

Parameter	Format	Description
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
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, 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
```

10.5.11 $--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 80. $--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: Reserved 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
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
```

10.6 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 “$PSTM…” where “STM” indicate that it is a ST proprietary message ($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.

10.6.1 $PSTMINITGPSOK

Message sent in response to command *$PSTMINITGPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.6.2 $PSTMINITGPSERROR

Message sent in response to command *$PSTMINITGPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.3 $PSTMINITTIMEOK

Message sent in response to command *$PSTMINITTIME*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.6.4 $PSTMINITTIMEERROR

Message sent in response to command *$PSTMINITTIME*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.5 $PSTMSETRANGEOK

Message sent in response to command *$PSTMSETRANGE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.6.6 $PSTMSETRANGEERROR

Message sent in response to command *$PSTMSETRANGE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.7 $PSTMSBASSERVICEOK

Message sent in response to command *$PSTMSBASSERVICE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.6.8 $PSTMSBASSERVICEERROR

Message sent in response to command *$PSTMSBASSERVICE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.9 $PSTMSBASMOK

Message sent in response to command *$PSTMSBASM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.6.10 $PSTMSBASMERROR

Message sent in response to command *$PSTMSBASM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.11 $PSTMGETALGOOK

Message sent in response to command *$PSTMGETALGO*

Synopsis:

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

Arguments:

Table 81. $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.

10.6.12 $PSTMGETALGOERROR

Message sent in response to command *$PSTMGETALGO*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.13 $PSTMSETALGOOK

Message sent in response to command *$PSTMGETALGO*

Synopsis:

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

Arguments:

Table 82. $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.

10.6.14 $PSTMSETALGOERROR

Message sent in response to command *$PSTMSETALGO*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.15 $PSTMGETRTCTIME

Message sent in response to command *$PSTMGETRTCTIME*

Synopsis:

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

Arguments:

Table 83. $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 - USER_TIME 3 - USER_RTC_TIME 4 - RTC_TIME 5 - RTC_TIME_ACCURATE 6 - APPROX_TIME 8 - ACCURATE_TIME 9 - POSITION_TIME 10 - EPHEMERIS_TIME

Results:

None.

10.6.16 $PSTMDATUMSELECTOK

Message sent in response to command *$PSTMDATUMSELECT*

Synopsis:

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

Arguments:

Table 84. $PSTMDATUMSELECTOK field description

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

Results:

None

10.6.17 $PSTMDATUMSELECTERROR

Message sent in response to command *$PSTMDATUMSELECT*

Synopsis:

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

Arguments:

None

Result:

None

10.6.18 $PSTMDATUMSETPARAMOK

Message sent in response to command *$PSTMDATUMSETPARAM*

Synopsis:

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

Arguments:

None

Result:

None

10.6.19 $PSTMDATUMSETPARAMERROR

Message sent in response to command *$PSTMDATUMSETPARAM*

Synopsis:

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

Arguments:

None

Result:

None

10.6.20 $PSTMSETCONSTMASKOK

Message sent in response to command *$PSTMSETCONSTMASK*

Synopsis:

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

Arguments:

Table 85. $PSTMSETCONSTMASKOK message field description

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

Results:

Message sent in case of successful operation.

10.6.21 $PSTMSETCONSTMASKERROR

Message sent in response to command *$PSTMSETCONSTMASK*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.22 $PSTMADCSTARTOK

Message sent in response to command *$PSTMADCSTART*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of no errors

10.6.23 $PSTMADCSTARTERROR

Message sent in response to command *$PSTMADCSTART*

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of errors

10.6.24 $PSTMADCREADOK

Message sent in response to command *$PSTMADCREAD*

Synopsis:

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

Arguments:

Table 86. $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 no error

10.6.25 $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

10.6.26 $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 87. $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

10.6.27 $PSTMFORCESTANDBYOK

Message sent in response to command *$PSTMFORCESTANDBY*

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

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of no error

10.6.28 $PSTMFORCESTANDBYERROR

Message sent in response to command *$PSTMFORCESTANDBY*

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

Synopsis:

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

Arguments:

No arguments

Results:

Message is sent in case of error

10.6.29 $PSTMGALILEODUMPGGTO

Message sent in response to command *$PSTMGALILEODUMPGGTO*

Synopsis:

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

Arguments:

Table 88. $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

10.6.30 $PSTMSETTHTRKOK

Message sent in response to command *$PSTMSETTHTRK*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error

10.6.31 $PSTMSETTHTRKERROR

Message sent in response to command *$PSTMSETTHTRK*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error

10.6.32 $PSTMSETTHPOSOK

Message sent in response to command *$PSTMSETTHPOS*

Synopsis:

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

Arguments:

No arguments

Results:

Message sent in case no error

10.6.33 $PSTMSETTHPOSERROR

Message sent in response to command *$PSTMSETTHPOS*

Synopsis:

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

Arguments:

No arguments

Results:

Message sent in case of errors

10.6.34 $PSTMVER

Message sent in response to command *$PSTMGETSWVER*

Synopsis:

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

Arguments:

Table 89. $PSTMVER field specification

Parameter	Format	Description
Lib	Text, fixed	Text String identifying the Library that the command is requiring the version: GNSSLIB if type = 0 OS20LIB if type = 1 GPSAPP if type = 2 BINIMG if type = 6 SWCFG if type = 11 PID if type = 12
Ver	x.x.x.x	GNSS Library Version: example 7.1.1.15
Type	ARM, GNU	Compiler Type: ARM or GNU

Example:

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

Note: If any id is passed as parameter to the command, its output acts as in the id = 0 case

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

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

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

Arguments:

Table 90. $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 91. 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

10.6.35 $PSTMRF

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

Synopsis:

```
$PSTMRF,<MessgAmount>,<MessgIndex>,<used_sats>,
   [<Sat1ID>,<Sat1PhN>,<Sat1Freq>,<Sat1CN0>],
```

```
[<Sat2ID>,<Sat2PhN>,<Sat2Freq>,<Sat2CN0>],
[<Sat3ID>,<Sat3PhN>,<Sat3Freq>,<Sat3CN0>],
*<checksum><cr><lf>
```

Arguments:

Table 92. $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

10.6.36 $PSTMTESTRF

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

Synopsis:

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

Arguments:

Table 93. $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

10.6.37 $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 94. $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 95*
constellation_mask	Decimal, 3 digits max	It is a bit mask where each bit enables/disables a specific constellation independently of the others: bit 0: GPS constellation enabling/disabling bit 1: GLONASS constellation enabling/disabling bit 2: QZSS constellation enabling/disabling bit 3: GALILELO constellation enabling/disabling bit 7: BAIDEU constellation enabling/disabling
time_best_sat_type	Decimal	Selected best time satellite type
time_master_sat_type	Decimal	Master time satellite type

Table 94. $PSTMTG message field description (continued)

Parameter	Format	Description
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 95. $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

10.6.38 $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 96. $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,
```

10.6.39 $PSTMPA

Position Algorithm

Synopsis:

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

Arguments:

Table 97. $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>
```

10.6.40 $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 98. $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

10.6.41 $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 99. $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
```

10.6.42 $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 100. $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
```

10.6.43 $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 101. $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

10.6.44 $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 102. $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
CPU_Speed	Decimal, 1 digit	CPU clock frequency: 52, 104, 156, 208 MHz.

Results:

None

10.6.45 $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 103. $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]
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]

Table 103. $PSTMPPSDATA message field description (continued)

Parameter	Format	Description
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

10.6.46 $PSTMPOSHOLD

Reports the Position Hold status and position.

Synopsis:

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

Arguments:

Table 104. $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

10.6.47 $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 105. $PSTMTRAIMSTATUS message field description

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
traim_solution	Decimal, 1 digit	TRAIM algorithm status: 0 = UNDER Alarm 1 = OVER Alarm 2 = UNKNOWN
alarm	Decimal	Time error threshold [ns]
ave_error	Decimal	Average time error [ns]
used_sats	Decimal	Number of used satellites.

Table 105. $PSTMTRAIMSTATUS message field description (continued)

Parameter	Format	Description
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

10.6.48 $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 106. $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.

10.6.49 $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 107. $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.

10.6.50 $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 108. $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.

10.6.51 $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 109. $PSTMKFCOV message field description

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

Example:

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

10.6.52 $PSTMTIM

Time Validity.

Synopsis:

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

Arguments:

Table 110. $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

10.6.53 $PSTMDIFF

Time Validity.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 111. $PSTMDIFF message field description

Parameter	Format	Description
ListSize	Decimal, 2 digits	Amount of visible satellites in this message (n)
NCS	Decimal, 2 digits	Number of corrected satellites
SatxID	Decimal, 2 digits	Satellite x ID (PRN)
CorrxAvl	Decimal	Correction available for Satellite x

10.6.54 $PSTMSBAS

SBAS Satellite Data.

Synopsis:

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

N = number of tracked satellites

Arguments:

Table 112. $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
```

10.6.55 $PSTMSBASM

SBAS Frame.

Synopsis:

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

Arguments:

Table 113. $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
```

10.6.56 $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 114. $PSTMNOTCHSTATUS message field description

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

Results:

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

10.6.57 $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 115. $PSTMLOWPOWERDATA message field description

Parameter	Format	Description
low power state	Decimal, 1 digits	Low power state indicator: [0 → FULL CONST; 1 → LOW POWER STATE; 2 → EPH REFRESH]
steady state	Decimal, 1 digits	Steady state reached indicator
RESERVED		
RESERVED		
ehpe	dd.d [m]	Estimated Horizontal Position Error [m]
RESERVED		
ehpe_average	dd.d [m]	Estimated Horizontal Position Error Average [m]
RESERVED		
RESERVED		
eph const mask	Decimal, 2 digits	Bitfield of completed ephemeris download
switch constellation	Decimal, 1 digits	Switch constellation features indicator
duty cycle enable	Decimal, 1 digits	Duty cycle enable indicator
duty cycle ms off	Decimal, 3 digits	Duty cycle ms signal off
duty cycle state	Decimal, 1 digits	Duty cycle state indicator

Results:

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

10.6.58 $PSTMADCDATA

Reports the ADC channels data read.

Synopsis:

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

Arguments:

Table 116. $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).

10.6.59 $PSTMANTENNASTATUS

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

Synopsis:

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

Arguments:

Table 117. $PSTMANTENNASTATUS message field description

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

Results:

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

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

10.6.60 $PSTMPV

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

Synopsis:

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

Arguments:

Table 118. $PSTMPV message field description

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

10.6.61 $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 119. $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
```

10.6.62 $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 120. $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
```

10.6.63 $PSTMUTC

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

Synopsis:

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

Arguments:

Table 121. $PSTMUTC message field description

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

Example:

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

10.6.64 $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 122. $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
```

10.6.65 $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 123. $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
```

10.6.66 $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 124. $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

10.6.67 $PSTMNAVM

Navigation Data Frame.

Synopsis:

```
$PSTMNAVM,<msg_id>,<prn>,<nav_frame>*<checksum><cr><lf>
```

Arguments:

Table 125. $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 126. 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 4th is always zero. The payload is 84 bits long
GALILEO	payload	128	16 (4 words)	Each message contains the payload from I/NAV message (see Note for details)
BEIDOU	Sub-frame	300	40 (10 words)	For each 32 bit word 30 bits are used (the 2 msb are ignored)

Note: In the above table, "word" means a 32-bit little endian encoded word, while "msb" means most significant bit(s).
It means that, in a little endian architecture system, the navigation frame (converted to binary format) can be directly copied into a C 32 bit unsigned integer words array. In other words:

- For GPS, the navigation frame can be copied into a C language variable defined according to the following type definition:

```
typedef tU32  gps_subframe_t  [10];
```

- For GLONASS, the navigation frame can be copied into a C language variable defined according to the following type definition:

```
typedef tU08  glo_subframe_t  [22];
```

Note: For strings for #1 to #5 just the first 11 bytes will be used, while for strings from #6 to #15 all 22 bytes will be used by storing two consecutive strings (e.g. strings #7 and #6). In this latter case the first sting (e.g. string #n) will be stored in the second part of the array (i.e. from byte #12 to #22), and the second string (e.g. string #n+1) will be stored in the first part of the array (i.e. from byte #1 to #11).

- For GALILEO, the navigation frame can be copied in a C language variable defined according to the following type definition:

```
typedef tU32  gal_subframe_t  [4];
```

Note: The GALILEO navigation frame contains the message payload, encoded according to the following table.

Figure 14. 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
```

10.6.68 $PSTMEPHEM

Ephemeris Data Dump.

This message is sent as a reply to a *$PSTMDUMPEPHEMS* command.

Synopsis:

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

Arguments:

Table 127. $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 128. $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 128. $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 129. $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 129. $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 130. $PSTMEPHEM message field description for BEIDOU constellation

Bits	Structure Member	Description
32	inclination	Inclination angle at reference time
32	eccentricity	Eccentricity.
32	root_a	Square root of major axis.
32	mean_anomaly	Mean anomaly at reference time.
32	omega_zero	Longitude of ascending node of orbit plane at weekly epoch.
32	perigee	Argument of perigee.
17	toe	Time of week for ephemeris epoch
10	time_group_delay	Estimated group delay differential.
5	aode	Issue of data, ephemeris
24	omega_dot	Rate of right ascension.
8	A0	Ionospheric Delay Model Parameter α_0
24	af0	Constant clock correction.
8	A1	Ionospheric Delay Model Parameter α_1
20	sow	Seconds of week
11	af2	Second order clock correction.
1	is_geo	1 for Geostationary satellites, otherwise 0

Table 130. $PSTMEPHEM message field description for BEIDOU constellation (continued)

Bits	Structure Member	Description
22	af1	First order clock correction.
10	subframe_avail	Must be 0x3FF.
16	motion_difference	Mean motion difference from computed value
8	A2	Ionospheric Delay Model Parameter α_2
8	A3	Ionospheric Delay Model Parameter α_3
18	crs	Amplitude of the sine harmonic correction to the orbit radius.
8	B2	Ionospheric Delay Model Parameter β_2
4	urai	User range accuracy index
2	RESERVED	Must be 0.
18	crc	Amplitude of the cosine harmonic correction to the orbit radius.
8	B3	Ionospheric Delay Model Parameter β_3
5	aodc	Issue of data, clock
1	spare	
18	cus	Amplitude of the sine harmonic correction to the argument of latitude.
14	i_dot	Rate of inclination angle.
18	cuc	Amplitude of the cosine harmonic correction to the argument of latitude.
8	B0	Ionospheric Delay Model Parameter β_0
6	spare	
18	cis	Amplitude of the sine harmonic correction to the angle of inclination.
8	B1	Ionospheric Delay Model Parameter β_1
6	RESERVED	Must be 0.
18	cic	Amplitude of the cosine harmonic correction to the angle of inclination.
1	nvm_reliable	Must be 1.
11	RESERVED	Must be 0.
2	spare	
17	toc	Time of week for clock epoch
13	week	Week number of the Issue of Data
1	available	Contains 1 if ephemeris is available, 0 if not
1	health	Contains 1 if the satellite is unhealthy, 0 if healthy

10.6.69 $PSTMALMANAC

Almanac Data Dump.

This message is sent as a reply to a *$PSTMDUMPALMANAC* command.

Synopsis:

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

Arguments:

Table 131. $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 132. $PSTMALMANAC message field description for GPS constellation

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

Table 133. $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.

Table 133. $PSTMALMANAC field description for GLONASS constellation (continued)

Bits	Structure Member	Description
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	

10.6.70 $PSTMGPSSUSPENDED

Message sent in response to command *$PSTMGPSSUSPEND*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.6.71 PSTMUSEDSATS

This message reports the number of used satellites for each constellation.

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

Synopsis:

```
$PSTMUSEDSATS,<GPS_n>,<GLONASS_n>,<GALILEO_n>,<BEIDOU_n>,<QZSS_n>*<checksum><cr><lf>
```

Arguments:

Table 134. $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
```

10.7 ST system configuration messages

10.7.1 $PSTMSETPAROK

Message sent in response to command *$PSTMSETPAR*

Synopsis:

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

Arguments:

Table 135. $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.

10.7.2 $PSTMSETPARERROR

Message sent in response to command *$PSTMSETPAR*

Synopsis:

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

Argument:

No argument

Results:

Message sent in case of error.

10.7.3 $PSTMRESTOREPAROK

Message sent in response to command *$PSTMRESTOREPAR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.4 $PSTMRESTOREPARERROR

Message sent in response to command *$PSTMRESTOREPAR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.5 $PSTMSAVEPAROK

Message sent in response to command *$PSTMSAVEPAR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.6 $PSTMSAVEPARERROR

Message sent in response to command *$PSTMSAVEPAR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.7 $PSTMSETPAR

Message sent in response to command *$PSTMGETPAR*

Synopsis:

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

Arguments:

Table 136. $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).

10.7.8 $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

10.7.9 $PSTMCFGPORTOK

Message sent in response to command *$PSTMCFGPORT*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.10 $PSTMCFGPORTERROR

Message sent in response to command *$PSTMCFGPORT*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.11 $PSTMCFGANTSENSOK

Message sent in response to command *$PSTMCFGANTSENS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.12 $PSTMCFGANTSENSERROR

Message sent in response to command *$PSTMCFGANTSENS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.13 $PSTMCFGCLKSOK

Message sent in response to command *$PSTMCFGCLKS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.14 $PSTMCFGCLKSERROR

Message sent in response to command *$PSTMCFGCLKS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.15 $PSTMCFGMSGLOK

Message sent in response to command *$PSTMCFGMSGL*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.16 $PSTMCFGMSGLERROR

Message sent in response to command *$PSTMCFGMSGL*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.17 $PSTMCFGGNSSOK

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.18 $PSTMCFGGNSSERROR

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.19 $PSTMCFGSBASOK

Message sent in response to command *$PSTMCFGSBAS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.20 $PSTMCFGSBASERROR

Message sent in response to command *$PSTMCFGSBAS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.21 $PSTMCFGLPAOK

Message sent in response to command *$PSTMCFGLPA*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.22 $PSTMCFGLPAERROR

Message sent in response to command *$PSTMCFGLPA*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.23 $PSTMCFGLPSOK

Message sent in response to command *$PSTMCFGLPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.24 $PSTMCFGLPSERROR

Message sent in response to command *$PSTMCFGLPS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.25 $PSTMCFGAJMOK

Message sent in response to command *$PSTMCFGAJM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.26 $PSTMCFGAJMERROR

Message sent in response to command *$PSTMCFGAJM*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.27 $PSTMCFGODOOK

Message sent in response to command *$PSTMCFGODO*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.28 $PSTMCFGODOERROR

Message sent in response to command *$PSTMCFGODO*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.29 $PSTMCFGGEOFENCEOK

Message sent in response to command *$PSTMCFGGEOFENCE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.30 $PSTMCFGGEOFENCEERROR

Message sent in response to command *$PSTMCFGGEOFENCE*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.31 $PSTMCFGGEOCIROK

Message sent in response to command *$PSTMCFGGEOCIR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.32 $PSTMCFGGEOCIRERROR

Message sent in response to command *$PSTMCFGGEOCIR*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.33 $PSTMCFGGNSSOK

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.34 $PSTMCFGGNSSERROR

Message sent in response to command *$PSTMCFGGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.35 $PSTMCFGCONSTOK

Message sent in response to command *$PSTMCFGCONST*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.36 $PSTMCFGCONSTERROR

Message sent in response to command *$PSTMCFGCONST*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.37 $PSTMCFGTHGNSSOK

Message sent in response to command *$PSTMCFGTHGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of successful operation.

10.7.38 $PSTMCFGTHGNSSERROR

Message sent in response to command *$PSTMCFGTHGNSS*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.7.39 $PSTMCFGTDATAOK

Message sent in response to command *$PSTMCFGTDATA*

Synopsis:

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

Arguments:

None.

Results:

"Message sent in case of successful operation.

10.7.40 $PSTMCFGTDATAERROR

Message sent in response to command *$PSTMCFGTDATA*

Synopsis:

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

Arguments:

None.

Results:

Message sent in case of error.

10.8 Geofencing NMEA messages

10.8.1 $PSTMGEOFENCECFGOK

Message sent in response to command *$PSTMGEOFENCECFG*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

10.8.2 $PSTMGEOFENCECFGERROR

Message sent in response to command *$PSTMGEOFENCECFG*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

10.8.3 $PSTMGEOFENCESTATUS

This message is sent from GNSS Teseo to the host as 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 137. $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

10.8.4 $PSTMGEOFENCEREQERROR

Message sent in response to command *$PSTMGEOFENCEREQ*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

10.9 Odometer NMEA messages

10.9.1 $PSTMODOSTARTOK

Message sent in response to command *$PSTMODOSTART*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

10.9.2 $PSTMODOSTARTERROR

Message sent in response to command *$PSTMODOSTART*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

10.9.3 $PSTMODOSTOPOK

Message sent in response to command *$PSTMODOSTOP*

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

10.9.4 $PSTMODOSTOPERROR

Message sent in response to command *$PSTMODOSTOP*.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

10.9.5 $PSTMODORESETOK

Message sent in response to command *$PSTMODORESET*.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of successful operation.

10.9.6 $PSTMODORESETERROR

Message sent in response to command *$PSTMODORESET*.

Synopsis:

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

Arguments:

No argument

Results:

Message sent in case of error.

10.9.7 $PSTMODO

This message is sent from GNSS Teseo III to the host periodically if Odometer subsystem is enabled and 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 138. $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

Table 138. $PSTMODO message field description

Parameter	Format	Description
odo-B	Unsigned	Odometer B value
odo-pon	Unsigned	Odometer PON value

10.9.8 $PSTMODOREQERROR

Message sent in response to command *$PSTMODOREQ*.

Synopsis:

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

Arguments:

None

Result:

Message sent in case of error.

10.10 Real Time AGNSS NMEA messages

10.10.1 $PSTMSTAGPS8PASSRTN

Message sent in response to command *$PSTMSTAGPS8PASSGEN*.

Synopsis:

```
$PSTMSTAGPS8PASSRTN,<DevID>,<Password>*<checksum><cr><lf>
```

Arguments:

Table 139. $PSTMSTAGPS8PASSRTN message field description

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

Results:

None

11 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 140. Configuration data block list

ID	Parameter name	Size bytes	Allowed values	Default	Description
100	Reserved	1	0...2	0	
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	Reserved	1		0	
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	Reserved	1		0xA	
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

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
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 0x44 = NMEA 0x81 = NMEA over I2C	0x11	Configure the output method for NMEA messages (over UART or SD card)
125	Notch Filter Setting	1	0x0...0xF	0x0	Enable or disable the Notch Filter usage
126	Reserved	1	0...1	1	
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 140. 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 140. 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	Reserved	1		0	
194	Reserved	1		0	
195	Reserved	1		1	
197	PPS Clock	1	16,32,48,64	32	Allow setting the PPS clock. For accurate timing application, 64 is mandatory.
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.

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
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 140. 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 = Reserved 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 = Reserved 0x2000000 = Reserved 0x4000000 = Reserved 0x8000000 = Reserved 0x10000000 = RESERVED 0x20000000 = HIGH_DYNAMICS_ON_OFF 0x40000000 = NMEA_RAW_ON_OFF 0x80000000 = LOW_POWER_ON_OFF	0x09419644	Activates/Deactivates GNSS application features
201	NMEA Port Msg-List 0 (LOW)	4	0x0000.0000 to 0xFFFF.FFFF	0x288435F	Set NMEA Message List 0 (32 bits low)

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
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	0xFFFF FFFF	Config0 for GPIO Port0
207	GPIO Port0 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000 000	Config1 for GPIO Port0
208	GPIO Port1 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFF FFFF	Config0 for GPIO Port1
209	GPIO Port1 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000 000	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	Reserved	4	-	0x00000 00	
214	Reserved	4	-	0x00000 00	
215	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
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.

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
219	SBAS satellite parameters	4	-	0xFFFFFFFF	Allow setting parameters (PRN, longitude and service) for new SBAS satellites not supported by the was library. Not valid value (e.g. 0xFFFFFFFF) means not used
220	Adaptive Low Power operating mode setting 1	4	-	15 m,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	-	0x7D096010	Allow setting parameters for configuration of Antenna Sensing feature

Table 140. 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 = Reserved 0x20 = NMEA_IN_OUT_INTERFACE_SELECT 0x40 = Reserved 0x80 = Reserved 0x100 = COMPASS_ENABLE 0x200 = COMPASS_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	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
232	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
233	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
234	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
235	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
236	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
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	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x1FF	
241	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0	
245	Reserved	4	0x0, 0xA, 0xB	0x0	
249	Reserved	4	-	0x1	
250	Reserved	4	-	0x8000000	
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
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	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x10180000	
265	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	
266	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x80000	
267	Reserved	4	0x0000.0000 to 0xFFFF.FFFF	0x0000010E	

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
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
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	Reserved	8	From -90.0 to 90.0	40.91747	
305	Reserved	8	From -180.0 to 180.0	14.27586	
306	Reserved	8	From -1500 to 100000	88.43307	
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	COMPASS RF delay correction	8		100E-9	Time delay compensation for the COMPASS RF path.
311	Reserved	8		718E-9	
314	Geofencing Circle 0 Latitude	8		41.11473	Allows to set up the geofencing circle number 0 by choosing its latitude as a double precision floating number
315	Geofencing Circle 0 Longitude	8		13.88093	Allows to set up the geofencing circle number 0 by choosing its longitude as a double precision floating number
316	Geofencing Circle 0 Radius	8		10.0	Allows to set up the geofencing circle number 0 by choosing its radius in meters as a double precision floating number

Table 140. Configuration data block list (continued)

ID	Parameter name	Size bytes	Allowed values	Default	Description
317	Geofencing Circle 1 Latitude	8		41.12148	Allows to set up the geofencing circle number 1 by choosing its latitude as a double precision floating number
318	Geofencing Circle 1 Longitude	8		13.87146	Allows to set up the geofencing circle number 1 by choosing its longitude as a double precision floating number
319	Geofencing Circle 1 Radius	8		10.0	Allows to set up the geofencing circle number 1 by choosing its radius in meters as a double precision floating number
320	Geofencing Circle 2 Latitude	8		41.24341	Allows to set up the geofencing circle number 2 by choosing its latitude as a double precision floating number
321	Geofencing Circle 2 Longitude	8		13.77443	Allows to set up the geofencing circle number 2 by choosing its longitude as a double precision floating number
322	Geofencing Circle 2 Radius	8		10.0	Allows to set up the geofencing circle number 2 by choosing its radius in meters as a double precision floating number
323	Geofencing Circle 3 Latitude	8		41.24328	Allows to set up the geofencing circle number 3 by choosing its latitude as a double precision floating number
324	Geofencing Circle 3 Longitude	8		13.77424	Allows to set up the geofencing circle number 3 by choosing its longitude as a double precision floating number
325	Geofencing Circle 3 Radius	8		10.0	Allows to set up the geofencing circle number 3 by choosing its radius in meters as a double precision floating number

11.1 CDB-ID 101 – NMEA port setting

Allow setting the NMEA port number.

System reboot needed to have new setting in use.

11.2 CDB-ID 102 – NMEA port baudrate setting

Allow setting the baudrate for the NMEA port number. The translation table is in *Table 141: CDB-ID 102 field description*.

Table 141. 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.

11.3 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.

11.4 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.

11.5 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 142. 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.

11.6 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 143. 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.

11.7 CDB-ID 122 – NMEA format configuration

Allow setting the change the format of NMEA. Note that this 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 144. 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

11.8 CDB-ID 124 – NMEA output redirection

Allow setting the output channel for NMEA messages. Supported channels are UART and SD card. UART is the default channel. If the SD card is selected for NMEA output but the SD card is not present in the slot, the system switches automatically to the UART mode.

This parameter is made by two bit masks (4 bits each one):

Table 145. CDB-ID 124 field description

Bit	Bitmask	Description
From B0 to B3		Reserved
From B4 to B7	0x10=enable/disable UART 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)

11.9 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 146. 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.

11.10 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 147. 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.

11.11 CDB-ID 128 – Differential Source Type

Allow selecting the differential mode source type.

Table 148. 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.

11.12 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 149. 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.

11.13 CDB-ID 130 – CPU clock speed

Allow setting the CPU clock speed.

Table 150. 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

11.14 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).

11.15 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.

11.16 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 parameters 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.

11.17 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.

11.18 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 messages.

System reboot needed to have new setting in use.

11.19 CDB-ID 139 – RTCM port baudrate setting

Allow setting the baudrate for the RTCM port number. The translation table is in *Table 151: CDB-ID 139 field description*.

Table 151. 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.

11.20 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 (see RF front-end reference manual for details about registers) 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.

11.21 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 152. 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 152. 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	RESERVED

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.

11.22 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 first 32 bits (low bits) of extended 64 bits NMEA message list, CDB-ID 220 represents second 32 bits (high bits) of 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 153. 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

11.23 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 the first 32 bits (low bits) of the extended 64 bits NMEA message list. See CDB-ID 230 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 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 154. 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.

11.24 CDB-ID 197 – PPS clock

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

Table 155. 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

11.25 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.

11.26 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.

11.27 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 156. 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

Table 156. CDB-ID 200 field description (continued)

Bit[1]	Bitmask	Function	Description
4	0x10	RESERVED	
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.
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 affect 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 affect 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

Table 156. CDB-ID 200 field description (continued)

Bit[1]	Bitmask	Function	Description
18	0x40000	QZSS constellation enable[2]	Enable/disable the QZSS constellation. When this bit is enabled QZSS satellites are enabled to be tracked and used for positioning
19	0x80000	NMEA GNGSV enable	Enable/disable the “GN” talker ID for GSV messages reporting satellite for all constellations. When this bit is enabled, only the talker ID “GN” is used for GSV messages.
20	0x100000	NMEA GNGSA enable	Enable/disable the “GN” talker ID for GSA messages reporting satellite for all constellations. When this bit is enabled, only the talker ID “GN” is used for GSA messages.
21	0x200000	GLONAS usage for positioning enable	Enable/disable the usage of GLONASS satellite for the GNSS position fix. If this bit is disabled and GLONASS constellation is enabled, the GLONASS satellites are only tracked.
22	0x400000	GPS usage for positioning enable	Enable/disable the usage of GPS satellite for the GNSS position fix. If this bit is disabled and GPS constellation is enabled, the GPS satellites are only tracked
23	0x800000	QZSS usage for positioning enable	Enables/disables the usage of QZSS satellites for the GNSS position fix. If this bit is disabled and QZSS constellation is enabled, the QZSS satellites are only tracked.
24	0x1000000	PPS enabling	Enables/disables the PPS generation on the PPS pin.
25	0x2000000	RESERVED	
26	0x4000000	RESERVED	
27	0x8000000	RESERVED	
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 (> 5Hz) 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, GLONASS, COMPASS and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+QZSS+GLONASS), (GPS+QZSS+COMPASS) and (GLONASS+COMPASS). Any constellation can be enabled as standalone satellite navigation system.

Table 157. CDB-ID 227 field description

Bit[1]	Bitmask	Function	Description
1	0x1	NMEA commands eco enable	Enable/disable the command eco on the NMEA port
2	0x2	NMEA Time To First Fix enable	Enable/disable the Time To First Fix message on the NMEA port. If enabled, the TTFF message is sent only one time as soon as the GNSS position fix is achieved.
3	0x4	Few satellites position estimation enable	Enable/disable the position estimation algorithm when tracked satellites are less than 3.
4	0x8	RESERVED	
5	0x10	RESERVED	
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
7	0x40	RESERVED	
8	0x80	RESERVED	
9	0x100	Compass constellation enable[2]	Enable/disable the Compass constellation. When this bit is enabled Compass satellites are enabled to be tracked and used for positioning.
10	0x200	Compass usage for positioning enable	Enable/disable the usage of Compass satellite for the GNSS position fix. If this bit is disabled and Compass constellation is enabled, the Compass 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	

Table 157. CDB-ID 227 field description (continued)

Bit[1]	Bitmask	Function	Description
17	0x10000	RESERVED	
18	0x20000	RESERVED	
19	0x40000	RESERVED	
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.

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, GLONASS, COMPASS and QZSS. All constellations cannot be enabled at the same time, allowed combinations to achieve maximum coverage, are: (GPS+QZSS+GLONASS), (GPS+QZSS+COMPASS). Any constellation can be enabled as standalone satellite navigation system.

11.28 CDB-ID 202 – NCO range max value

Allow setting the upper limit for the NCO search range.

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

11.29 CDB-ID 203 – NCO range min value

Allow setting the lower limit for the NCO search range.

The NCO range and center frequency settings depend on the TCXO in use. There is the possibility to let the GNSS software to evaluate automatically the best range and center values for the selected TCXO. In such case all NCO configuration parameters (CDB-ID 202, 203 and 204) must be set to 0.

System reboot needed to have new setting in use.

Note: Configured value is used only if the NCO value is not yet stored in the GNSS backup memory.

11.30 CDB-ID 204 – NCO centre value

Allow setting the NCO centre frequency.

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.

11.31 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.

11.32 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 158. 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.

11.33 CDB-ID 218 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 159. 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

11.34 CDB-ID 219 – SBAS satellite parameter

Allow to add or modify a SBAS satellite parameter into a default list.

Table 160. 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

11.35 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 161*.

Table 161. CDB-ID 220 field description

Bits	Values	Description
B0	0	Reserved - must be 0
B1	0/1	Duty cycle enable/disable
From B2 to B3	0	Reserved
From B4 to B11	0	Reserved - must be 0
From B12 to B19	32	Reserved - must be 32
From B20 to B31	1, 3, 5	Duty cycle fix period [s]

11.36 CDB-ID 221 – Low Power operating mode setting

Low Power management:

Table 162. CDB-ID 221 field description

Bits	Values	Description
From B0 to B31		RESERVED

11.37 CDB-ID 222 – LMS operating mode setting 1

Table 163. CDB-ID 222 field description

Bits	Values	Description
B0	0/1	2D Fix enable/disable
B1	0/1	HDOP product in range error metric enable/disable
B2	0/1	GLONASS path delay lock enable/disable
From B8 to B15	0...255	Position residual threshold [m]
From B16 to B23	0...255	Position residual threshold after RAIM [m]

11.38 CDB-ID 223 – LMS operating mode setting 2

Table 164. 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)

11.39 CDB-ID 224 – Low power operating mode setting

Low Power management.

Table 165. CDB-ID 224 field description

Bits	Values	Description
From B0 to B31		RESERVED

11.40 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 166. 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

11.41 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 167. 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	Clk divisor factor to configure ADC sampling rate

Table 167. CDB-ID 226 field description (continued)

Bits	Values	Description
From B12 to B21	< 63	Minimum Threshold value (mV).
From B22 to B31	> 210	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.

11.42 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 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 168. 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

11.43 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).

11.44 CDB-ID 242 – Antenna Sensing via GPIO setting 1

Allow GPIO pin configuration for the antenna detection and control signals.

Table 169. CDB-ID 242 field description

Bits	Values	Description
From B0 to B7	0...63	GPIO pin number for antenna diagnostic enable signal (output)
From B8 to B15	0...63	GPIO pin number for antenna switch control signal (output)
From B16 to B23	0...63	GPIO pin number for antenna SHORT detection signal (input)
From B24 to B31	0...63	GPIO pin number for antenna OPEN detection signal (input)

11.45 CDB-ID 243 – Antenna Sensing via GPIO setting 2

Allow GPIO mode configuration for the antenna detection and control signals.

Table 170. CDB-ID 243 field description

Bits	Values	Description
From B0 to B7	0...3	GPIO mode for antenna diagnostic enable signal (output) 0 = Alternate NONE 1 = Alternate MODE_A 2 = Alternate MODE_B 3 = Alternate MODE_C
From B8 to B15	0...3	GPIO mode for antenna switch control signal (output) 0 = Alternate NONE 1 = Alternate MODE_A 2 = Alternate MODE_B 3 = Alternate MODE_C
From B16 to B23	0...3	GPIO mode for antenna SHORT detection signal (input) 0 = Alternate NONE 1 = Alternate MODE_A 2 = Alternate MODE_B 3 = Alternate MODE_C
From B24 to B31	0...3	GPIO mode for antenna OPEN detection signal (input) 0 = Alternate NONE 1 = Alternate MODE_A 2 = Alternate MODE_B 3 = Alternate MODE_C

11.46 CDB-ID 244 – Antenna Sensing via GPIO setting 3

Allow setting the active levels for the antenna detection and control signals.

Table 171. CDB-ID 244 field description

Bits	Values	Description
From B0 to B7	0...1	Active level for antenna diagnostic enable signal (output)
From B8 to B15	0...1	Active level for antenna switch control signal (output)

Table 171. CDB-ID 244 field description (continued)

Bits	Values	Description
From B16 to B23	0...1	Active level for antenna SHORT detection signal (input)
From B24 to B31	0...1	Active level for antenna OPEN detection signal (input)

11.47 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.

11.48 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 172. 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.

11.49 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 173. 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.

11.50 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 174. 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.

Table 174. CDB-ID 259 field description (continued)

Bits	Values	Description
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.

11.51 CDB-ID 260 – WLS algorithm configuration

Allow to configure the WLS algorithm implemented in the positioning stage.

Table 175. CDB-ID 260 field description

Bits	Values	Description
B0	0...1	Enable/Disable the WLS algorithm usage in the positioning stage. 0 = disabled 1= enabled
B1...B7	xxx	Not used
B8...B15	1...100	Parameter1 multiplied by 10. Parameter1 is a coefficient to change the measurements weighting in the position filter. Allowed values are from 0.1 to 10.0 (suggested value is 1.0) means high acceptance of satellites measurements in the position filter. 10.0 means low acceptance of satellites measurements in the position filter.
B16...B23	10...100	Parameter2 multiplied by 10. Parameter2 is a coefficient to change the measurements acceptance threshold. Allowed values are from 1.0 to 10.0 (suggested value is 2.5) means strong satellite exclusions by FDE (high false alarm rate). 10.0 means relaxed satellites exclusions by FDE.

11.52 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 176. 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

11.53 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 177. 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

11.54 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 default ones.

Table 178. 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

Table 178. CDB-ID 263 field description (continued)

Bits	Values	Description	Default
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
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

11.55 CDB-ID 268 – Geofencing Configuration 0

Geofencing configuration field 0. This configuration is supported only in Binary Image 4.5.8 and later.

Table 179. 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

Table 179. CDB-ID 268 field description (continued)

Bits	Values	Description	Default
Bit 11	0...1	0 = Circle 3 disabled 1 = Circle 3 enabled	0x1
Bit 12-31	-	RESERVED	0

11.56 CDB-ID 270 – Odometer Configuration

Odometer configuration field. This configuration is supported only in Binary Image 4.5.8 and later.

Table 180. 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

11.57 CDB-ID 272 – GNSS integrity check configuration

Position and time integrity check enabling/disabling.

Table 181. 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

11.58 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.

11.59 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.

11.60 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 182. 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.

11.61 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.

11.62 CDB-ID 310 – COMPASS RF delay correction

Allow setting the RF time delay for COMPASS signal path.

11.63 CDB-ID 314 – CDB-ID 315 – CDB-ID 316 – Geofencing Circle 0

Allows to set up the geofencing circle number 0 parameters.

Table 183. 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.

11.64 CDB-ID 317 – CDB-ID 318 - CDB-ID 319 - Geofencing Circle 1

Allows to set up the geofencing circle number 1 parameters.

Table 184. 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.

11.65 CDB-ID 320 – CDB-ID 321 – CDB-ID 322 – Geofencing Circle 2

Allows to set up the geofencing circle number 2 parameters

Table 185. 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 186. 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.

11.66 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.

11.67 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.

11.68 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.

11.69 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.

11.70 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 187 lists the acronyms and definitions used in this document.

Table 187. 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.

Table 187. 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 187. 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 188. 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 188. 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 188. 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 189. 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 189. 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 189. 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 190. Australia geodetic datum

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

Table 191. 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 191. 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 192. 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 192. 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 193. South America geodetic datum

SOUTH AMERICA			
REGION		CODE	CDB-ID VALUE
BOGOTA OBSERVATORY			
	Colombia	BOO	128

Table 193. 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 193. 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 194. 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 194. 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 194. 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 195. 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 196. 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 196. 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 196. 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 197. 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 197. 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 198. 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 199. Document revision history

Date	Revision	Changes
17-Jan-2019	1	Initial release.