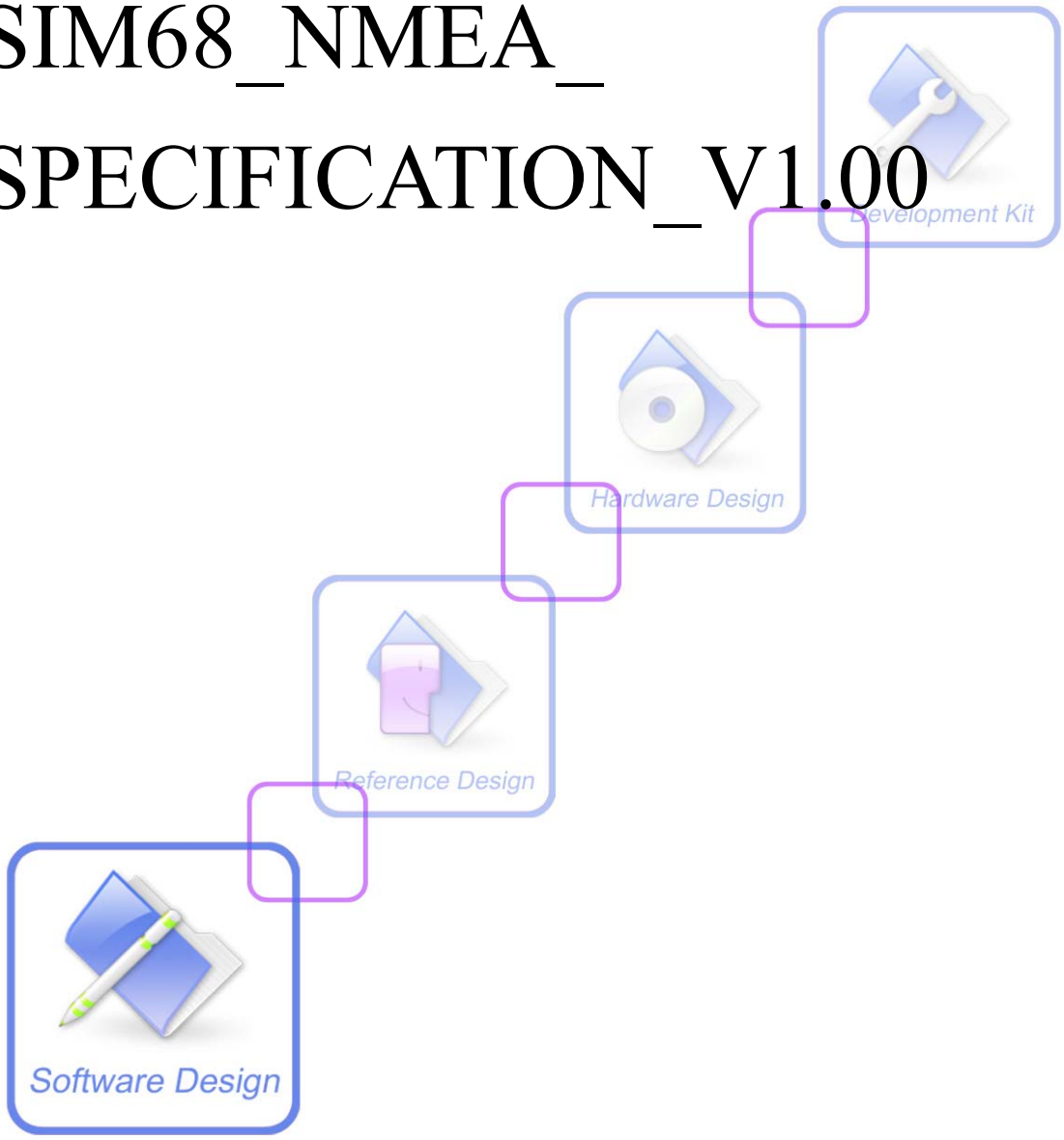
SIM68_NMEA_SPECIFICATION_V1.00



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Version History

Version	Chapter	What is new
V1.00	Original version	Original

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1 Introduction

1.1 Scope of the document

This document presents details of the frequently used NMEA messages supported by SIMCom SIM68 GNSSS module, does not provide information about the complete NMEA-0183, user can refer to the related documents for more information.

1.2 Related documents

(1). NMEA-0183 Standard For Interfacing Marine Electronic Devices

(2). GNSS_NMEA_Interface_312(STA8088_Binary_Image_v3_1_3)

(3). STA8088_Firmware_Configuration(STA8088_Binary_Image_v3_1_3)

1.3 Term abbreviation

Table 1-1: Key Words

Key Words	Definition
1PPS	1 pulse per second
2D Fix	Fix based on the use of 3 satellites
3D Fix	Fix based on the use of 4 satellites
ABP	Almanac Based Position
ACK	Acknowledge
Accuracy	Deviation of a GPS-based calculated position from the true position
Almanac	Contains the information about all available satellites , their orbit data and time of their clocks.
Azim	Azimuth -Angular distance from a reference
BAUD rate	Transmission Rate Measure for the effective transmission of data content. (may differ from Bits/sec).
Bank Swap	Exchanging two memory banks for storage of data
CN0	Carrier to Noise Ratio -Identifies the quality of a received signal
Checksum	Calculated from the transmitted characters of a message by “ex-OR”ing the 8 bit character values including delimeters (without checksum).
DGPS	Differential GPS -GPS Augmentation System, providing the accurate location of a Reference Station to reduce system errors.
Dead Reckoning	Sensor based process to determine the movement of a mobile unit, utilizing Gyro,Odometer and Wheel Pulses.
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
GDOP	Geometric Dilution Of Position -Quality value representing all geometry based error factors in a system.
GNSS	Global Navigation Satellite System -Satellite based system to calculate the position of the receiver on the earth surface.
GPS	Global Positioning System -United States Satellite Navigation System
GPS Library	STMicroelectronics C-Library containing all GPS relevant Functions
Gyro	Gyroscope -Sensor to determine rotational movements
HDOP	Horizontal Dilution Of Precision -Quality value representing all 2D plane geometry based error factors in a system.

Lat	Lattitude -Angular difference of a given position to the Equator. Values include 0°-90° either North or South
Long	Longitude -Angular difference to a “reference” Longitude indicated as “000”. Values include 0°… 180° either West or East.
NMEA	National Marine Electronics Association -United States Standards Organisation For Marine Equipment
NMEA 0183	National Marine Electronics Association -Standard for Interfacing Marine Electronics Devices
NVM	Non Volatile Memory -Any type of memory that conserves data in the absence of regular supply voltage (includes battery buffered memories)
OSP	One Socket Protocol
PDOP	Position Dilution of Precision
PRN	Pseudo Random Number -Satellite Specific 1023 Bit Number used for Spread Spectrum Modulation
RF	Radio Frequency -High Frequency for Reception with a RF-Receiver
RS232	IEEE Standard -Physical Layer Standard for Data Transmission
SBAS	Satellite Based Augmentation System -GPS enhancement system based on geostationary satellites.
SDK	Software Development Kit
SRAM	Static Random Access Memory
SVs	Satellites
SW	Software
Sat-ID	Satellite Identifier -Satellite specific Number used to generate the corresponding PRN code
UTC	Universal Time Coordinated
VDOP	Vertical Dilution of Precision
WAAS	Wide Area Augmentation System -American GPS Augmentation System delivering accurate Ionosphere Data
Cold Start	Start Condition for a GPS system having no position or time. Almanac and Ephemeris is not available, too.
Warm Start	Start Condition for a GPS system having current Almanac, position and time availability. Ephemerides are not available. Time needs to be available with reasonable accuracy (some seconds).
Hot Start	Start Condition for a GPS System having position, time, Almanac and Ephemeris already available. High time accuracy is required.

2 Communication Interface

Communication between a host processor and the SIM68 GNSS System can be established in different ways, depending on the implementation of the Baseband Processor as a standalone 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. There are other implementations to communicate like USB. The hardware interface used will not influence the data content send or received.

All information contained in this document is related to the “NMEA port” of the Baseband Processor.

SIM68 GNSS Systems contain an additional “Debug port” but the data exchanged on the “Debug Port” is not within the scope of this document.

2.1 Commands Input

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

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

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

115200 Baud rate

8 Data Bits

0 Parity Bits

1 Stop Bit

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

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

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

Table 2-1: Commands Input

Syntax	Description
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITFRQ	Initialize centre frequency
$PSTMSETRANGE	Set the frequency range for satellite searching
$PSTMCLREPHS	Clear all ephemeris
$PSTMDUMPEPHEMS	Dump Ephemeris data
$PSTMEPHEM	Load Ephemeris data
$PSTMCLRALMS	Clear all almanacs
$PSTMDUMPALMANAC	Dump Almanacs data
$PSTMALMANAC	Load Almanacs data
$PSTMCOLD	Perform COLD start
$PSTMWARM	Perform WARM start
$PSTMHOT	Perform HOT start
$PSTMNMEAONOFF	Toggle ON/OFF the NMEA output
$PSTMDEBUGONOFF	Toggle ON/OFF the DEBUG output
$PSTMSRR	System Reset
$PSTMGPSRESET	Reset the GPS engine
$PSTMGPSSUSPEND	Suspend GPS engine
$PSTMGPSRESTART	Restart GPS engine
$PSTMTIMEINV	Invalidate the GPS time
$PSTMGETSWVER	Provide the GPS library version string.
$PSTMNVMSWAP[2]	Execute a bank swap on the NVM GPS backup memory
$PSTMSBASONOFF	Enable/Disable the SBAS activity
$PSTMSBASSAT	Set the SBAS satellite’s ID
$PSTMRFTESTON	Enable the RF test mode
$PSTMRFTESTOFF	Disable the RF test mode
$PSTMGETALGO	Get FDE algorithm ON/OFF status
$PSTMSETALGO	Set FDE algorithm ON/OFF status

$PSTM2DFIXONOFF	Enable/Disable the 2D fix algorithm
$PSTMGETRTCTIME	Get the current RTC time.
$PSTMSELECTDATUM	Set a geodetic local datum different from WGS84
$PSTMDATUMSETPARAM	Set parameters to local geodetic to WGS84 datum transformations
$PSTMENABLEPOSITIONHOLD	Set status and position for the Position Hold feature.
$PSTMSETCONSTMASK	Set GNSS constellation mask.
$PSTMNOTCH	Set the ANF operation mode.
$PSTMPPS	Command interface for Pulse Per Second management.
$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).

Note:

1. If not explicitly declared, all commands which modify the status of parameters, modifications are not saved in the backup memory. Any new setting will be replaced by default values after system reset or system power cycling.

2. This command is supported only by platforms or SW 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

2.1.1 $PSTMINITGPS

Initialize GPS position and time

Synopsis:

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

Arguments:

Table 2-2: $PSTMINITGPS parameter

arameter	Format	Description
Lat	DDMM.MMMM	Latitude (Degree-Minute.Minute decimals)
LatRef	Nor S	Latitude direction (North or South)
Lon	DDDMM.MMMM	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 (1994 -…)
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. No message will be sent as reply.

Example:

```
$PSTMINITGPS,4811.365,N,01164.123,E,0530,23,02,2009,09,44,12
```

2.1.2 $PSTMINITFRQ

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

Synopsis:

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

Arguments:

Table 2-3: $PSTMINITFRQ parameter

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

Results:

The centre frequency will be initialized. No message will be sent as reply.

Example:

```
$PSTMINITFRQ,-47000
```

5.2.3 $PSTMSETRANGE

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

Synopsis:

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

Arguments:

Table 2-4: $PSTMSETRANGE parameter

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

Results:

The following message will be output on NMEA communication channel:

if success

```
$PSTMSETRANGEOK<cr><lf>
```

if no success

```
$PSTMSETRANGEERROR<cr><lf>
```

Example:

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

2.1.3 $PSTMCLREPHS

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
$PSTMCLREPHS
```

2.1.4 $PSTMDUMPEPHEMS

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

Synopsis:

```
$PSTMDUMPEPHS<cr><lf>
```

Arguments:

None.

Results:

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

Where:

Table 2-5: $PSTMDUMPEPHEMS parameter

Parameter	Format	Description
sat_id	nn – Decimal, 2 digits	Satellite number
N	N -Decimal, 1 Digit	Number of the ephemeris data bytes
byte1	bb -Hexadecimal, 2 digits	First byte of the ephemeris data
byteN	BB -Hexadecimal, 2 digits	Last byte of the ephemeris data
checksum	cc -Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMDUMPEPHEMS
$PSTMEPHEM,1,64,0f06bc34bc345f5f5f84f400dea4ff00f9f63c239f0a35f81400
fbff33420000ee632f27698ef001afa50da16cfcfa22e0b65a3e7a3cee27d700f7ffc616fe03*57
$PSTMEPHEM,2,64,0f06bc34bc344f4f4f78110019a5ff00b004fa1d1e0e3f04c8ff
caff1937000033515726556ba9048eae0da1b6c346bd8f985c93ade10c76db001d00f8c7c503*58
$PSTMEPHEM,4,64,0f06bb34bb344b4b4b98050038a4ff000005351e110eea041b00
b8ffd037000020b84e26b5138b0425580ca16b211030e68b1a949cac9615f30066ffea92f603*06
$PSTMEPHEM,9,64,0f06bc34bc341818189c0a0069aaff005f06eb249a09ca0477ff
6c00f72e00005131d827592b950a91010da1c7af88538e7ca1122fb9be3df4001300c4a0c203*52
```

2.1.5 $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 2-6: $PSTMEPHEM parameter

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

Results:

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

Example:

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

2.1.6 $PSTMCLRALMS

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

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
$PSTMCLRALMS
```

2.1.7 $PSTMDUMPALMANAC

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

Synopsis:

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

Arguments:

None.

Results:

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

Where:

Table 2-7: $PSTMDUMPALMANAC parameter

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

Example:

```
$PSTMDUMPALMANAC
$PSTMALMANAC,1,32,011a06903f1f9f0d58fd0800d90ca1418713060099ee260034
024200b4ffff00*1a
$PSTMALMANAC,2,32,021a0690944b78fe37fd0800770da141ef0c5b006048770098
9bd800d8088000*1a
$PSTMALMANAC,3,32,031a06904f68a2f540fd0800f60ca141922a2c003cae270094
96cf00020a8000*15
$PSTMALMANAC,4,32,041a0690a94aeffd36fd0800390ca141afc95b00de7a1700df
c74e004ddebf00*13
$PSTMALMANAC,5,32,051a0690940eee0b5efd0800900ca141582b8600d3000b0060
641200e40f8000*14
```

2.1.8 $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 2-8: $PSTMALMANAC parameter

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

Results:

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

Example: *x*

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

Note:

For further details about the almanacs management please refer to the dedicated chapter below.

2.1.9 $PSTMCOLD

Perform a COLD start.

Synopsis:

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

Arguments:

Table 2-9: $PSTMCOLD parameter

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.

Note:

1.If Mask parameter is used, only the selected GPS data is invalidated for this actual Coldstart. Multiple selects are supported (i.e. 0xD).

2. If Mask parameter is not used, default is 0xE (clear ephemeris, time and position).

Example:

```
$PSTMCOLD,6
```

2.1.10 $PSTMWARM

Perform a WARM start.

Synopsis:

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

Arguments:

None .

Results:

Warm start initialization and system restart.

Example:

```
$PSTMWARM
```

2.1.11 $PSTMHOT

Perform an HOT start.

Synopsis:

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

Arguments:

None .

Results:

The system restart .

Example:

```
$PSTMHOT
```

2.1.12 $PSTMNMEAONOFF

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

Synopsis:

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

Arguments:

Table 2-10: $PSTMNMEAONOFF parameter

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

Note:

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:

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

Example:

```
$PSTMNMEAONOFF,0
```

2.1.13 $PSTMDEBUGONOFF

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

Synopsis:

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

Arguments:

Table 2-11: $PSTMDEBUGONOFF parameter

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

Results:

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

Example:

```
$PSTMDEBUGONOFF,0
```

2.1.14 $PSTMSRR

Executes a system reset. The GNSS firmware is rebooted.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
$PSTMSRR
```

2.1.15 $PSTMGPSRESET

Reset the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

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

Note:

Using this command the GPS module won't reboot.

Example:

```
$PSTMGPSRESET
```

2.1.16 $PSTMGPSSUSPEND

Suspend the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
$PSTMGPSSUSPEND
```

2.1.17 $PSTMGPSRESTART

Restart the GPS receiver engine.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
PSTMGPSRESTART
```

2.1.18 $PSTMTIMEINV

Invalidate the Real Time Clock (RTC).

Synopsis:

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

Arguments:

None.

Results:

The RTC time will be invalidated.

Example:

```
$PSTMTIMEINV
```

2.1.19 $PSTMGETSWVER

Get the version string of the libraries (GNSS, OS20, GPSAPP and WAAS) embedded in the software application.

Synopsis:

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

Arguments:

Table 2-12: $PSTMGETSWVER parameter

Parameter	Format	Description
lib_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 = GNSS App Version 4 = WAAS Version

Results:

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

Where:
Table 2-13: $PSTMGETSWVER Results parameter

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

Example:

```
$PSTMGETSWVER,0
```

Note:

If any lib_id is passed as parameter to the command, its output act as in the lib_id = 0 case.

2.1.20 $PSTMNVMSWAP

Execute a bank swap on the NVM GPS backup memory.

Synopsis:

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

Arguments:

None.

Results:

The non-volatile backup memory banks will be swapped. No message will be sent as reply

Example:

```
$PSTMNVMSWAP
```

2.1.21 $PSTMSBASONOFF

Suspend / resume the SBAS software execution.

Synopsis:

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

Arguments:

None.

Results:

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

Example:

```
$PSTMSBASONOFF
```

2.1.22 $PSTMSBASSAT

Change the SBAS satellite.

Synopsis:

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

Arguments:

Table 2-14: $PSTMSBASSAT parameter

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

Results:

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

Example:

```
$PSTMSBASSAT,128
```

2.1.23 $PSTMRFTESTON

Enable the RF test mode for production line tests.

Synopsis:

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

Arguments:

Table 2-15: $PSTMRFTESTON parameter

Parameter	Format	Description
sat_id	Decimal, 2 digits	Satellite number

Results:

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

Example:

```
$PSTMRFTESTON,24
```

2.1.24 $PSTMRFTESTOFF

Disable the RF test mode for production line tests.

Synopsis:

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

Arguments:

None.

Results:

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

Note:

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

Example:

```
$PSTMRFTESTOFF
```

2.1.25 $PSTMGETALGO

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

Synopsis:

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

Arguments:

Table 2-16: $PSTMGETALGO parameter

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

Results:

If success the following message is sent:

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

Table 2-17: $PSTMGETALGO Results parameter

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

In case of error the following message will be sent:

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

Example:

```
$PSTMGETALGO,1
```

2.1.26 $PSTMSETALGO

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

Synopsis:

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

Arguments:

Table 2-18: $PSTMSETALGO parameter

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

Results:

If success the following message is sent:

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

Table 2-19: $PSTMSETALGO Results parameter

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

In case of error the following message will be sent:

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

Example:

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

2.1.27 $PSTM2DFIXONOFF

Enable/Disable the GPS 2D fix algorithm.

Synopsis:

```
$PSTM2DFIXONOFF,<on_off><cr><lf>
```

Arguments:

Table 2-20: $ PSTM2DFIXONOFF parameter

Parameter	Format	Description
on_off	Decimal, 1 digit	0 = the 2D fix algorithm will be disabled. 1 = the 2D fix algorithm will be enabled.

Results:

If the input parameter is 0 the 2D fix algorithm will be disabled. The following message is send:

```
$PSTM2DFIXDISABLED
```

If the input parameter is 1 the 2D fix algorithm will be enabled. The following message will be send:

```
$PSTM2DFIXENABLED
```

In case of an error the system will reply:

```
$PSTM2DFIXONOFFERROR
```

Note:

The changes made by the above command will take effect only after a GPS engine reset. It is recommended to send the $PSTMGPSRESET command after the $PSTM2DFIXONOFF command

Example:

```
$PSTM2DFIXONOFF,1
```

2.1.28 $PSTMGETRTCTIME

Get the current RTC time.

Synopsis:

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

Arguments:

None.

Results:

System will send RTC Data and Status.

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

Where:

Table 2-21: $ PSTMGETRTCTIME Results parameter

Parameter	Format	Description
time	hhmmss.ms	Current time read on RTC.
date	ddmmyy	Current date read on RTC.
tc_status	Decimal, 1 digit	Status: 0 -RTC_STATUS_INVALID 1 -RTC_STATUS_STORED 2 -RTC_STATUS_APPROXIMATE
time_validi ty	Decimal, 1 digit	Validity: 0 -NO_TIME 1 -FLASH_TIME 2 -USER_TIME 3 -USER_RTC_TIME

		4 -RTC_TIME 5 -RTC_TIME_ACCURATE 6 -APPROX_TIME 7 -POSITION_TIME 8 -EPHEMERIS_TIME
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$PSTMGETRTCTIME
```

2.1.29 $PSTMDATUMSELECT

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

Synopsis:

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

Arguments:

Table 2-22: $ PSTMDATUMSELECT parameter

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

Results:

If success the following message is sent:

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

In case of error the following message will be sent:

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

Example:

```
$PSTMSELETDATUM,1
```

2.1.30 $PSTMDATUMSETPARAM

Set parameters to local geodetic to WGS84 datum transformations.

Synopsis:

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

Arguments:

Table 2-23: $ PSTMDATUMSETPARAM parameter

Parameter	Format	Description
d_x d_y d_z	Decimal	shifts between centers of the local geodetic datum andWGS84 Ellipsoid
d_a	Decimal	differences between the semi-major axis of the local geodetic datum ellipsoid and the WGS 84 ellipsoid, respectively (WGS 84 minus Local)
d_f	Decimal	differences between flattening of the local geodetic datum ellipsoid and the WGS 84 ellipsoid, respectively (WGS 84 minus Local)

Results:

If success the following message is sent:

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

In case of error the following message will be sent:

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

Example:

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

2.1.31 $PSTMENABLEPOSITIONHOLD

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

Synopsis:

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

Arguments:

Table 2-24: $ PSTMENABLEPOSITIONHOLD parameter

Parameter	Format	Description
on_off	%d	Set the position hold enable/disable status: 0: disabled. 1: enabled.
Lat	DDMM.MMMMM	Latitude (Degree-Minute.Minute decimals)
LatRef	“N” or “S”	Latitude direction (North or South)
Lon	DDDMM.MMMMM	Longitude (Degree-Minute.Minute decimals)
LonRef	“E” or “W”	Longitude Direction (East or West)
Alt8	dddddd.dddd	Altitude in meters (-1500 to 100000)

Results:

If success the following message is sent:
If on_off = 1

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

If on_off = 0

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

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

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

Example:

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

2.1.32 $PSTMSETCONSTMASK

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

Synopsis:

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

Arguments:

Table 2-25: $ PSTMSETCONSTMASK parameter

Parameter	Format	Description
constellation_mask	%d	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

Results:

If success the following message is sent:

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

In case of error the following message will be sent:

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

Examples:

Enabling GPS only:

```
$PSTMSETCONSTMASK,1
```

Enabling GLONASS only:

```
$PSTMSETCONSTMASK,2
```

Enabling GPS and GLONASS:

```
$PSTMSETCONSTMASK,3
```

2.1.33 $PSTMNOTCH

Set the NOTCH filter operating mode.

Synopsis:

```
$PSTMNOTCH,<Sat_type>,<Mode><cr><lf>
```

Arguments:

Table 2-26: $ PSTMNOTCH parameter

Parameter	Format	Description
Sat_type	Decimal, 1 digits	Sat type ANF path [0 -> GPS; 1->GLONASS]
Mode	Decimal, 1 digits	ANF operation mode

Results:

This command set the NOTCH filter operating mode in three different ways.

Example:

```
$PSTMNOTCH,0,1 [GPS path, always ON mode]
$PSTMNOTCH,0,2 [GPS path, auto insertion mode]
$PSTMNOTCH,0,0 [GPS path, ANF disabled]
$PSTMNOTCH,1,1 [GLONASS path, always ON mode]
$PSTMNOTCH,1,2 [GLONASS path, auto insertion mode]
$PSTMNOTCH,1,0 [GLONASS path, ANF disabled]
```

2.1.34 $PSTMSQISET

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

Synopsis:

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

Arguments:

Table 2-27: $ PSTMSQISET parameter

Parameter	Format	Description
offset	HexDecimal, 4 digits	Offset from the base address of the chosen sector
word1	HHHHHHHH Hexadecimal, 8 digits	32 bits-wide word
word8	HHHHHHHH Hexadecimal, 8 digits	32 bits-wide word
dest_addr	HexDecimal, 4 digits	Destination Address in which the data bytes are stored; it is composed by:*sector base address + offset*
checksum	cc -Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Results:

If success the following message is sent

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

In case of error the following message will be sent

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

Example:

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

2.1.35 $PSTMSQIGET

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

Synopsis:

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

Arguments:

Table 2-28: $ PSTMSQIGET parameter

Parameter	Format	Description
offset	HexDecimal, 4 digits	Offset from the base address of the chosen sector
word1	HHHHHHHH Hexadecimal, 8 digits	32 bits-wide word
word8	HHHHHHHH Hexadecimal, 8 digits	32 bits-wide word
dest_addr	HexDecimal, 4 digits	Destination Address in which the data bytes are stored; it is composed by: *sector base address* + *offset*
checksum	cc -Hexadecimal, 2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Results:

if success the following message is sent

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

in case of error the following message will be sent

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

Example:

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

2.1.36 $PSTMSIERASE

This NMEA command erases the specified sector (64kbytes wide) of the SQI Data Storage Area.

Synopsis:

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

Arguments:

None.

Results:

if success the following message is sent

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

in case of error the following message will be sent

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

Example:

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

```
$PSTMSQIERASE
```

2.1.37 $PSTMPPS

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

Synopsis:

```
$PSTMPPS,<cmd_mode>,<cmd_type>,<par_1>,…,<par_N><cr><lf>
```

Arguments:

Table 2-29: $ PSTMPPS parameter

Parameter	Format	Description
cmd_mode	Decimal, 1 digit	Select the command operation mode: 1 = GET operation (to get data from PPS manager) 2 = SET operation (to set data into PPS manager)
cmd_type	Decimal, 1 digit	1 = PPS_IF_ON_OFF_CMD 2= PPS_IF_OUT_MODE_CMD 3 = PPS_IF_REFERENCE_CONSTELLATION_CMD 4 = PPS_IF_PULSE_DELAY_CMD 5 = PPS_IF_PULSE_DURATION_CMD 6 = PPS_IF_PULSE_POLARITY_CMD 7 = PPS_IF_PULSE_DATA_CMD 8 = PPS_IF_FIX_CONDITION_CMD 9 = PPS_IF_SAT_TRHESHOLD_CMD 10 = PPS_IF_ELEVATION_MASK_CMD 11 = PPS_IF_COSTELLATION_MASK_CMD 12 = PPS_IF_TIMING_DATA_CMD 13 = PPS_IF_POSITION_HOLD_DATA_CMD 14 = PPS_IF_AUTO_HOLD_SAMPLES_CMD 15 = PPS_IF_TRAIM_CMD 16 = PPS_IF_TRAIM_USED_CMD 17 = PPS_IF_TRAIM_RES_CMD 18 = PPS_IF_TRAIM_REMOVED_CMD

		19 = PPS_IF_REFERENCE_TIME_CMD 20 = PPS_IF_CONSTELLATION_RF_DELAY_CMD
par_1 … par_N		Parameters list according to the command type specification (see below).

2.1.37.1 Getting PPS Data (cmd_mode = 1)

(1). **PPS_IF_PULSE_DATA_CMD**

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

Replay:

```
$PSTMPPS,1,7,<out_mode>,<reference_time>,<pulse_delay>,<pulse_durati
on>,<pulse_polarity><cr><lf>
```

Table 2-30: ***PPS_IF_PULSE_DATA_CMD replay*** parameter

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated. 1 = PPS generated on even seconds. 2 = PPS generated on odd seconds.
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = not inverted. 1 = inverted.

(2). **PPS_IF_TIMING_DATA_CMD**

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

Replay:

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

Table 2-31: ***PPS_IF_TIMING_DATA_CMD*** replay parameter

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

(3). **PPS_IF_POSITION_HOLD_DATA_CMD**

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

Table 2-32: ***PPS_IF_POSITION_HOLD_DATA_CMD*** parameter

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

Replay:

```
$PSTMPPS,1,13<cr><lf>
```

(4). **PPS_IF_TRAIM_CMD**

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

Replay:

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

Table 2-33: ***PPS_IF_TRAIM_CMD*** Replay parameter

Parameter	Format	Description
traim_enabled	Decimal, 1 digit	TRAIM ON/OFF status 0 = OFF 1 = ON
traim_solution	Decimal, 1 digit	TRAIM Algorithm status: 0 = UNDER Alarm 1 = OVER Alarm 2 = UNKNOWN
ave_error	Decimal	Average time error [ns]
used_sats	Decimal	Number of satellite used for timing correction.
removed_sats	Decimal	Number of satellites removed by the timing correction.

(5). **PPS_IF_TRAIM_USED_CMD**

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

Replay:

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

Table 2-34: ***PPS_IF_TRAIM_USED_CMD*** Replay parameter

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

(6). **PPS_IF_TRAIM_RES_CMD**

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

Replay:

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

Table 2-35: ***PPS_IF_TRAIM_RES_CMD*** Replay parameter

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

(7). **PPS_IF_TRAIM_REMOVED_CMD**

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

Replay:

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

Table 2-36: ***PPS_IF_TRAIM_REMOVED_CMD*** Replay parameter

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

2.1.37.2 Setting PPS Data (cmd_mode = 2)

(1). **PPS_IF_ON_OFF_CMD**

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

Table 2-37: ***PPS_IF_ON_OFF_CMD*** parameter

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

(2). **PPS_IF_OUT_MODE_CMD**

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

Table 2-38: ***PPS_IF_OUT_MODE_CMD*** parameter

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

(3). **PPS_IF_REFERENCE_TIME_CMD**

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

Table 2-39: ***PPS_IF_REFERENCE_TIME_CMD*** parameter

Parameter	Format	Description
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC. 2 = GLONASS_UTC. 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS

(4). **PPS_IF_PULSE_DELAY_CMD**

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

Table 2-40: ***PPS_IF_PULSE_DELAY_CMD*** parameter

Parameter	Format	Description
pulse_delay	Decimal	Pulse delay [ns]

(5). **PPS_IF_CONSTELLATION_RF_DELAY_CMD**

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

Table 2-41: ***PPS_IF_CONSTELLATION_RF_DELAY_CMD*** parameter

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

(6). **PPS_IF_PULSE_DURATION_CMD**

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

Table 2-42: ***PPS_IF_PULSE_DURATION_CMD*** parameter

Parameter	Format	Description
pulse_duration	Double	Pulse duration [s]

(7). **PPS_IF_PULSE_POLARITY_CMD**

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

Table 2-43: ***PPS_IF_PULSE_POLARITY_CMD*** parameter

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

(8). **PPS_IF_PULSE_DATA_CMD**

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

Table 2-44: ***PPS_IF_PULSE_DATA_CMD*** parameter

Parameter	Format	Description
out_mode	Decimal, 1 digit	0 = PPS always generated. 1 = PPS generated on even seconds. 2 = PPS generated on odd seconds.
reference_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC 2 = GLONASS_UTC
pulse_delay	Decimal	Pulse delay [ns]
pulse_duration	Double	Pulse duration [s]
pulse_polarity	Decimal, 1 digit	0 = not inverted. 1 = inverted.

(9). **PPS_IF_FIX_CONDITION_CMD**

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

Table 2-45: ***PPS_IF_FIX_CONDITION_CMD*** parameter

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

(10). **PPS_IF_SAT_TRHESHOLD_CMD**

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

Table 2-46: ***PPS_IF_SAT_TRHESHOLD_CMD*** parameter

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

(11). **PPS_IF_ELEVATION_MASK_CMD**

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

Table 2-47: ***PPS_IF_ELEVATION_MASK_CMD*** parameter

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

(12). **PPS_IF_COSTELLATION_MASK_CMD**

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

Table 2-48: ***PPS_IF_COSTELLATION_MASK_CMD*** parameter

Parameter	Format	Description

constellation_mask[1]	Decimal (bit mask)	Satellite constellation selection for usage in timing filtering. bit0 = GPS bit1 = GLONASS

Note:

1. ***This parameter enables the usage of mixed constellations satellites in the timing filtering. If bit0 is enabled GPS satellites are used to correct the GLONASS reference time together with GLONASS satellites. If bit1 is enabled, GLONASS satellites are used to correct the GPS reference time together with the GPS satellites. When constellation mask is zero (default) only GPS sats are used to correct the GPS reference time and only GLONASS sats are used to correct the GLONASS reference time.***

(13). **PPS_IF_TIMING_DATA_CMD**

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

Table 2-49: ***PPS_IF_TIMING_DATA_CMD*** parameter

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

(14). **PPS_IF_POSITION_HOLD_DATA_CMD**

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

Table 2-50: ***PPS_IF_POSITION_HOLD_DATA_CMD*** parameter

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

(15). **PPS_IF_AUTO_HOLD_SAMPLES_CMD**

$PSTMPPS,2,14,<auto_ph_samples><cr><lf>

Table 2-51: ***PPS_IF_AUTO_HOLD_SAMPLES_CMD*** parameter

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

(16). **PPS_IF_TRAIM_CMD**

$PSTMPPS,2,15,<on_off>,<alarm><cr><lf>

Table 2-52: ***PPS_IF_TRAIM_CMD*** parameter

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

Results:

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

2.1.38 NMEA System Configuration Commands

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

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

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

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

NVM stored configuration: it is available in the NVM backup memory as soon as the $PSTMSAVEPAR

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

Note:

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

2.1.38.1 $PSTMSETPAR

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

Synopsis:

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

Arguments:

Table 2-53: $PSTMSETPAR parameter

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

Results:

The parameter indicated by the ID value is set according to the parameters included in param_value. In case of

no errors, the following message is returned.

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

In case of errors, the error message is returned.

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

Where:

Table 2-54: $PSTMSETPAR Results parameter

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

Example:

Issuing the command:

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

You could have this answer:

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

Note:

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

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

3. 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.

2.1.38.2 $PSTMGETPAR

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

Synopsis:

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

Arguments:

Table 2-55: $PSTMGETPAR parameter

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

Results:

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

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

In case of errors, the error message is returned

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

Where:

Table 2-56: $PSTMGETPAR Results parameter

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

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

Example:

Issuing the command:

```
$PSTMGETPAR,1403*
```

You could have this answer:

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

Note:

There is no comma and no space between ConfigBlock and ID parameters. In case of no errors the answer is deliberately $PSTMSET and not $PSTMGET. if the parameter ID is "000" all the configuration block is

printed out using one message for each parameter. The message syntax is the same as reported above.

2.1.38.3 $PSTMSAVEPAR

Save current configuration data block into the backup memory.

Synopsis:

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

Arguments:

None.

Results:

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

Note:

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

Example:

```
$PSTMSAVEPAR
```

2.1.38.4 $PSTMRESTOREPAR

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

Synopsis:

```
$PSTMRESTOREPAR<cr><lf>
```

Arguments:

None.

Results:

The factory setting parameters will be restored and the configuration block in the backup memory will be lost. A system reboot is needed to complete the factory reset restoring ad to get system working with default setting.

Example:

```
$PSTMRESTOREPAR
```

2.2 Messages output

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

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

There are two basic sets of messages implemented.

2.2.1 Standard NMEA Messages

Standard NMEA Messages are defined in the “NMEA 0183” Standard, issued from the “National Marine Electronics Association”. The latest issue is Rev. 3.1 dated January 2002.

NMEA0183 refers to it as Sentences (single line message) and Messages (multiple line messages).

To get an overview on the standard NMEA messages supported by ST´s GPS Systems

please refer to 7.1 “Standard NMEA Messages” in this document.Standard NMEA messages start the “message-ID” with:

```
$<Talker ID>
```

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

Standard NMEA messages list below:

Table 2-57: Standard NMEA messages list

Syntax	Default	Description
$GPGGA	OFF	NMEA: Global Position System Fix Data
$GPGGA5	ON	NMEA: Global Position System Fix Data (as before) with 5 digits instead of 3 in the latitude and longitude fractional parts.
$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: Recom. Min. Spec. GPS/TRANSIT Data
$GPVTG	OFF	NMEA: Track made good and ground speed
$GPZDA	OFF	NMEA: Time and Date

2.2.1.1 $GPGGA

Global Positioning System Fixed data NMEA message list bitmask: 0x1

Format:

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

Table 2-58: $GPGGA Parameter

Parameter	Format	Description
Timestamp	Hhmmss	UTC Time of GPS Sample, example: 160836
Lat	DDMM.MMM	Lat in Degree-Minutes.partsMinutes: 4208.536
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMM	Long in Degree-Minutes.partsMinutes: 1105.345
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 view: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 5 digits	Height above WGS84 Elipsoid, max: 999.99
Alt-Val	“M”	Height measure in “M” = meters
GEOSep		
GEOVal		
DGPSAge		
DGPSRef		
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

$GPGGA,183417.366,4814.03970,N,1128.52205,E,0,00,99.0,495.53,M,47.6,M,,*53

2.2.1.2 $GPGGA5

Global Positioning System Fixed data (5 digits for latitude and longitude fractional parts)NMEA message list bitmask: 0x2

Format:

```
$GPGGA5,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,<HDOP>,
<Alt>,<AltVal>,<GEOSep>,<GEOVal>,<DGPSAge>,<DGPSRef>,
<checksum><cr><lf>
```

Table 2-59: $GPGSA5 Parameter

Parameter	Format	Description
Timestamp	Hhmmss	UTC Time of GPS Sample, example: 160836
Lat	DDMM.MMMMM	Lat in Degree-Minutes.partsMinutes: 4208.53683
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in Degree-Minutes.partsMinutes: 1105.34567
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 view: example: 8
HDOP	Decimal, 3 digits	Horizontal Dilution of Precision, max: 99.0
Alt	Decimal, 6 digits	Height above WGS84 Elipsoid, max: 100000m
Alt-Val	“M”	Height measure in “M” = meters
GEOSep		
GEOVal		
DGPSAge		
DGPSRef		
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPGGA5,183417.366,04814.03970,N,01128.52205,E,0,00,99.0,495.53,M,47.6,M,,*53
```

6.4.3 $GPGLL

Geographic Positioning Latitude / Longitude NMEA message list bitmask: 0x100000

Format:

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

Table 2-60: $GPGLL Parameter

Parameter	Format	Description
Lat	DDMM.MMMM	Latitude in Degree-Minutes.partsMinutes: 4208.5368
N/S	“N” or “S”	Latitude Direction: North or South
Long	DDMM.MMMM	Longitude in Degree-Minutes.partsMinutes: 1105.3456
E/W	“E” or “W”	Longitude Direction: East or West
Timestamp	hhmmss	UTC Time of GGL Sample, example: 160836
Status	“A”	Validity of Data: “A” = valid, “V” = invalid
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

2.2.1.3 $--GSA

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

“GP” if only GPS constellation is enabled. “GL” if only GLONASS constellation is enabled. “GN” if both GPS and GLONASS constellation are enabled. This talker ID is used even if

it is forced to be used in the configuration block (see Application ON/OFF parameter Bit 20). Satellites from different constellations are sent on separate messages. NMEA message list bitmask: 0x4.

Format:

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

Table 2-61: $--GSA Parameter

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

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

Example:

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

2.2.1.4 $--GSV

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

“GP” is used only for GPS satellites. A set of $GPGSV messages is sent to report all GPS satellites.

“GL” is used only for GLONASS satellites. A set of $GLGSV messages is sent to report all GLONASS satellites.

“QZ” is used only for QZSS satellites. A set of $QZGSV messages is sent to report all QZSS satellites.

GN” if enabled in the configuration block (see Application ON/OFF parameter Bit 21) to report all satellites for all enabled constellation. A single set of $GNGSV messages is sent to report all satellites.

NMEA message list bitmask: 0x80000

Format:

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

N max 4

Table 2-62: $--GSV Parameter

Parameter	Format	Description
GSVAmount	Decimal, 1 digit	Total amount of GSV messages, max. 3
GSVNumber	Decimal, 1 digit	Continued GSV number of this message
TotSats	Decimal, 2 digits	Total Number of Satellites in view, max. 12
SatxPRN	Decimal, 2 digits	PRN Number of satellite x
SatxElev	Decimal, 2 digits	Elevation of satellite x in Degree, 0 … 90
SatxAzim	Decimal, 3 digits	Azimuth of satellite x in degree, ref. “North”, 000 … 359
SatxC/N0	Decimal, 2 digits	Carrier to Noise Ratio for satellite x in dB, 00 … 99
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

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

Note:

Due to the fact that up to 12 Satellites may be in view, this message can be repeated up to 3 times containing 4 different Satellites per message. GSVAmount reports the total number of GSV messages to be transmitted, while GSVNumber reports the actual number of the current message frame.

2.2.1.5 $GPRMC

Recommended Minimum Specific GPS/Transit data NMEA message list bitmask: 0x40

Format:

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

Table 2-63: $GPRMC Parameter

Parameter	Format	Description
Timestamp	hhmmss	UTC Time of RMC Sample, example: 160836
Status	“A” or “V”	Receiver warning: “A” = valid, “V” = Warning

Lat	DDMM.MMMM	Latitude in Degree-Minutes.partsMinutes: 4208.5368
N/S	“N” or “S”	Latitude Direction: North or South
Long	DDMM.MMMM	Longitude in Degree-Minutes.partsMinutes: 1105.3456
E/W	“E” or “W”	Longitude Direction: East or West
Speed	ddd.d	Speed over ground in knots
Trackgood	Decimal, 4 digits	Course made good, max. 999.9
Date	Decimal, 6 digits	Date of Fix : ddmmyyyy
MagVar	Decimal, 4 digits	Magnetic Variation, max.: 090.0
MagVarDir	“E” , “W”	Magnetic Variation Direction
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters.

Example:

```
$GPRMC,183417.366,V,4814.040,N,01128.522,E,0.0,0.0,170907,0.0,W*6C
```

2.2.1.6 $GPVTG

Recommended Minimum Specific GPS/Transit data NMEA message list bitmask: 0x10

Format:

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

Table 2-64: $GPVTG Parameter

Parameter	Format	Description
TMGT	ddd.d in degrees	Track in reference to “true” earth poles
T		Indicates “terrestrian”
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 “kilometers”
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

2.2.2 Proprietary NMEA Messages

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

Proprietary Messages from STMicroelectronics start with:

$PSTM…

ST NMEA messages list below:

Table 2-65: ST NMEA messages list

Syntax	Default	Description
$PSTMDIFF	OFF	ST: Differential Correction Data
$PSTMPRES	OFF	ST: Position Residuals
$PSTMVRES	OFF	ST: Velocity Residuals
$PSTMPA	OFF	ST: Position Algorithm
$PSTMRF	OFF	ST: Radio Frequency
$PSTMSAT	OFF	ST: Satellite Information
$PSTMSBAS	ON	ST: Augmentation System
$PSTMSBASCORR	OFF	ST: Satellite Correction Data
$PSTMTIM	OFF	ST: System Time
$PSTMTG	OFF	ST: Time and Number of used Satellites
$PSTMTS	OFF	ST: Tracked Satellite Data
$PSTMKFCOV	OFF	ST: Standard Deviation and Covariance
$PSTMAGPS	OFF	ST: STAGPS predicted ephemeris information
$PSTMNOTCHSTATUS	OFF	ST: Reports the Notch filter status.
$PSTMCPU	ON	ST: Reports the CPU usage and CPU speed setting.

$PSTMPOSNHOLD	OFF	ST: Reports the status and position of Position Hold.
$PSTMPPSDATA	OFF	ST: Reports the Pulse Per Second data.
$PSTMTRAIMSTATUS	OFF	ST: Reports the TRAIM status data.
$PSTMTRAIMUSED	OFF	ST: Reports the satellites used for timing correction.
$PSTMTRAIMRES	OFF	ST: Reports the residuals for used satellites.
$PSTMTRAIMREMOVED	OFF	ST: Reports the satellites removed by timing correction algorithm.

2.2.2.1 $PSTMRF

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

NMEA message list bitmask: 0x80

Format:

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

N max 3

Table 2-66: $PSTMRF Parameter

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

Example:

2.2.2.2 $PSTMTESTRF

Specific message containing information on just one satellite for RF testing purposes.NMEA message list bitmask: 0x40000

Format:

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

Table 2-67: $PSTMTESTRF Parameter

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

2.2.2.3 $PSTMTG

Time and Satellites Information NMEA message list bitmask: 0x100

Format:

$PSTMTG,<Week>,<TOW>,<Tot-Sat>,<CPU-Time><Timevalid><cr><lf>

Table 2-68: $PSTMTG Parameter

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

2.2.2.4 $PSTMTS

This message is repeated for each satellite tracked and used for the calculation of a fix NMEA message list bitmask: 0x200

Format:

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

Table 2-69: $PSTMTS Parameter

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 ued for prediction (1 or 2)
predtd	Decimal, 1 digit	Time distance of Ephemeris calculated from 2 Sats. Only valid if <pred-eph> = 2

Note:

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

Example:

```
$PSTMTS,1,05,15748178.41,30992.22,1,44,306150,1,16278399.26,20504574
.30,4653136.69,38.03,703.04,-3046.01,141169.29,11.45,1,-12.75,0.00,
$PSTMTS,1,31,14242886.83,-28462.15,1,37,304775,1,20641723.13,
-8713847.54,14517949.66,1788.86,311.39,-2382.23,1804.01,7.09,1,
-5.74,0.00,
$PSTMTS,1,21,14885540.17,-25018.74,1,50,301653,1,25482227.75,
6629457.30,5528104.33,-699.61,220.74,2983.68,23248.85,8.12,1,
```

```
-2.84,0.00,
$PSTMTS,1,07,13337296.04,-27966.11,1,31,296621,1,15777659.46,
4155044.35,21301094.71,-1287.52,2301.27,509.20,-15394.31,5.65,1,
-3.83,0.00,
$PSTMTS,1,06,1216319.39,-28367.75,0,23,40492,1,14595868.85,
6511991.60,21397698.91,-1394.03,2294.91,251.81,70766.81,5.72,1,
-3.28,0.00,
$PSTMTS,1,24,13629659.89,-27176.62,1,40,298187,1,17698708.17,
12886703.95,15024752.78,-1901.12,-1.00,2298.33,11530.25,6.39,1,
-9.27,0.00,
$PSTMTS,1,30,14421546.48,-30401.97,1,44,298264,1,17539544.73,
16864817.03,10440026.12,394.97,1346.12,-2741.16,14708.79,7.87,1,
-9.96,0.00,
$PSTMTS,1,16,16177492.44,-24593.30,1,40,298572,1,6202032.13,
-17659074.51,18852818.90,1139.40,2098.88,1613.11,35896.88,12.03,1,
-4.54,0.00,
$PSTMTS,1,10,16728325.63,-26663.46,1,30,124750,1,-2057875.88,
21248945.17,15476302.66,-1018.51,-1731.48,2256.47,
-32564.02,15.33,1,-12.86,0.00,
$PSTMTS,1,12,17539958.05,-31018.23,1,35,10528,1,11788804.59,
23841922.01,245355.77,-236.27,137.48,-3173.58,-103404.01,20.66,1,
-19.21,0.00,
$PSTMTS,1,23,17770191.78,-27801.14,1,28,196026,1,-6131001.55,
-15740405.01,20363733.86,1549.10,-2097.11,-1173.09,89981.45,
27.98,0,0.00,0.00,
```

2.2.2.5 $PSTMPA

Position Algorithm NMEA message list bitmask: 0x400

Format:

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

Table 2-70: $PSTMPA Parameter

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

Example:

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

2.2.2.6 $PSTMSAT

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

NMEA message list bitmask: 0x800

Format:

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

Table 2-71: $PSTMSAT Parameter

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

Example:

2.2.2.7 $PSTMPRES

Position Residual

NMEA message list bitmask: 0x1000 ($PSTMPRES and $PSTMVRES are always enabled together)

Format:

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

N = number of tracked satellites

Table 2-72: $PSTMPRES Parameter

Parameter	Format	Description
RMSpos	dd.d Decimal, 3 digits	position “rms” residual for the fix

resx	dd.d Decimal, 3 digits	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)
.	Fixed Character	Delimiter of datafield
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

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

2.2.2.8 $PSTMVRES

Position Residual

NMEA message list bitmask: 0x1000 ($PSTMPRES and $PSTMVRES are always enabled together)

Format:

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

N = number of tracked satellites

Table 2-73: $PSTMVRES Parameter

Parameter	Format	Description
RMSvel	dd.d Decimal, 3 digits	velocity “rms” residual for the fix
vresx	dd.d Decimal, 3 digits	Residual of tracked satellite x (Corresponds to x satellite in $GPGSA Message)
.	Fixed Character	Delimiter of datafield
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

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

2.2.2.9 $PSTMCPU

This message contains the real time CPU usage and the CPU speed setting.NMEA message list bitmask: 0x800000

Format:

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

Table 2-74: $PSTMCPU Parameter

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.

2.2.2.10 $PSTMPPSDATA

Reports the Pulse Per Second data NMEA message list bitmask: 0x200000

Format:

```
$PSTMPPSDATA,<on_off>,<pps_valid>,<synch_valid>,<out_mode>,<ref_time
>,<ref_constellation>,<pulse_duration>,<pulse_delay>,<gps_delay>,<gl
o_delay>,<inverted_polarity>,<fix_cond>,<sat_th>,<elev_mask>,<const_
mask>,<ref_sec>,<fix_status>,<used_sats>,<gps_utc_delta_s>,<gps_utc_
delta_ns>,<glonass_utc_delta_ns>,<quantization_error>,<pps_clock_fre
q>,<tcxo_clock_freq>*<checksum><cr><lf>
```

Table 2-75: $PSTMPPSDATA Parameter

Parameter	Format	Description
on_off	Decimal, 1 digit	PPS signal ON/OFF status 0: OFF 1: ON
pps_valid	Decimal, 1 digit	Global PPS validity flag 0: PPS not valid 1: PPS valid
synch_valid	Decimal, 1 digit	PPS synchronization validity 0: Not Valid 1: Valid
out_mode	Decimal, 1 digit	0 = PPS_OUT_MODE_ALWAYS 1 = PPS_OUT_MODE_ON_EVEN_SECONDS 2 = PPS_OUT_MODE_ON_ODD_SECONDS

ref_time	Decimal, 1 digit	0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS
ref_constellation	Decimal, 1 digit	0 = GPS 1 = GLONASS ***Note: the reference constellation reports which reference time has been used for the PPS generation.***
pulse_duration	Double	Pulse duration [s]
pulse_delay	Decimal	Pulse delay [ns]
gps_delay	Decimal	GPS path RF delay [ns]
glonass_delay	Decimal	GLONASS path RF delay [ns]
inverted_polarity	Decimal, 1 digit	Pulse polarity invertion: 0 = not inverted 1 = inverted
fix_cond	Decimal, 1 digit	Selected GNSS fix condition for PPS signal generation: 1 = NO_FIX 2 = 2D_FIX 3 = 3D_FIX
sat_th	Decimal	Selected minimum number of satellites for PPS signal generation.
elev_mask	Decimal	Selected minimum satellite elevation for time correction.
const_mask	Decimal	Selected constellations for time correction.
ref_sec	Decimal, 2 digits	Second at which the reported PPS data is applied. According to the reference time configuration it could be a UTC or a GPS or a GLONASS time second.
fix_status	Decimal, 1 digit	GNSS position fix status when the time has been corrected.
used_sats	Decimal	Used satellites for time correction.
gps_utc_delta_s	Decimal	UTC leap seconds [s]
gps_utc_delta_ns	Decimal	UTC – GPS delta time [ns]
glonass_utc_delta_ns	Decimal	UTC – GLONASS delta time [ns]
quantization_error	Double (scientific notation format)	Quantization error [s].

pps_clock_freq	Double, 2 fractional digits	PPS clock frequency [Hz]
tcxo_clock_freq	Double, 2 fractional digits	TCXO clock frequency [Hz]

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.

2.2.2.11 $PSTMPOSHOLD

Reports the Position Hold status and position.NMEA message list bitmask: 0x4000000

Format:

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

Table 2-76: $PSTMPOSHOLD Parameter

Parameter	Format	Description
On_off	Decimal, 1 digit	Position Hold enabling/disabling status 0: disabled 1: enabled
Lat	DDMM.MMMMM	Lat in Degree-Minutes.partsMinutes: 4208.53683
N/S	“N” or “S”	Lat Direction: North or South
Long	DDMM.MMMMM	Long in Degree-Minutes.partsMinutes: 1105.34567
E/W	“E” or “W”	Long Direction: East or West
Alt	Decimal, 8 digits	Height above WGS84 Elipsoid, max: 100000

2.2.2.12 $PSTMTRAIMSTATUS

Reports the TRAIM algorithm status.

NMEA message list bitmask: 0x2000000 – all TRAIM related messages are enabled/disabled all together by the same mask.

Format:

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

Table 2-77: $PSTMTRAIMSTATUS Parameter

Parameter	Format	Description
on_off	Decimal, 1 digit	TRAIM ON/OFF status 0: OFF 1: ON
traim_solution	Decimal, 1 digit	TRAIM algorithm status: 0 = UNDER Alarm 1 = OVER Alarm 2 = UNKNOWN
alarm	Decimal	Time error threshold [ns]
ave_error	Decimal	Average time error [ns]
used_sats	Decimal	Number of used satellites.
removed_sats	Decimal	Number of removed satellites.
ref_second	Decimal	Second at which the PPS signal is generated based on reported TRAIM status.

2.2.2.13 $PSTMTRAIMUSED

Reports the satellite used for timing correction.

NMEA message list bitmask: 0x2000000 – all TRAIM related messages are enabled/disabled all together by the same mask.

Format:

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

Table 2-78: $PSTMTRAIMUSED Parameter

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.

2.2.2.14 $PSTMTRAIMRES

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

NMEA message list bitmask: 0x2000000 – all TRAIM related messages are enabled/disabled all together by the same mask.

Format:

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

Table 2-79: $PSTMTRAIMRES Parameter

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

2.2.2.15 $PSTMTRAIMREMOVED

Reports the satellite removed by the timing correction algorithm.

NMEA message list bitmask: 0x2000000 – all TRAIM related messages are enabled/disabled all together by the same mask.

Format:

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

Table 2-80: $PSTMTRAIMREMOVED Parameter

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.

2.2.2.16 $PSTMKFCOV

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

NMEA message list bitmask: 0x8000000

Format:

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

Table 2-81: $PSTMKFCOV Parameter

Parameter	Format	Description
PosStd	ddd.d Decimal, 2 digit	Standard Deviation of Position in meters
PosNcov	ddd.d Decimal, 4 digit	Covariance (North/South) in m² (from Kalman Filter)
PosEcov	ddd.d Decimal, 4 digit	Covariance (East/West) in m² (from Kalman Filter)
PosVcov	ddd.d Decimal, 4 digit	Covariance (Vertical) in m² (from Kalman Filter)
VelStd	ddd.d Decimal, 2 digit	Standard Deviation of Velocity in meter/second
VelNcov	ddd.d Decimal, 4 digit	Covariance (North/South) in m²/s (from Kalman Filter)
VelEcov	ddd.d Decimal, 4 digit	Covariance (East/West) in m²/s (from Kalman Filter)
VelVcov	ddd.d Decimal, 4 digit	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
```

2.2.2.17 $PSTMAGPS

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

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

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

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

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

decoding a single sentence, to show on the screen satellite bars coloured with different colours according to each ephemeris prediction age. Of course, if STAGPS is not enabled, it will behave in the same way of NMEA GSA sentence.

NMEA message list bitmask: 0x10000000

Format:

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

Table 2-82: $PSTMAGPS Parameter

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

Example:

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

The example above should be read in the following way:

Satellites 5, 24, 30, 12 don”t have predicted ephemeris (they are reported as in the case of standard GSA message – basically all satellites reported with a number less or equal 32 have no predicted ephemeris).

Satellite 21 has a predicted ephemeris 2 days old. Satellite 7 has predicted ephemeris 3 days old. Satellite 16 has predicted ephemeris 1 day old.

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

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

2.2.2.18 $PSTMTIM

Time Validity NMEA message list bitmask: 0x2000

Format:

```
$PSTMTIM,<Tvalid><cr><lf>
```

Table 2-83: $PSTMTIM Parameter

Parameter	Format	Description
Tvalid	ASCII	"RTC" = time read from RTC "VALID" = time downloaded from satellite or corrected using position "INVALID" = time is not valid

Example:

2.2.2.19 $PSTMDIFF

Time Validity NMEA message list bitmask: 0x8000

Format:

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

N = number of tracked satellites

Table 2-84: $PSTMDIFF Parameter

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

Example:

2.2.2.20 $PSTMSBAS

SBAS Satellite Data NMEA message list bitmask: 0x20000

Format:

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

N = number of tracked satellites

Table 2-85: $PSTMSBAS Parameter

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
SatID	Decimal, 3 digits	SBAS Satellite ID
Elev	Decimal, 2 digits	SBAS Satellite Elevation (in degrees)
Azim	Decimal, 3 digits	SBAS Satellite Azimuth (in degrees)
Sig	Decimal, 2 digits	SBAS Satellite Signal Strength CN0 (in dB)
,	Fixed Character	Delimiter for data field
checksum	Hexadecimal,2 digits	Checksum of the message bytes without *<checksum><cr><lf> characters

Example:

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

2.2.2.21 $PSTMNOTCHSTATUS

Reports the Notch filter status.NMEA message list bitmask: 0x40000000

Format:

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

Table 2-86: $PSTMNOTCHSTATUS Parameter

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, 4 digits	Band Pass Filter power estimation (GPS path)
ovfs_gps	Decimal, 1 digits	Notch overflows flag (GPS path)
mode_gps	Decimal, 1 digits	ANF mode operation (GPS path) [1 → Always ON; 2 → Auto insertion mode; 0 → ANF disabled;]
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, 4 digits	Band Pass Filter power estimation (GLONASS path)
ovfs_gln	Decimal, 1 digits	Notch overflows flag (GLONASS path)
mode_gln	Decimal, 1 digits	ANF mode operation (GLONASS path) [1 → Always ON; 2 → Auto insertion mode; 0 → ANF disabled;]

Example:

```
$PSTMNOTCHSTATUS,3672980,0,1463,0,2,6474453,0,2469,0,2*5B
```

2.2.3 Commands answers messages specification

2.2.3.1 $PSTMALMANAC

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

Format:

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

Table 2-87: $PSTMALMANAC Parameter

Parameter	Format	Description
SatID	Decimal, 2 digits	Satellite Number (PRN)

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

Example:

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

2.2.3.2 $PSTMEPH

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

Format:

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

Table 2-88: $PSTMEPH Parameter

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

Example:

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

2.3 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 represent 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 STA8088 firmware.

The IDs not reported in the table should be considered as reserved and must be left untouched to avoid unexpected system behaviors.

Table 2-89: Configuration Data Block

ID	Parameter Name	Size Bytes	Allowed values	Default	Description
100	Debug Port Number	1	0 .. 2	0	Set debug port number
101	NMEA Port Number	1	0 .. 2	2	Set NMEA port number
102	NMEA Port Baudrate	1	0x0 = 300 baud 0x1 = 600 baud 0x2 = 1200 baud 0x3 = 2400 baud 0x4 = 4800 baud 0x5 = 9600 baud 0x6 = 14400 baud 0x7 = 19200 baud 0x8 = 38400 baud 0x9 = 57600 baud 0xA = 115200 baud 0xB = 230400 baud 0xC = 460800 baud 0xD = 921600 baud	0xA	Set NMEA Baudrate
103	GPS Debug Mode	1	0 = Debug Mode ON 1 = Debug Mode OFF	0	Debug Mode ON/OFF
104	GNSS Mask Angle	1	0 …. 45	0	Set the GNSS Mask Angle for low Satellite Elevation
105	GNSS Tracking Threshold [dB]	1	10..50	10	Set the satellites tracking threshold
120	Cold Start Type	1	0xF = clear Alamance, Ephemeris, Time &Position 0xE = clear Ephemeris,	0xE	Set the cold start type with selective data erase

			Time, Position		
121	NMEA GSV Rate	1	0 …. 255	1	Set Message Rate in seconds
124	NMEA and Debug Output Redirection	1	0x11 = NMEA and Debug over UART 0x21 = NMEA over USB and Debug over UART 0x12 = NMEA over UART and Debug over USB 0x44 = NMEA and Debug over SD card	0x11	Configure the output method for NMEA and Debug messages (over UART, USB or SD card)
125	Notch Filter Setting	1	0x0..0xF	0xC	Enable or disable the Notch Filter usage
126	HW CONFIG	1	0..1	1	Select the HW configuration: 0: SOC 1: SAL
127	NMEA Decimal Digits	1	First nibble: 0x1..0x8 Second nibble: 0x1..0x8	0x55	Allow setting the number of decimal digits for the position data in the NMEA messages.
128	Differential Source Type	1	0..3	0x3	Allow selecting the differential mode source type.
129	GLONASS Satellite ID Type	1	0..1	0x1	Allow setting the GLONASS satellite ID type used in the GSV and GSA messages. 0x0 – the satellite ID is based on frequency 0x1 – the satellite ID is based on slot number.
130	CPU clock speed	1	0x00, 0x10, 0x20, 0x30, 0x02	0x02	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.
135	SBAS Default PRN	1	120 … 138	124	Set the SBAS default PRN
138	RTCM Port Number	1	0 .. 2	0	Set the serial port number for the RTCM input.

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.
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) Message list output rate scaling factor referred to the fix rate.
190	NMEA Msg-List 0 output rate scaling factor.	1	1..255	1	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 Message list output rate scaling factor referred to the fix rate.

191	NMEA Msg-List 1 output rate scaling factor.	1	1..255	1	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 Message list output rate scaling factor referred to the fix rate.
192	NMEA Msg-List 2 output rate scaling factor.	1	1..255	1	Examples: 1 = message list is sent out at the selected fix-rate 2 = message list is sent out every 2 fixes N = message list is sent out every N fixes
193	USB Detect feature	1	0..1	0	Enable or disable the USB detect feature
194	USB Detect GPIO pin configuration	1	b0..b5 = GPIO pin number (from 0 to 63) b6..b7= GPIO Alternate Function configuration (00b or 01b or 10b or 11b)	0	Configure GPIO pin used for USB detect feature
195	USB Data Terminal Equipment feature	1	0..1	1	Enable or disable the USB Data Terminal Equipment feature
197	PPS Clock	1	16,32,48,64	32	Allow setting the PPS clock. For accurate timing application, 64 is mandatory.

200	Application ON/OFF	4	0x2 = GPS_2D_FIX_ENABLE 0x4 = SBAS_ENABLE 0x8 = SBAS_SAT_ON_GSV_MSG_ENABLE 0x10 = STAGPS_ENABLE 0x40 = NMEA_v301_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 =	0x9639644	Activates/Deactivates GNSS application features

			QZSS_USE_ENABLE 0x1000000 = PPS_ENABLE 0x2000000 = PPS_POLARITY_INV ERSION 0x4000000 = POSITION_HOLD_EN ABLE 0x8000000 = TIMING_TRAIM_ON_ OFF_SWITCH 0x10000000 = WAAS_AUTOSEARC H_ON_OFF_SWITCH		
201	NMEA Port Msg-List 0	4	0x0000.0000 to 0xFFFF.FFFF	0x884356	Set NMEA Message List 0
202	NCO Range max.	4	-132000 to 132000	0xFFFF6F78 (-37000)	Set NCO range max. value in Hz
203	NCO Range min.	4	-132000 to 132000	0xFFFF2158 (-57000)	Set NCO range min. value in Hz
204	NCO Center	4	-132000 to 132000	0xFFFF4868 (-47000)	Set NCO centre frequency Offset in Hz Set the time delay between the measurements (on UTC second) and the position data delivery.
205	Position Data Time Delay [ms]	4			
206	GPIO Port0 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port0
207	GPIO Port0 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port0
208	GPIO Port1 CFG0	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Config0 for GPIO Port1
209	GPIO Port1 CFG1	4	0x0000.0000 to 0xFFFF.FFFF	0x00000000	Config1 for GPIO Port1
210	NMEA Port Msg-List 1	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 1
211	NMEA Port Msg-List 2	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Set NMEA Message List 2
212	SBAS satellites	4	0x0000.0000 to 0xFFFF.FFFF	0xFFFFFFFF	Allow enabling/disabling satellites to be searched by

	enable mask				the autoserch procedure.
213	PPS operating mode setting 1	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation. (see details in the corresponding section)
214	PPS operating mode setting 2	4	-	0x0000000	Allow setting different operating modes for the PPS signal generation (see details in the corresponding section)
215	Position hold auto survey samples.	4	0x0000.0000 to 0xFFFF.FFFF	0x0	Sets the number of position samples to be captured before entering in the position hold mode. If it is set to 0, the auto survey is disabled.
301	PPS Pulse Duration	8	<= 1.0 seconds	0.5	PPS pulse width. It is the time distance (in seconds) from PPS rising edge and next PPS falling edge.
302	PPS Delay Correction	8	< 1.0 seconds	0.0	PPS time delay correction n seconds. It allows to compensate any delay introduced on PPS signal by RF chain.
303	GNSS Fix Rate	8	> 0.1 seconds	1.0	Set the GNSS fix rate period in seconds. ***Note: high fix rates may require a different setting (e.g. 208MHz) of the CPU speed.***
304	Position Hold Latitude [deg]	8	From -90.0 to 90.0	40.91747	Set the position hold latitude.
305	Position Hold Longitude [deg]	8	From -180.0 to 180.0	14.27586	Set the position hold longitude.
306	Position Hold Altitude [m]	8	From -1500 to 100000	88.43307	Set the position hold altitude.
307	GPS RF delay correction	8		0.0	Time delay compensation for the GPS RF path.

308	GLONASS RF delay correction	8		0.0	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.
400	2D DOPs Threshold	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set default DOP values for 2D fixes
401	3D DOPs Threshold	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set default DOP values for 3D fixes
402	2D DOPs Startup	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set startup DOP values for 2D fixes
403	3D DOPs Startup	4	P = 0..99,V = 0..99, H = 0..99,G=0..99	P=15,V=12, H=12,G=18	Set startup DOP values for 3D fixes
500	Text Message	72	ASCII Characters	Default Configuration	Define Text message to be sent at startup

2.3.1 CDB-ID 100 –Debug port setting

Allow setting the debug port number. A system reboot is needed to have new setting in use.

2.3.2 CDB-ID 101 –NMEA port setting

Allow setting the NMEA port number.A system reboot is needed to have new setting in use.

2.3.3 CDB-ID 102 –NMEA port baudrate setting

Allow setting the baudrate for the NMEA port number. The translation table is reported below.
Table 2-90: CDB-ID 102 translation table

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

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

2.3.4 CDB-ID 103 –Debug mode setting

Allow enabling/disabling the GNSS debug messages. For Confidential Use Only Rev 1.5 12/43 A system reboot is needed to have new setting in use.

2.3.5 CDB-ID 104 –Mask angle setting

Allow setting the minimum elevation angle at which a satellite can be tracked. Satellite with elevation below the mask angle cannot be tracked. A system reboot is needed to have new setting in use.

2.3.6 CDB-ID 105 –GNSS Tracking threshold

Allow setting the minimum CN0 [dB] at which a satellite can be tracked. Satellite with CN0below the configured threshold cannot be tracked. A GNSS engine reset (suspend/restart) is needed to have this setting in place..

2.3.7 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 2-91: CDB-ID 120

Bit	Bitmask	Description
0	0x1	Clear almanacs
1	0x2	Clear ephemeris
2	0x4	Clear position
3	0x8	Clear time

Any bitmask combination can be used, the default one is 0xE.This setting is in place as soon as the $PSTMSETPAR is performed.

2.3.8 CDB-ID 121 –NMEA GSV message rate

Allow setting the time period at which the GVS message is sent on the NMEA port. A GNSS engine reset (suspend/restart) is needed to have this setting in place.

2.3.9 CDB-ID 124 –NMEA and Debug Output Redirection

Allow setting the output channel for NMEA and Debug messages. Supported channels are UART, USB and SD card. UART is the default channel. If the SD card is selected for NMEA and Debug output but the SD card is not present in the slot, the system switch automatically to the UART mode. NMEA and Debug output cannot be redirected to USB together.

This parameter is made by two bit masks (4 bits each one):
Table 2-92: CDB-ID 124

Bit	Bitmask	Description
From B0 to B3	0x01=enable/disable UART output 0x02=enable/disable USB output 0x04=enable/disable SD output	Bit mask for Debug output configuration (only one bit can be enabled at same time in the bitmask)
From B4 to B7	0x10=enable/disable UART output 0x20=enable/disable USB output 0x40=enable/disable SD output	Bit mask for NMEA output configuration (only one bit can be enabled at same time in the bitmask)

Note:

If the USB is selected make sure that the PLL is enabled even if the CPU speed is set to 52MHz (see CDB-ID 130 for details on PLL enabling).

2.3.10 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 2-93: CDB-ID 125

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.

2.3.11 CDB-ID 126 –HW Config

Allow setting the HW configuration (SOC=0 or SAL=1). It is currently used for PPS signal configuration.

2.3.12 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 2-94: CDB-ID 127

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.

2.3.13 CDB-ID 128 –Differential Source Type

Allow selecting the differential mode source type.
Table 2-95: CDB-ID 128

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.

2.3.14 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 2-96: CDB-ID 129

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.

2.3.15 CDB-ID 130 –CPU clock speed

Allow setting the CPU clock speed. By default the GNSS software starts with CPU clock at 52MHz, it is then configured during the system startup phase according to the configuration parameters.

Table 2-97: CDB-ID 130

Bit	Values	Description
From B0 to B3	0 = PLL is ON and it is the clock source. 2 = PLL is OFF. The clock source is the input frequency (26MHz) multiplied by 2.	Allow setting the CPU clock source
From B4 to B7	If PLL is ON: 0 = 52MHz 1 = 104MHz 2= 156MHz 3 = 208MHz	Allow setting the CPU clock speed. If PLL is OFF the clock speed is set to 52MHz.

2.3.16 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).

2.3.17 CDB-ID 135 –SBAS default PRN

Allow setting the default PRN for the SBAS library. A system reboot is needed to have new setting in use.

2.3.18 CDB-ID 138 –RTCM port setting

Allow setting the RTCM port number.
A system reboot is needed to have new setting in use.

Note:

Pay attention to avoid conflicts with other serial ports used for debug and NMEA. The RTCM port can be shared with the debug data (debug data is only output and RTCM is only input) but not with the NMEA.

2.3.19 CDB-ID 139 –RTCM port baudrate setting

Allow setting the baudrate for the RTCM port number. The translation table is reported below.

Table 2-98: CDB-ID 139

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

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

2.3.20 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 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 value to be applied (according to the operation) to the address reported on 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 apply any configuration to the front-end registers. The default setting in the ST binary image is all addresses parameters set to 0xFF.

2.3.21 CDB-ID 190 –NMEA Message list 0 output rate scaling factor

Allow 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 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.

Note:

The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate features is not required.

2.3.22 CDB-ID 191 -NMEA Message list 1 output rate scaling factor.

Allow setting the message list output rate for the message list 1. It is a scaling factor referred to the selected fix rate. The default value is 1 and 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.

2.3.23 CDB-ID 192 -NMEA Message list 2 output rate scaling factor.

Allow 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 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.

2.3.24 CDB-ID 193 -USB Detect feature

Enable or disable the USB detect feature. When enabled the USB VCOM is open only if detect pin is high. Look at next CDB to see how to configure detect GPIO pin.

2.3.25 CDB-ID 194 -USB Detect GPIO pin configuration

Allow setting of USB detect GPIO pin.
Table 2-99: CDB-ID 194

Bit	Values	Description
From B0 to B5	From 0 to 63	GPIO pin number
From B6 to B7	0 = Default mode 1 = Alternate function mode A 2 = Alternate function mode B 3 = Alternate function mode C	GPIO pin alternate mode configuration

2.3.26 CDB-ID 195 -USB Data Terminal Equipment feature

Enable or disable the USB Data Terminal Equipment feature. When enabled, the data (NMEA or Debug depending on CDB-ID 124 configuration) are sent over USB VCOM only when DTE is present. This signal corresponds to RS-232 signal DTR. When this feature is enabled, the host must open the VCOM enabling DTR mode.

2.3.27 CDB-ID 197 –PPS Clock

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

2.3.28 CDB-ID 200 -Application ON/OFF

Allow enabling/disabling different features in the GNSS library.
For each bit: 0 means feature disabled; 1 means feature enabled.
Table 2-100: CDB-ID 200

Bit	Bitmask	Function
1	0x2	2D position fix (with large position shift algorithm)
2	0x4	SBAS (WAAS / EGNOS) augmentation system
3	0x8	Enabling SBAS satellite reporting in the GSV messages
4	0x10	STAGPS enable
6	0x40	NMEA v301 support enable
9	0x200	Send “configure text” in the “Header Message” at start up
10	0x400	Send standard ST NMEA Headers
11	0x800	RTCM enable
12	0x1000	FDE Algorithm

14	0x4000	Walking Mode Algorithm
15	0x8000	Stop Detection Algorithm
16	0x10000	GPS constellation enable
17	0x20000	GLONASS constellation enable
18	0x40000	QZSS constellation enable
19	0x80000	NMEA GNGSV enable
20	0x100000	NMEA GNGSA enable
21	0x200000	GLONAS usage for positioning enable
22	0x400000	GPS usage for positioning enable
23	0x800000	QZSS usage for positioning enable
24	0x1000000	PPS enabling
25	0x2000000	PPS polarity inversion
26	0x4000000	Position Hold enable
27	0x8000000	TRAIM algorithm enable
28	0x10000000	SBAS auto search algorithm enabled.

Note:

The Bit-Value indicates the bit position (starting from 0 as least significant bit), thus multiple choices are possible.

2.3.28.1 Bit 1 – 2D position fix algorithm

Enable/disable the 2D fix algorithm. When this bit is enabled large position shift for 2D fix position are allowed in cold start conditions. This feature is OFF by default.

2.3.28.2 Bit 2 – SBAS (WAAS / EGNOS) augmentation system

Enable/disable the SBAS engine. When this bit is enabled, the SBAS engine starts searching for SBAS satellites at system startup.

2.3.28.3 Bit 3 – 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.

2.3.28.4 Bit 4 – Enabling STAGPS functionality

Enable/disable the STAGPS functionality. During STAGPS processing a high CPU load is required, for best performances it is suggested to increase the CPU frequency when the STAGPS is enabled. The server based assisted GPS (PGPS) is included in the STAGPS software. It is enabled/disabled if the STAGPS functionality is enabled/disabled.

Note:

If the STAGPS feature is not required and it is disabled, it is strongly suggested to clear all the STAGPS data from the NVM memory. This can be done via NMEA sending the "$PSTMSTAGPSINVALIDATE,7" command. If the NVM was empty (e.g. the STAGPS has been never enabled or the NVM has been

completely erased before) the invalidate command is not required.

2.3.28.5 Bit 6 – Enabling the NMEA v3.01 support

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 fully compatibility with previous releases, the old NMEA format can be restored disabling this feature.

2.3.28.6 Bit 9 – Send Configured Text

Enable/disable sending the configured text on the NMEA port at startup.

2.3.28.7 Bit 10 –Send ST headers

Enable/disable sending the ST standard headers on the NMEA port at startup.

2.3.28.8 Bit 11 –RTCM enable

Enable/disable the RTCM data processing.

2.3.28.9 Bit 12 –FDE algorithm

Enable/disable the False Detection and Exclusion algorithm.

2.3.28.10 Bit 14 –Walking Mode algorithm

Enable/disable the Walking Mode algorithm.

2.3.28.11 Bit 15 –Stop Detection algorithm

Enable/disable the Stop Detection algorithm.

2.3.28.12 Bit 16 –GPS constellation

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.

Note:

When GPS and GLONASS constellation are enabled, the GSV messages are sent in two separate sets: one with “GP” as talker ID and one with “GL”.

2.3.28.13 Bit 17 –GLONASS constellation

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

Note:

When GPS and GLONASS constellation are enabled, the GSV messages are sent in two separate sets: one with “GP” as talker ID and one with “GL”.

2.3.28.14 Bit 18 –QZSS constellation

Enable/disable the QZSS constellation. When this bit is enabled QZSS satellites are enabled to be tracked and used for positioning.

Note:

Only "GN" is supported as talker ID for QZSS GSV and GSA messages.

2.3.28.15 Bit 19 –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.

Note:

In this case the GSV messages are sent in a single set reporting satellites for all enabled constellations.

2.3.28.16 Bit 20 –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.

Note:

In this case the GSA messages are sent in a single set reporting satellites for all enabled constellations.

2.3.28.17 Bit 21 –GLONASS usage

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.

2.3.28.18 Bit 22 –GPS usage

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.

2.3.28.19 Bit 23 –QZSS usage

Enable/disable 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.

2.3.28.20 Bit 24 –PPS enabling

Enable/disable the PPS generation on the PPS pin.

2.3.28.21 Bit 25 –PPS signal polarity inversion.

Enable/disable the PPS signal polarity inversion. If polarity inversion is disabled (Bit25 = 0) the PPS signal has the rising edge on the PPS event. If polarity inversion is enabled (Bit25 = 1) the PPS signal has a falling edge on the PPS event.

2.3.28.22 Bit 26 –Position Hold enabling

Enable/disable the Position Hold functionality (timing applications).

2.3.28.23 Bit 27 –TRAIM algorithm enabling

Enable/disable the TRAIM algorithm (timing applications).

2.3.28.24 Bit 28 –SBAS auto search algorithm enabling

Enable/disable the SBAS satellites auto search functionality.

2.3.29 CDB-ID 201 –NMEA Message List 0

Allow enabling/disabling each NMEA message in the message list 0.

For each bit: 0 means feature disabled; 1 means feature enabled.

Table 2-101: CDB-ID 201

Bit	Bitmask	Function
0	0x1	$GPGGA Message
1	0x2	$GPGGA Message
2	0x4	$GPGSA Message
3	0x8	Not used anymore
4	0x10	$GPVTG Message
5	0x20	Not used anymore
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	Not used
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	Not used
30	0x40000000	$PSTMNOTCHSTATUS
31	0x80000000	Not used

Note:

The message list 0 is the standard message list. Only the message list 0 should be used if the NMEA multiple rate features is not required.

2.3.30 CDB-ID 202 –NCO range max value

Allow setting the upper limit for the NCO search range. A system

reboot is needed to have new setting in use.

2.3.31 CDB-ID 203 –NCO range min value

Allow setting the lower limit for the NCO search range. A system

reboot is needed to have new setting in use.

2.3.32 CDB-ID 204 –NCO centre value

Allow setting the NCO centre frequency. A system reboot is needed to have new setting in use.

2.3.33 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 be never bigger than the time period of the configured fix rate.

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

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

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

2.3.34 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 2-102: CDB-ID from 206 to 209

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.

2.3.35 CDB-ID 210 –NMEA Message List 1

Allow enabling/disabling each NMEA message in the message list 1. The message list configuration is done in the same way as for the message list 0 (see CDB-ID 201 for details).

If not used the message list must be set to “0”.

2.3.36 CDB-ID 211 –NMEA Message List 2

Allow enabling/disabling each NMEA message in the message list 2. Allow enabling/disabling each NMEA message in the message list 1. The message list configuration is done in the same way as for the message list 0 (see CDB-ID 201 for details).

If not used the message list must be set to “0”.

Note:

The message list 2 is reserved for those messages which need to be sent at high rate (e.g. 10Hz) and/or require accurate message output timing (low jitter). If high rate messages or low jitter are not required, this message list should not be used.

2.3.37 CDB-ID 212 –SBAS satellites enable mask

Allow enabling/disabling the SBAS satellites to be searched by the auto search procedure.

It is a bit mask and the less significant bit (bit 0) refers to the lowest SBAS satellite ID (PRN 120). If the bit is set, the corresponding satellite is searched; if the bit is 0 the satellite is not searched. This parameter is by default configured to search all satellites in the SBAs range.

2.3.38 CDB-ID 213 –PPS operating mode setting 1

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table:

Table 2-103: CDB-ID 213

Bits	Values	Description
From B0 to B3	0 = on every second 1 = on even seconds 2 = on odd seconds	PPS generation mode

From B4 to B7	0 = UTC 1 = GPS Time 2 = GLONASS Time 3 = UTC(SU) 4 = GPS Time (From Glonass Time Reference)	Reference time on which the PPS signal is synchronized.
From B8 to B11	1 = NO FIX 2 = 2D FIX 3 = 3D FIX	GNSS fix condition for PPS signal generation. NO FIX: PPS signal is present even in GNSS NO fix conditions. 2D FIX: the PPS is present if the GNSS is at least in 2D fix condition. 3D FIX: the PPS is present only if the GNSS is in 3D fix conditions.
From B16 to B23	0..24	Minimun number of satellites used for timing correction. PPS signal is generated if the number of satellites used for time correction is bigger the minimun number. This parameter should be set to 0 is the threshold is not used.
From B24 to B31	0..90	Satellite elevation mask for time correction. It is the minimum satellite elevation angle to use the satellite for time correction. If this parameter is set to 0 there is no satellites filetring based on the elevation.

2.3.39 CDB-ID 214 –PPS operating mode setting 2

Allow setting different operating modes for the PPS signal generation. Full operating mode setting is achieved using both 213 and 214 parameters. This parameter includes different fields as reported in the following table:

Table 2-104: CDB-ID 214

Bits	Values	Description
From B0 to B7	0 = mixing constellation disabled 1 = GPS sats are enabled for GLONASS time correction. 2 = GLONASS sats are enabled for GPS time correction.	Enable/disable mixing constellations for time correction.

2.3.40 CDB-ID 215 –Position hold auto survey samples

Sets the number of position samples to be captured before entering in the position hold mode. The auto survey procedure is disabled is the number of samples is set to 0.

2.3.41 CDB-ID 301 –PPS Pulse Duration

Allow setting the pulse duration of the PPS signal. The pulse duration is intended to be the time distance between the PPS rising edge and the next falling edge if polarity inversion is disabled or the time distance between falling and rising edge if polarity inversion is enabled.

2.3.42 CDB-ID 302 –PPS Delay Correction

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

2.3.43 CDB-ID 303 –GNSS fix rate

Allow setting the GNSS library fix rate. It is the time period between two consecutive position fix evaluations.

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

2.3.44 CDB-ID 304 –Position Hold Latitude

Allow setting the latitude [degrees] for the position hold mode .

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

Note:

To be used the position hold functionality must be enabled, see CDB-ID 200 for details.

2.3.45 CDB-ID 305 –Position Hold Longitude

Allow setting the longitude [degrees] for the position hold mode

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

Note:

To be used the position hold functionality must be enabled, see CDB-ID 200 for details.

2.3.46 CDB-ID 306 –Position Hold Altitude

Allow setting the altitude [m] for the position hold mode (Note:).

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

Note:

To be used the position hold functionality must be enabled, see CDB-ID 200 for details

The altitude to be configured in this parameter mustn't be compensated with the geoid correction. If the altitude value is retrieved by the $GPGGA NMEA message, it must be added to the geoid correction

(reported in the same $GPGGA message) before setting it in the CDB-ID 306 parameter.

2.3.47 CDB-ID 307 –GPS RF delay correction

Allow setting the RF time delay for the GPS signal path.

2.3.48 CDB-ID 308 –GLONASS RF delay correction

Allow setting the RF time delay for the GLONAS signal path.

2.3.49 CDB-ID 309 –TRAIM alarm threshold

Allow setting the time error threshold for satellites removal in the TRAIM algorithm. Satellites which have a time error bigger than the TRAIM threshold are not used for time correction. The TRAIM threshold is also used to rise the TRAIM alarm if the time correction error is bigger than it.

2.3.50 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.

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

2.3.51 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.

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

2.3.52 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.

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

2.3.53 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.

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

2.3.54 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.

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

3 Almanacs and Ephemeris Management

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

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

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

Note:

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

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

It is also useful that the commands have been saved in various text files that may be transmitted over the connection by the terminal emulator. This example makes use of the following files:

SUSPEND.txt

RESUME.txt

DUMPEPHEMS.txt

DUMPALMANAC.txt

The content of these files has been reproduced in section TODO.

Step 1

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

Step 2 Ensure that the terminal emulator is logging its input to a text file e.g. log.txt.

Step 3

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

Step 4

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

Note:

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

Step 5

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

```
$PSTMEPHEM,1,64,42056a626a6281818170100009a9ff00cb05e920580e65052f00
ecff212c00000ced2b287d1021031f5b0da1b0eabad3c9277301316763b9f9001100
9184c003*59
$PSTMEPHEM,2,64,4205706270629898941f60034a3ff0017014e23c90ad20095ff
feff40360000e59fd126b3f39f04ddda0ca160ecc10ed28dacaa512bc74edb000300
e21eff03*09
$PSTMEPHEM,5,64,4205706270626f6f6fd1f600fea6ff0076f8491883120ff9c5ff
f0ff5b36000089e92c26d3a6700364ca0da109f24862068422525c188929f700f201
032bc703*5b
$PSTMEPHEM,6,64,4205706270627d7d7d800800a4a6ff007506cf18ee1178050a00
200053370000a4b113261c5b240333740da1b1d91e956051cf7e3f6ed4b3f6000400
6fa5db03*00
$PSTMEPHEM,14,64,420570627062c5c5c5e10e007ea9ff0064058520a30ea604160
00200772c000024c01b28451e1f01c49f0ca10aeb5ff83bcf570002bc35acec00040
0a632ff03*6b
$PSTMEPHEM,21,64,4205706270622121212188f9009da5ff00e7004622cd0aba00d9f
f9efffd3500001a618a2634ba500506010ea1e9f9fa926c745cac2cc31f84e700200
044a6c403*3c
$PSTMEPHEM,25,64,42056c626c62b2b2b20c04008ca5ff0007fc3b250b0820fd5b0
0290079370000ada6bd26d78f350664e90ca176ebc4a6c5e0fd26c93f03c6f000070
04d12c003*3d
$PSTMEPHEM,30,64,420570627062b0b0b091f800caa6ff00cff8e2179e1355f999f
fc0ff553500003f077326f97e6c04c8140da10c14be42db05f853b7a66b34ef005e0
09ff7cd03*3e
```

Step 6

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

$PSTMALMANAC,1,32,0142056314325b1c5efd0140020da14009730160ad61b900ca
ffe12011088020*1d
$PSTMALMANAC,2,32,02420563034ab50634fd01406c0ca1402eacaa6047c64e005b
741c20e4078020*15
$PSTMALMANAC,3,32,03420563483df0f537fd0140bb0ca140807d7c60237f19000a
3ef92030088020*1c$PSTMALMANAC,4,32,04420563f93a700633fd0140450da140447bab606fd20200
8ec97f201e208020*1a
$PSTMALMANAC,5,32,054205630d3765fc3ffd0140500da14033225260f08929006c
f96f20e6808020*19
$PSTMALMANAC,6,32,064205634532d6fa3ffd0140fc0ca14018cf7e600cd4b30037
d0a22075038020*49
$PSTMALMANAC,7,32,07420563f56cd9fb3ffd0140d20da1402eb77d6082d2b7003b
dcfa2099218020*13
$PSTMALMANAC,8,32,08420563ee4e011242fd0140190da14072452c609b4a6900fb
e2a620d0078020*1b
$PSTMALMANAC,9,32,09420563588ed00938fd0140cf0ca1406728296083eb3000c2
729720f1078020*44
$PSTMALMANAC,10,32,0a420563ed35ee155ffd0140ac0da140f82cd6609c7a0e004
eb22a204c008020*76
$PSTMALMANAC,11,32,0b420563fc2632e406fd0140fc0ca1403c39a56064700a006
08bbe2023098020*7b
$PSTMALMANAC,13,32,0d4205632315171f64fd0140ca0ca140d1d4006012ed2d00d
0a1242016088020*2c
$PSTMALMANAC,14,32,0e420563f711581b5efd0140480ca140b2570060bd35ac002
a110620e6078020*20
$PSTMALMANAC,15,32,0f420563f14a070b3bfd0140780ba1400dc3ad60b14366000
ce9a92017128020*2f
$PSTMALMANAC,16,32,10420563c917770c58fd0140550ca140199f55601c2bd800a
2196b200d008020*24
$PSTMALMANAC,17,32,114205630c0d1a0c54fd0140430ca140aeef7f6043406d000
8044920c427c020*79
$PSTMALMANAC,18,32,12420563c0367d0b50fd0140b30ca140c130d76094349100f
755672031ffbf20*25
$PSTMALMANAC,19,32,13420563b01ad60a51fd01409a0da140d1628260fc19c500a
7d23520e4078020*72
$PSTMALMANAC,20,32,14420563e0133f0b4efd0140830ca140db0ad560ed613a00a
1365a20d3078020*7c
$PSTMALMANAC,21,32,154205630955410230fd0140880da1400d5cac60921f84007
faca02095088020*29
$PSTMALMANAC,22,32,164205631029da094efd0140140da140808ad7608e4abf00d
bfc212032088020*27
$PSTMALMANAC,23,32,174205630f23bf0f51fd0140a50ca140a0f0ff60905c61001
72d0720aff8bf20*7d
$PSTMALMANAC,24,32,184205634b4a1f0d3ffd01404d0da1400ec6ac604db9d4000
6aac7203c088020*2c
$PSTMALMANAC,25,32,19420563596376052ffd0140760ca1408bfd26603c01c600e

```
9d9b42002008020*28
$PSTMALMANAC,26,32,1a420563fd87eb1d61fd0140bc0ca140e5e2006013041e001
389e320f7ffbf20*22
$PSTMALMANAC,27,32,1b4205630e9e660834fd0140720da140313f28606565ae002
a2d772016008020*7b
$PSTMALMANAC,28,32,1c4205631756300b57fd0000dc0ca1402f06562082c6a1205
0f344002a008000*25
$PSTMALMANAC,29,32,1d4205638f49d21b60fd0140090da1407880ff60c018d5000
095352095298020*73
$PSTMALMANAC,30,32,1e420563ca46c70045fd0140a00ca140baf75360466c3400e
26e5020bf198020*28
```

Step 7

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

Step 8

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

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

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

Note:

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

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

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

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

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

This example makes use of the following files:

SUSPEND.txt
RESUME.txt
LOADEPHEMS.txt
LOADALMANAC.txt

The content of these files has been reproduced in section TODO.

Step 1

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

Step 2

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

Step 3

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

Note:

Steps 4 and 5 are separate operations and may be carried out individually or together depending on the wishes of the user.

Step 4

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

Step 5

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

Step 6

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

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

Appendix A: Datum List

No	Datum	Region
0	WGS1984	International
1	Tokyo	Japan
2	Tokyo	Mean For Japan, South Korea, Okinawa
3	User Setting	User Setting
4	Adindan	Burkina Faso
5	Adindan	Cameroon
6	Adindan	Ethiopia
7	Adindan	Mali
8	Adindan	Mean For Ethiopia, Sudan
9	Adindan	Senegal
10	Adindan	Sudan
11	Afgooye	Somalia
12	Ain El Abd1970	Bahrain
13	Ain El Abd1970	Saudi Arabia
14	American Samoa1962	American Samoa Islands
15	Anna 1 Astro1965	Cocos Island
16	Antigua Island Astro1943	Antigua(Leeward Islands)
17	Arc1950	Botswana
18	Arc1950	Burundi
19	Arc1950	Lesotho
20	Arc1950	Malawi
21	Arc1950	Mean For Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe
22	Arc1950	Swaziland
23	Arc1950	Zaire
24	Arc1950	Zambia
25	Arc1950	Zimbabwe
26	Arc1960	Mean For Kenya Tanzania
27	Arc1960	Kenya
68	Arc1960	Tamzamia
29	Ascension Island1958	Ascension Island
30	Astro Beacon E 1945	Iwo Jima

31	Astro Dos 71/4	St Helena Island
32	Astro Tern Island (FRIG) 1961	Tern Island
33	Astronomical Station 1952	Marcus Island
34	Australian Geodetic 1966	Australia, Tasmania
35	Australian Geodetic 1984	Australia, Tasmania
36	Ayabelle Lighthouse	Djibouti
37	Bellevue (IGN)	Efate and Erromango Islands
38	Bermuda 1957	Bermuda
39	Bissau	Guuinea-Bissau
40	Bogota Observatory	Colombia
41	Bukit Rimpah	Indonesia(Bangka and Belitung Ids)
42	Camp Area Astro	Antarctica(McMurdi Camp Area)
43	Campo Inchauspe	Argentina
44	Canton Astro1966	Phoenix Island
45	Cape	South Africa
46	Cape Canaveral	Bahamas, Florida
47	Carthage	Tunisia
48	Chatham Island Astro1971	New Zealand(Chatham Island)
49	Chua Astro	Paraguay
50	Corrego Alegre	Brazil
51	Dabola	Guinea
52	Deception Island	Deception Island, Antarctia
53	Djakarta (Batavia)	Indonesia(Sumatra)
54	Dos 1968	New Georgia Islands (Gizo Island)
55	Easter Island 1967	Easter Island
56	Estonia Coordinate System1937	Estonia
57	European 1950	Cyprus
58	European 1950	Egypt
59	European 1950	England, Channel Islands, Scotland, Shetland Islands
60	European 1950	England, Ireland, Scotland, Shetland Islands
61	European 1950	Finland, Norway
62	European 1950	Greece
63	European 1950	Iran
64	European 1950	Italy (Sardinia)
65	European 1950	Italy (Slcily)
66	European 1950	Malta

67	European 1950	Mean For Austria, Belgium,Denmark, Finland, France, W Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portuga,l Spain, Sweden, Switzerland
68	European 1950	Mean For Austria, Debnmark,France, W Germany, Netherland , Switzerland
69	European 1950	Mean For Irag, Israel, Jordan, Lebanon, Kuwait, Saudi Arabia, Syria
70	European 1950	Portugal, Spain
71	European 1950	Tunisia,
72	European 1979	Mean For Austria, Finland ,Netherlands ,Norway, Spain, Sweden, Switzerland
73	Fort Thomas 1955	Nevis St Kitts (Leeward Islands)
74	Gan 1970	Republic Of Maldives
75	Geodetic Dataum 1970	New Zealand
76	Graciosa Base SW1948	Azores (Faial, Graciosa, Pico, Sao, Jorge, Terceria)
77	Guam1963	Guam
78	Gunung Segara	Indonesia (Kalimantan)
79	Gux l Astro	Guadalcanal Island
80	Herat North	Afghanistan
81	Hermannskogel Datum	Croatia-Serbia, Bosnia-Herzegoivna
82	Hjorsey 1955	Iceland
83	Hongkong 1963	Hongkong
84	Hu Tzu Shan	Taiwan
85	Indian	Bangladesh
86	Indian	India,Nepal
87	Indian	Pakistan
88	Indian 1954	Thailand
89	Indian 1960	Vietnam (Con Son Island)
90	Indian 1960	Vietnam (Near 16 deg N)
91	Indian 1975	Thailand
92	Indonesian 1974	Indonesian
93	Ireland 1965	Ireland
94	ISTS 061 Astro 1968	South Georgia Islands
95	ISTS 073 Astro 1969	Diego Garcia
96	Johnston Island 1961	Johnston Island
97	Kandawala	Sri Lanka
98	Kerguelen Island 1949	Kerguelen Island

99	Kertau 1948	West Malaysia and Singapore
100	Kusaie Astro 1951	Caroline Islands
101	Korean Geodetic System	South Korea
102	LC5 Astro 1961	Cayman Brac Island
103	Leigon	Ghana
104	Liberia 1964	Liberia
105	Luzon	Philippines (Excluding Mindanao)
106	Luzon	Philippines (Mindanao)
107	M'Poraloko	Gabon
108	Mahe 1971	Mahe Island
109	Massawa	Ethiopia (Eritrea)
110	Merchich	Morocco
111	Midway Astro 1961	Midway Islands
112	Minna	Cameroon
113	Minna	Nigeria
114	Montserrat Island Astro 1958	Montserrat (Leeward Island)
115	Nahrwan	Oman (Masirah Island)
116	Nahrwan	Saudi Arabia
117	Nahrwan	United Arab Emirates
118	Naparima BWI	Trinidad and Tobago
119	North American 1927	Alaska (Excluding Aleutian Ids)
120	North American 1927	Alaska (Aleutian Ids East of 180 degW)
121	North American 1927	Alaska (Aleutian Ids West of 180 degW)
122	North American 1927	Bahamas (Except San Salvador Islands)
123	North American 1927	Bahamas (San Salvador Islands)
124	North American 1927	Canada (Alberta, British Columbia)
125	North American 1927	Canada (Manitoba, Ontario)
126	North American 1927	Canada (New Brunswick, Newfoundland, Nova Scotia, Qubec)
127	North American 1927	Canada (Northwest Territories, Saskatchewan)
168	North American 1927	Canada (Yukon)
129	North American 1927	Canal Zone
130	North American 1927	Cuba
131	North American 1927	Greenland (Hayes Peninsula)
132	North American 1927	Mean For Antigua, Barbados, Barbuda, Caicos Islands, Cuba, Dominican, Grand Cayman, Jamaica, Turks Islands

133	North American 1927	Mean For Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua
134	North American 1927	Mean For Canada
135	North American 1927	Mean For Conus
136	North American 1927	Mean For Conus (East of Mississippi, River Including Louisiana,Missouri, Minnesota)
137	North American 1927	Mean For Conus (West of Mississippi, Rive Excluding Louisiana,Minnesota, Missouri)
138	North American 1927	Mexico
139	North American 1983	Alaska (Excluding Aleutian Ids)
140	North American 1983	Aleutian Ids
141	North American 1983	Canada
142	North American 1983	Conus
143	North American 1983	Hahawii
144	North American 1983	Mexico, Central America
145	North Sahara 1959	Algeria
146	Observatorio Meteorologico 1939	Azores (Corvo and Flores Islands)
147	Old Egyptian 1907	Egypt
148	Old Hawaiian	Hawaii
149	Old Hawaiian	Kauai
150	Old Hawaiian	Maui
151	Old Hawaiian	Mean For Hawaii, Kauai, Maui, Oahu
152	Old Hawaiian	Oahu
153	Oman	Oman
154	Ordnance Survey Great Britian 1936	England
155	Ordnance Survey Great Britian 1936	England, Isle of Man, Wales
156	Ordnance Survey Great Britian 1936	Mean For England ,Isle of Man, Scotland, Shetland Island, Wales
157	Ordnance Survey Great Britian 1936	Scotland, Shetland Islands
158	Ordnance Survey Great Britian 1936	Wales
159	Pico de las Nieves	Canary Islands
160	Pitcairn Astro 1967	Pitcairn Island
161	Point 58	Mean For Burkina Faso and Niger
162	Pointe Noire 1948	Congo
163	Porto Santo 1936	Porto Santo, Maderia Islands
164	Provisional South American 1956	Bolovia
165	Provisional South American 1956	Chile (Northern Near 19 deg S)

166	Provisional South American 1956	Chile (Southern Near 43 deg S)
167	Provisional South American 1956	Colombia
168	Provisional South American 1956	Ecuador
169	Provisional South American 1956	Guyana
170	Provisional South American 1956	Mean For Bolivia Chile,Colombia, Ecuador, Guyana, Peru, Venezuela
171	Provisional South American 1956	Peru
172	Provisional South American 1956	Venezuela
173	Provisional South Chilean 1963	Chile (Near 53 deg S) (Hito XVIII)
174	Puerto Rico	Puerto Rico, Virgin Islands
175	Pulkovo 1942	Russia
176	Qatar National	Qatar
177	Qornoq	Greenland (South)
178	Reunion	Mascarene Island
179	Rome 1940	Italy (Sardinia)
180	S-42 (Pulkovo 1942)	Hungary
181	S-42 (Pulkovo 1942)	Poland
182	S-42 (Pulkovo 1942)	Czechoslavakia
183	S-42 (Pulkovo 1942)	Lativa
184	S-42 (Pulkovo 1942)	Kazakhstan
185	S-42 (Pulkovo 1942)	Albania
186	S-42 (Pulkovo 1942)	Romania
187	S-JTSK	Czechoslavakia (Prior 1 Jan1993)
188	Santo (Dos) 1965	Espirito Santo Island
189	Sao Braz	Azores (Sao Miguel, Santa Maria Ids)
190	Sapper Hill 1943	East Falkland Island
191	Schwarzeck	Namibia
192	Selvagem Grande 1938	Salvage Islands
193	Sierra Leone 1960	Sierra Leone
194	South American 1969	Argentina
195	South American 1969	Bolivia
196	South American 1969	Brazial
197	South American 1969	Chile
198	South American 1969	Colombia
199	South American 1969	Ecuador
200	South American 1969	Ecuador (Baltra, Galapagos)

201	South American 1969	Guyana
202	South American 1969	Mean For Argentina, Bolivia, Brazil,Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, Venezuela
203	South American 1969	Paraguay
204	South American 1969	Peru
205	South American 1969	Trinidad and Tobago
206	South American 1969	Venezuela
207	South Asia	Singapore
208	Tananarive Observatory 1925	Madagascar
209	Timbalai 1948	Brunei, E Malaysia (Sabah Sarawak)
210	Tokyo	Japan
211	Tokyo	Mean For Japan, South Korea, Okinawa
212	Tokyo	Okinawa
213	Tokyo	South Korea
214	Tristan Astro 1968	Tristam Da Cunha
215	Viti Levu 1916	Fiji (Viti Levu Island)
216	Voirol 1960	Algeria
217	Wake Island Astro 1952	Wake Atoll
218	Wake-Eniwetok 1960	Marshall Islands
219	WGS 1972	Global Definition
220	Yacare	Uruguay
221	Zanderij	Suriname

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