Telit wireless solutions

GPS Application Note

1vv0300914 Rev.0 – 2011-07-07

Making machines talk.

APPLICABILITY TABLE

PRODUCT
GM862-GPS
GE863-GPS
GE864-GPS

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Contents

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AT Commands list in alphabetical order

The following list shows the AT Commands, concerning the GPS receiver, covered by the present user guide.

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1. Introduction

TELIT Modules providing GPS feature are equipped with a SiRF Star III or SiRF Star IV GPS receiver in accordance with the product. The GPS receiver is controlled by means of a dedicated set of AT Commands [6] or NMEA sentences [1].

1.1. Scope

The present document provides the reader with a description concerning the use of the AT Commands developed by TELIT and the standard NMEA sentences. The description of the SIRF BINARY protocol [8] is out of the scope of the present note, and only a brief description of the NMEA sentences is reported in paragraph 5, for the complete description refer to [9].

1.2. Audience

This document is intended for users who are interested in developing GPS applications based on TELIT modules.

1.3. Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
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Alternatively, use:

http://www.telit.com/en/products/technical-support-center/contact.php

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

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1.4. Related Documents

[1] NMEA-0183 Standard for Interfacing Marine Electronic Devices
[2] WGS84 Implementation Manual, Eurocontrol and ifEN
[3] TELIT GM862 Family Hardware User Guide, 1vv0300794
[4] TELIT EVK2 User Guide, 1vv0300704
[5] TELIT GE863 Family Hardware User Guide, 1VV0300783
[6] TELIT AT Commands Reference Guide, 80000ST10025a
[7] TELIT Virtual Serial Device User Guide, 80000NT10045a
[8] SiRF Binary Protocol Reference Manual
[9] SiRF NMEA Reference Manual
[10] TELIT GE_GC864-QUAD V2 and GE864-GPS Hardware User Guide, 1vv0300915

1.5. Abbreviations and acronyms

DTE	Data Terminal Equipment
ECEF	Earth-Centered Earth-Fixed
LNA	Low Noise Amplifier
NMEA	National Marine Electronics Association
NVM	Non Volatile Memory
RTD	Real Time Debugger
WGS 84	World Geodetic System 1984

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2. A brief GPS Introduction

The description of the GPS system is beyond the scope of this document. The reader that is interested to deepen the argument should refer to the dedicated literature, hereafter are only mentioned the basic concepts.

GPS system is based on a constellation of 24 satellites distributed equally among six circular orbital planes; the height of the orbits is about 20200 km. Orbits in this height are referred to as medium earth orbit (MEO).

GPS receiver performs initial position and velocity calculations using an ECEF coordinate system, fig. 1. Because the earth has a complex shape a method to approximate the earth's shape is required.

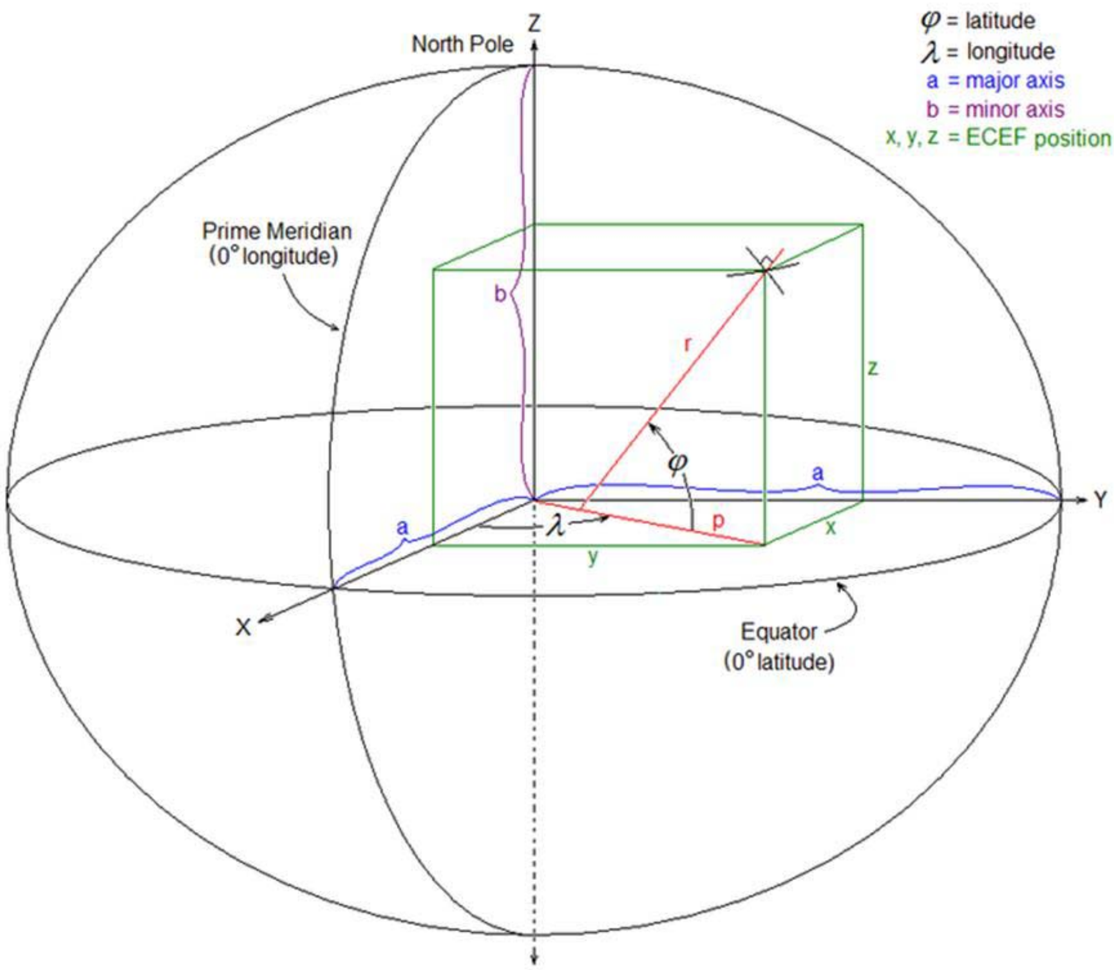

fig. 1: ECEF coordinate system [from Wikipedia]

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The use of a geodetic reference (reference ellipsoid) allows for the conversion of the ECEF coordinates to the more commonly used coordinates of Latitude, Longitude and Altitude (LLA).

GPS receiver, used by GPS TELIT solution, uses (by default) the geodetic reference (datum) WGS 84 [2] which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. Many reference ellipsoids are used throughout the word. The main reason for choosing a reference datum other than WGS 84 is to minimize the local differences between the geoid and the ellipsoid separation or other mapping distortions. Local map datums are a best fit to the local shape of the earth and not valid worldwide.

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3. GSM Modem /GPS Receiver Interface

The present paragraph will describe the TELIT GPS Solutions configurations: GM862-GPS [3], GE863-GPS [5] and GE864-GPS [10] modules.

GM862-GPS, GE863-GPS

The interface between TELIT GSM modem and GPS receiver is carried out by means of a serial line as depicted on fig. 2. In this configuration only two serial lines are externally available for the user applications.

The fig. 3 shows a second configuration: all the serial lines are available to the user. In this solution it is responsibility of the user to connect together GSM modem and GPS receiver through the dedicated serial line (jumper in centre-position).

The GPS receiver (SiRF Star III) is equipped with two serial ports:

SIRF BINARY port: supports GPS navigation data in SIRF BINARY format [1] [8]. The factory configuration is 57600 bps, 8, n, 1, where it is applicable.

NMEA port: supports GPS navigation data in NMEA-0183 format, see paragraph 5. The factory configuration is 4800 bps, 8, n, 1.

GM862-GPS

Refer to the fig. 2: the user may interface the TELIT module with two different applications: the first one could be a script, running on User DTE, to control the GSM modem and GPS receiver by means of AT commands, the second one, running on User Device 1, can directly exchange NMEA sentences with the GPS receiver .

[1]This protocol is not object of the present document.

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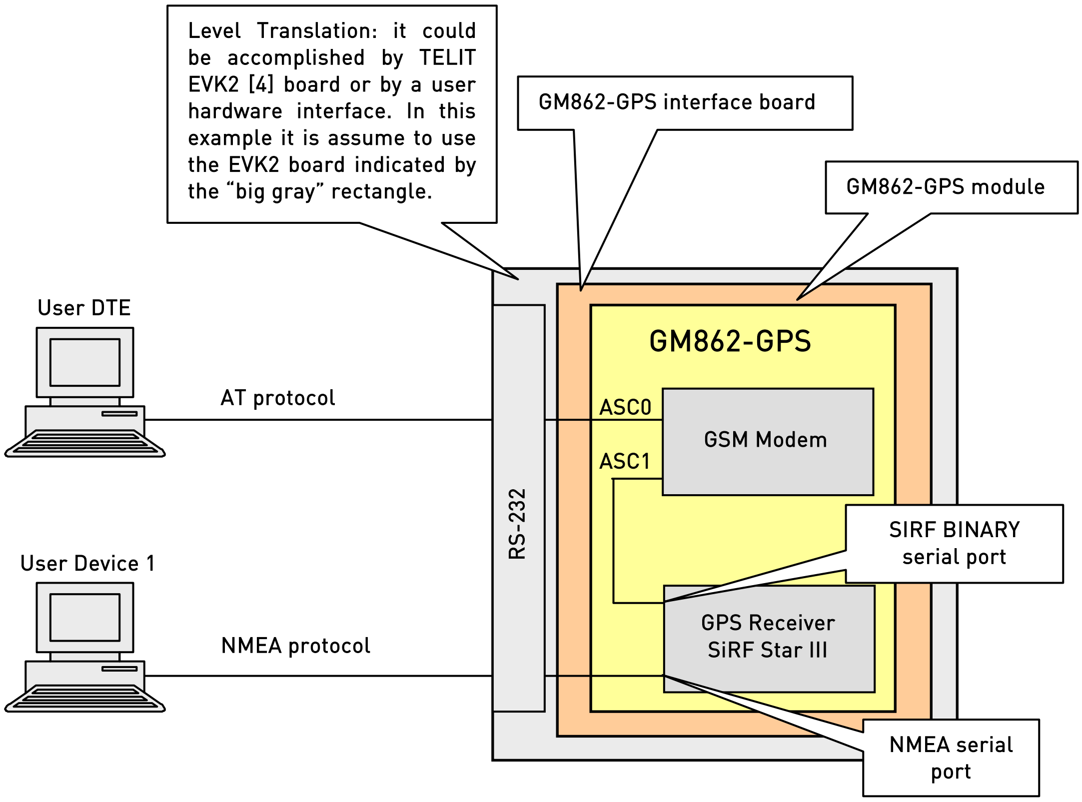

fig. 2: **Serial Ports' availability: GM862-GPS**

GE863-GPS

Refer to the fig. 3 and let's assume that a jumper is plugged into down-position: the user may interface the TELIT module with three applications: the first one, running on User DTE, could be a script to manage the GSM modem; the second one, running on User Device 2, to exchange data with GPS receiver through SIRF BINARY protocol; the third one, running on User Device 1, to display NMEA sentences.

In addition, the ASC1 serial port, that in this configuration is not used, can be logically connected to Python script running on the GSM modem. In order to make the Python outputs available to the user a new jumper shall be plugged into up-position, refer to [7].

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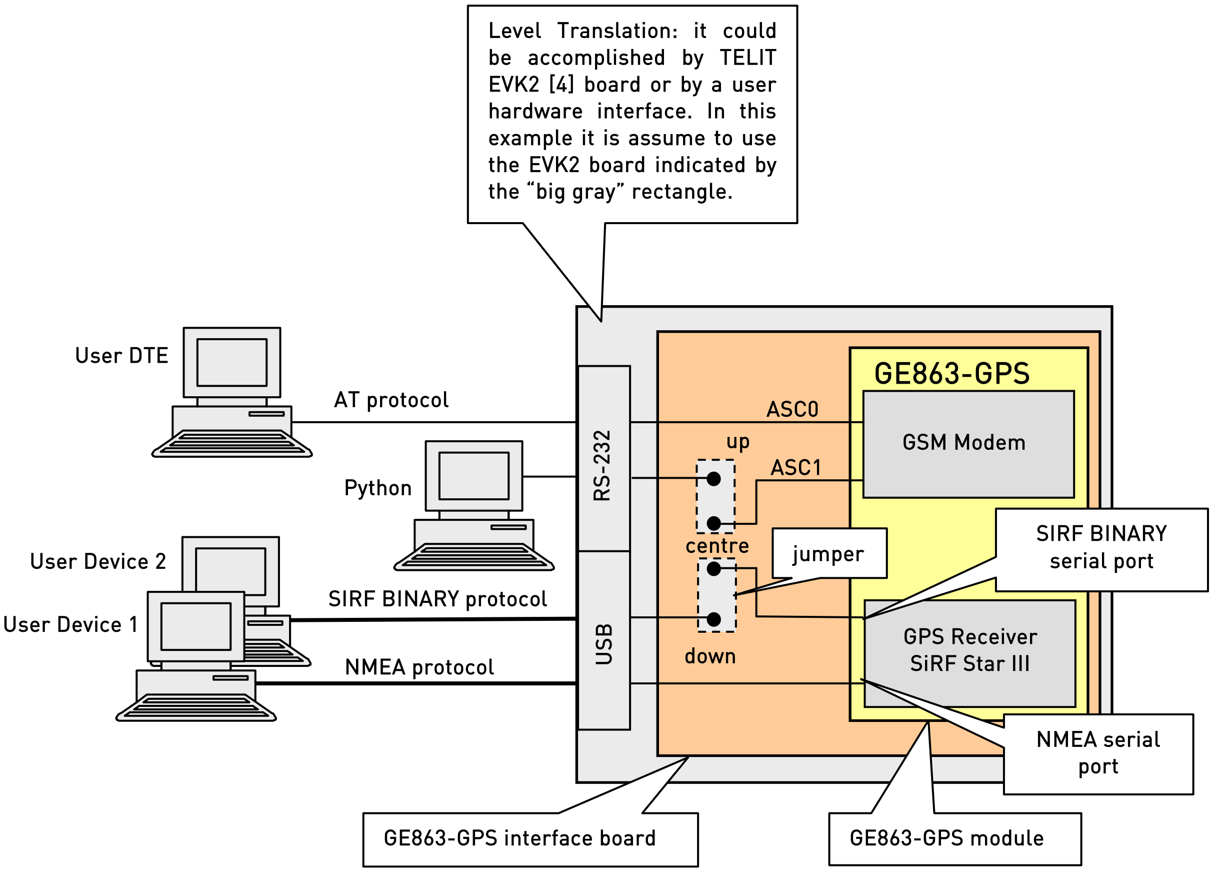

fig. 3: **Serial Ports' availability: GE863-GPS**

Now, let's remove the two jumpers from up and down-positions and plug one in centre-position. In this configuration the user, through the User DTE, can control the GPS receiver using the suitable AT commands.

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GE864-GPS

Hereafter is illustrated the user interface provided by the GE864-GPS product that is equipped with a SiRF Star IV GPS receiver. It is endowed with one serial port only called NMEA serial port (factory configuration: 4800 bps, 8, n, 1).

Refer to the fig. 4 and let’s assume that a jumper is plugged into down-position: the user may interface the GE864-GPS module with two applications: the first one, running on User DTE, could be a script to manage the GSM modem; the second one, running on User Device 1, displays NMEA sentences.

In addition, the ASC1 serial port, that in this configuration is not used, can be logically connected to Python script running on the GSM modem. In order to make the Python outputs available to the user a new jumper shall be plugged into up-position, refer to [7].

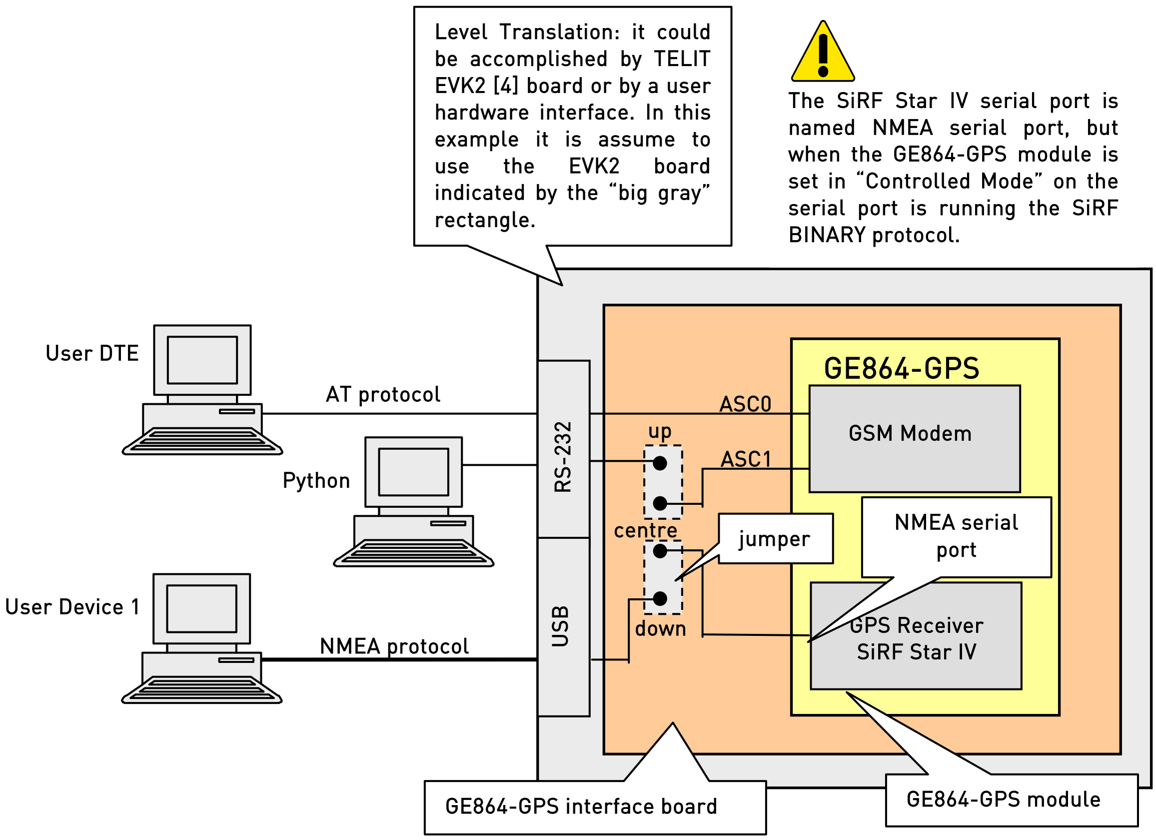

fig. 4: Serial Ports’ availability: GE864-GPS

Now, let’s remove the two jumpers from up and down-positions and plug one into centre-position. In this configuration the user, through the User DTE, can control the GPS receiver using the suitable AT commands.

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4. AT Commands to Control GPS Receiver

This paragraph describes some AT Commands developed by TELIT to manage the GPS receiver. For each command is illustrated a short description just to give to the reader a guideline. The reader to deepen his knowledge about TELIT AT commands should refer to [6].

Same AT commands could have different behavior in accordance with the product where they are running. If no indications are provided, AT commands have the same behavior for all products even if equipped with different GPS receivers; it doesn't matter the type of GPS receiver that is installed on the product.

After power on, the GSM modem is ready to receive AT commands on the ASC0 serial port connected to the DTE; the GPS receiver starts the scan of the available GPS signals and the NMEA sentences are sent to the NMEA serial port that could be connected to the User Device 1 in accordance with jumper position, see fig. 2, fig. 3, fig. 4, and software configuration. To simplify the AT command description sometime it makes reference to the GPS factory configuration recorded in NVM. To force the TELIT module into GPS factory configuration see the command described in paragraph 4.1.8.

On the following pages it is assumed that the generic TELIT GPS module is used connected to its own interface board and plugged into EVK2 board as showed by the previous figures. Furthermore, it is clear that GSM module can control the GPS receiver only if it is set in “Controlled Mode” consequently, before using an AT command to control the GPS receiver, AT$GPSD=2 command shall be entered and activated, in addition –where it is applicable- the jumper shall plugged into centre-position.

4.1.1. Controlled Mode

In general, by means of AT$GPSD AT command, the ASC1 serial port of the GSM modem may be forced to enter or exit “Controlled Mode” and in accordance with its current mode can be dedicated to different services.

AT$GPSD=<device type>

<u>**GM862-GPS** module, refer to fig. 2</u>

ASC1 serial port is hardwired to SIRF BINARY serial port, in accordance with this hardware solution the ASC1 serial port is permanently dedicated to GPS receiver control: <device type> = 2. No other configurations are allowed.

AT$GPSD?

$GPSD: 2	GPS factory configuration: “Controlled Mode”
OK	

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GE863-GPS module, refer to fig. 3

Let's assume that the GPS factory configuration, memorized on NVM, hasn't been changed and a jumper is plugged into centre-position. At the power on, the ASC1 serial port is running the SIRF BINARY protocol. For details concerning physical connection refer to [4], [5].

AT$GPSD?
$GPSD: 2 GPS factory configuration: "Controlled Mode"
OK

Use the following procedure to exit "Controlled Mode" and make available to the user the SIRF BINARY serial port:

- Turn on the GE863-GPS module
- AT$GPSP = 1 SiRF Star III is turned on when the module is powered on.
- AT$GPSD = 0 no "Controlled Mode"
- AT$GPSSAV save the configuration in NVM
- Turn off the GE863-GPS module (both GSM and GPS sides)
- Plug the jumper into down-position
- Turn on the GE863-GPS module

Now, ASC1 serial port is available for other services as Python [7],

- plug a new jumper into up-position.

GE864-GPS module, refer to fig. 4

Let's assume that the GPS factory configuration is still memorized on NVM, when the module is turned on it enters into "Controlled Mode". Before executing the power on, plug a jumper into centre-position in order to physically connect ASC1 serial port to NMEA serial port. In this configuration SiRF BINARY protocol is running on NMEA serial port.

AT$GPSD?
$GPSD: 2 GPS factory configuration: "Controlled Mode"
OK

Use the following procedure to exit "Controlled Mode", run NMEA sentences on NMEA serial port and make it available to the user.

- Turn on the GE864-GPS module
- AT$GPSP = 1 SiRF Star IV is turned on when the module is powered on.
- AT$GPSD = 0 no "Controlled Mode"

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- AT$GPSSAV save the configuration in NVM
- Turn off the GE864-GPS module (both GSM and GPS sides, refer to [10])
- Plug a jumper into down-position
- Turn on the GE864-GPS module

Now, ASC1 serial port is available for other services as Python [7],

- plug a new jumper into up-position.

4.1.2. NMEA Sentences on ASC0 Serial Port

Let's assume that the GPS factory configuration, memorized on NVM, hasn't been changed and a jumper is plugged into centre-position (GE863-GPS and GE864-GPS). By means of the following AT command, NMEA sentences can be available on ASC0 serial port connected to the User DTE.

AT$GPSNMUN=<enable>[,<GGA>,<GLL>,<GSA>,<GSV>,<RMC>,<VTG>]

Examples:

Check the range of the values supported by the AT command. In accordance with the requirements select them.

AT$GPSNMUN=?
$GPSNMUN: (0-3),(0,1),(0,1),(0,1),(0,1),(0,1),(0,1)
OK

Enable the entire set of the NMEA sentences running on ASC0 serial port.

AT$GPSNMUN=1,1,1,1,1,1,1,
OK

```
$GPSNMUN: $GPGGA,080028.999,4542.8011,N,01344.2644,E,1,07,1.2,260.5,M,45.2,M,,0000*58
$GPSNMUN: $GPGLL,4542.8011,N,01344.2644,E,080028.999,A,A*5B
$GPSNMUN: $GPRMC,080028.999,A,4542.8011,N,01344.2644,E,1.14,257.62,190508,,,A*69
$GPSNMUN: $GPVTG,257.62,T,,M,1.14,N,2.12,K,A*3C
$GPSNMUN: $GPGSV,3,1,09,19,02,171,17,23,38,199,38,17,32,300,31,20,71,292,34*75
$GPSNMUN: $GPGSV,3,2,09,31,24,084,23,13,04,208,27,11,72,175,28,14,08,039,20*78
$GPSNMUN: $GPGSV,3,3,09,32,48,061,23*4B
$GPSNMUN: $GPGSA,A,3,14,17,20,31,11,23,32,,,,,,,1.2,*32
$GPSNMUN: $GPGGA,080029.999,4542.8011,N,01344.2646,E,1,07,1.2,259.7,M,45.2,M,,0000*53
$GPSNMUN: $GPGLL,4542.8011,N,01344.2646,E,080029.999,A,A*58
$GPSNMUN: $GPRMC,080029.999,A,4542.8011,N,01344.2646,E,0.29,67.31,190508,,,A*52
$GPSNMUN: $GPVTG,67.31,T,,M,0.29,N,0.54,K,A*04
```

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…

GM862-GPS and GE863-GPS modules

At this point both devices display, on User DTE and User Device1, NMEA sentences. To disable the entire set of the NMEA sentences running on ASC0 serial port enter:

AT$GPSNMUN=0
OK

GE864-GPS module

At this point the device displays, on User DTE, NMEA sentences. To disable the entire set of the NMEA sentences running on ASC0 serial port enter:

AT$GPSNMUN=0
OK

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4.1.3. GPS Power Control

Let's assume that the GPS factory configuration, memorized on NVM, hasn't been changed: when the GSM modem is powered on, the GPS receiver is switched on. The following AT command is used to switch on/off the GPS receiver.

AT$GPSP=<status>

Examples:

AT$GPSP=0 Switch off GPS receiver
OK

AT$GPSP? Check its status
$GPSP: 0
OK

AT$GPSP=1 Switch on GPS receiver
OK

4.1.4. GPS Reset

AT command used to reset the GPS receiver.

AT$GPSR=<reset_type>

Examples:

Check the range of available values supported by the module. In accordance with the requirements select it.

AT$GPSR=?
$GPSR: (0-4)
OK

Force a cold start of the GPS receiver, it clears all the parameters in its memory and starts a new scanning of the available satellites.

AT$GPSR=1
OK

NOTE: Refer to [6] to see the different behavior of AT$GPSR=0 in accordance with the different products.

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4.1.5. GPS Antenna Power Supply

The GPS receiver needs an active antenna that may be powered by the module (by default) or by an external power supply. The following AT command is used to select power source of the GPS antenna.

GM862-GPS and **GE863-GPS** modules

AT$GPSAT=<type>

Examples

Check the range of available values supported by the module

AT$GPSAT=?
$GPSAT: (0,1)
OK

Check if the GPS antenna is supplied by the module itself. 1 means that the GPS antenna is supplied by the module.

AT$GPSAT?
$GPSAT: 1
OK

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4.1.5.1. GPS Antenna Current and Voltage Readout

The following two AT commands are available for GM862-GPS and GE863-GPS modules only. Both commands work when the GPS antenna is supplied by the module itself.

AT command used to check the GPS antenna voltage supply.

AT$GPSAV?

AT command used to check the GPS antenna current consumption.

AT$GPSAI?

Examples:

Check the GPS antenna voltage supply:

AT$GPSAV?
$GPSAV: 3800 it means 3,8 V dc
OK

Check the GPS antenna current consumption:

AT$GPSAI?
$GPSAI: 18 in mA
OK

4.1.6. External LNA

For GE864-GPS module the AT$GPSAT command has a different functionality compared with the same command running on GM862-GPS and GE863-GPS modules. In fact, GE864-GPS is furnished with a SiRF Star IV GPS chipset. The chipset is equipped with an internal LNA, if the user needs an external LNA having a better gain than the internal one, he may disable the internal LNA using the AT$GPSAT command.

AT$GPSAT=1 Enable external GPS antenna LNA
OK

4.1.7. Saving GPS Parameters

AT command used to save the set parameters in the module memory (NVM).

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AT$GPSSAV
OK

Example:

Power on the module, for example the GE863-GPS, and let's assume that the module is using the GPS factory configuration.

AT$GPSD? Check the Mode
$GPSD: 2 the module is in "Controlled Mode"
OK

AT$GPSD=0 force the module out of the "Controlled Mode"
OK

AT$GPSD? Check the new Mode
$GPSD: 0
OK

AT$GPSSAV save the new configuration on NVM
OK

NOTE: After this command, restart the module to make active the modifications.

AT$GPSD? Check the Mode
$GPSD: 0
OK

AT$GPSRST Restore the GPS factory configuration
OK

Turn off/on the module to activate the new configuration

AT$GPSD? Check the restored GPS factory configuration
$GPSD: 2
OK

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4.1.8. Restoring GPS Parameters

AT command used to restore the factory default parameters for the GPS modules

AT$GPSRST
OK

NOTE: After this command, restart the module to make active the modifications.

4.1.9. Reading Acquired GPS Position

AT command used to read the acquired position of the GPS Receiver.

AT$GPSACP

Example

Check the acquired GPS position.

AT$GPSACP
$GPSACP:080220,4542.82691N,01344.26820E,259.07,3,2.1,0.1,0.0,0.0,270705,09
OK

4.1.10. Setting the GPS Module in Power Saving Mode

AT command used to set the GPS module in Power Saving mode.

AT$GPSPS=<mode> [,<PTF_Period>]

Examples:

Check the range of available values supported by the module

AT$GPSPS=?
$GPSPS: (0-2),(0-300000)
OK

Check the current values.

AT$GPSPS?
$GPSPS: 0,1800
OK

0 means full power mode. The second parameter expressed in seconds is valid only if the first parameter is equal to 2 (push-to-fix mode), see [6].

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NOTE: Refer to [6] to see the behavior of AT$GPSPS=3 in accordance with the different products: parameter 3 is available for GE864-GPS product only.

4.1.11. Wake Up GPS from Power Saving Mode

AT command used to wake up the GPS module from Power Saving mode.

AT$GPSWK

Examples:

Check the current values.

AT$GPSPS?
$GPSPS: 0,1800
OK

0 means full power mode. The second parameter expressed in seconds is valid only if the first parameter is equal to 2 (push-to-fix mode), see [6].

Wake up GPS receiver.

AT$GPSWK
+CME ERROR: operation not supported[2]

Operation not supported because the GPS receiver is powered ON.

Power down the GPS receiver.

AT$GPSPS=2
OK

Wake up the GPS receiver.

AT$GPSWK
OK

[2] See AT+CMEE command to enable the error report [6].

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4.1.12. GPS Software Version

AT command used to read the GPS Receiver software version.

AT$GPSSW

Example:

AT$GPSSW
$GPSSW: GSW3.1.1_3.1.00.07-C23P1.00
OK

4.1.13. Direct Access to GPS

The following AT command is used to directly access the port of the GPS receiver physically connected to ASC1 serial port; GSM module is set in transparent mode: ASC0 serial port is logically connected to ASC1 serial port. To exit transparent mode the user shall enter the escape sequence +++.

AT$GPSCON

Example:

AT$GPSCON
CONNECT GPS receiver is connected, GSM module is in transparent mode

Begin the data exchange.

……..

For all GM862-GPS, GE863-GPS and GE864-GPS modules the protocol running on ASC1 serial port is the SiRF BINARY. It means that the application running on User DTE shall be able, after the reception of the “CONNECT” message, to manage the SiRF BINARY protocol.

……..

+++ Close the connection

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5. NMEA 0183 Protocol

NMEA-0183 [1] is the standard specification created by the NMEA that defines the interface between marine electronic equipments. The standard permits marine electronics to send information to computers and to other marine equipments.

The present paragraph provides information concerning the NMEA sentences that have applicability to GPS receivers[3]. This paragraph has been added for reader convenience, exhaustive descriptions are in [1], [9]. TELIT GPS modules are equipped with GPS receivers, see Tab. 1, supporting a sub set of NMEA-0183 sentences.

TELIT Product	GPS Module	GPS SW Option	NMEA-0183
GM862-GPS	SiRF Star III	GSW3	Ver. 2.20
GE863-GPS	SiRF Star III	GSW3	Ver. 2.20
GE864-GPS	SiRF Star IV	GSD4e	Ver. 3.01

Tab. 1: TELIT Products vs. GPS Modules

The following sub-paragraphs will describe the structure and the parameters meaning of this sentences sub set. The following information is extracted from [9].

5.1. NMEA Output Messages

As factory configured, the GPS receiver provides the user with the following sentences continuously sent on NMEA serial port: GGA, GSA, GSV, RMC.

In order to enable the VTG and GLL sentences as well, the user can use the NMEA command $PSRF103, refer to paragraph 5.2.1.

GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
VTG	Course and speed information relative to the ground.
RMC	Time, date, position, course and speed data.

Tab. 2: NMEA Output Messages

[3] There are many sentences in the NMEA standard for all kinds of devices that may be used in a Marine environment.

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At power on, both GM862-GPS and GE863-GPS modules show, on User Device 1, the sequence of the output NMEA sentences hereafter listed. In the case of GE864-GPS module, it displays on the User Device 1 the NMEA sentences only if the jumper is plugged into down-position, the module is out of the "Controlled Mode", see paragraph 4.1.1.

```
$GPGGA,065049.000,4542.8078,N,01344.2698,E,1,07,1.2,268.1,M,45.2,M,,0000*5F
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPRMC,065049.000,A,4542.8078,N,01344.2698,E,0.25,103.45,190508,,,A*66
$GPGGA,065050.000,4542.8077,N,01344.2698,E,1,07,1.2,267.9,M,45.2,M,,0000*5F
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPRMC,065050.000,A,4542.8077,N,01344.2698,E,0.15,131.12,190508,,,A*61
$GPGGA,065051.000,4542.8077,N,01344.2698,E,1,07,1.2,267.8,M,45.2,M,,0000*5F
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPGSV,3,1,11,32,77,037,33,11,69,292,31,20,44,253,26,14,34,050,32*7E
$GPGSV,3,2,11,19,32,174,25,28,12,287,26,17,12,321,33,23,07,195,25*7D
$GPGSV,3,3,11,31,07,111,19,22,06,062,,03,04,166,18*48
$GPRMC,065051.000,A,4542.8077,N,01344.2698,E,0.10,306.95,190508,,,A*6C
$GPGGA,065052.000,4542.8076,N,01344.2697,E,1,07,1.2,267.5,M,45.2,M,,0000*5F
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPRMC,065052.000,A,4542.8076,N,01344.2697,E,0.15,185.15,190508,,,A*65
$GPGGA,065053.000,4542.8076,N,01344.2697,E,1,07,1.2,267.3,M,45.2,M,,0000*58
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPRMC,065053.000,A,4542.8076,N,01344.2697,E,0.32,198.79,190508,,,A*67
$GPGGA,065054.000,4542.8074,N,01344.2696,E,1,07,1.2,267.1,M,45.2,M,,0000*5E
$GPGSA,A,3,20,11,32,28,17,19,14,,,,,,1.9,1.2,1.5*3F
$GPRMC,065054.000,A,4542.8074,N,01344.2696,E,0.46,205.36,190508,,,A*6C
```

…

…

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5.1.1. GGA - Global Positioning System Fixed Data

GGA sentence is displayed on the user device with the following format:

```
$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18
```

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Tab. 4
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Units	M	meters	
Geoid Separation		meters	
Units	M	meters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

Tab. 3: GGA Data Format

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3-5	Not supported
6	Dead Reckoning Mode, fix valid[4]

Tab. 4: Position Fix Indicator

[4] Apply only to NMEA version 2.3 (and later).

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5.1.2. GLL - Geographic Position - Latitude/Longitude

GLL sentence is displayed on the user device with the following format:

```
$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41
```

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=Autonomous, D=DGPS, E=DR (Only present in NMEA version 3.00)
Checksum	*41		
<CR> <LF>			End of message termination

Tab. 5: GLL Data Format

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5.1.3. GSA - GNSS DOP and Active Satellites

GSA sentence is displayed on the user device with the following format:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Tab. 7
Mode 2	3		See Tab. 8
Satellite Used[5]	07		Sv on Channel 1
Satellite Used	02		Sv on Channel 2
....			
Satellite Used1			
PDOP	1.8		
HDOP	1.0		
VDOP	1.5		
Checksum	*33		
<CR> <LF>			End of message termination

Tab. 6: GSA Data Format

Value	Description
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Tab. 7: Mode 1

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

Tab. 8: Mode 2

[5] Satellite used in sollution.

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5.1.4. GSV - GNSS Satellites in View

GSV sentences are displayed on the user device with the following format:

```
$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71
$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41
```

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages[6]	2		Range 1 to 3
Message Number	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	
Azimuth	048	degrees	
SNR (C/No)	42	dBHz	
....	....	....	
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR> <LF>			End of message termination

Tab. 9: GSV Data Format

[6] Depending on the number of satellites tracked, multiple messages of GSV data may be required

5.1.5. RMC - Recommended Minimum Specific GNSS Data

RMC sentence is displayed on the user device with the following format:

```
$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10
```

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status[7]	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	120598		ddmmyy
Magnetic Variation[8]		degrees	E=east or W=west
East/West Indicator	E		E=east
Mode[9]	A		A=Autonomous, D=DGPS, E=DR
Checksum	*10		
<CR> <LF>			End of message termination

Tab. 10: RMC Data Format

[7] See [8], [9]
[8] See [9]
[9] Apply only to NMEA version 2.3 (and later).

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5.1.6. VTG - Course Over Ground and Ground Speed

VTG sentence is displayed on the user device with the following format:

```
$GPVTG,309.62,T, ,M,0.13,N,0.2,K,A*23
```

Table I: **VTG Data Format**

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62		Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic[10]
Speed	0.13	knots	Measured horizontal speed
Units	N	Knots	
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode[11]	A		A=Autonomous, D=DGPS, E=DR
Checksum	*23		
<CR> <LF>			End of message termination

Tab. 11: VTG Data Format

[10] See [9]

[11] Apply only to NMEA version 2.3 (and later).

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5.2. NMEA Input Messages

NMEA input messages enable the user to control the GPS receiver using the NMEA serial port, refer to fig. 2, fig. 3, fig. 4. In the following sub paragraphs are showed only the NMEA input message supported by the TELIT GPS solutions.

The message syntax is explained in the following table:

Start Sequence	Payload	Checksum	End Sequence
$PSRF<MID>	Data	*CKSUM	<CR> <LF>

Tab. 12: Transport Message parameters

Field Description:

$PSRF<MID> identifies the command. <MID> (Message IDentifier) consists of three numeric characters.

The following table summarizes the available commands:

Message	Name	Description
103	Query / Rate Control	Query standard NMEA message and/or set output rate
105	Development Data On/Off	Development Data messages On/Off
106	Select Datum	Selection of datum used for coordinate transformations

Tab. 13: Supported NMEA Input Messages

Data depends from the selected command. Refer to a specific message section for <data> definition.

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*CKSUM	is a two-hex characters defined in the NMEA specification [1]. Checksum consists of a binary exclusive OR of the lower 7 bits of each message character represented in ASCII form starting from "$" (excluded) until "*" (excluded). The resulting 7-bit binary number is translated in an hexadecimal number of two digits. Each digit is transformed in ASCII format and entered into the message.
<CR> <LF>	each message must be terminated with a Carriage Return (CR) followed by a Line Feed (LF) (hex: 0D 0A). They cause the GPS receiver to process the input message.

NOTE: All fields in the SIRF proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

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5.2.1. Message 103 – Query / Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

The command has the following syntax:

```
$PSRF103,<Msg>,<Mode>,<Rate>,<Checksum Enable>*<checksum><CR><LF>
```

Example:

Querying the GGA message with checksum enabled:

```
$PSRF103,00,01,00,01*25
```

The following table describes the command fields:

Name	Example	Unit	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See Tab. 15
Mode	01		0=Set rate, 1=Query
Rate	00	sec	Output off=0, max =255
CksumEnable	01		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR><LF>			End of message termination

Tab. 14: Query/Rate Control Data Format

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG

Tab. 15: Available messages

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Examples:

Enabling VTG message for a 1 Hz constant output with checksum enabled:

$PSRF103,05,00,01,01*20

Disabling VTG message:

$PSRF103,05,00,00,01*21

Enabling VTG and GLL sentences:

$PSRF103,05,00,01,01*20<CR><LF>

$PSRF103,01,00,01,01*24<CR><LF>

5.2.2. Message 105 – Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables you to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

The command has the following syntax:

$PSRF105,<Debug>< checksum><CR><LF>

Examples:

Debug On

$PSRF105,1*3E

Debug Off

$PSRF105,0*3F

The following table describes the command fields:

Name	Example	Unit	Description
Message ID	$PSRF105		PSRF105 protocol header
Debug	1		0=off, 1=On
Checksum	*3E		
<CR><LF>			End of message termination

Tab. 16: Development Data On/Off Data Format

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5.2.3. Message 106 – Select Datum

GPS receivers perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS 84 (World Geodetic System 1984), which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. (Local map datums are a best fit to the local shape of the earth and not valid worldwide.)

The command has the following syntax:

$PSRF106,<Datum>< checksum><CR><LF>

Examples:

Datum select TOKYO_MEAN

$PSRF106,178*32

The following table describes the command fields:

Name	Example	Unit	Description
Message ID	$PSRF106		PSRF106 protocol header
Datum	178		21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	*32		
<CR><LF>			End of message termination

Tab. 17: Select Datum Data Format

6. Document History

Revision	Date	Changes
0	2011-07-07	First issue

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