Telit wireless solutions

# GM, GE/GL Families GPS Solutions

## User Guide

1vv0300914 Rev.1 – 2011-12- 02

Making machines talk.

# APPLICABILITY TABLES

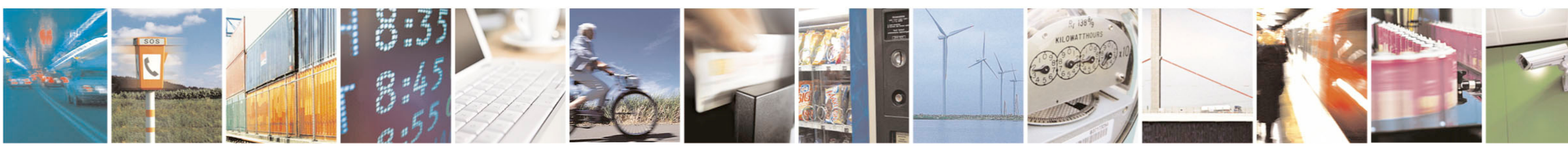
**Table Legend:** • command is supported; – command is not supported; * factory setting

| GM Family ( Modem) | Software Version | AT Ref. Guide | Technology Family | #SELINT=0 | #SELINT=1 | #SELINT=2 | GPS Module | GPS SW Option | NMEA-0183 |
|---|---|---|---|---|---|---|---|---|---|
| GM862-GPS | 7.03.xx3 | [1] | GSM/GPRS | • | • | * | SiRF Star III | GSW3 | Ver. 2.20 |
| **GE/GL Family ( Embedded )** | | | | | | | | | |
| GE863-GPS | 7.03.xx3 | [1] | GSM/GPRS | • | • | * | SiRF Star III | GSW3 | Ver. 2.20 |
| GE864-GPS | 10.00.xx5 | [1] | GSM/GPRS | – | – | • | SiRF Star IV | GSD4e | Ver. 3.01 |

**Tab. 1: Products covered by the present document**

The following list, organized in alphabetical order, shows the AT commands, concerning the GPS receiver, covered by this User Guide. The number close to each command indicates the page of the first AT command occurrence.





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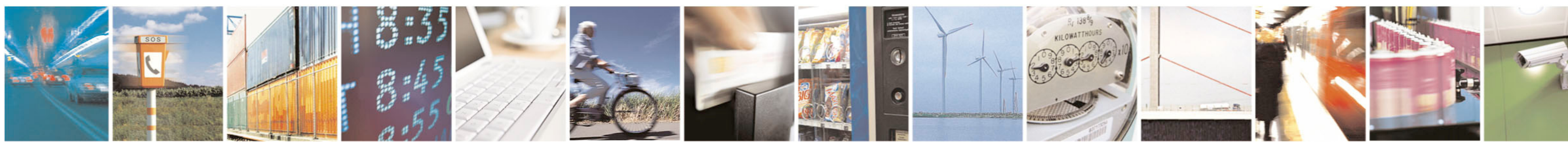

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# 1. Introduction

Telit Modules providing GPS feature are equipped with a SiRF chips as showed by Tab. 1. 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 GPS 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 document, and only a brief description of the NMEA sentences is reported in chapter 5, for the complete description refer to [9].

## 1.2. Audience

This User Guide is intended for users that need to learn and try quickly GPS AT commands provided by the Telit Modules. The reader can approach to the GPS AT commands by means of the examples showed on the present document and then deepen the interested AT commands reading the documents [6].

## 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
TS-APAC@telit.com

Alternatively, use:

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

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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

## 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] Virtual Serial Device, Application Note, 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. Document History

| Revision | Date | Changes |
|---|---|---|
| 0 | 2011-07-07 | First issue: Title: TELIT GPS Solutions, Application Note |
| 1 | 2011-12-02 | This revision has been obtained through a total make up of the preceding revision. The document title of the old revision has been change in accordance with the document code: GM, GE/GL Families GPS Solutions, User Guide |

## 1.6. Abbreviations and acronyms

| | |
|---|---|
| ASCx | Asynchronous Serial Communication |
| 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 |

# 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.

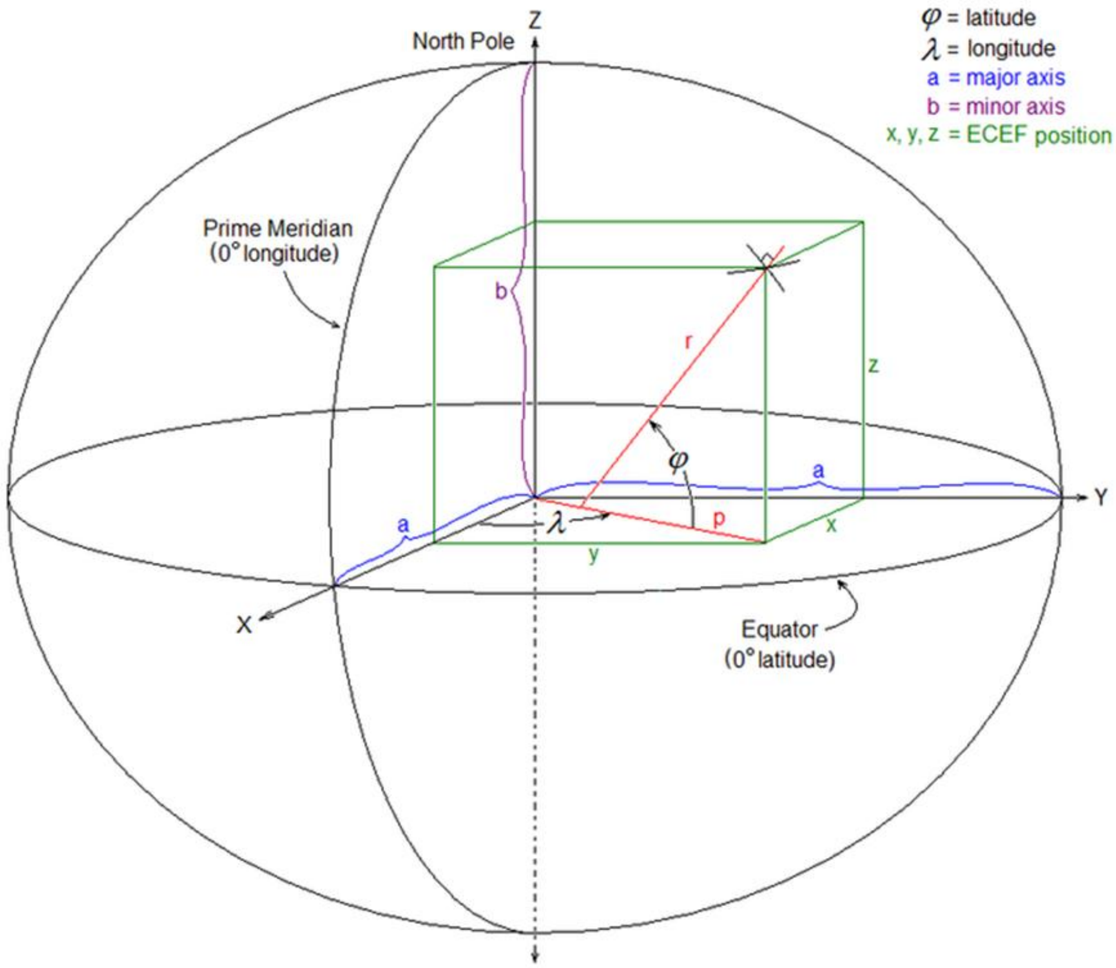



fig. 1: ECEF coordinate system [from Wikipedia]

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.

# 3. GSM Modem /GPS Receiver Interface

The present chapter will describe the GPS configurations provided by each module indicated on the Tab. 1.

## 3.1. GM862-GPS

The interface between Telit GSM modem and GPS receiver is carried out by means of an internal serial line (hardwired) as sketched on fig. 2. In this module only two serial lines are externally available for the user applications. The external physical ports are: Modem Serial Port and GPS Serial Port (NMEA), refer to [3].

The GPS receiver is equipped with two serial ports:

SIRF BINARY port: supports GPS navigation data in SIRF BINARY format [1] [8]. The factory configuration is 57,600 bps, 8, n, 1.

NMEA port: supports GPS navigation data in NMEA-0183 format, see chapter 5. The factory configuration is 4,800 bps, 8, n, 1.

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.

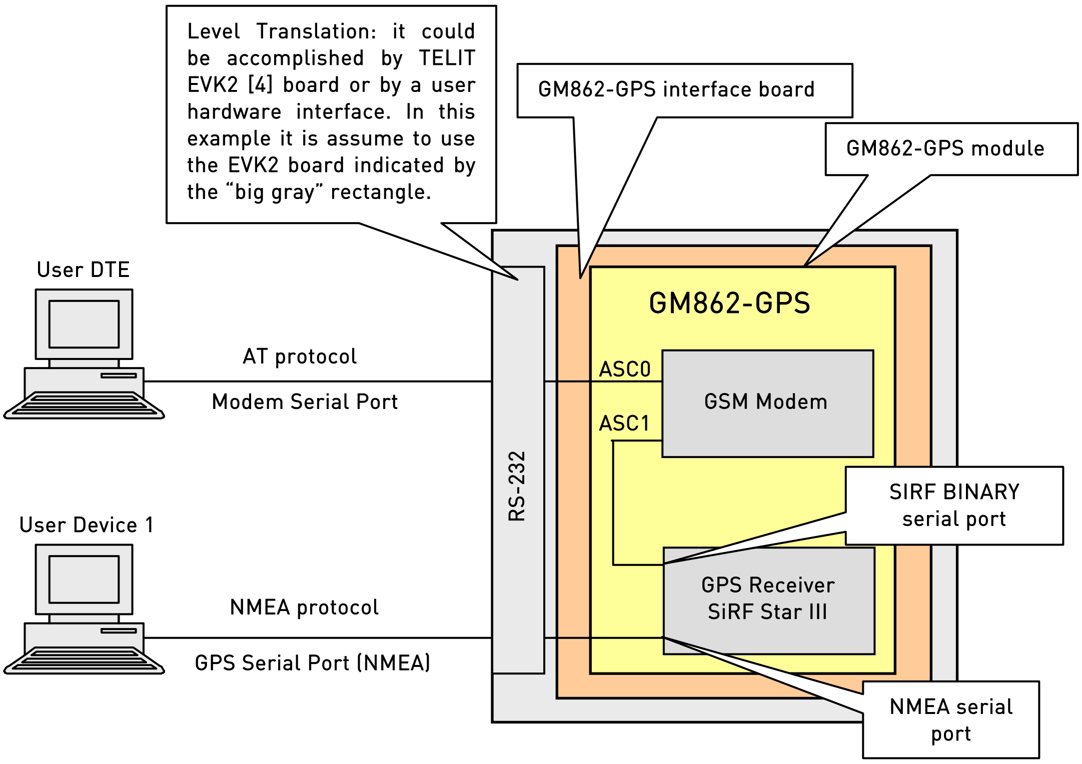



fig. 2: GM862-GPS Serial Ports' availability

## 3.2. GE863-GPS

The interface between Telit GSM modem and GPS receiver is carried out by means of a serial line as sketched on
fig. 3. In this module four serial lines are externally available for the user applications. The external physical ports are: Modem Serial Port, Modem Serial Port 2 (GPS Control Port), GPS Serial Port A (SIRF BINARY) and GPS Serial Port B (NMEA), refer to [5].

The GPS receiver is equipped with two serial ports:

SIRF BINARY port: supports GPS navigation data in SIRF BINARY format[2] [8]. The factory configuration is 57600 bps, 8, n, 1.

NMEA port: supports GPS navigation data in NMEA-0183 format, see chapter 5. The factory configuration is 4,800 bps, 8, n, 1.

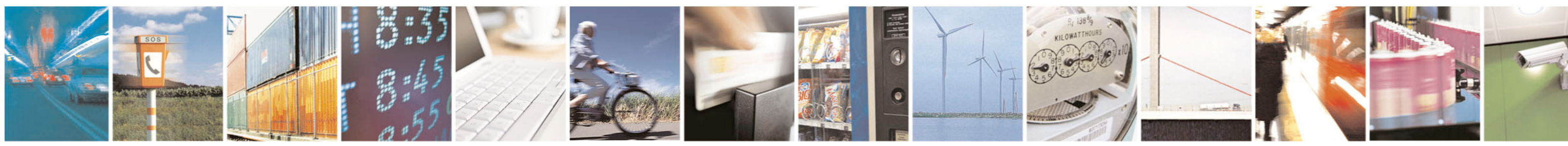
Refer to

fig. 3. Let's assume that a jumper is plugged into centre-position, the user may interface the Telit module with two applications: the first one, running on User DTE, could be a script to manage the GSM modem and GPS receiver; the second one, running on User Device 1, to display NMEA sentences.

Now, 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].

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



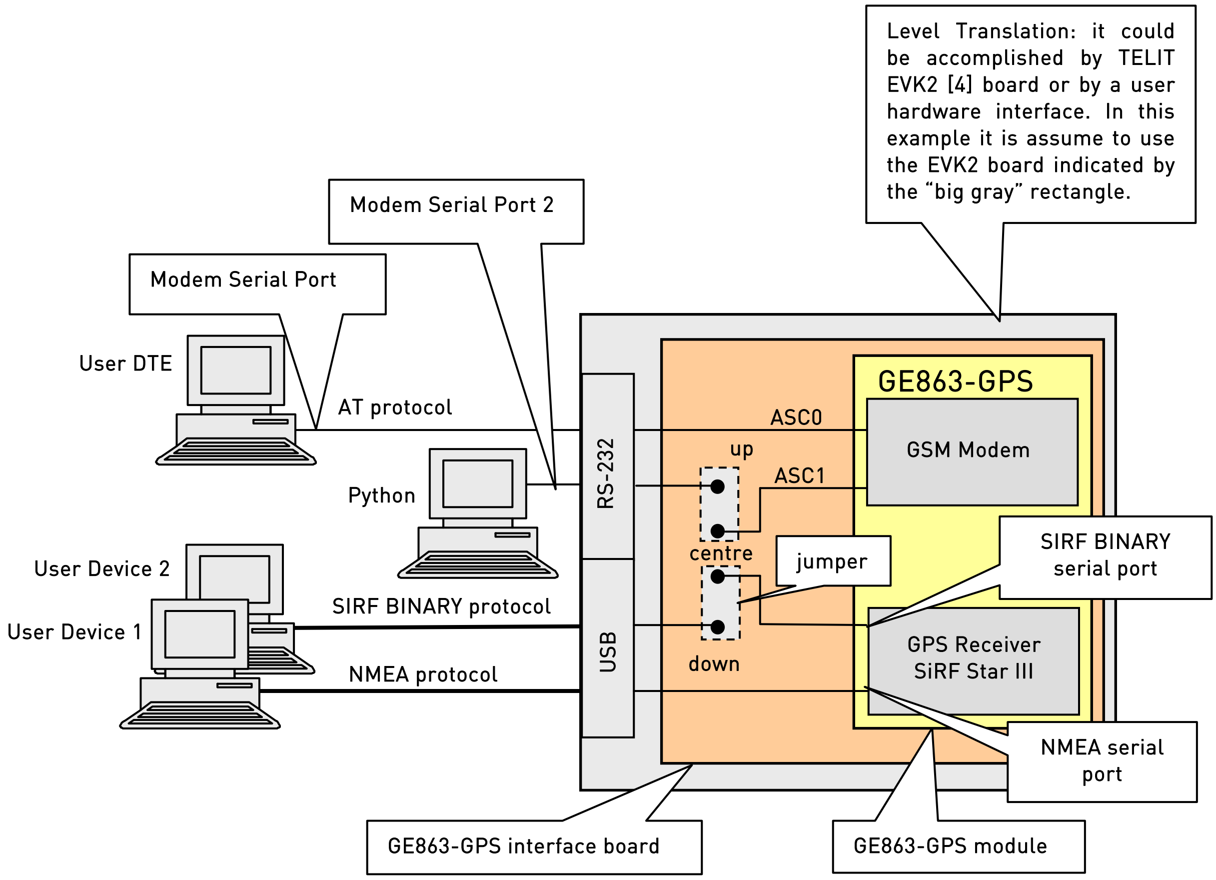



fig. 3: GE863-GPS Serial Ports' availability

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.

## 3.3. GE864-GPS

The interface between Telit GSM modem and GPS receiver is carried out by means of a serial line as sketched on fig. 4. Three serial lines are externally available for the user applications. The external physical serial ports are: Modem Serial Port, Modem Serial Port 2 and GPS Serial Port (NMEA), refer to [10].

GE864-GPS product is equipped with a SiRF Star IV GPS receiver endowed with only one serial port called NMEA serial port (factory setting: 4,800 bps, 8, n, 1).

Refer to the fig. 4. 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 - refer to [7]. In order to make the Python outputs available to the user a new jumper shall be plugged into up-position,

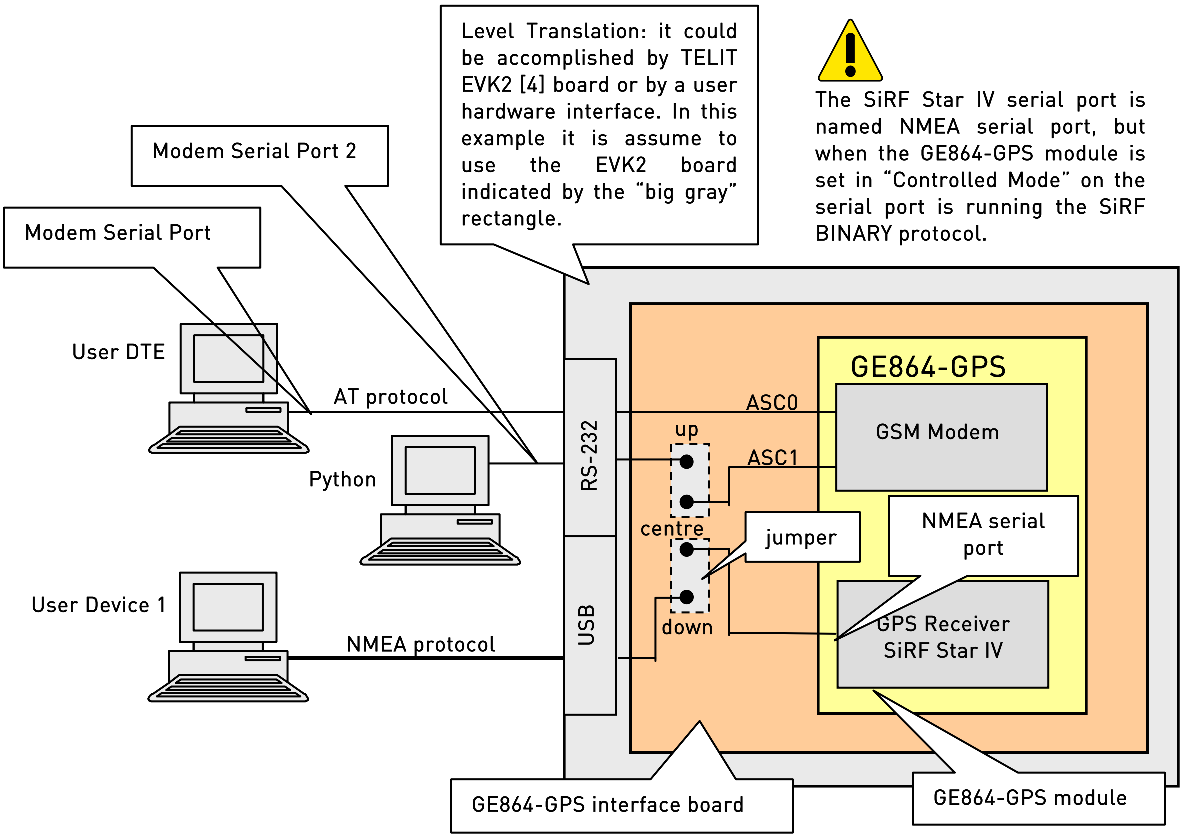



fig. 4: GE864-GPS Serial Ports' availability

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.

# 4. AT Commands to Control GPS Receiver

The following chapters describe a reduced set of 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, refer to Tab. 1.

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 chapter 4.8.

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 ASC1 port 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.

Tab. 1 shows that all modules providing the GPS feature are able to support the AT Interface Style #SELINT=2, it is the suggested AT interface. In accordance with the suggestion the present document will only refer to AT$GPS commands supported by #SELINT=2.

## 4.1. Controlled Mode

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

AT$GPSD=<device type>

**GM862-GPS** module, refer to fig. 2

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 setting: "Controlled Mode"
OK

GE863-GPS module, refer to

fig. 3

Let's assume that the GPS factory setting, memorized on NVM memory, 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 setting: "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, e.g.: 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 setting: "Controlled Mode"
OK

Use the following procedure to exit "Controlled Mode", free ASC1 port and run NMEA sentences on NMEA serial port 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"
- 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 free and available for other services, e.g.: Python [7],

- plug a new jumper into up-position.

## 4.2. NMEA Sentences on Modem Serial Port

Let's assume that the GPS factory setting, memorized on NVM memory, hasn't been changed and a jumper is plugged into centre-position, where applicable: GE863-GPS and GE864-GPS. By means of the following AT command NMEA sentences can be available on Modem Serial Port (ASC0) 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 current 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
...
...
```

GM862-GPS and GE863-GPS modules

After entering AT$GPSNMUN=1, … command, NMEA sentences appear on User DTE and User Device1. To disable the entire set of the NMEA sentences running on Modem Serial Port (ASC0) enter:

AT$GPSNMUN=0
OK

GE864-GPS module

After entering AT$GPSNMUN=1, … command, NMEA sentences appear on User DTE. To disable the entire set of the NMEA sentences running on Modem Serial Port (ASC0) enter:

AT$GPSNMUN=0
OK

## 4.3. 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$GPSP=0<br>OK | Switch off GPS receiver |
| AT$GPSP?<br>$GPSP: 0<br>OK | Check its status |
| AT$GPSP=1<br>OK | Switch on GPS receiver |

## 4.4. GPS Reset

AT command used to reset the GPS receiver.

AT$GPSR=<reset_type>

### Examples:

Check the value range of the AT command. In accordance with the requirements select it.

AT$GPSR=?
$GPSR: (0-3)
OK

The following command forces 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.

## 4.5. GPS Antenna Power Supply

The GPS receiver needs an active antenna that may be powered by the module itself (factory setting) 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

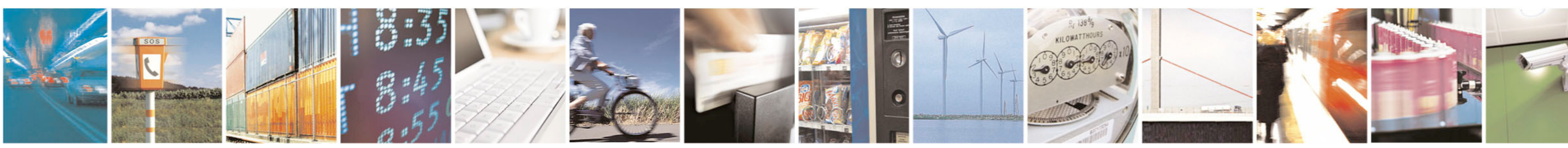
AT$GPSAT=<type>

### Examples

Check the values range supported by the AT command.

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

### 4.5.1. GPS Antenna Current and Voltage Readout

The following AT commands are available on GM862-GPS and GE863-GPS modules only, and 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 mA
OK

## 4.6. 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.

GE864-GPS is provided 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 LNA
OK

## 4.7. Saving GPS Parameters

The following AT command is used to save the GPS parameters set into NVM memory.

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 setting.

| | |
|---|---|
| AT$GPSD? | check the ASC1 Mode |
| $GPSD: 2 | ASC1 is in "Controlled Mode" |
| OK | |
| AT$GPSD=0 | force ASC1 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 ASC1 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 | |

## 4.8. Restoring GPS Parameters

The following AT command is used to restore the factory setting GPS parameters.

AT$GPSRST
OK

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

## 4.9. Reading Acquired GPS Position

The following AT command is 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

## 4.10. Setting the GPS Module in Power Saving Mode

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

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

### Examples:

Check the values ranges supported by the AT command

AT$GPSPS=?
$GPSPS: (0-3),(0-300000)
OK

Check the current values.

AT$GPSPS?
$GPSPS: 0,1800
OK

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

NOTE: AT$GPSPS=3 is supported only by #SELINT=2, the suggested AT Interface Style. Refer to Tab. 1 and [6].

## 4.11. Wake Up GPS from Power Saving Mode

The following AT command is 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 that power saving is disabled (factory setting). 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[3]

Operation not supported because the GPS receiver is powered ON.

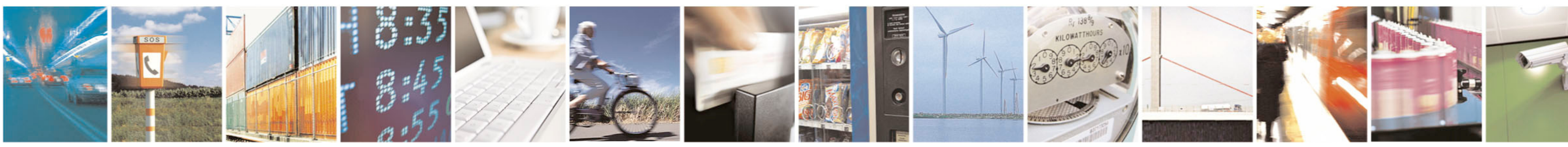
Power down the GPS receiver.

AT$GPSPS=2
OK

Wake up the GPS receiver.

AT$GPSWK
OK

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



## 4.12. GPS Software Version

The following AT command is used to read the GPS Receiver software version.

AT$GPSSW

**Example:**

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

## 4.13. Direct Access to GPS

Assume that the GPS receiver port is physically connected to ASC1 serial port. The following AT command sets GSM module 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

# 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 following chapters provide information concerning the NMEA sentences that have applicability to GPS receivers[4], 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.

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

## 5.1. NMEA Output Messages

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

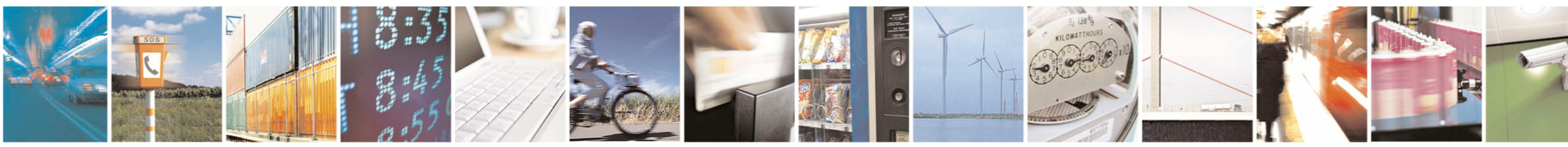
In order to enable the VTG and GLL sentences as well, the user can use the NMEA command $PSRF103, refer to paragraph 5.2.1.

| | |
|---|---|
| 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

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, refer to fig. 4. The module is out of the “Controlled Mode”, see paragraph 4.1.

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



```
$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
...
...
```

### 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[5] |

Tab. 4: Position Fix Indicator

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

### 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<br>(Only present in NMEA version 3.00) |
| Checksum | *41 | | |
| <CR> <LF> | | | End of message termination |

Tab. 5: GLL Data Format

### 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[6] | 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

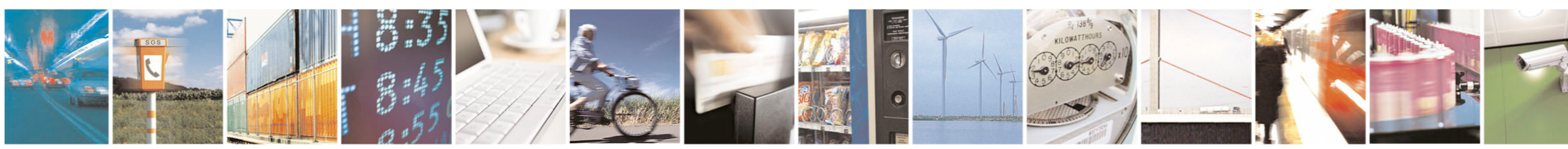
| Value | Description |
|---|---|
| M | Manual—forced to operate in 2D or 3D mode |
| A | 2D Automatic—allowed to automatically switch 2D/3D |

Tab. 7: Mode 1

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

Tab. 8: Mode 2

[6] Satellite used in solution.



## 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[7] | 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

[7] 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[8] | 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[9] | | degrees | E=east or W=west |
| East/West Indicator | E | | E=east |
| Mode[10] | A | | A=Autonomous, D=DGPS, E=DR |
| Checksum | *10 | | |
| <CR> <LF> | | | End of message termination |

Tab. 10: RMC Data Format

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

### 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[11] |
| Speed | 0.13 | knots | Measured horizontal speed |
| Units | N | Knots | |
| Speed | 0.2 | km/hr | Measured horizontal speed |
| Units | K | | Kilometers per hour |
| Mode[12] | A | | A=Autonomous, D=DGPS, E=DR |
| Checksum | *23 | | |
| <CR> <LF> | | | End of message termination |

Tab. 11: VTG Data Format

[11] See [9]
[12] Apply only to NMEA version 2.3 (and later).

## 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 chapters 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:

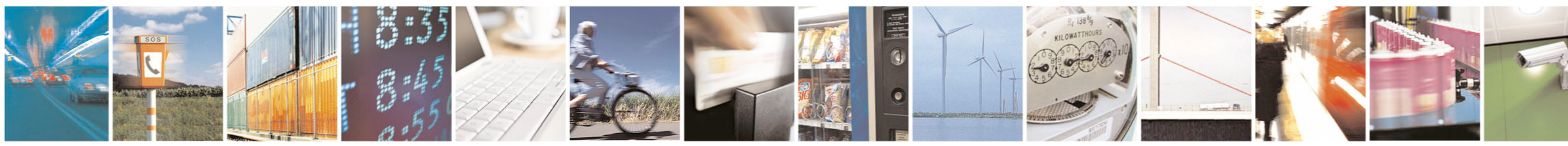
| Message | Name | Description |
|---|---|---|
| 103 | Query / Rate Control | Query standard NMEA message and/or set output rate |
| 105 | Development Data On/Off | Development Data messages On/Off |
| 106 | Select Datum | Selection of datum used for coordinate transformations |

Tab. 13: Supported NMEA Input Messages

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

*CKSUM 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), refer to Tab. 12. 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.

### 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

**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

### 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<br>178=TOKYO_MEAN<br>179=TOKYO_JAPAN<br>180=TOKYO_KOREA<br>181=TOKYO_OKINAWA |
| Checksum | *32 | | |
| <CR><LF> | | | End of message termination |

Tab. 17: Select Datum Data Format