V33 Software User Guide

1VV0301317 Rev.1 - 2017-03-08

Making machines talk.

APPLICABILITY TABLE

PRODUCT
SL869-V3
SL869-ADR
SL869-3DR

SW Version
V33-1.0.4-STD
V33-1.0.2-CLDR

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

Notice

While reasonable efforts have been made to assure the accuracy of this document, Telit assumes no liability resulting from any inaccuracies or omissions in this document, or from use of the information obtained herein. The information in this document has been carefully checked and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies or omissions. Telit reserves the right to make changes to any products described herein and reserves the right to revise this document and to make changes from time to time in content hereof with no obligation to notify any person of revisions or changes. Telit does not assume any liability arising out of the application or use of any product, software, or circuit described herein; neither does it convey license under its patent rights or the rights of others.

It is possible that this publication may contain references to, or information about Telit products (machines and programs), programming, or services that are not announced in your country. Such references or information must not be construed to mean that Telit intends to announce such Telit products, programming, or services in your country.

Copyrights

This instruction manual and the Telit products described in this instruction manual may be, include or describe copyrighted Telit material, such as computer programs stored in semiconductor memories or other media. Laws in the Italy and other countries preserve for Telit and its licensors certain exclusive rights for copyrighted material, including the exclusive right to copy, reproduce in any form, distribute and make derivative works of the copyrighted material. Accordingly, any copyrighted material of Telit and its licensors contained herein or in the Telit products described in this instruction manual may not be copied, reproduced, distributed, merged or modified in any manner without the express written permission of Telit. Furthermore, the purchase of Telit products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Telit, as arises by operation of law in the sale of a product.

Computer Software Copyrights

The Telit and 3rd Party supplied Software (SW) products described in this instruction manual may include copyrighted Telit and other 3rd Party supplied computer programs stored in semiconductor memories or other media. Laws in the Italy and other countries preserve for Telit and other 3rd Party supplied SW certain exclusive rights for copyrighted computer programs, including the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Telit or other 3rd Party supplied SW computer programs contained in the Telit products described in this instruction manual may not be copied (reverse engineered) or reproduced in any manner without the express written permission of Telit or the 3rd Party SW supplier. Furthermore, the purchase of Telit products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Telit or other 3rd Party supplied SW, except for the normal non-exclusive, royalty free license to use that arises by operation of law in the sale of a product.

Usage and Disclosure Restrictions

License Agreements

The software described in this document is the property of Telit and its licensors. It is furnished by express license agreement only and may be used only in accordance with the terms of such an agreement.

Copyrighted Materials

Software and documentation are copyrighted materials. Making unauthorized copies is prohibited by law. No part of the software or documentation may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, without prior written permission of Telit

High Risk Materials

Components, units, or third-party products used in the product described herein are NOT fault-tolerant and are NOT designed, manufactured, or intended for use as on-line control equipment in the following hazardous environments requiring fail-safe controls: the operation of Nuclear Facilities, Aircraft Navigation or Aircraft Communication Systems, Air Traffic Control, Life Support, or Weapons Systems (High Risk Activities"). Telit and its supplier(s) specifically disclaim any expressed or implied warranty of fitness for such High Risk Activities.

Trademarks

TELIT and the Stylized T Logo are registered in Trademark Office. All other product or service names are the property of their respective owners.

Contents

1. Introduction

1.1. Scope

This document describes the basic serial communications interface for any GNSS receiver module within the V33 product family.

1.2. Audience

This document is intended for public distribution to potential customers who are evaluating a GNSS module from the V33 product family and which is listed in the Applicability Table on page 2. It can also be used by customers who are developing application software for a Host Processor contained within their product that incorporates one of the listed 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
TS-APAC@telit.com

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

To register for product news and announcements or for product questions contact Telit Technical Support Center (TTSC).

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. Document Organization

This document contains the following chapters:

Chapter 1: "Introduction" provides a scope for this document, target audience, contact and support information, and text conventions.

Chapter 2: "Communication Interface" gives an overview of the serial communications interface and describes general characteristics of input commands and output messages.

Chapter 3: "Commands Description" describes in detail each of the input commands for the SL869.

Chapter 4: "Messages Description" describes in detail each of the output messages produced by the SL869.

Chapter 5: "Document History" provides of the changes made to this User Guide.

1.5. Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.6. Related Documents

N/A

2. Communication Interface

The serial communication interface between a GNSS receiver module within the V33 product family and the Host Processor is based on the NMEA-0183 protocol standard specified by the National Marine Electronics Association (NMEA). This is an ASCII-based standard that is widely used in the GPS and GNSS industry for serial communication with GPS and GNSS receivers.

2.1. UART

Serial communication with the module is primarily conducted over the UART port, which is assigned to Pins 20 (Tx) and 21 (Rx). There is no hardware flow control. The default port settings are:

- 9600 Baud
- Eight data bits
- No parity bits
- One stop bit

Note that manual user interaction with the module can be achieved using a PC terminal emulator.

2.2. USB

Alternatively, serial communication can be conducted over the module's USB port, which is assigned to Pins 5 (USB D-) and 6 (USB D+). The USB port is enabled and the UART port is disabled when the USB Detect input signal (Pin 7) is asserted high.

IMPORTANT NOTE:

The USB interface is currently not supported.

2.3. NMEA Characteristics

This subsection highlights characteristics of the NMEA-0183 protocol as they pertain to the serial communication interface.

2.3.1. Start And Termination

An NMEA data packet is transmitted as an ASCII string beginning with a "$" character, but it is terminated with <carriage return> <line feed> character sequence. The hexadecimal representation of this sequence is 0x0D 0x0A.

2.3.2. Talker ID and Standard Packets

Standard data packets as defined in the NMEA-0183 protocol begin the "$" character followed by an NMEA talker ID. Modules within the V33 product family use the following talker IDs: "GP" indicating GPS, "GL" indicating GLONASS, "BD" indicating BEIDOU, "GA" indicating GALILEO, and "GN" indicating a span of multiple global navigation satellite systems (GNSS).

2.3.3. Proprietary Packets

Proprietary data packets are allowed by the NMEA protocol standard. They begin with "$P" followed by a Manufacturer's Mnemonic Code that is assigned by the NMEA. A module in the V33 product family is based on the STA8090 device from ST Microelectronics, who has been assigned the code "STM." Therefore, proprietary packets used by the module and that were developed by ST Microelectronics begin with the character sequence "$PSTM."

2.3.4. Checksums

The NMEA standard specifies a two-character checksum field that follows a '*" delimiting character placed at the end of the ASCII data string. The checksum is calculated as the 8-bit exclusive-OR (XOR) of all characters in the string, excluding the "$" and "*' delimiters.

The module includes checksums on all periodic output messages. With one exception, checksums are not required on the input commands presented in this document. However, if the checksum is present, it is verified by the module.

2.3.5. Packet Length

The NMEA standard specifies a maximum number of characters for each data packet, but the module does not strictly adhere to this limit for proprietary data packets.

2.4. Commands

Commands are sent from the Host Processor to the module and have the basic structure illustrated below:

```
command-ID[,parameter1,parameter2,…,parameterN]<cr><lf>
```

Parameters, if present, are delimited by "," characters as per the NMEA protocol. All commands sent to modules within the V33 product family are proprietary and therefore all command-ID's begin with the "$PSTM" character sequence.

In most cases, the module will echo the command back out to the Host Processor after the command has been executed. Commands that are not echoed are indicated in the detailed commands descriptions later in this Guide.

NOTE:

An easy way to send commands to the module manually is to write the command to a text file and use the "send text file" function of the terminal emulator. When doing so, make sure that the <cr><lf> characters are transmitted at the end of the command.

2.5. Messages

Messages are sent from the module to the Host Processor and have the basic structure illustrated below:

```
message-ID,<data1,data2,…,dataN>*<checksum><cr><lf>
```

Individual data fields are delimited by "," characters. The checksum is provided for purposes of bit error detection by the Host if desired.

GNSS modules in the V33 product family output certain standard messages on a periodic basis using message IDs as defined in the NMEA-0183 protocol. These are message IDs that begin with "$<talker ID>" as mentioned in section 2.3 regarding standard data packets.

The module also supports proprietary messages that are output as responses to input commands. As with commands, proprietary message-IDs begin with "$PSTM." Note that not all response messages include a checksum.

3. Command Descriptions

The table below summarizes the set of basic commands for any module in the V33 product family:

Command ID	Description
$PSTMINITGPS	Initialize GPS position and time
$PSTMINITTIME	Initialize GPS time
$PSTMCLREPHS	Clear all ephemeris data
$PSTMDUMPEPHEMS	Dump ephemeris data
$PSTMEPH	Load ephemeris data
$PSTMNMEAONOFF	Toggle the NMEA output ON and OFF
$PSTMCOLD	Perform a COLD start
$PSTMWARM	Perform a WARM start
$PSTMHOT	Perform a HOT start
$PSTMSRR	Perform a system reset
$PSTMGPSRESET	Reset the GPS engine
$PSTMGETSWVER	Get the GNSS Library version
$PSTMSBASONOFF	Toggle the SBAS feature ON and OFF
$PSTMSBASSAT	Select the SBAS satellite PRN code
$PSTMSETCONSTMASK	Set the GNSS constellation mask

Unless otherwise noted in the following subsections, commands are echoed by the module after the command is executed.

3.1. $PSTMINITGPS

This command is used to initialize position and GPS time in the receiver module. It is typically only used for test purposes or for aiding satellite acquisitions in very harsh RF signal environments.

Synopsis:

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

Parameter	Format	Description
Lat	DDMM.MMM	Latitude (DegreesMinutes.FractionalMinute)
LatRef	'N' or 'S'	Latitude direction (North or South)
Lon	DDDMM.MMM	Longitude (DegreesMinutes.FractionalMinute)
LonRef	'E' or 'W'	Longitude direction (East or West)
Alt	dddd – Decimal, 4 digits	WGS-84 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)

The provided date must be no earlier than November 30, 2014. Date/time data will be ignored by the module if it already has an estimate of time. Likewise, the position data will be ignored by the module if it already has an estimate position. If the data is accepted, it will be reflected in the output messages, for example $GPGGA, and the module will respond with the message:

```
$PSTMINITGPSOK*40<cr><lf>
```

The $PSTMINITGPS command is ignored by the module if any of the input parameters are out of range or if the command is otherwise formatted incorrectly, and the module will respond with the message:

```
$PSTMINITGPSERROR*1c<cr><lf>
```

Example:

Initialize position to 48^0 11.365' N latitude, 11^0 54.123' E longitude and 530 meters altitude, and set current time to 9:44:12 GPS on Feb 23rd, 2015.

```
$PSTMINITGPS,4811.365,N,01154.123,E,0530,23,02,2015,09,44,12
```

3.2. $PSTMINITTIME

This command may be used to initialize GPS time in the receiver. It is typically only used for test purposes or for aiding satellite acquisitions in very harsh RF signal environments.

Synopsis:

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

Parameter	Format	Description
Day	dd – Decimal, 2 digits	Day of month (01 to 31)
Month	mm – Decimal, 2 digits	Month (01 to 12)
Year	yyyy – Decimal, 4 digits	Year (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)

The provide date must be no earlier than November 30, 2014. The input time will be ignored by the module if it already has an estimate of time. If the data is accepted, it will be reflected in the output messages, for example $GPGGA, and the module will respond with the message:

```
$PSTMINITTIMEOK*11<cr><lf>
```

The $PSTMINITTIME command is ignored by the module if any of the input parameters are out of range or if the command is otherwise formatted incorrectly, and the module will respond with the message:

```
$PSTMINITTIMEERROR*4d<cr><lf>
```

Example:

Initialize current time to 9:44:12 GPS on Feb 23rd, 2015.

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

3.3. $PSTMCLREPHS

This command allows the user to clear all ephemeris data from battery-backed RAM and erase all ephemeris stored in non-volatile backup memory. It is typically used to force the module to collect the most recent satellite ephemeris data, or to prepare the module to be loaded with ephemeris data over the serial port. There are no parameters, and there is no response message to this command.

Synopsis:

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

As a result of clearing ephemeris data, the module stops producing position fixes using tracked satellites for which it had ephemeris. Note however that this command does not clear predicted ephemeris associated with the STAGPS feature. Thus if the module had been navigating using predicted ephemeris for a tracked satellite (because broadcast ephemeris had not yet been collected), then the module continues to use that satellite.

Typically the module falls out of navigation as a result of the $PSTMCLREPHS command because there are an insufficient number of satellites used. It will produce position fixes after it has re-collected ephemeris from a sufficient number of satellites.

3.4. $PSTMDUMPEPHEMS

This command is used to request that the module output all ephemeris data stored in backup memory. There are no parameters.

Synopsis:

```
$PSTMDUMPEPHEMS<cr><lf>
```

The module responds with a series of $PSTMEPHEM messages, each containing the ephemeris data for one satellite. Each of these messages has the same format as the $PSTMEPHEM command described in the next section. Checksums are included in $PSTMEPHEM when it is a message, but they are not required when $PSTMEPHEM is used as a command.

The module echoes the command once all of the response messages have been output.

NOTE:

The $PSTMEPHEM response messages do not block regularly scheduled periodic output messages, and therefore they are not guaranteed to be output all in sequence. The $PSTMNMEAONOFF command can be used to temporarily disable periodic output so that the response messages can be captured as one sequence and then be re-used as a source of $PSTMEPHEM load ephemeris commands.

3.5. $PSTMEPHEM

This command allows the user to load ephemeris data for a satellite into battery-backed RAM and non-volatile backup memory. It has the same ID and data structure as when it is output as a message.

Synopsis:

```
$PSTMEPHEM,<SatId>,<Size>,<Byte1>……<ByteN>*<checksum><cr><lf>
```

Parameter	Format	Description
SatId	ii – Decimal, 2 digits	Satellite ID (GPS PRN number, range 1 to 32, or GLONASS frequency number , range 65 to 92)
Size	nn - Decimal, 2 digits	Number of ephemeris data bytes in the command
Byte1… ByteN	bb – Hexadecimal, 2 digits	N ephemeris data bytes
checksum	cc – Hexadecimal, 2 digits	NMEA checksum

Note also that the ephemeris data bytes are input as a single parameter and are not delimited by commas.

Example:

```
$PSTMEPHEM,3,64,8f06786978691313132001009ba4ff009af9e5178c12aa
faba006e00fc3700001f7eea25cab5b60780b00da183d906cb6048efd545e6
e12ff7002d0012c0c003*58
```

If the command is successful the module responds with the message:

```
$PSTMEPHEMOK*48
```

If the module detects a problem with data, for example an insufficient number of data bytes, and the command fails to execute, the module responds with the message:

```
$PSTMEPHEMERROR*17
```

NOTE:

This command has the same format as the $PSTMEPHEM message that is output in response to the $PSTMDUMPEPHEMS command described in the previous section.

3.6. $PSTMNMEAONOFF

This command can be used to switch the periodic NMEA output on and off. It does not affect command responses. The parameter is optional. If the parameter is not provided, the NMEA output is toggled on or off. There is no response message to this command.

Synopsis:

```
$PSTMNMEAONOFF[,<OnOff]<cr><lf>
```

Parameter	Format	Description
OnOff	One digit decimal	0 – NMEA output will be disabled 1 – NMEA output will be enabled

3.7. $PSTMCOLD

This command can be used to cause the module to perform a cold start. There is no response message to this command.

Synopsis:

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

Parameter	Format	Description
Mask	Integer	Optional configuration parameter used to specify data to be invalidated for the cold start: 0x01 – clear almanac 0x02 – clear ephemeris 0x04 – clear position 0x08 – clear time

If the mask parameter is not provided, the default cold start configuration, bitmap 0xE (clear ephemeris, position and time), is used. This is equivalent to an input parameter of 14 and is the most common definition of a cold start used in the industry.

Note that this command does not necessarily replicate an operational cold start, which occurs when the module is powered up from an off state (both main power and Vbatt are removed). In this case the module uses stored position, time, date and ephemeris from non-volatile memory as its initial data.

In response to this message the module will restart the GNSS engine.

Example:

Cold start with all data cleared:

```
$PSTMCOLD,15
```

3.8. $PSTMWARM

This command causes the module to perform a warm start. A warm start is defined as one in which position and time is known from a previous operation but ephemeris is invalid. There are no parameters, and there is no response message to this command.

Synopsis:

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

In response to this message the module will restart the GNSS engine.

3.9. $PSTMHOT

This command causes the module to perform a hot start. A hot start is defined as one in which position and time is known and ephemeris is valid from previous operation. There are no parameters, and there is no response message to this command.

Synopsis:

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

In response to this message the module will restart the GNSS engine.

3.10. $PSTMSRR

This command allows the user to execute a system reset and reboot the GNSS firmware on the module. There are no parameters, and there is no response message to this command.

Synopsis:

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

NOTE:

The module does not echo the $PSTMSRR command.

3.11. $PSTMGPSRESET

This command is used to restart the GNSS receiver engine without rebooting the GNSS module firmware. There are no parameters for this command, and there is no response message to this command.

Synopsis:

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

3.12. $PSTMGETSWVER

This command allows the user to get the versions of the libraries embedded within the firmware application. It also allows the user to get the Telit firmware application version string, which is also output in a GPTXT message when the module starts up.

Synopsis:

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

Parameter	Format	Description
Id	Integer	Identifier representing the specified library or libraries for which the version number is being requested 0 – GNSS Library 1 – OS20 Library 2 – SDK Application 4 – WAAS (SBAS) Library 6 – Binary Image 8 – STAGPS Library 10 – Automotive DR Library[1] 255 – Telit Version

Note 1: This parameter value is only applicable to modules that have automotive DR firmware.

The module responds with the following message format for all valid input parameter values except for 255:

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

Parameter	Format	Description
Lib	Fixed Text	Text string indicating the requested library: - GNSSLIB - OS20LIB - GPSAPP - WAASLIB - BINIMG - STAGPSLIB
Ver	x.x.x.x	Library version, for example 7.3.1.43
Type	ARM	Indicates ARM compiler type

If the input parameter value is 255, the module responds with a message of the form:

```
$PTWSVER,<Telit version string>*<checksum><cr><lf>
```

3.13. $PSTMSBASONOFF

This command can be used to toggle the SBAS differential GPS feature on and off. By default the SBAS feature is off (disabled) whenever the module is reset. When SBAS is on (enabled), the module searches for SBAS satellites. If the module successfully acquires a satellite, it obtains and uses differential GPS corrections transmitted by the satellite. The satellite ID of the acquired SBAS satellite appears in the GPGSV messages. For WAAS satellites the ID is the system PRN minus an offset of 87.

Synopsis:

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

There is no response message associated with this command.

3.14. $PSTMSBASSAT

This command is used to select the SBAS PRN code to be used for differential operation. If the selected SBAS PRN cannot be acquired within five minutes, the module automatically selects another SBAS satellite. The selected satellite reverts back to the default PRN when the module is reset or is power cycled. The default selected SBAS PRN is 135.

Synopsis:

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

Parameter	Format	Description
Prn	Decimal, three digits	SBAS Satellite PRN code, ranging from 120 to 138

There is no response message associated with this command.

Example:

Set the SBAS PRN code to 138:

```
$PSTMSBASSAT,138
```

3.15. $PSTMSETCONSTMASK

This command can be used to select the GNSS constellations to be used by the module for positioning. The constellations are specified using a bit mask. If a constellation is disabled, the associated GSV messages (satellite visibility) and the GSA message for that constellation are no longer output.

Synopsis:

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

Parameter	Format	Description
Mask	Decimal	Each bit enables/disables a specific constellation independent from the other bits: 0x01 – enable GPS constellation 0x02 – enable GLONASS constellation 0x04 – enable QZSS constellation 0x08 – enable GALILEO constellation 0x80 – enable BEIDOU constellation

Note that the mask is input as a decimal number. If the command is successful, the module responds with the following message and echoes the specified mask:

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

The new constellation mask remains in effect until a system reset is performed on the module.

If the input parameter for the command is missing or is not a valid value, the module responds with the following message:

```
$PSTMSETCONSTMASKERROR*51<cr><lf>
```

Examples:

Enable use of the GPS constellation only:

```
$PSTMSETCONSTMASK,1
```

Enable use of the GLONASS constellation only:

```
$PSTMSETCONSTMASK,2
```

Enable use of GPS, GLONASS and QZSS constellations:

```
$PSTMSETCONSTMASK,7
```

Enable use of the GPS and BEIDOU constellations:

```
$PSTMSETCONSTMASK,129
```

3.16. $PSTMFORCESTANDBY

This command is used to put the module in a very low power Standby state for a specified length of time. After the specified time period has elapsed, the module returns to its previous operational mode.

Synopsis:

```
$PSTMFORCESTANDBY,<Duration><cr><lf>
```

where `Duration` is an unsigned integer value specifying the Standby mode time period in seconds, ranging from 1 to 65535 seconds (~18.2 hours).

If the command is successful, the module responds with the following message and enters Standby mode:

```
$PSTMFORCESTANDBYOK*14<cr><lf>
```

If the input parameter is missing or contains invalid characters, the module responds with the following message:

```
$PSTMFORCESTANDBYERROR*48<cr><lf>
```

CAUTION:

1. If the command is successful, note that the module could enter Standby mode before issuing the OK response message and/or command echo.

2. Numerical command parameter values outside the specified range should be avoided.

4. Messages Description

The table below summarizes the messages that are output periodically by the module:

Message ID	Description
$--GGA	NMEA: Global Position System fix data "GP" talker ID in GPS-only mode "GL" talker ID in GLONASS-only mode "BD" talker ID in BEIDOU-only mode "GN" talker ID in multi-constellation mode
$--GSA	NMEA: GNSS Dilution of Precision (DOP) and active satellites "GP" talker ID in GPS-only mode "GL" talker ID in GLONASS-only mode "BD" talker ID in BEIDOU-only mode "GN" talker ID in multi-constellation mode
$--GSV	NMEA: GNSS satellites in view "GP" talker ID reports GPS satellites "GL" talker ID reports GLONASS satellites "BD" talker ID reports BEIDOU satellites "QZ" talker ID reports QZSS satellites
$--RMC	NMEA: Recommended minimum specific GNSS data "GP" talker ID in GPS-only mode "GL" talker ID in GLONASS-only mode "BD" talker ID in BEIDOU-only mode "GN" talker ID in multi-constellation mode

All messages in the above table are output once per second. There can be multiple GSA and GSV messages output each second, and there can be multiple sentences for a given GSA or GSV message.

In addition to periodic messages, the module outputs a single $GPTXT message at start-up.

4.1. --GGA

This message contains time, position, and fix status data. If the module is using a single constellation, the talker ID reflects that constellation. If the module is operating in multi-constellation mode, the talker ID is 'GN', and the HDOP value in the message is for the combined GNSS constellation geometry.

Format:

```
$--GGA,<Timestamp>,<Lat>,<N/S>,<Long>,<E/W>,<GPSQual>,<Sats>,
<HDOP>,<Alt>,M,<GEOSep>,M,<DGPSAge>,<DGPSRef>
*<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC time of position fix (HoursMinutesSeconds.Millisecs)
Lat	DDMM.MMMM	Latitude (DegreesMinutes.FractionalMinute)
N/S	'N' or 'S'	Latitude direction (North or South)
Lon	DDDMM.MMMM	Longitude (DegreesMinutes.FractionalMinute)
E/W	'E' or 'W'	Longitude direction (East or West)
GPSQual	Decimal, 1 digit	0 – Invalid 1 – Valid GNSS fix 2 – Valid differential GNSS fix
Sats	ss – Decimal, 2 digits	Number of GNSS satellites in use
HDOP	HH.H	Horizontal Dilution of Precision, maximum of 99.0
Alt	+/-AAA.AA	Height above WGS-84 ellipsoid in meters, maximum of 999.99
GEOSep	+/-aa.a	Difference between mean sea level (MSL) altitude and WGS-84 ellipsoid, in meters. Leading '-' indicates MSL below ellipsoid surface.
DGPSAge		Age of RTCM Type 1 or 9 corrections. Not populated.
DGPSRef		Differential reference station ID. Not populated.

Example:

```
$GNGGA,194829.000,3309.1073,N,09638.0012,W,1,15,0.7,182.64,M,
-24.2,M,,*11
```

Valid GNSS fix using 15 satellites from multiple constellations.

4.2. --GSA

This message reports Dilution of Precision (DOP) values and the PRN codes of the active satellites used in the position fix. At least one of these messages is output each second for each enabled GNSS constellation. The output order is the message for GPS satellites first, then the message for GLONASS satellites, then the message for QZSS satellites, then the message for GALILEO satellites, and lastly the message for BEIDOU satellites.

If the module is using a single constellation, the talker ID reflects that constellation. If the module is operating in multi-constellation mode, the talker ID is 'GN', and all of the messages contain DOP values for the combined GNSS constellation geometry.

The maximum number of satellites reported in a single message is 12. If the number of satellites used from a given constellation exceeds 12, a second message is output listing the additional satellites.

Format:

```
$--GSA,<Mode1>,<Mode2>,[<SatPRN1>],...,[<SatPRNn>],<PDOP>,
<HDOP>,<VDOP>*<checksum><cr><lf>
```

Parameter	Format	Description
Mode1	"M" or "A"	M – Manual, forced to operate in 3D mode A – Automatic, allowed to switch between 2D and 3D mode
Mode2	Decimal, 1 digit	1 – No fix available 2 – 2D fix 3 – 3D fix
SatPRN1… SatPRNn	Decimal, 2 digits	List of satellite PRN codes used in the position fix.
PDOP	PP.P	Position Dilution of Precision, maximum of 99.0
HDOP	HH.H	Horizontal Dilution of Precision, maximum of 99.0
VDOP	VV.V	Vertical Dilution of Precision, maximum of 99.0

Example:

```
$GNGSA,A,3,25,11,01,18,12,32,31,22,14,30,,,1.2,0.7,0.9*28
$GNGSA,A,3,65,66,76,75,72,,,,,,,,1.2,0.7,0.9*24
```

The talker ID indicates that both GPS and GLONASS constellations are enabled, and thus two messages are output.

4.3. --GSV

This message reports the azimuth, elevation, and signal-to-noise (SNR) values for all satellites in view. A message is output each second for each enabled GNSS constellation. The message having the "GP" talker ID contains the visible GPS satellites. The message having the "GL" talker ID contains the visible GLONASS satellites. The message having the "BD" talker ID contains the visible BEIDOU satellites. The message having the "GA" talker ID contains the visible GALILEO satellites. The message having the "QZ" talker ID contains the visible QZSS satellites.

Each message can be transmitted as multiple sentences, with four satellites maximum per sentence, and each sentence having the format below.

Format:

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

Parameter	Format	Description
GSVAmount	Decimal, 1 digit	Total amount of GSV sentences in this message, maximum of 4
GSVNumber	Decimal, 1 digit	Number of the specific GSV sentence within the message
TotSats	nn – Decimal, 2 digits	Total number of GPS or GLONASS satellites in view
Sat1PRN	ss – Decimal, 2 digits	PRN of first satellite.
Sat1Elev	ee – Decimal, 2 digits	Elevation of first satellite in degrees, 0 to 90
Sat1Azim	aaa – Decimal, 3 digits	Azimuth of first satellite in degrees, 0 to 359
Sat1C/N0	cc – Decimal, 2 digits	Carrier to Noise ration of first satellite in dB-Hz
…		
SatNPRN	ss – Decimal, 2 digits	PRN of Nth satellite (maximum N is 4)
SatNElev	ee – Decimal, 2 digits	Elevation of Nth satellite in degrees, 0 to 90
SatNAzim	aaa – Decimal, 3 digits	Azimuth of Nth satellite in degrees, 0 to 359
SatNC/N0	cc – Decimal, 2 digits	Carrier to Noise ration of Nth satellite in dB-Hz

Example:

```
$GPGSV,3,1,11,01,23,257,26,11,10,239,,14,30,079,23,16,27,175,23*7F
$GPGSV,3,2,11,20,37,311,33,22,14,146,28,23,12,294,31,25,13,040,37*7B
$GPGSV,3,3,11,30,51,156,31,31,60,026,37,32,65,305,24,,,,*48
$GLGSV,2,1,06,66,77,110,32,76,49,021,31,65,22,140,25,67,45,333,25*69
$GLGSV,2,2,06,78,18,227,,77,65,257,17,,,,,,,,*67
```

4.4. --RMC

This message contains position, velocity, and time and date information for the current fix. If the module is using a single constellation, the talker ID reflects that constellation. If the module is operating in multi-constellation mode, the talker ID is 'GN'.

Format:

```
$--RMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/W>,<Speed>,
<Course>,<Date>,<MagVar>,<MagVarDir>,<Mode>*<checksum><cr><lf>
```

Parameter	Format	Description
Timestamp	hhmmss.sss	UTC time of position fix (HoursMinutesSeconds.Millisecs)
Status	"A" or "V"	A – Data valid V – Navigation warning
Lat	DDMM.MMMM	Latitude (DegreesMinutes.FractionalMinute)
N/S	'N' or 'S'	Latitude direction (North or South)
Lon	DDDMM.MMMM	Longitude (DegreesMinutes.FractionalMinute)
E/W	'E' or 'W'	Longitude direction (East or West)
Speed	sss.s	Speed over ground in knots, maximum 999.9
Course	ccc.c	Course over ground, degrees True, 0 to 359.9
Date	DDMMYY	Day of month (1 to 31), Month (1 to 12), and Year
MagVar		Magnetic variation. Not populated.
MagVarDir		Magnetic variation direction (E or W). Not populated.
Mode	'A', 'D' or 'N'	Position system mode indicator A – Autonomous mode D – Differential mode N – Position data not valid

Example:

```
$GPRMC,225124.000,A,3309.1077,N,09638.0032,W,0.0,0.0,180113,,,
A*79
```

Valid fix with only the GPS constellation enabled.

4.5. GPTXT

At start-up the module outputs an NMEA standard text message containing information about the Telit firmware application version.

Format:

```
$GPTXT,<Telit version string>*<checksum><cr><lf>
```

Note that this start-up message is output whenever the module performs a GNSS engine restart in response to a command. This message is also output as a response to a request for the Telit firmware version string (see section 3.12 on the $PSTMGETSWVER command).

5. Document History

Revision	Date	Changes
0	2016-08-23	Draft Issue
1	2017-03-08	Added PSTMFORCESTANDBY command, updated SW versions in Applicability Table.