SL869 SW User Guide

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Making machines talk.

APPLICABILITY TABLE

PRODUCT
SL869

SW Version
3.1.0.1

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Contents

1. Introduction

1.1. Scope

This document describes the serial communications interface between the SL869 GPS/GLONASS receiver module firmware and Host Processor software.

1.2. Audience

This document is intended for public distribution to potential customers who are evaluating the SL869 GPS/GLONASS module. It can also be used by customers who are developing application software for the Host Processor in a device that incorporates the SL869.

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
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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:

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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. Document Organization

This document contains the following chapters (sample):

"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

- SL869 Product Description, 80405ST10105a

2. Communication Interface

The serial communication interface between the SL869 receiver module 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 industry for serial communication with GPS receivers.

2.1. UART

Serial communication with the SL869 is 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 SL869 can be achieved using a PC terminal emulator.

2.2. NMEA Characteristics

This subsection highlights characteristics of the NMEA-0183 protocol as they pertain to the SL869 interface.

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.

Proprietary Packets
Proprietary data packets are allowed by the NMEA protocol standard. They begin with "$P" followed by a Manufacturer's Mnemonic Code that is assigned by the NMEA. The SL869 module is based on the STA8088 device from ST Microelectronics, who has been assigned the code "STM." Therefore, proprietary packets used by the SL869 begin with the character sequence "$PSTM."

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 SL869 includes checksums on all output NMEA messages. With one exception, checksums are not required on input messages and if present are ignored by the SL869.

Packet Length
The NMEA standard specifies a maximum number of characters for each data packet, but the SL869 does not strictly adhere to this limit.

2.3. Commands

Commands are sent from the Host Processor to the SL869 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 SL869 commands are proprietary and therefore all command-ID's begin with the "$PSTM" character sequence.

In most cases, the SL869 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 SL869 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.

2.4. Messages

Messages are sent from the SL869 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.

The SL869 outputs certain standard messages as defined in version 2.2 of the NMEA-0183 protocol standard. The message-ID for standard messages begins with an NMEA talker ID: "$GP" indicating GPS, "$GL" indicating GLONASS, and "$GN" indicating global navigation. Specific talker IDs used for each message are described later in this Guide in the Messages section.

The SL869 also outputs proprietary messages. As with commands, proprietary message-IDs begin with "$PSTM." Note that some proprietary messages are responses to input commands.

3. Commands Description

The table below summarizes the set of commands for the SL869:

Command ID	Description
$PSTMINITGPS	Initialize GPS position and 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
$PSTM2DFIXONOFF	Enable/disable 2-D acquisition fixes
$PSTMGETSWVER	Get the GNSS Library version
$PSTMSBASONOFF	Toggle the SBAS feature ON and OFF
$PSTMSBASSAT	Select the SBAS satellite PRN code

Unless otherwise noted in the following subsections, commands are echoed by the SL869 after the command is executed.

3.1. $PSTMINITGPS

This command is used to initialize GPS position and time. It is typically only used for test purposes or for aiding satellite acquisitions in harsh RF signal environments. There is no response message to this command.

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 (01 to 59)
Second	SS – Decimal, 2 digits	Second (01 to 59)

Example:

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

3.2. $PSTMCLREPHS

This command allows the user to clear all ephemeris data from backup SRAM and erase all ephemeris stored in NVM backup memory. It is typically used to force the SL869 to collect the most recent satellite ephemeris data, or to prepare the SL869 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 SL869 drops out of navigation. It will produce position fixes after it has re-collected ephemeris from a sufficient number of satellites.

3.3. $PSTMDUMPEPHEMS

This command is used to request that the SL869 output all ephemeris data stored in backup memory. There are no parameters.

Synopsis:

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

The SL869 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 SL869 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.

3.4. $PSTMEPHEM

This command allows the user to load ephemeris data for a satellite into backup memory. It has the same ID and data structure as when it is output as a message. Note that this command also requires a checksum.

Synopsis:

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

Parameter	Format	Description
SatId	ii – Decimal, 2 digits	Satellite PRN number
N	One digit decimal	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 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
```

Note that the command is not echoed. The SL869 responds with a message having the following format:

```
$PSTMEPHEM,<SatId>,<N>, <status>
```

where `SatId` and `N` are the echoed parameters from the load command. The status is “OK” if the ephemeris message was accepted.

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.

3.5. $ PSTMNMEAONOFF

This command can be used to toggle the periodic NMEA output on and off. It does not affect command responses. There are no parameters, and there is no response message to this command.

Synopsis:

```
$PSTMNMEAONOFF<cr><lf>
```

This command is only echoed when the NMEA output is being toggled on, and not when it is being toggled off.

3.6. $PSTMCOLD

This command causes the SL869 to perform a cold start. There is no response message to this command.

Synopsis:

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

Parameter	Format	Description
Mask	Bitmap	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, 0x0E (clear ephemeris, position and time), is used. This is the most common definition of a cold start.

In response to this message the will perform a GPS engine reset. It will not perform a system reboot.

Example:

Cold start with all data cleared:

```
$PSTMCOLD,F
```

3.7. $PSTMWARM

This command causes the SL869 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 will perform a GPS engine reset. It will not perform a system reboot.

3.8. $PSTMHOT

This command causes the SL869 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 will perform a GPS engine reset. It will not perform a system reboot.

3.9. $PSTMSRR

This command allows the user to execute a system reset and reboot the GNSS firmware on the SL869. There are no parameters, and there is no response message to this command.

Synopsis:

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

NOTE:

The SL869 does not echo this command.

3.10. $PSTMGPSRESET

This command is used to reset the GPS receiver engine. It does not reboot the GNSS firmware. There are no parameters for this command, and there is no response message to this command.

Synopsis:

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

3.11. $PSTM2DFIXONOFF

This command allows the user to enable or disable the 2D fix algorithm. When enabled the algorithm uses last known altitude to produce a 2D position fix. In cold start conditions where position is not known, the altitude is assumed to be zero, and therefore large position shifts for 2D fixes are allowed.

Synopsis:

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

Parameter	Format	Description
OnOff	One digit decimal	0 – the 2D fix algorithm will be disabled 1 – the 2D fix algorithm will be enabled

If the input parameter is 0 and the 2D fix algorithm is to be disabled, the SL869 responds with the following message:

```
$PSTM2DFIXDISABLED
```

If the input parameter is 1 and the 2D fix algorithm is to be enabled, the SL869 responds with the following message:

```
$PSTM2DFIXENABLED
```

If the input parameter is missing or is not a defined value, the SL869 responds with the following message:

```
$PSTM2DFIXERROR
```

Example:

Enable the 2D fix algorithm:

```
$PSTM2DFIXONOFF,1
```

If the state of the 2D fix algorithm is changed by the above command, the change will take effect only after a GPS engine reset.

3.12. $PSTMGETSWVER

This command gets the version string of the GNSS library embedded within the firmware application. It does not return the Telit firmware application version string, which is output in a GPTXT message when the SL869 starts up.

Synopsis:

```
$PSTMGETSWVER<cr><lf>
```

The SL869 responds with the following message:

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

Parameter	Format	Description
Ver	x.x.x.x	GNSS Library version, for example 7.3.1.43
Type	ARM	Indicates ARM compiler type

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). When SBAS is on (enabled) the SL869 obtains differential GPS corrections from the selected SBAS PRN, and the selected SBAS PRN appears in the GPGSV messages if it is visible.

Synopsis:

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

3.14. $PSTMSBASSAT

This command is used to select the SBAS PRN code to be used for differential operation. By default the selected SBAS PRN is 135. If changed the selected SBAS PRN reverts back to the default when the SL869 is reset or is power cycled.

Synopsis:

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

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

Example:

Set the SBAS PRN code to 138:

```
$PSTMSBASSAT,138
```

4. Messages Description

The table below summarizes the messages that are output periodically by the SL869:

Message ID	Description
$GPGGA	NMEA: Global Position System fix data
$GNGSA	NMEA: GNSS Dilution of Precision (DOP) and active satellites
$--GSV	NMEA: GNSS satellites in view. “GP” talker ID reports GPS, “GL” talker ID reports GLONASS satellites.
$GPRMC	NMEA: Recommended minimum specific GNSS data

All messages are output once per second. There are multiple GSA and GSV messages output each second.

4.1. GPGGA

This message contains time, position, and fix status data.

Format:

```
$GPGGA,<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 view
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:

```
$GPGGA,194829.000,3309.1073,N,09638.0012,W,1,15,0.7,182.64,M,
-24.2,M,,*59
```

4.2. GNGSA

This message reports Dilution of Precision (DOP) values and the PRN codes of the active satellites used in the position fix. Two of these messages are output each second, one listing the GPS satellites, the other listing the GLONASS satellites. Both messages contain DOP values for the combined GPS and GLONASS geometry.

Format:
`$GNGSA,<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 1 – 2D fix 2 – 3D fix
SatPRN1… SatPRNn	Decimal, 2 digits	List of GPS satellite PRN codes, or list of GLONASS 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
```

4.3. --GSV

This message reports the azimuth, elevation, and signal-to-noise (SNR) values for all satellites in view. Two of these messages are output each second, one having the "GP" talker ID and containing the visible GPS satellites, the other having the "GL" talker ID and containing the visible GLONASS satellites.

Each message is 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. GPRMC

This message contains position, velocity, and time and date information for the current fix.

Format:
`$GPRMC,<Timestamp>,<Status>,<Lat>,<N/S>,<Long>,<E/W>,<Speed>,<Course>,<Date>,<MagVar>,<MagVarDir>*<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 kilometers per hour, 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 computed, set to 0.0.
MagVarDir		Magnetic variation direction (E or W). Set to W.

Example:
`$GPRMC,214157.000,A,3309.1052,N,09638.0028,W,0.0,0.0,190312,0.0,W*65`

5. Document History

Revision	Date	Changes
0	2012-03-19	Draft issue
1	2012-04-11	Corrected PSTMEPHEM command description by adding checksum field.
2	2012-06-15	Preliminary release for 3.1.0.1 firmware. Added SBAS and SW version commands, removed notch filter status output.