Using SiRF Star IV with an External Host

Application Note

80000NT10057a Rev.0 – 2011-11-10

Making machines talk.

APPLICABILITY TABLE

PRODUCT
GE864-GPS

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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Contents

1. Introduction

1.1. Scope

This Application Note describes how GE864-GPS' internal SiRF Star IV (GSD4e) GPS chip may be used in conjunction with an External Host.

1.2. Audience

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

1.3. Contact Information, Support

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

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
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:

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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: "Configuring GE864-GPS in "External Host Controlled Mode" describes how to configure GE864-GPS to work with an External Host.

"Chapter 3: "SiRF Star IV Functionalities" describes how to switch GPS serial communication protocols and how to configure SiRF Star IV specific functionalities when in "External Host Controlled Mode".

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

- [1] Telit_GE_GC864-QUAD_V2_and_GE864-GPS_Hardware_User_Guide, 1vv0300915
- [2] Telit_AT_Commands_Reference_Guide, 80000ST10025a
- [3] Telit_GPS_Application_Note, 1vv0300914

2. Configuring GE864-GPS in "External Host Controlled Mode"

GE864-GPS' internal SiRF Star IV (GSD4e) GPS chip may be driven by the GSM engine or by an External Host.
Please refer to reference [1] for information on the needed circuital connections for the two configurations.

GE864-GPS firmware is by default configured to work in "GSM Controlled Mode" (see reference [2], AT$GPSD command and [3]) in order to fully control SiRF Star IV (GSD4e) GPS chip by means of the Telit AT commands.

Customers who plan to use SiRF Star IV chip directly controlled by their own external host processor must configure GE864-GPS in "External Host Controlled Mode" as described in reference [1] and issue the AT$GPSD=0 command.

3. SiRF Star IV Functionalities

The "External Host Controlled Mode" allows a customer not only to directly receive the NMEA data stream relayed by SiRF Star IV (see [3]) but also to configure and control SiRF Star IV specific functionalities.

These functionalities, almost the same available by means of the Telit AT commands, can be configured by switching SiRF Star IV communication protocol from NMEA to SiRF Binary (OSP), and by sending specific OSP messages.

The following paragraphs show how to switch communication protocols and how to configure and control SiRF Star IV specific functionalities.

WARNING:

The following NMEA and OSP messages are formatted and ready to be sent as they are over SiRF Star IV's NMEA serial port: NMEA messages already include checksum while OSP messages are in HEX format.

3.1. Switching SiRF Star IV serial communication protocols

SiRF Star IV serial communication protocol may be switched from NMEA to SiRF Binary OSP and vice-versa.

SiRF Star IV serial communication protocol can be switched from NMEA to OSP (57600bps) by sending the following SiRF custom NMEA sentence:

$PSRF100,0,57600,8,1,0*37 <CR><LF>

Once in OSP mode, SiRF Star IV is able to receive OSP messages.

SiRF Star IV serial Communication Protocol can be switched back to NMEA (4800bps) by sending the following OSP message (MID 129):

A0 A2 00 18 81 02 01 01 00 01 01 01 05 01 01 01 00 01 00 01 00 00 00 01 00 00 12 C0 01 65 B0 B3

3.2. SiRF Star IV Software Version

Before configuring SiRF Star IV functionalities, it might sometimes be useful to retrieve SiRF firmware version:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Poll Software Version Message (OSP MID 132):

A0 A2 00 02 84 00 00 84 B0 B3

3) Wait for Software Version String (Response to Poll) Message (OSP MID 6), example:

A0 A2 00 27 06 1E 06 47 53 44 34 65 5F 34 2E 31 2E 30 2D 50 31 20 31 32 2F 32 30 2F 32 30 31 30 20 33 35 34 00 47 53 44 34 65 00 07 D8 B0 B3

This message has a variable length:

- **A0 A2 00 27 -** Start Sequence (2 bytes) and Payload Length (2 bytes): **00 27 => 39 bytes**
- **06 1E 06 47 53 44 34 65 5F 34 2E 31 2E 30 2D 50 31 20 31 32 2F 32 30 2F 32 30 31 30 20 33 35 34 00 47 53 44 34 65 00 –** Payload (see **Table 1**)
- **07 D8 B0 B3 -** Message Checksum (2 bytes) and End Sequence (2 bytes)

Field	Bytes	Example
Message ID	1	**0x06**
LENGTH_SIRF_VERSION_ID	1	**0x1E**
LENGTH_CUSTOMER_VERSION_ID	1	**0x06**
SIRF_VERSION_ID	[0…80] (variable)	**0x47 0x53 … 0x34 0x00** In ASCII: *GSD4e_4.1.0-P1 12/20/2010 354*
CUSTOMER_VERSION_ID	[0…80] (variable)	**0x47 0x53 0x44 0x34 0x65 0x00** In ASCII: *GSD4e*

Table 1 - Software Version Response Message Payload

LENGTH_SIRF_VERSION_ID: Number of characters in SiRF Version ID

This field shall be set to the length equal to the number of characters in the SIRF_VERSION_ID (including the null terminator). The range shall be from 0 to 80. Any other value has no meaning.

LENGTH_CUSTOMER_VERSION_ID: Number of characters in Customer Version ID

This field shall be set to the length equal to the number of characters in the CUSTOMER_VERSION_ID (including the null terminator). The range shall be from 0 to 80. Any other value has no meaning.

SIRF_VERSION_ID: SiRF Software Version ID
This field shall be set to the SiRF Software version ID. The ASCII representation of the character string, with the null terminator at the end, will be used. The number of characters (including the null terminator) should equal that set by LENGTH_SIRF_VERSION_ID. For

instance, the software version ID string denoted by A would be represented as 0100 0001 0000 0000 (including the null terminator).

CUSTOMER_VERSION_ID: Customer Software Version ID

This field shall be set to the Customer Software version ID. The ASCII representation of the character string, with the null terminator at the end, will be used. The number of characters (including the null terminator) should equal that set by LENGTH_CUSTOMER_VERSION_ID. For instance, the software version ID string denoted by A would be represented as 0100 0001 0000 0000 (including the null terminator).

4) Wait for SiRF StarIV Ack: **A0 A2 00 03 0B 84 00 00 8F B0 B3**

5) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

3.3. Software Reset

Initialize Data Source Message (OSP MID 128) can be used to perform one of the following specific SiRF Star IV software reset/re-starts:

- **Factory Reset**: this option clears all GPS memory including clock drift.
- **Cold Start** (No Almanac, No Ephemeris): this option clears all data that is currently stored in the internal memory of the GPS receiver including position, almanac, ephemeris, and time. The stored clock drift however, is retained.
- **Warm Start** (No ephemeris): this option clears all initialization data in the GPS receiver and subsequently reloads the data that is currently displayed in the Receiver Initialization Setup screen. The almanac is retained but the ephemeris is cleared.
- **Hot Start** (with stored Almanac and Ephemeris): the GPS receiver restarts by using the values stored in the internal memory of the GPS receiver; validated ephemeris and almanac.

3.3.1. Factory Reset

SiRF Star IV Factory Reset can be performed as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Initialize Data Source Message (OSP MID 128):

A0 A2 00 19 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0C 88 01 14 B0 B3

WARNING:

Factory reset causes immediate SiRF Star IV restart with default Serial Communication Protocol (NMEA, 4800bps).

3.3.2. Cold Start

SiRF Star IV Cold Start can be performed as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Initialize Data Source Message (OSP MID 128):

A0 A2 00 19 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0C 84 01 10 B0 B3

3) Wait for SiRF StarIV Ack: **A0 A2 00 03 0B 80 00 00 8B B0 B3**

4) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

3.3.3. Warm Start

SiRF Star IV Warm Start can be performed as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Initialize Data Source Message (OSP MID 128):

A0 A2 00 19 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0C 02 00 8E B0 B3

3) Wait for SiRF StarIV Ack: **A0 A2 00 03 0B 80 00 00 8B B0 B3**

4) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

3.3.4. Hot Start

SiRF Star IV Hot Start can be performed as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Initialize Data Source Message (OSP MID 128):

A0 A2 00 19 80 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 0C 00 00 8C B0 B3

3) Wait for SiRF StarIV Ack: **A0 A2 00 03 0B 80 00 00 8B B0 B3**

4) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

3.4. Internal LNA Gain

SiRF Star IV GPS chip is provided with an internal LNA amplifier with two selectable gain levels (see reference [1]).
In general, the high gain mode is intended for use with passive antennas, while the low gain mode is used when there is an external LNA as part of the RF front end (e.g. active antenna).

By default the internal LNA amplifier is configured in high gain mode.

When an active antenna with an external LNA has to be used, the internal LNA amplifier must be configured in low gain mode:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Tracker Configuration Message (OSP MID178,02) - (Disable Internal LNA and drive GPS_EXT-LNA_EN signal):

A0 A2 00 39 B2 02 00 F9 C5 68 03 FF 00 00 0B B8 00 01 77 FA 01 01 03 FC 03 FC 00 7D 00 00 00 00 00 07 00 00 00 00 00 00 00 00 00 00 00 00 00 E1 00 00 00 62 00 60 01 01 01 F4 2A 01 0B 5A B0 B3

3) Wait for SiRF StarIV Ack: **A0 A2 00 03 0B B2 00 00 BD B0 B3**

Tracker configuration setting requests in message (OSP 178,02) will apply after the next reset.

4) Perform a Hot Start reset (see 3.3.4)

Wait for SiRF StarIV Ack: **A0 A2 00 03 0B 80 00 00 8B B0 B3**

5) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

NOTE:

Tracker Configuration Message configures the internal LNA amplifier in low gain mode and drives HIGH the GPS_EXT_LNA_EN signal (see reference [1]) that can be used to enable an external LNA (same effects as AT$GPSAT command usage).

3.5. Power Management

SiRF Star IV offers four power operating modes designed to meet the demands of applications that have different requirements for the interval between position updates and for power consumption: **Full-Power**, **Trickle-Power™**, **Push-To-Fix™** and **Micro Power**. All of these modes perform similarly in principle but provide different output rates and reliability.

3.5.1. Full-Power

Full-power mode, also known as Continuous Navigation mode, is the most accurate navigation mode and supports the most dynamic motion scenarios. In this mode, the RF block produces continuous RF samples that are continuously processed by the acquisition and tracking processes. Measurements and decoded GPS demodulated data are continuously sent to the host GPS software for the highest quality and dynamic mode of GPS navigation. SiRF Star IV enters this power mode as soon as power is applied and a pulse is issued on the input GPS_ON_OFF pin (see [1]).

3.5.2. Trickle-Power™

Trickle-Power Mode is a duty-cycled mode. It reduces average current, while retaining a high quality of GPS accuracy and dynamic motion response.

In Trickle-Power Mode, the system selects a minimum rate of navigation solution updates and minimizes average current. TP Mode focuses on an update rate and navigation solution quality, so it can transition to FP Mode for specified limited periods when conditions are difficult or satellite navigation data must be demodulated. This results in variable power savings but for a fixed output rate, much more reliable performance. Applications using TP Mode perform similarly to applications using full power, but with significant power savings in strong-signal conditions.

Trickle-Power Mode is best suited for applications that require solutions:

- At a fixed rate
- Low-power consumption and still
- Maintain the ability to track weak signals

Position requests are set for a specific update period (Update-Rate), and a specific RF sampling time during each period (On-Period).

Trickle-Power Mode, with 3 seconds Update-Rate and 300ms On-Period can be configured as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Power Mode Request Message (OSP MID 218, SID 3):

A0 A2 00 10 DA 03 00 64 00 00 01 2C 00 00 75 30 00 04 93 E0 03 8A B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

Trickle-Power Mode can be disabled as follows during the On-Period (i.e., whenever the GPS_WAKEUP output pin goes high, see [1]):

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Power Mode Request Message (OSP MID 218, SID 0):

A0 A2 00 02 DA 00 00 DA B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

WARNING:

When in Trickle-Power Mode all NMEA and OSP messages must be sent during the On-Period (i.e., whenever the GPS_WAKEUP output pin goes high, see [1]), otherwise SiRF Star IV might not be able to successfully receive them.

Therefore, if the GPS Serial protocol has to be switched, this should be done as soon as Power Mode Request Message has been sent or when SiRF Star IV is still ON.

SiRF Star IV can be awakened at any moment (GPS_WAKEUP output pin should be low) by issuing a pulse on the input GPS_ON_OFF pin (see [1]).

3.5.3. Push-To-Fix™

Push-to-Fix Mode is designed for applications that require infrequent position reporting. The receiver generally stays in hibernate system power state, but wakes up periodically to refresh position, time, ephemeris data and RTC calibration.
A pulse on the input GPS_ON_OFF pin to the receiver acts as a position update request. The request wakes up the receiver, which is then able to supply a position within the hot start time specification.

The Push-To-Fix Mode is similar to Trickle-Power Mode, except that:

- The time in the OFF state is longer
- It uses the hibernate settings
- It is prepared to wake any time in response to an edge on the GPS_ON_OFF pin

By default, the PTF Mode period is 30 minutes. When the PTF Mode is enabled at power on or a new PTF Mode cycle, the receiver stays on FP Mode until a good navigation solution is computed. The HIBERNATE state follows for the remainder of the period. If it takes 36 seconds to fix position and refresh ephemeris on the default period of 30 minutes, the GPS sleeps for the 29 minutes and 24 seconds.

Push-to-Fix Mode can be configured as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Power Mode Request Message (OSP MID 218, SID 4):

A0 A2 00 0E DA 04 00 00 07 08 00 01 D4 C0 00 00 75 30 03 27 B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

Push-To-Fix Mode can be disabled as follows:

1) Wakeup SiRF Star IV if it is sleeping by issuing a pulse on the input GPS_ON_OFF pin (if and only if GPS_WAKEUP output pin is low)

2) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

3) Send Power Mode Request Message (OSP MID 218, SID 0):

A0 A2 00 02 DA 00 00 DA B0 B3

4) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

WARNING:

When in Push-To-Fix Mode all NMEA and OSP messages must be sent when SiRF Star IV is awake (i.e., whenever the GPS_WAKEUP output pin goes high, see [1]), otherwise it might not be able to successfully receive them.

Therefore, if the GPS Serial protocol has to be switched, this should be done as soon as Power Mode Request Message has been sent or when SiRF Star IV is still ON.

SiRF Star IV can be awakened at any moment (GPS_WAKEUP output pin should be low) by issuing a pulse on the input GPS_ON_OFF pin (see [1]).

3.5.4. Micro Power Mode

Micro Power Mode is a very low-power maintenance mode.
The objective of Micro Power Mode is to remain below a stated average current level while maintaining a low level of uncertainty in time, frequency, position and ephemeris state.
SiRF Star IV goes to a very low power state while maintaining Hot Start conditions.

When this mode is turned on, SiRF Star IV goes into update cycles (usually every 1-10 minutes) or maintenance cycles (usually every 30 to 60 minutes).

When the MPM request is sent from full power mode, a direct transition is requested as soon as sufficient ephemeris data is available, and a valid navigation solution is calculated at near zero user velocity.
If the request is sent when SiRF Star IV is in any other low power mode, it will first switch to Full-Power Mode, then switch to MPM mode.

Micro Power Mode can be configured as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Power Mode Request Message (OSP MID 218, SID 2):

A0 A2 00 06 DA 02 FF FF FF FF 04 D8 B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

Micro Power Mode can be disabled at any moment (GPS_WAKEUP output pin should be low) by issuing a pulse on the input GPS_ON_OFF pin (see [1]): this will send the receiver to Full-Power Mode.

WARNING:

When in Micro Power Mode all NMEA and OSP messages must be sent when SiRF Star IV is awake (i.e., whenever the GPS_WAKEUP output pin goes high, see [1]), otherwise it might not be able to successfully receive them.

Therefore, if the GPS Serial protocol has to be switched, this should be done as soon as Power Mode Request Message has been sent or when SiRF Star IV is still ON.

3.6. Static Navigation

Static navigation, also called position pinning, is a mechanism that it is used by the receiver to freeze, or pin, the position when the velocity falls below a threshold indicating that the receiver is stationary. The heading is also frozen, and the velocity is reported as 0.
The solution is then unpinned when the velocity increases above a threshold or when the computed position is a set distance from the pinned position, indicating that the receiver is in motion again. Note that these velocity and distance thresholds cannot be changed.

By default static navigation is disabled.

Static navigation can be enabled as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Static Navigation Message (OSP MID 143):

A0 A2 00 02 8F 01 00 90 B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

Static navigation can be disabled as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send Static Navigation Message (OSP MID 143):

A0 A2 00 02 8F 00 00 8F B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

3.7. SBAS

SiRF Star IV is capable [*] of using Satellite-Based Augmentation System (SBAS) satellites as a source of both differential corrections and satellite range measurements.
These systems (WAAS, EGNOS, MSAS) use geostationary satellites to transmit regional differential corrections via a GPS-compatible signal. The use of SBAS corrections can improve typical position accuracy to 3m or less in open-sky applications.

SBAS can be enabled as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send DGPS Source Message (OSP MID 133):

A0 A2 00 07 85 01 00 00 00 00 00 00 86 B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

SBAS can be disabled as follows:

1) Switch GPS Communication Protocol from NMEA to OSP as described in 3.1

2) Send DGPS Source Message (OSP MID 143):

A0 A2 00 07 85 00 00 00 00 00 00 00 85 B0 B3

3) Switch GPS Communication Protocol back to NMEA 4800bps as described in 3.1

[*] *SBAS will be implemented starting from GSD4e_4.1.2 GSD4e FW version 4.1.2.*

4. Document History

Revision	Date	Changes
0	2011-11-10	First issue