Application Note on Firmware for GSC3-based Products

A description of useful modes supported via the SiRF binary protocol on Vincotech's GPS modules based on SiRFstarIII – GSC3
A1080, A1084, A1088, A1035-D, A1035-H

Application Note

Version 1.3
Firmware Revision 3.2.4, 3.2.5 and 3.5.0

Revision History

Rev.	Date	Description
1.0	10-26-07	Initial version, comprising PTF, SBAS and static mode
1.1	12-06-07	Corrected table 4 description
1.2	08-21-08	New style; moved to Vincotech
1.3	03-23-09	Renamed (GSC3-generic) and added shutdown command for 3.5.0
	mm-dd-yy	

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Table of Contents

1 Introduction **5**
2 NMEA and Binary mode **5**
2.1 From NMEA to Binary Mode 5
2.2 From Binary to NMEA Mode 6
2.3 SiRFDemo Software 7
3 Push-To-Fix Mode **8**
3.1 Necessary Steps 8
3.1.1 Set Trickle Power Parameters – Message ID 151 9
3.1.2 Set Low Power Acquisition Parameters – Message ID 167 9
3.2 Exit Push-To-Fix Mode 10
3.3 Summary of Main Advantages 11
4 SBAS Support **12**
5 Static Mode **13**
6 Shut-Down Module **15**
7 Related Information **16**
7.1 Contact 16
7.2 Related Documents 16
7.3 Related Tools 16
8 List of Tables **17**

1 Introduction

The intention of the application notes described in this document is to help customers make use of the most important features of Vincotech's SiRFstarIII / GSC3-based products. This document is a living document; it mostly explains the software commands necessary to support the different features but also tries to explain the background of these features.

2 NMEA and Binary mode

By default the A1080 receivers start off in NMEA mode. You can get the well known NMEA sentences, switch them on or off – but not much more. In order to go deeper into the SiRFstarIII configuration, it is necessary to switch to binary mode.

2.1 From NMEA to Binary Mode

This is done using the following NMEA command (note that the baud rate can be different):

- $PSRF100,0,57600,8,1,0*37

Here is a more general description on the PSRF100 command that allows switching to SiRF binary protocol:

Name	**Example**	**Description**
Message ID	$PSRF100	PSRF100 protocol header
Protocol	0	0 SiRF binary
Baud	9600	4800, 9600, 19200, 38400, 57600, 115200
DataBits	8	8
StopBits	1	1
Parity	0	0 none
Checksum	*0C	End of message termination

Table 1: Command to switch to SiRF binary protocol

After that information from the module and commands to the module are transmitted in SiRF binary protocol mode. For details please refer to the according manual.

This command has no impact on the serial port used. All data exchange will be done via port 0.

If backed by a battery (Vbak), the module will store the configuration and reboot after a reset in the very same way. If completely powered off, the module will start in default NMEA mode again.

2.2 From Binary to NMEA Mode

When you configured the module you might wish to go back to NMEA mode in order to get the PVT information in the standard, familiar way. In order to do that, you can use the following binary command sequence:

```
A0A2001881020101000101010101010001000100010001000112C00163B0B3
```

Within this message one can determine the following segments (this applies generally to all SiRF binary commands):

- `A0A20018` — Start Sequence (A0A2) and Payload Length (0x18 = 24)
- `81020101000101010101010001000100010001000112C0` — Payload
- `0163B0B3` — Message Checksum (0163) and End Sequence (B0B3)

Name	Bytes	Example	Unit	Description
Message ID	1 U	0x81		Decimal 129
Mode	1 U	0x02		Do not change last-set value for NMEA debug
GGA Message[1)]	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum[2)]	1 U	0x01		Send checksum with GGA message
GLL Message	1 U	0x00	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
GSA Message	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
GSV Message	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
RMC Message	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
VTG Message	1 U	0x00	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
MSS Message	1 U	0x00	sec	Output rate for MSS message (always zero, as not supported here)
Checksum	1 U	0x01		
Unused field[3)]	1 U	0x00		
Unused field[3)]	1 U	0x01		
ZDA Message	1 U	0x00	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
Unused field[3)]	1 U	0x00		
Unused field[3)]	1 U	0x01		
Bit rate	2 U	0x12C0		1200, 2400, 4800, 9600, 19200, 38400, and 57600

Table 2: Switch to NMEA mode – Message ID 129

1) A value of 0x00 implies not to send message, otherwise data is sent at 1 message every X seconds requested (e.g., to request a message to be sent every 5 seconds, request the message using a value of 0x05). Maximum rate is 1/255 sec.
2) A value of 0x00 implies the checksum is not transmitted with the message (not recommended). A value of 0x01 has a checksum calculated and transmitted as part of the message (recommended).
3) These fields are available if additional messages have been implemented in the NMEA protocol.

So this command would result in switching to NMEA mode with a baud rate of 4800 bits per second and the following configuration:

GGA – ON at 1 sec, GLL – OFF, GSA – ON at 1sec, GSV – ON at 1 sec, RMC – ON at 1sec, VTG - OFF, MSS – OFF, ZDA - OFF.

After that information from the module and commands to the module are transmitted in NMEA format again. For details please refer to the according manual.

This command has no impact on the serial port used. All data exchange will be done via port 0.

If backed by a battery (Vbak), the module will store the configuration and reboot after a reset in the very same way. If completely powered off, the module will start with the default NMEA settings.

2.3 SiRFDemo Software

A useful tool to test and evaluate SiRF binary commands is the SiRFDemo Software. This tool is available from Vincotech. Please contact your local sales representative if you should need this tool. Detailed information about the tool is available in the SiRFDemo User Guide.

3 Push-To-Fix Mode

With hardware revision 02 support of the SiRFstarIII push-to-fix mode was introduced. The goal of using this mode is to keep the receiver always in a state where it has more or less the latest satellite information (Ephemeris data) – after initialization without any further external engagement. When then finally being awakened by an external microcontroller the receiver can perform a hot start with a very short time to fix. Along with the sleep cycles this will result in an excellent power budget.

Initialized to this mode the receiver turns on every cycle period to perform a system update consisting of an RTC calibration and satellite ephemeris data collection if required. This is the case when a new satellite has become visible or validity of old Ephemeris data did expire. In addition it performs all software tasks to support a quick fix request in the event of a Non-Maskable Interrupt (NMI). If Ephemeris data collection is not required then the system re-calibrates and shuts down. Ephemeris collection time in general takes 18 to 36 seconds. A fix request is initiated by toggling the module’s ON_OFF pin (see also: Receiver Manual) – resulting in an internal NMI. Note that the toggling should be performed only when RFPWUP is low, i.e. when the receiver is sleeping. When a fix request was initiated the module will calculate at least **one fix**, try to update Ephemeris data and go back to sleep.

3.1 Necessary Steps

To put the receiver into push-to-fix mode, two commands are necessary. First of all, the receiver has to be brought into push-to-fix mode using the trickle power mode command. Anyhow, one has to see that trickle power mode and push-to-fix mode are two different things! In a further step push-to-fix parameters have to be defined.

3.1.1 Set Trickle Power Parameters – Message ID 151

A0A2000997000103E8000000C8024BB0B3

Within this message one can determine the following segments:

- A0A20009 — Start Sequence (A0A2) and Payload Length (0x09 = 9)
- 97000103E8000000C8 — Payload
- 024BB0B3 — Message Checksum (024B) and End Sequence (B0B3)

Name	Bytes	Scale	Example	Unit	Description
Message ID	1 U		0x97		Decimal 151
PTF Mode	2 S		0x0001		0 = OFF, 1 = ON (here)
Duty cycle	2 U	*10	0x03E8	%	% time ON. A duty cycle of 1000 (100%) means continuous operation. Here: 1000. → Trickle power mode settings are unused!
On time	4 U	*10	0x000000C8	ms	Allowed range 200 – 900ms. Here: 200ms. → Only used, when duty cycle is different from 1000, so meaningless here!

Table 3: Set trickle power mode parameters (enter) – Message ID 151

So this way we tell the receiver to switch to push-to-fix mode.

3.1.2 Set Low Power Acquisition Parameters – Message ID 167

A0A2000FA70001D4C000007530000012C0000030EB0B3

Within this message one can determine the following segments:

- A0A2000F — Start Sequence (A0A2) and Payload Length (0x0F = 15)
- A70001D4C000007530000012C0000 — Payload
- 030EB0B3 — Message Checksum (030E) and End Sequence (B0B3)

Name	Bytes	Scale	Example	Unit	Description
Message ID	1 U		0xA7		Decimal 167
Max. Off Time	4 S		0x0001D4C0	ms	Maximum time for sleep mode, default 30s, here 120000ms = 120s
Max. Search Time	4 U		0x00007530	ms	Max. satellite search time, default 120s, here 30000ms = 30s
Push-to-fix Period	4 U		0x0000012C	s	Push-to-fix cycle period, here 300s
Adaptive T.P.	2 U		0x0000	s	Always 0!

Table 4: Set low power acquisition parameters – Message ID 167

3.1.2.1 Maximum Off Time

The receiver turns on after the maximum off time, if the receiver could not catch satellite signals within the maximum search time during the last attempt.

3.1.2.2 Maximum Search time

This is the maximum time period the receiver tries to catch satellite signals. The receiver will go back to stand-by if the receiver cannot receive satellite signals within this period and will try it again after the maximum off time.

3.1.2.3 PTF Period

This is the PTF cycle period. The receiver turns on automatically to perform a system update.

3.1.2.4 Examples

Parameters			**Command (Hex Representation)**	**Comment**
Max. Off Time [s]	Max. Search Time [s]	PTF Period [s]		
120	30	300	A0A2000FA70001D4C0000075300000012C0000030EB0B3	Test setting
1800	30	1800	A0A2000FA7001B77400000753000000708000022DB0B3	SiRF recommended default setting
2100	30	4200	A0A2000FA700200B200000753000010680000020FB0B3	Test setting

Table 5: Push-to-fix mode examples

3.2 Exit Push-To-Fix Mode

To exit from push-to-fix mode, the according command needs to be sent while the receiver is awake. If the receiver is awake can be detected by checking if anything (NMEA or binary information) is transmitted by the receiver or by looking at the pins RFWUP (High = ON) or nWakeup (Low = ON). Naturally, the receiver will be also awake after a fix request (toggling of ON_OFF pin) was done.

The following message will bring back the receiver to normal operation. Of course the receiver needs to be put into binary command mode before.

`A0A2000997000003E8000000C8024AB0B3`

Within this message one can determine the following segments:

- `A0A20009` — Start Sequence (A0A2) and Payload Length (0x09 = 9)
- `97000003E8000000C8` — Payload
- `024AB0B3` — Message Checksum (024A) and End Sequence (B0B3)

Name	Bytes	Scale	Example	Unit	Description
Message ID	1 U		0x97		Decimal 151
PTF Mode	2 S		0x0000		0 = OFF (here), 1 = ON
Duty cycle	2 U	*10	0x03E8	%	% time ON. A duty cycle of 1000 (100%) means continuous operation. Here: 1000. → Don't use any trickle power mode settings!
On time	4 U	*10	0x000000C8	ms	Allowed range 200 – 900ms. Here: 200ms. → Only used, when duty cycle is different from 1000, so meaningless here!

Table 6: Set trickle power mode parameters (exit) – Message ID 151

3.3 Summary of Main Advantages

The push-to-fix mode gives the following advantages:

- One initialization – no further engagement from external microcontroller
- Receiver is always up-to-date with Ephemeris data (of course, if satellites are „visible")
- Whenever awakened it is ready for a hot start
- This results in a minimum TTFF
- Total power budget optimized

4 SBAS Support

The SiRFstarIII chip set supports the Satellite Based Augmentation System SBAS – a kind of Differential GPS (DGPS) via satellite. The advantage of SBAS towards traditional DGPS lies in the fact that correctional data are received on a normal GPS channel. Therefore the receiver can use one of its 20 channels to detect and decode SBAS information. There is no need for an additional external receiver.

To initialize SBAS mode it is necessary to send the message with ID 133 (DGPS source) to the receiver – which has to be put into binary mode before.

```
A0A2000785010000000000086B0B3
```

Within this message one can determine the following segments:

- `A0A20007` — Start Sequence (A0A2) and Payload Length (0x07 = 7)
- `85010000000000` — Payload
- `0086B0B3` — Message Checksum (0086) and End Sequence (B0B3)

Name	**Bytes**	**Scale**	**Example**	**Unit**	**Description**
Message ID	1 U		0x85		Decimal 133
DGPS Source	1 U		0x01		0 = None 1 = SBAS (here) 2 = External RTCM data 3 = Internal DGPS beacon receiver 4 = User software
Internal beacon frequency	4 U		0x00000000		Not used!
Internal beacon bit rate	1 U		0x00		Not used!

Table 7: DGPS source selection – Message ID 133

By default the receiver will find the right SBAS satellite automatically. One can select a specific SBAS satellite using message ID 170. Please refer to the SiRF Binary Reference Manual for details.

5 Static Mode

Static navigation is a position filter designed to be used with applications intended for motor vehicles. When the vehicle's speed falls below a threshold, the position and heading are frozen, and speed is set to zero. This condition continues until the computed speed rises above 1.2 times the threshold or until the computed position is at least a set distance from the frozen place. The threshold speed and set distance may vary with software versions, currently the thresholds are as follows:

- Speed: ~ 3km/h
- Position: ~ 50m

These thresholds are fixed and cannot be modified by the user. Also, with the static mode one cannot reach a higher accuracy! But one will avoid small jumps due to the "noise" in the GPS signals and receiver.

To initialize static mode it is necessary to send the message with ID 143 to the receiver – which has to be put into binary mode before.

`A0A200028F010090B0B3`

Within this message one can determine the following segments:

- `A0A20002` — Start Sequence (A0A2) and Payload Length (0x02 = 2)
- `8F01` — Payload
- `0090B0B3` — Message Checksum (0090) and End Sequence (B0B3)

Name	Bytes	Scale	Example	Unit	Description
Message ID	1 U		0x8F		Decimal 143
Static Navigation Flag	1 U		0x01		0 = Enable (here) 1 = Disable

Table 8: Static Navigation enable – Message ID 143

To disable static mode, the according command would be:

`A0A200028F00008FB0B3`

Within this message one can determine the following segments:

- `A0A20002` — Start Sequence (A0A2) and Payload Length (0x02 = 2)
- `8F00` — Payload
- `008FB0B3` — Message Checksum (008F) and End Sequence (B0B3)

Name	Bytes	Scale	Example	Unit	Description
Message ID	1 U		0x8F		Decimal 143
Static Navigation Flag	1 U		0x00		0 = Enable 1 = Disable (here)

Table 9: Static Navigation disable – Message ID 143

6 Shut-Down Module

This command is available starting with **firmware version 3.5.0** only!

All GSC3-based GPS modules will enter hibernate mode after this command has been issued. Data in SRAM are being maintained, the RTC will keep on running.

To shut-down the module it is necessary to send the message with ID 205 along with Sub ID 16 to the receiver – which has to be put into binary mode before.

`A0A20002CD1000DDB0B3`

Within this message one can determine the following segments:

- `A0A20002` — Start Sequence (A0A2) and Payload Length (0x02 = 2)
- `CD10` — Payload
- `00DDB0B3` — Message Checksum (00DD) and End Sequence (B0B3)

Name	**Bytes**	**Scale**	**Example**	**Unit**	**Description**
Message ID	1 U		`0xCD`		Decimal 205
Message Sub ID	1 U		`0x10`		Message Sub ID for software command off

Table 10: Shut-down module – Message ID 205

Note: The SiRF Binary Manual shows a payload length of 0 bytes. This is incorrect. Please use the payload length of 2 bytes as described here.

To wake up the GPS module again one of the following methods can be used:

- Toggle ON-OFF
- Toggle nReset

7 Related Information

7.1 Contact

This manual was created with due diligence. We hope that it will be helpful to the user to get the most out of the GPS modules.

Inputs regarding errors or mistaken verbalizations and comments or proposals to Vincotech, Germany, for further improvements are highly appreciated.

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7.2 Related Documents

- SiRF_NMEA_Reference_Manual_2.2 (SiRF)
- SiRF_Binary_Reference_Manual_2.4 (SiRF)

- GPS Receiver A1080 (Vincotech)
- GPS Evaluation Kit EVA1080 (Vincotech)
- GPS Receiver A1084 (Vincotech)
- GPS Evaluation Kit EVA1084 (Vincotech)
- GPS Receiver A1088 (Vincotech)
- GPS Evaluation Kit EVA1088 (Vincotech)
- GPS Receiver A1035-D (Vincotech)
- GPS Evaluation Kit EVA1035-D (Vincotech)
- GPS Receiver A1035-H (Vincotech)
- GPS Evaluation Kit EVA1035-H (Vincotech)

7.3 Related Tools

- GPS Cockpit (Vincotech)
- SiRF Demo (SiRF)
- SiRF Flash (SiRF)

8 List of Tables

Table 1: Command to switch to SiRF binary protocol 5
Table 2: Switch to NMEA mode – Message ID 129 6
Table 3: Set trickle power mode parameters (enter) – Message ID 151 9
Table 4: Set low power acquisition parameters – Message ID 167.......................... 9
Table 5: Push-to-fix mode examples.. 10
Table 6: Set trickle power mode parameters (exit) – Message ID 151................... 11
Table 7: DGPS source selection – Message ID 133 12
Table 8: Static Navigation enable – Message ID 143 13
Table 9: Static Navigation disable – Message ID 143.. 14
Table 10: Shut-down module – Message ID 205 15