GPS Firmware GSC3-based Products

A Description of the standard NMEA GPS firmware provided on Vincotech's GPS modules based on SiRFstarIII – GSC3
A1080, A1084, A1088, A1035-D, A1035-H

User's Manual

Version 4.2
Firmware Revision 3.5.0

Revision History

Rev.	Date	Description
1.0	10-18-06	Initial draft
2.0	04-02-07	New design
3.0	07-03-07	Reworked manual (NMEA only)
4.0	08-19-08	New layout; moved to Vincotech
4.1	11-25-08	Minor corrections
4.2	03-11-09	Renamed to “GSC3-based”; added command for shutdown
	mm-dd-yy	

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Table of Contents

1 Introduction

This document contains a description of NMEA output sentences and NMEA commands which are implemented in the standard GPS firmware used in all GPS modules based on the SiRFstar GSC3 chip set: A1080's, A1084's, A1088, A1035-D, and A035-H. Only fully available commands are described. For more details of the original SiRF firmware please see chapter "5.2 Related Documents".

This revision of the manual refers to firmware **3.5.0**!

The purpose of this paper is the explanation of the behavior of the "NMEA" interface, i.e. a description of the outputs coming from this interface, and a summary of the commands that can be issued to this interface. This will allow easy and full adjustment and control of the module.

1.1 Serial Port Configuration

The firmware supports the bi-directional serial interface of Vincotech's GPS modules. It is implemented by use of the full duplex UART (Universal Asynchronous Receiver Transmitter) interface of the GPS processor.

- For the communication with UART the use of a kind of terminal program or another appropriate method is necessary.
- NMEA communication is always on port 0 (pin Tx0 and Rx0) of the module or on the serial USB port of one of the evaluation boards, respectively.
- The default configuration of this serial port is: 4800 baud, 8 data bits, no parity, 1 stop bit, no flow control.

This interface is bi-directional, i.e. on the one side the output of the GPS modules (NMEA sentences, etc.) is sent to the UART interface, on the other side the UART interface can be used to send commands to Vincotech's GPS modules.

2 Standard NMEA Sentences

2.1 Introduction

The **N**ational **M**arine **E**lectronics **A**ssociation created a uniform interface standard for digital data exchange between different marine electronic products back in the early nineteen-eighties.

- NMEA information is transmitted from a 'vendor' in 'sentences' with a maximum length of 80 characters.
- The general format is:
  "$<vendor><message><parameters>*<checksum><CR><LF>".
- The combination of <vendor><message> is called address field.
- The vendor code for the Global Positioning System is "GP".
- In this document NMEA sentences refer to the NMEA 0183 Standard.

For details see:
http://www.nmea.org/
http://www.nmea.org/pub/index.html

2.2 Supported NMEA Sentences

The Vincotech's GPS firmware currently supports 6 NMEA sentences:

- $GPGGA (default: ON)
- $GPVTG (default: OFF)
- $GPRMC (default: ON)
- $GPGSA (default: ON)
- $GPGSV (default: ON, 0.2Hz)
- $GPGLL (default: OFF)

Note: Please consider max transfer rate (depending on baud rate setting) before activating additional NMEA sentences.

The following paragraphs give an overview of NMEA messages with example strings and short explanation.

2.2.1 GGA - Global Positioning System Fix Data

e.g. $GPGGA,152145.000,4805.8193,N,01132.2317,E,1,04,2.5,607.5,M,47.6,M,,*67		
(1)	$GPGGA	Vendor and message identifier
(2)	152145.000	Universal time coordinated (15h 21m 45.000s)
(3)	4805.8193	Latitude (48deg 05.8193min)
(4)	N	N North S South
(5)	01132.2317	Longitude (011deg 32.2317min)
(6)	E	E East W West
(7)	1	Fix quality: 0 fix not valid or invalid, 1 GPS SPS mode, fix valid, 2 Differential GPS, SPS mode, fix valid
(8)	04	Four satellites in use (min 00, max 12)
(9)	2.5	Horizontal dilution of precision
(10)	607.5	MSL altitude
(11)	M	Unit of antenna altitude: meters
(12)	47.6	Geoidal separation
(13)	M	Unit of geoidal separation: meters
(14)	<empty>	Age of differential GPS data, null field when DGPS is not used
(15)	<empty>	Differential reference station ID, null field when DGPS is not used
(16)	*67	Checksum

Table 1: GGA example and description

2.2.2 VTG – Course Over Ground and Ground Speed

e.g. $GPVTG,169.31,T,,M,0.31,N,0.5,K,A*6B		
(1)	$GPVTG	Vendor and message identifier
(2)	169.31	Track degrees
(3)	T	True
(4)	<empty>	Track degrees
(5)	M	Magnetic
(6)	0.31	Horizontal speed [knots]
(7)	N	Knots
(8)	0.5	Horizontal speed [kilometers per hour]
(9)	K	Kilometers per hour
(10)	A	A Autonomous mode D Differential mode E Estimated/dead reckoning
(11)	*6B	Checksum

Table 2: VTG example and description

2.2.3 RMC - Recommended Minimum Specific GPS Data

e.g. $GPRMC,092516.000,A,4805.8021,N,01132.2243,E,1.91,183.81,270302,0.0,W,A*7B		
(1)	$GPRMC	Vendor and message identifier
(2)	092516.000	UTC - Universal Time Coordinated (09h 25m 16.000s)
(3)	A	A Fix valid V for invalid or no fix
(4)	4805.8021	Latitude (48deg 05.8021min)
(5)	N	N North S South
(6)	01132.2243	Longitude (011deg 32.2243min)
(7)	E	E East W West
(8)	1.91	Speed over ground in knots
(9)	183.81	Course over ground, degrees true
(10)	270302	Date (ddmmyy – 27th March 2002)
(11)	0.0 (1)	Magnetic variation, degrees
(12)	W (1)	W West E East
(13)	A	A Autonomous mode D Differential Mode E Estimated/dead reckoning
(14)	*7B	Checksum

(1) SiRF Technology Inc. does not support magnetic declination. All course over ground data are geodetic WGS84 directions

Table 3: RMC example and description

2.2.4 GSA - GPS DOP and Active Satellites

e.g. $GPGSA,A,3,03,20,14,31,,,,,,,,,3.7,2.5,2.8*3D		
(1)	$GPGSA	Vendor and message identifier
(2)	A	A 2D automatic – allowed to automatically switch 2D/3D M Manual – forced to operate in 2D or 3D mode
(3)	3	1 Fix not available 2 2D fix (<4 SVs used) 3 3D fix (>3 SVs used)
(4)	03	ID of satellite used in 1st channel
(5)	20	ID of satellite used in 2nd channel
…		…
(23)	<empty>	ID of satellite used in 12th channel
(24)	3.7	PDOP in meters
(25)	2.5	HDOP in meters
(26)	2.8	VDOP in meters
(27)	*3D	Checksum

Table 4: GSA example and description

2.2.5 GSV – GPS Satellites in View

e.g. $GPGSV,1,1,04,03,27,159,45,14,43,095,48,20,17,231,40,31,60,190,42*7F		
(1)	$GPGSV	Vendor and message identifier
(2)	1	Total numbers of messages
(3)	1	Number of current message
(4)	04	Satellites in view
(5)	03	Satellite number of 1st satellite
(6)	27	Elevation in degrees of 1st satellite
(7)	159	Azimuth in degrees to true of 1st satellite
(8)	45	SNR (signal to noise ratio) in dB of 1st satellite (00 when not tracking)
(9)	14	Satellite number of 2nd satellite
(10)	43	Elevation in degrees of 2nd satellite
(11)	095	Azimuth in degrees to true of 2nd satellite
(12)	48	SNR (signal to noise ratio) in dB of 2nd satellite (00 when not tracking)
(13)	20	Satellite number of 3rd satellite
(14)	17	Elevation in degrees of 3rd satellite
(15)	231	Azimuth in degrees to true of 3rd satellite
(16)	40	SNR (signal to noise ratio) in dB of 3rd satellite (00 when not tracking)
(17)	31	Satellite number of 4th satellite
(18)	60	Elevation in degrees of 4th satellite
(19)	190	Azimuth in degrees to true of 4th satellite
(20)	42	SNR (signal to noise ratio) in dB of 4th satellite (00 when not tracking)
(21)	*7F	Checksum

Table 5: GSV example and description

2.2.6 GLL – Latitude, Longitude, UTC and status

e.g. $GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41		
(1)	$GPGSV	Vendor and message identifier
(2)	3723.2475	Latitude (37deg 23.2475min)
(3)	N	N North S South
(4)	12158.3416	Longitude (121deg 58.3416min)
(5)	W	W West E East
(6)	161229.487	UTC - Universal Time Coordinated (16h 12m 29.487s)
(7)	A	A Data valid V Data not valid
(8)	A	A Autonomous mode D DGPS mode E DR mode
(9)	*41	Checksum

Table 6: GLL example and description

3 Start-up Message

After reset or power-off the GPS modules will transmit a start-up message first, this message will look like:

$PSRFTXT,Version: GSW3.5.0_3.5.00.00-C25P2.01 *03
$PSRFTXT,TOW: 0*25
$PSRFTXT,WK: 1517*67
$PSRFTXT,POS: 6378137 0 0*2A
$PSRFTXT,CLK: 96250*25
$PSRFTXT,CHNL: 12*73
$PSRFTXT,Baud rate: 4800*65

This message holds information on the firmware version, GPS time and position (if available) and others. The contents might change in future release so this information should not be used in an application (except for checking the firmware version).

4 Proprietary NMEA Sentences

NMEA input messages enable you to control the receiver while in NMEA protocol mode. By default, the receiver is configured for NMEA mode on port 0. Messages can be sent by using a terminal program, by using Vincotech's GPS Cockpit software, or the SiRFdemo software. If the receiver is in SiRF binary mode, all NMEA input messages are ignored. Once the receiver is put into NMEA mode, the following messages may be used to command the module.

All settings transmitted by NMEA or binary messages are stored in SRAM; as long as either Vcc or Vbak is supplied the settings are maintained.

The GPS module falls back to factory settings in case neither Vcc nor Vbak are supplied properly.

4.1 Transport Message

Device manufacturer define extensions of the standard NMEA protocol or sentences thereof.

- The general format is:
  "$<vendor><MID><parameters><*cksum><CR><LF>".

Vendor:	GSC3-based products use "PSRF"
MID:	Message identifier consisting of three numeric characters. Input Messages begin at MID 100.
Parameters:	Message specific parameters refer to a specific section for <data> … <data> definition.
Cksum:	Two hex character checksum as defined in the NMEA specification. Use of checksum is required on all input messages!
<CR><LF>	A "Carriage Return" and "Line Feed" is mandatory to complete the NMEA message.

Note1: All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

Note2: Both, GPS Cockpit and SiRFdemo software support the calculation of a checksum.

4.2 NMEA Input Messages

The following NMEA input messages are supported.

Message	MID(1)	Description
Set serial port	100	Set Port 0 parameters and protocol
Reset Configuration	101	Initialize various start up behaviors
Query/rate control	103	Query standard NMEA message and/or set output rate
Development data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transforming

(1) Message Identification (MID)

Table 7: NMEA Input Messages

Note: NMEA input messages 100 to 106 are SiRF proprietary NMEA messages.

4.3 Serial Port Set-up

This command message is used to set the protocol (SiRF binary or NMEA) and/or the communication parameters (baud rate, data bits, stop bits, and parity). Generally, this command is used to switch the module back to SiRF binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and the GSC3-based products will restart using the saved parameters.

- $PSRF100,0,9600,8,1,0*0C

Name	Example	Description
Message ID	$PSRF100	PSRF100 protocol header
Protocol	0	0 SiRF binary / 1 NMEA
Baud	9600	4800, 9600, 19200, 38400, 57600, 115200
DataBits	8	8, 7 (1)
StopBits	1	0, 1
Parity	0	0 none / 1 odd / 2 even
Checksum	*0C	End of message termination

(1) Sirf protocol is only valid for 8 data bits, 1 stop bit and no parity

Table 8: Serial Port Set-up

4.4 Reset Configuration *(SiRF's original: NavigationInitialization)*

This command is used to configure various reset situations (Hot Start, Warm Start and Cold Start).

- $PSRF101,0,0,0,0,0,0,12,4*10

Name	Example	Units	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X		meters	X coordinate position
ECEF Y		meters	Y coordinate position
ECEF Z		meters	Z coordinate position
ClkOffset		Hz	Clock Offset of the GSC3-based product(1)
TimeOfWeek		seconds	GPS Time Of Week
WeekNo			GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	4		Reset configurations: See Table 3-4 and Table 3-5
Checksum	*10		End of message termination

(1) Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 is used

Table 9: Navigation Initialization

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets the receiver back to factory defaults

Table 10: Reset configurations

4.5 Query/Rate control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

Table 3-6 contains the input values for the following examples:

1. Query the GGA message with checksum enabled
   - $PSRF103,00,01,00,01*25
2. Enable VTG message for a 1 Hz constant output with checksum enabled
   - $PSRF103,05,00,01,01*20
3. Disable VTG message
   - $PSRF103,05,00,00,01*21

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See Table 3-7
Mode	01		0=SetRate, 1=Query
Rate	00	seconds	Output rate 0 off Max 255
CksumEnable	01		0 Disable Checksum 1 Enable Checksum
Checksum	*25		End of message termination

Table 11: Query/Rate Control Data Format (See example 1)

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG
6	MSS (If internal beacon is supported)
7	Not defined
8	ZDA (if 1PPS output is supported)
9	Not defined

Table 12: NMEA Messages

Note: Please consider max transfer rate (depending on baud rate setting) before activating additional NMEA sentences.

Note: In TricklePower mode, update rate is specified by the user. When switching to NMEA protocol, the message update rate is also required. The resulting update rate is the product of the TricklePower update rate and the NMEA update rate (i.e., TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 x 5 = 10)).

4.6 Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables you to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

Table 3-10 contains the input values for the following examples:

1. Debug On

- $PSRF105,1*3E

2. Debug Off

- $PSRF105,0*3F

Name	Example	Description
Message ID	$PSRF105	PSRF105 protocol header
Debug	1	0 Off 1 On
Checksum	*3E	End of message termination

Table 13: Development Data On/Off Data Format

4.7 Select Datum

All GSC3-based GPS modules perform initial position and velocity calculations using an earth-centered earth-fixed (ECEF) coordinate system. Results may be converted to an earth model (geoid) defined by the selected datum. The default datum is WGS84 (World Geodetic System 1984) which provides a worldwide common grid system that may be translated into local coordinate systems or map datums. Local map datums are a best fit to the local shape of the earth and not valid worldwide.

The table below contains the input values for the following examples:

1. Datum select TOKYO_MEAN

- $PSRF106,178*32

Name	Example	Description
Message ID	$PSRF106	PSRF106 protocol header
Datum	178	21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	*32	End of message termination

Table 14: Select Datum Data Format

4.8 Shut-Down Module

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.

- $PSRF117,16*0B

Name	Example	Description
Message ID	$PSRF117	PSRF117 protocol header
Shutdown	16	Shutdown command
Checksum	*0B	End of message termination

Table 15: Shut-down command

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

- Toggle ON-OFF
- Toggle nReset

5 Related Information

5.1 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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5.2 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)

5.3 Related Tools

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

6 List of Tables