

# **Data Sheet / GM-316**

**SiRFstarIII, 13x16**

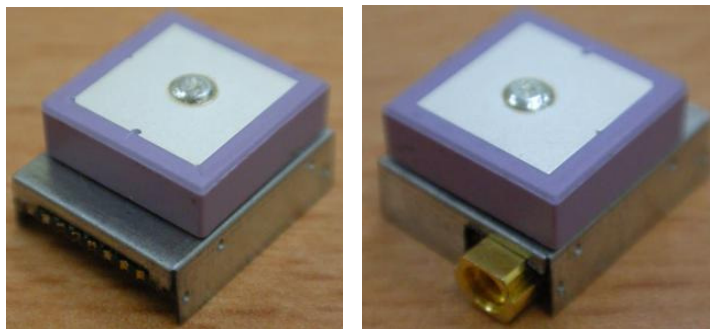
**Ultra-Low Power**

**Tiny & Easy to Use**

**GPS Smart Antenna Module**

**with**

**MMCX RF Connector**



**Version 1.0**

**Navisys Technology Corp.**

Tel : +886-3-5632598

Sales contact: [sales@navisys.com.tw](mailto:sales@navisys.com.tw)

Address: 5F, No.2, Industry E. Rd. IX, Science-Based Industrial Park, Hsinchu 300, Taiwan (R.O.C.)

<http://www.navisys.com.tw/>

Fax: +886-3-5632597

Technical support: [support@navisys.com.tw](mailto:support@navisys.com.tw)

The specifications in this document are subject to change without prior notice. NaviSys Technology Corp. assumes no warranties (either expressed or implied) regarding the accuracy and completeness of this document and shall in no event be liable for any loss of profit or any other commercial damage, including but not limited to special, incidental, consequential, or other damages. NaviSys products are not intended for use in medical, life-support devices, commercial aircraft or any applications involving potential risk of personal injury, death, or severe property damage in case of failure of the product.

No part of this document may be reproduced or transmitted in any form by any means without the express written permission of NaviSys Technology Corp.

“NaviSys Technology – Your Location Partner” is a trademark of NaviSys Technology Corp. All brand names and product names used in this document are trademarks or registered trademarks of their respective holders.

## Revision History

Ver.	Date	Description
1.0	Jun. 26 <sup>th</sup> , 2008	Initial release

## Contents

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	OVERVIEW .....	1
1.2	MAIN FEATURES .....	1
1.3	RECEIVER SPECIFICATIONS .....	2
1.4	PROTOCOLS .....	3
1.5	ANTENNA .....	3
<b>2</b>	<b>HARDWARE INTERFACE .....</b>	<b>4</b>
2.1	MODULE DIMENSION .....	4
2.2	PIN ASSIGNMENT .....	5
2.3	POWER SAVING .....	5
2.3.1	<i>Power Saving of Adaptive Trickle Power .....</i>	<i>5</i>
2.3.2	<i>Power Saving of Push To Fix .....</i>	<i>6</i>
2.3.3	<i>Power Saving by Controlling VCC Power Supply .....</i>	<i>6</i>
2.4	1PPS OUTPUT .....	6
<b>3</b>	<b>SOFTWARE INTERFACE – NMEA OUTPUT .....</b>	<b>8</b>
3.1	NMEA OUTPUT MESSAGES .....	8
3.2	GPGGA - GLOBAL POSITIONING SYSTEM FIX DATA .....	8
3.3	GPGLL - GEOGRAPHIC POSITION - LATITUDE / LONGITUDE .....	9
3.4	GPGSA - GNSS DOP AND ACTIVE SATELLITES .....	10
3.5	GPGSV - GNSS SATELLITES IN VIEW .....	10
3.6	GPRMC - RECOMMENDED MINIMUM SPECIFIC GNSS DATA .....	11
3.7	GPVTG - COURSE OVER GROUND AND GROUND SPEED .....	11
3.8	GPZDA - SiRF TIMING MESSAGE .....	12
<b>4</b>	<b>SOFTWARE INTERFACE – NMEA INPUT .....</b>	<b>13</b>
4.1	TRANSPORT MESSAGE .....	13
4.2	NMEA INPUT MESSAGES SUMMARY .....	14
4.3	100 — SET SERIAL PORT .....	14
4.4	101 — NAVIGATION INITIALIZATION .....	15
4.5	102 — SET DGPS PORT .....	16
4.6	103 — QUERY / RATE CONTROL .....	16
4.7	104 — LATITUDE / LONGITUDE / ALTITUDE NAVIGATION INITIALIZATION .....	17
4.8	105 — DEVELOPMENT DATA ON / OFF .....	18
4.9	106 — SELECT DATUM .....	18
<b>5</b>	<b>ELECTRICAL AND ENVIRONMENTAL DATA .....</b>	<b>19</b>

<b>6</b>	<b>REFERENCE CIRCUIT .....</b>	<b>20</b>
<b>7</b>	<b>APPLICATION.....</b>	<b>21</b>
<b>8</b>	<b>ORDERING INFORMATION .....</b>	<b>22</b>

# 1 Introduction

---

## 1.1 Overview



As shown in the above pictures, NaviSys GM-316 is a low-power, ultra-high performance, easy to use GPS smart antenna module based on SiRF's third generation single chip.

Its low power consumption, tiny size, and ultra-high performance enable the adoption of handheld applications. The slim design allows GM-316 to be placed on top side of the housing to have best GPS signal reception. The 6-pin I/O interface is then connected to the main board with either connector or wire soldering.

The integrated antenna helps reducing the RF and EMI issues to minimum. Fast adoption and high yield production becomes possible. The embedded RF connector allows receiving GPS signal using external active antenna when the built-in antenna is blocked from GPS signal.

## 1.2 Main Features

Not only handheld but also any other GPS applications can share the following major features of GM-316.

- ◆ **Small** – 13 x 16 x 9 (mm) with patch antenna of 12.8 x 12.8 x 4 (mm)
- ◆ **Dual antenna support:** Built-in patch antenna and MMCX RF connector for external antenna connection
- ◆ Easy use - connecting 4~6 digital pins & ready to use
- ◆ Backup power pin allowing hot/warm starts and better performance
- ◆ Minimum RF and EMI efforts
- ◆ Fully implementation of ultra-high performance **SiRFstarIII** single chip architecture
- ◆ High tracking sensitivity of **-159dBm**

- ◆ **Low power** consumption of **26mA** at full tracking
- ◆ GM-316 could be arranged at best reception location inside housing
- ◆ **Firmware upgradeable** for future potential performance enhancements

### 1.3 Receiver Specifications

Features	Specifications <sup>1</sup>
GPS receiver type	20 channels, L1 frequency, C/A code
Horizontal Position Accuracy	< 2.5m (Autonomous) < 2.0m (WAAS) (50% 24hr static, -130dBm)
Velocity Accuracy	<0.01 m/s (speed) <0.01° (heading) (50%@30m/s)
Time accuracy	1µs or less
TTFF (Time to First Fix) (50%, -130dBm, autonomous)	Hot Start: 1s Warm Start: 35s Cold Start: 42s
Sensitivity (Autonomous)	Tracking: -159dBm Acquisition: -142dBm (-142dBm 28dB-Hz with 4dB noise figure)
Measurement data output	Update time: 1 second NMEA output protocol: V.3.00 Baud rate: 4800 (default), 9600, 19200, 38400, 57600 bps (8-N-1) Datum: WGS-84 Default: GGA, GSA, RMC, VTG at 1Hz and GSV at 1/5Hz Other options: GLL, ZDA, or SiRF binary
Max. Altitude	<18,000 m
Max. Velocity	<1,852 km/hr
SBAS Support	WAAS, EGNOS
Dynamics	<4g
Power consumption	26mA, continuous tracking mode
Power supply	3 ~ 6 V
Dimension	13 (W) x 16 (L) x 9 (H) mm
Operating temperature	-40°C ~ +85°C
Storage temperature	-40°C ~ +85°C

<sup>1</sup>Note. Data is from chip vendor.

## 1.4 Protocols

Both NMEA and SiRF binary protocols could be supported via serial UART I/O port – RXA/TXA. The default supported protocol is NMEA protocol.

1. Serial communication channel
  - i. No parity, 8-data bit, 1-stop bit (N-8-1)
  - ii. User selectable baud rate among 4800, 9600, 19200, 38400, and 57600 (default 4800) bps.
2. NMEA 0183 Version 3.00 ASCII output
  - i. Default GGA (1 sec), GSA (1 sec), GSV (5 sec), RMC (1 sec), VTG (1 sec)
  - ii. Optional GLL, ZDA

## 1.5 Antenna

To have the best performance, Navisys suggests tuning the built-in patch antenna together with product's outside shell of housing.

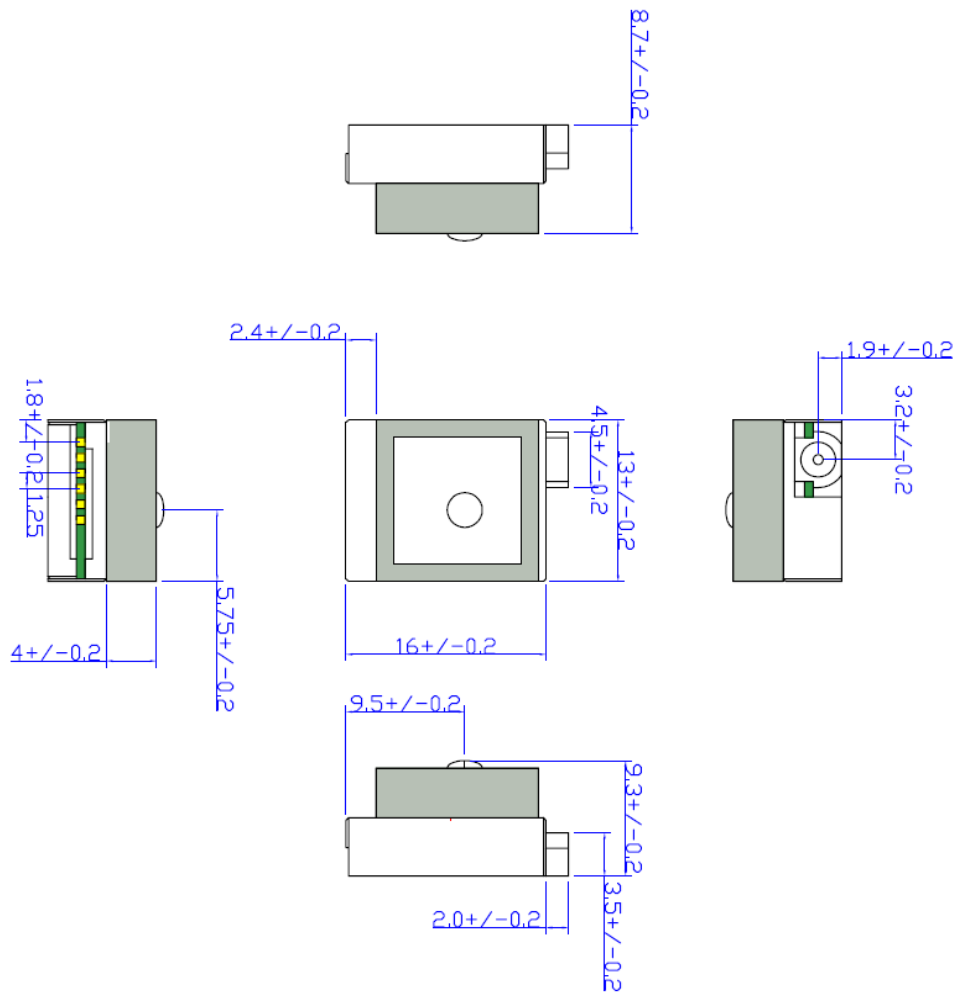
In addition to the built-in patch antenna, the MMCX RF connector allows connection of an external active antenna. The gain of the external active antenna is suggested to be 23 ~ 27 dB with Noise Figure less than 2dB.

If the external antenna is connected, suggest putting it at location distant from GM-316 so that it can still receive signals while GM-316 is blocked from GPS signal.

## 2 Hardware Interface

### 2.1 Module Dimension

The dimension of GM-316 is 13 mm (W) x 16 mm (L) x 9 mm (H) as shown below.



## 2.2 Pin Assignment



Please note that pin1 is soldered to the shielding case in the above picture.

### 6-pin Interface

Pin	Name	Function	I/O
1	GND	Ground	Input
2	VCC	3 ~ 6 V power supply	Input
3	TXA	Port A serial data output (from GPS)	Output
4	RXA	Port A serial data input (to GPS)	Input
5	V_BAT	Backup power (1.3~6V)	Input
6	1PPS/ or Reset	* 1 pulse per second signal for timing application (default) Normally, leave it open if this pin is not used. / or * Active low reset signal; min. 250ms/ or Normally, leave it open if this pin is not used.	Output/ or  Input

## 2.3 Power Saving

GM-316 supports power saving mechanisms – Adaptive Trickle Power and Push To Fix. They are implemented in software.

### 2.3.1 Power Saving of Adaptive Trickle Power

The Adaptive Trickle Power (ATP) saving is based on trickle power (TP) saving mechanism. TP is achieved by switching off and on CPU and RF at a fixed time interval. The biggest time interval to report a position is 10 seconds. The on and off ratio is configurable. TP provides a fixed power savings and provides a constant output rate, but may suffer lost fixes in a weak-signal environment. ATP operates similar to TP. However, when signal levels drop, ATP returns to full power so that message output rates remain constant even in difficult environments. This results in variable power savings but much more reliable performance for

a fixed output rate. Applications using ATP should give performance very similar to full power, but with significant power savings in strong-signal conditions. This feature is done by firmware automatically if this feature is enabled. The standard firmware does not turn on this feature. It could be customized based on request of MOQ.

### *2.3.2 Power Saving of Push To Fix*

The Push To Fix (PTF) power saving mechanism generally keeps the receiver in a low-power mode, but wakes up either on demand or periodically (10 seconds to 2 hours, configurable) to refresh position, time, ephemeris data, RTC calibration and output position fixing data.

When the PTF mode is enabled, upon power on or a new PTF cycle, the receiver will stay on full power until the good navigation solution is computed. The low-power mode will follow for the remainder of the period. For example, for a PTF time interval of 30 minutes, if it took 36 seconds to fix position and refresh ephemeris, the receiver will sleep for the remaining 29 minutes and 24 seconds.

This mechanism is especially useful for applications that need position data only on demand. This feature is done by firmware automatically if this feature is enabled. The standard firmware does not turn on this feature. It could be customized based on request of MOQ.

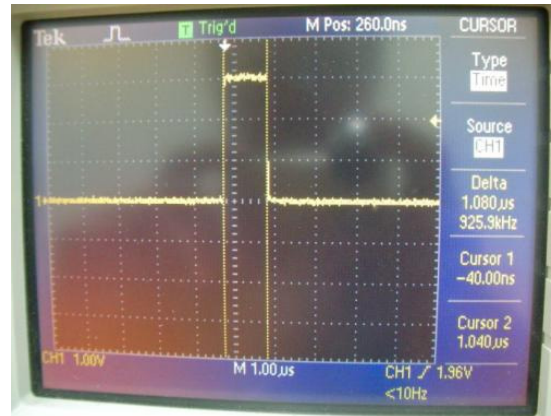
### *2.3.3 Power Saving by Controlling VCC Power Supply*

Another easy way to save the GPS power is to control the VCC power supply. Many handheld platforms allow controlling power supply by application program. When the power supply to GPS is cut, there is no power consumption.

Please note the power supply to V\_BAT should always be connected. Otherwise, the position fixing data will get lost and thus it will suffer longer position fix time when the power supply is connected again.

## **2.4 1PPS Output**

The 1 pulse per second signal output is a precise reference time signal. The rising edge of 1PPS pulse is synchronized to GPS second with precision of better than 1 micro-second, pulse width of 1 micro-second.



Please note that 1PPS signal will not output until the position has been fixed. Above is the 1PPS signal taken from the screen of oscilloscope.

#### 1PPS output

- Low: before position is fixed
- High/low alternating: after position is fixed

Please note that duty cycle of 1µs is not able to light up an LED due to too small duty cycle. To light up an LED, customized firmware can drive 1PPS to output pulse with longer duty cycle, say 100ms.

### 3 Software Interface – NMEA Output

#### 3.1 NMEA Output Messages

The NMEA-0183 Output Messages are shown as below:

NMEA Record	Descriptions
GPGGA	Global positioning system fixed data: time, position, fixed type
GPGLL	Geographic position: latitude, longitude, UTC time of position fix and status
GPGSA	GPS receiver operating mode, active satellites, and DOP values
GPGSV	GNSS satellites in view: ID number, elevation, azimuth, and SNR values
GPRMC	Recommended minimum specific GNSS data: time, date, position, course, speed
GPVTG	Course over ground and ground speed
GPZDA	PPS timing message (synchronized to PPS)

The GM-316 adopts interface protocol of National Marine Electronics Association's NMEA-0183 Version 3.00 interface specification. GM-316 supports 7 types of NMEA sentences (GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, and GPZDA).

The default output sentences are GPGGA, GPGSA, GPGSV, GPRMC, and GPVTG. The UART communication parameters are 4800 bps, 8 data bits, 1 stop bit, and no parity. Other output sentences, baud rate, and related configurations could be requested based on MOQ.

Single message example

```
$GPGGA,101229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,, , ,0000*3E
$GPGLL,2446.8619,N,12100.2579,E,060725.000,A,A*7E
$GPGSA,A,3,05,02,26,27,09,04,15, , , , ,1.8,1.0,1.5*11
$GPGSV,3,1,12,07,62,081,37,16,61,333,37,01,60,166,37,25,56,053,36*74
$GPGSV,3,2,12,03,43,123,33,23,32,316,34,14,17,152,30,20,16,263,33*78
$GPGSV,3,3,12,19,17,210,29,06,08,040,,15,06,117,27,21,05,092,27*7E
$GPRMC,121229.487,A,3723.2475,N,12148.3416,W,0.13,309.62,120598,, ,A*7A
$GPVTG,,T,,M,0.00,N,0.0,K,A*13
$GPZDA,060526.000,20,06,2006,,*51
```

#### 3.2 GPGGA - Global Positioning System Fix Data

- Example

\$GPGGA,101229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000\*3E

■ Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPGGA		GGA protocol header
UTC Time	101229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12158.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Position Fix Indicator	1		0: Fix not available or invalid, 1: GPS SPS Mode, fix valid, 2: Differential GPS, SPS Mode, fix valid, 3~5: Not supported, 6: Dead Reckoning Mode, fix valid
Satellites Used	07		Number of satellites used in positioning calculation (0 to 12)
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude	9.0	meters	
Unit	M		Meters
Geoidal separation		meters	
Units	M		Meters
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
checksum	*3E		
<CR><LF>			End of sentence

### 3.3 GPGLL - Geographic Position - Latitude / Longitude

■ Example

\$ GPGLL,2446.8619,N,12100.2579,E,060725.000,A,A\*7E

■ Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPGLL		GLL protocol header
Latitude	2446.8619		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12100.2579		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	E		E: East Longitude, W: West Longitude
UTC Time	060725.000		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Mode Indicator	A		A: Autonomous, D: DGPS, E: DR
checksum	*7E		
<CR><LF>			End of sentence

### 3.4 GPGSA - GNSS DOP and Active Satellites

■ Example

\$GPGSA,A,3,05,02,26,27,09,04,15,, , , , ,1.8,1.0,1.5\*11

■ Explanation

Contents	Example	Explanation
Message ID	\$GPGSA	GSA protocol header
Mode 1	A	M: Manual—forced to operate in 2D or 3D mode A: 2D Automatic—allowed to automatically switch 2D/3D
Mode 2	3	1: Fix not available 2: 2D (< 4 Satellites used) 3: 3D (> 3 Satellites used)
Satellite used in solution	05	Satellite on Channel 1
Satellite used in solution	02	Satellite on Channel 2
...		Display of quantity used (12 max)
PDOP	1.8	Position Dilution of Precision
HDOP	1.0	Horizontal Dilution of Precision
VDOP	1.5	Vertical Dilution of Precision
checksum	*11	
<CR><LF>		End of sentence

### 3.5 GPGSV - GNSS Satellites in View

■ Example

\$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42\*71

\$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42\*41

■ Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPGSV		GSV protocol header
Number of messages	2		Range 1 to 3
Message number	1		Range 1 to 3
Satellites in view	07		Number of satellites visible from receiver
Satellite ID number	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Elevation angle of satellite as seen from receiver channel 1 (00 to 90)
Azimuth	048	degrees	Satellite azimuth as seen from receiver channel 1 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 1 (00 to 99, null when not tracking)
...			
Satellite ID number	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Elevation angle of satellite as seen from receiver channel 4 (00 to 90)
Azimuth	138	degrees	Satellite azimuth as seen from receiver channel 4 (000 to 359)
SNR (C/No)	42	dBHz	Received signal level C/No from receiver channel 4 (00 to 99, null when not tracking)
checksum	*71		
<CR><LF>			End of sentence

### 3.6 GPRMC - Recommended Minimum Specific GNSS Data

■ Example

\$GPRMC,151229.487,A,3723.2475,N,12148.3416,W,0.13,309.62,120598,,,A\*5F

■ Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPRMC		RMC protocol header
UTC Time	151229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12148.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Speed over ground	0.13	knots	Receiver's speed
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	120598		ddmmyy dd: Day, mm: Month, yy: Year
Magnetic variation		degrees	This receiver does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.
Mode Indicator	A		A: Autonomous                      M: Manual D: DGPS                                S: Simulation E: Dead Reckoning                N: Data Invalid
checksum	*5F		
<CR><LF>			End of sentence

### 3.7 GPVTG - Course over Ground and Ground Speed

■ Example

\$GPVTG,309.62,T,,M,0.18,N,0.5,K,A\*0F

■ Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPVTG		VTG protocol header
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north (geodetic WGS84 directions)
Reference	T		True
Course over ground		degrees	Receiver's direction of travel
Reference	M		Magnetic
Speed over ground	0.18	knots	Measured horizontal speed
Unit	N		Knots
Speed over ground	0.5	km/hr	Measured horizontal speed
Unit	K		km/hr
Mode Indicator	A		A: Autonomous, D: DGPS, E: DR
checksum	*0F		
<CR><LF>			End of sentence

### 3.8 GPZDA - SiRF Timing Message

- Example

\$GPZDA,181813,14,10,2006,00,00\*4A

- Explanation

Contents	Example	Unit	Explanation
Message ID	\$GPZDA		ZDA protocol header
UTC time	181813		Either using valid IONO/UTC or estimated from default leap seconds
Day	14		Day according to UTC time (01 to 31)
Month	10		Month according to UTC time (01 to 12)
Year	2006		Year according to UTC time (1980 to 2079)
Local zone hour	00	hour	Offset from UTC (set to 00)
Local zone minutes	00	minute	Offset from UTC (set to 00)
checksum	*4F		
<CR><LF>			End of sentence

## 4 Software Interface – NMEA Input

---

A NMEA command is actually a NMEA input message. In addition to the NMEA output messages, NMEA input messages allow users to control SiRFstarIII-based product while in NMEA protocol mode. If the receiver is in SiRF binary mode, all NMEA input messages are ignored and it can be switched to NMEA mode by using the SiRFDemo software and selecting Switch to NMEA Protocol from the Action menu. Once the receiver is put into NMEA mode, the following messages could be used to command the SiRFstarIII-based product.

Please note that for normal use, there is no need to input any message to the device.

### 4.1 Transport Message

There are four parts in a NMEA input message:

Start Sequence	Payload	Checksum	End Sequence
\$PSRF<MID> <sup>1</sup>	Data <sup>2</sup>	*CKSUM <sup>3</sup>	<CR><LF> <sup>4</sup>

1. Message Identifier consisting of reserved word "\$PSRF" and three numeric characters. Input messages begin from MID 100.
2. Message-specific data. Refer to a specific message section for <data>...<data> definition described in following sections.
3. CKSUM is a two-hex character checksum as defined in the NMEA specification, NMEA-0183 Standard for Interfacing Marine Electronic Devices. Checksum consists of a binary exclusive OR the lower 7 bits of each character after the "\$" and before the "\*" symbols. The resulting 7-bit binary number is displayed as the ASCII equivalent of two hexadecimal characters representing the contents of the checksum. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR) and Line Feed (LF) which is \r\n or hexadecimal 0D 0A. Because \r and \n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Please note that all fields in all proprietary NMEA messages are required, none are optional.

All NMEA, messages are comma delimited.

## 4.2 NMEA Input Messages Summary

Please note that following input messages are SiRF proprietary NMEA messages.

Message	MID	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z. Input coordinates must be WGS84.
SetDGPSPort	102	Set PORT B parameters for DGPS input (Not applicable)
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt. Input coordinates must be WGS84.
Development Data On/Off	105	Development Data messages On/Off
Select Datum	106	Selection of datum to be used for coordinate transformations.

## 4.3 100 — Set Serial Port

This command message is used to set the protocol (SiRF binary or NMEA) and/or the communication parameters (Baud, 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. Sometimes, it is used to set a new baud rate. When a valid message is received, the parameters are stored in battery-backed SRAM for future use.

- Example - Switch to SiRF binary protocol at 38400,8,N,1  
\$PSRF100,0,38400,8,1,0\*3C

- Explanation

Name	Example	Units	Description
Message ID	\$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF binary, 1=NMEA
Baud	38400		4800, 9600, 19200, 38400
DataBits	8		7, 8
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*3C		
<CR> <LF>			End of message termination

## 4.4 101 — Navigation Initialization

This command is used to initialize the GPS device by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the GPS device to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable GPS device to acquire signals quickly. This message is also used for TTFF (Time To First Fix) tests.

- Example - Start using known position and time.

\$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3\*2F

- Explanation

Name	Example	Units	Description
Message ID	\$PSRF101		PSRF101 protocol header
ECEF X	-2686700	meters	X coordinate position
ECEF Y	-4304200	meters	Y coordinate position
ECEF Z	3851624	meters	Z coordinate position
ClkOffset	96000	Hz	Clock offset of the evaluation receiver. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 is used.
TimeOfWeek	497260	seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See following table
Checksum	*2F		
<CR> <LF>			End of message termination

### Reset Configuration

Hex	Description
0x00	Perform a hot start using internal RAM data. No initialization data is used.
0x01	Use initialization data and begin in start mode. Uncertainties are 5 seconds time accuracy and 300km position accuracy. Ephemeris data in SRAM is used.
0x02	No initialization data is used, ephemeris data is cleared, and warm start performed using remaining data in RAM.
0x03	Initialization data is used, ephemeris data is cleared, and warm start performed using remaining data in RAM.
0x04	No initialization data is used. Position, time and ephemeris are cleared and a cold start is performed.
0x08	No initialization data is used. Internal RAM is cleared and a factory reset is performed.

## 4.5 102 — Set DGPS Port

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used that has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and the receiver restarts using the saved parameters.

- Example - Set DGPS Port to be 9600,8,N,1.

\$PSRF102,9600,8,1,0\*12

- Explanation

Name	Example	Units	Description
Message ID	\$PSRF102		PSRF102 protocol header
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*12		
<CR> <LF>			End of message termination

## 4.6 103 — 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.

- Example 1 - Query the GSV message with checksum enabled.

\$PSRF103,03,01,00,01\*26

- Example 2 - Enable VTG message for a 1Hz constant output with checksum enabled

\$PSRF103,05,00,01,01\*20

- Example 3 - Disable VTG message

\$PSRF103,05,00,00,01\*21

- Explanation

Name	Example	Units	Description
Message ID	\$PSRF103		PSRF103 protocol header
Msg	03		0: GGA, 1: GLL, 2: GSA, 3:GSV, 4:RMC, 5: VTG, 6:MSS, 7:reserved, 8: ZDA, 9: reserved.
Mode	01		0=SetRate, 1=Query

Rate	00	Seconds	Output-off = 0, max=255
CksumEnable	01		0=Disable checksum, 1=Enable checksum
Checksum	*26		
<CR> <LF>			End of message termination

## 4.7 104 — Latitude / Longitude / Altitude Navigation Initialization

This command is used to initialize GPS DEVICE by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

- Example - Start using known position and time.

\$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1\*07

- Explanation

Name	Example	Units	Description
Message ID	\$PSRF104		PSRF104 protocol header
Lat	37.3875111	degrees	Latitude position (Range 90 to -90)
Lon	-121.97232	degrees	Longitude position (Range 180 to -180)
Alt	0	meters	Altitude position
ClkOffset	96000	Hz	Clock offset of the evaluation receiver. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 is used.
TimeOfWeek	237759	seconds	GPS Time Of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See following table
Checksum	*07		
<CR> <LF>			End of message termination

### Reset Configuration

Hex	Description
0x01	Hot Start – All data valid.
0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) – Ephemeris cleared, initialization data loaded
0x04	Cold Start – Clears all data in memory
0x08	Clear Memory – Clears all data in memory and resets receiver back to factory defaults.

### 4.8 105 — 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. Please note that this command is useful only when you develop your own application with SiRF SDK.

■ Example 1 - Debug On

\$PSRF105,1\*3E

■ Example 2 - Debug Off

\$PSRF105,0\*3F

■ Explanation

Name	Example	Units	Description
Message ID	\$PSRF105		PSRF105 protocol header
Debug	1		0=Off, 1=On
Checksum	*3E		
<CR> <LF>			End of message termination

### 4.9 106 — Select Datum

GPS receivers 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 WGS 84 (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.)

■ Example – Select datum TOKYO\_KOREA

\$PSRF106,180\*35

■ Explanation

Name	Example	Units	Description
Message ID	\$PSRF106		PSRF106 protocol header
Datum	180		21=WGS84 178=TOKYO_MEAN 179=TOKYO_JAPAN 180=TOKYO_KOREA 181=TOKYO_OKINAWA
Checksum	*35		
<CR> <LF>			End of message termination

## 5 Electrical and Environmental Data

---

### Absolute Maximum Ratings

Power Supply (pin 2)	6.5 VDC
Backup Battery Supply (pin 5)	7 VDC

**Warning** – Stressing the device beyond the “Absolute Maximum Ratings” may cause permanent damage. These are stress ratings only. Operation beyond the “DC Recommended Operating Condition” is not recommended and extended exposure beyond the “DC Recommended Operating Condition” may affect device reliability.

### DC Recommended Operation Condition

Power Supply (pin 2)	3 ~ 6 VDC
Backup Battery Supply (pin 5)	1.3 ~ 6 VDC

### Digital I/O Data

$V_{IH}$ : 2 ~ 3.15V High level input voltage	$V_{IL}$ : 0 ~ 0.85V Low level input voltage
$V_{OH}$ : > 2.1V High level output voltage	$V_{OL}$ : < 0.72V Low level output voltage

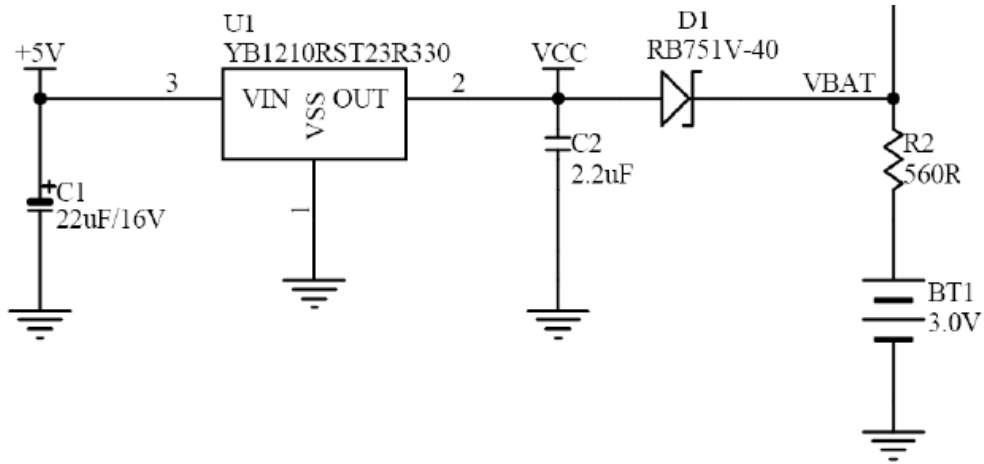
### Environmental Data

Operating temperature	-40 ~ 85 °C
Storage temperature	-40 ~ 85 °C

## 6 Reference Circuit

---

Backup battery reference circuit



## 7 Application

---

To have best performance, it is suggested to **place** GM-316 at the location of best RF signal reception, say, the upper side of product housing. The mother board is usually perpendicular to the upper side housing. In this case, just connect the 6-pin to the mother board via connection wires.

In some cases, **EMI** may still affect the module. Enhance the ground pin between GM-316 and mother board may help it.

## 8 Ordering Information

---

Each product has a default configuration. Customer is strongly suggested to check the product configuration before ordering.

### GM-316X

A	A: GGA, GSA, RMC, VTG@1Hz, GSV@1/5Hz 4800bps
---	---