WX1312 Datasheet

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1 Introduction

1.1 Overview

The Power Star WX1312 is an OEM GPS receiver module, which provides the SiRFstar IV receiver functionality using the state of the art SiRF GSD4e chip (ROM variant). The module has ultra small form factor 13x11.5 mm, height is 2.0 mm typical. The Power Star WX1312 receiver provides low power and very fast TTFF together with weak signal acquisition and tracking capability to meet even the most stringent performance expectations.

The module provides complete signal processing from antenna input to host port in either NMEA messages or in SiRF OSP binary protocol. The module requires a single power supply VDD +3.3V. The host port is configurable to UART during power up. Host data and I/O signal levels are 3.3V CMOS compatible, inputs are 3.6V tolerable.

The antenna input supports passive and active antennas and provides also an input for externally generated antenna bias supply.

This document describes the electrical connectivity and main functionality of the Power Star WX1312 OEM GPS Receiver module.

1.2 Features

- SiRFstar IV GSD4e GPS engine
- 48 track verification channels
- SBAS (WAAS or EGNOS)
- High sensitivity navigation engine (PVT) tracks as low as -163dBm
- Excellent TTFFs at low signal levels, cold start to -147dBm

- Active and Passive antenna support
- Integrated high performance LNA with 4.2dB noise figure
- Integrated LDO and switch mode regulator
- Ultra low power mode using RTC clock

1.3 Application

- Asset tracking
- Fleet management
- Geo Tagging
- Any consumer electronics requiring position capability

1.4 Specification

GPS Receiver

Chipset	SiRFstar IV, GSD4e
Frequency	L1, 1575.42MHz
Code	C/A Code
Protocol	NMEA 0183 rev 3.0 (configurable to SiRF binary OSP)
Channels	48
Position accuracy	< 2.5m CEP autonomous < 2m SBAS
Sensitivity	Acquisition: -147 dBm typ. Tracking: -163 dBm typ.
Time to First Fix , cold start	33 second typ.*(Note 1)*

Note 1: With nominal GPS signal levels -130dBm.

Serial Port

Channels	2 channels with full duplex capability
Baudrate	9600 default
Data Format	8 bits, no parity, 1 stop bit

Physical Characteristics

PCB Type	16 pin LCC(Leadless Chip Carrier)
Dimensions	13x11.5 mm

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Power Characteristics

	Min	Typ	Max	Unit
VCC	2.5	3.3	3.6	V
VBAT	1.25	3.3	3.6	V
ANT-Power	3	3.3	5	V
Icc Acquisition(VCC=3.3V)	42	55	65	mA
Icc Tracking(VCC=3.3V)	30	31.5	33.5	mA
Suspend Timelong (C=0.22F, VCC=3.3V)	150		180	min.

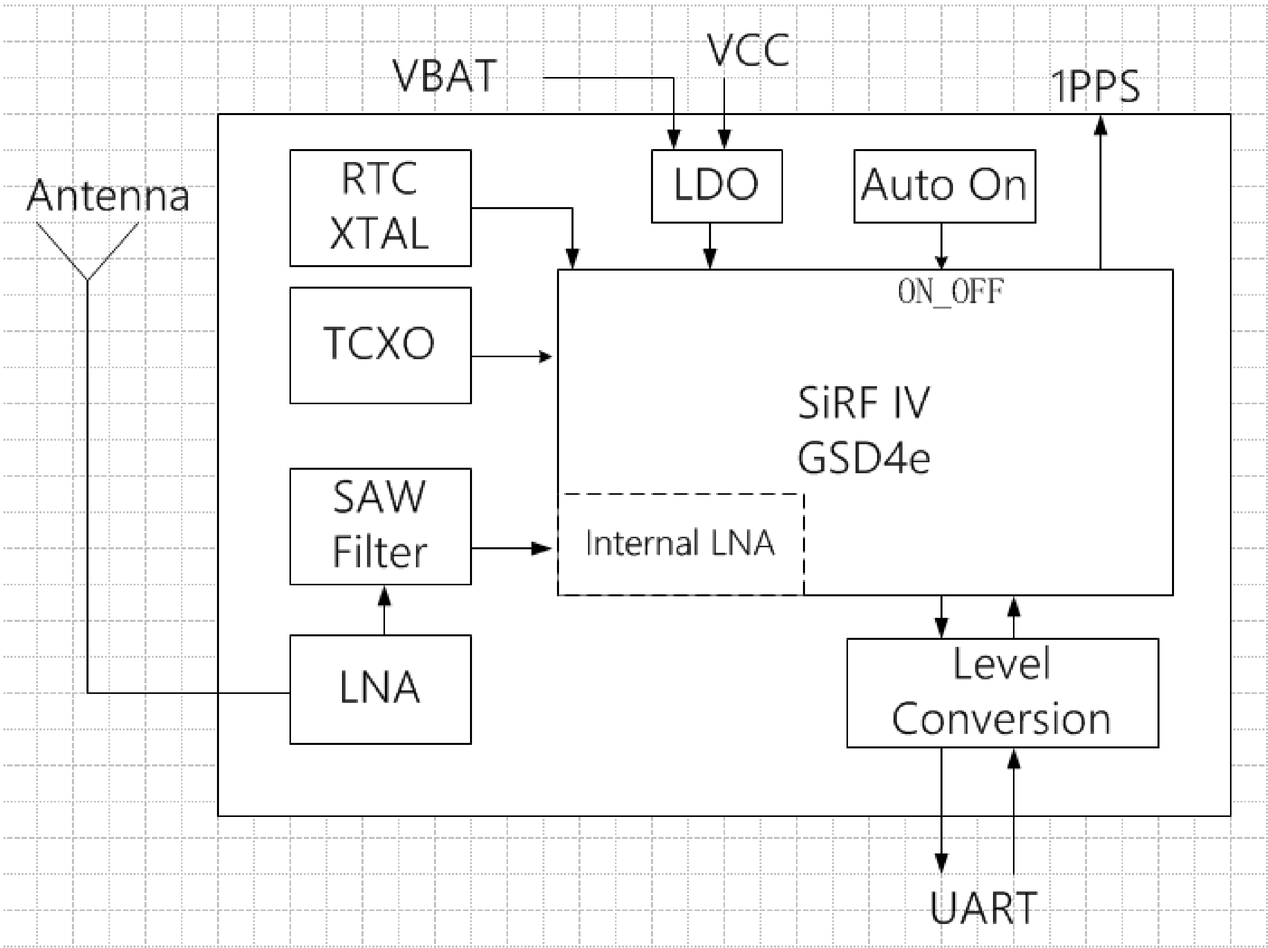
Environmental data

	Min	Max	Unit
Operating temperature	-40*(Note 2)*	85	℃
Storing temperature	-40	85	℃

Note 2: Operation in the temperature range -40 ℃...-30 ℃ is allowed but Time-to-First-Fix performance and tracking sensitivity may be degraded.

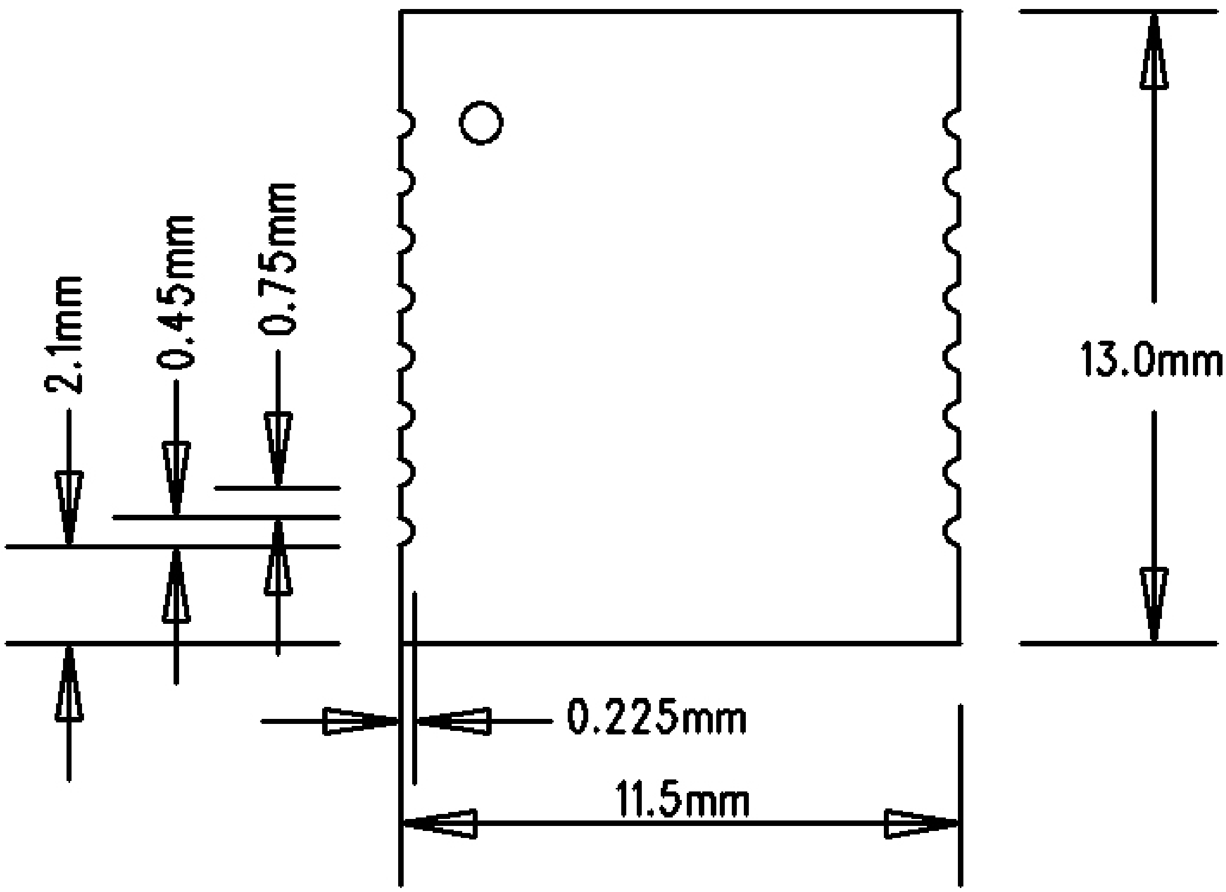
2 Technical Description

2.1 Block diagram



Block diagram

2.2 Dimension



2.3 PCB Footprint

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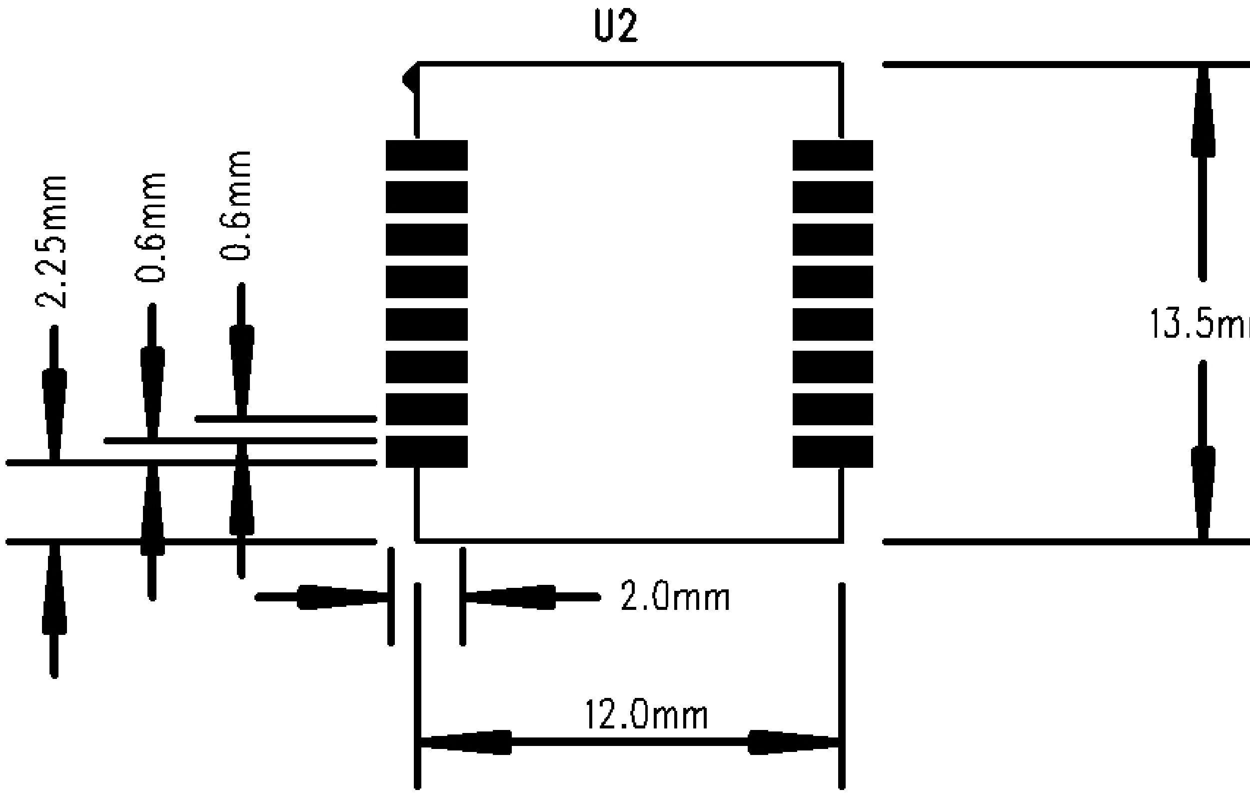
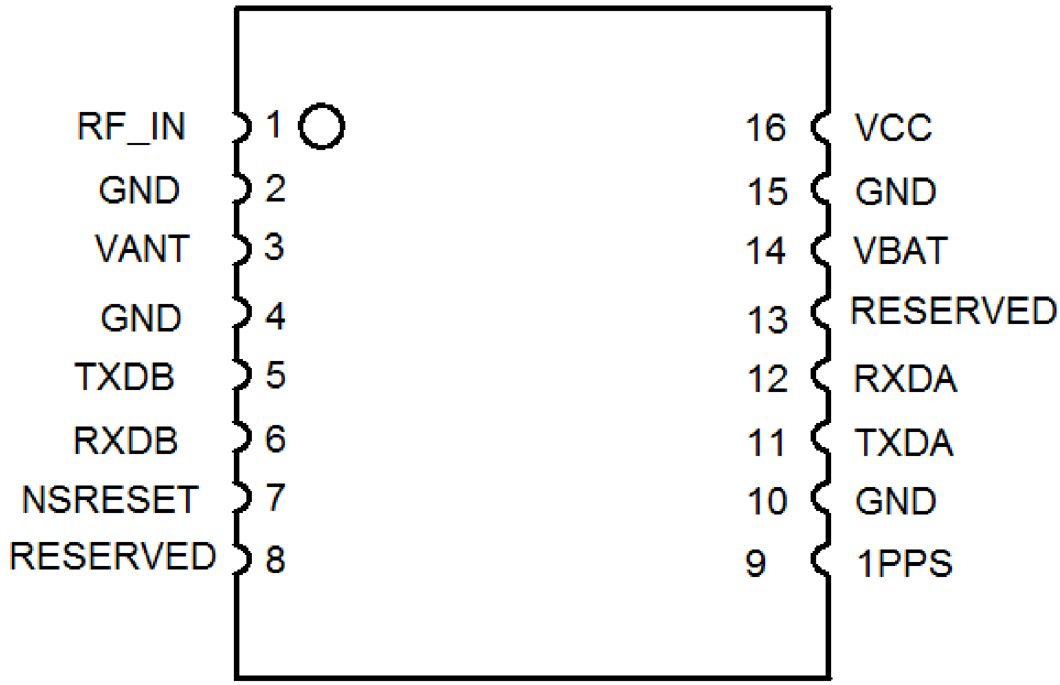


2.4 Pin Assignment



Pin	Name	I/O	Description
1	RF_IN	I	Antenna Signal Input
2	GND	P	Ground
3	VANT	PI	Antenna Power Input
4	GND	P	Ground
5	TXDB	O	Serial Data Output B
6	RXDB	I	Serial Data Input B
7	NSRESET	I	System Reset Active Low
8	RESERVED		NC
9	1PPS	O	1PPS Time Mark Output
10	GND	P	Ground
11	TXDA	O	Serial Data Output A
12	RXDA	I	Serial Data Input A
13	RESERVED		NC
14	VBAT	PI	Backup Power
15	GND	P	Ground
16	VCC	P	DC Power Input

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2.5 Pin Description

RF_IN(Pin 1)
GPS analog signal input to module

GND(Pin 2, 4, 10, 15)
The analog ground and digital ground for the module. Connect all grounds.

VANT(Pin 3)
Antenna power input pin. When user wants to use external antenna, this is the antenna power input.

TXDB(Pin 5)
This is the UART transmitter of the module. It is the same as TXDA.

RXDB(Pin 6)
This is the UART receiver of the module. It is the same as RXDA.

NSRESET(Pin 7)
With a low level, it causes the module to reset. If not utilized, keep floating.

RESERVED(Pin 8, 13)
NC

1PPS(Pin 9)
This pin provides one pulse-per-second output from the module, which is synchronized to GPS time

TXDA(Pin 11)
This is the UART transmitter of the module. It outputs the GPS information for post-processing.

RXDA(Pin 12)
This is the UART receiver of the module. It is used to receive software commands and firmware update.

VBAT(Pin 14)
This is the backup power that maintains the RTC time to keep the GPS information when main power is removed. Regulated DC supply from mother board.

VCC(Pin 16)
The main DC power supply for the module.

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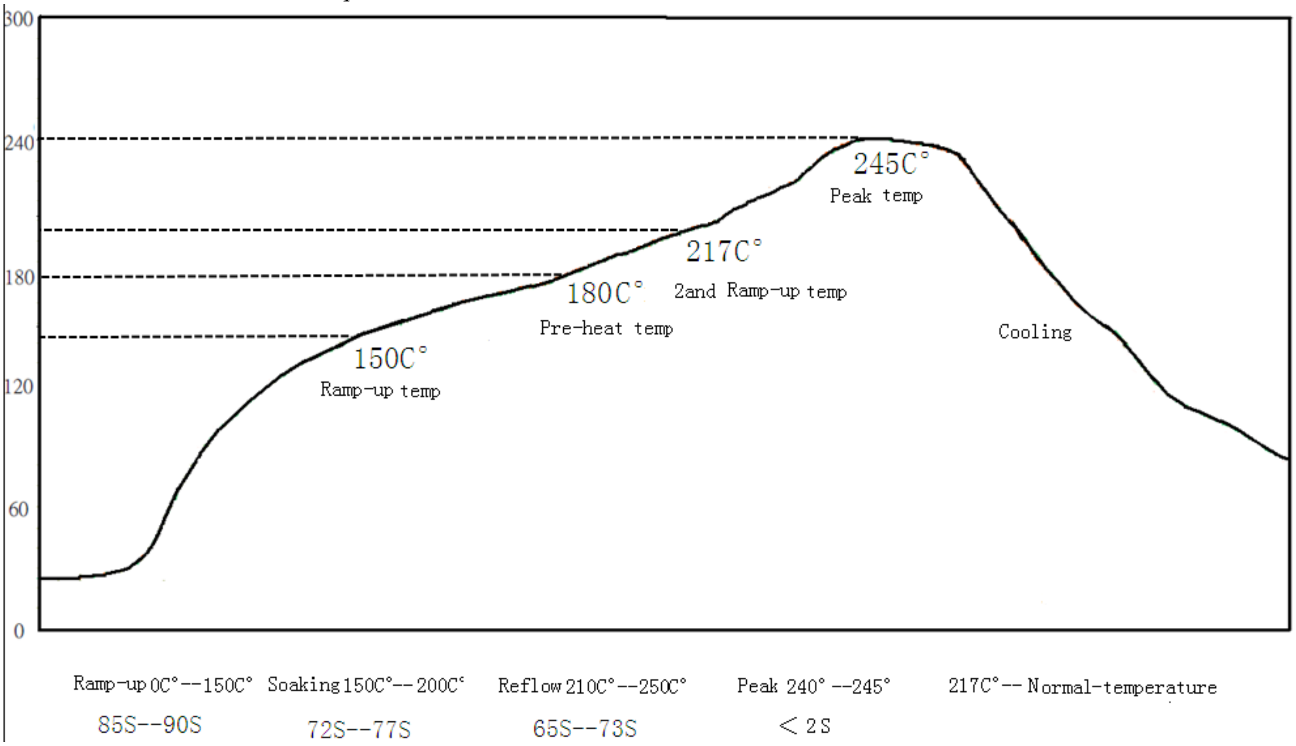
2.6 Reflow Information

Recommand the reflow profile show as below.



3 Software Interface

3.1 General Format

This charpter contains a description of NMEA output sentences and NMEA commands which are implemented in the standard GPS firmware used in WX1312 module based on the SiRFstar GSD4e chip.

The firmware supports the bi-directional serial interface of Powerstar'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 serial port 0 (pin TxDA and RxDA) of the module or on the serial USB port of one of the evaluation boards, respectively.
- The default configuration of this serial port is: 9600 baud, 8 data bits, no parity, 1 stop bit, no flow control.

NMEA 0183 messages use the ASCII character set and have a defined format. Each message begins with a $ (hex 0x24) and end with a carriage return and line feed (hex 0x0D 0x0A, represented as <CR><LF>). Each message consists of one or more fields of ASCII letters and numbers, separated by commas. After the last field, and before the <CR><LF> is a checksum consisting of an asterisk (*, hex 0x2A) followed by two ASCII characters representing the hexadecimal value of the checksum. The checksum is computed as the exclusive OR of all characters between the $ and * characters.

For details about NMEA, please see:
http://www.nmea.org/

Note - In NMEA 0183 specifications earlier than version 2.3, the checksum is optional.

Note - Fields marked in italic red apply only to NMEA version 2.3 (and later) in this NMEA message description.

3.2 NMEA output sentences

Table 3-1 lists each of the NMEA output messages specifically developed and defined by SiRF for use within SiRF products.

Table 3-1 NMEA Output Message

Message	Description
GGA	Time, position and fix type data
GLL	Latitude, longitude, UTC time of position fix and status
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values
GSV	Number of GPS satellites in view satellite ID numbers, elevation, azimuth, & SNR values
RMC	Time, date, position, course and speed data
VTG	Course and speed information relative to the ground
ZDA	PPS timing message (synchronized to PPS)

A full description of the listed NMEA output messages is provided in the following sections.

3.2.1 GGA – Global Positioning System Fixed Data

Table 3-2 contains the values for the following example:
$GPGGA,002153.000,3342.6618,N,11751.3858,W,1,10,1.2,27.0,M,- 34.2, M,,0000*5E<CR><LF>

Table 3-2 GGA Data Format

Name	Example	Unit	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	002153.000		hhmmss.sss
Latitude	3342.6618		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11751.3858		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 3-3
Satellites Used	10		Range 0 to 12
HDOP	1.2		Horizontal Dilution of Precision
MSL Altitude	27.0	meters	
Units	M	meters	
Geoid Separation	-34.2	meters	Geoid-to-ellipsoid separation. Ellipsoid altitude = MSL Altitude + Geoid Separation.

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Units	M	meters	
Age of Diff. Corr.		sec	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*5E		
<CR><LF>			End of message termination

Table 3-3 Position Fix Indicator

Value	Description
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*

Note �?A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met the solution will be marked as invalid.

3.2.2 GLL – Geographic Position – Latitude/Longitude

Table 3-4 contains the values for the following example:

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41<CR><LF>

Table 3-4 GLL Data Format

Name	Example	Unit	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	*A*		*A=Autonomous,* *D=DGPS,* *E=DR ,* *N = Output Data Not Valid ,* *R = Coarse Position(Note 3-1)*
Checksum	*41		
<CR><LF>			End of message termination

Note 3-1 - Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

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3.2.3 GSA – GNSS DOP and Active Satellites

Table 3-5 contains the values for the following example:

$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33<CR><LF>

Table 3-5 GSA Data Format

Name	Example	Unit	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 3-6
Mode 2	3		See Table 3-7
Satellite Used *(Note 3-2)*	07		SV on Channel 1
Satellite Used *(Note 3-2)*	02		SV on Channel 2
......			......
Satellite Used *(Note 3-2)*			SV on Channel 12
PDOP *(Note 3-3)*	1.8		Position Dilution of Precision
HDOP *(Note 3-3)*	1.0		Horizontal Dilution of Precision
VDOP *(Note 3-3)*	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR><LF>			End of message termination

Note 3-2 Satellite used in solution.

Note 3-3 Maximum DOP value reported is 50. When 50 is reported, the actual DOP may be much larger.

Table 3-6 Mode 1

Value	Description
M	Manual–forced to operate in 2D or 3D mode
A	2D Automatic–allowed to automatically switch 2D/3D

Table 3-7 Mode 2

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

3.2.4 GSV – GNSS Satellites in View

Table 3-8 contains the values for the following example:

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

$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41<CR><LF>

Table 3-8 GSV Data Format

Name	Example	Unit	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages *(Note 3-4)*	2		Total number of GSV messages to be sent in this group
Message Number1	1		Message number in this group of GSV messages
Satellites in View1	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Channel 1 (Maximum 90)
Azimuth	048	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/N0)	42	dBHz	Range 0 to 99, null when not tracking
……			……
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/N0)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR><LF>			End of message termination

Note 3-4 Depending on the number of satellites tracked, multiple messages of GSV data may be required. In some software versions, the maximum number of satellites reported as visible is limited to 12, even though more may be visible.

3.2.5 RMC – Recommended Minimum Specific GNSS Data

Table 3-9 contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, , *10<CR><LF>

Table 3-9 RMC Data Format

Name	Example	Unit	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status *(Note 3-5)*	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	120598		ddmmyy
Magnetic Variation		degrees	E=east or W=west

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(Note 3-6)			
East/West Indicator2	E		E=east
Mode	*A*		*A=Autonomous,* *D=DGPS,* *E=DR,* *N = Output Data Not Valid ,* *R = Coarse Position(Note 3-7)*
Checksum	*10		
<CR><LF>			End of message termination

Note 3-5 A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met the solution will be marked as invalid.

Note 3-6 SiRF Technology Inc. does not support magnetic declination. All "course over ground�?data are geodetic WGS84 directions relative to true North.

Note 3-7 Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

3.2.6 VTG – Course Over Ground and Ground Speed

Table 3-10 contains the values for the following example:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K,A*23<CR><LF>

Table 3-10 VTG Data Format

Name	Example	Unit	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic(Note 3-8)
Speed	0.13	knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	*A*		*A=Autonomous,* *D=DGPS,* *E=DR,* *N = Output Data Not Valid ,* *R = Coarse Position(Note 3-9)*
Checksum	*23		
<CR><LF>			End of message termination

Note 3-8 SiRF Technology Inc. does not support magnetic declination. All "course over ground�?data are geodetic WGS84 directions.

Note 3-9 Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

3.2.7 ZDA – Time & Date

This message is included only with systems which support a time-mark output pulse identified as �?PPS�? Outputs the time associated with the current 1PPS pulse. Each message is output within a few hundred ms after the 1PPS pulse is output and tells the time of the pulse that just occurred.

Table 3-11 contains the values for the following example:
$GPZDA,181813,14,10,2003,,*4F<CR><LF>

Table 3-11 ZDA Data Format

Name	Example	Unit	Description
Message ID	$GPZDA		ZDA protocol header
UTC time	181813	hhmmss	The UTC time units are: hh = UTC hours from 00 to 23 mm = UTC minutes from 00 to 59 ss = UTC seconds from 00 to 59 Either using valid IONO/UTC or estimated from default leap seconds
Day	14		Day of the month, range 1 to 31
Month	10		Month of the year, range 1 to 12
Year	2003		1980 to 2079
Local zone hour *(Note 3-10)*		hour	Offset from UTC (set to 00)
Local zone minutes *(Note 3-10)*		minute	Offset from UTC (set to 00)
Checksum	*4F		
<CR><LF>			End of message termination

Note 3-10 Not supported by SiRF. Reported as 00.

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3.3 Proprietary NMEA input 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 serial port 0. Messages can be sent by using a terminal program, by using Powerstar's GPS software, or the SiRF demo 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 VDD or VBAT is supplied the settings are maintained.

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

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

The general format is as below,:

"$<vendor><MID><parameters><*cksum><CR><LF>"

Table 3-12 Proprietary NMEA Data Format

Name	Example	Description
$	$	ZDA protocol header
<vendor>	PSRF	GSD4e-based products use “PSRF�?
<MID>	100	Message identifier consisting of three numeric characters. Input Messages begin at MID 100.
<parameters>	,0,9600,8,1,0	Message specific parameters refer to a specific section for <data> �?<data> definition.
<*cksum>	*0C	Two hex character checksum as defined in the NMEA specification. Use of checksum is required on all input messages!
<CR><LF>		End of message termination

Note - All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

Table 3-13 lists each of the NMEA input messages are supported.

Table 3-13 NMEA input messages

Message	MID *(Note 3-11)*	Description
Set serial port	100	Set Port 0 parameters and protocol

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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

Note 3-11 Message Identification

A full description of the listed NMEA input messages is provided in the following sections.

3.3.1 Serial Port Setup

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 GSD4e-based products will restart using the saved parameters.

Table 3-14 contains the values for the following example:

$PSRF100,0,9600,8,1,0*0C<CR><LF>

Table 3-14 Serial Port Setup

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 *(Note 3-12)*
StopBits	1	0, 1
Parity	0	0 none / 1 odd / 2 even
Checksum	*0C	
<CR><LF>		End of message termination

Note 3-12 Sirf protocol is only valid for 8 data bits, 1 stop bit and no parity

3.3.2 Reset Configuration

This command(*SiRF's original: NavigationInitialization*) is used to configure various reset situations (Hot Start, Warm Start and Cold Start).

Table 3-15 contains the values for the following example:

$PSRF101,0,0,0,0,0,0,12,4*10<CR><LF>

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Table 3-15 Navigation Initialization

Name	Example	Unit	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X	0	meters	X coordinate position
ECEF Y	0	meters	Y coordinate position
ECEF Z	0	meters	Z coordinate position
ClkDrift	0	Hz	Clock Drift of the Receiver *(Note 3-13)*
TimeOfWeek	0	seconds	GPS Time Of Week
WeekNo	0		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	4		Reset configurations: See Table 3-16
Checksum	*10		
<CR><LF>			End of message termination

Note 3-13 Use 0 for last saved value if available.If this is unavailable, a default value of 96250 is used.

Table 3-16 Reset configurations

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

3.3.3 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.

1. Query the GGA message with checksum enabled
   Table 3-17 contains the input values for the following examples:
   $PSRF103,00,01,00,01*25<CR><LF>

2. Enable VTG message for a 1 Hz constant output with checksum enabled
   $PSRF103,05,00,01,01*20<CR><LF>

3. Disable VTG message
   $PSRF103,05,00,00,01*21<CR><LF>

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Table 3-17 Query/Rate Control Data Format

Name	Example	Unit	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		Message to control. See Table 3-18
Mode	01		0 = Set Rate 1 = Query one time
Rate	00	seconds	Output Rate, 0 = Off 1-255 = seconds between messages *(Note 3-14)*
CksumEnable	01		0=Disable Checksum 1=Enable Checksum
Checksum	*25		
<CR><LF>			End of message termination

Note 3-14 This field is ignored if Mode field is set to Query one time.

Tabel 3-18 Message

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

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)).

3.3.4 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 3-19 contains the input values for the following examples:

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1. Debug On
   $PSRF105,1*3E<CR><LF>

2. Debug Off
   $PSRF105,0*3F<CR><LF>

Table 3-19 Development Data On/Off Data Format

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

3.3.5 Select Datum

All GSD4e-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 3-20 below contains the input values for the following examples:

1. Datum select TOKYO_MEAN
   $PSRF106,178*32<CR><LF>

Table 3-20 Select Datum

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	
<CR><LF>		End of message termination

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4 Reference Circuit