GLOBALSAT GPS Engine Board

Hardware Data Sheet

Product No : EB-365

Version 1.0

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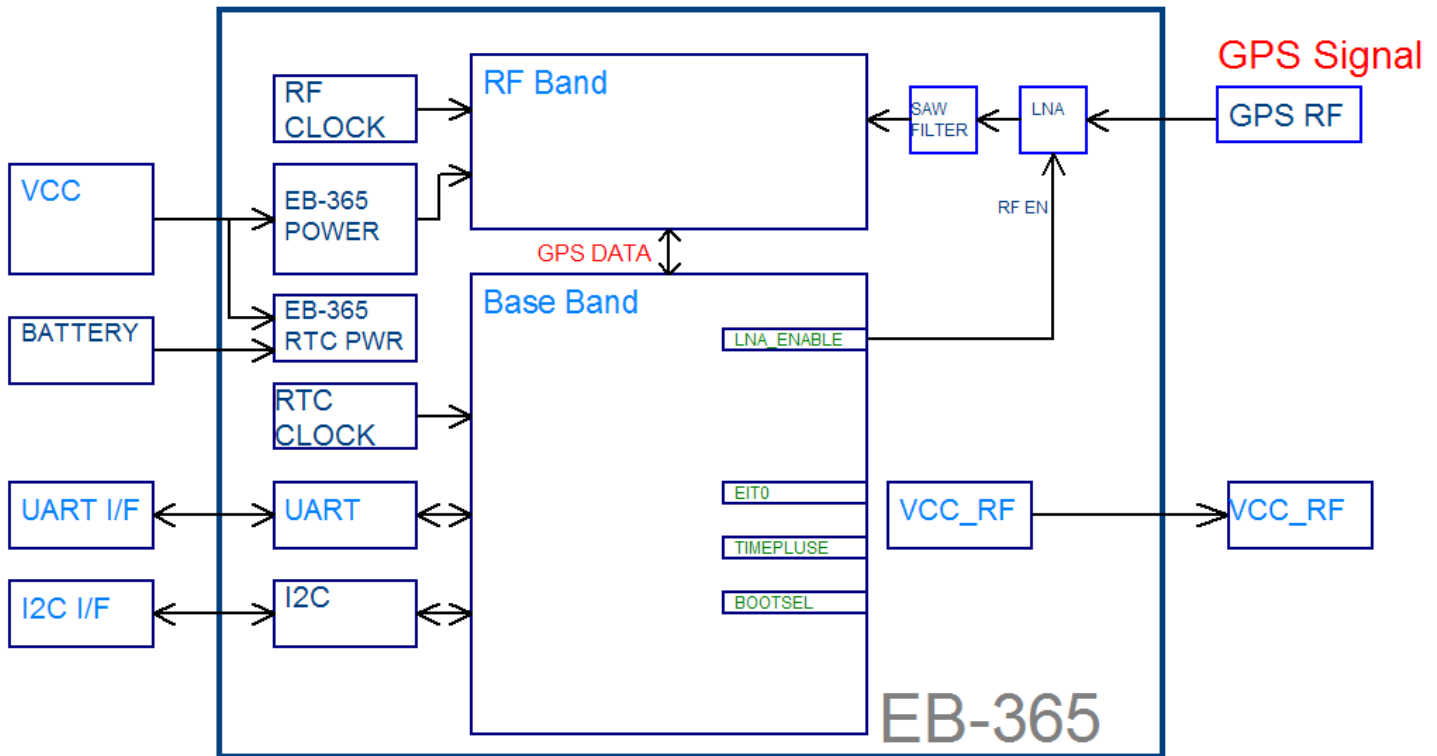| Issue Date	APPR	CHECK	PREPARE
2010/07/19	Ray	Luwalk	Jeff

Product Description

Product Description

EB-365 is a compact, high performance, and low power consumption GPS engine board. It uses SiRF Star III chipset which can track up to 20 satellites at a time and perform fast TTFF in weak signal environments. EB-365 is suitable for the following applications:

- Automotive navigation
- Personal positioning
- Fleet management
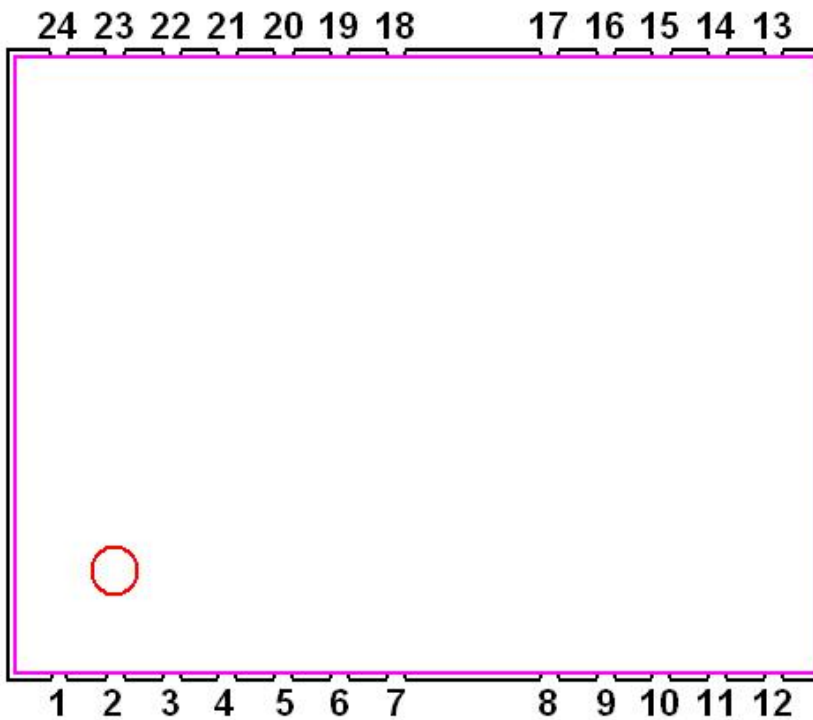- Mobile phone navigation
- Marine navigation

Product Features

- SiRF star III high performance GPS Chipset
- Very high sensitivity (Tracking Sensitivity: -159 dBm)
- Extremely fast TTFF (Time To First Fix) at low signal level
- Serial port
- I2C interface
- 4Mb flash
- Built-in LNA
- Compact size (16mm * 12.2 mm * 2.4mm) suitable for space-sensitive application
- One size component, easy to mount on another PCB board
- Support NMEA 0183 V2.3 (Output: GGA, GSA, GSV, RMC, VTG, GLL, ZDA)
- Support SiRF binary protocol

Product Block Diagram

Product Pin Description

PIN Number(s)	Name	Type	Description	Note
1,2,5,7,8,14,15, 16,17	NC			
3	TIMEPULSE	O	One pulse per second output.(1PPS)	2,3
4	EIT0		External Interrupt	1
6	BOOTSEL	I	Set this pin to high for programming flash.	2
9	VCC_RF	O	Supply Antenna Bias voltage (V=VCC)	
10,12,13,24	GND	P	Ground.	
11	RF IN	RF	GPS antenna input	
18	SDA	I/O	I2C DATA	1,3
19	SCL	I/O	I2C Clock	1,3
20	TxD	O	This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software. Output TTL level, 0V ~ 2.85V.	
21	RxD	I	This is the main receive channel for receiving software commands to the engine board from SiRFdemo software or from user written software.	1
22	V_BAT	P	Backup battery supply voltage	
23	VCC	P	Main power supply to the engine board.	

<Note>

1. Internal pull-up resistor (100KΩ nominal).

2. Internal pull-down resistor (100KΩ nominal).

3. Default input at reset.

Electrical Specification

Absolute Maximums Ratings

Parameter	Min.	Typ.	Max.	Conditions	Unit
POWER Supply					
Main power supply	3.1	3.3	3.5		V
Backup battery supply	2.0		3.5		V
Main power supply Current	23	25	27		mA
Backup battery supply Current	4.5	5	5.5		uA
Interface (VCC = 3.3V, VBAT= 3.3V, Operation Temp.= 25℃)					
High Level input Voltage	0.7*VDD		3.5		V
Low Level input Voltage	-0.3		0.3*VDD		V
High Level input Current	-10		10 / 60	(V=2.85V) (with Pull Low)	uA
Low Level input Current	-10		10 / -60	(V=0V) (with Pull High)	uA
High Level output Voltage	0.75*VDD				V
Low Level output Voltage			0.25*VDD		V
RF Input					
Input Impedance		50			Ω
Operating Frequency		1.575			Ghz

☆ VDD is 2.85V for SiRF STARIII CHIP

Environmental Characteristics

Parameter	Min	Typ	Max	Unit
Humidity Range	5		95	% non-condensing
Operation Temperature	-40	25	85	℃
Storage Temperature	-40		85	℃

Physical Characteristic

Type	24-pin stamp holes
Dimensions	16mm X 12.2mm X 2.4mm (±0.2mm)

Receiver Performance

Sensitivity[1]	Tracking :	-159dBm
	Autonomous acquisition :	-142 dBm
Time-To-First-Fix[2]	Cold Start – Autonomous	< 35s
	Warm Start – Autonomous	< 35s
	Hot Start – Autonomous	< 1s
Horizontal Position Accuracy[3]	Autonomous	< 2.5m
	SBAS	< 2.0m
Velocity Accuracy[4]	Speed	< 0.01 m/s
	Heading	< 0.01 degrees
Reacquisition	0.1 second, average	
Max Update Rate	5 Hz	
Maximum Altitude	< 18,000 meter	
Maximum Velocity	< 515 meter/ second	
Maximum Acceleration	< 4G	

<Note>

1. -142 dBm ≈ 28dB-Hz with 4 dB noise figure

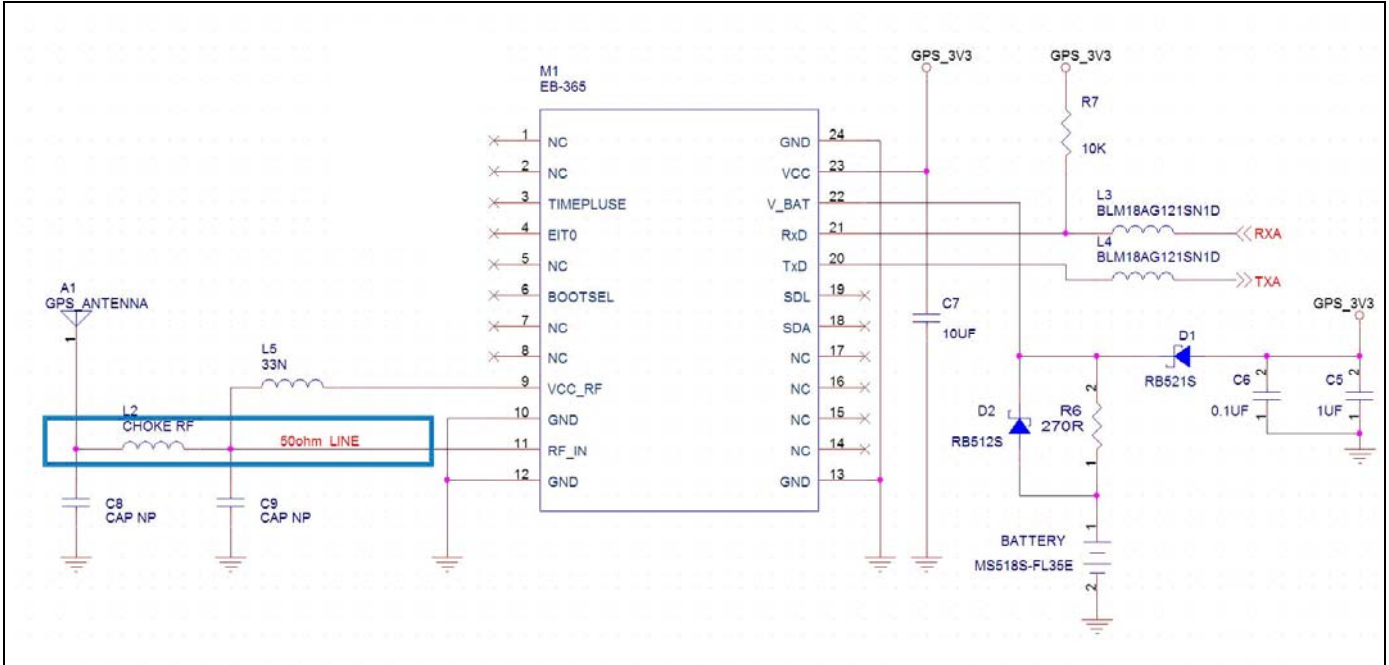2. 50% -130dBm Fu 0.5ppm Tu ±2s Pu 30Km

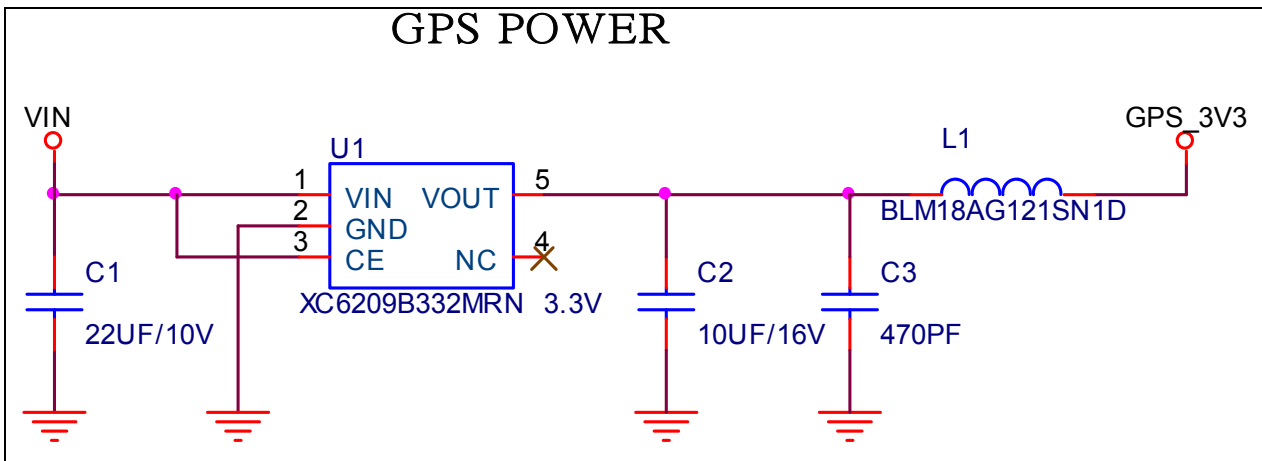3. 50% 24hr static, -130dBm

4. 50% @ 30m/s

Package Dimensions
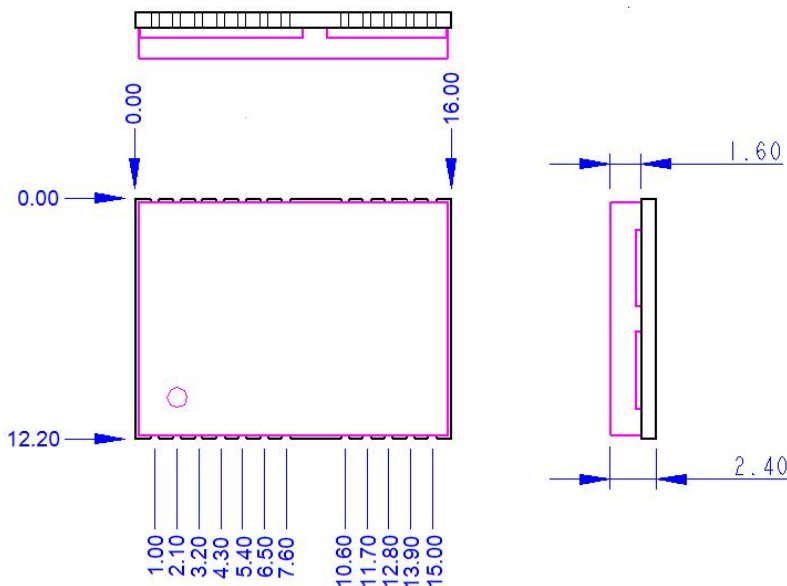
Unit: mm

Application

Application Circuit

POWER Circuit

GPS Active Antenna Specifications (Recommendation)

Frequency:	1575.42 + 2MHz	Amplifier Gain:	18~22dB Typical
Axial Ratio:	3 dB Typical	Output VSWR:	2.0 Max.
Output Impedance:	50Ω	Noise Figure:	2.0 dB Max
Polarization:	RHCP	Antenna Input Voltage:	2.85V (Typ.)

OPERATING Description

VCC
This is the main power supply to the engine board. (3.1Vdc to 3.5Vdc)

GND
This is Ground pin for the baseband circuit.

RxD
This is the main channel for receiving software commands from SiRFdemo software or from your proprietary software.

TxD
This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software. Output is TTL level, 0V ~ 2.85V.

RF_IN
This pin receives signal of GPS analog via external active antenna. It has to be a controlled impedance trace at 50ohm. Do not have RF traces closed the other signal path and routing it on the top layer. Keep the RF traces as short as possible.

VBAT
This is the battery backup power input for the SRAM and RTC when main power is off. Without the external backup battery, EB-365 will always execute a cold star after turning on. To achieve the faster start-up offered by a hot or warm start, a battery backup must be connected. The battery voltage should be between 2.0V and 3.5V.

EINT0
This PIN is External Interrupt, If do not use it, Just NC.

BOOTSEL
Set this pin to high for programming flash in debug mode. If need programming EB-365 Flash, just pull-up 15KΩ resistor to 3.3V. When EB-365 used in normal function, this pin just NC.

TIMEPLUSE
This pin provides one pulse-per-second output from the board, which is synchronized to GPS time. This is not available in Trickle Power mode. If do not use it, Just NC.

NC
EB-365 reserves pin, Just NC.

VCC_RF
VCC_RF can supply Active Antenna Bias voltage(3.3V). This pin will supply Active Antenna. If do not use it, Just NC.

I2C Interface
EB-365 had I2C interface. This is second channel for outputting navigation and measurement data to user's navigation software or user written software. Output is TTL level, 0V ~ 2.85V.If do not use it, Just NC.

SOFTWARE COMMAND

NMEA Output Command

GGA - Global Positioning System Fixed Data

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

Table B-2 contains the values for the following example:

$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,,,,0000*18

Table B-2 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
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
Position Fix Indicator	1		See Table B-3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude[1]	9.0	meters	
Units	M	meters	
Geoid Separation[1]		meters	
Units	M	meters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR><LF>			End of message termination

SiRF Technology Inc. does not support geoid corrections. Values are WGS84 ellipsoid heights.

Table B-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	Not supported
6	*Dead Reckoning Mode, fix valid*

GLL - Geographic Position-Latitude/Longitude

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

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

$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,A*41

Table B-4 GLL Data Format

Name	Example	Units	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 Position	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*
Checksum	*41		
<CR><LF>			End of message termination

GSA - GNSS DOP and Active Satellites

Table B-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

Table B-5 GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table B-6
Mode 2	3		See Table B-7
Satellite Used[1]	07		Sv on Channel 1
Satellite Used[1]	02		Sv on Channel 2
…..			
Satellite Used[1]			Sv on Channel 12
PDOP[2]	1.8		Position dilution of Precision
HDOP[2]	1.0		Horizontal dilution of Precision
VDOP[2]	1.5		Vertical dilution of Precision
Checksum	*33		
<CR><LF>			End of message termination

Satellite used in solution.

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

Table B-6 Mode1

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

Table B-7 Mode 2

Value	Description
1	Fix Not Available
2	2D
3	3D

GSV - GNSS Satellites in View

Table B-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

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

Table B-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages1	2		Range 1 to 3
Message Number1	1		Range 1 to 3
Satellites in View1	07		
Satellite ID	07		Channel 1(Range 1 to 32)
Elevation	79	degrees	Channel 1(Maximum90)
Azimuth	048	degrees	Channel 1(True, Range 0 to 359)
SNR(C/No)	42	dBHz	Range 0 to 99,null when not tracking
…….			…….
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	Degrees	Channel 4(Maximum90)
Azimuth	138	Degrees	Channel 4(True, Range 0 to 359)
SNR(C/No)	42	dBHz	Range 0 to 99,null when not tracking
Checksum	*71		
<CR><LF>			End of message termination

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.

RMC - Recommended Minimum Specific GNSS Data

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

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

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598,,*10

Table B-10 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status[1]	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[2]		degrees	E=east or W=west
East/West Indicator[2]	E		E=east
Mode	*A*		*A=Autonomous, D=DGPS, E=DR* *N=Output Data Not Valid*
Checksum	*10		
<CR><LF>			End of message termination

1. 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.

2. SiRF Technology Inc. does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions relative to true North.

VTG - Course Over Ground and Ground Speed

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

Table B-12 contains the values for the following example:

$GPVTG,309.62,T,,M,0.13,N,0.2,K,A*23

Table B-10 RMC Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic[1]
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*
Checksum	*23		
<CR><LF>			End of message termination

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

NMEA Input Command

A). Set Serial Port ID: 100 Set PORTA parameters and protocol

This command message is used to set the protocol (SiRF Binary, NMEA, or USER1) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command would be used to switch the module back to SiRF Binary protocol mode where a more extensive command message set is available. For example, to change navigation parameters. When a valid message is received, the parameters will be stored in battery backed SRAM and then the receiver will restart using the saved parameters.

Format:

$PSRF100,<protocol>,<baud>,<DataBits>,<StopBits>,<Parity>*CKSUM<CR><LF>

<protocol>	0=SiRF Binary, 1=NMEA, 4=USER1
<baud>	1200, 2400, 4800, 9600, 19200, 38400
<DataBits>	8,7. Note that SiRF protocol is only valid f8 Data bits
<StopBits>	0,1
<Parity>	0=None, 1=Odd, 2=Even

Example 1: Switch to SiRF Binary protocol at 9600,8,N,1

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

Example 2: Switch to User1 protocol at 38400,8,N,1

$PSRF100,4,38400,8,1,0*38<CR><LF>

**Checksum Field: The absolute value calculated by exclusive-OR the 8 data bits of each character in the Sentence, between, but excluding "$" and "*". The hexadecimal value of the most significant and least significant 4 bits of the result are convertted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

**<CR><LF>   : Hex 0D 0A

B). Navigation Initialization ID：101 Parameters required for start

This command is used to initialize the module for a warm start, by providing current position （in X, Y, Z coordinates）,clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters will enable the receiver to acquire signals more quickly, and thus, produce a faster navigational solution. When a valid Navigation Initialization command is received, the receiver will restart using the input parameters as a basis for satellite selection and acquisition.

Format：

$PSRF101,<X>,<Y>,<Z>,<ClkOffset>,<TimeOfWeek>,<WeekNo>,<chnlCount>,<ResetCfg>*CK SUM<CR><LF>

<X>	X coordinate position INT32
<Y>	Y coordinate position INT32
<Z>	Z coordinate position INT32
<ClkOffset>	Clock offset of the receiver in Hz, Use 0 for last saved value if available. If this is unavailable, a default value of 75000 for GSP1, 95000 for GSP 1/LX will be used. INT32
<TimeOf Week>	GPS Time Of Week UINT32
<WeekNo>	GPS Week Number UINT16 （ Week No and Time Of Week calculation from UTC time）
<chnlCount>	Number of channels to use.1-12. If your CPU throughput is not high enough, you could decrease needed throughput by reducing the number of active channels UBYTE
<ResetCfg>	bit mask 0×01=Data Valid warm/hotstarts=1 0×02=clear ephemeris warm start=1 0×04=clear memory. Cold start=1 UBYTE

Example: Start using known position and time.

＄PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*7F

C). Set DGPS Port ID: 102 Set PORT B parameters for DGPS input

This command is used to control Serial Port B that is an input only serial port used to receive RTCM differential corrections.

Differential receivers may output corrections using different communication parameters.

The default communication parameters for PORT B are 9600Baud, 8data bits, 0 stop bits, and no parity. If a DGPS receiver is used which has different communication parameters, use this

command to allow the receiver to correctly decode the data.   When a valid message is received, the parameters will be stored in battery backed SRAM and then the receiver will restart using the saved parameters.

Format:
＄PSRF102,<Baud>,<DataBits>,<StopBits>,<Parity>*CKSUM<CR><LF>

<baud>	1200,2400,4800,9600,19200,38400
<DataBits>	8
<StopBits>	0,1
<Parity>	0=None,Odd=1,Even=2

Example: Set DGPS Port to be 9600,8,N,1
　　　　＄PSRF102,9600,8,1.0*12

D). Query/Rate Control ID: 103 Query standard NMEA message and/or set output rate
This command is used to control the output of standard NMEA message GGA, GLL, GSA, GSV, RMC, VTG. Using this command message, standard NMEA message 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.

Format:
＄PSRF103,<msg>,<mode>,<rate>,<cksumEnable>*CKSUM<CR><LF>

<msg>	0=GGA,1=GLL,2=GSA,3=GSV,4=RMC,5=VTG
<mode>	0=SetRate,1=Query
<rate>	Output every <rate>seconds, off=0,max=255
<cksumEnable>	0=disable Checksum,1=Enable checksum for specified message

Example 1: Query the GGA message with checksum enabled
　　　　＄PSRF103,00,01,00,01*25
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

E). LLA Navigation Initialization ID: 104 Parameters required to start using Lat/Lon/Alt
This command is used to initialize the module for a warm start, by providing current position (in Latitude, Longitude, 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 will enable the receiver to acquire signals more quickly, and thus, will produce a faster navigational soution.

When a valid LLA Navigation Initialization command is received, the receiver will restart using the input parameters as a basis for satellite selection and acquisition.

Format:
＄PSRF104,<Lat>,<Lon>,<Alt>,<ClkOffset>,<TimeOfWeek>,<WeekNo>,<ChannelCount>, <ResetCfg>*CKSUM<CR><LF>

<Lat>	Latitude position, assumed positive north of equator and negative south of equator float, possibly signed
<Lon>	Longitude position, it is assumed positive east of Greenwich and negative west of Greenwich Float, possibly signed
<Alt>	Altitude position float, possibly signed
<ClkOffset>	Clock Offset of the receiver in Hz, use 0 for last saved value if available. If this is unavailable, a default value of 75000 for GSP1, 95000 for GSP1/LX will be used. INT32
<TimeOfWeek>	GPS Time Of Week UINT32
<WeekNo>	GPS Week Number UINT16
<ChannelCount>	Number of channels to use. 1-12 UBYTE
<ResetCfg>	bit mask 0×01=Data Valid warm/hot starts=1 0×02=clear ephemeris warm start=1 0×04=clear memory. Cold start=1 UBYTE

Example: Start using known position and time.
＄PSRF104,37.3875111,-121.97232,0,96000,237759,922,12,3*37

F). Development Data On/Off ID: 105 Switch Development Data Messages On/Off

Use this command to enable development debug information if you are having trouble getting commands accepted. Invalid commands will generate debug information that should enable the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range. This setting is not preserved across a module reset.

Format: ＄PSRF105,<debug>*CKSUM<CR><LF>

        <debug>   0=Off, 1=On

        Example: Debug On   ＄PSRF105,1*3E

        Example: Debug Off   ＄PSRF105,0*3F

G). Select Datum ID: 106 Selection of datum to be used for coordinate Transformations

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.)

Examples:
Datum select TOKYO_MEAN
$PSRF106,178*32

PCB Layout Recommend

Recommended Layout PAD
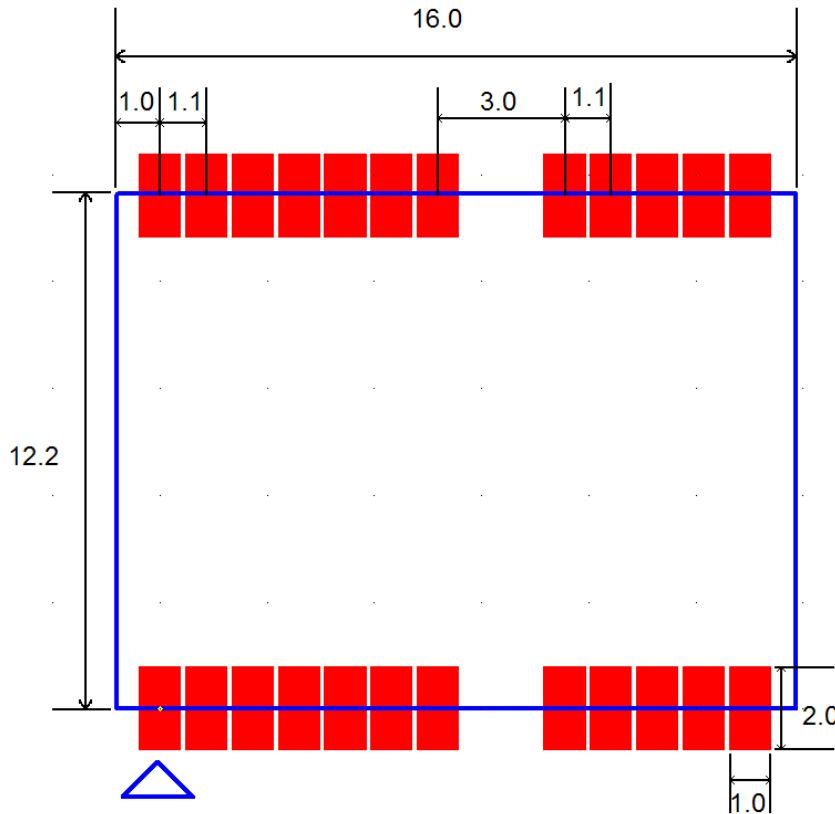
Unit: mm

Tolerance: 0.1mm

PCB Layout Recommendations

Do not routing the other signal or power trace under the engine board.

RF:

This pin receives signal of GPS analog via external active antenna .It has to be a controlled impedance trace at 50ohm.

Do not place the RF traces close to the other signal path and not routing it on the top layer.

Keep the RF traces as short as possible.

Antenna:

Keep the active antenna on the top of your system and confirm the antenna radiation pattern、axial ratio、power gain、noise figure、VSWR are correct when you Setup the antenna in your case.

Recommended Reflow Profile:
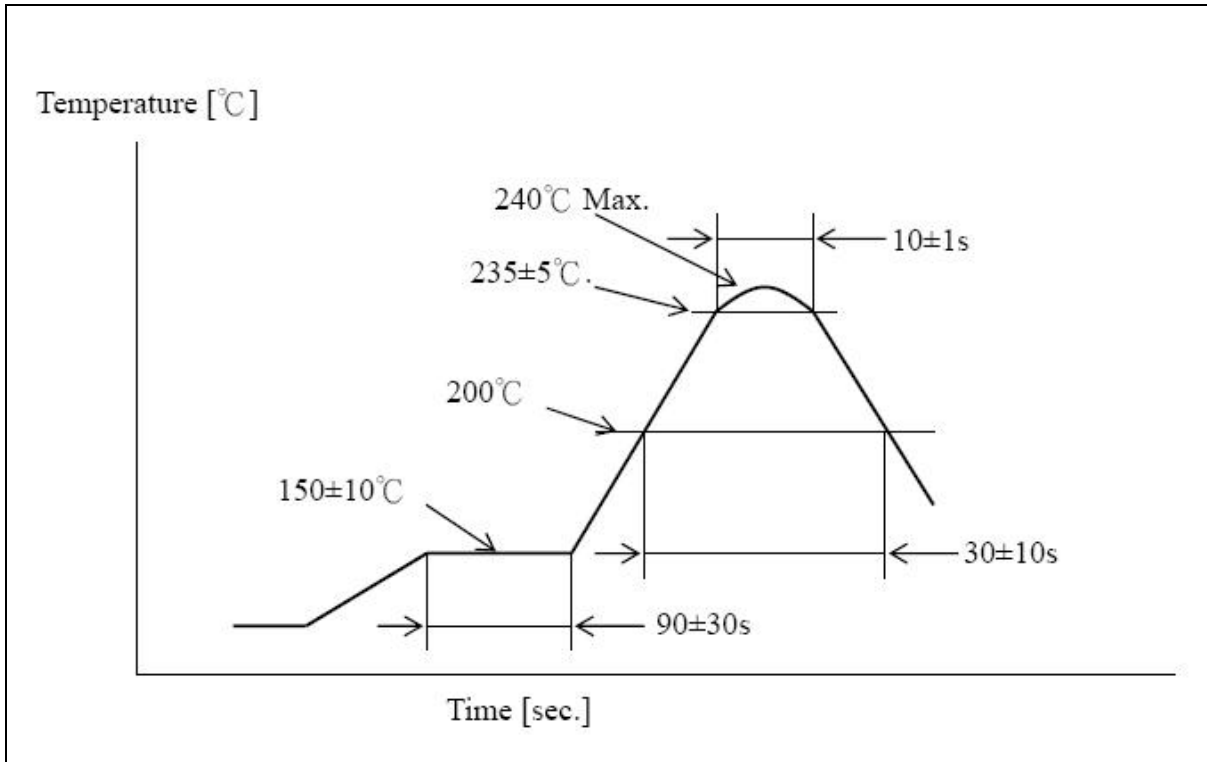
| Pre heating temperature: | 150±10[℃] | Pre heating time: | 90±30[sec.] |
| Heating temperature: | 235±5[℃] | Heating time: | 10±1[sec.] |

Peak temperature must not exceed 240℃ and the duration of over 200℃ should be 30±10 Seconds.