1. Product Information

- Product Name: VPN1513
- Product Description:

VPN1513 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. VPN1513 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 Two serial ports 4Mb flash Built-in LNA Compact size (15.9mm * 13.1 mm * 2.2mm) suitable for space-sensitive application One size component, easy to mount on another PCB board Support NMEA 0183 and SiRF binary protocol

- Product Specifications

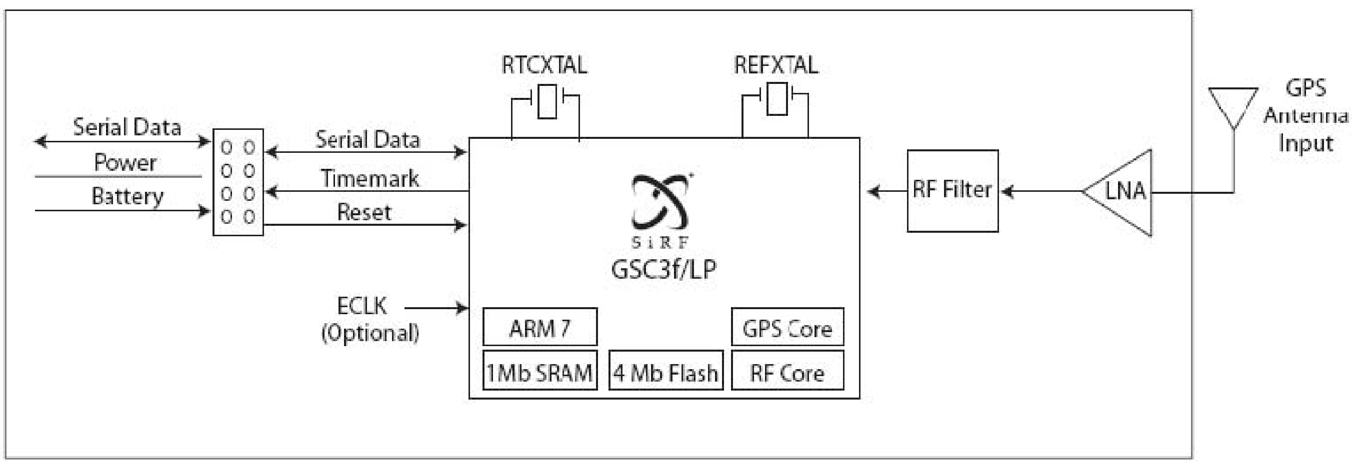
GPS Receiver	
Chipset	SiRF GSC3e/LP
Frequency	L1, 1575.42 MHz
Code	C/A Code
Protocol	NMEA 0183 v2.2 Default:GGA,GSA,GSV,RMC Support:VTG,GLL,ZDA) SiRF binary and NMEA Command
Available Baud Rate	4,800 to 57,600 bps adjustable

Channels	20
Flash	4Mbit
Sensitivity	Tracking:-159dBm
Cold Start	42 seconds, average
Warm Start	38 seconds, average
Hot Start	1 second, average
Reacquisition	0.1 second, average

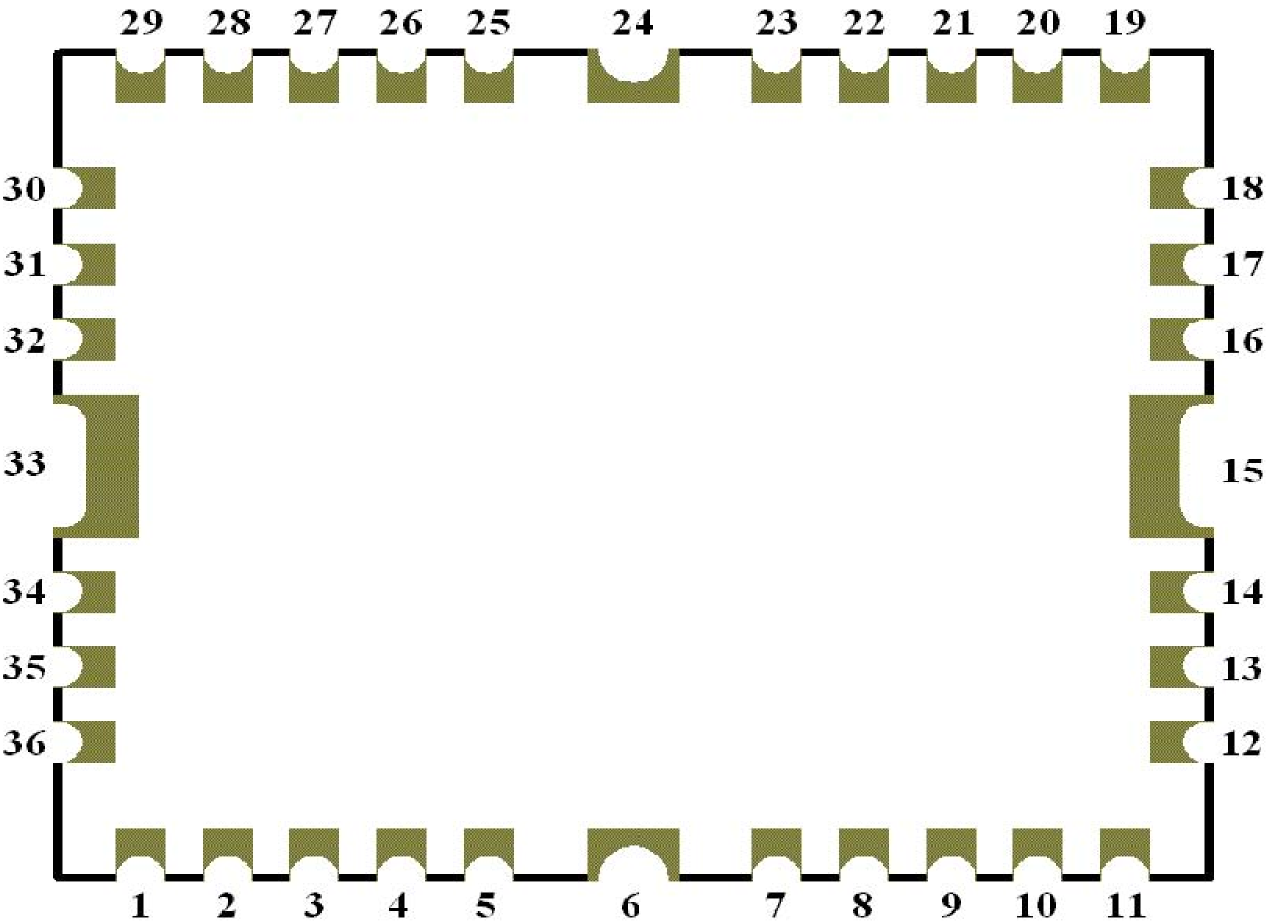
Accuracy	Position: 10 meters, 2D RMS 5 meters, 2D RMS, WAAS enabled Velocity: 0.1 m/s Time: 1us synchronized to GPS time
Maximum Altitude	＜ 18,000 meter
Maximum Velocity	＜ 515 meter/second
Maximum Acceleration	＜ 4G
Update Rate	1 Hz
DGPS	WAAS, EGNOS, MSAS
Datum	WGS-84
Interface	
I/O Pins	2 serial ports
Physical Characteristic	
Type	36-pin stamp holes
Dimensions	15.9 mm * 13.1 mm * 2.2 mm ±0.2mm
DC Characteristics	
Power Supply	3.3Vdc ± 5%
Backup Voltage	2.0 ~ 3.6Vdc ± 10%
Power Consumption	Acquisition: 42mA Tracking: 25mA
Environmental Range	
Humidity Range	5% to 95% non-condensing
Operation Temperature	-30℃ to 85℃
Storage Temperature	-40℃ to 125℃

2. Technical Information

Block Diagram

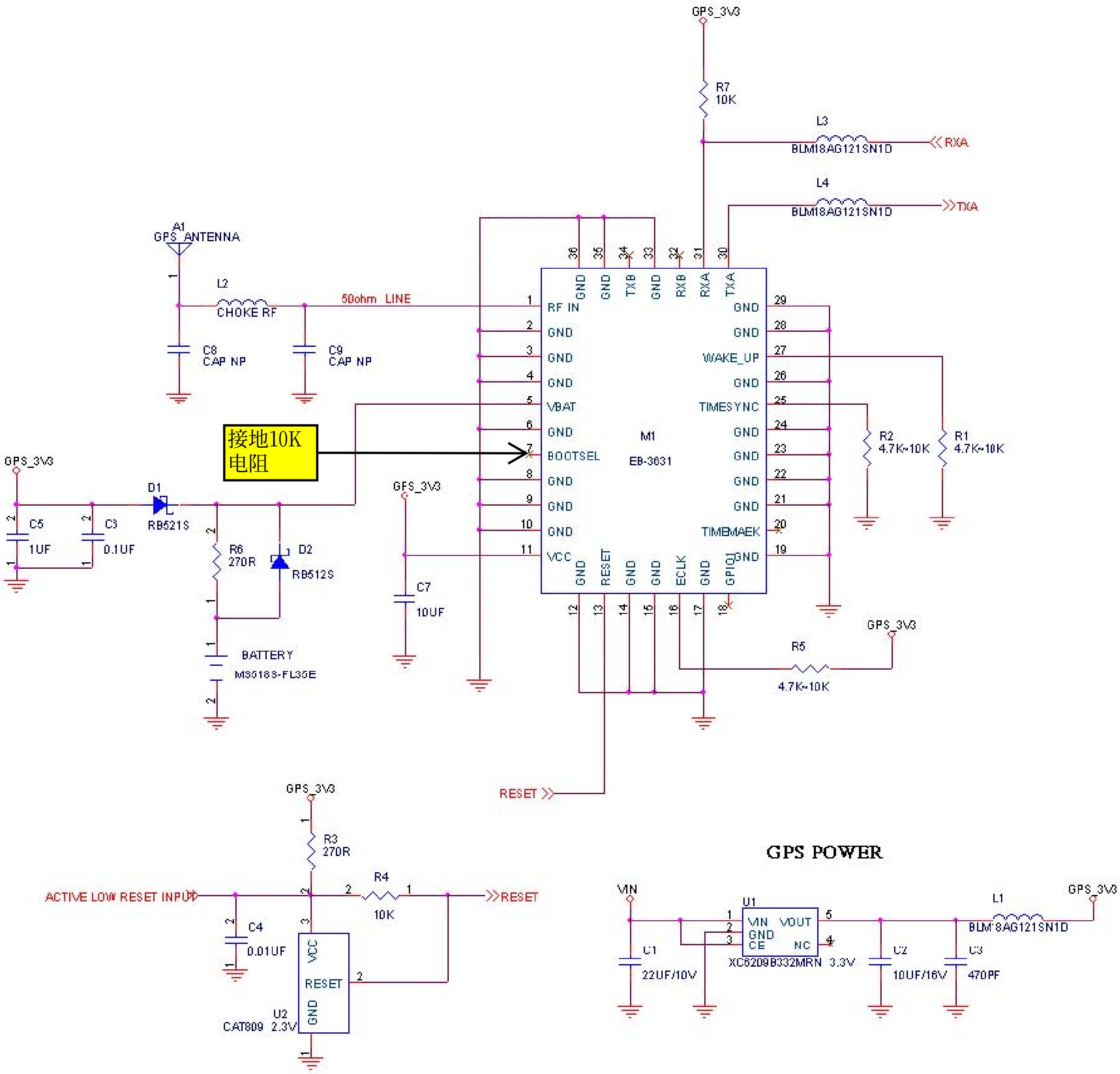


Module Pin Assignment: Application Circuit



Pin NO.	Pin Name	Remark
1.	RF IN	Connect to External Active Antenna. While external antenna is used.
2.	GND	Ground.
3.	GND	Ground.
4.	GND	Ground.
5.	VBAT	This is the battery backup input that powers the SRAM and RTC, The battery voltage should be between 2.0v and 5.0v.
6.	GND	Ground.
7.	BOOTSEL	Set this pin to high for programming flash.
8.	GND	Ground.
9.	GND	Ground.
10.	GND	Ground.
11.	VCC	This is the main DC supply for a 3.3V +- 5% DC input power module board.
12.	GND	Ground.
13.	RESET	This input is low active.
14.	GND	Ground.
15.	GND	Ground.
16.	ECLK	Pull-up via 4.7K to 10K.
17.	GND	Ground.
18.	GPIO	User can use this I/O pin for special function.For example, on/off LED.
19.	GND	Ground.
20.	TIMEMARK	One pulse per second.

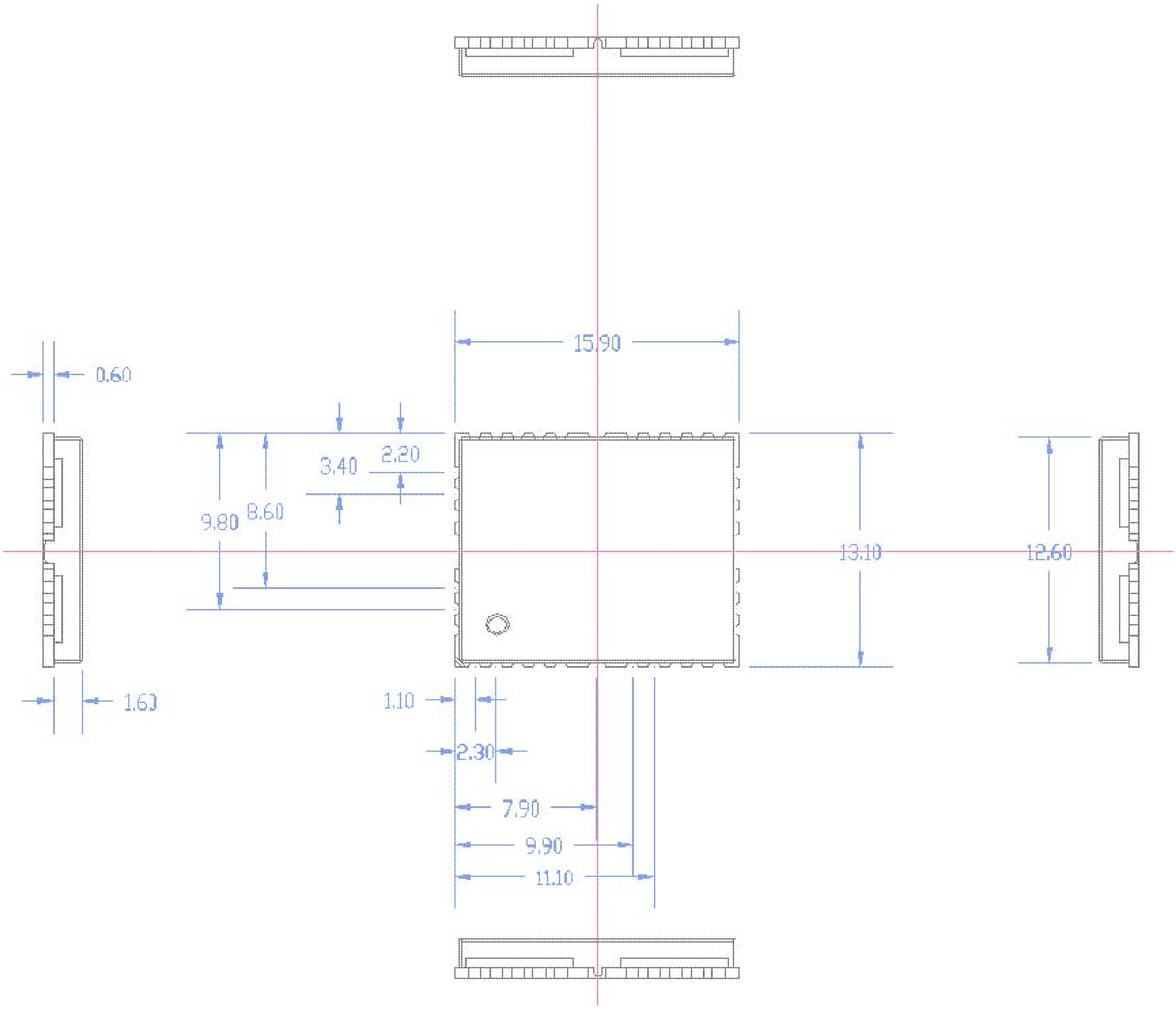
21.	GND	Ground.
22.	GND	Ground.
23.	GND	Ground.
24.	GND	Ground.
25.	TIMESYNC	Pull-down via 4.7K to 10K.
26.	GND	Ground.
27.	WAKE_UP	Pull-down via 4.7K to 10K.
28.	GND	Ground.
29.	GND	Ground.
30.	TXA	This is the main transmits channel for outputting navigation and measurement data to user's navigation software or user written software.Output TTL level, 0V ~ 2.85V.
31.	RXA	This is the main receive channel for receiving software commands to the engine board from SiRFdemo software or from user written software.
32.	RXB	Unused, not connect.
33.	GND	Ground.
34.	TXB	Unused, not connect.
35.	GND	Ground.
36.	GND	Ground.



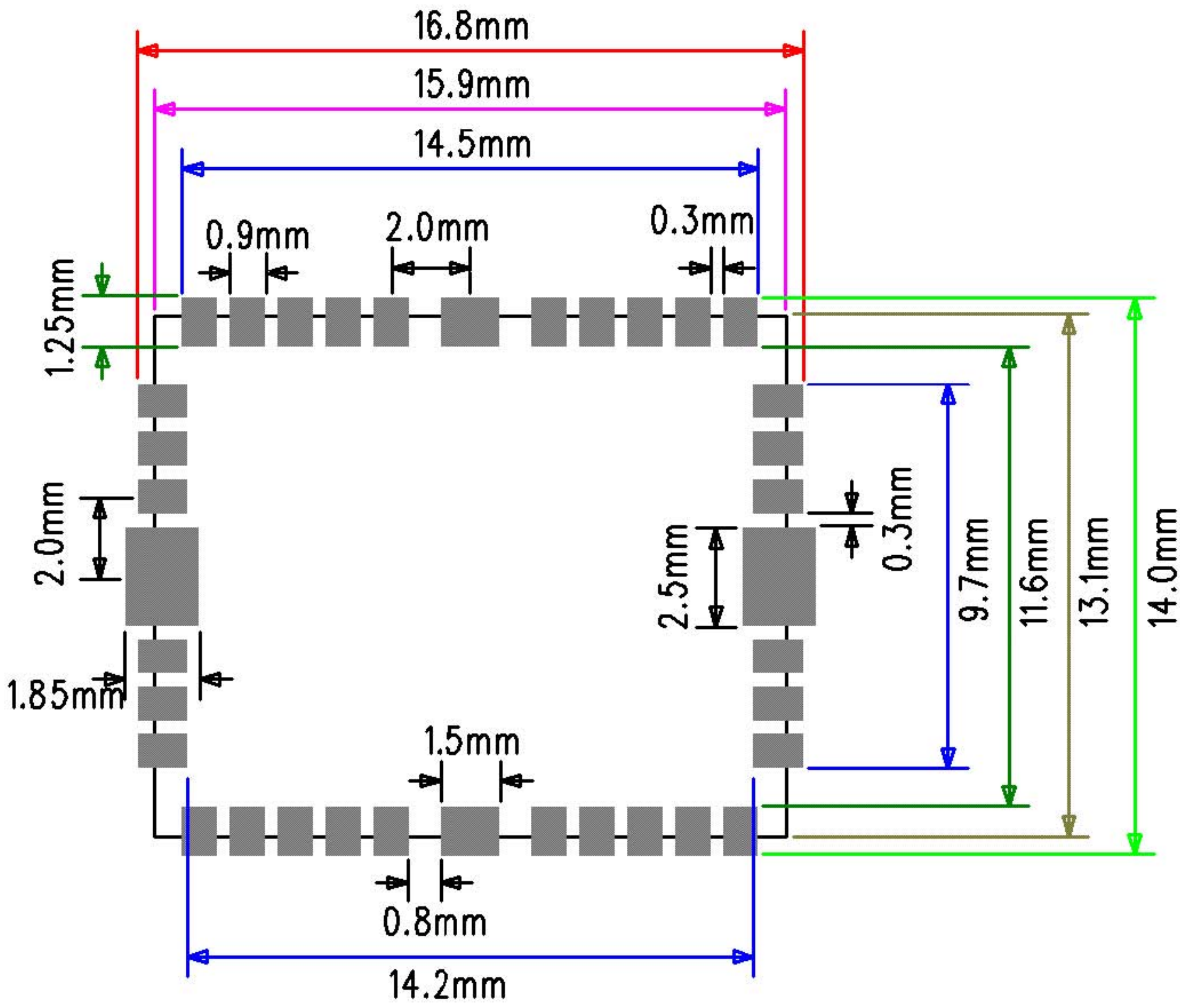
GPS Active Antenna Specification (Recommendation)

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

Dimensions



 Recommended Layout PAD



Tolerance : ±0.1mm

VPN1513 **Version 1.0**

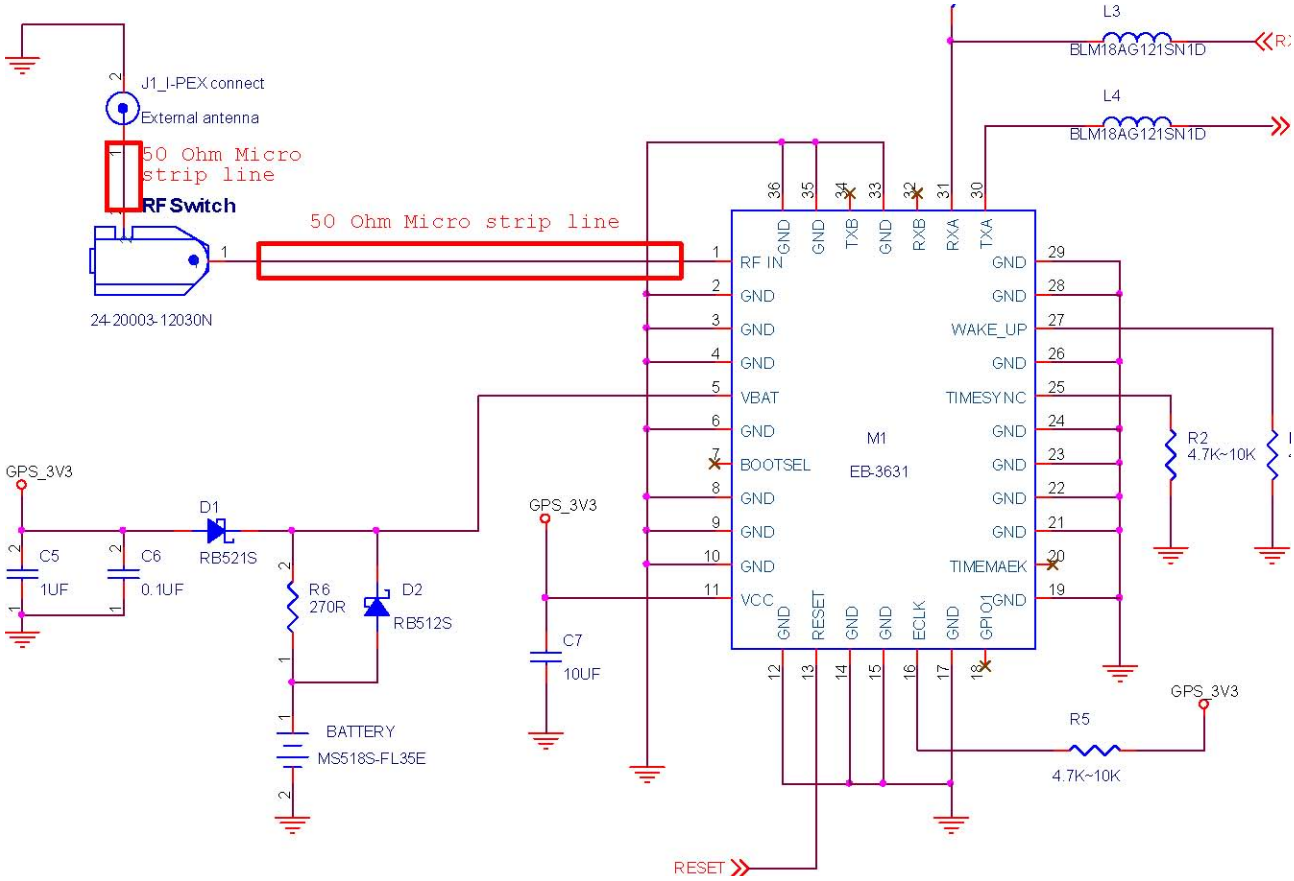
VPN1513 Application guideline

Application Circuit

1.

GPS_3V3

R7
10K



RXA

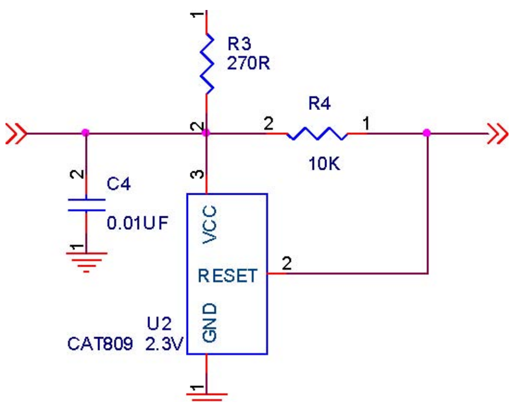
TXA

R1 4.7K~10K

Recommend RESET Circuit

GPS_3V3

ACTIVE LOW RESET INPUT

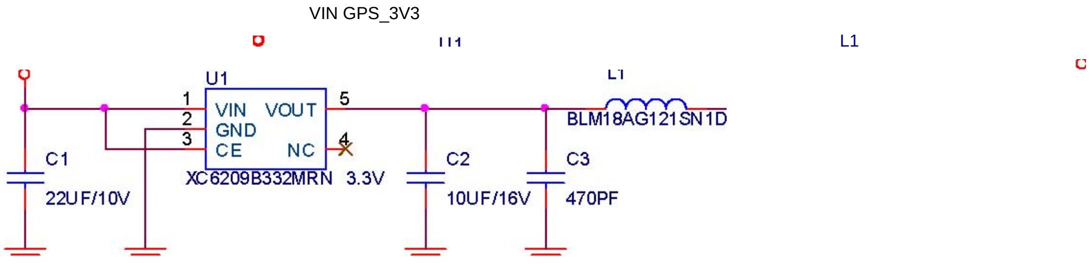


R3 270R

RESET

2.

GPS POWER



Layout Rule

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 have RF traces closed the other signal path and 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 you case.

GPS Passive (or Active)Antenna Specification(Recommendation)

Frequency: 1575.42±2 MHz
Axial Ratio: 3 dB Typical
output Impedance: 50Ω
Polarization: RHCP
Output VSWR: 1.5 Max.

Active option Low Noise Amplifier:

Amplifier Gain :18~22dB Typical
Output VSWR: 2.0 Max.
Noise Figure: 2.0 dB Max.
Antenna Input Voltage : 2.85V(Typ.)

Definition of Pin assignment

VCC

This is the main DC supply for a 3.3V ± 5% DC input power module board.

GND

GND provides the ground for digital part.

RXA

This is the main receive channel for receiving software commands to the engine board from SiRFdemo software or from user written software.

RXB

For user's application (not currently used).

TXA

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

TXB

For user's application (not currently used).

RF_IN

This pin receives signal of GPS analog via external active antenna .It has to be a has to be a controlled impedance at 50 ohm .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 input that powers the SRAM and RTC when main power is removed. Typical current draw is 15uA. Without an external backup battery, the module/engine board will execute a cold star after every turn 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 5.0v.

GPIO User can use this I/O pin for special function. (For example, on/off LED)

RESET You must have reset circuit that has Min. 200msec reset time. This Module do not have internal Power On Reset circuit.

ECLK

Pull-up (4.7K ~ 10.0K).

TIMESYNC

Pull-down (4.7K ~ 10.0K).

Wake Up

This pin is not available now. Pull-down (4.7K ~ 10.0K).

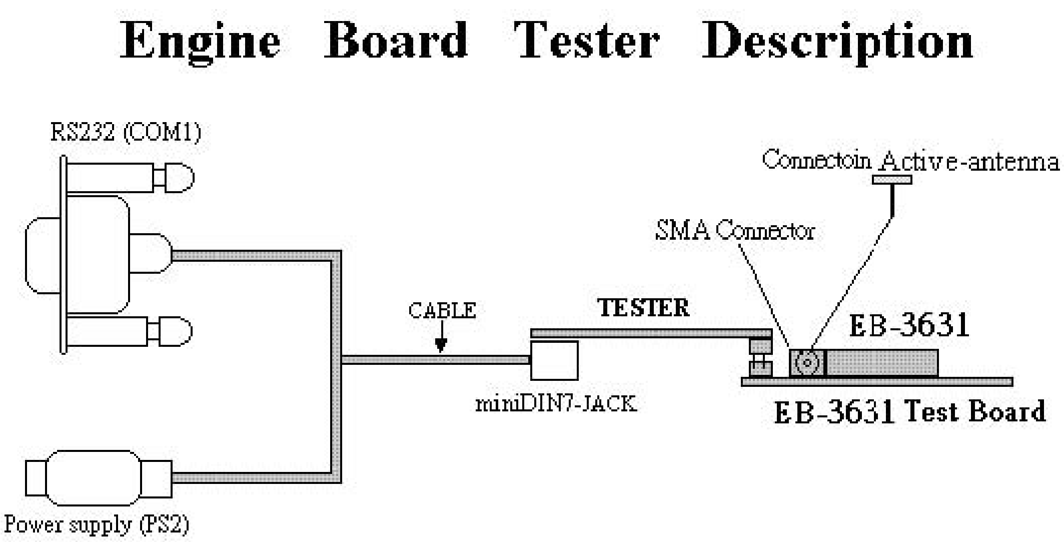
BOOTSEL

Set this pin to high for programming flash.

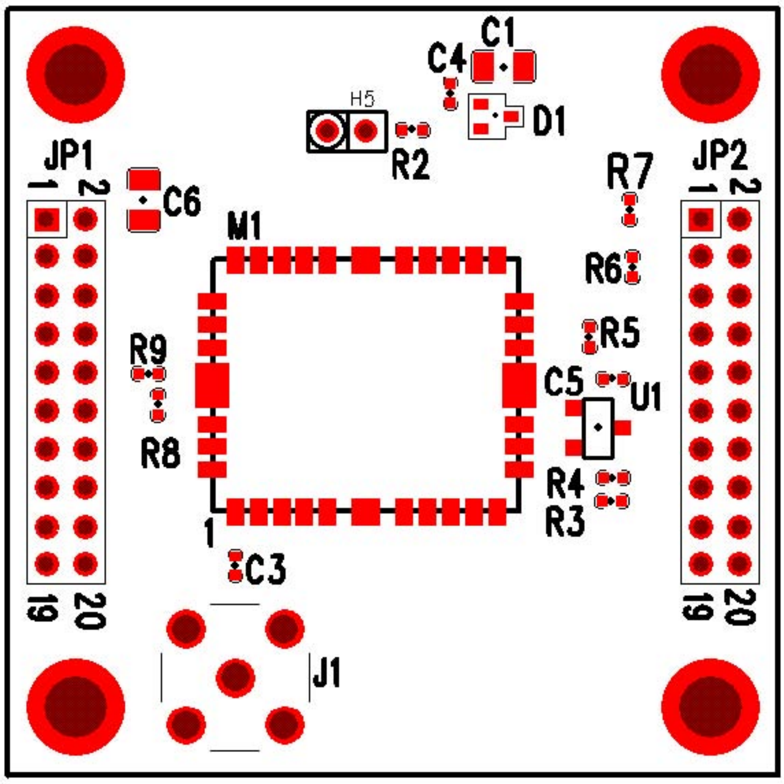
VPN1513 Demo Kit Test Description

Test Board Connection VPN1513 Demo Kit:

Demo Kit JP1 (Male) Connection Test Board J5 (Female)



Definition of Pin assignment



JP1:

Pin	Signal Name	Pin	Signal Name
1	NC	2	VCC
3	NC	4	VCC
5	NC	6	NC
7	NC	8	NC
9	NC	10	NC
11	TXA	12	RXA
13	NC	14	TXB
15	RXB	16	GND
17	NC	18	GND
19	NC	20	NC

JP2

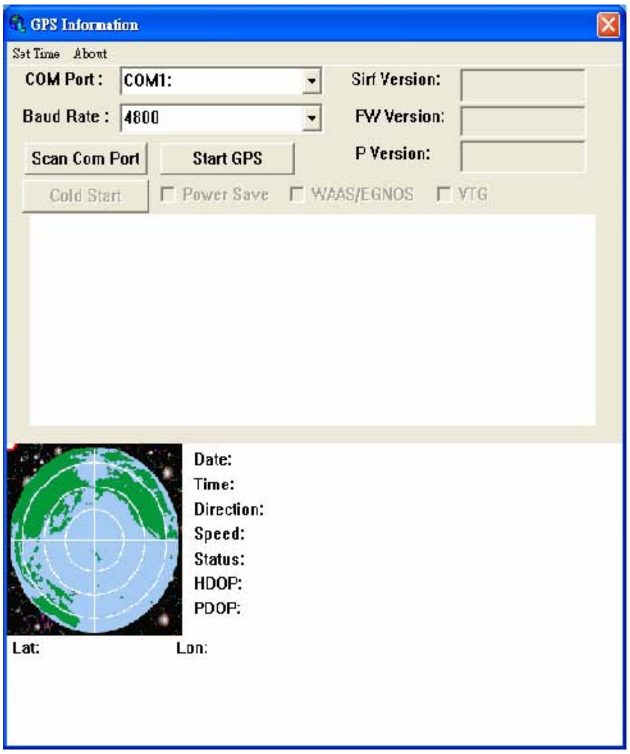
Pin	Signal Name	Pin	Signal Name
1	nWakeup	2	NC
3	TIMESYNC	4	NC
5	TIMEMARK	6	NC
7	GPIO	8	NC
9	ECLK	10	NC
11	RESET	12	NC
13	BOOTSEL	14	NC
15	NC	16	NC
17	NC	18	NC
19	NC	20	NC

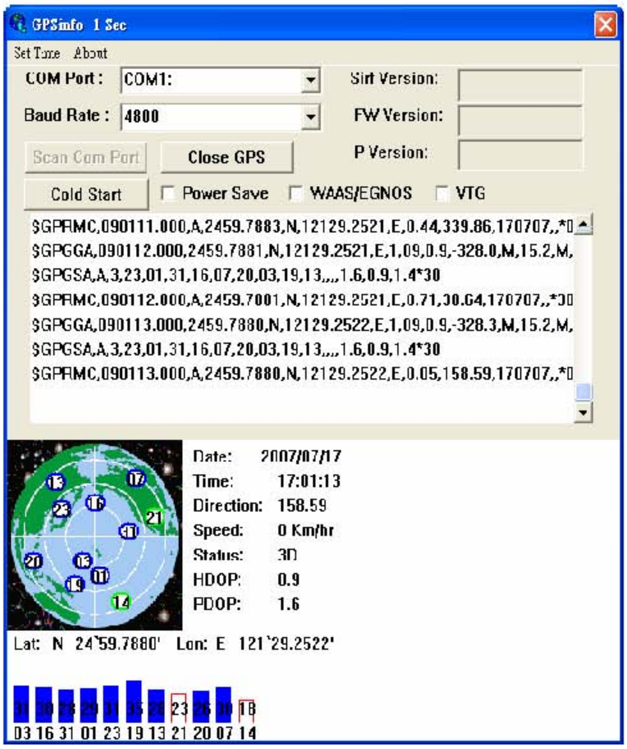
JP3: VBAT

Test Software GPSinfo:

1 Select COM Port & Baud Rate

2 Press Start GPS





SOFTWARE COMMAND

NMEA Output Command

GGA-Global Positioning System Fixed Data

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 Altitude1	9.0	meters	
Units	M	meters	
Geoid Separation1		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

Table B-3 Position Fix Indicator

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

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode , fix valid
3	GPS PPS Mode, fix valid

GLL-Geographic Position-Latitude/Longitude Table B-4 contains the values for the following example: $GPGLL,3723.2475,N,12158.3416,W,161229.487,A*2C

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
Checksum	*2C		
<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
Mode1	A		See Table B-6
Mode2	3		See Table B-7
Satellite Used1	07		Sv on Channel 1
Satellite Used1	02		Sv on Channel 2
…..			
Satellite Used1			Sv on Channel 12
PDOP	1.8		Position dilution of Precision
HDOP	1.0		Horizontal dilution of Precision
VDOP	1.5		Vertical dilution of Precision
Checksum	*33		
<CR><LF>			End of message termination

1. Satellite used in solution.

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		Description
Message ID	$GPGSV		GSV protocol header
Number of Messages[1]	2		Range 1 to 3
Message Number1	1		Range 1 to 3
Satellites in View	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.

RMC-Recommended Minimum Specific GNSS Data

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	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
Checksum	*10		
<CR><LF>			End of message termination

SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS48 directions.

VTG-Course Over Ground and Ground Speed $GPVTG,309.62,T,,M,0.13,N,0.2,K*6E

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
Speed	0.13	knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Checksum	*6E		
<CR><LF>			End of message termination

2.2 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 lnitialization 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>
*CKSUM<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 9600

Baud, 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>*C

KSUM<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*20Example 3: Disable VTG message $

PSRF103,05,00,00,01*21

E). LLA Navigation lnitialization 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 LLANavigationInitialization 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=OnExample: 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

Name	Example	Units	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