

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

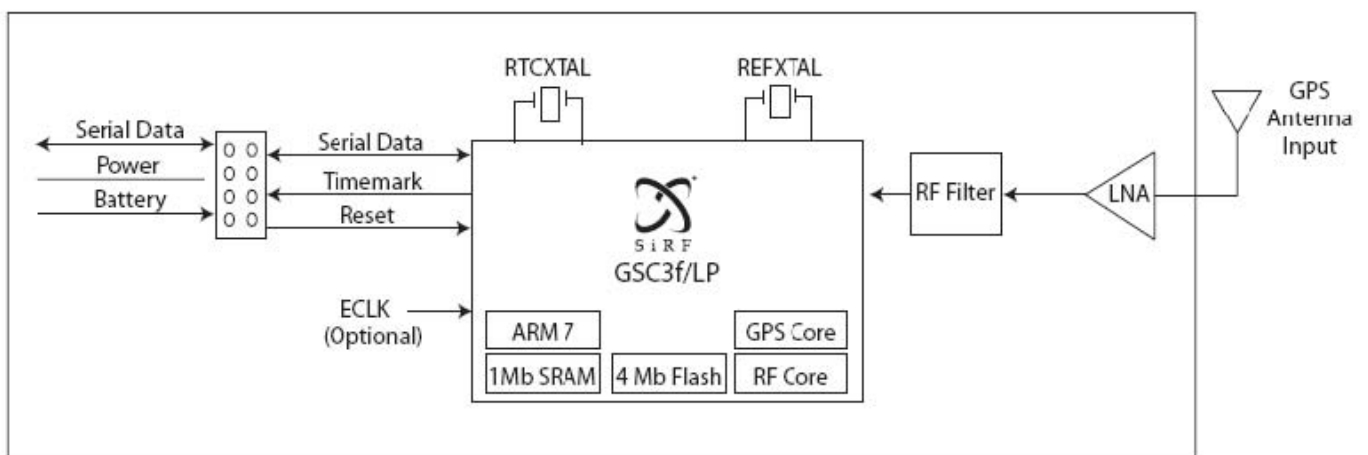
| GPS Receiver | |
|---------------------|--|
| Chipset | SiRF GSC3e/LP |
| Frequency | L1, 1575.42 MHz |
| Code | C/A Code |
| Protocol | NMEA 0183 v2.2 Default:GGA,GSA,GSV,RMC Support:VTG,GLL,ZDA) SiRF binary and NMEA Command |
| Available Baud Rate | 4,800 to 57,600 bps adjustable |

| | |
|---------------|---------------------|
| 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 |

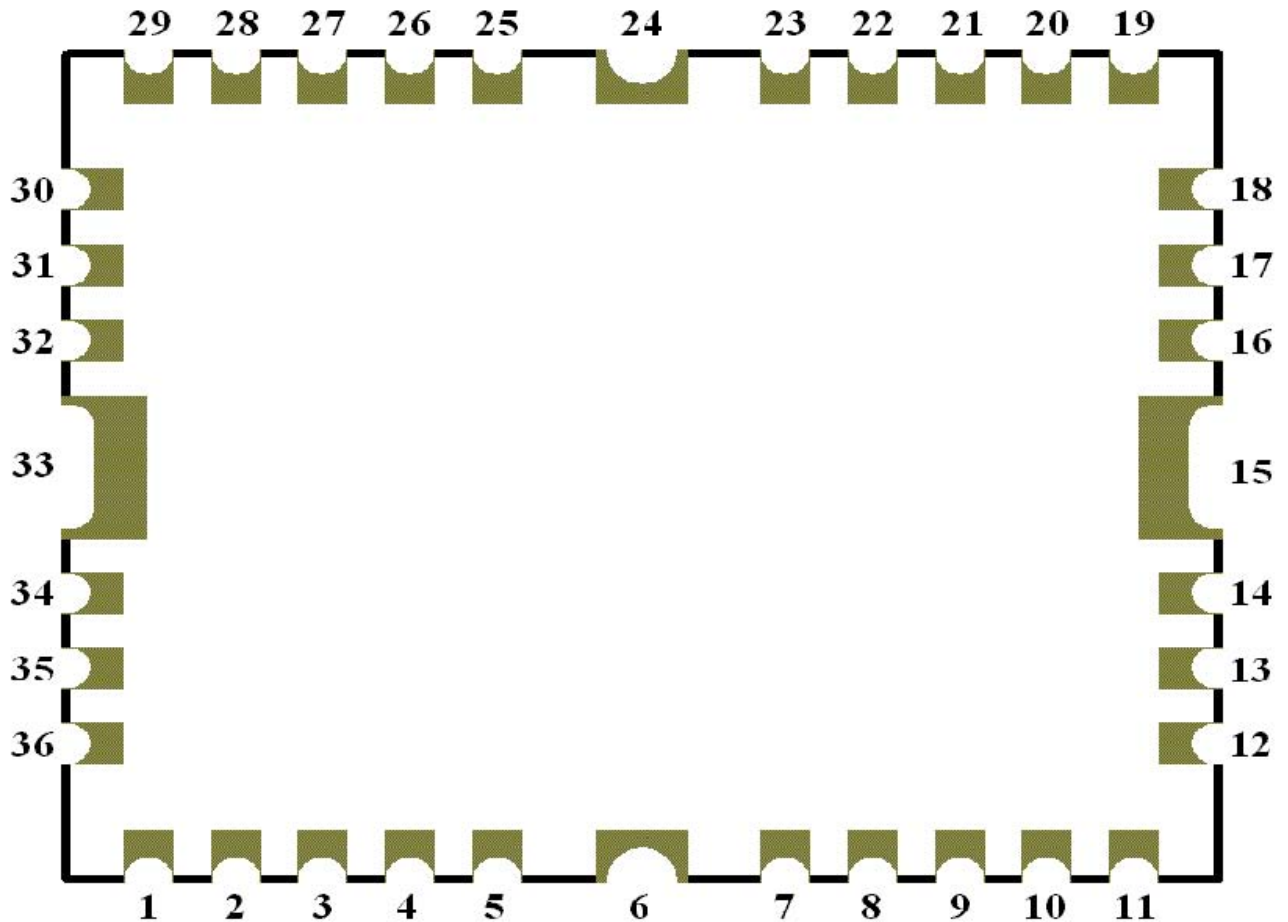
| | |
|--------------------------------|---|
| Accuracy | Position: 10 meters, 2D RMS 5 meters, 2D RMS, WAAS enabled Velocity: 0.1 m/s Time: 1us synchronized to GPS time |
| Maximum Altitude | < 18,000 meter |
| Maximum Velocity | < 515 meter/second |
| Maximum Acceleration | < 4G |
| Update Rate | 1 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°C to 85°C |
| Storage Temperature | -40°C to 125°C |

2. Technical Information

□ Block Diagram

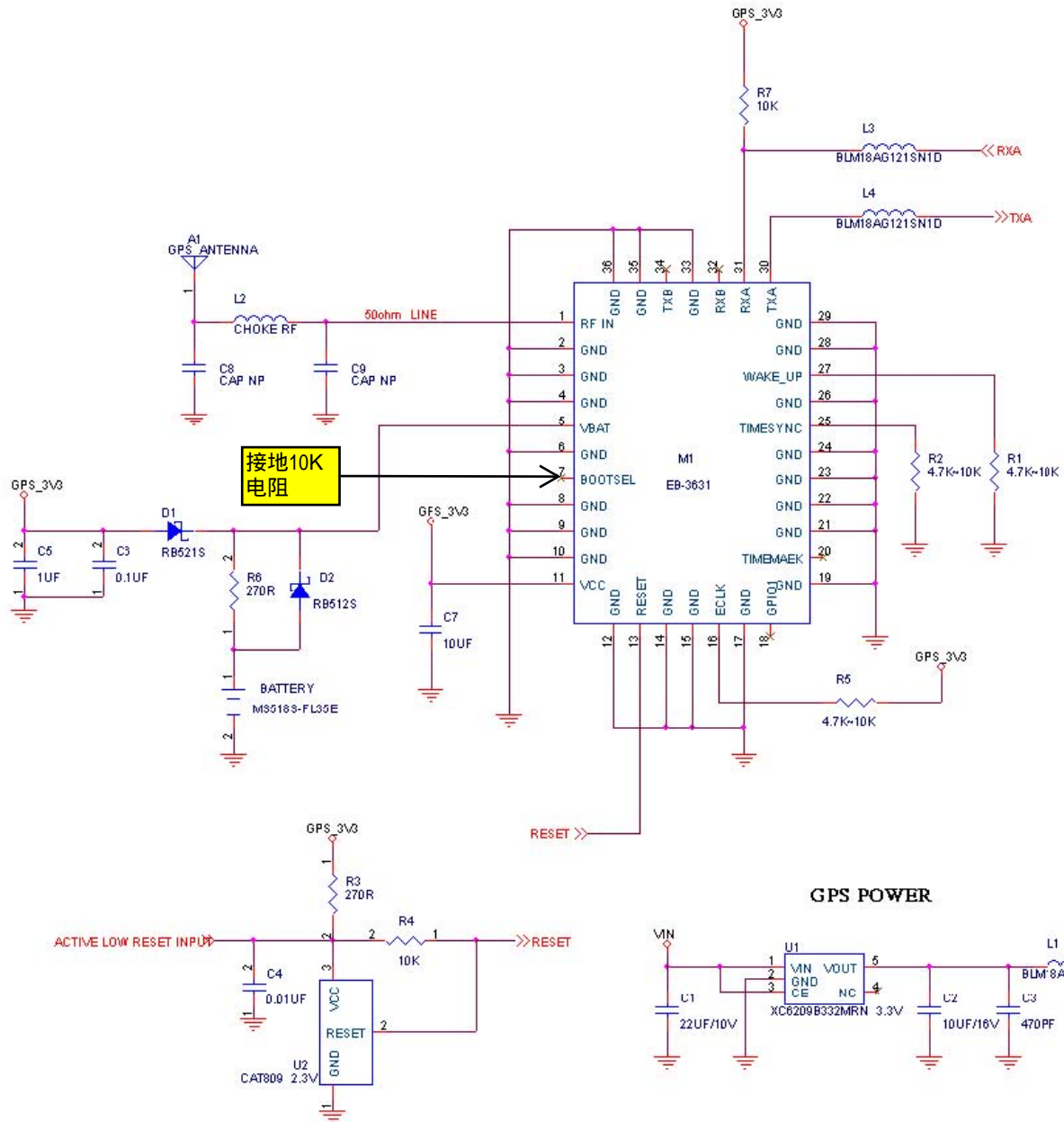


□ Module Pin Assignment: □ Application Circuit



| 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. |

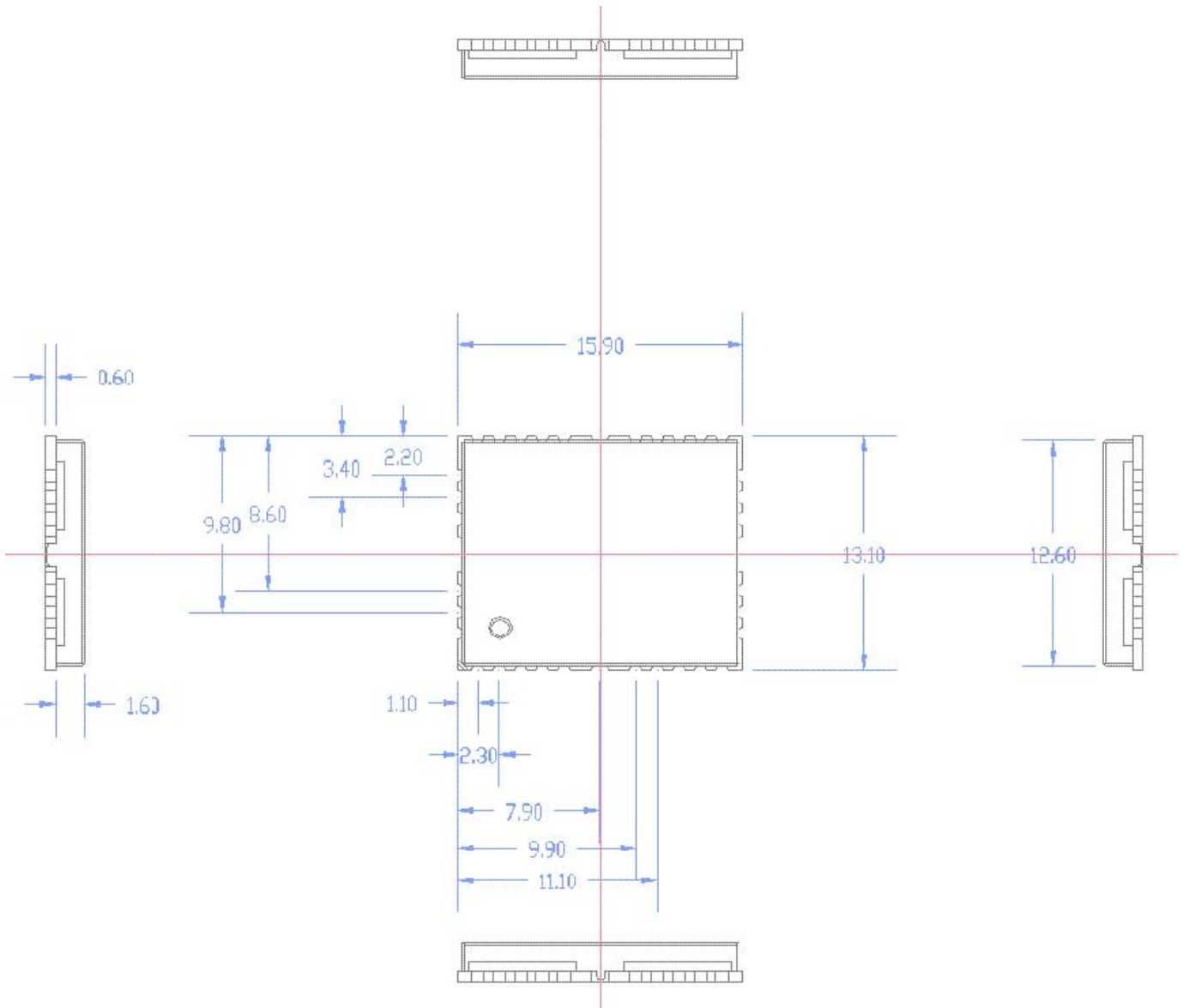
| | | |
|-----|----------|---|
| 21. | GND | Ground. |
| 22. | GND | Ground. |
| 23. | GND | Ground. |
| 24. | GND | Ground. |
| 25. | TIMESYNC | Pull-down via 4.7K to 10K. |
| 26. | GND | Ground. |
| 27. | WAKE_UP | Pull-down via 4.7K to 10K. |
| 28. | GND | Ground. |
| 29. | GND | Ground. |
| 30. | 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. |



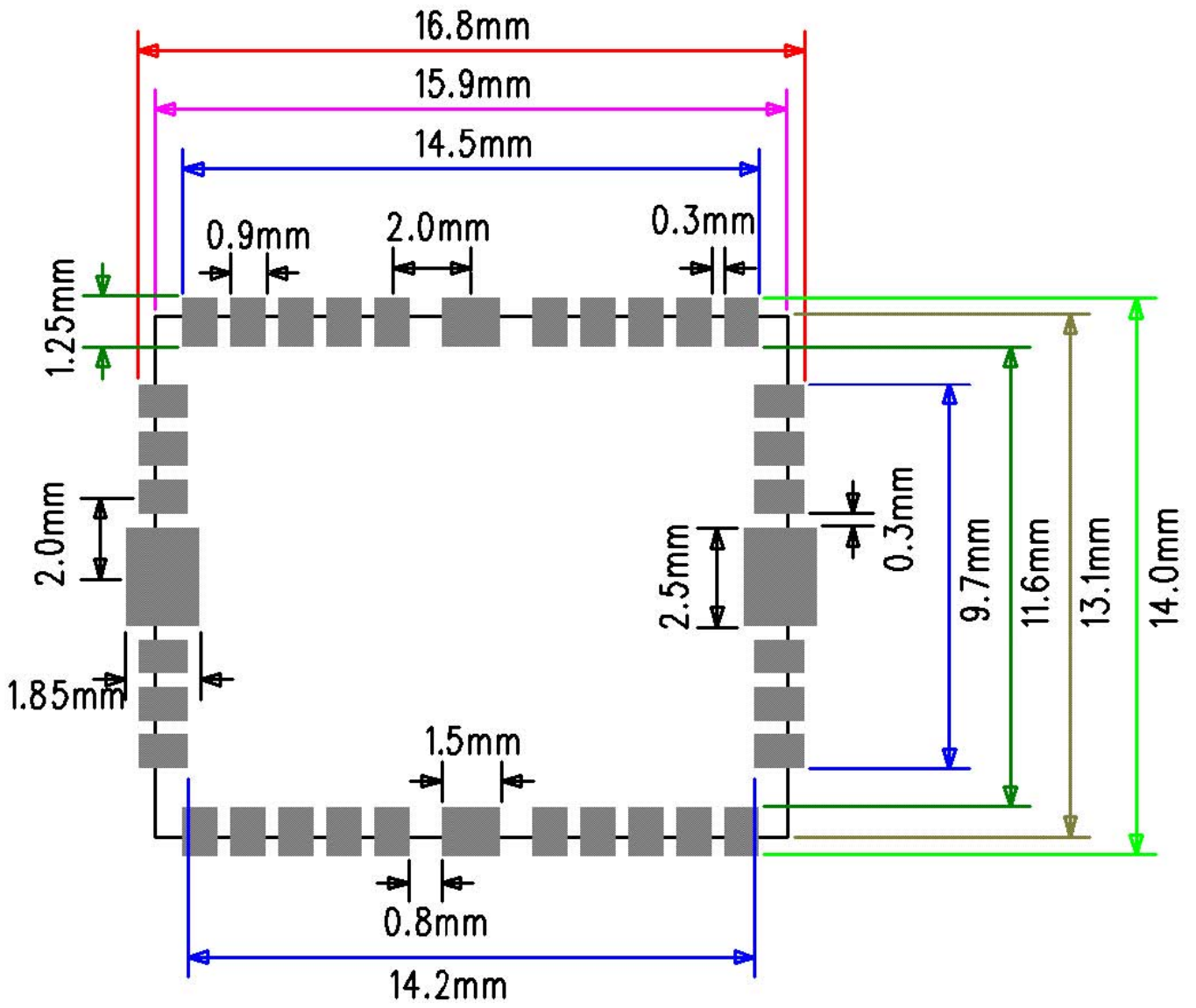
GPS Active Antenna Specification (Recommendation)

Frequency: 1575.42 + 2MHz Axial Ratio: 3 dB Typical output Impedance: 50Ω Polarization: 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 : $\pm 0.1\text{mm}$

VPN1513 Version 1.0

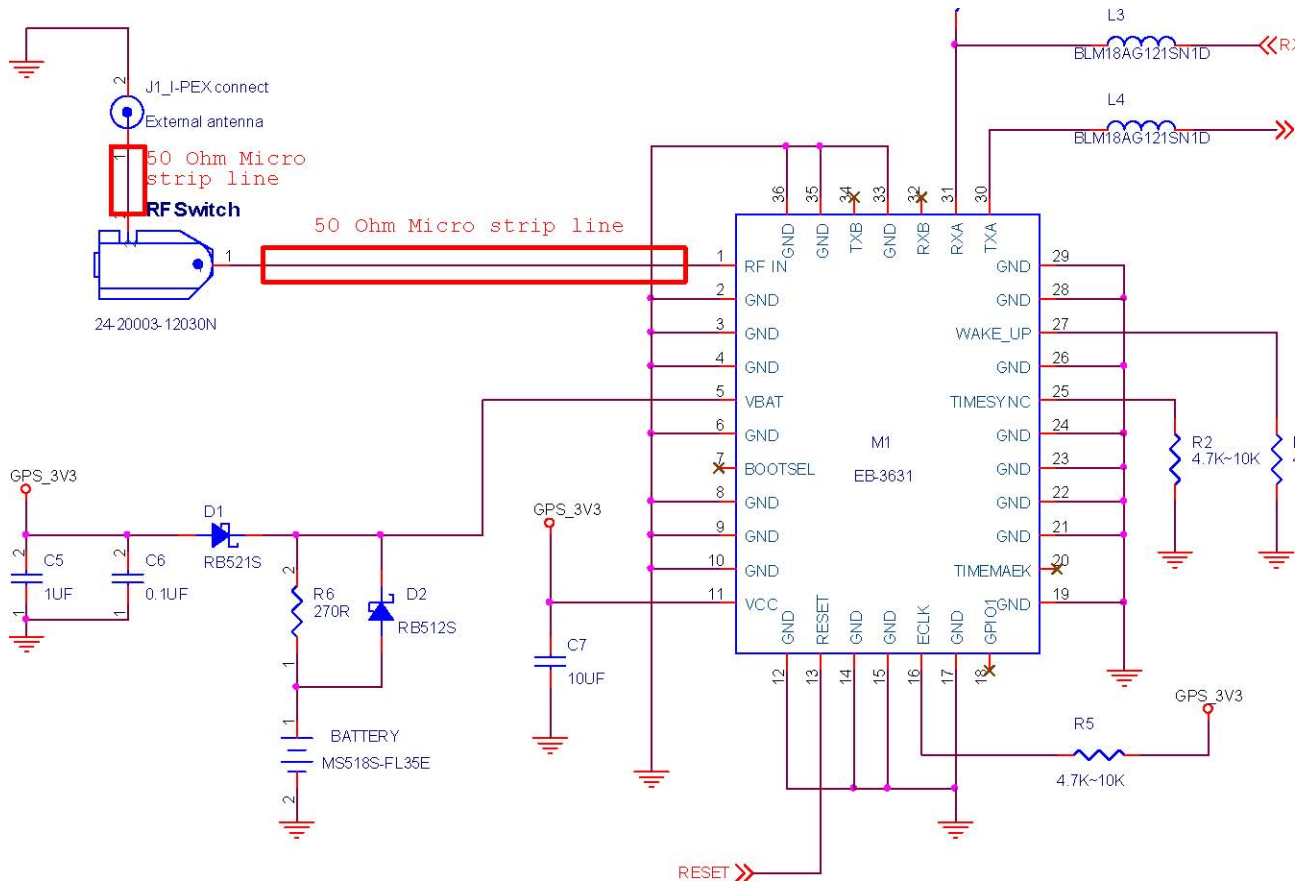
VPN1513 Application guideline

Application Circuit

1.

GPS_3V3

R7
10K



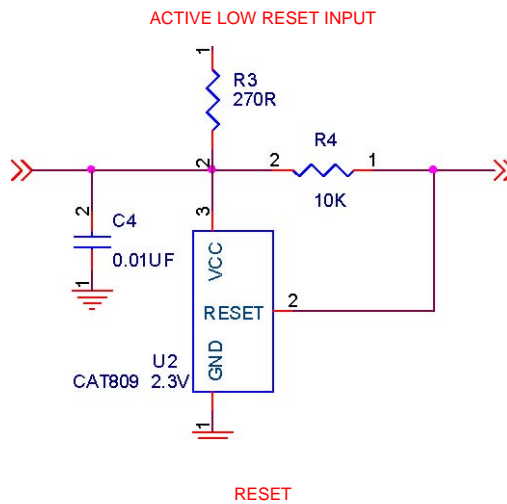
RXA

TXA

R1 4.7K-10K

Recommend RESET Circuit

GPS_3V3

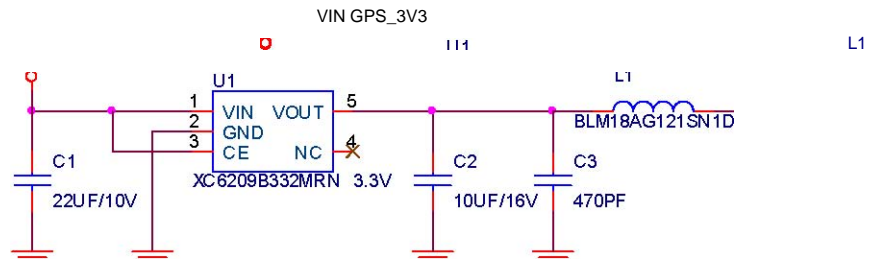


R3 270R

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 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

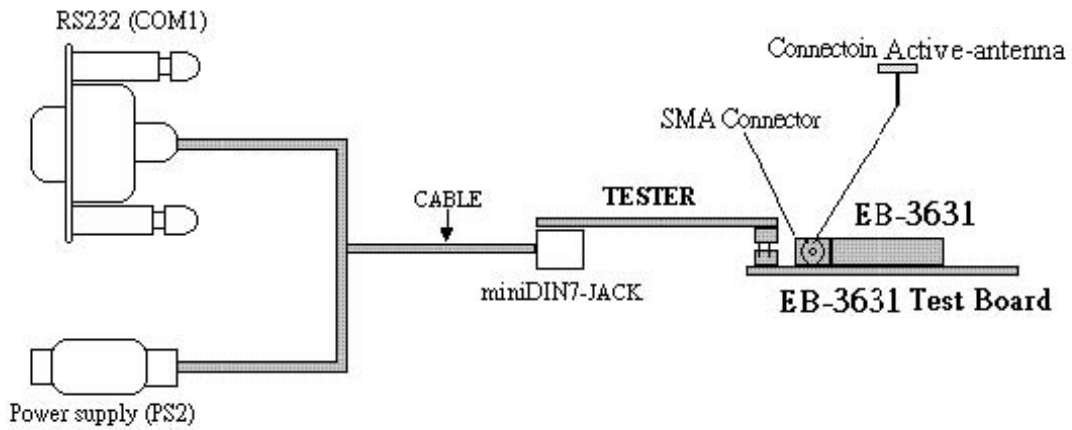
Set this pin to high for programming flash.

VPN1513 Demo Kit Test Description

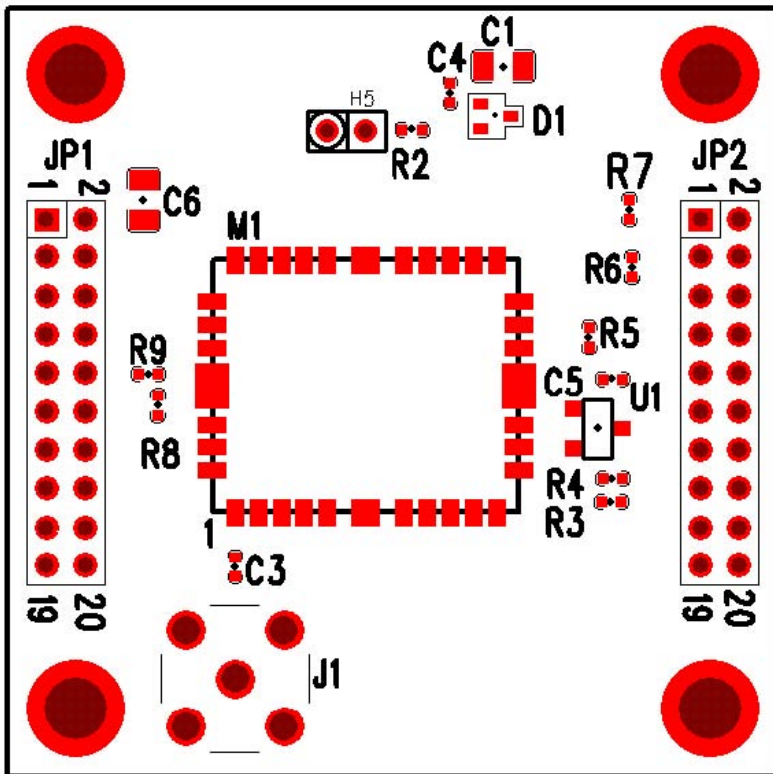
Test Board Connection VPN1513 Demo Kit:

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

Engine Board Tester Description



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 |

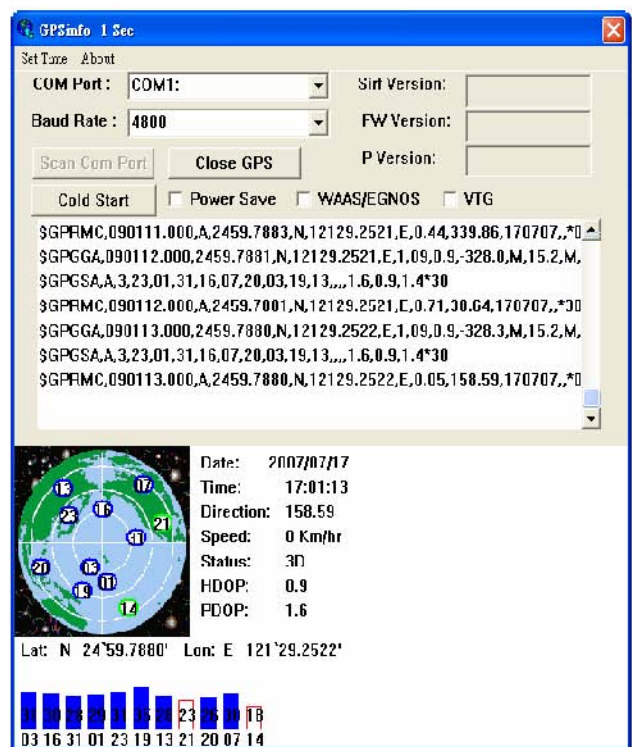
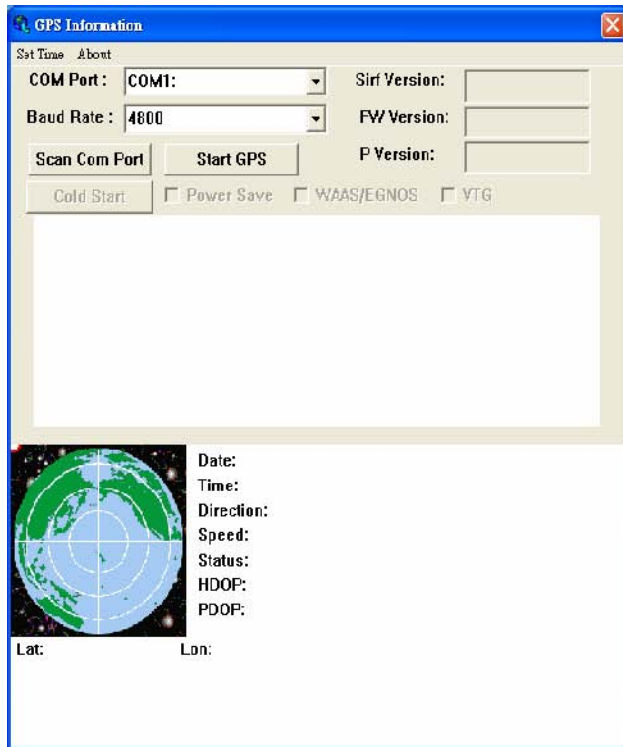
JP2

| 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 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 |

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 Used ₁ | 07 | | Sv on Channel 1 |
| Satellite Used ₁ | 02 | | Sv on Channel 2 |
| | | | |
| Satellite Used ₁ | | | 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 Number ₁ | 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.

****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 converted 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>
*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

<TimeOfWeek> GPS Time Of Week
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*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 solution. 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=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

| 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 |