

Data Sheet / GM-318

SiRFstarIII

Easy to Use Ultra-High Performance

GPS Smart Antenna Module

with

Power Control



RoHS
Compliant

Version 1.1

The specifications in this document are subject to change without prior notice.

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1 Introduction

1.1 Overview



As shown in the above pictures, GM-318 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 and high performance enables the adoption of handheld applications. The slim design allows GM-318 to be placed on top side of the housing to have best GPS signal reception. The 5-pin I/O interface is then connected to the main board with either connector or wire soldering.

The integrated antenna design helps reduce the RF and EMI issues to minimum. Fast adoption and high yield production becomes possible.

The power control feature is very convenient to turn on/off power via GPIO control pin. It's especially useful in cases such as to turn off power as the user just wants to watch a movie and GPS function is not needed in the PMP case.

1.2 Main Features

Not only handheld but also any other GPS applications can share the following major features of GM-318.

- ◆ Easy adoption with best performance
- ◆ Integrated antenna and EMC protection
- ◆ Built-in backup battery allowing hot/warm starts and better performance
- ◆ No external component demand, just connect and use.
- ◆ Minimum RF and EMI efforts
- ◆ Small size of 18 (W) x 21 (L) x 7 (H) (mm) with patch antenna of 18x18x4mm.
- ◆ Fully implementation of ultra-high performance **SiRFstarIII** single chip architecture

- ◆ High tracking sensitivity of **-159dBm**
- ◆ Low power consumption of **40mA** at full tracking
- ◆ Hardware **power saving control pin** allowing power off GPS via GPIO
- ◆ GM-318 could be arranged at best reception location inside housing
- ◆ **Firmware upgradeable** for future potential performance enhancements

1.3 Receiver Specifications

| Features | Specifications ¹ |
|---|---|
| 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 |
| TTF (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 | 40mA, continuous tracking mode |
| Power supply | 3.3V |
| Dimension (single side) | 18 (W) x 21 (L) x 5 (H) mm w/ 18x18x2 (mm) patch antenna 18 (W) x 21 (L) x 7 (H) mm w/ 18x18x4 (mm) patch antenna |
| Operating temperature | -40°C ~ +85°C |
| Storage temperature | -40°C ~ +125°C |

¹Note. 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

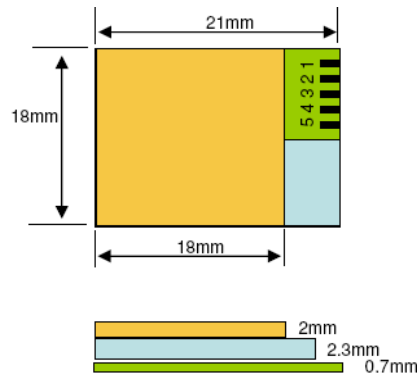
GM-318 has a built-in patch antenna of dimension 18x18x4 or 18x18x2 (mm).

To have the best performance, NaviSys suggests tuning the RF antenna together with product's outside shell of housing.

2 Hardware Interface

2.1 Module Dimension

The dimension of GM-318 is 18 mm (W) x 21 mm (L) x 5 mm (H) for patch antenna of 18x18x2 or is 18 mm (W) x 21 mm (L) x 7 mm (H) for patch antenna of 18x18x4.



2.2 Pin Assignment

5-pin Interface

| Pin | Name | Function | I/O |
|-----|----------|---|--------|
| 1 | GND | Ground | Input |
| 2 | VCC | Power supply of 3.3 ~ 3.5 VDC | Input |
| 3 | TX | Port A serial data output (GPS out); N-8-1, NMEA v3.00 output | Output |
| 4 | RX | Port A serial data input (GPS in); N-8-1, accepts commands from external applications, e.g. SiRFDemo. | Input |
| 5 | PWR_CTRL | Hardware controlled power saving pin. If this function is used, it is usually connected to a GPIO pin of a micro-processor. "Low": for normal run "High" or floating; turn off VCC for power saving Tie it to low if this pin is not used. | Input |

2.3 Module Placement

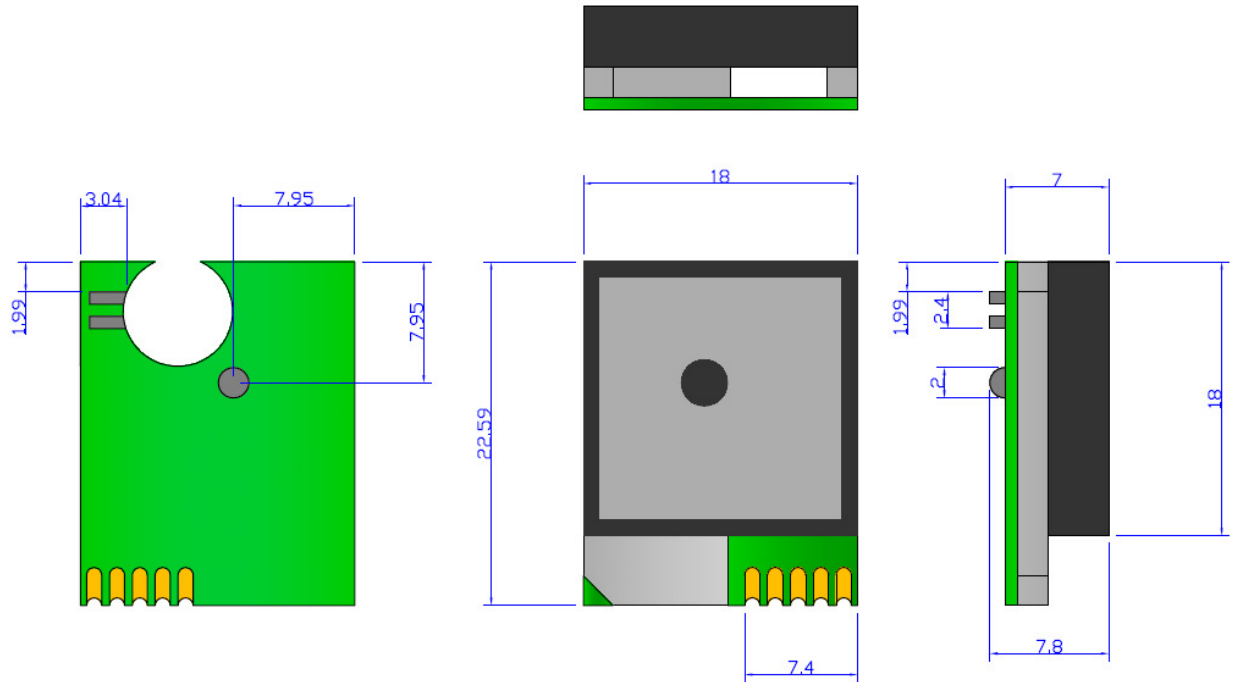
The GM-318 module could be placed on any location of your product's housing that has best signal reception. The 5-pin interface is then connected to your mother board. There are two items that extrude the bottom PCB plane of GM-318. It may affect the placement of GM-318 into your product's housing.

1. The antenna is soldered to GM-318 at the bottom via 1 soldering point. The soldering extrudes the bottom PCB plane of GM-318. It is suggested to reserve a hole of ϕ



= 2 mm and depth of 1mm on the under housing.

2. The built-in battery is also soldered to GM-318 at the bottom via two soldering points. The soldering extrudes the bottom PCB plane of GM-318. Please see the following figure for the detailed data.



2.4 Power Saving

GM-318 supports various kinds of power saving mechanisms – Trickle Power, Adaptive Trickle Power, Push To Fix, and power switch. The first three kinds of power saving mechanisms are implemented in software and the power switch mechanism is implemented in hardware.

2.4.1 Power Saving of Trickle Power

The trickle power saving mechanism 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. This feature is useful for applications that need to report position regularly while power saving is significant. 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 by request of MOQ.

2.4.2 Power Saving of Adaptive Trickle Power

The adaptive trickle power saving mechanism is basically the same as trickle power

saving mechanism with difference that it would not turn the power off if the signal quality is not good enough for tracking. Thus, it keeps both benefits of performance and power saving intelligently. 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 by request of MOQ.

2.4.3 Power Saving of Push To Fix

The Push To Fix power saving mechanism will not report position data until a specified time interval expires or triggered by external event. Typically, to keep the up to date position data, it would wake up to collect ephemeris and almanac data every 30 minutes. The time interval is also configurable. 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 by request of MOQ.

2.4.4 Power Saving of Power Switch

The Power Switch power saving mechanism will turn off not only the CPU and RF but also the whole engine board. In the mean time, the backup battery will start to power GPS's RTC and internal memory for better performance.

The power saving is controlled by the external application via the control pin (PWR_CTRL; pin 5). The engine board will be on if PWR_CTRL pin is low. It would be off if the pin is high or floating. [The designer has full control of the power supply status of the smart antenna.](#) The power saving is also more complete. Applications such as PMP navigator may prefer to stop GPS while it just runs movie watching. There might be similar demand for different applications. This mechanism is achieved by hardware and external control of pin PWR_CTRL is required if this mechanism is used. Tie this pin to low if the mechanism is not used.

3 Software Interface

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-318 adopts interface protocol of National Marine Electronics Association's NMEA-0183 Version 3.00 interface specification. GM-318 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, D: D-GPS, N: Data not valid |
| checksum | *5F | | A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid |
| <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 Electrical and Environmental Data

Electrical Data

| | |
|---------------------------------|--|
| Power Supply | 3.3 ~ 3.5VDC |
| Power Consumption (w/o antenna) | 40mA/average tracking |
| Backup Battery Supply | Nominal voltage: 3.0 V |
| Digital I/O | V _{IH} : 2~3.15V, V _{IL} : 0~0.85V V _{OH} : >2.1V, V _{OL} : < 0.72V |
| Protocols | NMEA (default), SiRF Binary |

Environmental Data

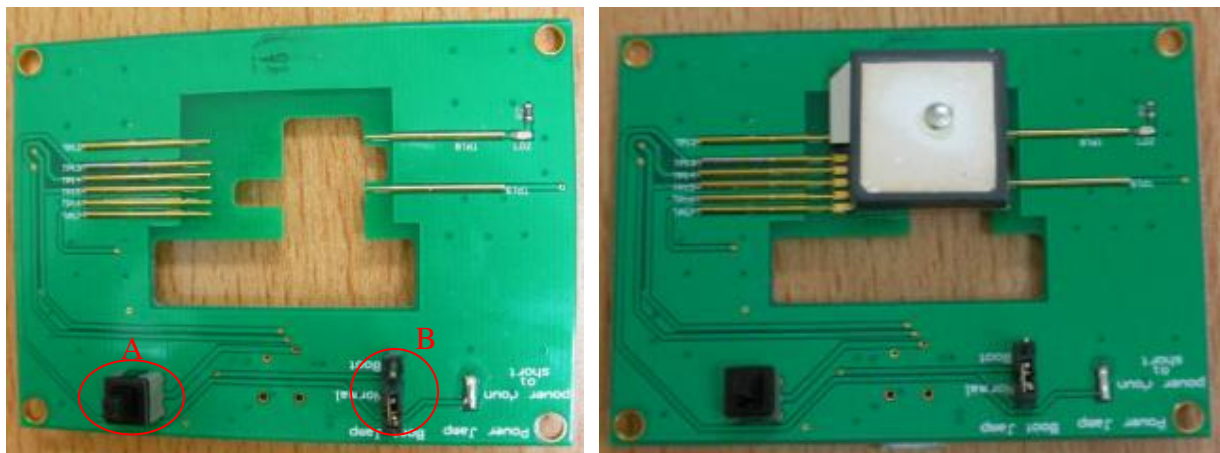
| | |
|-----------------------|--------------------|
| Operating temperature | -40 ~ 85°C |
| Storage temperature | -40 ~ 125°C |
| Vibration | 5Hz to 500Hz, 5g |
| Shock | Half sine 30g/11ms |

5 Evaluation Board

The GM-318 evaluation board is equipped with jiggers (retractable pins) for connection to pins of GM-318.

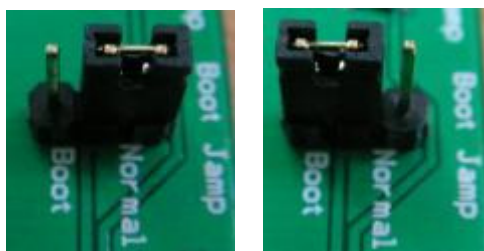
To connect GM-318 to the evaluation board, align and push jiggers to connect one side first. And then align and release to connect the second side.

Please note that the jigger connection is not strong. Shake it or external forces may make the GM-318 disconnect from the evaluation board.

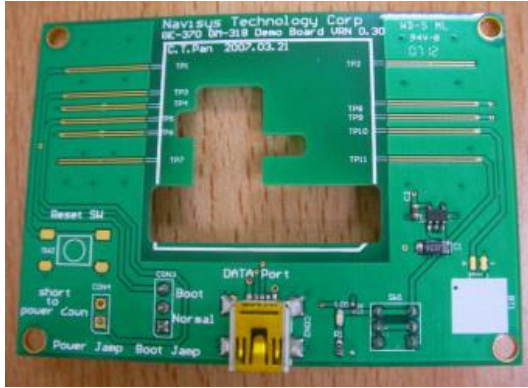


As shown in upper photos. Area “A” is the power switch. The power is ON when the toggle switch is at lower position. On the contrary, the power is OFF when the toggle switch is at higher position.

Area “B” is the boot selection jumper. It determines whether to upgrade the GPS firmware or not. In “Normal” case, as shown in the left photo shown below, it runs with normal GPS function. In “Boot” case, as shown in the right photo shown below, it will wait for firmware upgrade after power on.

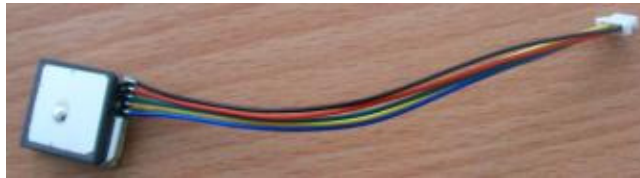


The evaluation board is equipped with a mini-USB connector as shown below. It could be used to connect PC's USB port using a [proprietary data cable from Navisys](#). Following are a few photos for such kind of connection.



6 Application

To have best performance, it is suggested to **place** GM-318 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 5-pin to the mother board via connection wires.



In some cases, **EMI** may still affect the module. Enhance the ground pin between GM-318 and mother board may help it.

Please note that the **backup battery** is already included in GM-318. You saved the space, charging circuit and related materials.

To control the power of GM-318, connect the **PWR_CTRL** pin to a GPIO of micro-processor. One can pull low it during normal run. To cut off the power of GM-318, pull high or just let it floating. Tie the PWR_CTRL pin to low if the power saving control feature is not needed.

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

GM-318X

| | |
|---|--|
| A | A: standard - patch: 18x18x2 mm, 4800bps, N-8-1, GGA, GSA, RMC, VTG@1Hz, GSV@1/5Hz |
| B | A: standard - patch: 18x18x4 mm, 4800bps, N-8-1, GGA, GSA, RMC, VTG@1Hz, GSV@1/5Hz |