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## **SPECIFICATION**

### Smart Antenna **SPK- GPS – GS405**



V. 1.0

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## 1. FUNCTIONAL DESCRIPTION

### 1.1. OVERVIEW

**SPK-GPS-GS405** is a Global Position System receiver module based on SiRF Star III high-sensitivity chipset solution which includes a built-in Sarantel omni-directional Geo-Helix SMP passive antenna. The receiver module can track 20 satellites simultaneously, integration with GPS receiver update navigation data every second and provide your exact location information soon after the power is turned on.

**SPK-GPS-GS405** designed for a broad spectrum of OEM personal positioning and navigation applications, such as hand-held or portable device. It will help you integrate to the system platform easily. **SPK-GPS-GS405** meets strict needs such as car navigation, mapping, surveying, security, agriculture and so on.

### 1.2. MAIN FEATURES

- Built-in SiRF Star III chipset with standard SiRF GSW 3.0 software
- Built-in Sarantel omni-directional Geo-helix SMP passive antenna, increases GSP signal reception sensitivity
- Twenty parallel satellites tracking channels for fast acquisition.
- A-GPS ready
- Compact size
- Support NMEA0183 V. 3.01 data protocol.
- TTL level output serial port easily for system on board integration

### 1.3. KEY BENEFITS

- Integrate GPS antenna and receiver
- Filtering effect of the antenna gives high immunity to RF interface
- High sensitivity GPS solution – Fast TTFF
- Wide antenna Beam width
- Simple integration and acceleration for time-to-market

# Specifications

## 2. SPECIFICATION

### 2.1. ABSOLUTE MAXIMUM RATING

| Parameter            | Min | Typ | Max | Units |
|----------------------|-----|-----|-----|-------|
| Power Supply Voltage | 3.1 | 3.3 | 3.5 | V     |
| Operating Current    | 67  | 75  | 82  | mA    |

### 2.2. GEOHELIX-SMP GPS ANTENNA CHARACTERISTICS

| Parameter                   | Min     | Typ     | Max     | Unit    |
|-----------------------------|---------|---------|---------|---------|
| Frequency                   | 1573.42 | 1575.42 | 1577.42 | MHz     |
| Gain                        | -5.5    | -3.5    |         | dBic    |
| Beamwidth                   |         | >120    |         | Degrees |
| VSWR                        |         | 2.0:1   | 2.3:1   |         |
| Impedance                   |         | 50      |         |         |
| Operating Temperature Range | -40     | +20     | +85     |         |

### 2.3. GPS TECHNICAL SPECIFICATION

|   | ITEMS                                  | DESCRIPTION                          |
|---|--|--------------------------------------|
| Chipset   | GRF3w&GSP3f                            | SiRF StarIII technology              |
| General   | Frequency                              | L1, 1575.42 MHz                      |
|   | C/A code                               | 1.023 MHz chip rate                  |
|   | Channels                               | 20                                   |
| Accuracy  | Position                               | 10 meters, 2D RMS                    |
|   |  | 5 meters 2D RMS, WAAS enabled        |
|   |  | < 5meters(50%), DGPS corrected       |
|   | Velocity                               | 0.1 meters/second                    |
| Time  | 1 microsecond synchronized to GPS time |                                      |
| Datum   | Default                                | WGS-84                               |
|   | Other                                  | selectable for other Datum           |
| Time to First Fix<br>(Open Sky &<br>Stationary<br>Requirements) | Reacquisition                          | 0.1 sec., average                    |
|   | Snap start                             | 1 sec., average                      |
|   | Hot start                              | 8 sec., average                      |
|   | Warm start                             | 38 sec., average                     |
|   | Cold start                             | 42 sec., average                     |
| Dynamic<br>Conditions   | Altitude                               | 18,000 meters (60,000 feet) max.     |
|   | Velocity                               | 515 meters/second (1000 knots) max.  |
|   | Acceleration                           | Less than 4g                         |
|   | Jerk                                   | 20 meters/second <sup>3</sup> , max. |

# Specifications

|   |                      |  |
|---|----------------------|--|
| Power   | Main power input     | 3.3 ± 5%V DC input.                        |
|   | Power consumption    | Less than 250 mW (Continuous mode)         |
|   | Supply Current       | ≈75 mA (Continuous mode)                   |
|   | Backup Power         | See section 2.9 PIN DESCRIPTION Pin#7      |
| Serial Port                                     | Electrical interface | One full duplex serial TTL UART interface. |
|   | Protocol messages    | NMEA-0183@4800 bps (Default)               |
| Timemark-1PPS<br>Pulse(Customization<br>Device) | Level                | TTL  |
|   | Pulse duration       | 100ms                                      |
|   | Time reference       | At the pulse positive edge.                |
|   | Measurements         | Aligned to GPS second, ±1 microsecond      |

## 2.4. EXTERNAL BACKUP POWER CONDITIONS

| PARAMETER          | Symbol  | Min | Typ | Max | Units |
|--------------------|---------|-----|-----|-----|-------|
| RTC(Battery) Power | BATTERY |     | 2.0 | 5.0 | V     |
| Supply Current     |         |     | 15  |     | μA    |

## 2.5. SOFTWARE OPERATION CONDITION

| ITEMS                   | DESCRIPTION                      |                    |
|-------------------------|----------------------------------|--------------------|
| Core of firmware        | SiRF GSW version 3.0             |                    |
| Baud rate               | 4800 (Default)                   |                    |
| Code type               | NMEA-0183 ASCII                  |                    |
| Datum                   | WGS-84                           |                    |
| Protocol message        | GGA, GSA, GSV, RMC / per second. |                    |
| Output frequency        | 1 Hz                             |                    |
| Acquisition Sensitivity | Cold start                       | 28 dB-Hz (-143dBm) |
|                         | Warm start                       | 28 dB-Hz           |
|                         | Hot start (Standard)             | 15 dB-Hz           |
|                         | Tracking                         | -159 dB            |

## 2.6. COMMUNICATION SPECIFICATION

| PARAMETER         | SPECIFICATION     |
|-------------------|-------------------|
| Interface         | Simple UART       |
| Bit rate          | 4,800 bps         |
| Start bit         | 1 bit             |
| Stop bit          | 1 bit             |
| Data bit          | 8 bit             |
| Parity            | None              |
| Transmission data | NMEA 0183 Ver3.01 |

## 2.7. ENVIRONMENTAL CHARACTERISTICS

| ITEM                 | MINIMUM | MAXIMUM |
|----------------------|---------|---------|
| Operation conditions | -40     | +85     |
| Storage conditions   | -55     | +100    |

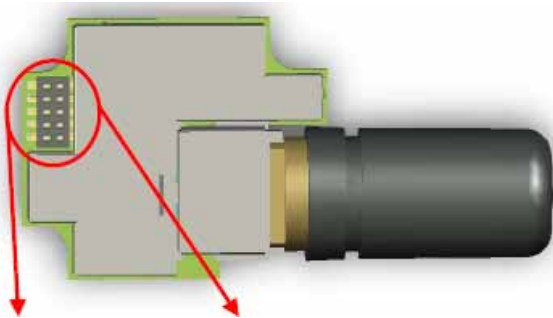
\* Operation humidity: 5 % to 90 % No condensing.

## 2.8. OTHER CHARACTERISTICS

|                          | ITEMS                 | DESCRIPTION  |
|--------------------------|-----------------------|--------------|
| Physical Characteristics | Length (with Antenna) | 52mm (2in)   |
|                          | Width                 | 25.6mm (1in) |
|                          | Weight                | ≈16g         |

## 2.9. PIN ASSIGNMENT AND DESCRIPTIONS

### 2.9.1 PIN ASSIGNMENT



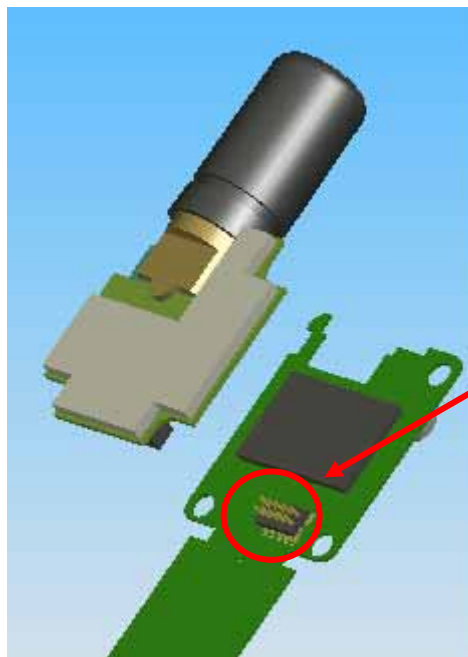
|   |       |        |    |
|---|-------|--------|----|
| 1 | GND   | GND    | 6  |
|   | VIN   | BATTEY |    |
|   | GND   | GND    |    |
|   | GND   | RX     |    |
| 5 | GPIO1 | TX     | 10 |

# Specifications

## 2.9.2 PIN DESCRIPTIONS

| PIN NO. | PIN NAME | I/O | REMARK  |
|---------|----------|-----|---|
| 1       | GND      |     | Ground.   |
| 2       | VIN      | I   | This is the main DC supply for a 3.3V $\pm$ 5% DC input power module board.   |
| 3       | GND      |     | Ground.   |
| 4       | GND      |     | Ground.   |
| 5       | GPIO1    | O   | User can use this I/O pin for special function. For example, ON/OFF LED   |
| 6       | GND      |     | Ground.   |
| 7       | BATTERY  | I   | This is the backup power input that powers the SRAM and RTC when main power is removed. Typical current draw is 15 $\mu$ A. 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 backup battery must be connected. The battery voltage should be between 2.0v and 5.0v. |
| 8       | GND      |     | Ground  |
| 9       | RX       | I   | This is the main receive channel for receiving software commands to the engine board from SiRFdemo software or from user written software.  |
| 10      | TX       | 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  |

### NOTE : BOARD TO BOARD CONNECTION



**Pin Header 1.27 mm (.050")  
Dual Row 2 $\times$ 5 H=2.0mm**

# Specifications

## 2.10. NMEA OUTPUT MESSAGES

### 2.10.1. SiRF NMEA Output Message

The unit output data is in NMEA-0183 format as defined by the *National Marine Electronics Association* (NMEA) Standard

### 2.10.2. Protocol of NMEA Message

This NMEA output message is designed to include:

**Start Sequence:** Start with character '\$' and behind it is the string representing message type.

**Payload:** Datum collected to output and being separated with comma.

**Checksum:** The value of checksum-algorithm.

|                |         |          |              |
|----------------|---------|----------|--------------|
| Start Sequence | Payload | Checksum | End Sequence |
|----------------|---------|----------|--------------|

### Checksum

The checksum is two-byte in the payload data. The following pseudo code defines the algorithm used.

*Let message to be the array of bytes to be sent by the transport.*

*Index = 1*

*hecksum = 0*

*while message[ Index != '\*' ]*

*hecksum ^= message[ index++ ]*

Checksum will skip the '\$' character and then be calculated one character by one character using XOR(EXCLUSIVE-OR) operator to do so until getting '\*'

**Example :**

### GGA—Global Positioning System Fixed Data

```
$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M,0.0,0000.18
```

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          |



# Specifications

|                               |      |        |                                   |
|-------------------------------|------|--------|-----------------------------------|
| E/W Indicator                 | W    |        | E=east or W=west                  |
| Position Fix Indicator        | 1    |        | <b>See Note</b>                   |
| Satellites Used               | 07   |        | Range 0 to 12                     |
| HDOP                          | 1.0  |        | Horizontal Dilution of Precision  |
| MSL Altitude <sup>1</sup>     | 9.0  | meters |                                   |
| Units                         | M    | meters |                                   |
| Geoid Separation <sup>1</sup> |      | 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        |

Note : 1.Values are WGS84 ellipsoid heights.

**Note:** 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     | GPS PPS Mode, fix valid               |

### 2.10.3. NMEA OUTPUT MESSAGES FORMAT

| MESSAGES   | DESCRIPTION                            |
|------------|--|
| <b>GGA</b> | Global positioning system fixed data   |
| <b>GSA</b> | GNSS DOP and active satellites         |
| <b>GSV</b> | GNSS satellites in view                |
| <b>RMC</b> | Recommended minimum specific GNSS data |

#### GGA —Global Positioning System Fixed Data

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

| 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  |

# Specifications

|                               |            |        |                                   |
|-------------------------------|------------|--------|-----------------------------------|
| Longitude                     | 12158.3416 |        | dddmm.mmmm                        |
| E/W Indicator                 | W          |        | E=east or W=west                  |
| Position Fix Indicator        | 1          |        | <b>See Note</b>                   |
| Satellites Used               | 07         |        | Range 0 to 12                     |
| HDOP                          | 1.0        |        | Horizontal Dilution of Precision  |
| MSL Altitude <sup>1</sup>     | 9.0        | meters |                                   |
| Units                         | M          | meters |                                   |
| Geoid Separation <sup>1</sup> |            | 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        |

6. Values are WGS84 ellipsoid heights.

**Note:** 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     | GPS PPS Mode, fix valid               |

## GSA—GNSS DOP and Active Satellites

\$GPGSA,A,3,07,02,26,27,09,04,15, , , , , 1.8,1.0,1.5\*33

| Name                        | Example | Units | Description                      |
|-----------------------------|---------|-------|----------------------------------|
| Message ID                  | \$GPGSA |       | GSA protocol header              |
| Mode 1                      | A       |       | See <b>Note1</b>                 |
| Mode 2                      | 3       |       | See <b>Note2</b>                 |
| Satellite Used <sup>1</sup> | 07      |       | Sv on Channel 1                  |
| Satellite Used <sup>1</sup> | 02      |       | Sv on Channel 2                  |
| .... ....                   |         |       |                                  |
| Satellite Used <sup>1</sup> |         |       | 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       |

6. Satellite used in solution.

# Specifications

**Note 1**

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

**Note2**

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

**GSV—GNSS Satellites in View**

\$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

| Name                            | Example | Units   | Description                           |
|---------------------------------|---------|---------|---------------------------------------|
| Message ID                      | \$GPGSV |         | GSV protocol header                   |
| Number of Messages <sup>1</sup> | 2       |         | Range 1 t o 3                         |
| Message Number <sup>1</sup>     | 1       |         | Range 1 t o 3                         |
| Satellites in View              | 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/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 (Maximum 90)                |
| 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            |

6. Depending on the number of satellites tracked multiple messages of GSV data may be required.

**RMC—Recommended Minimum Specific GNSS Data**

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

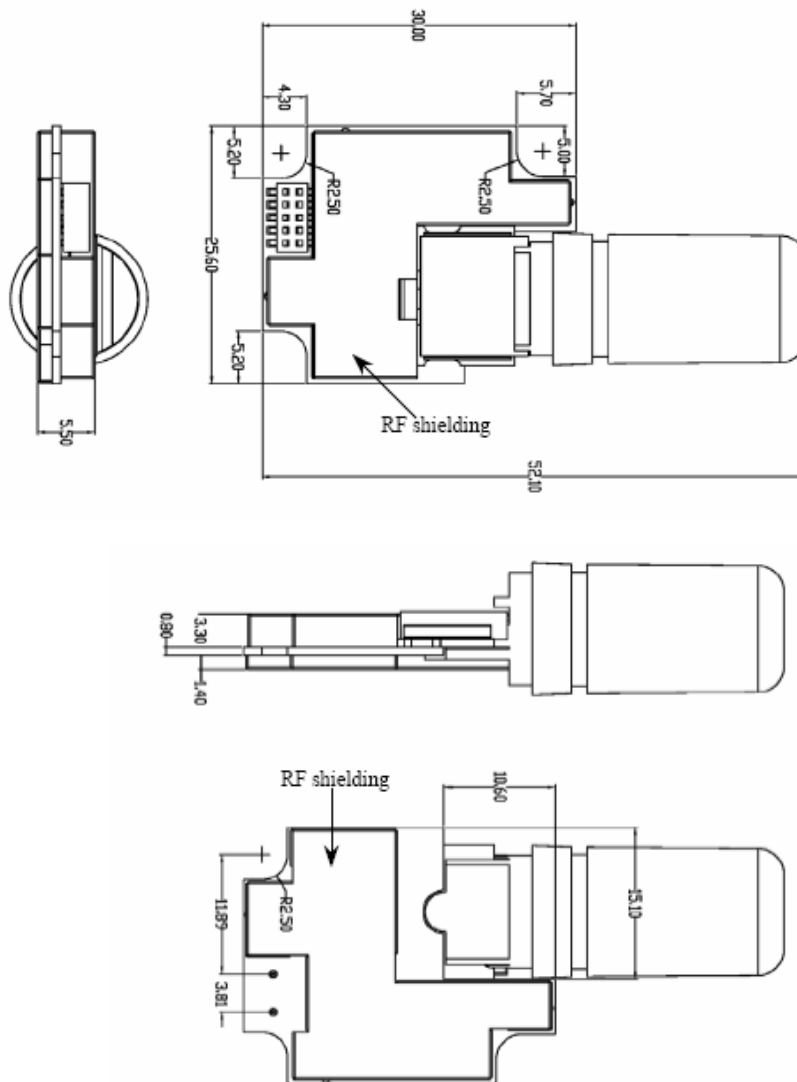
| Name       | Example    | Units | Description         |
|------------|------------|-------|---------------------|
| Message ID | \$GPRMC    |       | RMC protocol header |
| UTC Time   | 161229.487 |       | hhmmss.sss          |

# Specifications

|                                 |            |         |                                  |
|---------------------------------|------------|---------|----------------------------------|
| 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 <sup>1</sup> |            | degrees | E=east or W=west                 |
| Checksum *10                    |            |         |                                  |
| <CR> <LF>                       |            |         | End of message termination       |

1.All "course over ground" data are geodetic WGS84 directions.

### 3. DIMENSIONS

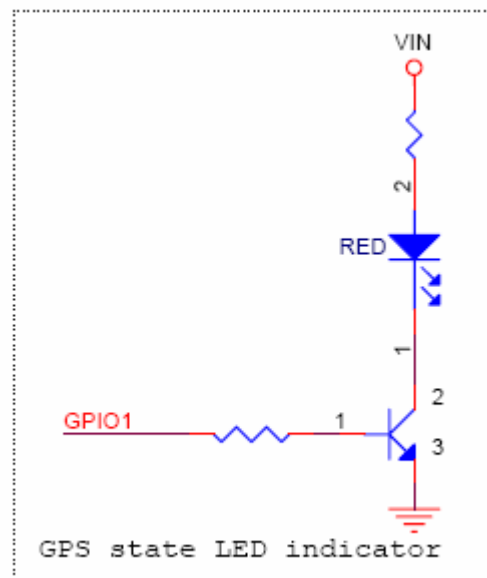
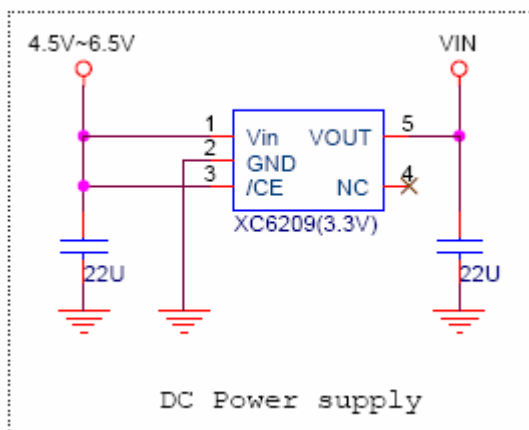
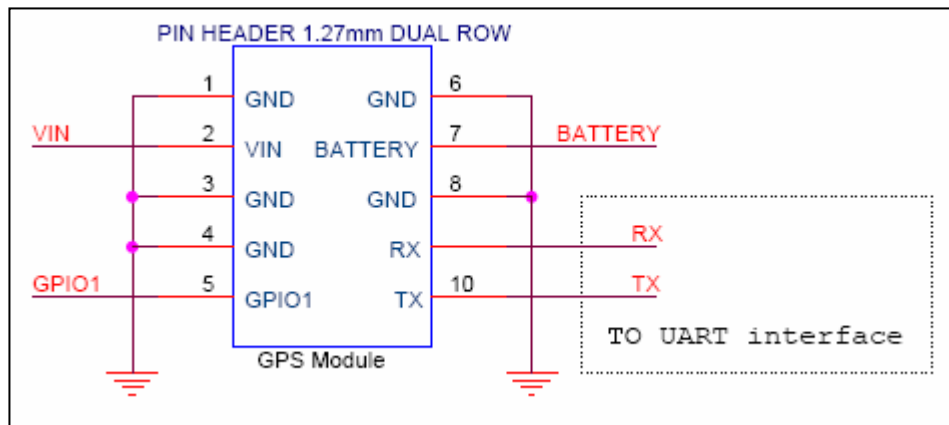
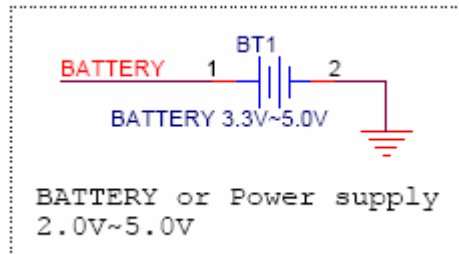


# Specifications

## 4. INTERFACE CONNECTOR

Female Header 1.27 mm (.050) Dual Row H=2.2 mm

## 5.REFERENCE DESIGN



# Specifications

## 6. BOARD TO BOARD SMT TYPE CONNECTOR

**PIN Header 1.27 mm (.050") Dual Row 2x5 H=2.0 mm**

