

## GPS Engine Board

### EB-5080

EB-5080 is a **19x16.2 mm** (0.75"x0.64") GPS engine that is to replace A1080 with much improved receiving sensitivity. EB-5080 provides superior navigation performance under dynamic conditions in areas with limited sky view like urban canyons.

Its high receiving sensitivity up to **-165dBm** for weak signal operation without compromising accuracy. With pin locations compatible to A1080, there is nearly no extra effort for your system to upgrade to latest high sensitivity GPS receiver available in the industry.

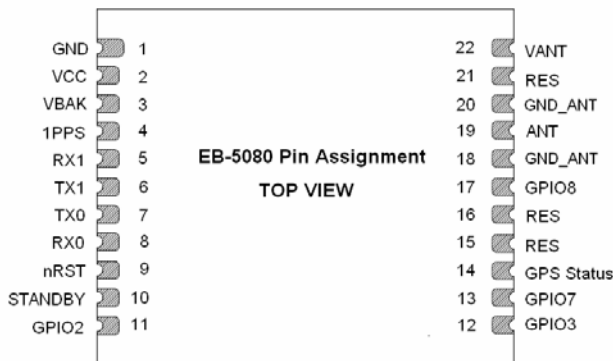
#### Key Features :

- Small form factor: 19x16.2 x 2.4 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm
- Tracks 66-Channel of satellites
- Fast Position Fix
- Low power consumption

#### Applications :

- Automotive and Marine Navigation / Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation

#### PIN Assignment :



# TRANSYSTEM INC.

An A+ supplier of RF microwave & GPS products

## Ultimate

## EB

**Revision History**

| Rev. | Date       | Description   |
|------|------------|---------------|
| 0.1  | 10-20-2010 | Initial draft |
|      |            |               |
|      |            |               |
|      |            |               |
|      | MM-DD-YYYY |               |

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EB-5080 is ESD (electrostatic discharge) sensitive device and may be damaged with ESD or spike voltage. Please handle with care to avoid permanent malfunction or performance degradation.

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## 1 Introduction

EB-5080 is a compact 19x16.2x2.4 mm<sup>3</sup> GPS engine board designed to replace A1080. It provides superior navigation performance under dynamic conditions in areas with limited sky view like urban canyons. High sensitivity up to -165dBm for weak signal operation and 66 channels of satellite tracking gives your product best GPS accuracy. EB-5080 is the best choice for embedded GPS receivers.

### 1.1 Key Features

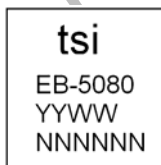
- Small form factor: 19x16.2x2.4 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm
- Tracks 66-channel of satellites
- Fast Position Fix
- 3.0~4.2V wide power range
- Low power consumption
- -40°C to 85°C operation range

### 1.2 Applications

- Automotive and Marine Navigation / Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation

### 1.3 Labeling

There are 4 lines of top marking on the GPS engine and they are :



Line #1: TSI company icon

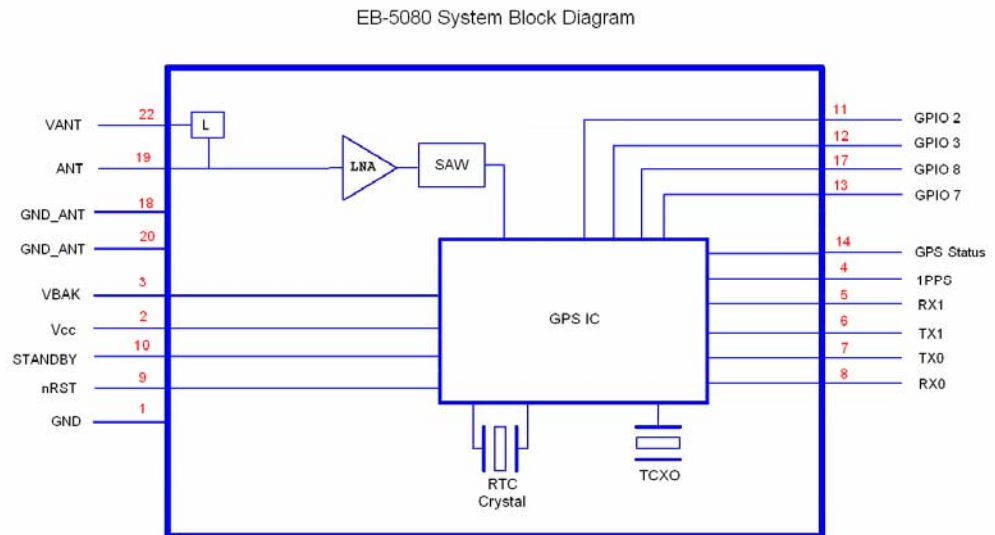
Line #2: Model number, i.e. EB-5080

Line #3: Date code, the year and week when the product is built.

Line #4: Lot control code for TSI internal use

## 2 Technical Description

### 2.1 Block Diagram



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## 2.2 Pin Definition

| Pin# | Name       | Type | Description  |
|------|------------|------|--|
| 1    | GND        | P    | Power ground   |
| 2    | VCC        | P    | 3.0~4.2 VDC  |
| 3    | VBAK       | P    | Back-up power with "super cap" or battery, 2.0~4.3VDC                  |
| 4    | 1PPS       | O    | 1PPS output  |
| 5    | RX1        | I    | Serial input 1   |
| 6    | TX1        | O    | Serial output 1  |
| 7    | TX0        | O    | Serial output 0, default NMEA output                                   |
| 8    | RX0        | I    | Serial input 0, default NMEA input                                     |
| 9    | nRST       | I    | Input, active low to reset module                                      |
| 10   | STANDBY    | I    | Input, falling edge to put GPS to standby mode, leave open if not used |
| 11   | GPIO 2     | I/O* | Reserved – leave open if not used                                      |
| 12   | GPIO 3     | I/O* | Reserved – leave open if not used                                      |
| 13   | GPIO 7     | I/O* | Reserved – leave open if not used                                      |
| 14   | GPS Status | O    | Output, blinking when GPS has position fix                             |
| 15   | Res.       | N/A  | Reserved – leave open  |
| 16   | Res.       | N/A  | Reserved – leave open  |
| 17   | GPIO 8     | I/O* | Reserved – leave open if not used                                      |
| 18   | GND_ANT    | P    | Antenna Ground, connect to antenna shield                              |
| 19   | ANT        | I    | Antenna signal / Z=50 Ohm  |
| 20   | GND_ANT    | P    | Antenna Ground, connect to antenna shield                              |
| 21   | Res.       | N/A  | Reserved – leave open  |
| 22   | VANT       | P    | Antenna power supply, 0~5V   |

P: Power I: Input O: Output I/O: Input or Output

## 2.3 General Comment

Following comments should be considered for a design using EB-5080 module:

- Serial port default configuration: 9600 baud, 8 data bits, no parity, 1 stop bit, no flow control
- Antenna: Use antenna ground pins (pin #18, pin #20) close to the antenna input for RF ground.

# EB-5080 Data Sheet

## 2.4 Specifications

| <i>Item</i>                   | <i>Description</i>   |
|-------------------------------|--|
| <b>General</b>                | L1 frequency, C/A code (SPS)<br>66 independent tracking channels             |
| <b>Sensitivity*</b>           | -165dBm /Tracking; -148dBm /Acquisition                                      |
| <b>Update Rate</b>            | Up to 10Hz   |
| <b>Accuracy</b>               | <3m CEP (50%) without SA<br>2.5m DGPS (WAAS, EGNOS, MSAS, RTCM)              |
| <b>Acquisition (open sky)</b> | Cold Start: 35sec<br>Warm Start: 34sec<br>Hot Start: 1.5sec                  |
| <b>Reacquisition</b>          | < 1sec   |
| <b>Dynamics</b>               | Altitude: 18000m (max.)<br>Velocity: 515m/sec (max.)<br>Vibration: 4G (max.) |
| <b>NMEA</b>                   | NMEA0183 v3.1<br>GGA, GSA, GSV, RMC ( Default ) / GLL, VTG (Optional )       |
| <b>Datum</b>                  | Default WGS-84   |
| <b>Antenna</b>                | External active or passive antenna   |
| <b>Power Supply</b>           | DC 3.0V ~ 4.2V   |
| <b>Current</b>                | 35mA @ 3.3V / Tracking   |
| <b>Interface</b>              | UART, Baud rate : 4800/9600( Default )/.../115200                            |
| <b>Mounting</b>               | SMT  |
| <b>Dimension</b>              | 19x16.2x2.4 mm (0.75"x0.64"x0.095")  |
| <b>Operating Temp.</b>        | -40°C to 85°C  |
| <b>Storage Temp.</b>          | -40°C to 85°C  |
| <b>Operating Humidity</b>     | ≤95%, non condensing   |



## 3 Electrical Characteristics

### 3.1 Absolute maximum ratings

| Symbol | Parameter  | Min  | Max  | Unit |
|--------|--|------|------|------|
| Vcc    | power supply   | -0.3 | +4.2 | V    |
| Vin    | voltage to any pin   | -0.3 | +3.6 | V    |
| Iov    | input current on any pin                                     | -10  | 10   | mA   |
| Itdv   | absolute sum of all input currents during overload condition |      | 200  | mA   |
| Tst    | storage temperature  | -40  | 85   | °C   |
| Vant   | antenna supply voltage                                       | 0    | 5.5  | V    |
| Iant   | antenna supply current                                       | 0    | 50   | mA   |

Table 5: Absolute maximum ratings

**Note:**

- (1) Stresses beyond absolute maximum ratings may cause permanent damage to the device.
- (2) Exposure to absolute maximum rating conditions for extended period may affect device reliability.

### 3.2 Operating Conditions

| Pin | Description                  | Min  | Typical | Max  |
|-----|------------------------------|------|---------|------|
| 15  | Vbak                         | 2.0V |         | 4.3V |
|     | Standby Current (1)          |      | 20µA    |      |
| 3   | Vcc                          | 3.0V | 3.3V    | 4.2V |
|     | Peak Acquisition Current (2) |      |         | 30mA |
|     | Tracking Current (3)         |      | 23mA    |      |

Table 6: Electrical characteristics

**Note:**

- (1) During standby state: RTC block and core powered on and clock off.
- (2) Peak acquisition current is the maximum current with passive antenna.
- (3) Tracking current is the average current with passive antenna includes tracking and post acquisition portion.

### 3.3 DC Electrical Characteristics

| Symbol                                   | Parameter      | Min  | Max | Unit |
|--|----------------|------|-----|------|
| 1PPS, GPS Status, TX1, TX0, GPIO 2,3,7,8 | Voh            | 2.4  | 3.9 | V    |
|  | Vol            | -0.3 | 0.4 | V    |
| RX1, RX0, STANDBY                        | Vih            | 2.0  | 3.6 | V    |
|  | Vil            | -0.3 | 0.8 | V    |
| nRST                                     | for safe reset |      | 0.2 | V    |

## 4 Serial Port Interface

EB-5080 provides 2-wire digital UART port for communication of GPS position data using NMEA protocol or MTK extension protocol. UART port is capable of 4800 to 115200 baud rate.

### 4.1 Protocol

EB-5080 is default to support standard NMEA-0183 protocol. In addition, a series of MTK extensions (PMTK messages) have been developed that can be used to provide extended capabilities common to many applications. Please refer to “GPS Engine Board UART Port Command” for detailed command information.

#### 4.1.1 NMEA Protocol

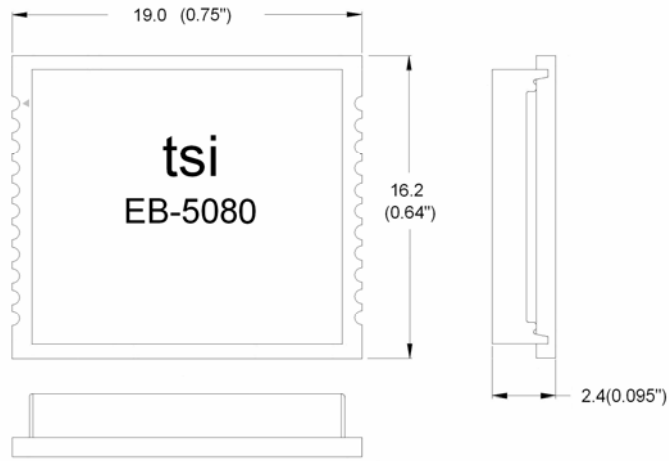
EB-5080 is capable of supporting following NMEA formats:

| NMEA Prefix | Format                                   | Direction |
|-------------|--|-----------|
| \$GPGGA     | GPS fix data                             | Out       |
| \$GPGLL     | Geographic position Latitude / Longitude | Out       |
| \$GPGSA     | GNSS DOP and active satellites           | Out       |
| \$GPGSV     | Satellites in view                       | Out       |
| \$GPRMC     | Recommended minimum specific GNSS data   | Out       |
| \$GPVTG     | Velocity and track over ground           | Out       |
| \$GPZDA     | Date and time                            | Out       |

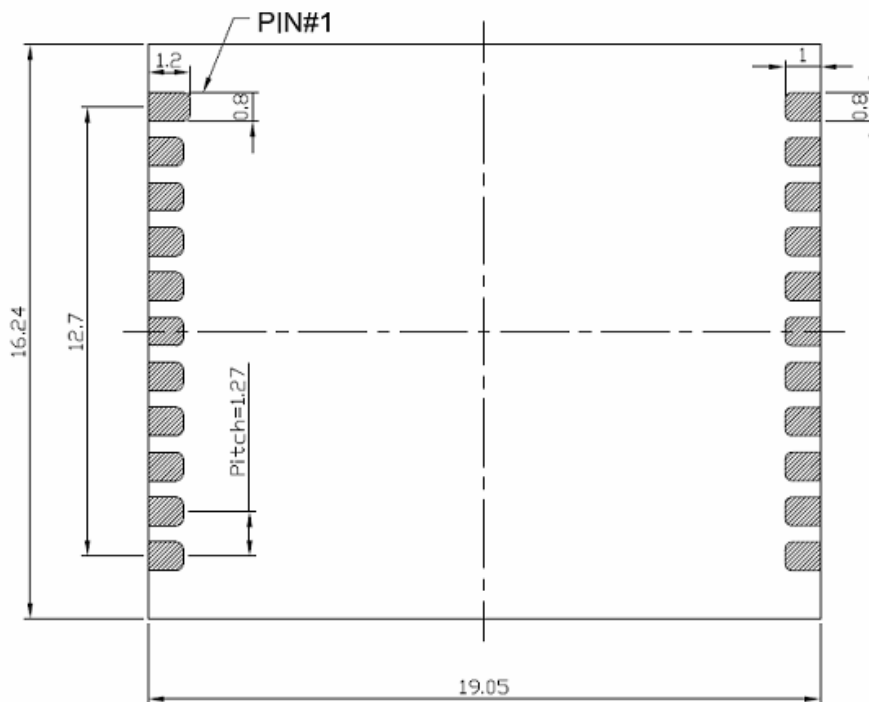
# EB-5080 Data Sheet

## 5 Dimension and Package

### 5.1 Mechanical Dimension



### 5.2 Recommend Layout Pattern

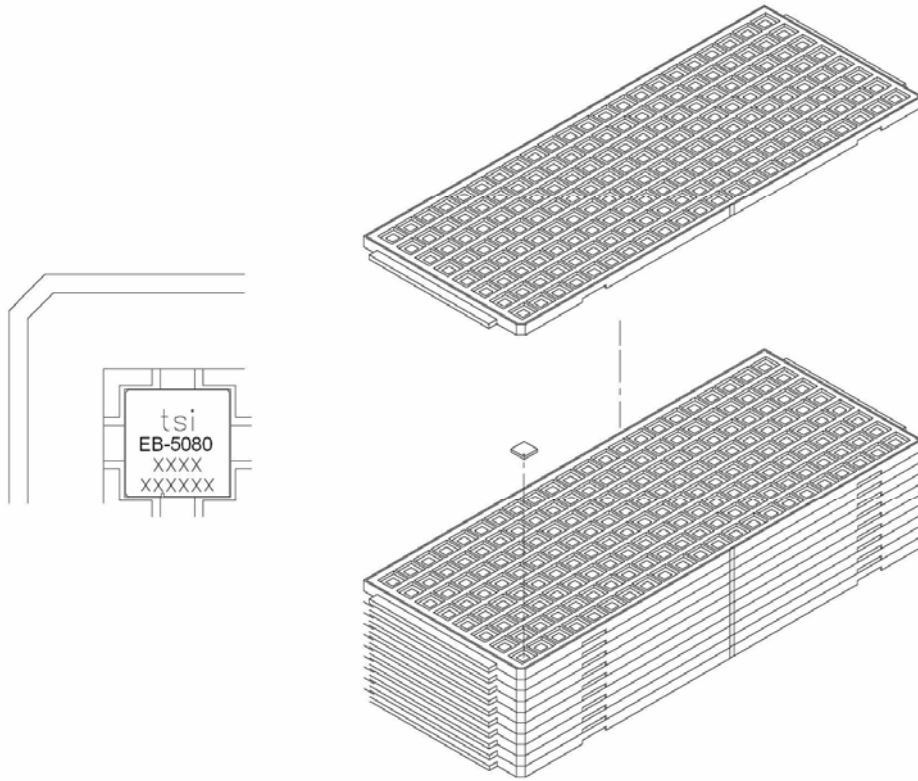


Solder pad size (outer pads): 1.0 x 0.8  
ALL dimensions in [mm,(inch)]  
EB-5080 Layout Pattern

# EB-5080 Data Sheet

## 5.3 Packing

EB-5080 GPS modules come in tray package suitable for pick and place machines. Each tray contains total 96 pieces of EB-5080 and maximum 10 trays are stacked together before sealed in ESD protective vacuum dry pack to provide protection against moisture and ESD during storage and shipment.



# EB-5080 Data Sheet

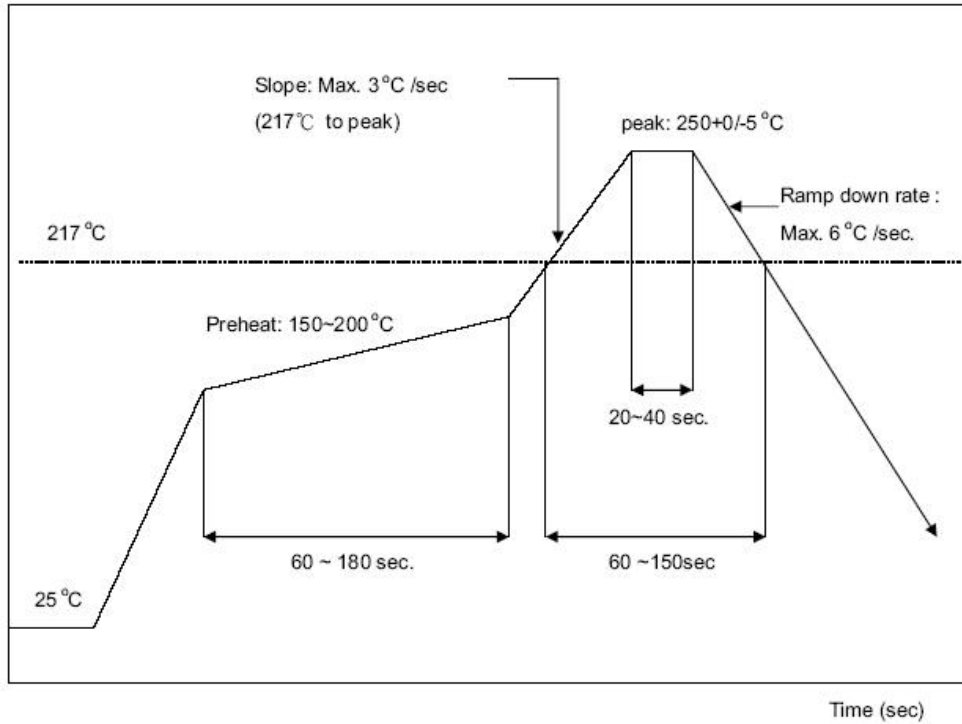
## 6 Recommended IR Profile

Follow below IR profile for reflow during SMT assembly for EB-5080.

Ramp-down rate : 6 °C /sec. max.

Time 25 °C to peak temperature : 8 minutes max.

Cycle interval : 5 minus

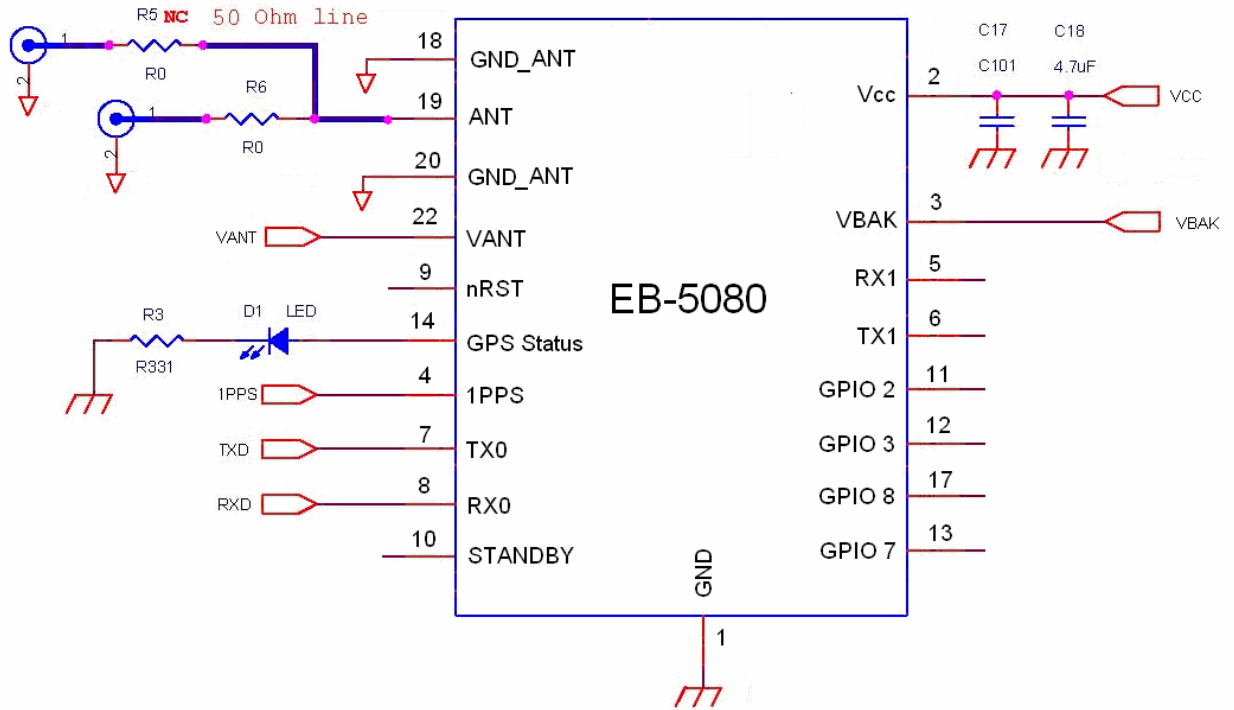


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# EB-5080 Data Sheet

## 7 Application Information

### 7.1 Minimum Configuration



## 7.2 General Antenna Selection

In general, GPS antenna plays a very important role in the overall quality / sensitivity of the GPS system. Losses through a bad antenna or long cable or un-matched trace or a bad antenna position can't be compensated afterwards.

## 7.3 Connection to Antenna

GPS antenna plays a very important role in the overall quality / sensitivity of the GPS system. Losses through a bad antenna or long cable or un-matched trace or a bad antenna position can't be compensated afterwards.

Following points should be followed when connecting RF signal to EB-5080 ANT pin (pin #19).

- Use 50Ω PCB strip line
- Keep the strip line as short as possible
- Route antenna ground (GND\_ANT) to the ground plane of the PCB by via
- Receiving frequency  $1575.42 \pm 1.032\text{MHz}$
- Polarization RHCP (right hand circular polarized)

When using active antenna, please follow below points:

- Supply voltage to VANT pin (5V max.)
- Supply current 50mA (max.)
- Gain  $\geq 20\text{dB}$  (should not exceed 35dB)
- Noise figure  $\leq 1.5\text{dB}$

## 7.4 Improved TTFF

In order to improve the TTFF (Time To First Fix), it is recommended to support the RTC with a back-up power supply when no system power is available. (see section 7.8 Battery Back-up).

## 7.5 VANT Pin (antenna voltage input pin)

The supply voltage for active GPS antenna on the ANT port has to be fed into the VANT pin (pin #20). The maximum current is 50 mA. Short circuit between VANT and GND may damage the EB-5080 GPS receiver module. Caution should be taken to avoid it or by use of antenna current limiter if needed.

## 7.6 1PPS pin

GPS also provides accurate timing information due to the synchronized atomic clocks in the GPS satellites. In addition to the current date and time is transmitted in NMEA sentences (UTC), an accurate timing signal is provided via the 1PPS pin (pin #4) of the EB-5080 GPS receiver.

Under good signal conditions the 1PPS signal comes between 620ns and 710ns after the full GPS system second which is accurately (around 10ns) synchronized to UTC. Therefore the 1 second clock can be derived and maintained within around 90ns under good signal conditions.

The 1PPS signal accuracy directly relates to the position accuracy. The GPS signals travel at the speed of light, therefore a position inaccuracy directly translates into 1PPS inaccuracies.

10 m position deviation  $\approx$  33 ns 1PPS deviation (typically)

100 m position deviation  $\approx$  333 ns 1PPS deviation (typically)

The 1PPS signal is provided on an “as it is” basis with no accuracy specification.

## 7.7 Reset Signal

The nRST pin (pin #9) can be used to reset the EB-5080 module. Resetting the module will result in a restart of the complete firmware.

The EB-5080 is equipped with a voltage monitoring circuit that generates a proper power-on reset signal at the appropriate threshold and delay. Usually there is no need to deal with the reset input externally, thus the general advice is to leave this pin open.

## 7.8 Battery Back-up

VBAK input (pin #3) provides back-up power for the RTC and SRAM of the GPS receiver module. Typical quiescent current  $<1.2\mu\text{A}$  allows the use of a separate battery or a “Supercap”. The VBAK pin draws 3mA maximum under normal operation.



## 7.9 General GPS Receiver User's Tips

In general, GPS receiver performs best in open space where it can see clean sky. Weather condition will affect GPS reception – rain & snow contribute to worsen sensitivity.

If the satellite signals can not be locked or experiencing receiving problem (while in urban area), following steps are suggested:

- Use of external active antenna if that option exists.
- Move to another open space or reposition GPS receiver toward the direction with least blockage.
- Move the GPS receiver away from the interference sources.
- Wait until the weather condition is improved.

Some vehicles using heavy metallic sun protecting coating on windshields may affect GPS signal reception.

- Driving in and around high buildings may affect signal reception.
- Driving in tunnels or in building structure may affect signal reception.
- When GPS receiver is moving, it will take longer time to get position fix. Wait for satellite signals to be locked at a fixed point when first power-on the GPS receiver to ensure quick GPS position fix.

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## 8 Quality and Reliability

Each module is electrically tested prior to packing and shipping to ensure state of the art product quality and best GPS receiver performance and accuracy.

### 8.1 Environmental Conditions

|  |                                |
|--|--------------------------------|
| Operating temperature                  | -40 ~ +85°C                    |
| Operating humidity                     | Max. 95%, non-condensing       |
| MSL JEDEC (Moisture Sensitivity Level) | 3                              |
| Storage temperature                    | -40 ~ +85°C                    |
| Storage                                | 12 months in original package. |

### 8.2 How to avoid ESD damage

- Any person handling the module should be grounded either with a wrist strap or ESD-protective footwear used in conjunction with a conductive or static-dissipative floor or floor mat.
- The work surface where devices are placed for handling, processing, testing, etc., must, be made of static-dissipative material and be grounded to ESD ground.
- All insulator materials must either be removed from the work area or must be neutralized with an ionizer. Static-generating clothing must be covered with an ESD-protective smock.
- When module are being stored, transferred between operations or workstations, or shipped, they must be kept in a Faraday shield container with inside surfaces (surfaces touching the module) that are static-dissipative.

# EB-5080 Data Sheet

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