GPS Engine Board

EB-870A

EB-870A is an ultra miniature 10.5 x10.4 mm^2 GPS and GLONASS engine board. 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 without compromising accuracy.
EB-870A series is your best choice for embedded applications.

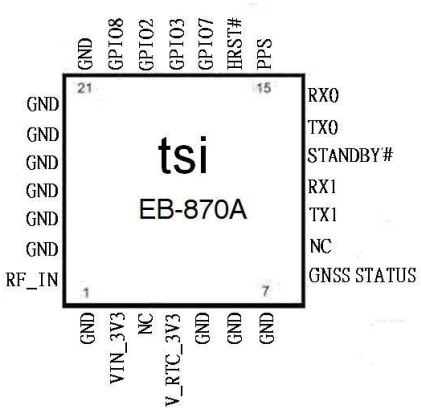
Key Features :

- Small form factor: 10.5 x 10.4 x 2.0 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm (With external LNA)
- Tracks 99-Channel of satellites
- Support multi-GNSS including. QZSS, SBAS
- WAAS/EGNOS/MSAS/GAGAN supported
- RTCM ready
- AlwaysLocate™ location awareness technology
- EPO™ / HotStill™ orbit prediction
- EASY™ self-generated orbit prediction
- Fast Position Fix
- Ultra low power consumption
- FCC E911 compliance and A-GPS support

Applications :

- Handheld devices
- Automotive and Marine Navigation
- Automotive Navigator Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation
- Embedded applications: PDA, DSC, Smart phone, UMPC, PND, MP4

PIN Definition :



RoHS Compilant

ELECTROSTATIC SENSITIVE DEVICES

Revision History

Rev.	Date	Description
0.5	11-09-2012	Modify Standby current
0.4	09-25-2012	Update V_RTC Quiescent Current info
0.3	08-28-2012	Revise GPS / GLONASS description
0.2	08-27-2012	Update GNSS status
0.1	08-22-2012	Initial draft
	MM-DD-YYYY	

EB-870A 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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Table of Contents

1 Introduction

EB-870A is an ultra miniature 10.4 x10.5mm^2 GPS and GLONASS engine board with added features. 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 without compromising accuracy. EB-870A is your best choice for embedded applications.

1.1 Key Features

- Small form factor: 10.4 x 10.5 x 2.0 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm (with external LNA)
- Tracks 99-Channel of satellites
- Fast Position Fix
- Ultra low power consumption
- AlwaysLocate™ location awareness technology
- EPO™ / HotStill™ orbit predition
- EASY™ self-generated orbit prediction

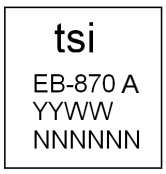
1.2 Applications

- Handheld devices
- Automotive and Marine Navigation
- Automotive Navigator Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation
- Embedded applications such as: PDA, DSC, Smart phone, UMPC, PND, MP4

1.3 Look & Feel

1.4 Labeling

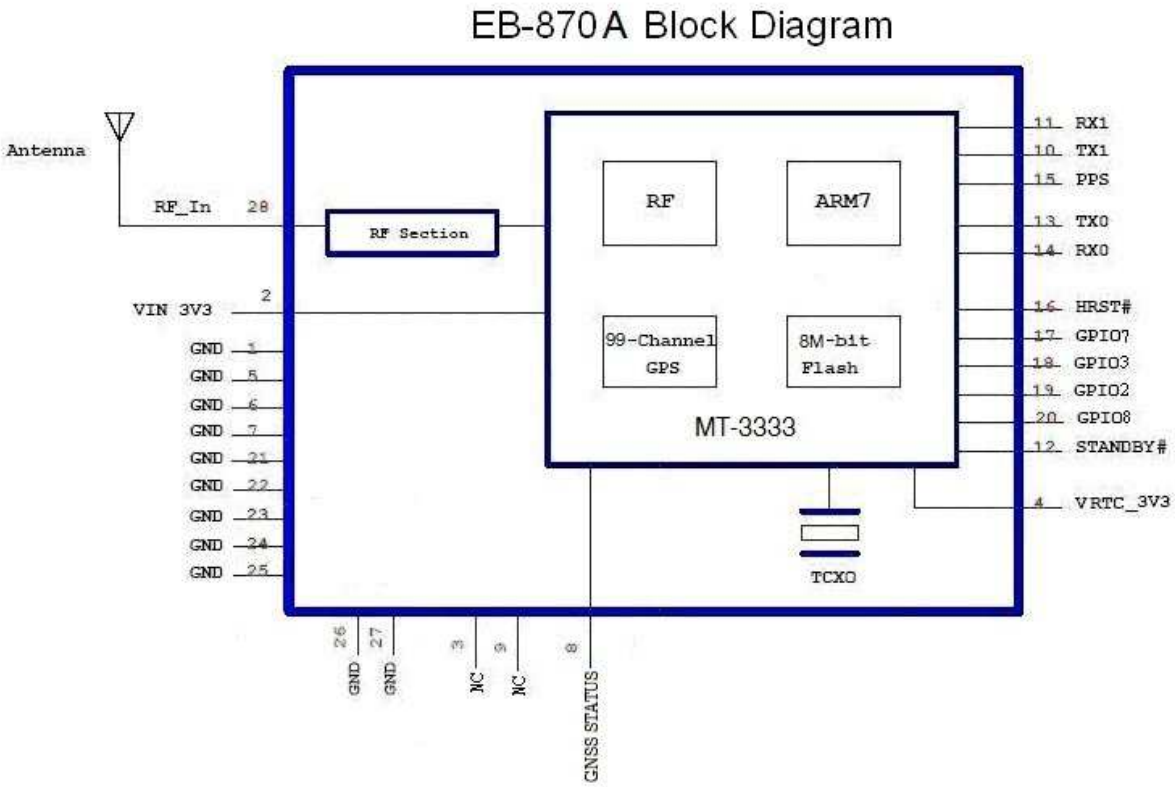
There are 4 lines of top marking on the GPS engine and they are :



Line #1: TSI company icon
Line #2: Model number, i.e. EB-870A
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



2.2 Pin Definition

Pin#	Signal Name	Type	Description
1	GND	P	Ground
2	VIN_3V3	P	Power Supply 2.8~4.2V DC
3	NC	NC	NC
4	VRTC_3V3	P	RTC power 2.0~4.2V, 40uA @ 3.3V typical
5	GND	P	Ground
6	GND	P	Ground
7	GND	P	Ground
8	GNSS Status	O	GNSS status, blink when GPS or GLONASS has position fix
9	NC	NC	NC
10	TX1	O	UART port 1 output, leave open if not used
11	RX1	I	UART port 1 input (RTCM only), leave open if not used
12	STANDBY#	I	Falling edge trigger. Back to High for normal operation. Leave open if not used
13	TX0	O	UART port 0 for NMEA output
14	RX0	I	UART port 0 input
15	PPS	O	PPS
16	HRST#	I	Reset input, active low. Internal pull high, leave open if not used
17	GPIO3 / SO	I/O*	General input / output ; SPI serial output, leave open if not used
18	GPIO4 / SCK	I/O*	General input / output ; SPI clock output, leave open if not used
19	GPIO5 / SCS#	I/O*	General input / output ; SPI select, active low, leave open if not used
20	GPIO2 / SI	I/O*	General input / output ; SPI serial input, leave open if not used
21	GND	P	Ground
22	GND	P	Ground
23	GND	P	Ground
24	GND	P	Ground
25	GND	P	Ground
26	GND	P	Ground
27	GND	P	Ground
28	RF_IN	I	Antenna port, L1 band 1573MHz ~1610MHz DC O/P: 2.8V Current ≦ 25mA

Note : 1) P: Power, I: Input, O: Output, I/O: Input or Output
2) GPIO current output default：4mA, Max ：16mA

2.3 Specifications

Item	Description
General	L1 frequency, C/A code (SPS) 99 independent tracking channels
Sensitivity	-165dBm /Tracking; -148dBm /Acquisition
Update Rate	Up to 10Hz
Accuracy	Without aid: 3.0m 2D-RMS <3m CEP (50%) without SA (horizontal) DGPS (WAAS, EGNOS, MSAS, RTCM): 2.5m
Acquisition (open sky)	Cold Start: <35sec Warm Start: <34sec Hot Start: <1.5sec
Reacquisition	< 1sec
Dynamics	Altitude：18000m（max.） Velocity：515m/sec（max.） Vibration：4G（max.）
Supply Voltage	DC 2.8~4.2 V
Power Consumption	< 20 mA @ 3.3V (w/o Active ANT) / Tracking
Backup Battery	DC 2.0~4.2V, 40 uA@3.3V typical
NMEA Message	NMEA0183 v4.1 GGA, GSA, GSV, RMC (Default) / GLL, VTG (Optional) Baud rate 4800/9600/…/115200, default 9600
Datum	Default WGS-84
Antenna	External Active Antenna Output Voltage: 2.8 VDC or Passive Antenna
Serial Interface	UART
Operating Temp.	-40℃ to 85℃
Storage Temp.	-40℃ to 85℃
Operating Humidity	≦95%, non condensing
Mounting	SMT Type, 28 Pin
Dimension	10.5 x 10.4 x 2.0(H) mm

3 Electrical Characteristics

3.1 Absolute maximum ratings

Symbol	Parameter	Min	Max	Unit
Vcc	power supply	-0.3	+4.3	V
Vin	voltage to any pin	-0.3	+3.6	V
Iov	input current on any pin	-10	10	mA
Tst	storage temperature	-40	85	°C
Iant	antenna supply current		30	mA

Table 3-1 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	Unit
4	V_RTC_3V3	2	4	4.3	V
	Tracking Current (2)		40		uA
2	VIN_3V3	2.8	3.3	4.3	V
	Peak Acquisition Current (1)			25	mA
	Tracking Current (2)		18		mA
	Standby Current		0.3		mA

Table 3-2 Operating Conditions

Note:
(1) Peak acquisition current is the maximum current with passive antenna.
(2) 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, GNSS Status, TX1, TX0, GPIO 2,3,4,5	Voh	0.85*VDDIO		V
	Vol		0.15*VDDIO	V
RX1, RX0, STANDBY#, HRST#	Vih	0.75*VDDIO	VDDIO+0.3	V
	Vil	-0.3	0.25*VDDIO	V

Table 3-3 DC Electrical characteristics

Note:
(1) The typical of VDDIO is 2.8V

4 Serial Port Interface

EB-870A provides 2- wire digital UART port for communication of GPS / GLONASS position data using NMEA protocol or MTK extension protocol. UART port is capable of 4800 to 115200 baud rate.

4.1 Protocol

EB-870A 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.

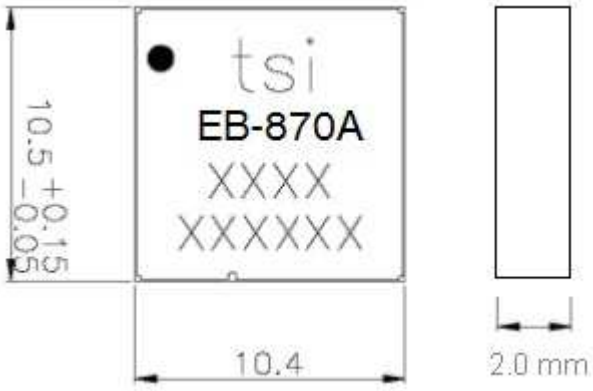
4.1.1 NMEA Protocol

EB-870A is capable of supporting following NMEA formats:

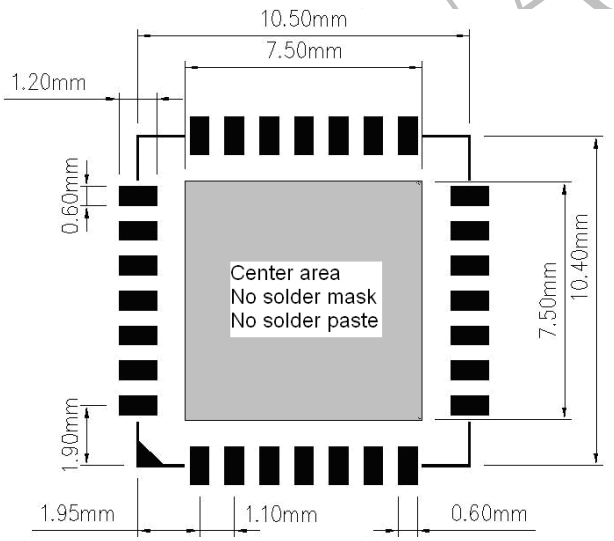
NMEA Prefix	Format	Direction
$GPGGA	GPS fix data	Out
$GPGLL	Geographic position Latitude / Longitude	Out
$GNGSA	GNSS DOP and active satellites	Out
$GPGSV	GPS Satellites in view	Out
$GPRMC	Recommended minimum specific GNSS data	Out
$GPVTG	Velocity and track over ground	Out
$GPZDA	Date and time	Out
$GLGSV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

5 Dimension and Package

5.1 Mechanical Dimension



5.2 Recommend Layout Pattern



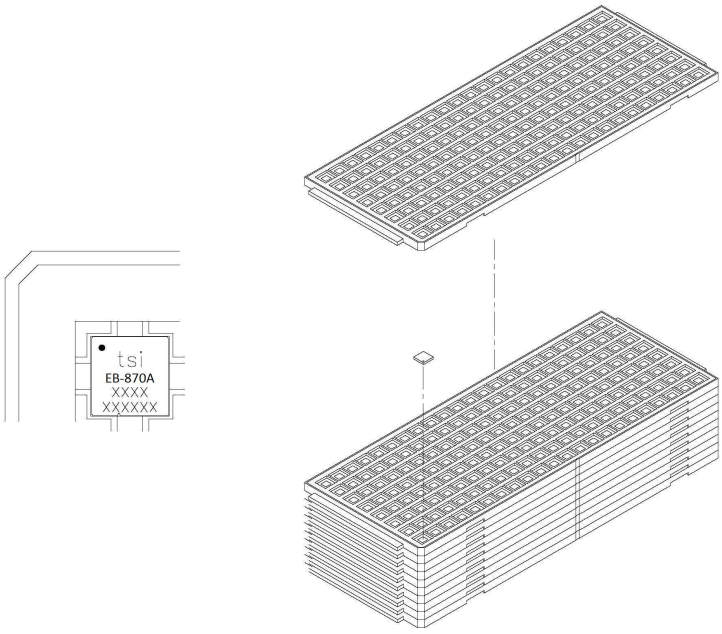
5.3 PIN Coordinates

Unit:mm

Pin #	X	Y	Pin #	X	Y
1	0.00	0.00	15	6.60	10.40
2	1.10	0.00	16	5.50	10.40
3	2.20	0.00	17	4.40	10.40
4	3.30	0.00	18	3.30	10.40
5	4.40	0.00	19	2.20	10.40
6	5.50	0.00	20	1.10	10.40
7	6.60	0.00	21	0.00	10.40
8	8.55	1.90	22	-1.95	8.50
9	8.55	3.00	23	-1.95	7.40
10	8.55	4.10	24	-1.95	6.30
11	8.55	5.20	25	-1.95	5.20
12	8.55	6.30	26	-1.95	4.10
13	8.55	7.40	27	-1.95	3.00
14	8.55	8.50	28	-1.95	1.90

5.4 Package

EB-870A GPS modules come in tray package suitable for pick and place machines. Each tray contains total 168 pieces of EB-870A 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.



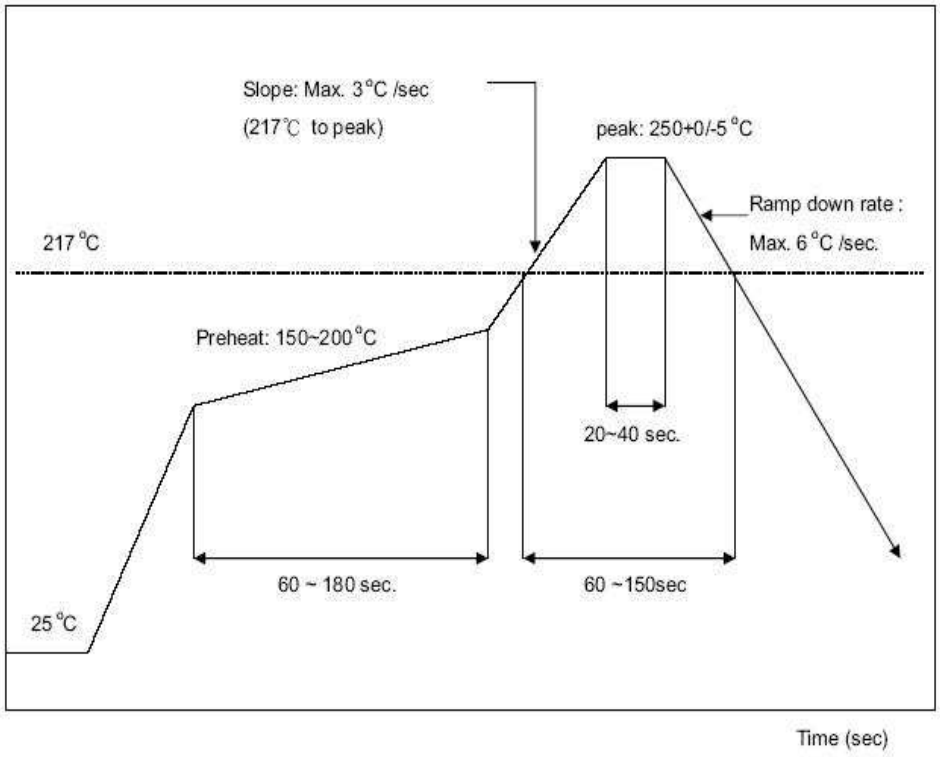
6 Recommended IR Profile

Follow below IR profile for reflow during SMT assembly for EB-870A.

Ramp-down rate : 6 °C /sec. max.

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

Cycle interval : 5 minus



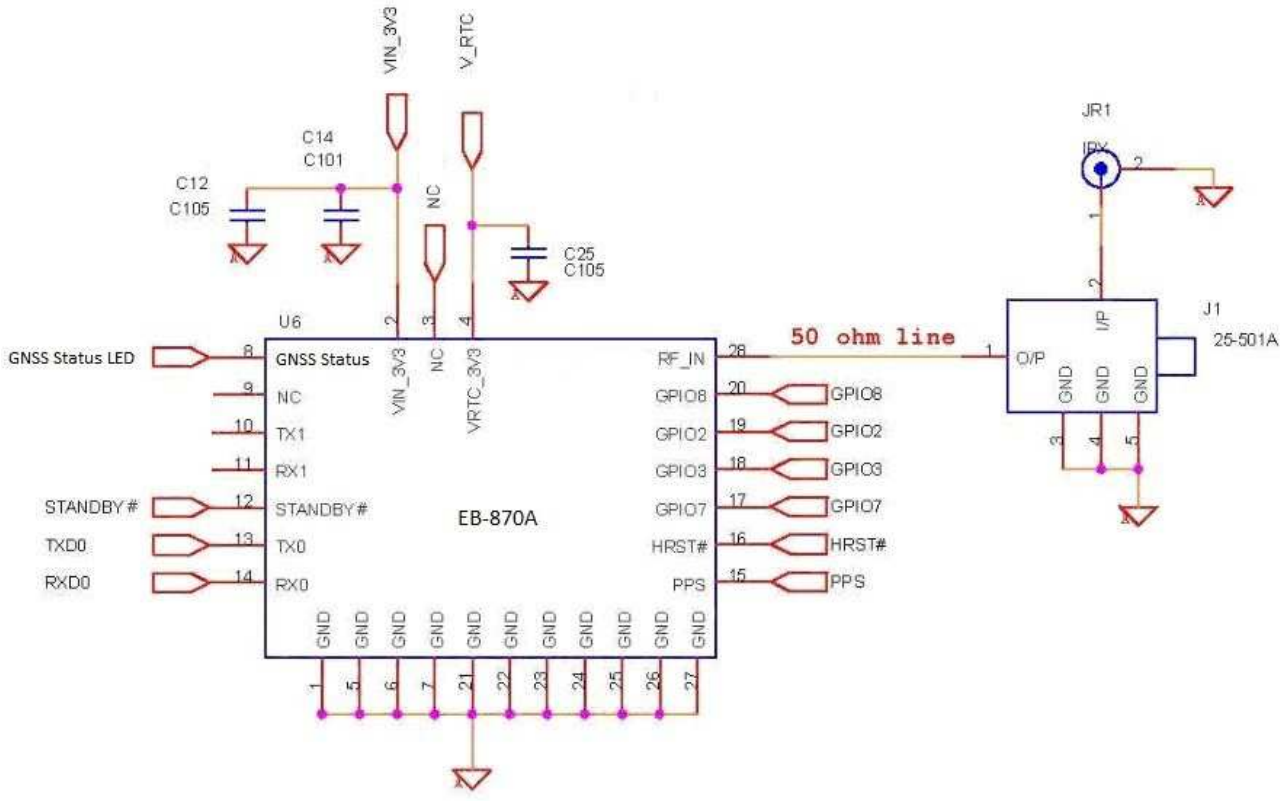
7 Application Information

7.1 GPS / GLONASS Antenna Recommendations

Follow below recommendations when choosing GPS / GLONASS dual band antenna for EB-870A for best system performance. Transystem also offers active antenna products for optimal performance with EB-870A. For details, please contact your Transystem sales contact directly.

- Use active antenna that works with 2.8V power supply
- Receiving frequency 1573MHz ~ 1610MHz
- Polarization RHCP (right hand circular polarized)
- Output impedance = 50 Ohm
- 15dB ≦ LNA Gain ≦ 20dB
- Noise figure ≦ 1.5dB
- Connector: surface mounted on main PCB, Ipex or MMCX

7.2 Application Circuit



【Note 1】: VRTC_3V3 (pin#4) could connect to 3.3V DC power supply or battery directly. (EB-870A)

7.3 PPS pin

EB-870A also provides accurate timing information due to the synchronized atomic clocks in the GPS / GLONASS satellites. In addition to the current date and time is transmitted in NMEA sentences (UTC), an accurate timing signal is provided via the PPS pin (pin #15) of the EB-870A GPS / GLONASS 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 / GLONASS signals travel at the speed of light, therefore a position inaccuracy directly translates into 1PPS inaccuracies.

10 m position deviation ≈ 33 ns 1PPS deviation (typically)
100 m position deviation ≈ 333 ns 1PPS deviation (typically)

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

7.4 Reset Signal

The HRST# pin (pin #16) can be used to reset the EB-870A module. Resetting the module will result in a restart of the complete firmware.

The EB-870A 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.

7.5 Battery Back-up

VRTC_3V3 input (pin #4) provides back-up power for the RTC and SRAM of the GPS / GLONASS receiver module. Typical quiescent current 2uA allows the use of a separate battery or a “Supercap”. The VRTC_3V3 pin draws 40uA typical under normal operation

7.6 General GPS / GLONASS Receiver User's Tips

In general, GPS / GLONASS receiver performs best in open space where it can see clean sky. Weather condition will affect satellite signals 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 / GLONASS receiver toward the direction with least blockage.
- Move the GPS / GLONASS 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 satellite signals reception.

- Driving in and around high buildings may affect signal reception.
- Driving in tunnels or in building structure may affect signal reception.
- When GPS / GLONASS 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 / GLONASS receiver to ensure quick position fix.

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 / GLONASS 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 to module

- 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.

Contact Information

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