GPS Engine Board

EB-800A / EB-800AL

EB-800A is a miniature 13 x15 mm^2 **GPS / Glonass** engine that is capable of receiving both GPS and Glonass signal with single RF input and high receiving sensitivity.

With up to **-165dBm** superior tracking sensitivity, the GPS + Glonass dual system EB-800A enables better satellite coverage and superior position accuracy for your navigation need under dynamic conditions in areas with limited sky view like urban canyons.

EB-800A is pin compatible with TSI's popular EB-500, it provides best migration path for your embedded applications.
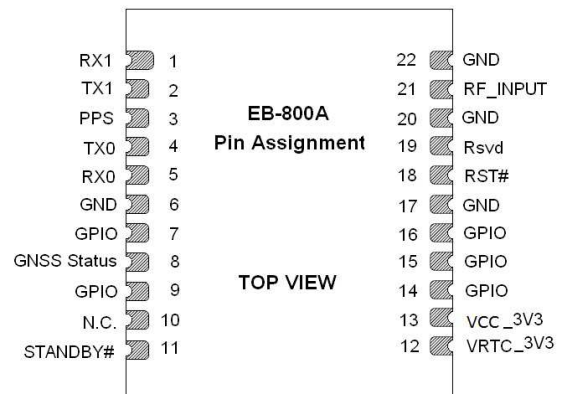
Key Features :

- Small form factor: 13 x 15 x 2.2 mm
- Support GPS + Glonass dual system
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm
- Tracks 99-Channel of satellites
- Support multi-GNSS including. QZSS, SBAS
- WAAS/EGNOS/MSAS/GAGAN supported
- RTCM ready
- AlwaysLocate^{TM} location awareness technology
- EPO^{TM} / HotStill^{TM} orbit predition
- EASY^{TM} self-generated orbit prediction
- Fast Position Fix
- Ultra low power consumption
- FCC E911 compliance and A-GPS support
- Backward compatible with EB-500
- EB-800A w/ LNA, EB-800AL w/o LNA
- EB-800A can match passive antenna
- EB-800AL recommend use active antenna

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 :

Pin	Signal		Pin	Signal
1	RX1		22	GND
2	TX1		21	RF_INPUT
3	PPS		20	GND
4	TX0		19	Rsvd
5	RX0		18	RST#
6	GND		17	GND
7	GPIO		16	GPIO
8	GNSS Status		15	GPIO
9	GPIO		14	GPIO
10	N.C.		13	VCC_3V3
11	STANDBY#		12	VRTC_3V3

EB-800A Pin Assignment — TOP VIEW

RoHS Compilant

ELECTROSTATIC SENSITIVE DEVICES

Ultimate

EB

Revision History

Rev.	Date	Description
0.8	09-06-2013	Add description of $GPMRC / $GNRMC sentence
0.7	04-10-2013	Modify pin 19 description, update block diagram, UART baud rate info
0.6	03-25-2013	Modify the description of EB-800AL info
0.5	03-06-2013	Add EB-800AL info
0.4	11-28-2012	Modify 2.2 Pin Definition table
0.3	11-21-2012	Modify standby current and supply voltage data. Remove quiescent current data.
0.2	09-25-2012	Update V_RTC Quiescent Current info
0.1	09-19-2012	Initial draft
	MM-DD-YYYY	

EB-800A series are 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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Transystem Inc. reserves the right to make change to specifications and product description without prior notification.

Table of Contents

1 Introduction

EB-800A is an ultra miniature 13 x15 x 2.2mm GPS / 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-800A series are your best choice for embedded applications.

1.1 Key Features

- Small form factor: 13 x 15 x 2.2 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm
- Tracks 99-Channel of satellites
- Fast Position Fix, 35/ 34/ 1.5s for Cold/ Warm/ Hot start
- Low power consumption
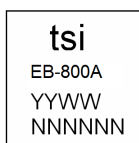
1.2 Applications

- 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
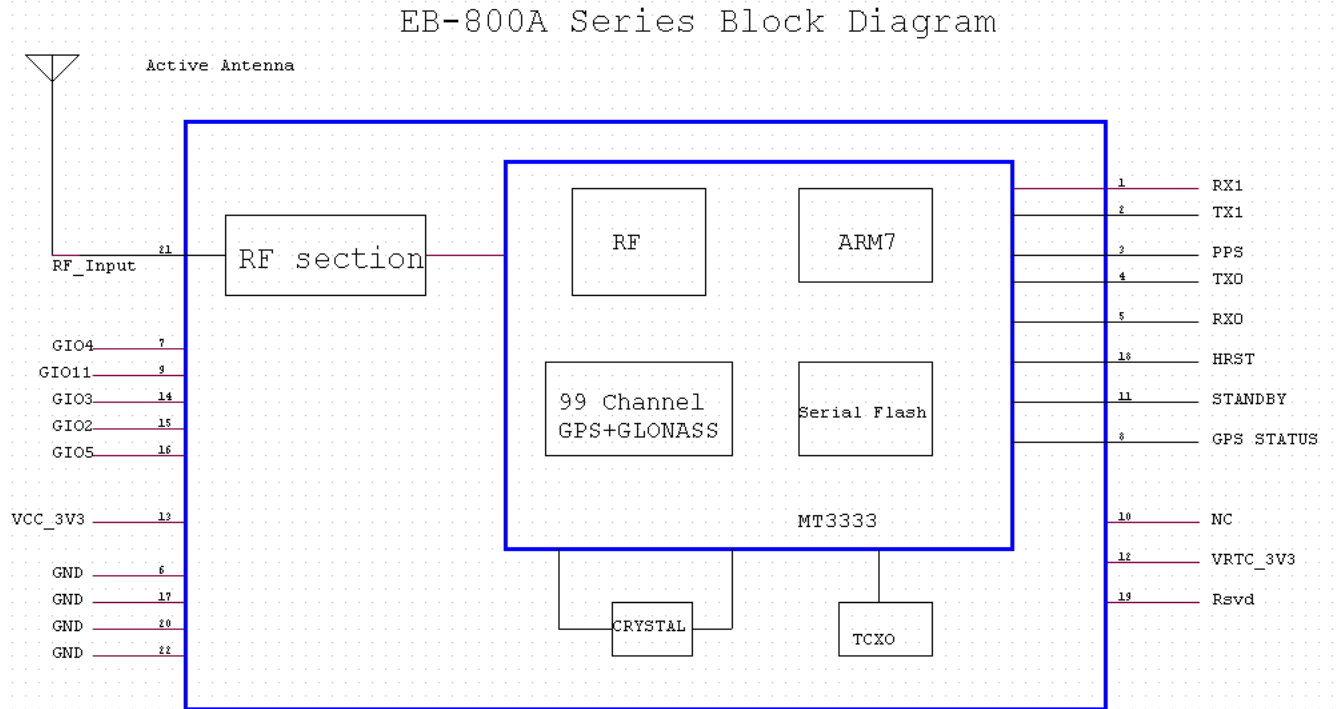
1.3 Look & Feel

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-800A
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	RX1	I	UART port 1 input
2	TX1	O	UART port 1 output
3	PPS	O	Pulse per second output when GPS has position fix, 10% duty cycle
4	TX0	O	GPS TX0
5	RX0	I	GPS RX0
6	GND	P	Ground
7	GPIO	I/O*	General input/ output, leave open if not used
8	GNSS status	O	When GNSS is position fix, pin 8 alternates between High/Low. When no fix, pin8 always goes low.
9	GPIO	I/O*	General input/ output, leave open if not used
10	NC	I	NC
11	Standby	I	Falling edge trigger. Back to High for normal operation. Leave open if not used
12	VRTC_3V3	P	RTC power 2.0~4.3V Quiescent current 2.0uA max
13	VCC_3V3	P	Power Supply 2.8~4.3V DC
14	GPIO	I/O*	General input/ output, leave open if not used
15	GPIO	I/O*	General input/ output, leave open if not used
16	GPIO	I/O*	General input/ output, leave open if not used

17	GND	P	Ground
18	HRST	I	Module reset, active low. Internal pull high leave open if not used
19	Rsvd	I/O*	Reserve for future use, leave open if not used
20	GND	P	Ground
21	RF Input	I	Antenna port, L1, 1575.42MHz, 50 ohm
22	GND	P	Ground

Note : 1) P: Power, I: Input, O: Output, I/O*: Input or Output, leave open if not used

2) GPIO current output default：4mA, Max ：16mA

3) Please supply VRTC_3V3 / VCC_3V3 voltage simultaneously or supply VRTC_3V3 voltage first when powering on the module.

2.3 Specification

Item	Description
General	L1 frequency, C/A code (SPS) 99 independent tracking channels
Sensitivity	-165dBm /Tracking; -148dBm /Acquisition
Update Rate	Up to 10Hz
Accuracy	<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 2.8~4.3 V
Power Consumption	EB-800A: < 22 mA @ 3.3V (w/o Active ANT) / Tracking EB-800AL: < 20 mA @ 3.3V (w/o Active ANT) / Tracking
Backup Battery	DC 2.0~4.3V, 20 uA@3.3V typical
NMEA Message	NMEA0183 v3.1 baud rate 4800/9600/…/115200, default 9600 Selectable Output: GGA, GLL, GSA, GSV, RMC, and VTG
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, 22 Pin
Dimension	13 x 15 x 2.2(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
12	VRTC_3V3	2.0	4.0	4.3	V
	Tracking Current (2)		43		uA
13	VCC_3V3	2.8	3.3	4.3	V
	Peak Acquisition Current (1)			26	mA
	Tracking Current (2)		22		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-800A 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 14400 to 115200 baud rate.

4.1 Protocol

EB-800A 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-800A is capable of supporting following NMEA formats:

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

Note:
1) When only GPS is fix or no fix, EB-800A will output $GPRMC / $GPGLL / $GPGSA.
2) When GPS + GLONASS is fix, EB-800A will output $GNRMC / $GNGLL / $GNGSA.

5 Dimension and Package

5.1 Mechanical Dimension
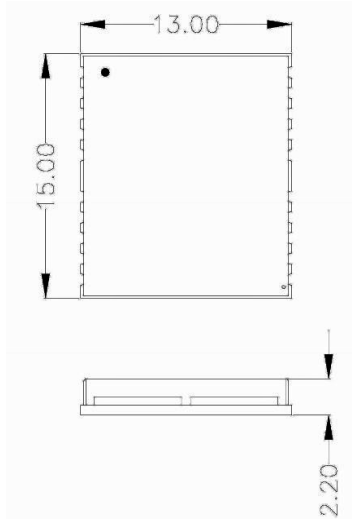
5.2 Recommend Layout Pattern
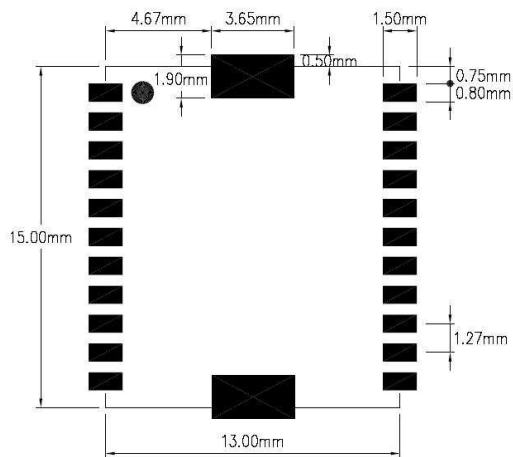
5.3 PIN Coordinates

Unit:mm

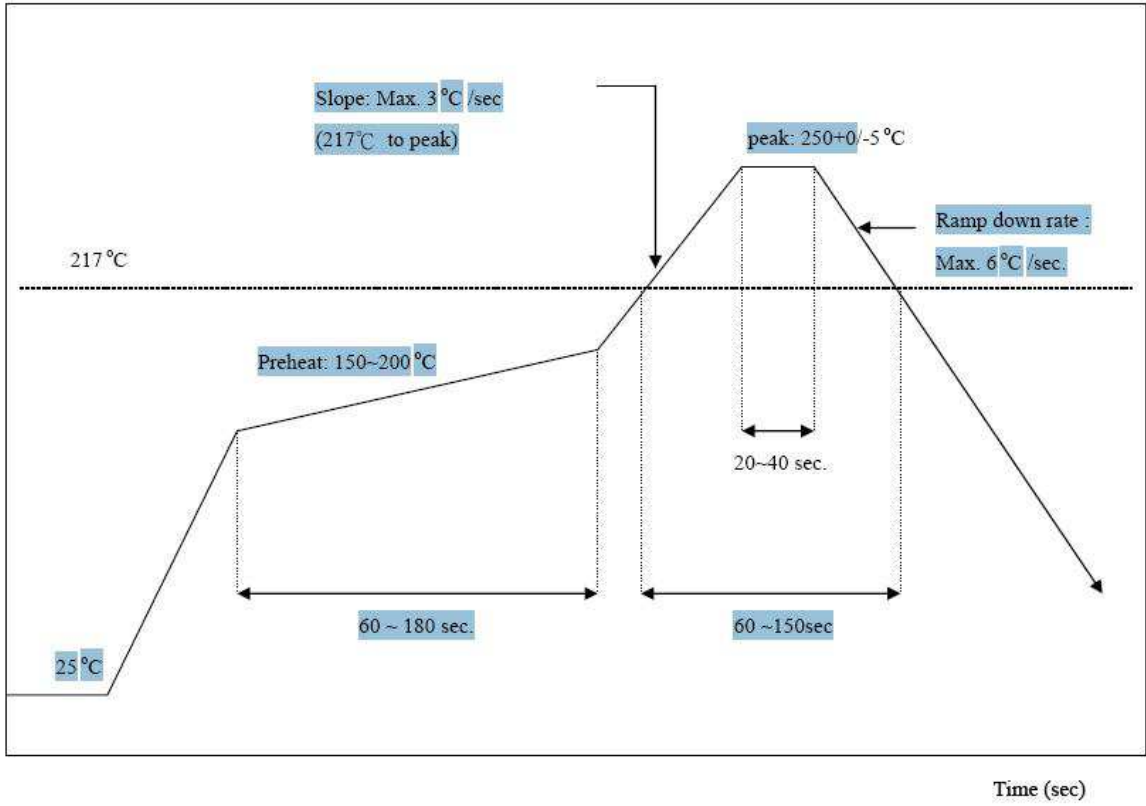| Pin #	X	Y	Pin #	X	Y
1	0.00	0.00	12	13.0	12.7
2	0.00	1.27	13	13.0	11.43
3	0.00	2.54	14	13.0	10.16
4	0.00	3.81	15	13.0	8.89
5	0.00	5.08	16	13.0	7.62
6	0.00	6.35	17	13.0	6.35
7	0.00	7.62	18	13.0	5.08
8	0.00	8.89	19	13.0	3.81
9	0.00	10.16	20	13.0	2.54
10	0.00	11.43	21	13.0	1.27
11	0.00	12.7	22	13.0	0.00

5.4 Package

EB-800A GPS modules come in tray package suitable for pick and place machines. Each tray contains total 96 pieces of EB-800A 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.
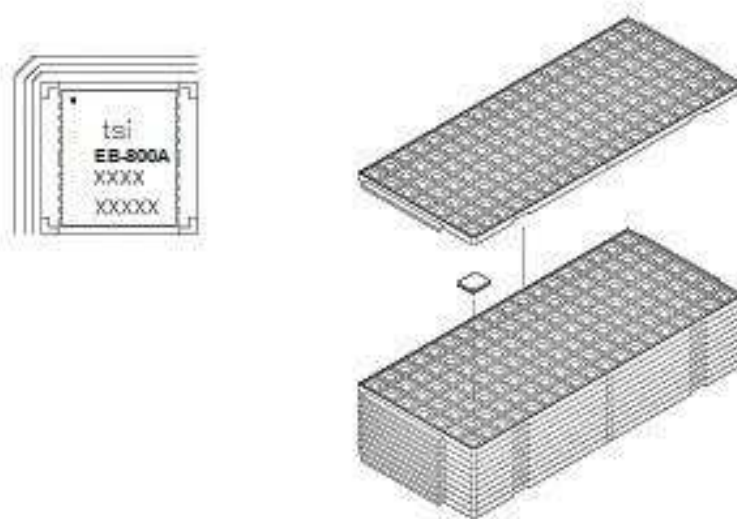
6 Recommended IR Profile

Follow below IR profile for reflow during SMT assembly for EB-800A.

Cycle interval : 5 minus

Slope: Max. 3 °C /sec
(217°C to peak)

peak: 250+0/-5 °C

Ramp down rate :
Max. 6 °C /sec.

217 °C

Preheat: 150~200 °C

20~40 sec.

60 ~ 180 sec.

60 ~150sec

25 °C

Time (sec)

7 Application Information

7.1 GPS / Glonass Antenna Recommendations

Follow below recommendations when choosing GPS / Glonass antenna for EB-800A series for best system performance. Transsystem also offers active antenna products for optimal performance with EB-800A series. For details, please contact your Transsystem 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 $\leq$ LNA Gain $\leq$ 20dB (for EB-800AL only)
- Noise figure $\leq$ 1.5dB
- Connector: surface mounted on main PCB, Ipex or MMCX

7.2 Application Circuit
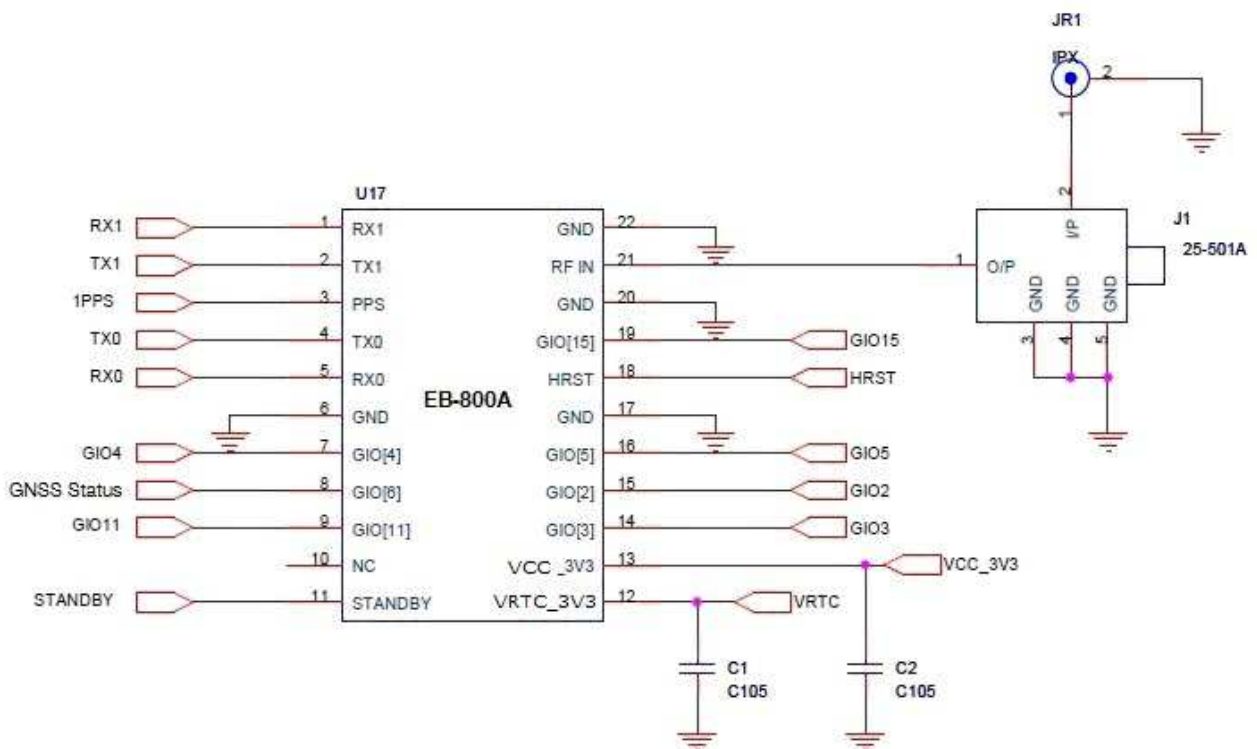
【Note1】: GPIO[6] (pin#8) can be used as GPS / Glonass position fix indicator.
【Note2】: VRTC_3V3 (pin#12) could connect to 3.3V DC power supply or battery directly.

7.3 PPS pin

EB-800A 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 #3) of the EB-800A 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 #18) can be used to reset the EB-800A module. Resetting the module will result in a restart of the complete firmware.

The EB-800A 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 #12) 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 20uA typical under normal operation

7.6 General GPS / Glonass Receiver User's Tips

- If the satellite signals can not be locked or experiencing receiving problem (while in urban area), following steps are suggested:
    a) Please plug the external active antenna into GPS / Glonass receiver and put the antenna outdoor or on the roof of the vehicle for better receiving performance.
    b) Move to another open space or reposition GPS / Glonass receiver toward the direction with least blockage.
    c) Move the GPS / Glonass receiver away from the interference sources.
    d) Wait until the weather condition is improved.
- Some vehicles having heavy metallic sun protecting coating on windshields may affect signal receptions
- Driving in and around high buildings may affect signal reception.
- Driving under tunnels or in buildings may affect signal reception.
- In general, GPS / Glonass receiver performs best in open space where it can see clean sky. Weather will affect GPS / Glonass reception – rain & snow contribute to worsen sensitivity.
- 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 GPS / Glonass 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.

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