

GPS Engine Board

EB-500A/AL

EB-500A/AL is an ultra miniature 13 x15 mm² GPS 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-500A/AL series is your best choice for embedded applications.



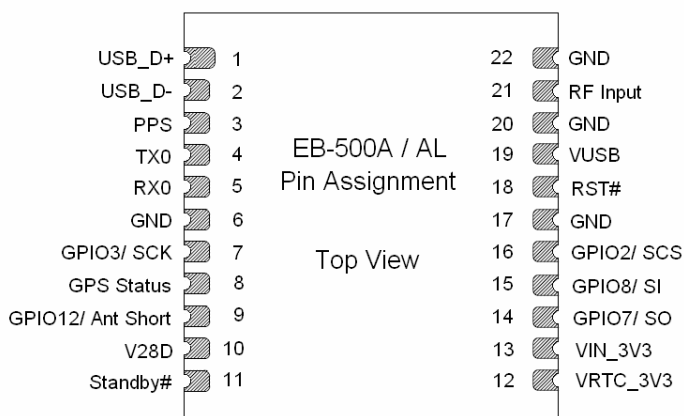
Key Features :

- Small form factor: 13 x 15 x 2.2 mm
- Lead-Free – RoHS/WEEE compliant
- High sensitivity -165dBm
- Tracks 66-Channel of satellites
- Fast Position Fix
- Low power consumption
- Ultra low power standby mode
- Support A-GPS
- Antenna sensing capability
- USB / UART interface

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 :



TRANSYSTEM INC.

An A+ supplier of RF microwave & GPS products

Ultimate

EB

Ver 1.0

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Revision History

Rev.	Date	Description
1.0	07-18-2011	Initial release
	MM-DD-YYYY	



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EB-500A/AL 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-500A/AL is an ultra miniature 13 x15mm² GPS 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-500A/AL is 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 (With external LNA)
- Tracks 66-Channel of satellites
- Fast Position Fix
- Low power consumption
- Ultra low power standby mode
- Support A-GPS
- Antenna sensing capability
- USB / UART interface
- Extended operation temperature range

1.2 Applications

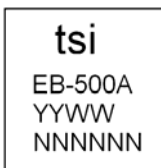
- Handheld devices
- Automotive and Marine Navigation
- Automotive Navigator Tracking
- Emergency Locator
- Geographic Surveying
- Personal Positioning
- Sporting and Recreation
- Embedded applications : PDA, DSC, Smart phone, UMPC, PND, MP4

1.3 Look & Feel



1.4 Labeling

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



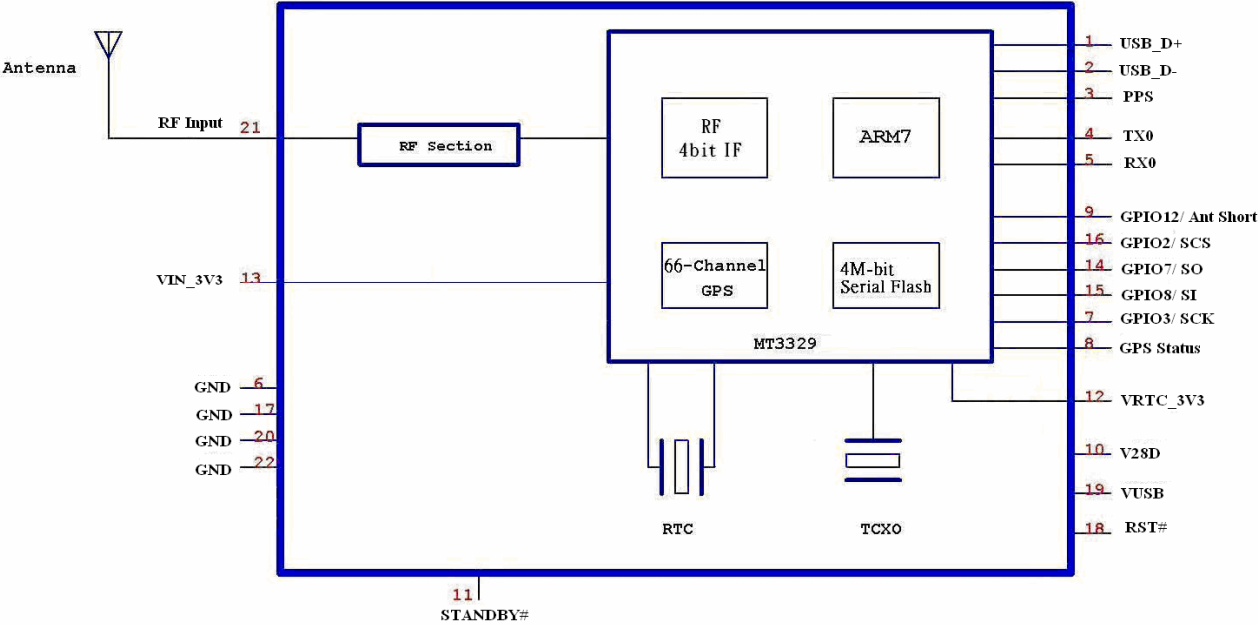
- Line #1: TSI company icon
- Line #2: Model number, i.e. EB-500A or EB-500AL
- Line #3: Date code, the year and week when the product is built
- Line #4: Lot control code for TSI internal use

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2 Technical Description

2.1 Block Diagram

EB-500A / AL Block Diagram



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2.2 Pin Definition

Pin#	Signal Name	Type	Description
1	USB_D+	I/O*	USB Data Plus, leave open if not used
2	USB_D-	I/O*	USB Data Minus, leave open if not used
3	PPS	O	PPS
4	TX0	O	GPS TX0
5	RX0	I	GPS RX0
6	GND	P	Ground
7	GPIO3 / SCK	I/O*	General input/ output, SPI clock, leave open if not used
8	GPS Status	O	GPS status, blink when GPS has position fix
9	GPIO12 / Antenna short	I/O*	General input/ output, Antenna short indicator (active high)
10	V28D	P	Digital power output, 2.8V±2%
11	STANDBY#	I	To put GPS into standby mode, falling edge trigger, leave open if not used.
12	VRTC_3V3	P	RTC power 2.0~4.3VDC. Quiescent current 1.5uA max
13	VIN_3V3	P	Power supply 3.0~4.2VDC
14	GPIO7 / SO	I/O*	General input/ output, SPI data output, leave open if not used
15	GPIO8 / SI	I/O*	General input/ output, SPI data input, leave open if not used
16	GPIO2 / SCS	I/O*	General input/ output, SPI chip select, leave open if not used
17	GND	P	Ground
18	RST#	I	GPS reset, active low, internal pull high, leave open if not used
19	VUSB	P	USB voltage input 3.3V±5%
20	GND	P	Ground
21	RF Input	I	RF input port, L1, 1575.42MHz, 50 ohm
22	GND	P	Ground

Note : 1) P: Power, I: Input, O: Output, I/O*: Input or Output, Open if not used
2) GPIO current output default : 4mA, Max : 16mA

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2.3 Specifications

Item	Description
General	L1 frequency, C/A code (SPS) 66 independent tracking channels
Sensitivity	-165dBm /Tracking; -148dBm /Acquisition
Update Rate	Up to 5Hz
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 3.0~4.2 V
Power Consumption	35mA @ 3.3V (w/o Active ANT) / Tracking
Backup Battery	DC 2.0~4.2V Quiescent current 5uA max
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: Same as VIN_3V3 or Passive Antenna
Serial Interface	UART / USB
Operating Temp.	-40°C to 85°C
Storage Temp.	-40°C to 85°C
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	+4.2	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
Iant	antenna supply current	0	50	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
4	VRTC_3V3	2.0V		4.2V
	Standby Current (1)		20µA	
	Tracking Current			3.0mA
3	VIN_3V3	3.0V	3.3V	4.2V
	Peak Acquisition Current (2)			45mA
	Tracking Current (3)		35mA	
	Standby Current			0.7mA

Table 3-2: 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, TX0, GPIO 2,3,7,8,12	Voh	2.4	3.9	V
	Vol	-0.3	0.4	V
RX0, STANDBY#	Vih	2.0	3.6	V
	Vil	-0.3	0.8	V
RST#	for reset		0.2	V

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4 Serial Port Interface

EB-500A/AL 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. Alternative USB port is also provided for communication of GPS position data.

4.1 Protocol

EB-500A/AL 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

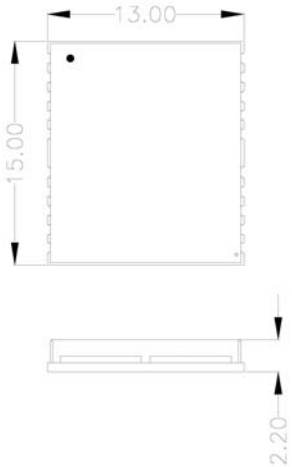
EB-500A/AL is capable of supporting following NMEA formats:

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

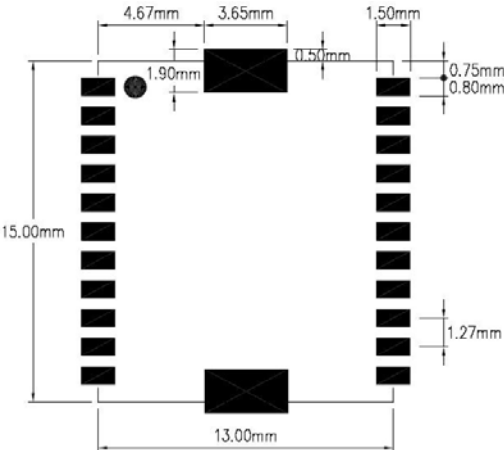
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5 Dimension and Package

5.1 Mechanical Dimension



5.2 Recommend Layout Pattern

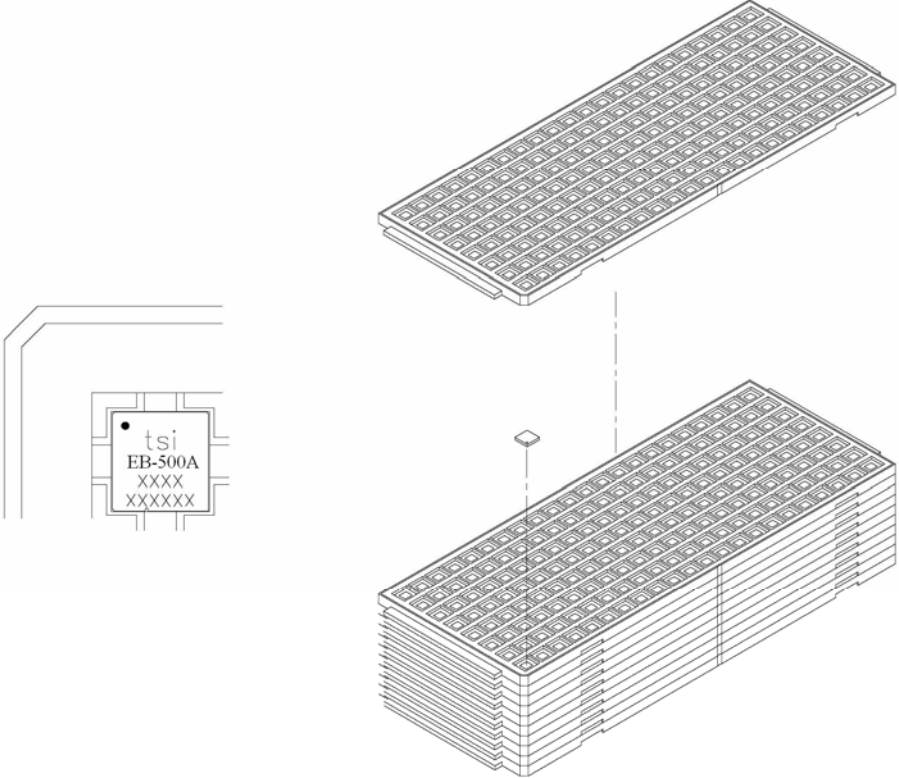


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5.3 Package

EB-500A/AL GPS modules come in tray package suitable for pick and place machines.

Each tray contains total 96 pieces of EB-500A/AL 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.

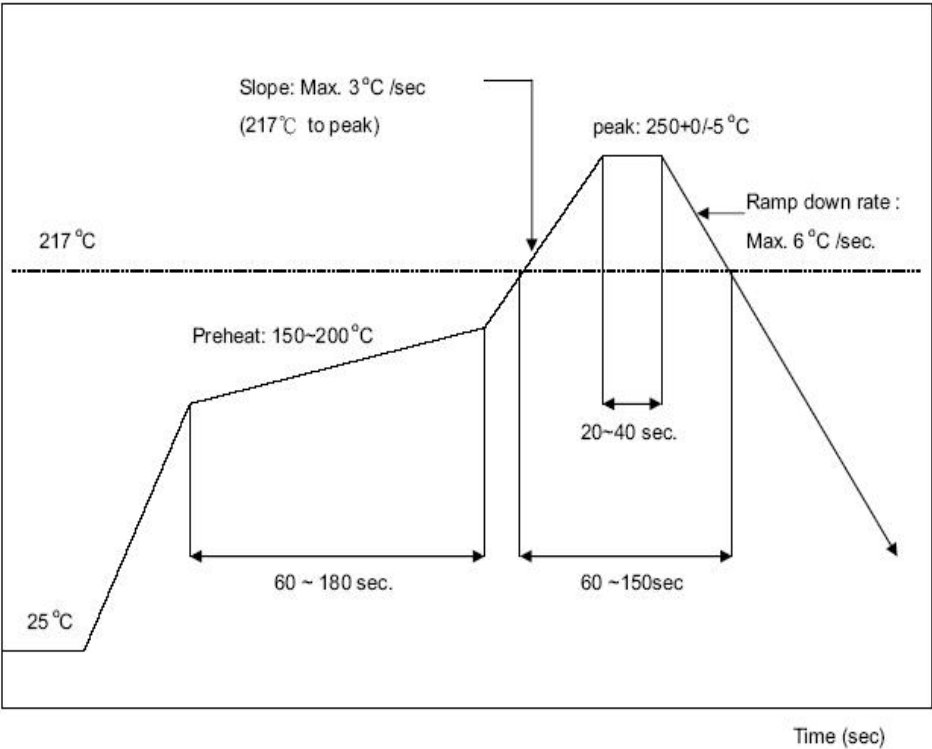


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6 Recommended IR Profile

Follow below IR profile for reflow during SMT assembly for EB-500A/AL.

- Ramp-down rate : 6 °C /sec. max.
- Time 25 °C to peak temperature : 8 minutes max.
- Cycle interval : 5 minus



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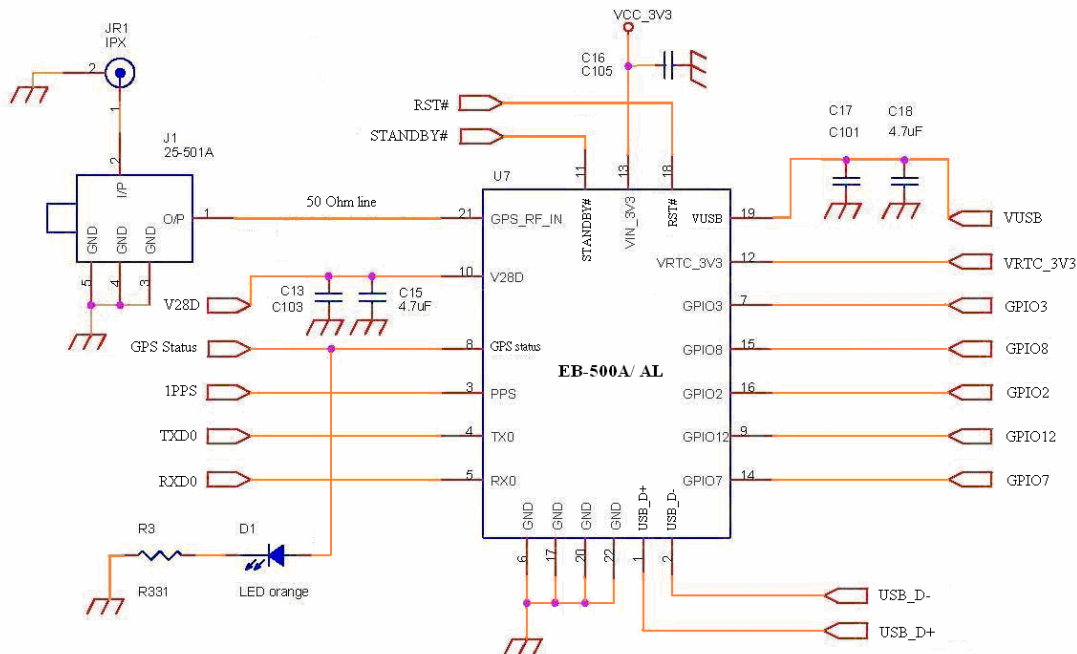
7 Application Information

7.1 GPS Antenna Recommendations

Follow below recommendations when choosing GPS antenna for EB-500A/AL for best system performance. Transystem also offers active antenna products for optimal performance with EB-500A/AL. For details, please contact your Transystem sales contact directly.

- Use active antenna that works with 2.8V power supply
- Receiving frequency $1575.42 \pm 1.032\text{MHz}$
- Polarization RHCP (right hand circular polarized)
- Output impedance = 50 Ohm
- $15\text{dB} \leq \text{LNA Gain} \leq 20\text{dB}$
- Noise figure $\leq 1.5\text{dB}$
- Connector: surface mounted on main PCB, Ipex or MMCX

7.2 Application Circuit



【Note 1】 : VRTC_3V3 (pin#12) could connect to 3.3V DC power supply or battery directly.

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7.3 PPS 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 PPS pin (pin #3) of the EB-500A/AL 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.

7.4 Reset Signal

The RST# pin (pin #18) can be used to reset the EB-500A/AL module. Resetting the module will result in a restart of the complete firmware.

The EB-500A/AL 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 receiver module. Typical quiescent current $<1.2\mu\text{A}$ allows the use of a separate battery or a “Supercap”. The V_RTC_3V3 pin draws 3mA maximum under normal operation

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7.6 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 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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