

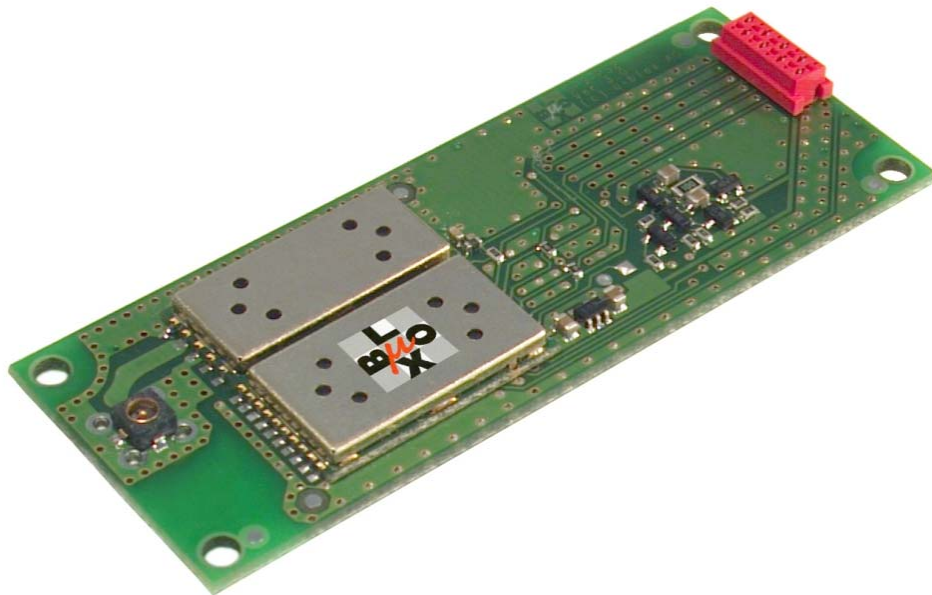


# GPS-PS2

## GPS Receiver Module

### DATA SHEET

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GPS Receiver Board based on SiRFstar™ II



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# 1 OVERVIEW

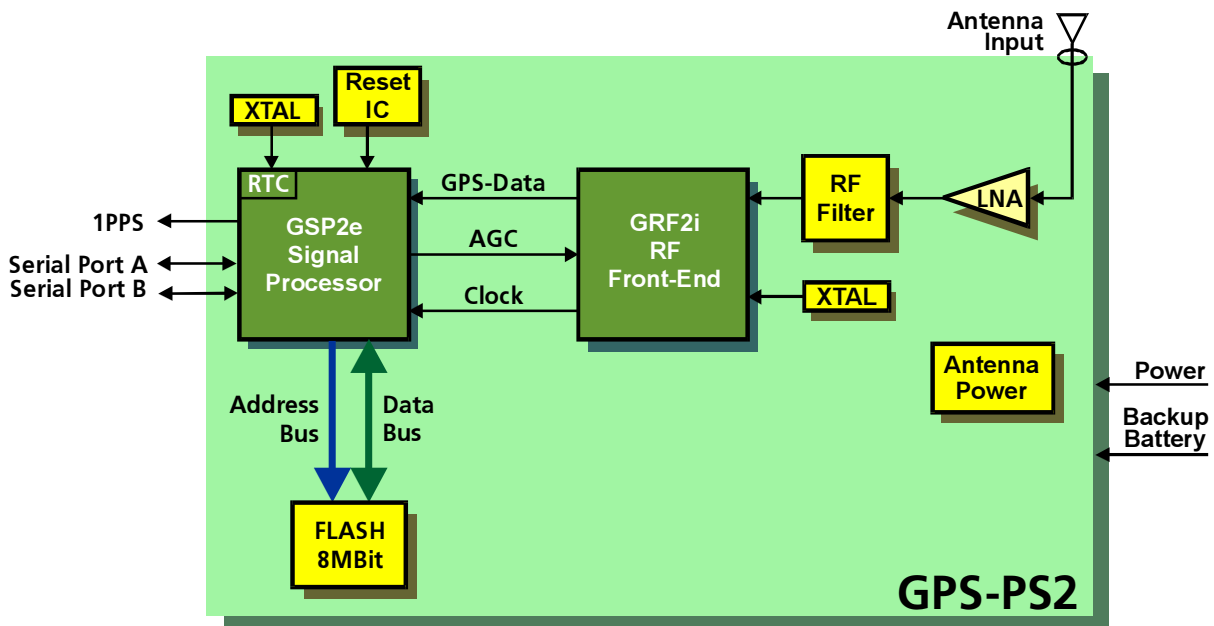


Figure 1-1: Block diagram of GPS-PS2

The GPS-PS2 receiver is a fully self-contained receiver module for the Global Positioning System (GPS). The module provides complete GPS signal processing from antenna input to serial data output (NMEA or SiRF<sup>®</sup> proprietary data format). A second serial port accepts differential GPS data (RTCM). Based on the SiRFstar<sup>™</sup> II chip set manufactured by SiRF Technology, Inc., the module supports features, and maintains the technical specifications of the SiRFstar<sup>™</sup> II architecture and maintains compatibility to the GPS-PS1E.

GPS-PS2 operates at a nominal voltage of 5 Volts. The implementation of the patent pending TricklePower<sup>™</sup> Mode allows an additional drastic reduction of power consumption for applications where power consumption is of primary concern.

The GPS-PS2 featuring the GRF2 RF front-end chip and an integrated Low-Noise Amplifier (LNA) connects seamlessly to low-cost passive antennas as well as active antennas. A dedicated antenna bias voltage pin is available.

The GPS-PS2 contains a completely shielded GPS receiver part.

## 2 FEATURES

- Fully self-contained GPS receiver (PVT output)
- Fully shielded
- Dimensions:
  - GPS-PS2: 82.5mm × 32mm × 7 mm
  - GPS-PS2-S: 82.5mm × 32mm × 12 mm
- Full implementation of SiRFstar<sup>™</sup> II architecture:
  - GRF2i Low-power RF front-end IC
  - GSP2e Low-power GPS DSP with integrated Real Time Clock (RTC) and ARM Core
  - 8 MBit FLASH memory
  - Low Noise Amplifier
  - Filter, Crystals, etc.
- Fast time-to-first-fix
- 2 bi-directional Serial Interfaces
- Differential GPS (RTCM-SC104) input
- Battery backup for internal voltage supply
- Passive and active antenna support
- Internal antenna bias voltage supply 5V ±0.25V
- Operating voltage 5 V ±0.25V
- Advanced low power modes
- Active antenna supervisor
- M/A-Com SSMT coax connector for RF-Input or standard SMB
- Industrial operating temperature range -40..85°C

## 3 GPS PERFORMANCE SPECIFICATION

### 3.1 GPS accuracy

GPS receiver accuracy is a function of GPS receiver performance, satellite visibility of the antenna, satellite constellation and Selective Availability (SA). GPS accuracy is not properly defined. Every manufacturer uses own means of defining, measuring and calculating position accuracy. On May 1, 2000 the US president decided to discontinue SA with immediate effect. This improves GPS accuracy dramatically without any modification on the receivers. See the *TIM Navigation Performance Application Note* [1] for more details on static and dynamic performance characteristics.

### 3.2 Start-up times

A GPS receiver has different start-up scenarios, which differ significantly in the Time-to-first-fix (TTFF). These start-up scenarios depend on the amount of knowledge the GPS receiver has regarding its position and the availability of satellites. Just like GPS accuracy, startup times for GPS receivers are another field where every manufacturer has its own naming scheme, and therefore, comparison between receivers is difficult. In the following a short introduction to our definitions of start-up times (see Table 3-1 for specifications) is given. Please note that these numbers were measured with good visibility (open view to the sky). Obstructed view will result in longer start-up times.

#### Definitions:

**Cold Start** In Cold Start scenario, the receiver has no knowledge on last position, approximate time or satellite constellation. The receiver starts to search for signals blindly. This is standard behavior, if no backup battery is connected.

Cold Start time is the longest startup time for u-blox GPS receivers.

**Warm Start** In Warm Start scenario, the receiver knows - due to a backup battery – his last position, approximate time and almanac. Thanks to this, it can quickly acquire satellites and get a position fix faster than in cold start mode.

**Hot Start** In Hot Start Scenario, the receiver- with a backup battery - was off for less than 2 hours. It uses its last Ephemeris data to calculate a position fix.

**Reacquisition** The reacquisition figure gives the time required to get lock on a satellite if the signal has been blocked for a short time (e.g. due to buildings). This is most important in urban areas. Reacquisition time is not related with TTFF.

Parameter	Specification	
Receiver Type	L1 frequency, C/A Code, 12-Channel	
Max Up-date Rate	1Hz	
Accuracy (SA off)	Position	4m CEP (See <sup>1</sup> )
Accuracy (DGPS, SA off)	Position	<2m CEP (see <sup>1, 2</sup> )
Acquisition (typical)	Cold Start	45 sec (typical)
	Warm Start	38 sec (typical)
	Hot Start	<8 sec (typical)
Signal Reacquisition	100 ms	
Dynamics	≤ 4g	
Operational Limits	COCOM restrictions apply	

<sup>1</sup> CEP = Circular Error Probability:  
The radius of a horizontal circle, centered at the antenna's true position, containing 50% of the fixes.

<sup>2</sup> Depends on accuracy of DGPS system

**Table 3-1: GPS receiver specifications**

## 4 OPERATING MODES

The GPS receiver can be operated in different operating modes described below.

### 4.1 Continuous Mode

In *Continuous Mode*, the module runs continuously as long as the operating voltage  $V_{cc}$  is supplied. Position fixes are generated at the maximum update rate. Use of an external backup battery is recommended to reduce the system's startup time. If an external backup battery is connected the module keeps the internal real time clock (RTC) running and holds the SRAM data (ephemeris and almanac data) during power supply interruption. This enables warm- and hot-start. However, under good visibility conditions cold- and warm start times do not differ significantly.

### 4.2 TricklePower™ Mode

In TricklePower™ Mode,  $V_{cc}$  is continuously supplied to the module. A software configurable internal timer periodically forces the module to acquire a position fix. Between the fixes, the module remains in an ultra-low power sleep mode. This mode is recommended for applications where lowest power consumption and a periodical position up-date are of primary concern. A backup battery must be connected to enable the module to reduce startup times when recovering from a  $V_{cc}$  supply interruption.

During the TricklePower™ mode the firmware periodically schedules ephemeris collection and RTC calibration to ensure that useable data is always available. Ephemeris collection occurs typically once within a 30 minutes period and also whenever a new satellite rises above the horizon.

The power-on scenario in TricklePower™ Mode differs from the one in Continuous Mode. If the module fails to acquire enough satellites within a given time (due to bad visibility or very low signal levels) the module goes into an extended sleep phase. *MaxOffTime* defines the length of this sleep time. After this period the module wakes up and tries to acquire a position fix again.

For more detailed information on TricklePower™ Mode please check the *TIM Low Power Mode Application Note* [2].

### 4.3 Push-to-Fix™ Mode

The Push-to-Fix™ Mode puts the receiver into a background duty cycle mode that provides a periodic refresh of position, GPS time, ephemeris data and RTC calibration. The receiver stays in sleep mode until either an external reset or the expiration of the *Push-to-Fix-Period* wakes it up for a position update. Ephemeris data is automatically updated whenever necessary.

The time to first fix stays under 8 seconds if the receiver performed a successful position fix in the last cycle (i.e. within the last ephemeris update phase).

For more detailed information on Push-to-Fix™ Mode please check the *TIM Low Power Mode Application Note* [2].

# 5 MECHANICAL DIMENSIONS

All dimensions are in mm. Those in rectangular brackets are in inches.

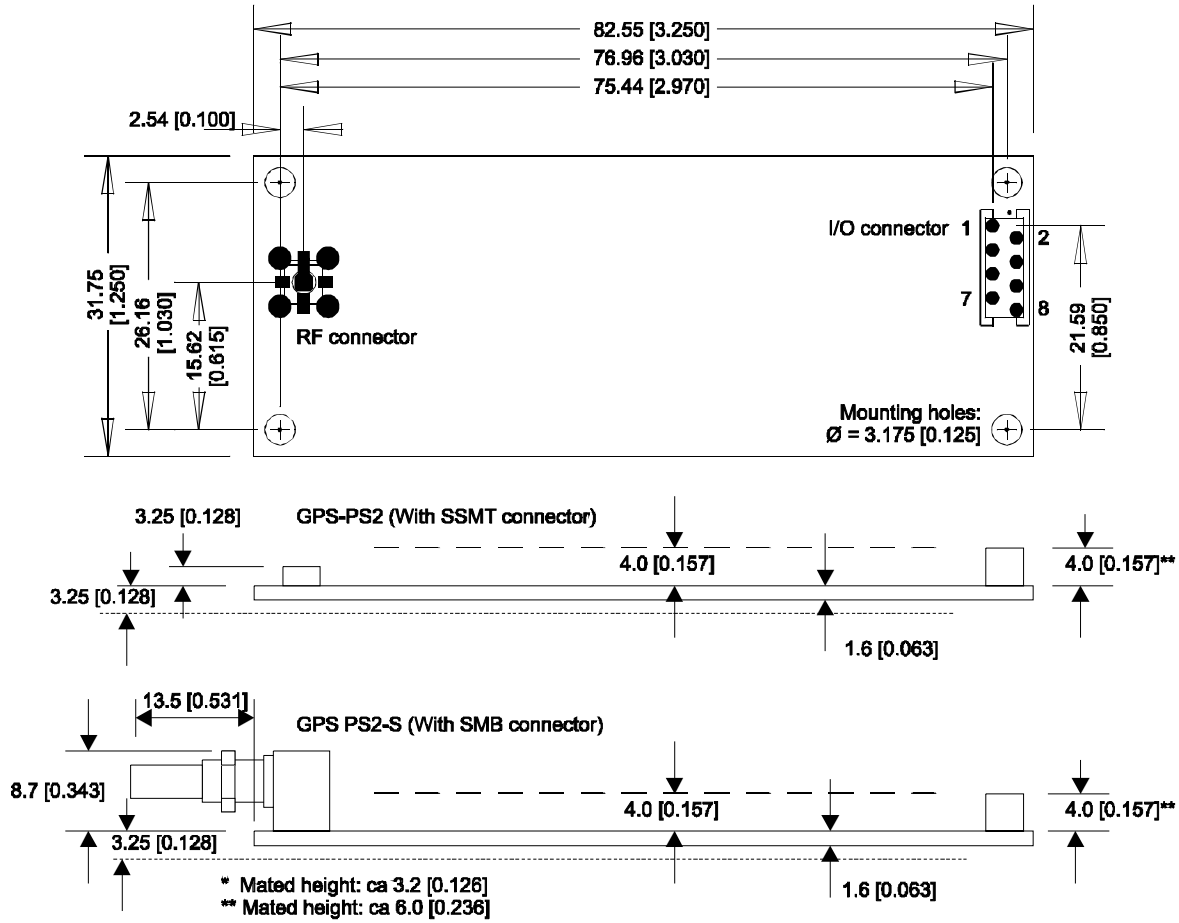


Figure 5-1: Mechanical dimensions and pin assignment

The weight of the module is approximately 13<sup>1</sup> grams including the metal shield.

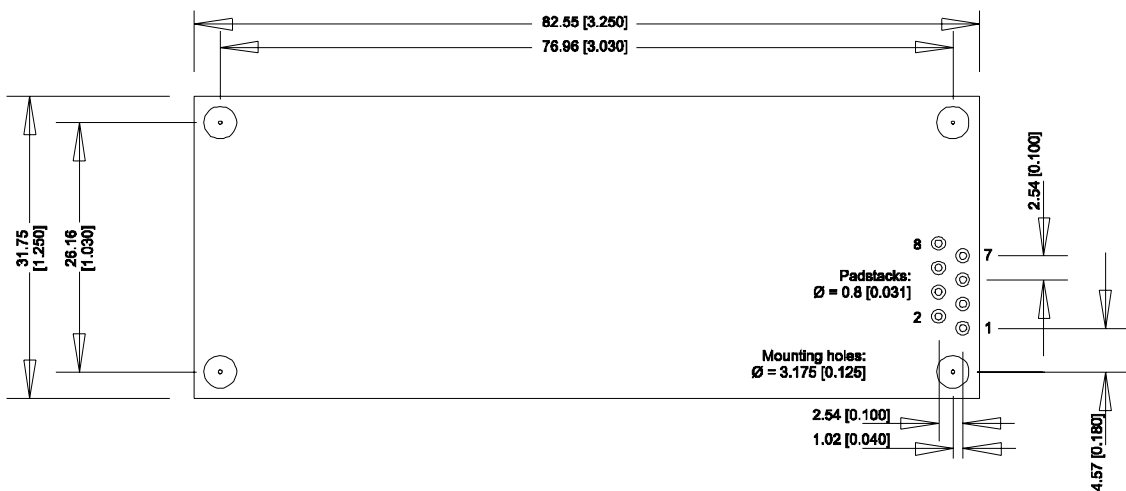


Figure 5-2: Recommended footprint

<sup>1</sup> 16 grams with SMB connector (GPS-PS2-S)

## 5.1 Matching connectors

Connector on module	Matching Connector	References
AMP MicroMatch 215079-8	Ribbon connector AMP215083-8	<a href="http://www.amp.com">http://www.amp.com</a>
AMP SSMT plug receptable	SSMT/OSMT Right Angle Jack Pigtail	<a href="http://www.macom.com">http://www.macom.com</a>
AMP SSMT plug receptable	SSMT/OSMT to SMA cable assembly (100mm)	
SMB connector male (S option) IMS 81.1524.201	SMB connector female	

Table 5-1: Matching connectors

# 6 EXTERNAL INTERFACES

## 6.1 Pin Description

The data IO connector is an 8 pin (2x4), AMP Micro-Match connector. See Table 5-1 for matching connectors. Table 6-1 describes the pin identification.

Pin No	Name	Meaning	I/O	Note
1	TxB	Serial Port B	Output	
2	VCC	Supply Voltage	Input	
3	TxA	Serial Port A	Output	
4	Vbat	Battery Backup Voltage	Input	Connect to GND, if not used.
5	RxA	Serial Port A	Input	
6	PPS	1-Pulse-Per-Second	Output	Named TIMEMARK on GPS-PS1E
7	RxB	Serial Port B	Input	
8	GND	Ground	Input	

Table 6-1: Pin identification

### 6.1.1 Serial Interface Signals

All serial interface signals (Port A: **TxA**, **RxA**; Port B: **TxB**, **RxB**) operate on 3.3V CMOS and 5V TTL compatible signal levels. External line transceivers (e.g. MAX3232) are necessary to provide RS 232 compatible signal levels.

Proprietary NMEA and SiRF<sup>®</sup> input messages are available to configure the serial ports, in particular the baud rates. Details on NMEA and SiRF<sup>®</sup> binary protocol messages are summarized in the *TIM Protocol Specification* [3].

Baud Rate	Comments
1200	NMEA, suitable for RMC message only
2400	NMEA, suitable for RMC message only
4800	Must deactivate some messages to avoid communication bottleneck and loss of information, e.g. NMEA: RMC and ZDA only
9600	Minimum recommended baud rate for NMEA output in standard configuration
19200	Minimum recommended baud rate for SiRF <sup>®</sup> Binary Protocol output
38400	Minimum recommended baud rate for SiRF <sup>®</sup> Binary Protocol output including development data and raw tracking data.
57600	Highest baud rate

**Table 6-2: Supported baud rates**

### 6.1.2 PPS Pin

A one-pulse-per-second active-high signal is output on pin **PPS**. This signal is 3.3V CMOS and 5V TTL compatible.

### 6.1.3 Special Power Pins

An external backup battery has to be connected to pin **Vbat** to enable RTC operation and SRAM backup and to allow GPS warm or hot starts after power supply interruption. Connect **Vbat** to GND if no battery is used. Use of supercaps is not recommended.

## 6.2 RF Connector

Depending on the option ordered:

The RF connector on the **GPS-PS2** is a straight AMP SSMT coaxial connector.

The RF connector on the **GPS-PS2-S** is a straight SMB coaxial connector.

See Table 5-1 for matching RF connectors for the GPS-PS2, GPS-PS2-S respectively.

## 7 ELECTRICAL SPECIFICATIONS

### 7.1 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Power Supply Voltage	Vcc	-0.3	5.5	V
Input Pin Voltage	Vin	-0.3	5.0	V
Antenna Bias Current	Iant		80	mA
Storage Temperature	Tstg	-40	125	°C

**Table 7-1: Absolute Maximum Ratings**

! Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. GPS-PS2 is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be reduced by using appropriate protection diodes.

### 7.2 Operating Conditions

Parameter (See <sup>1</sup> )	Symbol	Condition	Min	Typ	Max	Units
Power Supply Voltage	Vcc		4.75	5.0	5.25	V
Power Supply Voltage Ripple	Vcc_PP			50		mV
Backup Battery Voltage	Vbat		1.85		3.6	V
Antenna Bias Voltage (See <sup>2</sup> )	Vbias	Iant = 35mA		Vcc-0.5		V
Sustained Supply Current (See <sup>3,4</sup> )	Icc	Vcc = 5V		165		mA
Peak Supply Current (See <sup>3,4</sup> )	Iccp	Vcc = 5V		215		mA
TricklePower™ Sleep Mode Supply Current (See <sup>4</sup> )	Itps	Vcc = 5V		3		mA
Standby Battery Current	Ibat	Vbat = 3.3V		4.5		uA
Antenna Bias Current (See <sup>2</sup> )	Iant				35	mA
Operating Temperature	Topr		-40		85	°C

<sup>1</sup> An ambient temperature of 25°C is assumed. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

<sup>2</sup> Roughly a linear relationship between recognized voltage drop (Vcc-Vbias) and drawn bias current (Iant)

<sup>3</sup> During highly active CPU phases, the peak level may endure for several hundred milliseconds. Use the "Peak Supply Current" (Iccp) to dimension your power supply circuit. Use the "Average Supply Current" (Icc) for battery capacity budget calculations.

<sup>4</sup> Icc, Iccp and Itps figures are based on Iant = 0A. If current is drawn by the active antenna, then Icc increases by Iant.

**Table 7-2: Operating Conditions**

Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

## 8 EXTERNAL WIRING FOR MINIMAL CONFIGURATION

The following are the minimum outside connections one has to provide to allow basic GPS operation.

1. **Antenna** The SSMT (or SMB) connector is used to connect an active antenna to the GPS receiver. Concerning use of passive antennas, please consider leaving **Vant** unconnected or refer to section 9.
2. **Power** Connect **Vcc** pin to 5V and **GND** pin to ground.
3. **Serial Interface** Pins **TxA**, **TxB**, **RxA** and **RxB** are 3.3V CMOS and 5V TTL compatible. If you need different voltage levels, use appropriate level shifters, e.g. MAX3232 from Maxim or equivalent in order to obtain RS-232 compatible levels.
4. **Backup Battery** Connect a backup battery to **Vbat** if you intend to use this feature. If you don't intend to use a backup battery, connect this pin to GND.
5. **1PPS Signal** A one-pulse-per-second signal is available for use.

Leave all unused pins open, if not specified otherwise. That's all!

## 9 ACTIVE ANTENNA SUPERVISOR

An active antenna supervisor is provided which is able to detect and report short and open circuits. The antenna supply will shut off automatically when a short circuit has been detected and remains off until the next reset. Passive antennas with open DC circuit result to normal GPS reception, but an open circuit is reported. Passive antennas with short DC circuit result to short circuit detection.

Configuration parameters in the firmware are available to deactivate the active antenna supply by default. The SiRF<sup>®</sup> binary and NMEA messages with status information about the active antenna supervisor are documented in the *TIM Protocol Specification* [3]. Details on the functionality of the supervisor are summarized in the application note for active antenna supervisor [6].

## 10 PRODUCT LINEUP

### 10.1 Default startup

The GPS-PS2 is shipped with the following default start-up configuration:

- Output via port A: SiRF<sup>®</sup> binary protocol (19200 baud / 8 bits / no parity / 1 stop bit)
- RTCM DGPS input via port B (RTCM messages 1, 2, 3, 9) (9600 baud / 8 bits / no parity / 1 stop bit)

Refer to Table 10-1 for ordering information. Options are available in higher quantities.

Option	Features
GPS-PS2	Standard version with AMP SSMT/OSMT antenna connector
GPS-PS2-S	SMB antenna connector

Table 10-1: Ordering Options

### 10.2 Firmware Updates and Customized Configurations

Different start-up configurations can be set by reflashing the firmware with different default settings, e.g. SiRF<sup>®</sup> binary protocol on port A, different update rates, data output via serial port B, etc or to enable the active antenna supervisor status message.

The Firmware Update Utility, described in [4] is a free tool available in the TIM Evaluation Kit [5] and downloadable from the u-blox website. It enables convenient downloads of new firmware and modification of configuration parameters described in the *TIM Protocol Specification* [3].

## A RELATED DOCUMENTS

- [1] TIM Navigation Performance Application Note, GPS.G2-X-01001
- [2] TIM Low Power Modes - Application Note, GPS.G2-X-02003
- [3] TIM GPS Receiver - Protocol Specification - Application Note, GPS.G2-X-01003
- [4] TIM Firmware Update Utility - User's Manual, GPS.G2-SW-02004
- [5] TIM Evaluation Kit - User's Guide, GPS-EK-01001
- [6] TIM Active Antenna Supervisor Application Note, GPS-G2-X-02009
- [7] The GPS Dictionary, GPS-X-00001

All these documents are available on our homepage (<http://www.u-blox.com>).

## B GLOSSARY

Please refer to the *GPS Dictionary*, [7].

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