SYNERGY SYSTEMS, LLC
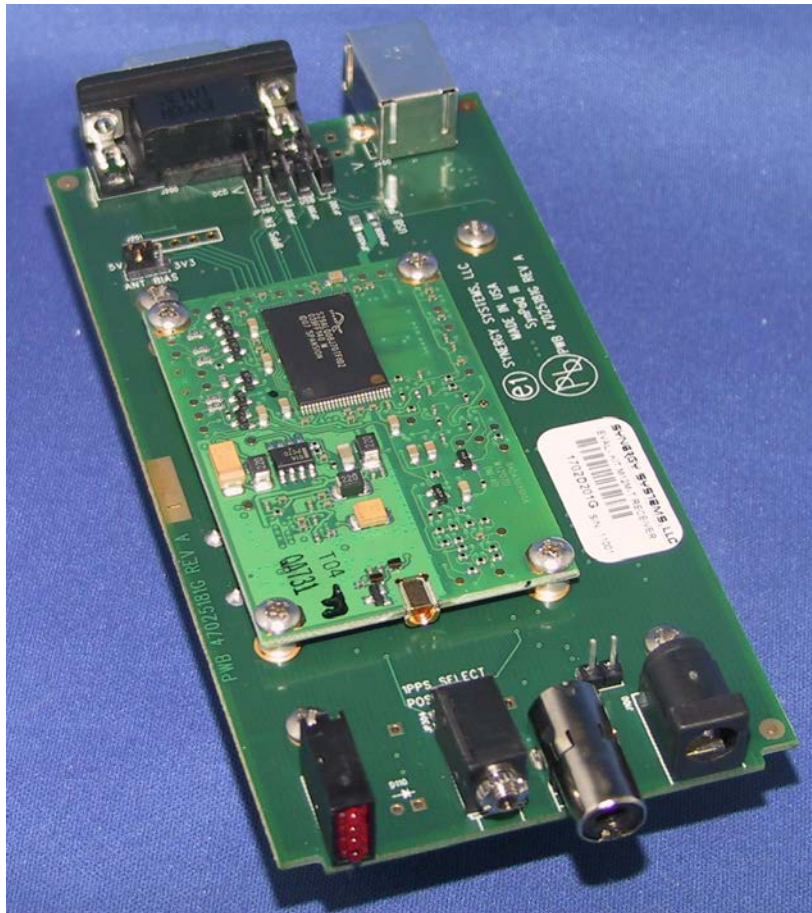*Time proven products and support*®

QUICK START GUIDE

SynPaQ/III Evaluation Board

For testing M12 and SSR Series GPS and Multi-GNSS OEM Boards

P/N 470251D1G Eval Board Shown with iLotus M12M installed

RECEIVER PERFORMANCE

GPS and Multi-GNSS Global Navigation Satellite Systems (GNSS) receivers shipped with the Eval Board rely on signals made available and controlled by different countries. The U.S. Department of Defense makes the NavStar Global Positioning System (GPS) available for civilian use solely at its discretion and the GPS is subject to degradation of position and velocity accuracies by the Department of Defense. Similar cautions apply for GNSS systems that are controlled by other countries: GLONASS by Russia; Galileo by the EU; BeiDou by China and QZSS by Japan. Neither Synergy Systems, LLC nor the various suppliers of the GNSS receiver modules and\or boards supplied with the Eval Board warrant or control GPS or Multi-GNSS GNSS signal availability or performance.

PRODUCT DESCRIPTION

The Eval Board includes an ESD tolerant RS-232 interface connected to a DB-9 I/O connector, a USB compatible communications link, input power regulation and filtering, and Power/Data display LEDs.

The GPS or Multi-GNSS receiver can be selected from several types depending on the user's requirements. See pages 10, 11 and 12 for receiver board options at the time of publication.

This document does not cover the differences in the available receivers, it is only intended as a User's Guide for the Evaluation Board regardless of receiver installed.

EVAL BOARD PHYSICAL CHARACTERISTICS

Size:	2.75" W x 5.5" L x 1.15" H
	(70 mm x 140 mm x 29 mm)
Weight:	10 oz. *(0.28 kg)*

ELECTRICAL INTERFACE (RS232)

Power:	2.1 mm Coaxial
Data to Host:	DB-9F I/O Connector
Differential Port:	2.5 mm phone jack
GPS Antenna:	(as supplied with receive board)
1PPS Out:	RCA Phono Jack

ELECTRICAL INTERFACE (USB)

Power: 2.1 mm Coaxial
Data to Host: USB
Differential Port: 2.5mm phone jack
GPS Antenna: (as supplied with receive board)
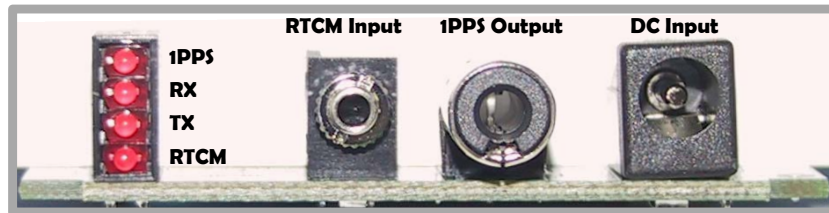1PPS Out: RCA Phone Jack

ENVIRONMENTAL CONDITIONS

Operating Temp: w/Batt   -20°C to +60°C
Storage Temp: w/Batt   -20°C to +60°C
Relative Humidity: 10% to 90%, non-condensing

POWER REQUIREMENTS

+9 to +32VDC (200 mA max)
Constant 1.6 W – 2 W max
(depends on receiver installed)

EVAL BOARD CONNECTORS AND INDICATORS

DC Input: The power connector is a standard 2.1 mm coaxial power jack. Allowable input voltage range is 9-32 VDC. Regulation of the input power is not required as voltage regulation, reverse voltage, over-current and over-voltage protection circuitry is provided by the Motherboard electronics.

A thermally activated, resettable fuse is mounted on the Motherboard. If it opens due to application of excessive input voltage, the unit should be allowed to cool for several minutes before power is re-applied (check input voltage). Repeated opening of this device under conditions of proper input power indicate a probable internal problem, and the Motherboard should be returned to Synergy Systems for repair or replacement (see Synergy's warranty statement).

1PPS Output: The 1PPS output connector is a standard RCA phone jack. The 1PPS is a 5 volt logic level signal. The 1PPS pulse can be jumper selected for positive or negative going edge. See the Jumper section in this document below.

INDICATORS
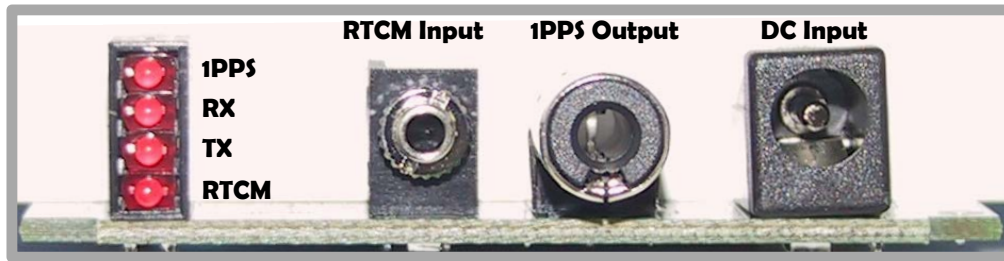
The Motherboard contains four LEDs for status display. Details are as follows:

1PPS - For navigation receivers, if a *1PPS* is available, the top LED will generally flash at once per second. No LED activity will be seen for navigation boards that do not output a 1PPS or have the 1PPS output disabled.

1PPS For Timing Receivers - The top *1PPS* indicator will flash as configured by the Timing Receiver Autonomous Integrity Monitor (T-RAIM) settings. There are 2 Modes of operation for the flashing *1PPS* LED. In Mode-1, the *1PPS* will start to flash whether satellites are being actively tracked and the receiver has developed a position fix or not. In Mode-2 the *1PPS* will only flash if satellites are being actively tracked and the receiver has developed a position fix. Some timing receivers include other T-RAIM configuration modes that affect the 1PPS LED.

These *1PPS* **Modes** are determined by the Receiver selected at time of purchase. The *1PPS* LED also serves as a "heart-beat," giving the user visual feedback that the receiver's processor is powered up and accomplishing normal housekeeping routines (unless the user has previously disabled the *1PPS* output through software control of the receiver).

RxD - The *RxD* indicator will flash whenever commands are received from the host computer.

TxD - The *TxD* indicator provides the user with visual feedback concerning data output from the receiver. The *TxD* LED will momentarily flash whenever the receiver is sending GPS data to the host.

RTCM - RTCM INPUT – For M12x navigation receivers, the 2.5 mm phone jack connector on the front end is used for inputting differential corrections into the GPS receiver. This connector is only used with RTCM enabled receivers.

INTERFACE CONNECTORS
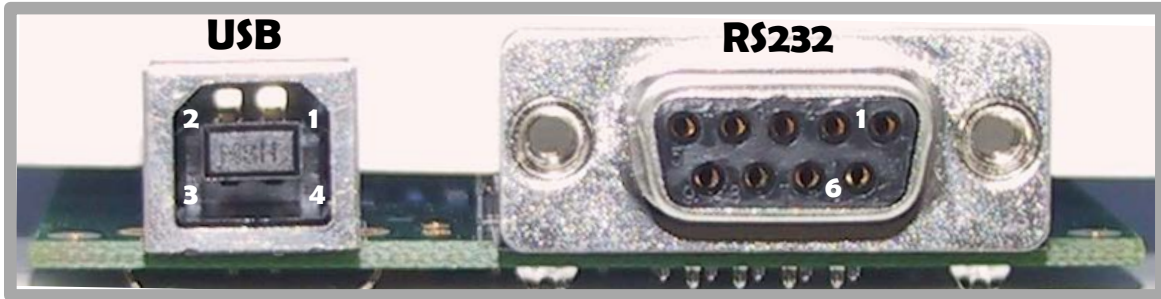
DB-9 RS-232 Interface

The DB-9 connector provides a standard RS-232 connection. Pin functions are as follows:

    PIN   FUNCTION

      1   1PPS Out, RS-232 levels
      2   TxD1 - Data Out, RS-232 levels
      3   RxD1 - Commands In, RS-232 levels
      5   Power and Signal Ground

USB INTERFACE

The USB connector is a standard Type B connector. Prior to using USB port verify the USB 2.0 driver is installed. Power can be derived from either the USB port or from externally applied power (not both at the same time).

Pin functions are as follows:

    PIN   FUNCTION

    1   Red: +5V / Voltage + / VCC
    2   White: D - / Data - / USB -
    3   Green: D + / Data + / USB +
   4   Black: GND / Voltage - / Ground

EVALUATION BOARD OPERATION

If Synergy has not pre-configured the Eval Board, or if the user needs to re-configure the settings, the Evaluation Board provides the user with several options that can be set before powering on the Motherboard/Receiver.

These options include type of communication (serial or USB), antenna bias, and 1PPS output. Each option is covered in the following sections.

COMMUNICATION

The user can select between RS-232 or USB for Host communication. For communication via the RS-232 DB-9 connector, place the Jumpers in the "A" position.
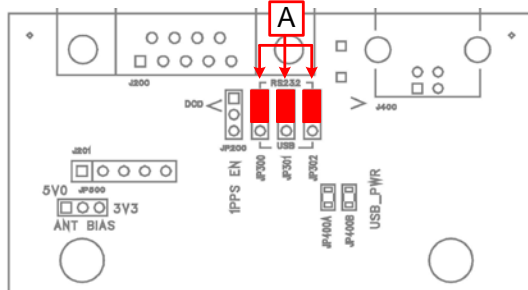
For communication via the USB connector, place the Jumpers in the "B" position.
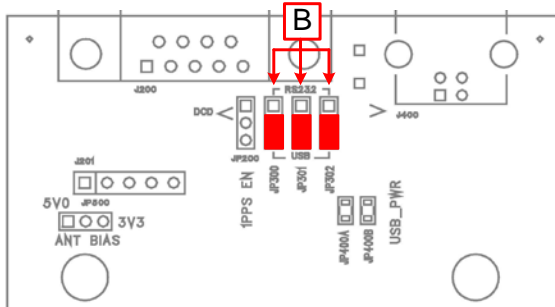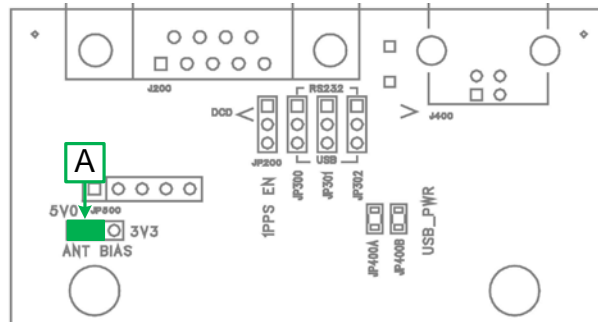

ANTENNA BIAS

Antenna Bias is the voltage supplied to power an active antenna's Low Noise Amplifier (LNA). For Evaluation purposes, Synergy supplies the Eval Board with the antenna bias set at 5 Volts (3.3 Volt antenna setting on request).

For user supplied antennas, always check the antenna manufacturer's voltage requirements before changing the antenna bias jumper.
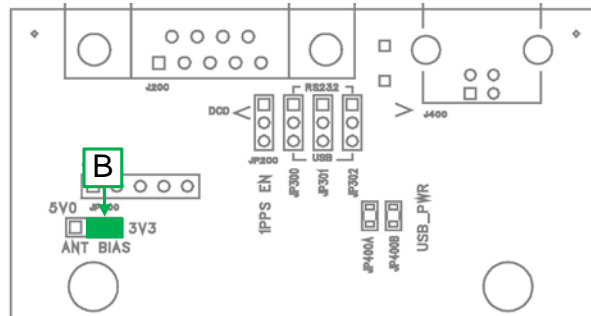
⚠ CAUTION

Do not change the antenna bias Jumper while the Evaluation Board is powered ON when the antenna is plugged into the receiver. This may lead to the failure of the LNA in the antenna and component failure on the Motherboard.

For 5 Volt antenna bias, place the Jumper in the "A" position.


For 3.3 Volt antenna bias place the Jumper in the "B" position.

1PPS OUTPUT

The *1PPS* is output in two locations. The first location is to the DCD line, Pin 1 on the DB-9 connector. The second location is the *1PPS* connector on the opposite end of the Motherboard.

Location One - The jumper ("A" shown below) is installed by default to provide the *1PPS* on the DCD line, pin 1 on the DB-9 connector. If this option is not required, typically used to synchronize GNSS time with a PC clock, simply remove the Jumper.
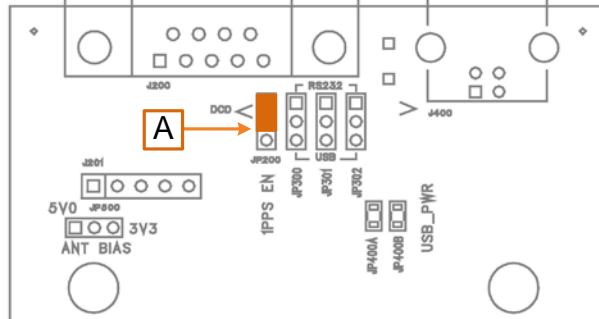
Location Two – This jumper is used to set the *1PPS* pulse as a positive or negative going pulse. The Jumper, by default, is installed to provide a positive going pulse in location "A".
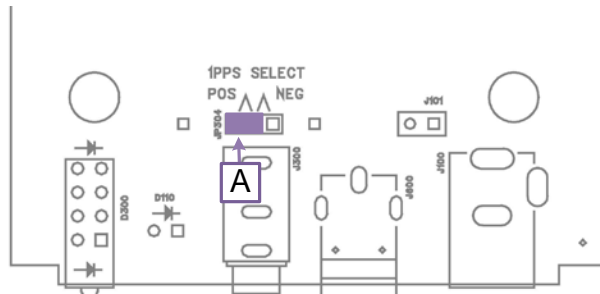
If a negative going pulse is desired, move the Jumper to the "B" location.
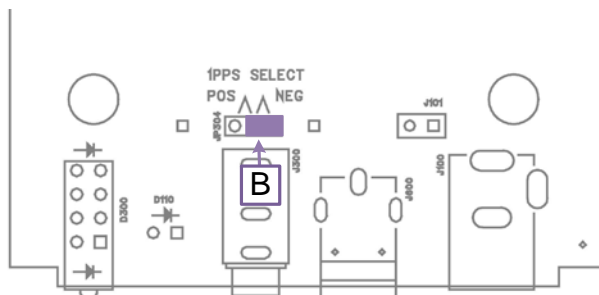
ANTENNA INSTALLATION

For Motorola M12+, iLotus M12M and M32M and Synergy's SSR Series Receivers, the receiver itself allows for connection to a GPS antenna through an MMCX connector. Other GPS boards may have different RF connectors.

An optional, 15 cm long coax cable, R/A MMCX plug to panel mount BNC jack connector P/N 10001290G-15, is available for interface to larger coax cables.

With the jumpers installed as needed, the antenna connected, and the power cable plugged in, the Evaluation Board is ready for operation. At this point, power-on the Eval Board and enable the software control application.

PURPOSE OF PROVIDING A BACKUP BATTERY ON THE EVAL BOARD

Legacy Motorola M12 Series GPS, and later iLotus M12M receivers, do not include on-board, non-volatile memory to store setup parameters. A battery backup, or externally applied backup voltage, is required to hold receiver set-up data in RAM and power the Real-Time Clock (RTC). Battery backed RAM in M12 Series timing receivers greatly reduces Time to First Fix (TTFF). By design, cold start of M12+ timing receivers can take up to several minutes.

The SynPaQ/III Eval Boards were originally designed for the Motorola M12 Series GPS receivers, but they remain popular for developing and testing applications using iLotus M12M Series and Synergy's SSR Series receivers.

The battery backs up receiver setup information in RAM and provides power for the Real Time Clock (RTC) through power cycles or when the receiver is powered down for an extended period; About 60 days with M12 Series receivers and about 3 - 4 weeks with SSR Series receivers.

As with competitive receivers of the 2000 era, older M12 Series receivers took a longer time to produce a 3-D fix. The TTFF for M12 Series receivers is greatly reduced if the date, time, and last position are available in RAM at power-on resulting in a warm start of < 50 seconds (almanac, Position, Time and Ephemeris for timing receivers).

When the SynPaQ/III Eval Boards are used with modern, faster starting SSR Series receivers, the backup battery is less useful for providing a better TTFF and more about keeping the RTC running during power-off conditions. Legacy SSR Series GPS and Multi-GNSS receiver boards, even without EEPROM and battery backed RAM, cold start in less than 30 seconds. The battery provides a warm start of about 1 second; about the same for later SSR receivers with EEPROM.

COMMUNICATING WITH RECEIVERS MOUNTED ON THE EVAL BOARD

Communications with receivers is generally done with Windows based GPS or Multi-GNSS software applications, although Unix\Linux and custom user applications may also be used.

To control and observe fundamental receiver performance for Legacy Motorola (M12+), and iLotus M12M navigation and precision timing receivers, use WinOncore12 or SiRF Oncore software. These software applications are free and available in the Accessories -> Software Section of Synergy's web site: http://www.synergy-gps.com.

For Synergy's SSR Series GPS and Multi-GNSS receivers (in addition to the above) install SynTAC from the web at http://www.cnssys.com/SynTac/. As an alternate, install Tac32Plus from here: http://www.cnssys.com/Tac32Plus/. These test and diagnostic applications are not free (SynTAC is $59, Tac32Plus $250) but they automatically initialize and configure virtually all of Motorola's Oncore GPS receivers produced from 1992 to 2005 and iLotus M12M GPS receivers from 2006 to date. These software applications are fully functional during a free, 30 day evaluation period.

For controlling Synergy's SSR Series OEM navigation and precision timing receivers in u-Blox mode, download the u-Blox u-Center software application from http://www.u-Blox.com. Use SynTAC or Tac32 to switch back and forth between Motorola mode and u-Blox mode and to make simple message selections. Use u-Center to fully configure and control all available functions. See Synergy's Change-Mode (Pass-Through) App-Note or SSR Integration Guide for details.

The actual performance parameters and supported commands for each OEM receiver board mounted on the Evaluation Board are totally dependent upon the GPS or Multi-GNSS receiver installed. Please refer to the relevant GPS Receiver User's Guide to determine which commands are supported by each receiver.

RECEIVER OPTIONS

The Synergy SynPaQ/III Eval Board is designed to incorporate a variety of GPS and Multi-GNSS receiver boards to optimize evaluation and testing for user applications. User selectable GPS and GNSS receivers are:

RECEIVER BOARD OPTIONS – GPS ONLY

- iLotus M12M OEM Precision Timing Receiver – Outputs high accuracy 1PPS, Motorola 12 channel binary and NMEA messages and is form-fit-function drop-in replacement for legacy Motorola M12+ precision timing receivers.

- iLotus M12M OEM Navigation Receiver - Outputs Motorola 12 channel binary and NMEA messages and is form-fit-function compatible with the legacy Motorola M12+ navigation receivers.

• Synergy SSR-6Tf OEM Precision Timing Receiver with SBAS – Embeds the SBAS Enabled, u-Blox LEA-6T module. Outputs u-Blox binary and NMEA and emulated 6, 8 and 12 channel Motorola binary messages.

• Synergy SSR-6H Navigation Receiver - Embeds the SBAS enabled u-Blox LEA-6H and outputs u-Blox binary and NMEA and emulated Motorola binary messages. (End of Life (EOL) use SSR-6Tf in Portable, or other dynamic mode).

Note: 1. For command details, refer to the LEA-6 Series "Receiver Description and Protocol Specification" located at: http://www.u-Blox.com.

2. When the above receivers include popular timing messages in Motorola 6, 8 and 12 channel binary emulation protocol, use SynTAC, SiRF Oncore, or WinOncore12 software applications as noted above.

3. All SSR-6 Series receivers are form, fit, function compatible with Motorola M12x GPS receivers.

4. The Eval Board also accommodates Synergy's legacy, u-Blox based SSR-4S and SSR-5H GPS receivers.

MULTI-GNSS RECEIVER OPTIONS

The Multi-GNSS receiver listed below use either SynTAC, Tac/32 and u-Blox u-Center software. Refer to LEA-8 Series "Receiver Description and Protocol Specification" for commands which are located at: http://www.u-Blox.com.

Synergy's SSR Series Multi-GNSS models that include Motorola binary messages require the use of SynTAC, TAC32, WinOncore12, SiRF Oncore software or user supplied custom software. u-Center is required for operation in u-Blox mode.

• Synergy SSR-6N Navigation Receiver - Embeds the SBAS enabled u-Blox LEA-6N GPS\GLONASS module. Outputs u-Blox binary and NMEA and emulated Motorola binary messages. (End of Life (EOL) due to introduction of SSR-8 Series Multi-GNSS OEM boards.

• Synergy SSR-M8T Multi-GNSS precision timing Receiver – Embeds the SBAS enabled u-Blox LEA-M8T precision timing Module with UBX binary and NMEA messages plus emulated Motorola binary messages. Includes GPS, GLONASS, BeiDou, QZSS and Galileo. Operates simultaneously in GPS/GLONASS, GPS/BeiDou and other combination GNSS modes.

• Synergy SSR-M8F Multi-GNSS Receiver – Embeds the u-Blox LEA-M8F Timing Module with UBX binary and NMEA and Motorola Binary emulation messages. Includes GPS, GLONASS, BeiDou, QZSS and Galileo. Operates simultaneously in GPS/GLONASS, GPS/BeiDou and other combination GNSS modes.

• Synergy SSR-F9P Multi-GNSS Receiver – Embeds the u-Blox ZED-F9P Precision Timing and High-Accuracy Navigation module with UBX binary and NMEA and Motorola Binary emulation messages. Includes GPS, GLONASS, BeiDou, QZSS and Galileo. Operates simultaneously with multiple satellite constellations and navigation correction services. Introduction planned for 2nd Quarter 2019; MP 3rd quarter 2019.

Note: The u-Blox GPS and Multi-GNSS based products listed above are optimized for fixed position Precision timing applications but, with proper setting of "Dynamic Mode," also provide superb performance in both high and low speed timing and navigation applications.

Synergy's SSR Series GPS and Multi-GNSS OEM receivers are also include backward compatible 6, 8 and 12 channel Motorola binary emulation messages. Email legacy receiver replacement requirements to OEMtech@synergy-gps.com.

LIMITED WARRANTY

Synergy Systems, LLC offers a limited warranty for the Eval Board, and associated Antenna, Interconnecting Cables and embedded GPS or GNSS receiver, if any, against defects in material and workmanship, under normal use and service, for a period of one year from the product's original ship date. For full Synergy Systems Terms and Conditions statement, visit: http://www.synergy-gps.com

The Eval Board may be supplied alone or with the user's choice of GPS or Multi-GNSS receivers matching the industry standard 40 mm x 60 mm size, I/O and RF connector footprints and operating from either 3 volts or 3.3 Volts DC.

Contact Synergy first for purchase details and pricing and tech-support as required to aid in operation, or trouble shooting problems prior to returning products.

After confirmation from Synergy that a return is needed, a Material Return Authorization (MRA) number is assigned based on the customer's completed MRA form available at Synergy's web site "Customer Support" section at: http://www.synergy-gps.com. Products should be shipped to Synergy via prepaid freight. On receipt at Synergy, the unit is diagnosed, refurbished or replaced and shipped back at no charge via pre-paid freight. Ship to:

> Attn: MRA number _____
> Synergy Systems, LLC
> 9950 Scripps Lake Drive, Suite 106
> San Diego, CA 92131 USA
> TEL: (858) 566-0666
> FAX: (858) 566-0768

Non-Warranty repairs are quoted on request.

For configuration assistance, order placement and technical support call or Email:

SYNERGY SYSTEMS, LLC *Time proven products and support®*	Phone: (858) 566-0666 Fax: (858) 566-0768 Email: oeminfo@synergy-ps.com Web: http://www.synergy-gps.com