

**NEW SSR "GPS Forever Board"™ - 1024 Week Roll-Over Free\*****DROP-IN\*\* REPLACEMENT BOARDS FOR MOTOROLA M12+ and iLOTUS M12M RECEIVERS  
UPDATE OLDER GPS BASED TIMING INSTRUMENTATION PRODUCTS****Introduction:**

SSR-6T+ Precision Timing receivers embed a state-of-the-art u-Blox 50 channel, LEA-6T GPS precision timing module. SSR Series replacements are form, fit, and plug-compatible with the original Motorola M12+ and iLotus M12M OEM GPS receiver boards and include the most popular timing messages and content.

**Features:**

- Designed specifically for precision timing applications
- Motorola binary message emulation at 9600 baud for backward compatibility with legacy Motorola 12 channel M12+ and iLotus M12M receivers
- Super-Fast TTFF and State-of-the-Art Sensitivity
- More satellites tracked than receivers being replaced
- Better ADEV performance in legacy timing instruments
- Anti-Jamming Performance in EMI Environments
- Drop-In to M12+ and M12M GPS receiver slots without the need for user configuration or adjustments.
- No Receiver 1024 Week Roll-Overs!

**Physical Characteristics:**

SSR-M12x receivers use Motorola's industry standard, 60 mm x 40 mm size, mounting hole locations, connector type and positions. They are also backward compatible with Synergy's legacy SS-12 Sony based receiver, u-Blox based SSR-4S, SSR-5H, SSR-6H, Motorola M12+, iLotus M12M and Synergy's SynPaQ® Eval Kits when used in Motorola binary mode.

**Electrical Characteristics:**

The high performance SSR-6Tf+ boards embed popular u-Blox LEA-6T Series Flash based GPS modules operating at 2.75 to 3.5 VDC. See basic characteristics on this page. Full performance specifications and features are listed at: <https://www.u-blox.com>.

SSR Series receivers feature an on-board microprocessor to generate emulated 12 channel Motorola binary messages. An Antenna Power Management System with antenna under current alert and over current protection is designed to supply 5VDC to a wide range of GPS antennas.

"Drop-In" Compatibility\*\* - See page 2

PHYSICAL CONSTRUCTION	
<b>Di</b>	40 mm x 60 mm x 4.5 mm
<b>W</b>	12 grams
<b>D</b>	10 Pin, 2x5 header, 1.27mm pitch
<b>A</b>	MMCX end-Launch jack

OPERATIONAL CHARACTERISTICS	
<b>Architecture</b>	50 channels with over 2 million correlators
<b>Acquisition Channels</b>	32 channels
<b>Tracking Channels</b>	16 channels (12 channels for Motorola M12x compatibility)
<b>Frequency</b>	1575.42 MHz, C/A code
<b>Acquisition Times:</b>	
<b>Hot Start</b>	< 1s
<b>Cold Start</b>	26 seconds typical
<b>Position Accuracy</b>	<2.5 m Autonomous - <2.0 m SBAS - <2.0 m RTCM-104
<b>Sensitivity</b>	-148 dBm at cold start -162 dBm while tracking (-160 dBm Reacquisition)
<b>Power Supply</b>	2.7-3.6 VDC 123 mW @ 3.0 V
<b>Backup Power</b>	+1.4 to +3.6V at 22 uA Max
<b>Temperature Range</b>	-40 Degrees to + 85 Degrees
<b>Storage Temperature</b>	-40 Degrees to + 85 Degrees
<b>Humidity</b>	95% over dry bulb range of +38°C to +85°C

1PPS Timing Pulse	
<b>Accuracy of 1PPS</b>	30 ns RMS, <60 ns 99%
<b>Granularity</b>	21 ns
<b>Compensated</b>	<15 ns (quantization error applied)

COMMUNICATIONS INTERFACE	
<b>Default Protocol</b>	Motorola 12 channel Binary emulation at 9600 baud
<b>Default Status</b>	1PPS output active at power-on, no message outputs
<b>Update Rate</b>	1Hz

Refer to Synergy's SSR Integration Guide and u-Blox LEA-6T GPS module User's Guide for full module technical and performance specifications. The "u-Blox LEA-6T Receiver Description Protocol" specification is copyright by u-Blox and available here: <https://www.u-blox.com>. For testing SSR Series receivers alone, refer to Motorola's M12+ User's Guide for Motorola binary message details. Download SynTAC, WinOncore12 or SiRF Oncore software at the Synergy web site listed below. A list of emulated Motorola Binary messages is shown in Tech-Note #498 (expanded as SSR Command/Reply Messages are added).

**SSR-6Tf+ OEM Precision Timing Board Ordering Information:**

Part Number	Configuration Description
16054423G P2	Motorola M12+ Clone with Motorola 12 channel Binary Emulation
16054423G P3	iLotus M12M Clone with Motorola 12 channel Binary Emulation

**Notes:**

1. See page 4 for photos of Motorola's M12+ and the iLotus M12M receiver. Prior to ordering, determine the exact GPS receiver board to be replaced.
2. u-Blox UBX and NMEA messages not supported in this SSR board configuration.
3. 1024 Week Roll-Over Free\* with firmware versions 3.58 and above.

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



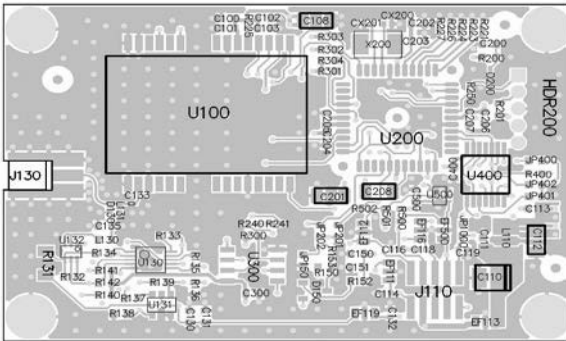
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**DROP-IN\* REPLACEMENT BOARDS FOR MOTOROLA M12+ and iLOTUS M12M RECEIVERS**

Component Layout

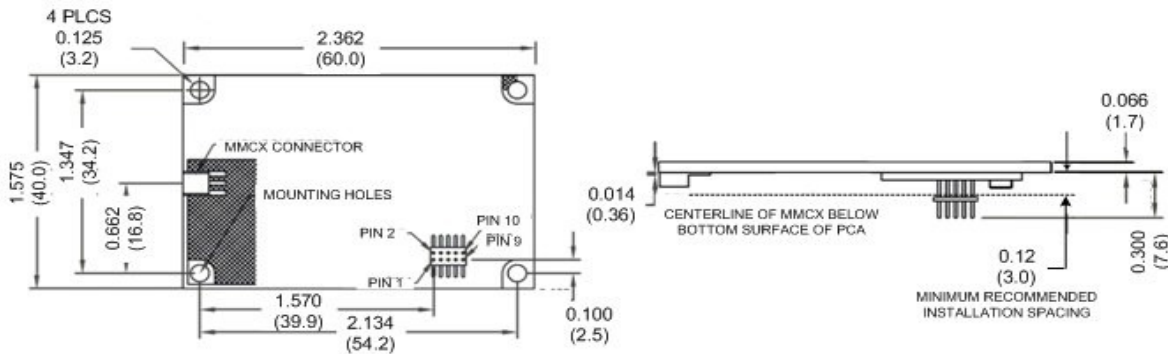


J110 Pin-Out Detail

Pin #	Signal Name	Description
1	TxD	Transmit Data
2	Rxd	Receive Commands
3	Power	Regulated 3.0-3.3 volts
4	1PPS	1PPS Output
5	Ground	Signal/Power Ground
6	Battery	Backup Battery Input
7	No Connect	No Connect
8	RTCM In *	RTCM Data Input
9	Ant. Bias	3.0-5.0 Ant. Bias Voltage
10	1PPS-2	.25Hz to 10MHz

\* RTCM Correction Input Special Order as of 1 January 2018

SSR Series board layout and connector position detail



Notes:

1. "Drop-In" Compatibility\* - SSR Series receivers include emulation of the most popular Motorola binary Command and Reply Messages that Synergy supported over 27 years as a distributor for Motorola and iLotus OEM GPS receiver products. Some reply messages do not have all of the binary bits listed in Motorola and iLotus User's Guides (<https://synergy-gps.com/support/>) because they were not needed by Synergy's customer base or raw data was not available in the more modern, updated u-Blox receiver architecture. Additional commands, including those to control NMEA output messages, although not popular in precision timing applications, can be added.
2. u-Blox based SSR receivers use a modern receiver architecture, completely different from Motorola's series of receivers with a firmware base originally designed in the late nineteen nineties (Eagle VIII). It is impractical to emulate an exact duplicate of the Motorola binary protocol, and it is not a compatibility goal since an exact duplicate would limit the performance advancements that u-Blox modules offer.
3. Most SSR Series receivers include a 5 pin connector for re-programming the binary emulation microprocessor for new products built in high quantities (Motorola and iLotus did not offer user firmware updates). For SSR Series receivers, an ICD2, ICD3, or similar in-circuit programming tool, can be used to update the processor when firmware updates become available.
4. Unlike M12+ and M12M receivers, a backup battery is not required to hold an Almanac and last position to produce a faster Time to First Fix (TTFF). An external backup voltage is recommended if running the Real Time Clock (RTC) if required. An optional (special order) SSR part number is available with an on-board 11 mAh rechargeable battery to operate the RTC for about 2 weeks when the receiver is powered down. The on-board battery reduces the normal operating and storage temperature range from -40°C to +85°C to -20°C to +60°C.

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



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Time proven products and support®

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**SSR Replacement Receiver Selection Chart For Updating Lucent Technologies  
Legacy Products Designed for Motorola 12 channel receivers**

Lucent Technologies Product	Original GPS Receiver Type	New Synergy Model	Synergy P/N
SII - RFTG L104D, L106D	Motorola - M12+ Oncore P2	SSR-M12+	16054423G-P2
CTU-II L1 series 1 to 7	Navman Pico T * P2	SSR-M12+	165K4423G
CTU-II L1 series 8 to 13	Trimble Res-T ** P2	SSR-M12+	16054423G-P2
CTU-II L1 series 14	Trimble SMT ** P2	SSR-M12+	16054423G-P2
CTU-II L2 series 1 to 7	Navman Pico-T * P2	SSR-M12+	165K4423G
CTU-II L2 series 8	Trimble Res-T ** P2	SSR-M12+	16054423G-P2

Notes: \* The SSR-Pico Clone P/N is a kit that includes the SSR-Pico P/N 16554423G-2 receiver, mounting hardware and RF Cable

\*\* Synergy may offer a solution for the Trimble and Furuno receivers shown if there are provisions on the motherboard for the Motorola M12+ 10 pin I/O header – Send photos to confirm.

Due to a contract agreement, Synergy does not offer SSR replacement GPS boards for the following Lucent Technologies legacy products: TFU - 44ww7, 44ww8, TFU - 44ww7B, 44ww8B, CTU - 1:1, 1:2, CTU - 1:3 and later

**SSR Replacement Receiver Selection Chart For Other Manufacturers Timing Instruments**

Manufacturer & Model or Receiver Type	Original GPS Receiver or Equivalent	New Synergy Model Replacement	Synergy Replacement P/N
Spectracom 9383 (early units)	Motorola M12+	SSR-M12+	16054423G-P2
Spectracom 9383 (later units)	iLotus M12M	SSR-M12M	16054423G-P3
Symmetricom SSU 2000	iLotus M12M	SSR-M12M	16054423G-P3
Symmetricom SyncServer S100, S200, S250, S300, S350*	iLotus M12M	SSR-M12M	16054423G-P3*
Symmetricom XLi	iLotus M12M	SSR-M12M	16054423G-P3
Arbiter 940A	iLotus M12M	SSR-M12M/T	16054423G-P3
FEI-Zyfer GSync 391 P/N 391-010-244	Motorola M12+	SSR-M12+	16054423G-P2
FEI-Zyfer GPStarplus 565	iLotus M12M	SSR-M12M	16054423G-P3
ESE ES-911	Motorola M12+	SSR-M12+	16054423G-P2

\* SyncServer products Shipped with several GPS receivers shown above. SSR part number 16054423G-P2 replaces the Pentar Model SA101 Adaptor board with Furuno GT8031 Module (an M12+ replacement). The Goshay Group’s Adaptor Board with an iLotus M12M is replaced with the SSR part number 16054423G-P3.

**To Order:**

- A. Determine a part number from this page. If a manufacturer’s name is not listed, please e-mail a photo of the front panel of the unit showing its model name.
- B. Even if a product is listed, e-mail a photo to Synergy of the Product model and the top of the Motorola or iLotus receiver’s serial number label.
- C. Synergy will return confirmation of the replacement SSR receiver part number and quote a price for the number of receivers desired.

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## Comparison of Motorola M12+ and iLotus M12M GPS Receivers

Note the small but distinguishable **Component differences**



**Motorola M12+  
RF Dam PC trace  
around RF Section**



**iLotus M12M  
No PC Trace  
around RF Section**



**Furuno on  
Pentar Adaptor Board**



**M12M on Goshay  
Adaptor Board**

Pentar produced a Furuno based Adaptor Board and The Goshay Group made an iLotus M12M based Adaptor Board. Both included an emulation processor to update timing instrumentation using Motorola 8 channel UT+ OEM GPS boards. Synergy's Single-Board Drop-In receiver replacements out-perform all of the above receivers in Time to First Fix (TTFF), have much higher sensitivity to track more satellites and produce better Allan Deviation results (see page 5).

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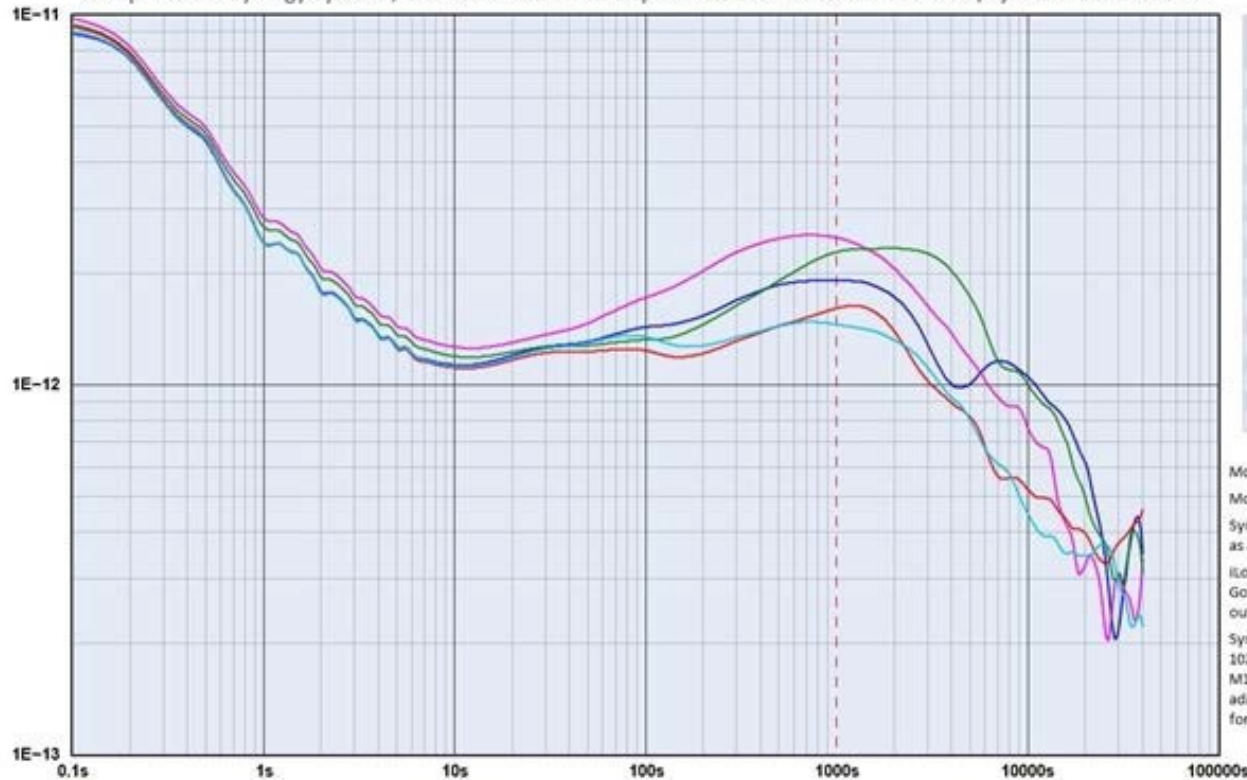
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27 October 2023

Allan Deviation  $\sigma_y(\tau)$

Comparison of Synergy Systems, LLC SSR-6Tf Receiver Replacement for 8 Channel UT+ in HP/Symmetricom 58503B



Tau	Sigma(Tau)
1s	2.42E-12
2s	1.77E-12
4s	1.35E-12
8s	1.15E-12
10s	1.13E-12
20s	1.19E-12
40s	1.28E-12
80s	1.36E-12
100s	1.35E-12
200s	1.28E-12
400s	1.41E-12
800s	1.48E-12
1000s	1.46E-12
2000s	1.32E-12
4000s	9.23E-13
8000s	5.72E-13
10000s	4.46E-13
20000s	3.48E-13
40000s	2.23E-13

**Configurations Compared:**  
 Motorola 8 Channel VP-88 Oncore FW v10.0  
 Motorola 8 Channel UT+ Oncore FW v3.2  
 Synergy 16 Channel SSR-VP/UT+ Configured as an 8 Channel SSR-UT+ for direct install.  
 ILotus 12 Channel M12M Mounted to a Goshay Group Adaptor Board Configured to output 8 Channels  
 Synergy 16 Channel SSR-M12M Clone, no 1024 Roll-Over, configured as a 12 Channel M12M Clone, Mounted to the Goshay Group adaptor board (for conversion to 8 channels for compatibility with the 58503B).

Trace	Input Freq	Sample Interval	ADEV at 1000s	Duration	Acquired	Instrument
53503B with VP 10.0	10.0 MHz	0.100 s	1.92E-12	1d 0h 0m 0s	864000 pts	Phase Station 53100A
53503B with UT+ V3.2	10.0 MHz	0.100 s	2.51E-12	1d 0h 0m 0s	864000 pts	Phase Station 53100A
53503B with Goshay + M12+	10.0 MHz	0.100 s	2.30E-12	1d 0h 0m 0s	864000 pts	Phase Station 53100A
53503B with Goshay + SSR-6Tf+	10.0 MHz	0.100 s	1.62E-12	1d 0h 0m 0s	864000 pts	Phase Station 53100A
53503B with SSR-VP/UT+	10.0 MHz	0.100 s	1.46E-12	1 d	857751 pts	Phase Station 53100A