



Preliminary Datasheet

XLi IEEE 1588 Grandmaster

Ultra-Precise, GPS Referenced IEEE 1588 Grandmaster Clock

KEY FEATURES

- Better Than 30 Nanosecond RMS Time Stamp Accuracy to UTC
- GPS Synchronized with 12 Channel GPS Receiver with TRAIM
- IEEE 1588-2002 protocol support
- Operates as IEEE 1588 Grandmaster or Slave clock
- Time Interval and Event Time capture (TIET)
- Better Than 1×10^{-12} Frequency Accuracy
- Supports Primary and Secondary Reference Inputs
- Standard 10/100Base-T Ethernet
- Telnet, SNMP & Enterprise MIB
- Standard Vacuum Fluorescent Display and Keypad
- Flash Memory for Remote Software Upgrades
- IRIG Generator or Synchronized Generator
- Standard 1PPS, Selectable Pulse Rate Outputs, Alarm, Auxiliary Reference, and various time code In/Out

KEY BENEFITS

- Nanosecond level synchronization accuracy possible between clocks over standard Ethernet network infrastructure.
- Uses GPS for precise UTC time accuracy.
- Operate as IEEE 1588 protocol Grandmaster clock for IEEE 1588 slaves, boundary clocks, and ordinary clocks.
- Plug and play compliant with IEEE 1588 -2002.
- Use the Time Interval and Event Time capture (TIET) to characterize network element induced latency and jitter.

IEEE 1588 Precise Time Protocol (PTP), with time transfer accuracy in the 10-100 nanosecond range, provides a significant improvement in time synchronization accuracy compared to other alternatives. IEEE 1588 also offers major cost savings in time distribution since it is deployed using hardware clocks with standard Ethernet LAN hubs, switches and cat 5 cables. The low overhead, multicast protocol can use the same LAN as normal network traffic.

For those industrial automation, military and aerospace applications that can benefit from the cost savings and time accuracy of IEEE 1588, Symmetricom offers the XLi IEEE 1588 Grandmaster, the ultra-precise master clock for an IEEE 1588 synchronized network. The Symmetricom Grandmaster is IEEE 1588-2002 compliant. It time stamps PTP packets with a time stamp accuracy of 30 nanoseconds RMS to UTC.

The XLi Grandmaster contains a dedicated high-speed 1588 time stamp processor. Operating at 100Base-Tx line speed with deep time stamp packet buffers, the XLi Grandmaster can support thousands of 1588 clients. This is made possible in part by sending 1588 *Sync & Follow_Up* messages periodically using multicast addressing, and in part by being able to quickly and accurately process 1588 client initiated *Delay_Req* and *Delay_Resp* messages.

Network infrastructure elements such as hubs and switches effect time transfer accuracy when using 1588. Hubs and particularly switches add nondeterministic latencies and jitter to the packet transit times from a 1588 master to 1588 slaves. As a result, the 1588 slave synchronization accuracy is degraded from that of the master. Hubs generally interfere the least whereas an Ethernet switch can easily add 100's of nanoseconds of nondeterministic delay to packets transiting the network. (Routers block IEEE 1588 packets because the hop count is set to 1).

To aid in characterizing the delay and jitter of network elements such as a switch, the XLi Grandmaster comes standard with Time Interval measurement capabilities. By synchronizing the slave via 1588 with and without the switch in-between, and analyzing the slave 1PPS output with the XLi Grandmaster Time Interval function, the latency of the switch can be characterized. This is very useful in estimating the time degradation effects of the switch (or any network element) before deployment in the network.

The XLi Grandmaster also operates as a 1588 slave on the network. Time derived from another 1588 master clock can be the primary or secondary time reference in the XLi Grandmaster. This is a means by which accurate time can be transferred over Ethernet to the XLi and, for example, then output as IRIG B time code.



XLi IEEE 1588 Grandmaster

XLi IEEE 1588 Grandmaster Specifications

IEEE 1588 SUBSYSTEM

- Compliance: IEEE 1588-2002
- Number of IEEE 1588 ports: 1 Standard 10/100 Base-T
- Max line speed: 10Base-T/100Base-Tx
- Grandmaster operation
 - Time stamp accuracy: XLi clock accuracy
 - Sync Intervals: 1, 2, 8, 16, and 64 seconds
 - Packet throughput: >100 Delay_Req/second
 - Delay_Req buffer: 256 time stamps
- Slave operation
 - Sync accuracy to master: 17 ns RMS typical (via crossover cable)

GPS RECEIVER

- Receiver input: 1575.42 MHz L1 C/A code
- Tracking: 12 parallel channels with TRAIM
- Acquisition time: Cold start <20 min. (typical)
- 1PPS output accuracy: UTC(USNO): ±30 nS RMS 100 ns peak 99%
- Frequency output accuracy: 1 x 10⁻¹² @ 1 day
- Stability when not tracking satellites: 5 x 10⁻⁷ (0°C to 50°C) typical

TIME CODE UNIT (TCU) SYNC GENERATOR

- Input/output: IRIG A, B, NASA 36

OSCILLATOR

- Standard oscillator: VCTCXO

STANDARD INPUT/OUTPUT SIGNALS

- Eight standard I/Os: Two for control and monitoring: Serial and Ethernet port. Six for signals: 1PPS out, code in, code out, rate out, aux reference, and Open Collector Alarm output. (all with BNC female connector).
- RS-232/422: User selectable up to 19200 bps
Connector: Male 9-pin D subminiature
- Network interface: Standard 10/100 base-T RJ-45 8-pin connector.
Protocols: Telnet and SNMP for the user interface, FTP (for firmware upgrades), and optional NTP.
- 1PPS: Pulse width: 20 µs (±1µs) on the rising edge on time, TTL levels into 50Ω, BNC female connector.
- Code input: AM or DC code IRIG-A, B, and NASA-36
AM Code: 0.5 Vp-p to 10 Vp-p, 100 kΩ ground, ratio (AM): 3:1 ±10%
DC Code: Logic low <1.25 V and Min 300 mV, Logic Hi >1.25 V and Max 10 V.
Impedance: 100 K or 50Ω
Polarity: positive or negative
Connector: BNC female
- Code out: Default is IRIG-B AM
Format: AM or DC code IRIG-A, B, and NASA-36.
AM Code: 3 Vp-p, into 50Ω ±10%, ratio (AM): 3:1.
DC Code: TTL into 50Ω
Connector: BNC female
- Rate out: Default: 10 MPPS. Rate: 1PPS, 10 PPS, 100 PPS, 1 KPPS, 10 KPPS, 100 KPPS, 1 MPPS, 5 MPPS, and 10 MPPS. Duty cycle: 50% and 60/40%.
Amplitude: TTL levels into 50Ω
Connector: BNC female
- Aux ref input: Input frequency: 1, 5, and 10 MHz sine-wave.
Amplitude: 1 Vp-p to 10 Vp-p at 1 kΩ to ground.
1 Vp-p to 3 Vp-p at 50Ω to ground.
Impedance: Configurable 1 kΩ or 50Ω to ground
Connector: BNC female
- Alarm: Open collector. Max 25V/50 mA.
Connector: BNC female

MECHANICAL/ENVIRONMENTAL

- Time and frequency system
 - Power: Voltage: 90–260 Vac. Frequency: 47–440 Hz
 - Connector: IEC 320
 - Size: 1U: 1.75" x 17.1" x 15.35"
(4.44 cm x 43.4 cm x 38.9 cm)
Standard 19" (48.26 cm) EIA rack system,
 - Operating temperature: 0°C to +50°C (+32°F to +122°F)
 - Storage temperature: -55°C to +85°C (-67°F to +185°F)
 - Humidity: 95%, non-condensing
 - Display: Graphics (160 X 16) vacuum fluorescent display. One line for time and day of year (TOD). Two-line alpha-numeric display for status messages and user input.
 - Keypad: Numeric 0–9, left, right, up, down, CLR, Enter, time key, status key and menu key.
- Antenna
 - Size: 3" Dia. x 3" H (7.62 cm x 7.62 cm)
 - Input: BNC female to GPS receiver. TNC on antenna +12 Vdc
 - Power: +12 Vdc
 - Operating temperature: -55°C to +85°C (-67°F to +185°F)
 - Storage temperature: -55°C to +85°C (-67°F to +185°F)
 - Humidity: 95%, non-condensing
- Certification: UL, FCC, CE, and C-UL

TIME INTERVAL FEATURE

- Measurement
 - Rate: 1 per second
 - Resolution: 5 nS
 - Accuracy: ±5 nS (+ clock accuracy)
 - Range: 0.0 to 1 year

* Display: Time into the second, updated once per second, is displayed to the nanosecond until another event occurs or until the "TIME", "STATUS", or "POSITION" push-button is pressed.

INPUT FREQUENCIES

- Rate: 1PPS
- High level: Logic Hi >1.25V <10V
- Low level: Logic Low <1.25V >0V
- Active edge: Rising (Positive)
- Pulse width: 100 nS minimum
- Input impedance: >1k, jumper selectable to 50

EVENT TIMING FEATURE

- Measurement
 - Rate: 10/second or 100/second burst
 - Resolution: 5 nS
 - Accuracy: ±5 nS (+ clock accuracy)
 - Range: 0.0 to 1 year

* Display: Event Time occurrence, hundreds of days through nanoseconds, is displayed until another event occurs or until the "TIME", "STATUS", or "POSITION" push-button is pressed.



Rear View



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