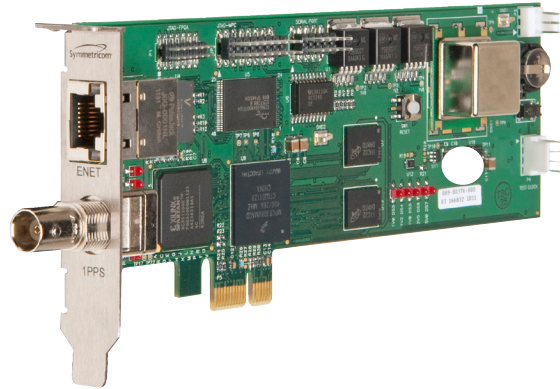


SyncPoint™ PCIe-1000

High Accuracy, High Precision
PTP Clock Card



Key Features

- 10 ns accuracy to master, typical
- 10 ns time stamping precision
- Gigabit Ethernet interface
- High performance OCXO oscillator standard
- Precision 1PPS Output
- DMA time writes to host memory with accuracy as good or better than 600 nanoseconds
- Continuous time available in Major.Minor or total nanoseconds
- Linux driver with source code included
- IEEE 1588 2008 v2 /PTP compliant
- Low profile PCIe form factor

Key Benefits

- Precise sub-microsecond time available to host applications
- High-speed, low-latency nanosecond caliber time reads from memory
- Resilience to network impairments that would otherwise degrade time accuracy
- GbE support for ease of network interoperability
- Source code for drivers to stay current
- Very well documented for easy and fast integration
- Very affordable and cost effective

The Symmetricom® SyncPoint™ PCIe-1000 PTP Clock Card provides ultra high availability time with sub-microsecond accurate time stamps for programs running in Linux. The IEEE 1588 based PCIe-1000 has been optimized to be resilient to network related time errors and provides nanosecond caliber time as needed to a Linux program in under a microsecond.

The PTP synchronized SyncPoint PCIe-1000 synchronizes to a PTP grandmaster, such as a SyncServer®, over a network. Networks can introduce arrival time jitter of critical timing packets at the PTP slave, called packet delay variation (PDV). To overcome PDV the PCIe-1000 deploys state-of-the-art filtering and servo algorithms, accommodates increased packet exchange rates, and includes a high performance OCXO oscillator as standard. The net result is an extremely accurate clock that is very resilient to network impairments.

The PCIe-1000 includes a 1PPS Output signal with a convenient BNC connector that is very useful to compare the time on the card to that of the master. This is useful in adjusting the PTP parameters for optimal time transfer accuracy over the network. The 1PPS is also useful to synchronize adjacent network devices or probes that accept a 1PPS Input.

Once synchronized, the PCIe-1000 provides time to the host machine by either writing the time directly to a host memory location or by responding to requests for time over the PCIe bus.

Applications accessing the hosted memory time location can read the time in excess of one million times per second and retrieve monotonically advancing time accurate to 600 nanoseconds or better.

The low profile PCIe-1000 with its Gigabit Ethernet interface is readily adaptable to modern networks and servers while also consuming a minimal amount of power. With its x1 PCIe connection the PCIe-1000 fits in a wide variety of server types with a minimal power footprint.

Integration of the PCIe-1000 is very straightforward using the included Linux driver and control interface. The included source code means those using the very latest Linux version can be compatible without having to wait for any proprietary software to be upgraded.

The SyncPoint PCIe-1000 is also a perfect combination of accuracy and price. The ultra precise time accuracy of the PCIe-1000 is balanced with a cost effective design, which makes it a very viable PTP slave solution for all essential servers needing the most accurate time.

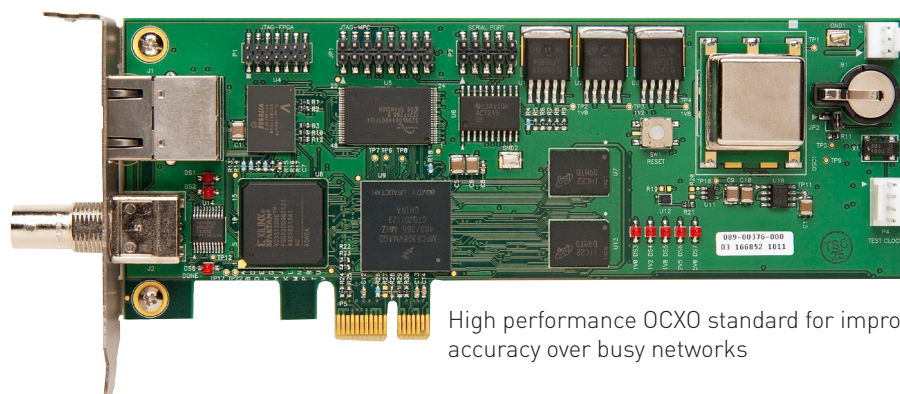
SyncPoint™ PCIe-1000

Inputs

- Gigabit Ethernet port
- IEEE 1588 2008 v2 / PTP
- 1-Step or 2-Step Clock Multicast
- Up to 32 Sync packets/second
- E2E or P2P
- 10 ns hardware time stamp resolution

Output

- Precision 1PPS
- Use to measure clock card accuracy
- Synchronize adjacent network devices



High performance OCXO standard for improved accuracy over busy networks

Over the PCIe Bus

- High speed time writes to host memory
- Time provided on request over bus
- Major.Minor time format
- Total time in nanoseconds format
- Linux configuration and control
- x1 PCIe low profile

When Speed and Accuracy Matter

The SyncPoint PCIe-1000 has been optimized for an environment where high-speed, low-latency access to time is just as important as the precision and accuracy of the time itself. The PCIe-1000 can continuously write time to host memory. This time is available in two formats, either Major.Minor or a total nanoseconds counter value.

Total Nanosecond Advantage

The advantage of reading the time in total nanoseconds is that in a single 64 bit memory read the entire time can be consumed by an application and quickly used or differenced with other time stamps if needed. This time can be converted to Major.Minor format later if desired. This technique reliably provides monotonically advancing, sub-microsecond accurate time (600 nanoseconds or better) with every time read at rates beyond a million times per second. This technique is also more accurate and reliable than using software that reads time from a clock card to steer the local Linux clock from which an application reads the time. (This is due to the instability of the local Linux clock versus the high stability of the SyncPoint PCIe-1000 clock.)

Reading Major.Minor time is a two step operation where Major (integer seconds) is read from one location and Minor (fractional seconds) from another.

As with any PCIe plug-in card, time can also be read directly from the PCIe-1000 over the PCIe bus but will be subject to PCIe bus delays that can be up to 3 microseconds.

PTP Enhancements to Overcome Network Caused Packet Delay Variation

Aside from support of the IEEE 1588 Default Profile, the PCIe-1000 supports increased timing packet exchange rates. Decades of Symmetricom timing expertise is incorporated in the filtering and servo technology in the PCIe-1000 to take advantage of these increased packet rates useful in overcoming PDV. As a result, PTP packets can transit more standard network switches and related packet queues while the PCIe-1000 still maintains a very high degree of accuracy. In many cases the need for expensive PTP-enabled switches such as boundary clocks and transparent clocks can be eliminated.

Linux Software Driver

A simple interface to the SyncPoint PCIe-1000 is all that is necessary to configure the clock card. In fact, the PCIe-1000 can automatically receive many of its configuration parameters directly from the PTP grandmaster.

The Linux driver to interface the PCIe-1000 is very straight forward as well. Driver support for the Host PC Linux drivers and sample application code provided to greatly facilitate integration into the customer's environment.

SyncPoint™ PCIe-1000 and SyncServer® S350

End-to-End Accuracy and Accuracy Verification

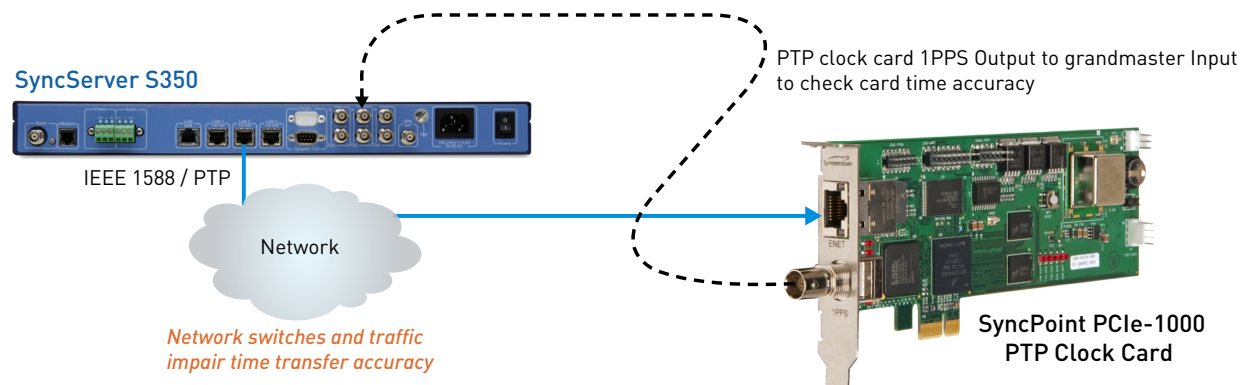


Figure 1. 1PPS loopback example to measure PCIe-1000 time accuracy to SyncServer

Closed Loop Accuracy Verification

While the PCIe-1000 conforms to the IEEE 1588 standard and will interoperate with any other PTP master that also conforms, there are advantages to working with the Symmetricom SyncServer S350. The S350 has a built-in Time Interval measurement function that provides real-time offset statistics of an externally supplied 1PPS signal. By taking the 1PPS Output from the PCIe-1000 and connecting it to the S350, the S350 can measure the exact time difference between the two clocks down to 5 nanoseconds.

Real-Time Measurement Statistics and Charting

The PTP slave accuracy statistics relative to the S350 are computed and displayed in real-time via S350 and displayed in the web interface. The sample count, max, min, mean, standard deviation, median and RMS of the measurement set is continuously updated on the instrument-like web interface throughout the duration of the test.

Data can be charted in the web interface in real-time either as a time series or

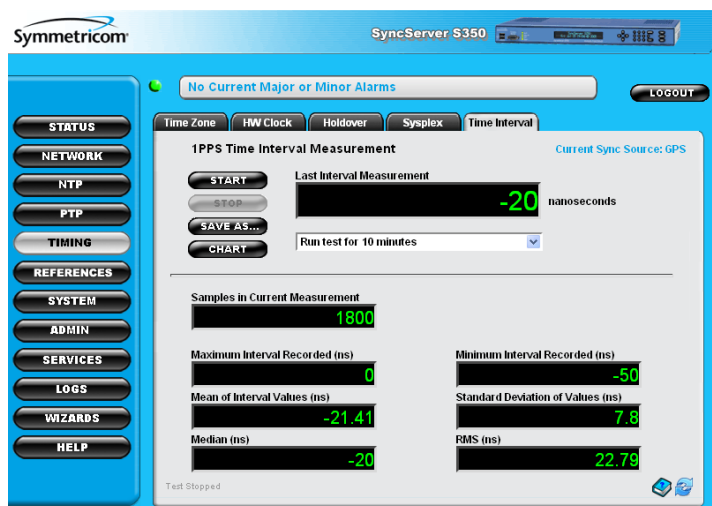
histogram. The chart continues to update as the measurements are made or charting

can be paused and viewed statically while measurements are made in the background. The charting is very flexible with line, scatter, column or histogram formats with a variety of viewing options. Measurements can be performed unattended and for specified periods of time. Once a test is completed the data can be saved to a local text file.

Real World Accuracy Measurements

Once the baseline accuracy has been verified network elements and traffic can be added and the effect on time accuracy at the PCIe-1000 can be directly measured. If the accuracy has degraded due to network impairments the packet rate can be increased as appropriate to optimize the time accuracy for that network/traffic configuration.

This 1PPS loopback accuracy testing is very useful to measure the detrimental effects of switches and data traffic as well as the effectiveness of boundary clocks or transparent clocks.



SyncPoint™ PCIe-1000

Specifications

IEEE 1588 / PTP COMPLIANCE

- IEEE 1588 2008 (v2)
- Role: PTP Slave
- Default Profile with parameter extensions
- 1-step or 2-step clock operation
- Multicast
- Hardware time stamping of PTP packets

TYPICAL PTP SLAVE PERFORMANCE

- Time Accuracy:
 - 1 pps Sync/Delay_req rate:
 - 7.9 nanoseconds @ 1 sigma (1 σ)
 - +/- 18 nanoseconds
 - To master via crossover cable
 - 32 pps Sync/Delay_req rate:
 - 10 nanoseconds @ 1 sigma (1 σ)
 - +/- 20 nanoseconds
 - To master via crossover cable
- Time Stamp Precision/Resolution: 10 nanoseconds

CONFIGURABLE PTP PARAMETERS

- Transport Protocol: UDP or 802.3
- Delay Mechanism: E2E or P2P
- Sync, E2E Delay and P2P Delay Intervals:
 - 32 packets / 1 sec
 - 1 packet / 1 sec
- Packet TTL: 1 to 256
- Priority 1 and 2: 0 to 255
- Domain Number : 0 to 255
- Mean Announce Message
 - Transmit Interval: 1, 2, 4, 8, 16, 32, 64 seconds
- Announce Receipt Timeout Multiplier: 2, 3, 4, 5, 6, 7, 8, 9, 10

Network

Ethernet: RJ-45 100/1000 Base-T

Timing I/O

1PPS-out: BNC Rising edge on-time, TTL into 50 Ω
Pulse width: 60 microseconds

Oscillator

Type: High Performance OCXO
Stability:

Short term: +/- 5 ppb max tempco
+/- 20 ppb max voltage
+/- 25 ppb max
Long term: +/- 1 ppb daily
+/- 100 ppb yearly
+/- 500 ppb 10 years

PCIe SPECIFICATION

Single lane PCI Express (PCIe) Interface, version 1.0 compliant
Power: +3.3V @ 1.9 A
+12V @ 50 mA

MECHANICAL

Size: Low Profile PCIe
Dimensions:
3.25 inches (8.26 cm) High
6.75 inches (17.15 cm) Deep

ENVIRONMENTAL

Temperature:
Operating: 0°C to 50°
Storage: -30°C to 85°C
Humidity: 5% to 95% non-condensing

Certifications: FCC Class B, CE(RoHS) 6 of 6

PRODUCT INCLUDES

SyncPoint PCIe-1000 clock card; standard height and low-profile cover plates; one year warranty; CD with User Guide and Linux Driver Software.

SOFTWARE

CD provides all software for 32/64 bit Linux including: Device driver, API driver, and source code to sample applications using the provided APIs. Command line interface and representative API calls to configure, monitor, and read time from card registers and host memory.

