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SyncServer® S650

Accurate, Secure and Flexible Time and Frequency Standard

Features

- <15 ns RMS to UTC (USNO) through GPS
- <1x10–12 frequency accuracy
- Modular timing architecture with unique and innovative FlexPort™ technology
- Popular timing signal inputs/outputs standard in the base timing I/O module (IRIG B, 10 MHz, 1PPS)
- Four standard GbE ports with NTP hardware time stamping, two additional 10 GbE ports optional
- Web-based management with high-security cipher suite
- –20°C to 65°C operating temperature, shock and vibration qualified
- Rubidium Atomic Clock or OCXO oscillator upgrades
- Dual power supply option
- Additional timecode I/O including IRIG A/B/C37/E/G/NASA/2137/XR3/HaveQuick/PTTI available
- T1/E1 Telecom I/O available
- Superior 10 MHz low phase noise options
- Galileo/GLONASS/BeiDou/SBAS/QZSS option
- PTP multi-port/profile output option
- PTP input option
- S650i model with no GNSS
- DISA/DoDIN approved product

Applications

- FlexPort timing technology efficiently and cost-effectively adds innovative "any signal, any connector" technology, eliminating the wasted space inherent with legacy style fixed-signal modules/BNCs
- Best-in-class low phase noise 10 MHz outputs for satellite ground stations and radar systems
- Multiple GbE network ports for easy network configuration and adaptation
- Reliable and rugged design for long product life and wide application scope
- Many security-hardened, network based features for stringent IA requirements

S650 with Timing I/O Modules (Optional Configuration)



Unparalleled Flexibility

The modular SyncServer® S650 combines the best of time and frequency instrumentation with unique flexibility and powerful network/security-based features.

The base Timing I/O module with eight BNC connectors comes standard with the most popular Timing I/O signals (IRIG B, 10 MHz and 1 PPS). When more flexibility is required, the unique FlexPort technology option enables six of the BNCs to output many supported signals (time codes, sine waves, programmable periods), all configurable in real time through the secure web interface. This incredibly flexible BNC-by-BNC configuration makes efficient and cost-effective use of the 1U space available. Similar functionality is applied to the two input BNCs, as well. Unlike legacy modules with fixed count BNCs outputting fixed signal types per module, FlexPort technology can allow up to 12 BNCs to output any combination of supported signal types.

The Timing I/O module is also available with T1/E1 Telecom I/O, HaveQuick/PTTI I/O and fiber input/output connectors.

Superior Low Phase Noise (LPN) Performance

For applications requiring superior LPN 10 MHz signals, two different LPN modules are available. Each module has eight extremely isolated 10 MHz LPN outputs, with each module offering excellent levels of LPN or ultra LPN performance.

Robust Timing and Design

The 72-channel GNSS receiver coupled with Microchip's patented active thermal compensation technology provides excellent accuracy of <15 ns RMS to UTC (USNO). This in addition to a durable hardware design subjected to MIL-STD-810H testing, high-reliability components extending the operating temperature range to –20°C to 65°C, and dual power supply options. Further, upgrading to a high-performance oscillator, such as a Rubidium atomic clock, keeps SyncServer S650 accurate for long periods in the event of a GNSS service disruption.

Secure Networking

Security is an inherent part of SyncServer S650. In addition to many security features and protocols, services can be selectively disabled. The four standard GbE ports, and two optional 10 GbE ports, can accommodate 10,000 NTP requests per second using hardware time stamping and compensation. NTP monitoring, charting and MRU logging assist in managing the NTP client activity. For more secure NTP operations, enable the optional security-hardened NTP Reflector™ with line speed, 100% hardware-based NTP packet processing.

Leverage Built-In Hardware

SyncServer S650 includes many built-in hardware features enabled through software license keys, such as the security-hardened NTP Reflector, Galileo/GLONASS/BeiDou/QZSS support, and multi-port/profile IEEE 1588 PTP output/input operations.

SyncServer S650, the future of time and frequency, today.

Four GbE Ports for Performance, Flexibility and Security

The S650 has four dedicated and isolated GbE Ethernet ports, each equipped with NTP hardware time stamping. These are connected to a high-speed microprocessor with microsecond-accurate time stamps to assure high-bandwidth NTP performance. This exceeds the need of servicing 10,000 NTP requests per second with no degradation in time stamp accuracy.



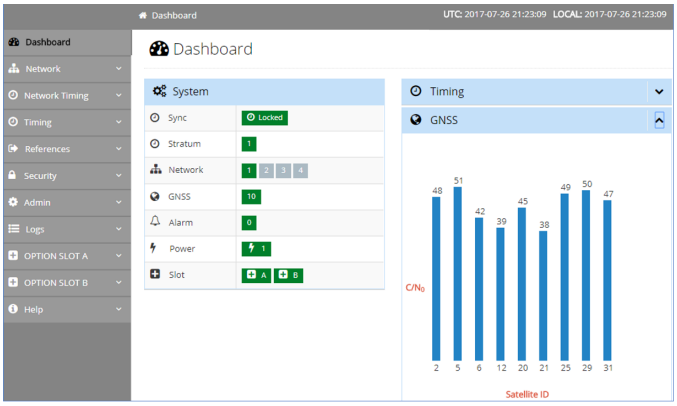
The four GbE ports provide network configuration flexibility and enhanced security. Multiple isolated and synchronized time servers can also be configured. Two 10 GbE SFP+ ports can be added for NTP/PTP operations as well.

Multiple ports provide the flexibility to adapt to different network topologies as networks grow and change. An S650 can be the single time source to synchronize clients on different subnets and physical networks. There is only one time reference, but it can appear as though there are four clocks available because each port is independent.

NTP can be served on all four ports (six if 10 GbE ports are added). The highly secure web-based management interface is only available on port 1, so that administrators may choose to keep that IP address private and secure. Unique access control lists per port can govern server response to client requests for time.

Intuitive, Secure and Easy-to-Use Web Interface

The modern web interface is the primary control interface of the S650. Once the keypad and display bring the unit online, complete status and control functions are easily found on the left navigation menu. A REST API also included.



At-a-glance dashboard presentation combined with logical organization and intuitive controls that make configuring the S650 easy.

Standard Management Access Security

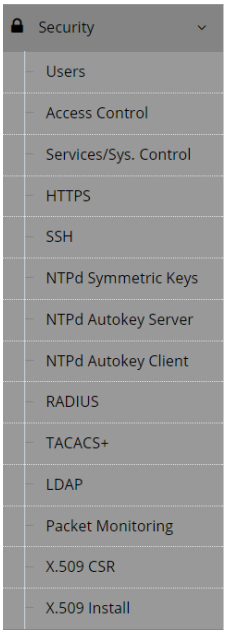
All of the expected network management protocols are standard in the S650. These include mandatory password access, HTTPS/SSL only (using the high-encryption cipher suite), SSH, access control lists, service termination, SNMPv2/v3, and NTP MD5 authentication. All traffic to the S650 CPU is bandwidth-limited for protection against DoS attacks. The local keypad on the server can be password-protected to prevent tampering.

Security-Hardening Option

The SyncServer S650 can be further hardened from both an NTP perspective and an authentication perspective through the Security Protocol License option that includes the security-hardened NTP Reflector.

Operational hardening through the 360,000 NTP packet per second NTP Reflector with 100% hardware-based NTP packet processing also works with a CPU-protecting firewall by bandwidth limiting all non-NTP traffic. The Reflector also monitors packet flow for DoS detection and reporting, yet remains impervious to the level of network traffic as it operates at line speed.

Authentication hardening is available for NTP client/server authentication through the NTP Autokey function or user access authentication through TACACS+, RADIUS and LDAP. Third party CA-signed X.509 certificates are installable for further hardening of management access. For more information about the protocol license option, see the SyncServer Options datasheet.



An entire drop-down menu in the S650 dedicated to security-related protocols.

Unprecedented NTP Accuracy

The Stratum 1 level S650 derives nanosecond-accurate time directly from the atomic clocks aboard the GPS satellites. By using an integrated, 72-channel GNSS receiver, every visible satellite can be tracked and used to maintain accurate and reliable time. Even in urban canyon environments where direct satellite visibility can be limited, manually inputting the position can be sufficient to acquire accurate time from as few as one intermittent satellite.

Ultra-High Performance NTP

The S650 can effortlessly support hundreds of thousands of network clients while maintaining microsecond-caliber NTP time stamp accuracy. NTP request throughput rates can exceed 10,000 requests/second while maintaining NTP time stamp accuracy. NTP monitoring, charting and MRU logging assist in managing the NTP client activity. If the Security Protocol License option is enabled, the NTP Reflector can process over 360,000 NTP requests per second with 15-nanosecond caliber time stamp accuracy with the added benefit of security-hardening the network port.

Superior Low Phase Noise Performance

The S650 can be optimized to provide the best possible low phase noise 10 MHz signals. Two LPN modules are available to choose from depending on the phase noise sensitivity of the user application. Each module has eight extremely isolated 10 MHz LPN outputs with each module offering excellent levels of LPN and Ultra LPN performance from the close in 1 Hz out to 100 kHz.

Multi-Port/Profile IEEE 1588 PTP Grandmaster

Applications demanding very precise time accuracy can require the IEEE 1588 precise time protocol (PTP). The S650 PTP Output License enables multi-port/profile PTP grandmaster operations leveraging the built-in hardware time stamping on each LAN port of the S650.

IEEE 1588 PTP Input License

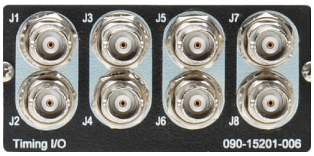
PTP input is useful for tunneling time to the S650 over the network. PTP input can be the primary time reference or used as a backup reference in the event of GPS signal loss. With GPS, the S650 can automatically calibrate and store observed network path delay asymmetries for PTP input use if the GPS signal is lost.

Multi-GNSS Constellation Support for Enhanced Reliability

Timing integrity, continuity and reliability can be improved with the GNSS option that adds support for Galileo, GLONASS, BeiDou, QZSS and SBAS constellations in addition to the standard GPS constellation. With more satellites in view, timing performance can be improved in challenging environments, such as urban canyons. SyncServer S650s ship with GNSS hardware ready to be enabled with a software license. The S650 is also available without GNSS in the S650i model.

More Timing I/O Standard

The base S650 can host two modules. The Timing I/O modules are equipped with eight connectors for timing signal input and output. The standard configuration offers a broad yet fixed selection of signal I/Os that include IRIG B, 10 MHz and 1PPS.



FlexPort—The Ultimate in Timing Flexibility

Our unique FlexPort technology efficiently and cost-effectively adds innovative “any signal, any connector” capabilities, eliminating the wasted space inherent with legacy style fixed signal modules.

The FlexPort option enables the six output connectors (J3-J8) to output many supported signals (time codes, sine waves, programmable periods) all configurable in real time through the secure web interface. User-entered, nanosecond caliber phase offsets for each connector output accommodates variable cable lengths. The two input connectors (J1-J2) can support a wide variety of input signal types.

This level of timing signal flexibility is unprecedented and can even eliminate the need for additional signal distribution chassis as there is no degradation in the precise quality of the coherent signals.



Oscillator Upgrades Improve Holdover Accuracy and Save Valuable Time

The standard S650 is equipped with a crystal oscillator that keeps the S650 accurate to nanoseconds when tracking GPS. However, if GPS connectivity is lost and the server is placed in holdover, the oscillator begins to drift, impacting timing accuracy. Upgrading the oscillator improves the holdover accuracy significantly. For example, consider the following drift rates for the standard oscillator compared to the OCXO and Rubidium upgrades.

Oscillator	Holdover Drift (first 24 hours)
Standard	400 microseconds
OCXO	25 microseconds
Rubidium	<1 microsecond

The value of the upgraded oscillator is that if the GPS signal is lost, the S650 can continue to provide accurate time and frequency. This provides personnel time to correct the problem with only gradual degradation or disruption in time synchronization accuracy.

Specifications

GNSS Receiver/Antenna

- 72 parallel channel GNSS receiver
- GPS time traceable to UTC (USNO)
- Static and dynamic operational modes
- Acquisition time of 30 seconds (cold start)
- Cable length up to 900 feet (275 m).
- GNSS option adds Galileo/GLONASS/BeiDou/SBAS/QZSS support in addition to GPS

Time Accuracy at 1 PPS Output

- Standard: <15 ns RMS to UTC (USNO), typical
- OCXO: <15 ns RMS to UTC (USNO)
- Rubidium: <15 ns RMS to UTC (USNO)

After one day locked to GPS; evaluated over normal environment (test range <±5 °F) defined in GR-2830.

Oscillator Aging (Monthly)

- Standard: $\pm 1 \times 10^{-7}$
- OCXO: $\pm 5 \times 10^{-9}$
- Rubidium: $\pm 1 \times 10^{-10}$

After one month of continuous operation.

Holdover Accuracy (One Day)

- Standard: 400 µs
- OCXO: 25 µs
- Rubidium: <1 µs

Evaluated over normal environment (test range <±5 °F) defined in GR-2830 after five days locked to GPS.

Frequency Output Accuracy and Stability

- $<1 \times 10^{-12}$ at 1 day, after locked to GPS for 1 day

Standard Network Protocols

- NTP v3,4 (RFC 1305/5905/8633), SNTP(RFC4330)
- NTP v3,4 Symmetric keys: SHA1/256/512 and MD5
- SNMP v2c, v3
- SNMP MIB II, Custom MIB, system status via SNMP
- DHCP/DHCPv6
- HTTPS/SSL* (TLS 1.1/1.2)
- SMTP forwarding
- SSHv2
- Telnet
- IPv4/IPv6
- Syslog: 1 to 8 servers
- Key management protocols can be individually disabled
- Port 1: Management and Time protocols
- Port 2, 3 and 4 (optional 5 and 6): time protocols only

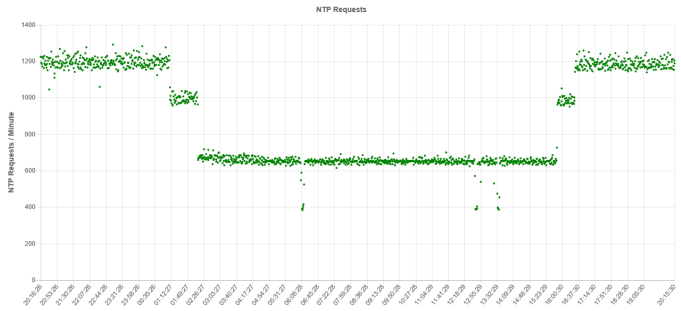
Optional Network Protocols

- Autokey (RFC5906)
- PTP
- TACACS+
- LDAPv3
- RADIUS
- X.509 HTTPS certificates

NTP Server Performance

- 10,000 NTP requests per second while maintaining accuracy associated with reference time source.**
- Stratum 1 through GPS: overall server time stamp accuracy of 5 µs to UTC with 1-sigma variation of 20 µs (typical). All NTP time stamps are hardware-based or have real-time hardware compensation for internal asymmetric delays. The accuracy is inclusive of all NTP packet delays in and out of the server, as measured at the network interface. NTP serves the UTC timescale by definition, but the user can choose to serve GPS timescale instead. The user can also select the UTC leap second smearing/slewing behavior. The SyncServer easily supports millions of NTP clients.
- NTP Activity Charting and MRU Logging: A rolling 24 hour chart displays overall NTPd requests/minute activity. An NTPd Most Recently Used (MRU) list provides details on the most recent 1024 NTP client IP addresses. Data is sortable and exportable. Selection of an individual IP address charts the NTP request totals in 30 minute increments over the past 24 hours. These tools are useful to verify an NTP client is reaching the SyncServer and to identify NTP clients that may be requesting the time more frequently than desired.
- NTP Reflector option: 360,000 NTP client mode three requests per second. NTP packets are timestamped 100% in hardware with prevailing clock accuracy. All non-NTP packets are provided to the CPU on a bandwidth-limited basis. The NTP Reflector is included as part of the Security Protocol License option.

NTP Activity Chart



Rolling 24-hour NTPd activity chart to accompany Most Recently Used (MRU) list with individual NTPd client activity details and chart.

Mechanical/Environmental

Specification	Details
Size	1.73" × 17.24" × 15.88" (4.4 cm × 43.8 cm × 40.3 cm) 1U rack mount, including BNCs
AC Power	88 VAC–264 VAC 50 Hz–60 Hz 50W Optional second power supply
Optional Dual-DC Power	20 VDC to 75 VDC 50W
Operating Temperature	Non-Rb: –20°C to 65°C Rb: –5°C to 55°C
Storage Temperature	–40°C to 85°C IEC 60068-2-1Ab (low-temp soak), IEC 60068-2-2Bb (hi-temp soak), IEC 60068-2-14Nb (change of temp), IEC 60068-2-78Cb (humidity storage), IEC 60068-2-30Db (humidity condensation)
Operational Humidity	≤95%, non-condensing, IEC 60068-2-78Cb, IEC 60068-2-30Db
Certifications	FCC Part 15, Class A, CISPR 32, Class A, UL/CSA 60950-1, IEC 60950-1, EN 60950-1, VCCI, RoHS 5/6
Server weight	12.5 lbs (5.7 kgs)
Shipping Package	16.3 lbs (7.4 kgs)

Shock and Vibration

Specification	Details
Operational	ETSI EN-300 019-2-3 Mil-Std-810H
Storage	IEC 60068-2-6 Fc (sinusoidal vibration) Mil-Std-810H, figure 514.6C-3
Transportation	
Bounce	IEC 60068-2-27Ea (shock 18 g)
Vibration	IEC 60068-2-64Fh (random vibration)
Package Drop	IEC 60068-2-31 Ec
Seismic	EN300 019-2-3, NEBS GR-63-CORE

Front Panel

Specification	Details
Display	Sharp, high-resolution, 160 × 32 vacuum-fluorescent
Keypad	0–9 numeric, up, down, left, right, ENTER, CLR, TIME, STATUS, MENU, keypad lockout.
LEDs (tri-color: green/red/orange)	
Sync	Time reference status
Network	Network connection status
Alarm	Fault condition

Rear Panel

Specification	Details
Network	Four RJ-45 100/1000BASE-T Ethernet, speed/duplex: auto, 100/1000 full
Serial Data/ Timing	NMEA-0183; ZDA/GGA/GSV/RMC messages; NENA 04-002 messages; DB9-F RS-232 user selectable rate to 115.2 kbps
1 PPS Out	BNC, rising edge on-time, TTL into 50Ω
GPS	BNC L1/B1, 1575/1602/1561 MHz
Console	DB9-F RS-232
Alarm Relay	SPST, maximum 300 mA and 32V
Power	IEC 60320 C14 connector, optional second power supply/connector, hitless switching
Optional DC Power	Mating connector is Molex HCS-125 series

Product Includes

S650

SyncServer S650 (no option modules installed in base unit), locking power cord, rack mount ears and a two-year hardware warranty. Current manual and MIB are available online at www.microsemi.com. MIB and REST API can also be downloaded from the SyncServer.

S650i

SyncServer S650i (no GNSS receiver), one Timing I/O module, locking power cord, rack mount ears and a two-year hardware warranty. Current manual and MIB are available online at www.microsemi.com. MIB and REST API can also be downloaded from the SyncServer.

S650 With Two Standard Timing I/O Modules (Optional Configuration)



Ordering Information

Custom configure your build-to-order SyncServer S650 using the online SyncServer Configurator tool at my.microsemi.com. Configurations can be submitted as requests for quotes.

Note: The SyncServer S650 is TAA Compliant

DISA APPROVED Approved Product for DoD Networks

Note: The SyncServer S650 is on the DISA/DoDIN Approved Products List

MICROCHIP

Hardware Options

Timing I/O Module(s)

Equipped with eight connectors for timing signal input and output, the standard configuration offers a broad yet fixed selection of signal I/O, including IRIG B, 10 MHz and 1PPS. Five variations of the Timing I/O Module are available as listed below. See the SyncServer Options Datasheet (DS00002920) for more signal types.

- Timing I/O Module
- Timing I/O Module + Telecom I/O
- Timing I/O Module + HaveQuick/PTTI
- Timing I/O Module + Fiber Outputs
- Timing I/O Module + Fiber Input

10 MHz Standard Low Phase Noise Module

Eight isolated, phase-coherent 10 MHz LPN outputs, with excellent levels of LPN and exhibiting low spurious noise characteristics.

10 MHz Ultra-Low Phase Noise Module

Superior levels of LPN provided on eight extremely isolated, phase-coherent 10 MHz LPN outputs with low spurious noise characteristics.

10 GbE LAN Ports

Two additional 10 GbE SFP+ ports equipped with hardware time stamping that supports NTP, PTP and NTP Reflector operations.

Rubidium Atomic Oscillator Upgrade

Improves stability, accuracy, and holdover accuracy. Holdover accuracy is <1 µs for the first 24 hours and <3 µs after the first three days.

OCXO Oscillator Upgrade

Improves holdover accuracy to 25 µs for the first day.

Dual AC Power Supplies

The dual-corded, dual-AC power supply option provides load sharing and active power management system with hitless failover.

Dual DC Power Supplies

The dual-corded, dual-DC power supply option provides load sharing and active power management system with hitless failover.

Antenna Accessories

Antenna cables and accessories enable versatile solutions to meet most installation requirements.

Note: For complete information, see the SyncServer Options Datasheet (DS00002920).

Software Options

Security Protocol License with Security-Hardened NTP Reflector

Security-hardened NTP Reflector and authentication hardening with NTP Autokey, TACACS+, RADIUS, LDAP and CA-signed X.509 certificates.

PTP Output/Grandmaster (Simultaneous Multi-Port/Profile)

Single license enables multi-port, multi-profile IEEE 1588 PTP Grandmaster operations leveraging the built-in hardware time stamping in all SyncServers.

PTP Input

PTP as a timing input for tunneling time through PTP or as a backup time reference in the event of the loss of the GNSS signal.

FlexPort Technology for Timing I/O Modules

Enables the output connectors to output many supported signals (time codes, sine waves, programmable rates) all configurable in real time. Input connectors can support a wide variety of input signal types.

Multi-GNSS Constellation

Track GPS/SBAS, Galileo, QZSS, GLONASS and/or BeiDou constellations for improved integrity and satellite visibility in an urban canyons.

1PPS Time Interval/Event Time Measurements

Use the S650 Timing I/O module to measure, store and statistically display in real time the difference of an external 1PPS relative to the S650. The Event Time capture feature time tags and stores external events.

Time-Triggered Programmable Pulse

Provides a user defined, repetitive and precise time-of-day pulse(s) at specific times or provides periodic, time-based pulse outputs.

Synchronization Software

Comprehensive MS Windows-based network time synchronization software with monitoring and auditing functions.

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