

SyncServer S650

Accurate, Secure, and Flexible Time and Frequency Standard

S650 with Timing I/O Modules (Optional Configuration)



Features

- <15 ns RMS to UTC (USNO) via GPS
- <1x10⁻¹² frequency accuracy
- Modular timing architecture with unique and innovative FlexPort™ technology
- Most popular timing signal inputs/ outputs are standard in the base timing I/O module (IRIG B, 10 MHz, 1 PPS)
- Four standard GbE ports, all with patented NTP hardware timestamping
- Web-based management with high-security cipher suite
- -20 °C to 65 °C operating temperature, shock and vibration qualified
- IPv6/IPv4 on all ports
- 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 available
- GLONASS/BeiDou/SBAS option
- PTP Grandmaster option
- S650i model with no GNSS receiver installed

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
- 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

Unparalleled Flexibility

The modular Microsemi 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 Microsemi FlexPort™ technology option enables six of the BNCs to output many supported signals (time codes, sine waves, programmable rates), all configurable in real time via 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 output in any combination of supported 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 output signals.

Robust Timing and Design

The 72-channel GNSS receiver coupled with Microsemi’s patented active thermal compensation technology provides excellent accuracy of <15 ns RMS to UTC (USNO) via GPS. Backstop this with a durable hardware design subjected to MIL-STD-810G testing, high-reliability components

extending the operating temperature range to -20 °C to 65 °C, and a dual power supply option. Further, upgrading to a high performance oscillator, such as a Rubidium atomic clock, keeps the S650 accurate for long periods in the event of a GNSS service disruption.

Secure Networking

Security is an inherent part of the SyncServer S650. In addition to many security features and protocols, unsecure access protocols are deliberately omitted while remaining services can be disabled.

The four standard GbE ports accommodate more than 10,000 NTP requests per second using hardware timestamping and compensation. All network traffic to the S650 CPU is bandwidth-limited for protection against denial-of-service (DoS) attacks. For more secure NTP operations, enable the optional security-hardened NTP Reflector™ with line speed, 100% hardware-based NTP packet processing. The Reflector is also a CPU-protecting firewall, with bandwidth limiting non-NTP traffic to the CPU. It is also equipped with DoS detection, notification, and protection against abnormally high network traffic.

Leverage Built-In Hardware

The SyncServer S650 includes additional built-in hardware features enabled through software license keys, such as the security-hardened NTP Reflector™, GLONASS/ BeiDou support, and IEEE1588 PTP operations.

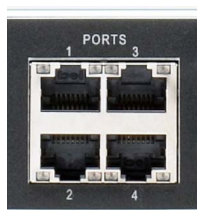
The SyncServer S650, the future of time and frequency, today.

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Four GbE Ports for Performance, Flexibility, and Security

The S650 has four dedicated and isolated GbE Ethernet ports, each equipped with NTP hardware timestamping. 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.



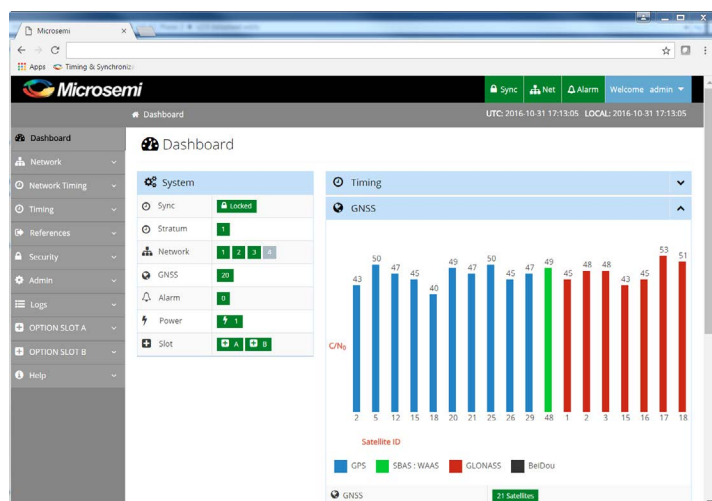
The four GbE ports provide network configuration flexibility and enhanced security. Multiple isolated and synchronized time servers can also be configured.

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. 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.



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

Standard Management Access Security

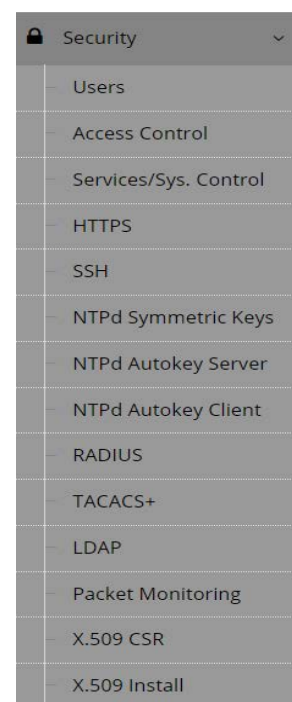
All of the expected network management protocols are standard in the S650. These include mandatory password access, HTTPS/SSL only (using the high encryption cipher suite), SSH, access control lists, service termination, SNMPv2/v3, and NTP MD5 authentication. All traffic to the S650 CPU is bandwidth-limited 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 seriously 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— via 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 via TACACS+, RADIUS, and LDAP. Third party CA-signed X.509 certificates are installable for further hardening of management access. (See the [SyncServer Options datasheet](#) for more detail on the Security Protocol License option).



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

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Unprecedented NTP Accuracy

The Stratum 1 level S650 derives nanosecond-accurate time directly from the atomic clocks aboard the GNSS 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 timestamp accuracy. NTP request throughput rates exceed 10,000 requests/second while maintaining NTP timestamp accuracy. If the Security License option is enabled, the NTP Reflector™ can process over 360,000 NTP requests per second with 15 ns caliber timestamp accuracy with the added benefit of security-hardening the network port. This can easily translate into sub-millisecond typical NTP client synchronization accuracy on a LAN.

Multi-GNSS Constellation Support for Enhanced Reliability

Timing integrity, continuity, and reliability can be improved with the GNSS option that adds support for GLONASS, BeiDou, 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 S650's ship with GNSS hardware ready to be enabled with a software license. The S650 is also available without GNSS in the S650i model.

IEEE1588 PTP Grandmaster

Applications demanding very precise time accuracy can require precise time protocol (PTP). The S650 PTP Output license enables PTP grandmaster operations leveraging the built-in hardware timestamping on each LAN port of the S650. (See the [SyncServer Options datasheet](#) for more detail on the PTP Output option.)

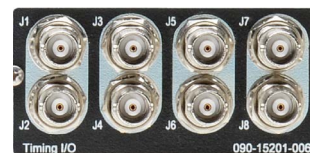


Serial Time Outputs

The dedicated data/timing port is provided to output NMEA-0183 or NENA PSAP strings. If NENA is selected, the serial console port also supports the two-way timing aspects of the standard. In addition, the F8 and F9 Microsemi legacy time strings are also available.

More Timing I/O Standard

The base S650 can host two modules. The Timing I/O module is equipped with eight BNC 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, 1 PPS.



FlexPort™, the Ultimate in Timing Flexibility

Microsemi's unique FlexPort™ technology efficiently and cost-effectively adds innovative "any signal, any connector" technology, eliminating the wasted space inherent with legacy style fixed signal modules/BNCs.

The FlexPort™ technology option enables the six output BNCs (J3-J8) to output many supported signals (time codes, sine waves, programmable rates) all configurable in real time through the secure web interface. User entered, nanosecond caliber phase offsets for each BNC output accommodates variable cable lengths. The two input BNCs (J1-J2) can support a wide variety of input signal types. (See the [SyncServer Options datasheet](#) for full details).

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 GNSS. However, if GNSS connectivity is lost, thereby placing the server 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

(1st 24 hours)

- Standard 400 microseconds
- OCXO 25 microseconds
- Rubidium <1 microsecond

The value of the upgraded oscillator is that if the GNSS 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.

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Specifications

GNSS Receiver/Antenna

- 72 parallel channel GNSS receiver
- GPS time traceable to UTC (USNO)
- Acquisition time of 30 seconds (cold start)
- Cable length up to 900 feet (275 m). See options below.
- GNSS option adds GLONASS/BeiDou/SBAS support in addition to GPS

Time Accuracy

- <15 ns RMS to UTC (USNO) at 1PPS output

After one day locked to GPS; evaluated over normal environment (test range $\pm 5^\circ\text{F}$) defined in GR-2830

Oscillator Aging (monthly)

Oscillator	Aging
Standard	$\pm 1 \times 10^{-7}$
OCXO	$\pm 5 \times 10^{-9}$
Rb	$\pm 1 \times 10^{-10}$
After one month of continuous operation	

Holdover Accuracy (one day)

Oscillator	Time
Standard	400 μs
OCXO	25 μs
Rb	<1 μs
Evaluated over normal environment (test range $\pm 5^\circ\text{F}$) defined in GR-2830 after three days locked to GNSS	

Frequency Output Accuracy and Stability

- Frequency output accuracy $< 1 \times 10^{-12}$ at one day locked to GNSS

Network Protocols

NTP (SHA1, Autokey, MD5), SNTP	SSHv2
PTP	IPv4/IPv6
SNMP v2c, v3	Syslog 1 to 8 servers
Custom MIB	Key management protocols can be individually disabled.
DHCP/DHCPv6	Port 1: Management and Time protocols
TACACS+	Port 2, 3, and 4: time protocols only
LDAPv3	RADIUS
RADIUS	HTTPS/SSL* (TLS 1.1/1.2)
HTTPS/SSL* (TLS 1.1/1.2)	X.509 HTTPS certificates
SMTP forwarding	

*SSL_High_Encryption Cypher suite or the SSL_High_And_Medium_Encryption Cypher suite

NTP Server Performance

- 10,000 NTP requests per second while maintaining accuracy associated with reference time source.
- Stratum 1 via GNSS: overall server timestamp accuracy of 5 μs to UTC with 1-sigma variation of 15 μs (typical). All NTP timestamps 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 SyncServer easily supports millions of NTP clients.
- 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.

Mechanical/Environmental

- Size 1.73" x 17.24" x 15.88" (4.4 cm x 43.8 cm x 40.3 cm)
1U rack mount, including BNCs
- Power 88 VAC–264 VAC, 50 Hz–60 Hz, 65 watts
Optional 2nd power supply
- 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 $\leq 95\%$, non-condensing, IEC 60068-2-78Cb, IEC 60068-2-30Db
- Certifications FCC Part 15, Class A, CISPR 22, Class A, UL/CSA 60950-1, IEC 60950-1, EN 60950-1, PSE, VCCI, RoHS 6/6
- Server weight 12.5 lbs (5.7 kgs),
- Shipping package 16.3 lbs (7.4 kgs)

Shock and Vibration

- Operational ETSI EN-300 019-2-3, Mil-Std-810G
- Storage IEC 60068-2-6 Fc (sinusoidal vib) Mil-Std-810G, figure 514.6C-3

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- Transportation
 - Bounce IEC 60068-2-27Ea (shock 18 g)
 - Vibration IEC 60068-2-64Fh (random vib)
 - Package drop IEC 60068-2-31 Ec
- Seismic EN300 019-2-3
NEBS GR-63-CORE

Front Panel

- Display Sharp, high-resolution 160x32 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

- 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
- 1PPS out BNC, rising edge on-time, TTL into 50 Ω
- GNSS BNC L1, 1575 MHz
- Console DB9-F RS-232
- Alarm relay SPST, maximum 300 mA and 32 V
- Power IEC 60320 C14 connector, optional second power supply/connector, hitless switching

Timing Input/Output Module (090-15201-0006)

Configuration	Input BNCs		Output BNCs					
	J1	J2	J3	J4	J5	J6	J7	J8
Standard	IRIG B AM 124 or 1PPS	10 MHz	IRIG B AM 124	10 MHz	IRIG B B004 DCLS	1PPS	off	off
FlexPort Option	IRIG: A000/A004/A130/A134 B000/B004/B120/B124 E115/E125 C37.118.1a-2014 IEEE-1344 Rates: 1PPS 10MPPS	1 MHz 5 MHz 10 MHz	FlexPort J3-J8 software selectable outputs per BNC (Configured via the web interface) <ul style="list-style-type: none"> • Pulse: <ul style="list-style-type: none"> • Fixed Rate: 10/5/1MPPS, 100/10/1kPPS, 100/10/1/0.5PPS, 1PPM • Programmable period: 100 ns to 2 sec, step size of 10 ns • Timecode <ul style="list-style-type: none"> • IRIG A 004/134 • IRIG B 000/001/002/003/004/005/006/007/C37.118.1a-2014/1344 DCLS • IRIG B 120/122/123/124/125/126/127/1344 AM • IRIG E 115/125 • IRIG G 005/145 • NASA 36 AM/DCLS, 2137 AM/DCLS, XR3 • Sine: 1/5/10 MHz • BNC-by-BNC output phase adjustment for timecodes and pulses 					

Signal Levels

Output Signal	Specification
IRIG-In	AM: Ratio 2:1 to 3.5:1; Amp: 1 V to 8 V p-p, into 50 Ω DCLS: <0.8 V for logic 0, >2 V for logic 1
IRIG-Out	AM: Ratio 10:3, Amp: 3.5 ±0.5 Vpp, Zout 50 Ω DCLS: <0.8 V for logic 0, >2.4 V for logic 1, Zout 50 Ω
1PPS-In	Rising edge active, TTL into 50 Ω
Rate/PulseOut	Rising edge on-time, TTL into 50 Ω
1,5,10 MHz-In	Sine wave, 1 Vpp to 8 Vpp, into 50 Ω
1/5/10 MHz-Out	Sine wave 2 Vpp-3 Vpp into 50 Ω
10 MPPS In	<0.8 V for logic 0, >2 V for logic 1, into 50 Ω

Output Stability (10 MHz)

Oscillator	1 S	10 S	100 S	1k S	10k S
Standard	<1×10 ⁻⁹	<2×10 ⁻¹⁰	<1×10 ⁻¹⁰	<1×10 ⁻¹¹	<1×10 ⁻¹²
OCXO	<1×10 ⁻⁹	<5×10 ⁻¹¹	<5×10 ⁻¹¹	<7×10 ⁻¹²	<7×10 ⁻¹³
Rubidium	<2×10 ⁻¹⁰	<3×10 ⁻¹¹	<3×10 ⁻¹¹	<5×10 ⁻¹²	<5×10 ⁻¹³

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Product Includes

S650

SyncServer S650 (no option modules installed in base unit), locking power cord, and rack mount ears. Two-year hardware warranty. Current manual and MIB are available online at www.microsemi.com.

Part Number

Description	Part Number
SyncServer S650 (base), Timing I/O module	090-15200-651
SyncServer S650 (base), Timing I/O module, Rubidium	090-15200-652
Contact factory to add more software options	

S650i

SyncServer S650i (no GNSS receiver), one Timing I/O module, locking power cord, and rack mount ears. Two-year hardware warranty. Current manual and MIB are available online at www.microsemi.com.

Part Number

Description	Part Number
SyncServer S650i, Timing I/O module	090-15200-653
Contact factory to add more software options	

S650 with Timing I/O Modules (Optional Configuration)



Options (See Options datasheet)

- Timing input/output module
- FlexPort option to enable software selectable signals on Timing I/O module BNCs
- Security license upgrade option for security-hardened NTP Reflector, RADIUS, LDAP, TACACS+, NTP Autokey, X.509 certificates
- Dual power supplies (with dual-corded connectors and load sharing)
- Rubidium or OCXO oscillator upgrade for extended holdover
- GNSS support of GLONASS/BeiDou/SBAS
- IEEE1588 PTP Grandmaster
- Antenna kits, cables, lightning arrestors, and inline amplifiers, documented in the SyncServer S600/S650 Options datasheet
- Domain Time II comprehensive time client, server and management software for easy distribution, management and monitoring of time across Windows networks



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