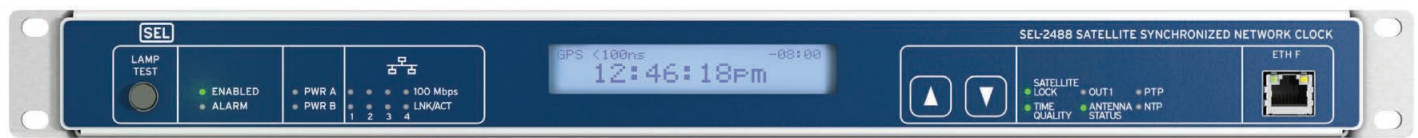


SEL-2488

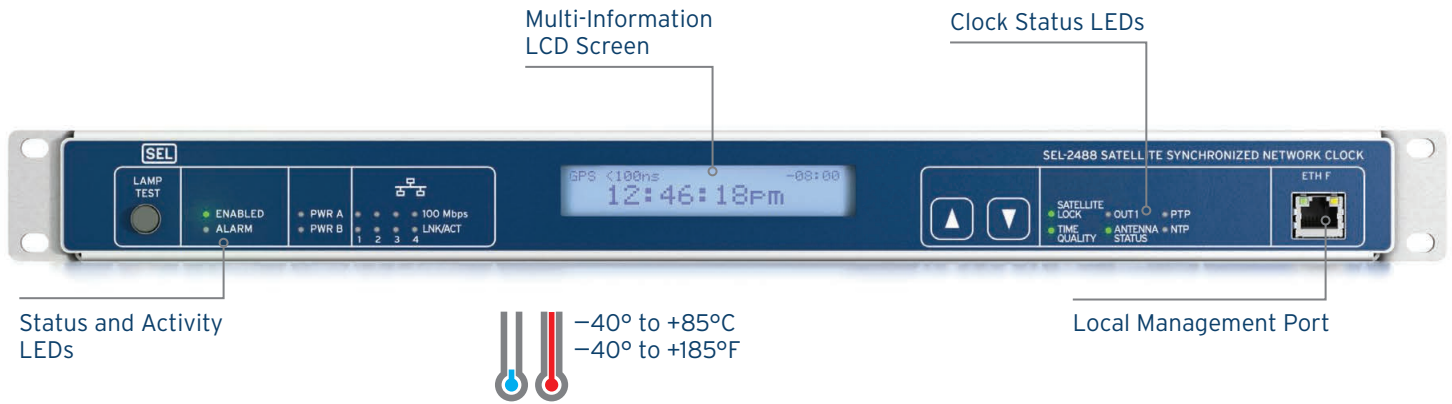
Satellite-Synchronized Network Clock



Provide advanced time synchronization using the industry's most accurate, reliable, and secure clock

- Synchronize devices to within ± 40 ns for demanding power utility applications, such as synchrophasors, sampled values (IEC 61850-9-2), and traveling wave fault location.
- Distribute time to a broad range of end devices using IRIG-B, the Precision Time Protocol (PTP), and the Network Time Protocol (NTP).
- Validate GPS authenticity using Satellite Signal Verification to mitigate GPS vulnerabilities.
- Secure your time source with syslog, the Simple Network Management Protocol (SNMP), the Lightweight Directory Access Protocol (LDAP), and an HTTPS web interface.





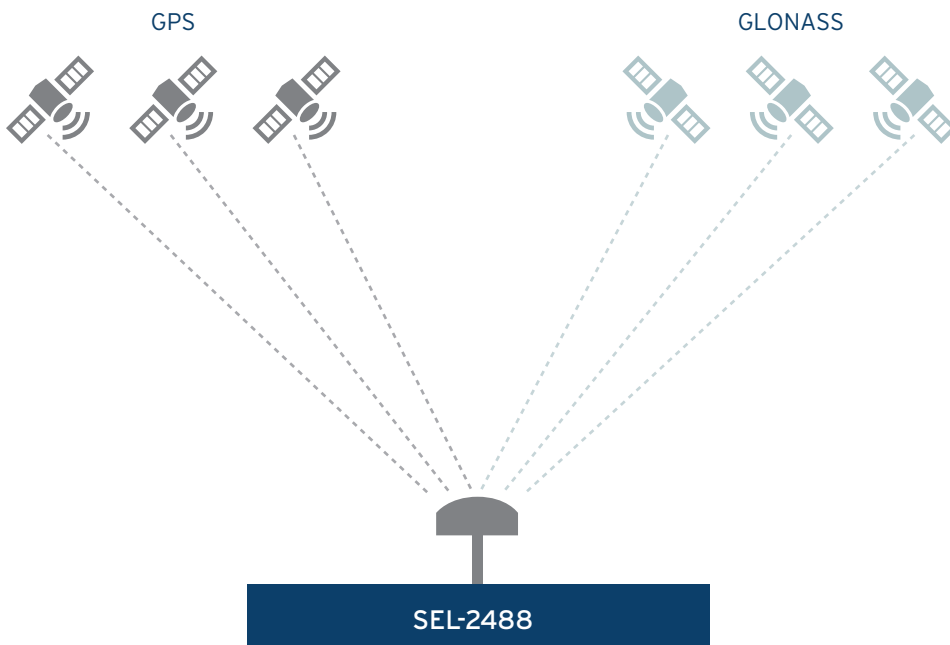
Time-Synchronize Your Substations

Advanced Technology for Demanding/Critical Time Synchronization

The SEL-2488 Satellite-Synchronized Network Clock receives Global Navigation Satellite System (GNSS) time signals and distributes precise time via multiple output protocols, including IRIG-B, PTP grandmaster as defined by IEEE 1588, and NTP. The SEL-2488 raises the bar for satellite-synchronized clocks by providing higher levels of accuracy, flexibility, dependability, and ease of use. The advanced capabilities of the SEL-2488 make it well-suited for demanding applications, like synchrophasors, sampled values, traveling wave fault location, and substations with multiple time synchronization requirements.

Accurate

Synchronize with precise time accuracy to within ± 40 ns for power utility applications. If GNSS time signals become unavailable, the clock switches to the internal TCXO holdover, with $36 \mu\text{s/day}$ accuracy, or to the optional OCXO holdover, with $5 \mu\text{s/day}$ accuracy. Both of these holdover accuracy specifications are based on a constant operating temperature.



Satellite Signal Verification

The SEL-2488 and SEL-9524B GPS/GLONASS GNSS Antenna receive signals from two satellite constellations to validate GPS time signals, providing a layer of protection from GPS spoofing attacks.

Flexible

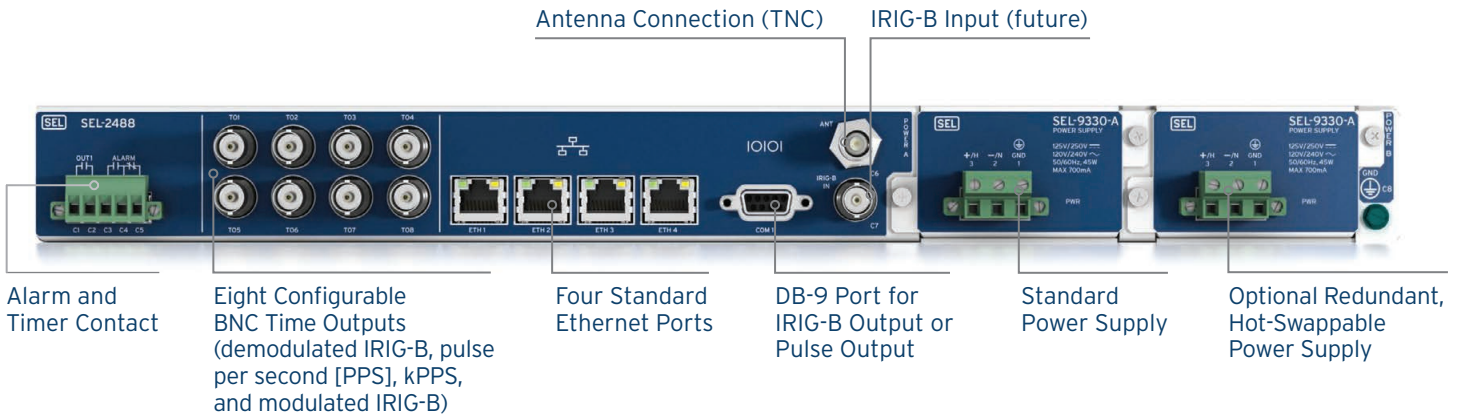
Distribute time from eight time outputs that are configurable for IRIG-B or time pulse outputs. The SEL-2488 also includes four independent Ethernet ports, which distribute time via NTPv4. The SEL-2488 provides Parallel Redundancy Protocol (PRP) support as a Dual Attached Node (DAN) device. With purchase of the PTP (IEEE 1588 v2) option, the SEL-2488 can act as a PTP grandmaster clock with default and power system profiles (IEEE C37.238-2011) and can distribute time to four independent networks.

Dependable

The SEL-2488 provides an option for a second, redundant, hot-swappable power supply; operates from -40° to $+85^{\circ}\text{C}$ (-40° to $+185^{\circ}\text{F}$); is certified to IEEE 1613 Class 2, IEC 61850-3, and IEC 60255; and is backed by our ten-year worldwide product warranty.

Secure and Simple

The SEL-2488 supports DHCP with a captive portal, LDAP, an HTTPS web interface, syslog, SNMP, and acSELEATOR QuickSet[®] SEL-5030 Software for easy and secure configuration.

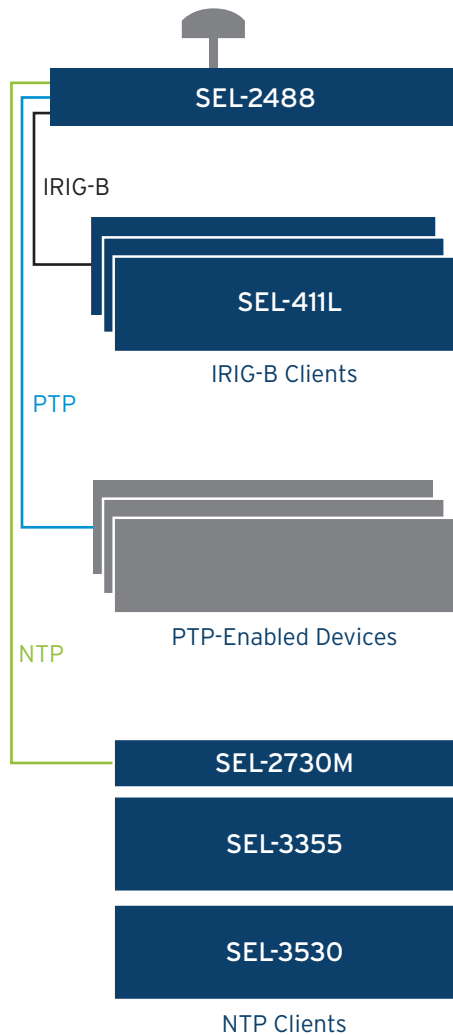


Electric Power System Applications

The SEL-2488 provides advanced time synchronization capabilities for demanding applications and larger substations with broad requirements for precise time.

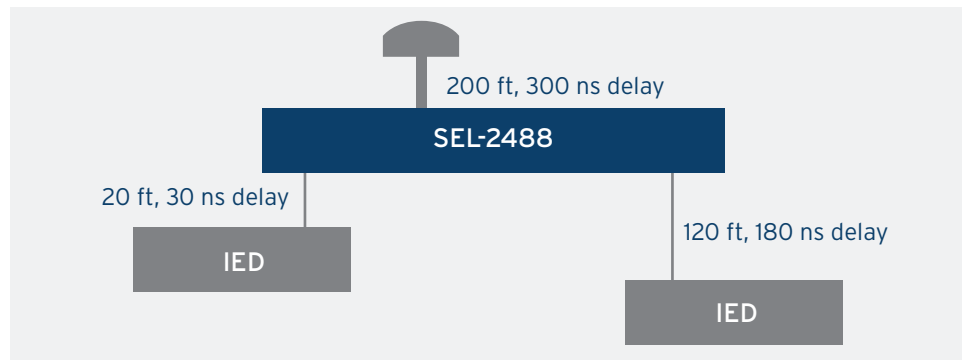
Time Distribution

The SEL-2488 has eight BNC ports, which can be configured for demodulated IRIG-B, time pulse, or modulated IRIG-B (up to four ports). Demodulated IRIG-B ports provide time output for protection applications, synchronizing relays, phasor measurement units (PMUs), and other intelligent electronic devices (IEDs) to within ± 40 ns average and ± 100 ns peak accuracy to UTC. Ethernet ports can distribute time using NTP to devices on the substation local-area network (LAN), such as servers, computers, and other devices that set their time through NTP or the Simple Network Time Protocol (SNTP). The SEL-2488 can act as a Stratum 1 time server with typical client synchronization accuracy on a LAN of 0.5–2 ms. With purchase of the PTP option, the SEL-2488 can act as a PTP grandmaster clock with default and power system profiles providing ± 100 ns peak time stamp accuracy to UTC. The SEL-2488 can serve time via NTP and PTP to four independent networks.



Cable Delay Compensation

The SEL-2488 provides time delay compensation for antenna cables and output cables on a per-port basis to preserve accuracy. Antenna cable delay compensation is a global device setting, and output cable delay compensation can be configured per port with demodulated IRIG-B and pulse outputs. The image below shows an example of a clock with an antenna and two output ports. One output port is configured for a 20-foot cable and another is configured for 120 feet, accounting for a difference of 150 ns. The SEL-2488 Clock's cable delay compensation ensures high-accuracy time distribution in large facilities with dispersed IEDs and/or in installations where antennas must be mounted high on towers.



Time accuracy of ± 40 ns is maintained with cable delay compensation.

General Specifications

Time Accuracy	±40 ns average, ±100 ns peak for demodulated IRIG-B and 1 PPS (from BNC ports) ±1 µs modulated IRIG-B (peak) to UTC <100 µs NTP time-stamp accuracy (typical) to UTC ±100 ns PTP time-stamp accuracy (peak) to UTC
Time Sources	GPS GLONASS for verification
Holdover Accuracy	Holdover, temperature TCXO, 36 µs, constant temperature TCXO, 315 µs, ±1°C OCXO, 5 µs, constant temperature OCXO, 5 µs, varied temperature
Ports	1 front RJ45 Ethernet management port 8 rear BNC ports 4 standard 100BASE-T rear Ethernet ports (can be 100BASE-FX or 100BASE-LX10, configured in pairs) 1 rear DB-9 port 1 rear IRIG-B input (supported in future firmware revision)
Output Protocols	Up to 8 demodulated IRIG-B (B002, B004) Up to 4 modulated IRIG-B (B122, B124) Up to 8 PPS or kPPS NTPv4 PTP grandmaster (IEEE 1588) with default and power system profiles, with PTP option
Output Contact	Alarm contact, Form C Timer contact, Form A, 1 µs accuracy
Display	LED status indications LCD screen with backlight
Mounting	19" rack-mount, 1.75" or 1U high
Power Supply	24–48 Vdc 125–250 Vdc or Vac
Antenna	SEL-9524B GPS/GLONASS GNSS Antenna required for Satellite Signal Verification
Operating Conditions	–40° to +85°C (–40° to +185°F)
Certifications	UL, CE, IEEE 1613 Class 2, IEC 61850-3, and IEC 60255
Warranty	10 years

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