Precise Time Overview

SEL-2488

The SEL-2488 receives GNSS time signals and distributes precise time via multiple output protocols, including IRIG-B, PTP, and NTP, with ±40 ns accuracy.

SEL-2407®

The SEL-2407 provides a time display and high-accuracy timing (±100 ns).

SEL-2401

The SEL-2401 is a satellite clock with high-accuracy timing (±100 ns) for compact spaces.

SEL-2404

The SEL-2404 is a high-accuracy (±100 ns) satellite clock with a highly visible time display.

SEL-3401

The SEL-3401 provides a highly visible time display for use anywhere there are time-critical functions set by IRIG-B synchronization signals.

SEL-9929

The SEL-9929 kit includes a satellite-synchronized clock, a large digital clock display, and all accessories to work right out of the box.

SEL-3400

The SEL-3400 verifies time signals and distributes precise time to 240 devices.

SEL-3405

SEL-3405 transceivers send delay-compensated demodulated IRIG-B signals up to 4 km (2.5 mi) over fiber-optic cable.

SEL-9524

The SEL-9524 is a rugged and reliable antenna for GNSS devices in critical infrastructure applications.

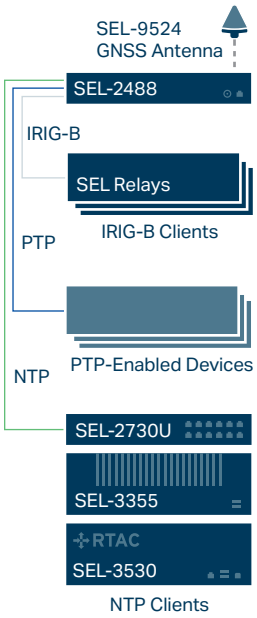
Applications	SEL-2401	SEL-2404	SEL-2407®	SEL-3400	SEL-3401	SEL ICON®	SEL-2488
Time Source for Substation	■	■	■	■		■	■
Time Source for Industrial Applications	■	■	■	■		■	■
Time Source for Phasor Measurement Unit (IEEE C37.118.1-2011 Synchrophasors)	■	■	■	■		■	■
Time Source for Recloser	■		■				
Time Source for Line Current Differential Protection	■	■	■	■		■	■
Time Source for Traveling-Wave Fault Location	■	■	■	■		■	■
Time-Synchronized Event Reporting	■	■	■	■		■	■
Long-Distance Viewing, 61 m (200 ft)		■			■		
Time Sources and Time Distribution							
Demodulated IRIG-B Outputs (Quantity)	1	4	6	12	4+	4	up to 8
Modulated IRIG-B Outputs (Quantity)			1				up to 4
GPS Satellite Tracking	■	■	■			■	■
GLONASS Satellite Tracking (Reference Only)							■
Demodulated IRIG-B Input				■	■	■	
Synchronized Pulse Output	■	■	■				■
Network Time Protocol (NTP) Server							■
IEEE 1588 Precision Time Protocol (PTP) (With IEEE C37.238 Power System Profile)						■	+
Satellite Signal Verification							■
Features							
76.2 mm (3.0 in) LED Display		■			■		
14 mm (0.56 in) LED Display			■	■			■
Rack-Mount Hardware	■	■	■	■	■	■	■
Panel-Mount or Wall-Mount Hardware	■	■	■	■	■	■	
Universal Power Supply			■	■		■	■
Dual, Redundant, Hot-Swappable Power Supplies						■	■
Power Over Ethernet (PoE) Power Sourcing Equipment (PSE)						■	
Secure Web Interface for Configuration							■
Serial Ports for Configuration	■	■	■				
User-Based Accounts						■	■
TCXO Holdover	■	■	■			■	■
OCXO Holdover							+
Time-Code Cable Delay Compensation				■		■	■
IEEE C37.90 and IEC 60255 Surge and Environmental Standards Compliance	■	■	■	■	■	■	■
Accuracy							
Average Accuracy (ns)	±100	±100	±100				±40
Peak Accuracy (ns)	±500	±500	±500			±1,000	±100

■ Standard feature + Model option/accessory

Precise Time Applications

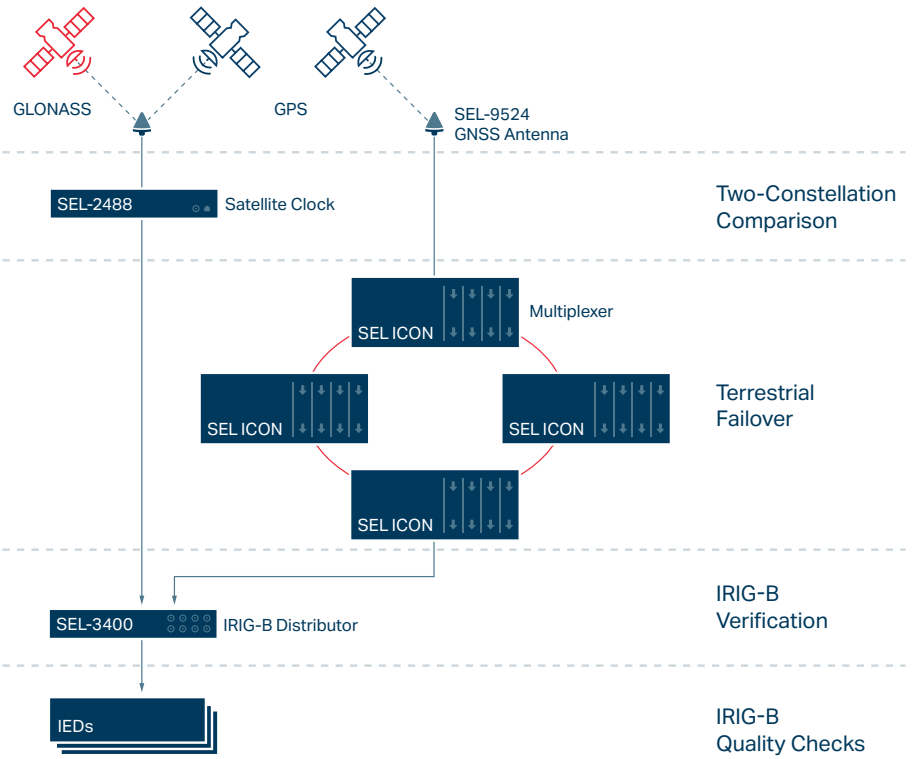
Time synchronization in the substation

Use the SEL-2488 Satellite-Synchronized Network Clock's demodulated IRIG-B time outputs in electric utility applications to synchronize relays, phasor measurement units, and other IEDs to within ±40 ns average accuracy of UTC. You can configure modulated IRIG-B for as many as four SEL-2488 BNC outputs to synchronize legacy devices. Using the DB-9 port with SEL-3405 High-Accuracy IRIG-B Fiber-Optic Transceivers lets you send IRIG-B time code long distances over fiber-optic cable. The SEL-2488 Ethernet ports can use the Network Time Protocol (NTP) to distribute time to devices on the substation LAN, such as servers, computers, and other devices that set their time through NTP or the Simple Network Time Protocol (SNTP). With the Precision Time Protocol (PTP) option, the SEL-2488 acts as a PTP grandmaster clock, supporting both the default PTP profile (IEEE 1588-2008) and the power system profile (IEEE C27.238). The SEL-2488 can serve NTP or PTP to four independent networks.



Layers of protection for time synchronization

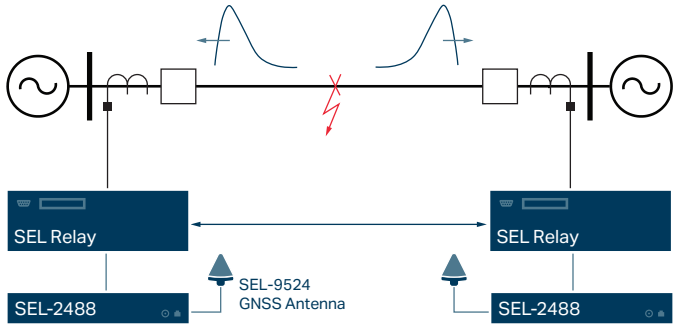
Configure your equipment to detect and respond to signal loss or degradation. Precise time is critical to the optimal operation of your system. You can combine SEL precise-time products into a multilayered system to ensure highly reliable time synchronization, from satellite signal acquisition through time distribution to end devices.

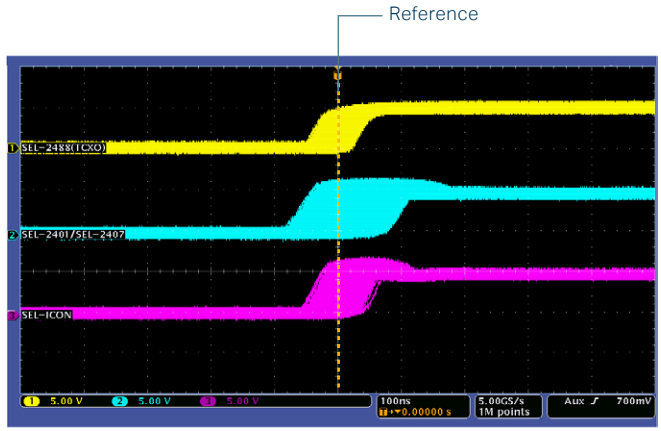


High-accuracy time synchronization for advanced relaying applications

Take advantage of the high accuracy of SEL clocks to perform time-dependent relaying applications. The SEL time-based system for line current differential protection in SEL-400 series relays requires submicrosecond accuracy in order to operate properly. For traveling-wave fault locating in the SEL-411L Advanced Line Differential Protection, Automation, and Control System, the performance of the application is tied directly to the performance of the time source. SEL clocks have the accuracy required to meet these stringent requirements. With tight initial accuracy and excellent holdover performance, clocks like the SEL-2488 Satellite-Synchronized Network Clock exceed timing needs.

The oscilloscope plot shows the accuracy of SEL products. The offset from zero represents the average accuracy of the clock, and the width of the signal represents the variance in the accuracy; i.e., jitter.

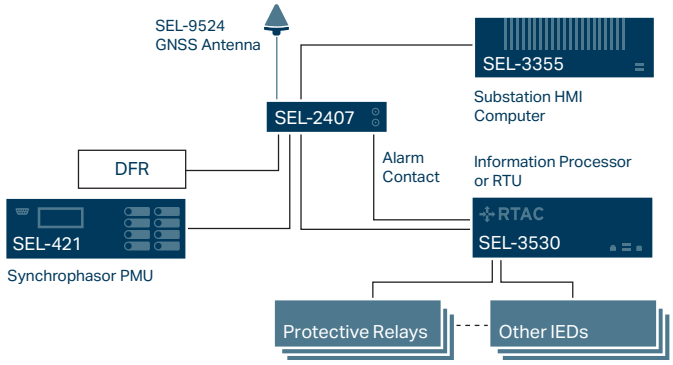




Dotted line represents 100 ns increments.

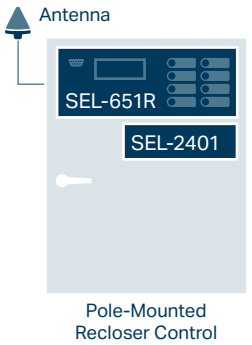
Time synchronization with the SEL-2407®

Apply the SEL-2407 Satellite-Synchronized Clock in a substation to synchronize relays, phasor measurement units (PMUs), Sequential Events Recorders, information processors, and other devices. You can synchronize up to 120 devices via the six demodulated IRIG-B output ports. The SEL-2407 also has an additional port for distributing modulated IRIG-B.



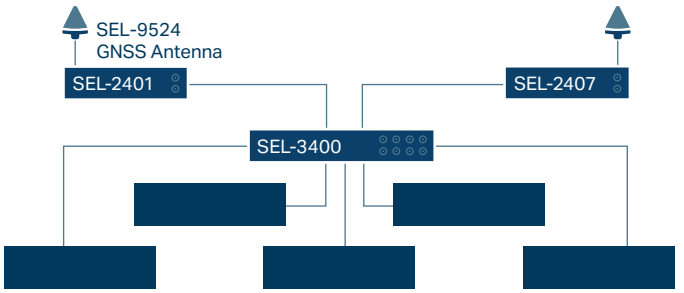
Synchrophasor control and event reporting with the SEL-2401

Install the SEL-2401 Satellite-Synchronized Clock in recloser control enclosures for synchrophasor control and high-accuracy event correlation and reporting. The SEL-2401 is a compact, low-cost, low-power clock that is reliable in harsh environments.



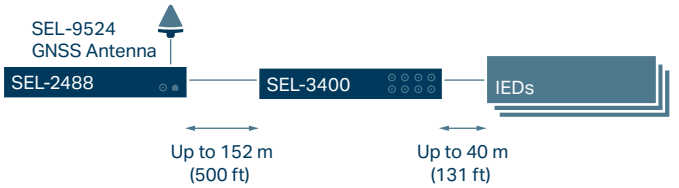
Time source validation

Connect the SEL-3400 IRIG-B Distribution Module to two IRIG-B inputs. You can configure those inputs for redundancy to maintain accurate time in the event of time source degradation or failure.



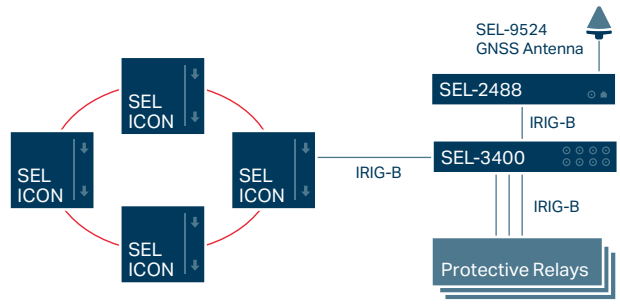
Increased distance for IRIG-B cabling

Synchronize devices using demodulated IRIG-B by applying an SEL-3400 to extend the distance between the clock and the devices. This is useful in large facilities where you want to avoid using multiple GPS clocks. The SEL-3400 compensates for its input-to-output latency plus the latencies of connected cables.



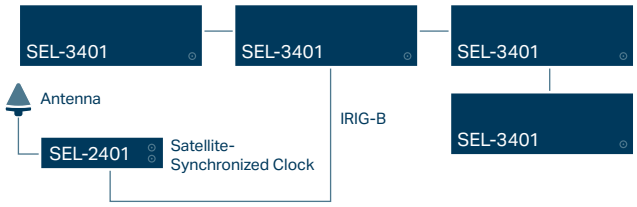
Precise time distribution with the ICON® and SEL-3400

Distribute precise time throughout a WAN with the SEL ICON Integrated Communications Optical Network, and use the SEL-3400 for convenient distribution within racks or panels. The SEL-3400 receives a precise time signal from an ICON network or other precise time source and distributes time to up to 240 devices via 12 demodulated IRIG-B outputs.



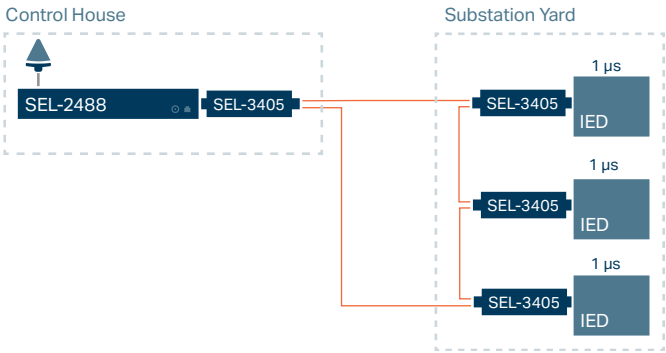
Time display and communication with the SEL-3401

Use SEL-3401 Digital Clocks to display time in control rooms, substations, and industrial and manufacturing environments. Optional IRIG-B ports let you distribute time signals to additional clocks and devices.



Time synchronization to remote devices

Use the SEL-3405 High-Accuracy IRIG-B Fiber-Optic Transceiver to send IRIG-B across distances where coaxial cabling is not feasible. Connecting an SEL-3405 at both the clock and the end device enables the device to receive delay-compensated IRIG-B, with no settings to adjust. The SEL-3405 automatically adjusts for the delay that occurs as the signal moves through the multimode fiber. With the SEL-3405, you can send time between individual devices or set up a ring network to provide <1 µs accurate IRIG-B signals to multiple devices simultaneously.



SEL-2488

Satellite-Synchronized Network Clock

Starting price
$2,540 USD

selinc.com/products/2488 | Select models typically ship in 2 days

The SEL-2488 receives GNSS time signals and distributes precise time via multiple output protocols, including IRIG-B and the Network Time Protocol (NTP). The SEL-2488 provides Parallel Redundancy Protocol (PRP) support as a dual attached node (DAN) device for NTP time distribution. When installed with a dual-constellation antenna, the SEL-2488 offers satellite signal verification by using signals from two satellite constellations to validate GNSS time signals, providing a layer of protection against spoofing attacks. With an optional upgrade, the SEL-2488 can serve as a Precision Time Protocol (PTP) grandmaster clock, as defined by IEEE 1588. The advanced capabilities of the SEL-2488 make it well-suited for demanding applications, such as synchrophasors, and for substations with multiple time synchronization requirements.

1. Status and activity LEDs
2. Multi-information LCD screen
3. Clock status LEDs
4. Local management port
5. Alarm and timer contact
6. Eight configurable BNC time outputs (demodulated IRIG-B, pulse per second [PPS], kPPS, and modulated IRIG-B)
7. Four standard Ethernet ports
8. DB-9 port for IRIG-B output or pulse output
9. Antenna port (TNC)
10. Standard power supply
11. Optional redundant, hot-swappable power supply

SEL-2407®
Satellite-Synchronized Clock

Starting price
$1,250 USD

selinc.com/products/2407 | Select models typically ship in 2 days

The SEL-2407 is a reliable, durable clock that offers a time display and high-accuracy, satellite-synchronized timing. The SEL-2407 provides ±100 ns average timing accuracy (±500 ns peak) for IEEE C37.118 synchrophasor control function extensions and event correlation and reporting. IEEE C37.90 and IEC 60255 design standards ensure accurate timing over a temperature range of –40° to +80°C (–40° to +176°F) and in the presence of electrical surges and power supply variations. One modulated and six demodulated IRIG-B outputs let you synchronize relays directly or through an SEL information processor.

SEL-2401
Satellite-Synchronized Clock

Starting price
$520 USD

selinc.com/products/2401 | Select models typically ship in 2 days

The SEL-2401 is a compact, precise-time device that offers ±100 ns timing accuracy for applications such as IEEE C37.118 synchrophasor control function extensions and event correlation and reporting. The SEL-2401 provides accurate operation from –40° to +80°C (–40° to +176°F) and is compliant with IEEE C37.90 and IEC 60255. You can synchronize up to 20 devices from one IRIG-B output. The SEL-2401 is FCC Part 15, Class A emissions-certified for industrial sites.

SEL-2404
Satellite-Synchronized Clock

selinc.com/products/2404

Starting Price
$1,250 USD

The SEL-2404 is a reliable, durable clock with a 76 mm (3 in) LED time display. Four demodulated IRIG-B outputs with an average accuracy of ±100 ns (±500 ns peak) meet requirements for existing and future timing applications.

SEL-3401
Digital Clock

selinc.com/products/3401

Starting Price
$410 USD

The SEL-3401 provides a highly visible time display for use anywhere there are time-critical functions. Easy-to-read 76 mm (3 in) LED digits are visible up to 60 m (200 ft) away. The SEL-3401 is set by IRIG-B signals and includes up to four IRIG-B outputs to send time signals to other SEL digital clocks or devices.

SEL-9929
Satellite-Synchronized Clock Display Kit

selinc.com/products/9929

Starting Price
$1,090 USD

This kit includes a satellite-synchronized clock, a large digital clock display, and all accessories to work right out of the box. The clock supplies accurate time to synchronize up to 15 display clocks. The clock display has high-visibility LED digits that can be read up to 60 m (200 ft) away. The clock and display are designed to work in harsh environments with a wide operating temperature.

SEL-3400
IRIG-B Distribution Module

selinc.com/products/3400

Starting Price
$730 USD

The SEL-3400 is a cost-effective, reliable, and precise way to distribute demodulated IRIG-B time information. With 12 IRIG-B distribution ports and a bright display, the SEL-3400 is ideal for time distribution in panels. When using two time inputs, the SEL-3400 automatically selects the best source for maintaining time. It exceeds IEEE C37.90 and IEC 60255 protective relay standards and accurately operates from –40° to +85°C (–40° to +185°F).

SEL-3405

High-Accuracy IRIG-B Fiber-Optic Transceiver

Starting price
$200 USD

selinc.com/products/3405 | Select models typically ship in 2 days

SEL-3405 transceivers provide a multimode fiber link between two DB-9 serial ports, sending delay-compensated demodulated IRIG-B up to 4 km (2.5 mi) over a fiber-optic cable. The transceivers require no settings to accurately calculate the delay compensation.

SEL-9524

GNSS Antenna

Starting price
SEL-9524A: $260 USD
SEL-9524B: $320 USD

selinc.com/products/9524 | Select models typically ship in 2 days

The SEL-9524 is a rugged and reliable antenna designed for GNSS devices in critical infrastructure applications. The antenna is IP68-rated, making it suitable for harsh environments. Industry-leading surge immunity allows this antenna to provide superior performance in the presence of lightning and other surge events. The SEL-9524A receives GPS signals, and the SEL-9524B receives both GPS and GLONASS signals.