

Time Synchronization Solutions



Layer innovative technologies to build dependability and security into your time synchronization system.

- Use wide-area terrestrial time distribution to maintain synchronization if a local GPS signal is lost.
- Protect from time source disruptions using input redundancy.
- Defend your system from GPS spoofing attacks with satellite and IRIG-B signal verification.

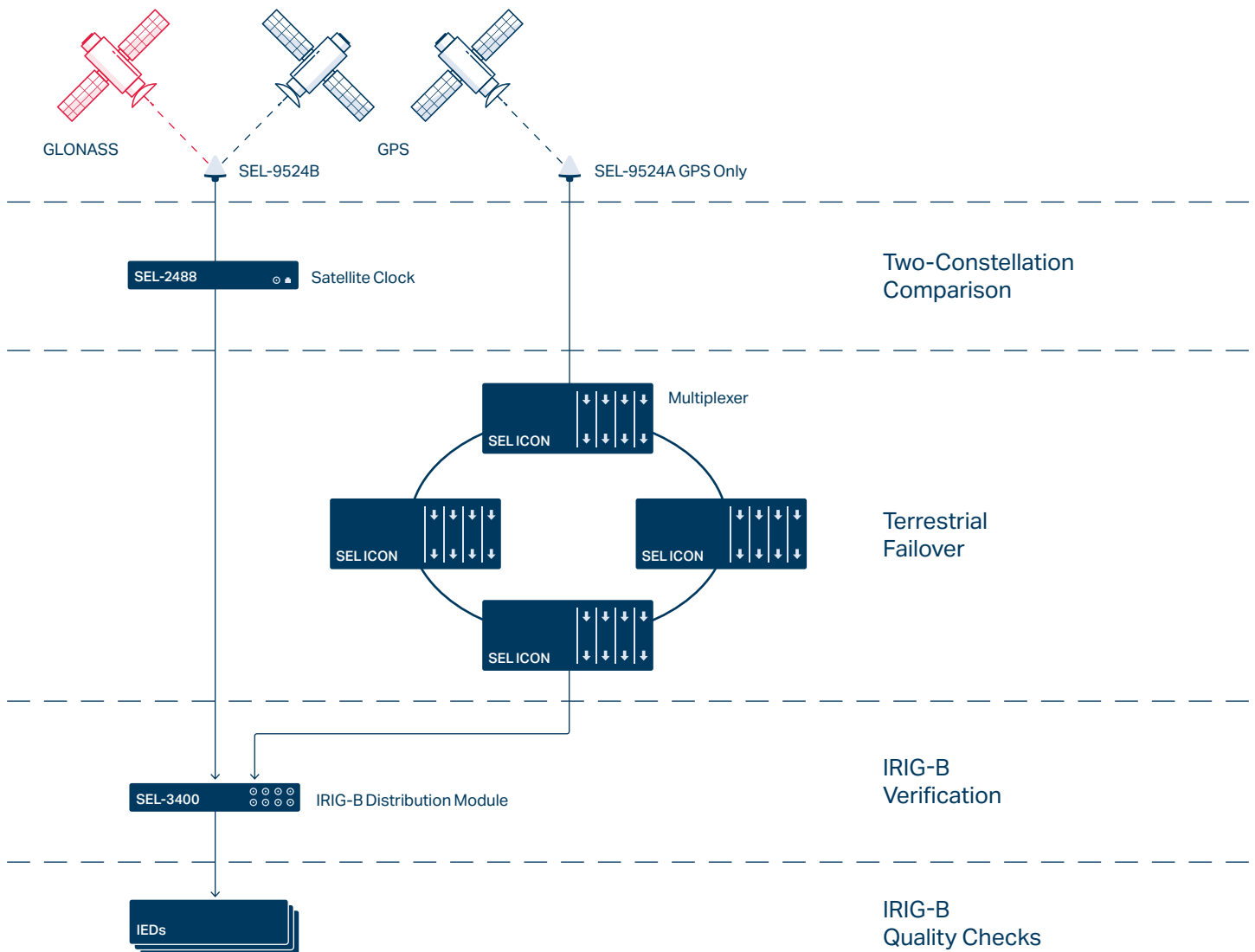
Mitigate GPS Vulnerabilities

Precise time synchronization enhances protection, monitoring, and control of electric power systems. Many precise time synchronization systems rely on navigation satellite systems, including GPS and GLONASS, which are highly accurate and effective but may not always be available or secure. We offer solutions that improve the reliability and security of time distribution and mitigate the effects of the following situations:

- Atmospheric interference caused by solar flares
- Multipath errors due to reflected radio signals
- Equipment failure
- Intentional and unintentional jamming
- Equipment maintenance or testing
- Spoofing attacks, in which a satellite system receiver locks to a counterfeit signal

SEL Solutions Build Greater Reliability Into Your Time Synchronization System

We understand that precise time is critical to the optimal operation of power systems. That's why we provide a variety of time synchronization solutions for detecting and responding to GPS signal loss or degradation. You can use the products on the following pages either individually or combined into a multilayered system to ensure highly reliable time synchronization in your application.



SEL ICON® Integrated Communications Optical Network

The SEL ICON provides a new approach to solving voice and data communications network design. By combining SONET and Ethernet technologies with flexible interfaces, the ICON integrates data and voice communications in a single platform. The ICON provides the communications infrastructure for complete end-to-end solutions and complex applications, including:

- Precise time distribution, <math><1 \mu\text{s}</math> across the entire wide-area network
- Synchrophasor control of power systems
- Teleprotection
- Security management

Each ICON comes standard with an integrated GPS receiver used for network timing and the distribution of a precise time reference. In the event of a GPS outage or compromise, precise time distribution is maintained with submicrosecond accuracy using an internal time reference across the entire wide-area network protection system.



SEL-2488 Satellite-Synchronized Network Clock

The SEL-2488 is more than a clock—it's an advanced precise-timing platform packed with new capabilities and ease-of-use features for utilities. The advanced capabilities of the SEL-2488 make it well-suited for demanding applications, like synchrophasors and event recording, as well as for larger substations with multiple time synchronization requirements. The SEL-2488 offers the following:

- Up to nine demodulated IRIG-B outputs and up to four modulated IRIG-B outputs
- Network Time Protocol (NTP) support
- Precision Time Protocol (PTP) support
- Average accuracy of ± 40 ns to UTC
- Redundant power supplies
- Satellite signal verification



Satellite Signal Verification

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

Holdover Oscillator Options

If Global Navigation Satellite System (GNSS) time signals become unavailable, the clock switches to the TCXO holdover, with an accuracy of $36 \mu\text{s}$ after 24 hours, or to the optional OCXO holdover, with an accuracy of $5 \mu\text{s}$ after 24 hours.

SEL-3400 IRIG-B Distribution Module

The SEL-3400 includes a visible time display and provides 12 IRIG-B output ports for time synchronization. When two inputs are configured for redundancy, if the primary input is lost or its time quality is worse than the secondary input, the SEL-3400 switches to the secondary input and indicates the change via the alarm contact.

When two inputs are configured for verification, the SEL-3400 will compare the time signals. If the signals match, the SEL-3400 will provide a valid IRIG-B output, but if there is a discrepancy in the signals, the IRIG-B output will report the failed time quality and trigger an alarm.



SEL-9524 GNSS ANTENNA

The SEL-9524 is a rugged and reliable antenna designed for GNSS devices for critical infrastructure applications. The antenna operates reliably from -50° to $+85^{\circ}\text{C}$ (-58° to $+185^{\circ}\text{F}$) and is IP68-rated, making it suitable for harsh environments. Industry-leading surge immunity allows this antenna to perform better in the presence of lightning and other surge events. The antenna is equipped with LEDs that provide diagnostic information.

Use the SEL-9524B to receive satellite signals from both GPS and GLONASS satellite constellations for added reliability. The antenna maintains excellent gain (>40 dB) while simultaneously providing strong rejection for signals outside of the nominal frequency band.



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