SEL-2488 Satellite-Synchronized Network Clock

Advanced Time Synchronization

Key Features and Benefits

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, Precision Time Protocol (PTP) as defined by IEEE 1588-2008, and Network Time Protocol (NTP). The advanced capabilities of the SEL-2488 make it well suited for demanding applications like synchrophasors and for substations with multiple time synchronization requirements.

- **Precise Time Accuracy Meets Demanding Requirements.** Provides demodulated IRIG-B time output for protection applications, synchronizing relays, phasor measurement units (PMUs), and other IEDs to within ±40 ns average and ±100 ns peak accuracy to coordinated universal time (UTC). 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 providing ±100 ns peak time stamp accuracy to UTC.
- **Holdover Oscillator Maintains Accuracy if GPS is Unavailable.** Maintains average accuracy of 36 µs after 24 hours at constant temperature (315 µs, ±1°C) with standard temperature compensated crystal oscillator (TCXO) holdover. With the oven-controlled crystal oscillator (OCXO) or double-oven-controlled crystal oscillator (DOCXO) holdover options, the average accuracies improve to 5 µs and 2.5 µs after 24 hours, respectively.
- **Thirteen Standard Outputs Provide Flexible Time Distribution.** Distributes time from eight time BNC outputs plus one DB-9 output, all configurable for IRIG-B or time pulse outputs. The DB-9 port can be used with SEL-2812 Fiber-Optic Transceivers With IRIG-B or SEL-3405 High-Accuracy IRIG-B Fiber-Optic Transceivers to send IRIG-B over long distances via a fiber-optic cable. The SEL-2488 also includes four standard Ethernet ports, which provide NTPv4. With purchase of the PTP option, the SEL-2488 can act as a PTP Grandmaster Clock (IEEE 1588-2008) with Default (Annex J), Power System (IEEE C37.238-2011/2017), and Power Utility Automation (IEC/IEEE 61850-9-3:2016) profiles. The SEL-2488 distributes NTP and PTP to four independent networks, and Ethernet ports are available in copper as well as single- or multimode fiber orderable in pairs.
- **Six Optional Frequency Outputs.** With the purchase of the frequency outputs hardware option, the SEL-2488 provides six SMA ports, one of which is a frequency-disciplined, TTL-compatible, 10 MHz square-wave frequency output and five of which are frequency-disciplined 10 MHz sine-wave frequency outputs.
- **Dual Power Supplies Offer Redundancy.** Provides an option for a second power supply that can receive power from a second source. SEL-9330-A power supplies support 125–250 Vdc or Vac input, and SEL-9330-C power supplies use 24–48 Vdc.
- **Satellite Signal Verification (SSV) Provides Assurance.** Receives signals from both GPS and GLONASS satellite systems for verification to provide a level of protection from GPS spoofing attacks.
- **DHCP, LDAP, SNMP, and Syslog Support Ensure Easy and Secure Integration.** Makes commissioning, management, and monitoring faster and more secure with DHCP Captive Port, LDAP authentication, SNMP read and trap support, and syslog event messaging.

- **Doubly Attached Node Implementing PRP (DANP) Support Provides Network Redundancy.** Supports as many as two DANP interfaces that use all four rear-panel physical Ethernet ports, allowing a connection to two separate PRP networks without requiring PRP Redboxes. Each DANP interface supports PTP over PRP as a Doubly Attached Clock (DAC) device. The SEL-2488 complies with the IEC 62439-3:2016 standard.
- **Active-Backup Port Bonding Provides Ethernet Failover.** Active-backup port bonding logically combines two physical Ethernet ports into a single network interface with only one port active while the other serves as a failover backup. The SEL-2488 supports as many as two independent active-backup bonded interfaces that use the four rear-panel physical Ethernet ports.
- **Ruggedness Provides Reliability in Harsh Environments.** Operates reliably between –40° and +85°C (–40° to +185°F), and complies with IEEE 1613, IEC 61850-3, and IEC 60255 standards.
- **Easy-to-Use Interface Streamlines Device Management.** The intuitive SEL-2488 HTTPS device webpage with SkyView® simplifies configuration, management, and troubleshooting.

Functional Overview

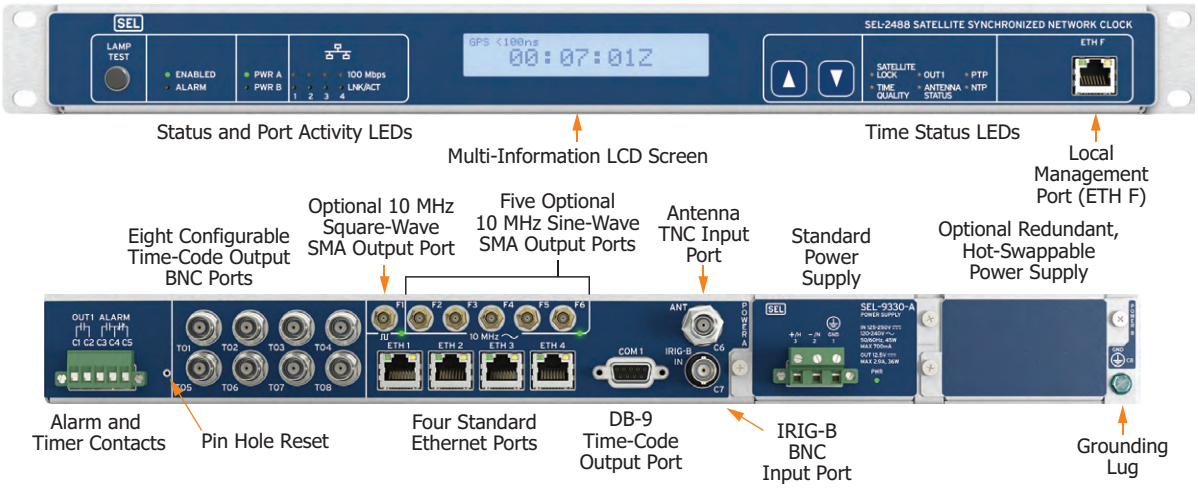

Figure 1 Functional Diagram

The SEL-2488 raises the bar for satellite-synchronized clocks by providing higher levels of accuracy, flexibility, dependability, and ease of use, all while providing advanced capabilities that make it especially well suited for critical infrastructure applications.

Features

- Average accuracy of ±40 ns to UTC, peak accuracy of ±100 ns to UTC for demodulated IRIG-B and pulse outputs
- Time sources used: GPS, GLONASS for satellite signal verification
- Typical NTP time-stamp accuracy <100 µs
- Peak PTP time-stamp accuracy of ±100 ns to UTC
- Peak accuracy of ±1 µs to UTC for modulated IRIG-B
- Standard TCXO holdover oscillator with 36 µs average timing error after 24 hours at constant temperature (315 µs, ±1°C)
- Optional OCXO and DOCXO holdover oscillators with average accuracies of 5 µs and 2.5 µs after 24 hours, respectively
- Eight rear BNC ports for demodulated IRIG-B, PPS, or kPPS, and as many as four ports for modulated IRIG-B
- Six optional SMA frequency output ports with one 10 MHz square-wave output and five 10 MHz sine-wave outputs
- Four Ethernet ports can serve NTPv4 and PTP (optional) to four independent networks
- One Form A solid-state contact output can provide a single contact closure or a repeating contact closure of configurable closure duration and period
- One Form C mechanical alarm contact notifies users of a major or minor event
- One standard power supply: 24–48 Vdc or 125–250 Vdc or Vac, optional second supply

- Satellite signal verification with SEL-9524B GPS/GLONASS GNSS Antenna
- LCD multi-information display plus LEDs for status
- HTTPS Web interface with SkyView, support for DHCP, LDAP, syslog, SNMP read and traps, and ACSELERATOR QuickSet® SEL-5030 Software
- Standard SEL 10-year warranty

Applications

Time Synchronization of Substations

The SEL-2488 has eight BNC ports, which can be configured for demodulated IRIG-B, time pulse, or modulated IRIG-B (as many as four ports). Demodulated IRIG-B provides time output for protection applications, synchronizing relays, phasor measurement units, and other IEDs to within ±40 ns average accuracy to UTC. Time synchronization is also essential for sequence of events recording, disturbance recording, and power system fault location.

Modulated IRIG-B can be configured for as many as four BNC outputs for synchronizing legacy devices. The DB-9 port can be used with SEL-2812 Fiber-Optic Transceivers With IRIG-B or SEL-3405 High-Accuracy IRIG-B Fiber-Optic Transceivers to send IRIG-B over long distances via a fiber-optic cable.

With the purchase of the frequency outputs hardware option, the SEL-2488 provides six 10 MHz outputs. Using both 10 MHz and PPS outputs, the SEL-2488 ensures reliable time synchronization for Land Mobile Radio (LMR) systems, such as simulcast radio systems used in 911 emergency response.

Ethernet ports can use NTP to distribute time 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 serve NTP to four independent networks. The SEL-2488 can act as a stratum 1 time server with typical client synchronization accuracy to the SEL-2488 NTP server on a LAN of 0.5–2 ms. With syslog support, all SEL-2488 event information, including diagnostic and status events, is available over Ethernet in a standardized format.

The SEL-2488 Ethernet ports support hardware time stamping, enabling support of the IEEE 1588 Precision Time Protocol (PTP) for advanced digital secondary applications, such as Sampled Values, with purchase of a firmware upgrade.

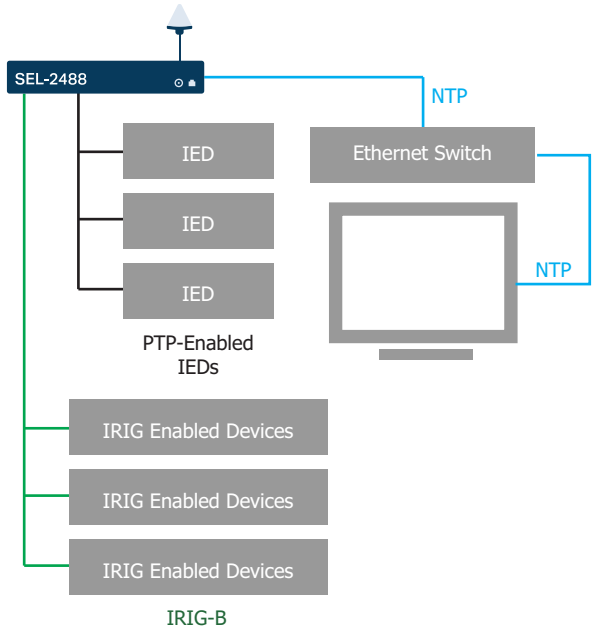

Figure 2 Functional Diagram for Utility Substation Time Synchronization

GNSS Vulnerability Mitigation

If GNSS time signals become unavailable as a result of solar flares, jamming, or an antenna failure, the SEL-2488 switches into holdover to maintain accurate time by using its high-stability, internal oscillator. The standard TCXO oscillator maintains a timing accuracy within 36 µs after 24 hours at constant temperature and 315 µs at ±1°C. The optional OCXO and DOCXO oscillators maintain a timing accuracy of 5 µs and 2.5 µs after 24 hours, respectively. In the case of a GPS spoofing attack, in which a satellite system receiver locks to a counterfeit signal, the SEL-2488 and SEL-9524B GPS/GLONASS GNSS Antenna use signals from the GLONASS Satellite constellation to validate GPS signals and identify mismatches in timing information caused by these attacks.

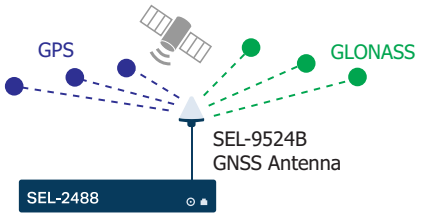

Figure 3 SEL-2488 Satellite Signal Verification

Cable Delay Compensation

The SEL-2488 preserves accuracy by providing time-delay compensation for antenna cables and output cables on a per-port basis with demodulated IRIG-B and pulse outputs.

The cable delay compensation of the SEL-2488 ensures high-accuracy time distribution in large facilities with dispersed IEDs or in installations where antennas must be mounted high on towers. The SEL-2488 supports as long as 500 ft of LMR-400 cable for an antenna and as long as 500 ft of RG-58 or LMR-195 for the output cable.

Figure 4 shows an example of a clock with an antenna and two output ports. One output port is configured for 30 ns of cable delay compensation and the other is configured for 180 ns.

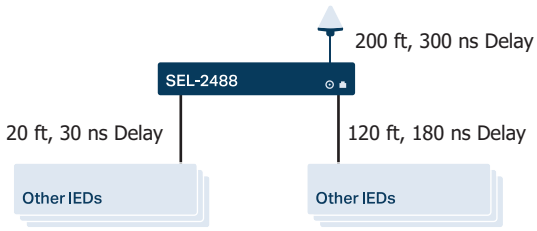

Figure 4 SEL-2488 Cable Delay Compensation

Configuration

HTTPS Device Webpage

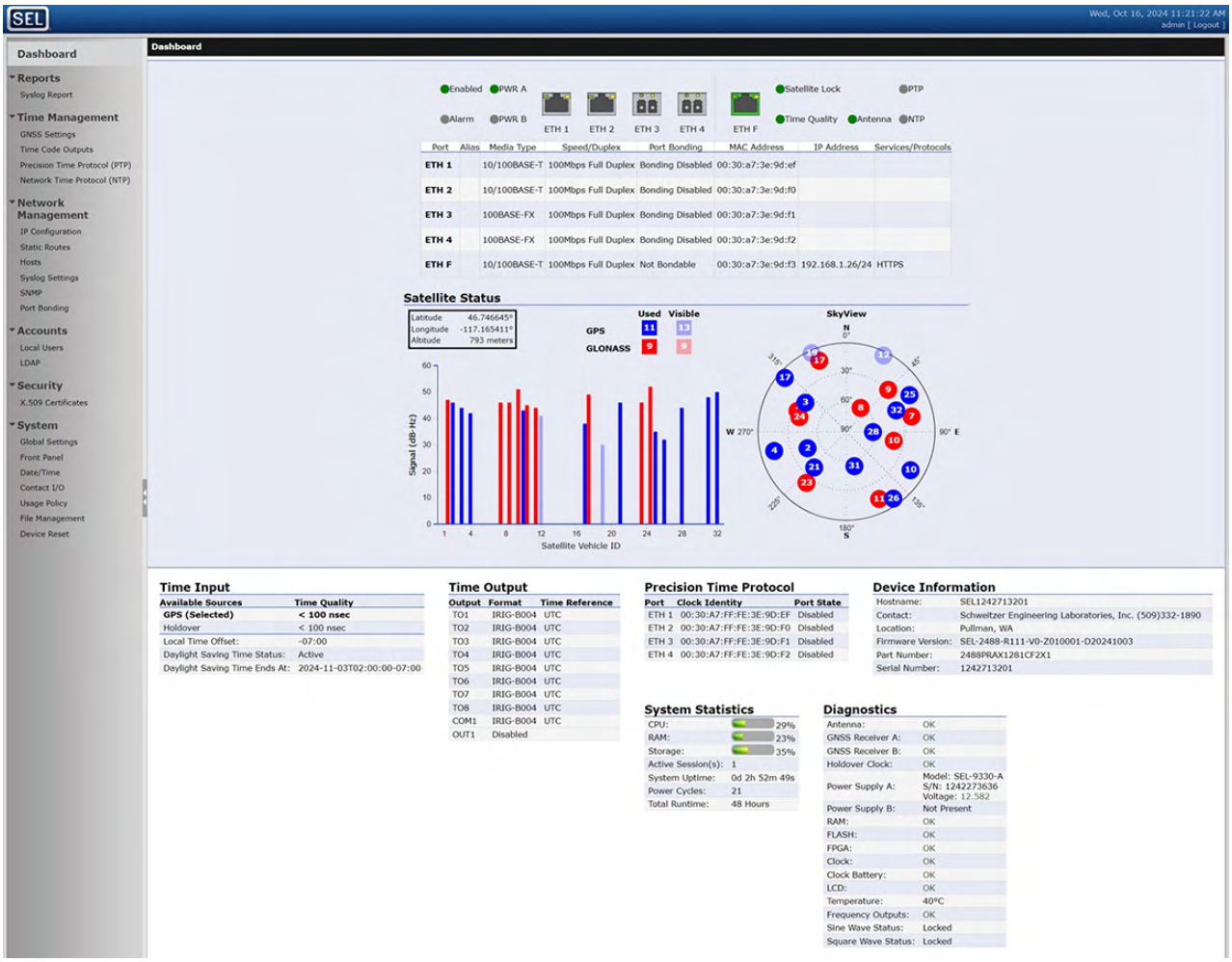

Figure 5 SEL-2488 Dashboard With SkyView

The Captive Port feature on the SEL-2488 provides a DHCP server and limited DNS resolver for an easy initial connection to the device webpage for configuration.

Secure access is controlled through X.509 certificates, user-based accounts, LDAP authentication, and complex passwords. The SEL device webpage includes a dashboard

display of satellite signals for both GPS and GLONASS satellites. Bar charts indicate signal strengths, and the SkyView displays the present satellite overhead positions, useful information for troubleshooting potential signal and antenna installation issues.

QuickSet

QuickSet can be used for secure configuration of the SEL-2488. QuickSet is an easy-to-use, powerful tool with template design capabilities for consistent configuration of settings across multiple devices.

Diagrams and Dimensions

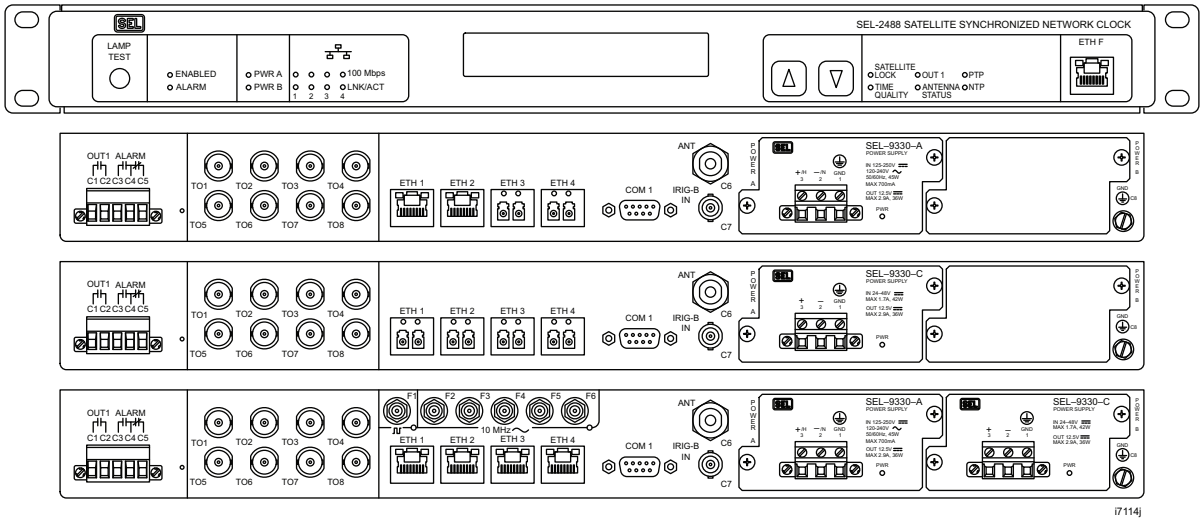

Figure 6 SEL-2488 Front and Rear Panels

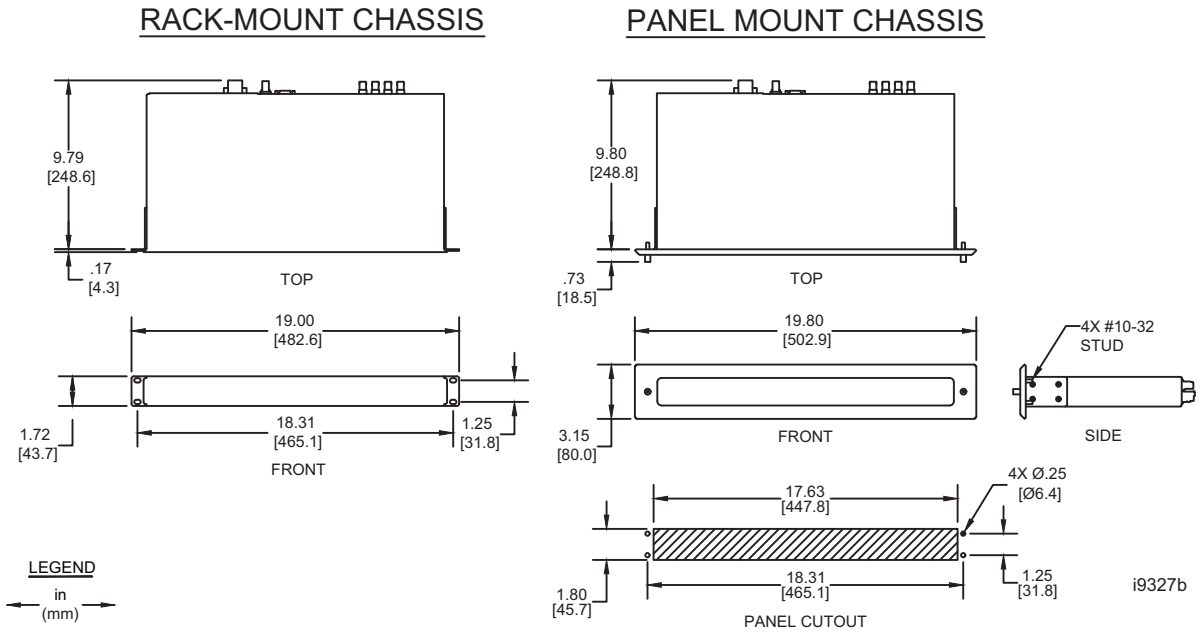

Figure 7 Dimensions for Rack- and Panel-Mount Models

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

United States and Canada

FCC 47 CFR Pt 15B, Class A

Industry Canada ICES-001 (A) / NMB-001 (A)

UL Listed to U.S. and Canadian safety standards (File 220228; NRAQ/NRAQ7)

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area may be likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Any changes or modifications not expressly approved by the manufacturer can void the user's authority to operate the equipment.

European Union

CE Mark

RoHS Compliant

United Kingdom

UKCA Mark

RoHS Compliant

Australia and New Zealand

RCM Mark

General

Receiver

Satellite Tracking:	GPS L1, C/A Code (1575.42 MHz), GLONASS L1 (1602 MHz), track as many as 16 satellites for each constellation

Acquisition Times

Warm Start:	240 s (with saved almanac data)
Cold Start:	240 s + UTC compensation time (as many as 12.5 minutes)

Clock Accuracy (to UTC)

1 PPS:	±40 ns average, ±100 ns peak
Demodulated IRIG-B:	±40 ns average, ±100 ns peak
Modulated IRIG-B:	±1 µs peak
PTP Time-Stamp Accuracy:	±100 ns peak
NTP Time-Stamp Accuracy (Typical):	<100 µs

Typical client synchronization accuracy to the SEL-2488 NTP server on a LAN is 0.5–2 ms. Actual accuracy depends on network conditions.

Frequency Outputs:	<1E-10 measured over 100 s <1E-12 measured over 24 hr

Holdover Timing Accuracy After 24 Hours (Typical)

TCXO:	36 µs, constant temperature 315 µs, ±1°C
OCXO:	5 µs
DOCXO:	2.5 µs

Note: Holdover accuracy values assume the device has been in operation for 24 hours or longer prior to holdover.

Holdover Frequency Accuracy After 24 Hours (Typical):

OCXO:	1E-10 Hz/Hz
DOCXO:	5E-11 Hz/Hz

Antenna Requirements

5 V, <80 mA
≥32 dB preamp

Electrical Output Drive Levels

Demodulated IRIG-B/PPS BNC Ports (**T01–T08**):	5 Vdc (TTL), 250 mA max
Modulated IRIG-B BNC Ports (**T01–T04**):	6.2 Vpp nominal
DB-9 Port IRIG-B Output (**COM1** Pin 4/Pin 6):	5 Vdc (TTL), 5 mA

Note: Cabling on the DB-9 port shall be no longer than 3 m.

Square-Wave Frequency SMA Port (**F1**):	10 MHz, 5 Vdc (TTL), 100 mA max

Note: Cable lengths >2 m requires use of LMR-240 or better quality cabling.

Sine-Wave Frequency SMA Ports (**F2–F6**):	10 MHz, +13 dBm nominal, ±2 dB into 50 Ω
Subharmonics:	<–40 dBc
Spurious:	<–70 dBc

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Insulation Class:	I

Dimensions

1U Rack Mount

Height:	43.7 mm (1.72 in)
Depth:	248.6 mm (9.79 in)
Width:	482.5 mm (19.0 in)

1U Panel Mount:

Height:	80.0 mm (3.15 in)
Depth:	248.8 mm (9.80 in)
Width:	502.9 mm (19.80 in)

Weight

2.8 kg (6.2 lb)

Warranty

10 years

Network Management

HTTPS Web User Interface
ACSELERATOR QuickSet SEL-5030 Software
Settings Import/Export

User-Based Accounts

Maximum Local Accounts:	256
User Roles:	Administrator, Engineer, User Manager, Monitor
Password Length:	1–72 characters
Password Set:	All printable ASCII characters

Note: If complex passwords are enabled, the password must have at least 8 characters with at least one digit, uppercase, lowercase, and special character.

Syslog

Storage for 60,000 local syslog messages

Support for three remote syslog destinations

Simple Network Management Protocol (SNMP)

Monitors diagnostics through SNMP v2c and v3 read operations

Sends notifications using SNMP v2c traps

Support for as many as three trap servers

Network Time Protocol (NTP)

Implements NTPv4 Server, Broadcast, and Multicast formats

Precision Time Protocol (PTP)

Implements the following IEEE 1588-2008 profiles:

Default UDP (Annex D and J)
Default 802.3 (Annex F and J)
IEEE C37.238-2011
IEEE C37.238-2017
IEC/IEEE 61850-9-3:2016

Parallel Redundancy Protocol (PRP)

Implements IEC 62439-3:2016

Supports as many as two Doubly Attached Node implementing PRP (DANP) interfaces for separate PRP networks using the following physical Ethernet port combinations:
ETH 1 and ETH 2
ETH 3 and ETH 4

Supports PTP as a Doubly Attached Clock (DAC) on ports where PRP is enabled.

Active-Backup Port Bonding

Implements Active-Backup port bonding (also known Failover) using the following physical Ethernet port combinations:
ETH 1 and ETH 2
ETH 3 and ETH 4

Communications Ports

Ethernet Ports

Ports:	4 rear, 1 front
Data Rate:	10 or 100 Mbps
Front Connector:	RJ45 Female
Rear Connectors:	RJ45 Female or LC Fiber (single-mode or multimode)
Standard:	IEEE 802.3

Fiber-Optic Ports

Multimode Option (to 2 km)

Maximum TX Power:	–14 dBm
Minimum TX Power:	–20 dBm
RX Sensitivity:	–31 dBm
System Gain:	11 dB
Source:	LED
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)

Single-Mode Option (to 15 km)

Maximum TX Power:	–8 dBm
Minimum TX Power:	–15 dBm
RX Sensitivity:	–28 dBm
System Gain:	13 dB
Source:	Laser
Wavelength:	1310 nm
Connector Type:	LC (IEC 61754-20)

Alarm Output

Pilot Duty Rating (Per UL 508):	B300, R300
Power Supply Burden:	<0.5 W max
Rated Operational Voltage:	24–250 Vdc
Contact Protection:	270 Vdc, MOV protected
Continuous Carry:	2 A
Pickup Time:	≤8 ms typical
Dropout Time:	≤8 ms typical

Timer Contact

Power Supply Burden:	<0.5 W max
Rated Operational Voltage:	12–250 Vdc
Contact Protection:	330 Vdc (250 Vac), MOV protected
Continuous Carry:	100 mA
Off Resistance:	5 MΩ
Minimum Voltage:	12 Vdc
Timing Accuracy (Closing):	±1 µs (applies only to dc voltages)

Terminal Connections

Warning: When using stranded wire, use crimp ferrules to safely capture all wire strands before assembling and attaching the plug or ground wire.

Power Supply Compression Screw Terminals

Part Number:	Use SEL P/N 420-0219 (provided)
Tightening Torque:	0.5–0.6 Nm (4–5 in-lb)
Insulation Ratings:	300 V, 90°C (194°F), minimum
Wire Material:	Copper
Size:	12–18 AWG (4.00–0.75 mm^2)

Alarm and Timing Contact Compression Screw Terminal

Part Number:	Use SEL P/N 420-0071 (provided)
Tightening Torque:	0.5–0.6 Nm (4–5 in-lb)
Insulation Ratings:	300 V, 90°C (194°F), minimum
Wire Material:	Copper
Size:	16–22 AWG (1.50–0.34 mm^2)

Ground Screw

Part Number:	#6 crimp ring terminal is recommended
Tightening Torque:	0.90–1.36 Nm (8–12 in-lb)
Insulation Ratings:	300 V, 90°C (194°F), minimum
Wire Material:	Copper
Size:	12–18 AWG (4.00–0.75 mm^2)
Length:	<3.0 m (<9.8 ft)

Power Supply

125–250 Volt Power Supply (SEL-9330-A)

Rated Supply Voltage:	125–250 Vdc 120–240 Vac, 50/60 Hz
Input Voltage Range:	88–300 Vdc or 85–264 Vac
Burden:	AC: <75 VA, 700 mA DC: <45 W
Input Voltage Interruptions:	50 ms @ 125 Vac/Vdc 100 ms @ 250 Vac/Vdc
Peak Inrush:	8 A
Internal Fuse Rating:	2.5 A, 250 Vdc/300 Vac time-lag T, 250 Vac/1500 A break rating

Note: Fuses are not user-serviceable.

24–48 Volt Power Supply (SEL-9330-C)

Rated Supply Voltage:	24–48 Vdc (polarized)
Input Voltage Range:	19.2–60.0 Vdc
Burden:	<42W, 1.7 A
Input Voltage Interruptions:	50 ms @ 48 Vdc 10 ms @ 24 Vdc
Peak Inrush:	18 A
Internal Fuse Rating:	4.0 A, 150 Vdc time-lag T, 250 Vac/1500 A break rating

Note: Fuses are not user-serviceable.

Recommended External Overcurrent Protection

Breaker Type:	Standard
Breaker Rating:	15 A at 250 Vdc

Current Breaking Capacity:	10 kA
Grounded Neutral Systems:	Device in series with the HOT or energized conductor
DC and Isolated Systems:	Device in series with both conductors

Environmental

Temperature

Operating:	–40° to +85°C (–40° to +185°F)

Note: UL Ambient +40°C (+104°F).
See *Safety Information* for additional details.

Non-Operating (Storage):	–40° to +85°C (–40° to +185°F)

Relative Humidity

5% to 95% noncondensing

Altitude

2000 m

Type Tests

Communication Product Testing

Communications for Substation Equipment:	IEEE 1613-2009 Class 2
Communications Networks and Systems for Power Utility Automation—Pt 3: General Requirements:	IEC 61850-3:2013

Electromagnetic Compatibility General

Measuring Relays and Protection Equipment:	IEC 60255-26:2013

Electromagnetic Compatibility Emissions

IEC 60255-25:2000
IEC 60255-26:2013
CISPR 11:2009 + A1:2010
CISPR 22:2008
Canada ICES-001 (A) / NMB-001 (A)
47 CFR Part 15.107 and 109
Severity Level: Class A

Electromagnetic Compatibility Immunity

Conducted RF Immunity:	IEC 60255-26:2013 IEC 61000-4-6:2014 Severity Level: 10 Vrms
Radiated RF Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-3:2005 + A1:2008 + A2:2010 Severity Level: 10 V/m IEEE C37.90.2-2004 IEEE 1613-2009 Severity Level: 20 V/m
Electrostatic Discharge Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-2:2008 Severity Level: ±2, 4, 6, 8 kV contact; ±2, 4, 8, 15 kV air IEEE 1613-2009 IEEE C37.90.3-2001 Severity Level: ±2, 4, 8 kV contact; ±4, 8, 15 kV air
IEEE Surge Withstand Capability:	IEC 60255-22-1:2007 Severity Level: ±2.5 kV peak common mode, ±1.0 kV peak differential mode IEEE C37.90.1-2005 IEEE 1613-2023 IEEE C37.90.1-2012 + ERTA:2–13 Severity Level: ±2.5 kV, 1 MHz oscillatory; ±4 kV, 5.0 kHz fast transient
IEC Fast Transient/Burst Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-4:2011 Severity Level: ±4 kV, 5 kHz; ±2 kV, 5 kHz on communications ports
IEC SDOW Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-18:2006 + A1:2010 Severity Level: ±2.5 kV; ±1.0 kV on communications ports
IEC Surge Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-5:2005 Severity Level: ±0.5 kV, 1 kV line-to-line, ±0.5 kV, 2 kV line-to-earth; ±0.5 kV, 1 kV, 2 kV line-to-earth on communications ports
Conducted Common-Mode Immunity:	IEC 61850-3:2013 IEC 61000-4-16:2016 Severity Level: 300 Vac for 60 s; 30 Vac for 1 s
Power Frequency Magnetic Field Immunity:	IEC 61000-4-8:2009 Severity Level: 1000 A/m for 3 s, 100 A/m for 1 min
Pulse Magnetic Field Immunity:	IEC 61000-4-9:2001 Severity Level: 1000 A/m
Damped Oscillatory Magnetic Field Immunity:	IEC 61000-4-10:2001 Severity Level: 100 A/m (at 1 kHz and 1 MHz)
Voltage Dips and Interruptions Immunity:	IEC 60255-26:2013 IEC 61850-3:2013 IEC 61000-4-11:2004 + A1:2017 IEC 61000-4-17:2002 + A1:2001 + A2:2008 IEC 61000-4-29:2000

Environmental

Cold:	IEC 60068-2-1:2007 Severity Level: 16 hours at –40°C
Damp Heat, Cyclic:	IEC 60068-2-30:2005 Severity Level: 25° to 55°C, 6 cycles, relative humidity (RH): 95%
Dry Heat:	IEC 60068-2-2:2007 Severity Level: 16 hours at +85°C
Change of Temperature:	IEC 60068-2-14:2009 Severity Level: 20°C and 60% RH to 90°C and 16% RH to –45°C and 36% RH
Damp Heat Steady State:	IEC 60068-2-78:2001 Severity Level: 40°C, RH: 93%, 10 days
Free Fall:	IEEE 1613-2009 Severity Level: 100 mm
Vibration:	IEC 60255-21-1:1988 Severity Level: Class 2 Endurance Class 2 Response
Shock & Bump:	IEC 60255-21-2:1998 Severity Level: Class 1 Shock Withstand Class 1 Bump Class 2 Shock Response
Seismic:	IEC 60255-21-3:1993 Severity Level: Class 2 (Quake Response)

Safety

Measuring Relays and Protection Equipment:	IEC 60255-27:2013
Protection IP Code:	IEC 60529:1989 + A1:1999 + A2:2013 IP Code: IP3X for category 2 equipment

Insulation Coordination:	IEC 60255-27:2013 IEEE C37.90-2005 Dielectric (HiPot) Severity Level: Power Supply: ±3.6 kVdc Timer/Alarm Contacts: ±3.6 kVdc IRIG-B Input: ±2.25 kVdc Ethernet Ports: ±2.25 kVdc Impulse Severity Level: 5 J; ±5 kV, 1.2/50 µs
Electrical Equipment for Measurement, Control, and Laboratory Use:	IEC 61010-1:2010/AMD1:2016/COR:2019 UL 61010-1:2019, C22.2 No. 61010-1:12/A1:18 IEC 61010-2-201:2017 UL 61010-2-201:2018, C22.2 No. 61010-2-201:18

Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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Notes

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