SEL-3610 Port Server

Major Features and Benefits

The SEL-3610 Port Server is an EIA-232, EIA-422 or EIA-485 serial-to-serial and Ethernet-to-serial cryptographic port server. The SEL-3610 increases the amount of available serial ports to communications processors and computers, and allows serial products to communicate securely through Ethernet networks. The port server tunnels serial data over an Ethernet connection through the use of Secure Shell (SSH), Telnet, Modbus, UDP, or raw TCP encapsulation. Communications establish virtual bonds between one or more logical Ethernet ports and one or more physical serial ports. The SEL-3610 provides highly flexible serial and Ethernet port mappings, and can filter based on which connections listen or transmit.

➤ **Secure Architecture and Malware Protection.** Maximize reliability with integrated exe-GUARD® whitelist antivirus and other malware protections, eliminating costly patch management and signature updates.

➤ **Serial-to-Ethernet Transceiver.** Establish an Ethernet connection by using SSH, Telnet, UDP, or raw TCP encapsulation to create a persistent tunnel between logical Ethernet ports and physical serial ports.

➤ **Master Port Functionality.** Configure one or more serial or Ethernet ports as a master port for authenticated, transparent connections to devices connected to the SEL-3610 Port Server.

➤ **Configurable Serial Mappings.** Provide granular network configuration options with a variety of serial-to-serial and serial-to-Ethernet maps that support point-to-point and point-to-multipoint architectures.

➤ **Centralized User-Based Access Controls.** Provide strong, centralized access control and user accountability with Lightweight Directory Access Protocol (LDAP) or Remote Authentication Dial In User Service (RADIUS).

➤ **Import/Export Configuration File.** Quickly restore system settings and create back-up files of the device's current configurations.

➤ **Modbus to Modbus TCP/IP.** Communicate with serial Modbus products by using Modbus TCP/IP.

➤ **Ethernet Port Bridge.** Support a reliable Ethernet ring topology.

➤ **Ease of Use.** Use the secure web interface for simple and convenient setup, configuration, and management.

➤ **Time Synchronization.** Synchronize and source IRIG and NTP. Time align events and user activity across your system.

➤ **Syslog.** Log events for speedy alerts, consistency, compatibility, and centralized collection. For slow communications links, the SEL-3610 can throttle the number of outgoing syslog messages.

➤ **Integrated Port Switch.** Map one or more of the serial ports to any other serial ports, or to Ethernet TCP or UDP connections.

➤ **SNMP.** Monitor device health and configuration by using Simple Network Management Protocol (SNMP).

➤ **5 V Pin One Power on Serial Ports.** Directly power 5 V devices from the serial ports.

➤ **High Reliability.** Rely on the SEL-3622, built for availability, hardened for the substation, and backed by a 10-year warranty.

➤ **Bit-Based Conversion.** Transform Conitel and other bit-based protocols to Ethernet and reduce reliance on expensive analog circuits.

➤ **Service Port.** Automate base-lining of the device settings with a basic command-line interface.
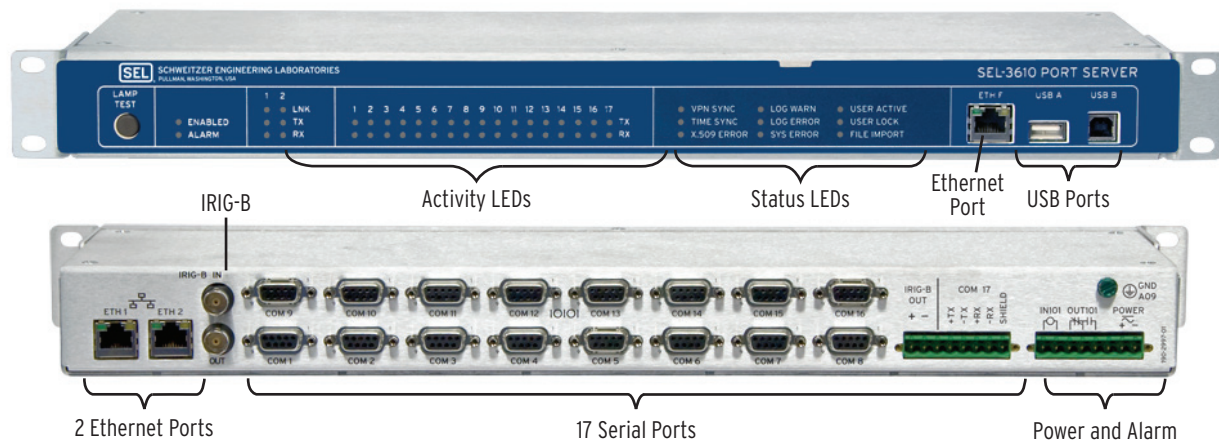
Functional Overview

Figure 1   SEL-3610 Functional Overview

The SEL-3610 is a serial port expansion product providing 17 additional serial ports to communications processors or computers. The SEL-3610 provides four options for tunneling of serial data over Ethernet networks: SSH, Telnet, Modbus, UDP, or raw TCP encapsulation. The port server converts serial Modbus to Ethernet Modbus TCP protocol on the fly.

The SEL-3610 uses IRIG-B and NTP to synchronize and source time. This functionality enables accurate time stamps on all internal logs, and allows the port server to act as a time distribution hub for all devices on the network. The SEL-3610 can synchronize its internal clock with external NTP or IRIG-B sources, and can source NTP and IRIG-B from its internal clock if the time input fails. The SEL-3610 can distribute IRIG-B time out to all 17 connected serial devices and its BNC port.

User-based accounts increase log granularity and provide user accountability. The SEL-3610 makes user account management easy by including support for centralized user authentication via Remote Authentication Dial In User Services (RADIUS) or the Microsoft Active Directory with LDAP. A system operator may configure the port server to access a primary and redundant Authentication server for maximum reliability.
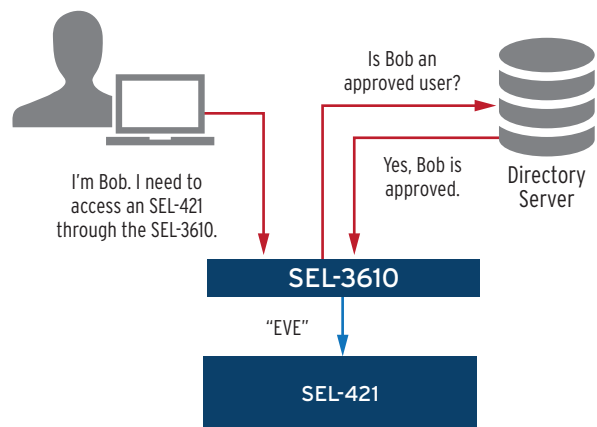

Figure 2   Centralized Authentication With the SEL-3610

The SEL-3610 provides master port functionality on logical Ethernet ports or on physical serial ports for engineering access. A master port provides an authentication portal for user-based account access, and then presents a list of available serial devices to the authenticated user. The SEL-3610 will then transparently forward the accessing user to the chosen serial device, log the connection, and hold the connection open until the user disconnects.

Figure 3   Master Port Login Window

Users can easily view and configure the SEL-3610 remotely with any web browser and hypertext transfer protocol with security (HTTPS). This allows for local and remote secure management of the device (see *Figure 4*).

The Syslog protocol enables centralized log collection and visualization of system events. The SEL-3610 can send logs to three different remote destinations, and can store as many as 60,000 logs locally.
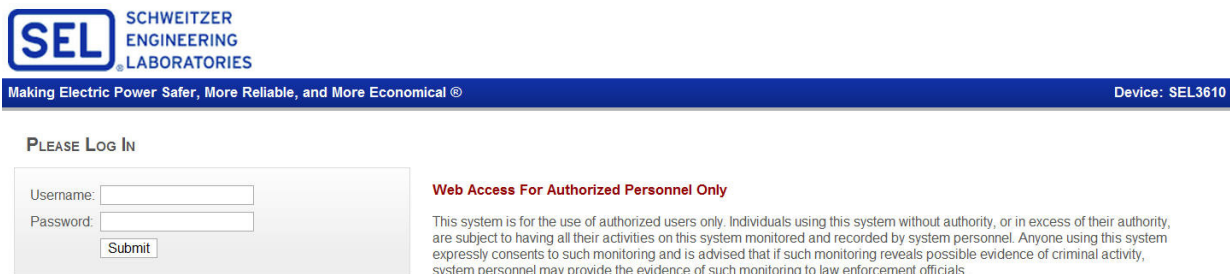

Figure 4   Easy-to-Use Web Management Interface

Applications

The SEL-3610 is ideally suited for serial port expansion applications, enhancing serial products to have secure Ethernet engineering access, point-to-point communication of serial devices over Ethernet, and many different serial-to-Ethernet and serial-to-serial port mapping scenarios. Configurable serial and Ethernet port mappings means engineers will never have to physically rewire communication cables.

Serial Port Expansion

Figure 5 shows the SEL-3610 providing serial port expansion for the SEL-3530 Real-Time Automation Controller. This expands the amount of serial devices the communications processor manages by simply mapping virtual serial ports to the SEL-3610. Communications processors or computers will route Ethernet traffic destined for a serial device hooked to the SEL-3610 across the LAN. Depending on the desired Ethernet protocol, the SEL-3610 uses SSH for encrypted and authenticated data communications, Telnet, UDP, or raw for unencrypted, serial encapsulated communications. Modbus mode does protocol conversions between Modbus TCP and Modbus RTU or ASCII. Select this mode when using the Modbus protocol.
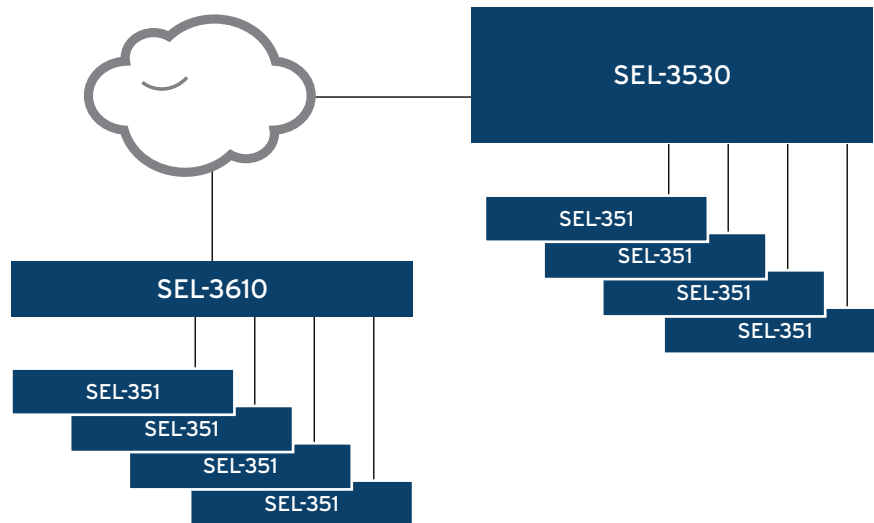
Figure 5   Serial Port Expansion Applications

Point-to-Point

Figure 6 shows the SEL-3610 in a point-to-point application allowing ᴀᴄSELᴇʀᴀᴛᴏʀ Tᴇᴀᴍ® SEL-5045 Software to transparently access serial devices across an Ethernet network. The SEL-3610 uses SSH for encrypted and authenticated data communications, Telnet, UDP, or raw for unencrypted communications.
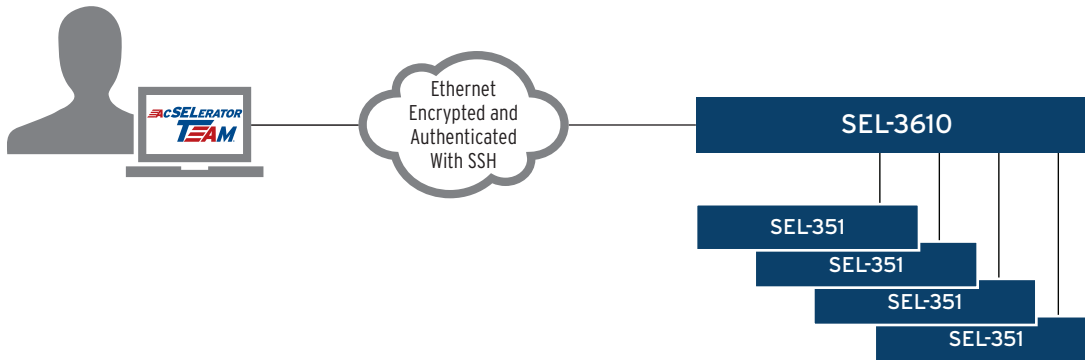

Figure 6   Point-to-Point Serial Tunneling

Time Synchronization and Distribution

The SEL-3610 synchronizes its own time to either an IRIG-B signal or NTP, and uses this time to stamp all logs it generates. The SEL-3610 also provides time distribution to other system devices. It can distribute IRIG-B time through its BNC port and all enabled serial ports, or through any enabled logical Ethernet port with NTP. This means the SEL-3610 provides the accurate time source required by time sensitive applications like synchrophasors. If a disruption breaks the time input to the SEL-3610, the port server will continue to synchronize system devices to its own internal clock via IRIG-B or NTP.
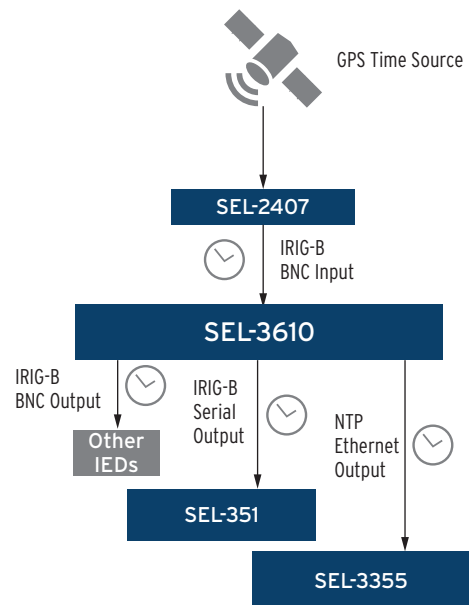

Figure 7   Time Distribution With IRIG-B and NTP

Log Collection

The SEL-3610 has the capability to store 60,000 logs locally. These logs detail product settings changes, health status, engineering access activities, and other essential changes needed for an operator to achieve a full understanding of the current state of the port server.

The port server also provides these logs in the syslog format, and can send them to three different locations. This provides a method to ensure an accurate storage of all logs for audit or compliance reasons, and allows the operator to structure network architecture to centrally collect logs system wide. Centralized collection provides context to logs and shows the system state of other products or events happening at the same time the SEL-3610 log was generated.

There are many viewers available for syslog servers, some are free downloads and others are highly flexible commercial tools. These tools centrally collect and display logs from all system products which ease the burden on system operations to collect and correlate the system events. These collection tools can run on SEL computer platforms.

Port Bridging

All three Ethernet ports on the SEL-3610 can join a bridge port. Bridging ports establishes a switch-like functionality that is used to hook multiple devices into a ring network without the need for an external switch (see *Figure 8*). Once a port is added to the bridge, it shares the same IP address as other ports on the bridge but maintains its own MAC address. If the bridge port receives a packet destined for itself, it processes that packet normally. If the bridge port receives a packet destined for another address, it forwards that packet on to the destination from the port best suited to send it. The bridge port runs spanning tree protocol (STP) to decide which port forwards packets. The ring topology shown in *Figure 8* provides reliable transport; if any given point in the ring is broken, the SEL-3610 reverses ring direction to forward packets to their final destinations.
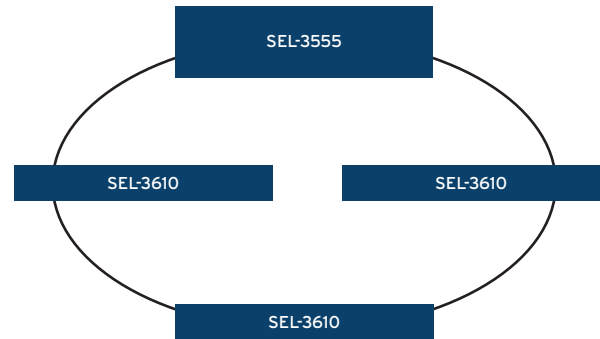

Figure 8   Bridging Ethernet Ports

Easy Serial Port Sniffing

The SEL-3610 port switch functionality enables the configuration and troubleshooting of a variety of Ethernet and serial communication scenarios without having to physically pull plugs or rewire cables. The port server can filter based on which connections listen or transmit. For example, multiple physical serial ports can receive data from an Ethernet source, but the Ethernet source will only listen to a response from one serial port.

The send and receive selective listening capabilities allow for easy serial port sniffing for troubleshooting purposes. In *Figure 9*, the SEL-3610 mirrors the serial communication stream between the SEL-2411 Programmable Automation Controller and the SEL-3355 Computer to an engineer's laptop over an Ethernet connection. The SEL-2411 and SEL-3355 do not listen for any response from the engineer's laptop, effectively making the laptop a read-only serial data sniffer.
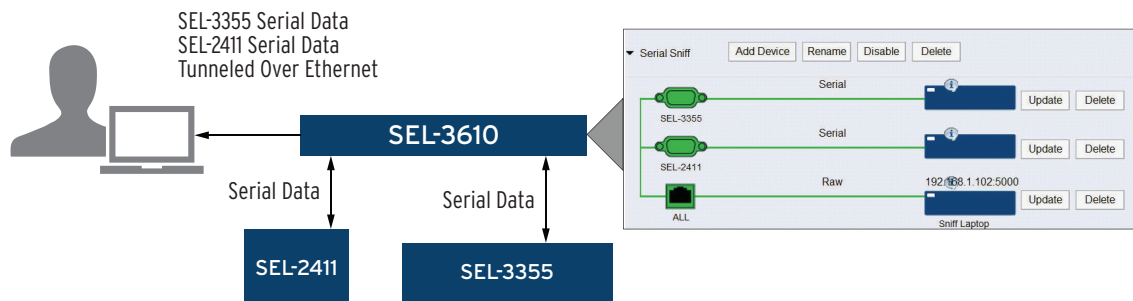

Figure 9   Configurable Port Mappings Allow Easy Troubleshooting

Secure User Access to IEDs

User access allows engineers to securely monitor or configure serial devices connected to the SEL-3610. Engineers can use SSH to secure remote access over Ethernet, or use an SEL-3025 Serial Shield connected to the port server to secure remote access over a serial or dial-up link. Both secure access options safeguard against eavesdroppers listening in on information as it traverses the communications channel; against man-in-the-middle attacks involving alteration, injection, or replaying of data between communications link endpoints; and against unauthorized access. The SEL-3610 authenticates and logs all user access sessions by a local or centralized account name before allowing access to a device on its serial port.

Users may securely access serial devices over Ethernet with SSH via a logical Ethernet master port. The master port will present a list of authorized devices for the user to select from, after the user authenticates to the SEL-3610, like in *Figure 3*. Users may securely access serial devices over dial-up or serial links by using the PC Serial Security Kit and an SEL-3025 Serial Shield connected to a serial master port on the SEL-3610.
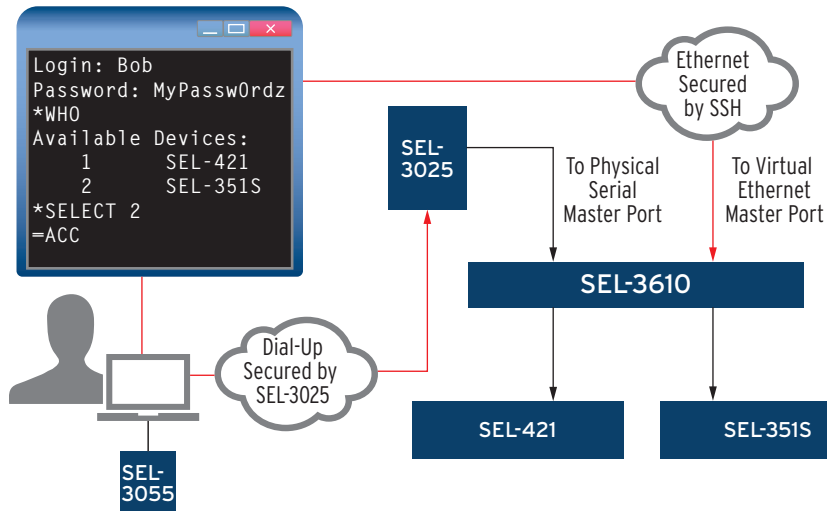

Figure 10   Secure Remote Access to Serial Devices

Secure Management

Administrators may configure the SEL-3610 settings and user accounts through a secure HTTPS web management interface that utilizes transport layer security (TLS). This eliminates the need for external software and is compatible with your computer's browser. Mutual authentication occurs before any secure web management session is opened. The device authenticates to the user by using a X.509 server-side certificate and the user authenticates to the device by username and password. From that point on users are restricted to actions that are authorized by the role that a system administrator assigned to their account. There are two roles: admin and user. The user is authorized to perform most tasks on the SEL-3610, with notable exceptions being the inability to change time settings, edit or add any user accounts, or modify their own account privileges. Administrators can perform any action on the SEL-3610, including creating and editing all accounts on the box.

The SEL-3610 syslog logging capability eliminates the need for user accounts used just for status monitoring. This allows the SEL-3610 to use a very simple and easy to maintain account structure with just two roles.

The web management interface provides simple-to-use graphic configuration pages that display how the device is configured through network diagrams, such as in *Figure 11*. This is a way of confirming that all configurations are as the operator intends them to be. It also supplies a single place to retrieve all communications channel information and network diagrams associated with the SEL-3610. The device can export and import configuration files, allowing for easy device backup and restoration. The device also features a basic command-line interface service port that allows for the automation of configuration base-lining. The service port is read-only and requires administrative credentials to access.

Figure 11   Web Management Dashboard
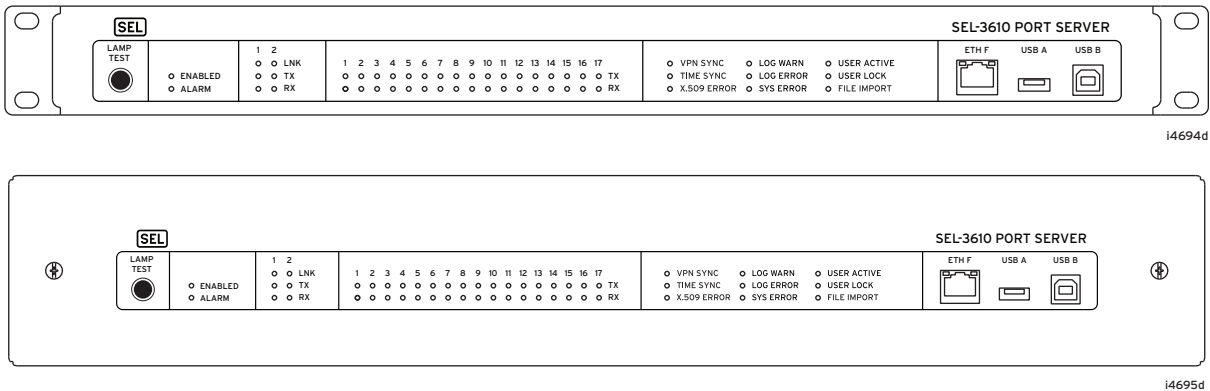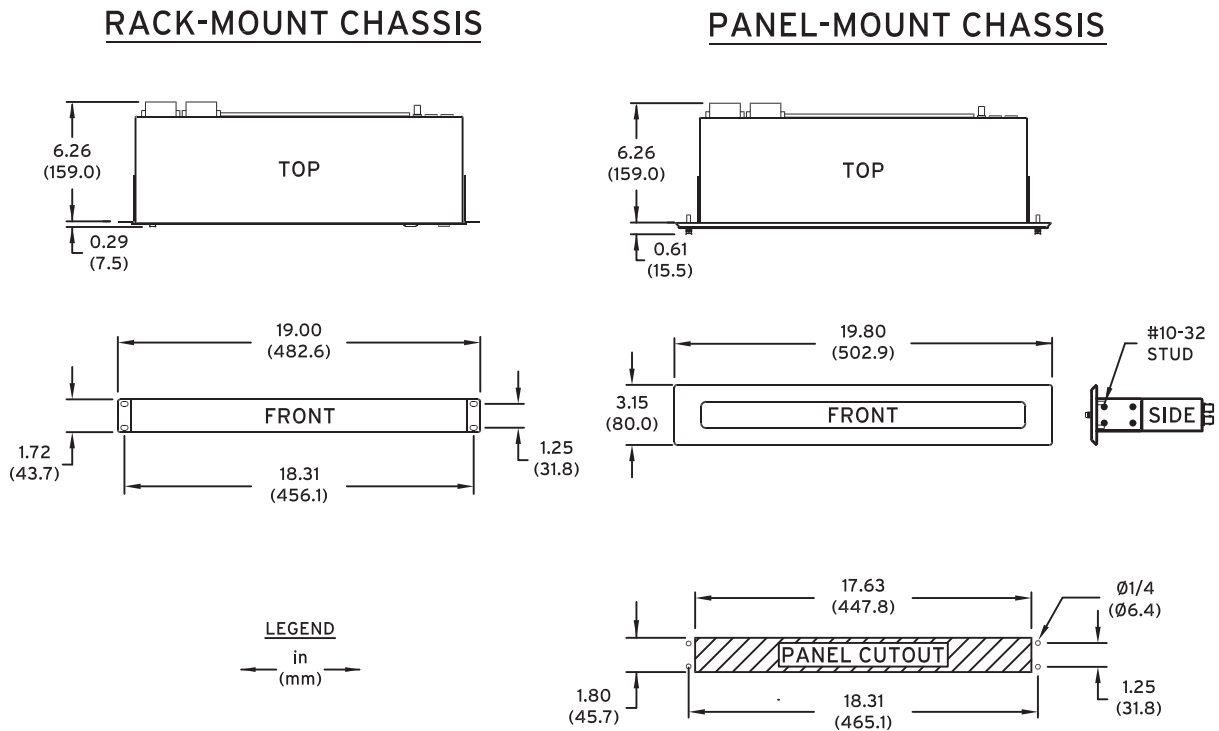
Mechanical Diagrams and Dimensions

Figure 12   Front-Panel Diagrams

Figure 13   Rear-Panel Diagrams

RACK-MOUNT CHASSIS

PANEL-MOUNT CHASSIS

Figure 14   SEL-3610 Dimensions

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

47 CFR 15B, Class A

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 is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense.

UL Listed to U.S. and Canadian safety standards (File E220228; NRAQ, NRAQ7)

CE Mark
UKCE Mark
RCM Mark

Networking

Web Management

Protection Protocols:	HTTPS, TLSv1.2, TLSv1.3
Authentication:	X.509 and Username/Password
Encryption Key Strength:	128-bit, 256-bit

Ethernet Protocols

Address Resolution Protocol (ARP)

Dynamic Host Configuration Protocol (DHCP) Client

Dynamic Host Configuration Protocol (DHCP) Server (USB-B Only)

Hypertext Transfer Protocol Secure (HTTPS)

Internet Control Message Protocol (ICMP)

Lightweight Directory Access Protocol (LDAP) Client

Modbus TCP/IP

Network Time Protocol (NTP) Client/Server

Remote Authentication Dial-In User Service (RADIUS)

Secure Shell version 2 (SSHv2) Client/Server

Simple Network Management Protocol (SNMP)

Spanning Tree Protocol (STP)

Syslog

Telnet

Transmission Control Protocol (TCP)

Transport Layer Security (TLS)

User Datagram Protocol (UDP)

VLAN

Maximum number of VLANs per physical interface:	1

Security

User-Based Accounts

Maximum Local Accounts:	256
Password Length:	8–128 characters
Password Set:	All printable ASCII characters
User Roles:	Administrative and Technician

Syslog

Storage for 60,000 messages

Forwarding to 3 destinations

General

Operating Temperature Range

–40° to +85°C (–40° to +185°F)
Note: Not applicable to UL applications.

Operating Environment

Pollution Degree:	2
Overvoltage Category:	II
Relative Humidity:	5%–95%, non-condensing
Maximum Altitude:	2000 m

Dimensions

1U Rack Mount:	482.6 mm W x 43.7 mm H x 159 mm D (19" W x 1.72" H x 6.26" D)
1U Panel Mount:	502.9 mm W x 80 mm H x 159 mm D (19.8" W x 3.15" H x 6.26" D)

Weight

2.35 kg (5.2 lb)

Warranty

10 Years

Processing and Memory

Processor Speed:	533 MHz
Memory:	1024 MB DDR2 ECC SDRAM
Storage:	4 GB

System Speeds

Firmware Update Time (Varies):	10 min
Cold Boot-Up Time:	2 min

Time-Code Input

IRIG accuracy depends on external GPS source

Input Type:	IRIG-B000 or B002, Even or Odd parity

NTP accuracy depends on network conditions

Modulated IRIG-B (BNC)

On (1) State: $V_{ih} \geq 3.3\ V_{p\text{-}p}$

Off (0) State: $V_{il} \leq 0.1\ V_{p\text{-}p}$

Input Impedance: 2.5 kΩ

Accuracy: 500 μs

Demodulated IRIG-B (BNC)

On (1) State: $V_{ih} \geq 2.2\ V$

Off (0) State: $V_{ih} \leq 0.8\ V$

Input Impedance: 2.5 kΩ

Accuracy: 250 ns

Network Time Protocol (Ethernet)

Accuracy: 10 ms (varies)

Time-Code Output

IRIG accuracy depends on source accuracy

NTP accuracy depends on network conditions

Demodulated IRIG-B000 Even Parity (BNC and Serial)

On (1) State: $V_{oh} \geq 2.4\ V$

Off (0) State: $V_{ol} \leq 0.8\ V$

Load: 50 Ω

Output Drive Levels

Demodulated IRIG-B: TTL 120 mA, 3.5 Vdc, 25 Ω

Serial Port: TTL 2.5 mA, 2.4 Vdc, 1 kΩ

Network Time Protocol (Ethernet)

Accuracy: 250 μs (ideal on LAN)

Communications Ports

Ethernet Ports

Ports: 2 rear, 1 front

Data Rate: 10 or 100 Mbps

Front Connector: RJ45 Female

Rear Connectors: RJ45 Female or LC Fiber (single-mode or multimode, 100 Mbps only)

Standard: IEEE 802.3

Fiber Optic

100BASE-FX Multimode Option (to 2 km)

Maximum TX Power: –14 dBm

Minimum TX Power: –19 dBm

RX Sensitivity: –30 dBm

System Gain: 11 dB

Source: LED

Wavelength: 1300 nm

Connector Type: LC (IEC 61754-20)

100BASE-LX10 Single-Mode Option (to 15 km)

Maximum TX Power: –8 dBm

Minimum TX Power: –15 dBm

RX Sensitivity: –25 dBm

System Gain: 10 dB

Source: Laser

Wavelength: 1300 nm

Connector Type: LC (IEC 61754-20)

Serial Ports

Type: EIA-232/EIA-422/EIA-485 (software selectable)

Data Rate: 1200 to 115200 bps

Connectors: DB-9 Female (Ports 1–16), Isolated 8 pin (Port 17)

Power: +5 Vdc power on Pin 1 (500 mA maximum cumulative for 16 ports)

USB Ports

1 Host Port: Type A (nonfunctional, for future use)

1 Device Port: Type B
Supports USB Networking with DHCP server for out-of-band management access(driver downloadable from selinc.com)

Power Supply

Input Voltage

Rated Supply Voltage: 125–250 Vdc; 110–240 Vac, 50/60 Hz 48–125 Vdc; 120 Vac, 50/60 Hz 24–48 Vdc

Input Voltage Range: 85–300 Vdc or 85–264 Vac 38.4–137.5 Vdc or 88–132 Vac, 18–60 Vdc polarity dependent

Power Consumption

AC: <40 VA

DC: <30 Watts

Input Voltage Interruptions

20 ms @ 24 Vdc
20 ms @ 48 Vdc
50 ms @ 125 Vac/Vdc
100 ms @ 250 Vac/Vdc

Digital Inputs

Contact Input

125 Vdc: Pickup: 105–150 Vdc Dropout: <75 Vdc

Digital Outputs

DC Ratings

Rated Operational Voltage (U_e): 24–250 Vdc

Rated Voltage Range: 19.2–275 Vdc

Rated Insulation Voltage (U_i): 300 Vdc

Continuous Carry: 6 A at 70°C 4 A at 85°C

Make: 30 A @ 250 Vdc per IEEE C37.90

Thermal: 50 A for 1 s

Contact Protection: 360 Vdc, 40 J MOV protection across open contacts

Leakage Current in a 500 Ω load at Rated Voltage: <0.02 mA

Impedance of a Closed Output, in D.C.:	<1 Ω
Bouncing Measured in Resistive Load of 10 kW at Rated Voltage:	<5 ms
Operating Time (Coil Energization to Contact Closure, Resistive Load):	Pickup time ≤ 5 ms typical Dropout time of ≤ 5 ms typical
Breaking Capacity (10,000 Operations):	Per IEC 60255-0-20: 1974: 24 V 0.75 A L/R = 40 ms 48 V 0.50 A L/R = 40 ms 125 V 0.30 A L/R = 40 ms 250 V 0.20 A L/R = 40 ms
Cyclic Capacity (2.5 Cycles/Second):	Per IEC 60255-0-20: 1974: 24 V 0.75 A L/R = 40 ms 48 V 0.50 A L/R = 40 ms 125 V 0.30 A L/R = 40 ms 250 V 0.20 A L/R = 40 ms
Mechanical Durability:	10 million no-load operations

AC Ratings

Operational Voltage (U_e):	250 Vac/Vdc
Rated Insulation Voltage (U_i):	300 Vac/Vdc
Utilization Category:	AC-15 (control of electromagnetic loads > 72 VA)
Contact Rating Designation:	B300 (B = 5 A, 300 = rated insulation voltage)
Rated Operational Current (I_e):	3 A @ 120 Vac 1.5 A @ 240 Vac.
Conventional Enclosed Thermal Current (I_{the}) Rating:	5 A
Operate Current:	>1 mA
Rated Operational Voltage (U_e):	240 Vac
Voltage Protection Across Open Contacts:	270 Vac, 40 J
Pickup/Dropout Time:	≤16 ms (coil energization to contact closure).
Electrical Durability Make VA Rating:	3600 VA, cos j = 0.3
Electrical Durability Break VA Rating:	360 VA, cos j = 0.3
Mechanical Durability:	10,000 no-load operations
Rated Frequency:	50/60 ±5 Hz

Type Tests

Electromagnetic Compatibility (EMC)

Emissions:	IEC 60255-25:2000 Canada ICES-001(A) / NMB-001(A)

Electromagnetic Compatibility Immunity

Conducted RF Immunity:	IEC 60255-22-6:2001 10 Vrms IEC 61000-4-6:2008 10 Vrms
Digital Radio Telephone RF Immunity:	ENV 50204:1995 10 V/m at 900 MHz and l.89 GHz

Electrostatic Discharge Immunity:	IEC 60255-22-2:2008 2, 4, 6, 8 kV contact; 2, 4, 8, 15 kV air IEC 61000-4-2:2008 2, 4, 6, 8 kV contact; 2, 4, 8, 15 kV air IEEE C37.90.3-2001 2, 4, and 8 kV contact; 4, 8, and 15 kV air
Fast Transient/Burst Immunity:	IEC 60255-22-4:2008 Class A: 4 kV at 5 kHz, 2 kV at 5 kHz on comm ports IEC 61000-4-4:2004 + CRGD:2006 4 kV at 5 kHz
Magnetic Field Immunity:	IEC 61000-4-8:2001 1000 A/m for 3 s, 100 A/m for 1 min IEC 61000-4-9:2001 1000 A/m
Power Supply Immunity:	IEC 60255-11:2008 IEC 61000-4-11:2004 IEC 61000-4-29:2000
Radiated Radio Frequency Immunity:	IEC 60255-22-3:2007 10 V/m IEC 61000-4-3:2008 10 V/m IEEE C37.90.2-2004 35 V/m
Surge Immunity:	IEC 60255-22-5:2008 1 kV Line-to-Line 2 kV Line-to-Earth IEC 61000-4-5:2005 1 kV Line-to-Line 2 kV Line-to-Earth
Surge Withstand Capability:	IEC 60255-22-1:2007 2.5 kV peak common mode 1.0 kV peak differential mode IEEE C37.90.1-2002 2.5 kV oscillatory 4 kV fast transient waveform

Environmental Tests

Cold:	IEC 60068-2-1:2007 16 hours at –40°C
Damp Heat, Cyclic:	IEC 60068-2-30:2005 25°C to 55°C, 6 cycles, 95% relative humidity
Dry Heat:	IEC 60068-2-2:2007 16 hours at +85°C
Vibration:	IEC 60255-21-1:1988 Class 1 Endurance, Class 2 Response IEC 60255-21-2:1988 Class 1 Shock Withstand, Bump Class 2 Shock Response IEC 60255-21-3:1993 Class 2 Quake Response

Safety

Dielectric Strength:	IEC 60255-5:2000 2500 Vac on contact inputs and contact outputs, 1 min 3100 Vdc on power supply, 1 min IEEE C37.90-2005 2500 Vac on contact inputs and contact outputs, 1 min 3100 Vdc on power supply, 1 min
Impulse:	IEC 60255-5:2000, 0.5 Joule 5 kV IEEE C37.90-2005, 0.5 Joule 5 kV
IP Code:	IEC 60529:2001 + CRGD:2003 IP20

PDS3610-01