SEL-3560 Real-Time Automation Controller (RTAC)

The SEL-3560 Real-Time Automation Controller (RTAC) is a powerful automation platform that combines the best features of the high-performance x86-64 architecture, embedded microcomputer, embedded real-time operating system, and secure communications framework with IEC 61131-3 PLC programmability.

Major Features and Benefits

➤ **Multiple Device Functions.** Use a single SEL-3560 RTAC as a protocol gateway, RTU, logic processor, PAC, engineering port server, event processor, and system-wide SER logger/viewer.

➤ **Proven Reliability.** Rely on the robust hardware of the SEL-3560 RTAC, designed and tested to withstand vibration, electrical surges, fast transients, and extreme temperatures that meet or exceed protective relay standards and IEEE 1613, Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations.

➤ **Integrated Local Display.** Build custom HMI displays quickly and easily without the need for mapping data tags. Because the HMI uses the local video port and is also web-based, no special software is needed for viewing HMI displays.

➤ **Protection Against Malware and Other Cybersecurity Threats.** Protect your RTAC system with exe-GUARD®, which uses advanced cryptographic algorithms to authorize the execution of any program or service on the system. Any tasks not approved by the whitelist are blocked from operation.

➤ **Standard IEC 61131-3 Logic Design.** Create innovative logic solutions directly in ACSELERATOR RTAC by using any of the editor tools: Tag Processor, Structured Text, Ladder Logic, or Continuous Function Chart.

➤ **Single-Point Engineering Access.** Gain engineering access to station IEDs through a single serial port, external modem, or high-speed network connection.

➤ **User Security.** Assign individual user and role-based account authentication and strong passwords. Use Lightweight Directory Access Protocol (LDAP) for central user authentication.

➤ **Integrated Security Management.** Comply with NERC/CIP user authentication, logging, and port control requirements.

➤ **IEC 61850.** Integrate high-speed control schemes between the RTAC and relays with IEC 61850 GOOSE peer-to-peer messaging. Poll and send data sets and reports from other IEDs with IEC 61850 MMS client/server.

➤ **Redundant Power Supply.** Apply redundant power support with two load-sharing, hot-swappable power supply modules, enabling you to power the SEL-3560 RTAC from two independent power sources for maximum availability and without inverters.

➤ **Synchrophasor Technology.** Use the IEEE C37.118 client protocol to integrate synchrophasor messages from relays or PMUs in your system. These messages can be used for logic and control in the station or converted to DNP3 or other protocol for SCADA usage.

➤ **Standard Data Management.** Map and scale data points easily between protocols in small and large systems. You can also normalize IED data into common data types, time-stamp formats, and time zones.

➤ **Simple Setup With AcSELERATOR RTAC® SEL-5033 Software.** Build a system quickly by using preconfigured device templates for SEL relays and other communications connections. The Tag Processor provides methods to visually map data relationships between communications protocols.

➤ **PCIe Expandability.** Employ as many as four standard PCI/PCIe form factor expansion cards, enabling you to add as many as eight fiber-optic or copper Ethernet ports or 18 additional rear-panel (RJ45) serial ports.

➤ **Remote Management.** Use remote access with Intel vPro Active Management Technology to give you full access to system video, keyboard, mouse, and storage.

➤ **Versatile Display Interfaces.** Connect to a Digital Visual Interface (DVI) or DisplayPort to use simultaneous independent high-definition display interfaces. Other video connections, such as High Definition Multimedia Interface (HDMI), are available when using interface adapters. The two front-panel and four rear-panel USB ports provide keyboard and mouse control.

➤ **Flexible Protocol Conversion.** Apply any available client or server protocol on any serial or Ethernet port. Each serial port on the expansion card can be used in software-selectable EIA-232 or EIA-485. The two rear Ethernet ports can optionally be copper or fiber-optic connectors.

Product Overview

Functional Diagram
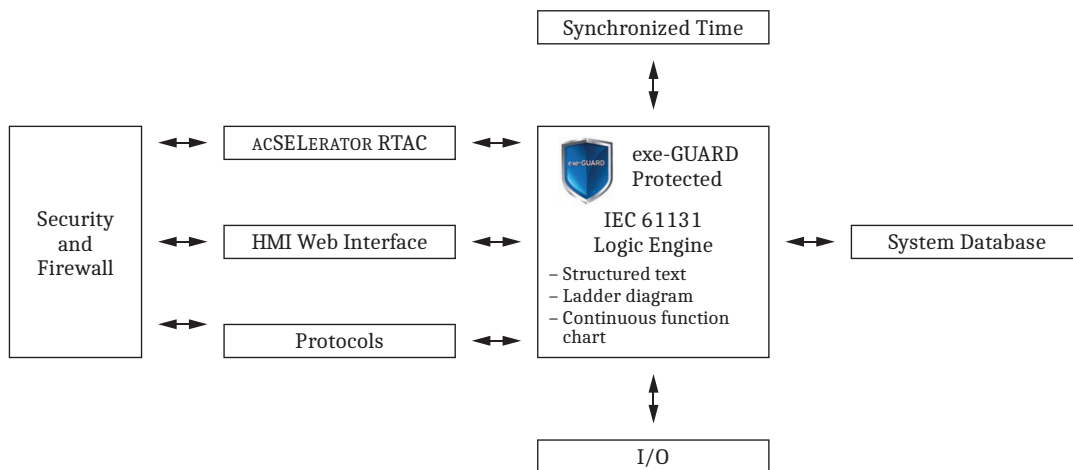
IEC 61131 Logic Engine

As depicted in the functional diagram, each RTAC includes an IEC 61131 logic engine that is preconfigured to have access for all system tags, IED data, diagnostics, alarms, security events, and communications statistics for use integrating your system. The system has no functional separation between those tags mapped for communications protocols and those used in programmable logic. This architecture greatly simplifies system configuration effort because no additional selection is required to identify tags used by the logic engine. You simply use any needed IED data, calculated values, and system tags in deterministic logic for the control of critical applications.

Management of the task-processing sequence and solve rate in the RTAC is similar to that for traditional PLCs or PACs. The fastest processing rate is 4 ms for the main task and 1 ms for the automation task. Optimize the processor utilization by setting the processing rate no faster than necessary for your application.

Task processing in the logic engine includes protocol I/O, system management, and any custom logic programs you create using Structured Text (ST), Ladder Logic Diagram (LD), or Continuous Function Charts (CFC). CFC programs are a type of IEC 61131-3 Function Block Diagram (FBD) that provide more programming flexibility than standard FBDs. The AcSELERATOR RTAC software includes the IEC 61131-3 and Tag Processor editors to manage any protocol information and custom logic needed for your system.

Manage User Accounts and Alarms in Web Server

The built-in RTAC web interface provides the ability to manage user accounts and system alarms remotely. Each user account has a unique username, password, and assigned role that defines system permissions. The RTAC can also be configured to use LDAP central authentication for user account management. The system includes web pages for monitoring user logs and maintaining network policies.

Logged tag values and system events provide a system-wide Sequence of Events report. View logs online or use ODBC connectivity to download them to a central database.

You can also configure Ethernet connections and monitor system status from the web interface. All of the Ethernet ports can operate on independent networks, or you can bind them for failover operation.

Flexible Engineering Access

Access Point Routers in the RTAC provide a means for creating transparent connections between any two ports. A transparent connection is a method for using the RTAC as a port server to connect remotely to an IED. Simple logic in the RTAC enables remote engineering access only through supervisory commands.

Seamless System Configuration

ACSELERATOR RTAC is a Microsoft Windows compatible configuration software for offline and online use with the SEL-3560 RTAC. A project in ACSELERATOR RTAC contains the complete configuration, settings, and logic for an individual RTAC device. Preconfigured device templates are available for you to add all device and master connections to the project tree view.
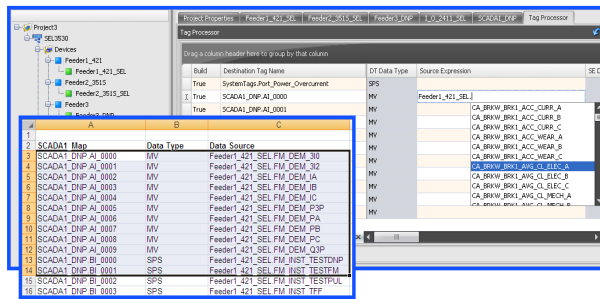

Figure 1   Map Source and Destination Tags Using Tag Processor or Copy SCADA Maps Directly From Spreadsheet

Once you create the settings for a specific device connection, improve engineering efficiency by saving a custom device template for later use with similar projects. Share custom templates via email or network for even greater savings.

The Tag Processor view facilitates the mapping of operational data quickly between IEDs and SCADA. ACSELERATOR RTAC is compatible with Microsoft Excel and other programs, so you can save time and increase accuracy by copying SCADA maps from the source.

There is no need to install or learn more than one software interface. Use the Structured Text, Ladder Diagram, or Continuous Function Chart editors included with ACSELERATOR RTAC to develop custom IEC 61131 logic.

Data Concentration and Protocol Conversion

Configure each serial or Ethernet port to use any of the client, server, or peer-to-peer protocols available for the RTAC. For example, when you use IEEE C37.118 protocol to receive synchrophasor messages, you can map analog or Boolean tags and time stamps to DNP3 and send the data to SCADA very efficiently. You can also map data to IEC 61850 GOOSE messages for high-speed control schemes.

Additionally, when you need to define relay connections in a primary/backup arrangement, use the Tag Processor to map relay tags so that the master stations will receive power system information only from the active relay.
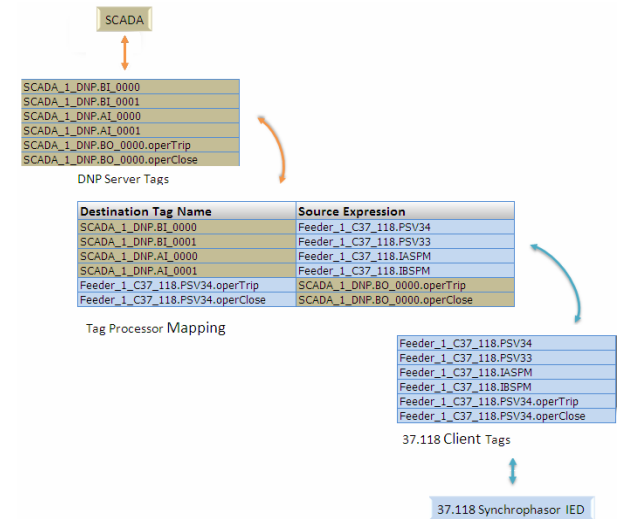

Figure 2   Synchrophasor Data Map Seamlessly Into SCADA Connections

Applications

## Substation SCADA, Report Retrieval, Engineering Access, and Alarm Notification

The RTAC can act as a data concentrator by using protocols such as IEC 61850 MMS client, Modbus, DNP3, IEC 61850 GOOSE or MIRRORED BITS® communications to integrate both serial and Ethernet IEDs. Enable logging on any system or IED tag to view and archive a station-wide event record.

The RTAC Ethernet connection provides a means to remotely access the system to monitor logs and diagnostics. First, establish a remote connection with any IED connected to the RTAC through Engineering Access communications channels. Then use the ACSELERATOR QuickSet® SEL-5030 Software suite to manage protection and control settings for these relays remotely.
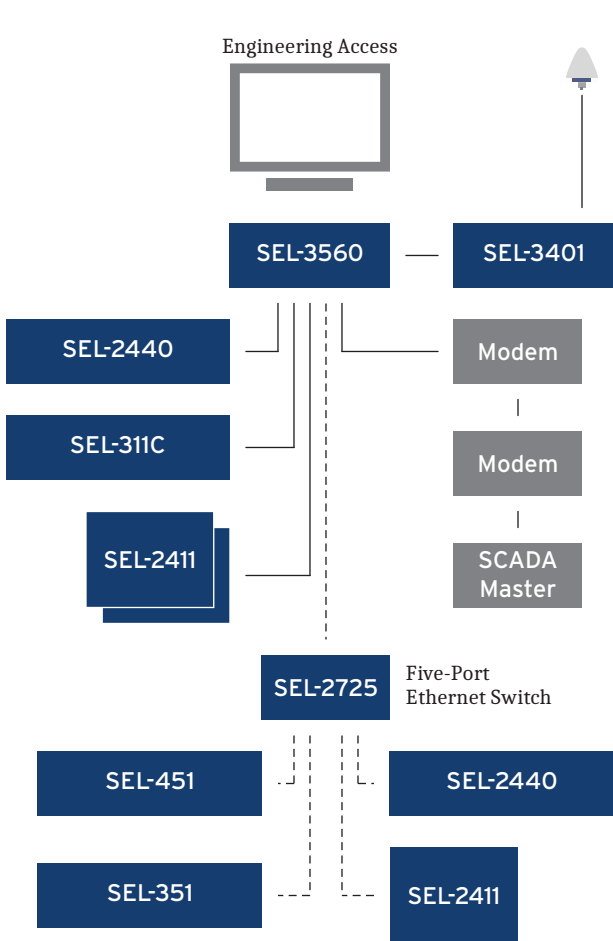
Micro-Grid Automation and Control

The SEL-3560 RTAC provides the control and monitoring capabilities necessary to automate a micro-grid. Implement capacitor bank control, load-shedding schemes, power-grid reconfigurations, and power-source selection with the built-in logic processor in the RTAC. Coupled with the secure, redundant, and self-healing network capabilities of the SEL ICON®, as well as accurate time distribution to all IEDs, the RTAC provides the capability to control and monitor all aspects of a micro-grid as well as display data with the optional built-in HMI. Built-in protocols provide a gateway to local and remote SCADA systems. To complete system integration, control and monitor remote I/O with the SEL-2240 Axion and collect event reports from connected IEDs with ACSELERATOR TEAM® SEL-5045 Software.
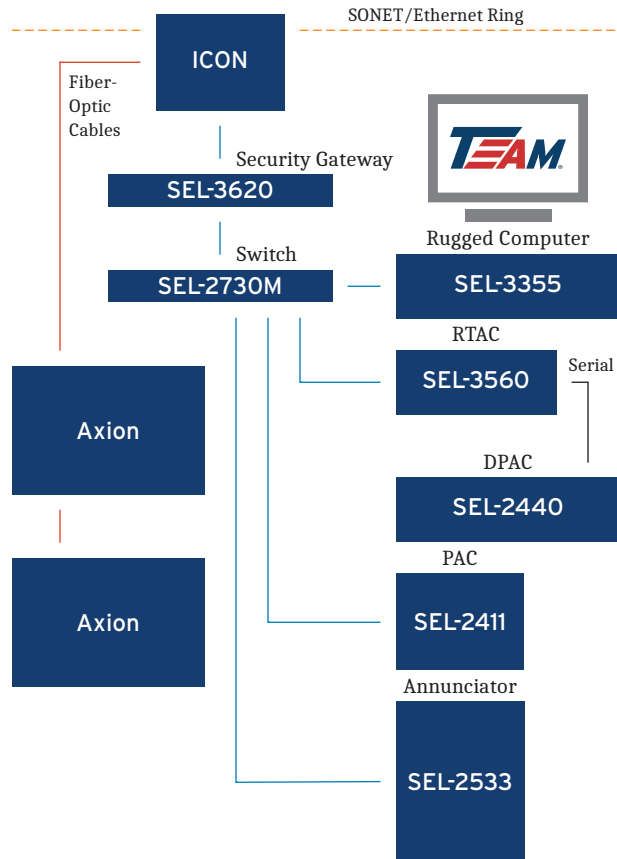
Real-Time Control and Logic Processing

The built-in logic processor provides high-speed control and transfer of signals from SEL MIRRORED BITS devices, or other protocols. The RTAC can serve as the system controller and SCADA gateway to eliminate costly equipment (such as breakers, interposing relays, and wiring) while also reducing engineering and labor costs.

The intuitive ACSELERATOR RTAC software provides simple setup of analog and binary tags from any device in the system. Integrated tools scale values and create logic in a flexible IEC 61131-3 configuration environment.

You can take advantage of multiprotocol support to collect SCADA information, process control commands, and use NTP time synchronization through a single communications link to each Ethernet device.
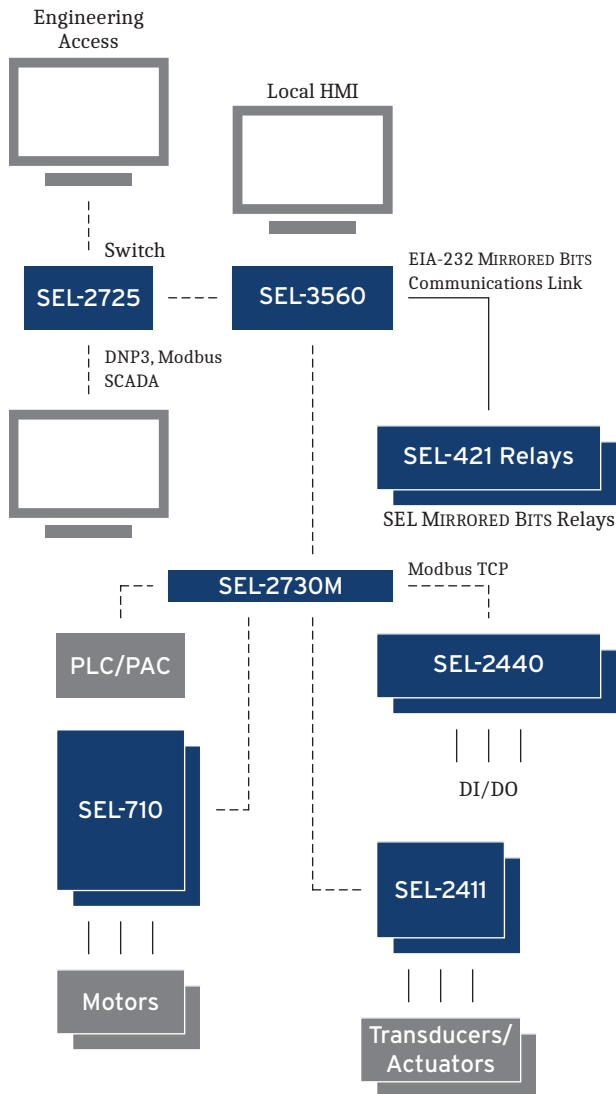
Secure Communications and User Management

The RTAC and SEL accessories offer security for your automation network. Per-user security profiles provide compliance with role-based requirements. The system can employ intrusion detection, notification, and logging to help maintain perimeter integrity.

The RTAC includes security features so that your system complies with NERC/CIP requirements for auditing, logging, port control, web authentication, and password restrictions. The RTAC also supports central authentication through your existing LDAP server.

By including SEL serial and wireless encrypting devices with the RTAC, you can protect remote serial communication to recloser controls or other connected devices.
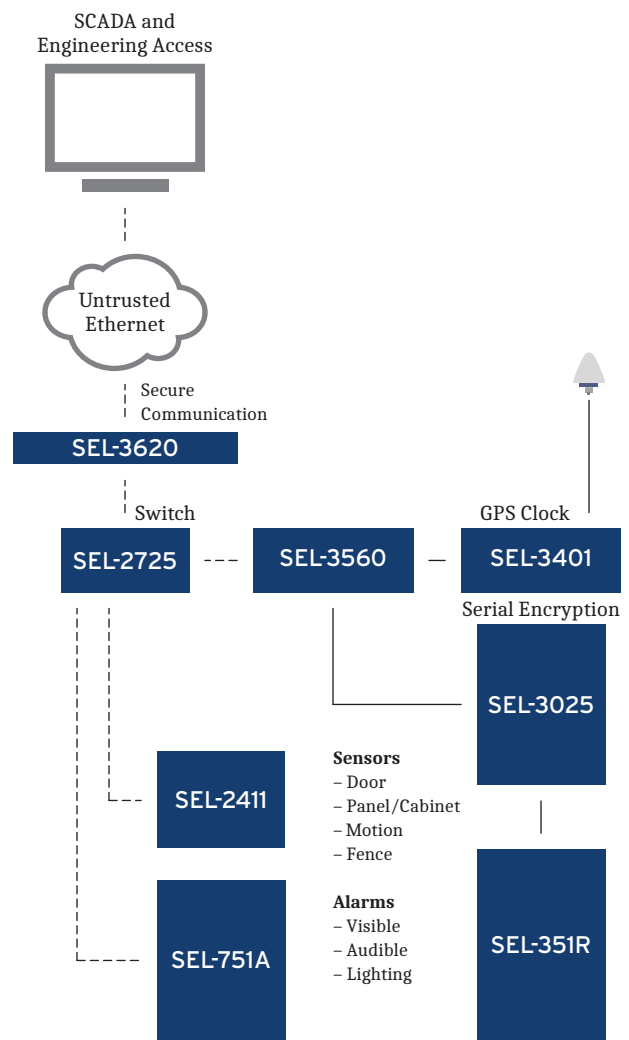
Control Systems

The custom logic and communications protocols in the SEL-3560 RTAC, along with the I/O in the SEL-2411 and SEL-2440, permit you to implement complete control systems, whether you perform discrete sequences, continuous control, monitoring, or asset management. SEL subjects its products to tests for harsh environments, so you can be confident that your control system will work reliably in tough applications. Minimize loop wiring and simplify commissioning by installing controls close to process equipment and integrating them with industry standard communications protocols. Additionally, the SEL-3560 RTAC can provide HMI and data archiving functions.

Use a powerful IEC 61131 logic engine to design custom control programs in the RTAC. You can set the logic solve rate and program execution order to meet your system requirements. Operate the RTAC as a master controller, and use SELOGIC® control equations in the SEL-2411 and SEL-2440 to perform distributed sequential or continuous control algorithms.

With a variety of physical interfaces and open protocol options, such as IEC 61850 GOOSE messaging, the RTAC makes system integration simple. It will reduce engineering time and complexity so that you can focus on improving productivity and efficiency rather than on fixing communications problems.
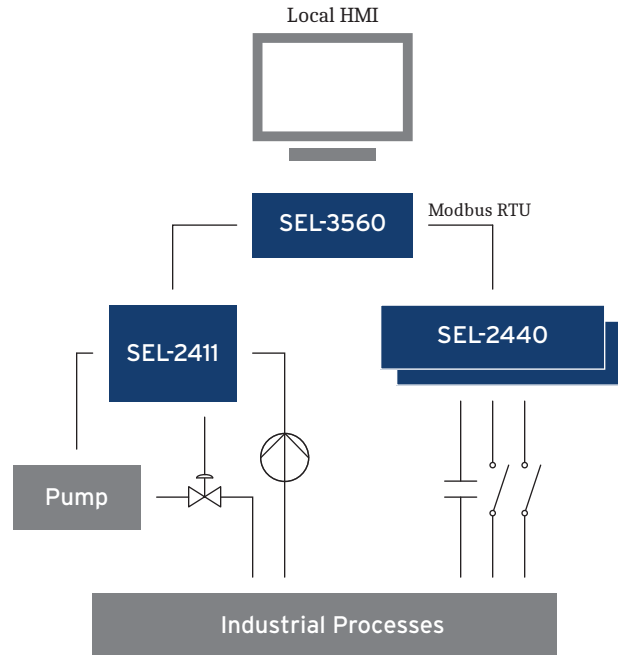
Front- and Rear-Panel Diagrams
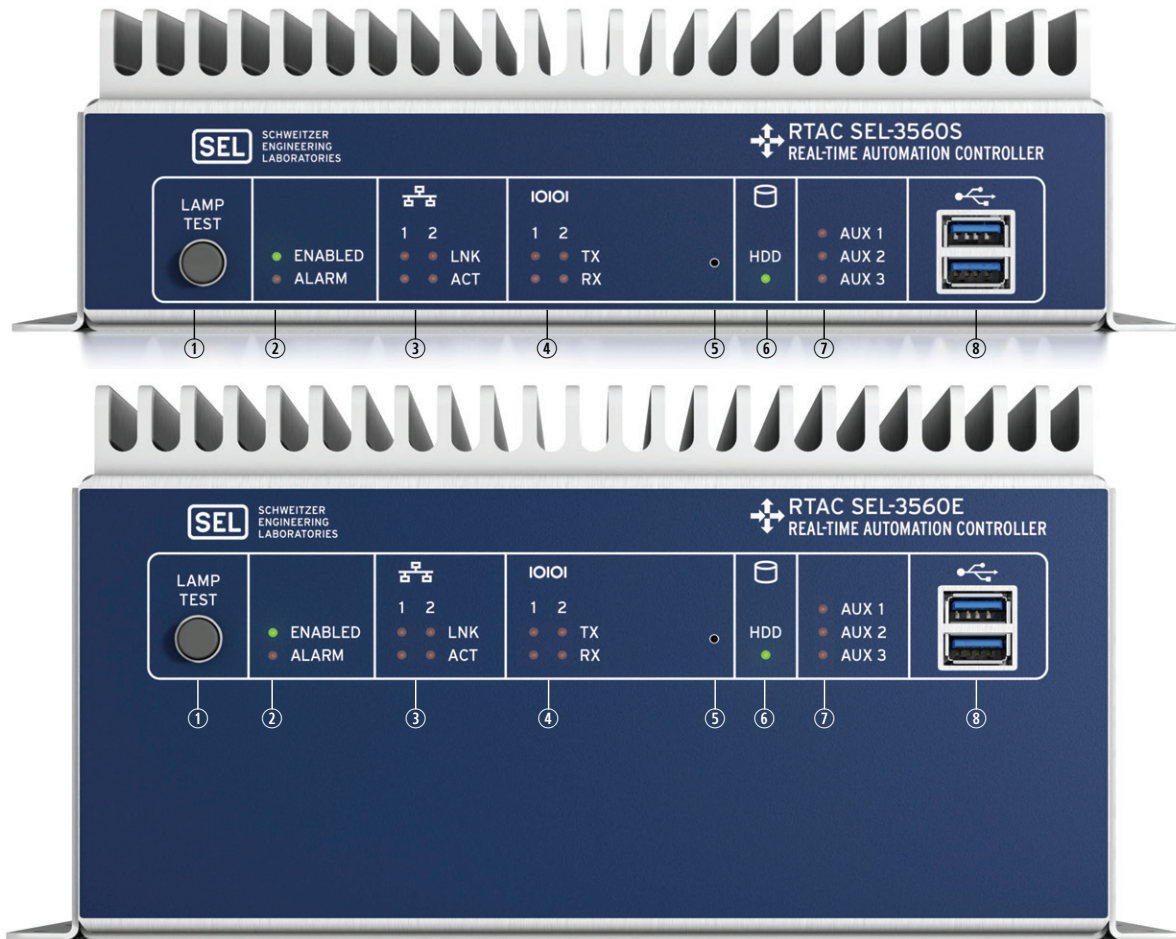
① **LAMP TEST** Button. Press and hold to test front-panel LEDs. Can be programmed to be an on/off or reset button.

② **ENABLED** and **ALARM** LEDs provide operational status. A green **ENABLED** LED indicates normal operation. The **ALARM** LED illuminates red when a nonoptimal system condition exists.

③ **ETHERNET** Status Indicators. Link (**LNK**) indicates that the port is connected, and activity (**ACT**) indicates when data are being transmitted and received.

④ **SERIAL** Status Indicators. Transmit (**TX**) and receive (**RX**) LEDs indicate activity on serial ports.

⑤ **PINHOLE** button. Provide reset and power functions, and requires a push-pin to prevent accidental use.

⑥ **HDD** Activity Indicator. Illuminates when SATA drives are accessed.

⑦ **AUXILIARY** Status Indicators. Three programmable, bicolor LEDs for your custom application.

⑧ **USB** Ports. Two easily accessible ports to connect USB 3.1 peripherals.

Figure 3   Front-Panel Diagram
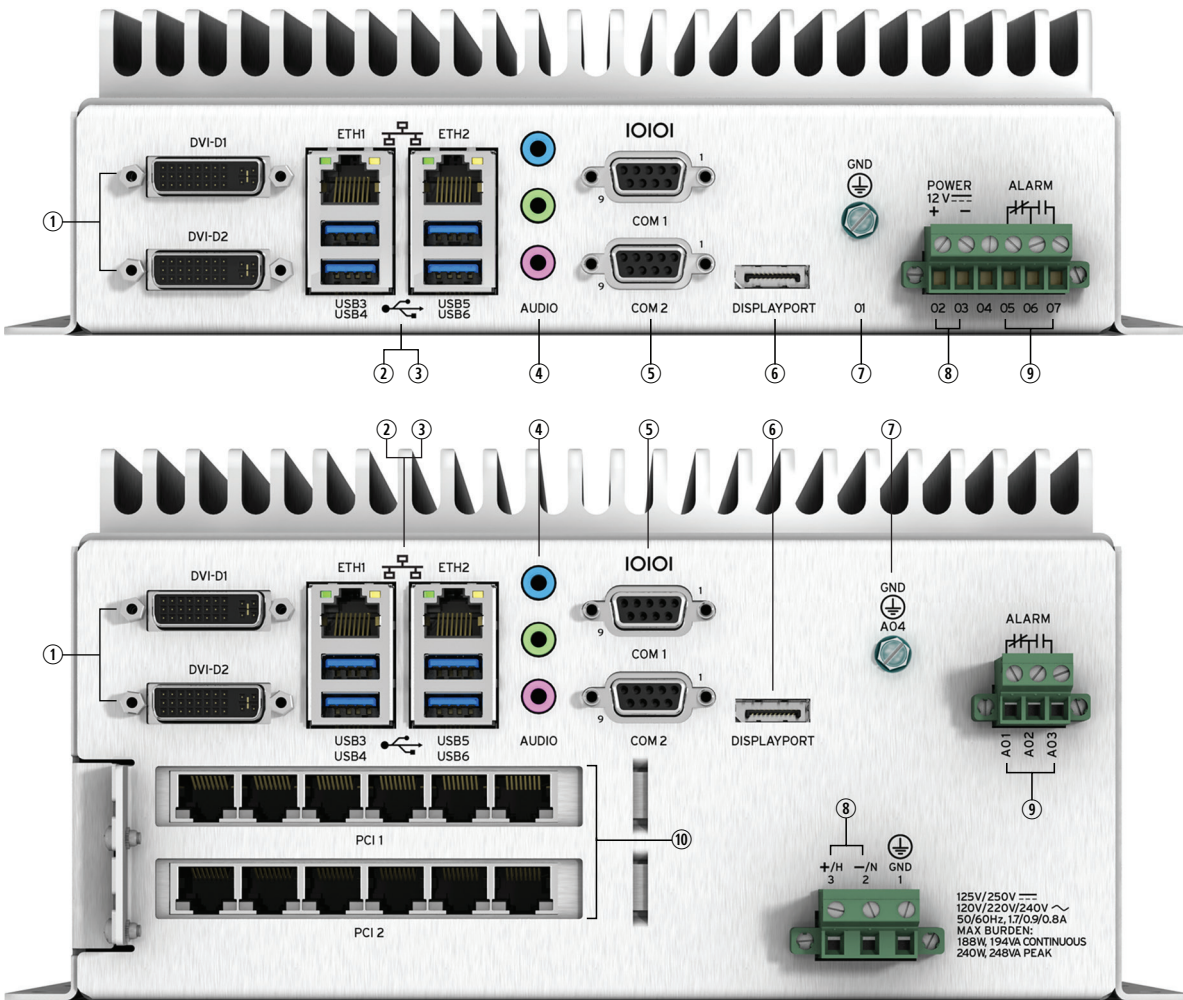
① **DVI-D**. Connect digital monitors by using native DVI or an HDMI adapter.
② **ETH1** and **ETH2**. Onboard independent Gigabit Ethernet interfaces.
③ **USB** Ports. Connect as many as four USB 3.1 peripherals at the rear panel.
④ **AUDIO** Ports. Line Input (blue), Line Output (green), and Microphone Input (pink).
⑤ **COM1** and **COM2**. Standard EIA-232 serial ports with configurable +5 Vdc power on Pin 1.
⑥ **DISPLAYPORT**. Connect new digital monitors supporting the DisplayPort interface.
⑦ **GROUND** Terminal Screw. The earth ground connection for the device.
⑧ **POWER** Input Terminals. The rated input voltage is clearly marked on the chassis near the terminals.
⑨ **ALARM**. The Form C alarm contact output enables both normally closed and normally open wiring connections.
⑩ **PCI** Expansion Slots. Install SEL or third-party PCI Express expansion cards for additional network, serial, or other application-specific I/O.

Figure 4   Rear-Panel Diagram

Product Dimensions

CHASSIS WITH
STANDARD HEATSINK

10.32
(262.1)

11.55
(293.3)

4.75
(120.7)

9.25
(235.0)

9.78
(248.4)

TOP

2.79
(70.9)

0.06
(1.5)

FRONT

CHASSIS WITH
CONDUCTION-COOLED HEATSINK

10.32
(262.1)

11.55
(293.3)

4.75
(120.7)

9.25
(235.0)

9.78
(248.4)

TOP

0.25
(6.3)

2.05
(52.1)

FRONT

LEGEND
in
(mm)

i9316a
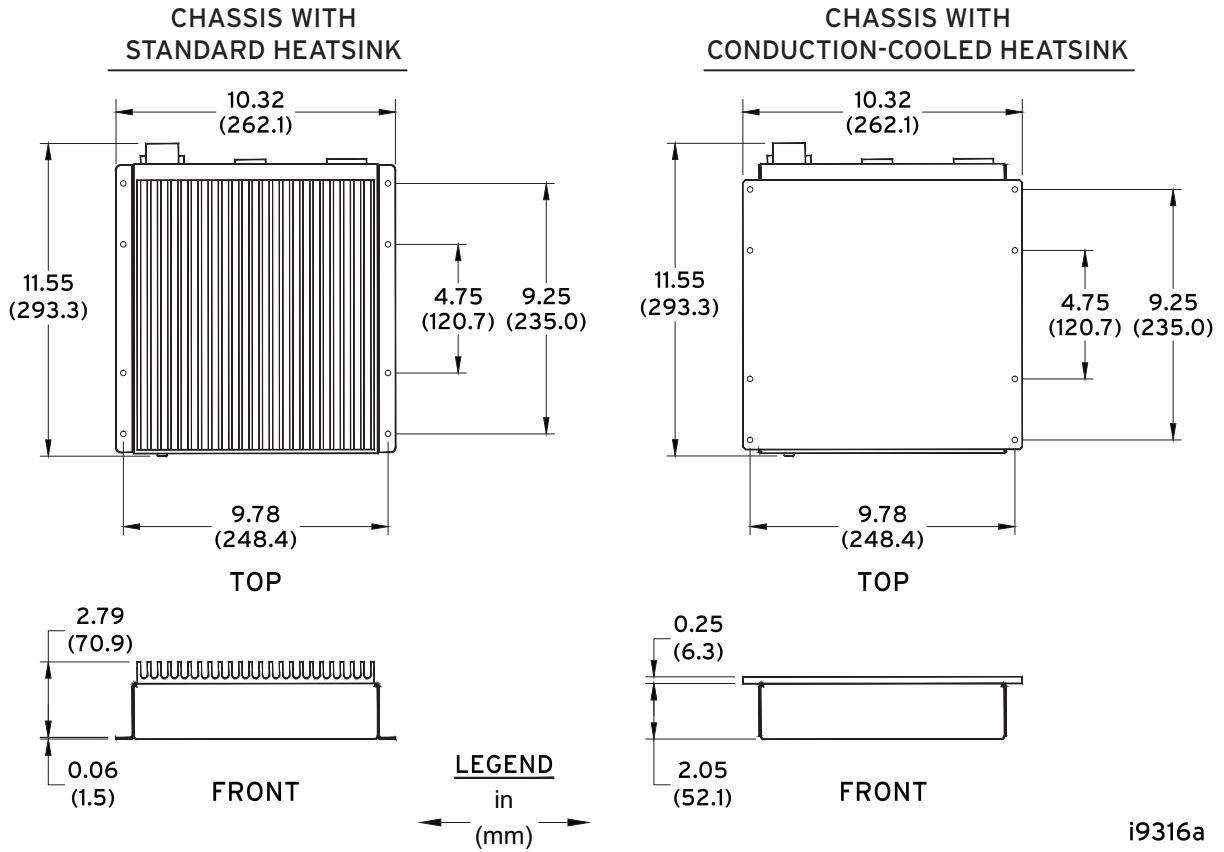
Figure 5 SEL-3560S Dimensions Diagram

CHASSIS WITH
STANDARD HEATSINK

10.32
(262.1)

11.53
(293.0)

4.75
(120.7)

9.25
(235.0)

9.78
(248.4)

TOP

4.81
(122.2)

0.06
(1.5)

FRONT

CHASSIS WITH
CONDUCTION-COOLED HEATSINK

10.32
(262.1)

11.53
(292.8)

4.75
(120.7)

9.25
(235.0)

9.78
(248.4)

TOP

0.25
(6.3)

4.07
(103.4)

FRONT
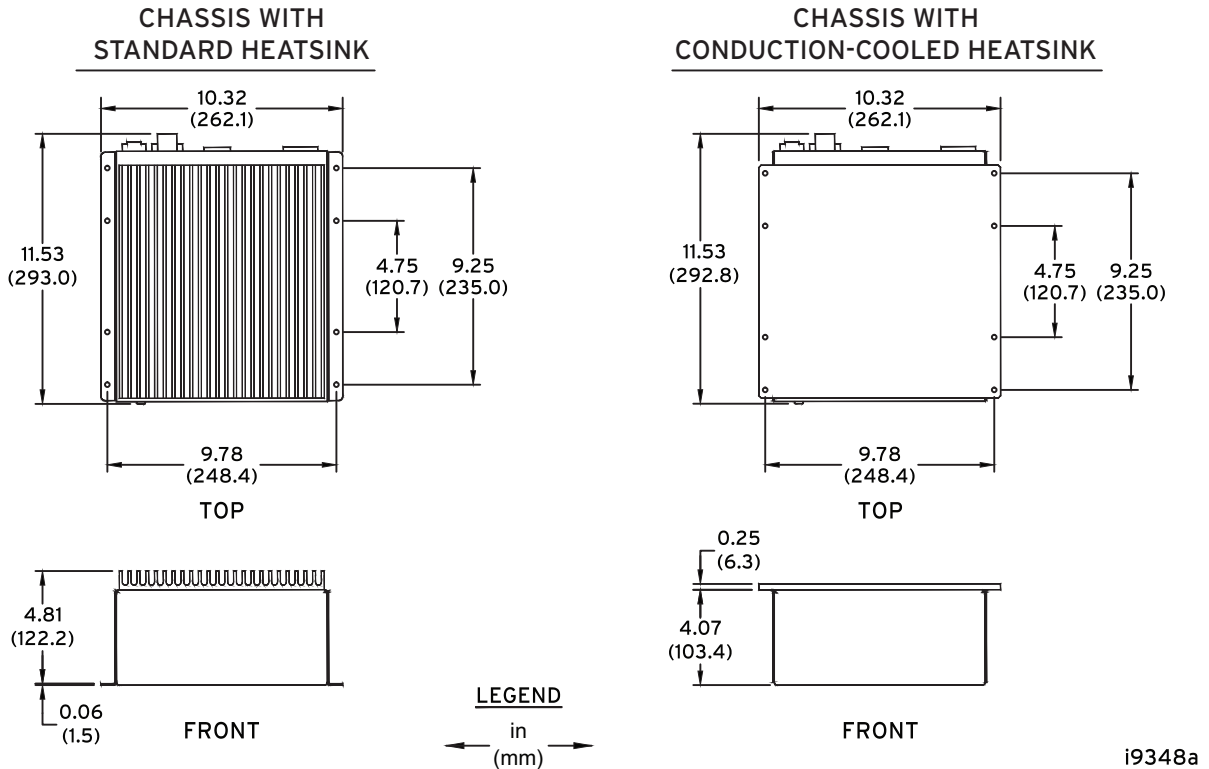
LEGEND
in
(mm)

i9348a

Figure 6 SEL-3560E Dimensions Diagram

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 his own expense.

UL Recognized to U.S. and Canadian safety standards (File E220228; NRAQ)

CE Mark

RCM Mark

RoHS Compliant

General

Supported Operating Systems

SEL Linux with real-time preemption patches

CPU

Intel Xeon E3-1505L Quad-Core

Speed:	2.0 GHz base, 2.8 GHz turbo
Cache:	1 MB L2, 8 MB L3

RAM

8–16 GB DDR4 ECC PC4-17000 (2133 MHz)

Chipset

Intel CM236 Chipset

Expansion Cards (SEL-3560E Only)

2 Half-Length, Full-Height PCI Expansion Card Slots:	PCI 1: PCIe x1 (Revision 2.0) PCI 2: PCIe x4 (Revision 2.0)

Mass Storage

Internal Drive Bay:	One 2.5-inch SSD SATA II 3.0 Gb/s
Optional SATA Drives:	Industrial-Grade SLC SSD 30–250 GB 10-year warranty Industrial-Grade pSLC SSD 120–480 GB 5-year warranty Industrial-Grade 3D TLC SSD 240–1920 GB 5-year warranty

Real-Time Clock/Calendar

Battery Type:	IEC No. BR2330A Lithium
Battery Life:	10 years with power 2 years without power

BIOS

AMI UEFI

Trusted Platform Module

Infineon SLB 9670VQ2.0 TPM 2.0

Intel Active Management Technology

Intel AMT v11, accessible through ETH1

Security Features

Account Management:	User Accounts User Roles LDAP Central Authentication RADIUS Central Authentication Strong Passwords Inactive Account Logouts
Intrusion Detection:	Access/Audit Logs Alarm LED Alarm Contact
Encrypted Communications:	SSL/TLS, SSH HTTPS

Automation Features

Protocols

Client

DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL ASCII, SEL Fast Messaging, LG 8979, IEEE C37.118, IEC 61850 MMS, CP2179, IEC 60870-5-101/104, SNMP, SES-92, CDC Type II, Courier, IEC 60870-5-103, EtherNet/IP Explicit Message Client

Server

DNP3 Serial, DNP3 LAN/WAN, Modbus RTU, Modbus TCP, SEL Fast Messaging, LG 8979, SES-92, IEC 61850 MMS, IEC 60870-5-101/104, IEEE C37.118, FTP, SFTP, CDC Type II, EtherNet/IP Implicit Message Adapter, OPC UA

Peer-to-Peer

IEC 61850 GOOSE, SEL MIRRORED BITS Communications, Network Global Variables (NGVL), Parallel Redundancy Protocol

Fieldbus

EtherCAT Client

Engineering Access

Modes:	SEL Interleaved, Direct
Port Server:	Map Serial Ports to IP Ports
Secure Web Server:	Diagnostic and Communications Data

Network Time Protocol (NTP) Modes

NTP Client:	As many as three configurable servers
NTP Server	

Precise Time Protocol (PTP)

PTP Client:	Peer delay request and end-to-end path delay supported

Operating Environment

Operating Temperature Range:

SEL-3560S With E3-1505L CPU:	–40° to +75°C (–40° to +167°F)
SEL-3560E With E3-1505L CPU:	–40° to +60°C (–40° to +140°F)

* Requires Industrial-Grade SSDs. See SEL Application Note, "Determining Solid-State Drive (SSD) Lifetimes for SEL Automation Controllers" (AN2016-03).

Note: UL ambient 40°C. See *Safety Information* for additional restrictions.

Storage Temperature Range:	–40° to +85°C (–40° to +185°F)
Relative Humidity	5% to 95% noncondensing
Insulation Class	1
Pollution Degree	2

Overvoltage Category:

Category	Maximum Altitude	Atmospheric Pressure
Category II	5,000 m	80–110 kPa

Weight

4 kg (9 lb) maximum (SEL-3560S)
7 kg (15 lb) maximum (SEL-3560E)

Peripheral Connections

Video

Intel P530 Graphics Controller

As many as three total displays using any combination of DVI and/or DisplayPort outputs:

DVI-D outputs:
 One display per output
 Maximum resolution*: 1920 x 1080 @ 60 Hz
 Digital output only; does not support passive VGA adapters
Display Port 1.2 output
 As many as three displays via DisplayPort MST
 Maximum resolution*: 4096 x 2304 @ 60 Hz (one display)
 1920 x 1200 @ 60 Hz (three displays)
Cable length < 10 m for Surge Immunity compliance.

*High-resolution displays require high-quality cables. Ensure your display cables are as short as possible and rated for the required screen resolution.

Audio

TSI (IDT) 92HD91 HD Audio Codec

3 Analog 3.5 mm TRS Jacks:

Line input
Line/headphone output
Microphone input
Cable length <2 m for Electromagnetic Compatibility Immunity compliance

Intel Display Audio

Digital Audio Outputs: DVI-D1, DVI-D2, DisplayPort

USB

4 Rear-Panel Ports, 2 Front-Panel Ports
 USB 3.2 Gen 1 (SuperSpeed USB 5 Gbps)
 2000 mA Maximum Current Each
 Cable length <2 m for Electromagnetic Compatibility Immunity compliance
2 Internal Ports on 1 Main Board Header
 USB 2.0 (High Speed USB 480 Mbps)

Communications Ports

Ethernet

2 Rear-Panel, 1 Gbps Copper RJ45 Ports

ETH1: Intel WGI219LM, 10/100/1000 Mbps RJ45 copper

ETH2: Intel WGI210IT, 10/100/1000 Mbps RJ45 copper

Optional SEL-3390E4 PCIe x4 Expansion Card (SEL-3560E Only): As many as four additional 10/100/1000 Mbps ports, copper or LC fiber SFP

Note: See the SEL-3390E4 instruction manual for additional information.

Serial Ports

Standard Ports: 2 EIA-232 ports, DB-9 connectors 300 to 115200 bps

(Meets EIA/TIA-562 Specifications)

Optional SEL-3390S8 PCIe x1 Expansion Cards (SEL-3560E Only): As many as 12 additional EIA-232/ EIA-422/EIA-485 ports, RJ45 connectors 300 to 921600 bps

Note: See the SEL-3390S8 instruction manual for additional information.

Time-Code Inputs and Outputs

SEL-3390S8 Expansion Card (Input/Output) (SEL-3560E Only)

Connector: RJ45 serial port

Time Code: Demodulated IRIG-B TTL compatible

Note: See the SEL-3390S8 instruction manual for additional information.

Note: Output generated from either IRIG-B input or SEL-3560 clock.

Power Supplies

See *Table 1* for additional burden information.

No Power Supply (SEL-3560S Only)

Voltage Rating:	12 Vdc
Voltage Range:	10–16.6 Vdc
Typical Burden:	25 W
Max Burden:	144 W (cold startup)
Peak Inrush:	15 A

Negative input power terminal is internally tied to chassis ground.

SEL-9331 160 W LV Power Supply

Voltage Rating:	48 Vdc
Voltage Range:	38–58 Vdc
Maximum Constant Burden	
External SEL-9331:	149 W
Internal SEL-3560E:	178 W
Maximum Peak Burden:	225 W
DC Ripple:	<15% rated voltage
Peak Inrush:	20 A
Insulation:	3600 Vdc
Input Isolated From Chassis Ground:	Yes

SEL-9331 160 W HV Power Supply

Voltage Ratings:	125/250 Vdc 120/220/240 Vac; 50/60 Hz
DC Range:	100–300 Vdc
Maximum DC Dropout:	88 Vdc
AC Range:	85–264 Vac
Frequency Range:	45–65 Hz
Maximum Constant Burden	
External SEL-9331:	155 W, 160 VA
Internal SEL-3560E:	188 W, 194 VA
Maximum Peak Burden:	240 W, 248 VA
DC Ripple:	<15% rated voltage
Peak Inrush:	20 A
Insulation:	3600 Vdc
Power Factor:	>0.9 (at full load)
Input Isolated From Chassis Ground:	Yes

Recommended External Overcurrent Protection

Breaker Type:	Standard
Breaker Rating:	20 A at 250 Vdc
Current Breaking Capacity:	10 kA
Grounded Neutral Systems:	Devices in series with the HOT or energized conductor

DC and Isolated Systems:	Device in serial with both conductors
Distance from Equipment:	Less than 2 m

Fuse Ratings

12 Vdc Input Power Fuse F1:	15 A, 250 Vac/60 Vdc fast acting 60 Vdc/50 A break rating

LV Power Supply Fuse

Rating:	15 A
Maximum Rated Voltage:	500 Vdc, 500 Vac
Breaking Capacity:	20 kA at 500 Vdc
Type:	Time-lag T

HV Power Supply Fuse

Rating:	5 A
Maximum Rated Voltage:	250 Vdc, 277 Vac
Breaking Capacity:	1500 A at 277 Vac
Type:	Time-lag T

Heater Fuses F2, F3:	5 A, 125 V slow blow 125 Vdc/50 A break rating

Note: Fuses are not serviceable.

Contact Inputs and Outputs

Alarm Output Contact

Per IEC 255-0-20:1974, using the simplified method of assessment

Output Type:	Relay, Form C, break-before-make
Power Supply Burden:	<1 W maximum
Mechanical Life:	2,000,000 operations
Operational Voltage:	250 Vac/Vdc
Make:	30 A at 250 Vdc
Carry:	6 A continuous at 70°C
1 s Rating:	50 A
MOV Protection:	270 Vac/360 Vdc, 75 J
Insulation Voltage:	300 Vac/Vdc
Pickup Time:	<8 ms
Dropout Time:	<8 ms

Breaking Capacity (10,000 Operations):

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):

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

Terminal Ratings

Compression Screw Terminal

Power Wiring

Insulation:	300 V min.
Size:	12–14 AWG, length <2 m

Alarm Wiring

Insulation:	300 V min.
Size:	12–18 AWG

Tightening Torque

Minimum:	0.6 Nm (5 in‑lb)
Maximum:	0.8 Nm (7 in‑lb)

Crimp Ferrule Recommended

Mounting Ear Tightening Torque

Minimum:	0.18 Nm (1.6 in‑lb)
Maximum:	0.25 Nm (2.2 in‑lb)

Grounding Screw

Ground Wiring

Insulation:	300 V min.
Size:	12 AWG, length <3 m

Tightening Torque

Minimum:	0.9 Nm (8 in‑lb)
Maximum:	1.4 Nm (12 in‑lb)

Ring Terminal Recommended

Serial Port

Tightening Torque

Minimum:	0.6 Nm (5 in‑lb)
Maximum:	0.8 Nm (7 in‑lb)

Video Port

Tightening Torque

Minimum:	0.6 Nm (5 in‑lb)
Maximum:	0.8 Nm (7 in‑lb)

Product Standards

Communications Equipment in Utility Substations:	IEC 61850-3:2013 IEEE 1613-2009 Severity Level: Class 1
Industrial Environment:	IEC 61000-6-2:2005 IEC 61000-6-4:2006
Electrical Equipment for Measurement, Control, and Laboratory Use:	IEC 61010-1:2013 UL 61010-1:2016, C22.2 No. 61010-1-12 IEC 61010-2-201:2013 UL 61010-2-201:2017, C22.2 No. 61010-2-201:14
Measuring Relays and Protection Equipment:	IEC 60255-26:2013 IEC 60255-27:2013

Type Tests

Note: To ensure good EMI and EMC performance, type tests were performed using shielded Ethernet and serial cables with the shell grounded at both ends of the cable, and the USB, video, and audio cables with ferrite chokes. Double-shielded cables are recommended for best EMI and EMC performance.

Electromagnetic Compatibility Emissions

Conducted and Radiated Emissions:	CISPR 11:2009 + A1:2010 CISPR 22:2008 CISPR 32:2015 IEC 61000-6-4:2006 IEC 61850-3:2013 FCC 15.107:2014 FCC 15.109:2014 Severity Level: Class A Canada ICES-001 (A) / NMB-001 (A)
Harmonic Current:	IEC 61000-3-2:2014 Severity Level: Class A
Voltage Flicker:	IEC 61000-3-3:2013

Electromagnetic Compatibility Immunity

Conducted RF:	IEC 61000-4-6:2013 Severity Level: 10 Vrms
Electrostatic Discharge:	IEC 61000-4-2:2008 IEEE C37.90.3-2001 Severity Level: 2, 4, 6, 8 kV contact discharge; 2, 4, 8, 15 kV air discharge

Fast Transient/Burst:	IEC 61000-4-4:2012
	  Severity Level: Class A
	    4 kV, 5 kHz on power supply and outputs;
	    2 kV, 5 kHz on communications lines

Magnetic Field:	IEC 61000-4-8:2009
	  Severity Level:
	    1000 A/m for 3 s
	    100 A/m for 1 m

Power Supply:	IEC 61000-4-11:2004 IEC 61000-4-17:1999 + A1:2001 + A2:2008 IEC 61000-4-29:2000

Radiated Radio Frequency:	IEC 61000-4-3:2006 + A1:2007
	  Severity Level: 10 V/m
	IEEE C37.90.2-2004
	  Severity Level: 20 V/m

Surge Withstand
  Capability:
	IEC 61000-4-18:2006 + A1:2010
	  Severity Level:
	  Power supply and outputs
	    2.5 kV peak common mode
	    1.0 kV peak differential mode
	  Communications ports
	    1.0 kV peak common mode
	IEEE C37.90.1-2012
	  Severity Level:
	    2.5 kV oscillatory
	    4 kV fast transient

Surge Immunity:	IEC 61000-4-5:2005
	  1 kV line-to-line
	  2 kV line-to-earth
	  2 kV communications ports

Note: Cables connected to EIA-232, EIA-422/485, and IRIG-B expansion slot communications ports should be less than 10 m for Zone A and Zone B compliance.

Environmental

Change of Temperature:	IEC 60068-2-14:2009
	  Severity Level:
	    5 cycles, 1°C per minute ramp

SEL-3560S With E3-1505L CPU:	–40°C to +75°C
SEL-3560E With E3-1505L CPU:	–40°C to +60°C
Cold, Operational:	IEC 60068-2-1:2007 Severity Level: 16 hours at –40°C
Cold, Storage:	IEC 60068-2-1:2007 Severity Level: 16 hours at –40°C

Damp Heat, Cyclic:	IEC 60068-2-30:2005
	  Severity Level:
	    12 + 12-hour cycle
	    25° to 55°C, 6 cycles, >93% r.h.

Damp Heat, Steady:	IEC 60068-2-78:2012
	  Severity Level:
	    40°C, 240 hours, >93% r.h.

Dry Heat, Operational:	IEC 60255-1:2009
	IEC 61850-3:2013
	IEC 60068-2-2:2007
	  Severity Level:
	    SEL-3560S With E3-1505L CPU:
	      16 hours at 75°C

Dry Heat, Storage:	IEC 60255-1:2009 IEC 61850-3:2013 IEC 60068-2-2:2007 Severity Level: 16 hours at 85°C
Free Fall:	IEEE 1613-2009 Severity Level: 100 mm

Vibration:	IEC 60255-21-1:1988
	  Severity Level:
	    Endurance Class 2
	    Response Class 2
	IEC 60255-21-2:1988
	  Severity Level:
	    Shock Withstand, Bump Class 1
	    Shock Response Class 2
	IEC 60255-21-3:1993
	  Severity Level:
	    Quake Response Class 2

Safety

Enclosure Protection:	IEC 60529:2001 + CRGD:2003 Severity Level: IP30

Dielectric Strength:	IEC 60255-27:2013
	IEEE C37.90-2005
	  Severity Level:
	    3600 Vdc on power supply
	    2500 Vac on contact output
	    1500 Vac Ethernet ports
	    Type tested for one minute

Impulse:	IEC 60255-27:2013
	IEEE C37.90-2005
	  Severity Level:
	    5 kV common mode, power supply,
	    contact outputs
	    1.5 kV Ethernet ports

Table 1 System Power Consumption (at 12 Vdc Input Voltage)

Power Consumption[a]			
Component	**Minimum**	**Typical**	**Maximum**
Base System (E3-1505L CPU, 4 GB RAM, 1 SATA Drive):	15 W	25 W	40 W
Additional Consumption From Optional Components			
SEL-9331 Power Supply (standard on SEL-3560E)	+10 W	+10 W	+10 W
8–32 GB RAM Configuration:	+2 W	+2 W	+3 W
2nd SATA Drive:	+1 W	+2 W	+3 W
SEL-3390E4 Ethernet Card	+6 W	+8 W	+10 W
SEL-3390S8 Serial Card	+4 W	+5 W	+7 W
Chipset Heater[b] cold startup (<5°C [41°F]): continuous operation (0°C [32°F]): continuous operation (–40°C [–40°F]):	N/A 0 W 0 W	N/A +5 W +20 W	+90 W +10 W +40 W

[a] Minimum: 0% load on all components; minimum power consumption started and idle.
Typical: 25%–50% load on all components; good indication of most application loads.
Maximum: 100% load on all components; generally cannot be reached in normal applications.

[b] Chipset heaters operate at low temperatures to keep the CPU and PCH within specified operating limits.

Table 2 Peripheral Connection Rated Current Output

Connection	Current Limit
DVI-D	0.2 A, +5 Vdc, 1 W total for both
DisplayPort	0.6 A, +3.3 Vdc, 2 W
COM 1 and COM 2	0.5 A, +5 Vdc, 2.5 W each
USB Ports	2.0 A, +5 Vdc, 10 W each, 25 W all ports combined

Notes

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