SEL-3555-2 Real-Time Automation Controller (RTAC)

The SEL-3555-2 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.

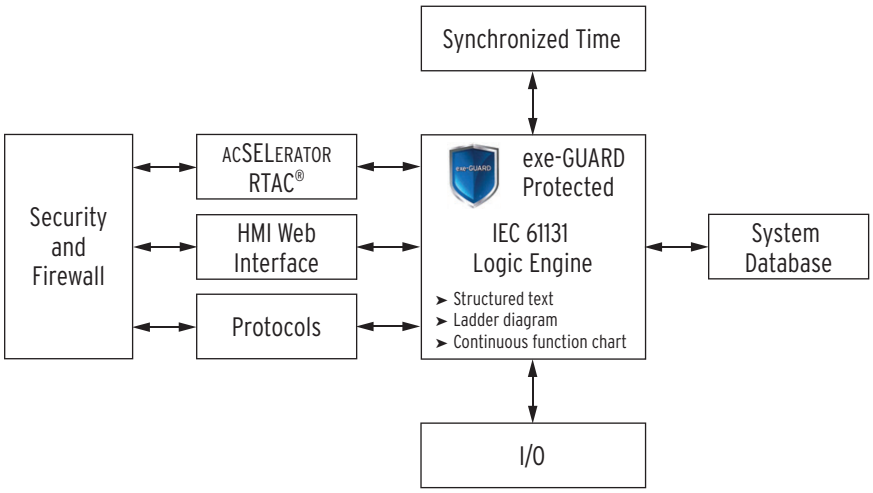
Major Features and Benefits

- **Multiple Device Functions.** Use a single SEL-3555-2 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-3555-2 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 human-machine interface (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 QuickSet 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-3555-2 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 QuickSet 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 map data relationships between communications protocols visually.
- **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 QuickSet RTAC software includes the IEC 61131-3 and Tag Processor editors you will use 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 QuickSet RTAC is a Microsoft Windows compatible configuration software for offline and online use with the SEL-3555-2 RTAC. A project in ACSELERATOR QuickSet 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.

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 QuickSet 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 QuickSet 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.

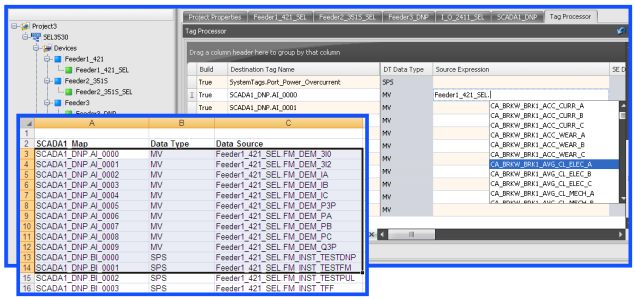


Figure 1 Map Source and Destination Tags Using Tag Processor or Copy SCADA Maps Directly From Spreadsheet

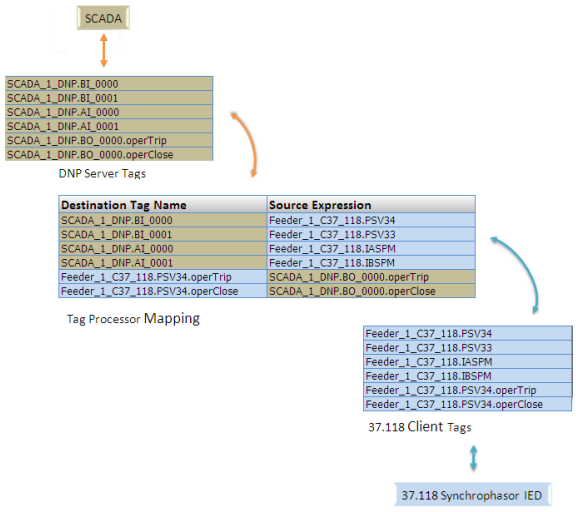


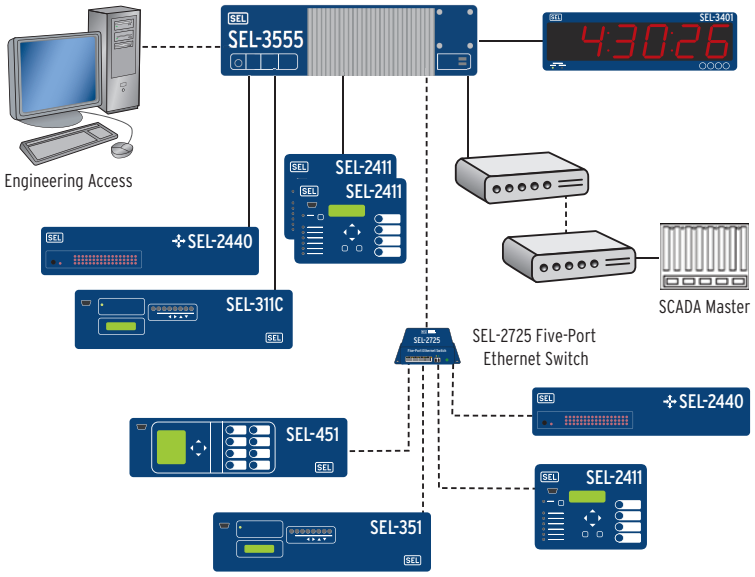
Figure 2 Synchrophasor Data Map Seamlessly Into SCADA Connections

Applications

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

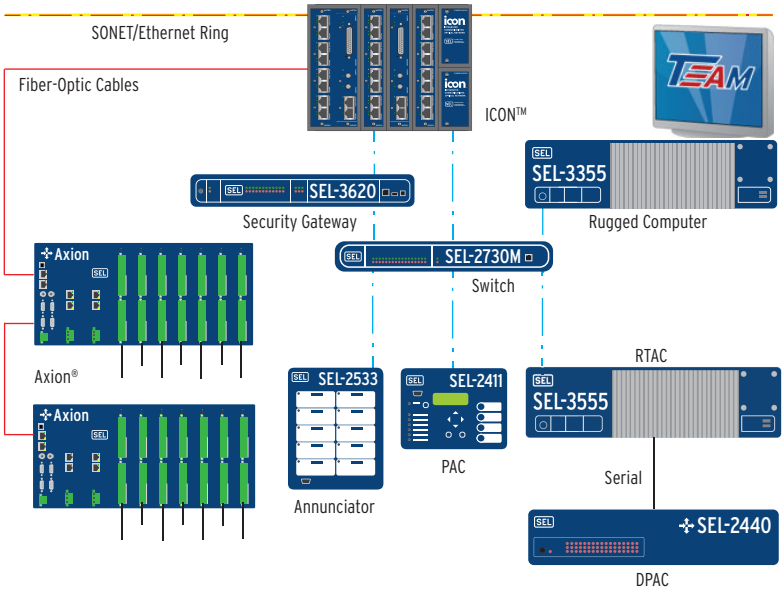
The RTAC can act as a data concentrator by using protocols such as IEC 61850 MMS client, Modbus, DNP3, IEC 61850 GOOSE or MIRRORED BITS® communications to integrate both serial and Ethernet IEDs. Enable logging on any system or IED tag to view and archive a station-wide event record.

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 QuickSet® SEL-5030 Software suite to manage protection and control settings for these relays remotely.



Micro-Grid Automation and Control

The SEL-3555-2 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.

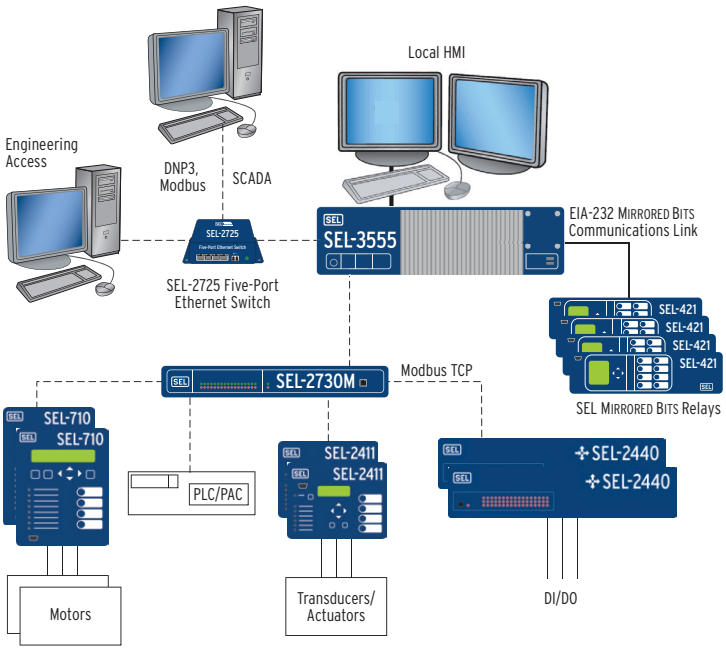


Real-Time Control and Logic Processing

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 QuickSet 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.

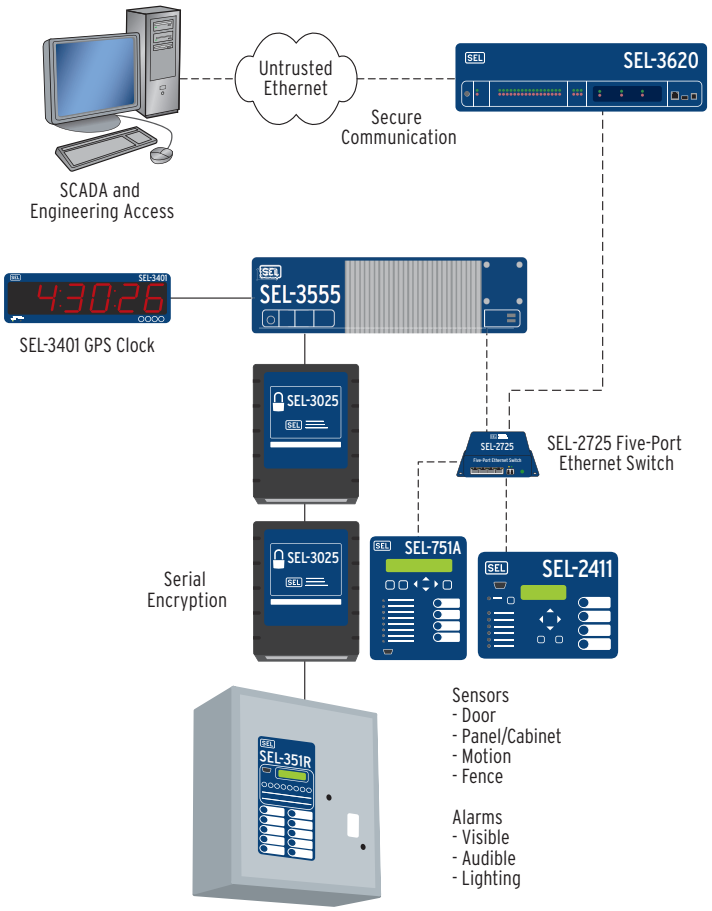


Secure Communications and User Management

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.

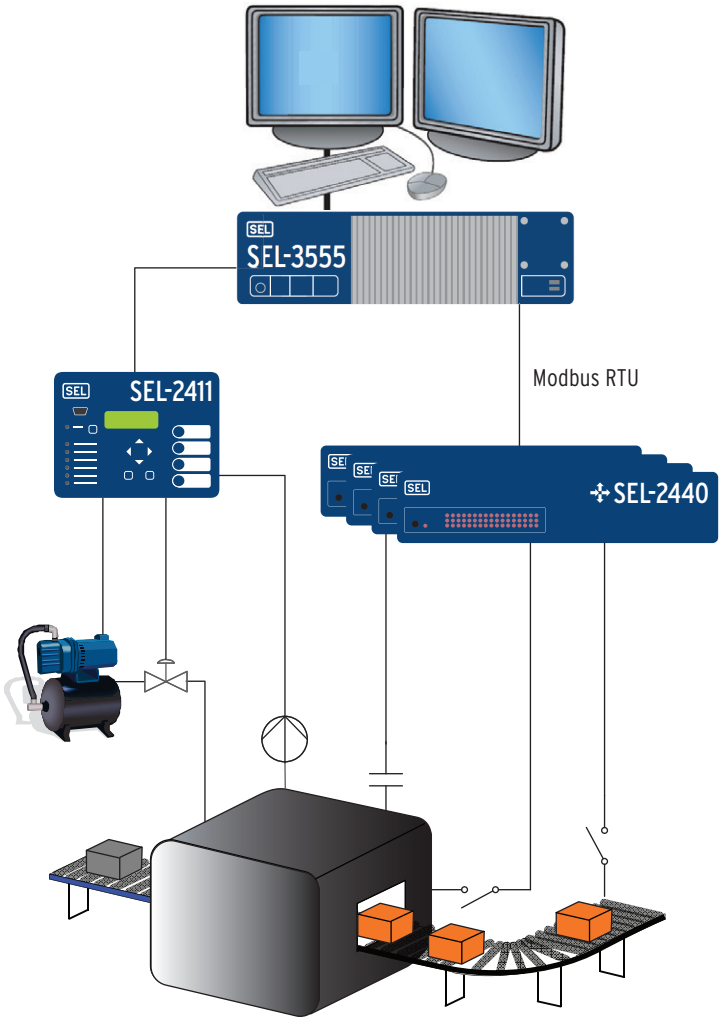


Control Systems

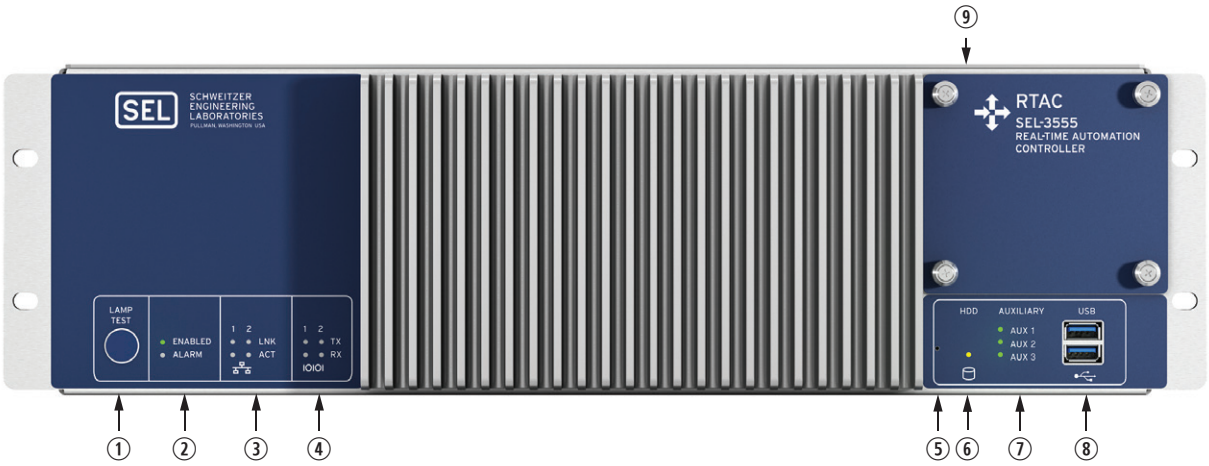
The custom logic and communications protocols in the SEL-3555-2 RTAC, along with the I/O in the SEL-2411 and SEL-2440, permit you to implement complete control systems, whether you perform discrete sequences, continuous control, monitoring, or asset management. SEL subjects its products to tests for 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-3555-2 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.

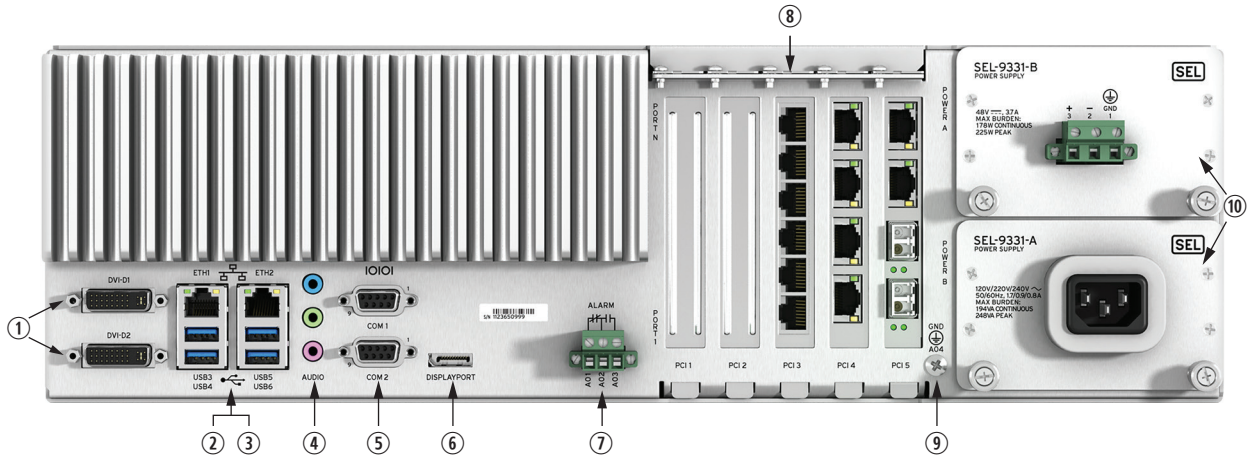


Front- and Rear-Panel Diagrams



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. Provides reset and power functions; requires a pushpin 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.
⑨ **SATA** Drive Bay. Removable cover plate enables easy access to SATA drives from the front panel.

Figure 3 SEL-3555-2 Front Panel



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 **ALARM**. The Form C alarm contact output can be wired either normally closed or normally open.
⑧ **PCI** Expansion Slots. Install SEL PCI Express expansion cards for additional network and serial I/O.
⑨ **Earth Ground** Terminal Screw. The earth ground connection for the device.
⑩ **POWER** Supply Modules. The rated input voltage is clearly marked on the chassis near the terminals.

Figure 4 SEL-3555-2 Rear Panel

Product Dimensions

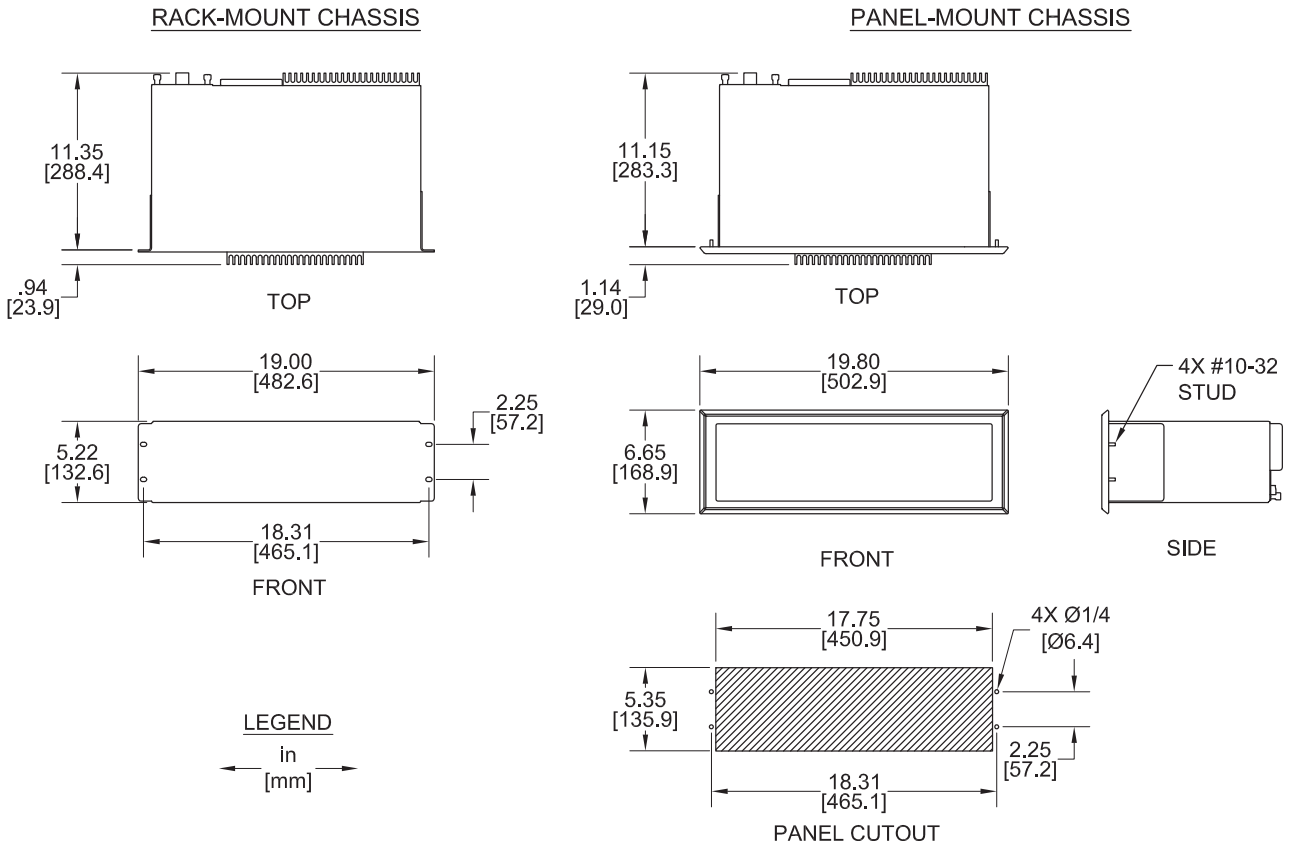


Figure 5 SEL-3555-2 Dimensions for Rack- and Panel-Mount Models

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

UKCA Mark

RoHS Compliant

RCM Mark

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

Intel Xeon E3-1505M Quad-Core

Speed:	2.8 GHz base, 3.7 GHz turbo
Cache:	1 MB L2, 8 MB L3

RAM

8–64 GB DDR4 ECC PC4-17000 (2133 MHz)

Chipset

Intel CM236 Chipset

Expansion Cards

5 Half-Length, Full-Height PCI Expansion Card Slots:	2 PCIe x4 (Revision 2.0) 2 PCIe x1 (Revision 2.0) 1 32-bit 5 V PCI

Mass Storage

Internal Drive Bay:	Supports four 2.5-inch SATA drives, four industrial-grade drives, or two consumer-grade drives Intel CM236 SATA Controller provides standard AHCI and Intel RST RAID modes SATA II 3.0 Gb/s RAID level 0, 1, 5, 10 Hot-swap support
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 240–7680 GB 5-year warranty Consumer-Grade MLC SSD 240–1920 GB 3-year warranty

Real-Time Clock/Calendar

Battery Type:	IEC No. BR-2330A Lithium
Battery Life:	10 years with power 2 years without power
Drift:	200 ppm

BIOS

AMI UEFI

Trusted Platform Module

Infineon SLM 9670AQ 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

Simple Network Time Protocol (SNTP) Accuracy

±1 ms:	This does not take into account external factors such as network switches and topologies

Precise Time Protocol (PTP)

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

Operating Environment

Operating Temperature Range

With E3-1505L CPU:	–40° to +75°C (–40° to +167°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 the instruction manual 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	9 kg (20 lb) maximum

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 DisplayPort 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 Gb 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 Cards:	As many as 8 additional 10/100/1000 Mbps ports, copper or LC fiber SFP
Optional SEL-3390T:	2 additional 10/100/1000 Mbps ports, copper or LC fiber. BNC IN and BNC OUT

Note: See the *SEL-3390E4 Instruction Manual* and the *SEL-3390T Instruction Manual* for additional information.

Serial Ports

Standard Ports:	2 EIA-232 ports, DB-9 connectors 300 to 115200 bps
Optional SEL-3390S8 PCIe x1 Expansion Cards:	As many as 24 additional EIA-232/422/485 ports, RJ45 connectors 300 to 921600 bps

(Meets EIA/TIA-562 Specifications)

Note: See the *SEL-3390S8 Instruction Manual* for additional information.

Time Code Inputs and Outputs

SEL-3390S8 Expansion Card (Input/Output)

Connector:	RJ45 serial port
Time Code:	Demodulated IRIG-B TTL compatible

SEL-3390T Time and Ethernet Adapter Card (Input/Output)

Connector:	BNC Input/BNC Output
Time Code:	Demodulated IRIG-B

Note: See the *SEL-3390S8 Instruction Manual* and the *SEL-3390T Instruction Manual* for additional information.

Note: Output generated from either IRIG-B input or SEL-3555-2 clock.

Power Supplies

See *Table 1* for additional burden information.

SEL-9331 160 W LV Power Supply

Voltage Rating:	48 Vdc
Voltage Range:	38–58 Vdc

Maximum Constant Burden:	178 W
Maximum Peak Burden:	225 W
DC Ripple:	<15% rated voltage
Peak Inrush:	15.5 A peak, 48 ms duration. Measured per IEC 60255-1, Section 6.10. Quiescent current level derived from 40 W input.
Interruption:	100 ms @ 48 Vdc
Insulation:	3600 Vdc
Input Isolated From Chassis Ground:	Yes

SEL-9331 160 W HV Power Supply

Voltage Ratings:	125/250 Vdc or 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:	188 W, 194 VA
Maximum Peak Burden:	240 W, 248 VA
DC Ripple:	<15% Rated Voltage
Peak Inrush:	16.6 A peak, 4 ms duration, 240 Vac 12.8 A peak, 9 ms duration, 250 Vdc Measured per IEC 60255-1. Section 6.10. Quiescent current level derived from 75 W input.
Interruption:	200 ms @ 125 Vdc/120 Vac
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:	Device in series with the HOT or energized conductor
DC and Isolated Systems:	Device in series with both conductors

Fuse Ratings

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

Fuses are not serviceable.

Contact Inputs and Outputs

Alarm Output Contact

Output Type:	Relay, Form C, break-before-make
Pilot Duty Ratings*:	B300 (UL) R300 (UL)
Rated Voltage**:	24–250 Vdc 110–240 Vrms

Note: The voltage across any of the contact output terminals must not exceed the operational voltage.

Operational Voltage**:	0–300 Vdc 0–264 Vrms
Contact Protection:	MOV protection across open contacts 264 Vrms continuous voltage 300 Vdc continuous voltage
Continuous Carry**:	6 A @ 70°C, 4 A @ 85°C
Pickup/Dropout Time**:	≤6 ms (resistive load)
Power Supply Burden**:	≤1 W
Mechanical Endurance**:	10,000 no-load operations
Make (Short Duration Contact Current)**:	30 Adc 1,000 operations @ 250 Vdc 2,000 operations @ 125 Vdc

Note: 200 ms on, 15 ms off, current interrupted by independent means.

Short-Time Thermal Withstand**:	50 A for 1 s
Limiting Making Capacity**:	1,000 W @ 250 Vdc (L/R = 40 ms)
Limiting Breaking Capacity/Electrical Endurance**:	10,000 operations 10 operations in 4 s, followed by 2 min idle

Rated Voltage	Resistive Break	Inductive Break L/R = 40 ms (DC) PF = 0.4 (AC)
24 Vdc	1.25 Adc	1.25 Adc
48 Vdc	0.63 Adc	0.63 Adc
125 Vdc	0.30 Adc	0.30 Adc
250 Vdc	0.20 Adc	0.20 Adc
110 Vrms	0.30 Arms	0.30 Arms
240 Vrms	0.20 Arms	0.20 Arms

* Per UL 508.
** Parameters verified by SEL per IEC 60255-1:2009 and IEEE C37.90-2005.

Terminal Connections

Compression Screw Terminal

Power Wiring	
Insulation:	300 V min.
Size:	12–18 AWG
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 61010-1:2010/AMD1:2016/COR:2019
UL 61010-1:2019, C22.2 No. 61010-1:12
IEC 61010-2-201:2017
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

Environmental

Change of Temperature:
IEC 60068-2-14:2009
Severity Level:
5 cycles, 1°C per minute ramp
–40°C to +60°C (E3-1505M CPU)
–40°C to +75°C (E3-1505L CPU)

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:
16 hours at 60°C (E3-1505M CPU)
16 hours at 75°C (E3-1505L CPU)

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

Power Consumption (Watts)[a]			
Component	**Minimum**	**Typical**	**Maximum**
Base System (E3-1505L CPU, 1 PSU, 4 GB RAM, 1 SATA Drive):	25 W	35 W	50 W
Additional Consumption From Optional Components			
2nd Power Supply	+10 W	+10 W	+13 W
SEL-3390E4 Ethernet Card	+6 W	+8 W	+10 W
SEL-3390S8 Serial Card or SEL-3390T Expansion Card	+4 W	+5 W	+7 W
Chipset Heater[b]			
cold startup (<5°C [41°F]):	N/A	N/A	+90 W
continuous operation (0°C [32°F]):	0 W	+5 W	+10 W
continuous operation (–40°C [–40°F]):	0 W	+20 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 A, +5 Vdc, 10 W each, 25 W all ports combined

Notes

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