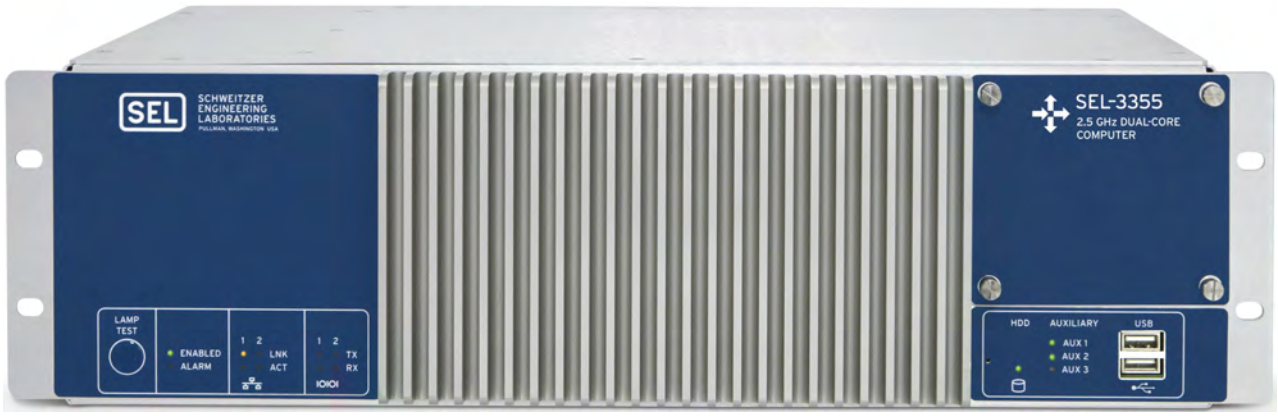
SEL-3355 Computer

Improve Reliability, Availability, and Serviceability With a Rugged Computer



The SEL-3355 Computer uses a high-performance x86-64 architecture processor to support modern operating systems like Microsoft® Windows® and Linux®. The extremely rugged SEL hardware of the SEL-3355 enables you to use your choice of computer operating system and software in very harsh environments not suitable for general purpose computers.

Integrate the SEL-3355 in computing applications that demand high performance, reliability, and low maintenance in extreme, harsh environments. The SEL-3355 offers a mean time between failure (MTBF) of at least ten times that of typical industrial computers by: eliminating all moving parts, including rotating hard drives and fans; using high-quality single-level cell (SLC) solid-state storage drives; and using error-correcting memory technology. By eliminating vent holes, the SEL-3355 significantly reduces dust buildup and foreign contaminants. Dual modular, hot-swappable, ac/dc power supplies eliminate the need for external inverters and enhance system reliability, availability, and serviceability. You can install software from SEL and third-party software vendors to customize the SEL-3355 for your specific applications. Every SEL-3355 comes with the unprecedented ten-year, worldwide SEL warranty.

Major Features and Benefits

The SEL-3355 provides a rugged, easy-to-use computing platform for substation, industrial, or other harsh environments.

- **x86-64 Architecture With Intel® Core™ i7 Performance.** The SEL-3355 uses the Intel Core i7 microprocessor architecture to deliver very high performance and broad operating system and software compatibility. Multiple processor cores and Intel Hyper-Threading Technology enable you to run multiple time-critical applications simultaneously. Choose between 2.5 GHz dual-core and 2.1 GHz quad-core CPU options.
- **Wide Power Supply Range.** The SEL-3355 supports two load-sharing, hot-swappable power supply modules, enabling you to power the SEL-3355 from two independent power sources for maximum availability and without inverters.

- **More and Faster Mass Storage.** The SEL-3355 supports four, hot-swappable, 2.5" solid-state Serial Advanced Technology Attachment (SATA) drives easily accessible from the front panel. The integrated SATA controller has support for Redundant Arrays of Independent Disks (RAID) to maximize data availability and improve storage performance. Factory-orderable solid-state drives (SSD) are high performance, SLC, and industrial temperature-rated for speed and longevity.
- **Versatile Display Interfaces.** One or two simultaneous independent high-definition display interfaces can be used to connect Digital Visual Interface (DVI) or DisplayPort. Other video connections, such as High Definition Multimedia Interface (HDMI), are available when using interface adapters.
- **Flexible System Interconnection.** A choice of 6 USB ports and as many as 26 serial ports (with SEL-3390S8 serial expansion card) support optimized I/O connections to various peripherals.
- **PCIe Expandability.** The SEL-3355 supports as many as five standard PCI/PCIe form factor expansion cards, enabling you to customize the system I/O to meet your application needs. Choose from a selection of SEL expansion cards, or install your own custom third-party expansion card enabling new or legacy applications.
- **High-Speed Network Access.** Two 10/100/1000 Mbps Ethernet connections on the rear-panel support high-speed network connectivity and enable connections to independent networks, or redundant paired network connections. Optional network interface cards, such as the SEL-3390E4 quad-gigabit Ethernet card, may be added to the SEL-3355 for additional network connectivity.
- **Remote Management.** Remote access over Ethernet using Windows Remote Desktop or Intel vPro™ Active Management Technology enables full access to the system video, keyboard, mouse, and storage.
- **Increased Reliability.** The SEL-3355 is designed and built to operate reliably in harsh environments, conforming to IEEE C37.90 and IEC 60255 Protective Relay Standards and IEEE 1613 Standard Environmental and Testing Requirements for Communication Networking Devices in Electric Power Substations. The computing platform meets or exceeds specifications for vibration, electrostatic discharge, fast transient, radiated emissions, dielectric strength, and pulse magnetic field disturbances.
- I**ncreased Availability.** RAID capabilities, teamed network interfaces, and redundant power supplies provide even higher data availability and maximize system uptime.
- **Increased Serviceability.** Error-correcting code (ECC) system memory can be field upgraded to 16 GB. An easily accessible front-panel drive bay enables field upgrade or replacement of solid-state drives. RAID technology and hot-swappable drives allow for replacement or adding storage capacity without taking the computing system out of service. Add a total of four solid-state drives for as much as a terabyte of disk space. Add additional capabilities in the field with field-serviceable PCIe expansion cards. Achieve a new level of remediation and repair capabilities with Intel vPro technology for local and remote monitoring and repair.

Functional Overview

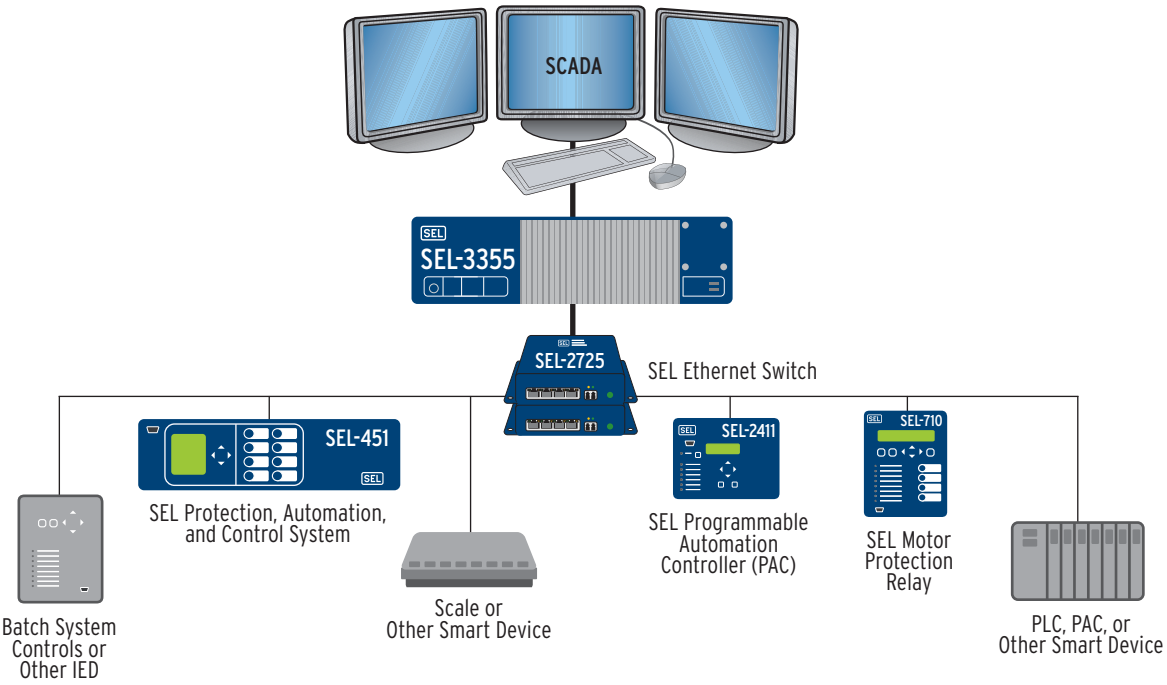


Figure 1 Functional Diagram in Utility Substation Applications

Watchdog Functionality

An embedded controller provides an extra level of computer system reliability. One function of the embedded controller is to reboot the computer if there is an operating system problem or a problem with specific software services running on the operating system.

SEL System Monitor

SEL System Monitor software monitors system performance and component health. Alerts for alarm conditions are issued on configurable thresholds. Example thresholds include CPU usage, free disk space, and available system memory.

Ethernet

Ethernet connections allow the SEL-3355 to connect to as many as ten separate, high-speed Ethernet networks via two built-in gigabit Ethernet ports, plus eight additional ports using two SEL-3390E4 PCIe network interface cards. Aggregate several ports for increased performance or redundancy or separate local area networks (LANs) for control, data, or engineering access.

Time

The SEL-3390S8 serial expansion card accepts IRIG-B time-code input for precise time input and distribution to connected devices.

EIA-232/EIA-485/EIA-422 Ports

The SEL-3355 computing platform comes standard with two built-in EIA-232 DB-9 ports and, optionally, as many as 24 rear-panel EIA-232/422/485 ports with RJ45 format connectors using the SEL-3390S8 PCIe serial expansion card. Serial expansion communications ports are software selectable to function as standard EIA-232/422/485 ports with +5 V power.

Alarm Output

An alarm contact output on the rear panel can be used to signal internal errors and operating system malfunctions.

Programmable LEDs

Program three front-panel bicolor LEDs for use with your custom applications.

Out-of-Band Management

Intel vPro Active Management Technology (AMT) provides out-of-band management for security, configuration, and monitoring.

Applications

Virtualization for HMI and Other Applications

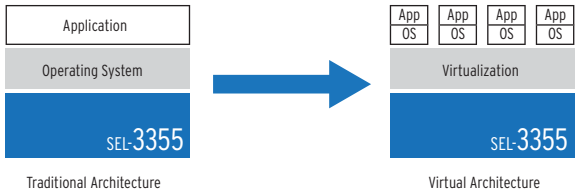


Figure 2 SEL-3355 OS and or Application Virtualization Platform

Create your own virtualization appliance by leveraging Intel Virtualization Technology (VT-x) to allow one hardware platform to function as multiple "virtual" platforms. Isolate your computing activity onto separate virtual machines to maintain productivity and realize improved manageability and reduced downtime. For example, run a virtualized OS specifically for your HMI or other essential but noncritical applications. Should your HMI require that the system be rebooted, simply restart the virtual machine and avoid an outage for your other critical processes. Similarly, multiple SEL-3355 computing platforms may be virtualized and entire operating systems transparently migrated from one physical SEL-3355 to another for hardware upgrades, security or software updates, or testing purposes.

Control System Applications

Use the SEL-3355 for process control applications, including as a human-machine interface (HMI) or for protocol conversion and high-speed control when working with other SEL products and solutions.

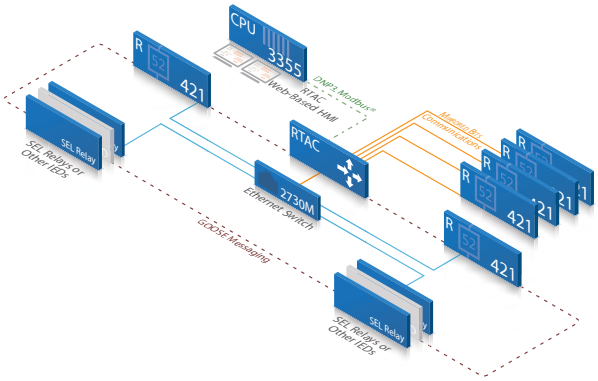


Figure 3 High-Speed Control With SEL MIRRORED BITS and IEC 61850 GOOSE Communications

Security Applications

Improve security with a single sign-on, enabled through using the SEL-3355 as a local Lightweight Directory Access Protocol (LDAP) server. Centrally manage user accounts and group memberships with Microsoft Active Directory® or with your choice of back-end database support.

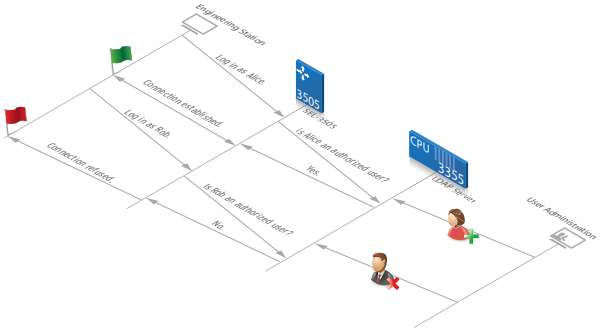


Figure 4 SEL-3355 as Remote Read-Only Domain Controller Performing Central Authentication Using LDAP

Disturbance Recording System for PRC-002-2

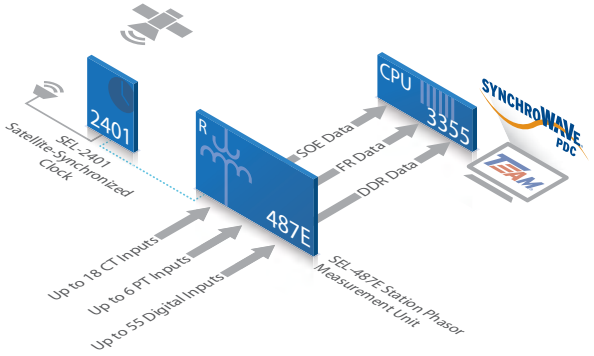


Figure 5 Reliable Hardware for Running Your Disturbance Recording System

Event Collection Applications

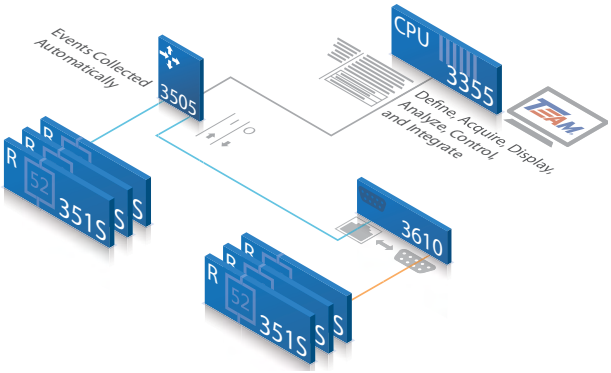


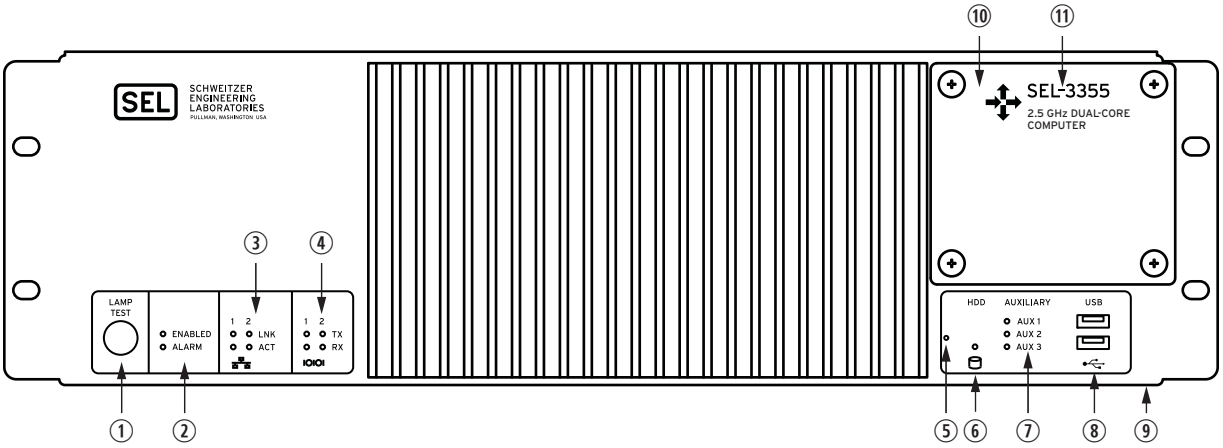
Figure 6 IED Event Collection With Optional ACSELERATOR TEAM SEL-5045 Software

Guideform Specification

The SEL-3355 Computer shall operate as a computer with network access to provide a combination of functions including, but not limited to, visualization and control of process equipment, data aggregation, simultaneous collection of data from serial and Ethernet® server devices (both SEL and non-SEL devices), and simultaneous data access for multiple client devices. The SEL-3355 shall conform to various industry standards, operate in harsh environments, and provide the operational and functional requirements as described below.

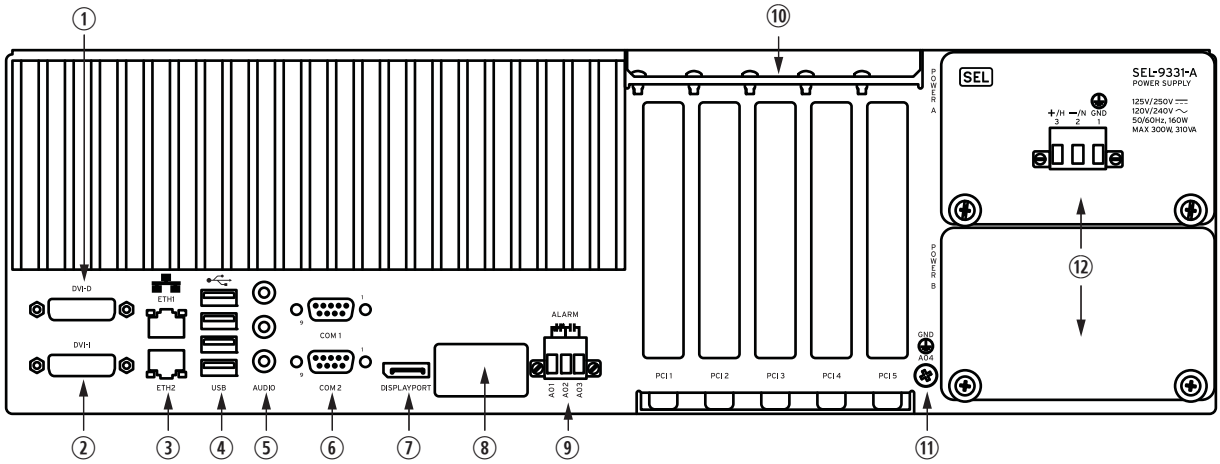
- **Power Supply.** The SEL-3355 shall be available with dual modular hot-swappable power supplies capable of load sharing and operating concurrently among independent power sources on a wide range of both ac and dc input power source voltages: 125/250 Vdc or 120/240 Vac.
- **Temperature.** The SEL-3355 shall be capable of continuous operation over a temperature range of –40° to +75°C (–40° to +167°F) for Intel® i7-3555LE dual-core processor and –40° to +60°C (–40° to +140°F) for Intel i7-3612QE quad-core processor, at 100 percent processor burden to allow mounting in an outdoor control cubicle. The SEL-3355 shall be type tested to IEC 60068-2-1:1990 (Test Ad 16 hr @ –40°C, IEC 60068-2-2:1974) (Test Bd 16 hr @ +75°C [dual-core], +60°C [quad-core]), and IEC 60068-2-30:1980 (Test Db 12 + 12-hour cycle @ 25° to 55°C, 6 cycles).
- **Environmental Testing.** The SEL-3355 shall be tested to the same standards as protective relays including IEC 60255-21-1, IEC 60255-21-2, IEC 60255-21-3, IEC 60255-22-1, IEC 60255-22-2, EN 61000-4-2, IEC 60255-22-3, IEC 60255-22-4, EN 61000-4-4, and IEEE C37.90.1.
- **Communications Ports.** The SEL-3355 shall come standard with two front-panel USB ports, four rear-panel USB ports, two rear-panel serial ports, and two rear-panel Ethernet ports. Each standard serial port shall be EIA-232, BIOS selectable for +5 Vdc port power and capable of operation at 300–115200 bps. Ethernet ports shall be independent 10/100/1000 Mbps. As many as 24 additional EIA-232/EIA-422/EIA-485 RJ45 serial ports capable of 300–921600 bps and +5 Vdc port power shall be available as ordering options. As many as eight additional Ethernet ports (RJ45 copper or SFP fiber optic) shall be available as ordering options with fiber SFP modules for fiber ports. All communications ports shall be ESD and RFI protected.
- **Hot-Swappable Industrial Solid-State Drives.** The SEL-3355 shall have high quality, industrial-temperature rated, single-level cell (SLC) NAND Flash solid-state drives available. All drives shall support hot-swapping.
- **RAID (Redundant Array of Independent Disks).** RAID levels 0, 1, 5, and 10 shall be supported to allow for a rich mix of speed, availability, and disaster recovery, depending upon application.
- **Expansion Slots.** A legacy PCI, two PCI Express (PCIe) x4, and two PCIe x1 slots shall provide room for legacy and the latest PCIe expansion cards.
- **CIS OS Security Benchmarks.** Operating systems shall provide a mechanism to quickly enable the Center for Internet Security benchmark configurations to improve the device security posture.
- **Configuration.** Configuration of messages and data processing functions shall be through a simple GUI interface. Configuration interface shall be through local keyboard, mouse, and monitor port or via Windows Remote Desktop or Intel Active Management Technology (AMT).
- **Alarm Output.** There shall be an alarm contact output to signal internal errors and malfunctions. The alarm contact shall be supervised by an internal watchdog system that independently monitors the operating system.
- **Operating System.** The SEL-3355 shall allow for at least the following operating systems: Microsoft Windows 7 Ultimate 64-bit, Microsoft Windows Server® 2008 R2, Windows Embedded 8, and CentOS Linux®.
- **Nonvolatile Storage.** There shall be Flash memory used as nonvolatile storage of settings, configuration, and incoming and calculated data within the SEL-3355. Data stored in the nonvolatile memory shall be available for retrieval after sustained power outage, including failure of the internal battery.
- **Moving Parts and Vent Holes.** The SEL-3355 shall not include any rotating disk drives, fans, moving parts, or vent holes.
- **Reliability.** The vendor shall supply the actual measured Mean Time Between Failures (MTBF) for the device upon request.
- **Service.** The device shall include no-charge technical support for the life of the product.
- **Manufacturer.** The device shall be manufactured in the United States.
- **Conformal Coating.** The device shall have optional conformal coating to protect the circuit boards from harsh environments.
- **Warranty Return.** The vendor shall support a 72-hour turnaround on all warranty repairs.
- **Warranty.** The device shall include a ten-year, no-questions-asked warranty for all material and workmanship defects. In addition, the warranty shall cover accidental customer-induced damage.

Front- and Rear-Panel Diagrams



① LEDs may all be tested by holding down the LAMP TEST button.
② ENABLED LED provides operational status. Green indicates normal operation, and red indicates that the system is halted or booting, or that an alarm condition has occurred. ALARM LED indicates a non-optimal system condition exists. The ALARM LED illuminates red whenever the alarm contact operates.
③ LINK and ACTIVITY LEDs indicate link status and network activity for each Ethernet port.
④ Transmit (TX) and Receive (RX) LEDs indicate activity on serial ports.
⑤ RESET pinhole may also be configured as a power button in the BIOS.
⑥ See SATA drive activity at a glance with the HDD LED indicator.
⑦ Program three bicolor AUXILIARY LEDs for your custom application.
⑧ Attach one or two USB 2.0 devices, enabling custom, application-specific peripherals.
⑨ Rugged enclosure withstands EMI, RFI, shock, and vibration.
⑩ Install up to four solid-state drives behind the easily accessible front panel. Configure your drives in a RAID configuration for even higher data availability.
⑪ High contrast, white-on-blue lettering is highly legible even in dark areas.

Figure 7 SEL-3355 Front Panel



① Connect digital displays to the DVI-D video port.
② Connect digital or analog (VGA) displays to the DVI-I video port.
③ Network with two high-speed Gigabit Ethernet ports. Ports may be teamed for redundancy or used individually.
④ Attach up to four USB 2.0 devices enabling custom, application-specific peripherals.
⑤ Use line-in, line/headphone-out, and microphone jacks for high-definition analog audio applications.
⑥ Two built-in EIA-232 ports are BIOS configurable for +5 Vdc port power.
⑦ Connect newer monitors using DisplayPort technology video port to leverage higher performance features than any other digital interface.
⑧ Serial number label.
⑨ Wire a Form C alarm contact output either normally closed or normally open. The ALARM LED on the front provides indication of the alarm contact state.
⑩ Use SEL rugged or third-party PCI or PCI Express expansion cards for additional networking, serial, time, video, or any other application-enabling solutions.
⑪ Attach chassis to ground.
⑫ Choose single or dual power supplies, and attach power from independent sources for even higher availability. Supplies load share and are hot-swappable for maximum online serviceability.

Figure 8 SEL-3355 Rear Panel

Product Dimensions

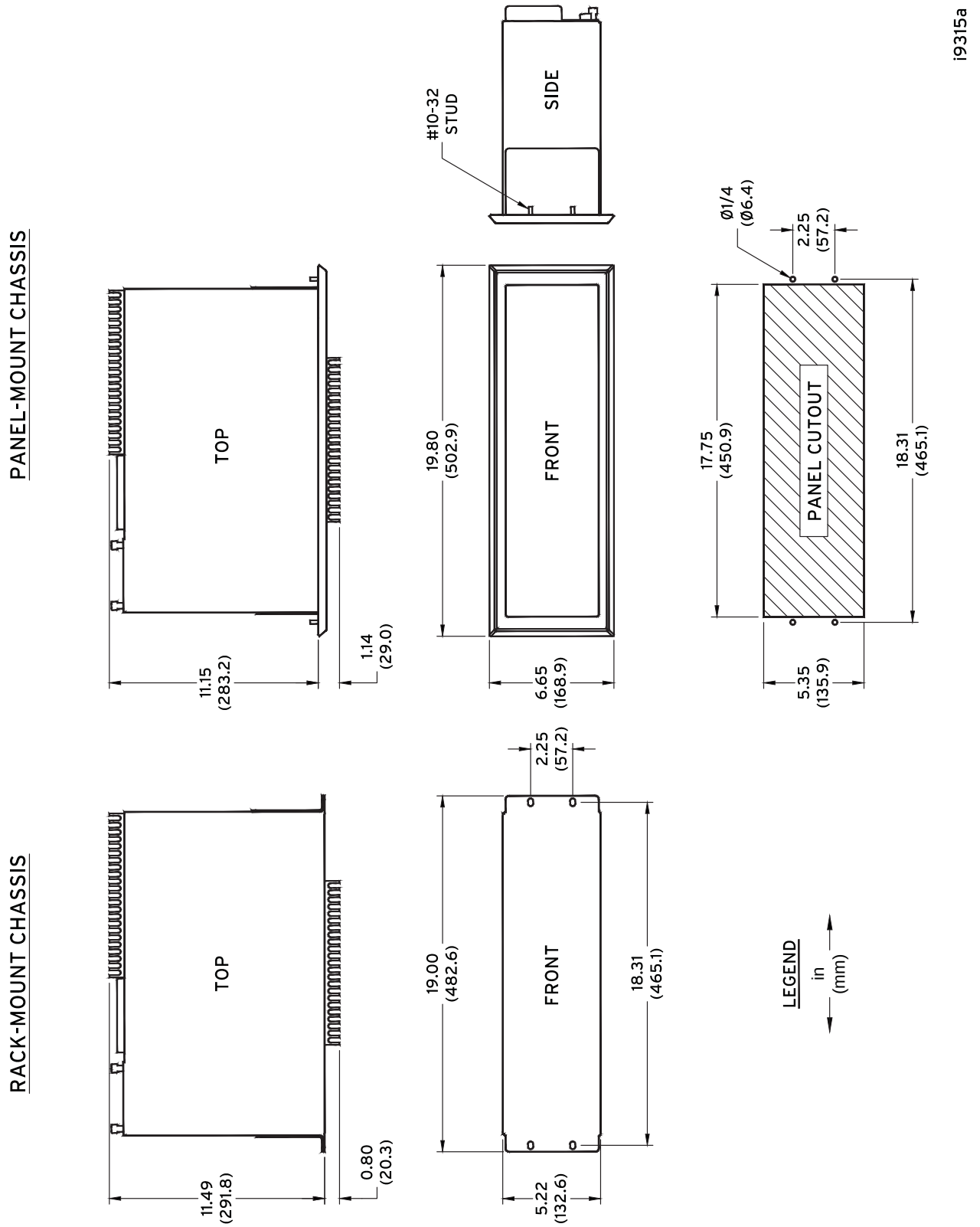


Figure 9 SEL-3355 Dimensions for Rack- and Panel-Mount Models

Specifications

General

Operating Systems

Microsoft Windows 7 Ultimate (64-bit)

Microsoft Windows Server 2008 R2 Standard

None (user-loaded operating system)

CPU

Intel Core i7-3555LE Dual-Core

Speed:	2.5 GHz base, 3.2 GHz turbo
Cache:	2 x 256 KB L2, 4 MB L3

Intel Core i7-3612QE Quad-Core

Speed:	2.1 GHz base, 3.1 GHz turbo
Cache:	4 x 256 KB L2, 6 MB L3

RAM

4–16 GB DDR3 ECC PC3-10600 (1333 MHz)

Chipset

Intel QM77 Express Chipset

Mass Storage

1 Internal Drive Bay:	Up to 4 2.5" SSDs SATA II 3.0 Gb/s RAID level 0, 1, 5, 10 Hot-Swap Support

Video

Intel HD Graphics 4000 Controller

Dual Independent Displays From 2 of the 3 Outputs:	DVI-I (digital + VGA) maximum resolution 1920 x 1200 @ 32 bpp DVI-D (digital only) maximum resolution 1920 x 1200 @ 32 bpp DisplayPort maximum resolution 1920 x 1200 @ 32 bpp

Audio

IDT 92HD91 HD Audio codec

3 Analog 3.5 mm TRS Jacks:	Line input Line/headphone output Microphone input

USB

4 Rear-Panel ports, 2 Front-Panel Ports
USB 2.0 Compliant
800 mA Current Limit Each

Expansion Cards

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

Ethernet

2 Rear-Panel 1 Gb Copper RJ45 Ports

ETH1:	Intel 82579LM, 10/100/1000 Mbps RJ45 copper
ETH2:	Intel 82574L, 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

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)

Time-Code Input/Output

Available With SEL-3390S8 Expansion Card

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

Note: Output generated from either IRIG-B input or SEL-3355 clock.

Real-Time Clock/Calendar

Battery Type:	IEC No. BR2335 Lithium
Battery Life:	10 years with power 2 years without power

BIOS

Phoenix SecureCore Tiano™ UEFI

Trusted Platform Module

Integrated TPM 1.2

Intel Active Management Technology

Intel AMT v8.0

Power Supply

Option: 125/250 Vdc or 120/240 Vac; 50/60 Hz

DC Range:	100–300 Vdc
AC Range:	85–264 Vac
Frequency Range:	45–65 Hz
Typical Burden:	50 W
Max Burden:	300 W, 310 VA
DC Ripple:	<15% Rated Voltage
Peak Inrush:	20 A
Insulation:	3100 Vdc

Terminal Connections

Grounding Screw

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

Ring Terminal Recommended

Compression Plug Tightening Torque

Minimum:	0.5 Nm (4.4 in-lb)
Maximum:	1.0 Nm (8.8 in-lb)

Crimp Ferrule Recommended

Compression Plug Mounting Ear Screw Tightening Torque

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

Operating Temperature Range

i7-3555LE CPU:	–40° to +75°C (–40° to +167°F)
i7-3612QE CPU:	–40° to +60°C (–40° to +140°F)

Note: Not applicable to UL applications.

Storage Temperature

–40° to +85°C (–40° to +185°F)

Relative Humidity

5 to 95% noncondensing

Maximum Altitude

2000 m

Atmospheric Pressure

80 ... 110 kPa

Overvoltage Category

Category II

Pollution Degree

2

Weight (Maximum)

9.072 kg (20 lbs)

Type Tests

Electromagnetic Compatibility Emissions

Radiated and Conducted Emissions:	IEC 60255-25:2000 IEC 61850-3:2002 CISPR 22:2008 FCC 15.109:2013 FCC 15.107:2013 Severity Level: Class A

Electromagnetic Compatibility Immunity

Conducted Common Mode Disturbances:	IEC 61000-4-16:2002 IEC 61850-3:2002
Conducted RF:	IEC 60255-22-6:2001 IEC 61000-4-6:2008 IEC 61850-3:2002 Severity Level: 10 Vrms
Digital Radio Telephone RF:	ENV 50204:1995 Severity Level: 10 V/m at 900 MHz and 1.89 GHz
Electrostatic Discharge:	IEC 60255-22-2:2008 IEC 61000-4-2:2008 IEEE 1613-2003 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 60255-22-4:2008 IEC 61000-4-4:2004 + CRGD:2006 IEC 61850-3:2002 Severity Level: Class A 4 kV, 5 kHz on power supply and outputs; 2 kV, 5 kHz on communication lines
Magnetic Field:	IEC 61000-4-8:2001 IEC 61000-4-9:2001 IEC 61850-3:2002 Severity Level: 1000 A/m for 3 s 100 A/m for 1 m IEC 61000-4-10:2001 Severity Level: 100 A/m
Power Supply:	IEC 60255-11:2008 IEC 61000-4-11:2004 IEC 61000-4-29:2000 IEEE 1613-2003
Radiated Radio Frequency:	IEC 60255-22-3:2007 IEC 61000-4-3:2008 IEC 61850-3:2002 IEEE 1613-2003 Severity Level: 10 V/m IEEE C37.90.2-2004 Severity Level: 35 V/m
Surge Withstand Capability:	IEC 60255-22-1:2007 IEEE 1613-2003 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 C37.90.1-2002 Severity Level: 2.5 kV oscillatory 4 kV fast transient
Surge Immunity:	IEC 60255-22-5:2008 IEC 61000-4-5:2005 IEC 61850-3:2002 1 kV line-to-line 2 kV line-to-earth
Oscillatory Waves Immunity:	IEC 61000-4-12:2006 IEC 61850-3:2002 Ring Wave: 2 kV common, 1.0 kV differential Oscillatory: 2.5 kV common, 1.0 kV differential
Power Frequency:	IEC 61850-3:2002 Class 1

Environmental

Cold:	IEC 60068-2-1:2007 IEC 61850-3:2002 IEEE 1613-2003 Severity Level: 16 hours at –40°C
Damp Heat, Cyclic:	IEC 60068-2-30:2005 IEC 61850-3:2002 IEEE 1613-2003 Severity Level: 12 + 12-hour cycle 25° to 55°C, 6 cycles, 95% r.h.
Dry Heat:	IEC 60068-2-2:2007 IEC 61850-3:2002 IEEE 1613-2003 Severity Level: 16 hours at 60°C (i7-3612QE CPU) 16 hours at 75°C (i7-3555LE CPU)
Vibration:	IEC 60255-21-1:1988 IEC 61850-3:2002 Severity Level: Endurance Class 1 Response Class 2 IEC 60255-21-2:1988 Severity Level: Shock Withstand, Bump Class 1 Shock Response Class 2 IEEE 1613-2003 Severity Level: V.S.4 IEC 60255-21-3:1993 Severity Level: Quake Response Class 2

Safety

Enclosure Protection:	IEC 60529:2001 + CRGD:2003 Severity Level: IP30C
Dielectric Strength:	IEC 60255-5:1977 IEEE 1613-2003 IEEE C37.90-2005 Severity Level: 3100 Vdc on power supply 2500 Vac on contact output Type tested for one minute
Impulse:	IEC 60255-5:2000 IEEE 1613-2003 Severity Level: 0.5 Joule, 5 kV

Certifications

ISO 9001: This product was designed and manufactured under an ISO 9001 certified quality management system.

CE: CE Mark
EMC Directive, Low Voltage Directive

UL, cUL (pending): UL 60950-1, C22.2 No. 60950-1

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