SEL-2664S
Stator Ground Protection Relay

100% Stator Ground Fault Protection 100% of the Time

Major Features and Benefits

The SEL-2664S Stator Ground Protection Relay provides an exceptional combination of protection, metering, monitoring, control, and communications in a compact industrial package.

- **Standard Protection and Control Features.** Protect your generator against stator ground faults and monitor the neutral grounding resistor. When used with an SEL-2664 Field Ground Module, the SEL-2664S Relay protects against rotor field insulation faults to ground. The stator ground protection works for 100 percent of the stator winding and for all operating conditions, including when the generator is starting, ramping, or offline using a novel multifrequency injection method in conjunction with the neutral overvoltage elements.
- **Operator Controls.** Take advantage of multiple methods for accessing and using the operator interface of the relay. The front and side panels have eight LEDs that indicate the **ENABLED**, **TRIP**, **WARNING**, **64S**, **64F**, **59N**, **64F MODULE FAIL**, **64S INJECT ON** status of the relay. The front panel also provides a **TARGET RESET** pushbutton for resetting the relay and the targets.
- **Relay and Logic Settings Software.** Use ACSELERATOR QuickSet® SEL-5030 Software to reduce your engineering costs for relay settings and logic programming and simplify development of SELOGIC® control equations.
- **Metering and Monitoring.** Use built-in metering functions to eliminate separately mounted metering devices. Analyze SER reports and oscillographic event reports for rapid commissioning, testing, and post-fault diagnostics. Additional monitoring functions include the Profile Report.
- **Control Inputs and Outputs.** Take advantage of two internally wetted control inputs and four contact outputs (one Form C and three Form A) for control and status indication.
- **SEL-4664 Calibration Module.** Take advantage of the SEL-2664S automated field calibration process streamlined with the SEL-4664 calibration module.

- **Communications Ports.**
  - Port 1 with dual fiber-optic Ethernet ports
  - Port 2 with an ST® fiber-optic EIA-232 serial port
  - Front port and Port 3 with an EIA-232 configurable serial port
- **Communications Protocols.**
  - Modbus® RTU, Modbus TCP/IP
  - DNP3 serial and LAN/WAN
  - IEC 61850
  - Simple Network Time Protocol (SNTP)
  - File Transfer Protocol (FTP)
  - Telnet (SEL ASCII)
  - SEL protocols, including MIRRORED BITS® communications
- **Conformally Coated.**

Overview

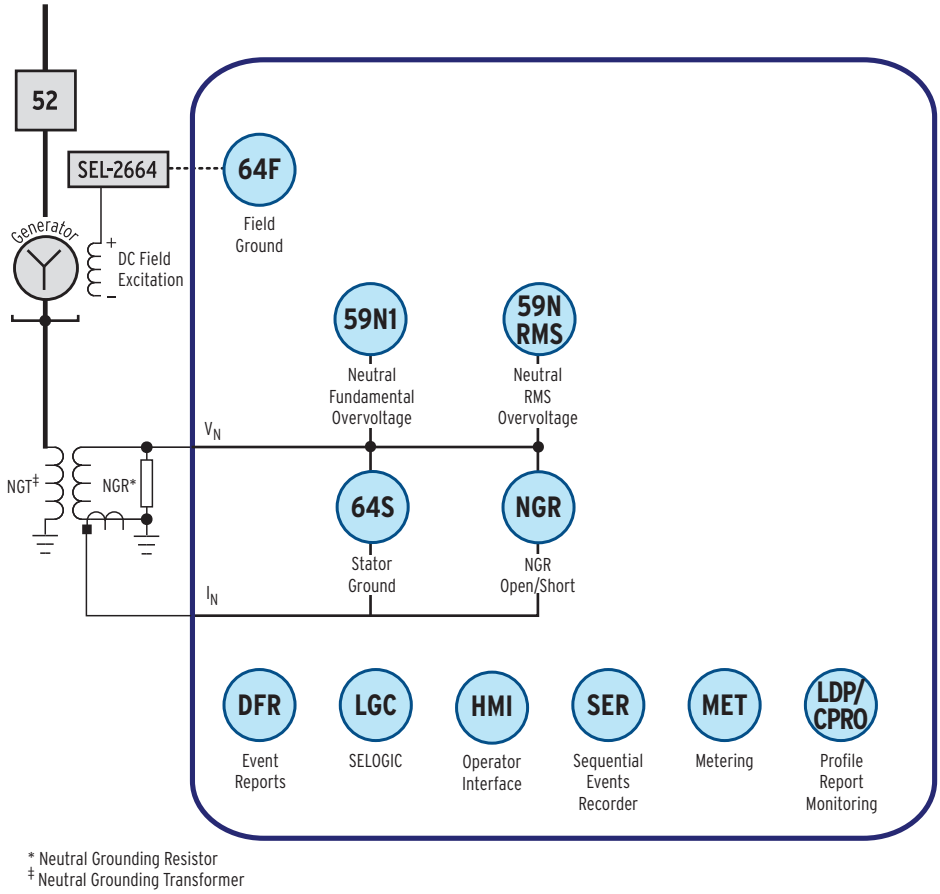


Figure 1 Functional Diagram

Protection and Control Features

- **Stator Insulation Protection.** The 64S element of the SEL-2664S uses multisine signal injection at generator neutral to monitor 100 percent of the stator insulation. The element works with the generator in- or out-of-service, including the generator ramp up, with no blind period. Two levels of 64S elements provide warning and trip along with delay and torque control settings. The combination of the 64S and the 59N elements provide 100 percent stator ground protection 100 percent of the time.
- **Rotor Field Ground Protection.** An SEL-2664S Relay connected to an SEL-2664 Field Ground Module detects field ground faults by measuring field insulation-to-ground resistance with the switched dc voltage injection method. Two-level protection for warning and trip functions along with delay and torque control settings is provided. The module transmits the insulation resistance value to the relay through a fiber-optic cable with ST connectors.
- **Neutral Overvoltage Protection.** The SEL-2664S provides two neutral overvoltage elements. The 59N1 element uses the nominal frequency magnitude of neutral voltage (VN), and the 59NRMS element uses the rms magnitude of VN. The relay provides one level from each of the 59N1 and 59NRMS elements for trip, along with delay and torque control settings. The 59N elements are independent of the 64S elements described previously. The combination of the two, with their overlapping coverage, provides 100 percent stator winding protection 100 percent of the time.
- **Neutral Ground Resistor Monitor.** The SEL-2664S monitors the generator neutral grounding resistor (NGR) value using NGR elements and operates when a short or an open circuit is detected.

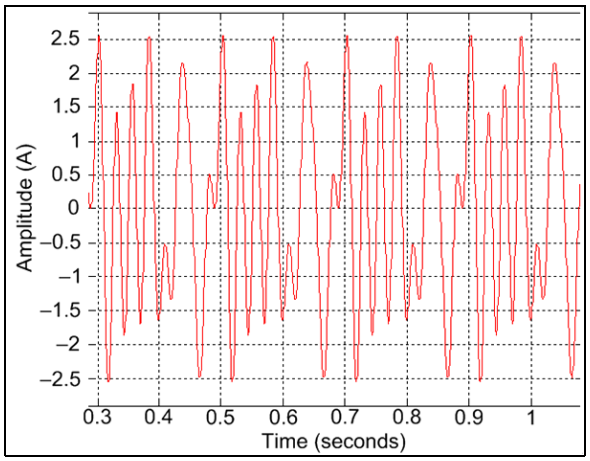


Figure 2 SEL-2664S Multisine Injection Signal Waveform

Metering and Monitoring

Metering Functions

The SEL-2664S provides metering for neutral voltage and current. The relay meters injection source currents and voltages, stator insulation resistance and capacitance, and neutral ground resistance. The relay also meters field insulation resistance when used with the SEL-2664 Field Ground Module. Refer to *Table 1* for detailed descriptions.

Table 1 Metered Quantities (Sheet 1 of 2)

Quantities	Description
Stator Insulation (kΩ)	Resistance of the stator insulation to ground in kilohms, primary
Stator Insulation (uF)[a]	Capacitance of the stator insulation to ground in microfarads, primary
Neutral Ground Resistor (Ω)	Resistance of the neutral grounding resistor in ohms (secondary or primary based on NGR location)[b]
Field Insulation (kΩ)	Resistance of field insulation to ground in kilohms
Neutral Voltage (V sec)	Magnitude of fundamental, third-harmonic, and rms neutral voltage in secondary volts
Neutral Current (A sec)[c]	RMS and third-harmonic magnitudes of neutral currents in secondary amperes
Neutral Current (A pri) [c]	RMS and third-harmonic magnitudes of neutral currents in primary amperes
Injected Current (A sec) [c]	RMS magnitude of injected current in secondary amperes

Table 1 Metered Quantities (Sheet 2 of 2)

Quantities	Description
Injected Voltages (V at NGR Tap)	Voltage magnitude of specific frequency at the NGR Tap
Neutral Currents (A sec)	Magnitude of neutral currents at the injected frequencies in secondary amperes

[a] Stator insulation capacitance measurements are applicable only when no faults are present.
[b] The meter report always displays the full-scale NGR value irrespective of the tap setting (NGR_TAP).
[c] Secondary and primary reference the neutral grounding transformer (NGT), not CTN.

Profile Report Monitoring

Profile report monitoring provides a periodic snapshot (selectable rate of every 0.1, 1, 5, 15, 30, or 60 minutes) of as many as 17 selectable analog quantities from the complete list of analog quantities the SEL-2664S generates. Examples of analog quantities available include the following:

- Stator insulation resistance
- Injected rms current
- Neutral ground resistance
- Third-harmonic neutral voltage

When used with the SEL-2664 Field Ground Module, the relay can also record the field insulation resistance.

The SEL-2664S maintains profile information in a nonvolatile buffer memory. The memory can hold data for 9800 time-stamped entries.

Automation

Flexible Control Logic and Integration Features

The SEL-2664S has three independently operated serial ports: one front and one rear EIA-232 serial port and one rear fiber-optic serial port. Also, the relay supports dual fiber Ethernet ports in the rear. The relay needs no special communications software. You can use any system that emulates a standard terminal system. Establish communication by connecting computers, modems, protocol converters, printers, an SEL real-time automation controller (RTAC), SEL communications processor, SEL computing platform, SCADA, and/or RTUs for local or remote communication. Refer to *Table 2* for a list of communications protocols available in the SEL-2664S.

Table 2 Communications Protocols

Type	Description
Simple ASCII	Plain language commands for human and simple machine communication. Use for metering, setting, self-test status, event reporting, and other functions.
Compressed ASCII	Comma-delimited ASCII data reports. Allows external devices to obtain relay data in an appropriate format for direct import into spreadsheets and database programs. Data are checksum protected.
Fast Meter and Fast Operate	Binary protocol for machine-to-machine communication. Quickly updates SEL communications processors, RTUs, and other substation devices with metering information, relay elements, I/O status, time tags, and summary event reports. Data are checksum protected. Binary and ASCII protocols operate simultaneously over the same communications lines, so there is no loss of control, status, or metering information while a technician transfers an event report.
Fast SER Protocol	Provides SER events to an automated data collection system.
Modbus	Serial or Ethernet-based Modbus with point remapping. Includes access to metering data, protection elements, contact I/O, targets, SER, relay summary event reports, and settings.
DNP3	Serial or Ethernet-based DNP3 protocols. Provides default and mappable DNP3 objects that include access to metering data, protection elements, Relay Word bits, contact I/O, targets, SER, and relay summary event reports.
IEC 61850	Ethernet-based international standard for interoperability among intelligent devices in a substation. Operates remote bits and I/O. Monitors Relay Word bits and analog quantities.
SNTP	Ethernet-based protocol that provides time synchronization of the relay.

Apply an SEL communications processor as the hub of a star network, with point-to-point connection between the hub and the SEL-2664S (see *Figure 3*).

The communications processor supports external communications links including the public switched telephone network for engineering access to dial-out alerts and private line connections of the SCADA system.

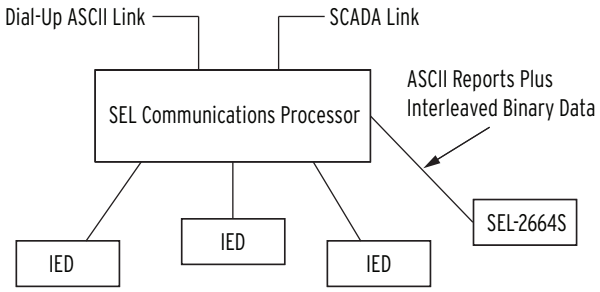


Figure 3 Example Communications System

SEL manufactures a variety of standard cables for connecting this and other relays to a variety of external devices. Consult your SEL representative for more information on cable availability.

SEL-2664S control logic improves integration in the following ways.

- **Eliminates RTU-to-relay wiring with eight remote bits.** Set, clear, or pulse remote bits through the use of serial port commands. Program the remote bits into your control scheme with SELOGIC control equations. Use remote bits for SCADA-type control operations, such as trip and close.
- **Replaces traditional latching relays.** Replace as many as eight traditional latching relays for such functions as "remote control enable" with latch bits. Program latch set and latch reset conditions with SELOGIC control equations. Use optoisolated inputs, remote bits, or any programmable logic condition to set or reset the nonvolatile latch bits. Each latch bit retains its state when the relay loses power.
- **Eliminates external timers.** Replace external timers for custom protection or control schemes with eight general-purpose SELOGIC control equation timers. Each timer has independent time-delay pickup and dropout settings. Program each timer input with any element you need (e.g., time qualify a current element). Assign the timer output to trip logic, transfer trip communications, or other control scheme logic.

Fast SER Protocol

SEL Fast SER Protocol provides SER events to an automated data collection system. SEL Fast SER Protocol is available on any serial port. Devices with embedded processing capability can use these messages to enable and accept unsolicited binary SER messages from the SEL-2664S Relay.

SEL relays and communications processors have two separate data streams that share the same serial port. The normal serial interface consists of ASCII character commands and reports that are human readable through use of a terminal or terminal emulation package. The binary data streams can interrupt the ASCII data stream to obtain information, and then allow the ASCII data stream to continue. This mechanism allows use of a single communications channel for ASCII communications (e.g., transmission of a long event report) interleaved with short bursts of binary data to support fast acquisition of metering or SER data.

Ethernet Network Architectures

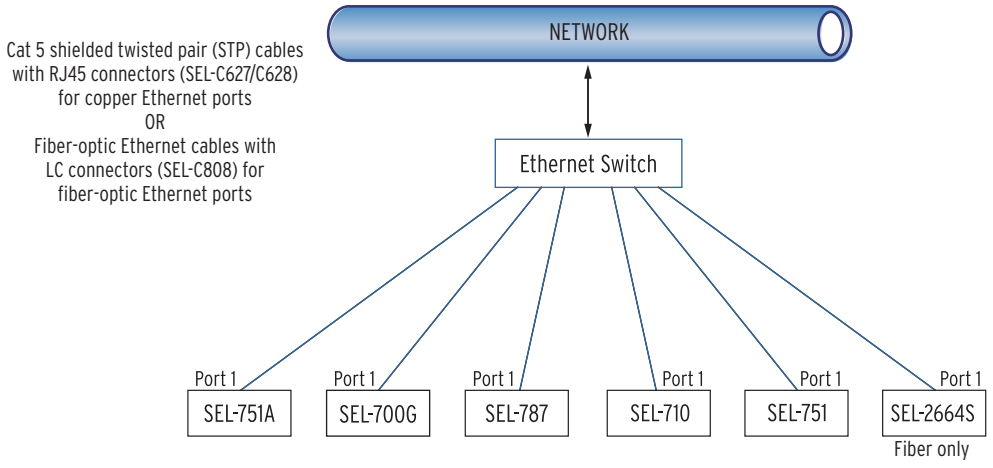


Figure 4 Simple Ethernet Network Configuration

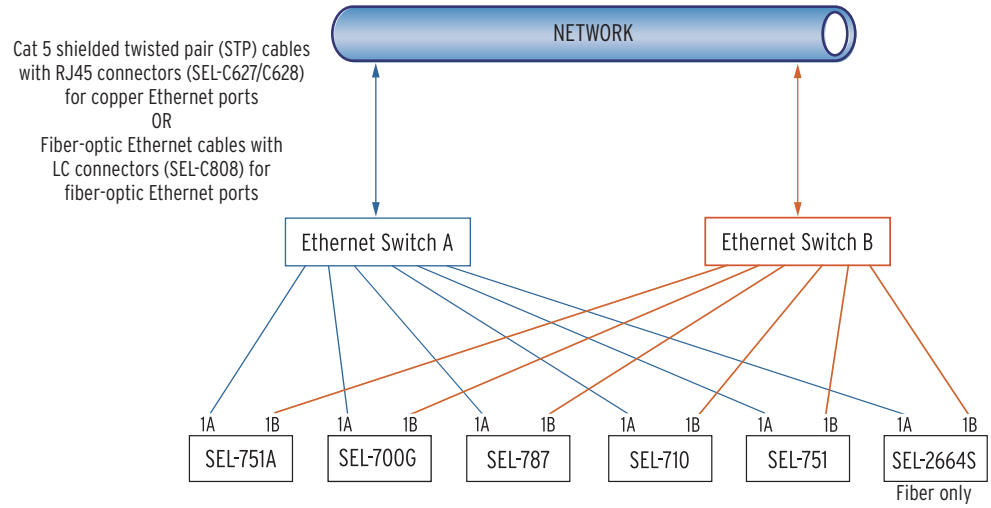


Figure 5 Simple Ethernet Network Configuration With Dual Redundant Connections (Failover Mode)

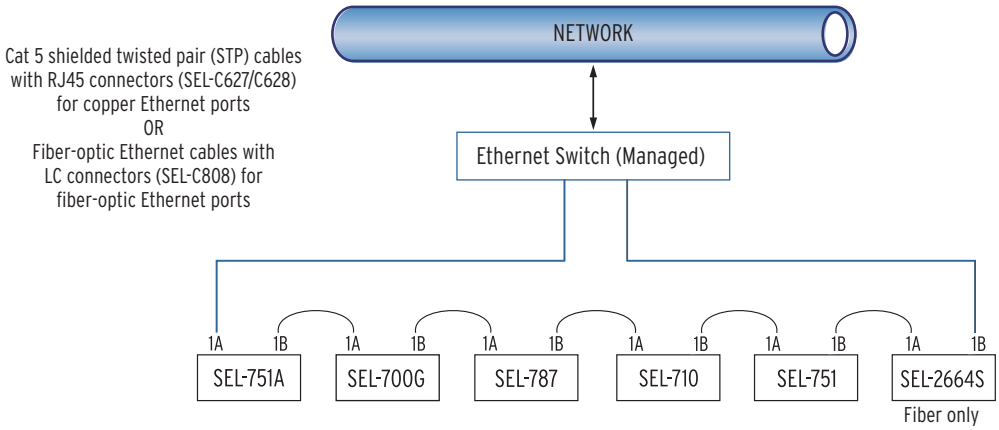


Figure 6 Simple Ethernet Network Configuration With Ring Structure (Switched Mode)

Operator Controls

There are multiple methods for accessing the operator interface of the relay. As shown in *Figure 19*, the front and side panels have eight LEDs that indicate the **ENABLED**, **TRIP**, **WARNING**, **64S**, **64F**, **59N**, **64F MODULE FAIL**, **64S INJECT ON** status of the relay. The front panel also provides a **TARGET RESET** pushbutton for resetting the relay and the targets.

Relay and Logic Settings Software

QuickSet simplifies settings and provides analysis support for the SEL-2664S. Create and manage relay settings with QuickSet in the following ways:

- ➤ Develop settings offline with an intelligent settings editor that only allows valid settings.
- ➤ Create SELOGIC control equations with a drag-and-drop text editor.
- ➤ Configure proper settings through the use of online help.
- ➤ Organize settings with the relay database manager.
- ➤ Load and retrieve settings through use of a simple PC communications link.

With QuickSet, you can use integrated waveform and harmonic analysis to verify settings, analyze events, and analyze power system events.

The following features of QuickSet monitor, commission, and test the SEL-2664S.

- ➤ The PC interface remotely retrieves power system data.
- ➤ The HMI monitors meter data, Relay Word bits, and output contacts status during testing. The control window allows resetting of diagnostics, and targets.
- ➤ The Firmware Loader in the Tools menu helps you upgrade the firmware.

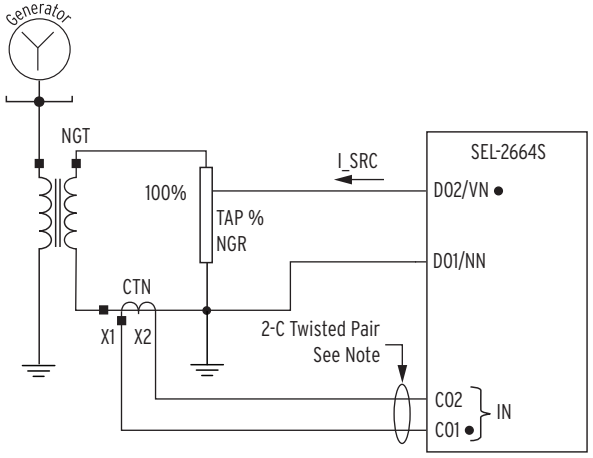
Applications

The SEL-2664S is intended for high-resistance grounded generator applications and cannot be used with low-impedance-grounded, solidly grounded, and ungrounded configurations. See *Application Considerations* in the *SEL-2664S Instruction Manual* for additional details.

You can use the SEL-2664S to provide protection at standstill and online. The SEL-2664S low-frequency injection function requires that VN/NN terminal voltage remains under 74 V peak (or 26 V for the original Amplifier Version 1.0). In the unlikely event that terminal voltage exceeds this level under normal operation (e.g., a voltage transient), the amplifier disconnects to protect the internal circuitry of the product. This disables 64S protection elements in the relay. However, the 59N1, 59NRMS, and 64F elements continue to protect the generator, and 64S elements are immediately restored when the voltage drops to a safe level.

Many generators produce varying amount of third-harmonic voltage during normal operation; however, when properly applied, 64S protection should remain in service under practical levels (typically up to 15 percent) of third-harmonic voltage.

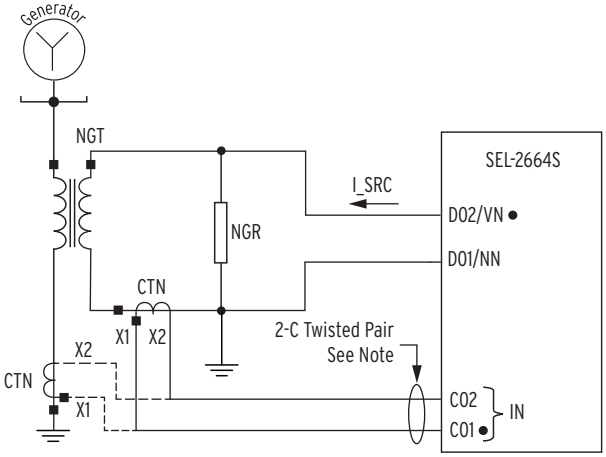
If you want to avoid disabling 64S elements, the SEL-2664S can be configured to inject a signal at an NGR Tap. See *Figure 7* for basic ac connections using the NGR Tap.



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

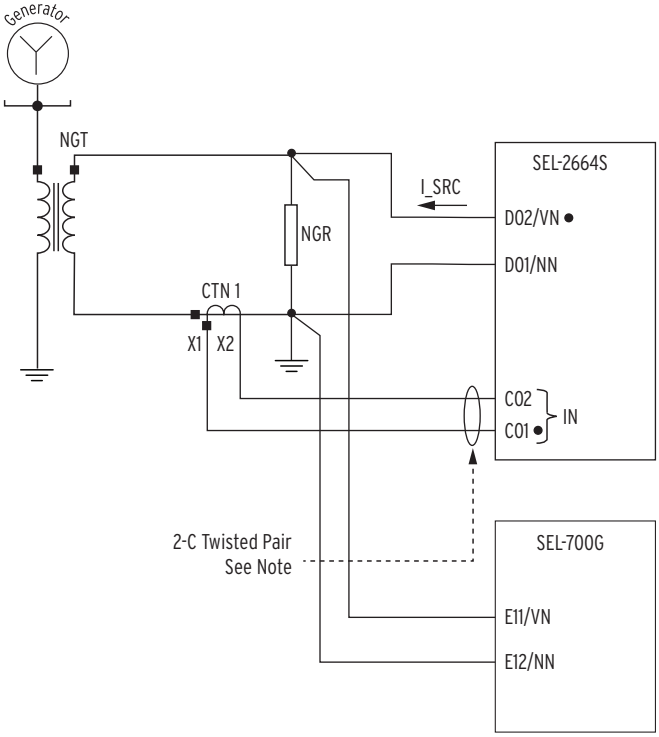
Figure 7 Basic AC Connections Using the NGR Tap

Figure 8 and *Figure 9* show ac connections for an SEL-2664S with the NGR on the secondary side of the neutral grounding transformer. The CTN can be located on either the secondary side as shown or the primary side in each configuration (e.g., as shown by the dotted lines in *Figure 8*) to suit specific applications.



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

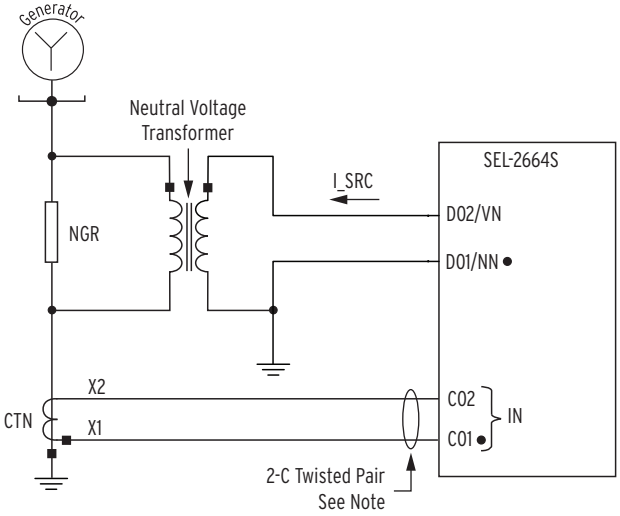
Figure 8 AC Connections With Neutral CT on the Secondary Side of the Neutral Grounding Transformer



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

Figure 9 AC Connections for the SEL-2664S and SEL-700G Relays With Neutral CTs on the Secondary Side of the Neutral Grounding Transformer

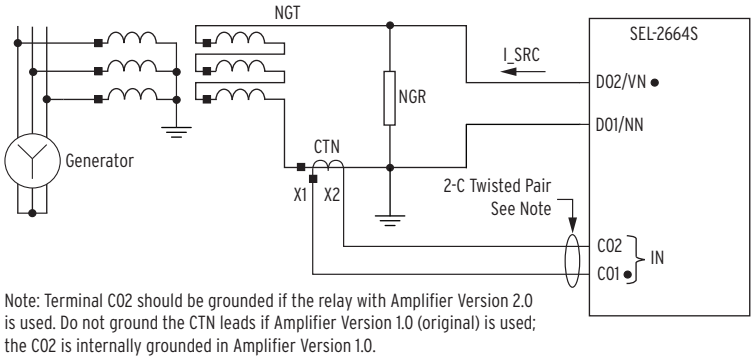
Figure 10 shows the ac connections for the SEL-2664S with a neutral voltage transformer and the NGR located directly on generator neutral.



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

Figure 10 AC Connections With Neutral CT on the Primary Side and Neutral Voltage Transformer

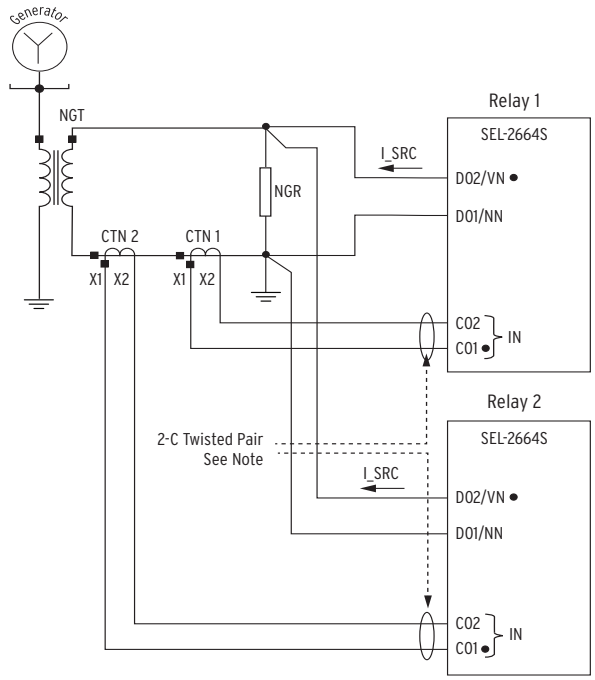
Figure 11 shows the ac connections with NGR in the secondary side of a wye-broken delta grounding transformer on the generator terminals.



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

Figure 11 AC Connections With NGR in the Secondary Side of a Wye-Broken Delta Grounding Transformer on the Generator Terminals

Figure 12 shows the typical ac connections for protection using redundant relays shown with neutral CTs and the NGR on the secondary side of the neutral grounding transformer. MODE_SRC = P_LOGIC allows an elaborate scheme that maximizes the use of all four injection frequencies in a redundant configuration.



Note: Terminal CO2 should be grounded if the relay with Amplifier Version 2.0 is used. Do not ground the CTN leads if Amplifier Version 1.0 (original) is used; the CO2 is internally grounded in Amplifier Version 1.0.

Figure 12 AC Connections for Protection Using Redundant Relays Shown With Neutral CBCTs on the Secondary Side of the Neutral Grounding Transformer

The SEL-2664S is generally applied to single generators with high-resistance grounded neutral as shown in *Figure 8* through *Figure 12*. Similarly, it can also be applied to a parallel generators configuration if only one of the generators is grounded (e.g., cross-compound generators).

For two generators connected in parallel, each with a high-resistance grounded neutral but sharing a common step-up transformer, the SEL-2664S cannot be used.

See *Figure 13* for a typical example of the dc connections for 100 percent stator ground protection using the SEL-2664S Stator Ground Protection Relay (stator-to-ground insulation resistance measurement) and the SEL-2664 Field Ground Module (dc field-to-ground insulation resistance measurement).

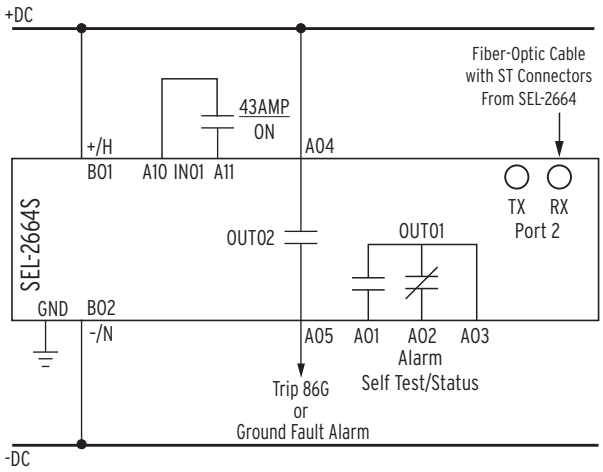


Figure 13 Typical DC Connections for an SEL-2664S Application

Relay Mounting and Dimensions

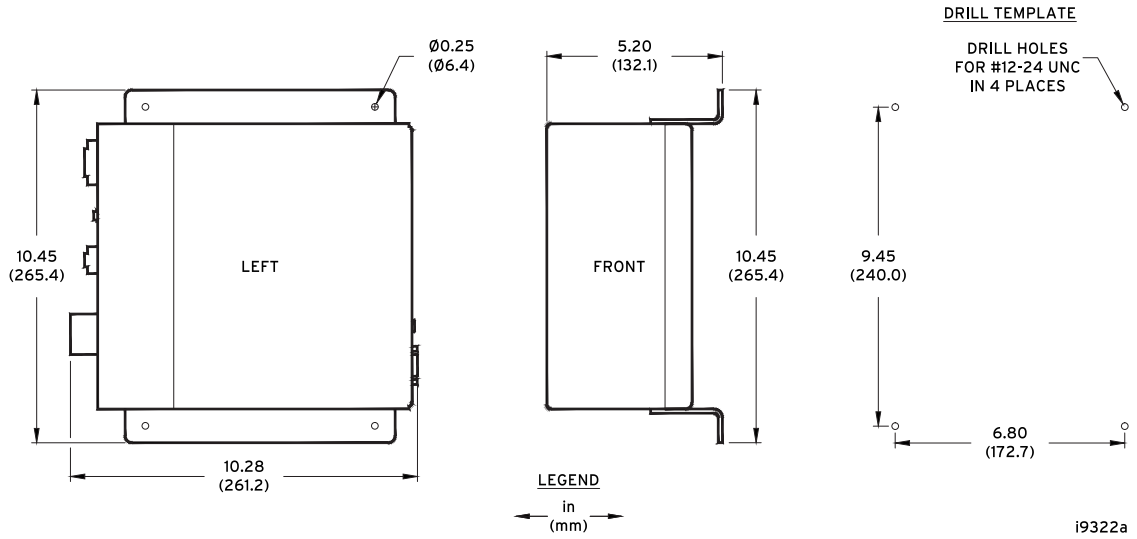


Figure 14 SEL-2664S Wall-Mount Dimensions

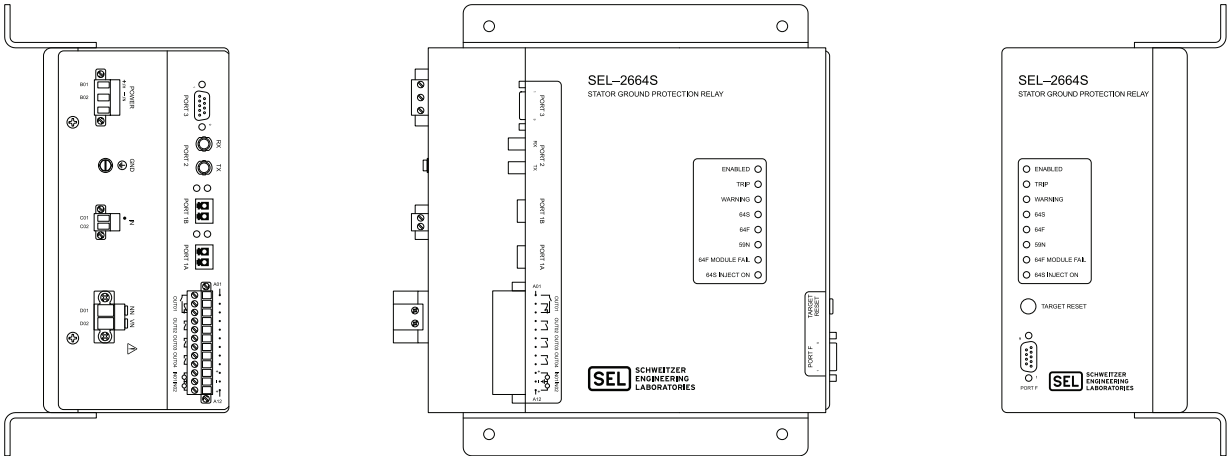


Figure 15 SEL-2664S Connection Diagram for Wall-Mount Option

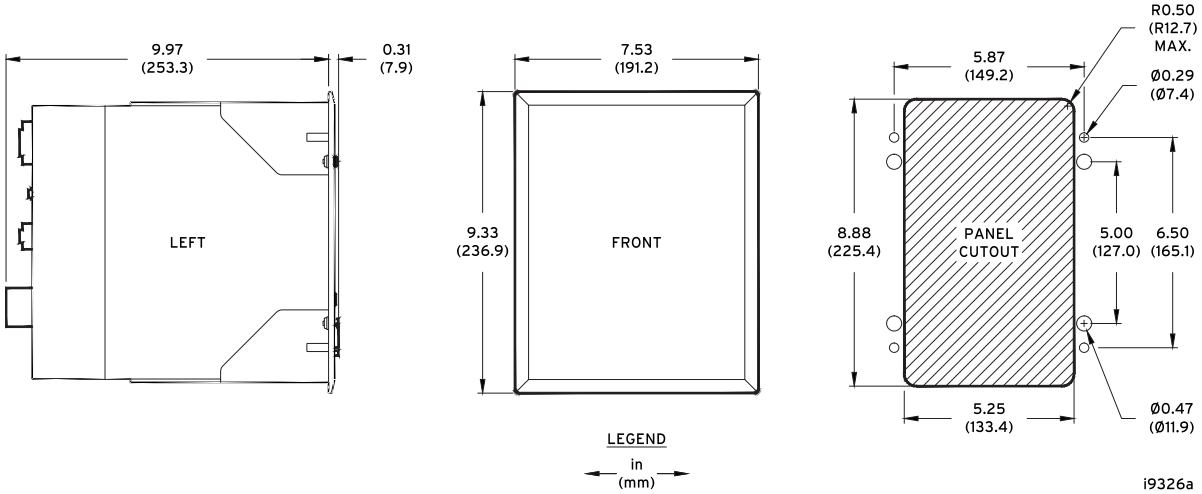


Figure 16 SEL-2664S Panel-Mount Dimensions

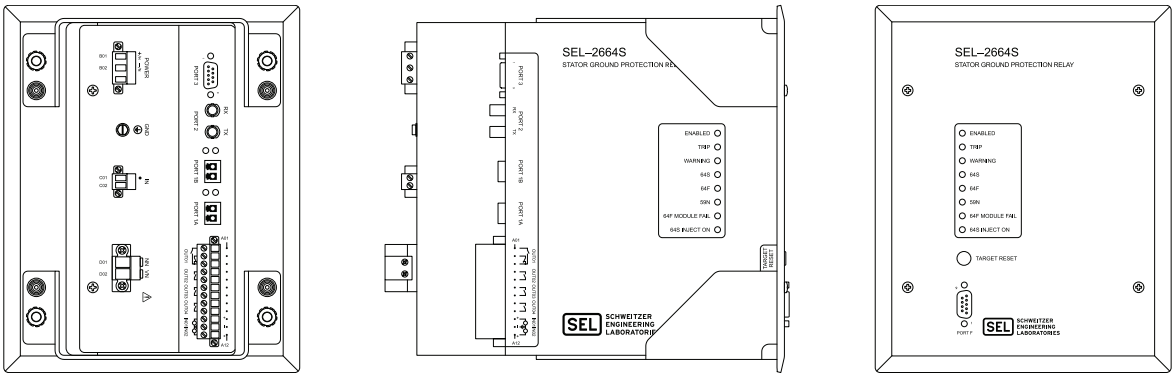


Figure 17 SEL-2664S Connection Diagram for Rack and Panel-Mount Options

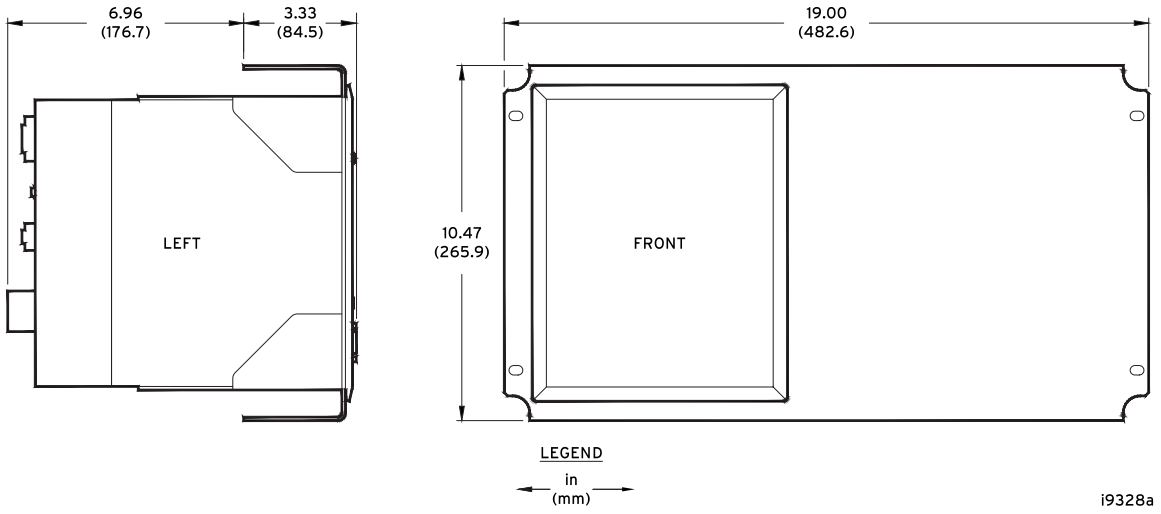


Figure 18 SEL-2664S Rack-Mount Dimensions

Relay Features and Connections

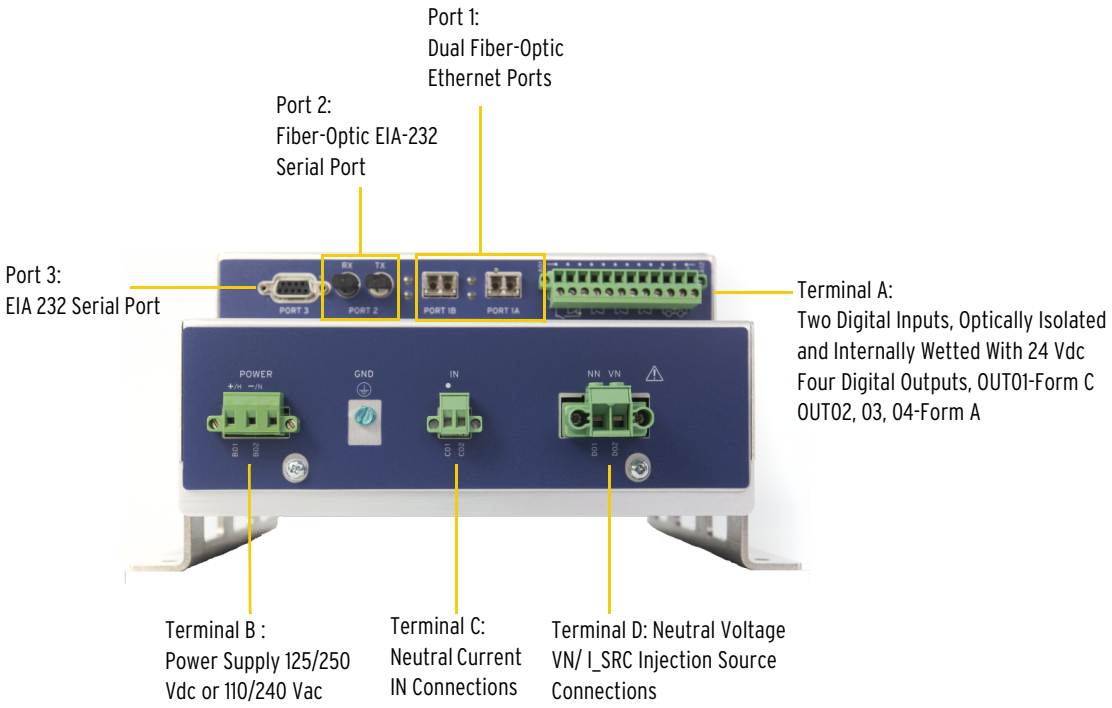


Figure 19 SEL-2664S Front and Side Faceplates

Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

47 CFR 15B, Class A

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 Listed to U.S. and Canadian safety standards (File E212775; NRGU; NRGU7)

CE Mark

RCM Mark

General

NOTE: The CBCT Current (IN), Neutral Voltage (VN), and Injection Source (I_SRC) specifications are dependent on the amplifier version (1.0 or 2.0).

CBCT Current Input (IN)

Nominal Input Current:	5 mA ac rms
Continuous Thermal Rating:	1 A
Measurement Clipping Level:	100 mA peak (Amplifier Version 2.0 when CTN_LOC = SEC) 12 mA peak (Amplifier Version 2.0 when CTN_LOC = PRIM) >22 mA peak (Amplifier Version 1.0 [original])
One-Second Thermal Rating:	10 A
Burden Rating:	4 Ω (Amplifier Version 2.0) 10 Ω (Amplifier Version 1.0 [original])
Rated Insulation Voltage (U_i):	300 Vac (IN inputs are galvanically connected to VN terminals in Amplifier Version 1.0; inputs are isolated in Amplifier Version 2.0)

Neutral Voltage Input (VN)

Rated Operating Voltage (U_e):	2.5–240 Vac
Rated Insulation Voltage (U_i):	300 Vac
Maximum Continuous Overvoltage Rating:	275 Vac

Injection Source (I_SRC)

Source Rating:	50 VA continuous
Nominal Injected Current Amplitude:	0.5–5.0 A rms
Continuous Thermal Rating:	5 A rms 0.5–2.5 A rms @ 85°C 2.5–5.0 A rms @ 70°C
Amplifier Clipping Level:	>±74 V peak (Amplifier Version 2.0) >±20 V peak (Amplifier Version 1.0 [original])

Four Frequency Multisine Injection

For 60 Hz nominal:	18, 24, 36, and 48 Hz
For 50 Hz nominal:	15, 20, 30, and 40 Hz
Maximum Open Terminal Voltage:	80 V peak (Amplifier Version 2.0) 26 V peak (Amplifier Version 1.0 [original])
Protection:	Self-protecting

Power Supply

Relay Start-Up Time:	Approximately 5–10 seconds (after power is applied until the **ENABLED** LED turns on)

High-Voltage Supply

Rated Supply Voltage:	110–250 Vdc 110–240 Vac, 50/60 Hz (Version 2.0)
Input Voltage Range:	85–300 Vdc 85–264 Vac
Power Consumption:	<120 W (dc) <120 VA (ac)
Interruptions:	10 ms @ 125 Vdc 10 ms @ 120 Vac

Fuse Ratings

HV Power Supply Fuse

Rating:	1.6 A
Maximum Rated Voltage:	300 Vdc, 277 Vac
Breaking Capacity:	200 A at 250 Vac
Type:	Time-lag T

Output Contacts

General

The relay supports Form A and Form C outputs.

Dielectric Test Voltages:	2500 Vac
Impulse Withstand Voltage (U_{IMP}):	5000 V
Mechanical Durability:	100,000 no-load operations

Standard Contacts

Pickup/Dropout Time:	≤8 ms (coil energization to contact closure)
Rated Insulation Voltage:	300 Vdc
Make:	30 A @ 250 Vdc per IEEE C37.90
Continuous Carry:	6 A @ 70°C 4 A @ 85°C
Thermal:	50 A for 1 s
Contact Protection:	360 Vdc, 80 J MOV protection across open contacts

Breaking Capacity (10,000 Operations) per IEC 60255-0-20:1974:

24 Vdc	0.75 A	L/R = 40 ms
48 Vdc	0.50 A	L/R = 40 ms
125 Vdc	0.30 A	L/R = 40 ms
250 Vdc	0.20 A	L/R = 40 ms

Cyclic (2.5 Cycles/Second) per IEC 60255-0-20:1974:

24 Vdc	0.75 A	L/R = 40 ms
48 Vdc	0.50 A	L/R = 40 ms
125 Vdc	0.30 A	L/R = 40 ms
250 Vdc	0.20 A	L/R = 40 ms

AC Output Ratings

Maximum Operational Voltage (U_e) Rating:	240 Vac
Insulation Voltage (U_i) Rating (excluding EN 61010-1):	300 Vac

Contact Rating Designation: B300

B300 (5 A Thermal Current, 300 Vac Max)			
	Maximum Current		Max VA
Voltage	120 Vac	240 Vac	—
Make	30 A	15 A	3600
Break	3 A	1.5 A	360
PF < 0.35, 50–60 Hz			

Utilization Category: AC-15
One-Second Thermal: 50 A

AC-15		
Operational Voltage (Ue)	120 Vac	240 Vac
Operational Current (Ie)	3 A	1.5 A
Make Current	30 A	15 A
Break Current	3 A	1.5 A
Electromagnetic loads > 72 VA, PF < 0.3, 50–60 Hz		

Voltage Protection Across Open Contacts: 270 Vac, 80 J

Optoisolated Control Inputs (Internally Wetted to 24 Vdc)

Current Draw at Nominal DC Voltage: 4 mA typical
Rated Insulation Voltage (U_i): 300 Vac
Rated Impulse Withstand Voltage (U_{imp}): 5000 V
Pickup/Dropout Time: <20 ms

Time-Code Input

Format: Demodulated IRIG-B
On (1) State: Vih ≥ 2.2 V
Off (0) State: Vil ≤ 0.8 V
Input Impedance: 2 kΩ
Synchronization Accuracy Internal Clock: ±1 µs
All Reports: ±5 ms
Simple Network Time Protocol (SNTP) Accuracy Internal Clock: ±5 ms
Unsynchronized Clock Drift Relay Powered: 2 minutes per year, typically

Communications Ports

Standard EIA-232 (2 Ports)
Location: Front Panel, Rear Panel
Data Speed: 300–38400 bps

Ethernet Port
Dual 100BASE-FX (LC connector)

Standard Multimode Fiber-Optic Serial Port
Location: Rear Panel
Data Speed: 300–38400 bps

Fiber-Optic Ports Characteristics

Port 1 (or 1A, 1B) Ethernet
Wavelength: 1300 nm
Optical Connector Type: LC
Fiber Type: Multimode
Link Budget: 16.1 dB
Typical TX Power: –15.7 dBm
RX Min. Sensitivity: –31.8 dBm
Fiber Size: 62.5/125 µm
Approximate Range: ~6.4 km
Data Rate: 100 Mbps
Typical Fiber Attenuation: –2 dB/km

Port 2 Serial
Wavelength: 820 nm
Optical Connector Type: ST
Fiber Type: Multimode
Link Budget: 8 dB
Typical TX Power: –16 dBm
RX Min. Sensitivity: –24 dBm
Fiber Size: 62.5/125 µm
Approximate Range: ~1 km
Data Rate: 5 Mbps
Typical Fiber Attenuation: –4 dB/km

Communications Protocols

SEL, Modbus, DNP3, FTP, TCP/IP, Telnet, SNTP, IEC 61850, MIRRORED BITS

Operating Temperature

IEC Performance Rating (per IEC/EN 60068-2-1 and 60068-2-2): –40° to +85°C (–40° to +185°F)
Not applicable to UL applications

Operating Environment

Insulation Class: 1
Pollution Degree: 2
Overvoltage Category: II
Atmospheric Pressure: 80–110 kPa
Relative Humidity: 5%–95%, noncondensing
Maximum Altitude Without Derating (Consult Factory for Higher Altitude Derating): 2000 m

Dimensions

Surface Mounting
Width: 26.12 cm (10.28 in) maximum
Depth: 13.21 cm (5.2 in) maximum (includes mounting brackets)
Height: 26.54 cm (10.45 in) maximum (includes mounting brackets)

Panel Mounting
Width: 19.12 cm (7.53 in) maximum
Depth: 26.11 cm (10.28 in) maximum
Height: 23.70 cm (9.33 in) maximum

Rack Mounting
Width: 48.26 cm (19 in) maximum
Depth: 26.11 cm (10.28 in) maximum
Height: 26.59 cm (10.47 in) maximum

Weight

Wall Mount: 4.02 kg (8.87 lbs)
Panel Mount: 4.69 kg (10.33 lbs)
Rack Mount: 7.96 kg (17.55 lbs)

#6 Ground Screw and #6 Chassis Screw Tightening Torque

Minimum: 1.13 Nm (10 in-lb)
Maximum: 1.36 Nm (12 in-lb)

#8 Chassis and Wall Mount Bracket Screw Tightening Torque

Minimum 1.24 Nm (11 in-lb)
Maximum: 1.47 Nm (13 in-lb)

#6 Captive Screw in Front Bezel, Screw Tightening Torque for Panel/ Rack Mount Options

Minimum: 1.13 Nm (10 in-lb)
Maximum: 1.36 Nm (12 in-lb)

1/4-20 Hex Nut Tightening Torque for Panel/ Rack Mount Options

Minimum: 5.08 Nm (45 in-lb)
Maximum: 6.21 Nm (55 in-lb)

Terminal Connections for Terminal Blocks A, B, and C

Compression Plug Tightening Torque

Minimum: 0.5 Nm (4.43 in-lb)
Maximum: 0.6 Nm (5.31 in-lb)

Compression Plug Mounting Ear Screw Tightening Torque

Minimum: 0.2 Nm (1.77 in-lb)
Maximum: 0.3 Nm (2.65 in-lb)

Terminal Connections for Terminal Block D

Compression Plug Tightening Torque

Minimum: 0.5 Nm (4.43 in-lb)
Maximum: 0.7 Nm (6.19 in-lb)

Compression Plug Mounting Ear Screw Tightening Torque

Minimum: 0.5 Nm (4.43 in-lb)
Maximum: 0.7 Nm (6.19 in-lb)

Wire Sizes

Use 105°C-rated wiring. Wire sizes for grounding (earthing) and power connections are dictated by the terminal blocks and expected load currents. Use the following table as a guide in selecting wire sizes.

Refer to *SEL Application Note AN2014-08* for wiring and termination guidance. Strip the wires 8 mm (0.31 in) for termination and installation.

	Wire Size	
Connection Type[a]	Minimum	Maximum
Grounding (Earthing)	18 AWG (0.8 mm^2)	14 AWG (2.1 mm^2)
Power	16 AWG (1.3 mm^2)	14 AWG (2.1 mm^2)
Current (IN)	18 AWG (0.8 mm^2)	14 AWG (2.1 mm^2)
Potential (Voltage) (VN)	12 AWG (3.3 mm^2)	10 AWG (6.0 mm^2)
Contact I/O	18 AWG (0.8 mm^2)	14 AWG (2.1 mm^2)

[a] For all connection types, the insulation voltage must be 300 V minimum.

Product Standards

Measuring Relays and Protection Equipment: IEC 60255-26:2013
IEC 60255-27:2013

Type Tests

Environmental Tests

Enclosure Protection: IEC 60529:2001 + CRDG:2003
IP20 for terminals

Vibration Resistance: IEC 60255-21-1:1998
IEC 60255-27:2013; Section 10.6.2.1

Endurance: Class 1 (Class 2 for wall mount only)

Response: Class 2

Shock Resistance: IEC 60255-21-2:1998
IEC 60255-27:2013; Section 10.6.2.2
IEC 60255-27:2013; Section 10.6.2.3

Withstand: Class 1
Response: Class 2
Bump: Class 1

Seismic (Quake Response): IEC 60255-21-3:1993
IEC 60255-27:2013; Section 10.6.2.4

Response: Class 2

Cold: IEC 60068-2-1:2007
IEC 60255-27:2013; Section 10.6.1.2
IEC 60255-27:2013; Section 10.6.1.4
–40°C, 16 hours

Dry Heat: IEC 60068-2-2:2007
IEC 60255-27:2013; Section 10.6.1.1
IEC 60255-27:2013; Section 10.6.1.3
85°C, 16 hours

Damp Heat, Steady State: IEC 60068-2-78:2001
IEC 60255-27:2013; Section 10.6.1.5
40°C, 93% relative humidity, 10 days

Damp Heat, Cyclic: IEC 60068-2-30:2001
IEC 60255-27:2013; Section 10.6.1.6
25–55°C, 6 cycles, 95% relative humidity

Dielectric Strength and Impulse Tests

Dielectric (HiPot): IEC 60255-27:2013; Section 10.6.4.3
IEEE C37.90-2005
2.5 kVac on contact outputs
3.6 kVdc on power supply IN, VN, contact input terminals

Impulse: IEC 60255-27:2013; Section 10.6.4.2
Severity Level: 0.5 J, 5 kV
IEEE C37.90:2005
Severity Level: 0.5 J, 5 kV

RFI and Interference Tests

EMC Immunity

Electrostatic Discharge Immunity: IEC 61000-4-2:2008
IEC 60255-26:2013; Section 7.2.3
IEEE C37.90.3:2001
Severity Level 4
8 kV contact discharge
15 kV air discharge

Radiated RF Immunity: IEC 61000-4-3:2010
IEC 60255-26:2013; Section 7.2.4
10 V/m
IEEE C37.90.2-2004
20 V/m

Fast Transient, Burst Immunity*: IEC 61000-4-4:2012
IEC 60255-26:2013; Section 7.2.5
4 kV @ 5.0 kHz
2 kV @ 5.0 kHz for comm. ports

Surge Immunity*: IEC 61000-4-5:2005
IEC 60255-26:2013; Section 7.2.7
1 kV line-to-line
2 kV line-to-earth

Surge Withstand Capability Immunity*: IEC 61000-4-18:2010
IEC 60255-26:2013; Section 7.2.6
2.5 kV common mode
1 kV differential mode
1 kV common mode on comm. ports
IEEE C37.90.1-2002
2.5 kV oscillatory
4 kV fast transient

Conducted RF Immunity: IEC 61000-4-6:2008
IEC 60255-26:2013; Section 7.2.8
10 Vrms

Magnetic Field Immunity: IEC 61000-4-8:2009
IEC 60225-26:2013; Section 7.2.10
Severity Level: 1000 A/m for 3 seconds
100 A/m for 1 minute; 50/60 Hz
IEC 61000-4-9:2001
Severity Level: 1000 A/m
IEC 61000-4-10:2001
Severity Level: 100 A/m (100 kHz and 1 MHz)

Power Supply Immunity:	IEC 61000-4-11:2004 IEC 61000-4-17:1999 IEC 61000-4-29:2000 IEC 60255-26:2013; Section 7.2.11 IEC 60255-26:2013; Section 7.2.12 IEC 60255-26:2013; Section 7.2.13

EMC Emissions

Conducted Emissions:	IEC 60255-26:2013 Class A FCC 47 CFR Part 15.107 Class A ICES-003 Issue 6 EN 55011:2009 + A1:2010 Class A EN 55022:2010 + AC:2011 Class A EN 55032:2012 + AC:2013 Class A CISPR 11:2009 + A1:2010 Class A CISPR 22:2008 Class A CISPR 32:2015 Class A
Radiated Emissions:	IEC 60255-26:2013 Class A FCC 47 CFR Part 15.109 Class A ICES-003 Issue 6 EN 55011:2009 + A1:2010 Class A EN 55022:2010 + AC:2011 Class A EN 55032:2012 + AC:2013 Class A CISPR 11:2009 + A1:2010 Class A CISPR 22:2008 Class A CISPR 32:2015 Class A

* Front-port serial cable (non-fiber) lengths assumed to be <3m.

Processing Specifications and Oscillography

AC Voltage and Current Inputs:	32 samples per power system cycle (based on FNOM)
Digital Filtering:	Fundamental, third-harmonic, and rms quantities are updated every 1/4 cycle in accordance with nominal frequency setting FNOM. Insulation resistance, insulation capacitance, and the NGR measurements are updated every 20 cycles.
Protection and Control Processing:	Processing interval is 4 times per power system cycle (except for math variables and analog quantities, which are processed every 25 ms).

Oscillography

Length:	180 cycles
Sampling Rate:	32 samples per cycle, unfiltered
Trigger:	Programmable with Boolean expression
Format:	Compressed ASCII
Time-Stamp Resolution:	1 ms
Time-Stamp Accuracy:	±5 ms

Sequential Events Recorder

Time-Stamp Resolution:	1 ms
Time-Stamp Accuracy (with respect to time source):	±5 ms

Relay Elements

Stator Ground (64S)

Pickup Range:	OFF, 0.1 kΩ–10 kΩ primary*
Pickup/Measurement Accuracy, Steady State:	±10% of pickup ±50 Ω for pickup ≤2 kΩ ±15% pickup for 2 kΩ < pickup ≤10 kΩ (NGR reflected on the primary side is between 500–6000 Ω)
Time Delay Range:	0.1–400.0 seconds
Time Delay Accuracy:	±0.1% of user setting, ±4.2 ms at 60 Hz

* Metering for stator insulation resistance to ground is supported as high as 99 kΩ. Values higher than 10kΩ are used for indication only and are not suitable for stator ground resistance trending purposes.

Neutral Grounding Resistor (NGR) Monitor

NGR Short Pickup Range:	OFF, 0.01 Ω–4000 Ω
NGR Open Pickup Range:	OFF, 0.1 Ω–4000 Ω
Pickup Accuracy:	±10% of user setting plus ±0.01 Ω *

* Accuracy specification applies when no stator insulation fault is present.

Neutral Fundamental Overvoltage (59N)*

Pickup Range:	OFF, 2.5–150.0 V
Pickup Accuracy:	±5% of user setting plus ±1 V
Time Delay Range:	0.1–400.0 seconds
Time Delay Accuracy:	±0.1% of user setting plus ±4.2 ms at 60 Hz

* The SEL-2664S uses the nominal frequency (setting FNOM) for the fundamental. The terms fundamental and nominal are used interchangeably when referring to frequency in this manual.

Neutral RMS Overvoltage (59NRMS)

Pickup Range:	OFF, 2.5–150.0 V
Pickup Accuracy:	±5% of user setting plus ±1 V
Time Delay Range:	0.1–400.0 seconds
Time Delay Accuracy:	±0.1% of user setting plus ±4.2 ms at 60 Hz

Rotor Field Ground Protection (64F)

(Optional—Requires SEL-2664 Field Ground Module)

Pickup Range:	OFF, 0.5 kΩ–200 kΩ *
Pickup Accuracy, Steady State:	±5% ±500 Ω for 48 ≤ field voltage ≤ 825 Vdc ±5% ±20 kΩ for 825 ≤ field voltage ≤ 1500 Vdc
Pickup Time:	≤2 s if the injection frequency in the SEL-2664 is selected at 1 Hz ≤8 s if the injection frequency in the SEL-2664 is selected at 0.25 Hz
Time Delay Range:	0.1–400.0 seconds
Time Delay Accuracy:	±0.5% ±5 ms

* Insulation resistance metering is supported as high as 20 MΩ; protection is supported as high as 200 kΩ.

Metering

Accuracies are specified at 20°C, nominal frequency, unless otherwise noted.

I_SRC (Injection Source Current) Magnitude Accuracy: ± 5% plus ± 0.05 mA

IN (Neutral Current) Magnitude Accuracy: ± 5% plus ± 0.05 mA

When Setting	Amplifier 1.0	Amplifier 2.0
CTN_LOC = SEC	1–16 mA rms	3–60 mA rms
CTN_LOC = PRIM	1–16 mA rms	0.5–8.0 mA rms

Stator Ground Insulation Resistance: ±10% of Rf ±50 Ω for Rf ≤ 2 kΩ *
±15% of Rf for 2 kΩ < Rf ≤ 10 kΩ *
(Rf = stator insulation resistance to ground)

Rotor Field Insulation Resistance: ±5% ±500 Ω. for 48 Vdc ≤ field voltage ≤ 825 Vdc
±5% ±20 kΩ. for 825 Vdc ≤ field voltage ≤ 1500 Vdc

VN (Neutral Voltage) (within 2.5–240 V secondary): ±5% plus ±1 V

* Typical. Measurement accuracy is affected by installation-specific factors such as NGR location, parallel generator configuration, injection transformer heating, accurate knowledge of the NGR tap ratio, etc. The highest value displayed is 99.99 kΩ. Measurement accuracy improves at lower insulation resistances.

SEL-4664 Calibration Module

Compliance

Product Safety:
UL 61010-1 2019
CSA C22.2 61010-1 2018
IEC 61010-1 2019
UL 61010-2-201 2018
CSA C22.2 61010-2-201 2018
IEC 61010-2-201 2017

EMC Requirements:
UL 61326-1 2013
IEC 61326-1 2012

Environment

Environment Conditions: Indoor only
Altitude: 2000 m
Humidity: 80%
Temperature: 0°–40°C
Overvoltage Category: II

Misc.

Input Voltage: 0–84 V
Input Current: 0–2.5 A
Fuse Rating: Fast blow 3 A 240 V
Power Supply: Use 9 V alkaline battery

Notes

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