SEL-849
Install the SEL-849 Motor Management Relay in motor protection applications for current-, voltage-, and thermal-based protection, arc-flash detection, and power metering.

SEL-300G
Apply the SEL-300G Generator Relay for comprehensive primary and backup generator protection for large and small machines.

SEL-710-5
Protect a full range of medium-voltage, three-phase induction and synchronous motors using the SEL-710-5 Motor Protection Relay.

SEL-700G
Install the SEL-700G Generator Protection Relay for utility and industrial generator protection. It offers an autosynchronizer, flexible I/O, and advanced communications.

SEL-2664S
Protect high-impedance grounded generators from ground faults at standstill, during startup, and while running with the SEL-2664S Stator Ground Protection Relay.

SEL-2664
Add the SEL-2664 Field Ground Module to the SEL-300G or SEL-700G to protect critical generator components. Or, add it to the SEL-2664S to protect rotor and stator windings from ground faults.

SEL-749M
Protect low- and medium-voltage induction and synchronous motors. The reliable and economical SEL-749M Motor Relay also protects three-phase motors, including two-speed and reduced-voltage start motors.

SEL-2600
Measure and transmit data from up to 12 resistance temperature detector (RTD) inputs and one contact input over a single fiber-optic link with the SEL-2600 RTD Module.
# Generators and Motors Protection

## Applications

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</tbody>
</table>

## Protection

- 21P Phase Mho or Compensator Distance
- 24 Overexcitation (Volts/Hertz)
- 27/59 Under-/Overvoltage
- 27I Inverse-Time Undervoltage
- 32 Directional Power
- 37 Underpower
- 40 Loss-of-Field
- 46 Current Unbalance
- 47 Phase Reversal
- 49 Thermal
- 49R Thermal Overload (Resistance Temperature Detector [RTD])
- 50 (P,N,Q) Overcurrent (Phase, Neutral, Negative Sequence)
- 50Q Negative-Sequence Overcurrent
- 51 (N,G) Time-Overcurrent (Neutral, Ground)
- 51 (P,Q) Time-Overcurrent (Phase, Negative Sequence)
- 55 Power Factor
- 60 Loss-of-Potential
- 64G 100 Percent Stator Ground
- 64F Field Ground
- 64S Injection-Based 100 Percent Stator Ground
- 67 (N,G) Directional Overcurrent (Neutral, Ground)
- 78 Out-of-Step
- 81 Over-/Underfrequency
- 87 Current Differential
- 87G Restricted Earth Fault
- Arc-Flash Detection
- Separate Neutral Overcurrent
- Broken Rotor Bar Detection

## Instrumentation and Control

- Multiple Settings Groups
- Breaker Wear Monitor
- Demand Meter
- Load Profile Report
- RTD Inputs
- Ethernet
- IEC 61850
- IEC 61850 Edition 2
- IEC 60870-5-103; Parallel Redundancy Protocol (PRP)
- DNP3 LAN/WAN
- Simple Network Time Protocol (SNTP)
- Modbus* TCP
- Modbus RTU Outstation
- Synchrophasors With IEEE C37.118 Protocol
- Mirrored Bits* Communications

* Standard feature  
+ Model option  
† May be created using settings
GENERATOR AND MOTOR PROTECTION APPLICATIONS

**GENERATOR PROTECTION**
Numerous current, voltage, frequency, distance, power, and out-of-step elements in SEL generator protection relays provide comprehensive protection for large, medium, and small generators.

**UNIT PROTECTION**
Apply sensitive percentage-restrained current differential elements and an unrestrained element, along with synchronism check and volts-per-hertz elements, to protect both the generator and the step-up transformer. Harmonic-blocking elements protect the unit transformer bushing and end windings while maintaining security for inrush and through-fault conditions.

**STATOR/FIELD GROUND PROTECTION**
With SEL generator relays, adding the neutral voltage connection provides 100 percent stator ground protection for most machines, based on third-harmonic voltage measurements. Connecting the neutral current input provides protection for solidly grounded or resistance-grounded machines. State-of-the-art voltage injection allows you to monitor field ground resistance.

**INJECTION-BASED STATOR GROUND PROTECTION**
Frequency injection takes advantage of the fact that a capacitive coupling exists between the stator winding and the ground. An injected signal passes through this higher impedance capacitive coupling to the ground. If a fault exists at any point in the stator winding, the injected signal will have a much lower impedance path to the ground. By monitoring the impedance to the ground using the injected signal, you can determine if a fault condition exists along the entire length of the winding. The SEL-2664S Stator Ground Protection Relay injects four frequencies to ensure that the machine is protected at all times, including during startup or overspeed conditions.
ADVANCED GENERATOR MONITORING AND REPORTING
With SEL software and generator relays, you can view autosynchronizer, Sequential Events Recorder (SER), and 180-cycle oscillographic event reports to analyze generator startup, shutdown, or system faults. You can also measure electrical, thermal, and generator run-time quantities. The breaker monitor function in the SEL-700G Generator Protection Relay lets you record accumulated breaker contact wear using manufacturer specifications for defining breaker operation limits. The relay’s circuit breaker monitor tracks the total number of close/open operations and interrupted current to determine the percent of contact wear.

AUTOMATIC SYNCHRONIZATION
SEL synchronizing systems measure the voltage and frequency of generator and utility systems, sending proportional correction pulses to adjust the governor and exciter as necessary and automatically close the breaker on synchronization. This process enables safe, secure, unattended synchronization of generation with the power system.

SYNCHRONIZED PHASOR MEASUREMENT
Combine the SEL-700G with an SEL IRIG-B time source to measure the system angle in real time with a timing accuracy of ±10 μs. You can measure instantaneous voltage and current phase angles in real time to improve system operation with synchrophasor information. With SEL-5078-2 SYNCHROVeW® Central Software, you can view system angles at multiple locations for precise system analysis and system-state measurement.
MOTOR PROTECTION
Protect a wide variety of low- and medium-voltage three-phase induction and synchronous motors using the SEL family of motor protection relays. Phase and neutral current elements feed accurate thermal models that track motor thermal characteristics during the stop/start/run cycles of the motor. One common application is a current-based protection scheme for across-the-line motor starting. Adding the voltage option to certain SEL motor relays enables the slip-dependent AccuTrack™ Thermal Model.

DIFFERENTIAL MOTOR PROTECTION
Use optional differential elements to protect the windings in high-value or critical-process motors.

ARC-FLASH MITIGATION
Arc-flash mitigation improves worker safety by reducing the incident energy of the arc flash. Supervised by phase overcurrent elements, SEL relays with arc-flash detection provide secure and fast arc-flash mitigation.

FLEXIBLE MOTOR STARTING
Take advantage of your SEL relay’s ability to control multiple contactors, and apply motor protection in configurations for two-speed motors, full-voltage reversing, and star-delta (reduced-voltage) starting. This diagram shows interlocking contactors for a two-speed start.
BROKEN ROTOR BAR DETECTION AND SPECTRAL ANALYSIS

Broken rotor bar detection is an important optional feature in the SEL-710-5 Motor Protection Relay. Fully loaded induction machines with broken rotor bars display unique frequency signatures as side-bands to the fundamental frequency. The magnitude of resulting side-band frequencies correlates to the number of broken rotor bars. The image shows a spectrum of a running motor with three broken rotor bars. The SEL-710-5 lets you catch rotor bar damage before it causes catastrophic damage to the motor.

SYNCHRONOUS MOTOR PROTECTION

Select the SEL-710-5 with the synchronous motor protection option to start and protect synchronous motors. With the SEL-710-5, you can monitor field voltage and current and effectively respond to loss-of-field, field resistance, out-of-step, power factor, and reactive power issues.

Shown here is a brush-type synchronous motor application where the field winding is connected to the relay through a voltage divider module.

CENTRALIZED MOTOR CONTROL

Create fully integrated motor control solutions with SEL motor relays, which include communications and protocol options that simplify device integration. This application shows SEL-849 Motor Management Relays in motor control center (MCC) buckets networked through an SEL-2730M Managed 24-Port Ethernet Switch. The relays share arc-flash detection data with the feeder relay using IEC 61850 GOOSE messaging.

For turnkey applications that require a smart integrated MCC, the SEL motormAX® Low-Voltage Motor Management and Protection System combines motor protection, network management, and real-time automation control. motormAX is a customizable motor management and control system that scales to fit any application. It delivers high-performance motor protection as well as high-speed reporting of motor status, alarms, and operating conditions at the HMI, allowing you to see the bigger picture.
**SEL-849**

**MOTOR MANAGEMENT RELAY**

**Starting Price**
- SEL-849: $699 USD
- SEL-3421: $180 USD
- SEL-3422: $120 USD

[selinc.com/products/849](http://selinc.com/products/849)

Select models typically ship in 2 days

The SEL-849 offers current-, voltage-, and thermal-based motor protection; arc-flash detection; and power metering for low- and medium-voltage industrial applications. It provides all basic motor protection features, including protection for short-circuit, load loss, load jam, frequent starting, unbalanced current, and phase reversal conditions. You can easily install the SEL-849 inside a motor control center (MCC) and add the optional SEL-3421 and SEL-3422 Motor Relay HMIs to the front of the MCC.

---

**ANSI NUMBERS/ACRONYMMS AND FUNCTIONS**

- 14  Speed Switch
- 27  Undervoltage*
- 32  Directional Power*
- 37 (C,P)  Undercurrent, Underpower*
- 46  Current Unbalance
- 47  Phase Reversal
- 49  Thermal Model
- 49P  PTC Overtemperature*
- 50G AF  Arc-Flash Residual Overcurrent
- 50N  Neutral Overcurrent
- 50P AF  Arc-Flash Phase Overcurrent
- 50 (P,G,Q)  Overcurrent (Phase, Ground, Negative Sequence)
- 50P LJ  Load Jam
- 50P LR  Locked-Rotor
- 51 (P,G,Q)  Time-Overcurrent (Phase, Residual, Negative Sequence)
- 51N  Neutral Time-Overcurrent
- 55  Power Factor*
- 59  Phase Overvoltage*
- 60  Loss-of-Potential*
- 66  Starts-Per-Hour
- 81 (O,U)  Over-/Underfrequency*
- 90  Load Control

**ADDITIONAL FUNCTIONS**

- AFD  Arc-Flash Detector
- CC  Conformal Coating*
- DFR  Event Reports—Motor Starts, Motor Operating Statistics, Sequential Events Recorder
- HMI  Operator Interface*
- LDP  Load Data Profiling
- LGC  SELoc® Control Equations
- MET  Metering—RMS Voltage and Current, Frequency, Power, Power Factor, Thermal, Thermal Capacity Used, Energy, Minimum/Maximum
- SER  Sequential Events Recorder
- VFD  Variable-Frequency Drive Support
- WEB  Web Server

*Optional feature
DETACHABLE DISPLAY MODULES*

- Large LCD display for navigation, relay control, and diagnostics
- Fundamental motor controls
- Two fixed and eight programmable tricolored LEDs
- Configurable label for programmable LEDs
- Simple HMI for status and control

Power supply options:
- 110/240 Vac, 110/250 Vdc, and 24/48 Vdc

Analog output and PTC (thermistor) input

Optical arc-flash sensor

Port for remote HMI with HMI power supply

EIA-232/EIA-485* or single or dual Ethernet port(s),* Modbus® RTU, Modbus TCP, and IEC 61850*

EIA-232 or EIA-485 serial port

Input for separate CBCT

Direct-connect voltage inputs* (up to 690 Vac)

Window-type CTs, 0.5–256 A range

DIN rail or surface mount

GENERATOR AND MOTOR PROTECTION
A single SEL-710-5 can protect asynchronous (induction) and synchronous motors. Features include broken rotor bar detection and variable-frequency drive (VFD) support as well as options for arc-flash detection (AFD), differential protection, and synchronous motor protection. The synchronous option supports power factor regulation and includes, at no additional cost, a voltage divider accessory to interface with the motor excitation system. Together with the SEL AccuTrack™ Thermal Model, these features provide a solution for all your motor protection applications.

**ANSI NUMBERS/ACRONYMS AND FUNCTIONS**

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<tr>
<th>ANSI Number/Function</th>
<th>Description</th>
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<td>50P AF</td>
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<td>50P LJ</td>
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<td>50N</td>
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<td>55</td>
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<td>87</td>
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<td>90 (P,I,T)</td>
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**ADDITIONAL FUNCTIONS**

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<td>LGC</td>
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<tr>
<td>VFD</td>
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</table>

*Optional feature  
C Copper or fiber-optic  
*Mutually exclusive optional features
Optional optical point sensor for AFD. Bare-fiber optical sensors are also available.

Power supply options include 24/48 Vdc, 110/250 Vdc, and 110/230 Vac.

Optional Ethernet, Modbus® TCP, DNP3, or IEC 61850 Edition 2 provides flexibility for communication with other devices and control systems.

Dual Modbus TCP session capability reduces the number of connections needed and improves port efficiency.

Folders and applications provide quick access to bay screens, metering and monitoring data, reports, settings, and more.

Programmable operator pushbuttons with user-configurable labels allow front-panel customization.

Programmable front-panel LEDs with user-configurable labels alert operators to faulted phases, the relay’s status, and element operation.

The 5-inch, 800 x 480 display offers direct navigation via a capacitive touchscreen.

Port options include demodulated IRIG-B for precise-time input or a PTC input to protect against overcurrent conditions.

Mirrored bits communications provides fast and reliable relay-to-relay communication.

Card slots include positions for optional I/O, arc-flash detection, or synchronous motor inputs/differential current inputs.

CT and PT inputs are located on one card, allowing for more I/O in other slots.

Optional optical point sensor for AFD. Bare-fiber optical sensors are also available.
SEL-700G
GENERATOR PROTECTION RELAY

Starting Price
$2,500 USD

The SEL-700G provides comprehensive primary and backup generator protection. With an autosynchronizer, flexible I/O, and advanced communications, it is the right solution for utility and industrial generator protection.

Model Comparison Table
You can customize the SEL-700G for specific applications by selecting preconfigured model options.

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<td>SEL-700GI</td>
<td>Full generator protection</td>
</tr>
<tr>
<td>SEL-700GI+</td>
<td>Full generator protection</td>
</tr>
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</table>

ANSI NUMBERS/ACRONYMS AND FUNCTIONS

- **21C/SIVC**: Compensator Distance, Voltage Righted/Controlled Time-Overcurrent
- **24**: Volts/Hertz
- **25G**: Synchronism Check
- **27**: Undervoltage
- **27I**: Inverse-Time Undervoltage
- **27S**: Synchronism Undervoltage
- **32**: Directional Power
- **40**: Loss-of-Field
- **46**: Current Unbalance
- **49R**: Thermal Overload (Resistance Temperature Detector [RTD])
- **49T**: Thermal Model
- **50**: Neutral Overcurrent
- **50 (P,G,Q)**: Overcurrent (Phase, Ground, Negative Sequence)
- **51 (P,G,Q)**: Time-Overcurrent (Phase, Ground, Negative Sequence)
- **51N**: Neutral Time Overcurrent
- **59**: Synchronism Overvoltage
- **59N**: Neutral Overvoltage
- **59S**: Synchronism Overvoltage
- **59 (P,G,Q)**: Overvoltage (Phase, Ground, Negative Sequence)
- **60**: Loss-of-Potential
- **64F**: Field Ground
- **64G**: 100% Stator Ground
- **67 (P,G,Q)**: Directional Overcurrent (Phase, Ground, Negative Sequence)
- **67N**: Neutral Current Differential
- **67**: Directional Neutral Overcurrent
- **78**: Out-of-Step
- **78VS**: Vector Shift
- **81 (O,U,R)**: Frequency (Over, Under, Rate)
- **87**: Three-Phase Current Differential
- **87N**: Neutral Current Differential
- **REF**: Restricted Earth Fault

ADDITIONAL FUNCTIONS

- **52PB**: Pushbutton Trip/Close
- **85 RIO**: SEL MirrorD BitS Communications
- **BF**: Breaker Failure
- **BRM**: Breaker Wear Monitor
- **DFR**: Event Reports
- **ENV**: SEL-2600
- **HMI**: Operator Interface
- **LDP**: Load Data Profiling
- **LGC**: SELiXt Control Equations
- **MET**: High-Accuracy Metering
- **PMU**: Synchrophasors
- **RTU**: Remote Terminal Unit
- **SER**: Sequential Events Recorder

Copper or fiber-optic *Optional feature
The 5-inch, 800 × 480 display offers direct navigation via a capacitive touchscreen.

Folders and applications provide quick access to bay screens, metering and monitoring data, reports, settings, and more.

Programmable operator pushbuttons with user-configurable labels allow front-panel customization.

Options for Ethernet, Modbus® TCP, DNP3, or IEC 61850 Edition 2 provide flexibility for communication with other devices and control systems.

Port options include demodulated IRIG-B for precise-time input and EIA-232 or EIA-485 serial for fast integration into applications.

Programmed front-panel LEDs with user-configurable labels alert operators to faulted phases, the relay’s status, and element operation.

Optional RTD inputs.

Power supply options include 24/48 Vdc, 110/250 Vdc, or 110/240 Vac.

Options for Ethernet, Modbus® TCP, DNP3, or IEC 61850 Edition 2 provide flexibility for communication with other devices and control systems.

Positions for optional expansion cards.

CT and PT inputs are located on one card, allowing for more I/O in other slots.
The SEL-300G provides proven primary and backup protection for utility and industrial generators, meeting IEEE turbine protection standards. High-speed protection for all types of phase and ground faults limits equipment damage and speeds up repairs. Current and voltage elements protect large and small generators against faults, and optional differential protection provides sensitive and fast protection for generators and unit transformers. In addition, harmonic blocking improves security when transformers are in the generator differential zone. The SEL-300G provides 100 percent stator ground fault protection, using fundamental and third-harmonic voltage signals to protect high-impedance grounded generators. Adding the SEL-2664 Field Ground Module lets you detect field ground faults whether the generator is operating, stopped, or de-energized.

**ANSI NUMBERS/ACRONYMS AND FUNCTIONS**

<table>
<thead>
<tr>
<th>ANSI Number</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21PC/51VC</td>
<td>Phase Mho or Compensator Distance Voltage</td>
</tr>
<tr>
<td>24</td>
<td>Volts/Hertz</td>
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<td>25</td>
<td>Synchronism Check*</td>
</tr>
<tr>
<td>27</td>
<td>Undervoltage</td>
</tr>
<tr>
<td>32</td>
<td>Directional Power</td>
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<tr>
<td>40</td>
<td>Loss-of-Field</td>
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<tr>
<td>46</td>
<td>Negative-Sequence Overcurrent</td>
</tr>
<tr>
<td>49</td>
<td>Thermal Overload</td>
</tr>
<tr>
<td>50N</td>
<td>Neutral Overcurrent</td>
</tr>
<tr>
<td>50 (P,G,Q)</td>
<td>Overcurrent (Phase, Ground, Negative Sequence)*</td>
</tr>
<tr>
<td>51G</td>
<td>Ground Time Overcurrent</td>
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<tr>
<td>51N</td>
<td>Neutral Time Overcurrent</td>
</tr>
<tr>
<td>59N</td>
<td>Neutral Overvoltage</td>
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<tr>
<td>59 (P,G,Q)</td>
<td>Overvoltage (Phase, Ground, Negative Sequence)</td>
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<tr>
<td>60</td>
<td>Loss-of-Potential</td>
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<tr>
<td>64F</td>
<td>Field Ground</td>
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<td>64G</td>
<td>100 Percent Stator Ground</td>
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<td>78</td>
<td>Out-of-Step</td>
</tr>
<tr>
<td>81 (O,U)</td>
<td>Over-/Underfrequency</td>
</tr>
<tr>
<td>87</td>
<td>Three-Phase Current Differential*</td>
</tr>
<tr>
<td>87N</td>
<td>Neutral Current Differential</td>
</tr>
</tbody>
</table>

*Optional feature  †Available in models that do not specify 87 element.
The SEL-749M provides comprehensive motor protection and SEL-exclusive reporting and trending that save you money in your industrial motor plant and processes. The SEL-749M uses the latest enhancements in the SEL-patented thermal overload model to accurately track the heating effects of operating and cyclic overload currents. The relay offers all basic motor protection features, including short-circuit, load loss, load jam, and frequent-starting protection as well as unbalance current and phase reversal protection. Optional voltage, I/O, and communications capabilities let you select a solution that is just right for your application.
SEL-2664/2664S
FIELD GROUND MODULE/
STATOR GROUND PROTECTION RELAY

Starting Price
SEL-2664: $1,500 USD
SEL-2664S: $9,000 USD

The SEL-2664 integrates with the SEL-300G Generator Relay or the SEL-700G Generator Protection Relay to protect all the critical components in your generator with one comprehensive relay. Or, you can add the SEL-2664 to the SEL-2664S for complete ground fault protection on both the rotor and stator.

In the SEL-2664S, multisine frequency injection and neutral overvoltage-based protection let you protect high-impedance grounded generators from ground faults at standstill, during startup, and while running. Up to four individual injected frequencies eliminate protection blind spots during generator startup.

ANSI NUMBERS/ACRONYMS AND FUNCTIONS

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>59N</td>
<td>Stall-Speed Switch</td>
</tr>
<tr>
<td>64F</td>
<td>Undervoltage*</td>
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<tr>
<td>64S</td>
<td>Undercurrent/Underpower*</td>
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</table>

ADDITIONAL FUNCTIONS

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>DESCRIPTION</th>
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<tr>
<td>DFR</td>
<td>Event Reports</td>
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<tr>
<td>HMI</td>
<td>Operator Interface</td>
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<td>LDP</td>
<td>Profile Report Monitoring</td>
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<tr>
<td>LGC</td>
<td>SELlogic® Control Equations</td>
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<tr>
<td>MET</td>
<td>Metering</td>
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<tr>
<td>NGR</td>
<td>Neutral Grounding Resistor Open/Short</td>
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<tr>
<td>SER</td>
<td>Sequential Events Recorder</td>
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</tbody>
</table>

*Optional feature

Neutral grounding transformer
Neutral grounding resistor
SEL-2600
RTD MODULE

Starting Price
$790 USD

selinc.com/products/2600
Select models typically ship in 2 days

The SEL-2600 transmits data from up to 12 resistance temperature detector (RTD) inputs and a single contact input over a fiber-optic link. One module can accommodate multiple RTD types—copper, nickel, and platinum—to reduce equipment costs. With a flexible panel mount and inexpensive fiber-optic communications, you can place the rugged module near equipment to avoid costly cable installation.

Motor protection with the SEL-710.

Transformer protection with the SEL-787, SEL-487E, SEL-387, or SEL-587. (Note: SEL-387 and SEL-387A Relays accept direct SEL-2600 RTD Module connection using SEL-2800 or SEL-2812 Fiber-Optic Transceivers.)

Generator protection with the SEL-300G, SEL-700G, or SEL-700GT.