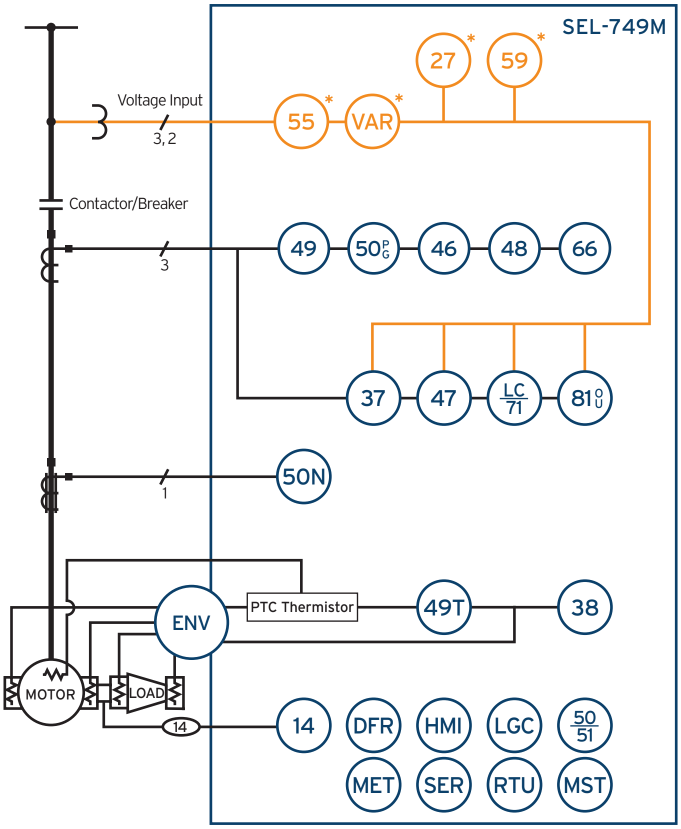
SEL-749M

Motor Relay

Comprehensive, economical protection for low- and medium-voltage motors

- Improve motor availability with our accurate, patented thermal model.
- Reliably track motor temperature without false tripping for cyclic overloads.
- Save panel space with the SEL-749M Motor Relay's compact design.
- Develop maintenance plans using motor start reports and trends.

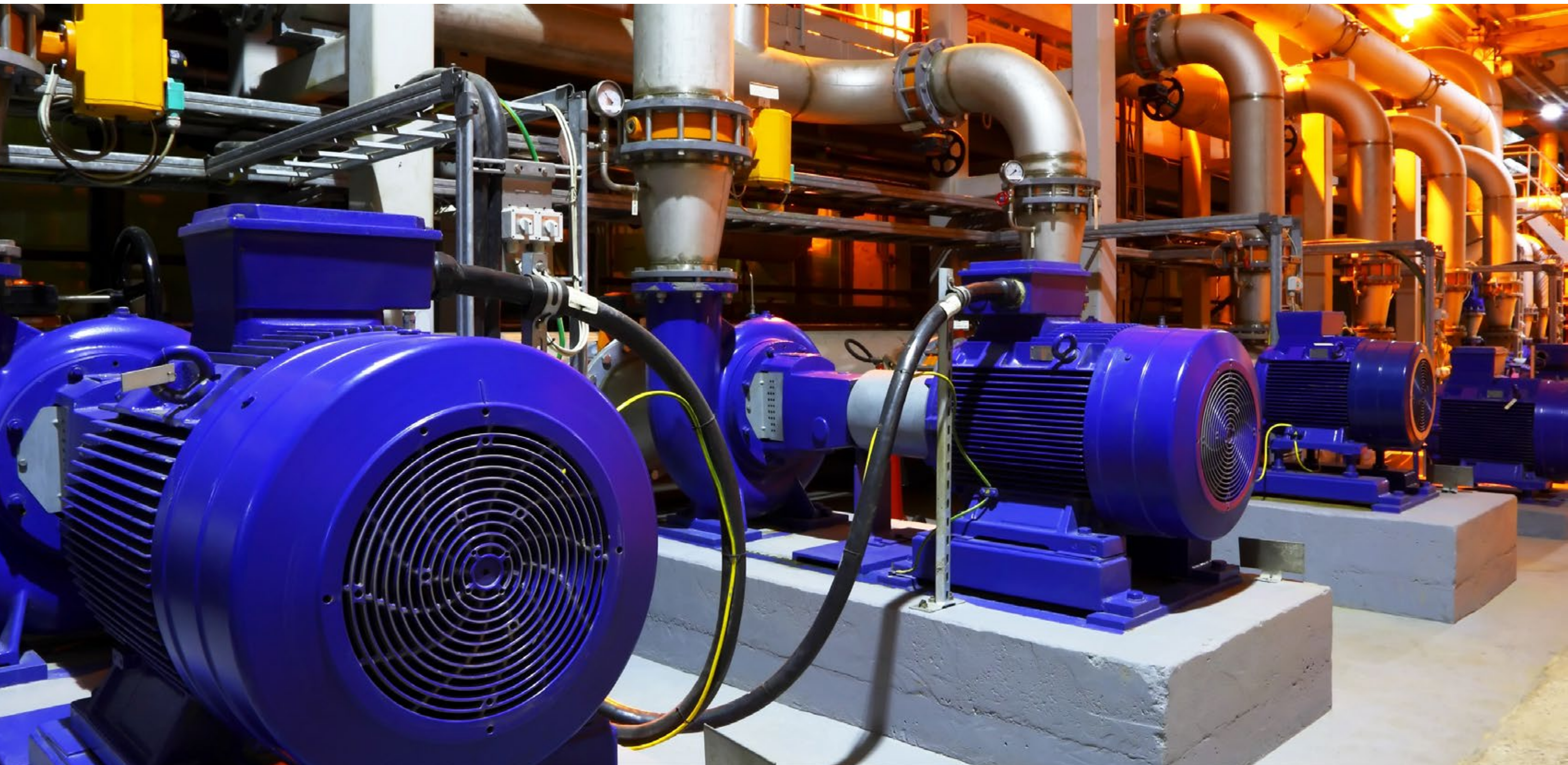
Functional Overview



ANSI Numbers/Acronyms and Functions	
14	Stall-Speed Switch
27	Undervoltage*
37	Undercurrent/Underpower*
38	Bearing Temperature
46	Current Balance and Phase Loss
47	Phase Reversal
48	Incomplete Sequence/Load Jam
49	Thermal Overload
49T	Temperature Alarms and Trips
50N	Neutral Overcurrent
50 (P, G)	Overcurrent (Phase, Residual)
55	Power Factor*
59	Phase Overvoltage*
66	Notching or Jogging Device
LC/71	Load Control (%TCU, Current, Power*)
81 (O, U)	Over-/Underfrequency
VAR	Reactive Power*

Additional Functions	
50/51	Adaptive Overcurrent
DFR	Events Reports-Motor Starts, Motor Operating Statistics
ENV	Optional SEL-2600 RTD Module
HMI	Operator Interface
LGC	SELogic® Control Equations
MET	High-Accuracy Metering
MST	Motor Starting/Running
RTU	Remote Terminal Unit
SER	Sequential Events Recorder

*Optional feature



Features and Benefits

True Temperature-Based Thermal Overload Protection

Eliminate false tripping, especially during cyclic overload operations. The release motor capability is unavailable with traditional overload relays.

Comprehensive Start Reports and Trends

Track motor performance during the critical starting period with complete motor start reports and 30-day average motor start trending.

Option Cards for Added Functionality

Customize the relay for your particular protection and control applications. You can select optional voltage, I/O, and communications cards.

Accelerated Troubleshooting With Complete Reporting

Troubleshoot motor and process problems using valuable, stored information from motor statistics, oscillograms, event reports, and sequential events records.

Extensive Communications and Software Capabilities

Communicate seamlessly with built-in SEL ASCII and optional Modbus® protocols. You can quickly and easily set the SEL-749M Motor Relay with the included Microsoft® Windows®-based ACSELERATOR QuickSet® SEL-5030 Software.

Compact, Ruggedized Hardware

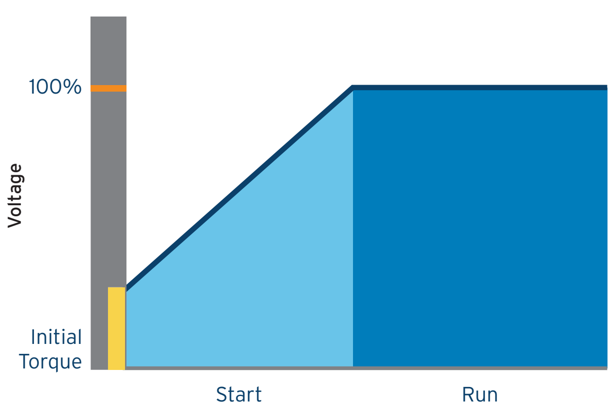
Mount the UL/IEC switchgear-rated SEL-749M in any motor control center (MCC), thanks to the relay's short mounting depth.

Applications

Choose the SEL-749M for three-phase motor protection and control installations. In addition to standard applications, the relay can protect motors in two specialized applications: reduced-voltage starting and two-speed processes.

Reduced-Voltage Start Motors

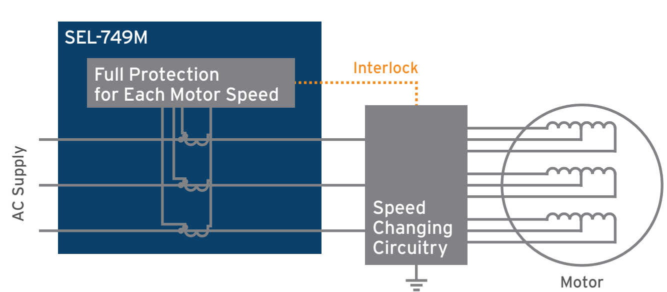
Protect motors that use soft-start starting profiles. The SEL-749M helps you avoid high current surges, high starting torque, and system mechanical stress on the motor. In addition, the SEL-749M protects the motor during voltage and current spikes caused by conventional wye-delta starters and other reduced-voltage starting techniques.



Reduced voltage starting decreases motor stress.

Two-Speed Motor Protection

Select a second value via a digital control input for the rated full-load ampere (FLA) motor current, CT input ration, and thermal overload protection. Two-speed applications include two-speed processes (blowers), increased motor loading, or maximized loading for ambient temperature excursions (e.g., day/night loading on exposed water pumps or conveyor belts).



Second settings provide full protection for each motor speed in two-speed motors.

Motor Protection

Motor Thermal Overload Protection

The SEL-749M provides locked rotor, running overload, and negative-sequence current imbalance protection using a patented thermal overload model. The relay accurately tracks the heating effects of load current and imbalance current while the motor is starting and running. You can choose two easy setting methods:

- Motor nameplate ratings
- Overload limit curves

For simple, effective protection, enter the motor nameplate ratings for the full load current, locked rotor current, hot stall limit (locked rotor) time, and motor service factor. The cooling time and thermal capacity reset level are also incorporated into the SEL-749M thermal overload protection. Alternatively, you can select the appropriate thermal overload limit curve from 45 standard curves.

Optional external resistance temperature detector (RTD) monitoring inputs extend the thermal overload protection to include direct temperature measurement for tripping or thermal overload model biasing to protect motor windings as well as motor and load bearings.

Thermal Overload Model Elements

The SEL-749M thermal overload model replicates motor heating and cooling characteristics according to applied motor current, using a starting (or locked rotor) element and a running element. In the starting element, the thermal overload model provides locked rotor protection using the I^2t threshold represented by the rated locked rotor current and locked rotor time. The relay compares this threshold to measured I^2t. The running element provides overload and imbalance protection by using current to calculate motor temperature in real time and comparing this temperature to predetermined thresholds. The relay trips if operating conditions exceed these settings.

Tracking Motor Temperature

Motor applications such as crushers and chippers can routinely and cyclically overload normal motor operating ratings. These cyclic overloads cause an ordinary overcurrent-based thermal model relay to false trip, resulting in unnecessary manufacturing process downtime. The SEL thermal model show how the SEL-749M thermal overload model accurately tracks motor heating (measured by RTD temperature) on a cyclic overload, which eliminates false tripping. The release motor capability is unavailable with traditional overload relays.

Short-Circuit Tripping

Phase, residual, and neutral/ground overcurrent elements detect cable and motor short-circuit faults. The SEL-749M includes:

- Two phase-overcurrent elements.
- Two residual-overcurrent elements.
- Two neutral-/ground-overcurrent elements.

You can set the relay to trip instantaneously or with a definite-time delay for short-circuit conditions. In the phase-overcurrent elements, the SEL adaptive overcurrent element detects CT saturation and responds with faster operation.

Load-Loss, Load-Jam, and Frequent-Starting Protection

The SEL-749M detects load loss (undercurrent) and load jam conditions. Load jam protection trips the motor quickly to prevent overheating from stall conditions. The SEL-749M provides frequent-starting protection using settable starts-per-hour and time-between-starts protection functions. The relay stores motor-starting and thermal overload data in nonvolatile memory to prevent motor damage caused by frequent starts.

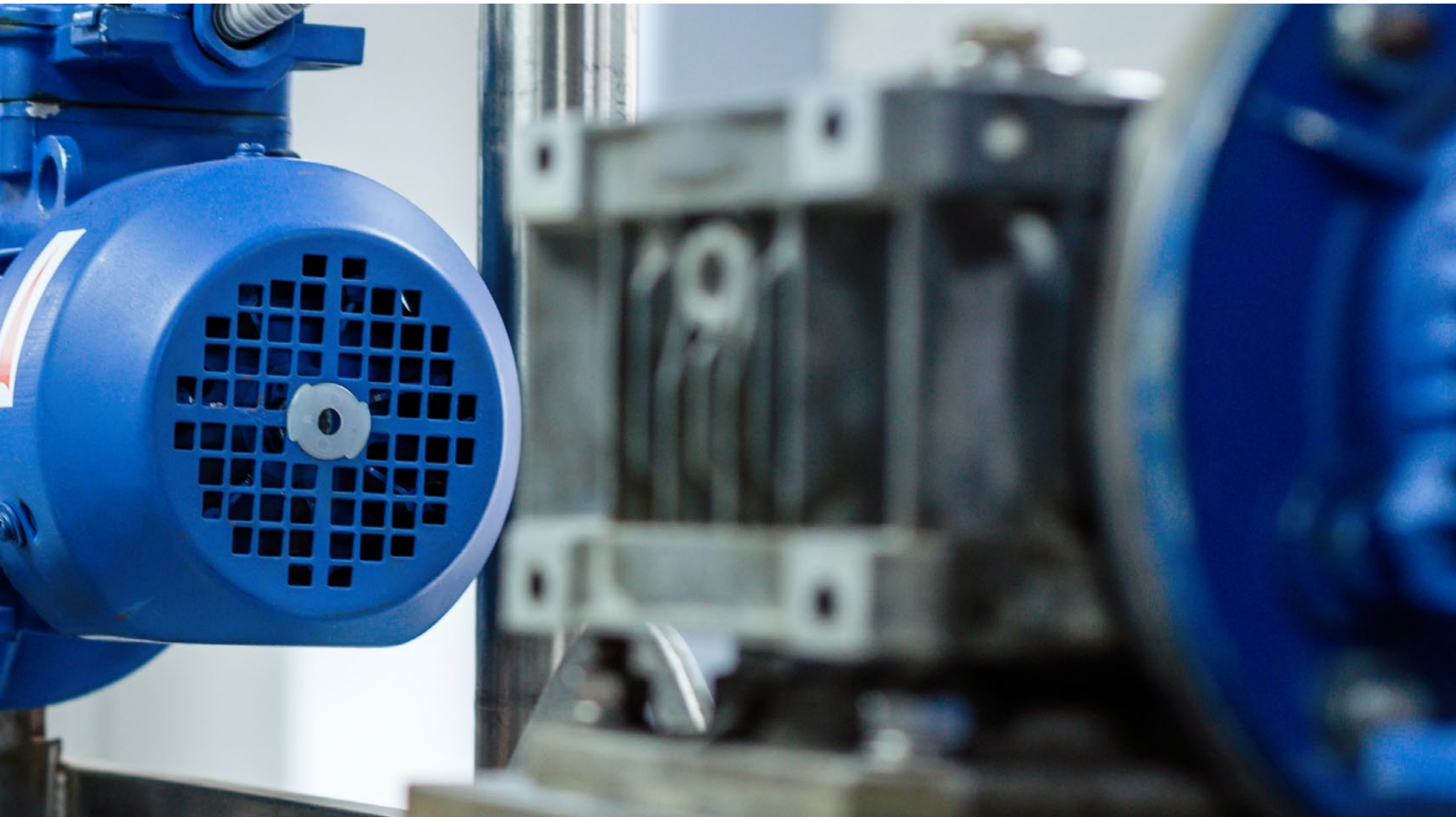
Imbalance Current and Phase-Reversal Protection

The SEL-749M provides an imbalance current element that trips in the event of a motor single-phasing condition or for heavy current imbalance. The relay phase-reversal protection detects the motor phase rotation and trips after a time delay if the phase rotation is incorrect. The SEL-749M provides this protection even when phase voltages are not available.

Voltage-Based Protection Elements

The SEL-749M offers optional voltage inputs for open-delta or four-wire wye connections for additional protection and monitoring:

- Over- and undervoltage
- Over- and underfrequency (voltage-based)
- Underpower
- Reactive power
- Power factor



Metering and Monitoring Capabilities

Current- and Voltage-Based Metering Functions

The SEL-749M provides accurate metering for input currents, optional voltages, and temperature measurement for optional RTDs. You can view the frequency and phase as well as neutral, residual, and imbalance current magnitudes. When equipped with voltage inputs, the relay provides additional meter quantities, such as phase and residual voltage; real, reactive, and apparent power (kW, kVAR, kVA); and power factor. When you select RTD inputs, the relay reports the temperature and location of each RTD.

Use front-panel menus, serial port commands, and the optional Modbus protocols to view metering values.

Analog Output

The SEL-749M has an optional 4–20 mA analog output for a remote panel meter or plant distributed control system input. You can program the analog output to provide important operation information, such as:

- Full-load current
- Average and maximum phase currents
- Percent thermal capacity
- Winding and bearing temperatures
- Average power consumed
- Power factor

Motor Operation Maintenance Tools

Motor Start Report

The SEL-749M provides an unmatched view of motor performance during the critical starting cycle. Every time the protected motor starts, the relay stores a start report detailing motor currents, optional voltages, and the thermal capacity used to start.

In addition, the relay calculates the starting time in seconds and records the maximum current magnitude and minimum voltage magnitude during the start. You can customize the report sample rate and length to record as much as 60 seconds of motor start data. The relay stores the five latest start reports in nonvolatile memory.

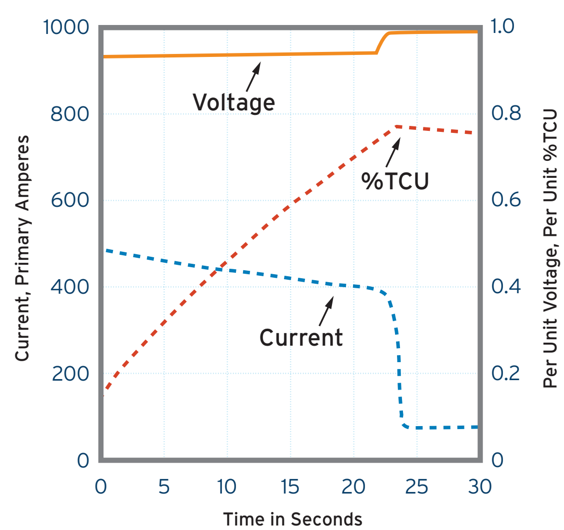
Motor Start Trending Report

Monitor starting trends with the motor trend report. The relay maintains the 18 most recent 30-day averages of motor start report data in nonvolatile memory. You can use actual start performance data to check for out-of-tolerance motor starting and perform preventive maintenance before an unplanned failure occurs.

Motor Operating Statistics

Reduce costs by scheduling preventive maintenance using relay data, such as:

- Time running and stopped
- Number of emergency starts
- Motor-running percent
- Average and peak current, voltage, and %TCU
- Protection element alarms/trips



Motor start report data exported to a plotting program.

Windows-Based Graphical User Interface

Use QuickSet to Set the SEL-749M Relay

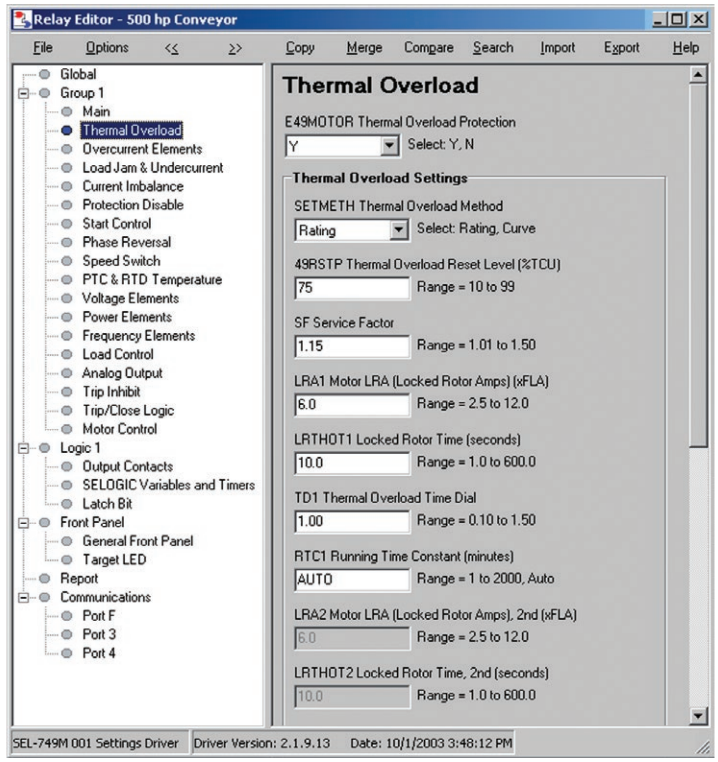
Save engineering time while maintaining flexibility. You can communicate with the SEL-749M through any ASCII terminal or use the QuickSet graphical user interface. The software supports Windows operating systems.

Develop settings offline with a menu-driven interface and completely documented help screens. Copying existing settings files and modifying only application-specific items speeds up the installation process.

Simplify the settings procedure with rules-based architecture to automatically check interrelated settings. The software highlights out-of-range or conflicting settings for correction. You can transfer settings files by using a PC communications link with the SEL-749M.

Use QuickSet to Analyze Fault Records and Relay Element Response

Convert relay event reports to oscillograms with time-coordinated element assertion and phasor/sequence element diagrams. You can quickly analyze fault records and relay element response using the QuickSet event viewer.



QuickSet simplifies settings and saves engineering time.

Fault Reporting

Event Summaries and Event Reports

The SEL-749M captures a 15-cycle or 64-cycle length event report and creates an event summary each time the relay trips in response to programmable conditions. You can view the summary using the front-panel LCD or by connecting a computer to the relay via the EIA-232 port on the front panel. Event summaries contain the following useful data about relay trips:

- Event number, date, and time.
- Trip type.
- Magnitudes of the phase, neutral, and residual currents.
- Magnitudes of the phase-to-phase or phase-to-neutral voltages.

The relay saves the most recent event reports and event summaries in nonvolatile memory, so the information is retained even if relay power is removed.

Full-length event reports contain the event summary data; 15 or 64 cycles of detailed current, voltage, and protection element data; and input and output data.

Sequential Events Recorder (SER)

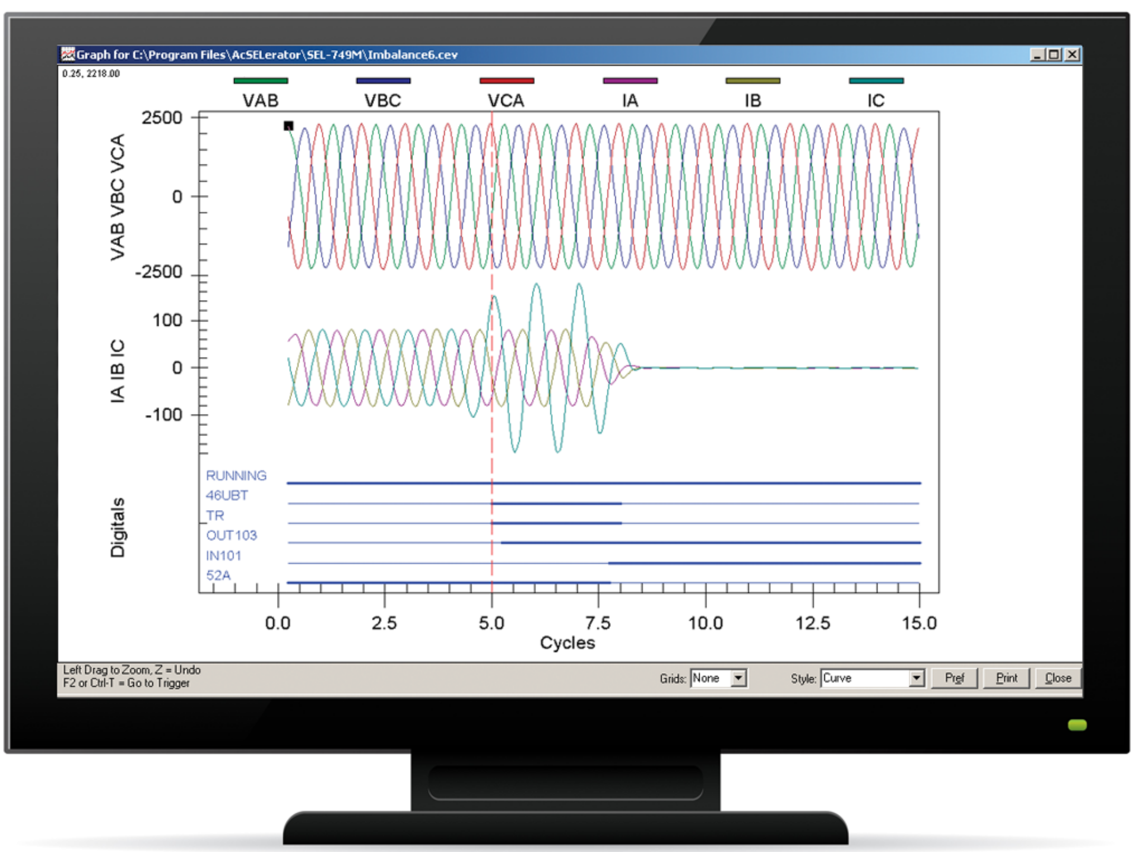
The SEL-749M tracks the pickup and dropout of protection elements, control inputs, and contact outputs. The date and time of each transition are available in an SER report. This chronological report helps you determine the order and cause of events and assists in troubleshooting.

Front-Panel Targets and Messages

You can program front-panel targets to indicate any relay element operation and modify front-panel labels via a customizable slide-in card. Extra cards and a word processor template are available.

The relay automatically determines the trip type and displays it on the front-panel display. Trip type messages reveal motor operating conditions that tripped the relay, such as:

- Thermal or locked rotor.
- Load loss or load jam.
- Imbalance current.
- Phase or ground fault.
- Voltage or frequency



Event report oscillogram shows current imbalance.

Flexible Design With Application-Specific Ordering Options

You can easily configure the SEL-749M to integrate into a wide range of environments. The following options are available:

Power Supply and I/O

- 110–240 Vac, 110–250 Vdc, 3 contact outputs, and 2 optoisolated control inputs
- 24–48 Vdc, 3 contact outputs, and 2 optoisolated control inputs
- Control input voltages (choose one): 24, 48, 110, 125, 220, or 250 Vdc/Vac

Secondary Input Current

- 1 A phase or 5 A phase
- 1 A neutral or 5 A neutral

IRIG-B/Positive Temperature Coefficient (PTC) Input

- IRIG-B time-code (demodulated) input
- PTC thermistor input (no IRIG-B time code)

Communications Port

EIA-485/232 (rear card)

Communications Protocols

Standard plus Modbus RTU EIA-485/232 (EIA-232 front and rear; EIA-485/232 rear card)

I/O Expansion

- Four additional contact outputs, three additional optoisolated control inputs, and one 4–20 mA output
- Control input voltages (choose one): 24, 48, 110, 120, 220, or 250 Vdc/Vac

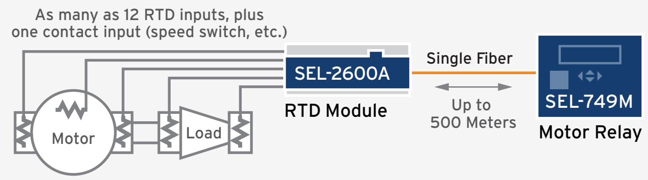
Voltage Inputs

Wye-connected VA, VB, and VC or delta-connected VAB and VBC (300 Vac maximum)

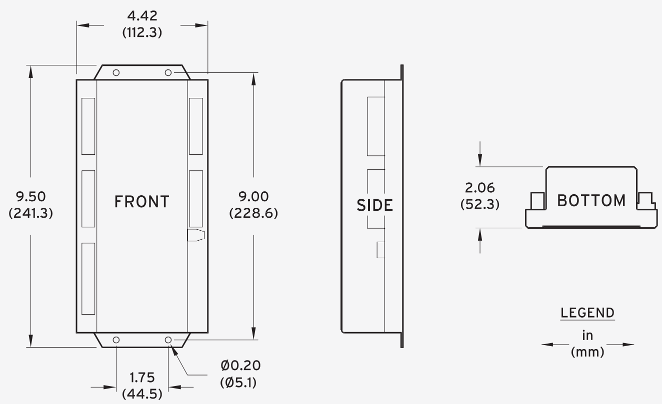
SEL-2600A RTD Module

Combining the SEL-749M with the SEL-2600A RTD Module adds temperature trips and alarms, a thermal overload element, RTD biasing, RTD open or short alarms, and temperature measurement. You can configure each RTD input to use any of four sensor types (PT100, NI100, NI120, or CU10). Relay settings also define the sensor locations: motor windings, motor or load bearings, ambient air, and "other" for uncategorized applications.

The optional SEL-2600A RTD Module monitors as many as 12 RTDs and a single contact at the motor. This remote device sends data to the relay through a tough, flexible optical fiber that is routed back to the MCC providing complete electrical isolation between the RTDs and the relay. The external module improves measuring accuracy by shortening RTD lead runs and reducing both the lead resistance and electrical noise.



Dimensions



For detailed information, including specifications, see selinc.com/products/2600.

SEL-749M Product Overview

Default messages or up to 32 customizable display labels notify personnel of power system events or the relay status.

Front-panel EIA-232 serial port.

2 × 16 character LCD provides navigation, relay control, data, and diagnostics.

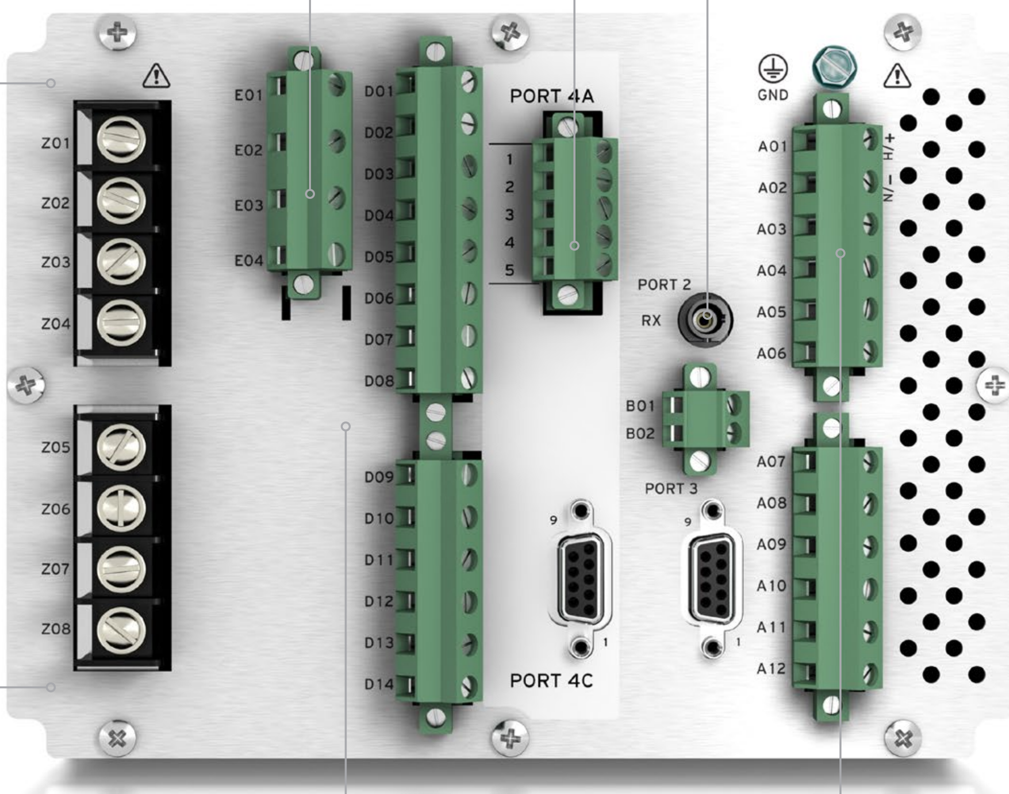
Programmable front-panel LEDs with user-configurable labels alert operators to faulted phases, the relay's status, and element operation.

Six-button keypad enables simple navigation for settings, status, and access to event reports.

Optional communications card includes an EIA-485 port, an additional EIA-232 port, and the Modbus RTU protocol.

3-phase ac voltage input; 300 Vac maximum.

Port options include demodulated IRIG-B for precise-time input or a PTC input to thermally monitor protected equipment.

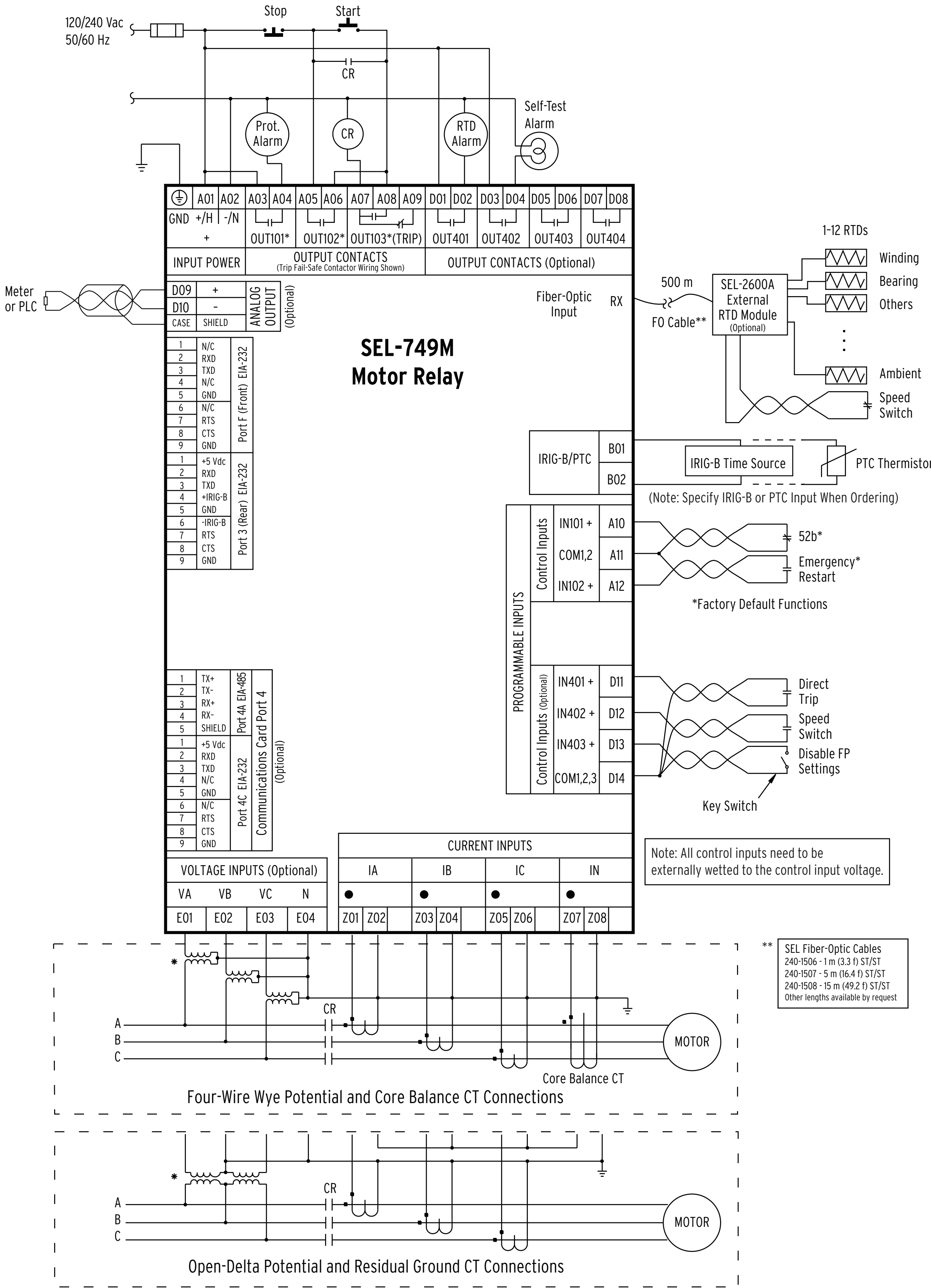


Secondary input current: 1 A phase or 5 A phase or 1 A neutral or 5 A neutral.

Optional I/O expansion: three digital inputs, four digital outputs, one 4–20 mA output.

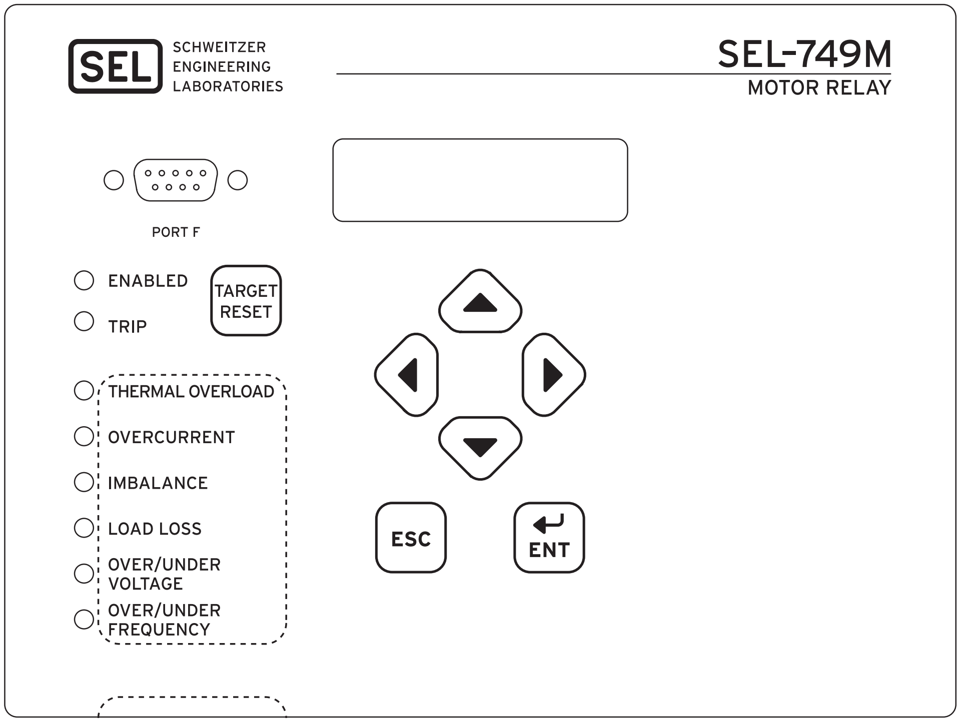
Power supply options include 110–240 Vac, 110–250 Vdc or 24–48 Vdc. The relay also includes two digital inputs and three digital outputs.

SEL-749M Wiring Diagram

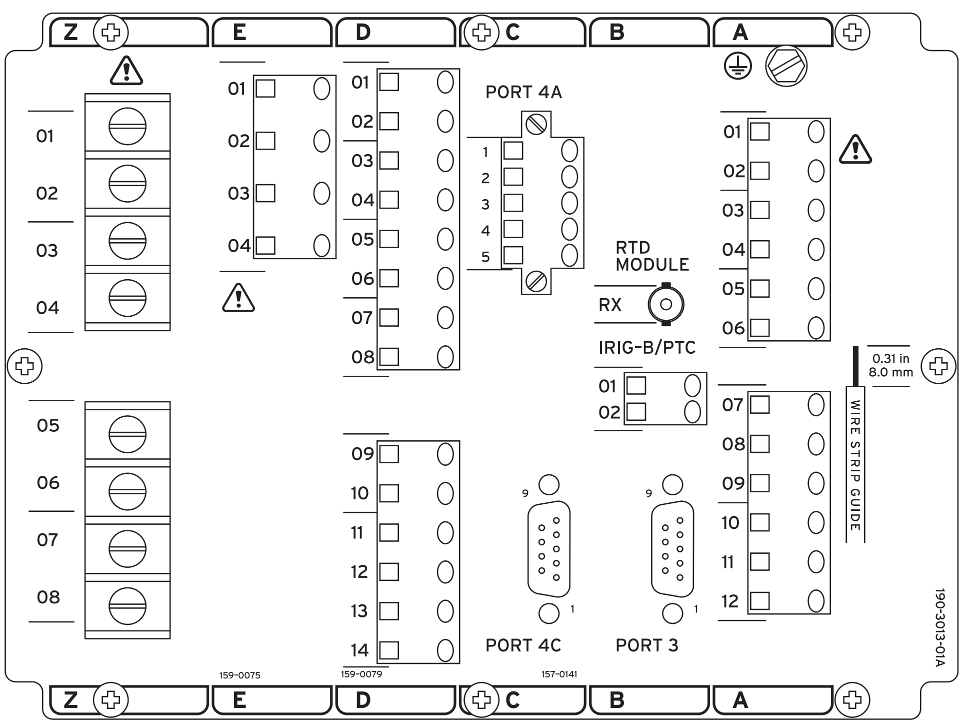


SEL-749M Front- and Rear-Panel Views

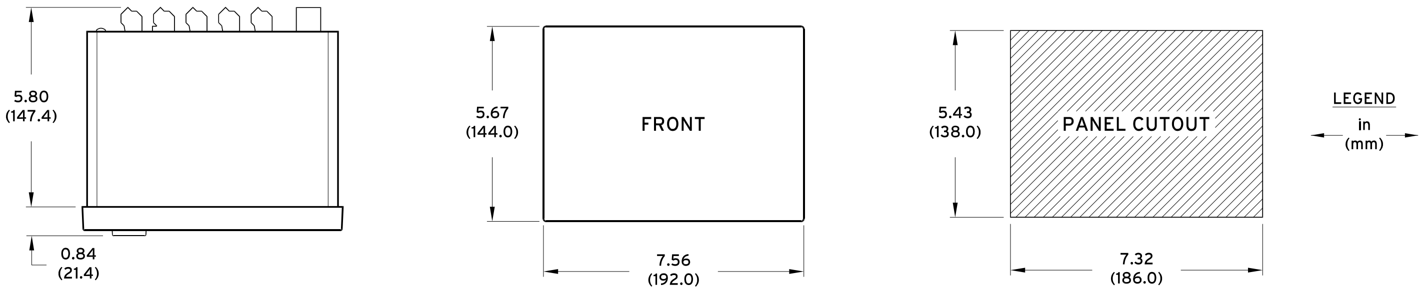
Front-Panel View



Rear-Panel View



SEL-749M Dimensions



SEL-749M Specifications

Compliance

Designed and manufactured under an ISO 9001:2008-certified quality management system

UL: Process control equipment category QUYX per UL61010-1; Auxiliary device category NKCR per UL508

CSA: C22.2 No. 61010-1CE (CE Mark-EMC Directive and Low-Voltage Directive)

Hazardous locations approvals: Complies with UL 1604, CSA 22.2 No. 213, ISA 12.12.01, and EN 60079-15

Hazardous Locations

EU ATEX: II 3 G Ex nC IIC 135°C (T4)

RCM mark

General

AC Current Input

Phase and neutral currents INOM = 5 A or 1 A secondary, depending on model

I_{NOM} = 5 A

Continuous Rating: 3 • INOM @ 85°C, linear to 96 A symmetrical; 4 • INOM @ 55°C, linear to 96 A symmetrical

1-second thermal: 500 A

Burden (per phase): <0.1 VA @ 5 A

I_{NOM} = 1 A

Continuous rating: 3 • INOM @ 85°C, linear to 19.2 A symmetrical; 4 • INOM @ 55°C, linear to 19.2 A symmetrical

1-second thermal: 100 A

Burden (per phase): <0.01 VA @ 1 A

Measurement category: II

AC Voltage Inputs

[VNOM (L-L)/PT Ratio]: 100–250 V (if DELTA_Y = DELTA)

Range: 100–440 V (if DELTA_Y = WYE)

Rated continuous: 300 Vac

10-second thermal: 600 Vac

Vphase

Burden: 0.01 VA @ 120 Vac

Input impedance (per phase): 5 MΩ

Input impedance (phase-to-phase): 10 MΩ

Power Supply

Relay startup time: Approximately 5–10 seconds (after power is applied until the "ENABLED" LED turns on)

High-Voltage Supply

Rated supply voltage: 110–240 Vac, 50/60 Hz; 110–250 Vdc

Input voltage range: 85–264 Vac, 85–300 Vdc

Power consumption: <40 VA (ac); <20 W (dc)

Interruptions: 50 ms @ 125 Vac/Vdc; 100 ms @ 250 Vac/Vdc

Low-Voltage Supply

Rated supply: 24–48 Vdc

Input voltage: 19.2–60 Vdc

Power consumption: <20 W (dc)

Interruptions: 10 ms @ 24 Vdc; 50 ms @ 48 Vdc

Fuse Ratings

Low-Voltage Power Supply Fuse

Rating: 3.15 A

Maximum rated voltage: 300 Vdc; 250 Vac

Breaking capacity: 1,500 A at 250 Vac

Type: Time-lag T

High-Voltage Power Supply Fuse

Rating: 3.15 A

Maximum rated voltage: 300 Vdc; 250 Vac

Breaking capacity: 1,500 A at 250 Vac

Type: Time-lag T

Output Contacts	General OUT103 is a Form C trip output; all other outputs are Form A. Dielectric test voltages: 2,500 Vac Impulse withstand voltage (U_{IMP}): 5,000 V Mechanical durability: 100,000 no-load operations Standard Contacts Pickup/dropout time: ≤8 ms (coil energization to contact closure) DC Output Ratings Rated operational voltage: 250 Vdc Rated voltage range: 19.2–275 Vdc Rated insulation voltage: 300 Vdc Make: 30 A @ 250 Vdc per IEEE C37.90 Continuous carry: 6 A @ 70°C; 4 A @ 85°C 1-second thermal: 50 A Contact protection: 360 Vdc, 115 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 (Ue) rating: 240 Vac Insulation voltage (Ui) rating (excluding EN 61010-1): 300 Vac 1-second thermal: 50 A Contact Rating Designation: B300 (5 A thermal current, 300 Vac maximum) Operational voltage: 120–240 Vac Make Current Maximum current: 30–15 A Maximum VA: 3,600 Break Current Maximum current: 3–1.5 A Maximum VA: 360 Electromagnetic loads: PF<0.35, 50–60 Hz Voltage protection across open contacts: 270 Vac, 40 J Utilization Category: AC-15 Operational voltage (U_e): 120–240 Vac Operational current (I_e): 3–1.5 A Make current: 30–15 A Break current: 3–1.5 A Electromagnetic loads: >72 VA, PF<0.3, 50–60 Hz	**Optoisolated Control Inputs**	Pickup/Dropout Time: 3/4 cycle maximum When Used With DC Control Signals 250 V ON for 200–312.5 Vdc; OFF below 150 Vdc 220 V ON for 176–275 Vdc; OFF below 132 Vdc 125 V ON for 100–156.2 Vdc; OFF below 75 Vdc 110 V ON for 88–137.5 Vdc; OFF below 66 Vdc 48 V ON for 38.4–60 Vdc; OFF below 28.8 Vdc 24 V ON for 15–30 Vdc; OFF for <5 Vdc When Used With AC Control Signals 250 V ON for 170.6–312.5 Vac; OFF below 106 Vac 220 V ON for 150.3–275 Vac; OFF below 93.2 Vac 125 V ON for 85–156.2 Vac; OFF below 53 Vac 110 V ON for 75.1–137.5 Vac; OFF below 46.6 Vac 48 V ON for 32.8–60 Vac; OFF below 20.3 Vac 24 V ON for 14–30 Vac; OFF below 5 Vac Current Draw at Nominal DC Voltages 2 mA (at 220–250 V) 4 mA (at 48–125 V) 10 mA (at 24 V) Except for 220–250 V (2 mA) and 24 V (10 mA) Rated insulation voltage: 300 Vac Rated impulse withstand voltage (U_{imp}): 4,000 V
		Analog Output (optional)	Single analog current output: 4–20 mA Maximum load: 300 Ω Error: <±1%, full scale, at 25°C Select from: FLA, % thermal capacity, hottest winding RTD, hottest bearing RTD, average phase current, maximum phase current, power, power factor
		Frequency and Phase Rotation	System: 50, 60 Hz Phase Rotation: ABC, ACB Frequency: 44–66 Hz
		Time-Code Input	Format: Demodulated IRIG-B On (1) state: V_{ih} ≥2.2 V Off (0) state: V_{il} ≤0.8 V Input impedance: 2 kΩ Synchronization accuracy internal clock: ±1 µs All reports: ±5 ms Unsynchronized clock drift: 2 minutes per year typical

Communications Ports	**Standard EIA-232 (2 Ports)** Location: front panel, rear panel Data speed: 300–38,400 bps Protocols: SEL ASCII, Modbus RTU **Optional Communications Card** Modbus RTU Protocol or ASCII Protocol over EIA-232 or EIA-485
Dimensions	144.0 mm (5.67 in) × 192.0 mm (7.56 in) × 147.4 mm (5.80 in)
Weight	2.0 kg (4.4 lb)
Relay Mounting Screws (#8-32) Tightening Torque	Minimum: 1.4 Nm (12 in-lb) Maximum: 1.7 Nm (15 in-lb)
Terminal Connections	**Terminal Block** Screw Size: #6 Ring terminal width: 0.310 inch maximum **Terminal Block Tightening Torque** Minimum: 0.9 Nm (8 in-lb) Maximum: 1.4 Nm (12 in-lb) **Compression Plug Tightening Torque** Minimum: 0.5 Nm (4.4 in-lb) Maximum: 1.0 Nm (8.8 in-lb) **Compression Plug Mounting Ear Screw** Minimum: 0.18 Nm (1.6 in-lb) Maximum: 0.25 Nm (2.2 in-lb)

Product Standards

Electromagnetic Compatibility	IEC 60255-26:2013 IEC 60255-27:2013 UL 508 CSA C22.2 No. 14-05

Environmental Conditions

Typical Conditions Under Which the Relay Is Designed to Operate	Location: Indoor use Altitude: As high as 2,000 m Temperature: –40° to +85°C (–40° to +185°F) LCD contrast is impaired for temperatures below –20°C and above +70°C. Relative humidity: 5% to 95% Overvoltage category: II Pollution degree: 3 Atmospheric pressure: 80–110 kPa

Type Tests

Environmental Tests	**Enclosure Protection** IEC 60529:2001 + CRDG:2003 IP65 enclosed in panel IP20 for terminals and the relay rear panel IP50 for terminals with optional dust prot. assy. (Part #915900170). 10°C temperature derating. **Vibration Resistance** IEC 60255-21-1:1988 IEC 60255-27:2013, Section 10.6.2.1 Endurance: Class 2 Response: Class 2 **Shock Resistance** IEC 60255-21-2:1988 IEC 60255-27:2013, Section 10.6.2.2 IEC 60255-27:2019, 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 **Change of Temperature** IEC 60068-2-14:2009 IEC 60255-1:2010, Section 6.12.3.5 –40° to +85°C, ramp rate 1°C/min, 5 cycles

Dielectric Strength and Impulse Tests	Dielectric (HIPOT) IEC 60255-27:2013, Section 10.6.4.3 IEEE C37.90-2005 2.5 kVac on current inputs, contact I/O 2.0 kVac on ac voltage inputs 1.0 kVac on PTC input and analog output 3.6 kVdc on power supply Impulse IEC 60255-27:2013, Section 10.6.4.2 IEEE C37.90:2005 0.5 J, 5.0 kV on power supply, contact I/O, ac current and voltage inputs 0.5 J, 530 V on PTC and analog output
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 61000-4-4:2011 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 2 kV line-to-line 4 kV line-to-earth Surge Withstand Capability Immunity IEC 60255-26:2013; Section 7.2.6 EN 61000-4-18:2010 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 60255-26:2013, Section 7.2.10 Severity level: 1,000 A/m for 3 seconds, 100 A/m for 1 minute (50/60 Hz) IEC 61000-4-9:2001 Severity level: 1,000 A/m IEC 61000-4-10:2001 Severity level: 100 A/m (100 kHz and 1 MHz)
EMC Immunity (continued)	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
Product Specific Electromagnetic Compatibility	**EN 50263:1999** [BS EN 50263:2000] **IEC 60947-4-1:2002** [BS EN 60947-4-1: 2001 + A1:2003] **IEC 60947-5-1:2003** [BS EN 60947-5-1: 2004]
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 Showering Arc NEMA ICSI-2000, severity level: 1.5 kV

Processing Specifications

AC Voltage and Current Inputs	16 samples-per-power system cycle
Digital Filtering	One-cycle cosine after low-pass analog filtering. Net filtering (analog plus digital) rejects dc and all harmonics greater than the fundamental.
Protection and Control Processing	Processing interval is 4 times per power system cycle.

Relay Elements

Thermal Overload (49)	Full-load current[1] (FLA) limits: 0.2–5,000 A primary Locked rotor current: (2.5–12) • FLA Hot locked rotor time: 1–600 seconds Service factor: 1.01–1.50 Accuracy: 5% ±25 ms at multiples of FLA>2 (cold curve method)
PTC Overtemperature (49)	Type of control unit: Mark A Maximum number of thermistors: 6 in a series connection Maximum cold resistance of PTC sensor chain: 1,500 Ω Trip resistance: 3,400 Ω ±150 Ω Reset resistance: 1,500–1,650 Ω Short-circuit trip resistance: 25 Ω ±10 Ω
Undercurrent (Load Loss) (37)	Setting range: Off, (0.1–1) • FLA Accuracy: ±5% of setting; ±0.02 • I_{NOM} A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0.4–120 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Current Unbalance and Phase Loss (46)	Setting range: Off, 5–80% Accuracy: ±10% of setting; ±0.02 • I_{NOM} A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0–240 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Overcurrent (Load Jam)	Setting range: Off, (1–6) • FLA Accuracy: ±5% of setting; ±0.02 • I_{NOM} A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0–120 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Short Circuit (50P)	Setting range: Off, (0.1–20) • FLA Accuracy: ±5% of setting; ±0.02 • I_{NOM} A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0–5 s, 0.01 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Ground Fault (50G)	Setting range: Off, (0.1–1) • FLA Accuracy: ±5% of setting; ±0.02 • I_{NOM} A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0–5 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Ground Fault (50N)	Setting range: Off, 0.01–25 A primary Accuracy: ±5% of setting, ±0.01 A secondary Maximum pickup/dropout time: 1.5 cycles Time delay: 0–5 s, 0.01 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Undervoltage (27)	Setting range:[2] Off, (0.6–1) • VNOM Accuracy: ±5% of setting, ±2 V Maximum pickup/dropout time: 1.5 cycles Time delay: 0–120 s, 0.1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Overvoltage (59)	Setting range: Off, (1–1.2) • VNOM Accuracy: ±5% of setting, ±2 V Maximum pickup/dropout time: 1.5 cycles Time delay: 0–120 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Underpower (37)	Setting range: Off, 1–25,000 kW primary Accuracy: ±3% of setting, ±5 W secondary Maximum pickup/dropout time: 10 cycles Time delay: 0.0–240.0 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Reactive Power (VAR)	Setting range: Off, (1–25,000) kVAR primary Accuracy: ±5% of setting ±5 VAR secondary for PF between −0.9 to +0.9 Maximum pickup/dropout time: 10 cycles Time delay: 0–240 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Power Factor (55)	Setting range: Off, 0.05–0.99 Accuracy: ±5% of full scale for current ≥0.5 • FLA Maximum pickup/dropout time: 10 cycles Time delay: 0–240 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
Frequency (81)	Setting range: Off, 55–65 Hz for FNOM[3] = 60 Off, 45–55 Hz for FNOM = 50 Accuracy: ±0.1 Hz Maximum pickup/dropout time: 5 cycles Time delay: 0–240 s, 1 s increments Accuracy: ±0.5% of setting ±1/4 cycle
RTD Protection[4] (Optional Using an SEL-2600 Series Module)	Setting range: Off, 1–250°C Accuracy: ±2°C RTD open-circuit detection: >250°C RTD short-circuit detection: <−50°C RTD types: PT100, NI100, NI120, CU10 RTD lead resistance: 25 Ω maximum per lead Lead length: <10 m to meet IEC 60255-22-1 and IEC 60255-22-5, otherwise <25 Ω limit Update rate: <3 s Noise immunity on RTD inputs: As much as 1.4 Vac (peak) at 50 Hz or greater frequency RTD trip/alarm time delay: Approx. 6 s

[1]FLA is a setting. See the Main Settings (SET Command) of the SEL-749M Settings Sheets at the end of Section 6 for setting ranges.

[2]VNOM is a setting. See the Main Settings (SET Command) of the SEL-749M Settings Sheets at the end of Section 6 for setting ranges.

[3]FNOM is a setting. See the Global Settings (SET G Command) of the SEL-749M Settings Sheets at the end of Section 6 for setting ranges.

[4]As many as 12 RTD inputs (SEL-2600 as far as 1,000 m away, using fiber-optic cable).

Metering

Accuracies are specified at 20°C, nominal frequency, ac phase currents within (0.2–20.0) • I_{NOM} A secondary, ac neutral currents within (0.2–2.0) • I_{NOM} A secondary, and ac voltages within 50–250 V secondary unless otherwise noted.

Motor phase currents: ±2% of reading, ±1.5% of I_{NOM}, ±2°
3-phase average motor current: ±2% of reading, ±2% of I_{NOM}
3-phase average motor load (%FLA): ±2% of reading, ±2% of I_{NOM}
Current unbalance (%): ±2% of reading, ±2% of I_{NOM}
IG (residual current): ±3% of reading, ±2% of I_{NOM}, ±2°
IN (neutral current): ±2% of reading, ±1°
3I2 negative-sequence current: ±3% of reading, ±2% of I_{NOM}
System frequency: ±0.1 Hz of reading for frequencies within 44–66 Hz
Thermal capacity: ±1% TCU; time to trip ±1 second
Line-to-line voltages: ±2% of reading, ±1° for voltages within 24–264 V
3-phase average line-to-line voltage: ±2% of reading for voltages within 24–264 V
Line-to-ground voltages: ±2% of reading, ±1° for voltages within 24–264 V
3-phase average line-to-ground voltages: ±2% of reading for voltages within 24–264 V
Voltage unbalance (%): ±2% of reading for voltages within 24–264 V
3V2 negative-sequence voltage: ±2% of reading for voltages within 24–264 V
Real 3-phase power (kW): ±5% of reading for 0.1 < pf < 1
Reactive 3-phase power (kVAR): ±5% of reading for 0 < pf < 0.9
Apparent 3-phase power (kVA): ±2% of reading
Power factor: ±2% of reading
RTD temperatures: ±2°C

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