

SEL-387E



Current Differential and Voltage Relay

Dependable and Secure Transformer Protection



Apply the SEL-387E Current Differential and Voltage Relay to provide comprehensive protection, metering, and automation of transformers, reactors, and other power apparatus.

Features and Benefits

Protection

Expand transformer protection capabilities with restricted earth fault (REF), negative-sequence overcurrent, overexcitation, and frequency elements. Innovative restraint and blocking prevent false trips and enhance security while maintaining sensitivity to internal faults.

Control

Simplify engineering designs with SELogic® control equations for customizing advanced protection and control schemes. Apply frequency elements for load shedding and/or load restoration schemes.

Monitoring/Metering

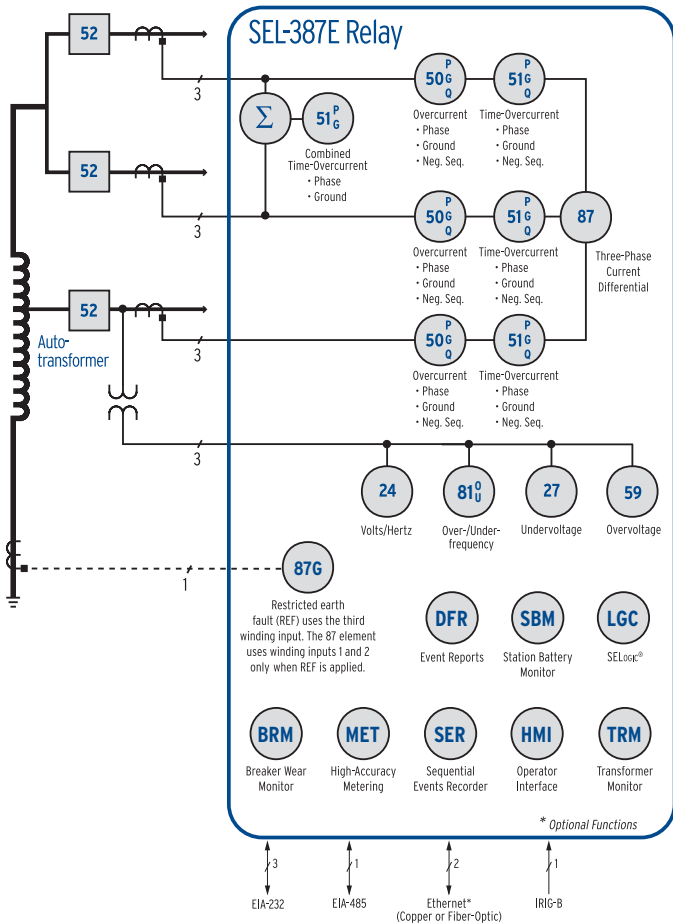
Oscillographic event reports, Sequential Events Recorder (SER) reporting, and accurate three-phase power metering reduce or eliminate external recorder and metering requirements. Station battery voltage monitor, through-fault monitor, and circuit breaker contact wear monitor assist maintenance programs.

Flexible Communications

Serial and Ethernet communications provide complete integration. IEC 61850 communications offer high-speed, relay-to-relay information exchange. Supported protocols include ASCII, binary, and SEL distributed port switch communications. Built-in web server provides read-only point of access to view metering, settings, targets, and SER.

Making Electric Power Safer, More Reliable, and More Economical®

Functional Overview



The SEL-387E Relay provides security against system and transformer conditions that may result in relay misoperation. The fifth-harmonic element prevents relay misoperation during allowable overexcitation conditions. Second- and fourth-harmonic elements along with the dc offset element provide security against inrush currents during transformer energization. The even harmonic elements offer the choice between harmonic blocking and harmonic restraint. In the blocking mode, select either blocking on an independent phase basis or on a common basis. The second-, fourth-, and fifth-harmonic thresholds are set independently, and the dc blocking and harmonic restraint features are independently enabled.

Overcurrent Protection

Each three-phase current input terminal has a total of 11 overcurrent elements, 9 of which are torque-controllable, providing comprehensive overcurrent protection on each winding input. For backup overcurrent protection in ring-bus or breaker-and-a-half configurations, two combined overcurrent elements operate on the sum of the currents from windings 1 and 2. The combined currents from two separate breaker CTs emulate the current as if from a single bushing CT applied on the transformer.

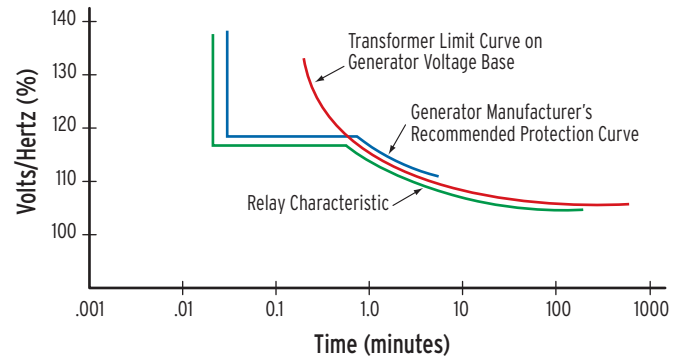
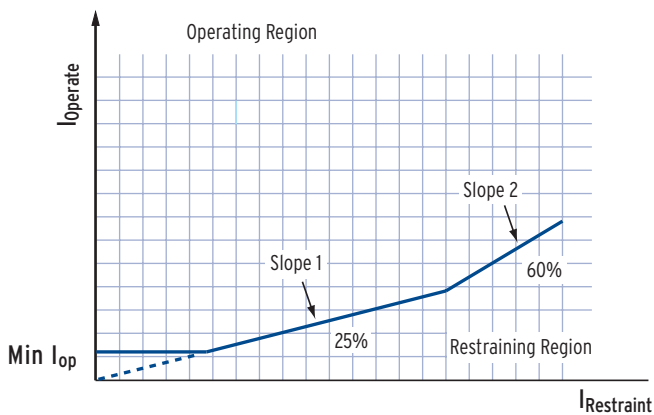
Volts-Per-Hertz Protection

Overexcitation occurs when the magnetic core of a transformer becomes saturated. When this happens, higher harmonic frequencies become more prominent, resulting in overheating and damage. Overexcitation conditions are detected by a volts-per-hertz element. Use the relay outputs for alarm or trip functions.

The SEL-387E Relay provides sensitive, instantaneous, definite-time elements plus a settable composite inverse-time/definite-time characteristic. The relay also includes one user-defined inverse-time characteristic programmed with SEL-5806 Curve Designer Software. The inverse-time element has a percent-travel operating characteristic similar to that employed by an induction-disk time-overcurrent element. This characteristic coincides well with the heating effect that overexcitation has on transformer components.

Differential Protection

The SEL-387E Relay has three differential elements that use operate and restraint quantities calculated from the two- or three-winding input currents. Set the differential elements with either a single- or dual-slope percentage-restraint differential characteristic, as shown below.



Restricted Earth Fault (REF) Protection

The REF function compares the directions of neutral current and winding residual current for sensitive ground fault detection in grounded-wye or autotransformer-connected windings.

Metering Functions

Voltage inputs combined with measured currents yield key metering information in the SEL-387E Relay. Measured quantities include:

- Three-phase voltage and current from all inputs
- Three-phase and per-phase MW and MWh
- Three-phase and per-phase MVA
- Three-phase and per-phase MVAR and MVARh
- Frequency, volts-per-hertz, harmonics
- Differential currents
- Station battery—four settable alarm levels

Sequential Events Recorder (SER)

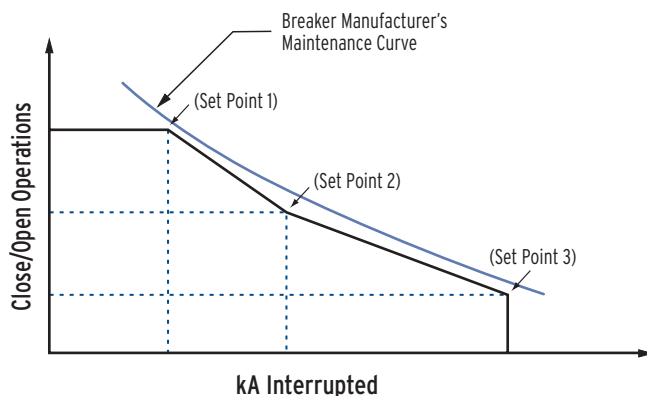
Retrieve time-tagged sequential event messages recorded by the SEL-387E Relay to analyze the time relationships between assertion and deassertion of logical elements. Apply the relay with an SEL-2032 Communications Processor to quickly and automatically receive SER messages from the relay in an efficient binary format.

Advanced SELoGic[®] Control Equations

Logically combine selected relay elements for various control functions, and assign outputs to logic functions. In addition to Boolean-type logic, 16 general-purpose SELoGic control equation timers eliminate external timers for custom protection or control schemes. Each timer has independent time-delay pickup and dropout settings.

Intelligent Breaker Monitor

For each terminal, the SEL-387E Relay keeps track of the number of breaker operations, total interrupted current by pole, and contact wear by pole. Schedule timely breaker maintenance based on actual breaker wear related to the breaker manufacturer's maintenance curves.



Enhanced Automation Elements

A convenient set of automation features reduces the need for external metering and control devices. Automation elements include 16 each of the following: local control switches, remote control switches, latch control switches, and local display points.



Local control switch elements provide the functionality of separately mounted switches without the cost burden of installing and documenting physical devices. Each of the 16 switches can be used for a variety of purposes, including inputs to internal relay logic and for operator-entered switch values to other devices.

Remote control switch elements are set, cleared, and/or pulsed via serial port commands from remote systems or human-machine interfaces. Typical applications include control switches for SCADA operations, such as trip, close, and settings group selection.

Use latch control switches to retain the status of logical element conditions, such as supervisory on/off selector switch positions, through a loss of dc power to the relay.

Display points provide 16 programmable messages for the front-panel liquid crystal display (LCD). Use SELoGic control equations to drive the LCD with any logical point in the relay.

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General Specifications

AC Voltage Inputs

300 V_{L-N} three-phase, four-wire connection
300 V_{L-N} continuous (connect any voltage from 0 to 300 Vac)
600 Vac for 10 seconds
Burden 0.03 VA @ 67 V; 0.06 VA @ 120 V; 0.8 VA @ 300 V

AC Current Inputs

5 A nominal
20 A @ 55°C, 15 A @ 85°C continuous, 500 A for 1 second,
linear to 100 A symmetrical, 1250 A for 1 cycle
Burden 0.27 VA @ 5 A; 2.51 VA @ 15 A

1 A nominal
4 A @ 55°C, 3 A @ 85°C continuous, 100 A for 1 second,
linear to 20 A symmetrical, 250 A for 1 cycle
Burden 0.13 VA @ 1 A; 1.31 VA @ 3 A

Power Supply Ratings

24/48 Vdc 18–60 Vdc
48/125 V 38–200 Vdc or 85–140 Vac
125/250 V 85–350 Vdc or 85–264 Vac
<25 W maximum for all supplies

Frequency and Phase Rotation

User-selectable 60/50 Hz system frequency and ABC/ACB phase rotation

Standard Control Input and Output Ranges

24, 48, 110, 125, or 250 Vdc
Standard configuration provides 6 inputs and 8 outputs, <5 ms pickup/dropout times with 30 A make, 6 A continuous duty. Additional I/O board may be selected with standard inputs and outputs, or with a combination of standard inputs and high-current interrupting outputs.

Serial Communication

Two rear-panel and one front-panel EIA-232 serial ports
One rear-panel EIA-485 serial port with 2.1 kVdc isolation
Data rate of 300, 1200, 2400, 4800, 9600, 19200 bps (per port)

Ethernet Communication

Optional Ethernet ports (specify 10BASE-T or 100BASE-FX when ordering) with dual failover

Built-In Web Server

View relay status, SER, metering information, and settings through read-only access within a local network.

Time-Code Input

Demodulated IRIG-B accepted at EIA-232 Port 2 and the EIA-485 port

Operating Temperature

–40° to +85°C (–40° to +185°F)
(Note: LCD contrast impaired for temperatures below –20°C.)

Mounting Options

Horizontal projection-, panel-, and rack-mount or vertical panel- and rack-mount hardware package

Conformal Coating Option

Protect equipment from harsh environments and airborne contaminants, such as hydrogen sulfide, chlorine, salt, and moisture.

Production Dielectric Strength Tests

V, I inputs, optoisolated inputs, and output contacts: 2500 Vac for 10 seconds
Power supply: 3100 Vdc for 10 seconds



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