



SEL-387E Current Differential and Voltage Relay

Apply Dependable and Secure Transformer Protection

IEC 61850
Compatible



Protect two- or three-winding power transformers. Save capital investment using the voltage inputs for power and energy metering, overexcitation protection, and over- and underfrequency load shedding.

Features and Benefits

■ Protection

Avoid costly false trips by using innovative restraint and blocking elements. Save the cost for separate relays using built-in overexcitation and frequency elements.

■ Control

Simplify engineering designs for remote and local control systems with built-in pushbutton and remote switch logic.

■ Monitoring/Metering

Eliminate costly panel meters and transducers by using accurate metering and monitoring functions included in the relay.

■ Automation

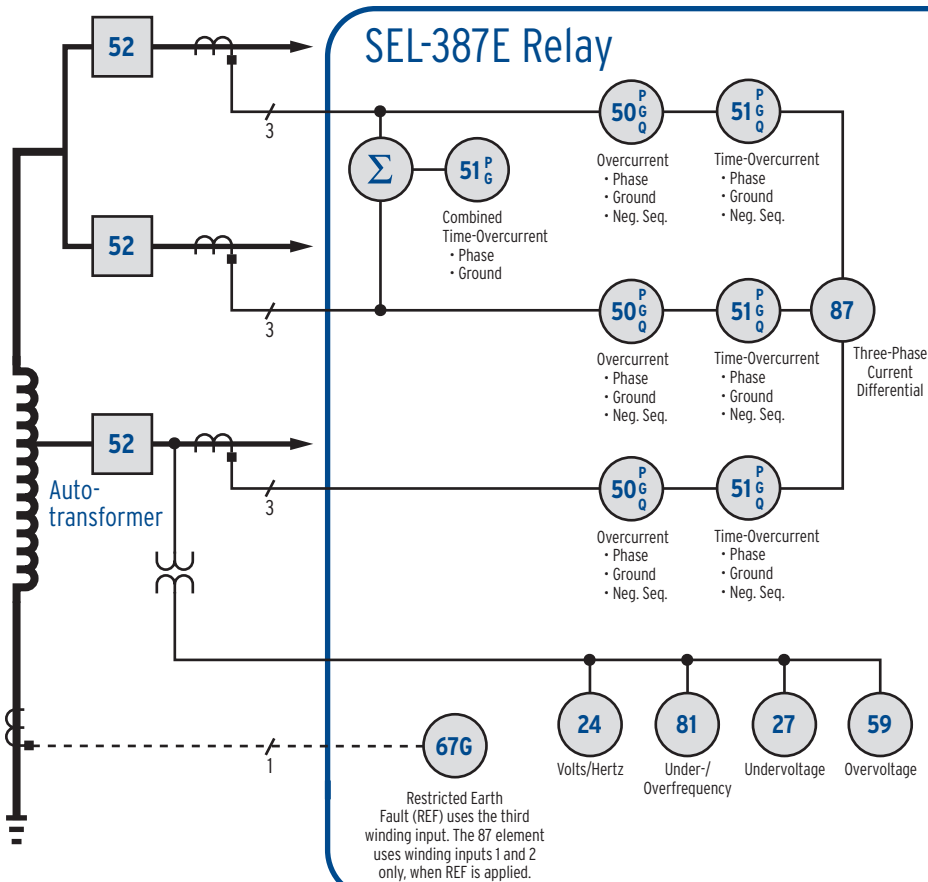
Reduce total project construction and operations costs by using programmable relay logic in place of separate, less reliable programmable logic controls.

■ Integration

Improve station integration with serial and Ethernet communications. Use IEC 61850 communications for interoperability between relays.

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

Functional Overview

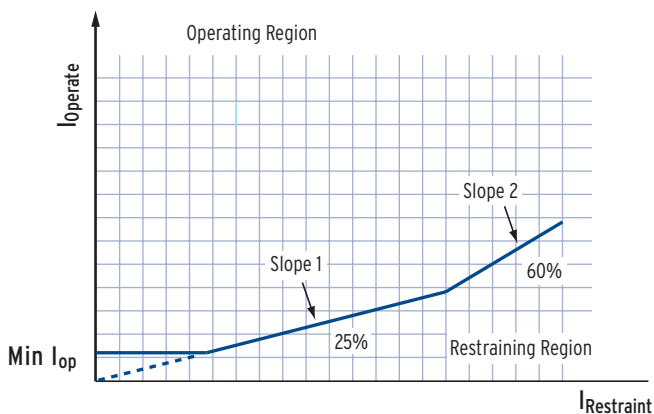


- SELogic® Control Equations
- Event Reports and Sequential Events Recorder
- Breaker Wear Monitor
- Station Battery Monitor
- ASCII, Binary, and Distributed Port Switch Communications
- Remote and Local Control Switches
- Accurate Metering Including Power, Frequency, and Energy
- Restrained and Unrestrained Differential Elements
- Second- and Fourth-Harmonic Blocking or Restraint
- DC and Fifth-Harmonic Blocking
- CT and Transformer Connection Compensation
- DNP3 Level 2 Slave Protocol*
- Ethernet Communications Port*
- IEC 61850 Protocol*
- Additional I/O*

* Optional Functions

Differential Protection

The SEL-387E Relay has three differential elements. These elements 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.



The SEL-387E Relay provides security against conditions that may result in relay misoperation, resulting from both system and transformer events. Use the fifth-harmonic element to prevent relay misoperation during allowable overexcitation conditions. Even harmonic elements (second and fourth harmonic) provide security against inrush currents during transformer energization, complemented by the dc element, which measures the dc offset. 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, as per application and philosophy. The second-, fourth-, and fifth-harmonic thresholds are set independently, and the dc blocking and harmonic restraint features are independently enabled.

Overcurrent Protection

Each of the three, three-phase current input terminals has a total of 11 overcurrent elements, nine of which are torque controlled. 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 power transformer.

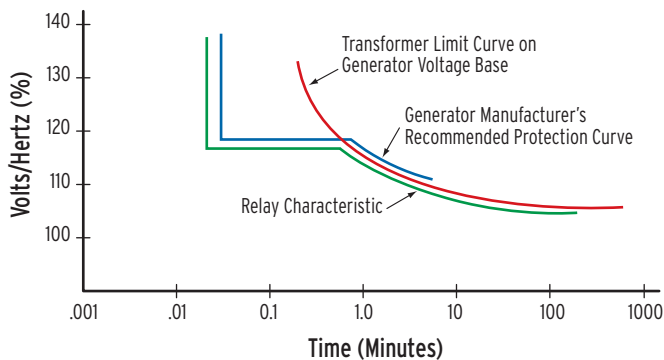
Restricted Earth Fault Protection

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

Volts-Per-Hertz Protection

Overexcitation occurs when the magnetic core of a power apparatus becomes saturated. When this happens, higher harmonic frequencies become more prominent, which results in overheating and consequent reduction of apparatus life. Overexcitation conditions are detected by a volts-per-hertz element in the SEL-387E Relay. 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.



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)

Use time-tagged sequential event messages recorded by the SEL-387E Relay to analyze the time relationships between assertion and deassertion of logical elements within the relay. Apply the relay with an SEL-2030 Communications Processor to quickly and automatically receive SER messages from the relay in an efficient binary format.

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.



Use integrated relay data for improved control.

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

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.

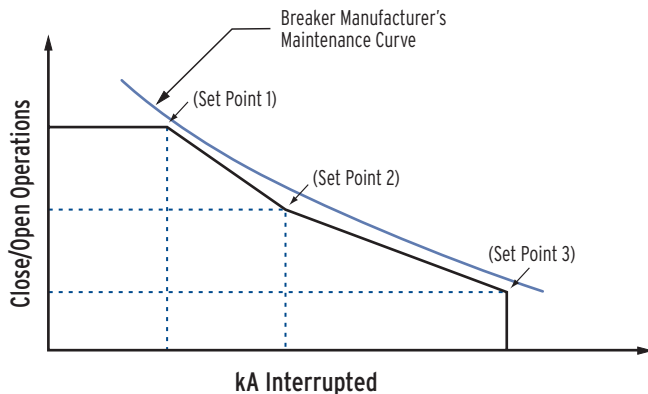
Advanced SELogic Control Equations

Advanced SELogic control equations put relay logic in the hands of the protection engineer. Assign relay inputs to suit the application. 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.

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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 that is related to the breaker manufacturer's maintenance curves.



General Specifications

AC Current Inputs (nine total)

1 A or 5 A I_{nom} (specify on order); 3 x I_{nom} continuous; 100 x I_{nom} one-second thermal rating; linear to 20 x I_{nom} symmetrical

AC Voltage Inputs (three total)

300 V_{L-N} three phase, four-wire connection

300 V_{L-N} continuous (connect any voltage from 0–300 Vac)

600 Vac for 10 seconds

Burden

0.27 VA @ I_{nom} for $I_{nom} = 5$ A; 0.13 VA @ I_{nom} for $I_{nom} = 1$ A

0.03 VA @ 67 V

0.06 VA @ 120 V

0.8 VA @ 300 V

Frequency and Phase Rotation

60/50 Hz system frequency and ABC/ACB phase rotation are user-settable

Output Contact Ratings (eight total, standard model)

30 A make per IEEE C37.90-1989 paragraph 6.7.2; 6 A continuous carry; MOV protected

Optoisolated Input Ratings (six total, standard model)

24, 48, 110, 125, 220, or 250 Vdc, level-sensitive (specify voltage when ordering)

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 port (specify 10BASE-T or 100BASE-FX* when ordering)

Time-Code Input

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

Power Supply Ratings

24/48 V 18–60 Vdc; <25 W

48/125 V 38–200 Vdc or 85–140 Vac; <25 W

125/250 V 85–350 Vdc or 85–264 Vac; <25 W

Operating Temperature

–40° to +85°C (–40° to +185°F)

Mounting Options

Horizontal rack-mount, horizontal panel-mount, and horizontal projection panel-mount versions available

Conformal Coating Option

Protect equipment from harsh environments, such as high humidity and airborne contaminants

Production Dielectric Strength Tests

V, I inputs, optoisolated inputs, and output contacts: 2500 Vac for 10 seconds

Power supply: 3100 Vdc for 10 seconds

*Eye-safe, Class 1 LED product per EN 60825-1



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