SEL-501 Dual Universal Overcurrent Relay

Major Features and Benefits

➤ Features two three-phase, current-based relays in one complete package.
➤ Protects feeders, buses, transformers, motors, breakers, and other apparatus.
➤ Is easily set from the front panel or communications port.
➤ Includes metering, self-testing, alarm, and event reporting.
➤ Saves 2 full reports and 20 summaries in nonvolatile memory.
➤ Makes redundant protection practical—ideal for stacked breaker switchgear.
➤ Includes low-level test interface.
➤ Supports ASCII, SEL LMD, Modbus, and Square-D SY/MAX protocol.
Features

Dual Relay Concept

The SEL-501 Dual Universal Overcurrent Relay provides two complete and independent groups of protection functions in one compact unit. The unit contains Relay X and Relay Y, each having separate optoisolated inputs, output contacts, and three-phase current inputs.

Five Relay Functions

Select the relay functions independently for Relays X and Y. Choose from five relay functions.

Table 1 Relay I/O and Current Inputs

<table>
<thead>
<tr>
<th>Relay</th>
<th>Input</th>
<th>Output Contacts</th>
<th>Current Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay X</td>
<td>XIN</td>
<td>XOUT1, XOUT2</td>
<td>IAX, IBX, ICX</td>
</tr>
<tr>
<td>Relay Y</td>
<td>YIN</td>
<td>YOUT1, YOUT2</td>
<td>IAY, IBY, ICY</td>
</tr>
</tbody>
</table>

Figure 1 Relay Application Single-Line Diagrams
SEL-501 Dual Relay Applications

Overcurrent Protection

The SEL-501 has two overcurrent protection setting options: FDR or OC1. Both options use the same overcurrent elements, but differ in input and output contact functions.
### Table 2  Overcurrent Settings and Ranges

<table>
<thead>
<tr>
<th>Eight Overcurrent Elements</th>
<th>Instantaneous</th>
<th>Definite-Time</th>
<th>Inverse-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase (Ia, Ib, and Ic)</td>
<td>50H</td>
<td>50PT</td>
<td>51PT</td>
</tr>
<tr>
<td>Negative-Sequence (IQ = 3 * I2)</td>
<td>50QT</td>
<td>51QT</td>
<td></td>
</tr>
<tr>
<td>Residual (IR = Ia + Ib + Ic)</td>
<td>50NH</td>
<td>50NT</td>
<td>51NT</td>
</tr>
<tr>
<td>Ranges (A secondary)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 A Model:</td>
<td>0.5–80 A, 0.1 step</td>
<td>0.5–80 A, 0.1 step</td>
<td>0.5–16 A, 0.1 step</td>
</tr>
<tr>
<td>1 A Model:</td>
<td>0.1–16 A, 0.1 step</td>
<td>0.1–16 A, 0.1 step</td>
<td>0.1–3.2 A, 0.1 step</td>
</tr>
<tr>
<td>Definite-Time Delay</td>
<td>0–16,000 cycles</td>
<td>US and IEC curves</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3  Overcurrent Contact Functions

<table>
<thead>
<tr>
<th>Setting</th>
<th>Input</th>
<th>Output Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDR</td>
<td>52A</td>
<td>TRIP (OUT1)—select any elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLOSE (OUT2)</td>
</tr>
<tr>
<td>OC1</td>
<td>Programmable—select one</td>
<td>Both trips have time-delay pickup timers, settable 0–16,000 cycles.</td>
</tr>
<tr>
<td></td>
<td>EN—Enable user-selected elements</td>
<td>TRIP1 (OUT1)—select any elements</td>
</tr>
<tr>
<td></td>
<td>BLK—Block user-selected elements</td>
<td>TRIP1 (OUT2)—select any elements</td>
</tr>
<tr>
<td></td>
<td>ET—External Trigger of event reports</td>
<td></td>
</tr>
</tbody>
</table>

### Motor Protection

### Table 4  Motor Protection Settings and Ranges

<table>
<thead>
<tr>
<th>Elements</th>
<th>Instantaneous</th>
<th>Definite-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase (Ia, Ib, and Ic)</td>
<td>50H</td>
<td>50PT</td>
</tr>
<tr>
<td>Negative-Sequence (IQ = 3 * I2)</td>
<td>50QT</td>
<td></td>
</tr>
<tr>
<td>Residual (IR = Ia + Ib + Ic)</td>
<td>50NH</td>
<td>50NT</td>
</tr>
<tr>
<td>Ranges (A secondary)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 A Model:</td>
<td>0.5–80 A</td>
<td>0.5–80 A</td>
</tr>
<tr>
<td>1 A Model:</td>
<td>0.1–16 A</td>
<td>0.1–16 A</td>
</tr>
<tr>
<td>Definite-Time Delay</td>
<td>0–16,000 cycles</td>
<td></td>
</tr>
</tbody>
</table>

Thermal Model (49) provides locked-rotor, unbalance and overload protection.

Motor operation monitors include load-jam trip, load-loss trip, and a starts per-hour limit.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>52A</td>
<td>TRIP (OUT1)</td>
</tr>
<tr>
<td></td>
<td>CLOSE (OUT2)</td>
</tr>
</tbody>
</table>
Breaker Failure Protection

Table 5  Breaker Failure Protection Settings and Ranges

<table>
<thead>
<tr>
<th>Instantaneous Overcurrent Elements</th>
<th>Breaker Failure Timer (62FC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase (Ia, Ib, and Ic)</td>
<td>50PP</td>
</tr>
<tr>
<td>Residual (IR = Ia + Ib + Ic)</td>
<td>50NP</td>
</tr>
<tr>
<td>Ranges (A secondary)</td>
<td></td>
</tr>
<tr>
<td>5 A Model:</td>
<td>0.5–80 A</td>
</tr>
<tr>
<td>1 A Model:</td>
<td>0.1–16 A</td>
</tr>
<tr>
<td>Maximum Reset Time</td>
<td>0.75 cycles</td>
</tr>
</tbody>
</table>

Input

BFI—Breaker Failure Initiate

Output Contacts

86TR—Breaker Failure Trip (OUT1)
RETRIP—Breaker Retrip (OUT2)

Note: The BFI input latch (seal-in) is optional via setting.

Figure 3  SEL-501 Relay Breaker Failure Logic

General-Purpose Timer

Timer Ranges (62 Device)

- Pickup: 0–16,000 cycles
- Dropout: 0–16,000 cycles

The timers are completely independent of the relay current inputs.

Figure 4  SEL-501 Relay General-Purpose Timer

Operation, Metering, and Communications

- Complete operation from front-panel controls or rear-panel serial port.
- Full access to event history, relay status, and meter information.
- Instantaneous, demand, and peak demand currents metered.
- Settings and control have passcode protection.
- One serial port for two relays cuts communications burden in half.
- Modbus RTU protocol supports direct integration, via appropriate gateways, into SCADA or DCS systems.

Event Reporting

- Relay stores 12 reports: newest two are in nonvolatile memory.
- Reports have 15-cycle duration and quarter-cycle resolution.
- Unique event headers for each application.
**Figure 5 Example Event Report**

**Event:** FAULT X  
**Targets:** X B C Q  
**Duration:** 11.00

**Relay X Settings:**  
ID = FEEDER 1  
APP = FDR  
CTR = 120  
DATC = 15  
S0PP = 15.5  
S0PD = 20.00  
S0DH = 40.0  
S0DP = 10.8  
S00D = 18.00  
S0NP = 4.3  
S0ND = 15.00  
S0NH = 18.0  
S1PP = 7.50  
S1PC = U4  
S1PTD = 3.20  
S1PRS = N  
S1OP = 5.00  
S1OC = U4  
S1OTD = 1.10  
S1ORS = N  
S1NP = 2.25  
S1NC = U4  
S1NTD = 2.00  
S1NRS = N

**Relay Y Settings:**  
ID = BFR 1  
APP = BFR  
CTR = 120  
DATC = 15  
S0PP = 4.0  
S0NP = 2.0  
FC = 10.50  
ERTR = N

---

**Event Summary**

- Breaker Failure Initiate input is asserted, starting breaker failure timer.  
- Relay Y 50PP element is picked up.  
- Relay X 51PT and 51QT time-overcurrent elements pick up for BC fault, triggering this report. Breaker is closed.

---

**Time tag corresponds to the 8th quarter-cycle of this event.**
Two Rear-Panel Options

Conventional Terminal Blocks

Output contacts XOUT1, XOUT2, YOUT1, YOUT2, and ALARM are not polarity-dependent.

Optoisolated inputs XIN and YIN are not polarity-dependent.

All screws are size #6-32.

Connectorized Relay (Plug-In Connectors)

Important: Improvements in Connectorized® SEL-501 relays (Plug-In Connectors) resulted in part number changes.

The current transformer shorting connectors for current channel inputs IAX, IBX, ICX, and IAY, IBY, ICY have been made more robust. This improvement makes the new connector design incompatible with the old design. Thus, new Connectorized SEL-501 relays with this improved connector have a new part number (partial part numbers shown):

Old
0501xJ
New
0501xW

The respective wiring harness part numbers for these old and new Connectorized SEL-501 relays are (partial part numbers shown):

Old
WA0501xJ
New
WA0501xW
Figure 7 shows the rear panel for new models 0501xW. Because all terminal/numbering remains the same between the new and old relays, these figures can also be used as a reference for old model 0501xJ. Only the connectors and part numbers have changed.

Connector terminals A01–A16 accept wire size AWG 24 to 12 (install wires with a small slotted screwdriver).

Output contacts XOUT1, XOUT2, YOUT1, YOUT2, and ALARM are polarity-dependent (note the + above terminal A02, A04, A06, A08, and A10).

See Specifications on page 14 for high-current interrupting output contact ratings.

Optoisolated inputs XIN and YIN are not polarity-dependent.

Current input connector (terminals Z01–Z12):

➤ Contains current transformer shorting mechanisms
➤ Accepts wire size AWG 16 to 10 (special tool required to attach wire to connector)
➤ Can be ordered prewired

Ground connection (terminal Z13): tab size 0.250 inch • 0.032 inch, screw size #6-32.
Front- and Rear-Panel Diagrams

SEL-501 Relay Fitted With Mounting Bracket (SEL P/N 9100) for Mounting in 19-Inch Rack

SEL-501 Relay Front Panel, Rack-Mount Version (Half-Rack Width)

SEL-501 Relay Front Panel, Panel-Mount Version

Figure 8  SEL-501 Front Panels
Figure 9 SEL-501 Rear-Panel Diagrams
Figure 10  SEL-501 Dimensions and Drill Plan for Single Rack-Mounted Relay
Figure 11  Relay Dimensions and Drill Plan for Mounting Two SEL-500 Series Relays Together Using Mounting Block (SEL P/N 9101)
RACK-MOUNT CHASSIS

Figure 12  Relay Dimensions and Drill Plan for Mounting an SEL-501 Relay with Rack Mount Bracket 9100 (bracket on right side front view)

*ADD 0.80 (20.3) FOR CONNECTORIZED RELAYS

i9028a

Schweitzer Engineering Laboratories, Inc.
Specifications

Compliance

Designed and manufactured under an ISO 9001 certified quality management system

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

CE Mark

RCM Mark

Note: 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.

General

Terminal Connections

Terminals or stranded copper wire. Ring terminals are recommended. Minimum temperature rating of 105°C.

Tightening Torque

Terminal Block

Minimum: 1.1 Nm (9-in-lb)
Maximum: 1.3 Nm (12-in-lb)

Connectorized

Minimum: 0.6 Nm (5-in-lb)
Maximum: 0.8 Nm (7-in-lb)

AC Current Inputs

5 A nominal: 15 A continuous, 500 A for 1 s, linear to 100 A symmetrical. 625 A for 1 cycle (sinusoidal waveform)

Burden: 0.16 VA at 5 A
1.15 VA at 15 A

1 A nominal: 3 A continuous, 100 A for 1 s, linear to 20 A symmetrical. 250 A for 1 cycle (sinusoidal waveform)

Burden: 0.06 VA at 1 A
0.18 VA at 3 A

Note: 60/50 Hz system frequency and ABC/ACB phase rotation are ordering options.

Power Supply

24 Vdc

Range: 16–36 Vdc polarity-dependent
Burden: <5.5 W
Interruption: 25 ms at 36 Vdc
Ripple: 5%


Output Contacts

The output type is dependent on the rear-panel terminal type. Output ratings were determined with IEC 60255-0-20:1974, using the simplified method of assessment.

Standard (Conventional Terminal Block Option)

Make: 30 A
Carry: 6 A continuous carry
1 s Rating: 100 A
MOV Protection: 270 Vac/360 Vdc
Pickup Time: <5 ms
Dropout Time: <5 ms

Breaking Capacity (10000 operations)

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

Cyclic Capacity (2.5 cycle/second)

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

High Current Interrupting (Plug-In Connectors Option)

Make: 30 A
Carry: 6 A continuous carry
MOV Protection: 330 Vdc
Pickup Time: <5 ms
Dropout Time: <8 ms, typical
Update Rate: 1/8 cycle

Breaking Capacity (10000 operations)

24 V 10.0 A L/R = 40 ms
48 V 10.0 A L/R = 40 ms
125 V 10.0 A L/R = 40 ms
250 V 10.0 A L/R = 20 ms

Cyclic Capacity (4 cycles in 1 second followed by 2 minutes idle for thermal dissipation)

24 V 10.0 A L/R = 40 ms
48 V 10.0 A L/R = 40 ms
125 V 10.0 A L/R = 40 ms
250 V 10.0 A L/R = 20 ms

Note: Do not use high-current interrupting output contacts to switch ac control signals. These outputs are polarity-dependent.


Optoisolated Inputs

The input type is dependent on the rear-panel terminal type. “Level-sensitive” inputs differ from “standard” jumper-selectable inputs in that they are guaranteed to deassert below a certain voltage level and they are not user-settable. The inputs are not polarity-dependent. With nominal control voltage applied, each input draws approximately 4 mA of current.
**Jumper-Selectable (Conventional Terminal Blocks Option)**
The conventional terminal block model is equipped with jumper-selectable inputs. Both inputs may be individually user-configured to operate on any of the following nominal voltages:
- 24 Vdc: on for 15–30 Vdc
- 48 Vdc: on for 30–60 Vdc
- 125 Vdc: on for 80–150 Vdc
- 250 Vdc: on for 150–330 Vdc

**Level-Sensitive (Conventional Terminal Blocks Option)**
Both inputs can be individually user-configured to operate on any of the following nominal voltages:
- 48 Vdc: on for 38.4–60 Vdc; off below 28.8 Vdc
- 110 Vdc: on for 88–132 Vdc; off below 66 Vdc
- 125 Vdc: on for 105–150 Vdc; off below 75 Vdc
- 220 Vdc: on for 176-264 Vdc; off below 132 Vdc
- 250 Vdc: on for 200–300 Vdc; off below 150 Vdc

**Level-Sensitive (Plug-In Connectors Option)**
The plug-in connectors model is equipped with fixed “level-sensitive” inputs. Both inputs are factory-configured to the control voltage specified at time of ordering. Please note that the 24 Vdc option is not available as “level-sensitive.”
- 24 Vdc: on for 15–30 Vdc
- 48 Vdc: on for 38.4–60 Vdc; off below 28.8 Vdc
- 110 Vdc: on for 88–132 Vdc; off below 66 Vdc
- 125 Vdc: on for 105–150 Vdc; off below 75 Vdc
- 250 Vdc: on for 200–300 Vdc; off below 150 Vdc

**Serial Communications**
- **Rear Panel:** 9-pin sub-D connector
- **Baud Rate:** 300–38400 baud

**Protocols**
- **Serial Port Protocols:** ASCII
  - Distributed Port Switch Protocol (LMD)
  - Modbus RTU (baud rate limited to 19200; only available in SEL-501 Relay)
  - SY/MAX (only available in SEL-501-1 Relay)

**Metering Functions**
- Instantaneous and Demand Ammetering functions.
- Measurement Accuracy: ±2%

**Breaker Monitor**
- Relay counts trip operations and accumulates interrupted current on a pole-by-pole basis.

**Routine Dielectric Test**
- **Current Inputs:** 2500 Vac for 10 s
- **Power Supply, Optoisolated Inputs, and Output Contacts:** 3000 Vdc for 10 s
- The following IEC 60255-5:1977 dielectric test is performed on all units with the CE mark:
  - 2500 Vac for 10 seconds on analog inputs.
  - 3100 Vdc for 10 seconds on power supply, optoisolated inputs, and contact inputs.

**Operating Temperature**
- –40° to +85°C (–40° to +185°F)

**Dimensions**
- 8.81 cm x 21.59 cm x 23.37 cm (3.47" x 8.5" x 9.2" ) (H x W x D)

**Type Tests**

**Environmental Tests**
- **Cold:** IEC 60068-2-1:1990 [EN 60068-1-1:1993]
  - Test Ad: 16 hr at –40°C
- **Damp Heat, Steady State:** IEC 60068-2-3:1969
  - Test Ca; 96 hours at +40°C, 93% RH
- **Damp Heat, Cyclic:** IEC 60068-2-30:1980
  - Test Db; 25° to 55°C, 6 cycles, 95% humidity
  - Test Bd: 16 hr at +85°C

**Dielectric Strength and Impulse Tests**
- **Dielectric:** IEC 60255-5:1977
  - IEEE C37.90-1989
  - 2500 Vac on analogs, contact inputs, and contact outputs;
  - 100 Vdc on power supply; 2200 Vdc on EIA-485 communications port
- **Impulse:** IEC 60255-5:1977
  - 0.5 J, 5000 V

**Electrostatic Discharge Test**
- **ESD:** IEC 60255-22:1996
  - IEC 60801-2:1991 Level 4

**RFI and Interference Tests**
- **Fast Transient Burst:** IEC 60801-4:1988
  - Level 4 (4 kV on power supply, 2 kV on inputs and outputs)
- **Fast Transient Disturbance:** IEC 60255-22-4:1992
  - IEC 60801-2:1991 Level 4
- **Radiated EMI:** IEC 60255-22-3:1989, 10 V/m
- **Surge Withstand:** IEEE C37.90.1-1989
  - 3.0 kV oscillatory; 5.0 kV fast transient

**Vibration and Shock Tests**
- **Shock and Bump:** IEC 60255-21-2:1992 Class 2
  - IEC 60255-21-3:1993 Class 2
- **Sinusoidal Vibration:** IEC 60255-21-1:1988 Class 2

**Object Penetration**
- **Object Penetration:** IEC 60529:1989
  - IP3X

**Weight**
- 2.6 kg (5 lb, 12 oz)
Technical Support

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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