SEL-501-2 Distribution Relay

Dual Overcurrent Relay

Major Features and Benefits

➤ Features two three-phase current-based relays in one compact package.
➤ Protects feeders, buses, and other apparatus.
➤ Is easily set from the front panel or communications port.
➤ Includes metering, self-testing, 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, and Modbus protocol.
Features

Dual Relay Concept

The SEL-501-2 Dual 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.

SEL-501-2 Dual Relay Applications

- Complete overcurrent and simple breaker failure protection for two feeders.
- Settable time delay on trip output contact provides simple breaker failure protection.
- Low-cost, compact protection.

- Ideal for two-high switchgear.
- Front-panel controls eliminate the need for manual control switches.
- Includes negative-sequence overcurrent protection for sensitive, fast phase-to-phase fault coverage.

Figure 1  Example SEL-501-2 Dual Relay Applications

Overcurrent Element Specifications

Table 2  Overcurrent Element Specifications

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

Control the SEL-501-2 overcurrent elements with either the optoisolated input IN or serial port remote bit RB. Any given overcurrent element can be enabled/blocked by the optoisolated input IN or remote bit RB, but not by both at the same time.

Relay Control by Input IN
Program input IN to function as one of the following:

<table>
<thead>
<tr>
<th>IN</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN</td>
<td>Enable user-selected elements</td>
</tr>
<tr>
<td>BLK</td>
<td>Block user-selected elements</td>
</tr>
<tr>
<td>ET</td>
<td>External Trigger of event reports</td>
</tr>
</tbody>
</table>

Relay Control by Remote Bit RB
Program individual overcurrent elements for control by remote bit RB. Enable/disable the specified overcurrent elements by deasserting/asserting remote bit RB via serial port command.

Relay Output Contact Functions

- TRIP1 (OUT1)—select any overcurrent elements
- TRIP2 (OUT2)—select any overcurrent elements

Both trips have time-delayed pickup timers, settable 0–16,000 cycles.

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
- Metering of instantaneous, demand, and peak demand currents
- Passcode protection of settings and control
- Communications burden reduced by sharing one serial port between two relays
- Modbus RTU protocol support for direct integration, via appropriate gateways, into SCADA or DCS systems

Event Reporting

The SEL-501-2 saves a 15-cycle event report each time the OUT1 or OUT2 output contact closes, or when any of several protection elements pick up for Relay X or Relay Y. Each event report contains detailed current, relay element, input, and output data associated with the event. Use the information contained in the relay event reports to review relay operation during faults and tests.

The relay stores event summaries for the 20 latest events and full-length reports for the 12 latest events.

Event Triggering

The relay generates an event report when any of the following occurs:

- Serial port TRIGGER command is executed
- Relay X or Relay Y issues a trip
- Definite-time or inverse-time overcurrent element triggers

The relay generates a second report for a single fault if either relay trips after the end of the initial report. This allows the relay to record the inception and clearance of faults.

Event Summary

Each time the relay generates an event report, it also generates an event summary. Event summaries contain the following information:

- Relay X and Relay Y identifier strings
- Date and time when the event was triggered
- Event type and duration
- Tripping targets for the relay that triggered the event
- Current magnitudes measured by Relay X and Relay Y at the trigger instant
Figure 3  Example Event Report
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)

The respective wiring harness part numbers for these old and new Connectorized SEL-501-2 relays are (partial part number shown):

<table>
<thead>
<tr>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA0501xJ</td>
<td>WA0501xW</td>
</tr>
</tbody>
</table>

Figure 5 shows the rear panel for new models 0501xW. Because all terminal/numbering remains the same between the new and old relays, these figures can 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 terminals A02, A04, A06, A08, and A10).

See Specifications for high-current interrupting output contact ratings.

Optoisolated inputs XIN and YIN are not polarity-dependent.

Current input connectors (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 x 0.032 inch, screw size #6-32.
Figure 6  SEL-501-2 Front Panels
Figure 7 SEL-501-2 Rear-Panel Diagrams
Figure 8 SEL-501-2 Dimensions for Rack- and Panel-Mount Models
Figure 9  Relay Dimensions and Drill Plan for Mounting Two SEL-500 Series Relays Together Using Mounting Block (SEL P/N 9101)

Figure 10  Relay Dimensions and Drill Plan for Mounting an SEL-501-2 Relay With Rack-Mount Bracket 9100 (bracket on right side front view)
Specifications

Compliance
Designed and manufactured under an ISO 9001 certified quality management system
UL Listed to US 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
125/250 Vdc or Vac
Range: 85–350 Vdc or 85–264 Vac
Burden: <5.5 W
 Interruption: 100 ms at 250 Vdc
Ripple: 100%

48/125 Vdc or 125 Vac
Range: 36–200 Vdc or 85–140 Vac
Burden: <5.5 W
 Interruption: 100 ms at 125 Vdc
Ripple: 5%

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

Note: Interruption and Ripple per IEC 60255-11:1979.

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 Blocks 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

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. “Levelsensitive” 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.

Schweitzer Engineering Laboratories, Inc.
SEL-501-2 Data Sheet
Conventional Terminal Blocks Option
The conventional terminal block model is can be ordered with either jumper-selectable voltage optoisolated inputs or level-sensitive optoisolated inputs.

Jumper-Selectible Control Voltage:
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 150–300 Vdc

Level-Sensitive
Both inputs are factory-configured for a fixed voltage level that cannot be changed:

- **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

Plug-In Connectors Option
Standard (Non-Level-Sensitive):
- **24 Vdc:** on for 15–30 Vdc

Level-Sensitive:
The plug-in connectors model is equipped with fixed “level-sensitive” inputs. Both inputs are factory configued to the control voltage specified at time of ordering:

- **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

Serial Communications
Rear Panel: 9-pin sub-D connector
Baud Rate: 300–38400 baud; selectable baud rate and data bit protocol

Protocols
Serial port protocols: ASCII Distributed Port Switch Protocol (LMD) Modbus RTU (baud rate limited to 19200)

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 Strength
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 outputs.

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)

Weight
2.6 kg (5 lb, 12 oz)

Type Tests

Environmental Tests
Cold: IEC 60668-2-1:1990 [EN 60668-1-1:1993]
Test Ad; 16 hr at −40°C
Test Ca; 96 hours at +40°C, 93% RH
Damp Heat, Cyclic IEC 60688-2-30:1980
Test Db; 25° to 55°C, 6 cycles, 95% humidity
[EN 60688-2-2:1993]
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
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 60255-21-2:1988 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
Technical Support

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

Schweitzer Engineering Laboratories, Inc.
2350 NE Hopkins Court
Pullman, WA 99163-5603 U.S.A.
Tel: +1.509.338.3838
Fax: +1.509.332.7990
Internet: selinc.com/support
Email: info@selinc.com