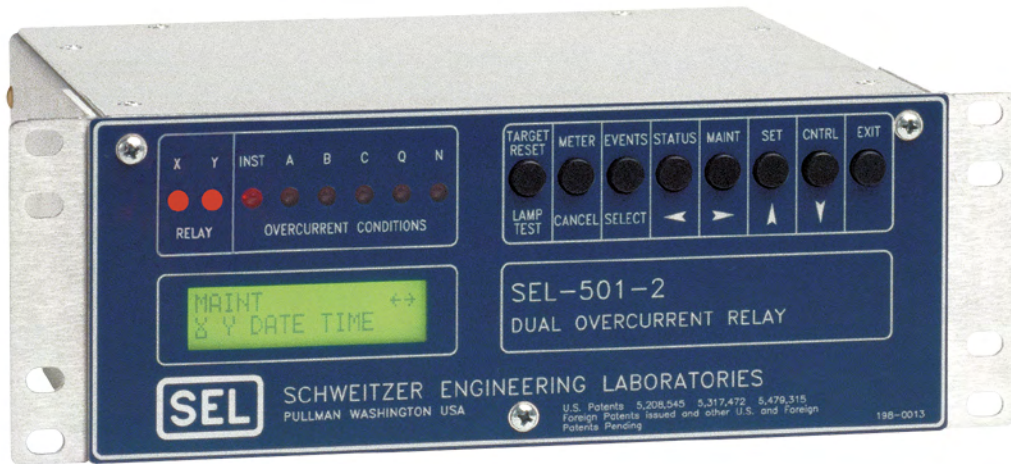




SEL-501-2 Distribution Relay

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 two 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

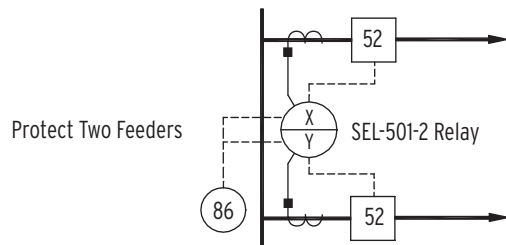
The SEL-501-2 Dual Overcurrent Relay provides two complete and independent groups of protection functions in one compact unit. The unit contains Relay X and Relay Y, each having separate optoisolated inputs, output contacts, and three-phase current inputs.

Table 1 Inputs and Outputs for Relays X and Y

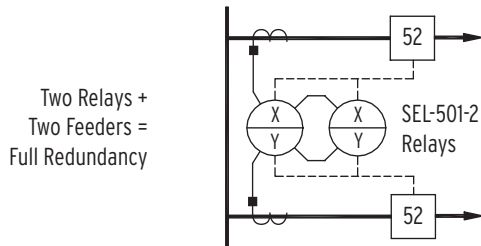
	Input	Output Contacts	Current Inputs
Relay X	XIN	XOUT1, XOUT2	IAX, IBX, ICX
Relay Y	YIN	YOUT1, YOUT2	IAY, IBY, ICY

Select the relay functions independently for Relays X and Y.

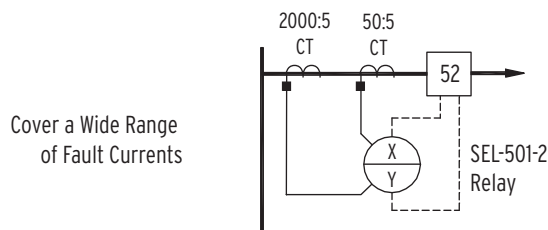
SEL-501-2 Dual Relay Applications



- 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.



- 2000:5 CT covers fault up to 32,000 amps (5 A Model).
- 50:5 CT meters load accurately, and covers faults down to 5 amps primary (5 A Model).

Figure 1 Example SEL-501-2 Dual Relay Applications

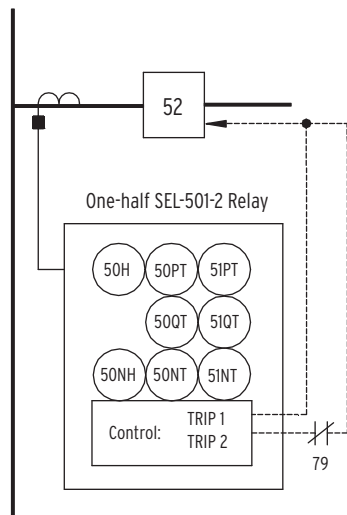
Overcurrent Element Specifications

Table 2 Overcurrent Element Specifications (Sheet 1 of 2)

	Instantaneous Elements	Definite-Time Elements	Inverse-Time Elements
Phase (Ia, Ib, and Ic)	50H	50PT	51PT
Negative-Sequence ($I_Q = 3 \cdot I_2$)		50QT	51QT
Residual ($I_R = I_a + I_b + I_c$)	50NH	50NT	51NT

Table 2 Overcurrent Element Specifications (Sheet 2 of 2)

	Instantaneous Elements	Definite-Time Elements	Inverse-Time Elements
Pickup Ranges (A secondary)			
5 A Model:	0.5–80 A, 0.1 step	0.5–80 A, 0.1 step	0.5–16 A, 0.1 step
1 A Model:	0.1–16 A, 0.1 step	0.1–16 A, 0.1 step	0.1–3.2 A, 0.1 step
Definite-Time Delay		0–16,000 cycles	US and IEC curves

**Figure 2** Relay Application Single-Line Diagram

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:

IN = EN	EN—Enable user-selected elements
IN = BLK	BLK—Block user-selected elements
IN = ET	ET—External Trigger of event reports

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

EXAMPLE FD Date: 06/02/97 Time: 16:04:50.541 Time tag corresponds to the eighth quarter-cycle of this event.

FID=SEL-501-2-R100-V65X1XXpa-D950426

Relay X				Relay Y				Relay X			Relay Y			A		
Amps Pri				Amps Pri				555555	0	555555	0	L				
IRX	IAX	IBX	ICX	IRY	IAY	IBY	ICY	PQNPN	NT	PQNPN	NT	IUR	IR			
-2	86	206	-294	-0	124	208	-332	.....	..	.....	..	..	..	|
-0	-288	220	68	-3	-313	265	46	.....	..	.....	..	..	..	|
0	-86	-206	292	-1	-125	-207	331	.....	..	.....	..	..	..	|
0	288	-220	-67	2	313	-265	-46	.....	..	.....	..	..	..	|
One cycle of data																
-2	86	205	-293	1	126	206	-332	.....	..	.....	..	..	..	|
-2	-288	220	66	-4	-314	265	46	.....	..	.....	..	..	..	|
2	-87	-206	294	-2	-126	-207	331	.....	..	.....	..	..	..	|
-480	-191	-220	-69	-42	270	-265	-47>	.....	..	.....	..	..	..	|
Relay X 51N element picks up, triggering this report																
1203	1291	206	-295	11	136	206	-332	p.n...	..	.....	..	..	..	|
584	297	219	69	124	-188	265	48	p.n...	..	.....	..	..	..	|
-2758	-2846	-207	294	-27	-152	-207	331	p.n..n	..	.....	..	..	..	|
-215	73	-219	-69	-165	149	-265	-48	p.n..n	..	.....	..	..	..	|
Relay X 51P, 51N, 50P, and 50N elements are picked up. The 50NH element picks up, causing a trip. Elements XOUT1 and XOUT2 both close.																
3110	3199	206	-295	32	157	206	-332	p.np.H	.b	.....	..	..	..	|
213	-75	219	69	164	-148	265	47	p.np.H	.b	.....	..	..	..	|
-3114	-3200	-207	294	-34	-157	-208	331	pqnp.H	.b	.....	..	..	..	|
-210	77	-219	-68	-164	149	-265	-47	pqnp.H	.b	.....	..	..	..	|
[Four cycles of data]																
1910	1956	130	-176	21	147	208	-334	pqn.qn	.b	.....	..	..	..	|
-372	-458	27	58	37	-277	264	50	pqn.qn	.b	.....	..	..	..	|
-350	-352	-28	30	-7	-131	-209	332	..n...	.b	.....	..	..	..	|
0	0	0	0	2	315	-264	-50	..n...	.b	.....	..	..	..	|
Breaker operates, clearing the fault.																

[Six cycles of data]
 Event: FAULT X Targets: X INST A N Duration: 7.25
 Relay X Currents (A Pri), ABCQN: 210 301 302 479 481
 Relay Y Currents (A Pri), ABCQN: 298 336 334 40 42

Event Summary

Relay X Settings:
 ID = EXAMPLE FD
 CTR = 120 DATC = 5 IN = ET
 50PP = 25.0 50PD = 20.00 50PTT = B
 50H = 40.0 50HT = B
 50QP = 15.0 50QD = 20.00 50QTT = B
 50NP = 15.0 50ND = 20.00 50NTT = B
 50NH = 25.0 50NHT = B
 51PP = 6.00 51PC = U3 51PTD = 3.00
 51PRS = Y 51PTT = B
 51QP = 6.00 51QC = U3 51QTD = 3.00
 51QRS = Y 51QTT = B
 51NP = 1.50 51NC = U3 51NTD = 3.00
 51NRS = Y 51NTT = B
 TRPU1 = 0.00 TDUR1 = 6.00
 TRPU2 = 0.00 TDUR2 = 6.00
 ELTCH = Y

Relay X Settings

IN: External Trigger
 TRIP1: 51PT, 51QT, 51NT, 50PT, 50H, 50QT, 50NT, 50NH
 TRIP2: 51PT, 51QT, 51NT, 50PT, 50H, 50QT, 50NT, 50NH

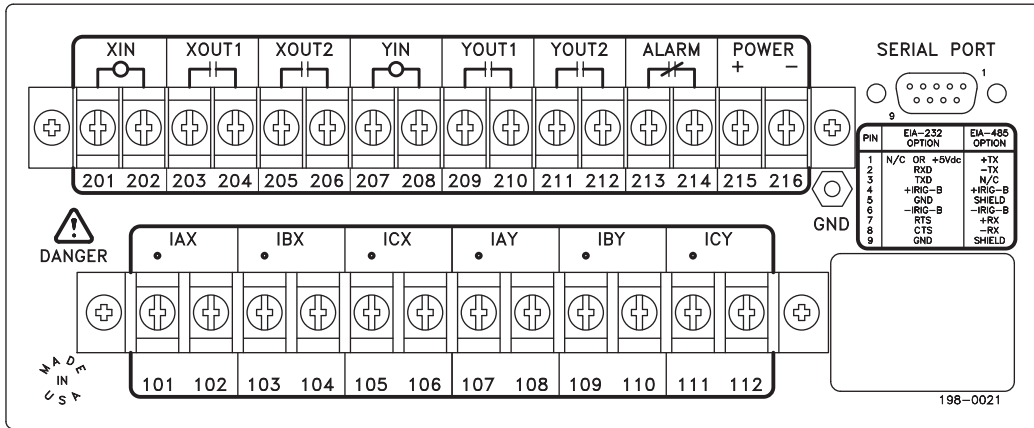
Input and output function summary, defined by relay settings.

Relay Y Settings: [similar to Relay X settings, above]

Figure 3 Example Event Report

Rear-Panel Options

Conventional Terminal Blocks



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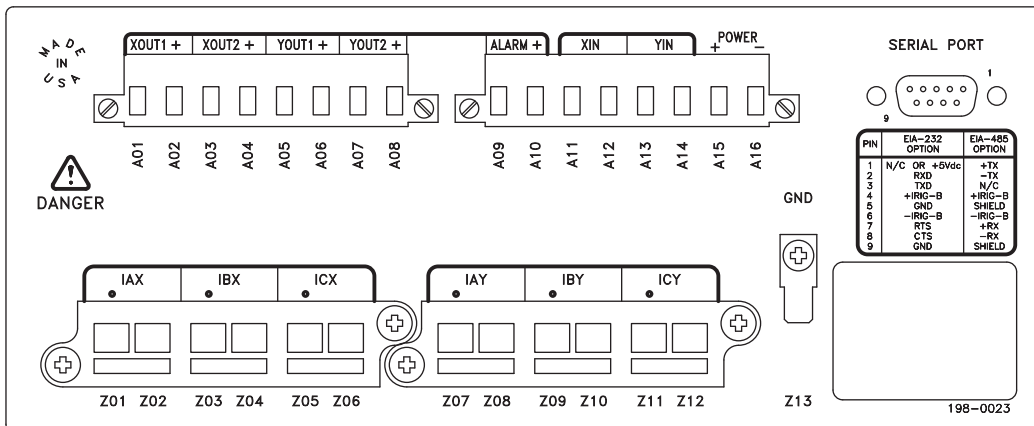
Figure 4 SEL-501-2 Relay Rear Panel (Conventional Terminal Blocks Option)

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)



i3034a

Figure 5 SEL-501-2 Relay Rear Panel (Plug-In Connectors Option)

Important: Improvements in Connectorized[®] SEL-501-2 relays (Plug-In Connectors) resulted in part number changes.

Old	New
0501xJ	0501xW

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-501-2 relays with this improved connector have a new part number (partial part number shown).

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

Old	New
WA0501xJ	WA0501xW

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.

Guideform Specification

The microprocessor-based relay shall provide a combination of functions including protection, monitoring, control, and automation. Relay self-checking functions shall be included. Specific operational and functional requirements are as follows.

Dual Relay Configuration. The relay shall have two independent sets of three-phase current inputs (X and Y) sharing a common data acquisition system, microprocessor, power supply, and alarm. Each set of current inputs and digital I/O shall independently protect, monitor and control its respective power system application. For each set of current inputs, there shall be one contact input and two contact outputs.

Overcurrent Protection. The relay shall have two overcurrent application settings for relays X and Y, respectively. Selection of overcurrent applications from the operator interface shall determine utilization of input and output contacts. Relay X and Y shall have eight overcurrent elements consisting of phase, negative-sequence, and ground protection elements. The time-overcurrent elements shall be comprised of four US and four IEC-type curves.

Adaptive Phase Overcurrent Elements. The relay shall incorporate adaptive phase overcurrent elements that perform reliably in the presence of current transformer saturation, DC offset, and off-frequency harmonics.

Motor Protection. Each relay shall protect motors using a patented thermal model capable of accounting for the thermal effects of both positive- and negative-sequence current. The motor protection application shall trip to prevent overheating for abnormal conditions of overload, locked rotor

starting, frequent or prolonged starts, and unbalanced current.

Application Settings and Security. The relay shall have a user interface with application settings that include feeder protection (FDR), overcurrent protection (OC1), motor protection (MOT), breaker failure protection (BFR), and a general-purpose timer (TMR)*. The relay shall have two levels of user-controlled password protection.

Event Reporting. The relay shall store five of the latest 15-cycle events, and event summaries for the latest twenty events. The event information shall present measured quantities for relay X and Y, respectively. The latest event shall be stored in nonvolatile memory.

Communication and Protocol. The relay shall be equipped with a serial interface capable of hosting Modbus[®] RTU, SEL ASCII, SEL Distributed Port Switch (LMD), and/or SY/MAX protocols. Data rates shall range from 300 to 38,400 baud. Hardware options shall include either an EIA-232 or EIA-485 serial interface.

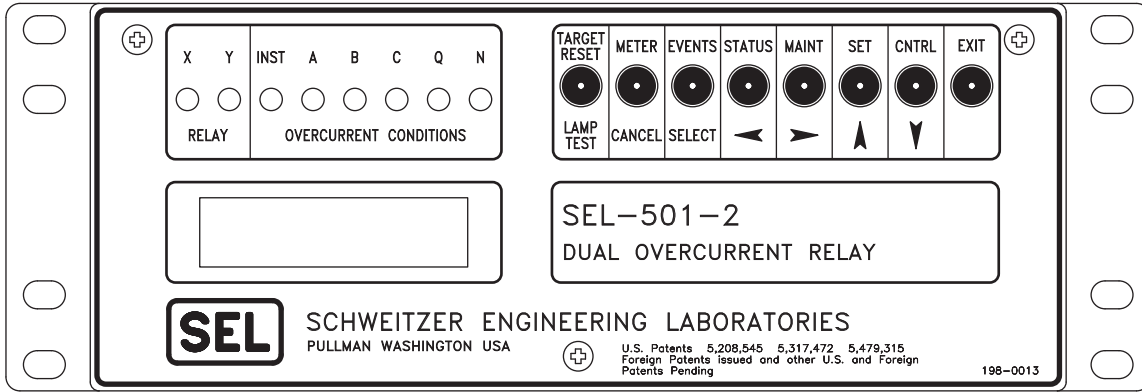
Temperature Rating. The relay shall be capable of withstanding operating temperatures ranging from -40° to $+85^{\circ}\text{C}$ (-40° to $+185^{\circ}\text{F}$).

Packaging. The relay shall have physical dimensions not to exceed 221 mm wide, 208.3 mm deep, and 88.1 mm high.

Warranty. The relay shall be covered by a ten-year product warranty.

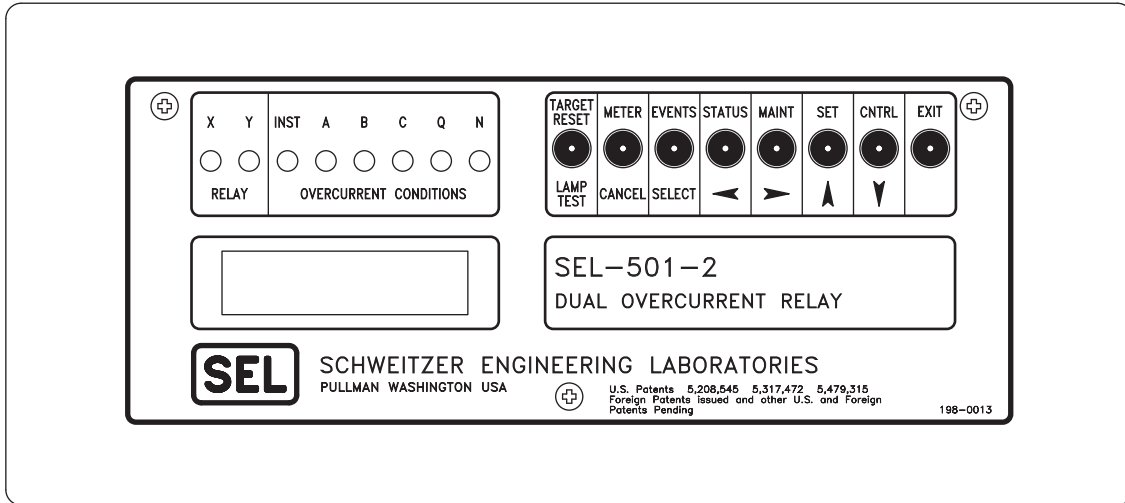
* The SEL-501-2 is equipped with the OC1 function only.

Front- and Rear-Panel Diagrams



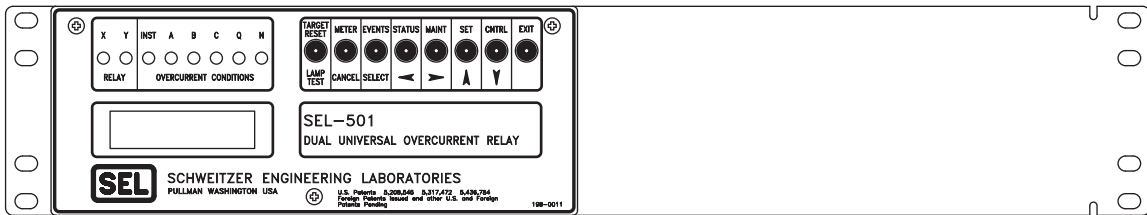
SEL-501-2 Relay, Rack-Mount Version (Half-Rack Width)

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SEL-501-2 Relay Front Panel, Panel-Mount Version

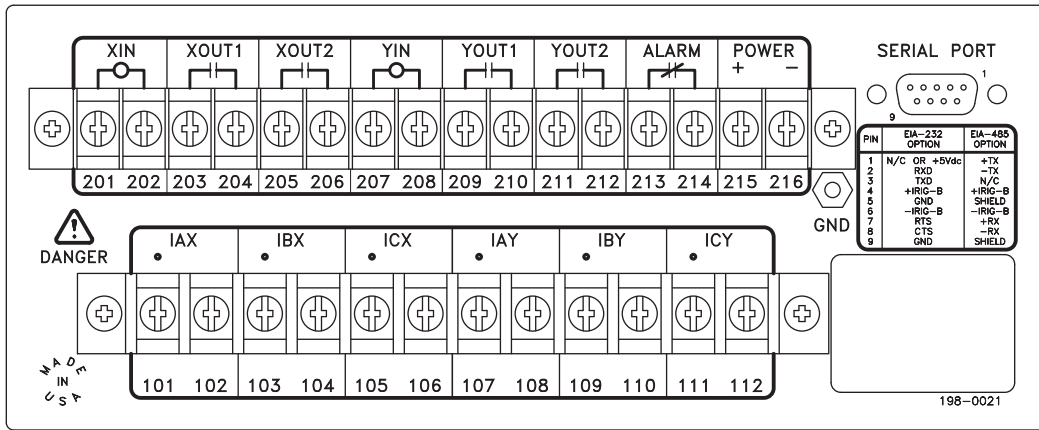
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SEL-501-2 Relay Fitted With Mounting Bracket (SEL P/N 9100) for Mounting in 19-inch Rack

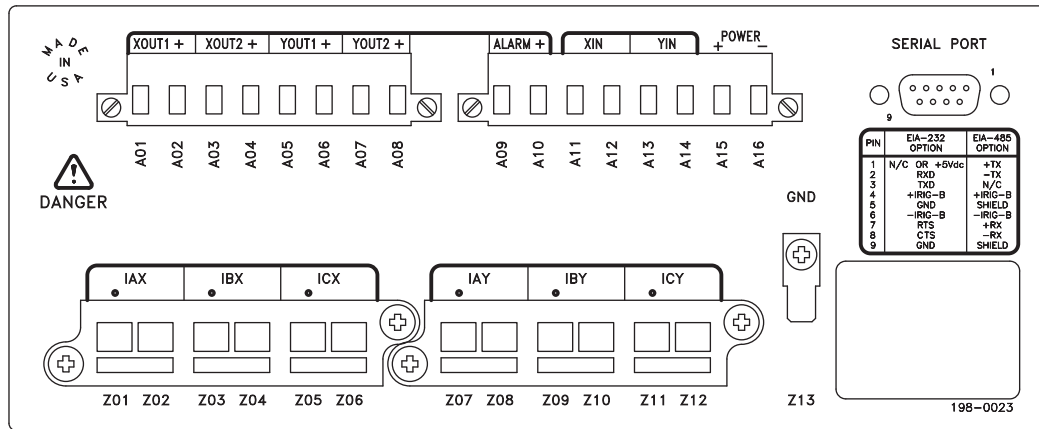
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Figure 6 SEL-501-2 Front Panels



SEL-501-2 Relay Rear Panel (Conventional Terminal Blocks Option)

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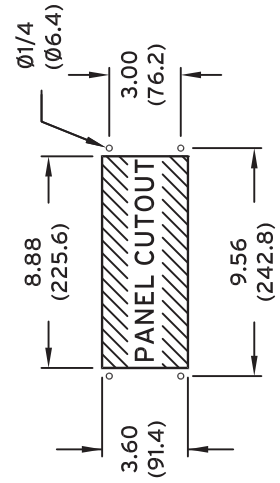
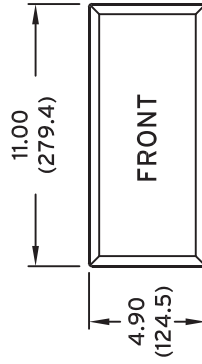
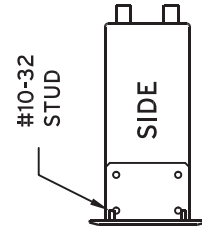
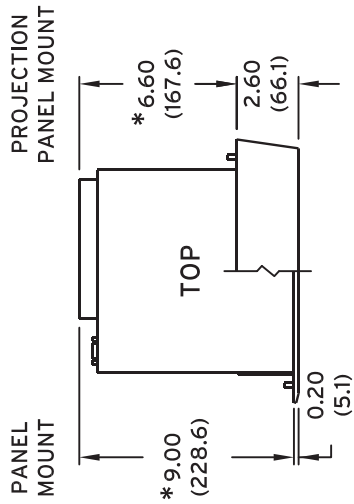
SEL-501-2 Relay Rear Panel (Plug-In Connectors Option)

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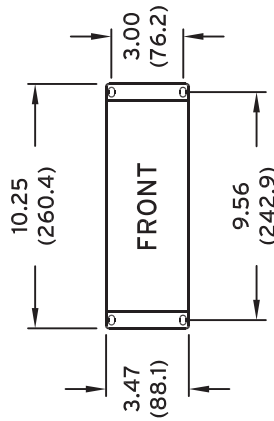
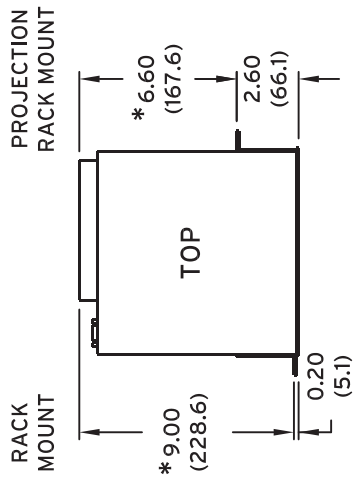
Figure 7 SEL-501-2 Rear-Panel Diagrams

Relay Dimensions

PANEL-MOUNT CHASSIS



RACK-MOUNT CHASSIS

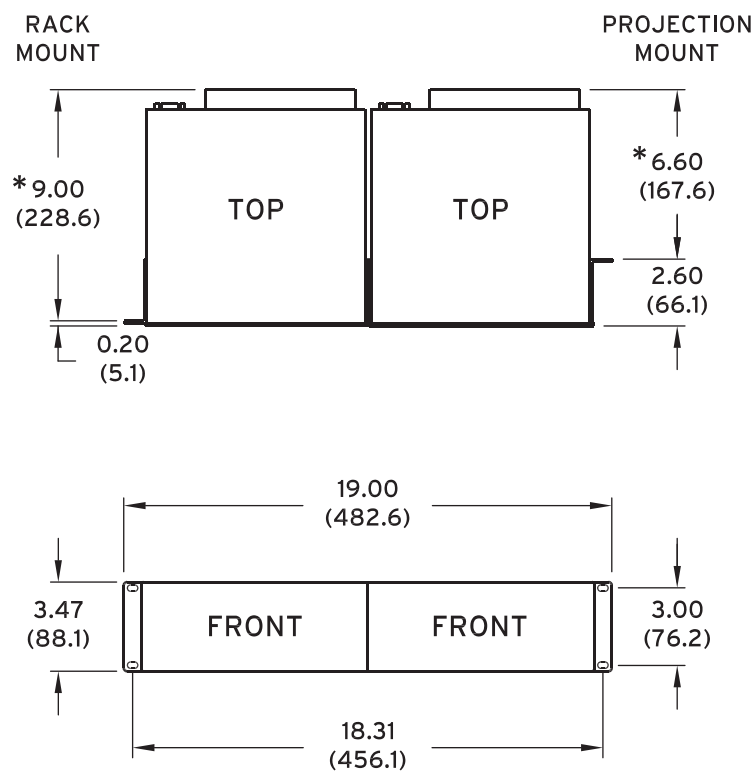


* ADD 0.80 (20.3) FOR CONNECTORIZED RELAYS

i9011b

Figure 8 SEL-501-2 Dimensions for Rack- and Panel-Mount Models

RACK-MOUNT CHASSIS



LEGEND

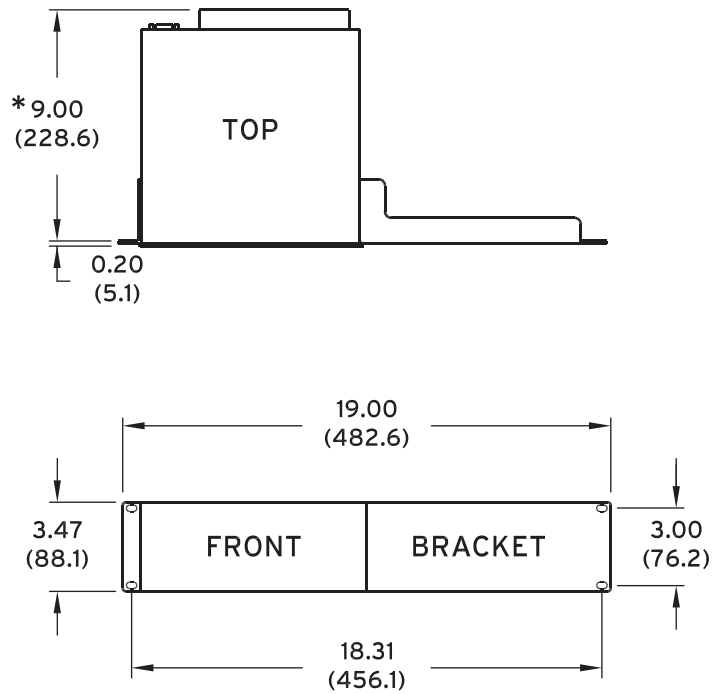
in
← (mm) →

* ADD 0.80 (20.3) FOR CONNECTORIZED RELAYS

i9024b

Figure 9 Relay Dimensions and Drill Plan for Mounting Two SEL-500 Series Relays Together Using Mounting Block (SEL P/N 9101)

RACK-MOUNT CHASSIS



LEGEND

← in →
(mm)

* ADD 0.80 (20.3) FOR CONNECTORIZED RELAYS

i9028a

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

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.

Note: Make per IEEE C37.90-1989.

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 150–300 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
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; settable 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: $\pm 2\%$

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 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
Dry Heat:	IEC 60068-2-2:1974 [EN 60068-2-2:1993] 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

ESD:	IEC 60255-22-2:1996 IEC 60801-2:1991 Level 4
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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
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Notes

Notes

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