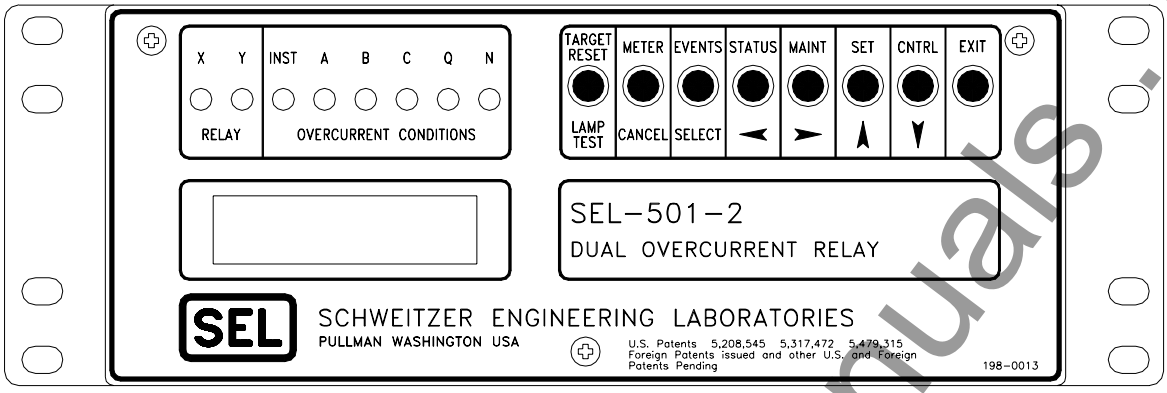
SEL-501-2 Distribution Relay



DWG. FRONT

Dual Overcurrent Relay

Data Sheet

- Features Two Three-Phase Current-Based Relays in One Compact Package
- Protects Feeders, Buses, and Other Apparatus
- Easily Set From the Front Panel or Communications Port
- Includes Metering, Self-Testing, and Event Reporting
- Saves Two Full Reports and Twenty 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

SCHWEITZER ENGINEERING LABORATORIES
2350 NE Hopkins Court • Pullman, WA •99163-5603 •USA
Phone: (509) 332-1890 • Fax: (509) 332-7990
E-mail: info@selinc.com • Internet: www.selinc.com

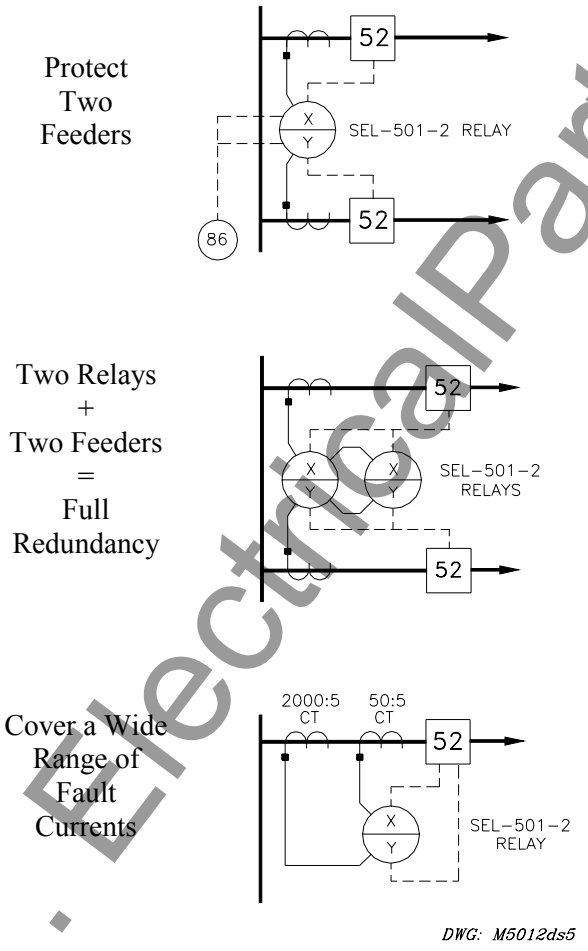
DUAL RELAY CONCEPT

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.

	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 faults 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

TWO REAR-PANEL OPTIONS

Conventional Terminal Blocks

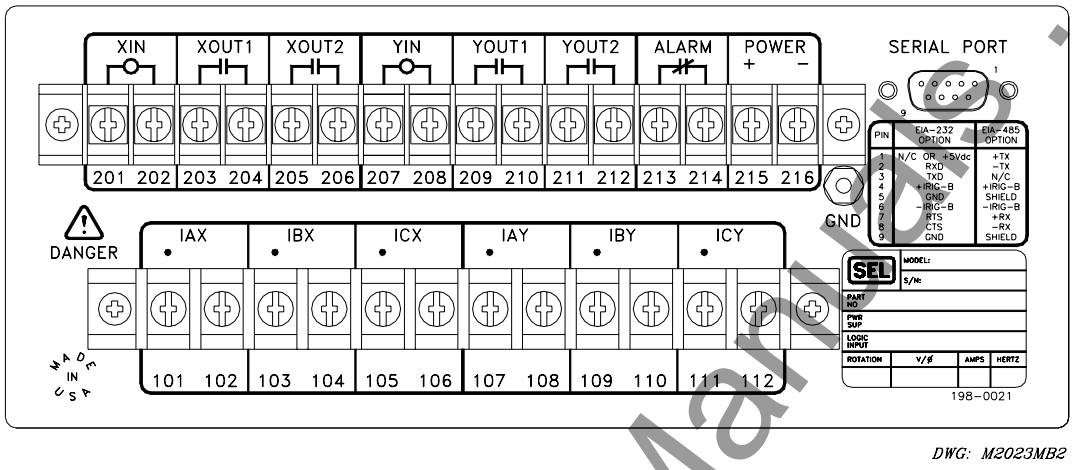


Figure 2: SEL-501-2 Relay Rear Panel (Conventional Terminal Blocks Option)

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)

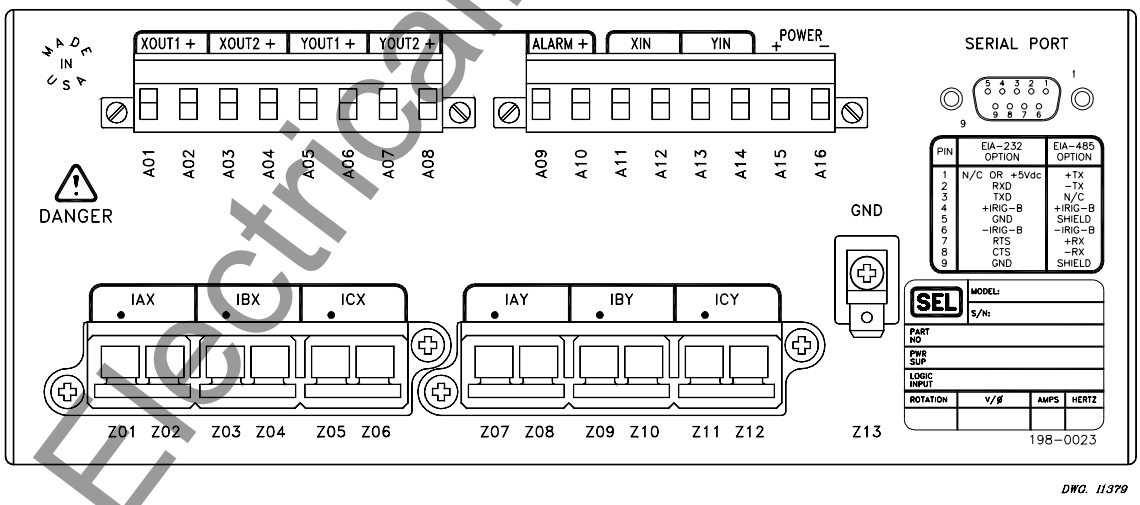


Figure 3: SEL-501-2 Relay Rear Panel (Plug-In Connectors Option)

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		New
0501xJ	→	0501xW

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

Old		New
WA0501xJ	→	WA0501xW

Figure 3 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 ***General Specifications*** 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 x 0.032 inch, screw size #6-32.

GENERAL SPECIFICATIONS

AC Current Inputs

5 A nominal: 15 A continuous; 250 A for 1 second; linear to 100 A symmetrical
Limiting Dynamic Value: 625 A for 1 cycle (sinusoidal waveform)
Burden: 0.16 VA @ 5 A, 1.15 VA @ 15 A

1 A nominal: 3 A continuous; 100 A for 1 second: linear to 20 A symmetrical
Limiting Dynamic Value: 250 A for 1 cycle (sinusoidal waveform)
Burden: 0.06 VA @ 1 A, 0.18 VA @ 3 A

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

Output Contacts

The output type is dependent on the rear-panel terminal type. Output ratings were determined with *IEC 255-0-20 - 1974*, using the simplified method of assessment.

Standard (Conventional Terminal Blocks Option):

6 A continuous carry
30 A make per *IEEE C37.90 - 1989*
100 A for one second
270 Vac/360 Vdc MOV for differential surge protection.
Pickup/dropout time: < 5 ms

Breaking Capacity (L/R = 40 ms):

24 V	0.75 A	10,000 operations
48 V	0.50 A	10,000 operations
125 V	0.30 A	10,000 operations
250 V	0.20 A	10,000 operations

Cyclic Capacity (L/R = 40 ms):

24 V	0.75 A	2.5 cycles per second
48 V	0.50 A	2.5 cycles per second
125 V	0.30 A	2.5 cycles per second
250 V	0.20 A	2.5 cycles per second

High Current Interrupting (Plug-in Connectors Option):

6 A continuous carry
30 A make per *IEEE C37.90 - 1989*
330 Vdc MOV for differential surge protection.
Pickup time: < 5 ms
Dropout time: < 8 ms (typical)

Breaking Capacity: 10 A	10,000 operations
24, 48, and 125 V	(L/R = 40 ms)
250 V	(L/R = 20 ms)
Cyclic Capacity: 10 A	4 cycles in 1 second, followed by 2 minutes idle for thermal dissipation
24, 48, and 125 V	(L/R = 40 ms)
250 V	(L/R = 20 ms)

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

Optoisolated Input Ratings

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

Power Supply Ratings

24Volt*:	16 - 36 Vdc		
48/125 Volt:	36 - 200 Vdc	or	85 - 140 Vac
250 Volt:	85 - 350 Vdc	or	85 - 264 Vac

3.5 watts nominal, 5.5 watts maximum

*The 24-volt power supply is polarity-dependent.

Serial Communications

Rear-panel 9-pin sub-D connector; 300, 1200, 2400, 4800, 9600, 19200 and 38400 baud; settable baud rate and data bit protocols.

Protocols The serial port will support the following user selectable 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 Test Current inputs: 2500 Vac for 10 seconds.
Power supply, optoisolated inputs, and output contacts: 3000 Vdc for 10 seconds.

The following *IEC 255-5 - 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 Temp. -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 and Standards The SEL-501-2 Relay complies with the rules governing CE marking.

IEEE C37.90 - 1989 IEEE Standards for Relay Systems Associated with Electrical Power Apparatus, Section 8: Dielectric Tests.
Severity Level: 2500 Vac on analog inputs; 3100 Vdc (3000 Vdc for Plug-In Connectors option) on contact inputs, contact outputs, and power supply.

IEEE C37.90.1 - 1989 IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
Severity Level: 3.0 kV oscillatory, 5.0 kV fast transient.

IEEE C37.90.2 - 1987 IEEE Trial-Use Standard, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
Severity Level: 10 V/m
Exceptions:
5.5.2 (2) Performed with 200 frequency steps per octave
5.5.3 *Digital Equipment Modulation Test* not performed
5.5.4 Test signal turned off between frequency steps to simulate keying

IEC 68-2-1 - 1990 Environmental testing, Part 2: Tests - Test Ad: Cold.
Severity Level: 16 hours at -40°C.

IEC 68-2-2 - 1974 Environmental testing, Part 2: Tests - Test Bd: Dry heat.
Severity Level: 16 hours at +85°C.

IEC 68-2-3 - 1969 Basic environmental testing procedures, Part 2: Tests - Test Ca: Damp heat, steady state.
Severity Level: 96 hours at +40°C, 93% RH.

IEC 68-2-30 - 1980 Basic environmental testing procedures, Part 2: Tests, Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle).
Severity Level: 55°C, 6 cycles; Variant 1.
Exceptions:
6.3.3 Humidity not less than 94%

IEC 255-5 - 1977 Electrical relays, Part 5: Insulation tests for electrical relays. Section 6: Dielectric Tests.
Severity Level: Series C (2500 Vac on analog inputs; 3000 Vdc on power supply, contact inputs, and contact outputs).
Section 8: Impulse voltage test.
Severity Level: 0.5 Joule, 5000 volt.

IEC 255-21-1 - 1988 Electrical relays - Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 1: Vibration test (sinusoidal).
Severity Level: Class 2.

IEC 255-21-2 - 1988 Electrical relays - Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 2: Shock and bump tests.
Severity Level: Class 2.

IEC 255-21-3 - 1993 Electrical relays - Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section 3: Seismic tests. (Conventional Terminal Block option only.)
Severity Level: Class 2.

IEC 255-22-1 - 1988 Electrical disturbance tests for measuring relays and protection equipment, Section 1: 1 MHz burst disturbance tests.
Severity Level: 2.5 kV peak common mode, 2.5 kV peak differential mode.

IEC 255-22-2 - 1996 Electrical disturbance tests for measuring relays and protection equipment, Section 2: Electrostatic Discharge tests.
Severity Level: 4.

IEC 255-22-3 - 1989 Electrical disturbance tests for measuring relays and protection equipment, Section 3: Radiated electromagnetic field disturbance tests.
Severity Level: 10 V/m

Exceptions:

4.3.2.2 Frequency sweep approximated with 200 frequency steps per octave

IEC 255-22-4 - 1992 Electrical disturbance tests for measuring relays and protection equipment, Section 4: Fast transient disturbance test.
Severity Level: 4 (4 kV on power supply, 2 kV on inputs and outputs)

IEC 529 - 1989 Degrees of protection provided by enclosures.
Severity Level: IP3X.

IEC 801-2 - 1991 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 2: Electrostatic discharge requirements.
Severity Level: 4.

IEC 801-3 - 1984 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 3: Radiated electromagnetic field requirements.
Severity Level: 10 V/m

Exceptions:

9.1 Frequency sweep approximated with 200 frequency steps per octave

IEC 801-4 - 1988 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 4: Electrical fast transient/burst requirements.
Severity Level: 4 (4 kV on power supply, 2 kV on inputs and outputs).

UL 508 Industrial Control Equipment Standard for Safety (not applicable for Plug-In Connectors Option).

OVERCURRENT ELEMENT SPECIFICATIONS

	Instantaneous Elements	Definite-Time Elements	Inverse-Time Elements
Phase (Ia, Ib, and Ic)	50H	50PT	51PT
Negative-Sequence (IQ = 3•I2)		50QT	51QT
Residual (IR = Ia + Ib + Ic)	50NH	50NT	51NT
Pickup Ranges (A secondary)			
5 A Model:	0.5 - 80 A	0.5 - 80 A	0.5 - 16 A
1 A Model:	0.1 - 16 A	0.1 - 16 A	0.1 - 3.2 A
Definite-Time Delay		0 - 16,000 cycles	US and IEC curves

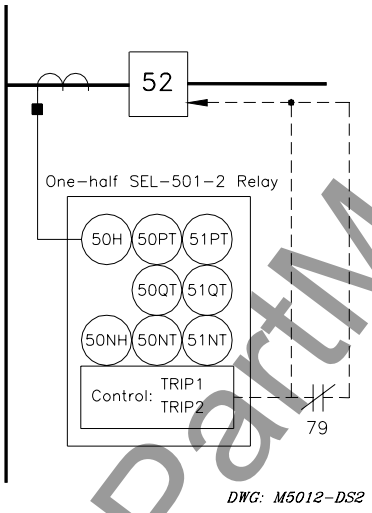


Figure 4: Relay Application Single-Line Diagram

RELAY CONTROL FUNCTIONS

Control the SEL-501-2 Relay 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.
- 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

The SEL-501-2 Relay saves a 15-cycle event report each time 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 twenty latest events and full length reports for the twelve 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
- Pickup of definite-time or inverse-time overcurrent element

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 Event Report

```
EXAMPLE FD                              Date: 06/02/97   Time: 16:04:50.541
EXAMPLE FD

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

                                                          Relay X    Relay Y  A
          Relay X                      Relay Y           555555   0 555555   0 L
          Amps Pri                     Amps Pri          111000  IU 111000  IU R
  IRX    IAX    IBX    ICX     IRY    IAY    IBY    ICY  PQNPQN  NT PQNPQN  NT M

    -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 ......  .. ......  .. .

    -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>..n...  .. ......  .. .

  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  .. ......  .. .

  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 ......  .. .

[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

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

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

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

Time-tag corresponds to the eighth quarter-cycle of this event.

One cycle of data.

Relay X 51N element picks up, triggering this report.

Relay X 51P, 51N, 50P, and 50N elements are picked up. 50NH element picks up, causing a trip. XOUT1 and XOUT2 both close.

Breaker operates, clearing the fault.

Event Summary

Relay X Settings

Input and output function summary, defined by relay settings.

RELAY MOUNTING

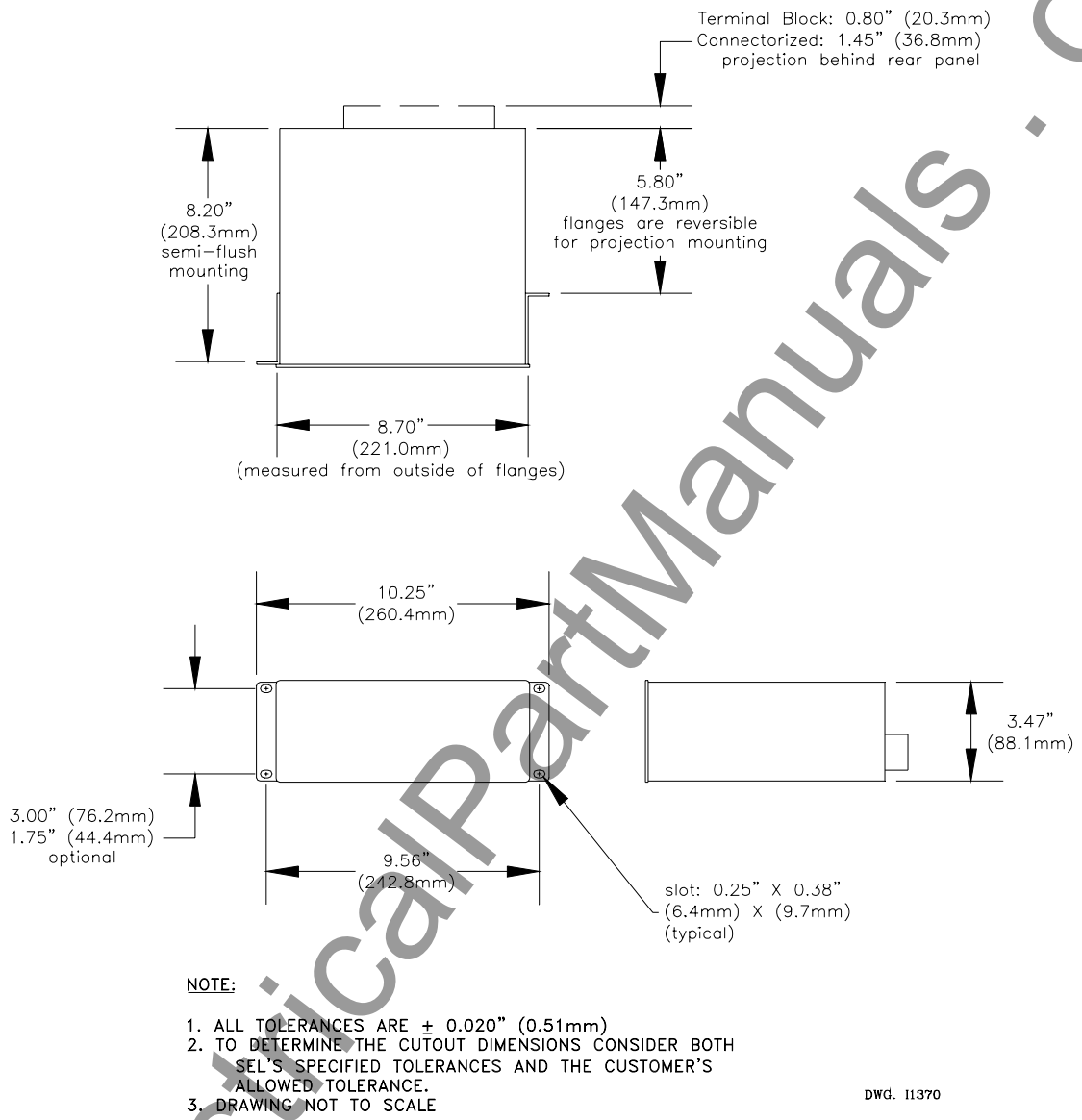
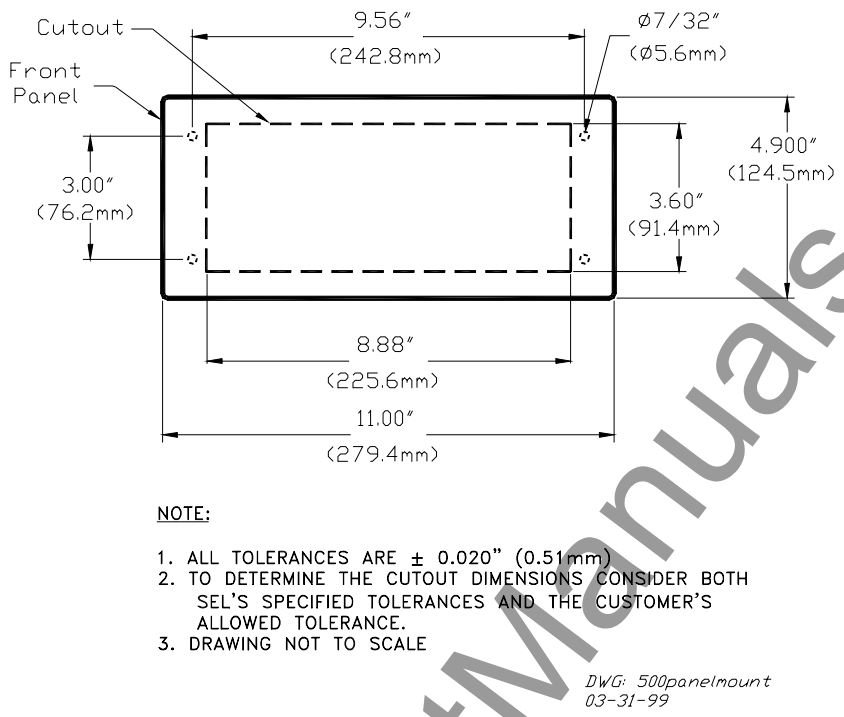


Figure 5: SEL-501-2 Relay Dimensions and Drill Plan for Single Rack-Mount Relay



NOTE:

1. ALL TOLERANCES ARE ± 0.020" (0.51mm)
2. TO DETERMINE THE CUTOUT DIMENSIONS CONSIDER BOTH SEL'S SPECIFIED TOLERANCES AND THE CUSTOMER'S ALLOWED TOLERANCE.
3. DRAWING NOT TO SCALE

DWG: 500panelmount
03-31-99

Figure 6: Panel Cut-Out and Drill Plan for Single Panel-Mount Relay

RELAY MOUNTING (TWO SEL-501-2 RELAYS)

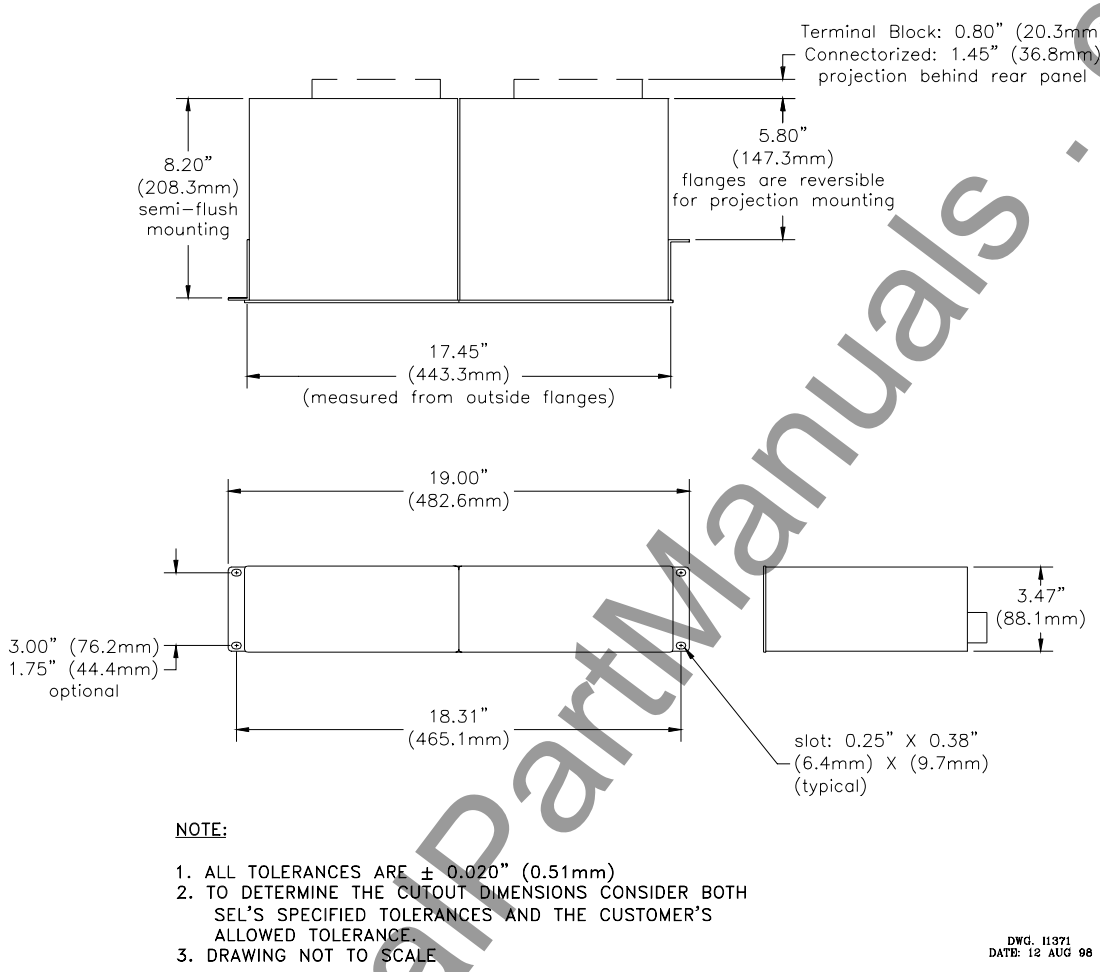


Figure 7: Relay Dimensions and Drill Plan for Mounting Two SEL-500 Series Relays Together Using Mounting Block (SEL P/N 9101)

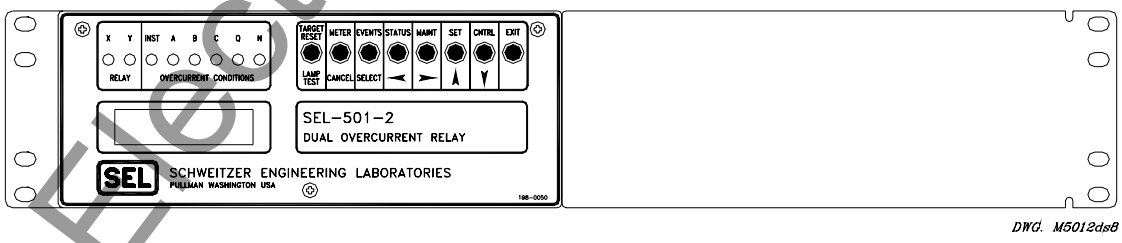


Figure 8: SEL-501-2 Relay Fitted with Mounting Bracket (SEL P/N 9100) for Mounting in 19-Inch Rack

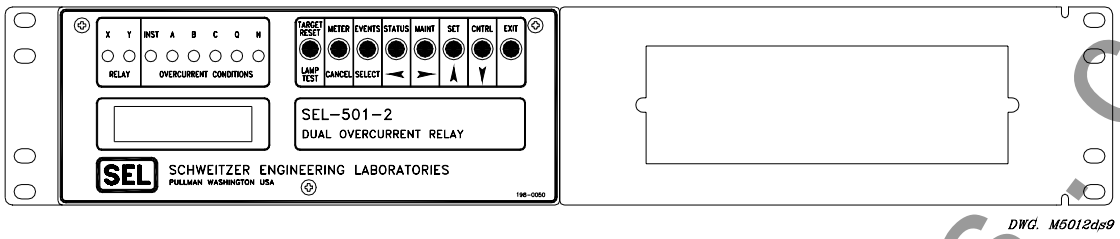


Figure 9: SEL-501-2 Relay Fitted With Mounting Bracket (SEL P/N 9102) for Mounting in 19-Inch Rack Including Cutout to Fit an FT-1 Test Switch

FACTORY ASSISTANCE

The employee-owners of Schweitzer Engineering Laboratories are dedicated to making electric power safer, more reliable, and more economical.

We appreciate your interest in SEL products, and we are committed to making sure you are satisfied. If you have any questions, please contact us at:

Schweitzer Engineering Laboratories
2350 NE Hopkins Court
Pullman, WA USA 99163-5603
Tel: (509) 332-1890
Fax: (509) 332-7990

We guarantee prompt, courteous, and professional service.

We appreciate receiving any comments and suggestions about new products or product improvements that would help us make your job easier.

SEL-501-2 Distribution Relay Data Sheet Date Code 20000105

SCHWEITZER ENGINEERING LABORATORIES
2350 NE Hopkins Court • Pullman, WA 99163-5603 USA
Phone: (509) 332-1890 • Fax: (509) 332-7990
Internet: www.selinc.com • E-mail: info@selinc.com