SCHWEITZER ENGINEERING LABORATORIES, INC.

Making Electric Power Safer, More Reliable, and More Economical

SEL-267D

PHASE AND GROUND DIRECTIONAL OVERCURRENT RELAY
RECLOSING RELAY
FAULT LOCATOR
FOR USE ON GROUNDED SYSTEMS WITH
DELTA-CONNECTED VOLTAGE TRANSFORMERS

DATA SHEET

- Similar to SEL-267 Relay except for delta-connected voltage transformers
- Nine phase overcurrent relays with three timers
- Phase time-overcurrent element with selectable curves
- Phase directional elements for phase faults
- Three residual-overcurrent relays and timers
- Residual time-overcurrent element with selectable curves
- Negative- and zero-sequence ground directional elements
- Programmable logic for outputs, tripping, and reclosing
- Three-shot reclosing with programmable initiate and cancel conditions
- Fault locating, event reporting, metering, and demand ammeter
- Automatic self-testing, EIA RS-232-C communications
- Horizontal and vertical mounting configurations available

GENERAL DESCRIPTION

The SEL-267D Phase and Ground Directional Overcurrent Relay provides high-speed and time delayed directional overcurrent protection for transmission lines, distribution lines, and cables. It is intended for application where open-delta connected PTs are applied. The SEL-267D Relay is very similar to the SEL-267 Relay (which is preferred when four-wire voltages are available).

The fault locator in the SEL-267D Relay is modified to locate ground faults, even though the open-delta PT connection denies the relay the zero-sequence voltage information. The relay does this by estimating the zero-sequence voltage from the product of a setting for the zero-sequence source impedance (R0S, X0S) and the measured zero-sequence current. This field-proven technique was first applied in the SEL-21D Relay, and repeated in the SEL-121D Relay.

Tailor the fault locator to your system. The relay can be set to compensate for shunt load on a radial feeder to provide more accurate fault locations when the relay overlooks more than one feeder, or a feeder with tapped load.

Ground-fault directionality is a negative-sequence directional element or a current-polarized zero-sequence directional element.

Relay overcurrent elements, directional elements, timers, and other data and control bits are combined in a 32-bit Relay Word. Logic, programmable by the application engineer, combines these bits to control tripping, reclosing (initiation and cancellation), and four programmable outputs. Forward- and reverse-looking relay outputs are available.

Because of the many relay elements, programmability, and low cost, the SEL-267D Relay meets the requirements of a broad spectrum of applications. The flexible yet simple programmability provides access to the relay elements (before and after time delays) and logic results such as reclose initiate (or cancel), alarm and trip.

Analog inputs from current and voltage transformers are analog filtered and digitally sampled. Voltage and current magnitudes and angles are used to perform protective functions and saved for additional features, such as event reporting, metering, and fault locating.

The SEL-267D Relay generates an 11-cycle event report following each fault. Each report includes current and voltage information, and sequence-of-events information for relay elements, contact inputs, and contact outputs. The relay saves the twelve latest event reports. You can retrieve any or all of the records remotely or locally through the serial communications ports.

A metering function permits interrogation of the SEL-267D Relay to obtain voltage, current, real power, and reactive power readings. The function includes per-phase measurements of current and phase-to-phase measurements of voltage, as well as indication of the per-phase demand current and peak demand current.

The CLOSE, A1-A4, and ALARM outputs may be specified as an "a" or "b" contact type. The TRIP outputs are always an "a" contact type.

In horizontal configuration, the SEL-267D Relay fits in a standard 19 inch rack. However, it is only 3.5 inches tall and 10.5 inches deep. You can fit more equipment in each protection panel, or consolidate existing panels.

The high reliability of the SEL-100 series relays is improved in the SEL-200 series relays. In the new hardware, all electronic components (excluding the power supply and instrument transformers) are contained on a single printed circuit board.

The SEL-267D Relay is compatible with the SEL-PRTU Protective Relay Terminal Unit, the SEL-DTA Display/Transducer Adapter, and the SEL-RD Relay Display.

APPLICATIONS

Replacement of Outdated Protective Relays

The SEL-267D Relay is ideal to replace obsolete directional overcurrent electromechanical relay schemes. Compact size and simple field wiring make replacement especially convenient in crowded substations. Event-reporting and fault-locating features economically provide valuable engineering and operating information, eliminating the need for event recorders and oscillographs in most applications. Its instrument transformer burden is negligible.

Backup Relaying

Where adequate high-speed primary protection already exists, the SEL-267D Relay can be applied for backup. Programmability and remote-access capabilities allow the relay settings to be adjusted remotely to meet virtually any contingency.

Its application also adds demand ammetering, event reporting, and fault locating.

Other Applications

The relay is cost-effective in these applications: fault locating, temporary installation, bus-tie breaker relaying (where frequent setting changes may be required), and remote control and monitoring.

GENERAL SPECIFICATIONS

Voltage Input	115 V nominal phase-to-phase, three-phase, three-wire connection
Current Inputs	5 A per phase nominal; 15 A per phase continuous; 500 A for one second thermal rating
Output Contact Current Ratings	30 A make per IEEE C37.90 para 6.7.2 6 A carry continuously; MOV protection provided
Optical Isolator Logic Input Ratings	24 Vdc: 10 - 30 Vdc 48 Vdc: 25 - 60 Vdc 125 Vdc: 60 - 200 Vdc 250 Vdc: 200 - 280 Vdc Current = 4 mA at nominal voltage
Power Supply	24/48 Volt: 20 - 60 Vdc; 12 watts 125/250 Volt: 85 - 350 Vdc or 85 - 264 Vac; 12 watts
Time Code Input	Relay accepts demodulated IRIG-B time code input.
Communications	Two EIA RS-232-C serial communications ports. Port 2 includes front and rear panel connectors. Connectors are standard 9-pin D subminiature type.
Dimensions	3.5" x 19" x 10.5" (8.89 cm x 48.2 cm x 26.7 cm) (H x W x D)
Dielectric Strength	V, I inputs: 2500 Vac for 10 seconds Other: 3000 Vdc for 10 seconds (excludes EIA RS-232-C)
Operating Temp.	-40°F to 158°F (-40°C to 70°C)
Environment	IEC 68-2-30 Temperature/Humidity Cycle Test - six day (type tested)
Interference Tests	IEEE C37.90 SWC Test (type tested) IEC 255-6 Interference Test (type tested)
Impulse Tests	IEC 255-5 0.5 joule 5000 volt test (type tested)
RFI Tests	Type-tested in field from a quarter-wave antenna driven by 20 watts at 150 MHz and 450 MHz randomly keyed on and off one meter from relay.
ESD Test	IEC 801-2 Electrostatic Discharge Test (type tested)
Weight	16 lbs (7.3 kg); shipping weight 26 lbs (11.8 kg), including two manuals
Burn-in	140°F (60°C) for 100 hours

FUNCTIONAL SPECIFICATIONS

Relay Functions

Directional overcurrent protection for phase faults:

- Nine phase overcurrent elements, in three groups
- Three timers, one per group
- Polyphase time-overcurrent element with selectable curve shapes
- Phase directional element operates on negative- and positive-sequence quantities, with the negative-sequence voltamperes weighted four times the positive-sequence voltamperes.

Directional residual-overcurrent protection for ground faults:

- Three definite-time elements
- One time-overcurrent element with selectable curve shapes
- Negative- and zero-sequence directional elements for ground faults.
- Zero-sequence element is current polarized.

Automatic reclosing for selectable fault types (3 shots).

Relay Elements

Phase Overcurrent:

- 51P phase time-overcurrent element
  Selectable curve shape (4 curves)
  Time Dial: 0.50 to 15.00 in steps of 0.01
  Pickup: 1 to 12.6 A, +/- 0.05 A +/- 2% of setting

- 50A1, 50B1, 50C1 Zone 1 phase overcurrent elements (50P1)
- 50A2, 50B2, 50C2 Zone 2 phase overcurrent elements (50P2)
- 50A3, 50B3, 50C3 Zone 3 phase overcurrent elements (50P3)
  Pickup: 1 A to 25 times 51P pickup
  Timers are provided for each zone:
  Zone 1 Timer: 0-60 cycles in quarter-cycle steps
  Zone 2 Timer: 0-2000 cycles in quarter-cycle steps
  Zone 3 Timer: 0-2000 cycles in quarter-cycle steps

Ground Overcurrent:

- 51N residual time-overcurrent element
  Selectable curve shape (4 curves)
  Time dial: 0.50 to 15.00 in steps of 0.01
  Pickup: 0.25 to 6.3 A, +/- 0.05 A +/- 2% of setting

- 50N1, 50N2, 50N3 residual overcurrent elements
  Pickup: 0.2 to 47 times 51N pickup
  Timers are provided for 50N1, 50N2 and 50N3:
  Zone 1 Timer: 0-60 cycles in quarter-cycle steps
  Zone 2 Timer: 0-2000 cycles in quarter-cycle steps
  Zone 3 Timer: 0-2000 cycles in quarter-cycle steps

Demand Overcurrent:

- DCTH phase demand overcurrent element
  Pickup: 0.2 to 15 times phase time-overcurrent element pickup (51P pickup). (See Metering)

Directional Elements:

- Phase directional element (32PQ):
  Angle: MTA (maximum torque angle) setting (47°- 90° in 1° steps)
  Sensitivity: 1 VA of positive-sequence and 0.25 VA of negative-sequence at MTA
  Memory: 8 cycles

- Negative-sequence directional element (32Q):
  Angle: MTA setting (47 - 90° in 1° steps)
  Sensitivity: Proportional to 51P pickup for 4 < 51PP < 12.6A:
  0.35 VA at 12.6 A pickup at MTA
  0.11 VA at 4.0A pickup and below at MTA

- Zero-sequence directional element (32I):
  Angle: 0°
  Sensitivity: (0.5 amps) x (51N pickup setting), at 0°, in units of residual amps squared, and Ipol > 0.5 amps

Note: The MTA setting is common to the 32PQ and 32Q directional elements.

Three-shot reclosing relay:

- 79OI1 setting defines open interval 1,
- 79OI2 setting defines open interval 2,
- 79OI3 setting defines open interval 3:
  Timer ranges: 0 - 10,000 cycles in quarter-cycle steps; a setting of 0 disables that shot and successive shots.
- 79RS reset interval:
  Timer range: 60 - 8,000 cycles in quarter-cycle steps

- 50N1, 50N2, 50N3 residual overcurrent elements
  Pickup: 0.2 to 47 times 51N pickup
  Timers are provided for 50N1, 50N2 and 50N3:
  Zone 1 Timer: 0-60 cycles in quarter-cycle steps
  Zone 2 Timer: 0-2000 cycles in quarter-cycle steps
  Zone 3 Timer: 0-2000 cycles in quarter-cycle steps

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  Sensitivity: Proportional to 51P pickup for 4 < 51PP < 12.6A:
  0.35 VA at 12.6 A pickup at MTA
  0.11 VA at 4.0A pickup and below at MTA

- Zero-sequence directional element (32I):
  Angle: 0°
  Sensitivity: (0.5 amps) x (51N pickup setting), at 0°, in units of residual amps squared, and Ipol > 0.5 amps

Note: The MTA setting is common to the 32PQ and 32Q directional elements.

Three-shot reclosing relay:

- 79OI1 setting defines open interval 1,
- 79OI2 setting defines open interval 2,
- 79OI3 setting defines open interval 3:
  Timer ranges: 0 - 10,000 cycles in quarter-cycle steps; a setting of 0 disables that shot and successive shots.
- 79RS reset interval:
  Timer range: 60 - 8,000 cycles in quarter-cycle steps

LOGIC INPUTS

The relay has six opto-isolator inputs to sense external conditions: received permissive trip and block trip signals, breaker status, direct close, direct trip, and external event report trigger. Assert an input by applying control voltage to the corresponding rear panel input terminals.

OUTPUT CONTACTS

The relay has seven output contacts: TRIP, CLOSE, ALARM, and four programmable outputs: A1, A2, A3, and A4. Any output contact except TRIP may be factory configured as either Form A or Form B.

RELAY WORD

The Relay Word consists of four eight-bit rows containing relay elements, intermediate logic results, logic inputs, and relay outputs. Each bit in the Relay Word is either a logical 1 or logical 0.

Relay Word							
51NP	50N1	50N2	50N3	51PP	50P1	50P2	50P3
DFP	67N1	67N2	67N3	DFG	67P1	67P2	67P3
51NT	Z1GT	Z2GT	Z3GT	51PT	Z1PT	Z2PT	Z3PT
ALRM	TRIP	TC	DT	52BT	52AT	TOCP	DCTH

The Relay Word Bit Summary Table explains the meaning of each bit in the Relay Word.

Table 1: SEL-267D Relay Word Bit Summary Table

51NP	-	Residual time-overcurrent pickup
50N1	-	Residual instantaneous-overcurrent element
50N2	-	Residual instantaneous-overcurrent element
50N3	-	Residual instantaneous-overcurrent element
51PP	-	Phase time-overcurrent pickup
50P1	-	Phase instantaneous-overcurrent element
50P2	-	Phase instantaneous-overcurrent element
50P3	-	Phase instantaneous-overcurrent element
DFP	-	Direction forward--phase fault
67N1	-	Zone 1 ground directional overcurrent element
67N2	-	Zone 2 ground directional overcurrent element
67N3	-	Zone 3 ground directional overcurrent element
DFG	-	Direction forward--ground fault
67P1	-	Zone 1 phase directional overcurrent element
67P2	-	Zone 2 phase directional overcurrent element
67P3	-	Zone 3 phase directional overcurrent element
51NT	-	Ground time-overcurrent trip
Z1GT	-	Zone 1 timeout-ground
Z2GT	-	Zone 2 timeout-ground
Z3GT	-	Zone 3 timeout-ground
51PT	-	Phase time-overcurrent trip
Z1PT	-	Zone 1 timeout-phase
Z2PT	-	Zone 2 timeout-phase
Z3PT	-	Zone 3 timeout-phase
ALRM	-	System alarm
TRIP	-	Circuit breaker trip
TC	-	Trip (OPEN) command
DT	-	Direct trip from DT input
52BT	-	Inverse of 52AT
52AT	-	Time delayed 52A
TOCP	-	Time-overcurrent pickup indicator (51PP + 51NP)
DCTH	-	Demand current threshold exceeded

The use of the Relay Word and programmable masks provide the user with great flexibility in applying the SEL-267D Relay, without rewiring panels or changing jumpers on circuit boards.

PROGRAMMABLE OUTPUT LOGIC

The relay uses programmable logic masks to control the TRIP and programmable output relays. Logic masks are saved in nonvolatile memory with the other settings. They are set with the LOGIC command and retained through losses of control power.

To program each logic mask, select elements of the Relay Word. If any element in the Relay Word asserts and the same element is selected in a logic mask, the output contact associated with the logic mask closes.

The output equations follow:

Let R = Relay Word

MTU = mask for trip (unconditional)
MPT = mask for trip (with permissive trip input asserted)
MTB = mask for trip (with block trip input deasserted)
MTO = mask for trip (with breaker open)

Then: TRIP	=	R * MTU	unconditional tripping
	+	R * MPT * PT	permissive tripping
	+	R * MTB * NOT (BT)	block tripping
	+	R * MTO * 52BT	breaker-open/just closed tripping

close TRIP = TRIP
open TRIP = NOT (TRIP) * [NOT (Any element in Relay Word row 1 pickup) + TARGET RESET button pushed] * (TRIP Duration Timer Expired (TDUR))

close CLOSE = (DC + 79OI1 + 79OI2 + 79OI3 + CLOSE command) * NOT (52A) * NOT(TRIP)
open CLOSE = NOT (CLOSE) + 79RS

A1 = R * MA1
A2 = R * MA2
A3 = R * MA3
A4 = R * MA4

The "*" symbol indicates logical "and", and the "+" indicates logical "or".

RECLOSING RELAY

The reclosing relay provides up to three shots of automatic reclosing for selectable fault types and relay elements contained in the 32-bit Relay Word. The three open intervals and the reset timer are individually settable through the SET command.

To provide flexibility in applying the SEL-267D Relay to various reclosing schemes, the conditions for reclose initiation and cancellation are selected in a similar way to the programming of the output relays:

RI = R * MRI MRI selects reclose initiate conditions from R
RC = R * MRC MRC selects reclose cancel conditions from R

where MRI is the mask for reclose initiation, and MRC is the mask for reclose cancellation.

The open intervals do not begin until the TRIP output deasserts. Since the TRIP output never asserts for less than the TDUR timer setting, the open interval may start several milliseconds after the fault has actually cleared and the breaker opened.

Reclose is automatically cancelled when the circuit breaker is observed to trip when a fault condition is not present.

RELAY TARGETS

The relay normally displays the targets identified on the front panel. Under normal operating conditions, the enable (EN) target lamp is lit. If the relay trips, it illuminates the LED corresponding to the element asserted at the time of trip. The target LEDs latch. The target LEDs which illuminated during the last trip remain lit until one of the following occurs:

- Next trip occurs
- Operator presses front panel TARGET RESET button
- Operator executes TARGET R command

When a new trip occurs, the targets clear and the LEDs display the most recent tripping target.

When you press the TARGET RESET button, all eight indicators illuminate for a one-second lamp test. If no TRIP condition is present, the relay clears the targets and illuminates the Enable light (EN) to indicate that the relay is operational. If a TRIP condition is present, the relay displays the old targets following the lamp test.

Use the TARGET command and display to examine the state of the relay inputs, outputs, and the elements of the Relay Word.

SERIAL INTERFACES

The SEL-267D Relay is equipped with two EIA RS-232-C serial communications ports. Port 2 has 9-pin connectors on both the front and rear panels, designated Port 2F and Port 2R, respectively.

Port 2R, located on the relay rear panel, is typically used with an SEL-DTA Display/ Transducer Adapter, SEL-RD Relay Display, or local printer. Port 2F is always available for short term local communications with a portable computer or printing terminal. Simply plug the device into the front panel port. The relay automatically discontinues communications with Port 2R and addresses Port 2F. When testing or data retrieval is complete, unplug the temporary device from Port 2F. The relay automatically resumes communications with the device connected to Port 2R.

Serial communications Port 1 and the Auxiliary Input for demodulated IRIG-B time code input remain on the relay rear panel. Generally, Port 1 is used for remote communications via a modem.

Communications port baud rate jumpers are located along the front edge of the circuit board. To select a baud rate for Port 1 or Ports 2, remove the relay front panel. The jumpers are visible near the center of the relay drawout assembly, to the right of the target LEDs. Carefully move the jumpers using needle-nosed pliers. Available baud rates are 300, 600, 1200, 2400, 4800, or 9600.

The serial data format is eight data bits, two stop bits, no parity. Communications use XON/XOFF flow control.

EVENT REPORTING

The relay retains a data record for each of the last twelve events. The record includes fault location, input voltages and currents, relay elements, input contacts, and output contacts. The relay saves a report when any of the following occur:

- The relay trips
- Selected relay elements assert
- User executes the TRIGGER or OPEN commands
- DT (Direct Trip) or ET (External Trigger) input is asserted

Two sample event reports are included near the end of this data sheet.

FAULT LOCATION

The relay computes fault location from event report data stored for each fault or disturbance. The relay uses two fault locating methods: the Takagi method where sound prefault data are available, or simple reactance method when sound prefault data are not available. The Takagi fault locating algorithm compensates for prefault load current to improve fault locating accuracy under load and for high-resistance faults. The relay also includes logic to improve fault locator accuracy when applied on radial lines with tapped loads.

METERING

The meter function shows the line-line ac voltage, phase current values, demand and peak demand current values, megawatts (P to represent real power), and megavars (Q to represent reactive power) in primary values. You can display these values locally or remotely with the METER command.

SELF-TESTING

The relay runs a variety of self-tests. Some tests have warning and failure states; others only have failure states. The relay generates a status report after any self-test warning or failure.

The relay closes the ALARM contact after any self-test fails. When the relay detects certain failures, it disables the breaker control functions and places the output relay driver port in an input mode. No outputs may be asserted when the relay is in this configuration. The relay runs all self-tests at least every five minutes.

Table 2 shows a list of the self-tests performed by the relay.

Table 2: Relay Self-Tests

Test	Description
Offset	Measures dc offset of analog input channels.
Power Supply	Measures internal power supply voltages.
Random-Access Memory	Verifies RAM operation.
Read-Only Memory	Verifies ROM operation.
Analog-to-Digital Converter	Verifies A/D operation.
Master Offset	Measures dc offset of multiplexer channel.
Settings	Verifies checksum of setting group.

SETTING PROCEDURE

The SET command invokes the relay setting procedure. Each setting is presented and prompted for in turn. If a new setting value is desired, it is entered in response to the appropriate prompt, while just pressing carriage return retains the old setting and prompts for the next one.

In the example beginning on the next page, only the X0 value was changed. It was changed from 152.34 to 143.07. Note that the new value of 143.07 is presented at the end of the procedure before enabling, along with all other settings. This provides a final inspection for typographical or other errors.

As a convenience, the operator could have typed END in response to the prompt for Line Length (or any other setting except Relay ID), and gone directly to the final presentation of settings, without having to scroll through the rest of the prompts.

As an option, the operator could type any setting descriptor (except for the ID setting) with the SET command. All settings prior to the specified setting are skipped when the command is executed in this manner. For example, typing "SET Z3DP <ENTER>" instructs the relay to initiate the setting procedure at the Z3DP setting.

SET COMMAND EXAMPLE

```
=>>SET <ENTER>

SET clears events. CTRL-X cancels.
Enter data, or RETURN for no change

ID   : Example 69 kV Line
  ?
R1   : (Ohms pri)..... = 49.83    ?
X1   : ..............  = 56.32    ?
R0   : ..............  = 56.07    ?
X0   : ..............  = 152.34   ? 143.07 <- operator changes X0
LL   : Line Length (mi)..... = 60.00    ?        <- could type END here

R0S  : Zero-Seq Source Imp... = 11.21    ?
X0S  : ..............  = 28.61    ?

CTR  : ..............  = 60.00    ?
PTR  : ..............  = 600.00   ?
MTA  : Max Torque Angle (deg) = 49.00    ?
LOCAT: Locate faults (L,R,N). = L        ?
DATC : Demand TC (5-60 min).. = 15       ?

DCTH : Dmd Thresh (Amps pri). = 120.00   ?
79OI1: Open Int 1 (cyc)..... = 40.00    ?
79OI2: ..............  = 60.00    ?
79OI3: ..............  = 80.00    ?
79RS : Reset Int..... = 240.00   ?

51PP : PU (Amps pri)..... = 120.00   ?
51PTD: Time Dial..... = 1.00     ?
51PC : Curve (1,2,3,or4)..... = 2        ?
51PTC: Torque Ctrl (Y/N)..... = N        ?

50P1 : PU (Amps pri)..... = 1158.00  ?
50P2 : ..............  = 516.00   ?
50P3 : ..............  = 210.00   ?

Z1DP : Dly-Phase (cyc)..... = 0.00     ?
Z2DP : ..............  = 160.00   ?
Z3DP : ..............  = 30.00    ?

51NP : PU (Amps pri)..... = 30.00    ?
51NTD: Time Dial..... = 2.00     ?
51NC : Curve (1,2,3,or4)..... = 2        ?
51NTC: Torque Ctrl (Y/N)..... = N        ?

50N1 : PU (Amps pri)..... = 1008.00  ?
50N2 : ..............  = 450.00   ?
50N3 : ..............  = 30.00    ?

Z1DG : Dly-Gnd (cyc)..... = 0.00     ?
Z2DG : ..............  = 30.00    ?
Z3DG : ..............  = 10.00    ?
TDUR : Trip Duration (cyc)... = 9.00     ?

52BT : Dly (cyc)..... = 30.00    ?
ZONE3: Dir (F=fwd or R=rvs).. = R        ?
67NE : GND Flt Dir (Y/N)..... = Y        ?
67PE : Phase Flt Dir (Y/N)... = Y        ?

32OE : Enable (Y/N)..... = Y        ?
32IE : ..............  = N        ?

TIME1: Port 1 timeout (min).. = 5        ?
TIME2: ..............  = 0        ?
AUTO : Auto port (1,2,3)..... = 2        ?
RINGS: (1-30)..... = 3        ?

New settings for: Example 69 kV Line

R1   =49.83    X1   =56.32    R0   =56.07    X0   =143.07   LL   =60.00
R0S  =11.21    X0S  =28.61
CTR  =60.00    PTR  =600.00   MTA  =49.00    LOCAT=L         DATC =15
DCTH =120.00   79OI1=40.00   79OI2=60.00   79OI3=80.00    79RS =240.00
51PP =120.00   51PTD=1.00     51PC =2        51PTC=N
50P1 =1158.00  50P2 =516.00   50P3 =210.00
Z1DP =0.00     Z2DP =160.00   Z3DP =30.00
51NP =30.00    51NTD=2.00     51NC =2        51NTC=N
50N1 =1008.00  50N2 =450.00   50N3 =30.00
Z1DG =0.00     Z2DG =30.00    Z3DG =10.00    TDUR =9.00
52BT =30.00    ZONE3=R        67NE =Y        67PE =Y
32OE =Y        32IE =N
TIME1=5        TIME2=0        AUTO =2        RINGS=3
```

SAMPLE EVENT REPORT

Example 69 kV Line Date: 5/19/89 Time: 16:19:43.100

FID=SEL-167D-R100-V656m-0890518

	Currents (amps)				Voltages (kV)			Relays	Outputs	Inputs
IPOL	IR	IA	IB	IC	VAB	VBC	VCA	565565 071071 PPPNNN	TCAAAA/ PL1234L	DPBD5E TTTC2T A
0	1	68	-14	-54	68.1	-22.4	-45.3	.....	.....	....*.
0	0	-24	71	-47	-13.5	65.7	-52.6	.....	.....	....*.
0	-1	-68	14	54	-68.1	22.4	45.3	.....	.....	....*.
0	0	24	-71	47	13.5	-65.7	52.6	.....	.....	....*.
0	1	68	-14	-54	68.1	-22.4	-45.3	.....	.....	....*.
0	-0	-24	71	-47	-13.4	65.7	-52.6	.....	.....	....*.
0	-1	-68	14	54	-68.1	22.4	45.3	.....	.....	....*.
0	0	24	-71	47	13.5	-65.7	52.6	.....	.....	....*.
0	1	68	-14	-54	68.1	-22.4	-45.3	.....	.....	....*.
0	-0	-24	72	-47	-13.5	65.7	-52.6	.....	.....	....*.
0	-1	-68	13	54	-68.1	22.4	45.3	.....	.....	....*.
0	0	24	-72	47	13.5	-65.7	52.6	.....	.....	....*.
0	1	68	-13	-54	68.0	-22.4	-45.2	.....	.....	....*.
0	9	-14	71	-48	-15.4	65.7	-50.6	.....	.....	....*.
0	85	20	13	54	-64.8	22.4	42.1	...3.P	.....	....*.
0	-422	-413	-66	53	18.4	-65.7	47.6	3.P3.P	.....	....*.
0	6	74	-14	-55	59.8	-22.4	-37.0	3.P3.P	.....	....*.
0	997	1006	60	-59	-19.7	65.7	-46.2	2.P2.P	.....	....*.
0	-199	-275	17	57	-57.5	22.4	34.8	22P12P	*.*...	....*.
0	-1192	-1206	-58	63	20.1	-65.7	45.9	12P11P	*.*...	....*.
0	217	294	-17	-58	57.2	-22.3	-34.5	11P11P	*.*...	....*.
0	1219	1233	57	-63	-20.1	65.7	-45.8	11P11P	*.*...	....*.
0	-219	-295	17	58	-57.1	22.4	34.4	11P11P	*.*...	....*.
0	-1223	-1238	-57	63	20.1	-65.7	45.8	11P11P	*.*...	....*.
0	219	295	-17	-58	57.1	-22.3	-34.4	11P11P	*.*...	....*.
0	1223	1239	57	-63	-20.1	65.7	-45.8	11P11P	*.*...	....*.
0	-219	-295	17	58	-57.1	22.3	34.4	11P11P	*.*...	....*.
0	-1223	-1239	-57	63	20.1	-65.7	45.8	11P11P	*.*...	....*.
0	219	296	-17	-58	57.3	-22.3	-34.6	11P11P	*.*...	....*.
0	1214	1228	55	-63	-18.2	65.7	-47.7	11P11P	*.*...	....*.
0	-306	-367	6	53	-60.4	22.3	37.7	11P11P	*.*...	....*.
0	-799	-809	-35	41	15.3	-65.7	50.7	22P22P	*.*...	.....
0	214	239	2	-27	65.4	-22.3	-42.8	22P22P	*.*...	.....
0	224	228	9	-12	-14.0	65.8	-52.1	3.P3.P	*.....	.....
0	-20	-22	0	4	-67.7	22.3	45.1	3.P3.P	.....	.....
0	-31	-31	-1	1	13.7	-65.8	52.4	...3.P	.....	.....
0	2	1	0	0	68.0	-22.3	-45.4	...3.P	.....	.....
0	4	4	0	1	-13.6	65.8	-52.5	.....	.....	.....
0	-1	0	0	-1	-68.0	22.3	45.4	.....	.....	.....
0	0	0	0	-1	13.6	-65.8	52.5	.....	.....	.....
0	1	0	0	1	68.0	-22.2	-45.5	.....	.....	.....
0	-0	0	0	1	-13.6	65.8	-52.4	.....	.....	.....
0	-1	0	0	-1	-68.0	22.2	45.4	.....	.....	.....
0	0	0	0	-1	13.6	-65.8	52.4	.....	.....	.....

Event : AG Location : 9.02 mi 1.13 ohms sec
Duration: 5.75 Flt Current: 1273.7 Targets: G1

R1	=49.83	X1	=56.32	R0	=56.07	X0	=143.07	LL	=60.00
ROS	=11.21	XOS	=28.61						
CTR	=60.00	PTR	=600.00	MTA	=49.00	LOCAT=L		DATC	=15
DCTH	=120.00	79OI1	=40.00	79OI2	=60.00	79OI3	=80.00	79RS	=240.00
51PP	=120.00	51PTD	=1.00	51PC	=2	51PTC=N			
50P1	=1158.00	50P2	=516.00	50P3	=210.00				
Z1DP	=0.00	Z2DP	=160.00	Z3DP	=30.00				
51NP	=30.00	51NTD	=2.00	51NC	=2	51NTC=N			
50N1	=1008.00	50N2	=450.00	50N3	=30.00				
Z1DG	=0.00	Z2DG	=30.00	Z3DG	=10.00	TDUR	=9.00		
52BT	=30.00	ZONE3	=R	67NE	=Y	67PE	=Y		
32OE	=Y	32IE	=N						
TIME1	=5	TIME2	=0	AUTO	=2	RINGS	=3		

Logic settings:

MTU	MPT	MTB	MTO	MA1	MA2	MA3	MA4	MRI	MRC
44	44	00	77	44	00	00	00	00	00
44	66	00	77	66	00	00	00	44	00
FF	FF	00	FF	FF	00	80	08	00	88
30	00	00	30	00	01	00	00	00	30

EXPLANATION OF EVENT REPORT

```
Example 69 kV Line                                  Date: 5/19/89     Time: 16:19:43.100

FID=SEL-167D-R100-V656m-D890518
                Currents                          Voltages                Relays Outputs Inputs
                (Amps)                              (kV)
                                                                          565565 TCAAAAA OPBOSE
  IPOL      IR      IA      IB      IC     VAB     VBC     VCA            071071 PL1234L TTTC2T
                                                                          PPPNNN           A

     0      85      20      13      54   -64.8    22.4    42.1  ..3.P ....... ....*.
     0    -422    -413     -66      53    18.4   -65.7    47.6  3.P3.P ....... ....*.

     0       6      74     -14     -55    59.8   -22.4   -37.0  3.P3.P ....... ....*.
     0     997    1006      60     -59   -19.7    65.7   -46.2  2.P2.P *.*.... ....*.
     0    -199    -275      17      57   -57.5    22.4    34.8  22P12P *.*.... ....*.
     0   -1192   -1206     -58      63    20.1   -65.7    45.9  12P11P *.*.... ....*.

Event    : AG     Location    : 9.02   mi  1.13   ohms sec
Duration: 5.75    Flt Current: 1273.7  Targets: G1

R1   =49.83     X1   =56.32     R0   =56.07     X0   =143.07    LL   =60.00
R0S  =11.21     X0S  =28.61
CTR  =60.00     PTR  =600.00    MTA  =49.00     LOCAT=L         DATC =15
DCTH =120.00    79OI1=40.00     79OI2=60.00     79OI3=80.00     79RS =240.00
51PP =120.00    51PTD=1.00      51PC =2         51PTC=N
50P1 =1158.00   50P2 =516.00    50P3 =210.00
Z1DP =0.00      Z2DP =160.00    Z3DP =30.00
51NP =30.00     51NTD=2.00      51NC =2         51NTC=N
50N1 =1008.00   50N2 =450.00    50N3 =30.00
Z1DG =0.00      Z2DG =30.00     Z3DG =10.00     TDUR =9.00
52BT =30.00     ZONE3=R         67NE =Y         67PE =Y
32QE =Y         32IE =N
TIME1=5         TIME2=0         AUTO =2         RINGS=3
```

Currents and voltages are in primary Amps and kV. Rows are quarter-cycle apart. Time runs down page. Obtain phasor RMS value and angle using any entry as the Y-component, and the entry immediately underneath as the X-component. For example, from bottom rows, IAY = -275, IAX = -1206. Therefore, IA = 1237 amps RMS primary, at an angle of ATAN(-275/-1206) = -167°, with respect to the sampling clock.

<FID>	Firmware Identification Data. This line varies according to version.
<Relays>	Columns show states of internal relay elements ---> Designators 50P : phase overcurrent ..... : 50P1, 50P2, 50P3 ---> 1,2,3 67P : directional phase overcurrent : 67P1, 67P2, 67P3 ---> 1,2,3 51P : phase time-overcurrent ..... : 51PT ---> P,T 50N : inst ground overcurrent ..... : 50N1, 50N2, 50N3 ---> 1,2,3 67N : directional ground overcurrent : 67N1, 67N2, 67N3 ---> 1,2,3 51N : ground time-overcurrent ..... : 51NT ---> P,T
<Outputs>	Columns show states of output contacts: ON = "*" , OFF = "." TP=TRIP, CL=CLOSE, A1-A4=PROGRAMMABLE, AL=ALARM
<Inputs>	Columns show states of input contacts: DT=DIRECT TRIP, PT=PERMISSIVE TRIP, BT=BLOCK TRIP, DC=DIRECT CLOSE, 52A=PCB A-CONTACT, ET=EXTERNAL TRIGGER (event report)
<Event>	Event type is one of the following: AG,BG,CG = single-phase, AB,BC,CA = two-phase ABG,BCG,CAG = two-phase to ground, ABC = three-phase followed by a "T" if a TRIP triggered the report Other indications are TRIP = triggered by TRIP output and EXT = externally or otherwise triggered
<Location>	Distance to fault in miles. Indeterminate distance is 999999.
<Ohms Sec>	Distance to fault in secondary ohms. Indeterminate ohms is 999999.
<Duration>	Fault duration determined from relay element(s) pickup time
<Flt Current>	Max phase current (primary amps) taken near middle of fault
<Targets>	The targets indicate the relay elements that caused the trip. These targets are the same as the targets displayed on the front panel of the SEL-267D via the TARGET 0 command. The targets field indicates any combination of the following: P1: Zone 1 phase fault P3: Zone 3 phase fault G1: Zone 1 ground fault G3: Zone 3 ground fault P2: Zone 2 phase fault 51P: Phase time-overcurrent trip G2: Zone 2 ground fault 51N: Residual time-overcurrent trip
R1,X1,R0,X0	Primary series impedance settings for transmission line
LL	Line length corresponding to specified line impedances
R0S,X0S	Zero-sequence source impedance (used by fault locator only)
CTR, PTR	Current and potential transformer ratios (XTR:1)
MTA	Maximum torque angle for the directional elements
LOCAT	Enable fault locator using looped or radial method or disable (L,R,N)
DATC	Demand ammeter time constant
DCTH	Demand current threshold
79OI1,2,3,RS	Three-shot recloser Open and Reset intervals
51PP,TD,C,TC	Phase time-overcurrent pickup, Time-Dial, Curve, Torque Control
50P1,2,3	Phase inst-overcurrent pickup settings Zones 1, 2 and 3
Z1DP,2,3	Zones 1, 2 and 3 timer settings for three- and two-phase faults
51NP,TD,C,TC	GND time-overcurrent pickup, Time-Dial, Curve, Torque Control
50N1,2,3	Ground inst-overcurrent pickup settings Zones 1, 2 and 3
Z1DG,2,3	Zone timers for ground faults
TDUR	Minimum trip output duration
52BT	52B delay setting (for switch-onto-fault coordination)
ZONE3	Directional orientation of ALL Zone 3 elements (Fwd/Rvs)
67NE,PE	Ground and phase fault torque control enables
32QE,IE	Ground fault directionality from (V2,I2), or (IP,IO)
TIME1,2	Communications port timeout intervals (automatic log-off)
AUTO	Port assignment for automatic message transmissions
RINGS	Number of rings to wait before modem answers telephone
<Logic Settings>	See LOGIC command for a description of mask setting.

SAMPLE COMMAND DISPLAYS

Sample History Command

```
=>> HISTORY<ENTER>

Example 69 kV Line                          Date: 5/25/89       Time: 11:12:12

#   DATE        TIME          TYPE  DIST    DUR   CURR   TARGETS
1   5/25/89   11:11:28.829    AGT   54.20  10.50  366.5  51N
2   5/25/89   11:11:28.429    AG    54.54   7.50  365.7
3   5/25/89   11:09:50.346    BC     9.20   4.00 1320.9  P1
4   5/25/89   11:08:58.787    AG     9.08   4.75 1155.9  G1
5
6
7
8
9
10
11
12
```

Sample Meter Command

```
=>>METER

Example 69 kV Line                          Date: 5/25/89       Time: 01:24:56

                A         B         C
I (A)          99        98       100
D (A)         100        99       100
PD (A)        107       105       105
               AB        BC        CA
V (kV)       69.6      69.6      69.5

P (MW)      11.95
Q (MVAR)    -0.08
```

Sample Self-Test Status Report

```
=>>STATUS

Example 69 kV Line                          Date: 5/25/89       Time: 01:04:56
SELF-TESTS

W=Warn   F=Fail
      IP   IR   IA   IB   IC  VAB  VBC  VCA
OS     0    0    0    0    0    0    0    0
PS      4.99      15.14     -14.85
RAM    ROM    A/D     MOF     SET
OK     OK     OK      OK      OK
```

Targets Command

The eight-LED display on the front panel can be programmed to show targets (default), Relay Word bits, contact inputs and contact outputs, as shown below. This feature is especially useful in testing individual relay elements.

```
=>>TARGETS [N]

LED:  1     2     3     4     5     6     7     8

N

0     PH1   G1    PH2   G2    PH3   G3    51P   51N   RELAY TARGETS
1     51NP  50N1  50N2  50N3  51PP  50P1  50P2  50P3  RELAY WORD #1
2     DFP   67N1  67N2  67N3  DFG   67P1  67P2  67P3  RELAY WORD #2
3     51NT  Z1GT  Z2GT  Z3GT  51PT  Z1PT  Z2PT  Z3PT  RELAY WORD #3
4     ALRM  TRIP  TC    DT    52BT  52AT  TOCP  DCTH  RELAY WORD #4
5     52AT        ET    52A   DC    BT    PT    DT    CONTACT INPUTS
6           TRIP  CLOS  A1    A2    A3    A4    ALRM  CONTACT OUTPUTS
```

The front panel targets can be reset and cleared remotely or locally using the target command. Type "TARGET R <**ENTER**>" to reset and clear the targets.

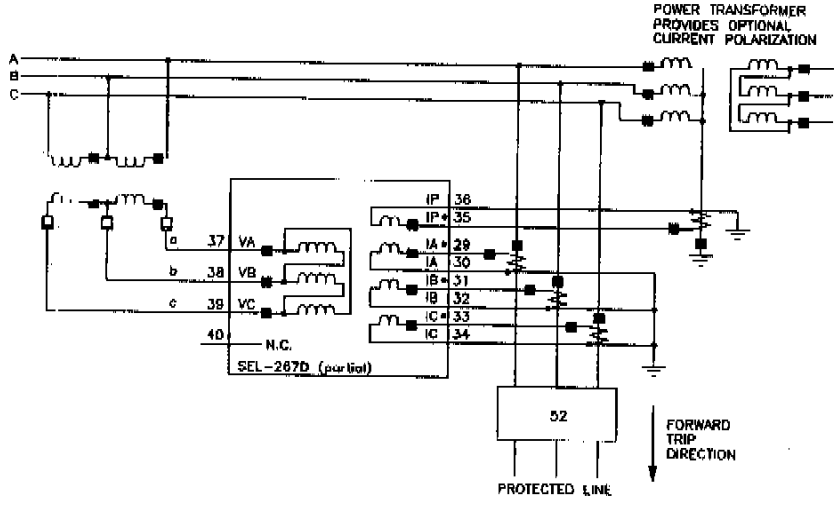

Figure 1: SEL-267D Relay AC Connection Diagram

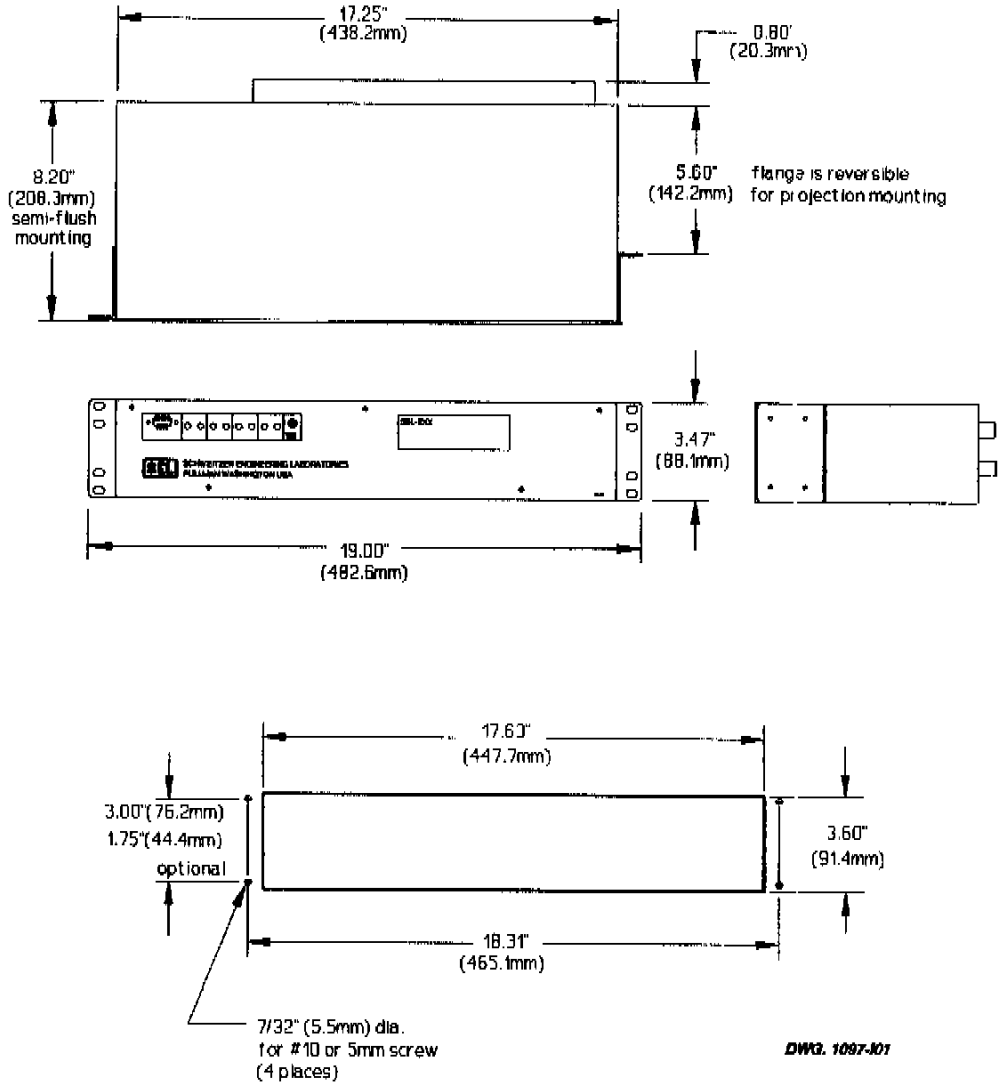

Figure 2: SEL-200 Series (Shallow) Relay Dimensions, Panel Cutout, and Drill Diagrams

SEL-267D RELAY COMMAND SUMMARY

Level 0

ACCESS Answer password prompt (if password protection enabled) to gain access to Level 1. Three unsuccessful attempts pulses ALARM relay.

Level 1

2ACCESS Answer password prompt (if password protection enabled) to gain access to Level 2. This command always pulses the ALARM relay.

DATE Show or set date. DAT 2/3/89 sets date to Feb. 3, 1989. Pulses the ALARM momentarily when a different year is entered than the one previously stored. This setting is overridden when IRIG-B synchronization occurs.

EVENT Show event record. EVE 1 shows long form of most-recent event.

HISTORY Show DATE, TIME, EVENT TYPE, FAULT LOCATION, DURATION, CURRENT, and TARGETS for the 12 most-recent faults.

IRIG Force immediate execution of time-code synchronization task.

METER Show primary current, demand current, peak demand, voltage, and real and reactive power. METER runs once. METER N runs N times. METER R resets the peak demand currents.

QUIT Return to Access Level 0 and reset targets to Target 0.

SHOWSET Show the relay settings and logic settings--does not affect the settings. The logic settings are shown in hexadecimal format for each.

STATUS Show relay self-test status.

TARGET Show data and set target lights as follows:

TAR 0: Relay Targets	TAR 1: Relay Word #1
TAR 2: Relay Word #2	TAR 3: Relay Word #3
TAR 4: Relay Word #4	TAR 5: Contact Inputs
TAR 6: Contact Outputs	TAR R: Returns to TAR 0 and clears.

Be sure to return to TAR 0 when done, so LEDs display fault targets.

TIME Show or set time. TIM 13/32/00 sets clock to 1:32:00 PM. This setting is overridden when IRIG-B synchronization occurs.

TRIGGER Trigger and save an event record. (Type of event is EXT).

Level 2

CLOSE Close circuit breaker, if allowed by jumper setting.

LOGIC* Show or set logic masks MTU, MPT, MTO, MTB, MRI, MRC, MA1-MA4

OPEN Open circuit breaker, if allowed by jumper setting.

PASSWORD Show or set passwords. Pulses the ALARM momentarily when new passwords are set.
PAS 1 OTTER sets Level 1 password to OTTER.
PAS 2 TAIL sets Level 2 password to TAIL.

SET* Initiate setting procedure. SET N initiates setting procedure at setting N.

Use the following to separate commands and their parameters: space, comma, semicolon, colon, slash.

* ALARM relay closes momentarily while the new settings are stored in EEPROM and event data buffers are cleared.

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Rev. 2