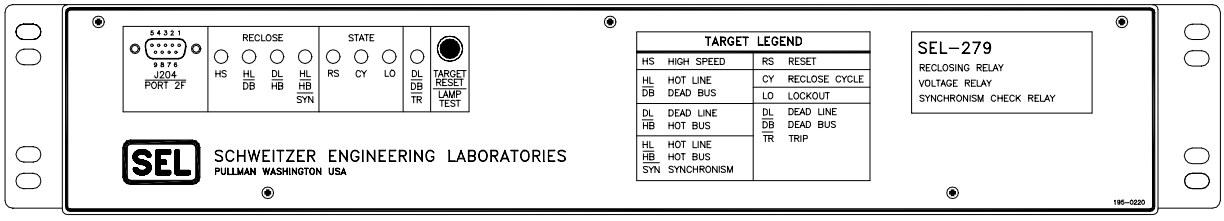
SEL-279 Relay



SEL-279 Reclosing Relay, Voltage Relay, Synchronism Check Relay

Data Sheet

- Includes all logic and elements for restoration, test, and synchronism check:
  - Restore dead bus from hot line (hot line/dead bus)
  - Test dead line from hot bus (dead line/hot bus)
  - Connect two hot systems (hot line/hot bus/synchronism)
  - Open breaker status only (no voltage checks)
- Controls a breaker or switching device for delayed and high-speed reclosures
- Dead line/dead bus/trip scheme isolates bus sections for test and restoration
- Event reports show reclosing sequences and timing
- Accepts wye- or delta-connected voltage inputs
- User can program custom reclosing, alarm, and control schemes
- Ideal reclosing relay for retrofits
- Includes:
  - Serial communications ports
  - Automatic self-testing
  - Metering
  - Horizontal or vertical mounting

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GENERAL DESCRIPTION

The primary function of the SEL-279 Relay is to control reclosing sequences. The relay includes all logic and voltage elements needed to control reclosing sequences and perform synchronism check and isolation functions for switching devices at all voltage levels.

All traditional reclose functions are combined in a single device. Metering, sequence-of-event recording capabilities, and programmable output contacts enhance the basic package.

Time-Delayed and High-Speed Reclosing Restore Normal Power System Operation

The SEL-279 Relay provides both time-delayed and high-speed reclose functions.

Use the time-delayed reclosing functions to:

- Energize a dead bus from a hot line
- Test a dead line from a hot bus
- Connect two hot systems with synchronism supervision
- Connect two systems, regardless of voltage conditions

The relay provides up to eight time-delayed reclose attempts for these and other conditions. Each reclose attempt time is a setpoint on a timer that emulates a motor-driven timer with eight timing lobes. This timer is labeled the Master Timer. Programmable aspects are:

- Master Timer run conditions
- Individual Master Timer setpoint time reclose conditions

High-speed reclose timing is independent of the Master Timer. Use the high-speed reclose function to energize a line following a fault. Internal voltage and instantaneous synchronism check elements may be enabled to supervise high-speed reclosing.

Dead Line/Dead Bus/Trip Scheme Sectionalizes Dead Power Systems

The Dead Line/Dead Bus/Trip scheme logic trips circuit switching devices when the voltages are dead on both sides of the closed switching device. This feature permits an orderly restoration of your system following an outage of multiple line or bus sections.

Analyze Reclosing Sequences Using Event Reports

The SEL-279 Relay stores voltage, relay element, input, and output contact information in an event report. You select between two formats for the event reports. The relay stores the latest twelve event reports. Event reporting economically provides valuable engineering and operating information, eliminating the need for event recorders and oscillographs in most applications.

Access Relay Information with Local and Remote Communications

Two EIA-232 serial communications ports (Port 1 and Port 2) allow local or remote communications with the relay. Each port's baud rate is set independently.

Voltage Metering on Both Sides of the Circuit Switching Device

The relay meters per-phase voltages on both sides of the circuit switching device. Voltage magnitude differences across the switching device are also metered for each phase.

Automatic Self-Testing Enhances Relay Reliability and Availability

The relay runs a variety of self-tests. The ALARM OUT contact closes for a self-test failure or loss-of-power, immediately alerting maintenance personnel of relay service needs.

Sample Applications

The bus/line arrangements shown in Figure 1 illustrate a sampling of installations where the SEL-279 Relay is applicable. A single SEL-279 Relay controls one circuit switching device. The reclose timing between adjacent SEL-279 Relay installations can be coordinated for orderly system restoration.

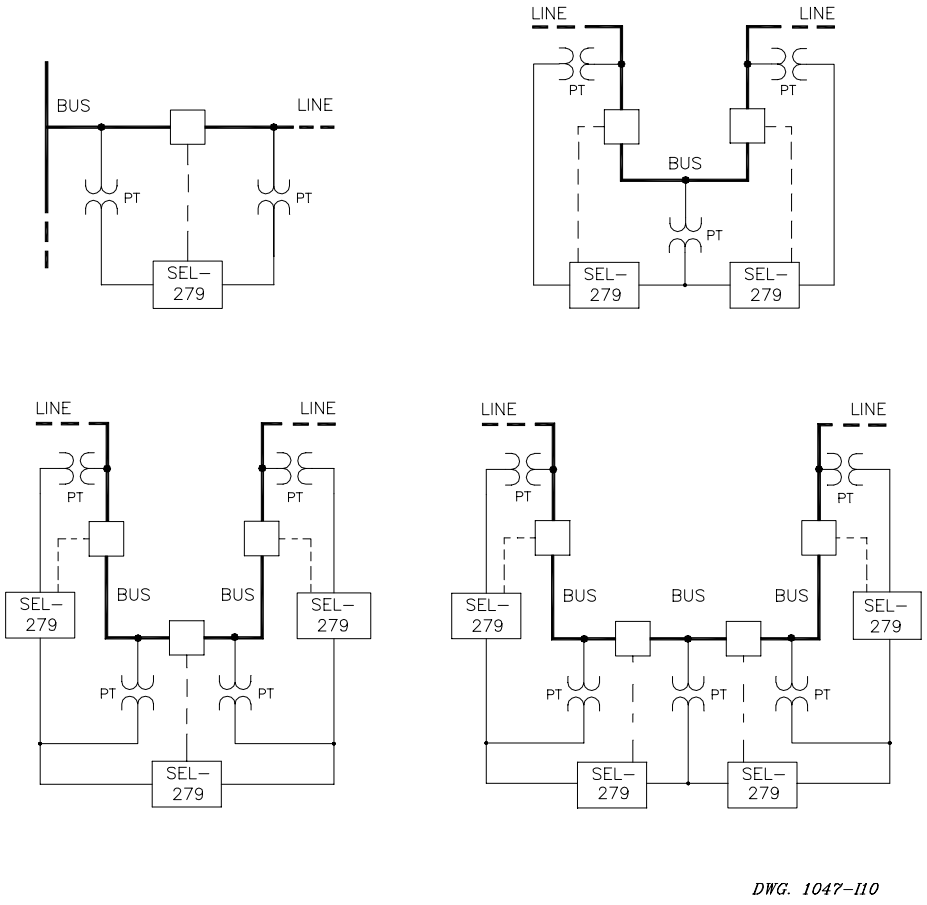

Figure 1: Example SEL-279 Relay Bus/Line Applications

GENERAL SPECIFICATIONS

AC Input

270 V rms for each voltage input V1, V3, V5, V2, V4, and V6

Voltages Limiting Short-Time Thermal Withstand

Voltage Inputs

365 Vac for 10 seconds

Output Contacts

Per *IEC 255-0-20 : 1974*, using the simplified method of assessment

6 A continuous carry

30 A make per *IEEE C37.90 : 1989*

100 A for one second

Breaking Capacity (L/R = 40 ms):

48 V	0.5 A	10,000 operations
125 V	0.3 A	10,000 operations
250 V	0.2 A	10,000 operations

Cyclic Capacity (L/R = 40 ms):

48 V	0.5 A	2.5 cycles per second
125 V	0.3 A	2.5 cycles per second
250 V	0.2 A	2.5 cycles per second

Optoisolated Inputs

24 Vdc: 15 - 30 Vdc
48 Vdc: 30 - 60 Vdc
125 Vdc: 80 - 150 Vdc
250 Vdc:150 - 300 Vdc
Current = 4 mA at nominal voltage

Communications

Two EIA-232-C serial communications ports (Ports 1 and 2) with separately settable baud rates. Port 2 has front and rear panel connectors. The ports use standard, 9-pin subminiature "D" connectors.

Frequency

50 or 60 Hz (specified when ordered)

Power Supply

24/48 V: 20 - 60 Vdc; 125/250 V: 85 - 350 Vdc or 85 - 264 Vac
10 W nominal, 14 W max. (all output relays energized).

Rated Burden

Voltage Inputs
0.3 VA @ 270 V
0.45 VA @ 365 V

Timer Accuracy

Pickup: ±1 cycle
Dropout: ±1 cycle

Relay Dimensions

3.47" H x 19.00" W x 11.66" D (8.81 cm x 48.26 cm x 29.72 cm) Depth (D) is to end of the rear panel terminal blocks

Mounting

Available in horizontal and vertical mounting configurations.

Routine Dielectric Test

IEC 255-5 Dielectric Tests: 1977:

2500 Vac for 10 seconds on analog inputs.

3100 Vdc for 10 seconds on power supply, optoisolated inputs, and output contacts.

Operating Temp.

-40° to 158°F (-40° to 70°C)

RFI and Interference Tests

IEEE C37.90.1: 1989 IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (type test).

IEEE C37.90.2: 1987 IEEE Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers (type test).

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 255-6: 1988 Electrical relays, Part 6: Measuring relays and protection equipment, high frequency disturbance tests (type test).

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) (type test).

ESD Test

IEC 801-2: 1991 Electromagnetic compatibility for industrial-process measurement and control equipment, Part 2: Electrical discharge requirements (type test).

Impulse Test

IEC 255-5: 1977 Electrical relays, Part 5: Insulation tests for electrical relays, Section 8: Impulse Voltage Test: 0.5 Joule, 5 kV (type test).

Environment Test

IEC 68-2-30: 1980 Basic environmental testing procedures, Part 2: Tests - Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle). Humidity, 95% between 25° and 55°C (type test).

Vibration and Shock Test

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

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

IEC 255-21-3: 1993 Electrical relays, Part 21: Vibration, shock, bump, and seismic tests on measuring relays and protection equipment, Section Three - Seismic tests, Class 2 (type test).

Unit Weight

16 pounds (7.3 kg)

Shipping Weight

Approximately 21 lbs (9.5 kg), including one instruction manual

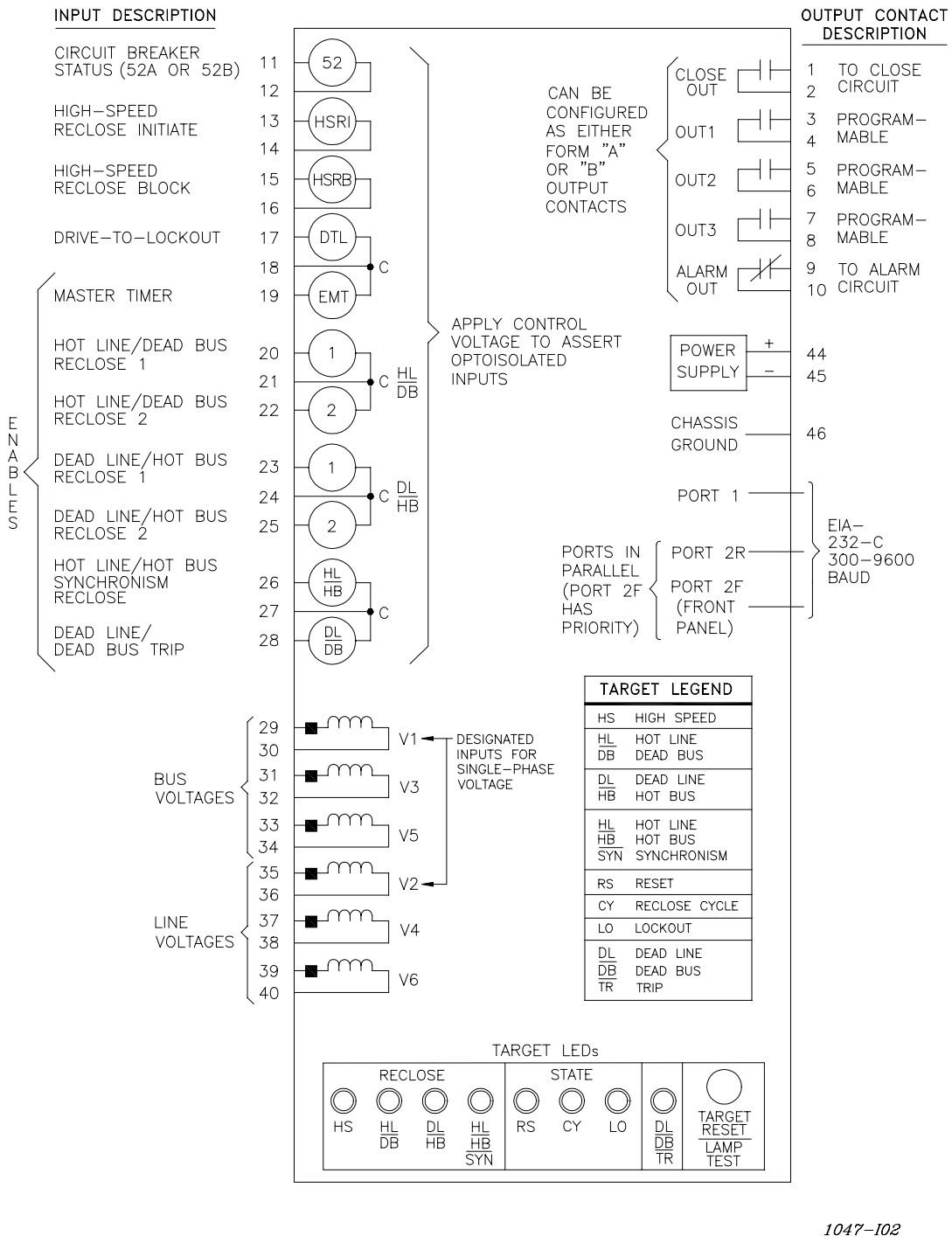

Figure 2: SEL-279 Relay Input, Output, and Target Diagram

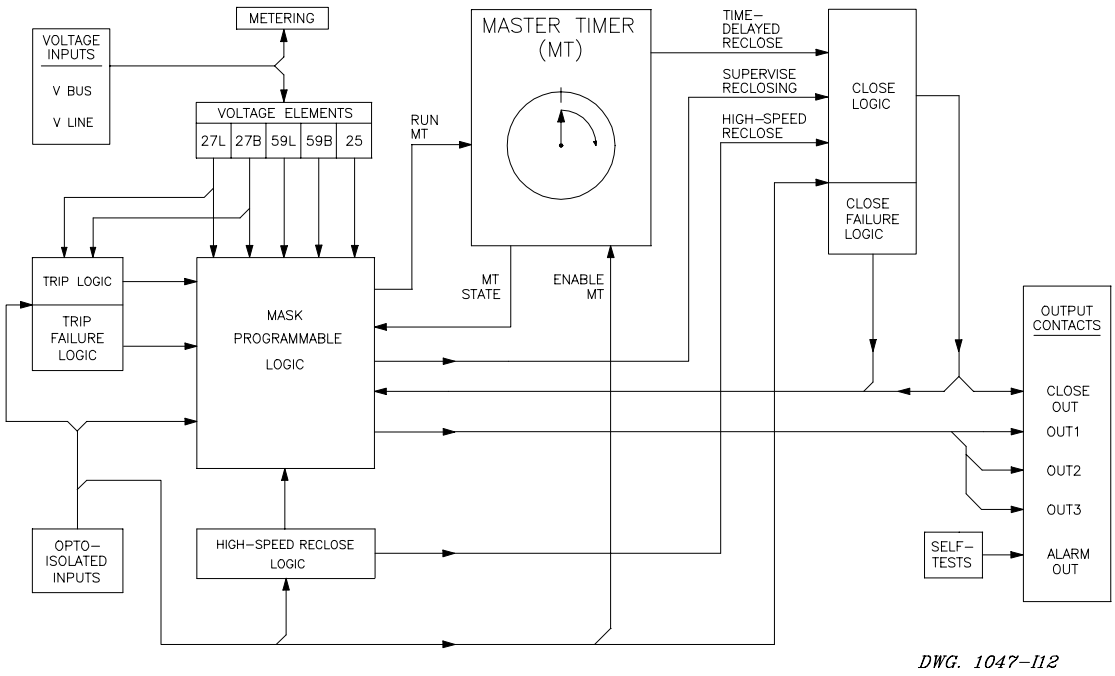

Figure 3: SEL-279 Relay Function Block Diagram

BASIC FUNCTIONAL OVERVIEW

Figure 2 on the preceding page gives an overview of SEL-279 Relay inputs and outputs. Figure 3 above gives an overview of SEL-279 Relay functions.

Inputs

The relay ac voltage inputs are taken from potential transformers on both sides of a circuit switching device. The voltages are used for dead bus or line (27B or 27L), hot bus or line (59B or 59L), and synchronism checking elements (25). These voltage elements and combinations of these voltage elements form logic elements (called bits) in the Relay Word (see Table 1 and Table 2 on the following pages).

The optoisolated inputs to the relay are energized by a status contact from a circuit breaker or switching device, external contacts, and external switches. These logic inputs read the circuit breaker or switching device position, initiate or block high-speed reclosures, and enable or disable reclosing features. Certain enabling inputs, in combination with the voltage elements, form logic elements (called bits) in the Relay Word.

Programmable Logic Masks

Use logic masks to select Relay Word bits (Table 1 below) to control the reclosing process.

Logic Mask	Specific Logic Mask Purposes
MTR	Mask for Master Timer Run: • Selects which Relay Word bits control Master Timer timing.
MT1	Mask for Master Timer Setpoint 1 Time Reclose Conditions
MT2	Mask for Master Timer Setpoint 2 Time Reclose Conditions
MT3	Mask for Master Timer Setpoint 3 Time Reclose Conditions
MT4	Mask for Master Timer Setpoint 4 Time Reclose Conditions
MT5	Mask for Master Timer Setpoint 5 Time Reclose Conditions
MT6	Mask for Master Timer Setpoint 6 Time Reclose Conditions
MT7	Mask for Master Timer Setpoint 7 Time Reclose Conditions
MT8	Mask for Master Timer Setpoint 8 Time Reclose Conditions: • At each setpoint, the relay asserts the CLOSE OUT contact if at least one of the Relay Word bits selected in the corresponding logic mask is asserted.
HSR	Mask for High-Speed Reclose Supervision Conditions: • Select Relay Word bits for supervising high-speed reclosing (if no bits are selected, high-speed reclosing is unsupervised).
OUT1	Mask for Programmable Output Contact OUT1: • Select Relay Word bits to operate output contact OUT1.
OUT2	Mask for Programmable Output Contact OUT2: • Select Relay Word bits to operate output contact OUT2.
OUT3	Mask for Programmable Output Contact OUT3: • Select Relay Word bits to operate output contact OUT3.
ER	Mask for Event Report Generation: • Select Relay Word bits to generate event reports.

Relay Word

Each Relay Word bit has two states: logical 1 when asserted, and logical 0 when not asserted.

Table 1: Relay Word

Row 1	**27B**	**27L**	**59B**	**59L**	**HLDB**	**DLHB**	**HLHB**	**DLDB**
Row 2	**HLD1**	**HLD2**	**DLH1**	**DLH2**	**HLHS**	**HOT**	**DEAD**	**52B**
Row 3	**DB1**	**DB2**	**HL1**	**HL2**	**DL1**	**DL2**	**HB1**	**HB2**
Row 4	**CLOS**	**TRIP**	**HSRN**	**RSET**	**CYCL**	**LOCK**	**25I**	**25T**
Row 5	**HD1M**	**HD2M**	**DH1M**	**DH2M**	**CF**	**TF**	**HSRT**	**MTT**

Table 2 on the following page lists the definition of each bit in the Relay Word. Where intermediate logic is involved, it is included in the definition of the Relay Word bit.

Table 2: Relay Word Bit Definitions

Bit		Definition
27B	=	Dead bus element - asserts for bus voltage below setting 27B (no input check)
27L	=	Dead line element - asserts for line voltage below setting 27L (no input check)
59B	=	Hot bus element - asserts for bus voltage above setting 59B (no input check)
59L	=	Hot line element - asserts for line voltage above setting 59L (no input check)
HLDB	=	**59L * 27B** (no input check)
DLHB	=	**27L * 59B** (no input check)
HLHB	=	**59L * 59B** (no input check)
DLDB	=	**27L * 27B** (no input check)
HLD1	=	**59L * 27B** * 52B * HL/DB 1 input asserted
HLD2	=	**59L * 27B** * 52B * HL/DB 2 input asserted
DLH1	=	**27L * 59B** * 52B * DL/HB 1 input asserted
DLH2	=	**27L * 59B** * 52B * DL/HB 2 input asserted
HLHS	=	**25T** * HL/HB input asserted
HOT	=	**59L * 59B** * 52B * HL/HB input asserted
DEAD	=	**27L * 27B** * 52B * HL/HB input asserted
52B	=	52B (no voltage checks)
DB1	=	**27B** * 52B * HL/DB 1 input asserted
DB2	=	**27B** * 52B * HL/DB 2 input asserted
HL1	=	**59L** * 52B * HL/DB 1 input asserted
HL2	=	**59L** * 52B * HL/DB 2 input asserted
DL1	=	**27L** * 52B * DL/HB 1 input asserted
DL2	=	**27L** * 52B * DL/HB 2 input asserted
HB1	=	**59B** * 52B * DL/HB 1 input asserted
HB2	=	**59B** * 52B * DL/HB 2 input asserted
CLOS	=	Follows state of the CLOSE OUT contact
TRIP	=	Dead line/Dead bus/Trip condition or OPEN command
HSRN	=	Successful high-speed reclose timer timeout (30-cycle pulse) - use in testing
RSET	=	Master Timer is in the Reset State (see Figure 4)
CYCL	=	Master Timer is in the Reclose Cycle State (see Figure 4)
LOCK	=	Master Timer is in the Lockout State (see Figure 4)
25I	=	Instantaneous Synchronism Check element (=25***59L***59B***52B)
25T	=	Time-Delayed Synchronism Check element (25I time qualified by setting 25D)
HD1M	=	**HLD1** reclose attempt latched until the Reset State
HD2M	=	**HLD2** reclose attempt latched until the Reset State
DH1M	=	**DLH1** reclose attempt latched until the Reset State
DH2M	=	**DLH2** reclose attempt latched until the Reset State
CF	=	Close Failure condition
TF	=	Trip Failure condition
HSRT	=	High-speed reclose timer timing - use in testing
MTT	=	Master Timer timing - use in testing

Note: 52B = Circuit breaker open
25 = Magnitude of bus and line phasor voltage difference less than setting 25DV

Master Timer and Time-Delayed Reclosing

All time-delayed reclosing is performed by the Master Timer. High-speed reclosing is controlled by an independent timer. The Master Timer has three states: Reset, Reclose Cycle, and Lockout. Time setting MTPD (Master Timer Period Delay) specifies the Master Timer timing limit (see Figure 4).

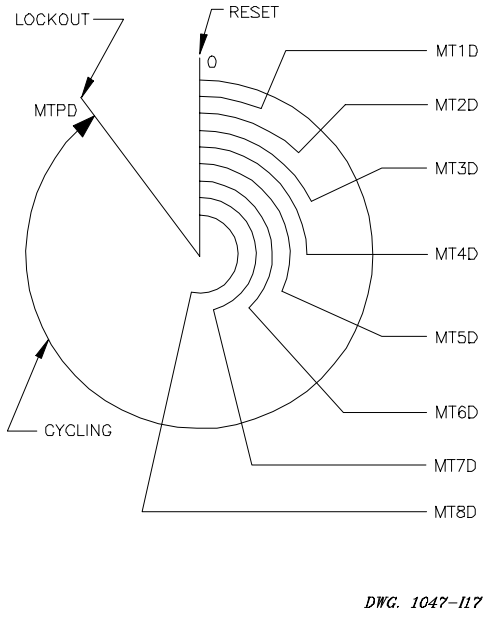

Figure 4: Master Timer Setpoints

Master Timer timing is controlled by the MTR logic mask. Select Relay Word bits with the MTR logic mask which represent reclose conditions appropriate for your reclosing scheme. The Master Timer starts timing when at least one selected condition comes true and the Master Timer is enabled (input EMT). If no selected condition is true or the Master Timer is not enabled, then the Master Timer stops timing.

Select reclosing times with eight settable Master Timer Setpoint Time Delays, MT1D through MT8D (see Figure 4). Each setpoint has a corresponding Master Timer Setpoint Time Reclose Condition logic mask, MT1 through MT8, respectively. When a setpoint is reached, the corresponding logic mask is compared with the present state of the Relay Word. If at least one selected Relay Word bit in the logic mask is asserted, the CLOSE OUT contact closes.

High-Speed Reclosing

You can supervise single-shot high-speed reclosing with elements in the High-Speed Reclose Supervision logic mask, HSR. High-speed reclosing is unsupervised if no bits are selected in the HSR logic mask. After a high-speed reclose attempt, the relay can proceed with time-delayed reclosures if desired.

Dead Line/Dead Bus/Trip Scheme

The Dead Line/Dead Bus/Trip scheme logic asserts the **TRIP** bit when voltages on both sides of the closed circuit switching device are dead for a settable amount of time. Assign the **TRIP** bit to a programmable output contact to trip the circuit switching device.

Output Contacts

The CLOSE OUT contact closes for Master Timer time-delayed or high-speed reclosures. The ALARM OUT contact closes in response to any self-test failure or loss-of-power.

The programmable OUT1, OUT2, and OUT3 contacts close when at least one Relay Word bit selected by their respectively labeled logic masks asserts.

EXAMPLE EVENT REPORT

Setting ERT (Event Report Type) determines the format of the event report:

ERT = 1 or 2 1 = standard 60-cycle event report
2 = sequence-of-events event report

The example below is a standard 60-cycle event report.

```
Example SEL-279 Relay              Date: 06/08/94    Time: 12:35:42.026

     FID=SEL-279-R403-V6-D931217-E2

               Voltages (V sec.)        Elements Timing Bkr Out   Inputs

      C    Bus     Line    Difference   22 55 22 MH 777 TC  C123A 5HHDEH D HD
      Y                                 77 99 55 TS 999 FF  L   L 2SSTMD H HD
      C V1 V3 V5 V2 V4 V6  d12 d34 d56  BL BL IT  R RCL     O   R  IBLT1212
     1 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  ..... *...**.*.**
     2 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  ..... *...**.*.**
     3 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  ..... *...**.*.**
     4 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  ..... *...**.*.**
     5 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  ..... *...**.*.**
     6 67 67 67  0  0  0   67  67  67  .* *. .. *. .*. ..  *.... *...**.*.**
     7 67 67 67  0  0  0   67  67  67  .* *. .. .. .*. ..  *.... *...**.*.**
     8 67 67 67  0  0  0   67  67  67  .* *. .. .. .*. ..  *.... *...**.*.**
     9 66 65 66 37  0  0   29  65  66  .. *. .. .. .*. ..  *.... *...**.*.**
    10 67 67 67 67  0  0    0  67  67  .. ** .. .. .*. ..  .....*...**.*.**
    11 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  .....|...**.*.**
    12 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  .....|...**.*.**
                    •
                    •
                    •
    55 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**
    56 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**
     7 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**
    58 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**
    59 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**
    60 67 67 67 67  0  0    0  67  67  .. ** .. *. .*. ..  ..... ...**.*.**

     Event: CLOS     Targets: DLHB CY
     MT pos. at CYC 6: 300

     Settings:

     BSPT =3        LNPT =1        27B  =7        27L  =7
     59B  =56       59L  =56       25DV =17       25D  =120
     MT1D =300      MT2D =600      MT3D =1800     MT4D =0
     MT5D =0        MT6D =0        MT7D =0        MT8D =0
     MTPD =3000     RS1D =1200     RS2D =0        RS3D =0
     CFD  =0        DLDBD=300      TDURD=7        TFD  =0      HSRD =0
     MTED =0        MTCD =0        MTLD =0        52   =B      HSRL =N
      ERT =1        TIME1=15       TIME2=0        AUTO =2

     Logic Mask settings:

     MTR   MT1   MT2   MT3   MT4   MT5   MT6   MT7   MT8   HSR   OUT1  OUT2  OUT3  ER
     00    00    00    00    00    00    00    00    00    00    00    00    00    00
     A8    20    80    08    00    00    00    00    00    00    00    00    00    00
     00    00    00    00    00    00    00    00    00    00    00    00    00    00
     00    00    00    00    00    00    00    00    00    00    40    00    00    C0
     00    00    00    00    00    00    00    00    00    00    00    00    00    00
```

60 cycles of data

Dead line (27L)
Hot bus (59B)
Circuit breaker open (52b asserted)

CLOSE OUT contact asserts at setpoint time MT1D=300 and triggers event report

Circuit breaker closes (52b deasserts)

Hot bus (59B)
Hot line (59L)
Circuit breaker closed (52b deasserted)

Master Timer timing; Relay in Reclose Cycle State

Three (3) bus PTs
One (1) line PT

52b connected to input 52 (if 52=A, 52a connected to input 52)

60-cycle report format chosen

Logic Mask settings displayed in hexadecimal

DLH1 is reclose condition for setpoint time MT1D = 300

OUT1 contact functions as a TRIP for the Dead Line/Dead Bus Trip scheme

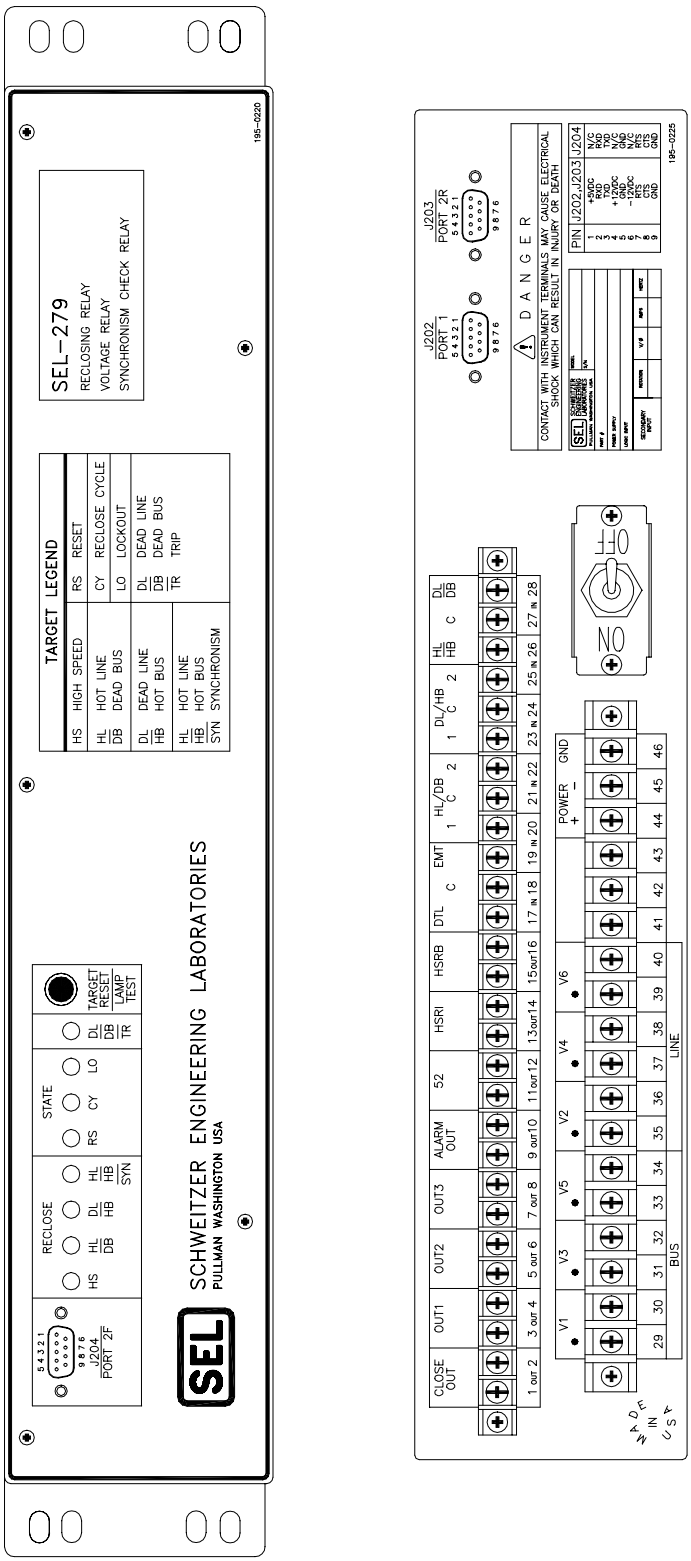

Figure 5: SEL-279 Relay Horizontal Front and Rear Panels

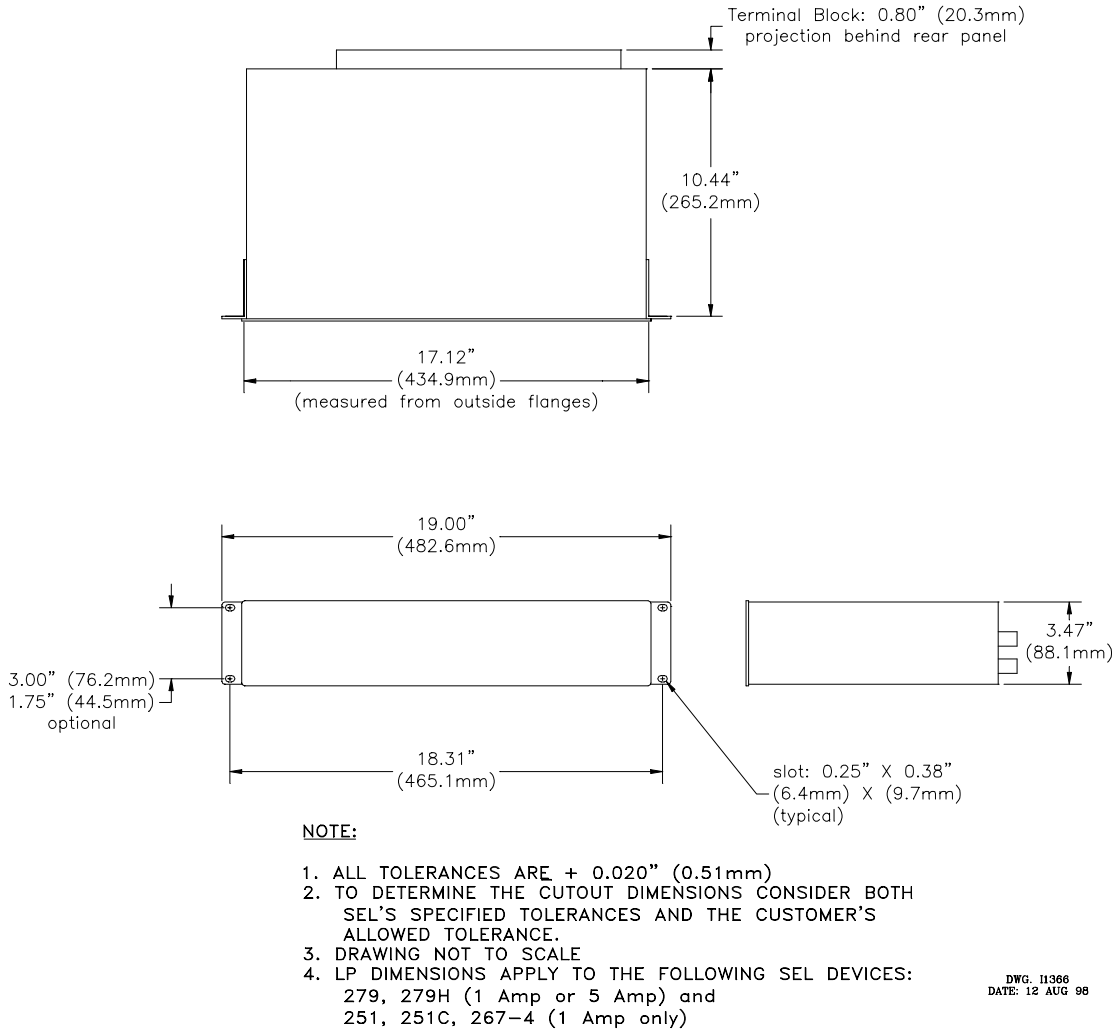

Figure 6: SEL-200 Series Relay Panel Cutout and Drill Diagram

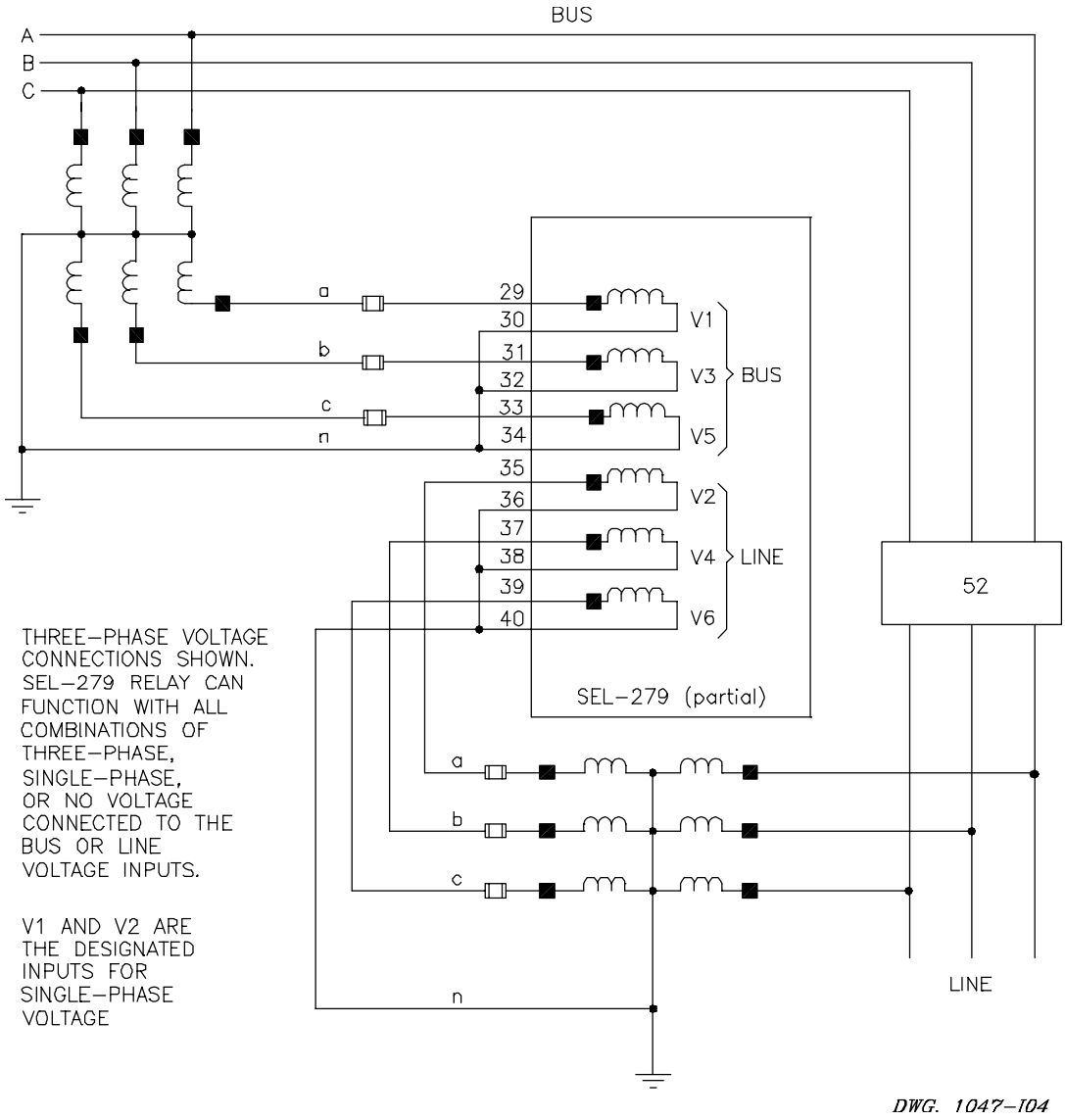

Figure 7: SEL-279 Relay Typical AC External Wye-Connected Voltages
(Can also be wired for Delta-Connected Voltages.)

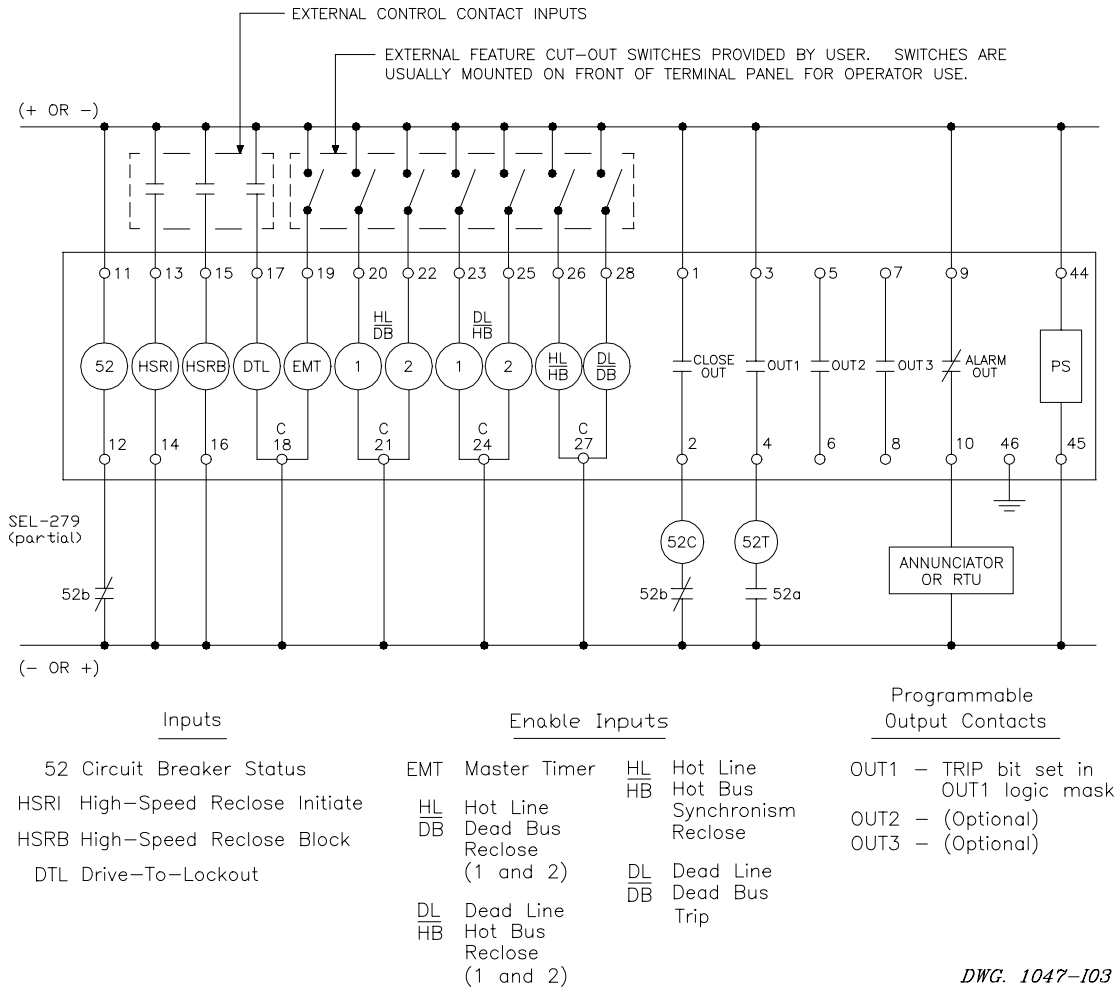

Figure 8: SEL-279 Relay Typical DC External Connections9

FACTORY ASSISTANCE

The employee-owners of Schweitzer Engineering Laboratories, Inc. 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:

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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.

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