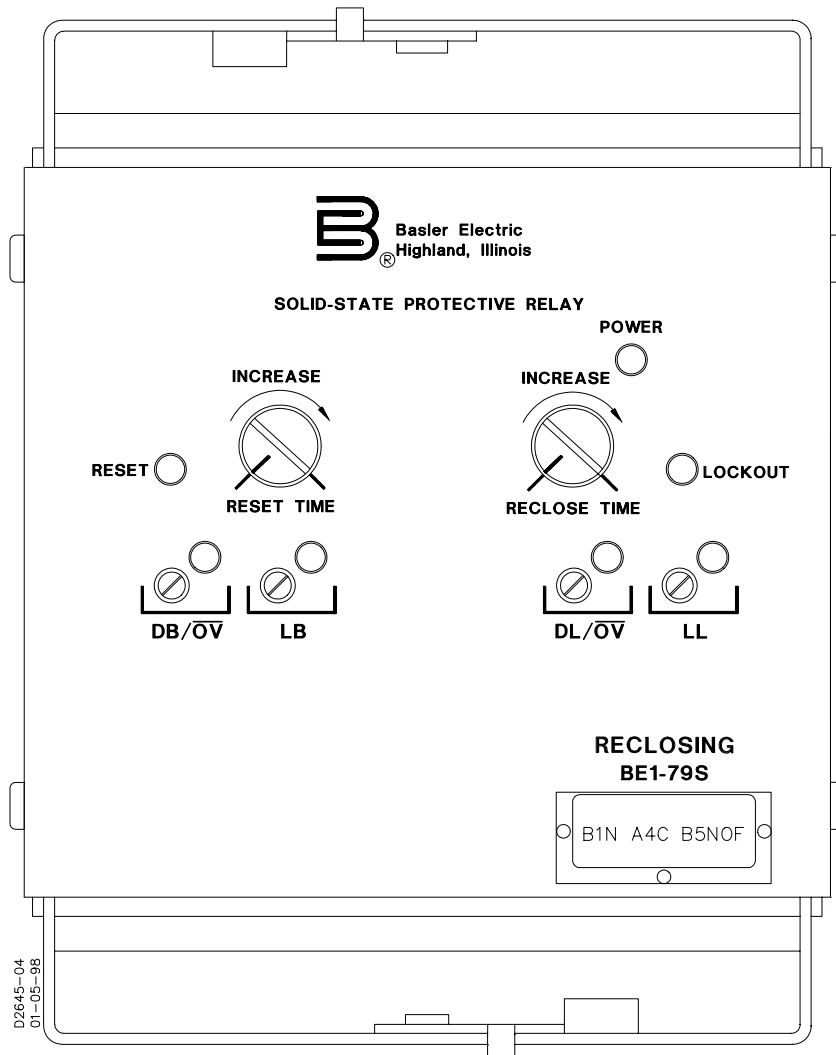


INSTRUCTION MANUAL

FOR

SINGLE SHOT RECLOSING RELAY BE1-79S



B Basler Electric

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INTRODUCTION

This Instruction Manual provides information concerning the operation and installation of BE1-79S Single Shot Reclosing Relay. To accomplish this, the following is provided.

- Specifications
- Installation
- Operational Tests
- Mounting Information

WARNING

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures presented in this manual.

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SECTION 1 • GENERAL INFORMATION

PURPOSE

The BE1-79S Single Shot Reclosing Relay is a solid-state device that provides automatic reclosure of circuit breakers that have been tripped by a protective relay. Many faults are temporary and when a circuit breaker has tripped, due to a protective system operation, it may be successfully reclosed after a short delay without retripping. The BE1-79S Reclosing Relay will provide a single reclosure signal following a trip as an attempt in restoring power and minimizing system disturbances.

DESCRIPTION

The Basler Electric Single Shot Reclosing Relay senses opening and closing of an associated circuit breaker. If the reclosing relay has received a Reclose Initiate signal prior to the opening of the breaker, the reclosing relay after a programmed interval will attempt to reclose the breaker. If the fault is not cleared, and the breaker trips again, no further attempt is made by the reclosing relay to close the breaker. If reclosing is successful and the breaker remains closed for a predetermined interval, the reclosing relay automatically resets and is ready to attempt reclosing for a subsequent trip of the protected breaker.

The programmed time interval between breaker tripping and the reclosure attempt is continuously adjustable by a front panel RECLOSE TIME control within three optional time ranges (0.1 to 2.0 seconds, 1.0 to 20 seconds, or 5 to 60 seconds).

A front panel RESET TIME control adjusts a reset timer in the relay over a range of 5 to 60 seconds. When the reclosed breaker has remained closed over the reset interval, the reclosing relay will reset and provide automatic reclosing for a subsequent protective trip. If the breaker trips before the expiration of the reset interval, the reclosing relay will not attempt another reclosure. Resetting of the relay when this has occurred requires closure of the breaker by other means and its remaining closed for the reset interval.

Automatic reclosing of a tripped breaker requires that a reclose initiate signal (RI) be generated by the protective system and received by the reclosing relay prior to the breaker open signal (52b). The reclose initiate feature allows the reclosing relay to distinguish between protective trips for which automatic reclosing is required and those breaker operations for which automatic reclosing is not desirable. When this feature is not required, the reclose initiate input may be connected to the system battery positive lead or relay terminal 15*, depending on the specified contact sensing input type, to provide a permanent enable.

(*) This requires routing through the external sensing input module if the Type X power supply is used.

A reclose cancel signal (RC) may be applied to the reclosing relay to inhibit the reclosing operation. When the reclose cancel signal is received, and a breaker trip occurs, the automatic reclose operation is inhibited and the reclose output contacts of the relay do not close. Receipt of a reclose cancel signal will reset the closing contacts regardless of the breaker position. The reset interval then times out when the breaker is closed by other means to reset the relay. The reclose cancel signal provides a means of inhibiting automatic reclosing of the breaker.

A wide range of options permit the relay to be specifically tailored to a variety of applications. Options are available in the reclosing relay to provide a choice of three ranges for the reclosure time delay, and to provide isolated or non-isolated contact sensing. The reclose signal to the controlled breaker may be continuously maintained until breaker closure is detected or, optionally, may be maintained for a maximum of 2-3 or 5-6 seconds or until breaker closure is detected.

A voltage monitor option permits active monitoring of a single phase of line and bus voltages to permit reclosure if pre-selected live-line/live-bus, live-line/dead-bus, dead-line/live-bus and dead-line/dead-bus voltage conditions are met. The measurable voltage input limits are adjustable over the range of 10 Vac to 135 Vac.

The relay assembly is mounted in a drawout cradle and enclosed in a standard, utility style, semi-flush case. Test points and circuit components are accessible by removal of the individual printed circuit boards from the relay cradle and using an extender board (Basler part number 9 1129 30 101) to test or troubleshoot. An available test plug (Basler part number 10095) permits the relay to be tested in place without disturbing external control circuit wiring.

MODEL AND STYLE NUMBER

The electrical characteristics and optional features included in a particular style BE1-79S Reclosing Relay are defined by a combination of letters and numbers that make up its style number. The model number, and style number, describing the options included in the specific device, appear on the front panel, drawout cradle, and inside the case assembly. Upon receipt of a reclosing relay, be sure to check relay style number against the requisition and packing list to see that they agree.

Style Number Example

The Style Number Identification Chart (Figure 1-1) defines the electrical characteristics and operational features included in BE1-79S relays. For example, if the Style Number were **1IN A4C B4S0F**, the device would have the following:

- (B) Single-shot reclosing with reclose initiate and reclose cancel.
- (1) Lockout and reset circuits.
- (A4) Reclose time delay continuously variable over the range of 5 to 60 seconds.
- (C) Internal relay operating power to be obtained from an external 125 Vdc or 100/120 Vac, 50/60 Hz source.
- (B) A reset timer that is continuously adjustable over the range of 5 to 60 seconds, together with a 95 second limit for the voltage monitor to accept line and bus conditions.
- (4) Non-isolated contact sensing input is supplied.
- (S) Line and bus voltage monitor is supplied.
- (0) The reclose signal is continuous until controlled breaker is closed.
- (F) Semi-flush mounting.

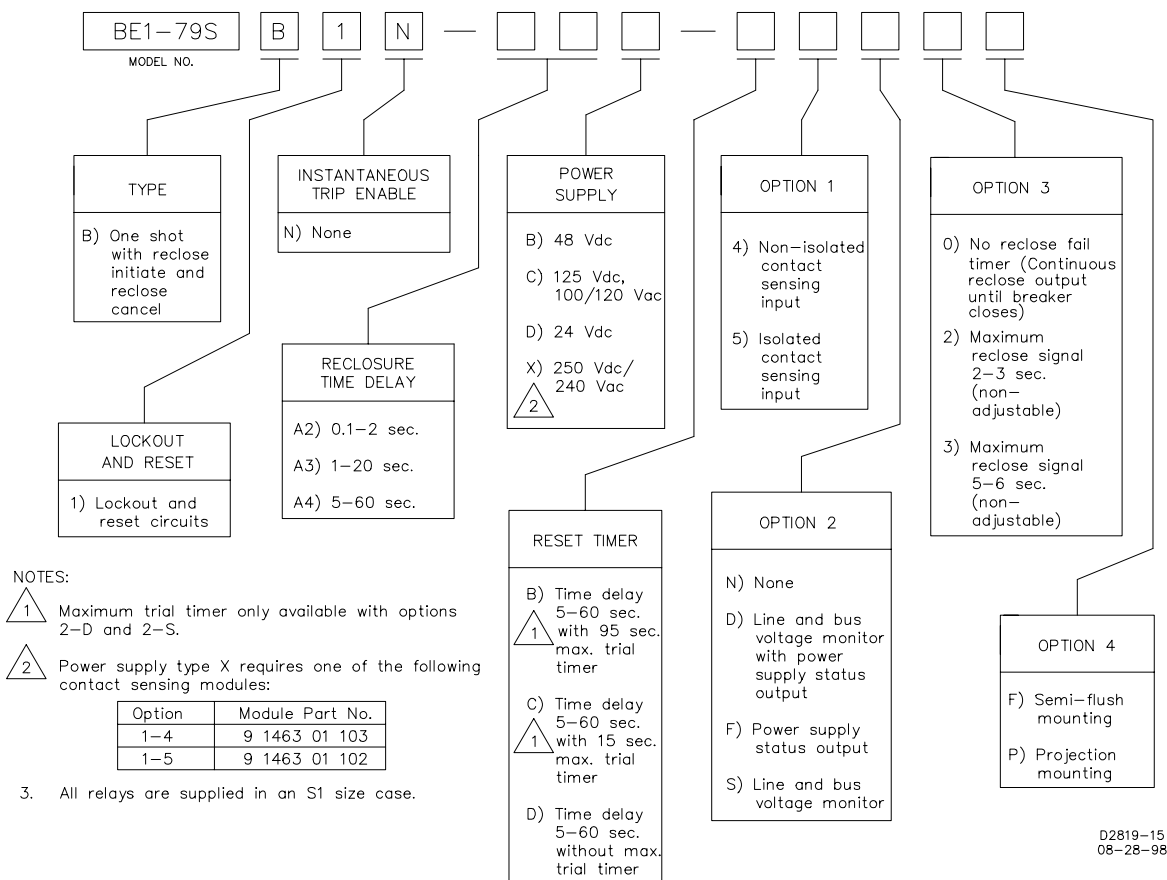


Figure 1-1. Style Number Identification Chart

SPECIFICATIONS

Power Input

The following table describes the various power supplies that are available for this relay.

Table 1-1. Power Supplies

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
B (Mid Range)	48 Vdc	24 to 150 Vdc	5.5 W
C (Mid Range)	125 Vdc 120 Vac	24 to 150 Vdc 90 to 132 Vac	4.0 W 10.0 VA
D (Low Range)	24 Vdc	12† to 32 Vdc	5.0 W
X (High Range)	250 Vdc 240 Vac	62 to 280 Vdc 90 to 270 Vac	5.0 W 14.0 VA

† Type D power supply initially requires 14 Vdc to begin operating. Once operating, the voltage

maybe reduced to 12 Vdc and operation will continue.

Contact Sensing Inputs

All contact sensing inputs recognize a change in contact status within 8.0 milliseconds.

When isolated contact sensing is provided, a dedicated Form A dry contact rated 0.05 amp at 250 Vdc is required to complete the sensing circuit.

When non-isolated contact sensing is provided, the input is polarity sensitive and requires 24-60 Vdc at a burden of 3.5 W for a Type B power supply, 62-150 Vdc at 4.5 W for a Type C power supply, 12-32 Vdc at 2.0 W for a Type D power supply, and 140-280 Vdc at 7.5 W for a Type X power supply.

Reclose Initiate (RI) Input

The RI input, when closed prior to the operation of the breaker sensing contact (52b), initiates the relay to respond to the change of state of the breaker sensing input.

Breaker Sensing Input (52b)

When isolated contact sensing is provided, a dedicated Form B dry contact rated 0.05 amp at 250 Vdc is required to complete the sensing circuit.

When non-isolated contact sensing is provided, the input is polarity sensitive and requires 24-60 Vdc at a burden of 3.5 W for a Type B power supply, 62-150 Vdc at 4.5 W for a Type C power supply, 12-32 Vdc at 2.0 W for a Type D power supply, and 140-280 Vdc at 7.5 W for a Type X power supply.

The breaker sensing input, when closed, signifies that the controlled breaker is open

Reclose Cancel (RC) Input

Isolated and non-isolated input requirements are the same as the reclose initiate (RI) input above.

The reclose cancel input, when closed, terminates reclose timing and cancels the automatic breaker reclosure.

Voltage Monitor (Option 2-S, D)

The voltage monitor compares the sensing inputs of a single phase of line and bus voltages with pre-selected levels and permits automatic breaker reclosure when specific voltage conditions have been satisfied. These levels are independently adjustable over the range of 10 to 135 Vac.

Each voltage sensing input is rated for 150 Vac continuously at 50/60 Hz \pm 10 Hz, at a maximum burden of 1 VA.

Output Circuits

Resistive

120/240 Vac

Make 30 A for 0.2 seconds, carry 7 A continuously, and break 7 A.

125/250 Vdc

Make
30 A for 0.2 seconds, carry 7 A continuously, and break 0.1 A.

Inductive

120/240 Vac,
125/250 Vdc

Make 30A for 0.2 seconds, carry 7 A continuously, and break 0.1 A (L/R = 0.04).

Reclosure Time Delay	Selectable from optional ranges of 0.1 to 2 seconds, 1 to 20 seconds or 5 to 60 seconds. Continuously adjustable with front panel control over the selected range. Timing accuracy within 5%.
Reclose Signal	May be optionally specified to be continuous until breaker closes; or for a maximum duration of 2 to 3 or 5 to 6 seconds.
Reset Time Delay	Continuously adjustable with front panel control over the range of 5 to 60 seconds. Timing accuracy within 5%.
Voltage Monitor Range	Continuously adjustable over the range of 10 to 135 Vac.
Voltage Monitor Accuracy	Within 3% over the range of 0 to 150 Vac for a nominal input frequency of 50/60 Hz, and at 25°C (or within 1% from 25°C over a temperature range of 15°C to +40°C).
Maximum Trial Timer Accuracy	Either 95 ± 10.0 seconds (with Reset Timer B) or 15 ± 2.0 seconds (with Reset Timer C), for a nominal input frequency of 50/60 Hz at 25°C. (Non adjustable.)
Temperature	
<i><u>Operating Temperature</u></i>	-40°C (-40°F) to +70°C (+158°F).
<i><u>Storage Temperature</u></i>	-65°C (-85°F) to +100°C (+212°F).
Shock	In standard tests, the relay has withstood 15 g in each of three mutually perpendicular planes without structural damage or degradation of performance.
Vibration	In standard tests, the relay has withstood 2 g in each of three mutually perpendicular planes, swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance.
Isolation	In accordance with IEC 255-5 and ANSI/IEEE C37.90, one minute dielectric (high potential) tests as follows: <div style="margin-left: 100px;"> All circuits to ground: 2121 Vdc Input to output circuits: 1500 Vac or 2121 Vdc </div>
Surge Withstand Capability	Qualified to ANSI/IEEE C37.90-1978, C37.90a-1974, and IEC 255.
Weight	12.5 pounds net.
Case Size	S1 (double ended).

SECTION 2 • FUNCTIONAL DESCRIPTION

GENERAL

The functional description contained in this section applies to the BE1-79S Single Shot Reclosing Relays with all combinations of available options.

The reclosing relay, functionally shown in Figure 2-1, provides automatic reclosure of circuit breakers that have been tripped by a protective relay. The relay uses a Form B auxiliary contact of the controlled circuit breaker to detect the position of the breaker. A reclose initiate (RI) signal must be received from the protective system prior to the closure of the breaker auxiliary contact. Closure of this contact indicates that automatic reclosing is to be permitted.

A reclose cancel (RC) signal may be generated by the protective system. The RC signal must remain at least 8 milliseconds before it is recognized by the relay. When RC is recognized, the relay is inhibited from reclosing the controlled breaker. Following an RC signal, the controlled breaker must be closed by other means. This permits the relay to be automatically reset by its internal reset timer as described below.

Contact sensing (52b, RI, and RC) is provided in one of two configurations. If isolated contact sensing (Option 1-5) is specified, current is supplied to the contacts by the relay. If non-isolated contact sensing (Option 1-4) is specified, direct current is supplied by the protective system through the contacts to the polarity sensitive relay inputs. If the relay is equipped with the Type X power supply, these configurations must be modified to accommodate an essential external sensing input module. (See Figure 4-9).

When Option 2-D or 2-S is included, a voltage monitor circuit compares the line and bus voltage levels against pre-selected live-line/live-bus, live-line/dead-bus, dead-line/live-bus and dead-line/dead-bus reclosing conditions. The reclosing conditions' voltage levels are established by adjustable controls on the front panel. LB, DB/ $\overline{\text{OV}}$, LL and DL/ $\overline{\text{OV}}$. (The overvoltage limit ($\overline{\text{OV}}$) mode allows an upper voltage limit to be set for the recognition of a live-line or live-bus condition.) If the measured voltages are not correct for the selected reclosing conditions, breaker closing is inhibited.

In some units (those with Reset Timer B or C) there is a Maximum Trial Timer on the voltage monitor board that limits the opportunity for reclosing to either 95 or 15 seconds (for B and C respectively) after an open breaker is sensed at the 52b input. If the required line and/or bus voltages have not been detected during the specified time, the relay is inhibited from issuing a reclosing signal. The inhibit remains in effect until the breaker is closed by other means, thereby circumventing the somewhat precarious situation that could result from a relay poised to issue a reclose signal long after the instigating event has passed. (Like a loaded gun with its safety off.)

When the controlled breaker is closed, the reset timer begins to measure a programmed interval. If the breaker remains closed for this interval, the relay resets and is ready to perform an automatic reclosing operation following a subsequent breaker trip by the protective system. If the breaker opens before the programmed interval has expired, the relay is disabled (locked out) and will not respond further to the breaker position until it is reset. Resetting is accomplished by closing the breaker by other means and its remaining closed for the duration of the reset interval.

A red LOCKOUT indicator on the relay front panel lights when the relay generates the reclose command or the breaker opens prior to expiration of the reset timer. It goes out when the reset time expires. A Form C lockout relay is slaved to the LOCKOUT indicator and provides output contacts for monitoring the state of the reclosing relay.

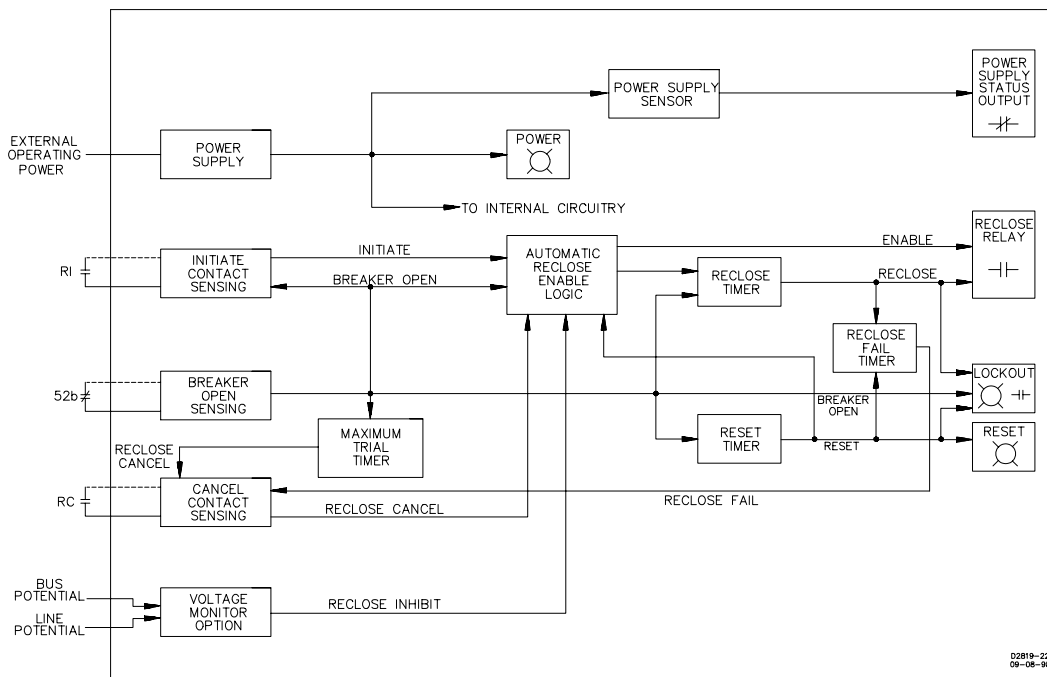


Figure 2-1. Functional Block Diagram

POWER SUPPLY

Basler Electric enhanced the power supply design for unit case relays. This new design created three, wide range power supplies that replace the four previous power supplies. Style number identifiers for these power supplies have not been changed so that customers may order the same style numbers that they ordered previously. The first newly designed power supplies were installed in unit case relays with EIA date codes 9638 (third week of September 1996). Relays with a serial number that consists of one alpha character followed by eight numerical characters also have the wide range power supplies. A benefit of this new design increases the power supply operating ranges such that the 48/125 volt selector is no longer necessary. Specific voltage ranges for the three new power supplies and a cross reference to the style number identifiers are shown in the following table.

Table 2-1. Wide Range Power Supply Voltage Ranges

Power Supply	Style Chart Identifiers	Nominal Voltage	Voltage Range
Low Range	D	24 Vdc	12† to 32 Vdc
Mid Range	B, C	48, 125 Vdc, 120 Vac	24 to 150 Vdc, 90 to 132 Vac
High Range	X	125, 250 Vdc, 120, 240 Vac	62 to 280 Vdc, 90 to 270 Vac

† 14 Vdc is required to start the power supply.

Relay operating power is developed by the wide range, isolated, low burden, flyback switching, solid state power supply. Nominal ± 12 Vdc is delivered to the relay internal circuitry. Input (source voltage) for the power supply is not polarity sensitive. A red LED turns ON to indicate that the power supply is functioning properly.

INITIATE CONTACT SENSING (RI)

When an external form A contact (RI) is closed (typically by a protective relay), the initiate contact sensing circuit generates an INITIATE signal to the automatic reclose enable logic.

BREAKER OPEN SENSING (52b)

When the 52b circuit breaker auxiliary contact closes a BREAKER OPEN signal is generated by the breaker open sensing circuit to the automatic reclose enable logic.

When the controlled breaker closes, the BREAKER OPEN signal is terminated. This occurs regardless of the state of the other inputs to the relay. Termination of the BREAKER OPEN signal stops the reclose timer, initiates the reset timer, and terminates the reclose output.

CANCEL CONTACT SENSING (RC)

When an external form A contact (RC) is closed, the cancel contact sensing circuit generates a RECLOSE CANCEL signal which inhibits or terminates the automatic reclose enable logic.

AUTOMATIC RECLOSE ENABLE LOGIC

The automatic reclose enable logic allows operation of the reclose timer when a RECLOSE CANCEL or INHIBIT signal is not present, and the INITIATE signal has been present prior to recognition of the BREAKER OPEN signal.

RECLOSE TIMER

The reclose timer is started by the automatic reclose enable logic and measures an interval determined by the front panel RECLOSE TIME control. At the completion of the programmed interval, if RECLOSE CANCEL is not generated and BREAKER OPEN is still present, the reclose timer generates RECLOSE to close the contacts of the reclose relay, energizing the breaker close coil and the internal lockout relay. RECLOSE is terminated when the breaker closes, or when RECLOSE CANCEL is generated, or when the maximum reclose signal time has expired (Option 3-2 or 3-3).

RECLOSE FAIL TIMER (Option 3-2 or 3-3)

A RECLOSE FAIL signal is generated by the reclose fail timer if the reclose command from the relay does not cause the controlled breaker to close within the specified time. The RECLOSE FAIL signal, when present, is internally applied to the cancel contact sensing circuit and has an effect similar to receiving RC from the protective system. RECLOSE CANCEL generated in response to RECLOSE FAIL inhibits the automatic reclose enable logic, causing it to disregard the BREAKER OPEN signal from the breaker open sensing circuit.

For relays specified to have Option 3-0, the reclose fail timer is not present and the relay will output a continuous RECLOSE signal until the controlled breaker is closed or until the RECLOSE CANCEL signal is received from the RC contact.

RESET TIMER

The reset timer provides an automatic reset for the relay when the controlled breaker remains closed for the duration of the reset interval. The reset timer measures an interval between 5 and 60 seconds as determined by the RESET TIME control on the front panel.

When BREAKER OPEN is terminated, indicating that the controlled breaker is closed, the reset timer begins to measure the programmed interval. At the completion of this interval, the timer generates RESET and lights the RESET indicator. The RESET signal resets the reclose fail timer, resets the automatic reclose enable logic so that it is able to respond to a subsequent protective trip of the breaker, deenergizes the internal lockout relay and extinguishes the LOCKOUT indicator. Reset, with RESET indicator lit, is the normal state for the relay as it waits for a protective breaker trip.

If a breaker trip occurs before the reset interval has expired, the RESET signal is not generated, the internal lockout relay is energized (if not previously energized by a close command), and the relay will not attempt to close the breaker or to reset its circuits. When this occurs, resetting of the relay requires closing the controlled breaker by other means and its remaining closed for the duration of the reset interval.

VOLTAGE MONITOR (Option 2-D or 2-S)

This circuitry monitors a single-phase each of line and bus voltages and inhibits operation of the reclose logic unless specific voltage conditions are met. Selector switches and adjustment controls allow tailoring operation of the relay to a wide range of line/bus closing conditions.

Circuit board mounted switches provide selection of any combination of four permissible closing conditions: LIVE-LINE/LIVE-BUS, DEAD-LINE/LIVE-BUS, LIVE-LINE/DEAD-BUS, AND DEAD-LINE/DEAD-BUS (see Figure 2-2). Four front panel controls provide independent selection of the live and dead voltage levels for the line and bus inputs over the range of 10 to 135 volts. This scheme establishes precise voltage conditions under which reclosing can occur. Non-selection of specific closing conditions prevents closing from occurring during these conditions.

As an example, the reclosing relay may be programmed for LIVE-LINE/LIVE-BUS DEAD-LINE/LIVE-BUS closing, with the individual controls set for: LIVE-LINE, above 100 volts; DEAD-LINE, below 40 volts; and LIVE-BUS, above 35 volts (Figure 2-3). In this case, reclosing would be permitted only when the line and bus voltage conditions satisfy the front panel settings. If these conditions are not met, the voltage monitor circuit generates an INHIBIT signal to disable the automatic reclose enable logic.

Circuit board-mounted MODE switches allow selection of either a "normal" mode or an overvoltage limit (\overline{OV}) mode ("normal" mode denotes non-operation of the \overline{OV} mode). MODE switch no. 1 (for the live-bus condition) and MODE switch no. 2 (for the live-line condition) allow independent selection of an adjustable overvoltage limit (\overline{OV}) level that defines a live voltage band for permissible relay closing (see Figure 2-2). In this mode, live-line or live-bus closing will be permitted if the appropriate monitored voltage(s) is within the permissible band.

As shown in Figure 2-3, closing will not be permitted if the monitored bus voltage is above the selected \overline{OV} setting of 80 volts or below the "live" setting of 35 volts. Adjustments of the \overline{OV} limits for the live-line and live-bus are provided by the dual-function front panel controls, DL/ \overline{OV} and DB/ \overline{OV} .

NOTE

For proper operation of the voltage monitor logic, the "live" controls, when not used, must be adjusted above the "dead" control leads, but below 80 Vac. Unused "dead" controls must be adjusted fully CCW, then backed off one turn.

When the situation occurs in which both a live zone and a dead zone are elected, and \overline{OV} is selected for the live zone, the dead zone will occupy the area immediately below the live zone established by the LL or LB control (see the \overline{OV} MODE column of Figure 2-2, using the combined live-line/dead-bus and dead-line/live-bus conditions as examples).

Figure 2-4 provides further examples of the selection of line and bus live/dead zones using the selection diagram of Figure 2-2.

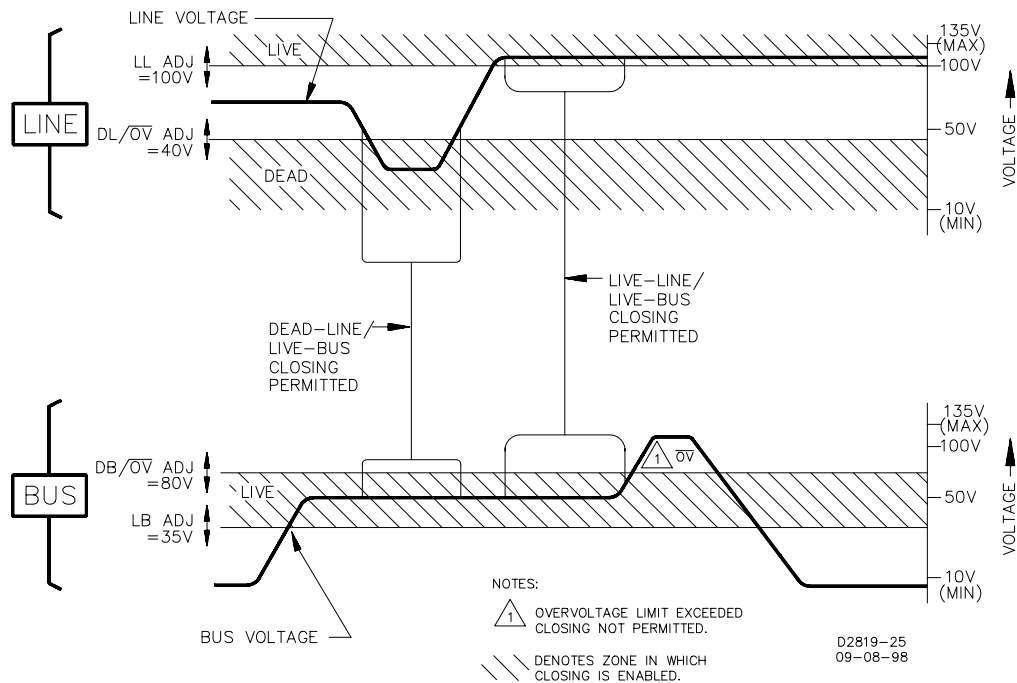
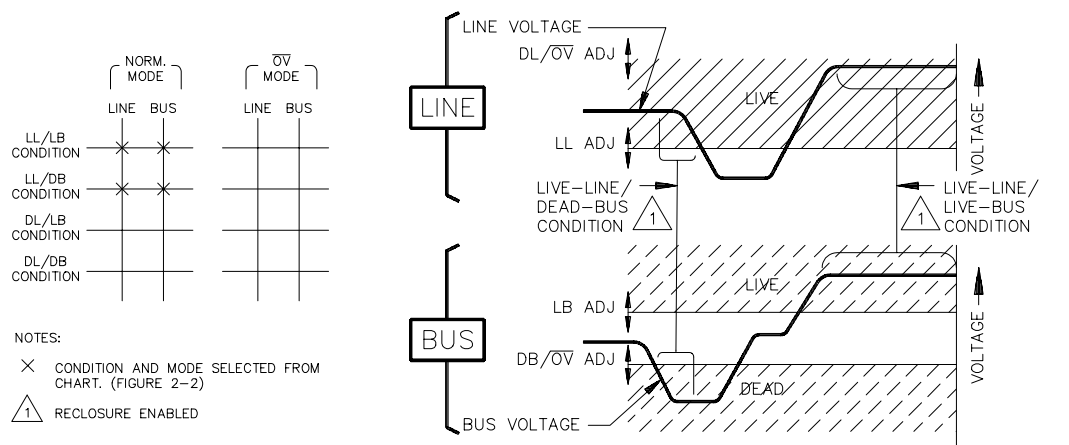
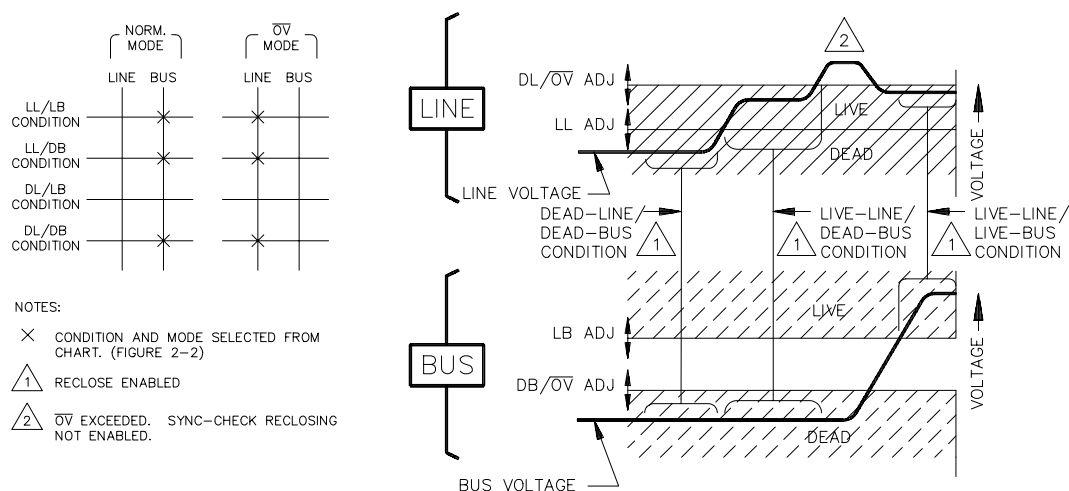


Figure 2-3. Example of Optional Voltage Monitor Live-Line/Live-Bus and Dead-Line/Live-Bus Reclosing with Live-Bus Overvoltage Limit (\overline{OV})



SELECTED LIVE-LINE/LIVE-BUS AND LIVE-LINE/DEAD-BUS CONDITIONS



SELECTED LIVE-LINE/LIVE-BUS, LIVE-LINE/DEAD-BUS AND DEAD-LINE/DEAD-BUS CONDITIONS, WITH OV FOR THE LIVE-LINE

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Figure 2-4. Examples of Optional Voltage Monitor Live and Dead Zones Selection

POWER SUPPLY STATUS OUTPUT (Option 2-D or 2-F)

The power supply status output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay continuously energized with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is deenergized, closing the NC output contact.

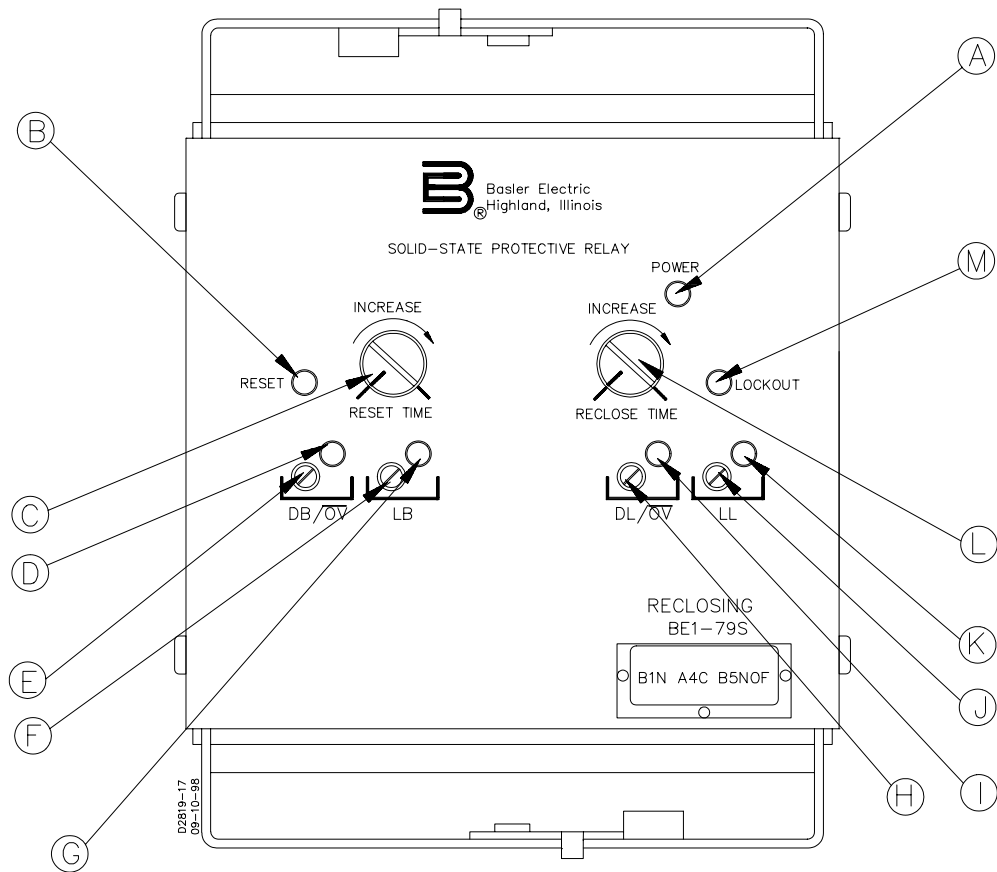


Figure 3-1. Location of Controls and Indicators

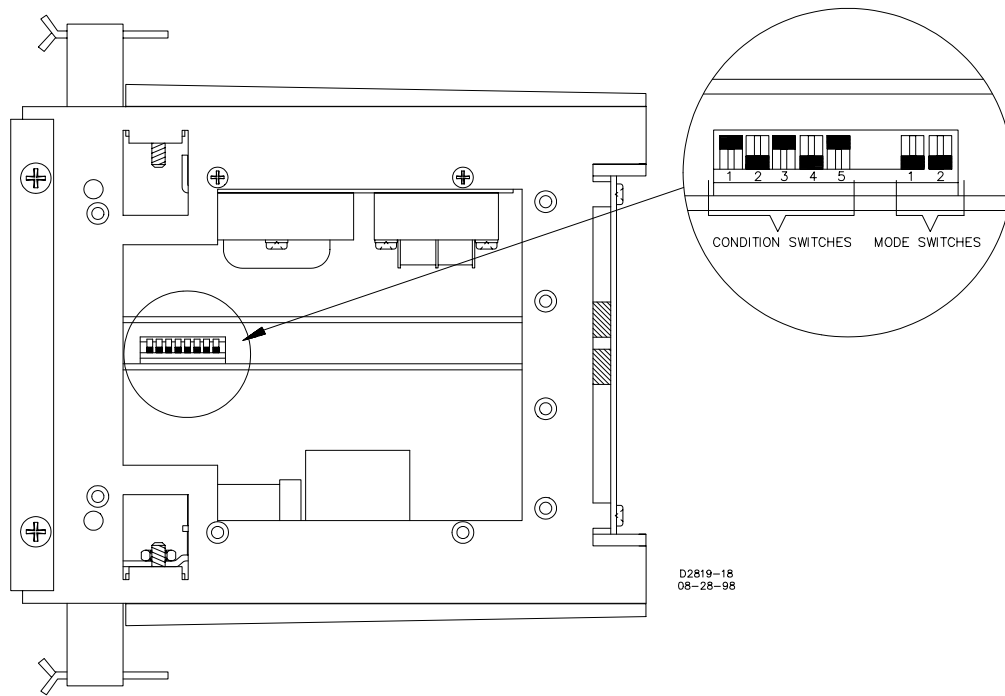


Figure 3-2. Optional Voltage Monitor Board CONDITION and MODE Switches Location

SECTION 3 • HUMAN-MACHINE INTERFACE

CONTROLS AND INDICATORS

The following table is referenced to the callouts in Figure 3-1.

Locator	Control or Indicator	Function
A	POWER Indicator	This red light emitting diode (LED) lights when the relay power supply is supplying a nominal ± 12 Vdc to the relay internal circuitry.
B	RESET Indicator	This red LED lights when the controlled breaker has remained closed for the duration of the programmed reset time and the relay is reset. The indicator goes out when the breaker opens (52b closes).
C	RESET TIME Control	This continuously adjustable dial provides a means for the operator to set the reset time interval. The range is from 5 to 60 seconds.
D	DB/ \overline{OV} Indicator (Option 2-S, D)	This red LED lights when the bus voltage is less than the dead-bus setting during the normal mode, or less than the overvoltage limit setting during the overvoltage limit mode.
E	DB/ \overline{OV} Control (Option 2-S, D)	<p>This multi-turn screw, accessible through the front panel, provides continuous selection over a range of 10 to 135 volts of the dead-bus (DB) voltage monitoring level during the normal mode, or the overvoltage limit for the live-bus voltage monitoring level during the overvoltage limit mode. Adjustment is by small screwdriver. Minimum voltage is CCW.</p> <p>When unused, this control must be adjusted fully CCW, then backed off one turn.</p>
F	LB Control (Option 2-S, D)	<p>This multi-turn screw, accessible through the front panel, provides continuous selection over a range of 10 to 135 volts of the live-bus voltage monitoring level. Adjustment is by small screwdriver. Minimum voltage is CCW. This control must always be set higher than the DB control, whether or not the LB function is used. When not in use, be sure (additionally) that it is set lower than 80 Vac.</p>
G	LB Indicator (Option 2-S, D)	This red LED lights when the bus voltage is greater than the live-bus setting.

Locator	Control or Indicator	Function
H	DL/\overline{OV} Control (Option 2-S, D)	<p>This multi-turn screw, accessible through the front panel, provides continuous selection over a range of 10 to 135 volts of the dead-line voltage monitoring level during the normal mode, or the overvoltage limit for the live-line voltage monitoring level during the overvoltage limit mode. Adjustment is by small screwdriver. Minimum voltage is CCW.</p> <p>When unused, this control must be adjusted fully CCW, then backed off one turn.</p>
I	DL/\overline{OV} Indicator (Option 2-S, D)	<p>This red LED lights when the line voltage is less than the dead-line setting during the normal mode, or less than the overvoltage limit setting during the overvoltage limit mode.</p>
J	LL Control (Option 2-S, D)	<p>This multi-turn screw, accessible through the front panel, provides continuous selection over a range of 10 to 135 volts of the live-line voltage monitoring level.</p> <p>Adjustment is by small screwdriver. Minimum voltage is CCW.</p> <p>This control must always be set higher than the DL control, whether or not the LL function is used. When not used, be sure (additionally) that it is set lower than 80 Vac.</p>
K	LL Indicator (Option 2-S, D)	<p>This red LED lights when the line voltage is greater than the live-line setting.</p>
L	RECLOSE TIME Control	<p>This continuously adjustable dial provides a means for the operator to set the reclose time delay. The relay may be specified with one of three optional ranges: 0.1 to 2 seconds, 1 to 20 seconds, or 5 to 60 seconds.</p>
M	LOCKOUT Indicator	<p>This red LED lights when the relay generates a reclose command, or if the breaker reopens before the reset timer has expired. The indicator goes out when the breaker is closed and the reset time interval expires.</p>

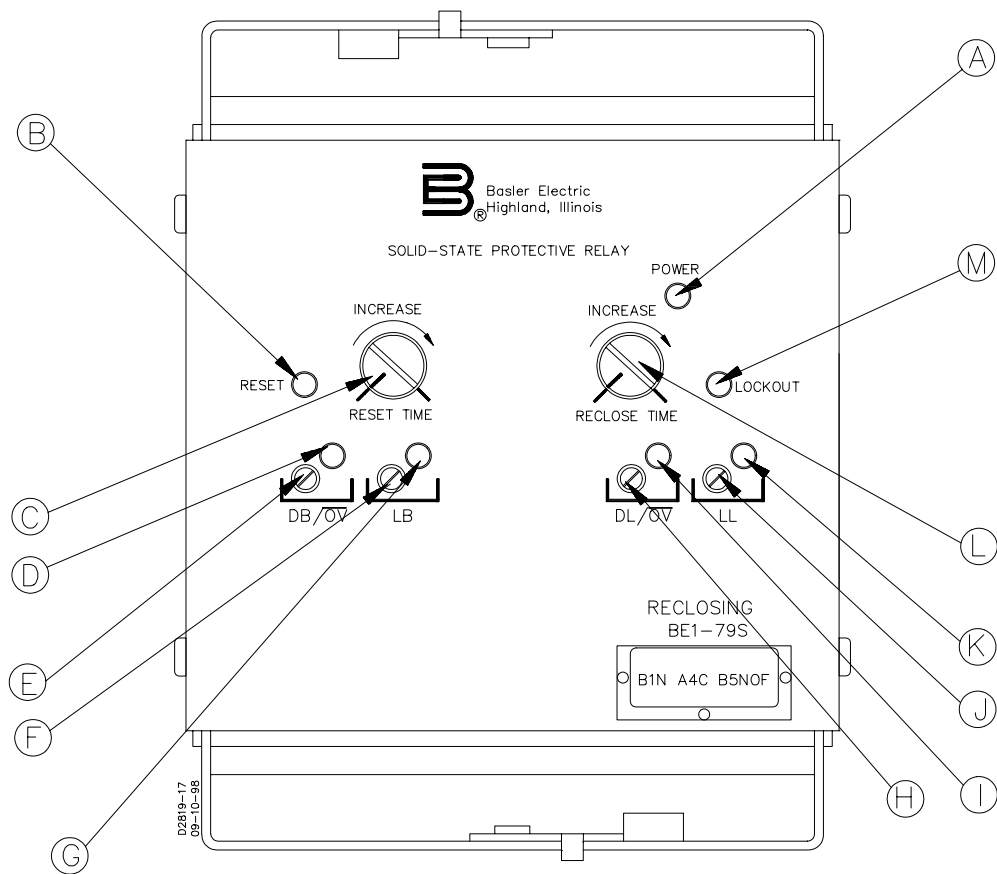


Figure 3-1. Location of Controls and Indicators

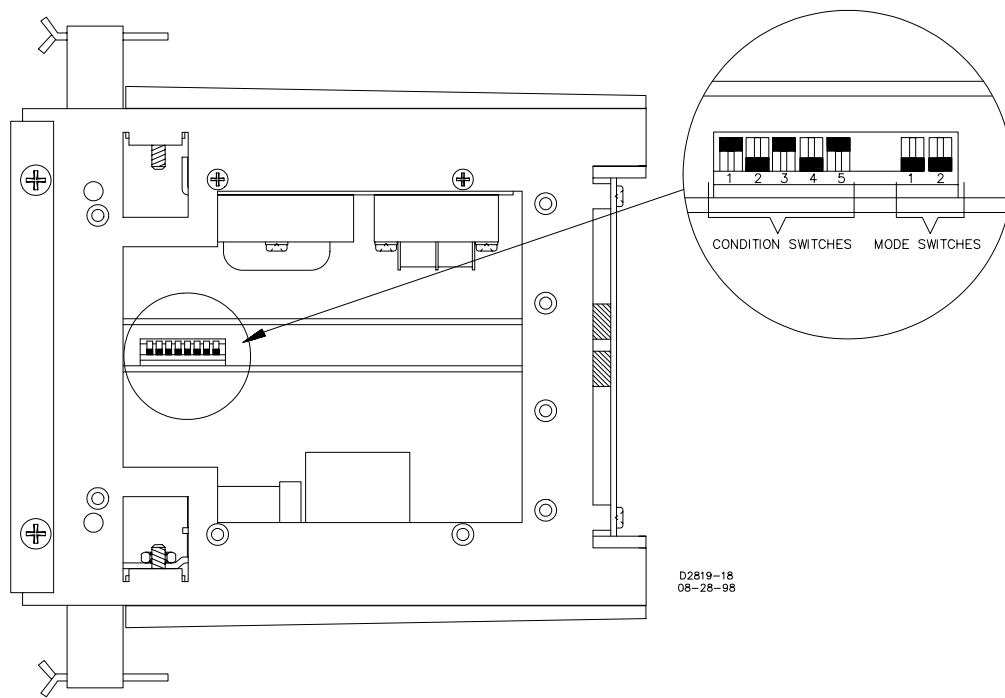


Figure 3-2. Optional Voltage Monitor Board CONDITION and MODE Switches Location

SWITCHES

Refer to Figure 3-2 for the following table.

Switch	Description
*CONDITION Switch No. 1 (Option 2-S, D)	Not used.
*CONDITION Switch No. 2 (Option 2-S, D)	Off (up) position: disables live-line/live-bus reclosing. On (down) position: enables live-line/live-bus reclosing.
*CONDITION Switch No. 3 (Option 2-S, D)	Off (up) position: disables dead-line/live-bus reclosing. On (down) position: enables dead-line/live-bus reclosing.
*CONDITION Switch No. 4 (Option 2-S, D)	Off (up) position: disables live-line/dead-bus reclosing. On (down) position: enables live-line/dead-bus reclosing.
*CONDITION Switch No. 5 (Option 2-S, D)	Off (up) position: disables dead-line/dead-bus reclosing. On (down) position: enables dead-line/dead-bus reclosing.
*MODE Switch No. 1 (Option 2-S, D)	Normal (up) position: prevents the overvoltage mode of operation during all live-bus conditions. Overvoltage limit (down) position: allows the overvoltage mode of operation during all live-bus conditions.
*MODE Switch No. 2 (Option 2-S, D)	(Same as for MODE switch no. 1, for all live-line conditions).

(*) Cradle must be removed for access to circuit board-mounted switches. See Figure 3-2 for location of switches on voltage monitor board.

SECTION 4 • INSTALLATION

UNPACKING

When not shipped as part of a control or switchgear panel, the relays are shipped in sturdy cartons to prevent damage during transit. Reasonable care should be exercised when unpacking the relay to prevent damage or disturbing of adjustments.

INSPECTING

Visually inspect the relay for damage that may have been incurred during shipment. If there is evidence of damage, immediately file a claim with the carrier and notify either the Customer Service Representative or Basler Electric Company's main office in Highland, Illinois.

Be sure also to check the relay model and style number against the requisition and packing list to see that they agree.

MOUNTING

The relay is intended to be vertically mounted in a location relatively free of moisture, dust, and excessive vibration. Relay outline dimension and panel drilling diagrams are shown in Figures 4-1 through 4-6.

CONNECTING

CAUTION

THIS IS A SOLID-STATE DEVICE. MEGGER AND HIGH POTENTIAL TEST EQUIPMENT MUST NOT BE USED. IF A WIRING INSULATION TEST IS REQUIRED, REMOVE THE CONNECTING PLUG AND WITHDRAW THE RELAY FROM ITS CASE.

External connections to the relay are made at the rear of the case. Typical external connections are shown in Figures 4-7 through 4-9. Typical internal connections are shown in Figure 4-10. Incorrect wiring may result in damage to the relay. Be sure to check model and style number against the options described in Section 1 before interconnecting and energizing a particular relay. Interconnections should be made with minimum 14 AWG stranded wire.

NOTE

Be sure that the relay case is hardwired to earth ground using the ground terminal on the rear of the relay case with not less than 12 AWG copper wire. Do not "daisy chain" ground connections. Always use a separate ground lead to the ground bus for each relay.

The output contacts should be interrupted by a breaker auxiliary form B contact to de-energize the output circuit and prevent arcing.

Non-isolated sensing inputs are polarity sensitive. Relay case terminals 12, 13, and 14 are positive with respect to terminal 15.

Terminals 3 and 4 are external relay power supply voltage inputs and are not polarity sensitive.

Relays containing the Type X (250 Vdc, 240 Vac) power supply require an external sensing input module. Connections for this module are shown in Figure 4-9.

Removal of the connecting plugs opens the reclosing contact and power circuits before opening the contact sensing circuits.

STORING

In the event that the relay is not to be installed immediately, or has been taken out of service, store the relay in its original shipping carton in a moisture and dust free area.

NOTE

This protective relay contains Aluminum Electrolytic Capacitors which generally have a life expectancy in excess of 10 years at storage temperatures less than 40°C. Typically, the life expectancy of the capacitor is cut in half for every 10°C rise in temperature. Storage life can be extended, if at 1 (one) year intervals, power is applied to the relay for a period of 30 (thirty) minutes.

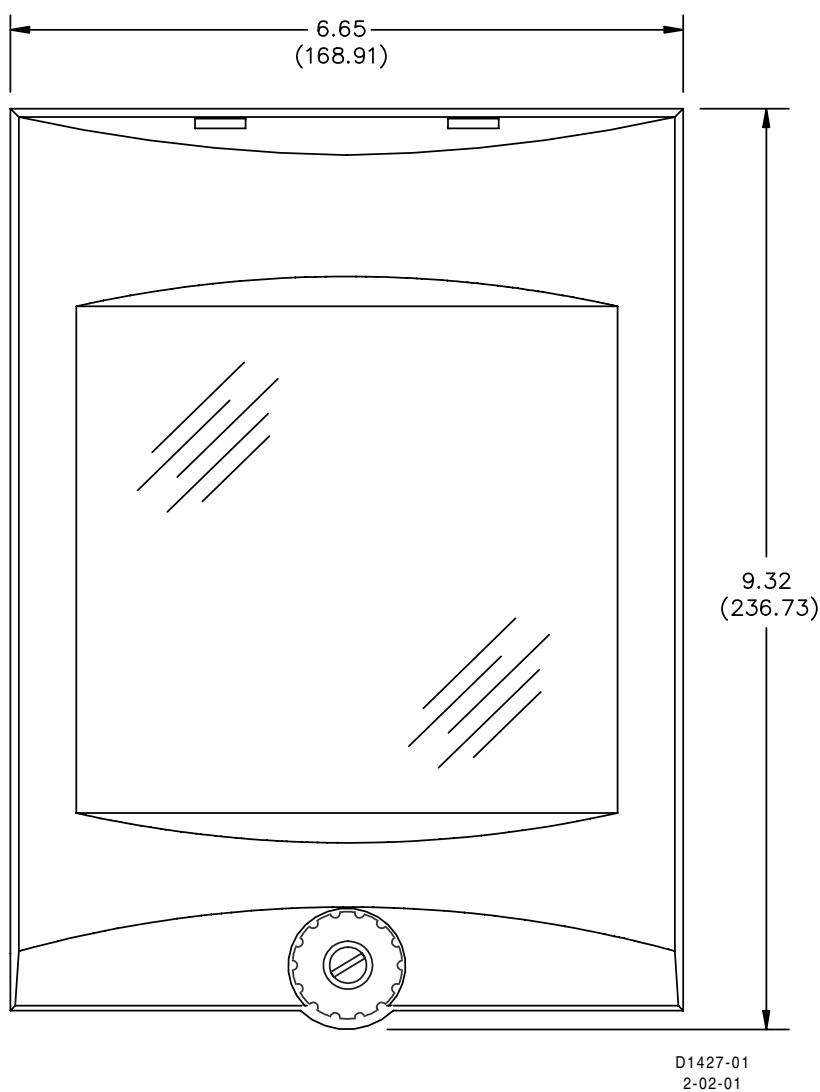


Figure 4-1 . S1 Case, Outline Dimensions, Front View

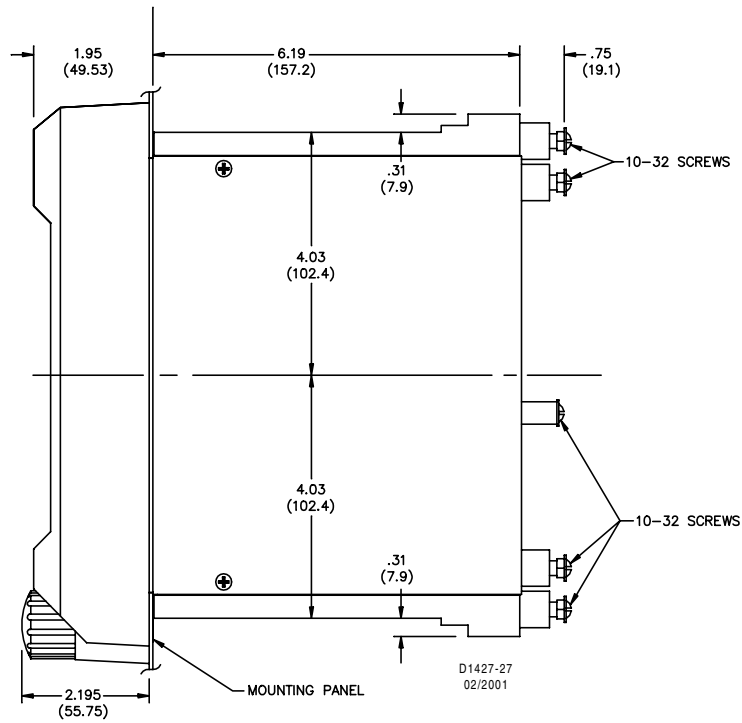


Figure 4-2 . S1 Case, Double-Ended, Semi-Flush Mounting, Outline Dimensions, Side View

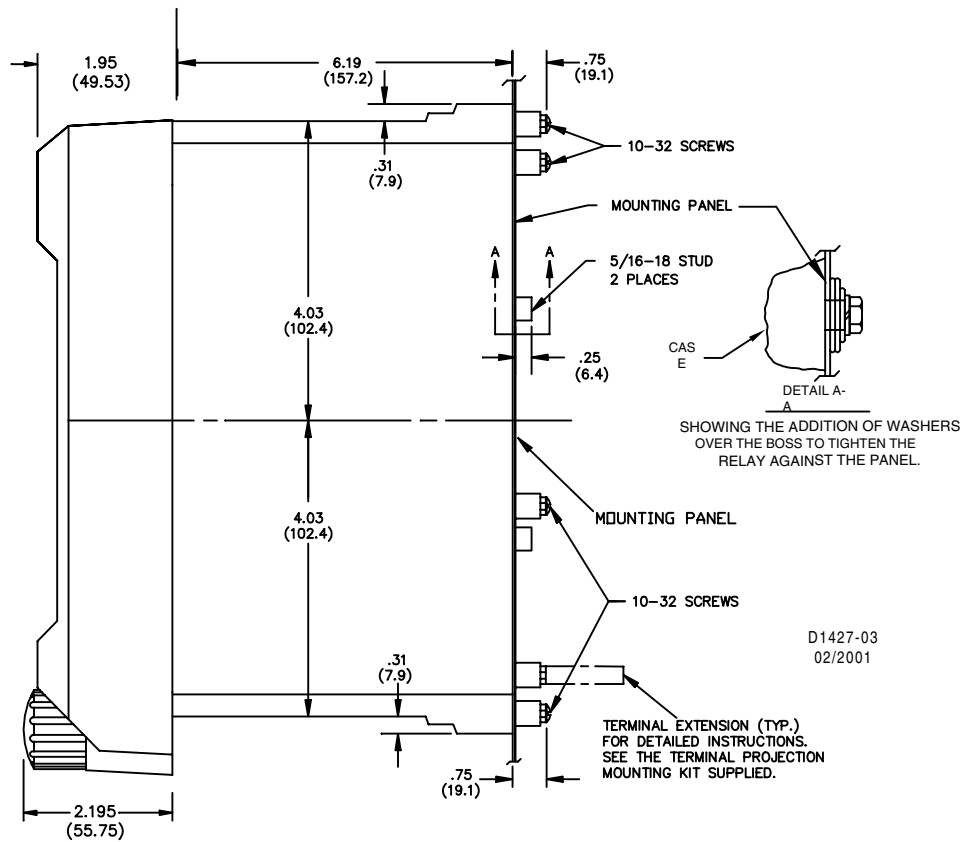


Figure 4-3 . S1 Case, Double-Ended, Projection Mount, Outline Dimensions, Side View

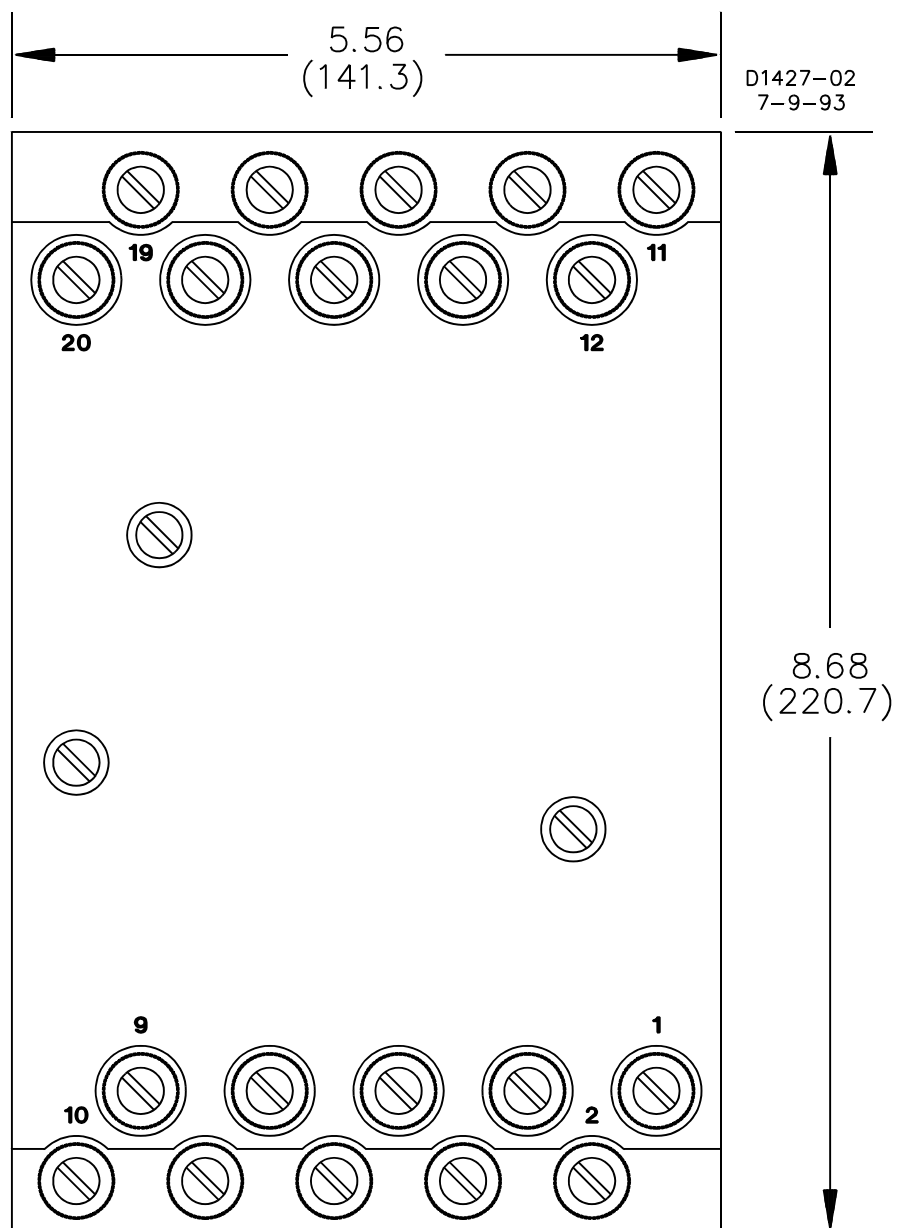


Figure 4-4 . S1 Case, Double-Ended, Projection Mount, Outline Dimensions, Rear View

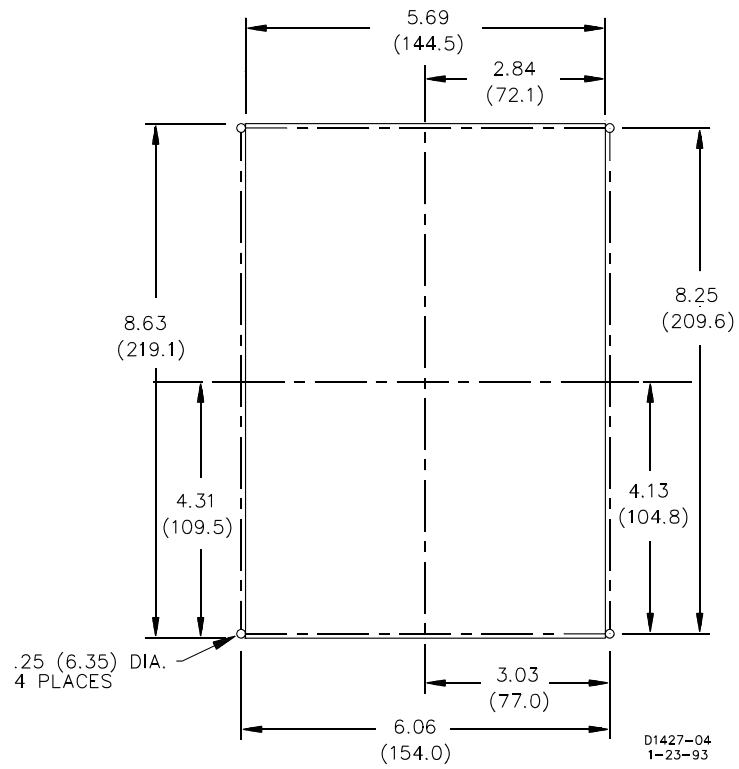


Figure 4-5 . S1 Case, Panel Drilling Diagram, Semi-Flush Mounting

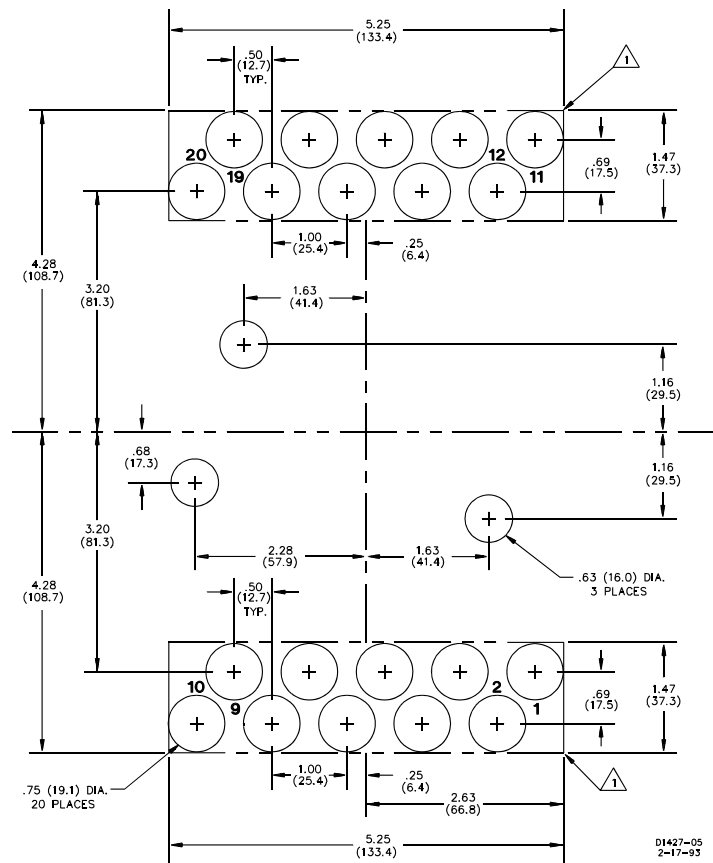


Figure 4-6 . S1 Case, Double-Ended, Projection Mounting, Panel Drilling Diagram, Rear View

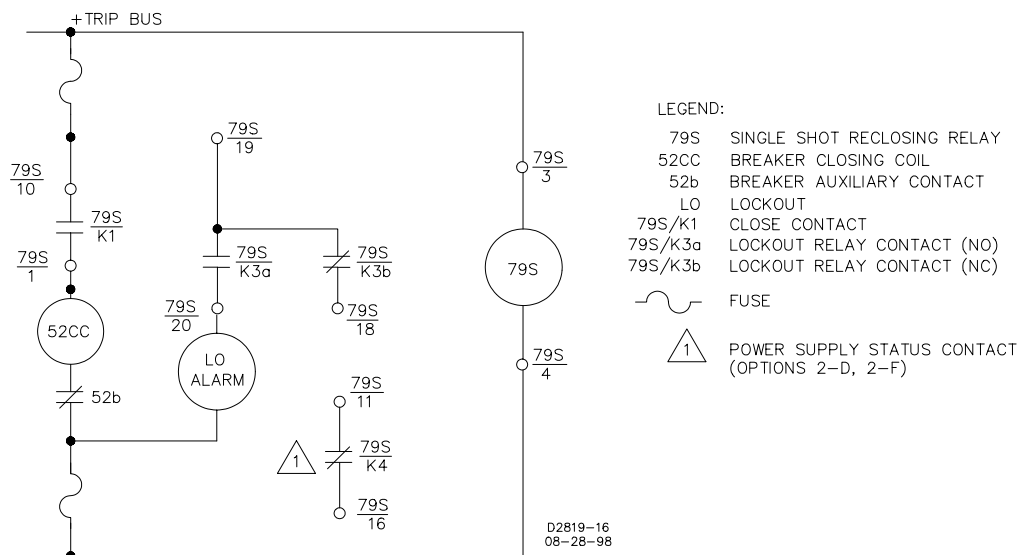


Figure 4-7. Control Circuit Connections (Typical)

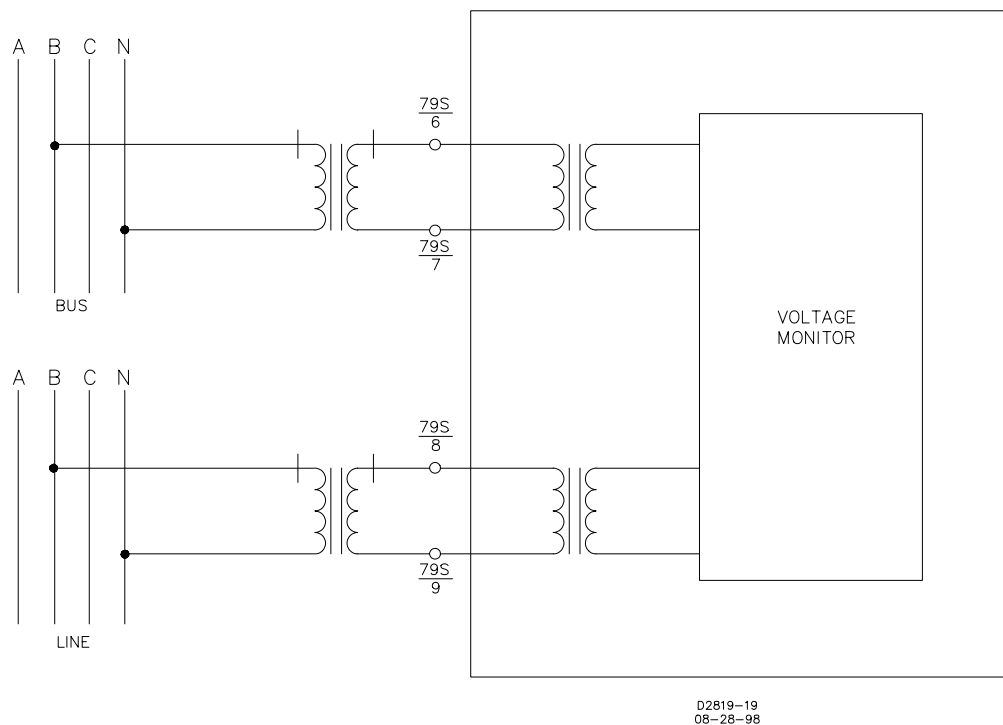


Figure 4-8. Voltage Sensing Circuit Connections

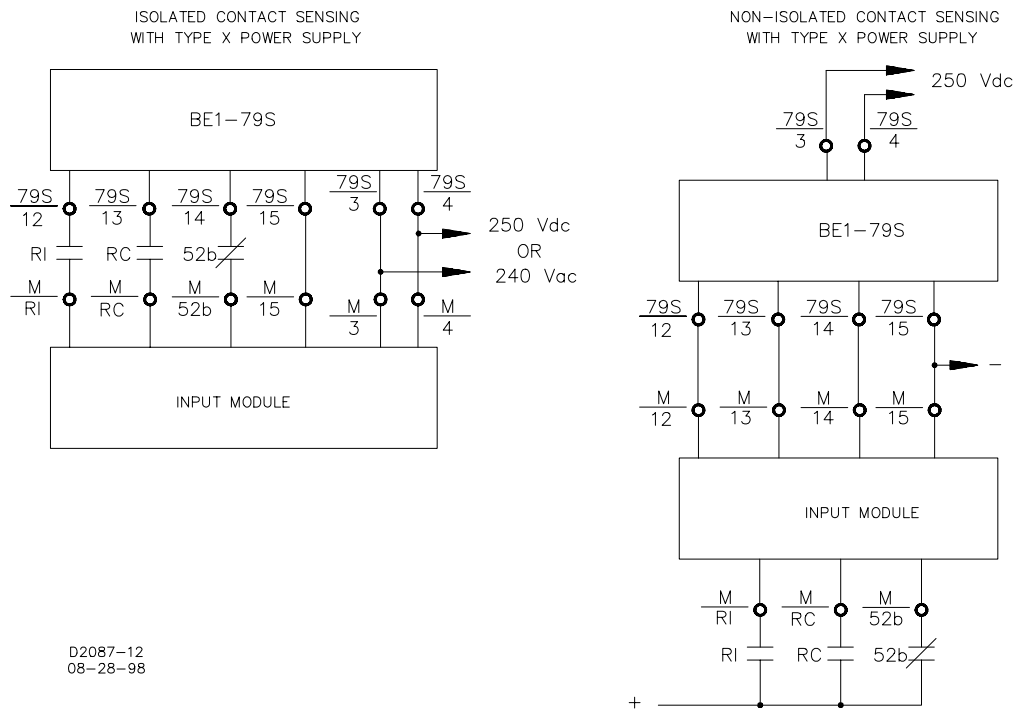
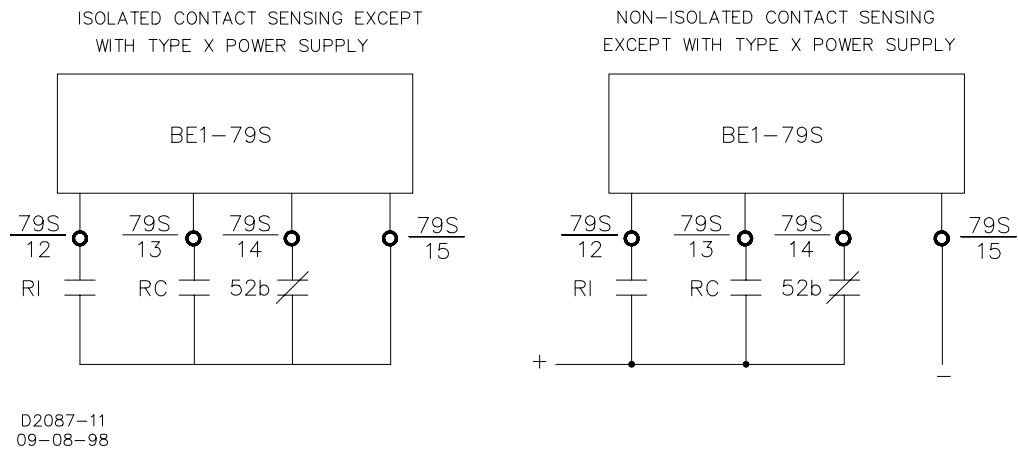


Figure 4-9. RI, RC, and 52b Sensing Circuit Connections

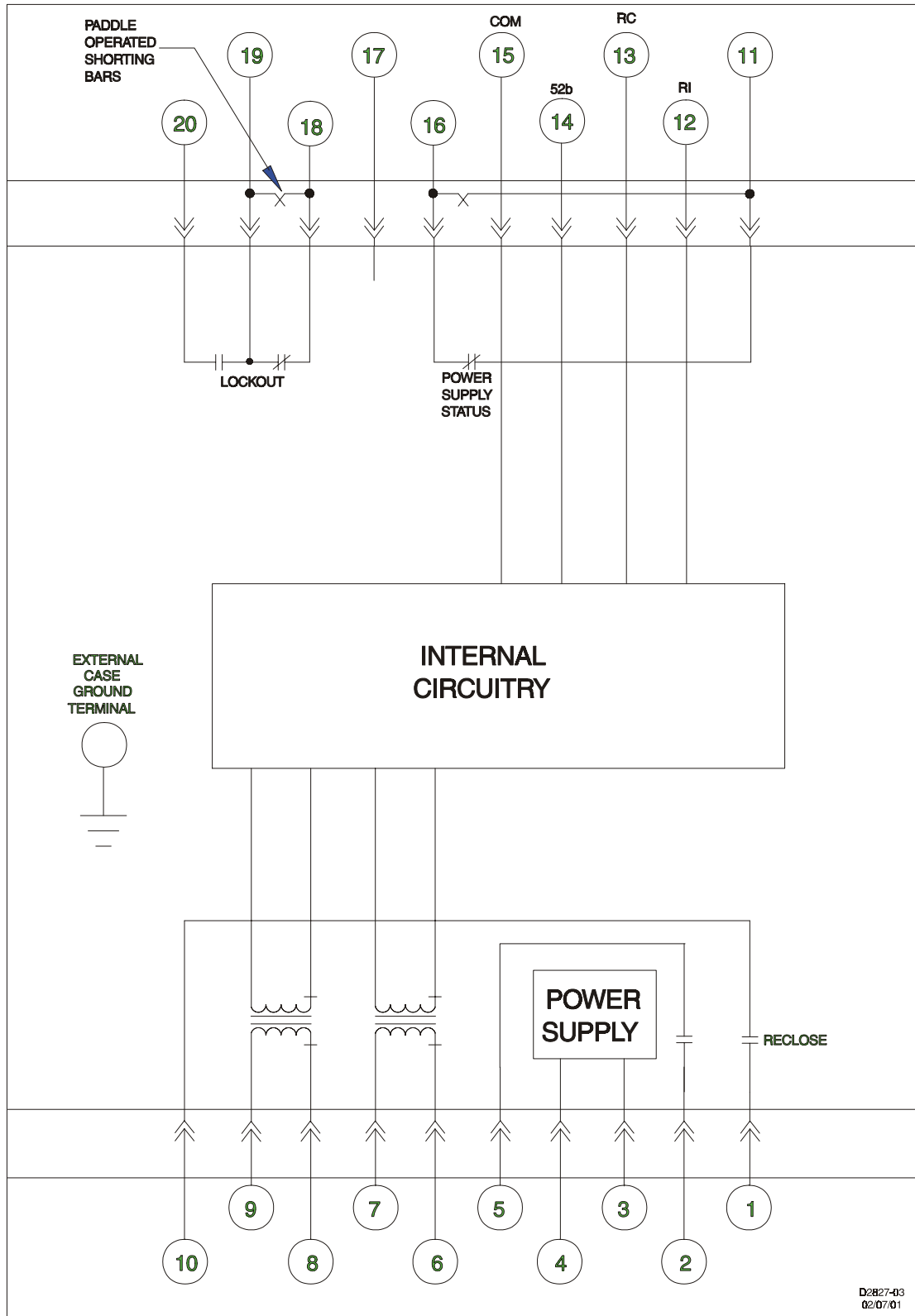


Figure 4-10. Internal Connection Diagram With Power Supply Status

SECTION 5 • OPERATIONAL TEST

GENERAL

The procedures in this section are for use in testing the relay and for selecting the optional (Option 2-S and 2-D) line and bus voltage monitoring levels.

If a relay fails an operational test, or if the optional voltage monitor reclose enable level selection is faulty, and factory repair is desired, contact the Customer Service Department of the Power Systems Group, Basler Electric, for a return authorization number prior to shipping.

RECLOSING RELAY OPERATIONAL TEST

Step 1. Connect the relay as shown in Figures 5-1 and 5-2. If equipped with Power Supply Status Output (Option 2-F), and with the unit in a powered-up condition, verify that the power supply status output contact is energized open (terminals 11 and 16). Remove input power and verify that the status output contact closes. Restore input power.

NOTE

If the optional voltage logic (Option 2-S, D) is installed in the relay, perform steps 2 through 22. If not, proceed to the note which follows step 22.

Step 2. To gain access to the voltage monitor board CONDITION and MODE switches, remove the connecting plugs and remove the cradle assembly from the relay.

Step 3. Ensure that all CONDITION and MODE switches on the voltage monitor board are set to normal (up) or off (up) (see Figure 3-2).

Step 4. Re-install the cradle in the relay and replace plugs.

NOTE

The front panel LL, LB, DL/ \overline{OV} and DB/ \overline{OV} controls are multiturn controls requiring a screwdriver for adjustment.

Step 5. Adjust the LL and LB controls fully CW, and the LB/ \overline{OV} and DB/ \overline{OV} controls fully CCW.

NOTE

Steps 6 through 9 verify operation of maximum and minimum voltage monitor settings for live-line and live-bus.

Step 6. Adjust the T1 (bus) and T2 (line) output voltages to 135 Vac.

Step 7. Adjust the LL and LB controls until the LL and LB indicators light. Both adjustments should require only a few turns from the maximum (fully CW) position.

Step 8. Adjust the T1 (bus) and T2 (line) output voltages to 10 Vac, extinguishing both indicators.

Step 9. Adjust the LL and LB controls CCW until the LL and LB indicators light. Both adjustments should be near their minimum turn limits.

NOTE

Steps 10 through 12 verify the operation of the maximum and minimum voltage monitor settings for dead-line and dead-bus.

- Step 10. With input voltages remaining at 10 Vac, adjust the DL/\overline{OV} and DB/\overline{OV} controls until the DL/\overline{OV} and DB/\overline{OV} indicators light. Both adjustments should require only a few turns from the minimum (fully CCW) position.
- Step 11. Adjust the T1 (bus) and T2 (line) voltages to 135 Vac, extinguishing both indicators.
- Step 12. Adjust the DL/\overline{OV} and DB/\overline{OV} controls CW until the DL/\overline{OV} and DB/\overline{OV} indicators light. Both adjustments should be near their maximum turn limits.

NOTE

Steps 13 through 22 set up the voltage monitor circuitry to prevent generation of the INHIBIT signal, allowing the reclose logic to operate.

- Step 13. Repeat step 5.
- Step 14. To gain access to the voltage monitor board CONDITION and MODE switches, remove the connecting plugs and remove the cradle assembly from the relay.
- Step 15. Select the LL/DB condition by setting CONDITION switch no. 4 to on (down).
- Step 16. Select the \overline{OV} (overvoltage limit) mode for the live-line by setting MODE switch no. 2 to \overline{OV} (down).
- Step 17. Re-install the cradle in the relay and replace the plugs .
- Step 18. Adjust the T1 (bus) output to 20 Vac and the T2 (line) output to 40 Vac.
- Step 19. Slowly adjust the DB/\overline{OV} control until the DB/\overline{OV} indicator lights, establishing the reclosing enable zone for the dead-bus at below the 20 Vac level.
- Step 20. Slowly adjust the LL control until the LL indicator lights, establishing the reclosing enable zone for the live-line at above the 40 Vac level.
- Step 21. To set up an overvoltage limit (\overline{OV}) for the live-line, adjust the T2 output voltage to 100 Vac and adjust the DL/\overline{OV} control fully CCW. Slowly adjust the DL/\overline{OV} control CW until the DL/\overline{OV} indicator lights, establishing the \overline{OV} level at 100 Vac.
- Step 22. Adjust the T1 output voltage to 10 Vac, placing the dead-bus voltage within the dead-bus closing zone; adjust the T2 output voltage to 70 Vac, placing the live-line voltage below the \overline{OV} limit and within the live-line closing zone.

NOTE

The following steps test the reclose circuit in a relay with a reclosure time delay range of 0.1 to 2 seconds (Option A2). If your relay has a different time delay option, refer to Table 5-1 for the steps and values to substitute in the test procedure.

Table 5-1. Reclose Time

STEP	RECLOSE TIME OPTIONAL RANGES		
24	0.1 second	1 second	5 seconds
28	50 to 150 ms	950 to 1050 ms	4750 to 5250 ms
30	2 seconds	20 seconds	60 seconds
32	2 seconds or more	20 seconds or more	60 seconds or more

NOTE: ms = milliseconds

Step 23. (Refer to note and Table 5-1, above) With the relay connected as shown in Figure 5-1, indicators DS1 and DS2 are slaved to the LOCKOUT LED. When the LED is lit, DS1 is on and DS2 is off and vice versa.

Step 24. Set RECLOSE TIME fully counter clockwise (0.1 second) and RESET TIME to maximum (fully clockwise) to test minimum reclose time operation.

Step 25. Close switch S4 to supply RI signal to relay.

NOTE

To obtain an accurate reading in STEP 27, switch S2 should be pressed and released in less time than the reclose setting.

Step 26. Press and release S1 to reset relay (allow reset timer to time out as indicated by the RESET LED).

Step 27. Depress and release momentary contact switch S2 to simulate a breaker trip.

Step 28. Observe RESET LED goes out, K1 is reenergized, and LOCKOUT LED lights. Timer displays between 50 and 150 milliseconds.

Step 29. About one minute after S2 was depressed, LOCKOUT LED goes out and RESET LED lights.

Step 30. Set RECLOSE TIME fully clockwise (2 seconds) to test maximum reclose time operation.

Step 31. Depress and release momentary contact switch S2 to simulate a breaker trip.

Step 32. Observe RESET LED goes out. LOCKOUT LED lights and K1 is reenergized after two seconds. Timer displays 2000 milliseconds or more.

Step 33. Observe RESET LED lights and LOCKOUT LED goes out about one minute after lighting.

Step 34. Open switch S4. Depress and release momentary contact switch S2 to simulate a breaker trip when RI is not present.

Step 35. Observe RESET LED goes out, LOCKOUT LED does not light. Automatic reclosure does not occur.

Step 36. Depress and release S1 to simulate closing the breaker by other means. Within 5 seconds, depress and release S2 to simulate a breaker trip before the reset interval has expired.

Step 37. Observe LOCKOUT LED lights.

Step 38. Depress and release switch S1 to simulate closing the breaker by other means.

Step 39. Observe RESET LED lights after about one minute.

Step 40. Close switch S4 to supply the RI signal to the relay.

Step 41. Depress and hold switch S2.

Step 42. Connect a jumper across relay contact K1b on test setup to simulate a breaker trip that will not

be cleared by an automatic reclose signal.

NOTE

Input to timer in STEP 43 is reverse of that shown in Figure 5-1. Voltage goes low on trip and returns to high when reclose signal terminates.

- Step 43. Observe RESET LED goes out and LOCKOUT LED lights and remains lit. If relay is provided with Option 3-0 (continuous reclose signal) the timer is started and not stopped. If relay is provided with Option 3-2, the timer will indicate between 2 and 3 seconds. If relay is provided with Option 3-3, the timer will indicate between 5 and 6 seconds.
- Step 44. Release switch S2, remove jumper installed in STEP 42. Press and release switch S1 to simulate closing the breaker by other means.
- Step 45. Observe after 60 seconds LOCKOUT LED goes out and RESET LED lights.
- Step 46. Press and release S2 and immediately press S3 to simulate a breaker trip followed by an RC signal.
- Step 47. Observe RESET LED goes out. No automatic reclosure occurs.
- Step 48. Press and release switch S1 to simulate closing the breaker by other means.
- Step 49. Observe after 60 seconds RESET LED lights.

NOTE

If the optional voltage monitor (Option 2-S, D) is installed in the relay, perform the remainder of the test. If not, the test is ended here.

The following steps simulate a breaker trip with a live-line overvoltage condition such that the line voltage is higher than the \overline{OV} setting established in STEP 21. The voltage monitor timer that prevents reclosing is then checked.

- Step 50. Ensure K1 is energized by pressing and releasing S1.
- Step 51. Adjust the T2 output voltage to 120 Vac, so that the live-line voltage is above the \overline{OV} level of 100 Vac.
- Step 52. Depress and release S2 to simulate a breaker trip.
- Step 53. Observe RESET LED goes out. No automatic reclosure occurs.
- Step 54. When the timer indicates 'X' seconds, rapidly adjust the T2 output voltage to 70 Vac.
- X = 80 seconds for units with Reset Timer B.
- X = 10 seconds for units with Reset Timer C.

(Don't do test for units with Reset Timer D.)

- Step 55. Observe K1 is energized after two seconds.

NOTE

If equipped with Reset Timer D, omit steps 56 through 60.

- Step 56. Repeat steps 50 through 53.

- Step 57. When the timer indicates 'Y' seconds, rapidly adjust the T2 output voltage to 70 Vac.
- Y = 110 seconds for units with Reset Timer B.
- Y = 20 seconds for units with Reset Timer C.
- Step 58. Observe RESET LED remains out. No automatic reclosure occurs.
- Step 59. Press and release switch S1 to simulate closing the breaker by other means.
- Step 60. Observe after 60 seconds RESET LED lights.
- Step 61. Remove the connecting plugs and remove the cradle assembly from the relay.
- Step 62. Set all MODE and CONDITION switches on the voltage monitor board to off (up) or normal (up).
- Step 63. Re-install the cradle in the relay and replace the plugs .

VOLTAGE MONITOR CONDITIONS, MODES AND VOLTAGE LEVELS SELECTION (OPTION 2-S, D ONLY)

- Step 1. To gain access to the voltage monitor board CONDITION and MODE switches, remove the connecting plugs and remove the cradle assembly from the relay.
- Step 2. Insure that all the CONDITION and MODE switches are set to the off (up) or normal (up) positions.
- Step 3. To select condition(s), perform any or all of the following (see Figures 2-2 and 3-2).
- a) For the live-line/live-bus condition: set CONDITION switch no. 2 to the on (down) position.
 - b) For the live-line/dead-bus condition: set CONDITION switch no. 4 to the on (down) position.
 - c) For the dead-line/live-bus condition: set CONDITION switch no. 3 to the on (down) position.
 - d) For the dead-line/dead-bus condition: set CONDITION switch no. 5 to the on (down) position.
- Step 4. To select the overvoltage limit (\overline{OV}) mode for the live-line and/or live-bus conditions, perform one or both of the following (see Figures 2-2 and 3-2):
- a) For \overline{OV} during the live-line condition: set MODE switch no. 2 to \overline{OV} (down).
 - b) For \overline{OV} during the live-bus condition: set MODE switch no. 1 to \overline{OV} (down).
- Step 5. Re-install the cradle in the relay and replace plugs.
- Step 6. Connect the relay as shown in Figures 5-1 and 5-2.
- Step 7. Adjust the LL and LB controls on the front panel fully CW. Adjust the DL/ \overline{OV} and DB/ \overline{OV} controls fully CCW, then back off 1 turn.
- Step 8. To select the desired voltage levels for the previously selected conditions, perform the following (see Figure 2-2):
- a) If the live-line condition is selected (STEP 3a or 3b), adjust the T2 (line) output to the voltage level above which reclosing is desired. Slowly adjust the LL control until the LL indicator just lights.
 - b) (Normal mode only) If the dead-line condition is selected (STEP 3c or 3d), adjust the T2 (line) output to the voltage level below which reclosing is desired. Slowly adjust the DL/ \overline{OV} control until the DL/ \overline{OV} indicator just lights.
 - c) If the live-bus condition is selected (STEP 3a or 3b), adjust the T1 (bus) output to the voltage level above which reclosing is desired. Slowly adjust the LB control until the LB indicator just lights.
 - d) Normal mode only) If the dead-bus condition is selected (STEP 3c or 3d), adjust the T1 (bus) output to the voltage level below which reclosing is desired. Slowly adjust the DB/ \overline{OV} control until

the DB/ \overline{OV} indicator just lights.

NOTE

The voltage monitor is now set to allow reclosure when the line and bus voltage conditions established in STEP 8 are encountered in the protective system.

- Step 9. If \overline{OV} was selected (STEP 4) adjust the T1 (bus) and/or T2 (line) output voltages to the desired higher voltage limit such that, for anticipated voltages above the setting(s), reclosure will not occur.
- Step 10. Slowly adjust the \overline{OV} voltage level adjustments that correspond with the selected conditions until the associated indicator just lights.

NOTE

The voltage monitor is now set to inhibit reclosure when the line and/or bus conditions established in STEP 9 are encountered in the protective system.

To check the operation of the relay with the resulting set-up, perform the following steps:

- Step 11. Momentarily press switch S1 to energize relay K1.
- Step 12. Close switch S4 to supply RI signal to relay.
- Step 13. Adjust the T1 (bus) and T2 (line) outputs to within reclosure enable zones established in the previous steps.
- Step 14. Press and release switch S2. Relay K1 should momentarily trip, then reset.
- Step 15. If the \overline{OV} mode was selected, adjust the appropriate input voltage (T1 or T2) until the voltage exceeds the \overline{OV} level. With relay K1 energized, press and release switch S2. Relay K1 should trip, but no reclosure should occur.

NOTE

Steps 16 through 20 provide a means of calibrating the Maximum Trial timer . This timer is only present when Reset Timer Option B or C is installed. For all other relays the operational test is concluded .

- Step 16. Set Condition Switches 1 and 2 down, 3 through 5 up .
- Step 17. Set Mode Switches 1 down, 2 up .
- Step 18. Place a voltmeter between pin 39 of Voltage Monitor board and ground. (Should read 0 volts.)
- Step 19. Apply a high (tripping) signal to relay terminal 14 (52b) and note the time it takes until terminal 39 goes high . Time should be as follows.
- For Reset Option B: 95 +10 seconds
- For Reset Option C: 15 +2 seconds
- Step 20. If time period falls outside of the specified tolerance, adjust potentiometer R60 as required .

NOTE

The voltage monitor is now verified to operate in accordance with the previous selections.

SECTION 6 • MAINTENANCE

GENERAL

The relay is a solid-state device and requires no preventive maintenance other than a periodic operational check. The procedures in Section 5 of this manual provide an adequate check to verify proper operation of the relay. If the relay fails to function, and factory repair is desired, contact the Customer Service Department of the Power Systems Group, Basler Electric, for a return authorization number prior to shipping.

Due to the fact that most components are on conformally coated printed circuit boards, in-house replacement of individual components may be difficult and should not be attempted unless appropriate equipment and adequately trained personnel are available.

NOTE

It is recommended that the relay be returned to the factory for repair and recalibration due to the availability of factory or production quality test and calibration equipment as well as parts. If returned, as a minimum, the entire relay cradle should be shipped as an assembly, preferably in a case.

IN-HOUSE REPAIR

When complete boards or assemblies are needed, the following information is required.

1. Relay model and style number.
2. Relay serial number.
3. Board or assembly.
 - a) Part number
 - b) Serial number
 - c) Revision letter
4. The name of the board or assembly.

The quality of replacement parts must be at least equal to the type in the original circuit.

CAUTION

Removal and direct substitution of printed circuit boards or individual components does not necessarily mean the relay will operate properly without further calibration or verification. Always check/calibrate relay prior to replacing relay into the operating system.

SECTION 7 • MANUAL CHANGE INFORMATION

CHANGES

This section contains information concerning the previous editions of the manual. The substantive changes to date are summarized in the Table 7-1.

Table 7-1. Changes

Revision	Summary of Changes	ECO/Date
A	Deleted all references to Service Manual. Updated Style Number Identification Chart by changing Power Supply X from “230 Vac” to “240 Vac” and Option 3 from “(0) None” to “(0) No reclose fail timer (continuous reclose output until breaker closes.” Added Option 2-D when Option 2-S is referred to in the manual. Added new power supply information to Specifications and Section 3 starting with “Basler Electric enhanced the power supply design...” Corrected Figure 2-1 and Figure 4-9 by making 52b a NC output. Added new Section 7 “Manual Change Information.” Changed the format of the manual. Added internal connection diagram.	64/09-08-98
B	Replace all drawings of the S1 case with the most current drawing. Changed the burden data for the type C power supply on page 1-3.	12229/02-06-01