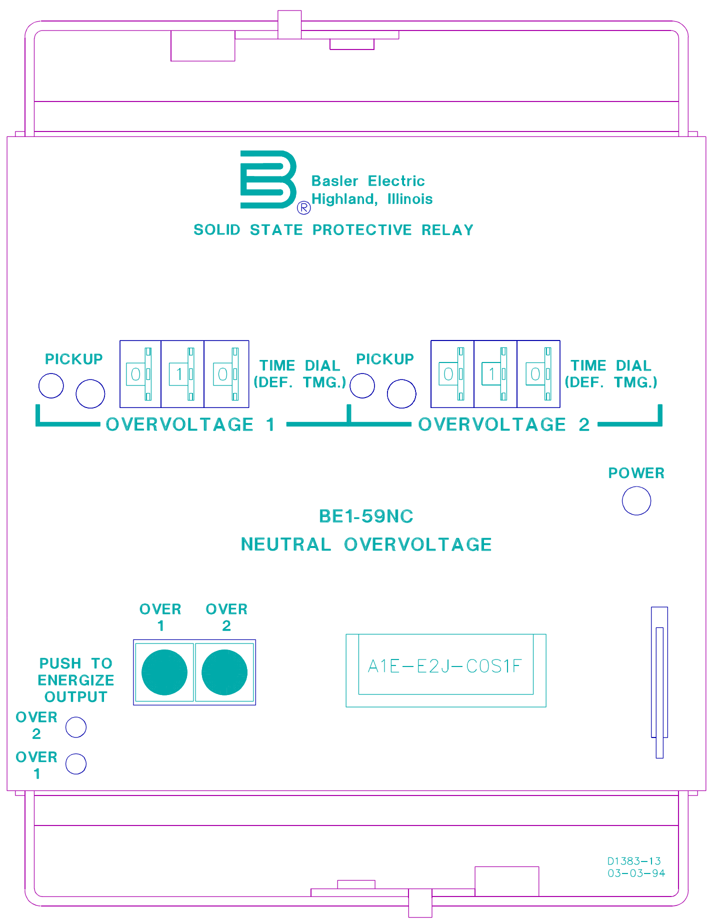
INSTRUCTION MANUAL

FOR

NEUTRAL OVERVOLTAGE RELAY

BE1-59NC



Basler Electric

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INTRODUCTION

This Instruction Manual provides information concerning the operation and installation of the BE1-59NC Neutral Overvoltage Relay. To accomplish this, the following is provided.

- **Specifications**
- **Functional characteristics**
- **Mounting Information**
- **Connections**
- **Testing**

WARNING!

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

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It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric Company, Highland, Illinois.

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SECTION 1

GENERAL INFORMATION

GENERAL

BE1-59NC Neutral Overvoltage Relays provide sensitive protection for capacitor banks. There are three common types of capacitor bank failures that BE1-59NC Neutral Overvoltage Relays recognize. They are:

- Unit dielectric failure.
- Capacitor bank insulator failure.
- Blown fuses.

BE1-59NC Neutral Overvoltage Relays protect for overvoltages due to internal voltage shifts that occur as a result of these types of failures.

APPLICATION

Capacitor banks are widely used by utilities to maintain specified system voltage. Addition of capacitive loads at appropriate points on the system compensate for heavy inductive loading that normally tends to reduce voltage. This adding of leading megavars to compensate for the lagging megavar component of electric loads is frequently referred to as power factor correction. Capacitor banks must be switched in response to actual load conditions in order to obtain maximum power factor correction benefits.

Capacitor Bank Switching

One of the common methods of maximizing capacitor bank benefits is by evaluating the bus voltage. A bandwidth surrounding the desired bus voltage level is established. When the bus voltage falls below the bandwidth level, the capacitor bank is switched into the circuit. When the bus voltage rises above the bandwidth level, the capacitor bank is switched out.

Protection

Protection of capacitor banks has always been difficult. It is especially difficult to sense failures inside the capacitor banks because of the configuration. Experience indicates that most capacitor bank faults involve one or more insulator failures with arcing across groups and/or phase-to-phase inside the bank. In most cases, these types of faults are not seen by the bus differential or other protection unless the arcing spills over to the area between the fuses and the circuit switcher. A fault across an insulator usually means that one or more groups of parallel units are shorted. This will cause a neutral shift and unbalanced phase currents. Unbalanced phase current magnitudes are determined by the number of series connected groups. For full phase-to-neutral flashover, the maximum phase current is three times normal capacitor bank load in the faulted phase.

One main protection concern is overvoltage cascading. A capacitor bank is unique in that cascading of units may take place after a predetermined number of unit fuses have operated. Normally after a fuse has blown in any other type of equipment, the faulted apparatus is disconnected and usually does not affect any remaining equipment that is in service. That is not so with a capacitor bank. Each fuse that blows to isolate the faulted unit sets up an increased voltage stress on the remaining units (Figure 1-1). Sometime later, the next weakest unit in that group fails. As each successive fuse blows, the voltage increases another step and rapidly causes the next unit to fail. Cascading takes place and results in serious damage to the capacitor bank and possible hazards to personnel. While the capacitor bank is failing, the station in minimally affected.

The voltage is nearly normal, the current flow is almost unaffected, and station relay protection is not taking any action until the failure has developed into a phase-to-phase or phase-to-ground fault.

A solution was to develop a protective scheme for the capacitor bank with the main emphasis on preventing overvoltage cascading. To do this, a ground fault relay or neutral shift device had to be developed that was sensitive enough to detect blown fuses for both alarming and tripping purposes. The best place to obtain the sensing information is between the neutral of the capacitor bank and ground. Voltage differentials between the normal capacitor bank status and that of one blown fuse are very small. However, BE1-59NC Neutral Overvoltage Relays are sensitive enough to differentiate between these conditions and act decisively.

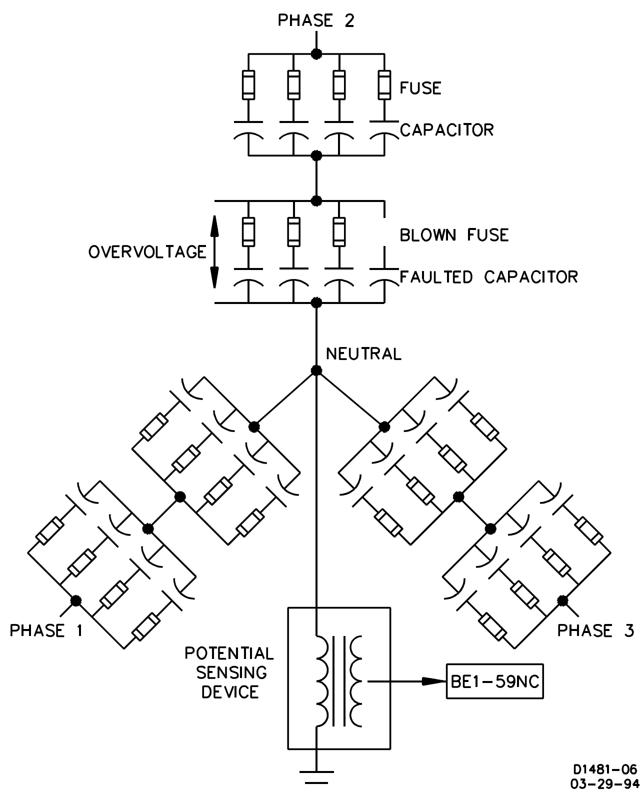


Figure 1-1. Ungrounded 3-Phase, 3-Wire System

Input Sensing

BE1-59NC Neutral Overvoltage Relays receive the input signal from voltage sensing devices connected between the capacitor bank neutral and ground. These voltage sensing devices can be potential transformers or resistor potential devices. Ideally, the voltage across each leg of a capacitor bank is balanced, and the voltage from neutral to ground is zero. If a single capacitor fails and blows the protecting fuse, an unbalanced condition occurs that shifts the neutral and creates a small but measurable voltage. Through the potential sensing devices, the neutral relay senses this voltage unbalance and reacts to give the appropriate signal (usually an alarm or trip depending on the voltage level).

Further loss of more capacitors increases the neutral voltage. The relay senses this voltage increase, and reacts to give the appropriate signal. This signal is usually a trip depending on the voltage levels and how the protection scheme is designed.

Alarms And Outputs

Sensitive settings on the relay are used as an alarm to alert that a fuse has blown and maintenance is required. They would be typically set at a level corresponding to the voltage rise caused by one blown fuse. The second output would have a setting that would be set to trip the capacitor bank off the bus or line when the voltage exceeds 110% of the nominal capacitor bank voltage. This setting depends on the capacitor bank size and configuration.

MODEL AND STYLE NUMBER DESCRIPTION

BE1-59NC Neutral Overvoltage Relays electrical characteristics and operational features are defined by a combination of letters and numbers that make up the style number. Model numbers BE1-59NC designate the relay as a Basler Electric, Class 100, Relay. The model number, together with the style number, describe the options included in a specific device, and appear on the front panel, drawout cradle, and inside the case assembly. Upon receipt of a relay, be sure to check the style number against the requisition and the packing list to ensure that they agree.

Sample Style Number

Style number identification chart (Figure 1-2) defines the electrical characteristics and operational features included in BE1-59NC Neutral Overvoltage Relays. For example, if the model number of the relay was BE1-59NC, and the style number was **A5E-E2J-C0S1F**, the device would have the following features:

- **A** - Single-phase voltage
- **5** - 120 Vac, 60 Hz, nominal 1 to 20 Vac pickup
- **E** - Two output relays with normally open contacts
- **E2** - Two setpoints; setpoint 1, definite timing 00.0 to 99.9 seconds; setpoint 2, definite timing 00.0 to 99.9 seconds
- **J** - 125 Vdc or 100/120 Vac power supply
- **C** - Internally operated targets
- **O** - None
- **S** - Push-to-energize outputs
- **1** - Two auxiliary output relays, two SPDT sets of contacts; one for setpoint 1 and one for setpoint 2
- **F** - Semi-flush mounting case

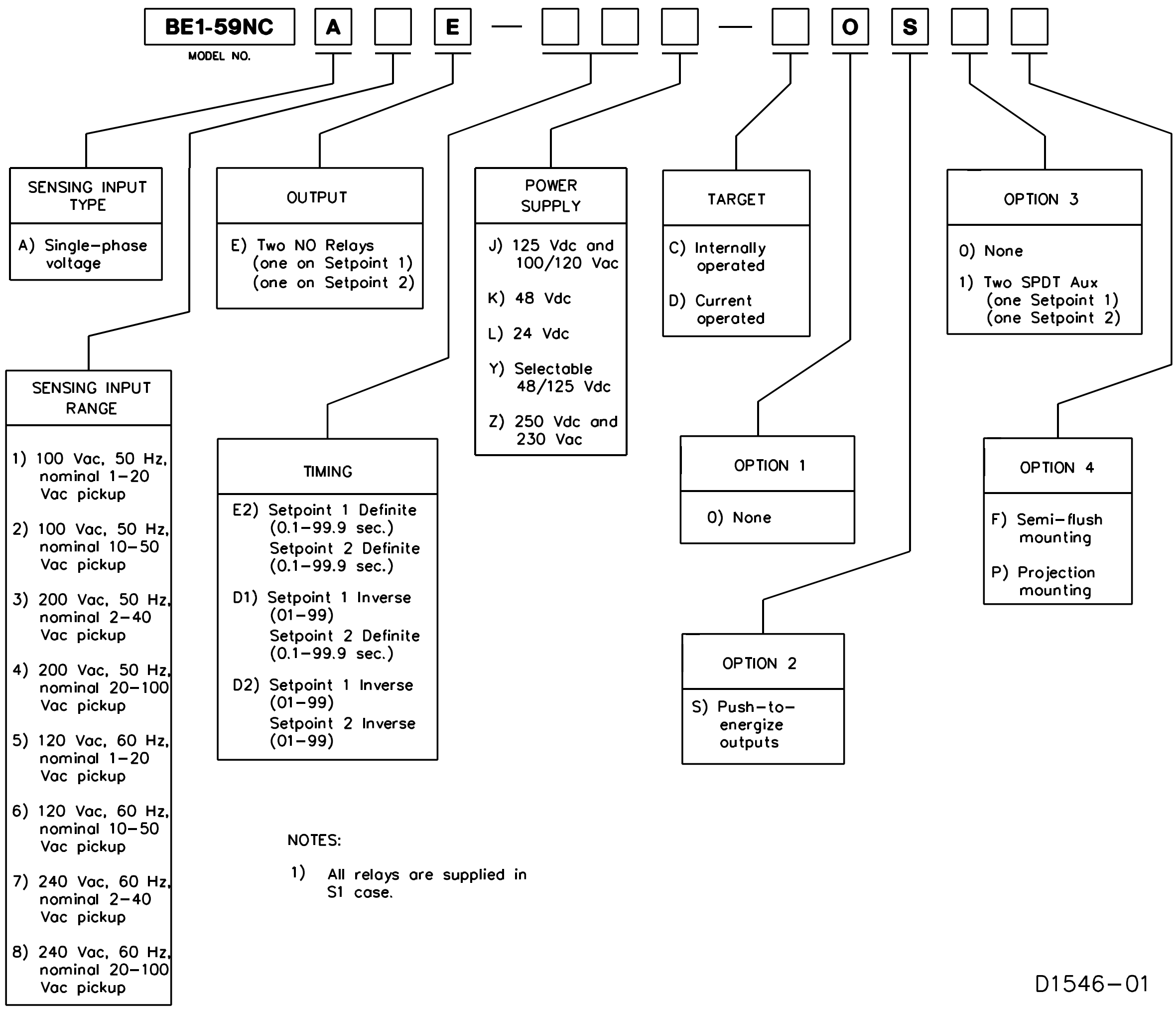


Figure 1-2. Style Number Identification Chart

SPECIFICATIONS

BE1-59NC Neutral Overvoltage Relays have the following features and capabilities.

Voltage Sensing Inputs Maximum continuous rating: 360 Vac for 100/120 Vac input, 480 Vac for 200/240 Vac input, with a maximum burden of 2 VA.

Sensing Input Ranges

Ranges 1 and 5	1 to 20 Vac pickup
Ranges 2 and 6	10 to 50 Vac pickup
Ranges 3 and 7	2 to 40 Vac pickup
Ranges 4 and 8	20 to 100 Vac pickup

Pickup Accuracy

Ranges 1, 3, 5, or 7 ±2.0% or 100 millivolts, whichever is greater.
Ranges 2, 4, 6, or 8 ±2.0% or 200 millivolts, whichever is greater.

Dropout 98% of pickup within 7 cycles.

Timing Characteristics

Inverse Response time decreases as the difference between the monitored voltage and the setpoint increases. The inverse time characteristics switch is adjustable from 01 to 99 in 01 increments. Each position corresponds to a specific curve except 00, which is instantaneous.

Definite Adjustable from 00.1 to 99.9 seconds, in steps of 0.1 seconds. Accuracy is within 2.0 % or 100 milliseconds, whichever is greater. (A setting of 00.0 provides instantaneous timing.)

Accuracy Within ±5% or 25.0 milliseconds (whichever is greater) of the indicated time for any combination of the time dial and within ±2% of the voltage magnitude or 100 millivolts (for the 100/120 Vac sensing ranges) or 200 millivolts (for the 200/240 Vac sensing ranges) (whichever is greater) from the actual pickup value. Inverse time is repeatable within ±2% or 25.0 milliseconds (whichever is greater) for any time dial or pickup setting.

Power Supply Refer to Table 1-1.

Table 1-1. Power Supply Specifications.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
J	125 Vdc 120 Vac	62 to 150 Vdc 90 to 132 Vac	7.5 W 15.0 W
K	48 Vdc	24 to 60 Vdc	7.0 W
†L	24 Vdc	12 to 32 Vdc	7.5 W
‡Y	48 Vdc 125 Vdc	24 to 60 Vdc 62 to 150 Vdc	7.0 W 7.5 W
Z	250 Vdc 230 Vac	140 to 280 Vdc 190 to 270 Vac	12.0 W 33.5 VA

NOTES:

† Type L Power Supply may require 14 Vdc to begin operation. Once operating, the voltage may be reduced to 12 Vdc.

‡ Type Y Power Supply is field selectable for 48 or 125 Vdc. Selection must be implemented at time of installation. This Power Supply option is factory set for 125 Vdc.

Output Contacts Output contacts are rated as follows:

Resistive:

120/240 Vac Make 30 A for 0.2 seconds, carry 7 A continuously, and break 7 A.

250 Vdc Make and carry 30 A for 0.2 seconds, carry 7 A continuously, and break 0.3 A.

500 Vdc Make and carry 15 A for 0.2 seconds, carry 7 A continuously, and break

	0.1 A.
Output Contacts	- Continued
Inductive:	
120/240 Vac, 125/250 Vdc	Make and carry 30 A for 0.2 seconds, carry 7 A continuously, and break 0.3 A. (L/R = 0.04).
Target Indicators	Targets indicators are operated by a minimum of 0.2 A through the output trip circuit. The output circuit must be limited to 30 A for 0.2 seconds, 7 A for 2 minutes, and 3 A continuously. Target coil resistance is 0.1 ohm.
Isolation	1500 Vac at 60 hertz for one minute in accordance with IEC 255-5 and ANSI/IEEE C37.90-1989 (Dielectric Test).
Radio Frequency Interference (RFI)	Field Tested using a five watt, hand-held transceiver operating at random frequencies centered around 144 MHz and 440 MHz, with the antenna located six inches from the relay in both horizontal and vertical planes.
Surge Withstand Capability	Qualified to ANSI/IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.*
Operating Temperature	-40°C (-40°F) to +70°C (+158°F).
Storage Temperature	-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.
Weight	13.6 pounds maximum.
Case Size	S1.

CHARACTERISTIC CURVES

Figures 1-3 (drawing number 99-1510) and 1-4 (drawing number 99-1545) illustrate the overvoltage inverse time curves for this relay. To order a full-size drawing on transparent paper (vellum) of these characteristic curves, contact Customer Service Department of the Power Systems Group, Basler Electric, and request the appropriate drawing number.

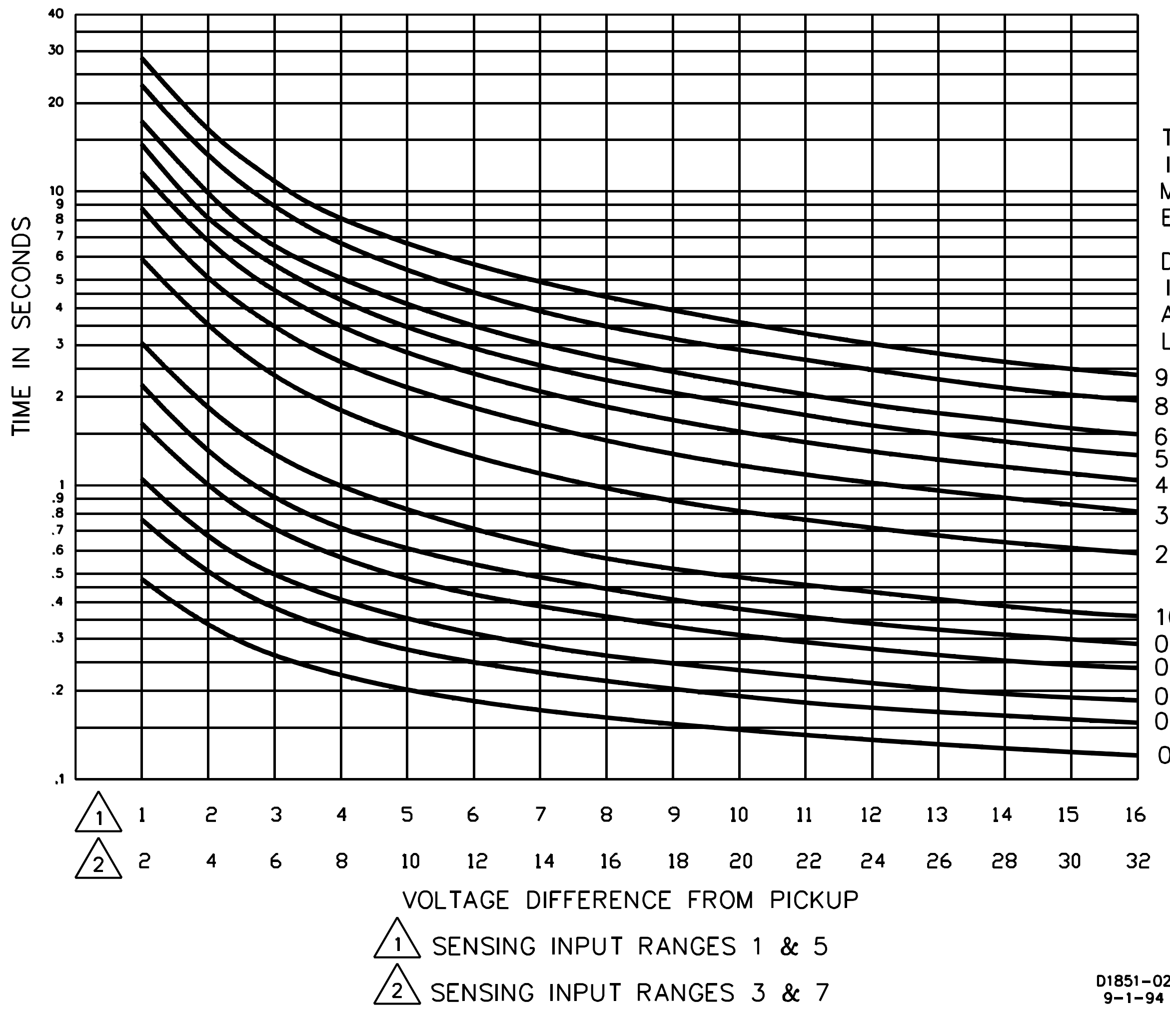


Figure 1-3. Overvoltage Inverse Time Curves, Low Ranges (Drawing Number 99-1510)

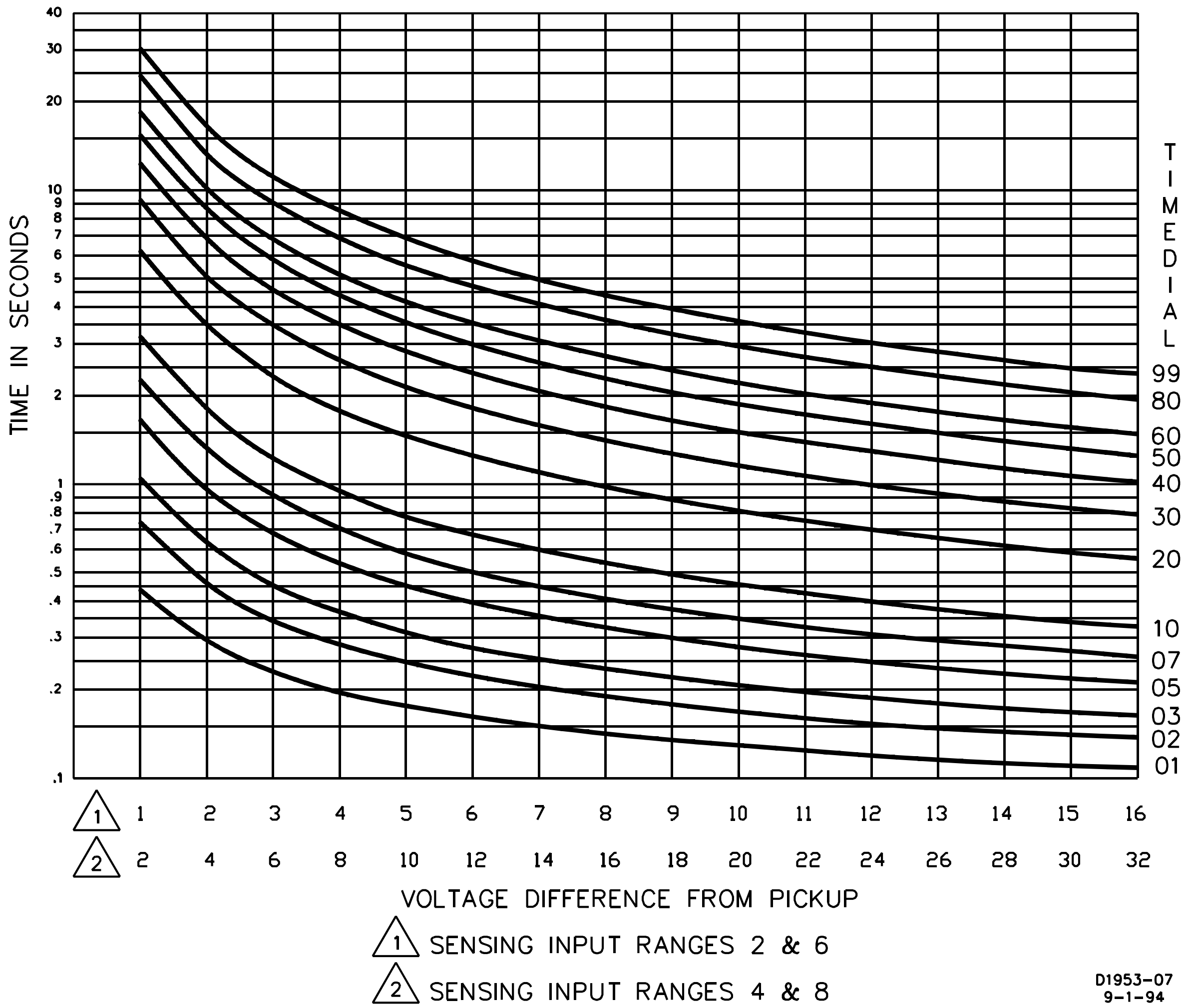


Figure 1-4. Overvoltage Inverse Time Curves, High Ranges (Drawing Number 99-1545)

SECTION 2

CONTROLS AND INDICATORS

GENERAL

Table 2-1 lists and describes the controls and indicators of BE1-59NC Ground Fault Overcurrent Relays.

Table 2-1. Controls and Indicators (Refer to Figure 2-1)

Letter	Control or Indicator	Function or Indicator
A	**OVERVOLTAGE 1 PICKUP** Adjustment	A multiturn potentiometer that sets the overvoltage comparator threshold voltage. Continuously adjustable for the sensing input voltage range.
B	**OVERVOLTAGE 1 PICKUP** LED	A red LED that lites when overvoltage exceeds the pickup setting.
C	**OVERVOLTAGE 1 TIME DIAL**	Thumbwheel switch that selects the desired overvoltage output delay (inverse time characteristic curves 01 through 99). A setting of 00 is instantaneous.
D	**OVERVOLTAGE 2 TIME DIAL**	Thumbwheel switch that selects the desired overvoltage output delay (definite timing characteristic adjustable from 00.1 to 99.9 seconds, in 0.1 second increments). A setting of 00 is instantaneous.
E	**POWER** LED	LED lites to indicate that the relay power supply is functioning.
F	Target Reset Lever	Linkage extending through bottom of front cover that resets magnetically latching target indicators.
G	Target Indicators	Magnetically latching targets that indicate that trip current in excess of 0.2 A was present and that the associated output relay has been energized.
H	**PUSH TO ENERGIZE OUTPUT** Switches	Momentary pushbutton switches accessible by inserting a 1/8 inch diameter non-conducting rod through the front panel. Pushbuttons are used to energize the output relays to test external system wiring. If current flows in externally operated target trip circuits, the targets drop.
I	**OVERVOLTAGE 2 PICKUP** LED	A red LED that lites when overvoltage exceeds the pickup setting.
J	**OVERVOLTAGE 2 PICKUP** Adjustment	A multiturn potentiometer that sets the overvoltage comparator threshold voltage. Continuously adjustable for the sensing input voltage range.

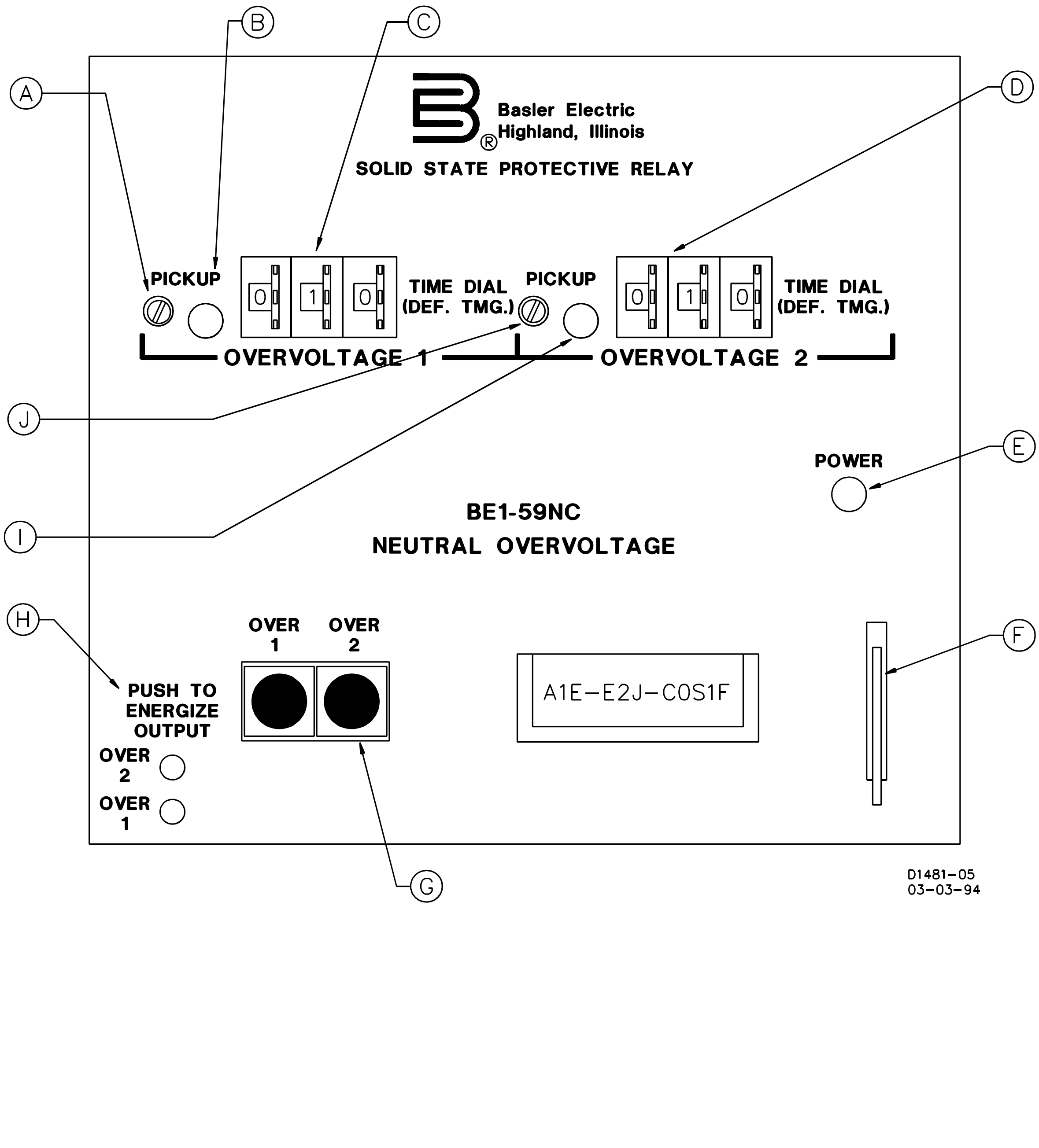


Figure 2-1. Location of Controls and Indicators.

SECTION 3

FUNCTIONAL DESCRIPTION

GENERAL

BE1-59NC Neutral Overvoltage Relays are solid state digital devices that detect ground faults and neutral overvoltages. Figure 3-1 illustrates the overall operation of the relay and the following paragraphs describe the functional description.

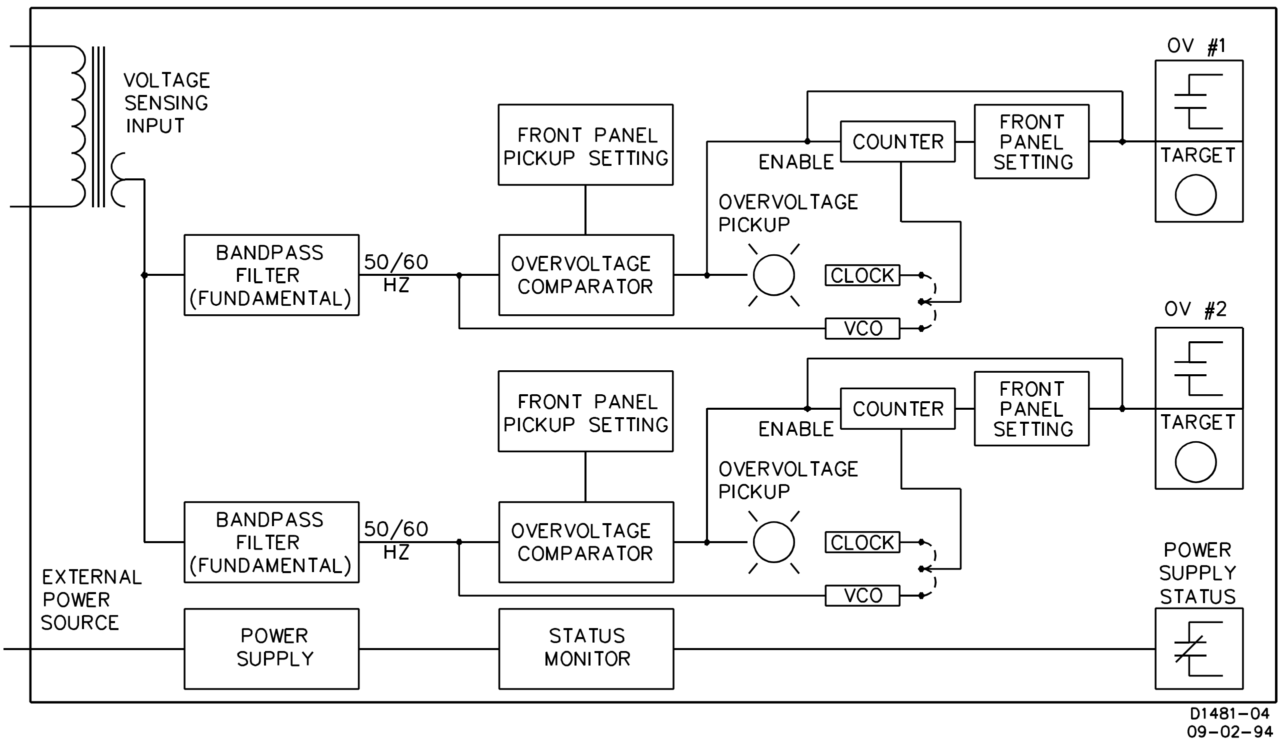


Figure 3-1. Functional Block Diagram

FUNCTIONAL DESCRIPTION

Inputs

Sensed voltage developed across the input sensing device connected in the neutral-grounding current transformer secondary is applied to the BE1-59NC Neutral Overvoltage Relay. Internal transformers provide further isolation and step down for the relay logic circuits. BE1-59NC Neutral Overvoltage Relays may also be used in ungrounded systems with voltage transformers connected in wye/broken delta configurations. Typical connection methods are shown in Section 4. Overvoltage #1 and Overvoltage #2 circuits are functionally the same except for timing characteristics.

Filters

Bandpass filters provide peak sensitivity at 50 or 60 hertz for the overvoltage #1 and overvoltage #2 inputs. Third harmonic rejection is 40 dB minimum.

Overvoltage Comparator

Each overvoltage comparator circuit receives a sensing voltage from the bandpass filter and a reference voltage from the front panel setting. When the input exceeds the setting reference, the comparator output enables the timing circuit and the OVERVOLTAGE PICKUP LED turns ON.

Definite Time Delay

An output signal from the comparator circuit enables a counting circuit to be incremented by an internal clock. When the counting circuit reaches the count that matches the number entered on the TIME DIAL, the output relay and auxiliary relay are energized. However, if the sensed input voltage falls below the pickup setting before the timer completes its cycle, the timer resets within 2.0 cycles.

The definite time delay is adjustable from 00.1 to 99.9 seconds in 0.1 second increments. Front panel mounted switches determine the delay. Position 00.0 is instantaneous.

Inverse Time Delay

Inverse time delay circuits are identical to definite time delay circuits except that a voltage controlled oscillator (VCO) is substituted for the clock signal. The VCO is controlled by a voltage derived from the sensed input. Because the frequency of the oscillator is kept proportional to the sensed input voltage, the desired inverse time delay is produced.

Inverse time characteristic curve thumbwheel switches are setable from 01 to 99 in 01 increments. Each position corresponds to a specific curve setting except 00, which is instantaneous. Refer to Figures 1-3 and 1-4 to see the inverse time characteristic curves.

Reference Voltage Circuit

A constant voltage source provides a reference voltage to the potentiometers on the front panel. The potentiometers, in turn, provide reference voltages to all the comparator circuits and establish the threshold for each circuit.

Power Supply

The solid-state power supply is a low burden, flyback switching design that delivers a nominal plus or minus twelve volts dc to the internal circuitry. Power supply inputs are not polarity sensitive. A red LED lites to indicate that the power supply is functioning properly.

Power Supply Status Contacts

Power supply output contacts are monitored at the mother board. Normal supply voltage causes the status relay to be continually energized. However, if at any time the voltage falls below requirements, the relay drops out, and closes the normally closed contacts.

Target Indicator Circuits

A front panel target indicator is provided for each overvoltage element. These targets operate only when a minimum of 0.2 amperes flows in the output circuit. A special reed relay in series with the output contact provides the signal to the target indicator. Each target, when operated, is magnetically latched and must be reset manually.

SECTION 4

INSTALLATION

GENERAL

When not shipped as part of a control or switchgear panel, the relays are shipped in sturdy cartons to prevent damage during transit. Immediately upon receipt of a relay, check the model and style number against the requisition and packing list to see that they agree. Visually inspect the relay for damage that may have occurred during shipment. If there is evidence of damage, immediately file a claim with the carrier and notify the Regional Sales Office, or contact the Sales Representative at Basler Electric, Highland, Illinois.

In the event the relay is not to be installed immediately, store the relay in its original shipping carton in a moisture and dust free environment. When relay is to be placed in service, it is recommended that the operational test procedure (Secton 5) be performed prior to installation.

RELAY OPERATING PRECAUTIONS

Before installation or operation of the relay, note the following precautions:

1. A minimum of 0.2 A in the output circuit is required to ensure operation of current operated targets.

2. Do not touch target indicator vanes. Always reset targets by use of the target reset lever.

3. The relay is a solid-state device. If a wiring insulation test is required, remove the connection plugs and withdraw the cradle from its case.

4. When the connection plugs are removed, the relay is disconnected from the operating circuit and will not provide system protection. Always be sure that external operating (monitored) conditions are stable before removing a relay for inspection, test, or service.

5. Be sure the relay case is hard wired to earth ground using the ground terminal on the rear of the unit. It is recommended to use a separate ground lead to the ground bus for each relay.

DIELECTRIC TEST

In accordance with IEC 255-5 and ANSI/IEEE C37.90-1978, one-minute dielectric (high potential) tests up to 1500 Vac (45-65 hertz) may be performed. This device employs decoupling capacitors to ground from the input and output terminals. Leakage current of less than 5 milliamperes is to be expected at the grouped power supply inputs or sensing inputs and less than 20 milliamperes at the outputs.

RELAY MOUNTING

Because the relay is of solid state design, it does not have to be mounted vertically. Any convenient mounting angle may be chosen. Figures 4-1 through 4-13 provide relay outline dimensions and panel drilling diagrams.

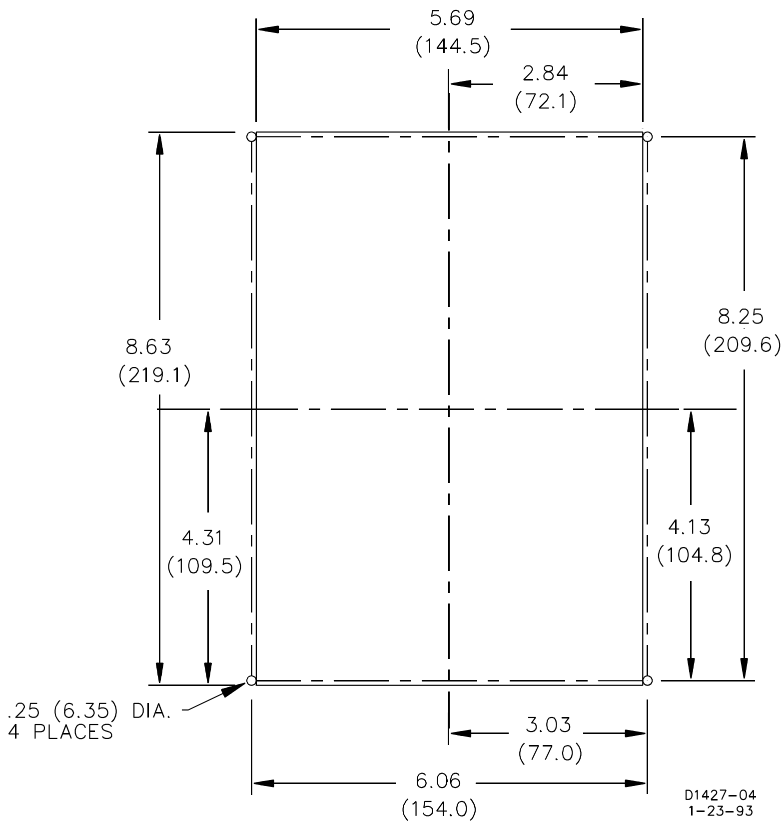


Figure 4-1. S1 Case, Panel Drilling Diagram, Semi-Flush Mounting

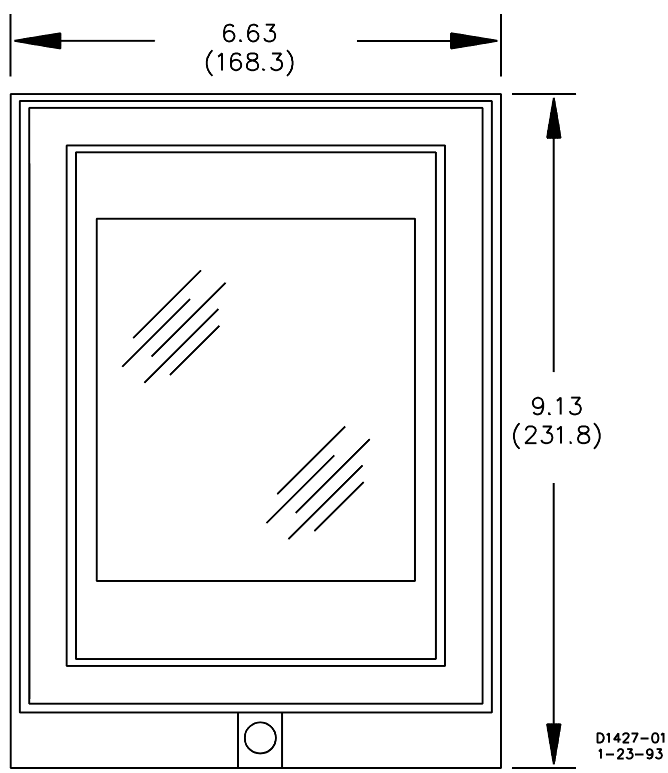


Figure 4-2. S1 Case, Outline Dimensions, Front View

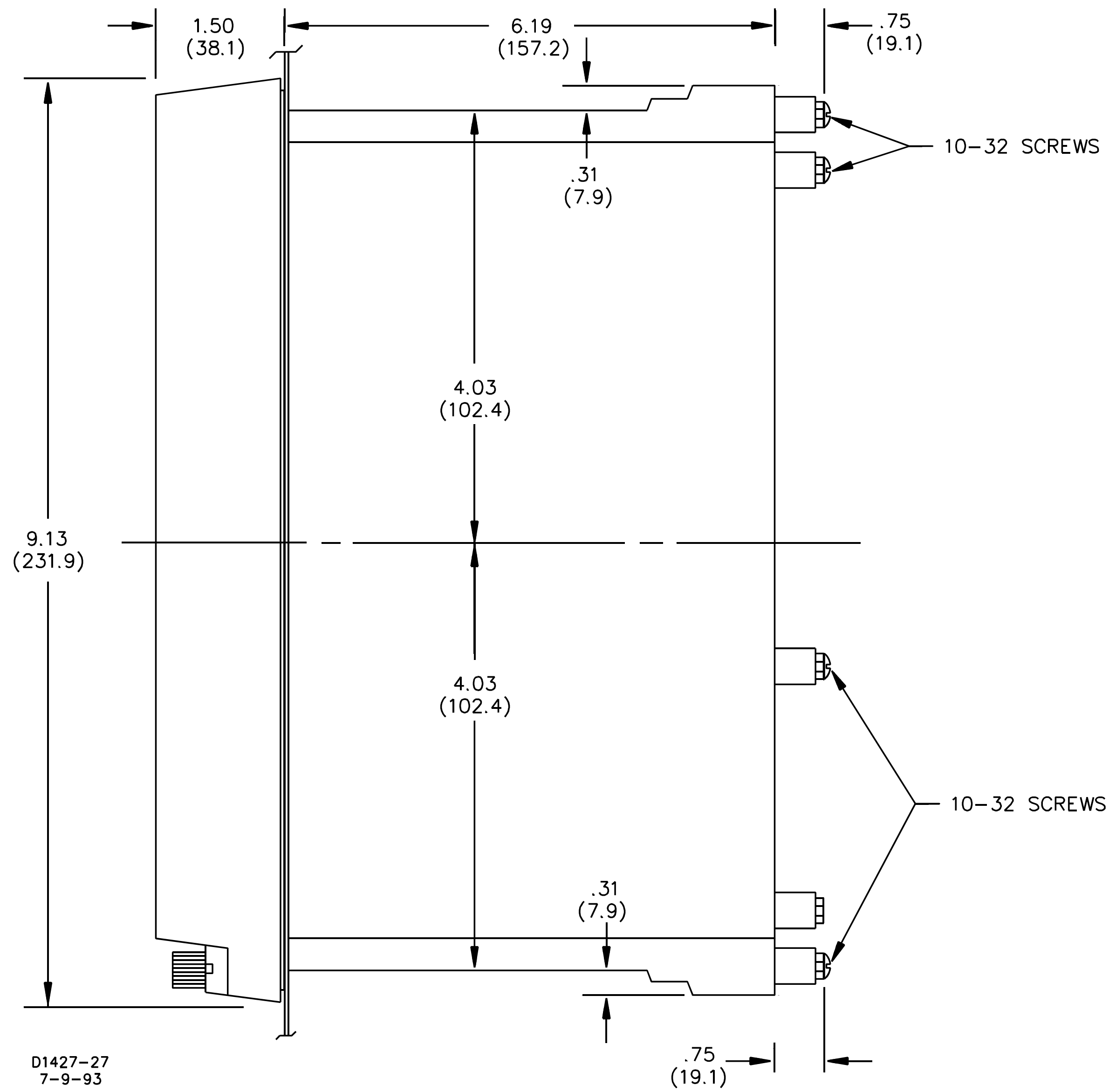


Figure 4-3. S1 Case, Double-Ended, Semi-Flush Mounting, Side View

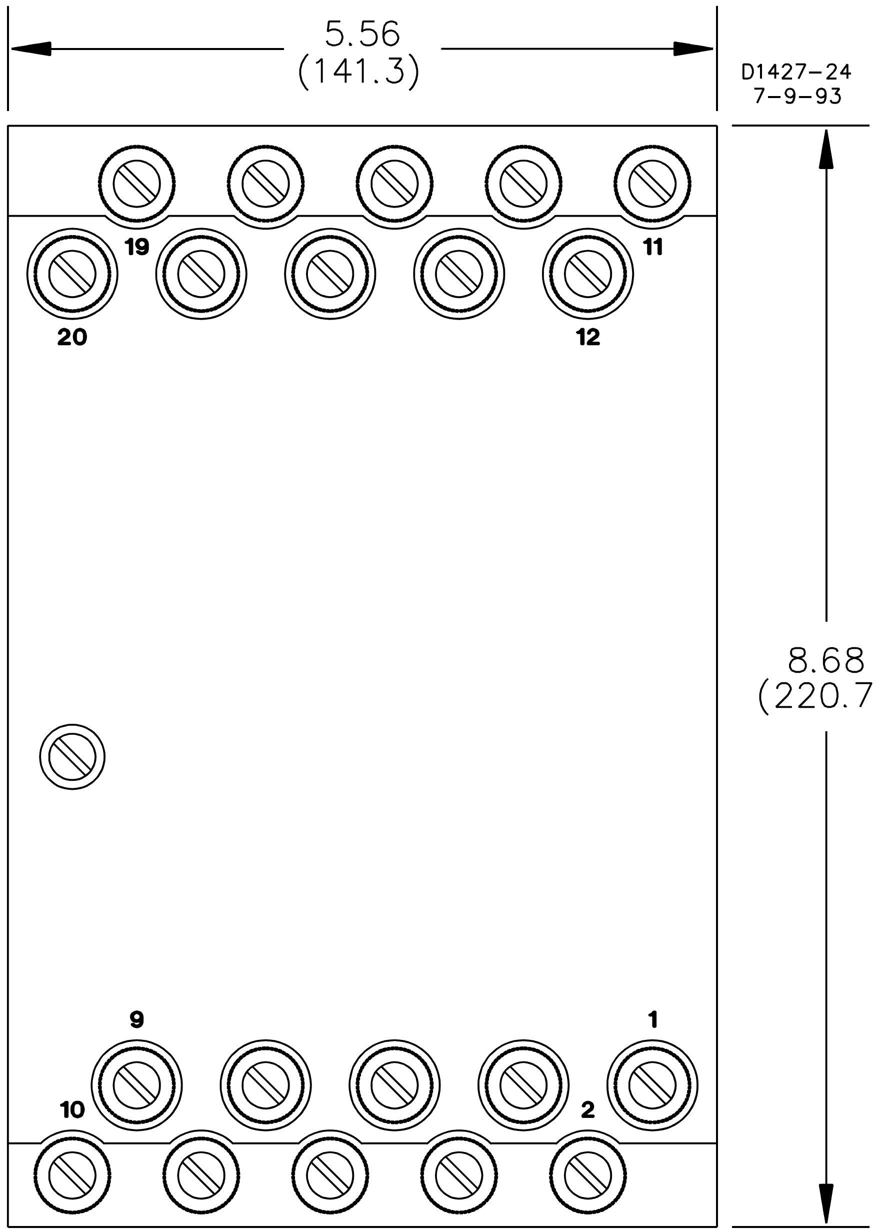


Figure 4-4. S1 Case, Double-Ended, Semi-Flush Mounting, Outline Dimensions, Rear View

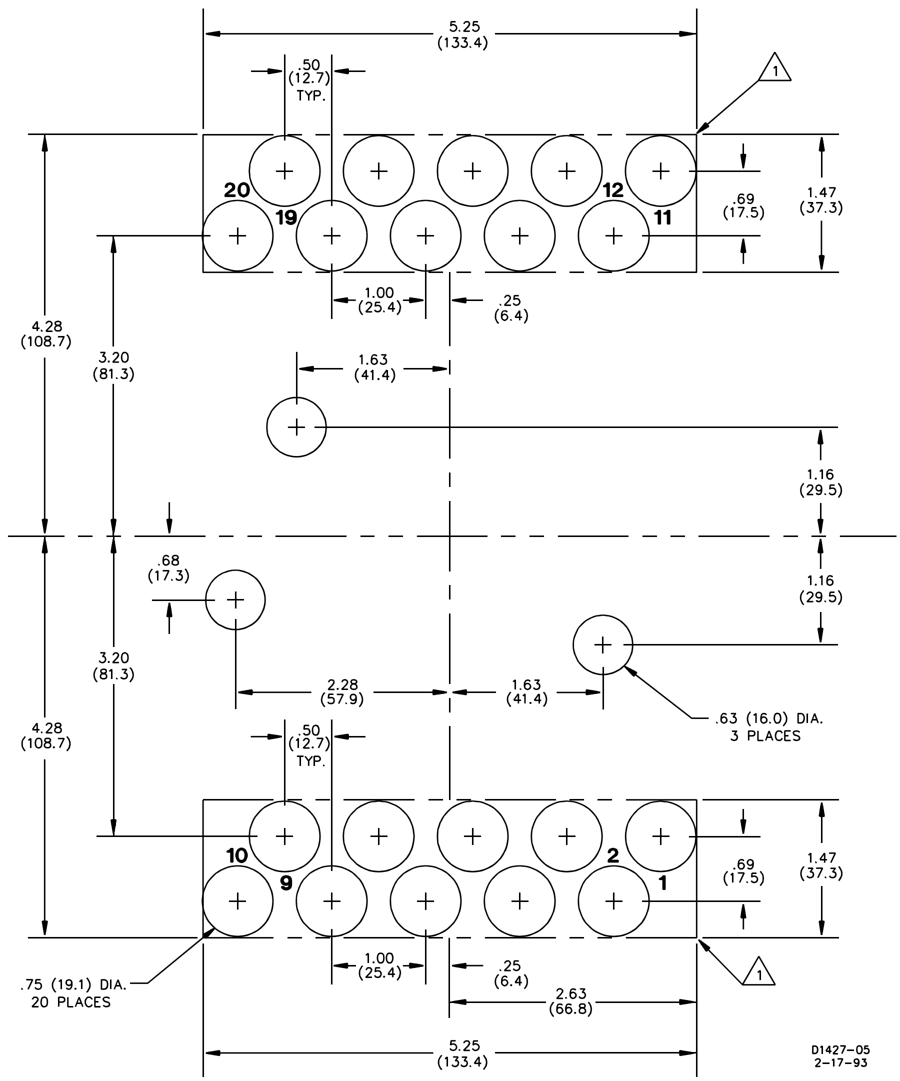


Figure 4-5. S1 Case, Double-Ended, Projection Mounting, Panel Drilling Diagram, Rear View

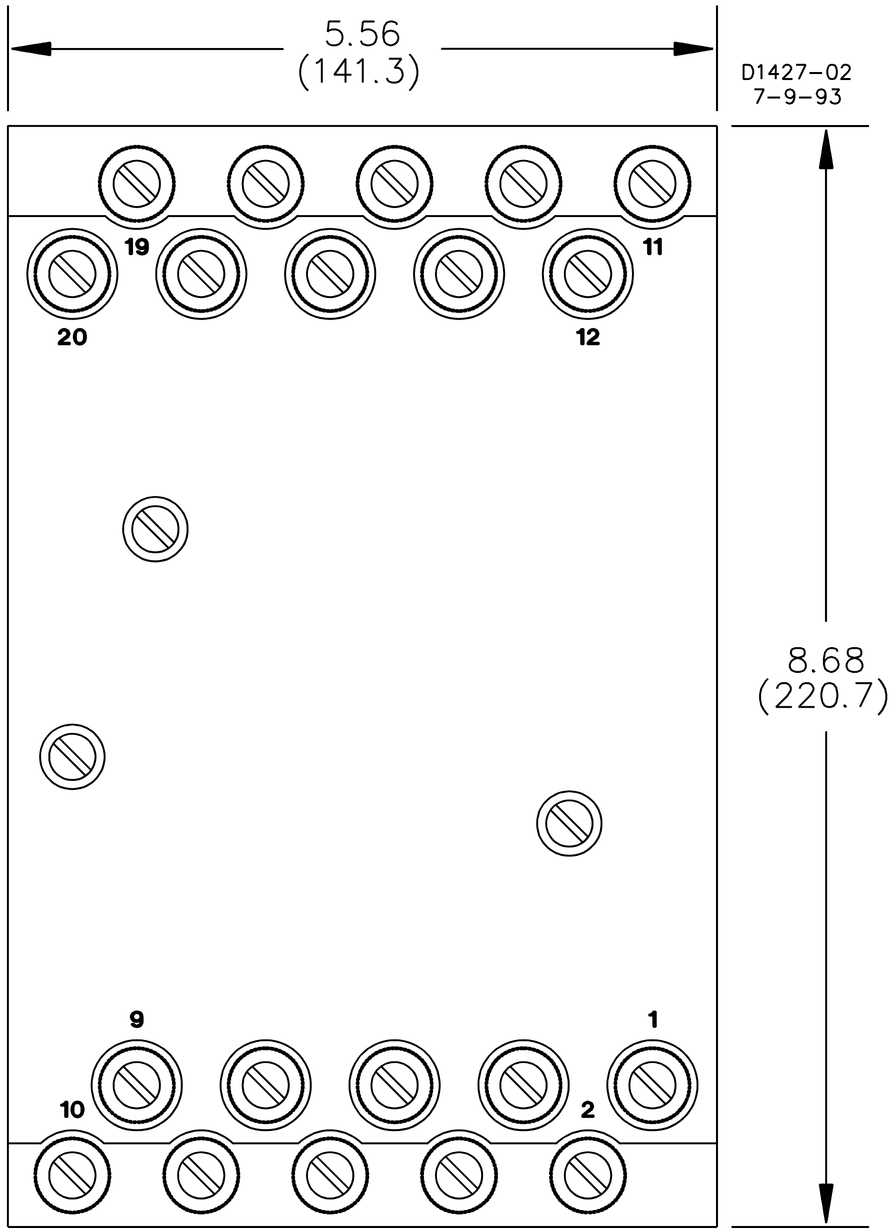


Figure 4-6. S1 Case, Double-Ended, Projection Mounting, Rear View

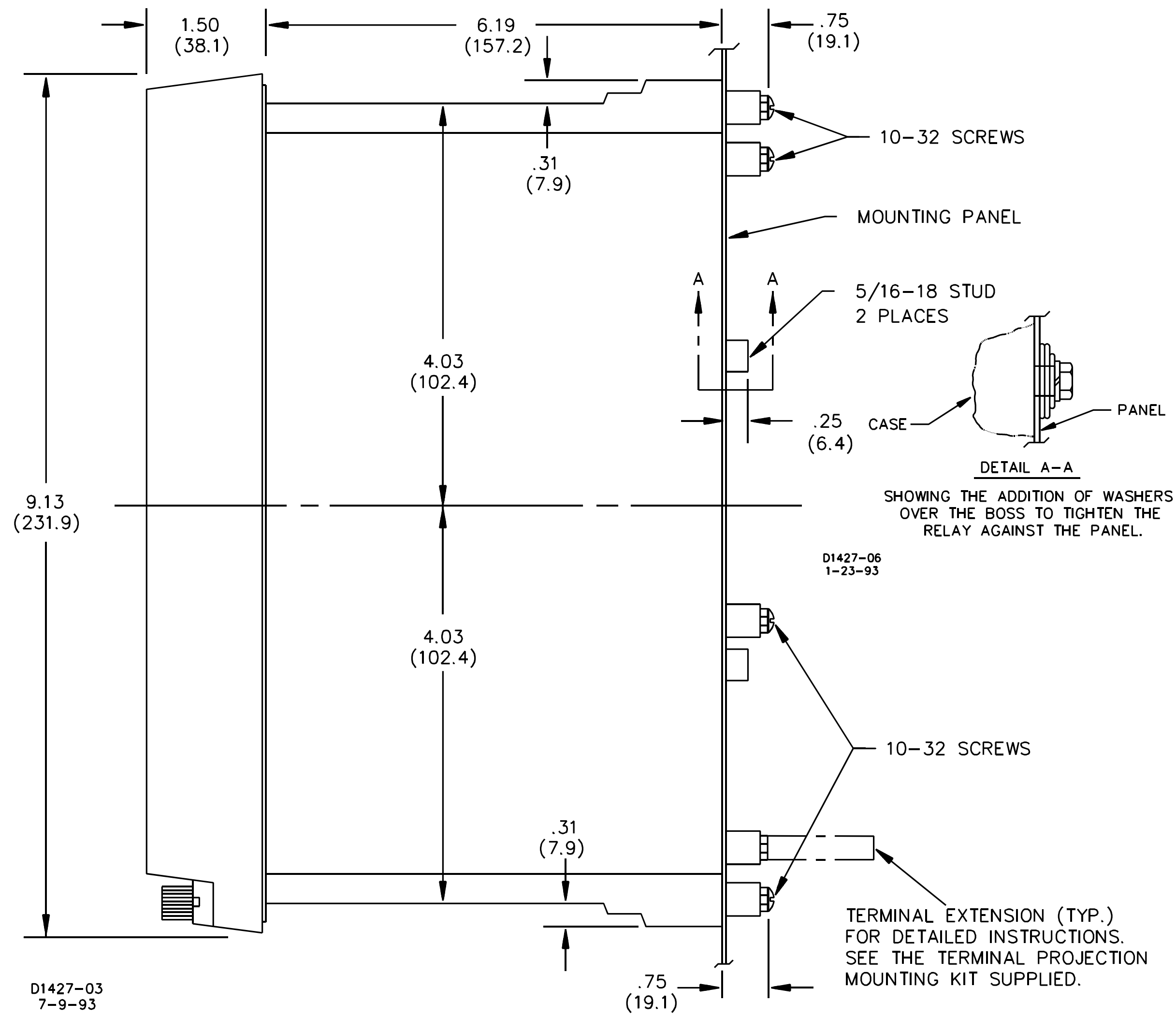


Figure 4-7. S1 Case, Double-Ended, Projection Mounting, Side View

CONNECTIONS

> NOTE
> Be sure the relay case is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the relay case. When the relay is configured in a system with other protective devices, it is recommended to use a separate lead to the ground bus from each relay.

Incorrect wiring may result in damage to the relay. Except as noted previously, connections should be made with minimum wire size of 14 AWG. Typical dc control circuit connections are shown in Figure 4-8, and typical protection methods in Figure 4-9. Internal connections are shown in Figure 4-10.

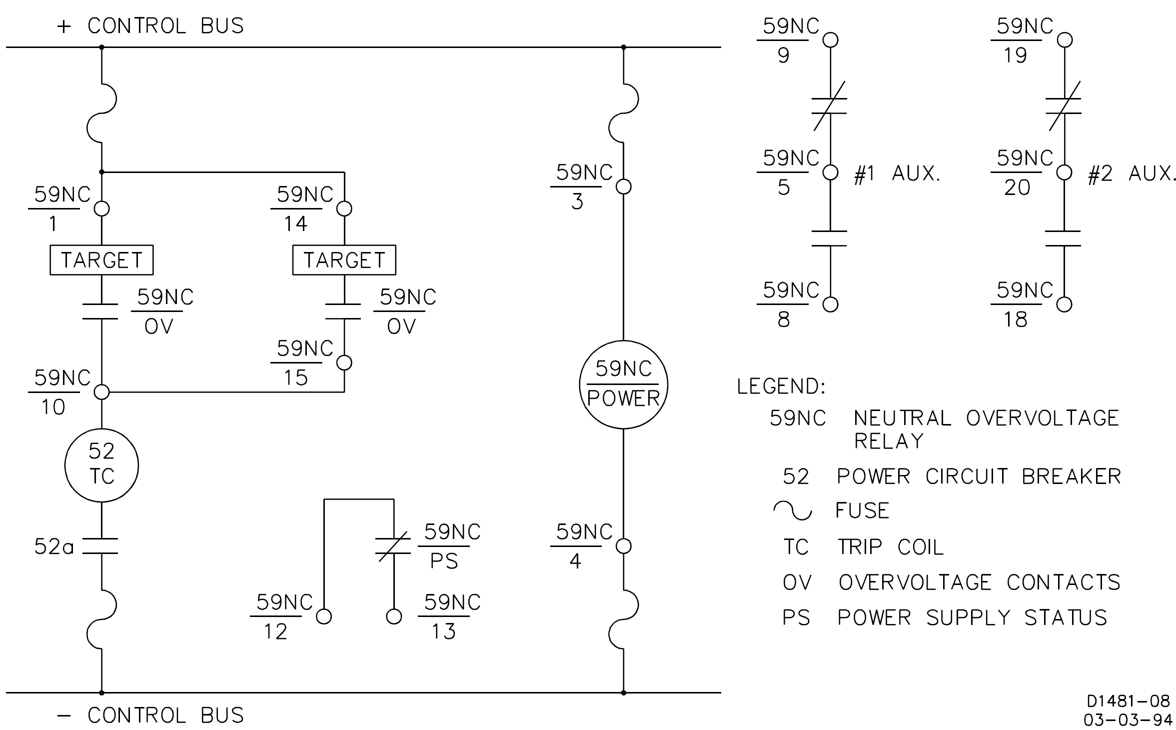
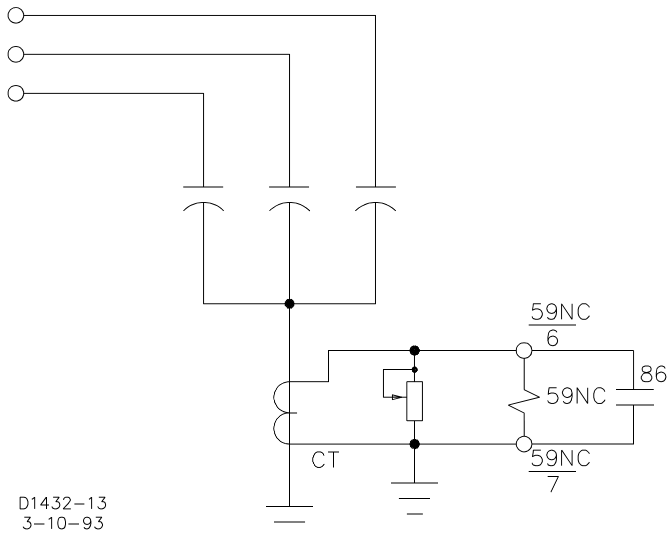


Figure 4-8. Typical Control Circuit Connections



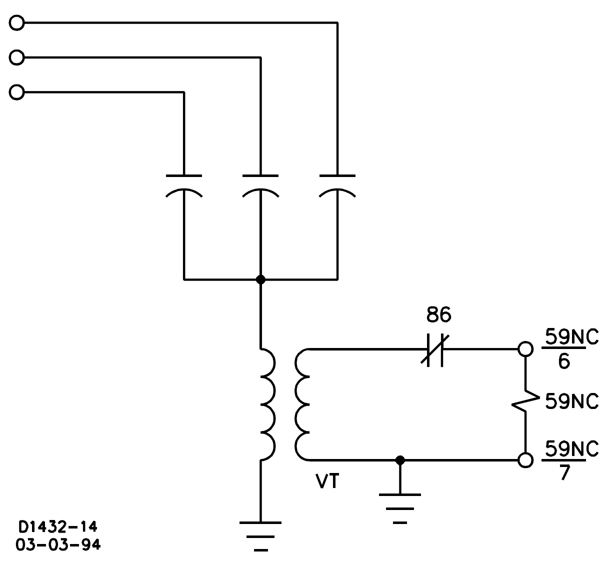


Figure 4-9. Typical Protection Methods

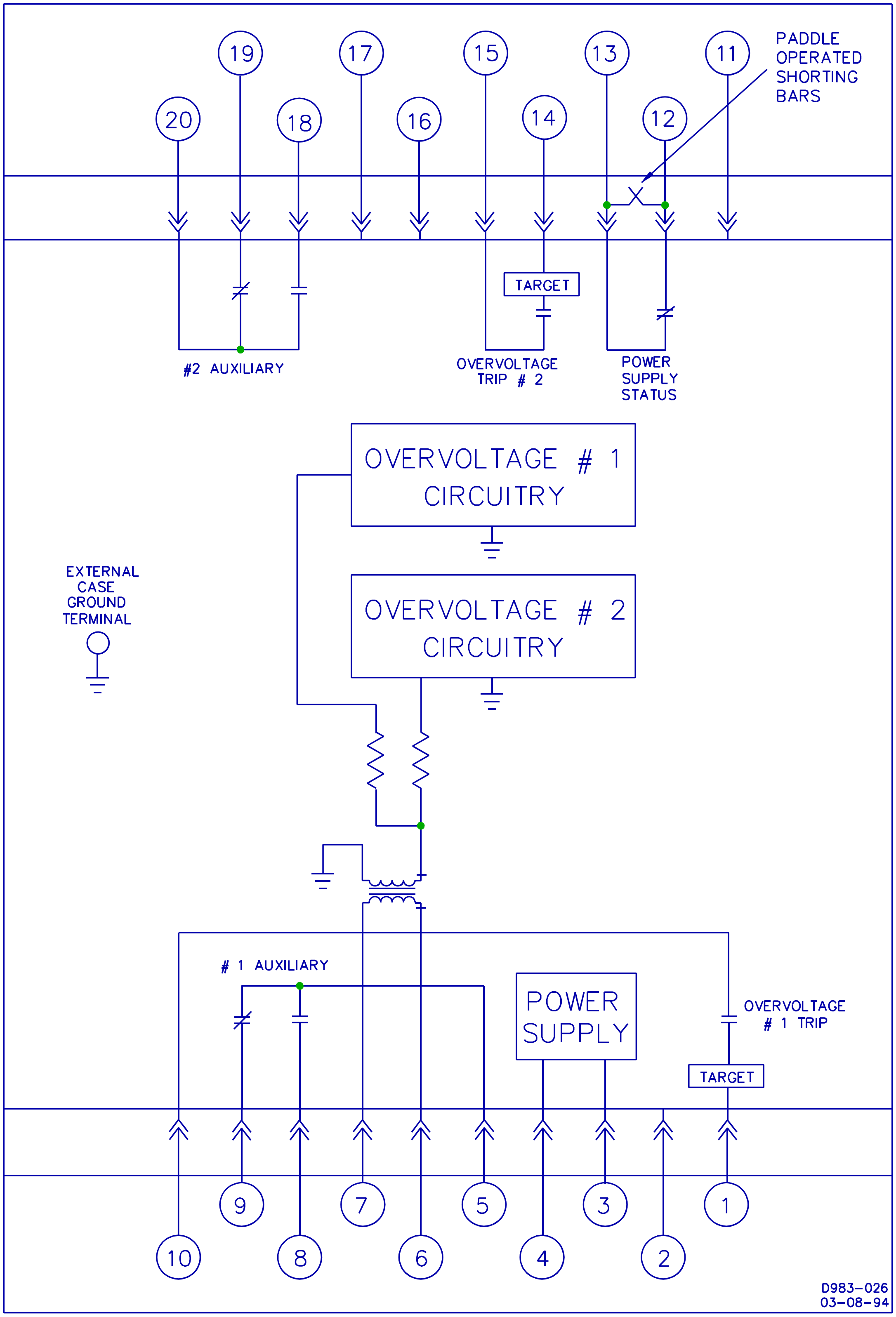


Figure 4-10. Typical Internal Connections

SECTION 5

TESTING

GENERAL

Results obtained from these procedures may not fall within specified tolerance. When evaluating results, consideration should be given to the following prominent factors.

- Inherent error of the test equipment used.
- Inherent inconsistency or repeatability of the testing method.
- Tolerance level and accuracy of components used in the test setup.

EQUIPMENT REQUIRED

- Two Multi-Amp SSR-78 and a counter/timer accurate to at least 1.0% or one Doble F2500 (has timer included) or suitable substitute.
- Digital voltmeter accurate to within 1% or better
- Variable AC/DC (0-250V) power supply (for power input)
- DC power supply (for current operated targets)

OPERATIONAL TEST

Step 1. Perform the appropriate test setup for your relay. Use Figure 5-1 for timing option E2 and Figure 5-2 for timing options D1 or D2. On D1, setpoint one is inverse time and setpoint two is definite time.

Step 2. Apply operating power to the relay, verify that the POWER LED is ON, and verify that the power supply status contact is open.

Step 3. Perform the following timing tests as appropriate for your relay.

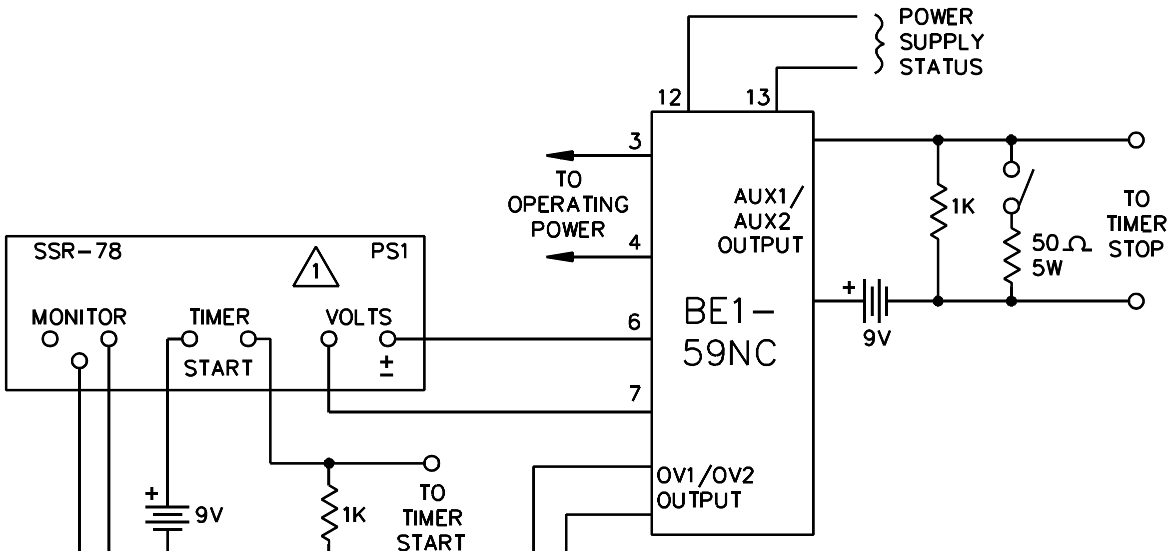
E2 Timing Option

Step 1. Reference to Figure 5-1, connect an ac voltage source (50 or 60 Hz, depending upon input option) to case terminals 6 and 7. Adjust this voltage to equal the desired overvoltage pickup level for OVERVOLTAGE 1.

Step 2. Starting at maximum CW, slowly turn OVERVOLTAGE 1 PICKUP ADJUST potentiometer R63 CCW until OVERVOLTAGE 1 PICKUP LED just illuminates.

Step 3. Set OVERVOLTAGE 1 TIME DIAL to 001 and apply to case terminals 6 and 7, a voltage that is 10% greater than the value applied in Step 1.

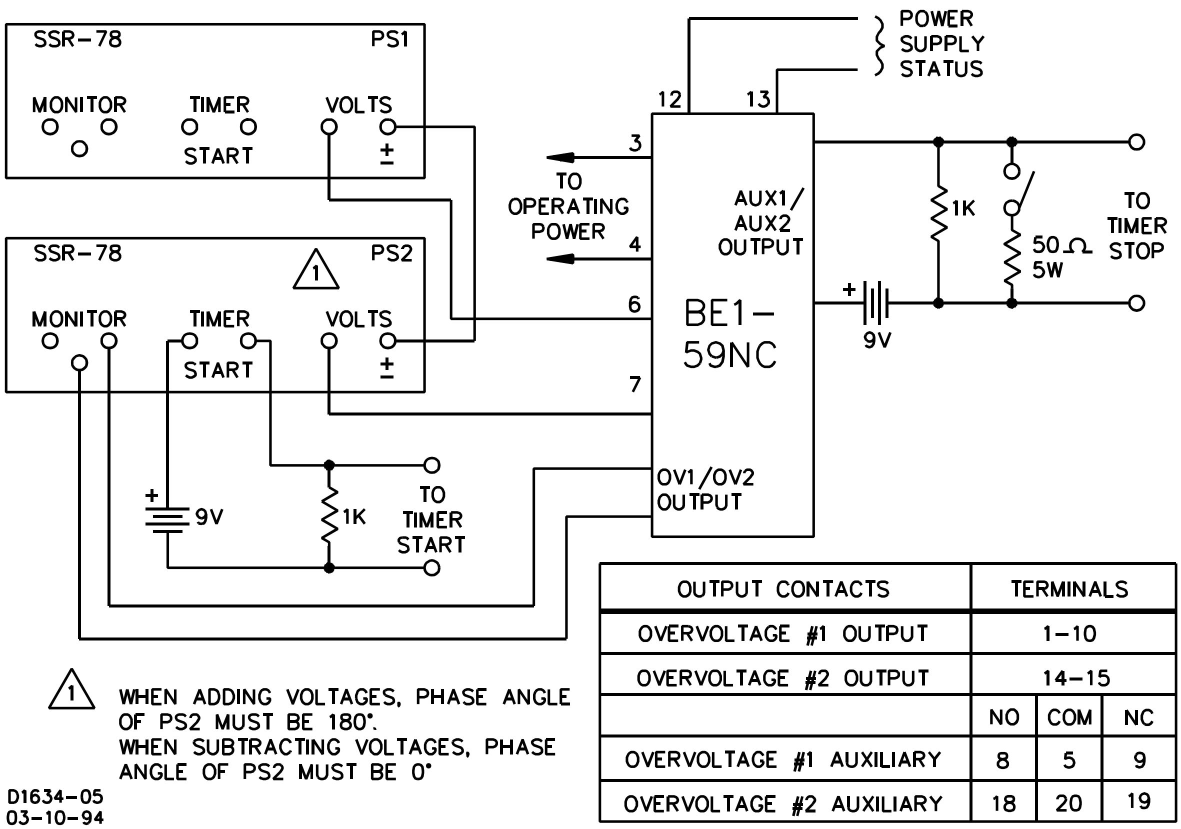
Step 4. Monitor the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1. Remove, then reapply the overvoltage at case terminals 6 and 7.   Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.



OUTPUT CONTACTS	TERMINALS		
OVERVOLTAGE #1 OUTPUT	1-10		
OVERVOLTAGE #2 OUTPUT	14-15		
	NO	COM	NC
OVERVOLTAGE #1 AUXILIARY	8	5	9
OVERVOLTAGE #2 AUXILIARY	18	20	19

D1634-20
03-29-94

Figure 5-1. Typical Test Setup Timing Option E2



OUTPUT CONTACTS	TERMINALS		
OVERVOLTAGE #1 OUTPUT	1-10		
OVERVOLTAGE #2 OUTPUT	14-15		
	NO	COM	NC
OVERVOLTAGE #1 AUXILIARY	8	5	9
OVERVOLTAGE #2 AUXILIARY	18	20	19

Figure 5-2. Typical Test Setup Timing Options D1 Or D2

E2 Timing Option - continued

Step 5. Set OVERVOLTAGE 1 TIME DIAL to 010. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 1. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 6. Set OVERVOLTAGE 1 TIME DIAL to 100. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 1. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 7. Set OVERVOLTAGE 1 TIME DIAL to 999. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 1. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 8. Adjust the voltage source to equal the desired overvoltage pickup level for OVERVOLTAGE 2.

Step 9. Starting at maximum CW, slowly turn OVERVOLTAGE 2 PICKUP ADJUST potentiometer R43 CCW until OVERVOLTAGE 2 PICKUP LED just illuminates.

Step 10. Set OVERVOLTAGE 2 TIME DIAL to 001 and apply to case terminals 6 and 7, a voltage that is 10% greater than the value applied in Step 1.

Step 11. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 12. Set OVERVOLTAGE 2 TIME DIAL to 010. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 13. Set OVERVOLTAGE 2 TIME DIAL to 100. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 14. Set OVERVOLTAGE 2 TIME DIAL to 999. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

D1 Timing Option

NOTE

In the following inverse time tests, voltage is stepped from one-half of pickup to a voltage that is higher (by value in column for Volts Over Pickup, Table 1) than the pickup.

Step 1. With reference to Figure 5-2, set PS1 for the value shown in Table 5-1, input option (column 1) and for the specific pickup voltage (column 2, **Volts Pickup 50/60 Hz**). **Example:** input option 1, PS1 set to 10 volts, at 0°.

Table 5-1. Inverse Time Overvoltage Levels And Delays For Input Options

Input Option (Style NO. 2nd Digit)	**Volts Pickup 50/60 Hz**	**PS1 50/60 Hz Volts @ °**	**PS2 50/60 Hz Volts @ °**	**Volts Over Pickup**	**TIME DIAL**			
					11	**33**	**55**	**88**
1	10	5 @ 0°	13 @ 180°	8	0.612	1.545	2.478	3.876
2	30	15 @ 0°	23 @ 180°	8	0.582	1.534	2.487	3.916
3	21	10.5 @ 0°	26.5 @ 180°	16	0.612	1.545	2.478	3.876
4	60	30 @ 0°	46 @ 180°	16	0.582	1.534	2.487	3.916
5	10	5 @ 0°	13 @ 180°	8	0.612	1.545	2.478	3.876
6	30	15 @ 0°	23 @ 180°	8	0.582	1.534	2.487	3.916
7	21	10.5 @ 0°	26.5 @ 180°	16	0.612	1.545	2.478	3.876
8	60	30 @ 0°	46 @ 180°	16	0.582	1.534	2.487	3.916

Step 2. Adjust the OVERVOLTAGE 1 PICKUP adjust potentiometer R63 so the OVERVOLTAGE 1 PICKUP LED just illuminates.

Step 3. Adjust PS1 and PS2 for the voltage levels and phase angles based on input options as shown in Table 5-1 (columns 3 and 4).

Step 4. Set the OVERVOLTAGE 1 TIME DIAL to 11.

Step 5. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 6. Remove PS1 and PS2 voltage.

Step 7. Set the OVERVOLTAGE 1 TIME DIAL to 33.

Step 8. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 9. Remove PS1 and PS2 voltage.

Step 10. Set the OVERVOLTAGE 1 TIME DIAL to 88.

Step 11. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 12. Remove PS1 and PS2 voltage.

Step 13. Adjust the voltage source to equal the desired overvoltage pickup level for OVERVOLTAGE 2.

Step 14. Starting at maximum CW, slowly turn OVERVOLTAGE 2 PICKUP ADJUST potentiometer R43 CCW until OVERVOLTAGE 2 PICKUP LED just illuminates.

Step 15. Set OVERVOLTAGE 2 TIME DIAL to 001 and apply to case terminals 6 and 7, a voltage that is 10% greater than the value applied in Step 13.

Step 16. Monitor the output terminals indicated in Figure 5-1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 17. Set OVERVOLTAGE 2 TIME DIAL to 010. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 18. Set OVERVOLTAGE 2 TIME DIAL to 100. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

Step 19. Set OVERVOLTAGE 2 TIME DIAL to 999. Monitor the output terminals indicated in Figure 1 for OVERVOLTAGE 2. Remove, then reapply the overvoltage at case terminals 6 and 7. Observe the time registered by the counter. Time must equal the setting ±100 milliseconds or 2%, whichever is greater.

D2 Timing Option

NOTE

In the following inverse time tests, voltage is stepped from one-half of pickup to a voltage that is higher (by value in column for Volts Over Pickup, Table 1) than the pickup.

Step 1. With reference to Figure 5-2, set PS1 for the value shown in Table 5-1, input option (column 1) and for the specific pickup voltage (column 2, **Volts Pickup 50/60 Hz**). **Example:** input option 1, PS1 set to 10 volts, at 0°.

Step 2. Adjust the OVERVOLTAGE 1 PICKUP adjust potentiometer R63 so the OVERVOLTAGE 1 PICKUP LED just illuminates.

Step 3. Adjust PS1 and PS2 for the voltage levels and phase angles based on input options as shown in Table 5-1 (columns 3 and 4).

Step 4. Set the OVERVOLTAGE 1 TIME DIAL to 11.

Step 5. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 6. Remove PS1 and PS2 voltage.

Step 7. Set the OVERVOLTAGE 1 TIME DIAL to 33.

Step 8. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 9. Remove PS1 and PS2 voltage.

Step 10. Set the OVERVOLTAGE 1 TIME DIAL to 88.

Step 11. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 1, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 12. Remove PS1 and PS2 voltage.

Step 13. With reference to Figure 5-2, set PS1 for the value shown in Table 5-1 and for the specific input option.

Step 14. Adjust the OVERVOLTAGE 2 PICKUP adjust potentiometer R43 so the OVERVOLTAGE 2 PICKUP LED just illuminates.

Step 15. Adjust PS1 and PS2 for the voltage levels and phase angles based on input options as shown in Table 5-1.

Step 16. Set the OVERVOLTAGE 2 TIME DIAL to 11.

Step 17. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 2, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 18. Remove PS1 and PS2 voltage.

Step 19. Set the OVERVOLTAGE 2 TIME DIAL to 33.

Step 20. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 2, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 21. Remove PS1 and PS2 voltage.

Step 22. Set the OVERVOLTAGE 2 TIME DIAL to 88.

Step 23. Reset the timer. Turn on PS1. While monitoring the output terminals indicated in Figure 5-1 for OVERVOLTAGE 2, initiate PS2 and record the time delay. Verify that the time is within 5.0% or 25 milliseconds (whichever is greater) of the time shown in Table 5-1.

Step 24. Remove PS1 and PS2 voltage.

SECTION 6

MAINTENANCE

GENERAL

BE1-59NC Neutral Overvoltage Relays require no preventive maintenance other than a periodic operational test (refer to Section 5 for operational test procedure). If the relay fails to function properly, contact the Customer Service Department of the Power Systems Group, Basler Electric, for a return authorization number prior to shipping.

STORAGE

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 one-year intervals, power is applied to the relay for a period of thirty minutes.

TEST PLUG

Test plugs (Basler part number 10095 or G.E. part number 12XLA12A1) provide a quick, easy method of testing relays without removing them from their case. A test plug is simply substituted for the connection plug. This provides access to the external stud connections as well as to the internal circuitry.

Test plugs consist of a black and red phenolic molding with twenty electrically separated contact fingers connected to ten coaxial binding posts. The ten fingers on the black side are connected to the inner binding posts (black thumb nuts) and tap into the relay internal circuitry. The ten fingers on the red side of the test plug are connected to the outer binding posts (red thumb nuts) and also connect to the relay case terminals.

When testing circuits connected to the bottom set of case terminals, the test plug is inserted with the numbers 1 through 10 facing up. Similarly, when using the test plug in the upper part of the relay, the numbers 11 through 20 are faceup. It is impossible, due to the construction of the test plug, to insert it with the wrong orientation.

SECTION 7

MANUAL CHANGE INFORMATION

Table 7-1. Substantive Changes In This Manual To Date Are Summarized Below.

Revision	Summary of Changes
A	Corrected voltage sensing Input range in *Specifications* and throughout the manual. Changed Figure 1-3, Overvoltage Inverse Time Curves to divide the curves for low ranges (sensing input ranges 1, 3, 5, and 7) and high ranges (sensing input ranges 2, 4, 6, and 8). Corrected typographical error in Figure 4-9. Changed *Testing Procedures, D1* and *D2 Timing Options* TIME DIAL settings. Added *Section 7*.