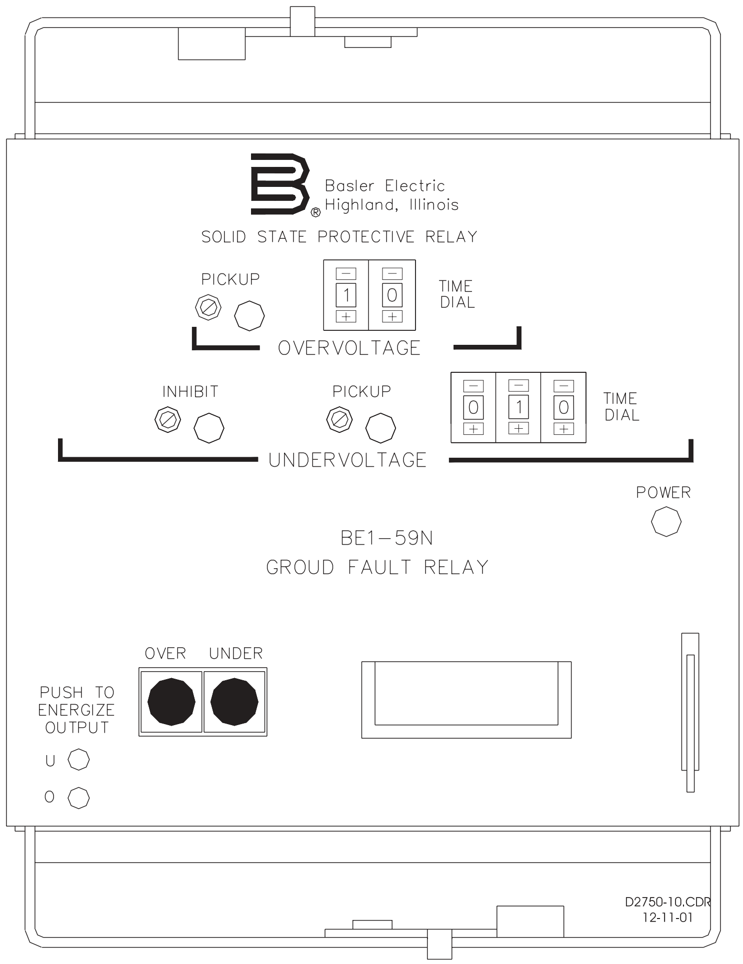
INSTRUCTION MANUAL

FOR

GROUND FAULT OVERVOLTAGE RELAY

BE1-59N



Basler Electric

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INTRODUCTION

The purpose of this Instruction Manual is to furnish information concerning the operation and installation of this device. To accomplish this, the following is provided.

- Specifications
- Functional characteristics
- Operational Tests
- Mounting Information

W A R N I N G !

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.

BASLER ELECTRIC
ROUTE 143, BOX 269
HIGHLAND, IL 62249 USA
http://www.basler.com, info@basler.com
PHONE 618-654-2341 **FAX 618-654-2351**

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SECTION 1 • GENERAL INFORMATION

DESCRIPTION

The available fault current for single-phase-to-ground faults is very limited for ungrounded systems and systems which are grounded through a high resistance. This current limiting reduces the possibility of extensive equipment damage, and eliminates the need for a neutral breaker by reducing the fault current below the level required to sustain an arc. But, it remains important to detect and isolate single-phase-to-ground faults in order to prevent their evolution into more dangerous faults such as phase-to-phase-to-ground and three-phase-to-ground faults. Sensitive voltage relays can be used to detect ground faults where the fault current is very small. The BE1-59N Ground Fault Overvoltage Relay is especially suited to this task.

HIGH RESISTANCE GROUNDING

A common method of grounding an ac generator is to connect a distribution transformer between the neutral of the generator and the station ground. The distribution transformer's primary voltage rating is equal to, or greater than, the generator's rated line-to-neutral voltage. The distribution transformer secondary is rated at 200/240 Vac or 100/120 Vac, and a resistor is connected across the secondary winding. When reflected through the transformer, the resistor is effectively a high resistance.

$$R_p = R_s \times N^2$$

where R_p is the effective primary resistance
R_s is the actual value of the secondary resistor
N is the turns ratio of the distribution transformer

Available single-phase-to-ground fault current at the generator terminals is greatly reduced by the high effective resistance of the distribution transformer and secondary resistor. The distribution transformer provides isolation for the protection scheme and reduces the voltage to a convenient level.

The BE1-59N Ground Fault Overvoltage Relay is connected across the secondary resistor to detect the increase in voltage across the distribution transformer caused by a ground fault in the generator stator windings. A ground fault at the generator terminals will result in rated line-to-neutral voltage across the transformer primary, while ground faults near the neutral will result in lower voltages. The overvoltage relay setpoint must be higher than any neutral voltage caused by normal unbalances in order to avoid nuisance trips. This will allow a certain percentage of the stator windings to go unprotected by the overvoltage relay. The overvoltage relay function typically protects 90 to 95% of the generator stator windings.

The BE1-59N Ground Fault Overvoltage Relay monitors the fundamental frequency (50 or 60 Hz) voltage which accompanies a ground fault, but is insensitive to the third harmonic voltage present during normal operation. One hundred percent protection of the generator stator windings is obtainable with the optional overlapping undervoltage element. The under voltage element is tuned to the third harmonic voltage which is present in the generator neutral under normal conditions. The undervoltage element detects the reduction of the normal third harmonic voltage which accompanies a ground fault near the neutral point of the generator.

An undervoltage inhibit feature is included with the third harmonic undervoltage element. This feature supervises the operation of the ground fault relay to prevent operation during startup and shutdown by monitoring the generator terminal voltage.

UNGROUNDED SYSTEMS

The BE1-59N Ground Fault Overvoltage Relay is used to detect ground faults on ungrounded three-phase-three-wire systems. The relay is connected as shown in Figure 1-1. A set of voltage transformers are wired with a grounded wye primary and a broken delta secondary. The BEl-59N is connected across the broken delta. It is often necessary to connect a resistor across the broken delta to avoid ferroresonance.

Grounded wye/broken delta voltage transformers act as a zero sequence filters by summing the three phase voltages. Under normal conditions this sum is zero. When a ground fault occurs, the BE1-59N Ground Fault Overvoltage Relay will detect the presence of the secondary zero sequence voltage ($3V_O$).

The BE1-59N Ground Fault Overvoltage Relay greatly reduces the risk of equipment damage by detecting and isolating the first ground on an ungrounded system.

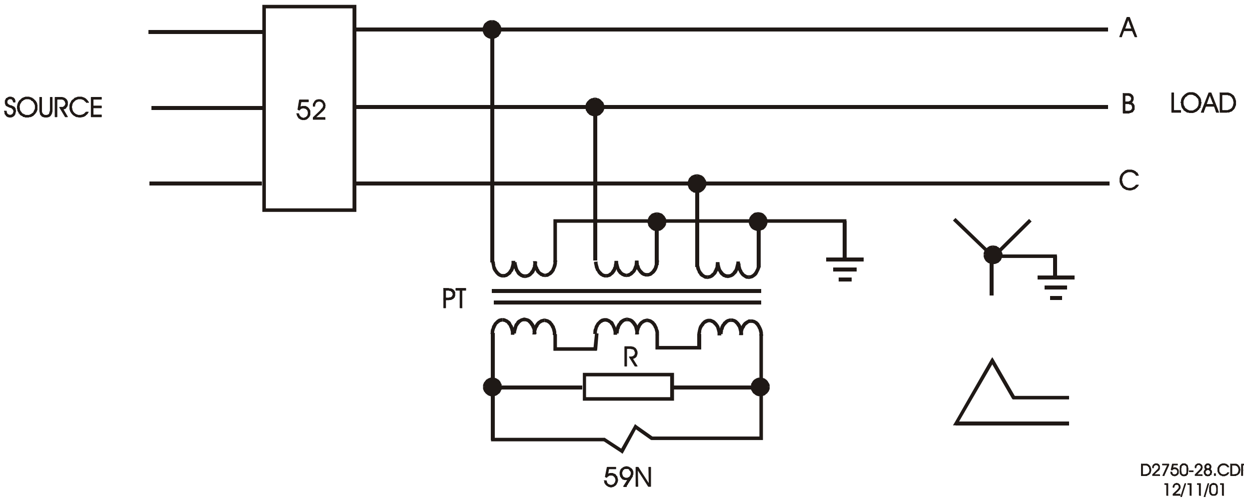


Figure 1-1. Ungrounded 3-Phase, 3-Wire System

MODEL AND STYLE NUMBER

Electrical characteristics and operational features included in a specific relay are defined by a combination of letters and numbers which makes up the device style number. The model number, BE1-59N, designates the device as a Basler Electric Class 100 Ground Fault Overvoltage protective relay. The style number together with the model number describe the features and options in a particular device and appear on the front panel, drawout cradle and inside the case assembly.

Sample Style Number

In Figure 1-2, the style number identification chart illustrates the features of a relay sample style number. If the style number were A5F F6P D2S3F, the relay would have the following features:

BE1-59N	Model Number
A	Single-phase voltage sensing input
5	120 Vac, 60 hertz sensing input (nominal) with 1 to 20 Vac pickup range
F	Two normally-open output relays (one overvoltage and one undervoltage)
F6	Inverse time delay for overvoltage and definite time delay for undervoltage
P	Operating power derived from either 125 Vdc or 100/120 Vac
D	Two current operated targets (one per function)
2	Undervoltage element range 0.1 to 2.5 Vac (low range with sensing input 5)
S	Push-to-energize outputs
3	Two auxiliary output relays, normally-open (one per function)
F	Semi-flush mounting

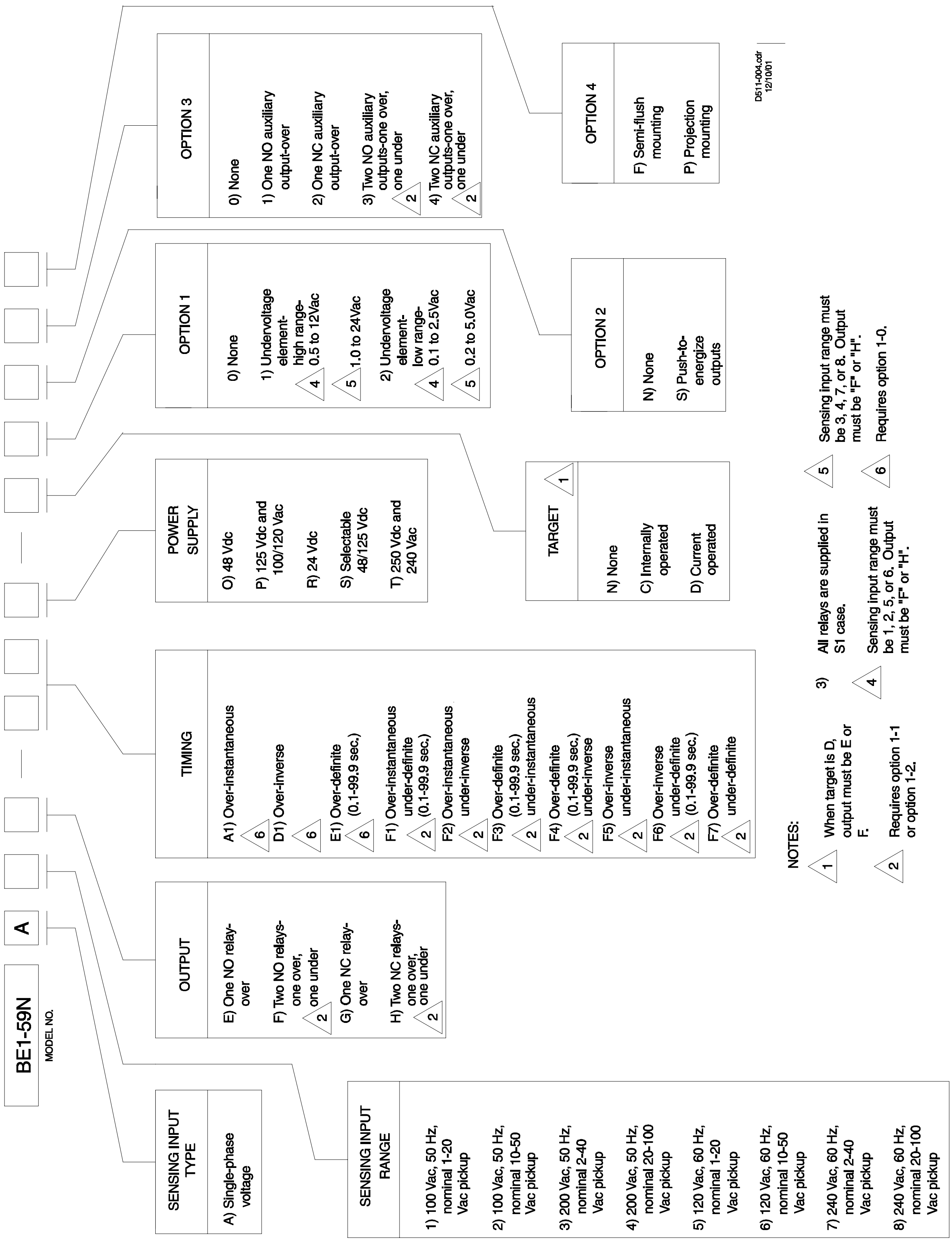


Figure 1-2. Style Number Identification Chart

SPECIFICATIONS

The BE1-59N Ground Fault Overvoltage Relay has 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 for each input.

Undervoltage Sensing Input Range
High range: 0.5 to 12 Vac (sensing input range 1, 2, 5, or 6) or 1.0 to 24 Vac (Sensing input range 3, 4, 7, or 8)
Low range: 0.1 to 2.5 Vac (sensing input range 1, 2, 5, or 6) or 0.2 to 5.0 Vac (Sensing input range 3, 4, 7, or 8)

Pickup Accuracy
1 to 24 Vac range: ± 2% or 20 millivolts
All other ranges: ± 2% or 10 millivolts

Overvoltage Sensing Input Range
Ranges selctable by unit type for 50 or 60 Hz operation: 1 to 20 Vac, 10 to 50 Vac, 2 to 40 Vac, 20 to 100 Vac

Pickup Accuracy
120 Vac (sensing input range 1, 2, 5, or 6) ±2.0% or 100 millivolts, whichever is greater.

240 Vac (sensing input range 3, 4, 7, or 8) ±2.0% or 200 millivolts, whichever is greater.

Dropout
98% of pickup within 7 cycles.

Timing Characteristics

Instantaneous (no intentional delay)
Less than 70 milliseconds for a voltage level that exceeds the pickup setting by 5% or 1 volt (whichever is greater).

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.)

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.

Accuracy is 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 120 Vac sensing range) or 200 millivolts (for the 240 Vac sensing range) (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. The characteristic curves are defined in Figures 1-3 and 1-4.

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 0.1 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 0.1 A. (L/R = 0.04).

Target Indicators

Function targets may be specified as either internally operated, or current operated by a minimum of 0.2 A through the output trip circuit. When current operated, the output circuit must be limited to 30 A for 0.2 seconds, 7 A for 2 minutes, and 3 A continuously.

Power Supply

Input power may be obtained from a variety of ac or dc external power sources. Available power supply options are indicated in Table 1-1.

Table 1-1. Power Supply Specifications.

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
O	48 Vdc	24 to 60 Vdc	7.0 W
P	125 Vdc 120 Vac	62 to 150 Vdc 90 to 132 Vac	7.5 W 15.0 W
†R	24 Vdc	12 to 32 Vdc	7.5 W
‡S	48 Vdc 125 Vdc	24 to 60 Vdc 62 to 150 Vdc	7.0 W 7.5 W
T	250 Vdc 240 Vac	140 to 280 Vdc 190 to 270 Vac	12.0 W 33.5 VA

NOTES:

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

‡ Type S 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.

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 (6.17 kg) maximum.

Case Size S1 (6.85"W x 9.32"H x 9.405"D).

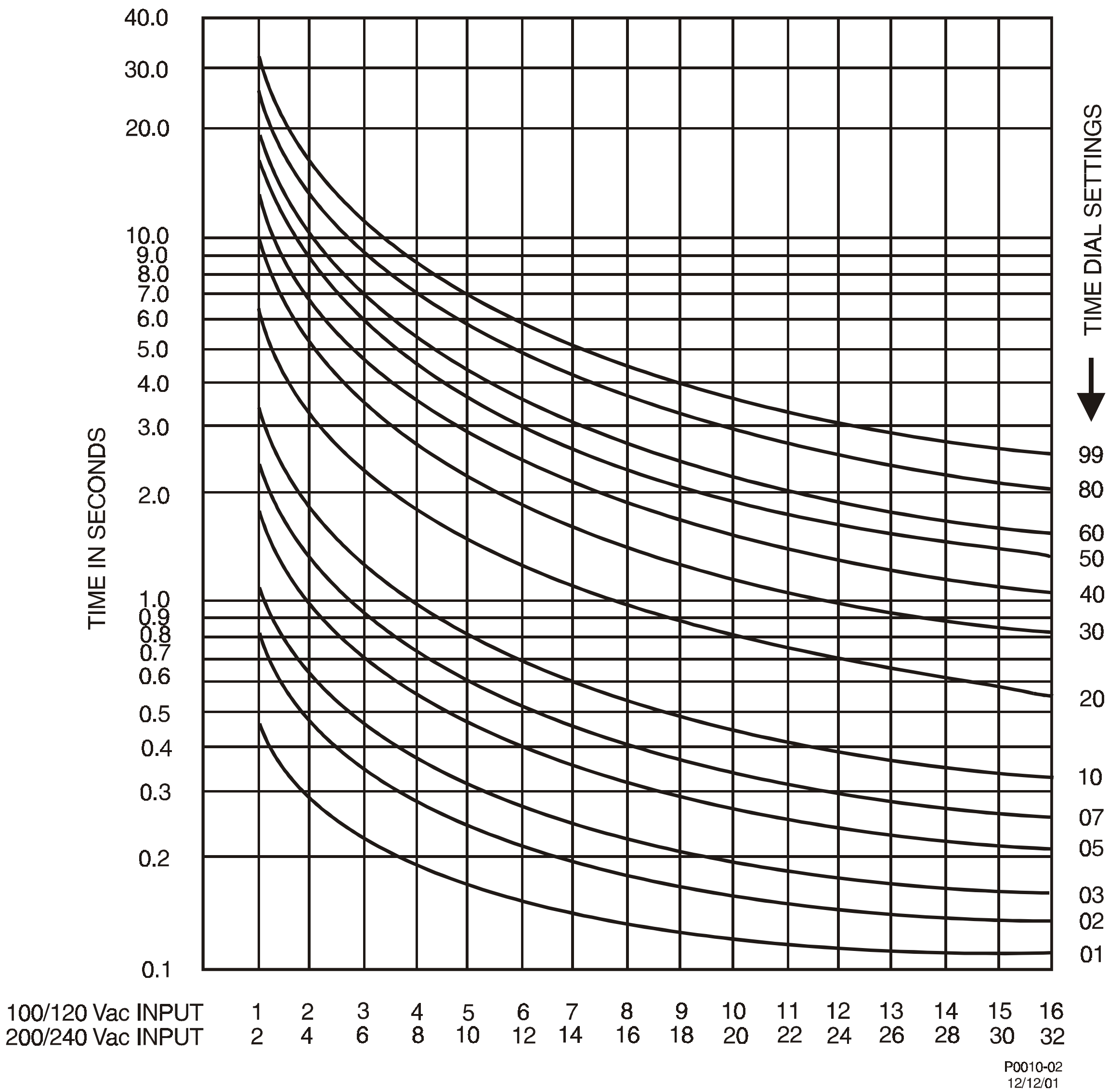
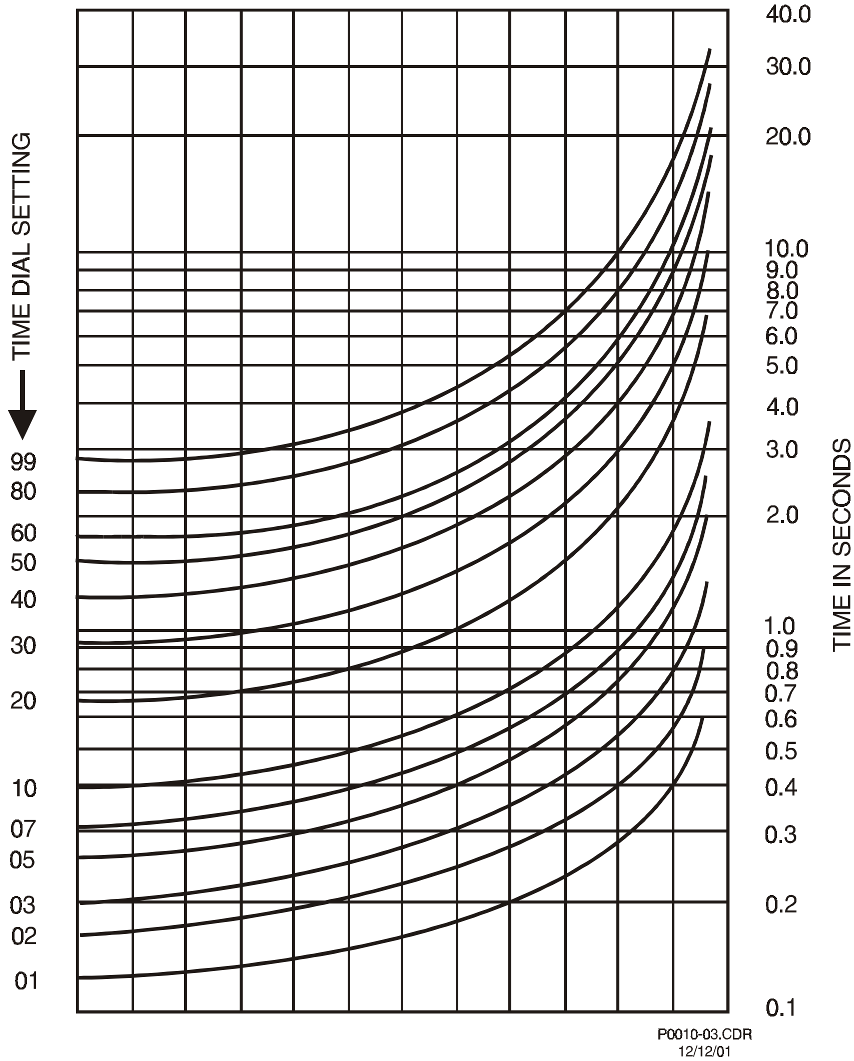


Figure 1-3. Overvoltage Inverse Time Curves



SCALE A	2.4	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2
SCALE B	4.8	4.4	4.0	3.6	3.2	2.8	2.4	2.0	1.6	1.2	0.8	0.4
SCALE C	12	11	10	9	8	7	6	5	4	3	2	1
SCALE D	24	22	20	18	16	14	12	10	8	6	4	2

VOLTAGE DIFFERENCE FROM PICKUP

Figure 1-4. Undervoltage Inverse Time Curves

Table 1-2. Undervoltage Inverse Time Curves Scale

Sensing Input Range	**Option 1-2**	**Option 1-1**
1, 2, 5, or 6	Scale A	Scale C
3, 4, 7, or 8	Scale B	Scale D

SECTION 2 • CONTROLS AND INDICATORS

GENERAL

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

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

Letter	Control or Indicator	Function or Indicator
A	Overvoltage Pickup Adjustment	A multiturn potentiometer that sets the overvoltage comparator threshold voltage. Continuously adjustable over the range indicated by the style chart.
B	Overvoltage Pickup LED	A red LED that lights when overvoltage exceeds the pickup setting.
C	Overvoltage Time Dial	Pushbutton switch that selects the desired overvoltage output delay, either definite time (from 00.1 to 99.9 seconds) or, inverse time (characteristic curves 01 through 99). A setting of 00 is instantaneous in either case.
D	Undervoltage Time Dial	Pushbutton switch that selects the desired undervoltage output delay, either definite time (from 00.1 to 99.9 seconds) or, inverse time (characteristic curves 01 through 99). A setting of 00 is instantaneous in either case.
E	Power LED	LED illuminates to indicate that the relay power supply is functioning.
F	Target Reset Lever	Linkage extending through bottom of front cover that is used to reset magnetically latching target indicators.
G	Target Indicator(s)	Magnetically latching indicators that indicate that the associated output relay(s) have been energized.
H, I	Push to Energize Output Switches	Momentary pushbuttons accessible by inserting a 1/8 inch diameter non-conducting rod through the front panel. Pushbuttons are used to energize the output relays in order to test system wiring.
J	Undervoltage Pickup LED	A red LED that lights when undervoltage exceeds the pickup setting.
K	Undervoltage Pickup Adjustment	A multiturn potentiometer that sets the undervoltage comparator threshold voltage. Continuously adjustable over the range indicated by the style chart.
L	Inhibit LED	A red LED that lights when the monitored generator voltage is under the inhibit set point.
M	Inhibit Pickup Adjustment	Multiturn potentiometer that sets the inhibit comparator threshold so that whenever generator voltage falls below the set point, the (optional) undervoltage measuring circuitry is inhibited from operation.

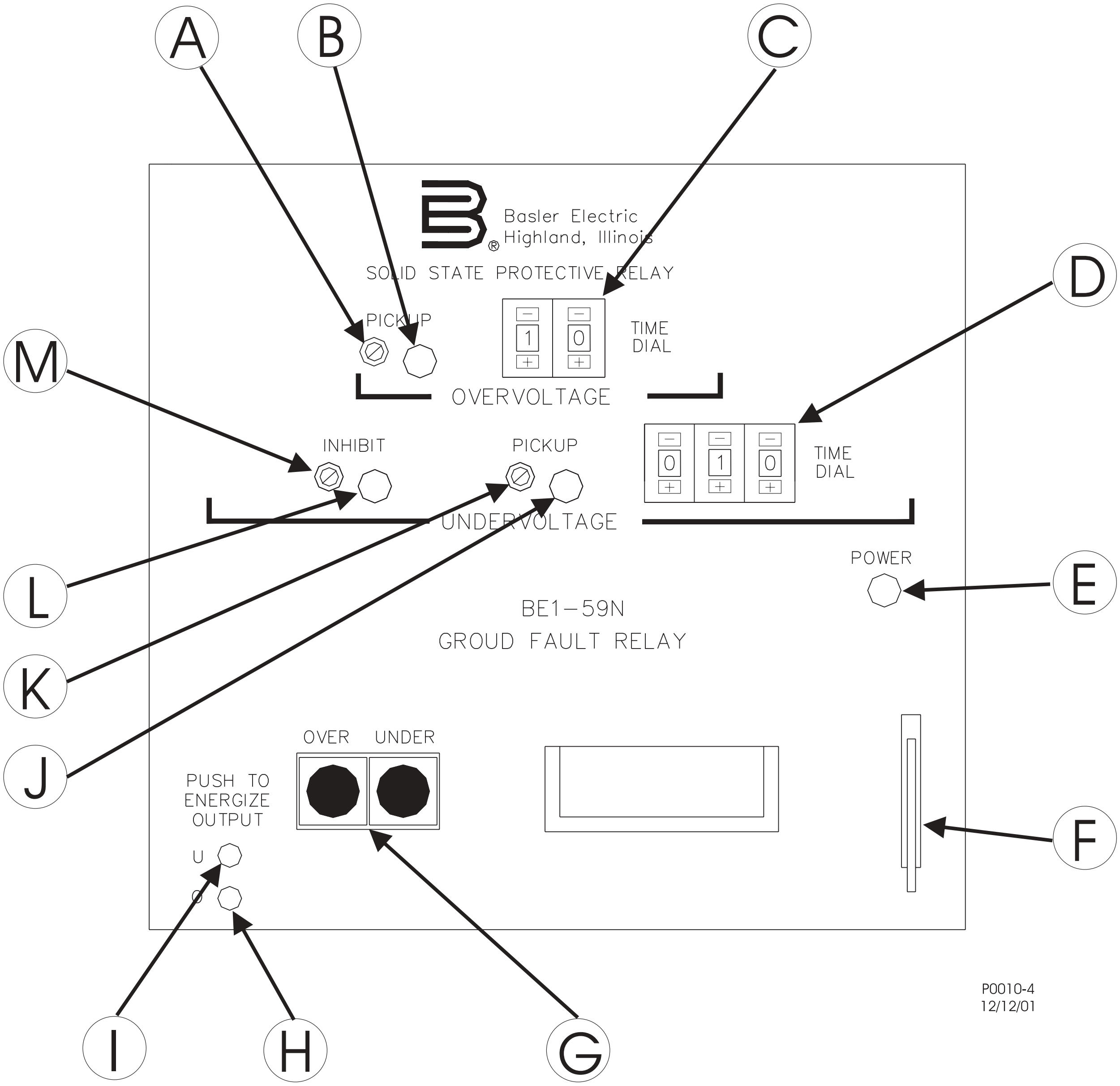


Figure 2-1. Location of Controls and Indicators.

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL

The BE1-59N Ground Fault Overvoltage Relay is a solid state digital device that is designed to detect ground faults. The functional block diagram of Figure 3-1 illustrates the overall operation of the relay.

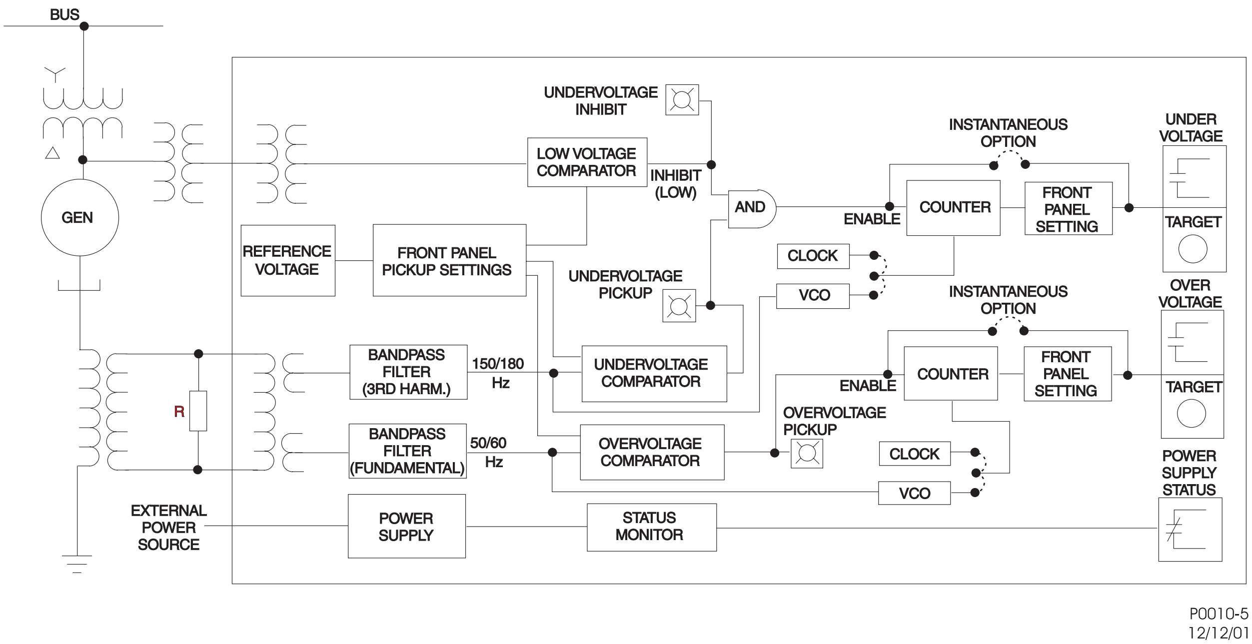


Figure 3-1. Functional Block Diagram

INPUTS

The relay senses the level of voltage developed across a resistor connected in the neutral-grounding transformer secondary. The relay may also be used with ungrounded systems with voltage transformers connected in a wye/broken delta configuration. These connections are shown in Section 4.

Internal transformers provide further isolation and step down for the relay logic circuits.

FILTERS

A bandpass filter provides a peak sensitivity at 50 or 60 Hz for the overvoltage input, with third harmonic rejection of 40 dB minimum. If an undervoltage element is specified, an additional filter with peak sensitivity at the third harmonic is included. The filter provides 40 dB rejection of the fundamental.

OVERVOLTAGE COMPARATOR

The overvoltage comparator circuit receives a sensing voltage from the bandpass filter and a reference voltage from the front panel setting. The comparator determines within five cycles if the fundamental frequency (50 or 60 hertz) is less than or greater than the reference setting. When the input exceeds the setting, the resulting comparator output enables the timing circuit if definite or inverse time delay is specified, and the OVERVOLTAGE PICKUP LED illuminates. If instantaneous timing is used, the comparator output immediately energizes the overvoltage relay and, if present, the overvoltage auxiliary relay.

DEFINITE TIME DELAY (OPTIONAL)

An output signal from the comparator circuit enables a counting circuit to be incremented by an internal clock. When the counting circuit reaches a count which matches the number entered on the TIME DIAL, the output relay and auxiliary relay, if present, 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 (OPTIONAL)

The inverse time delay circuit is identical to the definite time delay circuit except that a voltage controlled oscillator (VCO) is substituted for the clock signal. The VCO, in turn, 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.

The inverse time characteristic curve switch is adjustable from 01 to 99 in 01 increments. Each position corresponds to a specific curve setting except 00, which is instantaneous. Refer to Figure 1-2 to see the inverse time characteristic curve.

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.

UNDERVOLTAGE ELEMENT (OPTIONAL)

Undervoltage Operation

The undervoltage option is sensitive to the third harmonic voltage (150 Hz or 180 hertz) at generator neutral, and provides 40 dB rejection of the fundamental frequency (50 or 60 hertz). The undervoltage measuring element determines within five cycles if the third harmonic voltage is less than or greater than the reference setting. If the measured third harmonic voltage is less than the reference setting, the undervoltage pickup LED will illuminate, and the delay timer is triggered. When the timer completes its cycle, a signal is generated to energize the undervoltage output relay and, if selected, the undervoltage auxiliary relay. But, if the voltage level swings above the reference setting before the delay timer has cycled, the output contacts reset within 7.0 cycles.

In the event that both trip conditions (undervoltage and overvoltage) are present, the undervoltage response is inhibited.

The third harmonic pickup setting (i.e., UNDERVOLTAGE PICKUP) is a front panel mounted potentiometer, continuously adjustable on the high range from 0.5 to 12 Vac (sensing input range 1, 2, 5, or 6) or 1.0 to 24 Vac (Sensing input range 3, 4, 7, or 8). On the low range, it is adjustable from 0.1 to 2.5 Vac (sensing input range 1, 2, 5, or 6) or 0.2 to 5.0 Vac (Sensing input range 3, 4, 7, or 8). The time delays available are instantaneous, definite, or inverse time. (Instantaneous is defined as no intentional time delay. The timing circuits are analogous to those previously described.)

Undervoltage Inhibit

When the undervoltage measuring element is selected, an undervoltage inhibit circuit is included to monitor the generator terminal voltage. this circuit inhibits operation of the 150/180 hertz measuring element if the generator terminal voltage is less than the undervoltage inhibit setting. The panel mounted undervoltage inhibit potentiometer is continuously adjustable from 40 to 120 Vac for 100/120 Vac sensing input, and 80 to 240 Vac for the 200/240 Vac input.

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 five previous power supplies. Style number identifiers for these power supplies have not been changes so that customers may order the same styled 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 new 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 3-1. Wide Range Power Supply Voltage Ranges

Power Supply	Style Chart Identifiers	Nominal Voltage	Voltage Range
Low Range	R	24 Vdc	12† to 32 Vdc
Mid Range	O, P, S	48, 125 Vdc	24 to 150 Vdc
High Range	T	125, 250 Vdc	62 to 280 Vdc

† 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.

POWER SUPPLY STATUS OUTPUT

A normally closed output relay may be provided, whose contact remains open when energized by the presence of nominal voltage at the output of the power supply. If the power supply voltage fails or falls below requirements, the power supply status output relay will de-energize, closing its contact.

A shorting bar is included in the relay case so that the status output terminals can provide a remote indication that the BE1-59N relay has been withdrawn from its case or taken out of service by removing the connection plug.

If the power supply status output is provided, then auxiliary output contacts are not available.

TARGET INDICATOR CIRCUITS

When specified, a front panel target indicator for each type of monitoring (i.e., overvoltage or undervoltage) will be supplied. Two types of target drive circuits are available:

Internally Operated Targets

The output from an overvoltage or undervoltage circuit is directly applied to drive the appropriate target indicator. The indicator is tripped regardless of the current level of the trip circuit.

Current Operated

This target will operate only when a minimum of 0.2 A 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 (page 4-4) 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 connecting plugs and withdraw the cradle from its case.
4. When the connecting 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 terminals 3 and 4. Accordingly, a leakage current is to be expected at these terminals.

MOUNTING

Because the relay is of solid state design, it does not have to be mounted vertically. Any convenient mounting angle may be chosen. Relay outline dimensions and panel drilling diagrams are supplied at the end of this section.

CONNECTIONS

Incorrect wiring may result in damage to the relay. Be sure to check model and style number against the options listed in the Style Number Identification Chart before connecting and energizing a particular relay.

> **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.

Connections should be made with minimum wire size of 14 AWG. Typical external connections are shown in Figures 4-1 and 4-2. Internal connections are shown in Figure 4-3.

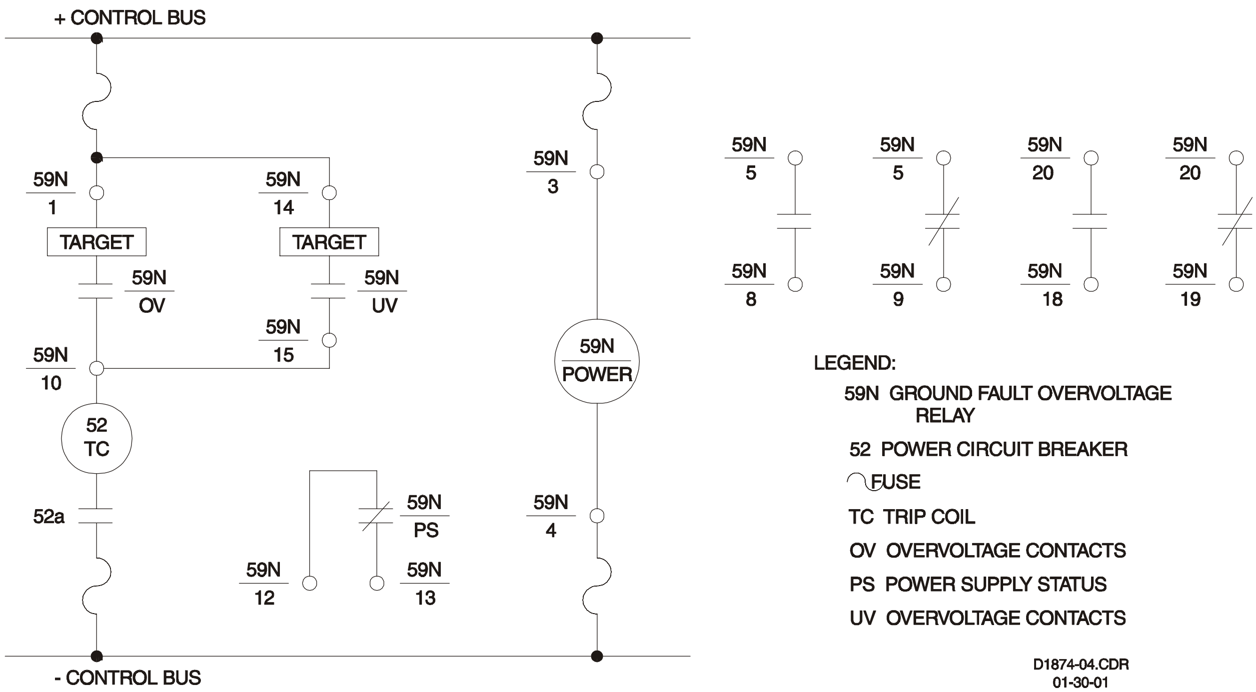


Figure 4-1. Typical Control Circuit Connections

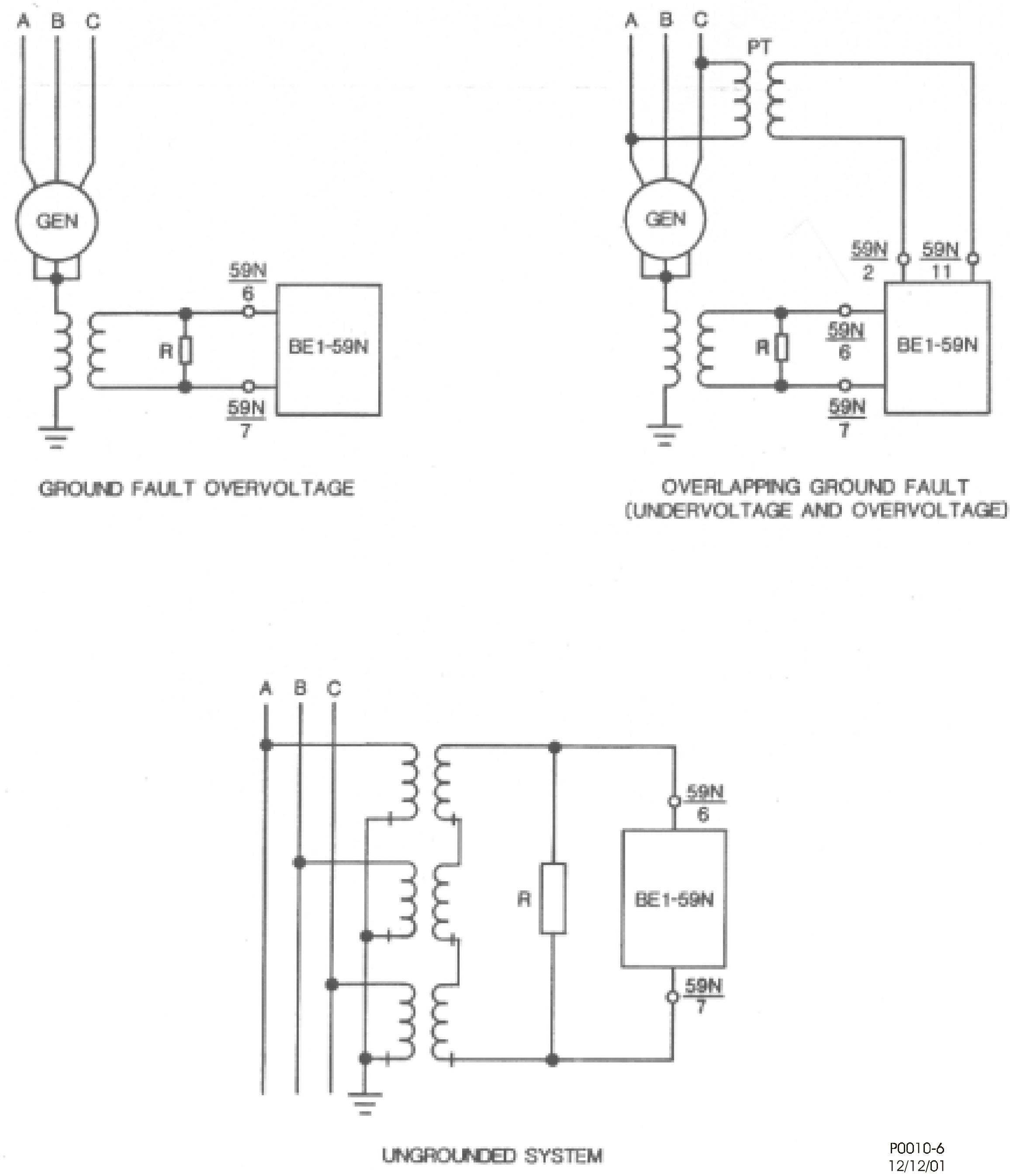


Figure 4-2. Typical Voltage Sensing Connections

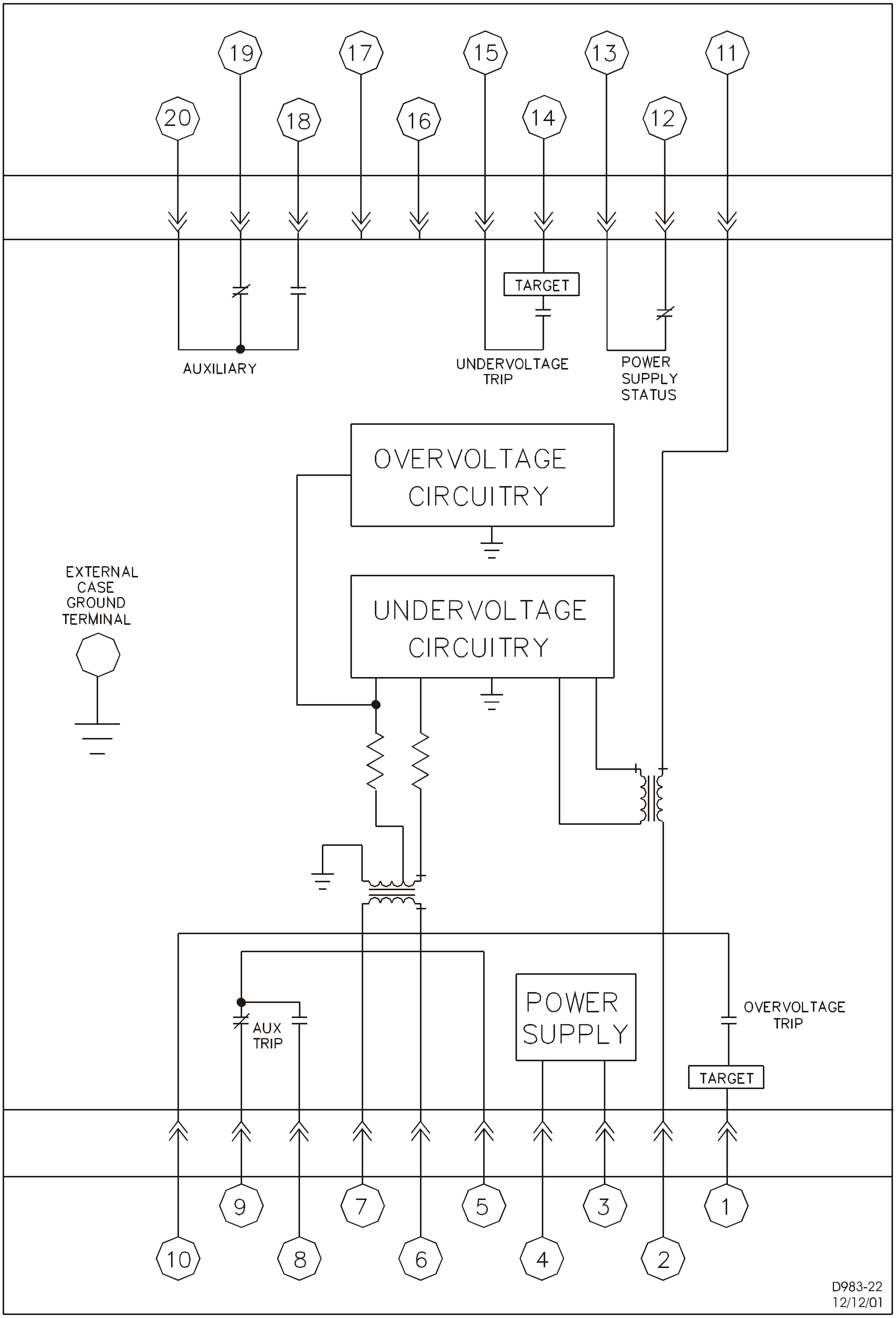


Figure 4-3. Typical Internal Connections

OPERATIONAL TEST

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

- The inherent error of the test equipment used.
- The inherent inconsistency or repeatability of the testing method.
- The tolerance level and accuracy of components used in the test setup.

STEP 1. Perform test setup (Figure 4-4) and apply power to the relay. Verify that the POWER LED is ON, and that the power supply status contact is open.

STEP 2. Set all TIME DIALS (if any) to the zero position.

STEP 3. Connect an ac voltage source (50 or 60 Hz, depending upon input option) to input terminals 6 and 7. Adjust this voltage to equal the desired overvoltage pickup level.

STEP 4. Rotate the front panel OVERVOLTAGE PICKUP potentiometer to maximum CW, then slowly turn CCW until the associated LED just lites. Interrupt and then reclose sensing power to terminals 6 and 7, noting the time between application of power and trip of overvoltage relay. Time must be less than 70 milliseconds for a voltage level that exceeds the pickup setting by 1 volt or 5% of the setting (whichever is greater).

NOTE
Step 5 applies only to relays with overvoltage definite time delay.

STEP 5. Open the sensing input and reset the target indicator. Set the OVERVOLTAGE TIME DIAL for the desired delay. Close the sensing input and verify that the relay trips according to the setting ±525 milliseconds.

NOTE
Steps 6 through 12 apply only to relays with overvoltage inverse time delay.

STEP 6. Connect a 50/60 Hz source to relay terminals 6 and 7 as shown in Figure 4-4. Note that this setup allows rapid switching from a voltage that is approximately one half of pickup to a voltage (ΔV) that is higher than pickup. The switching also provides a means of precisely verifying the time between the voltage step change and the resulting output response.

STEP 7. Set the OVERVOLTAGE TIME DIAL to the desired characteristic curve. (Reference Figure 1-2b.)

STEP 8. Adjust the voltage output of T2 to one half of T1.

STEP 9. Increase the voltage of T1 by an amount that represents any voltage (ΔV) of interest.

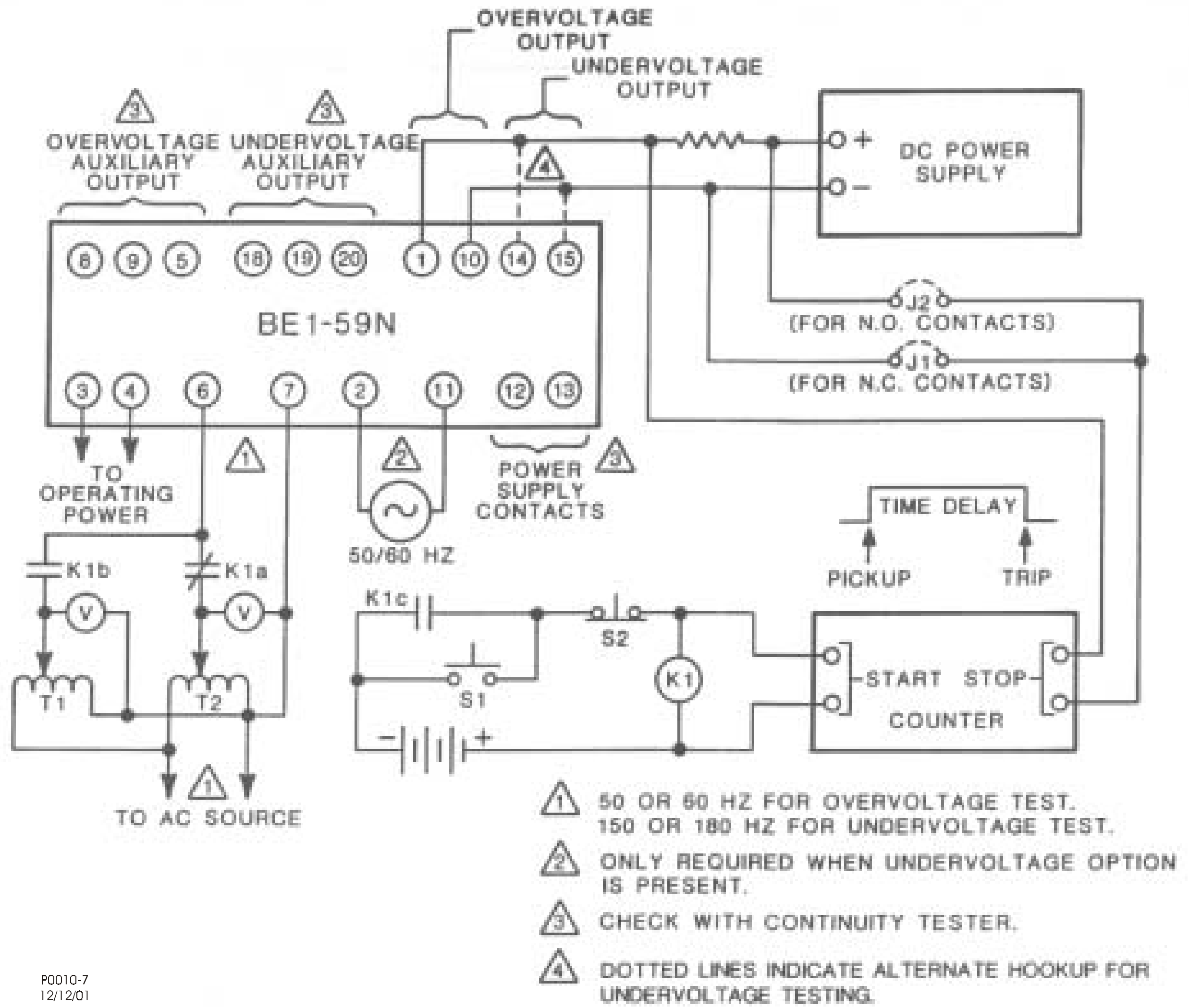


Figure 4-4. Typical Test Setup

STEP 10. Press and release S2 (of Figure 4-4) to assure that K1 is de-energized. Reset the timer. Press S1. The time recorded by the counter should be within 5.0% or 25 milliseconds (whichever is greater) of the time given in Figure 1-2b for the particular ΔV of the test.

STEP 11. By changing ΔV, steps 9 and 10 may be repeated to verify any segment of the characteristic curve that is of interest.

NOTE
If the Undervoltage option is included, proceed with the following steps. Otherwise, the Operational Test is concluded.

STEP 12. Connect 100 Vac at 50/60 Hz to terminals 2 and 11. Set the UNDERVOLTAGE INHIBIT potentiometer to the maximum CCW position. INHIBIT LED should be OFF.

STEP 13. Connect a 150 or 180 Hz voltage source (i.e., 3 times specified frequency) to input terminals 6 and 7. Adjust this voltage to the desired undervoltage threshold level. Rotate the UNDERVOLTAGE PICKUP potentiometer to maximum CCW. Reset targets.

STEP 14. Rotate the UNDERVOLTAGE PICKUP potentiometer slowly CW until the UNDERVOLTAGE LED just lites. At this time the undervoltage relay(s) and undervoltage auxiliary relay (if so equipped) should be energized, and undervoltage target tripped.

STEP 15. Adjust the UNDERVOLTAGE INHIBIT potentiometer so that the INHIBIT LED just lites. At this time, the UNDERVOLTAGE LED should extinguish, and the undervoltage relay(s) should de-energize. Rotate the UNDERVOLTAGE INHIBIT potentiometer to maximum CW to disable the inhibit function during the remainder of this test procedure.

NOTE
Steps 16 through 18 apply only to relays with undervoltage definite time delay. If not so equipped, proceed to the note following step 18.

STEP 16. Adjust the 150 or 180 Hz voltage (at terminals 6 and 7) to above pickup (i.e., UNDERVOLTAGE LED OFF).

STEP 17. Set the UNDERVOLTAGE TIME DIAL for any convenient delay. Reset targets (if present).

STEP 18. Reduce the sensing input below pickup (or disconnect it) while noting the time lapse before the undervoltage relay(s) trip. Check that response time is the TIME DIAL setting ±525 milliseconds.

NOTE
The remaining steps of this procedure apply only to relays with undervoltage inverse time delay. For all other relays, the operational test is concluded.

STEP 19. Connect a 150/180 Hz source to relay terminals 6 and 7 as shown in Figure 4-4. Note that this setup allows rapid switching from a voltage that is approximately twice pickup to a voltage that is ΔV lower than pickup. The switching also provides a means of precisely verifying the time between the voltage step change and the resulting output response.

STEP 20. Set the UNDERVOLTAGE TIME DIAL to the desired characteristic curve. (Reference Figure 1-2a.)

STEP 21. Adjust the voltage output of T2 to twice that of T1.

STEP 22. Decrease the voltage of T1 by an amount which represents any ΔV of interest.

STEP 23. Press and release S2 (of Figure 4-4) to assure that K1 is de-energized. Reset the timer. Press S1. The time recorded by the counter should be within 5.0% or 25 milliseconds (whichever is greater) of the time given in Figure 1-2a.

STEP 24. By changing ΔV, steps 22 and 23 may be repeated to verify any segment of the characteristic curve that is of interest.

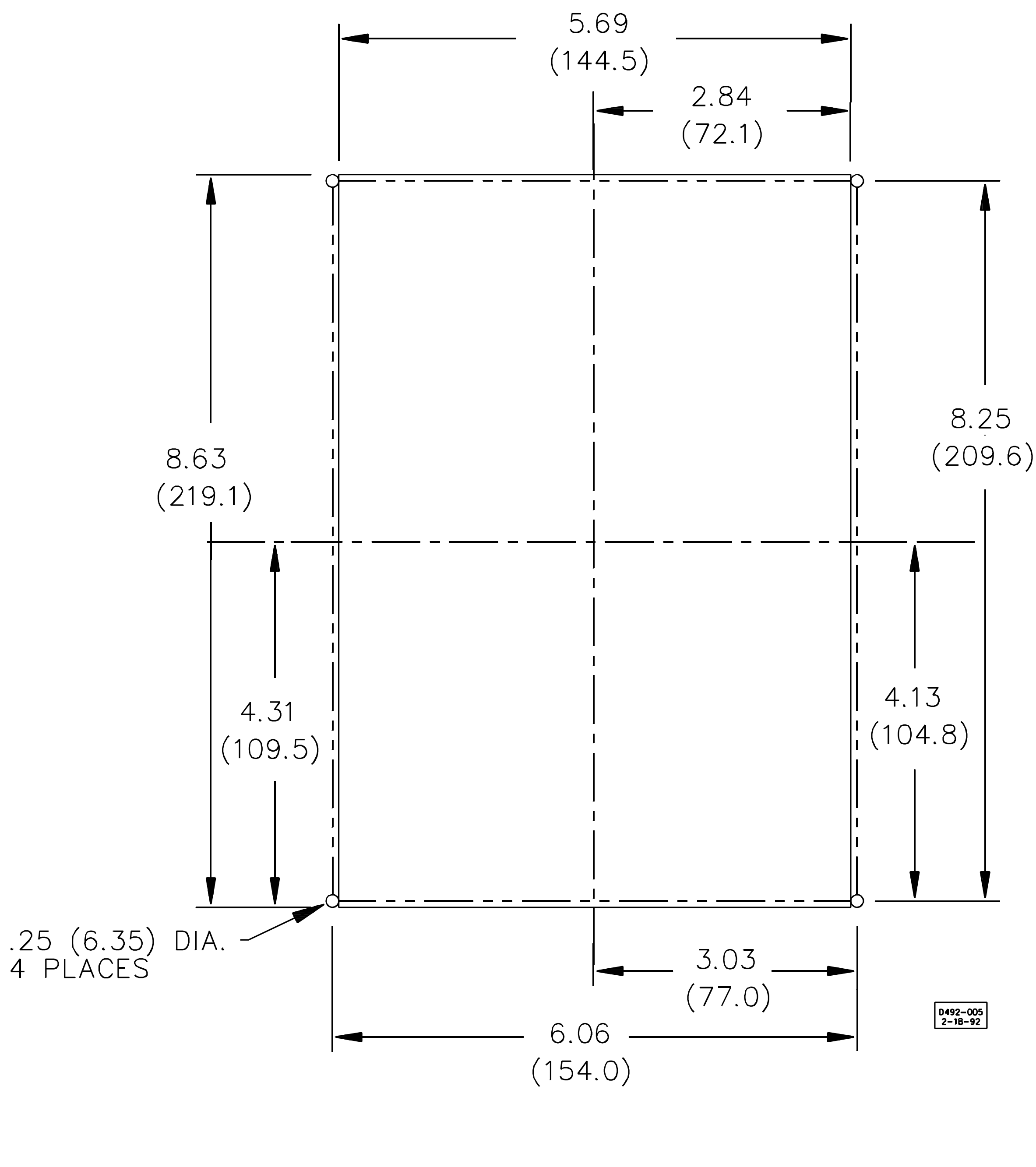


Figure 4-5. Panel Drilling Diagram (Flush Mounting)

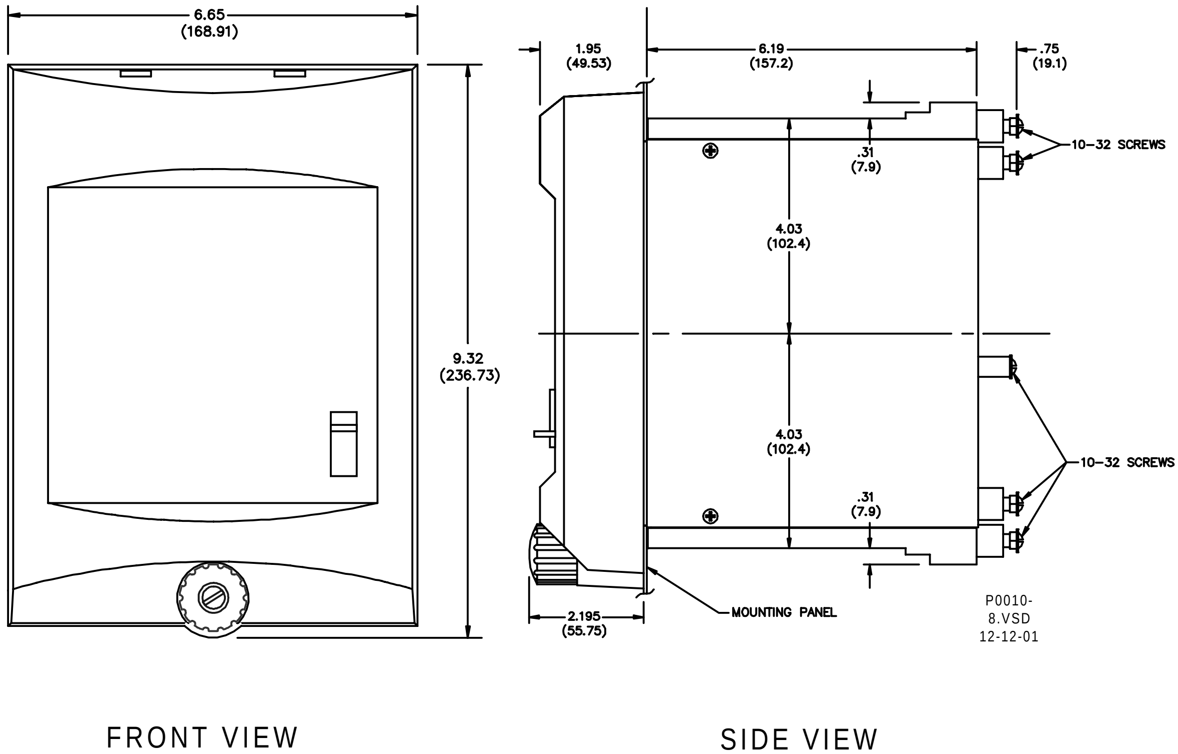


Figure 4-6. Outline Dimensions (Flush Mounting)

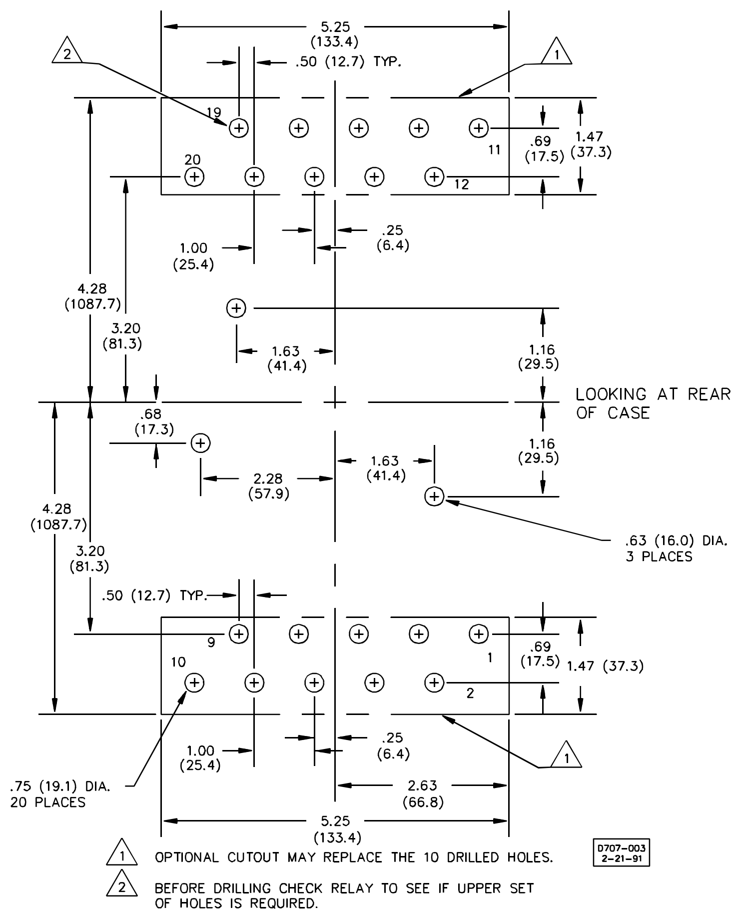


Figure 4-7. Panel Drilling Diagram (Projection Mounting)

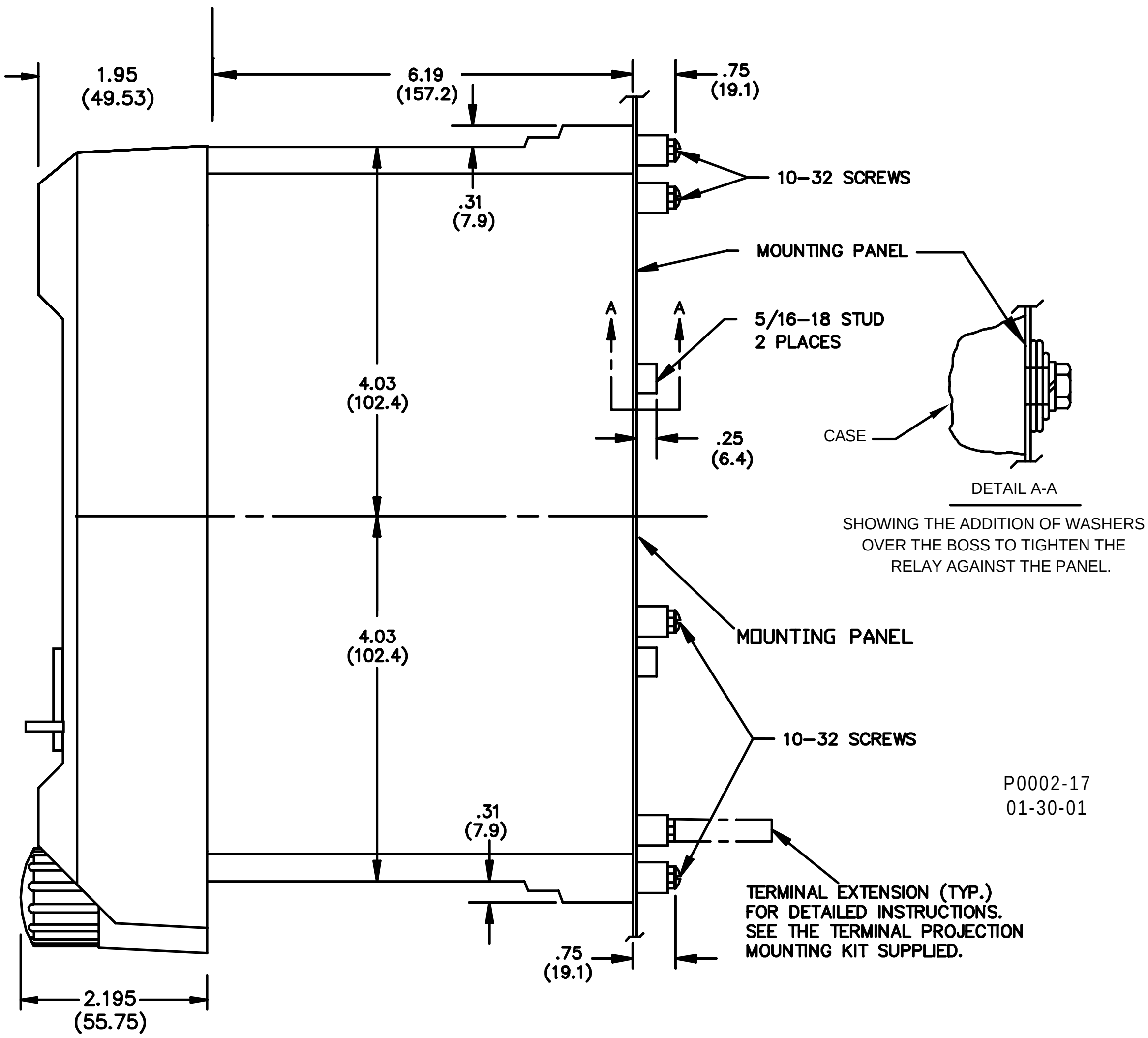


Figure 4-8. Outline Dimensions (Projection Mounting)

SECTION 5 • MAINTENANCE

GENERAL

BE1-59N Ground Fault Overvoltage Relay requires no preventive maintenance other than a periodic operational test (refer to Section 4 for operational test procedure). If the relay fails to function properly, and in-house repair is contemplated, consult the Service Manual (publication number 9 1714 00 620). If factory repair is desired, contact the Customer Service Department of the Power Systems Group, Basler Electric, for a return authorization number prior to shipping.

IN-HOUSE REPAIR

In-house replacement of individual components may be difficult and should not be attempted unless appropriate equipment and qualified personnel are available.

CAUTION

Substitution of printed circuit boards or individual components does not necessarily mean the relay will operate properly. Always test the relay before placing it in operation.

If in-house repair is to be attempted, component values may be obtained from the schematics or the parts list of the Service Manual. Replacement parts may be purchased locally. The quality of replacement parts must be at least equal to that of the original components.

Where special components are involved, Basler Electric part numbers may be obtained from the number stamped on the component or assembly, the schematic, or parts list. These parts may be ordered directly from Basler Electric. 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.

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

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

The test plug consists 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 6 • MANUAL CHANGE INFORMATION

MANUAL CHANGE INFORMATION

Table 6-1. Changes in this manual are summarized below.

Revision	Summary of Changes
E/15652	Updated Power supply information in the style chart on page 1-3 and in the example on 1-2. Updated pickup voltage ranges and accuracies on page 1-4. Updated power supply description paragraphs on page 3-3. Updated unit case covers on pages 4-9 and 4-10. Updated drawings of front cover to show the new pushbutton switches instead of the thumbwheel switches.
D/13079	New style chart (new option 1-2 and expanded option 1-1). Restructured the entire manual to conform with manual updates.
C/11591	Page 1-4: Accuracy specification for the Definite Timing Characteristic was clarified and upgraded. Output contact spec. updated.
B/10222	New timing option, F7, incorporated in manual. Page 2-3: K was clarified for the various options.
A/9248	Page 1-4: Accuracy specification for the Inverse Timing Characteristic was clarified and upgraded.

Basler Electric
ROUTE 143, BOX 269
HIGHLAND, IL 62249 USA
http://www.basler.com, info@basler.com
PHONE 618-654-2341 FAX 618-654-2351