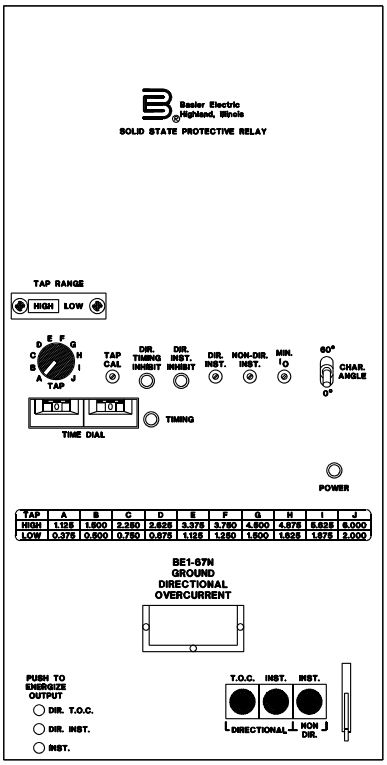
INSTRUCTION MANUAL

FOR

BE1-67N

GROUND DIRECTIONAL OVERCURRENT RELAY



TAP	A	B	C	D	E	F	G	H	I	J
HIGH	1.125	1.500	2.250	2.625	3.375	3.750	4.500	4.875	5.625	6.000
LOW	0.375	0.500	0.750	0.875	1.125	1.250	1.500	1.625	1.875	2.000

Basler Electric

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INTRODUCTION

This manual provides information concerning the operation and installation of the BE1-67N Ground Directional Overcurrent Relay. To accomplish this, the following is provided.

- **Specifications**
- **Functional description**
- **Mounting information**
- **Setting procedure/example.**

A Service Manual, publication 9 1907 00 620, is available on special order as an aid in troubleshooting and repair.

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.

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SECTION 1

GENERAL INFORMATION

PURPOSE

BE1-67N Ground Directional Overcurrent Relays provide ground fault protection for transmission and distribution lines by sensing the flow of ground (zero sequence) current into or out of protected zones. Zero sequence quantities provide a secure reference for the directional element because these quantities are defined by the total source impedance of the power system.

APPLICATION

BE1-67N Ground Directional Overcurrent Relays are recommended for multigrounded systems to provide coordination necessary to selectively trip the faulted line. A directional overcurrent relay operates by comparing the measured current to a reference quantity to determine whether current is flowing into or out of the protected zone. Reference quantity is also referred to as polarizing quantity.

BE1-67N relays use one of the following quantities for polarization :

- Zero sequence current
- Zero sequence voltage
- Dual zero sequence current and voltage

The polarizing quantity is field selectable using a switch mounted on the analog circuit board.

Zero Sequence Current

Zero sequence current polarization is preferred for applications with low ground source impedance. Refer to Figure 1-1 for relay connections that obtain zero sequence current ($3I_O$) from a separate current transformer in the grounded neutral of a two winding wye-delta power transformer. Refer to Figure 1-2 for relay connections that obtain zero sequence current from a current transformer(s) in the grounded neutral(s) of a three winding transformer. The magnitude of the zero sequence current used for polarizing may be different from that of the ground current seen by the measuring element(s) of the relay.

Zero Sequence Voltage

Zero sequence voltage polarization is preferred for higher ground source impedances. Refer to Figures 1-1 and 1-2 for relay connections that obtain zero sequence voltage ($3V_O$) from a set of grounded wye-broken delta voltage transformers. The voltage polarized relay has a directional polarization adjustment to match the impedance angle of the protected line to the characteristic angle of the relay. This is the angle about which the directional angle is centered. A choice of line angles allows the relay to be adjusted to include the resistance component of the ground fault.

Dual Zero Sequence Current and Voltage

Dual polarization is preferred where ground source impedance varies, or to provide redundant polarization. Dual polarization is achieved using a polarizing signal which is the phasor sum of the current and voltage polarizing signals.

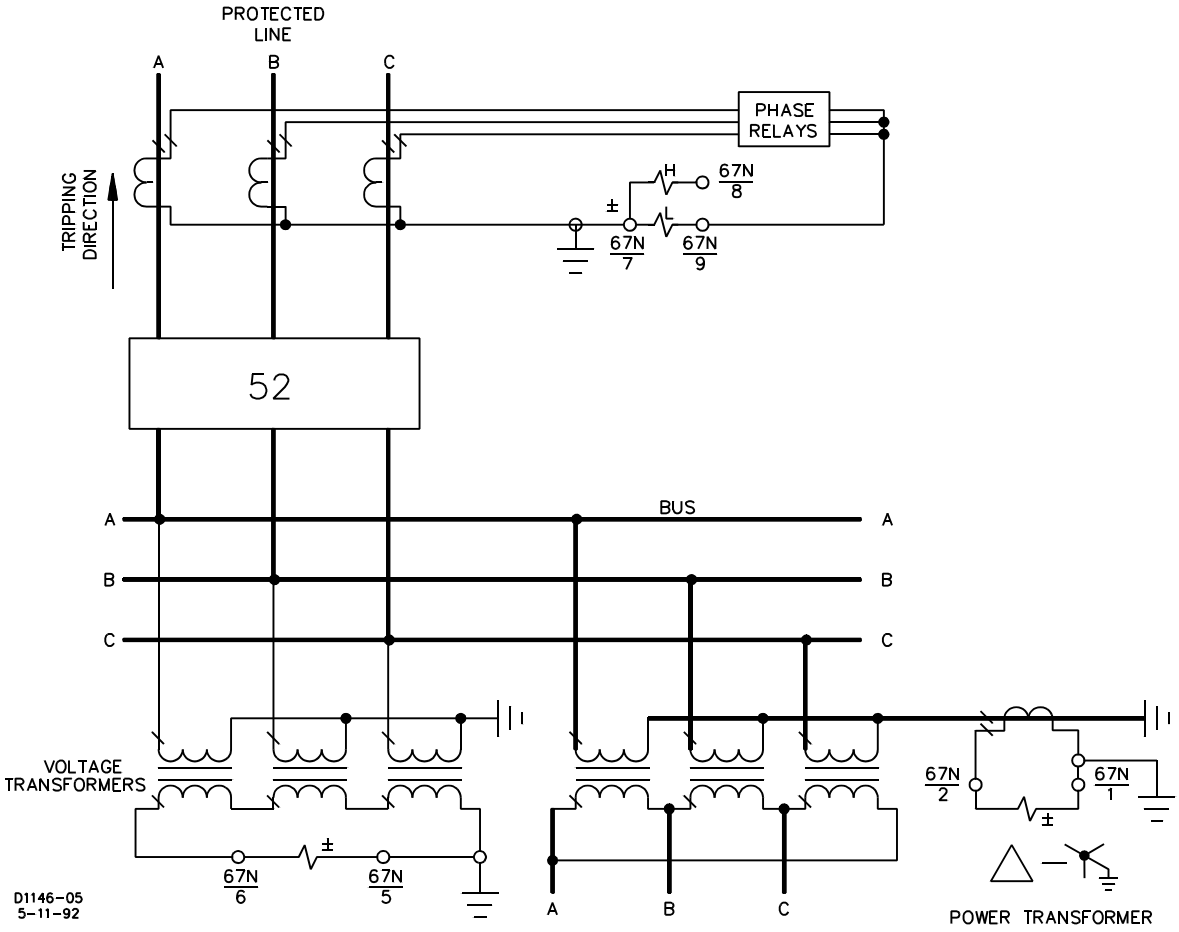

Figure 1-1. Zero Sequence Polarizing (Two Winding Transformer)

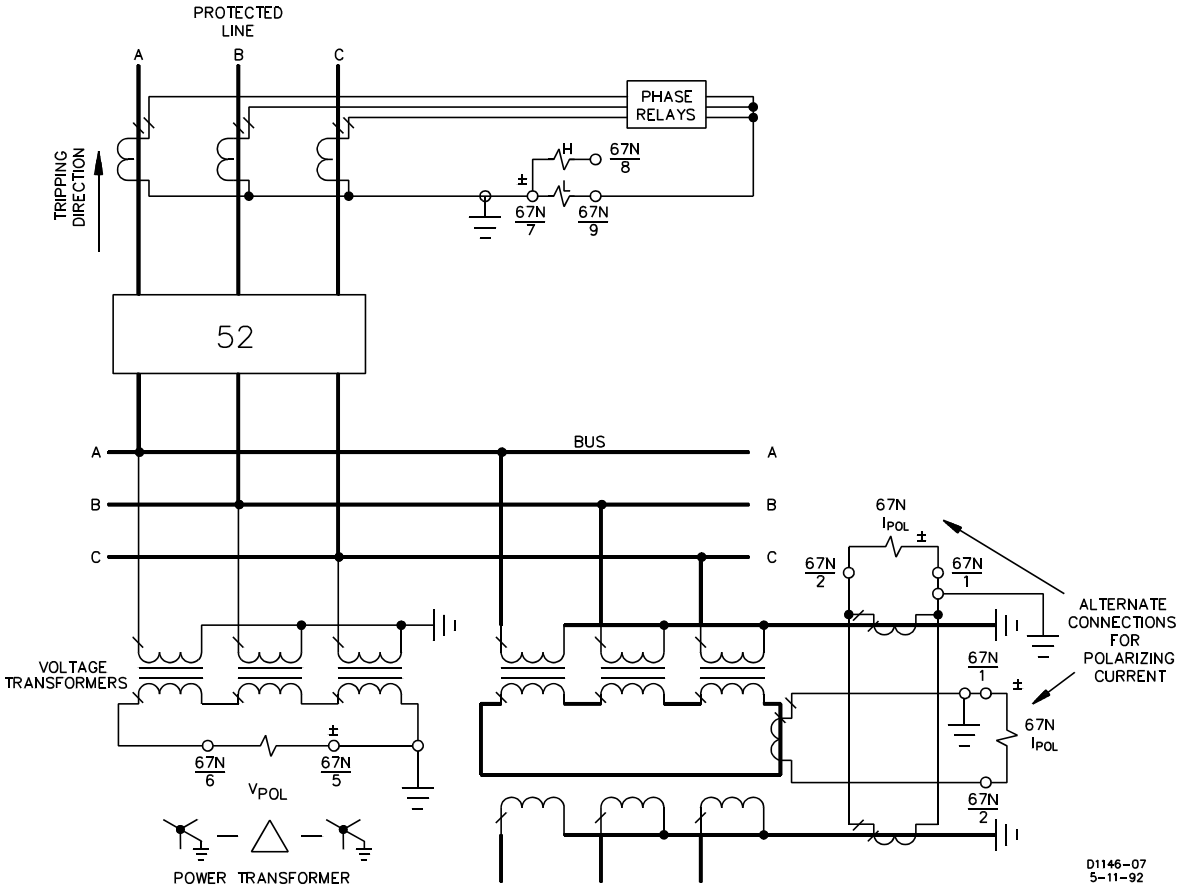

Figure 1-2. Zero Sequence Polarizing (Three Winding Transformer)

OUTPUT CONTACTS

BE1-67N relays have the following output contacts: relay status alarm (relay fail), tripping, and auxiliary (optional).

Relay Status Alarm

A relay status alarm output contact (relay fail) indicates that proper voltages are not being supplied to the internal relay circuitry or that the microprocessor self-diagnostics has detected an error. This alarm output contact is normally closed.

Tripping

Normally open or normally closed tripping contacts are included for each function within the relay. Configuration of these contacts are defined by the relay style number. These output contacts are used with optionally selected target indicator circuits.

Auxiliary

Normally open, normally closed, or single pole double throw (SPDT) auxiliary contact configurations are provided to act in parallel with the tripping function(s) of the relay. Configuration of the auxiliary output contacts are also defined by the relay style chart.

An auxiliary contact can be configured (via internal switches) to operate in parallel with any combination of tripping outputs. Configurable auxiliary outputs permit use of the BE1-67N relay in various carrier schemes.

PUSH-TO-ENERGIZE

A push-to-energize pushbutton is included for each tripping output contact. These pushbuttons provide a means of verifying the correct operation of external control circuit wiring without the need to supply test signals to the relay. Control power must be applied for this function to operate. The pushbuttons are recessed behind the relay front panel and are not accessible with the cover installed.

TARGETS

One target is included for each tripping function as specified by style number. Targets are operated either by the internal signal initiating tripping (internally operated) or by a minimum of 0.2 amperes (dc) flowing through the series circuit consisting of the target coil and output relay contacts (current operated). Within a specific relay, all targets must be operated the same way.

POWER SUPPLY OPTIONS

Various power supply options are available to allow the BE1-67N relay to be used with standard supply voltages. See the Style Chart for details.

POWER-UP DELAY

A power-up delay timer is initiated upon application of control power to the relay to prevent undesired contact transitions when sensing signals are present. Operation of measuring circuits and output circuits are inhibited (less than 0.5 seconds) until the power-up delay period has expired.

MODEL AND STYLE NUMBER

Electrical characteristics and operational features included in a specific relay are defined by a combination of letters and numbers that makes up the style number. Refer to Figure 1-3 for the Style Number Identification Chart. 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. Model number BE1-67N designates the relay as a Basler Electric, Class 100, Ground Directional Overcurrent Relay.

Style Number Example

Electrical characteristics and operational features in BE1-67N relays are identified by the style number. For example, if the style number were **A1E Z2J B4C0F** the device would have the following features and options.

BE1-67N Model Number
- **A** Zero sequence current, voltage, or dual polarized
- **1** 0.25 to 6.0 A sensing range (60 Hz)
- **E** Normally open output contacts
- **Z2** Switch selectable timing characteristics
- **J** Operating power derived from 125 Vdc or 100/120 Vac
- **B** Current operated targets
- **4** Two instantaneous elements (directional and non-directional)
- **C** Push-to-energize outputs (pushbuttons)
- **0** No auxiliary output contacts
- **F** Semi-flush mounting

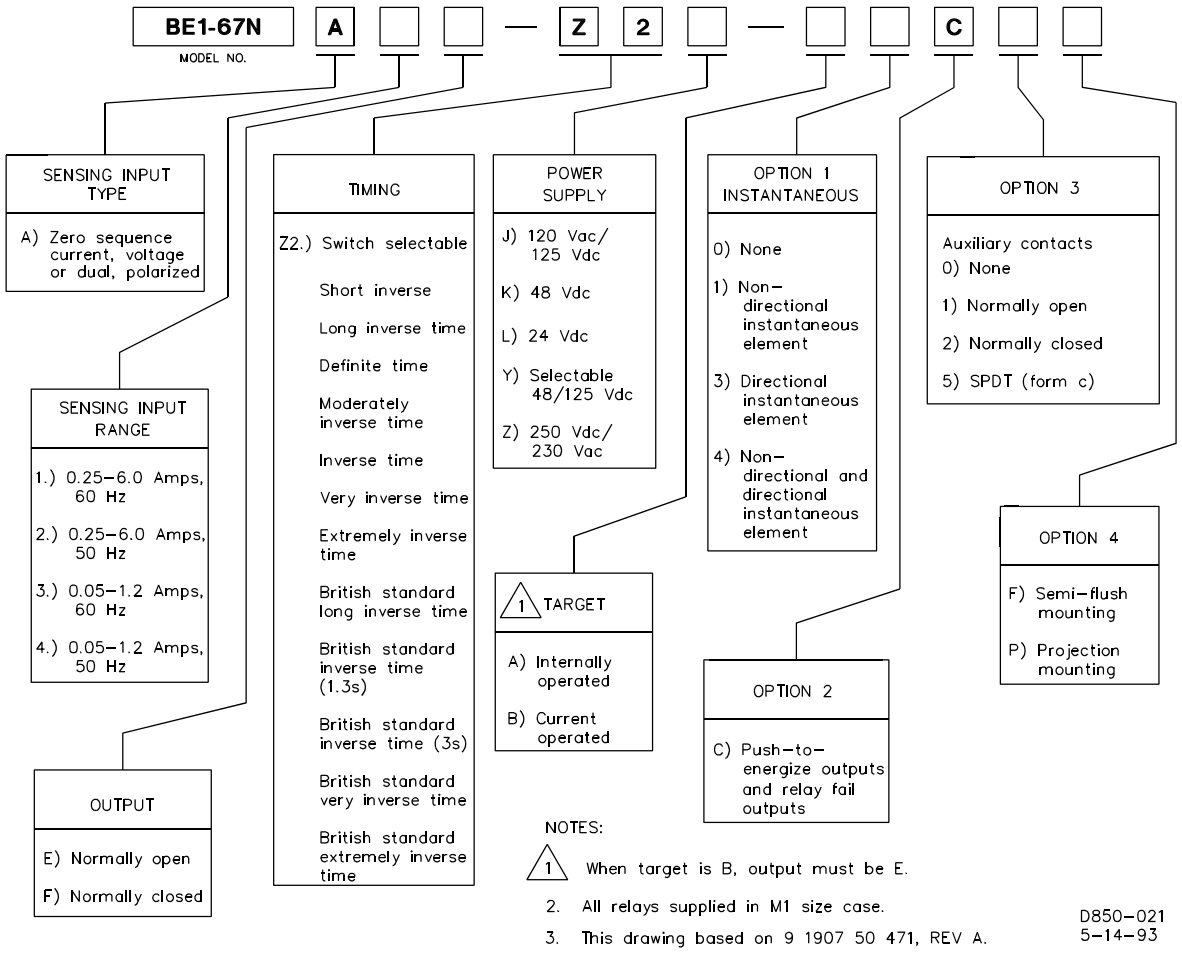

Figure 1-3. Style Number Identification Chart

SPECIFICATIONS

Current Sensing (I_{OP})

Inputs

Pickup adjustment range is:

0.25 - 6.0 amperes for sensing input ranges 1 and 2.
0.05 - 1.2 amperes for sensing input ranges 3 and 4.

Refer to Table 1-1 for maximum current carrying capacities.

Table 1-1. Maximum Current Capacities

Current	Sensing Input Range	
	1 and 2	3 and 4
Continuous	7.5 amp	1.5 amp
5 min	20 amp	4 amp
1 sec	150 amp	30 amp

Burden	Burden is less than 0.1 ohm.

Frequency

The relay is designed to operate on power systems with a nominal frequency of either 50 or 60 hertz. The relay has been type-tested for proper operation over the frequency range of 45 to 55 hertz for 50 hertz systems and 55 to 65 hertz for 60 hertz systems.

Polarizing Current (I_O)

Input	Current polarizing inputs are rated for:
	Continuous current - 10 amperes
	One second current - 150 amperes
Minimum Sensing Level	*Directional instantaneous* - Front panel adjustable 0.75 to 2.0 amperes.
	Time Overcurrent - 0.2 ampere.
Burden	Burden is less than 0.1 ohm.

Polarizing Voltage (V_O)

Input	Maximum polarizing voltage (line-to-neutral) is:
	Continuous - 240 Vac
	One second - 360 Vac
Minimum Sensing Level	*Directional instantaneous* - 4.0 volts
	Time Overcurrent - 0.75 volts
Burden	Burden is less than 0.1 ohm.
Operating Region	Operating region is ± 75° (150° window) centered about the characteristic angle.
Harmonic Sensitivity	Polarizing voltage is not affected by third or higher harmonics.
Characteristic Angle	Characteristic angle is switch selectable to 0 or 60°. Characteristic angle accuracy is ±5° for V_O inputs below 30 volts and ±10° for V_O inputs greater than 30 volts.
Directional Closing Band	Directional closing band is ± 75° centered about the characteristic angle.

Directional Unit

Response Time	Within 15 milliseconds to change in direction and magnitude.
Repeatability	Set angles are repeatable within ± 3% or 1°, whichever is greater.

Time Overcurrent

Pickup Range	Pickup settings for the time overcurrent element are:

0.25 to 6 amperes for sensing input ranges 1 and 2.
0.05 to 1.2 amperes for sensing input ranges 3 and 4.

Time Overcurrent - Continued

Pickup Accuracy — Within ± 2% of the expected value established by TAP selector switch with the intertap adjustment at its maximum clockwise setting.

Repeatability — Repeatability of pickup setting (combination of TAP selector switch and intertap adjustment) is ± 2%.

Response Time Accuracy — Within ± 5% of the time value indicated on the characteristic time curve or 25 milliseconds, whichever is greater.

Operate Time Repeatability — Operate time is repeatable within ± 2% or 25 milliseconds, whichever is greater.

Instantaneous Overcurrent

Pickup Range — Pickup settings for the non-directional and directional instantaneous elements are:

2 to 100 amperes for sensing input ranges 1 and 2.
0.4 to 20 amperes for sensing input ranges 3 and 4.

Maximum Operating Times — Refer to Table 1-2 for instantaneous operate times for multiples of pickup.

Table 1-2. Maximum Operating Times

Multiple of Pickup (current)	Operate Times (milliseconds)
1.05	100
2.0	34
5.0	17

Pickup Accuracy — Pickup accuracy is within ± 5% of the defined pickup setting.

Repeatability — Repeatability of pickup setting is ± 5%.

Response Time — Within 25 milliseconds to a current reversal after fault inception.

Power Supply — Refer to Table 1-4 for power supply burden data.

Table 1-1. Burden (Nominal) Per Non-isolated Sensing Contact

Power Supply Type	K	J	L	Z
Nominal Burden Per Input	0.75 W	1.60 W	0.70W	2.20 W

NOTE: For type Y Power supply, use burden for type K or type J power supply depending on selected operating voltage.

Power for the internal circuitry may be derived from ac or dc external power sources. Refer to Table 1-3.

Table 1-3. Power Supplies

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal (Maximum)
K	48 Vdc	24 to 60 Vdc	6.5 W
J	125 Vdc 120 Vac	62 to 150 Vdc 90 to 132 Vac	10.0 W 20.0 VA
L+	24 Vdc	12 to 32 Vdc	5.5 W
Z	250 Vdc 230 Vac	140 to 280 Vdc 190 to 270 Vac	14.0 W 20.0 VA

NOTE: + Type L power supply may initially require 14 Vdc to begin operating. Once operating, the voltage may be reduced to 12 Vdc and operation will continue.

Output Circuits

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.

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 Indicator

A choice of either internally operated targets or current operated targets is available as specified by style number.

Internally operated targets use the internal trip signal to energize the output relay and target drivers. Current operated targets are energized by a minimum of 0.2 A flowing through the output contacts.

Isolation

1500 Vac at 60 hertz for one minute in accordance with IEC 255-5 and ANSI/IEEE C37.90-1989 (Dielectric Test).

Surge Withstand Capability

Qualified to C37.90.1-1989 and IEC 255-5.

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.

Temperature

Operating Range
-40°C (-40°F) to 70°C (158°F)

Storage Range
-65°C (-85°F) to 90°C (194°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.

Case Size M1.

Weight 18 pounds maximum.

CHARACTERISTIC CURVES

Sample curves for the time overcurrent functions are provided in the following graphs. A six digit drawing number -- i.e., 99-0932 -- is provided with each graph. Use this drawing number to order a full-size (10 inch by 12 inch) chart from Basler Electric Company. Table 1-3 lists the characteristic curve style, drawing number, and characteristic description for each position of the characteristic curve selector switch.

Table 1-3. Characteristic Curves and Switch Positions

Switch Position	Characteristic Curve	Characteristic Description	Drawing Number
3	B1	Short Inverse	99-0932
1	B2	Long Inverse	99-0931
5	B3	Definite	99-0933
2	B4	Moderately Inverse	99-0930
4	B5	Inverse	99-0929
6	B6	Very Inverse	99-0928
7	B7	Extremely Inverse	99-0927
8	E2	Long Inverse (BS 142)	99-1093
9	E4	Inverse (1.3 Sec.) (BS 142)	99-1094
A	E5	Inverse (2.9 Sec.) (BS 142)	99-1095
B	E6	Very Inverse (BS 142)	99-1096
C, D, E, F	E7	Extremely Inverse (BS 142)	99-1097

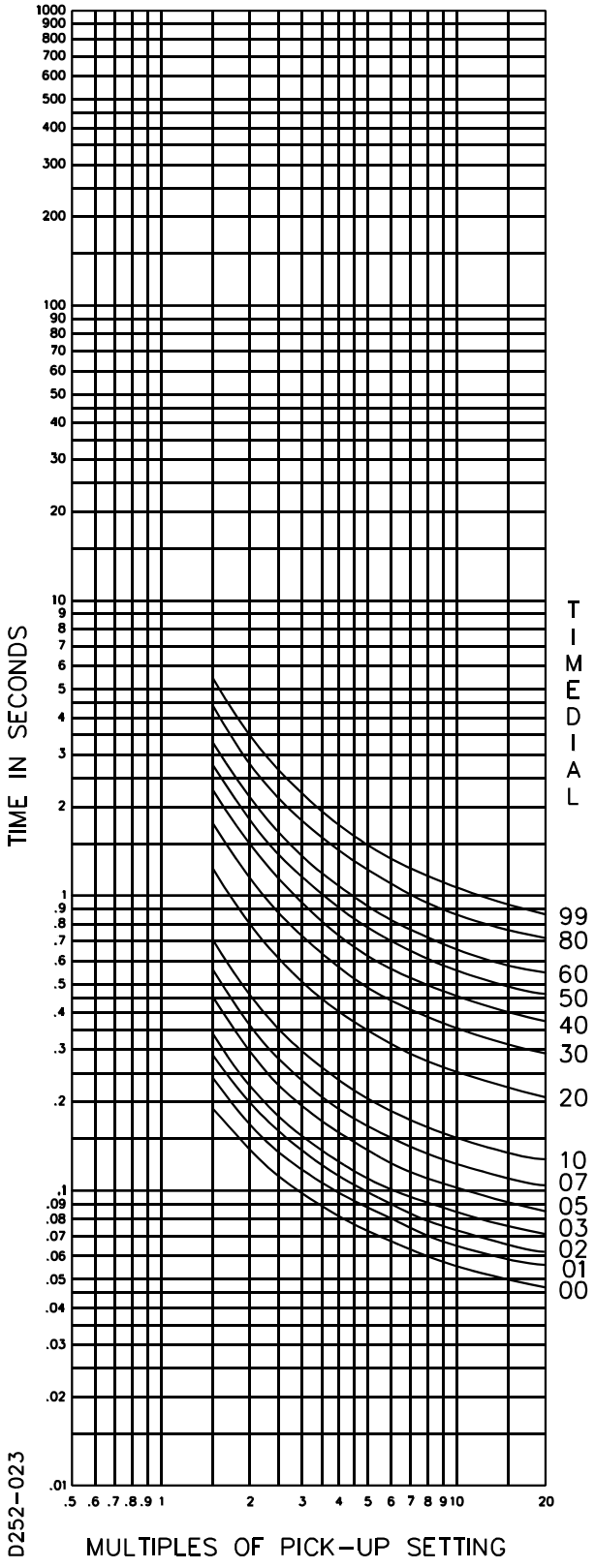

Figure 1-4. Timing Type B1 - Short Inverse (Drawing Number 99-0932)

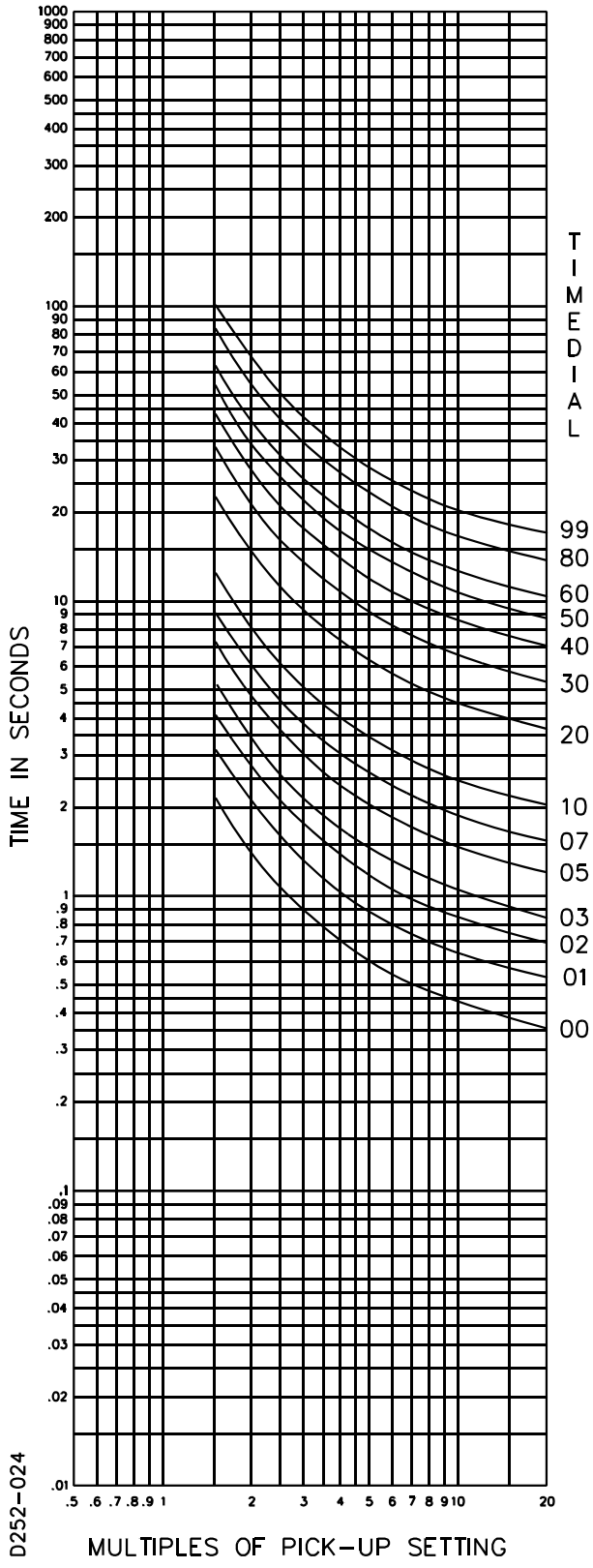

Figure 1-5. Timing Type B2 - Long Inverse (Drawing Number 99-0931)

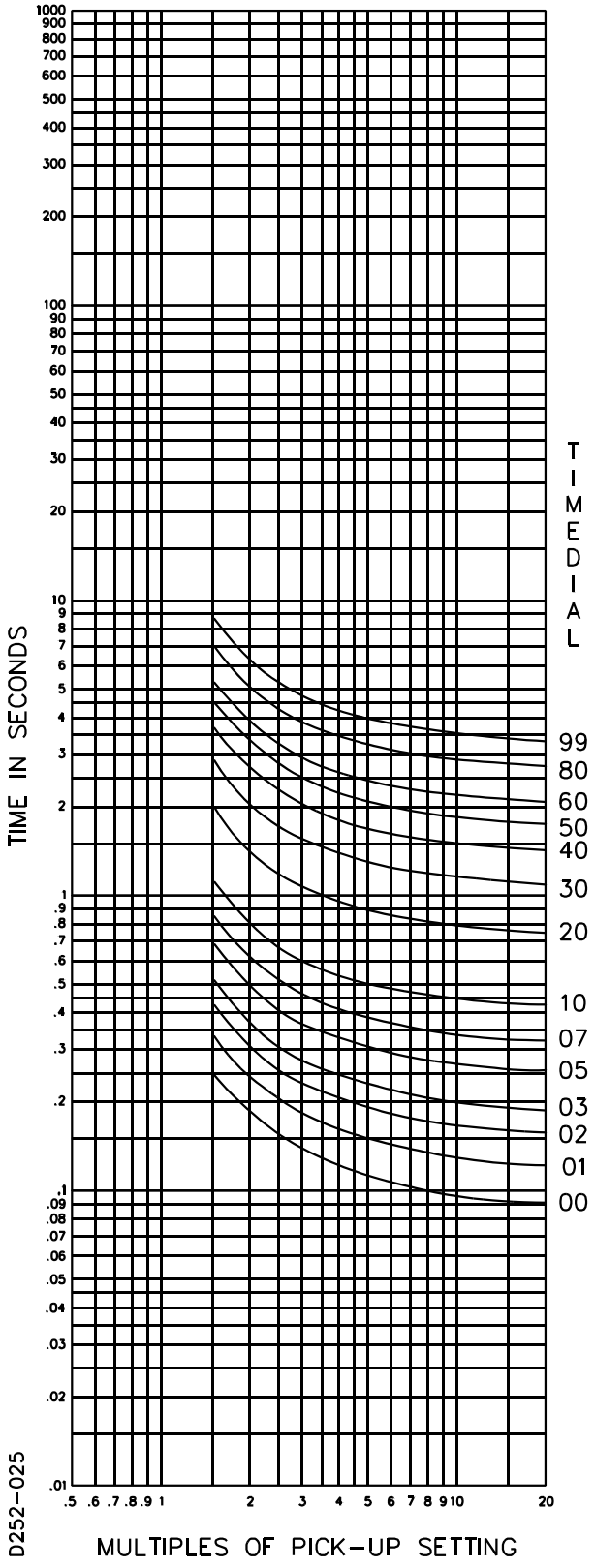

Figure 1-6. Timing Type B3 - Definite Time (Drawing Number 99-0933)

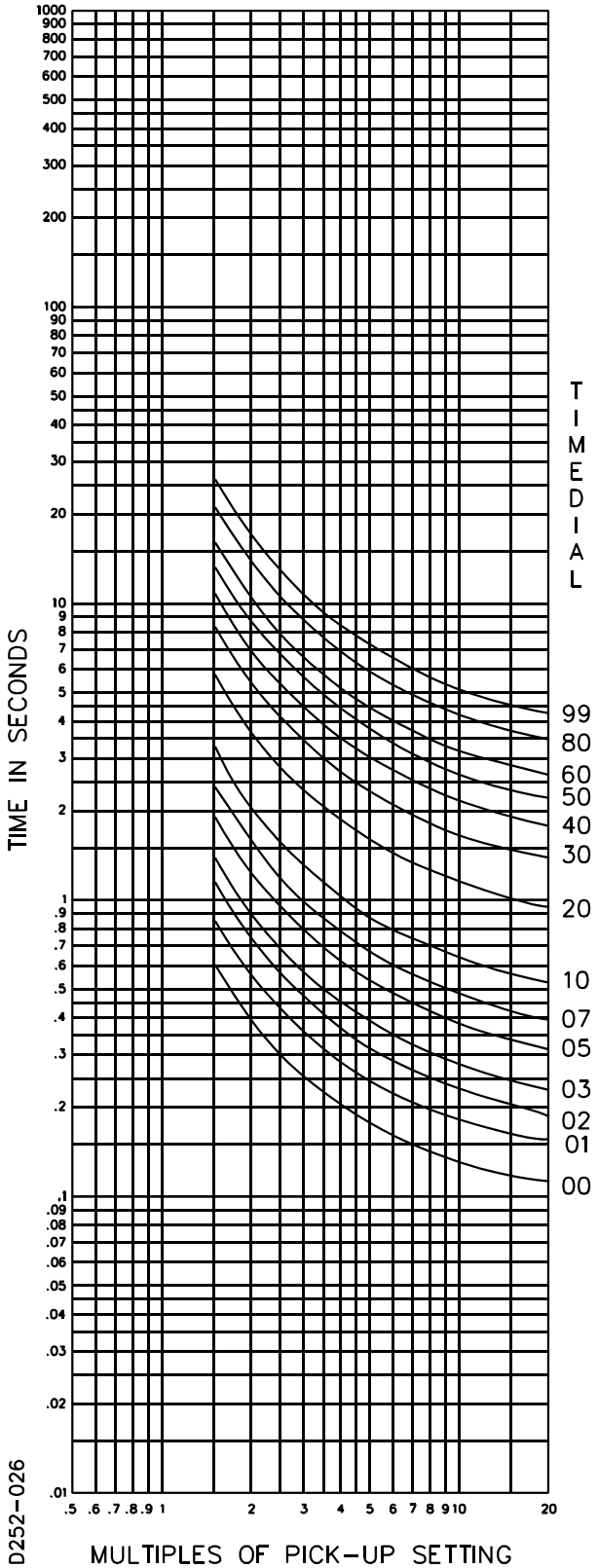

Figure 1-7. Timing Type B4 - Moderate Inverse (Drawing Number 99-0930)

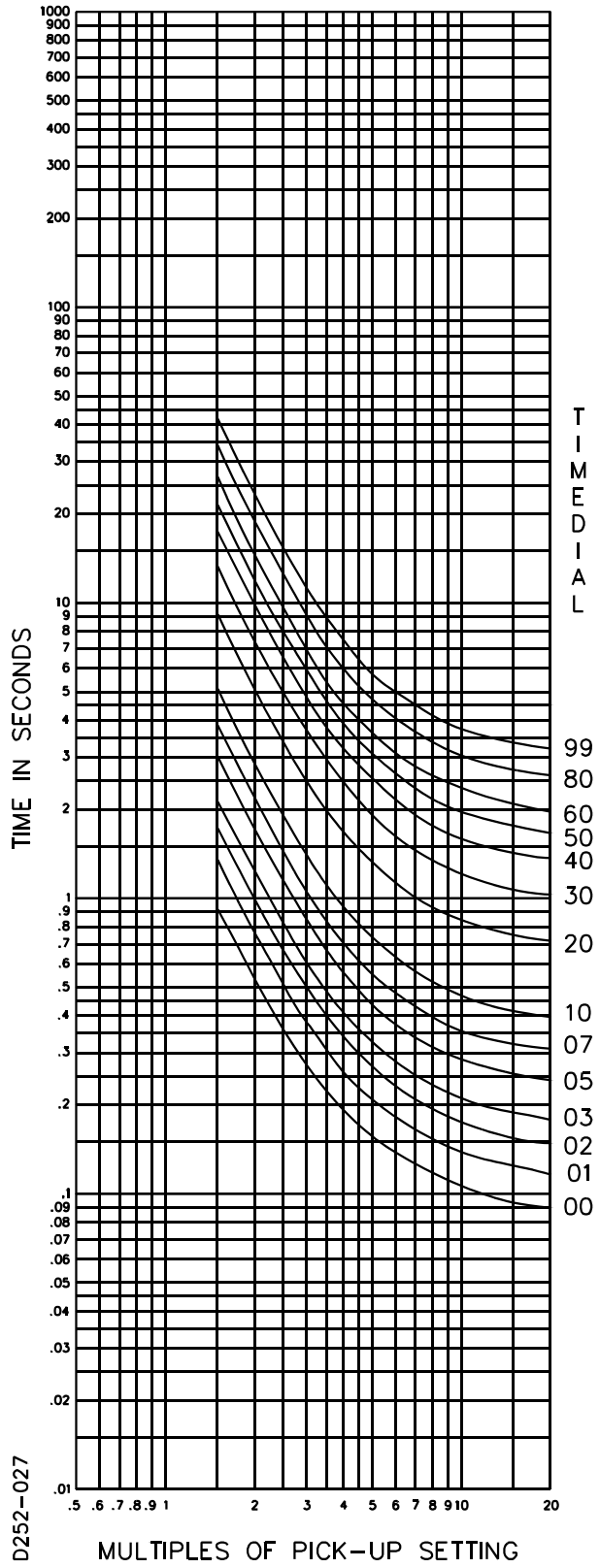

Figure 1-8. Timing Type B5 - Inverse
(Drawing Number 99-0929)

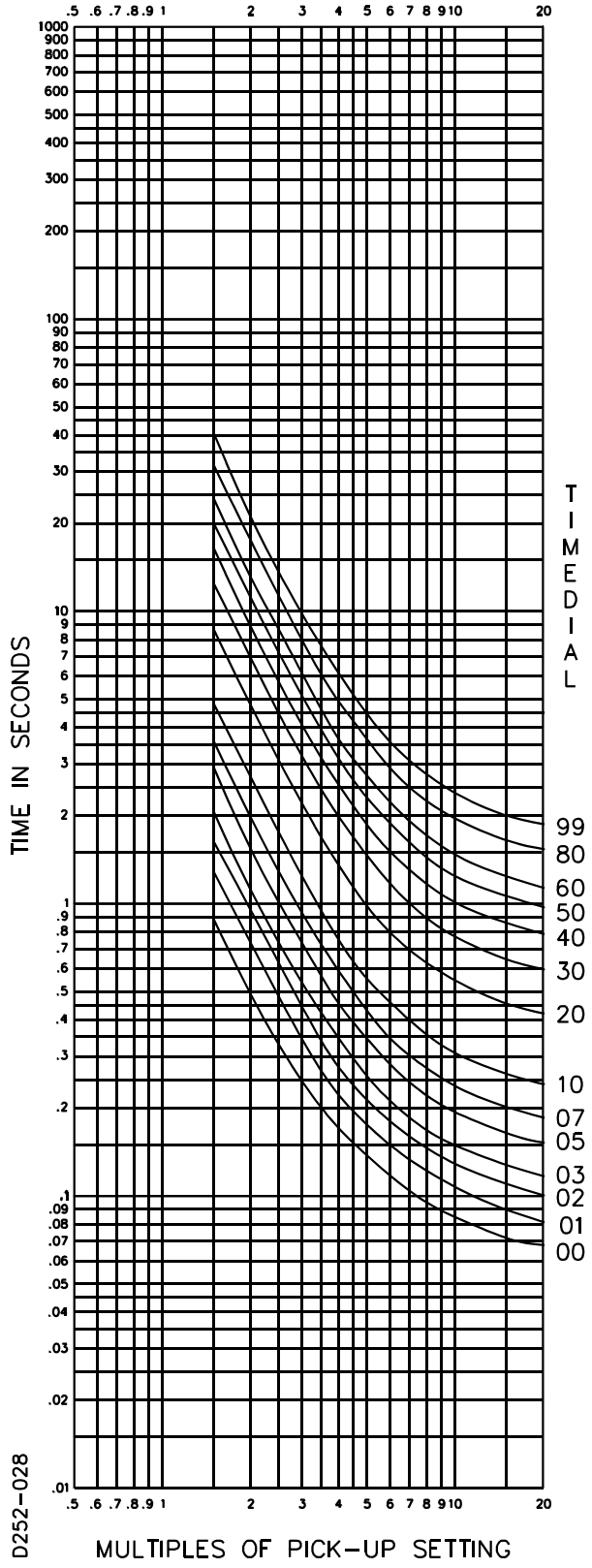

Figure 1-9. Timing Type B6 - Very Inverse (Drawing Number 99-0928)

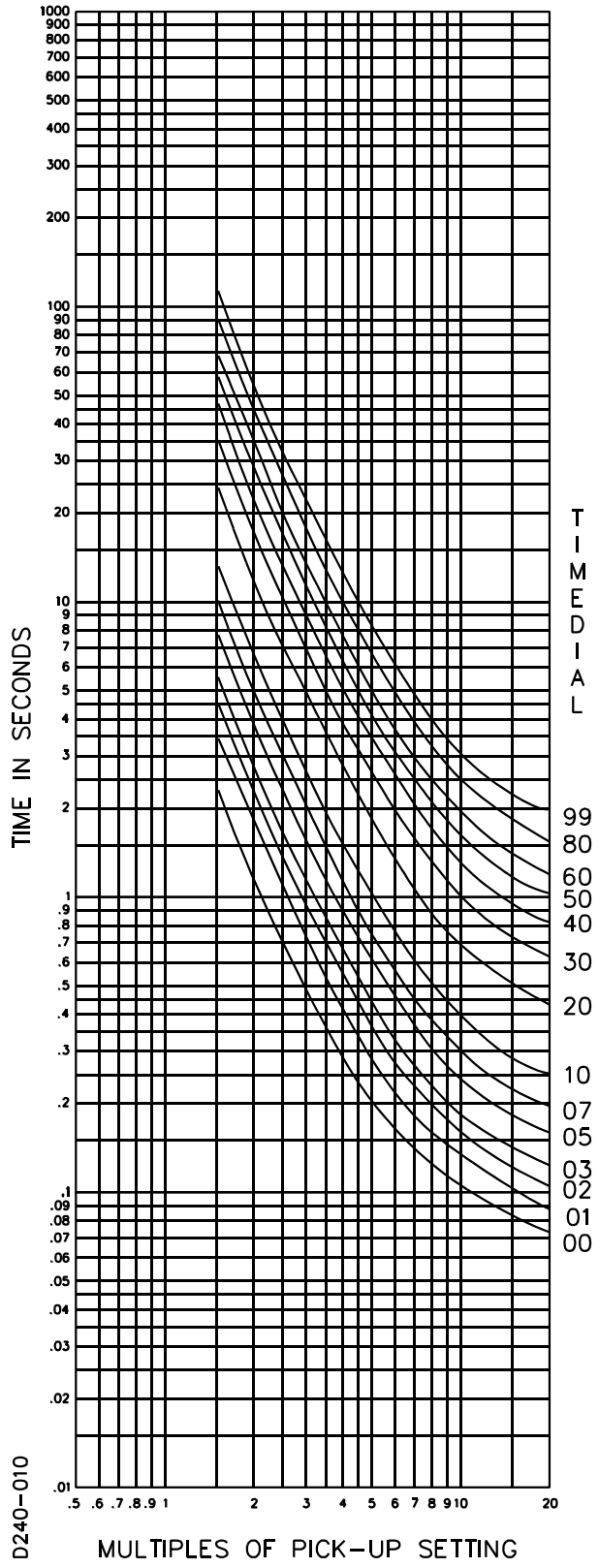

Figure 1-10. Timing Type B7 - Extremely Inverse (Drawing Number 99-0927)

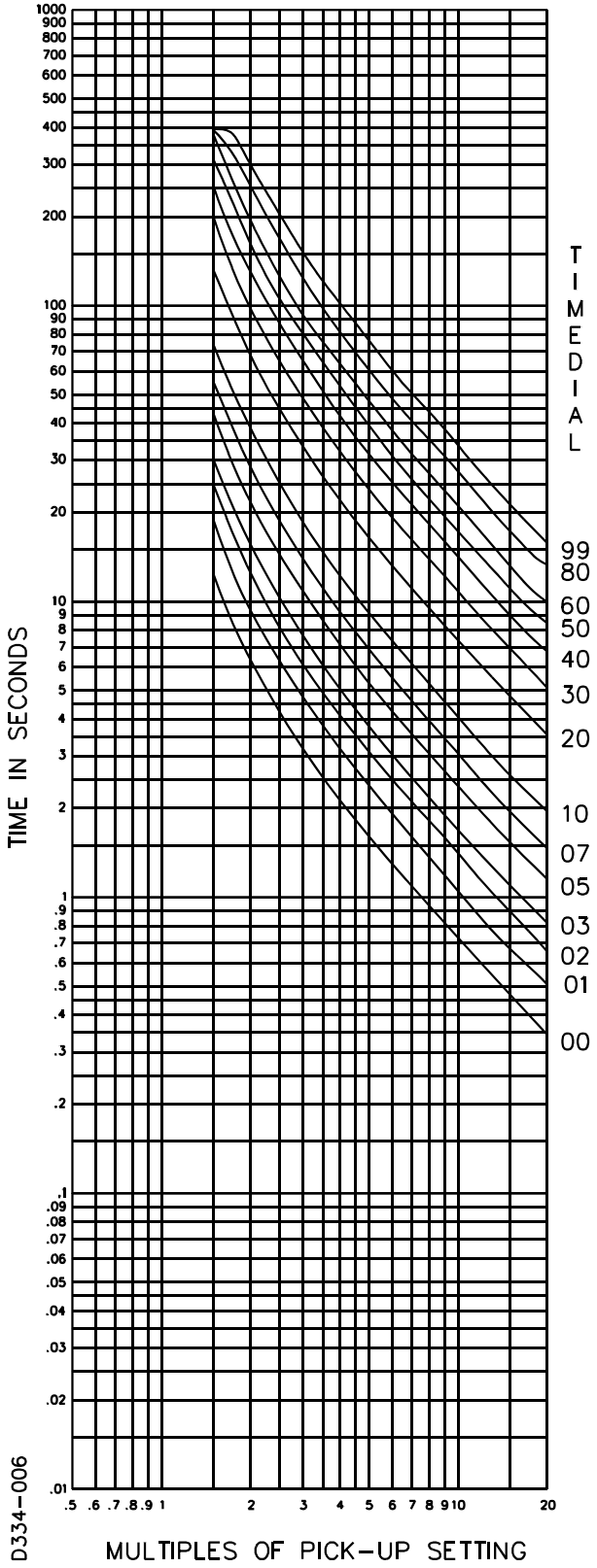

Figure 1-11. Timing Type E2 - BS-142 Long Inverse (Drawing Number 99-1093)

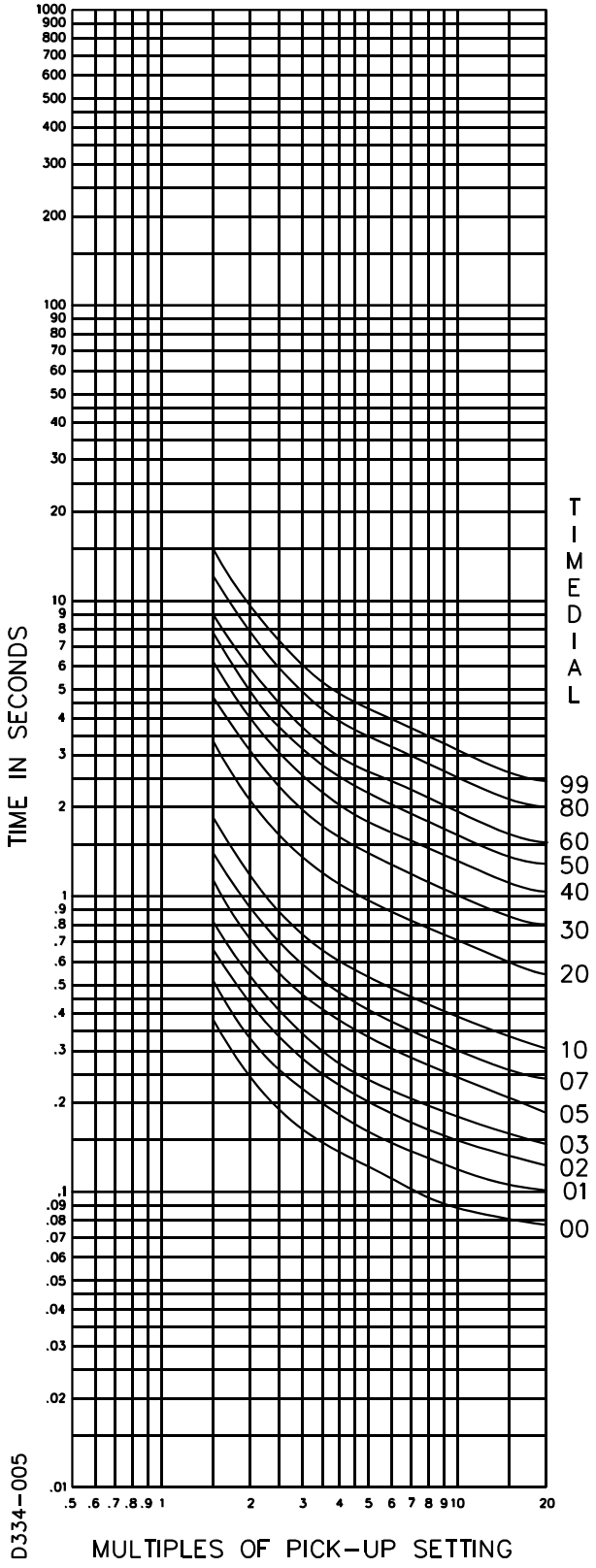

Figure 1-12. Timing Type E4 - BS-132 Inverse (Drawing Number 99-1094)

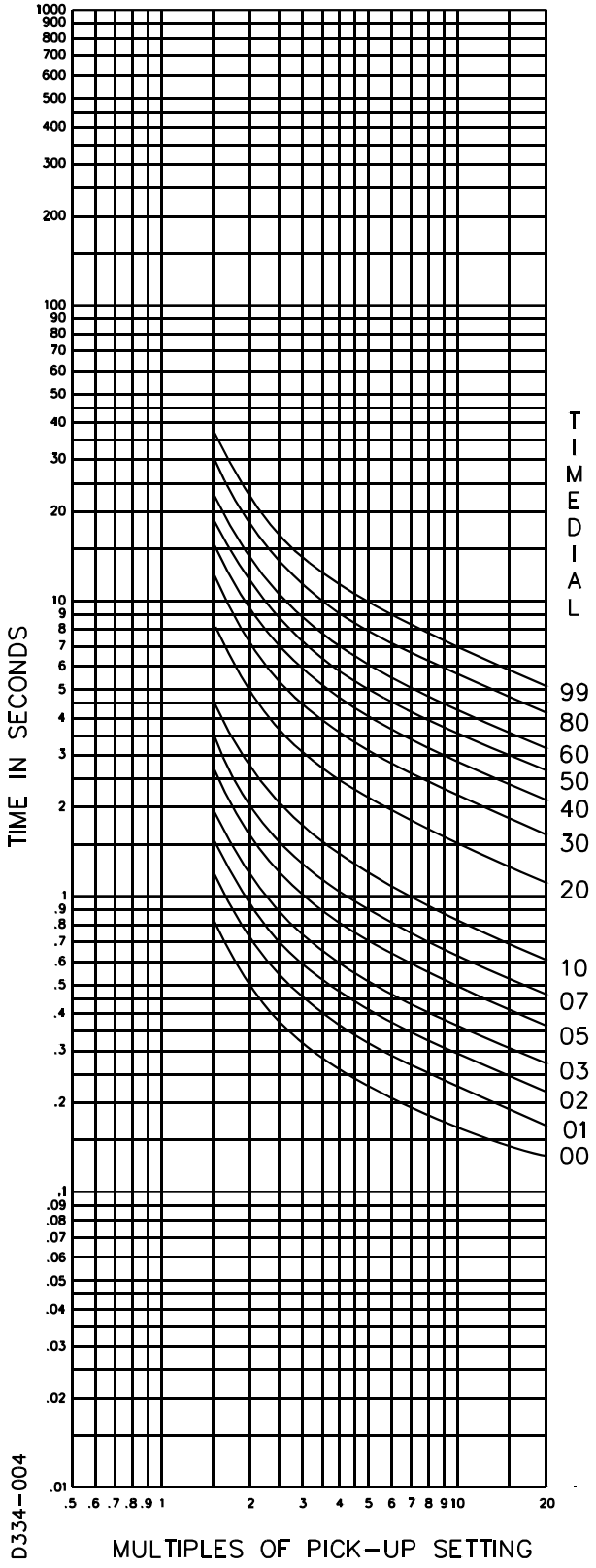

Figure 1-13. Timing Type E5 - BS-142 Inverse (Drawing Number 99-1095)

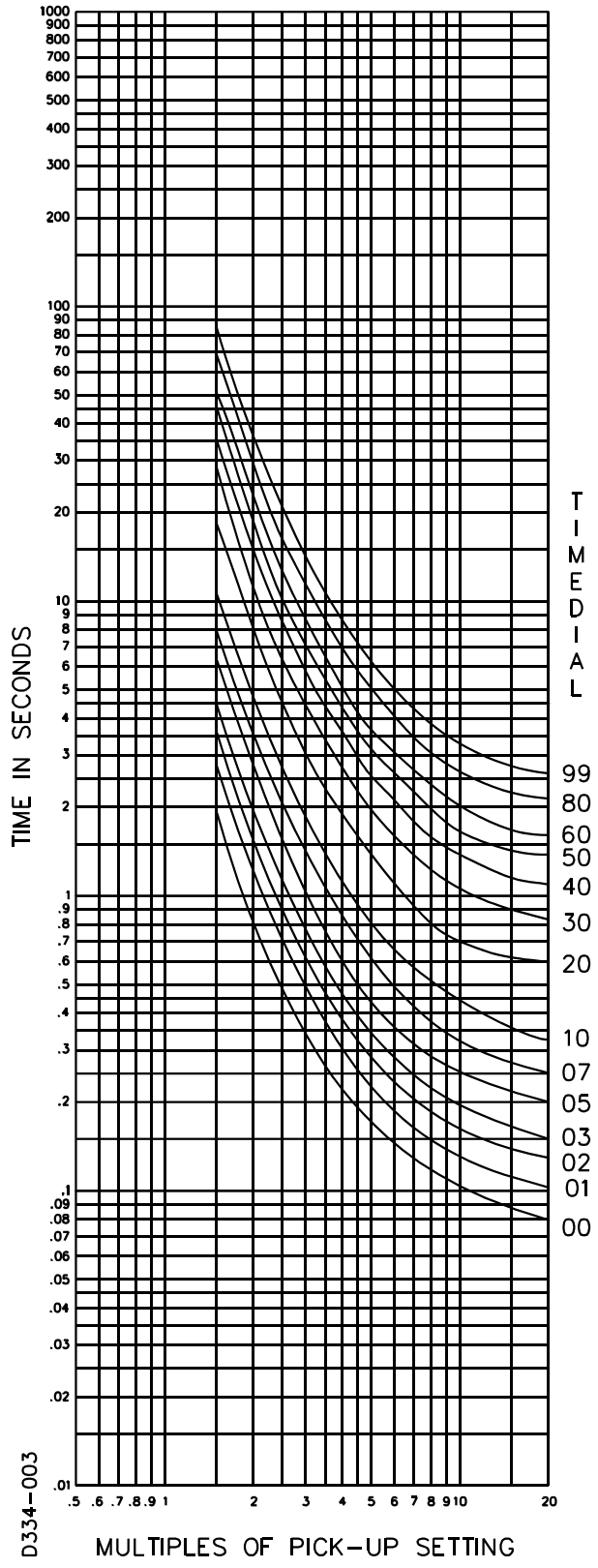

Figure 1-14. Timing Type E6 - BS-142 Very Inverse (Drawing Number 99-1096)

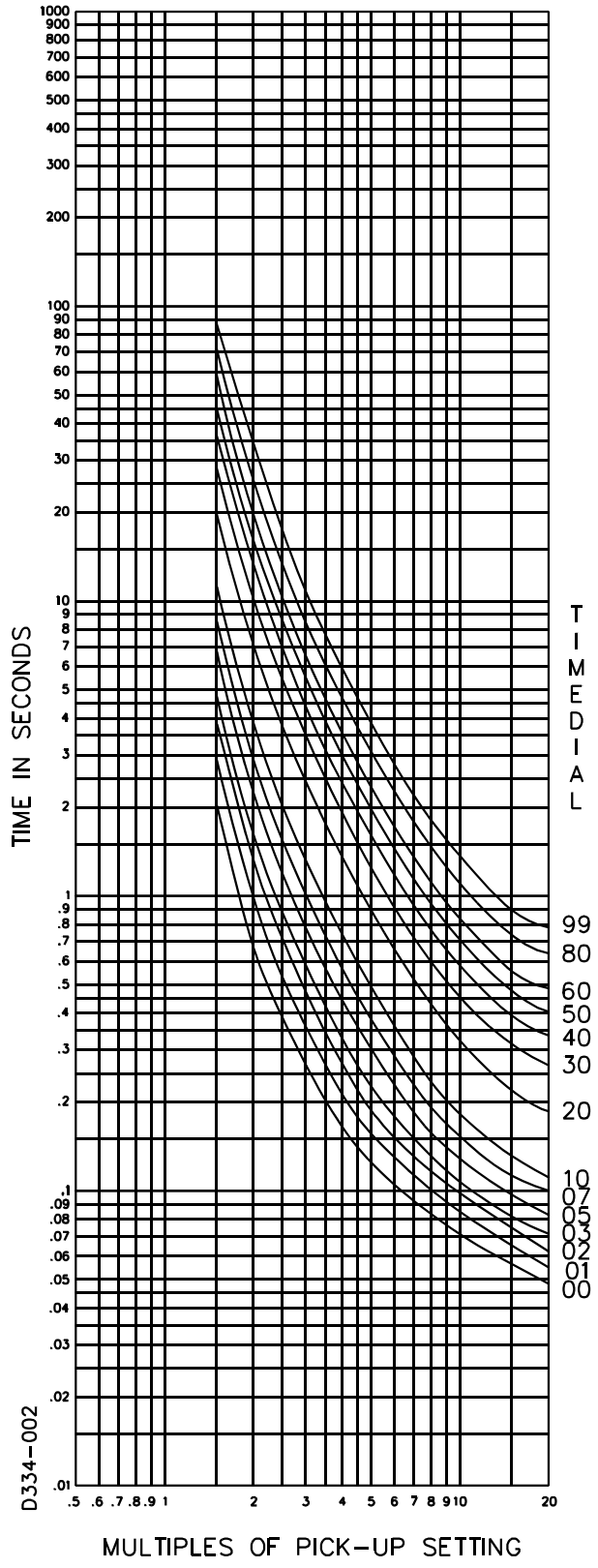

Figure 1-15. Timing Type E7 - BS-142 Extremely Inverse (Drawing Number 99-1097)

SECTION 2

CONTROLS AND INDICATORS

Table 2-1. BE1-67N Controls and Indicators (Refer to Figures 2-1 through 2-3)

Locator	Control or Indicator	Function
A	**DIR INST. Control**	Multiturn potentiometer (continuous turns, no stops) allows screwdriver adjustment of the directional instantaneous overcurrent element.
B	**NON-DIR INST. Control**	Multiturn potentiometer (continuous turns, no stops) allows screwdriver adjustment of the non-directional instantaneous overcurrent element.
C	**MIN I_o Control**	Multiturn potentiometer allows screwdriver adjustment of zero sequence current (I_O) level applied to the directional instantaneous overcurrent element.
D	**CHAR. ANGLE Switch**	Two-position switch sets the characteristic angle (0° or 60°) for the zero sequence voltage polarizing unit. When in the 60°position, characteristic angle accuracy is ±5° for V_O inputs below 30 volts and ±10° for V_O inputs greater than 30 volts.
E	**POWER Indicator**	Red LED is ON when operating power is supplied to relay internal circuitry.
F	**Target Indicators**	Magnetically latching indicators that display which element caused the trip.
G	**Target Reset Lever**	Allows manual reset of targets when pushed up.
H	**PUSH TO ENERGIZE OUTPUT Switches**	Momentary pushbuttons provide the means to cause functional output contacts to close without applying current or voltage to the sensing inputs. These pushbutton switches are accessible by inserting a 1/8 inch diameter non-conducting rod through holes in the front panel. One switch is provided for each tripping output contact.
I	**TIMING Indicator**	Red LED turns ON when time overcurrent function setpoint is exceeded and directional condition is met.
J	**TIME DIAL**	Dual thumbwheel switches set time delay for the time-current characteristic shape.
K	**TAP Selector**	Ten-position rotary switch sets pickup level for the time overcurrent function. When the TAP CAL control is in the full clockwise position, pickup of relay is based on the setting of the TAP selector. The setting for the time overcurrent function is the value defined by switch position (A to J, refer to TAP range decal on front panel).

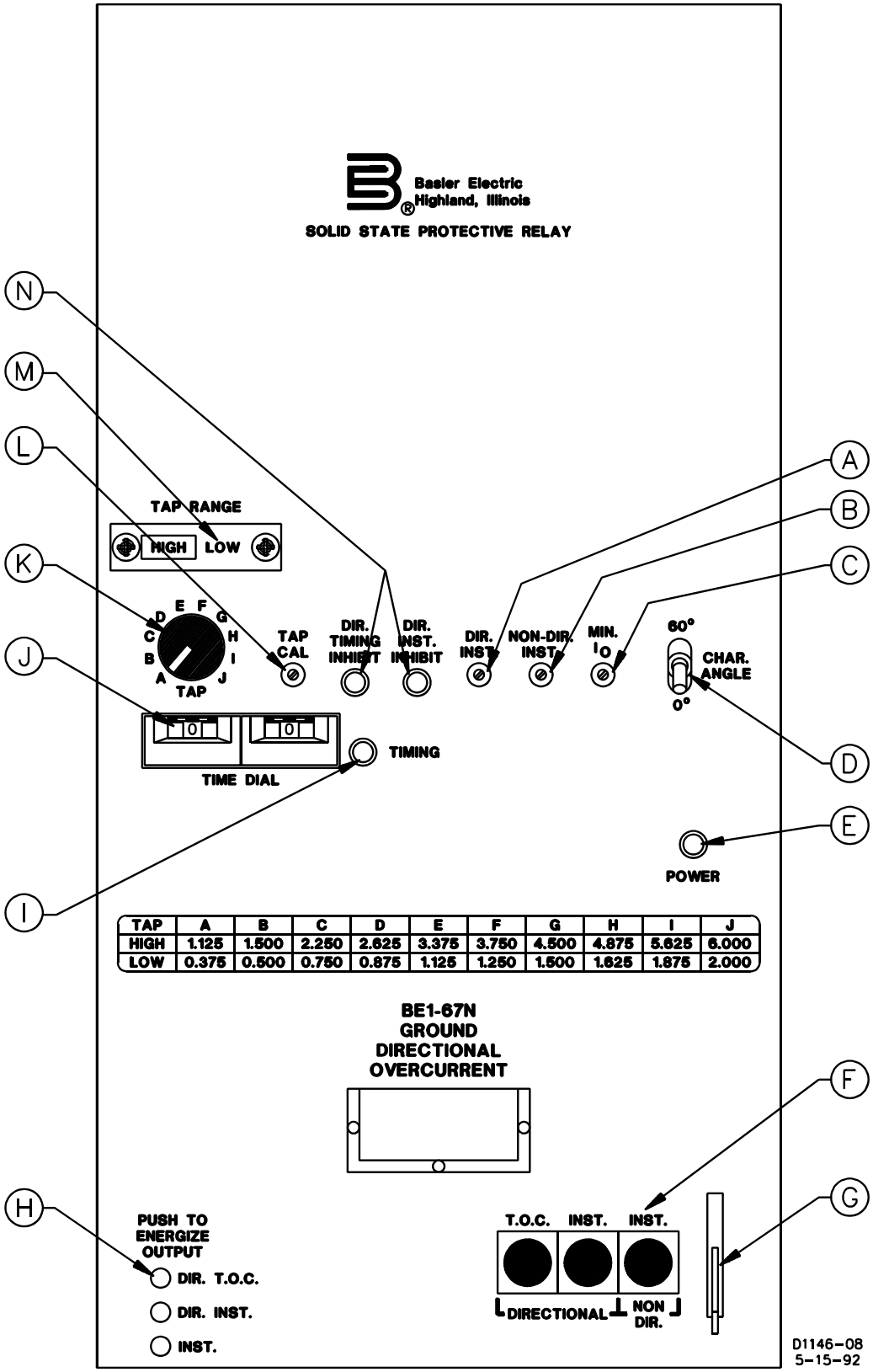

Figure 2-1. Location of Controls and Indicators

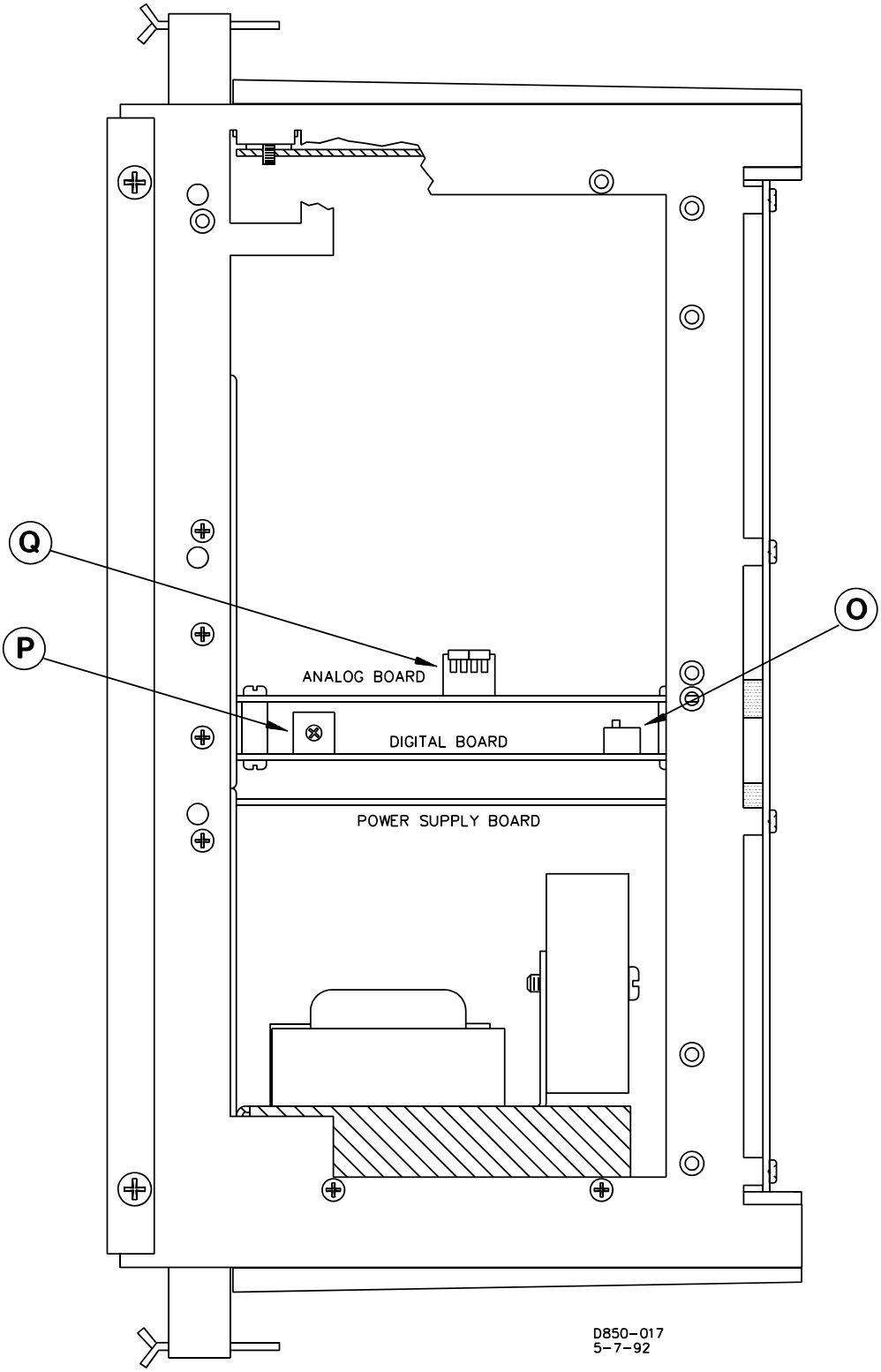

Figure 2-2. Locations of Controls and Indicators

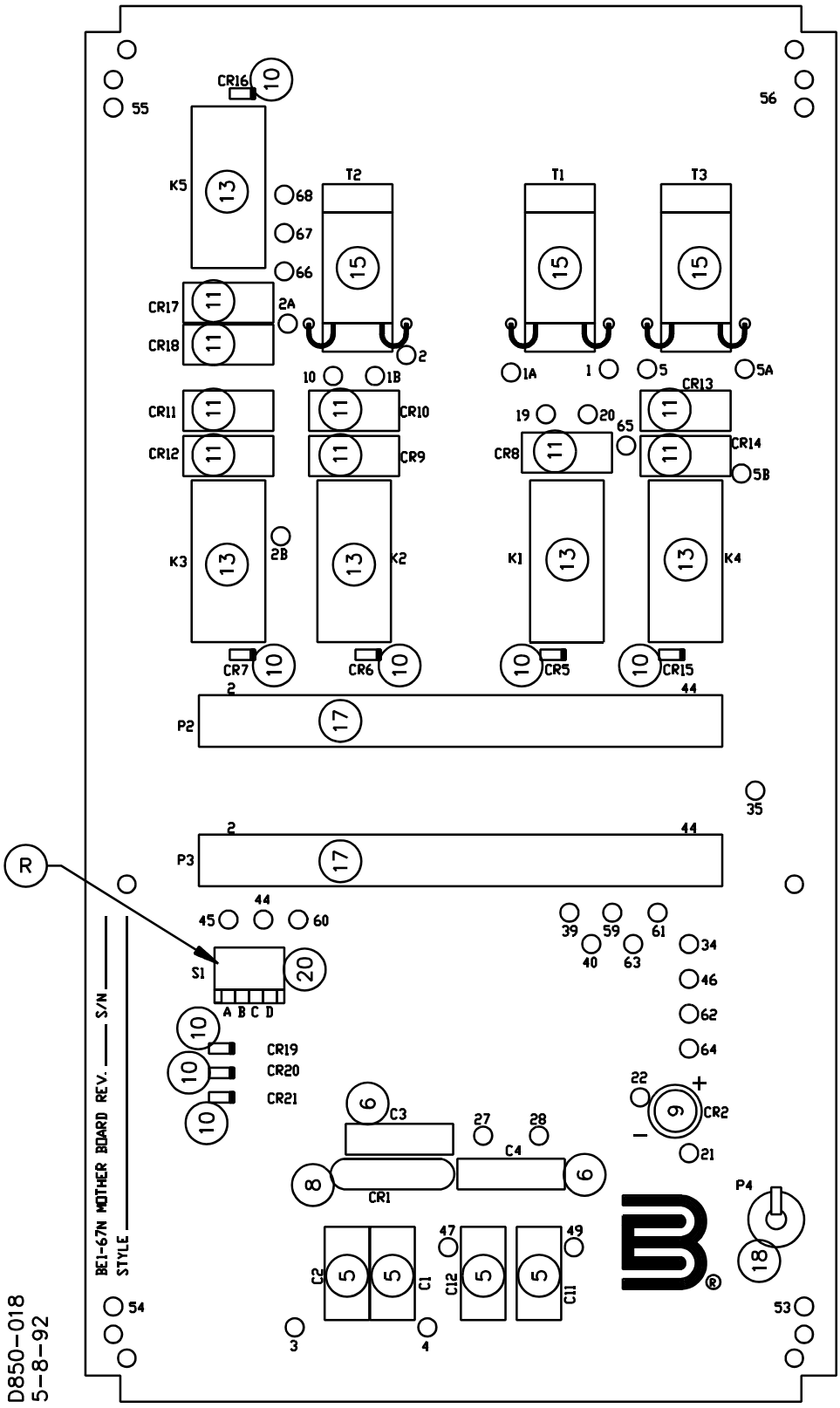

Figure 2-3. Location of Controls and Indicators

Table 2-1. BE1-67N Controls and Indicators - Continued

Locator	Control or Indicator	Function
L	**TAP CAL Control**	Multiturn potentiometer (continuous turns, no stops) allows screwdriver adjustment to the pickup level for the time overcurrent function. When this control is in the full clockwise position, the setting of the time overcurrent element is within +/- 5% of the selected tap setting. As the control is rotated counterclockwise, the pickup value of the element is reduced. Range of this control allows adjustment of the time pickup between the tap setting selected and the next lower value.
M	**TAP RANGE Plate (High/Low)**	This plate indicates the setting range corresponding to external connections of relay.
N	**INHIBIT Indicators**	Amber LED turns ON to indicate operation of the appropriate element (directional time overcurrent or directional instantaneous overcurrent) is inhibited by directional unit.
O	**NORMAL/TEST Switch**	Slide switch S1 (shown in NORMAL position), mounted on side of digital board, permits access to a series of stored diagnostic routines to validate calibration of relay, and to test and troubleshoot the unit on the bench. These built-in-test (BIT) routines are described in the service manual.
P	**Time Overcurrent Characteristic Curve Selector**	Circuit board mounted switch (S6) selects the characteristic curve to be used for the specific application.
Q	**Polarizing Source Select Switch**	Circuit board mounted switch (S3) selects voltage (V_O) and current (I_O) polarizing functions. Up position (as shown) selects function. Circuit boards are marked VoSEL and IoSEL on opposite sides of the switch to designate switch functions.
R	**Auxiliary Relay Select Switch**	Circuit board mounted switch (S1) allows auxiliary output contact to operate in parallel with any combination of tripping outputs. S1-A selects directional instantaneous, S1-B selects time overcurrent, and S1-C selects non-directional instantaneous. S1-D is not used.

SECTION 3

FUNCTIONAL DESCRIPTION

GENERAL

BE1-67N Ground Directional Overcurrent Relays are microprocessor based time ground overcurrent relays with directional supervision.

FUNCTIONAL DESCRIPTION

The following paragraphs describe the relay circuit functions illustrated in Figure 3-1.

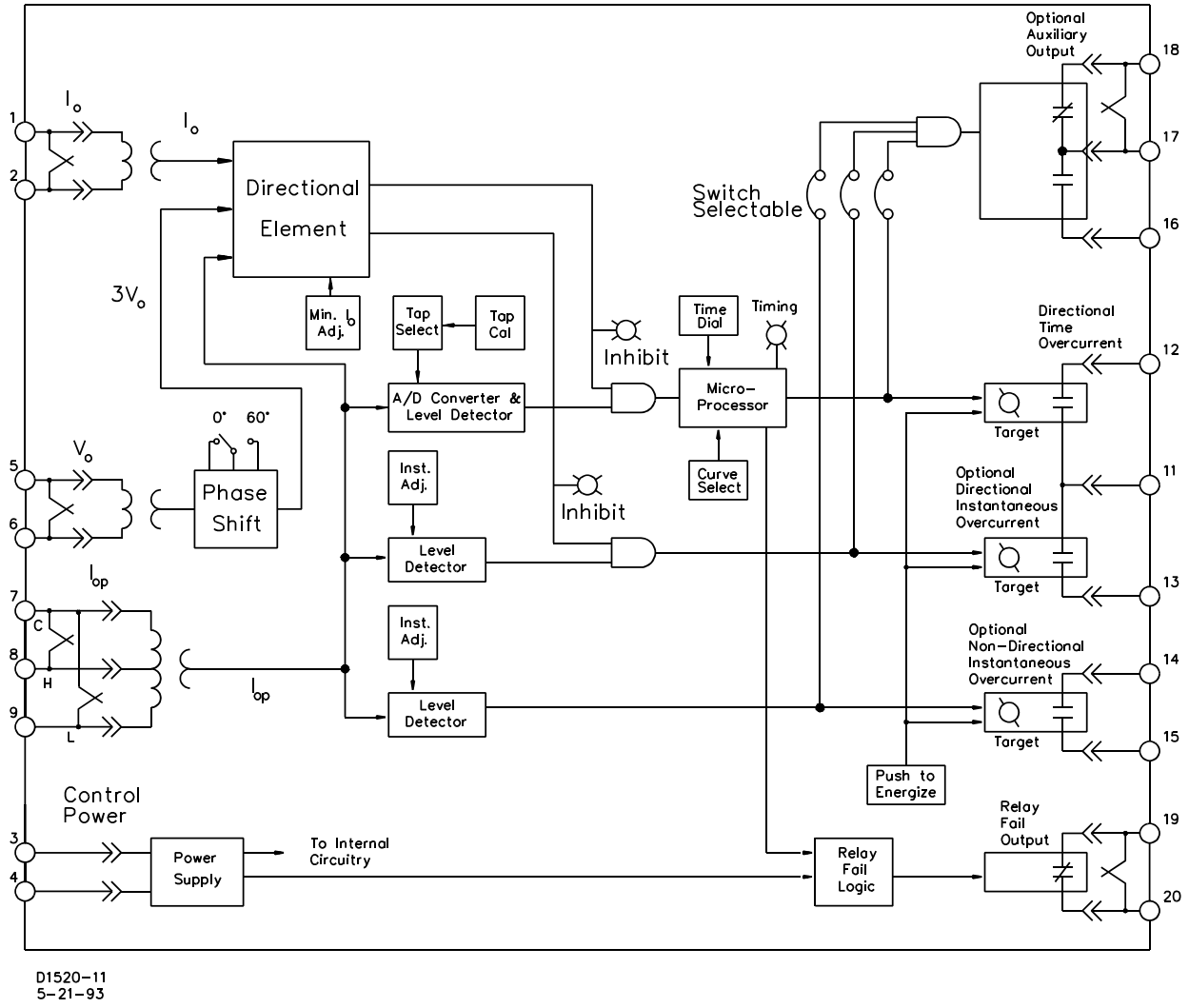

Figure 3-1. Functional Block Diagram

Current Sensing

Internal current sensing transformers receive inputs from the 5 amperes (or optional 1 ampere) nominal secondary of standard transformers. Input transformers for the sensed measured current (I_{OP}) are

tapped so that the relay range is determined by its external connections. External connections are listed in Table 3-1.

Outputs from the sensing input transformers are applied to a scaling circuit that converts each of the input currents to a dc voltage level. Scaling is controlled by the TAP selector switch and the TAP CAL control on the front of the relay.

The TAP selector switch is a 10-position rotary switch that controls the relay settings as listed in Tables 3-2 and 3-3. Note that these settings are with the TAP CAL control in the most clockwise position. Range is determined by the relay input connections. When the TAP CAL control is fully clockwise, the relay pickup setting will be within ± 5% of the TAP selector setting.

Table 3-1. I_{OP} Current Sensing Input Connections

Range			Term Numbers
1 Amp Nominal	High	0.225 to 1.20 A	7 & 8
	Low	0.075 to 0.40 A	7 & 9
5 Amp Nominal	High	1.125 to 6.0 A	7 & 8
	Low	0.375 to 2.0 A	7 & 9

Table 3-2. Sensing Input Range and Setting for 1 Amp Secondary

Nominal Range	TAP Selector										I_{OP} Terminals
	A	B	C	D	E	F	G	H	I	J	
High	0.225	0.30	0.45	0.453	0.675	0.75	0.90	0.925	1.125	1.20	7 & 8
Low	0.075	0.10	0.15	0.175	0.175	0.25	0.25	0.375	0.375	0.40	7 & 9

Table 3-3. Sensing Input Range and Setting for 5 Amp Secondary

Nominal Range	TAP Selector										I_{OP} Terminals
	A	B	C	D	E	F	G	H	I	J	
High	1.125	1.50	2.25	2.265	3.375	3.75	4.5	4.875	5.625	6.0	7 & 8
Low	0.375	0.50	0.75	0.875	1.125	1.25	1.5	1.625	1.875	2.0	7 & 9

TAP CAL control provides continuous adjustment between a selected setting of the TAP selector and the next lower setting. When the TAP CAL control is fully clockwise, relay pickup setting will be within +/- 5% of the TAP selector setting.

Voltage Sensing

The relay receives a polarized voltage input (V_O) from secondary windings of standard potential transformers or coupling capacitor potential devices. These components supply up to 240 V line-to-neutral for a 50/60 Hz nominal system frequency.

Directional Unit

A directional unit determines when the monitored power system quantities have the proper phase relationship for tripping. This unit has the following three types of directional capabilities that are selectable by a circuit board switch. One, zero sequence current polarization. Two, zero sequence voltage polarization. Three, dual zero sequence current and voltage polarization.

Zero Sequence Current Polarization

The zero sequence current polarizing unit is capable of detecting the phase relationship between the zero sequence current I_O and the sensed measured current I_{OP} for the relay. This unit is insensitive to third and higher harmonics.

An enabling output from the zero sequence current unit is given when the phase angle between I_0 and I_{OP} is 75° or less as shown in Figure 3-2. The total trip region (shaded area in Figures 3-2, 3-3, and 3-4) is 150°.

To allow operation of the time overcurrent element, the level of I_O applied to the directional element must be in excess of 0.2 amperess.

To allow operation of the directional instantaneous overcurrent element, the level of I_O applied to the directional element must be in excess of an internal, user set, adjustable threshold. The range of this setting is 0.75 to 2 amperes. The default factory setting of this adjustment is 2 amperes.

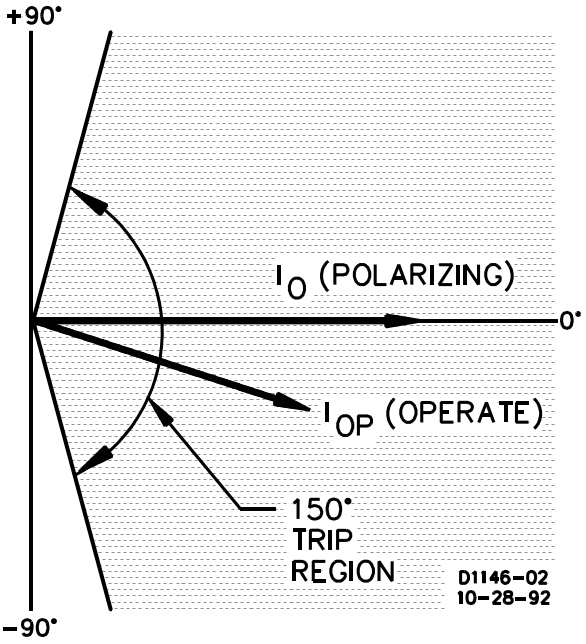

Figure 3-2. Zero Sequence Current Polarizing Phase Relationship

Zero Sequence Voltage Polarization

Zero sequence voltage polarization determines the phase relationship between the zero sequence voltage V_O and the sensed measured current I_{OP}. Third and higher harmonics have no affect on the relay.

Zero sequence voltage element outputs require a minimum voltage level of V_O = 0.75 volts applied to the relay. To enable the directional instantaneous overcurrent element, the level of V_O applied to the relay

must be 4 volts or more.

Figure 3-3 shows the phase relationship between the sensed measured current I_{OP} and the zero sequence voltage (V_O).

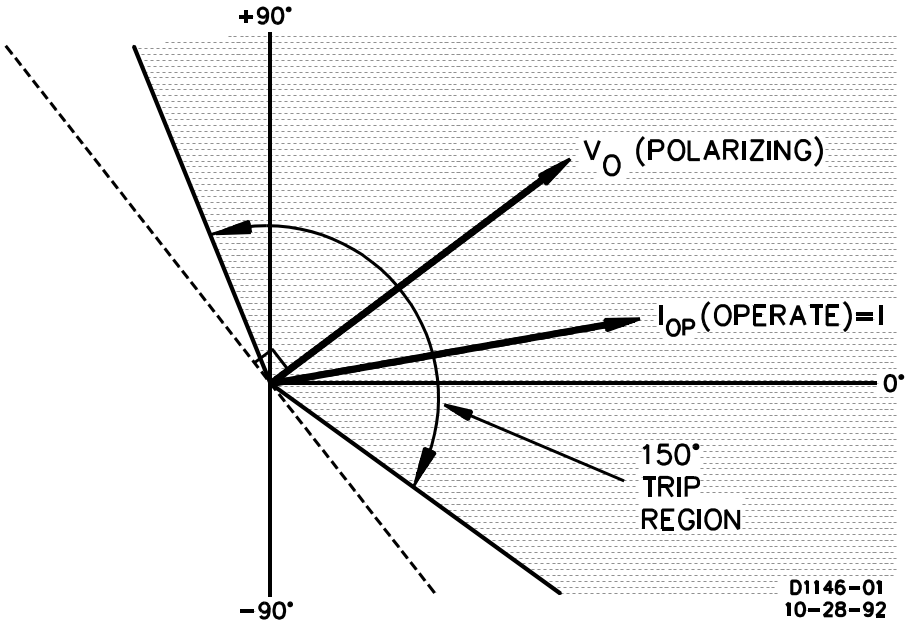

Figure 3-3. Zero Sequence Voltage Polarizing Phase Relationship (0° Characteristic Angle)

The characteristic angle is front panel selectable for a line impedance angle of 0° or 60°. This is the angle between V_O and the directional characteristic. The closing band is centered around the directional characteristic (V_O in Figure 3-3 and shifted 60° in Figure 3-4).

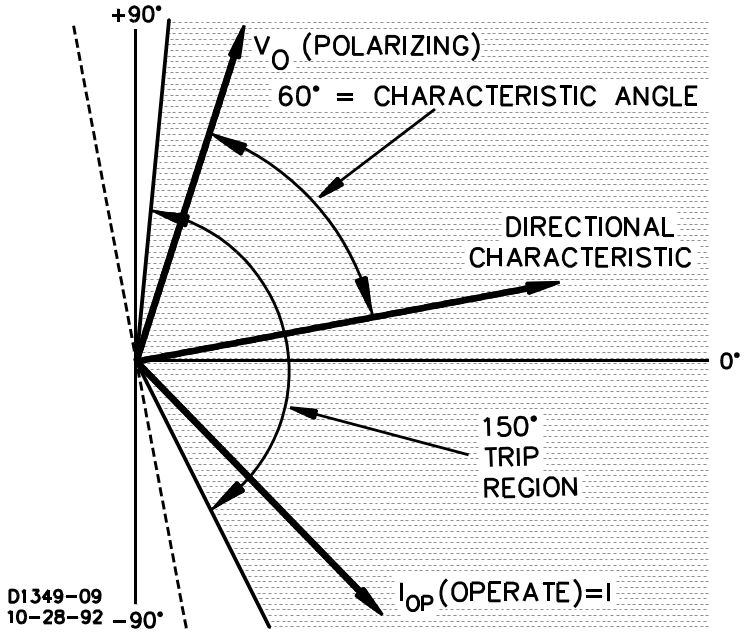

Figure 3-4. Zero Sequence Voltage Polarizing Phase Relationship (60° Characteristic Angle)

Dual Zero Sequence Current and Voltage Polarization

When both zero sequence current (I_O) and voltage (V_O) are applied to the directional unit, the relay responds by developing a single signal which is the phasor sum of the two polarizing signals. This signal is compared to the measured residual line current. Thus a large polarizing signal on one input overrides a small unreliable signal on the other input.

If only one polarizing input is above the specified minimum level, that input is used to determine current direction.

Overcurrent Elements

The BE1-67N relay has a directional controlled time overcurrent element, and may optionally include non-directional and/or directional instantaneous overcurrent element(s) as specified by style number.

Time Overcurrent Element

The time overcurrent element has all of the standard time current characteristics as listed in Table 3-4. These twelve time current characteristics are available to aid in the coordination of this relay with other protective devices in the system. These include seven characteristics that are standard in North America and five that are compatible with British or IEC Standard requirements. A user adjustable, circuit board mounted switch selects the time curve characteristics.

Table 3-4. Selection Considerations for Characteristic Curves

Style Designation	Characteristic Shape	Special Characteristics
B1	Short Inverse	Relatively short time, desirable where preserving system stability is a critical factor.
B2, E2	Long Inverse	Provides protection for starting motors and overloads of short duration.
B3	Definite Time	Fixed time delay according to time dial setting. Useful for sequential tripping schemes.
B4, E4	Moderately Inverse	Accommodates moderate load changes, as may occur on parallel lines where one line may occasionally have to carry both loads.
B5, E5	Inverse	Provide additional variations of the inverse characteristic, allowing flexibility in meeting load variations, or in coordinating with other relays.
B6, E6	Very Inverse	
B7, E7	Extremely Inverse	

Instantaneous Overcurrent Elements

BE1-67N relays may be optionally supplied with one or two instantaneous elements (one supervised by the directional unit). Instantaneous units are supplied from a separately obtained input signal, to permit a setting independent of the time overcurrent unit. Maximum operating times are as follows:

Multiples of Pickup (current)	Operate Time (milliseconds)

1.05	100
2.0	34
5.0	17

Power Supply

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

Type Y power supplies use a field adjustable link (J4) to select the appropriate input voltage (either 48 Vdc or 125 Vdc). Selection is accomplished by placing the link into the desired position (see Figure 3-5). This link is factory pre-set for 125 Vdc.

CAUTION

Damage will result to the power supply and the relay if J4 link (jumper) is not properly installed.

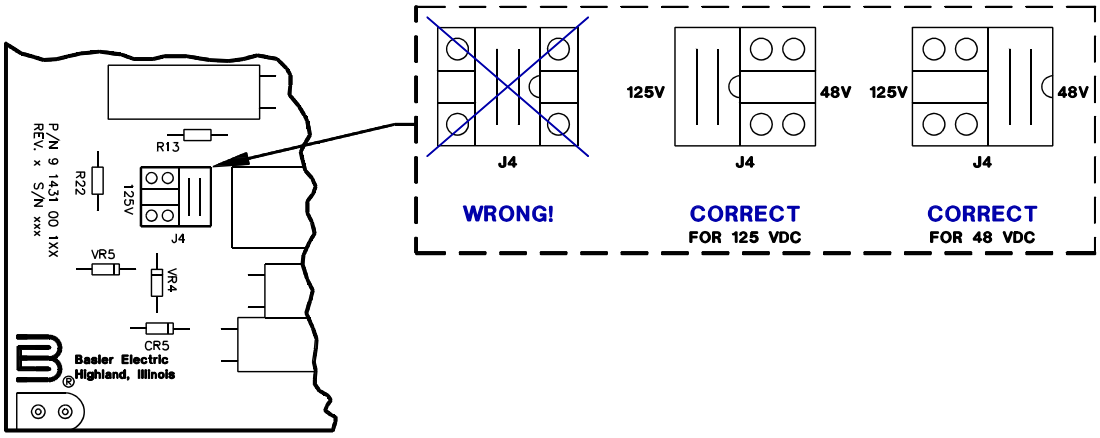

Figure 3-5. Power Supply Type Y Link Position

Output Contacts

BE1-67N relays have the following output contacts:

- Relay status alarm (relay fail) output contact
- Tripping output contacts
- Auxiliary output contacts (optional)

Relay Fail Output Contact

A relay fail output contact indicates that proper voltages are not being supplied to the internal relay circuitry or that the microprocessor self-diagnostics has detected an error. This alarm output contact is normally closed (NC).

Relay status output coils are continuously energized during normal conditions and de-energized (contacts closed) for a relay failure. A shorting bar is installed to short out the relay status terminals when the cradle is removed from the case.

Tripping Output Contacts

Normally open (NO) or normally closed (NC) tripping contacts are included for each function within the relay. The configuration of these contacts is defined by relay style number. These output contacts are used with optionally selected target indicator circuits.

Auxiliary Output Contacts (optional)

Normally open (NO), normally closed (NC), or single pole double throw (SPDT) auxiliary contact configurations are provided to act in parallel with the tripping function(s) of the relay. The configuration of the auxiliary output contacts is defined by the relay style chart.

An auxiliary contact can be configured (via internal switches) to operate in parallel with any combination of tripping outputs. Configurable auxiliary outputs permit use of the BE1-67N relay in various carrier schemes.

Push-to-Energize Output Switches

A pushbutton (one for each tripping function) energizes the corresponding output relay for testing purposes. To prevent accidental operation of these switches, they are recessed behind the front panel and are accessed by inserting a thin non-conducting rod through access holes in the panel. Control power must be applied for this function to operate. However, it is not necessary to apply currents and voltages to the sensing inputs.

Targets

A target (one for each tripping function) is visible on the relay front panel. Targets are operated either by the internal signal initiating tripping (internally operated) or by a minimum of 0.2 amperes dc flowing through the series circuit consisting of the target coil and output relay contacts (current operated). All targets are of the same type within a specific relay.

When operated, a disc in the target changes from black to red and is magnetically latched in this position. To reset the target after an abnormal system condition has been cleared, manually raise target reset lever located on relay front panel.

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 the relay is to be placed in service, it is recommended that the operational test procedure (page 4-5) be performed prior to installation.

RELAY OPERATING PRECAUTIONS

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

1. 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.

2. 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.

3. 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 C37.90-1989, one-minute dielectric (high potential) tests up to 1500 Vac (45-65 Hz) may be performed. Note that this device employs decoupling capacitors to ground from terminals 1 through 9, and 11 through 20. At 1500 Vac, a leakage current of approximately 5 milliamperes per terminal is to be expected.

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 except as noted for the ground wire. Typical sensing input connections are shown in Figures 4-1 and 4-2. Typical external connections are shown in Figure 4-3. Internal connections are shown in Figure 4-4.

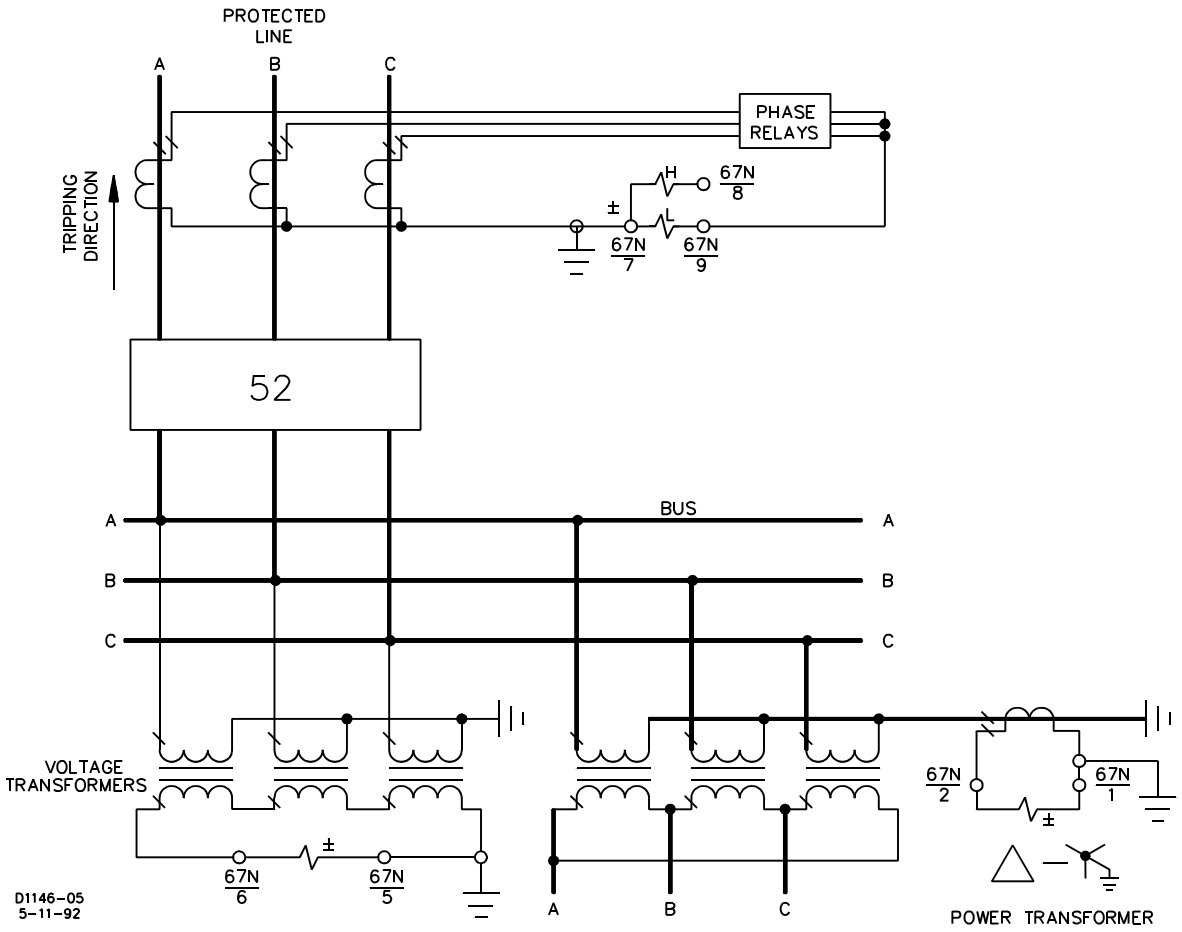

Figure 4-1. Typical Sensing Input Connections (Two Winding Transformer)

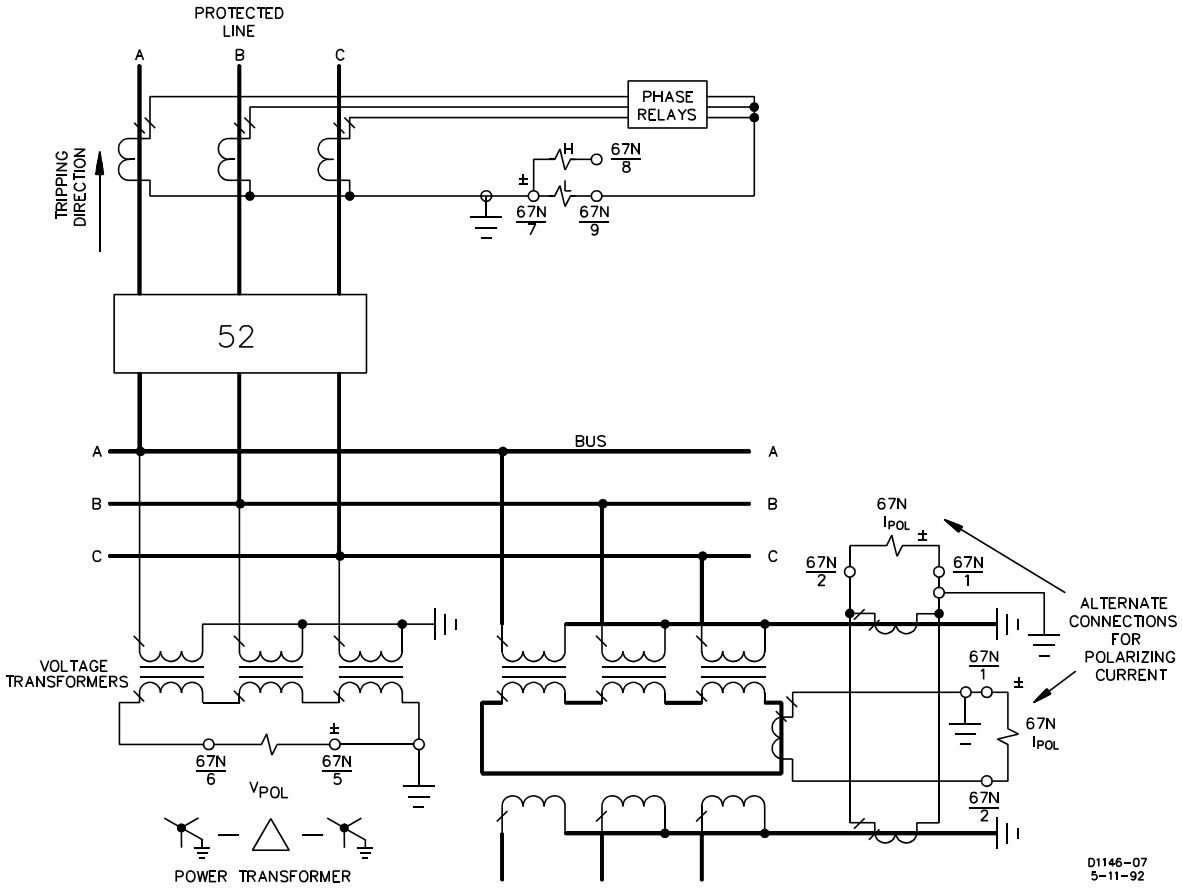

Figure 4-2. Typical Sensing Input Connections (Three Winding Transformer)

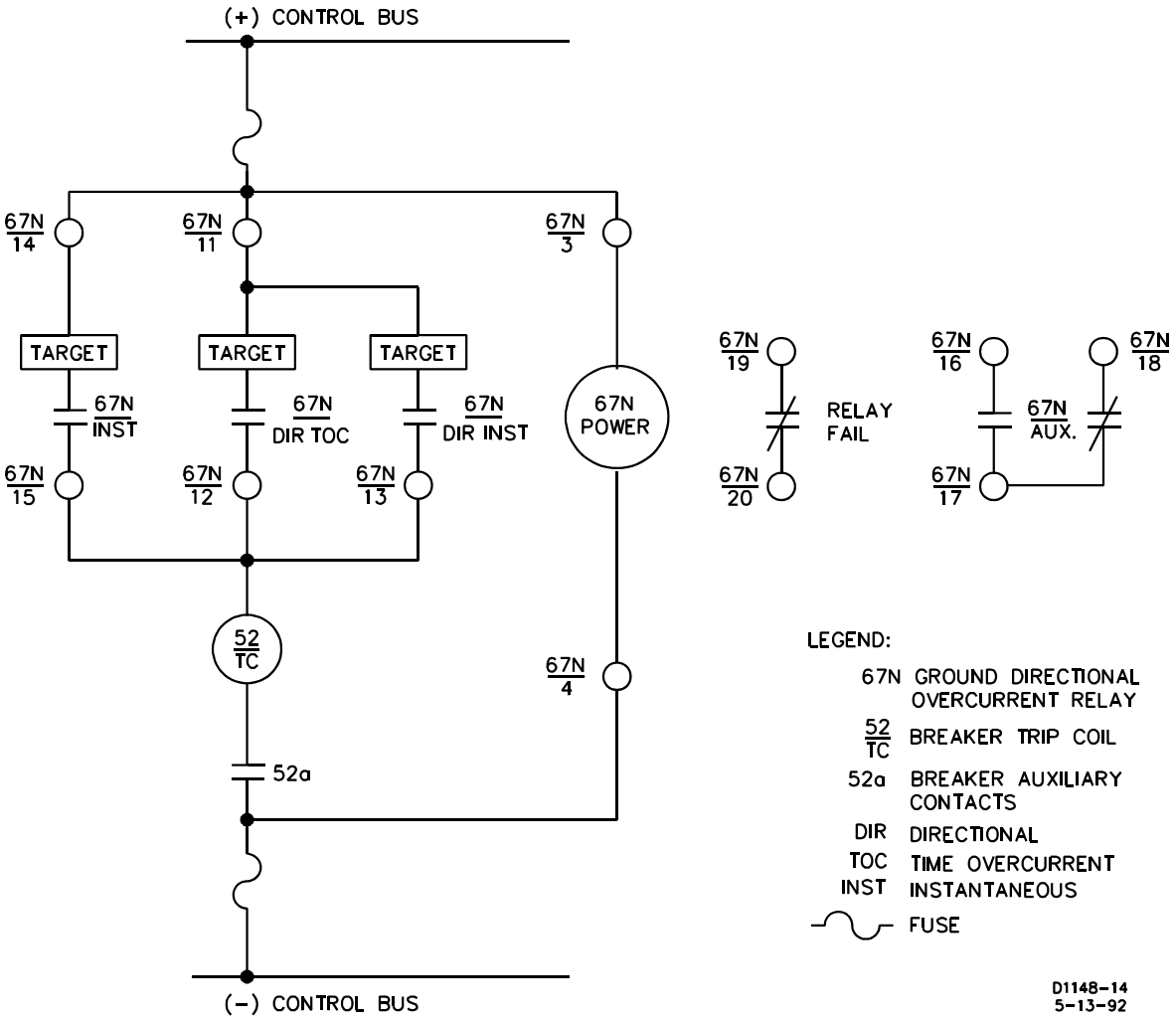

Figure 4-3. Typical Output Connections

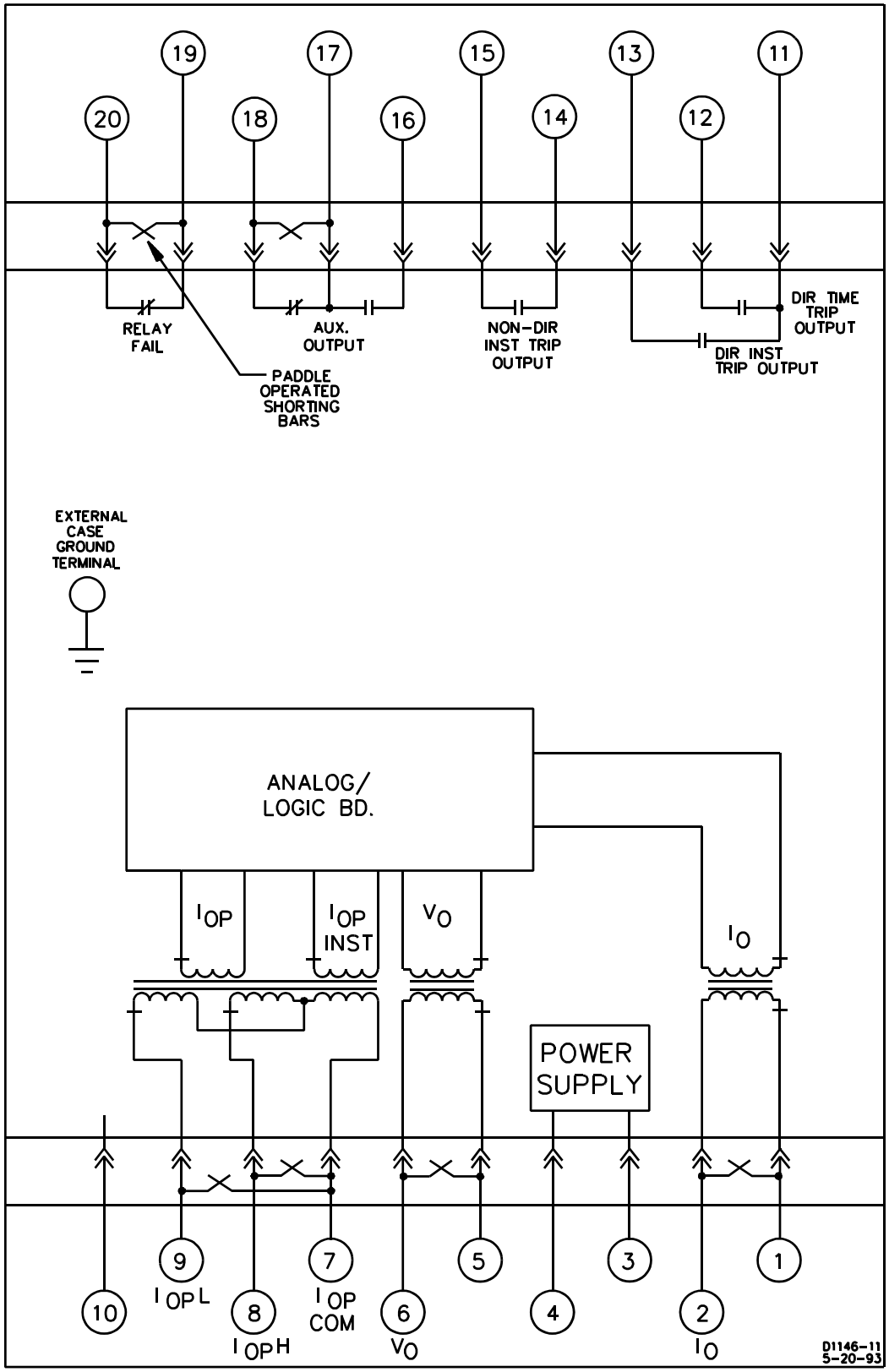

Figure 4-4. Typical Internal Connections

OPERATIONAL TEST PROCEDURE (Sensing Input Ranges 1 and 2)

Preliminary Test Setup

> NOTE
> Confirm that the TEST/NORMAL switch (callout O of Figure 2-2) is in the NORMAL position.

Step 1. Connect the circuit as shown in Figure 4-5.

Step 2. Adjust TAP CAL control fully CW.

Step 3. Set TIME DIAL to 99.

Step 4. Set TAP selector switch to position A.

Step 5. Adjust DIR INST. and NON-DIR INST. controls fully CW.

Step 6. Set CHAR. ANGLE switch to 0° position.

Step 7. Set polarizing source select switch (callout Q of Figure 2-2) to dual polarization (V_O and I_O switches up).

Step 8. Verify that proper power supply voltage and operating frequency (50 or 60 hertz) is connected to relay case terminals 3 and 4. (See Section 1 for ranges of each supply.)

Step 9. Insert relay connection plug(s).

Step 10. Verify that POWER, DIR. TIMING INHIBIT, and DIR. INST. INHIBIT LEDs are lit and that the relay fail contacts are functioning properly (terminals 19 and 20).

> **NOTE**
> Operational tests provided here for time overcurrent pickup, non-directional instantaneous overcurrent pickup, and directional instantaneous overcurrent pickup are performed using only voltage polarizing ($V_{O)}$) inputs.

Time Overcurrent Pickup Test

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing input voltage source (V_O) for 4 Vac at 0° phase angle.

Step 3. Adjust I_{OP} input current source for .25 A (low range) or .75 A (high range) at 0° phase angle.

Step 4. Slowly turn TAP CAL control CCW until TIMING LED is lit, verifying the minimum pickup point of the range.

Step 5. Turn TAP CAL control fully CW. The TIMING LED will extinguish. Slowly increase magnitude of input current until TIMING LED is lit. The input current level should be within ± 5% of 0.375 A (low range) or 1.125 A (high range). This verifies pickup accuracy of the TAP A setting.

Step 6. If verification of remaining TAP selector positions is desired, adjust TAP selector to its next CW position, then slowly increase magnitude of input current until TIMING LED is lit. Observe that

current level is within ± 5% of value given in Table 4-1.

NOTE
TAP switch position can be changed without disconnecting current sensing inputs.

Table 4-1. Pickup Values for TAP Selector Positions

Range	TAP Selector Position									
	A	B	C	D	E	F	G	H	I	J
High	1.125	1.500	2.250	2.625	3.375	3.750	4.500	4.875	5.625	6.000
Low	0.375	0.500	0.750	0.875	1.125	1.250	1.500	1.625	1.875	2.000

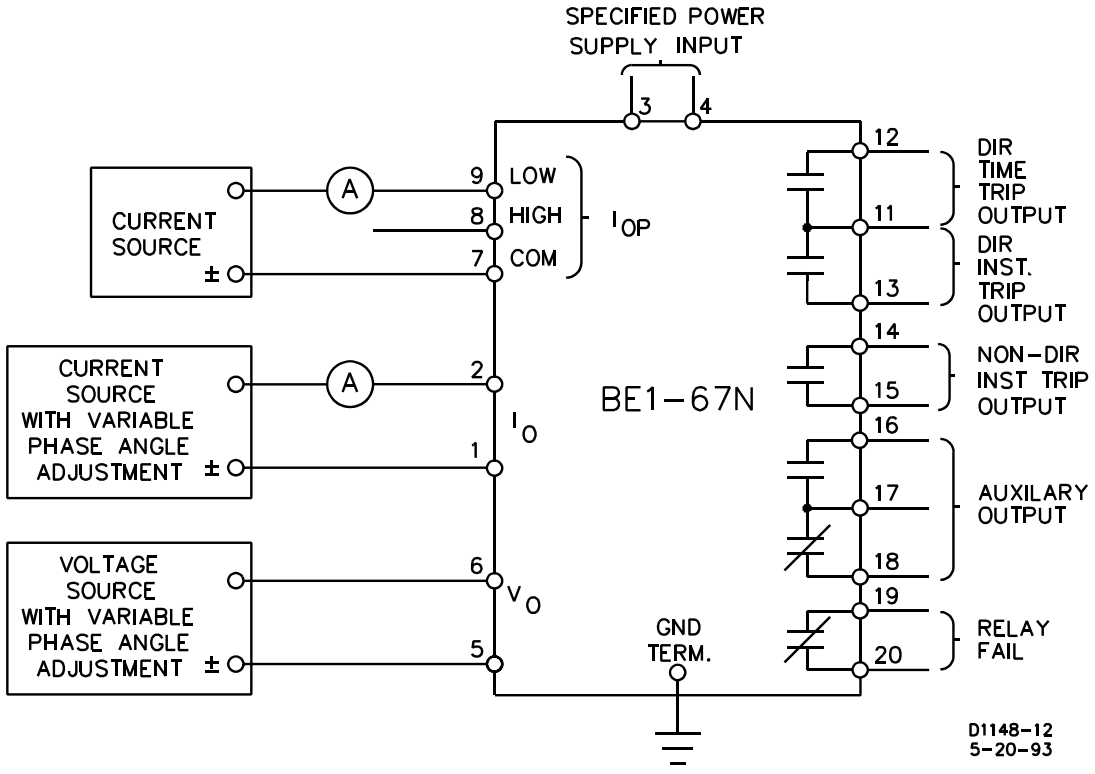

Figure 4-5. Typical Test Setup

Instantaneous Overcurrent Pickup Test (Non-directional)

Step 1. Perform preliminary test setup.

Step 2. Adjust NON-DIR. INST. control fully CW.

Step 3. Apply (I_{OP}) input current of 2.0 A.

Step 4. Adjust NON-DIR. INST control CCW slowly until the non-directional instantaneous relay activates (contacts 14 and 15 transfer).

Step 5. Adjust polarizing voltage source (V_O) for 4.0 Vac at 90° phase angle. Relay should stay tripped.

Step 6. Reduce input current (I_{OP}) to 1.8 A.

Step 7. Confirm that output relay (contacts 14 and 15) transfer (open).

Step 8. Adjust NON-DIR. INST control fully CW.

Instantaneous Overcurrent Pickup Test (Directional)

Step 1. Perform preliminary test setup.

Step 2. Adjust polarizing voltage source (V_O) for 4.0 Vac at 0° phase angle.

Step 3. Adjust DIR. INST. control fully CW.

Step 4. Apply (I_{OP}) input current of 2.0 A.

Step 5. Adjust DIR. INST control CCW slowly until the directional instantaneous relay activates (contacts 11 and 13 transfer (closes)).

Step 6. Adjust V_O phase angle until relay contacts transfer (opens) and DIR INST. INHIBIT LED lites (phase angle should be 75°±5°).

Step 7. Adjust V_O phase angle for 0° (relay contacts close).

Step 8. Reduce input current (I_{OP}) to 1.8 A.

Step 9. Confirm that output relay contacts open.

Step 10. Adjust DIR. INST control fully CW.

V_O Directional Verification

For the following tests, it will be necessary to adjust and monitor the magnitude of voltage(s) and current(s) as well as phase angle relationship between sensing quantities. Record the results on polar graph paper to understand the significance of the results. Blank forms are furnished in this section.

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing voltage source (V_O) for 4.0 Vac at 0° phase angle.

Step 3. With the I_{OP} input current source set at 1.0 A (low range) or 2.0 A (high range), and CHAR. ANGLE switch at 0°, vary phase angle of V_O input through 360° and note phase angles within which the DIR. TIMING INHIBIT LED is extinguished. When these results are shown on a polar plot, the graph should be a V-shaped line through the origin from -75 to +75°±5°. This plot defines the trip region as shown in Figure 4-6. The trip region is the shaded portion of the figure (DIR. TIMING INHIBIT LED extinguished).

Step 4. Set CHAR. ANGLE switch to 60°.

Step 5. Vary the phase angle of V_O input through 360° and record phase angles with which the DIR. TIMING INHIBIT LED is extinguished. When shown on a polar plot, the result should be a V-shaped line (through the origin) from -15 to +135°±5°. This plot defines the trip region as shown in Figure 4-7.

I_o Directional Verification

For the following tests, it will be necessary to adjust and monitor the magnitude of voltage(s) and current(s) as well as phase angle relationship between sensing quantities. Record the results on polar graph paper to understand the significance of the results. Blank forms are furnished in this section.

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing current (I_O) to 1 Aac at 0° phase angle.

Step 3. With the I_{OP} input current source set at 1.0 A (low range) or 2.0 A (high range), and CHAR. ANGLE switch at 0°, vary phase angle of I_O input through 360° and note phase angles within which the DIR. TIMING INHIBIT LED is extinguished. When these results are shown on a polar plot, the graph should be a V-shaped line through the origin from -75 to +75°±5°. This plot defines the trip region as shown in Figure 4-8 The trip region is the shaded portion of the figure (DIR. TIMING INHIBIT LED extinguished).

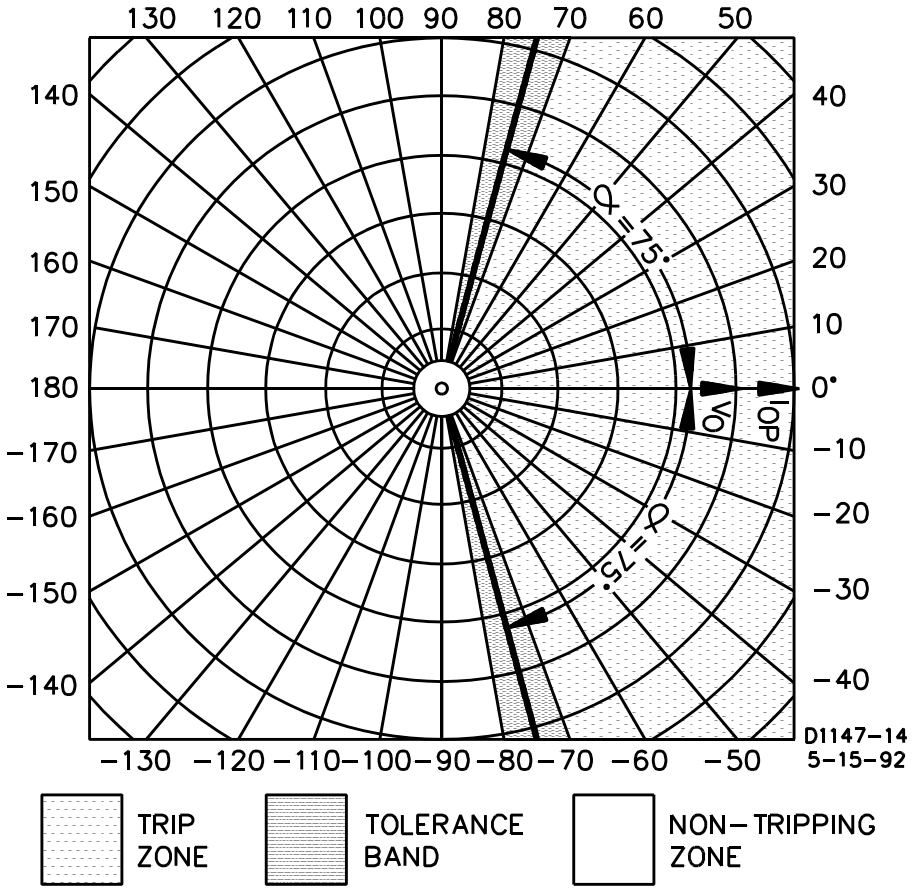

Figure 4-6. Trip Zone Using V_O as Polarizing Source (CHAR. ANGLE = 0°)

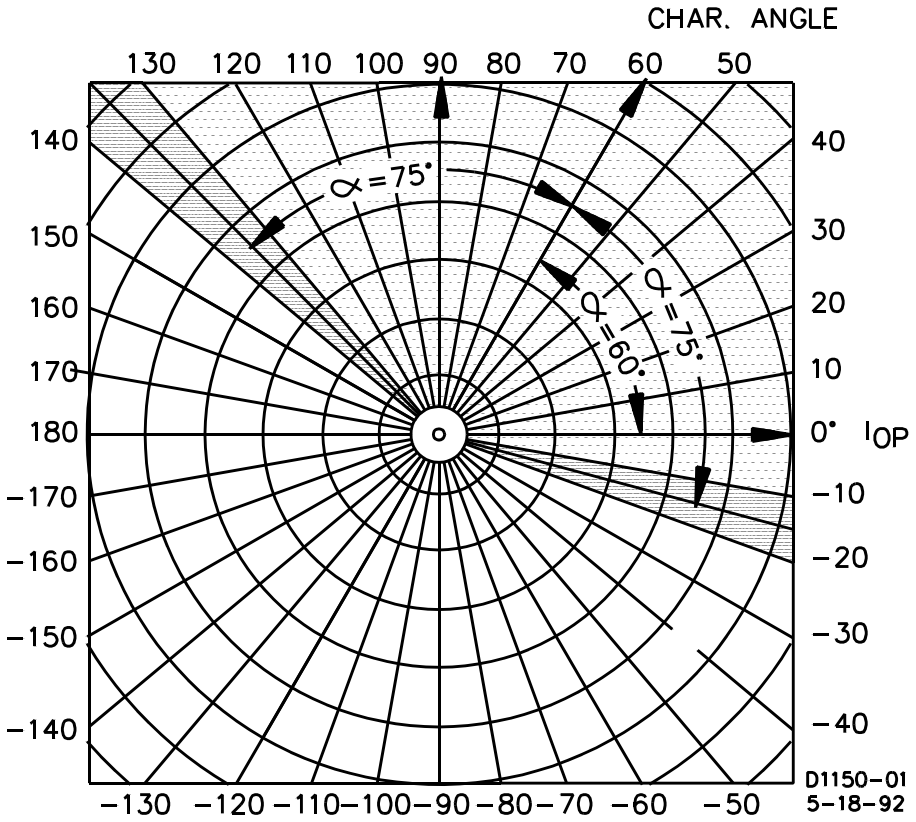

Figure 4-7. Trip Zone Using V_O as Polarizing Source (CHAR. ANGLE = 60°)

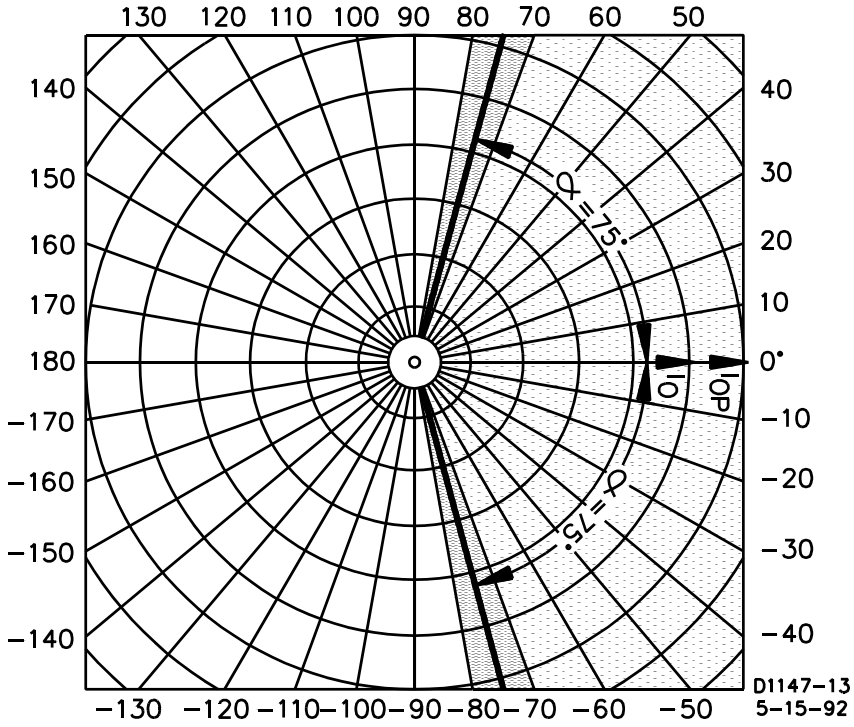

Figure 4-8. Trip Zone Using I_O as Polarizing Source (CHAR. ANGLE = 0°)

OPERATIONAL TEST PROCEDURE (Sensing Input Ranges 3 and 4)

Preliminary Test Setup

> NOTE
> Confirm that the TEST/NORMAL switch (callout O of Figure 2-2) is in the NORMAL position.

Step 1. Connect the circuit as shown in Figure 4-5.

Step 2. Adjust TAP CAL control fully CW.

Step 3. Set TIME DIAL to 99.

Step 4. Set TAP selector switch to position A.

Step 5. Adjust DIR INST. and NON-DIR INST. controls fully CW.

Step 6. Set CHAR. ANGLE switch to 0° position.

Step 7. Set polarizing source select switch (callout Q of Figure 2-2) to dual (V_O and I_O switches up)

Step 8. Verify that proper power supply voltage and operating frequency (50 or 60 hertz) is connected to relay case terminals 3 and 4. (See Section 1 for ranges of each supply.)

Step 9. Insert relay connection plug(s).

Step 10. Verify that POWER, DIR. TIMING INHIBIT, and DIR. INST. INHIBIT LEDs are lit and that the relay fail contacts are functioning properly (terminals 19 and 20).

> **NOTE**
> Operational tests provided here for time overcurrent pickup, non-directional instantaneous overcurrent pickup, and directional instantaneous overcurrent pickup are performed using only voltage polarizing ($V_{O)}$) inputs.

Time Overcurrent Pickup Test

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing input voltage source (V_O) for 4 Vac at 0° phase angle.

Step 3. Adjust I_{OP} input current source for .05 A (low range) or .15 A (high range) at 0° phase angle.

Step 4. Slowly turn TAP CAL control CCW until TIMING LED is lit, verifying the minimum pickup point of the range.

Step 5. Turn TAP CAL control fully CW. The TIMING LED will extinguish. Slowly increase magnitude of input current until TIMING LED is lit. The input current level should be within ± 5% of 0.075 A (low range) or 0.225 A (high range). This verifies pickup accuracy of the TAP A setting.

Step 6. If verification of remaining TAP selector positions is desired, adjust TAP selector to its next CW position, then slowly increase magnitude of input current until TIMING LED is lit. Observe that current level is within ± 5% of value given in Table 4-3.

NOTE
TAP switch position can be changed without disconnecting current sensing inputs.

Table 4-3. Pickup Values for TAP Selector Positions

Range	TAP Selector Position									
	A	B	C	D	E	F	G	H	I	J
High	0.225	0.300	0.450	0.525	0.675	0.750	0.900	0.975	1.125	1.200
Low	0.075	0.100	0.150	0.175	0.225	0.250	0.300	0.325	0.375	0.400

Instantaneous Overcurrent Pickup Test (Non-directional)

Step 1. Perform preliminary test setup.

Step 2. Adjust NON-DIR. INST. control fully CW.

Step 3. Apply (I_{OP}) input current of 0.40 A.

Step 4. Adjust NON-DIR. INST control CCW slowly until the non-directional instantaneous relay activates (contacts 14 and 15 transfer).

Step 5. Adjust polarizing voltage source (V_O) for 4.0 Vac at 90° phase angle. Relay should stay tripped.

Step 6. Reduce input current (I_{OP}) to 0.35 A.

Step 7. Confirm that output relay (contacts 14 and 15) transfer (open).

Step 8. Adjust NON-DIR. INST. control fully CW.

Instantaneous Overcurrent Pickup Test (Directional)

Step 1. Perform preliminary test setup.

Step 2. Adjust polarizing voltage source (V_O) for 4.0 Vac at 0° phase angle.

Step 3. Adjust DIR. INST. control fully CW.

Step 4. Apply (I_{OP}) input current of 0.40 A.

Step 5. Adjust DIR. INST control CCW slowly until the directional instantaneous relay activates (contacts 11 and 13 transfer (closes)).

Step 6. Adjust V_O phase angle until relay contacts transfer (opens) and DIR INST. INHIBIT LED lites (phase angle should be 75°±5°).

Step 7. Adjust V_O phase angle for 0° (relay contacts close).

Step 8. Reduce input current (I_{OP}) to 0.35 A.

Step 9. Confirm that output relay contacts open.

Step 10. Adjust DIR. INST. control fully CW.

V_o Directional Verification

For the following tests, it will be necessary to adjust and monitor the magnitude of voltage(s) and current(s) as well as phase angle relationship between sensing quantities. Record the results on polar graph paper to understand the significance of the results. Blank forms are furnished in this section.

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing voltage source (V_O) for 4.0 Vac at 0° phase angle.

Step 3. With the I_{OP} input current source set at 0.2 A (low range) or 0.4 A (high range), and CHAR. ANGLE switch at 0°, vary phase angle of V_O input through 360° and note phase angles within which the DIR. TIMING INHIBIT LED is extinguished. When these results are shown on a polar plot, the graph should be a V-shaped line through the origin from -75 to +75°±5°. This plot defines the trip region as shown in Figure 4-6. The trip region is the shaded portion of the figure (DIR. TIMING INHIBIT LED extinguished).

Step 4. Set CHAR. ANGLE switch to 60°.

Step 5. Vary the phase angle of V_O input through 360° and record phase angles with which the DIR. TIMING INHIBIT LED is extinguished. When shown on a polar plot, the result should be a V-shaped line (through the origin) from -15 to +135°±5°. This plot defines the trip region as shown in Figure 4-7.

I_o Directional Verification

For the following tests, it will be necessary to adjust and monitor the magnitude of voltage(s) and current(s) as well as phase angle relationship between sensing quantities. Record the results on polar graph paper to understand the significance of the results. Blank forms are furnished in this section.

Step 1. Perform the preliminary test setup.

Step 2. Adjust polarizing current (I_O) to 1.0 Aac at 0° phase angle.

Step 3. With the I_{OP} input current source set at 0.20 A (low range) or 0.40 A (high range), and CHAR. ANGLE switch at 0°, vary phase angle of I_O input through 360° and note phase angles within which the DIR. TIMING INHIBIT LED is extinguished. When these results are shown on a polar plot, the graph should be a V-shaped line through the origin from -75 to +75°±5°. This plot defines the trip region as shown in Figure 4-8 The trip region is the shaded portion of the figure (DIR. TIMING INHIBIT LED extinguished).

TIMING CURVE VERIFICATION

Timing Curve Verification (Sensing Input Ranges 1 and 2)

Table 4-4 provides checkpoints for each timing characteristic. Select the desired characteristic by a time overcurrent characteristic curve selector switch, located on the digital board (refer to Section 2, Controls and Indicators).

Verification of the timing may be performed at a low current level for convenience. Connect relay as shown in Figure 4-5. Timing will be measured from the point that the sensed current is applied until the output contact is energized. The equipment to accomplish this task will need to step from 0 to 1.875 A (if relay is connected for low range) or to 5.625 A (if relay is connected for high range).

Table 4-4. Expected Timing at Five Times Pickup

Timing Type	Selector Option	Expected Times at Indicated Time Dial Setting * (in seconds)	
		00	10
B1	3	0.066	0.194
B2	1	0.587	3.410
B3	5	0.103	0.494
B4	2	0.168	0.875
B5	4	0.149	0.722
B6	6	0.126	0.551
B7	7	0.195	1.011
B8	0	0.329	1.790
E2	8	1.560	9.060
E4	9	0.130	0.540
E5	A	0.233	1.190
E6	B	0.160	0.770
E7	C,D,E,F	0.130	0.480

* Accuracy, with TAP CAL rotated fully CW, is ± 5% or 50 milliseconds (whichever is greater) within values shown graphically on the published characteristic curves.

Step 1. Set TAP select switch to position A and rotate TAP CAL control fully CW. Rotate both instantaneous control fully CW. Set TIME DIAL to 00.

Step 2. Adjust I_{OP} source current for 0.375 A (low range) or 1.125 A (high range) and apply this current to the sensing input(s). Voltage (V_O, 4.0 Vac) will also need to be applied to the sensing input of the directional element for this test. The phase angle between current and voltage should be adjusted so that the TIMING LED lites when the pickup current is applied. Adjust TAP CAL control (if required) such that the TIMING LED is lit. This sets the relay pickup for the following steps.

Step 3. Connect a counter to monitor the time interval from initiation of the timing condition to the output transition (terminals 11 and 12).

Step 4. Switch sensing current to 1.875 A (low range) or 5.625 A (high range). (This is 5 times the level set in step 2.) Monitor time required to energize output contact and compare with the value in Table 4-4.

Step 5. Set TIME DIAL to 10 and repeat step 4.

Timing Curve Verification (Sensing Input Ranges 3 and 4)

Table 4-4 provides checkpoints for each timing characteristic. Select the desired characteristic by a time overcurrent characteristic curve selector switch, located on the digital board (refer to Section 2, Controls and Indicators).

Verification of the timing may be performed at a low current level for convenience. Connect relay as shown in Figure 4-5. Timing will be measured from the point that the sensed current is applied until the output contact is energized. The equipment to accomplish this task will need to step from 0 to 0.375 A (if relay is connected for low range) or to 1.125 A (if relay is connected for high range).

Step 1. Set TAP select switch to position A and rotate TAP CAL control fully CW. Rotate both instantaneous control fully CW. Set TIME DIAL to 00.

Step 2. Adjust I_{OP} source current for 0.375 A (low range) or 1.125 A (high range) and apply this current to the sensing input(s). Voltage (V_O, 4.0 Vac) will also need to be applied to the sensing input of the directional element for this test. The phase angle between current and voltage should be adjusted so that the TIMING LED lites when the pickup current is applied. Adjust TAP CAL control (if required) such that the TIMING LED is lit. This sets the relay pickup for the following steps.

Step 3. Connect a counter to monitor the time interval from initiation of the timing condition to the output transition (terminals 11 and 12).

Step 4. Switch sensing current to 0.375 A (low range) or 1.125 A (high range). (This is 5 times the level set in step 2.) Monitor time required to energize output contact and compare with the value in Table 4-4.

Step 5. Set TIME DIAL to 10 and repeat step 4.

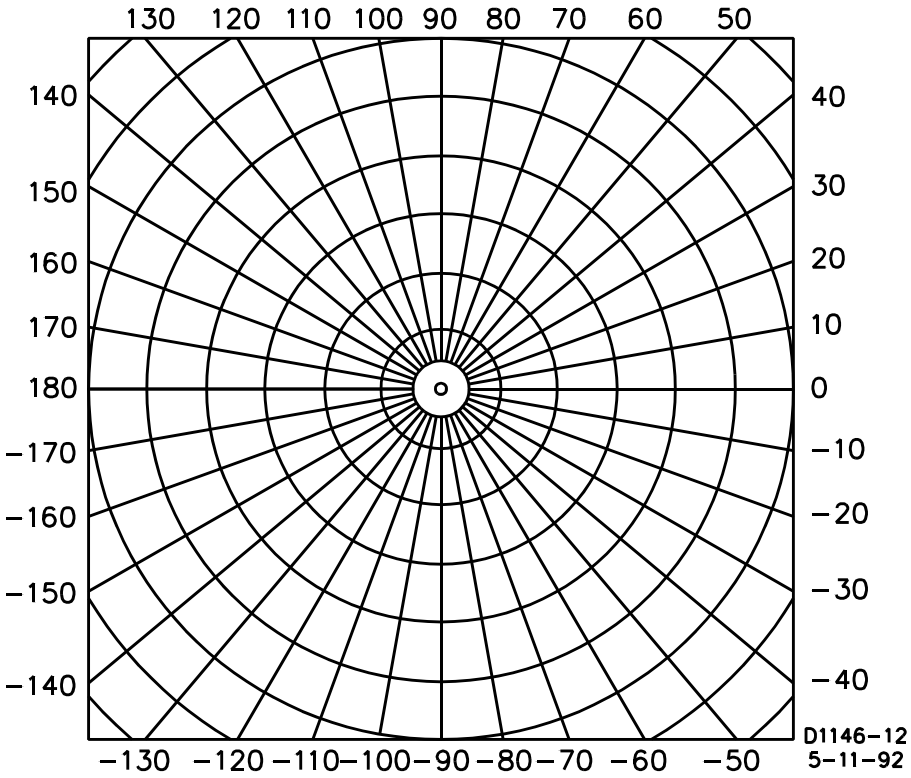

Figure 4-9. Blank Graph Form

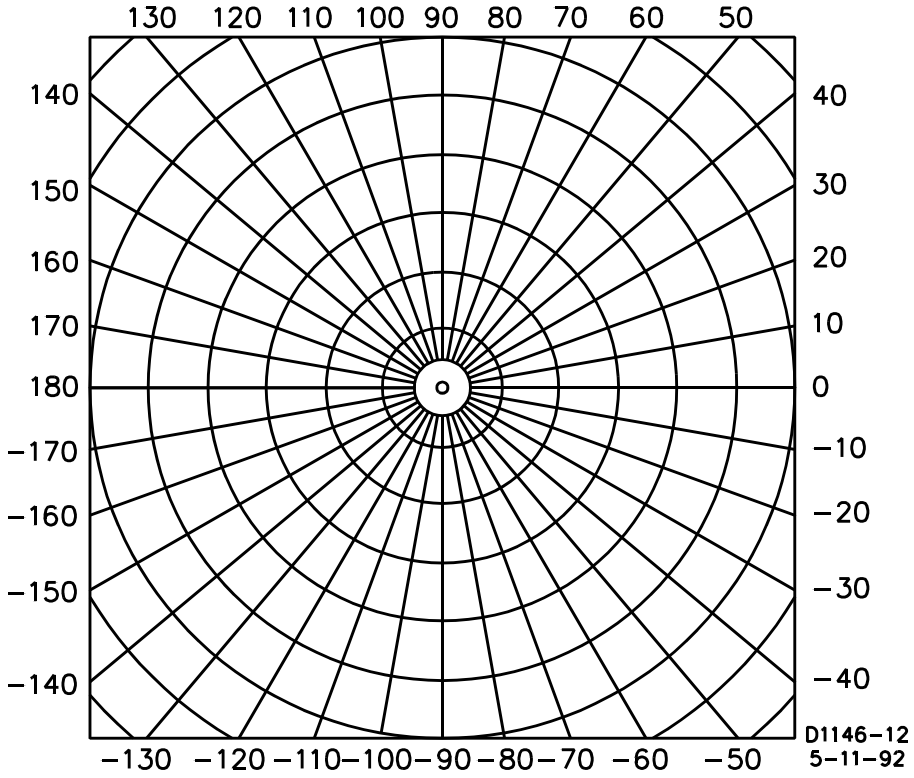

Figure 4-10. Blank Graph Form

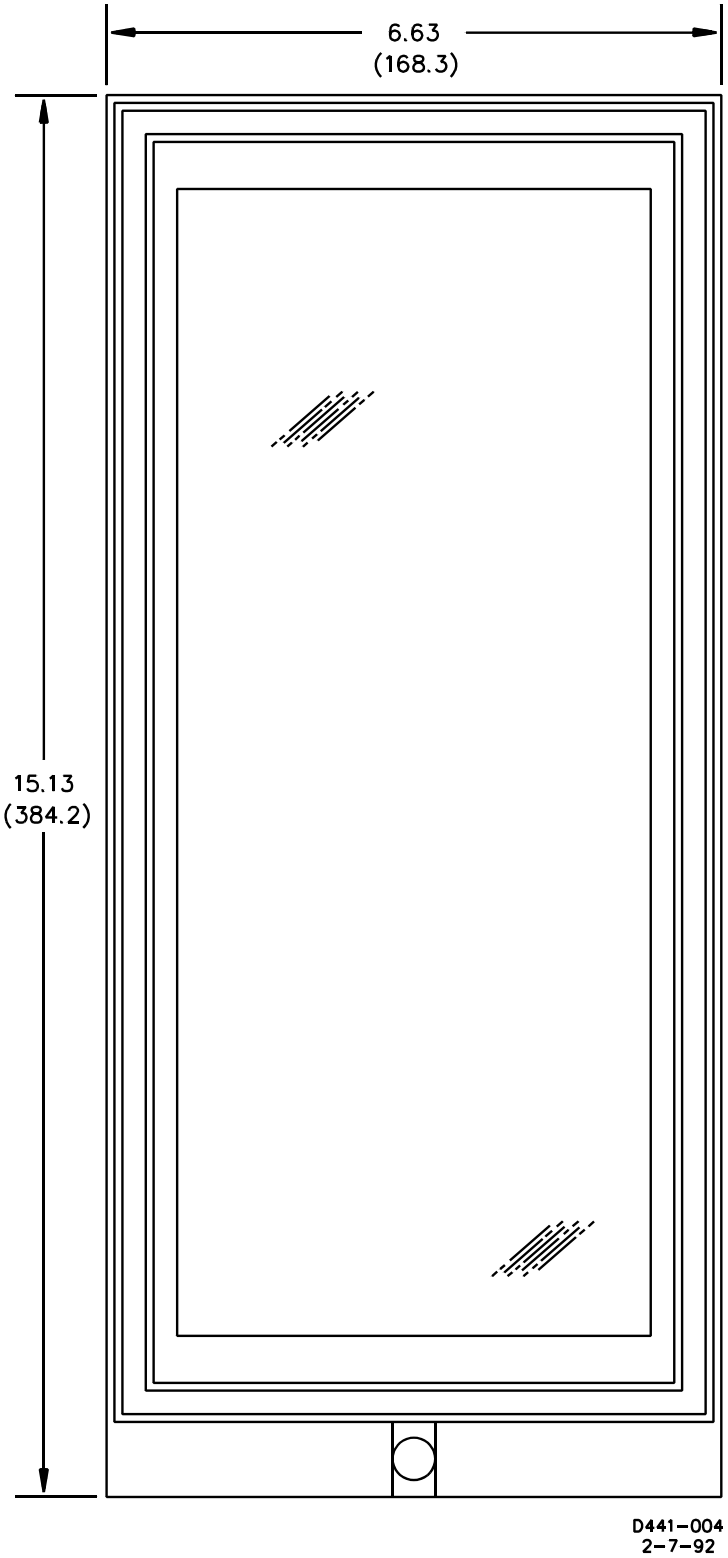

Figure 4-11. Outline Dimensions, Front View

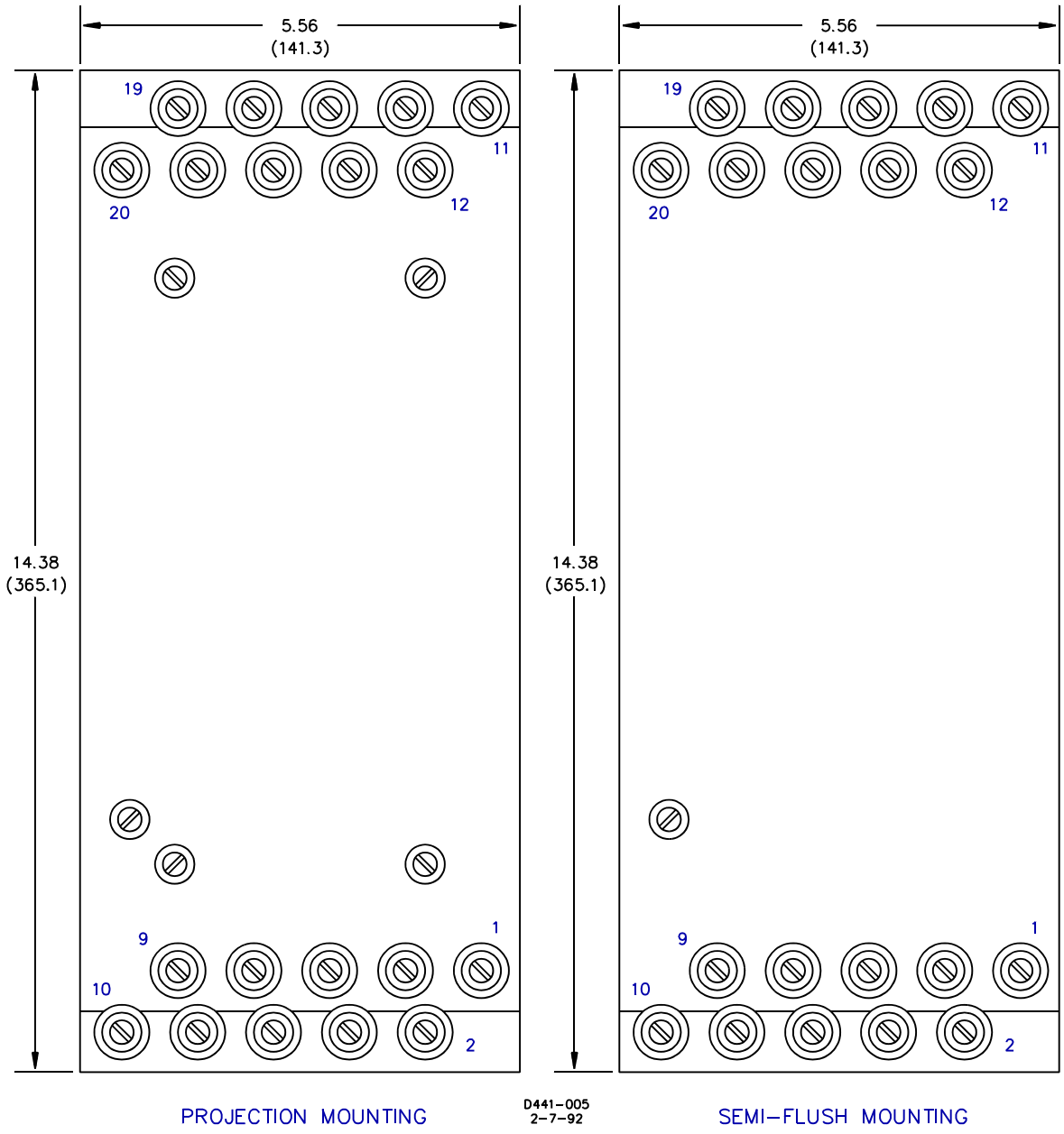

Figure 4-12. Outline Dimensions, Rear View

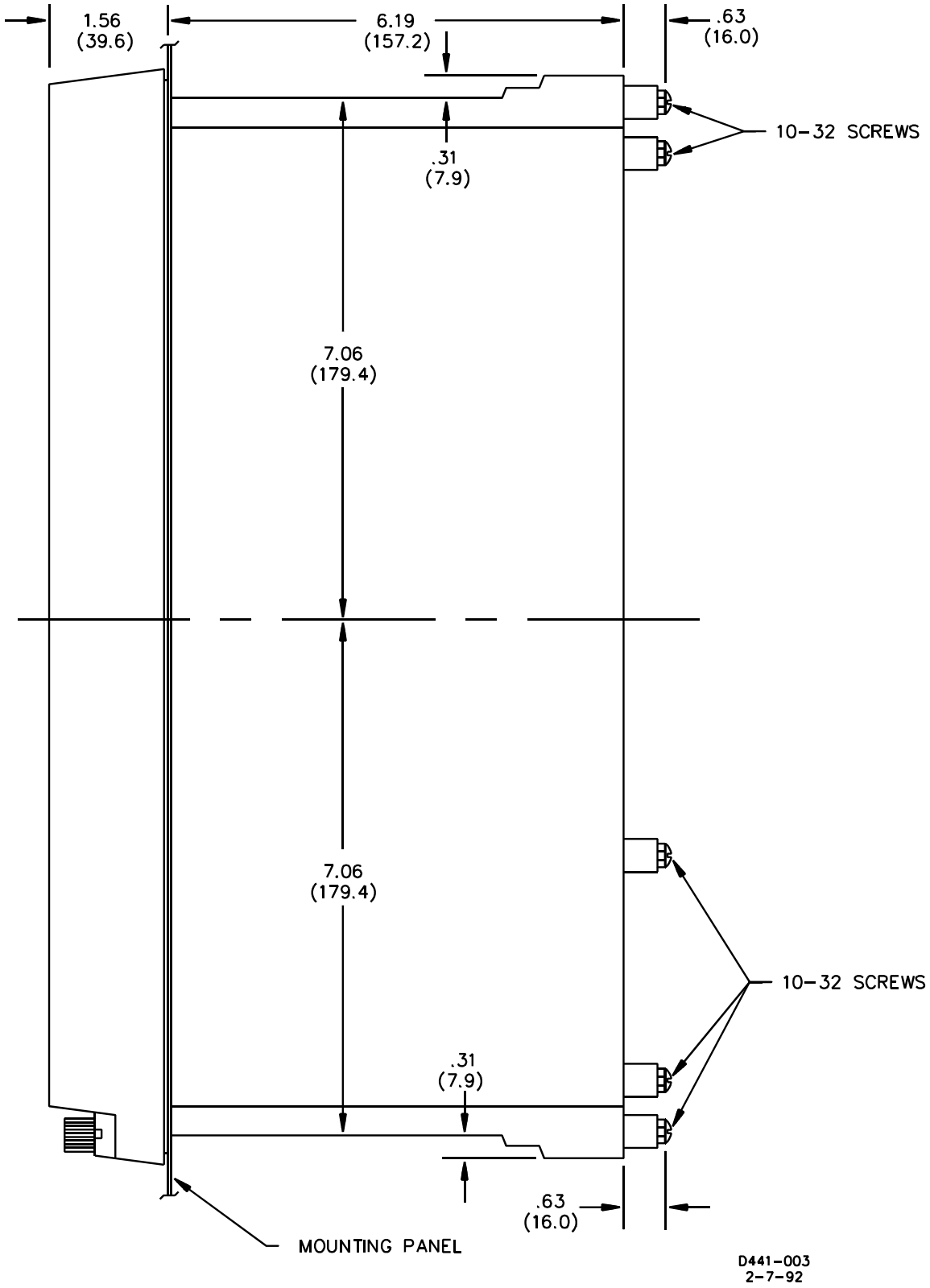

Figure 4-13. Outline Dimensions, Side View — Semi-Flush Mounting

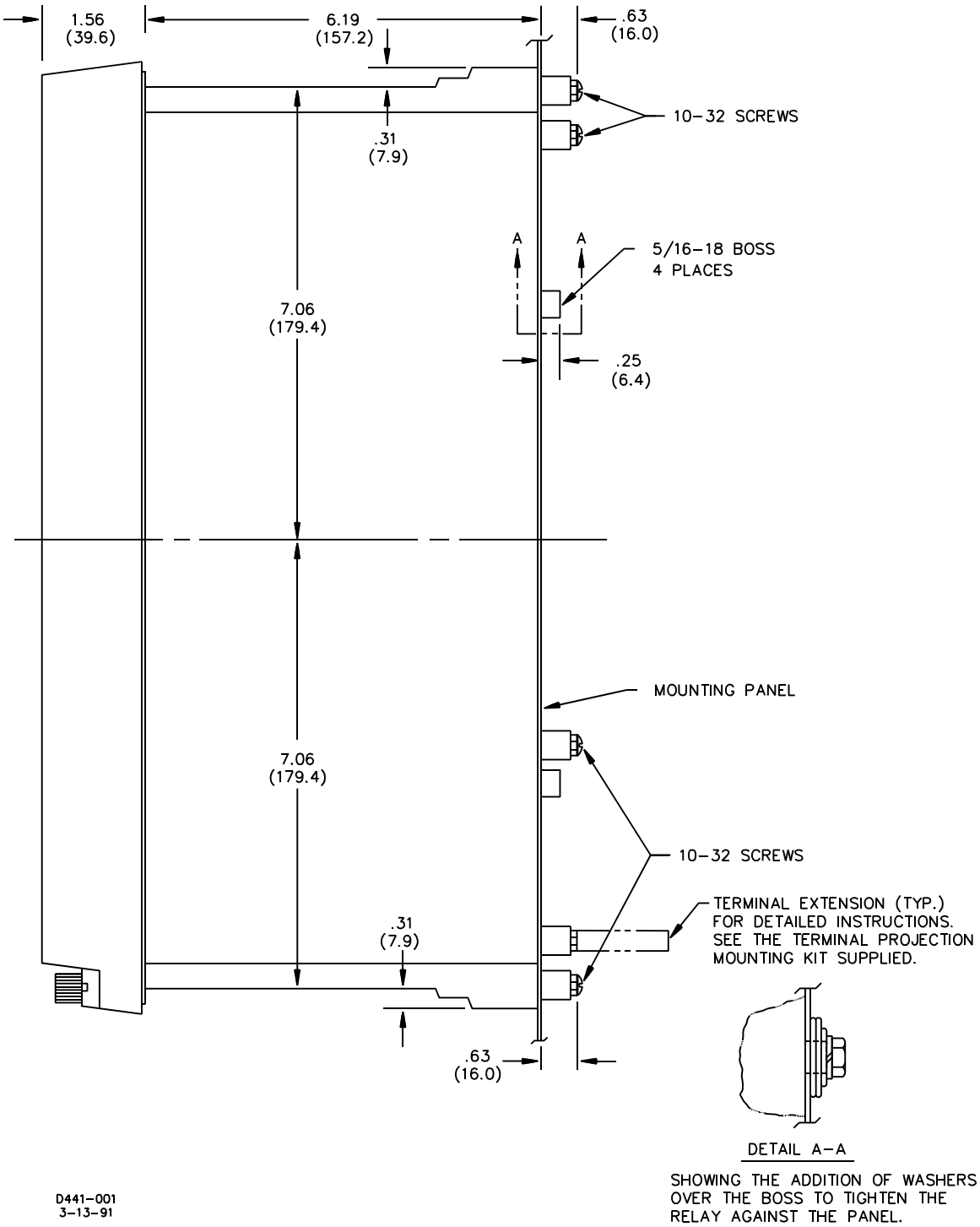

Figure 4-14. Outline Dimensions, Side View — Projection Mounting

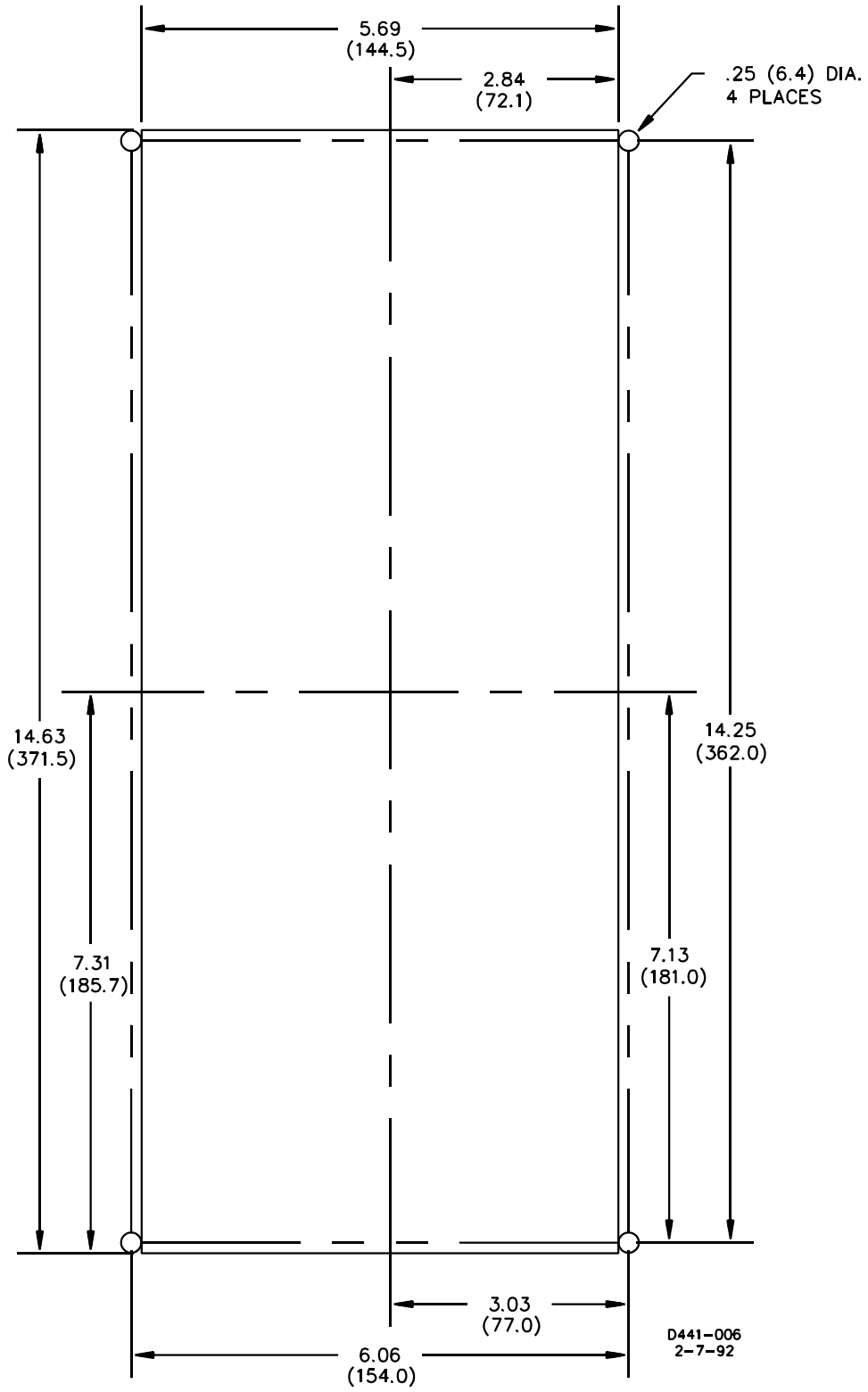

Figure 4-15. Panel Drilling Diagram — Semi-Flush Mounting

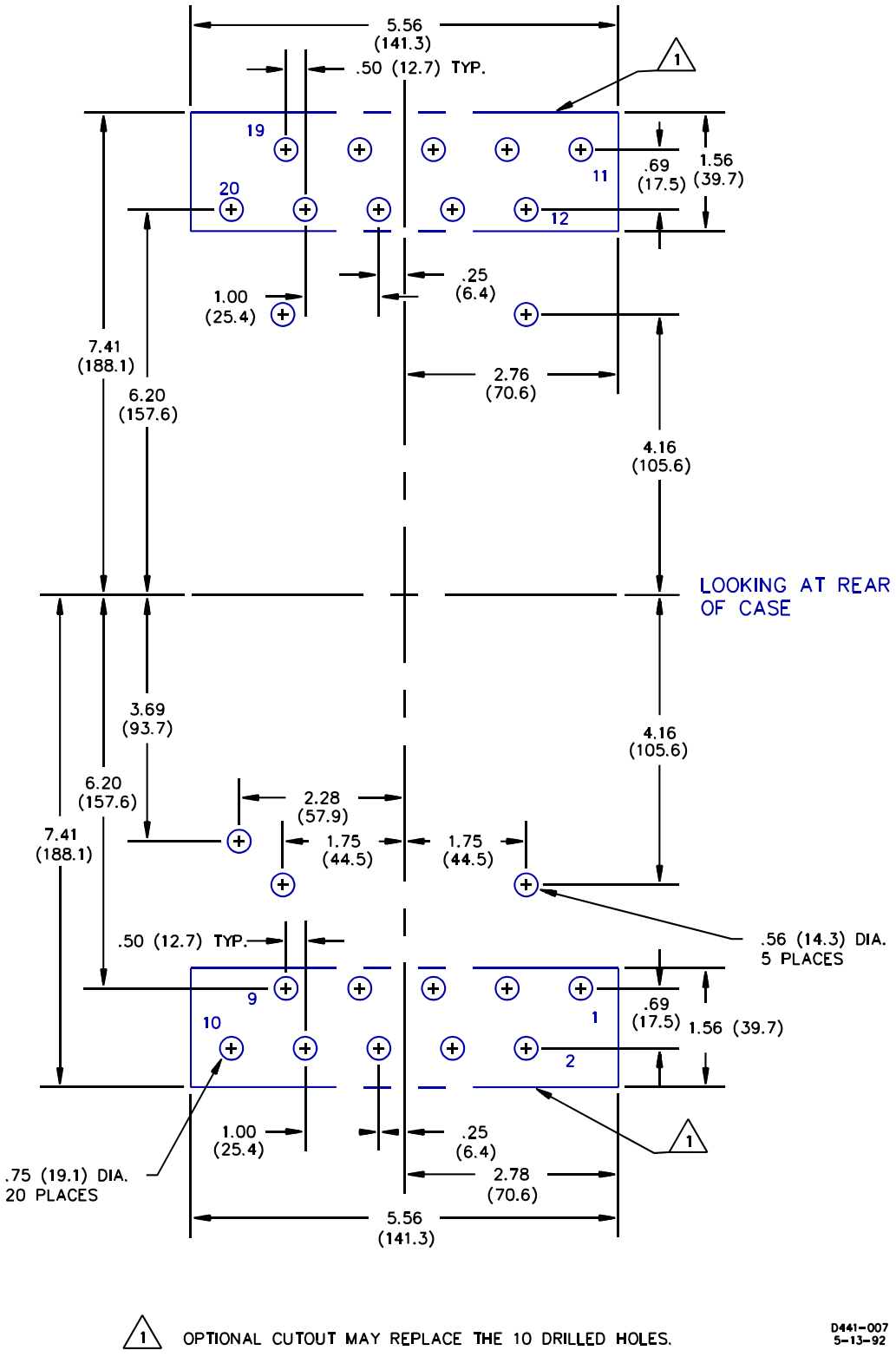

Figure 4-16. Panel Drilling Diagram — Projection Mounting

SECTION 5

MAINTENANCE

GENERAL

BE1-67N Ground Directional Overcurrent 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 is to be repaired in-house, consult the Service Manual (publication number 9 1907 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.

SECTION 6

MANUAL CHANGE INFORMATION

Substantive changes in this manual to date are summarized below.

Revision	Summary of Changes
A	Changed Figures 3-1 through 3-3 and added new Figure 3-4. Renumbered old Figure 3-4 to 3-5. Added Section 6 Manual Change Information.
B	Changed all sections of the manual to reflect revised specifications. Expanded switch and potentiometer terminology in Section 2. Changed Figure 3-1. In Section 4, included I_O polarization testing and a separate operational test procedure for sensing input ranges 3 and 4 (one ampere current transformers).