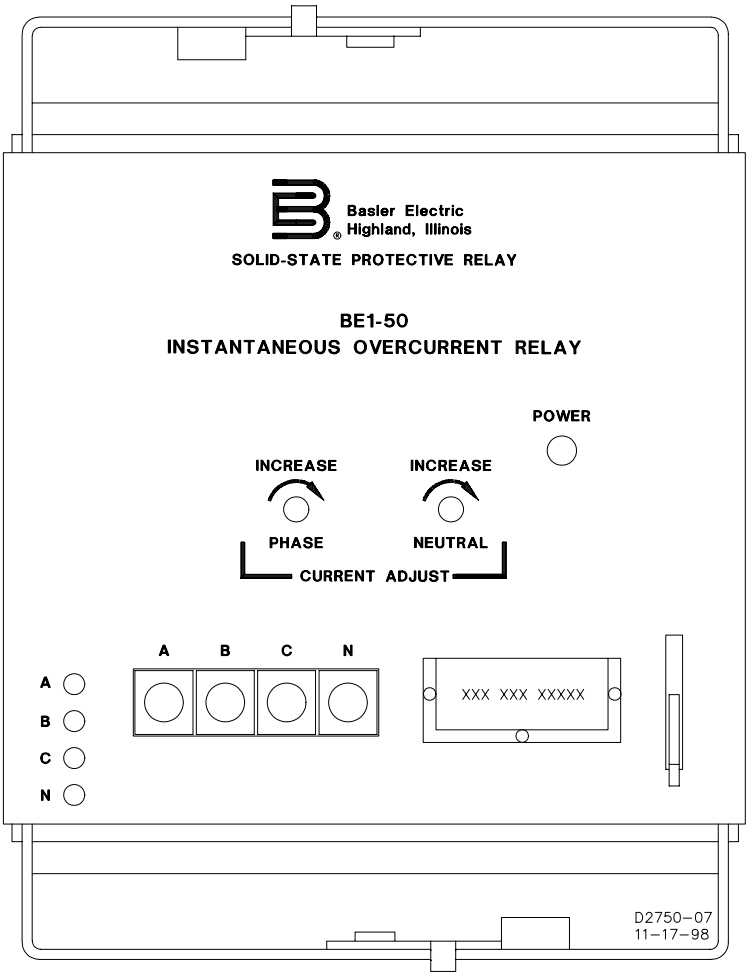
INSTRUCTION MANUAL

FOR

INSTANTANEOUS OVERCURRENT RELAY

BE1-50



Basler Electric

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INTRODUCTION

This Instruction Manual provides information concerning the operation and installation of BE1-50 Instantaneous Overcurrent Relays. To accomplish this, the following is provided.

- Specifications
- Functional characteristics
- Installation
- 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.

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SECTION 1 • GENERAL INFORMATION

APPLICATION

General

Instantaneous overcurrent relays provide phase and ground fault protection for distribution circuits, generators, motors, transformers, and other major components of power systems. BE1-50 Instantaneous Overcurrent Relays have a wide range of pickup settings and input configurations to accommodate protection requirements for power systems. BE1-50 relays are available in single- or multi-phase for power units. Some applications are illustrated in Figure 1-1.

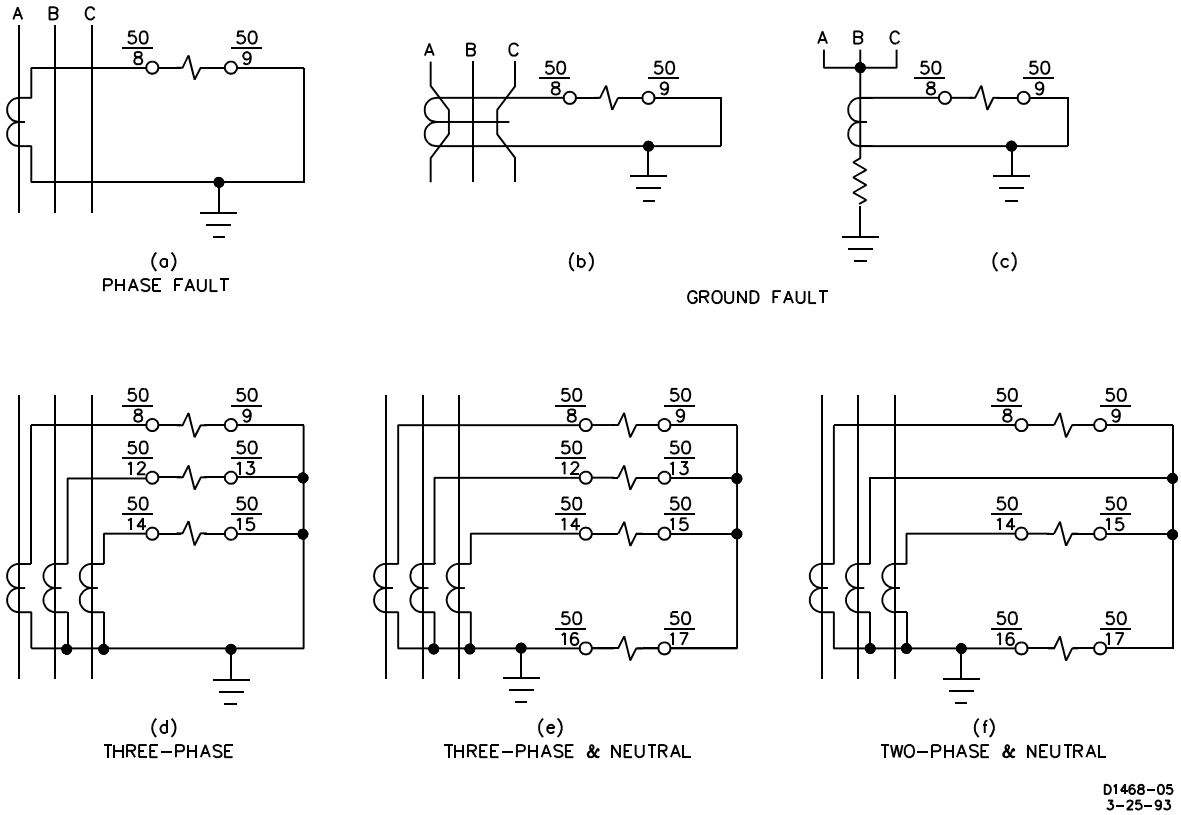

Figure 1-1. Typical BE1-50 Applications

Ground Fault Detection

BE1-50 relays can be applied to monitor zero sequence currents that are indicative of ground faults. The most sensitive method of ground fault protection utilizes a single current transformer through which all the conductors are passed (Figure 1-1b). Another method uses the residual connection of the three-phase CTs (Figure 1-1d) with the relay set higher than the normal system unbalance. The most direct method is to place a CT in the neutral of a grounded wye connection for equipment such as power transformers or generators (Figure 1-1c).

Phase Fault Detection

BE1-50 relays can be used in two ways to detect phase faults. The first method is to place an instantaneous overcurrent element in each phase with the setting higher than expected load current for any power system

element (Figure 1-1a, d, e, f). The second method is called self-balancing differential protection (Figure 1-2). In this application, the two leads of each phase of the protected motor or generator are passed through the window of the same associated phase current transformer so that the resulting secondary current is zero under normal operating conditions.

Combination With Other Protective Devices

Because BE1-50 relays can provide complete phase and ground fault protection in one unit (and with independent settings for phase and ground), they are often used to supervise other relay functions. In distance protection, BE1-50 relays can be used to prevent misoperation for light loading conditions by requiring a minimum current level before enabling the distance relay. As a fault detector, they are particularly effective because of their sensitivity, speed, and drop-out ratio.

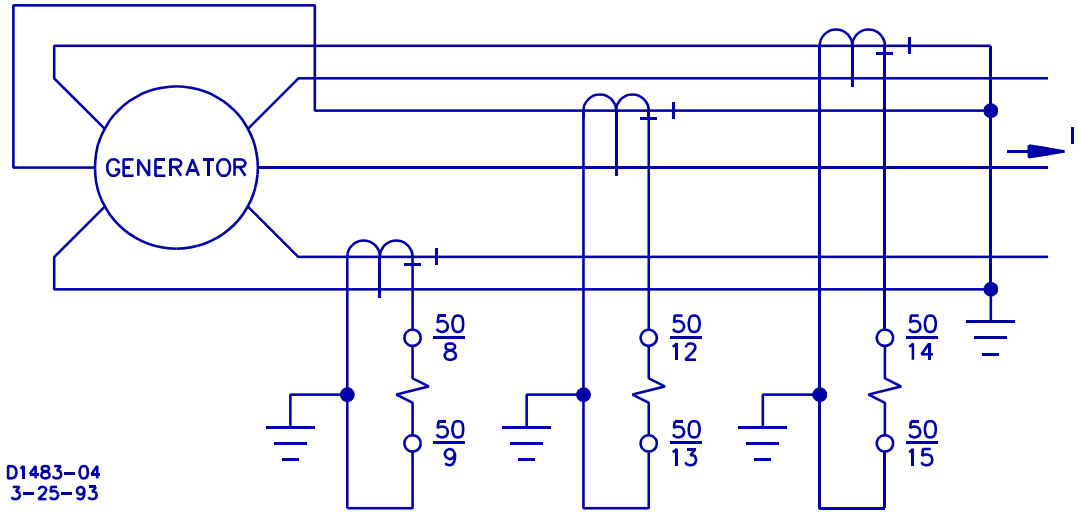

Figure 1-2. Self-Balancing Differential Protection

MODEL AND STYLE NUMBER DESCRIPTION

BE1-50 Instantaneous Overcurrent Relays electrical characteristics and operational features are defined by a combination of letters and numbers that make up its style number. The model number, together with the style number, describe the options included in a specific device, and appear on the front panel, drawout cradle, and inside the case assembly. Upon receipt of a relay, be sure to check the style number against the requisition and the packing list to ensure that they agree.

Style number identification chart (Figure 1-3) defines the electrical characteristics and operational features included in BE1-50 relays. For example, if the style number were **J6J A1P J1E1F**, the device would have the following:

(J) - 3-phase-and-neutral sensing
(6) - Phase sensing input range of 4.0 to 32 amperes.
(J) - Four normally open (N.O.) output relays.
(A1) - Instantaneous timing.
(P) - Operating power derived from 125 Vdc or 100/120 Vac.
(J) - Four internally operated targets.
(1) - Push-to-energize outputs (pushbuttons).
(E) - Neutral sensing range of 0.25 to 2.0 amperes.
(1) - N.O. auxiliary output relay.
(F) - Semi-flush mounting.

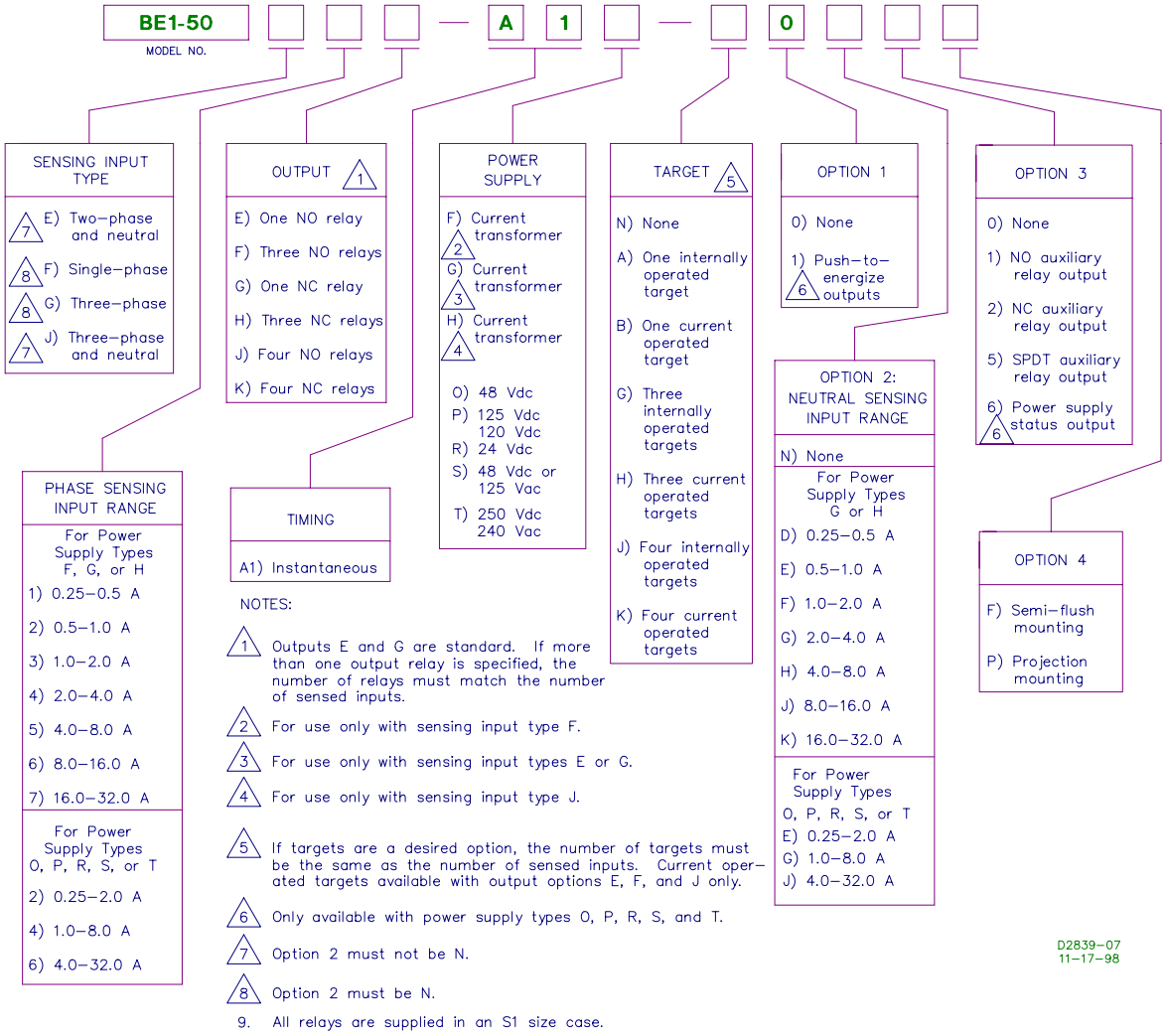

Figure 1-3. Style Number Identification Chart

SPECIFICATIONS

Current Sensing

Sensing inputs are nominally rated at 50/60 Hz and have a frequency range of 40 to 70 Hz. Current ratings and sensing burdens depend on the sensing range and power supply type (defined by the style number), and are shown in Table 1-1.

Pickup Range

Continuously adjustable over the range defined by the style number with independent ranges and adjustments for each phase and neutral pickup.

Pickup Accuracy

±2% or ±40 mA of pickup setting, whichever is greater.

Dropout

Within 2% of pickup.

Timing

1.5 cycles or less from onset of overcurrent condition. (30 milliseconds at 50 Hz, 25 milliseconds at 60 Hz)

Power Supply

Power supply Types F, G, and H derive operating power from the sensing inputs at a maximum burden of 5 VA per phase at pickup. Externally powered power supply ratings are shown in Table 1-2.

Table 1-1. Current Ratings and Sensing Burdens

Power Supply	Sensing Range Designation		Actual Sensing Range	Maximum Rating 50 or 60 Hz			
	For Phase	For Neutral		Current			Burden Per Input
				K*	1 Second	Continuous	
F, G or H	1	D	0.25 - 0.5A	144	12.0A	0.75A	8.5VA
	2	E	0.5 - 1.0A	144	12.0A	1.5A	8.5VA
	3	F	1.0 - 2.0A	625	25.0A	3A	8.5VA
	4	G	2.0 - 4.0A	2500	50.0A	6A	8.5VA
	5	H	4.0 - 8.0A	10000	100 A	12A	8.5VA
	6	J	8.0 - 16.0A	40000	200 A	20A	9.5VA
	7	K	16.0 - 32.0A	90000	300 A	20A	14.0VA
O, P, R, S or T	2	E	0.25 - 2.0A	10000	100 A	5A	0.2VA
	4	G	1.0 - 8.0A	90000	300 A	10A	0.6VA
	6	J	4.0 - 32.0A	90000	300 A	20A	4.8VA

* Ratings other than continuous may be calculated using the equation:

$$I = \sqrt{\frac{K}{t}}$$

where:

K = the indicated value
t = the time in seconds
I = maximum current

Table 1-2. Power Supply Burden

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
O (Mid Range)	48 Vdc	24 to 150 Vdc	4.0 W
P (Mid Range)	125 Vdc 120 Vac	24 to 150 Vdc 90 to 132 Vac	4.0 W 10.0 VA
R (Low Range)	24 Vdc	12† to 32 Vdc	4.0 W
S (Mid Range)	48 Vdc 125 Vdc	24 to 150 Vdc 24 to 150 Vdc	4.0 W 4.0 W
T (High Range)	250 Vdc 240 Vac	62 to 280 Vdc 90 to 270 Vac	6.0 W 14.0 VA

† Type R power supply initially requires 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 30 A for 0.2 seconds, carry 7 A continuously, and break 0.3 A.

Inductive:

120/240 Vac, 125/250 Vdc — Make 30 A for 0.2 seconds, carry 7 A continuously, and break 0.3 A. (L/R = 0.04).

Targets	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.
Radio Frequency Interference (RFI)	Maintains proper operation when tested for interference in accordance with IECC C37.90-1989, *Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.*
Fast Transient	Qualified to ANSI/IEEE C37.90.1-1989.
Isolation	In accordance with ANSI/IEEE C37.90-1989 one minute dielectric (high potential) test as follows:, All circuits to ground: 2121 Vdc. Input to output circuits: 1500 Vac or 2121 Vdc.
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.
Surge Withstand Capability	Qualified to ANSI/IEEE C37.90.1-1989 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.
UL Recognition	UL recognized per Standard 508, UL File No. E97033.
Operating Temperature	-40°C (-40°F) to +70°C (+158°F).
Storage Temperature	-65°C (-85°F) to +100°C (+212°F).
Weight	17.5 pounds (7.76 kg) minimum.
Case Size	S1.

SECTION 2 • HUMAN-MACHINE INTERFACE

CONTROLS AND INDICATORS

GENERAL

Table 2-1 lists and briefly describes the operator controls and indicators of the BE1-50 Instantaneous Overcurrent Relay. Reference the call-out letters to Figure 2-1.

Table 2-1. Controls and Indicators

Letter	Control or Indicator	Function or Indicator
A	**PHASE CURRENT ADJUST**	Multiturn potentiometer (no stops) sets the pickup point for all phase overcurrent elements within the relay. Continuously adjustable over the range defined by the style number.
B	**NEUTRAL CURRENT ADJUST**	Multiturn potentiometer (no stops) sets the pickup point for all neutral overcurrent elements within the relay. Continuously adjustable over the range defined by the style number.
C	**POWER** Indicator	LED illuminates to indicate that the relay power supply is functioning.
D	Target Reset Lever	Linkage extends through bottom of front cover to reset the target indicators.
E	Target Indicators (Optional)	Magnetically latching indicators are tripped to red to indicate that the corresponding output relay either has been energized (internally operated) or that a minimum of 0.2 amperes has flowed through the contacts (current operated).
F	Push-to-Energize (Optional) (Only available with power supply types O, P, R, S, T)	Momentary pushbuttons are accessible through the front panel and used to test output relays and verify system wiring.

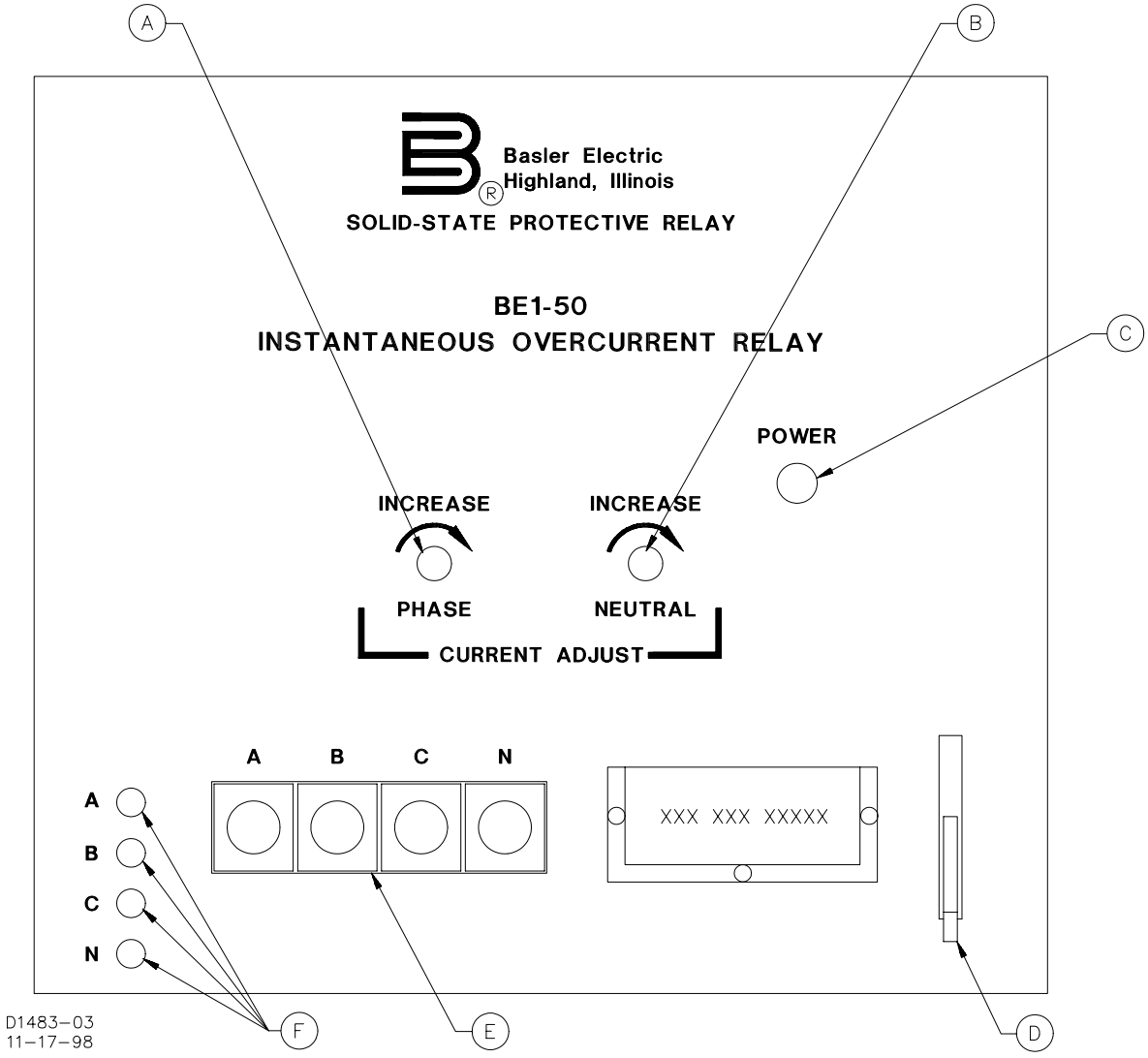

Figure 2-1. Location of Controls and Indicators

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL

BE1-50 Instantaneous Overcurrent Relays are static devices that respond to the current magnitude of the monitored circuit.

FUNCTIONAL DESCRIPTION

Figure 3-1 is a functional block diagram of the BE1-50 Instantaneous Overcurrent Relay.

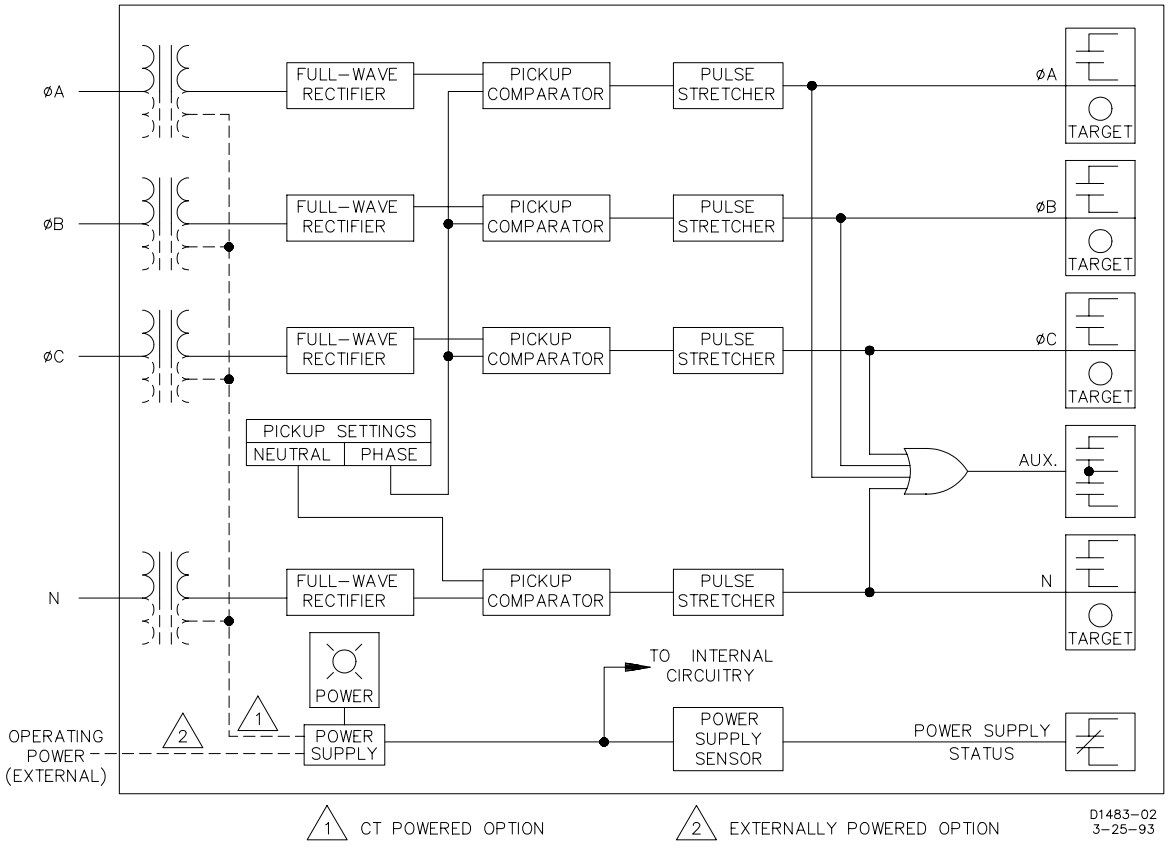

Figure 3-1. Functional Block Diagram

Step-Down Transformer

Monitored system currents are applied to the primaries of internal current transformers and stepped down to internal circuit levels. The internal current transformers provide 1500 V isolation for the twelve volt logic circuits of the relay.

Full-Wave Rectifiers

Outputs from each step-down transformer are full-wave rectified and applied to resistor networks to develop voltages that represent the magnitude of the monitored system currents.

Response Characteristics

Input current signals are rectified and passed through a low pass filter. Filtering smooths out current spikes and provides a degree of security against operation on short term transients.

Filtering also smooths out the harmonic component effects on current signals. Harmonic component effects are reduced approximately by 1/*n* where *n* is the order of the harmonic. For example, the third harmonic effect is reduced by filtering to 1/3rd. of what it would be without filtering. With filtering, the response characteristics are similar to those of electromechanical relays.

Pickup Settings

A front panel multiple-turn potentiometer controls the pickup setting for all phases. The potentiometer establishes the reference voltage representative of the system current which will cause the relay to respond. On relay styles monitoring neutral current, an independent potentiometer is provided to establish the pickup level for neutral.

Pickup Comparators

The magnitude of each monitored current is compared with the appropriate pickup setting. When a pickup setting is exceeded, a pulse stretcher for that phase (or neutral) is activated.

Pulse Stretchers

Because the sensed currents are full-wave rectified and minimally filtered to retain high speed operation, the pulse output from the comparators must be extended.

Outputs

Defined by the style number, individual output relays may be provided for each monitored phase (and neutral). One output relay may serve for all monitored phases (and neutral). In addition, one auxiliary output relay may be provided that serves for all monitored phases (and neutral).

Targets

Magnetically latching target indicators may be provided for each monitored phase and neutral. These targets are actuated upon an overcurrent condition and may be either internally operated or current operated. Current operated targets require a minimum of 0.2 A flowing through their corresponding output relay's contacts. Target indicators may be reset with the manual reset lever.

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 changed so that customers may order the same style numbers that they ordered previously. The first newly designed power supplies were installed in unit case relays with EIA date codes 9638 (third week of September 1996). Relays with a serial number that consists of one alpha character followed by eight numerical characters also have the 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, 120 Vac	24 to 150 Vdc, 90 to 132 Vac
High Range	T	125, 250 Vdc, 120, 240 Vac	62 to 280 Vdc, 90 to 270 Vac

† 14 Vdc is required to start the power supply.

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

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

SECTION 4 • INSTALLATION

GENERAL

When not shipped as part of a control or switchgear panel, 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 (Section 5) be performed prior to installation.

RELAY OPERATING PRECAUTIONS

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

1. A minimum of 0.2 A in the output circuit is required to ensure operation of current operated targets.
2. 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.
3. 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.
4. 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 ANSI/IEEE C37.90-1989 one minute dielectric (high potential) test as follows:

All circuits to ground:	2121 Vdc.
Input to output circuits:	1500 Vac or 2121 Vdc.

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 in Figures 4-1 through 4-9.

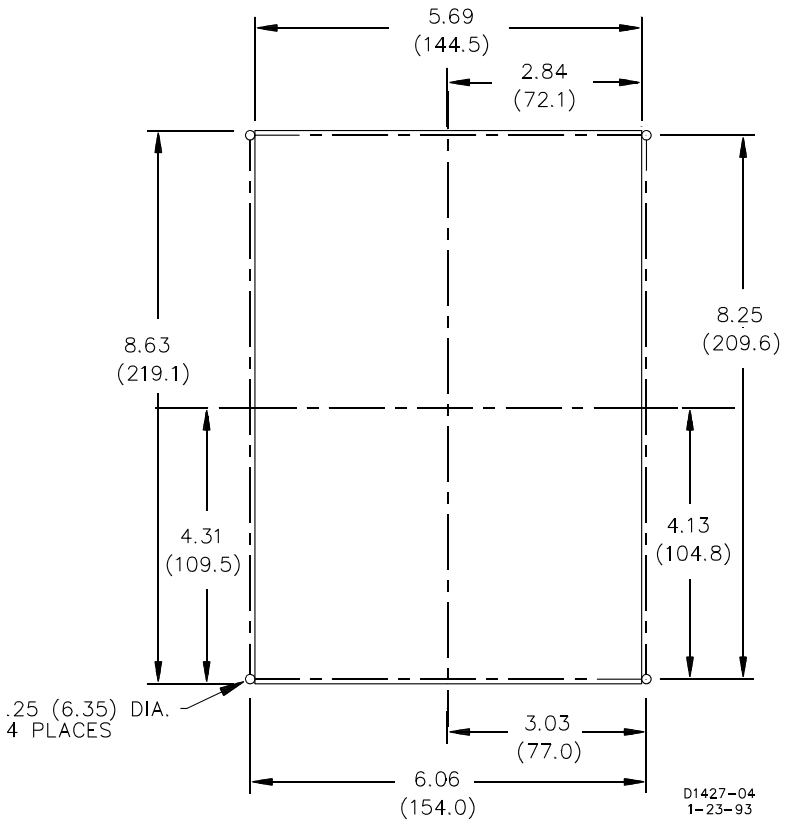

Figure 4-1. S1 Case, Panel Drilling Diagram, Semi-Flush Mounting

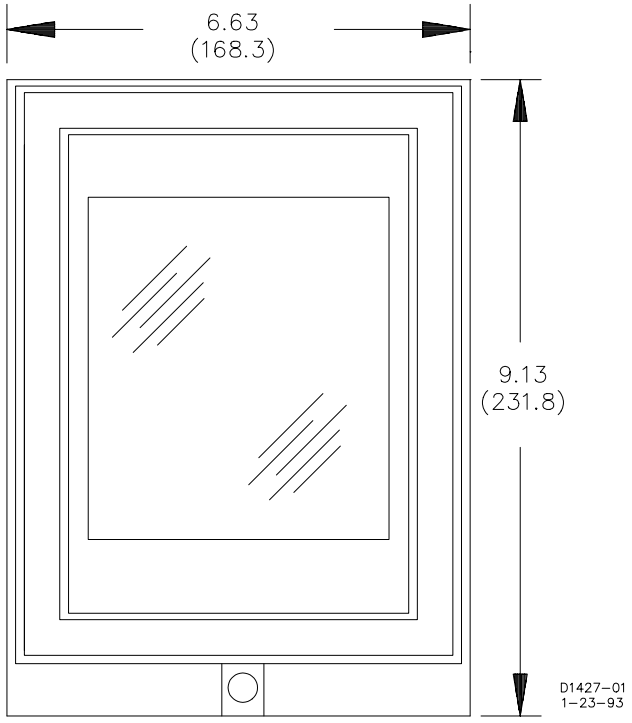

Figure 4-2. S1 Case, Outline Dimensions, Front View

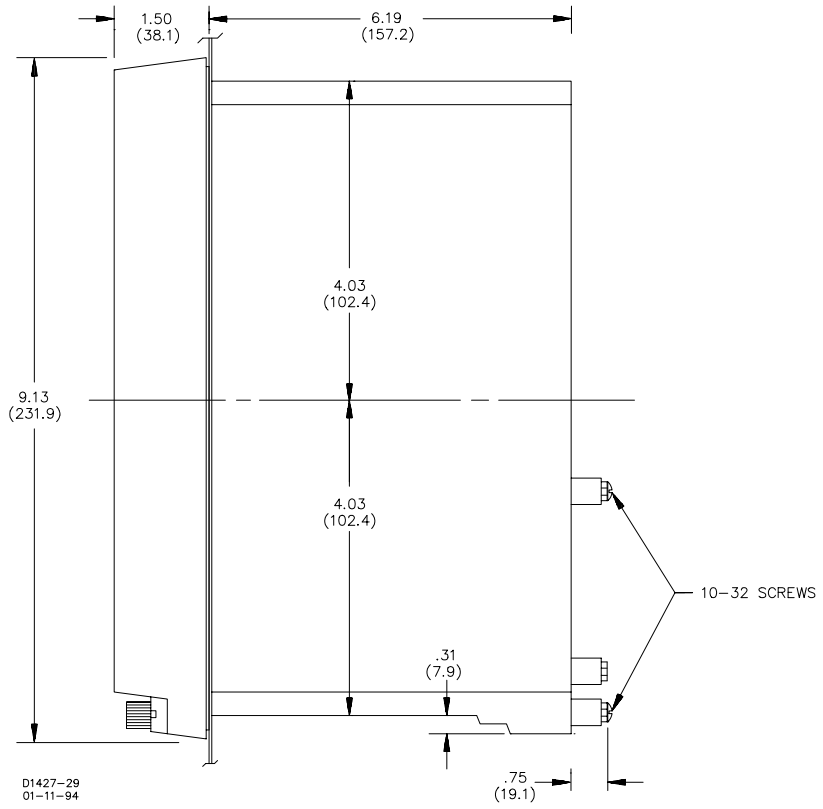

Figure 4-3. S1 Case, Single-Ended, Semi-Flush Mounting, Outline Dimensions, Side View

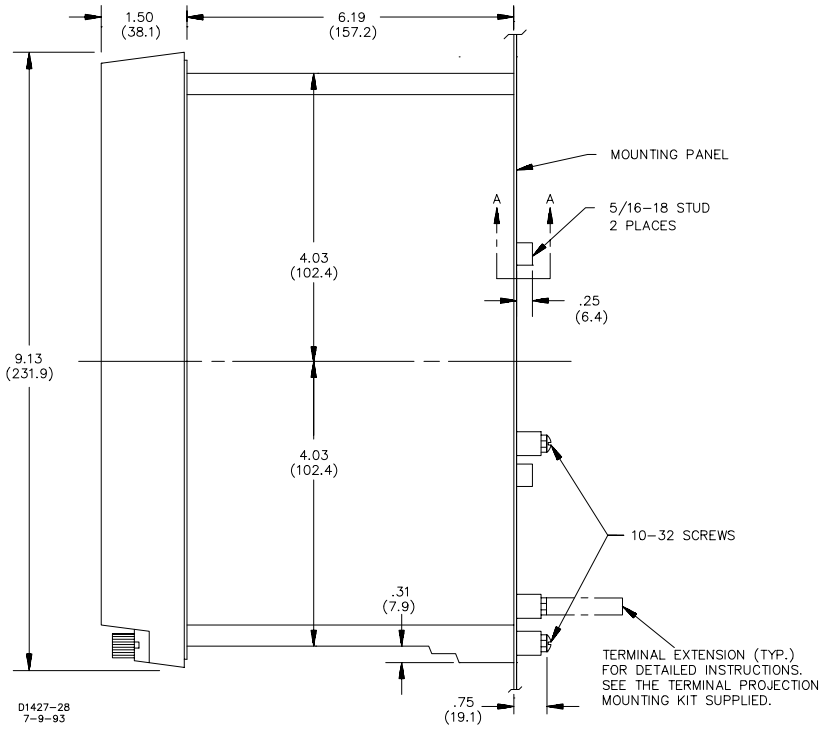

Figure 4-4. S1 Case, Single-Ended, Projection Mounting, Outline Dimensions, Side View

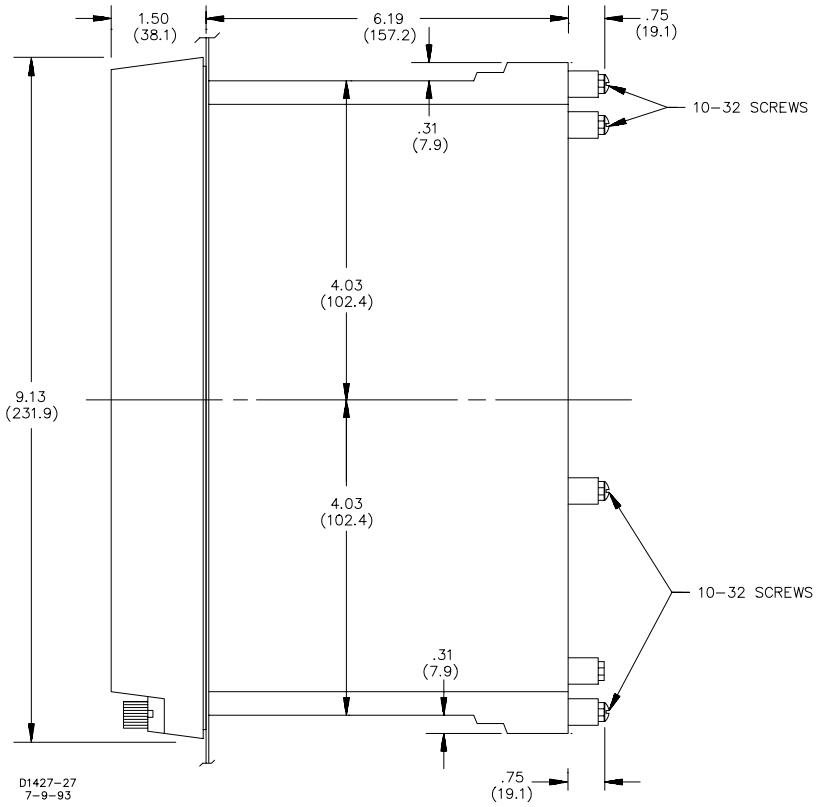

Figure 4-5. S1 Case, Double-Ended, Semi-Flush Mounting, Outline Dimensions, Side View

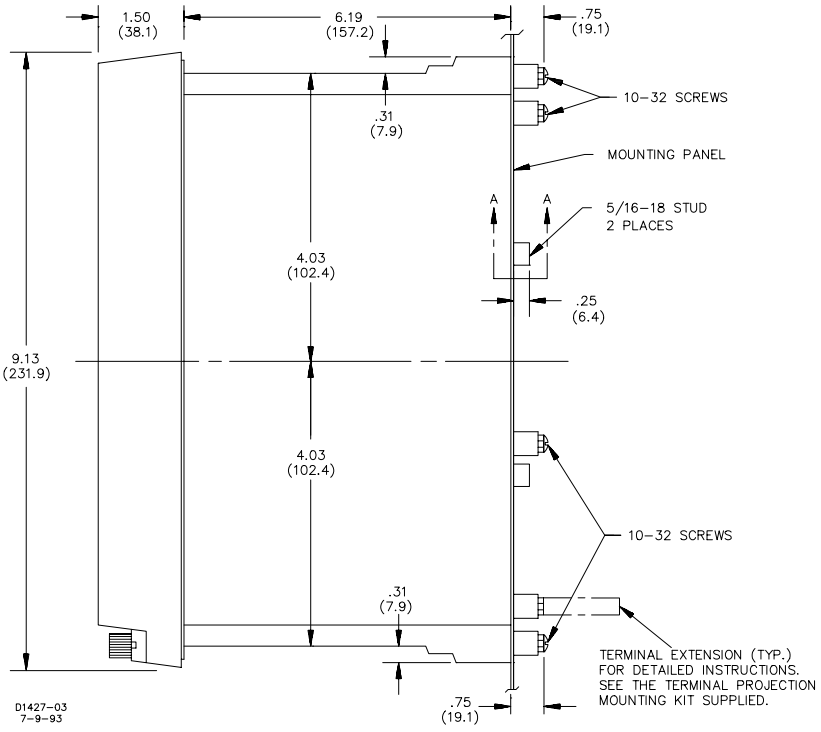

Figure 4-6. S1 Case, Double-Ended, Projection Mounting, Outline Dimensions, Side View

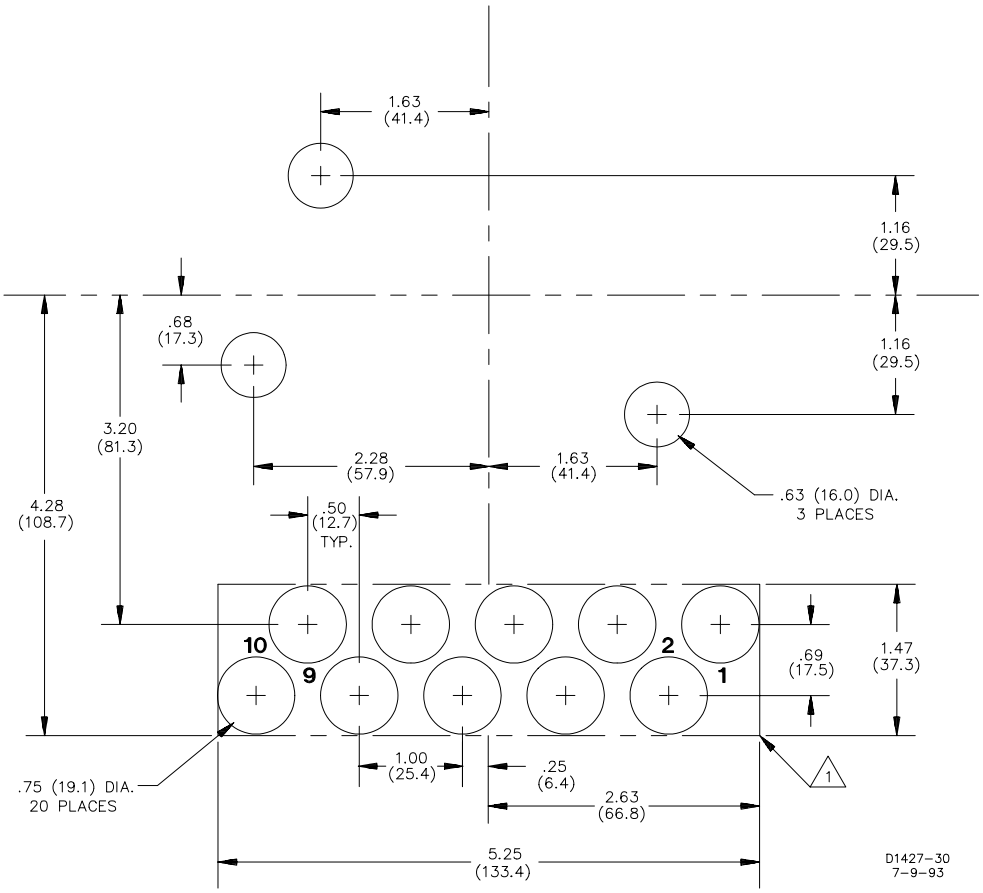

Figure 4-7. S1 Case, Single-Ended, Panel Drilling Diagram, Rear View

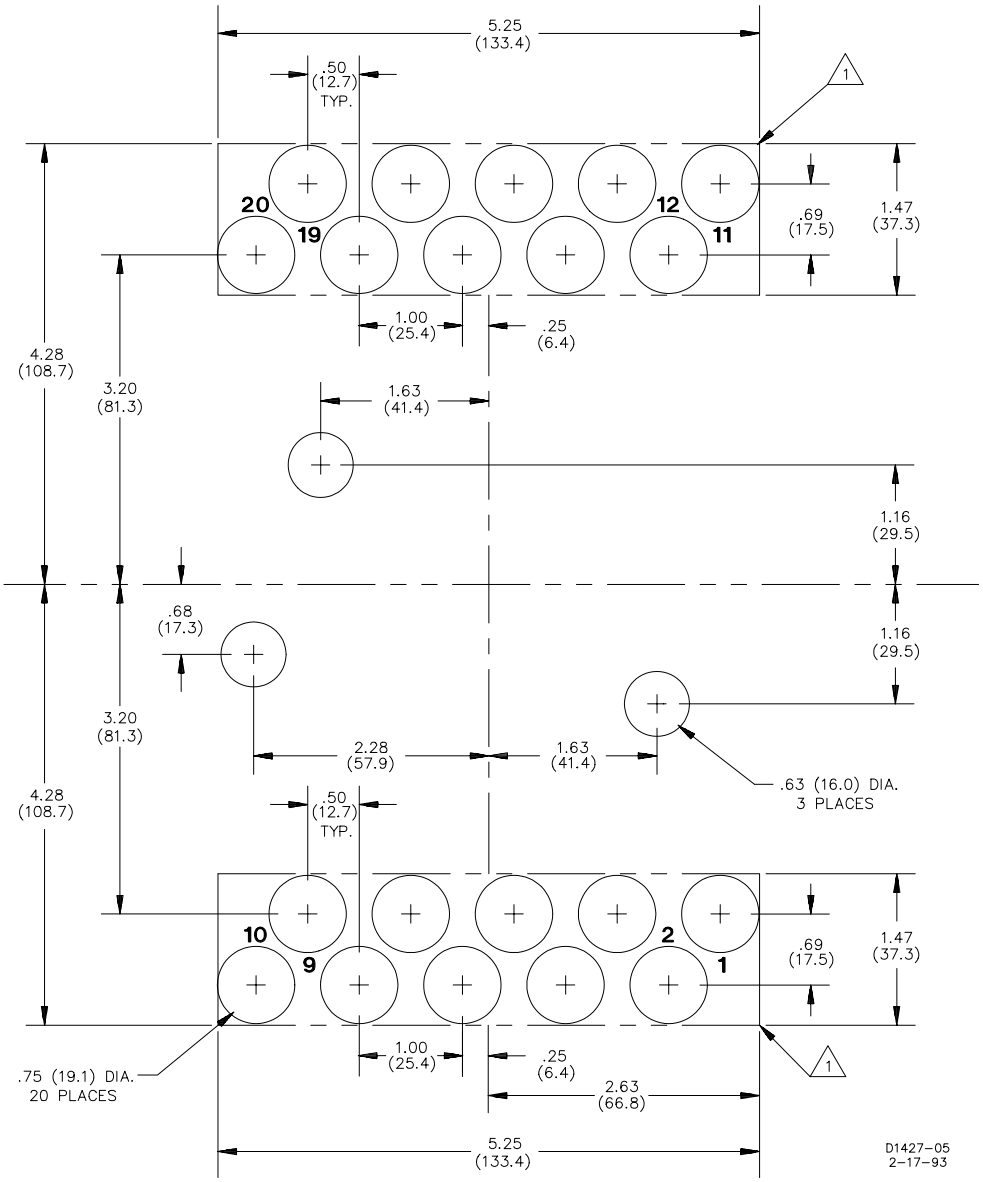

Figure 4-8. S1 Case, Double-Ended, Panel Drilling Diagram, Rear View

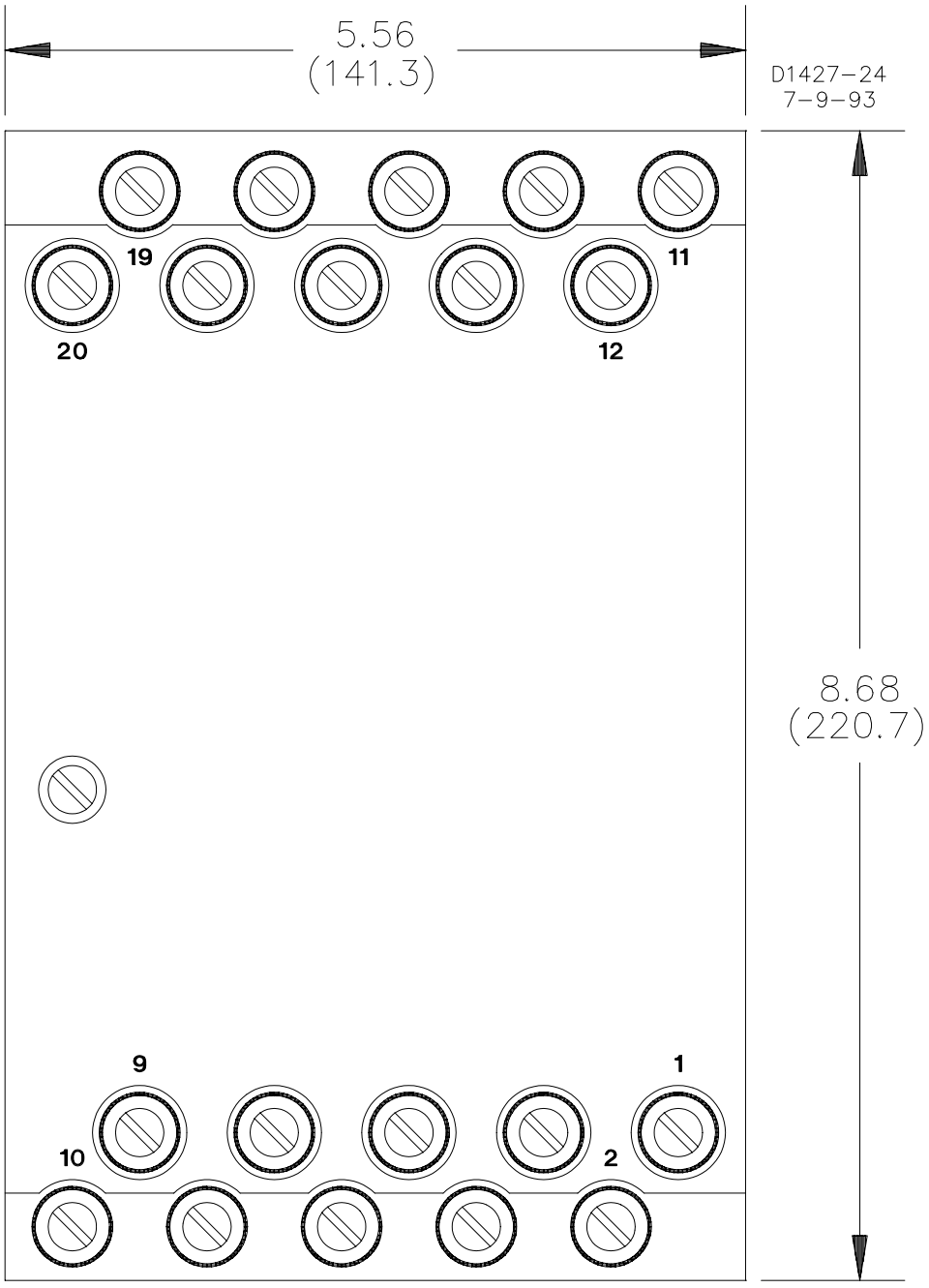

Figure 4-9. Outline Dimensions, Rear View

CONNECTIONS

Incorrect wiring may result in damage to the relay. Except for the ground wire, connections should be made with minimum wire size of 14 AWG. For the ground wire, refer to the following note. Typical sensing input connections are shown in Figures 4-10 through 4-13. Typical output connections are shown in Figures 4-14 and 4-15. Typical internal connections are shown in Figures 4-16 through 4-18.

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.

Relay circuitry is connected to the case terminals by removable connection plugs (1 plug for 10-terminal cases and 2 plugs for 20-terminal cases). Removal of the connection plug(s) opens the N.O. trip contact circuits and shorts the N.C. trip contact circuits before opening the power and Sensing Circuits.

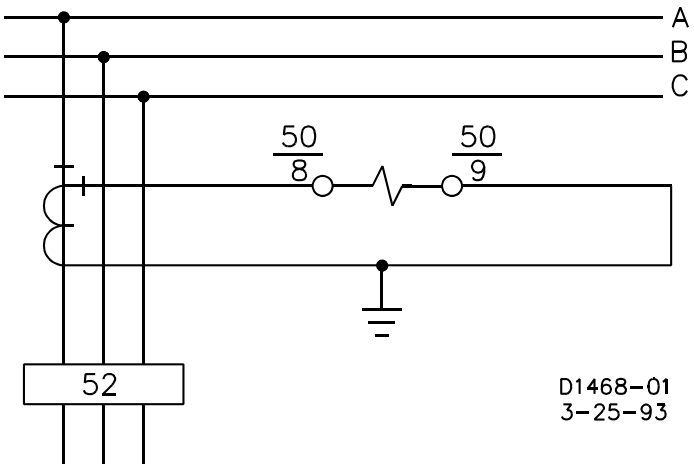

Figure 4-10. Single-Phase Sensing Input Connections

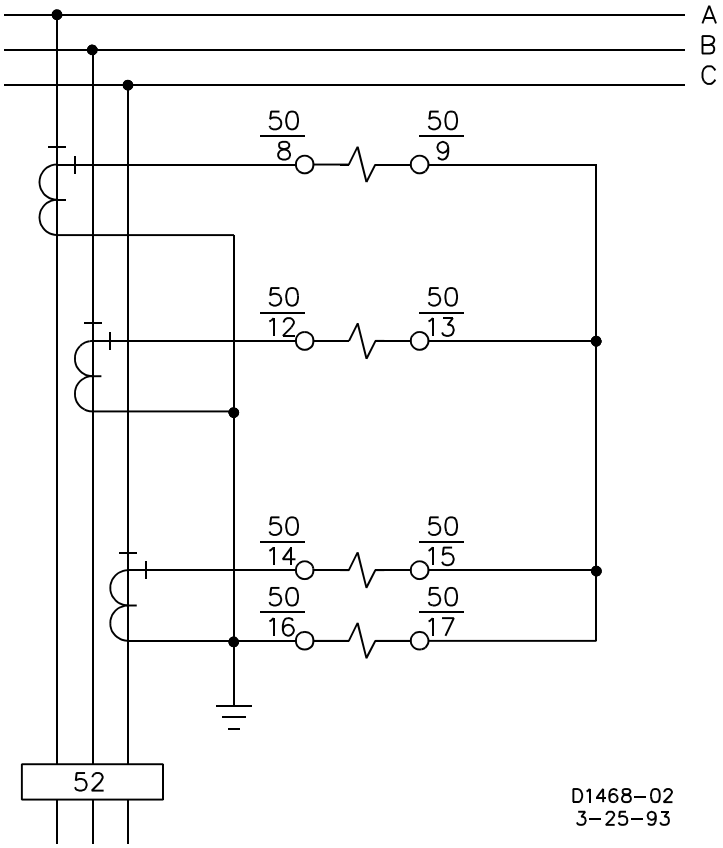

Figure 4-11. Three-Phase and Neutral Sensing Input Connections

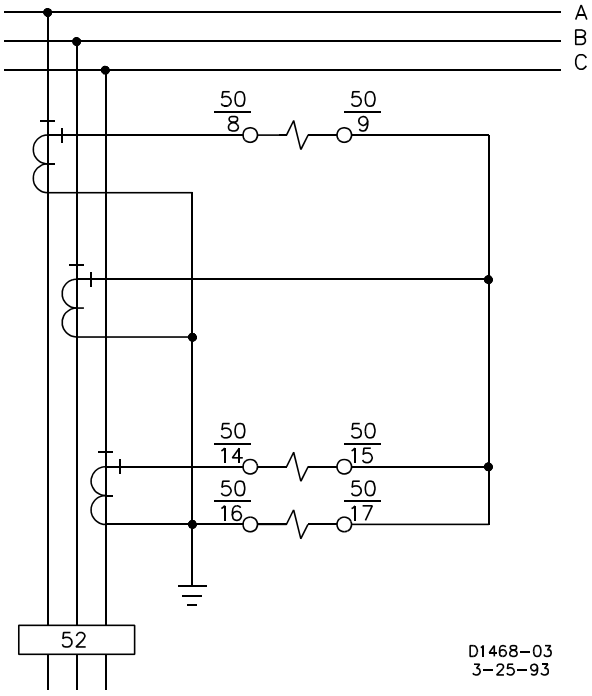

Figure 4-12. Two-Phase and Neutral Sensing Input Connections

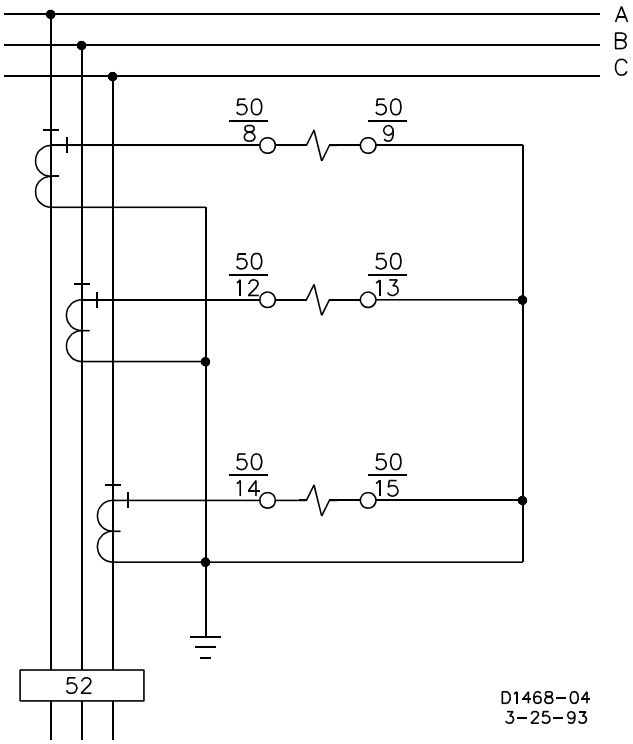

Figure 4-13. Three-Phase Sensing Input Connections

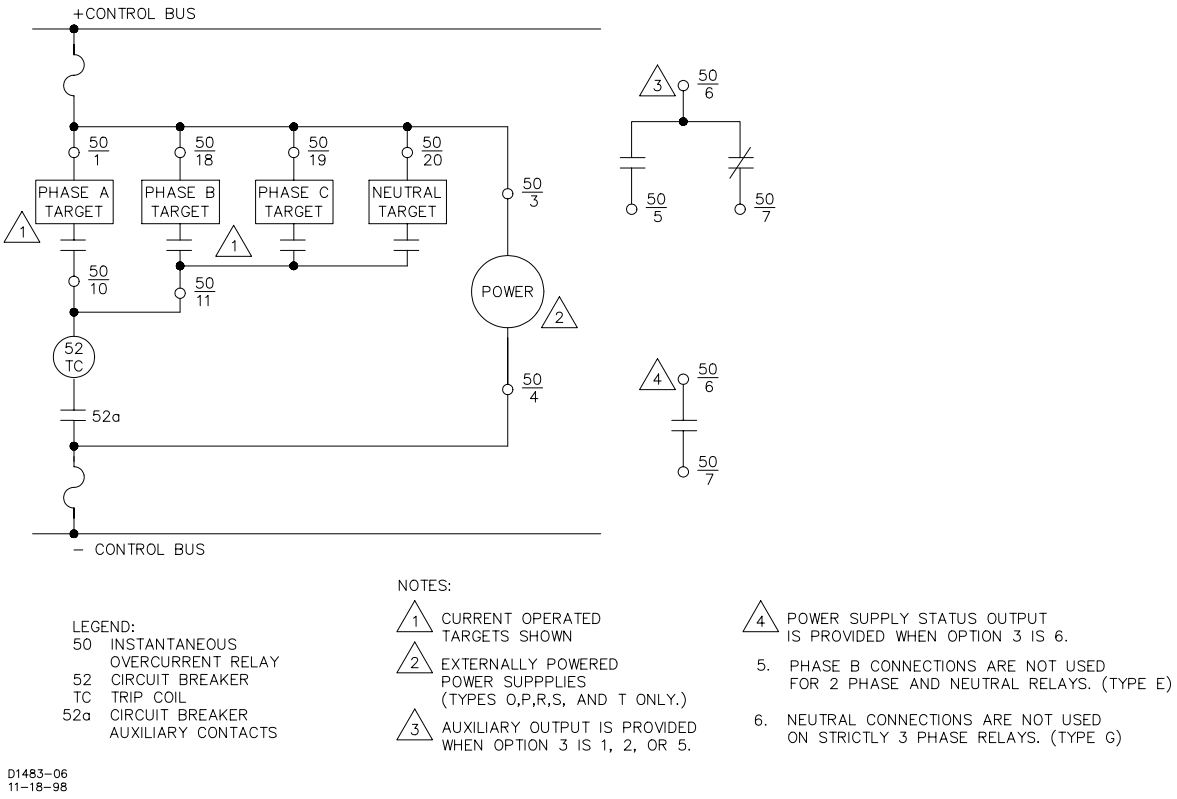

Figure 4-14. Typical Output Connections (Sensing Input Type E or G and Output F or H) or (Sensing Input Type J and Output J or K)

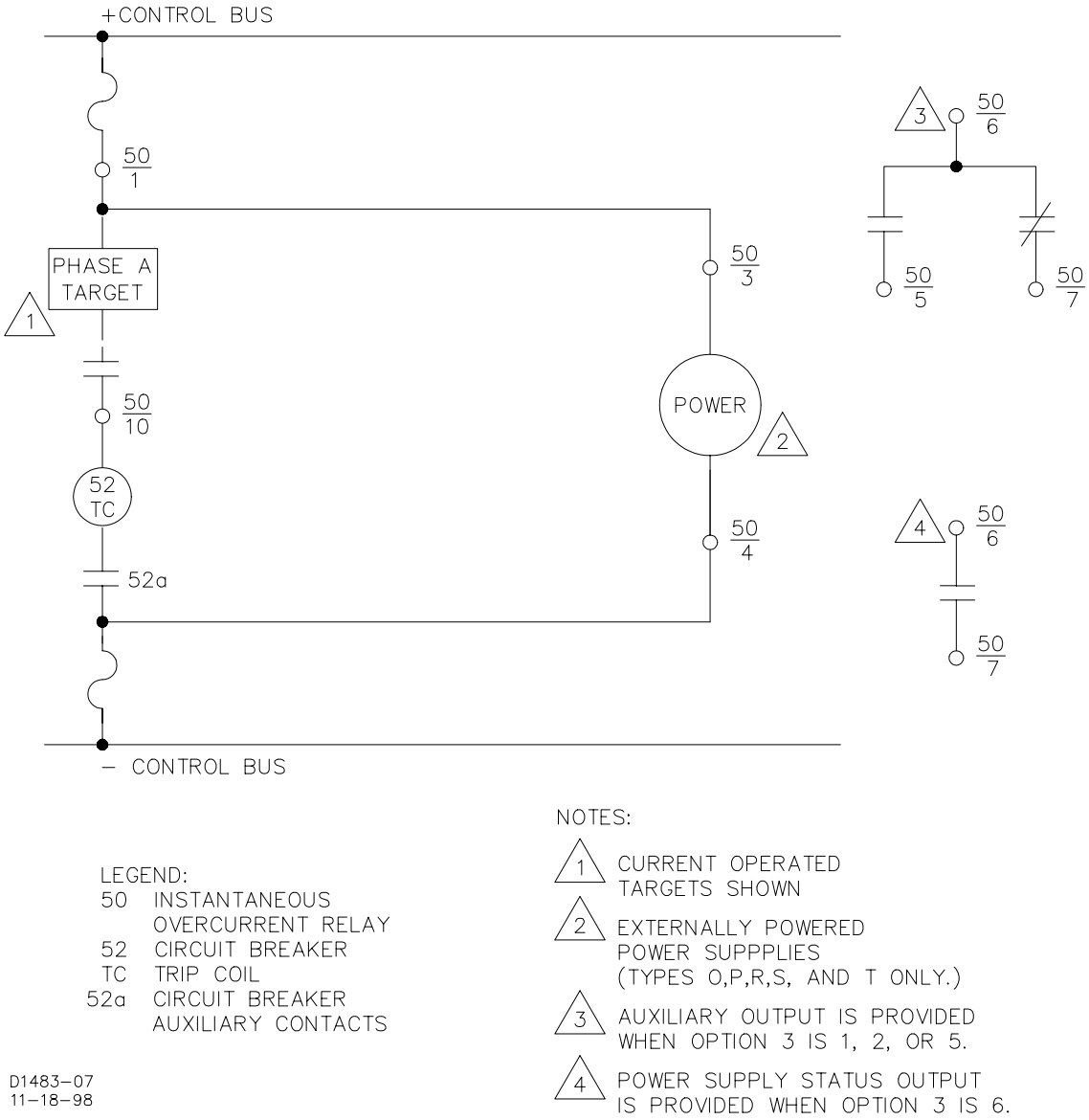

Figure 4-15. Typical Output Connections (Sensing Input Type F and Output E or G)

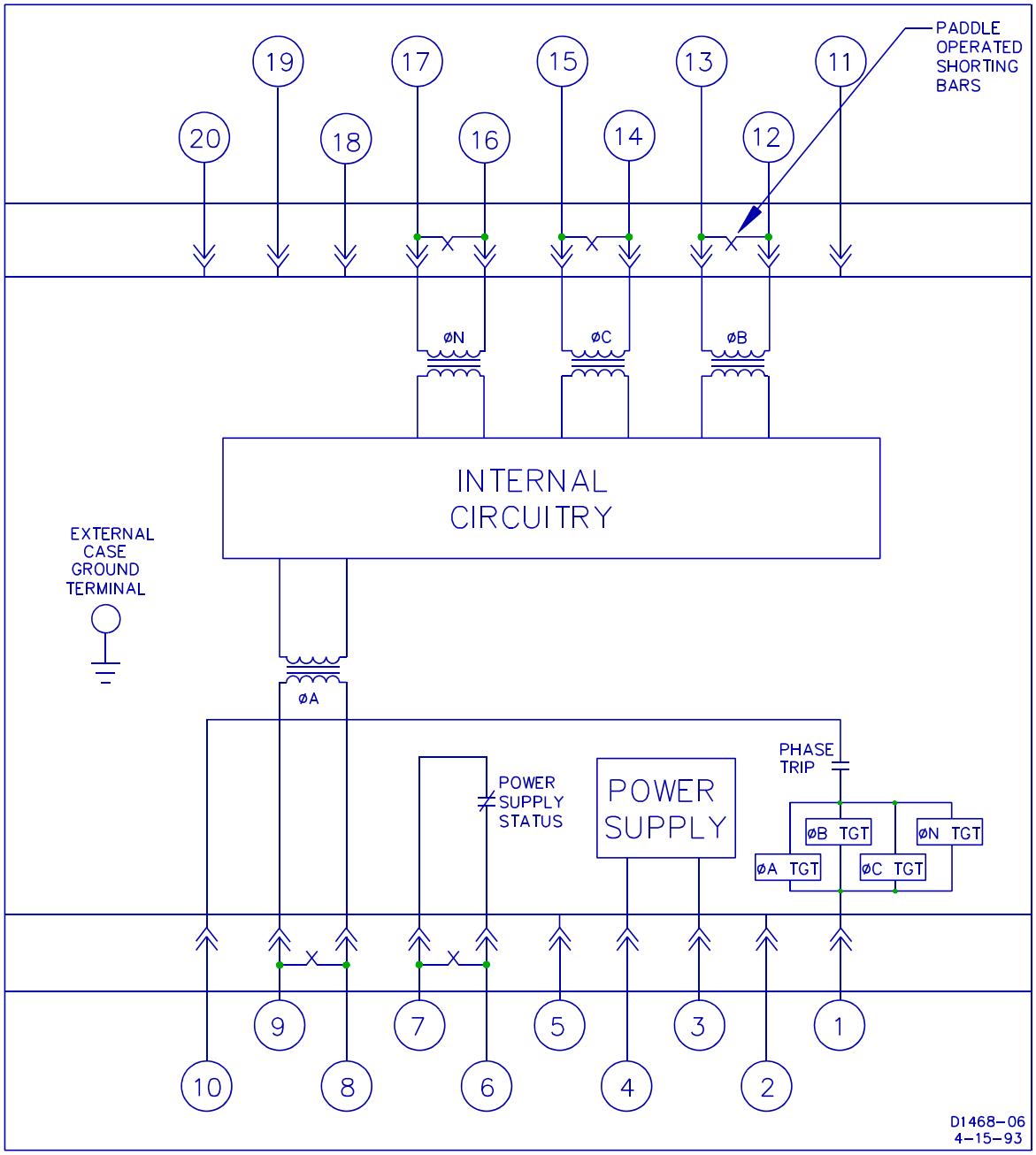

Figure 4-16. Typical Internal Connections Three-Phase and Neutral Sensing, Output Type E, Option 3-6

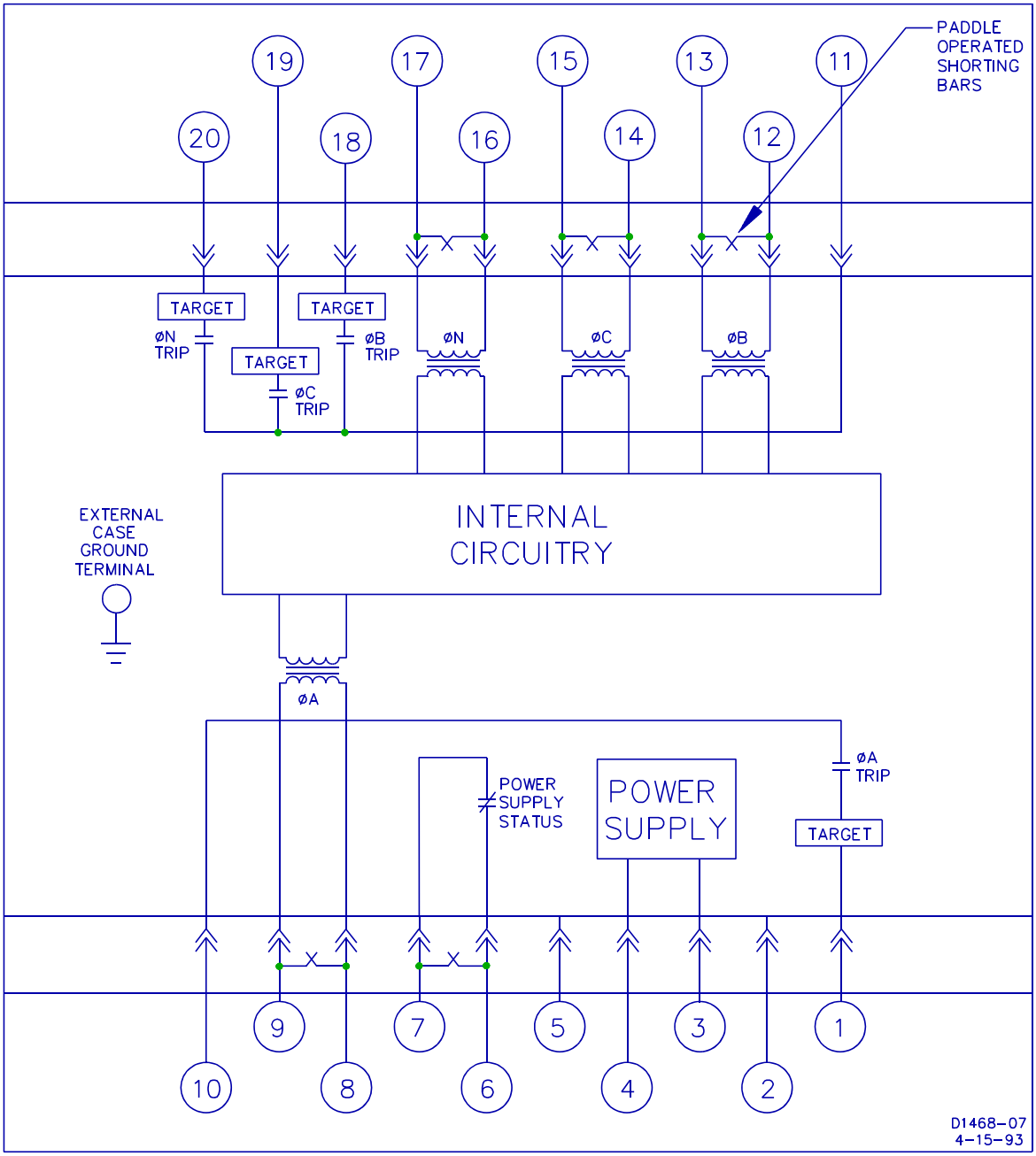

Figure 4-17. Typical Internal Connections Three-Phase and Neutral Sensing, Multiple Output Relays

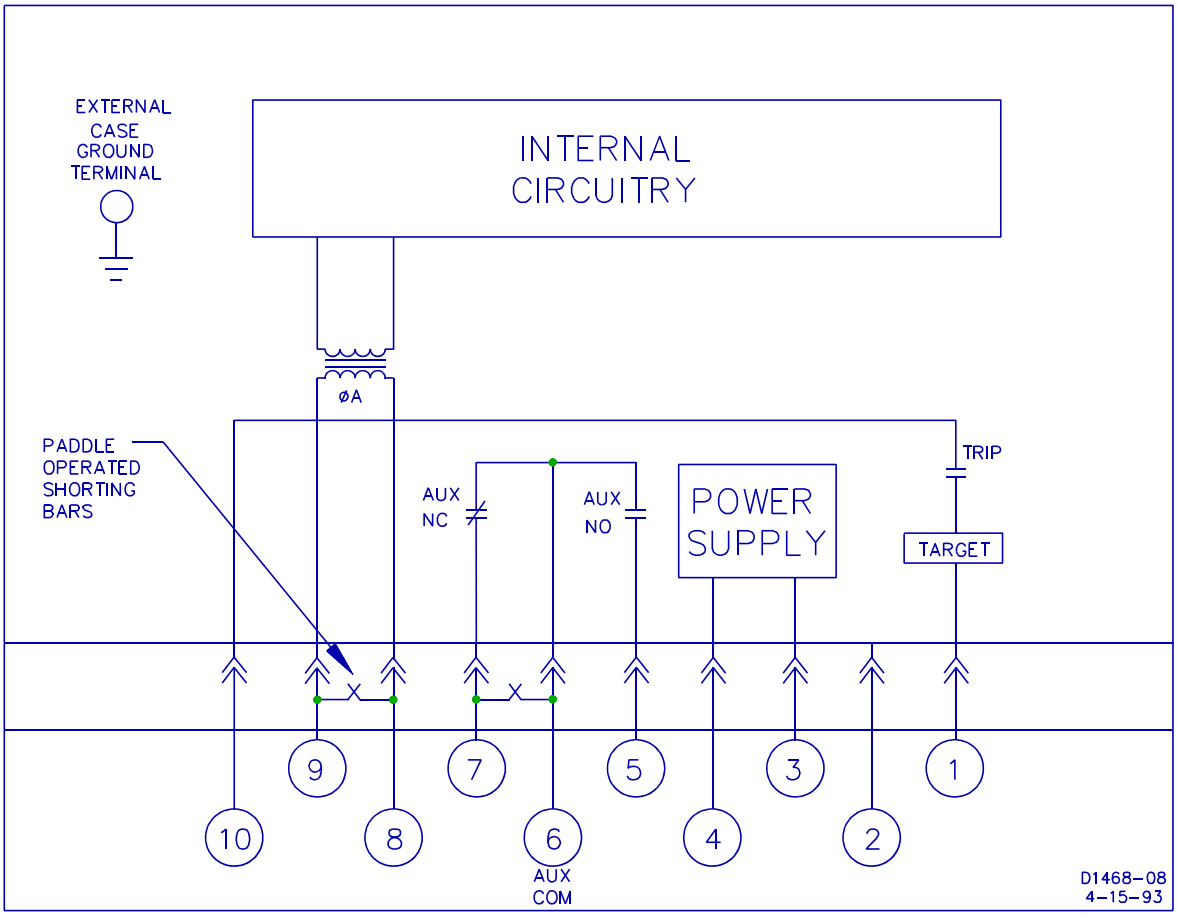

Figure 4-18. Typical Internal Connections Single-Phase, Output E, Option 3-5

SECTION 5 • TESTING

GENERAL

When not shipped as part of a control or switchgear panel, 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 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. 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.
3. 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.
4. 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.

OPERATIONAL TEST PROCEDURE

BE1-50 Instantaneous Overcurrent Relays operation and calibration can be verified by the following operational test procedure. Test results obtained from this procedure may not fall within specified tolerances. When evaluating results, consider the inherent error of the test equipment. Test equipment should be accurate within one percent or better.

CAUTION

When adjusting for currents higher than 20 amperes AC, do NOT allow sustained current flow longer than thirty seconds. Allow a minimum of one minute cooling time between applications.

Step 1. Connect the test circuit shown in Figure 5-1. For relay styles with power supply types O, P, R, S, or T, apply appropriate operating power to terminals 3 and 4. If equipped with power supply status contacts (option 3-6), verify that these contacts are open when external power is applied. Remove input power and verify that the status contacts close. (For relay styles with power supply types F, G, and H, the relay is powered from the current sensing inputs.)

Step 2. Turn the phase pickup adjustment full CCW. For relay styles with target indicators, actuate the manual reset lever to insure that the targets are reset.

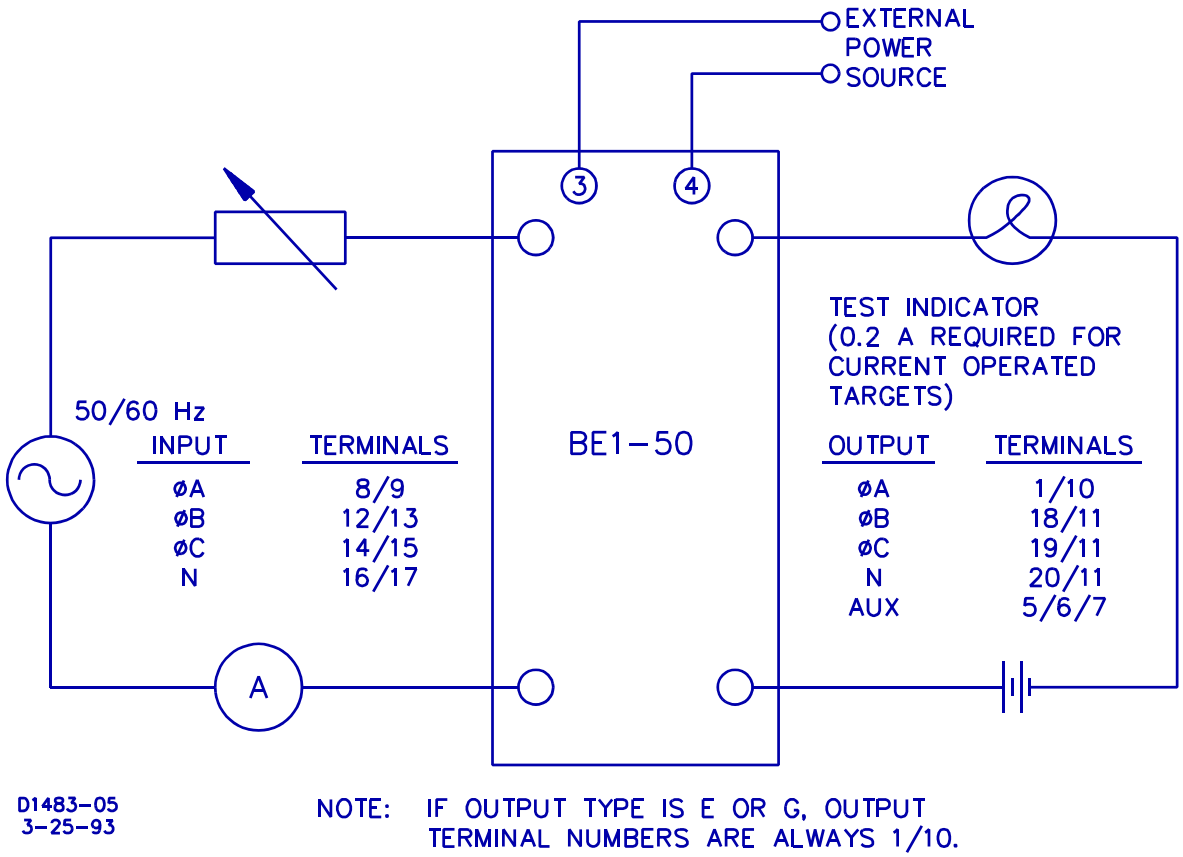

Figure 5-1. Test Circuit Connection

Step 3. Apply sensing current (near zero) and slowly increase the sensed current until the test indicator changes state.

Result: Current indicated by the ammeter is within two percent of the low end of the sensing range. If present, the target indicator for the tested phase (or neutral) should be actuated.

Step 4. Turn the pickup adjustment fully CW. Reset target indicators if present.

Step 5. Apply sensing current (near zero) and slowly increase the sensed current until the test indicator changes state.

Result: Current indicated by the ammeter is within two percent of the high end of the sensing range. If present, the target indicator for the tested phase (or neutral) should be actuated.

Step 6. Repeat Steps 2 through 5 for each phase and neutral as necessary for your style relay. (Neutral sensing ranges may be different than the phase sensing range.)

SECTION 6 • MAINTENANCE

GENERAL

BE1-50 Instantaneous Overcurrent Relays require no preventive maintenance other than a periodic operational test (refer to Section 5 for operational test procedure). If the relay fails to function properly, and factory repair is desired, contact the Customer Service Department of the Power Systems Group, Basler Electric, for a return authorization number prior to shipping.

IN-HOUSE REPAIR

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.

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

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

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

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

SECTION 7 • MANUAL CHANGE INFORMATION

CHANGES

Substantive changes in this manual to date are summarized in the following table.

Table 7-1. Summary of Changes

Revision	Summary of Changes	ECA (ECO)/Date
B	Added UL Recognition statement, page 1-5 and added new Figures 4-6 through 4-9.	13261/06-93
C	Deleted all references to Service Manual. Updated Style Chart by adding Option 3-6 Power Supply Status Output, changing Power Supply Type T from “230 Vac” to “240 Vac,” deleted “Selectable” from Type S, and added Note 6. Deleted 500 Vdc from Output Circuits in *Specifications*. Added Note* to Table 1-1. Added new power supply information and Fast Transient to *Specifications*. Corrected Figure 2-1 from “Instantaneous Undercurrent Relay” to “Instantaneous Overcurrent Relay.” Added new power supply information to Section 3 starting with “Basler Electric enhanced the power supply design...” Divided *Section 4, Installation* into two sections *Section 4, Installation* and *Section 5, Testing*. Added new dimension figures to include all options available (S1 Single-Ended and Double-Ended, and both mounting positions) to Section 4. Changed Output Connection diagrams to include Sensing Type E or G and Output F or H, Sensing Type J and Output J or K, and Sensing Type F and output E or G. Corrected minor errors and changed the format of the manual.	1639/11-98