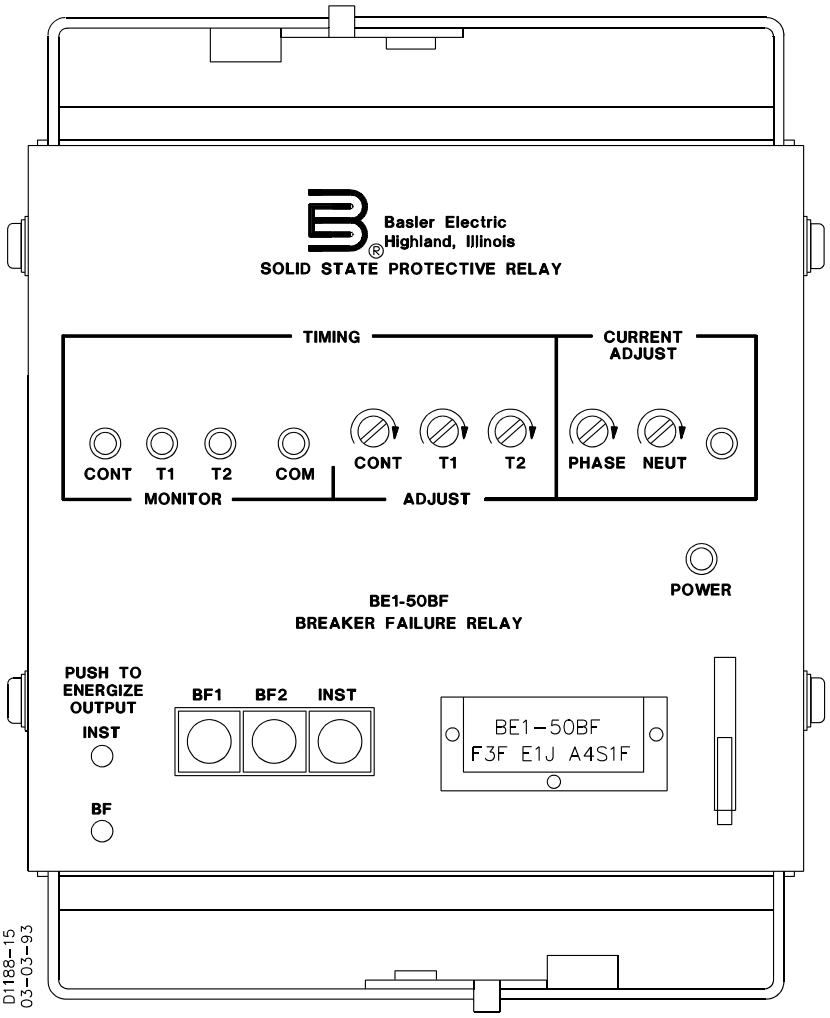
INSTRUCTION MANUAL

FOR

BREAKER FAILURE RELAY

MODEL BE1-50BF



Basler Electric

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INTRODUCTION

This manual provides information concerning the operation and installation of the BE1-50BF Breaker Failure Relay. To accomplish this, the following is provided.

- Specifications
- Functional description
- Mounting information
- Testing 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

DESCRIPTION

BE1-50BF Breaker Failure Relays are three-phase, solid state relays designed to provide protection and security for the power system against failure of the monitored breaker.

Breaker failure relaying is the use of a current monitoring relay to determine whether or not current continues to flow into a faulted circuit some time after a circuit breaker has been instructed to interrupt the circuit. In the event that current continues to flow into the faulted circuit (after a defined period of time has elapsed sufficient for the breaker to have interrupted the current), then the circuit breaker is considered to have failed, and steps must be initiated to trip the next set of breakers in the power system. The back up scheme must be designed to isolate both the faulted circuit and the failed breaker.

Following are several reasons why a breaker fails to clear a fault:

- Trip circuit can be open (broken wire, blown fuse, open trip coil).
- Interrupting mechanism can stick, leaving a single phase of a three-phase circuit connected.
- Interrupter can flash-over due to the loss of dielectric strength through contamination or damage.
- Operating mechanism can fail to operate.

Breaker failure relays detect these conditions and initiate contingency or back up procedures.

Typically, breaker failure protection is applied to transmission and subtransmission systems. However, breaker failure protection may be applied to any portion of the power system where failure of a circuit breaker to operate properly could result in severe system damage or instability.

Trip Timing

Within the relay are two timers that control operation of the device. Timer 1 defines the delay time between recognition of the breaker trip signal and the interrogation of the current monitoring circuits for the presence of current. Adjustment range for this timer is 18 to 500 milliseconds.

At the same time that timer 1 is initiated, the control timer is also initiated. Figure 1-1 illustrates the trip timing relationships. The purpose of the control timer is to increase security by limiting the response time of the relay to a short period following any given attempt to interrupt the breaker. The control timer also terminates the closure of the BF output relays, and breaks the seal of the seal-in circuit (if used).

Breaker failure initiate (BFI) input seal-in is selected by closing printed circuit board switch S1-3 (refer to Section 2 for location). This selection may be required when current from an isolated weak source cannot be depended on to maintain the minimum signal level to the protective relays initiating the BFI input. Such a condition can occur when the fault voltage is depressed to zero. The seal-in feature may also counteract contact bounce.

An optional supervisory contact input to the BE1-50BF relay may be specified. When the supervisory contact input is specified, a third timer (timer 2) is built into the relay. Timer 2 (plus associated circuitry together with the supervisory contact) duplicates the corresponding features of the timer 1 system. This addition allows different breaker failure times for different types of failures.

As an example, it might be desirable to use a shorter tripping time if the breaker mechanism fails to operate (all three breaker poles failed to clear the fault). If the mechanism did operate, but only one of the poles failed to clear, a longer breaker failure time might be appropriate. This protection can be provided by connecting a 52a contact of the breaker to the supervisory contact input and setting the delay on timer 2 shorter than timer 1. If the breaker mechanism failed to operate, the breaker failure relay would be controlled by timer 2. If the breaker mechanism did operate, timer 2 would (in time) reset, and the breaker failure relay would be controlled by timer 1.

This situation requires the following conditions.

- 52a contact must be supervised by the BFI contact input.
- Seal-in feature must not be used.
- Switch S1-4 on the printed circuit board (refer to Section 2 for location) must be closed.

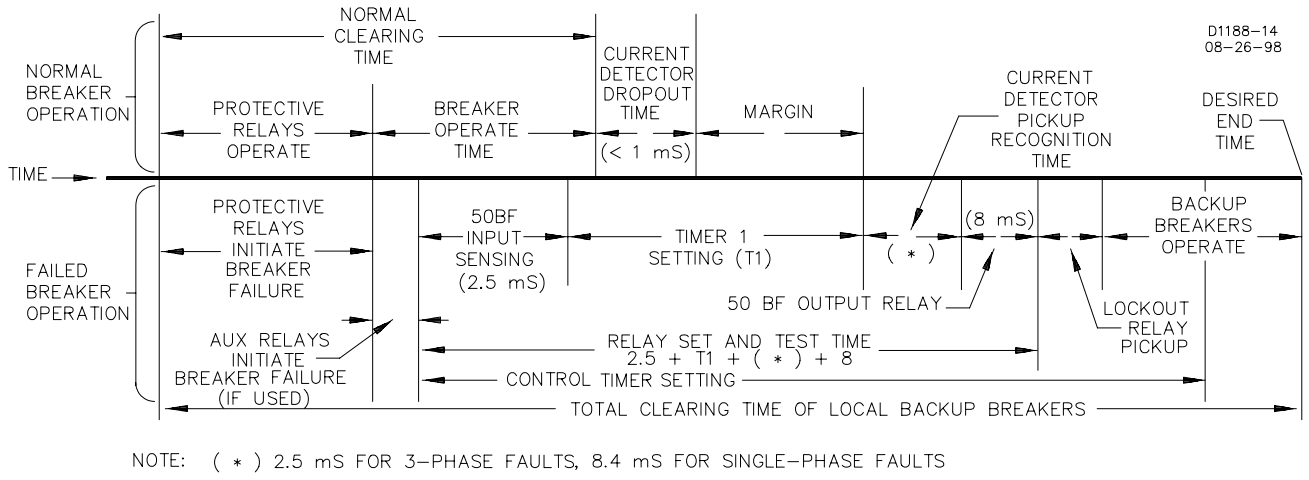

Figure 1-1. Timing

MODEL AND STYLE NUMBER

Style Number

Electrical characteristics and operational features included in a specific relay are defined by the relay style number. The model number and style number appear on the front panel, drawout cradle and inside the case assembly. Model number BE1-50BF, designates the relay as a Basler Electric Class 100 Breaker Failure Relay. Refer to Figure 1-2 for the style number identification chart.

Sample Style Number

To determine the features in a BE1-50BF relay, style number F3F E1J A4S1F, refer to the style number identification and the following example.

F Three-phase sensing input type.
3 Sensing input range 1.0 to 8.0 amperes for all phases.
F Three output relays with normally open contacts.
E1 Definite Timing.
J Power supply operates from 125 Vdc or 100/120 Vac.
A Internally operated targets.
4 Non-isolated contact sensing.
S Push-to-energize outputs (pushbuttons).
1 Instantaneous Trip.
F Semi-flush mounting.

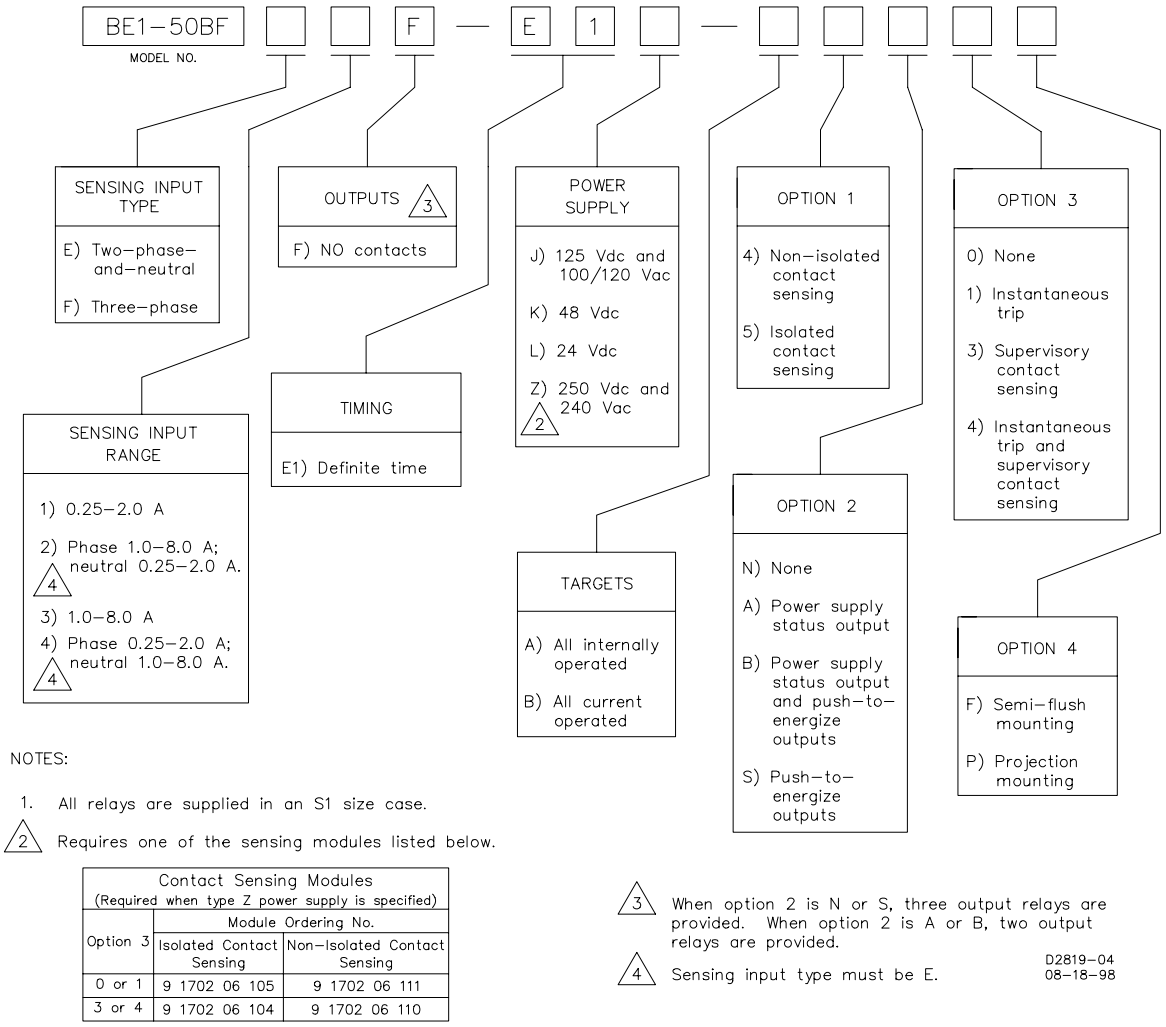

Figure 1-2. Style Number Identification Chart

SPECIFICATIONS

The BE1-50BF Breaker Failure Relay has the following features and capabilities.

Current Sensing

Maximum burden of 1 VA per phase at range maximum, 50/60 Hz. Operable over a frequency range of 40 to 70 Hz. Maximum continuous current: 5 A for sensing range of 0.25 to 2.0 A; 10 A for sensing range of 1.0 to 8.0 A. Maximum one second current: 300 A.

For ratings other than one second, the rating may be calculated as follows:

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

where t = the time in seconds, and K = 90,000.

Dropout Above 98% of actual pickup level.

Current Detector Reset Less than 1 millisecond.

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

Pickup Accuracy +2% or +40 mA of pickup setting, whichever is greater.

Pickup Tracking Accuracy (Phase-to-Phase) 0.25 to 2.0 A range — Whichever is greater, 0.025 A or 2% between any two phases.

1.0 to 8.0 A range — Whichever is greater, 0.10 A or 2% between any two phases.

Contact Recognition Time Less than 2.5 milliseconds.

Adjustment Range of Control Timer 150 to 600 milliseconds.

Adjustment Range of Timer 1 and (optional) Timer 2 18 to 500 milliseconds.

Energizing Time of Output Relay Approximately 8 milliseconds.

Timing Test Points Oscilloscope test points are provided on the front panel for precise checking of the control timer, as well as timer 1. These nominal 10 V test points are optically coupled to the logic circuits to provide 1500 V isolation.

Contact Sensing The sensing circuits require user-supplied contacts with a minimum rating of 0.05 A at 250 Vdc. Sensing current is supplied by the relay in style with isolated sensing. Styles with non-isolated sensing require an applied sensing voltage equal to the relay dc power supply input rating.

Contact Sensing Burden Burden per contact for non-isolated sensing depends on the power supply type. Refer to Table 1-1.

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

Power Supply Type	J	K	L	Z
Nominal Burden Per Input	3.5 W / 5.5 VA	3.5 W	1.25 W	7.0 W / 20 VA

Target Indicators Magnetically latched, manually reset targets indicate that an output relay has energized. Either internally operated or current operated targets may be specified. Current operated targets require a minimum of 0.2 A in the output trip circuit, and are rated at 30 A for 1 second, 7 A for 2 minutes, and 3 A continuously.

Power Supply Power for the internal circuitry may be derived from ac or dc external power sources. Refer to Table 1-2.

Table 1-2. Power Supplies

Type	Nominal Input Voltage	Input Voltage Range	Burden at Nominal
K (Mid Range)	48 Vdc	24 to 150 Vdc	6.0 W
J (Mid Range)	125 Vdc 120 Vac	24 to 150 Vdc 90 to 132 Vac	6.0 W 15.0 VA
L (Low Range)	24 Vdc	12† to 32 Vdc	5.3 W
Z (High Range)	250 Vdc 240 Vac	62 to 280 Vdc 90 to 270 Vac	6.0 W 15.0 VA

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

125/250 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).

Isolation In accordance with IEC 255-5 and ANSI/IEEE C37.90, one minute dielectric (high potential) tests as follows:

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

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.

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.

Surge Withstand Capability Qualified to ANSI/IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems.*

Fast Transient Qualified to ANSI/IEEE C37.90.1-1989.

Impulse Test Qualified to IEC 255-5.

Temperature

Operating Range

-40°C (-40°F) to 70°C (158°F)

Storage Range

-65°C (-85°F) to 100°C (212°F)

Shock In standard tests, the relay has withstood 15 g in each of three mutually perpendicular planes without structural damage or degradation of performance.

Vibration In standard tests, the relay has withstood 2 g in each of three mutually perpendicular planes, swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance.

Weight 14.1 pounds maximum.

Case Size S1

SECTION 2 • HUMAN-MACHINE INTERFACE

CONTROLS AND INDICATORS

The following table locators reference the callouts in Figure 2-1.

Table 2-1. BE1-50BF Controls and Indicators (Refer to Figure 2-1)

Locator	Control or Indicator	Function
A thru **D**	**TIMING MONITOR** Test Points	Jacks provide nominal 10 V oscilloscope test points for monitoring the control timer, timer T1 and timer T2. The jacks accommodate a standard 0.080 diameter phone tip plug.
E thru **G**	**CONT, T1, T2, TIMING ADJUST**	Multiturn potentiometers allow screwdriver adjustment of timers (control, T1 and (optional) T2).
H	**PHASE CURRENT ADJUST** Pickup Control	Multiturn potentiometer establishes the pickup point for phase current. Continuously adjustable over the range defined by the style number.
I	**NEUTral CURRENT ADJUST** Pickup Control	Multiturn potentiometer establishes the pickup point for neutral current. Continuously adjustable over the range defined by the style number.
J	Current Pickup Indicator	LED lights when current exceeds the pickup point on any monitored phase (or neutral). The lamp extinguishes as soon as all monitored inputs drop below pickup.
K	**POWER** LED	LED illuminates to indicate that power supply is operating.
L	Target Reset Lever	Linkage extending through the bottom of front cover resets the target indicators.
M	**BF1, BF2, INST** Target Indicators (optional)	Magnetically latching indicators are tripped to red to indicate that the associated output relay has been energized.

CAUTION

If S1-3 is closed and pickup current present, the push-to-energize switch for the instantaneous output will also close the breaker failure output.

N	**PUSH-TO-ENERGIZE OUTPUT** (optional)	Momentary pushbuttons accessible by inserting a 1/8 inch diameter non-conducting rod through the front panel. Pushbuttons are used to energize the output relays in order to test system wiring.

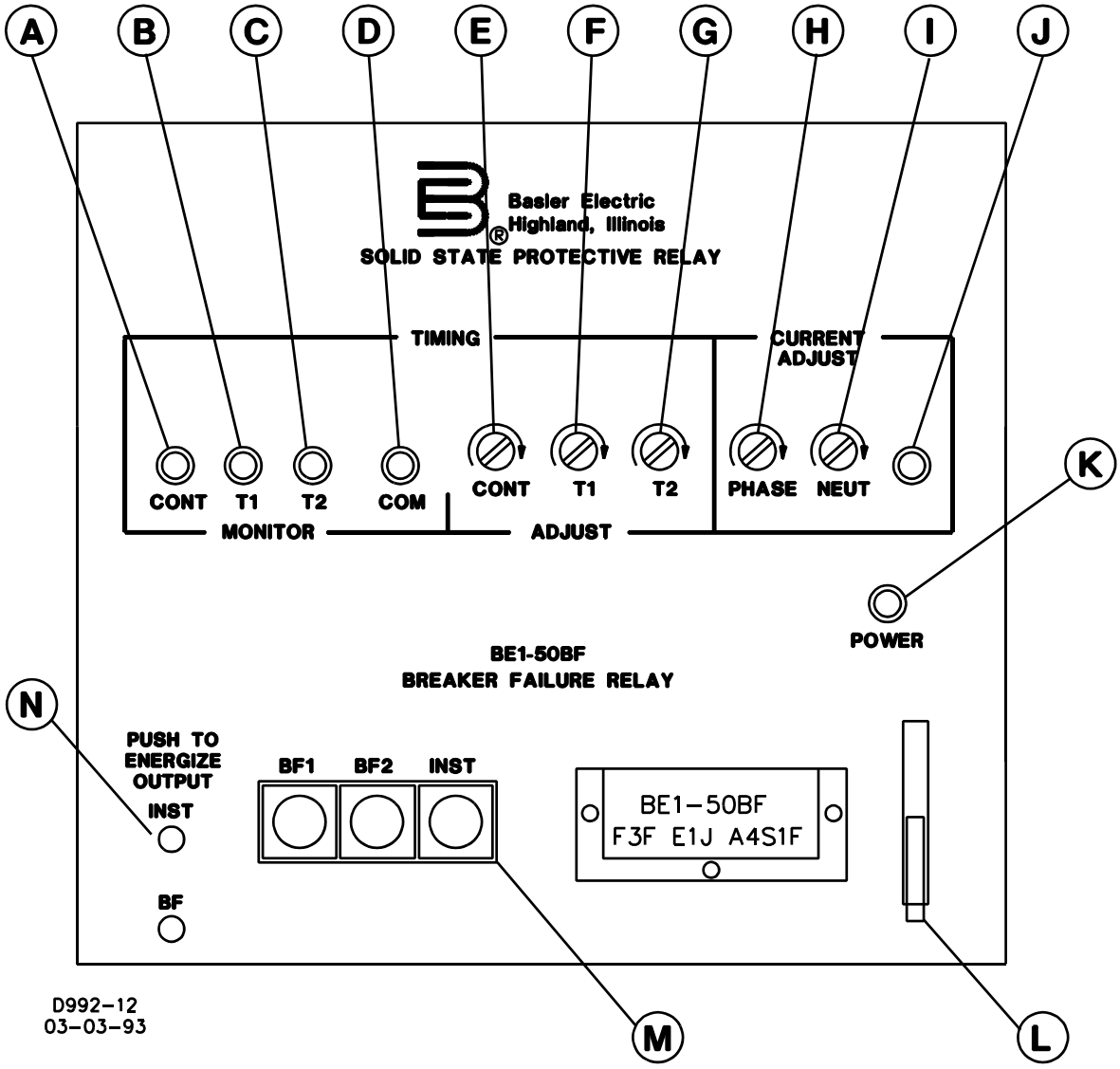

Figure 2-1. Location of Controls and Indicators

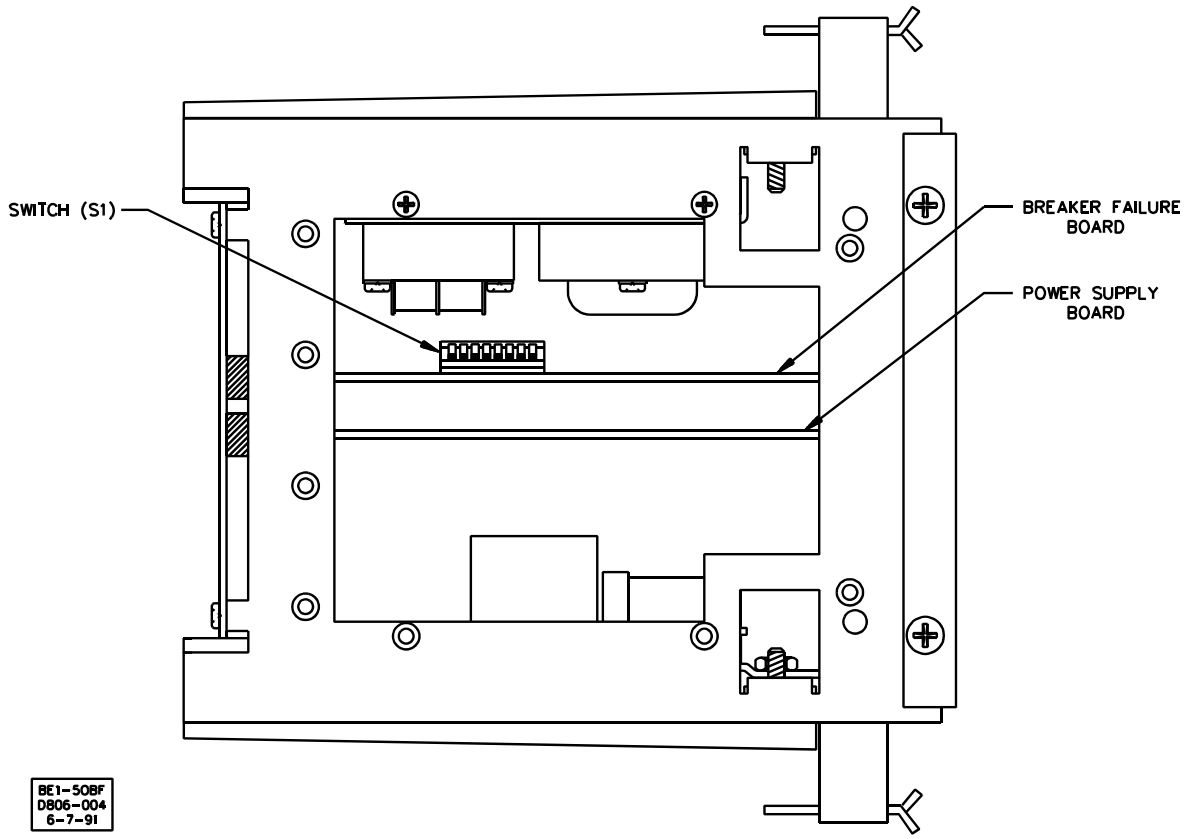

Figure 2-2. Location of Controls and Indicators

Table 2-2. Field Programmable Switch S1

Switch Section	Function
1	When ON (down), enables the (optional) instantaneous relay whenever a BFI contact closure occurs. The instantaneous relay will reset at the expiration of the BFI signal, or at the end of the control timer cycle, whichever comes first.
2	When ON (down), enables the (optional) instantaneous relay whenever a supervisory input occurs. The relay will reset at the expiration of the supervisory signal, or at the end of the control timer cycle, whichever comes first.
3	S1-3 is NOT functional unless S1-1, S1-2, or both switches are in the ON (down) position. With S1-3 closed and a recognized BFI input, the instantaneous output is held activated until the control timer times out.
4	When ON (down), allows the supervisory contacts to initiate a preset timing sequence that duplicates the BFI timing circuit. The preset time for the two timers may be different. In this mode, either set of input contacts can initiate a sequence that enables the output relay when T1 or T2 has timed out (and until the control timer has timed out).
5	When ON (down), inhibits operation of the output relays unless the supervisory contacts are closed.
6	When ON (down), the output relays are inhibited until both the T1 and T2 timers have cycled. At this time, a sensed current above pickup will energize the output relay.

NOTE

Switches seven and eight may be used for conducting system tests. Note that a BFI output can be obtained **WITHOUT** the presence of line current.

Table 2-2. Field Programmable Switch S1 - Continued

Switch Section	Function
7	When ON (down), a BF output will occur after the expiration of Timer 1 if the supervisory contact is closed, regardless of the presence or absence of sensing current.
8	When ON (down), requires closure of the supervisory contact, and completion of both T1 and T2 timing cycles to energize the BF output relays. In this case, sensed current need not be present. However, if T1 times out before T2, and if sensing current is above pickup, a BF output will occur.

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL

BE1-50BF Breaker Failure Relays are static devices designed to detect circuit breaker failure, and to trip backup circuit breakers when such failures are detected.

FUNCTIONAL DESCRIPTION

Relay circuit functions illustrated in Figure 3-1 are described in the following paragraphs.

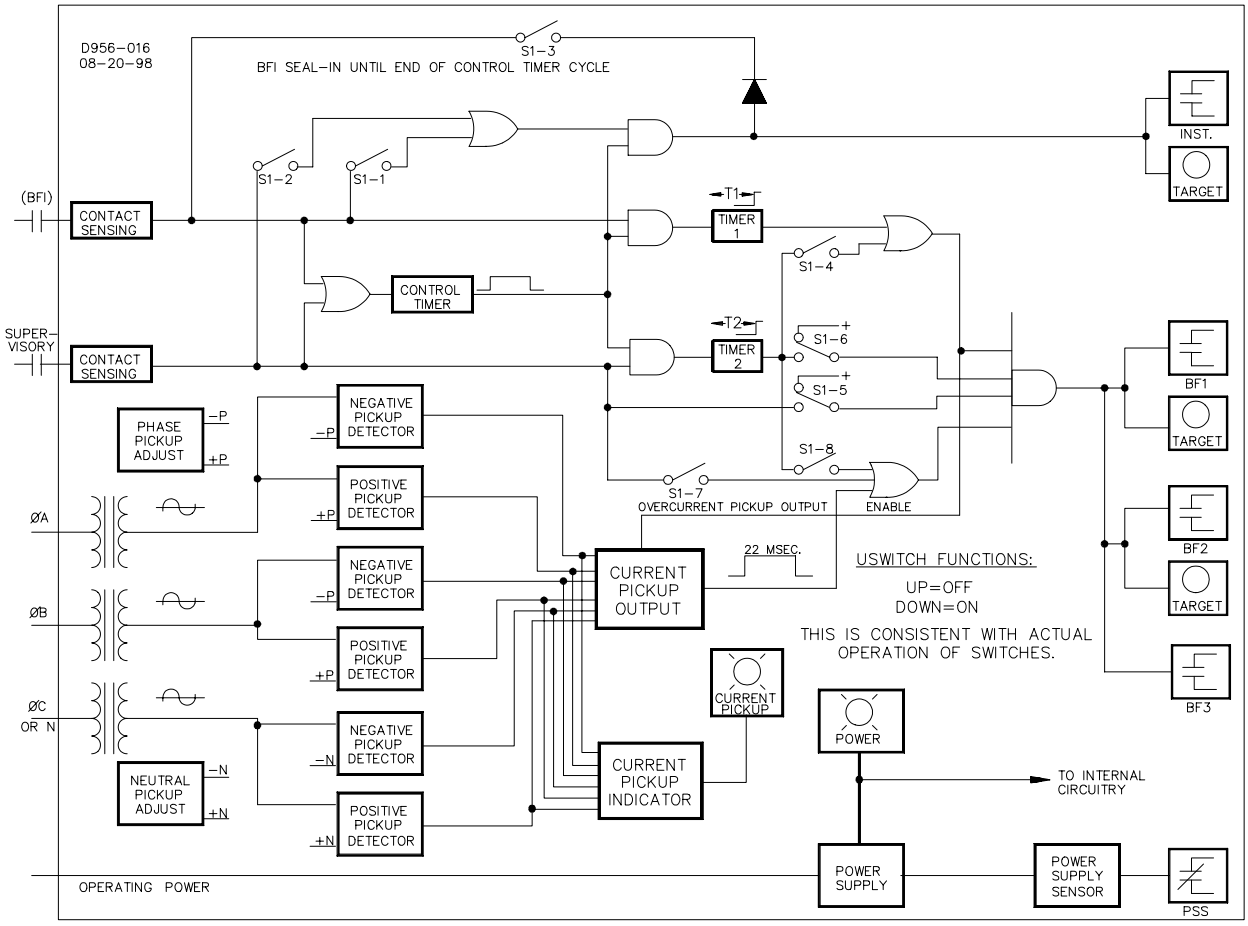

Figure 3-1. Functional Block Diagram

Contact Sensing

Before any relay output can occur, there must first be an initiating signal from external contacts. Two possible initiating signals are either the breaker failure initiate (BFI) signal or the optional supervisory signal. Contact sensing circuitry allows the relay to monitor external contacts for the presence of these signals.

Contact sensing inputs must use either isolated sensing or non-isolated sensing. Isolated sensing (option 1-5) uses current supplied by the relay to monitor external contacts. Non-isolated sensing uses an external dc source to monitor the contacts. Nominal voltages of the external dc source must match the dc input voltages of the relay power supply. If the power supply of the relay has an ac source, a separate dc source must be utilized for the contact sensing input.

Instantaneous Output - Optional

Instantaneous output relays are enabled whenever a BFI contact closure and enabling switch S1-1 is closed. They are also enabled whenever a supervisory contact closure is detected and enabling switch S1-2 is closed. S1-3, when closed, seals the instantaneous relays through the BFI input. Instantaneous output relays remain enabled until the control timer times out, and reset when the control timer times out. If S1-3 is open, instantaneous output relays remain enabled only for the period of time that the BFI or supervisory contacts are closed. Two instantaneous output relays are provided.

Control Timer

The control timer provides a window of opportunity for a breaker failure output. Control timer timing cycles are initiated by either a BFI or supervisory input signal. For the breaker failure output contacts to close as shown in Figure 3-2, the sensed current must be in excess of the pickup setting. Note that all output relays, if operated, are restored at the end of the control timer cycle.

To facilitate setting the relay, four oscilloscope test jacks are provided on the front panel (A through D, Figure 2-1). These jacks are completely isolated from all other circuits.

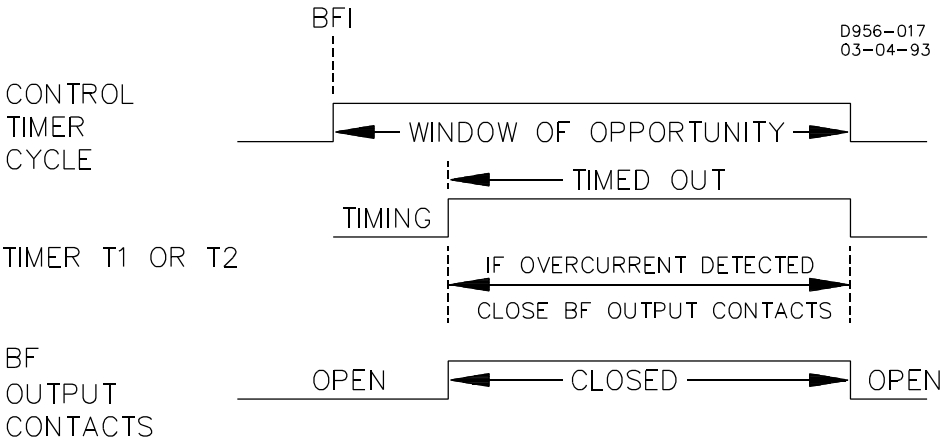

Figure 3-2. Control Timer Cycle

Timer T1 and T2

Timers T1 and T2 provide (independently) an adjustable time delay to allow current to decay after the breaker is tripped. If sensed current is in excess of the pickup setting and the timer times out while the window of opportunity is present (before the control timer times out), the BF output contacts will close.

Field Programmable Logic

Field programmable switch S1 is an eight section switch (S1-1 through S1-8) that allows the relay to be reconfigured to meet changing requirements. Switch S1 is located on left side of the logic board and is accessible by withdrawing the cradle assembly from the case. The purpose of each switch section is explained in detail in Section 2.

Outputs and Targets

Breaker failure output relays, BF1 through BF3, are simultaneously operated when the associated logic AND function receives qualifying signals. Optional target indicators are mechanically latched whenever relays are energized and a minimum of 0.2 A flows through the output. Targets must be reset with the manual reset lever provided.

Current Sensing

Monitored line currents are applied to the primaries of internal current transformers and stepped down to internal circuit levels. Transformers provide a high degree of isolation.

Current Pickup Detector

Each sensing input is fed to both a positive and negative half cycle pickup detector. Each detector will provide an output when the sensing current increases to a level greater than the pickup setting.

Current Pickup Indicator

Each current pickup detector provides an input to the current pickup indicator. The current pickup indicator turns ON the LED for 22 milliseconds after the most recent input.

Current Pickup Output

Each current pickup detector provides an input to the current pickup output. The current pickup output provides an output to the logic if enabled by timer 1.

Pickup Settings

A front panel, multi-turn potentiometer sets the phase currents pickup thresholds. A second potentiometer is provided to establish the neutral current pickup threshold.

Power Supply

Basler Electric enhanced the power supply design for unit case relays. This new design created three, wide range power supplies that replace the four previous power supplies. Style number identifiers for these power supplies have not been changed so that customers may order the same style numbers that they ordered previously. The first newly designed power supplies were installed in unit case relays with EIA date codes 9638 (third week of September 1996). Relays with a serial number that consists of one alpha character followed by eight numerical characters also have the 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 Identifier	Nominal Voltage	Voltage Range
Low Range	L	24 Vdc	12† to 32 Vdc
Mid Range	J, K	48, 125 Vdc, 120 Vac	24 to 150 Vdc 90 to 132 Vac
High Range	Z	125, 250 Vdc, 120, 240 Vac	62 to 280 Vdc 90 to 270 Vac

† 14 Vdc 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 $\pm$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 Contacts

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

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, 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 Customer Service 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 in 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. Always reset targets by use of the target reset lever.
3. The relay is a solid-state device. If a wiring insulation test is required, remove the connection plugs and withdraw the cradle from its case.
4. When the connection plugs are removed the relay is disconnected from the operating circuit and will not provide system protection. Always be sure that external operating (monitored) conditions are stable before removing a relay for inspection, test, or service.
5. Be sure the relay case is hard wired to earth ground using the ground terminal on the rear of the unit. It is recommended to use a separate ground lead to the ground bus for each relay.

DIELECTRIC TEST

In accordance with IEC 255-5 and ANSI/IEEE C37.90, one minute dielectric (high potential) tests 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. Refer to Figures 4-1 through 4-5 for relay outline dimensions and panel drilling diagrams.

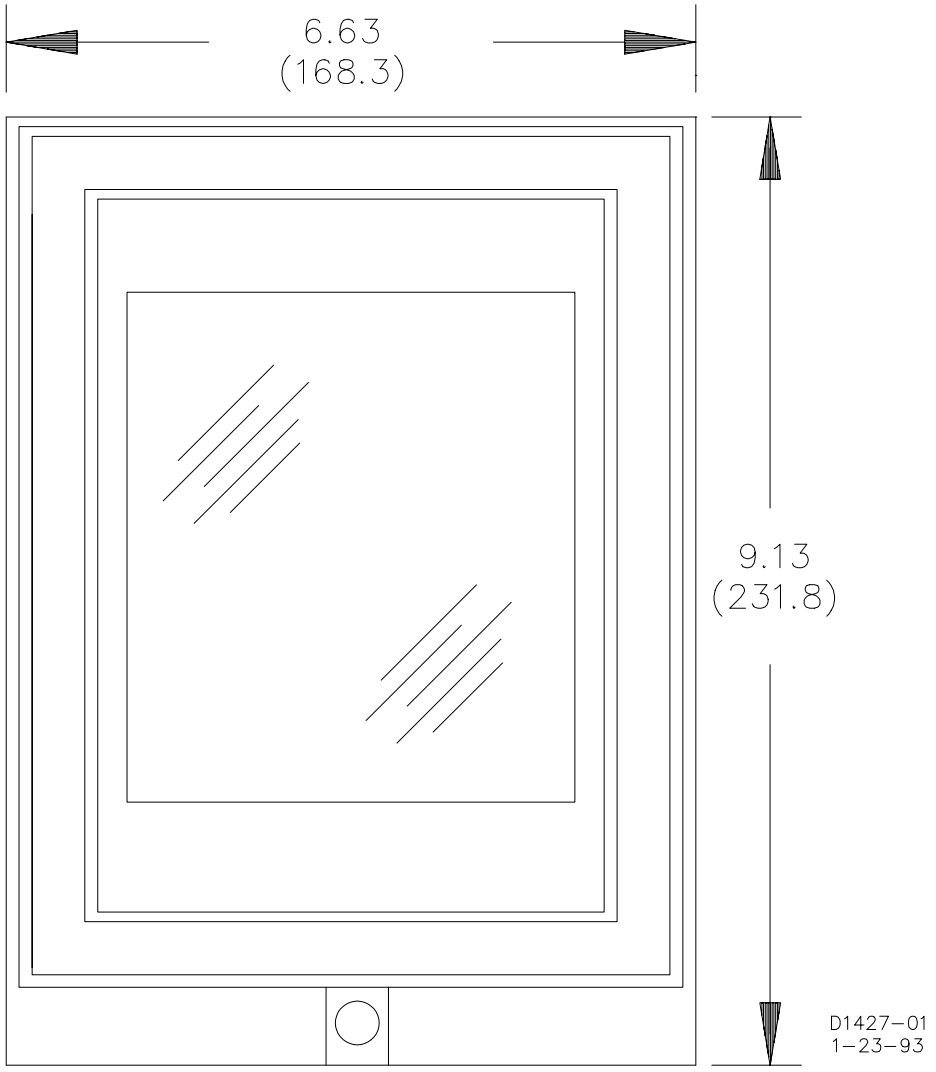

Figure 4-1. S1 Case, Outline Dimensions, Front View

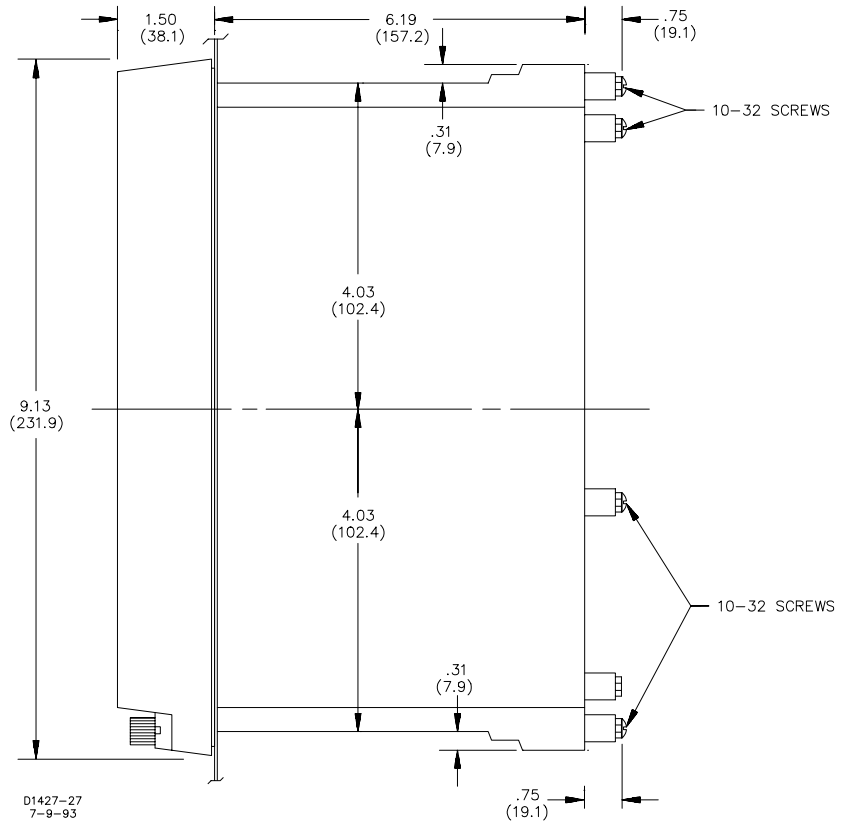

Figure 4-2. S1 Case, Double-Ended, Semi-Flush Mounting, Outline Dimensions, Side View

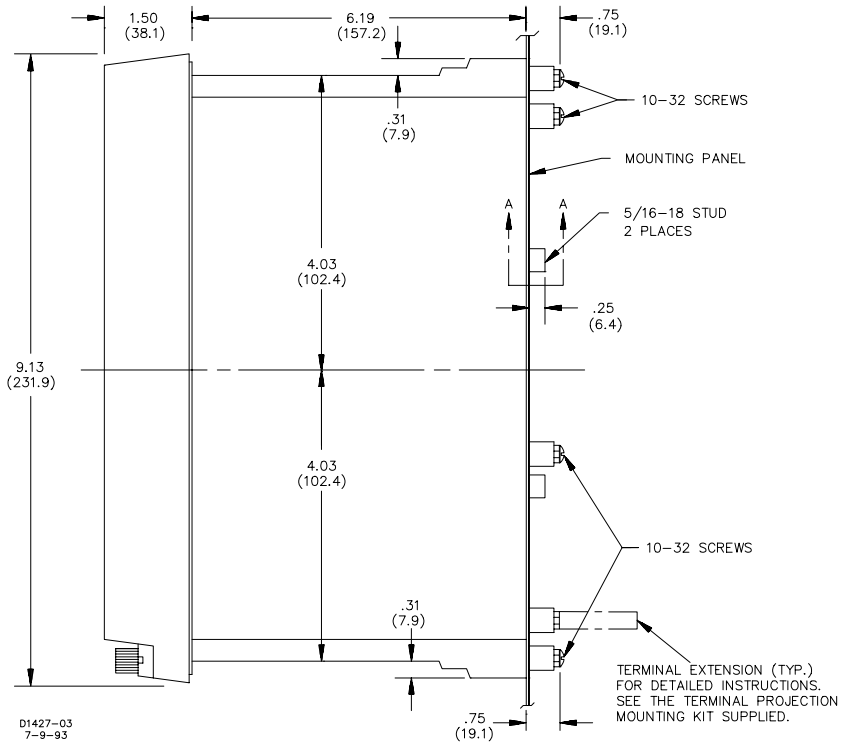

Figure 4-3. S1 Case, Double-Ended, Projection Mounting, Outline Dimensions, Side View

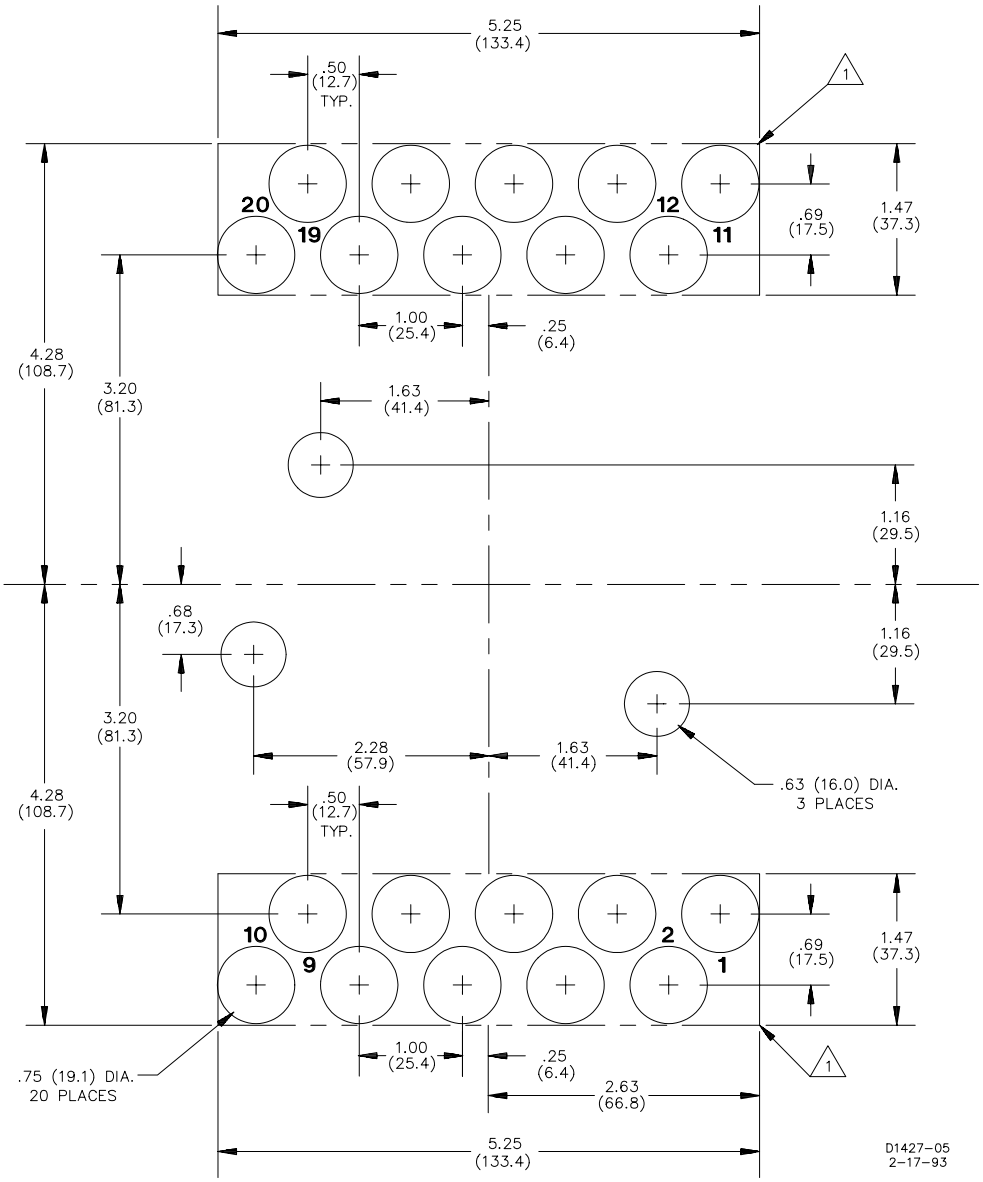

Figure 4-4. S1 Case, Double-Ended, Panel Drilling Diagram, Rear View

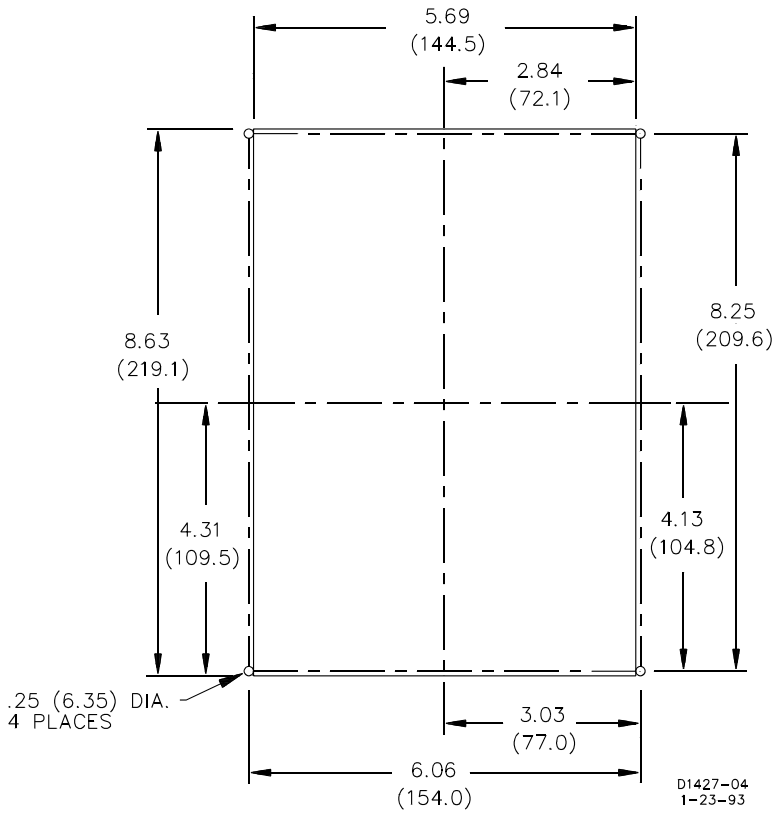

Figure 4-5. S1 Case, Panel Drilling Diagram, Semi-Flush Mounting

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.

Except as noted above, connections should be made with minimum wire size of 14 AWG. Typical internal connections are shown in Figures 4-6 and 4-7. External connections are shown in Figures 4-8 through 4-11.

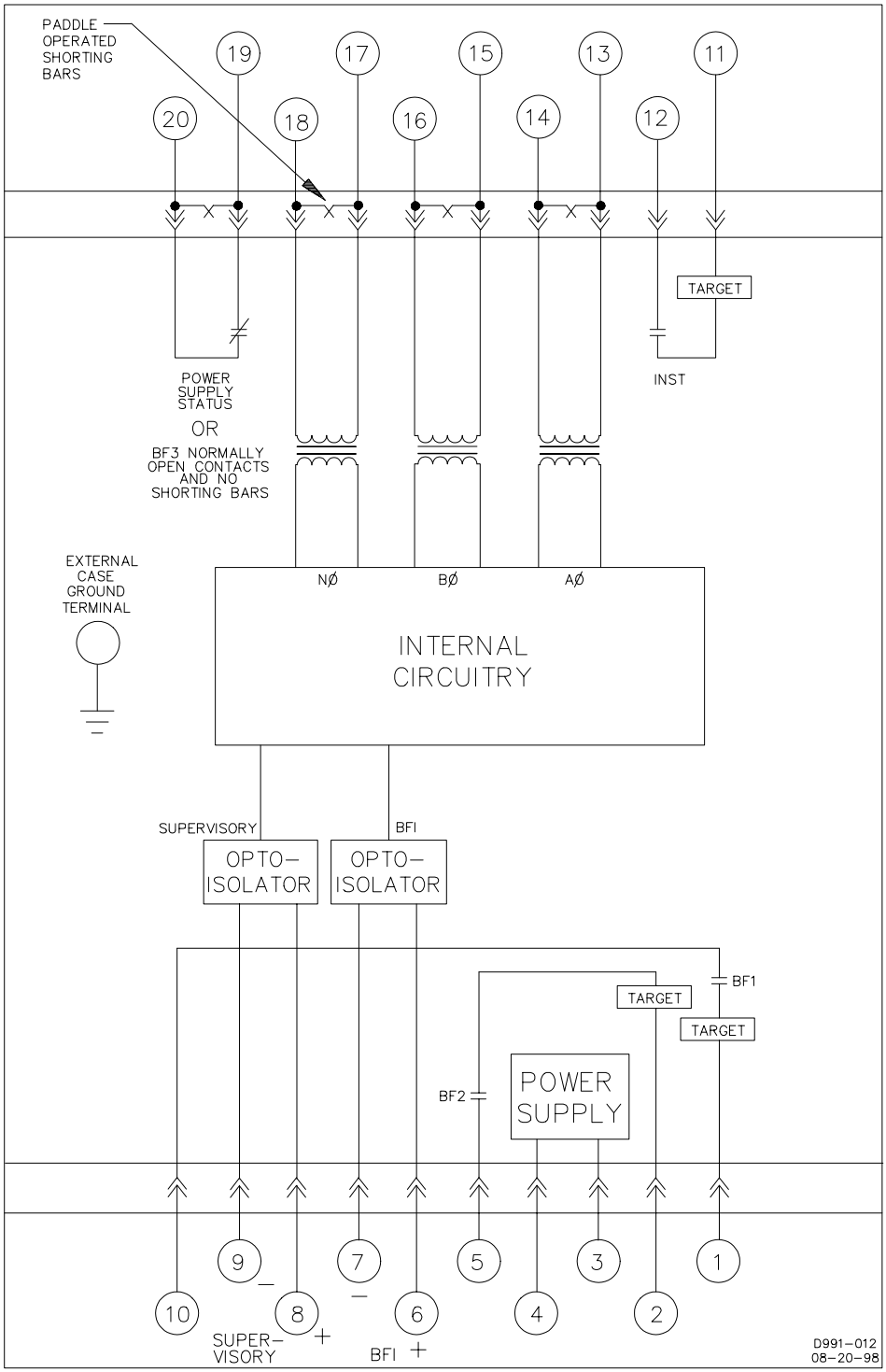

Figure 4-6. Typical Internal Connections, Sensing Input Type E

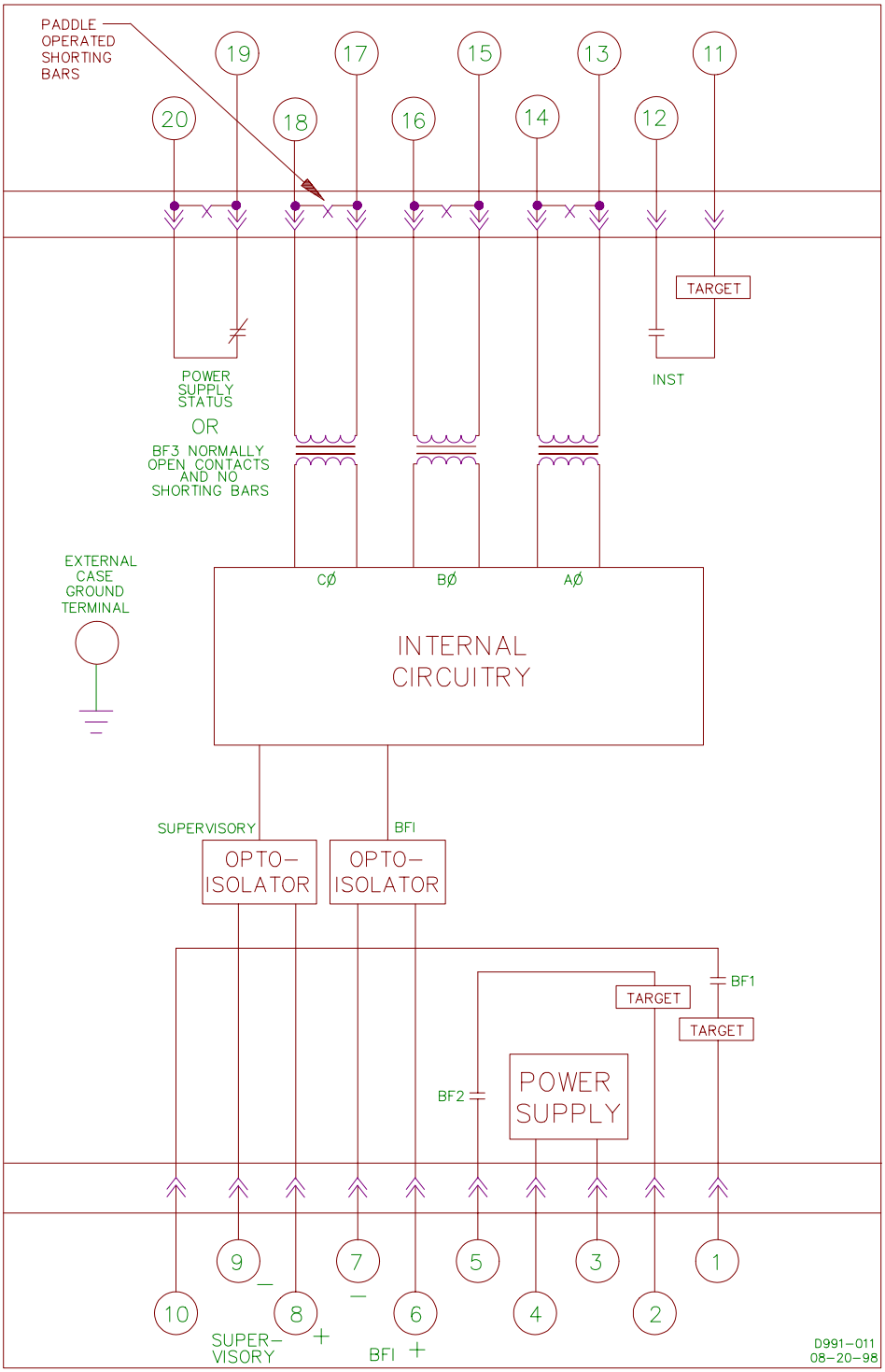

Figure 4-7. Typical Internal Connections, Sensing Input Type F

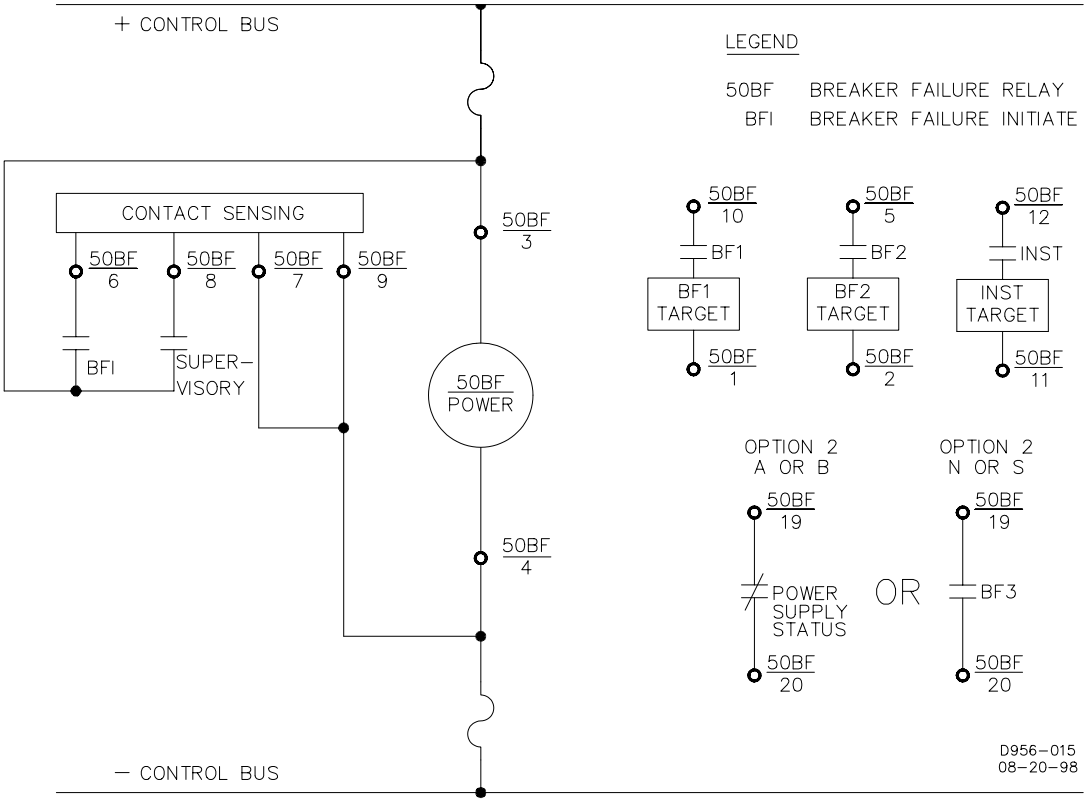

Figure 4-8. Control Circuit Connections (Typical) Non-Isolated Inputs

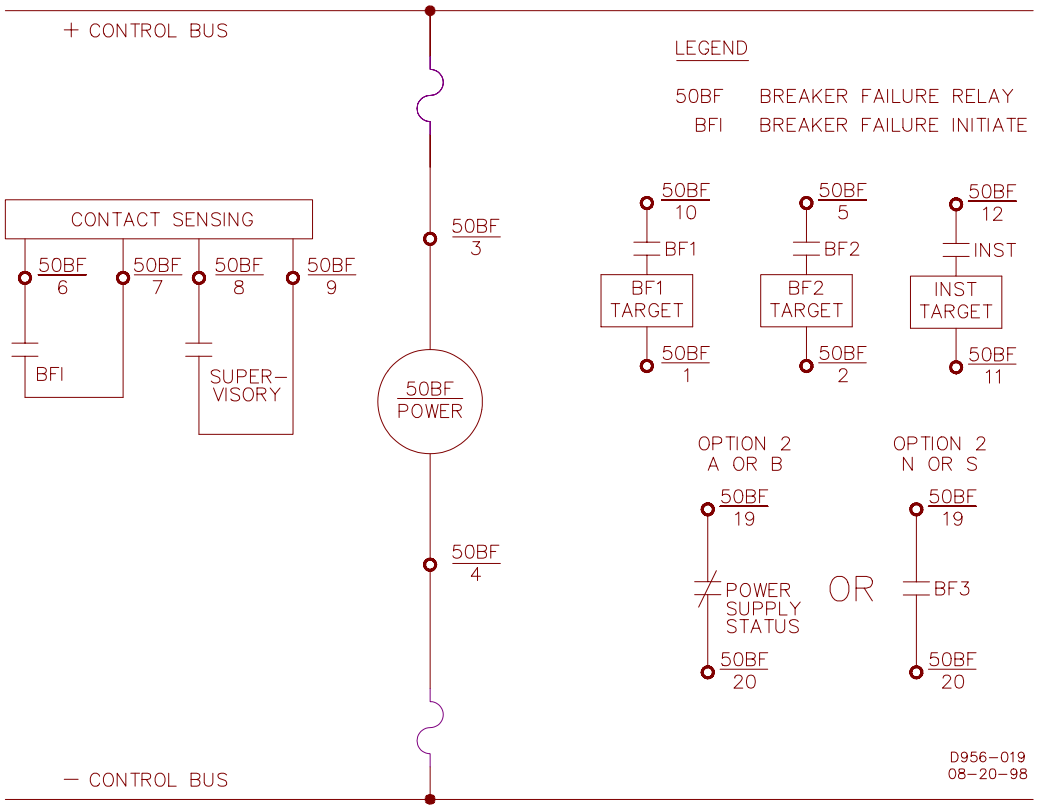

Figure 4-9. Control Circuit Connections (Typical) Isolated Inputs

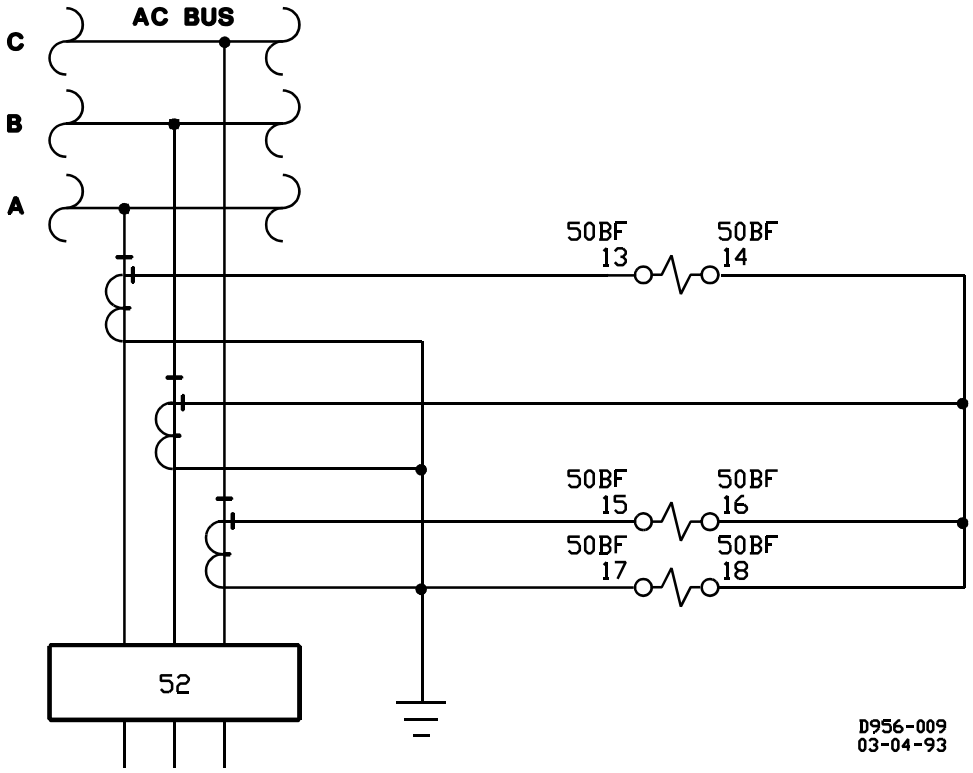

Figure 4-10. Typical Connections Sensing Input Type E

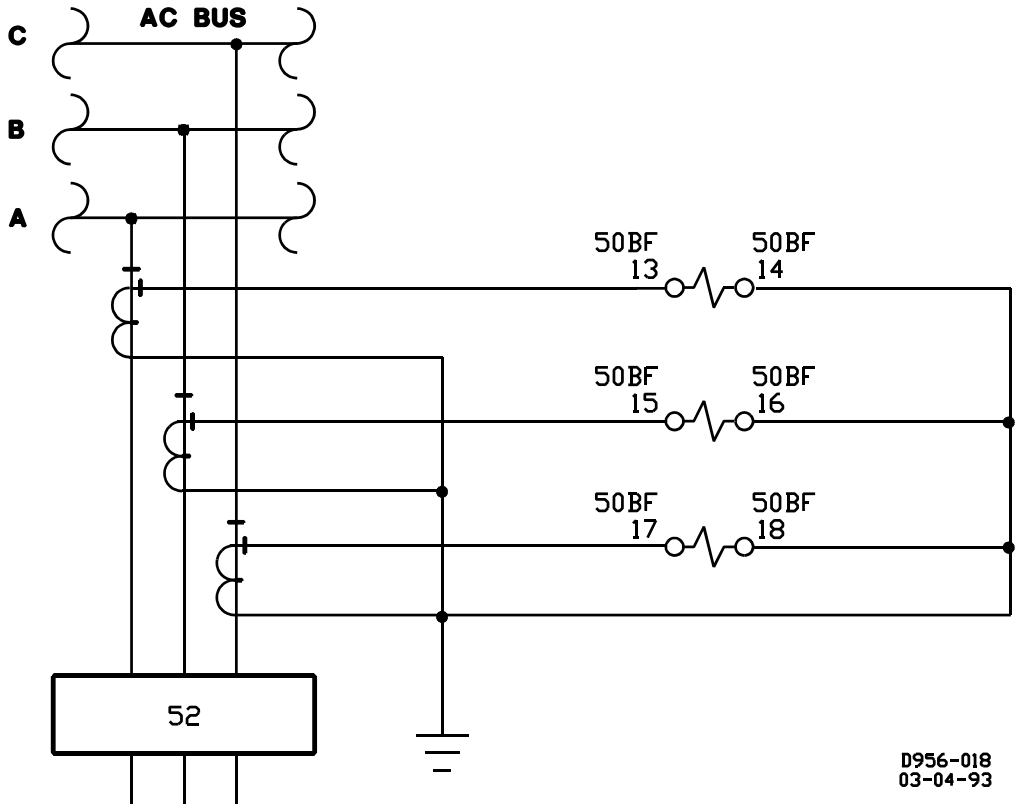

Figure 4-11. Typical Connections Sensing Input Type F

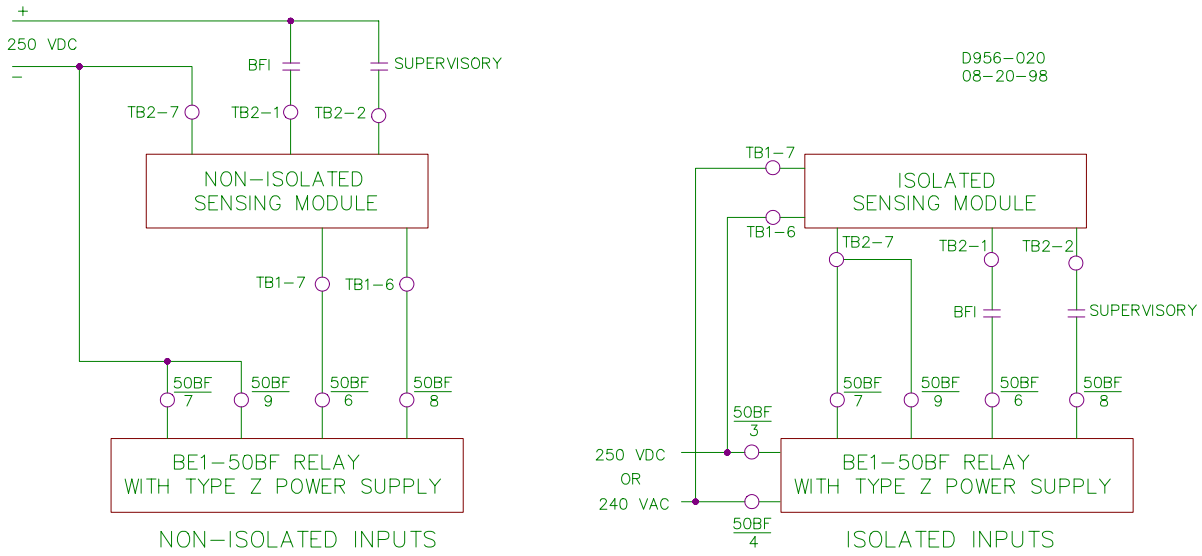

Figure 4-12. Contact Sensing Modules, Power Supply Type Z

SECTION 5 • TESTING

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, 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 in this section be performed prior to installation.

CAUTION

Before performing following tests, refer to relay operating precautions in Section 4.

OPERATIONAL TEST PROCEDURE

The following test procedure verifies operation and calibration of the relay. Note that the results obtained from this procedure may not fall strictly within specified tolerances. When evaluating results, consider the inherent error of test equipment. Test equipment should be accurate within 1% or better.

Step 1. On the logic board (left side), find S1 and set S1-4 to ON (down) and all other switches to OFF (up).

Step 2. Apply appropriate operating power to terminals 3 and 4. Verify that the POWER LED is ON and power supply status contacts (if supplied) are open.

Step 3. Apply a variable source of ac current to phase A, terminals 13 and 14. Range of current source should be appropriate to the sensing input range.

Step 4. Turn the phase pickup adjustment fully CCW. From near zero, slowly increase current from the variable current source until the current pickup indicator on front panel lights. Measure the current: it should be at or below the low end of the sensing input range.

Step 5. Turn the phase pickup adjustment fully CW. Slowly increase current until the current pickup indicator lights. Measure the current: it should be at or above the high end of the sensing input range.

Step 6. Repeat steps 3 (substitute appropriate terminals for terminals 13 and 14), 4, and 5 for each phase and neutral (if supplied). Note that the neutral sensing input range may be different than the phase sensing input range.

Step 7. Set the control timer to its maximum period (potentiometer fully CW). Set timers T1 and T2 to their minimum period (both potentiometers fully CCW).

Step 8. Provide a means for monitoring contact closure for the three BF outputs (terminals 1 and 10, 2 and 5, 11 and 12). If current operated targets are supplied, there must be at least 0.2 A flowing through the contacts when closed. Reset targets (if supplied).

Step 9. Apply a current to any sensing input so that the current pickup indicator LED is ON. Then apply a simulated BFI signal to terminals 6 and 7, observing the requirements of isolated and non-isolated contact sensing. BF1, BF2, and BF3 contacts should close briefly. Also, the BF1 and

BF2 targets (if supplied) should be tripped. Remove sensing input current. Reset targets (if supplied).

Step 10. If supervisory contact sensing is supplied, perform this step. If not, continue testing with Step 11. Apply a current to any sensing input so that the current pickup indicator LED is ON. Apply a simulated BFI signal to terminals 6 and 7 and a simulated 52a (supervisory) signal to terminals 8 and 9, observing the requirements of contact sensing. BF1, BF2, and BF3 contacts should close briefly. Also, the BF1 and BF2 targets should be tripped. Reset targets (if supplied).

Step 11. If an instantaneous output is not supplied, omit all remaining tests. If supplied, provide a monitor for contact terminals 11 and 12. For current operated targets, use at least 0.2 A current flowing through the contacts.

Step 12. Set switch S1-1 to ON and all other switches (S1-2 through S1-8) to OFF.

Step 13. With NO current applied to any sensing inputs, apply a simulated BFI signal to terminals 6 and 7. Instantaneous contacts should close briefly and the INST target should be tripped. Reset target.

Step 14. If supervisory contact sensing in supplied, open switch S1-1 and close S1-2. With NO current applied to any sensing inputs, apply a simulated supervisory signal to terminals 8 and 9. Instantaneous contacts should close briefly and INST target should be tripped. Reset target.

This completes the operational test procedure.

SECTION 6 • MAINTENANCE

GENERAL

BE1-50 Breaker Failure 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

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.

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

1. Relay model and part 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 7 • MANUAL CHANGE INFORMATION

CHANGES

Substantive changes in this manual to date are summarized below.

Table 7-1. Summary of Changes

Revision	Summary of Changes	ECA/Date
A	Page 1-4: Added contact sensing specifications. Page 1-5: Added contact sensing burden chart.	12799
B	Manual revised to reflect the availability of these options not previously offered: Power Supply Status Output (Options 2-A and 2-B).	12863
C	Page 1-3: Note 4 added to style chart. Page 1-4: Specification for pickup tracking accuracy added.	12912
D	Manual revised to reflect relay modification revision D, affective 03-01-93, serial number 2236, 2295, and subsequent. Relay dropout specification changed from 5 milliseconds at 2 times pickup to 1 milliseconds at 2 times pickup. Changed Figures 1-1 and 2-1, added Figure 2-2, changed Figure 3-2, and added new Figures 4-1 and 4-2.	13204
E	Deleted all references to Service Manual 9 1906 00 620. Replaced Figure 1-1 with a revised Timing diagram. Corrected Style Chart by changing power supply type Z from “230 Vac” to “240 Vac”. Changed *Current Detector Reset* from “Within 1 millisecond at 2 times pickup” to “Less than 1 millisecond.” Changed Input Voltage Range and Burden Data in Power supply table in *Specifications*, Section 1. Updated the Dielectric Test information. Added RFI information to *Specifications.* Corrected *Functional Block Diagram.* Replaced Full-Wave Rectifiers and Pickup Comparators with Current Pickup Detector, Current Pickup Indicator, and Current Pickup Output. Added new power supply information to Section 3 in *Power Supply* paragraph starting with “Basler Electric enhanced the power supply design...”. Added new dimension figures to include all options available (S1 Double-Ended, and both mounting positions). Added shorting bars to both Internal Connection Diagrams. Added Option 2, N or S to Control Circuit Diagrams. Changed “230 Vac” to “240 Vac” in the Contact Sensing Module Diagram. Remove testing information from Section 4 and added a new Section 5 Testing. Changed the format of the manual.	16971/08-98