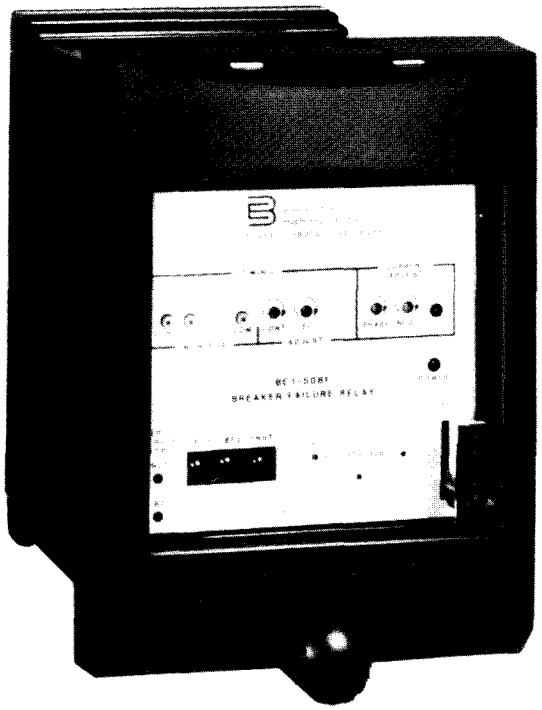


BE1-50BF BREAKER FAILURE RELAY

The BE1-50BF Breaker Failure Relay offers a wide variety of options and field selectable operating variations. These features allow the relay to be applied to any circuit breaker for the protection and security of the power system against failure of the monitored breaker to open under a fault when instructed to do so.

FEATURES

- Reset time less than 1 millisecond.
- Three-phase and two-phase-and-neutral sensing configurations are available.
- Wide range of current pickup adjustment with a high continuous current capability.
- An Instantaneous tripping output is available to retrip a breaker.
- A second contact input and timer circuit allow the relay to respond correctly to specific operating conditions.
- Wide operating frequency range of 40 to 70 Hertz.
- Field selectable logic allows the protection engineer to tailor the operation of the relay to the specific application requirements.
- Qualified to the requirements of
  IEEE C39.90-1978, C37.90a-1974, and IEC 255 for surge withstand capability;
  IEEE C37.90.1-108X for fast transient;
  IEC 255-5 for impulse.
- Two-year warranty.

ADDITIONAL INFORMATION

INSTRUCTION MANUAL
Request Publication 9190600990

STANDARDS, DIMENSIONS & ACCESSORIES
Request bulletin SDA

Basler Electric
BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UBT-7
6-00

APPLICATION

PURPOSE

Breaker failure relaying is the use of a current monitoring relay to determine whether or not current continues to flow into a faulted circuit for a defined 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 backup breakers in the power system. The breaker failure scheme must be designed to isolate both the faulted circuit and the failed breaker.

Breakers can fail to clear a fault for several reasons: 1) the trip circuit can be open (broken wire, blown fuse, open trip coil); 2) the interrupting mechanism can stick, leaving a single phase of a three-phase circuit connected; 3) the interrupter can flash-over due to the loss of dielectric strength through contamination or damage; 4) the operating mechanism can fail to operate. The purpose of the breaker failure relay is to detect this condition and initiate contingency, or backup, procedures.

Typically, breaker failure protection is applied to transmission and sub-transmission systems, but 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.

Breaker failure relays are applied on a per breaker basis: one breaker failure relay for each breaker in the substation. The outputs of the relay must be arranged to initiate the tripping of all the circuit breakers necessary to isolate a fault in the event the protected circuit breaker fails to operate. The relay may also need to initiate transfer tripping of remote breakers to accomplish this task. Transfer tripping of the remote line end for a breaker failure scheme should also block reclosing of the remote circuit breakers.

It should be noted that each user's breaker failure scheme is unique, and that all breaker failure schemes are designed to accomplish one objective: isolate the failed breaker. Exterior lockout relays are typically used to trip and block reclosing of the backup breakers because they normally require a positive operator action to reset them. This implies that the operator has determined the problem and taken the appropriate corrective actions (such as opening the isolation switches) before resetting the lockout relay and manually closing the necessary breakers to restore station operation to as normal as possible following an incident.

SPECIFICATIONS

FUNCTIONAL DESCRIPTION

The specifications on these pages define the many features and options that can be combined to satisfy a specific application requirement. The block diagram, Figure 1, illustrates how the various standard features and options function together. Front panel controls and indicators are shown in Figure 3. Identification and functional description are provided in Table 2.

INPUTS

Current Sensing

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

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

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

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

Dropout

Above 98% of actual pickup level.

Pickup Settings

A front panel potentiometer, continuously adjustable over the range defined by the style number, establishes the phase current pickup level. For relay styles sensing neutral current, a second potentiometer is provided to establish the neutral current pickup level. Pickup is repeatable within 2% of setting or 40 milliamps, whichever is greater.

Energizing Time of Output Relay

Approximately 8 milliseconds.

Contact Recognition Time

Less than 2.5 milliseconds.

Relay Logic

The magnitude of the currents is compared to the pickup setting(s). When the pickup setting has been exceeded and the logic enabled by the expiration of the allowed time, the three output relays BF1, BF2, and BF3 are simultaneously energized.

Power Supply

One of four power supply types may be selected to provide internal operating power. They are described in Table 1.

SPECIFICATIONS, continued

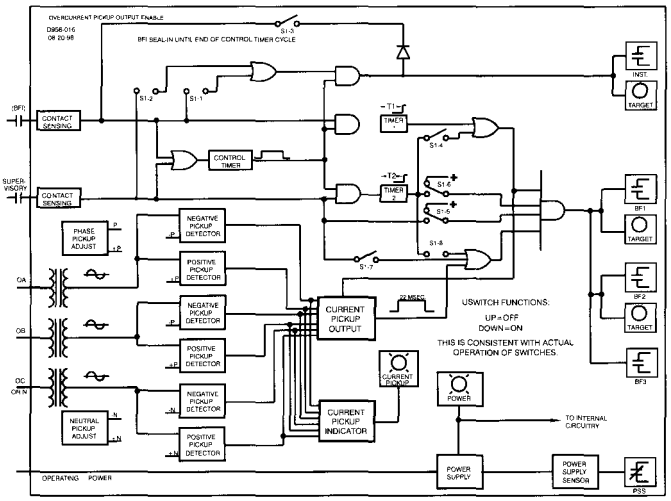


Figure 1 - Functional Block Diagram

Table 1 - Power Supply Options

Type	K	J	L	Z*
Nominal Voltage	48Vdc	125Vdc 120Vac	24Vdc	250Vdc 240Vac
Burden	6.0W	6W 15VA	5.3W	6W 15VA

* External modules required for contact sensing when type Z power supply is specified.

POWER SUPPLY STATUS OUTPUT

The power supply output relay is energized and its NC output contact is opened when power is applied to the relay. Normal internal relay operating voltage maintains the power supply status output relay in a continuously energized state with its output contact open. If the power supply output voltage falls below the requirements of proper operation, the power supply output relay is de-energized, closing the NC output contact.

Contact Sensing

The Breaker Failure Relay monitors the state of external user-supplied contacts. These contacts must have a minimum rating of 0.05 A at 250 Vdc.

Maximum contact sensing burden ranges from 1.25 W per contact for power supply L to 7.0 W for power supply Z. (This burden only applies when contact is closed.)

Depending on the selected option, the current through the contacts may be obtained from the relay itself (isolated contact sensing), or from a dc source with a voltage rating equal to the relay's power supply input (non-isolated contact sensing).

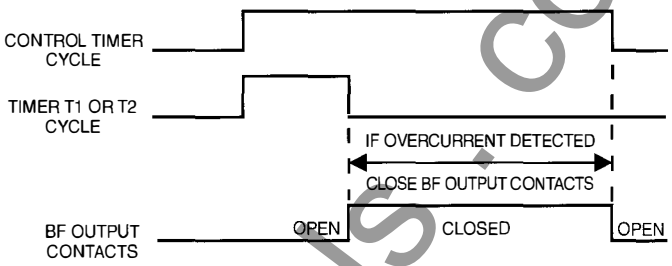


Figure 2 - Timing Sequence

Current through the contact is filtered and optically isolated by the contact interface circuitry. User-supplied contacts perform the following functions.

1. BFI (Breaker Failure Initiate)
2. Supervisory (Option)

TIMING

Figure 2 illustrates the timing sequence. Timers 1 or 2 (the latter optional) begin their cycle as soon as the BFI or (optional) Supervisory contacts close. At the end of the T1 or T2 timing cycle (and until the end of the Control timer cycle) the output of the pickup comparator is examined by the field selectable logic, and a BF (i.e., BF1, BF2, and BF3) output will occur if line current remains above the pickup point.

The optional Instantaneous Output (i.e., no intentional delay) responds to an input contact closure within 8 milliseconds.

Range of Timers

Timers are adjustable as follows.

Control Timer: 150-500 milliseconds

T1 and T2: 18-500 milliseconds each

Timing Test Points

Oscilloscope test points are provided on the front panel for precise checking of the Control Timer, as well as Timer 1 and Timer 2. These test points are optically coupled to the logic circuits for complete isolation.

FIELD SELECTABLE LOGIC

Eight switches (located on a printed circuit board) allow the user to program the internal logic that functionally relates the relay's inputs, outputs, timers, and current pickup elements. This programming capability greatly expands the versatility of the relay, allowing it to be compatible with virtually any breaker failure scheme. The functions of these 8 switches, when closed, are briefly summarized on next page.

SPECIFICATIONS, continued

FIELD SELECTABLE LOGIC, continued

No. 1 - Causes the (optional) Instantaneous relay to be energized by an incoming BFI signal.

No. 2 - Causes the (optional) Instantaneous relay to be energized by an incoming Supervisory signal.

No. 3 - Seals-in the BFI signal.

No. 4 - Allows the (optional) Timer 2 to serve as an alternate time delay to Timer 1. (Timer 2 is initiated by the Supervisory signal.)

No. 5 - Inhibits BF output until Supervisory contacts are closed.

No. 6 - Inhibits BF output until Timer 1 and Timer 2 have timed out. When the inhibit is removed, and if current is above pickup, the BF relays are energized.

No. 7 - 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.

No. 8 - 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.

OUTPUTS

Output contacts are rated as follows:

Resistive

120/240 Vac - make 30 A for 0.2 seconds, carry 7 A continuously, break 7 A.

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

500 Vdc - make and carry 15 A for 0.2 seconds, carry 7 A continuously, break 0.1A.

Inductive

120/240 Vac, 125 Vdc, 250 Vdc - break 0.3 A (L/R = 0.04).

Push-to-Energize Pushbutton

Applying a thin non-conducting rod through the "BF" hole in the front panel energizes each output relay for testing the external trip circuits. Another pushbutton similarly provides for energizing the instantaneous output relay.

TARGETS

Magnetically latched, manually reset, target indicators are optionally available to indicate that an output has tripped. Either internally operated or current operated targets may be specified. Current operated targets require 0.2 A in the output trip circuit to actuate, and trip circuit current must not exceed 30 A for 0.2 seconds, 7 A for 2 minutes, and 3 A continuous. Current operated targets may be selected only when normally open (NO) output contacts have been specified.

SURGE WITHSTAND CAPABILITY

Qualified to IEEE C37.90-1978, C37.90a-1974, Surge Withstand Capability Test and IEC 255, Impulse Test and Dielectric Test. Qualified to IEEE C37.90.1-198X for Fast Transient.

MECHANICAL

Operating Temperature

-40°C (-40°F) to +70°C (+158°F)

Storage Temperature

-65°C (-85°F) to +100°C (+212°F)

Weight

14.1 pounds maximum

Shock

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

Vibration

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

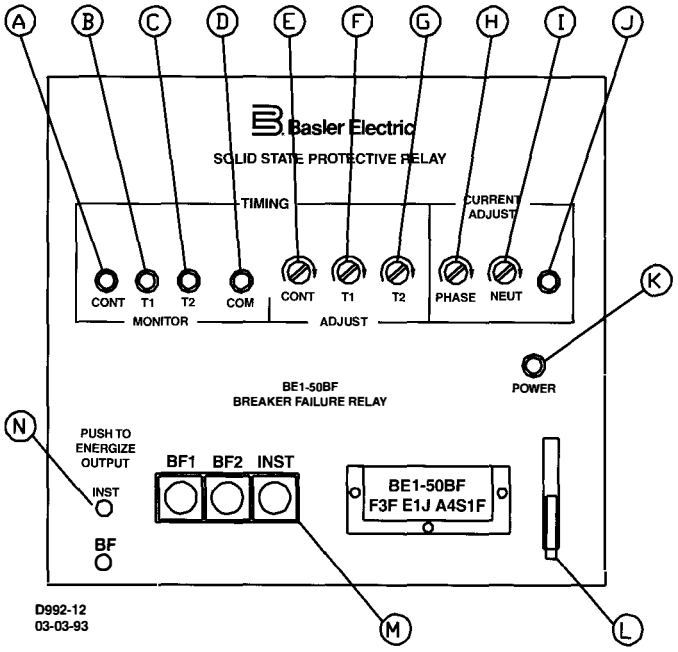


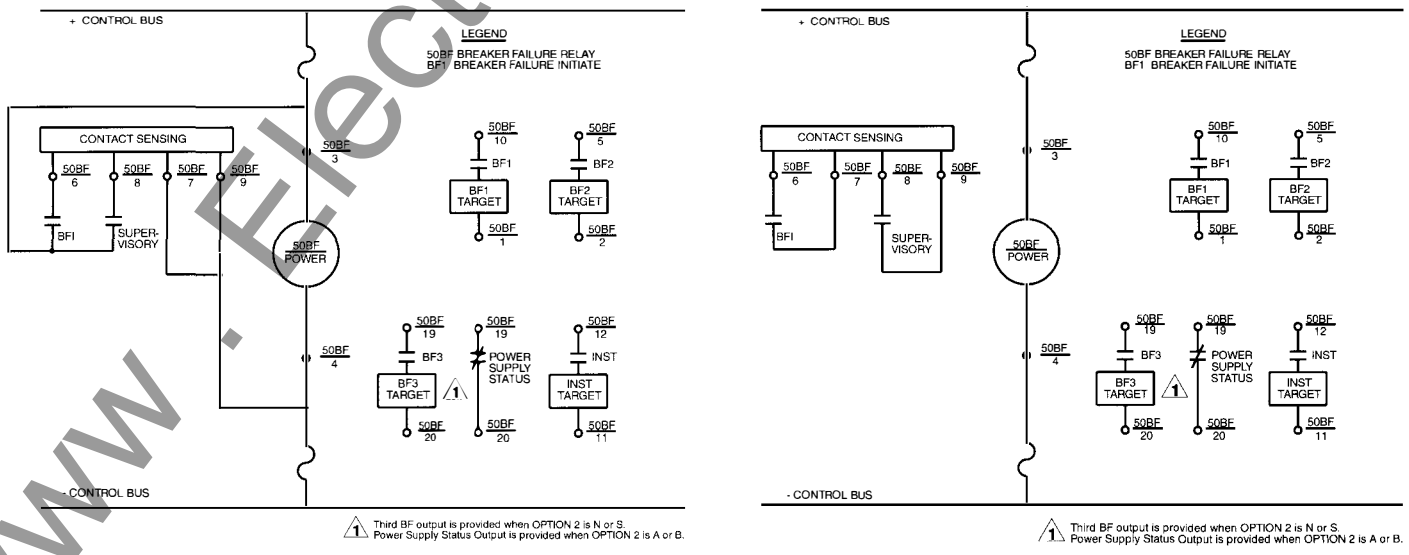
Figure 3 - Front Panel, BE1-50BF

SPECIFICATIONS, continued

Table 2 - Controls and Indicators

Locator	Control or Indicator	Function
A thru D	TIMING MONITOR TEST POINTS	Jacks provide nominal 10V 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 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.

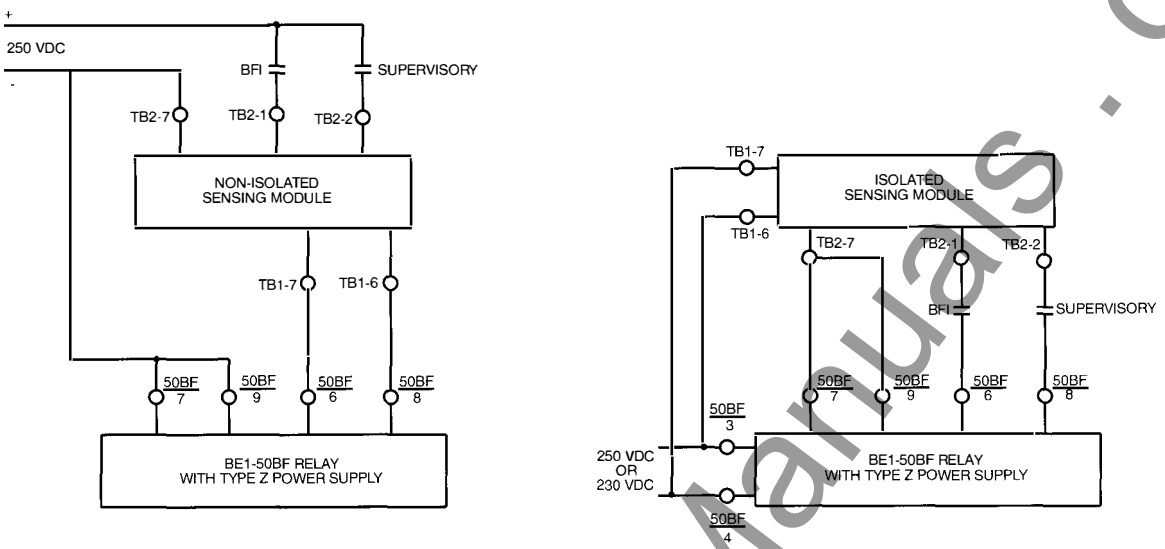
CONNECTIONS



NON-ISOLATED INPUTS **ISOLATED INPUTS**

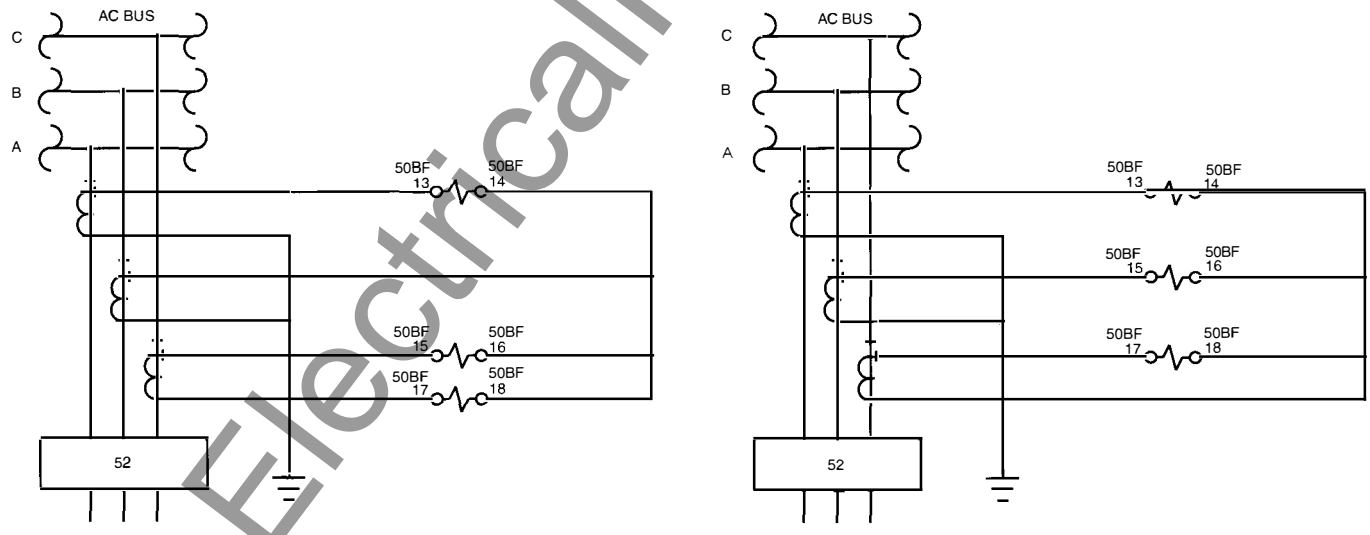
Figure 4 - Control Circuit Connections (Typical)

CONNECTIONS



NON-ISOLATED INPUTS **ISOLATED INPUTS**

Figure 5 - Contact Sensing Using Modules (Only for relays with Type Z Power Supply)



SENSING TYPE E TWO-PHASE AND NEUTRAL **SENSING TYPE F THREE-PHASE**

Figure 6 - Current Sensing

ORDERING

MODEL NUMBER

BE1-50BF Breaker Failure Relay

STYLE NUMBER

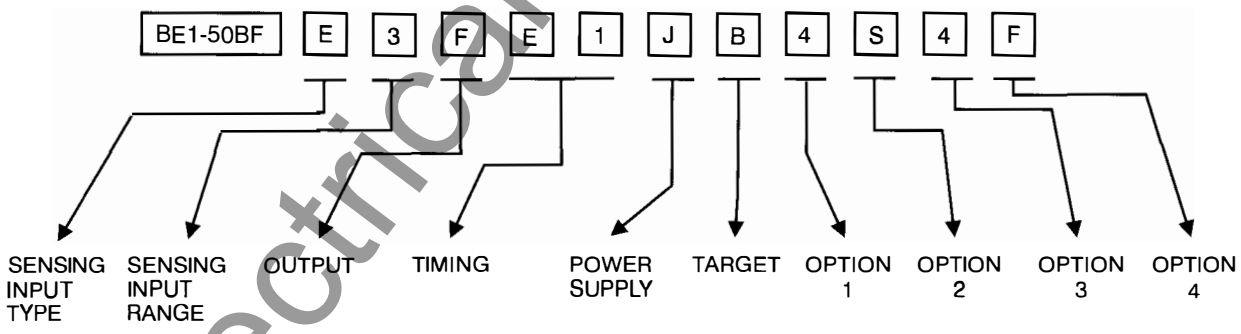
The style number appears on the front panel, drawout cradle, and inside the case assembly. This style number is an alphanumeric combination of characters identifying the features included in a particular unit. The sample style number below illustrates the manner in which the various features are designated. The Style Number Identification Chart (page 8) defines each of the options and characteristics available for this device.

SAMPLE STYLE NUMBER: E3FE1JB4S4F

The style number above describes a BE1-50BF Breaker Failure Relay having the following features.

Sensing Input Type	(E)	Two-phase and Neutral
Sensing Input Range	(3)	1.0 - 8.0 A
Output	(F)	Three relays, NO
Timing	(E1)	Definite time
Power Supply	(J)	125 Vdc or 100/120 Vac external power source
Target	(B)	Three current operated targets: BF-1, BF-2, and Instantaneous
Option 1	(4)	Non-isolated contact sensing
Option 2	(S)	Push-to-energize outputs
Option 3	(4)	Instantaneous trip and Supervisory contact sensing
Option 4	(F)	Semi-flush mounting

NOTE: The description of a complete relay must include both the model number and the style number.



SAMPLE STYLE NUMBER ILLUSTRATED

HOW TO ORDER:

Designate the model number followed by the complete Style Number.

BE1-50BF Style Number ☐☐☐☐☐☐☐☐☐☐

Complete the Style Number by selecting one feature from each column of the Style Number Identification Chart and entering its designation letter or number into the appropriate square. (Two squares are used to indicate time delay characteristics.) All squares must be completed.

STANDARD ACCESSORIES:

The following accessories are available for the BE1-50BF Breaker Failure Relay.

Test Plug

To allow testing of the relay without removing system wiring, order two test plugs, Basler Electric part number 10095.

Extender Board

The extender board permits troubleshooting of the printed circuit boards outside of the relay cradle. Order Basler Electric part number 9165500100.

STYLE NUMBER IDENTIFICATION CHART

BE1-50BF [ ] [ ] F E 1 [ ] [ ] [ ] [ ] [ ] [ ]

MODEL NO.

SENSING INPUT TYPE
- E) Two-phase-and-neutral
- F) Three-phase

SENSING INPUT RANGE
- 1) 0.25 - 2.0 A
- 2) Phase 1.0 - 8.0 A; neutral 0.25 - 2.0 A. (4)
- 3) 1.0 - 8.0 A

OUTPUT (3)
- F) NO contacts

TIMING
- E1) Definite time

POWER SUPPLY
- J) 125 Vdc and 100/120 Vac
- K) 48 Vdc
- L) 24 Vdc
- Z) 250 Vdc and 230 Vac (2)

TARGETS
- A) All internally operated
- B) All current operated

OPTION 1
- 4) Non-isolated contact sensing (5)
- 5) Isolated contact sensing

OPTION 2 (3)
- N) None
- A) Power supply status output
- B) Power supply status output and push-to-energize outputs
- S) Push-to-energize outputs

OPTION 3
- 0) None
- 1) Instantaneous trip
- 3) Supervisory contact sensing
- 4) Instantaneous trip and supervisory contact sensing

OPTION 4
- F) Semi-flush mounting
- P) Projection mounting

NOTES:

1. All relays are supplied in an S1 size case.

(2) Requires one of the sensing modules listed below.

Contact Sensing Modules (Required when type Z power supply is specified)		
	Module Ordering No.	
Option 3	Isolated Contact Sensing	Non-Isolated Contact Sensing
0 or 1	9170206105	9170206111
3 or 4	9170206104	9170206110

(3) When option 2 is N or S, three output relays are provided. When option 2 is A or B, two output relays are provided.

(4) Sensing input type must be E.

(5) Non-isolated contact sensing 4 requires dc sensing power.

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