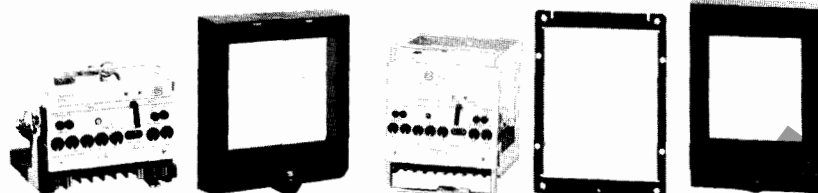


BE1-50/51B in S1 Case

**BE1-50/51B**  
**TIME OVERCURRENT RELAY**  
**and RETROFIT KITS**  
 219, 226 and 214, 225: CO and IAC  
 218: IAC Complete Replacement



BE1-50/51B-219, 226

BE1-50/51B-214, 225

The BE1-50/51B Time Overcurrent Relay provides economical overload and fault protection for generators, transformers, lines and motors.

## ADVANTAGES

- Self powered from 50/60Hz systems, available for 5 or 1 amp CT secondaries.
- Models available to replicate decaying reset of electromechanical relay disks when current goes to zero.
- Ten field selectable curves.
- Independent instantaneous overcurrent function.
- Drawout construction, testable in the case.
- Qualified to the requirements of:
  - IEEE C37.90-1989, C37.90.1-1989, C37.90.2-1989, UL508
- Five year warranty.

## ADDITIONAL INFORMATION

### INSTRUCTION MANUAL

Request Publication 9252000991

### RETROFIT KITS

Request Publication 9252000994 (214, 225)

Request Publication 9252000995 (218)

Request Publication 9252000981 (219, 226)

### TIMING CURVES

Request Publication 9252000998 for IAC curves

Request Publication 9252000999 for CO and BS142 curves

### STANDARDS, DIMENSIONS and ACCESSORIES

Request Publication SDA

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**ORDERING INFORMATION**  
 Page 10

**B Basler Electric**

ROUTE 143, BOX 269 HIGHLAND, ILLINOIS 62249, U.S.A. PHONE 618-654-2341 FAX 618-654-2351

UHD-8  
 8-01

## FEATURES

- Ten field selectable, inverse, fixed time and British Standard (BS142) time overcurrent curves.
- Instantaneous overcurrent function.
- Wide setting ranges:  
Time Overcurrent: 0.5 to 15.9 (5 Amp Unit)  
0.1 to 3.18 (1 Amp Unit)
- Inst. Overcurrent: 1 to 99 (5 Amp Unit)  
0.2 to 19.8 (1 Amp Unit)
- Current pickup accuracy  $\pm 2\%$ .
- Timing accuracy  $\pm 2\%$ .
- Less than 10% transient overreach.
- Zero Pickup setting for safety during installation.
- Timed Overcurrent Reset - Selectable Instantaneous or Decay Characteristic.
- 5VA burden (at nominal) self powered from 50/60 Hz systems, utilizes standard 5 or 1 Amp CT secondaries.
- Drawout construction.
- Manual method for trip circuit testing.
- Standard magnetically latched targets for TOC and IOC.
- Direct reading front panel controls.
- UL recognized under standard 508.
- Qualified to the requirements of:  
-IEEE C37.90.1-1989 for SWC.  
-IEEE C37.90.2-1989 for RFI.  
-IEC 255-5 for impulse.
- Continuous automatic calibration.
- Time characteristics extend to 40 X Pickup.
- Positive visual indication that microprocessor is executing code.
- Two year warranty.

## APPLICATION

The BE1-50/51B is a single phase self powered, micro-processor based time overcurrent relay. The relay is designed for use in applications requiring time delayed coordination for phase or ground overcurrent conditions.

The relay can be used to provide coordinated protection for overhead and underground distribution circuits. Other applications include overcurrent back-up protection for transformers and generators, and the protection of neutral grounding resistors and reactors.

Since all of the time-current characteristics are included within the relay, a standard relay may be ordered before the coordination study is completed, thereby allowing the physical construction to proceed. This is also an advantage as changes in the system configuration or coordination may be accomplished without a hardware change. Table 1 lists typical applications for each of the time-current characteristic curves.

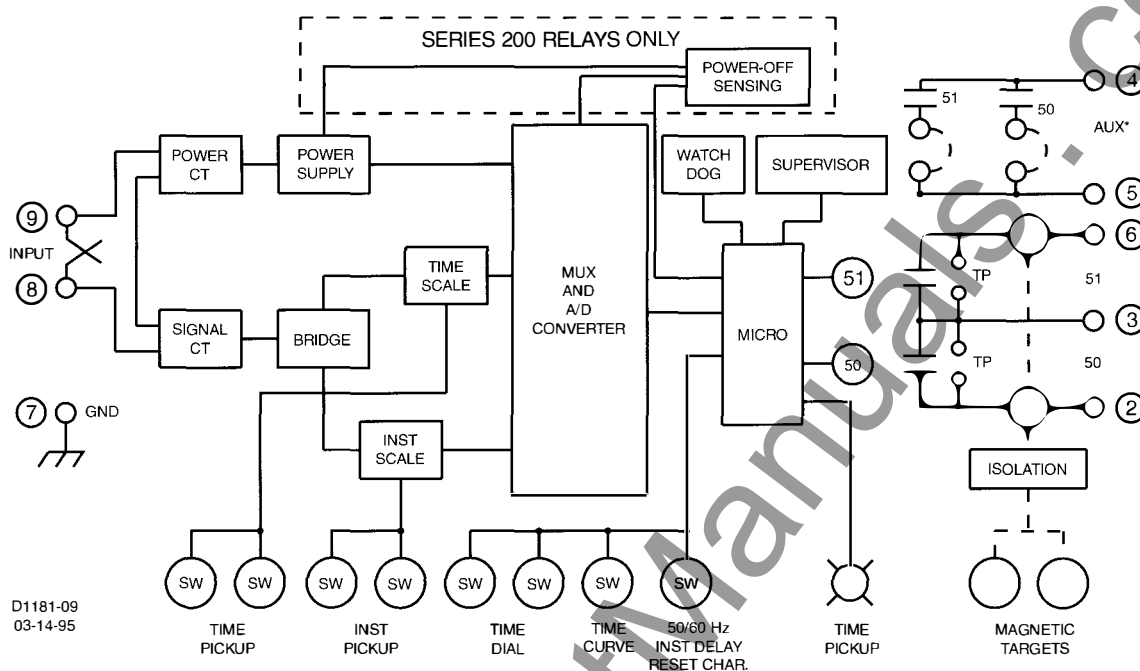
Models are included (200 series) which have memory to replicate the decaying reset of electromechanical relays even when power to the relay is lost. Use the 200 series for applications that require coordination with the resetting of nearby electromechanical relays.

The instantaneous overcurrent element is standard in the relay. This element is designed to minimize transient overreach. The instantaneous element includes selectable delay characteristics for improved coordination with downstream devices and customer requirements.

**Table 1 - Time-Current Characteristics**

CHARACTERISTIC CURVE		TYPICAL PROTECTIVE APPLICATION	APPLICATION COMMENTS
SWITCH DESIGNATION	NAME		
S	Short Inverse	Generator or Bus	Relatively short time, desirable where preserving system stability is a critical factor.
L	Long Inverse	Motors	Provides protection for starting surges and short duration overloads.
D	Definite Time	General Use	Timing relatively independent of current. Useful in sequential tripping schemes.
M	Moderately Inverse	Transmission and feeder lines. Useful for both phase and ground application.	Accommodates moderate load changes, as may occur on parallel lines where one line may occasionally have to carry both loads.
I	Inverse	Feeder lines or back-up protection for other types of relays.	Provides additional variations of the inverse characteristic, thereby allowing flexibility in meeting load variations, or in coordinating with other relays.
V	Very Inverse		
E	Extremely Inverse		
B	BS142 Very Inverse		
C	BS142 Extremely Inverse		
F	Fixed Time	General Use	Fixed time delay defined by dial setting. Useful in sequential tripping schemes.

## FUNCTIONAL DESCRIPTION



\* Aux. output is not provided on IAC or CO replacement units.

### Figure 1 - Functional Block Diagram

### CURRENT INPUT

A single phase of ac current from a 5 Amp, or 1 Amp, 50/60 Hz, system current transformer (CT) is applied to the BE1-50/51B. This input current provides both the power and sensing quantity for the relay.

The current applied to the relay provides the energy for the internal power supply. When sufficient current is available, the Active/Pickup LED will turn green. In applications where circuit loading conditions are less than that required to illuminate the LED, the relay remains operable and will provide overcurrent protection.

The sensing input transformer provides the quantity to be scaled and measured by the Time and Instantaneous functions. Ranges, ratings, and accuracies apply as described in Table 2.

Scaling of the input signal is accomplished by separate networks for the time and instantaneous functions. The scale factors are established by the front panel pick-up settings. Pickup settings of 00 provide maximum sensitivity as a safety precaution for the installation process. Pickup will occur when the input current level is adequate to power the unit.

## MICROPROCESSOR

The setting of the TIME DIAL, TIME CURVE selector switch, and circuit board jumpers provide the microprocessor with ten operating parameters for the desired response by the relay. The microprocessor performs the program operations based on the input current level and internal software program. When the Active/Pickup LED is green, the microprocessor is active and executing code.

Operating power from the power supply is applied to the microprocessor supervisor circuit. When the input current falls below an acceptable level, the supervisor circuit interrupts the microprocessor and halts further operation.

The watchdog timer monitors the microprocessor for specific pulses indicating proper program operation. If something occurs to disrupt the microprocessor, these pulses stop, the watchdog timer times out and sends a reset pulse to the microprocessor. The microprocessor resets and resumes normal operation.

### Table 2 - Current Sensing Capabilities

50/60 Hz System CT Secondary	Time Element Pickup Range	Time Element Max. Continuous Current	Time Element Max. Current For 1 Second	Instantaneous Pickup Range	Time Element Pickup Accuracy	Instantaneous Pickup Accuracy
5 Amp	0.5 to 15.9 Amps in 0.1 Amp Steps	14 Amps	400 Amps	1 to 99 Amps in 1 Amp Steps	2% from 0.5 to 15.9 Amps	2% from 1 to 99 Amps
1 Amp	0.1 to 3.18 Amps in .02 Amp Steps	2.8 Amps	80 Amps	0.2 to 19.8 Amps in 0.2 Amp Steps	2% from 0.1 to 3.18 Amps	2% from 0.2 to 19.8 Amps

FUNCTIONAL DESCRIPTION, continued

OUTPUTS

The TIME contacts (51 and 51AUX) are closed in accordance with conditions defined by the selected time characteristic equation and the sensed current magnitude. If the sensed current exceeds the INST PICKUP setting, the INST contacts (50) are closed.

Breakers controlled by the output contacts can be manually trip tested by inserting a jumper between the TIME and INST MANUAL TRIP test points on the front panel.

TIME ELEMENT CHARACTERISTIC SHAPES FOR CO and BS142 CURVES

All time characteristic curves follow the relation:

T<sub>T</sub> = AD / M<sup>N-C</sup> + BD + K = Time to trip

T<sub>R</sub> = RD / M<sup>2-1</sup> = Time for decaying reset

Table 3.

Curve Type	Constants					
	A	B	C	N	K	R
S	0.2663	0.03393	1.000	1.2969	0.028	0.500
L	5.6143	2.18592	1.000	1.0000	0.028	15.750
D	0.4797	0.21359	1.000	1.5625	0.028	0.875
M	0.3022	0.12840	1.000	0.5000	0.028	1.750
I	8.9341	0.17966	1.000	2.0938	0.028	9.000
V	5.4678	0.10814	1.000	2.0469	0.028	5.500
E	7.7624	0.02758	1.000	2.0938	0.028	7.750
B	1.4636	0.00000	1.000	1.0469	0.028	3.250
C	8.2506	0.00000	1.000	2.0469	0.028	8.000
F	0.0000	1.00000	0.000	0.0000	0.000	1.000

S=Short Inverse L=Long Inverse D=Definite Time M=Moderately Inverse I=Inverse V=Very Inverse E=Extremely Inverse B=BS142 Very Inverse C=BS142 Extremely Inverse F=Fixed Time

Where D is the time dial setting (0.0 to 9.9) and M is the multiple of pickup. A, B, C, N, K and R are constants defining the shape of the curve. The constants have been selected to provide a very close match to the characteristics of electromechanical relays. The constants are provided in Table 3 for each characteristic curve shape. Figure 2 illustrates the characteristic shapes. Constants for IAC curves can be found in the manuals provided with 200 series models.

The Active/Pickup LED on the front panel will turn red when the applied current just exceeds the PICKUP setting (See Figure 4).

RESET

Reset occurs when the current level is less than pickup. Internal switch provides selection of either an Instantaneous or a decaying reset characteristic.

The instantaneous reset characteristic forces the timer to zero when the input current falls below 95% of setting. This fast reset characteristic prevents the ratcheting effect on electro-mechanical relay disks that occurs for repeated faults.

The decaying reset characteristic replicates the decaying reset of electromechanical relay disks. Models with dash numbers in the 200 series continue the decaying process even when the input current goes to zero. Models with dash numbers in the 100 series reset immediately when the input current drops below the minimum required to power-up the relay (.5A for 5A models and 0.1A for 1A models).

TIME DIAL RANGE AND ACCURACY

The TIME DIAL range is 0.0 to 9.9 in 0.1 steps. A setting of 0.0 results in instantaneous operation without intentional time delay.

INSTANTANEOUS ELEMENT CHARACTERISTICS

The characteristic for phase faults is faster because the relay will be powered-up. However, the tripping characteristic for ground applications is slightly longer to allow time to power-up the relay. This longer trip time for ground applications is beneficial because it helps avoid nuisance trips. These timing characteristics are shown in Figure 3.

Additional definite time delays of 0.1, 0.2 or 0.3 seconds may be added to the instantaneous element on 100 series units; 200 series units have only 0.1 seconds. The definite delay is determined by switches on the circuit card.

OUTPUTS

Separate output contacts are provided for the TIME (51) and INST (50) trip functions. An additional auxiliary output relay (51 AUX) is included. This output operates simultaneously with the TIME output relay. All output contacts are configured normally open (NO).

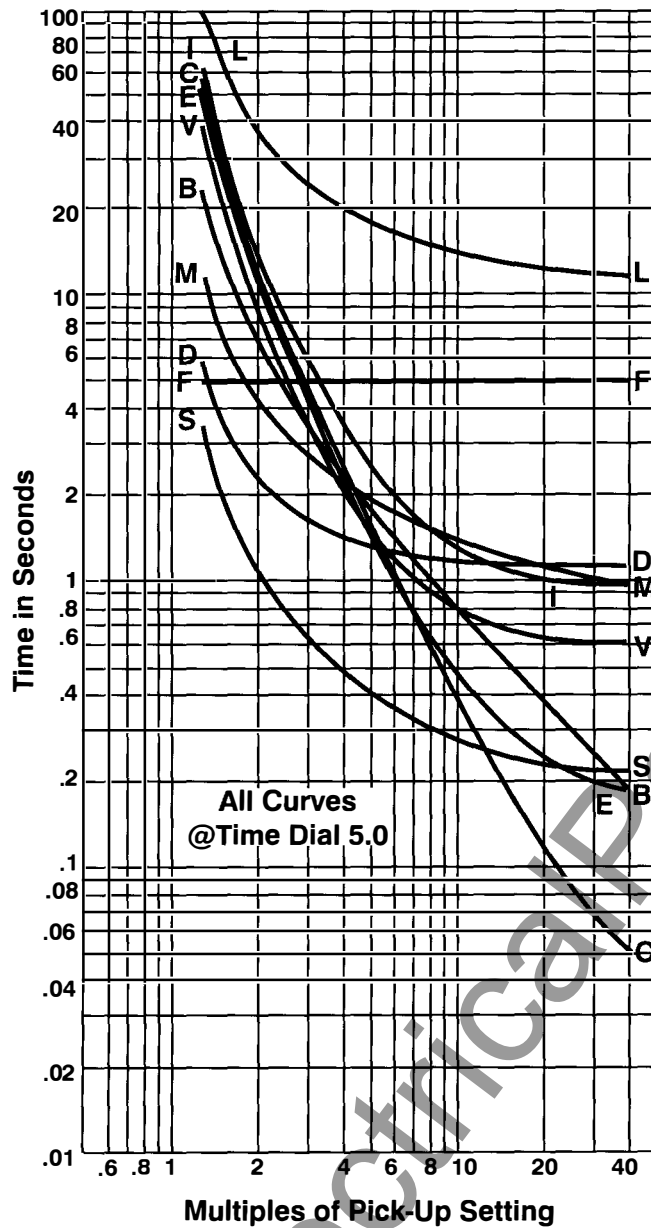
MANUAL TRIP TESTING

The relay is provided with front panel test points to allow shorting the output terminals to verify external control circuit wiring.

TARGETS

Two target indicators are provided as a standard feature of the BE1-50/51B. These magnetically latched, current operated targets provide visual indication of trip by the TIME or INST output contact. These targets must be manually reset after the abnormal condition has been removed or corrected.

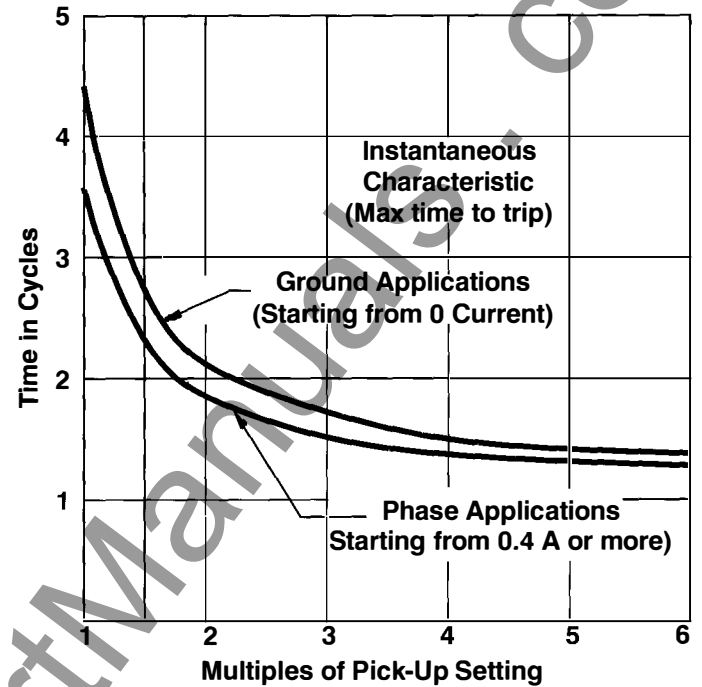
## FUNCTIONAL DESCRIPTION, continued



CO and BS142 curves in both 100 and 200 series models:

S=Short Inverse	M=Moderately Inverse	B=BS142 Very Inverse
L=Long Inverse	I=Inverse	C=BS142 Extremely Inverse
D=Definite Time	V=Very Inverse	F=Fixed Time
	E=Extremely Inverse	

Figure 2 - Time-Current Characteristics

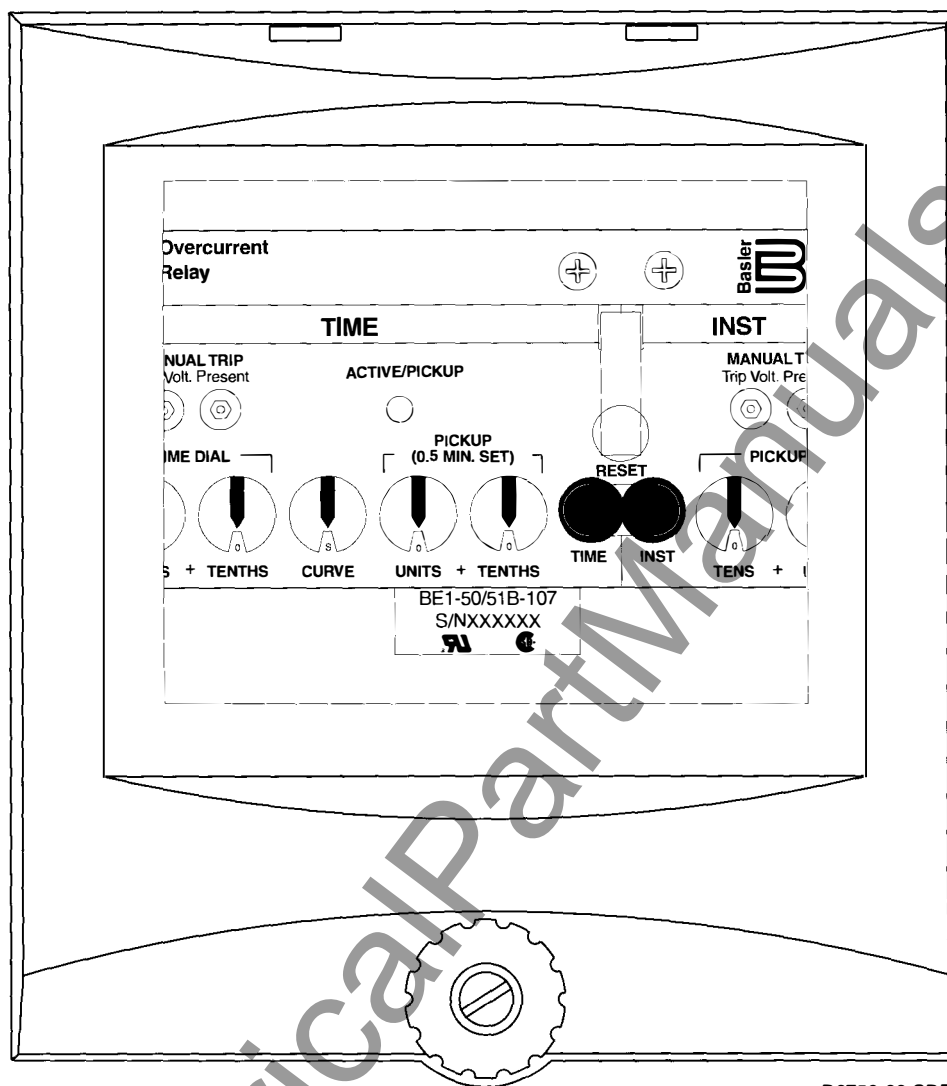


IAC curves in 200 series models only:

- Short Inverse
- Inverse
- Very Inverse
- Extremely Inverse
- Long Inverse

Figure 3 - Instantaneous Characteristics

## FUNCTIONAL DESCRIPTION, continued



D2750-22.CDR  
12-04-00

Figure 4 - Front Panel, S1 Case

## SPECIFICATIONS

CURRENT SENSING INPUT:	Continuous Current	One Second Current
5 Amp Unit	14.0 Amps	400 Amps
1 Amp Unit	2.8 Amps	80 Amps

### TIME PICKUP RANGE:

5 Amp Unit: 0.5 to 15.9 Amps in 0.1 Amp steps  
1 Amp Unit: 0.1 to 3.18 Amps in 0.02 Amp steps

### TIME DROPOUT:

Not less than 95% of pickup value.

### TIME PICKUP ACCURACY:

± 2% of setting

### TIME DIAL RANGE:

0.0 to 9.9 in 0.1 steps

### TIME CHARACTERISTICS:

Nine inverse time and 1 fixed time function can be selected by a front panel switch. Characteristic curves are defined by the time characteristic equation. The fixed time characteristic provides delays of 0.0 to 9.9 seconds corresponding to the dial setting.

### INVERSE TIMING ACCURACY:

± 2%, ± 1 cycle for multiples of pickup from 2 to 40.  
Below multiples of 2, errors may increase directly proportional to the value of  $\frac{1}{(M^N-1)}$ .

### FIXED TIME ACCURACY:

± 2% or 30 milliseconds, whichever is greater.

### TIME RESET:

Instantaneous or decay as selected by jumper.

### INST PICKUP RANGE:

5 Amp Unit: 1 to 99 Amps in 1 Amp steps  
1 Amp Unit: 0.2 to 19.8 Amps in 0.2 Amp steps

### INST DROPOUT:

95% of pickup

### INST PICKUP ACCURACY:

± 2% of setting

### INST CHARACTERISTIC:

Industry accepted shape. Longer time for ground applications. Additional definite delays of 0.1, 0.2 and 0.3 seconds are user selectable by jumpers.

### INST TRANSIENT RESPONSE:

Less than 10% overreach with system time constants up to 40 milliseconds.

### BURDEN: Burden is non-linear and resistive.

5 Amp Unit: 4.8 Ohms @ 0.5A & 0.2 Ohms @ 5A  
1 Amp Unit: 120 Ohms @ 0.1A & 5 Ohms @ 1A

### TARGETS:

Magnetically latched, manually reset for TIME and INST output functions.

Operate Current: 0.2 Amp minimum

Coil Resistance: 0.1 Ohm

Operate Time: < 1 millisecond

### OUTPUTS: (50, 51 and 51 Aux)

Resistive:

250 Vdc-Make and carry 30 Amps for 0.2 seconds, 7 Amps for 2 minutes and 3 Amps continuously, break 0.3 Amp.

Inductive:

250 Vdc- Break 0.3 Amp (L/R = 0.04)

### ISOLATION:

2000 Vac at 50/60 Hz for one minute (1500 Vac for one minute across open contacts) in accordance with IEC 255-5 and IEEE C37.90-1-1989 (Dielectric Test).

### SURGE WITHSTAND CAPABILITY:

Qualified to IEEE C37.90.1-1989

*Standard Surge Withstand Capability (SWC)*

*Tests for Protective Relays and Relay Systems.*

### FAST TRANSIENT:

Qualified to IEEE C37.90.1-1989

### IMPULSE TEST:

Qualified to IEC 255-5

### RADIO FREQUENCY INTERFERENCE (RFI):

Qualified to IEEE C37.90.2-1989. Field tested using five watt transceiver operating at random frequencies centered around 144 MHz and 440 MHz.

### TEMPERATURE:

Operating Range -40° C (-40° F) to 70° C (158° F).  
Recommended Storage Range -50° C (-58° F) to 50° C (122° F).

### SHOCK:

15g in each of three mutually perpendicular planes.

### VIBRATION:

2g in each of three mutually perpendicular planes swept over the range of 10 to 500 Hz for a total of 6 sweeps, 15 minutes per sweep.

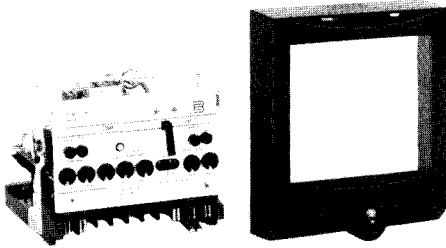
### CASE SIZE:

A1 or S1

### NET WEIGHT:

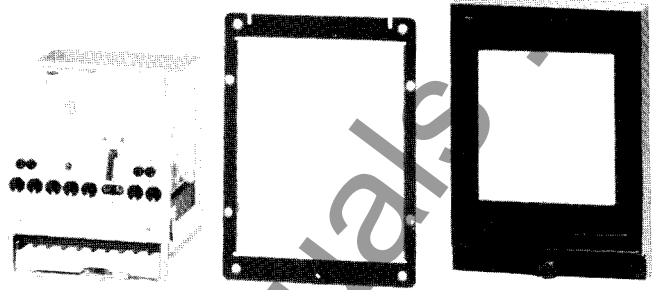
8.6 pounds

## RETROFIT FEATURES and ADVANTAGES



### BE1-50/51B-219/226 Cradle and cover

The BE1-50/51B-219 and -226 retrofit kits consist of a cradle and a cover and provides for installing a Basler BE1-50/51B single-phase time overcurrent relay in an existing CO case without making any wiring changes.



### BE1-50/51B-214/225 Cradle, adapter plate and cover

The BE1-50/51B-214 and -225 retrofit kits consist of a cradle, an adapter plate, and a cover and provides for installing a Basler BE1-50/51B single-phase time overcurrent relay in an existing IAC case without making any wiring changes.

The BE1-50/51B-218 is a complete replacement relay with a case.

## ADVANTAGES

- The 219 or 226 kit is a direct replacement for a CO drawout cradle.
- The 214 or 225 kit is a direct replacement for an IAC drawout cradle.
- No electrical or mechanical rework is required to panels during retrofit.
- Competitively priced.
- One model replaces more than 100 IAC or 40 CO models listed on next page.
- Patent #5,751,532.
- Numerous technical advantages:
  - All units are equipped with an instantaneous element.
  - Instantaneous element can be set lower, because the relay is corrected for transient overreach. Therefore, the range does not need to be as high as on the IAC relay.
  - Ten selectable curves and wide pickup ranges.
  - Lower burden extends linear range of CTs.
  - Self-calibration feature eliminates need for recalibration, thereby reducing maintenance labor.



## REPLACEABLE MODELS

These relays are self-powered and include memory to replicate the decaying reset of electro-mechanical relay disks.

CO models that may be retrofitted with the BE1-50/51B-219:

Curve	CO Model Numbers
Short Time	CO-2*11*1N
Long Time	CO-5*11*1N
Definite	CO-6*11*1N
Moderately Inverse	CO-7*11*1N
Inverse	CO-8*11*1N
Very Inverse	CO-9*11*1N
Extremely Inverse	CO-11*11*1N

IAC models that may be retrofitted with the BE1-50/51B-214:

Curve	IAC Model Numbers
Inverse	12IAC51A***A 12IAC51B***A
Very Inverse	12IAC53A***A 12IAC53B***A
Extremely Inverse	12IAC77A***A 12IAC77B***A
Short Time	12IAC55A***A 12IAC55B***A
Long Time	12IAC66A**A 12IAC66B**A

NOTES: 1. \* = any digit covering all pickup ranges, instantaneous, non-instantaneous, and 50 Hz and 60 Hz models.

2. Units with instantaneous elements are designated with a "B" for the eighth character in the model number.

## ORDERING

### MODEL NUMBER

BE1-50/51B Time Overcurrent Relay

### HOW TO ORDER:

Designate the Model Number and the three-digit dash number from Table 4 to define the configuration desired.

Table 4.

DESCRIPTION	MODEL NUMBER (NOTE)
<b>For 5 Amp System CT Secondaries</b> Semi-Flush Mounting, A1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-105 BE1-50/51B-205
Projection Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-106 BE1-50/51B-206
Semi-Flush Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-107 BE1-50/51B-207
Retrofit kit for IAC relays Cradle plugs into existing case. Adapter plate and new cover are included.	BE1-50/51B-214
Complete IAC replacement relay with same terminal connections as IAC units. S1 style case.	BE1-50/51B-218
Retrofit kit for CO relays. Cradle plugs into existing case. A new cover is provided.	BE1-50/51B-219
<b>For 1 Amp System CT Secondaries</b> Semi-Flush Mounting, A1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-101 BE1-50/51B-201
Semi-Flush Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-103 BE1-50/51B-203
Projection Mounting, S1 Size Case Drawout Construction, Testable-in-Case	BE1-50/51B-102 BE1-50/51B-202
Retrofit kit for IAC relays Cradle plugs into existing case. Adapter plate and new cover are included.	BE1-50/51B-225
Retrofit kit for CO relays Cradle plugs into existing case. A new cover is provided.	BE1-50/51B-226

**NOTE:** Model numbers ending in 200 series include memory to replicate the decaying reset characteristic of electromechanical relay disks even while the input current is zero. Model numbers ending in 100 series reset instantaneously (regardless of settings) when the input current drops below the minimum TOC pickup value.

### ORDERING INFORMATION

All units are self powered and supplied with 10 switch selectable curves, TIME and INST functions and outputs, magnetically latched targets, and an auxiliary output contact.

### STANDARD ACCESSORIES:

A test plug is available to allow testing of the relay without removing external wiring.  
Order test plug: Basler part number: 10095.

## NOTES

www.ElectricalPartManuals.com

 **Basler Electric**

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