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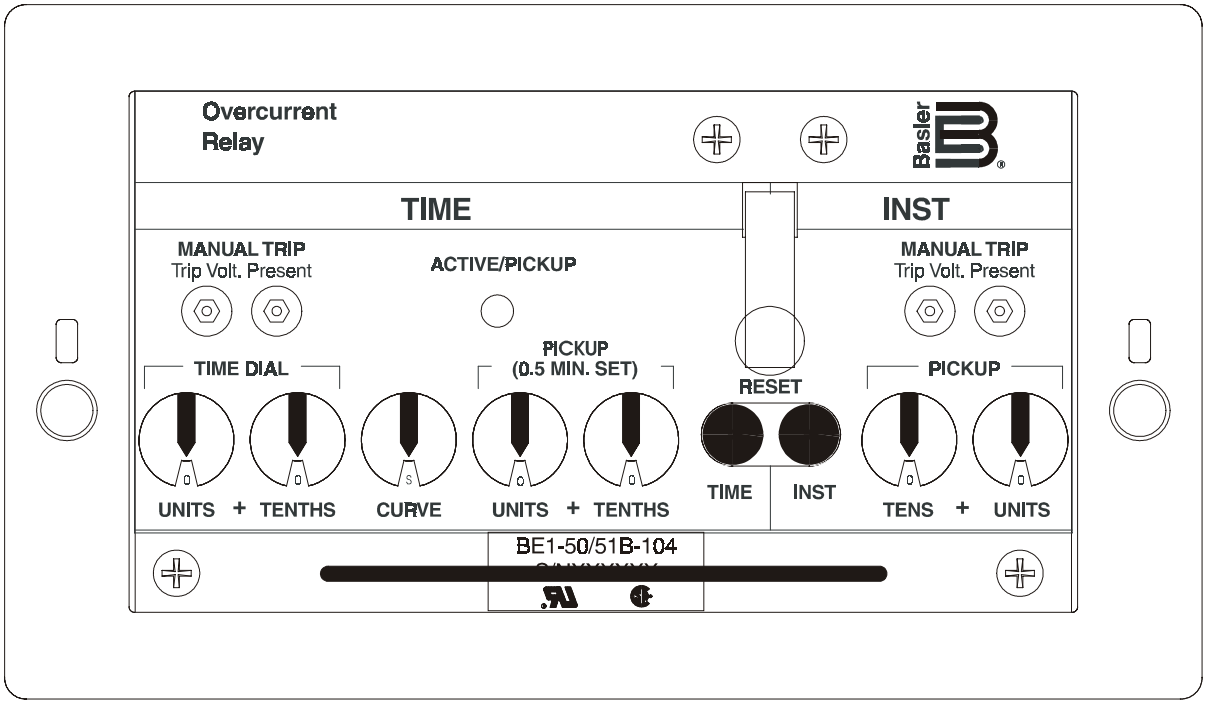
INSTRUCTION MANUAL

FOR

OVERCURRENT RELAY BE1-50/51M



D1144-01.CDR
12/01/00

Basler Electric

Publication: 9252000990
Revision: M 11/2000

INTRODUCTION

This manual provides information concerning the operation and installation of the BE1-50/51M Overcurrent Relay. To accomplish this, the following is provided.

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

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.

First Printing: April 1992

Printed in USA

November 2000

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.

BASLER ELECTRIC
ROUTE 143, BOX 269
HIGHLAND, IL 62249 USA
http://www.basler.com, info@basler.com
PHONE 618-654-2341 **FAX 618-654-2351**

SECTION 1 • GENERAL INFORMATION

DESCRIPTION

BE1-50/51M Overcurrent Relays are microprocessor based, non-directional phase or ground relays that monitor the magnitude of a single phase ac current to provide accurate instantaneous and time overcurrent protection for 50 hertz or 60 hertz power systems. Models are available with fifteen popular time characteristics and a wide range of pickup settings.

APPLICATION

The wide range of pickup settings and front panel selectable time characteristics permit applications involving coordination with fuses, reclosers, cold load pickup, motor starting, and fixed time requirements. Integrating reset functions are available to simulate the disk reset of electromechanical relays. BE1-50/51M Overcurrent Relays have the following standard features.

- Independent time and instantaneous elements.
- A secure method to manually trip the breaker at the relay front panel.
- Direct reading front panel controls.
- Minimum pickup setting for safety during installation.
- Time characteristics extend to a pickup multiple of 40.
- Rugged draw-out construction with steel case.
- Magnetic latching targets retain indication without power.
- Built-in accuracy eliminates internal adjustments.
- Minimum transient overreach.
- Field selectable characteristic curve selection.
- Field selectable instantaneous or integrating reset.
- Field selectable 50 or 60 hertz operation.
- Field selectable fixed instantaneous delay (0.0, 0.1, 0.2, or 0.3 second on 100 series relays and 0.0 or 0.1 second on 200 series relays.).

Individual models are available for 1 ampere and 5 amperes sensing input currents. BE1-50/51M Overcurrent Relays (both horizontal and vertical mounts) must be removed from the case and installed on a test bench for testing. Shorting contacts are provided for all current inputs when the relay chassis is removed from the relay case. Figure 1-1 shows the front panel of the BE1-50/51M Overcurrent Relay, in a C1, horizontal mount case. Figure 1-2 shows the front panel of the BE1-50/51M Overcurrent Relay, in a C1, vertical mount case. Internally (circuit wise), all relay models are the same and use the same circuit assemblies.

BE1-50/51M Overcurrent Relays have many advantages over other overcurrent relays. The five primary advantages are:

- Time characteristics are defined by equations and graphs.
- Field selectable time characteristics.
- Very low burden.
- Self powered from the sensed current.
- Continuous automatic calibration.

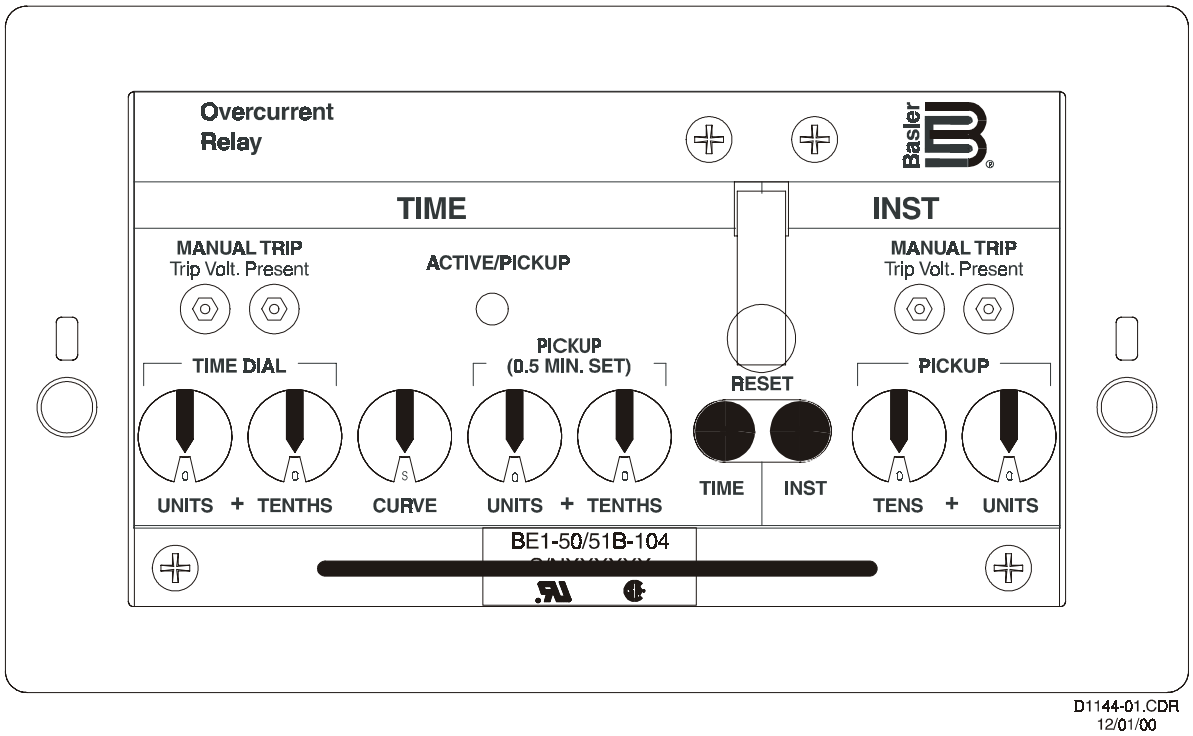


Figure 1-1. BE1-50/51M, C1 (Horizontal Mount) Case

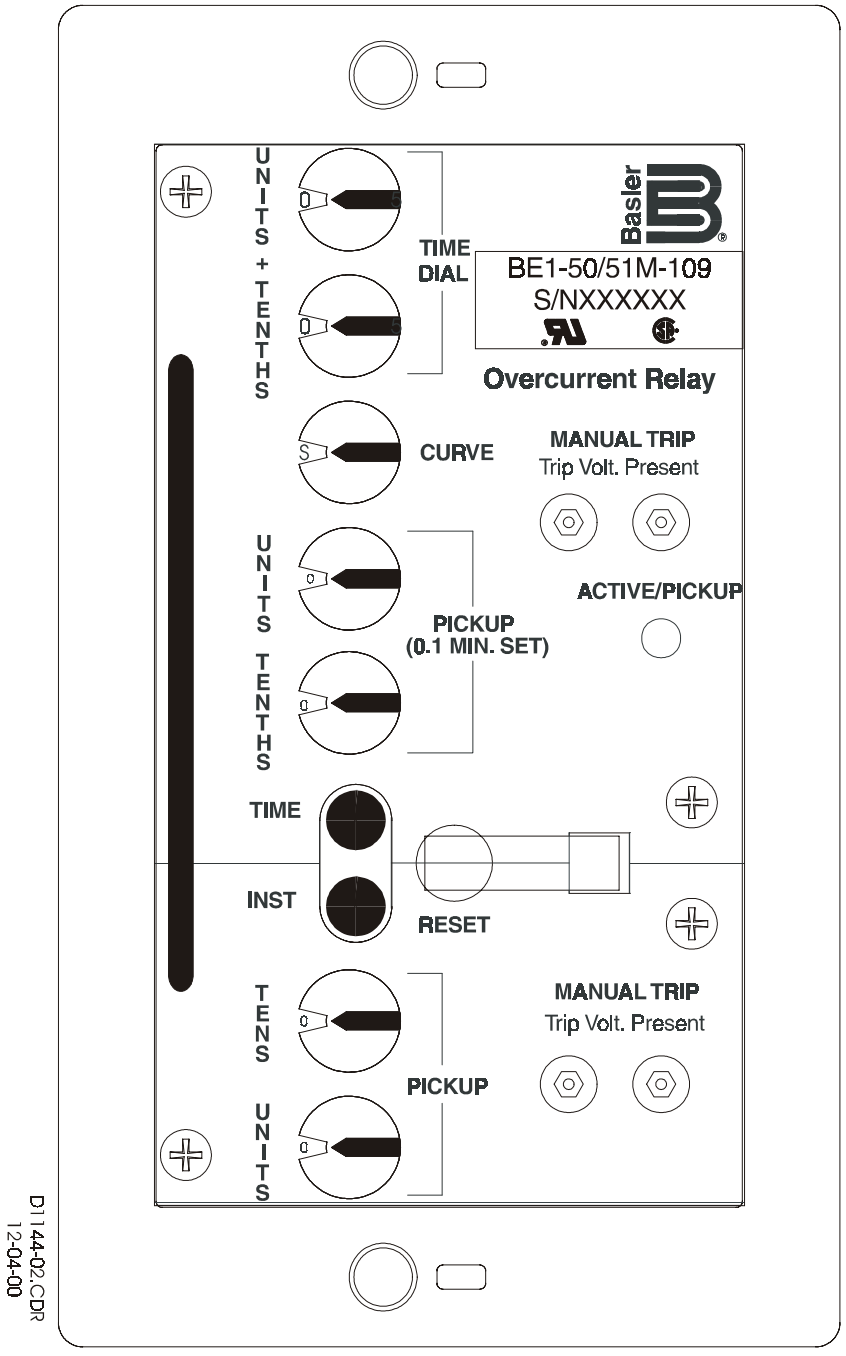


Figure 1-2. BE1-50/51M, C1 (Vertical Mount) Case

MODEL NUMBERS

Model number variations in the BE1-50/51M Overcurrent Relays are specified by a three digit extension to the model number. Tables 1-1 and 1-2 provide model number, case style, switch SW3-3 selections, and sensing current input ranges. Internal switches provide for selecting system operating frequencies of 50 or 60 hertz, instantaneous element delays, curve sets, and instantaneous or integrating reset characteristics. The location and description of these switches is provided in Section 2. Integrating reset is available in 100 series relays (e.g. - BE1-50/51M-100) when there is adequate input current to power the relay. Integrating reset is available in 200 series relays (e.g. - BE1-50/51M-200) even when the input current falls to zero. Two-hundred series relays also have additional characteristic curves available through curve set selection.

Table 1-1. BE1-50/51M Overcurrent Relays, One Ampere CT Secondary, 50/60 Hertz

Model Number	Case Style	SW3-3 Selects	Sensing Input Range (Amps)	
			TIME	INST
BE1-50/51M-100*	C1 (Horizontal Mount)	0.2 Second Delay	0.1 - 3.18	0.2 - 19.8
BE1-50/51M-200*	C1 (Horizontal Mount)	Curve Set	0.1 - 3.18	0.2 - 19.8
BE1-50/51M-108*	C1 (Vertical Mount)	0.2 Second Delay	0.1 - 3.18	0.2 - 19.8
BE1-50/51M-208*	C1 (Vertical Mount)	Curve Set	0.1 - 3.18	0.2 - 19.8

Table 1-2. BE1-50/51M Overcurrent Relays, Five Ampere CT Secondary, 50/60 Hertz

Model Number	Case Style	SW3-3 Selects	Sensing Input Range (Amperes)	
			TIME	INST
BE1-50/51M-104*	C1 (Horizontal Mount)	0.2 Second Delay	0.5 - 15.9	1.0 - 99.0
BE1-50/51M-204*	C1 (Horizontal Mount)	Curve Set	0.5 - 15.9	1.0 - 99.0
BE1-50/51M-109*	C1 (Vertical Mount)	0.2 Second Delay	0.5 - 15.9	1.0 - 99.0
BE1-50/51M-209*	C1 (Vertical Mount)	Curve Set	0.5 - 15.9	1.0 - 99.0

NOTE:

* 100 series relays (e.g. - BE1-50/51M-104) have the integrating reset function when there is adequate input current to power the relay. 200 series relays (e.g. - BE1-50/51M-204) have the integrating reset function even when the input current falls to zero.

SPECIFICATIONS

BE1-50/51M Overcurrent Relays are available with the following features and capabilities.

Current Sensing Input

(1 Ampere Unit) Continuous current: 2.8 amperes. One second current: 80 amperes.

(5 Ampere Unit) Continuous current: 14 amperes. One second current: 400 amperes.

TIME PICKUP Range Setting the TIME PICKUP below the minimum pickup (0.1 on the 1 ampere unit and 0.5 on the 5 ampere unit), places the relay in the most sensitive state and may be used as a safety setting.

(1 Ampere Unit) 0.1 to 3.18 amperes in 0.02 ampere steps.

(5 Ampere Unit) 0.5 to 15.9 amperes in 0.1 ampere steps.

TIME Dropout Dropout occurs at 95% of pickup value.

TIME PICKUP

Accuracy The timing accuracy is the sum of $\pm$1 cycle $\pm$2%. This is over the range of 1.3 to 40 times tap. This accuracy is for a given measured multiple of tap. The measurement of the multiple of tap has an accuracy that is the sum of $\pm$2% $\pm$25 milliampere for 5 ampere units and $\pm$2% $\pm$5 milliamperes for 1 ampere units.

Example: (5 ampere unit)

PU Setting:	5 amperes
Current Applied:	6.5 amperes
+ Multiple Tolerance:	6.655 amperes
- Multiple Tolerance:	6.345 amperes
Time Curve:	E
Time Dial:	5.0
Minimum Time Using 6.655 amperes:	46.5470 seconds
Maximum Time Using 6.345 amperes:	61.3968 seconds
Curve Time Using 6.5 amperes:	53.1800 seconds

Frequency Response A change of ±5 hertz from the nominal 50/60 hertz current causes less than 0.5% change in the current required for pickup.

TIME DIAL Range

(1 Ampere Unit) 0.0 to 9.9, in 0.1 steps.

(5 Ampere Unit) 0.0 to 9.9, in 0.1 steps.

INST PICKUP Range Setting the INST PICKUP below the minimum pickup (0.2 on the 1 ampere unit and 1.0 on the 5 ampere unit), places the relay in the most sensitive state and may be used as a safety setting.

(1 Ampere Unit) 0.2 to 19.8 amperes in 0.2 ampere steps.

(5 Ampere Unit) 1 to 99 amperes in 1 ampere steps.

INST Dropout Dropout occurs at 95% of pickup value.

INST PICKUP

Accuracy

(1 Ampere Unit) ±2% ±5 milliamperes at or above 0.2 ampere settings.

(5 Ampere Unit) ±2% ±25 milliamperes at or above 1.0 ampere settings.

Frequency Response A change of ±5 hertz from the nominal 50/60 hertz current causes less than 0.5% change in the current required for pickup.

INST Transient Response Less than 10% overreach with system time constants up to 40 milliseconds

Burden Burden is non-linear. (Figure 1-3 illustrates the device burden.)

(1 Ampere Unit) At 0.1 amperes, Z = 120 ohms. At 1.0 ampere, Z = 5 ohms.

(5 Ampere Unit) At 0.5 amperes, Z = 4.8 ohms. At 5.0 amperes, Z = 0.2 ohms.

U.L. Recognition

U.L. recognized per Standard 508, U.L. File Number E97033. Note: Output contacts are not U.L. recognized for voltages greater than 250 V.

C.S.A. Certification

C.S.A. certified per Standard CAN/CSA-C22.2 Number 14-M91, C.S.A. File Number LR23131-103s. Note: Output contacts are not C.S.A. certified for voltages greater than 250 V.

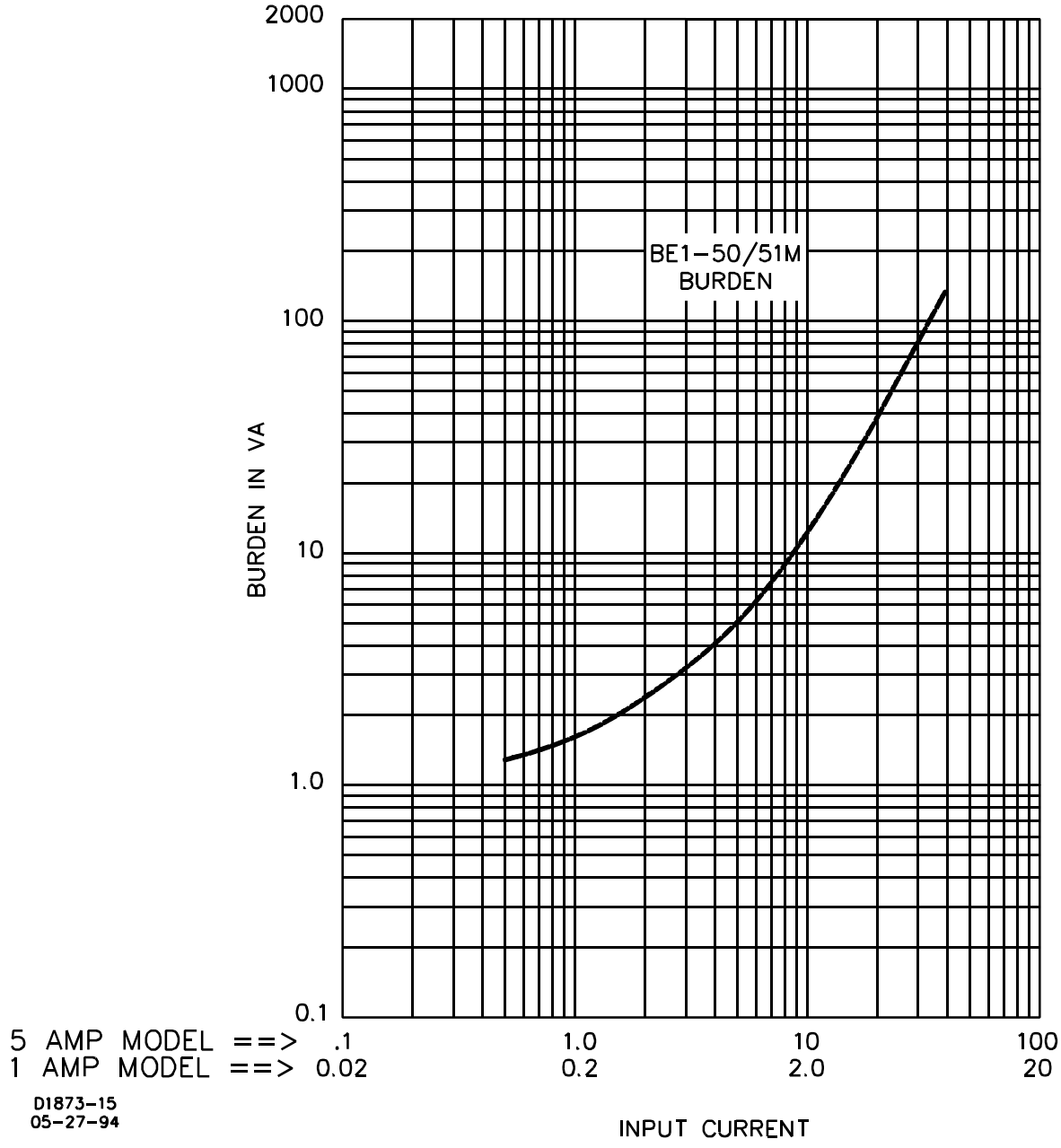


Figure 1-3. Device Burden Characteristics

Harmonic Response

BE1-50/51M harmonic rejection is illustrated in Figure 1-4.

Figure 1-4 shows that a relay set for one ampere pickup would pickup at 0.96 ampere on a current containing 40% seventh harmonic. This corresponds to a ten-to-one rejection ratio. Other conditions may be evaluated in the same manner.

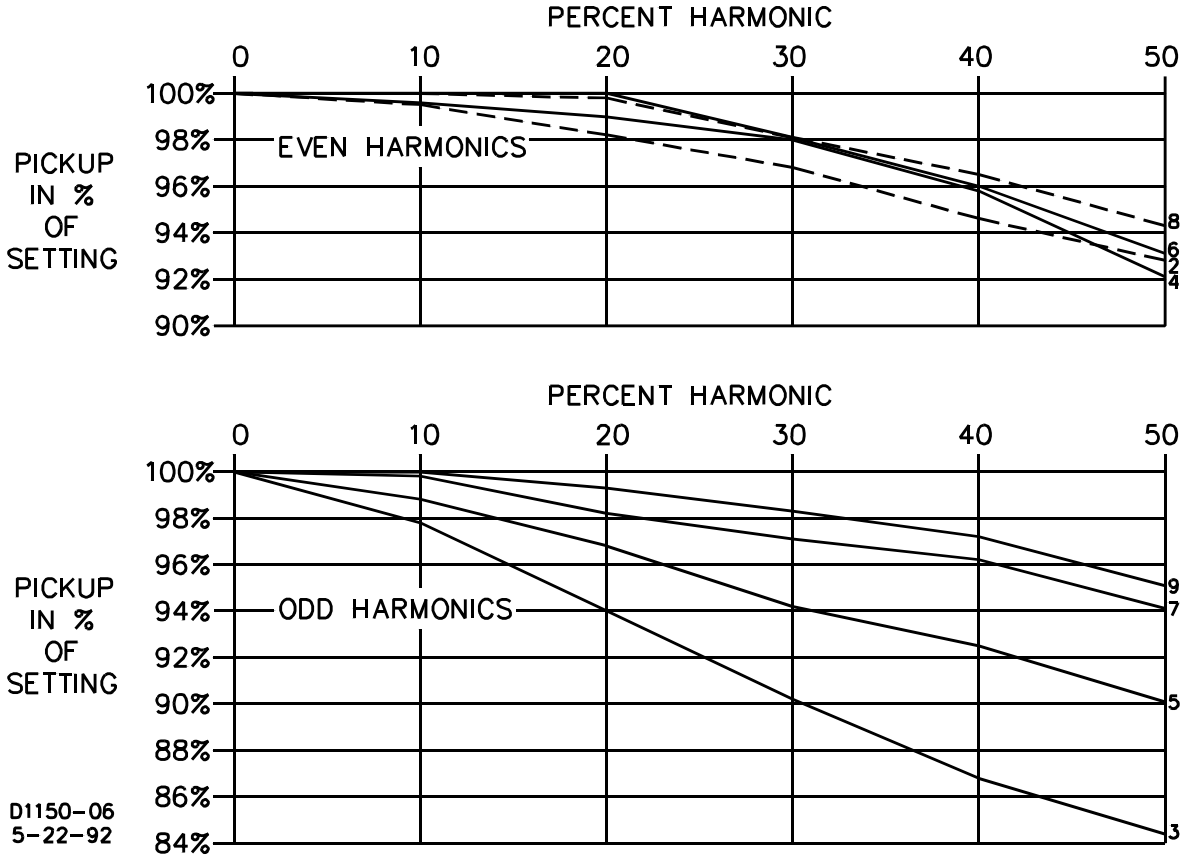


Figure 1-4. Harmonic Response

INST Characteristics

BE1-50/51M instantaneous characteristic curves are similar to standard electromechanical instantaneous units. However, the time to trip for ground applications is slightly longer than that for phase applications to allow time to power-up the relay. Longer trip time for ground applications is beneficial because it helps to avoid nuisance trips.

For phase applications, the maximum time to trip is 3.5 cycles at a pickup multiple of 1.0, and 1.5 cycles at a pickup multiple of 3.0. The corresponding times for ground applications are 4.5 and 1.75 cycles. Figure 1-5 shows the instantaneous characteristic curves for maximum time to trip.

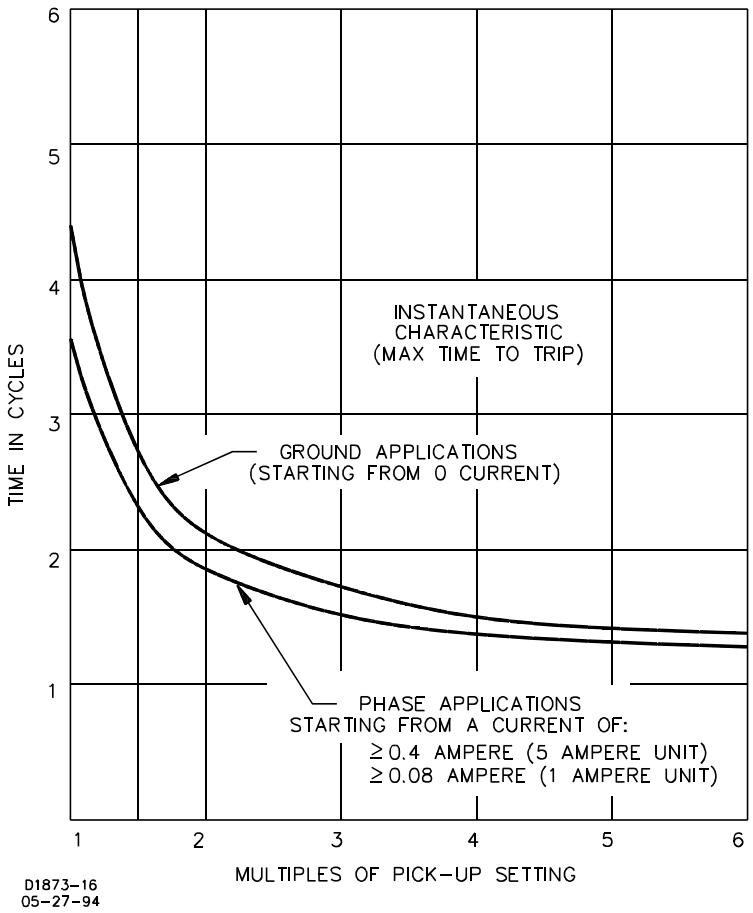


Figure 1-5. Instantaneous Characteristic Curves

INST Characteristics - Continued

On 100 series relays, additional delays of 0.1, 0.2, or 0.3 seconds may be added with internal switches SW3-2 and -3. These delays apply to both phase and ground applications. Closing switch SW3-2 provides an additional delay of 0.1 second. Closing switch SW3-3 provides an additional delay of 0.2 second. Closing both switches SW3-2 and -3 provides an additional delay of 0.3 second. Section 2 illustrates the location of SW3.

On 200 series relays, an additional delay of 0.1 second may be added with internal switch SW3-2. This delay applies to both phase and ground applications. Closing switch SW3-2 provides the additional delay of 0.1 second.

Time Characteristics

Nine inverse time functions and one fixed time function can be selected by a front panel switch. Characteristic curves for the inverse and definite time functions are defined by the following equation.

$$T_T = \frac{AD}{M^N - C} + BD + K$$

Where: D = TIME DIAL setting
M = Multiple of PICKUP
A, B, C, N, K = Constants for the particular curve

Time Characteristics - Continued

Refer to Tables 1-3 or 1-4 for the time characteristic curve constants. Constants have been selected to conform to the characteristics of electromechanical relays over a range of pickup multiples from 1.3 to 40. Values of the constants are available for use in computer relay setting programs. Timing accuracy is the sum of ±1 cycle and ±2%.

The fixed time characteristic provides delays of 0.0 to 9.9 seconds corresponding to the time dial setting. The time set is constant over a range of pickup multiples from 1.0 to 40. Accuracy is ±2% ±1 cycle for time dial settings of 0.1 and greater.

Table 1-3. Time Characteristic Curve Constants
(Series 100 Relays or Series 200 Relays With SW3-3 Open (OFF))

Curve Type		Figure	Constants					
BE1	Similar To	Number	A	B	C	N	K	R
S	ABB CO-2	1-7	0.2663	0.03393	1.000	1.2969	0.028	0.500
L	ABB CO-5	1-8	5.6143	2.18592	1.000	1.000	0.028	15.750
D	ABB CO-6	1-9	0.4797	0.21359	1.000	1.5625	0.028	0.875
M	ABB CO-7	1-10	0.3022	0.12840	1.000	0.5000	0.028	1.750
I	ABB CO-8	1-11	8.9341	0.17966	1.000	2.0938	0.028	9.000
V	ABB CO-9	1-12	5.4678	0.10814	1.000	2.0469	0.028	5.500
E	ABB CO-11	1-13	7.7624	0.02758	1.000	2.0938	0.028	7.750
B	BS142-B*	1-14	1.4636	0.00000	1.000	1.0469	0.028	3.250
C	BS142-C*	1-15	8.2506	0.00000	1.000	2.0469	0.028	8.000
F	None**	None	0.0000	1.00000	0.000	0.0000	0.000	1.000

* Curves B and C are defined in British Standard BS142 and IEC 255-4 (International Electrotechnical Commission)
** Fixed time from 0.1 to 9.9 seconds.

BE1 Curve Types:

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

Table 1-4. Time Characteristic Curve Constants (200 Series Relays With SW3-3 Closed (ON)

Curve Type		Figure	Constants					
BE1	Similar To	Number	A	B	C	N	K	R
S	GE IAC 55	1-16	0.0286	0.0208	1.000	0.9844	0.028	0.0940
L	GE IAC 66	1-17	2.3955	0.00000	1.000	0.3125	0.028	7.8001
D	ABB CO-6	1-9	0.4797	0.21359	1.000	1.5625	0.028	0.8750
M	ABB CO-7	1-10	0.3022	0.12840	1.000	0.5000	0.028	1.7500
I	GE IAC 51	1-18	0.2747	0.1042	1.000	0.4375	0.028	0.8868
V	GE IAC 53	1-19	4.4309	0.0991	1.000	1.9531	0.028	5.8231
E	GE IAC 77	1-20	4.9883	0.0129	1.000	2.0469	0.028	4.7742
B	BS142-B*	1-14	1.4636	0.00000	1.000	1.0469	0.028	3.2500
C	BS142-C*	1-15	8.2506	0.00000	1.000	2.0469	0.028	8.0000
F	None**	None	0.0000	1.00000	0.000	0.0000	0.000	1.0000

* Curves B and C are defined in British Standard BS142 and IEC 255-4 (International Electrotechnical Commission)

** Fixed time from 0.1 to 9.9 seconds.

BE1 Curve Types:

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

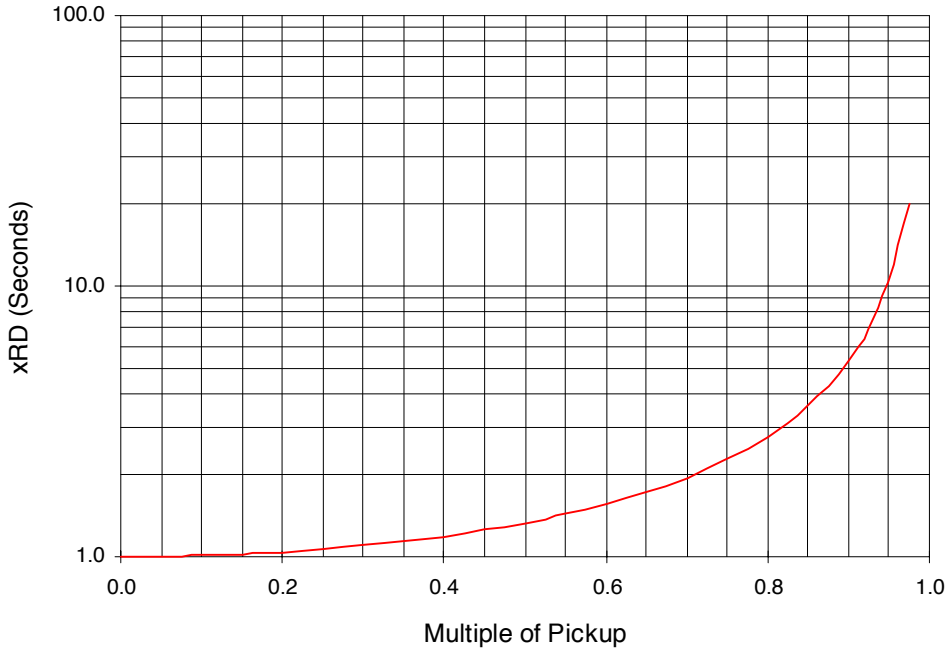
Time Reset

Reset occurs when the current drops below pickup and the relay has not timed out. Switch SW3-4 provides selection of either an instantaneous or integrating reset characteristic. Opening SW3-4 forces the instantaneous reset timer to zero when timed dropout occurs. This fast reset characteristic prevents the ratcheting effect that may occur with repeating system faults. Closing SW3-4 selects the integrating reset characteristic. The integrating reset characteristic simulates the disk reset of electromechanical relays. When the integrating reset characteristic is selected on 100 series relays, insure that sufficient input power is available to power-up the relay. This is not required on Series 200 relays. Series 200 relays provide the integrating reset function even when input current falls to zero.

Integrating reset characteristics are defined by the following equation and shown in Figure 1-6. Equation constants are provided in Tables 1-3 and 1-4.

$$T_R\left(\text{Time To Reset}\right) = \frac{RD}{M^2 - 1}$$

Where: R = Constant for the particular curve
D = TIME DIAL setting
M = Multiple of PICKUP



This chart vertical axis **xRD (Seconds)** is applicable for all curves and is derived from multiplying the constant **R** for the curve selected times **D** (the TIME DIAL setting).

Figure 1-6. Integrating Reset Characteristic Curve

Target Indicators

Magnetically latched, manually reset targets indicate that current of 0.2 amperes or greater was present in the trip circuit. Target coil resistance is less than 0.1 ohms and operate time is less than one millisecond. See 50/51 Output specifications for maximum current rating.

50/51 Output

Output contacts are surge protected and rated as follows:

Resistive:

120/240 Vac — Make and carry 30 amperes for 0.2 seconds, carry 7 amperes for 2 minutes, 3 amperes continuously, and break 5 amperes.

125/250 Vdc — Make and carry 30 amperes for 0.2 seconds, carry 7 amperes for 2 minutes, 3 amperes continuously, and break 0.3 ampere.

Inductive:

120/240 Vac, 125/250 Vdc — Make and carry 30 amperes for 0.2 seconds, carry 7 amperes for 2 minutes, 3 amperes continuously, and break 0.3 ampere. 0.3 amperes. (L/R = 0.04).

AUX Output

Output contacts can be configured in the field using jumpers to select closing on either/or timed or instantaneous trip. Output contacts are surge protected and rated as follows:

Resistive:

120/240 Vac — Make and carry 30 amperes for 0.2 seconds, carry 7 amperes continuously, and break 5 amperes.

125/250 Vdc — Make and carry 30 amperes for 0.2 seconds, carry 7 amperes continuously, and break 0.3 ampere.

Inductive:

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

Isolation

Meets IEC 255-5 and exceeds IEEE C37.90-1989, one-minute dielectric (high potential) tests as follows:

All circuits to ground:	2828 Vdc
Input to Output Circuits:	2000 Vac or 2828 Vdc

Surge Withstand Capability

Oscillatory

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 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay*

Impulse Test

Qualified to IEC 255-5.

Radio Frequency Interference (RFI)

Field tested using a five watt, hand held transceiver operating at random frequencies centered around 144 Mhz and 440 Mhz, with the antenna located six inches from the relay in both horizontal and vertical planes.

Patent

Patented in U.S., 1998, U.S. Patent No. 5751532.

UL Recognized/ CSA Certified

UL Recognized per Standard 508, UL File No. E97033. CSA Certified per Standard CAN/CSA-C22.2 No. 14-M91, CSA File No. LR 23131. Note: Output contacts are not UL Recognized/CSA Certified for voltages greater than 250 volts.

Temperature

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

Recommended Storage Range
-50°C (-58°F) to 50°C (122°F). Parts are rated to 125°C (257°F), however, the recommended storage range is as shown.

Shock

15 g in each of three mutually perpendicular planes.

Vibration

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

Weight

5.2 pounds.

CHARACTERISTIC CURVES

Figures 1-7 through 1-15 illustrate the characteristic curves that are programmed into the nonvolatile memory of series 100 relays. Figures 1-7 through 1-20 illustrate the characteristic curves that are programmed into the nonvolatile memory of series 200 relays. To order full-size drawings of these characteristic curves, contact Customer Service Department of the Power Systems Group, Basler Electric, and request publication number 9 2520 00 999 (Figures 1-7 through 1-20). These publications contain full size characteristic curves on transparent paper (vellum).

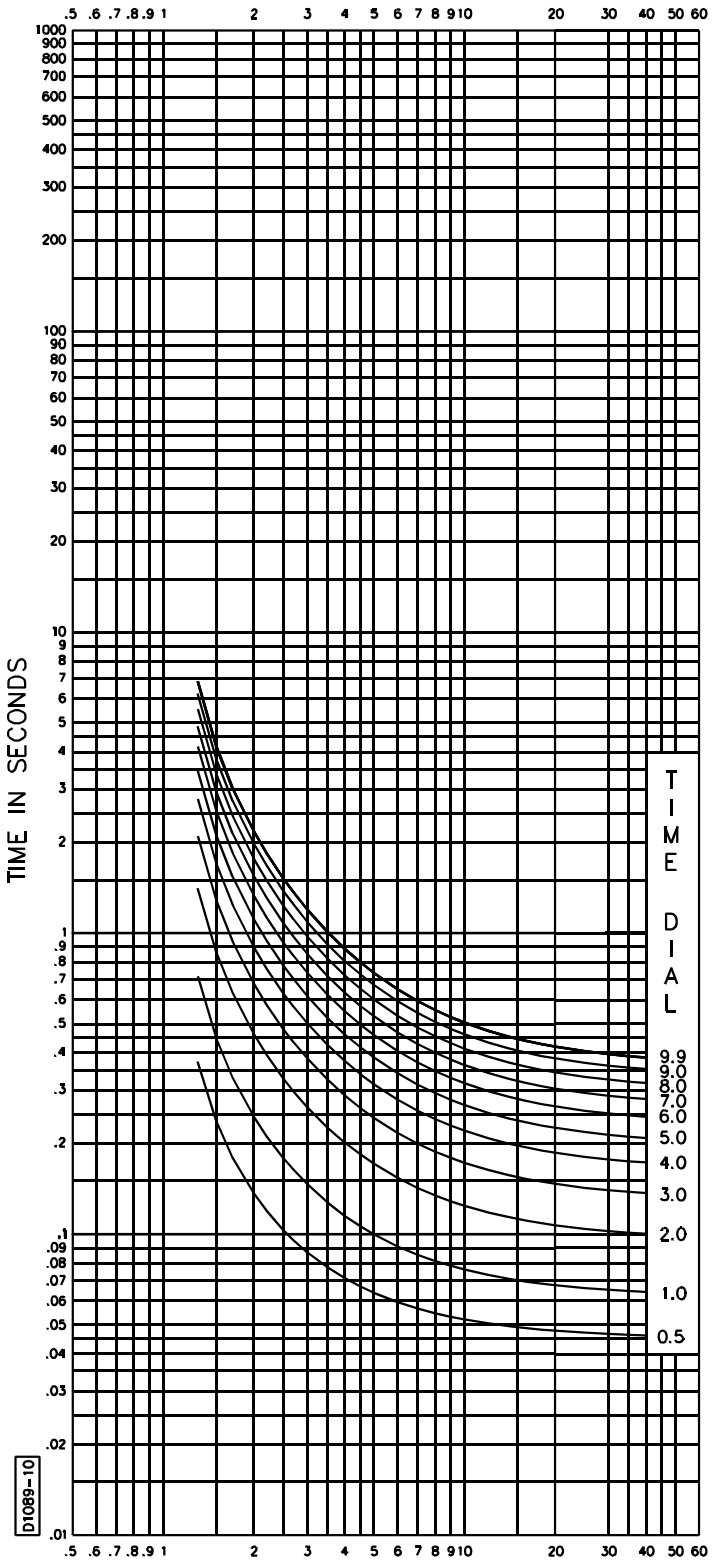


Figure 1-7. *Time Characteristic Curve 99-1369, S-Short Inverse (SW3-3 OFF, Similar to ABB CO-2)*

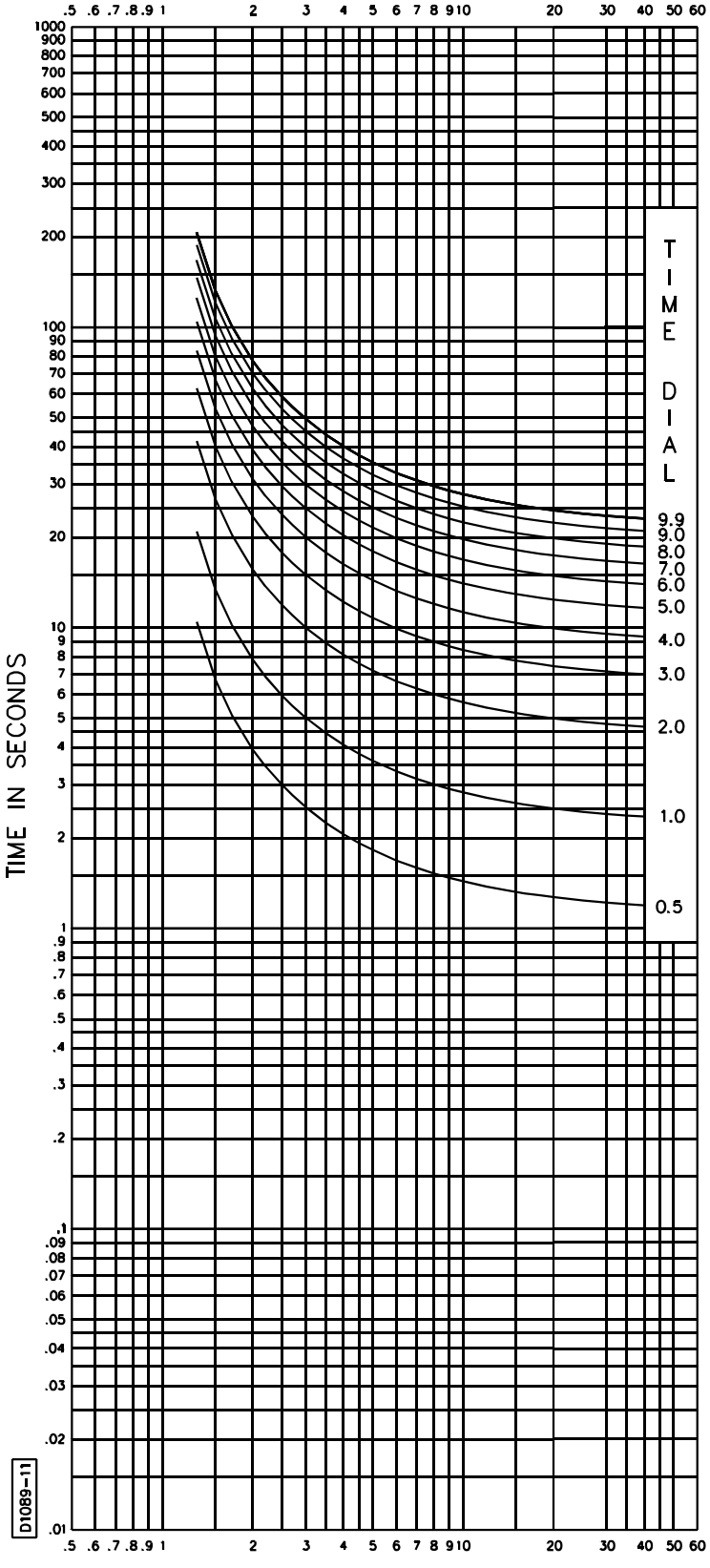


Figure 1-8. Time Characteristic Curve, 99-1370, L-Long Inverse (SW3-3 OFF, Similar to ABB CO-5)

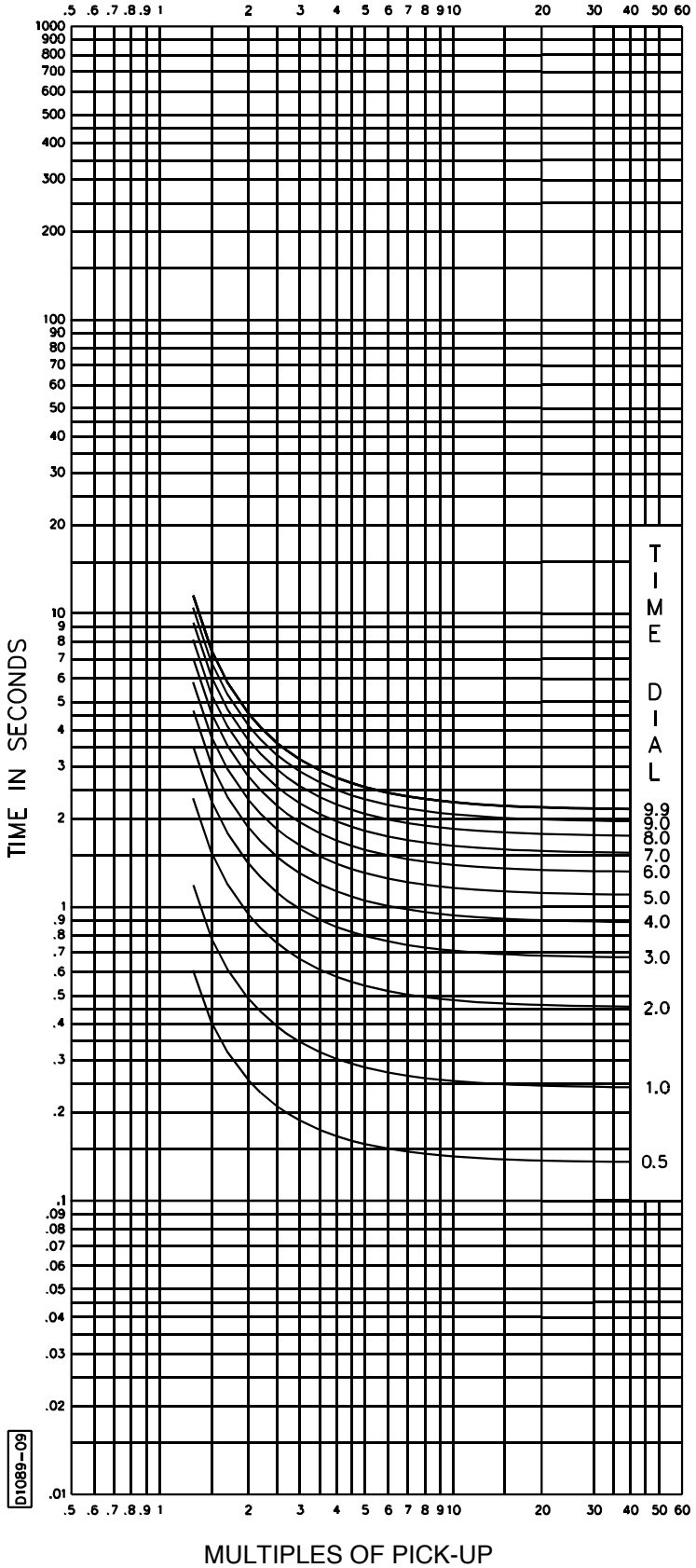


Figure 1-9. Time Characteristic Curve, 99-1371, D-Definite Time (Similar to ABB CO-6)

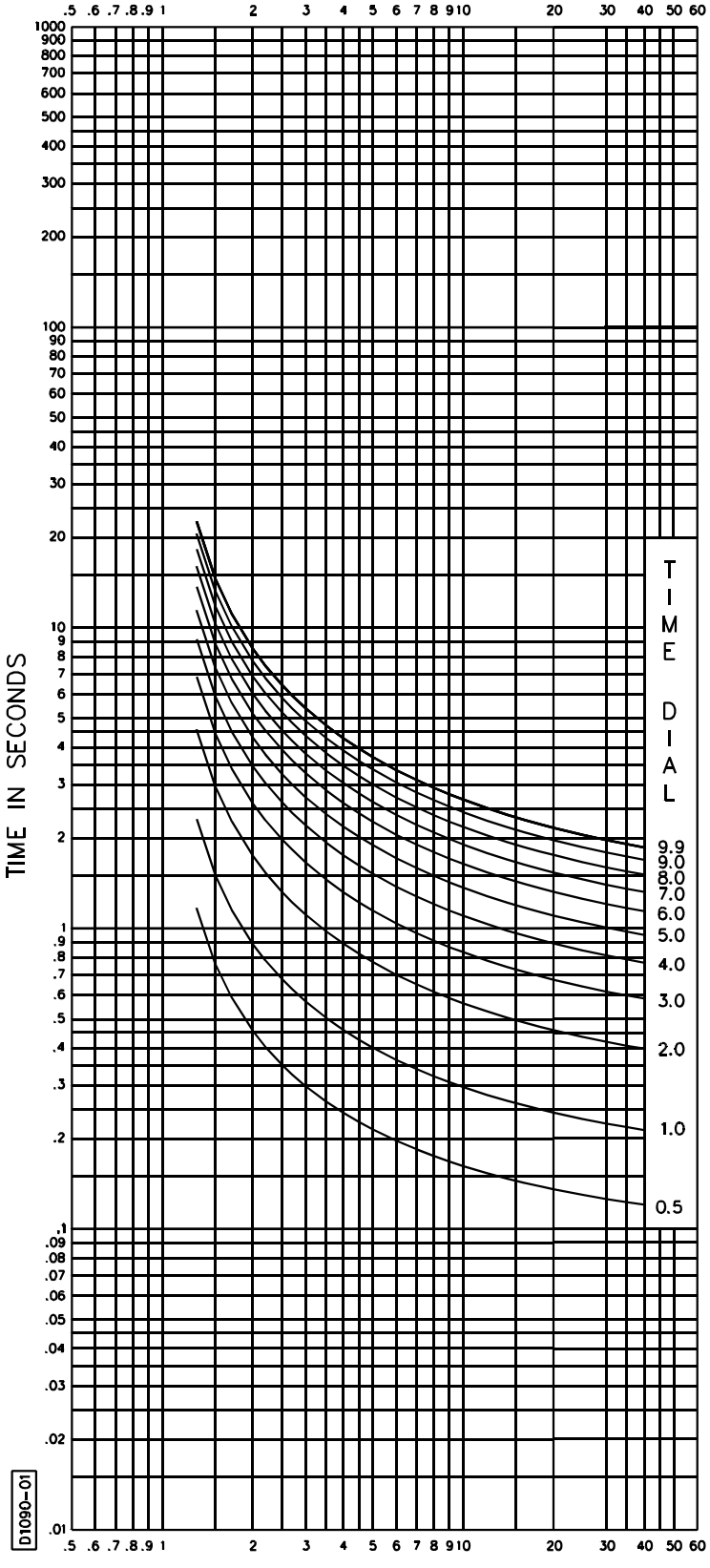


Figure 1-10. Time Characteristic Curve, 99-1372, M-Moderately Inverse (Similar to ABB CO-7)

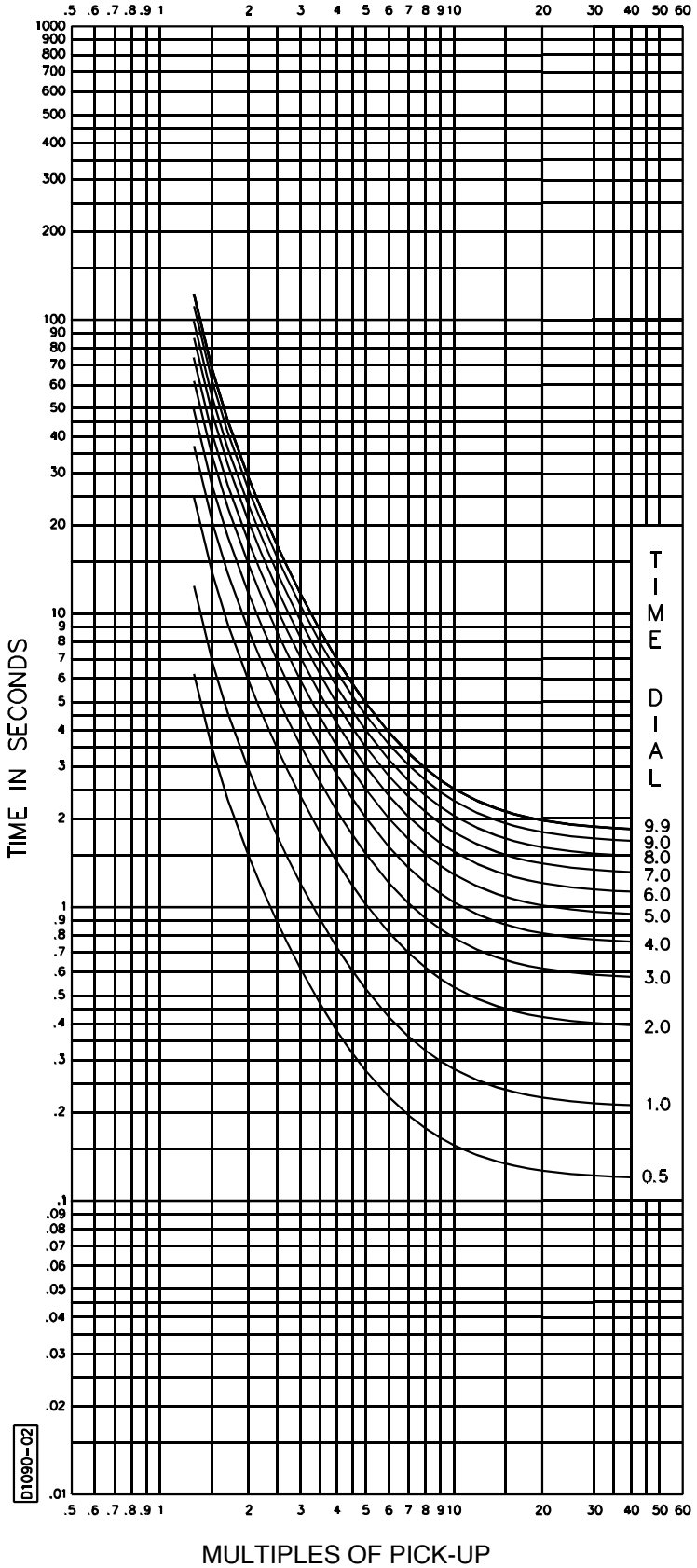


Figure 1-11. Time Characteristic Curve, I-Inverse (SW3-3 OFF, Similar to ABB CO-8)

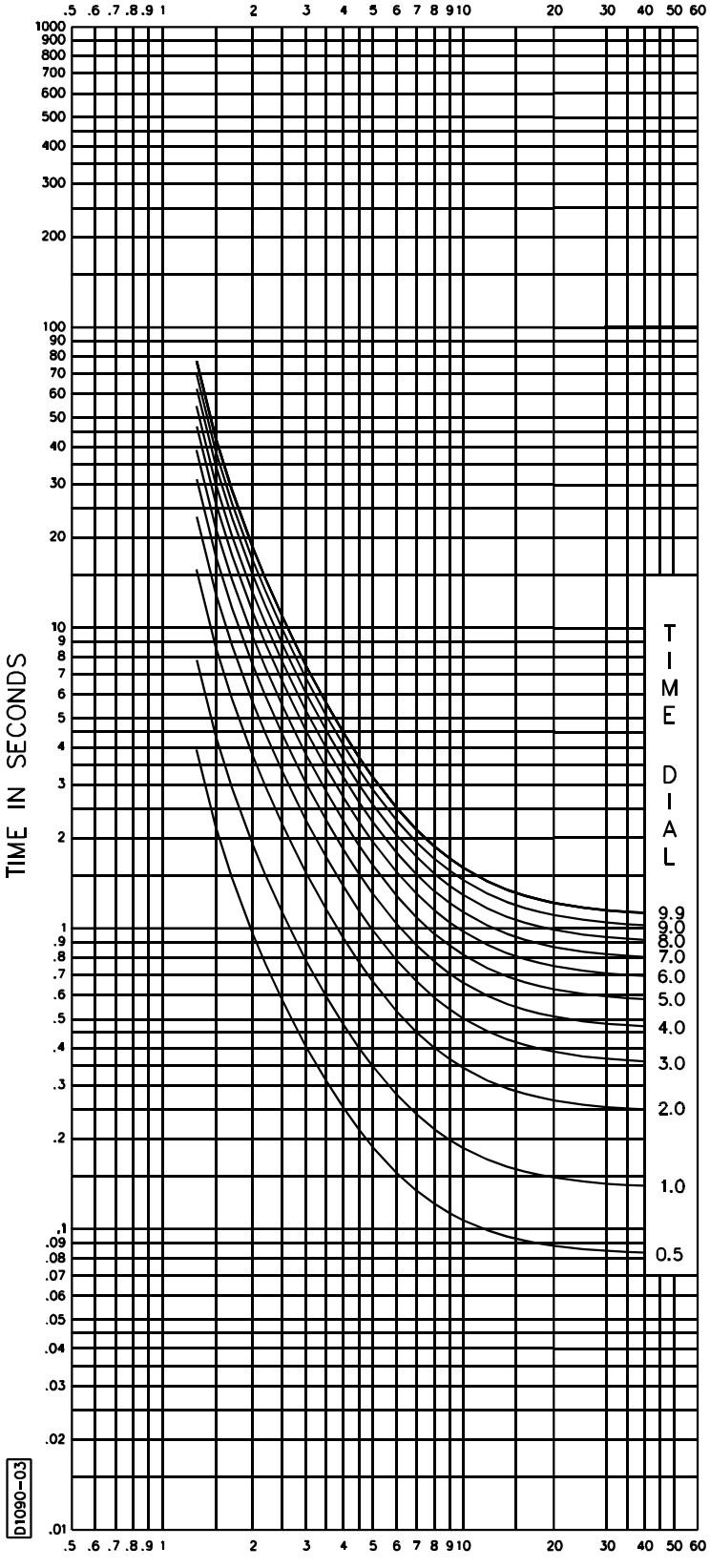


Figure 1-12. Time Characteristic Curve, 99-1374, V-Very Inverse (SW3-3 OFF, Similar to ABB C0-9)

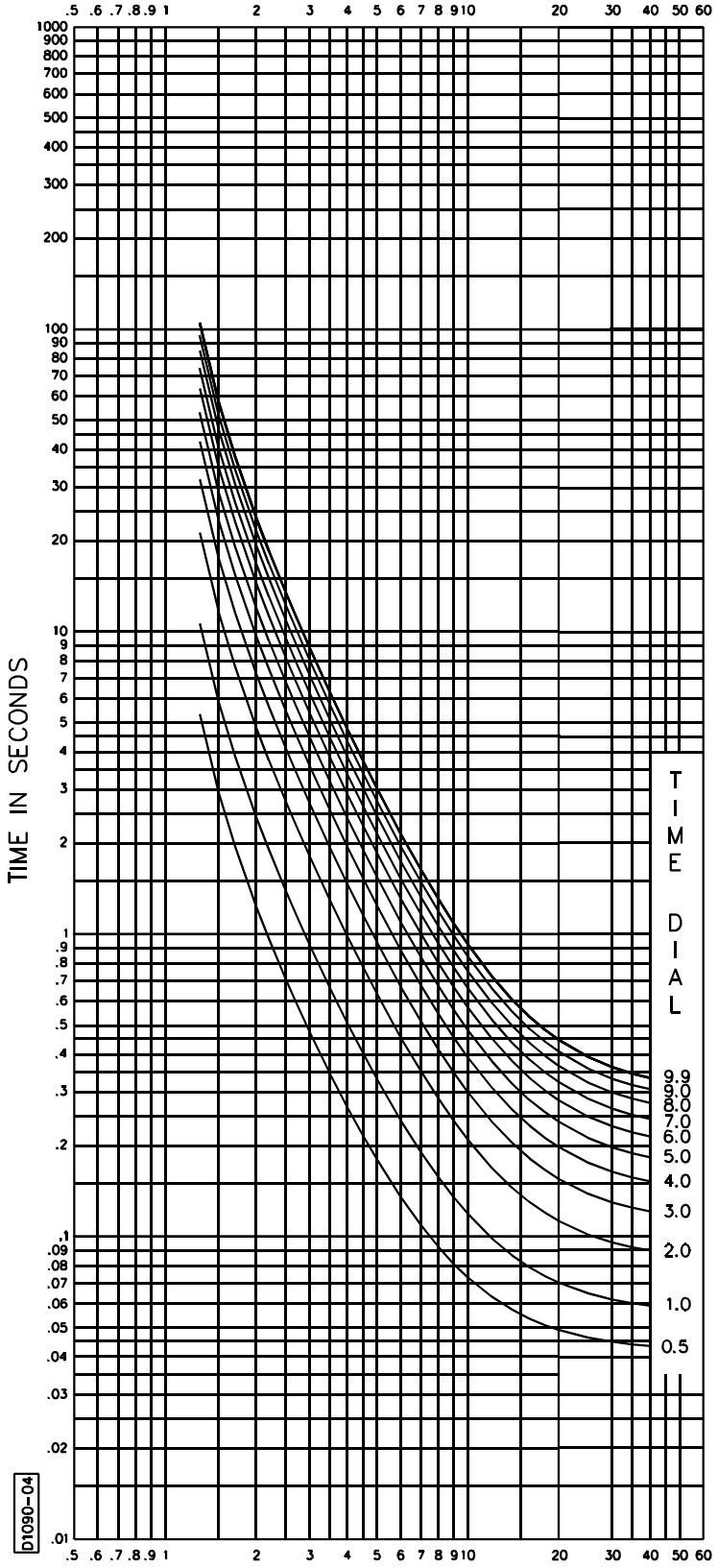


Figure 1-13. Time Characteristic Curve, 99-1375, E-Extremely Inverse (SW3-3 OFF, Similar to ABB C0-11)

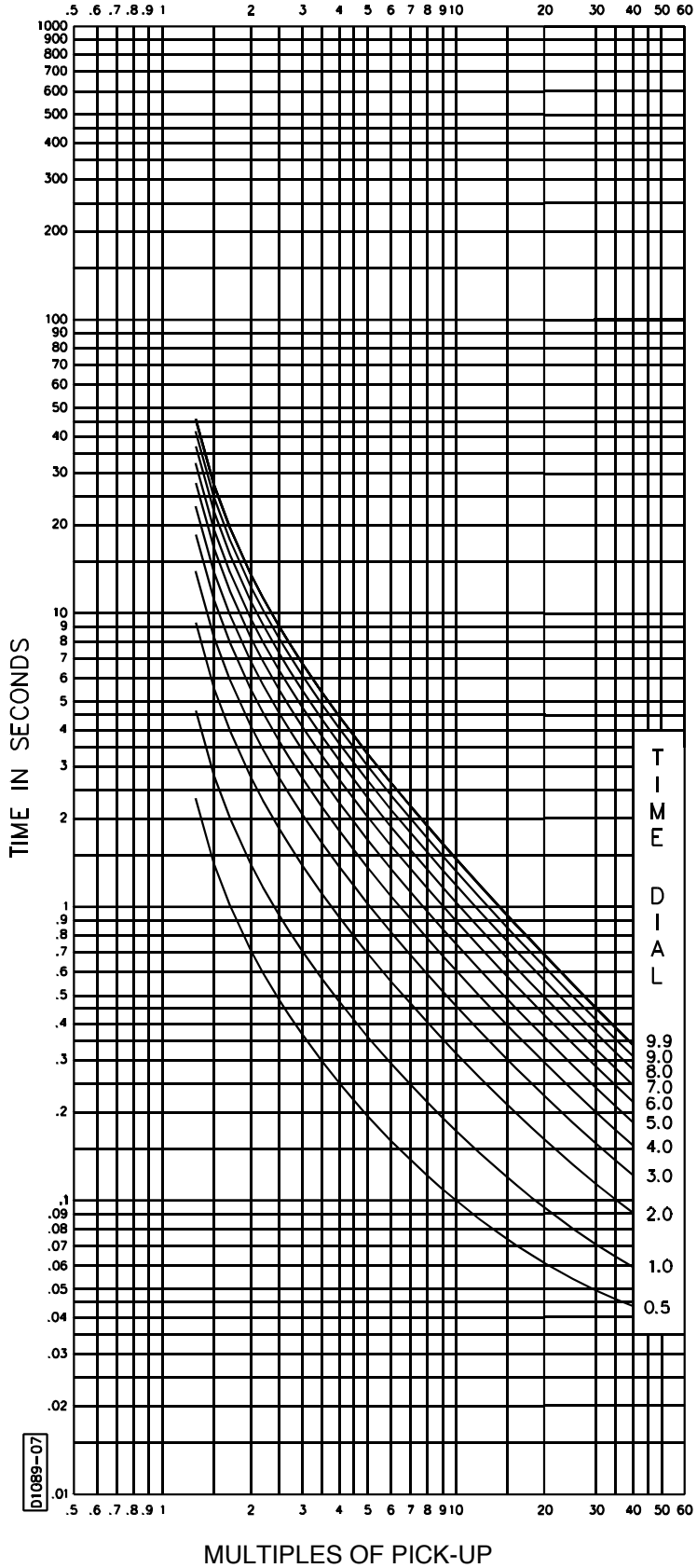


Figure 1-14. Time Characteristic Curve B, 99-1376, BS142-B (BS142 Very Inverse)

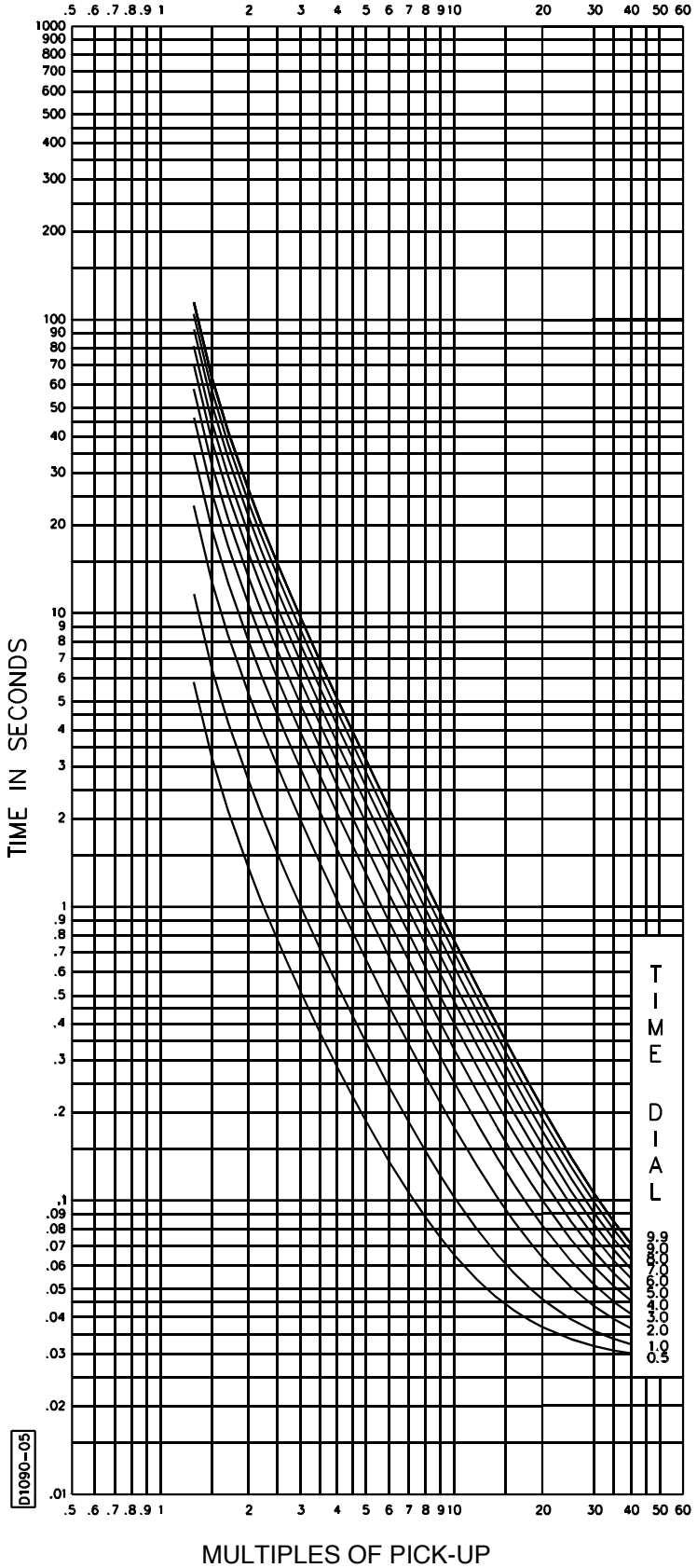


Figure 1-15. Time Characteristic Curve, 99-1377, BS142-C (BS142 Extremely Inverse)

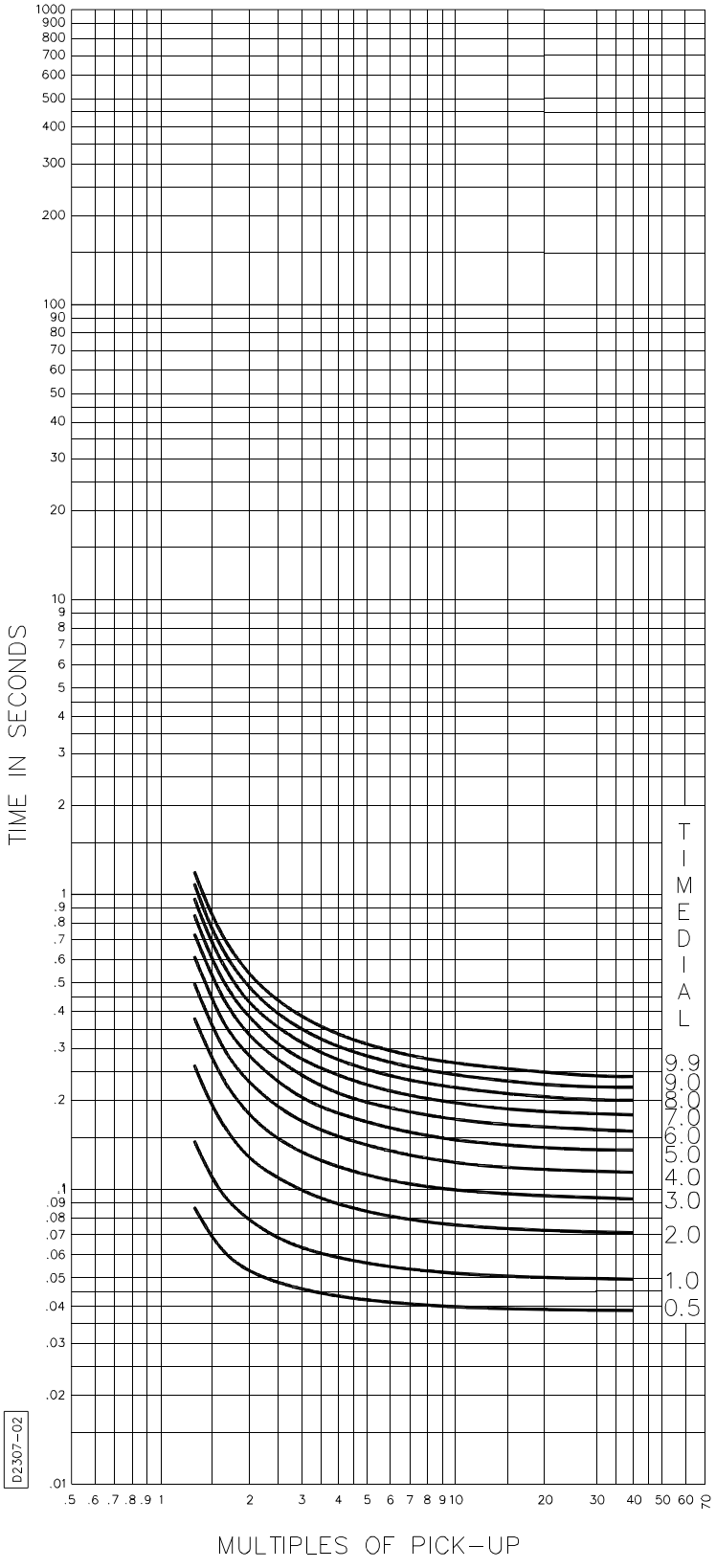


Figure 1-16. Time Characteristic Curve, 99-1595, S2-Short Inverse (SW3-3 ON, Similar to GE IAC 55)

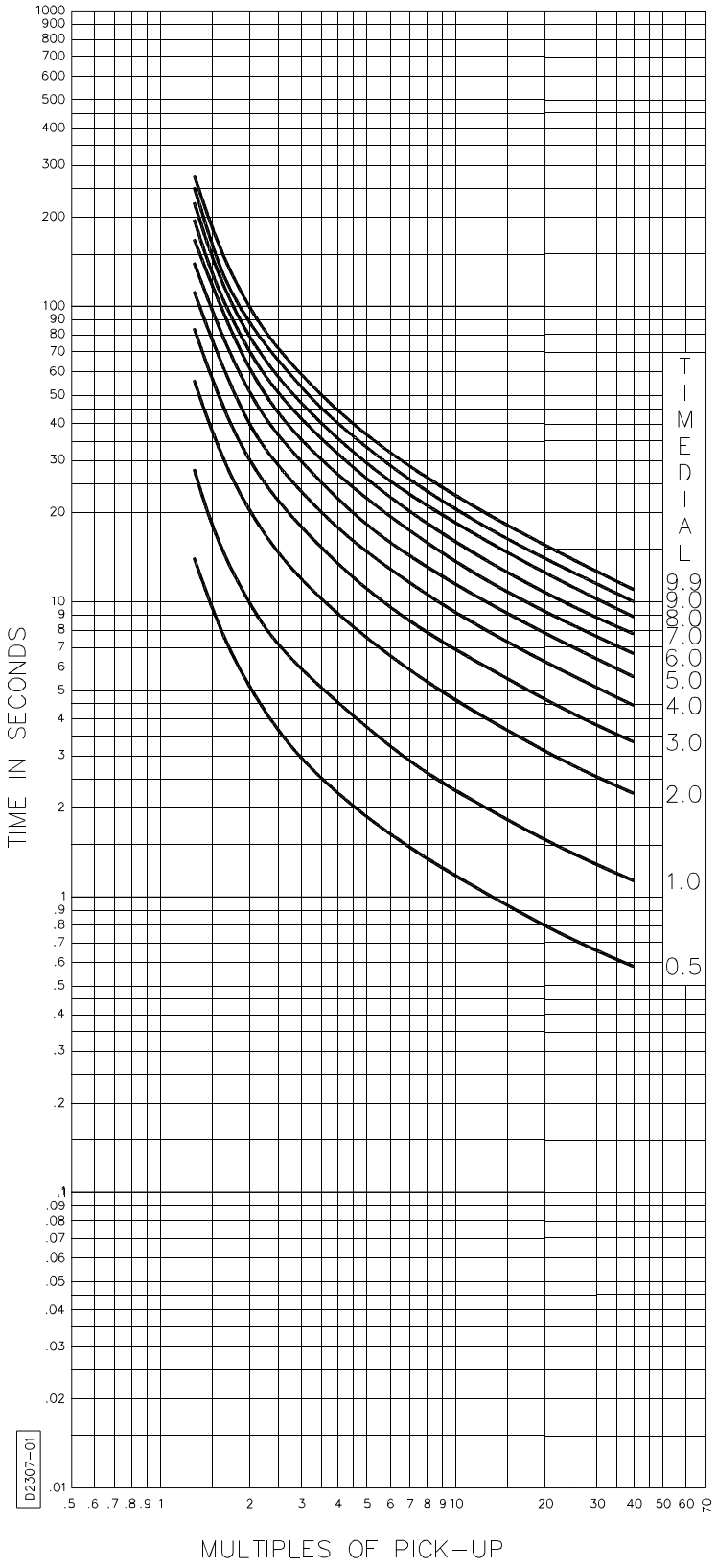


Figure 1-17. Time Characteristic Curve, 99-1594, L2-Long Inverse (SW3-3 ON, Similar To GE IAC 66)

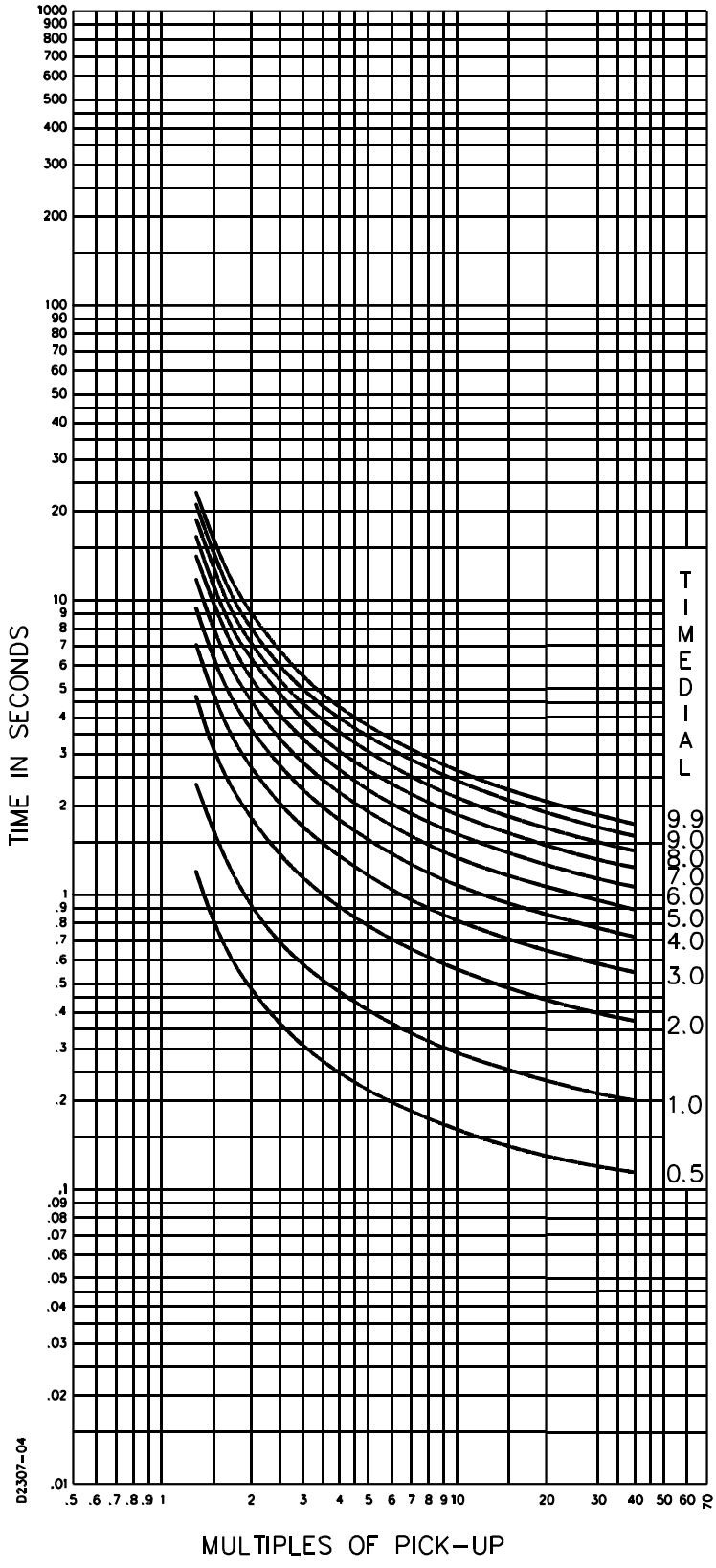


Figure 1-18. Time Characteristic Curve, 99-1597, I2-Inverse (SW3-3 ON, Similar To GE IAC 51)

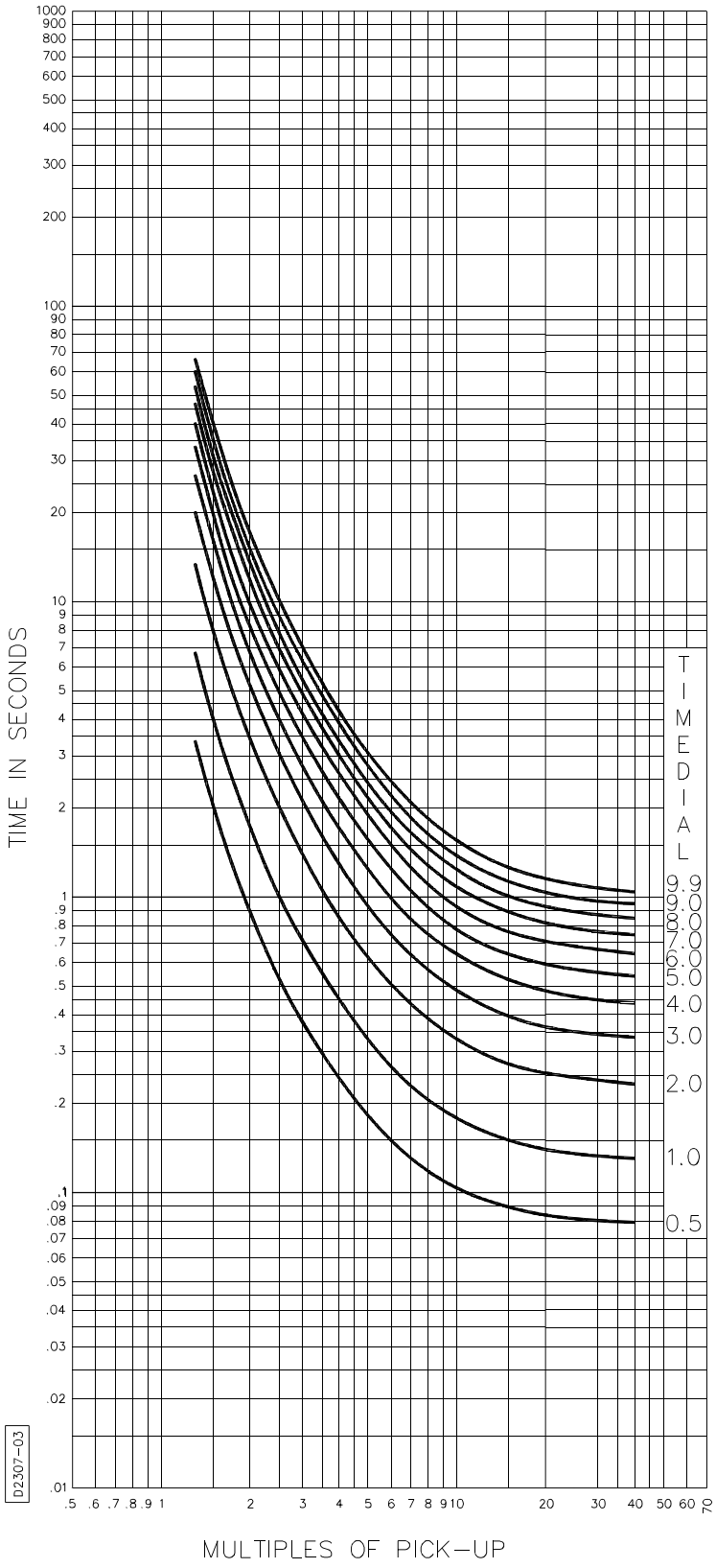


Figure 1-19. Time Characteristic Curve, 99-1596, V2-Very Inverse (SW3-3 ON, Similar To GE IAC 53)

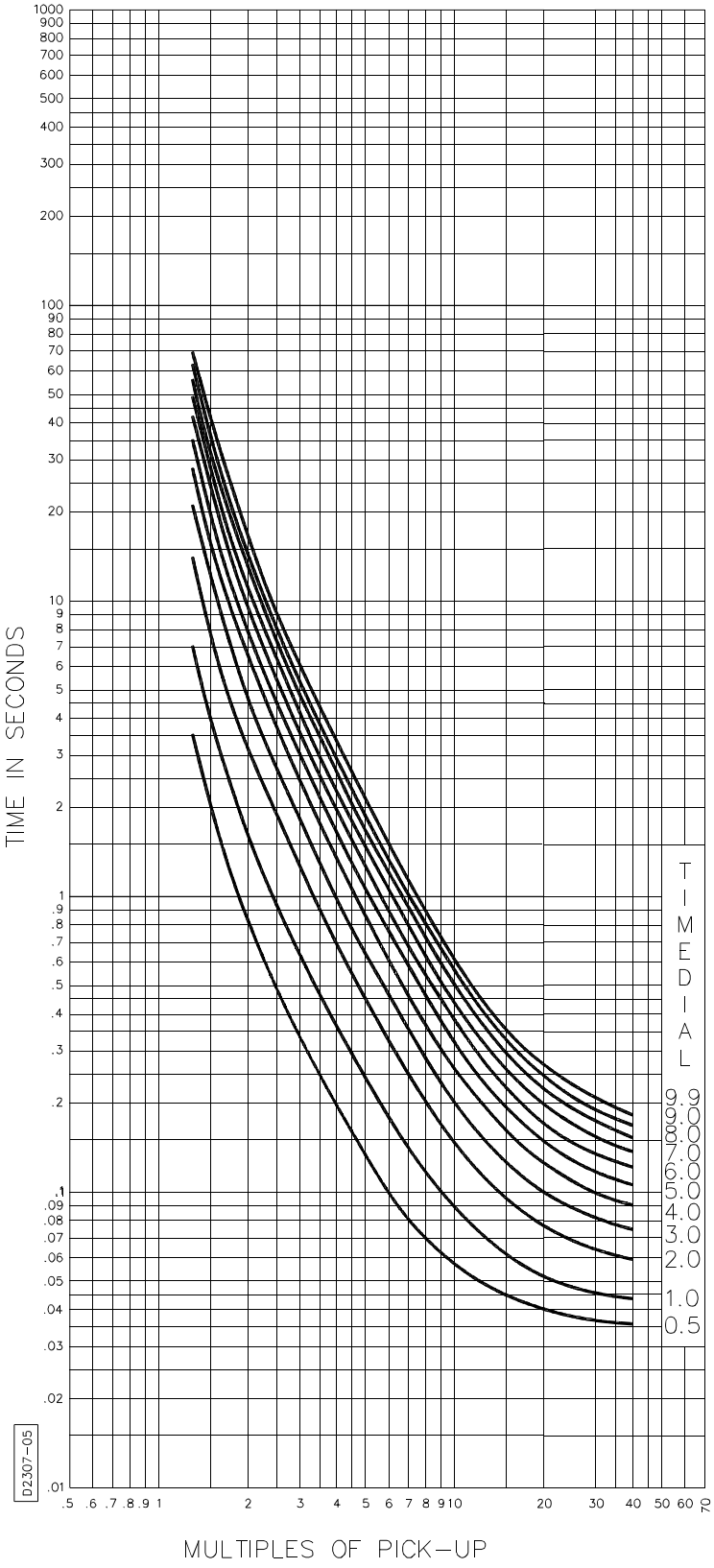


Figure 1-20. Time Characteristic Curve, 99-1598, E2-Extremely Inverse (SW3-3 ON, Similar To GE IAC 77)

SECTION 2 • HUMAN MACHINE INTERFACE (Controls And Indicators)

DESCRIPTION

Table 2-1 lists and briefly describes the operator controls and indicators of the BE1-50/51M Overcurrent Relay. Reference the call-out letters to Figures 2-1 and 2-2.

Table 2-1. BE1-50/51M Controls and Indicators (Refer to Figures 2-1 and 2-2*)*

Locator	Control or Indicator	Function
A	**INST MANUAL TRIP** Test Points	When shorted, the test points (jacks) provide a secure means to manually trip the controlled breaker. Jacks accept a standard 0.080 inch diameter phone tip plug.
B	**INST PICKUP** Selectors	Two switches to select pickup current in amperes (UNITS and TENTHS on five ampere models, COURSE and FINE on one ampere models). Changing switch selectors while the relay is in service may cause tripping.
C	**Targets**	Black target indicators trip to red and magnetically latch when the trip circuit current is greater than 0.2 amperes. One target each for TIME and INST.
D	**TIME PICKUP** Selectors	Two switches to select pickup current in amperes (UNITS and TENTHS on five ampere models, COURSE and FINE on one ampere models). Changing switch selectors while the relay is in service may cause tripping.
E	**CURVE** Selector	Ten position selector switch to select one of nine inverse functions or one fixed time function.
F	**TIME DIAL** Selectors	Two selector switches (UNITS and TENTHS) to select the desired characteristic curve. A setting of 0.0 results in instantaneous operation without any intentional delay. A setting of 9.9 corresponds to the typical time provided by an electromechanical relay at its maximum dial setting.
G	**TIME MANUAL TRIP** Test Points	When shorted, the test points provide a secure means to manually trip the controlled breaker. Jacks accept a standard 0.080 inch diameter phone tip plug.
H	**ACTIVE/PICKUP** LED	Red LED indicates sensed current has exceeded the TIME PICKUP setting. LED turns from red to green when sensed current falls below 95 % of pickup setting. When the LED is green, the relay is active but has not picked up.
I	**Target Reset** Lever	Linkage extends through back of front cover to reset both magnetically latched target indicators.
J	**SW3 -1**	SW3-1 selects the system operating frequency. SW3-1 open (OFF) selects 60 hertz operation. SW3-1 closed (ON) selects 50 hertz operation.
	SW3-2	In 100 and 200 series relays, SW3-2 selects additional delay for the instantaneous element. Switch SW3-2 closed (ON) provides an additional instantaneous delay of 0.1 seconds.
	SW3-3	In 100 series relays, switch SW3-3 closed (ON) provides an additional instantaneous delay of 0.2 seconds. Closing both switches SW3-2 and SW3-3 provides an additional instantaneous delay of 0.3 seconds. In 200 series relays, SW3-3 open (OFF) selects ABB type curves (refer to Table 1-3. SW3-3 closed (ON) selects GE IAC type curves (refer to Table 1-4).

Table 2-1. BE1-50/51M Controls and Indicators - Continued

Locator	Control or Indicator	Function
J - Cont.	**SW3-4**	Provides selection of either instantaneous or integrating reset characteristic. SW3-4 closed (ON) provides integrating reset. SW3-4 open (OFF) provides instantaneous reset.
K	Auxiliary Output Jumper Terminations	Configures the auxiliary output contacts to close with either the instantaneous (50) trip and/or the timed (51) trip. Jumper E2 to E1A to close the auxiliary contact with the timed (51) trip. This jumper is yellow and factory installed to close the auxiliary output contacts with the timed trip. Jumper E3 to E1B to close the auxiliary contact with the instantaneous (50) trip. This jumper is blue and factory installed to close the auxiliary output contacts with the instantaneous trip. Users with BE1-50/51B unit revisionsQ, R, and S in 100 series relays and unit revisions H and previous in 200 series relays, refer to Section 8 for the location of the auxiliary output jumper terminations and the location of SW3 (Note: In all previous revisions, the reference designator for SW3 was SW8.).

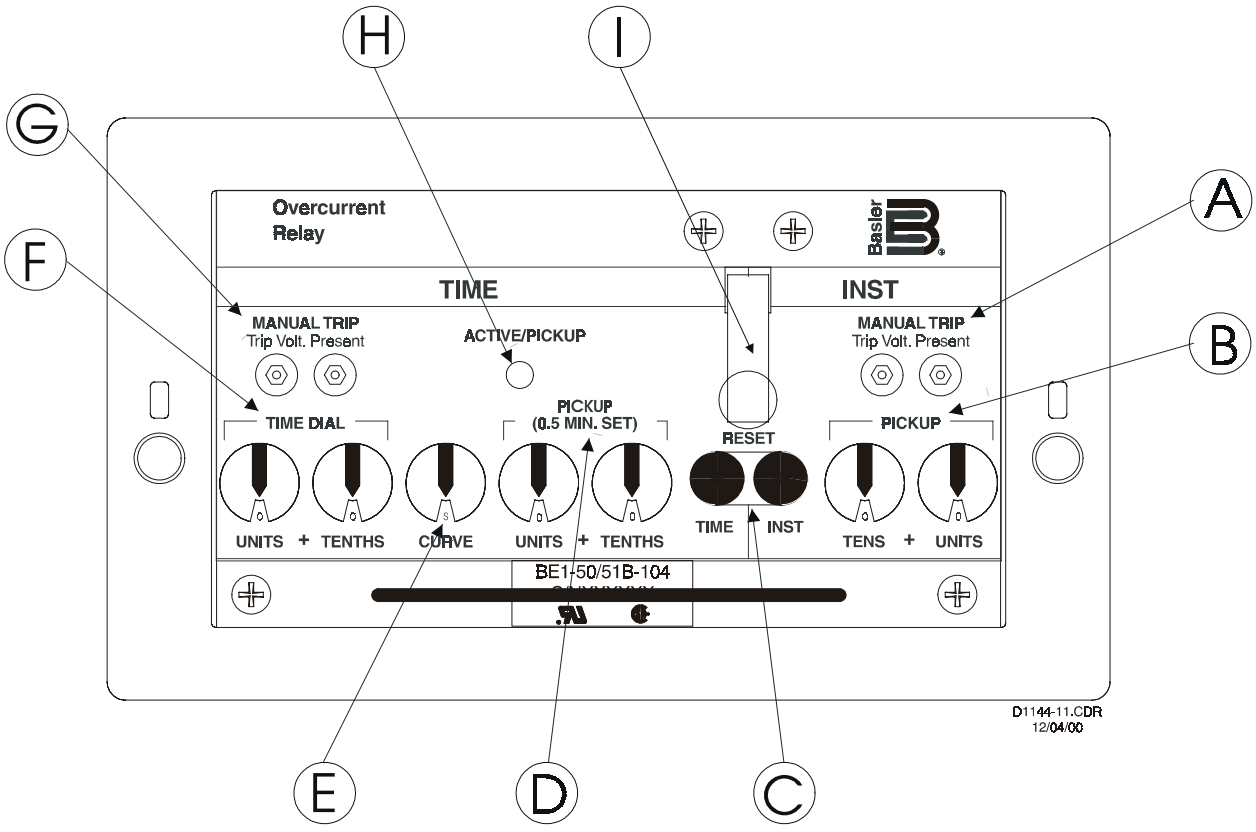


Figure 2-1. Location of Controls and Indicators

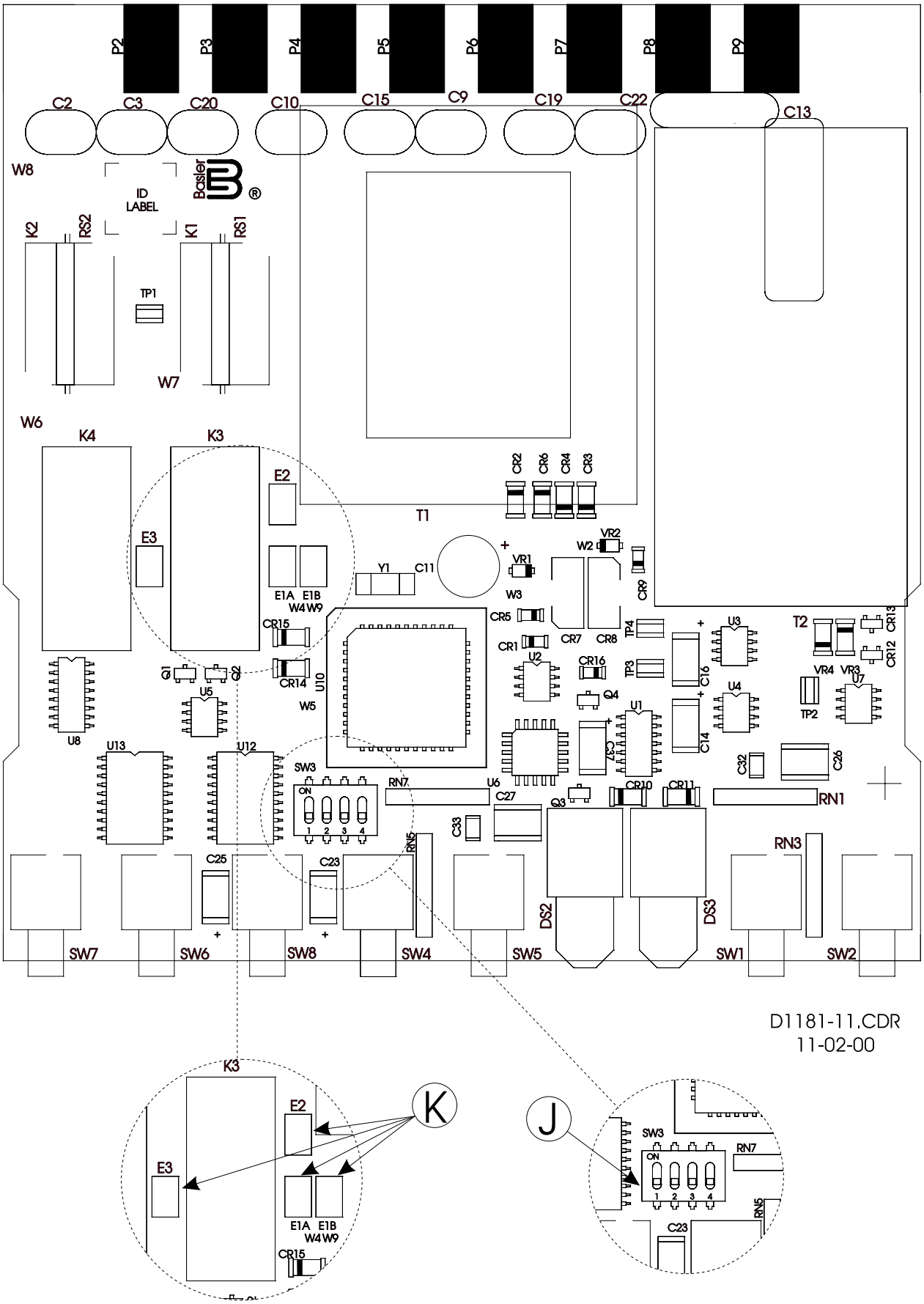


Figure 2-2. Location of Controls and Indicators (100 And 200 Series Relays)

SECTION 3 • FUNCTIONAL DESCRIPTION

GENERAL

BE1-50/51M Overcurrent Relays are microprocessor based non-directional relays that measure ac current to provide secure and reliable instantaneous and time overcurrent protection for power systems.

FUNCTIONAL DESCRIPTION

Sensing Input

Single phase ac current from system current transformers (CT) is brought into the BE1-50/51M Overcurrent Relay at terminals eight and nine. Refer to Figure 3-1 to follow the functional description. The input current is applied to internal power and signal CTs.

Power Supply

Current from the power CT is rectified, filtered, and supplied to all of the internal circuitry for operating power. A precision +5 Vdc supply also serves as a reference for automatic calibration.

Instantaneous Signal

Current from the signal CT is rectified and applied to the instantaneous scaling resistors controlled by the INST PICKUP selector switches. The analog voltage of the instantaneous input signal developed across the scaling resistors is filtered and applied to the multiplexor (MUX).

Time Signal

Current from the signal CT is also rectified and applied to the time scaling resistors controlled by the TIME PICKUP selector switches. The analog voltage of the time input signal is also filtered and applied to the multiplexor.

Microprocessor

Operating power from the power supply is applied to the microprocessor supervisor circuit. When the microprocessor is active and executing code, ACTIVE/PICKUP LED is green. When the input current falls below an acceptable level, the supervisor circuit interrupts the microprocessor and halts further operation, and turns OFF the ACTIVE/PICKUP LED.

Output pulses from the microprocessor are applied regularly to the watchdog timer during normal 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 then resets and resumes normal operation.

Information from the TIME DIAL selector switches, the TIME CURVE selector switch, and the 50/60 Hz, INST DELAY, and RESET CHAR switches is also applied to the microprocessor. The microprocessor uses these inputs to set the operating parameters.

When the microprocessor is ready for analog information from the multiplexor, microprocessor control signals cause the multiplexor to route the desired input through to the output. The output is converted from an analog value to a digital value and applied to the microprocessor.

The microprocessor performs the program operations based on the inputs and the internal software program. When the sensed current exceeds the TIME PICKUP setting, the ACTIVE/PICKUP LED turns from Green to RED. TIME contacts (51) are closed in accordance with the time characteristic equation. If the sensed current exceeds the INST PICKUP setting, the INST contacts (50) are closed.

Power-Off Sensing

In 200 series relays, the power-off sensing circuits measure the decaying voltage to determine the length of time that power is removed (zero current). This provides information for the integrating reset function even when power has been entirely removed.

Outputs

Instantaneous And Timed

System circuit breakers controlled by the output contacts can be manually tripped by applying a short across the TIME or INST MANUAL TRIP front panel test points. Targets will not be pulled for a manual trip if the relay is de-energized. Current flow in the trip circuit is indicated by the operation of the target. The targets will not operate without adequate operating power for the relay.

CAUTION

Trip circuit voltage is present at the front panel test points. When shorting the test points, use insulated jumpers to avoid contact with these voltages.

Auxiliary

The auxiliary output contacts can be configured by the user to close when the timed and/or instantaneous trip occurs. With both jumpers installed (this is the factory setting) either the timed or instantaneous trip closes the auxiliary contacts. Effective with unit revision R, in units 9 2520 00 100 through 109, the printed circuit board was changed. Now, the PCB for 100 and 200 series relays are similar. User's with units previous to revision R may see Section 8, *Relay Differences*, for installing auxiliary output contact jumpers.

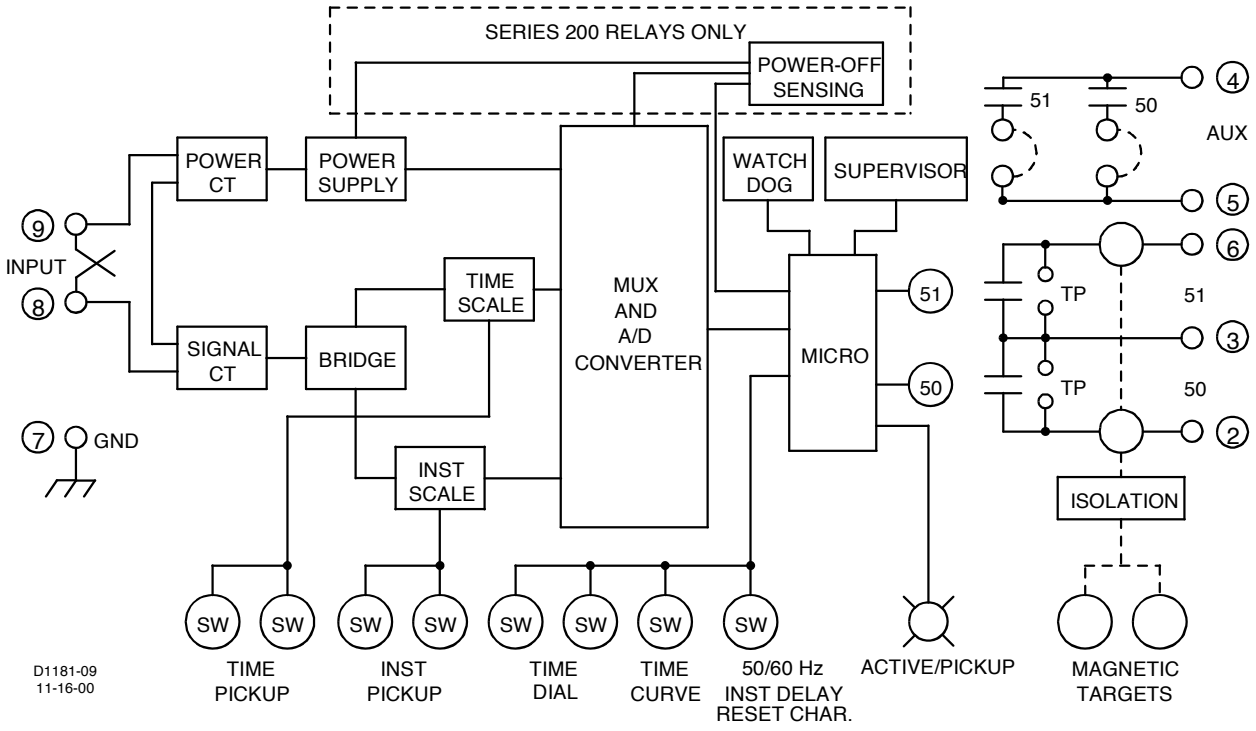


Figure 3-1. Functional Block Diagram

SECTION 4 • INSTALLATION

GENERAL

When not shipped as part of a control or switchgear panel, the relays are shipped in sturdy cartons to prevent damage during transit. Immediately upon receipt of a relay, check the model and part 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.

Proper operation of the relay may be confirmed by performing the operational test procedure in Section 5. 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.

DIELECTRIC TEST

In accordance with IEC 255-5 and IEEE C37.90-1989, one-minute dielectric (high potential) tests may be performed as follows:

All circuits to ground:	2828 Vdc
Input to output circuits:	2000 Vac or 2828 Vdc

Output contacts are surge protected.

MOUNTING

Because the relay is of solid state design, it does not have to be mounted vertically. Any convenient mounting angle may be chosen. A rack mounting plate (part number 9 2520 12 001) can be purchased to mount four BE1-50/51M (vertical mount) relays side-by-side in a standard 19 inch wide rack. The rack mounting plate is four rack units (seven inches) high and is shown in Figure 4-1. A cover, (part number 9 2520 12 102) is also available that covers one mounting location. Relay outline dimensions and panel drilling diagrams are shown in Figures 4-2 and 4-3.

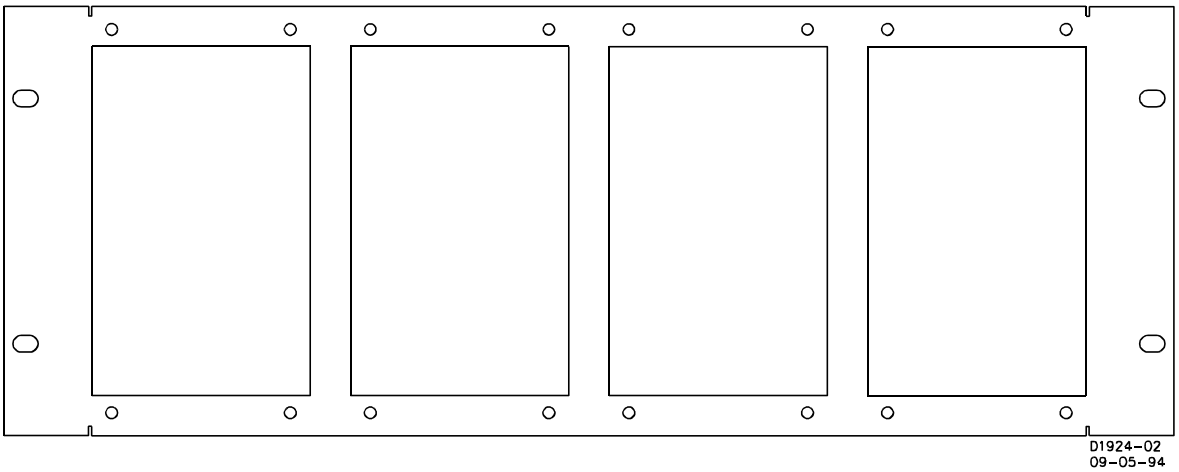


Figure 4-1. Rack Mounting Plate, Part Number 9 2520 12 001

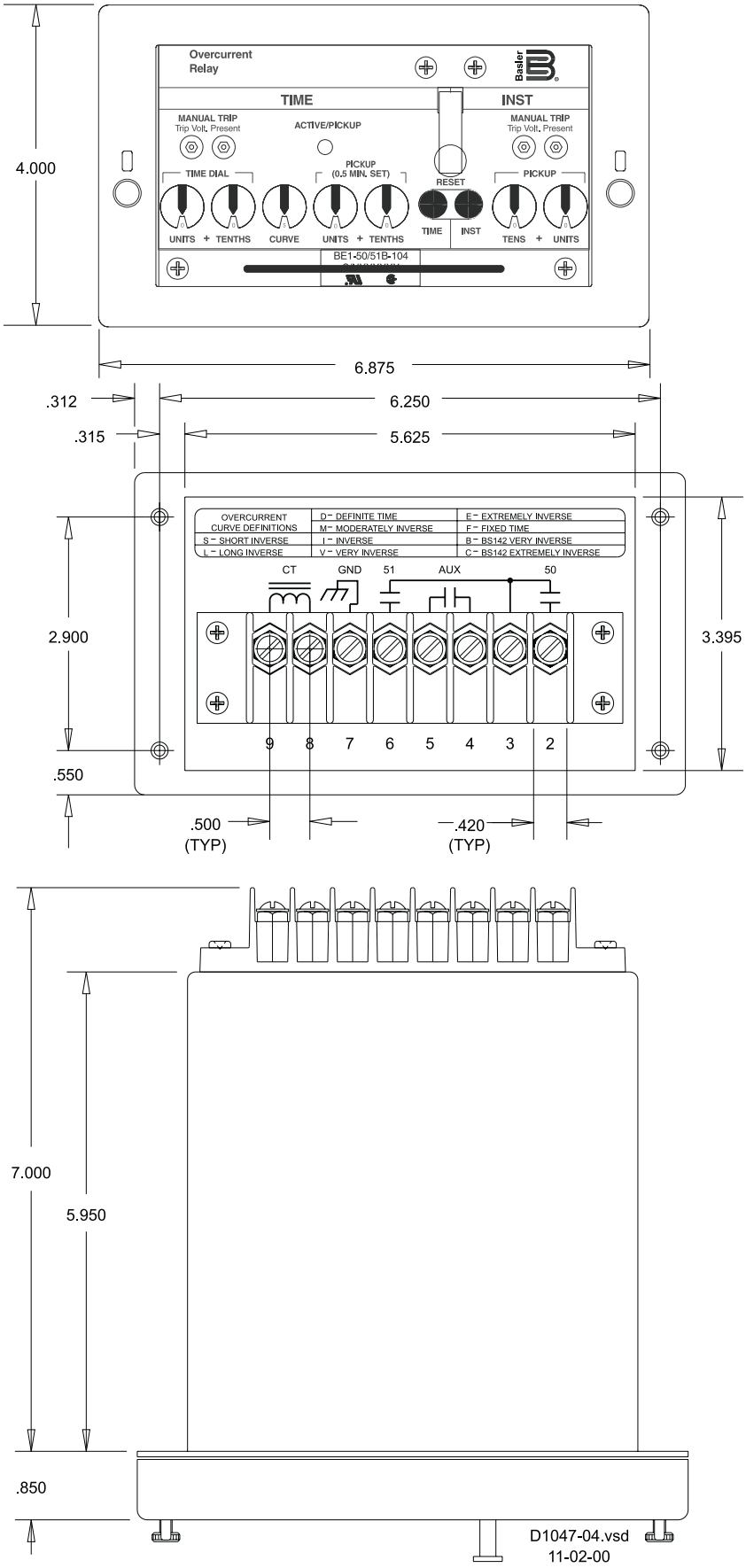


Figure 4-2. Outline Dimensions

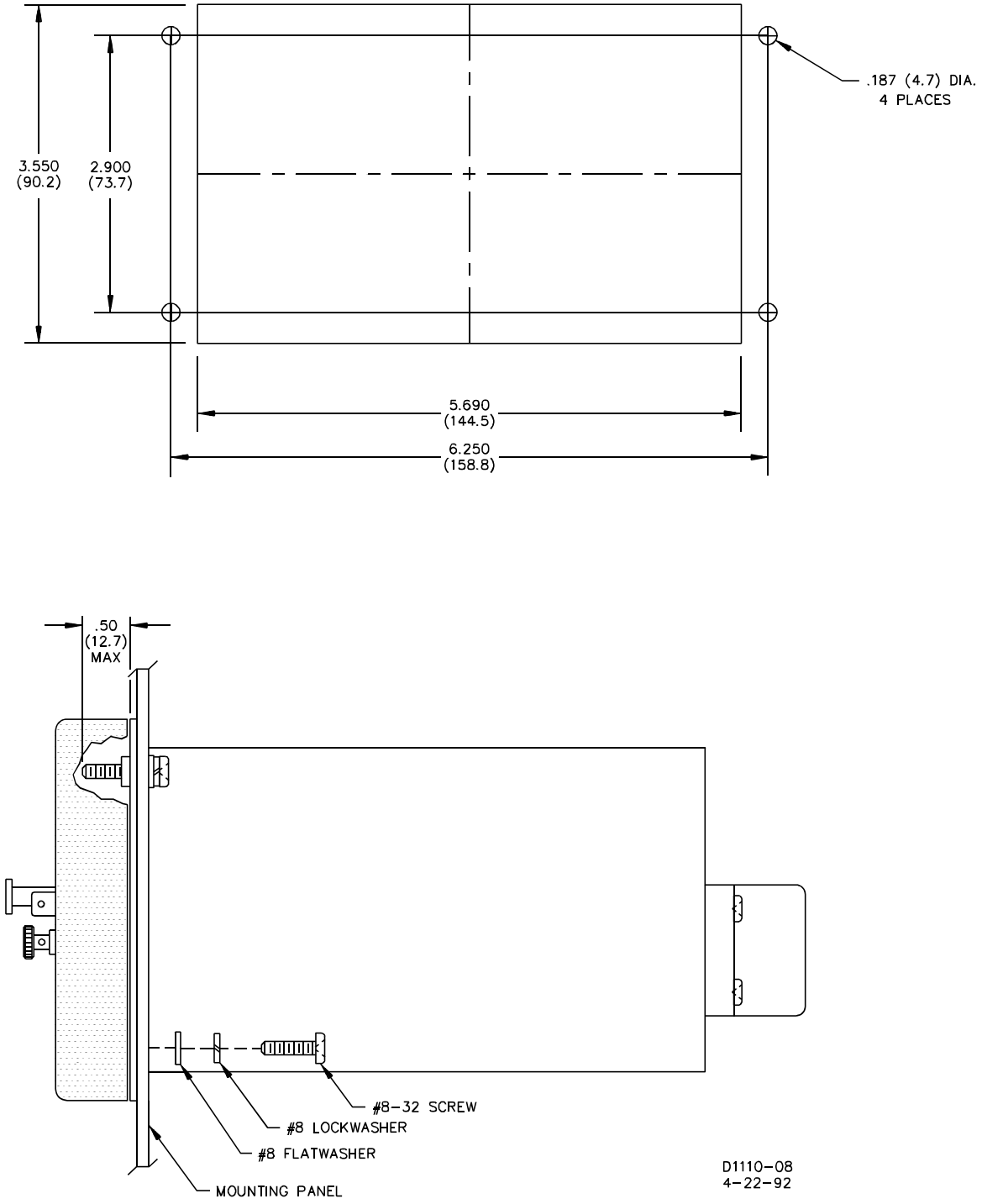


Figure 4-3. Panel Drilling Diagram, C1 Case

CONNECTIONS

Incorrect wiring may result in damage to the relay. Be sure to check model and part number before connecting and energizing a particular relay.

> **NOTE**
> Be sure the ground terminal is hard-wired to the relay panel with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the terminal strip.

Connections should be made with minimum wire size of 14 AWG except as noted for the ground wire. Typical ac input and dc control connections are shown in Figures 4-4 and 4-5. The auxiliary output jumper configuration schematic diagram is also shown in Figure 4-5. Relay internal connections are shown on the back of the relay. Figure 4-6 shows a rear view of the relay and the connections.

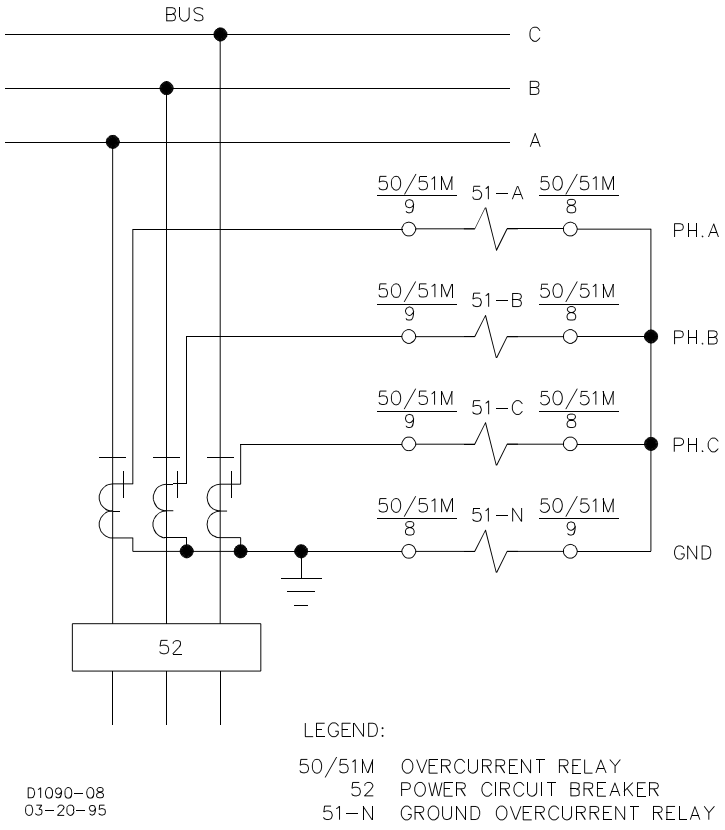
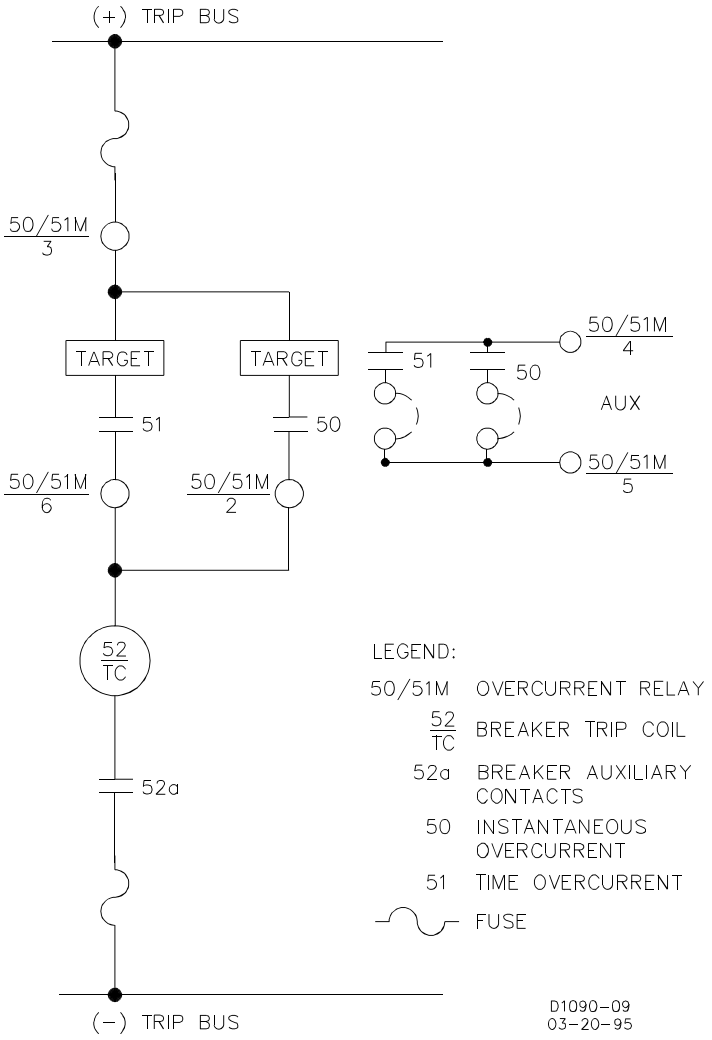


Figure 4-4. AC Input Connections



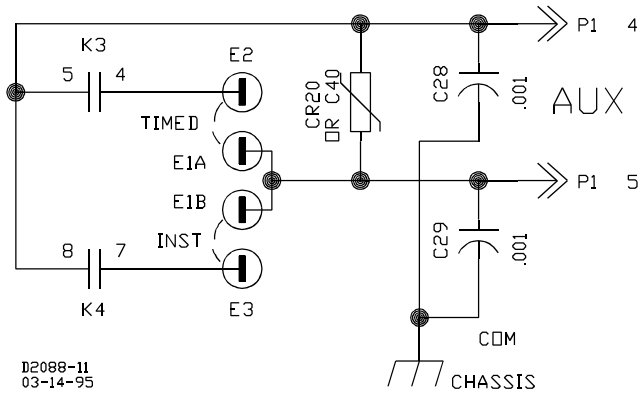
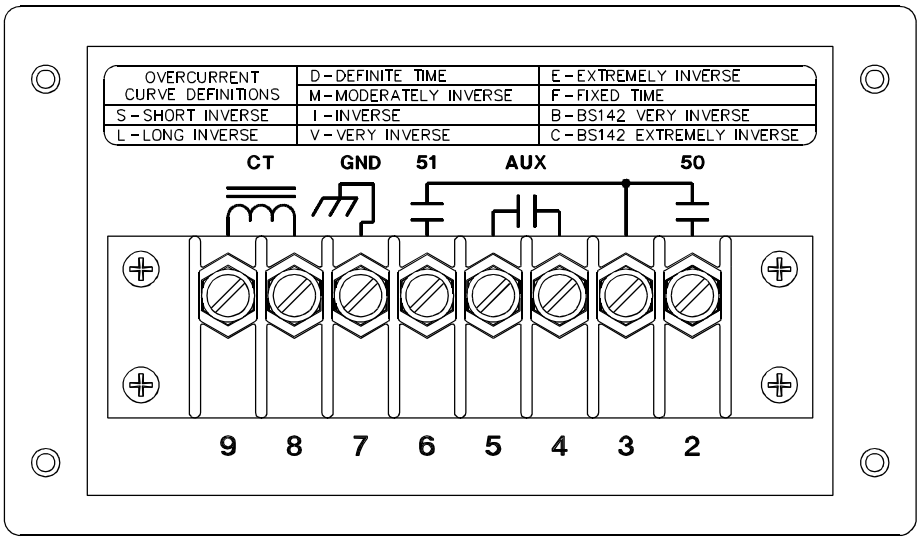


Figure 4-5. DC Control Connections



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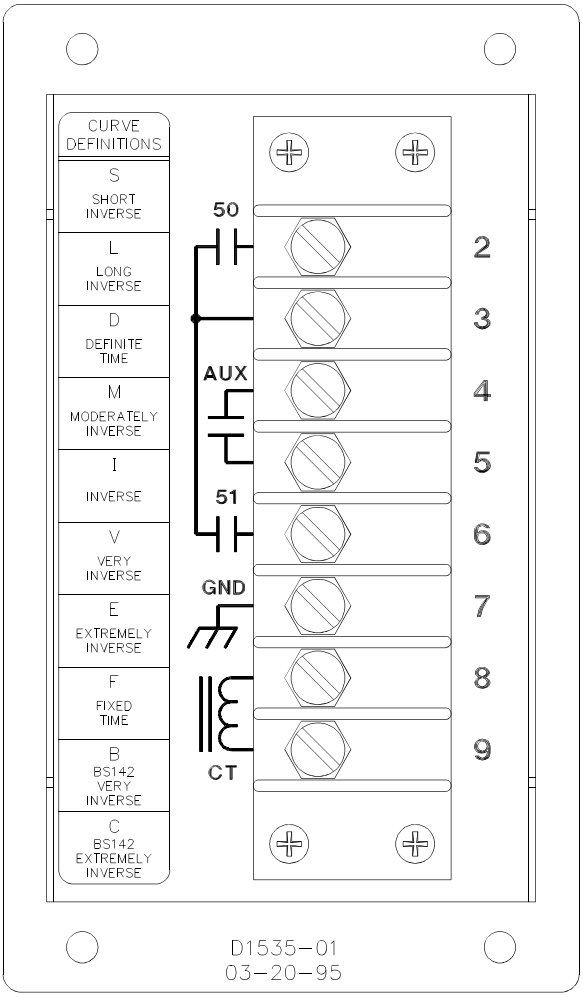

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Figure 4-6. BE1-50/51M Overcurrent Relay, Rear View

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, check the model and part 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.

Proper operation of the relay may be confirmed by performing the operational test procedure in this Section. 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.

DIELECTRIC TEST

In accordance with IEC 255-5 and IEEE C37.90-1989, one-minute dielectric (high potential) tests may be performed as follows:

All circuits to ground:	2828 Vdc.
Input to output circuits:	2000 Vac or 2828 Vdc.

Output contacts are surge protected.

OPERATIONAL TEST PROCEDURE

The following procedure verifies operation of the relay. The test setups of Figures 5-1 and 5-2 are intended primarily as an illustration of the principles involved. Other test setups known to be capable of testing to the stated and implied tolerances (including equipment specifically designed for testing relays) may be used.

Test Equipment Required

- Current source with a range from 0 to 20 amperes ac (sensing input current).
- Current source 0.2 to 3 amperes ac (target operation).
- Timer or counter.

CAUTION

When testing units with integrating reset characteristics selected, timing may be affected by the integrating reset.

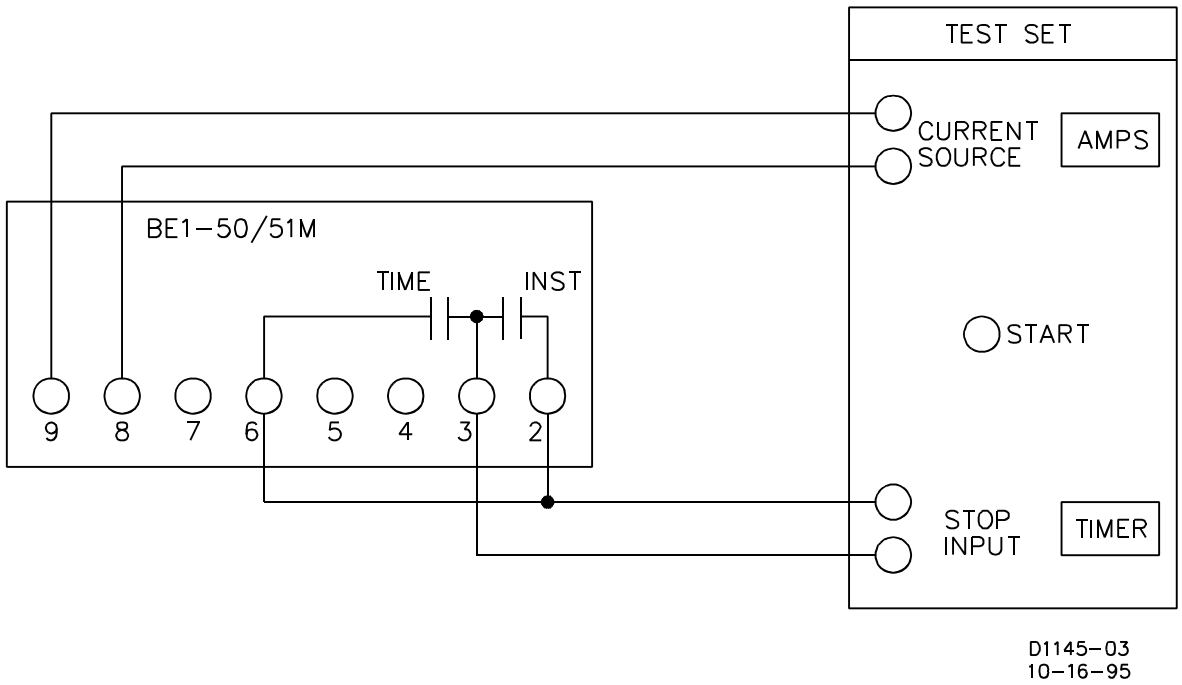

Figure 5-1. Pickup and Timing Test Setup

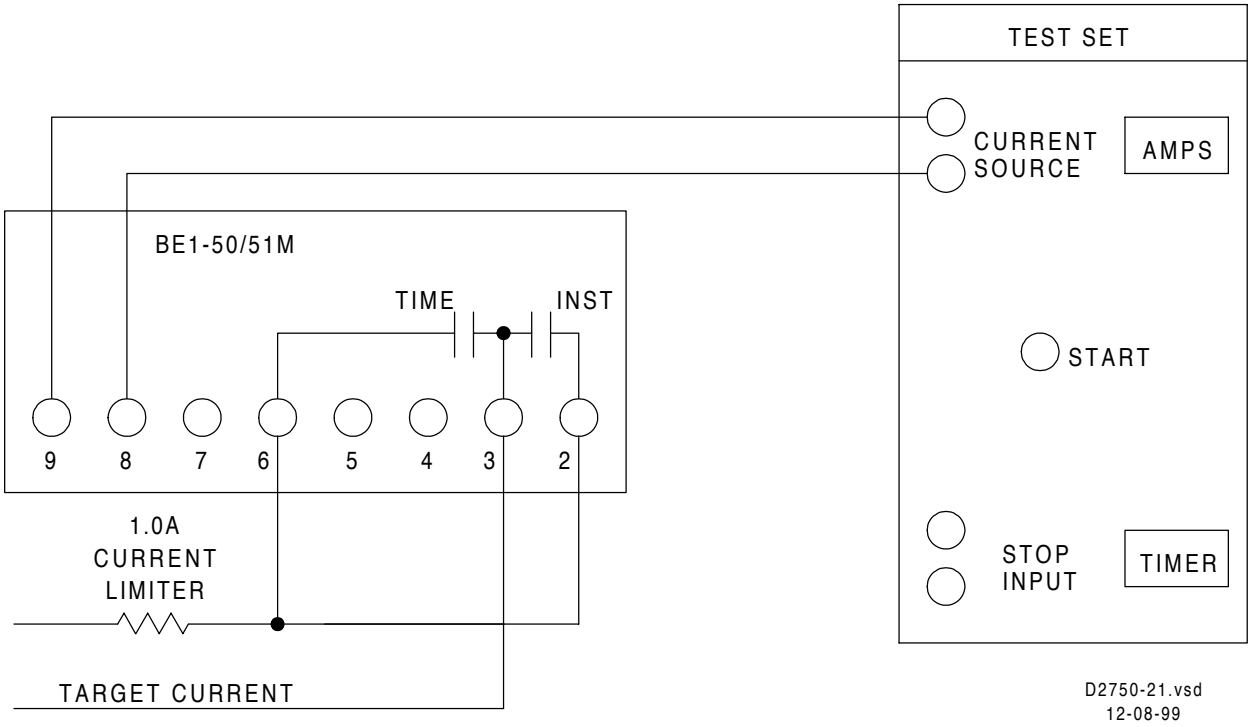

Figure 5-2. Target Operational Test Setup

NOTES

When testing TIME overcurrent functions, INST PICKUP settings of 00 will affect the calibration of the TIME functions. TIME PICKUP settings of 00 also affect INST functions.

Test Procedure, Models BE1-50/51M-X04 and -X09 (Five Ampere Sensing Input)

Time Pickup Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 0.0.
- Set CURVE to S
- Set TIME PICKUP to 0.5.
- Set INST PICKUP to 90.

Step 1. Slowly increase current to terminals 8 and 9. ACTIVE/PICKUP LED should turn red at a maximum input current of 0.550 ampere.

Step 2. Decrease input current until ACTIVE/PICKUP LED turns green then OFF.

Step 3. Set TIME PICKUP to 2.2.

Step 4. Slowly increase current to terminals 8 and 9. ACTIVE/PICKUP LED should change from green to red at an input current of 2.131 to 2.269 amperes.

Step 5. Decrease input current until ACTIVE/PICKUP LED turns OFF.

INST Pickup Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 0.0.
- Set CURVE to S
- Set TIME PICKUP to 15.1.
- Set INST PICKUP to 01.

Step 1. Slowly increase current to terminals 8 and 9. INST contacts should close at an input current of 0.955 to 1.045 amperes.

Step 2. Decrease input current until INST output contacts open.

Step 3. Set INST PICKUP to 08.

Step 4. Slowly increase current to terminals 8 and 9. INST contacts should close at an input current of 7.815 to 8.185 amperes.

Step 5. Decrease input current until INST output contacts open.

Time Dial Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 1.0.
- Set INST PICKUP to 90.

Step 1. Prepare to apply 1.5 amperes input current to terminals 8 and 9 and record the elapsed time from when current is applied until TIME output contacts close.

Step 2. Apply the current (step from 0 to 1.5 amperes) and record the elapsed time. Elapsed time should be 1.754 to 2.084 seconds. (This tolerance is greater than ±2 % because it is the accumulation of both pickup and timing tolerances.)

Step 3. Remove input current.

Target Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-2.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 1.0.
- Set INST PICKUP to 01.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Apply 5 amperes input current to terminals 8 and 9. Check that both TIME and INST targets operate.

Step 3. Remove input current and reset targets.

Manual Trip Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-2.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 1.0.
- Set INST PICKUP to 01.

CAUTION

Trip circuit voltage is present at the front panel test points. When shorting the test points, use insulated jumpers to avoid contact with these voltages.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Apply 0.9 ampere input current to terminals 8 and 9.

Step 3. Connect a jumper between TIME MANUAL TRIP test points. Check that TIME target operates.

Step 4. Connect a jumper between INST MANUAL TRIP test points. Check that INST target operates.

Step 5. Reset targets.

Integrating Reset Test (Applicable Only To 200 Series Relays)

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and **SW3-4 to ON** (selects integrating reset).
- Set TIME DIAL to 4.5.
- Set CURVE to I.
- Set TIME PICKUP to 1.0.
- Set INST PICKUP to 90.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Read all of Step 3 before beginning Step 3.

Step 3. Apply 4.0 amperes input current to terminals 8 and 9. After the unit trips, remove the input current for 20 ±0.25 seconds, then reapply the 4.0 amperes input current. Record the elapsed time from the reapplication of input current to the output retrip.

Result: Elapsed time should be 1.55 ±0.3 seconds.

Test Procedure, Models BE1-50/51M-X00 and -X08 (One Ampere Sensing Input)

Time Pickup Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 0.0.
- Set CURVE to S
- Set TIME PICKUP to 0.1.
- Set INST PICKUP to 18.0.

Step 1. Slowly increase current to terminals 8 and 9. ACTIVE/PICKUP LED should turn red at a maximum input current of 0.11 ampere.

Step 2. Decrease input current until ACTIVE/PICKUP LED turns green then OFF.

Step 3. Set TIME PICKUP to 0.44

Step 4. Slowly increase current to terminals 8 and 9. ACTIVE/PICKUP LED should turn ON at an input current of 0.426 to 0.454 ampere.

Step 5. Decrease input current until ACTIVE/PICKUP LED turns OFF.

INST Pickup Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 0.0.
- Set CURVE to S
- Set TIME PICKUP to 3.02.
- Set INST PICKUP to 0.2.

Step 1. Slowly increase current to terminals 8 and 9. INST contacts should close at an input current of 0.191 to 0.209 ampere.

Step 2. Decrease input current until INST output contacts open.

Step 3. Set INST PICKUP to 1.6.

Step 4. Slowly increase current to terminals 8 and 9. INST contacts should close at an input current of 1.563 to 1.637 amperes.

Step 5. Decrease input current until INST output contacts open.

Time Dial Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 0.2.
- Set INST PICKUP to 18.0.

Step 1. Prepare to apply 0.3 ampere input current to terminals 8 and 9 and record the elapsed time from when current is applied until TIME output contacts close.

Step 2. Apply the current (step from 0 to 0.3 ampere) and record the elapsed time. Elapsed time should be 1.754 to 2.084 seconds. (This tolerance is greater than ±2 % because it is the accumulation of both pickup and timing tolerances.)

Step 3. Remove input current.

Target Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-2.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 0.2.
- Set INST PICKUP to 0.2.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Apply 1 ampere input current to terminals 8 and 9. Check that both TIME and INST targets operate.

Step 3. Remove input current and reset targets.

Manual Trip Test

Perform preliminary setup:

- Connect test setup as shown in Figure 5-2.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and SW3-4 to OFF (selects instantaneous reset).
- Set TIME DIAL to 4.5.
- Set CURVE to S
- Set TIME PICKUP to 0.2.
- Set INST PICKUP to 0.2

NOTES

When testing TIME overcurrent functions, INST PICKUP settings of 00 will affect the calibration of the TIME functions. TIME PICKUP settings of 00 also affect INST functions.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Apply 0.15 ampere input current to terminals 8 and 9.

Step 3. Connect a jumper between TIME MANUAL TRIP test points. Check that TIME target operates.

Step 4. Connect a jumper between INST MANUAL TRIP test points. Check that INST target operates.

Step 5. Reset targets.

Integrating Reset Test (Applicable Only To 200 Series Relays)

Perform preliminary setup:

- Connect test setup as shown in Figure 5-1.
- Insure that SW3 switches are set correctly: SW3-1 for operating frequency, SW3-2 to OFF (no instantaneous delay), SW3-3 to OFF (no instantaneous delay (100 series relays) or ABB type curves selected (200 series relays)), and **SW3-4 to ON** (selects integrating reset).
- Set TIME DIAL to 4.5.
- Set CURVE to I.
- Set TIME PICKUP to .20.
- Set INST PICKUP to 18.

Step 1. Set target current source to 1.0 ampere, ac.

Step 2. Read all of Step 3 before beginning Step 3.

Step 3. Apply 0.8 ampere input current to terminals 8 and 9. After the unit trips, remove the input current for 20 ±0.25 seconds, then reapply the 0.8 ampere input current. Record the elapsed time from the reapplication of input current to the output retrip.

Result: Elapsed time should be 1.55 ±0.3 seconds.

SETTING THE RELAY

Select the desired relay settings before putting the relay into service. Changing pickup current settings while the relay is in service may cause tripping.

PERIODIC TESTS

General

All relays should be tested periodically to identify and correct any problems that are found.

Single phase relays such as the BE1-50/51B-105 are normally used in groups of four (three phase and ground) on the protected circuit. Only three are required at any one time to provide complete protection. The fourth one assures that protection is maintained even if one relay failed.

This protection scheme also allows one unit at a time to be withdrawn for testing purposes without loosing protection during the test. Refer to Figures 5-1 and 5-2 for recommended test setups.

Periodic Test

Periodic testing should consist of the following procedures.

Step 1. Verify that the instantaneous pickup is within ±2% of the value set on the dials. Pickup occurs when the INST output contacts close.

Step 2. Verify that the time pickup is within ±2% of the value set on the dials. Pickup occurs when the LED changes from green to red.

Step 3. Verify that the time to trip for the curve and time dial settings at a multiple of six is the same as the time given on the characteristic curve. Refer to Section 1 for the characteristics curves.

Step 4. Verify that the time to trip for the instantaneous element at a pickup multiple of 2 is not greater than the time given on the instantaneous characteristic curve. Refer to Section 1 for the instantaneous characteristic curve.

Step 5. Verify that the 51 AUX contacts close when the time overcurrent element trips.

Step 6. Verify that the targets operate with one ac ampere of trip current in the trip circuits and that they can be reset using the RESET LEVER.

This completes the periodic test.

SECTION 6 • MAINTENANCE

GENERAL

BE1-50/51M Overcurrent Relays require no preventive maintenance. However, periodic tests should be performed according to scheduled practices. A recommended periodic test is provided in this section. If the relay fails to function properly, 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 should be performed by qualified technicians.

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 number
2. Relay serial number

STORAGE

This protective relay contains long life aluminum electrolytic capacitors. Life in excess of 20 years may be expected if the storage temperature does not exceed 40°C (72°F).

PERIODIC TESTS

General

All relays should be tested periodically to identify and correct any problems that are found.

Single phase relays such as the BE1-50/51M-104 are normally used in groups of four (three phase and ground) on the protected circuit. Only three are required at any one time to provide complete protection. The fourth one assures that protection is maintained even if one relay failed.

This protection scheme also allows one unit at a time to be withdrawn for testing purposes without loosing protection during the test. Refer to Section 5 for recommended test setups.

Periodic Test

Periodic testing should consist of the following procedures.

Step 1. Verify that the instantaneous pickup is within ±2% of the value set on the dials. Pickup occurs when the INST output contacts close.

Step 2. Verify that the time pickup is within ±2% of the value set on the dials. Pickup occurs when the LED changes from GREEN to RED.

Step 3. Verify that the time to trip for the curve and time dial settings at a multiple of six is the same as the time given on the characteristic curve. Refer to Section 1 for the characteristics curves.

Step 4. Verify that the time to trip for the instantaneous element at a pickup multiple of 2 is not greater than the time given on the instantaneous characteristic curve. Refer to Section 1 for the instantaneous characteristic curve.

Step 5. Verify that the 51 AUX contacts close when the time overcurrent element trips.

Step 6. Verify that the targets operate with one ac ampere of trip current in the trip circuits and that they can be reset using the RESET LEVER.

This completes the periodic test.

SECTION 7 • MANUAL CHANGE INFORMATION

SUMMARY AND CROSS REFERENCE GUIDE

This section contains information concerning the previous editions of the manual. The substantive changes to date are summarized in Table 7-1.

Table 7-1. Changes

Revision	Summary of Changes	ECA/ECO/Date
A	Changed manual title to BE1-50/51M and incorporated engineering changes accordingly.	12605/05-12-92
B	Changed the following pages. 1-1. Application, deleted reference to dust tight cover. 1-4. Specifications, TIME Dropout to not less than 95% of pickup value. 1-7. Specifications, Time Reset, added statement to insure sufficient power to power-up relay when using decaying characteristic. 1-8. Specifications, corrected Storage Range Temperature degrees F. 1-9. Defined British Standard curve types. 2-1. INST and TIME PICKUP selectors, added statement that changing selectors while relay is in service may cause tripping. 4-7. Time Pickup Test, Step 1., Changed 0.45 A to 0.485 A. 4-9. Time Pickup Test, Step 1., Changed 0.09 A to 0.096 A.4-11.Added paragraph SETTING THE RELAY 6-1. Added Section 6.	12822/09-02-92
C	Added column for CT secondary to Table 1-1 and UL Recognition and CSA Certification to specifications. Changed the following pages. 3-2 Deleted "or reset" from last sentence in paragraph **Outputs**. Changed from "The targets will not operate or reset ..." to "The targets will not operate..." 4-1 Corrected dielectric test leakage current per terminal and changed rack mounting plate part number from "9 2520 00 024" to "9 2520 12 001". 4-3 Added BE1-50/51M, vertical model rear view to Figure 4-3.	13392/06-04-93
D	Changed continuous current sensing input rating, and clarified TIME PICKUP and INST PICKUP specification ranges, page 1-4. Changed Figure 1-3 to also show one ampere unit burden data. Changed time characteristics accuracy statement, page 1-7. Added (repeated) equation for the characteristic curve time functions, page 1-9. Changed Figure 1-5 to show one ampere unit starting data. Separated *Section 4 Installation*, into *Section 4 Installation*, and *Section 5, Testing* and bumped all subsequent sections.	14240/05-27-94

Table 7-1. Changes - Continued

Revision	Summary of Changes	ECA/ECO/Date
E	Added new Figure 4-1 and bumped all following figures. Corrected old Figure 4-3, new Figure 4-4.	14479/09-06-94
F	Changed all sections to reflect 200 series relay additions and relay modifications that deleted P2 and P3 jumpers and added switch SW8. Changed *Specifications*, TIME and INST PICKUP accuracy; Output Circuits, and Isolation (Dielectric Test).	14885/02-01-95
G	Corrected minor typographical errors in Sections 1 and 2. Corrected Table 2-1, locator item K, *Function*. Changed Figure 5-2 and all testing target current source references from 0.2 ampere to 1.0 ampere. Changed Table 7-1 to add ECA and date data.	15325/10-16-95
H	Incorporated changes in series 200 relays that added five characteristic curves and changed switch SW8-3 functionality. Changed Section 5, *Testing*, to incorporate setting all sections of switch SW8.	15495/02-01-96
I	Corrected Tables 1-3 and 1-4, *Figure Number*. Changed "pickup setting" to "pickup" on pages 1-7, *Time Characteristics equation*, page 1-10, *Time Reset*, and Figures 1-7 thru 1-15. Added Oscillatory to *Surge Withstand Capability* on page 1-12. Corrected Figure 1-18 to reflect the correct Time Dial range: 0.5 to 9.9. Changed Table 7-1 to add ECA and date data.	16216/07-08-97
J	Added Patent Number to *Specifications* and changed the manual format to reflect current manual styles.	16746/05-12-98
K	Page 2-2, added description to Locator K for 100 series relays, unit revision Q and previous. Deleted Figure 2-2 from Section 2 and added it to new Section 8. Page 3-2, added description to *Auxiliary Output Contacts* for 100 series relays, unit revision R and subsequent. Added new Section 8, *Relay Differences*.	2848/02-03-99
L	Changed all references to the current for testing the targets to an ac only type of current.	7390/12-13-99
M	Updated drawings in Section 2 to reflect changes to the PC board. Also updated the rest of the manual to reflect the change in switch call out from SW8 to SW3. Added new functionality to the PICKUP LED. It is now the ACTIVE/PICKUP LED and will be green when active and red when picked up.	11293/11-06-00

SECTION 8 • RELAY DIFFERENCES

GENERAL

This section provides the information necessary to support BE1-50/51M 100 series relays, revision S and previous. In all unit revisions S and previous SW3 is the same as SW8

DIFFERENCES

BE1-50/51M 100 series relay boards revision Q and previous have the following locations for controls and indicators. Table 8-1 lists and briefly describes the operator controls of these relays. Reference the callout letters to Figure 8-1.

Table 8-1. BE1-50/51M Controls and Indicators for 100 Series Relays Revision Q and Previous

Locator	Control or Indicator	Function
J	**SW8 -1**	SW8-1 selects the system operating frequency. SW8-1 open (OFF) selects 60 hertz operation. SW8-1 closed (ON) selects 50 hertz operation.
	SW8-2	In 100 and 200 series relays, SW8-2 selects additional delay for the instantaneous element. Switch SW8-2 closed (ON) provides an additional instantaneous delay of 0.1 seconds.
	SW8-3	In 100 series relays, switch SW8-3 closed (ON) provides an additional instantaneous delay of 0.2 seconds. Closing both switches SW8-2 and SW8-3 provides an additional instantaneous delay of 0.3 seconds. In 200 series relays, SW8-3 open (OFF) selects ABB type curves (refer to Table 1-3. SW8-3 closed (ON) selects GE IAC type curves (refer to Table 1-4).
	SW8-4	Provides selection of either instantaneous or integrating reset characteristic. SW8-4 closed (ON) provides integrating reset. SW8-4 open (OFF) provides instantaneous reset.
K	Auxiliary Output Jumper Terminations	Configures the auxiliary output contacts to close with either the instantaneous (50) trip and/or the timed (51) trip. Jumper E2 to E1A to close the auxiliary contact with the timed (51) trip. This jumper is yellow and factory installed to close the auxiliary output contacts with the timed trip. Jumper E3 to E1B to close the auxiliary contact with the instantaneous (50) trip. This jumper is blue and factory installed to close the auxiliary output contacts with the instantaneous trip.

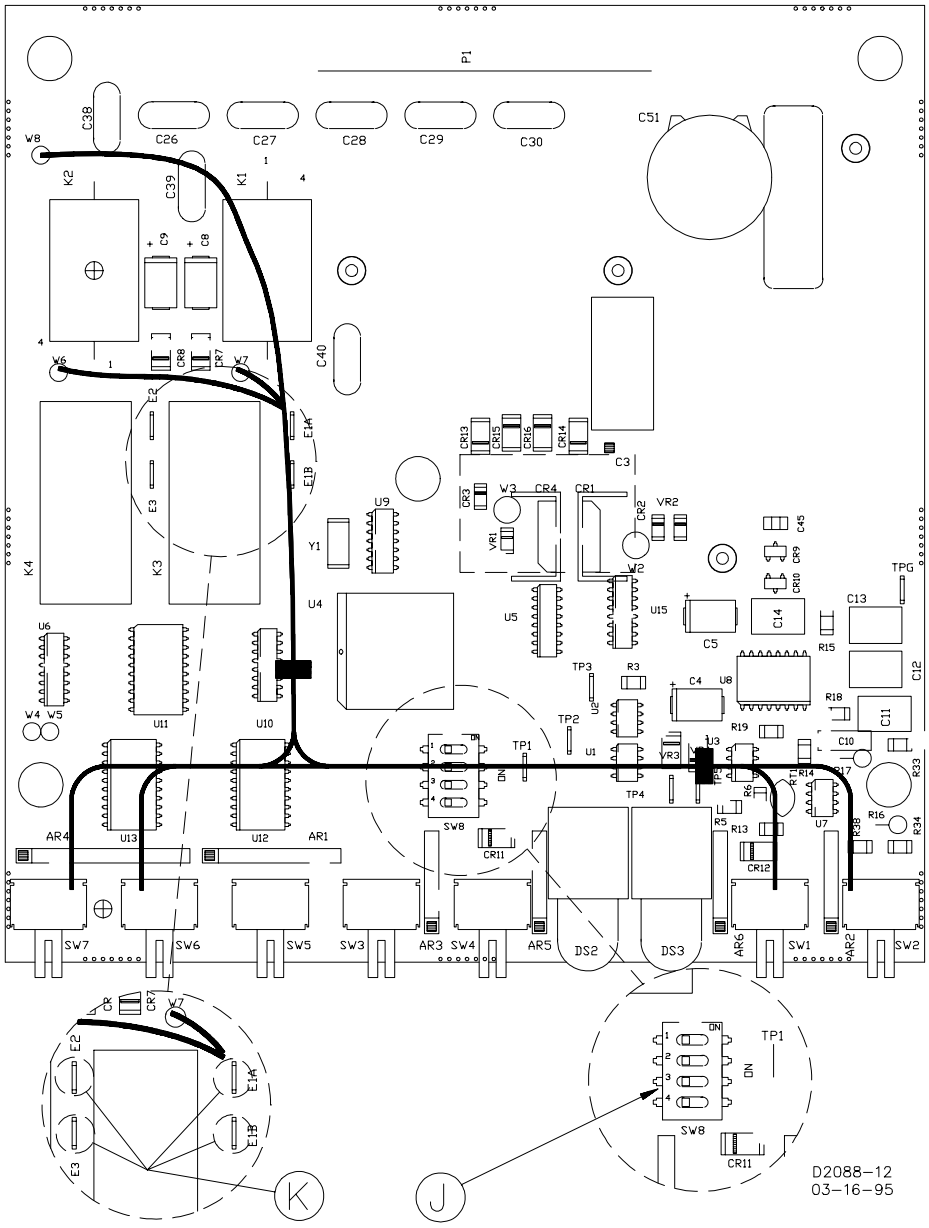

Figure 8-1. Location of Controls and Indicators for unit revisions Q and Previous, 100 Series Relays

BE1-50/51M 100 series relays, unit revisions R and S and 200 series relays, unit revisions H and previous have the following locations for controls and indicators. Table 8-2 lists and briefly describes the operator controls of these relays. Reference the callout letters to Figure 8-2.

Table 8-2. BE1-50/51M Controls and Indicators for 100 Series Relays Revision R and S

Locator	Control or Indicator	Function
J	**SW8 -1**	SW8-1 selects the system operating frequency. SW8-1 open (OFF) selects 60 hertz operation. SW8-1 closed (ON) selects 50 hertz operation.
	SW8-2	In 100 and 200 series relays, SW8-2 selects additional delay for the instantaneous element. Switch SW8-2 closed (ON) provides an additional instantaneous delay of 0.1 seconds.
	SW8-3	In 100 series relays, switch SW8-3 closed (ON) provides an additional instantaneous delay of 0.2 seconds. Closing both switches SW8-2 and SW8-3 provides an additional instantaneous delay of 0.3 seconds. In 200 series relays, SW8-3 open (OFF) selects ABB type curves (refer to Table 1-3. SW8-3 closed (ON) selects GE IAC type curves (refer to Table 1-4).
	SW8-4	Provides selection of either instantaneous or integrating reset characteristic. SW8-4 closed (ON) provides integrating reset. SW8-4 open (OFF) provides instantaneous reset.
K	Auxiliary Output Jumper Terminations	Configures the auxiliary output contacts to close with either the instantaneous (50) trip and/or the timed (51) trip. Jumper E2 to E1A to close the auxiliary contact with the timed (51) trip. This jumper is yellow and factory installed to close the auxiliary output contacts with the timed trip. Jumper E3 to E1B to close the auxiliary contact with the instantaneous (50) trip. This jumper is blue and factory installed to close the auxiliary output contacts with the instantaneous trip.

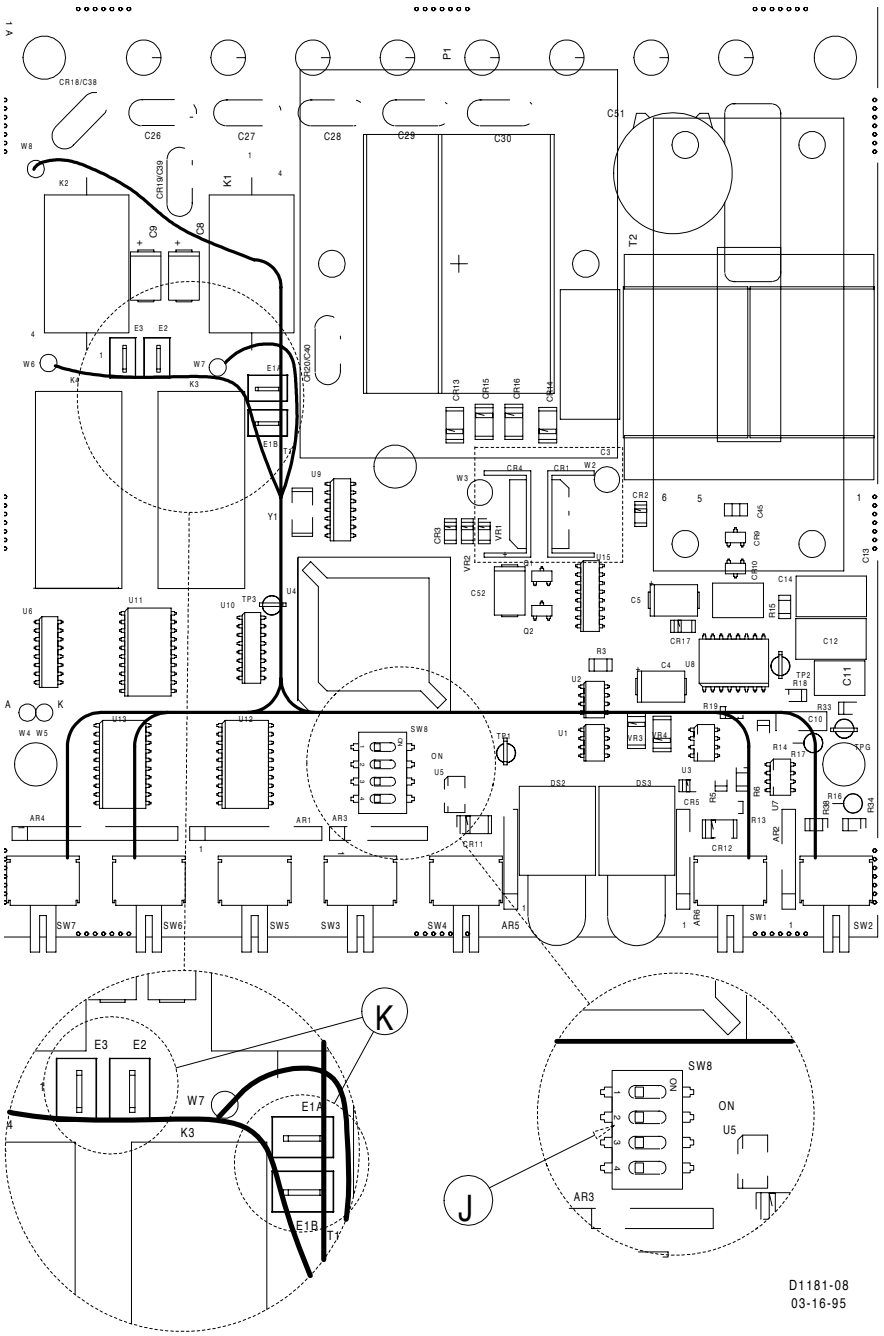

Figure 8-2. Location of Controls and Indicators for Unit Revisions R and S, 100 Series Relays and Unit Revisions H and Previous, 200 Series Relays.