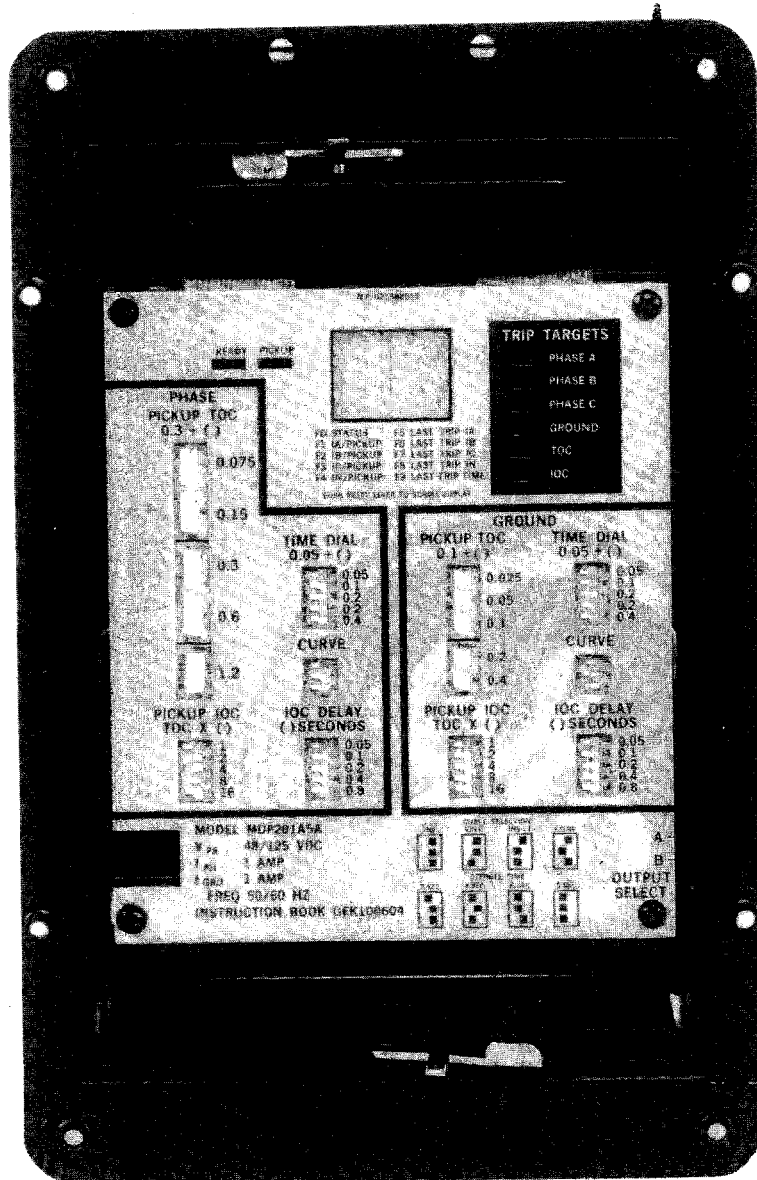


MDP™
 DIGITAL
 TIME OVERCURRENT
 RELAYING SYSTEM



Protection and Control

GE Technology Center
 205 Great Valley Parkway
 Malvern, PA 19355-1337

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Cover Photo: 8919428

These instructions do not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company (USA)

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

MDP™ DIGITAL TIME OVERCURRENT RELAYING SYSTEM

PRODUCT DESCRIPTION

Type MDP™ relays are digital, microprocessor-based, non-directional overcurrent relays that protect against phase-to-phase and phase-to-ground faults. The MDP™ system is UL recognized.

The MDP™ system performs the following functions:

- Inverse overcurrent, including four characteristic curves, and four values of definite time protection, as well as instantaneous overcurrent protection with programmable delay;
- Phase and ground current measurement;
- Phase and ground current metering;
- Operating time and fault current of the last trip.

The MDP201 series relays include four measuring units, one for each of the three phase currents and an additional one for ground or residual current. Each of the four measuring units includes a time and an instantaneous overcurrent unit. The phase settings are combined so that all phase units are set the same.

Nominal Current (I _n)	CURRENT RANGES	
	Inverse Time Unit (I _s)	Instantaneous unit
5 Amp	1.5 - 13.125 Amp	1 to 31 x I _s
	0.5 - 4.375 Amp	
1 Amp	0.3 - 2.625 Amp	
	0.1 - 0.875 Amp	

The pickup value for the instantaneous unit can be adjusted between 1 and 31 times the value selected for the inverse time unit.

The instantaneous unit can be disabled by adjusting the setting to zero (0) times the inverse value.

The MDP™ system has two output relays, which can be selected to indicate whether a trip has been produced (a) by an instantaneous unit or an inverse unit, or (b) by phase or ground. That selection is made by means of a switch behind the right lower side of the nameplate. An alarm output is also provided, to signal a critical alarm such as power supply failure or self-check failure.

NOMENCLATURE

MDP	*	*	*	* 000	*	A
	0					No communications or control inputs (Block Ground, Block Instantaneous, Breaker Status)
	1					Digital inputs and communications upgrade socket
	2					CommNet communications installed
	A					"A" series RS232 communications (no upgrade socket) No breaker status input
		1				5 Amp Nominal, 1.5 to 13.125 Amps Phase, 0.5 to 4.375 Amps Ground
		2				5 Amp Nominal, 1.5 to 13.125 Amps Phase, 1.5 to 13.125 Amps Ground
		3				5 Amp Nominal, 1.5 to 0.875 Amp Phase, 0.1 to 0.875 Amp Ground
		4				1 Amp Nominal, 0.3 to 2.625 Amp Phase, 0.1 to 0.875 Amp Ground
		5				1 Amp Nominal, 0.3 to 2.625 Amp Phase, 0.3 to 2.625 Amp Ground
		6				1 Amp Nominal, 0.3 to 2.625 Amp Phase, 0.05 to 0.4375 Amp Ground
		7				5 Amp Nominal, 0.5 to 4.375 Amp Phase, 0.5 to 4.375 Amp Ground
			1			24/48 Volts DC
			2			48/125 Volts DC
			3			125/250 Volts DC
				0		
					X	
						A
						Revision Level

APPLICATION

Time-overcurrent relays are used for the protection of feeders, transmission lines, alternating-current machines and transformers, and for numerous other applications where accurate measurement of current and timing is necessary. The operating time of associated protective devices should be considered in the selection of a time-current characteristic for a particular application, to ensure proper coordination with a minimum of circuit isolation. Four basic time-current characteristics are available in Type-MDP relays.

The inverse-time-current characteristic curves are shown in Figures 1 and 2. These relays are generally applied where the short-circuit-current magnitude is dependent largely upon the system generating capacity at the time of the fault.

The very inverse-time-current characteristic shown in Figure 3 is generally applied where the magnitude of short-circuit current flowing through any given relay is more dependent upon the location of the fault relative to the relay than on the system generation setup at the time of the fault.

The extremely inverse-time-current characteristic shown in Figure 4 is preferred for applications where sufficient time delay must be provided to allow a re-energized circuit to pick up an accumulated cold load without unnecessary tripping on inrush currents. Distribution-feeder circuits are a good example of such applications, and the extremely-inverse characteristic is best suited to such applications because it more nearly approximates typical power-fuse and fuse-cutout characteristics.

The general practice for grounded-distribution-system protection is to use three phase-overcurrent functions for protection against interphase faults and a ground/residual overcurrent function for single-phase-to-ground faults. The use of a separate ground overcurrent function is advantageous because it can generally be adjusted to provide faster and more sensitive protection for single-phase-to-ground faults than the phase-overcurrent functions. Typical connections for such an application are shown in Figures 10 and 11.

The pickup setting of the MDP time unit should be chosen so that it will operate for all short circuits in the protected zone, and also provide back-up protection for short circuits in the immediately-adjacent system element when possible. The time-unit pickup should be set low enough to ensure that the minimum fault current is at least 1.5 times the setting.

The time-delay adjustment of the time unit should be chosen to assure selectivity with the protection on the adjacent system elements. This adjustment should be made for the condition that yields maximum fault current at the relay location. The time delay is determined by the adjacent relay operating time for this condition, plus a coordinating time allowance that includes the adjacent circuit-breaker maximum operating time and a safety factor to accommodate any uncertainties. Since the MDP time unit has insignificant overtravel, the only relay variation that needs consideration in the safety factor is the tolerance on the time curves. A 0.17-second safety factor is generally used if the relay time is determined by selecting a time dial setting from the time curves. This safety factor can be reduced to 0.07 second if the time unit is instead set to the desired time by accurate tests.

The instantaneous-overcurrent unit can be applied in many instances to reduce the fault-clearing time for high fault currents. This unit is normally set to pick up only on internal faults in the protected zone. Significant transient overreach can be experienced under certain conditions, and this must be taken into account by selecting a pickup setting that is higher than that which would be dictated by the maximum steady-state external-fault current.

TECHNICAL SPECIFICATIONS

Nominal frequency:		50/60 Hz
Nominal current:		1 or 5 amps
Auxiliary power supply:		24-48 VDC (19 to 60 VDC) 24/36 VAC 48-125 VDC/AC (38.5 to 150 VDC/AC) 110/120 VAC 110-250 VDC (88 to 285 VDC) 220/240 VAC
Burden:	AC	0.1-0.875/0.3-2.65 = 0.09 Ω , 2.8° at 60 Hz (2.25VA at 5A) 0.1-0.875/0.3-2.65 = 0.09 Ω , 2.4° at 50 Hz (2.25VA at 5A) 0.5-4.375/1.5-13.25 = 0.01 Ω , 11.5° at 60 Hz (0.25VA at 5A) 0.5-4.375/1.5-13.25 = 0.01 Ω , 9.7° at 50 Hz (0.25VA at 5A)
	DC	Less than 3 watts at all voltages, quiescent Less than 4.5 watts at maximum voltages
Environmental Type Test		SWC ANSI C37.90.1 (1990) IEC 255-4 (1976) Class III IEC 255-22-1 (1988) Class III RFI ANSI C37.90.2
Temperature:	Operating:	-20° to +65° C
	Storage:	-40° to +65° C
Overcurrent Ratings:	Continuous:	2 x In
	Three Second:	50 x In
	One Second:	100 x In

Relative Humidity:	Up to 95% without condensing	
Accuracy:	Operating Value:	5%
	Operating Time:	5% or 0.025 seconds, whichever is greater
Repeatability:	Operating Value:	1%
	Operating Time:	2% or 0.025 seconds, whichever is greater
Output and Trip Contacts:		
Closing:	Contact will close and conduct up to a maximum of 30 amps for tripping duty at control voltages up to 300 VDC	
Interrupting:	50 watts resistive with a maximum of 2 amps and 300 VDC	
Continuous:	5 amps, with 300 VDC maximum	
Frequency operating range:	47-63 Hz	
Communications:	Baud Rate:	2400
	Type:	RS232
Overshoot	95% ± 5%	
Dielectric Withstand Voltage	2 KVrms	
Mechanical durability	10,000 cycles	
Test Voltage for disturbance test	Class 3	
Impulse test data	5 Kv	
Normal range error IOC	1 to 9 times pickup 5%	
	10 to 31 times 6%	
Burden tolerance	-25% to +5%	
Vibration class	Class 1	

NOTE

Interference suppression ground connection

The MDP relay contains high-frequency interference protection consisting of a series of capacitors connected between the input terminals and the case.

The case stud of the relay should be connected to ground, so these interference suppression circuits can perform their protective function. This connection should be as short as possible, to assure maximum protection. Braided #12 AWG conductors are recommended.

RANGES AND SETTINGS

The following indicates the ranges of standard models.

Time Overcurrent Unit (TOC) :	
(independent settings for phase and ground)	1 Amp: Ground, 0.1 - 0.875 Amp., in steps of 0.025 Amp.
	1 Amp: Phase, 0.3 - 2.625 Amp., in steps of 0.075 Amp.
TOC Setting Ranges, continued	5 Amp: Ground, 0.5 - 4.375 Amp., in steps of 0.125 Amp.
	5 Amp: Phase, 1.5 - 13.125 Amp., in steps of 0.375 Amp.

Time Delay (TOC) (independent for phase and ground)	Depends on the curve selected. Four Inverse Time curves are available (see Figures 1, 2, 3, and 4) as well as four definite times (maximum time 2, 4, 6, 8 seconds), all in the same relay.
Instantaneous Unit Pickup (independent for phase and ground)	1-31 times the pickup TOC setting Setting of zero (0) disables the instantaneous unit
Instantaneous Unit Time Delay (independent for phase and ground)	0-1.55 seconds in 50-millisecond steps
Phase Operating Curves	Inverse, Long Time Inverse, Very Inverse, and Extremely Inverse Four families of definite time characteristics, with maximum values of 2, 4, 6, and 8 seconds Between each family of curves, a specific curve can be selected between 0.5 and 10 for 5 amp relays, and 0.05 and 1.0 in steps of 0.05 for 1 amp relays
Ground Operating Curves	Inverse, Long Time Inverse, Very Inverse, and Extremely Inverse Four families of definite time characteristics, with maximum values of 2, 4, 6, and 8 seconds Between each family of curves, a specific curve can be selected between 0.5 and 10 for 5 amp relays, and 0.05 and 1.0 in steps of 0.05 for 1 amp relays

All values are adjusted with dip switches located at the front of the relay.

OPERATING PRINCIPLES

INPUTS

The secondary current from the current transformers of the protected line is connected to the relay and immediately reduced via the internal current transformers. The secondaries of the relay's current transformers are connected across input resistors, yielding a voltage proportional to the relay input current.

This voltage is rectified and filtered before being applied to the multiplexor and analog-to-digital converter, which are internal to the microprocessor.

EXTERNAL INPUTS

Two external inputs are provided. One (stud 9), when energized, blocks tripping by the ground units. The other (stud 19), blocks the phase and ground instantaneous trip elements when it is energized. Both inputs have one side common with the power supply stud 10, and since diode bridges are provided on each input, they can be actuated by either switched-to-positive or switched-to-negative, depending on the polarity connected to stud 10. NOTE that both 9 and 19 must be switched to the same polarity.

COMMUNICATIONS PORT

The MDP system has an RS232 communications port mounted on the rear of the relay case through an RJ45 connector. The communications baud rate is fixed at 2400 Baud, no parity, and 1 stop bit. The connector pin out is shown in the Internal Connections Diagram (Figure 5). Sufficient slack should be provided in the RS232 cable to allow the MDP relay to be drawn out of its case without straining the cable.

MEASUREMENT

A timer internal to the microprocessor generates an interrupt every millisecond on 50 Hz systems and every 0.833 milliseconds at 60 Hz, such that there are 20 interrupts per cycle.

Phase and ground measurements are made at each of these interrupts. These measurements are grouped, separately for each phase and ground, in groups of ten, and the average of the maximum value of these groups is taken.

This average is converted to "times pickup TOC", which is the value with which the relay works. This value is displayed in 5 second intervals.

INVERSE TIME UNIT

The times-pickup-TOC measurement obtained is compared, independently for each phase and ground, with a value, the pickup setting, that corresponds to one times (1x) pickup TOC. If the measurement exceeds the fixed setting, a Pickup LED lights on the front of the relay.

The minimum current necessary to cause the Inverse Time measuring elements to operate is never less than the set value (Is), nor greater than 10% more than (110% of) the set value.

$$1.0 I_s < I_{min} < 1.1 I_s$$

The dropout-to-pickup ratio is not less than 95%, based on the actual operating value.

The MDP system incorporates four inverse time curves and four definite times (see Figures 1-4).

The curve within a family is selected by the time dial.

The characteristic curves for the MDP system correspond approximately to the following formulae:

51 (INVERSE)

From 1.1 to 4 times the pickup TOC:

$$T = \left[\frac{0.0059}{P^{0.001} - 1} + 0.419 \right] * Dial + 0.018$$

From 4 to 31 times the pickup TOC:

$$T = \left[\frac{0.0069}{P^{0.001} - 1} - 0.252 \right] * Dial + 0.018$$

BS142 (INVERSE)

$$T = \left[\frac{0.14}{P^{0.02} - 1} \right] * Dial + 0.02$$

53 (VERY INVERSE)

From 1.1 to 4 times the pickup TOC:

$$T = \left[\frac{52.954}{P^{2.11} - 1} + 0.923 \right] * \text{Dial} + 0.018$$

From 4 to 31 times the pickup TOC:

$$T = \left[\frac{28.447}{P^{1.702} - 1} + 1.007 \right] * \text{Dial} + 0.018$$

77 (EXTREMELY INVERSE)

From 1.1 to 20 times the pickup TOC:

$$T = \left[\frac{58.132}{P^{2.135} - 1} + 0.166 \right] * \text{Dial} + 0.020$$

66 (INVERSE LONG TIME)

From 1.1 to 3 times the pickup TOC:

$$T = \left[\frac{0.0006}{P^{0.00001} - 1} + 5.644 \right] * \text{Dial}$$

From 3 to 5 times the pickup TOC:

$$T = \left[\frac{0.746}{P^{0.01} - 1} - 5.360 \right] * \text{Dial}$$

From 5 to 20 times the pickup TOC:

$$T = \left[\frac{0.00085}{P^{0.00001} - 1} - 12.530 \right] * \text{Dial}$$

From 20 to 31 times the pickup TOC:

$$T = \left[\frac{250 - 4.5P}{10} \right] * \text{Dial}$$

where:

T = time in seconds

P = multiple of pickup TOC

Dial = $\frac{\text{Time Dial Setting}}{10}$ for 5A rated (0.5 - 10)

= Time Dial Setting for 1A rated (0.05 - 1)

INSTANTANEOUS UNIT

The times-pickup-TOC measurement obtained is compared, independently for each phase and for ground, with a user-set value, and if the user-set value is exceeded, a Pickup LED is lit on the front of the relay and a user-programmable timer is started. When the timer times out, the relay trips and a Trip LED is lit on the front of the relay.

The trip level is user-adjustable independently for phase and ground. Likewise, the timer can be programmed, independently for phase and ground, between 0.0 and 1.55 seconds, in 50-millisecond steps.

The instantaneous unit can be disabled by setting the trip value multiplier to zero (0).

CHANGING SETTINGS

Settings can be changed by dip switches on the front of the relay. Once the desired changes are made, the relay has to be initialized. Initialization is accomplished by depressing the reset lever for three (3) seconds until the Ready LED goes out.

Any time a dip switch is changed, the Ready LED begins to flash twice per second. If the settings are returned to their previous positions, or if the relay is initialized by holding the reset lever for three (3) seconds, the Ready LED will stop flashing but remain lit. If the relay settings are changed and the relay is not reset, it will continue to flash for three (3) minutes, then it will accept the new settings and self-initialize.

NOTE: The pickup current setting change takes effect immediately, unlike other types of changes, even though the Ready LED flashes, indicating a change has been made. Initializing the relay by pressing the reset lever will return the Ready LED to an ON condition.

SETTINGS

PICKUP TOC

The pickup is the sum of the switches in the right-hand position, plus the base pickup. For example, if the second, third, and fifth phase TOC switches are in the right-hand position, the pickup current on a 5A-rated relay would be the base of 1.5, + 0.75 + 1.5 + 6 = 9.75 amperes.

PICKUP IOC

The IOC pickup is the sum of the switches in the right-hand position times the TOC pickup. For example, if the second and third switches are in the right-hand position, the IOC pickup would be 2 + 4 = 6 times the TOC setting; using the 9.75 amperes set above, this would result in an IOC pickup of 58.5 amperes.

TIME DIAL

The time dial is the sum of the switches in the right hand position plus the base .05 or .5. The time dial calibration is 0.05 for 1A-rated relays and 0.5 for 5A-rated relays.

CURVE SELECTION

Eight curves can be selected by means of the three (3) curve-selection switches. The settings are as follows:

	<u>First (Top)</u>	<u>Second (Middle)</u>	<u>Third (Bottom)</u>
Inverse	right	right	right
Very Inverse	right	right	left
Long Time Inverse	right	left	left
Extremely Inverse	right	left	right
2 Second Definite	left	right	right
4 Second Definite	left	right	left
6 Second Definite	left	left	right
8 Second Definite	left	left	left

The time delay of the definite time curve is the range times the time dial for 1A relays and the range times the time dial/10 for 5A relays. For example, to obtain a 3-second operating time, the time dial would be set first, third, and fourth switches to the right and second and fifth switches to the left (TD = base of .05, +.05 + .2 + .2 = .5[1A], or base of .5, + .5 + 2 + 2 = 5[5A]); the 6-second curve would be chosen with the curve switches left, left, right; the time delay is 6 (curve) times .5 (time dial), = 3 seconds for 1 amp relays. For 5A relays, the time dial (5) is divided by 10, = .5.

IOC DELAY

The Instantaneous unit can be delayed by .05 to 1.55 seconds. The time delay is the sum of the switches in the right-hand position. For example, if only the third and fifth switches are in the right-hand position, the delay would be .2 + .8 = 1 second.

OUTPUT CONTACT CONFIGURATION

The MDP relay has two output contacts that can be configured, allowing the user to distinguish between phase and ground, or between time delay and instantaneous, by means of the output selection switch.

In the A position on the nameplate, IOC phase and ground trips are output on studs 11,12 and 14,15, and TOC phase and ground trips are output on studs 11,13 and 14,16.

In the B position on the nameplate, IOC or TOC ground trips are output on studs 11, 13, and 14, 16, and IOC or TOC phase trips are output on studs 11,12 and 14,15.

		OUTPUT SELECT	
CONTACT		A	B
K1a	11-12	IOC	IOC or TOC Phase
K2a	11-13	TOC	IOC or TOC Ground
K1b	14-15	IOC	IOC or TOC Phase
K2b	14-16	TOC	IOC or TOC Ground

DISPLAY AND RESET

The MDP relays are provided with and a seven-segment display, which can be scrolled without removing the cover, by pushing the reset lever.

Upon energizing the relay, a value appears on the display that indicates the relay state. In order to differentiate this from the rest of the information, it appears with the two decimal points illuminated. The values displayed indicate:

- .00 Equipment in Service
- .01 Internal settings are different from the external settings
- 80 Fatal flaw

Pushing the reset lever for less than two (2) seconds advances through a sequence of data. This sequence is:

- F0 Actual State of the equipment
- F1 Phase A current, in multiples of pickup
- F2 Phase B current, in multiples of pickup
- F3 Phase C current, in multiples of pickup
- F4 Ground current, in multiples of pickup
- F5 Phase A current multiples for the last trip
- F6 Phase B current multiples for the last trip
- F7 Phase C current multiples for the last trip
- F8 Ground current multiples at the last trip
- F9 Operating time for the last trip

Last trip data, F5 to F9, is retained, provided auxiliary power is maintained.

With only a two-digit display, the maximum operating time that can be directly displayed is 99 seconds. When the time exceeds 99 seconds, the MDP system begins again from zero (0) with both decimal points lit to indicate the initial 100 units. If the time exceeds 199 seconds, the display stays lit with the figure 99 and both decimal points lit.

When the reset lever is pressed for less than 2 seconds, the next function appears on the display. If, for example, the phase A current is showing on the display and the lever is pushed, F2 appears, which indicates the next function, and the moment the lever is released, the display will show the value of this function, which is the B phase current multiples.

If the lever is held for more than 3 seconds, the In-Service LED goes out and the relay initializes itself. The display shows the status function.

The relay can only be initialized if the input current is below pickup. If it has picked up, or has tripped and the fault persists, the display will show the actual function when the lever is released, and it will not initialize.

If the reset lever has not been pressed for more than two (2) minutes, phase A current appears on the display.

SELF TEST AND ERROR ROUTINES

When the MDP system detects a critical failure of one of its components, it immediately gives a fatal error order and disables the trip outputs. In this case, the relay program is put in a DO loop, from which it cannot exit until power is removed and the relay re-energized. Locally, the Ready LED goes out and the state of the relay is indicated by an "80" on the display, flashing once per second.

The first thing the MDP system does when powered is to perform a complete check of the EPROM. If any error is detected, a Fatal Error output is given. Once in operation, partial EPROM checks are made. If any one of these checks gives an error signal, the relay goes to Fatal Error status.

The MDP system incorporates a WATCHDOG TIMER monitoring system for the program.

CONSTRUCTION

The components of the relay are mounted on a cradle assembly that can easily be removed from the relay case. The cradle is locked in the case by latches at the top and bottom. The electrical connections between the case blocks and the cradle blocks are completed through removable connection plugs, as shown in Figure 8, to permit testing the relay in its case. The cover is attached to the front of the case and includes two interlocking arms that prevent the cover from being restored until the connection plugs have been inserted.

The case is suitable for semi-flush mounting on panels. Hardware is available for all panel thicknesses up to two inches (2"). A panel thickness of 1/8 inch will be assumed unless otherwise specified on the order.

The printed circuit boards are mounted behind the nameplate and can be accessed by removing the four screws securing the nameplate. The boards are mounted horizontally in guides.

INTERNAL CONNECTION DIAGRAM

An internal connection diagram for the MDP system is shown in Figure 5.

DISPLAYS

The MDP system has seven Light-Emitting Diodes (LEDs) on the front of the relay in order to indicate the following situations:

- Ready. A green LED indicates that the relay is in operation.
- Pickup. An amber LED indicates that one of the protection units has picked up.

- Phase A trip. A red LED indicates that the A phase unit has produced a trip.
- Phase B trip. A red LED indicates that the B phase unit has produced a trip.
- Phase C trip. A red LED indicates that the C phase unit has produced a trip.
- Ground Trip. A red LED indicates that the ground unit has produced a trip.
- TOC Trip. A red LED indicates that the TOC element has produced a trip.
- IOC Trip. A red LED indicates that the IOC element has produced a trip.

RECEIVING, HANDLING, AND STORAGE

This relay contains electronic components that could be damaged by electrostatic discharge currents if those currents flow through certain terminals of the components. The main source of electrostatic discharge currents is the human body, and the conditions of low humidity, carpeted floors and isolating shoes are conducive to the generation of electrostatic discharge currents. Where these conditions exist, care should be exercised when removing and handling the modules. The persons handling the module should make sure that their body charge has been discharged, by touching some surface at ground potential, before touching any of the components on the modules.

These relays, when not included as part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If damage resulting from handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Sales Office.

The relays should be stored in their original cartons. If the relays are not to be installed immediately, they should be stored indoors in a place that is free from moisture, dust and metallic chips.

ACCEPTANCE TESTS

Immediately upon receipt of the relay, an inspection and acceptance test should be made to make sure that no damage has been sustained in shipment, and that the relay calibrations have not been disturbed.

VISUAL INSPECTION

Check the nameplate stamping to make sure that the model number and rating of the relay agree with the requisition. Remove the relay from its case and check that there are no broken or cracked molded parts or other signs of physical damage, and that all screws are tight.

ELECTRICAL TESTS

INVERSE TIME UNIT

Phase Pickup Calibration Verification

- Set the switch on the front of the relay so the output relays correspond to phase or ground (Position B).
- Connect the relay as indicated in Figure 9. In order to apply current to the relay, use a supply of 120 or 220 volts, 50/60 Hz, with a variable resistor in series, or an electronic test source.

- Set the relay at the desired pickup TOC and disable the instantaneous unit by setting the instantaneous multiplier to zero (0).

Apply current to the relay and verify that the Pickup LED on the front of the relay lights between 100% and 110% of the pickup TOC setting, and that the trip relay closes thereafter.

With the output relay closed, reduce the current applied, verifying that at a value between 95% and 105% of the pickup TOC, the relay resets, and the Pickup LED turns off.

Verification of Operating Time

With the relay still connected as indicated in Figure 9, set the inverse time unit to minimum pickup and set the corresponding time dial to 5 on a 5A relay, or 0.5 on a 1A relay.

Successively apply currents of 2, 5, and 10 times pickup TOC at a minimum, verifying that the operating times are within the margins indicated in Tables 1, 2, 3, and 4.

TABLE 1 INVERSE CHARACTERISTIC

<u>Times Pickup</u>	<u>Operating Times for Curve, in Seconds</u>
2	4.28 - 4.73
5	1.93 - 2.13
10	1.32 - 1.45

TABLE 2 VERY INVERSE CHARACTERISTIC

<u>Times Pickup</u>	<u>Operating Times for Curve, in Seconds</u>
2	8.03 - 8.87
5	1.43 - 1.58
10	0.77 - .85

TABLE 3 LONG TIME INVERSE CHARACTERISTIC

<u>Times Pickup</u>	<u>Operating Times for Curve, in Seconds</u>
2	44.8 - 49.5
5	19.3 - 21.3
10	11.7 - 12.9

TABLE 4 EXTREMELY INVERSE CHARACTERISTIC

<u>Times Pickup</u>	<u>Operating Times for Curve, in Seconds</u>
2	8.24 - 9.11
5	1.02 - 1.13
10	0.30 - 0.33

For the Definite Time Characteristics, based on any current input, the time should be half of the maximum value.

Verification of Time Dial

Set the relay at the minimum pickup TOC and verify that with an input current of five times (5x) pickup TOC, the operating time is between the margins shown in Tables 5 and 6.

TABLE 5 INVERSE TIME

Curve	Time in Seconds			
	<u>ANSI Inv.</u>	<u>Very Inv.</u>	<u>Long Time Inv.</u>	<u>Extremely Inv.</u>
Time Dial = 10(1)	3.84 - 4.24	2.84 - 3.14	38.6 - 42.7	2.02-2.23
Time Dial = 7(0.7)	2.69 - 2.98	2.00 - 2.20	27. - 29.9	1.42 - 1.57
Time Dial = 3(0.3)	1.16 - 1.29	0.86 - 0.96	11.6 - 12.9	0.62 - 0.69
Time Dial = 1(0.1)	APPX. 0.41	APPX. 0.31	3.86 - 4.27	APPX. 0.24

TABLE 6 DEFINITE TIME

Curve	Time in Seconds			
	<u>Tmax. = 2 sec</u>	<u>Tmax. = 4 sec.</u>	<u>Tmax. = 6 sec.</u>	<u>Tmax. = 8 sec.</u>
Time Dial = 10(1)	1.95 - 2.05	3.95 - 4.05	5.45 - 5.05	7.95 - 8.05
Time Dial = 7(0.7)	1.35 - 1.45	2.75 - 2.85	4.15 - 4.25	5.55 - 5.65
Time Dial = 3(0.3)	0.57 - 0.63	1.14 - 1.26	1.71 - 1.89	2.35 - 2.45
Time Dial = 1(0.1)	APPX. 0.2	APPX. 0.4	0.57 - 0.67	0.76 - 0.86

INSTANTANEOUS UNIT

Verification of Pickup

- Set the Output Select switch on the front of the relay to the B position so the output relays correspond to phase or ground.
- Connect the relay as indicated in Figure 9. Use a supply voltage with a variable resistor in series, or use an electronic test source.
- Set the relay at the minimum pickup TOC. Set the instantaneous unit to one times (1 x) the pickup TOC setting. Set the instantaneous time delay to zero (0) seconds.

Apply current to the relay and verify that the Pickup LED lights and the output trip relay closes when the current is between 95% and 105% of the pickup TOC setting.

With the trip output contact closed, lower the applied current, verifying that the trip relay resets and that the Pickup LED turns off at a current value equal to or greater than 95% of the pickup value.

Verification of Operating Time

With the relay still connected as in Figure 9, apply a current of 5 times (5 x) the pickup TOC setting, verifying that the operating time is less than 0.025 seconds.

Set the time delay of the instantaneous unit and verify that it is never less than the set time, nor greater than the set time + 10 milliseconds.

GROUND UNIT

Repeat each test with the relay connected as in Figure 9, except apply current to the ground unit (terminals 7 and 8). For each test, apply ground settings to the relay as instructed.

MDP-LINK SOFTWARE

OVERVIEW

A personal computer (PC) will provide a remote man-machine interface to the relay for operating personnel.

SYSTEM REQUIREMENTS

Hardware

The minimum PC hardware requirements consists of the following components. An IBM-AT or compatible (Compaq, Zenith, Tandy, etc...) with one parallel port, a minimum of 500K bytes of free memory (RAM) to run the program in, 40MB hard drive, low density 3 1/2 inch floppy drive, and EGA monitor.

Software

Requires MSDOS (PCDOS) 3.1 or above for the PC operating system.

INSTALLATION

Copy all files from the distribution diskette to your hard drive, using the DOS copy command.

GENERAL OPERATION

Mouse/Keyboard Usage

Either the mouse or the keyboard can be used to access all items in menus, dialog boxes and list boxes. For a description of how to use the mouse and keyboard in the various boxes and menus, refer to the following sections for menus and dialog boxes. For full manipulation of graphical data, the mouse is required.

The mouse is used to access items in menus and dialog boxes by moving the cursor to the item, followed by pressing and then releasing the left mouse button (clicking).

Main Horizontal Menu Bar

Items in the main horizontal menu are selected in one of three ways:

1. Position the mouse cursor on top of the menu item and click the left button.
2. Use a hot key. The hot key is the combination of the ALT key and the letter that is highlighted in the item description (blue).
3. Once either of the above methods has been used to select an item on the menu, indicated by one item being highlighted, the RIGHT and LEFT ARROW keys can be used to go to adjacent menu items. If the menu is not visible just below the highlighted item on the menu bar use the DOWN ARROW key to display the menu.

Pull-Down Menus

Pull-down menu items are selected in a number of ways:

Mouse

Position the mouse cursor on top of the menu item then press the left button once and release it (hereafter known as clicking on the mouse button) to display the pull-down menu. If the user wishes to select an item in the pull-down menu, position the mouse over the desired item and click on the left mouse button.

Both may be done at once by positioning the cursor over the menu item on the menu bar and holding the left mouse button down, moving the mouse cursor to the desired entry and the releasing the mouse button.

Keyboard

"Activating the hot key" is the combination of holding the ALT key and striking the highlighted key. Using a hot key will activate the associated menu or dialog box. If there is no hot key for a desired menu item, use the UP and DOWN ARROW keys to highlight the desired item, then press the ENTER key. Pressing the ENTER key will activate the associated menu or dialog box.

Dialog Boxes

Dialog boxes are generally characterized by a title bar, a grey box, and OK and CANCEL buttons. The dialog box cannot be moved, resized, or iconized. In addition, when a dialog box is displayed, the user can only access items in the dialog box, not any other items on the screen.

If an item in the dialog box has a title with a highlighted character (blue in the default color scheme), the user can access this item from the keyboard by using the ALT key with the highlighted character (the hot key). Items in a dialog box can also be accessed from the keyboard by using the cursor keys: UP/DOWN/LEFT/RIGHT ARROW keys, PAGE UP/DOWN keys and the TAB/SHIFT TAB keys. In any dialog box the TAB key will move sequentially in one direction, or the SHIFT TAB key in the opposite direction, selecting items in the dialog box with each keystroke. The other cursor keys will generally move within a selected item.

Buttons in the dialog box can be accessed from the keyboard by using the UP/DOWN ARROW keys, the TAB/SHIFT TAB keys, or if the button has a highlighted character, the hot key. If the buttons require the user to make a selection, the selection is made by using the ENTER key.

To exit from the dialog box and clear it from the screen, the user selects either the OK button or the CANCEL button. The mouse can be used to select these buttons by moving the mouse cursor over the button and clicking the left mouse button. In addition, the keyboard can be used to select these buttons by using their hot keys. The hot key for the OK button is ALT-O and the hot key for the CANCEL button is ALT-C.

The mouse can be used to select any item in a dialog box by moving the cursor with the mouse to the desired item and clicking on it with the left mouse button.

The OK button accepts the selection(s) made by the user and allows the program to use these selections. The CANCEL button does not accept the selections made by the user and thus the program uses the previous selections. Any highlighted button can be selected by striking the ENTER key.

List Boxes

A list box is another box within a dialog box that lists all choices for an item in the dialog box (for example, a list of file names). If the list of available entries is longer than the displayed list box, the list box has a vertical scroll bar that allows the user to scroll through the list.

To operate the scroll bar with the mouse, place the tip of the pointing arrow cursor in the gray hatched area, or on the arrows at the top and bottom of the scroll bar and click on the left mouse button. If the mouse arrow cursor is in the grey hatched area, then the contents of the list box will move a section at a time. If the mouse cursor is on one of the arrows at the top or bottom, the contents of the list box will move one line at a time. Holding down the mouse button will cause the movement to be repeated until the mouse button is released.

Once the desired item can be seen, click on the item with the left mouse button to select it. Once an item has been selected it will be highlighted.

To operate the scrolling of the list box with the keyboard, use the PAGE UP/DOWN keys to move the contents of the list box a section at a time and the UP/DOWN ARROW keys to move the contents one line at a time. Holding down the keys will cause the movement in the list box to repeat until the key is released.

Once the desired item can be seen, use the UP/DOWN ARROW keys to select it. The selected item is the highlighted one.

The following table lists the valid keys and their functions for list boxes:

UP ARROW	Move up one selection.
DOWN ARROW	Move down one selection.
PAGE UP	Move up one page of selections.
PAGE DOWN	Move down one page of selections.
HOME	Move to the first selection.
END	Move to the last selection.
RETURN	Accept the current selection and exit the list box.
ALT-X	Exit the list box without making a selection.

Entering Text and Numbers

The following keys are used when entering and editing text and numbers.

LEFT ARROW	Move the cursor one character to the left.
RIGHT ARROW	Move the cursor one character to the right.
DELETE	Delete the character at the cursor.
BACKSPACE	Delete the character to the left of the cursor.
INSERT	Toggle between the insert and overwrite mode. -Overwrite mode is indicated by an underscore-character cursor. -Insert mode is indicated by a block-character cursor.
ENTER	Accept the text or number in the field/box
ESCAPE	Clear the text or number in the field/box.

The first keystroke other than the arrow keys will clear the field/box; this enables a new entry without having to clear the box first. If a minor change is desired and the user does not wish to clear the field/box, move the cursor first and then do the editing to the entry.

PROGRAM OPERATION

MAIN MENU

The main horizontal menu has the following items and hot keys.

<u>R</u> elay Functions	ALT-R
<u>L</u> ocal Functions	ALT-L
<u>S</u> etup	ALT-S
<u>H</u> elp	ALT-H

Each item in the main horizontal menu has a pull-down menu associated with it.

RELAY FUNCTIONS

Relay functions has the following menu items and associated hot keys:

<u>L</u> ogin	ALT-L
<u>I</u> ogout	ALT-O
<u>H</u> ang up phone	ALT-H
request relay <u>D</u> ata	ALT-D
request <u>F</u> ault data	ALT-F
<u>R</u> eset fault data	ALT-R

Login

Login is used to gain access to the relay. The **Login** dialog box contains a list of the currently configured relays, a place to enter the unit ID, a button for adding a new MDP relay to the list of configured relays, an OK button and a CANCEL button.

The list of currently configured MDP systems contains the unit description, phone number, baud rate, and multiplexor switch code for each MDP system.

The **NEW RELAY** button in the dialog box allows the user to add a relay that has not been previously entered into the list of configured relays. The user enters the unit description, the phone number, the multiplexor switch code, the baud rate, the parity and the stop bits for the new relay. The new relay is added to the list of configured relays.

Once a relay has been picked from the list or entered as a new one, the **Unit Id** must be entered in order to communicate with the correct MDP system. When the correct **Unit Id** has been entered, click on the OK button with the left mouse button or use the ALT-O hot key to login.

To exit login use the CANCEL button by clicking on it with the left mouse button or using the ALT-C hot key.

Iogout

Logout is used to end a communications session with an MDP system and prepare MDP-LINK to communicate with another MDP relay. In order to communicate with another MDP system, Iogout must be used. To select Iogout click on the menu item with the left mouse button or use the ALT-O hot key.

Hang up phone

This selection will disconnect the phone line at the modem. If the user is logged in to the relay, The logout procedure will be completed before hanging up the phone. To pick this selection, use the hot key ALT-H or click on the menu item with the left mouse button.

request relay Data

This item allows the user to display, print and/or file the present relay values of current, LED status and switch status. To choose this item, either click on it with the left mouse button or use the ALT-D hot key. Once this item is selected, a dialog box will appear with three independent choices for displaying, printing and filing the relay data. To change any of the three choices, either click on it with the left mouse button or use the TAB key to highlight the selection and the space bar to change it. An X in the brackets indicates that choice has been selected and no X indicates that choice has not been selected. At least one must be chosen for the relay data to be retrieved from the relay.

If the user chooses to save the report in a file, a file name must be entered in the box supplied. To enter the file name, either move the mouse cursor to the box and click on the left mouse button or use the TAB key to highlight the box. Once the box has been selected, enter the filename followed by the ENTER key.

After all the choices have been made, click on the OK button, or use the ALT-O hot key, to retrieve the report from the relay. Selecting the CANCEL button will return to the **Relay functions** menu without any further action. If the report is displayed, when finished either click on the small box in the upper left corner with the left mouse button, or use the ALT-F4 hot key (F4 is the Function key F4, not the F key followed by the 4 key.). Once the relay data has been cleared from the screen, the **relay Data** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit relay Data.

request Fault data

This item allows the user to display, print and/or file the data for the last fault. To select this menu item, either click on it with the left mouse button or use the ALT-F hot key. Once this item is selected, a dialog box will appear with three independent choices for displaying, printing and filing the fault values. To change any of the three choices, either click on it with the left mouse button or use the TAB key to highlight one of the selections and the UP/DOWN ARROW keys to choose one of the three choices. An X in the brackets indicates that choice has been selected and no X indicates that choice has not been selected. Use the space bar to change any of the choices. At least one must be chosen for the fault data to be retrieved from the relay.

If the user chooses to save the report in a file, a file name must be entered in the box supplied. To enter the file name, either move the mouse cursor to the box and click on the left mouse button, or use the TAB key to highlight the box. Once the box has been selected, enter the filename followed by the ENTER key.

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the fault data from the relay. (Selecting the CANCEL button will return to the **Relay functions** menu without any further action.) To clear the fault data from the screen after it has been displayed, either click on the small box in the upper left corner with the left mouse button or, use the ALT-F4 hot key (F4 is the Function key F4, not the F key followed by the 4 key). Once the fault report has been cleared from the screen, the **Fault data** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

The user may scroll the screen to view any information which may not fit on one screen. To scroll through the report, use the PAGE UP/DOWN keys, or place the mouse on the UP or DOWN ARROW on the scroll bar and use the left mouse button. Clicking the left mouse button will move one line in that direction and holding the button down will cause the scrolling to happen repetitively.

Modem connection time

This item will change the time-out period for MDP-LINK to wait for the modem to make a connection. To select this item, either click on it with the left mouse button or use the ALT-M hot key. The modem connection time can be set for any time up to 999 seconds, provided the modem being used will accommodate that long a time-out period. This setting is useful for applications where the modem is set to pickup after a large number of rings, especially if the phone system has a lot of delay in making the initial connection. Once a connection time has been set, selecting the OK button with the left mouse button or the ALT-O hot key will store the new time-out period. Selecting the CANCEL button will exit this item without any further action.

Relay parameters

Relay parameters allows the communication parameters for a specific relay unit description to be changed or viewed. An entry in the list must be selected first, by clicking on it with the mouse or using the UP and DOWN ARROW keys to highlight the selection, and pressing the ENTER key.

Once a relay unit description has been picked, another window appears with the phone number, switch code, baud rate, number of stop bits and the parity for the selected relay unit description. Any of the entry values may be selected by clicking on it with the mouse or using the TAB key to move between the items, and then using the UP and DOWN ARROW keys to select the value for that item. To exit the dialog box for that unit description, select either the OK button or the CANCEL button. The OK button will accept the values in the dialog box and store them. Selecting the CANCEL button will exit the dialog box and will use the values that were already present when the unit description was selected.

The user should note that once a unit description has been picked, there are no more hot keys available to select items. The TAB key may be used to move from item to item, or the mouse may be used to select a specific item at any time.

To enter or change the phone number, select it by clicking on it with the left mouse button or use the TAB key to move the cursor to the phone number box. The normal text-editing keys may be used to enter or modify the phone number. This is an optional item, and should only be filled in if MDP-LINK is using a modem for the unit being described.

To enter or change the switch code, select it by clicking on it with the left mouse button or use the TAB key to move the cursor to the switch code box. The normal text-editing keys may be used to enter or modify the phone number. This is an optional item, and should only be filled in if a code-operated switch is being used.

The baud rate must be set at 2400 Baud.

A choice of one stop bit must be made for communications to work properly.

Parity must be set to None.

Add relay to list

Selecting this item will enable the user to add a unit description and the related values to the list of stored relay unit descriptions. The user can either move the mouse cursor to the entry in the menu and click on the left mouse button or use the hot key ALT-A to select this entry. Once the entry has been selected, the user is prompted for a unit description. The description is limited to 20 characters. After the description has been entered, the user can either click on the OK button with the left mouse button or use the ALT-O hot key to accept it. (Selecting the CANCEL button will not add the new unit description and will exit the user from the menu entry.)

After the new unit description has been accepted, a dialog box will appear with the phone number, switch code, baud rate, stop bits and parity items. Each item can be selected with the TAB or SHIFT TAB key and a value chosen with the UP and DOWN ARROW keys, or a value can be chosen by placing the mouse cursor over the desired value and clicking on the left mouse button.

dElete relay from list

This item allows the user to delete a relay unit description from the configuration file. To select this item, either click on it with the left mouse button or use the ALT-E hot key. Once this item has been selected, a dialog box will be displayed containing a list box with all the relay unit descriptions and the OK and CANCEL buttons.

The user selects the desired relay from a list box displaying the unit descriptions and logon parameters by using the UP and DOWN ARROW keys to highlight the desired relay and pressing the ENTER key, or moving the mouse cursor to the desired relay and clicking on it with the left mouse button. Selecting the OK button with the ALT-O hot key or clicking on it with the left mouse button will mark the unit description for deletion. Selecting the CANCEL button will exit without deleting any relay unit descriptions. If the OK button is selected, the user is asked to confirm the deletion of the unit description. Selecting the OK button will delete the relay unit description. Selecting the CANCEL button will return to the list box without deleting any relay unit description. Selecting the CANCEL button in the list box will exit from the menu entry.

dIisplay mode

This item will change the colors of the display to be more compatible with either a color display or a display for a portable or laptop computer. To select this item, use the ALT-I hot key or click on the menu item with the left mouse button. After selecting this item a dialog box will appear with a choice for color mode or black and white mode. To select an item either click on it with the left mouse button or use the TAB key to highlight the choice and use the SPACE BAR to toggle the X on and off. If there is an X next to a choice it has been selected. Only one mode can be selected and once a mode is selected the other mode is automatically de-selected.

Once the correct mode has been selected, click on OK with the left mouse button or use the ALT-O hot key. To exit this dialog box without any further action, click on CANCEL with the left mouse button or use the ALT-C hot key.

Memory available

To display the amount of available memory while MDP-LINK is running either click on this menu item with the left mouse button, or use the UP or DOWN ARROW keys to highlight the menu item, and hit the ENTER key. There is no hot key for this item.

HELP

This item displays a pull-down menu with a selection of topics for which help exists. This pull-down menu is different from the other pull-down menus in that the items do not have hot keys associated with them. The user must either click on the mouse or use the UP and DOWN ARROW keys followed by the ENTER key, to access the menu items.

EXITING MDP-LINK

There are two ways to exit MDP-LINK:

ALT-F4 will produce a dialog box with the exit message. Selecting the OK button with the mouse or using the ALT-O hot key will exit MDP-LINK. Selecting the CANCEL button will return the program without exiting.

The ALT key combined with the space bar will produce the System Menu after all menus have been cleared from the screen. Choosing the CLOSE entry, with the mouse or the hot key ALT-C, will produce a dialog box with the exit message. Selecting the OK button with the mouse or using the ALT-O hot key will exit MDP-LINK. Selecting the CANCEL button will return to the program without exiting. NOTE: To exit MDP-LINK, all dialog boxes and list boxes must be cleared from the screen. It is not necessary to clear all the menus from the screen.

INSTALLATION

The relay should be installed in a location that is clean and dry, free from excessive vibration, and well lighted to facilitate inspection and testing.

The relay should be mounted on a vertical surface. Figure 6 is an outline and panel drilling diagram.

External connection schemes are shown in Figure 10.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital role of relays in the operation of a power system, it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the points listed under INSTALLATION be checked on the same schedule as the associated protective relays. Follow the **ACCEPTANCE TEST** section of this Instruction book as a guide to Periodic Testing using your settings.

Since the last edition, UL recognition, Nomenclature chart, and zone interlock configuration have been added, the Technical Specifications have been expanded, the Inverse BS142 equation has been added, the output Contact Configuration for the B position has been revised, and Figure 12 has been revised.

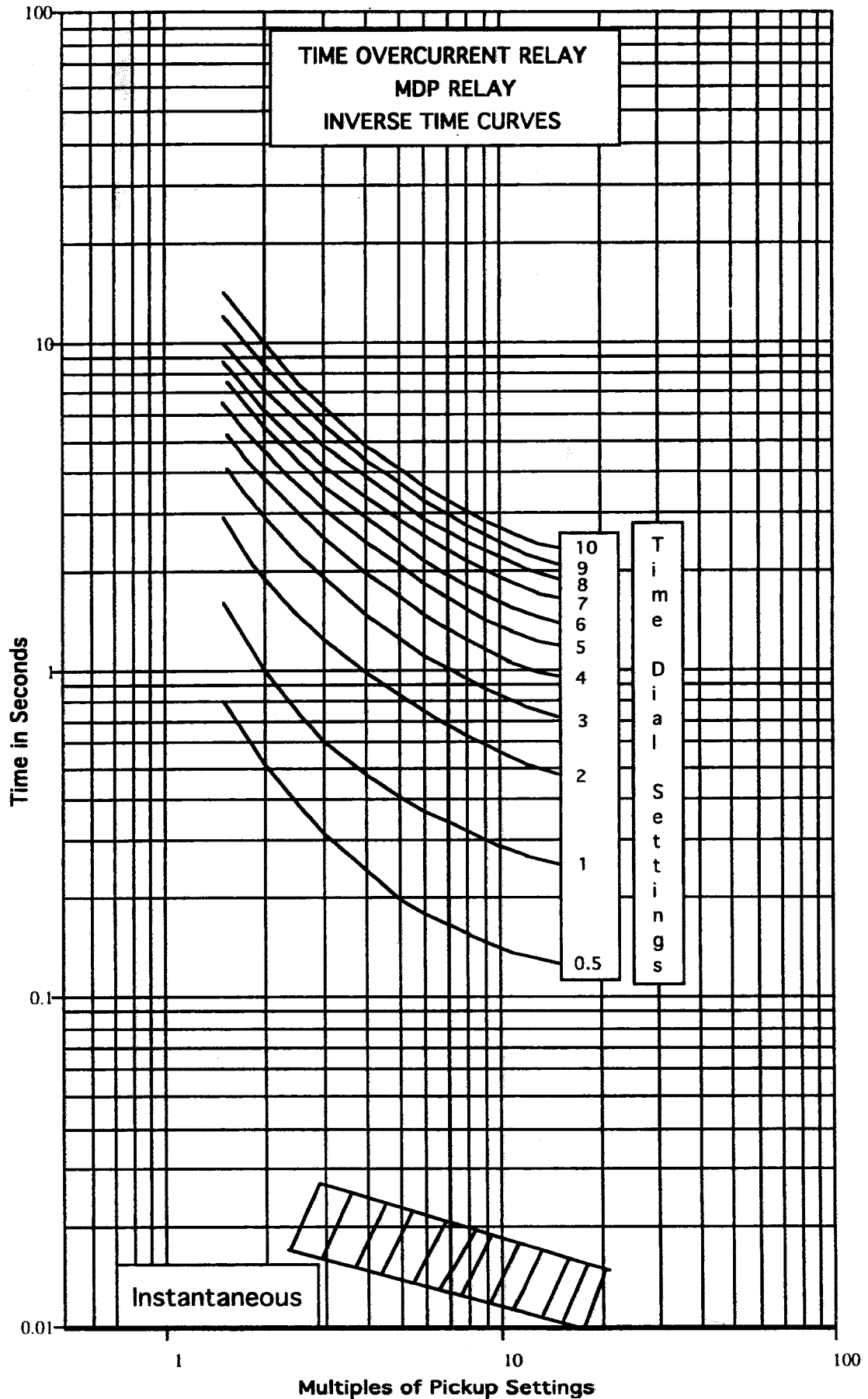


Figure 1 (GES-9869) Inverse Time Curve for the MDP System

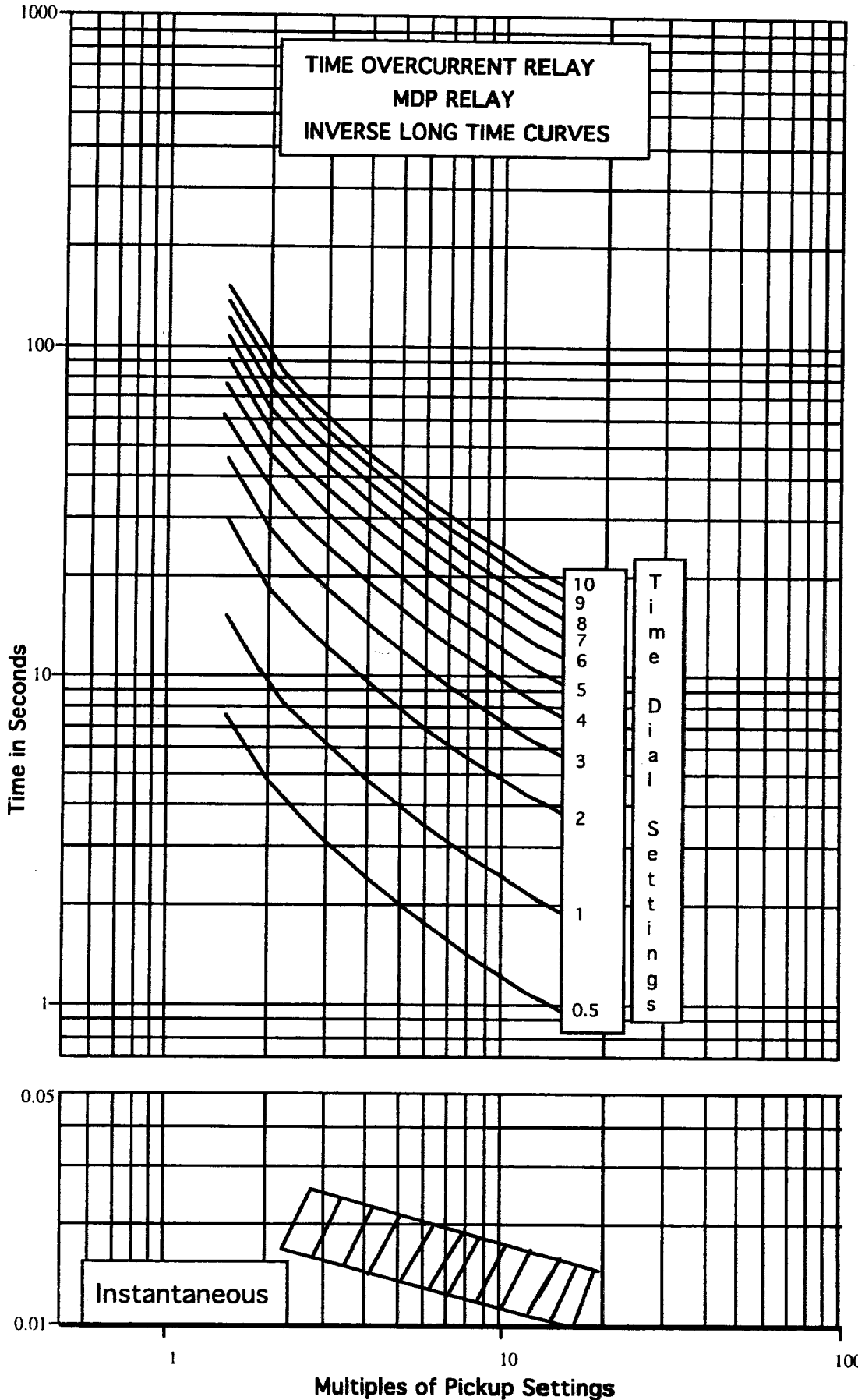


Figure 2 (GES-9870) Long Time Inverse Time Curve for the MDP System

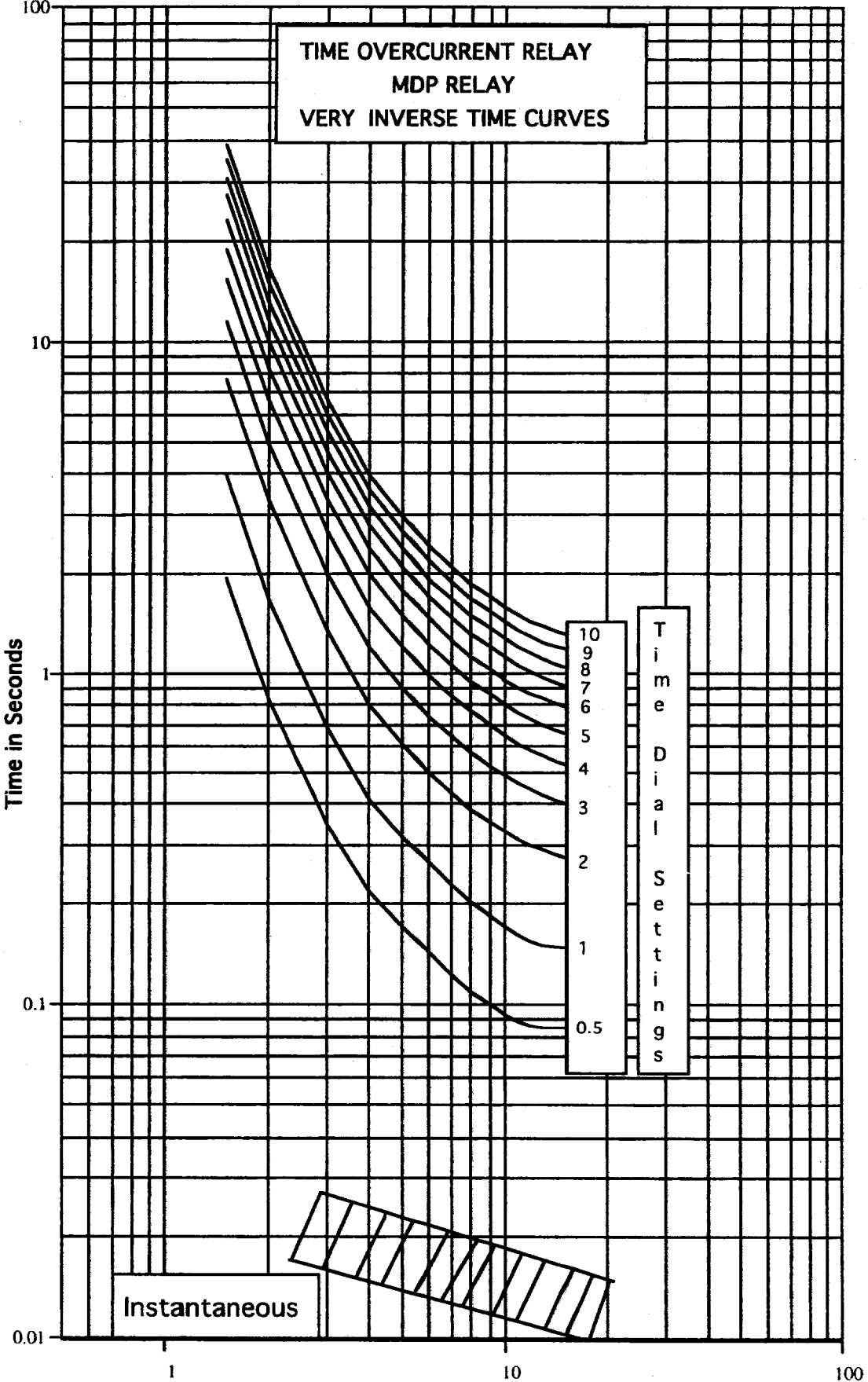


Figure 3 (GES-9871) Very Inverse Time Curve for the MDP System

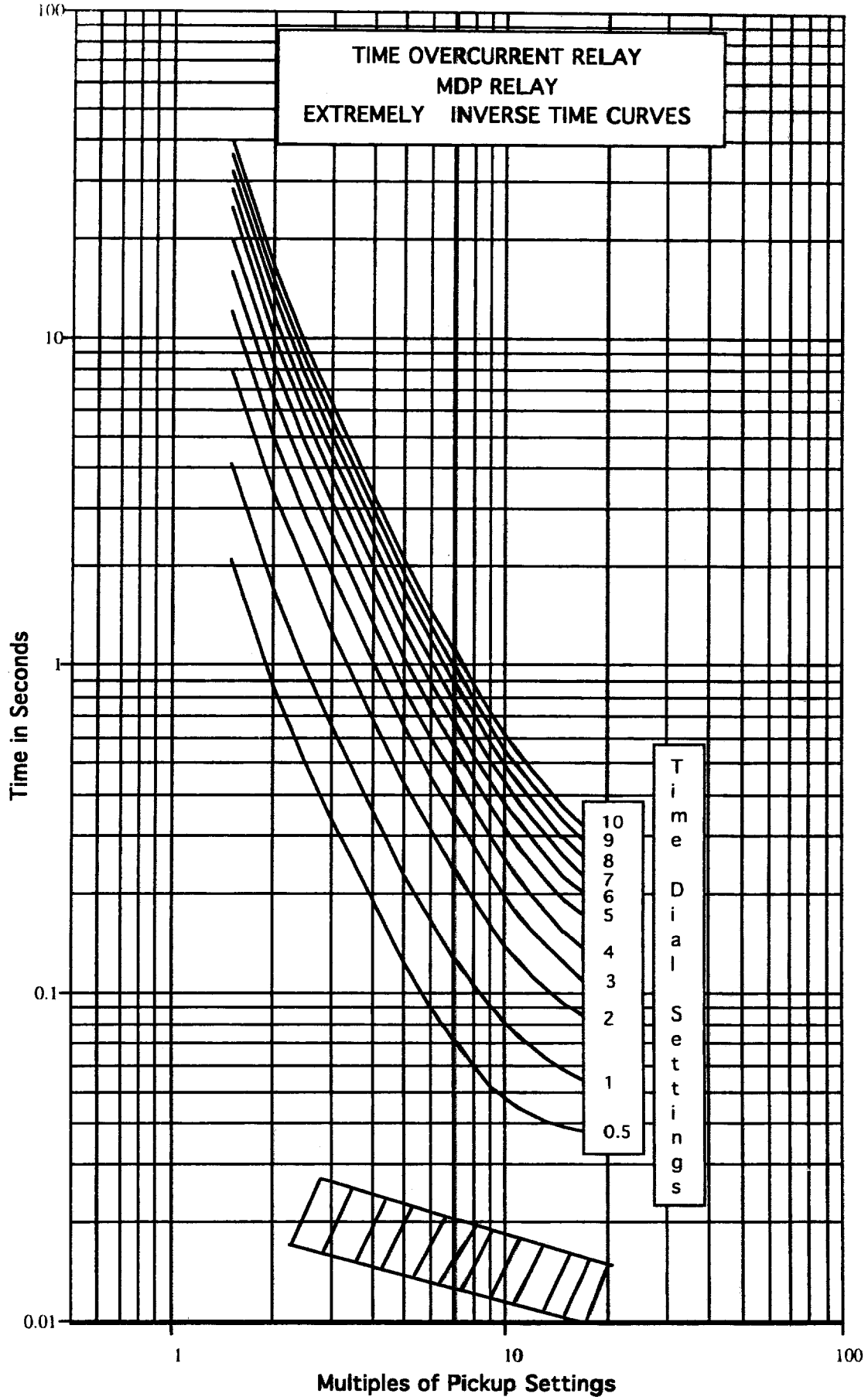


Figure 4A (GES-9872) Extremely Inverse Time Curve for the MDP System

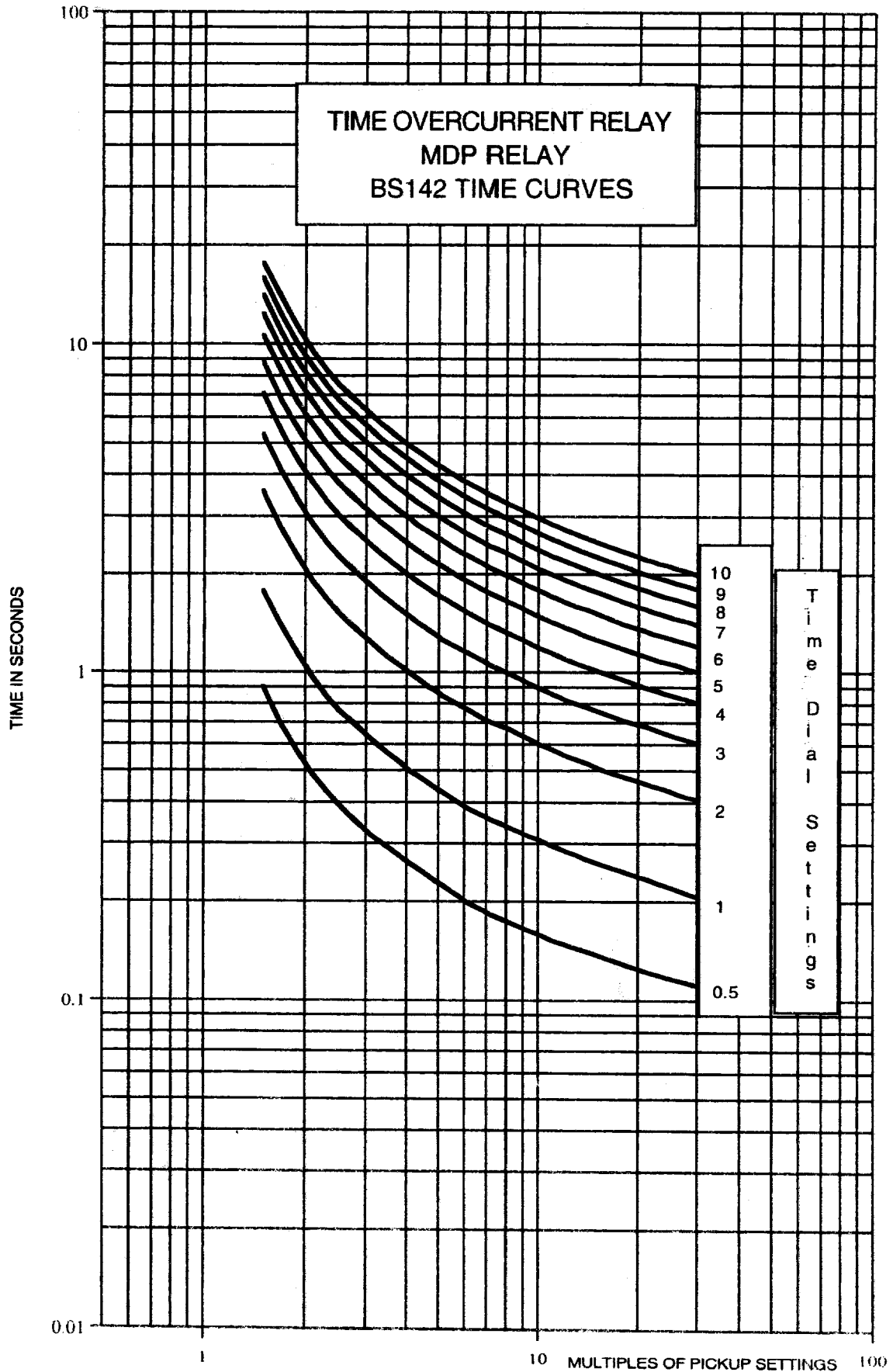


Figure 4B (GES-9880) Inverse BS142 Time Curve for the MDP System

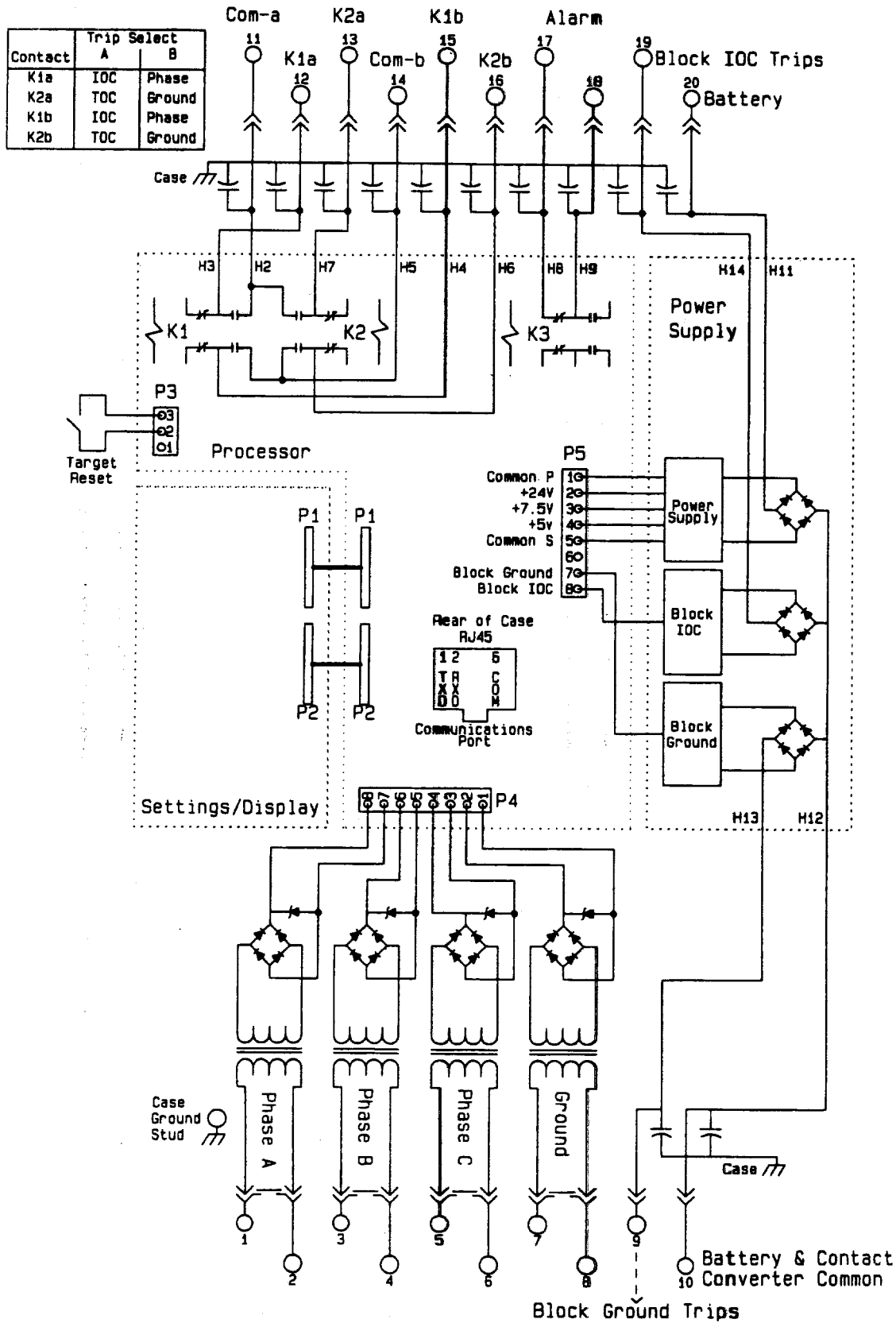


Figure 5 (0171C8793) Internal Connections Diagram for the MDP201A-A

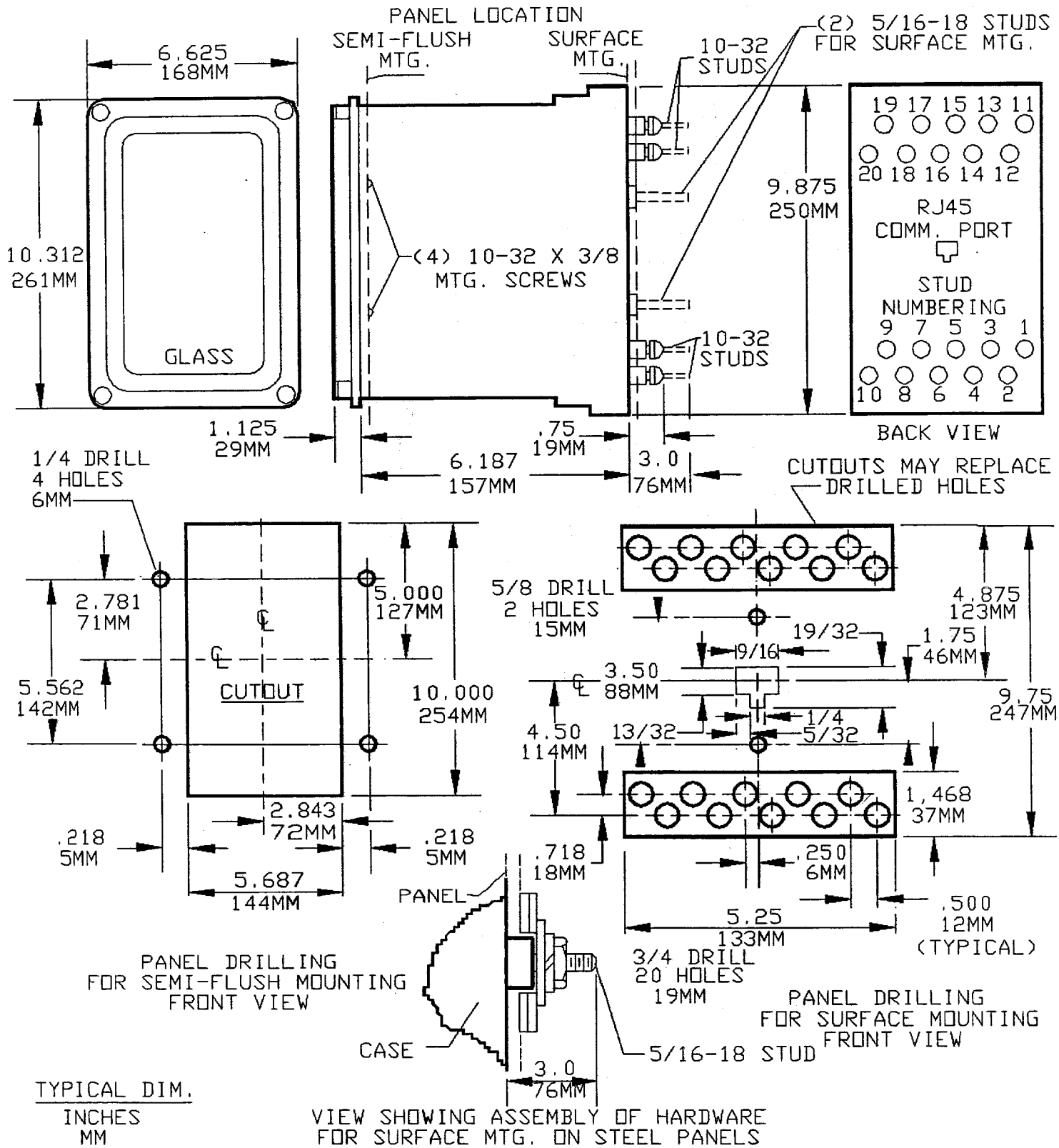


Figure 6 (0286A4975) Outline and Panel Drilling

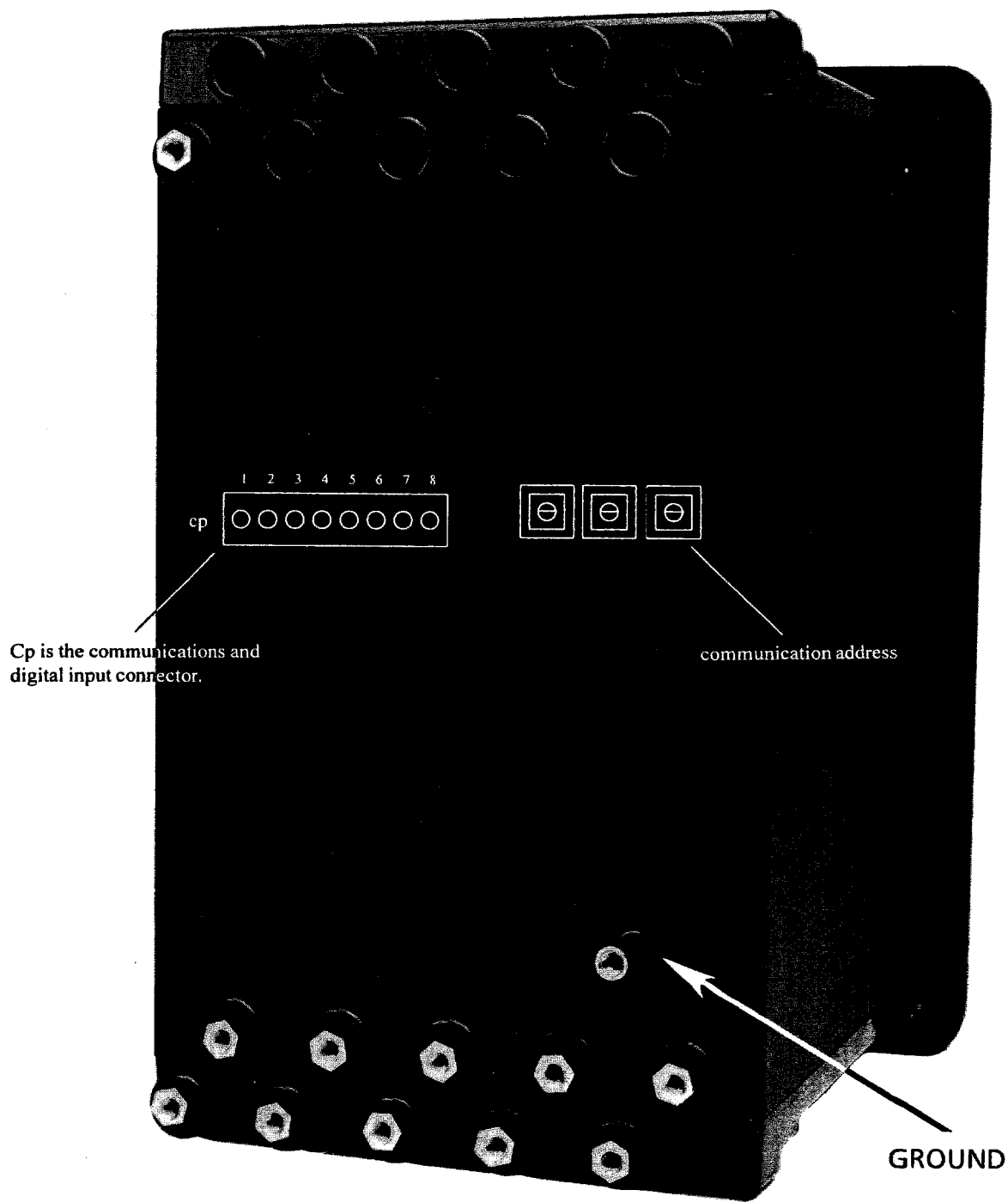
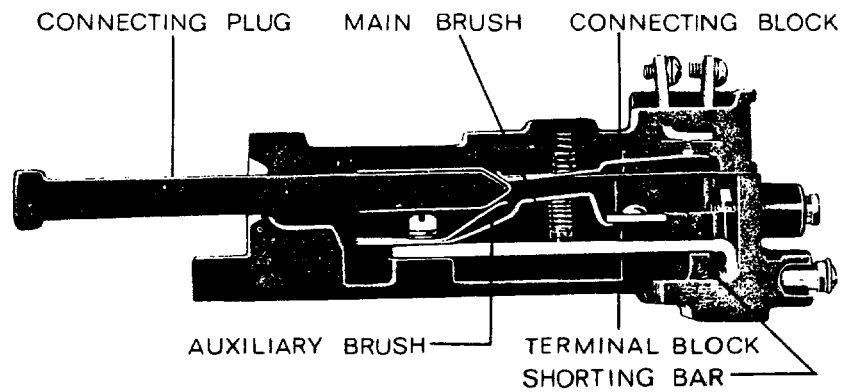


Figure 7 (8043802) Typical Surge Ground Stud Location



NOTE: AFTER ENGAGING AUXILIARY BRUSH CONNECTING PLUG TRAVELS 1/4 INCH BEFORE ENGAGING THE MAIN BRUSH ON THE TERMINAL BLOCK

Figure 8 (8025039) Removable Connection Plug

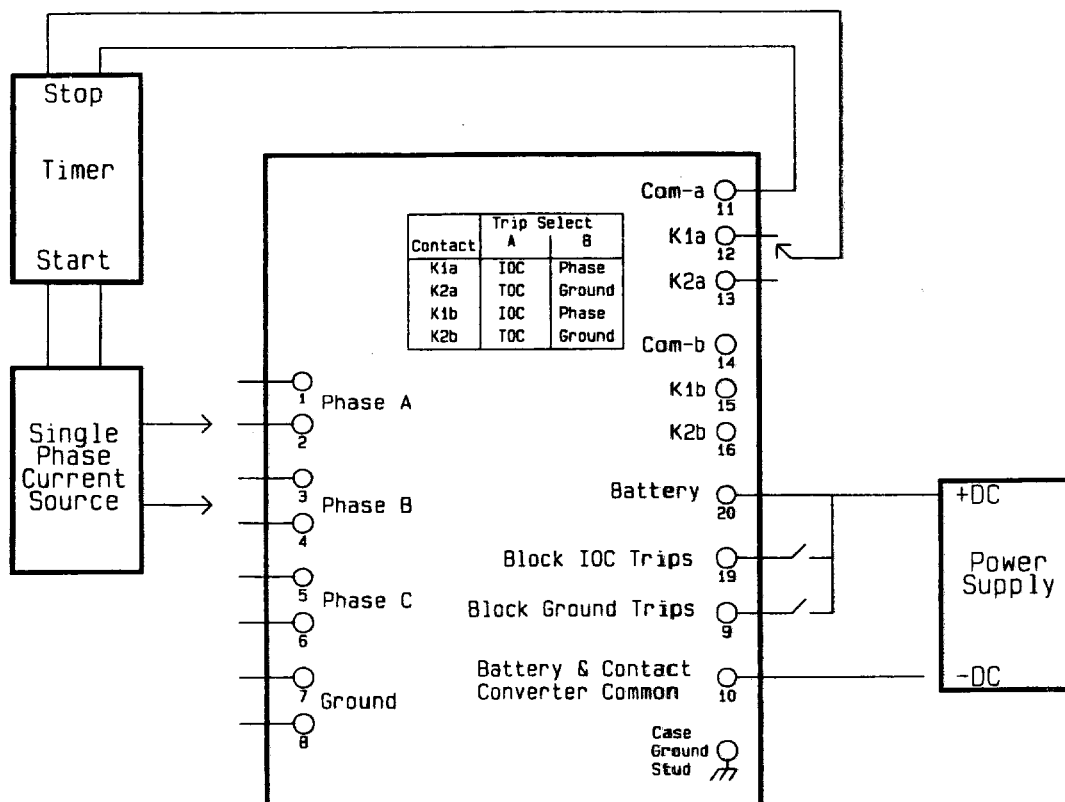


Figure 9 (0171C8792) Test Connections for the MDP201A

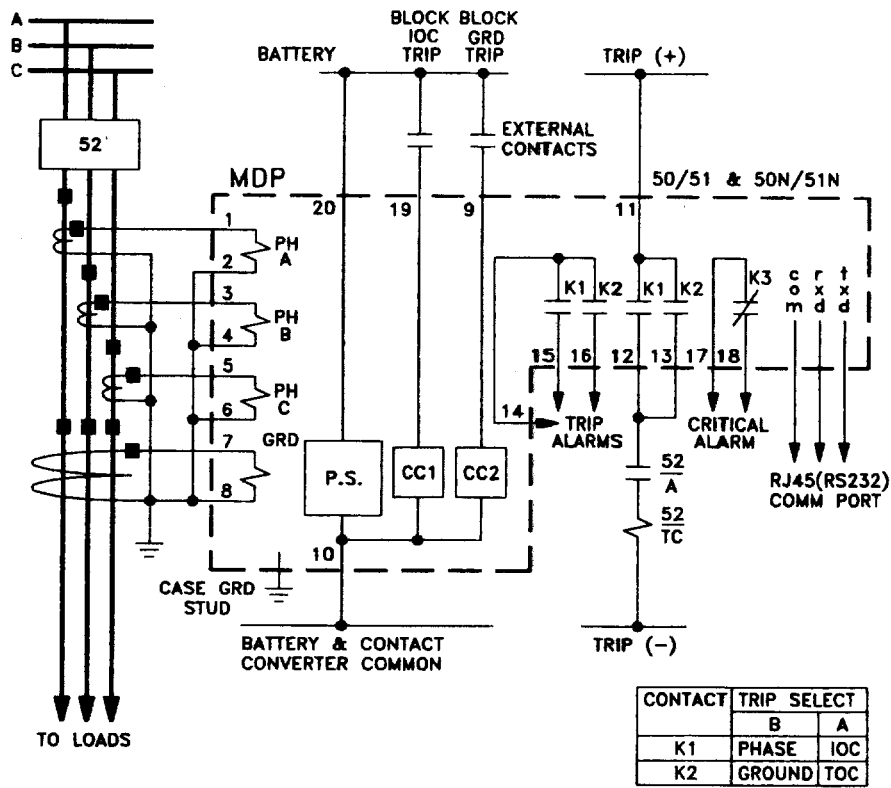


Figure 10 (0286A4857 Sh.1 [1] Typical External Connections Diagram, Ground Currents

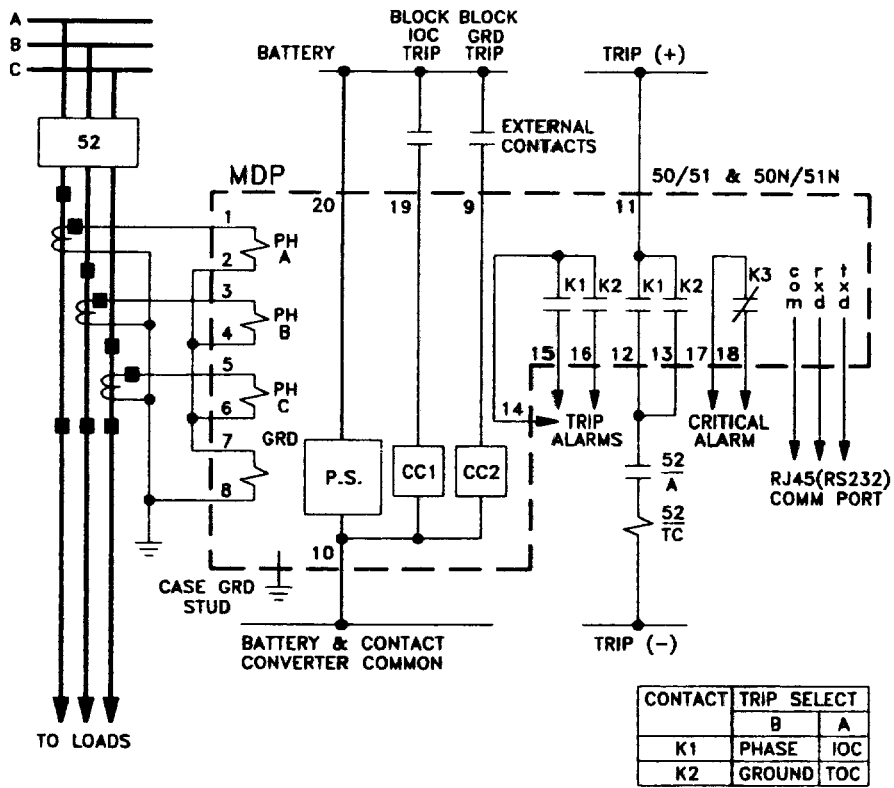
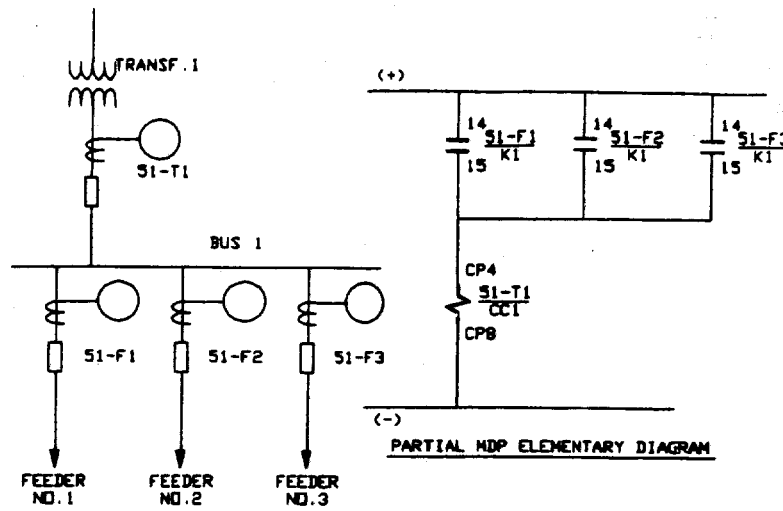


Figure 11 (0286A4857 Sh.2) Typical External Connections Diagram, Residual Currents



LEGEND

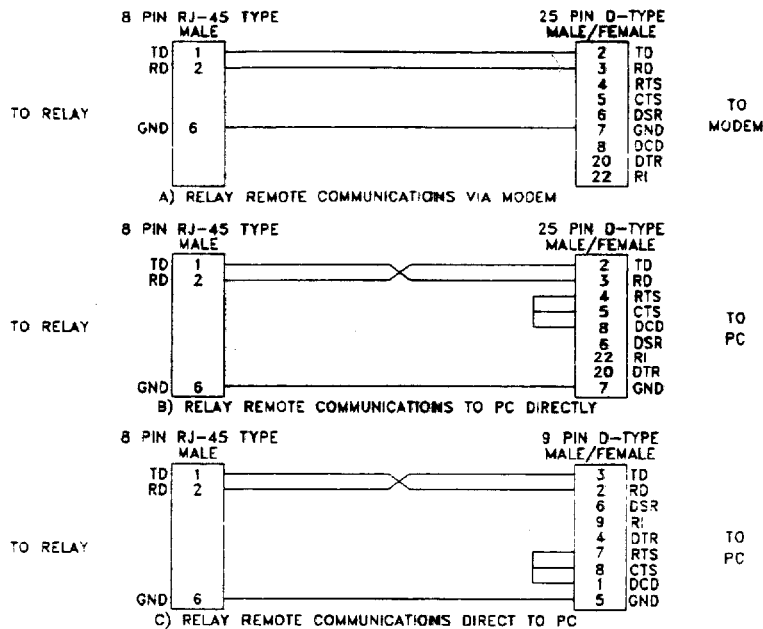
51-T1 }
 51-F1 } MDP1 OVERCURRENT RELAY WITH COMM. SOCKET.
 51-F2 }
 51-F3 }

NOTES

1-SETTING GUIDE

- (A)-51-T1 IDC DELAY=0.05 SEC.
 - (B)- $\left[\frac{\text{MINIMUM BUS FAULT CURRENT}}{\text{PICKUP}} \right] > (1.15) = \left[\frac{\text{51-T1 IDC PICKUP}}{\text{PICKUP}} \right]$
 - (C)- $(1.15) = \left[\frac{\text{51-T1 IDC PICKUP}}{\text{PICKUP}} \right] > (1.15) = \left[\frac{\text{HIGHEST OF 51-F1, F2, F3 IDC PICKUP}}{\text{PICKUP}} \right]$
 - (D)- 51-F1, F2, F3 IDC DELAY=0 SEC.
 - (E)- 51-F1, F2, F3 OUTPUT SELECT SWITCH IN POSITION 'A' (K1=IDC; K2=TOC)
- 2-ALL FEEDERS ARE RADIAL WITH NO OR VERY WEAK SOURCE

Figure 12 (0286A5817) Typical External Connections Diagram, Zone Selective Interlock



NOTE 1: SETUP MODEM TO IGNORE DTR FROM RELAY.

2: CABLES AVAILABLE UNDER GE PART NO. 0246A9866. SPECIFY CABLE TYPE AND CONNECTOR GENDER.

Figure 13 (0286A5315 [1]) Diagram of Cable Connections

GEK-100604

Protection and Control