# MDP
Digital Time Overcurrent Relay
Instruction Manual

MDP Revision: Rev. D

Manual P/N: GEK-100682D

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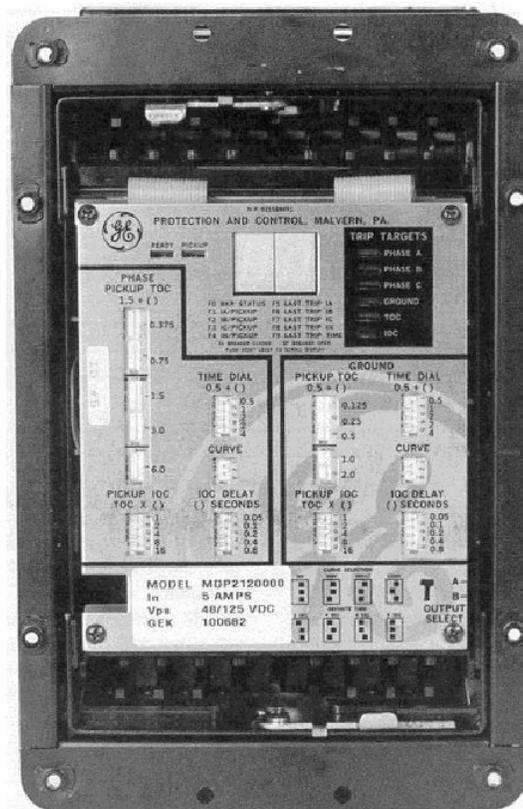
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The MDP Digital Time Overcurrent Relay is a digital, microprocessor based, nondirectional overcurrent relay that protects against phase-to-phase and phase-to-ground faults. The MDP™ performs the following functions:

- 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

- Breaker status

- Breaker operation (RS232 and RS485 versions only)

The MDP™ 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.

Table 1–1: CURRENT RANGES

NOMINAL CURRENT (In)	INVERSE TIME UNIT (Is)		INSTANTANEOUS UNIT
	PHASE	**GROUND**	
5 A	1.5 to 13.25 A	1.5 to 13.125 A	1 to 31 × Is (all relays)
		0.5 to 4.375 A	
		0.1 to 0.875 A	
	0.5 to 4.375 A	0.5 to 4.735 A	
1 A	0.3 to 2.625 A	0.3 to 2.625 A	
		0.1 to 0.875 A	
		0.05 to 0.4375 A (½ A CT)	

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 times the inverse value. The MDP relay has two trip output relays that can be selected to indicate whether a trip has been produced by

- an instantaneous unit or an inverse unit, or

- by phase or ground.

This selection is made by means of a switch behind the right lower side of the nameplate. An alarm output is provided to signal a critical alarm (such as power supply failure or self check failure). An output contact is provided to close the breaker from a command issued via the communications channel.

A single-line diagram illustrating the functionality of the MDP relay is shown on the following page. A typical wiring diagram is shown in Figure 1–2: TYPICAL WIRING DIAGRAM on page 1–3.

1
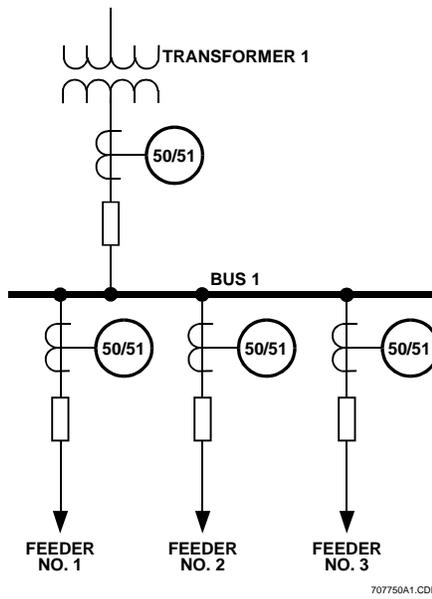
Figure 1–1: SINGLE-LINE DIAGRAM

MDP	✳	✳	✳	✳	✳	
	0					No communications or control inputs (Block Ground, Block Instantaneous, Breaker Status)
	1					Control Inputs and communications upgrade socket
	2					CommNet
	3					Modbus RTU
	4					RS232
	5					RS485
		1				5 A nominal, 0.5 to 4.375 A ground, 1.5 to 13.125 A phase
		2				5 A nominal, 1.5 to 13.125 A ground, 1.5 to 13.125 A phase
		3				5 A nominal, 0.1 to 0.875 A ground, 1.5 to 13.125 A phase
		4				1 A nominal, 0.1 to 0.875 A ground, 0.3 to 2.625 A phase
		5				1 A nominal, 0.3 to 2.625 A ground, 0.3 to 2.625 A phase
		6				1 A nominal, 0.05 to 0.4375 A ground, 0.3 to 2.625 A phase
		7				5 A nominal, 0.5 to 4.375 A ground and phase
			1			24 to 48 V DC
			2			48 to 125 V DC, 35 to 120 V AC
			3			110 to 250 V DC, 85 to 240 V AC
				00000		Reserved
					D	Revision Level

Figure 1–2: TYPICAL WIRING DIAGRAM

1
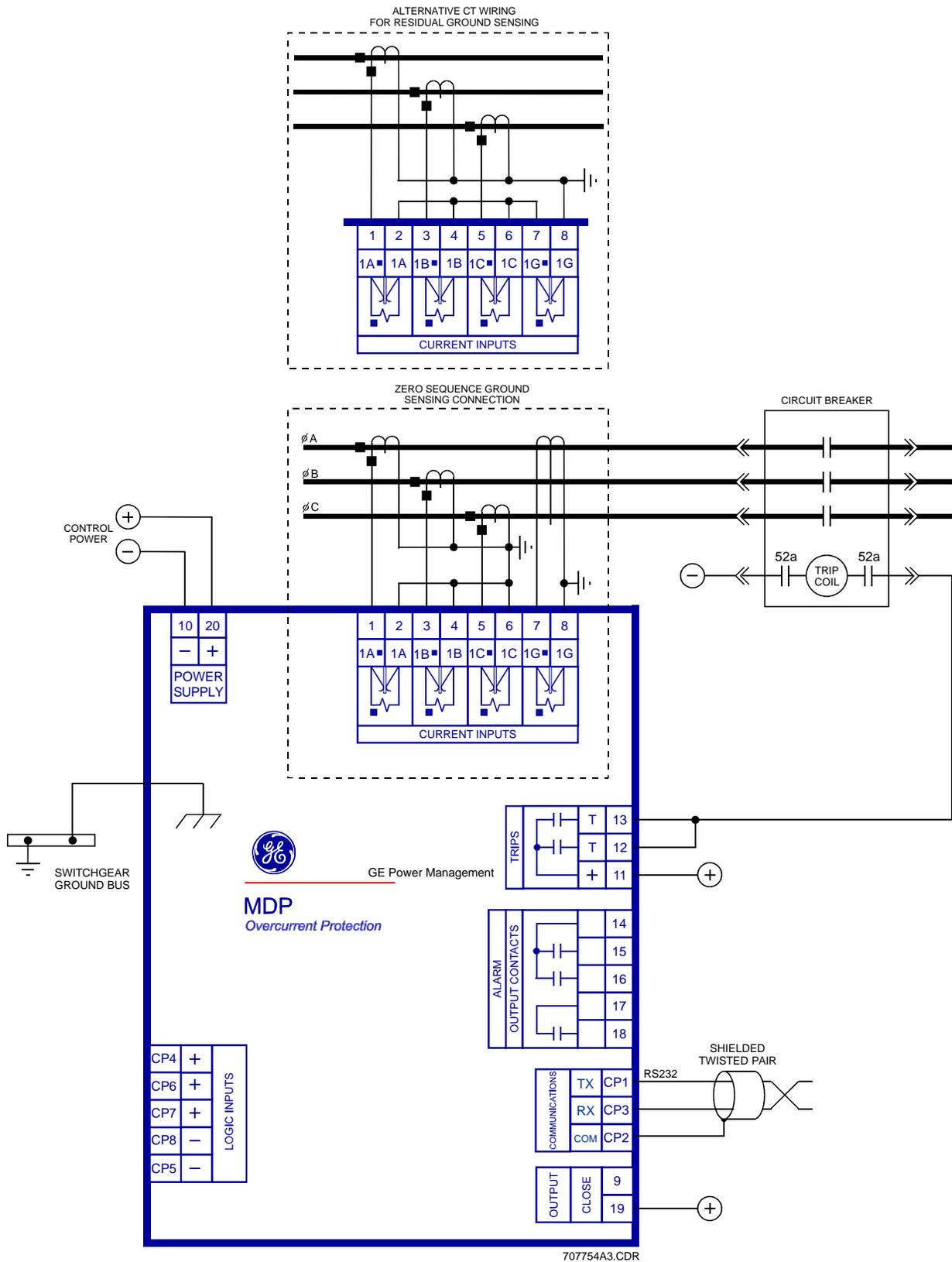
Time-overcurrent relays are used for the protection of feeders, transmission lines, alternating-current machines and transformers, and numerous other applications where accurate measurement of current and timing is necessary. To ensure proper coordination with a minimum of circuit isolation, the operating time of associated protective devices should be considered when selecting a time-current characteristic for a particular application. Four basic time-current characteristics are available for the MDP relay:

1. **INVERSE / BS142 INVERSE**: The inverse time current characteristic curves are shown in the following diagrams:

   • Figure 2–4: INVERSE TIME CURVE on page 2–5.

   • Figure 2–5: LONG INVERSE TIME CURVE on page 2–6.

   • Figure 2–8: BS142 INVERSE TIME CURVE (1 A MODELS ONLY) on page 2–9.

   The BS142 inverse curve applies to the 1 A model relays only. 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.

2. **VERY INVERSE**: The very inverse time-current characteristic shown in Figure 2–6: VERY INVERSE TIME CURVE on page 2–7 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.

3. **EXTREMELY INVERSE**: The extremely inverse time-current characteristic shown in Figure 2–7: EXTREMELY INVERSE TIME CURVE on page 2–8 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 Figure 4–2: TYPICAL EXTERNAL CONNECTIONS, GROUND CURRENTS and Figure 4–3: TYPICAL EXTERNAL CONNECTIONS, RESIDUAL CURRENTS on pages 4–2 and 4–3.

The pickup setting of the MDP time unit should be chosen so that it operates for all short circuits in the protected zone and, when possible, also provides backup protection for short circuits in the immediately adjacent system element. 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.

NOTE

> **IMPORTANT: If one unit (instantaneous or inverse) operates, the other unit (inverse or instantaneous)** *will also* **operate. The MDP fault report will record the first fault that occurred. When the fault is cleared, the fault LEDs will display Phase-Phase, Phase-Ground, Instantaneous, and Inverse Time faults. See display section on how to interpret the display for various fault conditions. The MDP generates a new fault report when the fault current drops below the pickup value and a new fault occurs.**

Contact converter input CC1 and the output select switch of the MDP allow a zone selective interlocking of the MDP relays. This scheme provides instantaneous operation (with a minimum time delay) of the upstream relay for faults between the upstream and downstream relays. Refer to Figure 4–4: TYPICAL EXTERNAL CONNECTIONS, ZONE SELECTIVE INTERLOCK on page 4–4 for a typical scheme and settings considerations. Note that all the feeders must be radial, with no (or very weak) source.

1.4 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.

1

ELECTRICAL RATINGS
Nominal frequency: 25/50/60 Hz

Nominal current: 1 or 5 A

Auxiliary Power Supply: 24 to 48 V DC, 48 to 125 V DC / 38.5 to 150 V AC, 110 to 250 V DC, 85 to 240 V AC

BURDEN RATINGS

GROUND CT	MDP MODEL[1]	PHASE INPUT	BURDEN		POWER SUPPLY AC/DC
			50 Hz AC	**60 Hz AC**	
1 A	6	0.05 to 0.4375 A			< 3 W at all voltages, quiescent < 4.5 W at maximum voltages
	4	0.1 to 0.875 A	0.09 Ω ∠2.4°	0.09 Ω ∠2.8°	
	5	0.3 to 2.625 A			
5 A	3	0.1 to 0.875 A			
	1, 7	0.5 to 4.375	0.01 Ω ∠9.7°	0.01 Ω ∠11.5°	
	2	1.5 to 13.125 A			

1. Refers to the MDP*X* model, see Section 1.2: ORDER CODES on page 1–2

OVERCURRENT RATINGS
Continuous: 2 x In

Three Second: 50 x In

One Second: 100 x In

CT RATINGS
1 A   34500

5 A   87500

1 A special   13600 (models MDPx6 have a sensitive ground CT)

ENVIRONMENTAL RATINGS
Temperature: Operating: −20°C to +65°C (−40°C available upon request)

                   Storage: −40°C to +65°C

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

DIGITAL INPUT
Voltage Range: 38.5 to 250 V AC, 24 to 250 V DC

Frequency Range: 40 to 70 Hz

OUTPUT AND TRIP CONTACTS
Closing: Contact will close and conduct up to a maximum of 30 A for tripping duty at control voltages up to 300 V DC. The output contact is also rated for Capacitive trip devices.

Interrupting: 50 W resistive with a maximum of 2 A and 300 V DC

Continuous: 5 A, with 300 V DC maximum

Frequency range: 25 to 70 Hz (note: the MDP responds to RMS values of harmonics to 600 Hz)

1

The following indicates the ranges of standard models.

NOMINAL CURRENT

5 A Phase Unit Models (models 1 to 3):

Phase Unit:	1.5 to 13.125 A in cumulative increments of 0.375, 0.750, 1.50, 3.0, and 6.0 A
Ground Unit model 1:	0.5 to 4.375 A in cumulative increments of 0.125, 0.250,0.50,1.0, and 2.0 A
Ground Unit model 2:	1.5 to 13.125 Amps in cumulative increments of 0.375, 0.750, 1.50, 3.0, and 6.0 A
Ground Unit model 3:	0.1 to 0.875 Amp in cumulative increments of 0.025, 0.050, 0.10, 0.2, and 0.4 A

5 A Phase Unit Model (model 7):

Phase Unit:	0.5 to 4.375 A in cumulative increments of 0.125, 0.25, 0.50, 1.0, and 2.0 A
Ground Unit:	0.5 to 4.375 A in cumulative increments of 0.125, 0.250, 0.50, 1.0, and 2.0 A

1 A Phase Unit (models 4 to 6):

Phase Unit:	0.3 to 2.625 A in cumulative increments of 0.075, 0.150, 0.30, 0.60, and 1.20 A
Ground Unit model 4:	0.1 to 0.875 A in cumulative increments of 0.025, 0.050, 0.10, 0.2, and 0.4 A
Ground Unit model 5:	0.3 to 2.625 A in cumulative increments of 0.075, 0.150, 0.30, 0.6, and 1.2 A
Ground Unit model 6:	0.05 to 0.4375 A in cumulative increments of 0.0125, 0.0250,0.050,0.1, and 0.2 A

TIME DELAY (TOC)

Independent for phase and ground.

Depends on the curve selected. Five Inverse Time curves are available (see Section 2.5: INVERSE TIME UNIT on page 2–3), as well as four definite times (maximum time 2, 4, 6, and 8 seconds), all in the same relay.

INSTANTANEOUS UNIT PICKUP

Independent for phase and ground.

1 to 31 times the pickup of the TOC setting.

A setting of zero (0) disables instantaneous unit. (X) no multiples selected.

INSTANTANEOUS UNIT TIME DELAY

Independent for phase and ground.

0 to 1.55 seconds in 50 millisecond steps.

PHASE OPERATING CURVES CURVE SELECTION

Available Curves: Inverse/BS142* (for 1 A models), Long Time Inverse, Very Inverse, 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 in cumulative steps of 0.5, 1, 2, 2 and 4 for 5 a relays. The 1 A model range is from 0.05 to 1.0 in cumulative steps of 0.05, 0.1, 0.2, 0.2, and 0.4.

GROUND OPERATING CURVES CURVE SELECTION

Available Curves: Inverse/BS142* (for 1 A models), Long Time Inverse, Very Inverse, 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 in cumulative steps of 0.5, 1, 2, 2, and 4 for 5 amp relays. A 1 amp model's range is from 0.05 to 1.0 in cumulative steps of 0.05, 0.1, 0.2, 0.2, and 0.4.

> **NOTE** **BS142 is the INVERSE curve of the 1 A model.**

COMMUNICATIONS ADDRESS

Range: 002 to 998.

A setting of 000 indicates no communications and sets the default display to phase A Current.

> **NOTE** **For RS232 and RS485 all relays will respond to address 001.**

> **NOTE** **All values are adjusted with DIP switches located at the front of the relay, except the communications address, which is located on the rear of the cradle.**

1

The secondary current from the protected line current transformers is connected to the relay and immediately reduced via the internal current transformers. The MDP CT secondaries 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 multiplexer and analog-to-digital converter, which are internal to the microprocessor.

2

Three external inputs (CP4, CP6, and CP7) are provided.

*   CP4 – Block IOC Trip: when energized, blocks tripping by the ground units.

*   CP6 – Block Ground Trip: blocks the phase and ground instantaneous trip elements when it is energized.

*   CP7 – Breaker Status Input: when energized, indicates that the Breaker Status is "closed".

Since diode bridges are provided on all inputs, they can all be actuated by either switched-to-positive or switched-to-negative, depending on the polarity connected to the stud. These inputs can be energized by either AC or DC.

> **NOTE**
> The Breaker Status and Block Ground inputs, CP7 and CP6 respectively, must be switched by the same polarity, since they share a common ground (CP8).

The MDP relay has a communications feature that permits easy installation of various communications interface modules. The procedure for installation/replacement of a communications upgrade card is provided below:

1. To install or replace a communications upgrade card, begin by removing the relay from the case.

2. Before continuing, connect an approved wrist grounding strap to ground. This discharges any static electricity in your body that could damage the electronics of the MDP relay. A wrist strap is provided with the communications card kit. The wrist strap must provide a "safe" high resistance to ground.

3. Remove four screws attaching the nameplate settings board and the NOMEX insulation paper to the relay cradle (see the cover photograph). Note that there are four metal spacers between the nameplate and the settings board. Be careful not to lose them or let them fall into the relay assembly. Carefully place the settings board on top of the cradle to expose the communication card SIMM socket located on the lowest board (digital input/communications board).

4. To expose the SIMM socket located on the lowest board, carefully push down on the board to disengage the board spacers. Do not try to remove the board from the cradle

5. This step is for replacement only – skip to step 6 if you are installing the card for the first time. If you are replacing an existing SIMM card, the old one must be removed! Start by simultaneously pushing the catches on either side of the SIMM board outwards while lifting the board to a 45° angle. This will release the board.

2

6. Remove the communications card from its protective packaging. Insert the card into the SIMM socket at a 45° angle to the socket with the integrated circuits facing up. Push the card down until it snaps into the socket and the latches on either side of the board catch above the new board
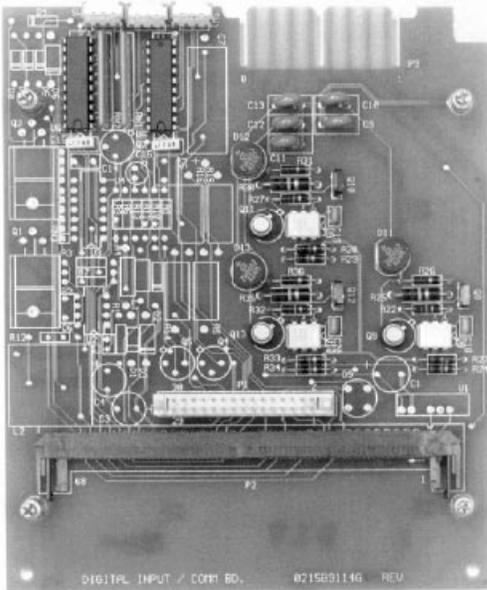
Without Communications Upgrade Card   Communications Upgrade Card Installed
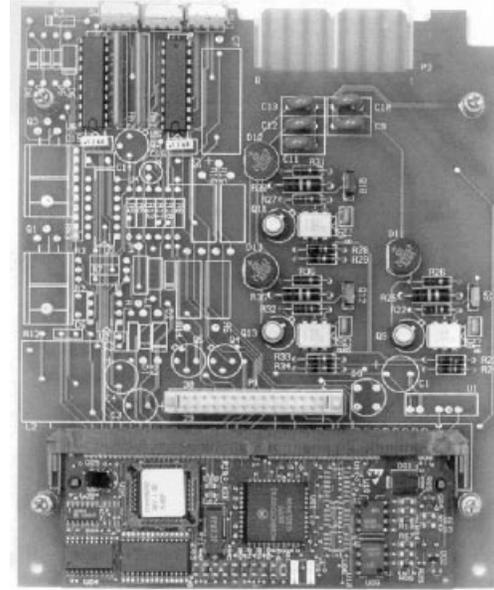
Figure 2–1: DIGITAL INPUT/COMMUNICATIONS BOARD

7. Reassemble the MDP relay by engaging the board spacers of the lowest board (digital input/communications board) into the processor board above it. Align the NOMEX shield on the solder side of the settings board. Take one screw and spacer at a time and push the screw through the nameplate, spacer, settings board and NOMEX. The NOMEX protects the ribbon cable from the leads on the settings board.
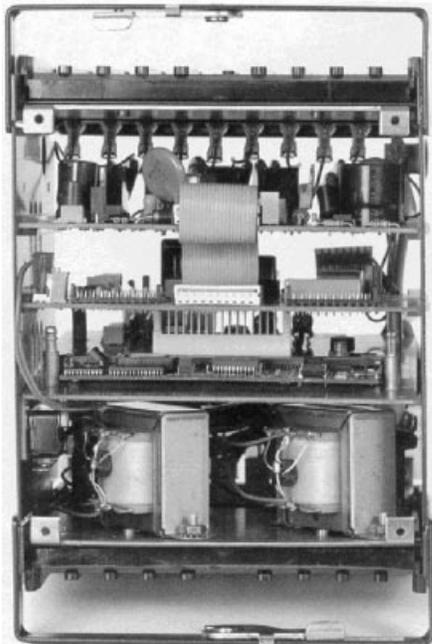
Before DI/Comm Board is Raised Back into Position   With DI/Comm Board in Position
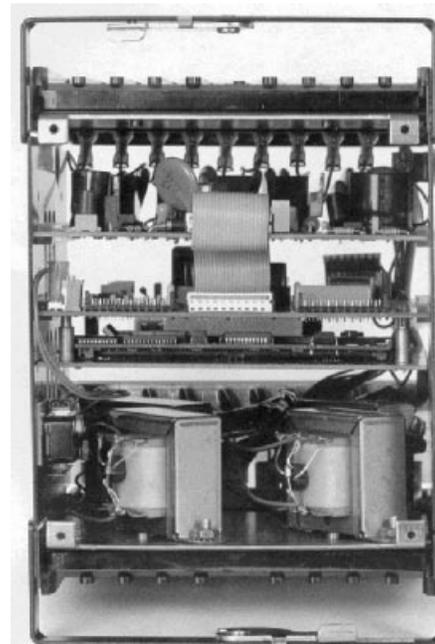
Figure 2–2: COMMUNICATIONS CARD INSTALLED

8.   Tighten the screw just enough to hold the assembly in place until all four screws are aligned. When all the screws are aligned, tighten them with gentle pressure so that the board is mounted evenly.

9.   **SET THE COMMUNICATIONS ADDRESS** before restoring the cradle to the case.
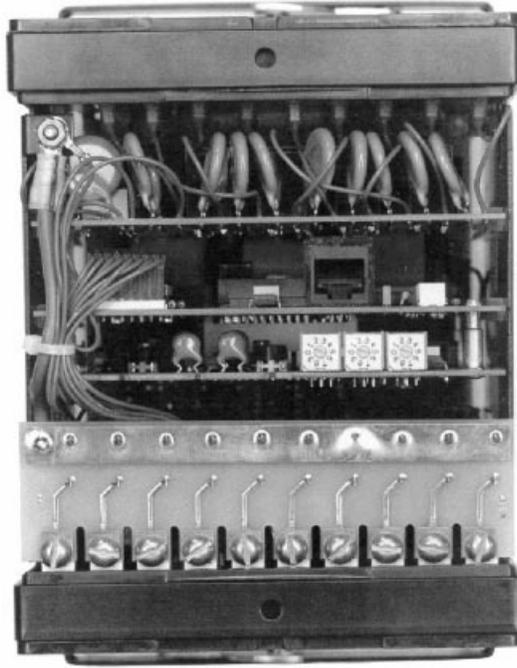
Figure 2–3: REAR VIEW SHOWING COMMUNICATION ADDRESS SWITCHES

2.4 MEASUREMENT

A timer internal to the microprocessor generates an interrupt every millisecond. 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 a multiple of pickup TOC, the format used by the relay. This value is displayed in 5 second intervals.

2.5 INVERSE TIME UNIT

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

The minimum current necessary to operate the Inverse Time measuring elements is never less than the set value (I_s), 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 relay incorporates five inverse time curves and four definite times. The curve within a family is selected by the time dial. The characteristic curves for the MDP relay correspond approximately as follows.

a) 51 INVERSE (5 A RATED RELAYS)

For 1.1 to 4 times the pickup TOC: $\quad T = \left(\dfrac{0.0059}{P^{0.001} - 1} + 0.419 \right) \times \text{Time Dial} + 0.018$

For 4 to 31 times the pickup TOC: $\quad T = \left(\dfrac{0.0069}{P^{0.001} - 1} - 0.252 \right) \times \text{Time Dial} + 0.018$

See Figure 2–4: INVERSE TIME CURVE on page 2–5.

b) BS142 INVERSE (1 A RATED RELAYS)

For 1 to 31 times the pickup TOC: $\quad T = \left(\dfrac{0.14}{P^{0.02} - 1} \right) \times \text{Time Dial} + 0.018$

See Figure 2–8: BS142 INVERSE TIME CURVE (1 A MODELS ONLY) on page 2–9.

c) 53 VERY INVERSE

For 1.1 to 4 times the pickup TOC: $\quad T = \left(\dfrac{52.954}{P^{2.11} - 1} + 0.923 \right) \times \text{Time Dial} + 0.018$

For 4 to 31 times the pickup TOC: $\quad T = \left(\dfrac{28.447}{P^{1.702} - 1} + 1.007 \right) \times \text{Time Dial} + 0.018$

See Figure 2–6: VERY INVERSE TIME CURVE on page 2–7

d) 77 EXTREMELY INVERSE

For 1.1 to 20 times the pickup TOC: $T = \left(\dfrac{58.132}{P^{2.135} - 1} + 0.166 \right) \times \text{Time Dial} + 0.020$

See Figure 2–7: EXTREMELY INVERSE TIME CURVE on page 2–8.

e) 66 INVERSE LONG TIME

For 1.1 to 3 times the pickup TOC: $\quad T = \left(\dfrac{0.0006}{P^{0.00001} - 1} + 5.644 \right) \times \text{Time Dial}$

For 3 to 5 times the pickup TOC: $\quad T = \left(\dfrac{0.746}{P^{0.01} - 1} - 5.630 \right) \times \text{Time Dial}$

For 5 to 20 times the pickup TOC: $\quad T = \left(\dfrac{0.00085}{P^{0.00001} - 1} - 12.530 \right) \times \text{Time Dial}$

For 20 to 31 times the pickup TOC: $\quad T = \left(\dfrac{250 - 4.5 \times P}{10} \right) \times \text{Time Dial}$

See Figure 2–5: LONG INVERSE TIME CURVE on page 2–6.

For all the above equations:

T = time in seconds
P = multiple of pickup TOC
$\text{Time Dial} = \dfrac{\text{Time Dial Setting}}{10}$ for 5 A rated unit
$= \text{Time Dial Setting for 1 A rated unit}$

Figure 2–4: INVERSE TIME CURVE

2

Figure 2–5: LONG INVERSE TIME CURVE

2

Figure 2–6: VERY INVERSE TIME CURVE

2
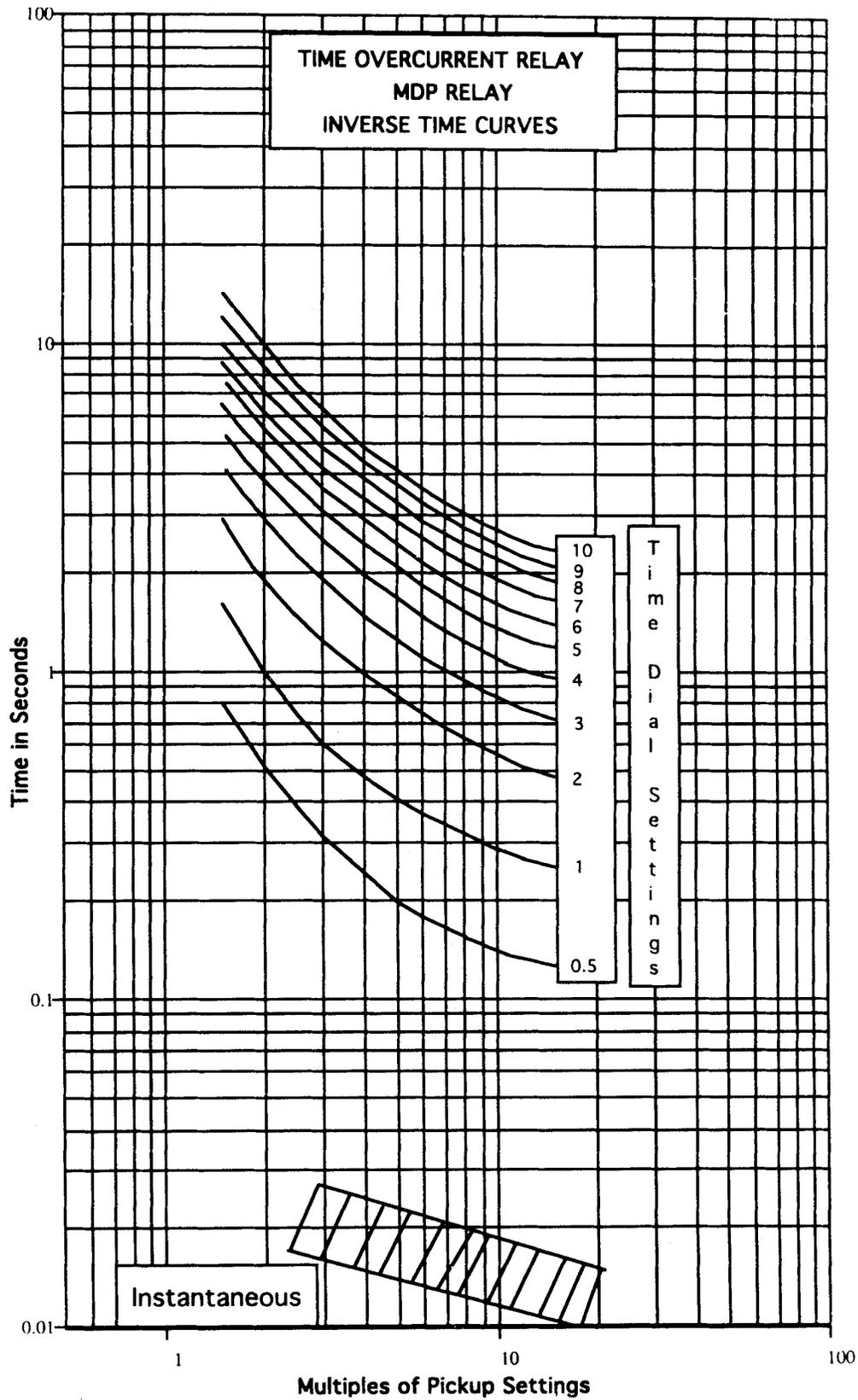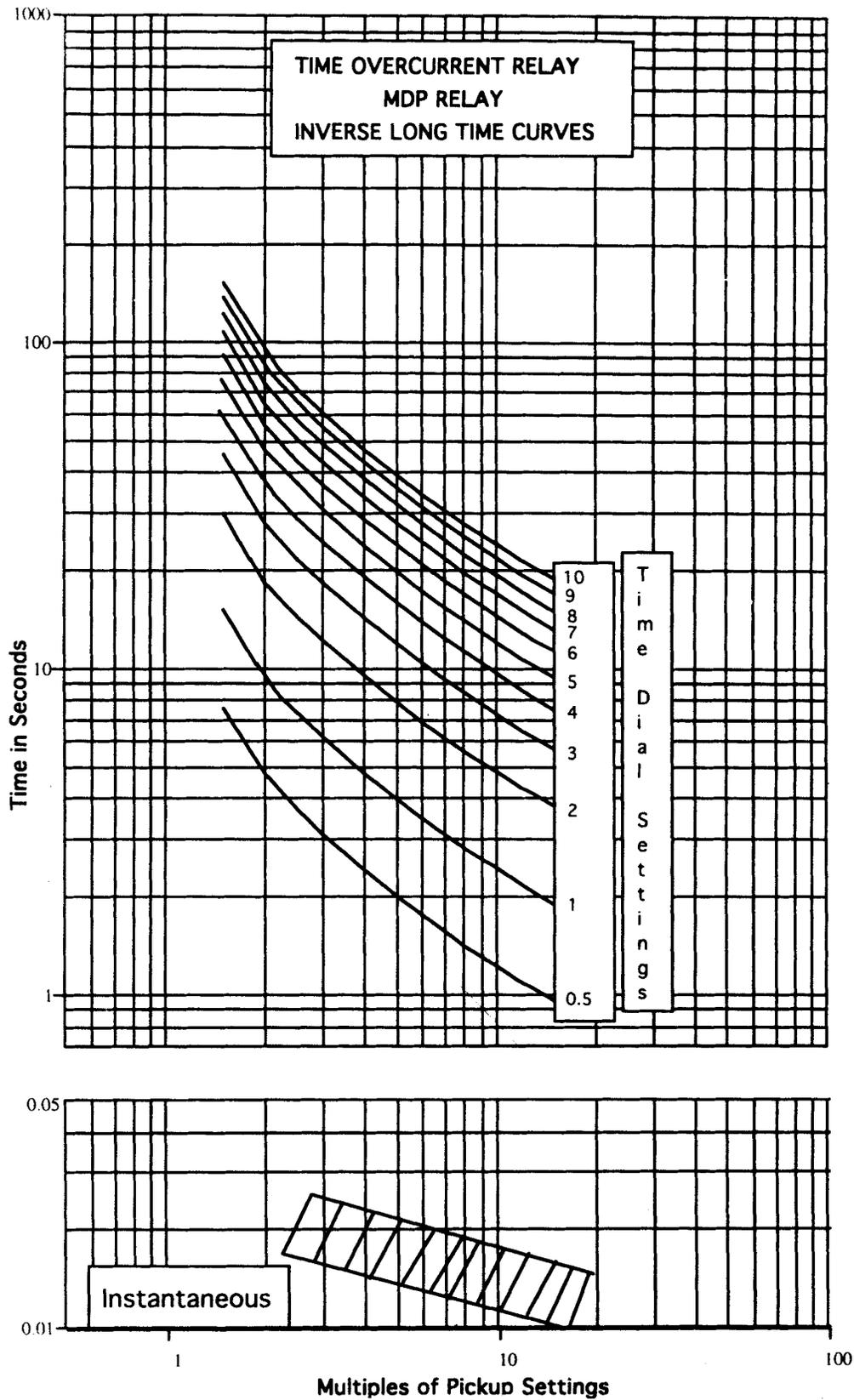
Figure 2–7: EXTREMELY INVERSE TIME CURVE
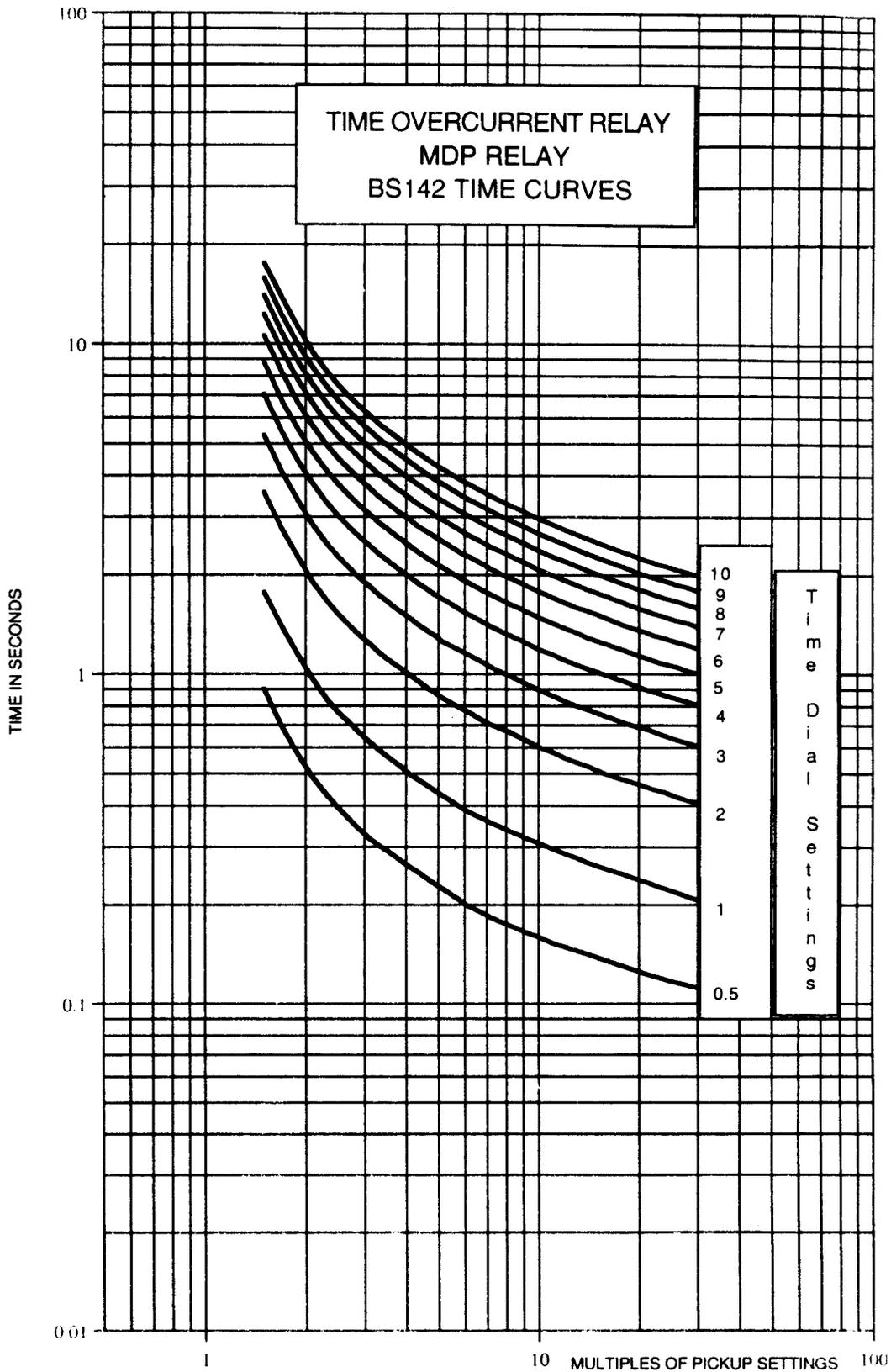
Figure 2–8: BS142 INVERSE TIME CURVE (1 A MODELS ONLY)

2

The multiple of pickup TOC measurement is compared, independently for each phase and ground, with a user set value. If the set value is exceeded, a Pickup LED is turned on and a user programmable timer is started. When the timer times out, the relay trips and a Trip LED is turned on. 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 steps of 50 ms steps. The instantaneous unit can be disabled by setting the trip value multiplier to zero.

2.7 CHANGING SETTINGS

⚠ **WARNING**
DO NOT CHANGE SETTINGS WHILE THE MDP IS IN OPERATION AND ITS PROTECTIVE ELEMENTS IN USE. TAKE THE RELAY OUT OF SERVICE BEFORE MAKING ANY SETTING CHANGES.

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 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 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 minutes, then it will accept the new settings and self-initialize.

NOTE
Pickup current setting changes take effect immediately, altering the TOC and IOC elements, and could cause the relay to trip; this is unlike other types of changes, where the flashing of the Ready LED indicates that a change has been made but not yet finalized. Initializing the relay by pressing the reset lever will return the Ready LED to an ON condition.

2

a) 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 5 A rated relay would be:

base of $1.5 + 0.75 + 1.5 + 6$ A $= 9.75$ A

b) 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 A set above, this would result in an IOC pickup of 58.5 A.

c) TIME DIAL

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

d) CURVE SELECTION

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

CURVE	FIRST (TOP)	SECOND (MIDDLE)	THIRD (BOTTOM)
Inverse / (BS142) Inverse [1]	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

1. For 1 A models, the inverse curve is defined by BS142

The time delay of the definite time curve is the range times the time dial for 1 A relays and the range times the time dial divided by 10 for 5 A 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, that is:

Time Dial $=$ base of $0.05 + 0.05 + 0.2 + 0.2$ A $= 0.5$ A [1 A]

or

Time Dial $=$ base of $0.5 + 0.5 + 2 + 2$ A $= 5$ A [5 A]

The 6 second curve would be chosen with the curve switches left, left, and right. The time delay is 6 (curve) times 0.5 (time dial) = 3 seconds for 1 A relays. For 5 A relays, the time dial (5) is divided by 10, also resulting in a 3 second delay.

e) IOC DELAY

The Instantaneous unit can be delayed from 0.05 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 0.2 + 0.8 = 1 second.

f) COMMUNICATIONS ADDRESS

The address for the communications port is set via three rotary switches on the rear of the cradle unit. A setting of 000 indicates no communications card is installed and disables the breaker status display. If breaker status is desired and there is no communications card installed, any address other than 000 or 999 may be set. See Figure 2–3: REAR VIEW SHOWING COMMUNICATION ADDRESS SWITCHES on page 2–3 for the location of the communication address switches.

All MDP relays with the RS232 or RS485 protocol will respond to address 001.

NOTE

g) OUTPUT CONTACT CONFIGURATION

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

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.

CONTACT	STUDS	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

The MDP relays are provided with 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:

- **.0.0**   Equipment in Service
- **.0.1**   Internal settings are different from the external settings
- **80**   Fatal flaw
- **CL**   Breaker closed
- **OP**   Breaker open

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

- **F0**   Current Breaker status (open, closed)
- **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.

The two-digit display can show a maximum operating time of 99 seconds. When the time exceeds 99 seconds, the MDP begins again from zero (0) with both decimal points lit to indicate the initial 100 units. If the time exceeds 199 seconds, the display shows 99 with 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.

2.10 SELF-TEST AND ERROR ROUTINES

2

When the MDP relay 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 reenergized. 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 relay 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 relay incorporates a WATCHDOG TIMER monitoring system for the program.

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 to permit testing the relay in its case, as shown below. 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.
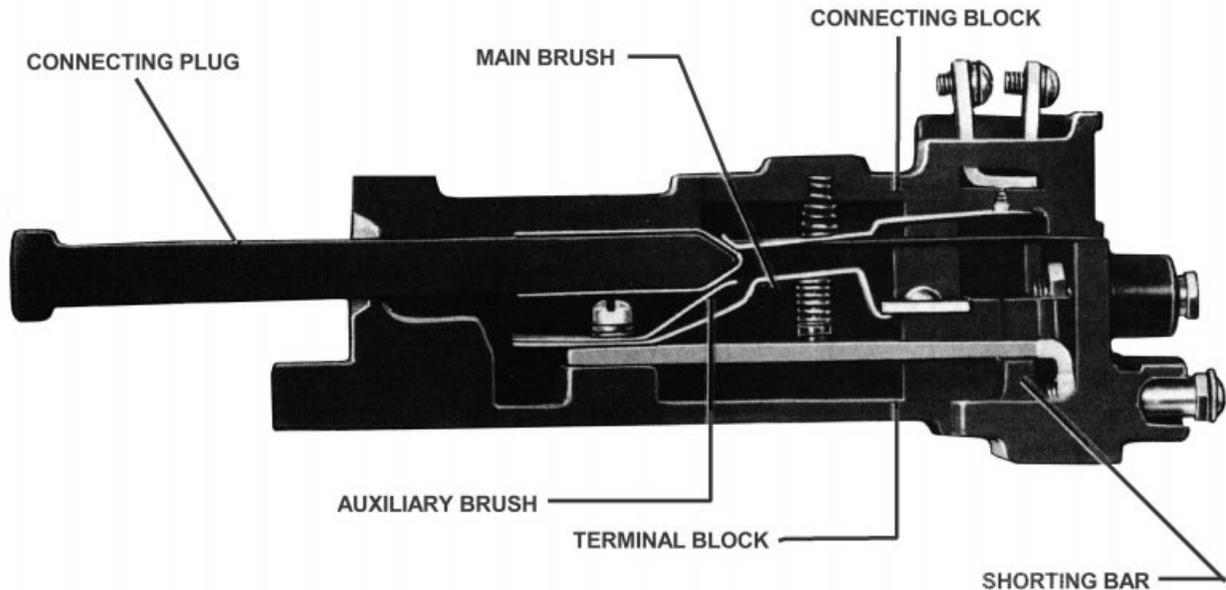
NOTE: After engaging auxiliary brush, connecting plug travels ¼-inch before engaging the main brush on the terminal block

Figure 3–1: REMOVABLE CONNECTION PLUG

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.

An internal connection diagram for the MDP is shown on the following page.

3
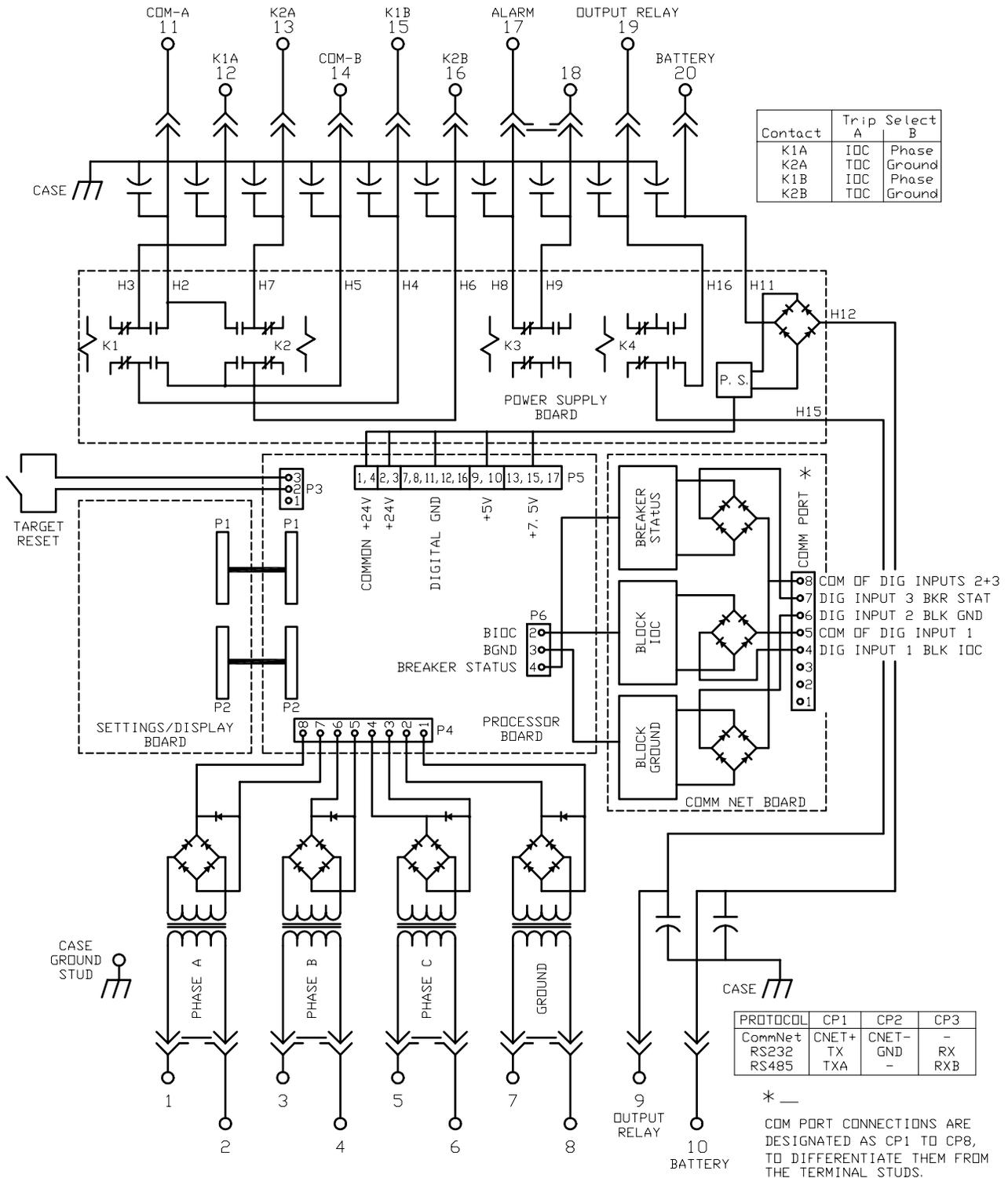
Figure 3–2: INTERNAL CONNECTIONS DIAGRAM

The MDP relay has eight light-emitting diodes (LEDs) at the top of 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.

LED combinations are defined as follows:

- Single Phase and Ground red LED indicates phase to ground fault.

- Two Phase red LEDs indicate Phase to Phase fault.

- Three Phase red LEDs indicate Three Phase fault.

- Three Phase and Ground red LEDs indicate three phase to ground fault.

- 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.

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.

3

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. An outline and panel drilling diagram is shown below. External connection schemes on the following pages.

4
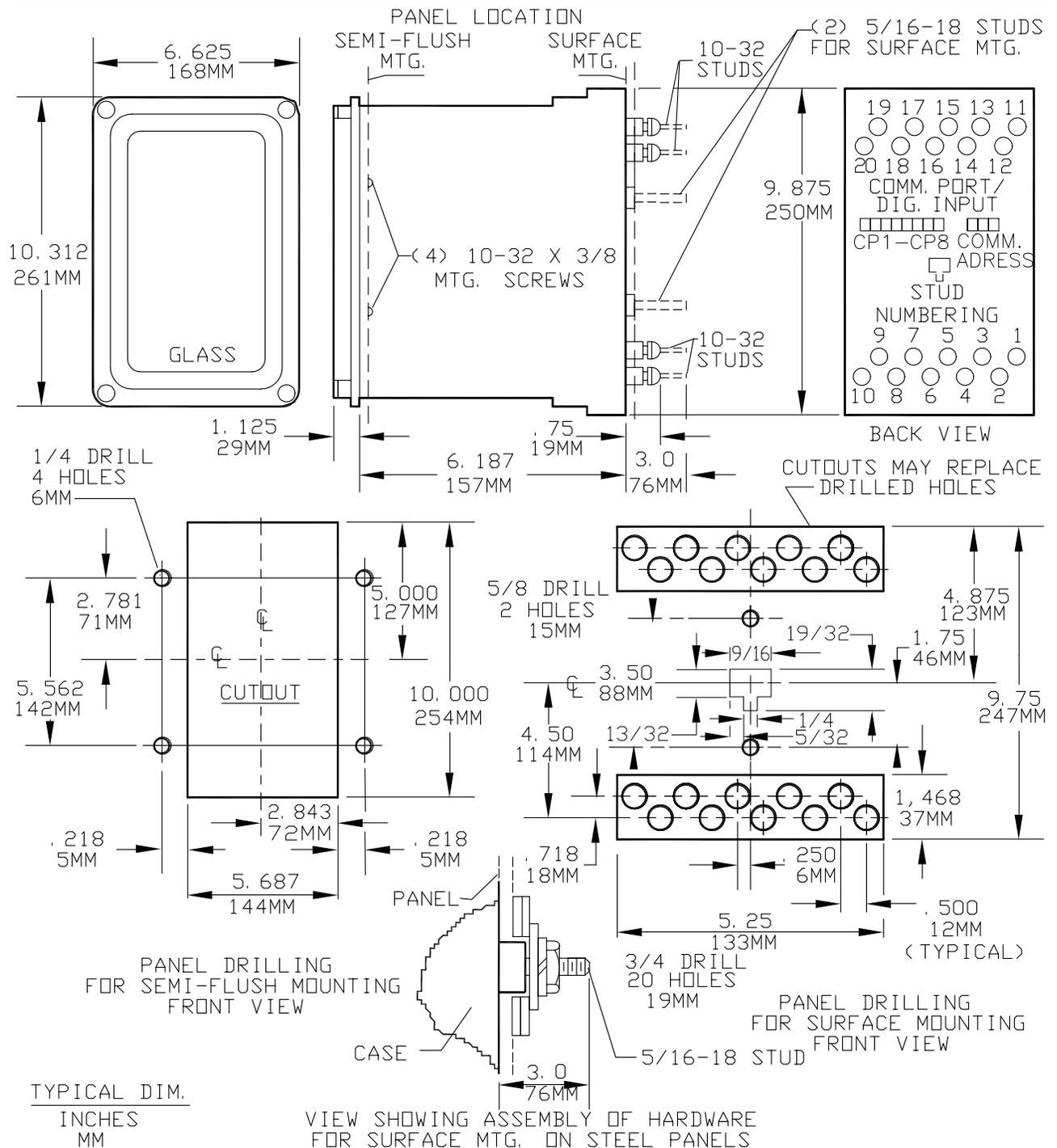
Figure 4–1: OUTLINE AND PANEL DRILLING

4

Figure 4–2: TYPICAL EXTERNAL CONNECTIONS, GROUND CURRENTS

Figure 4–3: TYPICAL EXTERNAL CONNECTIONS, RESIDUAL CURRENTS
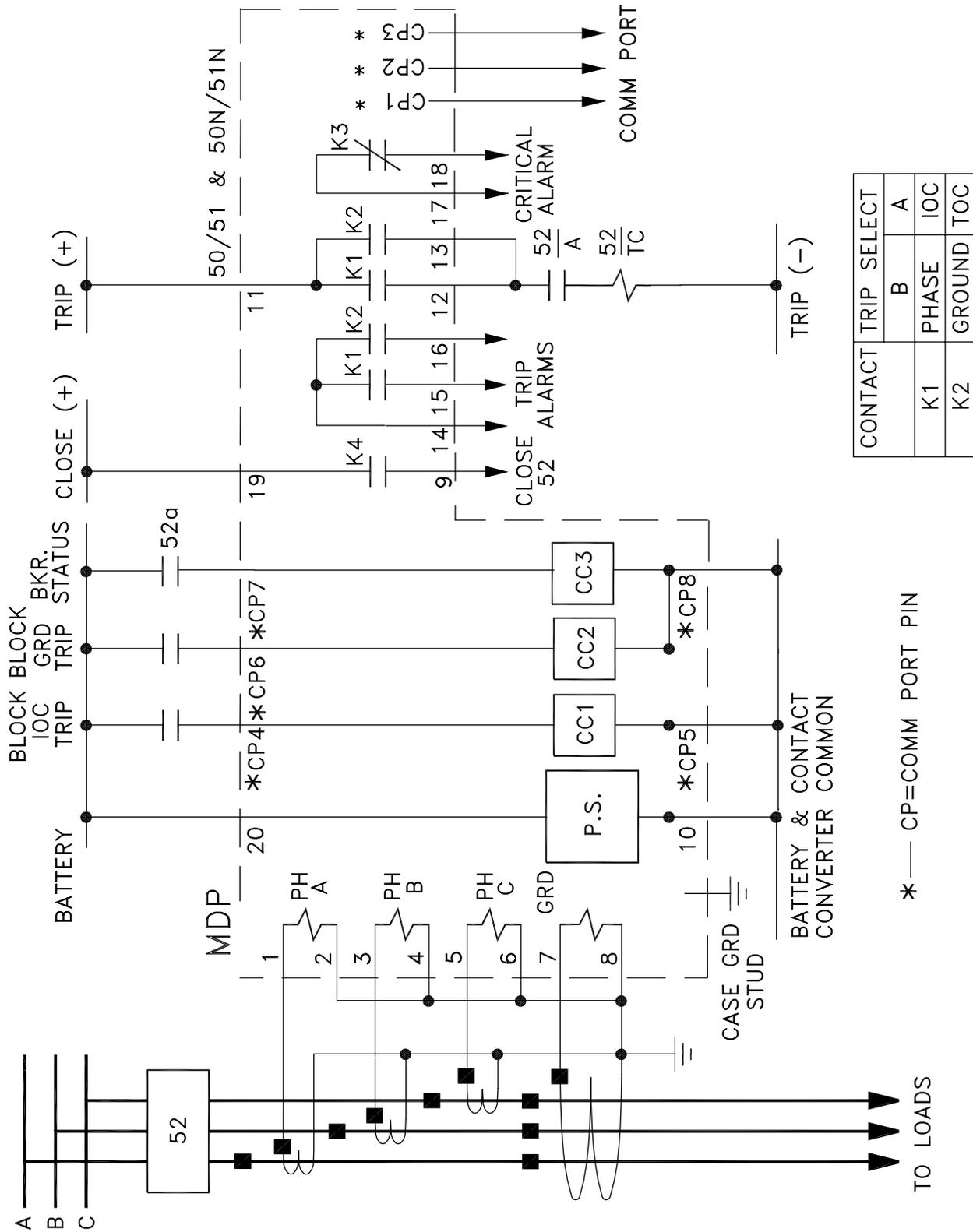
CONTACT	TRIP SELECT	
	B	A
K1	PHASE	IOC
K2	GROUND	TOC

4
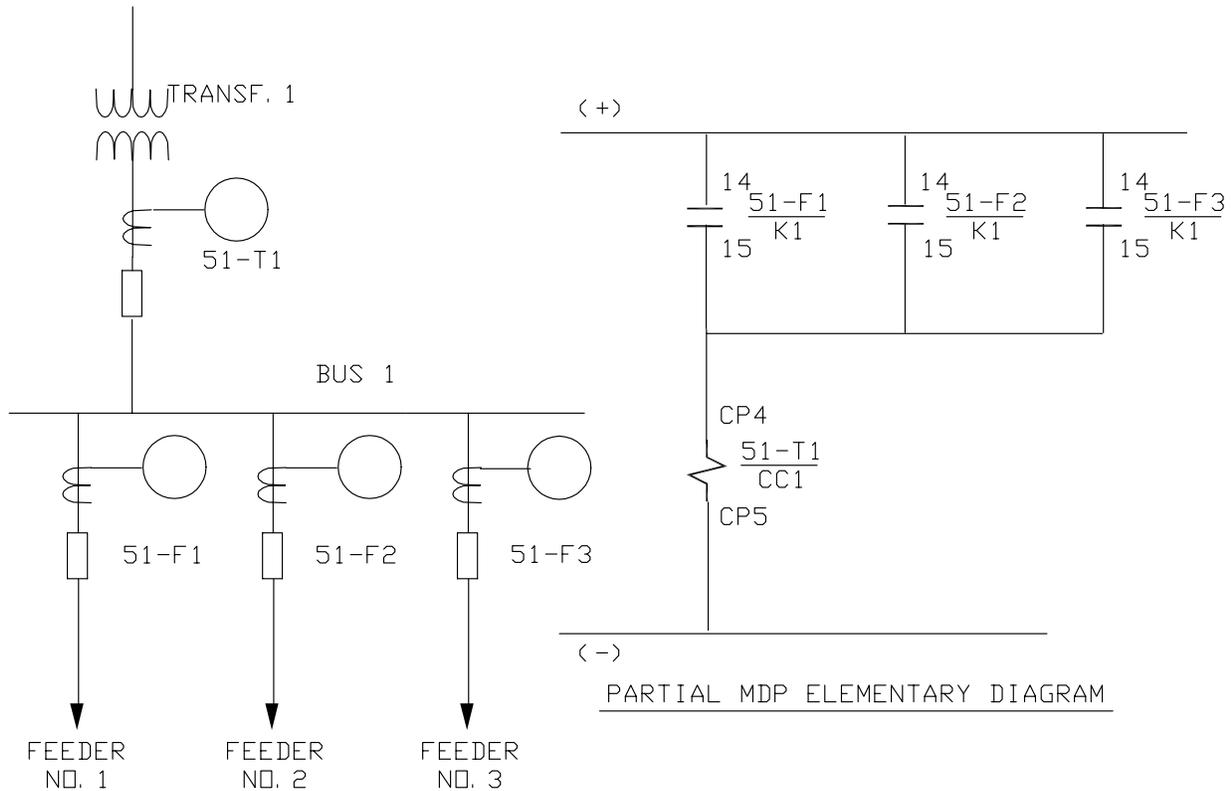
LEGEND

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

NOTES

1-SETTING GUIDE
 (A)-51-T1 IOC DELAY=0.05 SEC.

 (B)- $\begin{bmatrix} \text{MINIMUM} \\ \text{BUS FAULT} \\ \text{CURRENT} \end{bmatrix} \geqslant (1.15) * \begin{bmatrix} \text{51-T1 IOC} \\ \text{PICKUP} \end{bmatrix}$

 (C)- $(1.15) * \begin{bmatrix} \text{51-T1 IOC} \\ \text{PICKUP} \end{bmatrix} \geqslant (1.15) * \begin{bmatrix} \text{HIGHEST OF} \\ \text{51-F1,F2,F3 IOC} \\ \text{PICKUP} \end{bmatrix}$

 (D)- 51-F1,F2,F3 IOC DELAY=0 SEC.

 (E)- 51-F1,F2,F3 OUTPUT SELECT SWITCH IN POSITION "A"(K1=IOC;K2=TOC)
2-ALL FEEDERS ARE RADIAL WITH NO OR VERY WEAK SOURCE

Figure 4–4: TYPICAL EXTERNAL CONNECTIONS, ZONE SELECTIVE INTERLOCK

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. See Chapter 5: PERIODIC & ACCEPTANCE TESTS for periodic testing using your settings.

4

4

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.

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.

a) PHASE PICKUP CALIBRATION VERIFICATION

1.   Set the switch on the front of the relay so the output relays correspond to phase or ground (Position B).

2.   Connect the relay as indicated in the figure below. 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.

Contact	Trip Select A	B
K1a	IOC	Phase
K2a	TOC	Ground
K1b	IOC	Phase
K2b	TOC	Ground
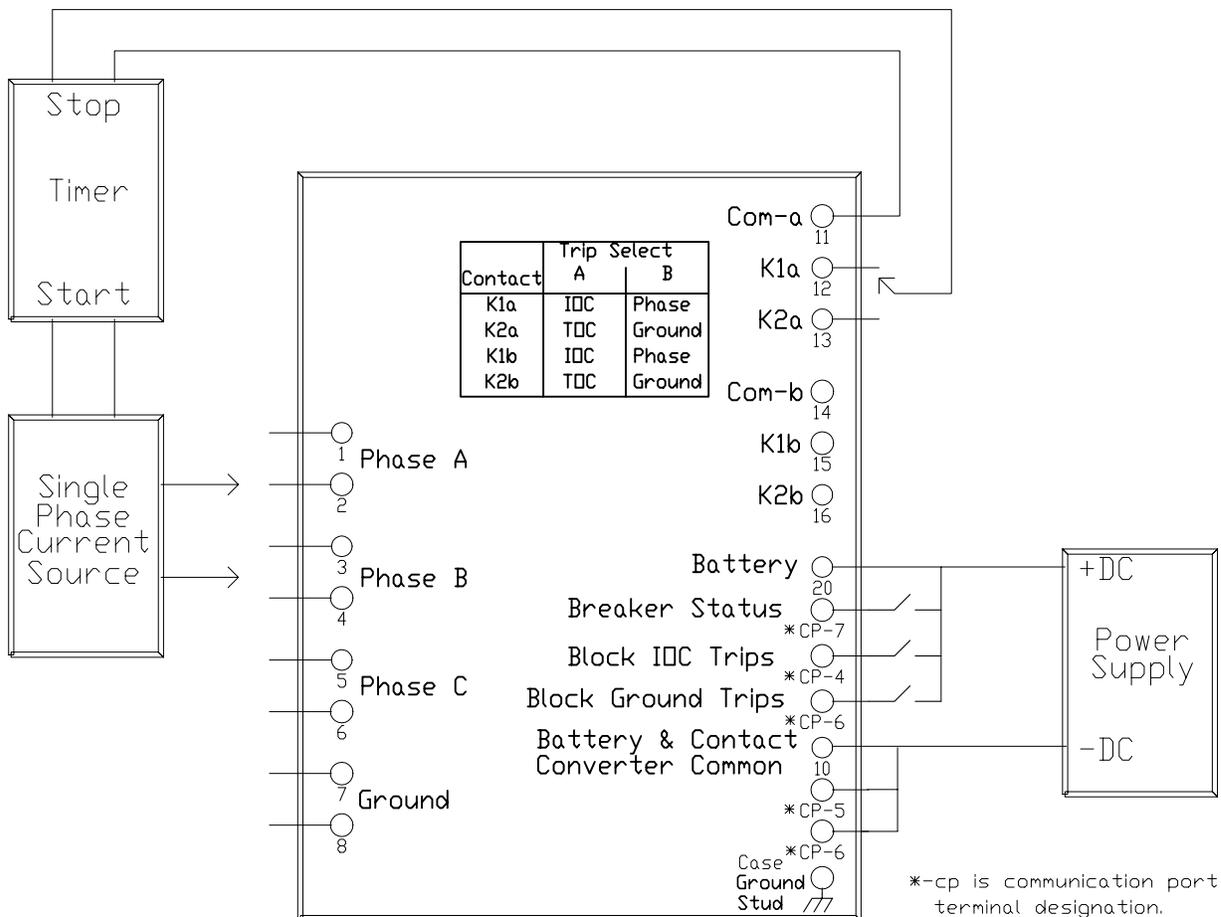
Figure 5–1: TEST CONNECTIONS

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

4. 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.

5. 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.

b) VERIFICATION OF OPERATING TIME

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

2. 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 the table below.

Table 5–1: INVERSE CHARACTERISTIC OPERATING TIMES

TIMES PICKUP TOC	OPERATING TIMES (in seconds)				
	INVERSE (ANSI)	INVERSE (BS142)	VERY INVERSE	LONG TIME INVERSE	EXTREMELY INVERSE
2	4.28 to 4.73	0.49 to 0.55	8.03 to 8.87	44.8 to 49.5	8.24 to 9.11
5	1.93 to 2.13	0.21 to 0.25	1.43 to 1.58	19.3 to 21.3	1.02 to 1.13
10	1.32 to 1.45	0.15 to 0.18	0.77 to 0.85	11.7 to 12.9	0.30 to 0.33

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

c) VERIFICATION OF TIME DIAL

1. 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 the tables below.

Table 5–2: TIME DIAL VERIFICATION – INVERSE TIME

TIME DIAL 5 A (1 A)	OPERATING TIMES (in seconds)				
	INVERSE (ANSI)	INVERSE (BS142)	VERY INVERSE	LONG TIME INVERSE	EXTREMELY INVERSE
10 (1)	3.84 to 4.24	4.08 to 4.51	2.84 to 3.14	38.6 to 42.7	2.02 to 2.23
7 (0.7)	2.69 to 2.98	2.86 to 3.16	2.00 to 2.20	27.0 to 29.9	1.42 to 1.57
3 (0.3)	1.16 to 1.29	1.24 to 1.37	0.86 to 0.96	11.6 to 12.9	0.62 to 0.69
1 (0.1)	approx. 0.41	0.42 to 0.47	approx. 0.31	3.86 to 4.27	approx 0.24

Table 5–3: TIME DIAL VERIFICATION – DEFINITE TIME

TIME DIAL 5 A (1 A)	OPERATING TIMES (in seconds)			
	T_{max} = 2 sec.	T_{max} = 4 sec.	T_{max} = 6 sec.	T_{max} = 8 sec.
10 (1)	1.95 to 2.05	3.95 to 4.05	5.45 to 5.05	7.95 to 8.05
7 (0.7)	1.35 to 1.45	2.75 to 2.85	4.15 to 4.25	5.55 to 5.65
3 (0.3)	0.57 to 0.63	1.14 to 1.26	1.71 to 1.89	2.35 to 2.45
1 (0.1)	approx. 0.20	approx. 0.40	0.57 to 0.67	0.76 to 0.86

a) VERIFICATION OF PICKUP

1. Set the Output Select switch on the front of the relay to the B position so the output relays correspond to phase or ground.

2. Connect the relay as indicated in Figure 5–1: TEST CONNECTIONS on page 5–1. Use a supply voltage with a variable resistor in series, or use an electronic test source.

3. Set the relay at the minimum pickup TOC. Set the instantaneous unit to one times (1 ×) the pickup TOC setting. Set the instantaneous time delay to zero (0) seconds.

4. 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.

5. 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.

b) VERIFICATION OF OPERATING TIME

1. With the relay still connected as in Figure 5–1: TEST CONNECTIONS on page 5–1, apply a current of 5 times (5 ×) the pickup TOC setting, verifying that the operating time is less than 0.025 seconds.

2. 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.

5

Repeat each test with the relay connected as in Figure 5–1: TEST CONNECTIONS on page 5–1, except apply current to the ground unit (terminals 7 and 8). For each test, apply ground settings to the relay as instructed.

5

6.1 OVERVIEW

This section contains information for the use of MDP-LINK software.

A personal computer (PC), along with MDP-LINK, provide local user interface to the relay for operating person-nel. This interface is available in two different serial communications protocols (RS232 and RS485). To deter-mine if your MDP contains this interface check the MDP model number as shown:

• **MDP4xxxxxxDA** – RS232

• **MDP5xxxxxxDA** – RS485

x = don't care

6.2 SYSTEM REQUIREMENTS

a) HARDWARE

The minimum PC hardware requirements consists of the following components.An IBM-AT or compatible (Compaq, Dell, HP, etc.) with one parallel port, a minimum of 500 KB of free memory (RAM) to run the program in, 40 MB hard drive, low density 3 1/2 inch floppy drive, and VGA monitor. See Figure 6–1: RS232 CABLE CONNECTION and Figure 6–2: RS485 CABLE CONNECTION for proper PC to MDP wiring.

b) SOFTWARE

Requires MS-DOS 3.1/Windows 3.1/ Windows 95 or above for the PC operating system.

Figure 6–1: RS232 CABLE CONNECTION

Figure 6–2: RS485 CABLE CONNECTION

a) 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.

b) 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, use the DOWN arrow key to display the menu.

c) PULL-DOWN MENUS

Pull-down menu items are selected with the mouse or the keyboard:

• With the 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.

• With the keyboard, activate the hot key by 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.

d) 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 or resized. 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.

6

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.

e) 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.

Use the UP/DOWN arrow keys to select the desired item. 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.

f) 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.

a) MAIN MENU

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

•   Relay Functions   ALT-R

•   Local Functions   ALT-L

•   Setup   ALT-S

•   Help   ALT-H

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

6.5 RELAY FUNCTIONS

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

•   Login   ALT-L

•   lOgout   ALT-O

•   Hang up phone   ALT-H

•   request relay Data   ALT-D

•   request Fault data   ALT-F

•   Reset fault data   ALT-R

•   Breaker status   ALT-B

•   Trip breaker   ALT-T

•   Close breaker   ALT-C

6

a) 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.

b) LOGOUT

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, lOgout must be used. To select lOgout click on the menu item with the left mouse button or use the ALT-O hot key.

c) 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.

d) 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.

e) 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.

f) RESET FAULT DATA

This item will clear the data associated with the last fault which is stored in the relay. To select this menu item, either click on it with the left mouse button or use the ALT-R hot key.

After the item has been selected, a dialog box will appear to confirm that the data is to be reset. If the data is not to be reset, click on the CANCEL button or use the ALT-C hot key to return to the Relay functions menu. If the data is to be reset, click on the OK button or use the ALT-O hot key to reset the fault data in the relay.

g) BREAKER STATUS

This item menu will display, print, and/or file the status of the Breaker Status input (CP-7 and CP-8). If this input is energized it will report "Breaker Closed", if this input is not energized it will report "Breaker Tripped".

To select this menu item, either click on it with the left mouse button or use the ALT-B hot key. Once this item is selected, a dialog box will appear with three independent choices for displaying, printing and filing the breaker status. 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 breaker status 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 breaker status from the relay. (Selecting the CANCEL button will return to the Relay functions menu without any further action.) To clear the breaker status 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 breaker status has been cleared from the screen, the **Breaker status** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

h) TRIP BREAKER

This item will operate the K1 and K2 output relays for 1 second (See Figure 6).

To select this menu item, either click on it with the left mouse button or use the ALT-T hot key.

After the item has been selected, a dialog box will appear to confirm that the breaker is to be tripped. If the breaker is not to be tripped, click on the CANCEL button or use the ALT-C hot key to return to the Relay functions menu. If the breaker is to be tripped, click on the OK button or use the ALT-O hot key to trip the breaker.

i) CLOSE BREAKER

This item will operate the K4 output relay for 1 second (See Figure 6).

To select this menu item, either click on it with the left mouse button or use the ALT-T hot key.

After the item has been selected, a dialog box will appear to confirm that the breaker is to be closed. If the breaker is not to be closed, click on the CANCEL button or use the ALT-C hot key to return to the Relay functions menu. If the breaker is to be closed, click on the OK button or use the ALT-O hot key to close the breaker.

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The Local functions menu has the item and hot key:

- go to <u>D</u>OS   ALT-D

- go to <u>D</u>OS

This choice enables the user to temporarily leave MDP-LINK and go to the DOS prompt to execute DOS commands. Any program or command that can run in the available memory can be executed. To return to the program, type EXIT at the DOS prompt.

The **Setup** menu has the following items and hot keys.

- <u>C</u>ommunication port numberALT-C

- <u>D</u>ial Type   ALT-D

- <u>M</u>odem connection time   ALT-M

- <u>R</u>elay parameters   ALT-R

- <u>A</u>dd relay to list   ALT-A

- d<u>E</u>lete relay from list   ALT-E

- d<u>I</u>splay mode   ALT-I

- Memory available   no hot key

a) COMMUNICATION PORT NUMBER

The communication port for the PC is chosen with this selection. To select this item, either click on it with the left mouse button or use the ALT-C hot key. Once this item is selected, a dialog box containing the port number and IRQ number will be displayed. The serial port that is connected to the MDP system, or the modem used to talk to the MDP system, must be entered before logging in to the relay. If the port chosen is not COM1(1) or COM2(2), the IRQ number for the port chosen must be entered. Use the TAB key to move between the port and IRQ fields and the buttons, or click on the desired field with the left mouse button.

Once a field has been selected, use the editing keys to change and/or enter data. When the port and IRQ numbers are correct, select the OK button to save the numbers. If the CANCEL button is selected, the **Setup** menu will be redisplayed without any further action.

b) DIAL TYPE

To select 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 containing the dialing type will be displayed. Either tone or pulse dialing can be chosen. The UP and DOWN ARROW keys will toggle between the tone and pulse choices. The TAB key will move between the selected dialing type and the OK and CANCEL choices in the box. Once the dialing type has been chosen, selecting the OK button will store the change. Selecting the CANCEL button will exit Dial type without any further action.

c) 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.

d) 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, parity, and the serial communications protocol 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. The parity must be set to None.

The serial communications protocol depends on which MDP you have. If your model number is MDP3XXXXXXCA then you must select RS485, however, if your model number is MDP4XXXXXXCA then you must select RS232.

e) 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, parity, and serial communications protocol 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.

f) 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.

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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.

g) DISPLAY 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 deselected.

Once the correct mode has been selected, click OK press 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.

h) 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.

6.8 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.

6.9 EXITING MDP-LINK

There are two ways to exit MDP-LINK:

1. ALT-F4 produces 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.

2. 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.

7.1 DESCRIPTION

This chapter describes the functional specifications of the Modicon Modbus protocol for interface module for the Microprocessor Distribution Protection (MDP Relay) Digital Time Overcurrent Relaying System. The specifications cover Modicon Modbus application messages supported by the MDP interface software module. The objective is to move the MDP relay from communicating through a concentrator to direct connection to Modbus. The MDP direct interface should provide all the same functions as were implemented using the concentrator interface, with the addition of breaker control.

Additional information on the Modbus protocol can be found at **www.modbus.org**.

7.2 OVERVIEW

The Modicon Modbus interface module allows the MDP to communicate with the Power Leader Distribution Software (PLDS) running on a host computer via Modbus. The Modbus interface card is built into the MDP relay unit and communicates with the relay via a TTL level serial asynchronous protocol. The Modbus interface card does not provide any LED display or key switches as provided for other devices. The MDP relay provides the user interface. The Modbus device address for the MDP unit is configurable from the switches provided on the MDP relay itself; the specified address is read by the Modbus interface module using the serial protocol. The baud rate for serial communication is internally fixed at 2400 baud and is not configurable by the user. The Modbus card can be configured externally for the following baud rates: 1200, 2400, 9600, and 19200 baud.

The Modbus interface module provides the protocol conversions required to allow full operability on a Power Leader network.

7.3 MODBUS COMMANDS

The Modus interface module provides the commands described below. Although some of the standard commands are specified in the Modicon Modbus reference guide PI-MBUS-300 REV.E (see www.modbus.org for additional information), they are described here for the sake of completeness.

a) READ HOLDING REGISTERS, FUNCTION CODE 03

Modbus description: Reads the binary contents of the MDP holding registers. Broadcast is not supported.

The following MDP registers are available to read: Unit ID/Modbus address, Setpoint parameters, COC software version, Product revision, and MDP software revision.

- QUERY: The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero; i.e., registers 1 to 16 are addressed as 0 to 15.

- RESPONSE: The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

  Data is scanned in the slave at the rate of 125 register per scan each register contains two bytes.

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b) READ INPUT REGISTERS, FUNCTION CODE 04

Modbus Description: Reads the binary contents of the input registers in the MDP relay.

The actual values available on the MDP are: Relay Status, Phase currents, Ground currents, Phase Trip currents, ground trip currents, and trip time.

- QUERY: The query message specifies the starting register and the quantity of the registers to be read. Registers are addressed starting at zero; i.e., registers 1 to16 are addressed as 0 to 15

- RESPONSE: The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register the first byte contains the high order bits and the second contains the low order bits.

    Data is scanned in the MDP at a rate of 125 registers per scan. In response to this command from Host the module will send back the latest actual value data stored in the MDP, these values will be periodically read by the module from the MDP relay.

c) FORCE SINGLE COIL: FUNCTION CODE 05

Modbus description: Forces a single coil (OX reference) to either ON or OFF. When broadcast, the function forces the same coil reference in all attached slaves.

MDP function to force: Breaker trip and breaker close.

- QUERY: The query message specifies the coil reference to be forced. Coils are addressed starting at zero: coil 1 is addressed as 0. The request ON/OFF state is specified by a constant in the query data field. A value of FF00 hex requests the coil to be ON. A value of 0000 requests it to be OFF. All other values are illegal and will not affect the coil.

- RESPONSE: The normal response is an echo of the query, returned after the coil state has been forced.

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Table 7–1: MODBUS MEMORY MAP (Sheet 1 of 4)

REGISTER	CONTENTS	RANGE	TYPE R/W	FORMAT CODE	BYTES	COMMNET COMMAND
FIXED VALUE INPUT REGISTERS (READ HOLDING REGISTERS)						
0000	Product ID	13h	RO	Unsigned Integer	1	80/01/01h
0001	Not assigned	0	RO	Unsigned Integer	1	
0002	Commnet Address	N/A	RO	Unsigned Integer	1	
0003	Modbus Address	N/A	RO	Unsigned Integer	1	
0004	COC Software Version	N/A	RO	Float4 digit BCD with decimal between 2nd & 3rd digits	2	80/74/14h
0006	Model	N/A	RO	Unsigned Integer 00h:1 A; 01h: 5 A	1	80/02/00h
0007	Ground Settings Scale	00h to 03h		Unsigned Integer 00h: Nominal, 01h: divide by 2 02h: Multiply by 3, 03h: Divide by 5	1	80/02/00h
0008	Product Revision	0.00 to 99.99	RO	4 digit BCD with decimal between 2nd and 3rd digits	2	80/01/05-06h
0010	MDP Software Revision	0.00 to 99.99	RO	4 digit BCD with decimal between 2nd and 3rd digits	2	80/01/02-03h
DYNAMIC VALUE INPUT REGISTERS						
1000	Number of pending events	0 to 24	RO	Integer	1	
1001	LED Status	0000h to 00FFh	RO	A bit set to 1 indicates the corresponding LED is ON b0: Ready, b1: Phase A, b2: Phase B, b3: Phase C, b4: Ground, b5: TOC Trip, b6: IOC Trip, b7: Pickup	1	80/74/00h
1002	Hardware Status	0000 to 008Fh	RO	b0: Breaker Status (1 = Open,0 = Closed) b1: External Input, Block Ground (1 = Active) b2: External Input, Block IOC (1 = Active) b3: Settings Status (1 = Settings changed but unentered), 0 = Settings Normal) b4: Undefined, b5: Undefined b6: Undefined b7: Relay Status (1= Fatal Error, 0=OK)	1	80/74/01h
1003	Phase A current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/01-02h
1005	Phase B current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/03-04h
1007	Phase C current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/05-06h
1009	Ground current	0 to 3 A (5 A relay) 0 to 0.7 A (1 A relay)	RO	Float	2	80/74/07-08h

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Table 7–1: MODBUS MEMORY MAP (Sheet 2 of 4)

REGISTER	CONTENTS	RANGE	TYPE R/W	FORMAT CODE	BYTES	COMMNET COMMAND
1011	Phase A trip current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/09-0Ah
1013	Phase B trip current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/0B-0Ch
1015	Phase C trip current	0 to 10 A (5 A relay) 0 to 2 A (1 A relay)	RO	Float	2	80/74/0D-0Eh
1017	Ground trip current	0 to 3 A (5 A relay) 0 to 0.7 A (1 A relay)	RO	Float	2	80/74/0F-10h
1019	Trip time	0 to 999.99 sec.	RO	Float	2	80/74/11-14h
1021	Breaker Status	00 to 01h	RO	Unsigned Integer 00h: Closed, 01h: Open	1	80/57/00h
1022	Relay Hardware Status	00 to 04h	RO	Unsigned Integer 00h: Relay is OK 01h: Relay not responding to read 02h: Relay not responding to write 03h: Command error reported 04h: Fatal error in Relay	1	80/57/03h
COMMNET COMMUNICATION STATISTICS REGISTERS						
1500	Device Status	N/A	RO	1 = ALIVE, 0 = DEAD	1	N/A
1501	Total Communication errors	N/A	RO	Unsigned Integer	1	N/A
1502	CRC Errors	N/A	RO	Unsigned Integer	1	N/A
1503	Transmit Failures	N/A	RO	Unsigned Integer	1	N/A
1504	Receive Time-out	N/A	RO	Unsigned Integer	1	N/A
1505	Receive Errors	N/A	RO	Unsigned Integer	1	N/A
EVENT REGISTERS						
2000	Event Code - EVENT 1	0 to 256	RO	Unsigned Integer	1	
2001	Hour	0 to 23 hrs.	RO	Unsigned Integer	1	
2002	Minute	0 to 59 min.	RO	Unsigned Integer	1	
2003	Seconds	0 to 59 sec.	RO	Unsigned Integer	1	
2004	Milliseconds	msecs	RO	Unsigned Integer	1	
2005	Event specific data 1				1	
2006	Event specific data 2				1	
2007	Event specific data 3				1	
2008	Event specific data 4				1	
2009	Event specific data 5				1	
2010	Event specific data 6				1	
2011	Event code - EVENT 2	0 to 256	RO	Unsigned Integer	1	
2012	Hour	0 to 23 hrs.	RO	Unsigned Integer	1	
2013	Minute	0 to 59 min.	RO	Unsigned Integer	1	
2014	Seconds	0 to 59 sec.	RO	Unsigned Integer	1	
2015	Milliseconds	msecs	RO	Unsigned Integer	1	

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Table 7–1: MODBUS MEMORY MAP (Sheet 3 of 4)

REGISTER	CONTENTS	RANGE	TYPE R/W	FORMAT CODE	BYTES	COMMNET COMMAND
2016	Event specific data 1				1	
2017	Event specific data 2				1	
2018	Event specific data 3				1	
2019	Event specific data 4				1	
2020	Event specific data 5				1	
2021	Event specific data 6				1	
↓	↓	↓	↓	↓	↓	↓
2253	Event code - EVENT 24	0 to 256	RO	Unsigned Integer	1	
2254	Hour	0 to 23 hrs.	RO	Unsigned Integer	1	
2255	Minute	0 to 59 min.	RO	Unsigned Integer	1	
2256	Seconds	0 to 59 sec.	RO	Unsigned Integer	1	
2257	Milliseconds	msecs	RO	Unsigned Integer	1	
2258	Event specific data 1				1	
2259	Event specific data 2				1	
2260	Event specific data 3				1	
2261	Event specific data 4				1	
2262	Event specific data 5				1	
2263	Event specific data 6				1	
SETPOINT REGISTERS						
3000	Hour	0 to 23 hrs.	RW	Integer	1	N/A
3001	Minute	0 to 59 min.	RW	Integer	1	N/A
3002	Second	0 to 59 sec.	RW	Integer	1	N/A
3003	Password	N/A	RW	Integer	1	N/A
3004	Phase Curve Selection	00 to 04h	RO	Unsigned Integer 00h: Not used, 01h: Long Time Inverse 02h: Very Inverse, 03h:Extremely Inverse, 04h: Inverse	1	80/73/00h
3005	Phase Definite Time	sec.	RO	Float (set to 0 if not used)	2	80/73/00h
3007	Ground Curve Selection	00 to 04h	RO	Unsigned Integer 00h: Not used, 0lh: Long Time Inverse 02h: Very Inverse 03h: Extremely Inverse, 04h: Inverse	1	80/73/00h
3008	Ground Definite Time	sec.	RO	Float (set to 0 if not used)	2	80/73/00h
3010	Output Selection	00 to 01h	RO	unsigned Integer (00h: A, 01h: B)	1	80/73/01h
3011	Ground Time Dial	0.5 to 10 (5 A relay) 0.05 to 1.0 (1 A relay)	RO	Float	2	80/73/02h
3013	Ground IOC Delay	0 to 1.55 sec.	RO	Float	2	80/73/02h
3015	Ground TOC pickup	0 to 4.375 A (5 A) 0 to 0.0875 A (1 A)	RO	Float	2	80/73/03h
3017	Ground IOC pickup	0 to 31 x TOC	RO	Float	2	80/73/03h

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Table 7–1: MODBUS MEMORY MAP (Sheet 4 of 4)

REGISTER	CONTENTS	RANGE	TYPE R/W	FORMAT CODE	BYTES	COMMNET COMMAND
3019	Phase Time Dial	0.5 to 10 (5 A relay) 0.05 to 1.0 (1 A relay)	RO	Float	2	80/73/04h
3021	Phase IOC Delay	0 to 1.55 sec.	RO	Float	2	80/73/04h
3023	Phase TOC pickup	1.5 to 13.12 A (5 A) 0.3 to 2.625 A (1 A)	RO	Float	2	80/73/05h
3025	Phase IOC pickup	0 to 31 x TOC	RO	Float	2	0/73/05h

7.5 COIL COMMANDS

Table 7–2: COMMAND REGISTES (READ COIL STATUS)

COIL NUMBER	CONTENTS	MODBUS USAGE	COMMNET COMMAND
0	Reset an event	Force ON (FFOO) to reset the event	80/58h
1	Trip breaker	Force ON (FFOO) to trip the breaker	52h
2	Close breaker	Force ON (FFOO) to close the breaker	53h

7.6 EVENT HANDLING

All asynchronous events are logged by the MDP. The most recent N (to be specified) events per device are available. The Concentrator stores the latest 24 events, this number was decided upon based on memory and timing constraints. Eleven registers are associated with each event. Events are stored in event registers in chronological order, EVENT 1 being the oldest event and EVENT n being the latest one. If there are more events than can be stored in the register map the oldest event is removed from the register map and rest of the event registers are shifted freeing the last set of event registers for the latest event.

'Number of active Events' indicates the unpolled events by the master. When there are no more unpolled events, the number of active events will be set to 0. The 'Number of active Events' register is stored at address 1000 in dynamic value registers.

Event registers are automatically cleared after the host reads them. Partially read events are not cleared. The number of Active Events register reflects unread events. If host does not read all the existing events, events registers are shifted to represent remaining events to be read by host.

The host may read event registers starting at any event register set boundary. Events registers following the event that was read will be shifted up. Events registers before the registers that are read will not be affected. Host requests to read event registers partially (e.g. only Event Code register) will be returned with an exception code.

Each status/event message is time stamped. Events will be stored in the same format for all devices. Event code register value 0 implies that there is no event in that register. One global event code table is maintained for all commnet devices. The event registers are shown in addresses 2000 to 2263 of the memory map.

Event specific data registers will be filled for the events which need to supply more data than just the event code. Event codes and their interpretation are listed in the table below:

Table 7–3: EVENT CODES

EVENT CODE	DESCRIPTION	MDP
00	No Event - Register is cleared.	✔
01	Remote command execution error	✔
02	Configuration change (80/56)	✔
03	Address conflict detected (80/56)	✔
04	General hardware failure	✔
05	Unknown event	✔
06	Device opened for a reason other than an event caused by the programmer	✔
07	Real energy cleared.	✘
08	Reactive energy cleared	✘
09	NVM failure (80/56)	✘
10	ROM failure (80/56)	✘
11	RAM failure (80/56)	✘
12	A/D converter failure (80/56)	✘
13	All voltages are OK. (80/50)	✘
14	Phase A-N voltage lost. (80/50)	✘
15	Phase B-N voltage lost. (80/50)	✘
73	Breaker status change	✔
74	EPROM checksum test failure	✔
75	Interface module not ready	✔
76	Communication error	✔
77	Relay is OK	✔
78	Relay is not responding to READ	✔
79	Relay is not responding to WRITE	✔
80	Relay reports an error	✔
81	Fatal error in relay	✔
82	Phase timed overcurrent trip	✔
83	Phase instantaneous overcurrent trip	✔
84	Ground timed overcurrent trip	✔
85	Ground instantaneous overcurrent trip	✔

7

7

A

Q

A

How do I set the phase overcurrent to 3.75?

1. Look at the front upper left side of the MDP at Phase Pickup TOC.

2. There is a minimum value x given in the equation $x + (num)$. This number is 1.5, 0.5, or 0.3, depending on the MDP model number.

3. Below the Pickup TOC label are 5 DIP switches. Every DIP switch moved to the right will add to the minimum pickup value. If the minimum pickup value is 1.5 A, then switch the second and third switches to the right to add their values; i.e., 1.5 + 0.75 + 1.5 = 3.75 A. Other MDP settings operate in the same manner.

Q

A

Does the MDP measure RMS?

No. The MDP was not designed to measure RMS. The relay was designed to sample the peak value every millisecond. After 10 samples, the largest sampled value is used to compute and display the current. Using this sampling technique, the relay detects harmonics and adds them onto the fundamental.

Q

A

Do I have breaker status and how to I connect the 52b wire?

1. To check if you have breaker status, examine the model number shown on the faceplate. If the model number is MDP0********, then the relay does not have communications or breaker status.

2. If the model number is anything other than MDP0********, then the MDP has breaker status.

3. To use breaker status, connect the two terminals from the breaker to the MDP terminals CP-7 and CP-8.

4. When voltage is applied to the relay, the display (F0) will read **CL**, indicating the breaker is closed.

5. If voltage is removed from the relay, the display (F0) will read **OP**, indicating the breaker is open.

Q

A

How do I check my last trip current and time?

1. Check to see if one of the six TRIP TARGETS LEDs is on.

2. Locate the reset lever on the lower left corner. Toggle until **F9** (Last Trip Time) is displayed.

3. The last trip time is stored in F9. It will display 0.01 to 199 seconds

4. If Phase A tripped, toggle through to **F5**. The display shows the current in multiples of pickup. If F5 shows **2.0**, then multiply that value by the phase pickup to obtain the secondary current level.

A

Q **Why can't I reset the relay?**

A The relay will not reset while it is picked up. Check the pickup light in the upper left corner next to the ready light. If the pickup light is on, it will not reset until current levels are below the pickup point.

Q **How do I set Definite Time?**

A Examine the front lower right-hand corner of the MDP faceplate, under CURVE SELECTION. There are four time selections shown for 2, 4, 6, and 8 seconds. The diagram correlates to the positions of the three DIP switches under CURVE. Once one of the definite time switches is selected under CURVE, the TIME DIAL (above CURVE on the faceplate) is used as a multiple of the definite time. The equation for computing the definite time is:

$$\text{Time} = \frac{\text{Definite Time} \times \text{TIME DIAL}}{10}$$

For example, to set a definite time of 3.2 seconds:

1. Move the three switches under CURVE to the left, indicating the 8 second DT.

2. Compute the equation and solve for x: $8x/10 = 32 \Rightarrow x = 4$.

3. Under TIME DIAL, move the first, second, and third switches to the right to add to 4 seconds.

4. The relay is now set to trip in 3.2 seconds

Q **Why is the green READY light flashing?**

A The green READY light flashes following a settings change. The relay will continue to flash for three minutes until it accept changes. Settings can be accepted faster by holding the reset lever up for five seconds. This resets the relay and stops the flashing.

B

Table B–1: REVISION HISTORY

MANUAL P/N	MDP REVISION	RELEASE DATE	ECO
GEK-100604	---	---	---
GEK-100604A	---	---	---
GEK-100604B	---	---	---
GEK-100604C	A	---	---
GEK-100682 replaces GEK-100604C	A	February 1995	---
GEK-100682A	A	March 1995	---
GEK-100682B	B	August 1996	---
GEK-100682C	D	March 1997	---
GEK-100682D	D	September 8, 2000	MDP-003

Table B–1: ADDITIONS TO MDP MANUAL GEK-100682D

PAGE IN GEK-100682C	ADDITION (to GEK-100682D)
Title	Added GE Power Management contact information on title page.
Title	Added ISO-9000 registration seal.
4	Figure 1-1: SINGLE LINE DIAGRAM
5	Added phase current ranges to ORDER CODES (NOMENCLATURE) table
5	Figure 1-2: TYPICAL WIRING DIAGRAM
7	Added the following text to the SPECIFICATIONS: **DIGITAL INPUT** Voltage Range: 38.5 to 250 V AC 24 to 250 V DC Frequency Range: 40 to 70 Hz
12	Added the following warning: ⚠ **WARNING** **DO NOT CHANGE SETTINGS WHILE THE MDP IS IN OPERATION AND ITS PROTECTIVE ELEMENTS IN USE. TAKE THE RELAY OUT OF SERVICE BEFORE MAKING ANY SETTING CHANGES.**
---	Added MODBUS PROTOCOL chapter
---	Added FREQUENTLY ASKED QUESTIONS Appendix
---	Added REVISION HISTORY Appendix
---	Added WARRANTY page, website information, and INDEX

Table B–1: MAJOR UPDATES FOR MDP MANUAL GEK-100682D

Page (100682C)	Change	From	To (in GEK-100682D)
Title	Updated	"GEK-100682C"	"GEK-100682D"
5	Corrected	In the Nomenclature Table: "24-48 VDC (19 to 60 VDC) 48-125 VDC/AC (38-150 VDC/AC) 35-120 AC 110-250 VDC (88-285 VDC) 85-240 AC"	"24 to 48 V DC 48 to 125 V DC, 35 to 120 V AC 110 to 250 V DC, 85 to 240 V AC"
6	Modified	"Nominal Frequency: 25/50/60 Hz"	"Nominal Frequency: 25 to 70 Hz"
17	Corrected	In headings for Table 5: INVERSE TIME: column 3 – "Long Time Very Inverse" column 4 – "Extremely Inverse" column 5 – "Inverse"	Table 5-1: INVERSE OPERATING TIMES column 3 – "Very Inverse" column 4 – "Long Time Inverse" column 5 – "Extremely Inverse"
18	Updated	"MDP4XXXXXXCA RS232"	"MDP4xxxxxxDA – RS232"
18	Updated	"MDP5XXXXXXCA RS485"	"MDP5xxxxxxDA – RS485"

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GE POWER MANAGEMENT RELAY WARRANTY

General Electric Power Management Inc. (GE Power Management) warrants each relay it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of shipment from factory.

In the event of a failure covered by warranty, GE Power Management will undertake to repair or replace the relay providing the warrantor determined that it is defective and it is returned with all transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under warranty will be made without charge.

Warranty shall not apply to any relay which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a GE Power Management authorized factory outlet.

GE Power Management is not liable for special, indirect or consequential damages or for loss of profit or for expenses sustained as a result of a relay malfunction, incorrect application or adjustment.

For complete text of Warranty (including limitations and disclaimers), refer to GE Power Management Standard Conditions of Sale.

The latest product information for the MDP Digital Time Overcurrent Relay is available on the Internet via the GE Power Management home page:

http://www.GEindustrial.com/pm

This site provides access to the following customer services:

- **Digital Products Directory**
  A brief description of products can be viewed online.

- **Product Catalog**
  Individual product brochures can be downloaded and printed

- **Product Selector Guide**
  A graphical tool for finding the product you are interested in

- **Sales Offices**
  A complete listing of world-wide sales offices

- **Technical Support**
  Complete contact information is available

- **Instruction Manuals**
  Manuals for many products are now available online

- **GE Product Software**
  The latest working versions of product software

- **Technical Drawings**
  Many technical drawings are available in either AutoCAD, CorelDRAW, or PDF formats.

- **Order Codes**
  Order codes for many products can be downloaded and printed

- **Technical Publications**
  Papers related to power management

Much more is also available. Visit us online at: **www.GEindustrial.com/pm**.