# DFP100
## DIGITAL FEEDER PROTECTION RELAY

# Instruction Manual

ISO9000
REGISTERED

Manufactured under an
IS09002 Registered System

**GE** MULTILIN

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# Chapter 1 -INTRODUCTION

### GETTING STARTED

1.  Unpack and examine the relay according to the instructions in the **HARDWARE DESCRIPTION** section of this manual

2.  Apply rated voltage at the power supply input terminals.  Refer to the **ELEMENTARY DIAGRAM,** Figure 2-3, in the **PRODUCT DESCRIPTION** section of this manual for the location of these terminals.

    The rated DC value for the relay is found on the nameplate located on the front panel of the relay.

3.  Determine which protocol your relay communicates with by examining the **MODEL NUMBER** located on the nameplate.  If the seventh digit is a 0 you can communicate with the relay with a standard ASCII terminal emulator.  If the seventh digit is a 1 you should load the M-Link software onto an IBM compatible computer.

    The null modem cable diagram can be found at the end of the **INTERFACE** section, Figure 9-2.

4.  The communications software, M-LINK required for the GE protocol relays, is included on the diskette in the plastic pocket at the back of this manual.  Follow the instructions in the **SOFTWARE** section under "Installation" to load the M-LINK onto the PC.

5.  Follow the instructions in the **SOFTWARE** section of this manual for communicating to the relay with the **ASCII** or GE protocol.

# Chapter 2 - PRODUCT DESCRIPTION

## GENERAL

The DFP100 is a digital protection, control, metering, and monitoring system. It uses waveform sampling of the current and voltage inputs together with appropriate algorithms to provide distribution and industrial feeder protection and monitoring. More generally, the DFP100 can be applied wherever overcurrent, over/under voltage, over/under frequency, control, metering, or monitoring is desired

The DFP100 is packaged in a compact 19 inch rack-mount drawout case. Different models of the DFP100 are available for either horizontal or vertical mounting, and the 7 inch depth makes it easy to mount in switchgear.

User interface to the DFP100 is either via a PC connected to a DFP100 serial port (RS232, RS485, or fiber optic) or via an optional local man-machine interface (MMI) consisting of a keypad and LCD display located on the front panel of the DFP100. A model selection guide is contained in the **SPECIFICATION** section of this instruction book. A block diagram of the DFP100 is shown in Figure 2-2. A typical external connection diagram is shown in Figure 2-3.

## APPLICATION

The DFP100 can be used to solve a variety of application requirements. Possible applications are listed below:

- primary protection for distribution or industrial feeders
- use as a bus relay to provide fast bus fault protection (requires contact wiring from the feeder relay to the bus relay)
- overcurrent backup protection for transformers
- distance/overcurrent backup protection for sub-transmission or transmission lines

## FUNCTIONS

### Protection

The following protection functions are provided with the DFP100:

**Phase Overcurrent :**

| | |
|---|---|
| 51PT | TOC (time overcurrent) |
| 51PD1, 51PD2 | DT (definite time unit 1, 2) |
| 50PH, 50PL | IOC (instantaneous overcurrent highset, lowset) |

Each of the functions listed above are per phase (A, B, C) for a total of fifteen phase overcurrent functions.

**Ground Overcurrent :**

| | |
|---|---|
| 51NT | TOC |
| 51ND1, 51ND2 | DT (definite time unit 1, 2) |
| 50NH, 50NL | IOC (Highset, Lowset) |

**Negative-sequence Overcurrent :**

| | |
|---|---|
| 46PT | TOC |
| 46PD | DT |

The TOC curves for 51PT, 51NT, and 46PT can be separately selected to be inverse, very inverse, or extremely inverse. These curves are based on ANSI P37.112 and are defined by the following equations:

Inverse:

$$t = TD\left[\frac{0.0103}{M^{0.02} - 1} + 0.0228\right]$$

Very Inverse:

$$t = TD\left[\frac{3.922}{M^2 - 1} + 0.0982\right]$$

Extremely Inverse

$$t = TD\left[\frac{5.64}{M^2 - 1} + 0.02434\right]$$

Where:
  t = time in seconds
  TD = Time Dial
  M = multiples of pickup

The curves generated by the above equations are shown in Figures 2-4, 2-5, and 2-6.

Note: **The trip time accuracy for the Time Overcurrent functions is ± 5% or one cycle whichever is greater.**

Note: **All currents and voltages are calculated from sampled values using a fundamental frequency Discrete Fourier Transform (DFT). Any reference in this instruction manual to "RMS" values indicates that the peak value obtained from the DFT has been divided by √2. The DFP100 does not calculate "true RMS" values of current or voltage.**

### 21P - Mho Phase Distance

The DFP100 provides the capability to supervise the phase overcurrents with a mho phase distance unit. The phase distance function can be used to supervise the phase overcurrent functions.

### 67N - Negative-sequence Directional

The DFP100 incorporates a negative sequence directional unit that can be used to supervise the ground overcurrent functions. It is also available as an input to the configurable logic.

### 27 - Undervoltage

The DFP100 incorporates an under voltage protection function that is used for supervision. The undervoltage unit operates on the measured phase-to-neutral voltage for wye-wye connected VTs or the calculated phase-to-neutral positive sequence voltage for open-delta connected VTs.

### 59 - Overvoltage

The DFP100 incorporates an over voltage protection function that is used for supervision. The overvoltage unit operates on the measured phase-to-neutral voltage for wye-wye connected VTs or the calculated phase-to-neutral positive sequence voltage for open-delta connected VTs.

### Torque Control

There are two separate torque control units, one for phase, and one for ground. The torque control of the phase overcurrent functions can be accomplished using the following signals:

1.   External contact  (digital input)

2.   50 PL - low-set phase instantaneous overcurrent

3.   21P - mho phase distance

4.   27 - undervoltage

The torque control of the ground overcurrent functions can be accomplished using the following signals:

1.   External contact  (digital input)

2.   67N

### 81UT1, 81UT2 - Under-Frequency Unit1, Unit2

The DFP100 contains two separate under frequency units. These can be set with or without time delay. These units also have a voltage supervision threshold.

### 81OT1,  81OT2 - Over-Frequency

The DFP100 contains two separate over frequency units. These can be set with or without time delay. These units also have a voltage supervision threshold.

### Metering

The metered quantities are current, voltage, watts, vars, and frequency. The applied currents and voltages are calculated per phase. Watts and vars are calculated per phase from the current and voltage values. RMS current and voltage values are displayed per phase, but only the three-phase watt and var values are displayed. This metering information can be accessed via a serial port, or it can be displayed locally on the LCD display when the DFP100 is supplied with the optional local MMI.

A demand ammeter function is incorporated. The maximum and average RMS current for each phase is determined over a selectable time interval of 15, 30, or 60 minutes for the last 24, 48, or 96 hours, respectively

### Control

By using the optional local MMI or a PC connected to a serial port, it is possible to trip or close the feeder breaker using DFP100 output

contacts.  The DFP100 is available with or without an automatic reclosing function.

### Recloser

The DFP100 is available with an option that allows the enabling of up to four (4) reclose attempts. The number of attempts is programmable between 1 and 4 and includes a separate setting to disable the reclose function.
The reclose cycle can be programmed to be initiated by an internal trip or if the 52/b contact indicates that the breaker has been opened by an internal or external trip.

For each reclose attempt, the time between the trip and reclose can be independently set.  The reset time, can be programmed between 1 and 600 seconds.

In order to initiate a reclose cycle, it is necessary for the 52/b contact to be wired to Digital Input #6 (which is dedicated to this input signal).  The reclose cycle will be initiated upon a "trip" command from the protection units, or from the 52/b contact monitor if the recloser is set to operate via the 52/b contact.  When the trip signal is issued, the reclose delay timer begins to decrement.  This time delay can be set between 0 and 600 seconds (the minimum setting is 0.1 seconds for version 4.1 Proms and earlier).  At the end of this time, the recloser issues the close signal via the dedicated close contact.

The recloser has a pause time setting which can be set between 0 and 100 seconds.  This pause can be initiated through a digital input and will prevent the close signal from being issued until the end of the pause time.

Once the 52b input indicates that the breaker is closed, the reset timer will begin to decrement.  If a trip, that is allowed to initiate a reclosure via the recloser trip mask, occurs before the reset timer has decremented to 0, the recloser will open the breaker and wait the second reclose delay time before closing the breaker.  This will repeat for the remaining number of programmed reclosures.

If the reclosure is the last one programmed for the cycle, and a trip is produced, the breaker will be opened and the recloser will go to the lockout state.  This lockout state is reset by a manual

close of the breaker through communications, the optional MMI, or by external means.

The capability exists to block the recloser by an MMI input, by a communication command, or by utilizing a digital input.

The recloser can be blocked in the following ways:

Local Block.  Local block is when a momentary signal is applied to a digital input which has been programmed as the Block reclose signal.  This low to high transition on the digital input will put the recloser into the lockout state.  A momentary signal to a digital input programmed as the UNBLOCK reclose signal will immediately put the recloser into the reset state.

Remote Block.  A remote block is produced when a BLOCK command is sent through a communication command or through the optional keypad.  When the UNBLOCK command is sent, the block is eliminated and the recloser is put into the reset state.

Block due to failure to open.  This block is produced when after a trip, the 52b status does not indicate that the breaker has opened within the BREAKER FAILURE TIME setting.  This block is eliminated when a manual close is produced.

Block due to repetitive trips.  In order to avoid excessive wear on breakers (e.g. during a storm, in which the breaker could be tripping and closing continuously), a one hour window has been created during which trips are recorded. The window moves in such a way that it is always counting the trips during the preceding 60 minutes.  If the number of trips is greater than the value defined by the user, the recloser is blocked, and the recloser goes to the lockout state.  This block is eliminated by a manual close.

The DFP100 has the capability to enable or disable, through a mask, which functions are allowed to initiate a reclose.  There is an independent mask for each of the 4 possible reclosures.

The DFP100 has the capability to enable or disable, through a mask, which functions are

allowed to trip after each reclosure. This mask overrides main trip mask used in each of the settings groups. There is an independent mask for each of the 4 possible reclosures.

### Fault Location

The DFP100 contains an algorithm for determining the distance to fault for Wye-Wye connected PT applications. This information is presented as miles (or kilometers) from the relay to the fault. The distance to fault is based on a line length (miles or kilometers) provided by the user as a setting. The other settings required for a fault location are: positive sequence impedance, positive sequence impedance angle, zero sequence impedance angle, and $K_0$ - the ratio of zero sequence impedance to positive sequence impedance ( $|Z_0|/|Z_p|$ ).

Fault location information is contained in the fault report, which is described in a following section. When the relay is set and connected in an open-delta configuration, a fault report is generated, but the fault type and distance to fault is not determined.

### FEATURES

### Remote Communications

There are three serial ports associated with the DFP100. PORT 1 is located on the front panel. PORT 2 and PORT 3 are located on the rear panel. PORT 1 and PORT 2 are driven by the same UART. PORT 3 is driven by a separate UART. Different models are available that have RS232 serial communications only , Fiber Optic & RS232 serial communications, or RS232 & RS485 serial communications. For the models with RS232 only, all three of the communication ports are RS232. For Fiber Optic & RS232 models, PORT 1 and PORT 2 are configured for RS232 communications, PORT 3 is disabled, and two fiber optic connectors (located next to PORT 2) are provided. For RS232 & RS485 models, PORT 1 and PORT 2 are configured for RS232 communications, and PORT 3 is configured for RS485 communications.

There is a choice of communication protocols. Different models are available for ASCII protocol or GE protocol. For ASCII protocol models, a general purpose PC communications program, such as PROCOMM, CROSS-TALK, Windows Terminal, etc., is sufficient. For GE protocol models, a unique PC communications program designated MLINK is required. MLINK is supplied free-of-charge by GE. Refer to the **SOFTWARE** section for more detailed information. The RS485 models are only available with the GE protocol which provides capability to individually address relays connected in a multi-drop configuration

### Man-Machine Interface

An optional local MMI incorporating a keypad and a liquid crystal display (LCD) is provided to allow the user to enter settings, display metering values, view fault target information, and access stored data. The use and functioning of the local MMI is fully described in the **INTERFACE** section. The local MMI is only available on models which utilize the GE protocol for remote communications.

### Trip Circuit Monitor

Any of the configurable digital inputs (contact converters) may be selected to monitor the DC voltage across a trip contact. This DC voltage must be wired from the trip contact terminals to the appropriate digital input terminals on the back of the relay.

With the DFP100 trip contact open, and the external trip circuit intact, full battery voltage is applied to the Trip Circuit Monitor digital input. If the external trip circuit is open-circuited because of a broken wire or failed trip coil, then the Trip Circuit Monitor voltage goes to zero resulting in a Trip Circuit Failure alarm.

If the 52/b contact from the breaker is wired to Digital Input #6, when the 52/b contact closes, the Trip Circuit Monitor function is disabled before an alarm can be issued. Also, the TCM is automatically disabled if the 52/b input is disabled.

Figure 2-1 shows the external connection for the Trip Circuit Monitor and the logic required to get a Trip Circuit Monitor Alarm output (TCM_A).
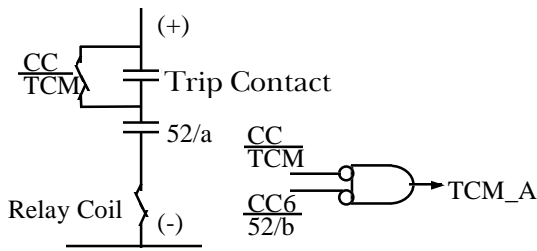


**Figure 2-1 Trip Circuit Monitor**

### 52/b Contact Monitor

The DFP100 provides the option to monitor the status of the 52/b contact via CC6. A setting is provided to allow the relay to check the status of this contact.

### Breaker Health Monitor

The DFP100 relay calculates and stores the cumulative $I*T$ or $I^2*T$ value of each of three phase currents. The choice of $I*t$ or $I^2*t$ is determined by the setting, BRKR HEALTH UNITS. The current value in $I*T$ or $I^2*T$ is the calculated average RMS value of current prior to opening of the breaker. The time T is a setting, BREAKER ARC TIME, that ideally represents the arcing time of the main contacts. However, if the arcing time is not known, then the nominal breaker opening time may be used.

A breaker health interrupting duty threshold is established by a setting, BREAKER HEALTH THRESH. If 80% of this threshold setting is exceeded, a breaker health alarm is issued. The intent of the Breaker Health Monitor function is that this alarm will be used to initiate breaker maintenance rather than relying on a fixed schedule or off-line calculations of cumulative $I*T$ or $I^2*T$ . Generally, the interrupting duty threshold can be obtained from the breaker manufacturer. A running count of the number of breaker openings is also maintained.

If a breaker that has had prior use is connected to the DFP100 relay, the relay accepts initial cumulative $I*T$ or $I^2*T$ values for each phase by using the ACCUM command. The initial value for the total number of breaker openings may be set using the OPENINGS command. Also, the cumulative $I*T$ or $I^2*T$ values and number of breaker openings can also be reset to zero following breaker maintenance or reset to pre-test values following relay testing by using the ACCUM and OPENINGS commands.

### Failure to Close Detection

After issuing a close signal, a timer is started. The pickup delay of this timer is determined by the FAILURE TO CLOSE TIME setting, and it is typically set at the longest expected breaker closing time. If this timer produces an output, an alarm is issued indicating that the breaker failed to close within the expected time. If the breaker closes prior to the BREAKER FAILURE TIME setting, the opening of a 52/b contact wired to one of the digital inputs will stop the timer.

If a 52/b contact is not wired to the DFP100 relay, a setting is provided which disables the Failure to Close Detection feature.

### Failure to Open Detection

When the DFP100 produces a trip output a timer is started. The pickup delay of this timer is determined by the FAILURE TO OPEN TIME setting; the dropout time is zero. The timer is stopped if the 52/b contact closes (breaker opens). If the breaker fails to open, the timer will produce an output and an alarm will be generated. By use of the configurable logic associated with outputs 1 - 4 it is possible to close a contact when this Fail to Open alarm is issued. This contact closure may be used to initiate tripping of backup breakers to implement a breaker failure scheme provided that an appropriate timer setting has been selected.

### Cold Load Pickup

Cold Load Pickup logic is provided to prevent operation of the overcurrent functions on the higher load currents that can result due to a loss of load diversity when a feeder is re-energized after being de-energized for a prolonged time. This

feature is implemented by the DFP100 automatically switching to settings group #6 following a trip output, a 52b contact closure and expiration of the pickup time, the COLD LOAD PICKUP DELAY setting. The pickup settings of the overcurrent functions in settings group #6 are selected to prevent operation on the higher cold load currents.

If you are in cold load pickup and you then switch settings groups through the use of a digital input, the DFP100 will immediately go to that setting group. And if the cold load condition still exists (i.e. The breaker remains open for a time longer than the Cold Load Pickup setting) settings group 6 will again be automatically switched in.

When the breaker is closed (52/b contact opens) a dropout timer is started, the COLD LOAD DROPOUT DELAY setting. Following expiration of the dropout timer, the DFP100 reverts to one of the six settings groups depending on what default setting group was set. This dropout delay allows time for re-establishment of normal load diversity and the corresponding lower load currents on the feeder.

## Configurable Inputs/Outputs

Five of the six digital inputs (contact converters) are configurable. The user can select from a list of possible assignments, but each digital input may be given one and only one assignment. If the same assignment is given to multiple digital inputs the inputs are internally logically ORed together. Refer to Table 3-2, in the CALCULATION OF SETTINGS section for a list of possible assignments for the digital inputs.

For the two outputs labeled TRIP 1 and TRIP 2, the user may select any OR combination of 16 trip flags to drive each output. For the four outputs labeled OUT 1, OUT 2, OUT 3, and OUT 4, the user may define unique combinational logic to drive each output. Refer to Table 3-3 in the CALCULATION OF SETTINGS section for a list of initiating signals and a description of how the combinational logic is defined.

## Multiple Setting Groups

Six separate groups of settings are stored in the DFP100 relay's nonvolatile memory, with only one group active at a given time. The setting ACTIVE SETTING GROUP determines the currently active group number. If any of the digital inputs are selected to be bit 0, bit 1, or bit 2 associated with setting group selection, then the digital inputs determine the active setting group and will override the setting ACTIVE SETTING GROUP .

## Events

A log of events is maintained in the DFP100 relay that contains the last 200 events. For event sequencing, logged events are time stamped to the nearest millisecond. Examples of events logged include alarms, contact operations, function pickup status, trips, setting changes, and self-check status. An EVENT MASK is used to control which events are stored. This mask enables or disables the storage of any event. Events are stored in EEPROM, and are maintained even when DC power is removed from the DFP100 relay.

## Fault Reports

A log of faults is maintained in the DFP100 relay that contains the last 8 faults. The fault report consists of a summary report that contain the date and time, the type of fault (if determined), and the fault location. There is an expanded report that contains the date and time, type of fault (if determined), prefault voltages and currents, fault voltages and currents, and the tripping function. These fault reports are time stamped to the nearest millisecond. If the primary VT's are connected in the open-delta configuration, the fault report is generated, but the fault location is not calculated.

## Oscillography

The DFP100 is available with an option that allows the capture of six oscillography records. These records can be downloaded and viewed using the optional GE-Data program. Each oscillography capture consists of:

1. Thirty four (34) cycles of IA, IB, IC, IN, I2, VA, VB, VC sampled values

- 16 samples per cycle
- 2 cycles pre-fault
- 32 cycles post-fault

2. Digital flags - indicating
   - function operations (pickup/dropout)
3. Signal that triggered oscillography capture
4. Time and date

A configurable mask determines which function operations or trips trigger oscillography capture. It is also possible to trigger oscillography by closing an external contact. The boundary between pre-fault and post-fault is the instant when the trigger signal occurs. Oscillography is stored in capacitor-backed dynamic RAM (CAPRAM). Following loss of DFP100 power, the oscillography data will be maintained for at least 48 hours.

**Phase Rotation Selection**

The DFP100 will operate properly for phase rotation A-B-C or C-B-A while maintaining the same external VT and CT wiring to the relay. The correct phase rotation is selected via a setting.

**Open-Delta/Wye-Wye Delta VT Connections**

The DFP100 will operate properly for external VT connections that are connected in the Open-Delta or Wye-Wye configuration. These connections are shown in Figure 2-3. The correct phase rotation is selected via a setting.

**Self Tests**

The DFP100 performs continuos self test of the Read Only Memory (ROM), Random Access Memory (RAM), and watch-dog timers for both Protection and Communication processors. The failure of any of these self-tests is stored as an event, and causes the operation of the alarm output contact and LED.

Processor Board

2-80196KC Microprocessors
10 bit A/D
EEProm
Local Ram
Capacitor Backed Ram
Dual Uart
RS-232 (3)
Contact Converter Inputs (6)
Relay Outputs (4)
Alarm Output
Trip Outputs (2)
Close Output
Status LED's
IRIG-B

Va, Vb, Vc
Ia, Ib, Ic, In

Magnetics
CTs (4)
PTs (3)

Power
Supply
Assembly
+5V, ±12V

Relay Outputs

Digital Inputs

IRIG-B

Front RS-232

Rear RS-232 (2)
RS485 (optional)
Fiber Option (optional)

Optional MMI

**Figure 2-2 DFP100 Block Diagram**
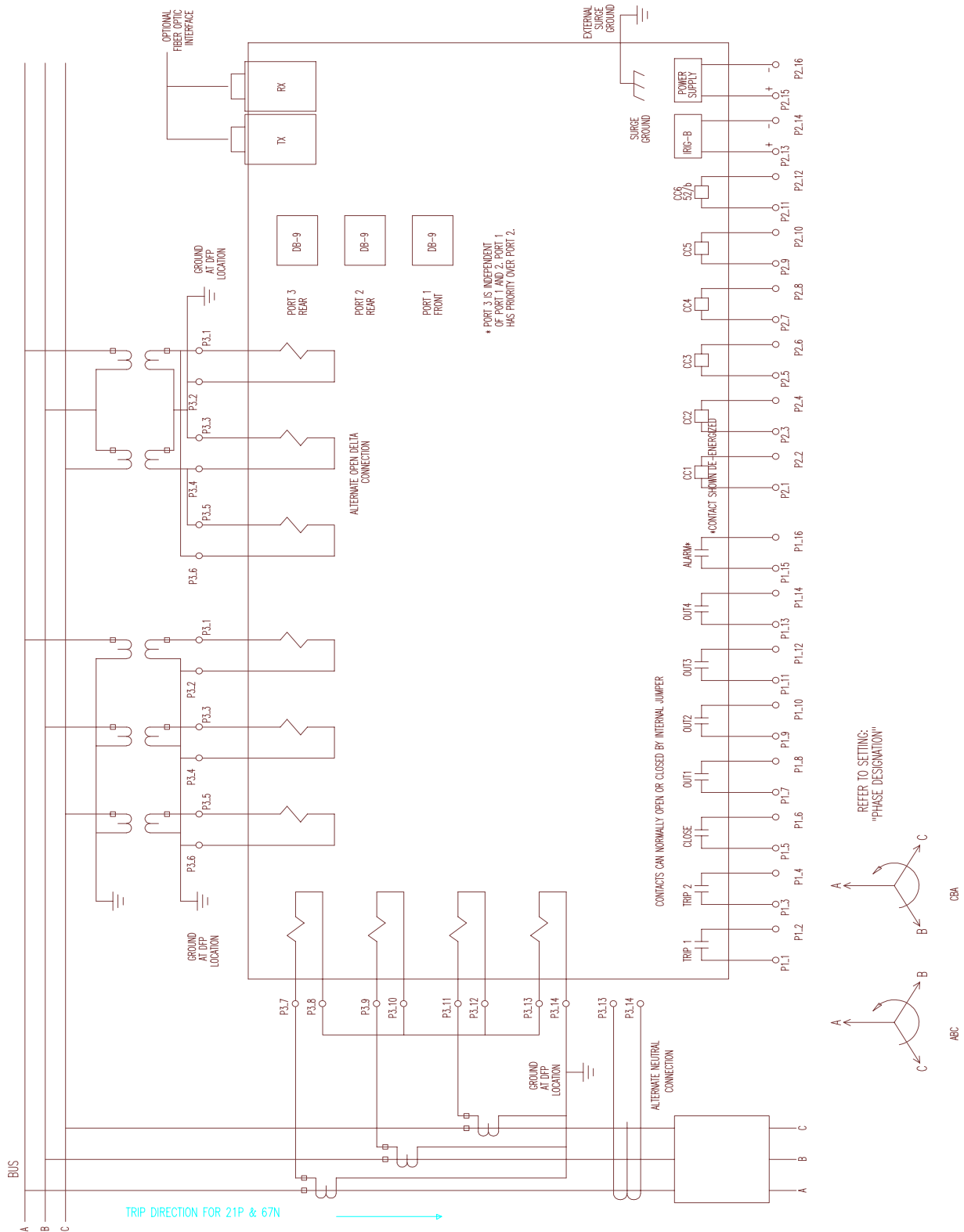
**Figure 2-3 DFP100 External Connections**
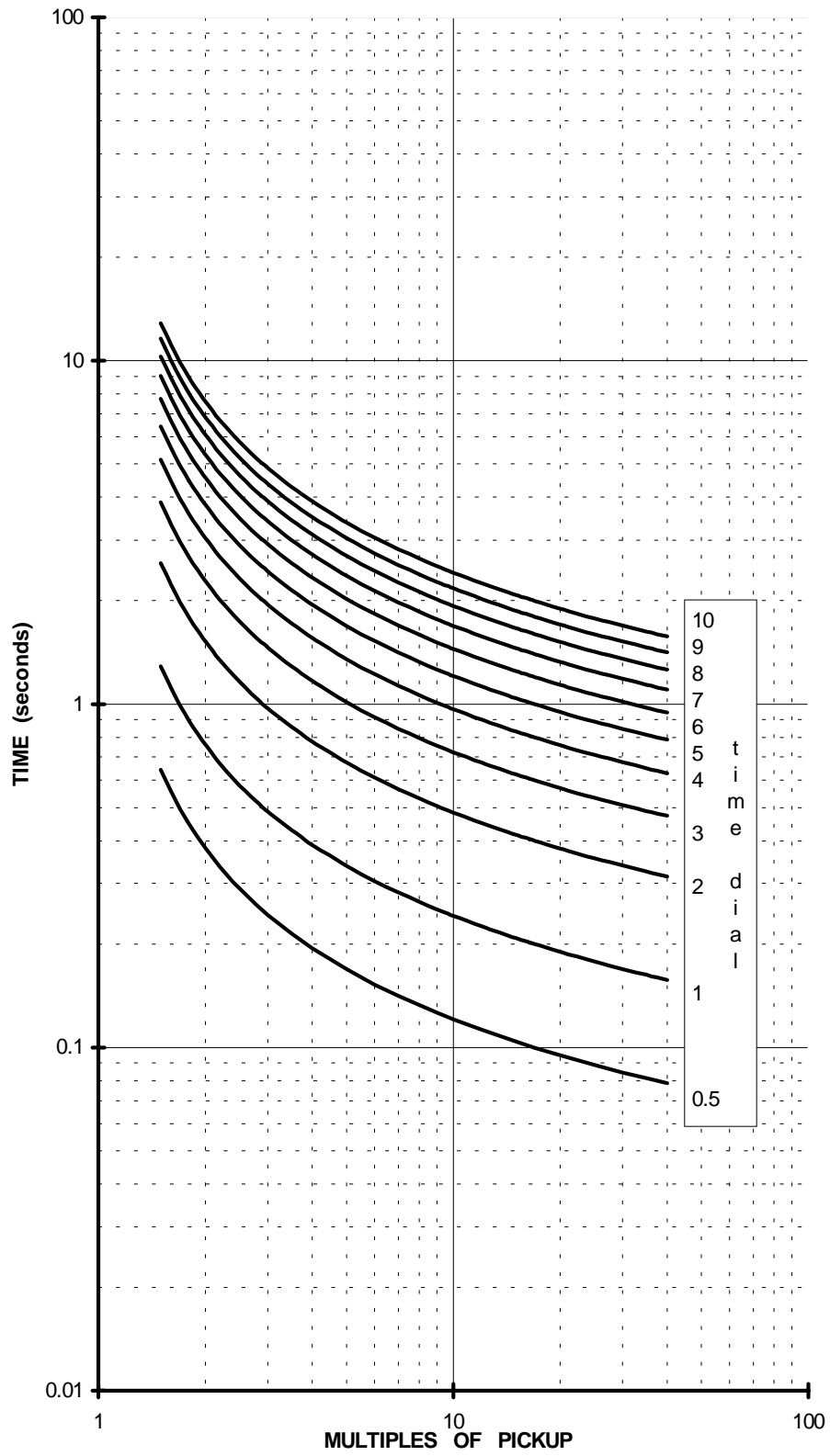
**Figure 2-4 DFP100 Inverse Curve (0358A1120)**
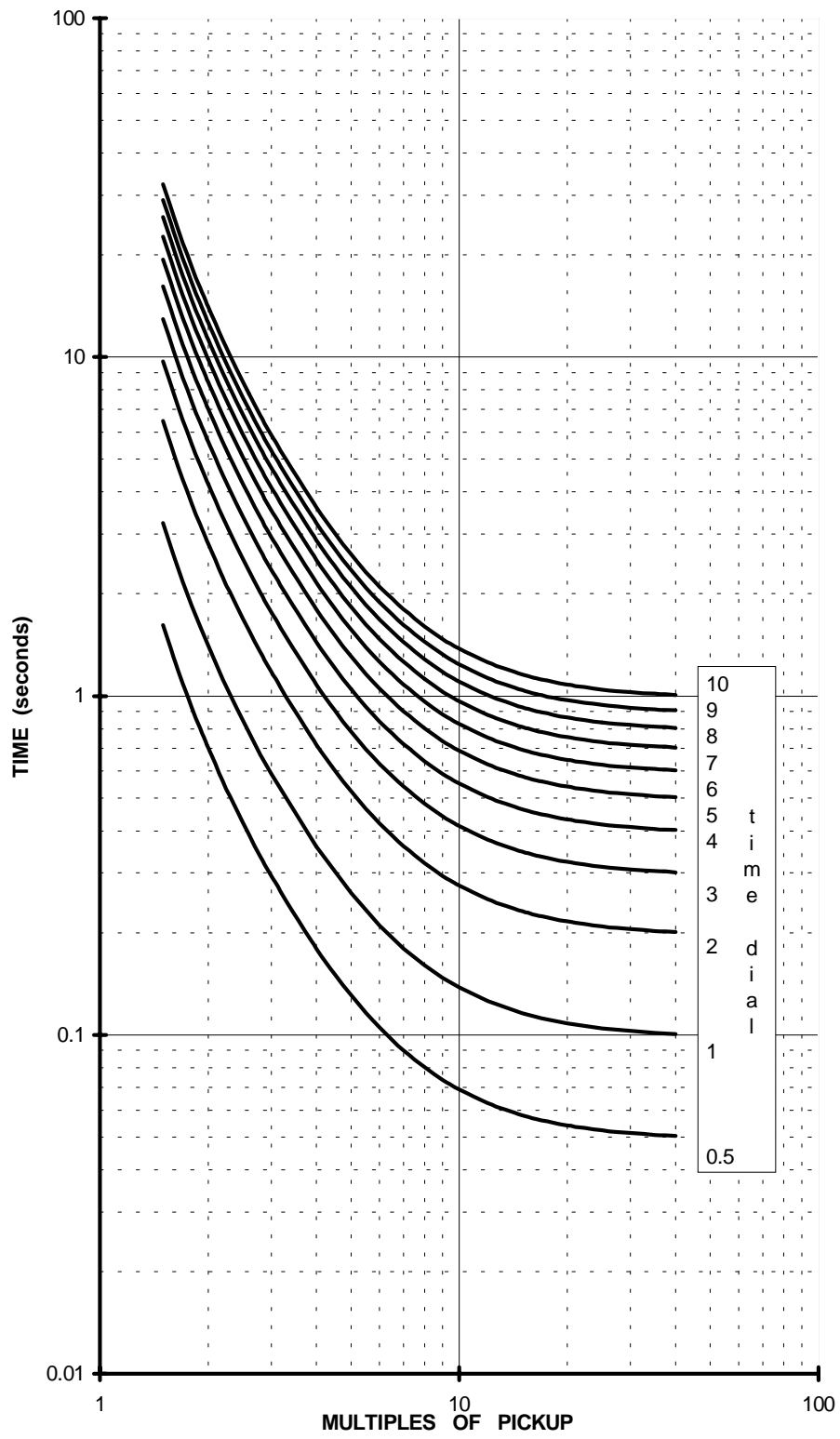
**Figure 2-5 DFP100 Very Inverse Curve (0358A1121)**
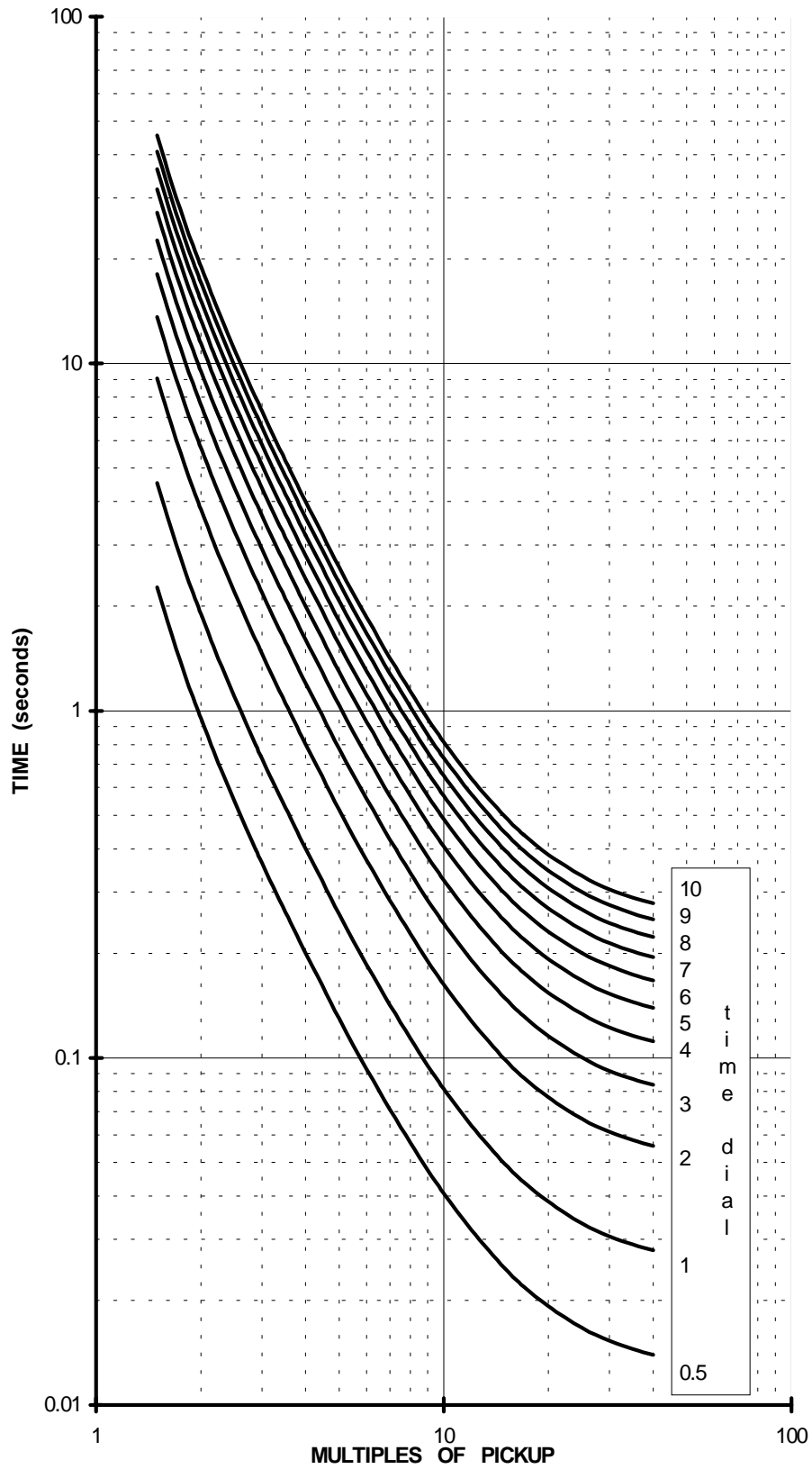
**Figure 2-6 DFP100 Extremely Inverse Curve (0358A1122)**

# Chapter 3 -CALCULATION OF SETTINGS

This section provides information to assist the user in determining the required settings for the DFP100 relay.  All the settings, along with corresponding ranges (and associated units, where applicable), are listed in TABLE 3-1.  The column entitled DEFAULT indicates the settings stored in memory as shipped from the factory. Both the ranges and defaults listed in TABLE 3-1 apply to DFP100 relays designed for use with current transformers having a nominal 5-amp secondary rating.  The settings for which the range and default differ for a 1-amp secondary rating are marked with an asterisk (*) as explained in a note at the end of table.

The DFP100 relay settings may be viewed or changed via a personal computer (PC) connected to a serial port or via the optional local man-machine interface (MMI).  The DFP100 stores six setting groups in non-volatile memory.  The following settings categories contain the settings that are common to all six setting groups.

> GENERAL
>
> BREAKER HEALTH
>
> INPUTS
>
> OUTPUTS
>
> MASKS
>
> ACCUMULATORS
>
> PASSWORDS
>
> RELAY ID
>
> DATE
>
> TIME
>
> LOCAL PORT
>
> REMOTE PORT

The remaining setting categories, listed below, contain the settings that are separately selectable in each of the six setting groups.

> TIME OVERCURRENT
>
> DEFINITE TIME

> INSTANTANEOUS
>
> NEGATIVE SEQUENCE
>
> FREQUENCY
>
> TORQUE CONTROL
>
> MISCELLANEOUS
>
> RECLOSER (optional)
>
> FAULT LOCATION

The CATEGORY column in Table 3-1 lists the category headings for the settings based on the ASCII model of the DFP100.  In addition, the ASCII command to access a particular setting category is listed directly below the category name. For instance **SET G** is the ASCII command to access the GENERAL settings.  For the GE protocol models of the DFP100, a menu-driven communications program, Mlink, is used.  The Mlink menu structure  that permits access to all of the settings is described in the **SOFTWARE** section.  The **INTERFACE** section describes how to use the local man-machine interface (MMI) and lists its associated setting abbreviations.

**Table 3-1 DFP100 Relay Settings**

| CATEGORY | SETTING NAME | RANGE | INCREMENT | DEFAULT |
|---|---|---|---|---|
| GENERAL<br>{ **SET G** } | DISABLE RELAY | 1 (YES)/0 (NO) | | NO |
| | LINE FREQUENCY | 50 (0)/60 (1) | Hertz | 60 |
| | PHASE CT RATIO | 1 - 2000 | 1 | 1 |
| | GROUND CT RATIO | 1 - 2000 | 1 | 1 |
| | VT RATIO | 1 - 2000 | 1 | 1 |
| | BREAKER NUMBER | ..................... | | 0 |
| | DEFAULT SETTINGS GROUP | 1 - 6 | 1 | 1 |
| | PHASE ROTATION | ABC/CBA | | ABC |
| | COLD LOAD PICKUP START TIME | 0 - 240.00 | 0.01 seconds | 0.01 |
| | COLD LOAD DROPOUT TIME | 0 - 240.00 | 0.01 seconds | 0.01 |
| | 52b WIRED | 1 (YES)/ 0 (N0) | | NO |
| | OPEN DELTA | YES (1)/NO (0) | | 0 (WYE-WYE) |
| BREAKER HEALTH<br>{**SET B**} | BRKR HEALTH UNITS | 0 (amp*sec.)<br>1 (amp$^2$*sec.) | | 1 (amp$^2$*sec.) |
| | BREAKER ARC TIME | 1 - 200 | 1 millisecond | 100 |
| | BREAKER HEALTH THRESH | 0 - 40,000,000 | 1 | 10,000.00 |
| INPUTS<br>{ **SET I** } | DIGITAL INPUT 1 | See Table 3-2 | | |
| | DIGITAL INPUT 2 | See Table 3-2 | | |
| | DIGITAL INPUT 3 | See Table 3-2 | | |
| | DIGITAL INPUT 4 | See Table 3-2 | | |
| | DIGITAL INPUT 5 | See Table 3-2 | | |
| OUTPUTS<br>{ **SET O** } | NOT1 | See Table 3-4 | | |
| | NOT2 | See Table 3-4 | | |
| | AND1 | See Table 3-4 | | |
| | AND2 | See Table 3-4 | | |
| | AND3 | See Table 3-4 | | |
| | AND4 | See Table 3-4 | | |
| | AND5 | See Table 3-4 | | |
| | OUT1 | See Table 3-4 | | |
| | OUT2 | See Table 3-4 | | |
| | OUT3 | See Table 3-4 | | |
| | OUT4 | See Table 3-4 | | |
| | TPU1 | 0 - 120.00 | 0.01 seconds | 0 |
| | TDO1 | 0 - 120.00 | 0.01 seconds | 0 |
| | TPU2 | 0 - 120.00 | 0.01 seconds | 0 |
| | TDO2 | 0 - 120.00 | 0.01 seconds | 0 |
| | TPU3 | 0 - 120.00 | 0.01 seconds | 0 |
| | TDO3 | 0 - 120.00 | 0.01 seconds | 0 |
| | TPU4 | 0 - 120.00 | 0.01 seconds | 0 |
| | TDO4 | 0 - 120.00 | 0.01 seconds | 0 |
| MASKS | EVENT MASKS | See Table 3-6 | | |
| | OSCILLOGRAPHY MASK | See Table 3-7 | | |

**Table 3-1  DFP100 Relay Settings (continued)**

| CATEGORY | SETTING NAME | RANGE | INCREMENT | DEFAULT |
|---|---|---|---|---|
| ACCUMULATORS<br>{**ACCUM A 0**}<br>{**ACCUM B 0**}<br>{**ACCUM C 0**} | ACCUM | 0-40,000,000 | 1 | 0 |
| PASSWORD<br>{**PASSWORD V,C,S**} | VIEW<br>CONTROL<br>SET | | | DFP_VIEW<br>DFP_CNTL<br>DFP_SETT |
| RELAY ID<br>{ **RELID C** } | RELID | 20 characters | | 0 |
| DATE<br>{**DATE mm/dd/yy** } | DATE | mm/dd/yy | | |
| TIME<br>{ **TIME hh:mm:ss** } | TIME | hh:mm:ss | | |
| LOCAL PORT<br>{ **SET P, PL** } | BAUD RATE<br><br><br><br><br>STOP BITS<br>TIME OUT | 300, 600,<br>1200, 2400,<br>4800, 9600<br>14400, 19200<br>38400, 57600<br>1,2<br>0 - 60 | <br><br><br><br>baud<br><br>1 minute | <br><br><br><br>2400<br>1<br>0 |
| REMOTE PORT<br>{ **SET P, PR** } | BAUD RATE<br><br><br><br><br>STOP BITS<br>TIME OUT | 300,600,<br>1200, 2400,<br>4800, 9600,<br>14400, 19200<br>38400, 57600<br>1, 2<br>0 - 60 | <br><br><br><br>baud<br><br>1 minute | <br><br><br><br>2400<br>1<br>0 |
| TIME OVER-<br>CURRENT<br>{ **SET** } | DISABLE PHASE TOC<br><br>CURVE PHASE TOC<br><br><br>(*) PICKUP PHASE TOC<br><br>TIME DIAL PHASE TOC<br>DISABLE GROUND TOC<br>CURVE GROUND TOC<br><br><br>(*)PICKUP GROUND TOC<br><br>TIME DIAL GROUND TOC | 1 (YES)/0 (NO)<br><br>1 (EXT INV)<br>2 (VERY INV.)<br>3 (INVERSE)<br>1.00 - 12.00<br>0.20 - 2.40<br>0.5 -10.0<br>1 (YES)/ 0(NO)<br>1 (EXT INV<br>2 (VERY INV.)<br>3 (INVERSE)<br>1.00 - 12.00<br>0.20 - 2.40<br>0.5 -10.0 | <br><br><br><br><br>0.01 amps<br>0.01 amps<br>0.1<br><br><br><br><br>0.01 amps<br>0.01 amps<br>0.1 | YES<br><br>3<br>(INVERSE)<br><br>1.00<br>0.20<br>10.0<br>YES<br>3 (INVERSE)<br><br><br>1.00<br>0.20<br>10.0 |

**Table 3-1  DFP100 Relay Settings (Continued)**

| CATEGORY | SETTING NAME | RANGE | INCREMENT | DEFAULT |
|---|---|---|---|---|
| DEFINITE TIME<br>{ **SET** } | DISABLE PHASE DT HIGH | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP PHASE DT HIGH | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY PHASE DT HIGH | 0 - 100.00 | 0.01 seconds | 0 |
| | DISABLE PHASE DT LOW | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP PHASE DT LOW | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY PHASE DT LOW | 0 - 100.00 | 0.01 seconds | 0 |
| | DISABLE GROUND DT HIGH | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP GROUND DT HIGH | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY GROUND DT HIGH | 0 - 100.00 | 0.01 seconds | 0 |
| | DISABLE GROUND DT LOW | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP GROUND DT LOW | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY GROUND DT LOW | 0 - 100.00 | 0.01 seconds | 0 |
| INSTANTANEOUS<br>{ **SET** } | DISABLE PHASE INST. HIGH | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP PHASE INST. HIGH | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY PHASE INST. HIGH | 0 - 2.00 | 0.01 seconds | 0 |
| | DISABLE PHASE INST. LOW | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP PHASE INST. LOW | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY PHASE INST. LOW | 0 - 2.00 | 0.01 seconds | 0 |
| | DISABLE GROUND INST. HIGH | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP GROUND INST. HIGH | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY GROUND INST. HIGH | 0 - 2.00 | 0.01 seconds | 0 |
| | DISABLE GROUND INST. LOW | 1 (YES) / 0 (NO) | | YES |
| | (*) PICKUP GROUND INST. LOW | 1.00 - 160.00 | 0.01 amps | 1.00 |
| | DELAY GROUND INST. LOW | 0 - 2.00 | 0.01 seconds | 0 |
| NEGATIVE<br>SEQUENCE<br>{ **SET** } | DISABLE NEG. SEQ. DT | 1 (YES)/0 (NO) | | YES |
| | (*) PICKUP NEG. SEQ. DT | 1.00 - 12.00 | 0.01 amps | 1.00 |
| | DELAY NEG. SEQ. DT | 0 - 100.00 | 0.01 seconds | 0 |
| | DISABLE NEG. SEQ. TOC | 1 (YES)/0 (NO) | | YES |
| | CURVE NEG. SEQ. TOC | 1 (EXT INV<br>2 (VERY INV.)<br>3 (INVERSE) | | 3 (INVERSE) |
| | (*) PICKUP NEQ. SEQ. TOC | 1.00 - 12.00 | 0.01 amps | 1.00 |
| | NEG. SEQ. TOC TIME DIAL | 0.5 - 10.0 | 0.1 | 10.0 |
| FREQUENCY<br>{ **SET** } | DISABLE UNDER-FREQ. UNIT 1 | 1 (YES)/0 (NO) | | YES |
| | DISABLE OVER-FREQ. UNIT 1 | 1 (YES)/0 (NO) | | YES |
| | DISABLE UNDER-FREQ. UNIT 2 | 1 (YES)/0 (NO) | | YES |
| | DISABLE OVER-FREQ. UNIT 2 | 1 (YES)/0 (NO) | | YES |
| | PICKUP UNDER-FREQ. UNIT 1 | 40.00 - 80.00 | 0.01 Hz | 40.00 |
| | PICKUP OVER-FREQ. UNIT 1 | 40.00 - 80.00 | 0.01 Hz | 80.00 |
| | DELAY FREQ. UNIT 1 | 3 - 600 | 1 cycle | 10 |
| | PICKUP UNDER-FREQ. UNIT 2 | 40.00 - 80.00 | 0.01 Hz | 40.00 |
| | PICKUP OVER-FREQ. UNIT 2 | 40.00 - 80.00 | 0.01 Hz | 80.00 |
| | DELAY FREQ. UNIT 2 | 3 - 600 | 1 cycle | 10 |
| | VOLTAGE SUPV. THRESHOLD | 35 - 95 | 1% | 35 |

**Table 3-1 DFP100 Relay Settings (Continued)**

| CATEGORY | SETTING NAME | RANGE | INCREMENT | DEFAULT |
|---|---|---|---|---|
| TORQUE | GROUND TORQUE CONTROL SIGNAL | 0  (DISABLED) | | 0 (DISABLED) |
| CONTROL { **SET** } | | 1  (EXTERNAL)<br>2  (67N) | | |
| | (*)NEGATIVE SEQUENCE LEVEL | 0.10 - 2.00 | 0.01 A | 1.0 |
| | PHASE TORQUE CONTROL SIGNAL | 0  (DISABLED) | | |
| | | 1 (EXTERNAL)<br>2  (21PT)<br>3  (27)<br>4  (50PL) | | 0 |
| | 21PT SIGNAL | 0  (DISABLED)<br>1  (OR)<br>2  (AND) | | 0 |
| | (**)21PT REACH | 0.05 - 50.00 | 0.01 ohms | 5.00 |
| | 21PT ANGLE | 10.0 - 90.0 | 0.1 degrees | 85.0 |
| | 59 OV PICKUP | 40.00 - 150.00 | 0.01 volts | 100 |
| | 27 UV PICKUP | 40.00 - 150.00 | 0.01 volts | 50 |
| | 59 TIME DELAY | 0 - 240.00 | 0.01 seconds | 0.20 |
| | 27 TIME DELAY | 0 - 240.00 | 0.01 seconds | 0.20 |
| MISCELLANEOUS | DEMAND INTERVAL | 1(15),2(30),60(3) | minutes | 1 (60) |
| { **SET** } | BREAKER FAIL TIME | 0.05 - 2.00 | 0.01 seconds | 0.50 |
| | FAILURE TO CLOSE TIME | 0.05 - 240.00 | 0.01 seconds | 1.00 |
| | TRIP MASK | See Table 3-4 | | |
| RECLOSER | DISABLE RECLOSER | 1 (YES)/0 (NO) | | YES |
| { **SET** } | 52/b RECLOSE INITIATE | 1 (YES)/0(NO) | | NO |
| | NUMBER OF RECLOSURES | 1 - 4 | 1 | 3 |
| | NUMBER OF REPETITIVE TRIPS | 1 - 50 | 1 | 30 |
| | RESET TIME | 1.00 - 600.00 | 0.01 seconds | 60.00 |
| | DISABLE HOLD | 1 (YES)/0 (NO) | | YES |
| | HOLD TIME | 0 - 100.00 | 0.01 seconds | 10.00 |
| | (***)RECLOSE 1 DELAY | 0.0 - 600.00 | 0.01 seconds | 5.00 |
| | (***)RECLOSE 2 DELAY | 0.0 - 600.00 | 0.01 seconds | 10.00 |
| | (***)RECLOSE 3 DELAY | 0.0 - 600.00 | 0.01 seconds | 15.00 |
| | (***)RECLOSE 4 DELAY | 0.0 - 600.00 | 0.01 seconds | 20.00 |
| | TRIP MASK AFTER RECLOSE 1 | See Table 3-8 | 16 bits | FFh |
| | TRIP MASK AFTER RECLOSE 2 | See Table 3-8 | 16 bits | FFh |
| | TRIP MASK AFTER RECLOSE 3 | See Table 3-8 | 16 bits | FFh |

**Table 3-1 DFP100 Relay Settings (Continued)**

| CATEGORY | SETTING NAME | RANGE | INCREMENT | DEFAULT |
|---|---|---|---|---|
| | TRIP MASK AFTER RECLOSE 4 | See Table 3-8 | 16 bits | FFh |
| | RECLOSE 1 INITIATE MASK | See Table 3-8 | 16 bits | FFh |
| | RECLOSE 2 INITIATE MASK | See Table 3-8 | 16 bits | FFh |
| | RECLOSE 3 INITIATE MASK | See Table 3-8 | 16 bits | FFh |
| | RECLOSE 4 INITIATE MASK | See Table 3-8 | 16 bits | FFh |
| FAULT LOCATION { **SET** } | (\*\*)POSITIVE SEQUENCE MAGNITUDE | 0.05 -50.00 | 0.01 ohms | 5.00 |
| | POSITIVE SEQUENCE IMPEDANCE ANGLE | 10.0 - 90.0 | 0.1 degrees | 85.0 |
| | K0 RATIO (\|Z0\|/\|Zp\|) | 0.5 - 7.0 | 0.1 | 3.0 |
| | ZERO SEQUENCE IMPEDANCE ANGLE | 10.0 - 90.0 | 0.1 | 85.0 |
| | LINE LENGTH UNITS | 0(Miles) 1 (KM) | | 0 (Miles) |
| | LINE LENGTH | 1.0 - 200.0 | 0.1 Mi or Km | 10.0+ |
| RECLOSURES | RECLOSURES | 0-99,999 | 1 | 0 |
| REPETITIVE TRIPS | TRIPCOUNT | RESET | RESET (0) | 0 |

**(\*) Note:  For models having a nominal 1-amp secondary rating, the ranges and default values for these settings should be divided by 5.  <u>All settings are in secondary amps.</u>**

**(#) Note:  The range for BRKR HEALTH THRESHOLD is given in terms of secondary current.  The DFP100 displays the range in terms of primary current by multiplying by the CT ratio or the CT ratio squared depending on the BRKR HEALTH UNITS  selected.**

**(\*\*) For models having a nominal 1-amp secondary rating, the ranges and default values should be multiplied by 5.**

**(\*\*\*) Minimum setting is 0.1 seconds for version 4.1 Proms or earlier.**

## General Settings

**Disable Relay -** This setting is used to enable or disable all of the DFP100 protective functions. When it is set to "YES" all the output contacts are disabled.   When set to "NO" all the output contacts are enabled.  Manual opening or closing of the breaker is not permitted when the relay is disabled.

**Frequency** - The setting is used to specify the frequency of the power system that the relay is operating on.  The setting range is 50 Hz or 60 Hz.

**Phase CT Ratio** - This setting is used to specify the primary-to-secondary ratio of the phase current transformers connected to the DFP100 relay.  A phase CT ratio of 1200/5, for example, would be entered as 240.  The range is 1 -2000.

**Ground CT Ratio -** This setting is used to specify the  primary-to-secondary  ratio  of  the  ground current transformer connected to the DFP100 relay.  If the ground current coil is connected in the  residual  circuit  formed  by  wye  connected phase CTs, then this setting is equal to the phase CT ratio.  The setting range is 1 - 2000.

**VT Ratio** - This setting is used to specify the primary-to-secondary ratio of the voltage inputs to the DFP100.  The setting range is 1 - 2000.

**Breaker Number -** This setting allows the user to enter  into the DFP100, a number designation for the breaker associated with the relay.  The setting range is 0 - 9999.

**Default Settings Group -** This setting determines which of the six setting groups is the active group. The range is 1 - 6.

**Cold Load Pickup Delay -** This is the time delay following breaker opening after which the active settings group is switched to group #6.  The range is 0 - 240 seconds.

**Cold Load Dropout Delay -** This is the time delay following breaker closing after which the active settings group is switched from group #6 to the default settings group. Setting both the cold load pickup delay and the cold load dropout delay to zero disables the function.

**52b Wired** - This setting is used to indicate to the relay whether it should monitor the status of digital input 6 which is dedicated to the 52b contact for breaker status.

**Potential Transformer Connection** - This setting reflects the connection of the voltage transformers wired to the DFP100. It permits the DFP100 to perform the proper calculations and display the proper information whether the external VT's are connected in the Open-delta or Wye-Wye configuration.

**Phase Rotation -** This setting determines the normal (positive-sequence) phase rotation, ABC or CBA. This permits the DFP100 to perform the proper calculations and display the proper information while maintaining the same external wiring to the relay regardless of phase rotation.

### Breaker Health Settings

**Breaker Health Units -** The breaker health accumulations can be expressed as either amp*seconds or amp$^2$*seconds.

**Breaker Arc Time -** This setting determines the time interval T in the I*T or I$^2$*T calculations. Ideally, it should be set to reflect the actual arcing time of the main contacts. If this value is not known, then a compromise position is to use the breaker opening time. The range is 1 - 200 milliseconds.

**Breaker Health Thresh -** This setting is the threshold for the accumulated I*T or I$^2$*T values used to determine whether or not a breaker health alarm condition exists. The range is 0 - 40,000,000 I*T or I$^2$*T. There is an accumulated value for each phase current. If any of the three phase values exceeds 80% of the **Breaker Health Thresh** setting, a breaker health alarm is indicated by the target LED and the alarm output contact.

### Digital Input Settings

**Digital Input 1 - 5 -** These settings determine how the five digital inputs (contact converters) are used. Table 3-2 lists the allowable digital input assignments. Each digital input may be given one and only one assignment at a time. If the setting is 0, the digital input is disabled.

The Reclose Block (ASCII Command 11) and Reclose Unblock ASCII Command 13) digital input selections must be used together. A momentary closure of an external contact converter on the Recloser Block digital input will send the relcoser to the lockout state. A momentary closure of an external contact on the Recloser Unblock digital input will send the recloser to the reset state.

### Configurable Output Settings

The following settings are used to determine which function pickup, trip, or control signals are to be used together with combinational logic to operate the four configurable outputs. As shown functionally in Figure 3-1, each output is driven by a 16 input OR followed by a timer with user selected pickup and dropout times. The inputs, A1 - A16, to each OR consist of pickup, trip, and control signals as well as AND and NOT operators.

There are a maximum of six 2-input AND operators and two single input NOT operators. These must be shared with all four outputs. If four of the AND operators are used as inputs to the OR associated with output 1, then only two AND operators remain to be used with the other three outputs. Each AND has only two inputs. The AND and NOT gates can be cascaded by following the hierarchy which is shown in Table 3-3. As shown in the table, any AND gate, NOT gate, PICKUP, TRIP, or CONTROL Signal can be used for AND6 except for itself, while AND1 can only use the NOT gates, PICKUP, TRIP or CONTROL signals for inputs. No gate output can be an input for itself.

A sample expression for the NOT, AND, and OUT settings are:

    NOT1 = A1
    NOT2 = A2

AND1 = A1*A2
(same for AND2, AND3, AND4, AND5, AND 6)
OUT1 = A1 + A2 + A3 + A4 + A5 + A6 + A7 + A8 +A9 + A10 + A11 + A12 + A13 + A14 + A15 +A16
(similar for OUT2, OUT3, OUT4)

A1*A2 expresses the logical AND of inputs A1 and A2.  A1 + A2 expresses the logical OR of inputs A1 and A2.  The inputs A1, A2, ........ A16 may be any of the PICKUP, TRIP, or CONTROL signals listed in Table 3-4.
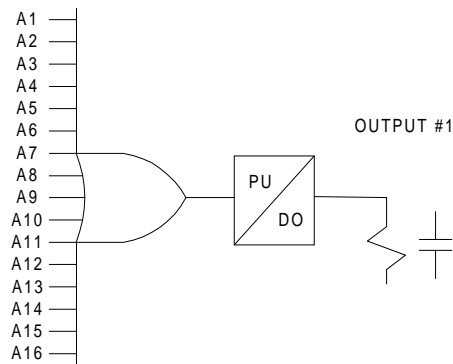


**Figure 3-1 Combinational Logic for Outputs #1, #2, #3, and #4**

## Mask Settings

**Event Masks** - Determines which functions are allowed to trigger system events.  The items are selected by placing a "1" in the event mask bit that corresponds to the function.  The items selectable for the event mask are shown in Table 3-6.

**Oscillography Masks** - Determines which functions are allowed to trigger oscillography captures.  The items are selected by placing a "1" in the Oscillography  mask bit that corresponds to the function.  The items selectable for the oscillography mask are shown in Table  3-7.

**Table 3-2 Possible Digital Input (Contact Converter) Assignments**

| NAME | ASCII Command | DESCRIPTION |
|---|---|---|
| DISABLE | 0 | Disables the digital input |
| SET GROUP BIT 0 | 1 | These three bits select the active settings group as indicated below: |
| SET GROUP BIT 1 | 2 | bit 2    bit 1    bit 0    active settings group |
| SET GROUP BIT 2 | 3 | 0    0    0    Default |
| | | 0    0    1    1 |
| | | 0    1    0    2 |
| | | 0    1    1    3 |
| | | 1    0    0    4 |
| | | 1    0    1    5 |
| | | 1    1    0    6 |
| | | 1    1    1    1 |
| TRIP CKT MON | 4 | Digital input senses the voltage across an open TRIP contact as part of the Trip Circuit Monitor function |
| DIRECT TRIP | 5 | Closure of external contact trips the breaker via the TRIP output |
| DIRECT CLOSE | 6 | Closure of external contact closes the breaker via the CLOSE output |
| TORQUE CNTL PHASE | 7 | Closure of external contact disables the phase and negative sequence overcurrent functions |
| TORQUE CNTL GND | 8 | Closure of external contact disables the ground overcurrent functions |
| OSC TRIGGER | 9 | Closure of external contact triggers oscillography capture |
| RECLOSE PAUSE | 10 | Closure of external contact forces the recloser to LOCKOUT state if the contact stays closed for the HOLD time |
| RECLOSE BLOCK | 11 | Reclose Block - momentary closure of external contact forces the recloser to the LOCKOUT state |
| RECLOSE INITIATE | 12 | External Reclose Initiate |
| RECLOSE UNBLOCK | 13 | Reclose Unblock - momentary closure of external contact forces the recloser to the RESET state if the breaker is closed |

**Table 3-3 Configurable Logic Hierarchy**

| LOGIC GATE | AVAILABLE INPUT SIGNALS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | PICKUPS | TRIPS | CONTROL | NOT1 | NOT2 | AND1 | AND2 | AND3 | AND4 | AND5 | AND6 |
| NOT1 | X | X | X | | | | | | | | |
| NOT2 | X | X | X | | | | | | | | |
| AND1 | X | X | X | X | X | | | | | | |
| AND2 | X | X | X | X | X | X | | | | | |
| AND3 | X | X | X | X | X | X | X | | | | |
| AND4 | X | X | X | X | X | X | X | X | | | |
| AND5 | X | X | X | X | X | X | X | X | X | | |
| AND6 | X | X | X | X | X | X | X | X | X | X | |

**Table 3-4 Pickup, Trip, & Control Signals For Configurable Logic**

| PICKUP | DESCRIPTION |
| --- | --- |
| 81O2_P | Over frequency unit 2 (81OT2) |
| 81O1_P | Over frequency unit 1 (81OT1) |
| 81U2_P | Under frequency unit 2 (81UT2) |
| 81U1_P | Under frequency unit 1 (81UT2) |
| 46D_P | Negative-sequence definite time overcurrent (46PD1) |
| 46T_P | Negative-sequence inverse time overcurrent (46PT) |
| 51N2_P | Ground definite time overcurrent, LOW (51ND2) |
| 51N1_P | Ground definite time overcurrent, HIGH (51ND1) |
| 51N_P | Ground inverse time overcurrent (51NT) |
| 51P2_P | Phase definite time overcurrent, LOW (51PD2) |
| 51P1_P | Phase definite time overcurrent, HIGH (51PD1) |
| 51P_P | Phase inverse time overcurrent (51PT) |
| **TRIP** | **DESCRIPTION** |
| 81O2_T | Over frequency unit 2 (81OT2) |
| 81O1_T | Over frequency unit 1 (81OT1) |
| 81U2_T | Under frequency unit 2 (81UT2) |
| 81U1_T | Under frequency unit 1 (81UT1) |
| 46D_T | Negative-sequence definite time overcurrent (46PD1) |
| 46T_T | Negative-sequence inverse time overcurrent (46PT) |
| 50NL_T | Ground instantaneous overcurrent, LOW (50NL) |
| 50NH_T | Ground instantaneous overcurrent, HIGH (50NH) |
| 50PL_T | Phase instantaneous overcurrent, LOW(50PL) |
| 50PH_T | Phase instantaneous overcurrent, HIGH (50PH) |
| 51N2_T | Ground definite time overcurrent, LOW (51ND2) |
| 51N1_T | Ground definite time overcurrent, HIGH (51ND1) |
| 51N_T | Ground inverse time overcurrent (51NT) |
| 51P2_T | Phase definite time overcurrent, LOW (51PD2) |
| 51P1_T | Phase definite time overcurrent, HIGH (51PD1) |
| 51P_T | Phase inverse time overcurrent (51PT) |
| **CONTROL** | **DESCRIPTION** |
| 21PT | Mho phase distance function |
| 67N | Negative Sequence Directional |
| 59 | Overvoltage |
| 27 | Undervoltage |
| TRIP | Trip (internal trips) |
| 79RST | Recloser reset timer on |
| 79CLE | Reclose cycle in progress |
| 79LCK | Recloser at lockout state |
| TCM | Trip circuit monitor event |
| OEBRK | Fail to open external Inputs |
| CLBRK | Fail to close for external command |
| OIBRK | Fail to open for internal command |

**Table 3-4 Pickup, Trip, & Control Signals For Configurable Logic(Cont.)**

| CONTROL | DESCRIPTION |
|---------|-------------|
| CC1 * | Logic State of Contact Converter 1 |
| CC2 * | Logic State of Contact Converter 2 |
| CC3 * | Logic State of Contact Converter 3 |
| CC4 * | Logic State of Contact Converter 4 |
| CC5 * | Logic State of Contact Converter 5 |
| CC6 * | Logic State of Contact Converter 6 |
| AND1 | Output of AND1 |
| AND2 | Output of AND2 |
| AND3 | Output of AND3 |
| AND4 | Output of AND4 |
| AND5 | Output of AND5 |
| AND6 | Output of AND6 |
| NOT1 | Output of NOT1 |
| NOT2 | Output of NOT2 |

*These inputs were introduced with version 4.0 Proms

### Accumulator Settings

**Accum** - The breaker health accumulators can be displayed by typing the ACCUM command for the ASCII models. The settings for each phase can be set or reset by entering ACCUM {Phase} {Value}. For example, to reset the accumulator for phase A enter ACCUM A 0. The range is 0 - 40,000.

### Password Settings

For the ASCII models of the DFP100, three levels of passwords are used to restrict access to the relay. There are passwords that allow user access to the relay to view settings, control breaker, and change settings. are used. Refer to the **SOFTWARE** section of this book under **ASCII** for a description of how to use these passwords. The following settings do not pertain to GE-Modem protocol models of the DFP100. Refer to the **SOFTWARE** section of this book under **GE Modem Protocol** for a description of how the M-Link communications program handles passwords.

### Relay Id Setting

**Relay ID -** This setting allows the user to set a unique identification for each DFP100. The setting range is a 28 character ASCII string.

### Date Setting

**Date -** The date can be changed by entering the desired date in the month/day/year format.

### Time Setting

**Time -** The time can be changed by entering the desired time in the hour/minute/second format.

### Local Port Settings

**Baud Rate -** This setting determines the baud rate for the two physical serial ports labeled PORT 1 (front panel) and PORT 2 (rear panel). The range is 300 to 19,200 baud.

**Stop Bits -** This setting determines the stop bits for the two physical serial ports labeled PORT 1 (front panel) and PORT 2 (rear panel). The

range is 1 or 2.

**Time Out -** This setting determines the login time-out for the two physical serial ports labeled PORT 1 (front panel) and PORT 2 (rear panel). When logged into the DFP100 relay, an automatic logout will occur if there is no serial link activity for the time interval determined by Time Out. The range is 0 - 60 minutes. A setting of "0" prevents the automatic logout function.

## Remote Port Settings

The same settings for LOCAL PORT except that they pertain to the port labeled PORT 3 (back panel. This setting is valid for all communication options (RS232, RS485, Fiber Optic) available for the communications port.

## Time Overcurrent Settings

**Disable Phase TOC -** Enables (NO) or disables (YES) the Phase TOC function.

**Phase TOC Curve -** This setting selects between the Inverse, Very Inverse, and Extremely Inverse curve shapes. The curves shapes are defined in the **DESCRIPTION** section of this book.

**Pickup Phase TOC -** This setting establishes the pickup level of the Phase TOC function. The range is 1.00 - 12.00 or 0.20 - 2.40 amps RMS.

**Phase TOC Time Dial -** This setting establishes the time dial value of the Phase TOC function. The range is 0.5 - 10.0.

**Disable Ground TOC -** Enables (NO) or disables (YES) the Ground TOC function.

**Ground TOC Curve -** This setting selects between the Inverse, Very Inverse, and Extremely Inverse curve shapes. The curves shapes are defined in the **DESCRIPTION** section of this book.

**Pickup Ground TOC -** This setting establishes the pickup level of the ground TOC function. The range is 1.00 - 12.00 or 0.20 - 2.40 amps RMS.

**Ground TOC Time Dial -** This setting establishes the time dial value of the ground

TOC function. The range is 0.5 - 10.0.

## Definite Time Overcurrent Settings

**Disable Phase DT High -** Enables (NO) or disables (YES) the Phase DT High function.

**Pickup Phase DT High -** This setting establishes the pickup level of the Phase DT High function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS depending on the model number.

**Delay Phase DT High -** This setting establishes the pickup delay of the Phase DT High function. The range is 0 - 100.00 seconds.

**Disable Phase DT Low -** Enables (NO) or disables (YES) the Phase DT Low function.

**Pickup Phase DT Low -** This setting establishes the pickup level of the Phase DT Low function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS depending on the model number.

**Delay Phase DT Low -** This setting establishes the pickup delay of the Phase DT Low function. The range is 0 - 100.00 seconds.

**Disable Ground DT High -** Enables (NO) or disables (YES) the Ground DT High function.

**Pickup Ground DT High -** This setting establishes the pickup level of the Ground DT High function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS.

**Delay Ground DT High -** This setting establishes the pickup delay of the Ground DT High function. The range is 0 - 100.00 seconds.

**Disable Ground DT Low -** Enables (NO) or disables (YES) the Ground DT Low function.

**Pickup Ground DT Low -** This setting establishes the pickup level of the Ground DT Low function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS.

**Delay Ground DT Low -** This setting establishes the pickup delay of the Ground DT Low function. The range is 0 - 100.00 seconds.

## Instantaneous Overcurrent Settings

**Disable Phase Inst. High -** Enables (NO) or disables (YES) the Phase Inst. High function.

**Pickup Phase Inst. High -** This setting establishes the pickup level of the Phase Inst. High function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS.

**Delay Phase Inst. High -** This setting establishes the pickup delay of the Phase Inst. High function. The range is 0 - 100.00 seconds.

**Disable Phase Inst. Low -** Enables (NO) or disables (YES) the Phase Inst. Low function.

**Pickup Phase Inst. Low -** This setting establishes the pickup level of the Phase Inst. Low function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS .

**Delay Phase Inst. Low -** This setting establishes the pickup delay of the Phase Inst. Low function. The range is 0 - 100.00 seconds.

**Disable Ground Inst. High -** Enables (NO) or disables (YES) the Ground Inst. High function.

**Pickup Ground Inst. High -** This setting establishes the pickup level of the Ground Inst. High function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS.

**Delay Ground Inst. High -** This setting establishes the pickup delay of the Ground Inst. High function. The range is 0 - 100.00 seconds.

**Disable Ground Inst. Low -** Enables (NO) or disables (YES) the Ground Inst. Low function.

**Pickup Ground Inst. Low -** This setting establishes the pickup level of the Ground Inst. Low function. The range is 1.00 - 160.00 amps RMS or 0.2 - 32 amps RMS.

**Delay Ground Inst. Low -** This setting establishes the pickup delay of the Ground Inst. Low function. The range is 0 - 100.00 seconds.

### Negative Sequence Overcurrent Settings

**Disable Neg. Seq. DT -** Enables (NO) or disables (YES) the Neg. Seq. DT function.

**Pickup Neg. Seq. DT -** This setting establishes the pickup level of the Neg. Seq. DT function. The range is 1.00 - 160.0 amps RMS or 0.2 - 32.0 amps RMS.

**Delay Neg. Seq. DT -** This setting establishes the pickup delay of the Neg. Seq. DT function. The range is 0 - 100.00 seconds.

**Disable Neg. Seq. TOC -** Enables (NO) or disables (YES) the Neg. Seq. TOC function.

**Neg. Seq. TOC Curve -** This setting selects between the Inverse, Very Inverse, and Extremely Inverse curve shapes. The curves shapes are defined in the **DESCRIPTION** section of this book.

**Pickup Neg. Seq. TOC -** This setting establishes the pickup level of the Neg. Seq. TOC function. The range is 1.00 - 12.00 amps RMS or 0.2 - 2.4 amps RMS.

**Neg. Seq. TOC Time Dial -** This setting establishes the time dial value of the Neg. Seq. TOC function. The range is 0.5 - 10.0.

### Over/Under Frequency Settings

**Disable Under-Freq. Unit 1 -** Enables (NO) or disables (YES) the Under-frequency Unit #1 function.

**Disable Over-Freq. Unit 1 -** Enables (NO) or disables (YES) the Over-frequency Unit #1 function.

**Disable Under-Freq. Unit 2 -** Enables (NO) or disables (YES) the Under-frequency Unit #2 function.

**Disable Over-Freq. Unit 2 -** Enables (NO) or disables (YES) the Over-frequency Unit #2 function.

**Pickup Under-Freq. Unit 1 -** Determines the frequency at which the Unit 1 under frequency function will pickup. The range is 40.00 - 80.00 Hertz.

**Pickup Over-Freq. Unit 1 -** Determines the frequency at which the Unit 1 over frequency function will pickup. The range is 40.00 - 80.00 Hertz.

**Delay Freq. Unit 1 -** Determines the time delay following pickup after which frequency unit 1 will produce an output. This time delay is common to both the under and over frequency functions. The range is 3 - 600 cycles.

**Pickup Under-Freq. Unit 2 -** Determines the frequency at which the Unit 2 under frequency function will pickup. The range is 40.00 - 80.00 Hertz.

**Pickup Over-Freq. Unit 2 -** Determines the frequency at which the Unit 2 over frequency function will pickup. The range is 40.00 - 80.00 Hertz.

**Delay Freq. Unit 2 -** Determines the time delay following pickup after which frequency unit 2 will produce an output. This time delay is common to both the under and over frequency functions. The range is 3 - 600 cycles.

**Voltage Supv. Threshold -** Determines the minimum voltage for which all four frequency functions will operate. If the voltage drops below this setting, then none of the frequency functions will operate. The range is 35% - 95% times the nominal voltage rating.

### Torque Control Settings

**Ground Torque Control Signal -** Determines which functions is designated as the ground torque control signal. If set to 0 (DISABLED), no ground torque control signal is generated. If set to 1 (EXTERNAL), the torque control signal is defined via the **INPUTS** setting category (see Table 3-2). If set to 2 (67N) the negative sequence directional function is used to torque control the ground overcurrent functions.

**Negative Sequence Level -** Setting used to add a restraint bias for the negative sequence directional function. This restraint bias is added when an associated when the level of negative sequence current present in the system is below this setting. When this overcurrent function operates, indicating a system fault or disturbance, the restraint bias is removed. This setting must be set as sensitively as possible, but it must be set above the value of negative sequence current present due to imbalance load and unsymmetrical feeder impedances. The range of this setting is 0.10 to 2.00 A for 5 A CT's or 0.02 to 0.4 for 1 A CT's.

**Phase Torque Control Signal -** Determines which function is designated as the phase torque

control signal. If set to 0 (DISABLED), no torque control signal is generated. If set to 1 (EXTERNAL), the torque control signal is defined via the **INPUTS** setting category (see Table 3-2). If set to 2 (21PT), then the phase mho distance functions are used to torque control the phase overcurrent functions only. If set to 3 (27), then torque control of the phase overcurrent functions only occurs when the applied voltage is below the 27 setting. If set to 4 (50PL), then the low-set phase instantaneous overcurrent function torque controls the other phase overcurrent functions only.

**21PT Signal -** Determines whether the three distance functions are ORed or ANDed to produce the torque control signal when Torque Control Signal = 2 (21PT). The three possible settings are 0 (DISABLED), 1 (OR), and 2 (AND).

**21PT Reach -** Determines the reach of the distance function. The range is 0.05 - 50 ohms (secondary) for models with 5A CTs, or 0.25 - 250 ohms (secondary) for models with 1A CTs.

**59 OV Pickup -** Determines the pickup level for the over-voltage unit. The range is 40-150 Vrms. The overvoltage unit operates on the measured phase-to-neutral voltage for wye-wye connected VTs or the calculated phase-to-neutral positive sequence voltage for open-delta connected VTs.

**27 UV Pickup -** Determines the pickup level for the under-voltage unit. The range is 40 - 150 Vrms. The undervoltage unit operates on the measured phase-to-neutral voltage for wye-wye connected VTs or the calculated phase-to-neutral positive sequence voltage for open-delta connected VTs.

### Miscellaneous Settings

**Demand Interval -** Determines the time interval over which the maximum and average RMS current is stored. The range is 15, 30, or 60 minutes, for the last 24, 48 or 96 hours.

**Breaker Failure Time (fail to open time)** - This setting establishes the time that the relay expects the breaker to open. The operating

time of the breaker is determined by monitoring the status of the 52/b contact through digital input #6. If the 52/b input is not energized by the Fail to Open time after a trip or manual open by the user, the DFP will log a Failure to Open event. The range for this setting is 0.050 to 2.00 seconds.

**Fail to Close Time** - This setting establishes the time that the relay expects the breaker to close. The operating time of the breaker is determined by monitoring the status of the 52/b contact through digital input #6. If a Close Breaker command is given by either the Recloser or the user, the DFP Close contact will remain closed until the 52/b input is de-energized or the Fail to Close time expires. The failure to close will cause the Recloser to go to lockout and log a Failure to Close event. The range for this setting is 0.050 to 240.0 seconds.

**Trip Mask** - Determines which protection functions are allowed to activate the trip contact outputs. The items are selected by placing a "1" in the trip mask word that corresponds to the function. The items selectable for the trip mask are shown in Table 3-5.

**Table 3-5 Trip Masks**

| TRIP | DESCRIPTION |
|------|-------------|
| 81O2 | Over frequency unit 2 |
| 81O1 | Over frequency unit 1 |
| 81U2 | Under frequency unit 2 |
| 81U1 | Under frequency unit 1 |
| 46D | Negative-sequence definite TOC |
| 46T | Negative-sequence TOC |
| 50NL | Ground IOC Lowset |
| 50NH | Ground IOC High-set |
| 50PL | Phase IOC Low-set |
| 50PH | Phase IOC High-set |
| 51N2 | Ground Definite TOC Unit 2 |
| 51N1 | Ground Definite TOC Unit 1 |
| 51N | Ground Inverse TOC |
| 51P2 | Phase Definite TOC Unit 2 |
| 51P1 | Phase Definite TOC Unit 1 |
| 51P | Phase Inverse TOC |

### Recloser Settings

**Disable Recloser** - Determines whether the recloser is enabled of disabled. The range is 0(No) or 1(Yes).

**52/b Reclose Initiate** - Allows or disallows the initiation of a reclose cycle based on the status of the 52/b contact. The range is 0(No) of 1(Yes).

**Number of Reclosures** - Determines the number of reclosures within a reclose cycle. The range is 1-4.

**Number of Repetitive Trips** - Determines the maximum number of trips allowed before operator intervention. The range is 1 - 50. This item is reset using the TRIPCOUNT command.

**Reset Time** - Determines the reset time for the recloser. The range is 1.00-600.00 seconds.

**Disable Hold** - Enables or disables the hold function of the recloser. The range is 0(No) - 1(Yes).

**Hold Time** - Determines the amount of time to hold within a reclose cycle. The range is 0.00 - 100.00 seconds.

**Reclose 1-4 Delay** - Determines the amount of time to delay before initiating a reclose of the breaker. The range is 0.10 to 600.00 seconds.

**Reclose Initiate Mask 1-4** - Determines which protection functions are allowed to initiate a reclose cycle. The items are selected by placing a "1" in the trip mask word that corresponds to the function. The items selectable for the trip mask are shown in Table 3-8

**Trip Mask After Reclose 1-4** - Determines which protection functions are allowed to activate the trip contact outputs after each of the reclosures. The items are selected by placing a "1" in the trip mask word that corresponds to the function. The items selectable for the trip mask are shown in Table 3-8

### Fault Location Settings

**Positive Sequence Impedance -** Determines the positive sequence impedance of the line. It is used for the 67N and the Fault Location functions. The range is 0.05 - 50ohms (secondary) for models with 5A CTs, or 0.25 -

250 ohms (secondary) for models with 1A CTs.

**Positive-Sequence Impedance Angle -** Determines the positive sequence angle of the line. It also sets the angle of maximum reach for the distance function (21PT). The range is 10 - 90 degrees

**Zero-Sequence Current Compensation, K0 -** Determines the amount of zero-sequence current fed back into the distance functions to provide "self compensation ." The range is 0.5 to 7.0. It should be set for :

$$K0 = Z0L/Z1L$$

Where:    Z0L = zero-sequence impedance of the line

Z1L = positive-sequence impedance of the line

**Line Length Units -** Determines the units for displaying the distance to fault information. The range is Miles or Kilometers.

**Line Length -** Determines the length of line in miles or Kilometers. The range is 1.0 to 200.0 MI or KM.

**Table 3-6 Event Masks**

| # | DESCRIPTION | # | DESCRIPTION |
|---|---|---|---|
| 1 | THREE PASSWORD FAIL | 49 | |
| 2 | EVENTS ERASED | 50 | |
| 3 | COUNTERS CHANGED | 51 | |
| 4 | BREAKER CLOSED | 52 | |
| 5 | BREAKER OPENED | 53 | |
| 6 | GROUP CHANGE BY DIGITAL INPUT | 54 | |
| 7 | SETTINGS CHANGE | 55 | |
| 8 | PROGRAM START | 56 | |
| 9 | | 57 | |
| 10 | | 58 | |
| 11 | | 59 | |
| 12 | GROUP CHANGE BY COLD LOAD PICKUP | 60 | |
| 13 | RESET BY PASSWORD | 61 | |
| 14 | SET DATE AND TIME | 62 | |
| 15 | DEFAULT SETTINGS | 63 | |
| 16 | EVENT BY COMM TRIGGER | 64 | |
| 17 | | 65 | |
| 18 | | 66 | |
| 19 | GROUP CHANGE AFTER COLD LOAD P/U | 67 | |
| 20 | END OF FAULT | 68 | |
| 21 | RECLOSE INITIATE | 69 | |
| 22 | REMOTE UNBLOCK COMMAND | 70 | EEPROM FAILURE |
| 23 | REMOTE BLOCK COMMAND | 71 | POWER SUPPLY FAILURE |
| 24 | OSC. TRIGGER BY EXT. INPUT | 72 | A/D VREF FAILURE |
| 25 | | 73 | BREAKER MAINTENANCE DUE |
| 26 | | 74 | CURRENT WITH BREAKER OPEN |
| 27 | | 75 | TRIPS INHIBITED |
| 28 | | 76 | CLOCK STOPPED |
| 29 | | 77 | RELAY DISABLE |
| 30 | | 78 | |
| 31 | | 79 | |
| 32 | | 80 | |
| 33 | | 81 | PICKUP 50PL |
| 34 | | 82 | PICKUP 50PH |
| 35 | EXTERNALLY INITIATED RECLOSE | 83 | PICKUP 51N2 |
| 36 | RECLOSER BLOCKED LOCALLY | 84 | PICKUP 51N1 |
| 37 | RECLOSER BLOCKED REMOTELY | 85 | PICKUP 51N |
| 38 | RECL. BLOCKED BY REPETITIVE TRIP | 86 | PICKUP 51P2 |
| 39 | RECLOSER LOCKOUT | 87 | PICKUP 51P1 |
| 40 | | 88 | PICKUP 51P |
| 41 | DIGITAL INPUT 1 ACTIVE | 89 | PICKUP 81O2 |
| 42 | DIGITAL INPUT 2 ACTIVE | 90 | PICKUP 81O1 |
| 43 | DIGITAL INPUT 3 ACTIVE | 91 | PICKUP 81U2 |
| 44 | DIGITAL INPUT 4 ACTIVE | 92 | PICKUP 81U1 |
| 45 | DIGITAL INPUT 5 ACTIVE | 93 | PICKUP 46D |
| 46 | 52B INPUT ACTIVE | 94 | PICKUP 46T |
| 47 | | 95 | PICKUP 50NL |
| 48 | | 96 | PICKUP 50NH |

**Table 3-6  Event Masks (continued)**

| # | DESCRIPTION |
|---|---|
| 97 | TRIP 50PL |
| 98 | TRIP 50PH |
| 99 | TRIP 51N2 |
| 100 | TRIP 51N1 |
| 101 | TRIP 51N |
| 102 | TRIP 51P2 |
| 103 | TRIP 51P1 |
| 104 | TRIP 51P |
| 105 | TRIP 81O2 |
| 106 | TRIP 81O1 |
| 107 | TRIP 81U2 |
| 108 | TRIP 81U1 |
| 109 | TRIP 46D |
| 110 | TRIP 46T |
| 111 | TRIP 50NL |
| 112 | TRIP 50NH |
| 113 | |
| 114 | |
| 115 | |
| 116 | |
| 117 | TRIP CIRCUIT FAILURE |
| 118 | FAILURE TO EXTERNAL OPEN CMD |
| 119 | FAILURE TO CLOSE CMD |
| 120 | FAILURE TO OPEN COMMAND |
| 121 | |
| 122 | |
| 123 | |
| 124 | |
| 125 | |
| 126 | |
| 127 | |
| 128 | |

**Note:  A blank next to a number indicates that there is no event associated with that number.**

**Table 3-7 Oscillography Masks**

| # | DESCRIPTION |
|---|---|
| 1 | PICKUP 50PL |
| 2 | PICKUP 50PH |
| 3 | PICKUP 51N2 |
| 4 | PICKUP 51N1 |
| 5 | PICKUP 51N |
| 6 | PICKUP 51P2 |
| 7 | PICKUP 51P1 |
| 8 | PICKUP 51P |
| 9 | PICKUP 81O2 |
| 10 | PICKUP 81O1 |
| 11 | PICKUP 81U2 |
| 12 | PICKUP 81U1 |
| 13 | PICKUP 46D |
| 14 | PICKUP 46T |
| 15 | PICKUP 50NL |
| 16 | PICKUP 50NH |
| 17 | TRIP 50PL |
| 18 | TRIP 50PH |
| 19 | TRIP 51N2 |
| 20 | TRIP 51N1 |
| 21 | TRIP 51N |
| 22 | TRIP 51P2 |
| 23 | TRIP 51P1 |
| 24 | TRIP 51P |
| 25 | TRIP 81O2 |
| 26 | TRIP 81O1 |
| 27 | TRIP 81U2 |
| 28 | TRIP 81U1 |
| 29 | TRIP 46D |
| 30 | TRIP 46T |
| 31 | TRIP 50NL |
| 32 | TRIP 50NH |
| 33 | |
| 34 | |
| 35 | |
| 36 | |
| 37 | |
| 38 | |
| 39 | COMMUNICATIONS TRIGGER |
| 40 | EXTERN. TRIGGER |

**Note:  A blank next to a number indicates that there is no
event associated with that number.**

**Table 3-8 Recloser Masks**

| # | DESCRIPTION |
|---|---|
| 1 | TRIP 50PL |
| 2 | TRIP 50PH |
| 3 | TRIP 51N2 |
| 4 | TRIP 51N1 |
| 5 | TRIP 51N |
| 6 | TRIP 51P2 |
| 7 | TRIP 51P1 |
| 8 | TRIP 51P |
| 9 | TRIP 81O2 |
| 10 | TRIP 81O1 |
| 11 | TRIP 81U2 |
| 12 | TRIP 81U1 |
| 13 | TRIP 46D |
| 14 | TRIP 46T |
| 15 | TRIP 50NL |
| 16 | TRIP 50NH |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | COMM. TRIGGER |
| 24 | EXTERNAL TRIGGER |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| 32 | |

**Note: A blank next to a number indicates that there is no event associated with that number.**

# Chapter 4 -HARDWARE DESCRIPTION

**\*\*\* CAUTION \*\*\***

> **The DFP100 contains electronic components that could be damaged by electrostatic discharge currents if those currents flow through certain terminals of internal components. The main source of electrostatic discharge currents is the human body, especially where the conditions of low humidity, carpeted floors , and isolating shoes exist which are conducive to the generation of electrostatic discharge currents. Where these conditions exist, care should be exercised when removing and handling the DFP100's internal components. The persons handling the components should make sure that their body charge has been discharged, by touching some surface at ground potential, or wearing a wrist strap, before touching any of the components.**

## CASE

### Case Construction

The DFP100 case assembly is constructed from an aluminum alloy. It consists of a main box assembly and a top cover. The main assembly supports the terminal blocks that are used to make the external connections and has slotted guides for supporting the shelf assembly. The unit is draw-out construction, where the Shelf Assembly is removable from the case. Proper alignment of the Shelf Assembly is maintained by integral slotted guides.

Front and Rear views of the DFP100 are shown in Figures 4-1 and 4-2 respectively.

### Electrical Connections

All electrical connections for the current and voltage inputs, digital inputs, and relay outputs, are made to the case through three terminal blocks mounted on the rear of the case. Connections for communications are made via three DB-9 connectors, two located on the rear of the unit, and one on the front of the unit.

### Internal Construction

The internal construction of the DFP100 is divided into the Case Assembly and the Shelf assembly. The Case Assembly consists of the case as described above, and the Magnetics. The Magnetics which consist of the current transformers (CTs) and voltage transformers

(VTs) are located on the bottom of the case and are connected to the Processor board through a harness assembly. The Shelf assembly consists of a Main Processor Board, a Power Supply assembly, a Front Panel assembly, and an aluminum shelf which supports the other components. The Front Panel assembly is available both with and without a local MMI. The front panel for the units without a Local MMI is constructed of brushed aluminum. The front panel for the units with the optional Local MMI is an aluminum panel with an overlay which contains a membrane switch keypad. The Optional MMI, contains an additional printed circuit board to interface to the Liquid Crystal Display, and the keypad. In the units with the local MMI, the front panel is an integral part of the shelf assembly and cannot be removed.

Access to all of the electronics is obtained by loosening the screws on the front panel and carefully sliding the shelf assembly out. A connector must be removed prior to complete removal of the DFP100's shelf assembly.

The block diagram of the DFP100 presented in Figure 2-1 illustrates the functional interaction among the DFP100's printed-circuit board, magnetics and power-supply assembly. Figure 4-3 is a layout drawing of the Processor board showing the location of jumpers and critical components.

### Identification

The model number label is located in the lower right hand side of the front panel of the DFP100

(see Figure 4-1). The method of interpreting a DFP100 model number is explained in the **INTRODUCTION** section.

The three terminal blocks located on the rear panel of the DFP100 are uniquely identified by the following two-letter codes P1, P2, P3, which can be found to the left of each terminal block as shown in Figure 4-2. The terminals on each block are labeled, according to their intended use (e.g. CC1, CC3, ALARM 2, VA, IN, etc.). In addition each of the terminal points (1 through 16) are identified by numbers.

Female DB-9 connectors for serial communications (RS232) are located on the left hand side on the front panel of the unit and on the right hand side of the DFP100's rear panel. The front port connector is labeled PORT 1, and the rear connector are labeled PORT 2 and PORT 3. The IRIG-B connection is made via connection to terminal block P2 for the IRIG-B time synchronization signal.

## THEORY OF OPERATION

The DFP100 operates by using hardware that digitizes current and voltage signals, performs digital computations on the required data, logs significant information, activates control contacts, and provides an interface to the utility engineer for determining power system status.

The DFP100 can be functionally divided into the following sections.

> Magnetics
> Processor Board
> Power Supply
> MMI

### Magnetics

The DFP100 Magnetics have two important functions: (1) high potential isolation and surge suppression, and (2) input scaling (VT) and current-to-voltage conversion (CT). The VT scales down the input voltage. The CT steps down the input current and passes it through a resistor, converting the input current (on the primary winding) to an output voltage (across a shunt on the secondary winding). Each CT and VT must be linear throughout the measurement range, and has a frequency response of at least the sampling rate of the DFP100 (800/960-Hz) so as to have minimal effect on the DFP100's frequency response. The voltage outputs of the Magnetics are applied to the Analog Input Board.

### Processor Board

The DFP100's Processor Board is divided into the following functional sections:

> Processing Functions
> Analog Functions
> Input/Output Functions

The DFP100 utilizes two 20-MHz 80196KC) processors, one to provide external communications and a second independent one to perform calculations for the protection functions. The 80C196KC is a 16-bit CMOS microcontroller designed to handle high-speed calculations and fast input/output (I/O) operations.

The analog-to-digital (A/D) converter converts an analog input voltage to a digital equivalent. The resolution of the A/D converter is 10 bits.

One processor is dedicated to providing the communications functions, and the other is dedicated to providing protective functions. Variables, buffers, and stack space reside in 16-bit-wide RAM. The non-volatile EPROM (64K) holds the program code, while EEPROM (8K) is used for configuration data and calibration constants. The oscillography files, peak demand records, and other long-term storage fields are placed in capacitor-backed RAM.

The DFP100's real-time Clock is used to keep track of the date and low-resolution time. When the processor is operating, a 16-bit timer provides a high-resolution time base that, in turn, provides time synchronization and a millisecond timer for time-tagging events. If external time synchronization is used, the real-time clock and timer are synchronized to an externally supplied IRIG-B signal.

### Analog Functions

The DFP100 has eight separate analog channels. Each voltage and current signal from the

magnetics pass through one of these eight channels. Each of these channels have measurement gains of 1x, 4x, 16x and 32x. These outputs are then sampled by the 10 bit A/D converter within the protection processor.

### Input/Output Functions

Input/output functions are divided between the two processors. The serial ports and MMI are handled by the communications processor. External communications are handled through a serial communications controller circuit, which contains a dual universal asynchronous receiver transmitter (DUART). The serial ports, digital inputs, and the output contacts are monitored by the protection processor.

The contact input isolation circuit accommodates six externally-wetted contact inputs for external control of the DFP100. Essentially the circuit checks for the presence or absence of the wetting voltage at the inputs. If a voltage is present at the input, the contact is assumed closed; otherwise, it is assumed open. This circuit is also responsible for providing isolation between the contact inputs and processor circuitry.

The Man-Machine Interface (MMI) circuitry controls the LEDs for indicating an instantaneous overcurrent trip (INST), phases for which an overcurrent function operated to trip (A,B,C,N), negative sequence overcurrent trip (NEGSEQ), over/under frequency (FREQ), recloser status (lockout (LO), reset (RES)), an alarm condition (ALARM), and power applied (READY). A target reset button allows the latched alarms and disturbance targets to be cleared. This button must be held for 2 seconds to clear the targets.

### Power Supply

The power supply is available in two options, one which operates from +20 to +60 VDC and one which operates from +88 to 300 VDC or VAC. The power supply provides ±12 VDC outputs for the analog and relay output circuits, and a +5 VDC output for the digital circuitry.

### MMI

The DFP100 is available with two basic MMI configurations: 1) Standard MMI which consists of status Light Emitting Diode (LEDs), target reset push button, and a serial-port-interface connector (see Figure 4-1). and 2) Optional MMI which adds a 2 line by 16 character Liquid Crystal alphanumeric Display (LCD) and 20 key membrane switch keypad to the basic MMI configuration. The Optional display is a separate component, connected to the DFP100's Processor Board but visible through a window on the front panel. Similarly, the LEDs are actually located on the Processor Board, but are also visible through windows on the front panel. A ribbon cable between the front cover and the Processor Board provides the circuitry for processing the push buttons and character generation. Both configurations are available in both horizontal and vertical mounting configurations.

### RECEIVING, HANDLING AND STORAGE

Immediately upon receipt, the DFP100 should be unpacked and examined for any damage sustained in transit. If damage resulting from rough handling is evident, a damage claim should be filed at once with the transportation company, and the nearest GE sales office should be promptly notified. If the equipment is not to be installed immediately, it should be returned to its original carton and stored indoors in a location that is dry and protected from dust, metallic chips, and severe atmospheric conditions.

### INSTALLATION

#### Environment

Installation of the DFP100 should be in a clean, dry location that is free from dust. The area should be well lighted to facilitate inspection and testing.

#### Mounting

The DFP100 should be securely mounted on a vertical surface that provides accessibility to both the front and rear panels of the unit. Side access is not required. The outline and panel drilling dimensions for the DFP100 are provided in Figure 4-4 (GE drawing 0215B8797).

**Alarm Contact**

The DFP100 alarm contact indicates the status of the following alarm conditions:

> Relay Disabled
>
> EProm Error Alarm
>
> Random Access Memory Alarm
>
> Watch Dog Timer Alarm
>
> Calibration Default Alarm
>
> Model Number Alarm
>
> Settings Group Alarm
>
> A/D Converter Error Alarm
>
> Clock Stopped
>
> Trips Disabled
>
> Current with Breaker open
>
> Power Supply Alarm
>
> Breaker Maintenance Due

When the DFP100 has none of the above alarm conditions, it will energize the Alarm contact. If one of the above conditions exist, the DFP100 will dropout the Alarm contact. Relay Disabled, EProm Error Alarm, Random Access Memory Alarm, and Watch Dog Timer Alarm will also operate the Alarm LED.

**External Connections**

External connections are made according to the elementary diagram presented in Figure 2-2 in the **PRODUCT DESCRIPTION** section.
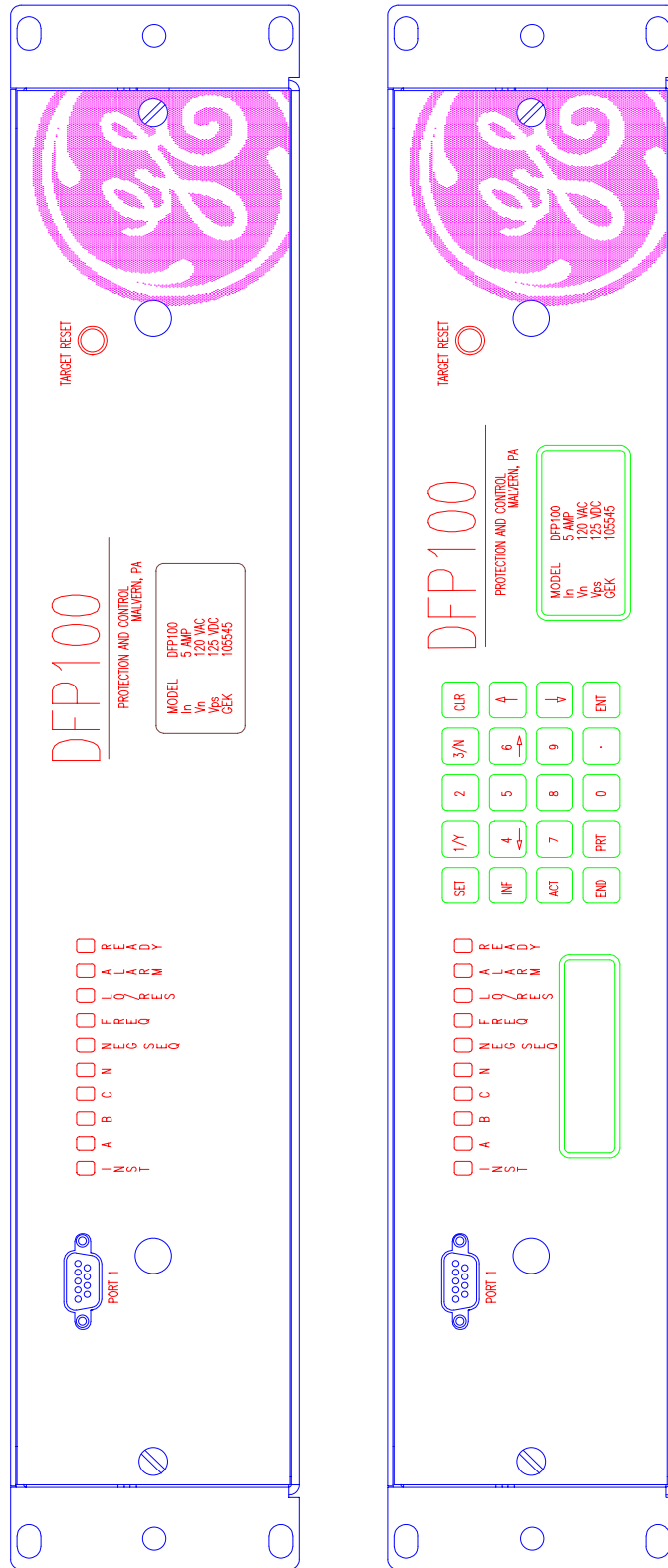
**Figure 4-1 DFP100 Front View (Horizontal Mounting Configurations)**
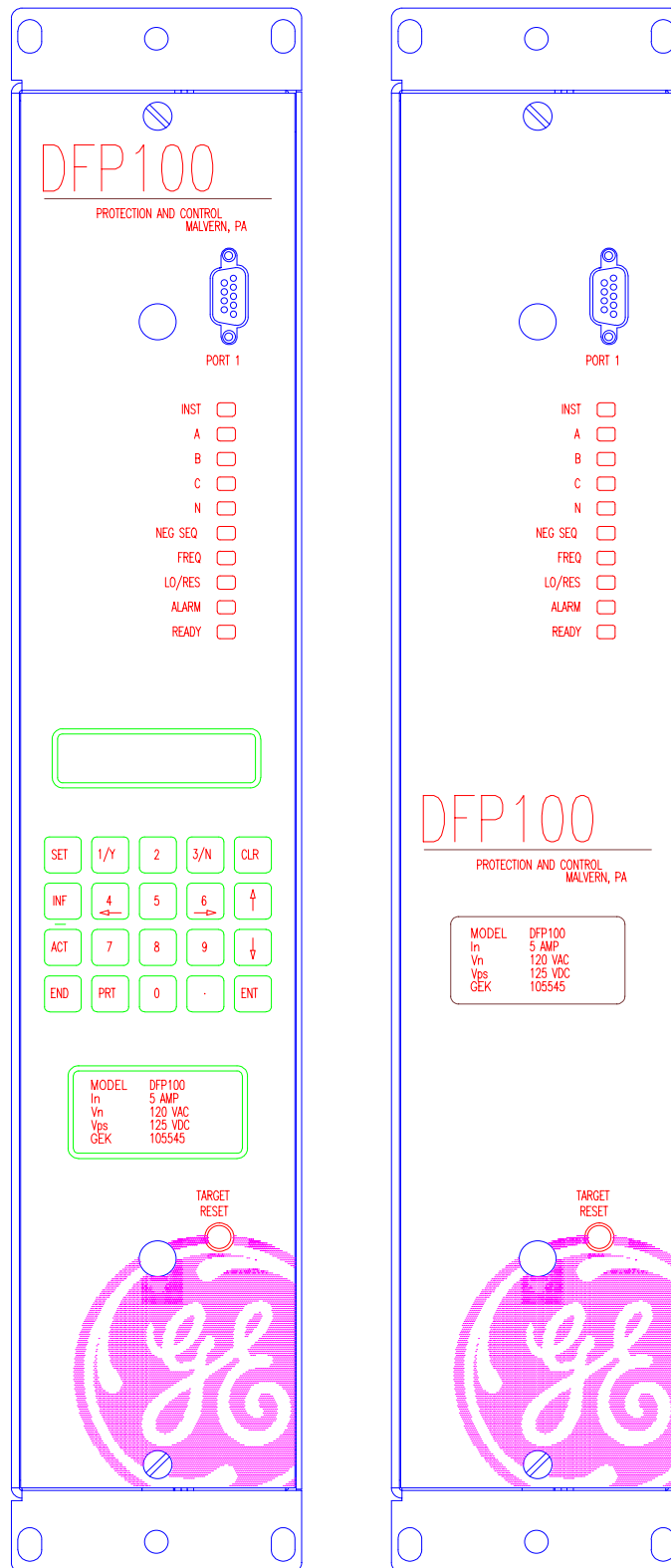
**Figure 4-1 (cont) DFP100 Front View (Vertical Mounting Configurations)**
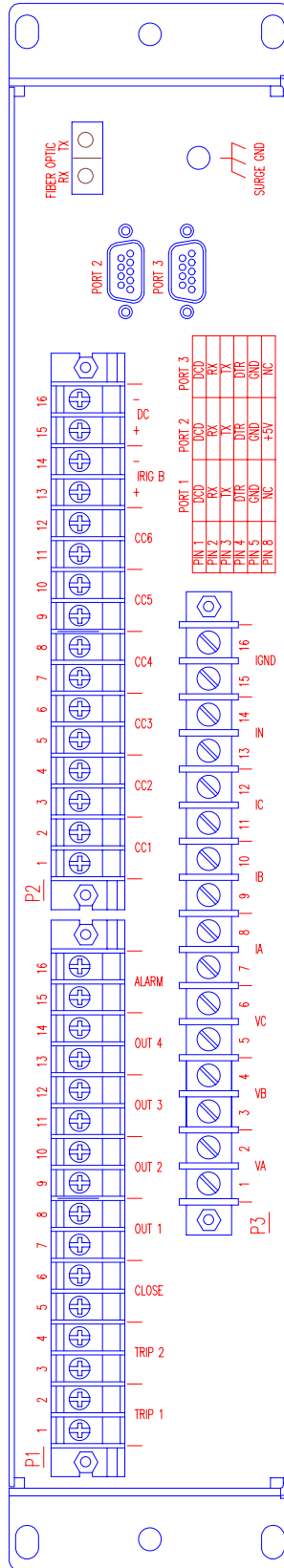
**Figure 4-2 DFP100 Rear View**
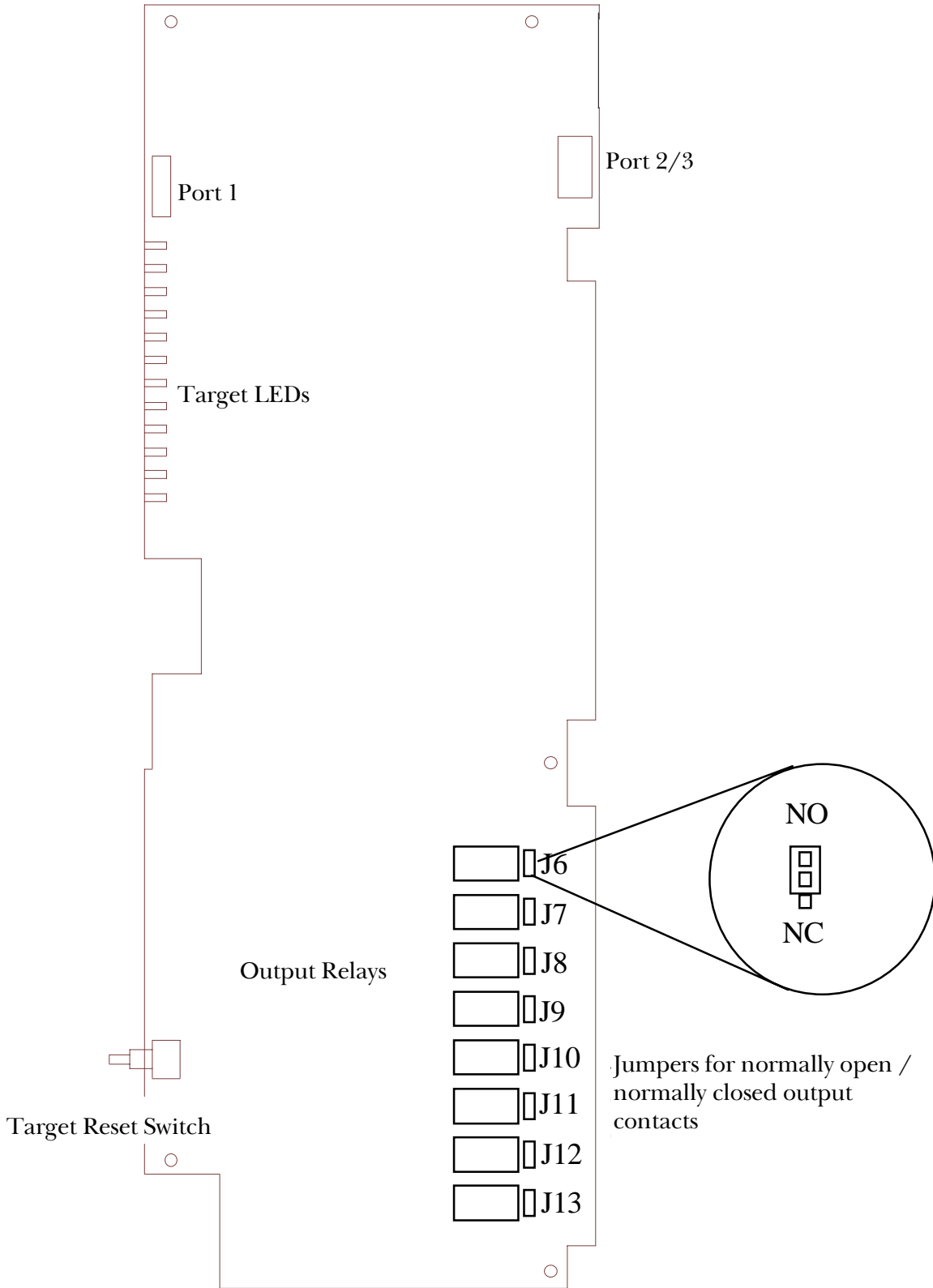
**Figure 4-3 DFP100 Processor Board**

**Figure 4-4  Outline and Panel Drilling Dimensions (0215B8797)**

## Chapter 5 -ACCEPTANCE TESTING

### GENERAL

This section is a guide for testing the relay. It is not necessary that the tests be performed for incoming inspection. The relay has been tested at the factory with automated test equipment. The DFP system is a digital relay monitored by "self-checking" software. If a system failure is detected, it can be reported through the communication port or the optional MMI.

### GENERAL TESTS

TEST 1       Readings Test
TEST 2       Phase/GND IOC Test
TEST 3       Phase/GND TOC Test
TEST 4       Negative Sequence Overcurrent Test
TEST 5       Under/Over Frequency Test
TEST 6       Under/Over Voltage Test
TEST 7       Phase/Distance Unit Test
TEST 8       Contact Converter
TEST 9       Programmable Output Test
TEST 10      Recloser Test

### TEST EQUIPMENT

1.   Three-phase source of voltage and a single-phase source of current.
2.   DC or AC control voltage source.
3.   A continuity tester or Ohm meter.
4.   A precision timer for testing timed events.

The specific requirements of the equipment are given in the text of this section, and in the associated circuit diagrams.

### DRAWINGS AND REFERENCES

The following drawings should be used for reference during testing. They are located in the **PRODUCT DESCRIPTION** and the **CALCULATION OF SETTINGS** sections.

Drawings:    Elementary Diagram; Figure 2-3
                 (PRODUCT DESCRIPTION)
References:   Default Relay Settings; Table 3-1
                 (CALCULATION OF SETTINGS)

### EQUIPMENT GROUNDING

All equipment used in testing the DFP relay should be connected to a common grounding point, to provide noise immunity. This includes the voltage and current sources, as well as, the DFP100 relay. The common for surge protection is clearly marked on the rear of the case.

### SETTING CHANGES

Setting changes required for a particular test will be listed before the test. Setting changes can be accomplished in one of three possible ways:

1.   Through ASCII communications.
2.   Through GE Protocol communications.
3.   Through the Man-Machine Interface (MMI).

To determine which options are available to you, see Table 5-1.

#### Table 5-1 DFP100 Communication Options

| Model Number | Option |
|---|---|
| DFP1XX0XXXXXXA | ASCII Protocol |
| DFP1XX1XXXXXXA | GE Protocol |
| DFP1XXXMXXXXXA | Man-Machine Interface |

Note: X = Don't Care

### Communication Requirements

If your DFP relay has ASCII Communications, you will be able to communicate with the relay through the use of any Personal Computer and any terminal emulation software (e.g. PROCOMM or Windows Terminal Emulator).

If your DFP relay has GE Protocol communications, you will be able to communicate with the relay through the use of any Personal Computer and the Mlink software program provided with the relay.

The pinouts of the DFP100 communication ports are marked on the rear of the unit. To build or order a cable to communicate between your relay and a computer, see the **INTERFACE** section. The Acceptance Test can be performed with an ASCII or MLINK relay connected to a PC or with a relay containing an MMI. Because of the large number of setting changes it is recommended that a PC be used to perform the Acceptance Test.

### Relay Set-up

Before performing the Acceptance Test you must configure the relay. Enter the following settings into the relay:

| Category | Setting Name | Relay Setting |
|----------|--------------|---------------|
| General | Relay Status | Enable |
| General | Line Frequency | 60 Hz |
| General | Phase CT Ratio | 1000 |
| General | GND CT Ratio | 1 |
| General | VT Ration | 1 |
| General | Default Settings Group | Group 1 |
| General | Phase Rotation | ABC |
| General | Cold Load Pickup Start Time | 240.0 |
| General | Cold Load Pickup Dropout Time | 0.0 |
| General | 52b Wired | Yes |
| Comm | Baud Rate | 4800 |
| Comm | Stop bits | 1 |

Note: All testing will be done with the relay connected as shown in Figure 5-1. Before starting a particular test disable all other functions from operating. After completing a particular test disable that function from operating.

### Convention

All angles are referenced to the phase A to GND voltage, Va, which is assumed to be at 0°. All lagging angles are listed as (-). All leading angles are listed as (+).

### Protection Function Tests

Note: For all tests the relay protection function setting changes should be made to the selected default settings Group 1.

### TEST 1 - Present Value Readings

This test uses the present values to verify that the voltages and currents are applied to the proper connections on the terminal and that the relay properly measures voltage, current and power.

1. Connect the DFP100 as shown in figure 5-1

2. Log into the DFP100 using the proper protocol for the relay.

3. Apply rated control power.

4. Apply the following voltages:

   Va = 67 VRMS 0°

   Vb = 57 VRMS -120°

   Vc = 47 VRMS +120°

5. Using the "Readings R" command for ASCII protocol units, or Relay status display for Mlink protocol units, verify that the displayed voltages are within the following ranges:

   Va: 65.0 - 69.0

   Vb: 55.3 - 58.7

   Vc: 45.6 - 48.4

6. Apply It = 1.0 A RMS 45° lagging for phase A as shown by the "Y" connection point in the phase under test.

7. Verify that the current reading is between 0.97 and 1.03 A RMS.

### TEST 2 Phase/GND IOC

This test verifies the proper operation of the instantaneous overcurrent functions.

| Category | Setting Name | Setting |
|----------|--------------|---------|
| General | Phase CT Ratio | 1 |
| IOC | Disable Phase INST Low | No |
| IOC | Pickup Phase INST Low | 1.00 |
| IOC | Delay PhaseLow | 0.50 |
| IOC | Disable GND INST High | No |
| IOC | Pickup GND INST High | 1.00 |
| IOC | Delay GND INST High | 0.50 |
| TORQ | GND Torque Contol Signal | 0 (Dislabled) |
| TORQ | Phase Torque Control Signal | 0 (Disabled) |

1. Connect the DFP100 relay as shown in Figure 5-1.

2. Log into the DFP100 using the proper protocol for the relay.

3. Make the above setting changes

4. Apply rated control power.

5. Apply test current (It) at rated frequency, according to the table below and verify that the relay operates within the times specified in the following table. Items with "——" indicate no pickup or operation.

6.  Press the Target Reset button and hold for
    three seconds

**Test 2 Current Inputs and Results**

| Current Input (It) | | | Trip Output | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | .95 Arms | P1_1,P1_2 P1_3,P1_4 | ———— | Ready |
| | P3_7, P3_8 | 1.05 Arms | P1_1,P1_2 P1_3,P1_4 | .50s <t< .55s | Ready, INST, A |
| B | P3_9, P3_10 | .95 Arms | P1_1,P1_2 P1_3,P1_4 | ———— | Ready |
| | P3_9, P3_10 | 1.05 Arms | P1_1,P1_2 P1_3,P1_4 | .50s <t< .55s | Ready, INST, B |
| C | P3_11, P3_12 | .95 Arms | P1_1,P1_2 P1_3,P1_4 | ———— | Ready |
| | P3_11, P3_12 | 1.05 Arms | P1_1,P1_2 P1_3,P1_4 | .50s <t<.55s | Ready, INST, C |
| N | P3_13, P3_14 | .95 Arms | P1_1,P1_2 P1_3,P1_4 | ———— | Ready |
| | P3_13, P3_14 | 1.05 Arms | P1_1,P1_2 P1_3,P1_4 | .50s <t< .55s | Ready, INST, N |

## TEST 3 - Phase/GND TOC

1.  Connect the DFP100 relay as shown in Figure 5-1.

2.  Log into the DFP100 using the proper
    protocol for the relay.

3.  Apply rated control power.

4.  Enter the following settings:

| Category | Setting Name | Relay Setting |
|---|---|---|
| IOC | DIS Phase INST Low | Yes |
| IOC | DIS GND INST High | Yes |
| TOC | Disable Phase TOC | No |
| TOC | Curve Phase TOC | 3 (Inverse) |
| TOC | Pickup Phase TOC | 1.00 |
| TOC | Time Dial Phase TOC | 1.00 |
| TOC | Disable GND TOC | No |
| TOC | Curve GND TOC | 3 (Inverse) |
| TOC | Pickup GND TOC | 1.00 |
| TOC | Time Dial GND TOC | 1.00 |
| TORQ | GND Torque Control Signal | 0 (Disabled) |
| TORQ | Phase Torque Control Signal | 0 (Disabled) |

5.  Apply test current (It) for each phase, one at a time, according to the table below and verify the relay function within the pickup time:

6.  Press and hold the Target Reset button.

**Test 3 Phase Inverse TOC Test Inputs and Results**

| Input Current | | | Trip Output | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .329s <t< .364s | Ready, A |
| B | P3_9, P3_10 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .329s <t< .364s | Ready, B |
| C | P3_11, P3_12 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .329s <t<.364s | Ready, C |
| N | P3_13, P3_14 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .329s <t< .364s | Ready, N |

7.  Apply rated control power

8.  Enter the following relay settings:

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Phase TOC | 2 (Very Inverse) |
| TOC | Curve GND TOC | 2 (Very Inverse) |

9.  Apply test current (It), according to the table below and verify that the relay operates within the times specified below.

10. Press and hold the Target Reset button.

**Test 3 Phase Very Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .254s <t< .281s | Ready,  A |
| B | P3_9, P3_10 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .254s <t< .281s | Ready, B |
| C | P3_11, P3_12 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .254s <t< .281s | Ready, C |
| N | P3_13, P3_14 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .254s <t< .281s | Ready, N |

11.  Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Phase TOC | 1 (Extremely Inverse) |
| TOC | Curve GND TOC | 1 (Extremely Inverse) |

12.  Apply test current (It), according to the table below and verify that the relay operates within the times specified in the following table.

13.  Press and hold the Target Reset button.

**Test 3 Phase Extremely Inverse TOC Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .251s <t< .278s | Ready, A |
| B | P3_9, P3_10 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .251s <t< .278s | Ready, B |
| C | P3_11, P3_12 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .251s <t< .278s | Ready, C |
| N | P3_13, P3_14 | 5.00 Arms | P1_1,P1_2 P1_3,P1_4 | .251s <t< .278s | Ready, N |

### TEST 4 - Negative Sequence Overcurrent

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Disable Phase TOC | Yes |
| TOC | Disable GND TOC | Yes |
| Neg. Seq. Overcurrent | Disable Negative Sequence TOC | No |
| Neg. Seq. Overcurrent | Curve Negative  Sequence TOC | 3 (Inverse) |
| Neg. Seq. Overcurrent | Pickup Negative  Sequence TOC | 1.00 |
| Neg. Seq. Overcurrent | Time Dial Negative  Sequence TOC | 1.00 |
| Torque Control | Torque Control Signal | 0 (Disable) |

1.  Enter the above settings.

2.  Apply current (It) according to the table below and check for the required results:

**Test 4 Negative Sequence Inverse TOC Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9.00 Arms | P1_1,P1_2 P1_3,P1_4 | .473s <t< .523s | Ready, Neg. Seq. |

3.  Press the Target Reset button and hold for three seconds

4.  Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Neg. Seq. TOC | 2 (Very Inverse) |

4.  Apply Current according to the table below and check for the required results:

5.  Press and hold the Target Reset button.

**Test 4 Negative Sequence Very Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9.00 Arms | P1_1,P1_2 P1_3,P1_4 | .572s <t< .633s | Ready, Neg. Seq. |

6.  Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Neg. Seq. TOC | 1 (Extremely Inverse) |

7.  Apply test current (It) according to the table below and check for the required results:

8.  Press and hold the Target Reset button.

**Test 4 Negative Sequence Extremely Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9.00 Arms | P1_1,P1_2 P1_3,P1_4 | .709s <t< .784s | Ready, Neg. Seq. |

### TEST 5 - Under/Over Frequency

| Category | Setting Name | Relay Setting |
|---|---|---|
| Neg. Seq. Overcurrent | Disable Negative Sequence TOC | Yes |
| U/O Frequency | Disable Under Frequency Unit 1 | No |
| U/O Frequency | Disable Over Frequency Unit 1 | Yes |
| U/O Frequency | Disable Under Frequency Unit 2 | Yes |
| U/O Frequency | Disable Over Frequency Unit 2 | No |
| U/O Frequency | Pickup Under Frequency Unit 1 | 58.00 |
| U/O Frequency | Pickup Over Frequency Unit 1 | 80.00 |
| U/O Frequency | Delay U/O Frequency Unit 1 | 10.0 (cycles) |
| U/O Frequency | Pickup Under Frequency Unit 2 | 40.00 |
| U/O Frequency | Pickup Over Frequency Unit 2 | 62.00 |
| U/O Frequency | Delay Under U/O Frequency Unit 2 | 10.0 (cycles) |
| U/O Frequency | Voltage Supervision Threshold | 85% |
| Torque Control | Torque Control Type | Disable |

1.  Enter the above settings.

2.  Apply test voltage according to the table below and verify that the relay operates within the times specified in the following table.

3.  Press and hold the Target Reset button.

**Test 5 Under/Over Frequency Test Inputs and Results**

| Voltage | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Relay Stud# | Amplitude | Freq. | Contact# | Pickup Time | Energized |
| P3_1, P3_2 | 67 Vrms | 57.94 | P1_1,P1_2 P1_3,P1_4 | .380s <t< .400s | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | 58.06 | P1_1,P1_2 P1_3,P1_4 | ———— | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | 61.94 | P1_1,P1_2 P1_3,P1_4 | ———— | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | 62.06 | P1_1,P1_2 P1_3,P1_4 | .380s <t< .400s | Ready, Freq. |

### TEST 6 - Under/Over Voltage

| Category | Setting Name | Relay Setting |
|---|---|---|
| Frequency | Disable Under Frequency Unit 1 | Yes |
| Frequency | Disable Over Frequency Unit 2 | Yes |
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Torque Control | Over Voltage | 100.00 |
| Torque Control | Under Voltage | 50.00 |
| Torque Control | Delay Over Voltage Unit | 5.0 |
| Torque Control | Delay Under Voltage Unit | 5.0 |
| Outputs | OUT1 | 27 + 59 |
| Outputs | TPU1 | 0 |
| Outputs | TDO1 | 0 |

1. Enter the above settings.

2. Apply test Voltage at rated frequency, according to the table below and verify that the relay operates within the times specified in the following table.

3. Press and hold the Target Reset button.

| Voltage | | Output | | LEDs |
|---|---|---|---|---|
| Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 103 Vrms<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | 5.00s <t< 5.05s | Ready |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 97 Vrms<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | ———— | Ready |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 51.5 Vrms<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | ———— | Ready |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 48.5 Vrms<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | 5.00s <t< 5.05s | Ready |

## TEST 7 - Phase Distance Units

| Category | Setting Name | Relay Setting |
|---|---|---|
| Instantaneous | Disable Phase INST Low | No |
| Instantaneous | Pickup Phase INST Low | 1.00 |
| Instantaneous | Delay Phase INST Low | 0.00 |
| Torque Control | Torque Control Signal | 2 (21PT) |
| Torque Control | 21PT Type | 1 (OR) |
| Torque Control | 21PT Reach | 9.00 |
| Fault Location | Positive Sequence.<br>Impedance. Angle | 85.00 |
| General | VT Connection | Open-Delta or Wye-Wye |

1. Enter the above settings.

2. Setup test according to how the relay will be set in operation.  Use Figure 5-2 (WYE- WYE) or Figure 5-3 (Open Delta).

3. Set initial voltages to the following values:

    Va=67 Vrms at 0 degrees,

    Vb=67 Vrms at -120 degrees,

    Vc=67 Vrms at 120 degrees.

4. Set the input current to 5 Arms at the phase angle listed in the table below.

5. Simultaneously apply voltage inputs according to the table below, and verify the required results:

**Test 7 Phase Distance Test Inputs and Results**

| | Voltage | | Current | Trip | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Ph. Ang. | Contact# | Energized |
| A | P3_1, P3_2 | 49 Vrms | -55° | P1_1,P1_2 | Ready, A, B INST |
| B | P3_3, P3_4 | 49 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |
| A | P3_1, P3_2 | 57 Vrms | -55° | P1_1,P1_2 | Ready |
| B | P3_3, P3_4 | 57 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |
| A | P3_1, P3_2 | 23 Vrms | +5° | P1_1,P1_2 | Ready, A, B INST |
| B | P3_3, P3_4 | 23 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |
| A | P3_1, P3_2 | 30 Vrms | +5° | P1_1,P1_2 | Ready |
| B | P3_3, P3_4 | 30 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |
| A | P3_1, P3_2 | 23 Vrms | -115 ° | P1_1,P1_2 | Ready, A, B INST |
| B | P3_3, P3_4 | 23 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |
| A | P3_1, P3_2 | 30 Vrms | -115° | P1_1,P1_2 | Ready |
| B | P3_3, P3_4 | 30 Vrms | | P1_3,P1_4 | |
| C | P3_5, P3_6 | 67 Vrms | | | |

6.    Press and hold the Target Reset button.

7.    Repeat steps 3a and 4a with the faulted
      phases being B&C and C&A.

## TEST 8 - Contact Converter Test

The DFP100 has 6 Contact Converters.  Contact
Converter #6 (CC6) is used to monitor the 52b
contact.  The other 5 Contact Converters can be
programmed to control different functions of the
relay.

This test will show that the Contact Converter
hardware, as well as, the Trip and Close Outputs
are working correctly.

| Category | Setting Name | Relay Setting |
|---|---|---|
| Input Configuration | DI 1 | Direct Trip |
| Input Configuration | DI 2 | Direct Trip |
| Input Configuration | DI 3 | Direct Close |
| Input Configuration | DI 4 | Direct Close |
| Input Configuration | DI 5 | Direct Close |

1.  Enter the above settings.

2.  Setup relay as shown in Figure 5-5.

3.  Apply voltage (38 to 300 VDC or 40 to 200 VAC) to CC1 (P2_1 and P2_2). Verify that Trip 1 (P1_1 and P1_2)and Trip 2 (P1_3 and P1_4) have closed. Repeat test for CC2 (P2_3 and P2_4).

4.  Apply voltage (38 to 300 VDC or 40 to 200 VAC) to CC3 (P2_5 and P2_6). Verify that Close (P1_5 and P1_6) has closed. Repeat test for CC4 (P2_7 and P2_8) and CC5 (P2_9 and P2_10).

Note: The DFP100 will only issue a Direct Close or a Direct Trip if the relay senses, through Digital Input 6, the opposite state of the breaker (i.e. it will only issue a Direct Close if the DFP100 senses the breaker is open).

### TEST 9 - Programmable Output Tests

The DFP100 has 4 Programmable Outputs. These Programmable Outputs make use of 6 AND gates and 2 NOT gates. The inputs to these gates can be any of the DFP100 control functions (See Calculation of Settings). The outputs of these gates can be ORed with each other or with any of the DFP100 protection or control functions. The final equation for each of the Programmable Outputs is equivalent to a 16 input Or gate. This test will show that the Programmable Outputs working correctly.

1.  Enter the following settings.

2.  Setup relay as shown in Figure 5-6.

3.  Apply 70 Vrms at 60 Hz to Phase A. Verify that OUT1 has operated. Increase the frequency to 63 Hz. Verify that OUT1 has dropped out.

4.  With the frequency at 63 Hz verify that OUT2 has operated. Decrease the frequency to 57 Hz.

**Test 9 Programmable Output Test Settings**

| Category | Setting Name | Setting |
|---|---|---|
| Outputs | NOT1 | 81O2 |
| Outputs | NOT2 | 81U1 |
| Outputs | AND1 | 50PL_T * |
|  |  | 81U1_T |
| Outputs | AND2 | 50PL_T * |
|  |  | 81O2_T |
| Outputs | OUT1 | NOT1 |
| Outputs | OUT2 | NOT2 |
| Outputs | OUT3 | AND1 |
| Outputs | OUT4 | AND2 |
| Outputs | Pickup Timer OUT4 | 5.0 |
| Outputs | Dropout Timer OUT4 | 5.0 |
| IOC | Phase IOC Low | Enable |
| IOC | Pickup Phase IOC Low | 1.00 |
| IOC | Delay Phase IOC Low | 0.50 |
| U/O Freq | Disable Under Freq Unit 1 | Enable |
| U/O Freq | Disable Over Freq Unit 1 | Disable |
| U/O Freq | Disable Under Freq Unit 1 | Disable |
| U/O Freq | Disable Over Freq  Unit 2 | Enable |
| U/O Freq | Pickup Under Freq Unit 2 | 58.00 |
| U/O Freq | Pickup Over Freq Unit  2 | 62.00 |
| U/O Freq | Voltage Supr Thd | 85% |
| TRQ CNTL | Torque Control Signal | Disable |

5. Verify that OUT2 has dropped out.

6. With the frequency at 57 Hz, apply 2 Arms to Phase A.  Verify that OUT3 has operated. Increase the frequency to 63 Hz.  Verify that OUT3 has dropped out.

7. With the frequency at 63Hz, apply 2 Arms to Phase A.  Verify that OUT4 operates after 5 seconds.

8. Decrease the frequency to 57 Hz.  Verify that OUT4 drops out after 5 seconds.

## TEST 10 - Recloser (Optional)

The DFP100 has the option of including a 4 shot recloser.  To determine if you have this option see the table below.

| Model Number | Option |
|---|---|
| DFP1XXXXX0XXXA | Without Recloser |
| DFP1XXXXX1XXXA | With Recloser |

This test  will demonstrate the functionality of the DFP100 Recloser.  There are many features for the recloser and this test does not claim to test all of

them. To obtain a better understanding of the recloser please see the Recloser Section in the **PRODUCT DESCRIPTION SECTION**.

**Test 10 Recloser Test Inputs and Results**

| Category | Setting Name | Setting |
|---|---|---|
| IOC | Disable Phase INST Low | No |
| IOC | Pickup Phase INST Low | 1.00 |
| IOC | Delay Phase INST Low | 0.00 |
| TOC | Disable Phase TOC | No |
| TOC | Phase TOC Curve | 3 (Inverse) |
| TOC | Pickup Phase TOC | 1.00 |
| TOC | Time Dial Phase TOC | 10.00 |
| TRQ CNTL | Torque Control Signal | 0 (Disable) |
| DIG Input | Digital Input 1 | Disable |
| DIG Input | Digital Input 2 | Disable |
| DIG Input | Digital Input 3 | Disable |
| DIG Input | Digital Input 4 | Disable |
| DIG Input | Digital Input 5 | Disable |
| Recloser | Disable Recloser | No |
| Recloser | 52b Reclose Initiate | No |
| Recloser | Number of Reclosures | 4 |
| Recloser | Number of Repetitive Trips | 30 |
| Recloser | Reset Time | 30 |
| Recloser | Disable Hold | Yes |
| Recloser | Reclose 1 Delay | 0.1 s |
| Recloser | Reclose 2 Delay | 5 s |
| Recloser | Reclose 3 Delay | 10 s |
| Recloser | Reclose 4 Delay | 15 s |
| Recloser | Trip Mask after Reclose 1 | TRIP 51PT |
| Recloser | Trip Mask after Reclose 2 | TRIP 50PL |
| Recloser | Trip Mask after Reclose 3 | TRIP 51PT |
| Recloser | Trip Mask after Reclose 4 | ALL |
| Recloser | Reclose 1 Initiate Mask | 50PL |
| Recloser | Reclose 2 Initiate Mask | 51PT |
| Recloser | Reclose 3 Initiate Mask | 50PL |
| Recloser | Reclose 4 Initiate Mask | None |

1.  Enter the above settings.

2.  Setup Breaker Simulator as shown in Figure 5.4.

3.  Apply 3 Arms to Phase A and determine that the relay performs the following steps:

    - INST Trip

    - .1 Second delay on Reclose

    - 1st Reclose

    - TOC Trip

    - 5 second delay on Reclose

- 2nd Reclose
- INST Trip
- 10 second delay on Reclose
- 3rd Reclose
- TOC Trip
- LOCKOUT

**END OF TEST!**
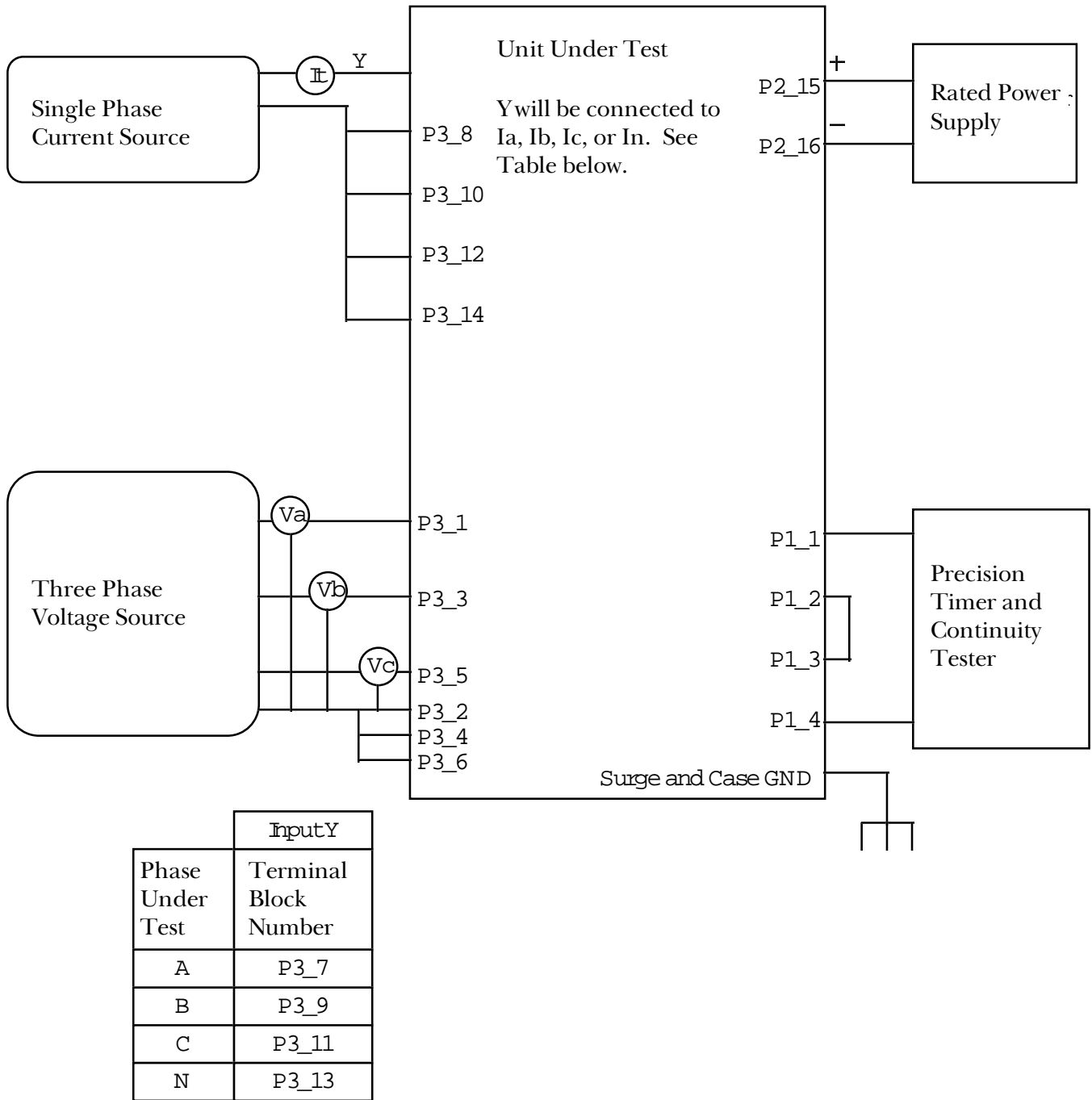
**Figure 5-1 Standard Functional Test Connections**

| Input Y | |
|---|---|
| Phase Under Test | Terminal Block Number |
| A | P3_7 |
| B | P3_9 |
| C | P3_11 |
| N | P3_13 |
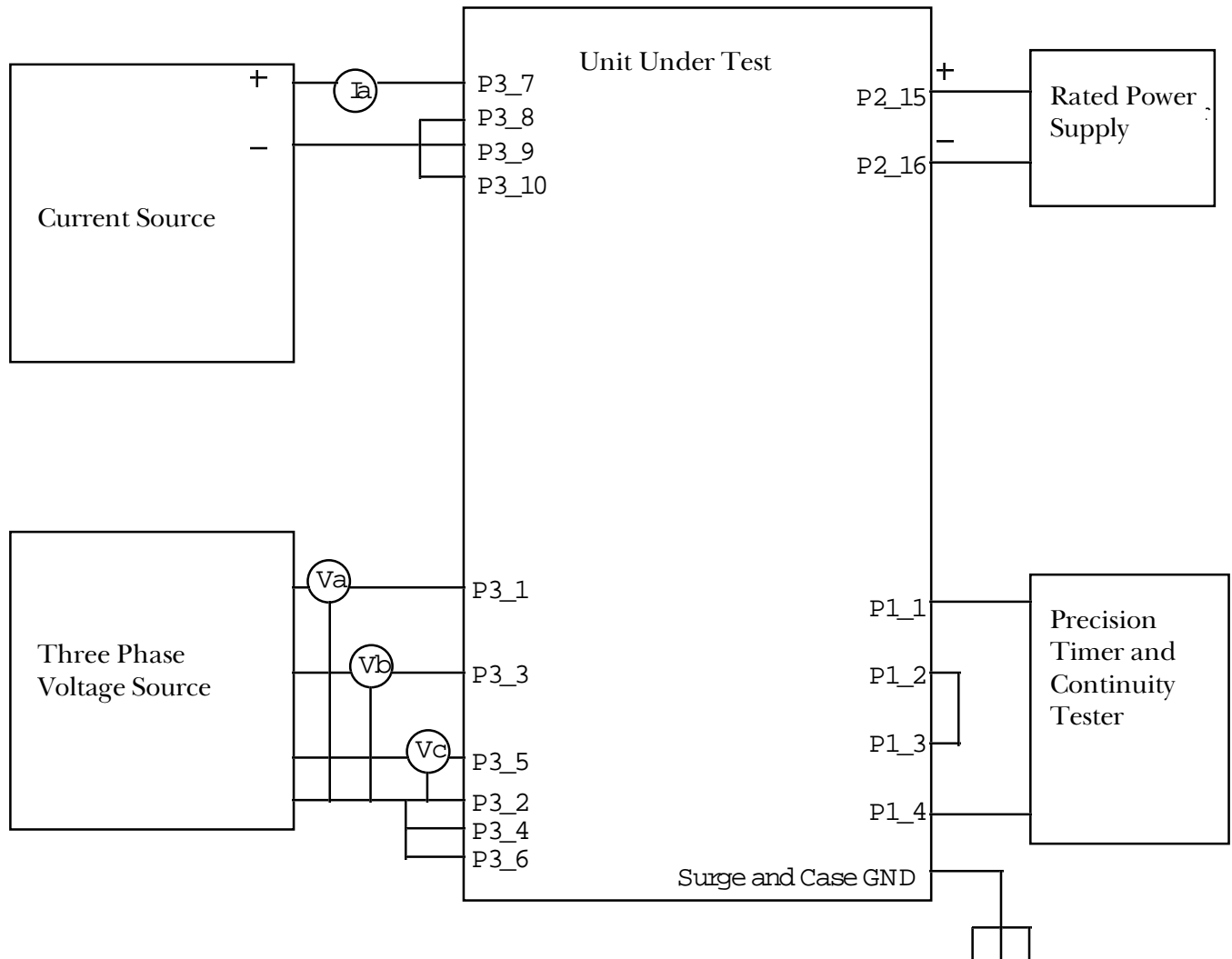
**Figure 5-2 Phase Distance Test (Wye-Wye)**
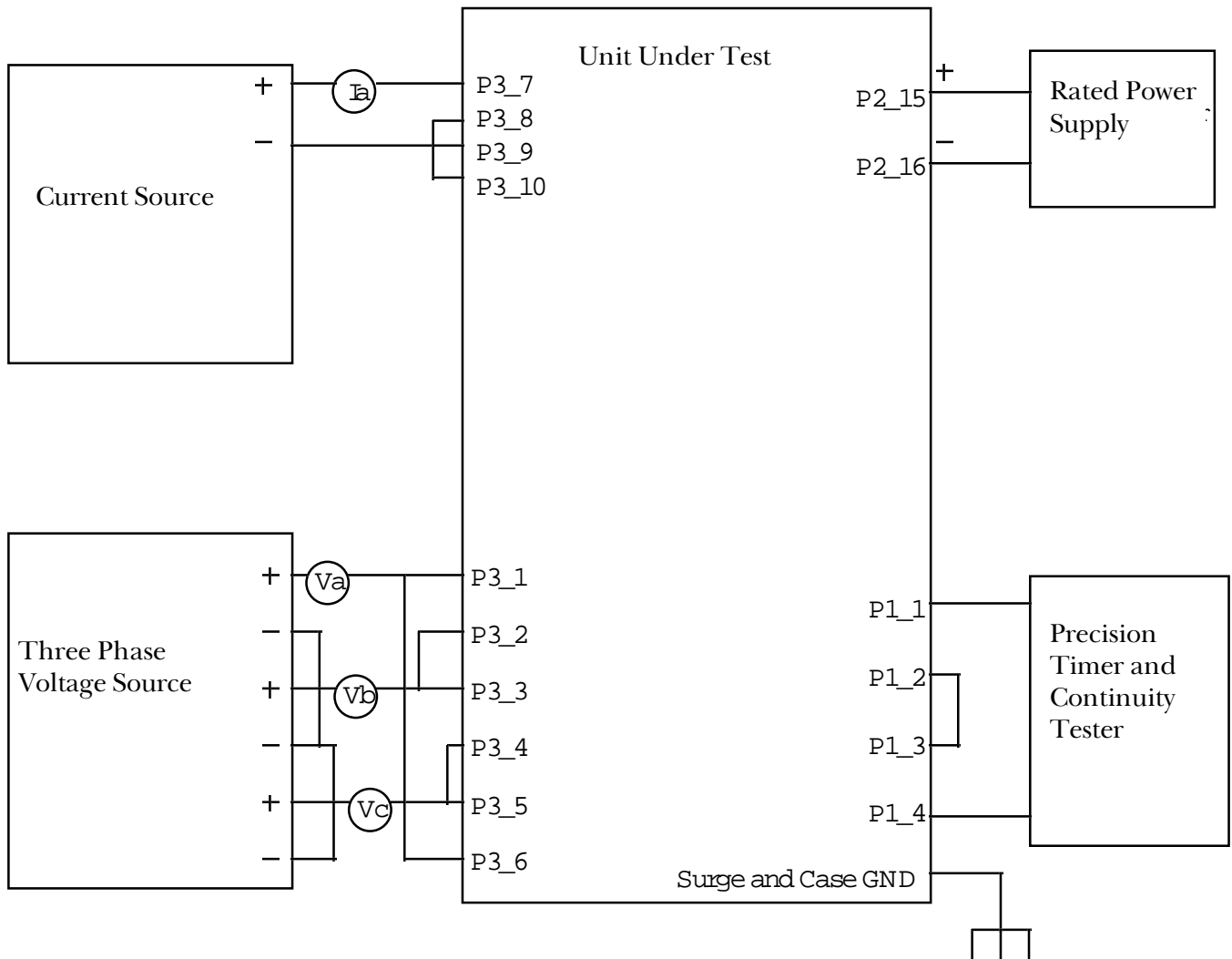
**Figure 5-3 Phase Distance Test (Open-delta)**

Potter and Brumfield Relay
Model # R30D-E1X2-24V

Unit Under Test

125 VDC

P2_11

P2_12

Current
Source

Ia

P3_7

P3_8

Set

Reset

P1_1

P1_2

P1_5

P1_6

24 VDC

P2_15

P2_16

Rated Power
Supply

Surge and Case GND
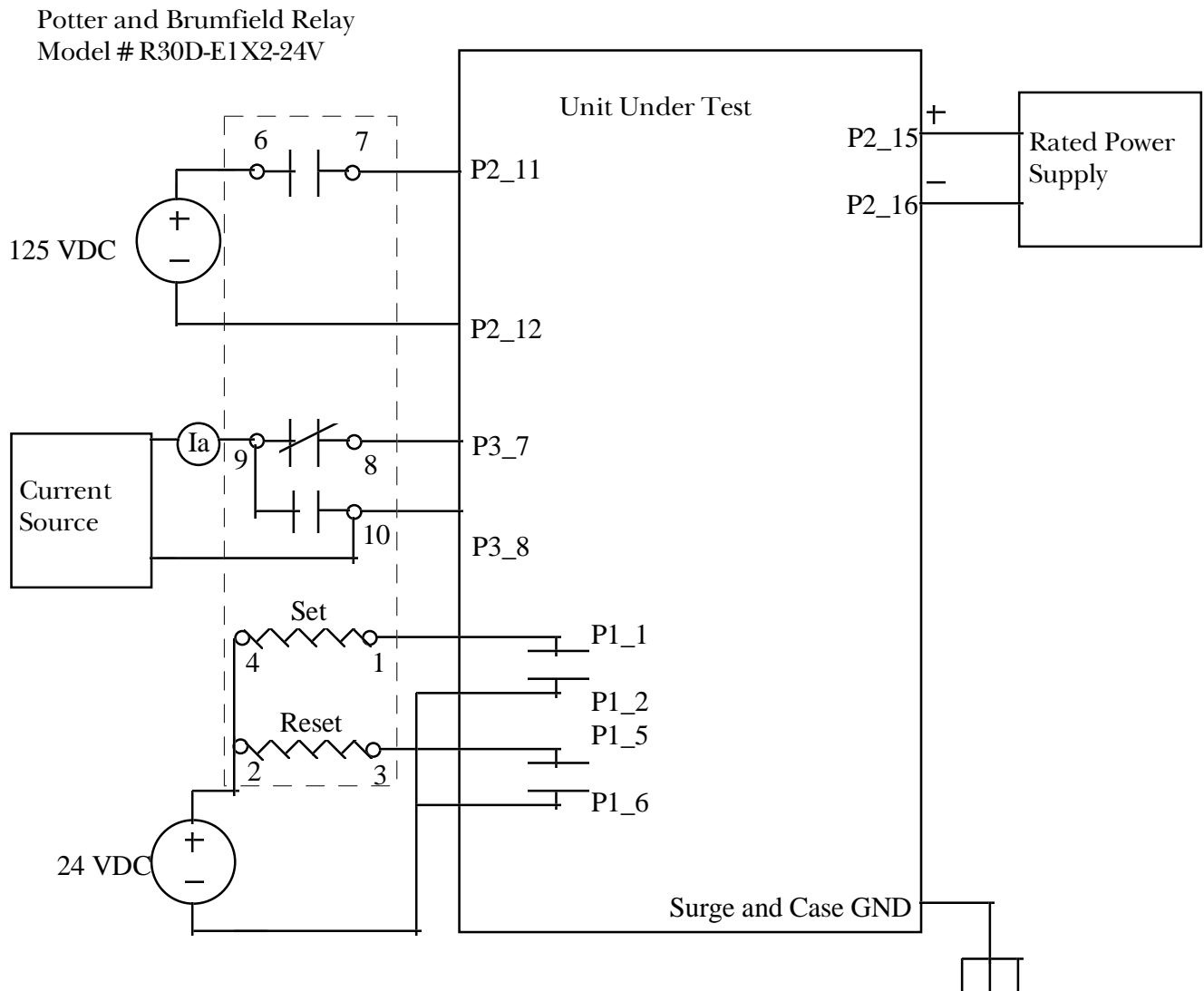
**Figure 5-4 Recloser Test**
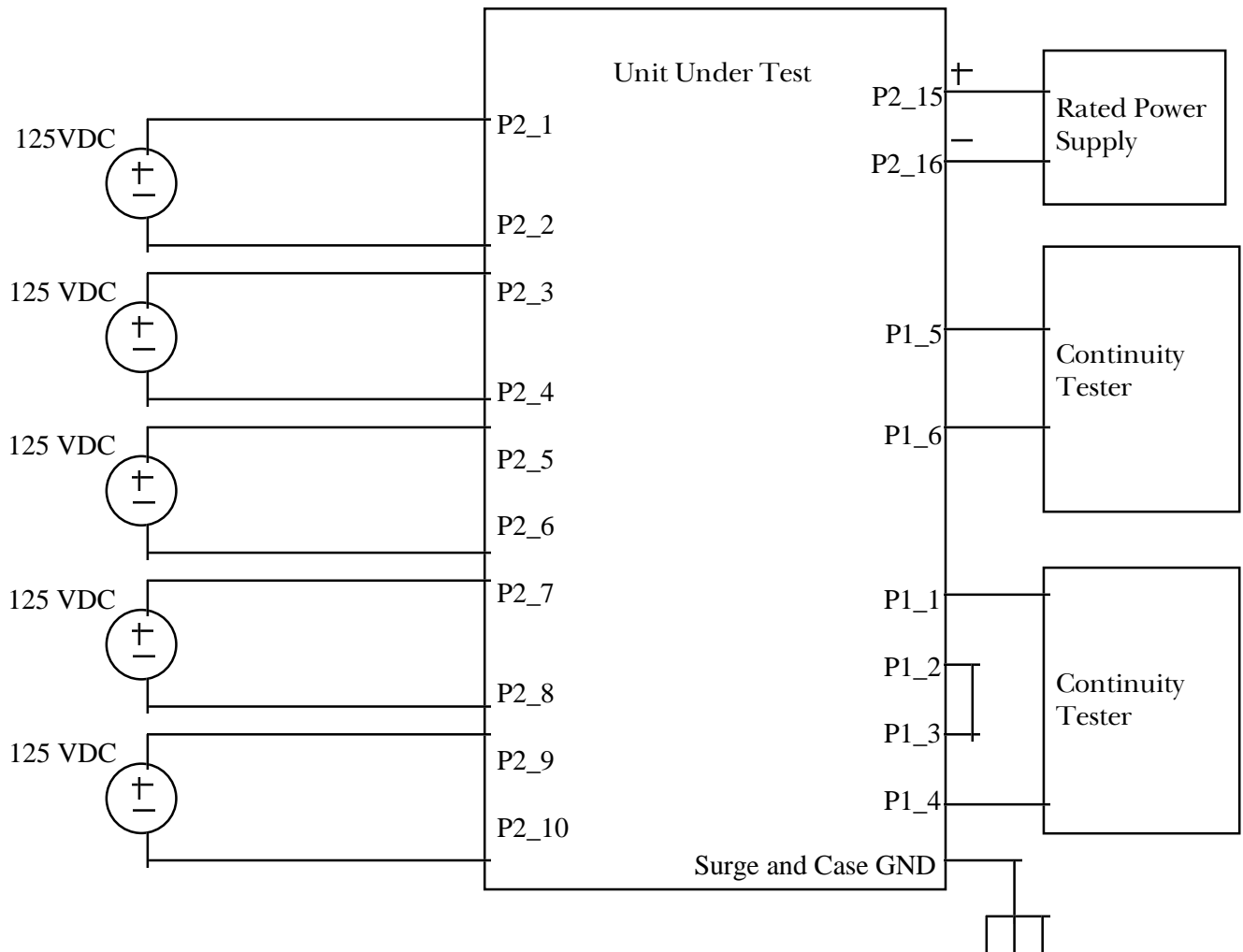
**Figure 5-5 Contact Converter (Digital Input) Test**
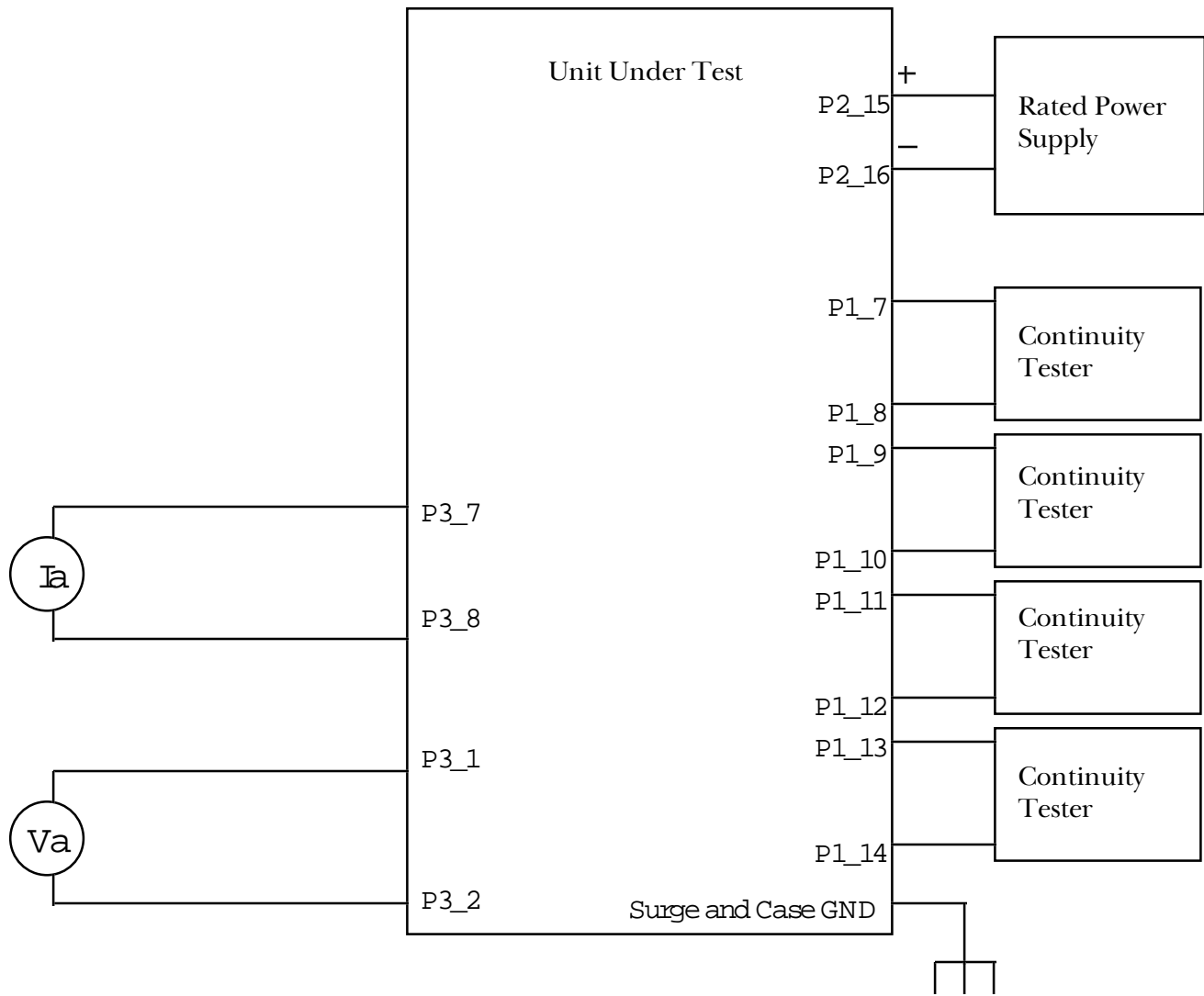
**Figure 5-6 Programmable Output Test**

# Chapter 6 -PERIODIC TESTING

## GENERAL

The procedure described in this section will give the user an outline for testing an in-service DFP100. The test circuits and procedures are similar to those used and illustrated in the ACCEPTANCE TEST section of this manual.

The user should determine the extent and frequency of periodic testing to be performed. The tests shown are guides for performing periodic tests; it is not strictly required that they be done at every periodic test of the unit.. The desired test procedures can be incorporated into the user's standard test procedures.

## GENERAL TESTS

TEST 1 Phase/GND IOC Test

TEST 2 Phase/GND TOC Test

TEST 3 Negative Sequence Overcurrent Test

TEST 4 Under/Over Frequency Test

TEST 5 Under/Over Voltage Test

TEST 6 Phase Distance Unit Test

These are the same tests as performed in the ACCEPTANCE TEST section. These tests will be performed with the user-specific settings already in the relay. Successful completion of these tests will insure a fully functioning and calibrated relay.

## TEST EQUIPMENT

1.  Three-phase source of voltage and a single-phase source of current.
2.  DC or AC control voltage source.
3.  A continuity tester or Ohm meter.
4.  A precision timer for testing timed events.

The specific requirements of the equipment are given in the text of this section, and in the associated circuit diagrams.

## DRAWINGS AND REFERENCES

The following drawings should be used for reference during testing. They are located in the PRODUCT DESCRIPTION and the CALCULATION OF SETTINGS sections.

Drawings:

1.  The Elementary Diagram; Figure 2-2 (PRODUCT DESCRIPTION).

References:

1.  Default Relay Settings; Figure 3-1 (CALCULATION OF SETTINGS).

## EQUIPMENT GROUNDING

All equipment used in testing the DFP relay should be connected to a common grounding point, to provide noise immunity. This includes the voltage and current sources, as well as, the DFP relay. The common for surge protection is clearly marked on the rear of the case.

## SETTING CHANGES

Setting changes required for a particular test will be listed before the test. Setting changes can be accomplished in one of three possible ways:

1.  Through ASCII communications
2.  Through the GE Protocol communications.
3.  Through the Man-Machine Interface (MMI).

To determine which communication options are available to you, see Table 6-1.

**Table 6-1 DFP100 Communication Options**

| Model Number | Option |
|---|---|
| DFP1XX0XXXXXXA | ASCII Protocol |
| DFP1XX1XXXXXXA | GE Protocol |
| DFP1XX1MXXXXXA | Man-Machine Interface |

Note: X = Don't Care

### Communication Requirements

If your DFP relay has ASCII Communications, you will be able to communicate with the relay through the use of any Personal Computer and any terminal emulation software (e.g. PROCOMM or Windows Terminal Emulator).

If your DFP relay has GE Protocol communications, you will be able to communicate with the relay through the use of any Personal

Computer and the Mlink software program provided with the relay.

The pinouts of the DFP100 communication ports are marked on the rear of the unit. To build or order a cable to communicate between your relay and a computer, see the **INTERFACE SECTION**. The Periodic Test can be performed with an ASCII or MLINK relay connected to a PC or with a relay containing an MMI. Because of the large number of setting changes it is recommended that a PC be used to perform the Periodic Test.

### Relay Set-up

Note:  All testing will be done with the relay connected as shown in Figure 5-1.

### PROTECTION FUNCTION TESTS

### TEST 1 - Phase/GND IOC

| Category | Setting Name | Relay Setting |
|---|---|---|
| Instantaneous | Disable Phase INST High | No |
| Instantaneous | Pickup Phase INST High (Is) | _____ Arms |
| Instantaneous | Delay Phase INST High (Ts) | _____ S |
| Instantaneous | Disable Ground INST High | No |
| Instantaneous | Pickup Ground INST High | _____ Arms |
| Instantaneous | Delay Ground INST High | _____ S |
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Outputs | OUT1 | = 50PH + 50NH |
| Outputs | TPU1 | 0 |
| Outputs | TDO1 | 0 |

1.  Enter the above settings.

2.  Apply current according to the table below and check for the required results:

3.  Press and hold the target reset button between tests.

Before starting a particular test disable all other functions from operating. After completing a particular test disable that function from operating.

When performing the Periodic test you may find that your DFP is connected to your system. This includes having the TRIP1 and TRIP2 contacts wired to the breaker trip coils. To avoid accidental tripping you can disable the trip contacts by making the TRIP mask equal to 0. To verify successful completion of the test you can program the programmable outputs to operate for the particular function being tested. In other words, before each test program set OUT1, OUT2, OUT3, or OUT4 to operate for the function being tested.

**Test 1 Phase/Ground IOC Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 95% of Is | P1_7,P1_8 | ——— | Ready |
|  | P3_7, P3_8 | 105% of Is | P1_7,P1_8 | Ts-.05 <t< Ts + .05s | READy, INST, A |
| B | P3_9, P3_10 | 95% of Is | P1_7,P1_8 | ——— | Ready |
|  | P3_9, P3_10 | 105% of Is | P1_7,P1_8 | Ts-.05 <t< Ts + .05s | READy, INST, B |
| C | P3_11, P3_12 | 95% of Is | P1_7,P1_8 | ——— | Ready |
|  | P3_11, P3_12 | 105% of Is | P1_7,P1_8 | Ts-.05 <t< Ts + .05s | READy, INST, C |
| N | P3_13, P3_14 | 95% of Is | P1_7,P1_8 | ——— | Ready |
|  | P3_13, P3_14 | 105% of Is | P1_7,P1_8 | Ts-.05 <t< Ts + .05s | READy, INST, N |

### TEST 2 - Phase/GND TOC

| Category | Setting Name | Relay Setting |
|---|---|---|
| Time Over Current | Disable Phase TOC | No |
| Time Over Current | Curve Phase TOC | 3 (Inverse) |
| Time Over Current | Pickup Phase TOC (Ip) | _____ Arms |
| Time Over Current | Time Dial Phase TOC | _____ Time Dial |
| Time Over Current | Disable Ground TOC | No |
| Time Over Current | Curve Ground TOC | 3 (Inverse) |
| Time Over Current | Pickup Ground TOC | _____ Arms |
| Time Over Current | Time Dial Ground TOC | _____ Time Dial |
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Outputs | OUT1 | = 51PT + 51NT |
| Outputs | TPO1 | 0 |
| Outputs | TDO1 | 0 |

1.  Enter the above settings. Trip times (Tc) for each of these tests can be obtained from the curves and equations contained in the PRODUCT DESCRIPTION section.

2.  Apply Current according to the table below and check for the required results:

**Test 2 Phase/Ground Inverse TOC Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, A |
| B | P3_9, P3_10 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, B |
| C | P3_11, P3_12 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, C |
| N | P3_13, P3_14 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, N |

3.  Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| Time Over Current (TOC) | Curve Phase TOC | 2 (Very Inverse) |
| Time Over Current (TOC) | Curve Ground TOC | 2 (Very Inverse) |

4.  Apply Current according to the table below and check for the required results:

**Test 2 Phase/Ground Very Inverse TOC Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, A |
| B | P3_9, P3_10 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, B |
| C | P3_11, P3_12 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, C |
| N | P3_13, P3_14 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, N |

5.  Enter the following settings:

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Phase TOC | 1 (Extremely Inverse) |
| TOC | Curve Ground TOC | 1 (Extremely Inverse) |

6.    Apply Current according to the table below
      and check for the required results:

**Test 2 Phase/Ground Extremely Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, A |
| B | P3_9, P3_10 | 5X Pi | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, B |
| C | P3_11, P3_12 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, C |
| N | P3_13, P3_14 | 5X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, N |

## TEST 3 - Negative Sequence Overcurrent

| Category | Setting Name | Relay Setting |
|---|---|---|
| Neg. Seq. Overcurrent | Disable Negative Sequence TOC | No |
| Neg. Seq. Overcurrent | Curve Negative Sequence TOC | 3 (Inverse) |
| Neg. Seq. Overcurrent | Pickup Negative Sequence TOC (Ip) | _____ Arms |
| Neg. Seq. Overcurrent | Time Dial Negative Sequence TOC | _____ Time Dial |
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Outputs | OUT1 | = 46PT |
| Outputs | TPO1 | =0 |
| Outputs | TDO1 | =0 |

1.    Enter the above settings.

2.    Apply Current according to the table below
      and check for the required results:

**Test 3 Negative Sequence Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| B | P3_9, P3_10 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| C | P3_11, P3_12 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |

3.    Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Neg Seq TOC | 2 (Very Inverse) |

4.    Apply Current according to the table below
      and check for the required results:

**Test 3 Negative Sequence Very Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| B | P3_9, P3_10 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| C | P3_11, P3_12 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |

5.    Enter the following settings.

| Category | Setting Name | Relay Setting |
|---|---|---|
| TOC | Curve Neg Seq TOC | 1 (Extremely Inverse) |

6.  Apply Current according to the table below
    and check for the required results:

**Test 3 Negative Sequence Extremely Inverse TOC Test Inputs and Results**

| Input Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Phase | Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| A | P3_7, P3_8 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| B | P3_9, P3_10 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |
| C | P3_11, P3_12 | 9X Ip | P1_7,P1_8 | Tc-5% <t< Tc + 5% | Ready, Neg. Seq. |

### TEST 4 - Under/Over Frequency

| Category | Setting Name | Relay Setting |
|---|---|---|
| U/O Frequency | Disable Under Frequency Unit 1 | No |
| U/O Frequency | Disable Over Frequency Unit 1 | Yes |
| U/O Frequency | Disable Under Frequency Unit 2 | Yes |
| U/O Frequency | Disable Over Frequency Unit 2 | No |
| U/O Frequency | Pickup Under Frequency Unit 1 | _____ Hz |
| U/O Frequency | Pickup Over Frequency Unit 1 | 80.0 Hz |
| U/O Frequency | Delay Frequency Unit 1 (Td) | _____ cycles |
| U/O Frequency | Pickup Under Frequency Unit 2 | 40.0 Hz |
| U/O Frequency | Pickup Over Frequency Unit 2 | _____ Hz |
| U/O Frequency | Delay Frequency Unit 2 | _____ cycles |
| U/O Frequency | Voltage Supervision Threshold | _____ % |
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Outputs | OUT1 | = 81UT1 + 81OT2 |
| Outputs | TPO1 | = 0 |
| Outputs | TDO1 | = 0 |

1.  Enter the above settings.

2.  Apply Voltage according to the table below
    and check for the required results:

**Test 4 Under/Over Frequency Test Inputs and Results**

| Current | | | Trip | | LEDs |
|---|---|---|---|---|---|
| Relay Stud# | Amplitude | Frequency | Contact# | Pickup Time | Energized |
| P3_1, P3_2 | 67 Vrms | UF Set - .1 Hz | P1_7,P1_8 | Td-.05 <t< Td + .05s | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | UF Set + .1 Hz | P1_7,P1_8 | ————— | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | OF Set - .1 Hz | P1_7,P1_8 | ————— | Ready, Freq. |
| P3_1, P3_2 | 67 Vrms | OF Set + .1 Hz | P1_7,P1_8 | Td-.05 <t< Td + .05s | Ready, Freq. |

### TEST 5 - Under/Over Voltage

| Category | Setting Name | Relay Setting |
|---|---|---|
| Torque Control | Torque Control Signal | 0 (Disabled) |
| Torque Control | 59 Over Voltage Pickup | _____ Vrms |
| Torque Control | 27 Under Voltage Pickup | _____ Vrms |
| Torque Control | 59 Over Voltage Time Delay | _____ S |
| Torque Control | 27 Under Voltage Time Delay | _____ S |
| Outputs | OUT1 | = 27 + 59 |
| Outputs | TPU1 | =0 |
| Outputs | TDO1 | =0 |

1.  Enter the above settings.

2.  Apply Voltage according to the table below and check for the required results:

**Test 5 Under/Over Voltage Test Inputs and Results**

| Input Voltage | | Output | | LEDs |
|---|---|---|---|---|
| Relay Stud# | Amplitude | Contact# | Pickup Time | Energized |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 105% of 59 Setting<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | 59t <t< 59t + .05s | Ready, A |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 95% of 59 Setting<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | ———— | Ready |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 105% of 27 Setting<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | ———— | Ready |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 95% of 27 Setting<br>67 Vrms<br>67 Vrms | P1_7,P1_8 | 27t <t< 27t + .05s | Ready, A |

### TEST 6 - Phase Distance Units

The following section provides a means for determining the test currents and voltages to verify correct operation of your Phase Distance Unit. This procedure will be used to determine the test current "$I_T$" and the voltage of pickup "VNOM".

The test current , "$I_T$", is determined from Table 6-2. The value of "$I_T$" is chosen according to the reach of the 21PT function. The nominal pickup voltage , "VNOM", is calculated with respect to "$I_T$" and several relay settings.

**Table 6-2 Test Current Ranges**

| In = 5 Arms<br>ZR Reach | $I_T$ Arms<br>Test | In = 1 Arms<br>ZR Reach | $I_T$ Arms<br>Test |
|---|---|---|---|
| 05 - 6.0 | 10 | .25 - 30.0 | 2 |
| 6.0 - 12.0 | 5 | 30.0 - 60.0 | 1 |
| 12.0 - 20.0 | 3 | 60.0 - 100.0 | 0.6 |
| 20.0 - 30.0 | 2 | 100.0 - 150.0 | 0.4 |
| 30.0 - 40.0 | 1.5 | 150.0 - 200.0 | 0.3 |
| 40.0 - 50.0 | 1.2 | 200.0 - 250.0 | 0.2 |

"VNOM" calculations are referenced to the "leading" phase-to-ground faulted voltage. When an AB fault is applied, the current angle is with respect to the phase angle of VA, not the phase-to-phase voltage. That is why the "1.732" (square root of three) factor and the added angle of 30° is included in the equation below.

VNOM     = $[(2/1.732)*(ZR)*($
                    $\mathbf{I_T})]*(COS((\phi I+30)-\phi Z))$

             for $(\phi Z - 90) < \phi I < \phi Z$

             = $[(2/1.732)*(ZR)*($
                    $\mathbf{I_T})]*(COS((\phi I+30)-\phi Z))$

             for $\phi Z < \phi I < (\phi Z +90)$

Definitions:

             ZR = Relay reach (Impedance)

             $\mathbf{I_T}$ = Faulted phase - test current

             $\phi Z$ = Angle of maximum reach

             $\phi I$ = Test current angle with respect to
                    the faulted phase

| Category | Setting Name | Relay Setting |
|----------|--------------|---------------|
| TRQ CNTL | Torque Control Signal | 2 (21PT) |
| TRQ CNTL | 21PT Signal | 1 (OR) |
| TRQ CNTL | 21PT Reach | _____ Ω (ZR) |
| FLT LOC | POS SEQ IMP ANG | _____° ($\phi Z$) |
| Outputs | OUT1 | = 21PT |
| Outputs | TPU1 | =0 |
| Outputs | TDO1 | =0 |

1.    Enter the above settings.

2.    Setup test according to how relay is set in the field.  Use Figure 5-2 (WYE-WYE) or Figure 5-3 (Open Delta).

3.    Set initial voltages to the following values: Va=67 Vrms at 0 degrees, Vb=67 Vrms at -120 degrees, Vc=67 Vrms at +120 degrees. Set the input current to $\mathbf{I_T}$ Arms at the phase angle listed in the table below.

4.    Simultaneously reduce all voltage inputs according to the table below, and check that the contacts close within 7% of VNOM:

**Test 6 Phase Distance Test Inputs and Results**

| Voltage | | Current | Trip | LEDs |
|---------|--|---------|------|------|
| Relay Stud# | Amplitude | Ph. Ang. | Contact# | Energized |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 93% of VNOM<br>93% of VNOM<br>67 Vrms | $\phi Z$ -30° | P1_7,P1_8 | Ready, A, B, INST |
| P3_1, P3_2<br>P3_3, P3_4<br>P3_5, P3_6 | 107% of VNOM<br>107% of VNOM<br>67 Vrms | $\phi Z$ -30° | P1_7,P1_8 | Ready |

5.    Repeat steps 3 and 4 with the faulted phases being B&C and C&A.

**END OF TEST!**

# Chapter 7 -SERVICING

## SPARES

There are three possible servicing methods for the DFP100 relay. They are: (1) unit replacement, (2) spare board replacement, and (3) component level repair. Replacing the entire unit would yield the shortest "down time" and this is the preferred servicing method. The spare board replacement method could yield a minimal "down time" if a spare processor board and power supply board were kept at the maintenance center.

It is not recommended that the DFP100 be serviced at the component level. This requires a substantial investment in test/repair equipment and in technical expertise, and usually results in a longer "down time" than unit or spare board replacement. For those who do wish to troubleshoot at the component level, drawings can be obtained by requesting them from the factory. The only information that must be supplied when requesting drawings is the DFP100 model number.

## SERVICING THE DFP100

Because of the design of the DFP100, determining which board to replace has become simplified. If you are going to use the board replacement method, there are at most three different boards that could have a problem. These boards are:

Power Supply Board            0246A9803

MMI Board                     0216B3056

Processor Board               0215B9149

When replacing any board in the DFP100 always replace boards that have identical part numbers and group numbers. Failure to do so could result in calibration problems and mis-operations.

## Power Supply

To determine which board has to be replaced, first check to see if the relay "powers up". If the READY light is "on" then you can assume that the 5 volt output of the power supply is operational. If the relay is able to measure

current accurately (within 3%), the 12 volt output of the power supply is operational.

If one or both of the above conditions do not exist, then a problem with the power supply is possible. To check and/or replace the power supply the user must first loosen the two self-captivating screws located on the front nameplate of the DFP100 (see Figure 7-1). Do not remove screws. Only loosen screws until they are able to move freely in their place. Slowly pull on both black handles simultaneously until the front nameplate has moved forward approximately 1 inch.

**WARNING: DO NOT JERK ON THE HANDLES. THIS MAY CAUSE DAMAGE TO THE ANALOG CABLE WHICH CONNECTS THE MAGNETICS TO THE PROCESSOR BOARD.**

Once the nameplate has moved forward 1 inch, reach around the right side of the nameplate and disconnect the analog cable from the processor board. After this is complete the entire electronics of the DFP100 (not including the magnetics) can be removed from the case. At this point you can inspect the power supply on the underside of the self assembly (see Figure 7-1). Be sure to inspect the two cables going from the power supply to the processor board. If these cables are making a good connection the problem is probably with the power supply. Changing power supplies will determine this.

## MMI Board

If you find that your DFP100 has proper operation with the exception of the MMI, this too can be replaced. Follow the steps in the above section to remove the processor board from the case. The MMI board is located on the reserve side of the nameplate. If you remove the five (5) mounting screws and unsolder the ribbon cable from the board, you can replace this board with a spare.

### Processor Board

The DFP100 has a continuos self-testing feature. The results of this self-test can be obtained through the MMI or through your communication port (GE-MODEM or ASCII), see SOFTWARE section for details. The errors displayed will give a technician an opportunity for component level repair. Although we do not recommend component level repairs, the self-test errors can help in troubleshooting the board.

To remove the processor board, follow the steps given in the POWER SUPPLY SECTION. This will remove the entire shelf assembly. Once this has been completed, disconnect the two cables going to the power supply and remove the five screws that are mounting the processor board to the shelf.
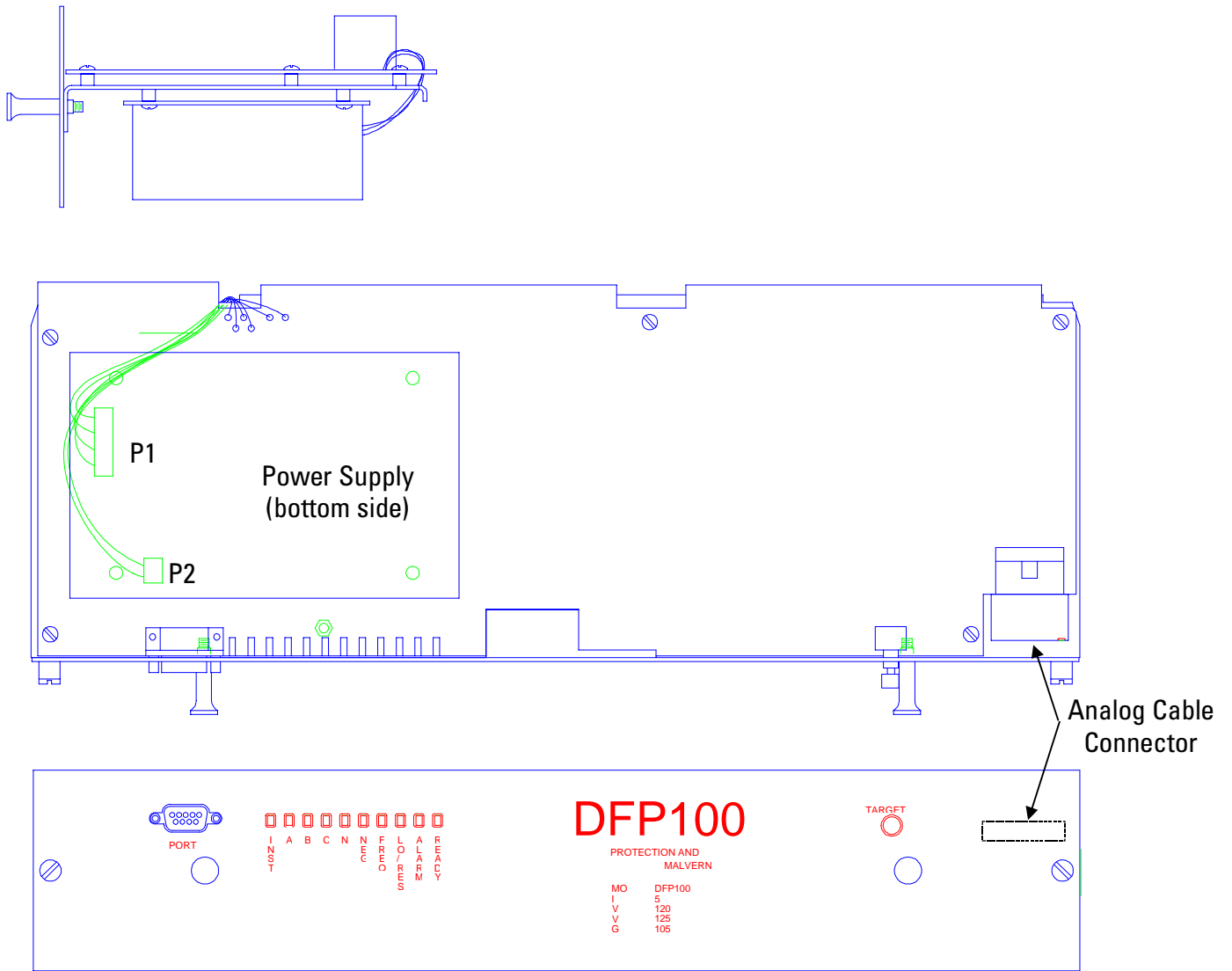
**Figure 7-1 DFP100 Servicing**

# Chapter 8 -SPECIFICATIONS

## RATINGS

| | |
|---|---|
| Rated Frequency | 50 or 60 Hertz |
| Rated Voltage | 120 or 208 Volts AC |
| Rated Current | $I_n$ = 1 or 5 Amperes |
| Control Voltage: | |
| 24 to 48 VDC | Range 19 to 60 VDC |
| 110/250 VDC or AC | Range 88 to 300 VDC |
| | 88 to 264 VAC |
| Maximum Permissible Current: | |
| Continuos | $2 \times I_n$ |
| Three Seconds | $50 \times I_n$ |
| One Second | $100 \times I_n$ |
| Max. AC Voltage: | |
| Continuos | 240 Volts AC |
| One Minute | 420 Volts AC |
| Sample Rate | 16 per Cycle |

## ENVIRONMENTAL

| | |
|---|---|
| Ambient Temperature Range: | |
| Storage | -40 °C to +85°C |
| Operation | -40°C to +70°C |
| Humidity | 95% Without Condensation |
| Insulation Test Voltage | 3 kVDC, One Minute |
| Impulse Voltage Withstand | 5 kV Peak, 1.2/50 Microseconds |
| | IEC255-4 |
| Interference Test Withstand | SWC and Fast Transient |
| | ANSI C37.90.1 |
| Interference Tests | IEC 255-22-1 Class III |
| Electrostatic Discharge | IEC 255-22-2 Class III |
| Radio Frequency Interference | IEC 255-22-3 Class III |
| | ANSI C37.90.2 |

## CONTACT RATINGS

| | |
|---|---|
| Configurable Inputs | 38.5 - 300 VDC or VAC |
| Trip Outputs Contacts | Continuos 5 Amps |
| | Make and Carry 30 Amps |
| | IAW ANSI C37.90 |
| Auxiliary Contacts | Continuos Rating 5 Amperes |
| | Make and Carry 30 Amps |
| | IAW ANSI C37.90 |

## BURDENS

| | |
|---|---|
| Current Circuits | |
| $I_n$ = 1A | @50 Hz 0.0507 $\angle 3.95$ |
| | @60 Hz 0.0507 $\angle 4.738$ |
| $I_n$ = 5A | @50 Hz 0.0058 $\angle 4.76$ |
| | @60 Hz 0.0058 $\angle 5.71$ |
| Control Power | <15 Watts |

## RANGES OF OVERCURRENT ADJUSTMENT

| | |
|---|---|
| Phase Time Overcurrent Units | 1.0 to 12 A or 0.2 to 2.4 A |
| Phase Instantaneous Unit | 1.0 to 160 A |
| Ground Time Overcurrent Units | 1.0 to 12 A or 0.2 to 2.4 A |
| Ground Instantaneous Units | 1.0 to 160 A |
| Phase and Ground Time | Inverse - ANSI PC37.112 |
| Overcurrent Operating Curves | Very Inverse - ANSI PC37.112 |
| | Extremely Inverse - ANSI PC37.112 |

## METERING (At Rated Voltage And Current)

| | |
|---|---|
| Current | 2% |
| Voltage | 2% |
| Watts | 4% |
| Vars | 4% |
| Frequency | ±0.1 Hz |

## RECLOSER

| | |
|---|---|
| Programmable Reclose Times | Programmable from 1 to 4 |

## OSCILLOGRAPHY

| | |
|---|---|
| Captures | 6 |
| Cycles | 34 |
| | 2 Prefault, 32 Post Fault |
| Samples/Cycle | 16 |

## COMMUNICATIONS

| | |
|---|---|
| Protocols | ASCII Protocol |
| | M-Link Protocol |
| Optional Local MMI | 20 Key Keypad |
| | 2 Line x 16 Character Display |
| Connectors | 1 - Front DB-9 |
| | RS232 |
| | 2 - Rear DB-9 |
| | RS232 |
| | Optional RS-485 |
| | Optional Glass Fiber Optic |
| | Optional Plastic Fiber Optic |

## WEIGHTS (Approximate)

| | |
|---|---|
| Net | 10.5 pounds (4.76 kilograms) |
| Shipping | 12.5 pounds (5.67 kilograms) |

## DIMENSIONS

| | |
|---|---|
| Overall Height | 3.5 inches (88.9 mm) |
| Width | 19” (482 mm) to Edge of Flanges |
| Depth | 7” (177.8 mm) to Rear of Terminals |

## NOMENCLATURE SELECTION GUIDE

```
DFP  *  *  *  *   *  *  *  *  *
1
     0  |  |  |   |  |  |  |  |     RS232
     1  |  |  |   |  |  |  |  |     Fiber Optic (Versatile Link Connector)
     2  |  |  |   |  |  |  |  |     Fiber Optic (SMA906 Connector)
     3  |  |  |   |  |  |  |  |     RS233 & RS485 **
     4  |  |  |   |  |  |  |  |     MODBUS
        A  |  |   |  |  |  |  |     1.0-12A Phase 1.0-12A GND (In =5A)
        B  |  |   |  |  |  |  |     0.2-2.4A Phase 0.2-2.4A GND (In=1A)
        C  |  |   |  |  |  |  |     1.0-12A Phase 0.2-2.4A GND (In = 5A)
           0  |   |  |  |  |  |     ASCII Protocol
           1  |   |  |  |  |  |     M-Link Protocol**
              N   |  |  |  |  |     Without MMI
              M   |  |  |  |  |     With MMI**
                  0  |  |  |  |     Without Oscillography
                  1  |  |  |  |     With Oscillography
                     0  |  |  |     Without Recloser
                     1  |  |  |     With Recloser
                        0  |  |     Horizontal Mounting
                        1  |  |     Vertical Mounting
                           F  |     24/48 VDC
                           G  |     110/250 VDC or AC
                              A     Revision level
```

\*\*RS485 is only available with M-Link Protocol
\*\*MMI is only available with M-Link Protocol

**Example:** DFP10A1M111GA - Digital Feeder Protector rated 5 amperes, RS-232, M-Link Protocol, with local MMI, with recloser, vertical mount, 110/250 VDC or AC control power.

# Chapter 9 -INTERFACE

## GENERAL

Their are two basic methods for communicating with the DFP100. The first method utilizes a local man-machine interface (MMI) consisting of a keypad and liquid crystal display mounted on the front panel. The MMI option allows the user to enter settings, display metering values, and access some data. The second method utilizes serial ports present on all models of the DFP100. There are three serial ports. Port 1 is located on the front panel. Ports 2 and 3 are located on the rear panel. Ports 1 and 2 are driven by the same UART (universal asynchronous receiver/transmitter chip). Port 3 is driven by a separate UART. Different models are available for RS232 only, RS485 and RS232, or Fiber Optic and RS232. The port utilization for the three options are shown in the following table.

|                   | Port 1 | Port 2 | Port 3   |
|-------------------|--------|--------|----------|
| **RS232 only**    | RS232  | RS232  | RS232    |
| **RS485 and RS232** | RS232 | RS232 | RS485    |
| **Fiber Optic and RS232** | RS232 | RS232 | Disabled |

When using the serial ports, there is a choice of communication protocols. Different models are available for ASCII or GE Protocol. For ASCII models, a general purpose PC communications program, such as PROCOMM, CROSS-TALK, etc., is sufficient. For GE Protocol models, a unique PC communications program designated **Mlink** is required. Mlink is supplied free of charge by GE. Note that the optional local MMI is only available in combination with GE Protocol.

## MAN-MACHINE INTERFACE (MMI)

### Display

The display consists of a 2 line by 16 character liquid crystal display (LCD) with the character positions arranged side-by-side horizontally.

Every keystroke at the MMI produces some feedback on the display: numeric keys are echoed as they are pressed, function keys produce an abbreviated word when they are pressed, the ENT key causes changes in the settings, etc.

The Initialization message consists of upside down question marks "?" and is displayed while the DFP100 is initializing itself during a power-up sequence. The display is blanked as soon as initialization is complete.

The default state for the MMI is to display the message DFP100 General Electric. All other messages that are the result of keyboard operations remain on the display until another key is pressed, or until no keys have been pressed for a period of 15 minutes; at the end of this time-out interval, the display is blanked.

### Keypad

The keypad is comprised of twenty keys; a 10 numeric keys, a decimal point, and nine function keys (See Figure 9-1)
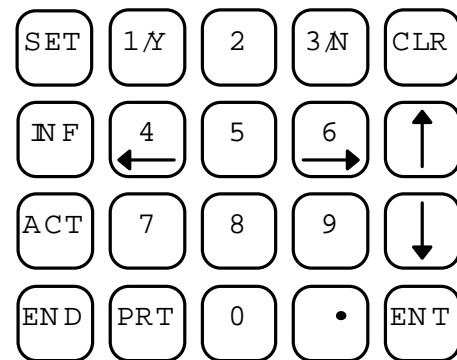


**Figure 9-1 DFP100 MMI Keypad**

## KEY FUNCTIONS

The following paragraphs contain a description of the function and data input keys.

### Print Key (PRT)

The PRT key has no function in the DFP100. Pressing it at any level will cause no response.

### Clear Key (CLR)

The CLR key is used to abort a keyboard sequence in progress (for example, when the user sees he has made an error). When the CLR key is pressed, the last keystroke entered will be cleared.

If there is user-entered information on the display, only the last information will be blanked. For

example, if the user is entering a Setting value when the CLR key is pressed, only the last stroke of the user's input will be blanked; the name of the setting and any other characters entered will remain on the display. As another example, if the user is responding to an Action prompt, only the user's input will be blanked; the prompt question will remain on the display

The CLR key must be pressed twice to return to the top level display. If a (*) is displayed in the top left corner, the CLR key must be pressed again to return to the top level menu.

### Arrow Keys

There are two types of ARROW keys on the DFP100 Keypad. The UP and DOWN arrow keys are used to scroll through the list of categories within a Command key or to scroll through the list of items within a category. For example, pressing the INF key will produce the name of the first category (e.g., EVENT LOGS) on the display. Pressing the UP-ARROW key will then produce the name of the second category (e.g., CURRENT LOGS) on the display. When the user reaches the desired category, pressing the ENT key will then produce the first item of that category on the display. From that point on, pressing the UP-ARROW key will produce each subsequent item in the category on the display.

While the UP-ARROW key scrolls in a forward direction through a list of categories or items, the DOWN-ARROW key can be used to scroll backward through a list; i.e., the user may return to the previously displayed item by pressing the DOWN-ARROW key.

When the user is scrolling through a list of categories or items with the UP-ARROW key and gets to the last entity in the list, pressing the UP-ARROW key again will produce the first category or item on the display (wrap-around). Using the DOWN-ARROW key will likewise wrap around from the first category or item to the last. If the user is scrolling through items within a category and wants to get out of that category, pressing the CLR key will display the current category name. The user may then use the ARROW keys to scroll through the categories.

The 4 and 6 key also function as LEFT and RIGHT ARROW keys respectively. These keys are used to move within a setting entry when entering certain setting such as the Relay ID.

### Enter Key (ENT)

The ENT key is used to enter data for action. It also is used to scroll the present value information. The default display is always shown until a key is pressed.

```
┌─────────────────────┐
│         DFP         │
│  GENERAL ELECTRIC   │
│                     │
└─────────────────────┘
```
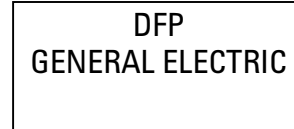
Pressing the ENT key will cause the following present values to be scrolled through: Ia, Ib, Ic, IN, Va, Vb, Vc, Vab, Vbc, Vca INEG SEQ, Act Pwr, React PWR and Frequency.

The ENT key is used to enter data or to enter a choice. When a category name is shown on the display (as the result of pressing a Command key followed by zero or more ARROW key presses) and the user presses the ENT key, he is choosing that category to begin scrolling through. When the user is establishing or changing a setting, he uses the numeric keys and decimal point to indicate the value; after the last digit, he presses the ENT key to indicate this is the value to use. When the display prompts the user to enter a number (e.g., for Fault Information, that of the 5 stored faults), the user enters the number that represents his choice, followed by the ENT key.

### Data Entry Keys

The Data Entry keys consist of the numeric keys and the decimal point. These keys are used to enter data into the DFP100 or to make choices in response to prompts. The numeric keys 1/Y and 3/N have two meanings.

If the user is entering numeric values, the 1/Y and 3/N keys are processed and echoed as 1 and 3. If the user is responding to a YES/NO prompt, the 1/Y key is processed and echoed as a YES and the 3/N key is processed and echoed as a NO.

### End Key

The END key is used to indicate that no more setting changes will be made.

The key sequence for indicating the end of setting changes and/or the end of a session is:

**ENT**
**END**

1.     If no setting values have been entered, the DFP100 takes no action in response to the ENT/ END key sequence other than to enable action items locked previously by the MMI, to allow action commands from remote communications to be executed
2.     If settings have been changed, the DFP100 now reinitializes itself to use the new setting values and the Event message SETTING CHANGED is displayed.    The DFP100 protection software reinitializes itself to use the new setting values. The MMI unlocks the settings lock to allow remote communication to display and change settings from the DFP100.

### Settings Key  (SET)

The SET key is used to view or modify settings. The settings that apply to all settings groups are as follows:

GENERAL SETTS

BREAKER SETTS

COUNTERS

CONFIGURABLE INPUTS

CONFIGURABLE OUTPUTS

There are independent six settings groups that can be individually set for the following

TIME OVER CURRENT (TOC GRP1 - GRP6)

DEFINITE TIME (DT GRP1 - GRP6)

INSTANTANEOUS     OVERCURRENT     (IOC GRP1-GRP6)

NEGATIVE SEQUENCE (NEGSEQ GRP1 - GRP6)

FREQUENCY (FREQ GRP1 - GRP6

TORQUE CONTROL (TRQ CTRL GRP1- GRP6)

MISCELLANEOUS (MISC GRP1 - GRP6)

RECLOSER (RCL1 - RCL6)

FAULT  LOCATION -  (FAULT  LOC  GRP1 - GRP6)

The user may scroll through all of the settings in a category by pressing the UP OR DOWN ARROW keys.   If the user wishes to leave that category, pressing the CLR key will cause the current category name to be displayed.  Pressing the CLR key again will cause the previous menu level to be displayed.

If the user wants to change a setting, he must first display that setting (item) as described above. With the present value of the setting displayed, he then uses the Data Entry keys to enter the new value.  When the first Data Entry key is pressed, the abbreviated name remains on the display, and the data value entered is echoed to the screen.

Note that there are some settings that logically represent a state rather than a number (i.e., YES/NO).  For these settings, the 1/Y and 3/N keys are used to indicate the state (1/Y = YES and 3/N = NO) and the words YES or NO are displayed.  After the last digit of the new value is pushed, the user presses the ENT key; and then the END key, and the DFP100 stores the new value as the value of the setting.  If the user presses any Command key, or the PRT key no action is taken. If either UP or the DOWN ARROW key is pressed instead of the ENT key, the next setting will be displayed. If the CLR key is pressed instead of the ENT key, the last keystroke will be erased.  If all key strokes are cleared no new values will be stored, and the old value will be retained.

When a setting value is entered, the value is checked against the allowable range of values for that setting.  If the value does not fall within the valid range of values, an error message is displayed.  If the setting is a YES/NO type, its value is checked to make sure it is set to either a YES or NO.  If the user enters any other digit for this type setting, an error message is displayed.  If an error message is displayed, the setting name and unchanged value will be displayed again when the CLR key is pressed.  The first time a setting is successfully changed, remote communications is inhibited from reading and changing settings in the DFP100.

After changing the value of a setting, the message SETTINGS CHANGED is displayed.  Pressing the CLR key will cause the setting name and the new value to be displayed.  The user may press one of the ARROW keys to move to the next setting in the category.  He may also press the CLR key to return to the next settings selection menu.

### General Settings

The general settings category contain the entries as shown in Table 9-1.  The ranges of the settings are also defined in Table 9-1.  The settings are entered by pressing the ENT key followed by the END key and confirming the change with the 1/Y key.  Pressing 3/N at the confirm prompt will return the DFP100 to the input selection level, where the arrow keys may again be used to make the selection.

**Table 9-1 MMI General Setting Abbreviations**

| SETTING NAME | ABBREVIATION | RANGE |
|---|---|---|
| RELAY STATUS | REL STATUS | DIS(1)/ ENA(3) |
| FREQUENCY | FREQ | 60(1)/50(3) Hz |
| PHASE CT RATIO | PH CT RT | 1-2000 |
| GROUND CT RATIO | GND CT RT | 1-2000 |
| TRANSFORMER RATION | VT RT | 1-2000 |
| BREAKER IDENTIFICATION | BREAKER ID | 1-9999 See Note #1 |
| ACTIVE SETTING GROUP | ACT GRP | 1-6 |
| PHASE ROTATION | PHASE ROTATION | CBA(1)/ ABC (3) |
| RELAY IDENTIFICATION | RELAY ID | "character string" See Note #1 |
| COLD LOAD PICKUP START TIME | CLPU START TIME | 0-240.00 See Note #2 |
| COLD LOAD PICKUP DROPOUT TIME | CLDRP TIME | 0.240.00 See Note #2 |
| 52b WIRED | 52b WIRED | YES (1)/NO (3) |
| POTENTIAL TRANSFORMER CONNECTION | OPEN DELTA | YES (1) NO (3) |

Note #1: The setting is changed pressing the ENT key and then using the 2 key or 8 key to scroll up, or down respectively through the total ASCII character set.

Note #2: Setting both the Cold Load Pickup Delay and Cold Load Dropout Delay to zero disables the Cold Load Pickup.

### Counter Settings

The Counter setting category contains the entries as shown in Table 9-2. The settings are changed by entering the value for each of the counters, pressing the ENT key, pressing the END key, and confirming the change with the 1/Y key. Pressing

the 3/N key will return the DFP100 to the input for the setting, which will allow the entry of a new value. The names and abbreviations for the counters group are show in Table 9-2.

**Table 9-2 MMI Counter Settings Names and Abbreviations**

| SETTING NAME | ABBREVIATION | RANGE |
|---|---|---|
| ACCUM PHASE A | ACC PH A | 0 - 40,000,000 |
| ACCUM PHASE B | ACC PH A | 0 - 40,000,000 |
| ACCUM PHASE C | ACC PH C | 0 - 40,000,000 |
| NUMBER OF OPENINGS | NUM OPEN | 0 - 99,999 |
| NUMBER OF RECLOSURES | NUM RCL | 0 - 99,999 |
| TRIP COUNT | TRIP COUNT | 0 See Note #1 |

Note #1: The Trip Count setting can only be set to 0 (reset).

### Breaker Settings

The Breaker setting category contains the entries for the breaker health function as shown in Table 9-3. The settings are changed by entering the value for each of the counters, pressing the ENT key, pressing the END key, and confirming the change with the 1/Y key. Pressing the 3/N key will return the DFP100 to the input for the setting, which will allow the entry of a new value. The names and abbreviations for the Breaker group are show in Table 9-3.

**Table 9-3 MMI Breaker Health Settings Names and Abbreviations**

| SETTING NAME | ABBREVIATION | RANGE |
|---|---|---|
| BREAKER HEALTH UNITS | BRKR UNITS | I^2T (1)- IT(3) |
| BREAKER ARC TIME | BRKR ARC TIME | 1-200 ms |
| BREAKER HEALTH THRESHOLD | BRKR THRESH | 0 - 40,000,000 |

### Configurable Input Settings

The setting names and abbreviations for the MMI are shown in Table 9-4. The settings ranges for each of the inputs are shown in Table 9-5. The ranges are scrolled through by using the LEFT ARROW (4) or the RIGHT ARROW (6) keys. The settings are entered by pressing the ENT key followed by the END key and confirming the change with the 1/Y key. Pressing 3/N at the confirm prompt will return the DFP100 to the input selection level, where the arrow keys may again be used to make a selection.

**Table 9-4 MMI Digital Input Setting Names and Abbreviations**

| SETTING NAME | ABBREVIATION | RANGE |
|---|---|---|
| DIGITAL INPUT 1 | DIG I1 | See Table 9-5 |
| DIGITAL INPUT 2 | DIG I2 | See Table 9-5 |
| DIGITAL INPUT 3 | DIG I3 | See Table 9-5 |
| DIGITAL INPUT 4 | DIG I4 | See Table 9-5 |
| DIGITAL INPUT 5 | DIG I5 | See Table 9-5 |

**Table 9-5 MMI Digital Input Setting Names and Abbreviations**

| SETTING NAME | ABBREVIATION |
|---|---|
| SET GROUP BIT 0 | SBIT 1 |
| SET GROUP BIT 1 | SBIT 2 |
| SET GROUP BIT 2 | SBIT 3 |
| TRIP CKT MON | TCM |
| DIRECT TRIP | DT |
| DIRECT CLOSE | DC |
| TORQ1 | TRQ1 |
| TORQ2 | TRQ2 |
| BLOCK RECLOSER | BLK |
| RECLOSE BY EXT INPUT | RCLEXT |
| TRIP BY EXT. INPUT | EXTT |
| RECLOSE PAUSE | RCLP |
| UNBLOCK RECLOSE | RCLUNB |

### Configurable Output Settings

The setting names and abbreviations for the MMI CONFIGURABLE OUTPUT settings are shown in Table 9-6. The settings ranges are shown in Table 9-7. The entries are scrolled through by using the LEFT ARROW (4) or the RIGHT ARROW (6) keys. The settings are entered by pressing the ENT key followed by the END key and confirming the change with the 1/Y key. Pressing 3/N at the confirm prompt will return the DFP100 to the input selection level, where the arrow keys may again be used to make the selection.

**Table 9-6 MMI Configurable Output Setting**
**Names and Abbreviations**

| SETTING NAME | ABBREVIATION | RANGE (KEY) |
|---|---|---|
| NOT1 | NOT1 | SEE TABLE 9-7 |
| NOT2 | NOT2 | SEE TABLE 9-7 |
| AND1 INPUT 1 | &1.1 | SEE TABLE 9-7 |
| AND1 INPUT 2 | &1.2 | SEE TABLE 9-7 |
| AND2 INPUT 1 | &2.1 | SEE TABLE 9-7 |
| AND2 INPUT 2 | &2.2 | SEE TABLE 9-7 |
| AND3 INPUT 1 | &3.1 | SEE TABLE 9-7 |
| AND2 INPUT 2 | &3.2 | SEE TABLE 9-7 |
| AND4 INPUT 1 | &4.1 | SEE TABLE 9-7 |
| AND2 INPUT 2 | &4.2 | SEE TABLE 9-7 |
| AND5 INPUT 1 | &5.1 | SEE TABLE 9-7 |
| AND5 INPUT 2 | &5.2 | SEE TABLE 9-7 |
| OUT1 OR INPUT 1-16 | OUT1.1 - OUT1.16 | SEE TABLE 9-7 |
| OUT2 OR INPUT 1-16 | OUT2.1 - OUT2.16 | SEE TABLE 9-7 |
| OUT3 OR INPUT 1-16 | OUT3.1 - OUT3.16 | SEE TABLE 9-7 |
| OUT4 OR INPUT 1-16 | OUT4.1 - OUT4.16 | SEE TABLE 9-7 |
| PICKUP TIMER OUT 1 | TPU1 | 0-120.00 |
| DROPOUT TIMER OUT 1 | TDO1 | 0-120.00 |
| PICKUP TIMER OUT 1 | TPU2 | 0-120.00 |
| DROPOUT TIMER OUT 2 | TDO2 | 0-120.00 |
| PICKUP TIMER OUT 1 | TPU3 | 0-120.00 |
| DROPOUT TIMER OUT 3 | TDO3 | 0-120.00 |
| PICKUP TIMER OUTPUT 1 | TPU4 | 0-120.00 |
| DROPOUT TIMER OUT 4 | TDO4 | 0-120.00 |

**Table 9-7 Pickup, Trip and Control Signals For Configurable Outputs**

| PICKUP | DESCRIPTION |
|---|---|
| 81O2_P | Over Frequency Unit 2 |
| 81O1_P | Over Frequency Unit 1 |
| 81U2_P | Under Frequency Unit 2 |
| 81U1_P | Under Frequency Unit 1 |
| 46P1_P | Negative-Sequence Definite TOC |
| 46P_P | Negative-Sequence Inverse TOC |
| 51N2_P | Ground Definite TOC Unit 2 |
| 51N1_P | Ground Definite TOC Unit 1 |
| 51N_P | Ground Inverse TOC |
| 51P2_P | Phase Definite Time Unit 2 |
| 51P1_P | Phase Definite Time Unit 1 |
| 51P_P | Phase Inverse Time Overcurrent |

| TRIP | DESCRIPTION |
|---|---|
| 81O2_T | Over Frequency Unit 2 |
| 81O1_T | Over Frequency Unit 1 |
| 81U2_T | Under Frequency Unit 2 |
| 81U1_T | Under Frequency Unit 1 |
| 46D_T | Negative-Sequence Definite TOC |
| 46T_T | Negative-Sequence TOC |
| 50NL_T | Ground IOC Low-Set |
| 50NH_T | Ground IOC High-Set |
| 50PL_T | Phase IOC Low-Set |
| 50PH_T | Phase IOC High-Set |
| 51N2_T | Ground Definite TOC Unit 2 |
| 51N1_T | Ground Definite TOC Unit 1 |
| 51N_T | Ground TOC |
| 51P2_T | Phase Definite Time Overcurrent Unit 2 |
| 51P1_T | Phase Definite Time Overcurrent Unit 1 |
| 51P_T | Phase Inverse Time Overcurrent |

| CONTROL | DESCRIPTION |
|---|---|
| 21PT | Mho Phase Distance Functions |
| 27 | Undervoltage |
| 59 | Overvoltage |
| TRIP | Trip Via Digital Input |
| 79RST | Recloser At Reset State |
| 79CLE | Recloser Enable |
| 79LCK | Recloser At Lockout State |
| TCM_A | Trip Circuit Monitor Via Digital Input |
| OEBRK | Failure to Open by Digital Input |
| CLBRK | Failure to Close by Digital Input |
| OIBRK | Fail to Open By Comm or Keypad |
| AND1 - AND6 | AND1-AND6 Inputs |
| NOT1 - NOT2 | NOT1 - NOT2 Inputs |

| CONTROL | DESCRIPTION |
|---|---|
| CC1* | Logic State of Contact Converter 1 |
| CC2* | Logic State of Contact Converter 2 |
| CC3* | Logic State of Contact Converter 3 |
| CC4* | Logic State of Contact Converter 4 |
| CC5* | Logic State of Contact Converter 5 |
| CC6* | Logic State of Contact Converter 6 |

*These Inputs were introduced with version 4.0 Proms.

## Protection Settings

The setting names and abbreviations for the MMI PROTECTION settings are shown in Table 9-8. The settings category are scrolled through using the UP and DOWN arrow keys. The entries are entered as shown in the range column of table 9-8. Some settings are entered by using the 1/Y or 3/N keys while others entries are scrolled through by using the LEFT ARROW (4) or the RIGHT ARROW (6) keys. The settings are entered by pressing the ENT key followed by the END key and confirming the change with the 1/Y key. Pressing 3/N at the confirm prompt will return the DFP100 to the input selection level, where the arrow keys may again be used to make the selection.

**Table 9-8 DFP100 MMI Protection Settings and Abbreviations**

| CATEGORY | SETTING | ABBREVIATION | RANGE |
|---|---|---|---|
| TIME OVERCURRENT | Group 1-6 | TOC GRP1-6 | |
| | Disable Phase TOC | DIS PH TOC | DIS (1)/ENA (3) |
| | Phase TOC Curve | PH TOC CRV | E. INV (Note #1) |
| | | | V. INV (Note #1) |
| | | | INV (Note #1) |
| | Pickup Phase TOC | PH TOC PU | 1.0-12.0 (Note #2) |
| | Phase TOC Time Dial | PH TOC DIAL | 0.5-10.0 |
| | Disable Ground TOC | DIS GND TOC | DIS (1)/ENA (3) |
| | Ground TOC Curve | GND TOC CRV | E. INV (Note #1) |
| | | | V. INV (Note #1) |
| | | | INV (Note #1) |
| | Pickup Ground TOC | GND TOC PU | 1.0-12.0 (Note #2) |
| | Ground TOC Time Dial | GND TOC DIAL | 0.5-10.0 |
| DEFINITE TIME | Group 1-6 | DT GRP1-6 | |
| | Disable Phase DT High | DIS PH DT H | DIS (1)/ENA (3) |
| | *Pickup Phase DT High | PU PH DT H | 1.00-160.00 |
| | Delay Phase DT High | DLY PH DT H | 0.00-2.00 |
| | Disable Phase DT Low | DIS PH DT | DIS (1)/ENA (3) |
| | *Pickup Phase DT Low | PU PH DT L | 1.00-160.00 |
| | Delay Phase DT Low | DLY PH DT L | 0.00-2.00 |
| | Disable Ground DT High | DIS GND DT H | DIS (1)/ENA (3) |
| | *Pickup Ground DT High | PU GND DT H | 1.00-160.00 |
| | Delay Ground DT High | DLY GND DT H | 0.00-2.00 |
| | Disable Ground DT Low | DIS GND DT L | DIS (1)/ENA (3) |
| | *Pickup Ground DT Low | PU GND DT L | 1.00-160.00 |
| | Delay Ground DT Low | DLY GND DT L | 0.00-2.00 |
| INSTANTANEOUS | Group 1-6 | IOC GRP1-6 | |
| | Disable Phase Inst. High | DIS PH IOC H | DIS (1)/ENA (3) |
| | *Pickup Phase Inst High | PU PH IOC H | 1.00-160.00 |
| | Delay Phase Inst High | DLY PH IOC H | 0.00-2.00 |
| | Disable Phase Inst Low | DIS PH IOC L | DIS (1)/ENA (3) |
| | *Pickup Phase Inst Low | PU PH IOC L | 1.00-160.00 |
| | Delay Phase DT Low | DLY PH IOC L | 0.00-2.00 |
| | Disable Ground Inst High | DIS GND IOC H | DIS (1)/ENA (3) |
| | *Pickup Ground Inst High | PU GND IOC H | 1.00-160.00 |
| | Delay Ground Inst High | DLY GND IOC H | 0.00-2.00 |
| | Disable Ground Inst Low | DIS GND IOC L | DIS (1)/ENA (3) |
| | *Pickup Ground Inst Low | PU GND IOC L | 1.00-160.00 |
| | Delay Ground Inst Low | DLY GND IOC L | 0.00-2.00 |

**Table 9-8 DFP100 MMI Settings and Abbreviations (Continued)**

| CATEGORY | SETTING NAME | ABBREVIATION | RANGE (KEY) |
|---|---|---|---|
| NEGATIVE SEQUENCE | Group 1-6 | NEGSEQ GRP1-6 | |
| | Disable Neg. Seq. DT | DIS NS DT L | DIS (1)/ENA (3) |
| | Pickup Neg. Seq DT | PU NS DT L | 1.00-160.00 |
| | Delay Neg. Seq DT | DLY NS DT L | 0.00-2.00 |
| | Disable Neg. Seq TOC | DIS NS H TOC | DIS (1)/ENA (3) |
| | Phase Neg. Seq Curve | NS TOC CRV | E. INV (Note #1) |
| | | | V. INV (Note #1) |
| | | | INV (Note #1) |
| | Pickup Neg. Seq TOC | PU NS TOC | 1.0-12.0 (Note #2) |
| | Neg. Seq TOC Time Dial | NS TOC DIAL | 0.5-10.0 |
| FREQUENCY | Group 1-6 | FREQ GRP1-6 | |
| | Disable Under Freq. Unit 1 | DIS U-FREQ1 | DIS (1)/ENA (3) |
| | Disable Over Freq. Unit 1 | DIS O-FREQ1 | DIS (1)/ENA (3) |
| | Disable Under Freq. Unit 2 | DIS U-FREQ2 | DIS (1)/ENA (3) |
| | Disable Over Freq. Unit 2 | DIS O-FREQ2 | DIS (1)/ENA (3) |
| | Pickup Under Freq. Unit 1 | PU U-FREQ1 | 40.00-80.00 |
| | Pickup Over Freq. Unit 1 | PU O-FREQ1 | 40.00-80.00 |
| | Delay Time Freq. Unit 1 | DLY FREQ1 | 3.0-600.00 |
| | Pickup Under Freq. Unit 2 | PU U-FREQ2 | 40.00-80.00 |
| | Pickup Over Freq. Unit 2 | PU O-FREQ2 | 40.00-80.00 |
| | Delay Time Freq. Unit 1 | DLY FREQ1 | 3.0-600.00 |
| | Voltage Supv. Threshold | V SUP THR | 35-95 |
| TORQUE CONTROL | Group 1-6 | TRQ CTRL GRP1-6 | |
| | GND Torque Signal | GND TRQ CRTL SGL | DIS (Note #1) |
| | | | EXT |
| | | | 67N |
| | Negative Sequence Level | NEG SEQ LEV | 0.10 - 2.00 |
| | Phase Torque Control Signal | PH TRQ CTRL SGL | DIS (Note #1) |
| | | | 21PT |
| | | | 27 |
| | | | 50PL |
| | 21PT Signal | 21PT SIGNAL | DIS |
| | | | OR |
| | | | AND (Note #1) |
| | 21PT Reach | 21PT REACH | 0.5 - 50 |
| | 59 Over Voltage Pickup | 59 OV PU | |
| | 27 Under Voltage Pickup | 27 UV PU | |
| | 59 Time Delay | 59 TIME DLY | |
| | 27 Time Delay | 27 TIME DLY | |
| MISCELLANEOUS | Group 1-6 | MISC GRP1-6 | |
| | Demand Interval | DEMAND INTERVAL | 15,30, 60 (Note #1) |
| | Breaker Fail Time | BRK F TIME | |
| | Fail To Close Time | F CLOSE TIME | |

**Table 9-8 DFP100 MMI Settings and Abbreviations  (Continued)**

| CATEGORY | SETTING NAME | ABBREVIATION | RANGE  (KEY) |
|---|---|---|---|
| RECLOSER | Group 1-6 | RCL GRP-1-6 | |
| (Optional) | Recloser Status | RCL STATUS | DIS (1)/ENA (3) |
| | Recloser Type | RCL TYPE | BY 52(1)/BY TRP(3) |
| | Number Of Reclosures | NUM RCL | 1-4 |
| | Number Of Repetitive Trips | NUM RPT TRP | 1-50 |
| | Reset Time | RST TIME | 1.00 - 600.00 |
| | Disable Hold | DIS HOLD | DIS (1)/ENA (3) |
| | Hold Time | HOLD TIME | 1.00-100.00 |
| | Reclose 1 Delay | RCL 1 DLY | 0.10 TO 600.00 |
| | Reclose 2 Delay | RCL 2 DLY | 0.10 TO 600.00 |
| | Reclose 3 Delay | RCL 3 DLY | 0.10 TO 600.00 |
| | Reclose 4 Delay | RCL 4 DLY | 0.10 TO 600.00 |
| FAULT LOCATION | Group 1-6 | FAULT LOC GRP 1-6 | |
| | Positive Sequence Impedance Magnitude | POS SEQ IMP MAG | 0.10 to 50.00 |
| | Positive Sequence Impedance Angle | POS SEQ IMP ANG | 10.00 - 90.00 |
| | K0 ( | K0 ($|Z0|/|Zp|$) | 0.50 - 7.00 |
| | Zero Sequence Impedance Angle | ZERO SEQ IMP ANG | 10.00 - 90.00 |
| | Line Length Units | LINE LGTH UNIT | KM(1) - MILE(3) |
| | Line Length | LINE LGTH | 0.0 -200 |

NOTE #1:  The setting is changed by  pressing the LEFT ARROW (4) or RIGHT ARROW (6) key to select the setting, and then pressing the ENT key followed by the END key.  The user will be prompted  Confirm Y/N. the 1/Y key will confirm the change, the 3/N key will clear the change.

**Actions Key  (ACT)**

The ACT key is used to perform immediate actions.   The categories available under the ACTIONS menu can be scrolled through, using the UP and DOWN ARROW keys.   The 12 available categories are listed in the following paragraphs.    The key sequence for selecting actions is:

**ACT**

↑ or ↓

**ENT**

**1/Y**

If the user wants the first category, he presses the ENT key to display the first item; otherwise, he can use the ARROW keys to get to the desired category

When the user presses the ENT key following the displayed name of a category, the first item or prompt in that category is displayed.  If the item selected was disable, enable, trip or close, the MMI will attempt to acquire the action lock. The action lock will lock remote communications from performing those functions.   After the user responds to the prompt and presses the ENT key, the next prompt (if any) will be automatically displayed.  The DFP100 performs the appropriate action after the last prompt has been satisfied.  As soon as the action is complete, the user will be taken back to the beginning of the category (where the category name is displayed, and the DFP100 is expecting the ENT key to produce the first prompt, an ARROW key to move to another category, or a Command key).

## OPEN BREAKER

This command is used to trip the breaker manually.

When the ENT key is pressed, the display prompts the user with the message CONF Y/N.  The user presses the 3/N for NO or the 1/Y for YES and then presses the ENT key.  If the user responds with a NO, the message BREAKER NOT OPENED appears on the display, and no DFP100 action occurs.  If the user responds with a YES, the action is performed and the 52/b contact for that breaker is monitored.  If the 52/b is present, and the contact reports that the breaker is open, then the display reports:

```
        BREAKER
        OPENED
```

If the 52/b contact reports that the breaker is not open then the display reports:

```
        BREAKER
      NOT OPENED
```

The trip command is issued for 1 second.

If the 52b contact is not wired, when the command is executed, the display reports :

```
    Command Executed
      52b Not Wired
```

## CLOSE BREAKER

This command is used to close a breaker manually.  When the ENT key is pressed, the display prompts the user with the message CONF Y/N.  The user presses the 3/N for NO or the 1/Y for YES and presses the ENT key.  If the user responds with a NO, the message BREAKER CLOSED appears on the display, and no DFP100 action occurs.  If the user responds with a YES, the action is performed and the 52/b contact for that breaker is monitored.  If the 52/b contact reports that breaker is closed then the display reports:

```
        BREAKER
        OPENED
```

If the 52/b contact reports that the breaker is not closed then the display reports:

```
        BREAKER
      NOT CLOSED
```

The Close command is issued for 1 second.

If the 52b contact is not wired, when the command is executed, the display reports :

```
    Command Executed
      52b Not Wired
```

## BLOCK RCL

This category is used to block a reclose cycle.

When the ENT key is pressed, the display prompts the user with the message CONF Y/N.  The user presses the 3/N for NO or the 1/Y for YES and then presses the ENT key.  If the user responds with a NO, the message CANCELED ″ appears on the display, and no DFP100 action occurs.  If the user responds with a YES, the action is performed and the reclose cycle is blocked.  The display indicates RCL BLOCKED.  If the recloser is already blocked, the DFP100 responds with RCL BLOCKED.

## UNBLOCK RCL

This command is used to unblock the recloser.

When the ENT key is pressed, the display prompts the user with the message CONF Y/N.  The user presses the 3/N for NO or the 1/Y for YES and then presses the ENT key.  If the user responds with a NO, the message RCL NOT UNBLOCKED, appears on the display, and no DFP100 action occurs.  If the user responds with a YES, the action is performed and the reclose cycle is blocked.  The display indicates RCL UBLOCKED.  If the recloser is already blocked, the DFP100 responds with UNBLOCKED RCL.

## SET TIME

This category is used to display or change the current date and/or time stored in the DFP100. When the ENT key is pressed, the display prompts YEAR, asking for the last two digits of the year. The user enters the 2 digits from the numeric keypad, then presses the ENT key.  The DFP100 then displays the prompt Month.  The user enters the 2 digits from the numeric keypad, then presses the ENT key.  The DFP100 then displays the prompt DAY,  The user enters the 2 digits from

the numeric keypad, then presses the ENT key. The DFP100 then displays the prompt Hour. The user enters the 1 or 2 digits of the hour from the numeric keypad, then presses the ENT key. The DFP100 then displays the prompt MINUTE. The user enters the 2 digits from the numeric keypad, then presses the ENT key. the DFP100 then displays the prompt SECOND. The user enters the 2 digits from the numeric keypad, then presses the ENT key. The DFP100 then responds TIME SET. If the user presses CLEAR at any time during the process, the date is not set and the DPF100 returns to the SET TIME actions category.

### Information Key (INF)

The INF key is used to request information. The categories are listed below.

EVENT LOGS
CURRENT LOGS
STATUS
ERASE EVENT LOGS
FAULT REPORTS

The categories can be scrolled through using the ARROW keys. For convenience, however, each category is also assigned a number so that the user may go directly to the category he wants.

When the user presses the INF key, the display shows EVENT LOGS. If the user wants the first category, he presses the ENT key to display the EVENT Logs stored in the DFP100; otherwise, he uses the UP or DOWN ARROW keys to scroll through the Information options. If the category contains a list of items, the user may scroll through the items using the UP or DOWN ARROW keys, in the same manner as described above for Settings. He may go to a previous category by pressing the CLR key.

### EVENT LOGS

This category is used to display the event logs stored in the DFP100 memory.

If the user presses the ENT key, the last event is displayed with the date and time that it occurred. Pressing the UP or DOWN arrow key will allow the user to scroll through the event logs.

### STATUS

This category is used to display relay and system status. The user presses the INF key and then the UP or DOWN ARROW key and then presses ENT when STATUS is displayed. The display will indicate the current value of the item being displayed, and will automatically update the display.

The following items are can be selected for display by pressing the UP or DOWN ARROW keys:

Model Number

```
MODEL
 DFP10X1MXXXXXXX
```

Date & Time

```
  DATE & TIME
DDMMM  HH:MM:SS
```

Frequency

```
    FREQ
   XX.XX HZ
```

Reactive Power

```
  REACT PWR
  XX.XX MVAR
```

Active Power

```
   ACT PWR
   XX.XX MW
```

Negative Sequence Current

```
    I NS
   X.X  A
```

Phase to Phase voltage (Vab, Vbc, Vca)

```
    Vxx
  XXX.XX  KV
```

Phase to Ground Voltage (Va, Vb, Vc)

```
        Vx
      XX.XX  KV
```

Current (Ia, Ib, Ic, IN)

```
        Ix
       X.X  A
```

Alarm Status

Trip Circuit Failure (Fail To Open)

```
      TRIP CIRC F
      NO (YES)
```

External Open Failure

```
      EXT OPEN F
      NO (YES)
```

Fail To Close

```
      FAIL TO CLOSE
      NO (YES)
```

Fail To Open

```
      FAIL TO OPEN
      NO (YES)
```

Breaker Maintenance

```
      MAINT 52 ALR
      NO (YES)
```

Current With 52 Open

```
     CUR- 52 OPEN ALR
      NO (YES)
```

Trips Disabled

```
      TRIP DIS ALR
      NO (YES)
```

Clock Stopped

```
      NO CLOCK ALR
      NO (YES)
```

Relay Enabled

```
      REL DIS ALR
      NO (YES)
```

Default Settings Group Alarm

```
      DEF SETTS GRP
      NO (YES)
```

Model Number Alarm

```
      MODEL ALR
      NO (YES)
```

Default Calibration Table Alarm

```
      DEF CALIB ALR
      NO (YES)
```

Active Settings Group (1-6)

```
       ACT GRP
         X
```

52 (Breaker) Status

If the 52b contact is wired, the 52 (breaker) status will be indicated on the MMI as follows:

```
         BRK
      CLOSED (OPEN)
```

If the 52b contact is not wired, the 52 (breaker) status will be indicated on the MMI as follows:

```
         52
      52b Not Wired
```

Digital Input 1-5 Status

```
        DIG IX
      INACT(ACT)
```

Recloser Type

```
       RCL TYPE
      BY TRIP (52)
```

Reclose Cycle In Progress

```
     RCL IN PROGR
        NO (YES)
```

External Reclose Enabled

```
        EXT RCL
        NO (YES)
```

Recloser Status

```
       RCL STAUS
        RST (LO)
```

Pickup Status

```
         XXXX
       NO PU (PU)
```

The status for the following pickups or trips can be displayed :

| | | |
|---|---|---|
| 51PT | 51PD1 | 51PD2 |
| 51NT | 51ND1 | 51ND2 |
| 50PH | 50PL | 50NH |
| 50NL | 46PT | 46PD1 |
| 81UT1 | 81UT2 | |
| 81OT1 | 81OT2 | |

### ERASE EVENT LOGS

This category is used to erase the event logs that are stored in the DFP100. After pressing the ENT key the user is prompted to confirm the change. Press the 1/Y key to erase the event log, or the 3/N key to cancel the erasure.

### FAULT REPORTS

This category is used to display the eight fault reports that can be stored in the DFP100. Pressing the ENT key will cause the display to first blank and then scroll rectangles as the reports are retrieved from memory. the display will then indicate the summary of the last fault stored in memory as follows:

```
      FAULT 1 XXX
    DDMMM HH:MM:SS
```

If no fault data has been stored in a report record, then the display will indicate that it is empty as follows:

```
        FAULT 3
         -EMPTY-
```

For each of the fault records, the following values can be displayed by pressing the enter key: Pressing the CLR key at any time while viewing fault details will return the user to the fault summary. From the fault summary, pressing the clear key will return the user to the Status selection of fault reports.

Distance To Fault

```
        Distance
     XX.X MILES (KMS)
```

Prefault Current  (Ia, Ib, Ic, In)

```
       Prefault Ix
       XXX.XXX A
```

Prefault Voltage (Va, Vb, Vc, Or Vab, Vbc, Vca If Open Delta Connected)

```
       Prefault Vx
      XXX.XXX KV
```

Fault Current (Ia, Ib, Ic, In)

```
        Fault Ix
       XXX.XXX A
```

Fault Voltage (Va, Vb, Vc, or Vab, Vbc, Vca if Open Delta Connected)

```
┌────────────────────────┐
│        Fault Vx        │
│      XXX.XXX KV        │
└────────────────────────┘
```

Pickups Or Trips

```
┌────────────────────────┐
│         TRIPS          │
│        XXX_X           │
└────────────────────────┘
```

The functions will be displayed with a suffix consisting of an underscore followed by the phase that indicated the fault for example 51PD1_A.

**ERASE FAULT REPORTS**

This category is used to erase the fault reports that are stored in the DFP100. After pressing the ENT key the user is prompted to confirm the change. Press the 1/Y key to erase the fault reports, or the 3/N key to cancel the erasure.

```
┌────────────────────────┐
│         ERASE          │
│     FAULT REPORTS      │
└────────────────────────┘
```

**Current Logs**

Pressing "ENT" when the DFP100 displays current logs will cause the demand data to be retrieved and the last demand entry to be displayed as follows:

```
┌────────────────────────┐
│   Ia, Ib, Ic, DEMAND   │
│     ddmmm hh:mm        │
└────────────────────────┘
```

The demand data for the intervals selected can be scrolled through using the "UP" or "DOWN" ARROW keys. Pressing "ENT" will cause the peak value of Ia that was stored over the demand interval. The following values can be scrolled through using the "ENT" key: Ia Peak, Ib Peak, Ic Peak, Ia Average, Ib Average, Ic Average.

```
┌────────────────────────┐
│       Ix p (avg)       │
│        X.XX A          │
└────────────────────────┘
```

Pressing the "CLR" key will return the DFP100 to the next higher level of menu.

**COMMUNICATIONS SETTINGS**

The communications settings menu is accessed by entering the digits "7169" when the default screen is displayed. This password will not be displayed, instead an " *" will be displayed as each key is entered. Pressing any other 4 digits will not be accepted, and after the fourth digit entry, the default display will be shown again. If more than 4 digits are entered in rapid succession, the display will appear to "flash". This is due the fact that the display reverts to the default screen after the fourth entry, and then clears and displays an "*" for each additional key pressed.

This password cannot be changed by the user.

Entering "7169" will display:

```
┌────────────────────────┐
│         COMM           │
│        SETTS           │
└────────────────────────┘
```

Pressing the ENT key will display the first setting which is the Unit number. Pressing the UP or DOWN arrow keys will allow the user to scroll through the communications setting options.

All settings are entered by entering the values shown in the Table 9-8 in table, pressing the "ENT" key followed by the end key and pressing Y to confirm the change.

**TABLE 9-8 MMI Communication Setting Names And Abbreviations**

| SETTING | ABBREVIATION | RANGE |
|---|---|---|
| UNIT NUMBER | UNIT NUM | 0 -255 |
| PASSWORD | PSW | 0 -9999998 |
| MMI OPERATIONS | MMI OPER | PER (1)/ NO PER (3) |
| REMOTE PORT OPERATIONS | REM OPER | PER (1)/ NO PER (3) |
| LOCAL PORT OPERATIONS | LOC OPER | PER (1)/ NO PER (3) |
| MMI SETTING CHANGES | MMI CHG | PER (1)/ NO PER (3) |
| REMOTE PORT SETTING CHANGES | REM CHG | PER (1)/ NO PER (3) |
| LOCAL PORT SETTING CHANGES | LOC CHG | PER (1)/ NO PER (3) |

**TABLE 9-8 MMI  Communication Setting Names And Abbreviations (Cont.)**

| SETTING | ABBREVIATION | RANGE |
|---|---|---|
| REMOTE BAUD RATE | REM BAUD | 300 -19200 (Note #1 ) |
| LOCAL BAUD RATE | LOC BAUD | 300 -19200 (Note #1 ) |
| REMOTE STOP BIT | REM STOP BIT | 1-2 |
| LOCAL  STOP BIT | LOC STOP BIT | 1-2 |

Note #1: The baud rate is changed by pressing the LEFT or RIGHT ARROWS and pressing ENT, END, and confirming by pressing 1/Y

**SAMPLE KEY SEQUENCE**

The sequence for setting the settings group #1 TOC function to VERY INVERSE with a time dial of 3 and a pickup of 5A is shown in Table 9-9.

**Table 9-9 Sample Key Sequences**

| KEY | RESULTING DISPLAY |
|---|---|
| SET | VIEW SETTINGS |
| ↑ | MODIFY SETTINGS |
| ENT | GENERAL SETTS |
| ↑ | BREAKER SETTS |
| ↑ | CFG INPUTS |
| ↑ | CFG OUTPUTS |
| ↑ | TOC GRP1 |
| ENT | PH TOC DIS —— |
| 3/N | PH TOC DIS 3 |
| ENT | PH TOC DIS ENA |
| END | CONF Y/N |
| 1/Y | SETTINGS CHANGED |
| CLR | PH TOC ENA —— |
| ↑ | PH TOC CRV INV |
| 4 | PH TOC CRV INV INV |
| ← | PH TOC CRV INV V. INV |
| 4 ← | PH TOC CRV INV V. INV |
| ENT | PH TOC CRV INV V. INV |
| END | CONF Y/N |
| 1/Y | SETTINGS CHANGED |
| CLR | PH TOC CRV V. INV —— |
| ↑ | PH TOC PU 1.00 —— |
| 5 | PH TOC PU 1.00 5 |
| ENT | PH TOC PU 1.00 5.00 |
| END | CONF Y/N |
| 1/Y | SETTINGS CHANGED |
| CLR | PH TOC PU 5.00 —— |
| ↑ | PH TOC DIAL 10.0 —— |
| 3 | PH TOC DIAL 10.0 3 |
| ENT | PH TOC DIAL 10.0 3.0 |
| END | CONF Y/N |
| 1/Y | SETTINGS CHANGED |
| CLR | PH TOC DIAL 10.0 —— |
| CLR | GENERAL SETTINGS |
| CLR | (*) DFP GENERAL ELECTRIC |

## REMOTE COMMUNICATION INTERFACE

### Modem Connections and Settings

When establishing communication between the DFP100 and a remote PC, two modems connected via a phone line are required; one modem is located at the DFP100 and the other modem is located at the PC. Each of these modems must be "Hayes-compatible" meaning that they must accept configuration commands first developed by Hayes. This is necessary since the MLINK communications software that runs on the PC sends a Hayes-compatible command string to the modem located at the PC. The DFP100 does not send any configuration commands to its modem. **Both, the DFP100 modem and the PC modem must be uniquely configured to permit the user to log into and communicate with the DFP100 using M-LINK software.**

The required configuration settings are presented as changes to the factory-default configuration settings for a Hayes V-Series 2400 SmartModem. The default settings are:

| | | | |
|------|------|--------|--------|
| B1   | &C0  | S0=0   | S36=1  |
| E1   | &D0  | S6=2   | S37=0  |
| L2   | &G0  | S7=30  | S38=20 |
| M1   | &J0  | S8=2   |        |
| N1   | &K3  | S9=6   |        |
| P    | &L0  | S10=14 |        |
| Q0   | &P0  | S11=95 |        |
| V1   | &Q5  | S12=50 |        |
| W0   | &R0  | S18=0  |        |
| X4   | &S0  | S25=5  |        |
| Y0   | &X0  | S26=1  |        |

Other "Hayes-compatible" modems may implement a subset of the full Hayes command set. **It is the responsibility of the user to ascertain the exact commands accepted by a particular modem.** The proper syntax for entering the Hayes-compatible commands (sometimes referred to as the "AT" command set) is not described here. Refer to the manual of your modem for an explanation of this syntax.

### PC Modem

The PC modem must be configured for "intelligent" operation (i.e., command recognition enabled). For the Hayes V-Series 2400

SmartModem this setting is made via an internal jumper. The default settings listed above are valid for MLINK. Those configuration settings critical to the operation of MLINK are changed by MLINK. The configuration commands sent to the modem from MLINK are:

+++  (set modem to command mode)

(delay 2 seconds)

ATE0L0Q0S7=60V0X4Y0 (see explanation below)

Command explanation:

| | | |
|--------|---|----------------------------------------------|
| AT     | - | modem attention command |
| E0     | - | disable command state echo |
| L0     | - | low speaker volume (not required) |
| Q0     | - | modem returns result codes |
| V0     | - | result codes returned in numeric form |
| X4     | - | enables features represented by result codes |
| Y0     | - | disable long space disconnect |
| S7=60  | - | allows modem to hang up if connection is not made within 60 sec. |

If all of the above commands are not programmable, then the modem will not operate properly. In addition to the required configuration settings listed above, it is suggested that two other settings be made by the user. These are:

| | | |
|-----|---|--------------------------------------------------|
| &D3 | - | causes the modem to reset on the ON-to-OFF transition of DTR |
| &C1 | - | causes DCD (Data Carrier Detect) to track the received carrier signal |

The modem will operate properly without making these two settings but the modem will not hang up if the appropriate handshaking signal is lost.

A MLINK setting establishes the baud rate, which must match the baud-rate setting of the DFP100. MLINK will then set the specified PC serial port (i.e., COM1, COM2) to the proper baud rate, parity, data bits, and stop bits. If the PC modem is capable of operating at more than one baud rate, then it must be able to automatically configure its baud rate, character length, and parity setting by examining the "AT" command prefix.

### DFP100 Modem

The DFP100 modem must be configured for "dumb" operation (i.e., command recognition disabled). For the Hayes V-Series 2400 SmartModem this setting is made via an internal jumper. Since the DFP100 does not send any configuration commands to its modem, the required configuration settings must be made prior to connecting the modem to the DFP100. **Additionally, the modem must be initialized to the required configuration settings each time modem power is turned OFF and then ON.** Depending on the design of the modem this is accomplished by making all the required settings via switches or saving the settings in non-volatile memory.

The required configuration settings are:

| | | |
|---|---|---|
| E0 | - | disable command state echo |
| L0 | - | low speaker volume (not necessary) |
| Q1 | - | disable result code display |
| &C1 | - | DCD to track the received carrier signal |
| &D3 | - | causes the modem to reset on the ON-to-OFF transition of DTR |
| &Q0 | - | asynchronous mode |
| S0=1 | - | enable auto-answer |

If any of the above settings cannot be implemented, the modem may not answer, the DFP100 may not connect properly, or the user may not be able to log into the DFP100.

With a Hayes V-Series 2400 SmartModem or equivalent, the DFP100 modem will perform a modulation handshake with the PC modem to set the baud rate of the DFP100 modem. The default setting of "N1" permits handshaking to occur at any baud rate supported by both modems. This is one reason why it is preferable to use identical modems at each end.

Note that auto-answering is controlled with register S0. S0=0 disables auto-answer. S0=1 will cause the DFP100 modem to answer the incoming call after one ring. S0 can be set for any value between 1 and 255, for the Hayes modem assumed here, if it is desirable to delay modem answering. If the DFP100 modem register S0 is set higher than 12, the PC modem may time out and hang up before the DFP100 modem can answer. S0=12 means that the DFP100 modem will answer after twelve rings and corresponds approximately to the 60 second delay (S7=60) at the PC modem, however the user should verify the number of rings that correspond to 60 seconds for a particular application.

Table 9-10 is a listing of the modem command set to communicate to the DFP100 from a remote PC.

### Null Modem Connections

A PC can be connected to a DFP100 relay without the intervening modems and phone line by using a special cable called a "null-modem" cable. The required pin-to-pin connections for a null-modem cable are shown in Figure 9-2. The null-modem cable should not exceed 50 feet in length.

**Table 9-10  Modem Setup Criteria (Hayes Compatible)**

| Function | DFP100 Modem (remote) | PC Modem (local) |
|---|---|---|
| DTR Status | Follow DTR (&D3) | Follow DTR (&D3) |
| Result Code Format | Numeric (V0) | Numeric (V0) |
| Result Code Display | Disable (Q1) | Enable (Q0) |
| Command State Echo | Disable (E0) | Disable (E0) |
| Auto-Answer | Enable (S0=1) | Disable (S0=0) |
| Carrier Detect | Follow CD (&C1) | Follow CD (&C1) |
| Jack Type | RJ-11, etc. (&J0) | RJ-11, etc. (&J0) |
| Command Recognition | Disable (Dumb) | Enable (Smart) |
| Comm. Std. (@1200 bps) | Bell 212A (B1) | Bell 212A (B1) |

**Table 9-10  Modem Setup Criteria (Hayes Compatible) (Cont.)**

| Function | DFP100 Modem (remote) | PC Modem (local |
|---|---|---|
| Response to DTR | Modem Reset (&D3) | Modem Reset (&D3) |
| Pulse Dial Ratio | 39%Mk/61%Bk (&P0) | 39%Mk/61%Bk (&P0) |
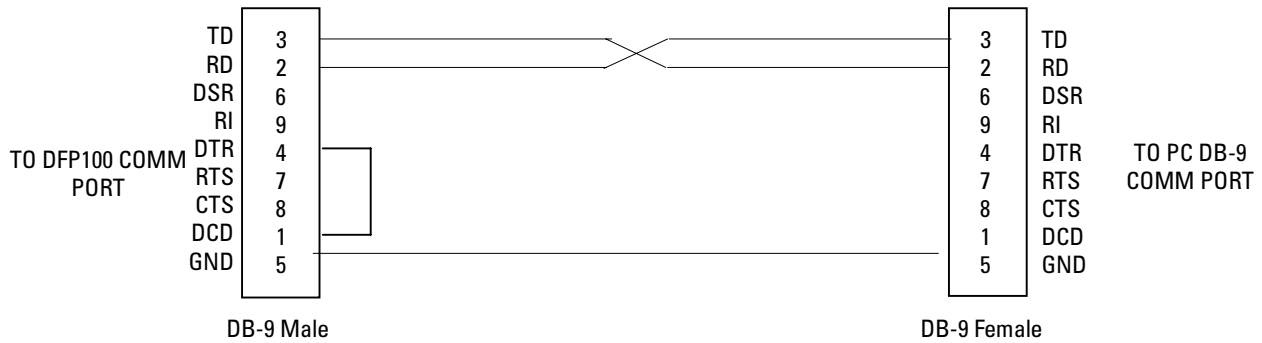


**Figure 9-2 DFP100 Remote Communications To PC Directly**

**Communication Cable Part# 0246A9866P0028**

## RS485

The RS485 option will give the user the ability to multi-drop up to 32 DFP100 relays onto a single pair of wires.  RS485 can only be used with the GE-Link protocol option.  The RS485 can be either a 2-wire or a 4-wire system  (see Figure 9-3).

## Installation

If you have a DFP13XXXXXXXXXX you will be able to communicate with the DFP100 using RS485 option.  The RS485 feature makes use of a plug-in board located at the upper-left corner of your processor board (see Figure 9-4).

If you have purchased the board separately you will first have to install it into the plug-in connector.  This is done by placing the card edge (with the gold fingers) into the plug-in connector at an approximately 45° angle and then pressing down until the tabs snap into place.  Check to see that the two guide pins on the plug-in card fall into there appropriate holes.

## Jumper Settings

The jumpers on the plug-in board and the processor board have to be configured correctly to allow proper communication.  The user must know two things.  First, the user must decide if he wants a 2-wire or a 4-wire system and second, the user must determine if the relay requires terminating resistors.

If your system does not require a modem a 2-wire system will be most efficient.  However, if your system has additional devices installed that do not have transmit/receive control lines, then a 4-wire system is the only alternative.  See Table 9-10 for the proper jumper settings to select 2 or 4 wire connections.

**Table 9-11 2 Wire vs 4 Wire Connection**

| Jumper | 2 Wire RS485 | 4 Wire RS485 |
|---|---|---|
| P1 | 1 | 0 |
| P8 | 1 | 0 |
| P9 | 1 | 0 |

1 = Jumper

0 = No Jumper

The terminating resistors are used to limit reflection on the communication cables. The relays at either end of your communication link should be terminated with the 120 ohm resistors located on the plug-in card. See Table 9-12 for jumper selection tables.

**Table 9-12 Terminating Resistor Selection**

| Jumper | No Termination | 2 Wire Termination | 4 Wire Termination |
|--------|---------------|--------------------|--------------------|
| P2 | 0 | 1 | 1 |
| P3 | 0 | 1 | 1 |
| P4 | 0 | 1 | 1 |
| P5 | 0 | 0 | 1 |
| P6 | 0 | 0 | 1 |
| P7 | 0 | 0 | 1 |

### RS485 Output

When you are using the RS485 option, port 3 is your RS485 output. The pin out of port 3 is configured as shown in Table 9-13.

**Table 9-13 Port 3 Pin Out with the RS485 Option Installed**

| Pin | Function |
|-----|----------|
| 2 | TXB (+) |
| 3 | RXA (-) |
| 6 | RXB |
| 8 | TXA |

RS-485 System (two-wire)
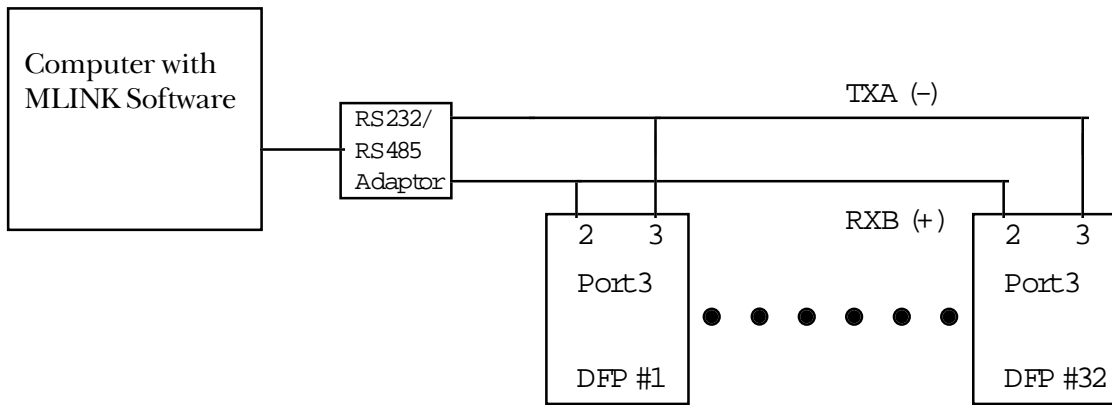


RS-485 System (four-wire)
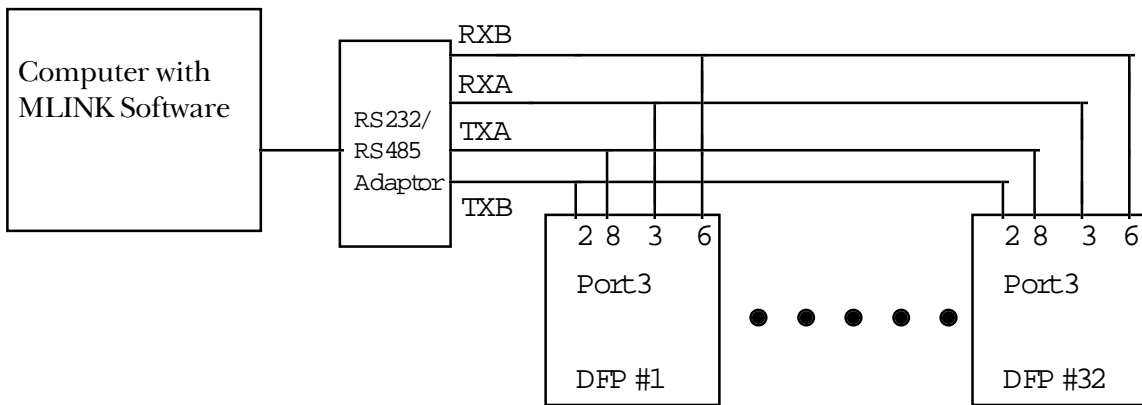


**Figure 9-3 RS485 Interconnections**

PC

RS-232

J3 J2   J1     P8     P9

P7       P2

J5    J4           P1

Port 1

Port2/3

Jumper PC on J1
through J5 for fiber
optic and RS485
communciation.

RS485 Card
(Optional)

Target LEDs

Output Relays

J6
J7
J8
J9
J10
J11
J12
J13

Target Reset Switch
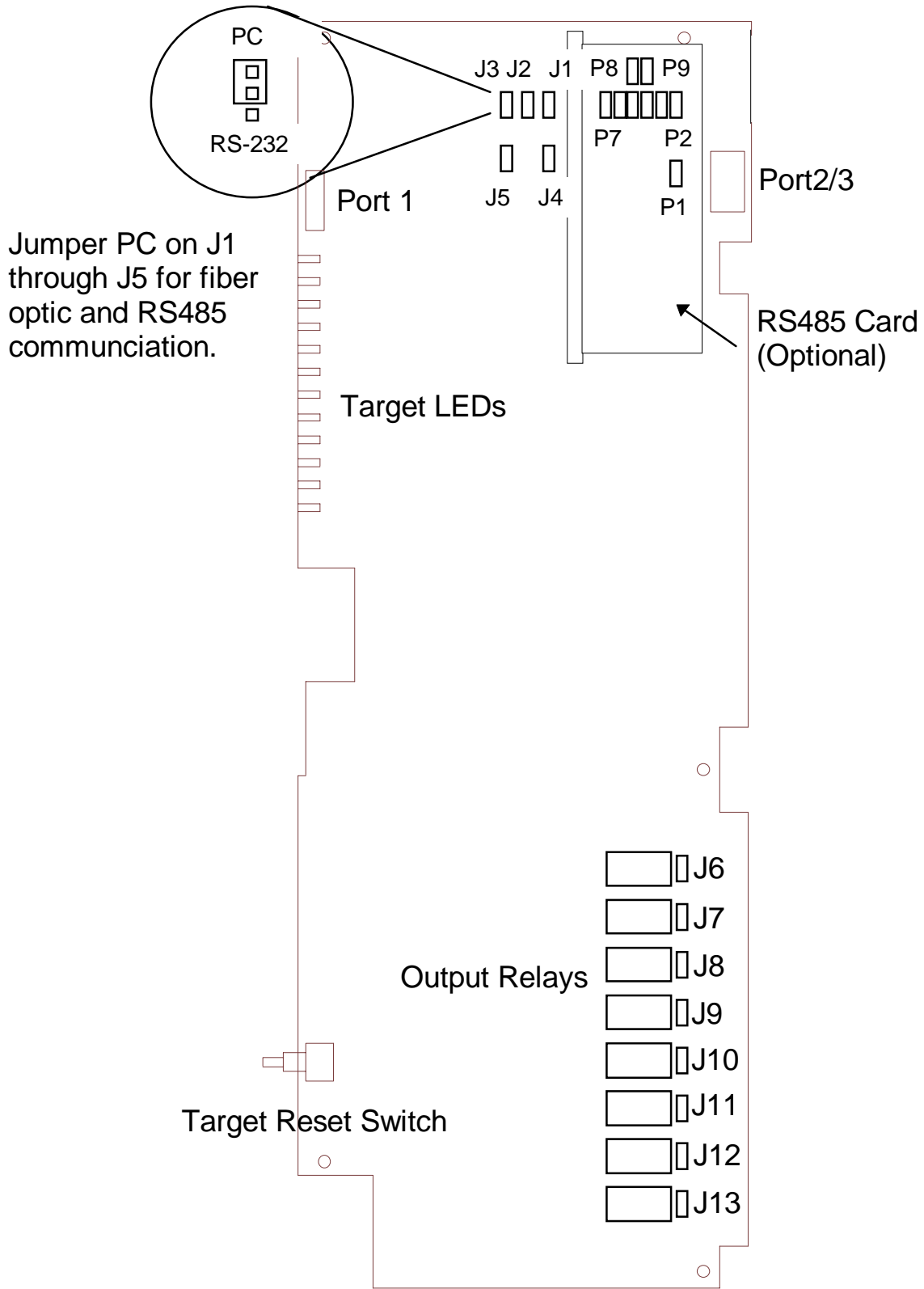
**Figure 9-4 Optional RS485 Board Location**

# Chapter 10 -SOFTWARE

The following section gives the user a description of the hardware and software necessary for remote communication to the DFP100. The DFP100 has two different communication protocols; GE-LINK and ASCII. This **SOFTWARE** section will likewise be separated into two sections. This first section will describe the operation of the GE protocol and the second section will describe the operation of the ASCII protocol.

## GE PROTOCOL - Mlink

### SYSTEM REQUIREMENTS

#### Hardware

The minimum hardware requirements consists of the following components: an IBM-AT or compatible computer with 550K bytes of free base memory, 5 MB of hard drive space, low density 3 1/2 inch floppy drive, EGA monitor , one serial port (an additional serial or parallel port if printing is required), and one HP Laser Jet compatible printer for printing reports.

Also, an interface cable will be necessary to communicate with the relay , See the **INTERFACE** section Figure 9-2.

#### Software

Requires MSDOS 3.1 or above for the operating system.

### INSTALLATION

To install the Mlink software insert the 3 1/2 inch floppy disk , change directory to the floppy drive, and type the following at the DOS prompt:

*Install  A:\ C:\MLINK  <ENTER>*

Install- {source location} {file destination}<ENTER>

### RUNNING MLINK

Once Mlink has been successfully installed, type the following commands at the DOS prompt to start the program:

C:\ cd \Mlink <ENTER>

Mlink <ENTER>

Once the program has started, the Mlink start-up screen will appear. Touching any key will move the program to the next screen which contains the General Electric disclaimer and a prompt for a password.



### PASSWORDS

Mlink contains two levels of passwords. These levels are the INQUIRY level and the MODIFICATION level.

#### Inquiry

The lowest access level is the INQUIRY level. The user gaining access to the program with this password is only authorized to make inquiries. The user can perform general configuration inquiries or establish communications with the protection equipment for the purpose of status, log, and setting inquires. Operations and protection setting modifications cannot be performed by users accessing the program at this security level.

#### Modifications

The MODIFICATION level allows the user complete access to all settings and protection system operations.

The default INQUIRY password is:  **DFP100**

The default MODIFICATIONS password is: **1**

If your relay has the GE protocol its internal default passwords will agree with the Mlink default passwords.

If your relay has the GE protocol its internal default passwords will agree with the Mlink default passwords.

## PROGRAM OPERATION

The initial horizontal menu has the following items:

**GENERAL**

**CONNECTION**

**EXIT**

Each of the menu items is used to control the setup and operation of the Mlink communication software with the relay.

### General

The GENERAL menu allows the user to configure the parameters used to communicate with the relay. The GENERAL menu contains the following items:

INQUIRY PASSWORD

MODIFICATION PASSWORD

LANGUAGE

DISTANCE UNITS

MONITOR

SERIAL PORT

BAUD RATE

MODEM TYPE

DIAL MODE

PARITY

WORD LENGTH

STOP BIT

INITIALIZATION STRING

```
╔══════════════ GENERAL CONFIGURATION ══════ Mlink  2.2 ══╗
║                                                          ║
║  INQUIRY PASSWORD : DFP100    MODIFICATIONS PASSWORD : 1 ║
║                                                          ║
║  LANGUAGE :  ENGLISH          DISTANCE UNITS      : MILES║
║                                                          ║
║  MONITOR   :  COLOR                                      ║
║                                                          ║
║  SERIAL PORT    : COM2                                   ║
║                                                          ║
║  BAUD RATE  : 4800            PARITY        : NO         ║
║                                                          ║
║  MODEM TYPE   : HAYES         WORD LENGTH  : 8           ║
║                                                          ║
║  DIAL MODE  : TONE            STOP BIT      : 1          ║
║                                                          ║
║  INITIALIZATION STRING :                                 ║
║                                                          ║
╚══════════════════════════════════════════════════════════╝
```

INQUIRY PASSWORD:

This location reveals the password used for inquiries to the relay. If you have entered into Mlink with your INQUIRY password, this item will be concealed by the asterisk character (*).

MODIFICATION PASSWORD:

This location reveals the password used for modifications to the relay. If you have entered into Mlink with your MODIFICATION password you can change the password by entering a different alpha-numeric string in this location.

LANGUAGE:

Mlink is capable of displaying all text in either English or Spanish. This location allows you to select your preference.

DISTANCE UNITS:

When viewing the distance to a fault this location will select the units (KM or Miles) for the distance display.

MONITOR:

To permit proper viewing of the menus, it is necessary to indicate which type of monitor is connected to the PC. The available options for this setting are: monochrome or color.

SERIAL PORT:

Mlink communicates with the relay, directly or via modem, through the computer's serial port. In the general configuration it is necessary to specify which serial port, COM1 or COM2, will be used for the connection.

Mlink also includes mouse support. It is not necessary to specify which port the mouse is connected to because detection is automatic.

BAUD RATE:

Mlink is capable of communicating with protection systems at transmission rates ranging from 300 to 57600 bits per second (bps). For successful communications it is necessary to configure Mlink to the same transmission rate as that of the relay.

MODEM TYPE:

Allows you to select the modem type. The modem options are:

V.25 BIS

Hayes compatible

DIAL MODE:

Parameter that depends on your phone system. Select tone or pulse according to dialing procedures.

PARITY:

Parameter whose value may be NO, EVEN, or ODD. For successful communications it is necessary to configure Mlink to the same parity as that of the modem.

WORD LENGTH:

Parameter whose value is normally 8. For remote communications some modems may require a different word length. For proper selection consult your modem manual.

STOP BIT:

Parameter whose value is normally 1. For successful communications it is necessary to configure Mlink to the same number of stop bits rate as that of the relay.

## Connection

The CONNECTION menu allows the user to select LOCAL MODE or REMOTE MODE CONNECTIONS (modem) to the relay as well as an EMULATION mode; which will allow a user to become familiar with the system settings without actually being connected to the relay. Also, EMULATION mode allows the user to edit and store settings in a file to be downloaded to the

relay at a latter date.

When entering the CONNECTION menu the user finds the following items:

EMULATION

LOCAL MODE CONNECTION

REMOTE MODE CONNECTION

```
GENERAL        CONNECTION      EXIT
┌─────────────────────────────────────────────┐
│                                   Mlnk  2.2  │
│   ┌──────────────────────────┐               │
│   │ EMULATION                │               │
│   │ LOCAL MODE CONNECTION    │               │
│   │ REMOTE MODE CONNECTION   │               │
│   └──────────────────────────┘               │
│                                              │
│           MLINK                              │
│                                              │
│                                              │
│   General Electric Protection and Control Equipment has designed this
│   software with the objective of obtaining data for, and transmitting data to
│   digital protection relays.  GE shall have no liability for any claim of any
│   kind from negligent use of the software or from failure of the software to
│   operate as intended.
│                                              │
└─────────────────────────────────────────────┘
```

EMULATION:

Emulation allows the user to emulate relay operations for making inquiries, editing, or copying settings. At a later date these tables can be retrieved and sent to the relay. Reports from previous logs can be retrieved from a file for consultation or sent directly to the printer.

LOCAL MODE CONNECTION:

Local connection consists of directly connecting the PC to the relay through their serial ports. Once the physical connection has been made , follow these steps to establish communication:

- From the CONNECTION menu select LOCAL
  MODE CONNECTION

- Select DFP from the next menu.

- Enter the UNIT ID of the relay

Each DFP100 will have a UNIT ID. If you enter the incorrect UNIT ID you will receive a MESSAGE TIME-OUT error.

The default UNIT ID for the DFP100 is: **255**

If your communication attempt is unsuccessful check the following areas:

- Physical Connection (See INTERFACE

section)

- General configuration communication parameters are not properly selected ( Note any changes made to the default settings of the relay. Failure to do so may result in you being unable to communicate with the relay).

- UNIT ID is correct.

REMOTE MODE CONNECTION:

Remote connection consists of connecting the PC to the relay through a telephone line and modem. Once the physical connection has been made , follow these steps to establish communication:

- From the CONNECTION menu select REMOTE MODE CONNECTION.

- Enter the telephone number with all prefixes, pause characters, etc.

- Select DFP from the next menu.

- Select model number of the DFP.

- Enter the UNIT ID of the relay.

The default UNIT ID for the DFP100 is: **255**

If your communication attempt is unsuccessful check the following areas:

- Physical Connection (See INTERFACE section)

- General configuration communication parameters.

- UNIT ID is incorrect.

## Main Menu

The main horizontal menu has the following items:
SETTINGS
OPERATIONS
LOGS
DEVICE STATUS
EXIT

SETTINGS     OPERATIONS     LOGS     DEVICE STATUS     EXIT

DFP10A1M110GA00                                        DFP100 Link
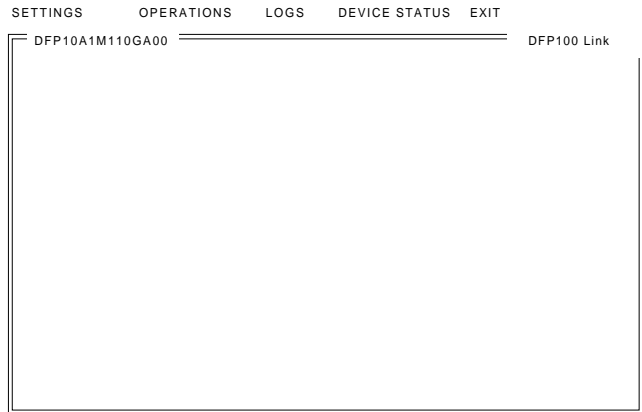
SETTINGS:

SETTINGS has the following menu items:

    GROUP 1

    GROUP 2

    GROUP 3

    GROUP 4

    GROUP 5

    GROUP 6

    GENERAL

    CONFIGURABLE INPUTS

    CONFIG OUTPUT GATES

    MASKS

    ACCUMULATORS

    COMMUNICATIONS

    CONFIG OUTPUTS

    PASSWORDS

SETTINGS     OPERATIONS     LOGS     DEVICE STATUS     EXIT

DFP100 Link

GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
GROUP 6
GENERAL
BREAKER HEALTH
CONFIGURABLE INPUTS
CONFIG OUTPUT GATES
MASKS
ACCUMULATORS
COMMUNICATIONS
CONFIG OUTPUTS
PASSWORD
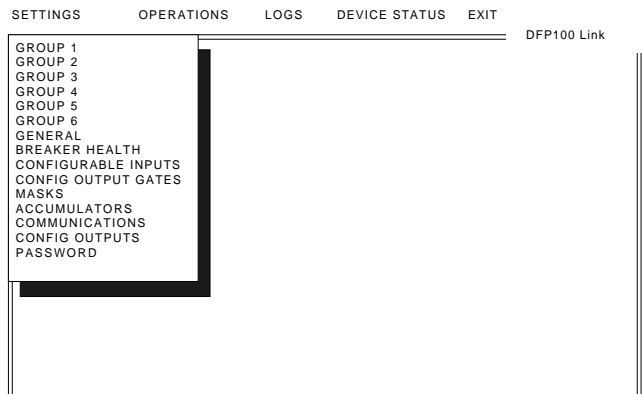
GROUP 1 through GROUP 6 contain the six different settings group for the DFP. These six groups contain all of the protection settings for the DFP. The DFP can be programmed to operate

with any of these groups through the use of the DEFAULT SETTINGS GROUP setting. The DEFAULT SETTINGS GROUP setting is an item under GENERAL which is in the SETTINGS menu.

The items in GROUP 1 through GROUP 6 are:

TIME OVERCURRENT

DEFINITE TIME

INSTANTANEOUS

NEGATIVE SEQUENCE

OVER/UNDER FREQ.

TORQUE CONTROL

RECLOSER

```
SETTINGS     OPERATIONS     LOGS     DEVICE STATUS     EXIT
                                                                    DFP100 Link
GROUP 1      TIME OVERCURRENT
GROUP 2      DEFINITE TIME
GROUP 3      INSTANTANEOUS
GROUP 4      NEGATIVE SEQUENCE
GROUP 5      OVER/UNDER FREQ.
GROUP 6      TORQUE CONTROL
GENERAL      MISCELLANEOUS
BREAKER HEALTH  FAULT LOCATION
CONFIGURABLE INPUTS
CONFIG OUTPUT GATES
MASKS
ACCUMULATORS
COMMUNICATIONS
CONFIG OUTPUTS
PASSWORD
```
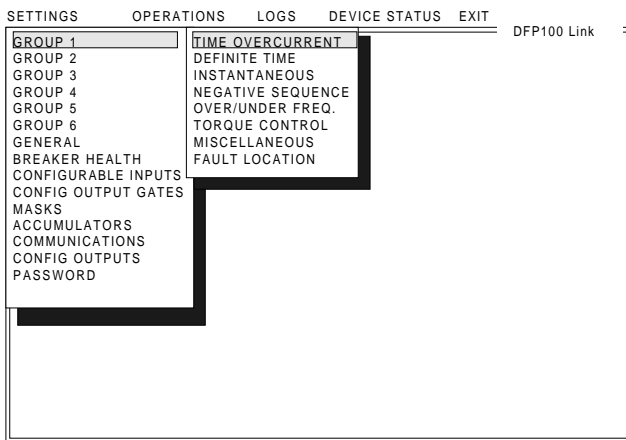
**MODIFYING SETTINGS**

To modify any of the protection settings under the SETTINGS menu select the item to be changed by using the arrow keys or the mouse to move the cursor over the setting to be changed. Once this is done the area will be highlighted with inverse video to show the chosen setting. Pressing enter or clicking the mouse button will then select the setting.

Once a setting has been selected the screen will change to reveal all of the settings associated with that protection function. For example, if you chose the TIME OVERCURRENT setting the screen will show:

```
MODIFY        FILE      RELAY     ACTIVATE      EXIT
TIME OVERCURRENT DFP10A1M110GA00                    DFP100 Link

        DISABLE/ENABLE PHASE TOC      : ENABLE

        CURVE PHASE TOC               : EXTREM_INVERSE

        PICKUP PHASE TOC              : 1.00

        TIME DIAL PHASE TOC           : 1.00


        DISABLE/ENABLE GND TOC        : DISABLE

        CURVE PHASE TOC               : INVERSE

        PICKUP PHASE TOC              : 1.00

        TIME DIAL PHASE TOC           : 1.00



  SETTINGS MODIFICATION
```
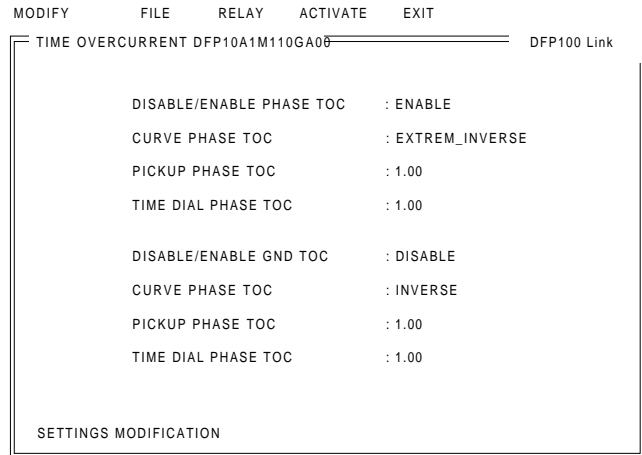
This lists all of the settings for the Time Overcurrent Function. To change any of these settings press ENTER when the MODIFY option is in reverse video. This will allow the user to change each of the settings of the Time Overcurrent Function.

Any setting that is text based (e.g. Curve Type, Enable/Disable,) will cause another window to appear on the screen . This menu will display all of the choices for that setting. You can move within that window by using the UP/DOWN arrow keys. When the selected setting is the setting you want press CTRL and ENTER simultaneously to accept the setting.

Any setting that is numerical (e.g. Pickup TOC, Time Dial) can be modified by typing in the value needed for that setting.

Once all of the settings have been changed press CTRL and ENTER simultaneously to return to the MODIFY menu. At this point the settings have been changed at the PC but the relay has not received the new settings.

**DOWNLOADING SETTINGS**

To download settings to the relay as they appear on the screen you must press ENTER when the RELAY option is in reverse video. This will cause another menu to appear on the screen. This menu will contain two options: LOAD and SEND. To SEND these settings to the relay press SEND.

**UPLOADING SETTINGS**

To upload settings from the relay you must press ENTER when the RELAY option is in reverse

video. This will cause another menu to appear on the screen. This menu will contain two options: LOAD and SEND. To LOAD these settings from the relay press LOAD. The screen will be updated with the relay settings for this particular function. Also, entering into a menu for the first time will give the current settings in the relay.

**RETRIEVING SETTINGS FROM A FILE**

To retrieve settings from a file press ENTER when the FILE option is in reverse video. This will cause another menu to appear on the screen. This menu will contain two options: RETRIEVE and SAVE. To RETRIEVE a complete set of settings press RETRIEVE. A list of all of the settings files currently available will appear on the screen. You can now select the appropriate file by using either the mouse or the arrow keys. After the file is selected the screen will be updated with the settings from the file.

**SAVING SETTINGS TO A FILE**

To save settings to a file press ENTER when the FILE option is in reverse video. This will cause another menu to appear on the screen. This menu will contain two options: RETRIEVE and SAVE. To SAVE a complete set of settings press SAVE. A pop-up window will appear on the screen. You can now select the appropriate file name by using the keyboard. After the file name is selected press ENTER and the file will be saved.

The remaining settings categories are as follows:

GENERAL

BREAKER HEALTH

CONFIGURABLE INPUTS

CONFIG OUTPUT GATES

MASKS

ACCUMULATORS

COMMUNICATIONS

CONFIG OUTPUTS

PASSWORD

GENERAL:

The GENERAL category contains the settings that apply for the overall operation of the relay. This category includes settings such as DISABLE\ENABLE RELAY, FREQUENCY, PHASE

CT RATIO, GND CT RATIO, VT RATIO, BREAKER NUMBER, DEFAULT SETTINGS GROUP, etc.

```
MODIFY      FILE       RELAY        ACTIVATE      EXIT
┌ GENERAL DFP10C1M110GA00 ═══════════════════════ DFP100 Link ┐
│                                                             │
│                                                             │
│                                                             │
│          DISABLE/ENABLE RELAY    :   ENABLE                 │
│          FREQUENCY (Hz)          :   60 Hz                  │
│          PHASE CT RATIO          :   1000                   │
│          GROUND CT RATIO         :   1000                   │
│          VT RATIO                :   1000                   │
│          BREAKER NUMBER          :   0000                   │
│                                                             │
│          DEFAULT SETTINGS GROUP  :   GROUP 1                │
│          PHASE ROTATION          :   ABC                    │
│          RELAY IDENTIFICATION    :   DFP100                 │
│                                                             │
│          COLD LOAD PICKUP DELAY  :   0.000                  │
│          COLD LOAD DROPOUT DELAY(s)  :   0.000              │
│          52/b WIRED (YES/NO)     :   YES                    │
│          OPEN DELTA CONNECTION   :   NO                     │
│                                                             │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```

BREAKER HEALTH

The BREAKER HEALTH category contains the settings for the breaker health functions of the relay. The settings are BREAKER HEALTH UNITS, BREAKER ARC TIME. and the BREAKER HEALTH THRESHOLD.

CONFIGURABLE INPUTS:

The CONFIGURABLE INPUTS category allows the user to select function for each of the configurable inputs. NOTE: Because this information is stored in EEProm, there is a short access time from the relay (5 seconds) before any information is displayed, please be patient.

```
MODIFY      FILE       RELAY        ACTIVATE      EXIT
┌ CONFIG INPUTS DFP10C1M110GA ═══════════════════ DFP100 Link ┐
│                                                             │
│                                                             │
│                                                             │
│      CONFIGURABLE INPUT CC1 :  ----------------------------- │
│                                                             │
│      CONFIGURABLE INPUT CC2 :  ----------------------------- │
│                                                             │
│      CONFIGURABLE INPUT CC3 :  ----------------------------- │
│                                                             │
│      CONFIGURABLE INPUT CC4 :  ----------------------------- │
│                                                             │
│      CONFIGURABLE INPUT CC5 :  ----------------------------- │
│                                                             │
│                                                             │
│                                                             │
└─────────────────────────────────────────────────────────────┘
```
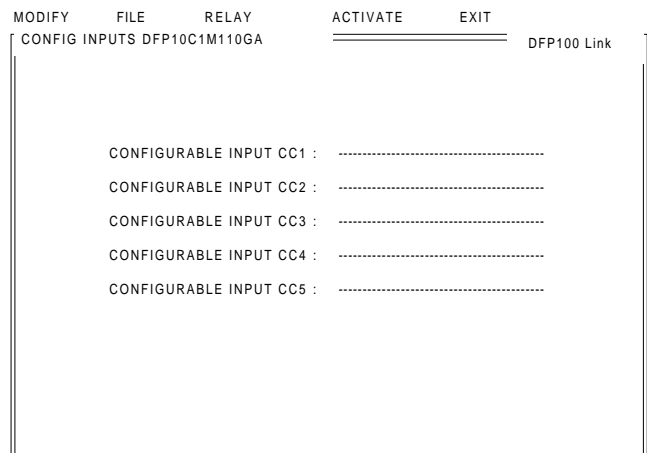
CONFIG OUTPUT GATES:

The CONFIG OUTPUT GATES category allows the user to select the inputs to the programmable logic gates (6 two-input AND gates and 2 NOT gates). NOTE: Because this information is stored in EEProm, there is a short access time from the relay (5 seconds) before any information is displayed, please be patient.

```
MODIFY      FILE      RELAY      ACTIVATE      EXIT
┌ CONFIG OUTPUT GATES DFP10C1M110GA ═══════         DFP100 Link
│
│
│
│                        NOT1 : ---
│                        NOT2 : ---
│
│                 AND1 :   ---   *   ---
│                 AND2 :   ---   *   ---
│                 AND3 :   ---   *   ---
│                 AND4 :   ---   *   ---
│                 AND5 :   ---   *   ---
│                 AND6 :   ---   *   ---
│
│
│
│
│
└
```
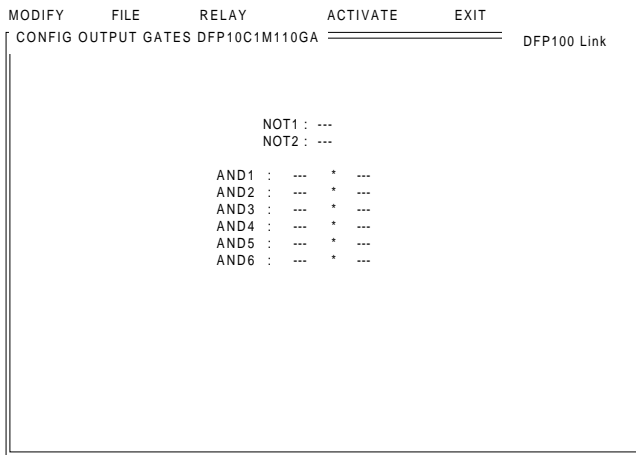
MASKS:

The MASKS category allows the user to select which flags will trigger an event or an oscillography capture.   For example, to set the mask for an EVENT press ENTER when the MODIFY menu is shown in reverse video.  This will cause the following window to appear:

```
MODIFY          FILE      RELAY    ACTIVATE    EXIT
┌ MASKS DFP10A1M110GA00 ═══════════      DFP100 Link
│
│
│   ┌ EVENT MASKS            : ═══════
│   │
│   │                    1  ┌─┐
│   │                    1  │1│
│   │                    2  │1│
│   │                    3  │1│
│   │                    4  │1│
│   │                    5  │1│
│   │                    6  │1│
│   │                    7  │1│
│   │                    8  │1│
│   │                       └─┘
│   │  THREE PASSWORD FAIL
│   └
│
│
│  MASKED: 0        UNMASKED:  1
│  <ESC>:EXIT    ↑>:PREVIOUS   ↓>:NEXT      <CTRL-ENTER>:CONTINUE
```

This window displays the first 8 bits of the EVENT MASK.  The first bit which is highlighted is the THREE PASSWORD FAIL event.  If the "1" in the first location where changed to a "0" this would mask-out the THREE PASSWORD FAIL event, in other words, no event would be logged for a THREE PASSWORD FAIL.

Using the UP/DOWN arrow keys you can move the highlighted area to another bit.  As each bit is shown the corresponding event is shown in the lower left corner of the box.   You can access the remaining bits of the mask by placing the highlighted area over the last bit and pressing the DOWN arrow key.

ACCUMULATORS:

The ACCUMULATOR category , as the name suggests, keeps a running total of the operations of the breaker.   In this menu you can reset the number of breaker operations, as well as, the $I^2T$ and IT values.

```
MODIFY        FILE        RELAY        ACTIVATE        EXIT
┌ ACCUMULATORS DFP10C1M110GA00 ═══════════     DFP100 Link
│
│
│        ACCUMULATOR PHASE A      :   0
│
│        ACCUMULATOR PHASE B      :   0
│
│        ACCUMULATOR PHASE C      :   0
│
│        NUMBER OF OPENINGS       :   0
│
│        NUMBER OF RECLOSURES     :   0
│
│        REPETITIVE TRIP COUNT    :   0
│
│
│
└
```
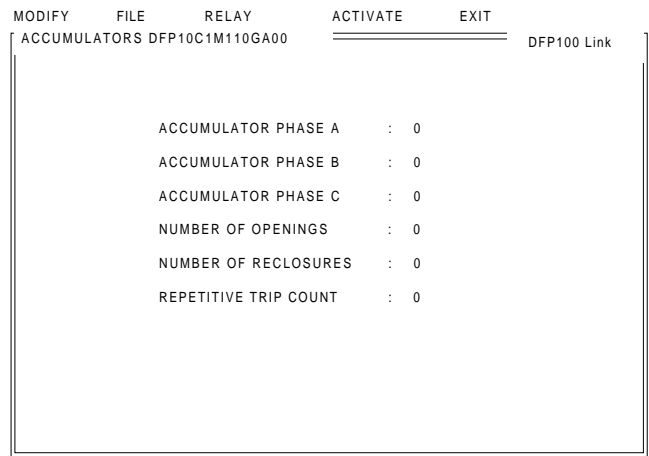
COMMUNICATIONS:

The COMMUNICATIONS category contains all of the settings necessary for proper communications. Here you can set RELAY ID, BAUD RATE, and STOP BITS.

```
 MODIFY      FILE       RELAY           ACTIVATE      EXIT
 COMMUNICATION DFP10C1M110GA00  ═══════════════════  DFP100 Link



          RELAY NUMBER  :   255




          BAUD RATE REMOTE PORT (P3)       : 4800
          BAUD RATE LOCAL PORT (P1 AND P2) : 4800

          STOP BITS REMOTE PORT (P3)       : 1
          STOP BITS LOCAL PORT (P1 AND P2) : 1
```
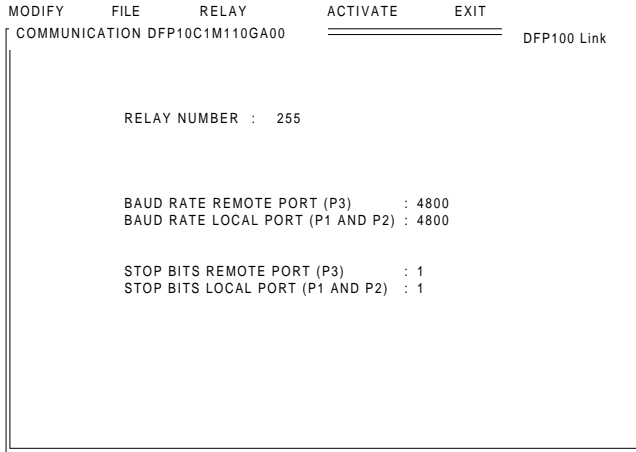
### CONFIG OUTPUTS:

The CONFIG OUTPUTS category allows the user to set the inputs to the 16 input OR gate that supervises each of the four output contacts (OUT1, OUT2, OUT3, and OUT4). Also, the setting for the pickup and dropout timers for each of these four outputs can be set here. NOTE: Because this information is stored in EEProm, there is a short access time from the relay (5 seconds) before any information is displayed, please be patient.
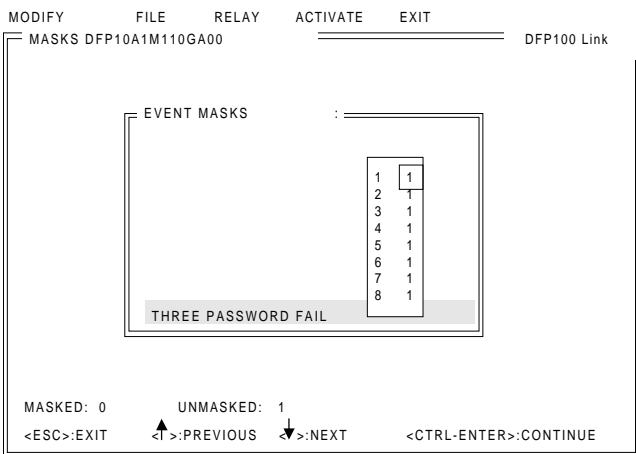
```
 DFP10A1M110GA00  ═══════════════════════════  DFP100 Link
              ▲
 OUT1     AND4    --   + ---  + ---  + ---  + ---  + ---  + ----
        + AND3    --   + ---  + ---  + ---  + ---  + ---  + ----
          AND2
 OUT2     AND1    --   + ---  + ---  + ---  + ---  + ---  + ----
        + NOT2    --   + ---  + ---  + ---  + ---  + ---  + ----
          NOT1
 OUT3     21PT    --   + ---  + ---  + ---  + ---  + ---  + ----
        + 27      --   + ---  + ---  + ---  + ---  + ---  + ----
          59
 OUT4     TRIP    --   + ---  + ---  + ---  + ---  + ---  + ----
        + ▼       --   + ---  + ---  + ---  + ---  + ---  + ----


 PICKUP TIME OUTPUT 1    : 0.0000    PICKUP TIME OUTPUT 3    : 0.0000
 DROPOUT TIME OUTPUT 1   : 0.0000    DROPOUT TIME OUTPUT 3   : 0.0000

 PICKUP TIME OUTPUT 1    : 0.0000    PICKUP TIME OUTPUT 3    : 0.0000
 DROPOUT TIME OUTPUT 1   : 0.0000    DROPOUT TIME OUTPUT 3   : 0.0000

 <ESC>:EXIT    ⬆>:PREVIOUS   ⬇>:NEXT      <CTRL-ENTER>:CONTINUE
```

To set the inputs for the OUT1 OR gate press ENTER when the MODIFY menu is shown in reverse video. This will cause the following screen to appear:

Using the UP/DOWN arrow keys you can move the cursor over the item you wish to be an input. Once the item is shown in reverse video press ENTER to accept this item and move to the next input. To remove an item as one of the inputs ,put the "——" in reverse video and press ENTER.

The PICKUP and DROPOUT times are changed by moving the cursor to the appropriate input and typing in the required time. After all of your settings are correct do not forget to send them to the relay.

### PASSWORD

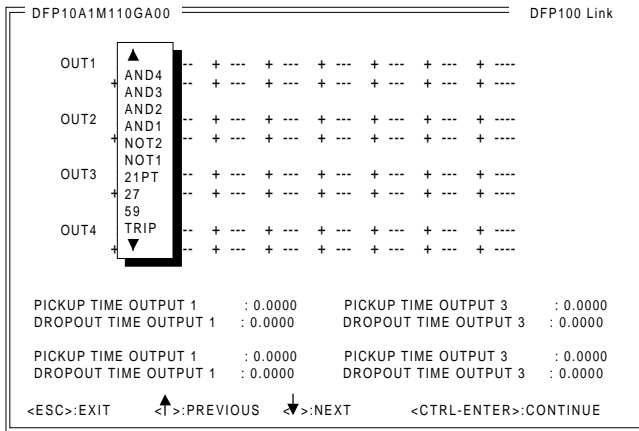This category allows the user to change the modification password on the DFP100. If you have not entered the modifications password the password will be encrypted. If you change this password please record it.

### OPERATIONS

The OPERATIONS has the following menu items:

OPEN

CLOSE

BLOCK (recloser option only)

UNBLOCK (recloser option only)

CLK SYNC.

TRIGGER

```
 SETTINGS      OPERATIONS     LOGS     DEVICE STATUS   EXIT
 DFP10A1M110  ┌──────────┐ ════════════════════════  DFP100 Link
              │ OPEN     │
              │ CLOSE    │
              │ CLK SYNC │
              │ TRIGGER  │
              └──────────┘
```
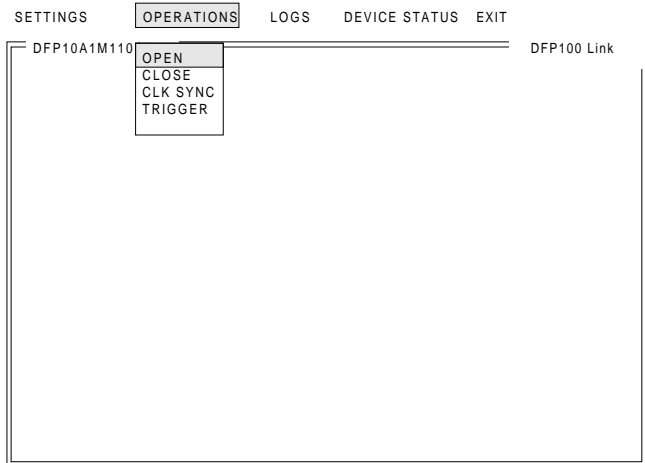
The items under the OPERATIONS menu are action items that cause immediate operations on the relay.

### OPEN:

This action item commands the relay to operate the TRIP1 and TRIP2 contacts. Before this command is sent Mlink will ask the user to confirm this action. If the 52B is wired into the

relay and the 52B is closed the DFP100 will not issue the command.

### CLOSE:

This action item commands the relay to operate the CLOSE contact.  Before this command is sent Mlink will ask the user to confirm this action.  If the 52B is wired into the relay and the 52B is open the DFP100 will not issue the command.

### BLOCK:

This action item commands the relay to block the recloser from operating.  Before this command is sent Mlink will ask the user to confirm this action.  If the recloser is already blocked, Mlink will report that the operation was unsuccessful.

### UNBLOCK:

This action item commands the relay to unblock the recloser .  Before this command is sent, Mlink, will ask the user to confirm this action.  If the recloser is already unblocked, Mlink will report that the operation was unsuccessful.

### CLK SYNC:

This action item commands Mlink to synchronize the clock of your PC with the clock of the DFP100.

### TRIGGER:

This action item commands the relay to record an EVENT and an OSCILLOGRAPHY capture .  Before this command is sent, Mlink will ask the user to confirm this action.  If the mask for EVENT or OSCILLOGRAPHY has a "0" in its EXT. TRIGGER bit, the corresponding operation will not be taken.

### LOGS:

When the LOGS menu is selected it will reveal all of the stored information that the DFP100 contains in its memory.  This stored information includes the eight fault report records, up to the latest 200 event records, the latest 96 intervals of demand data, and if you have the oscillography option, the latest 6 oscillography reports.   The LOGS selection has the following menu items:

EVENTS

CURRENTS

FAULTS

OSCILLO 1 (oscillography option only )

OSCILLO 2 (oscillography option only)

OSCILLO 3 (oscillography option only)

OSCILLO 4 (oscillography option only)

OSCILLO 5 (oscillography option only)

OSCILLO 6 (oscillography option only)

```
SETTINGS      OPERATIONS    LOGS    DEVICE STATUS  EXIT
  DFP10A1M110GA00          EVENTS                    DFP100 Link
                          CURRENTS
                          FAULTS
                          OCSILLO 1
                          OSCILLO 2
                          OSCILLO 3
                          OSCILLO 4
                          OSCILLO 5
                          OSCILLO 6
```
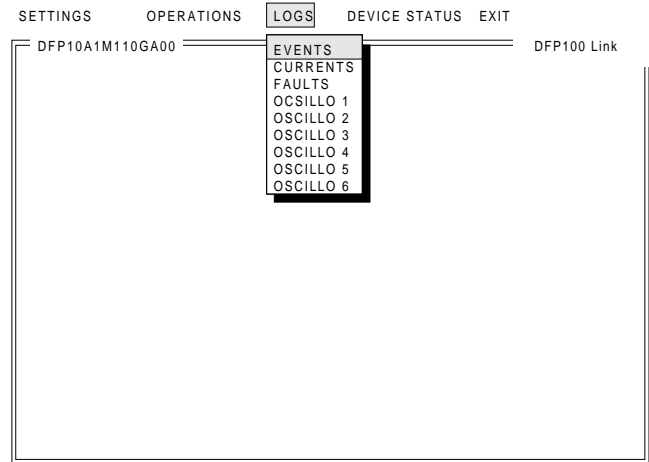
### EVENTS:

The last 200 events can be downloaded from the relay by pressing ENTER when EVENTS is shown in reverse video, then use the RIGHT/LEFT arrow keys to select the RELAY menu and choose LOAD from that menu.

Once they are loaded in the PC they will be displayed on your screen.

To delete events you must first load the events from the relay, once this is complete select DELETE from the RELAY menu.

To save events to a file you must first load events from your relay.  Once this is complete select SAVE from the FILE menu.  You will then enter your file name for these events.

To retrieve events from a file select RETRIEVE from the FILE menu.  A list of files will appear, after selecting the appropriate file the events will be shown on the screen.

### CURRENTS:

The last 96 intervals of demand data can be reported to your PC by selecting the CURRENTS menu.   These intervals will display the average and peak currents for each of the phases during that interval.  To upload the demand data from the relay press ENTER when CURRENTS is

shown in reverse video, then use the RIGHT/LEFT arrow keys to select the RELAY menu and choose LOAD from that menu.

```
┌─ LOGS : DFP10A1M110GA00 ══════════════════════════ DFP100 Link
│ ┌─ CURRENTS ─────────────────────────────────────────────
│ │
│ │        DATE    TIME    IAmax   IBmax   ICmax   IAavg   IBavg   ICavg
│ │        12/22   11:00   0.51    0.50    0.50    0.49    0.49    0.49
│ │        12/22   12:00   0.51    0.50    0.50    0.49    0.49    0.49
│ │        12/22   13:00   0.51    0.52    0.50    0.49    0.50    0.49
│ │        12/22   14:00   0.51    0.52    0.51    0.49    0.49    0.49
```

To save demand data to a file you must first load the data from your relay. Once this is complete select SAVE from the FILE menu. You will then enter your file name for this data.

To retrieve demand data from a file select RETRIEVE from the FILE menu. A list of files will appear, after selecting the appropriate file the data will be shown on the screen.

### FAULTS

The last 8 fault reports can be downloaded from the relay by pressing ENTER when FAULTS is shown in reverse video, then use the RIGHT/LEFT arrow keys to select the RELAY menu and choose LOAD from that menu. Once they are loaded in the PC a summary of the fault reports will be displayed on your screen.

```
┌─ LOGS : DFP10A1M110GA00 ══════════════════════ DFP100 Link
│
│   ┌──┐┌─────────────────────────────────────────────
│   │  ││ 000.   12/21/95 14:30:20.234 AG  FAULT
│   │  ││ 001.   12/21/95 15:10:21.231 ABG FAULT
│   │  ││ 002.   12/22/95 14:35:20.251 BG  FAULT
│   │  ││ 003.   12/23/95 10:22:20.249 AG  FAULT
│   │  ││ 004.   12/23/95 04:30:02.122 CG  FAULT
│   │  ││ 005.   EMPTY FAULT
│   │  ││ 006.   EMPTY FAULT
│   │  ││ 007.   EMPTY FAULT
```

The fault details can be displayed by highlighting the desired record, and pressing enter.

```
┌──────────────────────────────────────────────────────────────┐
│ 000.    12/21/95 14:30:20.234 AG  FAULT:              DFP100 Link │
│                          DISTANCE : 0.00  MILES                │
│   WYE_WYE                                                      │
│                                                                │
│ FAULT  Ia (A)  : 4930.00     PREFAULT Ia (A)  :  500.00        │
│        Ib (A)  : 4930.00              Ib (A)  :  500.00        │
│        Ic (A)  : 4930.00              Ic (A)  :  490.00        │
│        In (A)  : 4930.00              In (A)  :    0.00        │
│        Va(kV)  :   70.10              Va(kV)  :   70.10        │
│        Vb(kV)  :   69.78              Vb(kV)  :   69.78        │
│        Vc(kV)  :   70.10              Vc(kV)  :   70.10        │
│                                                                │
│ TRIP TYPE:                                                     │
│ 51PT_A  :      51PD1_A:     50PH_A : ACTIVE     46PD1  :       │
│ 51PT_B  :      51PD1_B:     50PH_B :            46PT   :       │
│ 51PT_C  :      51PD1_C:     50PH_C :                           │
│ 51NT    :      51ND1   :    50NH   :                           │
│                51PD2_A:     50PL_A :                           │
│                51PD2_B:     50PL_B :                           │
│                51PD2_C:     50PL_C :                           │
│                51ND2   :    50NL   :                           │
└──────────────────────────────────────────────────────────────┘
```

To delete faults you must first load the fault reports from the relay, once this is complete select DELETE from the RELAY menu.

To save faults to a file you must first load the faults from your relay. Once this is complete select SAVE from the FILE menu. Enter a file name when you are prompted.

To retrieve faults from a file select RETRIEVE from the FILE menu. A list of files will appear, after selecting the appropriate file the faults will be shown on the screen

### OSCILLO 1 THROUGH 6:

If your DFP100 has the following model number - DFP1XX1X1XXXA00 (X=Don't Care) each of the last 6 oscillography records can be reported to your PC by selecting the OSCILLO menu. These oscillography captures will display a snap-shot of the fault and through the use of GE-DATA will display 2 cycles of pre-fault data and 32 cycles of post fault data. To download an oscillography capture from the relay press ENTER when OSCILLO X is in reverse video, then use the RIGHT/LEFT arrow keys to select the RELAY menu and choose LOAD from that menu. A screen will appear that indicates that the file is being loaded from the relay. After the download is complete, a summary screen showing the date and time of the oscillography capture and the status reason for the capture will be displayed.

```
┌─ OSCILLO 1  DFP10A1M110GA00 ══════════════                DFP100 Link
│                                        DATE : 10/23/95   TIME 14:23:00
│
│                      FREQUENCY (Hz)   : 60
│
│
│                      OSCILLOGRAPHY TRIGGER  :
│
│
│  PICKUP 51P   INACTIVE   PICKUP 81U1  INACTIVE  TRIP 50NH        INACTIVE
│  PICKUP 51P1  INACTIVE   PICKUP 81U2  INACTIVE  TRIP 50NL        INACTIVE
│  PICKUP 51P2  INACTIVE   PICKUP 81O1  INACTIVE  TRIP 46T         INACTIVE
│  PICKUP 51NT  INACTIVE   PICKUP 81O2  INACTIVE  TRIP 46P         INACTIVE
│  PICKUP 51N1  INACTIVE   TRIP   51PT  INACTIVE  TRIP 81U1        INACTIVE
│  PICKUP 51N2  INACTIVE   TRIP   51P1  INACTIVE  TRIP 81U2        INACTIVE
│  PICKUP 50PH  ACTIVE     TRIP   51P2  INACTIVE  TRIP 81O1        INACTIVE
│  PICKUP 50PL  INACTIVE   TRIP   51NT  INACTIVE  TRIP 81O2        INACTIVE
│  PICKUP 5NH   INACTIVE   TRIP   51N1  INACTIVE  EXT. TRIGGER     INACTIVE
│  PICKUP 5NL   INACTIVE   TRIP   51N2  INACTIVE  COMM. TRIGGER    INACTIVE
│  PICKUP 46T   INACTIVE   TRIP   50PH  INACTIVE
│  PICKUP 46P   INACTIVE   TRIP   50PL  INACTIVE
│
└──────────────────────────────────────────────────────────────────────
```

To save an Oscillography capture to a file you must first load the capture from your relay. Once this is complete select SAVE from the FILE menu. You will then enter your file name for this capture. After the file is saved you must use GE-DATA to display it. Refer to the section on GE-DATA at the end of this chapter.

To retrieve an Oscillography capture from a file select RETRIEVE from the FILE menu. A list of files will appear, after selecting the appropriate file the capture will be shown on the screen.

### DEVICE STATUS:

DEVICE STATUS has the following menu items:-

RELAY STATUS

ACCUMULATORS

```
  SETTINGS      OPERATIONS    LOGS    ┌ DEVICE STATUS ┐  EXIT
┌─ DFP10A1M110GA00 ══════════════     │ RELAY STAT.   │    DFP100 Link
│                                     │ ACCUMULATORS  │
│                                     └───────────────┘
│
│
│
│
│
│
│
│
│
│
│
└──────────────────────────────────────────────────
```

### RELAY STATUS:

The RELAY STATUS command shows the current state of the relay. Selecting RELAY STATUS will display the following screen:

```
┌─ RELAY STAT.  DFP10A1M110GA00 ════════════                DFP100 Link
│
│   WYE_WYE                           DATE : 10/23/95   TIME 14:23:00
│   ACTIVE GROUP: 1   RECLOSE ON 52B OPEN: DISABLE   RECLOSER : INHIBITED
│
│
│     INPUT STATUS       Ia (A)   : 0.000      Va (Kv)     : 0.000
│   INPUT 1  : INACTIVE  Ib (A)   : 0.000      Vb (kV)     : 0.000
│   INPUT 2  : INACTIVE  Ic (A)   : 0.000      Vc (kV)     : 0.000
│   INPUT 3  : INACTIVE  In (A)   : 0.000      Vab (kV)    : 0.000
│   INPUT 4  : INACTIVE  I ns (A) : 0.000      Vbc (kV)    : 0.000
│   INPUT 5  : INACTIVE  P (MW)   : 0.000      Vca (kV)    : 0.000
│   BREAKER : INACTIVE   Q (MVAR) : 0.000      FREQ (Hz)   : 0.000
│
│       ALARMS   :                          PICKUPS  :
│
│    –              –              –              –
│    –              –              –              –
│    –              –              –              –
│    –              –              –              –
│    –              –              –              –
│    –              –              –              –
│    –              –              –              –
│
└──────────────────────────────────────────────────────────────────────
```

### ACCUMULATORS:

The ACCUMULATOR category , as the name suggests, keeps a running total of the operations of the breaker. The difference between this category and the one under the SETTINGS menu is that the data here can only be viewed. The only way to set or reset these quantities is through the SETTINGS menu. If you have a DFP100 with a recloser option the accumulator display will include the number of reclosures and the repetitive trip count accumulators.

```
┌─ ACCUMULATORS  DFP10A1M110GA00 ═══════════                DFP100 Link
│
│
│       ACCUM PHASE A          :     400
│
│       ACCUM PHASE B          :     358
│
│       ACCUM PHASE C          :     423
│
│       NUMBER OF OPENINGS   :      10
│
│       NUMBER OF RECLOSURES:      1
│
│       REPETITIVE TRIP COUNT :     0
│
│
│
└──────────────────────────────────────────────────
```

**ASCII**

**SYSTEM REQUIREMENTS**

### Hardware

The minimum hardware requirements consists of the following components: a VT100 type terminal, or a personal computer with terminal emulation software installed, one serial port, and one printer if printing is required.

Also, an interface cable will be necessary to communicate with the relay, See Figure 9-2 in the INTERFACE section.

### Software

The only software required for relay operation is a VT100 type terminal emulation program. Examples of this software are PROCOMM PLUS, Windows Terminal (Accessory found in Windows 3.1) or Reflections.

### Running ASCII

To begin communicating with your DFP100 using ASCII: start the terminal emulation software, configure the software for the correct serial port and baud rate (default baud rate is 2400), and use VT-100 terminal emulation.

### Program Operation

After you have connected the DFP100 to your PC with the interface cable as shown in Figure 9-2, you are ready to communicate. However, if when you power up the relay, and type a character and it is not echoed to the screen there is a connection problem. Some suggestion for trouble-shooting the problem are:

- Check integrity of interface cable.
- Check baud rate of PC and DFP100 (2400 factory default).
- Check that terminal emulation software is communicating through the correct PC port.
- Check that DB9 connector on the interface cable has a good connection with DB9 port on the DFP100.

If you have made a proper connection to the relay,

powering up the relay or pressing the RETURN key will cause a colon ":" to appear on the screen. You can then login into the relay using one of the login commands.

### Logon

When you are prompted by the ":" you can logon into the relay using one of the DFP100's three login commands. Each of the login commands give you access to different levels of relay control. The three commands that allow you to login to the relay are as follows:

LOGIN

CONTROL

SETACCESS

The LOGIN command gives you the VIEW access level, the CONTROL command gives you the CONTROL access level, and the SETACCESS command gives you the SETTINGS access level. After you have entered one of these commands the relay will ask for the corresponding password.

### Passwords

The ASCII protocol for the DFP100 contains three levels of passwords. These levels are the VIEW, CONTROL, and SETTING levels.

NOTE: All passwords are case sensitive, however, all commands are not case sensitive.

VIEW Level Access

The lowest access level is the VIEW level. The user gaining access to the program with this password is only authorized to view information in the DFP100. The user can perform general configuration inquiries or establish communications with the protection equipment for the purpose of status, log, and setting inquiries. Operations and protection setting modifications cannot be performed by users accessing the program at this security level.

The default VIEW password is:        **DFP_VIEW**

CONTROL Level Access

The CONTROL access level gives the user access to all of the information given to the VIEW

password plus the ability to operate the breaker and to remotely trigger an event and/or an oscillography (optional) capture.

The default CONTROL password is:
**DFP_CNTL**

SETTING Level Access

The SETTING access level gives the user complete control of the DFP100. This access level gives the user all of the capability of the CONTROL access level, plus the ability to change all of the relay settings, including the ability to view and change the passwords for all of three access levels.

The default SETTING password is: **DFP_SETT**

Once you have logged on with the correct password, the prompt that the DFP100 responds with will reflect the current access level you are at. You need not log out from your current access level to login to a new access level. If for example you are logged in at the view access level, and with to change a setting, all you need to do is enter the SETACCESS command and respond with the proper password.

| PROMPT | ACCESS LEVEL |
|--------|--------------|
| DFP> | VIEW |
| DFP_CON> | CONTROL |
| DFP_SET> | SETTINGS |

 **ASCII Commands**

The following list contains all of the ASCII commands and arguments that are available in the DFP100. Each of the arguments for the commands will be shown within set of brackets { }. These commands can be used with any of the arguments shown. In this section the items that are shown in Italics are displayed by the DFP100 and all items in shown in bold are commands to be entered by the user.

  **ACCUM { }, {0 - 99999}, {RESET}**

The ACCUM command allows the user to display/modify/reset the accumulated $I^2T$ or IT Breaker Health Value. The values are displayed for all three phases when the command is given with no argument, but each phase must be reset

independently. For example, **ACCUM A RESET**, will reset the phase A breaker health accumulator. This value is used to determine the health of the breaker. Under the general settings command (SET G) the user can set the threshold for the breaker health function. When the ACCUM value exceeds the Breaker Health value an EVENT and ALARM will be issued.

  **ALARMS { }, {R}**
The ALARMS command will display the current status for all of the DFP100 alarms. The R argument will cause the status to be continuously updated. The following is an example of the screen displayed when the **ALARMS** command is entered:

---

*DFP_CON>* **ALARMS**


    *RELAY DISABLED: No*

    *CLOCK STOPPED: No*

    *TRIPS DISABLED: No*

    *CURRENT WITH 52 OPEN: No*

    *BREAKER MAINTENANCE DUE: No*


    *DEFAULT SETTINGS: NONE*


    *FAILURE TO OPEN: NO*

    *FAILURE TO CLOSE: No*

    *TRIP CIRCUIT: OK*

---

  **CLOSE**

The CLOSE command requires CONTROL access. When this command is issued the DFP100 will operate its CLOSE contact. Before this command is issued the relay will ask again if you wish to close the breaker. Positive or negative indication of the proper execution of the command is given based on the status of the 52/b contact.

**NOTE:** If the 52B contact is wired in (See SET G) and the relay senses that the breaker is already closed the relay will not operate the CLOSE

contact. If the 52/b contact is not wired, the relay will execute the command and will respond with:

*COMMAND EXECUTED*

*52/b NOT WIRED*

### CONTROL

The CONTROL login gives the operator access to the CONTROL access level.

### DATE { }, {R}, {mm/dd/yy}

The DATE command allows the user to set the date or read the date and time. The R argument will cause the date to be continuously updated.

### DEMAND

The DEMAND command will display the peak and average current for each phase for the previous 24, 48, or 96 hours in a time interval of 15, 30, or 60 minutes, respectively

The following is an example of the screen displayed when the DEMAND command is entered into the relay:.

.

```
DFP_CON> DEMAND
Demand Data                              Page 01 of 01
**************************************************************************

10/09 20:00 IAp= 0.00 IBp= 0.00 ICp= 0.00 IAm= 0.00 IBm= 0.00 ICm= 0.00


10/09 19:00 IAp= 0.00 IBp= 0.00 ICp= 0.00 IAm= 0.00 IBm= 0.00 ICm= 0.00


10/09 18:00 IAp= 0.00 IBp= 0.00 ICp= 0.00 IAm= 0.00 IBm= 0.00 ICm= 0.00


10/09 17:00 IAp= 0.00 IBp= 0.00 ICp= 0.00 IAm= 0.00 IBm= 0.00 ICm= 0.00


10/09 16:00 IAp= 0.01 IBp= 0.00 ICp= 0.01 IAm= 0.00 IBm= 0.00 ICm= 0.00
```

### END

The END command is used whenever the user wants the DFP100 to accept setting changes. If the user is using the SET command and is finished changing settings the relay will continue to operate with the previous settings until the user enters END for one of the settings. This will cause the relay to ask the user if they want to accept the setting changes.

```
Group: 1(A) -> Curve Phase TOC
Please Enter New Value For The Setting: 1
Group: 1(A) -> Pickup Phase TOC
Please Enter New Value For The Setting: 5
Group: 1(A) -> Time Dial Phase TOC
Please Enter New Value For The Setting: END

Confirm Change of Settings (Y/N)? Y
Settings Changed
```

**FAULTS { }, {ERASE}**

The FAULTS command allows the user to display/erase the fault report.. This command will display the last 8 faults. A summary of the faults is displayed and details can be displayed by entering a "E" for expanded data, or by entering the number of the fault report. Press the space bar to advance to the next page, press the backspace key to scroll back to the previous events page, or press escape to return to the DFP100 prompt

**EVENTS { }, {ERASE}**

The EVENTS command allows the user to display/erase system events. This command will display the last 200 events. The following is an example of how the events are displayed. Press the space bar to advance to the next page, press the backspace key to scroll back to the previous events page, or press escape to return to the DFP100 prompt.

---

*DFP_SET>* **events**

*200   Processing Events.. Please wait...*

*Events                         Page 01 of 10*

*********************************************

*12/14/1995  16:11:30.190  Recloser out of lockout*

*12/14/1995  16:11:15.154  Recloser to lockout*

*12/14/1995  16:11:15.154  Change of Settings*

*12/14/1995  16:07:30.412  Recloser out of lockout*

*12/14/1995  16:07:15.381  Recloser to lockout*

*12/14/1995  16:07:15.381  Program Start*

*12/14/1995  11:20:00.762  Recloser out of lockout*

*12/14/1995  11:19:45.731  Recloser to lockout*

*12/14/1995  11:19:45.731  Program Start*

*12/14/1995  10:58:34.710  Digital Input 2 OFF*

*12/14/1995  10:58:34.704  Digital Input 3 OFF*

*12/14/1995  10:58:34.704  Digital Input 1 OFF*

*12/14/1995  10:58:27.390  Digital Input 3 ON*

*12/14/1995  10:58:27.390  Digital Input 2 ON*

*12/14/1995  10:58:27.390  Digital Input 1 ON*

*12/14/1995  10:58:25.149  Digital Input 2 OFF*

*12/14/1995  10:58:25.143  Digital Input 3 OFF*

*12/14/1995  10:58:25.142  Digital Input 1 OFF*

*12/14/1995  10:58:23.056  Recloser out of lockout*

*12/14/1995  10:58:18.691  Digital Input 3 ON*

*********************************************

*Press "<=",SPACE, ESCAPE*

---

*DFP_SET>* **FAULTS**

*********************************************
****


*FAULT  1*

*12/06/1995 15:18:17.003 CAG Fault Location = 118.0 MILE*

*FAULT  2*

*12/06/1995 15:18:10.345 CAG Fault Location = 79.0 MILE*

*FAULT  3*

*12/06/1995 15:18:00.043 CAG Fault Location = 52.0 MILE*

*FAULT  4*

*12/06/1995 15:17:54.218 CAG Fault Location = 25.0 MILE*

*FAULT  5*

*12/06/1995 15:17:45.193 CAG Fault Location = 4.0 MILE*

*FAULT  6*

*----EMPTY----*

*FAULT  7*

*----EMPTY----*

*FAULT  8*

*----EMPTY----*

*********************************************

Press  ESCAPE,  FAULT  NUMBER  or  E  for  Expanded mode

---

```
************************************************

FAULT 4                              Wye-Wye


12/06/1995 15:17:54.218   CAG Fault Location = 25.0
MILE
PREFAULT VALUES
Ia -    4.230 A     Va -  69.460 kV

Ib -    4.290 A     Vb -  70.100 kV

Ic -    4.250 A     Vc -  71.700 kV

In -    0.170 A
FAULT VALUES
Ia -   18.810 A     Va -  40.180 kV

Ib -    4.270 A     Vb -  70.740 kV

Ic -   22.090 A     Vc -  35.540 kV

In -   12.890 A
Trips -- 51PH_A 51PH_C

************************************************

Press "<=",SPACE, ESCAPE, FAULT NUMBER or C for
Condensed mode
```

### HELP

The HELP command will display all of the commands available to the user.

### LOGIN

The LOGIN command gives the user with the VIEW password access to the VIEW level.

### MODEL

The MODEL command displays the model number for your DFP100.

### OPEN

The OPEN command requires CONTROL access. When this command is issued the DFP100 will operate its TRIP contacts. Before this command is issued the relay will ask again if you wish to open the breaker.

NOTE: If the 52/b contact is wired in (See SET G) and the relay senses that the breaker is already open the relay will not operate the

TRIP contacts. If the 52/b contact is not wired, the relay will execute the command and will respond with:

```
COMMAND EXECUTED
52/b NOT WIRED
```

### OPENINGS { }, {0 - 99999}, {RESET}

The OPENINGS command allows the user to display/modify/reset the number of breaker openings.

### OSCILLO { }, {1 - 6}

The OSCILLO command will allow the user to download one of the six oscillography captures. If the user wants to see a table with the latest six captures the user can enter the OSCILLO command with no arguments. If the user enters the OSCILLO command with an argument of 1 to 6, the relay will prompt the user to prepare for a binary file transfer. If you use your terminal emulation software to receive this binary file, after a momentary pause the relay will download an approximately 14 kbyte file. This file can be converted to ASCII text or to GE-DATA format for display and analysis. See the Viewing Oscillography Data section of this instruction book for details on how to view and download the records..

### PASSWORD { }, {C}, {S}, {V}

The PASSWORD command will display/modify passwords. This command requires SETTING level access. If this command has no argument it will display all three passwords. If the command has a C, S, or a V as an argument it will change the corresponding password (CONTROL, SETTING, or VIEW).

### QUIT

The QUIT command serves two purposes. If you enter the QUIT command at any prompt it will automatically logout from the relay. Also, the QUIT command can be used to disregard any setting changes before they are accepted by the relay. The following is an example of a settings change followed by the quit command to properly save the command

*Group: 1(A) -> Disable Phase TOC*

*Please Enter New Value For The Setting:* **NO**

*Group: 1(A) -> Curve Phase TOC*

*Please Enter New Value For The Setting:* **1**

*Group: 1(A) -> Pickup Phase TOC*

*Please Enter New Value For The Setting:* **5**

*Group: 1(A) -> Time Dial Phase TOC*

*Please Enter New Value For The Setting:* **QUIT**

*Quit Without Changing Settings (Y/N)?* **Y**

## READINGS { }, {R}

The READINGS command will display to the user all of the measured quantities in the relay. To have this information continuously updated use the R argument The following is an example of what is displayed by the relay after the readings command is entered.

*DFP>* **READINGS**

*Ia: 0.000 A  Ib: 0.000 A  Ic: 0.000 A  In: 0.000 A*

*Va: 0.000 kV  Vb: 0.000 kV  Vc: 0.000 k*

*Vab: 0.000 kV  Vbc: 0.000 kV  Vca: 0.000 kV*

*P:    0.0 MW*
*Q:    0.0 MVAR*
*I2:   0.000 A*
*f:    0.00 Hz*

## RECLOSER

The RECLOSER command is used to display the status of the recloser. The recloser status display includes the following items:

*RECLOSER DISABLED: Yes*

*RECLOSE ON 52 OPEN: No*

*LOCKOUT: Yes*

*BLOCKED - REPETITIVE TRIPS: No*

*BLOCKED - REMOTE: No*

*BLOCKED - LOCAL: No*

*EXTERNAL RECLOSE INITIATE: No*

*RECLOSE IN PROGRESS: No*

## RECLOSURES { }, { 0 - 99999 }

The RECLOSURES command allows the user to display/modify the number of accumulated reclosures.

## RELID { }, {C}

The RELID command allows the user to display/modify the relay's identification. When this command is used with the C argument the relay will ask for a new identification.

## SET { }, {1 -6}, {G}, {B}, {I}, {M}, {O}, {P}, {PL}, {PR}

The SET command allows the user to modify any of the relay settings. The arguments available to the SET command are as follows:

| ARGUMENT | DESCRIPTION |
|---|---|
| SET 1 | MODIFY SETTING GROUP 1 |
| SET G | MODIFY GENERAL SETTINGS |
| SET B | MODIFY BREAKER HEATH SETTINGS |
| SET I | MODIFY CONFIGURABLE INPUTS |
| SET M | MODIFY EVENT AND OSCILLOGRAPHY MASKS |
| SET O | MODIFY CONFIGURABLE OUTPUTS |
| SET P | MODIFY CURRENT PORT SETTINGS |
| SET PL | MODIFY LOCAL SETTINGS |

SET PR          MODIFY REMOTE PORT

### SETTINGS

There are 6 different setting groups. In each of the setting groups, the individual settings are group together according to their function. The functions can be put into eight categories. These categories are as follows:

- Time Overcurrent
- Definite Time Overcurrent
- Instantaneous Overcurrent
- Negative Sequence Overcurrent
- Over/Under Frequency
- Torque Control
- Demand Data
- Recloser

Once the user has entered the SET command the user can enter ">" to jump to the next setting group.

*Group: 1(A) -> Disable Phase TOC*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Phase DT High*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Phase INST High*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Negative Sequence DT*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Under Frequency Unit 1*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Torque Control Signal*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Demand Interval*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Recloser*

*Please Enter New Value For The Setting:* >

*Group: 1(A) -> Disable Phase TOC*

*Please Enter New Value For The Setting:* **QUIT**

To set the Configurable Inputs and Configurable Outputs, see Tables 3-2 and 3-4, respectfully. When programming the Configurable Outputs the user enters equations that will determine the operation of OUT1, OUT2, OUT3, and OUT4. In any order the user chooses, he can enter the inputs for the 6 two-input AND gates (AND1, AND2, AND3, AND4, AND5, and AND6), for the 2 NOT gates (NOT1 and NOT2), or for the 4 sixteen -input OR gates (OUT1, OUT2, OUT3, and OUT4). The following is an example of how to set the configurable outputs with the ASCII communication software.

*DFP_SET>* **SET O**

*Please enter your definitions:*

**AND1=51N_T*51P_T**

**NOT1=50PH_P**

**OUT1=AND1+NOT1+81OT2+81OT1**

**AND2=46PT*50NL_T**

**AND3=21PT+51P2_T**

**OUT2=AND2+AND3+27+59**

**END**

*Confirm Change of Settings (Y/N)?* **Y**

*Settings Changed*

*DFP_SET>*

### SETACCESS

The SETACCESS command gives the user with the SETTING password access to the SETTING level.

**SHOWSET { }, {1 -6}, {G}, {I}, {M}, {O}, {P}, {PL}, {PR}**

The SHOWSET command allows the user to view any of the relay settings. The arguments available to the SHOWSET command are as follows:

| ARGUMENT | DESCRIPTION |
|---|---|
| SHOWSET 1 | VIEW SETTING GROUP 1 |
| SHOWSET G | VIEW GENERAL SETTINGS |
| SHOWSET I | VIEW CONFIGURABLE INPUTS |
| SHOWSET M | VIEW EVENT AND OSCILLOGRAPHY MASKS |
| SHOWSET O | VIEW CONFIGURABLE OUTPUTS |

SHOWSET P     VIEW CURRENT PORT
              SETTINGS

SHOWSET PL    VIEW LOCAL PORT SETTINGS

SHOWSET PR    VIEW REMOTE PORT
              SETTINGS

There are 6 different setting groups.  In each of the setting groups, the individual settings are group together according to their function.  The functions can be put into eight categories.  These categories are as follows:

- Time Overcurrent
- Definite Time Overcurrent
- Instantaneous Overcurrent
- Negative Sequence Overcurrent
- Over/Under Frequency
- Torque Control
- Demand Data
- Recloser

Once the user has entered the SHOWSET command the user can enter the following key to speed through the settings:

| KEY | EFFECT |
|---|---|
| Backspace | Shows previous setting category |
| & | Repeats setting category |
| Space Bar | Advances to the next setting category |
| Escape | Quit Showset |

**STATUS { }, {R}**

The STATUS command allows the user to display the relay's status. The STATUS display will show which protection functions are currently picked-up, which digital inputs are energized, which settings group is in use by the relay, and what is the status of the breaker.   To have this information continuously updated use the R argument.

**TIME { }, {R}, {hh/mm/ss}**

The TIME command allows the user to set the time or read the date and time.  The R argument will cause the time to be continuously updated.

**TRIGGER**

The TRIGGER command allows the user to generate an event and oscillography capture.

**Table 10-1 ASCII Command Set**

| COMMAND | DESCRIPTION | ARGUMENTS |
|---------|-------------|-----------|
| ACCUM | Display/Modify/Reset accumulated amps | { **none** }<br><br>- display accumulated amps<br>{ **integer number from 0 to 99999** }<br>- set the value of the counter to the given number - requires SET access<br>{ **RESET** }<br>- reset the counter to its default value - requires SET access |
| ALARMS | Display status of alarms | { **none** }<br>- display alarms once<br>{ **R** }<br>- display continuously refreshed alarms |
| CLOSE | Close breaker<br> - requires CONTROL access | - no arguments |
| CONTROL | Gives access to level 2 - CONTROL actions | - no arguments |
| DATE | Display/modify date | { **none** }<br>- display date and time once<br>{ **R** }<br>- display continuously refreshed date and time<br>{ **mm/dd/yy** }<br>- set the date and to the value of the argument - requires CONTROL access |
| DEMAND | Display demand data | - no arguments |
| END | End setting and write to memory | - no arguments |
| EVENTS | Display/erase system events | { **none** }<br>- display events<br>{ **ERASE** }<br>- erase all events - requires SET access |
| FAULTS | Display/erase system | { **none** }{ **#**}<br>- display fault reports<br>{ **ERASE** }<br>- erase all fault reports - requires SET access |
| HELP | Display a list of all available commands | - no arguments |
| LOGIN | Give access to level 1 - CONTROL actions | - no arguments |
| MODEL | Display relay's version and model | - no arguments |
| OPEN | Open breaker<br>- requires CONTROL access | - no arguments |

**TABLE 10-1   ASCII Command Set  (continued)**

| COMMAND | DESCRIPTION | ARGUMENTS |
|---|---|---|
| OPENINGS | Display/modify/reset number of breaker openings | **{ none }**<br>- display number of breaker openings<br>**{integer number from 0 to 99999]**<br>- set the value of the counter to the given number requires SET access<br>**{RESET}**<br>- reset the counter to its default value = requires SET access |
| OSCILLO | Display/download oscillography events | **{ none }**<br>- display a table of oscillography events<br>**{ integer number from 1 to 6 }**<br>- download specified oscillography event from relay to PC |
| PASSWORD | Display/modify passwords<br>- requires SET access | **{ none }**<br>- display passwords<br>**{ V }**<br>- modify the VIEW password<br>**{ C }**<br>- modify the CONTROL password<br>**{ S }**<br>- modify the SET password |
| QUIT | End session and return to access level 0 | - no arguments |
| READINGS | Display relay's metering data | **{ none }**<br>- display readings once<br>**{ R }**<br>- display continuously refreshed readings |
| RECLOSER | Displays the recloser status | - no arguments |
| RECLOSURES | Display/modify number of accumulated reclosures | **{none}**<br>- display number of reclosures<br>**{ integer number from 0 to 99999 }**<br>- set the number of reclosures to the given number requires SET access |
| RELID | Display/modify relay's ID | **{ none }**<br>- display relay's ID<br>**{ C }**<br>- modify relay's ID - requires SET access |
| SET | Modify settings<br>- requires SET access | **{ none }**<br>- modify settings in the active group<br>**{ integer number from 1 to 6 }**<br>- modify settings in the specified group<br>**{ G }**<br>- modify settings in the general group<br>**{ B }**<br>- modify the breaker heath settings |

**TABLE 10-1   ASCII Command Set  (continued)**

| COMMAND | DESCRIPTION | ARGUMENTS |
|---|---|---|
| SET<br>(continued) | | **{ I }**<br>- modify the configurable inputs<br>**{M}**<br>- modify event and oscillography mask<br>**{ O }**<br>- modify the configurable outputs<br>**{ P }**<br>- modify the parameters of the comm port<br>  presently in use<br>**{ PL }**<br>- modify the parameters of the local ports<br>**{ PR }**<br>- modify the parameters of the remote port |
| SETACCESS | Give access to level 3 - SET actions | - no arguments |
| SHOWSET | Display settings | **{ none }**<br>- display settings in the active group<br>**{ integer number from 1 to 6 }**<br>- display settings in the specified group<br>**{ G }**<br>- modify settings in the general group<br>**{ I }**<br>- display the configurable inputs<br>**{M}**<br>- display event and oscillography mask<br>**{ O }**<br>- display the configurable outputs<br>**{ P }**<br>- display the parameters of the comm port presently<br>  in use<br>**{ PL }**<br>- display the parameters of the local ports<br>**{ PR }**<br>- display the parameters of the remote port |
| STATUS | Display relay's status | **{ none }**<br>- display status once<br>**{ R }**<br>- display continuously refreshed status |
| TIME | Display/modify time | **{ none }**<br>- display date and time once<br>**{ R }**<br>- display continuously refreshed date and time<br>**{ hh/mm/ss }**<br>- set the time to the value of the argument |
| TRIGGER | Generates a system event<br>- requires CONTROL access | - no arguments |

## VIEWING OSCILLOGRAPHY DATA

The method to download and view oscillography data depends on the communication option that the relay utilizes.

This first section will describe how to download and view oscillography data with ASCII Protocol models and the second section will describe how to download and view oscillography data with GE protocol models of the DFP100. The program used to view oscillography data is called GE-DATA.

**Note: GE-DATA is a separately priced option.**

### Downloading From ASCII

Typing the command *OSCILLO*, will display a summary of the oscillography reports. To down load a record, you must first configure your terminal emulator for X-modem binary transfer.

The user enters OSCILLO X command with X as an argument of 1 to 6 for the desired record. The relay will prompt the user to prepare for a binary file transfer. The relay will respond with the message:

*Processing Oscillography data. Please Wait.....*

The relay takes approximately 60 seconds to prepare the data for download, and then it will prompt the user:

*Prepare your terminal for XMODEM/CHECKSUM Reception.*

*Cntrl - X to Cancel.*

Configure your terminal emulation software to receive this binary file, after a momentary pause the relay will download an approximately 14 kbyte file.

This file can be converted to ASCII text or to GE-DATA format for display and analysis.

Two conversion files are provided on the installation within the ASCCON directory on the included disk. Copy these files to a directory where you wish to store the oscillography records.

### Converting to ASCII

To convert a file to ASCII text, you will need to use the DFPTOASC.EXE file for conversion to an ASCII format, At a DOS type DFPTOASC and the program will prompt you for the oscillography file name. Enter the name of the file that was downloaded from the relay and press return. The program will then prompt for the ASCII file name that you want to same the file as. This can also be entered as a single command as follows:

```
DOS>DFPTOASC.EXE
[OSCILOGRAPHY_FILENAME] [ASCII_FILENAME]
```

The file which is created will contain 62 channels of data separated by commas, which is described in Table 10-2. This data file can be imported into any spreadsheet or data analysis program. The Voltage and Current channels have scale factors which must be applied to the data for proper display and analysis.

If you enter: *DFPTOASC /H*, the Channel information in Table will be displayed on the screen.

### Converting ASCII to GE-DATA

To convert an oscillography file that was downloaded from an ASCII relay to GE-DATA format, you will need to use the DFPTOGL.EXE file for conversion At a DOS type

```
DFPTOGL [SOURCE} [DESTINATION}
```

Enter the name of the file that was downloaded from the relay as the source file, and the name of the file that you wish to use as the GE-DATA format file. Use the file extension .OSC for the saved file.

The file which is created can be loaded directly into GE-DATA using the instructions provided in the GE-DATA section.

Please Note: This GE-DATA formatted file cannot be converted to ASCII using the DFPTOASC.EXE file. The original downloaded file must be used.

### Viewing Oscillography From Mlink

To download an oscillography record from the relay with the Mlink communication protocol, follow the instructions in the MLINK section. The downloaded file is saved in the following directory:

c:\MLINK\DFP\OSC.

Use this file path when selecting the file from the GE-DATA program.  This file can be loaded directly into the GE-DATA program and all of the scale factors and signal names will be applied.

Please Note:  This GE-DATA formatted file cannot be converted to ASCII using the DFPTOASC.EXE file

**Table 10-2 Oscillography Data Format**

| No. | NAME | SCALE |
|---|---|---|
| 1 | CHANNEL: | Sample Number |
| 2. | CHANNEL: | Time in microseconds from beginning of record |
| 3. | CHANNEL:Ia | (scale:0.01) |
| 4. | CHANNEL:Ib | (scale:0.01) |
| 5. | CHANNEL:Ic | (scale:0.01) |
| 6. | CHANNEL:In | (scale:0.01) |
| 7. | CHANNEL:Va | (scale:0.02) |
| 8. | CHANNEL:Vb | (scale:0.02) |
| 9. | CHANNEL:Vc | (scale:0.02) |
| 10. | CHANNEL:_51N | |
| 11. | CHANNEL:_51P-C | |
| 12. | CHANNEL:_51P-B | |
| 13. | CHANNEL:_51P-A | |
| 14. | CHANNEL:_51N2 | |
| 15. | CHANNEL:_51P2-C | |
| 16. | CHANNEL:_51P2-B | |
| 17. | CHANNEL:_51P2-A | |
| 18. | CHANNEL:_51N1 | |
| 19. | CHANNEL:_51P1-C | |
| 20. | CHANNEL:_51P1-B | |
| 21. | CHANNEL:_51P1-A | |
| 22. | CHANNEL:_50NL | |
| 23. | CHANNEL:_50PL-C | |
| 24. | CHANNEL:_50PL-B | |
| 25. | CHANNEL:_50PL-A | |
| 26. | CHANNEL:_50NH | |
| 27. | CHANNEL:_50PH-C | |
| 28. | CHANNEL:_50PH-B | |
| 29. | CHANNEL:_50PH-A | |
| 30. | CHANNEL:_46P | |
| 31. | CHANNEL:_46P1 | |
| 32. | CHANNEL:_81U1 | |
| 33. | CHANNEL:_81U2 | |
| 34. | CHANNEL:_81O1 | |
| 35. | CHANNEL:_81O2 | |
| 36. | CHANNEL:_51PT | |
| 37. | CHANNEL:_51PD1 | |

**Table 10-2 Oscillography Data Format (cont.)**

| No. | NAME | SCALE |
|---|---|---|
| 38. | CHANNEL:_51PD2 | |
| 39. | CHANNEL:_51NT | |
| 40. | CHANNEL:_51ND1 | |
| 41. | CHANNEL:_51ND2 | |
| 42. | CHANNEL:_50PH | |
| 43. | CHANNEL:_50PL | |
| 44. | CHANNEL:_50NH | |
| 45. | CHANNEL:_50NL | |
| 46. | CHANNEL:_46PT | |
| 47. | CHANNEL:_46PD1 | |
| 48. | CHANNEL:_81UT1 | |
| 49. | CHANNEL:_81UT2 | |
| 50. | CHANNEL:_81OT1 | |
| 51. | CHANNEL:_81OT2 | |
| 52. | CHANNEL:LOCKOUT | |
| 53. | CHANNEL:BLK_REP | |
| 54. | CHANNEL:BLK_REM | |
| 55. | CHANNEL:BLK_LOC | |
| 56. | CHANNEL:EXT_REC | |
| 57. | CHANNEL:INPUT_1 | |
| 58. | CHANNEL:INPUT_2 | |
| 59. | CHANNEL:INPUT_3 | |
| 60. | CHANNEL:INPUT_4 | |
| 61. | CHANNEL:INPUT_5 | |
| 62. | CHANNEL:INPUT_52 | |

## Installing GE-DATA

1. Insert the diskette labeled "GE - DATA Installation Disk 1/2" in your floppy drive.

2. Enter the following command:

    A:\INSTALL <Enter>

3. After you have entered the INSTALL command, a message is displayed informing you that you need at least 3 Mbytes of free disk space to install GE-DATA.  To continue with the installation press "Y"; to abort the installation press any other key.

4. If you responded "Y" during step 4 a message is displayed prompting you for the name of the target directory.  If this directory does not already exist it will be created.  This directory will be referred to as the GE-DATA system directory.

5. After you have entered the desired target directory name, press <Enter> to begin installation.

6. After a couple of minutes you will be prompted to insert "GE-DATA Installation Disk 2/2" in your floppy drive.  Insert the diskette labeled " GE-DATA Installation Disk 2/2" in your floppy drive then press <Enter> to continue the installation.

After all the GE-DATA files have been copied to your hard disk, a message is displayed informing you that the installation is complete.

### Running GE-DATA

Edit the PATH command in your AUTOEXEC.BAT file to include the GE-DATA system directory.

> PATH C:\;C:\DOS\;C:\GE-DATA;

Reboot your PC.  To run GE-DATA, type the following at the DOS prompt:

> GL

After a brief pause, the MAIN MENU is displayed. Select the SYSTEM option from the MAIN MENU, then select STATPACK! option from the MAIN MENU to swap to the STATPACK module.

Select the OPEN option from the FILE menu. The "File Open" entry form appears, prompting you to enter the name of the data file you wish to open.

DFP100 oscillography files will have the extension .OSC. therefore, enter "*.OSC" and press <ENTER>.  All available files with the extension .OSC will be displayed.  Select the file you want to display and press <ENTER>.

From the STATPACK menu select the CURVE option.  To open one or more curves select the OPEN option from the CURVE menu.  A " OPEN CURVE" selection box is displayed, listing all of the curves in the window.  Use the left or right arrow keys and press <ENTER> to select the desired curve name.  A small diamond appears next to each selected curve name.  Press F10 to open the curve(s).

All selected signals are displayed on your screen. Press ESC to hide the CURVE menu.

To close one or more curves select the CLOSE option from the CURVE menu.  A "CLOSE CURVE" selection box is displayed, listing all of the curves in the window.

Use the left or right arrow keys and press <ENTER> to select the desired curve name(s).  A small diamond appears next to each selected curve name. Press F10 to close the curve.  If you are using a mouse, click the left mouse button on the desired curve name.  Click the OK button to close the curve.

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