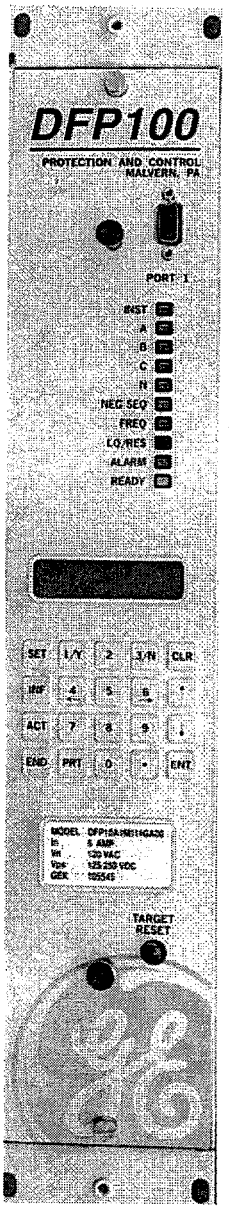
MULTILIN

DFP100 Digital Feeder Protection Relays

Instruction Book



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

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

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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 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 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. PORT 1 and PORT 2 are configured for RS232 communications, and PORT 3 is configured for RS485 communications.

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).

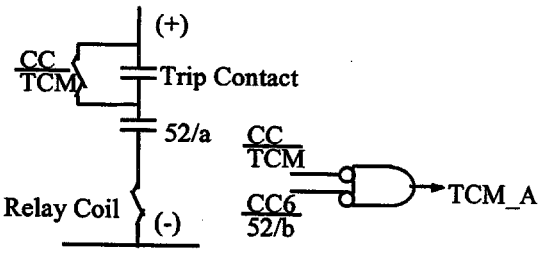


Figure 2-1 Trip Circuit Monitor

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.

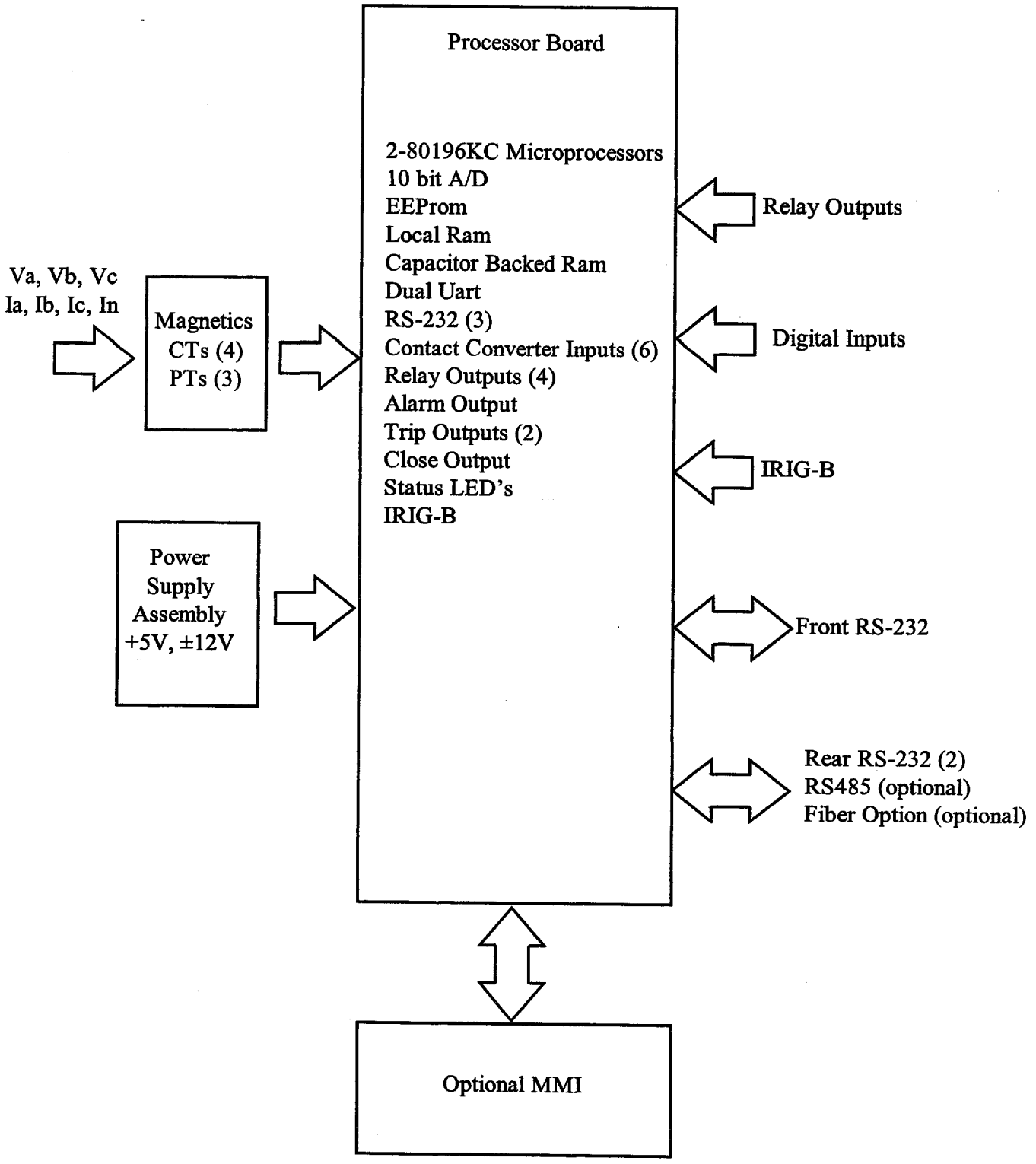


Figure 2-2 DFP100 Block Diagram

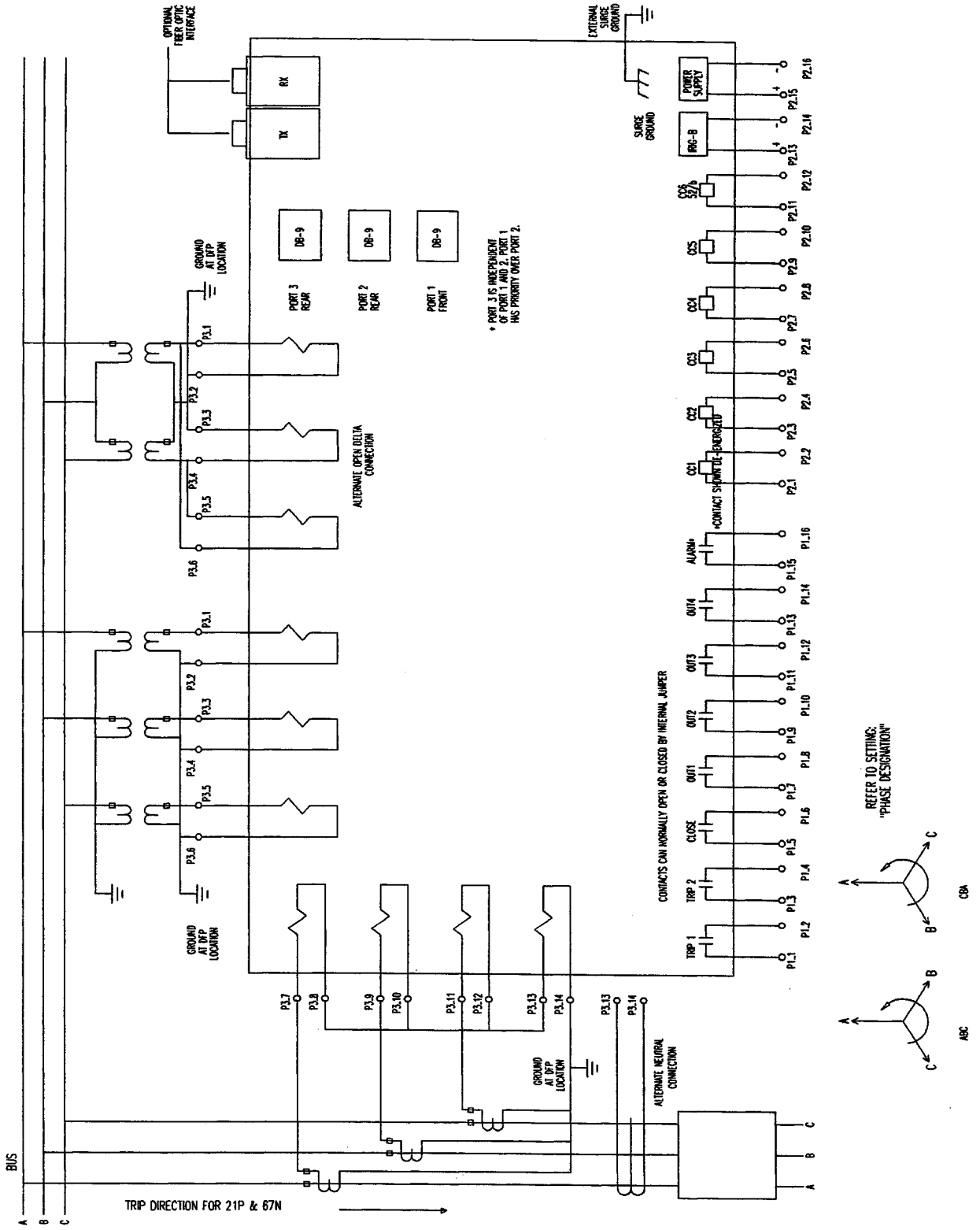


Figure 2-3 (0179C8565) DFP100 External Connections

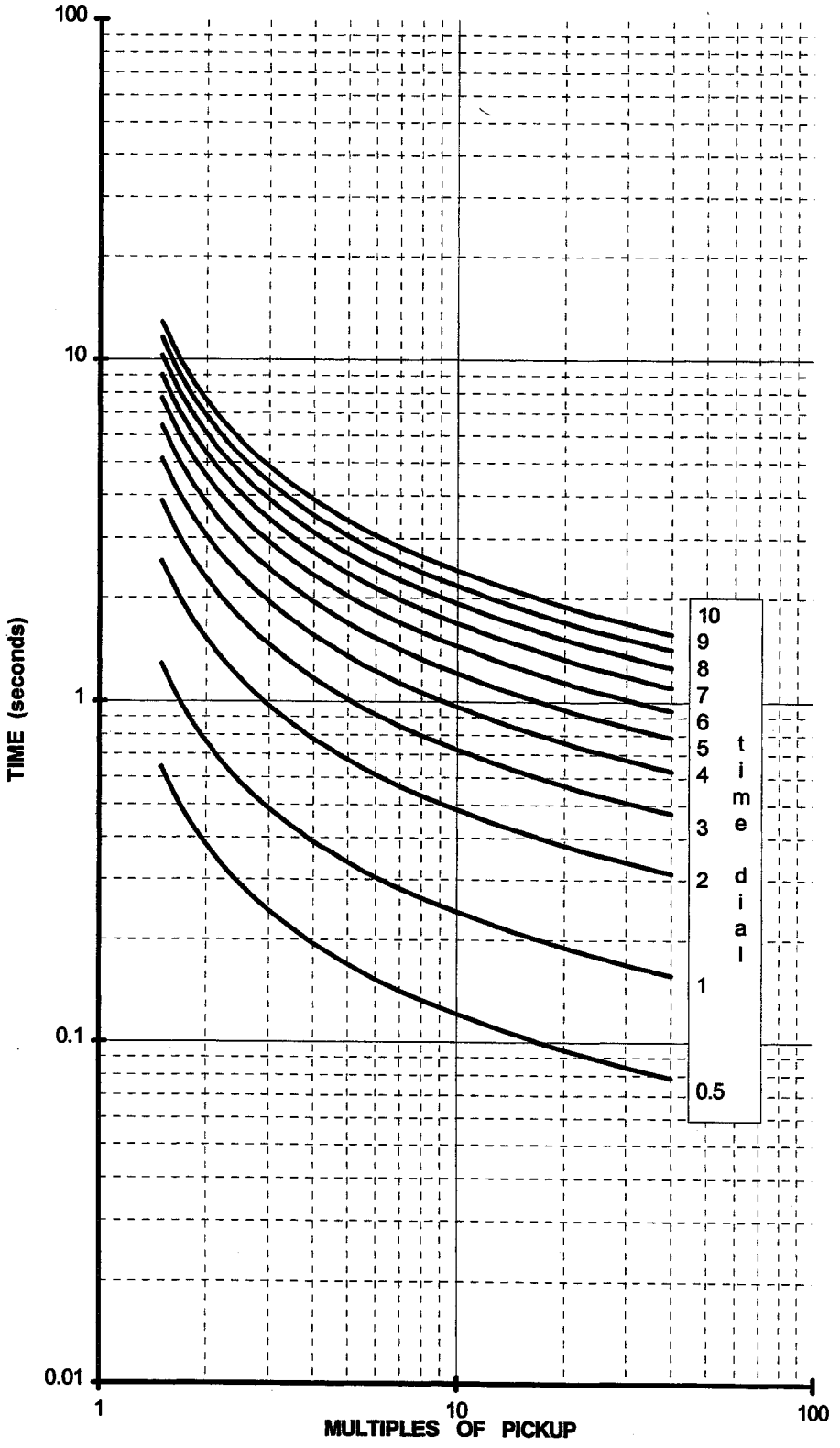


Figure 2-4 DFP100 Inverse Curve (0358A1120)

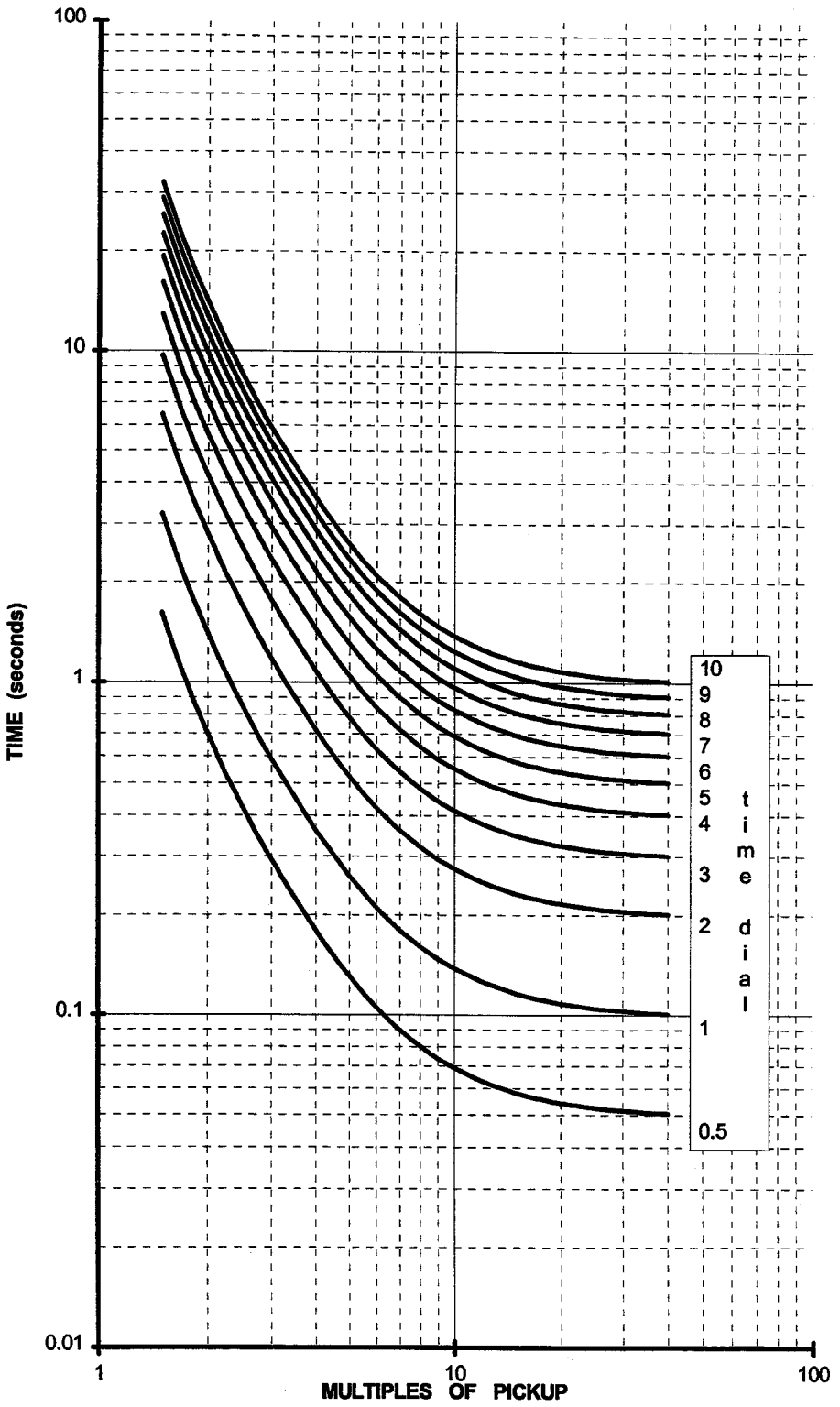


Figure 2-5 DFP100 Very Inverse Curve (0358A1121)

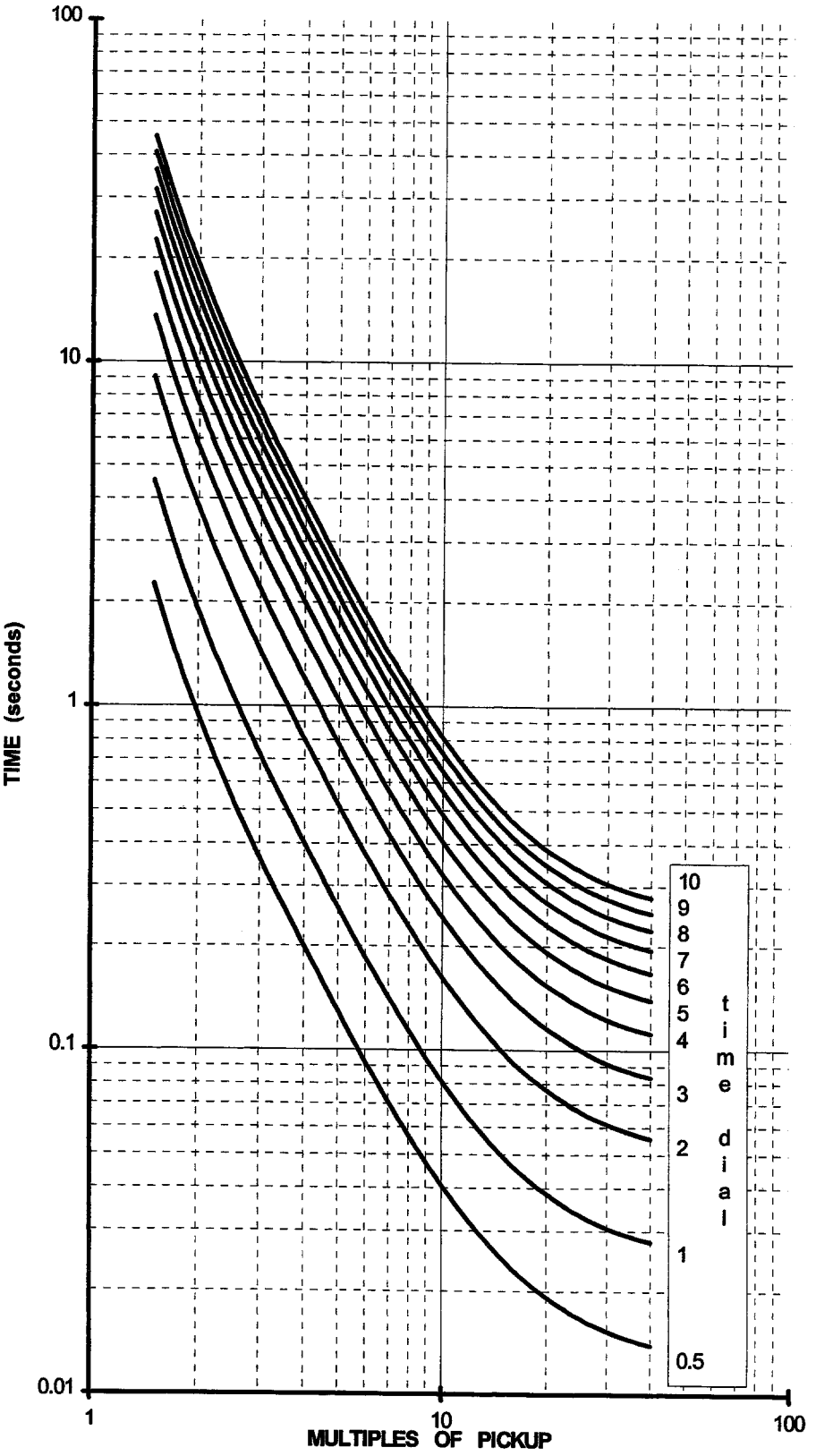


Figure 2-6 DFP100 Extremely Inverse Curve (0358A1122)

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	DISABLE RELAY	1 (YES)/0 (NO)		NO
{ SET G }	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	BRKR HEALTH UNITS	0 (amp*sec.) 1 (amp^2*sec.)		1 (amp^2*sec.)
{SET B}	BREAKER ARC TIME	1 - 200	1 millisecond	100
	BREAKER HEALTH THRESH	0 - 40,000,000	1	10,000.00
INPUTS	DIGITAL INPUT 1	See Table 3-2		
{ SET I }	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	NOT1	See Table 3-4		
{ SET O }	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 {ACCUM A 0} {ACCUM B 0} {ACCUM C 0}	ACCUM	0-40,000,000	1	0
PASSWORD {PASSWORD V,C,S}	VIEW CONTROL SET			DFP_VIEW DFP_CNTL DFP_SETT
RELAYID { RELID C }	RELID	20 characters		0
DATE {DATE mm/dd/yy }	DATE	mm/dd/yy		
TIME { TIME hh:mm:ss }	TIME	hh:mm:ss		
LOCAL PORT { SET P, PL }	BAUD RATE	300, 600, 1200, 2400, 4800, 9600 14400, 19200 38400, 57600	baud	2400
	STOP BITS	1,2		1
	TIME OUT	0 - 60	1 minute	0
REMOTE PORT { SET P, PR }	BAUD RATE	300,600, 1200, 2400, 4800, 9600, 14400, 19200 38400, 57600	baud	2400
	STOP BITS	1, 2		1
	TIME OUT	0 - 60	1 minute	0
TIME OVER-CURRENT { SET }	DISABLE PHASE TOC	1 (YES)/0 (NO)		YES
	CURVE PHASE TOC	1 (EXT INV) 2 (VERY INV.) 3 (INVERSE)		3 (INVERSE)
	(*) PICKUP PHASE TOC	1.00 - 12.00	0.01 amps	1.00
		0.20 - 2.40	0.01 amps	0.20
	TIME DIAL PHASE TOC	0.5 -10.0	0.1	10.0
	DISABLE GROUND TOC	1 (YES)/ 0(NO)		YES
	CURVE GROUND TOC	1 (EXT INV 2 (VERY INV.) 3 (INVERSE)		3 (INVERSE)
	(*)PICKUP GROUND TOC	1.00 - 12.00	0.01 amps	1.00
		0.20 - 2.40	0.01 amps	0.20
	TIME DIAL GROUND TOC	0.5 -10.0	0.1	10.0

Table 3-1 DFP100 Relay Settings (Continued)

CATEGORY	SETTING NAME	RANGE	INCREMENT	DEFAULT
DEFINITE TIME { 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 { 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 SEQUENCE { 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 2 (VERY INV.) 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 { 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)		
		2 (67N)		
	(*)NEGATIVE SEQUENCE LEVEL	0.10 - 2.00	0.01 A	1.0
	PHASE TORQUE CONTROL SIGNAL	0 (DISABLED)		
		1 (EXTERNAL)		
		2 (21PT)		
		3 (27)		
		4 (50PL)		0
	21PT SIGNAL	0 (DISABLED)		
		1 (OR)		
		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 { SET }	DEMAND INTERVAL	1(15),2(30),60(3)	minutes	1 (60)
	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 { SET }	DISABLE RECLOSER	1 (YES)/0 (NO)		YES
	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. All settings are in secondary amps.

(#) 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 recloser 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.

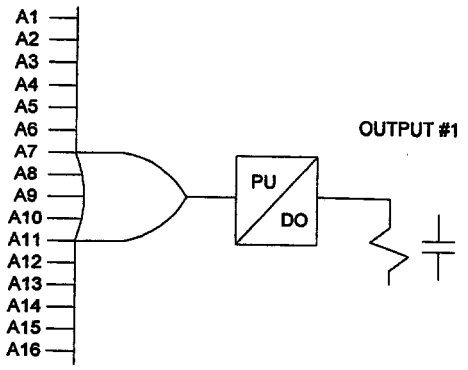


Figure 3-1 Combinational Logic for Outputs #1, #2, #3, and #4

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 range is 0 - 40,000.

Password Settings

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.

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 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 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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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
1	THREE PASSWORD FAIL
2	EVENTS ERASED
3	COUNTERS CHANGED
4	BREAKER CLOSED
5	BREAKER OPENED
6	GROUP CHANGE BY DIGITAL INPUT
7	SETTINGS CHANGE
8	PROGRAM START
9	
10	
11	
12	GROUP CHANGE BY COLD LOAD PICKUP
13	RESET BY PASSWORD
14	SET DATE AND TIME
15	DEFAULT SETTINGS
16	EVENT BY COMM TRIGGER
17	
18	
19	GROUP CHANGE AFTER COLD LOAD P/U
20	END OF FAULT
21	RECLOSE INITIATE
22	REMOTE UNBLOCK COMMAND
23	REMOTE BLOCK COMMAND
24	OSC. TRIGGER BY EXT. INPUT
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	EXTERNALLY INITIATED RECLOSE
36	RECLOSER BLOCKED LOCALLY
37	RECLOSER BLOCKED REMOTELY
38	RECL. BLOCKED BY REPETITIVE TRIP
39	RECLOSER LOCKOUT
40	
41	DIGITAL INPUT 1 ACTIVE
42	DIGITAL INPUT 2 ACTIVE
43	DIGITAL INPUT 3 ACTIVE
44	DIGITAL INPUT 4 ACTIVE
45	DIGITAL INPUT 5 ACTIVE
46	52B INPUT ACTIVE
47	
48	

#	DESCRIPTION
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	
61	
62	
63	
64	
65	
66	
67	
68	
69	
70	EEPROM FAILURE
71	POWER SUPPLY FAILURE
72	A/D VREF FAILURE
73	BREAKER MAINTENANCE DUE
74	CURRENT WITH BREAKER OPEN
75	TRIPS INHIBITED
76	CLOCK STOPPED
77	RELAY DISABLE
78	
79	
80	
81	PICKUP 50PL
82	PICKUP 50PH
83	PICKUP 51N2
84	PICKUP 51N1
85	PICKUP 51N
86	PICKUP 51P2
87	PICKUP 51P1
88	PICKUP 51P
89	PICKUP 81O2
90	PICKUP 81O1
91	PICKUP 81U2
92	PICKUP 81U1
93	PICKUP 46D
94	PICKUP 46T
95	PICKUP 50NL
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 for the units with the optional Local MMI is an aluminum panel with an overlay which contains a membrane switch keypad. The 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 MMI features a 2 line by 16 character Liquid Crystal alphanumeric Display (LCD) and 20 key membrane switch keypad display. The MMI is a separate component connected to the DFP100's Processor Board and 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.

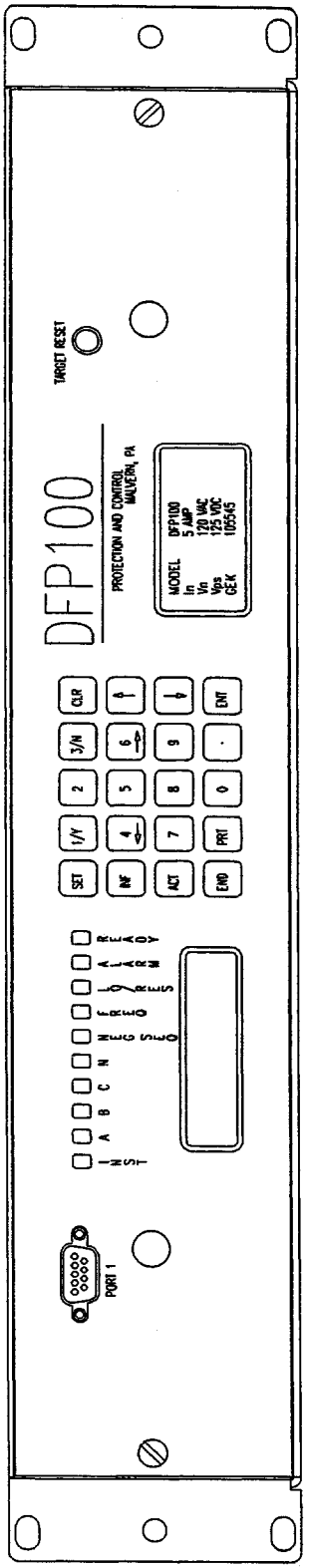


Figure 4-1 DFP100 Front View (Horizontal Mounting Configurations)

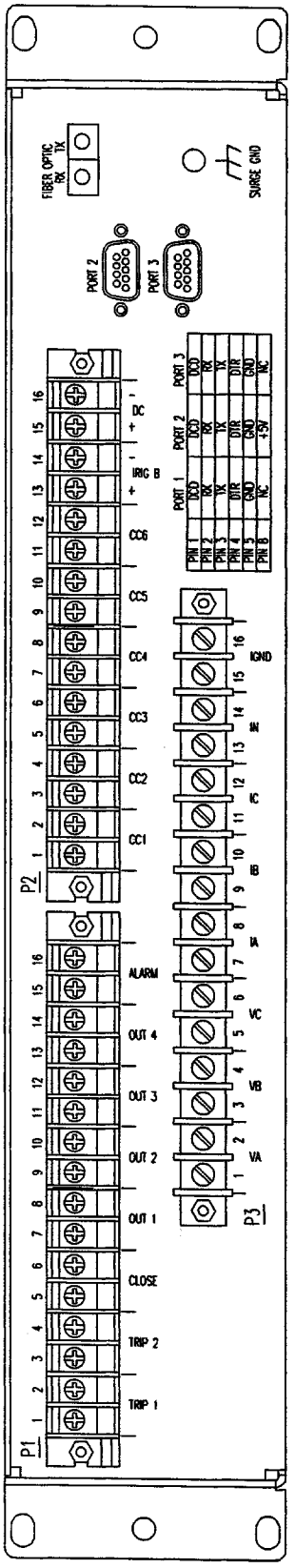


Figure 4-2 DFP100 Rear View

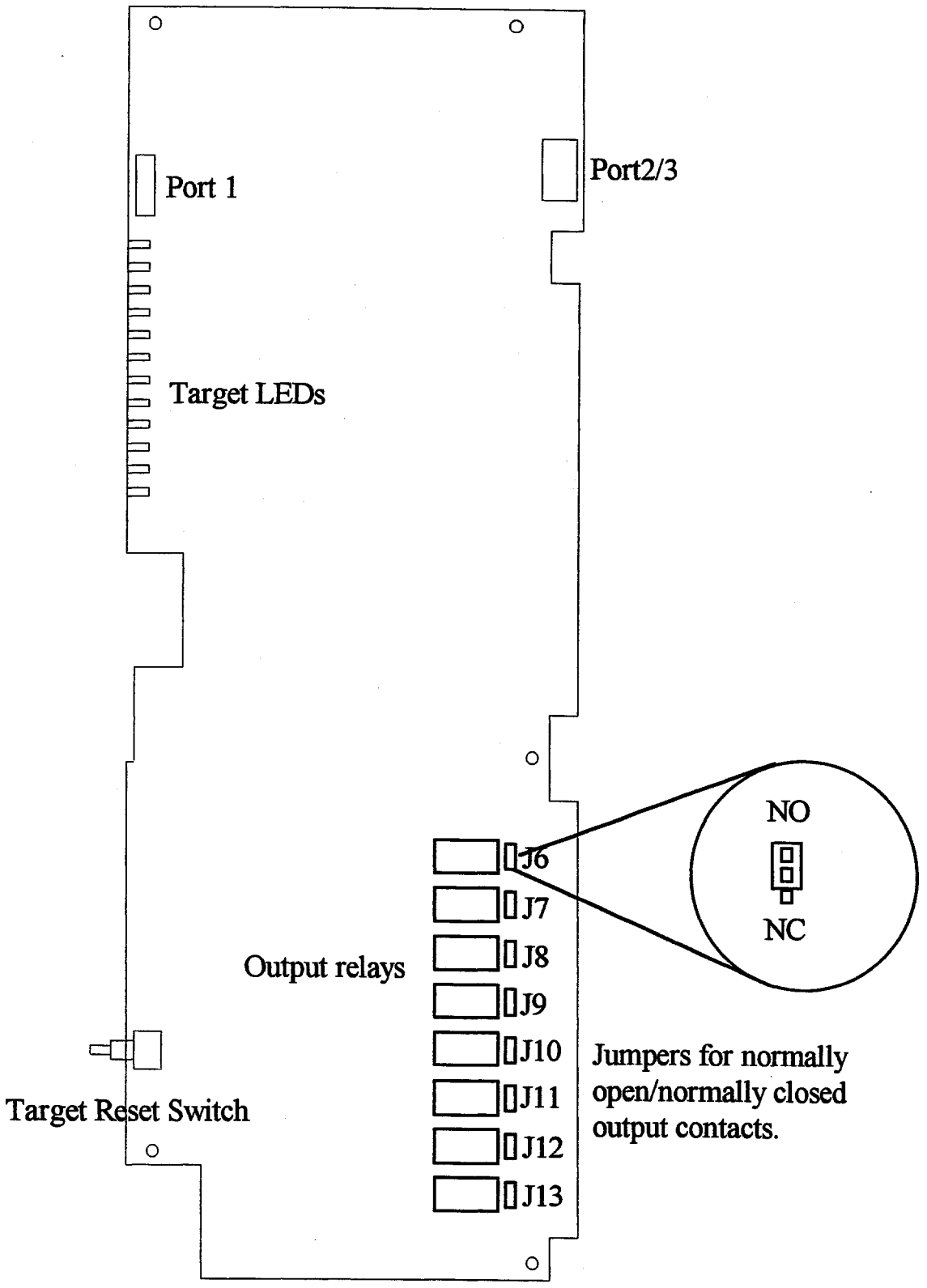


Figure 4-3 DFP100 Processor Board

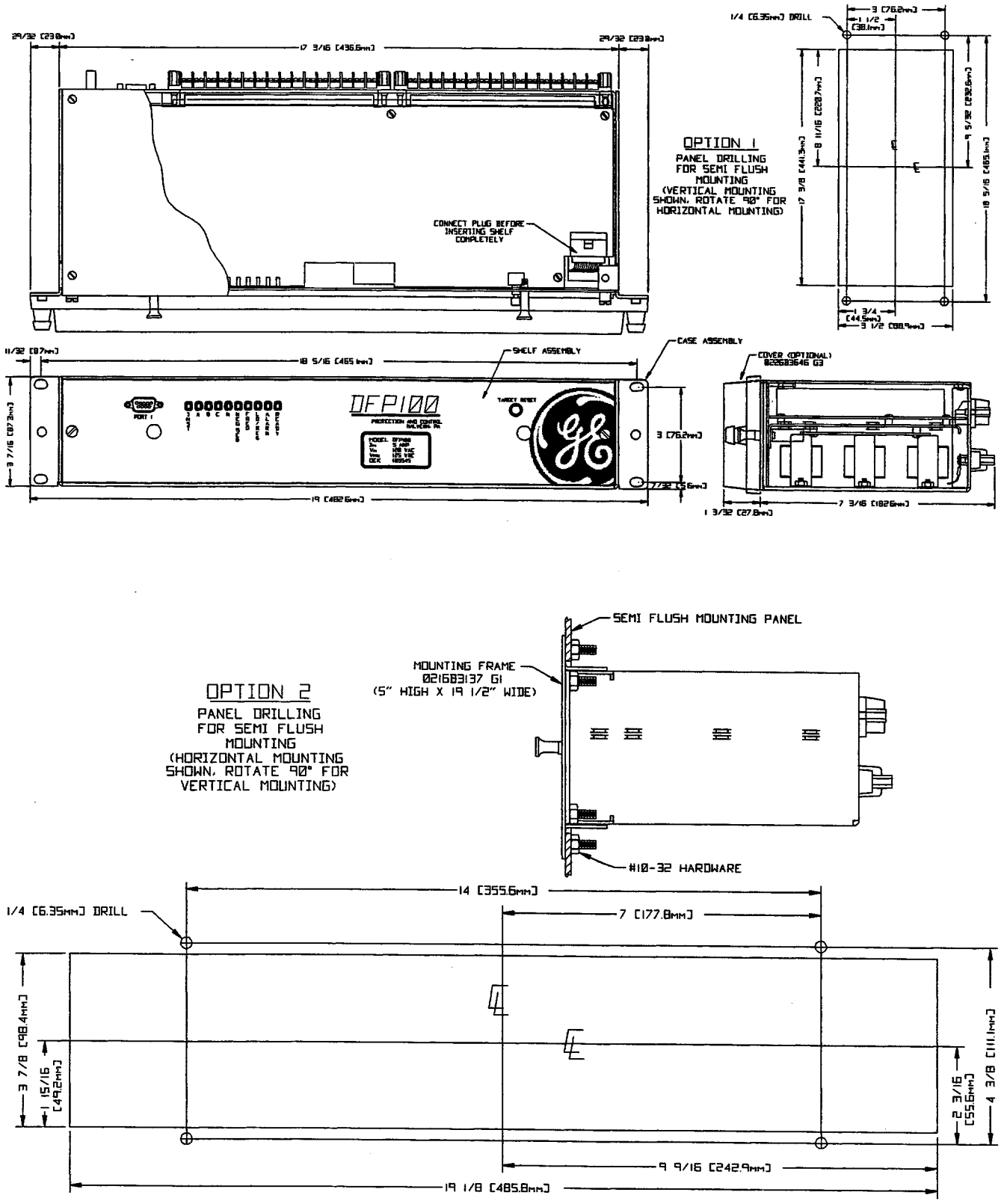


Figure 4-4 Outline and Panel Drilling Dimensions (0215B8797 [2])

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 two possible ways:

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

Communication Requirements

If the DFP relay uses 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 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 Phase Low	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 Control Signal	0 (Disabled)
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 P3_3, P3_4 P3_5, P3_6	103 Vrms 67 Vrms 67 Vrms	P1_7,P1_8	5.00s <t< 5.05s	Ready
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	97 Vrms 67 Vrms 67 Vrms	P1_7,P1_8	———	Ready
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	51.5 Vrms 67 Vrms 67 Vrms	P1_7,P1_8	———	Ready
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	48.5 Vrms 67 Vrms 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. 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 B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	49 Vrms 49 Vrms 67 Vrms	-55°	P1_1,P1_2 P1_3,P1_4	Ready, A, B INST
A B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	57 Vrms 57 Vrms 67 Vrms	-55°	P1_1,P1_2 P1_3,P1_4	Ready
A B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	23 Vrms 23 Vrms 67 Vrms	+5°	P1_1,P1_2 P1_3,P1_4	Ready, A, B INST
A B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	30 Vrms 30 Vrms 67 Vrms	+5°	P1_1,P1_2 P1_3,P1_4	Ready
A B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	23 Vrms 23 Vrms 67 Vrms	-115 °	P1_1,P1_2 P1_3,P1_4	Ready, A, B INST
A B C	P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	30 Vrms 30 Vrms 67 Vrms	-115°	P1_1,P1_2 P1_3,P1_4	Ready

6.

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

The DFP100 has a 4 shot recloser.

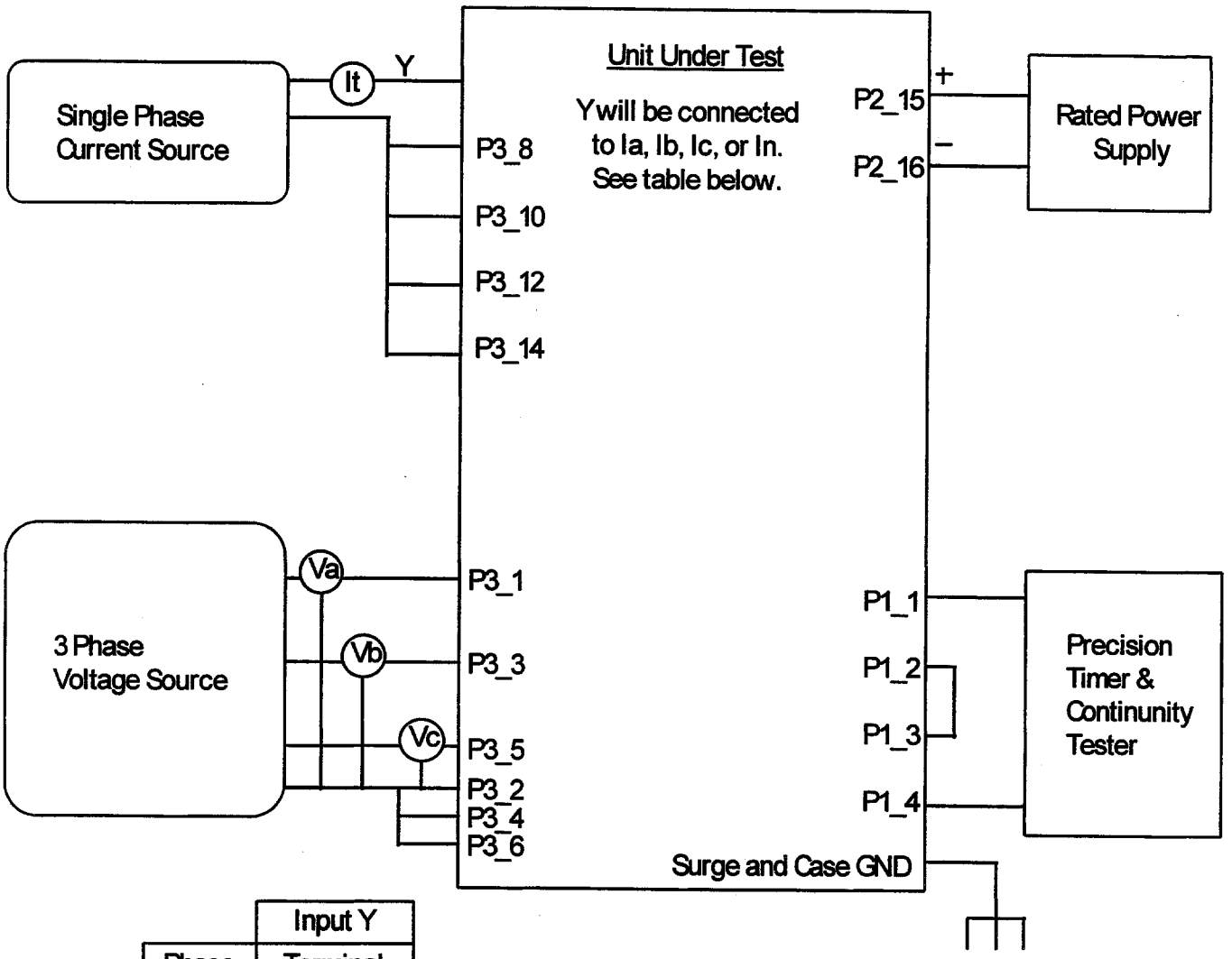
This test will demonstrate the functionality of the DFP100 Recloser. There are many features for the recloser and this test does not claim to test all of them. To obtain a better understanding of the recloser please see the Recloser Section in the **PRODUCT DESCRIPTION SECTION.**

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!



	Input Y
Phase Under Test	Terminal Block Number
A	P3_7
B	P3_9
C	P3_11
N	P3_13

Figure 5-1 Standard Functional Test Connections

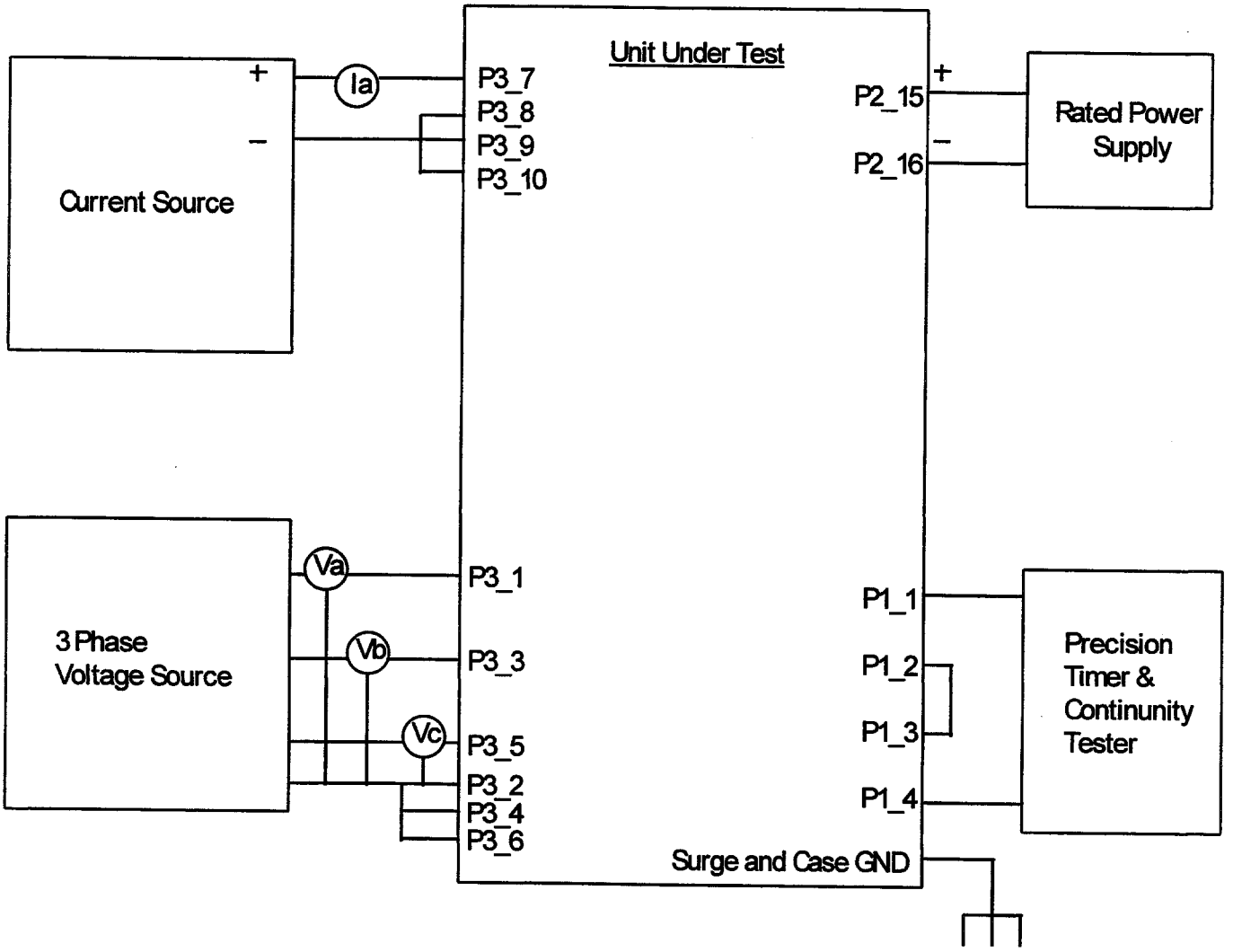


Figure 5-2 Phase Distance Test (Wye-Wye)

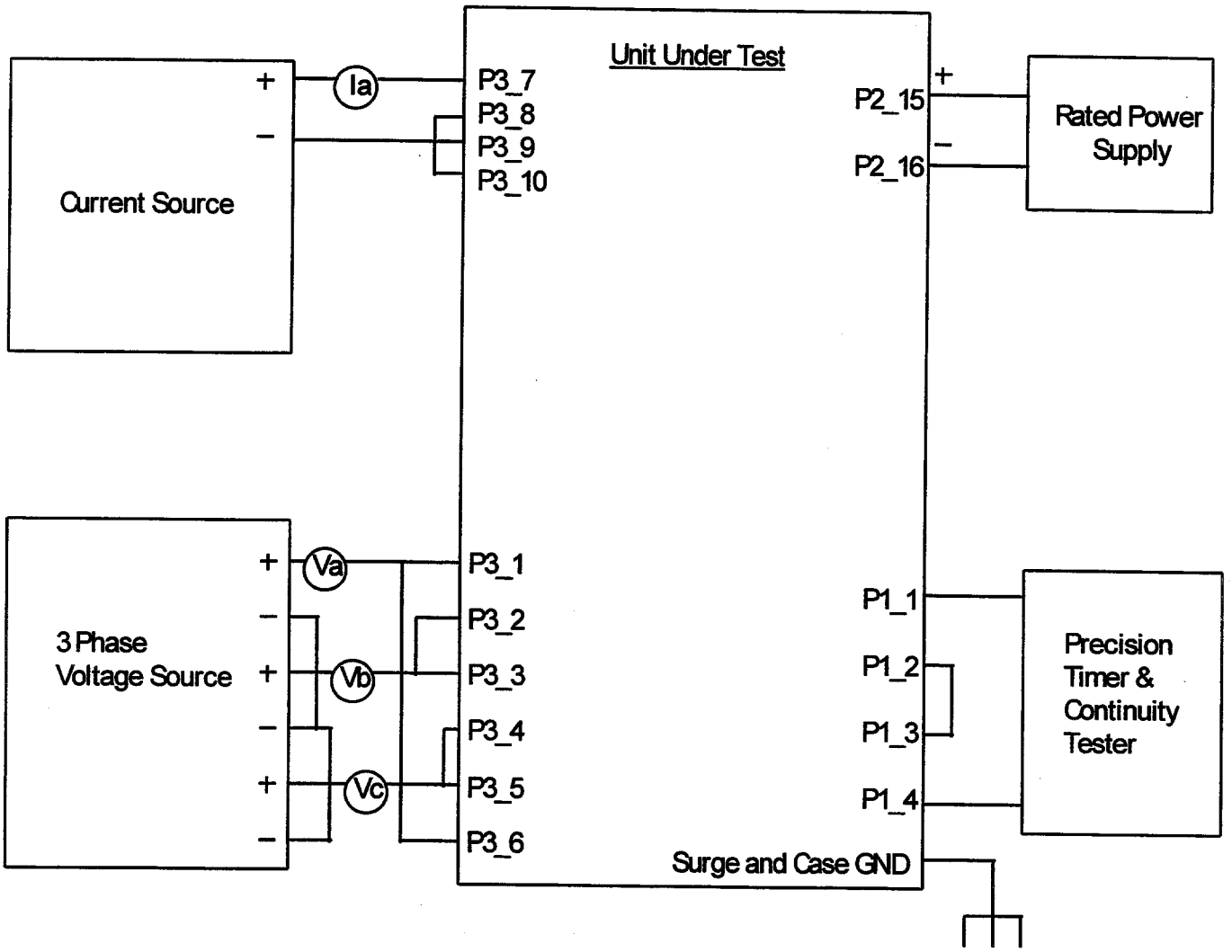


Figure 5-3 Phase Distance Test (Open-delta)

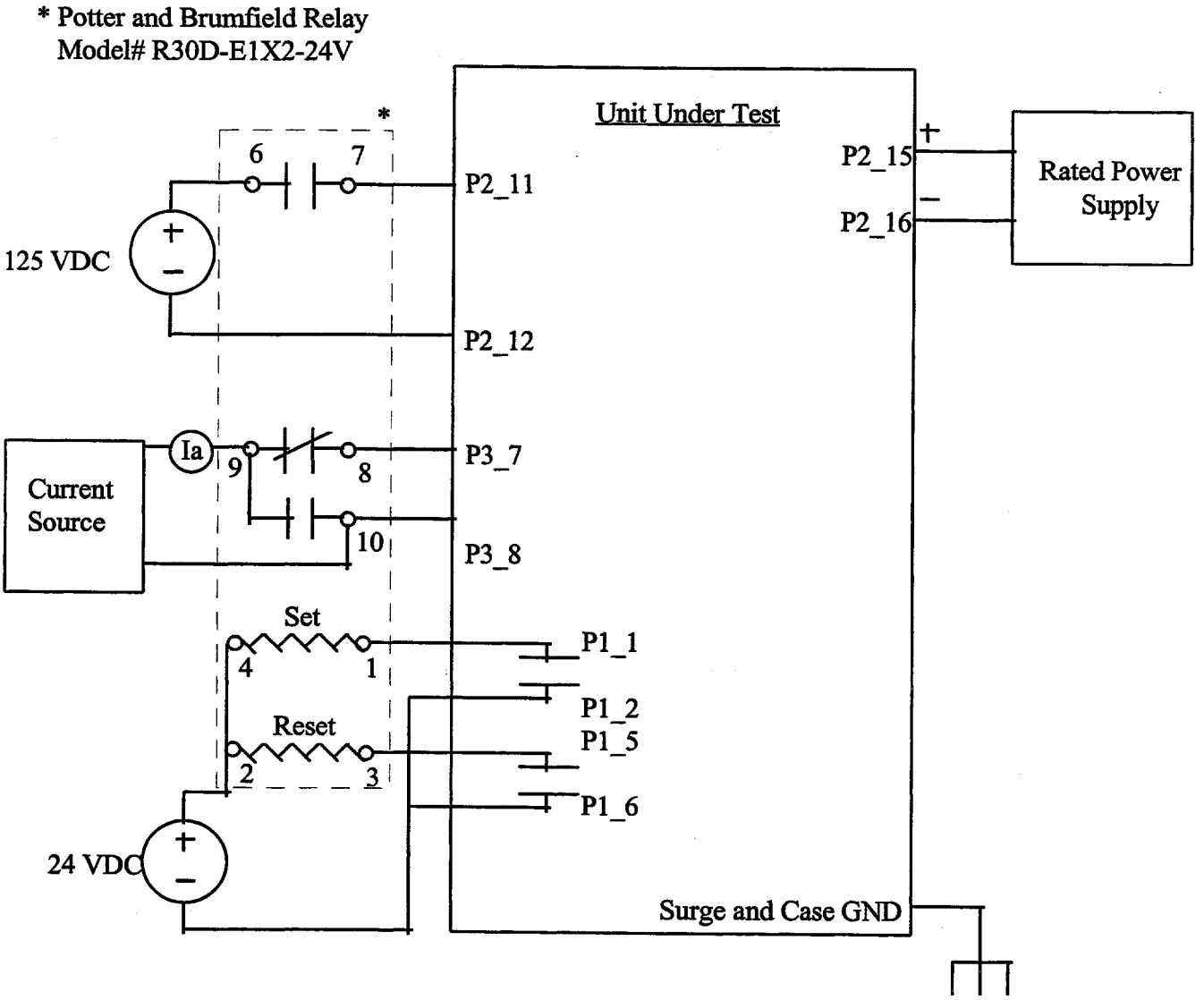


Figure 5-4 Recloser Test

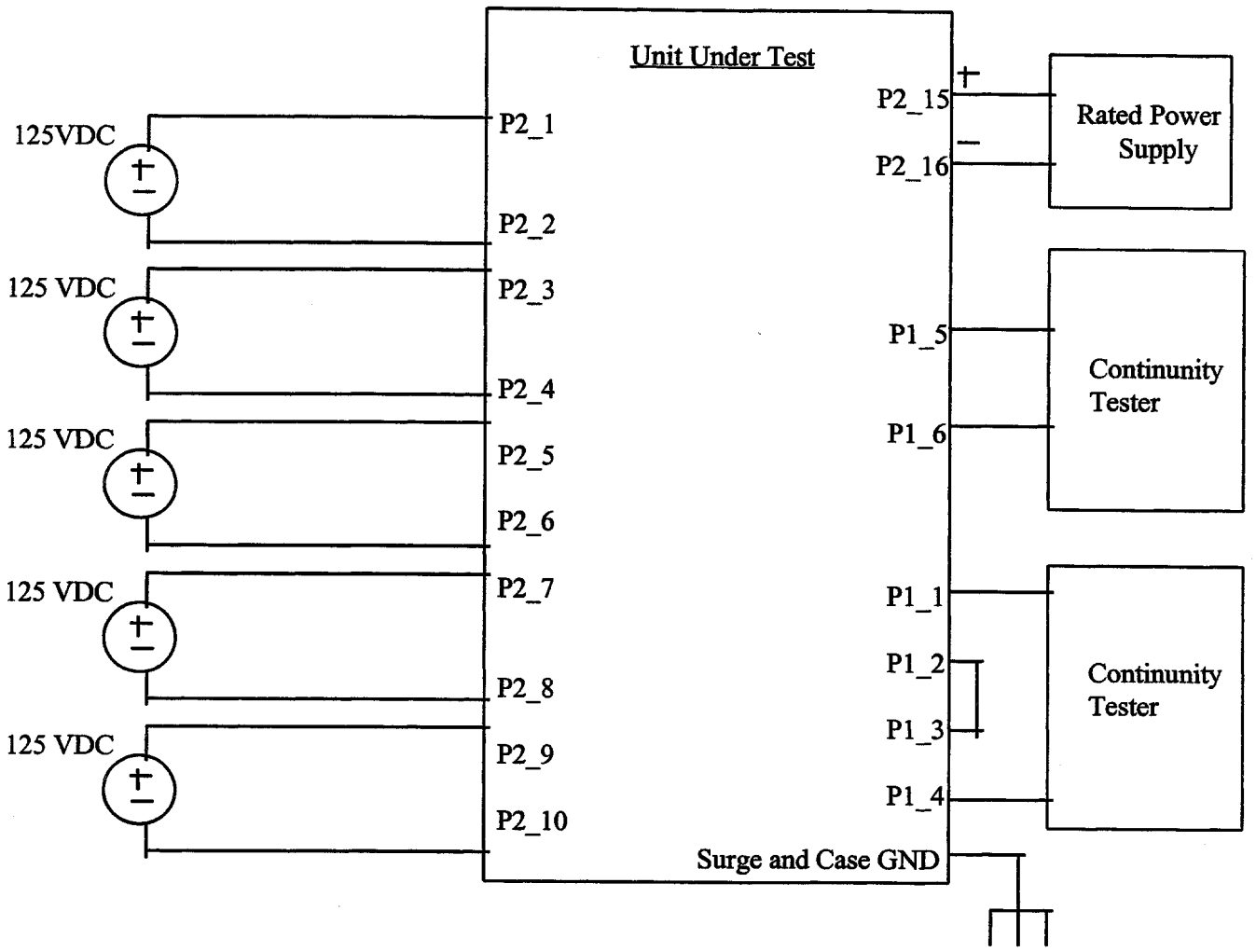


Figure 5-5 Contact Converter (Digital Input) Test

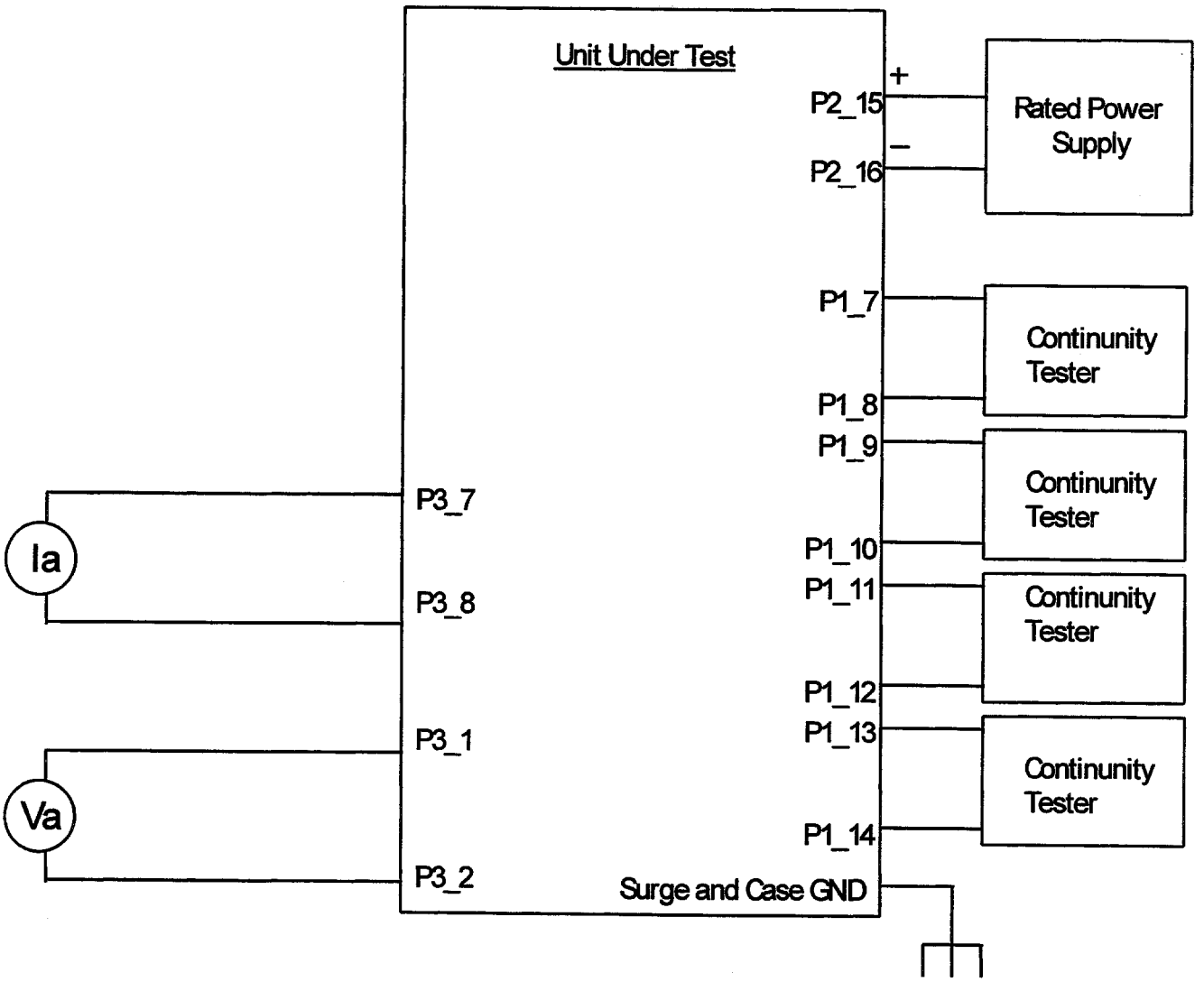


Figure 5-6 Programmable Output Test

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 two possible ways:

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

Communication Requirements

The DFP relay uses 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 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.

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.

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.

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 P3_3, P3_4 P3_5, P3_6	105% of 59 Setting 67 Vrms 67 Vrms	P1_7,P1_8	59t <t< 59t + .05s	Ready, A
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	95% of 59 Setting 67 Vrms 67 Vrms	P1_7,P1_8	————	Ready
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	105% of 27 Setting 67 Vrms 67 Vrms	P1_7,P1_8	————	Ready
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	95% of 27 Setting 67 Vrms 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 6-1. 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 6-1 Test Current Ranges

In = 5 Arms ZR Reach	I_T Arms Test	In = 1 Arms ZR Reach	I_T Arms 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)*(I_T)]*(COS((ϕI+30)-ϕZ))
for (ϕZ - 90) < ϕI < ϕZ
= [(2/1.732)*(ZR)*(I_T)]*(COS((ϕI+30)-ϕZ))
for ϕZ < ϕI < (ϕZ +90)

Definitions:

ZR = Relay reach (Impedance)

I_T = Faulted phase - test current

ϕZ = Angle of maximum reach

ϕI = 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	_____ ° (ϕZ)
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 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 P3_3, P3_4 P3_5, P3_6	93% of VNOM 93% of VNOM 67 Vrms	ϕZ -30°	P1_7,P1_8	Ready, A, B, INST
P3_1, P3_2 P3_3, P3_4 P3_5, P3_6	107% of VNOM 107% of VNOM 67 Vrms	ϕZ -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.

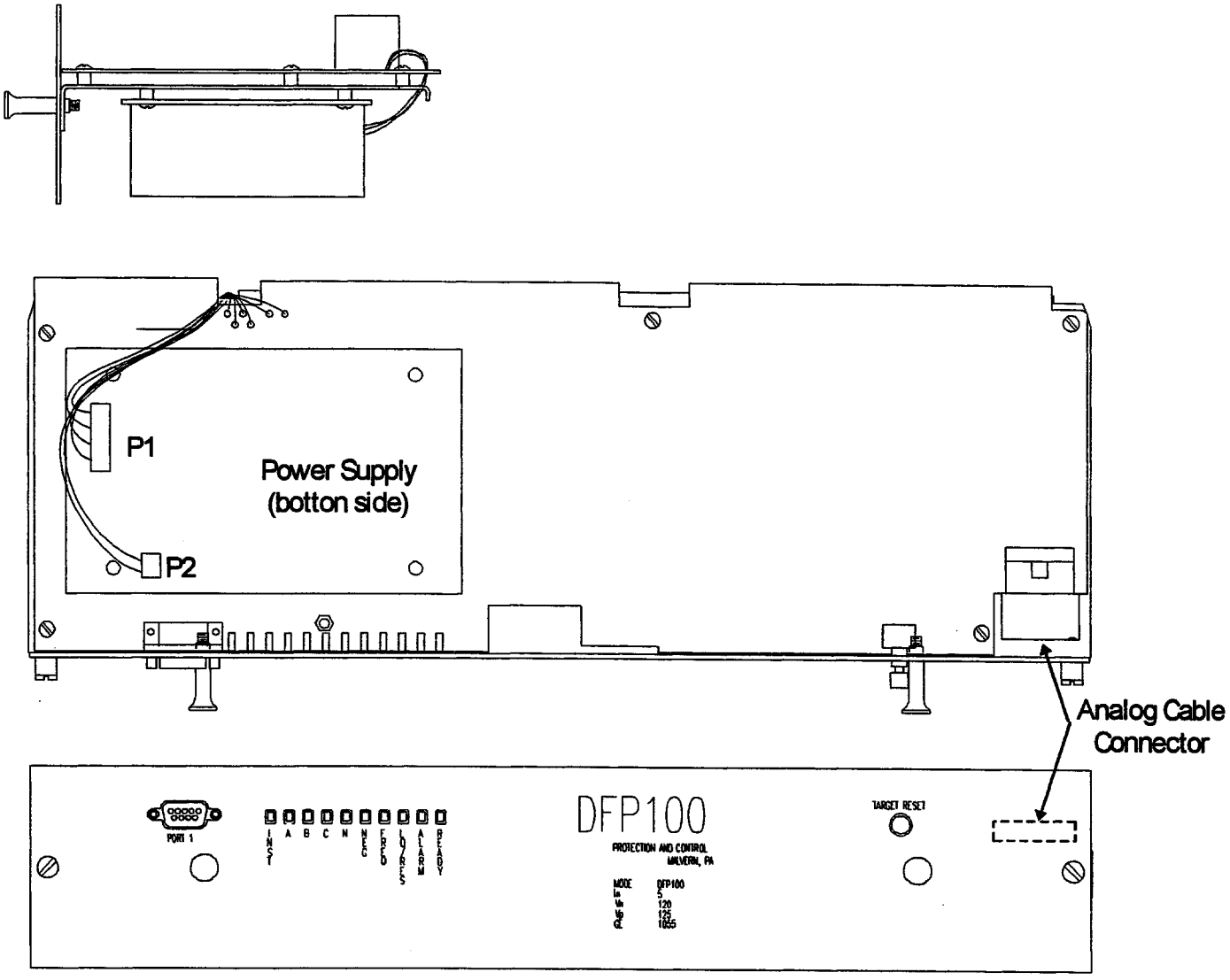


Figure 7-1 DFP100 Servicing

Chapter 8 -SPECIFICATIONS

RATINGS

Rated Frequency	60 Hertz
Rated Voltage	120 or 208 Volts AC
Rated Current	I_n = 5 Amperes
Control Voltage:	
110/250 VDC or AC	Range 88 to 300 VDC 88 to 264 VAC
Maximum Permissible Current:	
Continuos	3 x I_n
Three Seconds	50 x I_n
One Second	100 x 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 = 5A	@60 Hz 0.0058 ∠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

* 150/DC Close Contact will break 2.5A Inductive with L/R = 40ms

RECLOSER

Programmable Reclose Times	Programmable from 1 to 4

OSCILLOGRAPHY

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

COMMUNICATIONS

Protocols	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

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

DFP1 * * * * * * * * *	
0	RS232
1	Fiber Optic (Versatile Link Connector)
2	Fiber Optic (SMA906 Connector)
3	RS232 & RS485 **
4	MODBUS
A	1.0-12A Phase 1.0-12A GND (I_n =5A)
B	0.2-2.4A Phase 0.2-2.4A GND (I_n=1A)
C	1.0-12A Phase 0.2-2.4A GND (I_n = 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 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. The port utilization for the three options are shown in the following table.

	Port 1	Port 2	Port 3
RS485 and RS232	RS232	RS232	RS485

For GE Protocol models, a unique PC communications program designated **Mlink** is required. Mlink is supplied free of charge by GE.

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)

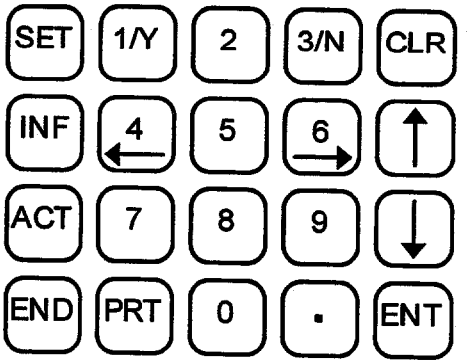


Figure 9-1 DFP100 MMI Keypad

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.

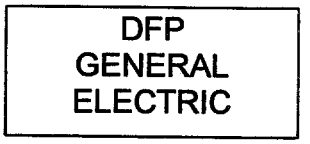
When the user is scrolling through a list of categories or items with the UP-ARROW key and gets to the last entity in the list, pressing the UP-ARROW key again will produce the first category or item on the display (wrap-around). Using the DOWN-ARROW key will likewise wrap around from the first category 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.



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
RELAYSTATUS	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	RELAYID	"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	OUT1.1 - OUT1.16	SEE TABLE 9-7
OUT2 OR INPUT 1	OUT2.1 - OUT2.16	SEE TABLE 9-7
OUT3 OR INPUT 1	OUT3.1 - OUT3.16	SEE TABLE 9-7
OUT4 OR INPUT 1	OUT4.1 - OUT4.16	SEE TABLE 9-7
PICKUP TIMER OUT1	TPU1	0-120.00
DROPOUT TIMER OUT1	TDO1	0-120.00
PICKUP TIMER OUT2	TPU2	0-120.00
DROPOUT TIMER OUT2	TDO2	0-120.00
PICKUP TIMER OUT3	TPU3	0-120.00
DROPOUT TIMER OUT3	TDO3	0-120.00
PICKUP TIMER OUT4	TPU4	0-120.00
DROPOUT TIMER OUT4	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
	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	0.2-2.4A
	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	DLYNS 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	DLYFREQ1	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	DLYFREQ1	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 (Optional)	Group 1-6	RCL GRP-1-6	
	Recloser Status	RCL STATUS	DIS (1)/ENA (3)
	Recloser Type	RCL TYPE	BY52(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 then 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.

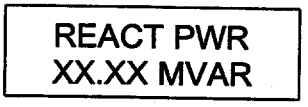
The following items are can be selected for display by pressing the UP or DOWN ARROW keys:

Model Number

Date & Time

Frequency

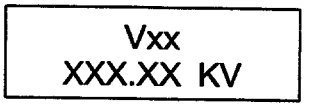
Reactive Power



Active Power

Negative Sequence Current

Phase to Phase voltage (Vab, Vbc, Vca)



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

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

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
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)

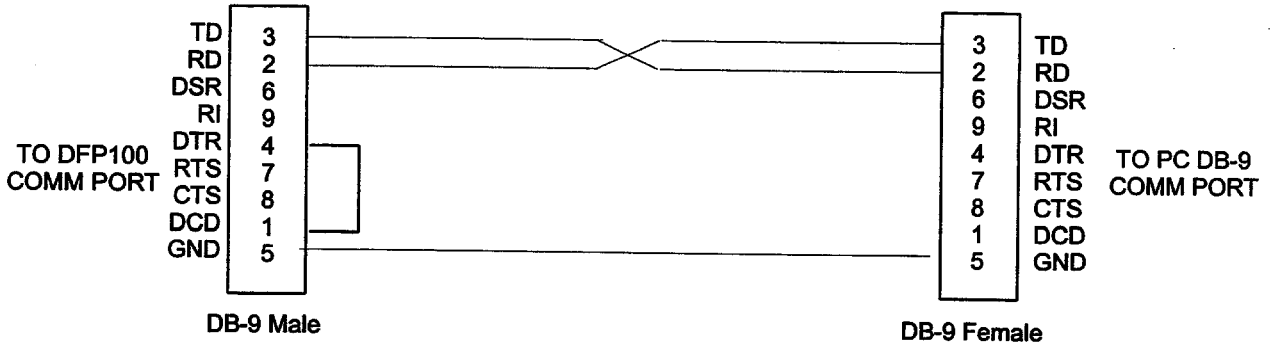


Figure 9-2 DFP100 Remote Communications To PC Directly

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

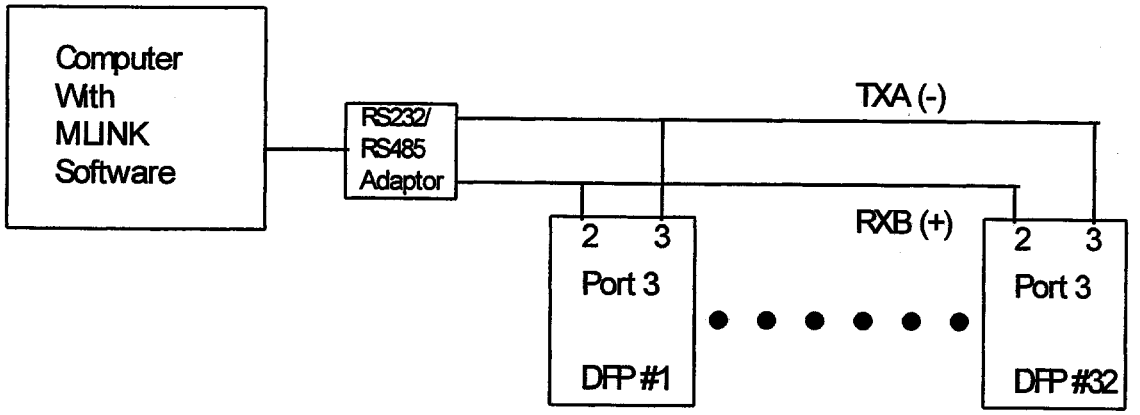
RS485 Output

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

RS485 System (2-wire)



RS485 System (4-wire)

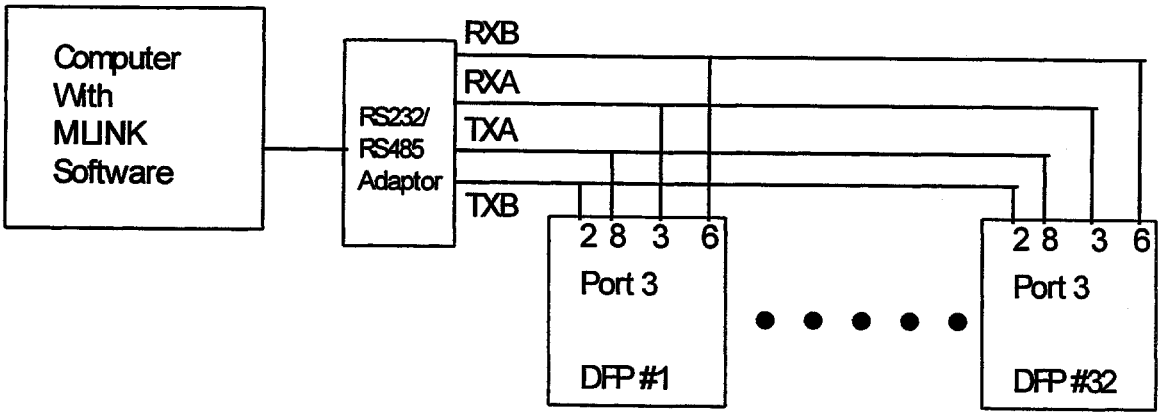


Figure 9-3 RS485 Interconnections

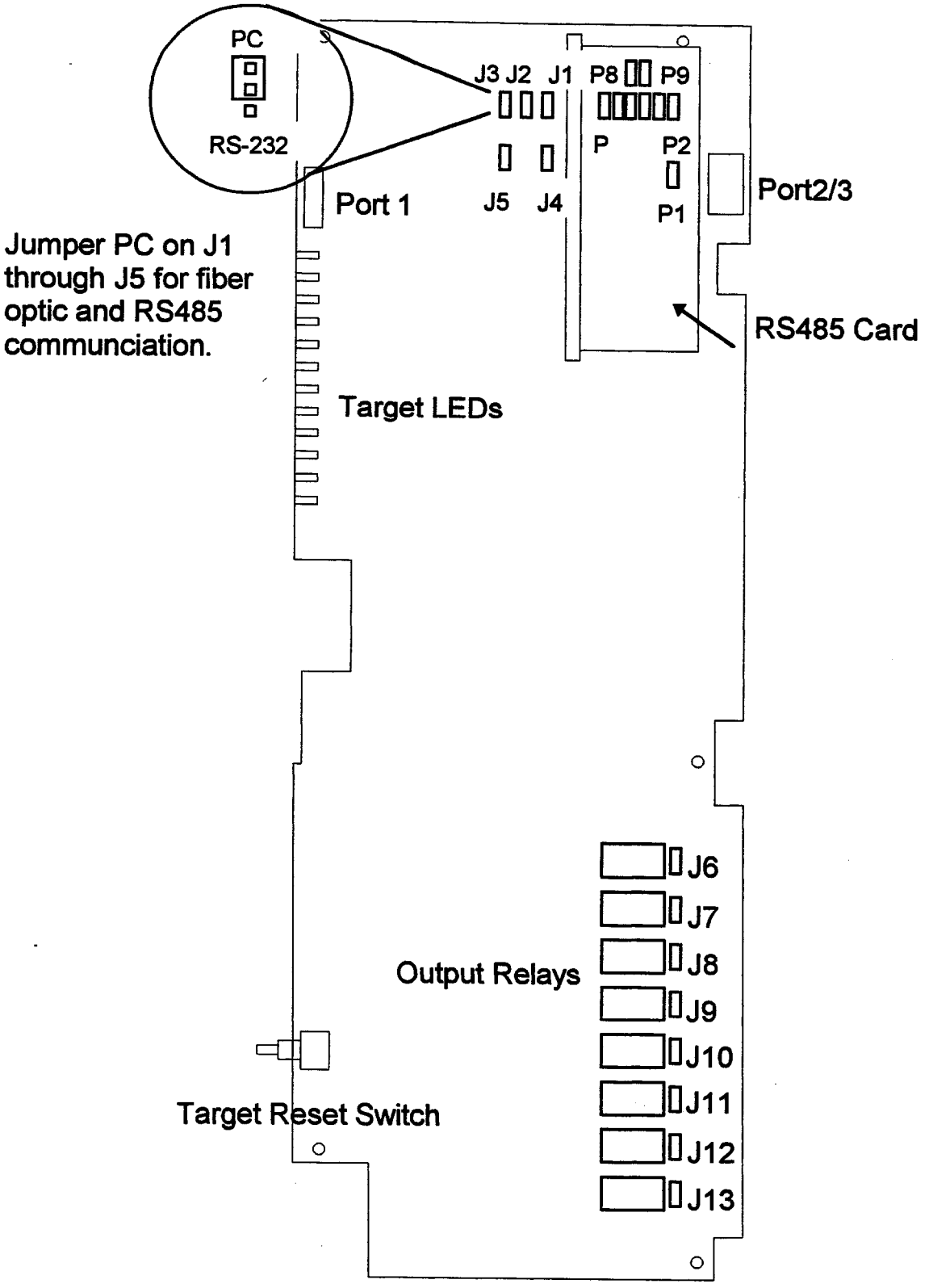


Figure 9-4 Optional RS485 Board Location

Chapter 10 -SOFTWARE

The following section gives the user a description of the hardware and software necessary for remote communication to the DFP100.

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>

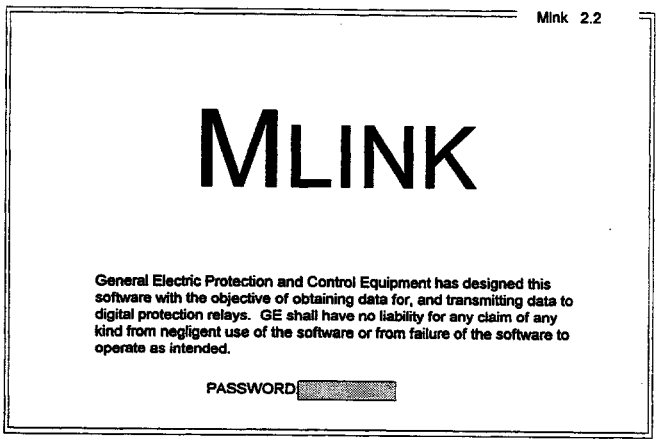
RUNNING MLINK

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.

PROGRAM OPERATION

The initial horizontal menu has the following items:

GENERAL

CONNECTION

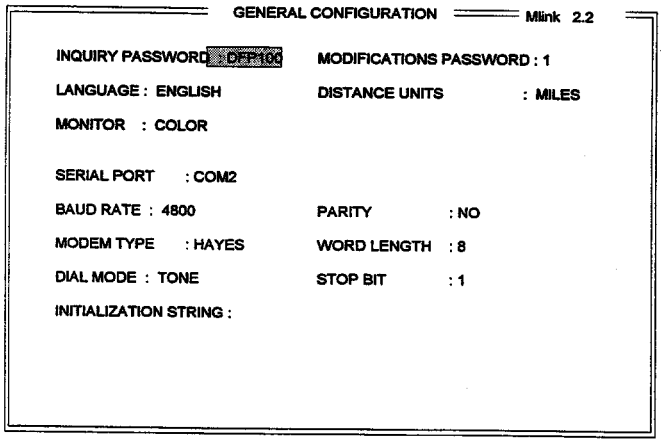
EXIT

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



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.

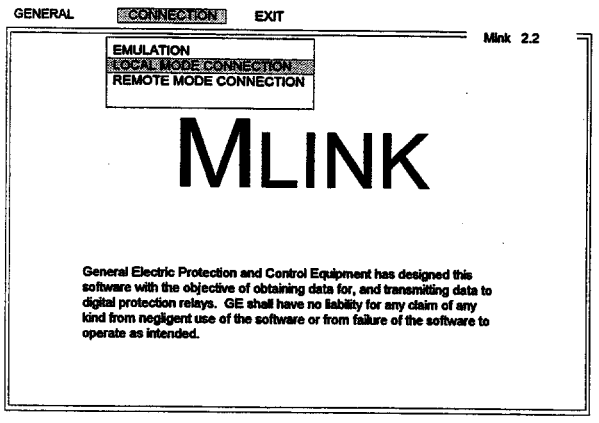
Connection

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

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**

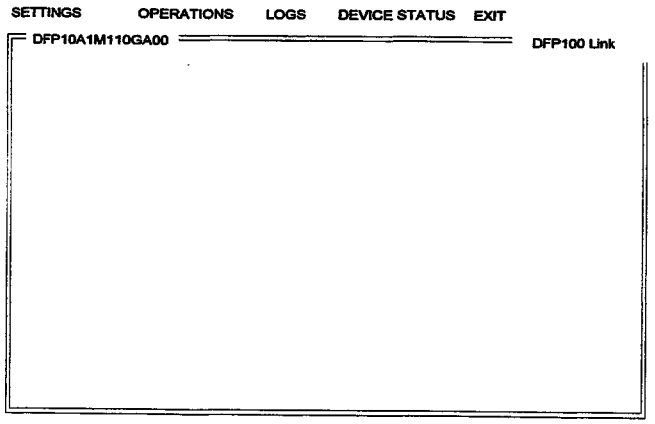
If your communication attempt is unsuccessful check the following areas:

- Physical Connection (See INTERFACE section)
- General configuration communication parameters.
- UNIT ID is incorrect.

Main Menu

The main horizontal menu has the following items:

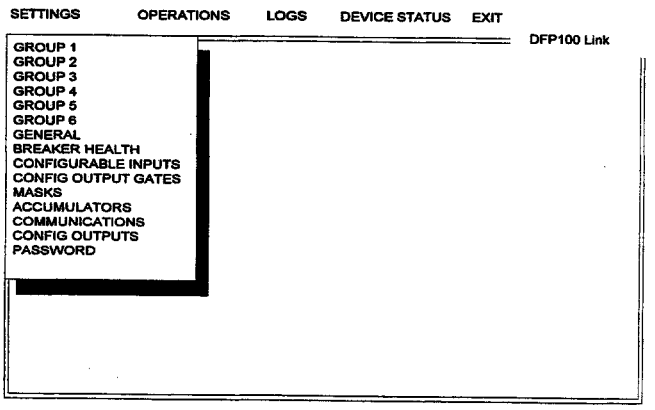
SETTINGS
OPERATIONS
LOGS
DEVICE STATUS
EXIT



SETTINGS:

SETTINGS has the following menu items:

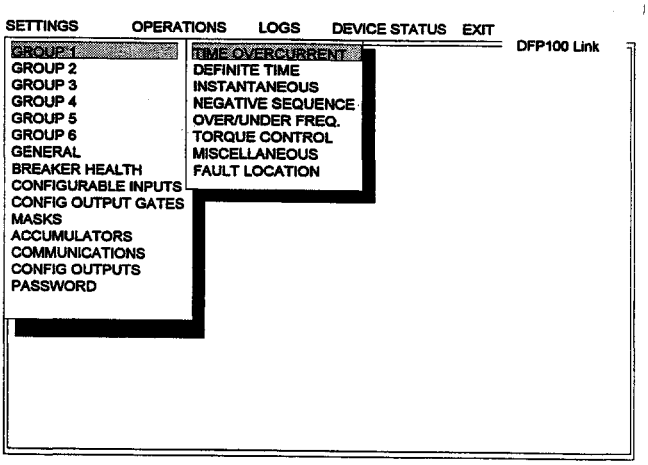
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
GROUP 6
GENERAL
CONFIGURABLE INPUTS
CONFIG OUTPUT GATES
MASKS
ACCUMULATORS
COMMUNICATIONS
CONFIG OUTPUTS
PASSWORDS



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:

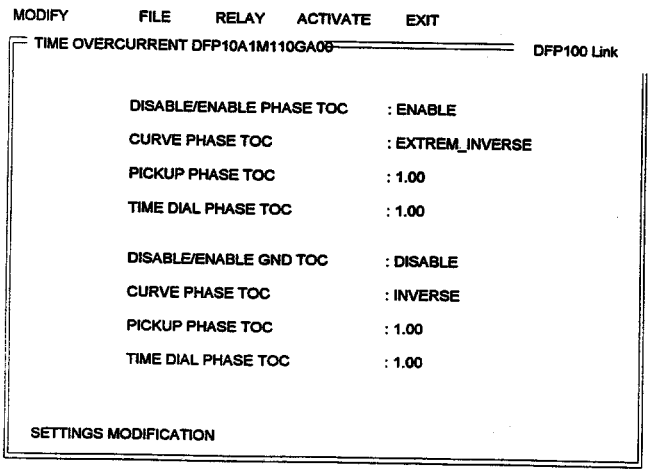
TIME OVERCURRENT
DEFINITE TIME
INSTANTANEOUS
NEGATIVE SEQUENCE
OVER/UNDER FREQ.
TORQUE CONTROL
RECLOSER



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:



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

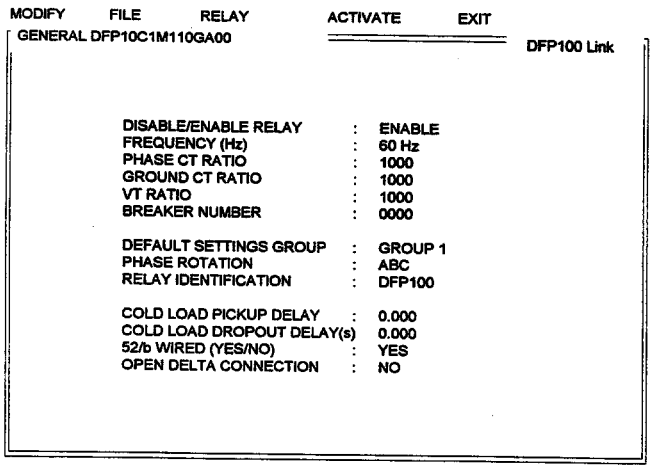
COMMUNICATIONS

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.

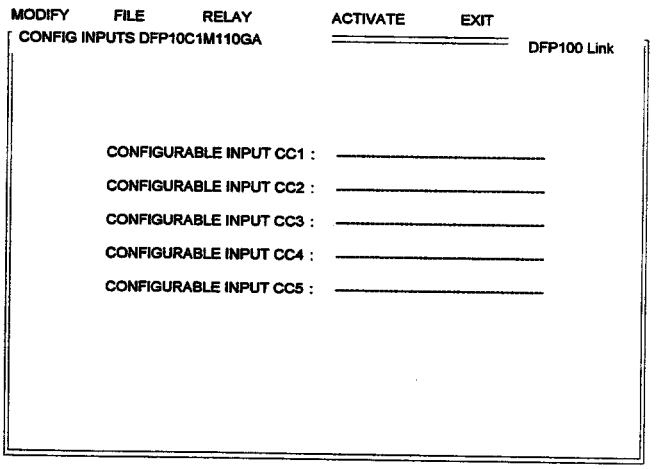


BREAKER HEALTH

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.

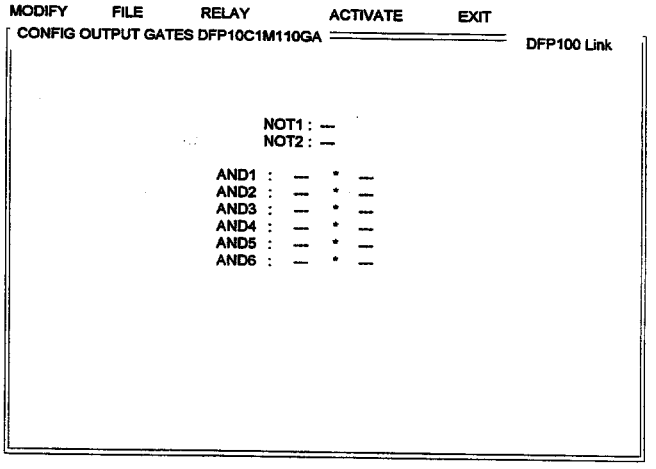
CONFIGURABLE INPUTS:

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.



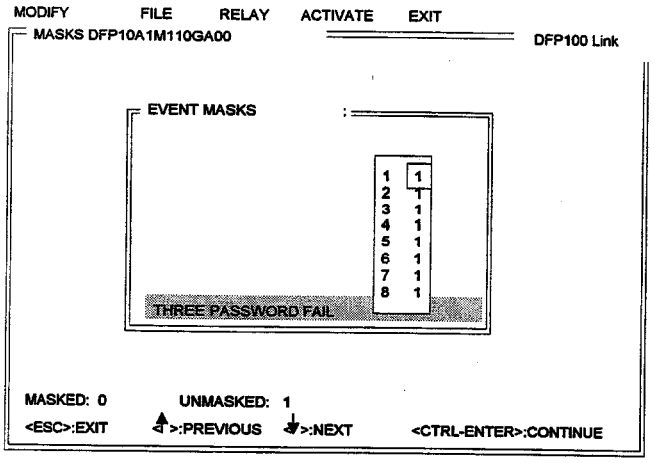
CONFIG OUTPUT GATES:

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.



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:

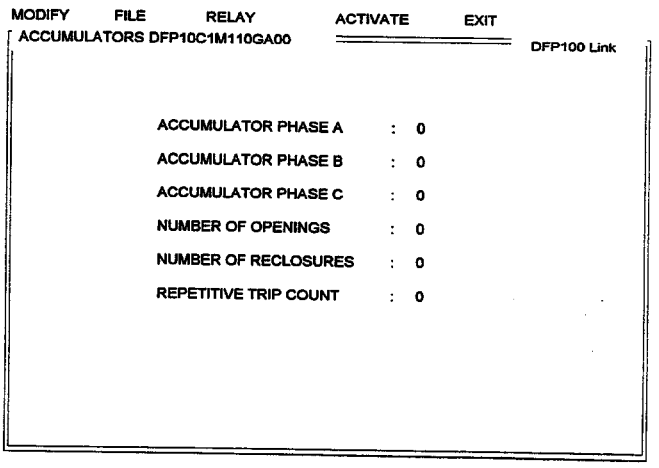


This window displays the first 8 bits of the EVENT MASK. The first bit which is highlighted is the THREE PASSWORD FAIL event. If the "1" in the first location where changed to a "0" this would mask-out the THREE PASSWORD FAIL event, in other words, no event would be logged for a THREE PASSWORD FAIL.

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.

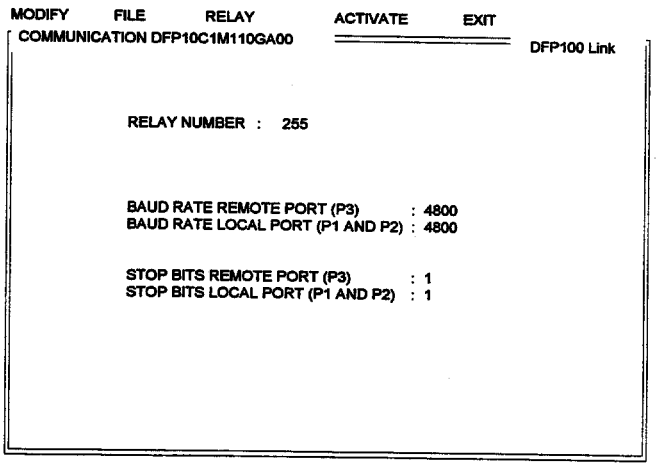
ACCUMULATORS:

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.



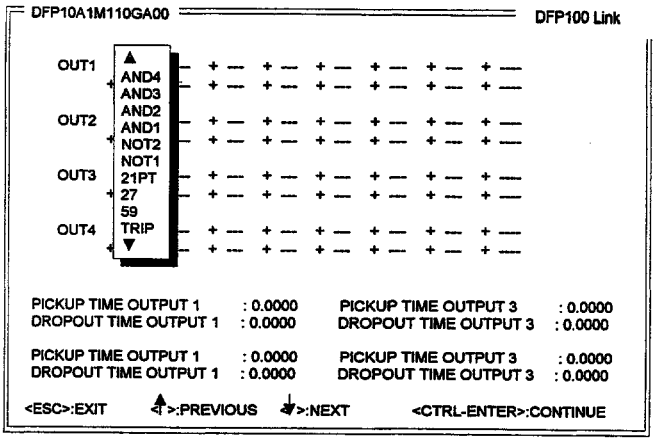
COMMUNICATIONS:

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



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.



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

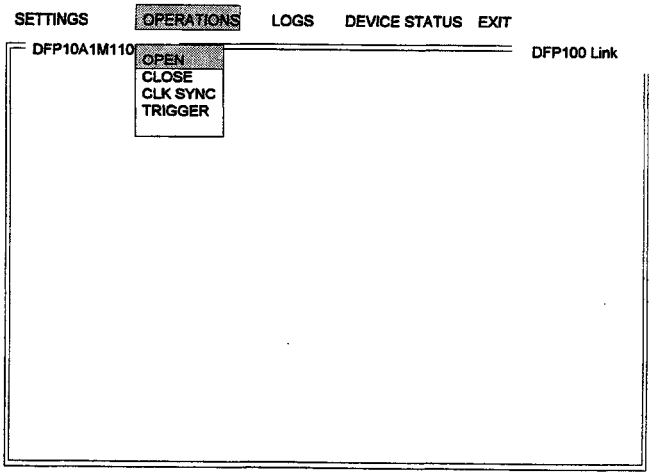
CLOSE

BLOCK (recloser option only)

UNBLOCK (recloser option only)

CLK SYNC.

TRIGGER



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)

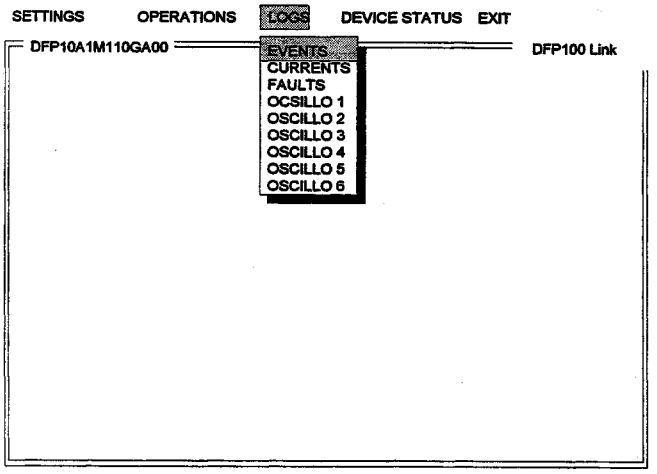
OSCILLO 2 (oscillography option only)

OSCILLO 3 (oscillography option only)

OSCILLO 4 (oscillography option only)

OSCILLO 5 (oscillography option only)

OSCILLO 6 (oscillography option only)



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.

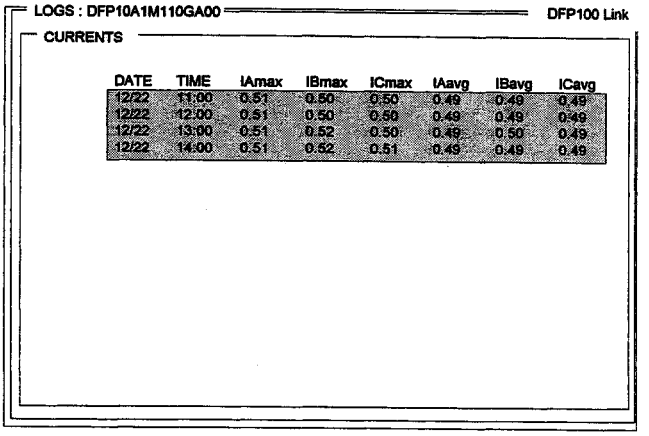
To delete events you must first load the events from the relay, once this is complete select DELETE from the RELAY menu.

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.

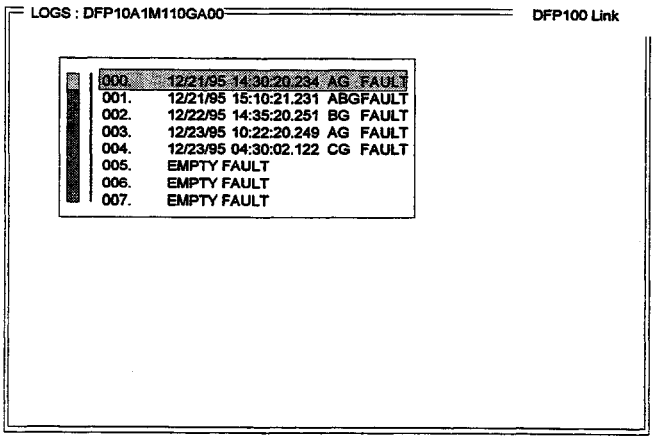


To save demand data to a file you must first load the data from your relay. Once this is complete select SAVE from the FILE menu. You will then enter your file name for this data.

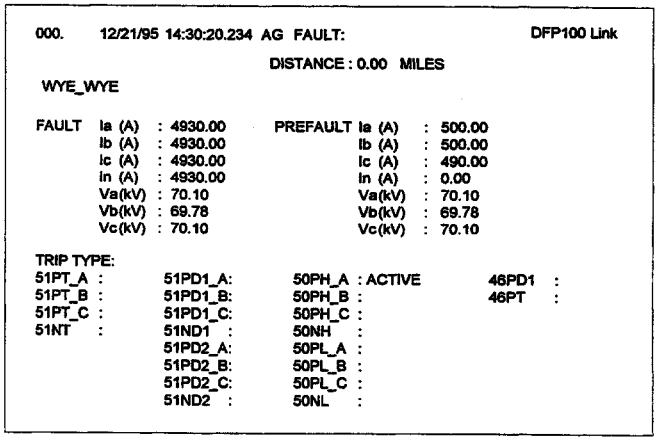
To retrieve demand data from a file select RETRIEVE from the FILE menu. A list of files will appear, after selecting the appropriate file the data will be shown on the screen.

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.



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



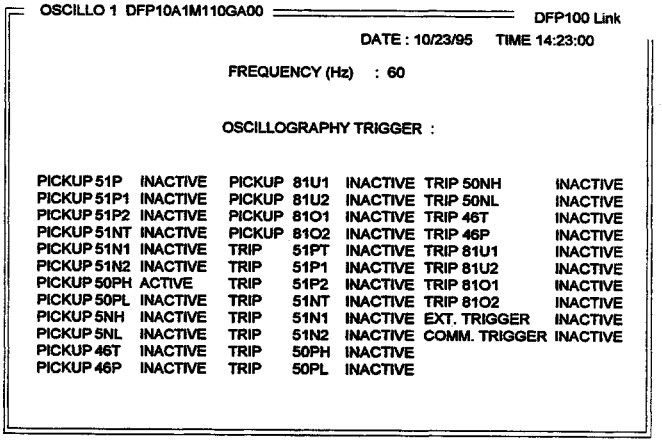
To delete faults you must first load the fault reports from the relay, once this is complete select DELETE from the RELAY menu.

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.



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.

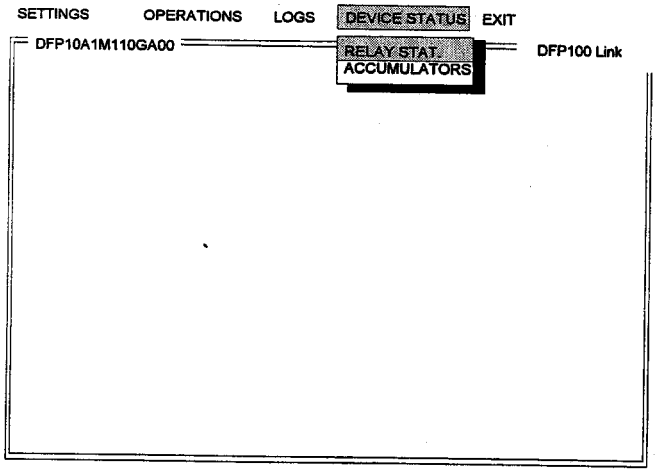
To retrieve an Oscillography capture from a file select RETRIEVE from the FILE menu. A list of files will appear, after selecting the appropriate file the capture will be shown on the screen.

DEVICE STATUS:

DEVICE STATUS has the following menu items:-

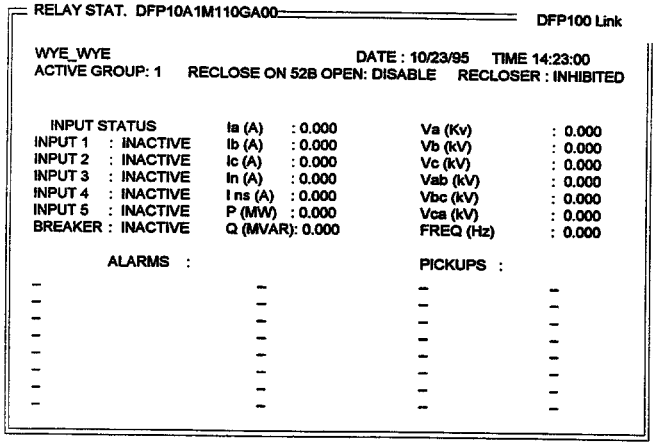
RELAY STATUS

ACCUMULATORS



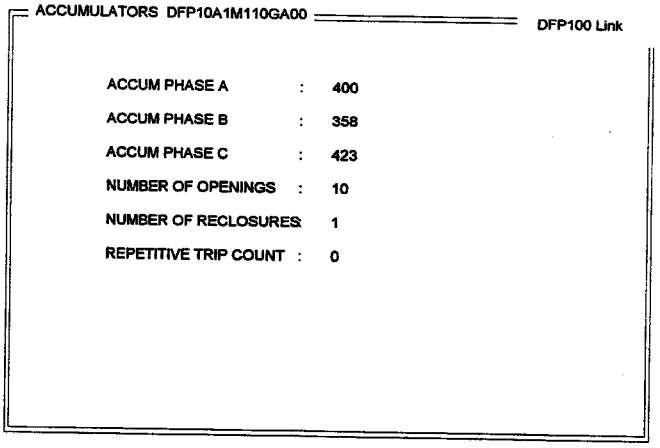
RELAY STATUS:

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



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.



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-OSC program. This file can be viewed using the GE-OSC software. Please refer to GEK-105596 for further information.

Table 10-11 Oscillography Data Format

No.	NAME	SCALE
1	CHANNEL:	Sample Number
2.	CHANNEL:	Time in
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 10-1 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	