DFP200

DIGITAL FEEDER PROTECTION

WITH HIGH IMPEDANCE FUNCTION

Instruction Manual

Manual P/N: GEK-105559B

Manufactured under an
IS09002 Registered System

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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.

Chapter 1
INTRODUCTION

GETTING STARTED

CAUTION: The DFP200 contains electronic components that could be damaged by electrostatic discharge. The main source of electrostatic discharge currents is the human body, especially where there are conditions of low humidity, carpeted floors, and insulated shoes. Where these conditions exist, exercise care when removing and handling the DFP200's internal components. The persons handling the components should discharge their body charge by touching some surface at ground potential, or preferably wear a wrist strap, before touching any of the components.

Unpack and examine the relay according to the instructions in the HARDWARE DESCRIPTION (Chapter 4) of this manual. This chapter contains detailed instructions for configuring several jumpers in the relay to meet the intended application.

The DFP200 supports remote communications. The DFP-LINK USERS GUIDE and ASCII COMMUNICATIONS chapters, explain how to communicate with the relay through DFP-Link or ASCII communications software respectively. One diskette in the plastic pocket at the back of this manual contains the DFP-Link software, and the installation instructions can be found in the DFP-LINK USERS GUIDE chapter.

Also included in the Packet is the Xpression Builder software diskette used for the design of configurable logic expressions to download to the relay. Refer to the Xpression Builder chapter for a description of this software.

Mounting Considerations

Either horizontal or vertical mounting of the DFP200 is possible. The faceplate is reversible, with printing on each side, to accommodate either position.

As shipped from the factory, the DFP200 is configured for *horizontal mounting*, with two plastic studs inserted into the two Keypad/Display Module mounting holes (see Figure 1-1). To mount the optional Keypad/Display Module to the front of the faceplate, remove the two plastic studs with a standard screwdriver blade and replace them with the provided shoulder screws.

For *vertical mounting*, the faceplate should be reversed. Remove the faceplate by unscrewing the two knurled screws in the extreme sides of the faceplate. The front DB-9 connector has two hex nuts that secure the faceplate to the connector. Remove these with a nut driver. Next, unscrew the two black pull-handles to free the faceplate from the Shelf Assembly in the unit. Remove and reverse the faceplate, making sure to align each of the LEDs on the front with its respective window, and check that the LEDs come through the windows. Re-install the fasteners by reversing the procedure above. It is not necessary to remove the Shelf Assembly from the unit to reconfigure the faceplate.

Mount the DFP200 on a vertical surface that provides access to both the front and rear panels of the unit. Side access is not required. The outline and panel drilling dimensions are provided in the HARDWARE DESCRIPTION chapter.

Voltage Sensing, Current Sensing, Control Power and Auxiliary Connections

The AC voltages and currents are wired to the left side of the lower 24 position terminal block located on the rear of the unit, as shown in Figure 1-2. Control power is connected on the extreme right of the connector, with polarity as

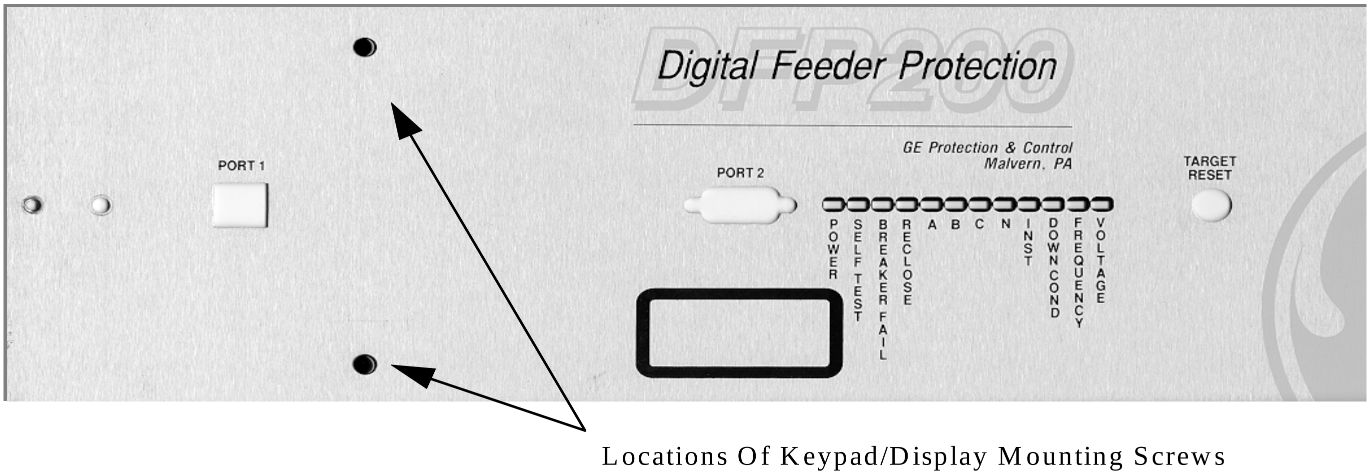


Figure 1-1 Case – Front View

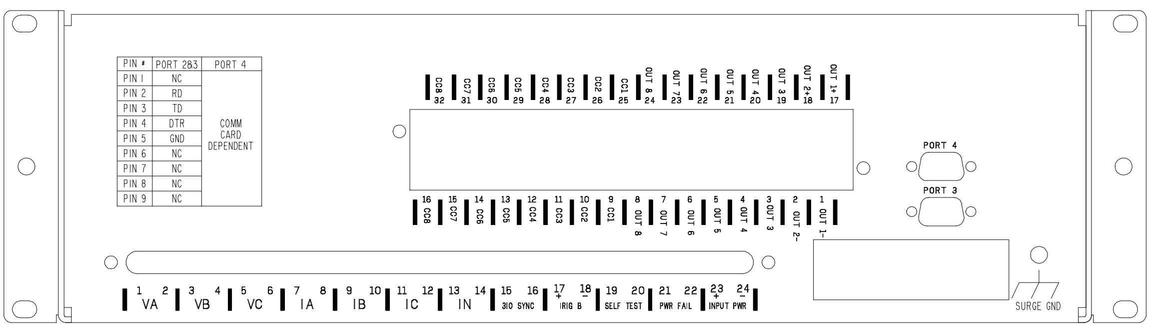


Figure 1-2 Case – Rear View

marked when DC is used. The rated AC and/or DC voltage value for the relay is found on the nameplate located on the front panel of the relay. The connections for the Self Test Alarm, the Power Failure Alarm and IRIG-B are also found on this terminal strip. Connections are made according to the external connection diagram, refer to Figure 2-2 in the PRODUCT DESCRIPTION chapter.

Digital Input and Output Connections

A second 32 position terminal block located on the rear of the unit provides connection points for the eight digital inputs and eight output contacts as shown in Figure 1-2.

Communications Connections

DB9 ports on the front and rear of the unit provide RS485 and RS232 communications connections, as illustrated in Figures 1-1 and 1-2.

These ports on the front and back of the DFP200 are used to connect a PC or modem to the DFP200. The PC may be used to configure the DFP200's settings, download time overcurrent curves or configurable logic expressions, extract oscillography data, or obtain relay status.

Connection of the DFP200 to a permanent serial line, such as may be the case in an automated substation, is best achieved through the rear DB-9 ports. The lower port (Port 3) is an RS-232 port. The upper port (Port 4) assumes the communications protocol of the communications card installed in the unit. The Model Number, located on the label affixed to the front of the faceplate, states the protocol used for Port 4. Port 4 is an RS-485 port when the tenth character of the Model Number is "B." Models with a "A" in the tenth position do not support communication through Port 4.

Keypad/Display Module Connection

A six wire modular jack is located on the front of the unit labeled Port 1. This port is used to connect the optional Keypad/Display Module. The Keypad/Display Module can be operated, un-mounted or mounted, on shoulder screws located on the front of the faceplate.

Default Passwords

The DFP200's factory-default passwords are listed below, in Table 1-1.

Table 1-1 Default Passwords

Privilege Level	Keypad/ Display	DFP-Link	ASCII
View	none	DFPD$	DFPD$
Control	.456	DFPC$	DFPC$
Setting	.123	DFPS$	DFPS$
Master	.789	DFPM$	DFPM$

These factory-default passwords contain invalid characters, '.' and '$', which prevent access to the corresponding privilege level.

NOTE: The user must first log into the DFP200 with a factory-default password and then change the password using only valid characters before being granted access to the corresponding privilege level.

Refer to the LOCAL INTERFACES, DFP-LINK USERS GUIDE, and ASCII COMMUNICATIONS chapters for a description of the procedure to change the passwords.

Chapter 2
PRODUCT DESCRIPTION

GENERAL

The DFP200 is an advanced microprocessor-based digital protection, control, metering, and monitoring system. It uses waveform sampling (32 samples/cycle) of the current and voltage inputs together with appropriate algorithms to provide distribution and industrial feeder protection and monitoring. More generally, the DFP200 can be applied wherever overcurrent, over/under voltage, over/under frequency, reclosing, general breaker control, metering, or monitoring is desired.

Standard features include three phase and ground instantaneous and time overcurrent functions, metering, demand storage, sequence of event reporting, oscillography, breaker health monitoring, breaker failure logic, a recloser, and user-configurable logic. A ‘full protection’ option adds negative-sequence instantaneous and time overcurrent functions, a phase directional function, a negative-sequence directional function, under/over voltage functions, under/over frequency functions, and fault location. Other options exist to include a RS-485 port, a zero-sequence directional function, increased demand storage, power quality, sync check, and high-impedance fault protection.

For the purpose of understanding the operation and performance of the DFP200 for high-impedance faults, it is necessary to define the high-impedance faults targeted by this device. A high-impedance fault is characterized by having an impedance sufficiently high that it is not detected by conventional overcurrent protection. A high-impedance, downed conductor fault is a high-impedance fault for which the primary conductor is no longer intact on pole top insulators, but instead is broken and in contact with earth or a grounded object. An arcing fault is any high-impedance fault which exhibits arcing.

Combinations of these types are possible. An example is an arcing, high-impedance, downed conductor fault. The intent of the DFP200 is to detect high-impedance faults which arc, and to differentiate downed conductors from intact conductors. Electrical signatures are used to identify the presence of arcing. If the arcing begins with a loss of load or with an overcurrent disturbance (as might occur when a conductor falls across another phase or a neutral conductor and then falls to the ground), the DFP200 assumes that a conductor is down or broken. If neither of these conditions initiates the arcing, the DFP200 assumes that a conductor is still intact. In the interest of system security, the DFP200 considers loss of load or an overcurrent disturbance to indicate a downed conductor if and only if one of these precedes the arcing, and not if one of these occurs after the initiation of arcing. The reason is that, following a recloser operation, power-system load levels will often change sufficiently such that the DFP200 cannot distinguish between a recloser operation and loss of load due to a broken conductor.

The DFP200 includes a capability for setting the sensitivity of the high-impedance fault detection. By changing this setting, a user may choose greater sensitivity, which would tend to increase the percentage of faults detected but decrease the security. Likewise, a lower sensitivity may be chosen, which would tend to decrease the percentage of faults detected while providing enhanced security. Time to detection is also affected.

It is difficult to derive a definitive, statistical performance figure of merit for the DFP200’s high-impedance fault detection because of the wide variety of ground and circuit conditions which may be encountered. However, based upon documented field experience and assumptions of circuit environmental conditions, it can be expected that approximately 80% of all arcing, high-impedance faults will be detected by the DFP200, assuming that the ARCING SENSITIVITY setting is at 5 and the remaining high-impedance settings are at their default values.

The DFP200 was designed to be flexible in application, and as a result, there are a number of features available which are intended to support unforeseen situations and future growth. The most prominent examples of this philosophy are:

- Program memory which may be altered without hardware modification or EPROM change, allowing software upgrades, algorithm improvements, and software to meet special customer needs to be downloaded through communications ports on the relay.
- An advanced configurable logic approach is implemented using Xpression Builder, a Windows-based PC program. This approach allows the user to program output contacts using digital inputs, internally generated protection flags, a variety of Boolean gates, timers, and latches. This flexible approach leads to the ability to create unique breaker failure schemes, relay coordination logic, and other unique input/output applications.
- Interchangeable communication cards can be snapped into place on a single board in the relay, and allow the relay to support additional communications protocols via port 4. As the communications requirements of the utility lead to more capable communications protocols, the relay can be updated to remain compatible with the addition of a new communication card.
- The hardware computer bus structure allows for the addition of hardware required to achieve new functionality which cannot be addressed by software upgrades alone.

The DFP200 is packaged in a compact 19 inch rack-mount drawout case. A reversible faceplate allows for either horizontal or vertical mounting, and the 7 inch depth makes it easy to mount in switchgear. Figure 2-1 shows a DFP200 mounted in a rack.

Figure 2-1 DFP200 relay, rack-mounted

User interaction is supported at three levels: LEDs on the front of the device provide status at a glance, an optional Keypad/Display Module provides remote control and viewing of data, and three serial ports permit a PC connection (RS232 or RS485).

A model selection guide is contained in the SPECIFICATIONS chapter. A typical external connection diagram (elementary) is shown in Figure 2-2.

APPLICATION

The DFP200 can be used to solve a variety of application requirements. Some 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 feeder relays to the bus relay)
- overcurrent backup protection for transformers
- directional or non-directional overcurrent backup protection for subtransmission or transmission lines
- detection of high impedance faults that do not produce enough fault current to operate conventional overcurrent functions

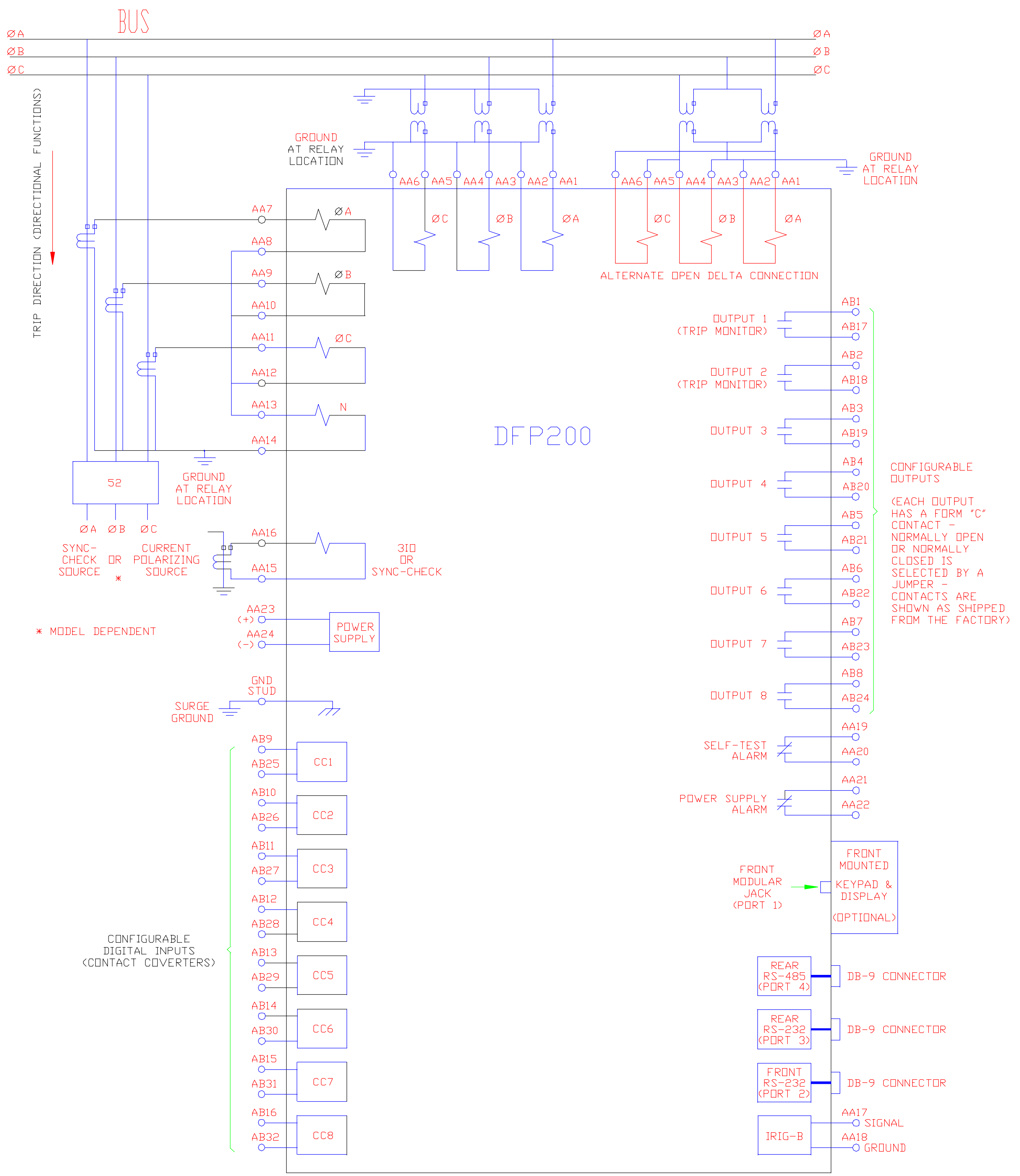


Figure 2-2 DFP200 External Connections

FEATURES

Multiple Setting Groups

Eight separate groups of HI-Z and PROTECTION settings are stored in the DFP200's non-volatile memory, with only one group active at a given time. The currently active group number is determined by setting 0113, SETFILE. This setting dictates which is the active group or that the active group is determined by the state of external contacts. If SETFILE = EXTERNAL, then 1, 2, or 3 digital inputs determine the active settings group. Refer to Table 3-2.

Configurable Digital Inputs and Outputs

The eight Digital Inputs and eight Digital Outputs of the DFP200 are not "hardwired" to any function within the relay. The effect of each input and driver for each output is determined by a software expression which is a part of each setting group. This expression is built by a Windows-based software application called Xpression Builder.

Xpression Builder allows the interconnection of any digital input and many internal software protection "flags" (true/false conditions of a given protection function) by means of Boolean operators, Latches, Timers and Counters, to drive an output. In addition, each digital input can be named by the user such that its function is correctly represented. For example, if Digital Input 1 is connected to the 52b contact of the circuit breaker, Input 1 can be named "52/b". An example of a logic is shown in Figure 2-3.

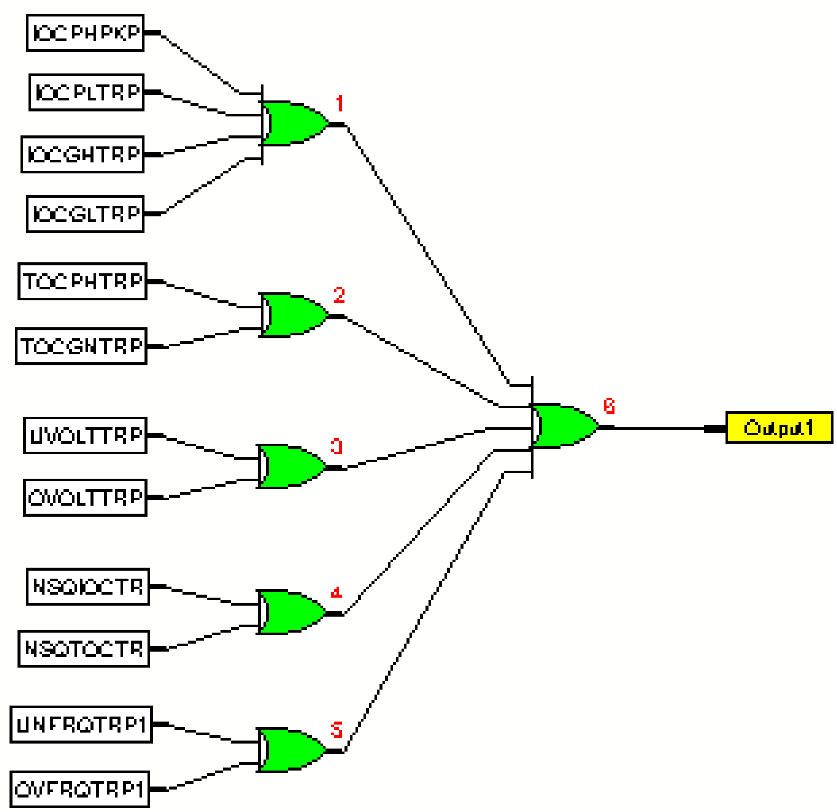


Figure 2-3 Xpression Builder logic diagram

For each settings group there can be a different Xpression Builder Logic. In most cases, it is expected that the same expression will be used in most of the settings groups, but the flexibility exists to address a multitude of applications.

The DFP200 comes shipped with default configurable logic expressions built into each setting group. These expressions include:

1. Logical OR of all trip protection flags
2. Breaker failure detection logic

These are fully described in the CONFIGURABLE LOGIC DESIGN chapter.

Breaker Control and Monitoring

Breaker Control

Remote breaker tripping and closing through the DFP200 is enabled or disabled by a hardware jumper located on the Analog-Input/Output circuit board (see J17 in Figure 4-2 of Chapter 4, HARDWARE DESCRIPTION). As shipped from the factory, this jumper is physically present, and remote breaker control is disabled. To enable remote breaker control, the jumper must be removed.

Breaker Health Monitor

The DFP200 calculates and stores the cumulative $I^X T$ value, where $1 \le x \le 2$ (in 0.01 steps), for each of three phases when the associated breaker opens. The value of x is determined by the setting, 0306 BHEXP. The current value is the calculated average RMS value of current prior to opening of the breaker. The time T is a setting, BRKRARCTME, 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, BHTHR. If 80% of this threshold setting is exceeded, a breaker health software flag is issued (can be wired to an output by configurable logic). 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 $I^X T$. Generally, the interrupting duty threshold can be obtained from the breaker manufacturer. A running count of the number of breaker openings is also maintained.

Breaker opening is determined by detecting that the RMS current for each phase has fallen below 0.1 amps secondary <u>and</u> that a 52/b auxiliary contact has passed through an open-to-closed transition during a window from the previous 2 seconds through the next 4 cycles.

NOTE: If a digital input has not been configured for "52/b CONTACT", then Breaker Health Monitoring is effectively out of service.

If a breaker is connected to the DFP200 that has had prior use, the DFP200 accepts initial cumulative values for each phase and an initial value for the total number of trips. This initialization is accomplished through a serial port. The breaker health values can also be reset through a serial port upon completion of breaker maintenance. If the DFP200 is configured to allow Keypad/Display Module resets, a breaker health reset can also be accomplished through the Keypad/Display Module.

Trip Circuit Monitors

Within the DFP200, the DC battery voltage across the OUTPUT 1 and the OUTPUT 2 contacts are monitored every second to indicate if the external control or trip circuit is intact. This function is enabled whenever 52/b STATUS is selected for a Digital Input. Once 52/b STATUS is selected the following table shows the output for the Trip Circuit Monitor:

Table 2-1 Trip Circuit Monitor Output

Breaker Status (As indicated by 52/b)	Trip Issued	Voltage Present at Output 1	TCM for OUTPUT1
X	YES	Yes	1
X	YES	No	0
Open	NO	X	0
Closed	NO	No	1
Closed	NO	Yes	0

X = Don't care 0 = No Alarm 1 = Alarm

If 52/b STATUS is not selected the DFP200 will not set any TCM alarms. If the 52/b STATUS is removed while a TCM alarm is on the alarm will be cleared. All TCM alarms consist of an event being logged (Trip Circuit #1 Monitor Alarm On) and a flag being set (OUT1FAIL). When the TCM alarm is cleared another event is logged (Trip Circuit #1 Monitor Alarm Off) and its flag is cleared (OUT1FAIL).

In addition, a current sensor is wired in series with the OUTPUT 1 and OUTPUT 2 contacts to detect dc current flow when the associated contact closes. If one of these two contacts do close and the current sensor measures 100 milliamperes or more of dc current, then a "Trip Circuit #1(2) Energized" event message is generated.

Breaker Failure

Breaker Failure Configurable Logic is included as a default expression in the DFP200. This is a simple expression, in which any breaker trip is logically ANDed with a current level detector. The output of this logic is fed to a timer. If this timer produces an output, a flag is raised which can be connected to an output contact. This flag also activates the Breaker Fail LED on the front panel. The logic diagram for this function is provided in the CONFIGURABLE LOGIC chapter. This can be altered by the user if desired.

Phase Rotation Selection

The DFP200 will operate properly for phase rotation A-B-C or A-C-B while maintaining the same external VT and CT wiring to the relay. Phase rotation is selected via setting 0114, PHASDESG.

Open-Delta/Wye-Wye VT Connections

The DFP200 will operate properly for external VT connections that are connected in the Open-Delta or Wye-Wye configuration. These connections are shown in Figure 2-2. The correct VT connection is selected via setting 0115, PHASPOTL.

Power-Up Self Tests

The most comprehensive self testing of the DFP200 is performed during a power-up. Since the DFP200 is not performing any protection or monitoring activities at that time, tests that would be disruptive to runtime processing may be performed. The power-on self-tests attempt to verify the DFP200's hardware components (EPROM, local RAM, interrupt controller, timer chip, serial ports, DMA channels, nonvolatile memory, analog and digital I/O circuitry, Keypad/Display Module hardware, etc.).

In most cases, if any critical self-test failure is detected, the DFP200 will not continue its power-up, nor will it cause a reset. An attempt will be made to store the DFP200 status and to initialize the Keypad/Display Module and remote communications hardware/software in a reduced operation mode. At this point, the DFP200 self-test alarm contact is energized. No protection functions are enabled in this mode.

If no failures are detected, the DFP200 completes initialization of its hardware and software. This includes reading information from the serial nonvolatile RAM in the magnetics module, stored during the manufacturing process, to determine the calibration coefficients of the magnetics in the unit. The power-up procedure is completed in about one minute. During the course of this power-up, a power-up self-test of the display segments and LEDs is performed for user verification. A pause is incorporated during this cycle to facilitate reprogramming the relay, and the Keypad/Display Module presents the message "DOWNLOAD MODE". This is intended to support future software upgrades. As the power-on diagnostics are run and the system's hardware and software are initialized, first the message "STARTING APPLICATION CODE", then the message "INITIALIZING" appears on the top line of the Keypad/Display Module. When all DFP200 initialization is completed satisfactorily, the message "GE POWER MANAGEMENT" appears on the top line of the display followed by "DFP200", "PRESS INF, SET, ACT" and "FOR MENUS" on the next three lines. The unit is then ready for operation. The DFP200 then begins acquiring and processing data.

Run-Time Self-Tests

The DFP200's run-time self-test diagnostics are executed on a regular basis during online operation. These self-tests are intended to diagnose possible real-time failures due to component aging, premature component failure, etc. Tests that are run verify DFP200 memory cell integrity and bus connections without disturbing ongoing algorithmic and communication processes.

If any runtime self-test fails, the test is repeated. To declare a component "failed", the test of that component must fail three consecutive times. In most cases, runtime self-test failures will force a reset in an attempt to get the failed component working again. As an extension of the runtime diagnostic self-tests, the user may initiate a visual-response test of the Keypad/Display Module at any time. For a detailed description of this Keypad/Display Module self-test, refer to Action Menu Options in the LOCAL INTERFACES chapter.

The DFP200 keeps a running count of warm boots that result from the detection of a runtime self-test failure. Only four resets are allowed in a one-hour period. On the fourth reset, the DFP200 does not perform initialization, but instead follows the same procedure as previously described when a critical self-test failure is detected on power-up.

Reporting

Configurable Time Interval Demand Reporting

Demand profiles are maintained per phase in the DFP200 for the currents, watts, VARs, 3-phase VA, and power factor, as well as for the minimum, maximum, and average total harmonic distortion (THD) and minimum 2-second average RMS voltages in models that include power quality monitoring. The demand profiles are averages that are calculated based on an interval of time known as the demand period, which is configurable from 1 to 60 minutes, in one minute steps. The model of the DFP200 determines whether the unit is capable of storing either 192 or 3360 separate entries of data. The range in days of storage of demand data is given in Table 2-2. As an example, for a relay with "35 day demand data," a sampling period of 15 minutes yields a capability for 35 days of stored demand data.

Table 2-2 Demand Reporting

Demand Reporting Option	Lower Limit in days (Greatest number of samples per day)	Upper limit in days (Lowest number of samples per day)
Basic (192 samples)	{192 samples / (1 sample/ 1 min)} / 1440 min/day = 0.13 days	{192 samples / (1 sample/ 60 min)} / 1440 min/day = 8 days
35 day demand memory (3360 samples)	{3360 samples / (1 sample/ 1 min)} / 1440 min/day = 2.3 days	{3360 samples / (1 sample/ 60 min)} / 1440 min/day = 140 days

Demand profiles can be accessed through a serial port. See the two remote access chapters for a detailed description of how these profiles can be organized and accessed using a PC.

Daily Maximum Demand Reporting

In addition to the demand profiles, a 35-day history of daily maximums (or minimums, depending on the data) is also maintained. Included in this history are the maximum current per phase and neutral, the maximum three-phase watts, VARs, and VA, and the minimum three-phase power factor. For DFP200 models that provide power quality monitoring, the maximum THD per current and voltage phase and the minimum 2-second RMS voltage per phase are also included. Each entry is time stamped independently to the nearest second.

The 35-day log of daily maximums can be accessed through a serial port. See the two remote access chapters for a detailed description of how this information is organized and accessed using a PC.

Peak Value Reporting

Peak values (both positive and negative) are maintained in the DFP200 which represent maximum values (or minimums, depending on the data) since the data storage memory was last cleared. Peak entries include the maximum phase and neutral currents, the maximum three-phase watts, VARs, and VA, and the minimum three-phase power factor. Peak THDs for each phase current and voltage, as well as the minimum 2-second average RMS voltages per phase are also included in models that provide power quality monitoring.

The latest peak data can be accessed or reset via a serial port. The peaks can also be viewed on the Keypad/Display Module, and can be reset through the Keypad/Display Module if the settings allow this.

Event Reporting

A log of events is maintained in the DFP200 that contains the last 255 system events. For event sequencing, events are time stamped to the nearest one-tenth of a millisecond. Examples of events logged include alarms, contact operations, logins and logouts, oscillography captures, remote operations, and resets. Event data can be accessed through a serial port. See the two remote access chapters for a detailed description of how event reports are organized and accessed using a PC.

Fault Reporting

Whenever a protection function operates, a fault report is captured. This stores pertinent information (unit ID, date and time, operating time, pre-fault currents, fault currents and voltages, fault type, operation type, selected events) in the DFP200. Complete data for the most recent faults is maintained, up to a maximum number of faults. This maximum can be set to either 1, 2, 4, 8, 12, or 16. The fault data can be accessed through a serial port, or an abbreviated summary containing only the fault types, operation types, and dates and times can be viewed on the DFP200's Keypad/Display Module. A full description of this fault display is contained in the LOCAL INTERFACES chapter. Detailed information regarding the PC presentation of fault reports is contained in the two remote access chapters.

Oscillography: Regular, RMS, HiZ, THD

Oscillography data are stored in capacitor-backed dynamic RAM (CAPRAM). Following loss of DFP200 control power, the oscillography data will be maintained for at least 24 hours.

NOTE: All the instantaneous and RMS oscillography capture data is destroyed when the oscillography memory size configuration is changed.

Regular Oscillography Data

A Regular Oscillography in the DFP200 contains 32 sample/cycle data for the items listed in Table 2-3. The number of pre-fault cycles is 3. The number of oscillography captures and post fault cycles depends on setting 304, NUMFLTS (1,2,4,8,12, or 16). If setting 304 is 1 then the DFP200 will have one oscillography capture with 240 cycles of post fault data. If setting 304 is another value the number of post fault cycles will be equal to 240 divided by setting 304. The number of oscillography captures equals setting 304.

Triggering of Regular Oscillography

The triggering of regular oscillography is accomplished if any function (except HiZ) picks-up and subsequently trips. If the function picks-up, but does not trip a regular oscillography will be saved only if setting 1401 or 1402, OSCMASK1 or OSCMASK2, has a one in the position corresponding to the function that picked-up. Also, a regular oscillography can be triggered through either a digital input, DFP200-Link, or MMI.

Setting 0304, NUMFLTS sets the number of Regular Oscillography captures the DFP200 can store at any one time. Whenever a new oscillography capture is made the data is first stored in a temporary buffer, the DFP200 must then determine if it should store this new capture. This determination is made with settings 0304, NUMFLTS and setting 0309, OSCTIME. If the relay has currently stored a number of Regular Oscillographies that is less than setting 0304, NUMFLTS the DFP200 will store the new capture. If the relay has currently stored a number of Regular Oscillographies that is equal to setting 0304, NUMFLTS the relay will first check to see if the old oscillography captures have ever been downloaded from the relay. If there are oscillography captures that have been downloaded from the relay the oldest of these captures will be overwritten by the new capture. If in the relay there are only captures that have never been downloaded from the relay the relay will check the date of these unread captures. If the oldest of these captures has been in the DFP200 for a time greater than setting 0309, OSCTIME this capture will be overwritten with the new capture. If all of the unread captures are newer than the time in setting 0309, OSCTIME the new capture will not be stored by the relay.

Table 2-3 Regular Oscillography Data

Item Name	Description
Ia	Phase A Current
Ib	Phase B Current
Ic	Phase C Current
In	Neutral Current
Va	Phase A voltage
Vb	Phase B voltage
Vc	Phase c voltage
CC1	Contact Converter 1 (a.k.a. Digital Input)
CC2	Contact Converter 2
CC3	Contact Converter 3
CC4	Contact Converter 4
CC5	Contact Converter 5
CC6	Contact Converter 6
OC1	Output Contact 1
OC2	Output Contact 2
OC3	Output Contact 3
OC4	Output Contact 4
OC5	Output Contact 5
OC6	Output Contact 6
Ph_IOCH_Pkup	Phase IOC High Pickup
Ph_IOCL_Pkup	Phase IOC Low Pickup
Gr_IOCH_Pkup	Ground IOC High Pickup
Gr_IOCL_Pkup	Ground IOC Low Pickup
Ph_TOC_Pkup	Phase TOC Pickup
Gr_TOC_Pkup	Ground TOC Pickup
UV_Pkup	Under voltage Pickup
OV_Pkup	Overvoltage Pickup
NS_IOC_pkup	Negative Sequence IOC Pickup
NS_TOC_Pkup	Negative Sequence TOC Pickup
UF_Set1_Pkup	Under Frequency Unit1 Pickup
OF_set1_Pickup	Over Frequency Unit1 Pickup
UF_Set2_Pkup	Under Frequency Unit2 Pickup
OF_set2_Pickup	Over Frequency Unit2 Pickup
Ph_IOCH_Out	Phase IOC High Output
Ph_IOCL_Out	Phase IOC Low Output
Gr_IOCH_Out	Ground IOC High Output
Gr_IOCL_Out	Ground IOC Low Output
Ph_TOC_Out	Phase TOC Output
Gr_TOC_Out	Ground TOC Output
UV_Out	Under voltage Output
OV_Out	Overvoltage Output
NS_IOC_Out	Negative Sequence IOC Output
NS_TOC_Out	Negative Sequence TOC Output
UF_Set1_Out	Under Frequency Unit1 Output
OF_set1_Out	Over Frequency Unit1 Output
UF_Set2_Out	Under Frequency Unit2 Output
OF_set2_Out	Over Frequency Unit2 Output

RMS Oscillography Data

RMS Oscillography in the DFP200 contains “2-cycle data” for the items listed in Table 2-4. Two cycle data is the average RMS of the data over a two cycle period. The number of pre-fault is 90 2-cycle data points. The number of RMS Oscillography captures and post fault data points depends on setting 308, NUMRMSFLTS (1,2,4,8,12, or 16). If setting 308 is 1 then the DFP200 will have one oscillography capture with 7680 points of post fault data. If setting 308 is another value the number of post fault data points will be equal to 7680 divided by setting 308. The number of RMS Oscillography captures equals setting 308.

Triggering of RMS Oscillography

The triggering of RMS Oscillography is accomplished if a 2 cycle overcurrent, Arcing Suspected, or Down Conductor event occurs.

Setting 0308, NUMRMSFLTS sets the number of RMS Oscillography captures the DFP200 can store at any one time. Whenever a new oscillography capture is made the data is first stored in a temporary buffer, the DFP200 must then determine if it should store this new capture. This determination is made with settings 308, NUMRMSFLTS and setting 0310, RMSTIME. If the relay has currently stored a number of RMS Oscillographies which is less than setting 0308, NUMRMSFLTS the DFP200 will store the new capture. If the relay has currently stored a number of RMS Oscillographies which is equal to setting 0308, NUMRMSFLTS the relay will first check to see if the old oscillography captures have ever been downloaded from the relay. If there are oscillography captures that have been downloaded from the relay the oldest of these captures will be overwritten by the new capture. If in the relay there are only captures that have never been downloaded from the relay the relay will check the date of these unread captures. If the oldest of these captures has been in the DFP200 for a time greater than setting 0310, RMSTIME this capture will be overwritten with the new capture. If all of the unread captures are newer than the time in setting 0310, RMSTIME the new capture will not be stored by the relay.

Table 2-4 RMS Oscillography Data

Ia	Phase A Current
Ib	Phase B Current
Ic	Phase C Current
In	Neutral Curren t
Va	Phase A voltage
Vb	Phase B voltage
Vc	Phase c voltage
Ia_LOL	Phase A Loss of Load
Ia_High _EAD	Phase A Expert Arc Detector High Output
Ia_OC	Phase A 2 cycle-overcurrent
Ia_ARC	Phase A arcing
Ia_DC	Phase A Down Conductor
Ib_LOL	Phase B Loss of Load
Ib_High _EAD	Phase B Expert Arc Detector High Output
Ib_OC	Phase B 2 cycle-overcurrent
Ib_ARC	Phase B arcing
Ib_DC	Phase B Down Conductor
Ic_LOL	Phase C Loss of Load
Ic_High _EAD	Phase C Expert Arc Detector High Output
Ic_OC	Phase C 2 cycle-overcurrent
Ic_ARC	Phase C arcing
Ic_DC	Phase C Down Conductor
In_LOL	Neutral Loss of Load
In_High _EAD	Neutral Expert Arc Detector High Output
In_OC	Neutral 2 cycle-overcurrent
In_ARC	Neutral arcing
In_DC	Neutral Down Conductor

HiZ Oscillography Data

HiZ Oscillography in the DFP200 contains HiZ data values for each of the items listed in Table 2-5. This data is captured once a second. The information contained in this report are all of the quantities associated with a HiZ detection. Each capture contains 240 data points. Of the 240 data points, 15 data points are pre-fault and 225 data points post fault. There is a fixed value of 8 captures in the DFP200.

Triggering of HiZ Oscillography

The triggering of a HiZ Oscillography is accomplished if a 2 cycle overcurrent, Arcing Suspected, or Down Conductor event occurs.

There are a fixed number (8) of HiZ Oscillography captures in the DFP200. Whenever a new oscillography capture is made the data is first stored in a temporary buffer, the DFP200 must then determine if it should store this new capture. This determination is made with setting 0310, RMSTIME. If the relay has currently stored a number of HiZ Oscillographies which is less than 8 the DFP200 will store the new capture. If the relay has currently stored a number of HiZ Oscillographies which is equal to 8 the relay will first check to see if the old oscillography captures have ever been downloaded from the relay. If there are oscillography captures that have been downloaded from the relay the oldest of these captures will be overwritten by the new capture. If in the relay there are only captures that have never been downloaded from the relay the relay will check the date of these unread captures. If the oldest of these captures has been in the DFP200 for a time greater than setting 0310, RMSTIME this capture will be overwritten with the new capture. If all of the unread captures are newer than the time in setting 0310, RMSTIME the new capture will not be stored by the relay

Table 2-5 Data of HiZ Oscillography

Item Name	Description
Ia_Arc_Cnf	Phase A Arc Confidence
Ia_AccumArc	Phase A Accumulated (Ingrated) Arc Confidence
Ia_Vblock	Phase A Voltage Block For Adjacent Lines
Ia_HiZArmed	Phase A Overcurrent or Loss of Load Flag Set
Ia_EAD_Tot	Phase A Expert Arc Detector Total
Ia_OutStat	Phase A Status of HiZ Function
Ia_ArcorDc	Phase A Arcing Detected or Down Co n-ductor
Ia_Loadloss	Phase A Loss of Load
Ia_OC	Phase A 2 Cycle Overcurrent
Ia_HiRoc	Phase A Rate of Change Output
Ia_3phEvent	Phase A 3 Phase Event
Ia_HiEAD	Phase A High EAD output
Ia_RMS	Phase A RMS value
Ib_Arc_Cnf	Phase B Arc Confidence
Ib_AccumArc	Phase B Accmulated (Ingrated) Arc Confidence
Ib_Vblock	Phase B Voltage Block For Adjacent Lines
Ib_HiZArmed	Phase B Overcurrent or Loss of Load Flag Set
Ib_EAD_Tot	Phase B Expert Arc Detector Total
Ib_OutStat	Phase B Status of HiZ Function
Ib_ArcorDc	Phase B Arcing Detected or Down Co n-ductor
Ib_Loadloss	Phase B Loss of Load
Ib_OC	Phase B 2 Cycle Overcurrent
Ib_HiRoc	Phase B Rate of Change Output
Ib_3phEvent	Phase B 3 Phase Event
Ib_HiEAD	Phase B High EAD output
Ib_RMS	Phase B RMS value
Ic_Arc_Cnf	Phase C Arc Confidence
Ic_AccumArc	Phase C Accmulated (Ingrated) Arc Confidence
Ic_Vblock	Phase C Voltage Block For Adjacent Lines
Ic_HiZArmed	Phase C Overcurrent or Loss of Load Flag Set
Ic_EAD_Tot	Phase C Expert Arc Detector Total
Ic_OutStat	Phase C Status of HiZ Function
Ic_ArcorDc	Phase C Arcing Detected or Down Co n-ductor
Ic_Loadloss	Phase C Loss of Load
Ic_OC	Phase C 2 Cycle Overcurrent
Ic_HiRoc	Phase C Rate of Change Output
Ic_3phEvent	Phase C 3 Phase Event
Ic_HiEAD	Phase C High EAD output
Ic_RMS	Phase C RMS value
In_Arc_Cnf	Neutral Arc Confidence
In_AccumArc	Neutral Accmulated (Ingrated) Arc Confidence
In_Vblock	Neutral Voltage Block For Adjacent Lines
In_HiZArmed	Neutral Overcurrent or Loss of Load Flag Set
In_EAD_Tot	Neutral Expert Arc Detector Total
In_OutStat	Neutral Status of HiZ Function
In_ArcorDc	Neutral Arcing Detected or Down Con-ductor
In_Loadloss	Neutral Loss of Load
In_OC	Neutral 2 Cycle Overcurrent
In_HiRoc	Neutral Rate of Change Output
In_3phEvent	Neutral 3 Phase Event
In_HiEAD	Neutral High EAD output
In_RMS	Neutral RMS value

THD Oscillography Data

THD Oscillography in the DFP200 contains data values for each of the items listed in Table 2-3. This data is captured at 32 samples/cycle. Each capture contains 2 cycles of data. There is a fixed value of 5 captures in the DFP200.

Triggering of THD Oscillography

The triggering of a THD Oscillography is accomplished if the THD of the current exceeds setting 0302 or if the THD of the voltage exceeds setting 0303.

Metering

Several different means exist to display metering data. The Keypad/Display Module has six different screen options available to display different types of quantities. Each of these screens are displayed in the LOCAL INTERFACES chapter. In addition, there are reports available through the serial ports. The two remote access chapters contain detailed explanations of the reports available.

Present value or metering data consists of the individual currents, voltages, watts, VARs, and power factors, as well as the individual total harmonic distortions (in models that include power quality monitoring) for each of the three phase currents and voltages. Three-phase values are calculated for the watts, VARs, VA, and power factors. Three-phase kWH and kVARH are also calculated. Each present value is updated once per second.

When the DFP200 is connected per Figure 2-2, the values for watts and vars will be preceded by a positive (+) sign if active power and lagging reactive power flow in the 'trip' direction (out of the bus). Leading reactive power flow in the trip direction will result in a negative (-) sign for vars.

Password Protection

Four different passwords provide remote access security. These 'remote' passwords are labeled:

- VIEW
- CONTROL
- SETTINGS
- MASTER

Each password grants the user a different privilege level. The VIEW password is required when uploading and viewing stored data and settings. The CONTROL password is required when performing control operations such as trip, close, reset data, etc. The SETTINGS password is required when changing settings. The MASTER password allows the user to perform all of the above actions using just one password.

Each password has an invalid default which is stored in memory as shipped from the factory. These invalid defaults must be changed before the user is given access to the associated privilege level. The four passwords may be viewed in their encrypted form on the Keypad/Display Module. They may be changed through a serial port. Refer to the two remote access chapters for a description of password usage when communicating via a serial port.

Three passwords provide local access (Keypad/Display Module) security. These 'local' passwords are labeled:

- CONTROL
- SETTINGS
- MASTER

Refer to the LOCAL INTERFACES chapter for a description of password usage when communicating via the Keypad/Display Module. These passwords may be viewed via the remote communications access.

Serial Communications

Three DB-9 serial ports are provided on the DFP200, one on the front panel and two on the rear panel. Each serial port supports ASCII or DFP-Link communications and is selected by a setting for each port.

The Port 3 DB-9 connector located on the rear of the case is provided to permit the user to communicate with the DFP200 from a local or remote computer by RS-232 protocol, either through direct connection or via a modem. The Port 4 DB-9 connector located on the rear of the DFP200 permits the user to communicate with the DFP200 via RS-485 (or other protocol), if the communications card option is installed.

When local communication through a PC is desired, the PC may be connected via the proper null-modem cable to Port 2, 3 or 4, provided the cable length does not exceed 50 feet, or the PC may be connected via interposing modems when it is physically remote from the DFP200. Unique PC software, DFP-Link, can be used to communicate with the DFP200, or an ASCII session can be conducted using a general purpose communication program such as MS Windows' terminal emulator. Refer to the two remote access chapters for a description of how to communicate with the DFP200 using the serial ports.

All communications ports can be accessed simultaneously for viewing data, retrieving logs, and downloading files, but only one port at a time has the capability to change settings or respond to commands. The first port logged in with the CONTROL, SETTINGS, or MASTER password is the designated port for changes, until it is logged out.

Time Synchronization

The DFP200 includes a clock that can run freely from the internal oscillator or be synchronized from an external signal. Two different external time synchronization signals are possible. If available, an unmodulated IRIG-B signal connected to the IRIG-B terminations on the DFP200's back panel is used to synchronize the clock. The clock in a given DFP200 is synchronized to within plus or minus one millisecond of any other DFP200 clock, provided the two devices are wired to the same external synchronizing signal. A time reference can also be supplied to the DFP200 from a PC. If a PC supplies a time reference while IRIG-B is connected, then the time supplied by the PC will be overwritten by the IRIG-B time.

Upgrade Model Number

An upgrade to include functions not originally purchased with the DFP200 (see the Model List in the SPECIFICATIONS chapter) is possible by purchasing a file from GE which will allow enabling these functions and changing the model number in the process. The upgrade file is encrypted and contains the serial number of the specific DFP200 to be upgraded. The file is supplied on a floppy disk and the upgrade is accomplished via the DFP-Link communications program. Note that this upgrade file can only be used to upgrade the one DFP200 corresponding to the unique serial number contained in the upgrade file.

FUNCTIONS

The following functions are available with the DFP200. Detailed descriptions of each follow below.

- High-Impedance Fault Detection (optional)
- Conventional Instantaneous and Time Overcurrent Protection
- Cold Load Pickup with Sequence Coordination
- Adaptive Time Overcurrent Protection
- Negative Sequence Instantaneous and Time Overcurrent Protection (optional)
- Zero and Negative Sequence Directional Functions (optional)
- Phase Direction Functions
- Over/Under Voltage Protection (optional)
- Over/Under Frequency Protection (optional)
- Fault Location (optional)
- Power Quality Monitoring (optional)
- Present Value Monitoring
- Recloser
- Sync Check (Optional)

High Impedance Fault Detection

The DFP200 accomplishes high-impedance fault detection using a variety of algorithms, all coordinated by an expert system. At the heart of the high-impedance fault-detection system is the identification of arcing on a feeder. If the DFP200 detects arcing, it then determines whether or not the arcing persists for a significant period of time. If it does, the DFP200 determines whether the persistent arcing is from a downed conductor or from an intact conductor and then closes the appropriate output contact to indicate either the detection of a downed conductor or the detection of arcing, respectively.

Distinction between an arcing intact conductor and an arcing downed conductor is determined by looking at patterns in the load current at the beginning of the fault. A downed conductor is indicated only when a precipitous loss of load or an overcurrent condition precedes arcing detection. Otherwise, the DFP200 assumes that the line is intact, even if arcing is present. In such a case, if the detected arcing can be classified as persistent, and an output contact is configured for 'arcing detected', the DFP200 will close that contact.

In some cases, arcing is determined to be present, but not persistent. For example, if it is caused by tree limb contact or insulator degradation, arcing will typically be present intermittently with relatively long periods of inactivity (e.g. minutes) interspersed. In such cases, arcing may be affected by such factors as the motion of a tree limb or the moisture and contamination on an insulator. Conditions such as these, characterized by a high number of brief occurrences of arcing over an extended period of time (e.g. from a fraction of an hour to one or two hours), lead the DFP200 to recognize and flag an "arcing suspected" event. None of these brief occurrences of arcing, if taken individually, are sufficient to indicate detection of a downed conductor or to set off an alarm indicating that persistent arcing has been detected. When considered cumulatively, however, they do indicate a need for attention. If an output contact is configured to indicate 'arcing suspected', the DFP200's recognition of such sporadic arcing will close that contact and appropriate actions can be taken.

If the DFP200 determines that a downed conductor exists, oscillography and fault data are captured. In addition, the Keypad/Display Module responds with a blinking high-impedance fault message and appropriate LEDs are activated on the front panel.

The detection of a downed conductor or arcing condition is accomplished through the execution of the following algorithms:

- Energy Algorithm
- Randomness Algorithm
- Expert Arc Detector Algorithm
- Load Event Detector Algorithm
- Load Analysis Algorithm
- Load Extraction Algorithm
- Arc Burst Pattern Analysis Algorithm
- Arcing-Suspected Identifier Algorithm

Energy Algorithm

The Energy Algorithm monitors a specific set of non-fundamental frequency component energies of phase and neutral current. After establishing an average value for a given component energy, the algorithm indicates arcing if it detects a sudden, sustained increase in the value of that component. The DFP200 runs the Energy Algorithm on each of the following parameters for each phase current and for the neutral: (1) even harmonics, (2) odd harmonics, and (3) non-harmonics. On a 60-Hz system, the non-harmonic component consists of a sum of the 30, 90, 150, ..., 750-Hz components, while on a 50-Hz system, it consists of a sum of the 25, 75, 125, ..., 625-Hz components. If the Energy Algorithm detects a sudden, sustained increase in one of these component energies, it reports this to the Expert Arc Detector Algorithm, resets itself, and continues to monitor for another sudden increase.

Randomness Algorithm

The Randomness Algorithm monitors the same set of component energies as the Energy Algorithm. However, rather than checking for a sudden, sustained increase in the value of the monitored component energy, it looks for a sudden increase in a component followed by highly erratic behavior. This type of highly random behavior is indicative of many arcing faults. Just as with the Energy Algorithm, if the Randomness Algorithm detects a suspicious event in one of its monitored components, it reports this to the Expert Arc Detector Algorithm, resets itself, and continues to monitor for another suspicious event.

Expert Arc Detector Algorithm

The purpose of the Expert Arc Detector Algorithm is to assimilate the outputs of the basic arc detection algorithms into one "arcing confidence" level per phase. Note that there are actually 24 independent basic arc detection algorithms, since both the Energy Algorithm and the Randomness Algorithm are run for the even harmonics, odd harmonics, and non-harmonics for each phase current and for the neutral. The assimilation performed by the Expert Arc Detector Algorithm, then, is accomplished by counting the number of arcing indications determined by any one of the twenty-four algorithms over a short period of time (e.g. the last 30 seconds). Also taken into account is the number of different basic algorithms that indicate arcing.

The Expert Arc Detector Algorithm's arcing confidence level for each phase increases as the number of basic algorithms that indicate arcing confidence increases. It also increases with increasing numbers of indications from any one basic algorithm. These confidence level increases occur because multiple, consecutive indications and multiple, independent indications are more characteristic of the presence of arcing than a single algorithm giving a single indication.

Load Event Detector Algorithm

The Load Event Detector Algorithm examines, on a per-phase basis, one reading of RMS values per two-cycle interval for each phase current and the neutral. It then sets flags for each phase current and for the neutral based on the following events: (1) an overcurrent condition, (2) a precipitous loss of load, (3) a high rate-of-change, (4) a significant three-phase event, and (5) a breaker open condition. These flags are examined by the Load Analysis Algorithm. Their states contribute to that algorithm's differentiation between arcing downed conductors and arcing intact conductors, and inhibit the Expert Arc Detector Algorithm from indicating the need for an arcing alarm for a limited time following an overcurrent or breaker open condition.

Any of the above five flags will zero the Expert Arc Detector buffer, since the power system is in a state of change and the values being calculated for use by the Energy and Randomness algorithms are probably not valid.

An extremely high rate of change is not characteristic of most high impedance faults and is more indicative of a breaker closing, causing associated inrush. Since this type of inrush current causes substantial variations in the harmonics used by the high impedance algorithms, these algorithms ignore all data for several seconds following a high rate-of-change event that exceeds the associated rate-of-change threshold, in order to give the power system a chance to stabilize.

Load Analysis Algorithm

The purpose of the Load Analysis Algorithm is to differentiate between arcing downed conductors and arcing intact conductors by looking for a precipitous loss of load and/or an overcurrent disturbance at the beginning of an arcing episode. The presence of arcing on the system is determined based on the output of the Expert Arc Detector Algorithm. If the DFP200 finds persistent arcing on the power system, the Load Analysis Algorithm then considers the type of incident that initiated the arcing and classifies the arcing conductor as either downed or intact. Another function of the algorithm is to provide coordination between the DFP200 and the power system's conventional overcurrent protection by observing a timeout, via setting OCCRDTMEOT, from the beginning of the arcing before giving an indication of arcing.

If the Load Analysis Algorithm determines that a downed conductor or arcing exists, it attempts to determine the phase on which the high impedance fault condition exists. It does this in a hierarchical manner. First, if a significant loss of load triggered the Load Analysis Algorithm, and if there was a significant loss on only one phase, that phase is identified. If there was not a single phase loss of load, and if an overcurrent condition on only one phase triggered the algorithm, that phase is identified. If both of these tests fail to identify the phase, the phase with a significantly higher confidence level (e.g. higher than the other two phases by at least 25%) is identified. Finally, if none of these tests provides phase identification, the result of the Arc Burst Pattern Analysis Algorithm is checked. If that test fails, the phase is not identified.

Load Extraction Algorithm

The Load Extraction Algorithm attempts to find a quiescent period during an arcing fault so that it can determine the background load current level in the neutral current. If it is successful in doing so, it then removes the load component from the total measured current, resulting in a signal which consists only of the fault component of the neutral current. This information is then provided as input to the Arc Burst Pattern Analysis Algorithm.

Arc Burst Pattern Analysis Algorithm

The Arc Burst Pattern Analysis Algorithm attempts to provide faulted phase identification information based on a correlation between the fault component of the measured neutral current and the phase voltages. The phase identified will be the one whose phase voltage peak lines up with the neutral current burst. The fault component is received from the Load Extraction Algorithm. The result of the analysis is checked by the Load Analysis Algorithm if its other phase identification methods prove unsuccessful.

Arcing Event Trend Identifier Algorithm

The purpose of the Arcing Suspected Identifier Algorithm is to detect multiple, sporadic arcing events. If taken individually, such events are not sufficient to warrant an arcing alarm. When taken cumulatively, however, these events do warrant an alarm to system operators so that the cause of the arcing can be investigated.

Overcurrent Disturbance Monitoring

This function is part of High Impedance Fault Detection and should not be confused with Conventional Overcurrent Protection. The DFP200 monitors for an overcurrent condition on the feeder by establishing overcurrent thresholds for the phases and for the neutral and then checking for a single two-cycle RMS current that exceeds those thresholds. Oscillography and fault data are captured if it is determined that an overcurrent condition exists (see Instantaneous and RMS Oscillography and Fault Reporting under FEATURES in this chapter).

Conventional Overcurrent Protection

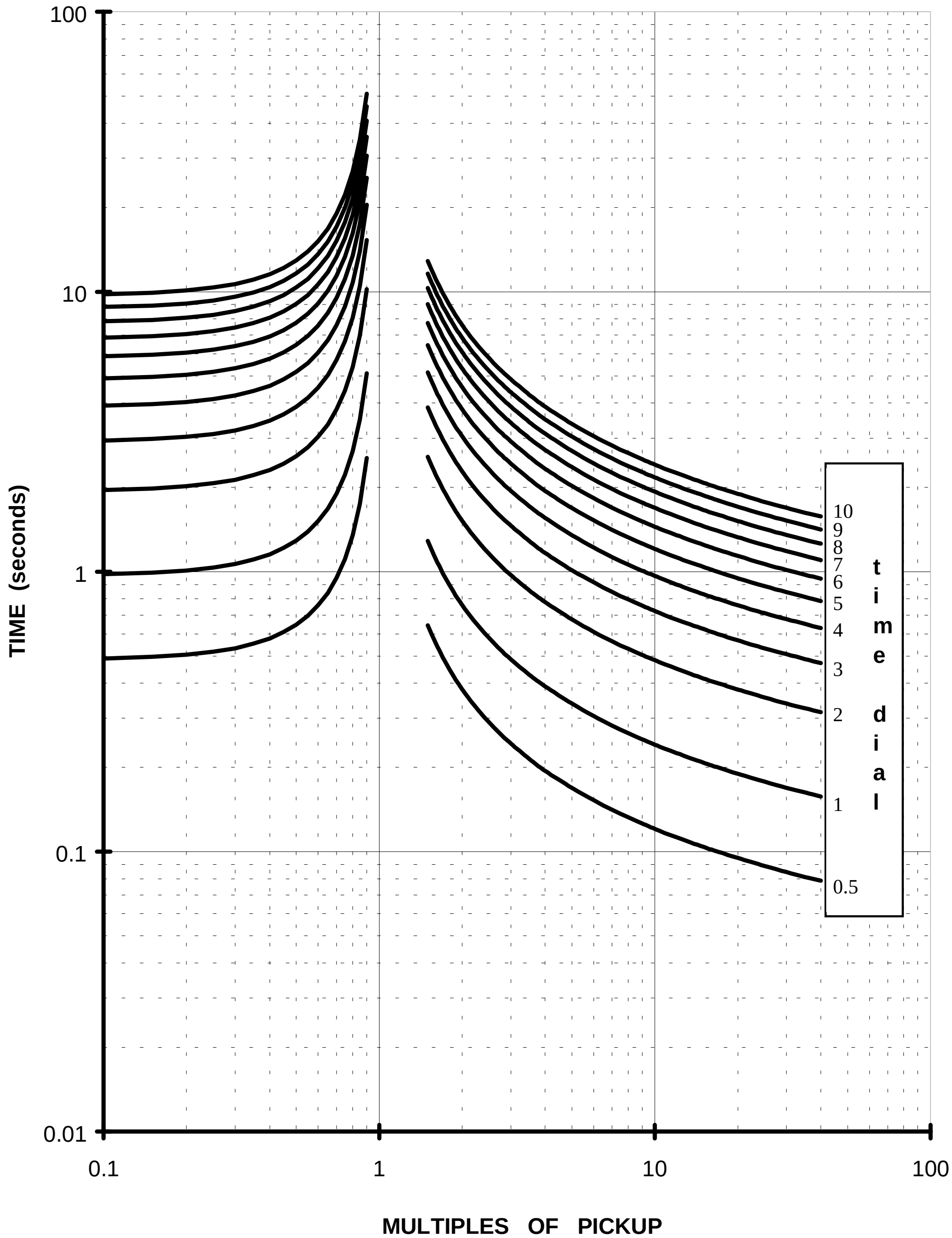
Two instantaneous (IOC low set and IOC high set) functions and one time-delay (TOC) nondirectional overcurrent function are provided for each phase and ground. There are separate time and instantaneous settings for phase and ground. Negative-sequence IOC and TOC functions are also provided.

For each of the eight settings groups, one phase TOC curve and one ground TOC curve may be selected from the nine curves stored in the DFP200. The TOC reset can be selected to emulate that of an EM induction-disk TOC relay or to have a fast reset.

For the TOC functions, five pre-defined (inverse, very inverse, extremely inverse, B.S. 142 inverse, and definite time) and up to four user-defined characteristic curves are stored in non-volatile memory. The four inverse predefined pickup curves are based on equations contained in ANSI C37.112 and IEC 255-4 (B.S. 142). These pickup and 'EM reset' characteristic curves and the equations used to generate them are given in Figures 2-4, 2-5, 2-6, and 2-7. The fifth pre-defined curve has a definite time characteristic.

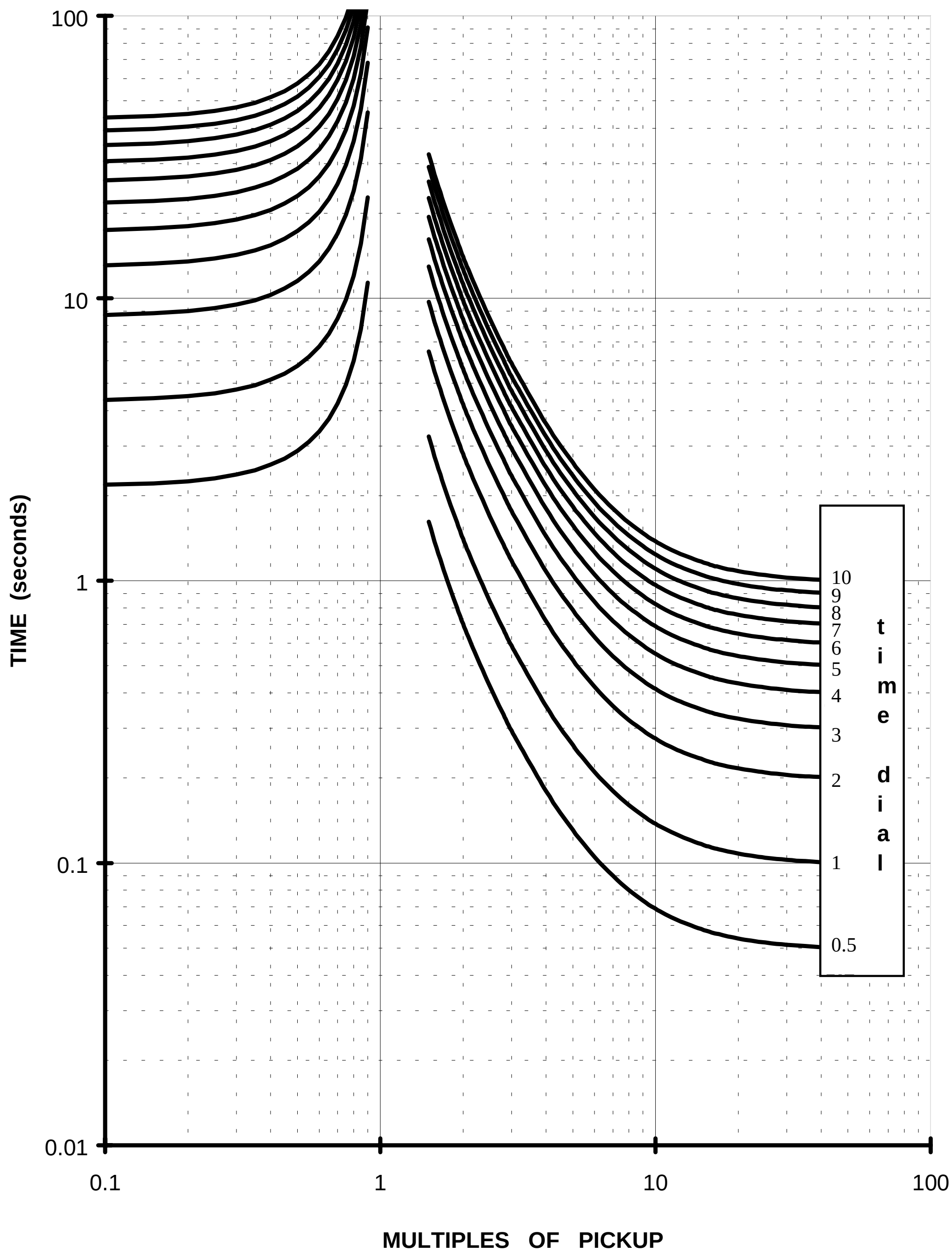
NOTE: The reset equations are valid for $0<M<1$ and the pickup equations are valid for $M>1$. A positive value calculated from a reset equation at $0<M<1$ indicates the time it takes for the function to integrate <u>down</u> to zero (function completely reset).

An Excel spreadsheet file, Curveq.xls, is provided by GE to allow the user to define curve shapes using ANSI C37.112 equation formats or by specifying 19 points. Curveq.xls will create a curve shape data file that can be directly downloaded to a DFP200 using the DFP-Link communications program.



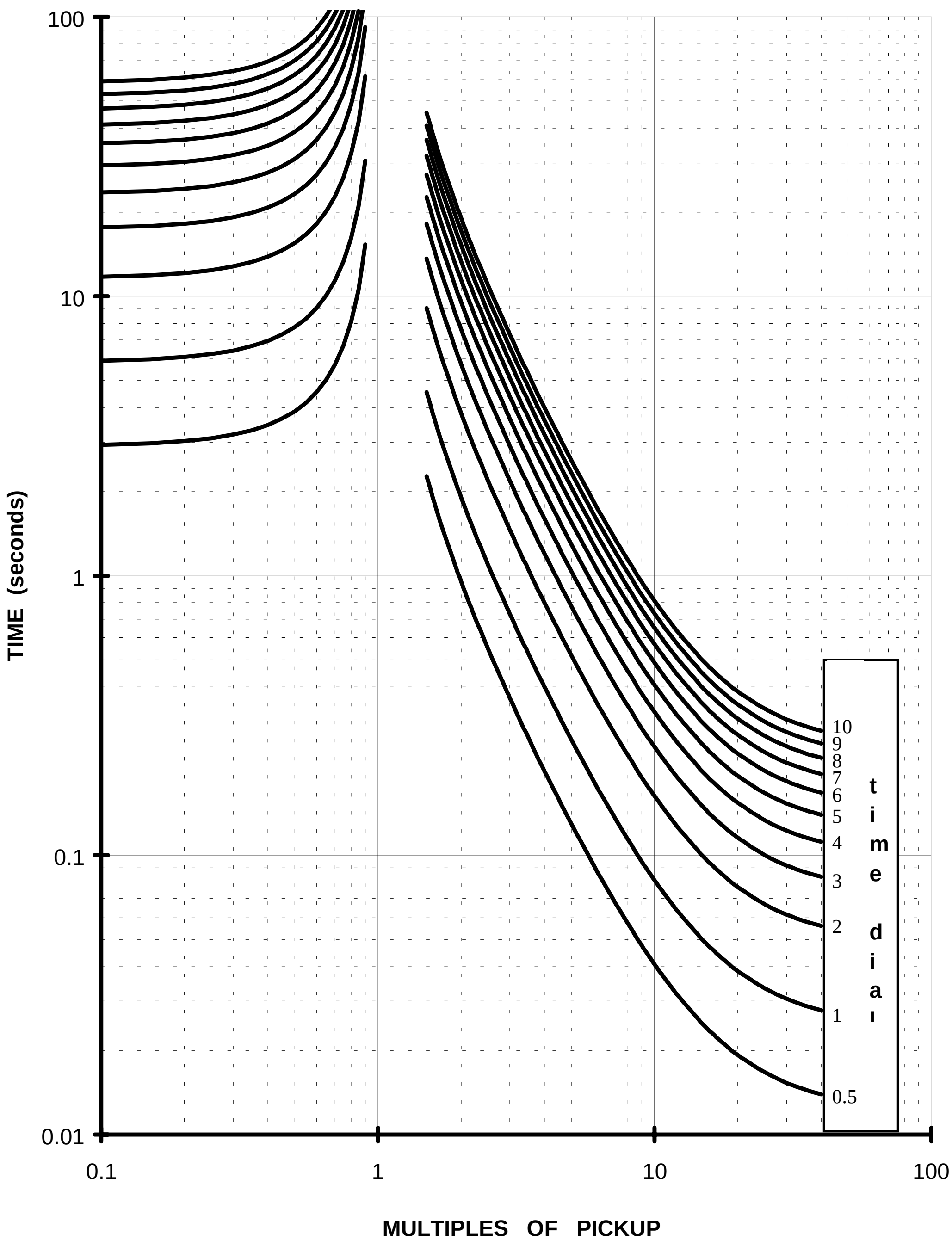
$$t(RESET) = TD\left[\frac{0.97}{M^2 - 1}\right] \qquad t(PU) = TD\left[\frac{0.0103}{M^{0.02} - 1} + 0.0228\right]$$

Figure 2-4 Inverse Curve



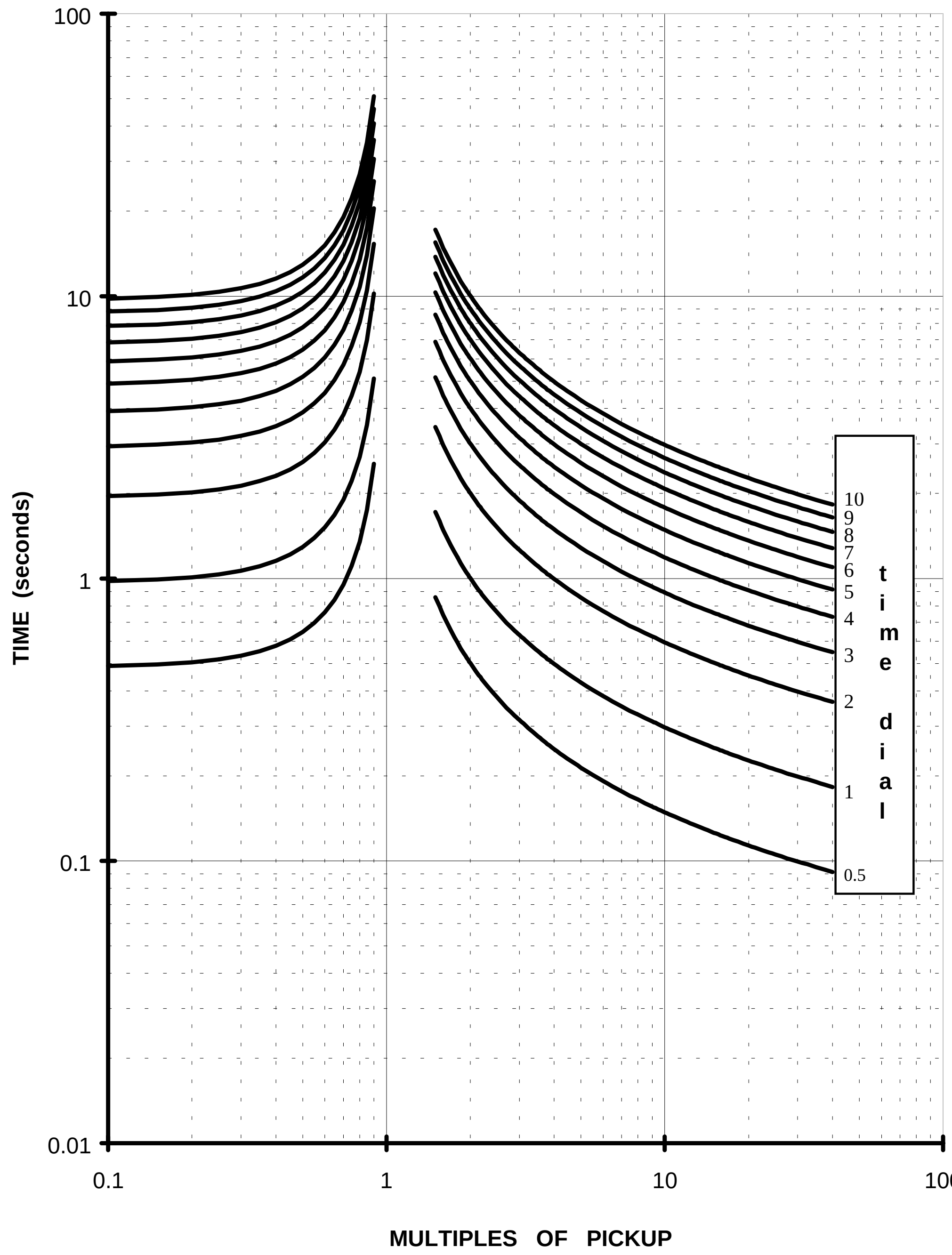
$$t(RESET) = TD\left[\frac{4.32}{M^2 - 1}\right] \qquad t(PU) = TD\left[\frac{3.922}{M^2 - 1} + 0.0982\right]$$

Figure 2-5 Very Inverse Curve



$$t(RESET) = TD\left[\frac{5.82}{M^2 - 1}\right] \qquad t(PU) = TD\left[\frac{5.64}{M^2 - 1} + 0.02434\right]$$

Figure 2-6 Extremely Inverse Curve



$$t(RESET) = TD\left[\frac{0.97}{M^2 - 1}\right] \qquad t(PU) = TD\left[\frac{0.014}{M^{0.02} - 1}\right]$$

Figure 2-7 BS142 Inverse Curve

where:

t = time in seconds
TD = Time Dial (0.5, 1.0...........10.0)
M = multiples of pickup

Cold Load Pickup

Special settings may be defined to prevent an unwanted trip during a cold load pickup condition. A cold-load-pickup condition is declared when the associated breaker has been open for three minutes. If one of the digital inputs has been configured for '52/b STATUS, then the 52/b contact closure starts the three-minute timer. If there is no 52/b input, then the three-minute timer is started when all the phase currents are less than 4% of the CT rating (i.e., 0.20 amp for a 5-amp unit or 0.04 amp for a 1 amp unit) over a two-cycle period. Settings group #8 is reserved as the cold-load settings group. If the Cold-Load-Pickup Time Delay is set to a non-zero value, then settings group #8 is made the active settings group following detection of a cold-load-pickup condition, and it remains in effect for a time interval determined by a setting. If the Cold-Load-Pickup Time Delay is set to zero, then the cold-load-pickup logic is disabled.

Adaptive Time Overcurrent Protection

A unique load-adaptive feature may be used to automatically change the TOC pickup within limits as a function of the average load current. This allows the TOC function to be more sensitive when feeder loading is light. If the Adaptive Phase TOC Averaging Period setting, 0621, is set to a non-zero value, then at the end of each averaging period, a candidate phase-TOC pickup will be computed by multiplying the computed average phase current by a multiple determined from the Adaptive Phase TOC Pickup Percentage setting, 0618. If the candidate phase-TOC pickup exceeds an upper or lower limit, then the value of the limit that was exceeded will become the new phase-TOC pickup. Otherwise, the candidate TOC pickup becomes the new phase-TOC pickup. The same scenario occurs for the ground-TOC pickup if the Adaptive Ground TOC Averaging Period setting, 0630, is set to a non-zero value. If both Adaptive Phase TOC Averaging Period and Adaptive Ground TOC Averaging Period are set to zero, then the TOC functions behave like conventional fixed-pickup functions.

Negative-Sequence Overcurrent

Instantaneous and Time Overcurrent Protection based on a Negative Sequence quantity are available in the DFP200. The TOC curve can be selected to be Inverse, Very Inverse, Extremely Inverse, BS142 Inverse, Definite Time, or one of the four possible user-defined curves. A slow or fast reset characteristic may be selected via a setting.

Sequence Coordination

The sequence coordination function provides coordination of the DFP200 instantaneous overcurrent protection functions, IOC, with a recloser (or reclosers) located downstream on the distribution feeder. This function, when enabled (if setting number 0803 SEQCRD = ON), utilizes a settable time delay (setting number 0801 SEQCRDDLTM) which is added to the instantaneous overcurrent function's time delay to allow time for the remote recloser to clear a fault beyond it before the DFP200 instantaneous functions operate.

Normally, the IOC protection at the feeder breaker will be set so as not to overreach the downstream recloser. However, the DFP200's sequence coordination function allows coordination with downstream reclosers should one or more IOC protection functions be set to reach beyond a recloser. If an IOC protection function is set to reach beyond a recloser, the user must select an IOC time delay (SEQCRDDLTM plus IOC time delay) that assures that the DFP200 IOC function will not trip before the downstream recloser trips open the first time following fault occurrence. The DFP200 time overcurrent functions remain in service (if selected) when the sequence coordination function is enabled. The user must coordinate these TOC settings with those of the downstream recloser.

With sequence coordination enabled, the sequence coordination reset time (SEQCRDRSTM, setting number 0802) is started only when the DFP200 detects that the downstream recloser has tripped. While the sequence coordination reset timer is timing out, the selected IOC functions are blocked from operating. At the expiration of the sequence coordination reset time, the IOC functions are placed back in service. Normally SEQCRDRSTM is set to allow the recloser to complete its programmed cycle.

Operation of the downstream recloser is sensed by the DFP200 when the fault current at the DFP200 transitions from being above IOC pickup to being below IOC pickup without the DFP200 issuing a trip command. If one of the digital inputs has been configured as a 52/b contact, then an additional check is made to determine that the local breaker has not opened.

The sequence coordination function always blocks the low-set IOC functions. The high-set IOC functions are blocked if setting number 0804 SEQBLKHI = 1 (YES).

Zero and Negative-Sequence Directional Functions

The ground overcurrent functions can be torque controlled (directionally controlled) by either a negative-sequence 67N or zero-sequence directional function 67G. The zero-sequence directional function can be single or dual polarized, and the polarizing quantity is determined by setting # 1301 ZSEQ POL. The voltage polarizing signal, $3V_0$, is calculated from the three phase-to-ground voltages. To utilize $3V_0$, three wye-wye connected external VTs are required. The current polarizing signal, $3I_0$, is measured using a separate auxiliary CT internal to the relay. To utilize $3I_0$, a suitable source must exist and the user must wire from the associated external CT(s) to the auxiliary $3I_0$ CT located in the relay. The angle that the $3I_0$ neutral current (operating quantity) lags the $-3v\phi$ for maximum operating torque or energy is determined by the setting #1204 ZERIMPANGL.

If current polarization is used maximum operating torque is obtained when the $3I\phi$ auxiliary current is in phase with $3I\phi$ neutral current.

The V_2 and I_2 quantities used by the negative-sequence directional function are calculated within the relay. External polarizing signals are not required. Note that either three wye-wye connected VTs or two open-delta connected VTs may be used when the negative-sequence directional function is selected. The angle that the I_2 current lags the $-V_2$ voltage for maximum operating torque or energy is determined by the setting #1202 POSANG.

Phase Directional Functions (67P)

The phase overcurrent functions can be torque controlled (directionally controlled) by three quadrature polarized (90° connected) phase directional functions. The actuating quantities are:

phase	I	V
A	$I_A - I_0$	V_{BC}
B	$I_B - I_0$	V_{CA}
C	$I_C - I_0$	V_{AB}

The phase n (A, B, or C) 67P function produces ‘maximum torque’ when the phase n current lags the phase n to ground voltage by an angle (0 to 90 degrees) determined from the TRQANGL setting (# 1307). Either three wye-wye connected VTs or two open-delta connected VTs can be utilized for these phase directional functions.

Over /Under Voltage

The voltage functions operate on the positive-sequence component of the applied voltage. Either wye-wye or open-delta connected VTs can be used since the calculated positive-sequence component of voltage, VA1, is referenced to phase A in either case. Each function has a separate pickup setting and a separate time delay setting.

Over/Under Frequency

The DFP200 contains two frequency trip functions, each of which have an under-frequency and an over-frequency setting with individual time delays. One restore function is also available.

The frequency calculation is performed once a cycle (or every 32 samples). The under/over frequency is based on the frequency of the calculated positive sequence voltage. The voltage cutoff for the under/over frequency unit is also based on the positive sequence voltage.

The under/over frequency unit will not start until the cycle after the positive sequence voltage has exceeded the voltage supervision level. If you are bench testing the DFP200 and your initial voltage level is below the voltage supervision level you will find that there is an additional cycle of delay in your measured output.

Once the DFP200 determines that the voltage has exceeded the voltage supervision cutoff and that the frequency is above the over frequency setting or below the under frequency setting, the relay will then wait 6 cycles for the frequency to stabilize. At this point the frequency unit will be picked-up. This 6 cycle delay will also have to be added to your measured delay time.

After the DFP200 determines that the frequency unit has picked-up it will then wait a delay equal to the delay setting for that particular frequency unit.

Therefore, the total delay time for the under/over frequency unit will be:

> 1 Cycle (voltage supervision time if required) + 6 cycle (stabilize time) + Time Delay Setting + Contact Closure Time.

Fault Location

The DFP200 contains an algorithm for determining distance to fault provided that wye-wye connected VTs are used. 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) and line impedances provided by the user as settings. Fault location information is contained in the fault report.

Power Quality Monitoring (OPTIONAL)

The DFP200's power quality monitoring function provides information for assessing the duration and severity of periods of poor power quality. The DFP200 checks the power quality by calculating the total harmonic distortion (THD) on each of the three phase currents and voltages over one-minute intervals. The THD is used, then, to define the effect of harmonics on the power system currents and voltages. It represents the ratio of the root-mean-square of the harmonic content to the root-mean-square value of the fundamental quantity, expressed as a percent of the fundamental. Calculation of THD values requires the accumulation of the real and imaginary components of the 2nd through 13th harmonic frequencies. This accumulation is performed on the phase currents for each two-cycle sample interval. The three voltage inputs are sequentially analyzed, also using a two-cycle data window.

The THD values stored in the DFP200 are updated once per minute for each phase current and voltage. These values can be viewed on the Keypad/Display Module or accessed through a serial port. A command may also be used to retrieve all the real and imaginary components of the thirteen multiples of the fundamental frequency for the last two-cycle interval.

The power quality data maintained in the DFP200 includes minimum, maximum, and average values for THD, and the minimum 2-second RMS average for each phase voltage. This data is reported for a time interval between 1 and 60 minutes, with up to 8 days of storage provided, depending on the time interval selected. An extended memory option is available that provides a maximum of 140 days of entries, again depending on the time interval. The selected interval and storage capability apply to all the demand data in the DFP200.

In addition to the above data, the maximum daily THD and voltage dip values are maintained in a 35-day log. These daily maximums are based on averages of the selected demand period (1 to 60 minutes). The maximum THD value since the data storage memory has been cleared (peak THD) for each current and voltage is also maintained, as well as the minimum 2-second average RMS voltage for each phase since the memory was cleared. These peak values (also based on averages of the selected demand period) can be accessed or reset from a local or remote computer connected to the DFP200 via a serial port. They can also be accessed through the Keypad/Display Module as well, and reset through the Keypad/Display Module if the DFP200 is configured to allow this. All demand data entries (including daily maximums and peaks) include a time stamp to the nearest second.

Settings are provided for establishing one-minute THD thresholds for currents and for voltages. These values are percentages, ranging from 0% to 100%. If a THD threshold setting is exceeded by any one-minute THD average, a THD alarm is indicated in the event log. The alarm can be configured to activate an output via configurable logic using Xpression Builder. Those settings can be changed and new settings downloaded to the DFP200 through a serial port. The configuration of the output contacts can be viewed in the Xpression Builder by uploading the configurable logic from the relay via a serial port to determine if THD Alarms is configured to drive an output contact. This configuration can be modified and downloaded to the relay.

If a THD threshold setting is exceeded, a snapshot of two cycles of instantaneous current and voltage data is captured together with the real and imaginary components of the 2nd through 13th harmonics. The five most recent captures are maintained in the system memory. Once a power quality capture occurs, no subsequent captures occur for a period of 15 minutes. THD monitoring is suspended during the operation of high impedance fault discrimination. The waveform capture can be viewed via GE-DATA software.

The THD threshold settings and the demand data calculation time interval can be viewed on the DFP200's local display. (The local display label associated with the time interval is "DEMAND PERIOD".)

An event is logged in the system each time any phase current or voltage THD exceeds its respective THD threshold setting, and then again when the THD value for that same phase current or voltage falls below its threshold. Each event is time stamped, and thus it is possible to monitor the duration of a period of poor power quality for individual phase currents and voltages.

Recloser

There is a recloser in every DFP200. This recloser allows up to four reclose attempts. The number of attempts is programmable between 1 and 4 (setting 1103, NUMRECL) and includes a separate setting to disable the reclose function (setting 1101, RECLEN).

The reclose cycle can be programmed to be initiated by an internal trip only (setting 1102, RECLON52B=OFF) or it can be initiated by either an internal or external trip (setting 1102, RECLON52B=ON).

For each reclose attempt, the time between the trip and the reclose can be independently set (setting 1105 - 1108, RECL1 - RECL4). The reset time, can be programmed between 0 and 600 seconds (setting1109, RCLRST).

In order to initiate a reclose cycle, it is necessary for one of the Configurable Inputs, setting

0401 - 0408, to be set to 52/b Status. This will enable the relay to “see” the status of the breaker. The end result of the Recloser algorithm (i.e. When the recloser is ready to reclose the breaker) is for the DFP200 to set the BRKRCLOSE flag true in the Xpression Builder Logic. Therefore, in order, to obtain any operation on the DFP200 recloser the user must:

1. A Configurable Input must be set to 52/b Status, See Figure 2-9.

2. The BRKRCLOSE Flag in Xpression Builder must be set to drive an Output Contact (the default BRKRCLOSE contact is OUTPUT 3, See Figure 2-8).

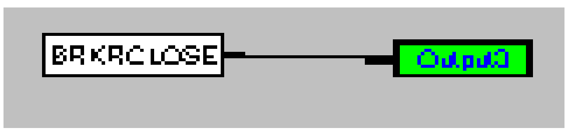


Figure 2-8 BRKRCLOSE Setting for Recloser in Xpression Builder

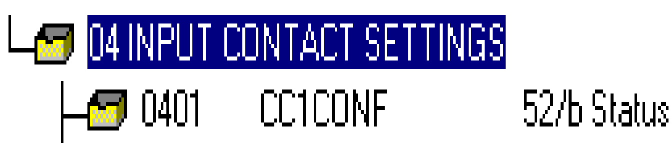


Figure 2-9 52/b Status for Recloser in DFP200-LINK

If setting 1102, RECLON52B is set to ON and the recloser is in the RESET state any opening of the breaker, as reported through the 52/b contact, will initiate the recloser in the DFP200. If setting 1102 is set to OFF the relay will only reclose if the breaker opening corresponds to a “trip” OUTPUT flag in Xpression Builder being set true.

A “trip” OUTPUT flag is identical to any other OUTPUT flag in Xpression Builder except the “trip” OUTPUT flags are red. These red OUTPUT flags signal the DFP200 do a variety of functions, including:

- Oscillography Capture
- Fault Report
- Trip Circuit Seal-In Function
- Initiate Reclosing

To create a red OUTPUT flag, after loading your configurable logic in Xpression Builder double-click on any OUTPUT flags. This will trigger a pop-up menu labeled OUPUT. In this menu select the option for trip. This will assign that OUTPUT flag as being a “trip” OUTPUT and will cause the DFP200 to initiate the above functions whenever it is set true. For a full description of the “trip” OUTPUT flags see CHAPTER 11 - Xpression Builder, Digital Output Assignment.

Recloser - Configurable Inputs

In addition to the 52/b Status flag, there are 5 Configurable Inputs flags that affect the operation of the recloser. They are:

SKIP FIRST RECLOSE CYCLE
RECLOSER PAUSE
RECLOSER LOCKOUT
RECLOSER RESET
BLOCK RECLOSER

Assigning SKIP FIRST RECLOSE CYCLE as one of your Configurable Inputs, and setting Setting 1104, DELRECL, YES will the user to signal the DFP200 to skip the first programmed and go directly to the second programmed reclose. For some applications it may be desirable to initiate high speed plus delayed reclosures following a high speed trip, but to allow delayed reclosures only after a time delayed trip. A signal from the time delayed trip bus can be routed to a Configurable Input which is then assigned to SKIP FIRST RECLOSE CYCLE. With this connection the recloser will skip the first reclosure and go to the next reclosure when a trip occurs.
A Configurable Input set to RECLOSER PAUSE will provide the recloser with the external digital signal needed when using the

PAUSE option of the recloser (SEE Product Description - RECLOSE PAUSE).

To prevent a reclose cycle from continuing the DFP200 has a RECLOSER LOCKOUT setting for the Configurable Inputs. Energizing this configurable input while the breaker is open will send the recloser to the LOCKOUT state. Removing the signal from the configurable input with the breaker closed will bring the recloser to the RESET state.

Another method to force the Recloser to RESET with the breaker closed can be done by energizing a Configurable Input set to RECLOSER RESET.

BLOCK RECLOSER is enabled if setting 1120, BLKRECL, is set to YES and a Configurable Input is set to BLOCK RECLOSER. If these settings are applied and the corresponding Configurable input is energized it will automatically send the recloser to the LOCKOUT state regardless if the recloser is at reset, in-progress, or counting down the reset timer. Removing the keying with the breaker closed will bring the recloser to the RESET state.

Recloser -Features

RECLOSE PAUSE

Reclose Pause is a feature of the recloser that allows the user to obtain control of the recloser throughout the reclose cycle. The Pause function, if enabled, will affect either the reclose time, the reset time, or both.

Setting 1110, PAUSE, will determine what operations will be affected by the PAUSE function. If setting 1110 is set to PAUSE ON RECLOSE ONLY, a reclose output will be delayed for up to the setting 1112, PAUSE ON RECLOSE TIME DELAY, timer setting or until an external contact is closed at the assigned digital input. If the contact closes during the PAUSE period, the reclose output will be produced immediately. If the contact does not close, the recloser will go to LOCKOUT at the end of the PAUSE period. The recloser cannot produce a close output unless the PAUSE input is present at some time during the PAUSE period which begins at the instant when the recloser would issue a close output with PAUSE disabled. This feature is commonly used for synchronism check supervision of reclosing.

If the PAUSE setting is set to PAUSE ON RESET ONLY, the reset time can be extended for a time equal to setting 1113, PAUSE ON RESET TIME DELAY. If the external contact is closed during the RESET period, the RESET timer will continue to count down. If the external contact is open during the RESET period, the RESET timer is stopped from counting down for an interval that cannot exceed the PAUSE ON RESET TIME DELAY timer setting. That is, the extension of the reset time is equal to the time that the external contact is open or the PAUSE ON RESET TIME DELAY setting, whichever is the lesser of the two.

The RECLOSE PAUSE flag used by the Pause function can be set by three methods:

1. Configurable Input
2. Sync Check Input (Optional)
3. Both - Configurable Input or Sync Check

Setting 1111, RECLOSE PAUSE INPUT, determines which of the three options will be used.

If option 1 is used, the RECLOSE PAUSE flag is set by the Configurable Input. Only energizing a Configurable Input set to RECLOSER PAUSE will set the RECLOSE PAUSE FLAG.

If option 2 is used, the RECLOSE PAUSE flag is set by the output of the Sync Check function. Only when the Sync Check unit gives a true output will the RECLOSE PAUSE flag be true (See - SYNC CHECK, in the PRODUCT DESCRIPTION section).

If option 3 is used, the output of options 1 and 2 are Ored together and this sets or clears the RECLOSE PAUSE flag.

RELAY SPARE

Relay Spare is another feature of the recloser. This feature allows the setting of a flag (RLYSPARE) during the reclose cycle. This RLYSPARE flag can then be used to drive an OUTPUT or provide an input to any gate used in Xpression Builder. The default settings in the DFP200 have RLYSPARE driving OUTPUT 5.

Figure 2-10 The default settings for Relay Spare

Settings 1114 - 1116 control the operation of the RLYSPARE flag. Setting 1114, RLYSPARE, will determine after which reclose (1^{st}, 2^{nd}, 3^{rd}, or 4^{th}) the RLYSPARE flag will be set. Setting 1115, RSPU, will set the pickup time for the RLYSPARE flag. Setting 1116, RSDO, will set the dropout time for the RLYSPARE flag.

As an example, if your Relay Spare function had the following settings:

Setting #	Setting Value
1114	3^{rd}
1115	5 seconds
1116	8 seconds

*Xpression Builder logic are the default settings, see Figure 2-10.

You output would be: five seconds after the 3^{rd} reclose, OUTPUT 5 would pickup and 8 seconds after the 3^{rd} reclose, OUTPUT 5 would dropout.

Note: The Relay Spare Pickup and Dropout Timer start at the same time. They will both start with the operation of the reclose number in setting 1114. In the above example the Relay Spare Pickup Timer will expire (setting the RLYSPARE flag) 5 seconds after the 3^{rd} reclose and the Relay Spare Dropout Timer will expire (clearing the RLYSPARE flag) 8 seconds after the 3^{rd} reclose. The result is that the RLYSPARE flag will be set for 3 seconds (setting 1116 minus setting 1115).

BLOCKING IOC

The DFP200 has settings available that allow the user to block the IOC functions from operating during the reclose cycle or while the recloser is in Lockout. If setting 1118, BLKIOC, is ON the IOC functions are blocked from tripping after the first reclose operation of the recloser. The IOC functions remain blocked until the recloser goes to the reset state.

If setting 1119, BLKIOCLK, is ON the IOC functions are blocked from tripping when the recloser is in the Lockout state. The IOC functions are returned to service when the recloser goes to the reset state.

RECLOSER MEMORY

The recloser memory feature is useful in those cases where the DFP200's control power input source (DC battery or AC control power transformer) can be lost when the recloser is active (in progress). If the memory feature is not used, RECLMEM = 0 (NO), then after control power is restored the recloser will reinitialize in either the reset state if the breaker is closed or the lockout state if the breaker is open.

If the memory feature is enabled, RECLMEM = 1 (YES), then the recloser will remember where in the reclose cycle control power was lost and return to the beginning of that reclose cycle when control power is restored. For example, assume the first reclosure was set to operate after a 15 second time delay and that control power was lost half-way through the 15 second period. When control power is restored, the recloser will reinitialize at the first reclosure but it will start timing the full 15 seconds rather than 7.5 seconds. After the first reclosure occurs the recloser will continue through the remainder of its sequence.

Sync-check

As an option, you can select a DFP200 with Sync-check. If the 9th character in your model number is an "E" (e.g. DFP2XXXXEXXX) your DFP200 will include the sync-check function.

The sync-check function is intended primarily for application where two parts of a system to be joined by the closure of a circuit breaker are interconnected at other points throughout the system. Although the voltages on either side of an open breaker are in synchronism, there may be an angular difference between them as a result of load flow throughout the interconnected system. It is usually desirable to close the breaker although this angular difference exists; provided of course that this difference is not great enough to be detrimental to the system or to connected equipment. Each application should be checked on an individual basis to determine the maximum angular difference for which closing can be tolerated.

Once an acceptable angular difference has been determined, the closing angle of the DFP200 can be set accordingly. The DFP200, with its Recloser unit and Sync-check unit, can not only determine that the angle between the voltages on the parts of the system to be joined are within the predetermined value, but it can also issue the Close command to the breaker.

The relay is a three phase device that is connected to either line-side voltage or bus-side voltage. The sync-check function requires the voltage from both sides of the open breaker. If the main PT connections are line-side then the sync-check connections are bus-side and vice-versa. This sync-check input is applied to studs AA15 and AA16, as shown in Figure 2-2. This single phase voltage can be either line voltage or bus voltage (as determined by setting 1510, SYNCCHINP).

The sync-check function , when enabled and with the breaker open (as seen through the 52/B), measures the bus and line voltage magnitude first. It checks the voltage for the phase set in setting 1509, SYNCPHAS and compares it to the voltage on the sync-check input. If these quantities exceed their respective settings (settings 1504, UV_LINE and setting 1505, UV_BUS) they are considered "LIVE". If these quantities do not exceed their settings they are considered "DEAD". After the DFP200 determines "LIVE"-"DEAD" state of the bus and line voltages it will look at settings 1506 - 1508 and find the corresponding condition. If the corresponding condition is set to ON the sync-check function will set the SYNCCHK flag. If the corresponding condition is set to OFF the sync-check function will clear the SYNCCHK flag.

The condition where voltage greater than setting 1504 and 1505 exists on both sides of the open breaker will cause the sync-check function to measure the angle and slip frequency between the two voltages. If these quantities are less than setting 1502, CLSANG_MAX and setting 1503, SLIP_MAX then the SYNCCHK flag will be set true.

The Sync-Check function works in conjunction with the PAUSE function of the Recloser (See RECLOSER in Product Description). The Pause function, when enabled, tells the Recloser to wait for the setting of the Pause flag prior to issuing the Close Breaker command. The Pause flag can only be set according to ORed output of the SYNCCHK flag and the PAUSINP flag. If this is true the Recloser will proceed with closing the breaker.

In short, the Sync-check function alone will only set the SYNCCHK flag, however, you have to enable the Pause function with Sync-check input (setting 1111, PAUSINP) for the Recloser to check that the SYNCCHK flag is set prior to closing the breaker.

Chapter 3
CALCULATION OF SETTINGS

This chapter provides information to assist the user in determining the required settings for the DFP200 relay. All settings, along with corresponding ranges (and associated units, where applicable), are listed in Table 3-1. The DEFAULT column indicates the settings stored in memory as shipped from the factory. Both the ranges and defaults listed in Table 3-1 apply to DFP200 relays designed for use with current transformers having a nominal 5 ampere secondary rating. The settings for which the range and default values differ for DFP200 relays designed for use with current transformers having a nominal 1 (one) ampere secondary rating are marked with a double or triple asterisk (**) (***). Notes at the end of Table 3-1 explain how the values must be modified.

The DFP200 relay settings may be viewed or changed via a personal computer (PC) connected to a serial port or via the optional keypad/display module. The DFP200 stores eight setting groups in non-volatile memory. The following setting categories contain the settings that are common to all eight groups.

- General
- Hardware
- Monitoring

The remaining setting categories, listed below, contain the settings that can have different values in each of the eight setting groups.

- Digital (Contact) Inputs
- High Impedance (HI-Z)
- Overcurrent Protection
- Negative Sequence Overcurrent
- Sequence Coordination
- Over/Under Voltage
- Over/Under Frequency
- Recloser
- Fault Location
- Directional (Torque) Control
- Oscillography
- Sync - Check

NOTE: For settings with units of current, voltage, or impedance, the setting value is in terms of secondary quantities.

GENERAL

DFP Unit ID (UNITID) [0101]

This setting is a decimal number between 0 and 9999 that uniquely identifies a DFP200 relay. When the DFP200 relay is accessed via a serial port the UNITID must be known to establish communication, thus providing a measure of security.

Phase CT Ratio (PHCTRATIO) [0102]

This setting specifies the primary-to-secondary ratio of the phase current transformers connected to the DFP200 relay. A CT ratio of 1200/5 would be entered as 240. The range is from 1-5000.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

Ground CT Ratio (G_CTRATIO) [0103]

This setting specifies the primary-to-secondary ratio of the ground current transformer connected to the DFP200 relay. If the ground current coil is connected to the residual circuit formed by wye connected CTs, then this setting is equal to the phase CT ratio. The range is 1-5000.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

VT Ratio (VTRATIO) [0104]

This setting specifies the primary-to-secondary ratio of voltage transformers connected to the DFP200 relay. The range is 1-7000.

Table 3-1 DFP200 Settings

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
GENERAL						
0101	DFP Unit ID	UNITID	N/A	0 - 9999	1	0
0102	Phase CT Ratio	PHCTRATIO	N/A	1 - 5000	1	120
0103	Ground CT Ratio	G_CTRATIO	N/A	1 - 5000	1	120
0104	VT Ratio	VTRATIO	N/A	1 - 7000	1	110
0105	Port 4 Settings (RS-485/RS-232 settings) Baud Rate: Parity: Stop Bits:	COM4SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1, 2	N/A	09601
0106	Port 3 Settings (RS-232 Settings) Baud Rate: Parity: StopBits:	COM3SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1,2	N/A	09601
0107	Port 2 Settings (RS-232 Settings) Baud Rate: Parity: Stop Bits:	COM2SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1, 2	N/A	09601
0108	Port 4 Protocol	COM4PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	0 (GE_MOD)
0109	Port 3 Protocol	COM3PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	0 (GE_MOD)
0110	Port 2 Protocol	COM2PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	0 (GE_MOD)
0111	Port 4 Interface	COM4IF	N/A	0 (RS232) 1 (RS485)	N/A	0 (RS232)
0112	System Frequency - Hz	SYSFREQ	Hz	50 Hz or 60 Hz	N/A	60 Hz
0113	Settings File	SETFILE	N/A	0 (EXTERNAL) 1 (SETGRP 1) 5 (SETGRP 5) 2 (SETGRP 2) 6 (SETGRP 6) 3 (SETGRP 3) 7 (SETGRP 7) 4 (SETGRP 4) 8 (SETGRP 8)	N/A	1 (SETGRP 1)
0114	Phase Designation	PHASDESG	N/A	0 (A-B-C) 1 (A-C-B)	N/A	0 (A-B-C)
0115	Phase Potential	PHASPOTL	N/A	0 (L-N) 1 (L-L)	N/A	0 (L-N)
0116	Displayed Values	DISPVAL	N/A	0 (SECNDRY) 1 (PRIMARY)	N/A	0 (SECNDRY)
0117	Front Panel Resets	FPNLRESET	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	1 (ALLOWD)

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
0118	Configured CTs	CONFCTS	N/A	0 (ABCN) 1 (BCN) 2 (CAN) 3 (CN) 4 (ABN) 5 (BN) 6 (AN) 7 (N) 8 (ABC) 9 (BC) 10 (CA) 11 (C) 12 (AB) 13 (B) 14 (A) 15 (NONE)	N/A	0 (ABCN)
0119	Configured VTs	CONFVTS	N/A	0 (ABC) 1 (BC) 2 (CA) 3 (C) 4 (AB) 5 (B) 6 (A) 7 (NONE)	N/A	0 (ABC)
0120	Login Timeout	LOGTMEOUT	min.	0 - 99 min	1	15 min
HARDWARE						
0201	Remote Breaker Operation	REMBKROP	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	0 (NOT ALLOWED)
0202	Remote Configuration	REMCONF	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	0 (NOT ALLOWED)
0203	CT Rating	CTRATING	N/A	0 (5-AMP) 1 (1-AMP)	N/A	model dependent
MONITORING						
0301	Brkr Health Threshold	BHTHR	A^XSEC	0 - 39,999,999.99 @	0.01	14400.00
0302	Current THD Threshold	AMPTHDTHR	%	0.0% - 100.0%	0.1	25.0%
0303	Voltage THD Threshold	VOLTTHDTHR	%	0.0% - 100.0%	0.1	3.0%
0304	# Disturbance Reports	NUMFLTS	N/A	1, 2, 4, 8,12,16	N/A	4
0305	Breaker Arc Time	BRKRARCTME	ms	20 ms - 200 ms	1	100 ms
0306	Breaker Health Exponent	BHEXP	N/A	1.0 - 2.0	0.1	1.0
0307	Demand Period	DEMPERIOD	min	1 - 60 min	1	15 min
0308	NUMRMSFLTS	NUMRMSFLTS		1, 2, 4, 8, 12, 16	N/A	4
0309	Oscillography Full Time	OSCTIME	min	0 - 10000 0 (Always overwrite) 1 (Never overwrite)	1	0
0310	RMS Oscillography Full Time	RMSTIME	hrs	0 - 10000	1	0
DIGITAL (CONTACT) INPUTS						
0401	CC1 Configuration	CC1CONF	N/A	See TABLE 3-2 "Digital Input Assignments"	N/A	(52/b STATUS)
0402	CC2 Configuration	CC2CONF	N/A		N/A	(OSC START)
0403	CC3 Configuration	CC3CONF	N/A		N/A	52/a STATUS
0404	CC4 Configuration	CC4CONF	N/A		N/A	Disable Control
0405	CC5 Configuration	CC5CONF	N/A		N/A	(TORQUE1 CONTROL)
0406	CC6 Configuration	CC6CONF	N/A		N/A	Open Breaker

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
0407	CC7 Configuration	CC7CONF	N/A		N/A	Block Re-closer
0408	CC8 Configuration	CC8CONF	N/A		N/A	User Flag 1
HIGH IMPEDANCE (HI-Z)						
0501	Arcing Sensitivity *	ARCSENS	N/A	1 - 10	1	5
0502	Phase Event Count	PHEVTCNT	N/A	10 - 250	1	20
0503	Ground Event Count	GNDEVTCNT	N/A	10 - 500	1	20
0504	Event Count Time	EVTCNTTME	min	5 min - 180 min	1	60 min
0505	OC Coord Timeout	OCCRDTMEOT	sec	10 sec - 200 sec	1	15 sec
0506	PCHZ (Phase OC) **	PCHZ	amps	0.50 - 50.00 amps	0.01	7.50 amps
0507	GCHZ (Ground OC) **	GCHZ	amps	0.50 - 50.00 amps	0.01	2.50 amps
0508	Phase Rate of Change **	PHRATECHG	amps/ 2cycles	0.05 - 10.00 amps/2 cycles	0.01	1.25 amps/2 cyles
0509	Ground Rate of Change	GNDRATECHG	amps/ 2cycles	0.05 - 10.00 amps/2 cycles	0.01	1.25 amps/2 cyles
0510	Loss of Load Threshold	LDTHRLOSS	%	5% - 100%	1	15%
0511	3-Ph Event Threshold **	PH3EVTTHR	amps	0.05 - 10.00 amps	0.01	0.42 amps
0512	Voltage Supervision	VSUP	%	0 - 100	1	0
0513	Voltage Supervision Time	VSUPTIME	cycles	0 - 300	1	0
0514	Second Harmonic Restraint	2HARMRES	%	0 - 100	1	0
0515	Hi-Z Monitoring	HIZMON	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
OVERCURRENT PROTECTION						
0601	IOC Low Phase Pickup **	IOCLOPH	amps	0.50 - 160.00 amps	0.01	0.5 amps
0602	IOC Low Phase Delay	IOCLOPHDL	ms	0 - 250 ms	1	100 ms
0603	Phase Low IOC Protection	PHLOIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0604	IOC High Phase Pickup **	IOCHIPH	amps	0.50 - 160.00 amps	0.01	0.5 amps
0605	IOC High Phase Delay	IOCHIPHDL	ms	0 - 50 ms	1	10 ms
0606	Phase High IOC Protection	PHHIIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0607	IOC Low Ground Pickup **	IOCLOGND	amps	0.50 - 160.00 amps	0.01	0.5 amps
0608	IOC Low Ground Delay	IOCLOGNDDL	ms	0 - 250 ms	1	100 ms
0609	Ground Low IOC Protection	G_LOIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0610	IOC High Ground Pickup **	IOCHIGND	amps	0.50 - 160.00 amps	0.01	10.00 amps
0611	IOC High Ground Delay	IOCHIGNDDL	ms	0 - 50 ms	1	10 ms
0612	Ground High IOC Protection	G_HIIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0613	Phase TOC Protection	PHTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0614	Phase TOC Pickup **	PHTOCPKUP	amps	0.50 -12.00 amps	0.01	1.00 amps
0615	Phase Time Dial	PHTMEDIAL	N/A	0.50 -10.00	0.01	5.00

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
0616	Phase TOC Curve	PHTOCCUR	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED)	N/A	3 (DEF TIME)
0617	Phase Definite Time	PHDEFNTME	sec	0.50 -30.00 sec	0.01	5.00 sec
0618	Phase Adaptive	PHADAPT	%	110 - 300 %	1	150%
0619	Min Phase Adaptive	MINPHADAPT	%	25 - 100 %	1	50%
0620	Max Phase Adaptive	MAXPHADAPT	%	110 - 300 %	1	150%
0621	Phase Averaging Period	PHAVEPD	sec	0 - 600 sec	1	0 sec
0622	Ground TOC Protection	GNDTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0623	Ground TOC Pickup	GNDTOCPKUP	amps	0.50 -12.00 amps	0.01	1.00 amps
0624	Ground Time Dial	GNDTMEDIAL	N/A	0.50 -10.00	0.01	5.00
0625	Ground TOC Curve	GNDTOCCUR	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED)	N/A	2 (EXT. INVERSE)
0626	Ground Definite Time	GNDDEFNTME	sec	0.50 -30.00 sec	0.01	5.00 sec
0627	Ground Adaptive	GNDADPT	%	110 - 300 %	1	150%
0628	Min Ground Adaptive	MINGNDADPT	%	25 - 100 %	1	50%
0629	Max Ground Adaptive	MAXGNDADPT	%	110 - 300 %	1	150%
0630	Ground Averaging Period	GNDAVEPD	sec	0 - 600 sec	1	0 sec
0631	Cold Load Pickup Time	COLDLDPKUP	min	0 - 60 min	1	0 min
0632	TOC Reset Option	TOCRESET	N/A	0 (EM RESET) 1 (FAST RESET)	N/A	0 (EM RESET)

NEGATIVE SEQUENCE OVERCURRENT						
0701	Neg Seq IOC Pickup **	NSIOCPKUP	amps	0.10 - 160.00 amps	0.01	1.00 amps
0702	Neg Seq IOC Time Delay	NSIOCTMEDL	ms	0 - 250	1	100 ms
0703	Neg Seq IOC Protection	NSIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
0704	Neg Seq TOC Protection	NSTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
0705	Neg Seq TOC Pickup **	NSTOCPKUP	amps	0.10 - 12.00 amps	0.01	1.0 amps
0706	Neg Seq Time Dial	NSTMEDL	N/A	0.50 - 10.00	0.01	5.00
0707	Neg Seq TOC Curve	NSTOCCURV	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED	N/A	2 (EXT. INVERSE)

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
0708	Neg Seq Definite Time Delay	NSDEFTMEDL	sec	0.50 - 30.00 sec	0.01	1.00 sec
0709	Neg Seq TOC Reset Option	NSTOCRESET	N/A	0 (EM RESET) 1 (FAST RESET)	N/A	0 (EM RESET)
SEQUENCE COORDINATION						
0801	Seq Coord Delay Time	SEQCRDDLTM	sec	0.05 - 0.50 sec	0.01	0.05 sec
0802	Seq Coord Reset Time	SEQCRDRSTM	sec	5 - 600 sec	1	5 sec
0803	Seq Coordination	SEQCRD	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
0804	Seq Block High IOC	SEQBLKHI	N/A	0 (NO) 1 (YES)	N/A	1 (YES)
OVER/UNDER VOLTAGE						
0901	Undervoltage Pickup	UVPKUP	Vac	1.0 - 200.0 Vac	0.1	40.0 Vac
0902	UV Time Delay	UVTMEDL	sec	0 - 1000 sec	1	10 sec
0903	Undervoltage Protection	UVPROT	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
0904	Overvoltage Pickup	OVPKUP	Vac	50.0 - 250.0 Vac	0.1	120.0 Vac
0905	OV Time Delay	OVTMEDL	sec	0 - 1000 sec	1	10 sec
0906	Overvoltage Protection	OVPROT	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
OVER/UNDER FREQUENCY						
1001	Set1 Underfreq Pickup	UF1PKUP	Hz	40.00 - 60.00 Hz	0.01	58.00 Hz
1002	Set1 Underfreq Time Delay	UF1DLY	sec	0.05 - 10.00 sec	0.01	0.05 sec
1003	Set1 Overfreq Pickup	OF1PKUP	Hz	40.00 - 80.00 Hz	0.01	62.00 Hz
1004	Set1 Overfreq Time Delay	OF1DLY	sec	0.05 - 10.00 sec	0.01	0.05 sec
1005	Set2 Underfreq Pickup	UF2PKUP	Hz	40.00 - 60.00 Hz	0.01	58.00 Hz
1006	Set2 Underfreq Time Delay	UF2DLY	sec	0.05 - 10.00 sec	0.01	0.05 sec
1007	Set2 Overfreq Pickup	OF2PKUP	Hz	40.00 - 80.00 Hz	0.01	62.00 Hz
1008	Set2 Overfreq Time Delay	OF2DLY	sec	0.05 - 10.00 sec	0.01	0.05 sec
1009	Restoration Freq	RESTFREQ	Hz	40.00 - 80.00 Hz	0.01	59.00 Hz
1010	Restoration Time Delay	RESTDLY	sec	0 - 999 sec	1	10 sec
1011	Voltage Supervision Threshold	VOLTTHR	Vac	20.0 - 200.0 Vac	0.1	80.0 Vac
1012	Underfreq Protection	UFPROT	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
1013	Overfreq Protection	OFPROT	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
RECLOSER						
1101	Reclose Enable	RECLEN	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
1102	Reclose On 52/b	RECLON52B	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
1103	Number of Reclosers	NUMRECL	N/A	1 - 4	1	4
1104	Delayed Reclose	DELRECL	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1105	First Reclose Time Delay	RECL1	sec	0 - 600	0.01	1.0 sec
1106	2nd Reclose Time Delay	RECL2	sec	0 - 600	0.01	2.0 sec
1107	3rd Reclose Time Delay	RECL3	sec	0 - 600	0.01	3.0 sec
1106	4th Reclose Time Delay	RECL4	sec	0 - 600	0.01	4.0 sec
1109	Reset Time Delay	RCLRST	sec	0 - 600	0.01	10.0 sec
1110	Reclose Pause	PAUSE	N/A	0 (DISABLE) 1 (PAUSE ON RECLOSE ONLY) 2 (PAUSE ON RESET ONLY) 3 (PAUSE ON RECLOSE AND RESET BOTH)	N/A	0 (DISABLE)
1111	Reclose pause input	PAUSINP	N/A	0 (NONE) 1 (PAUSE CC INPUT) 2 (SYNC CHECK INPUT) 3 (BOTH)	N/A	0 (NONE)
1112	Pause on Reclose Time Delay	PSONRECL	sec	0 - 4000 (0: INFINITE)	0.01	0.01 sec
1113	Pause on Reset Time Delay	PSONRES	sec	0.01 - 4000	0.01	0.01 sec
1114	Relay Spare at Reclose	RLYSPARE	N/A	0 (NONE) 3 (THIRD) 1 (FIRST) 4 (FOURTH) 2 (SECOND)	N/A	0 (NONE)
1115	Relay Spare Pickup Time Delay	RSPU	sec	0.01 - 50	0.01	0.01 sec
1116	Relay Spare Dropout Time Dly	RSDO	sec	0 - 200 (0: lockout)	0.01	0.01 sec
1117	Breaker Transition Time Delay	BRDRTRANS	sec	0 - 5	0.01	0.90 sec
1118	Block Instantaneous	BLKIOC	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1119	Block IOC During Lockout	BLKIOCLK	N/A	0 (OFF) 1 (OFF)	N/A	0 (OFF)
1120	Block Recloser	BLKRECL	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1121	Reclose Memory	RECLMEM	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
FAULT LOCATION						
1201	Pos Seq Impedance Magnitude ***	ZPMAG	ohms	0.05 - 50.00 ohms	0.01	7.00 ohms
1202	Pos Seq Impedance Angle	POSANG	deg.	10.0 - 90.0 deg	0.1	70.0 deg
1203	K0 Ratio	K0RATIO	N/A	0.5 - 7.0	0.1	3.0
1204	Zero Seq Impedance Angle	ZERIMPANGL	deg.	10.0 - 90.0 deg	0.1	70.0 deg
1205	Enable Fault Location	ENFLTLOC	N/A	0 (DISABLE) 1 (ENABLE)	N/A	1 (ENABLE)

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
1206	Line Length	LINELEN	N/A	0 - 200 miles (0 - 322 Km)	1	100 miles (161 Km)
1207	Line Length Units	LENUNITS	miles/ Km	0 (miles) 1 (Km)	N/A	0 (miles)
DIRECTIONAL (TORQUE) CONTROL						
1301	Zero Seq Polarization	ZSEQPOL	N/A	0 (3V0) 1 (3I0) 2 (BOTH)	N/A	0 (3V0)
1302	Ground Torque Control	GNDTRQCTL	N/A	0 (ZERO SEQUENCE) 1 (NEGATIVE SEQUENCE)	N/A	0 (ZERO SE- QUENCE)
1303	Torque1	TORQ1	N/A	a - 67G/67N b - 67P c - 27 d - DIGITAL INPUT 0 (DISABLED) 1 (ENABLED)	N/A	0011 abcd
1304	Torque2	TORQ2	N/A	a - 67G/67N b - 67P c - 27 d - DIGITAL INPUT 0 (DISABLED) 1 (ENABLED)	N/A	1100 abcd
1305	Torque Control 1	TRQCTL1	N/A	a - 51P b - 51G c - 50PH d - 50PL e - 50GH f - 50GL g - 46I h - 46T 0 (DISABLED) 1 (ENABLED)	N/A	11111111 abcdefgh
1306	Torque Control 2	TRQCTL2	N/A	a - 51P b - 51G c - 50PH d - 50PL e - 50GH f - 50GL g - 46I h - 46T 0 (DISABLED) 1 (ENABLED)	N/A	11111111 abcdefgh
1307	Max Torque Angle	MAXTRQANGL	deg.	0.0 - 90.0	0.1	80.0
1308	Fault Detector Level **	FLTDETLVL	amps	0.10 - 2.00 amps	0.01	2.00 amp

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	DEFAULT
			OSCILLOGRAPHY			
1401	Oscillography Mask Word 1	OSCMASK1	N/A	a - 50PH-PU b - 50PL-PU c- 50GH-PU d - 50GL-PU e - 51P-PU f - 51G-PU g - 27-PU h - 59-PU 0 (DISABLED) 1 (ENABLED)	N/A	00001111 abcdefgh
1402	Oscillography Mask Word 2	OSCMASK2	N/A	a - 46I-PU b - 46T-PU c - 81U-PU1 d - 81O-PU1 e - 81U-PU2 f - 81O-PU2 g - TORQ1PU h - TORQ2PU 0 (DISABLED) 1 (ENABLED)	N/A	11001111 abcdefgh
			SYNC CHECK			
1501	Synccheck Enable	SYNCCHEN	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1502	Maximum Close Angle	CLSANG_MAX	deg.	2 - 60	0.1	2.0 deg
1503	Maximum Slip	SLIP_MAX	Hz	0.01 - 10	0.01	1.00 Hz
1504	Undervoltage Line	UV_LINE	volts	10 - 120	0.1	10.0 volts
1505	Undervoltage Bus	UV_BUS	volts	10 - 120	0.1	10.0 volts
1506	Set Dead Line Bus	SETDL_BUS	N/A	0 (OFF) 1 (ON)	N/A	1 (ON)
1507	Set Live Line Dead Bus	SETLL_DB	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1508	Set Dead Line Live Bus	SETDL_LB	N/A	0 (OFF) 1 (ON)	N/A	0 (OFF)
1509	Synccheck Phase	SYNCPHAS	N/A	0 (A) 3 (AB) 1 (B) 4 (BC) 2 (C) 5 (CA)	N/A	0 (Phase A)
1510	Sync PT Input	SYNCCHINP	N/A	0 (Line Side) 1 (Bus Side)	N/A	0 (Line Side)
1511	Sync Check on Manual Close	SYNCCLBR	N/A	0 (Disabled) 1 (Enabled)	N/A	0 (Disabled)

[@] The range for Breaker Health Threshold is given in terms of secondary current. DFP-LINK and the DFP200 relay's optional keypad/display module display the range in terms of primary current by multiplying 39,999,999.99 by the CT ratio (setting 0102) raised to the ‘x’ power (where ‘x’ is determined by setting 0306).

[**] For DFP21xxxxxxx relays (models used with current transformers that have a nominal 1-amp secondary rating), the ranges and defaults for these settings should be divided by 5. <u>All settings are in secondary amps.</u>

[*] For DFP21xxxxxxx relays (models used with current transformers that have a nominal 1-amp secondary rating), the ranges and defaults for these settings should be multiplied by 5. <u>All settings are in secondary ohms.</u>**

Port 4 Settings (COM4SET) [0105]

This setting determines the baud rate, parity, and number of stop bits of the DFP200 relay's rear mounted serial port labeled 'PORT 4.' The setting format is xxxyz where:

- Baud Rate = xxx
- Parity = y
- Stop Bits = z

Port 3 Settings (COM3SET) [0106]

This setting determines the baud rate, parity, and number of stop bits of the DFP200 relay's rear mounted serial port that is labeled 'PORT 3.' The setting format is xxxyz where:

- Baud Rate = xxx
- Parity = y
- Stop Bits = z

Port 2 Settings (COM2SET) [0107]

This setting determines the baud rate, parity, and number of stop bits of the DFP200 relay's front mounted serial port that is labeled 'PORT 2.' The setting format is xxxyz where:

- Baud Rate = xxx
- Parity = y
- Stop Bits = z

For all three of the ports, the ranges are:

xxx =	003 (300 baud)
	012 (1200 baud)
	024 (2400 baud)
	096 (9600 baud)
	192 (19200 baud)
y =	0 (no parity)
	1 (odd parity)
	2 (even parity)
z =	1 (1 stop bit)
	2 (2 stop bits)

Port 4 Protocol (COM4PRO) [0108]

This setting establishes the communication protocol for the DFP200 relay's rear mounted serial port that is labeled 'PORT 4.' The two choices are GE Modem protocol or ASCII protocol. GE Modem protocol requires the use of DFP-LINK software when communicating via the serial ports. With ASCII protocol, any general purpose communication software may be used.

Port 3 Protocol (COM3PRO) [0109]

This setting establishes the communication protocol for the DFP200 relay's rear mounted serial port that is labeled 'PORT 3.' The choices are the same as for the COM4PRO setting.

Port 2 Protocol (COM2PRO) [0110]

This setting establishes the communication protocol for the DFP200 relay's front mounted serial port that is labeled 'PORT 2.' The choices are the same as for the COM4PRO setting.

Port 4 Interface (COM4IF) [0111]

This setting determines whether the DFP200's rear mounted port that is labeled 'PORT 4' is RS232 or RS485.

System Frequency (SYSFREQ) [0112]

Choose 50Hz or 60Hz to match the power system frequency.

Settings File (SETFILE) [0113]

This setting determines the 'active' setting group. The range is 0 to 8. A value of '0' allows external contacts, wired to DFP200 digital inputs, to determine the active setting group. A value from 1 to 8 selects the corresponding number setting group as the active group.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

Phase Designation (PHASDESG) [0114]

This setting determines the normal (positive-sequence) phase rotation, ABC or ACB. This permits the DFP200 to perform the proper calculations and display the proper information while maintaining the same external wiring to the relay regardless of phase rotation.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

Phase Potential (PHASPOTL) [0115]

This setting should be 0 (L-N) if the voltage transformers connected to the DFP200 are connected such that line-to-ground voltage is being applied to individual voltage coils in the relay, and it should be 1 (L-L) if line-to-line voltage is being applied to individual voltage coils in the relay.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

Displayed Values (DISPVAL) [0116]

This setting determines whether metering information is displayed in primary, 1 (PRIMARY), or secondary, 0 (SECONDARY), values.

Front Panel Resets (FPNLRESET) [0117]

If set to 1 (ALLOWED), the user is able to reset the peak values and the breaker health values via the optional keypad/display module that is attached to PORT1. If set to 0 (NOT ALLOWED) and the user attempts a reset via the keypad/display module, a message will be displayed indicating that local resets are not allowed.

Configured CTs (CONFCTS) [0118]

Normally three wye connected CTs will be wired to the four DFP200 current coils labeled A, B, C, and N in Figure 2-2. However, it may sometimes be necessary not to apply current to each current coil. This setting tells the DFP200 relay which current coils (A, B, C, N) have current applied. There are 16 settings from 0 to 15 which represent all the combinations.

NOTE: When this setting is changed, the DFP200 automatically reinitializes. DFP-LINK will stay logged into the relay during this reinitialization.

Configured VTs (CONVTS) [0119]

The DFP200 can be configured for none, one, two, or three voltage transformer (VT) secondaries. This setting tells the DFP200 relay which voltage coils (A, B, C) have voltage applied.

The DFP200 relay can operate (with reduced functionality) without voltage connected or with various single-phase and three-phase voltage connections. The practical possibilities are:

1. No voltage connected
2. Single phase to ground voltage using one VT
3. Phase-to-phase voltage using one VT
4. Three phase voltage using three wye-wye connected VTs
5. Three phase voltage using two open-delta connected VTs

The presence or absence of voltage inputs to the DFP200 relay has no effect on the HI-Z protection's ability to detect high impedance faults. However, with no voltage connected, phase identification for a high impedance fault would be limited and the following functions would be inoperative:

- power calculations
- directional functions
- voltage-based total harmonic distortion (THD) calculations

NOTE: When this setting is changed, the DFP200 automatically reinitializes. The communication software will stay logged into the relay during this reinitialization.

Login Timeout (LOGTMEOUT) [0120]

When logged into the DFP200 relay via a serial port, the relay will automatically logout if there is no serial port activity for the time interval determined by LOGTMEOUT. This setting range is 0-99 minutes. A setting of '0' prevents the DFP200 relay from initiating an automatic logout (the DFP200 relay will stay logged in until a logout command is sent).

HARDWARE

NOTE: The following settings are 'read only' and are provided for informational purposes only. These settings cannot be changed via either the optional keypad/display module or via a serial port.

Remote Breaker Operation (REMBKROP) [0201]

The setting value ALLOWED or NOT ALLOWED is determined by the position of a hardware jumper (J17 in Figure 4-2) and enables or disables breaker control via the rear serial ports (PORT3 and PORT4). If the jumper is installed, breaker operation is not allowed. If the jumper is not installed, breaker operation is allowed. As shipped from the factory, jumper J17 is installed.

Remote Configuration (REMCONF) [0202]

The setting value ALLOWED or NOT ALLOWED is determined by the position of a hardware jumper (J16 in Figure 4-2) and enables or disables the ability to change settings via the rear serial ports (PORT3 and PORT4). If the jumper is installed, remote setting capability is not allowed. If the jumper is not installed, remote setting capability is allowed. As shipped from the factory, jumper J16 is installed.

CT Rating (CTRATING) [0203]

The CTRATING is either 1 or 5 amperes, indicating whether the DFP200 relay is designed for use with current transformers having a nominal 1 ampere secondary rating or a nominal 5 ampere secondary, respectively. This setting is determined by the position of a hardware jumper (J18 in Figure 4-2) which is installed at the factory.

NOTE: The position of jumper J18 should not be changed by the user!

MONITORING

Brkr Health Threshold (BHTHR) [0301]

This setting represents an $I^X \cdot t$ accumulated value used in determining whether or not a breaker health alarm condition exists. The range is 0 to 39,999,999.99 $I^X \cdot t$ expressed in terms of secondary current values. If any of the three phase values of actual accumulated $I^X \cdot t$ exceeds 80% of BHTHR, a breaker health alarm occurs.

Current THD Threshold (AMPTHDTHR) [0302]

This setting represents a total harmonic distortion (THD) value for current that triggers a THD power quality snapshot capture and sets a THD alarm. The range is 0% to 100%.

Voltage THD Threshold (VOLTTHDTHR) [0303]

This setting represents a total harmonic distortion (THD) value for voltage that triggers a THD power quality snapshot capture and sets a THD alarm. The range is 0% to 100%.

Disturbance Reports (NUMFLTS) [0304]

This setting represents the number of regular oscillography captures the DFP200 can have at any time. This number of captures and the size of the data for each capture are determined by NUMFLTS, which can be set to 1, 2, 4, 8, 12, or 16. The way in which the standard memory size is allocated as a function of NUMFLTS is listed below:

NUMFLTS	# cycles of sampled values
1	240
2	120
4	60
8	30
12	20
16	15

Breaker Arc Time (BRKRARCTME) [0305]

This setting is the value of 't' in the $I^X \cdot t$ calculation. Ideally, it should be set to the actual arcing time of the breaker's main contacts. If this value is not known, then a compromise setting is the breaker opening time. The range is 20 - 200 milliseconds.

Breaker Health Exponent (BHEXP) [0306]

This setting is the value of 'x' in the $I^X \cdot t$ calculation. The range is 1.0 - 2.0.

Demand Period (DEMPERIOD) [0307]

Demand profiles for the average currents, voltages, watts, vars, and power factor are maintained for a specified time interval. This time interval is the DEMPERIOD which can be set to 1 - 60 minutes in increments of one minute.

The organization of demand data in the DFP200 relay depends on the model and on the demand period selected. Two different demand storage capabilities are available - 'standard' and '35 day.' - depending on the relay model number. In the 'standard' model, a total of 192 entries of demand data are stored. In the '35 day' model, a total of 3360 entries of demand data are stored. The days of demand storage are dependent upon the DEMPERIOD value. If DEMPERIOD = 15, then 2 days of storage are available with the 'standard' model and 35 days of storage are available with the '35 day' model.

Number of RMS Faults (NUMRMSFLTS) [0308]

This setting represents the number of RMS oscillography captures the DFP200 can have at any time. This number of captures and the size of the data for each capture is determined by NUMRMSFLTS, which can be set to 1, 4, 8, 12, or 16. The way in which the standard memory size is allocated as a function of NUMRMSFLTS is listed below:

NUMRMSFLTS	No. of Samples of RMS Values
1	7680
2	3840
4	1920
8	960
12	640
16	480

Oscillography Full Time (OSCTIME) [0309]

This setting represents the maximum time an unread regular oscillography capture can exist in the DFP200 without the possibility of being overwritten. If the number of regular oscillography captures equals setting 0304, NUMFLTS, the relay will overwrite the oldest "read" regular oscillography. If all of the regular oscillography captures are "unread" the relay will overwrite the oldest "unread" regular oscillography if it is older than the value of setting 0304. If this setting is set to 0, the relay will ALWAYS overwrite the oldest regular oscillography capture if the umber of captures equals setting 0304.

RMS Oscillography Full Time (RMSTIME) [0310]

This setting represents the maximum time an unread RMS oscillography capture can exist in the DFP200 without the possibility of being overwritten. If the number of RMS oscillography captures equals setting 0308, NUMRMSFLTS, the relay will overwrite the oldest "read" RMS oscillography. If all of the RMS oscillography captures are "unread", the relay will overwrite the oldest "unread" RMS oscillography if it is older than the value for setting 0310. If this setting is set to 0, the relay will ALWAYS overwrite the oldest RMS oscillography capture if the number of captures equals setting 0308.

DIGITAL (CONTACT) INPUTS

CC1 Configuration (CC1CONF) [0401]

CC2 Configuration (CC2CONF) [0402]

CC3 Configuration (CC3CONF) [0403]

CC4 Configuration (CC4CONF) [0404]

CC5 Configuration (CC5CONF) [0405]

CC6 Configuration (CC6CONF) [0406]

CC7 Configuration (CC7CONF) [0407]

CC8 Configuration (CC8CONF) [0408]

The eight settings listed above determine how the eight digital inputs (contact converters) are used. There are 21 allowable digital input assignments. Each digital input may be given one and only one assignment at a time, and no two digital inputs can have the same assignment.

A contact converter is an isolated interface that converts the DC battery voltage applied when an external contact closes into a ‘logic 1’ signal level within the DFP200 relay. The terms contact converter and digital input are synonymous. The digital input assignments are presented in Table 3-2. The mnemonic listed under the NAME column is displayed on the optional keypad/display module, the DFP-LINK program, and the ASCII strings.

Table 3-2 Digital Input Assignments

NAME	DESCRIPTION
STAT52B	(52/b circuit breaker auxiliary contact) - opposite sense of main contacts
STAT52A	(52/a circuit breaker auxiliary contact) - same sense as main contact
OSCSTRT	(oscillography start) - when the external contact closes an oscillography capture is triggered
DSBLCTL	(disable outputs) - when the external contact closes the eight programmable outputs are blocked -they will not operate even if an activation signal is produced within the DFP200
ATLSETO	(select setting group bit 0)
ALTSET1	(select setting group bit 1)
ALTSET2	(select setting group bit 2)
	These three bits control which one of the eight setting groups is active. When the respective contact is open the value of the bit is a 'logic 0', and when the respective contact is closed the value of the bit is a 'logic 1.' The following truth table shows how the active group is selected. bit 2 bit 1 bit 0 active group 0 0 0 1 0 0 1 2 0 1 0 3 0 1 1 4 1 0 0 5 1 0 1 6 1 1 0 7 1 1 1 8
RSTARGT	(reset targets)
OPENBKR	(open breaker)
CLOSBKR	(close breaker)
TAGEVNT	(time tag event) - when the external contact is closed an event is generated
TORQUE 1	(torque control 1)
TORQUE 2	(torque control 2)
DELYRCL	(delayed reclose) - input to recloser expression
PAUSINP	(pause input) - input to recloser expression
RECLLKT	(external lockout when breaker is open) - input to recloser expression
RECLRST	(external reset when breaker is closed) - input to recloser expression
BLKRECL	(external lockout) - input to recloser expression
USRFLG1	(user flag 1)
USRFLG2	(user flag 2)
USRFLG3	(user flag 3)
USRFLG4	(user flag 4)
USRFLG5	(user flag 5)
USRFLG6	(user flag 6)
USRFLG7	(user flag 7)
USRFLG8	(user flag 8)

HIGH IMPEDANCE (HI-Z)

Arcing Sensitivity (ARCSENS) [0501]

This one setting establishes both the belief-in-arcing confidence level at which the DFP200 relay's HI-Z protection will recognize arcing on the power system, and sets the arc-detection thresholds in the basic arc detection algorithms. The range is 1 to 10 where 10 is the most sensitive setting and 1 is the least sensitive setting.

Each belief-in-arcing confidence level that is derived by the system's Expert Arc Detector Algorithm is compared to ARCSENS before concluding that arcing is present. Increasing this setting results in the HI-Z protection recognizing arcing at a lower belief-in-arcing level; conversely, decreasing this setting results in recognition at a higher level.

A higher ARCSENS value causes the arc-detection thresholds in the basic arc-detection algorithms to be lower. A higher setting would be suitable for a very quiet, well-behaved power system. However, it would give the basic algorithms a higher propensity for the indication of arcing on a normal system transient. An initial setting of 5 is suggested if the user has no previous experience with the HI-Z protection contained in the DFP200 relay.

Phase Event Count (PHEVTCNT) [0502]

Ground Event Count (GNDEVTCNT) [0503]

The Phase Event Count and Ground Event Count settings allow the user to specify how many individual belief-in-arcing indications for a phase current or the residual current , respectively, must be counted in a specified time period before it is determined that an arcing-suspected event exists. The indications of arcing are detected by the HI-Z protection's basic arc detection algorithms (Energy and Randomness) for a specific set of non-fundamental frequency component energy. The range of PHEVTCNT is 10 - 250. The range of GNDEVTCNT is 10 - 500.

Event Count Time (EVTCNTTME) [0504]

This setting allows the user to specify the length of time (in minutes) over which the DFP200 relay monitors long term, sporadic, arcing events for determination of an <u>arcing-suspected event</u>. The belief -in-arcing confidence level of the DFP200 relay increases as the number of arcing indications increases during this time period. The range is 5 - 180 minutes.

OC Coord Timeout (OCCRDTMEOT) [0505]

The DFP200 relay's high impedance algorithms use OCCRDTMEOT in providing coordination between the HI-Z protection and the feeder's conventional overcurrent protection. The conventional overcurrent protection may be located in the DFP200 or external to the DFP200. The HI-Z protection will not indicate detection of a downed conductor or an arcing, intact conductor before the expiration of this timeout, which begins when the HI-Z protection detects a trigger condition (i.e., loss of load, high rate of change, HI-Z overcurrent, breaker open, or high belief-in-arcing confidence).

The value of this setting should be such that a feeder's conventional overcurrent protection is given adequate opportunity to operate before the timeout expires. The range is 10 - 200 seconds. In choosing a value for this setting, the user should keep in mind that the arcing activity of many downed lines diminishes as time passes due to drying of soil, burning through of the conductor, etc. When this occurs, the arcing becomes more difficult, or even impossible, to detect. Therefore, it is recommended that this timeout value not exceed 30 seconds. Note that at least one additional arc burst must occur after the timeout has expired in order for the HI-Z protection to proceed with its analysis.

PCHZ (Phase OC) - Amps (PCHZ) [0506]

GCHZ (Ground OC) - Amps (GCHZ) [0507]

PCHZ and GCHZ indicate the levels at which the HI-Z protection considers a phase current and residual current, respectively, to be an overcurrent condition. The HI-Z protection algorithms will ignore all data as long as an overcurrent condition exists on the system, because it is assumed that feeder's conventional overcurrent protection will clear an overcurrent fault. The range for both settings is 0.50 - 50.00 amps. It is recommended that PCHZ be set above the maximum load current and that GCHZ be set above the maximum $3I_0$ (residual) current due to unbalanced loading.

Phase Rate of Change (PHRATECHG) [0508]

Ground Rate of Change (CNDRATECHG) [0509]

PHRATECHG and GNDRATECHG establish thresholds for determining when a high rate-of-change event occurs on either a phase RMS current or residual RMS current, respectively, for the protected feeder. While the high impedance fault current exhibits a great deal of randomness, varying considerably from one half-cycle to the next, an extremely high rate of change is not characteristic of most high impedance faults. It is, in fact, more indicative of a breaker closing, causing associated inrush. Since this type of inrush current causes substantial variations in the harmonics used by the high impedance algorithms, these algorithms ignore all data for several seconds following a high rate-of-change event that exceeds the associated rate-of-change threshold, in order to give the system a chance to stabilize.

RMS currents in the HI-Z algorithms are calculated over a two cycle time window. The rate-of-change is calculated as the difference between two consecutive 2-cycle RMS readings. The range for both settings is 0.05 - 10.00 amps. The recommended setting is:

$$\frac{150}{CT\ RATIO} \quad amps / 2cycles$$

Loss of Load Threshold (LDTHRLOSS) [0510]

One way the HI-Z protection checks for a downed conductor is by looking for a precipitous loss of load. The level at which a loss of load is considered significant is determined by LDTHRLOSS expressed as a percentage of the feeder's loading. A loss of load flag is set if the HI-Z algorithms detect a percentage drop in phase current between two successive 2-cycle RMS values that equals or exceeds LDTHRLOSS.

Depending on this setting, if a conductor breaks very near the end of the line, the HI-Z protection will not be able to detect this loss of load. Thus, while it may be able to detect an arcing condition and set an arcing alarm, it will not classify the event as a downed conductor, even though there may be one. The range is 5% - 100%; 5% being the most sensitive setting.

3-Ph Event Threshold (PH3EVTTHR) [0511]

Suddenly adding a very large load on a feeder often has many of the same effects as the closing of a breaker, only on a smaller scale. Starting a large motor, for example, involves inrush that the HI-Z protection will see, and this inrush typically will be rich in certain harmonics. However, this type of load addition should be three-phase in nature, not single phase. The HI-Z protection algorithms ignore the data generated by a large three-phase event. PH3EVTTHR determines the level at which the HI-Z protection will characterize a sudden three-phase current increase as a three-phase event. The range is 0.05 - 10.00 amps. The recommended setting is:

$$\frac{50}{CT\ RATIO} \quad amps$$

HI-Z Monitoring (HIZMON) [0512]

This setting determines whether HI-Z protection is enabled, 1 (ON), or disabled, 0 (OFF).

OVERCURRENT PROTECTION

Phase Low IOC Protection (PHLOIOCPRO) [0603]

Phase High IOC Protection (PHHIIOCPRO) [0606]

Ground Low IOC Protection (G_LOIOCPRO) [0609]

Ground High IOC Protection (G_HIIOCPRO) [0612]

These ON/OFF settings enable or disable their respective IOC functions.

IOC Low Phase Pickup (IOCLOPH) [0601]

IOC High Phase Pickup (IOCHIPH) [0604]

The range is 0.50 - 160.00 amps (0.01 - 32.00 amps for 1-amp models). The phase IOC function is normally set not to overreach any downstream protective device. However, this is not always the case. For example, in a ‘fuse saving’ scheme, the phase IOC might be set to overreach branch fuses up to the first recloser. The actual setting should be selected based on providing the desired selectivity with other down-stream devices consistent with an overall coordination study.

IOC Low Ground Pickup (IOCLOGND) [0607]

IOC High Ground Pickup (IOCHIGND) [0610]

The range is 0.50 -160.00 amps (0.01- 32.00 amps for 1-amp models). The ground IOC function is normally set not to overreach any down-stream protective device. However, this is not always the case. For example, in a ‘fuse saving’ scheme, the ground IOC might be set to overreach branch fuses up to the first recloser. The actual setting should be selected based on providing the desired selectivity with other down-stream devices consistent with an overall coordination study.

IOC Low Phase Delay (IOCLOPHDL) [0602]

IOC Low Ground Delay (IOCLOGNDDL) [0608]

The range is 0 - 250 milliseconds. These settings add time delay to their respective IOC functions.

IOC High Phase Delay (IOCHIPHDL) [0605]

IOC High Ground Delay (IOCHIGNDDL) [0611]

The range is 0 - 50 milliseconds. These settings add time delay to their respective IOC functions.

Phase TOC Protection (PHTOCPRO) [0613]

Ground TOC Protection (GNDTOCPRO) [0622]

These ON-OFF settings enable or disable their respective TOC functions

Phase TOC Pickup (PHTOCPKUP) [0614]

The range is 0.50 - 12.00 amps (0.01 - 2.40 amps for 1- amp models). This one setting establishes the pickup level of the phase TOC functions on each of the three phases. The pickup is generally determined by a detailed study to assure coordination with down-stream overcurrent devices, and it should be set low enough to ensure that the minimum fault current is at least 1.5 times the pickup value.

Ground TOC Pickup (GNDTOCPKUP) [0623]

The range is 0.50 - 12.00 amps (0.01 - 2.40 amps for 1- amp models). If the feeder three-phase load is balanced, residual current is near zero and the ground TOC function could have a sensitive setting. However, feeder loads are typically unbalanced, requiring the ground TOC function to be set above the $3I_0$ value resulting from the maximum unbalance. The pickup is generally determined by a detailed study to assure coordination with down-stream overcurrent devices, and it should be set low enough to ensure that the minimum fault current is at least 1.5 times the pickup value.

Phase TOC Curve (PHTOCCUR) [0616]

Ground TOC Curve (GNDTOCCUR) [0625]

These settings determine whether one of the five pre-defined or four user-defined curve shapes is active for the respective TOC function. Curve shape selection allows for easier coordination with down-stream overcurrent devices. Normally a curve shape identical or similar to that of the down-stream device is chosen.

Phase Time Dial (PHTMEDIAL) [0615]

Ground Time Dial (GNDTMEDIAL) [0624]

The range is 0.50 - 10.00. The time dial value moves the TOC curves up and down on the time scale as shown in Figures 2-4 to 2-7, and it is selected based on providing selectivity with other down-stream overcurrent devices consistent with an overall coordination study. This setting has no effect if a DEFINITE TIME curve shape is selected.

Phase Definite Time (PHDEFNTME) [0617]

Ground Definite Time (GNDDEFNTME) [0626]

The range is 0.50 - 30.00 seconds. These settings have an effect only if a DEFINITE TIME curve shape was chosen for the respective TOC function, in which case they establish the definite time delay.

Phase Averaging Period (PHAVEPD) [0621]

Ground Averaging Period (GNDAVEPD) [0630]

The range is 0 - 600 seconds. If a zero '0' value is selected, then the respective TOC load-adaptive feature is disabled. If a non-zero value is selected, then this value is the time period at the end of which an adaptive TOC pickup is computed. The adaptive TOC pickup (ATOC) is:

$$ATOC\ \ (amps) = \frac{(I - AVG.)(ADAPTIVE\%)}{100} \qquad [1]$$

where:

I-AVG. = a computed average value of phase or ground current over the time period determined from PHAVGPD or GNDAVGPD.

ADAPTIVE% = percentage determined from the PHADAPT or GNDADAPT setting described below.

Phase Adaptive (PHADAPT) [0618]

Ground Adaptive (GNDADAPT) [0627]

The range is 110% - 300%. These settings determine the value of ADAPTIVE% in equation [1] above.

Min Phase Adaptive (MINPHADAPT) [0619]

Min Ground Adaptive (MINGNDADPT) [0628]

The range is 25% - 100%. A minimum adaptive pickup (MIN-ATOC) is computed as:

$$MIN - ATOC\ (amps) = \frac{(PU\ SETTING)(MINADAPT\%)}{100} \qquad [2]$$

where:

PU SETTING = either PHTOCPKUP or GNDTOCPKUP

MINADAPT% = either MINPHADAPT or MINGNDADPT

After the DFP200 relay calculates ATOC using equation [1], its value is compared against MIN-ATOC from equation [2]. If ATOC is greater than MIN-ATOC, then the new TOC pickup value is set equal to ATOC. If ATOC is less than MIN-ATOC, then the new TOC pickup value is set equal to MIN-ATOC.

Max Phase Adaptive (MAXPHADAPT) [0620]

Max Ground Adaptive (MAXGNDADPT) [0629]

The range is 110% - 300%. A maximum adaptive pickup (MAX-ATOC) is computed as:

$$MAX - ATOC\ (amps) = \frac{(PU\ SETTING)(MAXADAPT\%)}{100} \quad [3]$$

where:

PU SETTING = either PHTOCPKUP or GNDTOCPKUP

MAXADAPT% = either MAXPHADAPT or MAXGNDADPT

After the DFP200 relay calculates ATOC using equation [1], its value is compared against MAX-ATOC from equation [3]. If ATOC is less than MAX-ATOC, then the new TOC pickup value is set equal to ATOC. If ATOC is greater than MAX-ATOC, then the new TOC pickup value is set equal to MAX-ATOC.

Cold Load Pickup Time (COLDLDPKUP) [0631]

The range is 0 - 60 minutes. If set to '0', then the cold load pickup logic is disabled. If set to a non-zero value, then the cold load pickup logic is enabled and COLDLDPKUP is the time interval that the 'cold load setting group', group #8, remains the active setting group after being activated.

TOC Reset Option (TOCRESET) [0632]

The value is either 0 (EM RESET) or 1 (FAST RESET. If the protective devices down-stream from the DFP200 relay are electro-mechanical (EM) induction disk TOC relays, then it may be easier to obtain coordination if the DFP200 relay's TOC functions emulate the slow reset of the EM relays.

NEGATIVE SEQUENCE OVERCURRENT

Neg Seq IOC Protection (NSIOCPRO) [0703]

Neg Seq TOC Protection (NSTOCPRO) [0704]

These ON-OFF settings enable or disable their respective OC functions.

Neg Seq IOC Pickup (NSIOCPKUP) [0701]

The range is 0.10 - 160.00 amps (0.002 - 32.00 amps for 1-amp models). The negative sequence IOC function is normally set not to overreach any downstream protective device. The actual setting should be selected based on providing the desired selectivity with other downstream devices consistent with an overall coordination study.

Neg Seq IOC Time Delay (NSIOCTMEDL) [0702]

The range is 0 - 250 milliseconds. This setting adds time delay to the negative sequence IOC function.

Neg Seq TOC Pickup (NSTOCPKUP) [0705]

The range is 0.10 - 12.00 amps (0.002 - 2.40 amps for 1- amp models). The pickup is generally determined by a detailed study to assure coordination with down-stream overcurrent devices, and it should be set low enough to ensure that the minimum fault current is at least 1.5 times the pickup value.

Neg Seq TOC Curve (NSTOCCURV) [0707]

This setting determines whether one of the five pre-defined or four user-defined curve shapes is active for the negative sequence TOC function. Curve shape selection allows for easier coordination with down-stream overcurrent devices. Normally a curve shape identical or similar to that of the down-stream device is chosen.

Neg Seq Time Dial (NSTMEDL) [0706]

The range is 0.50 - 10.00. The time dial value moves the TOC curves up and down on the time scale as shown in Figures 2-4 to 2-7, and it is selected based on providing selectivity with other down-stream overcurrent devices consistent with an overall coordination study. This setting has no effect if a DEFINITE TIME curve shape is selected

Neg Seq Definite Time Delay (NSDEFTMEDL) [0708]

The range is 0.50 - 30.00 seconds. This setting has an effect only if a DEFINITE TIME curve shape was chosen for the negative sequence TOC function, in which case it establishes the definite time delay.

Neg Seq TOC Reset Option (NSTOCRESET) [0709]

The value is either 0 (EM RESET) or 1 (FAST RESET. If the protective devices down-stream from the DFP200 relay are electro-mechanical (EM) induction disk TOC relays, then it may be easier to obtain coordination if the DFP200 relay's TOC functions emulate the slow reset of the EM relays.

SEQUENCE COORDINATION

Seq Coord Delay Time (SEQCRDDLTM) [0801]

This setting establishes a time delay that is added to the IOC function's time delay to allow time for the down-stream recloser to clear a fault beyond it before the DFP200 relay's IOC functions operate. The range is 0.05 - 0.50 seconds.

Seq Coord Reset Time (SEQCRDRSTM) [0802]

The time delay established by this setting is started when the DFP200 relay detects that the down-stream recloser has tripped. While it is timing out the DFP200 relay's IOC functions are blocked from operating. Normally this setting value is selected to allow the down-stream recloser to complete its programmed cycle before the DFP200 relay's IOC functions are placed back in operation at the expiration of this time delay. The range is 5 - 600 seconds.

Seq Coordination (SEQCRD) [0803]

This ON/OFF setting either enables of disables the sequence coordination function.

Seq Block High IOC (SEQBLKHI) [0804]

The sequence coordination function always blocks the 'low-set' IOC functions in the DFP200 relay. If it is required to block the 'high-set' IOC functions as well, then set SEQBLKHI = 1 (YES).

OVER/UNDER VOLTAGE

Both the under and overvoltage functions utilize positive sequence voltage as the measurement quantity. All of the pickup settings in this section are in terms of positive sequence volts.

Undervoltage Pickup (UVPKUP) [0901]

This setting determines the pickup setting of the undervoltage function. The range is 1.0 - 200.0 volts AC.

UV Time Delay (UVTMEDL) [0902]

This setting determines the time delay from pickup to output of the undervoltage function. The range is 0 - 1000 seconds.

Undervoltage Protection (UVPROT) [0903]

This ON/OFF setting determines whether the undervoltage function is enabled or disabled.

Overvoltage Pickup (OVPKUP) [0904]

This setting determines the pickup setting of the overvoltage function. The range is 50.0 - 250.0 volts AC.

OV Time Delay (OVTMEDL) [0905]

This setting determines the time delay from pickup to output of the overvoltage function. The range is 0 - 1000 seconds.

Overvoltage Protection (OVPROT) [0906]

This ON/OFF setting determines whether the overvoltage function is enabled or disabled.

OVER/UNDER FREQUENCY

Underfreq Protection (UFPROT) [1012]

Overfreq Protection (OFPROT) [1013]

These two ON/OFF settings determine whether the underfrequency function or the overfrequency function are enabled or disabled.

Set1 Underfreq Pickup (UF1PKUP) [1001]

Set2 Underfreq Pickup (UF2PKUP) [1005]

These two settings determine the frequency at which the respective underfrequency function will pickup. The range is 40.00 - 60.00 Hertz.

Set1 Underfreq Time Delay (UF1DLY) [1002]

Set2 Underfreq Time Delay (UF2DLY) [1006]

These two settings determine the operating time delay of the respective underfrequency function. The range is 0 - 10.00 seconds.

Set1 Overfreq Pickup (OF1PKUP) [1003]

Set2 Overfreq Pickup (OF2PKUP) [1007]

These two settings determine the frequency at which the respective overfrequency function will pickup. The range is 40.00 - 80.00 Hertz.

Set1 Overfreq Time Delay (OF1DLY) [1004]

Set2 Overfreq Time Delay (OF2DLY) [1008]

These two settings determine the operating time delay of the respective overfrequency function. The range is 0.05 - 10.00 seconds.

Restoration Freq (RESTFREQ) [1009]

This setting determines the frequency at which the restoration function will pickup. The range is 40.00 - 80.00 Hertz.

Restoration Time Delay (RESTDLY) [1010]

This setting determines the operating time delay of restoration function. The range is 0 - 999 seconds.

Voltage Supervision Threshold (VOLTTHR) [1011]

This setting determines the minimum voltage for which all the frequency functions will operate. If the voltage drops below this setting, then none of the frequency functions will operate. The range is 20.0 - 200.0 volts AC.

RECLOSER

Reclose Enable (RECLEN) [1101]

With RECLEN=0 (OFF) the recloser is disabled and no reclosures can occur. To enable the recloser set RECLEN=1 (ON).

Reclose On 52/b (RECLON52B) [1102]

If set to OFF, the recloser will operate only if the DFP200 trips the breaker. If this setting is set to OFF, the relay will only reclose if the breaker opening corresponds to a “trip” output flag in Xpression Builder being set true. For a full description of the “trip” OUTPUT flags, see Chapter 11, Xpression Builder, Digital Output Assignment.

If set to ON, the recloser will operate whenever the breaker opens (52/b contact closes) regardless of whether the DFP200 or some other relay trips the breaker.

With RECLON5B = 1 (ON) the recloser will be started when the breaker is tripped manually. To prevent the recloser from closing the breaker following a manual trip, a contact from the breaker close switch or associated auxiliary relay must be wired in series between the DFP200 close contact and the breaker close circuit. This contact must be open after a manual trip and be closed for all other conditions. With the breaker close circuit isolated from the DFP200 close contact, the recloser will attempt to close the breaker following a manual trip, but it will go to the lockout state since the breaker will not close. Note that a manual trip issued via the DFP200 keypad or DFP-LINK software will not initiate the recloser.

Number of Reclosers (NUMRECL) [1103]

This setting determines the number of reclosing that the DFP200 will perform during one reclose cycle. The value for this setting is 1,2, 3, or 4. Whichever value is chosen will determine how many recloses are performed before the recloser goes to LOCKOUT.

Delayed Reclose (DRLRECL) [1104]

This ON/OFF setting determines whether this feature is enabled or disabled. For some applications it may be desirable to initiate high speed plus delayed reclosures following a high speed trip, but to allow delayed reclosures only after a time delayed trip. A signal from the time delayed trip bus can be routed to a digital input which is then assigned to 'DELYRCL' (see Table 3-2). With this connection the recloser will skip the first reclosure and go to the next reclosure when a time delayed trip occurs.

First Reclose Time Delay (RECL1) [1105]

This setting will determine the time that the DFP200 will wait before attempting to reclose the breaker after the first trip in a reclose cycle.

Second Reclose Time Delay (RECL2) [1106]

This setting will determine the time that the DFP200 will wait before attempting to reclose the breaker after the second trip in a reclose cycle.

THIRD RECLOSE TIME DELAY (RECL3) [1107]

This setting will determine the time that the DFP200 will wait before attempting to reclose the breaker after the third trip in a reclose cycle.

Fourth Reclose Time Delay (RECL4) [1108]

This setting will determine the time that the DFP200 will wait before attempting to reclose the breaker after the first trip in a reclose cycle.

Reset Time Delay (RCLRST) [1109]

The Reset Time Delay is the time after a 'close' signal has been removed (indicating the breaker has closed) that the recloser waits before going to RESET.

Reclose Pause (PAUSE) [1110]

This setting selects the operation of the Pause function. The Pause function, if enabled, can affect either the Reclose, the Reset, or Both.

If the Reclose Pause setting is set to Pause on Reclose Only, prior to the recloser issuing a reclose command it will check the status of the Pause flag. If the Pause flag is set (See setting 1111, for how to set the Pause flag), the recloser will close the breaker. If the Pause flag is not set the recloser will wait a time equal to setting 1112 (Pause on Reclose Time Delay). If the Pause flag is not set during this time the recloser will go to Lockout.

If the Reclose Pause setting is set to Pause on Reset Only, while the recloser is counting down to a Reset state it will check the status of the Pause flag. If the Pause flag is set the recloser will reset in a time equal to setting 1109. If the Pause flag is not set the Reset time will be extended by a time no greater than setting 1113.

If the DFP200 is in a reclose cycle and the breaker is closed, the relay will start to countdown to resetting the recloser. The Pause flag can get set or cleared while the recloser is in this time period. If the Pause flag is set the DFP200 will decrement the Reset Timer; if the Pause flag isn't set the DFP200 will decrement the Pause on Reset Timer. To bring the recloser to a reset state the Reset Timer must be decremented to 0.

Reclose Pause Input (PAUSINP) [1111]

This setting selects the method for setting the Pause flag. The three options are as follows: Pause CC Input, Sync Check Input or Both.

The Pause CC Input requires one of the Input Contact settings to be set to Recloser Pause. If that input contact has voltage applied the Pause flag will be set.

The Sync Check input requires the Sync Check unit to determine that it is OK for the recloser to reclose. When this is the case the Pause flag will be set.

If the setting is Both, the Pause flag will be set if either the Pause CC Input has voltage or the SyncCheck unit determines that the recloser can reclose.

Pause on Reclose Time Delay (PSONRECL) [1112]

This time delay establishes how long the recloser waits for an external contact closure (Pause CC Input) or for the Sync Check determination (Sync Check Input) starting from the instant when the recloser is set to reclose (i.e. the delay time for that particular reclose has timed out).

Pause on Reset Time Delay (PSONRES) [1113]

This time delay establishes the maximum time that the RESET time can be extended based on the state (i.e., open or closed) of an external contact wired to a digital input assigned to 'PAUSEINP.'

When the external PAUSEINP contact is closed the reset time continues to decrement. When the external PAUSEINP contact is open the reset time stops decrementing and the Pause on Reset time starts decrementing. If the Pause on Reset Timer has completely decremented then , regardless of the state of the external contact, the reset timer will start to decrement. In this manner, the RESET time is extended up to a maximum time determined by setting of 1113.

Relay Spare (RLYSPARE) [1114]

The relay spare function allows the user to set a flag (RLYSPARE) at a prescribed point during the reclose cycle. This RLYSPARE flag can then be used to drive an output in the configurable logic schematic.

The setting of the RLYSPARE flag is done through settings 1114 - 1116. Setting 1114 will determine after which reclose (1st, 2nd, 3rd, or 4th) the flag will be set. Setting 1115 and 1116 will determine the pickup and dropout time for the RLYSPARE flag.

Relay Spare Pickup Time Delay (RSPU) [1115]

This setting, along with setting 1114, will determine when the RLYSPARE flag will be set. After the reclose number set in 1114 has occurred the Relay Spare Pickup Time starts to countdown. When this time expires the RLYSPARE flag is set.

Relay Spare Dropout Time Delay (RSDO) [1116]

This setting, along with setting 1114, will determine when the RLYSPARE flag will be cleared. After the reclose number set in 1114 has occurred the Relay Spare Dropout Time starts to countdown. When this time expires the RLYSPARE flag is cleared.

Note: The Relay Spare Dropout Timer does not start with the pickup of the RLYSPARE flag, instead it starts with the execution of the reclose number in setting 1114. For example, if settings 1114, 1115, and 1116 were 2nd, 5 seconds and 11 seconds, respectfully. The RLYSPARE flag will be set 5 seconds after the 2nd reclose and the RLYSPARE flag will be cleared 11 seconds after the 2nd reclose. The result is that the RLYSPARE flag will be set for 6 seconds (setting 1116 minus setting 1115).

Breaker Transition Time Delay (BRKRTRANS) [1117]

This setting determines the maximum time the recloser will wait for the breaker to close (as indicated by an open 52/b contact). This times started when the recloser issues a CLOSE output. If the 52/b contact does not open before the time delay expires, the recloser is forced to LOCKOUT.

Block Instantaneous Overcurrent (BLKIOC) [1118]

When this setting is set to ON the instantaneous overcurrent functions are blocked from tripping after the first close operation of the recloser function. The IOC functions remain blocked until the recloser goes to the reset state. Note that the IOC functions remain blocked even when the recloser is in the lockout state.

Block Instantaneous Overcurrent During Lockout (BLKIOCLK) [1119]

When this setting is set to ON the instantaneous overcurrent functions are blocked from tripping only when the recloser is in the lockout state. The IOC functions are returned to service when the recloser goes to the reset state.

Block Recloser (BLKRECL) [1120]

This setting determines whether this feature is enabled or disabled. When enabled, an external contact closure forces the recloser to the LOCKOUT state whether the recloser is at reset, in-progress, or counting down the reset timer following a manual close. The external contact must be wired to a digital input that has been assigned to BLKRECL.

Reclose Memory (RECLMEM) [1121]

The recloser memory feature is useful in those cases where the DFP200's control power input source (DC battery or AC control power transformer) can be lost when the recloser is active (in progress). If the memory feature is not used, RECLMEM = 0 (NO), then after control power is restored the recloser will reinitialize in either the reset state if the breaker is closed or the lockout state if the breaker is open.

If the memory feature is enabled, RECLMEM = 1 (YES), then the recloser will remember where in the reclose cycle control power was lost and return to the beginning of that reclose cycle when control power is restored. For example, assume the first reclosure was set to operate after a 15 second time delay and that control power was lost half-way through the 15 second period. When control power is restored, the recloser will reinitialize at the first reclosure but it will start timing the full 15 seconds rather than 7.5 seconds. After the first reclosure occurs the recloser will continue through the remainder of its sequence.

FAULT LOCATION

Pos Seq Impedance Magnitude (ZPMAG) [1201]

The range is 0.05 - 50.00 ohms (secondary) [0.25 - 250 for 1-amp models]. It should be set for the positive sequence impedance of the protected line or feeder.

Pos Seq Impedance Angle (POSANG) [1202]

The range is 10 - 90 degrees. It should be set to a value that is equal to or just larger than the angle of the positive sequence impedance of the protected feeder or line.

K0 Ratio (K0RATIO) [1203]

The range is 0.5 - 7.0. This setting determines the amount of zero sequence current that is added to the phase current to provide 'self-compensation.' It should be set for:

$$K0 = \frac{Z0L}{Z1L}$$

where:

$Z0L$ = zero sequence impedance of the protected line or feeder

$Z1L$ = positive sequence impedance of the protected line or feeder

Zero Seq Impedance Angle (ZERIMPANGL) [1204]

The range is 10 - 90 degrees. It should be set to a value that is equal to or just larger than the angle of the zero sequence impedance of the protected feeder or line.

Enable Fault Location (ENFLTLOC) [1205]

This setting turns fault location on or off. The range is 0 (DISABLE) or 1 (ENABLE).

Line Length (LINELEN) [1206]

The range is 0 - 200 miles or 0 - 322 kilometers. It should be set to the physical length of the protected feeder or line if it is desired to report the fault location in miles or kilometers from the relay location. If set to 100, regardless of actual line length, the fault location is reported as a percentage of feeder or line length.

Line Length Units (LENUNITS) [1207]

This setting determines whether the distance to fault is displayed as miles, 0 (miles), or kilometers, 1 (Km).

DIRECTIONAL (TORQUE) CONTROL

Zero Seq Polarization (ZSEQPOL) [1301]

This setting determines whether the zero sequence directional function is polarized by voltage only, 0 (3V0), current only, 1 (3I0), or both voltage and current, 2 (BOTH).

Ground Torque Control (GNDTRQCTL) [1302]

This setting determines whether the zero sequence directional function, 0 (ZERO SEQUENCE), or the negative sequence directional function, 1 (NEGATIVE SEQUENCE), is active. Note that both of these functions cannot be active at the same time!

Torque1 (TORQ1) [1303]

Torque2 (TORQ2) [1304]

These two settings give the user flexibility in the selection of what torque controlling functions are used. TORQ1 and TORQ2 can individually be set to one of more of the following four choices:

a) 67G/67N - either zero or negative sequence directional depending on the GNDTRQCTL setting

b) 67P - phase directional function

c) 27 - undervoltage function

d) DIGITAL INPUT - external contact

A, b, c, and d are either binary 1 or 0. For instance, if a, b, c, and d are all set to binary 1, then TORQ1 is a binary 1 (TRUE) if any of the four choices is binary one (TRUE).

Torque Control 1 (TRQCTL1) [1305]

Torque Control 2 (TRQCTL2) [1306]

TRQCNTL1 selects which overcurrent functions are torque controlled by TORQ1. TRQCNTL2 selects which overcurrent functions are torque controlled by TORQ2. TRQCNTL1 and TRQCNTL2 can individually be set to one or more of the following eight choices:

a) 51P - phase TOC

b) 51G - ground TOC

c) 50PH - phase high-set IOC

d) 50PL - phase low-set IOC

e) 50GH - ground high-set IOC

f) 50GL - ground low-set IOC

g) 46I - negative sequence IOC

h) 46T - negative sequence TOC

(A) through (H) are either binary 1 or 0. For instance, if a and b are binary 1 while c - h are binary 0, then only 51P and 51G are torque controlled by TORQ1.

Max Torque Angle (MAXTRQANGL) [1307]

The range is 0.0 - 90.0 degrees. This setting determines the angle of maximum torque for the phase directional function, 67P. The phase n (A, B, or C) 67P function produces 'maximum torque' when the phase n current lags the phase n to ground voltage by the MAXTRQANGL angle. Normally the value is set equal to the positive sequence impedance angle of the feeder or line.

Fault Detector Level (FLTDETLVL) [1308]

The setting is associated with the negative sequence directional function, 67N. It determines the negative sequence current level at which the 'fixed bias restraint' associated with 67N is switched off. It should be set just above the maximum negative sequence current level that can exist on the feeder or line for worst case un-balanced load conditions. The range is 0.10 - 2.00 amps.

OSCILLOGRAPHY

The following three settings determine which measurement functions trigger oscillography capture. The choices consist of both pickup flags, 'PU', (e.g., when a TOC function operated to start timing) and trip flags, 'TR', (e.g., when a TOC function timed out and tripped). The three settings represent three eight bit words. Each bit can be set to a binary 1 or 0. When set to a binary 1 the associated flag, when set, will result in an oscillography capture. Listed below each of the three settings is the pickup or trip flag associated with each bit.

Oscillography Mask Word1 (OSCMASK1) [1401]

a (bit 8) - 50PH-PU

b (bit 7) - 50PL-PU

c (bit 6) - 50GH-PU

d (bit 5) - 50GL-PU

e (bit 4) - 51P-PU

f (bit 3) - 51G-PU

g (bit 1) - 27-PU

h (bit 0) - 59-PU

Oscillography Mask Word2 (OSCMASK2) [1402]

a (bit 8) - 46I-PU

b (bit 7) - 46T-PU

c (bit 6) - 81U-PU1

d (bit 5) - 81O-PU1

e (bit 4) - 81U-PU2

f (bit 3) - 81O-PU2

g (bit 1) - TORQ1PU

h (bit 0) - TORQ2PU

If any protection function in the DFP200 issues a trip, a regular oscillography capture will be made. However, the oscillography mask word (setting 1401 and 1402) allows the user to set the DFP200 to trigger a regular oscillography capture on the pickup of any protection function. In other words, the protection function does not have to issue a trip: the pickup of any function enabled in the oscillography.

SYNC-CHECK SETTINGS

Sync-Check Enable (SYCHEN) [1501]

This setting enables the sync-check function. If this setting is set to ON, the recloser will check with the sync-check function before performing any recloses.

MAXIMUM CLOSING ANGLE (CLSANG_MAX) [1502]

When the sync-check function does its determination to close the breaker, one of its criteria is what is the phase angle difference between the LINE and BUS voltage. If the phase angle difference is greater than this setting the sync-check function will not allow the recloser to close the breaker.

MAXIMUM SLIP (SLIP_MAX) [1503]

When the sync-check function does its determination to close the breaker, one of its criteria is what is the frequency difference between the LINE and BUS voltage. If the frequency difference is greater than this setting the sync-check function will not allow the recloser to close the breaker.

Under Voltage Line (UV_LINE) [1504]

Before the sync-check function does any phase angle or frequency calculations, this function will measure the amplitude for the phase selected by setting 1509 or the voltage applied to the sync-check PT input (whichever is determined to be the LINE side input by setting 1510). This will tell the DFP200 if it has a dead-line (DL) or live-line (LL) input. If the voltage for this input is less than setting 1504 the sync-check function determines that the DFP200 is working with a dead-line input.

Under Voltage Bus(UV_BUS) [1505]

Before the sync-check function does any phase angle or frequency calculations, this function will measure the amplitude for the phase selected by setting 1509 or the voltage applied to the sync-check PT input (whichever is determined to be the BUS side input by setting 1510). This will tell the DFP200 if it has a dead-bus (DB) or live-bus (LB) input. If the voltage for this input is less than setting 1504 the sync-check function determines that the DFP200 is working with a dead-bus input.

Set Dead Line Dead Bus (SETDL_DB) [1506]

After the relay performs its dead/live - line/bus determination (See settings 1504 and 1505), it will check this setting if it has a dead line/dead bus. If this setting is set to ON and it does have a dead line/dead bus, it will set the SYNC flag to 1, and allow the recloser to close the breaker. If this setting is set to OFF and it does have a dead line/dead bus, it will set the SYNC flag to 0, and not allow the recloser to close the breaker.

Set Live Line Dead Bus (SETLL_DB) [1507]

After the relay performs its dead/live - line/bus determination (See settings 1504 and 1505), it will check this setting if it has a live line/dead bus. If this setting is set to ON and it does have a live line/dead bus, it will set the SYNC flag to 1, and allow the recloser to close the breaker. If this setting is set to OFF and it does have a live line/dead bus, it will set the SYNC flag to 0, and not allow the recloser to close the breaker.

Set Dead Line Live Bus (SETDL_LB) [1508]

After the relay performs its dead/live - line/bus determination (See settings 1504 and 1505), it will check this setting if it has a dead line/live bus. If this setting is set to ON and it does have a dead line/live bus, it will set the SYNC flag to 1, and allow the recloser to close the breaker. If this setting is set to OFF and it does have a dead line/live bus, it will set the SYNC flag to 0, and not allow the recloser to close the breaker.

Synccheck Phase (SYNCPHAS) [1509]

The Sync-check function compares the angle and frequency of two inputs (LINE and BUS voltage). This setting informs the DFP200 as to which phase-to-ground or phase-to-phase is being applied to the Sync-check voltage input for the relay. The “Phase Potential” Setting (0115) must be consistent with setting 1509. If Setting 0115 is 0 (L-N), setting 1509 can be either A, B, C, AB, BC, or CA. If setting 0115 is 1 (L-L), setting 1509 MUST be either AB, BC, or CA. Setting 1509 and setting 1510 will describe the hardware configuration for the sync-check function.

Sync PT Input (SYNCCHINP) [1510]

This setting informs the relay as to whether the Sync check Input should be considered LINE or BUS voltage.

Sync Check on Manual Close [1511]

If the user orders a manual close, this setting will tell the DFP200 if it should check the sync check unit first. If setting 1510 is set to DISABLE, the sync check unit will not be checked and the relay will close the breaker. If setting 1510 is set to ENABLE, the DFP200 will check the sync check unit to see if this relay should close the breaker.

USER SETTINGS

Table 3-3 User Settings

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
GENERAL						
0101	DFP Unit ID	UNITID	N/A	0 - 9999	1	
0102	Phase CT Ratio	PHCTRATIO	N/A	1 - 5000	1	
0103	Ground CT Ratio	G_CTRATIO	N/A	1 - 5000	1	
0104	VT Ratio	VTRATIO	N/A	1 - 7000	1	
0105	Port 4 Settings (RS-485/RS-232 settings) Baud Rate: Parity: Stop Bits:	COM4SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1, 2	N/A	
0106	Port 3 Settings (RS-232 Settings) Baud Rate: Parity: StopBits:	COM3SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1,2	N/A	
0107	Port 2 Settings (RS-232 Settings) Baud Rate: Parity: Stop Bits:	COM2SET	N/A	xxxyz xxx = 003, 012, 024, 096, 192 y = 0(none), 1(odd), 2(even) z = 1, 2	N/A	
0108	Port 4 Protocol	COM4PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	
0109	Port 3 Protocol	COM3PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	
0110	Port 2 Protocol	COM2PRO	N/A	0 (GE_MODEM) 1 (ASCII)	N/A	
0111	Port 4 Interface	COM4IF	N/A	0 (RS232) 1 (RS485)	N/A	
0112	System Frequency - Hz	SYSFREQ	Hz	50 Hz or 60 Hz	N/A	
0113	Settings File	SETFILE	N/A	0 (EXTERNAL) 1 (SETGRP 1) 5 (SETGRP 5) 2 (SETGRP 2) 6 (SETGRP 6) 3 (SETGRP 3) 7 (SETGRP 7) 4 (SETGRP 4) 8 (SETGRP 8)	N/A	
0114	Phase Designation	PHASDESG	N/A	0 (A-B-C) 1 (A-C-B)	N/A	
0115	Phase Potential	PHASPOTL	N/A	0 (L-N) 1 (L-L)	N/A	
0116	Displayed Values	DISPVAL	N/A	0 (SECNDRY) 1 (PRIMARY)	N/A	
0117	Front Panel Resets	FPNLRESET	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
0118	Configured CTs	CONFCTS	N/A	0 (ABCN) 1 (BCN) 2 (CAN) 3 (CN) 4 (ABN) 5 (BN) 6 (AN) 7 (N) 8 (ABC) 9 (BC) 10 (CA) 11 (C) 12 (AB) 13 (B) 14 (A) 15 (NONE)	N/A	
0119	Configured VTs	CONFVTS	N/A	0 (ABC) 1 (BC) 2 (CA) 3 (C) 4 (AB) 5 (B) 6 (A) 7 (NONE)	N/A	
0120	Login Timeout	LOGTMEOUT	min.	0 - 99 min	1	
HARDWARE						
0201	Remote Breaker Operation	REMBKROP	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	
0202	Remote Configuration	REMCONF	N/A	0 (NOT ALLOWED) 1 (ALLOWED)	N/A	
0203	CT Rating	CTRATING	N/A	0 (5-AMP) 1 (1-AMP)	N/A	
MONITORING						
0301	Brkr Health Threshold	BHTHR	A^XSEC	0 - 39,999,999.99 @	0.01	
0302	Current THD Threshold	AMPTHDTHR	%	0.0% - 100.0%	0.1	
0303	Voltage THD Threshold	VOLTTHDTHR	%	0.0% - 100.0%	0.1	
0304	# Disturbance Reports	NUMFLTS	N/A	1, 2, 4, 8,12,16	N/A	
0305	Breaker Arc Time	BRKRARCTME	ms	20 ms - 200 ms	1	
0306	Breaker Health Exponent	BHEXP	N/A	1.0 - 2.0	0.1	
0307	Demand Period	DEMPERIOD	min	1 - 60 min	1	
0308	NUMRMSFLTS	NUMRMSFLTS		1, 2, 4, 8, 12, 16	N/A	
0309	Oscillography Full Time	OSCTIME	min	0 - 10000 0 (Always overwrite) 1 (Never overwrite)	1	
0310	RMS Oscillography Full Time	RMSTIME	hrs	0 - 10000	1	
DIGITAL (CONTACT) INPUTS						
0401	CC1 Configuration	CC1CONF	N/A	See TABLE 3-2 “Digital Input Assignments”	N/A	
0402	CC2 Configuration	CC2CONF	N/A		N/A	
0403	CC3 Configuration	CC3CONF	N/A		N/A	
0404	CC4 Configuration	CC4CONF	N/A		N/A	
0405	CC5 Configuration	CC5CONF	N/A		N/A	
0406	CC6 Configuration	CC6CONF	N/A		N/A	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
0407	CC7 Configuration	CC7CONF	N/A		N/A	
0408	CC8 Configuration	CC8CONF	N/A		N/A	
HIGH IMPEDANCE (HI-Z)						
0501	Arcing Sensitivity *	ARCSENS	N/A	1 - 10	1	
0502	Phase Event Count	PHEVTCNT	N/A	10 - 250	1	
0503	Ground Event Count	GNDEVTCNT	N/A	10 - 500	1	
0504	Event Count Time	EVTCNTTME	min	5 min - 180 min	1	
0505	OC Coord Timeout	OCCRDTMEOT	sec	10 sec - 200 sec	1	
0506	PCHZ (Phase OC) **	PCHZ	amps	0.50 - 50.00 amps	0.01	
0507	GCHZ (Ground OC) **	GCHZ	amps	0.50 - 50.00 amps	0.01	
0508	Phase Rate of Change **	PHRATECHG	amps/ 2cycles	0.05 - 10.00 amps/2 cycles	0.01	
0509	Ground Rate of Change	GNDRATECHG	amps/ 2cycles	0.05 - 10.00 amps/2 cycles	0.01	
0510	Loss of Load Threshold	LDTHRLOSS	%	5% - 100%	1	
0511	3-Ph Event Threshold **	PH3EVTTHR	amps	0.05 - 10.00 amps	0.01	
0512	Voltage Supervision	VSUP	%	0 - 100	1	
0513	Voltage Supervision Time	VSUPTIME	cycles	0 - 300	1	
0514	Second Harmonic Restraint	2HARMRES	%	0 - 100	1	
0515	Hi-Z Monitoring	HIZMON	N/A	0 (OFF) 1 (ON)	N/A	
OVERCURRENT PROTECTION						
0601	IOC Low Phase Pickup **	IOCLOPH	amps	0.50 - 160.00 amps	0.01	
0602	IOC Low Phase Delay	IOCLOPHDL	ms	0 - 250 ms	1	
0603	Phase Low IOC Protection	PHLOIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0604	IOC High Phase Pickup **	IOCHIPH	amps	0.50 - 160.00 amps	0.01	
0605	IOC High Phase Delay	IOCHIPHDL	ms	0 - 50 ms	1	
0606	Phase High IOC Protection	PHHIIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0607	IOC Low Ground Pickup **	IOCLOGND	amps	0.50 - 160.00 amps	0.01	
0608	IOC Low Ground Delay	IOCLOGNDDL	ms	0 - 250 ms	1	
0609	Ground Low IOC Protection	G_LOIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0610	IOC High Ground Pickup **	IOCHIGND	amps	0.50 - 160.00 amps	0.01	
0611	IOC High Ground Delay	IOCHIGNDDL	ms	0 - 50 ms	1	
0612	Ground High IOC Protection	G_HIIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0613	Phase TOC Protection	PHTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0614	Phase TOC Pickup **	PHTOCPKUP	amps	0.50 -12.00 amps	0.01	
0615	Phase Time Dial	PHTMEDIAL	N/A	0.50 -10.00	0.01	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
0616	Phase TOC Curve	PHTOCCUR	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED)	N/A	
0617	Phase Definite Time	PHDEFNTME	sec	0.50 -30.00 sec	0.01	
0618	Phase Adaptive	PHADAPT	%	110 - 300 %	1	
0619	Min Phase Adaptive	MINPHADAPT	%	25 - 100 %	1	
0620	Max Phase Adaptive	MAXPHADAPT	%	110 - 300 %	1	
0621	Phase Averaging Period	PHAVEPD	sec	0 - 600 sec	1	
0622	Ground TOC Protection	GNDTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0623	Ground TOC Pickup	GNDTOCPKUP	amps	0.50 -12.00 amps	0.01	
0624	Ground Time Dial	GNDTMEDIAL	N/A	0.50 -10.00	0.01	
0625	Ground TOC Curve	GNDTOCCUR	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED)	N/A	
0626	Ground Definite Time	GNDDEFNTME	sec	0.50 -30.00 sec	0.01	
0627	Ground Adaptive	GNDADPT	%	110 - 300 %	1	
0628	Min Ground Adaptive	MINGNDADPT	%	25 - 100 %	1	
0629	Max Ground Adaptive	MAXGNDADPT	%	110 - 300 %	1	
0630	Ground Averaging Period	GNDAVEPD	sec	0 - 600 sec	1	
0631	Cold Load Pickup Time	COLDLDPKUP	min	0 - 60 min	1	
0632	TOC Reset Option	TOCRESET	N/A	0 (EM RESET) 1 (FAST RESET)	N/A	

NEGATIVE SEQUENCE OVERCURRENT						
0701	Neg Seq IOC Pickup **	NSIOCPKUP	amps	0.10 - 160.00 amps	0.01	
0702	Neg Seq IOC Time Delay	NSIOCTMEDL	ms	0 - 250	1	
0703	Neg Seq IOC Protection	NSIOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0704	Neg Seq TOC Protection	NSTOCPRO	N/A	0 (OFF) 1 (ON)	N/A	
0705	Neg Seq TOC Pickup **	NSTOCPKUP	amps	0.10 - 12.00 amps	0.01	
0706	Neg Seq Time Dial	NSTMEDL	N/A	0.50 - 10.00	0.01	
0707	Neg Seq TOC Curve	NSTOCCURV	N/A	0 (INVERSE) 1 (VERY INVERSE) 2 (EXTREMELY INVERSE) 3 (DEFINITE TIME) 4 (BS142 INVERSE) 5 - 8 (USER DEFINED	N/A	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
0708	Neg Seq Definite Time Delay	NSDEFTMEDL	sec	0.50 - 30.00 sec	0.01	
0709	Neg Seq TOC Reset Option	NSTOCRESET	N/A	0 (EM RESET) 1 (FAST RESET)	N/A	
SEQUENCE COORDINATION						
0801	Seq Coord Delay Time	SEQCRDDLTM	sec	0.05 - 0.50 sec	0.01	
0802	Seq Coord Reset Time	SEQCRDRSTM	sec	5 - 600 sec	1	
0803	Seq Coordination	SEQCRD	N/A	0 (OFF) 1 (ON)	N/A	
0804	Seq Block High IOC	SEQBLKHI	N/A	0 (NO) 1 (YES)	N/A	
OVER/UNDER VOLTAGE						
0901	Undervoltage Pickup	UVPKUP	Vac	1.0 - 200.0 Vac	0.1	
0902	UV Time Delay	UVTMEDL	sec	0 - 1000 sec	1	
0903	Undervoltage Protection	UVPROT	N/A	0 (OFF) 1(ON)	N/A	
0904	Overvoltage Pickup	OVPKUP	Vac	50.0 - 250.0 Vac	0.1	
0905	OV Time Delay	OVTMEDL	sec	0 - 1000 sec	1	
0906	Overvoltage Protection	OVPROT	N/A	0 (OFF) 1 (ON)	N/A	
OVER/UNDER FREQUENCY						
1001	Set1 Underfreq Pickup	UF1PKUP	Hz	40.00 - 60.00 Hz	0.01	
1002	Set1 Underfreq Time Delay	UF1DLY	sec	0.05 - 10.00 sec	0.01	
1003	Set1 Overfreq Pickup	OF1PKUP	Hz	40.00 - 80.00 Hz	0.01	
1004	Set1 Overfreq Time Delay	OF1DLY	sec	0.05 - 10.00 sec	0.01	
1005	Set2 Underfreq Pickup	UF2PKUP	Hz	40.00 - 60.00 Hz	0.01	
1006	Set2 Underfreq Time Delay	UF2DLY	sec	0.05 - 10.00 sec	0.01	
1007	Set2 Overfreq Pickup	OF2PKUP	Hz	40.00 - 80.00 Hz	0.01	
1008	Set2 Overfreq Time Delay	OF2DLY	sec	0.05 - 10.00 sec	0.01	
1009	Restoration Freq	RESTFREQ	Hz	40.00 - 80.00 Hz	0.01	
1010	Restoration Time Delay	RESTDLY	sec	0 - 999 sec	1	
1011	Voltage Supervision Thres hold	VOLTTHR	Vac	20.0 - 200.0 Vac	0.1	
1012	Underfreq Protection	UFPROT	N/A	0 (OFF) 1 (ON)	N/A	
1013	Overfreq Protection	OFPROT	N/A	0 (OFF) 1 (ON)	N/A	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
RECLOSER						
1101	Reclose Enable	RECLEN	N/A	0 (OFF) 1 (ON)	N/A	
1102	Reclose On 52/b	RECLON52B	N/A	0 (OFF) 1 (ON)	N/A	
1103	Number of Reclosers	NUMRECL	N/A	1 - 4	1	
1104	Delayed Reclose	DELRECL	N/A	0 (OFF) 1 (ON)	N/A	
1105	First Reclose Time Delay	RECL1	sec	0 - 600	0.01	
1106	2nd Reclose Time Delay	RECL2	sec	0 - 600	0.01	
1107	3rd Reclose Time Delay	RECL3	sec	0 - 600	0.01	
1106	4th Reclose Time Delay	RECL4	sec	0 - 600	0.01	
1109	Reset Time Delay	RCLRST	sec	0 - 600	0.01	
1110	Reclose Pause	PAUSE	N/A	0 (DISABLE) 1 (PAUSE ON RECLOSE ONLY) 2 (PAUSE ON RESET ONLY) 3 (PAUSE ON RECLOSE AND RESET BOTH)	N/A	
1111	Reclose pause input	PAUSINP	N/A	0 (NONE) 1 (PAUSE CC INPUT) 2 (SYNC CHECK INPUT) 3 (BOTH)	N/A	
1112	Pause on Reclose Time Delay	PSONRECL	sec	0 - 4000 (0: INFINITE)	0.01	
1113	Pause on Reset Time Delay	PSONRES	sec	0.01 - 4000	0.01	
1114	Relay Spare at Reclose	RLYSPARE	N/A	0 (NONE) 3 (THIRD) 1 (FIRST) 4 (FOURTH) 2 (SECOND)	N/A	
1115	Relay Spare Pickup Time Delay	RSPU	sec	0.01 - 50	0.01	
1116	Relay Spare Dropout Time Dly	RSDO	sec	0 - 200 (0: lockout)	0.01	
1117	Breaker Transition Time Delay	BRDRTRANS	sec	0 - 5	0.01	
1118	Block Instantaneous	BLKIOC	N/A	0 (OFF) 1 (ON)	N/A	
1119	Block IOC During Lockout	BLKIOCLK	N/A	0 (OFF) 1 (OFF)	N/A	
1120	Block Recloser	BLKRECL	N/A	0 (OFF) 1 (ON)	N/A	
1121	Reclose Memory	RECLMEM	N/A	0 (OFF) 1 (ON)	N/A	
FAULT LOCATION						
1201	Pos Seq Impedance Magnitude ***	ZPMAG	ohms	0.05 - 50.00 ohms	0.01	
1202	Pos Seq Impedance Angle	POSANG	deg.	10.0 - 90.0 deg	0.1	
1203	K0 Ratio	K0RATIO	N/A	0.5 - 7.0	0.1	
1204	Zero Seq Impedance Angle	ZERIMPANGL	deg.	10.0 - 90.0 deg	0.1	
1205	Enable Fault Location	ENFLTLOC	N/A	0 (DISABLE) 1 (ENABLE)	N/A	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
1206	Line Length	LINELEN	N/A	0 - 200 miles (0 - 322 Km)	1	
1207	Line Length Units	LENUNITS	miles/ Km	0 (miles) 1 (Km)	N/A	
				DIRECTIONAL (TORQUE) CONTROL		
1301	Zero Seq Polarization	ZSEQPOL	N/A	0 (3V0) 1 (3I0) 2 (BOTH)	N/A	
1302	Ground Torque Control	GNDTRQCTL	N/A	0 (ZERO SEQUENCE) 1 (NEGATIVE SEQUENCE)	N/A	
1303	Torque1	TORQ1	N/A	a - 67G/67N b - 67P c - 27 d - DIGITAL INPUT 0 (DISABLED) 1 (ENABLED)	N/A	
1304	Torque2	TORQ2	N/A	a - 67G/67N b - 67P c - 27 d - DIGITAL INPUT 0 (DISABLED) 1 (ENABLED)	N/A	
1305	Torque Control 1	TRQCTL1	N/A	a - 51P b - 51G c - 50PH d - 50PL e - 50GH f - 50GL g - 46I h - 46T 0 (DISABLED) 1 (ENABLED)	N/A	
1306	Torque Control 2	TRQCTL2	N/A	a - 51P b - 51G c - 50PH d - 50PL e - 50GH f - 50GL g - 46I h - 46T 0 (DISABLED) 1 (ENABLED)	N/A	
1307	Max Torque Angle	MAXTRQANGL	deg.	0.0 - 90.0	0.1	
1308	Fault Detector Level **	FLTDETLVL	amps	0.10 - 2.00 amps	0.01	

SETTING #	SETTING NAME	MNEMONIC	UNITS	RANGE	STEP SIZE	USER SETTINGS
			OSCILLOGRAPHY			
1401	Oscillography Mask Word 1	OSCMASK1	N/A	a - 50PH-PU b - 50PL-PU c- 50GH-PU d - 50GL-PU e - 51P-PU f - 51G-PU g - 27-PU h - 59-PU 0 (DISABLED) 1 (ENABLED)	N/A	
1402	Oscillography Mask Word 2	OSCMASK2	N/A	a - 46I-PU b - 46T-PU c - 81U-PU1 d - 81O-PU1 e - 81U-PU2 f - 81O-PU2 g - TORQ1PU h - TORQ2PU 0 (DISABLED) 1 (ENABLED)	N/A	
			SYNC CHECK			
1501	Synccheck Enable	SYNCCHEN	N/A	0 (OFF) 1 (ON)	N/A	
1502	Maximum Close Angle	CLSANG_MAX	deg.	2 - 60	0.1	
1503	Maximum Slip	SLIP_MAX	Hz	0.01 - 10	0.01	
1504	Undervoltage Line	UV_LINE	volts	10 - 120	0.1	
1505	Undervoltage Bus	UV_BUS	volts	10 - 120	0.1	
1506	Set Dead Line Bus	SETDL_BUS	N/A	0 (OFF) 1 (ON)	N/A	
1507	Set Live Line Dead Bus	SETLL_DB	N/A	0 (OFF) 1 (ON)	N/A	
1508	Set Dead Line Live Bus	SETDL_LB	N/A	0 (OFF) 1 (ON)	N/A	
1509	Synccheck Phase	SYNCPHAS	N/A	0 (Phase A) 1 (Phase B) 2 (Phase C)	N/A	
1510	Sync PT Input	SYNCCHINP	N/A	0 (Line Side) 1 (Bus Side)	N/A	
1511	Sync Check on Manual Close	SYNCCLBR	N/A	0 (Disabled) 1 (Enabled)	N/A	

[@] The range for Breaker Health Threshold is given in terms of secondary current. DFP-LINK and the DFP200 relay's optional keypad/display module display the range in terms of primary current by multiplying 39,999,999.99 by the CT ratio (setting 0102) raised to the 'x' power (where 'x' is determined by setting 0306).

[**] For DFP21xxxxxxx relays (models used with current transformers that have a nominal 1-amp secondary rating), the ranges and defaults for these settings should be divided by 5. <u>All settings are in secondary amps.</u>

[*] For DFP21xxxxxxx relays (models used with current transformers that have a nominal 1-amp secondary rating), the ranges and defaults for these settings should be multiplied by 5. <u>All settings are in secondary ohms.</u>**

Chapter 4
HARDWARE DESCRIPTION

PHYSICAL DESCRIPTION

The construction of the DFP200 is divided into the Case Assembly, the Shelf Assembly and the optional Keypad/Display. The block diagram of the DFP200 presented in Figure 4-1 illustrates the functional interaction among the DFP200's printed-circuit boards, magnetics and power-supply assembly.

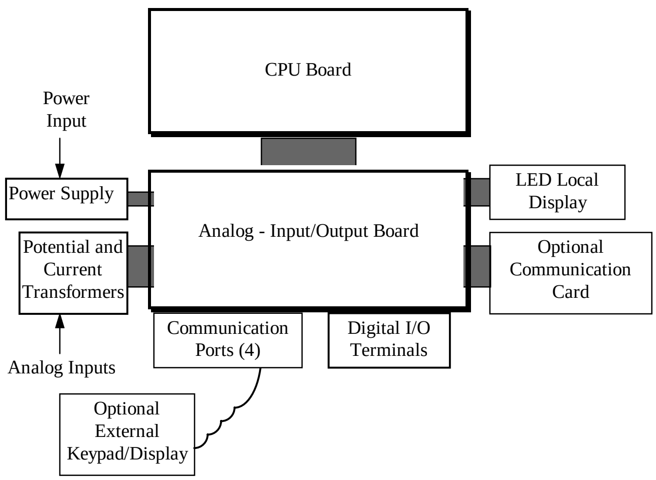


Figure 4-1. DFP200 Block Diagram.

Case Assembly

The DFP200 case assembly is constructed from an aluminum alloy. It consists of a main box assembly and a top cover. The main box assembly supports the terminal blocks that are used to make the external connections, has slotted guides to support the Shelf Assembly and has various studs and brackets to support the Magnetics hardware. The unit is draw-out construction, where the Shelf Assembly is removable from the case.

Figure 4-2 shows the DFP200 outline and panel drilling dimensions.

The Magnetics (fixed, non-drawout), which consist of the current transformers (CTs) and potential transformers (PTs) are located on the bottom of the case and are connected to the Shelf Assembly through a 50 position connector. In addition, a Magnetics E^2PROM is located on the right hand side of the case as viewed from the front, and this interfaces to the Shelf Assembly through the same 50 position connector.

The back of the case is printed to identify the number and function of each terminal lug, and a wiring chart for the DB-9 connectors is also provided.

Shelf Assembly

The Shelf Assembly consists of a Central Processor Unit (CPU) Board, a Power Supply Assembly (PSA), an Analog-Input/Output (A-I/O) Board, an optional Communications Card, a Front Panel assembly, PSA harnessing and an aluminum shelf that supports the components.

Figure 4-3 shows the assembly drawing for the A-I/O board, with several jumpers highlighted. The jumper (J18) to the right side of the board determines the current rating of the relay (5 Amps when installed, 1 Amp when left off). Jumpers J2-11 determine de-energized state of the digital output and alarm relays (Normally Open or Closed). Jumpers J12 and 13 connect the surge capacitors to surge ground and must be in place at all times, except during special testing as described in the Acceptance and Periodic Tests Sections. Jumpers J16 and J17 determine the remote operation capability to operate the trip contacts and command the relay through the rear ports. Jumper J14 determines whether the Analog-I/O board is configured for 3I0 or Sync Check function.

Figure 4-3 shows the location and function of each jumper.

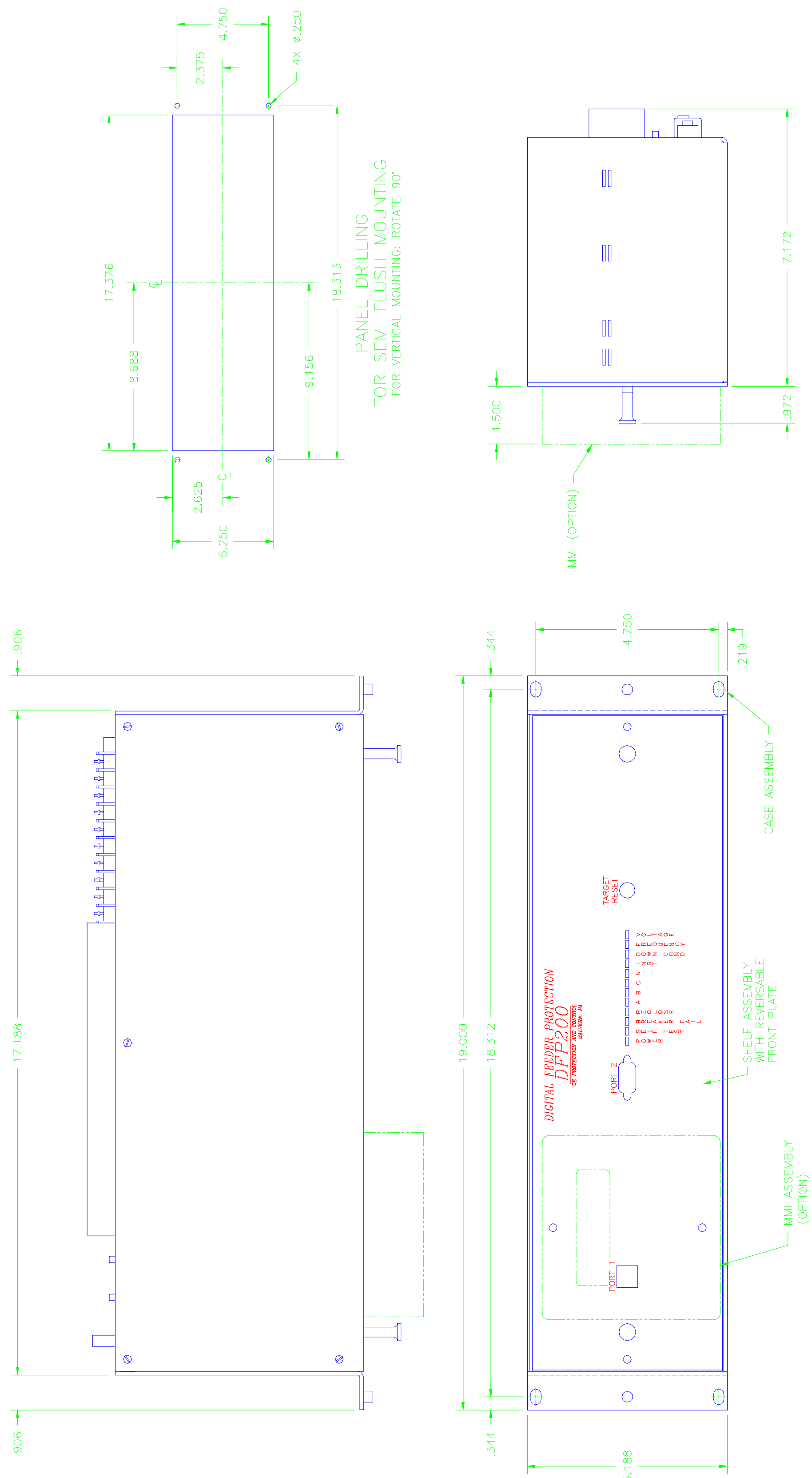


Figure 4-2 Outline and Panel Drilling Dimensions

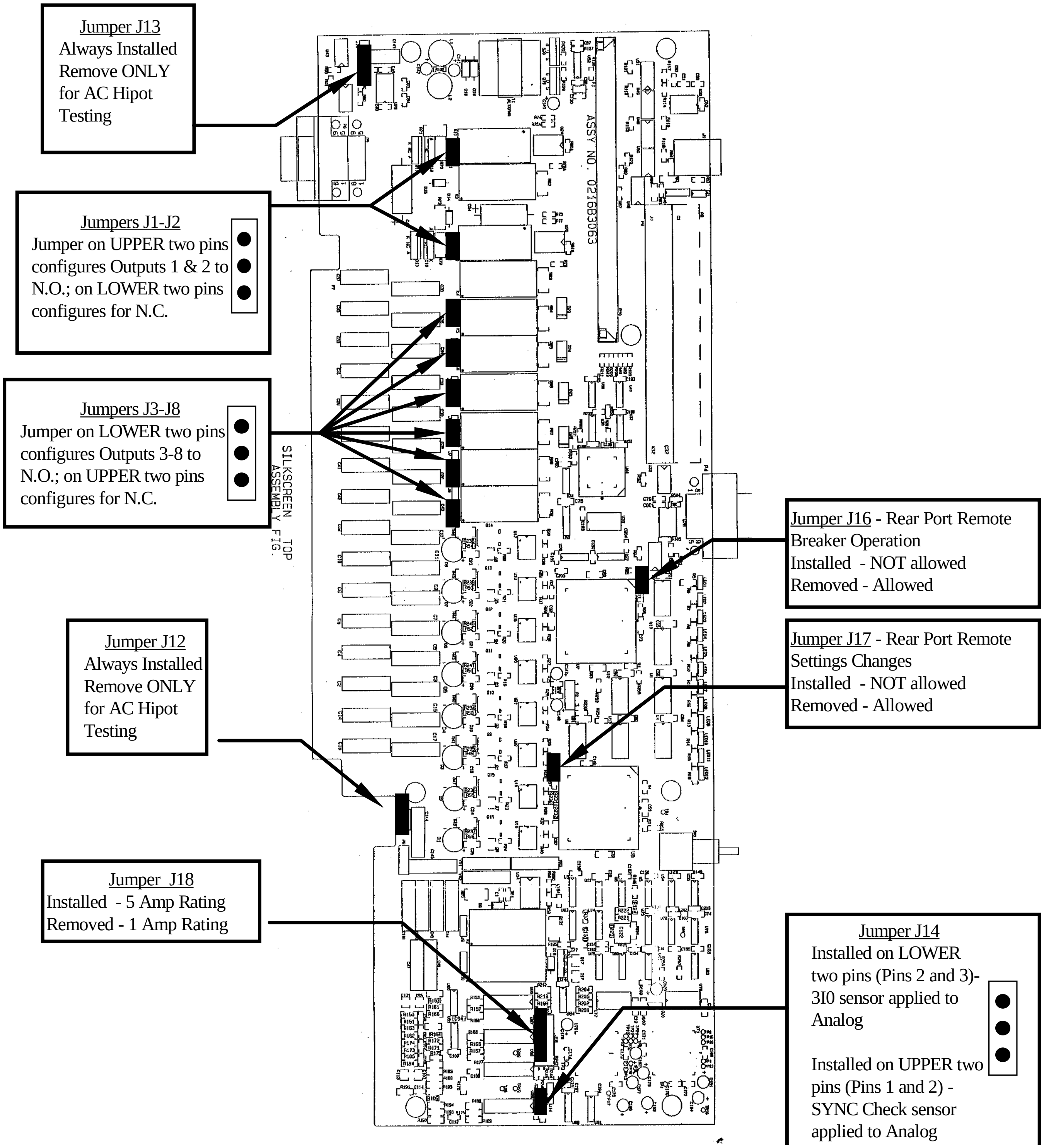


Figure 4-3 Assembly Drawing for Analog-I/O Board Showing Locations of Jumpers

Access to the electronics is obtained by loosening the two knurled screws on the front panel and carefully sliding out the shelf assembly. All connections between the Case and Shelf are through the 50 position connector in the back of the unit.

The Front Panel assembly is constructed of brushed aluminum, and is screen-printed on both sides, one side vertically and one side horizontally, to allow the DFP200 to be mounted in either orientation. Two shoulder screws are provided with the optionally mounted Keypad/Display, and these must be installed in the two holes in the faceplate if it is desired to mount the MMI on the relay.

Keypad/Display

The Keypad/Display clips to the front of the relay by locking keyholes in the back of the unit which engage the two shoulder screws. The design supports mounting the unit in either the horizontal or vertical configurations.

The MMI connects electrically to the relay through a six conductor telephone cord (RJ45) which can be stored in the recess in the back of the MMI. Longer lengths of wire, up to 50 feet, can be used to interface the Keypad/Display to the relay, but these must be stored separately. The Keypad/Display can provide enhanced safety for the relay operator when it is necessary to perform hazardous breaker operations in situations where the breaker is close to the controlling relay.

The MMI has one internal board, a display unit and a keyboard.

Ports and Connections

Two RS232 ports (one on the front [Port 1] and one on the back [Port 3] of the unit) allow connection of a dumb terminal or modem connection for configuration and troubleshooting the DFP200. One port [Port 4] on the back of the unit can be optionally configured to support the RS485 communications protocol. The RS232 and RS485 ports are DB-9 (9-pin D shell) connectors with the following pin assignments:

Pin #	Port 2 and 3
1	NC
2	RD
3	TD
4	DTR
5	GND
6	NC
7	NC
8	NC
9	NC

The RS485 port (optional) is a DB-9 connector with the following pin assignments:

Pin #	Port 4
2	TXB(+)
3	RXA (-)
6	RXB
8	TXA

The lower 24 position connector on the back of the case provides terminals for Control Power, Power Fail Alarm contacts, Self Test Fail Alarm contacts, IRIG-B connections, the 3I0/Sync Check terminals, and the terminations required for the standard input currents and voltages.

Eight input contacts and eight fully configurable relay output contacts are provided on the 32 position terminal block mounted on the rear of the case.

Figure 4-4 is a drawing of the back of the case showing the terminal block assignments.

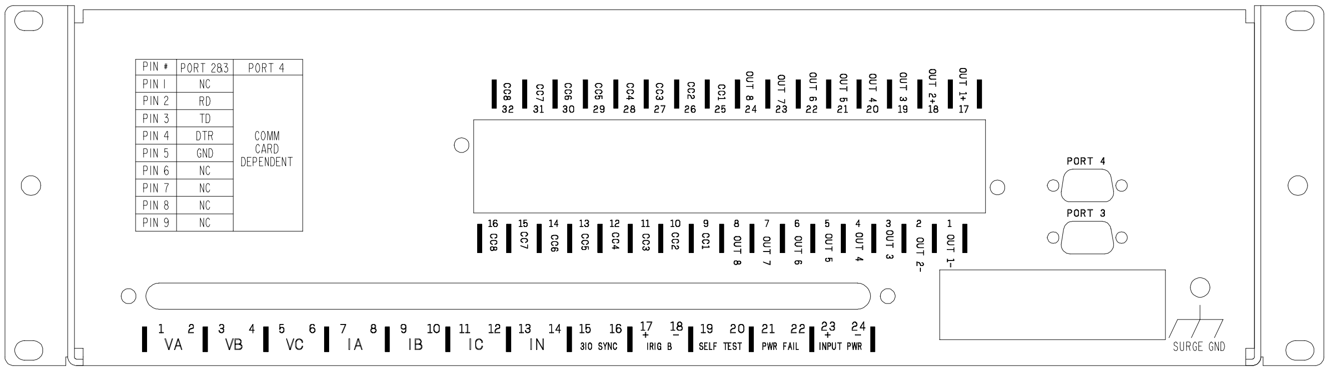


Figure 4-4 DFP200 Case Assembly Showing Rear Terminations

THEORY OF OPERATION

The DFP200 operates by digitizing current and voltage signals, performing digital computations on the required data, logging significant information, and activating control contacts. It provides an interface to the utility engineer for determining power system status.

The DFP200 can be functionally divided into the following sections.

- Magnetics (includes Surge Suppression Capacitors and E^2PROM)
- Central Processor Unit (CPU) Board
- Analog Input/Output (A-I/O) Board
- Power Supply
- Keypad/Display

Magnetics

The DFP200 Magnetics provide two functions: (1) high potential isolation and surge suppression, and (2) input voltage scaling (PT) and current scaling (CT). The PT scales down the input voltage by a factor of 28.

The voltage across the CT secondaries are passed to a proprietary Data Acquisition Platform (DAP) which is located on the A-I/O board. The CT and PT are linear throughout the measurement range. They have a frequency response of at least the sampling rate of the DFP200 (32 times the fundamental of line frequency, or 1.92 kHz on a 60 Hz line) so as to have minimal effect on the DFP200's frequency response. The outputs of the Magnetics are applied to the Analog Input Board.

A Surge board is located in the case at the points where the input voltages and currents enter the box. This board supports several capacitors that have been included to reduce the potential for misoperation associated with surge transients.

A small E^2PROM is located on the side of the case, and carries the calibration constants for the magnetics in the particular case in which it is installed. This means that all cases are calibrated and can be interchanged with other Shelf Assemblies without significantly impacting the calibration of the overall unit.

The 3I0/Sync Check terminals are connected internally to the 3I0 CT (optional) or to the Sync-Check PT (optional). The DFP200 CTs create a current step-down of 20,000 to 1. This current scaling allows for a more manageable processing of analog signals. The CTs' secondaries contain a load resistor across, from which a linear input current/output voltage is obtained.

Analog Functions

The analog functions for the DFP200 are implemented on the A-I/O board, primarily in the area near the 50 position connector interface. The DFP200 has eight separate analog channels, divided among four currents, three voltages and one channel that may be configured as a current or a voltage. This latter channel is used for the 3I0 sensing function, or the Sync Check function, when implemented. Each voltage and current signal from the magnetics pass through one of these eight channels.

Each of the four permanent current signals from the Magnetics Module passes through two parallel analog processing paths. These two paths provide filtering and amplification for the Relay Range and Metering Range. Each voltage signal from the Magnetics Module passes through a single analog processing path. The 3I0/Sync Check channel has only a single analog path in either mode.

The input current signal to the Analog Portion of the A-I/O board is developed by the CT in the Magnetics. The voltage required for the A/D is developed by passing the CT's secondary current through a load resistor.

A five gang jumper (J18) is located near the 50 position connector interface. If this jumper is installed, then the relay is rated as a five amp unit, and if removed the relay is configured as a one amp unit. The relay is calibrated according to the rating indicated in the Model number, and adding or removing the jumper will void this calibration.

There are two current channels in the DFP200.. They are the Relay Channel and the Meter Channel.

The relay channel takes the voltage directly from the load resistor across the CTs and inputs that quantity to the A/D converter, which is part of the DAP chip. The conversion resistor is sized to provide 44.6 per unit current (44.6 amps RMS full scale for a one amp rated unit, and 223.1 RMS amps for a five amp rated unit).

The meter channel takes the voltage from the load resistor and amplifies that signal with a gain of 21. This gain allows the DFP200 to accurately measure low level signals. The meter channel provides 2.12 per unit current (2.12 amps RMS full scale for a one amp rated unit, and 10.6 amps RMS full scale for a five amp rated unit).

An internal "Notch" channel is developed in the software of the relay to support the high impedance algorithm. This algorithm requires squared current (energy) units as an input, and the unique nature of the DAP A/D allows nearly 30 bits of resolution in these units. The Notch Range is obtained by squaring the Metering Range output and passing the result through a digital notch filter. The notch frequency for this filter tracks the line frequency such that a 40 dB notch is always centered on the fundamental of line frequency. The notch center frequency is under CPU control, and the commanded frequency is developed from a patented algorithm which takes into account the fundamental frequency of each phase, thereby eliminating any concern of notch frequency drift if a phase is lost completely. In addition, delays are built into the software and hardware of the Phase Locked Loop which performs this frequency tracking to prevent any rapid shift in notch frequency. The notch filter thus effectively eliminates the fundamental component of the input, while providing high resolution information for the other harmonics.

The Voltage Channels are developed by passing the outputs from the PTs through scaling resistors and a voltage follower amplification stage to the A/D converter. This yields 1.935 per unit voltage, or 232.1 volts RMS full scale.

This approach results in twelve current channels and three voltage channels being normally present, and one channel which is either a voltage or a current. Each of these channels is submitted to the A/D in one of two DAPs (eight channels per DAP). The design of these DAPs eliminates the need for Sample and Hold circuitry which is usually necessary to preserve phase information for power calculations. The DAPs provide the equivalent of sixteen A/Ds, and thus perform a simultaneous conversion of all channels. The A/D is a Delta-Sigma based device, and the $sinc^2$ nature of the conversion eliminates the need for anti-aliasing components. Each A/D simultaneously samples the input signal 1024 times per sample, and effectively averages the result to determine the reported value for the sample. The internal clocking for the A/D is driven by the same Phase Locked Loop which drives the Notch center frequency tracking, and as a result, there is always exactly 32 samples per cycle. At 60 Hz, the sampling rate is 1. 966 MHz.

The DAPs are directly interfaced to the CPU, and the channel data digital word is read out in 16 bit words. Direct Memory Access (DMA) interrupts are employed to alert the CPU that data is ready, and after various address and control lines are setup by the CPU, the data is clocked out over the lower half of the 16 bit wide data bus.

Processor Board

The DFP200 CPU board is based on the Intel 960CA microprocessor, which is a RISC machine running at 25 MHz. The board consists of the following major sections:

- Microprocessor
- Two Mbytes Flash Program memory
- Capacitor Backed SRAM, either 8x128 or 8x512 bytes, model number dependent
- Scratch pad SRAM
- EEPROM, parallel interface
- Timers and counters
- Real time clock
- Bus interface
- Watchdog circuit

Variables, buffers, and stack space reside in 32-bit-wide fast static RAM. A 32-bit-wide bank of Flash memory holds the program code, while EEPROM is used for configuration data and calibration constants. The oscillography files, peak demand records, and other long-term storage fields are placed in 48-hour capacitor-backed RAM.

About 600 Kbytes of program memory are utilized for the DFP200 functions, which leaves a significant future expansion capability in the Flash memory. Downloading new code into the relay is performed by interrupting the startup sequence with a specific sequence of commands issued when the Keypad/Interface flashes “DOWNLOAD MODE” just prior to initialization. Details of this procedure are provided with software upgrades to the relay software.

A Watchdog Timer and Power-Supply Monitor Circuit are used to monitor the power supply and microprocessor operation, among other basic functions. If the watchdog input to this circuit is not strobed within the watchdog timeout period (1-second minimum), a hardware reset is generated. If the unregulated power-supply voltage dips below a pre-determined threshold, a non-maskable interrupt (NMI) is issued to the microprocessor. Finally, this circuit has an input for both regulated 5 VDC and a capacitor voltage. If the 5 VDC input falls below the capacitor voltage, the internal circuitry switches over the capacitor voltage to the capacitor-backed RAM and the real-time clock so that their power supply is uninterrupted.

A Reset Lockout Counter is provided, which counts the number of hardware resets within a one-hour period. On the fourth warm boot after a power-up or a software-controlled reset of the lockout counter, a lockout occurs and the DFP200 relay's processor remains in the communications-only mode (no protection) until the power is cycled off and then on again. The lockout counter is normally reset once per hour if a warm boot has occurred within the hour. The DFP200 relay's design also includes a software counter that, under normal circumstances, puts the DFP200 relay in a reduced operational mode one reset before the lockout state is reached. This mode supports communication only functions at 9600 baud.

The DFP200 relay'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 either a pulse received on the rear RS-232 port based on a coded message received on that port's receive line, or to an externally supplied IRIG-B signal.

Serial Communication

There are four serial ports associated with the DFP200. PORT 1 and PORT 2 are located on the front panel. PORT 3 and PORT 4 are located on the rear panel. PORT 1, PORT 2, and PORT 3 are configured for RS232 communications. PORT 1 is dedicated for the optional MMI. PORT 4 of the DFP200 is communication card dependent. The external communication in the DFP200 is handled through two Dual Universal Asynchronous Receiver Transmitter (DUART) devices that are optically isolated and can handle baud rates of up to 19,200 bps. Each port can be simultaneously accessed for data, but software limits the number of ports which can send commands and change settings to the first port which logs on with the correct password.

Port 4, Optional Comm Card, and RS-485 Communications

Communications Port 4 is interfaced to the relay communications hardware through an optional communications card. This card can be inserted in a 68 pin Single Inline Memory Module (SIMM) socket which is located on the Analog - I/O board (labeled P10). If no card is installed, the port will not work. The removable card approach provides flexibility in response to changing protocols; as new protocols are developed, the relay can be updated by changing out the card as opposed to wholesale replacement.

At present, an RS-485 communications card is available. This card must be configured for the desired termination impedance and either four wire or two wire operation. It is installed in the board by orienting the components on the board towards the faceplate of the shelf with the PC board “fingers” aligned with and touching the socket. Rock the top of the board towards the faceplate, and push the board into the socket. Then rock the top of the board away from the faceplate until the card is perpendicular to the Analog - I/O board, and the spring keeprs on the side of the socket snap into place. To remove, simply pull the spring keeprs away from the board, rock the top of the board towards the faceplate, and pull the board from the socket.

The RS-485 card comes configured as a two wire, 120 ohm terminated unit when the option is purchased. Jumper changes required for other configurations are listed in Table 4-1.

RS - 485 Configuration	Installed Jumpers (remove jumpers not listed)
2 Wire, No Termination	P1, P8, P9
2 Wire, 120 Ohm Termination	P1 - P4, P8, P9
4 Wire, No Termination	No Jumpers Installed
4 Wire, 120 Ohm Termination	P2 - P7

Table 4-1 Optional Comm Card Jumper Configurations

Digital Outputs

The DFP200 has eight digitally controlled, programmable relay outputs and two nonprogrammable alarm outputs. All outputs are designed to be Form C and therefore can be configured through jumpers to be either in the Normally Open or in the Normally Closed position. The factory setting of the Digital Output jumpers is Normally Open, and Normally Closed for the alarm contacts. Refer to

Figure 4-3 jumper configuration to determine which two header pins need to be covered for a specific configuration.

Alarm Outputs

The Self Test Alarm contact is used to activate a remote alarm in case the DFP200 fails the internal self-test. This relay is energized (closed when configured in the normally open position) in normal operation mode and de-energized otherwise (in case of self-test failure).

The Power Fail contact is energized when rated voltage is applied to the Input Power terminals. The relay for this alarm derives voltage from the power supply inside the unit, and thus will also signal a failure of the DFP200 power supply. In the event the power supplied to the unit drops below or increases above the required voltage levels, the contacts will drop out to activate an external alarm.

Programmable outputs

The Digital Outputs are connected to protection and command functions by Configurable Logic, as described in the XPRESSION BUILDER chapter.

Upon the receipt of a close/open command from the CPU, all digitally controlled relays close/open within 7 msec. Output Contacts #1 and #2 are designed to have a current and voltage sensing mechanism that provide a signal accessible by the CPU (operation of this circuitry is described in the FEATURES - BREAKER CONTROL section).

A two-step process is required to energize any of the programmable digital outputs. The data is first pre-latched and verified and latched again. This process is not performed for the self-test relay.

Digital Inputs

The I/O portion has eight digital inputs. These inputs are used to convert any voltage of the range 38.5-300 VDC to a high logic level and any voltage of range of 0-24 VDC to a low logic level. These inputs are configurable through Settings 0401-0408.

Remote Operation Enabling Jumpers

Two jumpers on the A-I/O board determine the remote operation of the relay. Remote trip and close contact operation and remote commanding via the rear port are disabled in the factory default configuration. Removal of jumper J16 is required to command the DFP200 via the rear communication port. Similarly, removal of jumper J17 is required to trip or close the breaker (change relays state).

Power Supply:

The power supply is available in two options, one that operates from 20 to 60 VDC and one that operates from 88 to 300 VDC or 96-264 VAC at 47-63 Hz. The power supply provides 5 VDC output for digital and analog circuitry and 12 VDC output for the relay output circuits.

The DFP200 I/O board also contains a 5 VDC to 5 VDC converter with 3 kVDC isolation. This circuit is used to provide power supply for the isolated communication circuitry, the optional communication card, and the External Man Machine Interface (MMI).

MMI

The DFP200 is available with two basic MMI configurations: 1) Standard MMI which consists of status Light Emitting Diode (LEDs), target reset push button, and a serial-port-interface connector and 2) Optional Keypad/Display which adds a 4 line by 20 character Liquid Crystal alphanumeric Display (LCD) and a 20 key membrane switch keypad to the basic MMI configuration.

The LED assignments in the DFP200 Standard MMI are provided in Table 4-2.

The Keypad/Display is a separate component, connected to the DFP200's A-I/O Board through a standard six wire modular jack on the front panel. Similarly, the LEDs are located on the A-I/O Board, and are visible through windows on the front panel. Both configurations support horizontal and vertical mounting.

LED	Indication Function	Function Status	Color	LED Status
1	Power	ON	Green	ON
		OFF		OFF
2	Self Test	Fail	Red	ON
		Pass		OFF
3	Breaker Failure	Alarm	Red	ON
		Normal		OFF
4	Recloser	Lockout	Yellow	ON
		Any other State		OFF
5	Phase A	Fault	Red	ON
		Normal		OFF
6	Phase B	Fault	Red	ON
		Normal		OFF
7	Phase C	Fault	Red	ON
		Normal		OFF
8	Neutral	Fault	Red	ON
		Normal		OFF
9	Instantaneous	Fault	Red	ON
		Normal		OFF
10	Downed Conductor	Fault	Red	ON
		Normal		OFF
11	Frequency	Fault	Red	ON
		Normal		OFF
12	Voltage	Fault	Red	ON
		Normal		OFF

Table 4-2: LEDs Assignment and Status

Chapter 5
Acceptance / Periodic Tests

Warning: Remove all power from the relay by disconnecting the dc control power and removing all voltage inputs to the rear terminals prior to opening the unit. Dangerous or lethal voltages may be present inside the unit even if the power switch is OFF.

5–1 Overview

This section is a guide for testing the DFP200. These tests are not necessary for incoming inspection. The relay was tested at the factory with automated test equipment. The DFP200 is controlled by self-checking software. If a system failure is detected, it is reported through the display and SELF TEST LED.

The tests in this section include self-tests of the relay status, display, and Keypad/Display Interface. Tests of IOC, TOC, Under/Over Frequency, Under/Over Voltage, HiZ, etc. are also included, and can be performed at the customer's discretion.

For easier testing, all tests will be performed with DFP200-LINK as the communication medium. However, similar tests can be performed with the ASCII protocol.

General Relay Tests
T1 – Relay Status and Display Tests (Self Tests)
T2 – Configurable Output Tests
T3 – Configurable Input Tests
T4 – AC System Input Test
T5 – Insulation Test

Test Equipment

- A three-phase source of voltage and current at rated frequency.
- A DC Control voltage source.
- Three ac voltmeters.
- Three ac ammeters.
- A continuity tester or ohmmeter.
- An IBM PC-compatible computer with a serial port and mouse.
- An RS232 null modem cable to connect the PC to the DFP200.
- A precision timer for testing timed events.

The specific equipment requirements are listed in the instructions for each test and in the associated circuit diagrams.

The three-phase ac sinusoidal voltage must be balanced and undistorted. Similarly, the dc power should come from a "good" source with less than 5% ripple.

Alternatively, a three-phase electronic test source may be used. In many cases, these devices allow simplification of the test circuits.

Drawings and References

The following drawings should be used for reference during testing.

Drawings
Elementary Diagrams, Figures 2-2
TOC curves, Figures 2–4, 2–5, 2–6, 2-7

References
Chapter 9- DFP200 - Link

Equipment Grounding

All equipment used in testing the relay should be connected to surge ground to provide noise immunity. This includes the voltage and current sources and the DFP200 itself.

The common for surge protection on the DFP200 is clearly shown on the back of the case.

Required Settings

Most tests use the default settings. Any required setting changes are listed with the test procedure.

For details on performing the relay test with user-specific settings during periodic testing, see Chapter 6 - Functional Tests (User Settings)

General Instructions

1. The testing of the DFP200 will be performed with actual relay settings. The measuring units and functions are actually internal to the software. There are no individual hardware modules that are responsible for the specific measuring functions.

   During testing all functions will be turned off except the individual function being tested. To operate any of the DFP200 output contacts a configurable logic file will be needed. This file can be created by the Xpression Builder software located in the back cover of this manual. For each test an Xpression Builder file will be needed to operate the output contacts with the functions /pickup/trip output. The majority of all Acceptance testing will be performed with the default Xpression Builder file (DFP_CONF.EXP). Once DFP200-LINK is installed on your PC you will find this file in your DFPL directory.

CAUTION: Output contacts will chatter when the unit under test is near its threshold. *Do not let it continue to chatter.* Remove the test current. A single contact closure is enough to determine that the unit picked up.

   Use a continuity tester with high-input impedance, such as a digital ohmmeter, to monitor the output contact used during the relay testing.

NOTE: Output contacts will operate during this testing. It WILL trip the breaker if connected.

2. Where appropriate, current levels are defined with two numbers as xx(yy); xx is the value to be used for relays rated at 5 amperes and (yy) is the value to be used for 1-ampere relays.
3. One or more of the electronic current sources may not be used during a test. If the source is not used, it must be set to zero, in addition to being disabled. Also, the currents should always be set at or near zero whenever a current source is powered on or off.
4. The phase angles of the test sources are shown relative to phase A voltage. A positive phase angle indicates the referenced quantity is leading phase A voltage. A negative phase angle indicates the referenced quantity is lagging phase A voltage.
5. All test voltages are phase-to-ground measurements unless otherwise specified.
6. Entries at the keypad are shown as KEY, with the label of the key to be pressed. For tests that require a setting change, the setting number is shown in parentheses next to the setting. This is performed by pressing the SET key, choosing the setting type (Protection or General), the group (if necessary), the setting number (nnnn), and ENT. The new setting may then be entered.
7. When testing the relay using the DFP200-LINK software, the only time that information will automatically appear on the display is during the present value monitoring updates. Relay status will not automatically appear.
8. At the end of testing, make sure that all settings are returned to their initial values. This can be done through the DFP200-LINK by uploading the settings to the PC before testing begins, saving the settings, and then downloading them back to the relay when testing has been completed. If a PC is not available, scroll through all settings using the keypad and verify each one with the table in the Calculation of Settings section of this book.

Setting Changes

Setting changes required for a particular test are listed before the test. A sample setting change is shown below. Refer to Chapter 8 –

Local Interfaces for further details on making setting changes.

Example Setting Change

This example illustrates changing the pickup of the IOC LOW Ground Function to 1.2 Amps.

1. Apply rated dc and wait for relay initialization to complete, indicated by a solid green POWER LED on the front of the relay.
2. Press the SET key:

   Enter Password:

   is displayed.

   If this is the first time the Settings Level functions are used, the password has the factory value ".123". This password must be changed before any setting functions can be accessed. See Chapter 8 – Local Interfaces for details on changing the password.
3. Enter the current settings level password. If the password is not known, see Chapter 9 – DFP-Link Users Guide for details on viewing the password. When the correct password is entered, the settings menu is displayed.
4. Press the ENT key to select Protection settings. Press the 1, then ENT keys to select Group 1 settings.
5. Scroll with the ARROW key until the cursor is on,

   3. OVER CURRENT PROT

   then press the ENT key.
6. Scroll through the OVER CURRENT PROT menu until

   IOCLOGND = #.#

   appears on the display. (The #.# represents the present setting of the relay).
7. Press the ENT key and then press 1.2 on the keypad. The inputs appear on the display and the "=" changes to a colon (:) to indicate that a change has been made but not yet entered.
8. When the setting is entered, press the ENT key. The colon (:) will change back to a "=". This indicates that the change is entered into the settings buffer, but not permanently changed in the relay.
9. To complete the setting change, press the END key, followed by the 1 key, followed by the ENT key. If these keys are not pressed after setting changes, the settings are not stored in memory.
10. Restore the IOC LOW GND setting to its original value before beginning the test. You will have to enter the settings level password again.

Using Communications (Optional)

The relay can be tested without using the keypad. A PC and a communications program, either DFP200-LINK or an ASCII terminal emulator, are required to establish communications, change the passwords, and change settings for the tests. The example used here is for DFP200-LINK. All the functions available at the keypad are also available through communications.

This section contains a step-by-step procedure to test the relay, from setting up communications to the application of the voltage and current inputs. You must be familiar with the DFP200-LINK software. Refer to Chapter 9 – DFP200 - Link Users Guide for more details on using DFP200-LINK.

Hardware Setup

All 3 of the DFP200 ports (Port 2,3, and 4) accept a 9-pin male D-connector. The PC used may require a 9- or 25-pin connector. A null modem cable is used to connect the PC to the relay without a modem. Null modem cables are shown in Chapter 9 – DFP-Link Users Guide for connecting to the DFP200 to a PC.

PC Software Setup

The software setup consists of starting Windows, loading the software into the PC, starting the program, and configuring the program to the port and baud rate of the PC and DFP200. DFP200-LINK is a Windows program. Refer to Chapter 9 – DFP200 - Link Users Guide or the manuals that came with your computer for directions on using a mouse, menu bars, dialog boxes and windows.

Load & Start DFP200-LINK

1. Use the installation guide in Chapter 9 – DFP200 - Link Users Guide for directions on loading DFP200-LINK into the PC.
2. Double-click on the group icon that contains DFP200-LINK to open the window.
3. Start the program by double-clicking the DFP200-LINK icon.

Set the Local PC configuration.

1. When you start DFP200-LINK the main menu bar is displayed.
2. Click on the Support Func... menu item. Then click on the Host Setup... menu item. Then click on the Ports… menu item.
3. Enter the communications port number that you are using on your PC by clicking in the box.
4. Select OK when the port is configured.

Set Up a Test Unit Description

The next step is to create a new Unit Description that matches the DFP200's baud rate, phone number, and switch code. Usually, the DFP200 is accessed locally during testing; therefore, the PHONE NUMBER and SWITCH CODE are left blank. The BAUD RATE is set to the factory setting of 9600 with one stop bit and no parity.

1. Select the DEVICE SETUP heading from the DEVICE menu.
2. When prompted for the Device Name, select ADD. A new unit description is created and must now have parameters set for it. The Device Setup menu appears with spaces for DEVICE NAME, UNIT ID, BAUD RATE, STOP BITS, PARITY, PHONE NUMBER, and SWITCH CODE,.
3. At the DEVICE NAME prompt type in ADD. At the UNIT ID prompt, type in 0 and press TAB. (This should match the unit ID of the unit you are testing.)
4. At the BAUD RATE prompt, select 9600 and press TAB.
6. At the STOP BITS prompt, select 1 and press TAB.
7. At the PARITY prompt, select None and press TAB.
8. The Unit Description for TEST is complete. Enter OK to return to the Device Directory, and click on Close to return to the Main Menu.

Relay Setup

Before shipment, the relay is set with factory default settings. These include the Unit ID, the Baud Rate, and the Factory Passwords. The default communications parameters are listed in Table 5–1.

Parameter	*Setting*
Unit ID	0
View Password	DFPD$
Control Password	DFPC$
Settings Password	DFPS$
Master Password	DFPM$
Baud Rate	9600

Table 5–1. Factory-default communication parameters.

Logging Into the Relay

1. Select CONNECT from the DEVICE menu.
2. Select the TEST device just created. DFP200-LINK will prompt for a password. If this is the first relay login, after logging in, the passwords listed in Table 5–1 must be changed before any relay functions except CHANGE PASSWORD and LOGOUT will operate. See Chapter 9 – DFP200 - Link Users Guide for details on changing a password. If you have already changed the factory passwords you can go to step 5.

3. Type in the current password and press OK. If the password is not known, refer to Chapter 9 – DFP-Link Users Guide for details on displaying the current password.

5. If it was a successful login, the DFP200-LINK responds with the main connected menu.

   If this was an initial login, with the factory passwords, you must change the password, log out, and log in again, in order to get complete access of all the DFP200 menus.

6. Select LOGOUT from the DEVICE menu and select YES.

Setting Changes

Setting changes required for a particular test are listed before the test. A setting can be changed either individually or for an entire group A procedure for and example of how to change settings is provided in Chapter 9 – DFP200 - Link Users Guide or Chapter 10 - Communications.

It is important to remember to select SEND END from the DFP200 SETTINGS menu after all settings changes for a particular test are complete. This is necessary because settings are stored in a buffer so that they can all be downloaded at once. Selecting SEND END changes the settings in the relay itself.

Initial Test Setup

Before beginning a test, the relay settings should be checked for reference and verification. The factory settings are listed in Chapter 3 – Calculation of Settings. You may use either the communications ports or scroll through the settings to ensure they all match the defaults.

Once uploaded, the current DFP200 settings can be saved to a disk file so that they can be downloaded to the DFP200 when testing is completed. Use the SAVE command after the settings have been loaded from the relay. DFP200-LINK prompts for a name for the file, after which you should enter a valid MS-DOS filename. More information on how to use this command can be found in Chapter 9 – DFP200 - Link Users Guide or Chapter 10 - ASCII Communications.

5–2 General Relay Tests

T1 – Relay Status and Display Testing

The DFP200's Status is reported through the Keypad/Display Interface and through DFP200-LINK. If a system error causes relaying functions to cease, the SELF TEST status LED turns red and the critical alarm contact closes. This will also put the relay into a COMM ONLY mode, which will not allow relay operations.

Status Check

This test demonstrates the use of the Keypad/Display Interface to check relay status. See

Chapter 9 – DFP200 - Link Users Guide or Chapter 10 - ASCII Communications for further details.

1. Only the dc power supply voltage is required for this test. Apply the rated dc power and wait for initialization to complete (if this has not been done already), as indicated by the green LED.

2. Press the INF key, the display should show

   1. DFP200 STATUS

3. Press the ENT key. The display should contain

   1. System Status

   Press the ENT key again. The display should contain

   No Errors Detected

   which means that the relay is operational and there are no errors.

Note: If the relay is ever found to be in COMM ONLY mode, check the STATUS of the DFP200 and record the information for all categories of STATUS before calling GE for service.

Display and Keypad Tests

The Keypad/Display Interface Test is built into the software and allows testing the keypad and the display.

1. Apply rated dc power and wait for initialization to complete, as indicated by the green POWER LED, if necessary.
2. Press the ACT key, enter in the ACTION password (Note: You will have to change the factory default password if it hasn't been changed), then scroll with the arrow keys until the display contains the heading:

   7. MMI TEST

3. Press the ENT key. The display should contain three choices to test the Display, LEDs and Keypad.
4. Select 1. Display and press the ENT key.
5. Check that the display has four rows filled completely with #, then M, then I. Following this it will show:

   GE- P&C

   DFP200

Press the ENT key. The display will change to the MMI TEST menu.

6. Us e the ARROW keys to select

   2. LEDs

   and press the ENT key. Each LED will be powered sequentially. At the end of this test press ACT to return to the MMI TEST menu

7. Use the ARROW keys to select

   3. Keyboard

   and press ENT. Pressing any subsequent key will display that key on the screen. If the CLR key is pressed the test will end.

8. When the test is completed, press the END followed by the ENT key. Press the CLR key to clear the message. This ends the Keypad/Display Interface Test.

T2 – Configurable Output Test

This test checks all 8 of the configurable outputs of the relay, and the SELF TEST relay. It is a convenient way to determine proper system connections and verify the operation of all relay contacts, without having to apply currents and voltages to simulate faults. Protection can be enabled or disabled, as deemed necessary.

Note: If this test is run remotely through DFP200-LINK, then jumper J16 (Figure 4-3) should be removed. Note that the relay is shipped from the factory with the jumper removed allowing the outputs to operate.

---

1. Connect the relay as shown in Figure 5–1.
2. Press the ACT key and enter the control level password.
3. Use the ARROW key to select

   8. Digital Output Test

   Press the ENT key. Before a contact is allowed to be tested, the display prompts

   DISABLE PROTECTION?

   Press the 1/Y key followed by the ENT key to turn protection off. When protection is turned off the SELF TEST LED is turned on. Protection remains off until the test mode is ended. (If desired, protection can be left enabled during the test.)

4. Select the output to test by using the ARROW keys to scroll to the desired output, such as OUTPUT4, and press the ENT key.

   When the digital output is chosen, the selected relay output closes. Verify that the output under test has closed, using an ohmmeter or other suitable device. The output relay will energize for 10 seconds and then de-energize.

5. After the output is tested, scroll to the next output to test, then press the ENT key. This output closes and will remain energized for 10 seconds then it will de-energize. Continue in this fashion until all outputs are tested.

6. End the test mode by scrolling to the

END TEST MODE

selection, then press the ENT key.

The display will show:

ENABLE PROTECTION?

Press the 1/Y key followed by the ENT key to turn protection on. When protection is turned on the SELF TEST LED is turned off.

CONFIGURABLE OUTPUT	X	Y
OUT1*	AB1	AB17
OUT2 *	AB2	AB18
OUT3 *	AB3	AB19
OUT4 *	AB4	AB20
OUT5 *	AB5	AB21
OUT6 *	AB6	AB22
OUT7 *	AB7	AB23
OUT8 *	AB8	AB24
Self Test	AA19	AA20

* These contacts are shipped from the factory in the normally opened position.

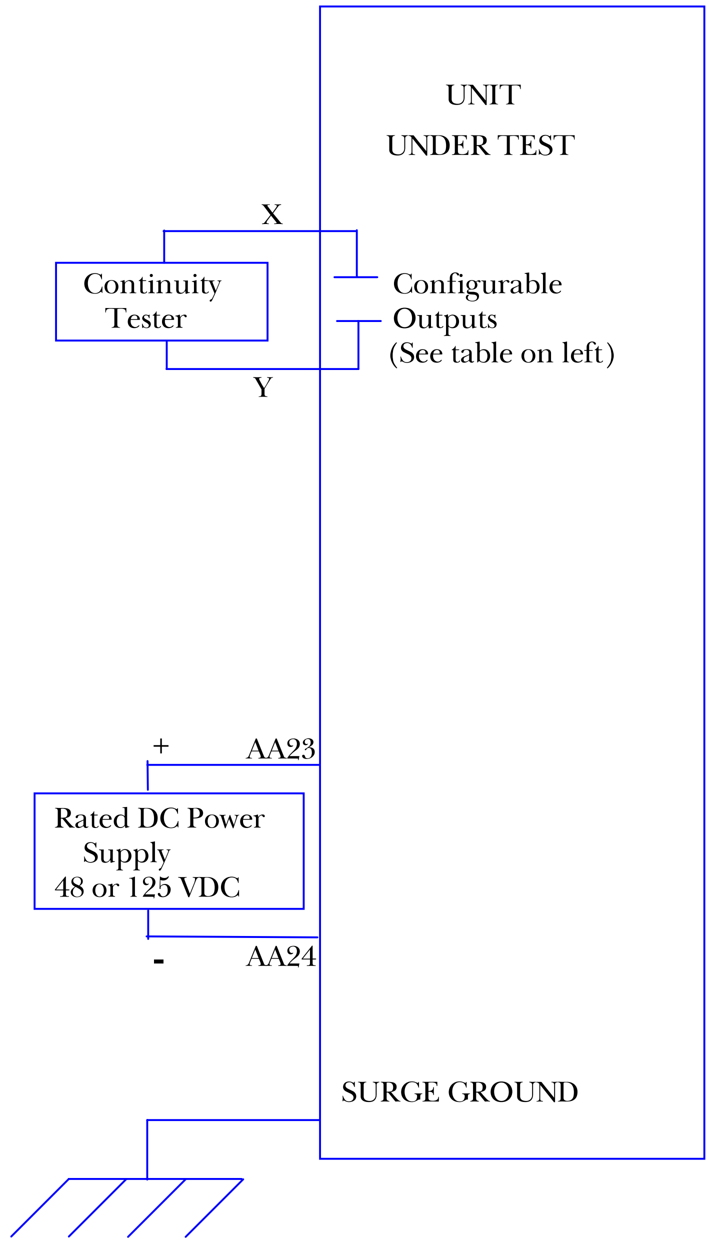


Figure 5-1 Configurable Outputs test connections diagram.

T3 – Configurable Input Test

The DFP200 includes eight configurable inputs which provide great flexibility in applying and testing the relay.

The configurable inputs are programmed to determine how they will be used. For example, one input could be used to trigger oscillography, while another could be used to select a settings group.

In the test case below, the digital inputs will be tested to show that they can correctly detect the application of voltage to their inputs. You can determine that the inputs see the voltage through the CONT CONV STATUS menu on the Keypad \ Display Interface.

To perform the Configurable Input Test, connect the relay as shown in Figure 5-2.

The steps of test T3 are as follows.

1. Apply rated DC across CC1 (AB9-AB25). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC1 is CLOSE. Press the CLR key.

2. Apply rated DC across CC2 (AB10-AB26). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC2 is CLOSE. Press the CLR key.

3. Apply rated DC across CC3 (AB11-AB27). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC3 is CLOSE. Press the CLR key.

4. Apply rated DC across CC (AB12-AB28). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC4 is CLOSE. Press the CLR key.

5. Apply rated DC across CC5 (AB13-AB29). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC5 is CLOSE. Press the CLR key.

6. Apply rated DC across CC6 (AB14-AB30). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC6 is CLOSE. Press the CLR key.

7. Apply rated DC across CC7 (AB15-AB31). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC7 is CLOSE. Press the CLR key.

8. Apply rated DC across CC8 (AB16-AB32). Using the keypad press the INF key and scroll to:

   7. Cont Conv Status

   Press the ENT key and check that the display shows that CC8 is CLOSE. Press the CLR key.

T4 – AC System Input Test

This test uses the Present Values to determine that the voltages and currents are connected properly to the terminal strip. The Mag/Angle Data function will be used to verify that the relay measures the magnitude and angle of the voltages and currents correctly.

1. Connect the relay as shown in Figure 5–3.

2. Set VA to 67 Vrms 0°, VB to 57 Vrms –120°, VC to 47 Vrms 120°, IA to 1.0 Arms 0°, IB to 1 Arms –120°, and IC to 1 Arms 120°,

3. Press the INF key on the keypad. Scroll, using the ARROW keys, to the heading,

6. Mag/Angle Data

and press the ENT key. The present values are now displayed. Note: This report is only updated when first entered.

4. Scroll to the values of VA, VB, and VC and verify that the voltages are within ±2 volts of the voltage source setting and 5° of setting. This verifies the connections of the voltage sources.

5. Scroll to the values of IA, IB, and IC and verify that the currents are within ±1% of the current source setting and 5° of setting. This verifies the connections of the current source.

Note: To test the current in the Neutral reduce the current in phases B and C to zero and check that the current in the Neutral is within ±1% of the source setting.

6. Reduce the test current to zero amps.

T5 - Insulation Test

Note: This test, at the very least, will degrade the insulation life of the DFP200, and if performed incorrectly, could cause permanent damage to several of the electronic parts of the DFP200. It is not recommended that this test be performed on each new DFP200. This section is only an explanation on how to conduct both the AC and DC hi-pot testing.

To correctly hi-pot the DFP200 you must first group together common points of the relay. The hi-pot groups are shown in Table 5-2.

Table 5-2 Hi-Pot Groups of the DFP200

Group #	Terminal Numbers
1	AA1, AA2
2	AA3, AA4
3	AA5, AA6
4	AA7, AA8
5	AA9, AA10
6	AA11, AA12
7	AA13, AA14
8	AA15, AA16
9	AA17, AA18
10	AA19, AA20
11	AA21, AA22
12	AB1, AB17
13	AB2, AB18
14	AB3, AB19
15	AB4, AB20
16	AB5, AB21
17	AB6, AB22
18	AB7, AB23
19	AB8, AB24
20	AB9, AB25
21	AB10, AB26
22	AB11, AB27
23	AB12, AB28
24	AB13, AB29
25	AB14, AB30
26	AB15, AB31
27	AB16, AB32
28	Surge GND

DC Hi-Pot Test

Common Mode Testing - This test will apply the DC voltage across all groups and surge GND.

1. Jumper together groups 1 through 27.
2. Place the negative (-) terminal of the DC hi-pot tester to group 28 (Surge GND stud).
3. Place the positive (+) terminal of the DC hi-pot tester to the groups 1 through 27.
4. Slowly increase the DC voltage to 3000 Volts and maintain that voltage for 1 minute. Verify that no breakdown occurs.
5. Decrease the DC voltage to 0 volts.

Transverse Mode Testing - This test will apply the DC voltage across each group individually. See Table 5-3 for which groups will receive the negative (-) terminal and which groups will receive the positive (+) terminal.

Table 5-3 Hi-Pot Test Groups

Test#	(+) Terminal	(-) Terminal
1	Group 1	Group 2 - 28
2	Group 2	Group 3 - 28
3	Group 3	Group 4 - 28
4	Group 4	Group 5 - 28
5	Group 5	Group 6 - 28
6	Group 6	Group 7 - 28
7	Group 7	Group 8 - 28
8	Group 8	Group 9 - 28
9	Group 9	Group 10 - 28
10	Group 10	Group 11 - 28
11	Group 11	Group 12 - 28
12	Group 12	Group 13 - 28
13	Group 13	Group 14 - 28
14	Group 14	Group 15 - 28
15	Group 15	Group 16 - 28
16	Group 16	Group 17 - 28
17	Group 17	Group 18 - 28
18	Group 18	Group 19 - 28
19	Group 19	Group 20 - 28
20	Group 20	Group 21 - 28
21	Group 21	Group 22 - 28
22	Group 22	Group 23 - 28
23	Group 23	Group 24 - 28
24	Group 24	Group 25 - 28
25	Group 25	Group 26 - 28
26	Group 26	Group 27 - 28
27	Group 27	Group 28

1. Set-up DC hi-pot tester according to test #1 in Table 5-3.
2. Slowly increase voltage to 3000 VDC and maintain that voltage for 1 minute. Verify that no breakdown occurs.
3. Decrease voltage to 0 VDC.
4. Repeat steps 1 through 3 for tests 2 through 27 of Table 5-3.

AC Hi-Pot Testing

The setup for this test requires the removal of three connections. The three connections are jumpers J12 and J13 on Figure 4-3 and the braided cable joining the surge capacitor board to the RFI board. The braided cable can be found on the right side of the 50 pin card-edge connector, located above the magnetics module. Once these connections are remove you can perform the AC Hi-pot test.

Note: After removing the braided cable from the surge capacitor board, you must cover this cable with an insulator during the AC hi-pot test. Failure to cover this cable could result in damage to the relay.

To correctly hi-pot the DFP200 you must first group together common points of the relay. The hi-pot groups are shown in Table 5-2.

Common Mode Testing - This test will apply the AC voltage across all groups and surge GND.

1. Jumper together groups 1 through 27.
2. Place the negative (-) terminal of the AC hi-pot tester to group 28 (Surge GND stud).
3. Place the positive (+) terminal of the AC hi-pot tester to the groups 1 through 27.
4. Slowly increase the AC voltage to 2000 Volts and maintain that voltage for 1 minute. Verify that no breakdown occurs.
5. Decrease the AC voltage to 0 volts.

After completing this test replace jumpers J12 and J13 from Figure 4-3 and the braided cable from the surge capacitor board.

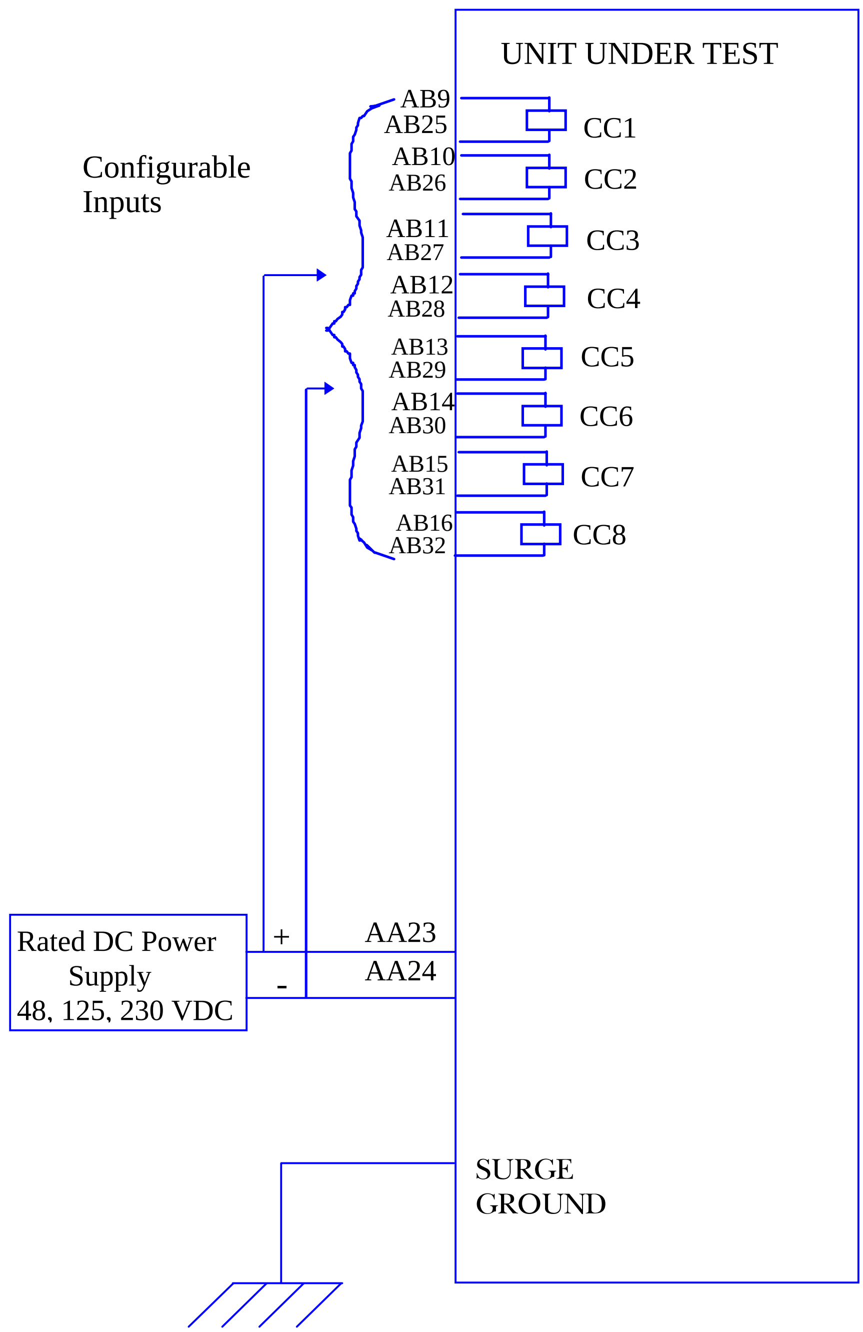


Figure 5-2 Configurable Input Test Connections

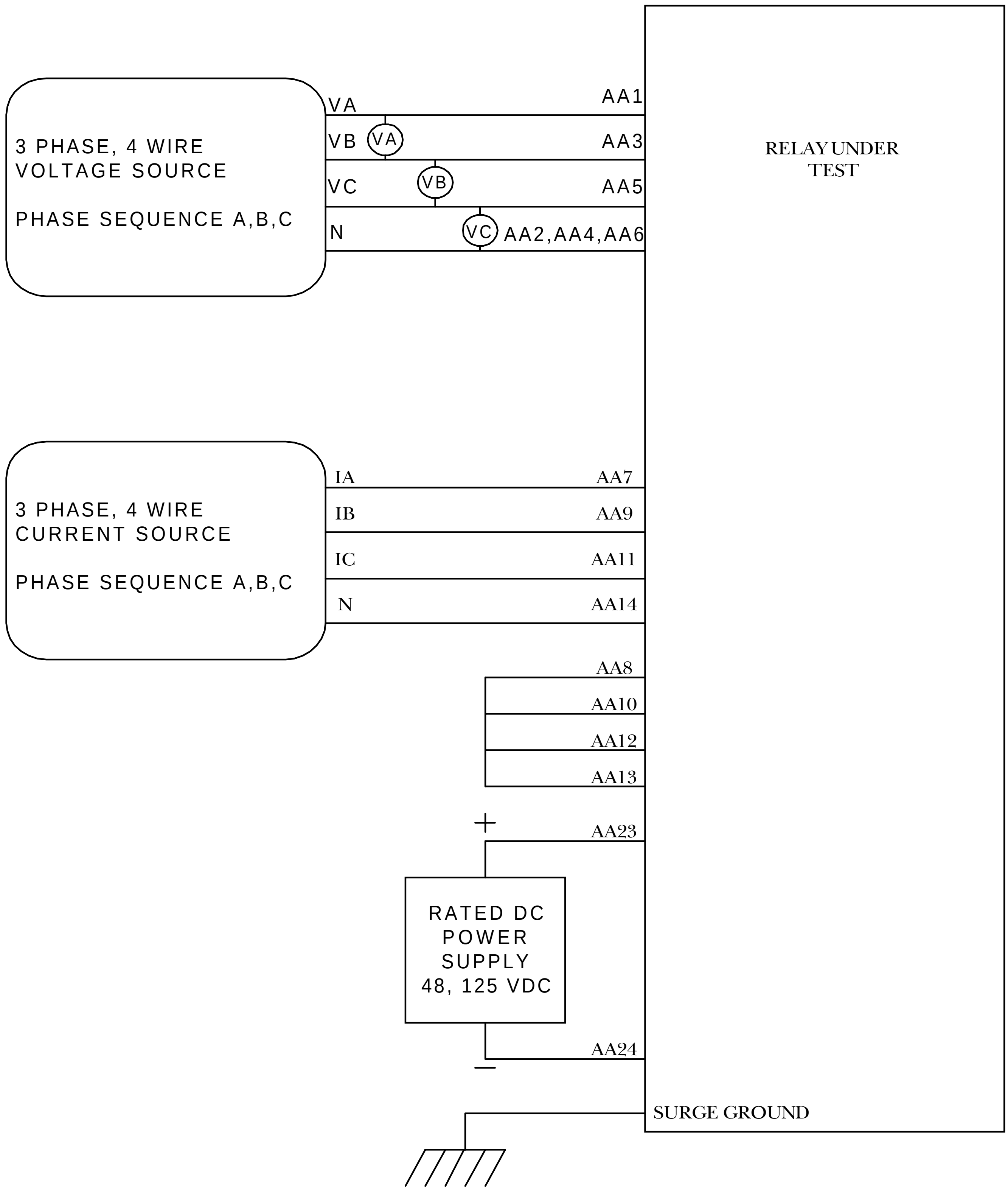


Figure 5–3 AC System Input Test Connections

Chapter 6 Functional Tests

6-1 Function Tests

The following section attempts to test every major function contained in the DFP200. Because the DFP200 has integrated a wide range of functions, testing all of them will require substantial time. This, however, is unnecessary to prove that every DFP200 works correctly. Successfully performing the acceptance test of the previous section will guarantee correct operation of the relay.

The DFP200 is a microprocessor based relay. After the analog to digital converter sends the data to the processor regarding the input signals, all calculations and decision are performed by the Intel 960 processor contained in the DFP200. In short, if the processor can measure current and voltage correctly it can perform all of the functions equally correctly.

This section is helpful for first time users who want to quickly become familiar with the relay.

Measuring Unit Tests

T1: HiZ Test
T2: IOC Phase Test
T3: TOC Phase Test
T4: IOC GND Test
T5: TOC GND Test
T6: Negative Sequence IOC Test
T7: Negative Sequence TOC Test
T8: Under Voltage Test
T9: Over Voltage Test
T10: Under Frequency Test
T11: Over Frequency Test
T12: Recloser Test
T13: Phase Directional, 67P
T14: GND Directional -Volt. Polar. 67G (3V0)
T15: GND Directional - Curr. Polar. 67G (3I0)
T16: Negative Sequence GND Direct. (67N)
T17: Sync-Check

Initial Setup

Before starting the functional test perform a BULK SETTINGS DOWNLOAD of the following settings:

DFP_FACT.SET
DFP_CONF.EXP

These files can be found in your DFP200-LINK directory.

Bulk Settings Download is perform by first logging into the relay with the settings password and then selecting Bulk Settings Download from the Settings menu. Place a check-mark in categories Settings Group #1 and Configurable Logic #1. Also, check that the file selected for Settings Group #1 is DFP_FACT.SET and the file for Configurable Logic #1 will be DFP_CONF.SET. This will send DFP_FACT.SET to settings group #1 and DFP_CONF.EXP configurable logic #1. This will give the relay the initial settings needed to perform this test.

Additional setting changes:

NEGATIVE SEQUENCE OVERCURRENT
(703) NSIOCPRO = OFF
(704) NSTOCPRO = OFF
SEQUENCE COORDINATION
(0803) SEQCRD = OFF
DIRECTIONAL OVERCURRENT SUPER.
(1304) TORQ2 = 0,0,0,0

NOTE: The Bulk Settings Download will change all of the settings in group #1 previously stored in the relay.

CAUTION: The defined output contact will chatter when the unit under test is near the threshold. ***Do not allow this to continue.*** Remove the test current. A single contact closure is enough to determine that the unit picked up.

T1 – HiZ Test

This test is only for models DFP2XXXHXXXX

X = Don't Care

The HiZ function of the DFP200 detects the existence of arcing or a down conductor situation on the monitored line. The algorithm compares the analog input with certain signature indications of arcing. If the DFP200 detects an overcurrent condition or a loss of load followed by an arcing condition, the DFP200 will set the DOWNCOND flag true. If only arcing is detected, with no overcurrent or loss of load, it will set the ARCDETEC flag true.

The HiZ settings contain overcurrent threshold settings (setting 0506, PCHZ and setting 0507, GCHZ). It is these settings that must be exceeded to obtain the down conductor output. If during the execution of the HiZ algorithm any of the "conventional overcurrent" settings are exceeded the HiZ algorithm will be blocked from operating to allow the conventional overcurrent to clear the fault. Therefore, to perform this test correctly you should disable the conventional overcurrent to prevent it from blocking the HiZ algorithm from operating.

1. Connect relay as shown in Figure 6-1.
2. Using the Keypad \ Display Interface login with your settings password. At the main menu for Settings enter 99 then press the ENT key. This will cause the DFP200 to re- initialize all protection functions.
3. Apply a current of 9 Arms to the phase A input (AA7,AA8). This current will exceed the 2-cycle overcurrent HiZ setting (setting 0506, PCHZ). Leave current applied for about 1 second.
4. Immediately after apply .5 Arms @ 3X the nominal frequency (180Hz for 60 Hz relays and 150 Hz for 50 Hz relays). Leave current applied for 2 seconds.
5. Immediately switch frequency to 4X nominal frequency while leaving amplitude at .5 Arms. Leave current applied for 2 seconds.
6. Repeat steps 5 and 6 until the DOWNCOND LED turns on and OUTPUT1 is energized. This should occur about 1 minute after the start of the test.
7. Reduce current to 0. Press the TARGET RESET button.

NOTE: During this test both the DOWNCOND flag and the ARCDETEC flag were picked-up. The DOWNCOND flag has an internal dropout time of 2 seconds and the ARCDETEC flag has an internal dropout time of 10 minutes. So if you find that the OUTPUT contacts are still energized after this test has completed it is because the DFP200 is waiting for the dropout timer to expire.

T2 – IOC Phase Test, 50PH

1. Setting Changes:
   OVERCURRENT PROTECTION
   (0604) IOCHIPH = 1.0 Arms
   (0605) IOCHIPHDL = 50 ms
   (0606) PHHIIOCPRO = ON
2. Connect the relay as shown in Figure 6-1.
3. Apply 2.0 Arms to the phase B input (AA9,AA14). The IOCPHPKP flag will be set true immediately and OUTPUT1 will operate in <85ms when IOCPHTRP is set true. The B and INST LED will turn on .
4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   OVERCURRENT PROTECTION
   (0606) PHHIIOCPRO = OFF

T3 – TOC Phase Test, 51P

1. Setting Changes:
   OVERCURRENT PROTECTION
   (0613) PHTOCPRO = ON
   (0614) PHTOCPKUP = .5 Arms
   (0615) PHTMEDIAL = 7
   (0616) PHTOCCUR = INVERSE TIME
2. Connect the relay as shown in Figure 6-1.
3. Apply 2.0 Arms to the phase C input (AA11,AA14). The TOCPHPKP flag will be set true immediately and OUTPUT1 will operate in 2.72 s < T < 2.86 s when

TOCPHTRP is set true. The C LED will turn on.

4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   OVERCURRENT PROTECTION
   (0613) PHTOCPRO = OFF

T4 – IOC GND Test, 50GH

1. Setting Changes:
   OVERCURRENT PROTECTION
   (0610) IOCHIGND = 1.0 Arms
   (0611) IOCHIGNDDL = 50 ms
   (0612) G_HIIOCPRO = ON
2. Connect the relay as shown in Figure 6-1.
3. Apply 2.0 Arms to the phase B input (AA9,AA14). The IOCGHPKP flag will be set true immediately and OUTPUT1 will operate in <85ms when IOCGHTRP is set true. The N and INST LED will turn on.
4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   OVERCURRENT PROTECTION
   (0612) G_HIIOCPRO = OFF

T5 – TOC GND Test, 51G

1. Setting Changes:
   OVERCURRENT PROTECTION
   (0622) GNDTOCPRO = ON
   (0623) GNDTOCPKUP = .5 Arms
   (0624) GNDTMEDIAL = 7
   (0625) GNDTOCCUR = INVERSE TIME
2. Connect the relay as shown in Figure 6-1.
3. Apply 2.0 Arms to the phase C input (AA11,AA14). The TOCGNPKP flag will be set true immediately and OUTPUT1 will operate in 2.72 s < T < 2.86 s when TOCGNTRP is set true. The N LED will turn on.
4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   OVERCURRENT PROTECTION
   (0625) GNDTOCPRO = OFF

T6 – Negative Sequence IOC Test, 46I

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

1. Setting Changes:
   NEGATIVE SEQUENCE OVERCURRENT
   (0701) NSIOCPKUP = 0.5Arms
   (0702) NSIOCTMEDL = 50 ms
   (0703) NSIOCPRO = ON
2. Connect the relay as shown in Figure 6-1. Negative sequence current is calculated as 1/3 of the single phase input (i.e. with a 3 Arms single phase input you will have a negative sequence current of 1 Arms).
3. Apply 3.0 Arms to the phase B input (AA9,AA14). The NSQIOCPU flag will be set true immediately and OUTPUT1 will operate in <80 ms when NSQIOCTR is set true. The INST LED will turn on.
4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   OVERCURRENT PROTECTION
   (0703) NSIOCPRO = OFF

T7 – Negative Sequence TOC Test, 46T

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

1. Setting Changes:
   NEGATIVE SEQUENCE OVERCURRENT
   (0704) NSTOCPRO = ON
   (0705) NSTOCPKUP = .5 Arms
   (0706) NSTMEDL = 7
   (0707) NSTOCCURV = INVERSE TIME
2. Connect the relay as shown in Figure 6-1.
3. Apply 6.0 Arms to the phase C input (AA11,AA14). The NSQTOCPU flag will

be set true immediately and OUTPUT1 will operate in 2.72 s < T < 2.86 s when NSQTOCTR is set true.

4. Reduce current to 0. Press the TARGET RESET button.
5. Setting Changes:
   NEGATIVE SEQUENCE OVERCURRENT
   (0704) NSTOCPRO = OFF

T8 – Under Voltage Test, 27

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: The Over/Under Voltage function on the DFP200 uses the positive sequence component of the three phase voltage as its measuring quantity. Basically, the positive sequence voltage that the relay measures must be less than the under voltage setting (setting 0901, UVPKUP) for the under voltage function to operate.

---

1. Setting Changes:
   OVER/UNDER VOLTAGE
   (0901) UVPKUP = ON
   (0902) UVTMEDL = 10 s
   (0903) UVPROT = 40
2. Connect the relay as shown in Figure 6-1.
3. Set the voltage inputs to the following values:
   VA: 45 volts rms 0° (AA1, AA2)
   VB: 45 volts rms –120° (AA3, AA4)
   VC: 45 volts rms –240° (AA5, AA6)

   This results in a positive sequence voltage of 45 Vrms. Simultaneously reduce the amplitude of the three voltage signals to 35 Vrms and start the timer. The UVOLTPKP flag will be set true immediately and OUTPUT1 will operate in 10 s < T < 10.1 s when UVOLTTRP is set true. The VOLTAGE LED will turn on.
4. Increase the voltage amplitude to 45 Vrms. Press the TARGET RESET button.
5. Setting Changes:
   OVER/UNDER VOLTAGE SETTING
   (0901) UVPKUP = OFF

T9 – Over Voltage Test, 59

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: The Over/Under Voltage function on the DFP200 uses the positive sequence component of the three phase voltage as its measuring quantity. Basically, the positive sequence voltage that the relay measures must be greater than the over voltage setting (setting 0904, OVPKUP) for the over voltage function to operate.

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1. Setting Changes:
   OVER/UNDER VOLTAGE
   (0904) OVPKUP = ON
   (0905) OVTMEDL = 10 s
   (0906) OVPROT = 60
2. Connect the relay as shown in Figure 6-1.
3. Set the voltage inputs to the following values:
   VA: 45 volts rms 0° (AA1, AA2)
   VB: 45 volts rms –120° (AA3, AA4)
   VC: 45 volts rms –240° (AA5, AA6)

   This results in a positive sequence voltage of 45 Vrms. Simultaneously increase the amplitude of the three voltage signals to 65 Vrms and start the timer. The OVOLTPKP flag will be set true immediately and OUTPUT1 will operate in 10 s < T < 10.1 s when OVOLTTRP is set true. The VOLTAGE LED will turn on.
4. Decrease the voltage amplitude to 45 Vrms. Press the TARGET RESET button.
5. Setting Changes:
   OVER/UNDER VOLTAGE SETTING

(0904) OVPKUP = OFF

T10 – Under Frequency Test, 81U

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: The Over/Under Frequency function on the DFP200 uses the positive sequence component of the three phase voltage as its measuring quantity for the voltage supervision. Basically, the positive sequence voltage that the relay measures must be greater than the voltage supervision threshold setting (setting 1011, VOLTTHR) for the over/under frequency function to operate.

NOTE: The operate times of the Over/Under Frequency function on the DFP200 can be determined as follows:

The under/over frequency unit will not start until the cycle after the positive sequence voltage has exceeded the voltage supervision level. If you are bench testing the DFP200 and your initial voltage level is below the voltage supervision level you will find that there is an additional cycle of delay in your measured output.

Once the DFP200 determines that the voltage has exceeded the voltage supervision cutoff and that the frequency is above the over frequency setting or below the under frequency setting, the relay will then wait 6 complete cycles for the frequency to stabilize. At this point the frequency unit will be picked-up. This 6 cycle delay will also have to be added to your measured delay time.

After the DFP200 determines that the frequency unit has picked-up it will then wait a delay equal to the delay setting for that particular frequency unit.

Therefore, the total delay time for the under/over frequency unit will be:

1 Cycle (voltage supervision time if required) + 6 cycle (stabilize time) + Time Delay Setting + Contact Closure Time

1. Setting Changes:
   OVER/UNDER FREQUENCY
   (1001) UF1PKUP = 58
   (1002) UF1DLY = 50 ms
   (1011) VOLTTHR = 50
   (1012) UFPROT = ON
2. Connect the relay as shown in Figure 6-1.
3. Set the voltage inputs to the following 60 Hz values:
   VA: 55 volts rms 0° (AA1, AA2)
   VB: 55 volts rms –120° (AA3, AA4)
   VC: 55 volts rms –240° (AA5, AA6)

   This results in a positive sequence voltage of 55 Vrms. Simultaneously reduce the frequency of the three voltage signals to 55 Hz and start the timer. The UNFRQPKP1 flag will be set true in 6 complete cycles and OUTPUT1 will operate in 165 ms < T < 185 ms when UNFRQTRP1 is set true. The FREQUENCY LED will turn on.
4. Increase the voltage frequency to 60 Hz. Press the TARGET RESET button.
5. Setting Changes:
   OVER/UNDER FREQUENCY SETTING
   (1012) UFPROT = OFF

T11 – Over Frequency Test, 81O

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: The Over/Under Frequency function on the DFP200 uses the positive sequence component of the three phase voltage as its measuring quantity for the voltage supervision. Basically, the positive sequence voltage that the relay measures must be greater than the voltage supervision threshold setting (setting 1011, VOLTTHR) for the over/under frequency function to operate.

NOTE: The operate times of the Over/Under Frequency function on the DFP200 can be determined as follows:

The under/over frequency unit will not start until the cycle after the positive sequence voltage has exceeded the voltage supervision level. If you are bench testing the DFP200 and your initial voltage level is below the voltage supervision level you will find that there is an additional cycle of delay in your measured output.

Once the DFP200 determines that the voltage has exceeded the voltage supervision cutoff and that the frequency is above the over frequency setting or below the under frequency setting, the relay will then wait 6 complete cycles for the frequency to stabilize. At this point the frequency unit will be picked-up. This 6 cycle delay will also have to be added to your measured delay time.

After the DFP200 determines that the frequency unit has picked-up it will then wait a delay equal to the delay setting for that particular frequency unit.

Therefore, the total delay time for the under/over frequency unit will be:

1 Cycle (voltage supervision time if required) + 6 cycle (stabilize time) + Time Delay Setting + Contact Closure Time

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1. Setting Changes:
   OVER/UNDER FREQUENCY
   (1003) OF1PKUP = 62
   (1004) OF1DLY = 50 ms
   (1011) VOLTTHR = 50
   (1013) OFPROT = ON
2. Connect the relay as shown in Figure 6-1.
3. Set the voltage inputs to the following 60 Hz values:
   VA: 55 volts rms 0° (AA1, AA2)
   VB: 55 volts rms –120° (AA3, AA4)
   VC: 55 volts rms –240° (AA5, AA6)

   This results in a positive sequence voltage of 55 Vrms. Simultaneously increase the frequency of the three voltage signals to 65 Hz and start the timer. The ONFRQPKP1 flag will be set true in 6 complete cycles and OUTPUT1 will operate in 165 ms < T < 185 ms when ONFRQTRP1 is set true. The FREQUENCY LED will turn on.
4. Decrease the voltage frequency to 60 Hz. Press the TARGET RESET button.
5. Setting Changes:
   OVER/UNDER FREQUENCY SETTING
   (1013) OFPROT = OFF

T12 – Recloser Test, 79

This test will check the recloser function of the DFP200. For the recloser to operate correctly, there are two settings that must be made.

1. One Configurable Input must be set to 52/b Status. This will give the relay the ability to see the current state of the breaker.

2. One Configurable Output must be set to BRKRCLOSE. This will give the relay the ability to send a CLOSE signal to the relay.

The default settings loaded at the beginning of this test have set Configurable Input #1 to 52/b Status and Configurable Output #3 to BRKRCLOSE.

1. Setting Changes:

OVERCURRENT PROTECTION SETTINGS
(0604) IOCHIPH = 1.0
(0605) IOCHIPHDL = 50 ms
(0606) PHHIIOCPRO = ON

THREE POLE RECLOSING
(1101) RECLEN = ON
(1102) RECLON52B = ON

2. Connect the relay as shown in Figure 6-2.

   Apply 2 Arms to Phase A of the relay. The DFP200 will perform a series of trips and re-closes. The sequence of events from the time the current is applied will be as follows:

   - The DFP200 will trip IOC after approx. 50 ms.
   - The DFP200 will send a CLOSE signal one second after the breaker opens.
   - The DFP200 will trip IOC approx. 50 ms after the breaker recloses.
   - The DFP200 will send a CLOSE signal two seconds after the breaker opens.
   - The DFP200 will trip IOC approx. 50 ms after the breaker recloses.
   - The DFP200 will send a CLOSE signal three seconds after the breaker opens.
   - The DFP200 will trip IOC approx. 50 ms after the breaker recloses.
   - The DFP200 will send a CLOSE signal four seconds after the breaker opens.
   - The DFP200 will trip IOC approx. 50 ms after the breaker recloses.
   - The DFP200 will go to Lockout and the RECLOSE LED will turn on.

4. Decrease the current to 0.
5. Setting Changes:

   THREE POLE RECLOSING

   (1101) RECLEN = OFF

T13 – Phase Directional Test, 67P

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: For a complete description of the Phase Directional function See Phase Directional section in Chapter 2 - Product Description.

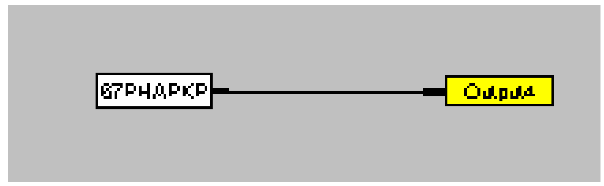
1. Setting Changes:

DIRECTIONAL OVERCURRENT SUPER.

(1303) TORQ1 = 0,1,0,0

(1307) MAXTRQANG = 80

Using Xpression Builder set OUTPUT4 to 67PHAPKP as shown below. Refer to Chapter 11-Xpression Builder for detailed instructions.



2. Connect the relay as shown in Figure 6-3.
3. Set the voltage/current inputs to the following values:

VA: 5 volts rms 0°	(AA1,AA2)
VB: 67 volts rms -120°	(AA3,AA4)
VC: 67 volts rms +120°	(AA5,AA6)
IA: 2 Arms -80°	(AA7,AA8)

With the above inputs OUTPUT4 will operate.

4. If you rotate the phase of IA +/- 85°, OUTPUT4 will remain picked-up. Outside of +/- 95° OUTPUT4 will dropout.
5. Setting Changes:

DIRECTIONAL OVERCURRENT SUPER.

(1303) TORQ1 = 0,0,0,0

T14 – GND Directional Test- Voltage Polarization (3V0), 67G

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: For a complete description of the GND Directional function See GND Directional section in Chapter 2 - Product Description.

1. Setting Changes:

FAULT LOCATION / DISTANCE

(1204) ZERIMPANGL = 80

DIRECTIONAL OVERCURRENT SUPER.

(1301) ZSEQPOL = 3V0

(1302) GNDTRQCTL = ZERO SEQUEN

(1303) TORQ1 = 1,0,0,0

Using Xpression Builder set OUTPUT4 to 67GPKP as shown below. Refer to Chapter 11 - Xpression Builder for detailed instructions.

2. Connect the relay as shown in Figure 6-3.

3. Set the voltage/current inputs to the following values:

VA: 67 volt rms +18 0° (AA1,AA2)

IA: 2 Arms -80° (AA7,AA8)

With the above inputs OUTPUT4 will operate.

4. If you rotate the phase of IA +/- 85°, OUTPUT4 will remain picked-up. Outside of +/- 95° OUTPUT4 will dropout.

5. Setting Changes:

DIRECTIONAL OVERCURRENT SUPER.

(1303) TORQ1 = 0,0,0,0

T15 – GND Directional Test- Current Polarization (3I0), 67G

This test is ONLY done on models DFP2XXXXCXXX

X = Don't Care

NOTE: For a complete description of the GND Directional function See GND Directional section in Chapter 2 - Product Description.

1. Setting Changes:

FAULT LOCATION / DISTANCE

(1204) ZERIMPANGL = 80

DIRECTIONAL OVERCURRENT SUPER.

(1301) ZSEQPOL = 3I0

(1302) GNDTRQCTL = ZERO SEQUEN

(1303) TORQ1 = 1,0,0,0

Using Xpression Builder set OUTPUT4 to 67GPKP as shown in the above figure. Refer to Chapter 11 - Xpression Builder for detailed instructions.

2. Connect the relay as shown in Figure 6-4.

3. Set the current inputs to the following values:

3I0: 2 Arms 0° (AA15,AA16)

In: 2 Arms 0° (AA13,AA14)

With the above inputs OUTPUT4 will operate.

4. If you rotate the phase of In +/- 85°, OUTPUT4 will remain picked-up. Outside of +/- 95° OUTPUT4 will dropout.

5. Setting Changes:

DIRECTIONAL OVERCURRENT SUPER.

(1303) TORQ1 = 0,0,0,0

T16 – Negative Sequence GND Directional Test, 67N

This test is NOT done on models DFP2XXXXAXXX

X = Don't Care

NOTE: For a complete description of the GND Directional function See GND Directional section in Chapter 2 - Product Description.

1. Setting Changes:

FAULT LOCATION / DISTANCE

(1202) POSANG = 80

DIRECTIONAL OVERCURRENT SUPER.

(1302) GNDTRQCTL = NEG. SEQUEN

(1303) TORQ1 = 1,0,0,0

Using Xpression Builder set OUTPUT4 to 67NPKP as shown below. Refer to Chapter 11 - Xpression Builder for detailed instructions.

2. Connect the relay as shown in Figure 6-3.

3. Set the voltage/current inputs to the following values:

VA: 67 volt rms +18 0° (AA1,AA2)

IA: 2 Arms -80° (AA7,AA8)

With the above inputs OUTPUT4 will operate.

4. If you rotate the phase of IA +/- 85°, OUTPUT4 will remain picked-up. Outside of +/- 95° OUTPUT4 will dropout.

5. Setting Changes:

DIRECTIONAL OVERCURRENT SUPER.

(1303) TORQ1 = 0,0,0,0

T17 – SYNC-CHECK, 25

This test is ONLY done on models DFP2XXXXEXXX

X = Don't Care

The sync-check function will compare the frequency and angle difference between two voltage signals. If this difference is less than their respective set points the SYNCCHK flag will be picked-up.

The link between the Sync-Check function and the Recloser is that the SYNCCHK flag can be used to drive the PAUSE function of the Recloser. The PAUSE function causes the Recloser to pause prior to issuing a reclose signal, while it checks the PAUSE flag. If this flag is set the Recloser continues its operation and closes the breaker. If this flag is not set the Recloser will not issue the reclose signal and will eventually time-out and go to Lockout.

The logic state of the PAUSE flag is determined internal to the DFP200. The DFP200 is hard-coded to internally OR the SYNCCHK flag and the PAUSEINP flag (which is the PAUSE signal through the contact converter input). The output of this ORing is the PAUSE flag.

1. Setting Changes:

SYNCCHECK SETTINGS

(1501) SYNCCHEN = ON

(1502) CLSANG_MAX = 10

(1503) SLIP_MAX = 1

(1509) SYNCPHAS = PHASE A

Using Xpression Builder set OUTPUT4 to SYNCCHK as shown below. Refer to Chapter 11-Xpression Builder for detailed instructions.

2. Connect the relay as shown in Figure 6-5

3. Set the voltage inputs to the following values 60 Hz:

VA: 67 volt rms + 0° (AA1,AA2)

SYNCCHEK INPUT : 67 volts rms +0° (AA15,AA16)

With the above inputs OUTPUT4 will operate.

4. If you rotate the phase of VA +/- 9°, OUTPUT4 will remain picked-up. Outside of +/- 11° OUTPUT4 will dropout.

5. Setting Changes:

SYNCCHECK SETTINGS

(1501) SYNCCHEN = OFF

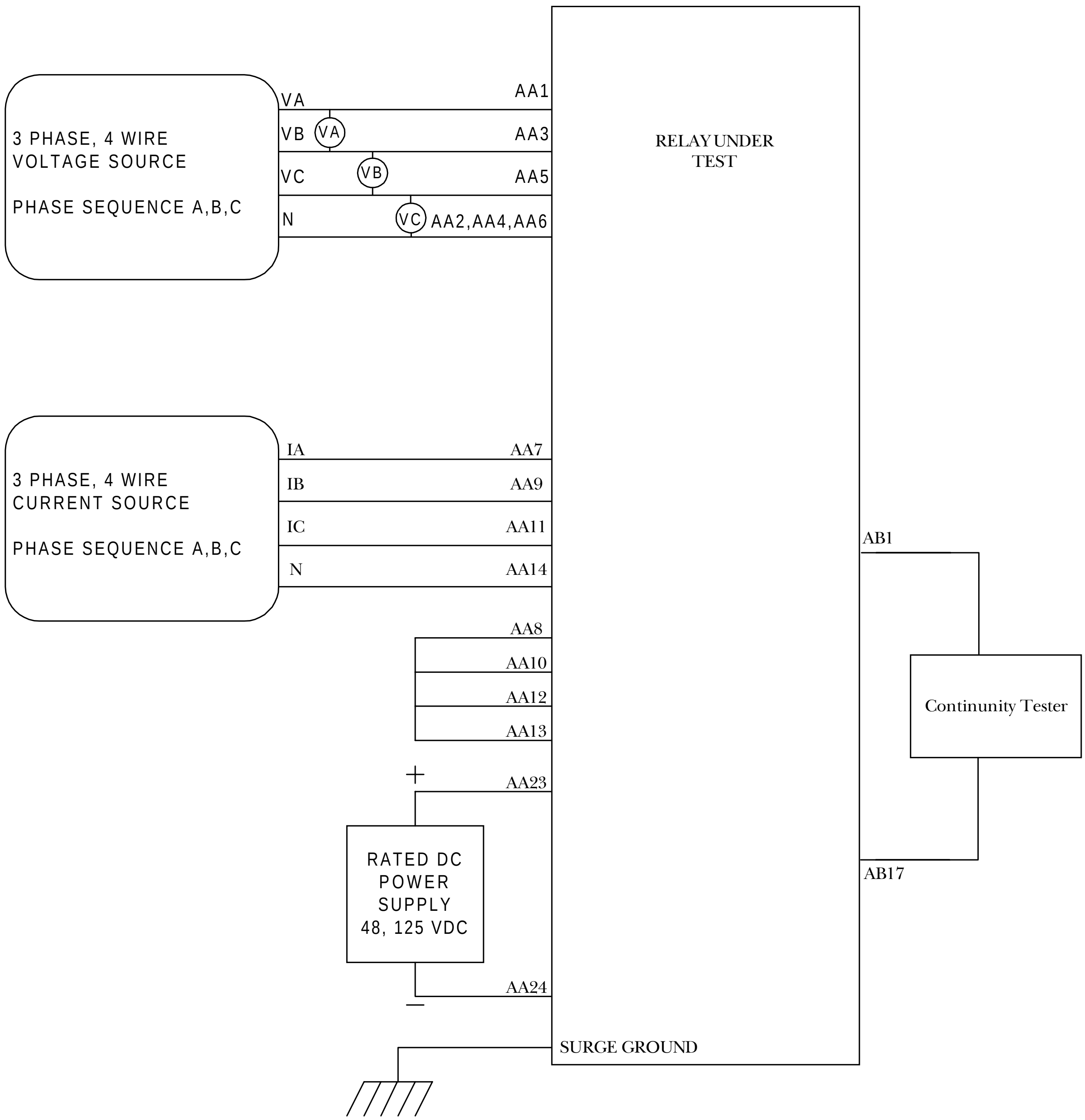


Figure 6-1 DFP200 Test Set Up

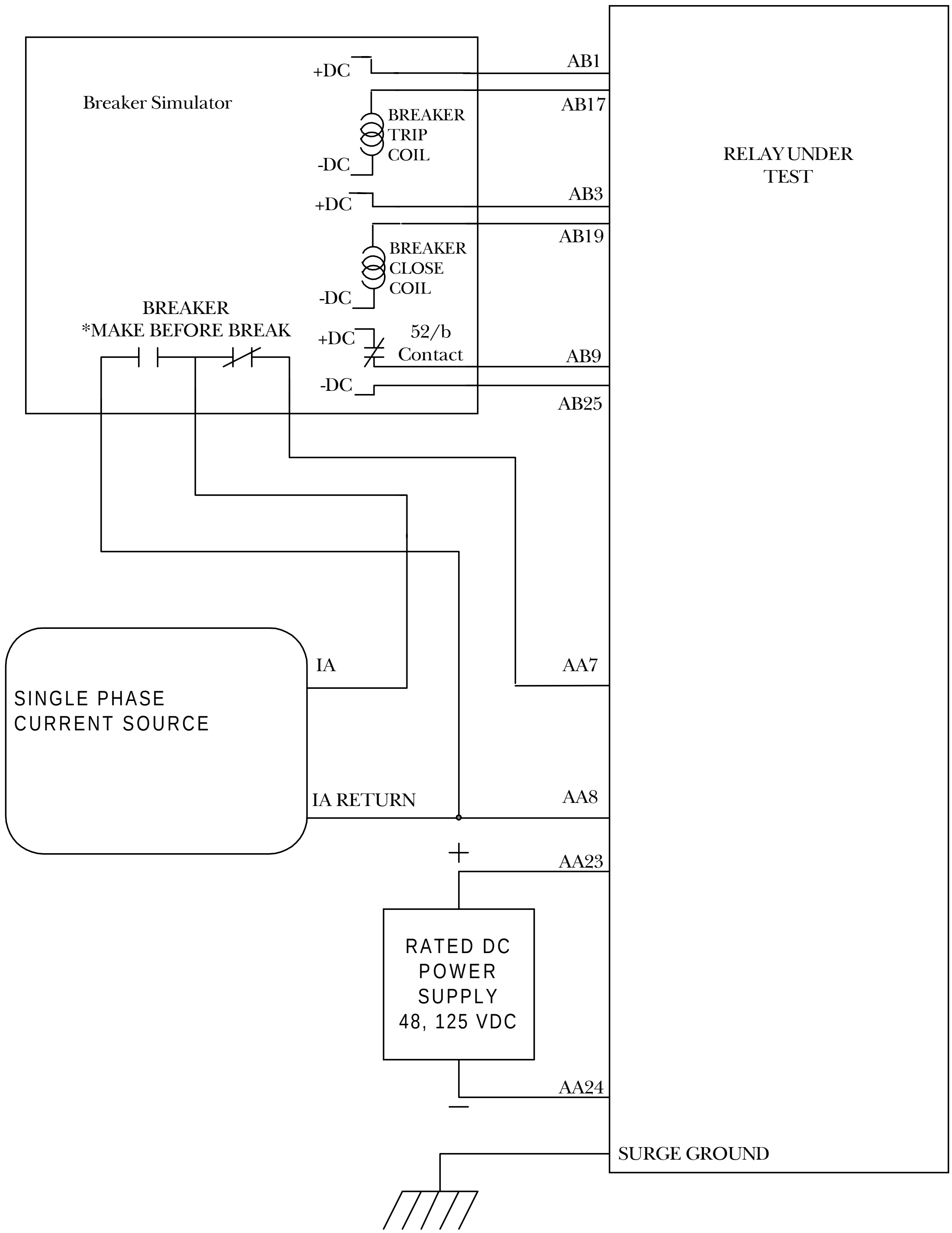


Figure 6-2 DFP200 Recloser Test

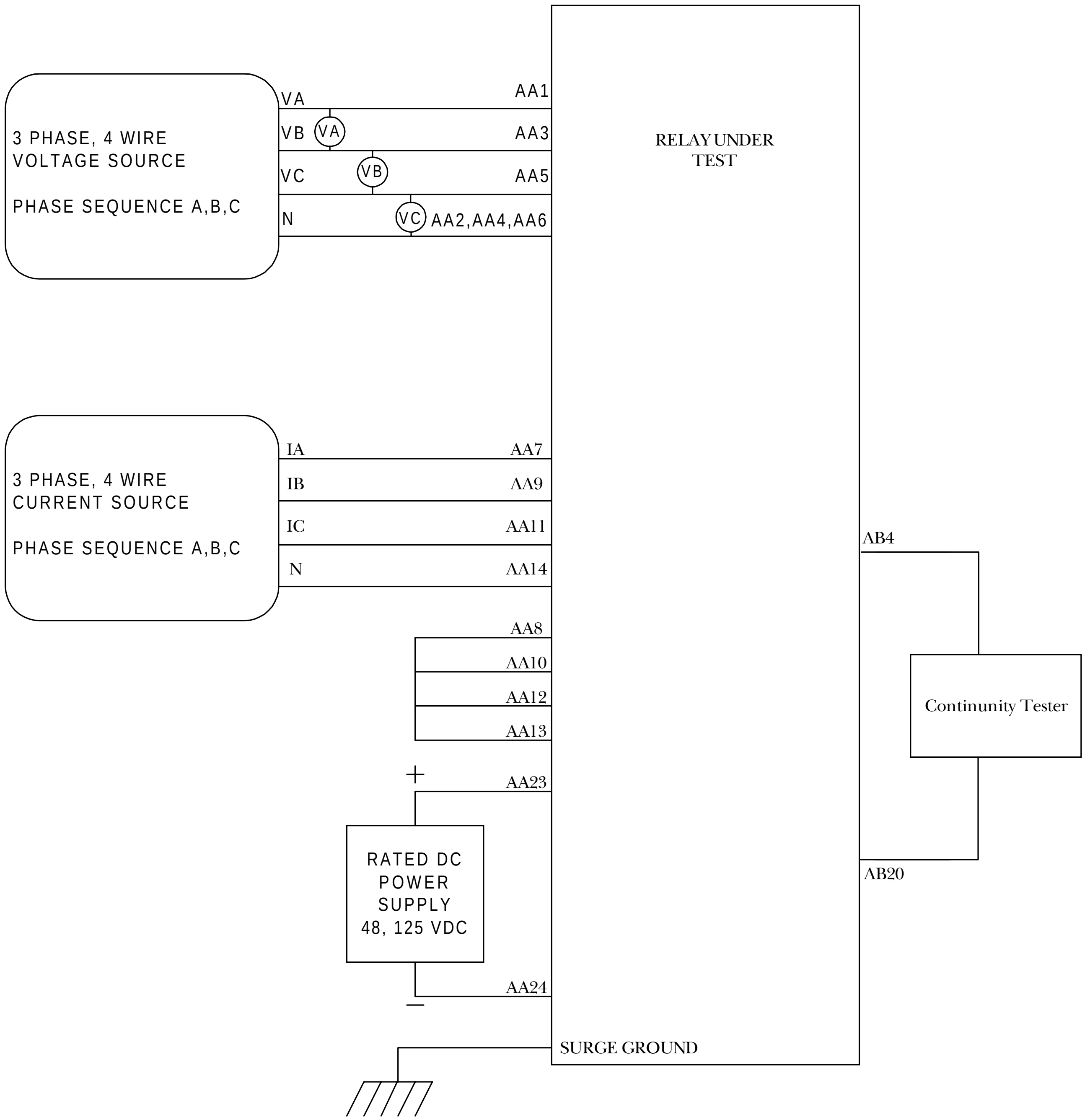


Figure 6-3 DFP200 Phase Directional Test

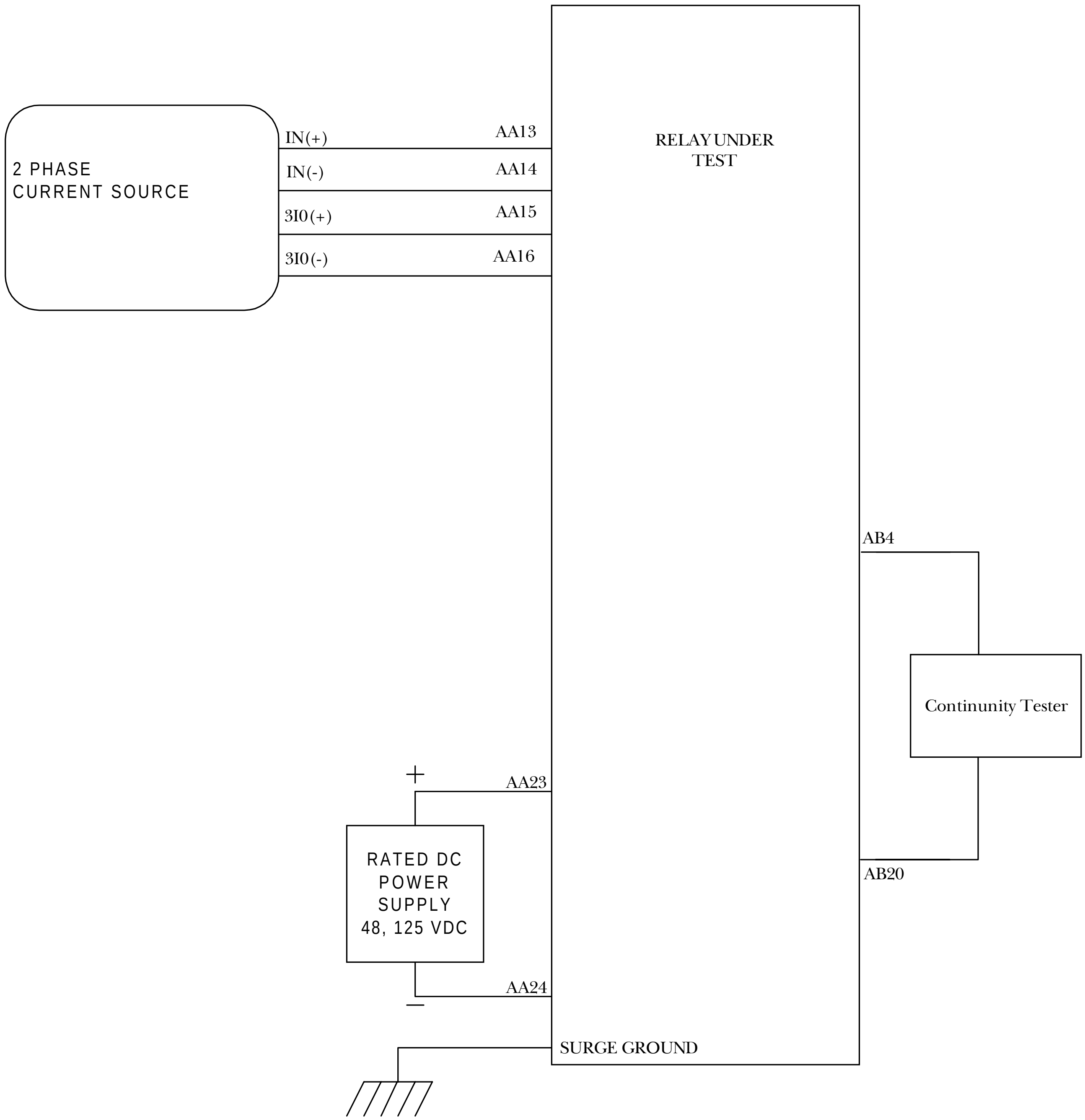


Figure 6-4 DFP200 Ground Directional Test

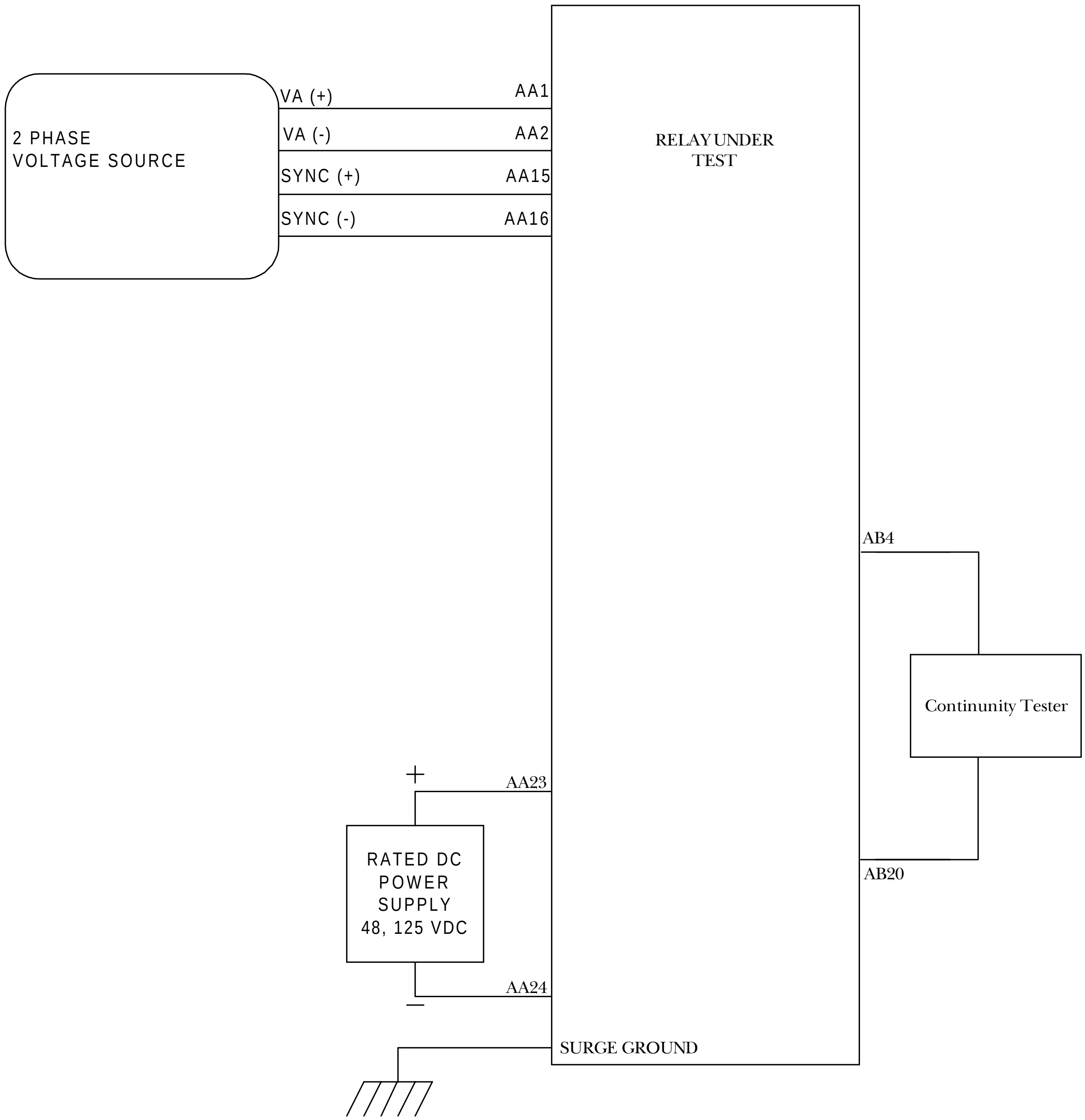


Figure 6-5 DFP200 Sync-Check Test

Chapter 7
SPECIFICATIONS

RATINGS

Rated Frequency	50 or 60 Hertz
Rated Voltage (phase to phase)	120 Vac
Rated Current	In= 1 or 5 Amperes
Control Voltage:	
24/48 Vdc	Range 20 to 60 Vdc
110/250 Vdc or Vac	Range 88 to 300 Vdc 88 to 264 Vac
Maximum Current:	
Continuous	2 x In
Three Seconds	50 x In
One Second	100 x In
Maximum AC Voltage:	
Continuous	2 x Rated voltage
One minute	3.5x Rated voltage
Sample Rate	32 per Cycle

CONTACT RATINGS

Digital Inputs	38.5 -300 Vdc or Vac
Trip Out Contacts	Continuous 3 Amps Make and Carry 30A IAW ANSI C37.90
Auxiliary Contacts	Continuous 3 Amps Make and Carry 30A IAW ANSI C37.90

BURDENS

Current Circuits	
In=1A	0.096 ohms∠3.26 @ 60Hz
	0.096 ohms∠2.16 @ 50Hz
In=5A	0.096 ohms∠3.26 @ 60Hz
	0.096 ohms∠2.16 @ 50Hz
Voltage Circuits	0.15 VA @ 60 Hz
	0.20 VA @ 50 Hz
Control Power	< 22 Watts

METERING

(At Rated Voltage and Current)

Current	1%
Voltage	1%
Watts	2%
Vars	2%
Frequency	± 0.1 Hz

RANGES OF OVERCURRENT

Phase Time Overcurrent Units	0.5 to 12.0 (5 Amp) or 0.1 to 2.4 (1 Amp)
Phase Instantaneous Unit	0.5 to 160.0 (5 Amp) or 0.1 to 32.0 (1 Amp)
Ground Time Overcurrent Unit	0.5 to 12.0 (5 Amp) or 0.1 to 2.4 (1 Amp)
Ground Instantaneous Unit	0.5 to 160.0 (5 Amp) or 0.1 to 32.0 (1 Amp
Phase and Ground Time Overcurrent Operating Curves	Inverse-ANSI PC37.112 Very Inverse-ANSI PC37.112 Extremely Inverse-ANSI PC37.112 BS142 Inverse Curve Definite Time Curves and 4 User Definable Curves

RECLOSER

Programmable Reclose Times	Programmable from 1 to 4

OSCILLOGRAPHY

Regular Oscillography	240 cycles total (Dividable into 1, 2, 4, 8, 12, or 16 segments)
RMS Oscillography	3 Prefault cycles 32 Samples/cycle 7680 data points (Dividable into 1, 2, 4, 8, 12, or 16 segments)*
HiZ Oscillography	240 Data Points per capture 15 Pre-fault 225 Post-fault 8 Captures Total
THD Oscillography	2 Cycles 32 Samples/cycle 5 Captures total

*Data point is equal to the RMS of the previous 2 cycles

ENVIRONMENTAL

Ambient Temperature Range:

Storage	-40°C to +85°C
Operation	-20°C to +65°C
Humidity	95% Without Condensation
Insulation Test Voltage	2 kV 50/60 Hz, One Minute IEC255-5 OR 3kV DC One Minute ANSI (C37.90)**
Impulse Voltage Withstand	5 kV Peak, 1.2/50 Microseconds, IEC255-4
Interference Tests	SWC and Fast Transient ANSI C37.90.1 IEC255-22-1 Class III
Electrostatic Discharge	IEC255-22-2 Class III
Radio Frequency Interference (RFI)	ANSI C37.90.2 IEC255-22-3 Class III

COMMUNICATIONS

Protocols	ASCII Protocol and GE Protocol
Optional plug-in keypad and display module (Port 1)	20 Key Keypad 4 Line X 20 Char. Display
Connectors	Port 2 - Front DB-9 (RS232) Port 3 - Rear DB-9 (RS232) Port 4 - Rear DB-9 (RS232) (RS485 Optional)

WEIGHTS

(Approximate)

Net	12 pounds (5.443 Kilograms)
Shipping	14 pounds (6.35 Kilograms)

DIMENSIONS

Overall Height	5.25 inches (131.25 mm)
Width	19 inches (482 mm) to edge of Mounting Flanges
Depth	7.172 inches (182.17 mm) to Rear of Terminals

** See Chapter 5 - Acceptance / Periodic Tests, Insulation Test for testing procedures.

MODEL SELECTION GUIDE

DFP2 * * * * * * * *

1	In = 1 amp
5	In = 5 amp
0	24/48 Vdc
1	125/250 Vdc or 120/240 Vac
N	Without plug-in keypad and display module
M	With plug-in keypad and display module ($)
L	Without Hi-Z monitoring
H	With Hi-Z monitoring ($)
A	Basic Unit*
B	Full Protection**($)
C	Full Protection & Zero-sequence directional ($)
D	Full Protection & sensitive ground OC ($)
E	Full Protection & synchronism check ($)
0	Basic Unit*
1	Power Quality & 35 day demand storage ($)
2	Power Quality ($)
3	35 day demand storage ($)
A	(2) RS232 ports (front and rear)
B	(2) RS232 ports/(1) RS485 port (rear) ($)
A	Revision Level

* Basic unit consists of phase and ground TOC/IOC, metering, demand, events, oscillography, breaker health, breaker failure, recloser, user-configurable logic.

**Full protection consists of the basic unit plus negative-sequence OC, phase directional, negative sequence directional, under voltage, overvoltage, under frequency, over frequency, and fault location.

($) denotes extra cost option

Example: DFP251MHB1BA = DFP2 rated 5 amperes, 125/250 Vdc or Vac, with plug-in keypad and display module, with Hi-Z, full protection, power quality and 35 day demand storage, two RS232 ports and one RS485 port.

Chapter 8
LOCAL INTERFACES

Front Panel Status Indicators

There are twelve status and target LEDs located on the front panel of the DFP200 as shown in Figure 8-1. The Power LED is green, the Lockout LED is yellow, and all the others are red.

The first four LEDs starting from the left are status indications. With external power applied (AC or DC) and the internal power supply functioning normally the Power LED is on. The Self Test LED is normally off and turns on only if a self-test failure is detected or if the relay is in a relay test mode. The Breaker FAIL LED turns on when the BRKRFAIL flag is set true in the Xpression Builder Logic. The RECLOSE LED is on while the recloser is in the lockout state or if the Recloser is disabled.

The other eight LEDs are targets. An A, B, C, or N LED is turned on if an overcurrent function associated with a particular phase or the neutral has produced a trip. The Inst LED turns on when any instantaneous overcurrent function produces a trip. The remaining three LEDs turn on when the respective DFP200 relay functions produce a trip.

Optional Keypad/Display Module

A portable Keyboard/Display Module (KDM), can be connected to the DFP200 relay via serial port 1 located on the front panel. The KDM may be physically attached to the front panel or used as a hand-held device. There is only one form of the KDM, and it may be used with any DFP200 relay regardless of the model number. The KDM is activated as soon as it is connected to a DFP200 relay.

Display

The display presents 4 lines of text with a maximum of 20 characters per line. The first line contains the menu name and cannot be edited or selected. Lines 2 - 4 are the selections contained within each menu or sub-

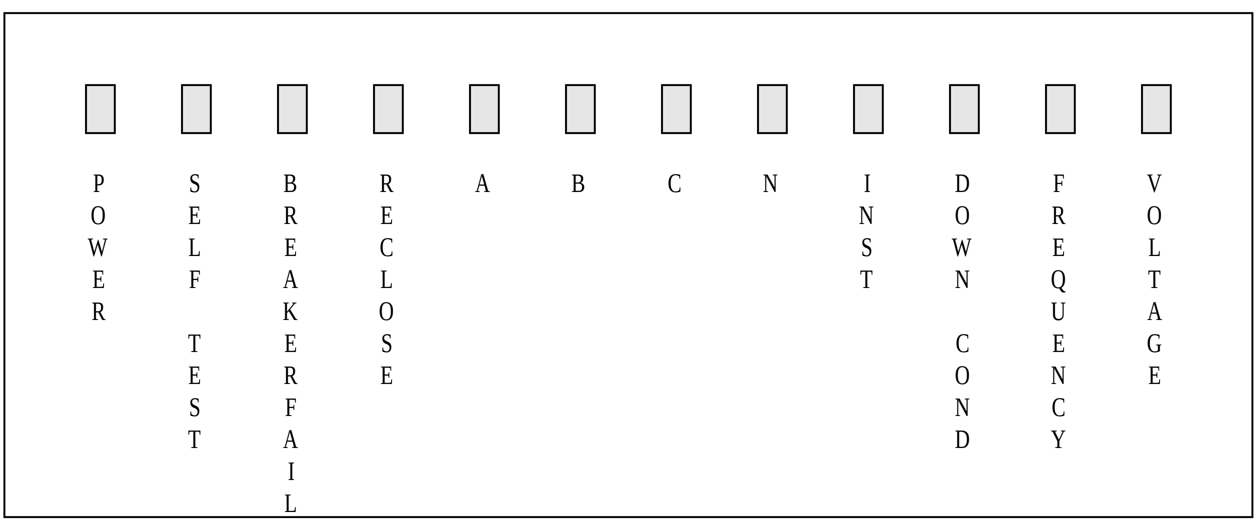


Figure 8-1 DFP200 Front Panel LEDs

menu and may be edited or selected. On the display, contrast is maintained automatically. However contrast may be adjusted if required under the ACTION menu.

Every keystroke at the KDM produces some feedback on the display. Numeric keys are echoed as they are pressed, and the enter key always causes some change in what is being displayed.

Keypad

The KDM keypad is comprised of twenty keys:

- 10-numeric keys
- a decimal point key
- eight function keys
- a SFT (shift) key.

SET	1/Y	2	3/N	CLR
INF	4	5	6	↑
ACT	7	8	9	↓
END	SFT	0	•	ENT

Figure 8-2 DFP200 keypad layout

The keys are functionally divided into four groups:

1. Command keys - those keys which begin a command sequence
2. Control keys - those keys which cause changes in what is being displayed
3. Data Entry keys - those keys which enter data into the DFP200 or answer prompts
4. END key

The SFT key is non-functional. It is reserved for future use.

Command Keys

Each of the Command keys: SET, INF, and ACT present the user with a menu when pressed.

SET key

When SET is pressed the following display appears:

SETTINGS
Enter Password :
*

The valid settings password can be entered if you want to change settings or ENT can be pressed if you want to ONLY VIEW settings.

If an invalid password is entered, 'PASSWORD INV' will appear on the bottom line. After a valid password is entered, the following four menu items are available:

1. Edit Prot Settings
2. Edit Gen Settings
3. Select Act Sett Gr
4. Modify Date/Time

When menu item 1 (Edit Prot Settings) is selected the following appears on the display:

EDIT PROT
Group1-8: *
Act Grp = 1

The under-line, ' _ ', indicates the position of the cursor when the screen first appears. After the settings group to be edited is selected the following menu items are available:

1. INPUT CONTACT
2. HI-Z
3. OVER CURRENT PROT
4. NEG SEQ OC
5. SEQ COORD
6. OVR/UND VOLTAGE

7. OVR/UND FREQ
8. 3-P RECLOSER
9. FAULT LOCATION
10. TORQUE CONTROL
11. OSCILLOGRAPHY
12. SYNC-CHECK

When menu item 2 (Edit Gen Settings) is selected the following menu items are available:

1. GENERAL
2. HARDWARE
3. MONITORING

The 14 menu items listed above correspond to the 14 setting categories in Table 3-1. When one of these menu items is selected the corresponding settings from Table 3-1 are available for editing.

When menu item 3 (Select Act Sett Gr) is selected the following appears on the display:

```
SELECT  ACT  GRP
Act  Grp  =  1


```

After a settings group is selected that is different from the present active group, the DFP200 will re-initialize.

When menu item 4 (Modify Date/Time) is selected the following appears on the display:

```
MODIFY  DATE/TIME
Date          =  08/19/96
TIme          =  08:10:47

```

To change the date, press ENT when the cursor is on the ‘D’ of Date. To change the time, press ENT when the cursor is on the ‘T’ of Time.

Table 8-1 is an alphabetized list of the setting mnemonics that appear on the Keypad/Display Module. Refer to Table 3-1 in the CALCULATION OF SETTINGS chapter for the range and factory default value of each setting.

Table 8-1 *List of Settings*

SETTING #	MNEMONIC	SETTING NAME
0302	AMPTHDTHR	Current THD Threshold
0501	ARCSENS	Arcing Sensitivity
0306	BHEXP	Breaker Health Exponent
0301	BHTHR	Brkr Health Threshold
1117	BRKRTRANS	Breaker Transition Time
1118	BLKIOC	Block Instantaneous
1119	BLKIOCLK	Block IOC During Lockout
1120	BLKRECL	Block Recloser
0305	BRKRARCTME	Breaker Arc Time
0401	CC1CONF	CC1 Configuration
0402	CC2CONF	CC2 Configuration
0403	CC3CONF	CC3 Configuration
0404	CC4CONF	CC4 Configuration
0405	CC5CONF	CC5 Configuration
0406	CC6CONF	CC6 Configuration
0407	CC7CONF	CC7 Configuration
0408	CC8CONF	CC8 Configuration
0631	COLDLDPKUP	Cold Load Pickup Time
0110	COM2PRO	Port 2 Protocol
0107	COM2SET	Port 2 Settings
0109	COM3PRO	Port 3 Protocol
0106	COM3SET	Port 3 Settings
0111	COM41IF	Port 4 Interface
0108	COM4PRO	Port 4 Protocol
0105	COM4SET	Port 4 Settings
0118	CONFCTS	Configured CTs
0119	CONFVTS	Configured VTs
0203	CTRATING	CT Rating
1104	DELRECL	Delayed Reclose

SETTING #	MNEMONIC	SETTING NAME
0307	DEMPERIOD	Demand Period
0116	DISPVAL	Displayed Values
1506	DL_DB	Dead Line / Dead Bus
1508	DL_LB	Dead Line / Live Bus
1205	ENFLTLOC	Enable Fault Location
0504	EVTCNTTME	Event Count Time
1308	FLTDETLVL	Fault Detector Level
0117	FPNLRESET	Front Panel Resets
0103	G_CTRATIO	Ground CT Ratio
0612	G_HIIOCPRO	Ground High IOC Protection
0609	G_LOIOCPRO	Ground Low IOC Protection
0507	GCHZ	Ground OC
0627	GNDADPT	Ground Adaptive
0630	GNDAVEPD	Ground Averaging Period
0626	GNDDEFNTME	Ground Definite Time
0503	GNDEVTCNT	Ground Event Count
0509	GNDRATECHG	Ground Rate of Change
0624	GNDTMEDIAL	Ground Time Dial
0625	GNDTOCCUR	Ground TOC Curve
0623	GNDTOCPKUP	Ground TOC Pickup
0622	GNDTOCPRO	Ground TOC Protection
1302	GNDTRQCTL	Ground Torque Control
0515	HIZMON	Hi-Z Monitoring
0610	IOCHIGND	IOC High Ground Pickup
0611	IOCHIGNDDL	IOC High Ground Delay
0604	IOCHIPH	IOC High Phase Pickup
0605	IOCHIPHDL	IOC High Phase Delay
0607	IOCLOGND	IOC Low Ground Pickup
0608	IOCLOGNDDL	IOC Low Ground Delay
0601	IOCLOPH	IOC Low Phase Pickup
0602	IOCLOPHDL	IOC Low Phase Delay

SETTING #	MNEMONIC	SETTING NAME
1203	K0RATIO	K0 Ratio
1510	LDTHRLOSS	Loss of Load Threshold
1207	LENUNITS	Line Length Units
1206	LINELEN	Line Length
1507	LL_DB	Live Line / Dead Bus
0120	LOGTMEOUT	Login Timeout
1502	MAXCLOSANGL	Maximum Close Angle
0629	MAXGNDADPT	Max Ground Adaptive
0620	MAXPHADAPT	Max Phase Adaptive
1503	MAXSLIP	Maximum Slip
1307	MAXTRQANGL	Max Torque Angle
0628	MINGNDADPT	Min Ground Adaptive
0619	MINPHADAPT	Min Phase Adaptive
0708	NSDEFTMEDL	Neg Seq Definite Time Delay
0701	NSIOCPKUP	Neg Seq IOC Pickup
0703	NSIOCPRO	Neg Seq IOC Protection
0702	NSIOCTMEDL	Neg Seq IOC Time Delay
0706	NSTMEDL	Neg Seq Time Dial
0707	NSTOCCURV	Neg Seq TOC Curve
0705	NSTOCPKUP	Neg Seq TOC Pickup
0704	NSTOCPRO	Neg Seq TOC Protection
0709	NSTOCRESET	Neg Seq TOC Reset
0304	NUMFLTS	# Disturbance Reports
1103	NUMRECL	Number of Recloses
0308	NUMRMSFLTS	Number of RMS Faults
0505	OCCRDTMEOT	OC Coord Timeout
1004	OF1DLY	Set 1 Overfreq Time Delay
1003	OF1PKUP	Set 1 Overfreq Pickup
1008	OF2DLY	Set 2 Overfreq Time Delay
1007	OF2PKUP	Set 2 Overfreq Pickup
1013	OFPROT	Overfreq Protection

SETTING #	MNEMONIC	SETTING NAME
1401	OSCMASK1	Oscillography Mask Word 1
1402	OSCMASK2	Oscillography Mask Word 2
0309	OSCTIME	Oscillography Time
0904	OVPKUP	Overvoltage Pickup
0906	OVPROT	Overvoltage Protection
0905	OVTMEDL	Overvoltage Time Delay
1110	PAUSE	Reclose Pause
1111	PAUSINP	Pause Input
0506	PCHZ	Phase OC
0511	PH3EVTTHR	3-Ph Event Threshold
0618	PHADPT	Phase Adaptive
0114	PHASEDESG	Phase Designation
0115	PHASPOTL	Phase Potential
0621	PHAVEPD	Phase Averaging Period
0102	PHCTRATIO	Phase CT Ratio
0617	PHDEFNTME	Phase Definite Time
0502	PHEVTCNT	Phase Event Count
0606	PHHIIOCPRO	Phase High IOC Protection
0603	PHLOIOCPRO	Phase Low IOC Protection
0508	PHRATECHG	Phase Rate of Change
0615	PHTMEDIAL	Phase Time Dial
0616	PHTOCCUR	Phase TOC Curve
0614	PHTOCPKUP	Phase TOC Pickup
0613	PHTOCPRO	Phase TOC Protection
1202	POSANG	Pos Seq Impedance Angle
1109	RCLRST	Reclose Reset Time
1112	PSONRECL	Pause on Reclose
1113	PSONRES	Pause on Reset
1101	RECLEN	Reclose Function Enable
1121	RECLMEM	Reclose Memory
1102	RECLON52B	Reclose On 52/b

SETTING #	MNEMONIC	SETTING NAME
1105	RECL1	Reclose #1 Time
1106	RECL2	Reclose #2 Time
1107	RECL3	Reclose #3 Time
1108	RECL4	Reclose #4 Time
0201	REMBKROP	Remote Breaker Operation
0202	REMCONF	Remote Configuration
1010	RESTDLY	Restoration Time Delay
1009	RESTFREQ	Restoration Freq
1114	RLYSPARE	Relay Spare at Reclose
0310	RMSTIME	RMS Time
1116	RSDO	Relay Spare Dropout
1115	RSPU	Relay Spare Pickup
0804	SEQBLKHI	Seq Block High IOC
0803	SEQCRD	Seq Coordination
0801	SEQCRDDLTM	Seq Coord Delay Time
0802	SEQCRDRSTM	Seq Coord Reset Time
0113	SETFILE	Settings File
1501	SYNCCHECK	Sync Check
0112	SYSFREQ	System Frequency
1510	SYNCCHINP	Sync-Check Input
1511	SYNCCLBR	Sync-Check Override
1509	SYNCPHAS	Sync-Check Phase
0632	TOCRESET	TOC Reset Option
1303	TORQ1	Torque 1
1304	TORQ2	Torque 2
1305	TRQCTL1	Torque Control 1
1306	TRQCTL2	Torque Control 2
1002	UF1DLY	Set1 Underfreq Time Delay
1001	UF1PKUP	Set1 Underfreq Pickup
1006	UF2DLY	Set2 Underfreq Time Delay
1005	UF2PKUP	Set2 Underfreq Pickup

SETTING #	MNEMONIC	SETTING NAME
1012	UFPROT	Underfreq Protection
0101	UNITID	Unit ID
1505	UVBUS	Under voltage bus
1504	UVLINE	Under voltage line
0901	UVPKUP	Undervoltage Pickup
0903	UVPROT	Undervoltage Protection
0902	UVTMEDL	UV Time Delay
0303	VOLTTHDTHR	Voltage THD Threshold
1011	VOLTTHR	Voltage Supervision Threshold
0514	2HARMRES	2^{nd} Harmonic Restraint
0512	VSUP	Voltage Supervision Percentage
0513	VSUPTIME	Voltage Supervision Time
0104	VTRATIO	VT Ratio
1204	ZERIMPANGL	Zer Seq Impedance Angle
1201	ZPMAG	Pos Seq Impedance Magnitude
1301	ZSEQPOL	Zero Seq Polarization

INF key

When INF is pressed the following menu items are available:

1. DFP status
2. Faults
3. RMS Faults
3. Present values
4. Cont Conv status
5. Events
6. MAG/ANGLE Data
7. Cont. Conv Status
8. Output Status
9. Comm passwords
10. Station/Feeder ID
11. DFP Model/Version
12. Trigger OSC
13. Request Peak
14. Present Harmonics
15. Breaker Health
16. Diagnostics

DFP_status:

This menu will log the status for four different areas of the DFP200:

1. System Status
2. Processor Board
3. Analog Interface
4. I/O Board

If there is an error or problem in any of the above areas a message would be logged in that area. This message can help to debug any DFP200 problem.

Faults:

This menu shows which Regular Oscillographies are currently stored in the DFP200. For more detail for the information contained in the Regular Oscillography see Chapter2 - Product Description.

Rms Faults:

This menu shows which Rms Oscillographies are currently stored in the DFP200. For more detail for the information contained in the Rms Oscillography see Chapter2 - Product Description.

Present Values:

This menu will continuously show updated values for all of the present values in the DFP200.

- Va (Phase A Vrms), Vb, Vc
- Ia (Phase A Arms value), Ib, Ic, In
- Watts A (Phase A watts), Watts B, Watts C
- Vars A (Phase A vars), Vars B, Vars C
- 3PH Watts, 3PH Vars, 3PH VA,
- PF A (Power Factor Phase A), PF B, PF C, 3PH PF
- 3PH WH (Three Phase Watt-Hours), 3PH VARH
- TOC PU A, TOC PU B, TOC PU C, TOC PU N
- THD, THD IB, THD IC, THD VA, THD VB, THD VC
- ARC CONF A (Arc Confidence Phase A), ARC CONF B, ARC CONF C, ARC CONF N
- FREQ (Frequency)

Events:

This menu will show all of the events currently stored in the DFP200.

Mag/Angle Data:

This menu will give you a snap-shot of the magnitude and angle for all of the voltage and current inputs.

Cont Conv Status:

This menu will give you a snap-shot of the status of the eight contact convertors.

Output Status:

This menu will give you a snap-shot of the status of the eight output contacts.

Comm Passwords:

This menu will show you the encoded passwords used by the DFP200-LINK. To decode these passwords see ASCII Communications - Chapter 10, Table 10-2.

Station/Feeded ID:

This menu will show you the station ID for the relay.

DFP model/version:

This menu will show you the model number, the code version, and the serial number for the relay.

Trigger Osc:

This menu when activated will give you the opportunity to generate a Regular Oscillography. This oscillography will be listed in the Faults menu with the date and time at which it occurred. To trigger an oscillography, all that is required is to enter this menu.

Request Peak:

This menu when entered will show the peaks for the following:

Max VA, Max Watts, Max Vars, , Min PF, Max Ia, Max Ib, Max Ic, Max In, MaxThdIa, MaxThdIb, MaxTHdIc, MaxThdVa, MaxThdVb, MaxThdVc, Min Va, Min Vb, Min Vc.

If you request the Overall Peak - entering a 0 will get the Max and Mins since the last time that the data was reset.

If you request a Daily Peak - entering a 1 will get you today's peaks, entering in a 2 will get you yesterday's peaks, 3 will give you the day before yesterday's peaks, and so on.

Present harmonics:

This menu will give you the 1st through 13th harmonics for the currents and voltages. Entering a 1 will give you the harmonics for Ia, 2 for Ib, 3 for Ic, 4 for In, 5 for Va, 6 for Vb, and 7 for Vc

Breaker Health:

This menu will give you the $I^x t$ for each breaker. It will also show the number of trips issued by the DFP200.

Diagnostics:

This menu is similar to the status menu, but there is more hardware detail for each event.

ACT key

When ACT is pressed and the privilege (password) level is 'View' the following display appears:

```
          A C T I O N
E n t e r   P a s s w o r d   :
_*
```

If an invalid password is entered, 'PASSWORD INV' will appear on the bottom line. After a valid password is entered, the following menu items are available:

1. Disable outputs
2. Enable outputs
3. Trip breaker
4. Close breaker
5. Reset Recloser
6. Lockout Recloser
7. MMI test
8. Dig output test
9. Change password
10. En/Dis passwords
11. Reset data
12. Adjust contrast

Disable Outputs:

This command will disable output contacts from operating. The SELF TEST led will come on when this is activated. This command can be used when setting changes are being made to insure against incomplete settings accidentally tripping the relay.

Enable Outputs:

The command will enable output to operate. This command is used after Disable Outputs to put the relay back on line.

Trip Breaker:

This command will energize any output contact that is a TRIP contact (a red contact flag) as seen in the configurable logic in Xpression Builder. See Chapter 11, Configurable Logic, Digital Output Assignments.

Close Breaker

This command will energize the BRKRCLOSE flag in the configurable logic.

Reset recloser

If the recloser is enabled and the breaker is closed, this command will send the recloser to reset.

Lockout recloser

If the recloser is enabled , this command will send the recloser to lockout.

MMI Test:

This command will exercise all of the options of the MMI. See Acceptance testing, Chapter 5.

Digital Output Test.

This command will put the relay in Digital Output Test mode. When in digital output mode the SELF TEST led will turn on and then you will be able to operate any of the relay outputs by selecting that output from the test.

Change Password:

This command will allow the user to change the password for the level he is in and any level under the level he is currently logged in with. An example, would be if you are logged in with the MASTER password you can change any of the MMI passwords (SETTINGS, CONTROL, or MASTER). If you are logged in with the SETTINGS password you can only change the SETTING password.

Disable Passwords:

This command when executed will disable the MMI passwords structure.

Reset data:

This command will allow you to reset the data in the DFP200. The data includes:

Peak Data
Faults
Brkr Health
Energy Data
Latched Alarms
THD Osc Data
All Logs

Adjust Contrast:

This setting will allow you to adjust the contrast for the MMI.

Control Keys

The four control keys are: ENT, CLR, ↑, and ↓. Depending on the current state of the KDM the clear (CLR) key performs the following:

- aborts a key sequence in progress
- clears an error message
- activates scrolling of present values
- activates scrolling of TRIP messages

CLR key

Pressing the clear key while entering data only removes the data from the display. Pressing the clear key after opening a menu selection but before entering data causes a return to the previous menu.

For example, if the user is changing the time, and enters the new time incorrectly, then pressing CLR erases the input and allows a new value to be entered. If instead of entering a new value, the CLR key is pressed a second time the previous menu is displayed.

If an error message is being displayed, the user must press CLR to blank the error message (all other keys will be ignored). When the error message is blanked, the last message will be redisplayed allowing the user to enter the correct response.

Arrow keys

The arrow keys, ↑ and ↓, are used to scroll through the various menu and sub-menu items. The arrow keys allow the menus to scroll continuously until released.

ENT key

The enter key (ENT) is used to enter data or to confirm a choice. When the appropriate menu or sub-menu is shown on the display (as a result of numeric selection or use of arrow keys) and ENT is pressed, that menu item is displayed. When changing a setting, the value is selected either by pressing the proper numeric keys or by using the arrow keys to select from a list. The value is entered by pressing ENT.

Data Entry Keys

The Data Entry keys consist of the numeric keys, and the decimal point. These keys are used to input data into the DFP200 or to make choices in response to prompts. The numeric keys 1 and 3 have dual uses. If the user is entering numeric values, the 1 and 3 keys are processed and echoed as 1 and 3. If the user is responding to a YES/NO question, keys 1 and 3 will display as YES and NO respectively.

END key

The END key causes setting changes to be saved, and it terminates the current session. 'Session' refers to one of the two 'privilege level sessions' started by entering either the 'Settings' or 'Action' password.

When in the settings privilege level session, pressing END will produce the following display provided no settings have been changed.

END
1. QuIt

If one or more settings have been changed, pressing END will produce the following display:

END
1. Save sett & quit
2. Save sett
3. Quit

Selecting item 1 saves the settings and ends the session. Selecting item 2 saves the settings only. Selecting item 3 (Quit) produces the following display.

END
Settings changed.
Save? _

A 'No' (numeric key 3) followed by ENT will end the session. A 'Yes' (numeric key 1) followed by ENT will save the settings and end the session.

When in the action privilege level session, pressing END will always produce the display that only offers the option to quit.

Selecting 'quit' from any display menu initiated by pressing END results in a display, similar to the one shown below, that contains a 'Session Ended' message.

END
SESSION ENDED.

Whenever a 'Session Ended' message is displayed the privilege level is immediately reset to 'View.'

NOTE: Before ending the current session, the DFP200 does the following:

1. If a Digital Output Test or Diagnostic Test was activated, it is deactivated.

2. If settings were changed in the active group or the general group, a check is made for a fault in progress. If there is no fault, the settings are

stored in EEPROM. If a fault exists, an error message is displayed stating that settings cannot be saved at that time. Pressing END after the fault goes away will allow the changed settings to be stored.

Chapter 9
DFP200-LINK USERS GUIDE

Overview

The Digital Feeder Protection System Link (DFP200-Link) User's Guide contains detailed information about using DFP200-Link.

The DFP200-Link software facilitates various operations with the data from the relay formatted for easy viewing. The link software has the capability of opening a dialog session for a remote device through a dial-up modem or directly over a serial link. The software uses the GEMODEM communications protocol to operate the relay remotely. All the operations performed on a device will be initiated by a user command. The responses from the relay will be formatted for easy viewing.

What's included in your DFP200-Link User's Guide

This guide is organized as a comprehensive reference. In addition to the information needed to help you use the DFP200-Link to interact with the relay, this manual also includes some basic information for those users with little experience of working with Windows applications

Using On-line Help

DFP200-Link software comes with on-line help for quick reference. It includes step-by-step procedures that you can follow as you work. You can view the DFP200-Link Contents window by choosing Contents from the Help menu. From this window, you can jump to more specific information. You can also press the F1 key on the keyboard to get the Help contents. Help information on any dialog box could be obtained by clicking the Help button in that dialog box.

DFP200-Link Installation

This section describes the required system hardware and software needed for installing DFP200-Link software on your machine.

Supported Architecture

The minimum system configuration required to run DFP200-Link software is:

1. Personal Computer(PC) with an 80386/80486 processor with:
   - 8 MB RAM
   - 200 MB Hard Disk Drive
   - 3.5”, 1.44 MB Floppy Disk drive
   - VGA / EGA display card and monitor
   - PC/AT keyboard
   - One or more RS-232 serial ports
   - One parallel port for printer
   - Mouse
   - Any printer supported by MS-Windows
   - MS-Windows, version 3.1 or 3.11 (Windows NT is not supported)

The DFP200 relays can be connected to the host machine directly or through a dial-up modem. The DFP200 may be connected directly to the host's RS232 port; for connection via the DFP200's RS485 port, an RS485/RS232 converter is required. If you wish to connect to your DFP200 over a dial-up modem, the relays should be connected as follows:

- Each device must have its own modem.
- Code Operated Switch (COS) is attached to the modem and a number of devices are connected to the multiplexor.

If a device is on an RS-485 line, a converter can be used between the device and the COS. Figure 9-1 depicts both types of connections.

The printer is connected on the parallel port of the PC.

Hardware Installation

Before proceeding verify that your computer is working well and meets the requirements above.

Connect the printer to the parallel port of the PC. You may have to choose an appropriate printer driver using the Windows Print Manager. For more details refer to the printer's installation manual.

It is assumed that the relay is installed and configured according to the Interface section of this instruction book.

Software Installation

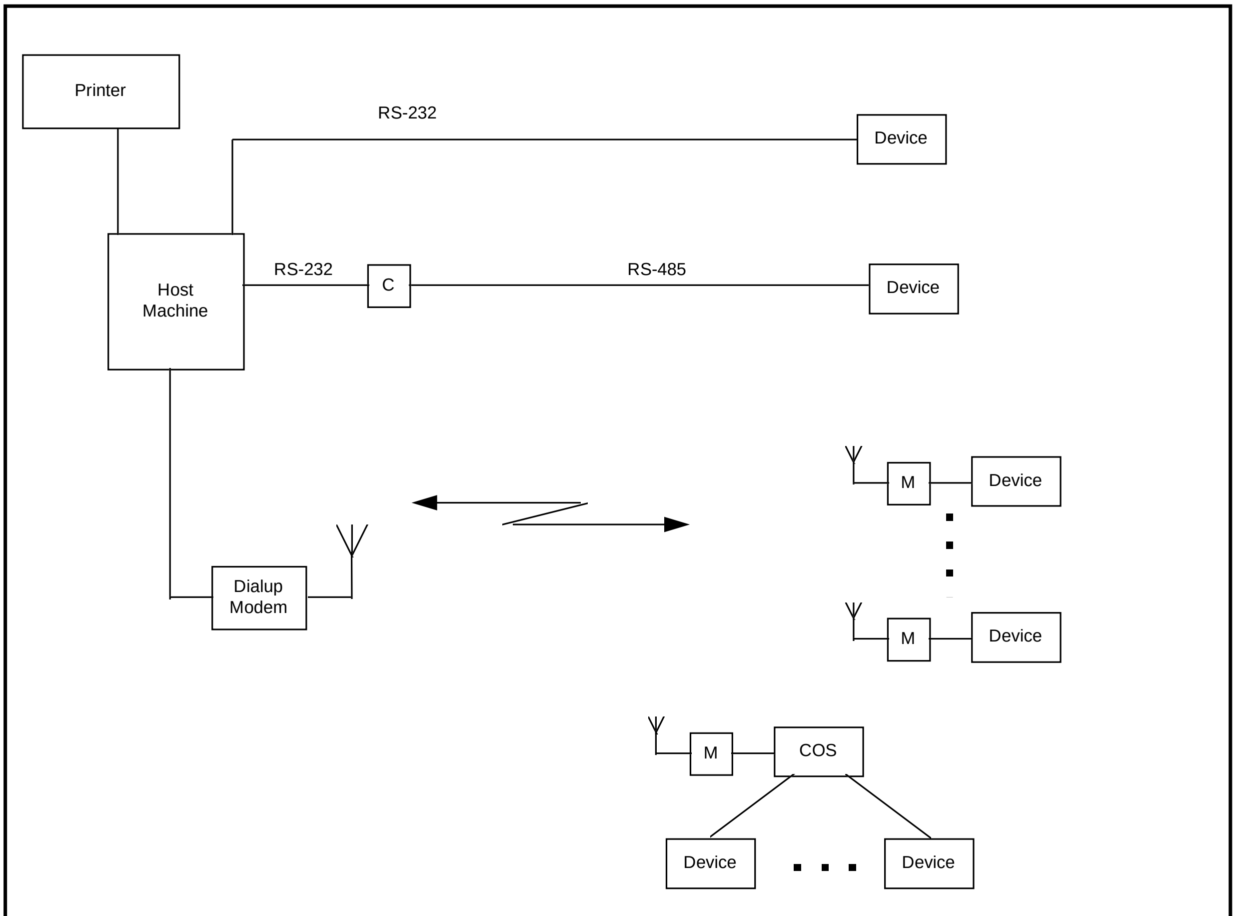
Microsoft Windows 3.1 or 3.11 or Windows 95 must be installed on your PC before proceeding with DFP200-Link installation.

To install DFP200-Link:

1. Start Windows
2. Insert the first Setup disk in drive A or drive B.
3. From Windows Program Manager, choose the Run command from the File Menu.
4. In the Command Line box, type `a:install` if you put the Setup disk in drive A or `b:install` if you put the Setup disk in drive B, then click OK.
5. You will be prompted to enter the directory and path where you wish to install the software. If the directory does not exist, the install will create it for you.

Once the DFP200-Link software is installed, set-up must be chosen from the Device menu to set-up to communicate to the relay.

Note: DFP200-Link may have difficulty operating with some WINDOWS applications running; therefore, it is recommended that before starting the application make sure there are no other programs or TSRs loaded on the system as this might affect the performance of DFP200-Link and related applications.



COS—Code Operated Switch
M—Modem
C – Converter between RS-232 and RS-485.

Figure 9-1 Supported Architecture

Startup

This section describes the Startup procedure and explains the main screen details. After a successful installation of DFP-Link, the group window appears on the screen as shown in Figure 9-2. This window consists of the DFP-Link icon and the Help icon. Choose the DFP-Link icon to start DFP-Link.

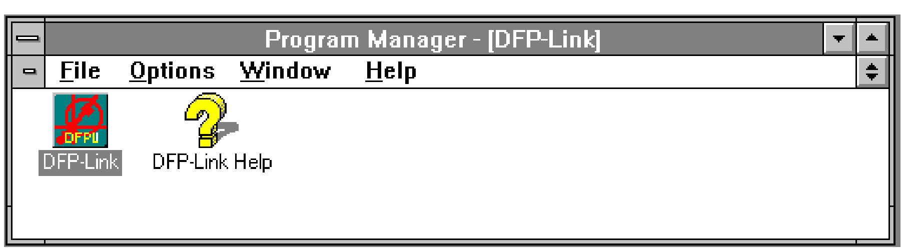


Figure 9-2 Group Window

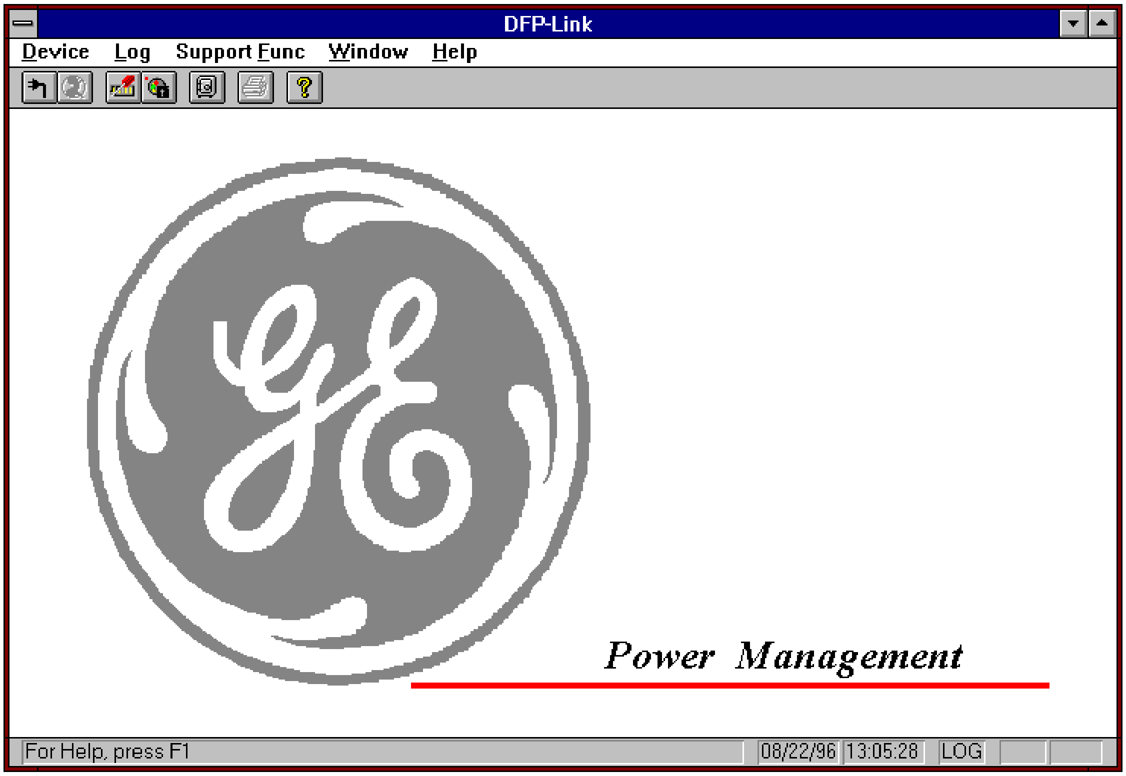


Figure 9-3 DFP-Link Application Window

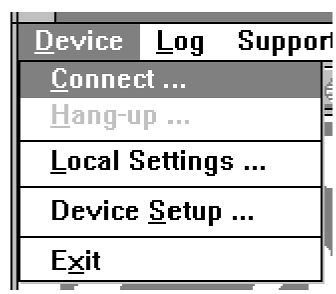
The DFP-Link application starts and the DFP-Link application window appears as shown in Figure 9-3. The main window has a title bar with DFP-Link, a menu bar, a tool bar and a status bar.

Menu Bar

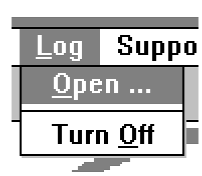
The items in the DFP-Link application window menu bar are:

- Device
- Log
- Support Func
- Window
- Help

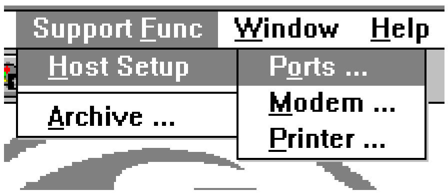
The items in each menu change when a relay is connected. For example, Log will not include the 'Current' item until connected to a relay.



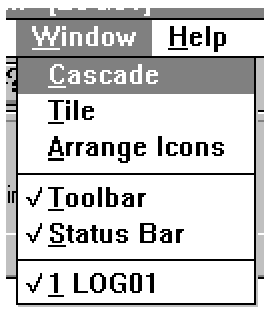
The items in the Device menu are displayed above. Hang-up will be enabled when the communication line is using a dial-up modem.



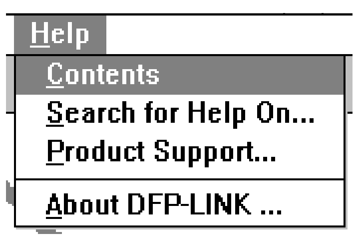
Under the Log item, an existing log file can be opened or the session log can be turned on/off.



Under Support functions use Host Setup to configure the port, modem and printer parameters. Archive makes backup files and retrieves files.



The Window item provides for arranging the display. Display of the status bar and tool bar can be enabled or disabled. It also displays the names of all the documents currently in view.



The Help item is available in all the menu bars of all windows.

Tool Bar

The tool bar consists of icons which help choose some of the DFP-Link activities quickly. The active icons shown in Figure 9-3 in the tool bar are

- Connect
- Hang-up(if a telephone line is used)
- Device Setup
- Local Settings
- Archive
- Printer
- Context Sensitive Help.

Status Bar

The status bar is divided into six parts as shown in the bottom most row of Figure 9-3. Starting from the left, part one displays the information regarding any command selected, part two and three display the date and time respectively, part four indicates if Log is on or off, part five and six indicate the Caps Lock and Num Lock respectively.

HARDWARE Setup

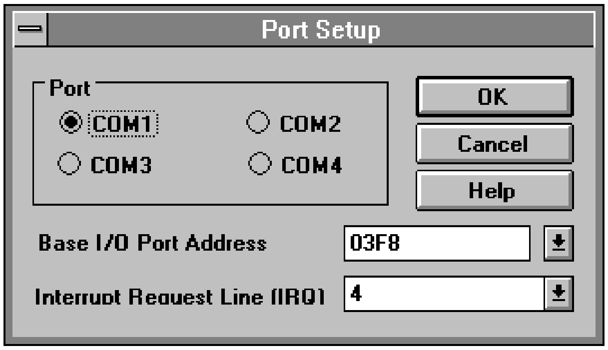
This is the preparation of the DFP200-Link software and the host machine for a trouble free and satisfactory operation with the DFP200 devices. Certain parameters of the serial (COM) port to which you wish to connect the device, the modem used for communication and the printer connected to the host machine are to be configured for DFP200-Link. DFP200-Link provides all the necessary user interface to set these parameters.

Keep the User's manuals for the serial port of your host machine, the modem and the printer handy for a quick reference.

Port Setup

For proper operation, it is essential that the PC and the DFP200 relay have a physical link established between them. This physical link could be an RS-232 line or an RS-485 line. If required, dial-up modems can be used. Any PC serial port can be used.

To setup the serial (COM) port click on Host Setup under the Support Functions menu. A pop up menu with Ports/Modem/Printer will be displayed. Choose the Ports item. The port setup dialog box appears as shown below.



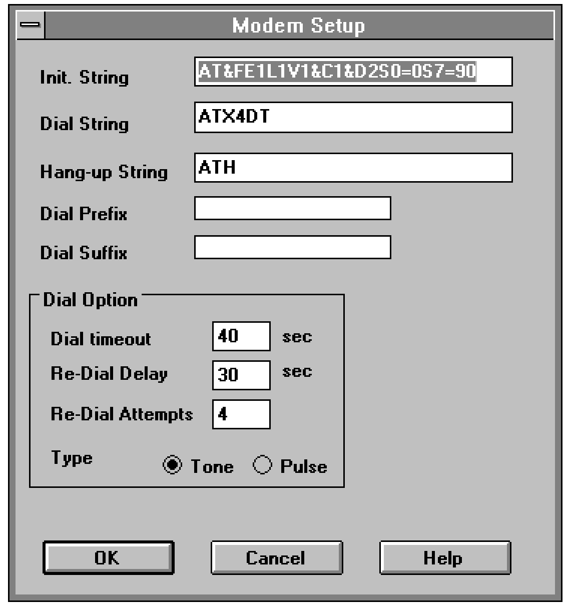
Change the Base port address only if the serial port uses an address value that differs from the value displayed in the text box. Open the list and select an address.

Before assigning IRQ numbers to serial ports, determine which interrupts are used and which are available in the PC. The serial port may need to be changed to use available interrupts. For information, refer to the serial port documentation.

Any changes made in this dialog box, take effect only when Windows is restarted. Click on OK to proceed with the selection or Cancel to quit without updating the selection.

Modem Setup

When the DFP200 relay is connected to a dial-up modem, it is essential that DFP-Link is supplied with information about the modem characteristics. To setup the modem click on Host Setup under the Support Functions menu. A pop up menu with Ports/Modem/Printer will be displayed. Choose the Modem item. The modem setup dialog box appears as shown below.



The init string, dial string and the hang-up string are all modem dependent. Refer to the modem manual for the suitable strings. Up to 40 characters are accepted for each of these fields.

If any number or string is to be dialed or sent on the port before dialing the phone number, specify it as the dial prefix. Similarly any strings to be appended at the end of the phone number are to be entered in the dial suffix field. These are modem independent and can be left blank if not needed.

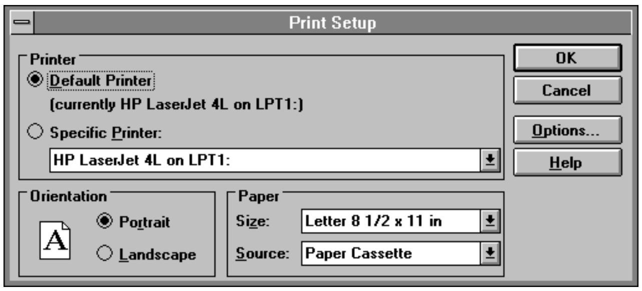
The amount of time the system waits before deciding that the telephone line is busy or not available is the dial time-out. A maximum of 99 seconds can be specified here. The modem will re-dial until the maximum number of re-dials is exceeded. A maximum of 9 re-dials can be specified.

The redial-delay is in addition to the dial time-out delay. This is the amount of time the PC waits before a re-dial. A maximum of 99 seconds can be specified here.

Any modifications made in the modem setup dialog box take effect the next time there is an attempt to connect with a DFP200.

Printer Setup

The hard copies for reports, logs and settings are made through the printer connected to the PC. To setup the printer click on Host Setup under the Support Functions menu. A pop up menu with Ports/Modem/Printer will be displayed. Choose the Printer item. The Print setup dialog box appears as shown below.



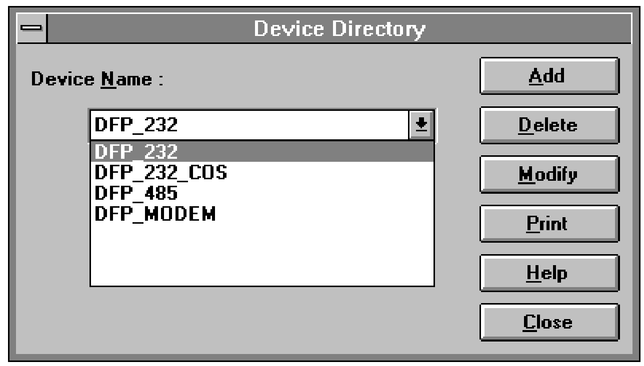
Select the Default Printer by clicking that radio button. Choose the Specific Printer option by clicking on that radio button and select one of the current installed printers shown in the box.

Click on the Options button to get additional choices about printing, specific to the type of printer that has been selected.

DEVICE Setup

More than one DFP200 relay can be connected to a PC on the physical link. But, at any given time, DFP-Link can communicate with only one DFP200 relay. It is possible that each of these DFP200s are configured with different communication parameters (e.g. telephone number, baud rate, etc.). DFP-Link must be setup with these parameters so that it can make proper connections with the relays. The Device Setup menu item is used to update DFP-Link with this information.

Device Setup can be used to either add a new relay setup or to modify an existing relay setup. Choose the Device Setup item in the Device menu. A Device directory dialog box appears as shown below.



The relays with existing setups are listed. Click on the scroll button of the device name field to view the complete list.

To add a new device, Click on the Add button. The Device Setup dialog box appears with the default parameters as shown in Figure 9-4.

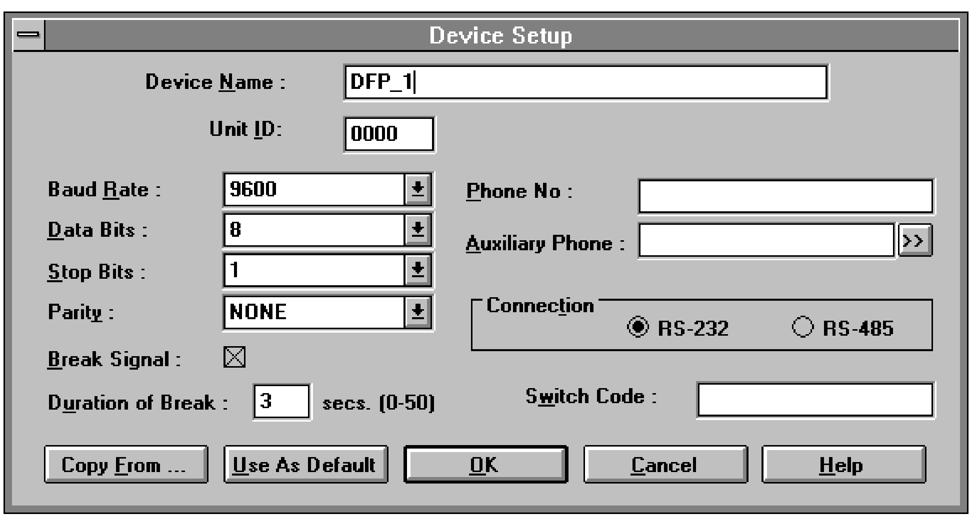
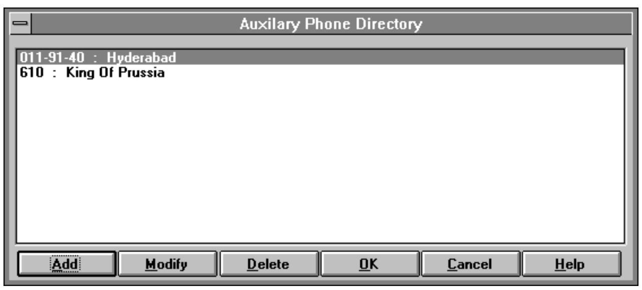
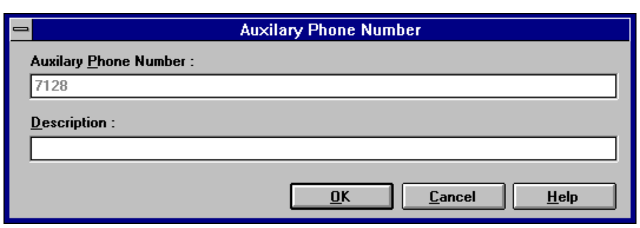


Figure 9-4 Device Setup

Enter the Device Name and the Unit Id to be added and specify all the parameters of that relay. The Baud Rate, Data Bits, Stop Bits, and Parity entries must match the corresponding settings of the DFP200 relay. The Break Signal is needed for communication with certain Code Operated Switches. Click this item if the COS used requires a break signal. The Duration of Break is the amount of time needed for the COS to determine that a message is intended for it. This may be needed even if the break signal is not required. The phone number the PC has to dial to get connected to this relay is specified in the Phone No field. A maximum of 60 characters can be entered in this field. The auxiliary phone number specified is dialed before dialing the actual phone number. The Browse button (>>) will display a dialog box with a list of existing auxiliary phone numbers as shown below.



In this dialog box, auxiliary phone numbers can be added, deleted and modified. For Modify or Delete, first select a number from the list and then choose the appropriate button. When Add or Modify is selected, a dialog box appears with fields for the number and description as shown below.

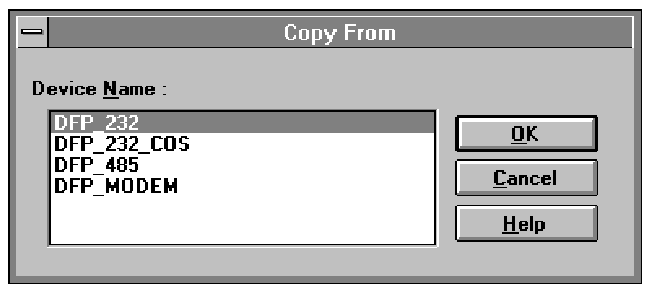


If no auxiliary phone number is necessary, leave these fields blank. A maximum of 60 characters can be entered in each of these field.

In the Device Setup dialog box, click on one of the radio buttons to choose either RS-232 or RS-485 as the physical communications link. Switch Code is a string of characters sent to the code operated switch. This field accepts a maximum of six characters in Hexadecimal format. These parameters take effect the next time DFP-Link connects to the specified relay.

Click on OK to save these parameters for the specified relay. Click on Cancel to quit the dialog box without updating Device Setup. Clicking on the Use As Default button will save the parameters and also makes them the default values. By selecting the most common parameters as the default values will simplify adding a relay.

To add a relay with parameters similar to an existing relay but not the default parameters, use the Copy From option. Choose this button to display a list box with the existing devices as shown below.



Select a device name and click on OK to proceed. All the device setup parameters of that relay are then displayed in the Device Setup dialog box. If any modifications are required, proceed as described above.

To Modify the parameters for an existing entry, select it from the device directory and choose the Modify button. The Device Setup dialog box appears with all the parameters. Make the necessary modifications and save or quit.

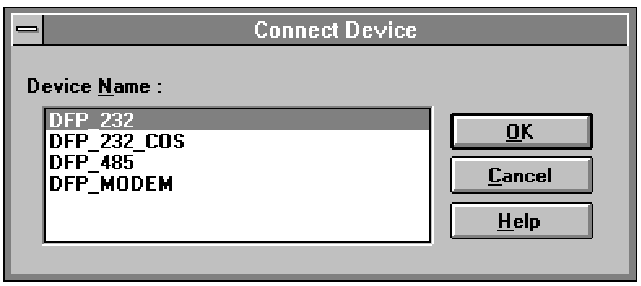
To delete an entry, select it from the device directory and choose the Delete button. A message box requesting confirmation for the deletion appears. Choose the Yes button to proceed with the deletion. Choose the No button to quit without deleting

Logging in and out

Once the PC and Device Setup are completed, a connection has to be established between the relay and PC.

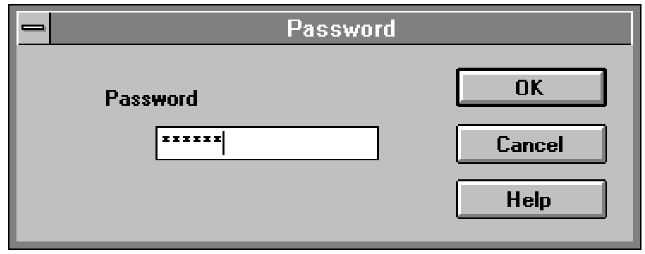
Connect

Choose Connect from the Device menu. A Connect Device dialog box appears as shown below.



From the list, select the relay and click on OK to proceed with the connection. Click on Cancel to quit the connection process.

Once the connection is established with the relay, a Password dialog box appears as shown below. A password must be entered to proceed.



The password determines the 'privilege level' of the current session. The VIEW, SETTINGS, or ACTION password entered must match the corresponding password stored in the relay. Choose the OK button to proceed with the password entered or choose the Cancel button to quit the connection process. If this is a new relay *See Chapter 1 – Introduction (Default Setting)*.

The password is sent to the relay and if the login is successful, the menu bar and the tool bar change to incorporate the additional functions. Reports, Settings and Actions items will be added to the existing items in the menu bar as shown in Figure 9-5.

Logging into the relay is the start of a session. A session log starts and logs all subsequent operations. The 'Current' item in the Log menu is enabled and can be used to view the current session log. The tool bar also changes to display the Logout symbol in place of the connect symbol.

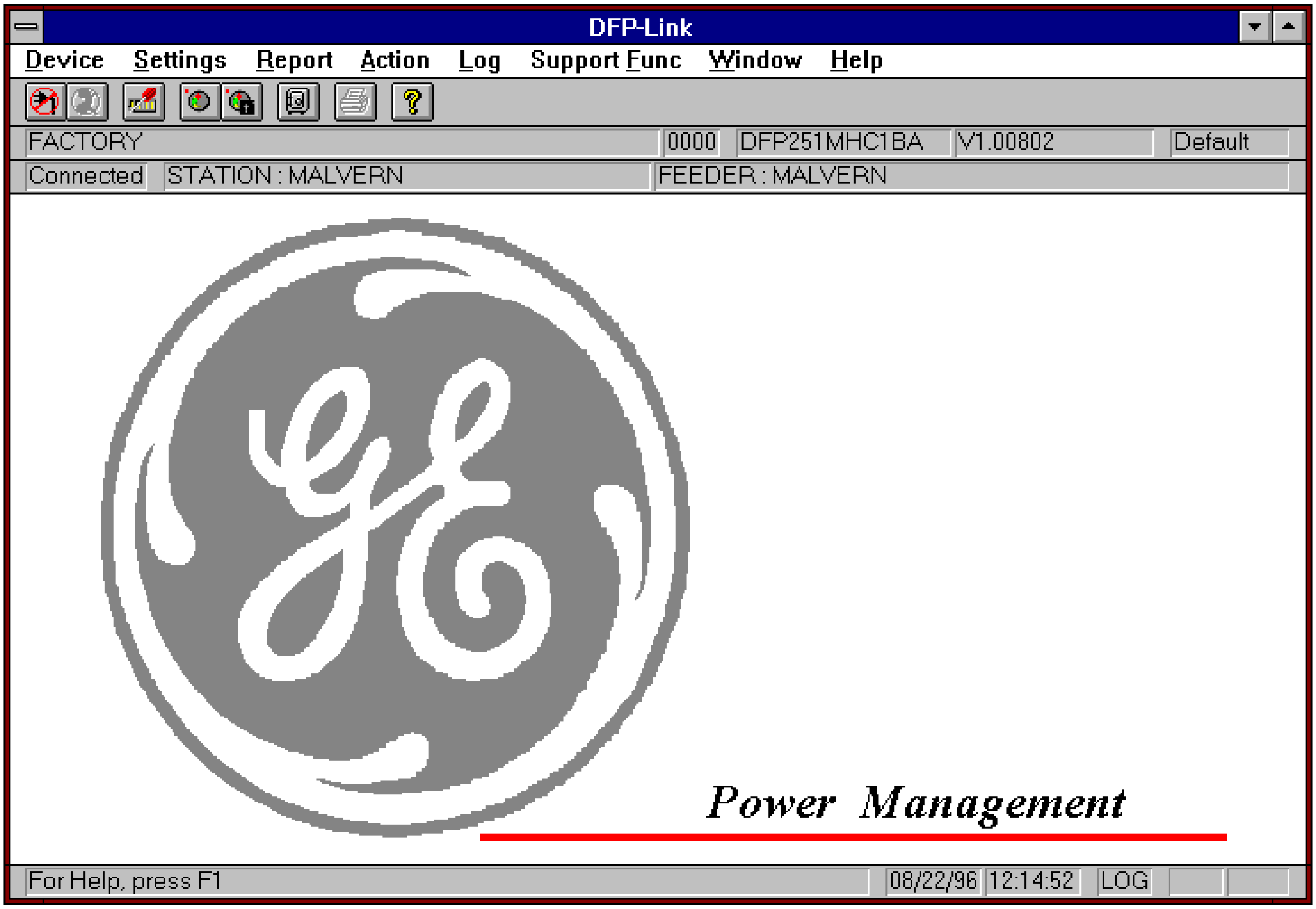
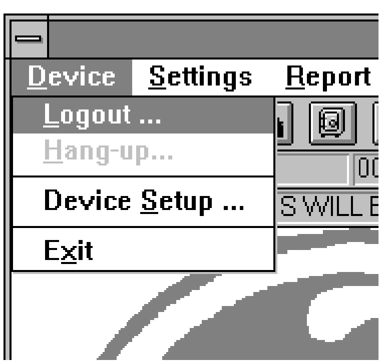


Figure 9-5 After a device connection

Logout

If the communication line is using a dial-up modem, the logout option will not hang-up the communication line. To logout from a relay, choose the Logout item in the device menu as shown below.



After a confirmation from the user, the relay will be logged out.

The following conditions will be checked before logout confirmation.

- If any settings were downloaded, was an END message sent ?
- Are the outputs in disabled condition ?
- Is the relay in Test mode ?

If any of the above conditions are true, DFP-Link will display an appropriate message box. To proceed with the logout, choose the Yes button.

If settings were changed, but the End message was not sent, the following message box will appear.

Click on No, get back to the settings, and send the END message to save the settings. There is no need to download the settings again. If the outputs were disabled, choose the Enable outputs item in the Actions menu. If the relay is in the Test mode, choose the End Test item in the Actions menu.

If logging out from a relay when a dial-up modem is being used, a separate hang-up request is required. If the hang-up request precedes a logout, DFP-Link will logout before hang-up.

With more than one relay connected to the other end of the telephone line using a code operated switch, it is not necessary to hang-up to logout from one relay and login to another on the same line. If the other relay is not on the same line, DFP-Link will automatically hang-up and dial the new number to connect to the new relay after a logout.

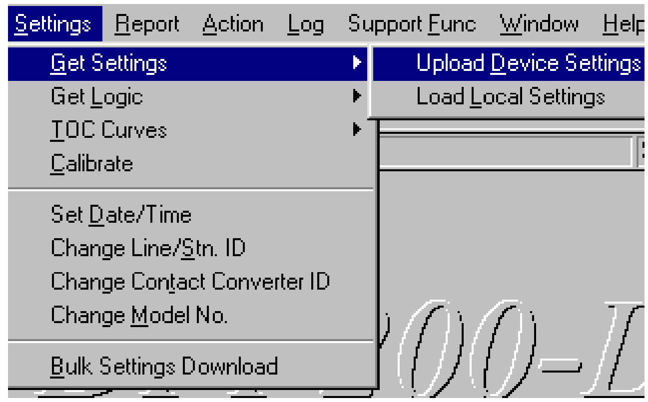
Settings

With DFP-Link settings can be uploaded from a DFP relay. Once uploaded, the settings can be modified, and these modified settings can either be downloaded to the relay or stored in a local file. Settings can also be loaded from these local files.

Upload Device Settings

The settings can be uploaded from a connected relay for viewing and modifying. An upload command will get all the settings from each of the eight setting groups.

After logging in to the relay, choose Settings / Get Settings / Upload Device Settings as shown below.



A Select Group dialog box appears as shown below.

The choices for Group No. are Active, 1, 2, 3, 4, 5, 6, 7, or 8. After selecting the settings group and clicking OK, the settings dialog box with the uploaded settings will appear as shown in Figure 9-6.

For an upload command, the relay sends the latest settings available with it. That means, if settings are downloaded to the DFP200 and there is a request to upload before sending the END message, the relay will send those downloaded settings even though they are not active.

In the settings dialog box, it is possible to modify the settings, save them to a file, print them, or download them to the relay.

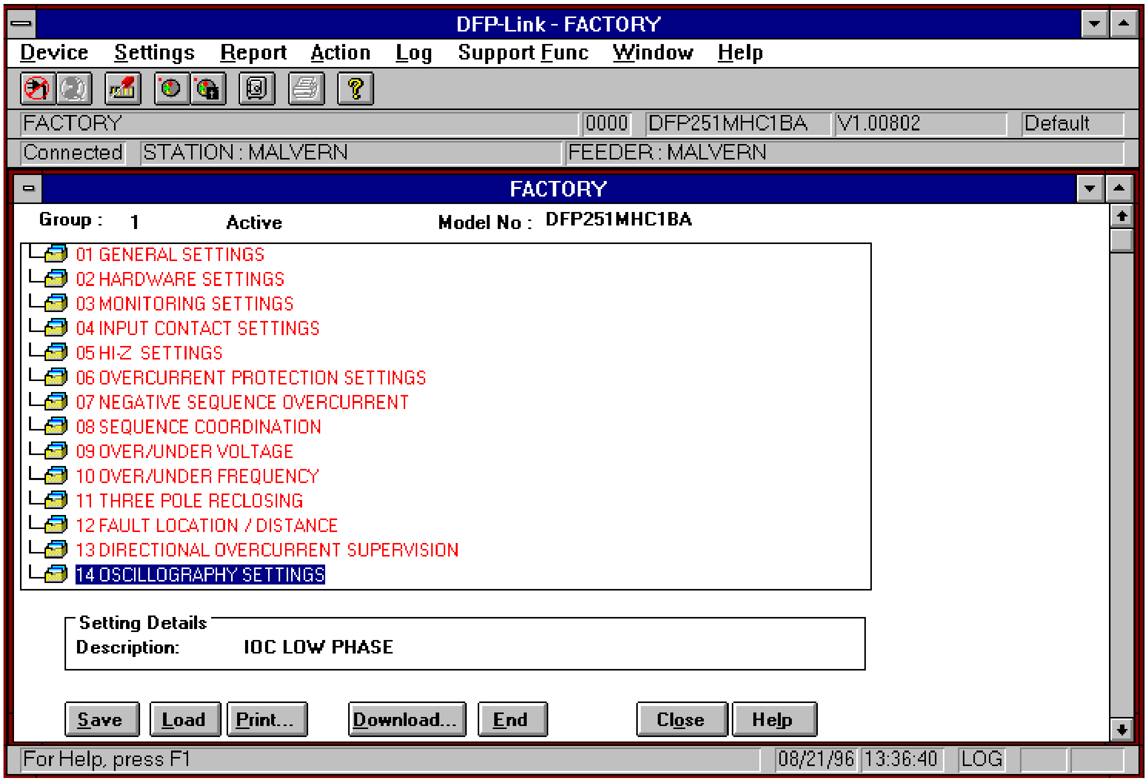
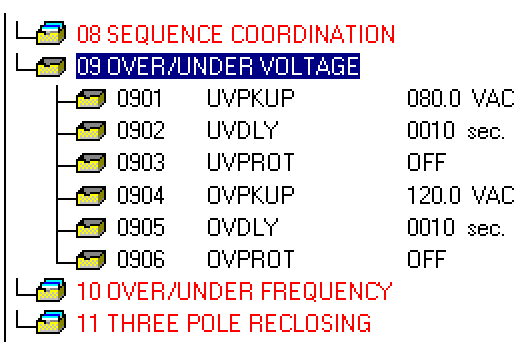


Figure 9-6 Settings

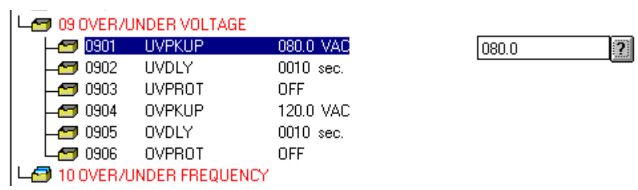
The settings dialog box has four parts:

1. top line with the settings group number and model number
2. settings list box
3. Setting Details box
4. bottom line with selection buttons

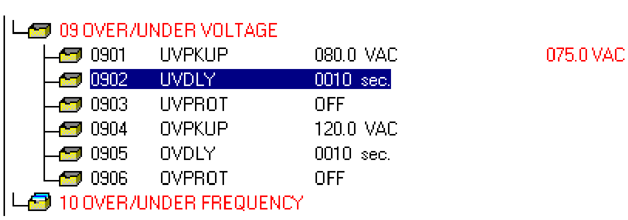
The settings list box shows the 14 setting categories (see Table 3-1). Double clicking on a settings category will display the individual settings as shown below.



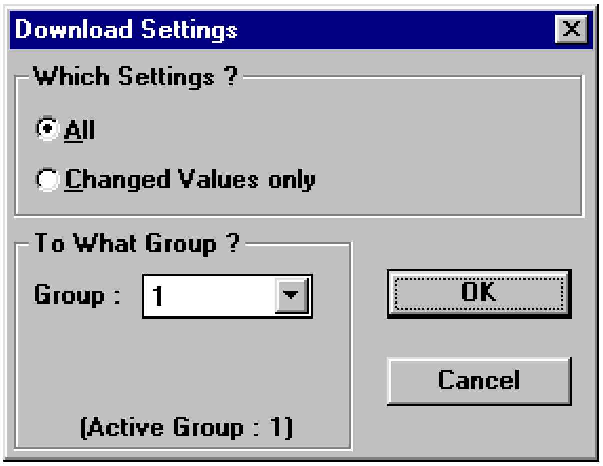
Double clicking on an individual setting allows the setting to be changed. An entry box appears to the right of the selected setting.



Once a new setting value has been entered, it replaces the entry box to the right of the old setting value to indicate a changed setting.



To download the changed setting to the relay click on the Download button. The following dialog box is displayed.



Selecting ALL followed by OK will download all of the settings to the DFP200. However, selecting Changed Values Only will download only the settings that have been changed, as indicated by their red appearance in the setting display.

Also, selecting a different settings group for the new settings can be accomplished by clinking the down arrow from the Group dialog box, and then selecting one of the 8 settings groups.

After a successful download, the following dialog box appears.

At this point, the changed setting values are present in the DFP200 but are not active; the old setting values are still in effect. To make the new values active and store them in non-volatile memory, an End message must be sent. Clicking the Send End button on the above dialog box accomplishes this. However, if the Close button is clicked instead, the changed setting values remain in a DFP200 temporary buffer but are not active. At some point prior to the end of current session, an End message must be sent or the changed setting values stored in the DFP200 will be discarded. The END message can be sent by clicking on the END button located at the bottom of the settings dialog box.

The settings can also be saved to a file. Click on the Save button in the settings dialog box. A 'File Save As' dialog box appears that allows selecting the name and location of the file. For a hard copy of the settings, click on the Print button in the settings dialog box.

Click on the Load button to read an existing settings file into DFP-Link. A 'File Open' dialog box will appear to permit selection of the file name and location. The setting values from this file will replace the setting values shown in the settings dialog box. These new settings can then be downloaded to the DFP200 relay.

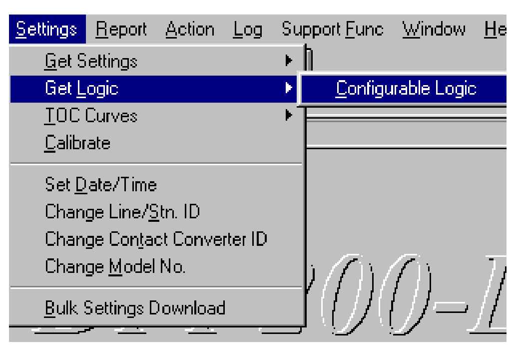
Load Local Settings

It is possible to view, modify, save, and print settings loaded from a file without being connected to a DFP200 relay. Choose Settings / Get Settings / Load Local Settings as shown in Figure 9-16. The file is selected from a 'File Open' dialog box. Multiple files can be opened simultaneously. The Download and End buttons are disabled in the settings dialog box.

Get Logic

The configurable logic can be uploaded from a connected relay for viewing and modifying within Xpression Builder. An upload command will get the logic from each of the eight setting groups.

After logging in to the relay, choose Settings / Get Logic / Configurable Logic as shown below.

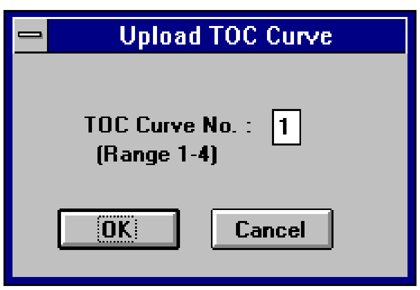


A ‘Select Group’ dialog box will appear which permits the selection of the settings group from which the logic will be uploaded. After clicking on OK, the Xpression Builder program is started, and the uploaded configurable logic is visible on the screen. At this point, Xpression Builder is active, not DFP-Link. Refer to the chapter on Xpression Builder for an explanation of how to modify and save the uploaded expression. To return to DFP-Link either close (ALT-F4) Xpression Builder or use ALT-TAB to switch back.

TOC Curves

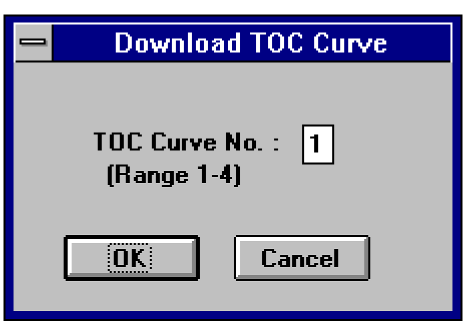
DFP-Link will facilitate uploading/downloading user-defined TOC curves to/from the DFP200 relay. A separate software program is used to create user-defined TOC curve files. This program is not an integral part of DFP-Link. The interface between this program and DFP-Link is the user-defined TOC curve files stored on a disk.

Choosing Settings / TOC Curve / Upload displays the following message box.



Clicking on OK displays a ‘Save As’ dialog box to select the name and location of the file that will be created to store the curve data.

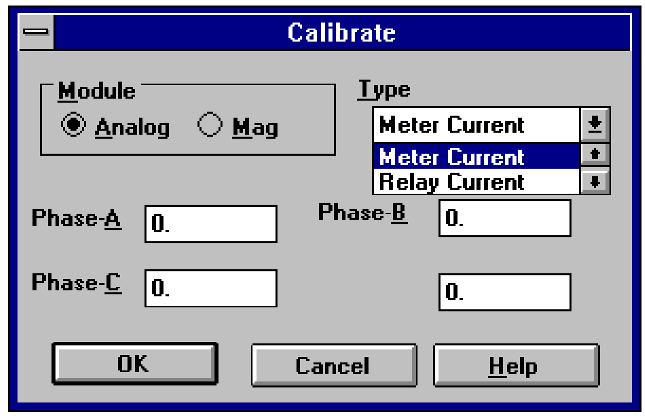
Choosing Settings / TOC Curve / Download displays the following message box.



Clicking on OK displays an ‘Open’ dialog box to select the name and location of an existing file that contains the curve data to be downloaded to the relay.

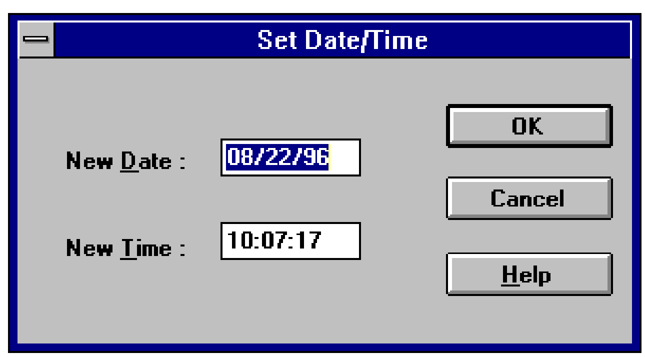
There can be up to four different user-defined curves stored in the relay. TOC Curve No. selects which curve will be uploaded or downloaded.

Calibrate



Set Date/Time

To modify the date and time in the DFP200 relay, click on the Set Date/Time item in the settings menu. As shown below, the Set Date/Time dialog box will appear with the date and time of the PC in the New Date and New Time boxes.

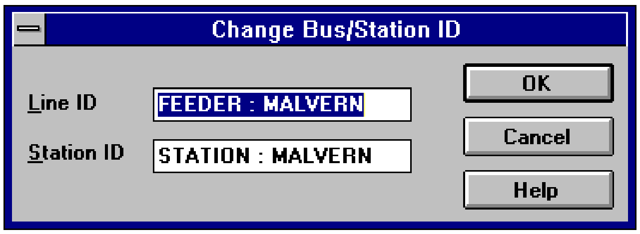


NOTE: The time and date shown in this dialog box are NOT the time and date that exsits in the DFP200 relay! To view the relay’s time and date, choose Report / New / Status.

Modify the date and time as required. Click on OK to download the new values to the relay. The Cancel button cancels the modifications and quits the dialog box.

Change Feeder/Station ID

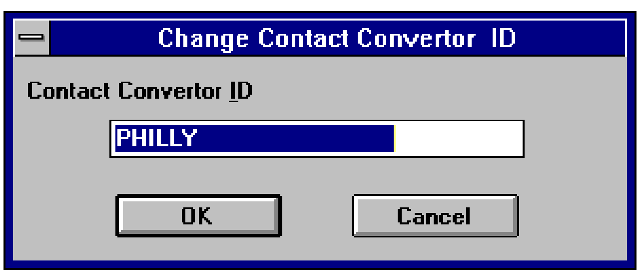
To modify the Feeder and Station ID in the DFP200 relay, click on the Change Feeder/Station ID item in the Settings menu. As shown below, the Change Feeder/Station ID dialog box will appear.



Modify these strings as required. A maximum of 32 characters are accepted in each box. Click on OK to download these strings to the relay or choose Cancel to quit.

Change Contact Converter ID

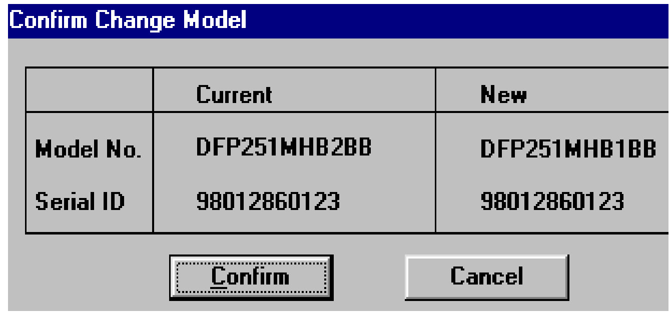
To modify the Contact Converter ID in the DFP200 relay, click on the Change Contact Converter ID item in the Settings menu. As shown below, the Change Contact Converter ID dialog box will appear.



The string entered in this box is listed in the event log when the digital input (contact converter) assigned to Time-Tag-Store Station Event produces an output.

Change Model No.

The DFP200 is field upgradeable. The Change Model No. selection allows the user to download a file which contains a new model number. This new model number will trigger the DFP200 software to enable different functions. Selecting this menu item will cause a file dialog box to appear. If an encrypted model number file is selected, the figure below will appear.

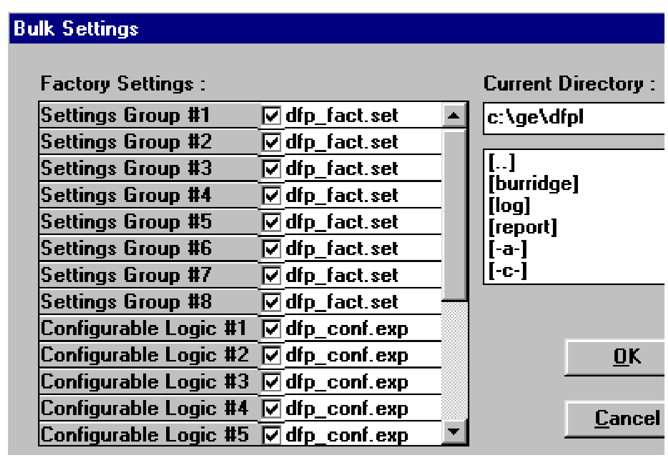


The figure above displays the old and the new model number for the DFP200. It also gives the user the opportunity to Confirm or Cancel the model number change.

If an upgrade is required contact your local GE sales representative for the necessary encrypt file.

Bulk Settings Download

The last item in the Settings menu is Bulk Settings Download. This selection allows the user access to all of the settings in the DFP200. As shown in the figure below, the Bulk Settings Download command allows the user the ability to enter in a pre-made file to download to the relay.

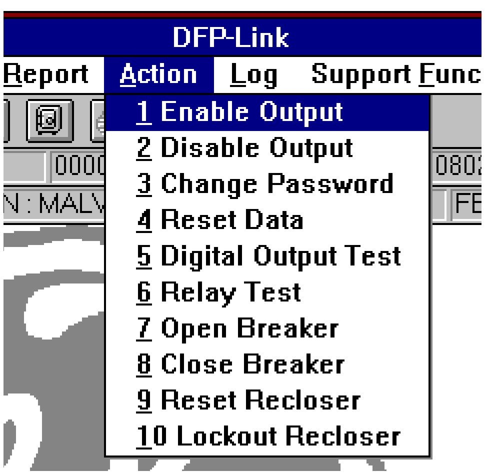


The pre-made file can be a settings file (.set), an Xpression Builder file (.exp), or a TOC curve file (.toc).

To download the file, select the settings group to change and double-click on the file name. A file selection box will appear showing all of the files in your DFP200 directory that contain the correct extension. Select the file to download, place a check-mark (√) next to the selected file, and click on OK.

Action

DFP-Link provides the capability to send Action commands to the connected relay. When necessary, the commands sent to the relay follow the 'Arm and Execute' sequence defined in GE protocol. After a user confirmation for an action request, the Arm and Execute sequence is transparent to the user. No actions can be done unless logged in to a relay with the appropriate privilege level (password) for performing actions. The Action menu is shown below.



Enable Outputs

Relay outputs are enabled by choosing the Enable Output menu item. This action follows the Arm and Execute sequence and requires a user confirmation before the command is executed.

To enable the relay's outputs, click the Enable Output item in the Actions menu. A message box will be posted for confirmation. Choose OK to proceed or Cancel to quit.

Disable Outputs

Relay outputs are disabled by choosing the Disable Output menu item. This action follows the Arm and Execute sequence and requires a user confirmation before the command is executed.

To disable the relay's outputs, click the Disable Output item in the Actions menu. A message box will be posted for confirmation. Choose OK to proceed or Cancel to quit. If the outputs are disabled at logout, DFP-Link will display a message box to warn the user.

Change Password

The View, Actions, Settings, and Master DFP-Link passwords can be changed by choosing the Change Password item in the Actions menu. A change password dialog box appears.

Changing the password requires three steps. First the old password is entered. This is the password entered at login. If the Master password was used at login, typing in the Settings password will produce an error message at the end of the process.

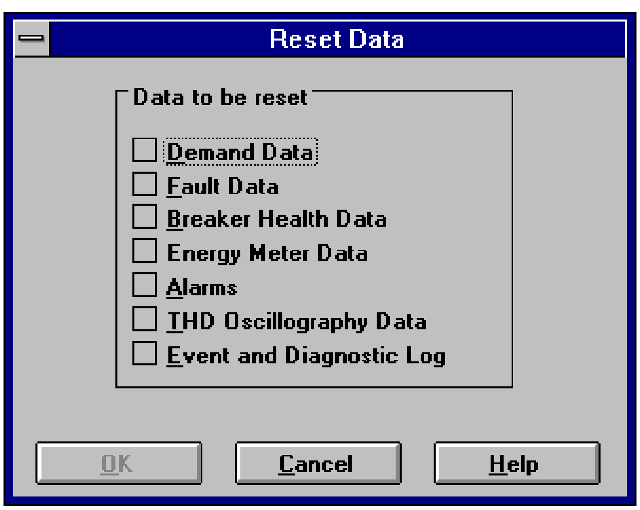
After clicking on OK to proceed with changing the password, DFP-Link will post another dialog box asking for the new password. Enter the new password and click OK. Only alphanumeric characters are accepted for the password. Since only upper case letters are accepted, all the characters entered are changed to upper case. The maximum password length is 16 characters.

For validation purposes, the new password must be entered a second time. This is to take care of any typographical errors in entering the password. Re-enter the new password again and choose the OK button.

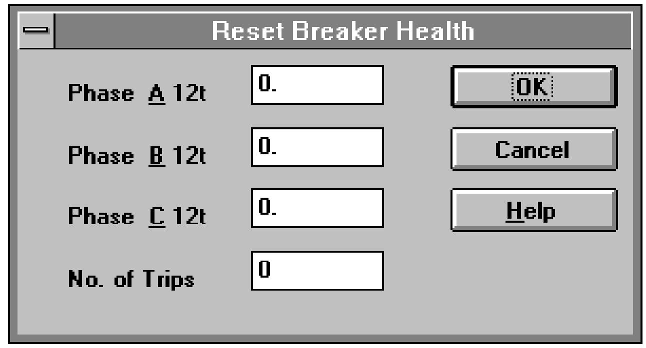
The new password is downloaded to the relay and stored in non-volatile memory. Any error will be displayed in a message box.

Reset Data

This menu item allows specific data stored in a DFP200 relay to be reset. Choose the Reset Data item in the Actions menu. A dialog box will appear with various data items listed.



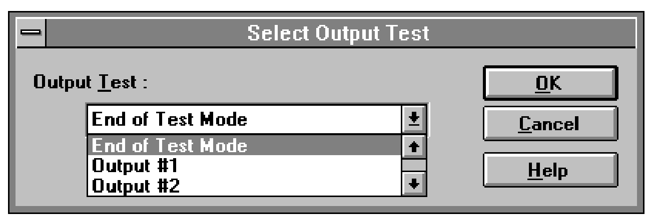
Check the associated boxes, for all the data items which are to be reset. Choose OK to proceed or Cancel to abort. If the Breaker Health Data item is checked, another dialog box appears for entering Breaker Health values. This Reset Breaker Health dialog box is shown below.



This allows the Breaker Health accumulations to be reset after relay testing or to be set to initial values when the relay is installed and the breaker has a previous operation history. Click on OK and the values entered will be sent to the relay. Choosing Cancel will re-display the Reset Data dialog box with the Breaker Health Data item unchecked.

Digital Output Test

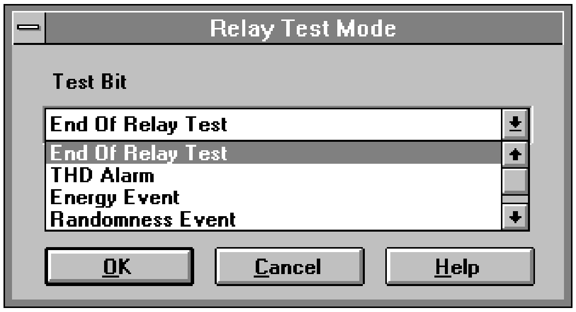
Choosing this item from the Actions menu displays a dialog box with a list of outputs.



This test simply causes the selected output contact to close. Select an output from the list and choose OK to proceed or choose Cancel to quit.

Relay Test

Choosing the Relay Test item from the Actions menu displays the following dialog box.



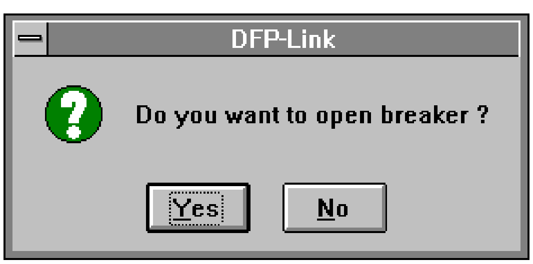
The items in the list box are:

1. End of Relay Test
2. Energy Event
3. Randomness Event
4. Use Relay Channel for RMS Calculation
5. Use Notch Channel for RMS Calculation
6. Phase A Energy Standard Deviation Test
7. Phase B Energy Standard Deviation Test
8. Phase C Energy Standard Deviation Test
9. Phase N Energy Standard Deviation Test
10. Hi-Z - Use Metering Channel
11. Hi-Z - Use Notch Channel
12. Use Polarizing Channel for RMS Calculation

Select an item and choose OK to proceed. Choose the Cancel button to quit. Select the End Of Relay Test item from the list to bring the relay out of the test mode. If the relay is in test mode during logout, DFP-Link will display a message box indicating this.

Open Breaker

Choose this menu item to open the breaker. A message box is displayed to prompt for a confirmation. Click Yes to open the breaker.



Close Breaker

Choose this menu item to close the breaker. A message box is displayed to prompt for a confirmation. Click Yes to close breaker.

Reset Recloser

Click on this item to force the recloser to the 'reset' state. This will work only if the breaker is closed.

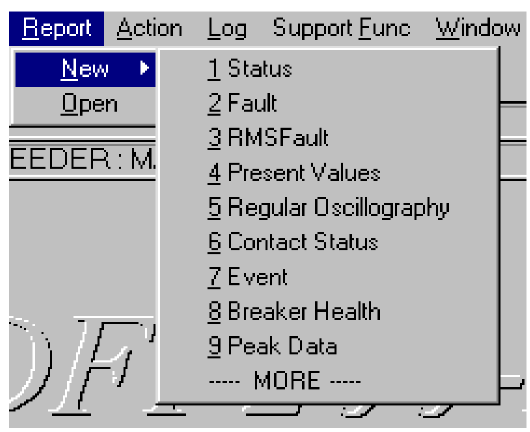
Lockout Recloser

Click on this item to force the recloser to the 'lockout' state. This will work only if the breaker is open.

Reports

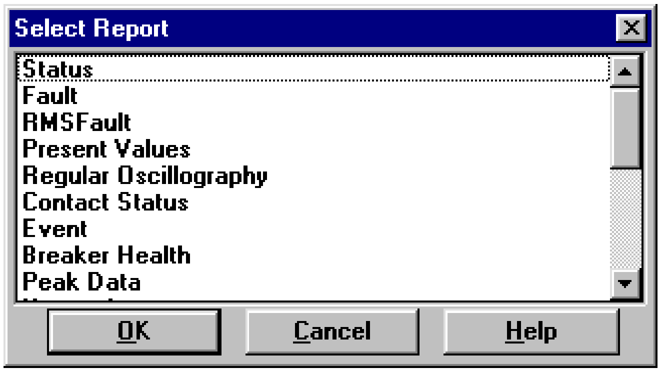
Different types of information stored in a DFP200 relay can be uploaded using DFP-Link. The data if formatted by DFP-Link into specific reports that can be viewed, printed, or saved to a file.

The Report item is not visible in the menu bar if not logged in to a relay.



New Report

Clicking on New displays a menu of available reports as shown above. Selecting MORE displays a dialog box containing a complete list of available reports.



The available reports are:

1. Status
2. Faults
3. RMS Faults
4. Present Values
5. Regular Oscillography
6. Contact Status
7. Event
8. Breaker Health
9. Peak Data
10. Harmonics
11. Memory Read
12. Demand
13. Diagnostics
14. MMI Passwords
15. THD Oscillography
16. RMS Oscillography
17. HiZ Oscillography
18. Trigger Oscillography
19. HS (High Speed Values)
20. Mag-Ang (Magnitude & Angle)

Select the desired report and click on OK. Each report is displayed in a fixed format and its contents cannot be changed. Multiple reports can be open at a given time by going through the steps for opening a new report several times.

Open Report

A report previously saved to a file can be displayed by selecting the Open item. Clicking on Open displays a 'File Open' dialog box.

Specific Reports

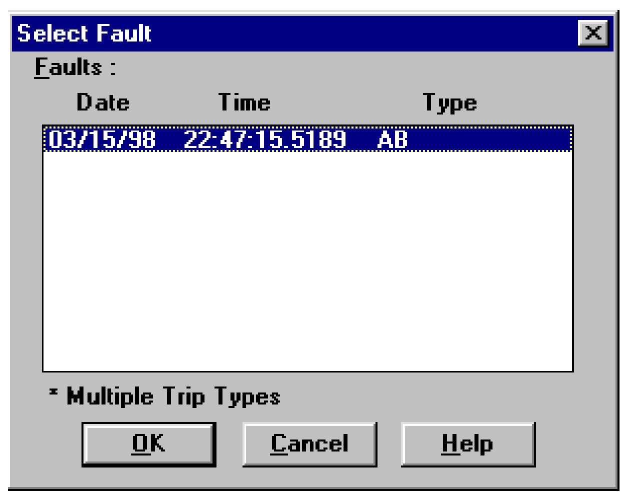
Some reports need further input from the user. In all such cases, the input is acquired through a dialog box, and DFP-Link attempts to validate the entered values before proceeding. The required user input to acquire each of the reports is described below.

Status Report

Select Status from the Report menu to get the status of various system components.

Fault Report

For every Regular Oscillography capture, a fault report is generated. To see a listing of the Regular fault reports in the DFP200 select Fault from the Reports menu. The figure below shows the Select Fault dialog box. It will not list the RMS faults.

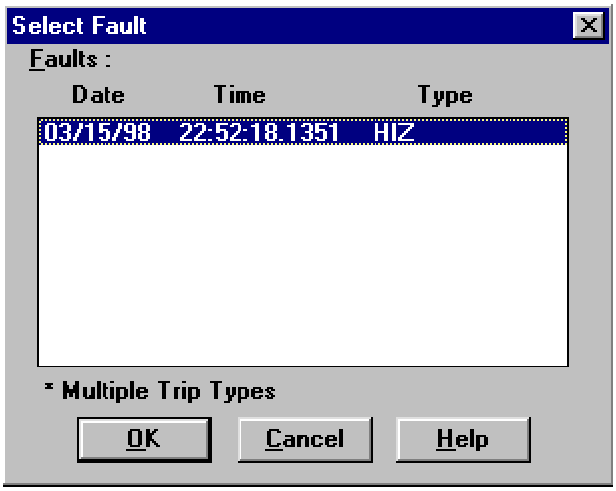


To display the complete fault report, select the desired fault and click on OK.

RMS Fault Report

For every RMS Oscillography capture, a fault report is generated. To see a listing of the

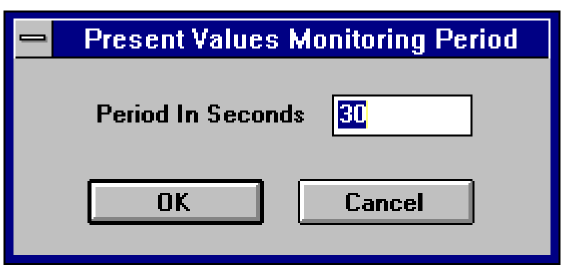
RMS fault reports in the DFP200 select Fault from the Reports menu. The figure below shows the Select Fault dialog box. It will not list the Regular Oscillography faults.



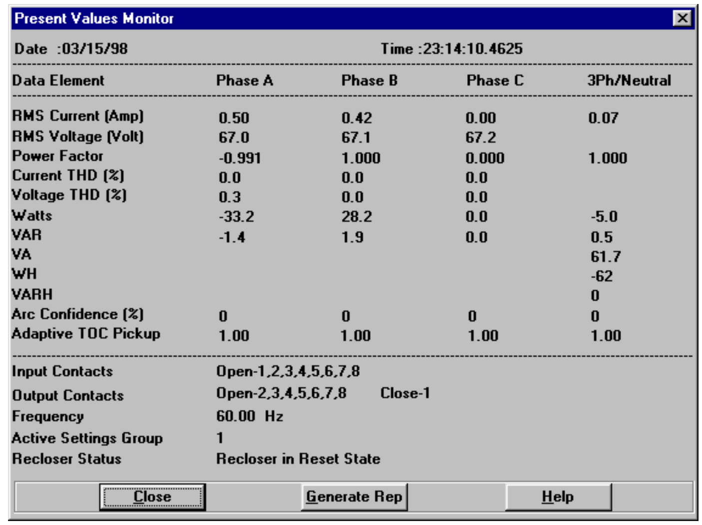
To display the complete fault report, select the desired fault t and click on OK.

Present Values Report

The Present Values Monitoring Period dialog box prompts for the period value in seconds.



DFP-Link will display and update these metering values at the end of the selected period within a special dialog box. A normal report window containing values frozen at the instant of creation can be obtained by selecting the Generate Rep button.



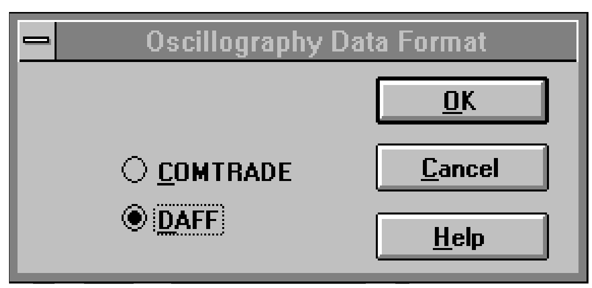
The figure above shows an example of a Present Values screen.

Oscillography Reports

For each of the Oscillography reports

- Regular Oscillography
- THD Oscillography
- RMS Oscillography
- Hi-Z Oscillography

two steps are involved. First select the fault or occurrence for which oscillography data is sought. A Data Format dialog box is then displayed.



There are two file formats available. The DAFF format should be selected if GE-DATA will be used to display the oscillography data. After the data format is selected, DFP-Link will proceed with the acquisition of data from the relay.

After the oscillography data is retrieved, an Oscillography Report or Fault Report box will be displayed. DFP-Link cannot display the sampled values of voltage and current. When the Fault report box is closed the user will be prompted to save the data to a file. If Yes is selected, a 'File Open' dialog box appears. A separate software program must then be used to read the resulting file and display the data graphically.

Contact Status Report

Select Contact Status from report menu to see the current state of all of the configurable inputs.

Event Report

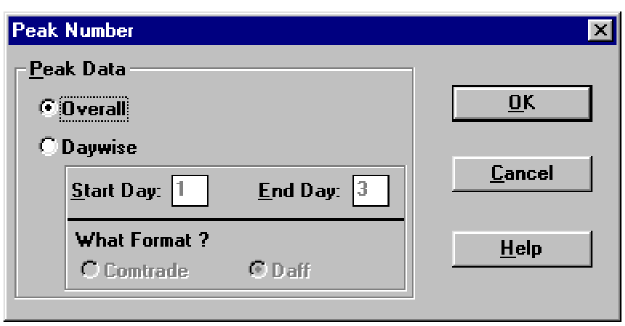
Select Event from the Report menu to see the events data.

Breaker Health Report

Select Breaker Health from report menu to see the current breaker health values.

Peak Data Report

For the Peak Data report the Peak Number dialog box offers Overall or Daywise peak data. For the Daywise option, a Start day and End day must be selected. The range is 1 - 35 days for both entries. For the Overall option, the Start day and End day edit fields are disabled.

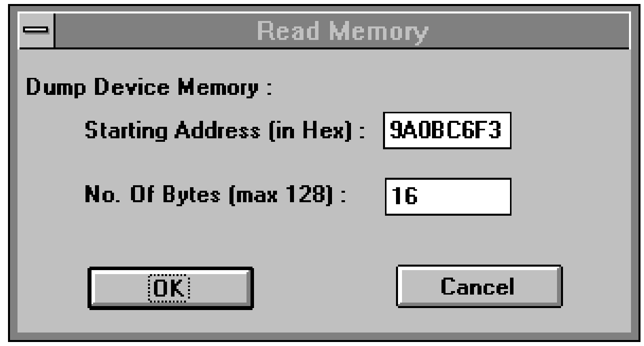


Harmonics Report

Select Harmonics from the Report menu to see the harmonics data.

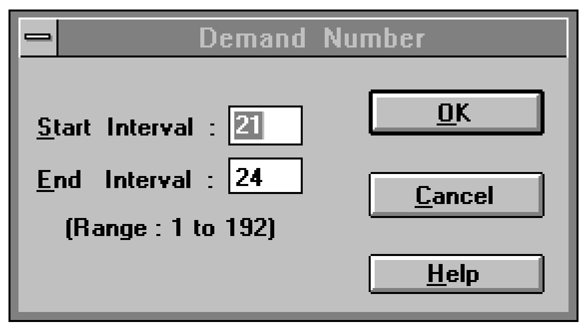
Memory Read Report

Select Memory Read to view the memory contents of the DFP200 relay. A Read Memory dialog box provides fields to enter the starting address and the number of bytes to be viewed. DFP-Link will check the validity of the entries before uploading the data.



Demand Report

For the demand report, it is necessary to select the range (start - end) of the demand entries. The allowed range is 1-192 or 1-3360 depending on the DFP200 model number.



Diagnostics Report

Select Diagnostics from the Report menu to see the diagnostic events.

MMI Password Report

Select MMI Password to see a list of the settings, control, and master passwords associated with the optional Keypad/Display Module. To decode passwords see Table 10-2 - Password Encryption.

HS Report

Select HS from the Report menu to view the latest 2-cycle RMS value of currents and voltages.

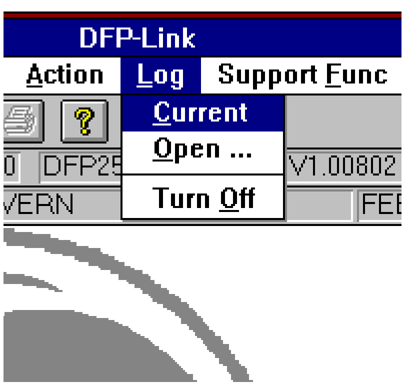
MAG-ANG (Magnitude & Angle)

Select Mag-Ang from the Report menu to view the report containing the magnitude and angle for all of the voltage and current inputs.

Session Log

DFP-Link can log all the transactions with a DFP200 relay during one session. Each session log is stored to a file in the 'log' subdirectory under the DFP-Link directory. A session is defined as the time between logging in and logging out of a relay.

Up to 100 session log files are saved to disk. When the 101st file is created it overwrites the first file. The Log menu item is displayed in the menu bar both before and after logging in to a relay. Since all the session log information is saved to disk, it is not necessary to be logged in to a relay to view the log files. The Log menu item 'Current' is visible only when logged into a relay. The LOG field in the DFP-Link status bar shows if the session log is on or off. When 'LOG' is showing, the session log is on.



Turn Off

By default, DFP-Link turns the session log on. To turn the session log off, choose the Turn Off item in the Log menu. This can be done either before or after logging in to a relay. From the moment the session log is turned off, DFP-Link will not create a session log for any relay until the session log is turned on.

After clicking on the Turn Off item, a select mark will be displayed with that item in the Log menu. The LOG field in the Status bar will be empty. To turn session log on again, click on this item again.

Current Session Log

The log for the current session can be viewed, only when connected to a relay, by clicking on Current in the Log menu. An example is shown if Figure 9-7. This log contains all the transactions with the relay since logging in. Comments can be added in the current log. This feature is limited to the current log, and no comments may be added to any previous logs.

After logout, DFP-Link automatically closes the log and stores it to a file. To print the current session log choose the Print item in the Log menu. To close the current log, choose the Close item in the Log menu. Note that the Print and Close items are only present when a log is open in a window.

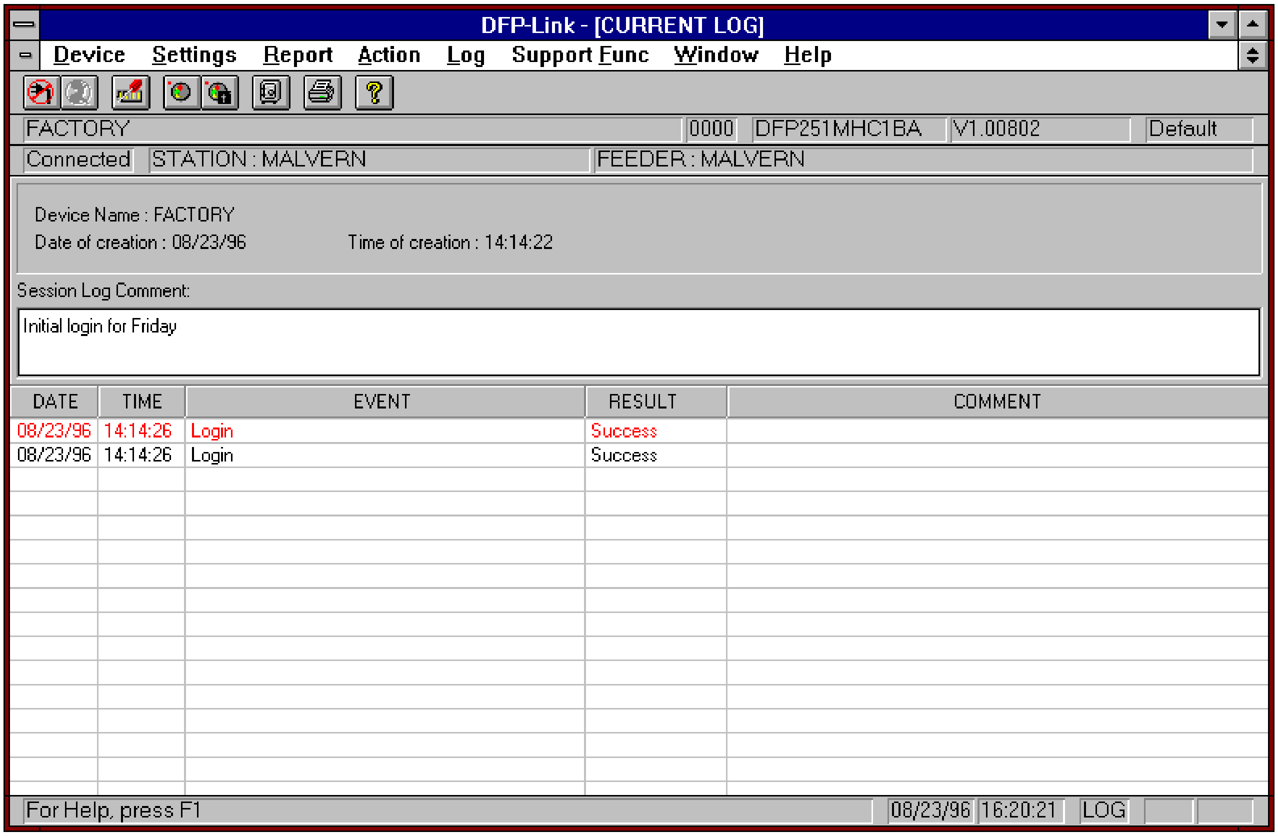
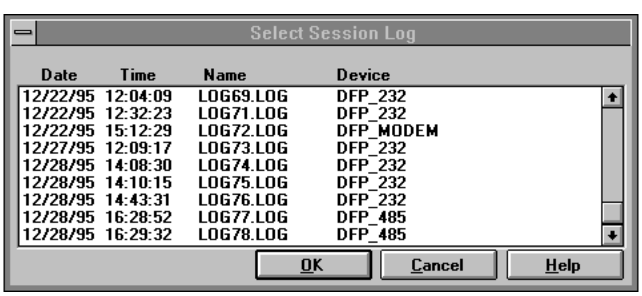


Figure 9-7 Current Session Log Window

Open Session Log

To open a log file for viewing and printing, choose the Open item in the Log menu. A list box with all the available log files will appear. It is not necessary to be logged into a relay to invoke this option.



The display consists of the log name, the date and time of occurrence, and the relay logged in during that session. Scroll through the window to see the entire list. Select a log file to open and choose the OK button to view it. Choose Cancel to quit the selection.

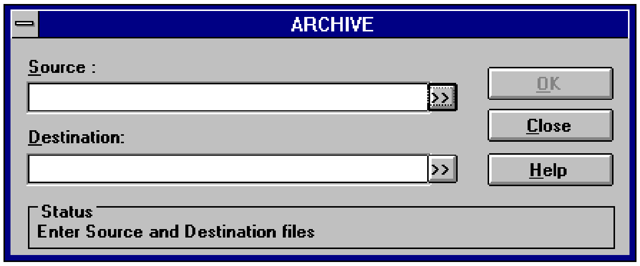
Comments cannot be added to a log opened from the list, but a hard copy can be made by choosing the Print item in the Log menu. Multiple logs can be viewed using the Open option. When the Print item is selected while viewing multiple logs, DFP-Link will print the log that is in the active window. To close a log, make sure that window is active and choose the Close item in the Log menu.

ArchivE

Reports and Settings can be stored as disk files. These files are only created if the user initiates the action. This contrasts with log file creation which is automatic as long as the session log is turned on.

DFP-Link supports the creation of backup (archive) copies of any of these files through the Archive option. The same option can be used to retrieve these backups.

To make a backup of one of the Report, Settings or Log files stored on a disk, choose the Archive item in the Support Functions menu. An Archive dialog box appears.



Enter the full path name of the source file and destination files. Choose OK to proceed with the backup. Clicking a browse(>>) button displays a 'Source File' or 'Destination File' dialog box that permits easy selection of the path and file name.

Remote Communication Interface

Modem Connections and Settings

When establishing communication between the DFP200 and a remote PC, two modems connected via a phone line are required; one modem is located at the DFP200 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 DFP200-LINK communications software that runs on the PC sends a Hayes-compatible command string to the modem located at the PC. The DFP200 does not send any configuration commands to its modem. **Both, the DFP200 modem and the PC modem must be uniquely configured to permit the user to log into and communicate with the DFP200 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 DFP200-LINK. Those configuration settings critical to the operation of DFP200-LINK are changed by DFP200-LINK. The configuration commands sent to the modem from DFP200-LINK 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 DFP200-LINK setting establishes the baud rate, which must match the baud-rate setting of the DFP200. DFP200-LINK 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.

DFP200 Modem

The DFP200 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 DFP200 does not send any configuration commands to its modem, the required configuration settings must be made prior to connecting the modem to the DFP200. **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 DFP200 may not connect properly, or the user may not be able to log into the DFP200.

With a Hayes V-Series 2400 SmartModem or equivalent, the DFP200 modem will perform a modulation handshake with the PC modem to set the baud rate of the DFP200 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 DFP200 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 DFP200 modem register S0 is set higher than 12, the PC modem may time out and hang up before the DFP200 modem can answer. S0=12 means that the DFP200 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 9-1 is a listing of the modem command set to communicate to the DFP200 from a remote PC.

Null Modem Connections

A PC can be connected to a DFP200 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 9-8. The null-modem cable should not exceed 50 feet in length.

Table 9-1 Modem Setup Criteria (Hayes Compatible)

Function	DFP200 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)

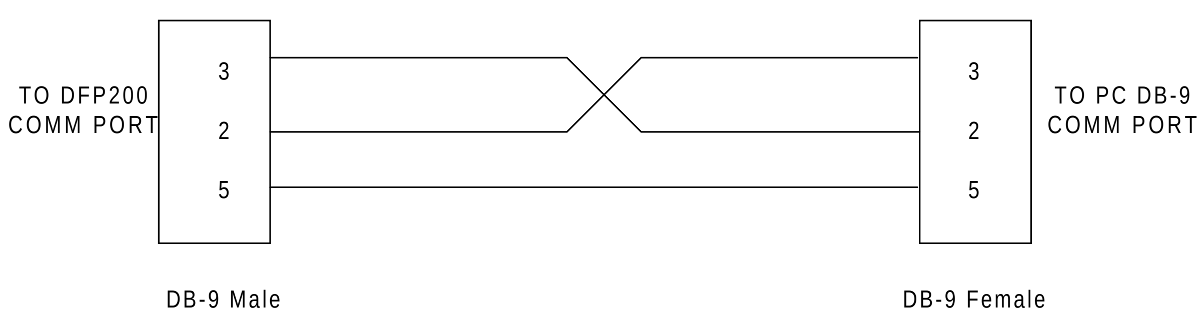


Figure 9-8 DFP200 Communications to PC Directly

Chapter 10
ASCII COMMUNICATIONS

The DFP200's ASCII communications capability permits control of the relay with a terminal emulator, such as Windows Terminal. This chapter contains information on the protocol itself, and syntax of the commands.

GETTING STARTED

After starting your terminal emulation program check that the following are correct:

- Number of Data Bits (8)
- Number of Stop Bits (1)
- Parity (None)
- Baud Rate (9600)

The values in () are default settings. After these parameters are set, press the ENTER key until the following prompt appears:

login >

At the login prompt type in LOGIN and press ENTER. At the prompt enter in the appropriate settings. After Logging in type HELP and press ENTER to view all of the possible commands.

ASCII PROTOCOL

All commands sent to and from the relay will have the following Serial Data Format:

<8 data bits><n stop bit(s)><no parity bit>

Commands Received (by the relay)

Commands sent to the relay should be structured as either a command followed by a carriage return or a command followed by a carriage return, then a line feed, as shown below:

<command><CR>
or
<command><CR><LF>

Either upper case or lower case characters or a combination of both may be used in a command,

Messages Transmitted (by the relay)

Messages transmitted by the relay will have the following format:

<STX><CR><LF>
<MESSAGE LINE 1><CR><LF>
<MESSAGE LINE 2><CR><LF>
…
<LAST MESSAGE LINE><CR><LF><ETX>
<STX><PROMPT><ETX>

where the following apply:

STX Start of Transmission Character (^B, ASCII 02)
ETX End of Transmission Character (^C, ASCII 03)
CR Carriage Return (ASCII 0D)
LF Carriage Return with Line Feed (ASCII 0A)

Handshaking

The following is the XON/XOFF protocol for the relay's RS-232 interface:

XON - ASCII hex 11 (Cntl Q)
XOFF- ASCII hex 13 (Cntl S)
CAN - ASCII hex 18 (Cntl X)

Actuation:

XON receive data buffer falls below ¼ full (for RS-232 RTS is asserted)
XOFF receive data buffer becomes above 3/4 full (for RS-232 RTS is

unasserted when buffer becomes 95% full)

CAN aborts a pending transmission

Notes:

1. Automatic Transmitting sources should monitor for the XOFF character so as not to overwrite the received data buffer.

2. If the system receives an XOFF character while no message is being transmitted, the system blocks transmission of any message that may be presented to its transmitting buffer. The message will be transmitted once XON is received.

COMMANDS

Table 10-1 lists all the ASCII commands. The entire command may be entered, but only the letters contained in the parentheses are required.

NOTE: The third column of Table 10-1 lists the 'privilege (password) level required for each command. Many of the commands can be executed under multiple privilege levels.

Each of the commands are described below:

BREAKRHEALTH

Displays the accumulated breaker health values.

```
DFP200_MST>breakerhealth
Phase A I2t :    0.00
Phase B I2t :    0.00
Phase C I2t :    0.00
Number of Trips :   0
```

CHGCCSTRING

The ASCII string entered here is used in the event log when the digital input (contact converter) assigned to Time-Tag-Store Event produces an output.

```
DFP200_MST>chgccstring
CC String :CCID : MALVERN
 Do you want to change CC string ? (y/n) :y
 Enter new CC string (max. 32 characters) :philly
```

CHGGROUP

This command determines which setting group is the active group.

```
DFP200_MST>chggroup
Currently Active Group = 1
 0 - Group Number from CC Inputs
 1 - Group 1
 2 - Group 2
 3 - Group 3
 4 - Group 4
 5 - Group 5
 6 - Group 6
 7 - Group 7
 8 - Group 8
To quit press 'ESC'
Enter your choice : 1
Are you sure (Y/N): ? y
 New Active Group = 1
```

In the above sequence, group 1 was selected to be the active group.

CHGPASSWORD

To change any of the four passwords associated with communicating via a serial port follow the sequence shown below.

```
DFP200_MST>chgp
Enter old password : XXXX
Enter  new password :XXXX
Re-Enter  new password :XXXX
The password is changed
```

Table 10-1 ASCII Command List

NAME	DESCRIPTION	PRIVILEGE LEVEL
(BREAK)ERHEALTH	Display breaker health	I, A, S, M
(CHGCC)STRING	Display/Change contact converter string	I, A, S, M
(CHGG)ROUP	Change active setting group	S, M
(CHGP)ASSWORD	Change password	I, A, S, M
(CHGS)ETTINGS	Change settings	S, M
(CHGST)ATION	Change station & feeder ID	I, A, S, M
(CLOS)E	Close breaker.	A, M
(CLS)	Clear the screen.	I, A, S, M
(DIGT)EST	Perform digital output tests	A, M
(DISABL)EOUTPUT	Disable outputs.	A, M
(ENAB)LEOUTPUTS	Enable outputs.	A, M
(EVE)NTS	Display events	I, A, S, M
(FAU)LTS	Display fault status and reports	I, A, S, M
(HELP)	Help screen for current privilege level	I, A, S, M
(INP)UTS	Request contact converter status	I, A, S, M
(LOCKR)ECLOSER	Recloser to LOCKOUT	A, M
(LOGI)N	Login to DFP-200	none
(MAGANG)L	Magnitude and Angle Report	I, A, S, M
(MMIP)ASSWORDS	Display encoded MMI passwords	I, A, S, M
(OPEN)	Open breaker.	A, M
(OUT)PUTS	Request Output Contact status	I, A, S, M
(PEAK)DATA	Display peak data	I, A, S, M
(QUIT)	End session	I, A, S, M
(READ)INGS	Present metering data with update	I, A, S, M
(RESETD)ATA	Clears the selected data	A, S, M
(RESETR)ECLOSER	Recloser to RESET	A, M
(RMSF)AULTS	Display RMS Fault Status and Reports	I, A, S, M
(SHOWCC)STRING	Display Contact Converter String	I, A, S, M
(SHOWSE)TTINGS	Display settings	S, M
(SHOWST)ATION	Display station and line id	I, A, S, M
(STATU)S	Display DFP200 status	I, A, S, M
(TRIG)GEROSC	Triggers Regular Oscillography	I, A, S, M
(VAL)UES	Display present values	I, A, S, M
(VER)SION	Display relay's Version and Model	I, A, S, M

I = Information privilege level
A = Action privilege level
S = Settings privilege level
M = Master privilege level

CHGSETTINGS

This command allows settings to be changed or viewed.

```
DFP200_MST>chgsettings
G : To View/Change complete GROUP Settings
C : To View/Change all Settings of CATEGORY
I : To View/Change an INDIVIDUAL setting
To quit press 'ESC'
Enter your choice : i
 1 - 8 : Group Numbers 1 to 8
 0 : Active Group
 B : Previous Menu
To quit press 'ESC'
Enter your choice : 0
1. GENERAL SETTINGS
3. MONITORING SETTINGS
4. INPUT CONTACT SETTINGS
5. HIZ SETTINGS
6. OVERCURRENT SETTINGS
7. NEGATIVE SEQUENCE SETTINGS
8. SEQUENCE COORDINATION SETTINGS
9. VOLTAGE PROTECTION SETTINGS
10. FREQUENCY PROTECTION SETTINGS
11. RECLOSER SETTINGS
12. FAULT LOCATION SETTINGS
13. TORQUE CONTROL SETTINGS
14. OSCILLOGRAPHY SETTINGS
15. SYNC-CHECK SETTINGS
To quit press 'ESC'
Enter your choice : 1
 Enter Setting Number (1 - 20) : 9
Port 3 Protocol  :  GE-MOD
RANGE : (0, 1)
 Enter New Value ('ESC' to quit) : 1
```

The sequence shown above changes the Port 3 Protocol from GE to ASCII.

CHGSTATION

This command allows the user to change the Station and Feeder ID. These names are seen on all reports from the relay.

```
DFP200_MST>chgstation
Station ID : STATION : MALVERN
Feeder ID : FEEDER : MALVERN
Change station and/or feeder ID ? (y/n) : y
Enter new station ID (max. 32 characters) : Blue
Enter new feeder ID (max. 32 characters) : Point
Are you sure ? (y/n) : y
```

In the sequence above the station ID was changed from Malvern to Blue, and the feeder ID was changed from Malvern to Point.

CLOSE

This command closes the breaker.

```
DFP200_MST>close
CLOSE BREAKER ? (y/n): y
Breaker CLOSE command sent
```

This command, when executed, will assign the BRKRCLOSE flag in Xpression Builder to be true.

CLS

This command will clear the screen, and place the cursor at the upper left-hand corner of the screen.

DIGTEST

This command allows each of the eight output relays and the self-test relay to be activated.

```
DFP200_MST>digtest
Protection will be disabled, do you want to continue? y
 0 - End Test
 1 - Output1
 2 - Output2
 3 - Output3
 4 - Output4
 5 - Output5
 6 - Output6
 7 - Output7
 8 - Output8
 9 - DFP Self Test Alarm
To quit press 'ESC'
Enter your choice : 1

Test 1 is Activated
```

The selected output relay coil will stay energized for 10 seconds and then dropout.

DISABLEOUTPUTS

This command prevents all outputs from operating. For instance, an overcurrent function might operate but no trip would occur since the trip signal cannot energize the associated output relay coil. Use the Enable command to restore the relay to normal operation.

```
DFP200_MST>disable
DISABLE OUTPUTS ? (y/n):y
Outputs are Disabled
```

ENABLEOUTPUTS

This command is used to make the outputs functional after a Disable command was issued.

```
DFP200_MST>enable
ENABLE OUTPUTS ? (y/n):y
```

Outputs are again Enabled.

EVENTS

This command will display all of the Events currently stored in the DFP200.

DFP200_MST>events

DATE	TIME	EVENTS
08/28/96	07:45:03.3817	Host Logon OK on Port2
08/28/96	07:44:36.0495	Phase C Arcing Suspected Alarm
08/28/96	07:40:44.2396	Host Logoff on MMI
08/28/96	07:25:44.1090	Non-Critical DFP Failure
08/28/96	07:25:39.0000	Setting Group 1 In Use
08/28/96	07:25:39.0000	System Booted
08/27/96	15:48:05.3028	Host Logoff on MMI
08/27/96	15:33:28.4416	Host Logon OK on Port2
08/27/96	15:33:09.8122	Host Logoff on Port2
08/27/96	15:33:03.3895	Host Logoff on MMI
08/27/96	15:32:33.5813	Host Logon OK on MMI
08/27/96	15:31:35.9188	Host Logoff on MMI
08/27/96	15:30:58.6882	Host Logon OK on MMI
08/27/96	14:31:21.4130	Host Logoff on MMI
08/27/96	13:44:22.2229	Host Logoff on MMI
08/27/96	13:32:37.9394	Host Logoff on Port2
08/27/96	13:17:13.3336	Host Logon OK on MMI
08/27/96	12:38:20.8546	Phase C Arcing Suspected Alarm
08/27/96	12:36:27.3778	Host Logoff on MMI

– More –

Press 'ESC'- quit, Any other key - continue

If another key is pressed the relay will continue to display events until all 200 events have been displayed. The user also has the option to view previous screens of events by pressing B.

FAULTS

Use the FAUlts command to display a list of fault reports for all of the Regular Oscillography stored in the relay.

```
DFP200_MST>faults
FLTNO     DATE       TIME             TRIP TYPE(s)
1         08/27/96   09:09:34.1044    TRG
2         08/27/96   07:57:20.0254    AB
3         08/23/96   14:30:30.5942    AG
4         08/23/96   14:25:23.5651    BG
5         08/23/96   14:15:14.5753    CG
6         08/23/96   14:07:33.5650    BC
7         08/23/96   14:03:03.5623    BCG
Enter Fault Number (press 'ESC' to quit):
```

A fault report is displayed for a selected fault.

```
Enter Fault Number (press 'ESC' to quit): 2
Report for Fault No:  2
TRIP DATE: 08/27/96          TRIP TIME: 07:57:20.0254
Relay Operating Time: 100  (ms)
Oscillography Trigger: Fault Detector
Trip type(s): 46I  46T
Trip phases:
Fault type: AB
Distance: 0  miles

ITEM              Phase A    Phase B    Phase C    Neutral

Prefault Current   0.00(A)    0.00(A)    0.00(A)    0.00(A)
Prefault Voltage   0.00(V)    0.10(V)    0.00(V)    —
Fault Current      5.03(A)    4.30(A)    0.00(A)    0.71(A)
Fault Voltage      0.00(V)    0.10(V)    0.00(V)    —

Press Any Key to continue
List of Fault events :
TIME            EVENT
07:57:20.0254   Negative Sequence IOC Pickup
07:57:20.0254   Negative Sequence TOC Pickup
07:57:20.0254   Reg. Oscillography Capture
07:57:20.1254   Negative Sequence IOC Trip
07:57:20.1263   Output Contact #1 Activated
Press Any Key to continue
```

After the available fault reports are listed, the user is given the opportunity to have the complete fault report displayed along with the events that were created during the fault. See Chapter 2 - Product Description, Regular Oscillography for a description of what faults/events will generate a Regular Oscillography.

HELP

Displays the commands in Table 10-1 that are allowed for the privilege level in effect at the time.

INPUTS

The state (open / closed) of the contact wired to each digital input (contact converter) is reported.

```
DFP200_MST>inputs
Contact Converter #0 = OPEN
Contact Converter #1 = OPEN
Contact Converter #2 = OPEN
Contact Converter #3 = OPEN
Contact Converter #4 = OPEN
Contact Converter #5 = OPEN
Contact Converter #6 = OPEN
Contact Converter #7 = OPEN
```

LOCKRECLOSER

This command will force the recloser to the lockout state provided that the breaker is open.

```
DFP200_MST>lockrecloser
LOCKOUT RECLOSER ? (y/n) :y
Recloser Locked
```

LOGIN

When local or remote (modem) communication is first established or the QUIT command is used to end the current session the prompt becomes:

```
login >
```

To begin a new session enter the LOGIN command:

```
login >LOGIN
```

The next two prompts are for the unit ID and password:

```
Unit ID: ? 0
Password: ? XXXX
```

If the ‘master’ password was entered, the response is:

```
MASTER privilege granted
DFP200_MST>
```

If the ‘settings’ password was entered, the response is:

```
INFORMATION & SETTINGS privileges granted
DFP200_SET>
```

If the ‘action’ password was entered, the response is:

```
INFORMATION & ACTION privileges granted
DFP200_ACT>
```

If the ‘information’ password was entered, the response is:

```
INFORMATION privilege granted
DFP200_INF>
```

As shown above, the privilege level of the current session is embedded in the last three letters of the prompt. Once the DFP200_XXX prompt is displayed, any command can be entered that is consistent with the existing privilege level. If it is not, an error message is displayed. For example, if the SET command is used with the information privilege level, the result is:

```
DFP200_INF>set
Invalid Command!
```

MAGANGI

Displays the magnitude and angle for each of the voltage and current inputs.

DFP200_MST>magang1		
ITEM	MAGNITUDE	ANGLE
Va	67.0 V	0
Vb	66.7 V	240
Vc	67.2 V	120
Ia	0.94 A	67
Ib	0.00 A	****
Ic	0.67 A	187
In	0.27 A	34
3Ip	0.00 A	****

If there is no analog input the phase angle would be reported as *.***

MMIPasswords

Displays a list of settings, control, and master passwords associated with the optional Keypad/Display Module.

```
DFP200_MST>mmipasswords
MMI PASSWORDS
Settings Password : DHLPPPPPPPPPPPPP
Control Password : AEIPPPPPPPPPPPPP
Master Password :MBFPPPPPPPPPPPPP
```

The passwords shown are encrypted. Use Table 10-2 to decode the passwords.

Table 10-2 Password Encryption

Displayed	Decoded	Displayed	Decoded
(space)	P	@	0
!	T	A	4
“	X	B	8
$	Q	D	1
%	U	E	5
&	Y	F	9
(	R	H	2
)	V	I	6
*	Z	L	3
,	S	M	7
-	W	P	(space)
1	D	Q	$
2	H	R	(
3	L	S	,
4	A	T	!
5	E	U	%
6	I	V	)
7	M	W	-
8	B	X	“
9	F	Y	&
:	J	Z	*
;	N	[	.
<	C	\	#
=	G	]	‘
>	K	^	+
?	O	_	/

OPEN

This command opens (trips) the breaker.

```
DFP200_MST>open
OPEN BREAKER ? (y/n): y
Command Failed! Breaker cannot be opened!
```

In this case, the command failed because the OPEN flag was not programmed to operate an output contact in the configurable logic.

OUTPUTS

The state (open / closed) of the 8 output contacts is reported.

DFP200_MST>outputs

Output Contact #1 = OPEN

Output Contact #2 = OPEN

Output Contact #3 = OPEN

Output Contact #4 = OPEN

Output Contact #5 = OPEN

Output Contact #6 = OPEN

Output Contact #7 = OPEN

Output Contact #8 = OPEN

PEAKDATA

Displays a tabular list of the peak values. The all time peak values or the peak values for one of the last 35 days may be selected.

DFP200_MST>peakdata

0 : All time peak, 1 - 35 : Daily peak

To quit press 'ESC'

Enter your choice : 4

ELEMENT	VALUE	DATE	TIME
Max VA	0.00(VA)	08/23/96	16:15:00.0000
Max Watts	0.00(W)	08/23/96	16:15:00.0000
Max VARs	0.00(VAR)	08/23/96	16:15:00.0000
Min Pf	0.000	08/23/96	16:15:00.0000
Max Ia	0.00(A)	08/23/96	16:15:00.0000
Max Ib	0.00(A)	08/23/96	16:15:00.0000
Max Ic	0.03(A)	08/23/96	08:30:00.0000
Max In	0.00(A)	08/23/96	08:30:00.0000
Max Thd Ia	0.0 %	08/23/96	16:15:00.0000
Max Thd Ib	0.0 %	08/23/96	16:15:00.0000
Max Thd Ic	0.0 %	08/23/96	16:15:00.0000
Max Thd Va	0.0 %	08/23/96	16:15:00.0000
Max Thd Vb	0.0 %	08/23/96	16:15:00.0000
Max Thd Vc	0.0 %	08/23/96	16:15:00.0000
Min Va	0.00(V)	08/23/96	07:30:00.0000
Min Vb	0.00(V)	08/23/96	07:30:00.0000
Min Vc	0.00(V)	08/23/96	07:30:00.0000

QUIT

To end the current session use the QUIT command. This forces a new login sequence during which a different password may be entered.

READINGS

This command is similar to Values. The tabular display is the same except 3ph WHR and 3ph VARHR are not present. In addition the display is updated (re-written) every second. See VALues for the display format.

RESETDATA

Use this command to reset or clear the stored data associated with various functions and to clear alarms.

```
DFP200_MST>resetdata
 1. Reset PEAK DATA
 2. Reset OSCILLOGRAPHY DATA (Regular and RMS)
 3. Reset BREAKER HEALTH
 4. Reset ENERGY DATA
 5. Reset ALARMS
 6. Reset THD OSCILLOGRAPHY
 7. Reset ALL LOGS

To quit press 'ESC'
Enter your choice : 3
Phase A (0 - 39,999,999.99): 0
Phase B (0 - 39,999,999.99): 0
Phase C (0 - 39,999,999.99): 0
Total Trips (0 - 999): 0
Data 3 is Reset
```

The above insert shows that when item 3 is selected, prompts appear to allow setting initial conditions for BREAKER HEALTH.

RESETRecloser

This command will force the recloser to the reset state provided that the breaker is closed.

```
DFP200_MST>resetrecloser
RESET RECLOSER ? (y/n) :y
Recloser reset
```

RMSFaults

Use the RMSFaults command to display a list of fault reports for all of the RMS Oscillography stored in the relay.

```
DFP200_MST>rmsfaults
FLTNO    DATE       TIME            TRIP TYPE(s)
1        03/16/98   01:18:14.0458   2COC
2        03/15/98   22:52:18.1351   HIZ
Enter Fault Number (press 'ESC' to quit):
```

A fault report is displayed for a selected fault.

```
Enter Fault Number (press 'ESC' to quit): 2
Report for Fault No:   2
TRIP DATE: 03/15/98              TRIP TIME: 22:52:18.1351
Trip type(s): HIZ
Trip phases: G
ITEM               Phase A    Phase B    Phase C   Neutral
Prefault Current   6.72(A)    5.79(A)    0.00(A)   0.93(A)
Prefault Voltage   0.00(V)    0.10(V)    0.00(V)    —
Fault Current      0.50(A)    0.41(A)    0.00(A)   0.10(A)
Fault Voltage      0.00(V)    0.10(V)    0.00(V)    —
Arc Confidence     94.0 %          94.0 %        0.0 %        54.0 %

Press Any Key to continue

List of Fault events :
TIME            EVENT
22:52:18.1334   Hi-Z Oscillography Capture
22:52:55.0602   Output Contact #1 Activated
Press Any Key to continue
```

After the available fault reports are listed, the user is given the opportunity to have the complete fault report displayed along with the events that were created during the fault. See Chapter 2 - Product Description, RMS Oscillography for a description of what faults/events will generate a RMS Oscillography.

SHOWCCstring

This command allows the user to view the label given to the Configurable Input when the input is set to Time Tag Store Station Event. If a Configurable Input is set to Time Tag Store Station Event, whenever the input is energized an event will be logged, with the text given in this setting (SHOWCCstring). The string can be set with setting CHGCCstring.

```
DFP200_MST>showccstring
CC String : ALARM_SET
```

SHOWSETTINGS

This command allows settings to be viewed only.

```
DFP200_MST>showset
G : To View complete GROUP Settings
 C : To View all Settings of a CATEGORY
 I : To View an INDIVIDUAL setting
To quit press 'ESC'
Enter your choice : c
 1 - 8 : Group Numbers 1 to 8
 0 : Active Group
 B : Previous Menu
To quit press 'ESC'
Enter your choice : 0
1. GENERAL SETTINGS
2. HARDWARE SETTINGS
3. MONITORING SETTINGS
4. INPUT CONTACT SETTINGS
5. HIZ SETTINGS
6. OVERCURRENT SETTINGS
7. NEGATIVE SEQUENCE SETTINGS
8. SEQUENCE COORDINATION SETTINGS
9. VOLTAGE PROTECTION SETTINGS
10. FREQUENCY PROTECTION SETTINGS
11. RECLOSER SETTINGS
12. FAULT LOCATION SETTINGS
13. TORQUE CONTROL SETTINGS
14. OSCILLOGRAPHY SETTINGS
15. SYNCH. CHECK SETTINGS
To quit press 'ESC'
Enter your choice : 12
FAULT LOCATION SETTINGS
Pos Seq Imp Mag-Ohms  :  7.00  OHMS
Pos Seq Imp Angl-Deg  :  70.0  DEG
KO Ratio   :  3.0
Zero Seq Imp Ang-Deg  :  70.0  DEG
Enable Fault Location  :  NO
Line Length     :  100
Length Units(Mi/Km)  :  0


Press Any Key to continue
```

The sequence shown above displays all the settings under the FAULT LOCATION category.

SHOWSTATION

The existing Station ID and Line ID are displayed.

```
DFP200_MST>station
Station ID : STATION : MALVERN
Line ID : FEEDER : MALVERN
```

STATUS

This command will display a status report for all of the modules in the DFP200.

```
DFP200_MST>status

  SYSTEM STATUS
No Errors Detected

  PROCESSOR BOARD STATUS
No Errors Detected

  ANALOG I/O BOARD STATUS
No Errors Detected

  I/O BOARD STATUS
No Errors Detected

  MISCELLANEOUS STATUS
Outputs Enabled
New Events
Rmt Brkr Op Enable
Rmt Sett Chg Enable
Active Settings Group is 1

  COMMUNICATION MODULE STATUS

No Errors Detected

  RECLOSER STATUS
Recloser in Reset
```

TRIGGEROSCSC

This command will trigger a Regular Oscillography capture.

```
DFP200_MST>triggerosc
Are you sure (Y/N): ? y
 Oscillography is triggered
```

VALUES

This command results in tabular display shown below.

DFP200_MST>values

PRESENT VALUES

DATE: 08/27/96 TIME: 15:54:13.6456

ITEM	Phase A	Phase B	Phase C	Neutral
Irms	0.00(A)	0.00(A)	0.00(A)	0.00(A)
Vrms	0.00(V)	0.00(V)	0.00(V)	–
PF	0.000	0.000	0.000	–
Thd I	0.0 %	0.0 %	0.0 %	–
Thd V	0.0 %	0.0 %	0.0 %	–
WATT	0.00(W)	0.00(W)	0.00(W)	–
VAR	0.00(VAR)	0.00(VAR)	0.00(VAR)	–
Arc Conf.	0.0 %	0.0 %	0.0 %	0.0 %
TOC Pickup	5.10(A)	5.10(A)	5.10(A)	1.00(A)
3ph WATT	0.00(W)			
3ph VAR	0.00(VAR)			
3ph VA	0.00(VA)			
3ph PF	0.000			
Frequency	60.00(Hz)			
3ph WHR	0.00(WHr)			
3ph VARHR	0.00(Whr)			

VERSION

A list of the model number, software version, and serial number are displayed.

DFP200_MST>version
VERSION: V2.04
MODEL: DFP251MHC1BA
SERIAL ID: 19961000001

Chapter 11
CONFIGURABLE LOGIC DESIGN SOFTWARE
XPRESSION BUILDER

Overview

DFP200 has been designed to allow flexibility in the operations of the digital outputs and inputs. None of the outputs or inputs are "hardwired" to any function; the functions of each input and output are defined by a software file which is downloaded to the relay as a part of each setting group.

The software file represents the linkage between the digital inputs, internally generated protection flags, and digital outputs; it contains information regarding the logical relationships among each entity. This file is built using a Windows based application called Xpression Builder.

Xpression Builder allows the utility engineer to design the interconnection of the inputs and outputs with Boolean operators, latches, timers and counters, in a graphical environment. The application performs the task of compiling the design from the graphical format, and allows the engineer to download the file to the relay settings group. Each of the eight settings groups can contain a different Xpression Builder file to define the outputs.

DFP200 comes with a default Configurable Logic implementation. This implementation, contained in the Configurable Logic file, is a trip contact definition, which merely is the logical OR of all trip functions set to drive Output #1. This Configurable Logic file, also contains a simple Breaker Failure scheme. The Xpression Builder file for this implementation is loaded into your DFP Link directory as part of the installation process for that application. The file name is:

dfp_conf.exp

The "Quick Start" paragraph of this chapter walks through the development of the Breaker Failure logic in Xpression Builder, and provides the basics of working with the application. The remainder of the chapter addresses the pull down menus in detail and the available logic devices in Xpression Builder.

Installation

Xpression Builder is installed by placing the Xpression Builder floppy disk into your computer floppy drive, and typing A:\SETUP (assuming your floppy drive is the A drive). Follow the PC prompts thereafter for the installation.

Xpression Builder: Quick Start

The simple breaker failure logic presented in Figure 11-1 can be quickly created and downloaded to the relay, using the following three steps:

1. Using DFP200 Link, upload the Configurable Logic file for the desired settings group. This action will shift you to the Xpression Builder application.
2. Execute the required changes in Xpression Builder, as described in the following paragraphs
3. Compile and download the expression, using the utility in Xpression Builder.

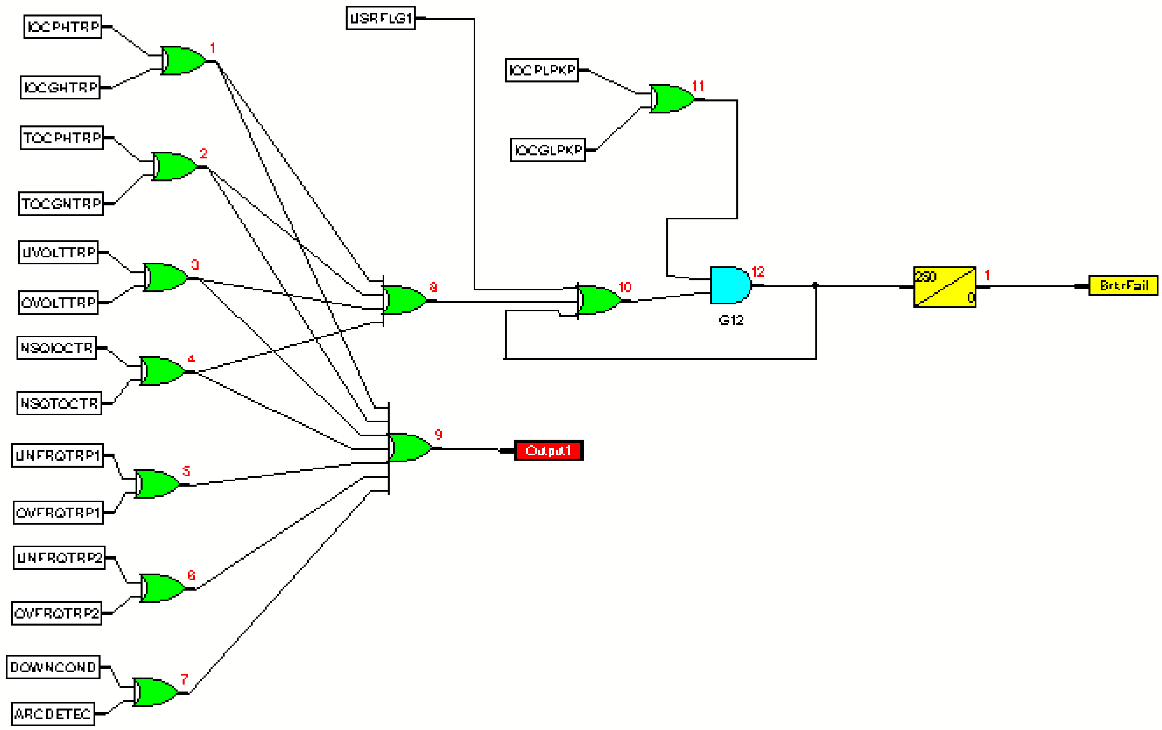


Figure 11-1 Example Breaker Failure Logic Executed in Xpression Builder

Uploading Relay Configurable Logic

The first step in changing the relay logic is to upload the existing logic. This is done from the DFP200 link application Settings menu. Ensure you are logged in with at least the settings password at this point. Selection of the Settings menu and the associated Configurable Logic item yields the screen shown in Figure 11-2. Selecting Configurable Logic with the mouse will lead to a group selection dialog box shown in Figure 11-3. Select “OK” for the active settings group or enter the desired group number, and then “OK”; this will lead to the link application opening the Xpression Builder routine and making it the active application. The resultant screen will appear similar to Figure 11-4. You are now ready to begin configurable logic design.

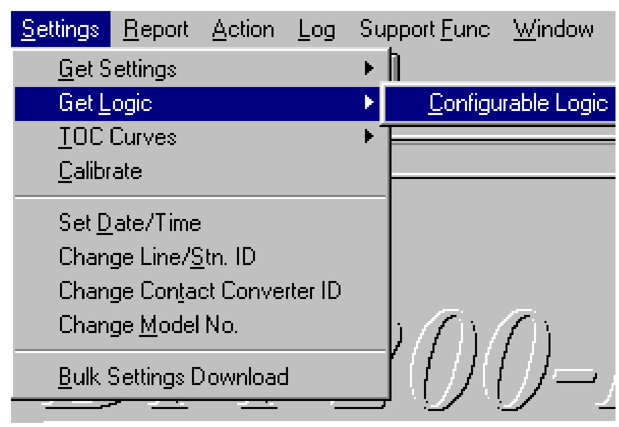


Figure 11-2 Opening Xpression Builder from DFP Link

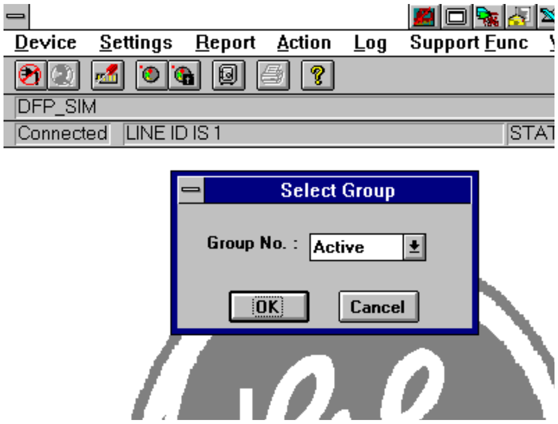


Figure 11-3 Settings Group Dialog Box

Figure 11-4 Xpression Builder Application Screen

Digital Input Assignment

The first step in the design or modification of a Configurable Logic design is to determine the need for digital inputs in the design. It may be necessary to invoke the state of the circuit breaker being monitored in the design, some other external contact, another relay digital output or to feedback the state of one of the DFP200 outputs to the input. In any case, one or more digital inputs may be employed to achieve this function. Before Xpression Builder can recognize these inputs, they must first be assigned in DFP200 Link. This is performed by the Change Settings command in either ASCII or DFP200 Link. Settings 0401 - 0408 control the assignment of the Digital Inputs to various functions. In effect, this process does nothing more than associate a given digital input with a name that Xpression Builder can use. The available assignments for digital inputs can be listed in DFP Link by selecting one of the inputs and pulling down the range menu. The method of changing settings in DFP200 Link is described in the DFP200 LINK section.

For this example, it is necessary to address the external trip contact drawn in the upper left corner of the drawing. Entering DFP200 Link allows calling up the 04xx series of settings in the Input Contact Settings category. Assume that you have determined that Digital Input #4 is available (free) for assignment to this function. Call up setting 0404, CC4 Configuration, and select one of the available options from the menu. In this case, it may be best to select the User Flag 1 name for the contact, since this external flag could be associated with many different trip contacts. The link screen for this assignment process is shown in Figure 11-5.

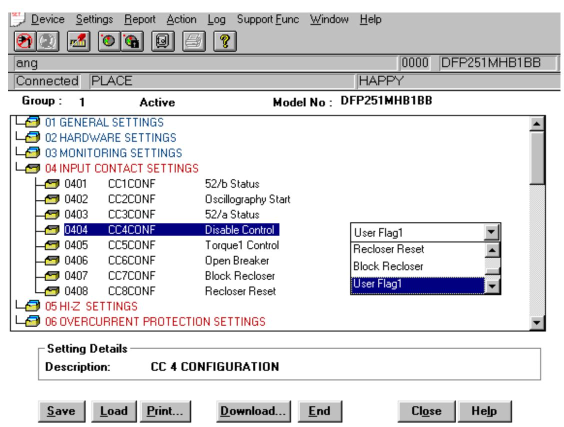


Figure 11-5 DFP200 Link Digital Input Assignment By Settings

When the digital inputs are assigned, the process of implementing them in Xpression Builder can occur. In Xpression Builder, select the Entity:Inputs selection, or use the mouse to select the box with the line on the right side as shown in Figure 11-6.

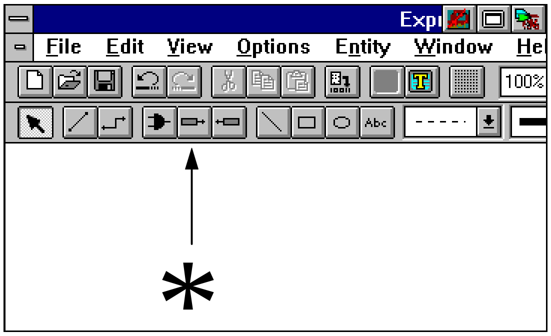


Figure 11-6 Digital Input Icon

This selection leads to the input selection list shown in Figure 11-7.

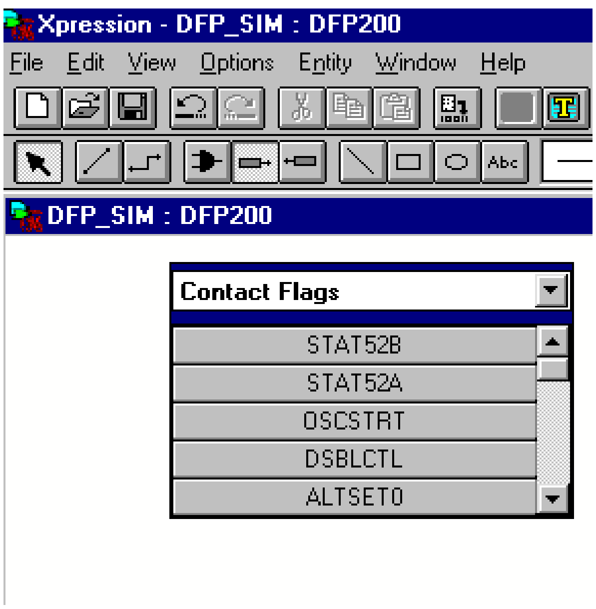


Figure 11-7 Input Contact Icon Select

Different input contact names can be selected using the scroll bar on the right of the menu. For example, if you set digital input number 4 equal to "User Flag 1" in the active settings group, then you can select the User Flag 1 icon from the menu; it will become highlighted, and then click on the location you desire it to appear at. (see Figure 11-8).

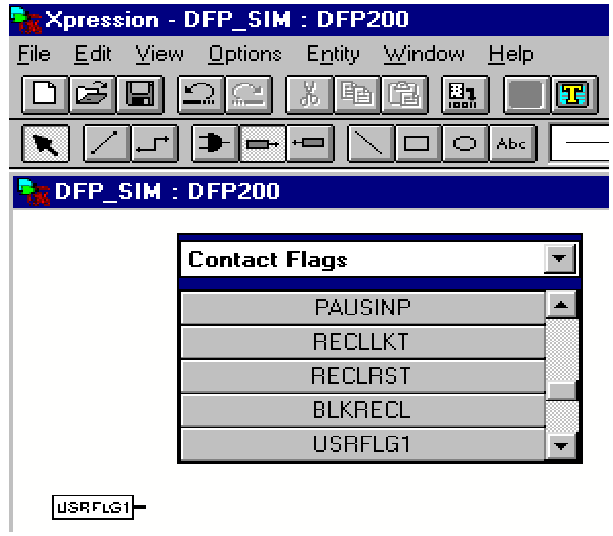


Figure 11-8 Placing the Icon

Protection Flags

Digital inputs are the most basic of inputs to configurable logic. It is also possible to take advantage of the internal protection flags or alarms in the relay, and put them to work in logical combinations necessary to your specific application. The process of selecting the input icon is exactly the same as it would be for the digital inputs, but the scroll bar in the upper right hand corner of the input menu is selected to "Protection Flags" or "Alarms", as shown in Figure 11-9 and Figure 11-10.

Figure 11-9 Input Flags Scroll Bar

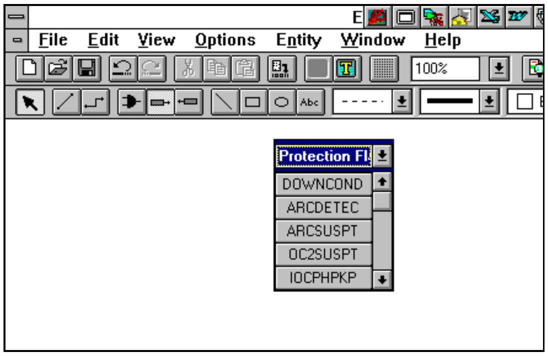


Figure 11-10 Protection Flags Menu

Protection flags can now be placed as required. Note that placing these flags can occur at any time in the design; it is not necessary that you place them all now, although it does speed up the mechanical process of entering the data if you do them all at once. In the breaker failure example, we need numerous flags, as shown in Figure 11-11.

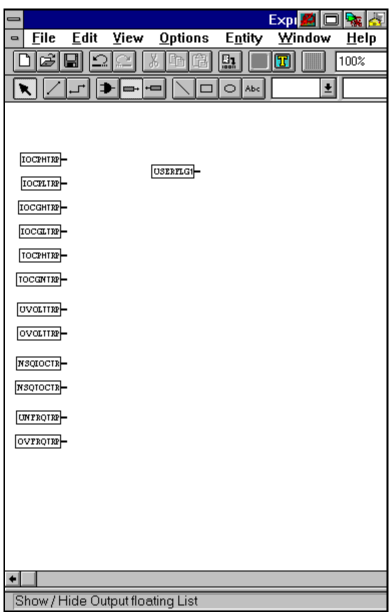


Figure 11-11 Protection Flags Added to Logic

Boolean Operators, Latches, Timers and Counters

At this point, most of the inputs are defined and it is time start connecting them to Boolean operators. The available operators are AND, OR, and NOT. In addition, latches, pickup/dropout timers, start/stop timers and counters are available for more complex logic. The menu for these operators is activated by clicking on the operator icon shown in Figure 11-12, or by selecting the Entity/Operator button in the pulldown menus. Operators are selected by clicking on the desired function, moving the mouse to the desired location, and clicking the mouse to place the device. Several OR gates are required in the breaker failure scheme, and these have been placed in Figure 11-13.

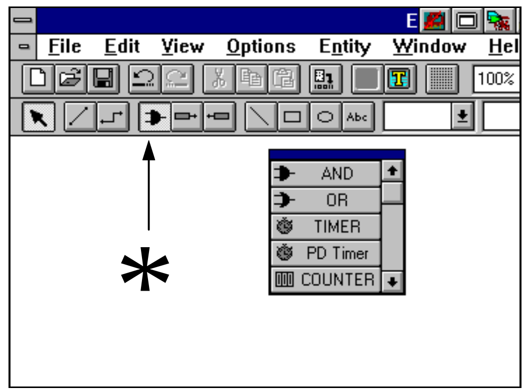


Figure 11-12 Operator Menu Icon and Menu

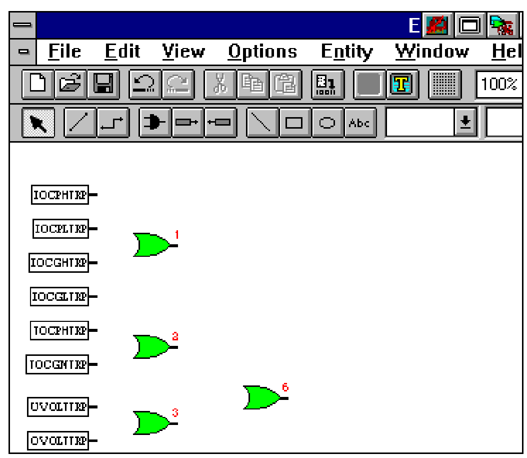
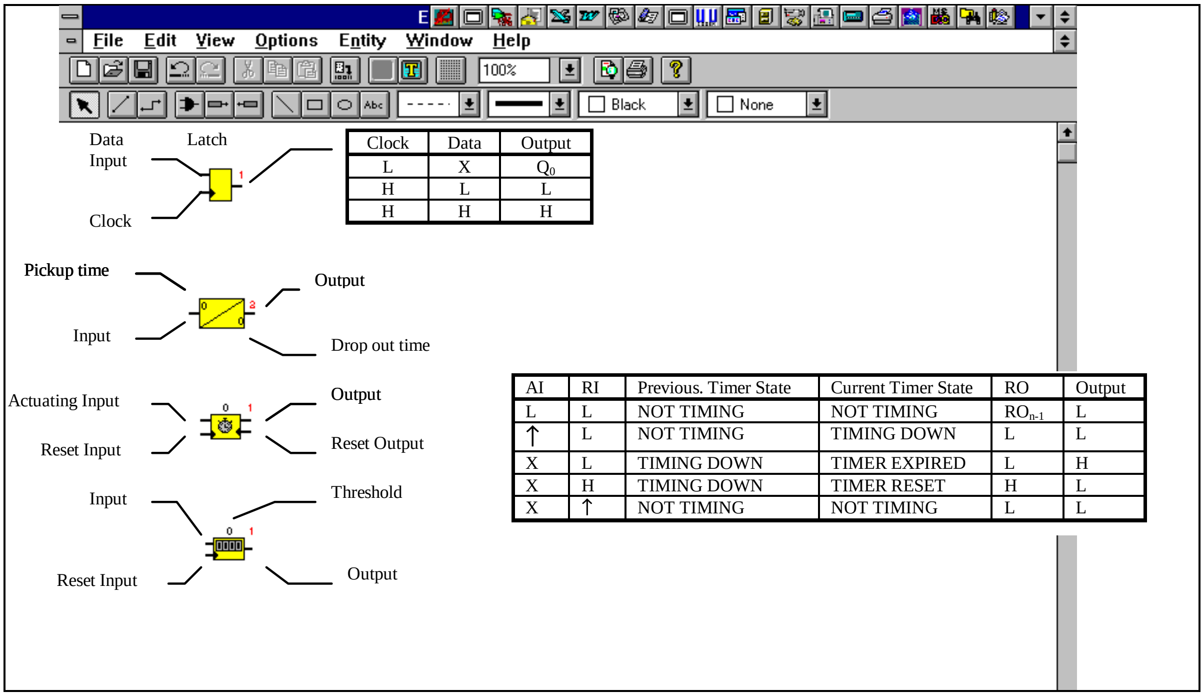


Figure 11-13 Operator Placement in the Breaker Failure Logic

The operation of the Boolean operators (AND, OR and NOT) is self explanatory. The symbols for the other operators are shown in Figure 11-14.



Clock	Data	Output
L	X	Q_0
H	L	L
H	H	H

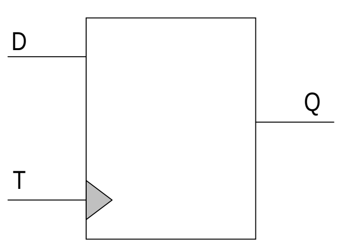
AI	RI	Previous. Timer State	Current Timer State	RO	Output
L	L	NOT TIMING	NOT TIMING	RO_{n-1}	L
↑	L	NOT TIMING	TIMING DOWN	L	L
X	L	TIMING DOWN	TIMER EXPIRED	L	H
X	H	TIMING DOWN	TIMER RESET	H	L
X	↑	NOT TIMING	NOT TIMING	L	L

Figure 11-14 Latch, Timer and Counter Logic

Logic Gates: Logical OR and AND gates can be defined. Each gate may have up to eight (8) inputs. Each of the inputs may be logically inverted as indicated by a small circle next to symbol shape. The output can be logically inverted to form a NOR or NAND.

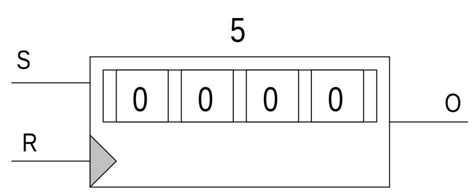
Shown above is a 3 input OR gate and a 3 input AND gate with the top input inverted.

Flip-Flops: Only one type is used - a 'D' flip-flop.



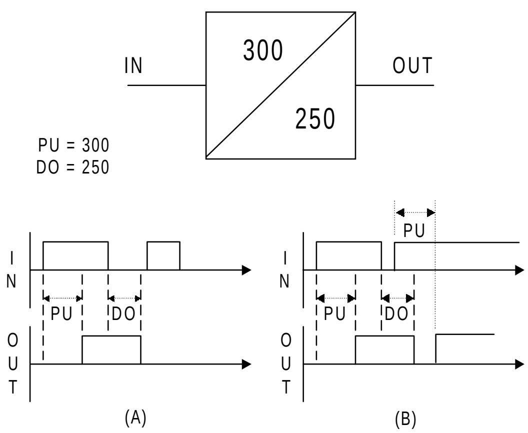
The D input is where the data bit to be stored is applied. The T or clock input controls the flip-flop. It determines whether the data on the D input line is recognized (clocked) or ignored. If the T input line is high or binary 1, the data on the D input line is stored in the flip-flop. If the T input line is low or binary 0, the D input line is not recognized. The Q output line directly reflects the state of the flip-flop. If the flip-flop is set, then Q equals a binary 1. If Q equals a binary 0, then the flip-flop is reset.

Counters: One type of counter is used.



The symbol shown above indicates two input lines, one output line, and a user selected count threshold (5). A transition from binary 0 to binary 1 on the S input line increments the counter by a value of one. The O output line is high or binary 1 when the accumulated count is equal to or greater than the count threshold. If the O output line is low or binary 0, then the accumulated count is less than the set value. A transition from binary 0 to binary 1 on the R input line resets the counter to zero.

Timers: Two types of timers are used. The simplest type is a 'pickup/dropout' timer.

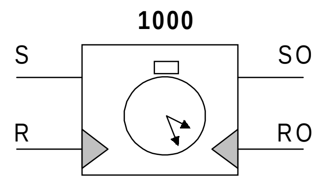


Shown above is the symbol for this timer where 300 indicates the pickup delay (PU) in milliseconds and 250 indicates the dropout delay (DO) in milliseconds. This timer functions as two independent timers, a pickup timer and a dropout timer.

The IN/OUT time charts below the symbol describe how the timer functions. If the input is high or binary 1 for a time equal to the pickup delay, the output becomes high or binary 1. Any reset of the input (high to low) causes the accumulated pickup time to reset immediately to zero. Once the output occurs, it remains high as long as the input remains high, and when the input subsequently goes low the output stays high for a time equal to the dropout delay. Once the dropout timer has started, it will continue to time out even if the input goes high during the reset time.

Time chart (A) shows a second input pulse occurring after the output goes low. Since this pulse length is less than the 300 ms. pickup delay, the output stays low. Time chart (B) shows a second input pulse occurring 100 ms. after the first input pulse goes low. The output goes low as shown in time chart (B), but the output then goes high 300 ms. after the leading edge of the second input pulse or 150 ms. after the trailing edge of the first output pulse. The pickup and dropout times are independent of each other.

The second type of timer is basically a pickup delay timer with a reset input/output feature.



The symbol shown above indicates two inputs, two outputs, and a user selected pickup delay (1000) with units of milliseconds.

In its 'initial' state with no inputs applied, binary 0 on both S and R, the timer outputs, SO and RO, are both low or binary 0. The timer starts counting when the S input is high or binary 1. When the count becomes equal to the set time delay (1000 ms., for the example above) the SO output is set high or binary 1 and the RO output is set low or binary 0. If the R input becomes high or binary 1 while the timer is counting, the count is reset to zero and the RO output is set high or binary 1. If the R input becomes high or binary 1 while the timer is not counting, then both outputs, SO and RO, are set low or binary 0 which returns the timer to its 'initial' state.

For the breaker failure example, we need some additional gates as well as a timer to complete the logic. This is shown in Figure 11-15.

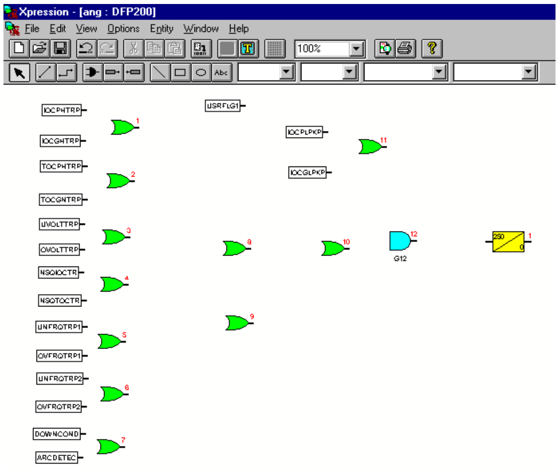


Figure 11-15 Breaker Failure Logic with All Operators Placed

Digital Output Assignment

Selection and placement of the desired outputs is accomplished with the output icon shown in Figure 11-16.

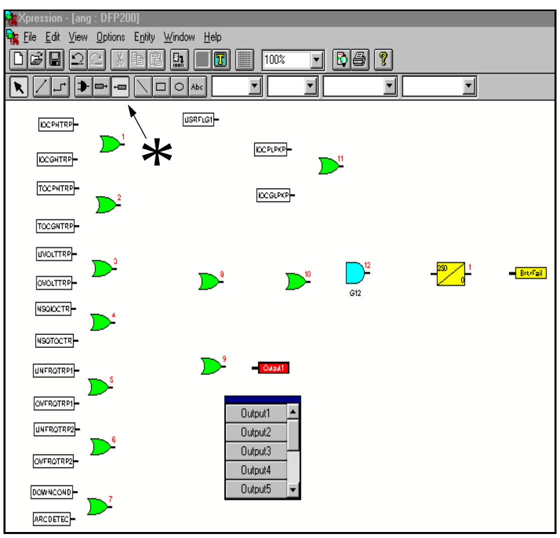


Figure 11-16 Output Icon and Menu

Again, the desired item is selected with the mouse, and placed by clicking the mouse in the desired location. All elements of the breaker failure example are now in place.

In the event that you desire to manually trip or close the breaker under control, it is necessary to identify in Xpression Builder the output which should operate when you send the command, either from Link, ASCII or the HMI.

Whenever the DFP200 attempts to close the breaker, either from a manual close command from a user or through the recloser function, the DFP200 will set the BRKRCLOSE flag true. Therefore, the user must assign this flag to whichever of the 8 output contacts wired to the breaker's Close coil.

Tripping a breaker can be accomplished by operating any of the 8 output contacts of the DFP200 that are wired to the Open coil of the breaker. However, in order for the DFP200 to recognize that the operating of one of its output contacts is a trip output, the Output flag has to be designated as a Trip Output. A trip output will generate the following:

- Regular Oscillography Capture
- Fault Location Calculation
- Breaker Health Calculation
- Fault Report
- Trip Seal-In Function
- Recloser Operation (See Note)

Note: If setting1102, RECLON52B is set to OFF the DFP200 will only start the reclose function if the breaker is opened following the operation of one of the output contacts that have been designated as being a trip output.

An output can be designated as being a trip output by double-clicking on the output flag. This will cause a pop-up window to appear as shown in Figure 11-17.

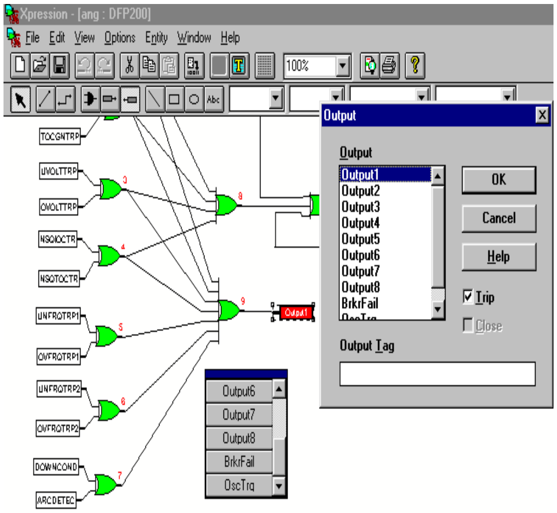


Figure 11-17 Identifying the TRIP Outputs

In this OUTPUT window click the box marked trip. The output flag will now become red. This red color indicates that the output is a trip output.

Note: All 8 of the output contacts can be trip outputs.

Connections

- Connecting the inputs, operators and outputs is accomplished with either the orthogonal or direct line connection icons shown in Figure 11-18. These should not be confused with the line icon used for drawing which is also included in the toolbar. The line icon carries no "intelligence" with it, and thus will not snap to the input and output points of the logic elements, and, more importantly, will not allow Xpression Builder to convey the correct expression to the relay.

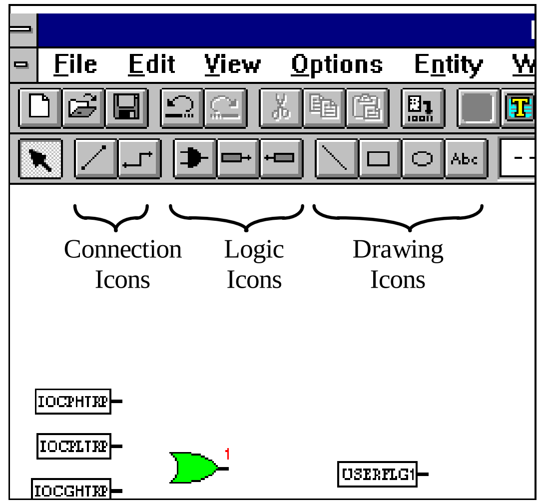


Figure 11-18 Connection Icons

Figure 11-19 shows the orthogonal and direct connections for several of the inputs and operators. Connections are made by simply selecting the desired type of connection, clicking on the origin of the connection (usually the output of an input or operator) and dragging the mouse to the end of the connection (input of an operator or output icon). It is also possible to start a connection at a node on a connection line, by clicking on the desired connection line and establishing the end of the connection as before.

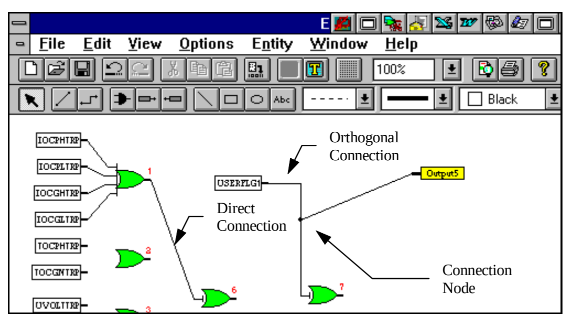


Figure 11-19 Types of Connections

Editing Configurable Logic

When it is necessary to remove an element or a connection, select the cursor from the toolbar and move it to the item to be deleted. Select the item, and press delete; the item and all associated connections will be deleted. A single item, or a group of items, may be moved by dragging a window open which includes all the items. Press Delete to remove them all, or click on one of the items and drag it to the new location to move the entire window. Selected items may be cut and pasted using the options available under the Edit menu.

Xpression Builder File Maintenance

After a logic diagram has been fully drawn, it is an easy process to download it to the relay and/or save it to your PC. You can also load files stored on your PC to the Xpression Builder application for editing and potential download to your relay.

It is prudent to periodically save the logic to a file on your PC as well as to the relay. Since there are eight settings groups, and thus eight sets of configurable logic, you may desire to maintain a file for each setting group (usually several settings groups will contain the same logic, which reduces the need for separate files). To save the logic, select File:Save from the menu bar, and follow the prompts for the save operation. The file is saved as a binary file. A file is loaded by selecting File:Open from the menu bar; a new Xpression Builder window will open with the logic displayed.

NOTE! There are eight settings groups in the relay and therefore eight sets of configurable logic. You must load the logic you desire to a given setting group; otherwise, when that group is made the active group, the default logic will be in effect.

Before you load the logic to a relay settings file, you may desire to verify that you have not inadvertently left gate inputs or outputs “hanging”, or that you have used the same output twice. Select File:Compile from the menu bar and the expression will be built, but not loaded. Click on the Text button (see Figure 11-20), and the window will shift to display the expression in text that you have built, or a set of compilation errors encountered. Click on the Graphics button, and you are shifted back to the diagram.

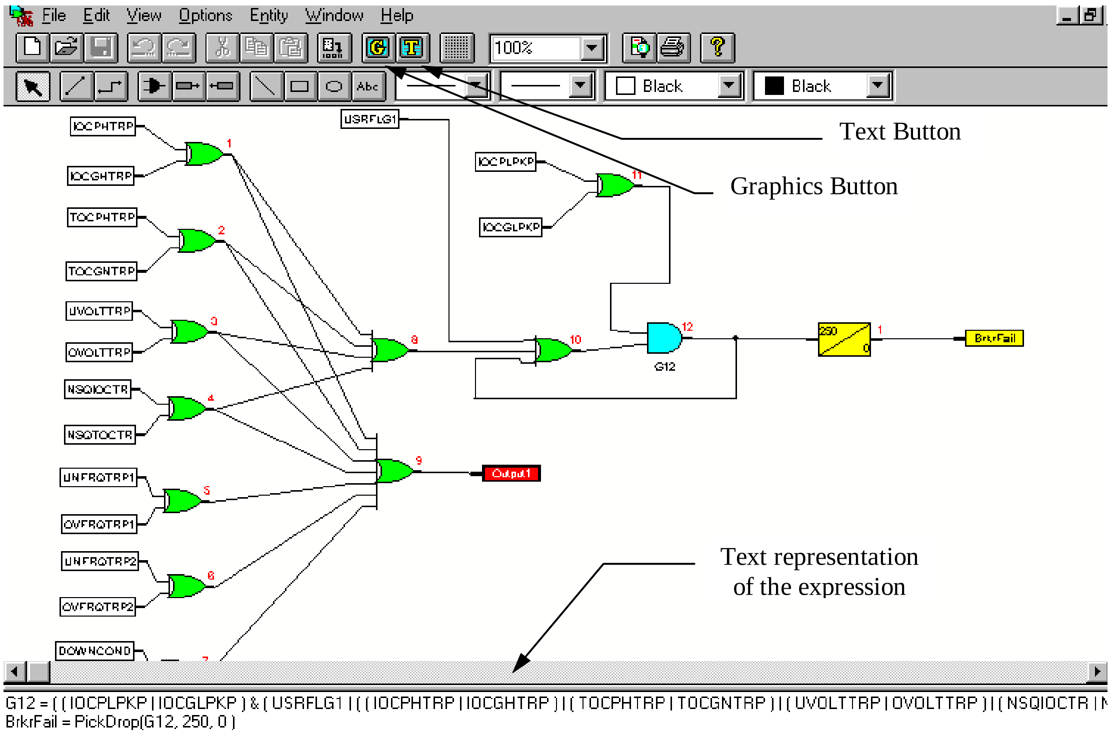


Figure 11-20 Breaker Failure Logic Showing the Text Representation of the Expression

A file is downloaded to the relay by selecting File: Download from the menu bar. This action is equivalent to changing a critical setting, and the relay will reboot upon sending the End command.

At times, you may desire to completely replace the logic in a given settings group with that stored in file on your PC. To do this, upload the setting group logic as described previously, select Edit:Select All and then press Delete. This clears the Active group window. Now Load the Logic file from the PC, and, again, select all, but this time select Copy. Now shift back to the Active window and select Paste. The PC logic now appears in the Active group window. Download the changed logic, and the relay now has the PC logic for that group.

Xpression Builder Flags

Output Flags

The Output Flags are used to signal the relay to perform an operation (e.g. close a contact, capture an oscillography, or log an event). Table 11-1 shows the Output Flags in the DFP200.

Table 11-1 Xpression Builder Output Flags

Mnemonic	Action
Output1	Operates Output #1
Output2	Operates Output #2
Output3	Operates Output #3
Output4	Operates Output #4
Output5	Operates Output #5
Output6	Operates Output #6
Output7	Operates Output #7
Output8	Operates Output #8
BRKRFAIL	Operates Breaker Fail LED and Generates Breaker Fail Event
OSCTRG	Generates Regular Oscillography Capture

Alarm Flags

The Alarm Flags are used to signal the user that some alarm has occurred (e.g. someone tried to login with the incorrect password, trip circuit monitor has detected a failure, etc.). Table 11-2 shows the Alarm Flags in the DFP200.

Table 11-2 Xpression Builder Alarm Flags

Mnemonic	Reason for Alarm
LOGINFL	Login Failure Three Consecutive Tries
NCFAIL	Non-Critical Alarm
FAIL	Critical Alarm
OUT1FAIL	Trip Circuit Monitor #1 Detected a Failure
OUT2FAIL	Trip Circuit Monitor #2 Detected a Failure
BRKRHLTH	Breaker Health Threshold Exceeded
THDALARM	Total Harmonic Distortion Alarm Occurred

Protection Flags

The Protection Flags are used to signal the user that a protection function has operated (e.g. IOC pickup, Down Conductor Detected, etc.). Table 11-3 shows the Protection Flags in the DFP200.

Table 11-3 Xpression Builder Protection Flags

Mnemonic	Action
DOWNCOND	HiZ Output - Downed Conductor Detected
ARCDETEC	HiZ Output - Arcing Detected
ARCSUSPT	HiZ Output - Arcing Suspected
2COCPKP	HiZ Output - 2 Cycle Overcurrent
BRKRCLOSE	DFP200 Issued Close Breaker Command
RLYSPARE	Relay Spare Output
RECLINP	Recloser is in Progress
RECLLKOUT	Recloser in Lockout
67PHAPKP	Phase A Directional Pickup
67PHBPKP	Phase B Directional Pickup
67PHCPKP	Phase C Directional Pickup
67NPKP	Negative Sequence GND Directional Pickup
67GPKP	Zero Sequence GND Directional Pickup
SYNCCHK	Sync-check Output
RESTORFR	Restore Frequency Output
IOCPHPKP	IOC Phase High Pickup
IOCPLPKP	IOC Phase Low Pickup
IOCGHPKP	IOC GND High Pickup
IOCGLPKP	IOC GND Low Pickup
TOCPHPKP	TOC Phase Pickup
TOCGNPKP	TOC GND Pickup
UVOLTPKP	Under Voltage Pickup
OVOLTPKP	Over Voltage Pickup
NSQIOCPU	Negative Sequence IOC Pickup
NSQTOCPU	Negative Sequence TOC Pickup
UNFRQPKP1	Under Frequency Unit #1 Pickup
OVFRQPKP1	Over Frequency Unit #1 Pickup
UNFRQPKP2	Under Frequency Unit #2 Pickup
OVFRQPKP2	Over Frequency Unit #2 Pickup
IOCPHTRP	IOC Phase High Trip
IOCPLTRP	IOC Phase Low Trip
IOCGHTRP	IOC GND High Trip
IOCGLTRP	IOC GND Low Trip
TOCPHTRP	TOC Phase Trip
TOCGNTRP	TOC GND Trip
UVOLTTRP	Under Voltage Trip
OVOLTTRP	Over Voltage Trip
NSQIOCTR	Negative Sequence IOC Trip
NSQTOCTR	Negative Sequence TOC Trip
UNFRQTRP1	Under Frequency Unit #1 Trip
OVFRQTRP1	Over Frequency Unit #1 Trip
UNFRQTRP2	Under Frequency Unit #2 Trip
OVFRQTRP2	Over Frequency Unit #2 Trip

Contact Flags

The Contact Flags are used to signal the user that one of the 8 configurable inputs for the DFP200 has been energized. The setting for the energized configurable input corresponds to a Contact Flag. This Contact Flag is assigned a value of True for the period which the contact is energized (e.g. 52B status is detected, User flag #1 is set, etc.). Table 11-4 shows the Contact Flags in the DFP200.

Table 11-4 Xpression Builder Contact Flags

Mnemonic	Reason for Alarm
STAT52B	52b Contact Closed
STAT52A	52a Contact Closed
OSCSTRT	Trigger Regular Oscillography Capture
DSBLCTL	Disable Protection
ALTSET0	Alternative Settings Bit 0
ALTSET1	Alternative Settings Bit 1
ALTSET2	Alternative Settings Bit 2
RSTARGT	Reset LED Targets
OPENBKR	External Open Breaker Command
CLOSBKR	External Close Breaker Command
TAGEVNT	Time Tag Event
TORQUE1	External Torque Control Input #1
TORQUE2	External Torque Control Input #2
DELYRCL	Skip First Reclose
PAUSINP	External Pause Input
RECLLKT	Recloser to Lockout Command
RECLRST	Recloser to Reset Command
BLKRECL	Block Recloser Operation
USERFLAG1	User Flag #1
USERFLAG2	User Flag #2
USERFLAG3	User Flag #3
USERFLAG4	User Flag #4
USERFLAG5	User Flag #5
USERFLAG6	User Flag #6
USERFLAG7	User Flag #7
USERFLAG8	User Flag #8

Xpression Builder Tip

The following “tip” is provided to address some of the more commonly asked questions about the Xpression Builder utility.

There are two types of file formats saved by Xpression Builder, and they are indicated by file extensions “.exp” and “.bin”. The .bin file are binary files that contain a subset of the information in the .exp files. The .exp files contain all the graphical information required to plot the logic in the fashion that you laid it out. For this reason, it is recommended that you save all your logic with a .exp extension.

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