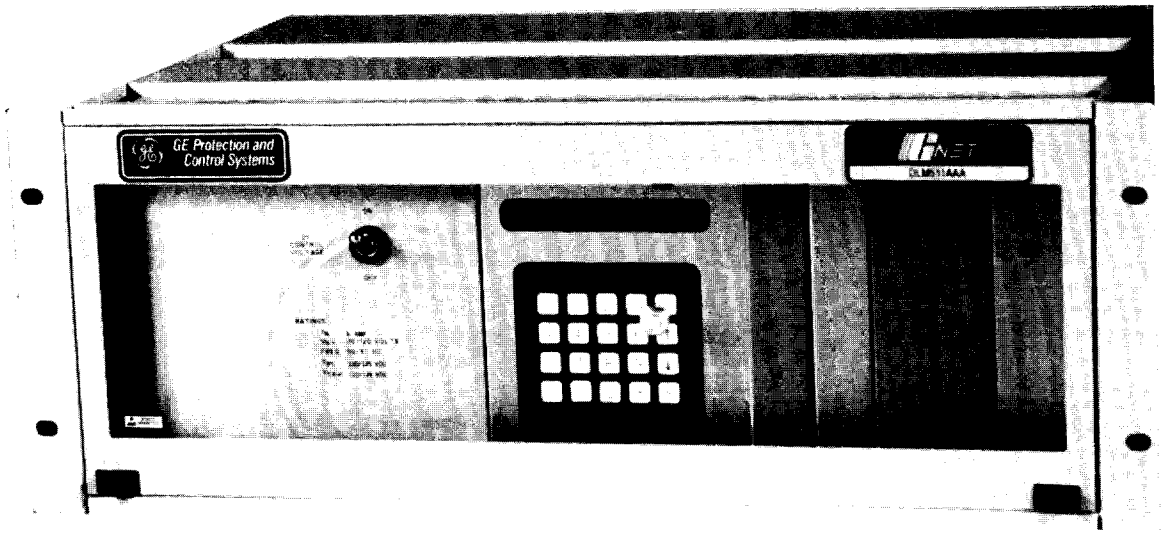
GEK-100609B

DLM
DIGITAL
TRANSMISSION LINE
MONITORING SYSTEM



MULTILIN

GE Power Management

205 Great Valley Parkway
Malvern, PA. 19355-1337
Telephone (610) 251-7000
http://www.ge.com/edc/pm

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 purpose, 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.

PRODUCT DESCRIPTION 1

CALCULATION OF SETTINGS 2

HARDWARE DESCRIPTION 3

MODULES 4

ACCEPTANCE TESTING 5

PERIODIC TESTING 6

SERVICING 7

SPECIFICATIONS 8

INTERFACE 9

SOFTWARE 10

TABLE OF CONTENTS

LIST OF FIGURES 9

LIST OF TABLES 9

INTRODUCTION GEA-12259

PRODUCT DESCRIPTION 1-1A
- GENERAL 1-1A
- APPLICATION 1-1A
- FEATURES 1-1A
  - Local Man-Machine Interface (MMI) 1-1A
  - Remote Communications 1-1A
  - Sequence of Events 1-1A
  - Disturbance Report 1-2A
  - Oscillography 1-2A
  - Alarm Outputs 1-2A
  - Breaker Control Outputs 1-2A
  - Fault Location 1-2A
  - Inputs 1-3A
  - Trigger Sources 1-3A
  - Electronic Target Sensors 1-3A

CALCULATION OF SETTINGS 2-1A
- CONFIGURATION SETTINGS, CONFIG 2-2A
  - Unit ID Number, UNITID 2-2A
  - System Frequency, SYSFREQ 2-3A
  - Phase Rotation, PHASDESG 2-3A
  - Number of Breakers, NUMBKRS 2-3A
  - Select Primary/Secondary Units, SELPRIM 2-3A
  - Current Transformer Ratio, CTRATIO 2-3A
  - Potential Transformer Ratio, PTRATIO 2-3A
  - Units of Distance, DISTUNIT 2-3A
  - Communications Baud Rate, BAUDRATE 2-3A
  - Transducer Inputs, XDUCER 2-3A
    - Example Settings: 2-4A
- CONTACT CLOSURE INPUT DEFINITION, CCIDEF 2-4A
  - Contact Converter Input Number 1,2 and 3,CCI1 - CCI3 2-4A
  - Contact Converter Inputs Number 4 through 24, CCI4-CCI24 2-4A
    - Example Settings: 2-5A
- FAULT LOCATION PARAMETERS, FAULTLOC 2-5A
  - Select Fault Locating, SELFLOC 2-5A
  - Positive-Sequence Angle of Maximum Reach, POSANG 2-5A
  - Zero-Sequence Angle of Maximum Reach, ZERANG 2-5A
  - Positive-Sequence Impedance, ZP 2-5A
  - Zero-Sequence Current Compensation, K0 2-5A
  - Line Length, LINELEN 2-6A
  - Display Fault Location for Reverse Faults, BEHIND 2-6A
  - Display Fault Location for Faults Beyond the Line, BEYOND 2-6A
    - Example Settings (based on Figure 2-1): 2-6A
- OVERCURRENT TRIGGERING, OVERCUR 2-6A
  - Select Overcurrent Triggering, SELOC 2-6A
  - Phase Overcurrent Pickup Setting, PUPH 2-6A
  - Ground Overcurrent Pickup Setting, PUGR 2-7A
  - Overcurrent Dropout Trigger Setting, SELDO 2-7A
    - Example Settings: 2-7A

CALCULATION OF SETTINGS, continued
UNDERVOLTAGE TRIGGERING, UNDERVOL 2-7A
Select Undervoltage Triggering, SELUV 2-7A
Undervoltage Trigger Setting, UVLEV 2-7A
Example Settings: 2-7A
TRANSDUCER INPUT DEFINITIONS, XDUCERS 2-7A
Transducer Number 1 Range, X1RANGE 2-7A
Transducer Number 1 Full Scale Value, X1FULL 2-8A
Transducer Number 1 Zero Value, X1ZERO 2-8A
Transducers Number 2 to 6 2-8A

HARDWARE DESCRIPTION
CASE ASSEMBLY 3-1A
Construction 3-1A
Electrical Connections and Internal Wiring 3-1A
Identification 3-1A
PRINTED-CIRCUIT-BOARD MODULES 3-1A
Basic Construction 3-2A
Identification 3-2A
RECEIVING, HANDLING AND STORAGE 3-2A
INSTALLATION 3-2A
Environment 3-2A
Mounting 3-2A
External Connections 3-2A
SURGE GROUND CONNECTIONS 3-2A
3-3A

MODULES
4-1A

ACCEPTANCE TESTS
GENERAL 5-1A
General Tests 5-1A
Internal Triggering Tests 5-1A
External Triggering Tests 5-1A
Transducer Tests 5-1A
TEST EQUIPMENT 5-1A
DRAWINGS AND REFERENCES: 5-1A
EQUIPMENT GROUNDING 5-2A
REQUIRED SETTINGS 5-2A
GENERAL INSTRUCTIONS 5-2A
SETTING CHANGES 5-2A
INITIAL TEST SETUP 5-3A
USING D-LINK (Optional) 5-3A
HARDWARE SETUP 5-3A
DLM SETUP 5-3A
PC SOFTWARE SETUP 5-4A
Load & Start D-LINK 5-4A
Set the Local (PC configuration) 5-4A
Set Up a Test Unit Description 5-4A
LOGIN TO THE DLM 5-5A
SETTING CHANGES 5-5A
SAVING AND VERIFYING INITIAL SETTINGS 5-6A
GENERAL TESTS 5-6A
T1 - MMI DLM Status Check 5-6A
Failure Status 5-6A
Optional - For users testing with D-LINK 5-7A
T2 - AC System Input Test 5-7A
5-8A

ACCEPTANCE TESTS, continued 5-9A
INTERNAL TRIGGERING TESTS 5-9A
T3 - Ground Overcurrent Test 5-9A
T4 - Phase Overcurrent Test 5-10A
T5 - Overcurrent Dropout Test 5-10A
T6 - Undervoltage Test - Phase-to-Ground 5-11A
T7 - Undervoltage Test - Phase-to-Phase 5-11A
EXTERNAL TRIGGERING TESTS 5-11A
T8 - External triggering - Phase-to-Ground 5-12A
T9 - External Triggering - Phase-to-Phase 5-12A
T10 - Transducer Input Tests 5-12A
END OF TEST

PERIODIC TESTS 6-1
GENERAL 6-1
General Tests 6-1
Internal Triggering Tests 6-1
External Triggering Tests 6-1
Transducer Tests 6-1
TEST EQUIPMENT 6-2
DRAWINGS AND REFERENCES: 6-2
EQUIPMENT GROUNDING 6-2
REQUIRED SETTINGS 6-2
GENERAL INSTRUCTIONS 6-3
SETTING CHANGES 6-3
INITIAL TEST SETUP 6-3
USING D-LINK (Optional) 6-4
HARDWARE SETUP 6-4
DLM SETUP 6-4
PC SOFTWARE SETUP 6-4
GENERAL TESTS 6-4
T1 - MMI DLM Status Check 6-4
Failure Status 6-5
Optional - For users testing with D-LINK 6-6
T2 - AC System Input Test 6-6
INTERNAL TRIGGERING TESTS 6-6
T3 - Ground Overcurrent Test 6-7
T4 - Phase Overcurrent Test 6-7
T5 - Overcurrent Dropout Test 6-8
T6 - Undervoltage Test - Phase-to-Ground 6-8
T7 - Undervoltage Test - Phase-to-Phase 6-9
EXTERNAL TRIGGERING TESTS 6-9
T8 - External triggering - Phase-to-Ground 6-9
T9 - External Triggering - Phase-to-Phase 6-10
T10 - Transducer Input Tests 6-10
END OF TEST

SERVICING 7-1A
SPARES 7-1A
CAUTION 7-1A
SERVICING WITH THE UNIT SELF-TEST 7-1A
TROUBLE SHOOTING 7-3A
Using the Information Status Command 7-4A
SERVICING A FATAL FAILURE 7-5A
Locating the defective module 7-5A
SERVICING A NON-FATAL FAILURE 7-6A
Locating the Defective Module 7-6A
SERVICING "SYSTEM STATUS" FAILURES 7-6A

SPECIFICATIONS
RATINGS 8-1A
BURDENS 8-1A
CONTACT DATA 8-1A
COMPENSATION FACTOR SETTINGS 8-2A
SYSTEM CONFIGURATION SETTINGS 8-2A
ACCURACY 8-2A
DIMENSIONS 8-2A
WEIGHT 8-2A
8-2A

INTERFACE
LOCAL MAN MACHINE INTERFACE (MMI) OPERATION 9-1A
Display 9-1A
Keyboard 9-1A
CLEAR Key (CLR) 9-2A
ARROW Keys 9-2A
ENTER Key (ENT) 9-3A
Data Entry Keys 9-3A
END Key 9-3A
SETTINGS Key (SET) 9-3A
ACTIONS Key (ACT) 9-4A
INFORMATION Key (INF) 9-5A
Errors 9-9A
REMOTE COMMUNICATION INTERFACE 9-13A
Hardware Jumpers 9-23A
Modem Connections and Settings 9-23A
PC Modem 9-23A
DLM Modem 9-24A
Modem Setup 9-24A
Null Modem Connections 9-25A
9-25A

SOFTWARE
DLM-LINK SOFTWARE 10-1A
OVERVIEW 10-1A
USING DLM-LINK 10-1A
SYSTEM REQUIREMENTS 10-1A
Hardware 10-1A
Software 10-1A
INSTALLATION 10-1A
GENERAL OPERATION 10-1A
Mouse/Keyboard Usage 10-1A
Main Horizontal Menu Bar 10-1A
Pull-Down Menus 10-1A
Mouse 10-2A
Keyboard 10-2A
Dialog Boxes 10-2A
List Boxes 10-2A
Entering Text and Numbers 10-3A
PROGRAM OPERATION 10-3A
MAIN MENU 10-4A
Unit Functions 10-4A
Login 10-4A
lOgout 10-5A
Hang up phone 10-5A
Actions 10-5A
change Password 10-5A
Manual trip 10-5A
manual Close 10-6A

cci Enable 10-6A
cci Disable 10-6A
change Time and date 10-6A
Fixup settings 10-7A
Information 10-7A
request Present values 10-7A
request disturbance report Identification 10-8A
request Disturbance report 10-8A
request Events 10-9A
request Oscillography data 10-9A
request dlm Status 10-10A
request dlm Model 10-10A
request cci sTatus 10-11A
Settings 10-11A
Upload dlm settings 10-11A
Print dlm settings 10-12A
view/change Category of settings 10-12A
view/change Individual settings 10-12A
Download changed settings to dlm 10-13A
download All settings to dlm 10-13A
End setting changes 10-13A
Save dlm settings to file 10-14A
Local Functions 10-14A
Settings 10-14A
Load settings from file 10-14A
Print local settings 10-15A
view/change Category of local settings 10-15A
view/change Individual local setting 10-15A
Save local settings to file 10-16A
Model/version number 10-16A
Download local settings to dlm 10-16A
End setting changes 10-17A
dLm descriptions 10-17A
New description 10-17A
Modify description 10-17A
Delete description 10-17A
Graph oscillography data 10-18A
go to DOS 10-18A
Setup 10-18A
Communication port number 10-18A
Dial type 10-19A
Modem connection time 10-19A
Unit parameters 10-20A
Add unit to list 10-20A
dElete unit from list 10-20A
set path for DL-DATA 10-20A
memory available 10-20A
Exiting DLM-LINK 10-21A
Help

DL-DATA SOFTWARE (Optional) 10-22A
OVERVIEW 10-22A
SYSTEM REQUIREMENTS 10-23A
HARDWARE 10-23A
SOFTWARE 10-23A
INSTALLATION 10-23A
GENERAL OPERATION 10-23A
MOUSE/KEYBOARD USAGE 10-23A
MAIN HORIZONTAL MENU BARS 10-23A
PULL DOWN MENUS 10-23A
WINDOWS 10-24A
DIALOG BOXES 10-24A
LIST BOXES 10-25A
ENTERING TEXT AND NUMBERS 10-25A
PLOTS OF CURRENTS/VOLTAGES AND FLAGS 10-25A
ZOOM 10-26A
REPORTS 10-26A
PROGRAM OPERATION 10-26A
MAIN MENU 10-26A
FILE MENU 10-26A
Open 10-27A
Create PCX File 10-27A
Print Screen 10-27A
Information 10-28A
GRAPHS MENU 10-28A
All Currents/Voltages 10-28A
Select Currents/Voltages 10-28A
Select Reference Current/Voltage 10-29A
Select Groups for All Flags Display 10-29A
All Flags 10-29A
Flag Group 10-29A
Custom (Flag) Group 10-30A
REPORTS MENU 10-30A
Fault Report 10-30A
Events 10-30A
Settings 10-30A
SETUP 10-30A
Line Frequency 10-30A
Flag Names 10-31A
Colors 10-31A
Default Colors 10-31A
Printer Grey Shades 10-32A
EXIT 10-32A
HELP

Since the last edition, the following changes have been made: Figures 1-1 and 1-2 have been revised, step 5 of Acceptance Test T6 has been qualified, setting 0203 has been added and 0204 to 0224 revised in Table 9-4, and references to D-LINK have been changed to DLM-LINK in the DL-DATA section of the **SOFTWARE** chapter.

LIST OF FIGURES

Figure 1-1	Elementary Diagram	1-4A
Figure 1-2	Symbol Definition Legend	1-5,6A
Figure 2-1	Sample 345 KV System	2-9A
Figure 3-1	DLM Outline drawing	3-3A
Figure 3-2	DLM Monitoring System (front view)	3-4A
Figure 3-3	DLM Monitoring System (rear view)	3-4A
Figure 4-1	Module Location	4-1A
Figure 4-2	MMI Module	4-2A
Figure 4-3	ATI Block Diagram	4-3A
Figure 4-4	DLM Overall Block Diagram	4-4A
Figure 4-5	ANI Block Diagram	4-5A
Figure 4-6	CCI Block Diagram	4-6A
Figure 4-7	DCI and MMI Block Diagram	4-7A
Figure 4-8	FSP Block Diagram	4-8A
Figure 4-9	MGM Block Diagram	4-9A
Figure 5-1	AC Input Test Connections	5-13A
Figure 5-2	Single Phase Current Test Connections	5-14A
Figure 5-3	Phase-to-Phase Test Connections	5-15A
Figure 5-4	Phase-to-Ground CCI Test Connections	5-16A
Figure 5-5	Phase-to-Phase CCI Test Connections	5-17A
Figure 5-6	Transducer Input Tests	5-18A
Figure 9-1	DLM MMI Keyboard	9-2A
Figure 9-2	DLM Remote Communications Cables	9-26A
Figure 10-1	Oscillography -- Currents and Voltages	10-33A
Figure 10-2	Digital Inputs Screen	10-34A
Figure 10-3	Flags Screen	10-35A

LIST OF TABLES

Table 2-1:	Settings and Ranges	2-1A
Table 5-1	Current & Distance, Ground Overcurrent Test	5-9A
Table 5-2	Current & Distance, Phase Overcurrent Test	5-9A
Table 7-1	Start-Up Self Tests	7-2A
Table 7-2	Run Time Background Self Tests	7-3A
Table 7-3	Run Time Foreground Self Tests	7-3A
Table 7-4	Error Messages	7-4,5A
Table 7-5	Fatal Failure Messages	7-5A
Table 7-6	Non-Fatal Failure Messages	7-6A
Table 7-7	System Status Error Messages	7-6A
Table 9-1	Sample Key Sequences	9-13-15A
Table 9-2	MMI Error Messages	9-16A
Table 9-3	MMI Event Messages	9-17-18A
Table 9-4	DLM Settings	9-18-21A
Table 9-5	Password Decoder Key	9-22A
Table 9-6	Modem Setup Criteria (Hayes Compatible)	9-25A

DLM DIGITAL LINE MONITOR

TECHNICAL DATA

RATINGS

Rated Frequency	• 50 or 60 Hertz
Rated Voltage (phase to phase)	• 100 to 120 Volts AC
Rated Current	• I_n = 1 or 5 amperes
DC Control Voltage	• 48VDC, Operating Range 38.5 = 60 VDC 110/125 VDC, Operating Range 88-150 VDC 220/250 VDC, Operating Range 178-300 VDC
Maximum Permissible Current	
Continuous	• 2 X I_n
Three Seconds	• 50 X I_n
One Second	• 100 X I_n
Maximum Permissible AC Voltage	
Continuous	• 2 X Rated
One Minute	• 3.5 X Rated (one per hour)
Ambient Temperature Range	
	• Storage: −30°C to +75°C
	• Operation: −20°C to +55°C
Humidity	• 95% without condensing
Insulation Test Voltage	• 2 kV 50/60, one minute
Impulse Voltage Withstand	• 5 kV peak, 1.2/50 milliseconds, 0.5 joules
Interference Test Withstand	• SWC per ANSI C37.90.1

BURDENS

Current Circuits	• 0.022 ohm, 5 deg, I_n = 5 amps
	• 0.12 ohm, 30 deg, I_n = 1 amp
Voltage Circuits	• 0.15 VA, 60 Hz
	• 0.20 VA, 50 Hz
DC Battery (for contact converters)	• 2.5 milliamperes at rated DC input voltage
DC Battery (power supply)	• 20 watts

CONTACT DATA

Trip Outputs	• Continuous Rating = 3 amperes. Make and carry for tripping duty = 30 amperes, (per ANSI C37.90)
Auxiliary Outputs (including alarms)	• Continuous Rating = 3 amperes Make and carry for tripping duty = 30 amperes, (per ANSI C37.90)

COMPENSATION FACTOR SETTINGS	RANGE	RESOLUTION
KO/0 (zero-sequence compensation)	1.0 - 7.0	0.1

SYSTEM CONFIGURATION SETTINGS

Communications Baud Rate	• 300, 1200, 2400, or 9600 Baud
Number of Breakers	• 0 to 3
CT ratios	• 1 to 5000
PT ratios	• 1 to 7000
Units of Distance for Reports	• Miles or Kilometers

ACCURACY

Fault Locator	• ± 3% (typical)

DIMENSIONS

Height - Standard 4 rack unit	• 6.945 inches (176 millimeters)
Width - Standard 19 inch rack	• 19.0 inches (484 millimeters)
Depth	• 16 inches (406 millimeters)

WEIGHT

Standard rack-mounted unit weighs approximately 26 pounds (11.8 kilograms)

ETS 101 SPECIFICATIONS (Current Target Sensor)

Input

Rated Current	• 0.15 to 30 Amps DC Trip Duty - Not Continuous)
Voltage Drop	• 0.5 V

Output Contact

Rated Voltage	• 30 VDC at 0.005 Amps
Operate Time	• 200 µS MAX
Drop Out Time	• 200 µS MAX
Rating	• 10 VA (resistive)

ETS 201 SPECIFICATIONS (Voltage Target Sensor)

Input

Rated Voltage	• 32 to 300 VDC
Burden	• 4 mA MAX

Output

Rated Voltage	•320 VDC MAX when "off"
Operating Time	• 200 µS MAX
Drop Out Time	• 200 µS MAX
Voltage Drop	• 1.5 V MAX when "On" @ 0.002 A
Leakage	• 10 µA MAX

BOTH ETS 101 and 201 SPECIFICATIONS

Hi-Pot
2.5 kV
Meets ANSI C37.90

Temperature	
Storage	• −40°C to +80°C
Operating	• −20°C to +65°C
Dimensions	
Height	• 2.44 inches (62 millimeters)
Width	• 1.85 inches (47 millimeters)
Depth	• 0.89 inches (22.4 millimeters)
Weight	• 2 ounces (54 grams)

NOMENCLATURE SELECTION GUIDE

DIGITAL LINE MONITOR

DLM Model Numbers

DLM *	*	*	*	*	*	
1						1 AMP rated current
5						5 AMP rated current
	0					VPS = 48 VDC VTRIP = 48 VDC
	1					VPS = 110/125 VDC VTRIP = 110/125 VDC
	2					VPS = 220/250 VDC VTRIP = 220/250 VDC
	3					VPS = 48 VDC VTRIP = 110/125 VDC
	4					VPS = 48 VDC VTRIP = 220/250 VDC
	5					VPS = 110/125 VDC VTRIP = 220/250 VDC
	6					VPS = 110/125 VDC VTRIP = 48 VDC
	7					VPS = 220/250 VDC VTRIP = 110/125 VDC
	8					VPS = 220/250 VDC VTRIP = 48 VDC
		0				No Transducer Inputs
		5				50 Hz Transducer Module
		6				60 Hz Transducer Module
			A			Future Features
				A		Future Features
						A Revision Level

Example: DLM511AAA000 rated 5 amps, 110/125 VDC, transducer outputs, standard model, Revision A.

GE Protection & Control

205 Great Valley Parkway
Malvern, PA 19355
Telephone (215) 251-7000

GEA-12259
ST 11/93 1000

PRODUCT DESCRIPTION

GENERAL

The DLM is a microprocessor-based digital monitoring and fault locating system that uses wave-form sampling together with appropriate algorithms to provide oscillography features, fault location, and breaker control features.

APPLICATION

The DLM system is designed to be used on transmission, subtransmission, or distribution lines of any voltage level. More detailed application considerations are contained below in the remaining headings of this section and in the **CALCULATION OF SETTINGS** section.

FEATURES

LOCAL MAN-MACHINE INTERFACE (MMI)

A local MMI, incorporating a keypad and light-emitting-diode (LED) display, is provided to allow the user to enter settings, display present values, view disturbance information, and access stored data. The use and functioning of the MMI is fully described in the **INTERFACE** section.

REMOTE COMMUNICATIONS

An RS232 port (PL-1) located on the rear of the case is provided to permit the user to communicate with the DLM system from an IBM PC-compatible computer. This computer may be connected via the proper RS232 cable when within 50 feet of the DLM system, or a fiber optic interface may be used for distance up to 0.5 km., or the computer may be connected via interposing modems when physically remote from the substation. Unique PC software, found in the rear of the book, is required to communicate with the DLM system. The capabilities and use of this PC software are described in the **SOFTWARE** section.

When connection to the G-NET host computer is desired, two different physical connections are possible. Standard hard-wire cables may be used for distances up to 50 feet. For longer distances it is possible to add an optional external adapter that plugs into PL-1 to provide a fiber optic link between the DLM and the G-NET host computer. An isolated 5 volt DC supply is internally connected to pin 11 of PL-1 to power this external adapter. When connected to the G-NET host computer the DLM receives a time-synchronization pulse via pin 25 of PL-1. This pulse sets the internal clock of the DLM to permit time synchronization to an external time standard connected to the G-NET host computer.

SEQUENCE OF EVENTS

This function time-tags and stores in memory the last 120 events. The resolution of the time-tagging is 1 millisecond. The event list contains power system events, operator actions, and self-test alarms. Sequence of events can be accessed remotely via the RS232 port and a PC. A full description of this function is contained in the **SOFTWARE** section.

DISTURBANCE REPORT

When a disturbance occurs, pertinent information, consisting of unit ID, date and time, pre-disturbance currents, disturbance currents and voltages, selected events, and, if appropriate, fault type and distance to fault, is stored in memory. The five most recent disturbance events are stored. A full description of this function is contained in the **INTERFACE** section.

OSCILLOGRAPHY

A set of oscillography data is stored in memory for each Disturbance Report. Oscillography data consist of date and time of trip, three cycles of pre-disturbance data samples, and 27 cycles of post-disturbance data samples. A full description of this function is contained in the **SOFTWARE** section.

ALARM OUTPUTS

A self-test alarm output (contact) is provided. The alarm indicates that self-test has detected a problem that may impair the performance of the DLM. This is a normally closed contact, which is held open for normal conditions but which closes when an alarm condition occurs, or when DC power is lost.

A separate alarm is located on the power supply to provide a contact closure if the power supply fails or is turned off. This is a normally closed contact, which is held open when the power supply is operational but which closes when the power supply fails.

BREAKER CONTROL OUTPUTS

By using the local MMI or a remote PC connected to the RS232 port, it is possible selectively to trip and close up to three different breakers. Three distinct breaker-trip commands can be issued; trip breaker 1, trip breaker 2, and trip breaker 3. Three distinct breaker-close commands can be issued; close breaker 1, close breaker 2, and close breaker 3. Separate auxiliary relays are associated with the close command. The contact of each auxiliary relay must be wired to the appropriate breaker's close circuit. The remote breaker tripping and closing described above can be enabled or disabled by a hard-wired jumper located on the MMI module, as shown in Figure 4-2 in the **MODULES** section. 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.

FAULT LOCATION

An algorithm is present to provide fault location information, which is presented as miles (or kilometers) from the DLM location to the fault. The distance to the fault is based on a line length (in miles or kilometers) provided by the user as a setting. Fault location output is displayed on the local MMI as part of the target information following a trigger input, and it is also contained in the Disturbance Report described above. A negative fault location is used to indicate that the fault was in the reverse direction. For faults behind the relay, or for faults beyond the remote end of the line, the fault location calculated by the DLM may be in error due to the effects of infeed currents at the busses.

INPUTS

The DLM is designed to monitor 3 phase-to-ground voltages and three phase currents. The neutral current is calculated by the DLM from the phase currents. These inputs are used in the fault location calculation. The DLM can also monitor up to 24 contact inputs. These circuits require a "dry" contact input, which may be obtained from an Electronic Target Sensor (ETS).

The DLM also has an option for six low-level analog transducer inputs. Each of the six transducer input channels may be individually configured to any one of the following ranges:

0 to 5 V
0 to 10 V
-5 to +5 V
-10 to +10 V
0 to 1 ma
4 to 20 ma

The use of any of these current ranges requires the installation of shunts on the rear terminals. Refer to Figure 1-1 for the proper shunt values.

TRIGGER SOURCES

The DLM disturbance reports may be triggered internally via voltage and current functions, or externally via the inputs to one or more of the Contact Inputs. The contact inputs may be individually selected as trigger sources; each may be configured as either a normally open or normally closed contact. They may also be defined as breaker contacts or alarm contacts.

ELECTRONIC TARGET SENSORS

Both current-operated sensors and voltage-operated sensors are available to isolate the inputs to the DLM Contact Converters from the station DC battery. Refer to GEK-100606 for current-operated sensors, and to GEK-100607 for voltage-operated ones.

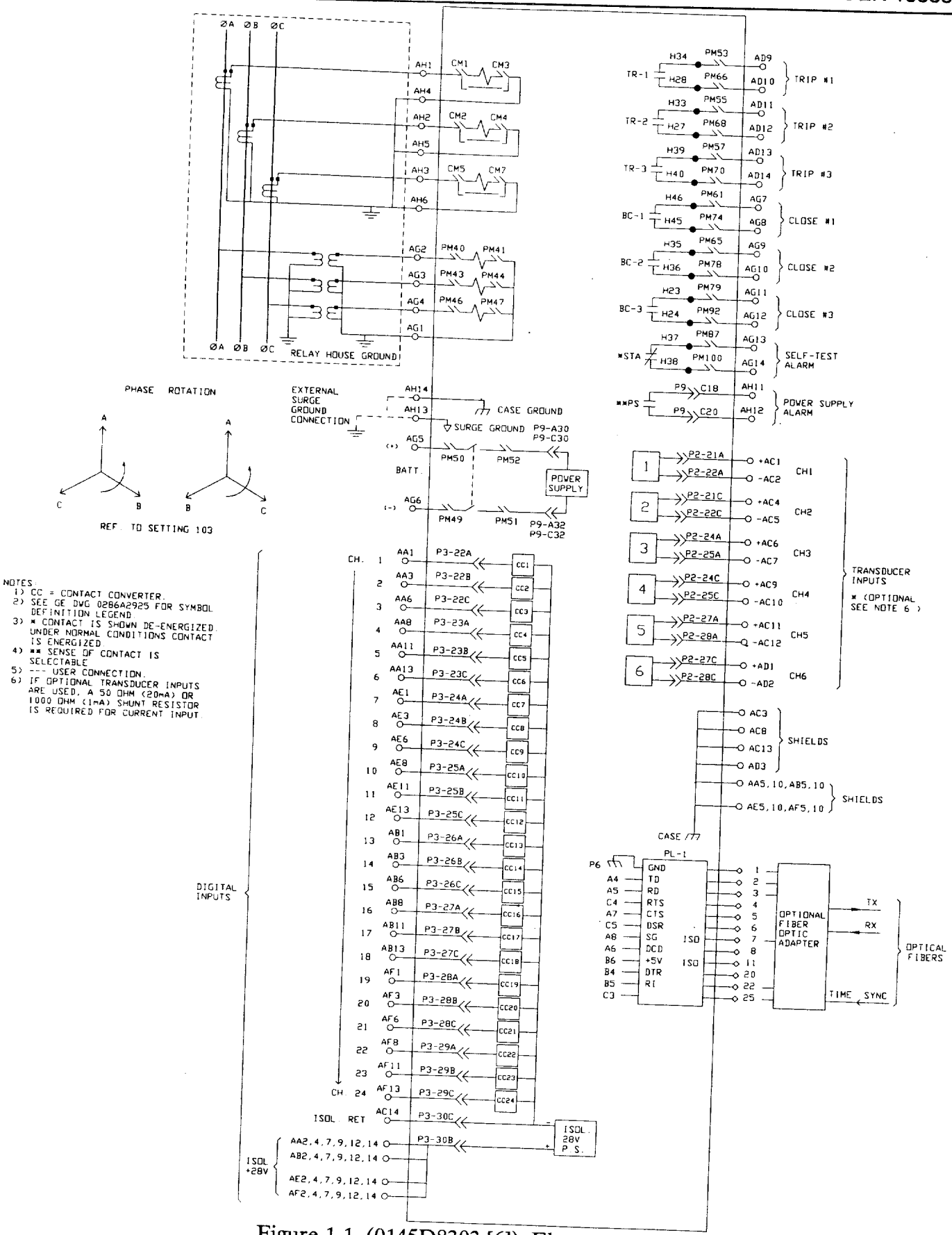


Figure 1-1 (0145D8303 [6]) Elementary Diagram

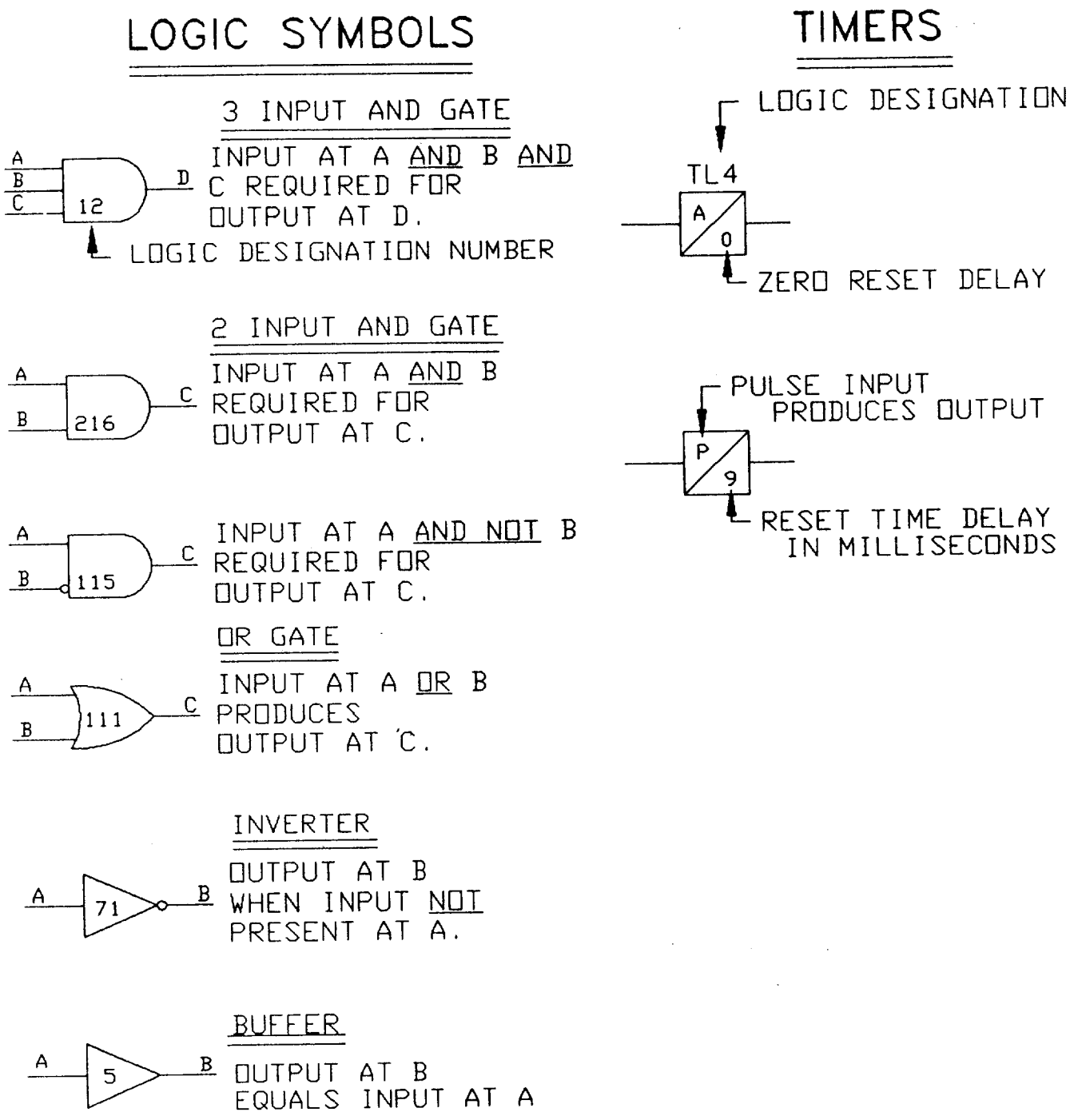


Figure 1-2 (0286A2925 Sh.1 [2]) Symbol Definition Legend

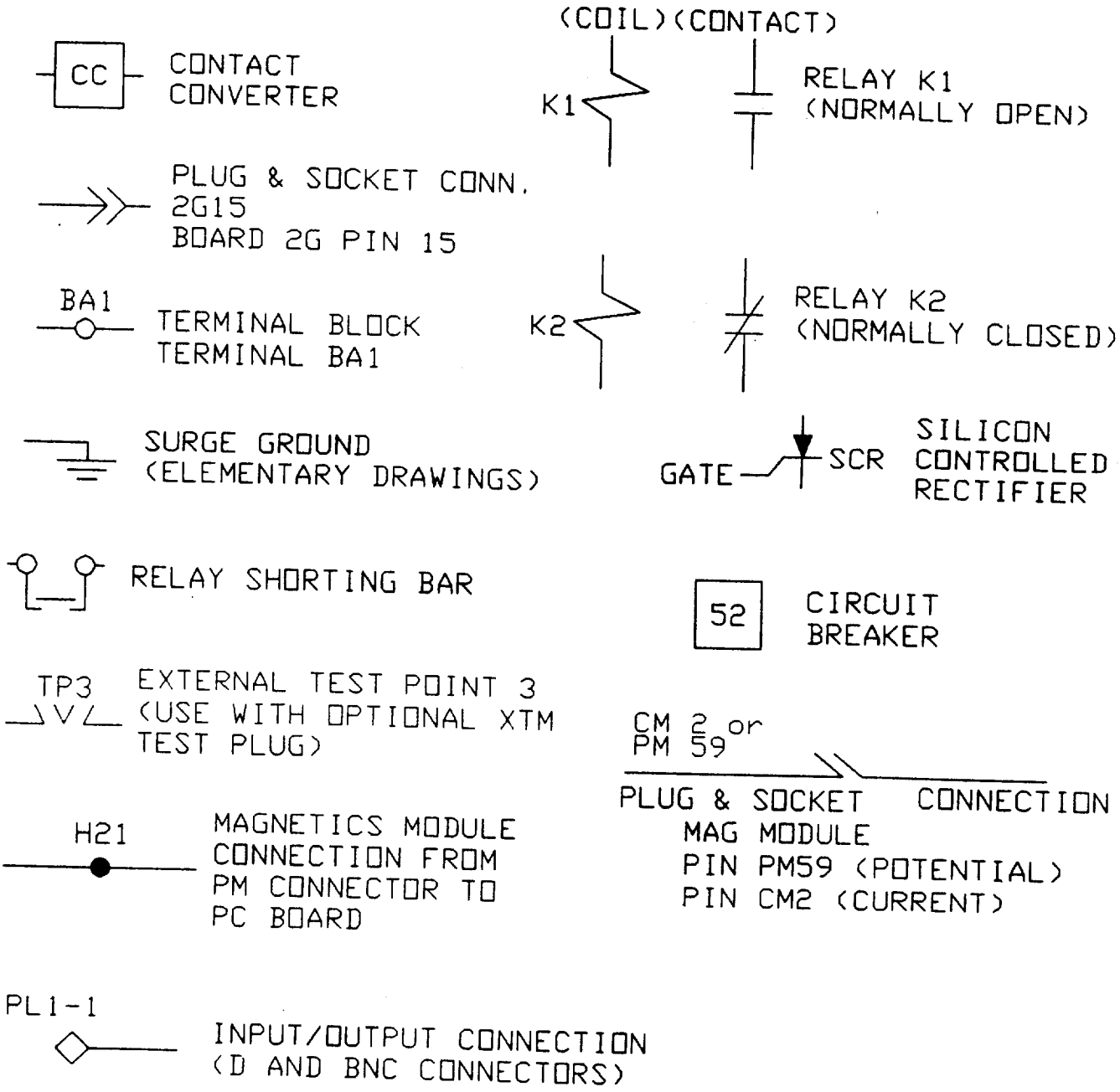


Figure 1-2 (0286A2925 Sh.2 [4]) Symbol Definition Legend, continued

CALCULATION OF SETTINGS

This section provides information to assist the user in determining the required settings for the DLM system.

Table 2-1 lists all the settings and the corresponding ranges and units. The column labeled DEFAULT in Table 2-1 indicates the DLM settings stored in memory as shipped from the factory. The settings described in the subsequent text are arranged by category of settings, which correspond to the category-of-settings headings displayed on the light-emitting-diode (LED) display of the local man-machine interface (MMI). A category of settings is identified by all capitals, e.g., CONFIGURATION SETTINGS, CONFIG. Individual settings or category-of-settings headings are listed by the descriptive name followed by its mnemonic. The mnemonic is what is displayed on the local MMI to identify the particular setting or category-of-settings heading.

Setting ranges for distance functions are given as a multiplier range times the quantity (5/IN). Setting ranges for overcurrent functions are given as a multiplier range times IN. IN is the nominal current rating, either 1 or 5 amps, for a particular DLM model. Those DLM systems used with current transformers that have a 5-amp-rated secondary have IN = 5. Those DLM systems used with current transformers that have a 1-amp-rated secondary have IN = 1.

Table 2-1: Settings and Ranges

SETTING	RANGE	UNITS	DEFAULT
CONFIG (Configuration)			
UNITID	0000-9999		0000
SYSFREQ	50,60	Hz	60
PHASDESG	0 (ABC)		0
	1 (ACB)		(ABC)
NUMBKRS	0,1,2,3		0
SELPRIM	0 (PRIMARY)		
	1 (SECNDRY)		SECNDRY
CTRATIO	1 - 5000		400
PTRATIO	1 - 7000		2000
DISTUNIT	0 (MILES)		
	1 (KM)		MILES
BAUDRATE	300		
	1200		
	2400		
	9600	BAUD	1200
XDUCER	YES/NO		NO*
CCIDEF (Contact Closure Input Definition)			
CCI1	Left Digit	Right Digit	01
	0 (trigger)	0 (normally closed)	
	1 (alarm)	1 (normally open)	
	2 (breaker status)	0 (Bkr A contact)	
		1 (Bkr B contact)	
CCI2	Same as CCI1		01
CCI3	Same as CCI1		01

* If optional transducer module is used, this setting should be "YES".

Table 2-1: Settings and Ranges (Continued)

SETTING	RANGE	UNITS	DEFAULT
CCIDEF (Contact Closure Input Definition) (Continued)			
CCI4	Left Digit 0 (trigger) 1 (alarm)	Right Digit 0 (normally closed) 1 (normally open)	01
CCI5	Same as CCI4		01
⋮	⋮		
CCI24	Same as CCI4		01
FAULTLOC (Fault Location)			
SELFLOC	YES/NO		YES
POSANG	45-90	deg.	85
ZERANG	45-90	deg.	75
ZP	.01-(50.00)(5/IN)	ohms	(6.0)(5/IN)
K0	1.0 - 7.0		3.0
LINELEN	0.0 - 200.0	miles	100.0
	0.0 - 322.0	km	161.0
BEHIND	YES/NO		NO
BEYOND	YES/NO		NO
OVERCUR (Overcurrent Triggering)			
SELOC	YES/NO		NO
PUPH	(0.4-20.0)(IN)	amps	2.0
PUGR	(0.1-16.0)(IN)	amps	0.2
SELDO	YES/NO		NO
UNDERVOL (Undervoltage Triggering)			
SELUV	YES/NO		NO
UVLEV	10-70	volts	60
XDUCERS (Transducer Input Definitions)			
X1RANGE	0 (± 10 volts) 1 (0 to + 10 volts) 2 (± 5 volts) 3 (0 to + 5 volts) 4 (0 to + 1 ma) 5 (4 to + 20 ma)		0
X1FULL	0 to ± 100000		100
X1ZERO	0 to ± 100000		0
X2RANGE	Same as X1		
⋮	⋮		
X6ZERO	Same as X1		0

CONFIGURATION SETTINGS, CONFIG

Unit ID Number, UNITID

The UNITID is a decimal number between 0 and 9999 stored in non-volatile memory, which uniquely identifies a DLM system. When the DLM is accessed via its PL-1 serial port, the UNITID must be known to establish communication, thus providing a measure of security.

System Frequency, SYSFREQ

SYSFREQ can be set to either 50 Hz or 60 Hz. When this setting is changed the DLM must be re-initialized by turning the DC power off, and then on.

Phase Rotation, PHASDESG

PHASDESG can be set to either 0 or 1. When set to zero, the DLM assumes a primary phase rotation of ABC; when set to 1, the DLM assumes a primary phase rotation of ACB. For either rotation, there is no need to change any current or voltage input connections; and the correct faulted phase targeting will be displayed.

Number of Breakers, NUMBKRS

NUMBKRS can be set to either 0, 1, 2 or 3. When set to 0, the TRIP and CLOSE commands will not be operational. When set to 1, the TRIP and CLOSE commands will only activate BREAKER 1 output. When set to 2 , the TRIP and CLOSE commands will selectively activate either the BREAKER 1 or BREAKER 2. When set to 3, the TRIP and CLOSE commands will selectively activate either the BREAKER 1, BREAKER 2 or BREAKER 3 output.

Select Primary/Secondary Units, SELPRIM

SELPRIM can be set to either 0 (PRIMARY) or 1 (SECNDRY), secondary. This setting determines whether current and voltage will be displayed as primary or secondary values. All settings are expressed in terms of secondary values regardless of whether SELPRIM is set to 0 or 1.

Current Transformer Ratio, CTRATIO

CTRATIO can be set over the range of 1 - 5000.

Potential Transformer Ratio, PTRATIO

PTRATIO can be set over the range of 1 - 7000.

Units of Distance, DISTUNIT

DISTUNIT can be set to either MILES or KM (kilometers). This setting determines the unit of distance used for reporting fault location in the Disturbance Report.

Communications Baud Rate, BAUDRATE

The BAUDRATE setting of 300, 1200, 2400, or 9600 must be set to match the baud rate of the modem or serial device connected to the RS232 serial port (PL-1) of the DLM system.

Transducer Inputs, XDUCER

The XDUCER setting indicates whether the optional analog transducer input board is present in the DLM. When set to YES, the DLM will convert the transducer inputs to digital data, and perform continual self-tests on the board circuitry.

Example Settings:

UNITID = 1
SYSFREQ = 60
PHASDESG = 0 (ABC)
NUMBKRS = 1
SELPRIM = 1 (SECNDRY)
CTRATIO = 400 (2000/5)
PTRATIO = 3000 (345,000/115)
DISTUNIT = MILES
BAUDRATE = 1200
XDUCER = NO

CONTACT CLOSURE INPUT DEFINITION, CCIDEF

Contact Converter Input Number 1, 2 and 3, CCI1 - CCI3

The first three contact converter inputs, CCI1, CCI2, and CCI3, are reserved for the three possible breakers that can be controlled by the DLM. These inputs are used to inform the DLM of the status, or change of status of the associated circuit breakers. If any of these three contact converters are not used for breaker status they may be used as either trigger or alarm inputs.

Each CCI is set by a two digit code:

a. The first digit describes the type of contact input; it may be set for 0, 1, or 2. A setting of 0 indicates a TRIGGER input. When this contact changes from its normal state, oscillography data will be collected, and a disturbance report will be generated. A setting of 1 indicates that the contact is an ALARM input. The status of this input will be reported in the oscillography data and in the present values, but it will not trigger the collection of oscillography data, nor generate a disturbance report when it changes state. A setting of 2 indicates that the contact input is used to report the status of a BREAKER.

b. The second digit defines the normal state of the contact; it may be set for 0 or 1. A setting of 0 indicates a contact input that is closed in normal operation (such as a normally closed contact, or a breaker "A" contact); a setting of 1 indicates a contact input that is open in normal operation.

Contact Converter Input Number 4 through 24, CCI4 - CCI24

Converter inputs CCI4 through CCI24 are reserved for either trigger or alarm inputs.

Each CCI is set by a two digit code:

a. The first digit describes the type of contact input; it may be set for 0, or 1. A setting of 0 indicates a TRIGGER input. When this contact changes from its normal state, oscillography data will be collected, and a disturbance report generated. A setting of 1 indicates that the contact is an ALARM input. The status of this input will be reported in the oscillography data and in the present values, but it will not trigger the collection of oscillography data, nor generate a disturbance report when it changes state.

b. The second digit defines the normal state of the contact; it may be set for 0 or 1. A setting of zero indicates a contact input that is closed in normal operation (such as a normally closed contact); a setting of 1 indicates a contact input that is open in normal operation.

NOTE: For the status of the contact converter inputs to be reported by the DLM, or for the contact converter input to trigger the DLM, the contact converter must be ENABLED. The CCI's may be enabled individually under the ACTION section of the MMI. The status of the CCI's (ENABLED or DISABLED) may be checked under the INFORMATION (INF) section of the MMI.

Example Settings:

CCI1 = 21
CCI2 = 20

CCI24 = 00

FAULT LOCATION PARAMETERS, FAULTLOC

Select Fault Locating, SELFLOC

SELFLOC can be set to either YES or NO. When set to YES, a fault location will be calculated for each Disturbance Report; when set to NO, a fault location will not be calculated. This setting will also affect the MMI display.

Positive-Sequence Angle of Maximum Reach, POSANG

POSANG can be set over the range of 45° - 90°, and is common to all of the distance functions. It should be set to a value that is equal to, or just larger than, the angle of the positive-sequence impedance of the monitored line.

Zero-Sequence Angle of Maximum Reach, ZERANG

ZERANG can be set over the range of 45° - 90°, and is common to all of the ground-distance functions. It should be set to a value that is equal to, or just larger than, the angle of the zero-sequence impedance of the monitored line.

Positive-Sequence Impedance, ZP

ZP can be set over the range of .01 - 30.00 x (5/IN) ohms where IN (nominal current) is either 1 or 5 amperes depending on the model number of the DLM system. It should typically be set to the positive-sequence impedance of the protected line.

Zero-Sequence Current Compensation, K0

K0 can be set over the range of 1.0 - 7.0. This setting is used in the fault location algorithm to permit the correct distance to be calculated on ground faults. It should be set for:

$$K0 = Z0L / Z1L$$

where: Z0L = zero-sequence impedance of line

Z1L = positive-sequence impedance of line

Line Length, LINELEN

LINELEN can be set over the range of 0.0 - 200.0 miles or 0.0 - 322.0 kilometers. This setting is the physical length of the monitored line, and is used to permit the fault location to be reported in miles or kilometers from the DLM location.

Display Fault Location for Reverse Faults, BEHIND

BEHIND can be set to either YES or NO. When set to YES, the DLM will display the calculated fault location for reverse faults. The distance to the fault will be preceded by a minus sign (-) to indicate that the fault is behind the relay. When BEHIND is set to NO, the DLM will not display the distance to fault for reverse faults; instead the DLM will display REV, to indicate that the fault was behind the DLM location.

NOTE: If BEHIND is set to YES, the fault location calculated by the DLM may be in error, due to infeed currents from other sources connected to the bus.

Display Fault Location for Faults Beyond the Line, BEYOND

BEYOND can be set to either YES or NO. When set to YES, the DLM will display the calculated fault location for faults beyond the remote end of the line. When BEYOND is set to NO, the DLM will not display the distance to fault if the calculated distance is greater than 110% of the line length; instead the DLM will display ***.

NOTE: If BEYOND is set to YES, the fault location calculated by the DLM may be in error due to infeed currents from other sources connected to the remote bus.

Example Settings (based on Figure 2-1):

POSANG = 85
ZERANG = 74
ZP = 6.00
K0 = 3.2
LINELEN = 75
BEHIND = NO
BEYOND = YES

OVERCURRENT TRIGGERING, OVERCUR

Select Overcurrent Triggering, SELOC

SELOC can be set to either YES or NO. When SELOC is set to NO, overcurrent conditions will not initiate collection of oscillography data or generate a Disturbance Report. When SELOC is set to YES, oscillography data will be collected and a Disturbance Report generated whenever the overcurrent setting is exceeded.

Phase Overcurrent Pickup Setting, PUPH

PUPH may be set over the range of (0.4 - 20)(IN) amperes. When the calculated RMS value of any of the three phase currents exceeds the setting of PUPH, the DLM will be triggered.

Ground Overcurrent Pickup Setting, PUGR

PUGR may be set over the range of (0.1 - 20)(IN) amperes. When the calculated RMS value of the 3I0 current exceeds the setting of PUGR, the DLM will be triggered.

Overcurrent Dropout Trigger Setting, SELDO

SELDO may be set to either YES or NO. When SELDO is set to YES, the DLM will be triggered when the current level drops **below** 90% of the setting of PUPH or PUGR. Thus two triggers will occur: one when the current exceeds the pickup, and a second when the current drops below the pickup.

Example Settings:

SELOC = YES
PUPH = 2
PUGR = 0.2
SELDO = NO

UNDERVOLTAGE TRIGGERING, UNDERVOL

Select Undervoltage Triggering, SELUV

SELUV may be set to either YES or NO. When SELUV is set to YES, the DLM will be triggered whenever the RMS value of any of the phase voltages drops below the set level.

Undervoltage Trigger Setting, UVLEV

UVLEV may be set over the range of 10 to 70 volts. Whenever the RMS value of any of the phase voltages drops below UVLEV, the DLM will be triggered if SELUV is set to YES.

Example Settings:

SELUV = YES
UVLEV = 50

TRANSDUCER INPUT DEFINITIONS, XDUCERS

Transducer Number 1 Range, X1RANGE

X1RANGE may be set from 0 to 5, which represents the following ranges:

0	(± 10 volt)
1	(0 to + 10 volts)
2	(± 5 volts)
3	(0 to + 5 volts)
4	(0 to + 1 ma)
5	(4 to + 20 ma)

In addition, the channel jumper on the ATI module must be set to select either a voltage input or a current input. A shunt resistor of the correct value must be installed on the rear terminals of current-input channels (see the elementary drawing, Figure 1-1).

Transducer Number 1 Full Scale Value, X1FULL

X1FULL may be set over the range of 0 to ± 10000. This setting is used to translate the voltage or current input to units appropriate for the quantity being measured. If, for example, an input of + 10 volts corresponds to a line current of 8000 amperes, then X1FULL should be set to 8000.

Transducer Number 1 Zero Value, X1ZERO

X1ZERO may be set over the range of 0 to ± 10000. This setting is similar to X1FULL, except that it is intended to set the level corresponding to the minimum input signal. If, for example, an input of 0 volts represents a line current of 0 ampere, then X1ZERO should be set to 0.

Transducers Number 2 to 6

Transducers 2 through 6 have the same settings as Transducer Number 1.

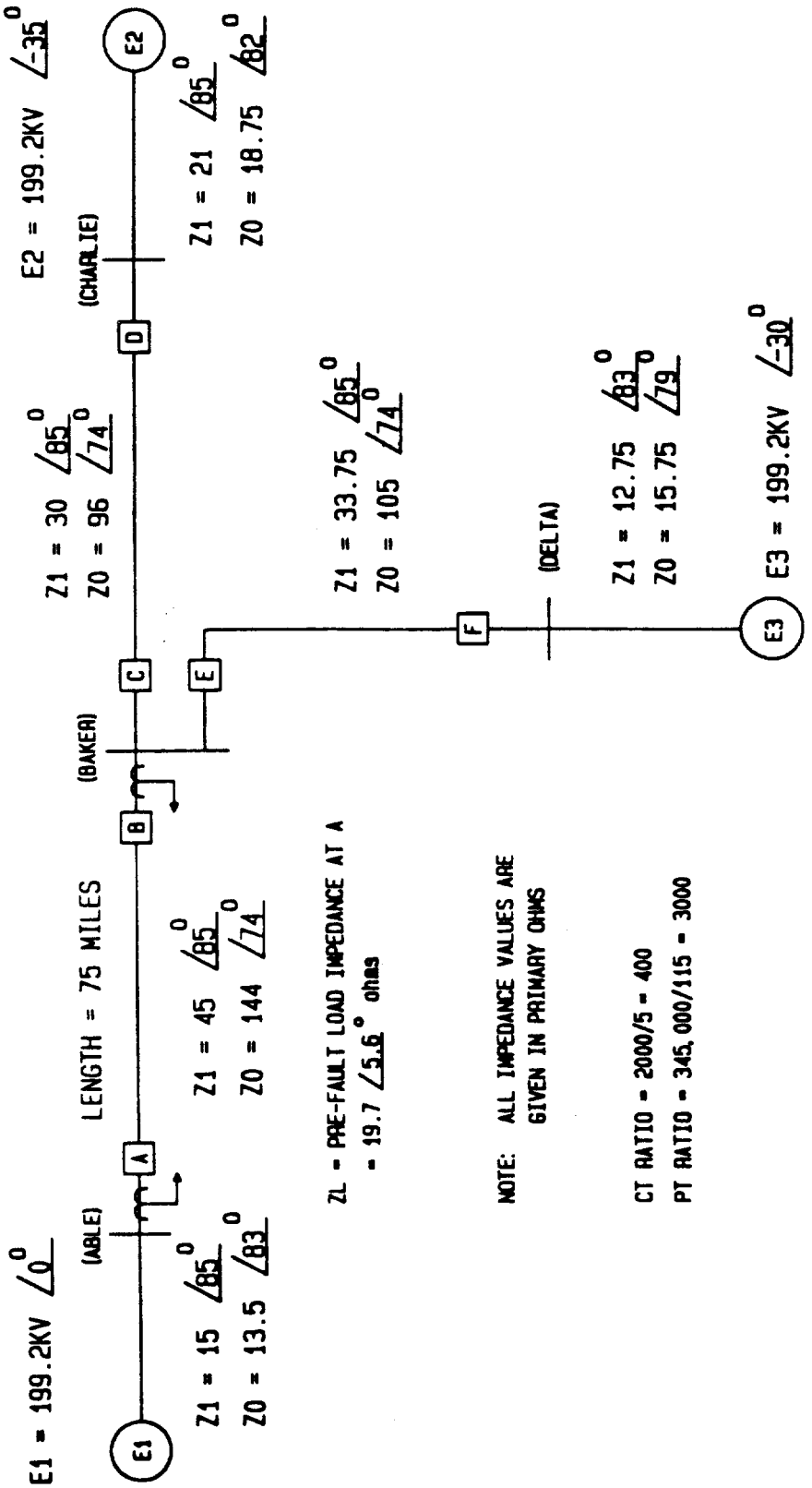


Figure 2-1 (0286A2912) Sample 345 KV System

HARDWARE DESCRIPTION

CAUTION

Power down the DLM with the power switch before removing or inserting modules. Failure to do so can permanently damage the unit.

CASE ASSEMBLY

Construction

The case that houses the electronic modules is constructed from an aluminum alloy. It consists of a main frame with side mounting brackets, a front cover and a rear cover.

The front cover, comprised of a metal frame with plate glass, is pivoted on the top and is opened from the bottom by way of two spring-loaded latches. The door is constrained from coming off by tabs that require the door to be unlatched and lifted slightly in order to be removed. A pushbutton extender installed into the plate glass makes it possible to clear the display without removing the front cover.

The rear cover supports terminal blocks that are used in making external connections to the case.

The modules are mounted vertically inside the case, and they are supported by sockets on the mother board within the case. In addition to providing this mechanical support, the sockets also offer the means of making the electrical connection to the modules. The modules are further restrained inside the case by the front cover.

Proper alignment of the module with respect to the socket is maintained by slotted guides, one guide above and one guide beneath each module, with the exception of the magnetics module, MGM, which requires two guides above and two beneath, and the man-machine interface module, MMI, which requires three pairs of guides.

Electrical Connections and Internal Wiring

As mentioned earlier, electrical connections are made to the case through eight terminal blocks mounted on the rear cover plate. Each block contains 14 terminal points, which consist of a Number 6 screw threaded into a flat contact plate.

Connection to the printed-circuit-board module is made by means of 96-pin Eurocard connectors. Connection to the MGM module is made by means of two connector sockets; an 8-contact current block and a 104-pin signal block. The current block contacts are rated to handle current transformer (CT) secondary currents, and they are shorted upon removal of the MGM module.

Identification

The DLM system model number label is located on the outside of the front cover, and on the right-hand sidesheet inside the case. A marking strip indicating the name and position of every module in a case is included on the front bottom of the case. It is placed to be read when the front cover is removed. Figure 4-1 in the **MODULES** section shows the location of the modules.

The terminal blocks located on the rear cover plate are uniquely identified by a two-letter code that is found directly beneath the outermost edge of each terminal block. Also, the terminal points (1 through 14) are identified by stamped numbers.

A connector, PL1, is used for serial communication between the DLM and a PC/Modem.

PRINTED-CIRCUIT-BOARD MODULES

CAUTION

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

Basic Construction

Each module consists of a printed-circuit board and front panel. Two knobs are provided on the front panel for removing and inserting the module. Electrical connection is made by the 96 pins of the Eurocard connector located at the back of the board. Not all module locations within the case have a printed-circuit board.

Identification

Each module has its own identification number, consisting of a three-letter code followed by a three-digit number. These are found at the bottom of each front panel and may be read when the front cover is removed.

RECEIVING, HANDLING AND STORAGE

Immediately upon receipt, the equipment should be unpacked and examined for any damage sustained in transit. If damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest GE Sales Office.

If the equipment is not to be installed immediately, it should be stored indoors in a location that is dry and protected from dust, metallic chips, and severe atmospheric conditions.

INSTALLATION

Environment

The location should be clean and dry, free from dust and excessive vibration, and well lighted to facilitate inspection and testing.

Mounting

The DLM case has been designed for standard rack mounting. The case measures four rack units (4 RU) in height. Refer to Figure 3-1 for the outline and mounting dimensions.

External Connections

External connections are made according to the elementary diagram, Figure 1-1 in the **PRODUCT DESCRIPTION** section. This is a general diagram incorporating all of the available options. Connection need not be made to those terminals associated with options that will not be used.

SURGE GROUND CONNECTIONS

CAUTION

DLM Terminals AH13 and AH14 must be tied together, and terminal AH14 must be tied to station ground, as shown in the elementary diagram Figure 1-1 in the PRODUCT DESCRIPTION section. The connection to the ground bus must be made as short as possible, using No.12 wire or larger.

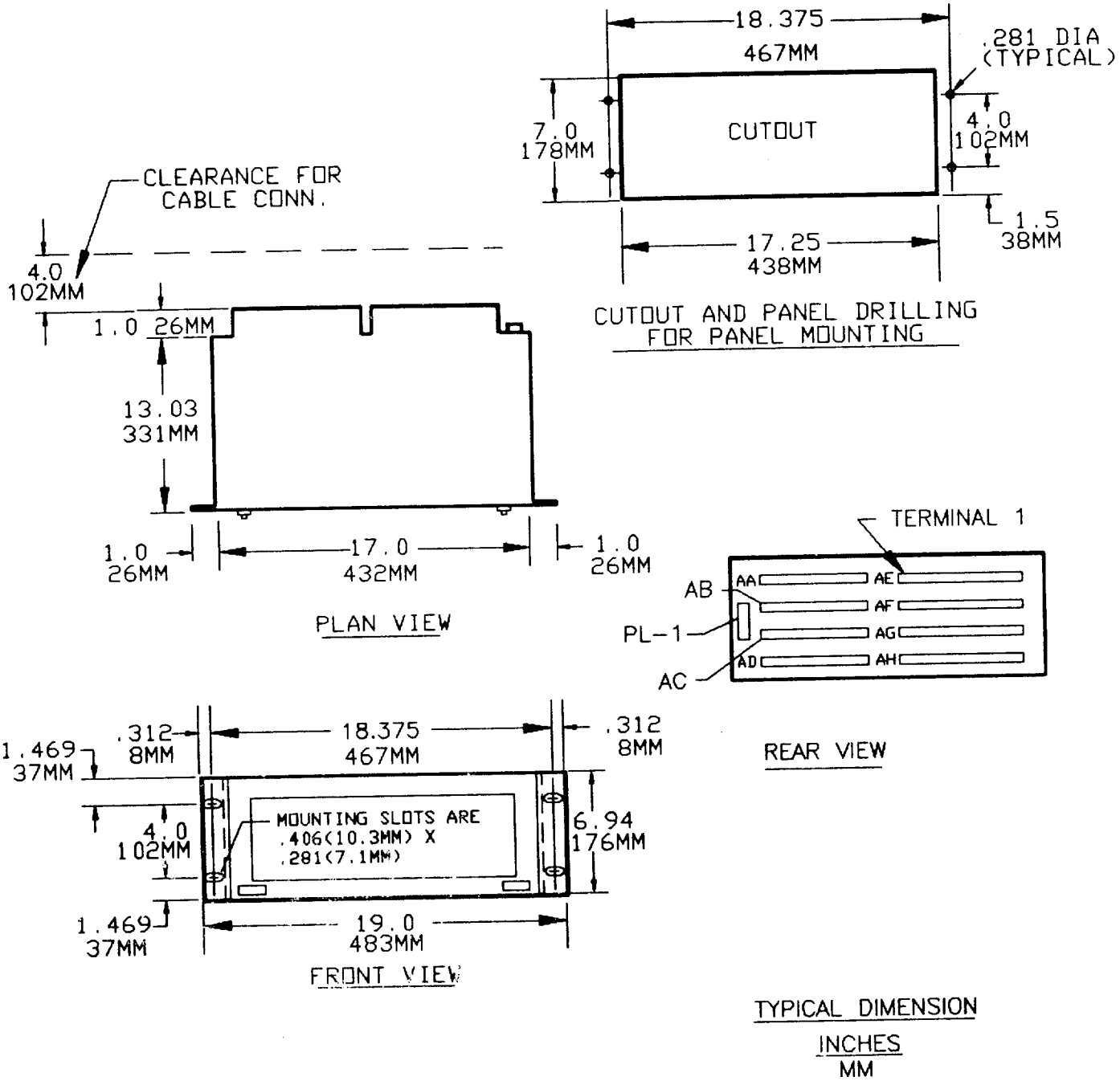


Figure 3-1 (0286A2046 [1]) DLM Outline drawing

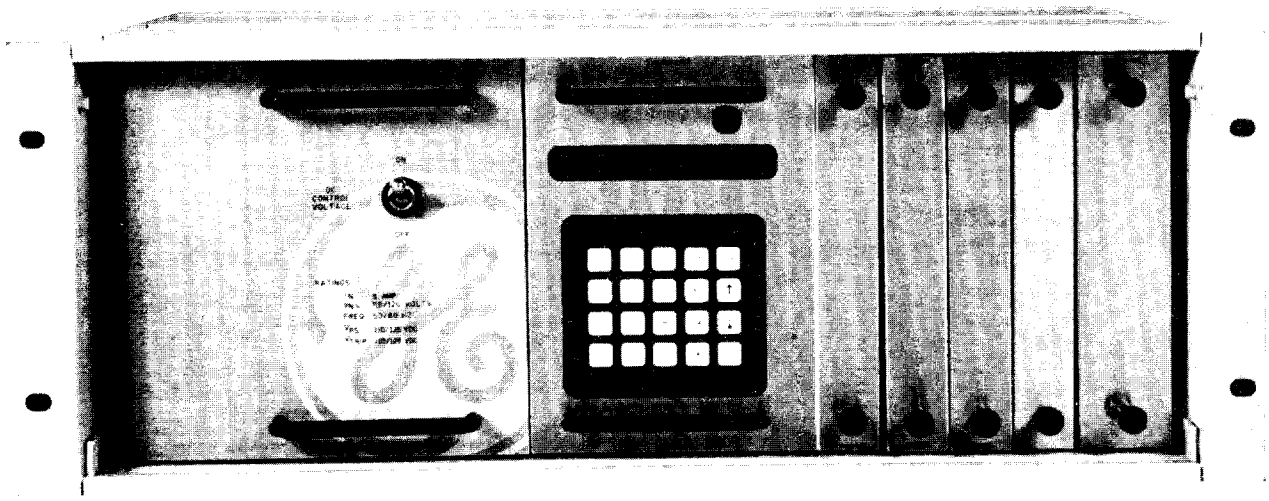


Figure 3-2 (8919422) DLM Monitoring System (front view)

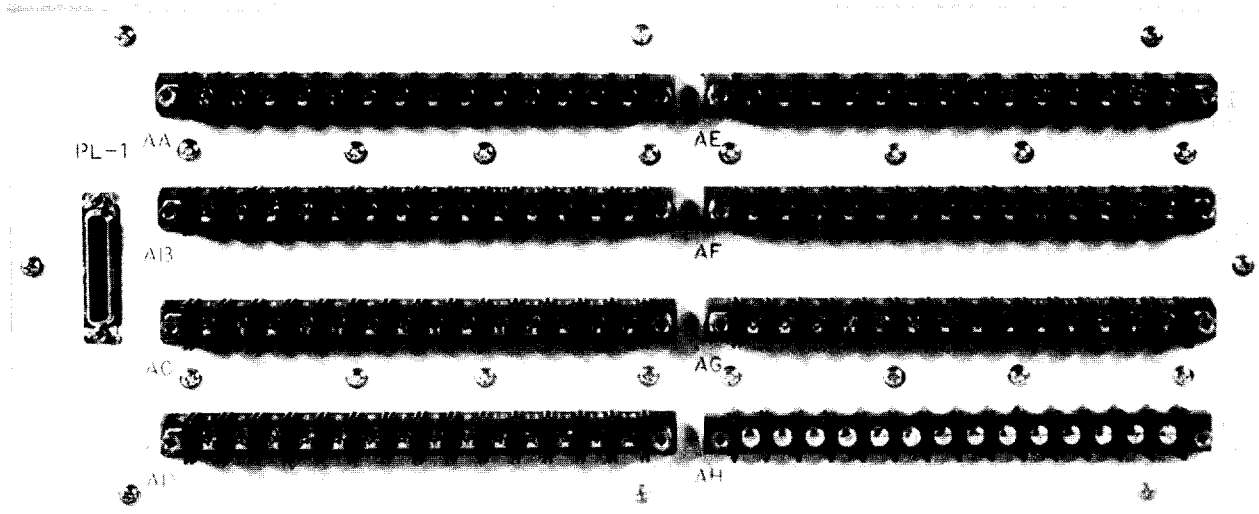


Figure 3-3 (8919423) DLM Monitoring System (rear view)

MODULES

CAUTION

Power Down the DLM before removing or inserting modules. Failure to do so can permanently damage the unit.

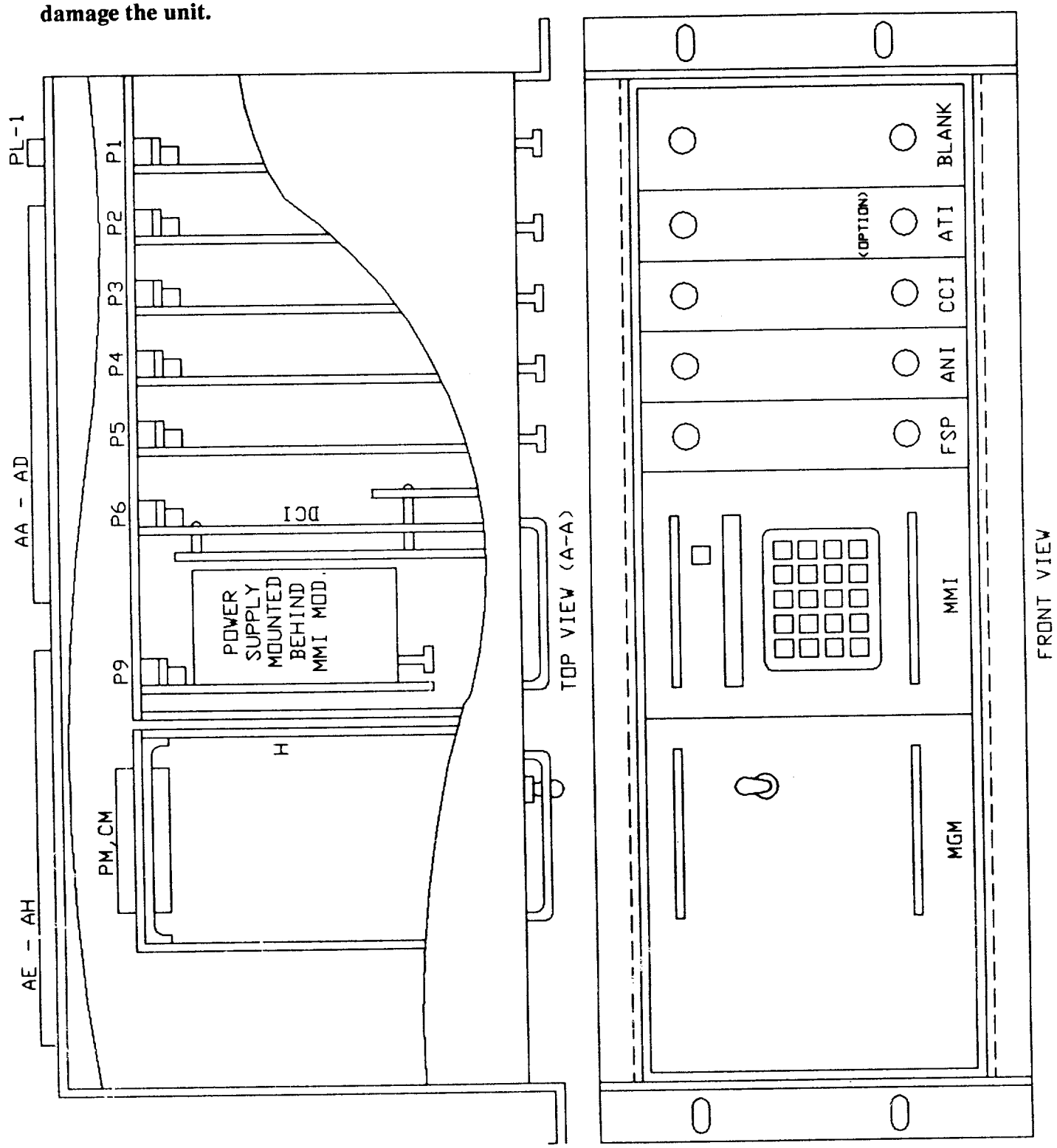


Figure 4-1 (0286A3792) Module Location

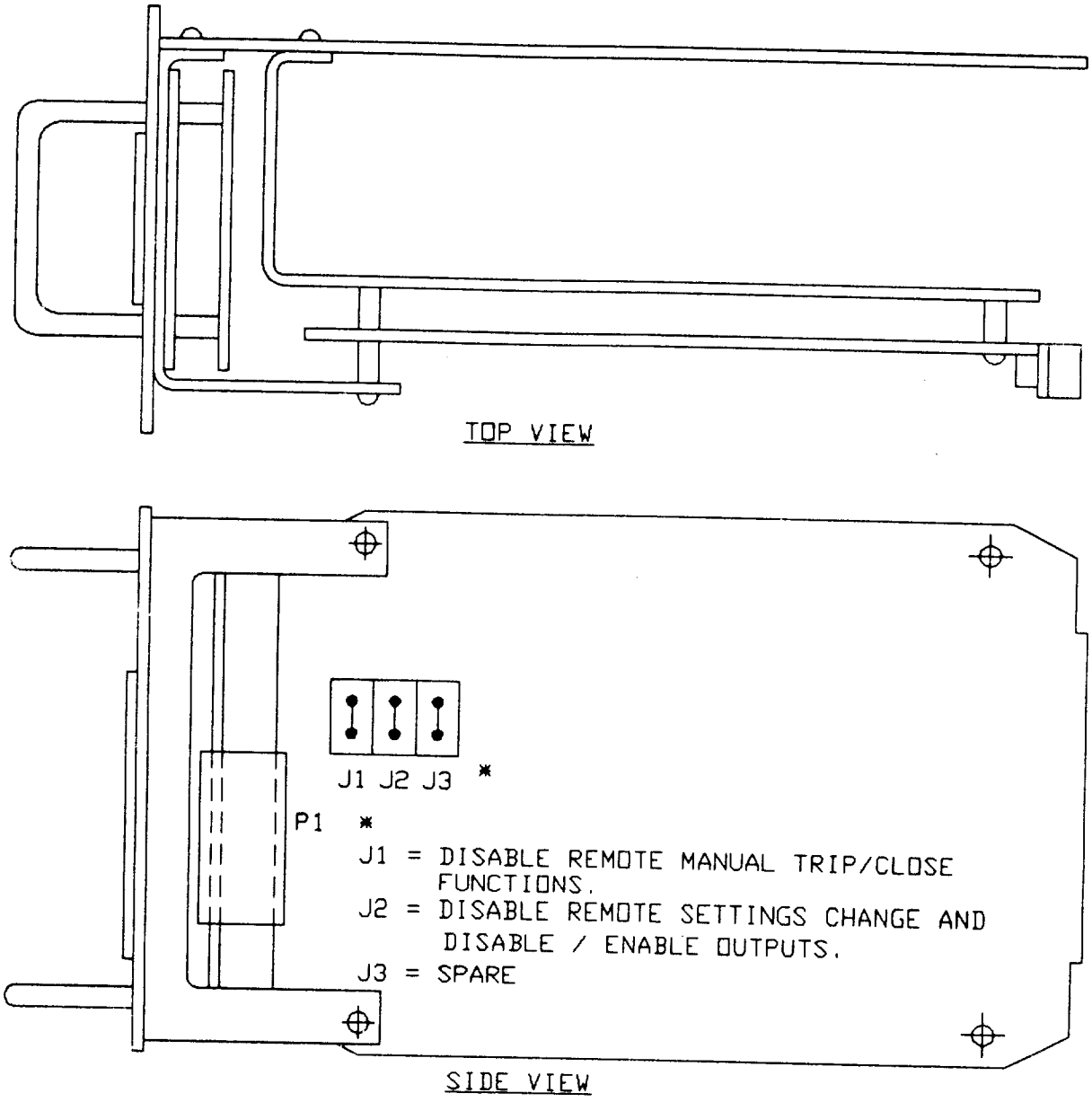


Figure 4-2 (0286A3797) MMI Module

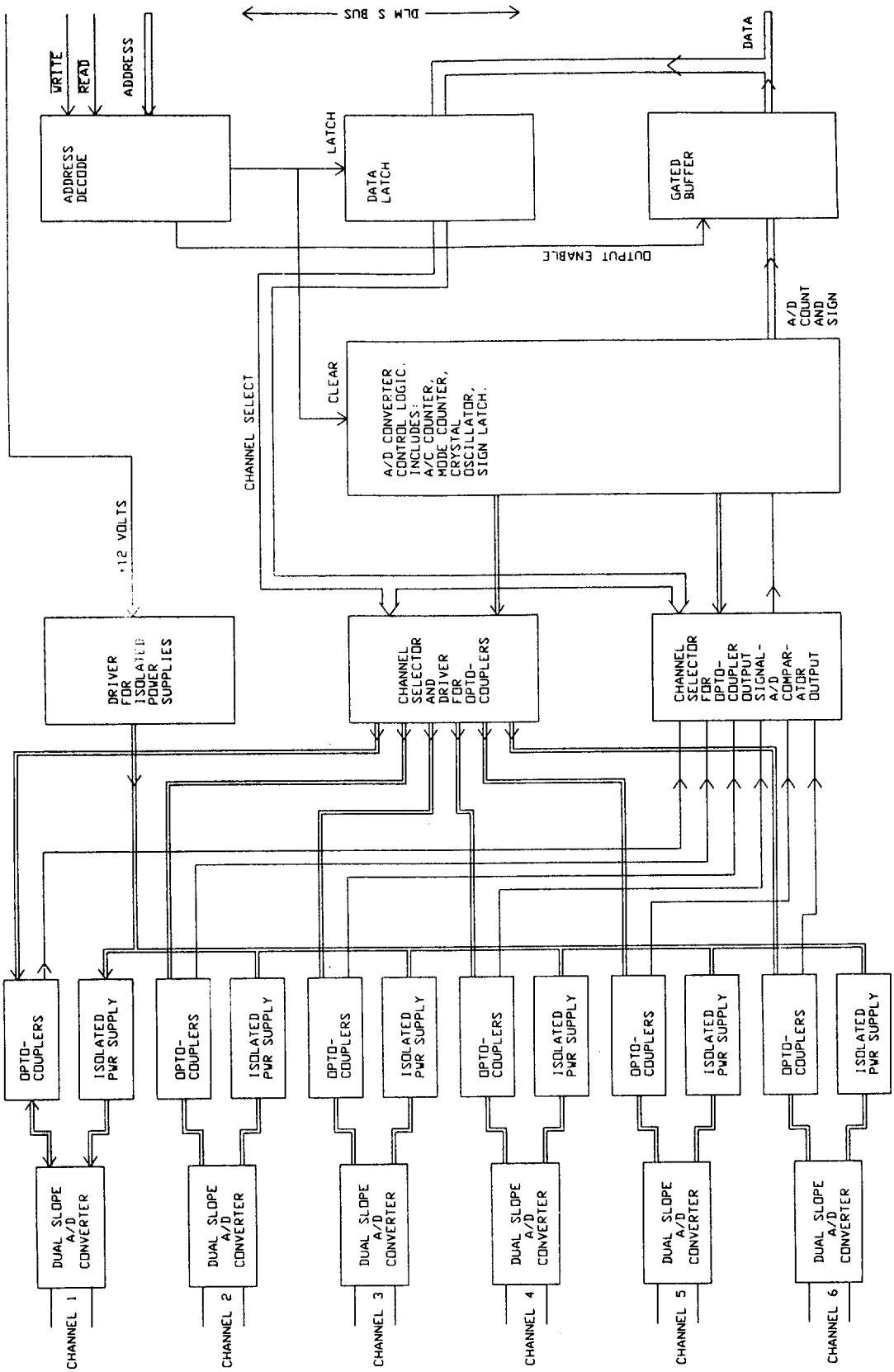


Figure 4-3 (0179C8428 Sh.5 [1]) ATI Block Diagram

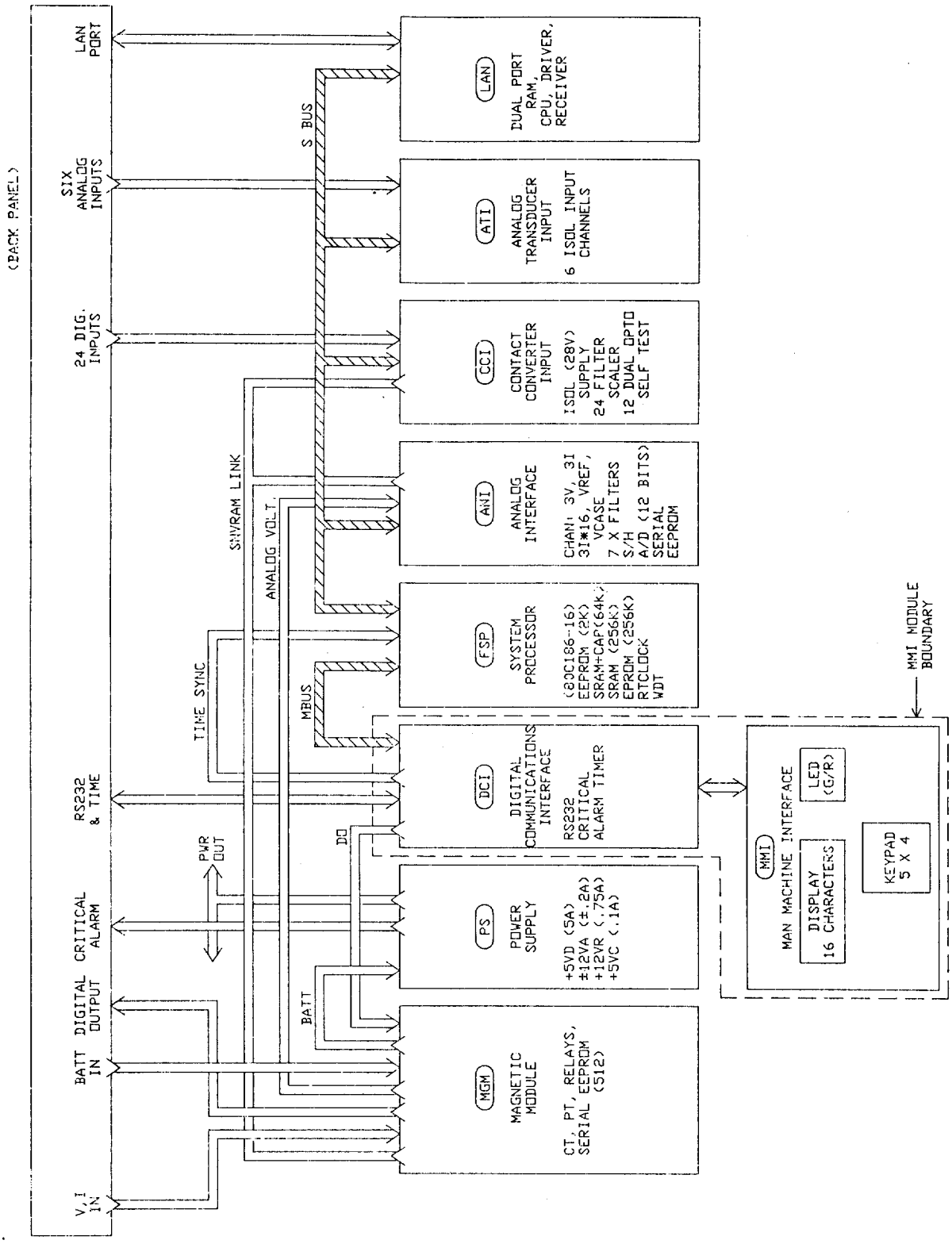


Figure 4-4 (0179C8428 Sh.1) DLM Overall Block Diagram

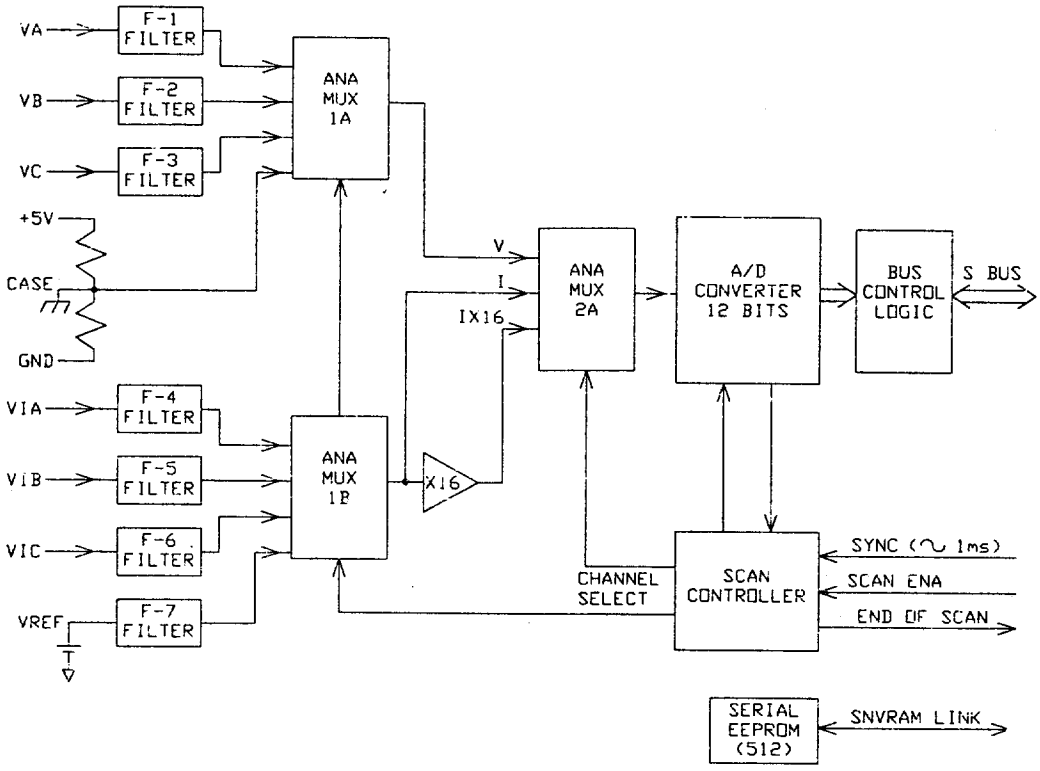


Figure 4-5 (0179C8428 Sh.3 [1]) ANI Block Diagram

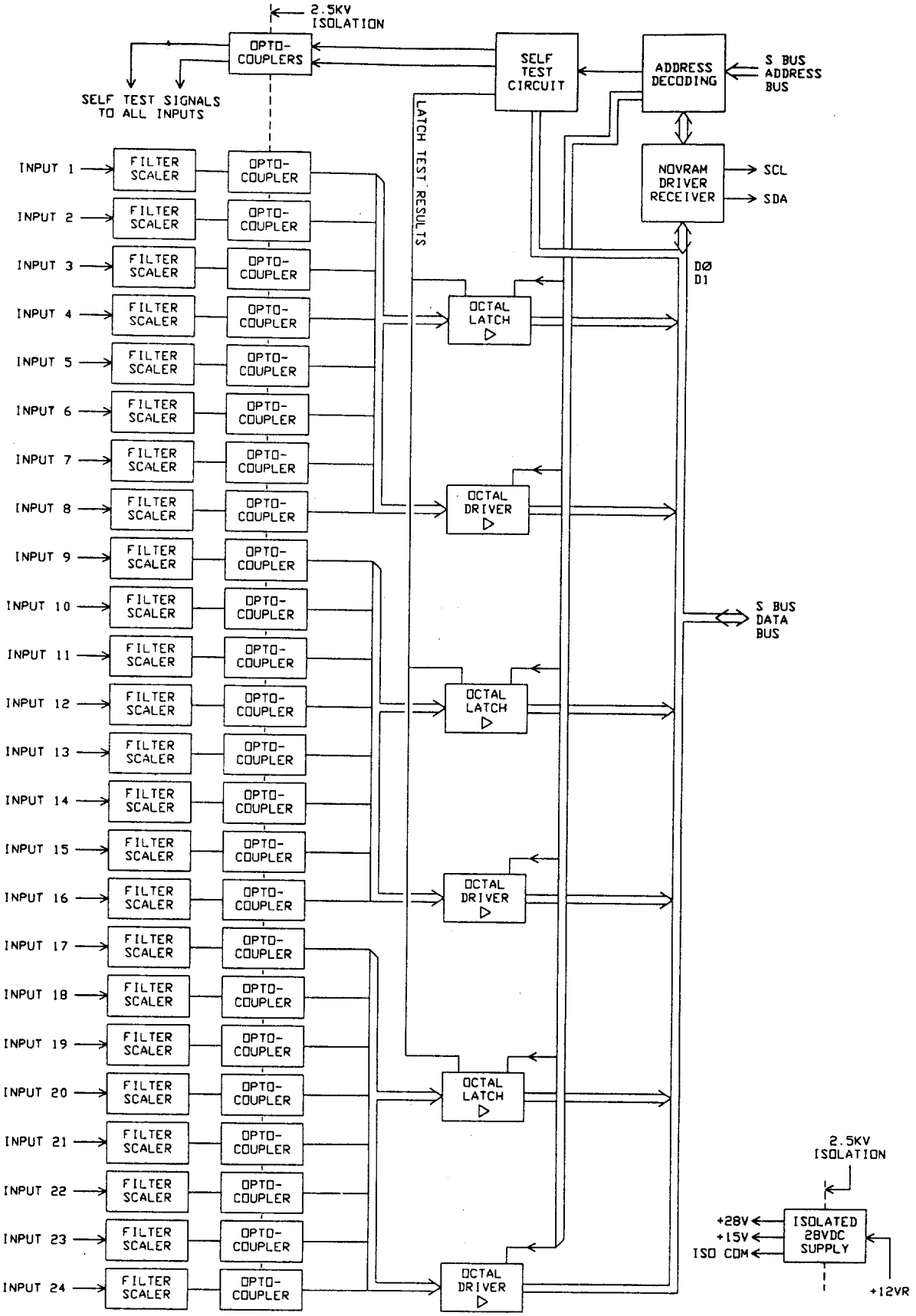


Figure 4-6 (0179C8428 Sh.4 [1]) CCI Block Diagram

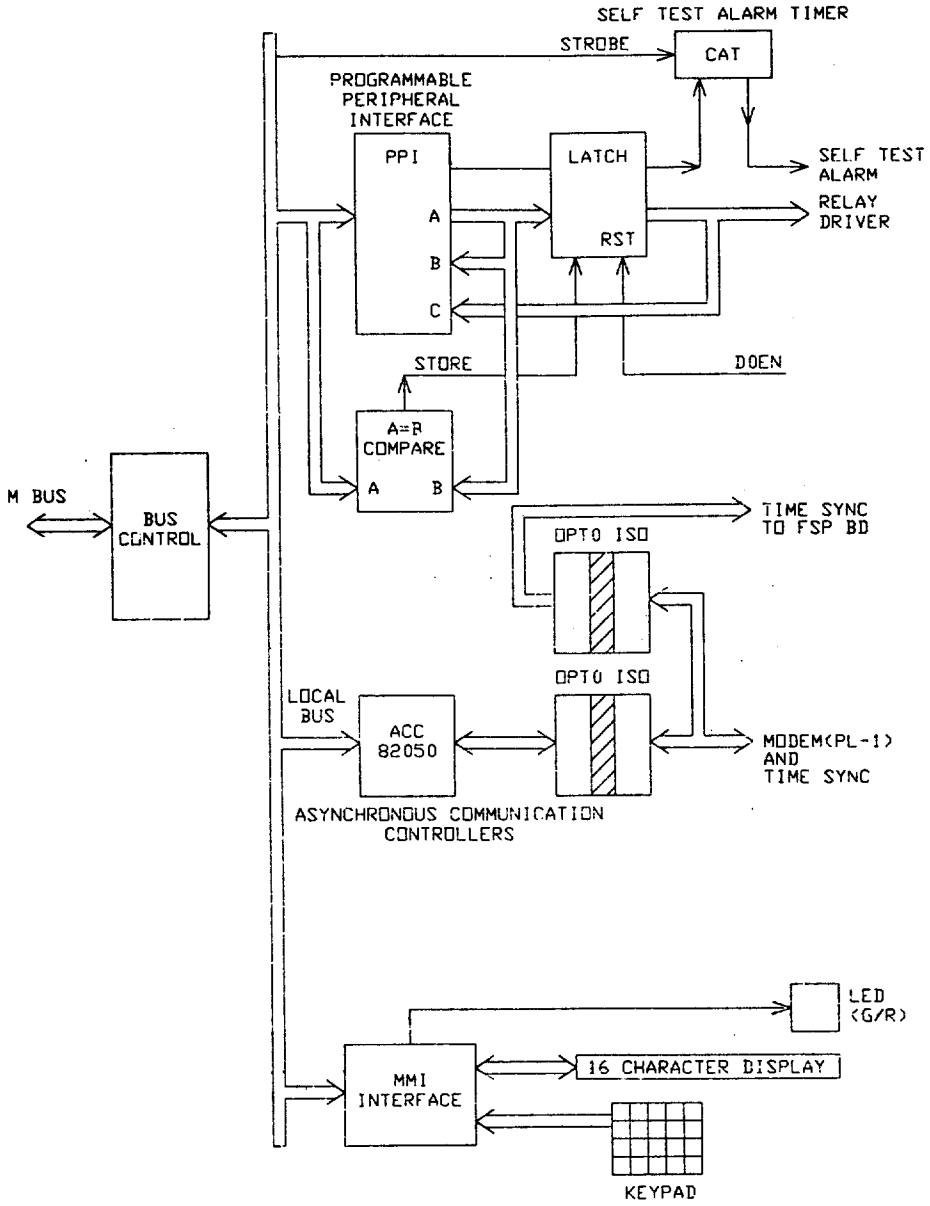


Figure 4-7 (0179C8428 Sh.2 [1]) DCI and MMI Block Diagram

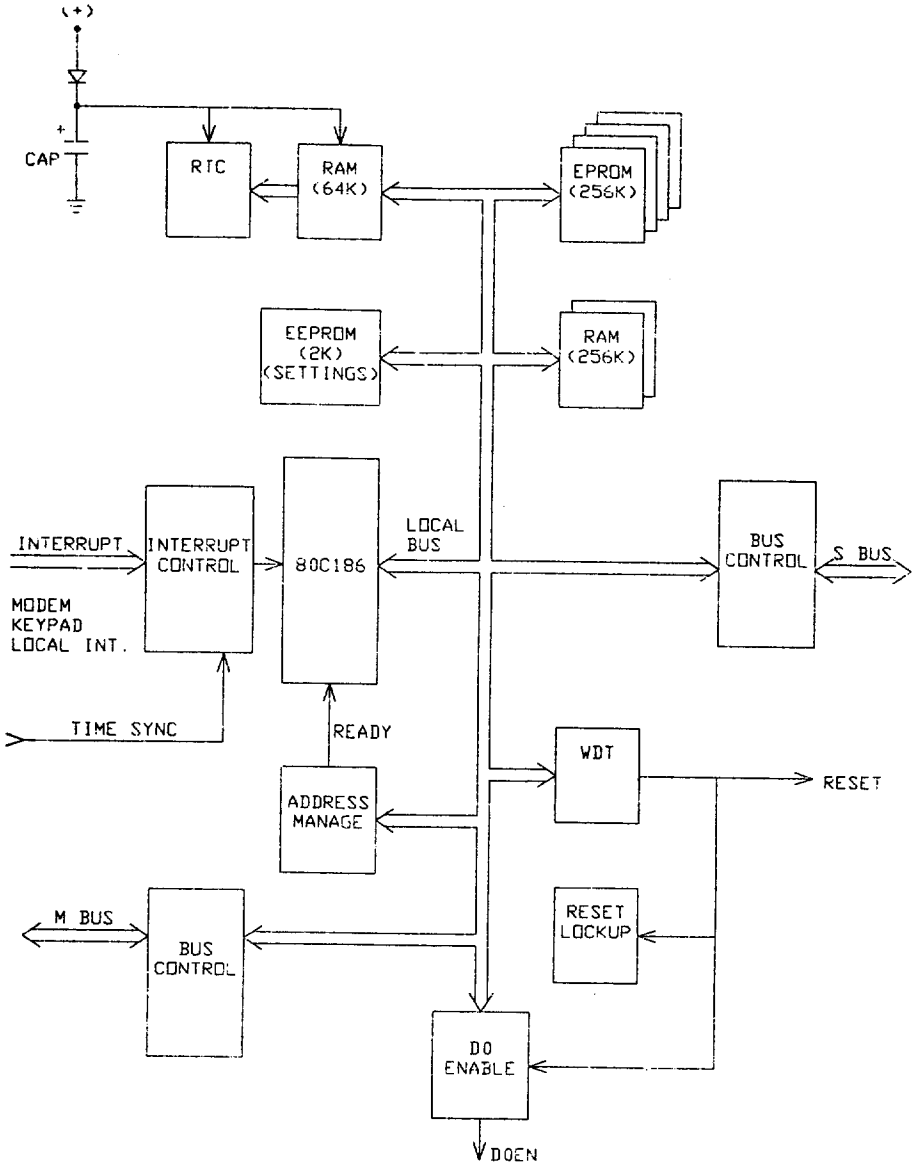


Figure 4-8 (0179C8428 Sh.3 [1]) FSP Block Diagram

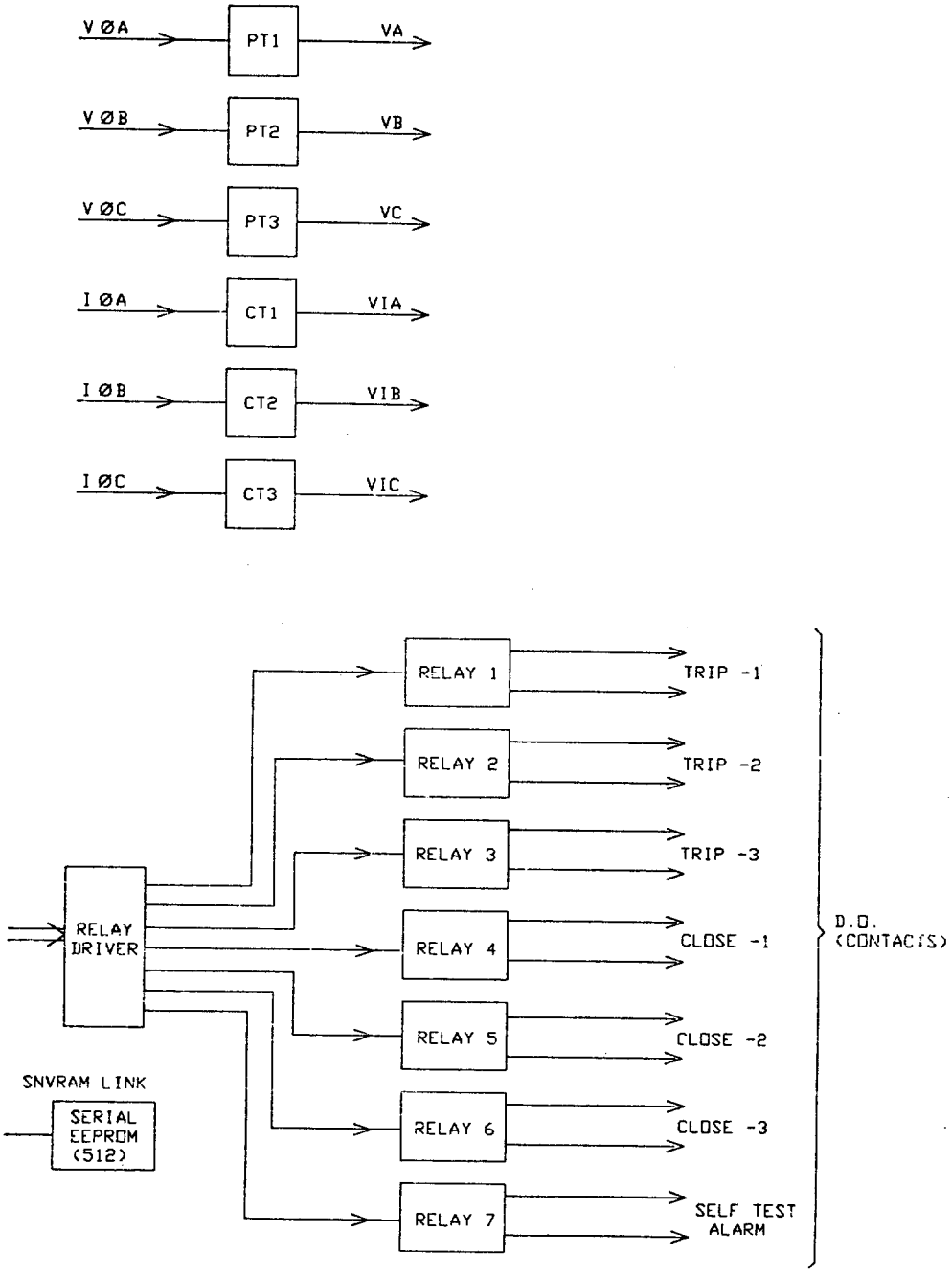


Figure 4-9 (0179C8428 Sh.2 [1]) MGM Block Diagram

ACCEPTANCE TESTS

CAUTION

Power Down the DLM before removing or inserting modules. Failure to do so can permanently damage the unit.

GENERAL

This section is a guide for testing the DLM. It is not necessary that the tests be performed for incoming inspection. The DLM has been tested at the factory with automated test equipment. The DLM is a digital fault concentrator controlled by "self checking" software. If a system failure is detected it will be reported through the MMI.

The following tests include: DLM status self test and display and MMI self test. Tests of triggering functions are also included and can be performed at the users discretion.

General Tests

T1 MMI Status and Display Tests (Self Tests)
T2 AC System Input Test

Internal Triggering Tests

T3 Ground Overcurrent
T4 Phase Overcurrent Test
T5 Overcurrent Dropout Test
T6 Undervoltage Test - Phase-to-Ground
T7 Undervoltage Test - Phase-to-Phase

External Triggering Tests

T8 Phase-to-Ground
T9 Phase-to-Phase

Transducer Tests

T10 Transducer Input Tests

TEST EQUIPMENT

1. Three-phase source of voltage and current at rated frequency
2. DC Control voltage source
3. Three AC voltmeters
4. An AC ammeter
5. A continuity tester or Ohm meter
6. An IBM compatible computer with a serial port
7. An RS232 null modem cable to connect the PC to the DLM
8. A normally open, single pole switch

The specific requirements of the equipment are given in the text of this section, 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. A "good source" is one that is within the voltage range shown in the **SPECIFICATIONS** section.

As an alternative, a three-phase electronic test source may be used. In many cases, these devices enable the test circuits to be simplified greatly.

DRAWINGS AND REFERENCES:

The following drawings should be used for reference during testing. They are located in the **PRODUCT DESCRIPTION** section and later in this **ACCEPTANCE TESTING** section.

Drawings:

1. The Elementary Diagram — Figure 1-1
2. Test Connection Diagrams — Figures 5-1 through 5-5

References:

1. **SOFTWARE** section of this manual
2. Default Settings in the **CALCULATION OF SETTINGS** section

EQUIPMENT GROUNDING

All equipment used in testing the DLM relay should be connected to a common grounding point to provide noise immunity. This includes the voltage and current sources, as well as the DLM itself.

The ground connection on the DLM is terminal AH14. The common for surge protection is terminal AH13. NOTE: AH13 should be connected to AH14 with #12 wire or larger during test as well as operation. (The separate surge ground is for High pot testing purposes.)

REQUIRED SETTINGS

Most tests will utilize the Default Settings. If setting changes are required, they will be listed prior to the test procedure.

GENERAL INSTRUCTIONS

1. Where appropriate, voltage and 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.

2. During the test, one or possibly more of the electronic current sources may not be used. If the source is not used it must be set to zero (0) in addition to being turned OFF. Also, the current sources should only be powered on or off with the currents set at or near zero (0).

3. The phase angles of the test sources are shown relative to phase A voltage. A positive (+) phase angle refers to the referenced quantity leading phase A voltage. A negative (-) phase angle refers to the referenced quantity lagging phase A voltage.

4. All test voltages are phase-to-ground measurements unless otherwise specified.

5. Typing an entry on the keypad will be shown as ["key"] where "key" is the alphanumeric label of the key to be pressed. For tests that require a setting change, the setting number will be shown in parentheses next to the setting to allow direct access to the setting. This is performed by pressing the [SET] key, the setting number (nnn), and [ENT]. The new setting can then be entered.

6. In most tests, fault distances are given. In some cases the distance calculated will be beyond the 100 mile default setting of the DLM. When that happens the distance will be displayed as "***" on the MMI, unless setting # (0308) BEYOND is set to YES.

At the end of testing, make sure that all settings are returned to initial values. Verify them before placing the DLM in service, by scrolling through all settings with the MMI Display.

SETTING CHANGES

Setting changes required for a particular test will be listed before the test. A sample setting change is shown below. Refer to the **INTERFACE** section for further details on making setting changes.

Setting change
Changing the Phase Overcurrent Pickup to 5.4 amps.

1. Apply rated DC and wait for relay initialization to complete, as indicated by the green LED on the MMI.
2. Press the [SET] "settings" key. Scroll with the arrow key until "SET: OVERCUR" is displayed, then press the [ENT] "enter" key.
3. Scroll through the OVERCUR settings until you get to "PUPH = #.#".
4. Type "5.4" on the keypad. The typed inputs will be shown on the MMI display at half intensity. This represents that a change is made but not yet entered.
5. When the correct value is entered, press the [ENT] "enter" key. The LED should turn red indicating that a setting has been altered, and the DLM is out of service.
6. To finalize the setting change, press the [END] "end" key followed by the [ENT] "enter" key. The MMI LED will return to green, indicating that the setting is in and the DLM is in service.

   If the "end" and the "enter" keys are not pressed after setting changes, the settings will not be stored into memory.

INITIAL TEST SETUP

Before beginning the test, the DLM settings should be verified. The factory settings are listed in the **CALCULATION OF SETTINGS** section. Scroll through each setting and make sure it matches the default setting listed.

For conducting tests with the MMI alone, see Tests 1-9. If using D-LINK, see below.

USING D-LINK (Optional)

To test the DLM without using the keypad, communication is accomplished via a PC with the program D-LINK. D-LINK is required to establish communications, change the password, and change settings for the tests. Then, current and voltages are applied to the DLM to simulate the desired system conditions.

The following section is intended to give a step by step procedure to test the DLM, from setting up communications to the application of the voltages and current inputs. It will be necessary to be familiar with the D-LINK software. Refer to the **SOFTWARE** section of this manual for information on how to use D-LINK.

HARDWARE SETUP

The hardware, specifically the cable to connect the PC to the relay, depends on the connection the PC requires and that of the DLM. The DLM port accepts a 25 pin male D-connector. The PC

used may require a 9 or a 25 pin connector. Null modem cables are shown in the **INTERFACE** section for connecting to the DLM with a 25-pin-to-25-pin setup.

Connect the PC to the DLM with the appropriate null modem cable.
See **INTERFACE** section for Cable diagrams.

DLM SETUP

Before shipment, the DLM is set with factory default settings. These include the Unit ID, the Baud Rate, and the Factory Password. The default communications parameters are:

Setting	Default (from the factory)
UNIT ID	0 (CONFIGURATION setting)
PASSWORD	DLM! (Remote Communication ACTION)
BAUD RATE	1200

If this is the first login to the relay, these parameters may need to be changed. The password must be changed before any functions except CHANGE PASSWORD or LOGOUT can be used. Refer to the **SOFTWARE** section of this manual.

PC SOFTWARE SETUP

The Software set up consists of loading the software on to the PC, starting the program, and configuring the program to the PORT and BAUD RATE of the PC and DLM.

Load & Start D-LINK

Use the INSTALLATION guide in the **SOFTWARE** section of this manual for directions to load D-LINK onto your PC.

Change directories to the location of the D-LINK program.

Start the program by typing "D-LINK" at the DOS prompt.

Set the Local PC Configuration

When you start D-LINK the MAIN MENU is displayed.

Select (using the arrow keys) the CONFIGURATION PARAMETERS heading by pressing the [ENT] key when that heading is highlighted.

The Configuration menu will now be displayed.

Select VIEW/CHANGE PC COMMUNICATIONS PORT and press the [ENT] key.

The default communications port will be displayed.

Type in the correct port number and press the [ENT] key or just press [ENT] if the PC port connected to the DLM matches the default displayed.

Set Up a Test Unit Description

The next step is to create a new "UNIT DESCRIPTION" that matches the DLM's BAUD RATE, PHONE NUMBER, and SWITCH CODE. The DLM is accessed locally during testing, therefore the PHONE NUMBER and the SWITCH CODE will be set to zeros. The BAUD RATE will be set to the factory setting of 1200.

Select the ADD UNIT DESCRIPTION heading from the CONFIGURATION PARAMETERS menu and press [ENT].

At the ENTER NEW UNIT DESCRIPTION prompt type "TEST" and press [ENT].

A new unit description called "TEST" is created and must now have parameters set for it.

Select the VIEW/CHANGE LOGIN DATA heading and press [ENT].

All of the unit descriptions will be listed.

Select the unit "TEST" and press [ENT].

The parameters PHONE NUMBER, SWITCH CODE, AND BAUD RATE will be displayed.

Select PHONE NUMBER and press [ENT].

After the prompt, type in 10 zeros and press [ENT]. (Ten zeros is the default used when there is no phone.)

Select SWITCH CODE and press [ENT].

After the prompt, type in "0" and press [ENT]. (This is the default value for no switch.)

Select BAUD RATE and press [ENT].

After the prompt, type in "1200" and press [ENT].

The Unit Description for "TEST" is complete.

Press [ESC] three times to return to the MAIN MENU.

LOGIN TO THE DLM

Select LOGIN from the MAIN MENU and press [ENT].

Select the relay login data for "TEST" and press [ENT].

D-LINK will prompt you for the password. If this is the first login to the relay, the password is "DLM!" and must be changed before any of the DLM functions except CHANGE PASSWORD and LOGOUT will operate. See the **SOFTWARE** section of this manual for information on how to change the password.

Type in the current password and press [ENT].

If the password is not known, refer to the **INTERFACE** section of this manual for information on how to display the current password.

D-LINK will prompt you for the unit ID.

Type in the unit ID (setting 101) and press [ENT].

D-LINK will respond with a "SUCCESSFUL LOGIN" message.

If this was an initial login, the user must logout at this point and login again in order to get a complete display of all the DLM menus.

Select LOGOUT from the MAIN MENU and press [ENT].

SETTING CHANGES

Setting changes required for a particular test will be listed before the test. A setting can be changed in two ways, by category or individually, by selecting either VIEW/CHANGE CATEGORY OF SETTINGS or VIEW/CHANGE INDIVIDUAL SETTINGS from the DLM SETTINGS menu. A procedure for and example of how to change settings is provided in the **SOFTWARE** section of this manual.

It is important to remember to select END SETTING CHANGES from the DLM SETTINGS menu after all settings changes for a particular test are completed. This is necessary because detection is turned off at the DLM whenever a setting is changed. (The LED on the MMI changes from green to red.) Selecting END SETTINGS CHANGES turns detection back on. (The LED changes back to green.)

SAVING AND VERIFYING INITIAL SETTINGS

Before beginning the test, the settings should be uploaded from the DLM and printed for reference and verification. The factory settings are listed in the **CALCULATION OF SETTINGS** section. Verify that each DLM setting matches the default setting listed. If no printer is available, use the VIEW/CHANGE CATEGORY OF SETTINGS command for verification.

Once uploaded, the current DLM settings can be saved to a disk file so that they can be reloaded back into the DLM when testing is completed. Use the SAVE DLM SETTINGS TO FILE command in the DLM SETTINGS menu. D-LINK will prompt you 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 the **SOFTWARE** section of this manual.

GENERAL TESTS

T1 - MMI DLM Status Check

The DLM's Status is reported through the MMI and the self-test alarm contact. If a system error caused monitoring functions to cease, the LED on the MMI would turn red and the self-test alarm contact would open. A failure that did not interrupt monitoring would be indicated by a "FAIL" message on the MMI display only.

The following test will demonstrate the use of the MMI to check DLM status. See the **SERVICING** section for further information.

1. Connect the DLM as shown in Figure 5-1. The AC inputs are not required for this test, only the DC power supply voltage. Apply rated DC power and wait for initialization to complete, as indicated by the green LED.

2. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

3. Press the [ENT] "enter" key.

   The display should be "STATUS OK". "OK" represents that the DLM is operational and there are no errors.

Failure Status

4. Change the setting of the undervoltage select: (501) SELUV = YES. For the purposes of this test only, do not press [END] and [ENT] after this setting change.

5. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

6. Press the [ENT] "enter" key.

   The display should be "STATUS: DET OFF".

   Detection in the DLM is turned off because a settings change has not been completed.

7. Change the undervoltage select setting back to: (501) SELUV = NO. This time, remember to press [END] and [ENT] after the setting change.

   Optional - For users testing with D-LINK

   8. Attempt to LOGIN to the DLM using an incorrect password. Do this three times.

   9. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

   10. Press the [ENT] "enter" key.

       The display should be "STATUS: WARN".

   11. Scroll with the arrow keys until the heading "FAIL: LOGIN FAILURE" is displayed.

   12. LOGIN with the correct password. The Login failure status will continue to be reported until a LOGOUT command is issued at the PC.

T1 - MMI test, (continued)

The MMI test is built into the software. It allows the user to test the keypad and the display.

1. Connect the DLM as shown in Figure 5-1. The AC inputs are not required for this test, only the DC power supply voltage. Apply rated DC power and wait for initialization to complete, as indicated by the green LED.

2. Press the [ACT] "action" key. Then scroll with the arrow keys until the heading "ACT: MMI TEST" is displayed.

3. Press the [ENT] "enter" key.

   The display should be eight fully lit rectangles, followed by the word "NEXT?".

4. Press the [1/Y] followed by the [ENT] key.

   The display will change to eight fully lit rectangles on the right of the display preceded by the word "LED TST?".

5. Press the [1/Y] followed by the [ENT] key.

   The green LED will momentarily turn red.

6. Next, the display will prompt you for the keyboard test with "KEYBRD TST?".

7. Press the [1/Y] key followed by the [ENT] key.

8. At this point the MMI is in the keyboard test. Press every key on the keypad, except for the [CLR] "clear" key. As you press each key, verify that the display indicates the key that was pressed. Example: pressing the up arrow would be displayed by the word "UP". The other keys will match the description that is on the key itself.

9. When all the keys have been checked, press the [CLR] key.

T2 - AC System Input Test

This initial test uses the "VALUES" function of the MMI to determine that the voltages and currents are applied to the proper connections on the terminal strip. The "VALUES" function can be used at any time during the test to verify that the DLM has the correct voltages and currents applied.

1. Connect the DLM as shown in Figure 5-2.

2. Set VA = 67 volts rms 0°, VB = 56 volts rms -125°, and VC = 45 volts rms 115°.

3. Press the [INF] "information" key on the MMI. Scroll with arrow keys to the "INF: VALUES" heading, then press the [ENT] key. The present values are now selected.

4. With the arrow keys, scroll through the values of Va, Vb, and Vc and verify that they are within ±2V of the voltage source setting. This verifies the connections of the voltage sources.

5. Set Iop = 1.0 amp rms 5° leading the voltage for phases Ia, Ib, or Ic, as shown by the "Y" connection point in Figure 5-1.

6. With the arrow keys, scroll to the value of Ia, Ib, or Ic depending on the "Y" connection. Verify that the current reading is between 0.9 and 1.1 amps rms.

7. Set VA = 67 volts rms 0°, VB = 67 volts rms -120°, and VC = 67 volts rms 120°.

8. With the arrow keys, scroll to the value of Wa, Wb, or Wc depending on the "Y" connection. Verify that the wattage reading is between 65 and 68 watts. Scroll to the value of Wt and verify that the wattage reading is also between 65 and 68 watts.

9. With the arrow keys, scroll to the value of VARa, VARb, or VARc depending on the "Y" connection. Verify that the VAR reading is between -8.0 and -4.0. Scroll to the value of VARt and verify that the reading is also between -8.0 and -4.0.

10. With the arrow keys, scroll to the value of PFa, PFb, or PFc depending on the "Y" connection. Verify that the PF reading is between 0.99 and 1.0. Scroll to the value of PFt and verify that the reading is also between 0.99 and 1.0.

11. Reduce the test current to zero (0) amps.

INTERNAL TRIGGERING TESTS

T3 - Ground Overcurrent Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = 20.0(4.0) AMP
(403) PUGR = 5.0(1.0) AMP

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.
2. Set VA = 39 volts rms 0° ; VB = 67 volts rms -120° ; VC = 67 volts rms +120° .
3. Apply Iop at the magnitude and angle shown in Table 5-1 for one second.

Table 5-1

Current RMS	I Degrees	DIST
5.2(1.1)	-85	72-78
8.0(1.6)	-55	39-45
10.0(2.0)	-25	16-22

Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC "DIST". Verify that "DIST" falls within the range shown in Table 5-1.

4. Repeat the test for phase BG and CG faults.

T4 - Phase Overcurrent Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = 5.0(1.0) AMP
(403) PUGR = 20.0(5.0) AMP

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.
2. Set VA = 47 volts rms 0° ; VB = 67 volts rms -120° ; VC = 67 volts rms +120° .
3. Apply Iop at the magnitude and angle shown in Table 5-2 for one second.

Table 5-2

Current RMS	I Degrees	DIST
5.2(1.1)	-85	88-94
8.0(1.6)	-55	48-54
10.0(2.0)	-25	20-26

Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC "DIST". Verify that "DIST" falls within the range shown in Table 5-2.

4. Repeat the test for phase BG and CG faults.

T5 - Overcurrent Dropout Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = 8.0(1.6) AMP
(403) PUGR = 20.0(2.0) AMP
(404) SELDO = YES

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.
2. Set VA = 39 volts rms 0° ; VB = 67 volts rms -120° ; VC = 67 volts rms +120° .
3. Apply Iop at 8.2(1.7) amps rms -25° continuously.

   Verify that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC 23 (+/- 3 mi).
4. Reduce Iop to zero (0).

   Note the new target indication. An AG overcurrent dropout fault will be displayed as: TRG AG OCD 23 (+/- 3 mi).
5. Repeat the test for phase BG and CG faults.

T6 - Undervoltage Test - Phase-to-Ground

Settings:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = YES
(502) UVLEV = 38 VOLT

1. Connect the DLM as shown in Figure 5-2 for the appropriate phase under test.
2. Set the voltage inputs to: VA = 48 volts rms 0° , VB = 67 volts rms -120° , and VC = 67 volts rms -240° .
3. Set the current of Iop to 3.5(0.7) amp rms -100° , and apply to the unit.
4. Reduce the voltage of the faulted phase to 37 volts rms.
5. Slowly reduce Iop to zero (0).

   Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG UV "DIST". The value for "DIST" will be inaccurate for the fault because it is calculated when current is first applied.
6. Repeat the test for phase BG and CG faults.

T7 - Undervoltage Test - Phase-to-Phase

Settings:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = YES
(502) UVLEV = 38

1. Connect the DLM as shown in Figure 5-3, for a phase AB, BC, or CA fault.
2. Set the voltage inputs to: VA = 42 volts rms 0°, VB = 42 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 5.0(1.0) amp rms -70°, and apply to the unit.
4. Simultaneously reduce the voltage of the faulted phases to 31 volts rms.
5. Reduce Iop to zero (0).

   Note that the target indication concurs with the fault. An AB fault will be displayed as: TRG AB UV "DIST". The value of "DIST" will be inaccurate for the fault because it is calculated when current is first applied.
6. Repeat the test for phase BC and CA faults.

5

EXTERNAL TRIGGERING TESTS

T8 - External triggering - Phase-to-Ground

Settings Changes:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = NO

1. Connect the DLM as shown in Figure 5-4, for a phase AG fault.
2. Set the voltage inputs to: VA = 27 volts rms 0°, VB = 67 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 4.6(0.9) amp rms -100°, and apply to the unit.
4. Momentarily close the switch on the input to CCI1.

   Verify that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG CCI 57 mi (+/- 3 mi).
5. Reduce Iop to zero (0).
6. Repeat the test for all contact inputs.

T9 - External Triggering - Phase-to-Phase

Settings Changes:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = NO

1. Connect the DLM as shown in Figure 5-5, for an AB fault.
2. Set the voltage inputs to: VA = 18 volts rms 0°, VB = 18 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 5.0(1.0) amp rms -55°, and apply to the unit.
4. Momentarily close the switch on the input to CCI1.

   Note that the target indication concurs with the fault. An AB fault will be displayed as: TRG AB CCI 52 mi (+/- 3 mi).
5. Reduce Iop to zero (0).
6. Repeat the test for all contact inputs.

T10 - Transducer Input Tests

Settings changes: None

1. Connect the DLM as shown in Figure 5-6.
2. Set the precision source to the low range setting of -10.00 VDC (**X1RANGE LOW**). Verify that the DLM reads between 99200 and 100000. The transducer value may be found by following these key strokes: Press the INF key. Scroll to VALUES. Press ENT. Scroll to the desired transducer input with the arrow keys. To update the value displayed, press the ENT key.
3. Set the precision source to 0.00 VDC. The DLM should read between -800 and 800.
4. Set the precision source to +10.00 VDC (**X1RANGE HIGH**). Check that the DLM reads between 99200 to 100000.
5. Repeat steps 2 through 5 for Transducer inputs 2 through 6 substituting the appropriate channel settings into each equation.

END OF TEST

Scroll through all of the settings. Compare them with the initial Settings of the relay, and change to initial values.

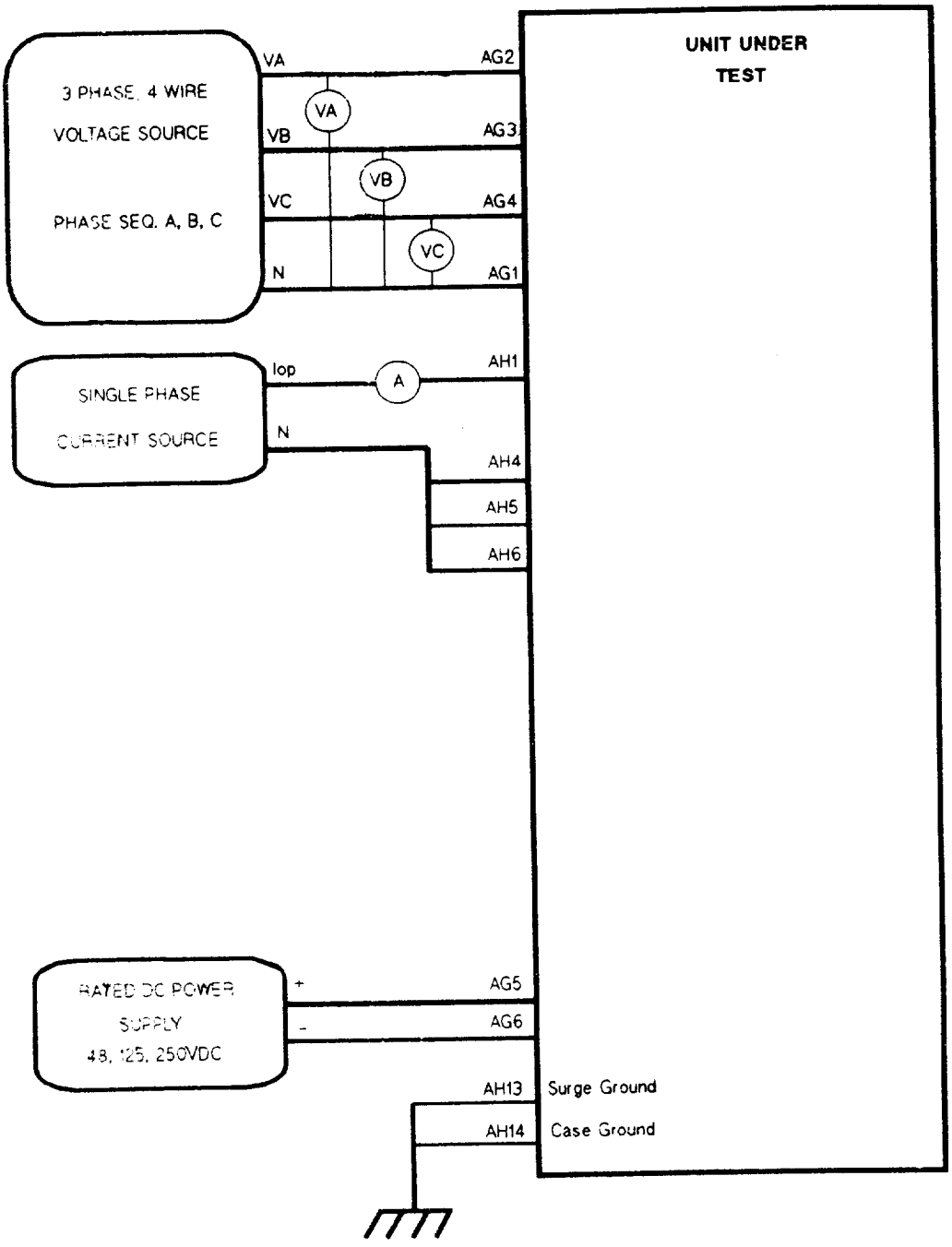
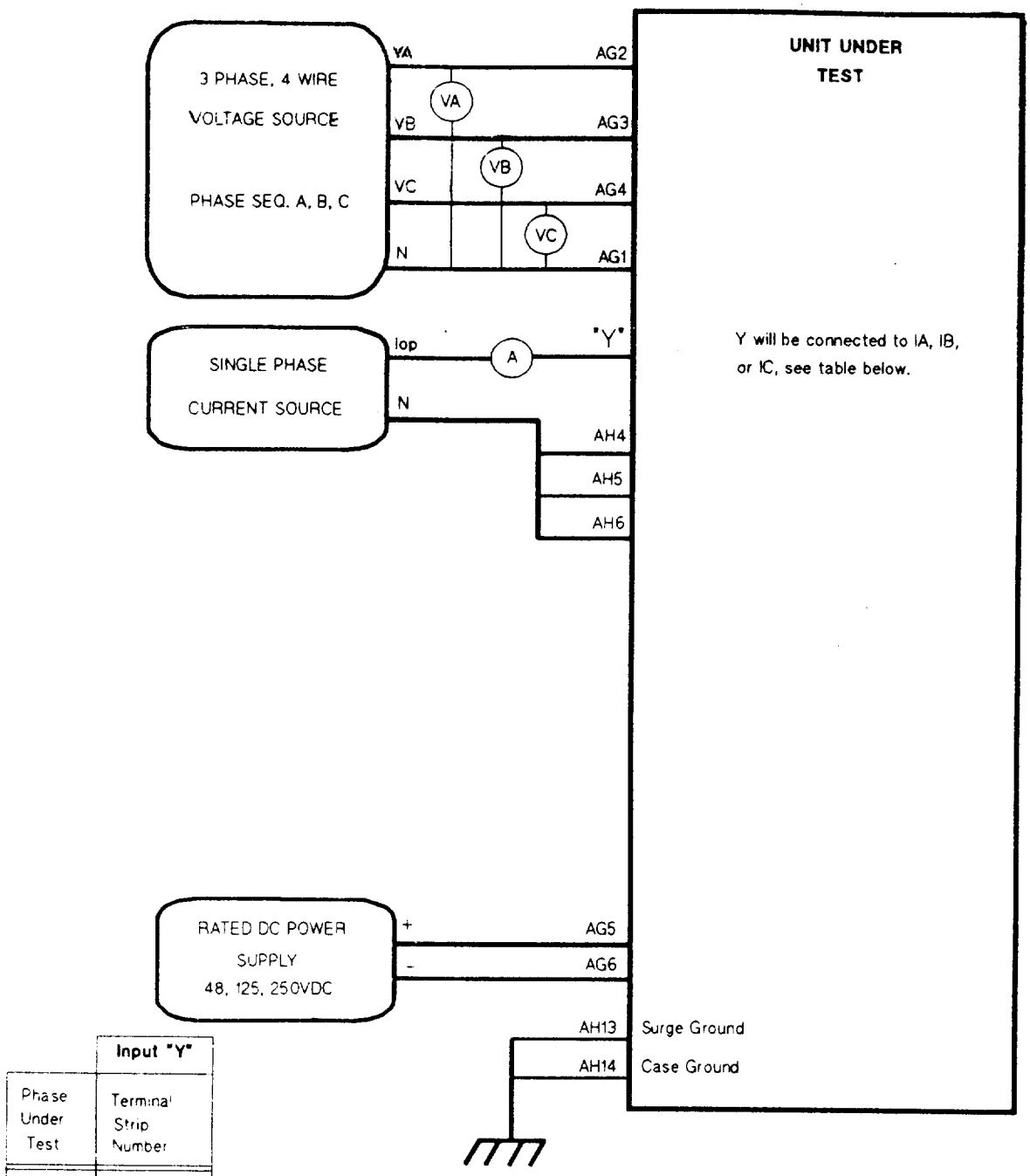
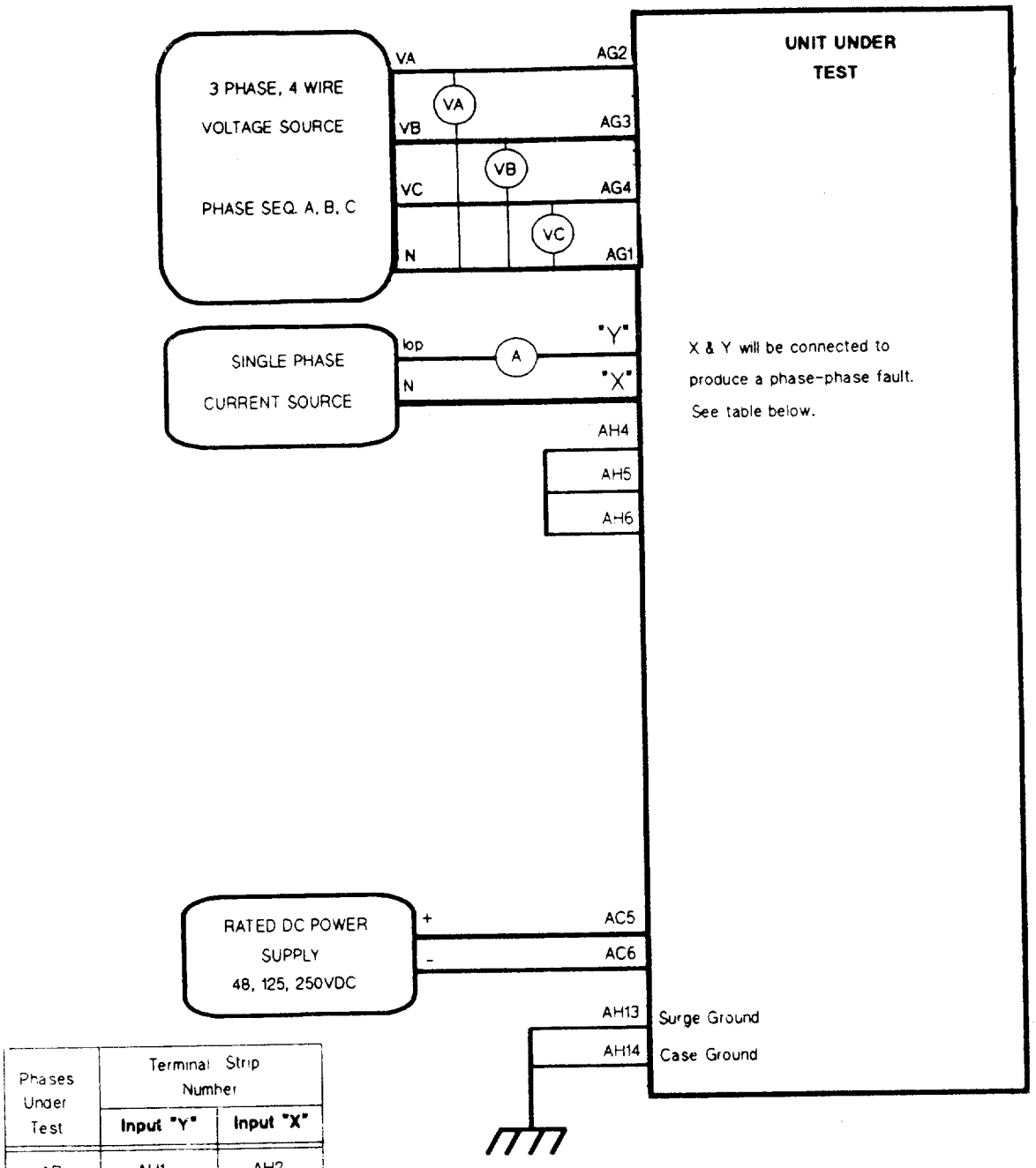


Figure 5-1 (0286A3819 Sh.1 [1]) AC Input Test Connections



	Input "Y"
Phase Under Test	Terminal Strip Number
IA	AH1
IB	AH2
IC	AH3

Figure 5-2 (0286A3819 Sh.2 [1]) Single Phase Current Test Connections



Phases Under Test	Terminal Strip Number	
	Input "Y"	**Input "X"**
AB	AH1	AH2
BC	AH2	AH3
CA	AH3	AH1

Figure 5-3 (0286A3819 Sh.3 [1]) Phase-to-Phase Test Connections

CCI#	Terminal Strip Number "X"	"Y"
1	AA1	AA2
2	AA3	AA4
3	AA6	AA7
4	AA8	AA9
5	AA11	AA12
6	AA13	AA14
7	AE1	AE2
8	AE3	AE4
9	AE6	AE7
10	AE8	AE9
11	AE11	AE12
12	AE13	AE14
13	AB1	AB2
14	AB3	AB4
15	AB6	AB7
16	AB8	AB9
17	AB11	AB12
18	AB13	AB14
19	AF1	AF2
20	AF3	AF4
21	AF6	AF7
22	AF8	AF9
23	AF11	AF12
24	AF13	AF14

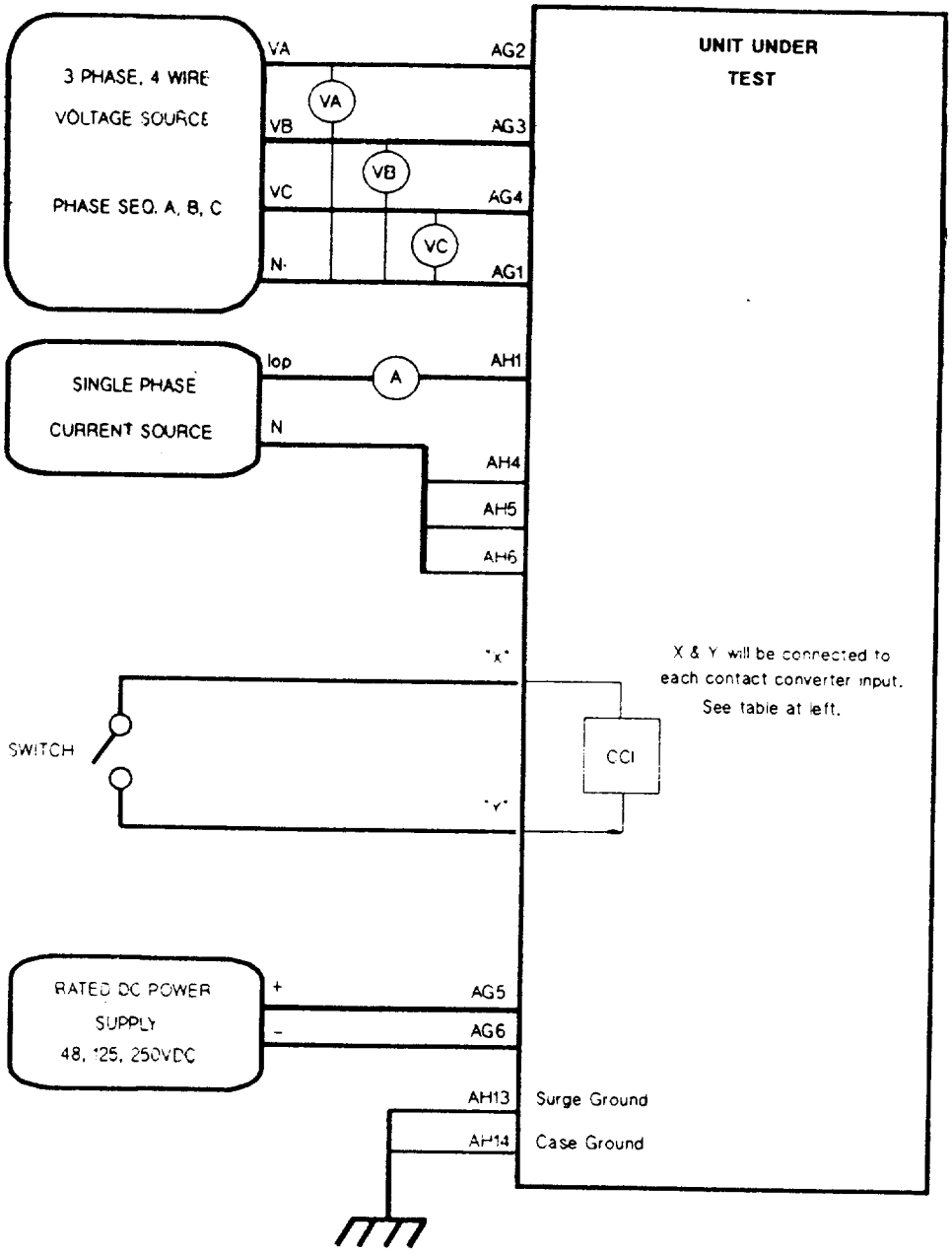


Figure 5-4 (0286A3819 Sh.4 [1]) Phase-to-Ground CCI Test Connections

CCI#	Terminal Strip Number "X"	"Y"
1	AA1	AA2
2	AA3	AA4
3	AA6	AA7
4	AA8	AA9
5	AA11	AA12
6	AA13	AA14
7	AE1	AE2
8	AE3	AE4
9	AE6	AE7
10	AE8	AE9
11	AE11	AE12
12	AE13	AE14
13	AB1	AB2
14	AB3	AB4
15	AB6	AB7
16	AB8	AB9
17	AB11	AB12
18	AB13	AB14
19	AF1	AF2
20	AF3	AF4
21	AF6	AF7
22	AF8	AF9
23	AF11	AF12
24	AF13	AF14

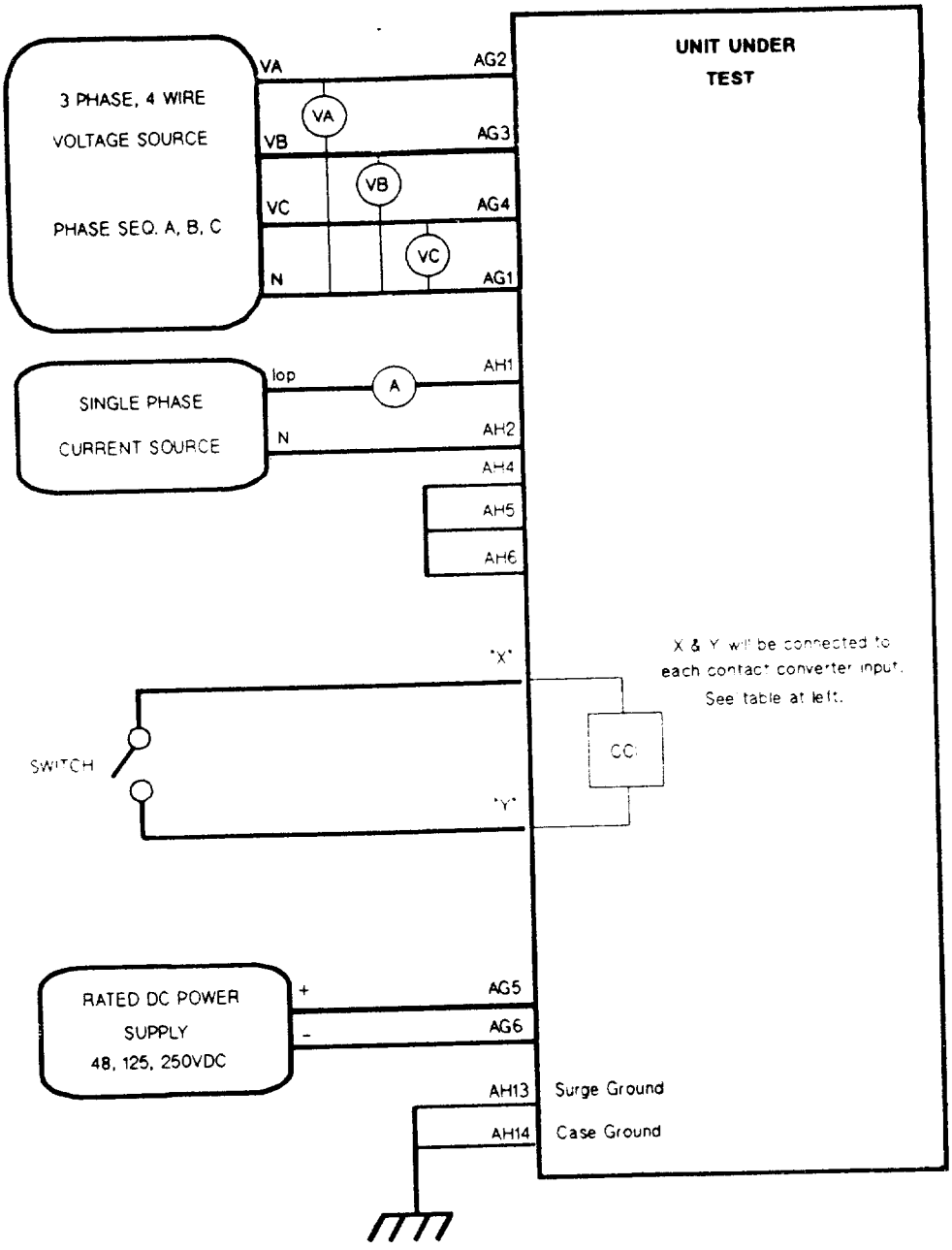


Figure 5-5 (0286A3819 Sh.5 [1]) Phase-to-Phase CCI Test Connections

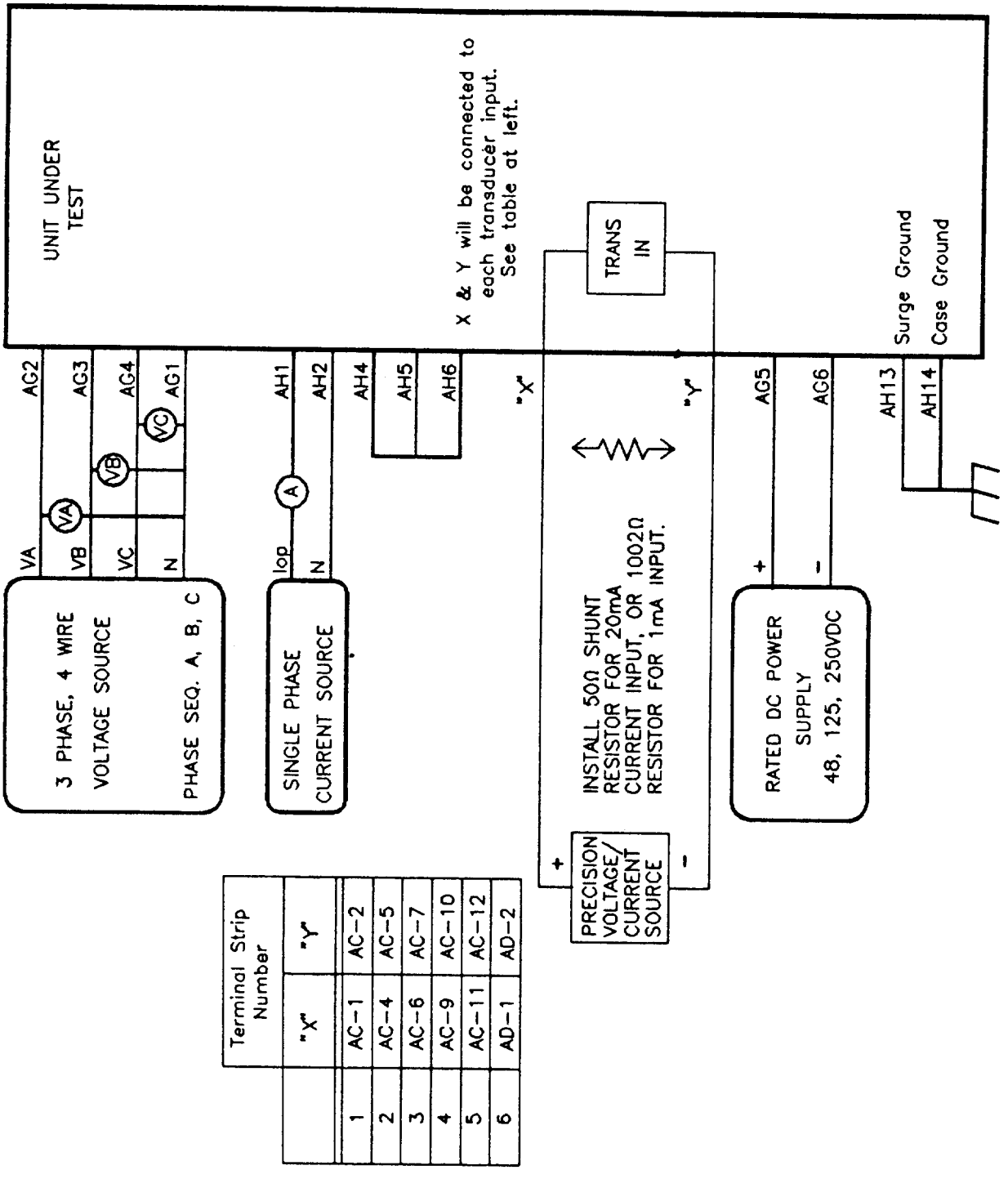


Figure 5-6 (0286A3819 Sh.6 [1]) Transducer Input Tests

PERIODIC TESTS

CAUTION

Power Down the DLM before removing or inserting modules. Failure to do so can permanently damage the unit.

GENERAL

This section is a guide for testing the DLM. The DLM is a digital fault concentrator controlled by "self checking" software. If a system failure is detected it will be reported through the MMI.

The following tests include: DLM status self test and display and MMI self test. Tests of triggering functions are also included and can be performed at the users discretion.

General Tests

T1 MMI Status and Display Tests (Self Tests)
T2 AC System Input Test

Internal Triggering Tests

T3 Ground Overcurrent
T4 Phase Overcurrent Test
T5 Overcurrent Dropout Test
T6 Undervoltage Test - Phase-to-Ground
T7 Undervoltage Test - Phase-to-Phase

External Triggering Tests

T8 Phase-to-Ground
T9 Phase-to-Phase

Transducer Tests

T10 Transducer Input Tests

TEST EQUIPMENT

1. Three-phase source of voltage and current at rated frequency
2. DC Control voltage source
3. Three AC voltmeters
4. An AC ammeter
5. A continuity tester or Ohm meter
6. An IBM compatible computer with a serial port
7. An RS232 null modem cable to connect the PC to the DLM
8. A normally open, single pole switch

The specific requirements of the equipment are given in the text of this section, 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. A "good source" is one that is within the voltage range shown in the **SPECIFICATIONS** section.

As an alternative, a three-phase electronic test source may be used. In many cases, these devices enable the test circuits to be simplified greatly.

DRAWINGS AND REFERENCES:

The following drawings should be used for reference during testing. They are located in the **PRODUCT DESCRIPTION** section and later in this section.

Drawings:

1. The Elementary Diagram — Figure 1-1
2. Test Connection Diagrams — Figures 5-1 through 5-5

References:

1. **SOFTWARE** section of this manual
2. Default Settings in the **CALCULATION OF SETTINGS** section

EQUIPMENT GROUNDING

All equipment used in testing the DLM relay should be connected to a common grounding point to provide noise immunity. This includes the voltage and current sources, as well as the DLM itself.

The ground connection on the DLM is terminal AH14. The common for surge protection is terminal AH13. NOTE: AH13 should be connected to AH14 with #12 wire or larger during test as well as operation. (The separate surge ground is for High pot testing purposes.)

REQUIRED SETTINGS

Most tests will utilize the your Settings. If setting changes are required, they will be listed prior to the test procedure.

GENERAL INSTRUCTIONS

1. Where appropriate, voltage and 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.

2. During the test, one or possibly more of the electronic current sources may not be used. If the source is not used it must be set to zero (0) in addition to being turned OFF. Also, the current sources should only be powered on or off with the currents set at or near zero (0).

3. The phase angles of the test sources are shown relative to phase A voltage. A positive (+) phase angle refers to the referenced quantity leading phase A voltage. A negative (-) phase angle refers to the referenced quantity lagging phase A voltage.

4. All test voltages are phase-to-ground measurements unless otherwise specified.

5. Typing an entry on the keypad will be shown as ["key"] where "key" is the alphanumeric label of the key to be pressed. For tests that require a setting change, the setting number will be shown in parentheses next to the setting to allow direct access to the setting. This is performed by pressing the [SET] key, the setting number (nnn), and [ENT]. The new setting can then be entered.

6. In most tests, fault distances are given. In some cases the distance calculated will be beyond the 100 mile default setting of the DLM. When that happens the distance will be displayed as "***" on the MMI, unless setting # (0308) BEYOND is set to YES.

At the end of testing, make sure that all settings are returned to initial values. Verify them before placing the DLM in service, by scrolling through all settings with the MMI Display.

SETTING CHANGES

Setting changes required for a particular test will be listed before the test. A sample setting change is shown below. Refer to the **INTERFACE** section for further details on making setting changes.

Setting change
Changing the Phase Overcurrent Pickup to 5.4 amps.

1. Apply rated DC and wait for relay initialization to complete, as indicated by the green LED on the MMI.
2. Press the [SET] "settings" key. Scroll with the arrow key until "SET: OVERCUR" is displayed, then press the [ENT] "enter" key.
3. Scroll through the OVERCUR settings until you get to "PUPH = #.#".
4. Type "5.4" on the keypad. The typed inputs will be shown on the MMI display at half intensity. This represents that a change is made but not yet entered.
5. When the correct value is entered, press the [ENT] "enter" key. The LED should turn red indicating that a setting has been altered, and the DLM is out of service.
6. To finalize the setting change, press the [END] "end" key followed by the [ENT] "enter" key. The MMI LED will return to green, indicating that the setting is in and the DLM is in service.

   If the "end" and the "enter" keys are not pressed after setting changes, the settings will not be stored into memory.

INITIAL TEST SETUP

Before beginning the test, the DLM settings should be verified. Scroll through each setting and make sure it matches the default setting listed.

For conducting tests with the MMI alone, see Tests 1-9. If using D-LINK, see below.

USING D-LINK (Optional)

Refer to the acceptance section of this instruction book for an example of using D-LINK while testing the relay.

HARDWARE SETUP

The hardware, specifically the cable to connect the PC to the relay, depends on the connection the PC requires and that of the DLM. The DLM port accepts a 25 pin male D-connector. The PC used may require a 9 or a 25 pin connector. Null modem cables are shown in the **INTERFACE** section for connecting to the DLM with a 25-pin-to-25-pin setup.

Connect the PC to the DLM with the appropriate null modem cable.
See **INTERFACE** section for Cable diagrams.

DLM SETUP

Before shipment, the DLM is set with factory default settings. These include the Unit ID, the Baud Rate, and the Factory Password. The default communications parameters are:

Setting	Default (from the factory)
UNIT ID	0 (CONFIGURATION setting)
PASSWORD	DLM! (Remote Communication ACTION)
BAUD RATE	1200

If this is the first login to the relay, these parameters may need to be changed. The password must be changed before any functions except CHANGE PASSWORD or LOGOUT can be used. Refer to the **SOFTWARE** section of this manual.

PC SOFTWARE SETUP

The Software set up consists of loading the software on to the PC, starting the program, and configuring the program to the PORT and BAUD RATE of the PC and DLM.

GENERAL TESTS

T1 - MMI DLM Status Check

The DLM's Status is reported through the MMI and the self-test alarm contact. If a system error caused monitoring functions to cease, the LED on the MMI would turn red and the self-test alarm contact would open. A failure that did not interrupt monitoring would be indicated by a "FAIL" message on the MMI display only.

The following test will demonstrate the use of the MMI to check DLM status. See the **SERVICING** section for further information.

1. Connect the DLM as shown in Figure 5-1. The AC inputs are not required for this test, only the DC power supply voltage. Apply rated DC power and wait for initialization to complete, as indicated by the green LED.

2. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

3. Press the [ENT] "enter" key.

   The display should be "STATUS OK". "OK" represents that the DLM is operational and there are no errors.

Failure Status

4. Change the setting of the undervoltage select: (501) SELUV = YES. For the purposes of this test only, do not press [END] and [ENT] after this setting change.

5. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

6. Press the [ENT] "enter" key.

   The display should be "STATUS: DET OFF".

   Detection in the DLM is turned off because a settings change has not been completed.

7. Change the undervoltage select setting back to: (501) SELUV = NO. This time, remember to press [END] and [ENT] after the setting change.

Optional - For users testing with D-LINK

8. Attempt to LOGIN to the DLM using an incorrect password. Do this three times.

9. Press the [INF] "information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.

10. Press the [ENT] "enter" key.

    The display should be "STATUS: WARN".

11. Scroll with the arrow keys until the heading "FAIL: LOGIN FAILURE" is displayed.

12. LOGIN with the correct password. The Login failure status will continue to be reported until a LOGOUT command is issued at the PC.

T1 - MMI test, (continued)

The MMI test is built into the software. It allows the user to test the keypad and the display.

1. Connect the DLM as shown in Figure 5-1. The AC inputs are not required for this test, only the DC power supply voltage. Apply rated DC power and wait for initialization to complete, as indicated by the green LED.

2. Press the [ACT] "action" key. Then scroll with the arrow keys until the heading "ACT: MMI TEST" is displayed.

3. Press the [ENT] "enter" key. The display should show eight fully lit rectangles, followed by the word "NEXT?".

4. Press the [1/Y] followed by the [ENT] key.

   The display will change to eight fully lit rectangles on the right of the display preceded by the word "LED TST?".

5. Press the [1/Y] followed by the [ENT] key.

   The green LED will momentarily turn red.

6. Next, the display will prompt you for the keyboard test with "KEYBRD TST?".

7. Press the [1/Y] key followed by the [ENT] key.

8. At this point the MMI is in the keyboard test. Press every key on the keypad, except for the [CLR] "clear" key. As you press each key, verify that the display indicates the key that was pressed. Example: pressing the up arrow would be displayed by the word "UP". The other keys will match the description that is on the key itself.

9. When all the keys have been checked, press the [CLR] key.

T2 - AC System Input Test

This initial test uses the "VALUES" function of the MMI to determine that the voltages and currents are applied to the proper connections on the terminal strip. The "VALUES" function can be used at any time during the test to verify that the DLM has the correct voltages and currents applied.

1. Connect the DLM as shown in Figure 5-2.
2. Set VA = 67 volts rms 0°, VB = 56 volts rms -125°, and VC = 45 volts rms 115°.
3. Press the [INF] "information" key on the MMI. Scroll with arrow keys to the "INF: VALUES" heading, then press the [ENT] key. The present values are now selected.
4. With the arrow keys, scroll through the values of Va, Vb, and Vc and verify that they are within ±2V of the voltage source setting. This verifies the connections of the voltage sources.
5. Set Iop = 1.0 amp rms 5° leading the voltage for phases Ia, Ib, or Ic, as shown by the "Y" connection point in Figure 5-1.
6. With the arrow keys, scroll to the value of Ia, Ib, or Ic depending on the "Y" connection. Verify that the current reading is between 0.9 and 1.1 amps rms.
7. With the arrow keys, scroll to the value of Wa, Wb, or Wc depending on the "Y" connection. Verify that the wattage reading is between 65 and 68 watts. Scroll to the value of Wt and verify that the wattage reading is also between 65 and 68 watts.
8. With the arrow keys, scroll to the value of VARa, VARb, or VARc depending on the "Y" connection. Verify that the VAR reading is between -8.0 and -4.0. Scroll to the value of VARt and verify that the reading is also between -8.0 and -4.0.
9. With the arrow keys, scroll to the value of PFa, PFb, or PFc depending on the "Y" connection. Verify that the PF reading is between 0.99 and 1.0. Scroll to the value of PFt and verify that the reading is also between 0.99 and 1.0.
10. Reduce the test current to zero (0) amps.

INTERNAL TRIGGERING TESTS

T3 - Ground Overcurrent Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = [_____]A (Set 20% higher than setting 403, PUPH=PUGR+(.2*PUGR)
(403) PUGR = [_____]A (Your in service setting)

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.
2. Set VA = 39 volts rms 0°; VB = 67 volts rms -120°; VC = 67 volts rms +120°.

3. Apply Iop at a magnitude 5% greater than setting 403 at -85ø for one second, by using the following equation:

$$IOP = PUGR + (.05 * PUGR)$$

Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC "DIST". The "DIST" value is for reference only.

4. Repeat the test for phase BG and CG faults.

T4 - Phase Overcurrent Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = [_____]A (Your in service setting)
(403) PUGR = [_____]A (Set 20% higher than setting 402, PUGR=PUPH+(.2*PUPH)

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.

2. Set VA = 39 volts rms 0° ; VB = 67 volts rms -120° ; VC = 67 volts rms +120° .

3. Apply Iop at a magnitude 5% greater than setting 403 at -85ø for one second, as shown in the following equation.

$$IOP = PUPH + (.05 * PUPH)$$

Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC "DIST". The "DIST" value is for reference only.

4. Repeat the test for phase BG and CG faults.

6

T5 - Overcurrent Dropout Test

Settings:
OVERCUR
(401) SELOC = YES
(402) PUPH = [_____]A (Your in service setting)
(403) PUGR = [_____]A (Set 20% higher than setting 402, PUGR=PUPH+(.2*PUPH)
(404) SELDO = YES

1. Connect the relay as shown in Figure 5-2 for the appropriate phase under test.

2. Set VA = 39 volts rms 0° ; VB = 67 volts rms -120° ; VC = 67 volts rms +120° .

3. Apply Iop at a magnitude 5% greater than setting 403 at -85ø continuouslyas shown in the following equation:

$$IOP = PUPH + (.05 * PUPH)$$

Verify that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG OC "DIST"

4. Reduce Iop to zero (0).

Note the new target indication. An AG overcurrent dropout fault will be displayed as: TRG AG OCD "DIST".

5. Repeat the test for phase BG and CG faults.

T6 - Undervoltage Test - Phase-to-Ground

Settings:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = YES
(502) UVLEV = [_____]VOLT

1. Connect the DLM as shown in Figure 5-2 for the appropriate phase under test.
2. Set the voltage inputs to: VA = 67 volts rms 0°, VB = 67 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 3.5(0.7) amp rms -100°, and apply to the unit.
4. Reduce the voltage of the faulted phase 5% below the value for setting 502.
5. Reduce Iop to zero (0).

   Note that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG UV "DIST". The value for "DIST" will be inaccurate for the fault because it is calculated when current is first applied.

6. Repeat the test for phase BG and CG faults.

T7 - Undervoltage Test - Phase-to-Phase

Settings:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = YES
(502) UVLEV = [_____]VOLT

1. Connect the DLM as shown in Figure 5-3, for a phase AB, BC, or CA fault.
2. Set the voltage inputs to: VA = 67 volts rms 0°, VB = 42 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 5.0(1.0) amp rms -70°, and apply to the unit.
4. Simultaneously reduce the voltage of the faulted phase pair to a value at least 20% below setting 502, as shown in the following equation:

   VOP=UVLEV-(UVLEV*.2)

5. Reduce Iop to zero (0).

   Note that the target indication concurs with the fault. An AB fault will be displayed as: TRG AB UV "DIST". The value of "DIST" will be inaccurate for the fault because it is calculated when current is first applied.

6. Repeat the test for phase BC and CA faults.

EXTERNAL TRIGGERING TESTS

T8 - External triggering - Phase-to-Ground

Settings Changes:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = NO

1. Connect the DLM as shown in Figure 5-4, for a phase AG fault.
2. Set the voltage inputs to: VA = 40% less than setting 502, 0°, VB = 67 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 4.6(0.9) amp rms -100°, and apply to the unit.
4. Momentarily close the switch on the input to CCI1.

   Verify that the target indication concurs with the fault. An AG fault will be displayed as: TRG AG CCI "DIST"
5. Reduce Iop to zero (0).
6. Repeat the test for all contact inputs.

T9 - External Triggering - Phase-to-Phase

Settings Changes:
OVERCUR
(401) SELOC = NO
UNDERVOL
(501) SELUV = NO

1. Connect the DLM as shown in Figure 5-5, for an AB fault.
2. Set the voltage inputs to: VA = 18 volts rms 0°, VB = 18 volts rms -120°, and VC = 67 volts rms -240°.
3. Set the current of Iop to 5.0(1.0) amp rms -55°, and apply to the unit.
4. Momentarily close the switch on the input to CCI1.

   Note that the target indication concurs with the fault. An AB fault will be displayed as: TRG AB CCI 52 mi (+/- 3 mi).
5. Reduce Iop to zero (0).
6. Repeat the test for all contact inputs.

T10 - Transducer Input Tests

Settings changes:
NONE

1. Connect the DLM as shown in Figure 5-6.

2. If a current input is required, install the appropriate shunts on the inputs to be driven by current signals as specified in figure AT-6.

3. Set the precision source to the low range setting (**X1RANGE LOW**). Check that the DLM reads the correct value within ±0.4% of full scale. The tolerance is calculated for each channel by using the following equation:

   Zero test Tolerance = **X1ZERO** ± (.004*X1FULL)

4. Set the precision source to .5(**X1RANGE** High value (Input = .5***X1RANGE**). This value will be the midpoint of the transducer input level. Check that the DLM reads the correct value within ±0.4% of full scale. The tolerance is calculated for each channel by using the following equation:

   Mid Range test Tolerance = (.5***X1RANGE HIGH** + **X1RANGE LOW**) ± (.004***X1FULL**)

5. Set the precision source to **X1RANGE** High value. Check that the DLM reads the correct value within ±0.4% of full scale. The tolerance is calculated for each channel by using the following equation:

   Full Scale test Tolerance = **X1FULL** ± (.004***X1FULL**)

6. Repeat steps 2 through 5 for Transducer inputs 2 through 6 substitute the appropriate channel settings into each equation.

END OF TEST

Scroll through all of the settings. Compare them with the initial Settings of the relay, and change to initial values.

SERVICING

SPARES

There are two possible servicing methods for the DLM. They are: spare module replacement and component level repair. The preferred method is module replacement using the DLM's automatic self-tests to isolate failed modules. When the defective module is found, it can be replaced with a spare, and the system can be returned to service. This method typically yields the shortest "down time" of the system. To further reduce "down time" it is recommended that a complete set of spare modules be kept at the maintenance center.

It is not recommended that the DLM be serviced at the component level. This requires a substantial investment in test/repair equipment, and in technical expertise, and usually results in longer "down times" than module replacement. For those who do wish to trouble-shoot to the component level, drawings can be obtained by requesting them from the factory. When requesting drawings, the following information must be supplied to the factory:

1. The model number of the module. This is found on the lower part of the front nameplate of each module, e.g. MGM812.

2. The assembly number of the module. This is found on the component side of the printed circuit board. It is an eight digit number with a letter inserted between the fourth and fifth digit and suffixed with a group identification, e.g. 0215B8090G001.

3. The revision number. This is found on the printed circuit board adjacent to the assembly number of the board.

CAUTION

Power down the DLM before removing or inserting modules. Failure to do so can permanently damage the unit.

SERVICING WITH THE UNIT SELF-TEST

The DLM automatically performs tests of major functions and critical hardware components and reports their status via the MMI Display/LED and the self-test alarm contacts. Any detected failure will operate the self-test alarm contact and the MMI LED. Also, a "FAIL" message is written to the MMI display.

The first level indicates severe monitoring failures. These **fatal** failures indicate that the unit is not capable of gathering oscillography information or calculating the accurate distance to a fault. Communications and MMI will be initialized if possible to facilitate diagnostic activity. If only communications and MMI are functional, the mode of the DLM is classified as **limited operation**.

The second level indicates **non-fatal** monitoring failures. These failures are less severe and the unit is still providing some degree of functionality. Examples of this condition are failed transducer input board or a failed communications chip.

The third level of self-test failure is in response to external signals. In this case, the DLM is fully operational. The alarms are activated to make the operators aware of unusual operating conditions. Failures of this type are referred to as **system status** errors. The single example of this type of failure in the DLM self-test is if three attempts are made to log into the DLM with an invalid password.

The types of self-tests performed are described in the **PRODUCT DESCRIPTION** section of this manual. The components tested during the start-up self-tests are listed in Table 7-1. The components tested during run time background and foreground self-tests are listed in Tables 7-2 and SE-3, respectively.

Table 7-1 Start-Up Self Tests

COMPONENT	METHOD	NATURE
PROM	CRC-type check	Fatal
RAM	Patterns to check for stuck bits, stuck address lines, cross-talk between adjacent bits	Fatal
Non-volatile RAM	CRC-type check on settings and analog calibration area; Checksum on disturbance storage area	Limited operation if settings or calibration storage area. Non-fatal otherwise
Timer Chip	Test all processor timers and their interrupts	Fatal
Interrupt Chips	Test all processor and external Interrupt Controllers	Fatal
Serial Communications	Wrap around and Interrupt tests for serial interface	Non-Fatal
A/D Controller	Reference channel check	Limited Operation
Digital Output Circuitry	Loop-back via parallel port	Non-Fatal
Digital Input Circuitry	Input signals forced high or low	Limited Operation
Real Time Clock	Test of real time clock Operation and Interrupts	Non-Fatal
LED display	Self-test built in by manufacturer	Non-Fatal

Table 7-2 Run Time Background Self Tests

COMPONENT	METHOD	NATURE
PROM	CRC-type check	Fatal, Restart
RAM	CRC-type check on areas holding settings	Fatal, Restart
Non-volatile RAM	CRC-type check on settings area; checksum on disturbance or event storage area	Fatal if settings area but will run. Non-fatal otherwise.
Timer Chip	Test that all timers are counting	Fatal, Restart

Table 7-3 Run Time Foreground Self Tests

COMPONENT	METHOD	NATURE
A/D Controller	Reference channel check	Fatal, but will continue
Digital Input Circuitry	Input signals forced high and low	Fatal, Restart
Digital Output Circuitry	Loop-back via parallel port	Non-Fatal, Restart
MMI	Operator-initiated, visual feedback	Non-Fatal

7

TROUBLE SHOOTING

Trouble shooting the DLM requires three steps. The first step is to determine the type of failure. The type is either a fatal, non-fatal, or a system-status failure. Next, the list of failure codes or the "Information Status" command is used to determine what module is defective. Lastly, the defective module is replaced in accordance with safety and static-discharge precautions.

The trouble shooting sections are as follows:

1. Servicing a Fatal Failure
2. Servicing a Non-Fatal Failure
3. Servicing a System Status Failure

NOTE: Refer to the **ACCEPTANCE TEST** section for test of the MMI display, keypad.

Using the Information Status Command

Tables have been provided in the SERVICING A FATAL FAILURE and SERVICING A NON-FATAL FAILURE sections below. They can be used to decode "Fail xxx" codes. The "Information Status" command can also be used to extract the same data from the MMI display without looking up the code on the table. The "Information Status" command can be used at the DLM site or remotely over a modem link.

The INFORMATION STATUS command is invoked as follows:

1. Apply rated DC power to the DLM and wait for initialization to complete.
2. Press the "Information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed.
3. Press the [ENT] "enter" key.

   The display will indicate that there is a failure with the words "STATUS: FAIL". Otherwise it will display "STATUS: OK".
4. Press the "Up Arrow" key to get a detailed report of the failure. A complete list of the possible errors is shown in Table 7-4, below.

NOTE: After initial power up or loss of power exceeding 24 hours, the time and date will reset to 00:00:00 01/01/90. All event and disturbance data will be reset.

Table 7-4 Error Messages

	Description
SYSTEM STATUS ERROR	
LOGIN FAILURE	Incorrect password used over three times
FAILURE MESSAGES	
ATI BOARD: ATI Inconsistency	
CCI BOARD: Status	
ANI BOARD: Controller Failure	
ANI BOARD: Serial NVM Failure	
ANI BOARD: Reference Failure	
MGM BOARD: Serial NVM Failure	
MGM BOARD: Model Number Failure	
FSP BOARD: PROM Failure	
FSP BOARD: RAM Failure	
FSP BOARD: Interrupt Failure	
FSP BOARD: EEPROM Failure	
FSP BOARD: Version Number Failure	
FSP BOARD: Timer Failure	
FSP BOARD: CAPRAM Failure	
FSP BOARD: Real Time Clock Failure	

Table 7-4 Error Messages, continued

FAILURE MESSAGES, continued

MMI BOARD: Digital Output Failure
MMI BOARD: Serial chip failure
MMI BOARD: LED display failure

Remote Comm - Login failed

SERVICING A FATAL FAILURE

A fatal failure indicates total interruption of the ability of the unit to gather oscillography data, calculate RMS quantities or return digital status information. When a fatal failure occurs on one of the modules (excluding the power supply) the self-test alarm contact will operate (either open or close, based on jumper position) and the MMI LED will turn red. Remove and re-apply the DC power to bring up the fail message on the display. If the DLM successfully restarts, the LED will turn green.

The Fail message has the format "FAIL xxx". The "xxx" field following the word "FAIL" is the numeric code that indicates the nature of the critical failure. The Fail message remains on the display until a key is pressed or until the DLM restarts successfully (with no self-test failures). See Table 7-5 for the list of Failure codes and their meanings.

NOTE: As an alternative, the "Information Status" command can be used to display the failure type directly on the MMI.

Locating the defective module

Use the table below, or the "Information Status" command, to isolate the cause of the failure. When the suspected module is found, power down the unit and replace it. Re-apply power. If the "FAIL" message is gone then the unit has been successfully repaired. If the message has changed it is possible that another module requires replacement.

Table 7-5 Fatal Failure Messages

CODE		Description
227	CCI BOARD:	Digital Input Failure
311	ANI BOARD:	Controller Failure
312	ANI BOARD:	Serial NVM Failure
313	ANI BOARD:	Reference Failure
414	MGM BOARD:	Serial NVM Failure
422	MGM BOARD:	Model Number Failure
515	FSP BOARD:	PROM Failure
516	FSP BOARD:	RAM Failure
519	FSP BOARD:	Interrupt Failure
520	FSP BOARD:	EEPROM Failure
523	FSP BOARD:	Version Number
537	FSP BOARD:	Timer Failure

SERVICING A NON-FATAL FAILURE

A non-fatal failure indicates a degradation in the unit's functionality, but not a total loss. When a non-fatal error condition occurs, the DLM's self-test alarm contact will operate (open/close, based on jumper position). The LED will illuminate red. Turn off the DC input power, then re-apply. The "FAIL XXX" message should appear if the failure still exists.

The non-critical Fail message has the same format as the critical Fail message. The "xxx" field following the word "FAIL" is the numeric code that indicates the nature of the failure. The FAIL message remains on the display until a key is pressed or until the DLM restarts successfully (with no self-test failures). See Table 7-6 for the list of non-fatal error codes and their meanings.

NOTE: As an alternative to using the table of warnings, the "Information Status" command can be used to display the warning type directly on the MMI.

Locating the Defective Module

Use the table below, or the "Information Status" command to isolate the cause of the failure. Power down the unit and replace the suspected module if appropriate. Re-apply power and the FAIL message should clear. If the "FAIL" message is gone then the unit has been successfully repaired. If the message has changed, it is possible that another module requires replacement.

Table 7-6 Non-Fatal Failure Messages

Number	Description
124	ATI BOARD: ATI Inconsistency
538	FSP BPARD: CAPRAM Fail
539	FSP BOARD: Real Time Clock Fail
621	MMI BOARD: Digital Output
640	MMI BOARD: Serial Communications
641	MMI BOARD: LED Display Fail

SERVICING "SYSTEM STATUS" FAILURES

A system failure is one that indicates a detection of undesirable signals by the DLM. They are indicated by the "self-test alarm" contact operating, and by a red LED.

Table 7-7 System Status Error Messages

SYSTEM STATUS ERROR	DESCRIPTION
LOGIN FAILURE	Incorrect password used over three times

SPECIFICATIONS

RATINGS

Rated Frequency	50 or 60 Hertz
Rated Voltage (phase to phase)	100 to 120 Volts AC
Rated Current	In = 1 or 5 Amperes
DC Control Voltage	48VDC, Operating Range 38.5-60 VDC 110/125VDC, Operating Range 88-150 VDC 220/250VDC, Operating Range 176-300 VDC
Maximum Permissible Current	
Continuous	2 X In
Three Seconds	50 X In
One Second	100 X In
Maximum Permissible AC Voltage	
Continuous	2 X Rated
One minute	3.5 X Rated (one per hour)
Transducer Input Ranges	
±10 Volt DC	
0 to +10 VDC	0- 1 ma (With external shunts)
±5 VDC	4-20 ma
0 to +5 VDC	
Ambient temperature Range	
Storage	−30C to + 75C
Operation	−20C to + 55C
Humidity	95% without condensation
Insulation Test Voltage	2kV 50/60 Hz, one minute
Impulse Voltage Withstand	5kV peak, 1.2/50 milliseconds, 0.5 joules
Interference Test Withstand	SWC, per ANSI C37.90.1

BURDENS

Current Circuits	0.022 ohm, 5 DEG, In=5 amps 0.12 ohm, 30 DEG, In=1 amp
Voltage Circuits	.15 VA, 60 Hz .20 VA, 50 Hz
DC Battery (for contact converters)	2.5 milliamperes at rated DC Input voltage
DC Battery (power supply)	20 Watts
Transducer Input	83KΩ on voltage 1KΩ shunt on 0- 1 ma 50 Ω shunt on 4-20 ma

Digital Inputs (ETS) — For complete specifications, see GEK-100606 (ETS101A) and GEK-100607 (ETS 201A)

Input: ETS 201A Voltage Sensor	
Rated Voltage	32 to 300 Volts DC
Burden	4 mA MAX
Input: ETS 101A Current Sensor	
Rated Current	0.15 to 30 Amps DC (Trip Duty - Not Continuous)
Voltage Drop	0.5 V
Output	
Rated Voltage	30 VDC MAX when "off"
Operate Time	200 μS MAX
Drop out Time	200 μS MAX
Voltage Drop	1.5 V MAX when "on" @ 0.002 A
Leakage	10 uA MAX

CONTACT DATA

Trip Outputs	Continuous Rating=3 amperes Make and carry for tripping duty: = 30 amperes, (per ANSI C37.90).
Auxiliary Outputs (including alarms)	Continuous Rating=3 amperes. Make and carry for tripping duty: = 30 Amperes (per ANSI C37.90)

COMPENSATION FACTOR SETTINGS

	RANGE	RESOLUTION
K0 (zero sequence compensation	1.0 - 7.0	0.1

SYSTEM CONFIGURATION SETTINGS

Communications Baud Rate	300, 1200 or 2400 Baud
Number of Breakers	0 to 3
CT ratios	1 to 5000
PT ratios	1 to 7000
Units of Distance for reports	Miles or Kilometers

ACCURACY

Fault Locator	3% (typical)
Transducer Inputs	$\pm$0.4%

DIMENSIONS

Height	6.945 inches (176 millimeters) Standard 4 rack unit
Width	19.0 inches (484 millimeters) Standard 19 inch rack
Depth	16 inches (406 millimeters)

WEIGHT

Standard rack-mounted unit weighs approximately 26 pounds (11.8 kilograms)

INTERFACE

LOCAL MAN MACHINE INTERFACE (MMI) OPERATION

Display

The display consists of 16 LED alphanumeric character positions arranged side-by-side horizontally.

Every keystroke at the MMI produces some feedback on the display. The numeric keys are echoed as they are pressed, command keys produce an abbreviated word when they are pressed and the ENT key always causes some change in what is being displayed.

All messages on the display are the result of some keyboard action, with three exceptions: the Trigger message when the DLM has seen a disturbance, the Fail message when the DLM has discovered a critical self-test failure, and the Initialization message when the DLM is initializing during a power up.

All messages other than the Trigger (TRG) message are displayed at the same intensity, about half of full-intensity. User input for setting changes are echoed at a lower intensity to help distinguish the stored setting value from one that has not yet been entered into the DLM.

The Trigger message is displayed at highest intensity and has the following format: "TRG xxx xxx xxx". The "TRG" blinks to indicate that the DLM has detected a disturbance. The three fields of information following the "TRG" are non-blinking and contain the following information: a three-character fault type (e.g. ABG), a three-character trigger type (see the section "Request Disturbance Information" under INFORMATION Key for a list of the trigger types), and optionally a three-digit distance to the fault (in the units specified by the user). The message will remain on the display permanently until removed by a keyboard operation, or by a loss of power.

The Fail message has the format "FAIL xxx". The field following the word "FAIL" is a numeric code that indicates the nature of the self-test failure. The Fail message remains on the display until a key is pressed or until the DLM restarts successfully (with no self-test failures). A list of the failure numbers and their meanings can be found in the **SERVICING** section.

The Initialization message has the format "INITIALIZING" and is displayed while the DLM is initializing during a power-up sequence. The display is blanked as soon as initialization is complete.

All other messages that are the result of keyboard operations remain on the display until another key is pressed, or until no keys have been pressed for a period of 15 minutes. At the end of this time-out interval, the display is blanked.

Keyboard

The keyboard is comprised of twenty keys; a 10-key numeric pad, a decimal point, minus key, and eight command keys (See Figure 9-1).

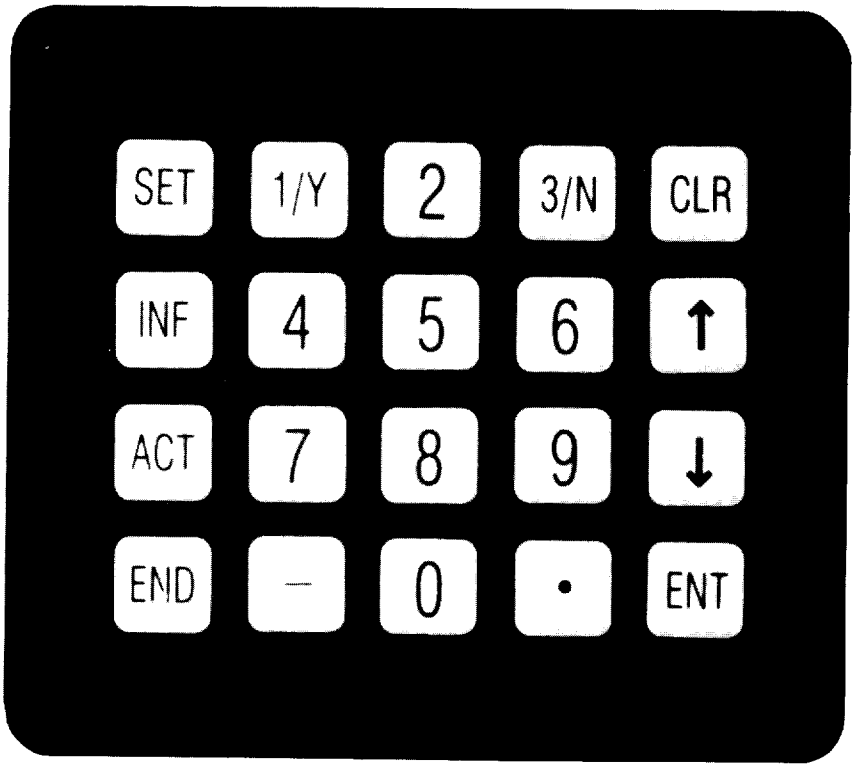


Figure 9-1 (8919424) DLM MMI Keyboard

CLEAR Key (CLR)

The CLR key is used to abort a keyboard sequence in progress (for example, when the user sees he has made an error). When the CLR key is pressed, all or part of the display will be blanked.

If there is user-entered information on the display, only that information will be blanked. For example, if the user is entering a setting value when the CLR key is pressed, only the user's input will be blanked; the name of the setting will remain on the display. As another example, if the user is responding to an ACTION prompt, only the user's input will be blanked. The prompt question will remain on the display. If there is no user-entered information on the display, the entire display will be blanked and the DLM will expect a Command key to be pressed.

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

ARROW Keys

The ARROW keys are used to "scroll" through the list of categories within a Command key or to scroll through the list of items within a category. For example, pressing the INF key will produce the name of the first category, "STATUS" on the display. Pressing the UP-ARROW key will then produce the name of the second category on the display. When the desired category is reached, pressing the ENT key will display the first item of that category. From that point on, pressing the UP-ARROW key will produce each subsequent item in the category on the display.

The UP-ARROW key scrolls in a "forward" direction through a list of categories or items while the DOWN-ARROW key scrolls "backward" through a list.

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

ENTER Key (ENT)

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

Data Entry Keys

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

When entering numeric values the 1/Y and 3/N keys indicate 1 or 3. In response to a YES/NO prompt the keys indicate YES/NO respectively.

END Key

The END key causes two actions. First it is used to indicate that no more setting changes will be made. (Detection processing is halted as soon as any setting change is made, and will not be resumed until the user indicates that all setting changes are complete.) Second it is used to end a session. That is, when the user presses the END key, the MMI becomes idle (without the 15 minute time-out) and remote communication actions and setting changes are again permitted, if they were previously prohibited by MMI usage.

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

END ENT

When the user presses the END key, the display shows "HIT ENT TO END". When the user presses the ENT key, the display shows "ENDED".

1. If no setting values have been entered (i.e., the DLM has not stopped its disturbance detection activities), the DLM takes no action in response to the END/ENT key sequence other than to allow action commands from remote communications to be executed.

2. If triggering activities had been stopped, the DLM now reinitializes itself to use the new setting values and if there are no critical self-test failures of the DLM, the MMI LED will turn green. The displayed message changes to "ENDED". Remote communications settings changes are enabled.

   The "ENDED" message is blanked from the display when another key is pressed or after a 10 second delay. In the latter case, the display remains blank until another key is pressed.

SETTINGS Key (SET)

The SET key is used to display or change settings. Settings are divided into categories. Categories are defined in Table 9-4. For example, one category is Configuration Settings, which includes items such as the user-assigned Unit ID Number, number of breakers, etc. The categories and the settings within each category can be scrolled through using the ARROW keys. For convenience each setting is also assigned a number so that the user may go directly to the setting to be viewed or changed.

The key sequence for selecting settings is: SET n ENT

where n is the optional 1 to 4 digit setting number. When the user presses the SET key, the display shows "SET:" followed by the name of the first category. If the user wants the first category, he presses the ENT key to display the first item; otherwise, he uses the ARROW keys to get to the desired category.

When the user presses the ENT key following the displayed name of a category, the first item in the category is displayed (as an 8-character abbreviated name of the setting) along with its value. Some examples are:

UNITID = 0
LINELEN = 100.0

When the user presses one or more digits following the SET key, the name of the category is blanked and the digits are displayed. When the user presses the ENT key following the last digit, the setting corresponding to the entered setting number is displayed as described above. If the setting number is invalid, an error message is displayed.

The user may scroll through all of the settings in a category using the ARROW keys. If the user wishes to leave that category, pressing the SET key will cause the current category name to be displayed. Then the user may go to another category by using an ARROW key or may enter a setting number followed by the ENT key to go to another setting.

If the user wants to change a setting, he must first display that setting (item) as described above. With the current value of the setting displayed, he then uses the Data Entry keys to enter the new value. When the first Data Entry key is pressed, the abbreviated name remains on the display but the value is blanked and a blinking ":" symbol appears at the end of the name in place of the "=" symbol; each Data Entry key is displayed as it is pressed, in a lower than normal intensity, and the ":" symbol continues to blink. Note that there are some settings that logically represent a state rather than a number (i.e., YES/NO). For these settings, the 1/Y and 3/N keys are used to indicate the state (1/Y = YES and 3/N = NO) and the words "YES" or "NO" are displayed. After the last digit of the new value is entered, the user presses the ENT key; at this point the blinking ":" symbol is replaced by an "=" symbol, the value is displayed at normal intensity, and the DLM stores the new value as the value of the setting. If the user presses any Command key, an ARROW key, or the CLR key instead of the ENT key, the new value will not be stored, and the old value will be retained.

When a setting value is entered, the value is checked against the allowable range of values for that setting. If the value does not fall within the range of values, an error message is displayed. If the setting is a YES/NO type, its value is checked to make sure it is set to either a YES or NO. If the user enters any other digit for this type setting, an error message is displayed. If an error message is displayed, the setting name and unchanged value will be displayed again when the CLR key is pressed.

The first time a setting is successfully changed, remote communications is inhibited from reading and changing settings in the DLM. Also, the first time a setting is successfully changed, it will be recorded as an event. After changing the value of a setting, the setting name and the new value remains on the display. The user may press one of the ARROW keys to move to the next setting in the category. He may also press any Command key to begin performing other operations. If the SET key is pressed, the current category is displayed and the user may then use the ARROW keys to go to another category. If the user presses the SET key again, the first setting category will be displayed. If the user presses any of the other Command keys, the first category associated with that Command key will be displayed.

It is important to note that as soon as any value is entered for any setting, the DLM stops its triggering activities; this is done to allow the user to change all desired settings without causing DLM processing to occur with an inconsistent set of settings. When triggering is halted, the MMI LED (LED on the MMI panel) turns from green to red. Triggering remains inhibited until the user presses the END/ENT key sequence to indicate all setting changes are complete. While the DLM is in the "trigger inhibited" state, all other MMI and remote communications functions can still be performed; i.e., the user can still request present values, perform a manual trip, etc.

ACTIONS Key (ACT)

The ACT key is used to perform actions. There are 7 categories:

1) Trip
2) Close
3) Enter Date and Time
4) MMI Test
5) Fix Up Settings
6) CCI Enable
7) CCI Disable

The categories can be scrolled through using the ARROW keys. For convenience, each category has also been assigned a number so that the user may go directly to the category he wants. The key sequence for selecting actions is: ACT n ENT

n = 1: Trip
2: Close
3: Date/Time
4: MMI Test
5: Fix Up Settings
6: CCI Enable
7: CCI Disable

n is the optional category number; if omitted, category 1 is assumed.

When the user presses the ACT key, the display shows "ACT:", followed by the abbreviated name of the first category. If the user wants the first category, he presses the ENT key to display the first item; otherwise, he uses the ARROW keys to get to the desired category. If the user presses a digit, the category name is blanked and the digit is displayed. Then when the user presses the ENT key, the abbreviated name of the category corresponding to that number is displayed. If the

user enters an invalid category number, an error message is displayed. The displayed names for the 7 categories listed above are:

n = 1: TRIP
2: CLOSE
3: DATE/TIME
4: MMI TEST
5: FIXUP SETTS
6: CCI ENABLE
7: CCI DISABLE

When the user presses the ENT key following the displayed name of a category, the first item or prompt in that category is displayed. If the category contains a list of items, the user may scroll through the items using the ARROW keys, in the same manner as described above for Settings; he may go to the next or previous category by pressing the ACT key followed by one of the ARROW keys. If the category contains prompts, the user must respond to each prompt or press any Command key or the END key to get out of the sequence of prompts. After the user responds to the prompt and presses the ENT key, the next prompt (if any) will be displayed. The DLM performs the appropriate action after the last prompt has been satisfied. As soon as the action is complete, the user will be taken back to the beginning of the category (the category name will be displayed, and the DLM will be expecting the ENT key to produce the first prompt, an ARROW key to move to another category, or a Command key).

1. **Trip**

This category is used to trip a breaker manually; if more than one breaker is being controlled by the DLM, each must be tripped individually.

When the ENT key is pressed, the display prompts the user with the message "TRIP BKR # ?". The user presses a 1, 2 or 3 (any other Data Entry key will cause an error message to be displayed) to indicate that breaker, and then presses the ENT key. The display then prompts the user with the message "TRIP BKR x?". The user presses the 3/N for NO or the 1/Y for YES and then presses the ENT key. (The response is echoed on the display as "NO" and "YES".) If the user responds with a NO, the message "CANCELLED" appears on the display, and no DLM action occurs. If the user responds with a YES, the action is performed and the 52/b contact for that breaker is monitored. If the 52/b contact reports the breaker is open, then the message "BKR x TRIPPED" appears on the display, and an event is recorded:

TIME/DATE
LOCAL - MANUAL TRIP

If the 52/b contact reports the breaker is not open then the message "NOT TRIPPED" appears on the display, and an event is recorded:

TIME/DATE
LOCAL - MANUAL TRIP ATTEMPTED

If the user responds with a Data Entry key other than the 3/N or 1/Y keys, an error message is displayed and the breaker is not tripped. If any of the breakers has been tripped or closed via remote communications during the previous 15 minutes, the message "REMOTE LINK ACTIVE" will appear on the LED display in response to the trip request, and no trip action will be performed.

The trip command is issued for approximately .5 to 1 second.

2. Close

This category is used to close a breaker manually. Each breaker must be closed individually.

When the ENT key is pressed, the display prompts the user with the message "CLSE BKR # ?". The user presses a 1, 2 or 3 (any other Data Entry key will cause an error message to be displayed) to indicate which breaker, and then presses the ENT key. The display then prompts the user with the message "CLOSE BKR x?". The user presses the 3/N for NO or the 1/Y for YES and then presses the ENT key. (The response is echoed on the display as "NO" and "YES".) If the user responds with a NO, the message "CANCELLED" appears on the display, and no DLM action occurs. If the user responds with a YES, the action is performed and the 52/b contact for the breaker is monitored. If the 52/b contact reports that the breaker is closed then the message "BKR x CLOSED" appears on the display, and an event is recorded:

TIME/DATE
LOCAL - MANUAL CLOSE

If the 52/b contact reports that the breaker is not closed then the message "NOT CLOSED" appears on the display, and an event is recorded:

TIME/DATE
LOCAL - MANUAL CLOSE ATTEMPTED

If the user responds with a Data Entry key other than the 3/N or 1/Y keys, an error message is displayed and the breaker is not closed. If any of the breakers has been tripped or closed via remote communications during the previous 15 minutes, the message "REMOTE LINK ACTIVE" will appear on the LED display in response to the trip request, and no trip action will be performed.

The Close command is issued for approximately .5 to 1 second.

3. Date/Time

This category is used to display or change the current date and/or time stored in the DLM. When the ENT key is pressed, the display shows "DATE: xx/xx/xx", giving the current date in the format mm/dd/yy. If the user wishes to change the date, he enters 6 digits from the numeric keypad, then presses the ENT key. If the user presses any key other than ENT, or the digits entered do not comprise a valid date, the old date is retained (new date is not stored) and an error message is displayed. As soon as the user begins entering digits, the 6 digits on the display are blanked, and the numeric keys pressed by the user are echoed in place of the displayed digits.

NOTE: After initial power up or loss of power exceeding 24 hours, the time and date will reset to 00:00:00 01/01/70. All event and disturbance data will be reset.

If the user presses the UP-ARROW key after viewing or changing the date, the display shows "TIME: xx:xx:xx", giving the current time in the format hh:mm:ss. If the user wishes to change the time, he enters 6 digits, then presses the ENT key. If the user presses any key other than ENT, or the digits entered do not comprise a valid time, the old time is retained (new time is not stored) and an error message is displayed. As soon as the user begins entering digits, the 6 digits on the display are blanked, and the numeric keys are echoed in place of the displayed digits.

NOTE: If the DLM is connected to a GNET Host system, the time is automatically updated by the Host. Therefore, after entry, the time and date might change to that of the synchronized time of the Host.

4. **MMI Test**

This is used to test the display, keyboard, and MMI LED (LED on the MMI panel).

If the user presses the ENT key, the entire left 8-character display is lit, enabling the user to verify that all those display LED segments are working. The right 8-character display prompts with "NEXT?". If the user presses the 3/N key followed by the ENT key, the next test (testing the right 8-character display) is skipped. If the user presses 1/Y key followed by the ENT key, the right 8-character display is lit, enabling the user to verify that all those display LED segments are working.

The left 8-character display prompts with "LED TST?". If the user presses the 3/N key followed by the ENT key, the MMI LED test is skipped. If the user presses the 1/Y key followed by the ENT key, the MMI LED will be tested. If the MMI LED is green, it will turn red and return to green. If the MMI LED is red, it will turn green and return to red.

The display then prompts with "KEYBRD TEST?". If the user presses the 3/N key followed by the ENT key, the keyboard test is skipped. If the user presses the 1/Y key followed by the ENT key, the keyboard test is initiated. First the display is blanked and the user is expected to press keys on the keyboard. The keys' mnemonics are echoed on the display, enabling the user to verify that each key is being sensed correctly. The CLR key terminates the keyboard test.

When the keyboard test is complete (or the user skipped the keyboard test), the MMI test is terminated.

5. **Fix Up Settings**

This category may be used after the DLM has reported an EEPROM failure, indicating that the stored settings do not match their CRC (Cyclic Redundancy Check) code. When using this command, it is advisable that the user EXAMINE EVERY SETTING IN THE DLM to assure that each setting is still correct, before performing the END/ENT key sequence to resume triggering (see **SERVICING** section).

After the ENT key is pressed, the display prompts the user with the message "FIXUP SETTS?". If the user presses the 3/N key, the message "CANCELLED" appears on the display and no action is taken. If the user presses the 1/Y key, the setting's CRC code is recalculated and the message "CHECK SETTINGS" appears on the display.

Once EVERY DLM SETTING HAS BEEN EXAMINED, the user must press the END key and the ENT key to resume triggering. If the user responds with a Data Entry key other than the 3/N or the 1/Y keys, an error message is displayed and the setting's CRC code is not recalculated.

6. **CCI Enable**

This category is used to tell the DLM to monitor a specific CCI (Contact Closure Input) that had been previously disabled. When selected, a prompt is displayed:

ENABLE CCI # ?

The user enters the number of the CCI to be enabled, or enters 0 for "ALL", and presses the ENT key. The DLM will echo back:

ENABLE CCI n? (n = 1 to 24)
or
CCI ENAB ALL?

The user enters Y or N and presses the ENT key again. A YES response will display a confirmation message:

CCI n ENABLED
or
CCI ALL ENABLED

while a NO response will display:

CANCELLED

(Note: To enable all CCIs at the same time the number 0 can be used, rather than enter a number between 1 and 24 to enable the individual CCIs.)

7. **CCI Disable**

This selection is used to instruct the DLM to stop monitoring a specific CCI; this Action is useful for preventing a chattering input from causing repeated events or triggers. When selected, a prompt is displayed:

DISABLE CCI n? (n = 1 to 24)

The user enters the number of the CCI to be disabled, of enters 0 for "ALL", and presses the ENT key. The DLM will echo back:

DISAB CCI n?
or
CCI DISAB ALL?

The user enters a Yes or No (1 or 3) and presses the ENT key again. A YES response will display a confirmation message:

CCI n DISABLED
or
CCI ALL DISABLED

while a NO response will display

CANCELLED

(Note: To disable all CCIs at the same time the number 0 can be used, rather than enter a number between 1 and 24 to disable the individual CCIs.)

INFORMATION Key (INF)

The INF key is used to request information. There are 6 possible categories:

1) Request DLM Status Information
2) Request Disturbance Information
3) Request Present Values
4) Request Password
5) Request DLM Model/Version
6) Request CCI Enable/Disable Status

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

The key sequence for requesting information is: INF n ENT

n = 1: Status Info
2: Disturbance Info
3: Present Values
4: Password
5: Model/Version
6: CCI Status

n is the optional category number; if omitted, category 1 is assumed.

When the user presses the INF key, the display shows "INF:" followed by the abbreviated name of the first category. If the user wants the first category, he presses the ENT key to display the first item; otherwise, he uses the ARROW keys to get to the desired category. If the user presses a digit, the category name is blanked and the digit is displayed. After pressing the ENT key, the abbreviated name of the category corresponding to the number is displayed. If the user enters an invalid category number, an error message is displayed.

The displayed names for the 6 categories listed above are:

n = 1: STATUS
2: DISTURB
3: VALUES
4: PASSWORD
5: MODEL
6: CCI

When the user presses the ENT key following the displayed name of a category, the first item or prompt in that category is displayed. If the category contains a list of items, the user may scroll through the items using the ARROW key, in the same manner as described above for Settings; he may go to the next or previous category by pressing the INF key followed by one of the ARROW keys. If the category contains prompts, the user must respond to each prompt, or press any Command key or the END key to get out of the sequence of prompts. After the user responds to the prompt and presses the ENT key, the next prompt (if any) will be automatically displayed. The DLM displays the appropriate information after the last prompt has been satisfied. Pressing the Command key at this point will take the user back to the beginning of the category (where the category name is displayed, and the DLM is expecting the ENT key to produce the first prompt, an ARROW key to move to another category, or a Command key).

1. **Request DLM Status Information**

   This category is used to display the present status of the DLM (see **SERVICING** section). If the user presses the ENT key, the first item displayed is the overall status of the DLM. If the DLM is working properly and monitoring the line, "STATUS: OK" will be displayed. If there is a failure, the display will be "STATUS: FAIL". If the DLM is working properly but not monitoring for disturbances, "STATUS: DET OFF" (detection off) will be displayed. The above order is the order in which the overall status will be displayed.

   The user may use the arrow keys for further information if the status is anything other than OK. If the DLM is working properly and monitoring for disturbances, the use of the arrow keys will result in an error message being displayed. If the status indicates a failure, boards containing failures will be reported in the following order: FSP processor board (displayed as FSP), analog interface board (displayed as ANI), contact input board (displayed as CCI), digital communications interface board and the MMI board (displayed as MMI), and the

magnetics module (displayed as MGM). The last group of failures to be displayed are those that are not related to a board. If the user presses the UP-ARROW key, the first failure will be displayed based on the above board order. Successive presses of the UP-ARROW key will display additional failures until there are no more failures to report. If the user continues to press the UP-ARROW key, the overall DLM status will be displayed again. Then the user can scroll through the failures again with the UP-ARROW key. In a similar manner the user can use the DOWN-ARROW key to scroll backwards through the failures.

If the status indicates that detection is off, the user will be able to display only the "detection off" status message.

2. **Request Disturbance Information**

This category is used to display information associated with any of the last 5 disturbances that the DLM has stored.

When the ENT key is pressed, the display will prompt for the disturbance number. The user enters a digit (1 to 5), and presses the ENT key. (NOTE: 1 = most recent disturbance, 2 = second most recent disturbance, etc.). If there is no valid disturbance information available for that disturbance, the message "NO DISTURB DATA" will be displayed.

If the user enters the disturbance number followed by the ENT key to display the information, the first item of the disturbance chosen is displayed as "DATE: xx/xx/xx". Repeatedly pressing the UP-ARROW key will invoke the following displays:

TIME: xx:xx:xx
FAULT TYPE: xxx (examples: AG,ABG,CA,3PH)
TRIG TYPE: xxx (OC, OCD, UV, CCI see the list below)
DIST: xxx MI (in user selected units)

Pressing the UP-ARROW key after the last quantity will return to the top of the list (DATE). The DOWN-ARROW key can be used to scroll backwards through the list.

The abbreviations for the trig types are as follows:

OC (Overcurrent)
OCD (Overcurrent Dropout)
UV (Undervoltage)
CCI (Contact Input Trigger)

3. **Request Present Values**

This category is used to display the present analog values and contact input statuses that the DLM is monitoring.

If the user presses the ENT key, the first item is displayed as "Ia = xxx.xx". Pressing the UP-ARROW key will produce "Ib = xxx.xx" on the display, etc. Continuing to press the UP-ARROW key will display each of the quantities shown below. Note that **contact input statuses** are shown only for those inputs that are presently in an abnormal state. Pressing the UP-ARROW key after the last **value** will return to the first quantity in the list (Ia). The DOWN-ARROW key can be used to scroll backwards through the items.

The values do not automatically update on the display. However each time the user presses the ENT key while an item is being displayed, the value will be updated.

Ia = xxx.xx A
Ib = xxx.xx A
Ic = xxx.xx A
In = xxx.xx A
Va = xxx.x V/KV
Vb = xxx.x V/KV
Vc = xxx.x V/KV
Wa = (-)xxxxx W/KW
Wb = (-)xxxxx W/KW
Wc = (-)xxxxx W/KW
Wtot = (-)xxxxxx W/KW
VARa = (-)xxxxx VAR/KVAR
VARb = (-)xxxxx VAR/KVAR
VARc = (-)xxxxx VAR/KVAR
VARtot = (-)xxxxxx VAR/KVAR
PFa = (-)x.xxx
PFb = (-)x.xxx
PFc = (-)x.xxx
PFtot = (-)x.xxx
BKRn = OPEN/CLOSED (for defined breakers)
C.C.#n ON (for ON CCIs)
XDUCER1 = (-)xxx.xx (if ATI board Present)
XDUCER2 = (-)xxx.xx
XDUCER3 = (-)xxx.xx
XDUCER4 = (-)xxx.xx
XDUCER5 = (-)xxx.xx
XDUCER6 = (-)xxx.xx

4. **View Password**

This category is used to view the remote communications password in encrypted form (see Table 9-5 for Password Key to translate encrypted password).

If the user presses the ENT key, the remote communications password is displayed in encrypted form.

5. **Request DLM Model/Version**

This category is used to display the DLM model number and the PROM version number.

If the user presses the ENT key, the model number will be displayed as "MD:AAAAAAAAAAAA". Pressing the UP-ARROW key will display the PROM version number as "VER:AAAAAAAAAAAA". Pressing the UP-ARROW key again will return to the model number. The DOWN-ARROW key can be used to scroll backwards through the items.

6. **CCI**

This category lists all the CCIs that are disabled. By pressing the UP-ARROW key the number of the next disabled CCI will be displayed as:

CCI n DISABLED (n = 1 to 24)

The DOWN-ARROW key may be used to view the previous disabled CCI. The MMI will display "All Enabled" if no CCIs are disabled.

Errors

If the user enters a wrong response (either data or a choice), an error message will be displayed. See Table 9-2 for a list of the error messages.

If a wrong response is entered, the display is blanked and an error message is displayed. The user must press the CLR key to blank the error message (all other keys will be ignored). When the error message has been blanked, the last message will be re-displayed, allowing the user to re-enter the correct response.

If the settings CRC code has become corrupted, certain MMI functions will become unavailable. Whenever the error occurs, the user will not be able to change any settings (although the settings can still be viewed). If the error occurs during startup, the user will not be able to perform any of the Action commands except Fixup Settings. Once the settings CRC has been recalculated by issuing the FIXUP SETTINGS command, the user will be able to perform the Action commands and change settings.

The CRC code is a Cyclic Redundancy Check value stored in memory that is automatically set up whenever a setting is changed. This CRC code enables the EEPROM Self Test to verify the integrity of the settings area in EEPROM.

Table 9-1 Sample Key Sequences

This key sequence shows how a setting is changed by going through categories and using the ARROW keys.

KEY	DISPLAY
SET	SET:CONFIG
UP-ARROW	SET:CCIDEF
UP-ARROW	SET:FAULTLOC
ENT	SELFLOC =YES
UP-ARROW	POSANG =85
9	POSANG :9
0	POSANG :90
ENT	POSANG =90

This key sequence shows how a setting is changed by accessing the setting directly.

KEY	DISPLAY
SET	SET:CONFIG
0	SET:0
3	SET:03
0	SET:030
1	SET:0301
ENT	SELFLOC =YES
3/N	SELFLOC :NO
ENT	SELFLOC =NO

Table 9-1 Sample Key Sequences, continued

The following key sequences show how each action is accomplished.

ACTION	KEY	DISPLAY
TRIP:		
	ACT	ACT:TRIP
	ENT	TRIP BKR #?
	2	TRIP BKR #? 2
	ENT	TRIP BKR2?
	1/Y	TRIP BKR 2? YES
	ENT	BKR 2 TRIPPED
CLOSE:		
	ACT	ACT:TRIP
	2	ACT:2
	ENT	CLOSE BKR #?
	2	CLOSE BKR #? 2
	ENT	CLOSE BKR 2?
	1/Y	CLOSE BKR 2? YES
	ENT	BKR CLOSED
DATE/TIME:		
	ACT	ACT:TRIP
	3	ACT:3
	ENT	DATE: 08/29/88
	0	DATE: 0 / /
	7	DATE: 07/ /
	0	DATE: 07/0
	1	DATE: 07/01/
	9	DATE: 07/01/9
	0	DATE: 07/01/90
	ENT	DATE= 07/01/90
	UP-ARROW	
TIME: 12:34:55		
	0	TIME: 0 : :
	1	TIME: 01: :
	2	TIME: 01:2 :
	4	TIME: 01:24:
	1	TIME: 01:24:1
	6	TIME: 01:24:16
	ENT	TIME= 01:24:16
MMI TEST:		
	ACT	ACT:TRIP
	4	ACT:4
	ENT	########NEXT?
	1/Y	########NEXT?YES
	ENT	LED TST?
	3/N	LED TST?NO
	ENT	KEYBRD TEST?
	3/N	KEYBRD TEST?NO
	ENT	ACT:MMI TEST

Table 9-1 Sample Key Sequences, continued

FIXUP SETTINGS:		
	ACT	ACT:TRIP
	5	ACT:5
	ENT	FIXUP SETTS?
	1/Y	FIXUP SETTS? YES
	ENT	CHECK SETTINGS
CCI ENABLE:		
	ACT	ACT:TRIP
	6	ACT:6
	ENT	ENABLE CCI # ?
	2	ENABLE CCI # ?2
	ENT	ENABLE CCI 02?
	1/Y	ENABLE CCI 02?YES
	ENT	CCI 02 ENABLED
CCI DISABLE:		
	ACT	ACT:TRIP
	7	ACT:7
	ENT	DISABLE CCI # ?
	2	DISABLE CCI # ?2
	ENT	DISABLE CCI 02?
	1/Y	DISABLE CCI 02?YES
	ENT	CCI 02 DISABLED

The following key sequences show how information is retrieved.

INFORMATION	KEY	DISPLAY
STATUS:		
	INF	INF:STATUS
	ENT	STATUS: FAIL
	UP-ARROW	LOGIN FAILURE
DISTURBANCE:	INF	INF:STATUS
	UP-ARROW	INF:DISTURB
	ENT	DISTURB #?
	1	DISTURB #? 1
	ENT	DATE: MM/DD/YY
	UP-ARROW	TIME: HH:MM:SS
	UP-ARROW	FLT TYPE: AG
	UP-ARROW	TRIG TYPE : OC
	UP-ARROW	DIST : 0.0MI
PRESENT VALUES:		
	INF	INF:STATUS
	UP-ARROW	INF:DISTURB
	UP-ARROW	INF:VALUES
	ENT	Ia = 5.00 A
	UP-ARROW	Ib = 5.00 A
PASSWORD:		
	INF	INF:STATUS
	UP-ARROW	INF:DISTURB
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:PASSWORD
	ENT	!A@1#$45%*T()

Table 9-1 Sample Key Sequences, continued

MODEL/VERSION:		
	INF	INF:STATUS
	UP-ARROW	INF:DISTURB
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:PASSWORD
	UP-ARROW	INF:MODEL
	ENT	MD:DLM51AAAAHHSS
	UP-ARROW	VER:V001.111A
CCI STATUS		
	INF	INF:STATUS
	6	INF:6
	ENT	CCI 02 DISABLED
	UP-ARROW	CCI 12 DISABLED

Table 9-2 MMI Error Messages

ERROR MESSAGE	CAUSE OF ERROR
VAL OUT OF RANGE	Setting value either greater than upper limit or less than lower limit.
SETT NUM INVALID	Setting number is not valid.
Y/N NOT ENTERED	Setting value or response to a prompt had to be a YES or NO but a 1/Y or 3/N key was not entered.
REQUEST INVALID	Any key that is invalid during a key sequence, for instance: The UP-ARROW key is pressed while entering a setting value.
CATEGORY INVALID	A wrong category number was entered for either an action or information item.
BKR NUM INVALID	A breaker number greater than 3 was entered.
DATE INVALID	The day, month, and/or year are not valid.
TIME INVALID	The hour, minute, and/or second are not valid.
DISTURB # INVALID	A DISTURB number greater than 5, or 0, was entered, or the DLM is busy computing a disturbance report.
REMOTE LINK ACT	The remote communications link is in use for actions or settings; local settings changes and action cannot be performed.
MMI KEY ERROR	MMI received an invalid key code from keyboard. (Hardware error)
ACT INVALID NOW	The current action that the user is attempting to perform is invalid because the settings CRC code is in error.
CCI NUM INVALID	The number entered to reference a CCI was larger than 24, or 0.

Table 9-3 MMI Event Messages

The following is the list of events is generated by the DLM:

FAIL - ANI BOARD: CONTROLLER
FAIL - ANI BOARD: SERIAL MEMORY
FAIL - ANI BOARD: REFERENCE
FAIL - MGM BOARD: SERIAL MEMORY
FAIL - MGM BOARD: MODEL NUMBER
FAIL - FSP BOARD: VERSION NUMBER
FAIL - FSP BOARD: PROM
FAIL - FSP BOARD: LOCAL RAM
FAIL - FSP BOARD: INTERRUPT
FAIL - FSP BOARD: EEPROM
FAIL - FSP BOARD: TIMER
FAIL - FSP BOARD: CAPRAM
FAIL - FSP BOARD: REAL TIME CLOCK
FAIL - MMI BOARD: DIGITAL OUTPUT
FAIL - MMI BOARD: SERIAL CHIP
FAIL - MMI BOARD: LED DISPLAY
FAIL - CCI BOARD: DIGITAL INPUT
FAIL - ATI BOARD: INCONSISTENCY
FAIL - REMOTE COMM LOGIN FAILED

BREAKER 1 OPEN
BREAKER 1 CLOSED
BREAKER 2 OPEN
BREAKER 2 CLOSED
BREAKER 3 OPEN
BREAKER 3 CLOSED

For the following events, "CCI #nn" is replaced by the user description, if a descriptor file was selected. Note that an event is generated whenever the corresponding CCI changes state:

CCI #01 ON
CCI #01 OPEN
CCI #01 NORMAL
CCI #01 CLOSED
CCI #02 ON
.
.
.
CCI #24 CLOSED

PHASE A OVERCURRENT
PHASE A CURRENT NORMAL
PHASE B OVERCURRENT
PHASE B CURRENT NORMAL
PHASE C OVERCURRENT
PHASE C CURRENT NORMAL
GROUND OVERCURRENT
GROUND CURRENT NORMAL
PHASE A UNDERVOLTAGE
PHASE A VOLTAGE NORMAL

Table 9-3 MMI Event Messages, continued

PHASE B UNDERVOLTAGE
PHASE B VOLTAGE NORMAL
PHASE C UNDERVOLTAGE
PHASE C VOLTAGE NORMAL

REMOTE COMM - PASSWORD CHANGED
REMOTE COMM - MANUAL TRIP
REMOTE COMM - MANUAL CLOSE
REMOTE COMM - SETTINGS CHANGE STARTED
REMOTE COMM - SETTINGS CHANGE DONE
REMOTE COMM - MANUAL TRIP UNSUCCESSFUL
REMOTE COMM - MANUAL CLOSE UNSUCCESSFUL
REMOTE COMM - CCI ENABLED
REMOTE COMM - CCI DISABLED
REMOTE COMM - CCI ENABLE FAILED
REMOTE COMM - CCI DISABLE FAILED

LOCAL - MANUAL TRIP
LOCAL - MANUAL CLOSE
LOCAL - SETTINGS CHANGE STARTED
LOCAL - SETTINGS CHANGE DONE
LOCAL - CCI ENABLE
LOCAL - CCI DISABLE
LOCAL - MANUAL TRIP UNSUCCESSFUL
LOCAL - MANUAL CLOSE UNSUCCESSFUL

FSP BOARD: FAILURE CLEARED
ANI BOARD: FAILURE CLEARED
MGM BOARD: FAILURE CLEARED
MMI BOARD: FAILURE CLEARED
ANI BOARD: REFERENCE CORRECTED
CCI BOARD: DIGITAL INPUT CORRECTED
FSP BOARD: QUEUES REINITIALIZED
ATI BOARD: REFERENCE CORRECTED

Table 9-4 DLM Settings

NOTE: IN = rated current, which is either 1 amp or 5 amps.

CATEGORY 1: CONFIG -- Configuration Settings

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0101	Unit ID number	UNITID	N/A	0 - 9999	xxxx	0000
0102	System frequency	SYSFREQ	Hz	50, 60	xx	60
0103	Phase angle rotation	PHASDESG	N/A	0=ABC 1=ACB	x	0
0104	Number of breakers	NUMBKRS	N/A	0 - 3	x	1
0105	Primary/secondary units for reports	SELPRIM	N/A	0 (Primary) 1 (Secndry)	x	0
0106	CT Ratio	CTRATIO	N/A	1 - 5000	xxxx	400
0107	PT Ratio	PTRATIO	N/A	1 - 7000	xxxx	2000
0108	Units of distance	DISTUNIT	N/A	0 = Miles 1 = Km	x	0
0109	Communication baud rate	BAUDRATE	N/A	300, 1200, 2400, 9600	xxxx	1200
0110	Transducer inputs	XDUCER	N/A	YES/NO	YES/NO	NO

Table 9-4 DLM Settings, continued

CATEGORY 2: CCIDEF -- Contact Closure Input Definitions

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0201	RANGE C.C.I.#1	CCI1	N/A	left digit: 0=trigger 1=alarm 2=bkr stat (*) right digit: 0 - N.C. - normally closed 1 - N.O. - normally open 0 - ACON - A Contact 1 - BCON - B Contact	xx	01
0202	C.C.I.#2	CCI2	N/A	Same as C.C.I.#1	xx	01
0203	C.C.I.#3	CCI3	N/A	Left Digit: 0 = trigger, 1 = Alarm Right Digit: 0 = N.C. Normally Closed, 1 = N.O. Normally Open		
	to					
0224	C.C.I.#24	CCI24	N/A	Same as C.C.I.#3		

(*) displayed values will be text, not digits; e.g.

TG / N.O
AL / N.C.
BK / ACON

CATEGORY 3: FAULTLOC -- Fault Location

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0301	Select fault location	SELFLOC	N/A	YES/NO	YES/NO	YES
0302	Pos. seq. angle of max reach (ZR1)	POSANG	DEG	45 - 90	xx	85
0303	Zero seq. angle of max reach (ZR0)	ZERANG	DEG	45 - 90	xx	75
0304	Pos. seq. impedance	ZP	OHMS	0.01 - (50)(5/IN)	xxx.xx	(6)(5/IN)
0305	Zero seq. current compensation for Z2, Z3	K0	N/A	1.0 - 7.0	x.x	3.0
0306	Line length	LINELEN	MILES KM	0 - 200 mi 0 - 322 km	xxx.x	100.0 161.0
0307	Behind Breaker	BEHIND	N/A	YES/NO	YES/NO	NO
0308	Beyond Breaker	BEYOND	N/A	YES/NO	YES/NO	NO

9

Table 9-4 DLM Settings, continued

CATEGORY 4: OVERCUR -- Overcurrent Triggering

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0401	Select overcurrent triggering	SELOC	N/A	YES/NO	YES/NO	NO
0402	OC pickup, phase	PUPH	AMPS	(0.4 - 20.0) times rated current	xx.x	2.0
0403	OC pickup, ground	PUGR	AMPS	(0.1 - 16.0) times rated current	xx.x	0.2
0404	Select overcurrent dropout triggering	SELDO	N/A	YES/NO	YES/NO	NO

CATEGORY 5: UNDERVOL -- Undervoltage Triggering

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0501	Select undervoltage triggering	SELUV	N/A	YES/NO	YES/NO	NO
0502	Undervoltage level	UVLEV	VOLTS	10 - 70	xx	60

CATEGORY 6: XDUCERS -- Transducer Input Definitions

SETT#	DESCRIPTION	ABBREV.	UNITS	RANGE LOW-HIGH	FORMAT	DEFAULT
0601	XDUCER 1 RANGE	X1RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0602	XDUCER 1 FULL SCALE VALUE	X1FULL	N/A	±10000	(-)xxxxx	100
0603	XDUCER 1 ZERO VALUE	X1ZERO	N/A	±10000	(-)xxxxx	0
0604	XDUCER 2 RANGE	X2RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0605	XDUCER 2 FULL SCALE VALUE	X2FULL	N/A	±10000	(-)xxxxx	100 0
0606	XDUCER 2 ZERO VALUE	X2ZERO	N/A	±10000	(-)xxxxx	0

0607	XDUCER 3 RANGE	X3RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0608	XDUCER 3 FULL SCALE VALUE	X3FULL	N/A	± 10000	(-)xxxxx	100 0
0609	XDUCER 3 ZERO VALUE	X3ZERO	N/A	± 10000	(-)xxxxx	0
0610	XDUCER 4 RANGE	X4RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0611	XDUCER 4 FULL SCALE VALUE	X4FULL	N/A	± 10000	(-)xxxxx	100 0
0612	XDUCER 4 ZERO VALUE	X4ZERO	N/A	± 10000	(-)xxxxx	0
0613	XDUCER 5 RANGE	X5RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0614	XDUCER 5 FULL SCALE VALUE	X5FULL	N/A	± 10000	(-)xxxxx	100 0
0615	XDUCER 5 ZERO VALUE	X5ZERO	N/A	± 10000	(-)xxxxx	0
0616	XDUCER 6 RANGE	X6RANGE	V/ma	0 - 5 0: ± 10V input source 1: 0 - 10V 2: ± 5V 3: 0 - 5V 4: 0 - 1ma 5: 4 - 20ma	x	0
0617	XDUCER 6 FULL SCALE VALUE	X6FULL	N/A	± 10000	(-)xxxxx	100 0
0618	XDUCER 6 ZERO VALUE	X6ZERO	N/A	± 10000	(-)xxxxx	0

Table 9-5 Password Decoder Key
Encrypted Password Conversion Table

MMI	DECODED	MMI	DECODED	FACTORY USE ONLY MMI	FACTORY USE ONLY DECODED
(sp)	P	:	J	Q	$
!	T	;	N	R	(
"	X	<	C	S	,
$	Q	=	G	T	!
%	U	>	K	U	%
&	Y	?	O	V	)
(	R	@	0	W	-
)	V			X	"
*	Z	A	4	Y	&
,	S	B	8	Z	*
-	W	D	1	[	.
		E	5	\	#
1	D	F	9	]	,
2	H	H	2	^	+
3	L	I	6	_	/
4	A	L	3		
5	E	M	7		
6	I	P	(sp)		
7	M				
8	B				
9	F				

REMOTE COMMUNICATION INTERFACE

HARDWARE JUMPERS

There are two factory-installed hardware jumpers in the MMI module (see **MODULE** section) used to inhibit the ability to perform the Remote Manual Trip function: the Remote Manual Close function and the Remote Change DLM Settings function. These hardware jumpers will need to be removed to perform the above functions.

CAUTION

Power Down the DLM before removing or inserting modules. Failure to do so can permanently damage the unit.

The hardware jumpers are defined as follows:

Hardware Jumper J1 = Manual Trip and Manual Close functions.
Hardware Jumper J2 = Change DLM Settings

MODEM CONNECTIONS AND SETTINGS

When establishing communication between the DLM and a remote PC, two modems connected via a phone line are required; one modem is located at the DLM and the other modem is located at the PC. The cable that connects the modem with either the DLM or the PC is shown in Figure 9-2. Each of these modems must be "Hayes compatible", meaning that they must accept configuration commands first developed by Hayes. This is necessary since the D-LINK communications software that runs on the PC sends a Hayes-compatible command string to the modem located at the PC. The DLM does not send any configuration commands to its modem. Both, the DLM modem and the PC modem must be uniquely configured to permit the user to log into and communicate with the DLM using D-LINK software.

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

B1	&C0	S0=0	S37=0
E1	&D0	S6=2	S38=20
L2	&G0	S7=30	
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	&T4	S26=1	
	&X0	S36=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 for 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 D-LINK. Those configuration settings critical to the operation of D-LINK are changed by D-LINK. The configuration commands sent to the modem from D-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 (desirable - 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.

The command S7=60 is present starting in version 1.05 of D-LINK. Earlier versions of D-LINK do not execute this command, leaving the time out at the default value, which is typically 30 seconds.

If any 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 (Data Terminal)
&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 D-LINK setting establishes the baud rate, which must match the baud rate setting of the DLM. D-LINK will then set the specified PC serial port (i.e., COM1, COM2) to the proper baud rate, parity, databits, and stopbits. 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.

DLM Modem

The DLM 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 DLM does not send any configuration commands to its modem, the required configuration settings must be made prior to connecting the modem to the DLM. **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 (advisable - not necessary)
Q1 - disable result code display
&C1 - causes DCD (Data Carrier Detect) to track the received carrier signal
&D3 - causes the modem to reset on the ON-to-OFF transition of DTR (Data Terminal Ready)
&Q0 - asynchronous mode
S0=1 - enable auto-answer

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

With a Hayes V-Series 2400 SmartModem or equivalent, the DLM modem will perform a modulation handshake with the PC modem to set the baud rate of the DLM 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 DLM 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. Note that D-LINK (version 1.05 or higher) configures the PC modem to wait 60 seconds for the DLM modem to answer. If the DLM modem register S0 is set higher than 12, the PC modem may time out and hang up before the DLM modem can answer. (S0=12 means that the DLM modem will answer after twelve rings, which corresponds approximately to the 60 second delay (S7=60) at the PC modem; however, the user should verify the number of rings corresponding to 60 seconds for a particular application.)

Modem Setup

Table 9-6 is a listing of the modem command set required for communication between the DLM and a remote PC.

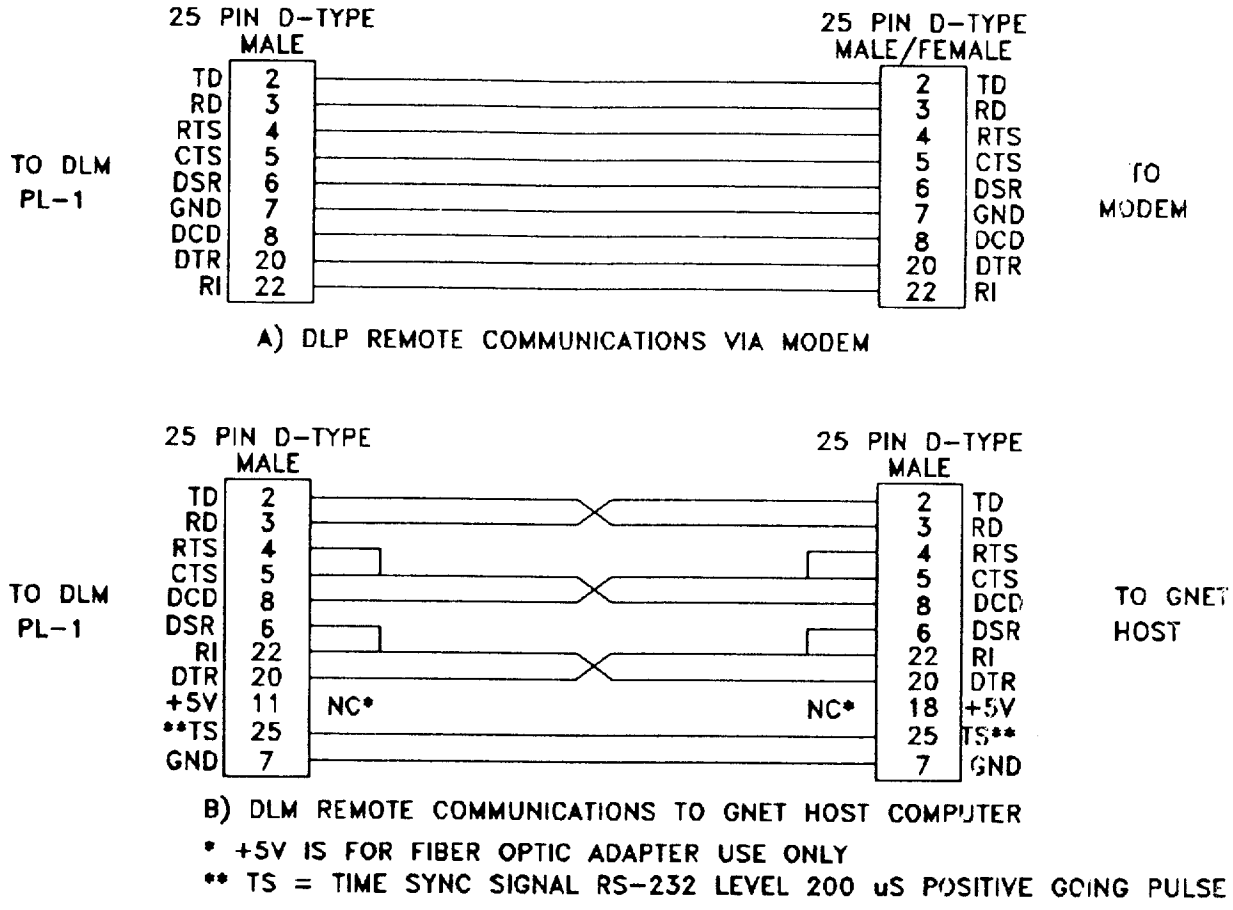
Table 9-6 Modem Setup Criteria (Hayes Compatible)

Function	DLM 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)	Disable (Q1)
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)
Response to DTR	Modem Reset (&D3)	Modem Reset (&D3)
Pulse Dial Ratio	39%Mk/61%Bk (&P0)	39%Mk/61%Bk (&P0)

9

NULL MODEM CONNECTIONS

A PC can be connected to a nearby DLM without the intervening modems and phone line, by using a special cable called a "null modem" cable. The required pin to pin connections for this null modem cable (which is also used for connection to G-Net™) is shown in Figure 9-2. The null modem cable should not exceed 50 feet in length.



CABLES AVAILABLE UNGER GE PART NO. 0246A9866.
SPECIFY CABLE TYPE AND CONNECTOR GENDER.

Figure 9-2 (0286A3599 Sh.1) DLM Remote Communications Cables

DLM-LINK SOFTWARE

OVERVIEW

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

USING DLM-LINK

Communications with the unit can be established via a PC with the program DLM-LINK.

SYSTEM REQUIREMENTS

Hardware

The minimum PC hardware requirements consists of the following components. An IBM-AT or compatible (Compaq, Zenith, Tandy, etc...) with one parallel port, a minimum of 400K bytes of free memory (RAM) to run the program in, 40MB hard drive, low density 3 1/2 inch floppy drive, and an EGA monitor.

Software

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

INSTALLATION

View the file README.TXT for updated information and installation instructions for this program. This file is found on the 3.5" floppy disk located at the end of this section.

GENERAL OPERATION

Mouse/Keyboard Usage

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

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

Main Horizontal Menu Bar

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

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

Pull-Down Menus

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

Mouse

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

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

Keyboard

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

Dialog Boxes

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

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

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

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

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

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

List Boxes

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

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

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

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

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

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

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

Entering Text and Numbers

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

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

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

PROGRAM OPERATION

MAIN MENU

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

Unit functions	ALT-R
Local functions	ALT-L
Setup	ALT-S
Help	ALT-H

Each item in the main horizontal menu has a pull-down menu associated with it. Some of the items will be displayed in a lighter shade or color. This is to denote the absence of the unit to perform that ability. Since DLM-LINK works for all revisons of the DLM unit there may be some functions that are present in one unit and not in another.

UNIT FUNCTIONS

Unit functions has the following active menu items and associated hot keys:

Login	ALT-L
lOgout	ALT-O
Hang up phone	ALT-H
Actions...	ALT-A
Information...	ALT-I
Settings...	ALT-S

Login

Login is used to gain access to the unit. When logging into a DLM for the first time, the user must use the factory password. When a user is logged in under the factory password, the only commands that can be used at the PC are those to change the password and to logout. The factory password is changed to the user's password by selecting the **change Password** menu item from the **Actions** menu item from the **UNIT FUNCTIONS** pull-down menu. The current password is the factory password and the new password is the user's password. The encoded Communications password can **only** be viewed locally, on the MMI.

The **Login** dialog box contains a list of the currently configured DLMs, a place to enter the password, a place to enter the unit ID, a button for adding a new DLM to the configured DLM list, an OK button and a CANCEL button.

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

The NEW UNIT button in the dialog box allows the user to add a unit that has not been previously entered into the list of configured units. The user enters the unit description, the phone number, the multiplexor switch code, and the phone number for the new unit. The new unit is added to the list of configured units.

Once a unit is selected from the list of units, the user is asked for the password and the unit ID. Neither of these is echoed on the screen. Once this information is entered, the user selects the OK button to log in to the unit.

lOgout

Logout disables access to the unit. A check is made to determine the status of protection at the DLM (ON or OFF). The status is displayed in the dialog box. Selecting the OK button logs out of the unit. Selecting the CANCEL button, leaves the user logged in to the unit. If the status of protection is OFF due to a setting change that was not ended, pick the CANCEL button and choose **End settings change** in **Settings** in the **UNIT FUNCTIONS** menu.

Hang up phone

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

Actions...

change Password	ALT-P
Manual trip	ALT-M
manual Close	ALT-C
cci Enable	ALT-E
cci Disable	ALT-D
change Time and date	ALT-T
Fixup settings	ALT-F

change Password

This item allows the user to change the password in the DLM. The password always consists of ASCII characters, even the factory password. The valid password characters are A to Z, 0 to 9, and space. The factory password contains one or more characters that are not valid. The Communications password can only be viewed on the MMI, in encrypted form, therefore it is **IMPORTANT** that the user keep a record of the password in a safe place.

First, the user must enter the present password. If the entered password is valid, the user must then enter the new password. If the new password is valid, the user must enter the identical new password again.

The user selects the OK button; this does not yet cause the password to be changed. Next, the user is asked to confirm the change. If the user selects the OK button, the password is changed.

Manual trip

This item allows the user to trip the breakers manually. If two breakers are being controlled by the DLM, each must be tripped individually. Note that the breakers cannot be tripped if the appropriate jumper is installed (see the MODULE Section for the location and description of the jumpers). To select **Manual trip**, use the hot key ALT-(M) or click on the menu item with the left mouse button.

The user selects the breaker to trip by using the UP and DOWN ARROW keys or clicking on the breaker selection with the left mouse button.

When the user selects the OK button and a breaker is selected, the user is asked to confirm the action. If the user selects the OK button, the breaker is tripped and the user is returned to the previous screen. Selecting the CANCEL button from the confirmation dialog box will return the user to the breaker-selection dialog box, without tripping the selected breaker. Selecting the CANCEL button from the breaker-selection dialog box returns the user to the **Actions** menu.

manual Close

This item allows the user to close the breakers manually. If two breakers are being controlled by the DLM, each must be closed individually. Note that the breakers cannot be closed if the appropriate jumper is installed (see the MODULE Section for the location and description of the jumpers). To select **manual Close**, use the hot key ALT-C or click on the menu item with the left mouse button.

The user selects the breaker to close by using the UP and DOWN ARROW keys or clicking on the breaker selection with the left mouse button.

When the user selects the OK button and a breaker is selected, the user is asked to confirm the action. If the user selects the OK button, the breaker is closed and the user is returned to the previous screen. Selecting the CANCEL button from the confirmation dialog box will return the user to the breaker-selection dialog box without closing the selected breaker. Selecting the CANCEL button from the breaker-selection dialog box returns the user to the **Actions** menu.

cci Enable

This item allows the user to permit the DLM to read the specified CCIs or all CCIs. This item is selected by using the ALT-E hot key or clicking on the menu item with the left mouse button.

If the user selects the CANCEL button then no action is taken and the **Actions** menu is redisplayed. If the user selects the OK button, another dialog box is displayed to confirm the action. If the user selects the OK button, the outputs are enabled. If the CANCEL button is selected, there is no change in the status of the CCIs, and the previous dialog box will be displayed.

cci Disable

This item allows the user to inhibit the DLM from reading the specified CCIs or all CCIs. This item is selected by using the ALT-D hot key or clicking on the menu item with the left mouse button.

If the user selects the CANCEL button then no action is taken and the **Actions** menu is redisplayed. If the user selects the OK button, another dialog box is displayed to confirm the action. If the user selects the OK button, the outputs are disabled. If the CANCEL button is selected, there is no change in the status of the CCIs, and the previous dialog box will be displayed.

change Time and date

This item allows the user to set the time and date in the DLM to the current time and date. Changing the time and date through this menu item does not affect the time and date in the PC. This item is selected by using the ALT-T hot key or clicking on the menu item with the left mouse button.

First the DLM's current time and date is displayed. The time is displayed in the format HH:MM:SS (for example: 10:55:09). The date is displayed in the format MM/DD/YY (for example: 07/16/90). The user may then edit the time and date.

When the user selects the OK button, the user is asked to confirm the action. If the user selects the OK button, the time and date are changed in the DLM.

Fixup settings

This item allows the user to recalculate the settings CRC code in non-volatile RAM. Fixup settings is selected by using the ALT-F hot key or clicking on the menu item with the left mouse button. Once Fixup settings has been chosen, a dialog box will be displayed. The dialog box contains only the OK and CANCEL buttons. If the user selects the CANCEL button at any time the user will be returned to the **Actions** menu box. For further information see the section on **SERVICING**.

If the OK button is selected, the user is asked to confirm the action with another dialog box. If the user selects the OK button, the settings CRC code is recalculated and all the settings are sent back to the PC. In addition, a message is displayed telling the user to verify all settings.
NOTE: If settings have been uploaded before executing this command and have not been saved to a disk file or downloaded, they will be lost.

If the user selects the CANCEL button, the CRC value is not recalculated and the previous dialog box will be displayed again.

Information...

request Present values	ALT-P
request disturbance report Identification	ALT-I
request Disturbance report	ALT-F
request Events	ALT-E
request Oscillography data	ALT-O
request dlm Status	ALT-S
request dlm Model	ALT-M
request cci sTatus	ALT-S

request Present values

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

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

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

NOTE: Phase angles go from 0° to 180° or −10° to −179°, and are referenced to Phase A voltage (VA). VA must be present for this function to operate. Currents and voltages are RMS values and are either primary or secondary, as the user has selected in setting 1505. Status is reported only for the number of breakers and carrier sets present in the configuration.

request disturbance report Identification

This item allows the user to display and/or print the identification of each disturbance report, which includes the time, date, and trip type for each disturbance. This information allows the user to determine easily which disturbance to examine.

To select this menu item either click on it with the left mouse button or use the ALT-I hot key. Once this item is selected, a dialog box will appear with three independent choices for displaying, printing and filing the disturbance report identifications. To change any of the three choices, either click on it with the left mouse button or use the TAB key to highlight the selection and the space bar to change it. An X in the brackets indicates that choice has been selected and no X indicates that choice has not been selected. One must be chosen for the disturbance report identifications to be retrieved from the unit.

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

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

request Disturbance report

This item allows the user to display, print and/or file a disturbance report and its associated events. To select this menu item, either click on it with the left mouse button or use the ALT-F hot key. Once this item is selected, a dialog box will appear with three independent choices for displaying, printing and filing the disturbance reports. To change any of the three choices, either click on it with the left mouse button or use the TAB key to highlight one of the selections and the UP/DOWN ARROW keys to choose one of the three choices. An X in the brackets indicates that choice has been selected and no X indicates that choice has not been selected. Use the space bar to change any of the choices. At least one must be chosen for the disturbance report to be retrieved from the unit. The user must enter the disturbance report number (from 1 to 5) in the box supplied on the first line of the **Disturbance report** dialog box.

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

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

The voltages are displayed with units of "V" if they are secondary. If the voltages are primary, the units are KV. The user may scroll the screen to view the events associated with the disturbance. To scroll through the report, use the PAGE UP/DOWN keys, or place the mouse on the UP or DOWN ARROW on the scroll bar and use the left mouse button. Clicking the left mouse button will move one line in that direction and holding the button down will cause the scrolling to happen repetitively. The events are displayed with the most recent event last.

request Events

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

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the events from the unit. Selecting the CANCEL button will return to the **Information** menu without any further action. The events are displayed chronologically, starting with the most recent event. There may be more events than can be displayed on one screen. If there are more events to see, a scroll bar will appear on the left side of the box. Use the PAGE UP/DOWN keys or use the mouse on the scroll bar to see the other events. To clear the events from the screen, if they have been displayed, either click on the small box in the upper left corner with the left mouse button or use the ALT-F4 hot key (F4 is the Function key F4, not the F key followed by the 4 key). Once the events have been cleared from the screen the **Events** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

NOTE: If DC power is removed for more than 24 hours, all event information will be lost.

request Oscillography data

This item allows the user to save on disk the oscillography data for a particular disturbance. To select this menu item either click on it with the left mouse button or use the ALT-O hot key. Once this item is selected a dialog box will appear with places to enter the disturbance number and a file name for the data to be stores in. To select one of the entries to change, click on it with the left mouse button or use the TAB key to highlight one of the selections. Once an entry has been chosen use the editing keys to enter and/or change the information in the selected box or field. The disturbance number associated with the oscillography data (1 to 5) and the file name for the data **must** be supplied, to have the oscillography data retrieved from the unit.

After the file name and disturbance number have been entered, click on the OK button or use the ALT-O hot key to retrieve the oscillography data from the unit. The disturbance report, the events associated with the disturbance report, and the data are saved to the specified file.

The oscillography data is an ASCII text file consisting of the disturbance report, the events associated with the disturbance report, the currents, the voltages, the digital inputs, digital outputs, and protection flags. This file can be read directly by Lotus 123, without any modification, by importing the data as numbers rather than text.

NOTE: If DC power is removed for more than 24 hours, the oscillography data will be lost.

request dlm Status

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

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

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

The status messages (not including the jumper status) are displayed in the same order as those at the DLM (described in the SERVICING section).

request dlm Model

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

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the model and PROM version from the unit. Selecting the CANCEL button will return to the **Information** menu without any further action. To clear the model and version from the screen, if they have been displayed, either click on the small box in the upper left corner with the left mouse button, or use the ALT-F4 hot key (F4 is the Function key F4, not the F key followed by the 4 key). Once the model and version have been cleared from the screen the **Model** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

request cci sTatus

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

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the CCI status from the unit. Selecting the CANCEL button will return to the **Information** menu without any further action. To clear the status information from the screen, if it has been displayed, either click on the small box in the upper left corner with the left mouse button, or use the ALT-F4 hot key (F4 is the Function key F4, not the F key followed by the 4 key). Once the model and version have been cleared from the screen the **Model** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

Settings...

The **UNIT FUNCTIONS Settings** menu has the following items and hot keys:

Upload dlm settings	ALT-U
Print dlm settings	ALT-P
view/change Category of settings	ALT-C
view/change Individual settings	ALT-I
Download changed settings to dlm	ALT-D
download All settings to dlm	ALT-A
End settings change	ALT-E
Save settings to file	ALT-S

Upload dlm settings

This menu item uploads the settings from the DLM. To select this menu item, use the ALT-U hot key or click on the menu item with the left mouse button. Once the item has been selected, a dialog box will ask for the desired group of the settings. Enter the group and select the OK button, by using the ALT-O hot key or clicking on the OK button with the left mouse button. Selecting the CANCEL button returns the user to the **Settings** menu.

Once a group has been selected, all the settings for the group will be uploaded and the functions that can be performed in the **Settings** menu will be displayed in black writing.

Print dlm settings

This item allows the user to print all settings or a specific category of settings. First a list box is displayed with the category names, plus one additional item for printing all categories. If the desired selection is not visible, use PAGE UP/DOWN or the UP/DOWN ARROW keys to see the other entries. To select an entry, either click on it with the left mouse button or highlight the item with the cursor control keys and hit ENTER.

After a category has been picked, selecting the OK button will print the settings. The settings are printed by category, with one setting name and value per line. Selecting the CANCEL button will return the user to the **Settings** menu. If CANCEL is picked before the OK button, then no settings will be printed.

view/change Category of settings

This item allows the user to change or view one or all of the settings in a category. To select this menu item, use the ALT-C hot key or click on the menu item with the left mouse button. Once the menu item has been selected, a list box of category names is displayed. The user must select a category to view or change, with the left mouse button or the UP and DOWN ARROW keys followed by the ENTER key. Once a category has been chosen, selecting the OK button will display a dialog box with the settings in the category. Selecting the CANCEL button will return the user to the **Settings...** menu.

The dialog box for the category consists of a list box containing the settings, the usual OK and CANCEL buttons, a box for a setting number to be entered, and a box for the setting value to be changed. The TAB key will select any of the above items in the list box. The arrow keys and PAGE UP/DOWN keys will move the contents to display the unseen settings. A setting can be chosen to be changed by highlighting it with the cursor keys and the hitting the ENTER key, or clicking on it with the left mouse button. After the setting has been selected, it can be changed in the box marked setting value.

After all the settings changes have been completed selecting the OK button will save the settings changes and return to the **Settings** menu. Selecting the CANCEL button at any time will return to the **Settings** menu without any further action.

view/change Individual settings

This item allows the user to change or view one setting at a time. To select this item, either click on it with the left mouse button or use the ALT-I hot key. Once this item has been selected, a dialog box is displayed containing a field to enter a setting number, a list box containing all the settings for the DLM, a field to enter a new setting value for a selected setting, and an informational field with the valid range for the setting value. Each of the different items can be selected by using the TAB key, or click on it with the left mouse button.

The field labeled "Enter setting number" allows the user to select a setting to change. Use the editing keys to enter and/or change the contents of the field. When a setting number has been entered, followed by the ENTER key, the list box scrolls to the setting and places the cursor in the setting value box so the setting may be changed. Hit ENTER after entering any setting value.

The list box contains a list of all the settings labeled "Setting list". To scroll to a setting that is not displayed, use the PAGE UP/DOWN keys or the ARROW keys, or place the tip of the mouse cursor in the scroll bar on the far-right side of the list box and click on the left mouse button. For more information see **List Boxes** near the beginning of this section.

The field labeled "Enter setting value" is used to enter a new value for the selected setting. The value is checked to make sure it is in the allowed range. The allowed range is specified in the field labeled "Setting range". When a setting valued is changed, the word "Changed" is displayed in the list box next to the setting.

The user selects the OK button to save the setting changes. Selecting the CANCEL button will return to the **Settings** menu without any further action.

Download changed settings to dlm

This item allows the user to transmit all the changed settings to the DLM. Note that if the appropriate jumper is installed, the DLM will not allow setting changes from the PC. See the **MODULES** section for more information on the jumpers.

Selecting Download with the ALT-D hot key or clicking on it with the left mouse button will display a dialog box with the changed settings. There is an option to end the settings change automatically. To pick this option, either place the mouse cursor over the box and click on the left mouse button or use the TAB key to highlight the selection and use the SPACE BAR to select it. Striking the SPACE BAR, or clicking the left mouse button again will deselect the option.

If the CANCEL button is selected, the **Settings** menu is redisplayed and no further action is taken. If the OK button is selected, another dialog box is displayed to confirm that the settings are to be downloaded. If the OK button is selected the changed settings are sent, and the changes are ended if the automatic end settings option was chosen. If the CANCEL button is selected no settings are sent and the **Download settings** dialog box is redisplayed.

download All settings to dlm

This item allows the user to transmit all the changed settings to the DLM. Note that if the appropriate jumper is installed, the DLM will not allow setting changes from the PC. See the **MODULES** section for more information on the jumpers.

Selecting download All settings with the ALT-A hot key or clicking on it with the left mouse button will display a dialog box. There is an option to end the settings change automatically. To pick this option, either place the mouse cursor over the box and click on the left mouse button or use the TAB key to highlight the selection and use the SPACE BAR to select it. Striking the SPACE BAR, or clicking the left mouse button again will deselect the option.

If the CANCEL button is selected, the **Settings** menu is redisplayed and no further action is taken. If the OK button is selected, another dialog box is displayed to confirm that the settings are to be downloaded. If the OK button is selected, all the settings are sent, and the unit is returned to service if the automatic end settings option was chosen. If the CANCEL button is selected no settings are sent and the **download All settings** dialog box is redisplayed.

End setting changes

This item is selected after downloading settings to tell the DLM that settings changes are complete and protection should use the new settings. If the option to end settings changes automatically was picked when downloading settings to the DLM, then this menu item does not need to be selected again. To select this menu item use the ALT-E hot key or click on it with the left mouse button. Once the item is selected, a dialog box that only contains the OK and CANCEL buttons is displayed. To end the settings changes, select the OK button with the ALT-O hot key or by clicking on it. Selecting the CANCEL button will return to the **Settings** menu. If the CANCEL button is selected before ending the settings changes, then the new settings will not be used.

If the OK button is selected, another dialog box will appear to confirm the choice to end the settings changes, since protection will be enabled with the new settings. If the user selects the OK button, the setting changes are ended. If the CANCEL button is selected from the confirmation dialog box, the settings changes are not ended and the previous dialog box will be active again.

Save dlm settings to file

This item allows the user to write the settings to a disk file. To select this item, use the ALT-S hot key or click on the menu item with the left mouse button. The user enters a file name (it may include a path also) in the field labeled "Enter file name". The user selects the OK button to save the settings in the specified file. The CANCEL button returns to the **Settings** menu. If CANCEL is selected before saving the settings, no settings will be saved.

The contents of the settings file saved with this menu item are raw numbers; there is no description of the contents in the file because it is used for input to the program. Use **Print dlm settings** in the **LOCAL FUNCTIONS Settings** menu if a description of the settings is desired.

LOCAL FUNCTIONS

The Local functions menu has the following items and hot keys.

Settings...	ALT-S
dLm descriptions	ALT-L
Graph oscillography data	ALT-G
go to DOS	ALT-D

Settings...

The **LOCAL FUNCTIONS Settings...** menu has the following items and hot keys.

Load settings from file	ALT-L
Print local settings	ALT-P
view/change Category of local settings	ALT-C
view/change Individual local setting	ALT-I
Model/version number	ALT-M
Save local settings to file	ALT-S
Download local settings to dlm	ALT-D
End setting changes	ALT-E

Load settings from file

This item allows the user to read settings from a disk file into the program as local settings. To select this item, either click on it with the left mouse button or use the ALT-L hot key. This permits the user to load and work on another set of settings other than the set that was initially loaded.

If the user then loads another set of local settings, the previous set of local settings is overwritten and lost, unless the user has saved the previous set of local settings by selecting **Save local settings to file** menu item from the **Settings...** menu.

Once this item has been selected, a dialog box is displayed containing several fields, including a list of files in the current directory and a list of disk drives and subdirectories. A file may be selected either by entering a file name in the field labeled "File name", or by selecting a file from the list box labeled "Files".

The field marked "File name" contains the file that is currently selected. This field may be selected by the user to specify a file containing settings (a file previously created by the **Save local settings to file** menu item or **Save dlm settings to file** menu item), or enter a partial file name using the standard DOS wild card characters * and ?.

The field labeled "Directory" indicates the current drive and directory from which the list of files is obtained. This field cannot be edited by the user.

The next two fields are list boxes. The list box labeled "Files" contains a list of files in the current directory from which the user can select a file. The list box labeled "Directories" contains a list of subdirectories and drives where the user can go for additional lists of files.

The user selects the OK button to read into DLM-LINK the local settings from the selected file.

Print local settings

This item allows the user to print all settings or categories of settings. To select this item, use the ALT-P hot key or click on it with the left mouse button. Once this item has been selected, a list box is displayed with the category names, plus one additional item for printing all categories.

The user selects the desired category of settings to print. To select a category that is not displayed use the PAGE UP/DOWN and ARROW keys or place the mouse cursor in the scroll bar or on the arrows at each end and click on the left mouse button. The highlighted item in the list box is the one that is selected. The user selects the OK button to print the settings.

The settings are printed by category, with one setting name and value per line.

view/change Category of local settings

This item allows the user to change or view one or all of the settings in a category. To select this menu item, use the ALT-C hot key or click on the menu item with the left mouse button. Once the menu item has been selected, a list box of category names is displayed. The user must select a category to view or change with the left mouse button or the UP and DOWN ARROW keys followed by the ENTER key. Once a category has been chosen, selecting the OK button will display a dialog box with the settings in the category. Selecting the CANCEL button will return the user to the **Settings** menu.

The dialog box for the category consists of a list box containing the settings, the usual OK and CANCEL buttons, a box for a setting number to be entered and a box for the setting value to be changed. The TAB key will select any of the above items in the list box. The ARROW keys and PAGE UP/DOWN keys will move the contents to display the unseen settings. A setting can be chosen to be changed, by highlighting it with the cursor keys and then hitting the ENTER key, or clicking on it with the left mouse button. After the setting has been selected it can be changed in the box marked "Setting Value".

After all the settings changes have been completed, selecting the OK button will save the settings changes and return to the **Settings** menu. Selecting the CANCEL button at any time will return to the category names dialog box without any further action.

view/change Individual local setting

This item allows the user change or view one setting at a time. To select this item, either click on it with the left mouse button or use the ALT-I hot key. Once this item has been selected, a dialog box is displayed containing a field to enter a setting number, a list box containing all the settings for the DLM from a saved-settings file, a field to enter a new setting value for a selected setting, and an informational field with the valid range for the setting value. Each of the different items can be selected by using the TAB key or clicking on it with the left mouse button.

The field labeled "Enter setting number" allows the user to select a setting to change. Use the editing keys to enter and/or change the contents of the field. When a setting number has been entered, followed by the ENTER key, the list box scrolls to the setting and places the cursor in the setting value box so the setting may be changed. Hit ENTER after entering any setting value.

The list box contains a list of all the settings labeled "Setting list". To scroll to a setting that is not displayed use the PAGE UP/DOWN keys and the ARROW keys, or place the tip of the mouse cursor in the scroll bar on the far right side of the list box and click on the left mouse button. See **List Boxes** under **GENERAL OPERATION** in this **DLM-LINK SOFTWARE** section for more information.

The field labeled "Enter setting value" is used to enter a new value for the selected setting. The value is checked to make sure it is in the allowed range. The allowed range is specified in the field labeled "Setting range". When a setting valued is changed, the word "Changed" is displayed in the list box next to the setting.

The user selects the OK button to save the setting changes. Selecting the CANCEL button will return to the **Settings** menu without any further action.

Save local settings to file

This item allows the user to write the settings to a disk file. To select this item either click on it with the left mouse button or use the ALT-S hot key. The user enters a file name (it may include a path also) in the field labeled "Enter file name". Selecting the OK button will save the settings in the specified file. Selecting the CANCEL button will return to the **Settings** menu without any further action. Selecting CANCEL after saving the settings to a file will return to the **Settings** menu.

Model/version number

This entry displays the model number and PROM firmware revision that match the settings in the local file. To select this item, either click on it with the left mouse button or use the ALT-M hot key. These numbers should **match** any unit to which you wish to send the local settings. If they do not match, the local settings download **will fail.**

Download local settings to dlm

This item allows the user to transmit all the local settings to the DLM. To select this item, either click on it with the left mouse button or use the ALT-D hot key. The user must be logged in to a DLM in order to use this menu item. Note that if the appropriate jumper is installed, the DLM will not allow setting changes from the PC. See the **MODULES** section for more information on the jumpers. The local settings file firmware revision **must** match the PROM version number in the unit or the settings download **will fail.**

Once this item has been selected a dialog box is displayed containing a list box of all the settings being downloaded, and a selection in the lower right corner to end the settings changes automatically. To select the automatic end of settings change, either click on it with the left mouse button or use the TAB key to highlight it and the space bar to change it. If an X appears in the brackets it has been selected.

To download the settings to the unit, select the OK button with the mouse or the ALT-O hot key. To exit download at any time select the CANCEL button. If the OK button is selected, another dialog box will be displayed to confirm the download. To continue the download process select the OK button. If the settings are not to be downloaded then select the CANCEL button. When finished, select the CANCEL button from the **Download** dialog box to exit.

End setting changes

This item allows the user to tell the DLM that settings changes are complete and protection should be re-enabled. This item is not necessary if the option to automatically end settings changes was selected when the settings were downloaded. To select this item either click on it with the left mouse button or use the ALT-E hot key.

Once this item has been selected a dialog box containing the OK and CANCEL buttons is displayed. The user selects the OK button to end setting changes. Selecting the CANCEL button will exit **End setting change** without any further action. If the OK button was selected, another dialog box is displayed to confirm the ending of setting changes. Selecting the CANCEL button will return to the previous dialog box without ending the setting changes. Selecting the OK button will end the settings changes. Select the CANCEL button to exit.

dLm descriptions

The **dLm descriptions** menu has the following items and hot keys.

New description	ALT-N
Modify description	ALT-M
Delete description	ALT-D

New description

New CCI descriptions are entered by choosing this selection. To select this item, either click on it with the left mouse button or use the ALT-N hot key. Once this item is selected, a dialog box containing a field to enter a filename for the descriptions and the OK and CANCEL buttons will be displayed. The user must enter a filename without an extension followed by the OK button. Once the filename is selected, another dialog box containing a list of default CCI descriptions will be displayed. Use the TAB key to move between the CCI list box and the OK and CANCEL buttons, or click on the desired field with the left mouse button.

Once a description in the list box has been selected, use the editing keys to change and/or enter data. When each description is correct, hit the ENTER key to save it in the list of CCI decriptions. The OK button will perform the same as the ENTER key. If the CANCEL button is selected, the **dLm descriptions** menu will be redisplayed without any further action. The CANCEL button is used to exit the description box after all descriptions have been entered.

Modify description

Existing CCI descriptions are changed by choosing this selection. To select this item, either click on it with the left mouse button or use the ALT-M hot key. Once this item is selected, a dialog box containing a list of already defined CCI description filenames will be displayed. Use the TAB key to move between the CCI list box and the OK and CANCEL buttons, or click on the desired filename with the left mouse button. To display the list of CCI descriptions in the selected file, select the OK button.

Once a field has been selected, use the editing keys to change and/or enter data. When all the CCI descriptions are complete select the OK button to save the descriptions. If the CANCEL button is selected, the **dLm descriptions** menu will be redisplayed without any further action.

Delete description

To delete a CCI description file, select this item by either either clicking on it with the left mouse button or use the ALT-D hot key. Once this item is selected, a dialog box containing a list of CCI description files will be displayed. To select the CCI description file you want to delete, click on the desired field with the left mouse button or use the UP and DOWN arrow keys to highlight the desired selection and hit the ENTER key.

Once a selection has been made, use the OK button to delete the CCI descriptions. Selecting the CANCEL button will exit the dialog box without any further action.

Graph oscillography data

The optional program DLDATA will be started (if present) if this entry is chosen. This enables the user to graph oscillography data without leaving DLM-LINK. The DOS path for the DLDATA program needs to be entered. The path is entered from the **SETUP** menu (see below) and is stored for later use. For more information on DLDATA, refer to the pages describing DLDATA at the end of this **SOFTWARE** section.

go to DOS

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

SETUP

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

Communication port number	ALT-C
Dial Type	ALT-D
Modem connection time	ALT-M
Unit parameters	ALT-R
Add unit to list	ALT-A
dElete unit from list	ALT-E
Set path for DLDATA	ALT-L
Memory available	no hot key

Communication port number

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

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

Dial type

To select this item, either click on it with the left mouse button or use the ALT-D hot key. Once this item is selected, a dialog box containing the dialing type will be displayed. Either tone or pulse dialing can be chosen. The UP and DOWN ARROW keys will toggle between the tone and pulse choices. The TAB key will move between the selected dialing type and the OK and CANCEL choices in the box. Once the dialing type has been chosen, selecting the OK button will store the change. Selecting the CANCEL button will exit Dial type without any further action.

Modem connection time

This item will change the time-out period for DLM-LINK to wait for the modem to make a connection. To select this item, either click on it with the left mouse button or use the ALT-M hot key. The modem connection time can be set for any time up to 255 seconds, provided the modem being used will accommodate that long a time-out period. This setting is useful for applications where the modem is set to pickup after a large number of rings, especially if the phone system has a lot of delay in making the initial connection. Once a connection time has been set, selecting the OK button with the left mouse button or the ALT-O hot key will store the new time-out period. Selecting the CANCEL button will exit this item without any further action.

Unit parameters

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

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

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

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

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

The baud rate must have one of the values selected. The baud rate item can be selected by clicking on it with the left mouse button or using the TAB key until the selected item is highlighted. The UP and DOWN ARROW keys select the desired value. A specific value can be selected by clicking on it directly with the left mouse button.

A choice of one or two stop bits must be made for communications to work properly. The stop bits item can be selected by clicking on it with the left mouse button or using the TAB key until the selected item is highlighted. The UP and DOWN ARROW keys select the desired value. A specific value can also be selected by clicking on it directly with the left mouse button.

Parity must have one of the values selected for communications to work properly. The parity item can be selected by clicking on it with the left mouse button or using the TAB key until the selected item is highlighted. The UP and DOWN ARROW keys select the desired value. A specific value can also be selected by clicking on it directly with the left mouse button.

NOTE: Units having model numbers ending with the letters "A" or "B" must have the number of stop bits set to "1" and parity set to "NONE".

Add unit to list

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

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

dElete unit from list

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

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

set path for DL-DATA

DL-DATA (optional) can be started from DLM-LINK from the **LOCAL FUNCTIONS** pull-down menu. The DOS path must first be set so DLM-LINK knows where to start the program from. To set the path, select this menu item by using the hot key ALT-L or click on it with the left mouse button. A dialog box will appear, with space to enter a path. After entering the path, select the OK button to accept the new path, or the CANCEL button to exit without changing the previous path.

memory available

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

Exiting DLM-LINK

There are two ways to exit DLM-LINK:

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

The ALT key combined with the space bar will produce the System Menu after all menus have been cleared from the screen. Choosing the CLOSE entry, with the mouse or the hot key ALT-C, will produce a dialog box with the exit message. Selecting the OK button with the mouse or using the ALT-O hot key will exit DLM-LINK. Selecting the CANCEL button will return to the program without exiting.

NOTE: To exit DLM-LINK, all dialog boxes and list boxes must be cleared from the screen. It is not necessary to clear all the menus from the screen.

HELP

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

DL-DATA SOFTWARE (Optional)

OVERVIEW

This program plots oscillography data obtained during a disturbance and displays disturbance reports and events. The data displayed includes currents, voltages, digital inputs, digital outputs, and triggering flags.

The program obtains the oscillography data from a disk file in the PC that is created by the DLM-LINK program or by other GE software. Refer to DLM INFORMATION under **DLM-LINK SOFTWARE** for a description of how to retrieve oscillography data from the DLM.

The disk file containing the oscillography data is an ASCII file and is formatted as follows. The disturbance report (in the format that is displayed on the screen in the DLM-LINK program) is in the file first, followed by the events associated with the disturbance report (again, in the format that is displayed on the screen in the DLM-LINK program). Next are the title columns for a spread sheet. The remaining data consist of the oscillography data. Each line in the file consists of one sample of data. Each sample has four currents (phase A, B, C and ground), three voltages (phase A, B, and C), and three flag groups. The flag groups contain the following data.

Flag	Description
1	DIGITAL INPUTS, 12 CCIs (Contact Converters 1-12) Identified by user's description
2	DIGITAL INPUTS, 12 CCIs (Contact Converters 13-24) Identified by user's description
3	FLAGS Overcurrent, A Overcurrent, B Overcurrent, C Overcurrent, Neutral Undervoltage, A Undervoltage, B Undervoltage, C Fault Detector Breaker 1 Trip Breaker 2 Trip Breaker 3 Trip Breaker 1 Close Breaker 2 Close Breaker 3 Close Alarm

SYSTEM REQUIREMENTS

HARDWARE

The minimum PC hardware requirements consists of the following components. An IBM-AT or compatible (Compaq, Zenith, Tandy, etc...) with one parallel port, a minimum of 450K of RAM to run the program in, 40MB hard drive, low density 3 1/2 inch floppy drive, EGA monitor, and one of the printers described below for plotting oscillography data.

SOFTWARE

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

INSTALLATION

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

GENERAL OPERATION

MOUSE/KEYBOARD USAGE

Either the mouse or the keyboard can be used to access all items in menus and dialog boxes. For full manipulation of graphical data, however, the mouse is required.

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

MAIN HORIZONTAL MENU BARS

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

1 - Position the mouse cursor on top of the menu item and click the left button.
2 - Use a hot key. The hot key is the combination of the ALT key and the letter that is highlighted in the item description (yellow in the default colors).
3 - Once an item on the menu has been selected, the RIGHT and LEFT ARROW keys can be used to go to adjacent menu items.

PULL DOWN MENUS

Pull down menus are selected in a number of ways:

1 - Position the mouse cursor on top of the menu item and click the left button.
2 - Position the mouse cursor on top of the menu item and press the left button. While holding the left button down, move the cursor to the desired menu item and release the button.
3 - Use a hot key (the combination of the ALT key and the key that is highlighted) (yellow in the default colors). This method is not available in the HELP pull down menu.
4 - Use the UP ARROW and DOWN ARROW keys to highlight the desired menu item, then press the ENTER key.

WINDOWS

Windows contain several objects that are of interest to the user. The first object is the title bar, which is displayed across the top of the window and has a small solid rectangle on the left side. The title bar contains the oscillography data file name, and the date and time of the fault. The second object is the QUIT button, which is just below the title bar. The remaining objects are specific to the data being viewed.

Windows containing data plots (currents/voltages/flags) and reports can in general be resized and moved anywhere on the screen. When the mouse cursor is moved into the title bar, the cursor changes shape into a cross hair. At this point, the window can be either resized or moved. To resize the window, hold the right mouse button down and drag the mouse until the window is the desired size, then release the right mouse button. To move the window, hold the left mouse button down and drag the mouse until the window is in the desired position, then release the left mouse button.

Windows can also be iconized (i.e. made into a small window just large enough to contain a title). The window can be iconized by moving the mouse cursor to the solid rectangle on the left of the title bar (the cursor will change shape to a left pointing arrow) and clicking the left button. The window can later be restored to its last size and position by moving the mouse cursor over the icon and clicking the right button.

The window can be exited (or closed) by moving the mouse cursor over the QUIT button (the mouse cursor changes shape to a left pointing arrow) and clicking the left button. Alternatively the user can enter ALT-Q to close the window.

A maximum of six windows can be placed on the screen at the same time, sized and positioned appropriately to view all of them.

DIALOG BOXES

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

If an item in the dialog box has a title with a highlighted character (yellow in the default colors), the user can access this item from the keyboard by using the ALT key with the highlighted character (the hot key).

Buttons in the dialog box can be accessed from the keyboard by using the UP/DOWN ARROW keys, the TAB/SHIFT TAB keys, or if the button has a highlighted character, the hot key. If the buttons require the user to make a selection, the selection is made by using the ENTER key. A button that is not selected has the same color as the dialog box (grey). A button that is selected turns white. Once a button is selected, it can be de-selected by using the ENTER key again. The mouse can also be used to select and de-select buttons. When the mouse cursor is moved inside a button, the cursor changes shape to a left pointing arrow. At this point, the user can select/de-select the button just by clicking the left mouse button to select an item and again clicking the left button to de-select the item.

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

The OK button accepts the selection(s) made by the user and allows the program to use these selections. The CANCEL button does not accept (cancels) the selections made by the user and thus the program uses the previous selections.

LIST BOXES

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

List boxes are accessed either with a mouse or the associated hot key. They can be used entirely with a mouse or from the keyboard. The following keys from the keyboard are valid:

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

The user may also click the left mouse button on the scroll bar to move through the selections. When the mouse cursor moves to the list of items in the list box, the cursor changes shape to a left pointing arrow. Clicking the left mouse button on an item selects that item.

The current selection of a list box is highlighted (yellow in the default colors).

ENTERING TEXT AND NUMBERS

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

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

PLOTS OF CURRENTS/VOLTAGES AND FLAGS

Each window containing a plot of the currents/voltages and flags has several characteristics.

The prefault cycles are all in grey.

The y axis for currents and voltages is the magnitude of the currents and voltages. The y axis has no specific meaning for the flags. The x axis represents the sample number with sample number 0 being the origin of the x axis.

There are two vertical bars through the graph that can be moved along the x axis to get information on timing and, in the case of currents/voltages, magnitudes of the currents/voltages. To move these vertical bars, place the left edge of the mouse cursor (the point of the left pointing arrow) on the bar or on the box at the top of the bar, press and hold down the left mouse button, and move (drag) the mouse until the bar is in the desired position, then release. (See Figures 10-1 through 10-3.)

At the top of the window (just below the title line) is the area for displaying the sample numbers at the vertical bars. The origin of the x axis represents sample number 0. Also the time difference (in milliseconds) between the two bars is displayed. The time difference is based on the line frequency. For currents and voltages, additional data is displayed, representing the magnitudes of the currents and voltages at each vertical bar.

On the left of the window is the area used for displaying the range for the y axis for currents and voltages and for displaying either the names of the flag groups or the individual flags in the group.

ZOOM

This feature allows the user to select a rectangular area of a graph and expand that area for more detail. If the graph is a current/voltage graph, the area can include from one phase to all phases. If it is the all-flags graph, the area can include from one flag group to all flag groups on the display. If it is a flag-group graph, the area can include from one flag to all flags in the group.

The user starts the process by positioning the mouse cursor in one corner of the rectangular area to be viewed in more detail and clicking the right mouse button. The cursor changes shape to a cross hair. The user then moves the mouse in any direction to create a rectangle (yellow in the default colors). When the user is satisfied with the rectangular area, he clicks the left mouse button. Then a message box is displayed on the screen to ask the user to zoom in on the rectangular area or cancel it. If the user cancels it (selects the CANCEL button), then the rectangle is removed and the screen is restored. If the user selects the OK button to zoom in on the rectangular area, a new window is created and the rectangular area is plotted. This window then can be manipulated in the same way as the previous window. In fact the previous window is still there (under the new window). If the user resizes the new window to a smaller size, then some portion of the previous window is displayed.

REPORTS

The windows containing the reports have scroll bars on the right side. If the report is too long for the window, the user may scroll through the report by clicking the left mouse button on the scroll bar.

PROGRAM OPERATION

MAIN MENU

The main menu has the following items and hot keys.

File	ALT-F
Graphs	ALT-G
Reports	ALT-R
Setup	ALT-S
eXit	ALT-X
F1=Help	F1

Each item in the main horizontal menu has a pull down menu associated with it except for "eXit".

FILE MENU

The file menu has the following items and hot keys.

Open	ALT-O
Create pcx file	ALT-C
Print screen	ALT-P
Information	ALT-I

Open

Selection of this item displays a dialog box that allows the user to select an oscillography data file to use. The file may be selected either by entering the file name in the data entry box, or by using the left list box.

The first field in the dialog box, marked "Selected file", contains the file that is currently selected. The user can select this field by either clicking the left mouse button on the field or typing an ALT-S (the highlighted character in the field title). Once this field is selected, a file name can be entered. The file name can consist of any characters that DOS accepts, including wild card characters (* or ?). When the file name has been entered, the user presses the ENTER key to accept the file name. This then places the user in the file name list box.

The next field indicates the current drive and directory where the list of files is obtained from. This field cannot be edited by the user.

The next two fields are list boxes. The left list box, titled "File list", contains a list of files from which the user can select. The right list box, titled "Directory list", contains a list of directories and drives where the user can go for additional lists of files.

The user can select the directory list box by using either the hot key, ALT-D (the letter highlighted in the title, with yellow in the default colors), or clicking the left mouse button inside the list box. When a new drive or directory is selected, both list boxes are rebuilt.

The user can select the file list box by using either the hot key, ALT-F (the letter highlighted in the title, with yellow in the default colors), or clicking the left mouse button inside the list box. When the user selects a file, the file name is displayed in the data entry box above the list box and it becomes the current file selection.

The last two fields are the OK button and the CANCEL button. If the user selects the CANCEL button, the oscillography data file is not read into the program, and the plotting of data and viewing reports are not allowed. If the user selects the OK button, the oscillography data file is read into the program and the plotting of data and viewing of reports are allowed.

Create PCX File

Selection of this item displays a dialog box that allows the user to select the file to which the screen is to be saved in PCX format. (The screen is saved without the main horizontal menu.)

The first field in the dialog box, marked "PCX file" contains the file to which the screen is saved. The user can select this field either by clicking on the field with the mouse, or by typing an ALT-P (the highlighted character in the field title). Once this field is selected, the file name can be entered. When the file name is entered, the user uses the ENTER key to accept the file name.

The last two fields are the OK button and the CANCEL button. If the user selects the CANCEL button, the screen is not saved in PCX format. If the user selects the OK button, the screen is saved to the specified file in PCX format.

Print Screen

Selection of this item displays a dialog box that allows the user either to print the screen or to save the screen in a file that can be printed later. The screen is printed with the main horizontal menu.

The first item in the dialog box is a list box listing the various types of printers that are supported. The printer type that the user selects can be saved in the setup file; then the user only has to select a printer type if the user's printer changes.

The next item in the dialog box is a button that determines whether the printer performs a form feed after printing the screen. The button in its unselected state does not cause a form feed after printing. In its selected state, it causes a form feed after printing. This item can also be saved in the setup file, so that a user need only select it once. The default is to have the printer do a form feed after printing (selected state of the button).

The next item allows the user to select a printer port (LPT1, LPT2, etc.). The default is LPT1. If the printer is attached to LPT1, the user can ignore this item. This item can also be saved in the setup file, so that a user need only select it once.

The next item allows the user to save the screen in a file for later printing. If this item is blank, the screen is not saved, but is printed. If this item contains a file name (is not blank), the screen is saved in the file and not printed. The file can be printed later by entering the DOS command:

TYPE Filename > LPT1

The next item is the number of copies to be printed. This item is always 1 unless the user changes it. If the user saves the screen to a file, this item is ignored.

Finally, there are the OK and CANCEL buttons. Selecting the OK button causes the screen to be printed (or saved in a file) and the necessary items to be saved in the setup file. Selecting the CANCEL button causes no action and the items are not saved in the setup file.

Information

Selection of this item displays a dialog box with the program name, version and copyright notice. It also displays the amount of memory available for the program to use. That amount of available memory needs to be at least 80K bytes for the program to run properly.

GRAPHS MENU

The graphs menu has the following items and hot keys.

All currents/voltages	ALT-A
Select currents/voltages	ALT-S
select Reference current/voltage	ALT-R
sElect groups for all flags display	ALT-E
all Flags	ALT-F
flag Group	ALT-G
Custom (flag) group	ALT-C

Once an item is selected to be displayed, the same item cannot be selected again until it is cleared from the display by closing the window, using the QUIT button just below the title block.

Note: An item can be saved by making it an icon, which can be restored and saved as many times as necessary. This eliminates the need to close the window to be able to view the item again.

All Currents/Voltages

This item plots all the currents and voltages in a single window.

Select Currents/Voltages

Selection of this item displays a dialog box that allows the user to select specific phases of currents and/or voltages for display. The user can select from one current or voltage to all seven currents and voltages.

The cursor is positioned at the first button. With the keyboard, the user can move through the buttons and select the currents and/or voltages to plot (this procedure is described under **DIALOG BOXES** under **GENERAL OPERATION**). Or the user can click the left mouse button on the dialog box buttons to select or de-select the currents/voltages.

The last two fields are the OK button and the CANCEL button. If the user selects the CANCEL button, the selected currents/voltages are not displayed. If the user selects the OK button, the selected currents/voltages are displayed and the selection remains in effect until the program is terminated.

Select Reference Current/Voltage

This item allows the user to select a reference current or voltage for display with the flags.

A dialog box is displayed, allowing the user to select the reference. The user can select the reference with the keyboard by moving through the buttons to select the current or voltage (this procedure is described under **DIALOG BOXES** under **GENERAL OPERATION**). The user can also select the reference by moving the mouse cursor to the desired button and clicking the left mouse button. The user can then select either the OK or the CANCEL button to leave the dialog box. If the user selects the OK button, the selected reference remains in effect until the program is terminated. If the user selects the CANCEL button, the previously selected reference remains in effect.

The default reference is phase-A current.

Select Groups for All Flags Display

Selection of this item displays a dialog box that allows the user to select specific flag groups for displaying in the ALL FLAGS display. The user can select a maximum of 6 flag groups for a VGA display and a maximum of 5 flag groups for an EGA display.

The cursor is positioned at the first button. With the keyboard, the user can move through the buttons to select the flag groups (this procedure is described under **DIALOG BOXES** under **GENERAL OPERATION**). The user can also use the mouse and click the left button on the dialog box buttons to alternately select and de-select the flag groups.

The last two fields are the OK button and the CANCEL button. If the user selects the CANCEL button, the selected flag groups are not changed. If the user selects the OK button, the selected flag groups are changed to those selected, and saved in the setup file.

All Flags

This item displays all the flags in all the flag groups selected for display, along with the previously selected reference current/voltage. The number of flag groups that can be displayed depends on whether the display is EGA or VGA (see **Select Groups for All Flags Display** above). If a reference current/voltage has not been previously selected, the reference is defaulted to phase A current.

Flag Group

This item allows the user to select a single group of flags for display.

A dialog box is displayed, allowing the user to select the group. The user can select the group by moving the mouse cursor to the desired group and clicking the left button. The user can also select the group with the keyboard, by moving through the buttons to select the flag group (this procedure is described under **DIALOG BOXES** under **GENERAL OPERATION**). The user can then select either the OK or the CANCEL button to leave the dialog box. If the user selects the

OK button, the selected group is displayed along with the previously selected reference current/voltage. If the user selects the CANCEL button, a flag group is not displayed.

Custom (Flag) Group

This menu item allows a user to select up to 16 flags from any of the flag groups and assign them to a custom group. The custom flag group is saved in the setup file, so that once the flags are selected, they remain in the group until the group is re-configured by the user.

A dialog box is displayed with 3 list boxes (1 for each flag group). Either the mouse or the keyboard can be used to select flags from any group in any order. The custom group list, on the right side of the dialog box, is automatically updated as the user selects and de-selects flags.

The user selects the OK button to save the custom group, plot the flags and return to the main menu; or the CANCEL button to cancel any changes made to the custom group and return to the main menu.

REPORTS MENU

The reports menu has the following items and hot keys.

Fault report	ALT-F
Events	ALT-E
Settings	ALT-S

Once an item is selected to be displayed, the same item cannot be selected again until it is cleared from the display.

Fault Report

Selection of this item displays the disturbance report associated with the oscillography data (the report is generated at the DLM).

Events

Selection of this item displays the events associated with the oscillography data (the events are generated at the DLM).

Settings

Selection of this item displays the settings from the DLM at the time of the disturbance. The settings can only be viewed.

SETUP

The setup menu has the following items and hot keys.

Line frequency	ALT-L
Flag names	ALT-F
Colors	ALT-C
Default colors	ALT-D
Printer grey shades	ALT-P

Line Frequency

Selection of this item displays a dialog box that allows the user to select either 50Hz or 60Hz for the line frequency. Select either frequency by using the UP/DOWN ARROW keys or clicking the

left mouse button on the desired frequency button. Select the OK button to make the change permanent (saved in the setup file). Select the CANCEL button to cancel the change.

Flag Names

Selection of this item displays a dialog box that allows the user to modify any of the flag names. The right list box is used to select the flag group. The left list box is used to select the flag name to modify from the selected flag group. The selected flag name is displayed in the data entry box above the left list box. The user may modify the name in the data entry box (it may be up to 13 characters long). When the name has been modified, press the ENTER key and the new name will be displayed in the left list box. Select the OK button to make the new flag names permanent (saved in the setup file) or select the CANCEL button to ignore any flag name changes.

Colors

Selection of this item displays a dialog box that allows the user with a color monitor to change any color that is displayed. The colors are divided into groups according to the types of objects that are displayed. The groups and their descriptions are:

HORIZONTAL MENU
Colors associated with the main horizontal menu.
PULL DOWN MENU
Colors associated with the pull down menus.
ACTION BUTTON
Colors associated with buttons that cause an action, such as the QUIT, OK, and CANCEL buttons.
DIALOG BOX
Colors associated with the basic (empty) dialog box and labels placed in the dialog box.
LIST BOX
Colors associated with a list box.
MESSAGE BOX
Colors associated with the message box.
DATA ENTRY BOX
Colors associated with the data entry box.
SELECTION BUTTON
Colors associated with selection buttons used to make selections in a dialog box.
WINDOW
Colors associated with the basic (empty) window (both the report and graph windows).
REPORT
Colors associated with the displaying of a report in a window.
GRAPH
Colors associated with the drawing of a graph.
GRAPH DATA
Colors associated with displaying the data in a graph.
GRAPH LABEL
Colors associated with displaying the axis labels in a graph.

This item uses two dialog boxes.

The first dialog box is used to select the color group, using either the mouse or the keyboard. Once the group has been selected, a second dialog box is displayed, which allows the modification of the colors of individual items in the group. The item is selected when it is highlighted. When an item is highlighted and the SPACE bar is pressed, the color of the item is changed to the color in the color box in the upper right corner of the dialog box. Also a sample of the color group is shown in the dialog box.

Select the OK button to make the new colors for the group permanent (saved in the setup file) or select the CANCEL button to ignore the new colors for the group. In either case, the first dialog box is displayed again.

Default Colors

This allows the user to put all items back to their original colors and shades of grey (those which are on the distribution diskettes). A message box is first displayed to make sure the user wants to do this. If the user wants to do this, the OK button in the message box should be selected; otherwise select the CANCEL button. If OK is selected, the original colors and shades of grey are made permanent (saved in the setup file).

Printer Grey Shades

Selection of this item displays a dialog box that allows the user to assign shades of grey to colors so that all items on a display can be seen on the output of a black and white printer. The user selects the color from the list box and then uses the indicated hot keys to select the button for the desired shade of grey. Select OK to make the changes permanent (saved in the setup file) or select CANCEL to cancel the changes.

BLACK cannot be assigned a shade of grey. It always results in the printer printing nothing (i.e. the color of the paper).

EXIT

This item causes the program to exit to DOS. A message box is first displayed to make sure the user really wants to exit the program. If the user wants to exit the program, the OK button in the message box should be selected; otherwise select the CANCEL button.

HELP

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

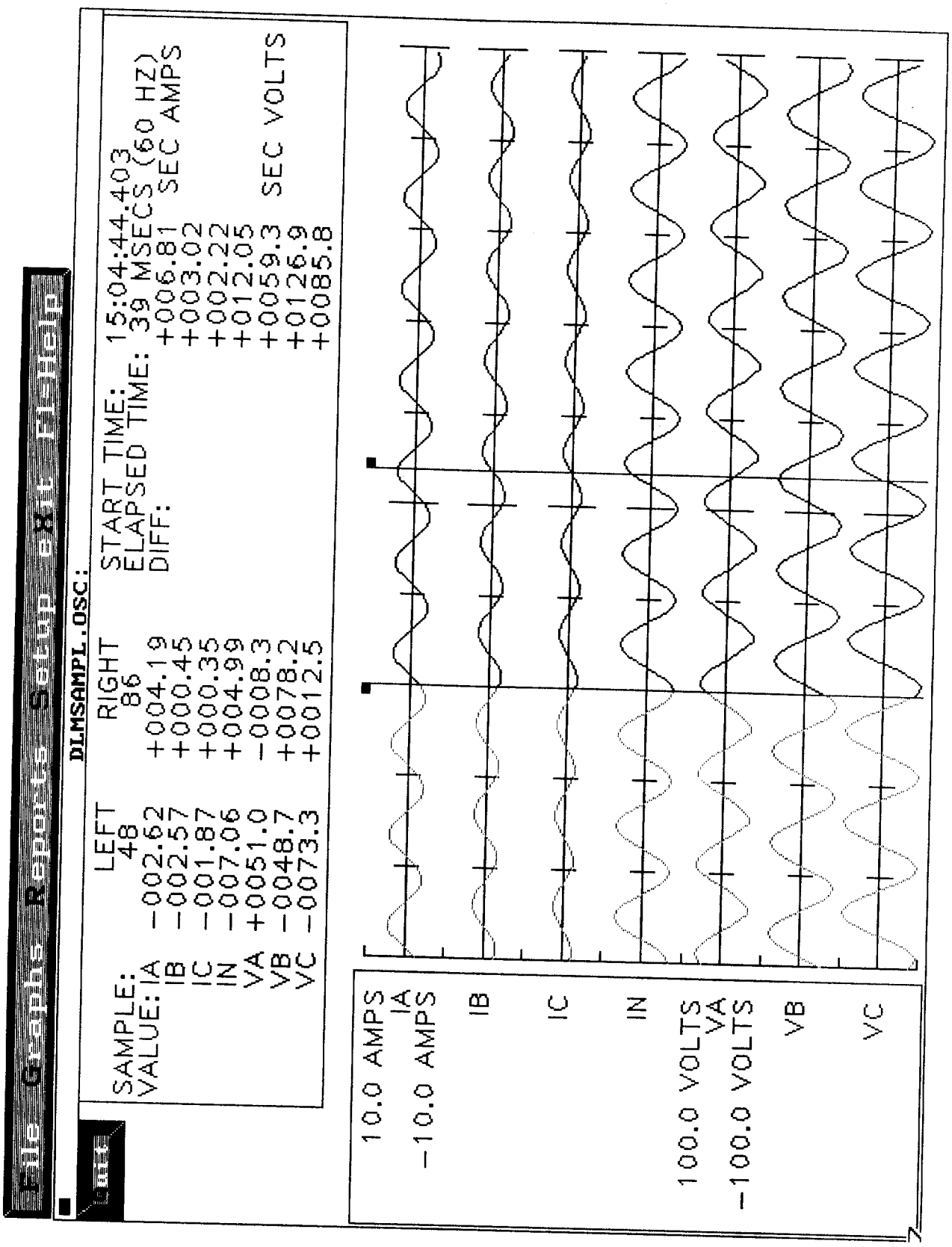


Figure 10-1 (0286A3835 Sh.1) Oscillography -- Currents and Voltages

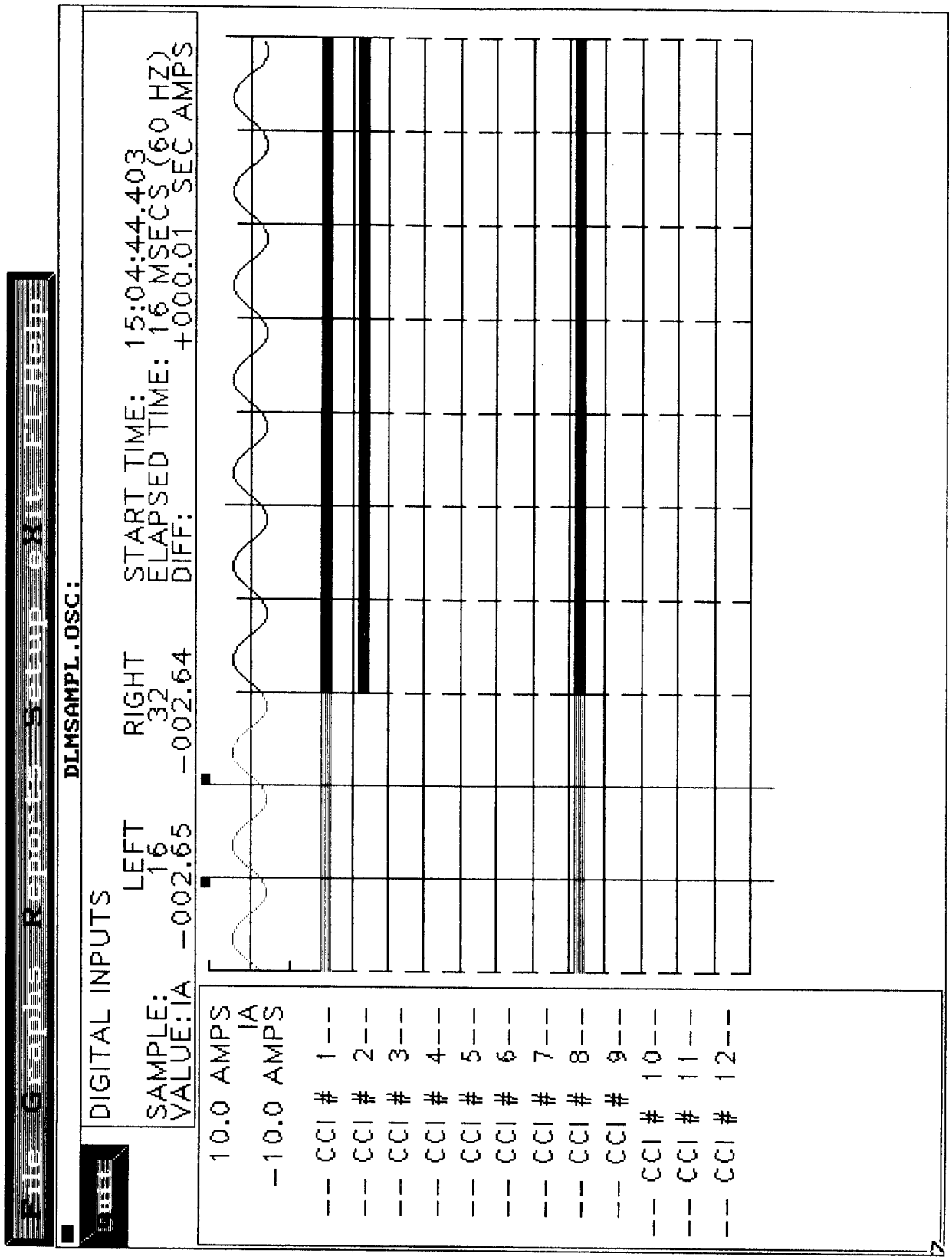


Figure 10-2 (0286A3835 Sh.2) Digital Inputs Screen

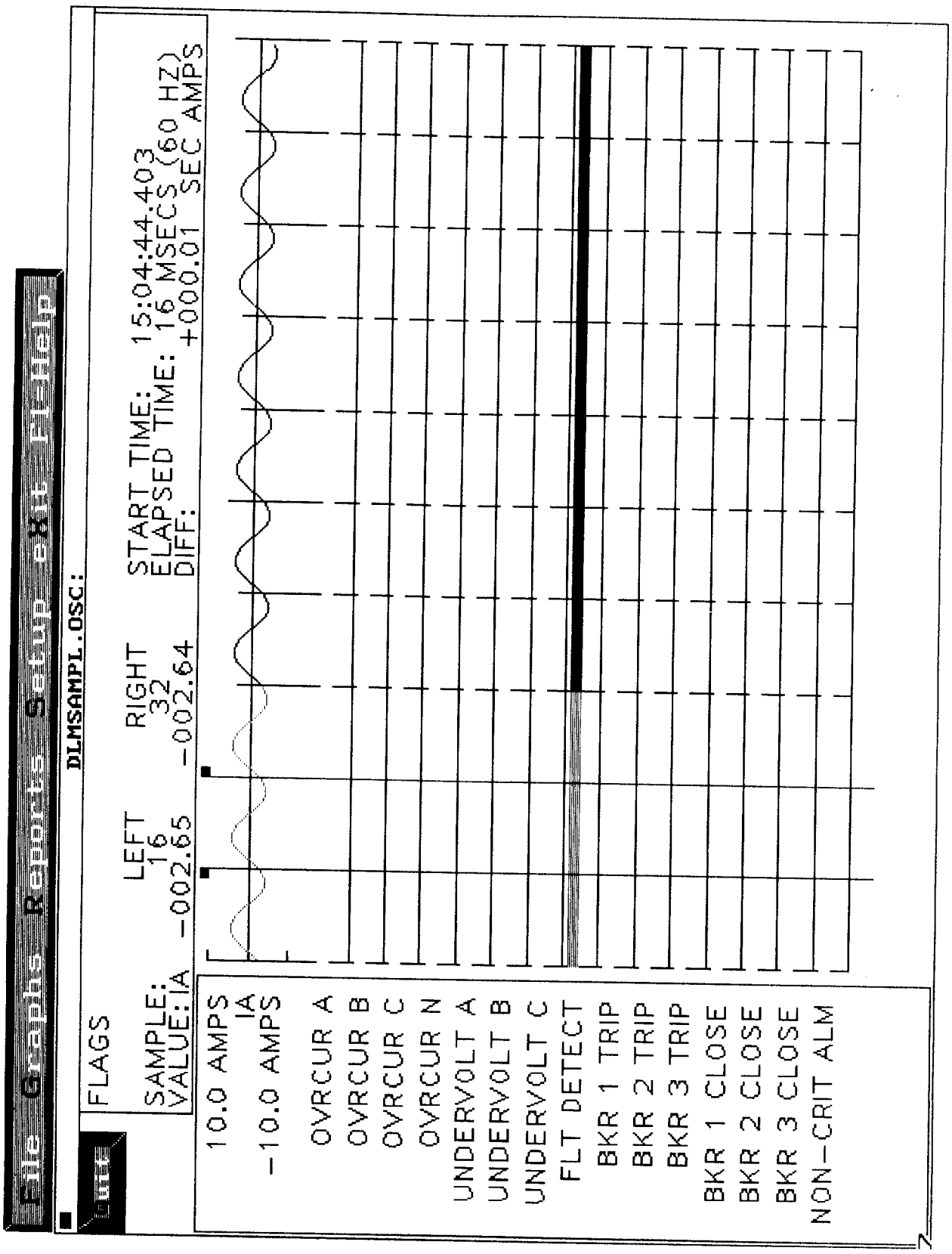


Figure 10-3 (0286A3835 Sh.3) Flags Screen

GE Power Management

215 Anderson Avenue
Markham, Ontario
Canada L6E 1B3
Tel: (905) 294-6222
Fax: (905) 201-2098
www.ge.com/indsys/pm