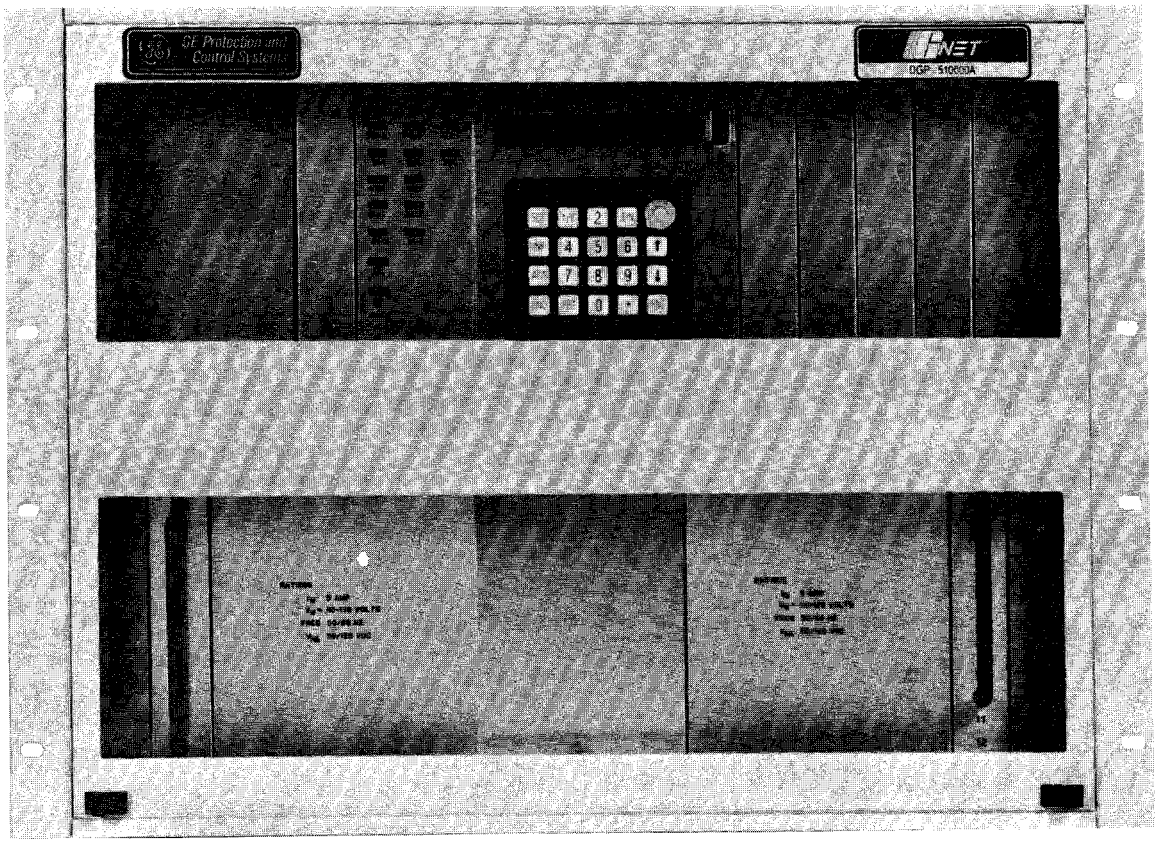
GEK-100605
DGP
DIGITAL
GENERATOR
PROTECTION SYSTEM



Protection and Control
Business Department

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

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

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Cover Photo: 8919478

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DGP DIGITAL GENERATOR PROTECTION SYSTEM

A Microprocessor-based Waveform-sampled Relay System

The DGP Digital Generator Protection System uses microprocessor technology to obtain a numerical relay system with a wide range of protection, monitoring, control, and recording functions. User-friendly Man-Machine Interface and standard communication ports allow for easy operation and maintenance.

Distributed processing and optional redundant power supply, in concert with diagnostics and self-test routines, provide a high degree of dependability while retaining maximum system security.

The integral Man-Machine Interface (MMI) allows the operator to enter settings, access data, and test outputs. The keyboard and the LED display associated with it are all that is required to program and interrogate the DGP locally. Present values of selected parameters can be displayed.

The display consists of 16 LED alphanumeric positions arranged side-by-side horizontally. Remote programming and data acquisition is possible through a dedicated RS 232 interface front and rear.

PROTECTION FUNCTIONS AND SETTINGS

Generator Differential (87G)	
Differential Current Pickup	0.2-1.0 Amp
Current Unbalance (46)	
Negative Sequence	
Current Pickup	0.05-2.99 Amps
Machine Constant -K2	1.0-50
Loss of Excitation (40) *(Two independent Zones)*	
Zone 1 & Zone 2 Center	2.5-60 ohms
Zone 1 & Zone 2 Radius	2.5-60 ohms
Zone 1 & Zone 2 Timer	0.01-9.99 sec
Anti-Motoring (32) *(Two independent Steps)*	
Reverse Power No. 1 & 2	0.5-99.9 watts
Time Delay	1-60 sec
100% Stator Ground (64G)	
Zone 1 Neutral OV Pickup	4-40 volts
Zone 1 Timer (Fundamental	0.1-9.9 sec
Zone 2 Timer (3rd Harmonic)*	0.1-9.9 sec
Overexcitation (24)	
V/Hz Pickup (Inverse)	1-1.99 per unit
Time Factor (Inverse)	0.1-99.99 sec
V/Hz Pickup (Instantaneous)	1-1.99 per unit
Timer (Instantaneous)	0-9.9 sec
Rate of Reset Timer	0-9.9 sec/%
Overvoltage (59)	
Voltage Pickup	100-200 volts
Time Factor	0.10-99.99 sec
Over and Underfrequency (81) *(Four independent Steps)*	
O/F Set Point (Each Step)	45.0-79.9 Hz
U/F Set Point (Each Step)	40.0-65.0 Hz
Timer (Each Step)	.05-99.99 sec
System Backup (51V)	
Phase Time OC Pickup	0.5-16 Amps
Time Factor	0.1-99.99 sec

*64G Zone 2 requires wye-connected VT's

ALARM FUNCTIONS AND SETTINGS

Current Unbalance (46)	
Negative Sequence	
Current Pickup	.05-2.99 Amps
Time Delay	1-5 sec
Overexcitation (24)	
V/Hz Pickup	1-1.99 PU
Timer	0-9.9 sec
Self-Test	
Critical	
Non-critical	
VT Fuse Failure	
Loss of Power Supply	
Power Supply No.1	
Power Supply No.2	

ADDITIONAL FEATURES

PROTECTION;
- Selectable for ABC or ACB phase sequence;
- Suitable for delta-* or wye-connected VT's;
- Includes logic to detect Accidental Energization of the generator while on turning gear;
- Algorithm tracks over a frequency range of 30.5-79.5 Hz;
- User configurable to four trip output relays and four alarm output relays;
- Differential function operates in 1 to 1¼ cycles.

INTERFACE:
- Compatible with G-NET, GE's substation protection and control integration system;
- Printer port provided on the rear;
- User configurable oscillography allows the capture of up to 120 cycles of the fault data with 1 to 20 prefault cycles selectable, triggered internally and externally.
- Graphical display is accomplished via DGP-DATA software.

CONSTRUCTION:
- Lift-off front cover with built-in reset button;
- Draw-out modules for ease in replacement;
- Standard modular test and connection plugs allow current/voltage injection testing;
- 19 inch wide rack mount case;
- Screw terminals on barrier terminal blocks provide external wiring termination.

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DGP DIGITAL GENERATOR PROTECTION SYSTEM

TECHNICAL DATA

Ratings

Voltage - Nominal	• 140 VAC (phase-to-phase)
Frequency - Nominal	• 50 or 60 Hz
Current - Nominal	• I_N = 5 amperes
DC Current Voltage	• 48 VDC (38.5 to 60 volts)
	• 125 VDC (88 to 150 volts)
	• 220/250 VDC (176 to 300 volts)

Maximum Permissible Currents

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 (One per hour)	• 3.5 x Rated

Insulation Test Voltage • 2 kV 50/60 Hz, one minute

Impulse Voltage Withstand • 5 kV peak, 1.2/50 millisecond, 0.5 joule

Interference Test Withstand • SWC per ANSI C37.90.1

Trip Output Contacts
- Continuous 3 amperes, make and carry for tripping duty = 30 amperes (per ANSI C37.90)
- Break 180 VA resistive @ 125/250 VDC
- Break 60 VA inductive @125/250 VDC

Auxiliary Contacts (Including Alarms)
- Continuous 3 amperes
- Make and carry for 30 seconds = 5 amperes
- Break 25 watts inductive @ 125/250 VDC; maximum 250 volts or 0.5 amperes

Ambient Temperature Range
- Storage: –30°C to +70°C
- Operation: –20°C to +55 °C

Humidity • 95% without condensing

Weight • 51 pounds (23 kilograms)

Dimensions

Height	• 14 inches (352 millimeters) 8 rack units
Width	• 19 inches (484 millimeters) standard 19 inch rack
Depth	• 14 inches (356 millimeters)

Burdens

Current Circuits	•0.022 / 5° ohms, I_N = 5 amps
Voltage Circuits	•0.30 VA, 60 Hz •0.40 VA, 50 Hz
DC Battery	•Contact converters = 2.5 milliamperes at rated DC input voltage •Power supply = 19 watts

Output Contacts

Trip Output Contacts - Form A
- •4 Programmable Relays with 2 Contacts Each

Alarm Output Contacts - Form C
- •4 Programmable Relays with 1 Contact Each
- •1 for Critical Self-test Alarm
- •1 for Non-critical Self-test Alarm
- •1 for VT Fuse Failure
- •1 for Loss of each Power Supply

System Interface
- •IRIG-B for Time Synchronization
- •RS232 port - rear panel
- •RS232 port - front panel
- •Printer Interface - rear panel

NOMENCLATURE SELECTION GUIDE

DGP Model Numbers

DGP	*	*	*	*	*	*	
	5						5 Amp rated
		0					Vps = 48 VDC
		1					Vps = 110/125
		2					Vps = 220/250 VDC
		3					48 VDC with backup
		4					110/125 VDC with backup
		5					220/250 VDC with backup
			A	A	A		STD. Model
						A	Revision Level

Example: DGP54AAAA: DGP rated 5 amperes, 50/60 Hz, 110/125 VDC redundant power supplies, no options, revision A.

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PRODUCT DESCRIPTION

GENERAL

The DGP is a microprocessor-based digital relay system that uses wave-form sampling of current and voltage inputs to provide protection, control and monitoring of generators. These samples are used to compute current and voltage phasors that are used for the protection-function algorithms. DGP uses a man-machine interface (MMI) and DGP-LINK communications software similar to other GE digital relay systems.

APPLICATION

The DGP system is designed to be used on hydroelectric, gas, and steam generating units. Any size of generator can be protected with this digital system.

More detailed application considerations are contained below in the remaining headings of this section and in the **CALCULATION OF SETTINGS** section.

PROTECTION

The following protection functions are included in the DGP system.

1. Stator Differential (87G)
2. Current Unbalance (46)
3. Loss of Excitation (40)
4. Anti-Motoring (32)
5. Time Overcurrent with Voltage Restraint (51V)
6. 100% Stator Ground (64G)
7. Over-excitation (24)
8. Overvoltage (59)
9. Over and Underfrequency (81)
10. Voltage Transformer Fuse Failure (VTFF)
11. Accidental Energization

Figures PD-1 through PD-5 show simplified logic diagrams of the above DGP functions.

1. STATOR DIFFERENTIAL (87G)

This function provides high-speed protection of the generator stator during internal phase-to-phase, and three-phase, faults. It uses a product-restraint algorithm with dual-slope characteristic as shown in Figures CS-2 through CS-5. Refer to Fig. PD-1 for the logic diagram of this function.

Function 87G will not operate for turn-to-turn faults in the machine windings. It will also not operate for single-phase-to-ground faults, if the system is ungrounded or high-impedance grounded.

Phase-to-ground protection by this function requires that the neutral of the machine (or another machine operating in parallel) be grounded. A small portion of the winding next to the neutral will not be protected, the amount being determined by the voltage necessary to cause minimum pickup current to flow through the neutral-to-ground impedance. Current-limiting devices in the neutral-ground circuit increase this impedance and will decrease the ground-fault-protection coverage of this function.

2. CURRENT UNBALANCE (46)

There are several causes for unbalance in the generator. Some of these conditions are unbalanced loads, unbalanced system faults and/or open circuits. The negative-sequence component (I_2) of stator current is directly related to this unbalance and sets up a counter-rotating flux field in the machine. This in turn causes local heating in the rotor iron. The capability of machines to withstand the heating caused by unbalance currents is typically expressed in terms of an I_2^2T constant, and is supplied by the manufacturer of the machine.

The current-unbalance trip function (46T) of the DGP provides operating-time characteristics expressed as $I_2^2T=K$, as shown in Figure CS-6. A linear reset characteristic is incorporated, to approximate the machine cooling following an intermittent current-unbalance condition. In addition to 46T, the DGP also includes a current-unbalance alarm function, 46A, which is operated by the negative-sequence component (I_2) with an adjustable pickup and time delay. See Figure PD-2 for the logic diagram.

3. LOSS OF EXCITATION (40)

This function is used to detect loss of excitation on synchronous machines. It includes two mho characteristics, looking into the machine, each with adjustable reach, offset, and time delay. Logic is provided in the DGP to block this function by presence of a negative-sequence voltage (indicating a voltage-transformer-fuse-failure condition) and/or an external VTFF Digital Input DI6 (See Figure PD-2).

Excitation can be lost due to inadvertent tripping of the field breaker, open or short circuit on the field winding, regulator failure, or loss of the source to the field winding. Loss of excitation can be damaging to the machine and/or detrimental to the operation of the system. When a synchronous generator loses excitation, it will tend to act as an induction generator; it will run above normal speed, operate at reduced power and receive its excitation (VARS) from the system. The impedance seen by a relay looking into a generator will depend on the machine characteristics, the load flow prior to the loss of excitation, and the type of excitation failure.

Studies indicates that first zone mho function (40-1) can be set to detect severe cases of excitation failure with a shorter time delay, whereas the second zone (40-2) can be set to detect **all** the excitation failure cases. A longer time delay setting is required for the 40-2 function for security during stable power system swing conditions. Figure CS-7 shows the characteristics of this function.

4. ANTI-MOTORING (32)

On a total or partial loss of prime mover, if the power generated is less than no-load losses of the machine, real power will start flowing into the generator. Typical motoring power of different kinds of prime movers are shown in Table PD-1. For a specific application, the minimum motoring power of the generator should be obtained from the supplier of the unit.

TABLE PD-1

TYPE OF PRIME MOVER	MOTORING POWER IN PERCENT OF UNIT RATING
Gas Turbine	10 - 100
Diesel	15 - 25
Hydraulic Turbine	2 - 100
Steam Turbine	0.5 - 4

The DGP includes a two step (32-1 and 32-2) reverse power function with individual time-delay adjustment as shown in Figure PD-1.

The 32-1 can be used as a part of sequential tripping of the generator, in which the turbine is tripped first. 32-1 is enabled when closing of turbine inlet valves is indicated by digital input DI2. The trip sequence is then continued when timer TL1 times out. 32-2 is not dependent on the DI2 and is primarily intended to provide backup to the sequential trip. If the sequential trip is not enabled, however, the 32-1 and 32-2 functions will follow identical logic.

5. TIME OVERCURRENT WITH VOLTAGE RESTRAINT (51V)

A system must be protected against prolonged generator contribution to a fault on the system. A time-overcurrent function with voltage restraint (51V) is incorporated in the DGP, primarily to provide a part of the system backup protection. As shown in the logic diagram Figure PD-2, this function is supervised by a fault detector and VTFF. The VTFF supervision can be by an internal and/or external (DI6) VTFF function. See Figures CS-8 through CS-11 for the characteristic curves of the 51V. Note that a separate algorithm is processed for each phase, with the restraint provided by corresponding phase voltage (see Table CS-2). The restraint is proportional to the magnitude of the voltage and is independent of the phase angle. A linear reset characteristic is incorporated for this function.

6. STATOR GROUND (64G)

This function consists of two overlapping zones (64G1 and 64G2) to detect stator ground faults in a high-impedance-grounded generator system. The two zones together cover 100% of the stator windings. See Figure PD-3 for the logic diagram.

Normally the generator-stator neutral has a potential close to ground. With the occurrence of a stator ground fault, a potential increase will occur on the neutral for all faults except those near the neutral. 64G1 uses a fundamental-frequency neutral overvoltage to cover about 95% of the stator winding, depending on the pickup voltage setting.

64G2 is based on computation of the percentage of third-harmonic voltage at the generator neutral, compared to the total third-harmonic voltage generated. This function is designed to cover 15% of the neutral end of the stator windings, and is supervised by fundamental- and third-harmonic voltage thresholds. These thresholds are fixed at 30 and 0.5 volts respectively. Note that wye-connected VT's on the generator terminals are required for proper operation of 64G2. Also, digital input DI1 can be configured to block this function when the generator is off-line. This provision is made to enhance security of the 64G2 under a condition such as static start of the gas turbine generator. Temporary ungrounding of generator neutral during the static start can look like a ground fault near the neutral.

7. OVER-EXCITATION (24)

Over-excitation can be caused by regulator failure, load rejection, or an excessive excitation when the generator is off line. It can also result from decreasing speed while the regulator or an operator attempts to maintain rated stator voltage. The quantity Volts/Hertz is proportional to magnetic flux in the generator and step-up transformer cores and is used by the DGP to detect the over-excitation condition. See Figure PD-3 for the logic diagram.

The over-excitation protection includes trip (24T) and alarm (24A) functions. 24T consists of an inverse function and an instantaneous function with time-delay characteristics. The combination of these two characteristics allows the 24T setting to follow closely the generator and/or step-up transformer V/Hz limit curve. Both 24A and 24T are computed for each of the three phase voltages (see Table CS-3).

Function 24T can be configured to operate different output relays for generator on-line and off-line conditions. This function incorporates a user-settable linear reset characteristic to mimic machine cooling. Figures CS-12 through CS-14 show the characteristics of this function.

8. OVERVOLTAGE (59)

This function consists of a positive-sequence overvoltage with an inverse characteristic. See Figure PD-1 for the logic diagram and Figure CS-15 for time-voltage characteristics. A linear reset characteristic is incorporated for this function. The overvoltage function can be considered as a backup to the volts-per-hertz function. Some possible causes of this condition are a system disturbance or regulator failure.

9. OVER AND UNDERFREQUENCY (81)

This function provides four steps of over- and four steps of under-frequency protection, each with an adjustable time delay. All eight frequency functions are supervised by an adjustable positive-sequence voltage level. This undervoltage cut-off level would block the function during the start-up. The frequency disturbance can occur due to a system fault or islanding of the unit. Also an unconnected unit can operate at abnormal frequency due to malfunction of speed control. Figure PD-4 shows the logic diagram for this function.

10. VOLTAGE TRANSFORMER FUSE FAILURE (VTFF)

Functions 40 and 51V may operate for a full or partial loss of AC potential caused by one or more blown fuses. Provisions are made in the DGP to block tripping by these functions when a fuse failure is detected. All other protection functions are allowed to trip. Figure PD-5 shows the functional logic for the VTFF function.

If AC potential is lost, the negative-sequence voltage detector would pick up and/or the positive-sequence voltage detector would drop out. In the absence of any evidence of a fault, this detected abnormal voltage will produce a VTFF output if positive-sequence current is above a threshold.

The VTFF logic of the DGP allows integration of an external VTFF contact. Either of the two fuse-failure signals or both signals can be configured to block tripping of functions 40 and 51V.

Detection of VTFF by the DGP will energize the 74FF (Fuse Failure alarm) relay, de-energize the 74CR (critical alarm) relay, and turn the status LED to red, even though all protection functions except 40 and 51V are unaffected.

11. ACCIDENTAL ENERGIZATION

A logic is incorporated, as shown in Figure PD-1, to detect accidental energization of the generator. When a generator is energized while at standstill or reduced speed, it will behave and accelerate as an induction motor. The machine terminal voltage and current during such an event will be a function of generator, transformer, and system impedances.

An instantaneous overcurrent signal (50) is used in the logic to detect the accidental energization. This signal is armed by a logic signal derived from positive-sequence voltage and GEN OFF LINE input DI1. These two "arming" signals can be configured either in AND or OR mode, as selected by AE ARM setting. The (50) function is armed 5 seconds after the generator is taken out of service. The logic will automatically disarm itself during a normal start-up sequence when the voltage detector picks up and/or the generator is on-line.

Special precautions must be taken to ensure that the DGP and associated trip circuits remain in service when the generator is out of service, for this logic to perform. Additionally, the generator off-line input, DI1, connected to the DGP must be reliable. It should also be noted that the pickup flag of function 51V is used as signal 50; therefore this logic will automatically be disabled if function 51V is disabled.

OTHER FEATURES

INPUTS

The DGP takes 8 current and 4 voltage inputs (Refer to Elementary Diagrams PD-6 & PD-7). The current coils are connected to system- and neutral-side phase CT's. The neutral current (IN) inputs are derived from the residual of the phase currents, which do not require dedicated neutral CT's.

The phase voltage inputs to the DGP can either be wye or delta, derived from the generator terminal voltage. The wye voltages are preferred, as they are required for function 64G2. If delta voltages are used, the stator ground-fault protection will be provided by function 64G1 only, which typically covers about 95% of the stator windings. V_N is derived from the generator neutral grounding transformer.

IRIG-B or GE's G-NET system signal can be used to synchronize the DGP's internal clock to within 1 ms. of a common time reference.

There are six digital inputs that can be connected to the DGP. Two of these inputs (DI3 & DI4) are assigned for possible routing of external trip/alarm signals through the DGP to take advantage of the output configuration or sequence-of-events capability. Generator off-line (DI1), turbine inlet-valve-close indication (DI2) and external VTFF (DI6) inputs are used for various relay logic functions. Also a contact input, (DI5), can be used to trigger the oscillograph feature of the DGP.

All the digital input circuits are universally rated for 48 to 250 VDC control voltages.

OUTPUTS

There are eight user-configurable output relays included in the DGP system. Four of these relays (94G, 94G1, 94G2 & 94G3) are trip-duty rated, with two form A contacts each, and the remaining four (74A, 74B, 74C & 74D) are alarm-duty rated, with one form C contact each. Each of the protection functions can be configured to operate any number of these output relays. The trip outputs are intended for, but are not limited to, the following purposes:

94G - operate a lockout relay to shut down the machine
94G1 - trip field breaker
94G2 - trip main generator breaker or breakers
94G3 - operate a lockout relay to trip turbine.

Also included are two additional relays (TEST PICKUP & TEST TRIP) that can be configured to operate by a selected protection-function pickup flag, and trip output, respectively. These two outputs are intended to facilitate testing of the selected protection function.

In addition to the configurable output relays, five pre-defined alarm duty relays with a form C contact each are also included in the DGP system. The form C contact of each of the alarm relays, except PS1 & PS2, are wired out to the terminal block. A hard wire jumper is used to select either the form A or the form B contact of each of the PS1 & PS2 relays, as shown in Figure MO-12.

ALARMS

There are a total of nine alarm-output relays included in the DGP. As mentioned earlier, each of the protection functions, and also alarm functions 24A & 46A, can be configured to operate any number of the four alarm relays, 74A, 74B, 74C, & 74D. The five pre-defined alarm relays include critical and non-critical self-test alarms (74CR & 74NC), the VTFF alarm (74FF), and loss of-power-supply alarms (PS1 & PS2).

All alarm relays, with the exception of 74CR, PS1 & PS2, are energized when the appropriate alarm conditions exist. Relays 74CR, PS1 and PS2, however, are energized under normal conditions and will drop out when the alarm conditions exist.

START-UP SELF TESTS

The most comprehensive testing of the DGP is performed during a power-up. Since the DGP is not performing any protection activities at that time, tests (such as RAM tests) that would be disruptive to run-time processing may be performed during the start-up.

All the processors participate in the start-up self-testing. The processors communicate their results to each other so that any failures found can be reported to the user, and so that each processor successfully completes its assigned self-tests before the DGP begins protection activity.

During power-up, each of the microprocessors performs start-up self-tests on its associated hardware (PROM, local RAM, shared RAM, interrupt controller, timer chip, serial and parallel I/O ports, non-volatile memory, analog and digital I/O circuitry, MMI hardware, etc.). In addition, the DGP verifies that the PROM version numbers in all the processor boards are compatible. The components tested at start-up are listed in the **Start-Up Self Tests** Table in the **SERVICING** section.

In most cases, if any critical self-test failure is detected, the DGP will not continue its start-up, nor will it cause a reset. An attempt will be made to store the DGP status, to initialize the MMI and remote communications hardware/software for communicating status, and to print a diagnostic message. The critical alarm relay will be de-energized.

If no failures are detected, the DGP completes initialization of its hardware and software. Next, each processor board (DAP and SSP) will enable the outputs. As the final step, the DGP checks the results of all the tests, to determine whether to turn on the green LED lamp on the front panel.

The start-up procedure will take approximately one minute. As soon as the SSP successfully completes its PROM test and initializes the display hardware, the message "INITIALIZING" will appear on the display. When all DGP initialization is completed satisfactorily, the display will be blanked and the DGP begins acquiring and processing data.

RUN-TIME SELF TESTS

Each of the processors will have "idle time" when the system is in a quiescent state; i.e., when the DGP is not performing fault or post-fault processing. During this idle time, each processor will perform "background" self-tests that are not disruptive to the foreground processing; that is, tests that do not interfere with the foreground tasks' use of serial and parallel ports, and tests that do not inhibit interrupts to any processor. If any background self-test fails, the test is repeated. To declare a component "failed", the test must fail three consecutive times. In the case of most critical failures, the DGP will force a reset to attempt to get the failed component working again.

The DGP is able to distinguish between a start-up (power-up) and a reset caused automatically by a DGP malfunction. The reset is a fault-tolerant feature of the DGP; it is performed as an attempt to resume operation again after an intermittent failure. The reset activities are identical to the start-up activities except that not all start-up self-tests are performed.

A reset is not reported to the user by the DGP. If the reset is successful, no message is printed, no failure status is recorded, and the critical alarm is not generated; however, during the reset procedure, the red LED on the MMI panel will light and a failure code may appear on the MMI display. If the reset is not successful, the processor board will be shut down, leaving the MMI panel displaying the above error information. Refer to the **SERVICING** section of this manual for error codes. To prevent continual resets in the case of a solid failure, both hardware and software will permit only four resets in a one-hour period. On the fifth reset, the DGP will not perform initialization, but will attempt to initialize MMI, communications, and the critical alarm output, as in the case of a start-up with a critical self-test failure. The reset procedure takes approximately one second, depending upon which start-up self-tests are to be run.

The components tested in the background are listed in the **Run-Time Background Self Tests** Table in the **SERVICING** section. The testing of I/O hardware is done in the foreground, so that the processors know when a given component or port is in use and therefore not available for testing. The components tested in the foreground are listed in the **Run-Time Foreground Self Tests** Table in the **SERVICING** section. Some foreground tests are performed every sample period, while others are performed less frequently. As with background self-tests, any failed test is repeated and must fail three consecutive times to be considered a failure. Although not specifically a "self" test, the trip-circuit continuity monitoring is performed as a foreground test. Refer to the **TRIP-CIRCUIT MONITOR** portion of this section.

In addition to regularly scheduled self-tests, the operator may initiate a visual-response test of the MMI components. Refer to the **MMI ... Display Test** in the **ACCEPTANCE TESTS** section of this manual.

ADAPTIVE SAMPLING FREQUENCY

The DGP samples analog input waveforms at a rate of 12 per cycle. An adaptive sampling frequency is used to maintain this rate over the power system frequencies of 30.5 to 79.5 Hz. As a result of this feature, the measurement accuracy of the analog inputs and the sensitivities of the protection functions are maintained over the range of power system frequencies. This feature provides an improved protection for faults during off-normal frequencies, such as start-up condition.

The sampling frequency is based on 30.5 Hz for the power system frequencies below 30.5 Hz and is based on 79.5 Hz for the frequencies above 79.5 Hz. In either case, if the AC voltage to the DGP drops below approximately 20 V, the sampling frequency is automatically based on nominal system frequency (SYSFREQ setting).

The sampling frequency, which is 12 times the measured system frequency, can be accessed as one of the Present Values from the DGP.

TRIP-CIRCUIT MONITOR

The trip-circuit monitor consists of DC voltage and current monitors (TVM and TCM respectively). Each of the trip contacts shown with polarity marks in Figures PD-6 & PD-7 is monitored. The TVM and TCM can be selectively disabled for each of the trip circuits.

Under normal conditions, DC voltage across each of the contacts is continuously monitored. If the DC voltage becomes virtually zero, then the trip circuit has "failed open". The TVM is active only when the generator is on-line, as indicated by the input DI1. This function is intended to replace the indicating light typically used for trip circuit monitoring, and it is universally rated for 48 through 250 volts DC. A non-critical alarm is generated when the TVM detects an abnormality.

When the DGP issues a trip, DC current through each of the appropriate trip contacts is monitored. The trip relay is sealed-in, as long as the current is flowing, to protect the contact. A minimum current of 150 milliamperes is required for the TCM to recognize the trip current. Status of the trip current flow, following issuance of any trip, is logged in the sequence of events.

SEQUENCE OF EVENTS

This function time-tags and stores in memory the last 100 events. The resolution of the time-tagging is 1 millisecond. The event list contains power system events, operator actions, and self-test alarms. The sequence of events can be accessed locally via the printer port, or remotely via the RS232 port and a PC. A full description of this function is contained in the **INTERFACE** section.

TIME SYNCHRONIZATION

The DGP includes a real time clock that can run freely or be synchronized from an external signal. Two different external time-sync signals are possible. If the DGP is connected to the host computer of a G-NET substation information and control system, then the DGP receives a time-sync pulse via pin 25 of PL-1. If the DGP is not connected to a G-NET host computer, then a demodulated IRIG-B signal connected to PL-3 may be used to synchronize the clock. In both cases, the clock in a given DGP is synchronized to within ± 1 millisecond of any other digital relay clock, provided the two relays are wired to the same synchronizing signal.

FAULT REPORT AND OSCILLOGRAPHY DATA

A fault report is initiated in the DGP by any one of the protection-function pickup flags or an external oscillograph trigger input, DI5 (OSC). For the fault report to be completed and stored, the DGP either has to issue a trip or the DI5 input contact must close any time during the fault report period. The fault report period begins when the first protection function flag is up, or the DI5 input contact is closed. It ends either when the DGP issues a trip, or when the DGP is done capturing the selected number of post-fault waveform cycles, whichever is later. If all the pickup flags reset without issuing a trip and the DI5 does not close, the fault report initiated by the protection flag will not be completed or stored.

The fault report includes unit ID, date and time, system operating time, pre-fault metering values, fault currents and voltages, trip/fault types, and up to 14 sequence-of-event points logged after the fault report was initiated. The system operating time (OP TIME) is the time difference between the first protection-function pickup flag and the first protection-function trip. The DGP stores up to the last three fault reports in its memory. A full description of the fault report is contained in the **INTERFACE** section.

A set of oscillography data is stored in memory each time the DGP stores a fault report. Capability to capture and store a total of 120 cycles of oscillography data is included in the DGP. The 120-cycles memory is divided in 1, 2 or 3 partitions, based on the NUM FLTS setting (#0111). The number of prefault cycles captured per fault can be set up to 20 cycles. It should be noted that the pre-fault cycles are based on the first flag or DI5 to initiate the data capture.

Oscillography data includes station and generator identification, a complete list of settings, the fault report, internal flags, and a selected number of pre-fault and post-fault data samples. Further description of this function is contained in the **SOFTWARE** section.

LOCAL MAN-MACHINE INTERFACE (MMI)

A local MMI, incorporating a keypad, light-emitting-diode (LED) display, and 19 target LED's, is provided to allow the user to enter settings, display present values, view fault target information, and access stored data. The use and functioning of the MMI is fully described in the **INTERFACE** section.

LOCAL PRINTER

A serial port (PL-2) on the rear of the DGP case permits the use of a local printer. When a local printer is connected, all events and fault reports (see appropriate descriptions above) are automatically printed at the time of occurrence. In addition, other information stored in the DGP's memory can be printed when requested via the local MMI, as described in the **INTERFACE** section.

REMOTE COMMUNICATIONS

Two RS232 serial ports are provided. A DB-25 plug (PL-1) located on the rear of the case is provided to permit the user 1) to communicate with the DGP from an IBM PC-compatible computer or 2) to connect the DGP to the host computer of a G-NET substation information and control system. A DB-9 plug located on the front plate of the MMI module (front port) permits the user to communicate with the DGP from an IBM PC-compatible computer, but it cannot be used to connect the DGP to the host computer of a G-NET system.

When communication via a PC is desired, the PC may be connected via the proper null-modem cable, provided the cable length does not exceed 50 feet, or the PC may be connected via interposing modems when physically remote from the DGP. Unique PC software, DGP-LINK, is required to communicate with the relay system. The capabilities and use of DGP-LINK are described in the **SOFTWARE** section. Refer to the **INTERFACE** section for details regarding the required cables.

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 DGP 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 DGP receives a time-synchronization pulse via pin 25 of PL-1. This pulse sets the internal clock of the DGP to permit time synchronization to an external time standard connected to the G-NET host computer.

The two RS232 serial ports, PL-1 and the front port, are implemented with separate universal asynchronous receiver transmitters (UART). It is permissible to have cables and associated equipment connected to each port simultaneously. However, when one is active the other is effectively disabled. For instance, when PL-1 is connected to the G-NET host computer and the G-NET system is active, it is not possible to log into the DGP from the front port. If PL-1 is connected to a modem and the front port is connected to a PC using a null-modem cable, then the first port that becomes active is given preference, and the other port is disabled until the first is released.

REMOTE CONTROL

By using the local MMI or a remote PC connected to the RS232 port, it is possible to operate selectively any of the four trip output relays for remote control. The control action may include shutdown of the machine, field breaker trip, main generator breaker trip, turbine trip, etcetera, depending on the equipment connected to the relays. The controls described above can be enabled or disabled by a hard-wired jumper located on the MMI module, as shown in Figure MO-3. As shipped from the factory, this jumper is physically present and the Remote Control is disabled. To enable the Control, the jumper must be removed.

PASSWORD PROTECTION

Passwords provide security when using the local man-machine interface (MMI) or during remote communications while running the DGP-LINK program. Two different passwords provide local MMI security for 1) control operations (close trip-output contacts) and 2) settings changes. Three different passwords in the DGP-LINK program provide remote communications security for 1) view and upload information, 2) control operations, and 3) settings changes. Refer to the **INTERFACE** section for a description of MMI password usage, and refer to the **SOFTWARE** section for a description of DGP-LINK password usage.

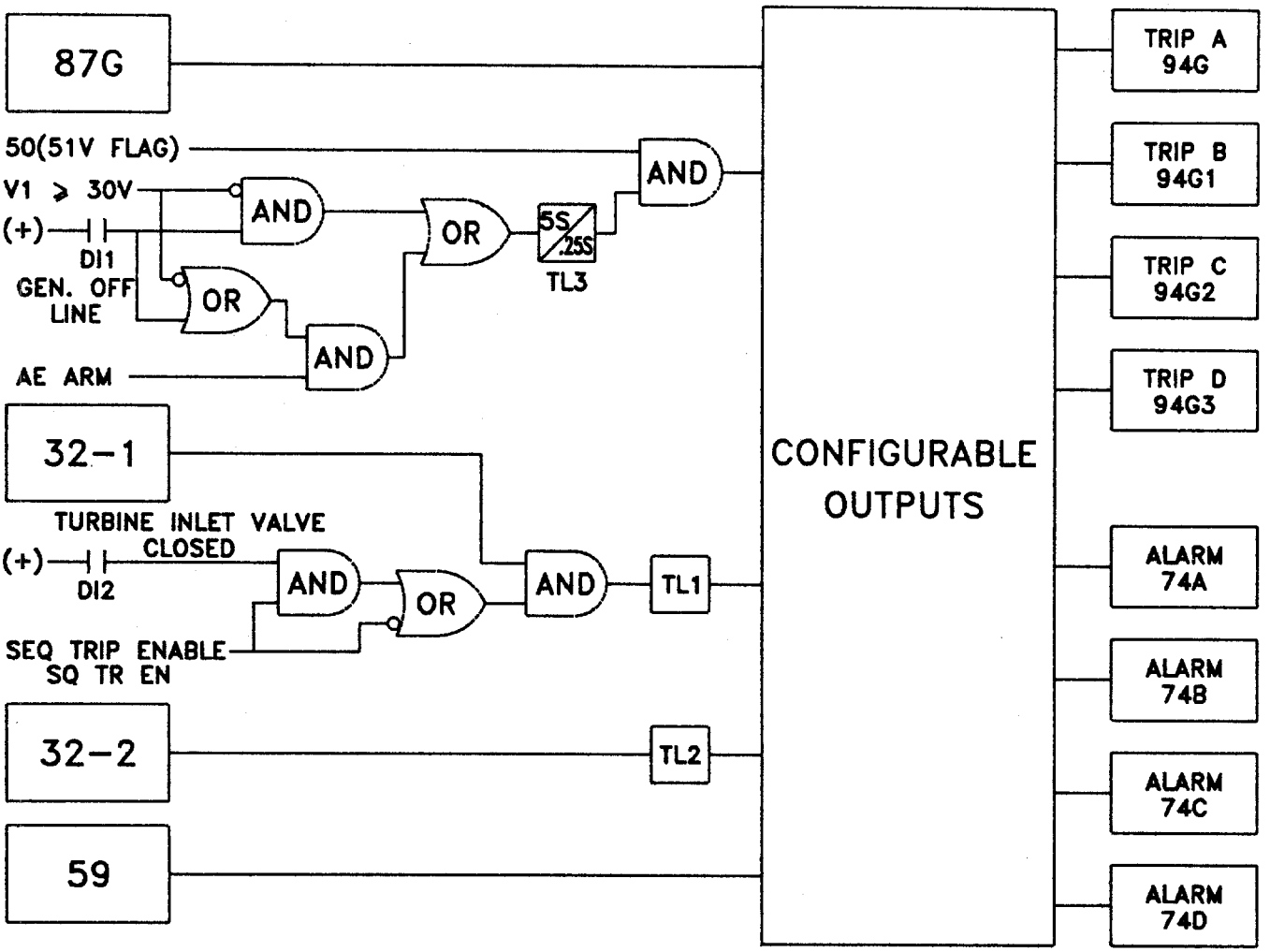


Figure PD-1 (0286A4960 [1]) Partial Logic Diagram, for Stator Differential, Overvoltage, and Accidental Energization Functions

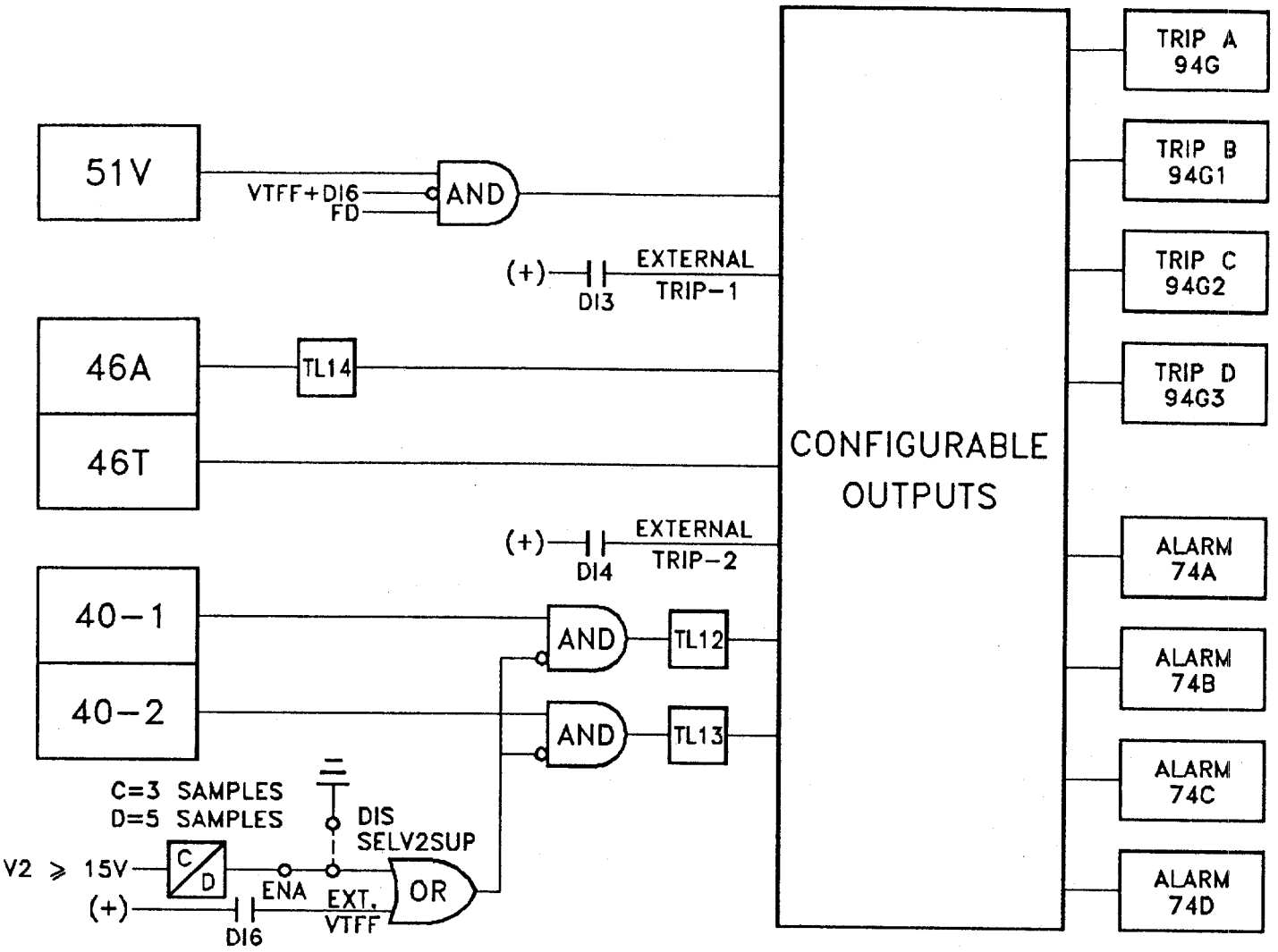


Figure PD-2 (0286A4959) Partial Logic Diagram, for Current Unbalance, Loss of Excitation, and Time Overcurrent with Voltage Restraint

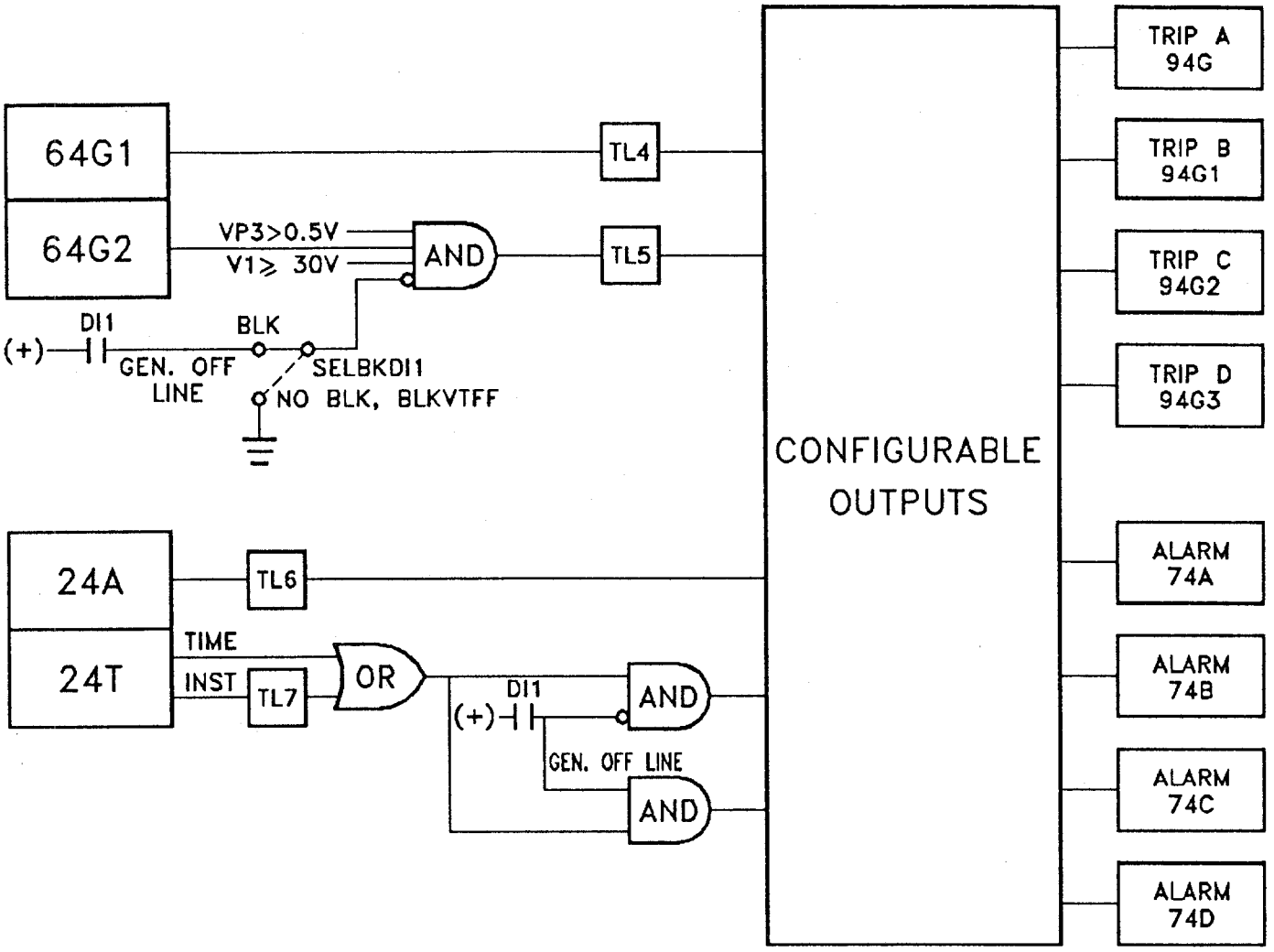


Figure PD-3 (0286A4961) Partial Logic Diagram, for Stator Ground and Over-excitation Functions

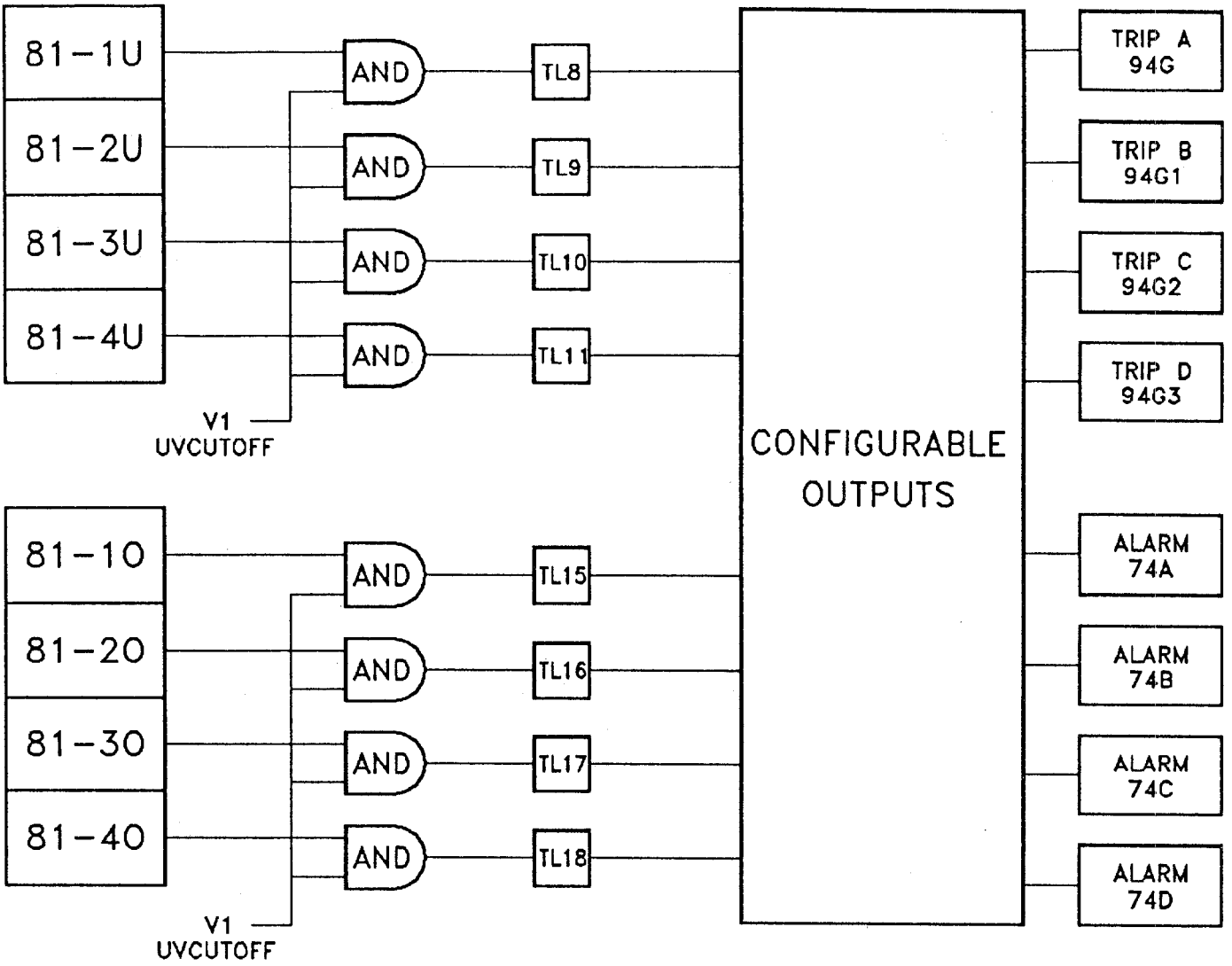


Figure PD-4 (0286A4962) Partial Logic Diagram, for Over- and Under-Frequency Functions

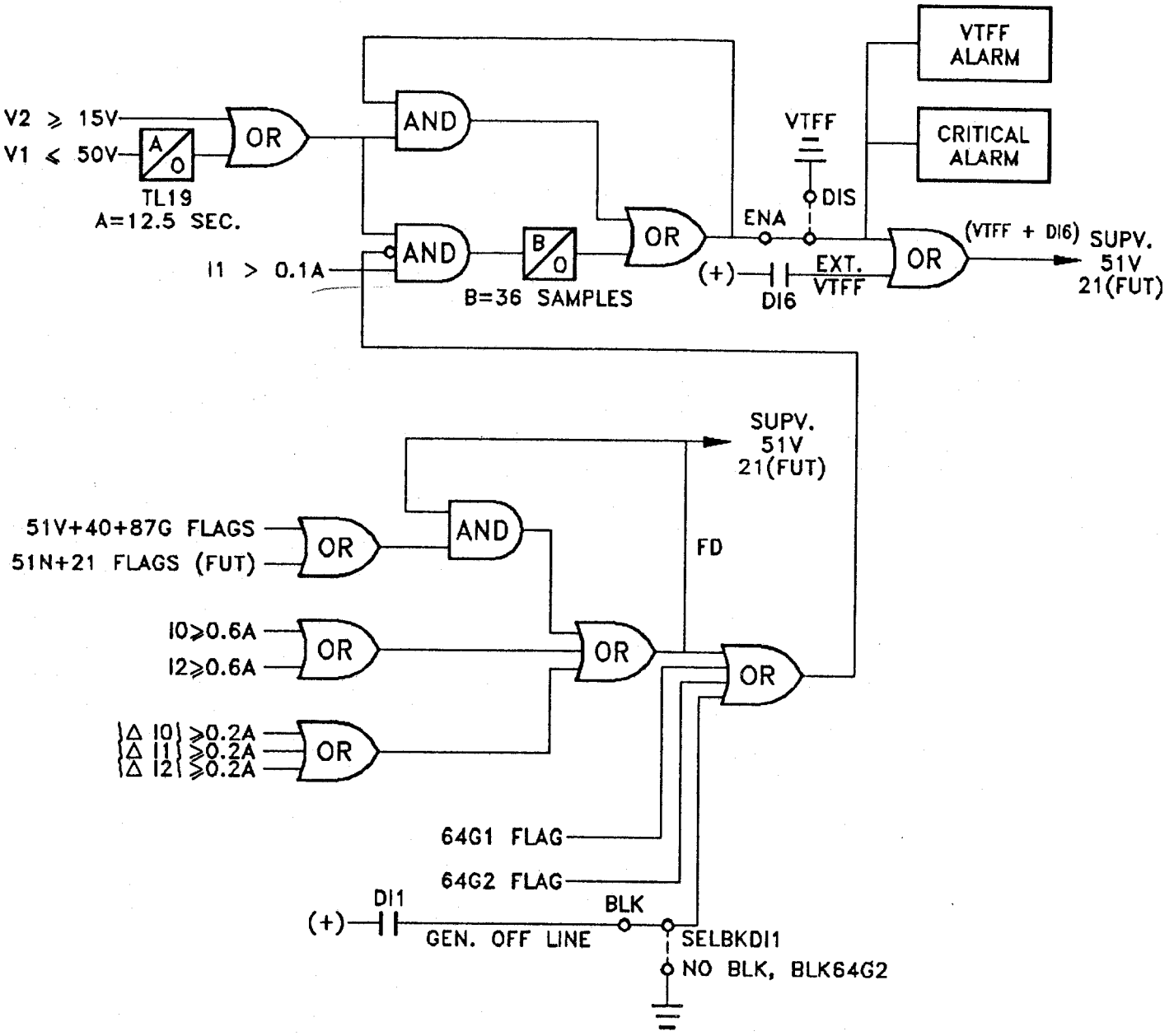


Figure PD-5 (0286A4963) VT Fuse Failure Logic Diagram

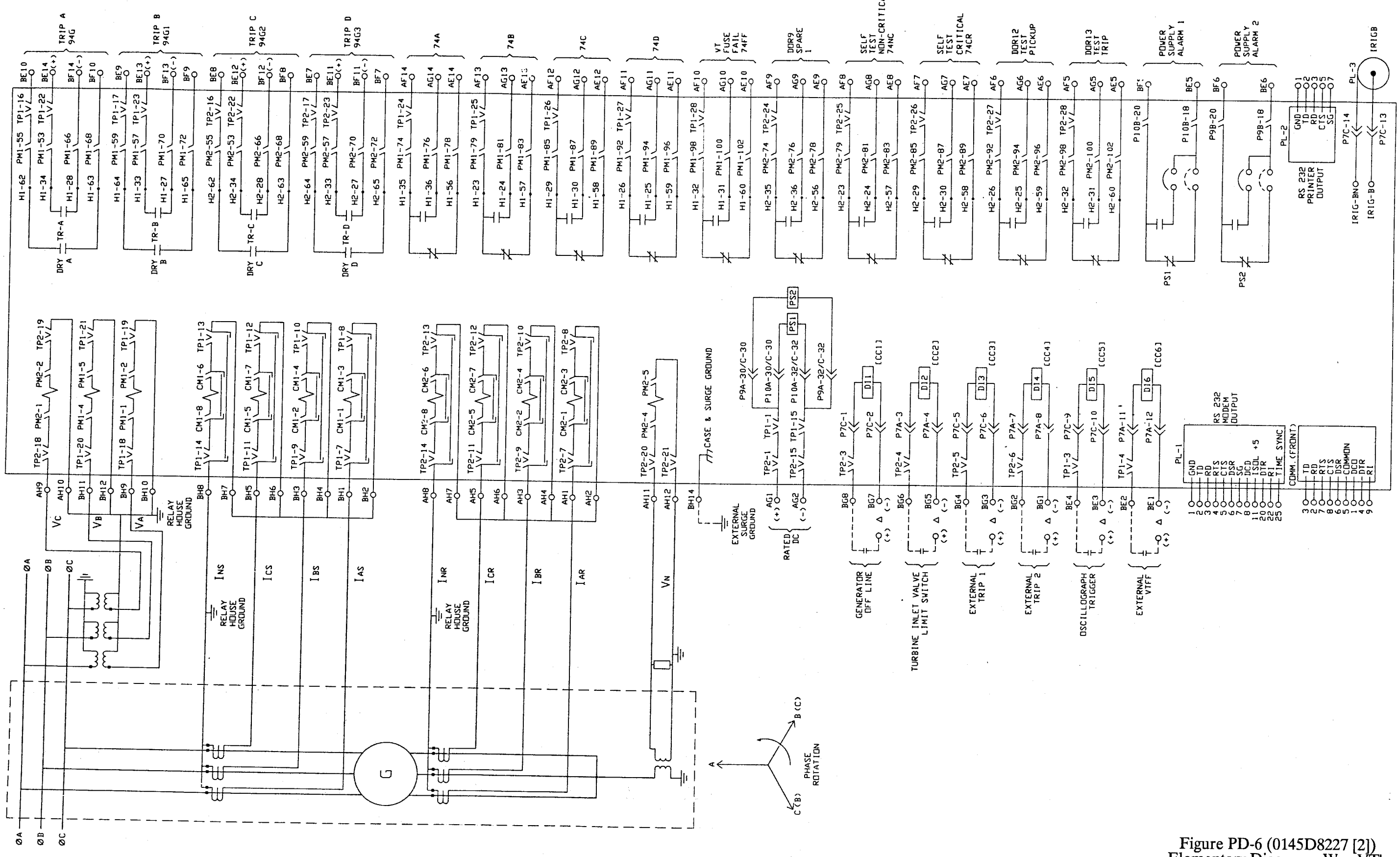


Figure PD-6 (0145D8227 [2])
Elementary Diagram - Wye VT's

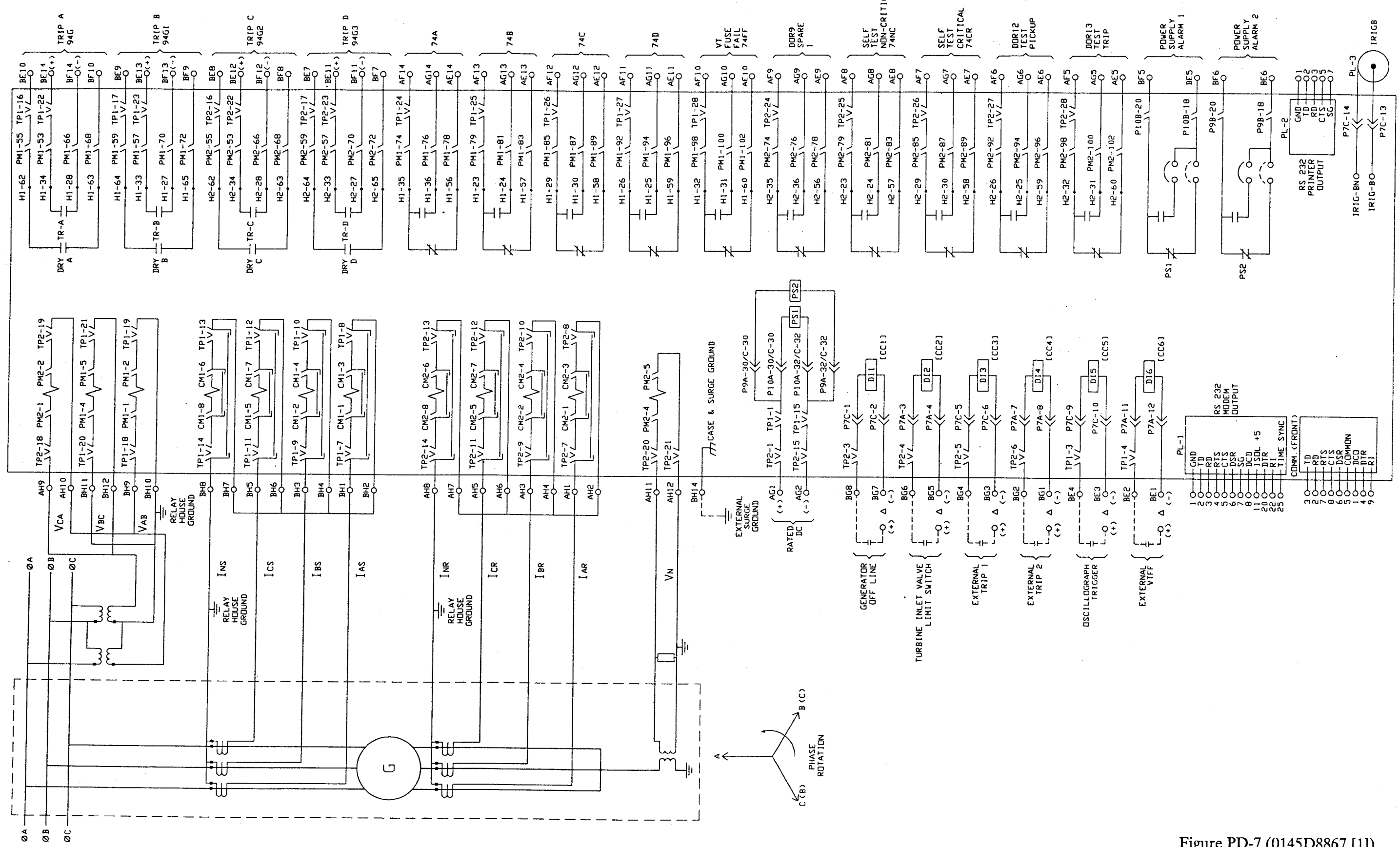


Figure PD-7 (0145D8867 [1])
Elementary Diagram - Delta VT's

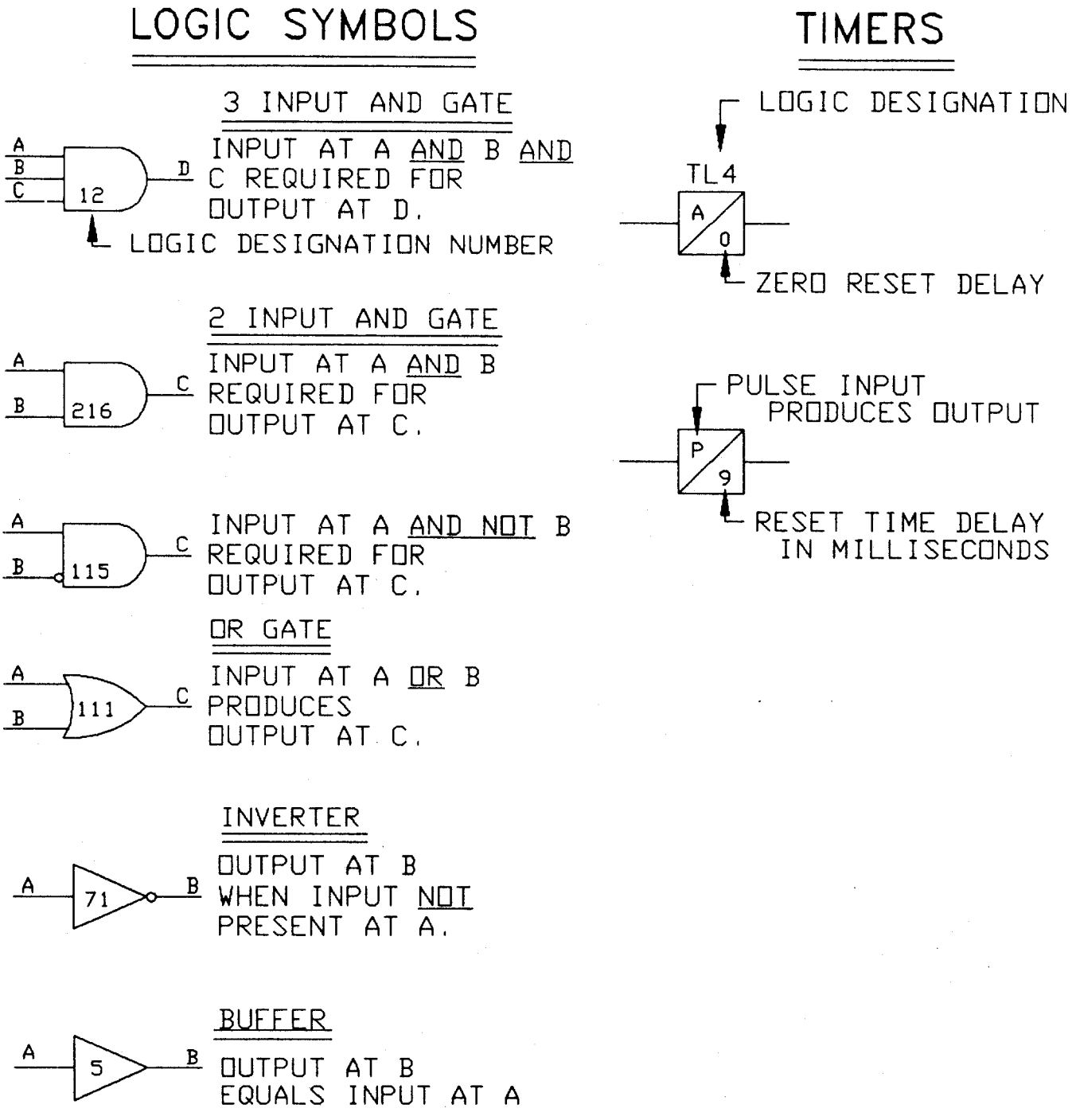


Figure PD-8 (0286A2925 Sh.1 [2]) Digital Relay Symbol Legend

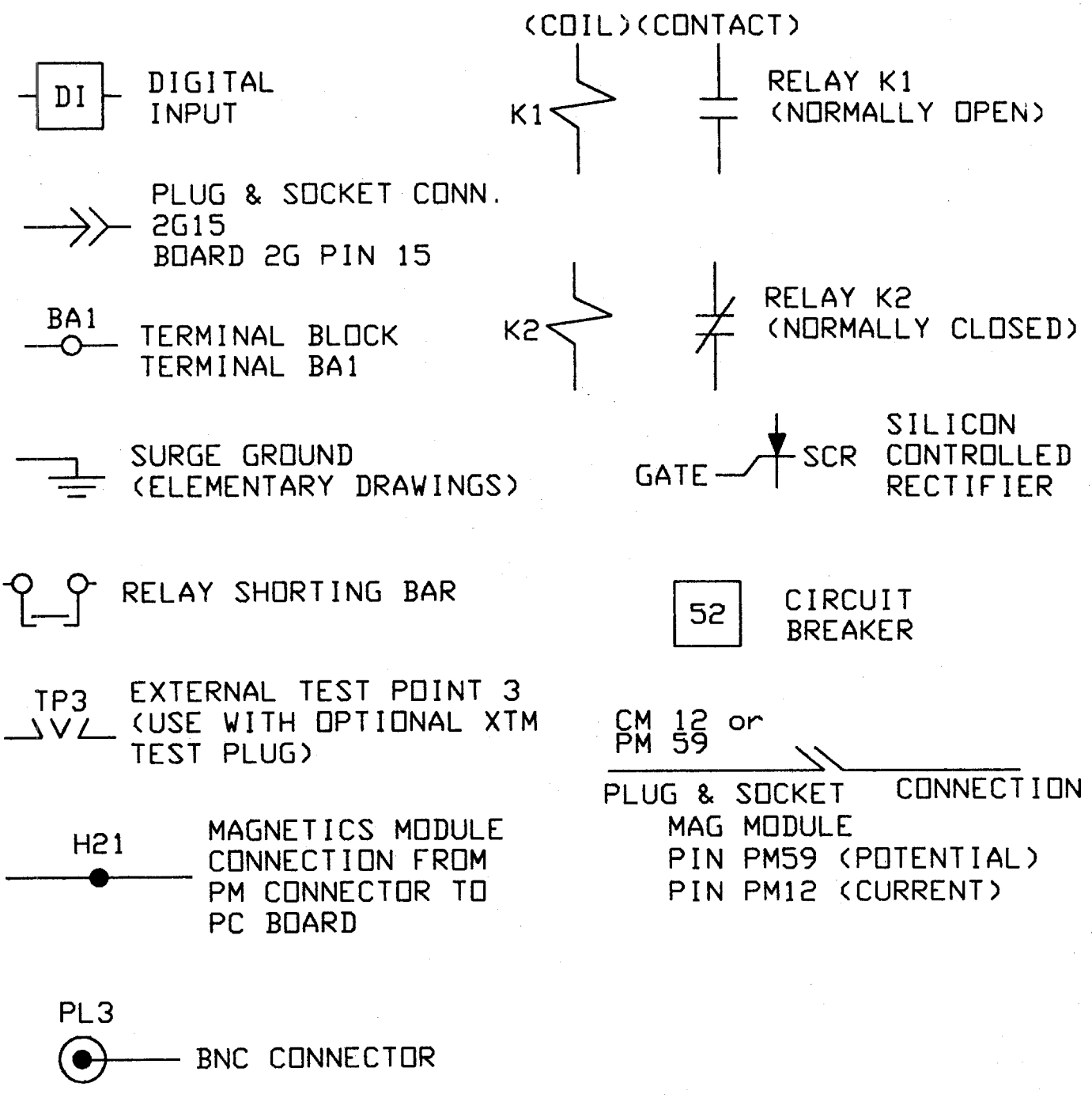


Figure PD-9 (0286A4911 Sh.9) Digital Relay Symbol Legend

CALCULATION OF SETTINGS

This section provides information to assist the user in determining the required settings for the DGP protection system. Some settings are based on the size and type of generator and the type of system it is connected to, while other settings are the same, regardless of the machine and system. Still other settings may be set based on user preference.

Those settings that are independent of the system and machine size or type will be presented first, followed by machine- and system-dependent settings. At the end of this section is a blank settings form (Table CS-4), which may be copied and used to record the required settings for a particular application.

Table CS-1 lists all the settings and the corresponding ranges and units. The column labelled DEFAULT in Table CS-1 indicates the DGP settings stored in memory when shipped from the factory. The settings described in the subsequent text are arranged by category-of-settings which correspond to the category headings displayed on the light-emitting diode (LED) display of the local man-machine interface (MMI). Individual settings or the category 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-setting heading. In the text, a category-of-settings is identified by all capitals, i. e., CONFIGURATION: CONFIG.

In the following section a set of example settings will be presented based on a typical generator system. By no means will this presentation encompasses all possible setting scenarios or calculations. More important is the demonstration of the setting method and procedure to follow.

A sample generator system one line diagram is shown in Figure CS-1; it will be used to demonstrate the example settings for a DGP protection system.

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 DGP relay system. When the DGP is accessed via its PL-1 serial port, the UNITID must be known to establish communication, thus providing a measure of security. UNITID can only be changed via the keypad of the local MMI. It is not possible to change UNITID via DGP-LINK communications software.

System Frequency, SYSFREQ

SYSFREQ can be set to either 50 Hz or 60 Hz.

Select Trip Contact Voltage Monitoring, SEL TVM

One contact of each of the four trip-output relays can be monitored for DC voltage by the DGP. The monitoring is enabled or disabled by setting the SELTVM to either 1 or 0 respectively. The four-digit code of the SELTVM setting applies to 94G, 94G1, 94G2, & 94G3, in that order. For example, a setting of 1100 enables TVM for 94G & 94G1 and disables for 94G2 & 94G3.

If any of the monitored contacts is not used in a circuit external to the DGP, it should be disabled to avoid nuisance alarms.

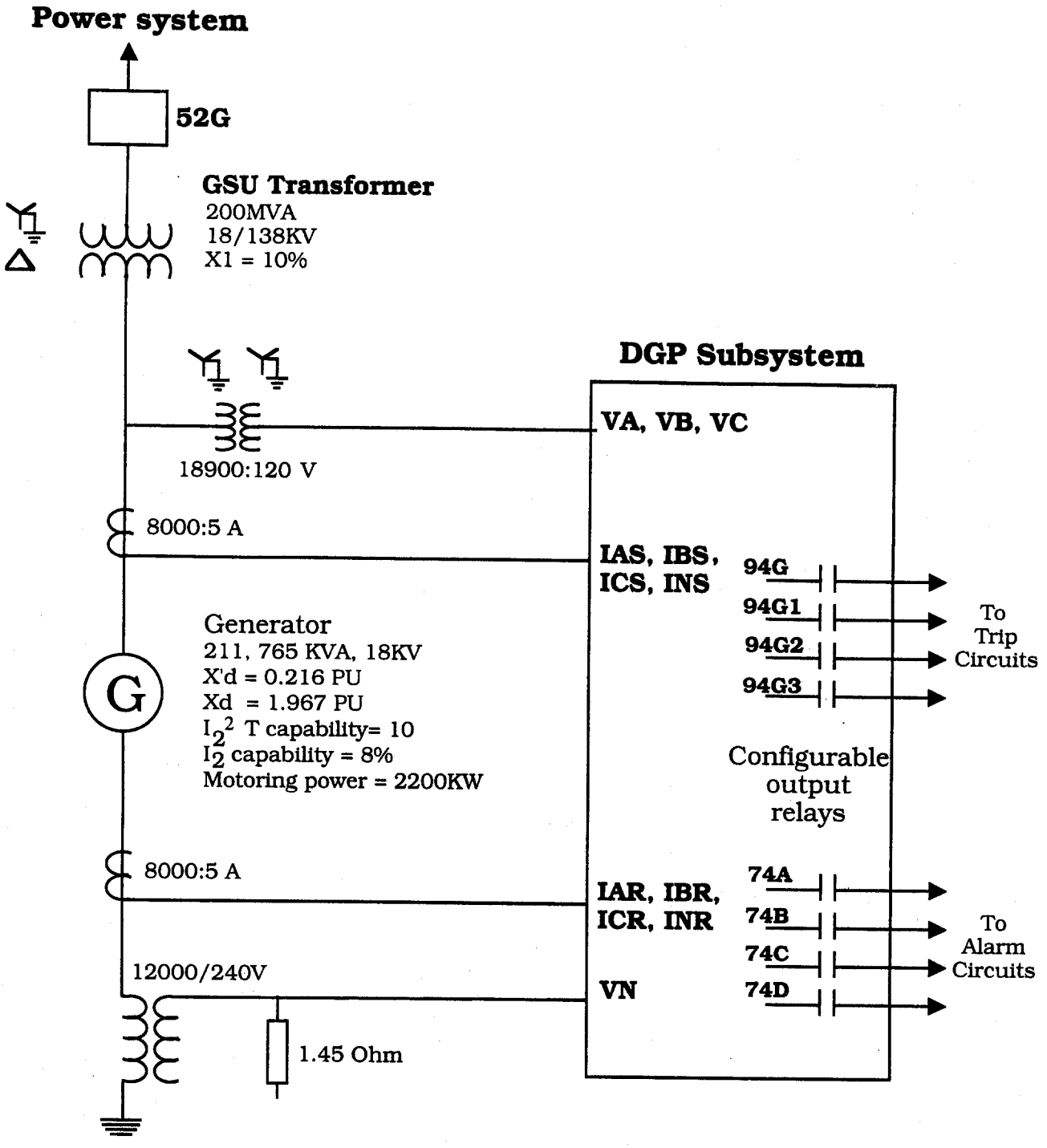


Figure CS-1 (0286A4982 [2]) Sample Generator System

TABLE CS-1: SETTINGS AND RANGES

SET. #	DESC.	RANGE	UNITS	DEFAULT
CONFIGURATION: CONFIG				
101	UNITID	0 - 9999	NA	0
102	SYSFREQ	50 - 60	HZ	60
103	SEL TVM	0000 - 1111	NA	0000
104	SEL TCM	0000 - 1111	NA	0000
105	SELPRIM	PRIMARY (0) SECNDRY (1)	NA	SECNDRY
106	CT RATIO	1 - 9999	NA	1
107	VT RATIO	1.0 - 240.0	NA	1
108	COMMPORT	BAUD, PARITY, ST BIT 300(3), NONE(0), 1(1) 1200(12), ODD (1), 2(2) 2400(24), EVEN(2), 4800(48) 9600(96)		24 N 1
109	PHASE	A-B-C (0) A-C-B (1)	NA	A-B-C
110	TIMESYNC	INTRNL (0) IRIG-B (1) G-NET (2)	NA	INTRNL
111	NUM FLTS	1 - 3	NA	3
112	PREFLT	1 - 20	CYCLES	20
113	OSC TRIG	DI ENA (0) DI DIS (1)	NA	DI ENA
114	NOM VOLT	100.0 - 140.0	VOLT	120
115	RATEDCUR	0.10 - 9.99	AMP	5
116	VT CONN	WYE (0) DELTA (1)	NA	WYE
STATOR DIFFERENTIAL: 87G				
201	TRIP	0000 - 1111	NA	0000
202	ALARM	0000 - 1111	NA	0000
203	K1	1 - 10	%	5
204	PICKUP	0.2 - 1.0	AMP	0.2
CURRENT UNBALANCE -ALARM: 46A				
301	ALARM	0000 - 1111	NA	0000
302	PICKUP	0.05 - 2.99	AMP	0.05
303	TL14	1 - 5	SEC	1
CURRENT UNBALANCE -TRIP: 46T				
401	TRIP	0000 - 1111	NA	0000
402	ALARM	0000 - 1111	NA	0000
403	PICKUP	0.05 - 2.99	AMP	2.0
404	K2	1.0 - 50.0	SEC	1
LOSS OF EXCITATION -SUPERVISION: 40				
501	SELV2SUP	DISABLE (0) ENABLE (1)	NA	DISABLE

TABLE CS-1: SETTINGS AND RANGES
(CONTINUED)

SET. #	DESC.	RANGE	UNITS	DEFAULT
LOSS OF EXCITATION -ZONE 1: 40-1				
601	TRIP	0000 - 1111	NA	0000
602	ALARM	0000 - 1111	NA	0000
603	CENTER	2.50 - 60.00	OHM	11
604	RADIUS	2.50 - 60.00	OHM	8.5
605	TL12	0.01 - 9.99	SEC	0.01
LOSS OF EXCITATION -ZONE 2: 40-2				
701	TRIP	0000 - 1111	NA	0000
702	ALARM	0000 - 1111	NA	0000
703	CENTER	2.50 - 60.00	OHM	11
704	RADIUS	2.50 - 60.00	OHM	8.5
705	TL13	0.01 - 9.99	SEC	2
ANTI-MOTORING #1: 32-1				
801	TRIP	0000 - 1111	NA	0000
802	ALARM	0000 - 1111	NA	0000
803	SQ TR EN	YES (1/Y) NO (3/N)	NA	YES
804	REV PWR	0.50 - 99.9	WATT	1.5
805	TL1	1 - 60	SEC	5
ANTI-MOTORING #2: 32-2				
901	TRIP	0000 - 1111	NA	0000
902	ALARM	0000 - 1111	NA	0000
903	REV PWR	0.50 - 99.9	WATT	1.5
904	TL2	1 - 60	SEC	1
OVERCURRENT WITH VOLTAGE RESTRAINT: 51V				
1001	TRIP	0000 - 1111	NA	0000
1002	ALARM	0000 - 1111	NA	0000
1003	PICKUP	0.5 - 16.0	AMP	0.5
1004	TIME FAC	0.10 - 99.99	SEC	O.1
STATOR GROUND -ZONE 1: 64G1				
1101	TRIP	0000 - 1111	NA	0000
1102	ALARM	0000 - 1111	NA	0000
1103	PICKUP	4.0 - 40.0	VOLT	4.0
1104	TL4	0.10 - 9.9	SEC	0.1
STATOR GROUND -ZONE 2: 64G2				
1201	TRIP	0000 - 1111	NA	0000
1202	ALARM	0000 - 1111	NA	0000
1203	TL5	0.10 -9.9	SEC	0.1
OVEREXCITATION -ALARM: 24A				
1301	ALARM	0000 - 1111	NA	0000
1302	PICKUP	1.0 - 1.99	PER UNIT	1.5
1303	TL6	0 - 9.9	SEC	1

TABLE CS-1: SETTINGS AND RANGES
(CONTINUED)

SET. #	DESC.	RANGE	UNITS	DEFAULT
OVEREXCITATION -TRIP: 24T				
1401	TRIP ON	0000 - 1111	NA	0000
1402	TRIP OFF	0000 - 1111	NA	0000
1403	ALARM	0000 - 1111	NA	0000
1404	CURVE #	1 - 4	NA	1
1405	INV PU	1.00 - 1.99	PER UNIT	1.5
1406	TIME FAC	0.10 - 99.99	SEC	99.99
1407	INST PU	1.00 - 1.99	PER UNIT	1.5
1408	TL7	0 - 9.9	SEC	1
1409	RESET	0 - 999	SEC	1
OVERVOLTAGE: 59				
1501	TRIP	0000 - 1111	NA	0000
1502	ALARM	0000 - 1111	NA	0000
1503	PICKUP	100 - 200	VOLT	120
1504	TIME FAC	0.10 - 99.99	SEC	1
OVER/UNDER FREQUENCY VOLTAGE CUTOFF: 81				
1601	UVCUTOFF	35 - 99	%	90
UNDER FREQUENCY SET POINT 1: 81-1U				
1701	TRIP	0000 - 1111	NA	0000
1702	ALARM	0000 - 1111	NA	0000
1703	SET PNT	40.00 - 65.00	HZ	60.0
1704	TL8	0.05 - 99.99	SEC	2
UNDER FREQUENCY SET POINT 2: 81-2U				
1801	TRIP	0000 - 1111	NA	0000
1802	ALARM	0000 - 1111	NA	0000
1803	SET PNT	40.00 - 65.00	HZ	60.0
1804	TL9	0.05 - 99.99	SEC	2
UNDER FREQUENCY SET POINT 3: 81-3U				
1901	TRIP	0000 - 1111	NA	0000
1902	ALARM	0000 - 1111	NA	0000
1903	SET PNT	40.00 - 65.00	HZ	60.0
1904	TL10	0.05 - 99.99	SEC	2
UNDER FREQUENCY SET POINT 4: 81-4U				
2001	TRIP	0000 - 1111	NA	0000
2002	ALARM	0000 - 1111	NA	0000
2003	SET PNT	40.00 - 65.00	HZ	60.0
2004	TL11	0.05 - 99.99	SEC	2
OVER FREQUENCY SET POINT 1: 81-1O				
2101	TRIP	0000 - 1111	NA	0000
2102	ALARM	0000 - 1111	NA	0000
2103	SET PNT	45.00 - 79.99	HZ	60.0
2104	TL15	0.05 - 99.99	SEC	2

TABLE CS-1: SETTINGS AND RANGES
(CONTINUED)

SET. #	DESC.	RANGE	UNITS	DEFAULT
OVER FREQUENCY SET POINT 2: 81-2O				
2201	TRIP	0000 - 1111	NA	0000
2202	ALARM	0000 - 1111	NA	0000
2203	SET PNT	45.00 - 79.99	HZ	60.0
2204	TL16	0.05 - 99.99	SEC	2
OVER FREQUENCY SET POINT 3: 81-3O				
2301	TRIP	0000 - 1111	NA	0000
2302	ALARM	0000 - 1111	NA	0000
2303	SET PNT	45.00 - 79.99	HZ	60
2304	TL17	0.05 - 99.99	SEC	2
OVER FREQUENCY SET POINT 4: 81-4O				
2401	TRIP	0000 - 1111	NA	0000
2402	ALARM	0000 - 1111	NA	0000
2403	SET PNT	45.00 - 79.99	HZ	60.0
2404	TL18	0.05 - 99.99	SEC	2
DIGITAL INPUT: DIG INP				
2501	SELBKDI1	NO BLK (0) BLKVTFF (1) BLK64G2 (2) BLKBOTH (3)	NA	NO BLK
2502	DI3 TRIP	0000 - 1111	NA	0000
2503	DI3 ALRM	0000 - 1111	NA	0000
2504	DI4 TRIP	0000 - 1111	NA	0000
2505	DI4 ALRM	0000 - 1111	NA	0000
VOLTAGE TRANSFORMER FUSE FAILURE: VTFF				
2601	VTFF	DISABLE (0) ENABLE (1)	NA	DISABLE
ACCIDENTAL ENERGIZATION: AE				
2701	TRIP	0000 - 1111	NA	0000
2702	ALARM	0000 - 1111	NA	0000
2703	AE ARM	AND (0) OR (1)	NA	AND

Select Trip Contact Current Monitoring, SEL TCM

The four trip contacts described above for the SEL TVM can also be monitored for DC current by the DGP when a trip signal is issued. The monitoring is enabled or disabled by setting the SEL TCM to either 1 or 0 respectively. The four-digit code of the SELTCM setting applies to 94G, 94G1, 94G2, & 94G3, in that order. If the trip current through any of the monitored contacts is not expected to be above 150 milliamperes, or if any of the trip circuit is not interrupted externally, it should be disabled to avoid nuisance sequence-of-event points, or seal-in of the output relay.

For example, a setting of 1000 enables TCM for 94G and disables for 94G1, 94G2 & 94G3.

Select Primary/Secondary Units, SELPRIM

SELPRIM can be set to either 0 (PRIMARY) or 1 (SECNDRY), secondary. This setting determines whether the PRESENT VALUES (currents, voltages, watts, and vars) are displayed and stored as primary or secondary values. All user-entered 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 - 9999.

For the sample generator system,
CTRATIO = 8000/5
= 1600

Voltage Transformer Ratio, VTRATIO

VTRATIO can be set over the range of 1.0 - 240.0.

For the sample generator system,
set VT ratio = 18900/120
= 157.5

Communications Port, COMMPORT

COMMPORT sets the baud rate, parity, and stop bits of the DGP's RS232 serial port. The setting format is xxyz, where:

Baud Rate = xx = 03, 12, 24, 48, 96
Parity = y = 0 (none), 1 (odd), 2 (even)
Stop Bits = z = 1, 2

The baud rate setting of 300, 1200, 2400, 4800, 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 DGP. The parity and stop bits must match those selected for the serial port of the remote PC. Normally 1 stop bit is selected. However, certain modems or other communications hardware might dictate using 2 stop bits. DGP-LINK communications software can be configured to match this DGP setting for baud rate, parity, and stop bits.

COMMPORT can only be changed via the keypad of the local MMI. It is not possible to change COMMPORT via DGP-LINK communications software.

Phase Designation, PHASE

PHASE can be set to either A-B-C or A-C-B to match the positive-sequence phase rotation for the generator system where the DGP is installed. This setting permits the DGP to properly compute and report the sequence-dependent quantities.

Time Synchronization Source, TIMESYNC

TIMESYNC determines the method of synchronizing the DGP's internal clock, and it can be set to 0 (INTERNAL), 1 (IRIG-B), or 2 (G-NET). TIMESYNC=0 lets the clock run freely from the internal oscillator. TIMESYNC=1 synchronizes the clock using an IRIG-B signal connected directly to the DGP relay via port PL-3. TIMESYNC=2 synchronizes the clock using a signal on pin 25 of RS232 port PL-1 when connected to a G-NET host computer.

Number of Fault Events, NUM FLTS

NUM FLTS selects the maximum number of fault reports and oscillography data that may be stored in memory without overwriting, and can be set to 1, 2, or 3. When the maximum number are stored in memory, the fault report and the oscillography data associated with a subsequent storage event will overwrite the data from the oldest event.

This setting also apportions a fixed amount of memory into different sized blocks for oscillography storage. The following tabulation shows the total number of oscillography cycles allowed per storage event as a function of NUM FLTS.

NUM FLTS	STORAGE CYCLES
1	120
2	60
3	40

Prefault Cycles, PREFLT

PREFLT selects the number of pre-trigger (or pre-fault) cycles in each oscillography data set, and it can be set over the range from 1 to 20. NUM FLTS determines the total number of cycles per storage event, as explained above, and PREFLT determines how many of these are pre-trigger cycles.

External Oscillography Trigger, OSC TRIG

A DGP trip always causes oscillography to be stored; OSC TRIG enables or disables an additional oscillography trigger by an external digital input (DI5) contact. Refer to OTHER FEATURES - FAULT REPORT AND OSCILLOGRAPHY DATA in the **PRODUCT DESCRIPTION** section for further explanation. OSC TRIG may be set to 0 (DI ENA), or 1 (DI DIS).

Nominal Voltage, NOM VOLT

NOM VOLT can be set over the range of 100.0-140.0 V (Phase-to-phase).

For the sample generator system,

NOM VOLT = 18000/(18900/120)
= 114.3 V.

Rated Current, RATEDCUR

RATEDCUR can be set over the range 0.10-9.99 Amperes.

For the sample generator system,
RATEDCUR = 211765/[(1.732 X 18)(8000/5)]
= 4.25 Amperes.

Voltage Transformer Connection Type, VT CONN

VT CONN may be set to 0 (WYE), or 1 (DELTA). VT CONN must be set to identify the connections of VT's that supply AC voltage to the DGP.

Example Settings (based on Figure CS-1):

UNITID	= 1
SYSFREQ	= 60
SELTVM	= as required
SELTCM	= as required
CTRATIO	= 1600
VTRATIO	= 157.5
COMMPORT	= 24 N 1
PHASE	= A-B-C (0)
TIMESYNC	= INTRNL (0)
NUM FLTS	= 3
PREFLT	= 10
OSC TRIG	= DI DIS (1)
NOM VOLT	= 114.3 volts
RATEDCUR	= 4.25 amps
VT CONN	= WYE (0)

PROTECTION FUNCTIONS

GENERAL

Configurable TRIP and ALARM Output Relays

Four trip-rated and four alarm-rated configurable output relays are provided in the DGP. Each of the protection functions described below includes two four-digit codes, TRIP and ALARM, which configure the function to operate any number of these relays. An output relay is selected, or not-selected, by setting a code to either 1, or 0, respectively. The four-digit code of the TRIP setting applies to 94G, 94G1, 94G2, & 94G3 relays, in that order. Also the four digit code of the ALARM setting applies to 74A, 74B, 74C, & 74D relays, in that order.

Any number of the protection functions can be disabled by setting both the TRIP and ALARM codes for the function or functions to 0000.

The configurable trip and alarm outputs can be used to customize the DGP in accordance with a number of trip and alarm strategies of various users.

Stator Differential (87G)

Algorithm: (87G) operates when the following inequality is met:

$$|\bar{I}_1 - \bar{I}_2|^2 > K(\bar{I}_1 \cdot \bar{I}_2)$$

$\bar{I}_1$ = Generator return-side phase current

$\bar{I}_2$ = Generator system-side phase current

K = An adaptive variable
= K1/100 if $|\bar{I}_1 \cdot \bar{I}_2| \leq 81$

= (15 X K1)/100 if $|\bar{I}_1 \cdot \bar{I}_2| > 81$

K1 = 87G K1 setting in %

1. The algorithm is processed only if $|\bar{I}_1 - \bar{I}_2| >$ (87G PICKUP).
2. The algorithm is processed separately for each phase.
3. The initial characteristic slope can be calculated using the formula: % slope = $100(K1/100)^{0.5}$

Characteristics: Figures CS-2 through CS-5 show the curves for selected values of K1 & PICKUP. The curve for any combination of the K1 & PICKUP settings can be derived using the above algorithm.

This function should be set to be as sensitive as practical, keeping adequate margin for CT errors under all through-load and through-fault current conditions. K1 and PICKUP settings of 2% and 0.3 ampere respectively are recommended for most applications; however, settings higher than these may be considered for higher CT error margin.

For the sample generator system, set K1=2% and PICKUP=0.3 ampere.

Current Unbalance Alarm (46A)

This function is intended to alarm prior to a 46T trip, so that an operator can take corrective action. The PICKUP setting should be a safe margin below the generator's allowable continuous negative-sequence current.

For the sample generator system,
set PICKUP = 70% of the I_2 capability of the machine

= 0.7 X 0.08 X 211765/(1.732 X 18)
= 380.4 Amperes primary
= 0.24 Ampere secondary

set TL14 = 2 seconds.

Current Unbalance Trip (46T)

Algorithm: Operating time T = $K2/(I_2/I_{FL})^2$ seconds at I_2 amperes

K2 = 46T K2 setting
I_{FL} = Rated full load current of the machine (RATEDCUR)

1. Time T is computed only if $I_2 >$ (46T PICKUP amperes).
2. Reset time: Linear reset with maximum of 227 seconds.

Characteristics: Figure CS-6 shows the curves for selected values of K2. The curve for any other K2 setting can be derived, using the above algorithm.

This function should be set at or below the negative-sequence current capability of the machine.

For the sample generator system,
set PICKUP = I_2 capability of the machine

= 0.08 X [211765/(1.732 X 18)]
= 543.4 Amperes primary
= 0.34 Ampere secondary

set K2 = machine I_2^2T capability
= 10

Loss of Excitation (40: 40-1, 40-2)

Algorithm: Impedance looking in to the machine is computed using delta voltage and delta current per the following equation. Functions 40-1 and 40-2 are identical, each with an adjustable time delay.

$Z_{ab} = (\bar{V}_a - \bar{V}_b)/(\bar{I}_a - \bar{I}_b)$ if phase designation (setting #109) is A-B-C.

$Z_{ac} = (\bar{V}_a - \bar{V}_c)/(\bar{I}_a - \bar{I}_c)$ if phase designation (setting #109) is A-C-B.

Characteristic and impedance setting criteria: See Figure CS-7.

With settings per the criteria shown in Figure CS-7, function 40-1 would detect the loss of excitation for about 30% or higher load conditions. Function 40-2 would detect for all load conditions; however, some stable power system swing conditions may momentarily enter the 40-2 characteristic. For security of the function under stable swing conditions, it is recommended to delay functions 40-1 and 40-2 by a minimum of 0.06 and 0.5 seconds respectively.

SELV2SUP can be set to either 0 (DISABLE) or 1 (ENABLE). It is recommended to set this to function to ENABLE unless an external VTFF is used via input DI6.

For the sample generator system,

Z_b (secondary) = $[(kV_{base})^2/MVA_{base}]X(CT\ ratio/VT\ ratio)$
= $[(18)^2/211.765](1600/157.5)$
= 15.54 ohms

X'd (secondary) = 15.54 ohms X 0.216 = 3.36 ohms

X_d (secondary) = 15.54 X 1.967 = 30.57 ohms

set SELV2SUP to 1 (ENABLE)

set 40-1,
CENTER = (15.54 + 3.36)/2 = 9.45 ohms
RADIUS = 15.54/2 = 7.77 ohms
TL12 = 0.06 seconds

set 40-2,
CENTER = (30.57+3.36)/2 = 16.97 ohms
RADIUS = 30.57/2 = 15.285 ohms
TL13 = 0.5 seconds

Anti-Motoring (Reverse Power: 32-1, 32-2)

32-1 and 32-2 REV PWR can be set over the range of 0.5-99.9 Watts each.

Reverse power levels (REV PWR) of these functions should be set a safe margin below the motoring power of the turbine-generator (30 to 70%).

Timer TL1, associated with the 32-1, should be set about 3 seconds if SQ TR EN (sequential trip enable) is set to YES. If the SQ TR EN is set to NO, the TL1 setting should be identical to the TL2 setting as described below.

Timer TL2, associated with the 32-2, should be set to override the power swings expected during normal system operations. A setting of 10 to 30 seconds is suggested.

SQ TR EN can be set to YES or NO, depending on the generator tripping strategy used.

For the sample generator system,

motoring power = (22000 X 1000)/[(CT RATIO)(VT RATIO)] watts
= (22000X1000)/[1600 X 157.5] watts
= 87.3 watts

set REV PWR = 0.7 X 87.3 (32-1 & 32-2)
= 61 watts

set TL2 = 30 seconds.

Overcurrent with Voltage Restraint (51V)

Algorithm: Operating time $T = \dfrac{K}{[(I/I_{PU})/(V/V_{NOM})]^{0.5-1}}$ seconds

K = time factor (TIME FAC).

I/I_{PU} = current in multiple of I_{PU} (PICKUP).

V = 1.732(phase-ground voltage) for wye VT's (see Table CS-2)
= phase-phase voltage for delta VT's (see Table CS-2)

V_{NOM} = Nominal Voltage (NOM VOLT)

1. Time T is computed individually for each phase.
2. See Table CS-2 for the restraint voltages used corresponding to phase currents for different PHASE designations (setting # 109) and VT CONN (setting # 116).
3. If the quantity $(V/V_{NOM}) < 0.3$ then 0.3 is used as its value in the equation.
4. If the quantity $[(I/I_{PU})/(V/V_{NOM})] > 65.5$ then 65.5 is used as its value in the equation.
5. Reset Time: Linear reset with maximum of 1.4 seconds.

TABLE CS-2: Restraint Voltages used by Function 51V

Current	Restraint Voltages			
	Phase = ABC VT = WYE	Phase = ABC VT = DELTA	Phase = ACB VT = WYE	Phase = ACB VT = DELTA
I_A	V_A	V_{AB}	V_A	V_{AC}
I_B	V_B	V_{BC}	V_B	V_{BA}
I_C	V_C	V_{CA}	V_C	V_{CB}

Characteristics: Figures CS-8 to CS-11 show the curves for selected values of K & Voltage Restraint. The curve for any combination of K and Restraint Voltage can be derived, using the above algorithm.

This function should be set to coordinate with the power system protective relays used at the generating station. Also the PICKUP setting should be a safe margin above the expected maximum load on the machine. Refer to the Accidental Energization (AE) section for additional considerations regarding the 51V PICKUP setting.

For the sample generator system,

set PICKUP (I_{PU}) = 1.75 X generator rated load current
= 1.75 X 4.25
= 7.5 amperes secondary

TIME FAC K should be selected to back up the relays on transmission lines out of the generating station. As the information about line relays is not known, let us set the TIME FAC such that the operate time of 51V for a 3-phase fault on the high side of the GSU is about 0.75 second. For simplicity, power system contribution to the fault is not considered in the following calculations.

Impedance to fault = 21.6 + [10 X (211.765/200)]
= 21.6 + 10.6
= 32.2% at machine base

Gen. contribution (I) = 4.25/0.322
= 13.2 amperes secondary

Multiple of PICKUP (I/I_{PU}) = 13.2/7.5
= 1.76

Gen. terminal volt. = 18 X (10.6/32.2)
= 5.93 KV

% Restraint (V/V_{NOM}) = (5.93/18) X 100
= 32.9 %

TIME FAC (K) = $0.75\,[(1.76/0.329)^{0.5} - 1]$
= 0.985 or higher

set TIME FAC = 1.0

Stator Ground Fault (64G-1, 64G-2)

Algorithm: 64G-1 operates when the following condition is met:
$V_{N1} \geq$ PICKUP for time > TL4 seconds.

V_{N1} = Fundamental frequency voltage at generator neutral.

PICKUP = 64G-1 pickup setting.
TL4 = timer TL4 setting.

64G-2 operates when the following condition is met:
$[V_{N3}/\{(V_{P3}/3)+V_{N3}\}] \leq 0.15$ for time > TL5 seconds.

V_{N3} = magnitude of third harmonic voltage at generator neutral.

V_{P3} = magnitude of third harmonic voltage at generator terminals.

TL5 = timer TL5 setting.

PICKUP of 64G-1 should be set with a safe margin above the highest voltage (fundamental frequency) expected at the generator neutral under normal operating conditions. Timer TL4 should be set with a safe margin above the longest clearing time for power system faults that are outside of the generator protection zone.

For the sample generator system,
set PICKUP = 5.0 volts
set TL4 = 1 second or higher
set TL5 = 0.10 second.

Overexcitation Alarm (Volts/Hertz: 24A)

This function is intended to alarm prior to a 24T trip, so that an operator can take corrective action. The PICKUP setting should be below the continuous Volt/Hz rating of the generator or step-up transformer, whichever is lower. Timer TL6 should be set to minimize the nuisance alarms.

For the sample generator system,
set PICKUP for 90% of allowable over V/Hz, assumed to be 10%.
= 1 + (0.9 X 0.1) per unit
= 1.09 per unit

set TL6 = 2 seconds.

Overexcitation Trip (Volts/Hertz: 24T)

Algorithm: operating time T = (curve 1, Fig. CS-12)

$$\frac{K}{[(V/F)/\{(V_{NOM}/F_S)PU\}]^2-1} \text{ seconds}$$

operating time T = (curve 2, Fig. CS-13)

$$\frac{K}{[(V/F)/\{(V_{NOM}/F_S)PU\}]-1} \text{ seconds}$$

operating time T = (curve 3, Fig. CS-14)

$$\frac{K}{[(V/F)/\{(V_{NOM}/F_S)PU\}]^{0.5}-1} \text{ seconds}$$

operating time T = K seconds, if $(V/F) > \{(V_{NOM}/F_S)PU\}$
(curve 4, Definite Time)

K = Time factor (TIME FAC)
V_{NOM} = nominal voltage (NOM VOLT)

F_S = system frequency (SYSFREQ)

PU = V/Hz pickup (INV PU)

1. The algorithm is processed separately for each phase.
2. V and V_{NOM} values used are phase-ground voltages for wye connected VT's, however phase-phase voltages are used if the VT's are delta connected. Table CS-3 shows the voltages used by each of the three phases for different phase designations (setting # 109) and VT connections (setting # 116).
3. Reset time: Linear reset with maximum time = RESET setting.

TABLE CS-3: Voltages used by Function 24T

Phase	Voltages			
	Phase = ABC VT = WYE	Phase = ABC VT = DELTA	Phase = ACB VT = WYE	Phase = ACB VT = DELTA
A	V_A	V_{AB}	V_A	V_{AB}
B	V_B	V_{BC}	V_B	V_{BC}
C	V_C	V_{CA}	V_C	V_{CA}

This function should be set with a safe margin below the excitation capability of the generator or step-up transformer, whichever is lower. The following example is based on the traditional criteria of 45 seconds operating time at V/Hz from 1.1 to 1.18 per unit; however, actual excitation capability curves should be obtained for the generator and the transformer to take full advantage of the inverse characteristic of this function. RESET time should be set to match the cooling characteristic of the protected equipment.

For the sample generator system,
let us use curve 4 (definite time) and operating time of 45 seconds.

set INV PU = 1.10 per unit

set TIME FAC = 45 seconds

set INST PU = 1.18 per unit

set TL7 = 2 seconds

Overvoltage (59)

Algorithm: operating time $T = \frac{K}{(V_1/V_{PU})-1}$ seconds

K = time factor (TIME FAC).
V_1 = positive-sequence voltage (phase-phase).

V_{PU} = overvoltage pickup (PICKUP).

Reset Time: Linear reset with maximum of 1.4 seconds.

Characteristics: Figure CS-15 shows the curves for selected values of K. The curve for any other K setting can be derived using the above algorithm.

This function should be set with a safe margin below the overvoltage capability of the protected equipment. Function 59 can provide backup to function 24T.

For the sample generator system,
set 59 using criteria similar to 24T settings except with lower sensitivity and higher operating time.

Set PICKUP (V_{PU}) = 1.1 X NOM VOLT
= 1.1 X 114.3
= 126 volts

For determining time factor K, let us use an operating time of about 45 seconds at 115% of PICKUP voltage.

Voltage (V) = 1.15 X 126
= 144.9 volts

Time factor K = $45[(144.9/126)-1]$
= 6.75 seconds.

Over/Under Frequency (81 Undervoltage Cutoff)

UVCUTOFF can be set over the range of 35 to 99 % of the nominal voltage (NOM VOLT). This setting can be used to block the frequency functions from operating during start-up conditions until near-normal generator field is applied and set voltage is generated.

Under Frequency (81-1U to 81-4U)

Each of the four under-frequency functions can be set (SET PNT) over the range of 40.00 to 65.00 Hz, with a time delay of 0.05 to 99.99 seconds each. The actual settings will depend on the protection and operating philosophies of the individual user.

Over Frequency (81-1O to 81-4O)

Each of the four over-frequency functions can be set (SET PNT) over the range of 45.00 to 79.99 Hz, with a time delay of 0.05 to 99.99 seconds each. The actual settings will depend on the protection and operating philosophies of the individual user.

Digital Input (DI)

The SELBKDI1 setting determines blocking action by digital input DI1 (Generator off-line) when it is energized. It can be set to 0, 1, 2, or 3 depending on the protection functions to be blocked during the start-up. The following describes the different blocking actions:

SELBKDI1	Action by Input DI1
0	no blocking action
1	block function VTFF
2	block function 64G2
3	block both functions VTFF and 64G2.

VTFF and/or 64G2 should be blocked during start-up (generator off-line) if required. For example, if the DGP is applied to a gas turbine generator with static start, one or both of these functions may have to be blocked to prevent nuisance operation during the start-up.

The DI3 Trip & Alarm and the DI4 Trip & Alarm settings can be used to operate directly any or all of the Trip (94G-94G3) or Alarm (74A-74D) relays. If the settings are selected, energizing the corresponding digital input will cause the appropriate Trip or Alarm relay to operate.

Voltage Transformer Fuse Failure (VTFF)

VTFF can be set to either 0 (DISABLE) or 1 (ENABLE) as desired. It is recommended to set VTFF = 1 (ENABLE) if the external VTFF input (DI6) is not used. If the external VTFF input is connected, the VTFF setting will depend on user preference.

Accidental Energization (AE)

AE ARM can be set to either 0 (AND) or 1 (OR) as desired. If it is set to 0 (AND), the logic will be armed when the positive sequence voltage V1 < 30 volts **AND** the generator is off-line. If it is set to 1 (OR), the logic will be armed when the voltage V1 < 30 volts **OR** the generator is off-line. The setting of 0 (AND) is recommended. However, if both of the following conditions apply, it must be set to 1 (OR) for effective arming of the logic.

1. The generator system includes a generator disconnect device (breaker or switch), **AND**
2. The VT's are connected on the power system side of the disconnect device.

As the pickup flag of function 51V is used for instantaneous overcurrent signal in the Accidental Energization logic (Figure PD-1), the following additional criteria should be used in setting the 51V PICKUP.

If the AE ARM is set to 0 (AND), the 51V PICKUP (setting # 1003) should be set with a safe margin above I_{LMAX}, where I_{LMAX} is an expected maximum load current of the machine. However, if it is set to 1 (OR), the PICKUP should be set with a safe margin above 3.33 X I_{LMAX}.

Note that function AE will be effectively disabled if function 51V is disabled by setting both TRIP and ALARM codes (setting# 1001 & 1002) to 0000. This is in addition to the normal way of disabling function AE by setting its TRIP and ALARM codes (setting# 2701 & 2702) to 0000.

For the sample generator system,
set AE ARM = 0 (AND)

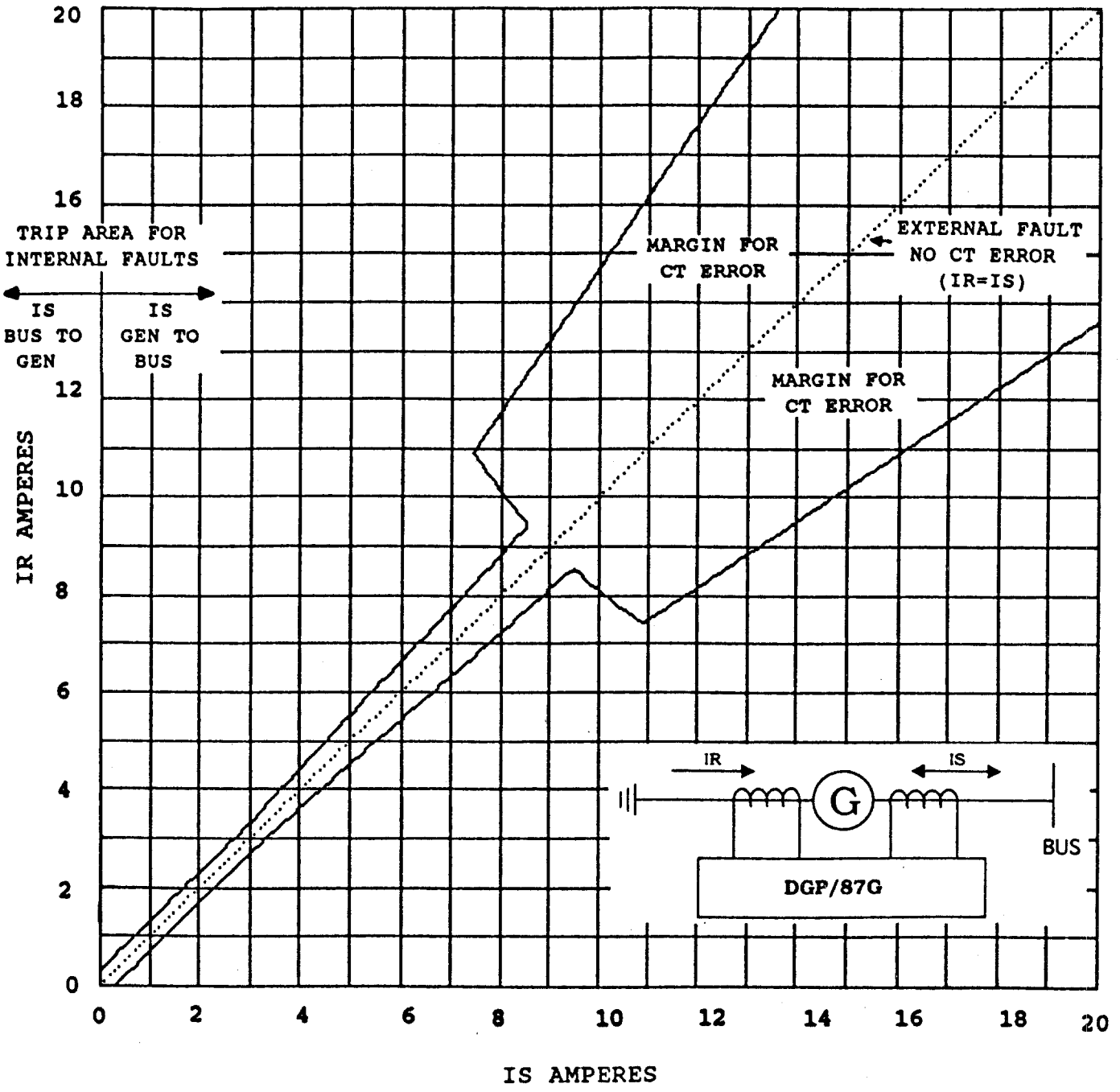


Figure CS-2 (0286A4983 [1]) Typical Operating Characteristics of Function **87G** with **K1 = 1%** and **PICKUP = 0.3 amp.**

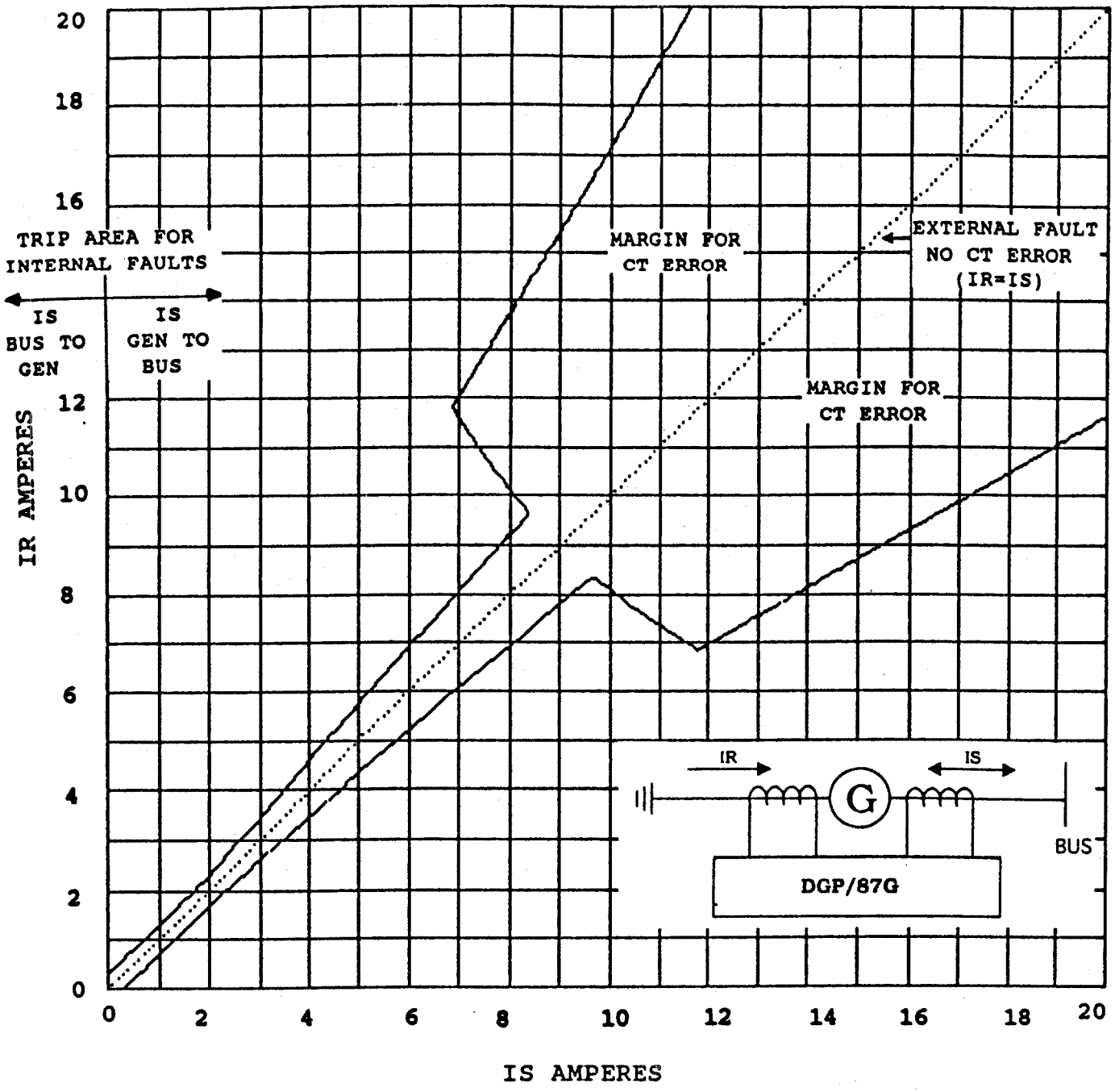


Figure CS-3 (0286A4984 [1]) Typical Operating Characteristics of Function **87G** with **K1=2%** and **PICKUP=0.3 amp.**

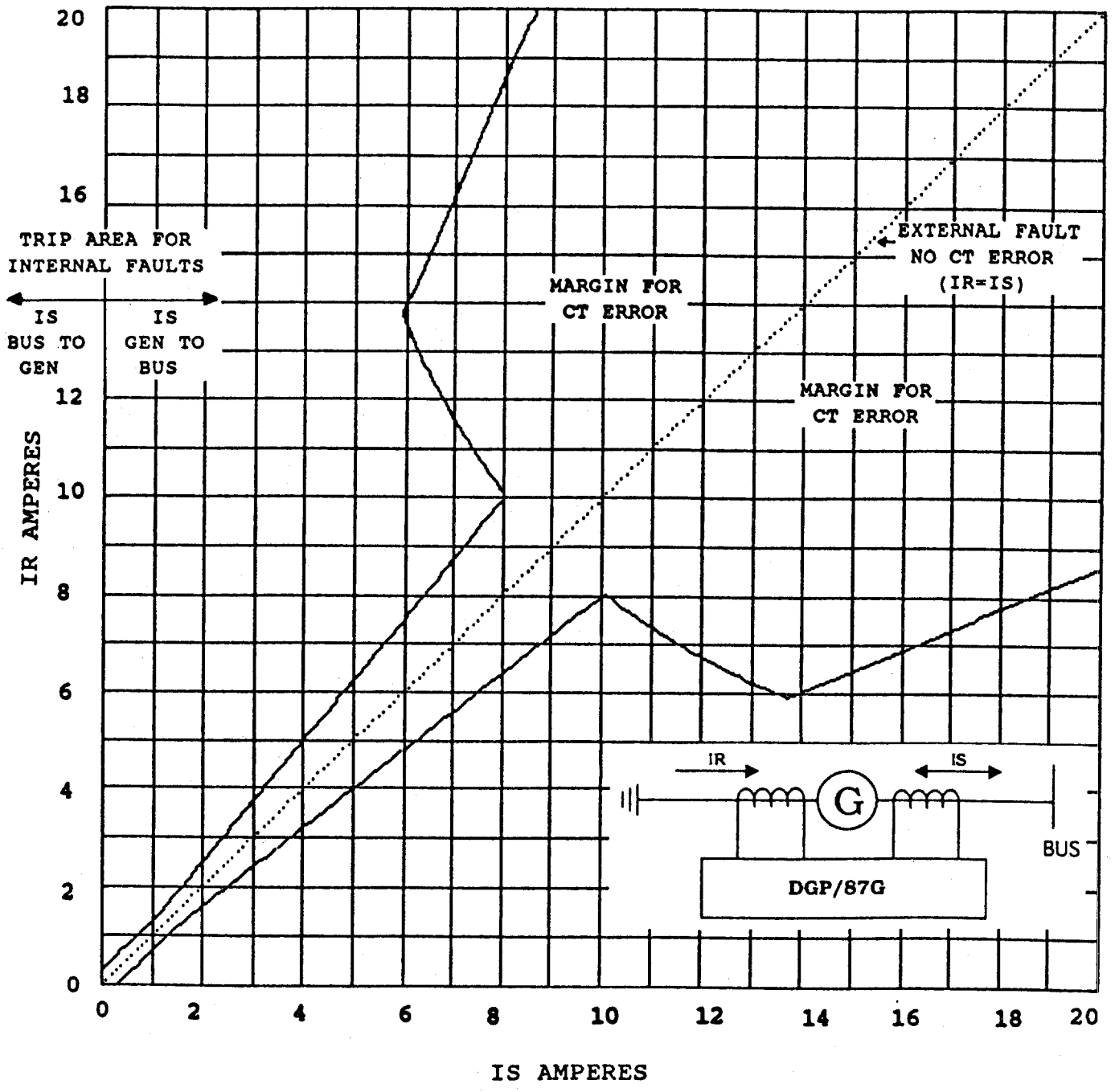


Figure CS-4 (0286A4985 [1]) Typical Operating Characteristics of Function **87G** with **K1 = 5%** and **PICKUP = 0.3 amp.**

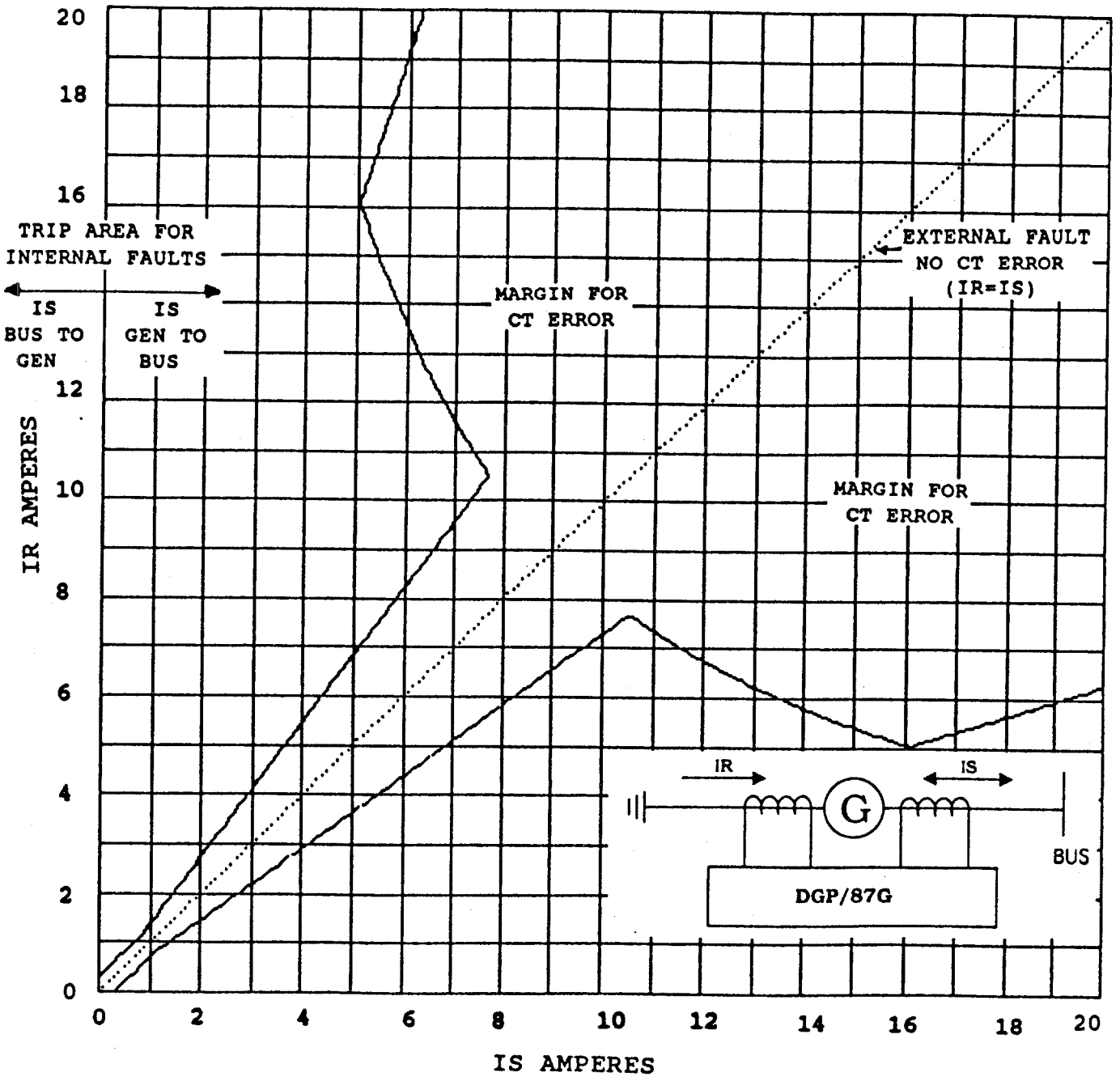


Figure CS-5 (0286A4986 [1]) Typical Operating Characteristics of Function **87G** with **K1 = 10%** and **PICKUP = 0.3 amp.**

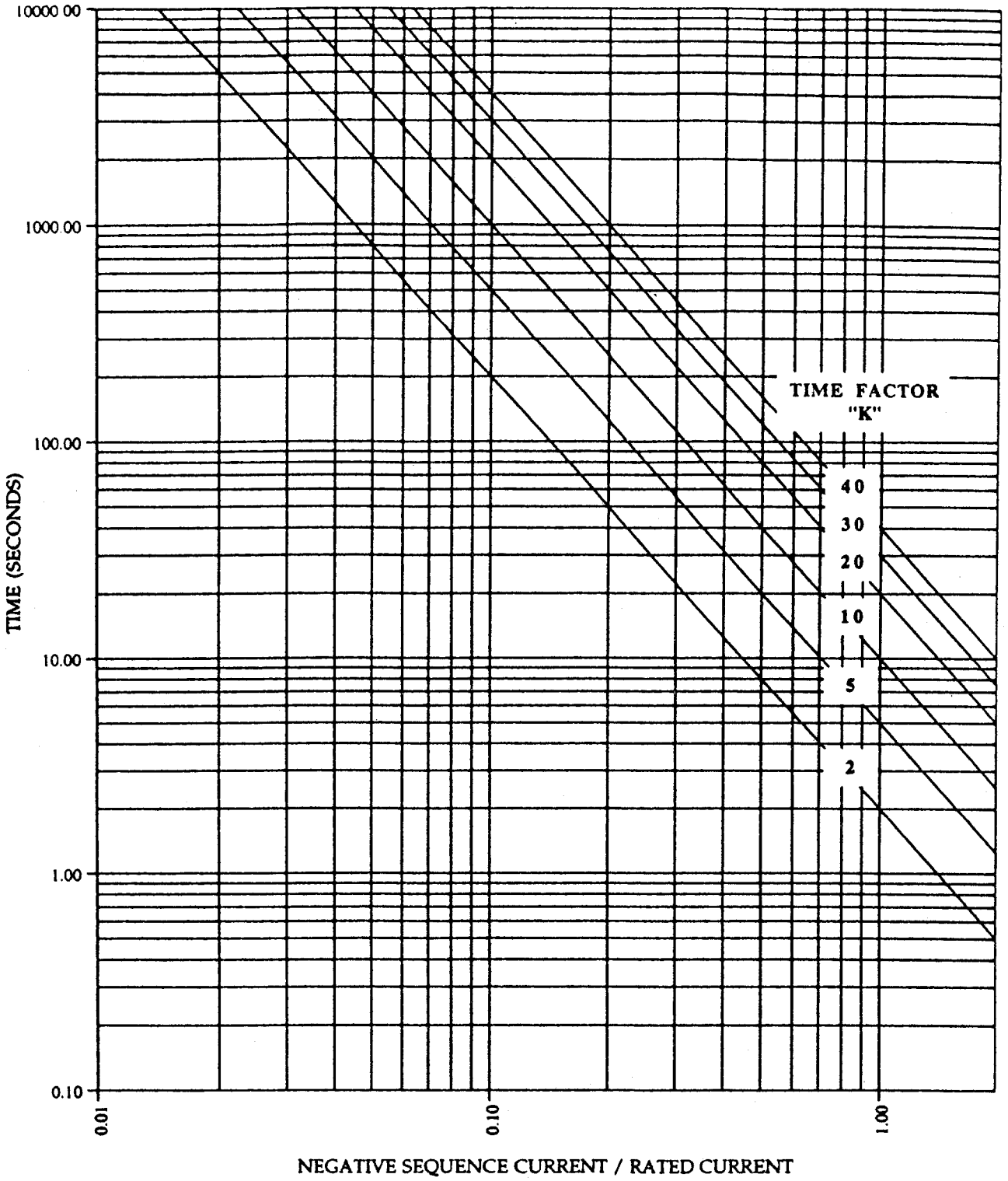
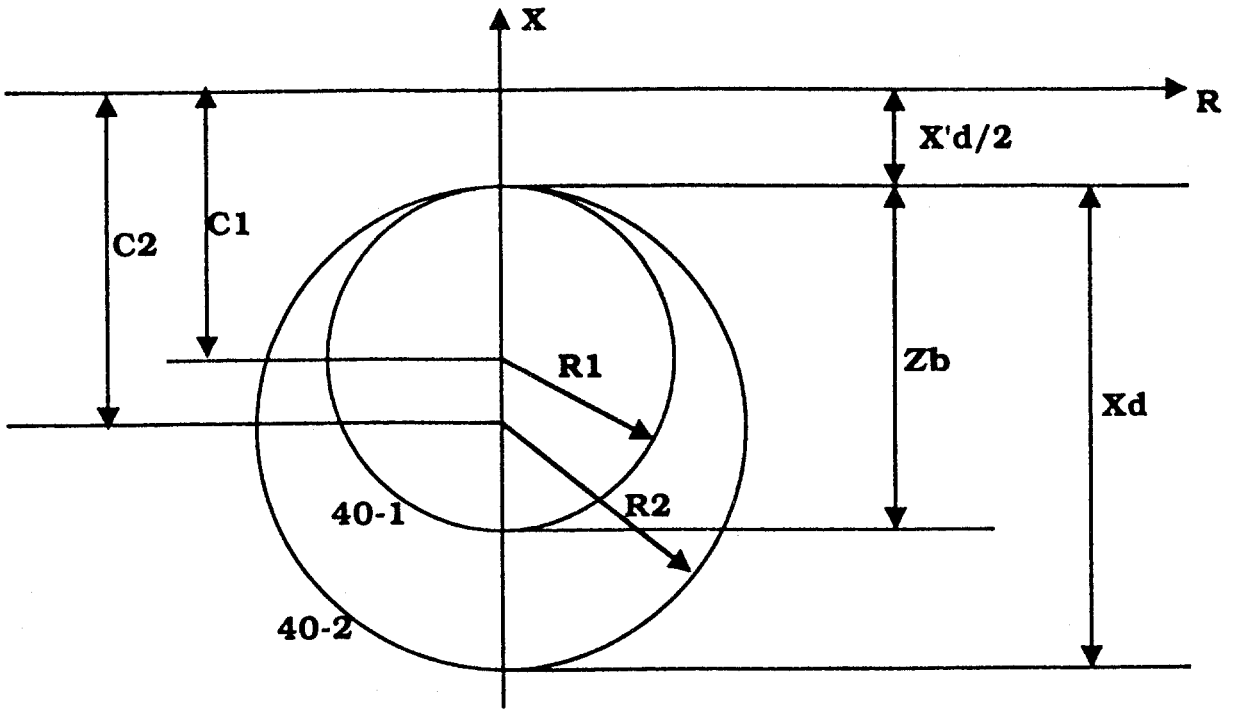


Figure CS-6 (0286A4987 [1]) Time-Current Characteristic of Function **46T**



C1 = CENTER OF 40-1
= (Zb + X'd)/2
R1 = RADIUS OF 40-1
= Zb/2
C2 = CENTER OF 40-2
= (Xd + X'd)/2
R2 = RADIUS OF 40-2
= Xd/2
Zb = Base impedance of the machine
X'd= Transient reactance of the machine
Xd = Synchronous reactance of the machine

Figure CS-7 (0286A4988 [1]) Mho Characteristics and Setting Criteria for Functions **40-1** and **40-2**

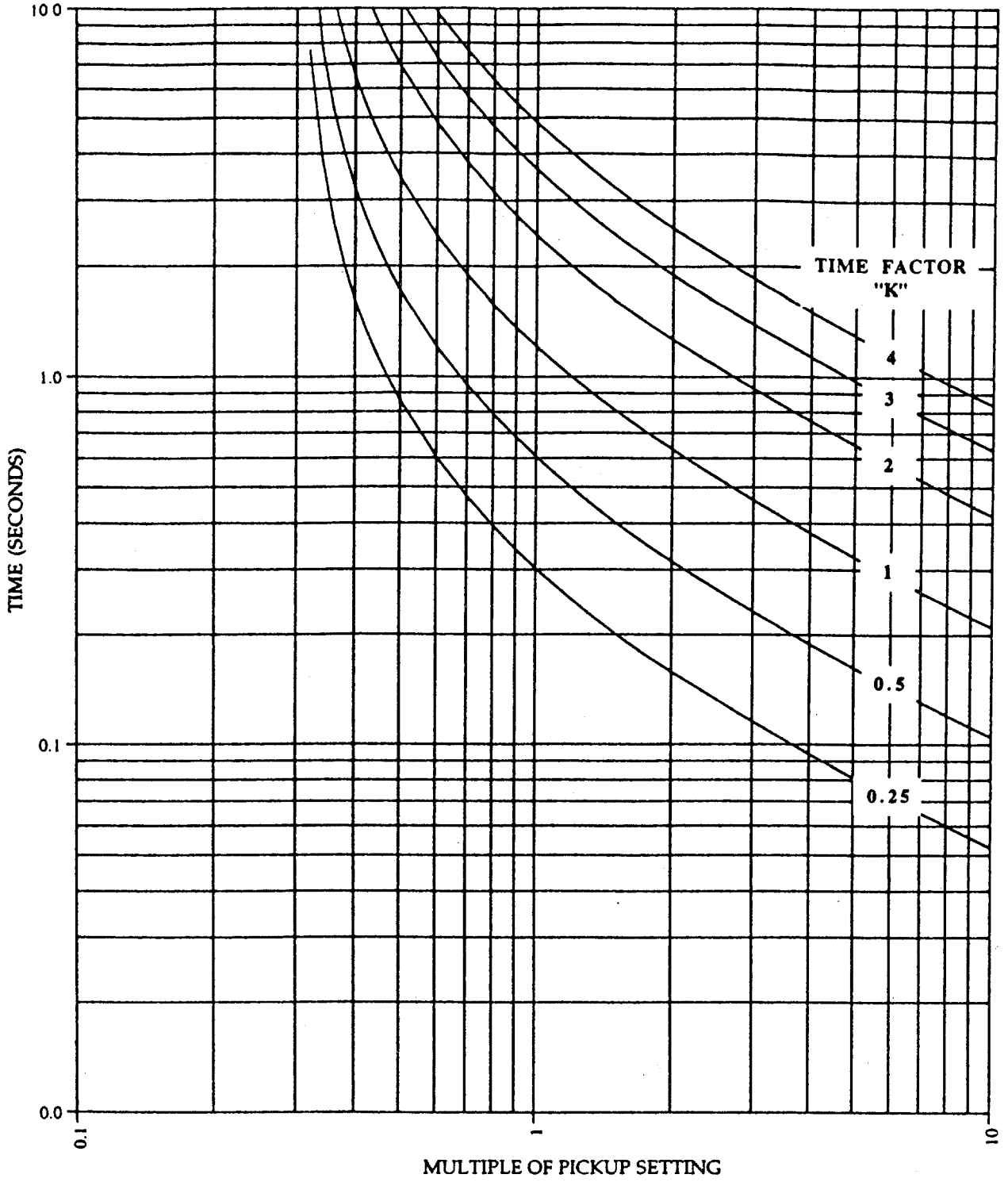


Figure CS-8 (0286A4989 [1]) Time-Current Characteristics of Function **51V** for **0-30% restraint** (30% PICKUP)

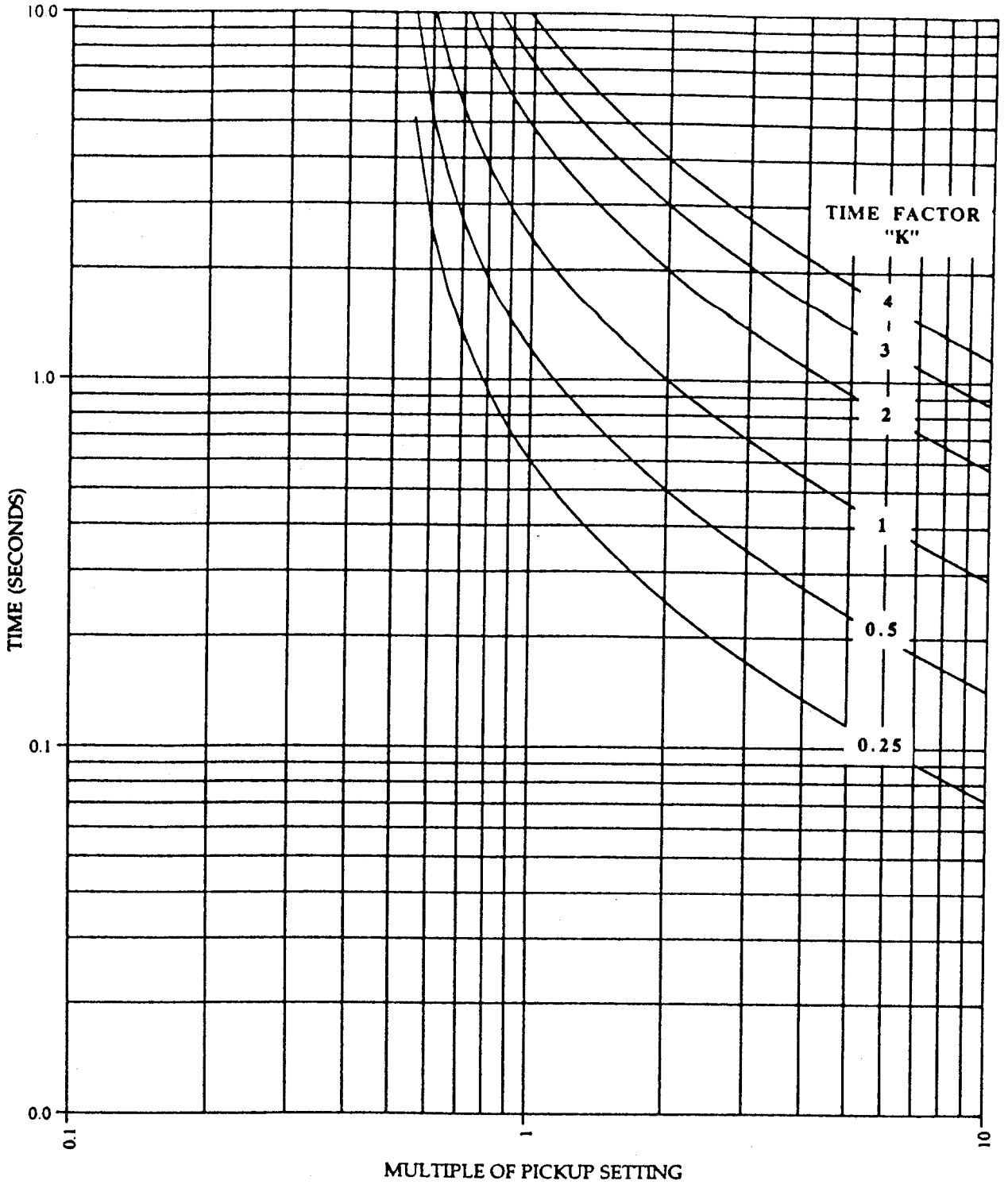


Figure CS-9 (0286A4990 [1]) Time-Current Characteristics of Function **51V** for **50% restraint** (50% PICKUP)

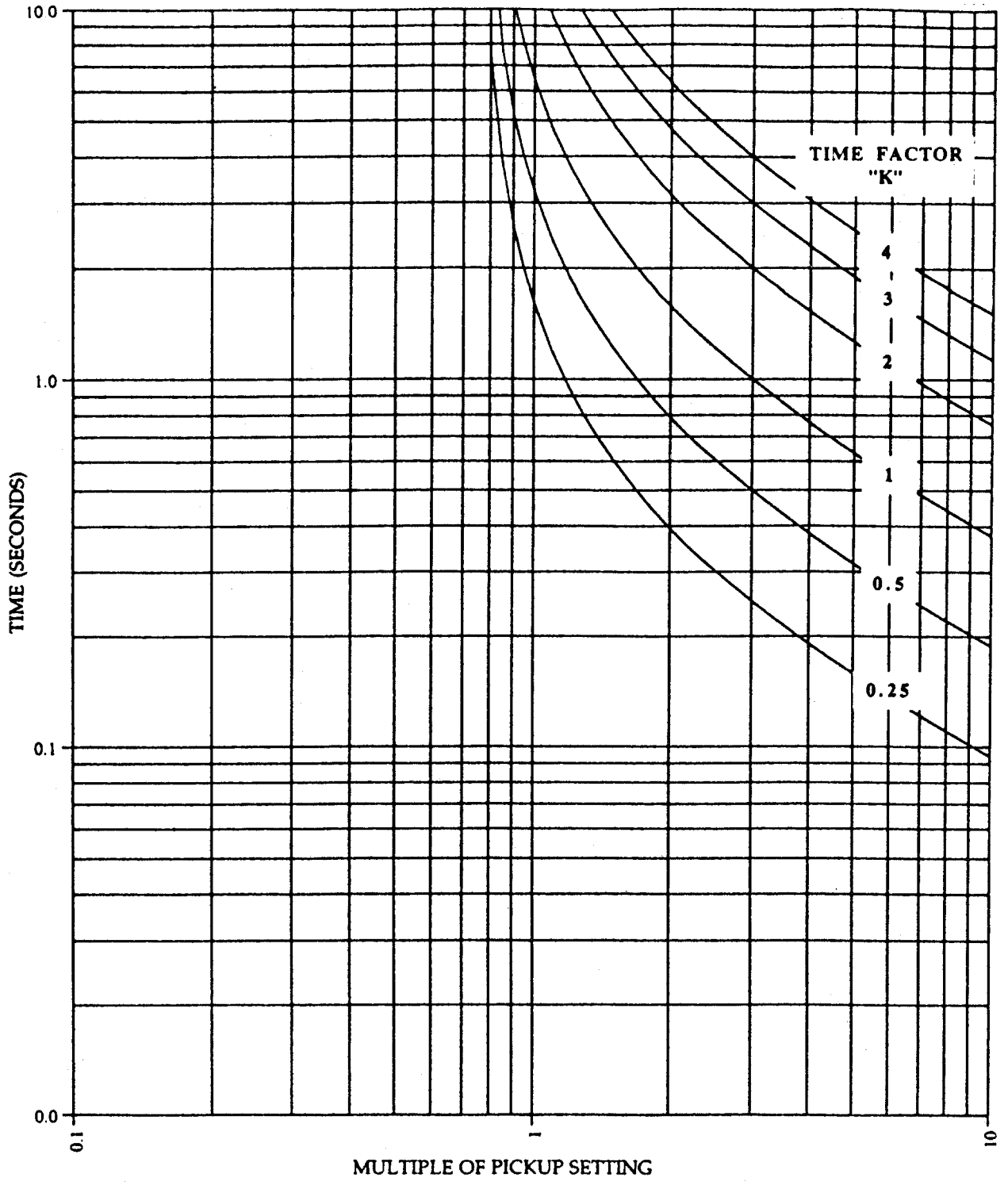


Figure CS-10 (0286A4991 [1]) Time-Current Characteristics of Function **51V** for **75% restraint** (75% PICKUP)

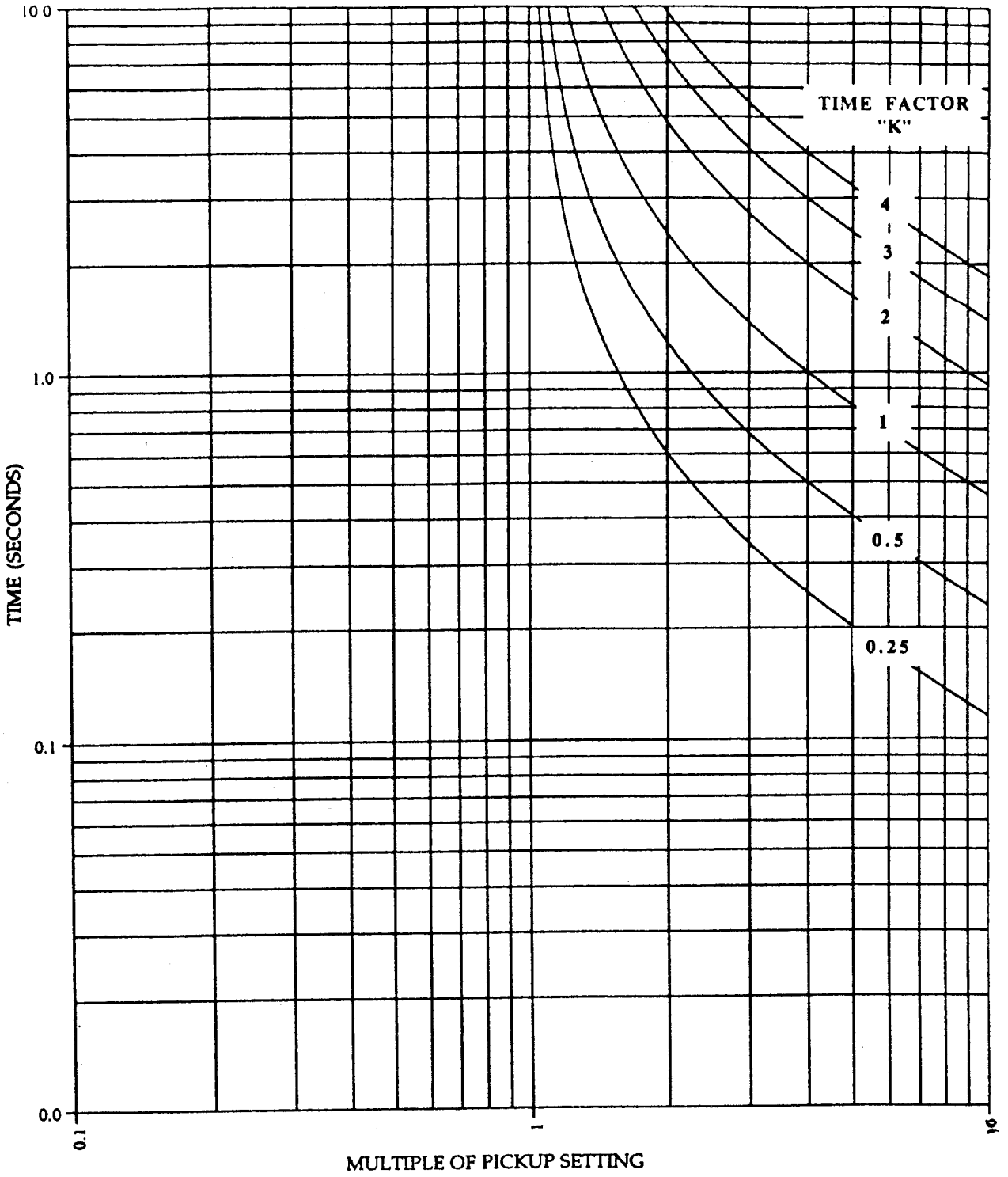


Figure CS-11 (0286A4992 [1]) Time-Current Characteristics of Function **51V** for **100% restraint** (100% PICKUP)

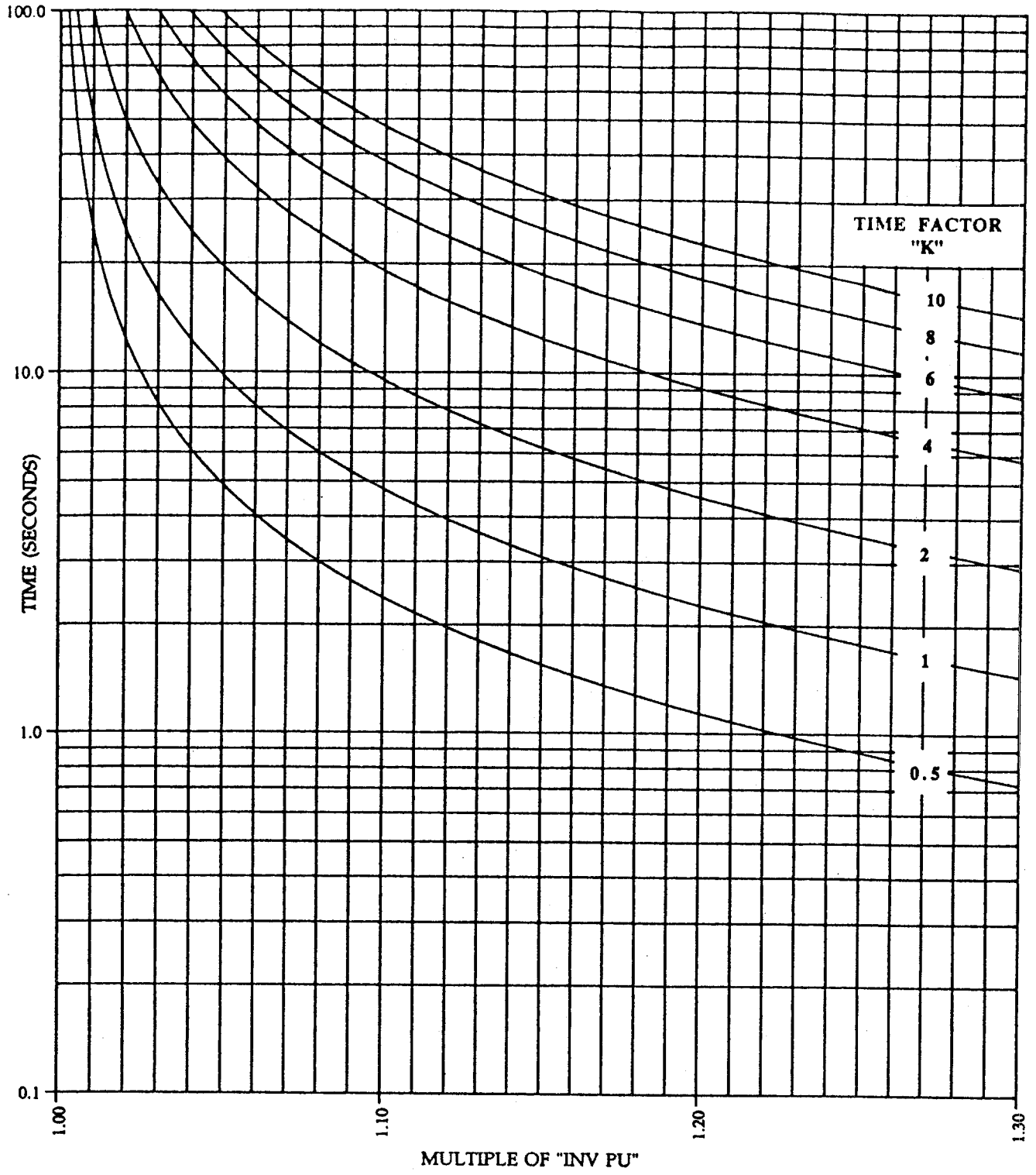


Figure CS-12 (0286A4993) Time Characteristics of Function **24T (CURVE 1)**

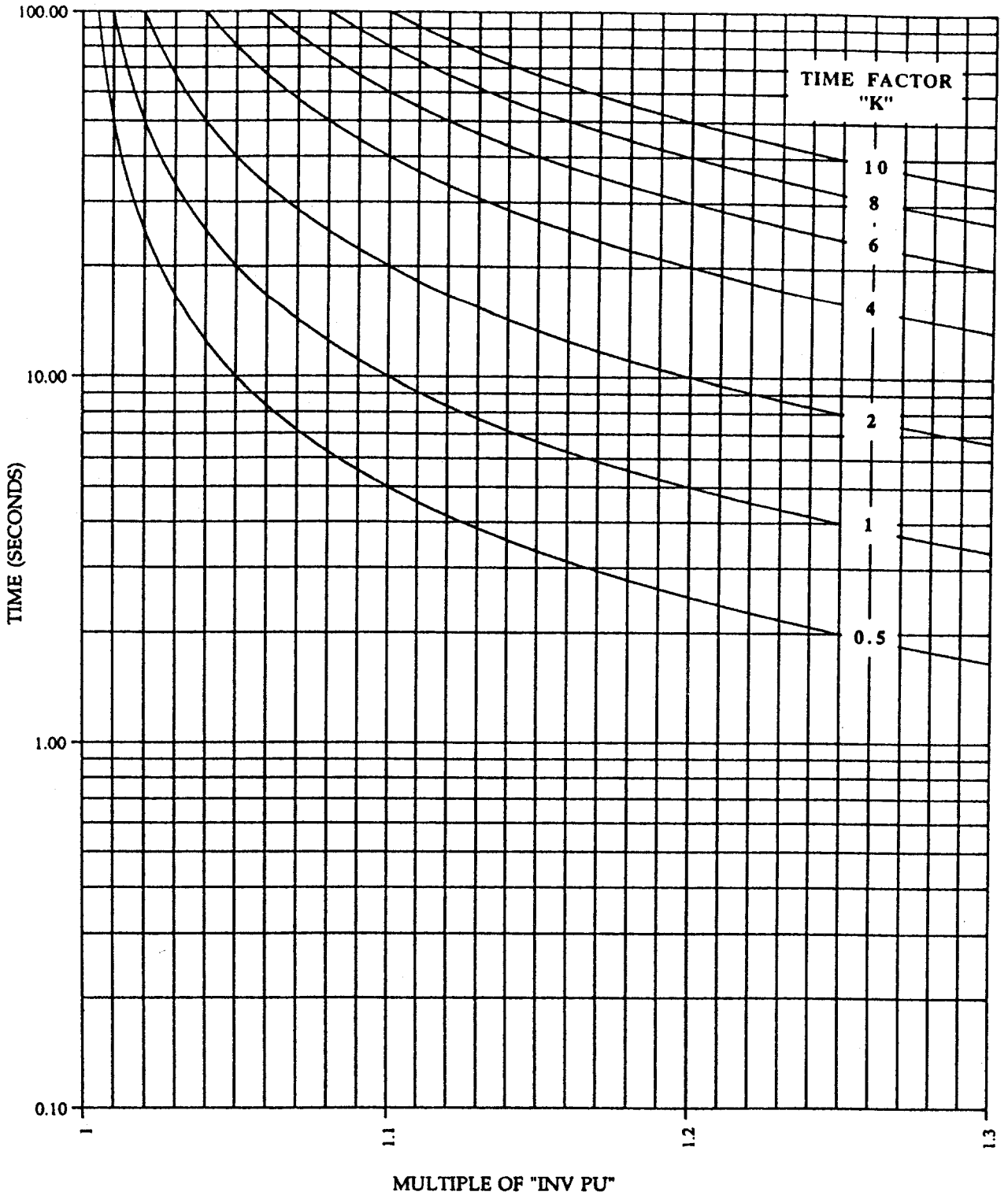


Figure CS-13 (0286A4994) Time Characteristics of Function **24T (CURVE 2)**

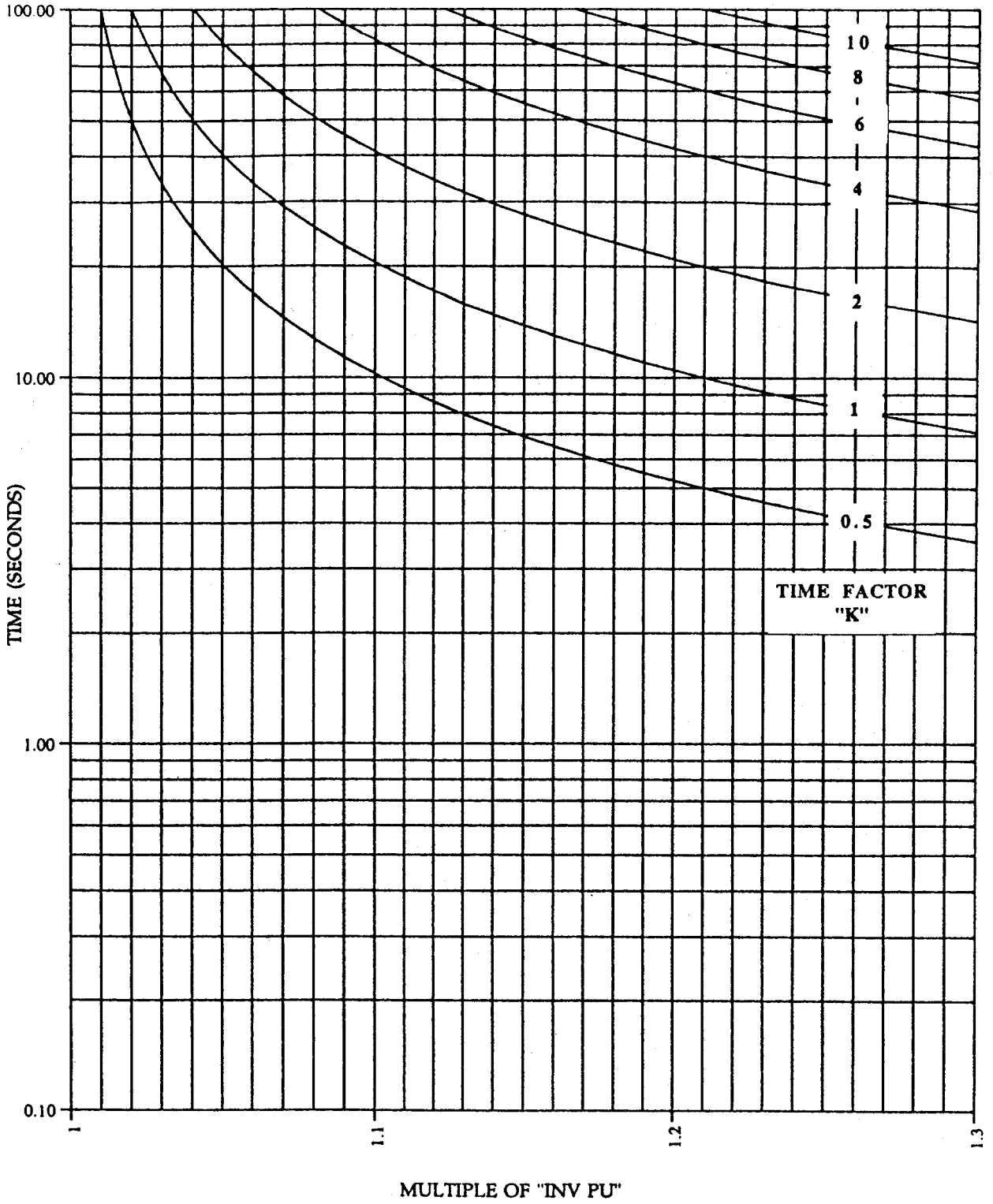


Figure CS-14 (0286A4995) Time Characteristics of Function **24T (CURVE 3)**

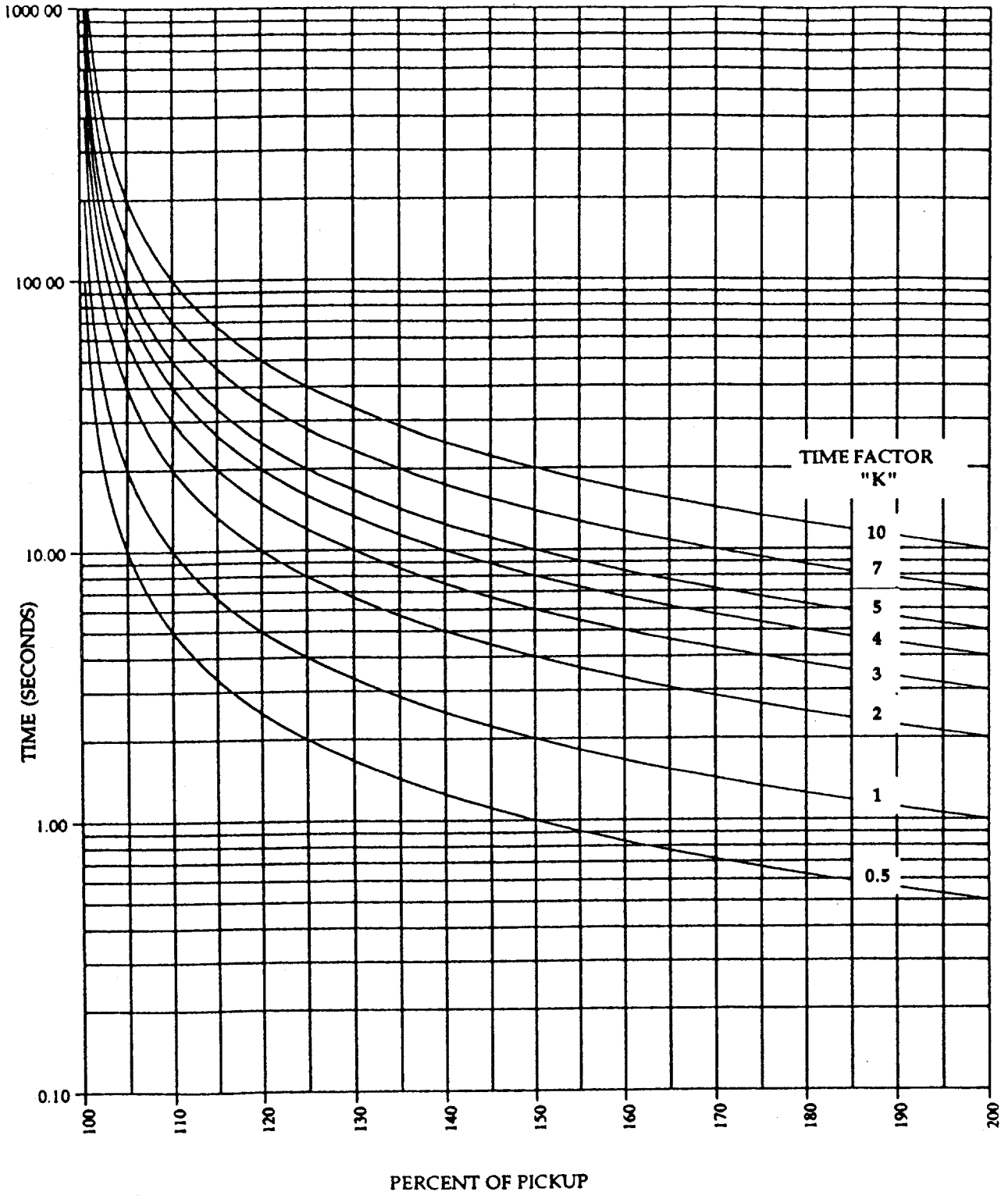


Figure CS-15 (0286A4996 [1]) Time Voltage Characteristics of Function **59**

TABLE CS-4: SETTINGS - DGP PROTECTION SYSTEM
(Page 1 of 4)

SETT#		DESCRIPTION	SETTING
Configuration settings, CONFIG			
101	**UNITID**	-Unit ID number	
102	**SYSFREQ**	-System Frequency	_____Hz
103	**SEL TVM**	-Select Trip Voltage Monitoring	_____
104	**SEL TCM**	-Select Trip Current Monitoring	_____
105	**SELPRIM**	-Select Primary/Secondary units	_____
106	**CT RATIO**	-Current Transformer Ratio	_____
107	**VT RATIO**	-Voltage Transformer Ratio	_____
108	**COMMPORT**	-Communications Port	_____
109	**PHASE**	-Phase Rotation	_____
110	**TIMESYNC**	-Time Synchronizing source	_____
111	**NUM FLTS**	-Number of Fault events stored	_____
112	**PREFLT**	-Number of Prefault cycles stored	_____Cycles
113	**OSC TRIG**	-External Oscillography Trigger	_____
114	**NOM VOLT**	-Nominal Voltage of generator	_____Volt
115	**RATEDCUR**	-Rated Current of generator	_____Amp
116	**VT CONN**	-Type of VT connection	_____
Stator Differential: 87G			
201	**TRIP**	-Configure trip outputs	_____
202	**ALARM**	-Configure alarm outputs	_____
203	**K1**	-K factor	_____%
204	**PICKUP**	-Pickup level	_____Amp
Current Unbalance -Alarm: 46A			
301	**ALARM**	-Configure alarm outputs	_____
302	**PICKUP**	-Pickup current (Negative sequence)	_____Amp
303	**TL14**	-Timer TL14 setting	_____Sec
Current Unbalance - Trip: 46T			
401	**TRIP**	-Configure trip outputs	_____
402	**ALARM**	-Configure alarm outputs	_____
403	**PICKUP**	-Pickup current (Negative sequence)	_____Amp
404	**K2**	-K factor	_____Sec
Loss of excitation supervision: 40			
501	**SELV2SUP**	-Select V2 supervision of 40	_____
Loss of excitation Zone 1: 40-1			
601	**TRIP**	-Configure trip outputs	_____
602	**ALARM**	-Configure alarm outputs	_____
603	**CENTER**	-Center of characteristic	_____Ohm
604	**RADIUS**	-Radius of characteristic	_____Ohm
605	**TL12**	-Timer TL12 setting	_____Sec

TABLE CS-4: SETTINGS - DGP PROTECTION SYSTEM
(Page 2 of 4)

SETT#		DESCRIPTION	SETTING
Loss of excitation Zone 2: 40-2			
701	**TRIP**	-Configure trip outputs	_____
702	**ALARM**	-Configure alarm outputs	_____
703	**CENTER**	-Center of characteristic	_____Ohm
704	**RADIUS**	-Radius of characteristic	_____Ohm
705	**TL13**	-Timer TL13 setting	_____Sec
Anti-Motoring: 32-1			
801	**TRIP**	-Configure trip outputs	_____
802	**ALARM**	-Configure alarm outputs	_____
803	**SQ TR EN**	-Enable sequential trip	_____
804	**REV PWR**	-Reverse power pickup	_____Watt
805	**TL1**	-Timer TL1 setting	_____Sec
Anti-Motoring: 32-2			
901	**TRIP**	-Configure trip outputs	_____
902	**ALARM**	-Configure alarm outputs	_____
903	**REV PWR**	-Reverse power pickup	_____Watt
904	**TL2**	-Timer TL2 setting	_____Sec
Overcurrent with voltage restraint: 51V			
1001	**TRIP**	-Configure trip outputs	_____
1002	**ALARM**	-Configure alarm outputs	_____
1003	**PICKUP**	-Pickup current	_____Amp
1004	**TIME FAC**	-Time factor	_____Sec
Stator ground -Zone 1: 64G1			
1101	**TRIP**	-Configure trip outputs	_____
1102	**ALARM**	-Configure alarm outputs	_____
1103	**PICKUP**	-Pickup voltage	_____Volt
1104	**TL4**	-Timer TL4 setting	_____Sec
Stator ground -Zone 2: 64G2			
1201	**TRIP**	-Configure trip outputs	_____
1202	**ALARM**	-Configure alarm outputs	_____
1203	**TL5**	-Timer TL5 setting	_____Sec
Overexcitation -Alarm: 24A			
1301	**ALARM**	-Configure alarm outputs	
1302	**PICKUP**	-Pickup (V/Hz)	_____Per Unit
1303	**TL6**	-Timer TL6 setting	_____Sec

TABLE CS-4: SETTINGS - DGP PROTECTION SYSTEM
(Page 3 of 4)

SETT#		DESCRIPTION	SETTING
Overexcitation -Trip: 24T			
1401	**TRIP ON**	-Configure trip outputs (on-line)	_____
1402	**TRIP OFF**	-Configure trip outputs (off-line)	_____
1403	**ALARM**	-Configure alarm outputs	_____
1404	**CURVE #**	-Curve number (Inverse characteristic)	_____
1405	**INV PU**	-Pickup -V/Hz (Inverse characteristic)	_____ Per Unit
1406	**TIME FAC**	-Time factor	_____ Sec
1407	**INST PU**	-Pickup -V/Hz (Instantaneous)	_____ Per Unit
1408	**TL7**	-Timer TL7 setting	_____ Sec
1409	**RESET**	-Reset time	_____ Sec
Overvoltage: 59			
1501	**TRIP**	-Configure trip outputs	_____
1502	**ALARM**	-Configure alarm outputs	_____
1503	**PICKUP**	-Pickup voltage (Positive sequence)	_____ Volt
1504	**TIME FAC**	-Time factor	_____ Sec
Over/under frequency voltage cutoff:			
1601	**UVCUTOFF**	Undervoltage cutoff level	_____ %
Underfrequency set point 1: 81-1U			
1701	**TRIP**	-Configure trip outputs	_____
1702	**ALARM**	-Configure alarm outputs	_____
1703	**SET PNT**	-Set point	_____ Hz
1704	**TL8**	-Timer TL8 setting	_____ Sec
Underfrequency set point 2: 81-2U			
1801	**TRIP**	-Configure trip outputs	_____
1802	**ALARM**	-Configure alarm outputs	_____
1803	**SET PNT**	-Set point	_____ Hz
1804	**TL9**	-Timer TL9 setting	_____ Sec
Underfrequency set point 3: 81-3U			
1901	**TRIP**	-Configure trip outputs	_____
1902	**ALARM**	-Configure alarm outputs	_____
1903	**SET PNT**	-Set point	_____ Hz
1904	**TL10**	-Timer TL10 setting	_____ Sec
Underfrequency set point 4: 81-4U			
2001	**TRIP**	-Configure trip outputs	_____
2002	**ALARM**	-Configure alarm outputs	_____
2003	**SET PNT**	-Set point	_____ Hz
2004	**TL11**	-Timer TL11 setting	_____ Sec
Overfrequency set point 1: 81-1O			
2101	**TRIP**	-Configure trip outputs	_____
2102	**ALARM**	-Configure alarm outputs	_____
2103	**SET PNT**	-Set point	_____ Hz
2104	**TL15**	-Timer TL15 setting	_____ Sec

TABLE CS-4: SETTINGS - DGP PROTECTION SYSTEM
(Page 4 of 4)

SETT#		DESCRIPTION	SETTING
Overfrequency set point 2:		**81-2O**	
2201	**TRIP**	-Configure trip outputs	_____
2202	**ALARM**	-Configure alarm outputs	_____
2203	**SET PNT**	-Set point	_____ Hz
2204	**TL16**	-Timer TL16 setting	_____ Sec
Overfrequency set point 3:		**81-3O**	
2301	**TRIP**	-Configure trip outputs	_____
2302	**ALARM**	-Configure alarm outputs	_____
2303	**SET PNT**	-Set point	_____ Hz
2304	**TL17**	-Timer TL17 setting	_____ Sec
Overfrequency set point 4:		**81-4O**	
2401	**TRIP**	-Configure trip outputs	_____
2402	**ALARM**	-Configure alarm outputs	_____
2403	**SET PNT**	-Set point	_____ Hz
2404	**TL18**	-Timer TL18 setting	_____ Sec
Digital Input: DIG INP			
2501	**SELBKDI1**	-Select blocking action by input DI1	_____
2502	**DI3 TRIP**	-Configure trip outputs	_____
2503	**DI3 ALRM**	-Configure alarm outputs	_____
2504	**DI4 TRIP**	-Configure trip outputs	_____
2505	**DI4 ALRM**	-Configure alarm outputs	_____
Voltage Transformer Fuse Failure: VTFF			
2601	**VTFF**	-Enable/Disable VTFF	_____
ACCIDENTAL ENERGIZATION: AE			
2701	**TRIP**	-Configure trip outputs	_____
2702	**ALARM**	-Configure alarm outputs	_____
2703	**AE ARM**	-Arming logic, Accidental Energization	_____

HARDWARE DESCRIPTION

CAUTION

Power down the relay by removing at least one of the connection plugs before removing or inserting modules. Failure to do so can permanently damage the relay.

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 DGP 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 MO-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.

Two connectors, PL1 and PL2, are used for serial communication between the DGP and the PC/Modem and printer, respectively. PL3 is a BNC connector, used for an unmodulated IRIG B input.

PRINTED-CIRCUIT-BOARD MODULES

CAUTION

This relay contains electronic components that could be damaged by electrostatic discharge currents if those currents flow through certain terminals of the components. The main source of electrostatic discharge currents is the human body, and the conditions of low humidity, carpeted floors and isolating shoes are conducive to the generation of electrostatic discharge currents. Where these conditions exist, care should be exercised when removing and handling the modules 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.

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.

XTM TEST PLUGS

Description

The XTM test plugs are designed specifically for post-installation testing of the DGP system. As many as four plugs can be used at one time; two XTM28L1 (left-hand plugs) and two XTM28R1 (right-hand plugs), each providing access to fourteen relay-side and fourteen system-side points. The system-side points are designated "S" and the relay-side points are designated "R". The plugs are keyed by the contact finger arrangement so that there may be no accidental interchange between the left-hand and right-hand plugs.

The plugs are fitted with a sliding handle that swings out to facilitate wiring to the terminals. The terminals consist of number 8 screws threaded into flat contact plates. The handles each have a tab on the outside edge to guide the wire dress of the test leads.

CAUTION

Not all external connections to the DGP are wired through the test receptacle.

Terminal Designation

The test receptacle and connection plugs are located on the lower unit to the extreme left and right-hand positions. The left hand plugs are labeled as TP1 with terminals 1 through 28. The right hand plugs are labeled TP2 with terminals 1 through 28. These points are designated on the elementary diagrams as TP1-1 (See Figures PD-6 and 7 in the **PRODUCT DESCRIPTION** section.

The left-hand test plug (XTM28L1) terminals are labeled 1R through 14R and 1S through 14S for the relay side and system side, respectively, with the system side labeled in red. Similarly, the right-hand test plug (XTM28R1) terminals are labeled 15R through 28R and 15S through 28S.

XTM Test-Circuit Connections

Test-circuit connections, designated as TP points in the elementary diagrams, should be made to the relay side of the test plug. Where it is desired to use available system quantities for testing, e.g., DC control power, jumpers may be inserted between the corresponding system-side and relay-side test plug terminals. Appropriate precautions should be taken when working with station battery DC.

Connections should be made to the test plugs **prior to insertion** into the DGP.

Test Plug Insertion

To remove power from the relay, remove at least one of the connection plugs (see Figure MO-1).

To insert the test plugs, the two connection plugs must first be removed. In so doing, electrical continuity is broken between the power system and the DGP for those signals that are wired through the test receptacle (refer to TP points on the elementary diagram, Figures PD-6 & 7 in the **PRODUCT DESCRIPTION** section). For the terminals connected to the current-transformer secondaries, shorting bars are included on the system side of the test receptacle. These are clearly visible through the transparent plastic face plate on the receptacle. The shorting bars make contact before the connection-plug contacts break during removal, so that the CT secondaries are never open-circuited.

Four test plugs may be inserted at the same time giving access to all 56 terminals simultaneously. Otherwise, if using fewer than four test plugs, the remaining connection plugs may remain in the other receptacles.

When the test plugs are inserted into the receptacle, parts of the power system become isolated from the DGP. Refer to the elementary diagram for the TP points associated with each of the test plugs.

WARNING

IT IS CRITICAL THAT JUMPERS BE INSERTED ON THE SYSTEM-SIDE TEST PLUG TERMINALS THAT ARE CONNECTED TO THE CT SECONDARIES, AS SHOWN IN FIGURE PD-6. IF THESE JUMPERS ARE LEFT OUT, THE RESULTING HIGH VOLTAGES DEVELOPED PRESENT A SERIOUS HAZARD TO PERSONNEL AND MAY SEVERELY DAMAGE EQUIPMENT.

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 DGP case has been designed for standard rack mounting. The case measures eight rack units (8 RU) in height. Refer to Figure HD-1 for the outline and mounting dimensions.

External Connections

External connections are made according to the elementary diagram, Figure PD-4 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.

External Connections Test

WARNING

THE DGP SHOULD BE DISABLED TO PREVENT TRIPPING OF THE CIRCUIT BREAKERS UNTIL IT HAS BEEN DETERMINED THAT THE UNIT IS CONNECTED PROPERLY. THIS CAN BE DONE IN TWO WAYS. ONE IS TO DE-ENERGIZE THE TRIP CIRCUIT CONNECTED TO THE RELAY; THE OTHER IS TO DISABLE THE DGP OUTPUTS BY SETTING THE "DISABLE OUTPUTS" FUNCTION TO "YES" PRIOR TO INSTALLATION.

An overall check of current transformer polarities, potential transformer polarities, and connections to the DGP relay, can be made prior to placing the DGP in service, by using the system voltages and load current while monitoring the MMI display for the Present Values of the DGP. Obtaining the present values of the DGP can be done in two ways. One is to access the INF category on the MMI keypad. Once the INF category is chosen use the UP-ARROW key to select the PRESENT VALUES menu. Scrolling through the present values will allow you to determine if the relay is wired correctly. Another method for finding the present values is to press the CLR key on the MMI and allow the DGP to automatically scroll through the present values.

SURGE GROUND CONNECTIONS

CAUTION

Terminal BH14 must be tied to station ground, as shown in the elementary diagram Figures PD-6 & 7. The connection to the ground bus must be made as short as possible, using No.12 wire or larger.

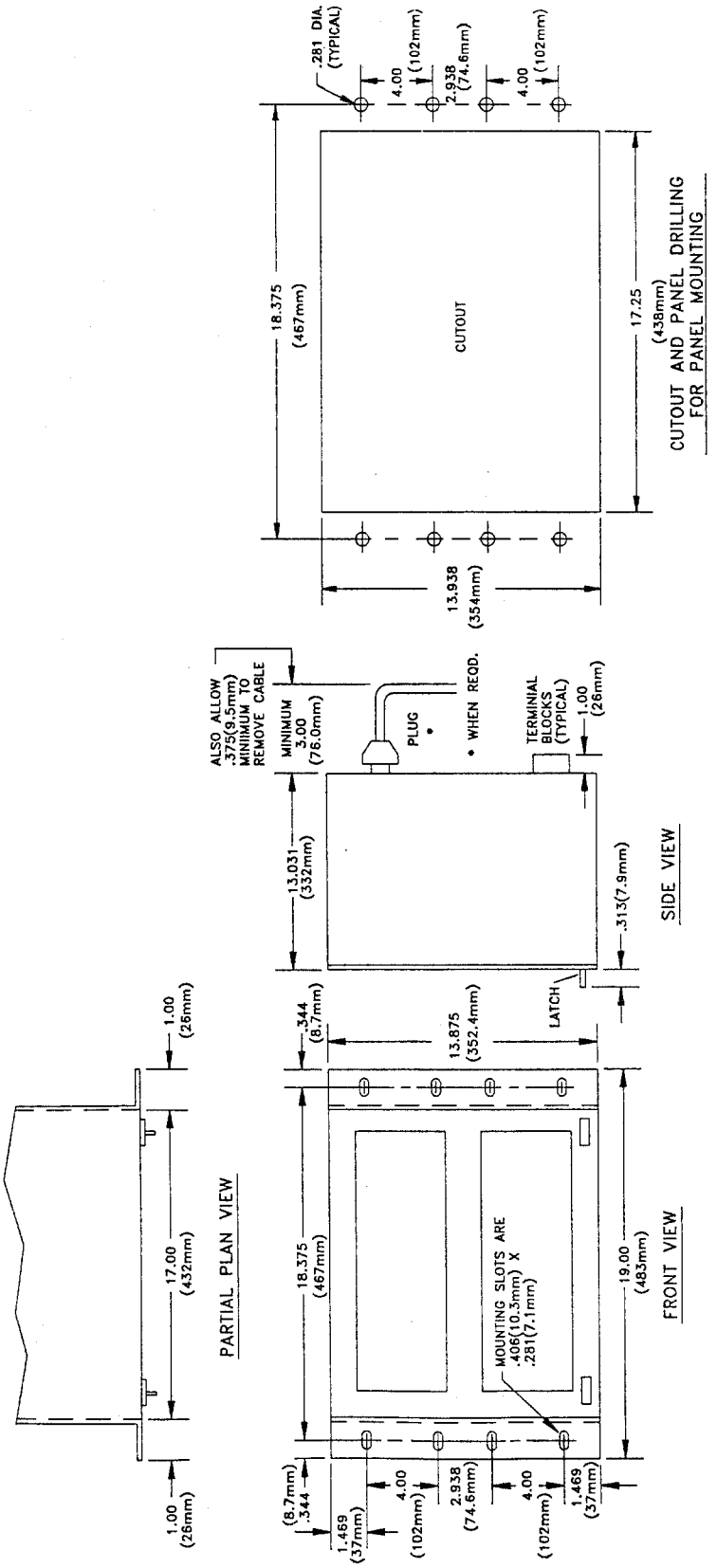


Figure HD-1 (0215B8477) DGP Outline drawing

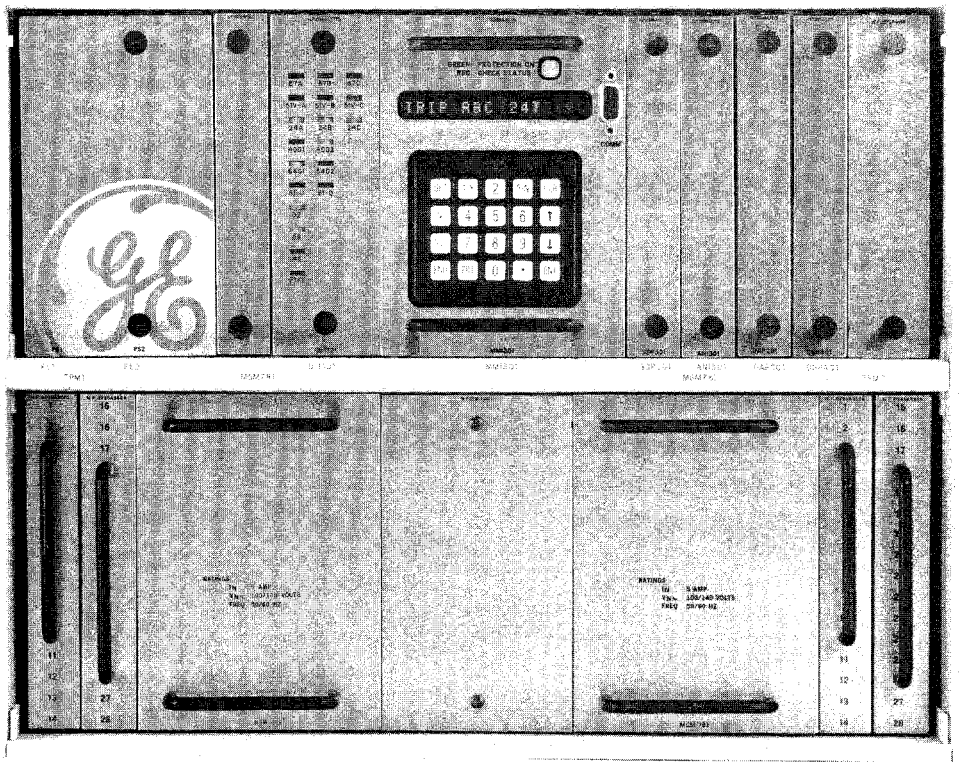


Figure HD-2 (8919546) DGP Relaying System (front view)

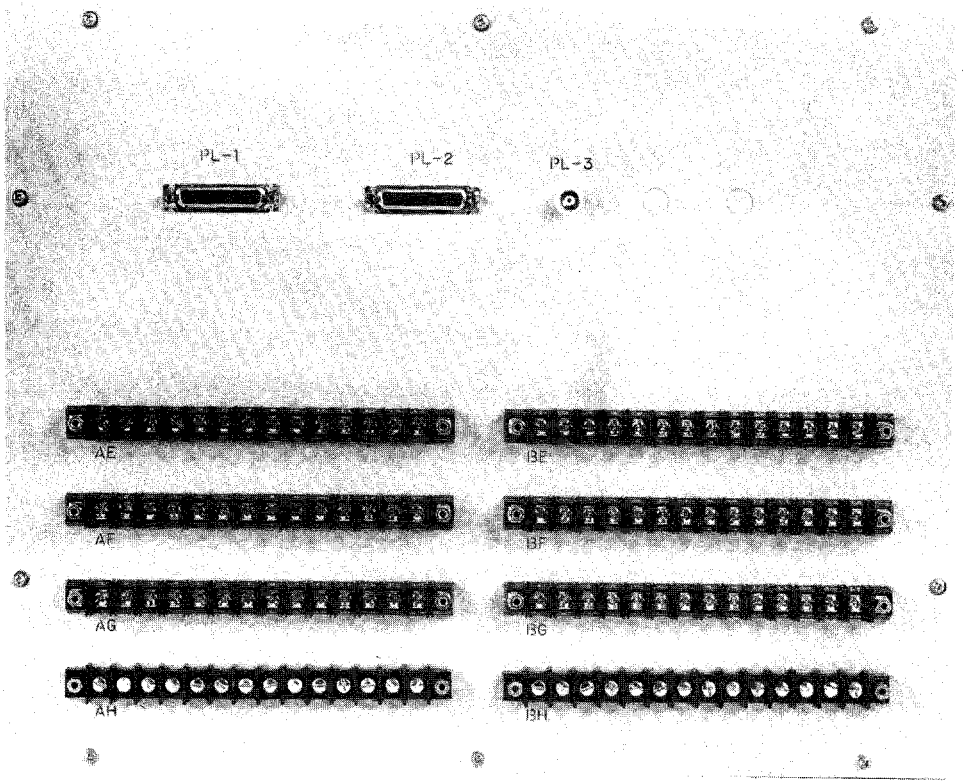
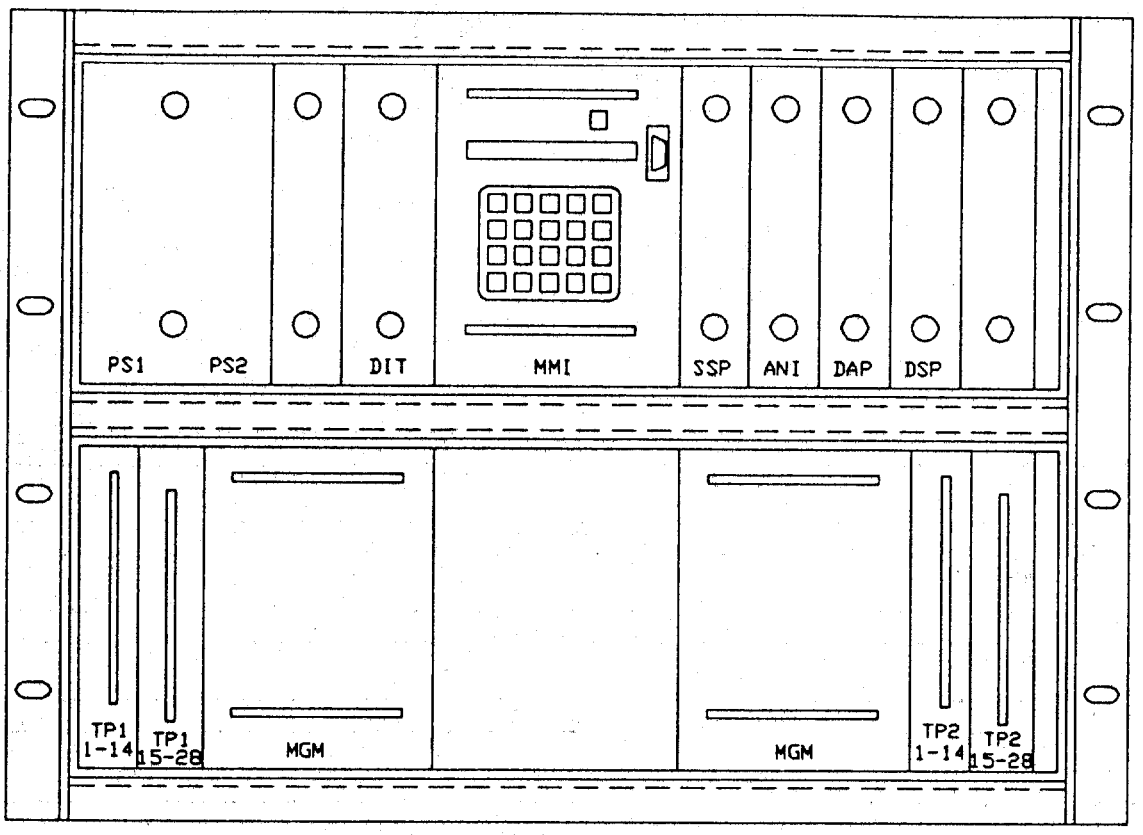


Figure HD-3 (8919547) DGP Relaying System (rear view)

MODULES

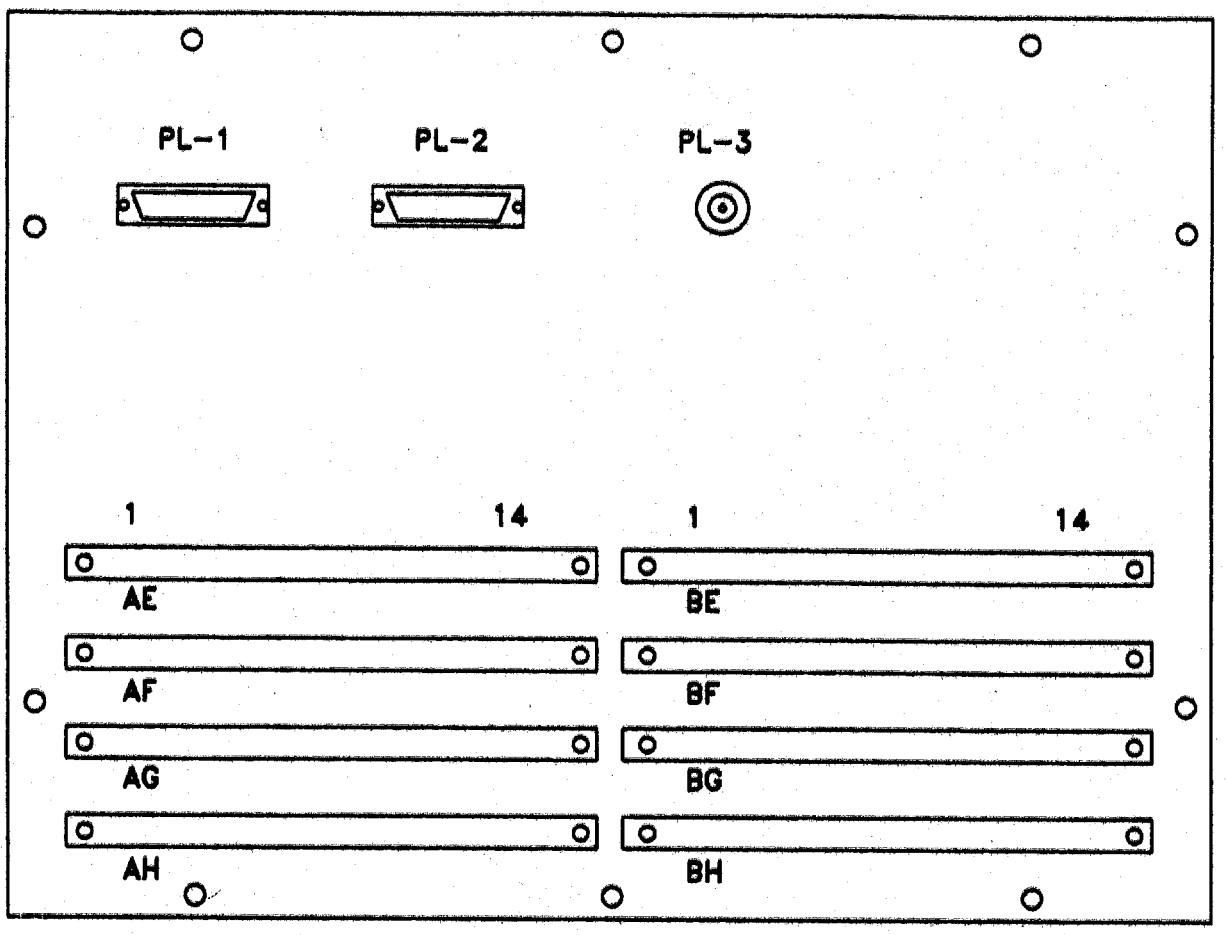
CAUTION

Power Down the relay by removing the test plugs before removing or inserting modules. Failure to do so can permanently damage the relay.



Note: TP1 and TP2 use interlocking connection plugs TPL. The interlock prevents the left plug (test points 1-14) from removal unless the right plug (test points 15-28) is out.

Figure MO-1 (0286A4911 Sh.6) Module Location



BACK VIEW

Figure MO-2 (0286A4911 Sh.7 [2]) Rear View of Relay

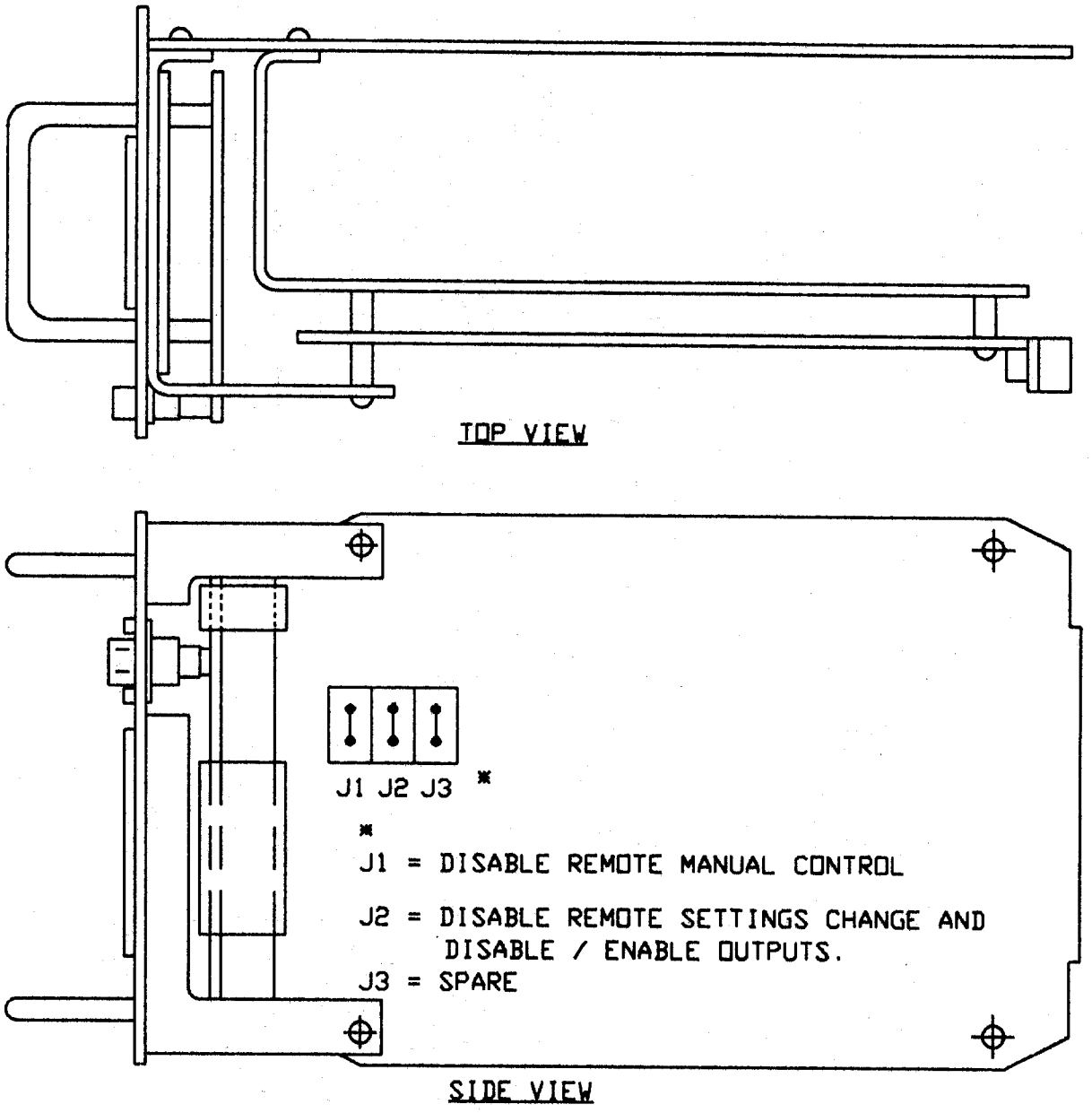


Figure MO-3 (0286A4911 Sh.8) MMI Module

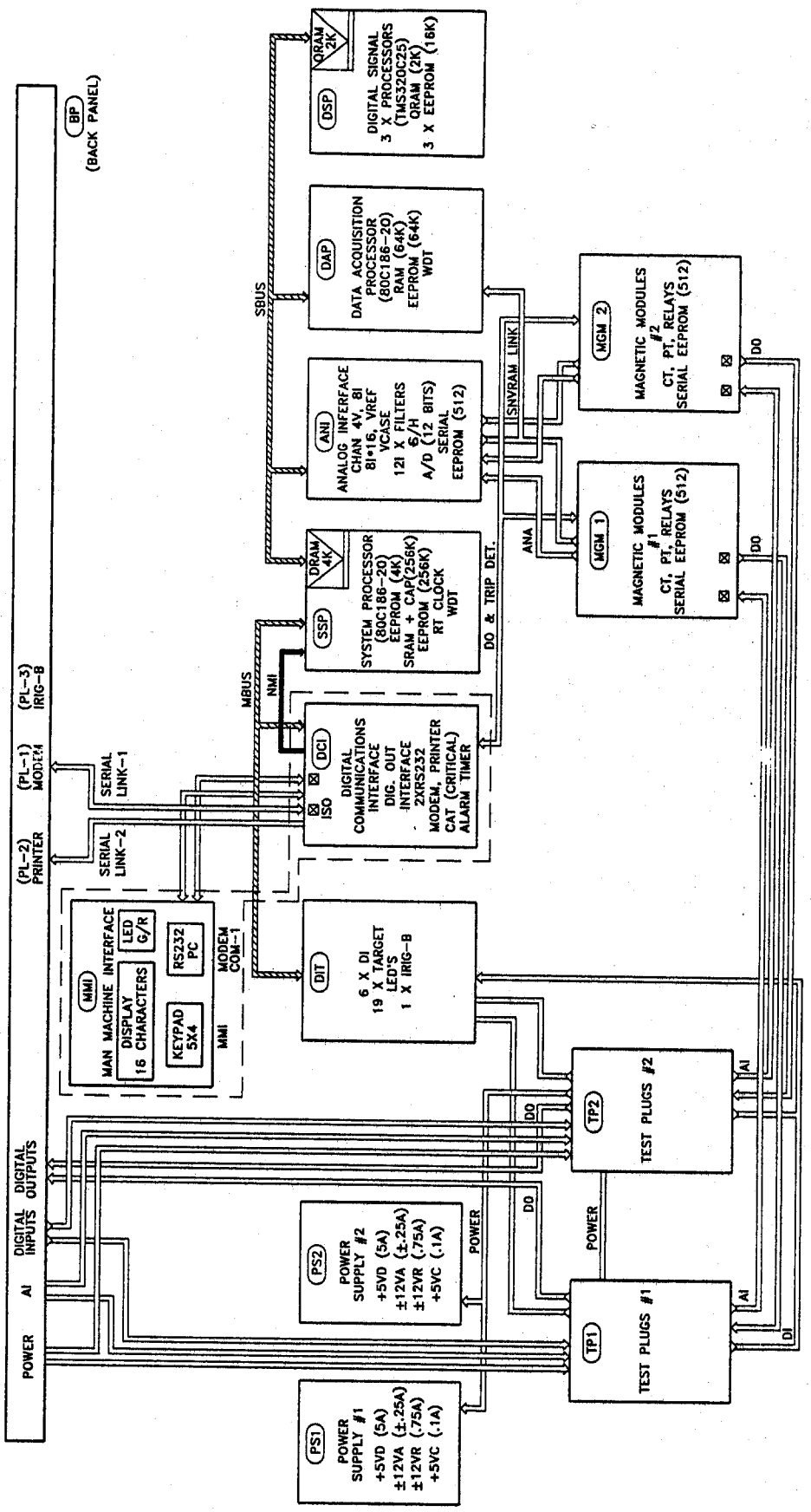


Figure MO-4 (0215B8476) DGP Overall Block Diagram

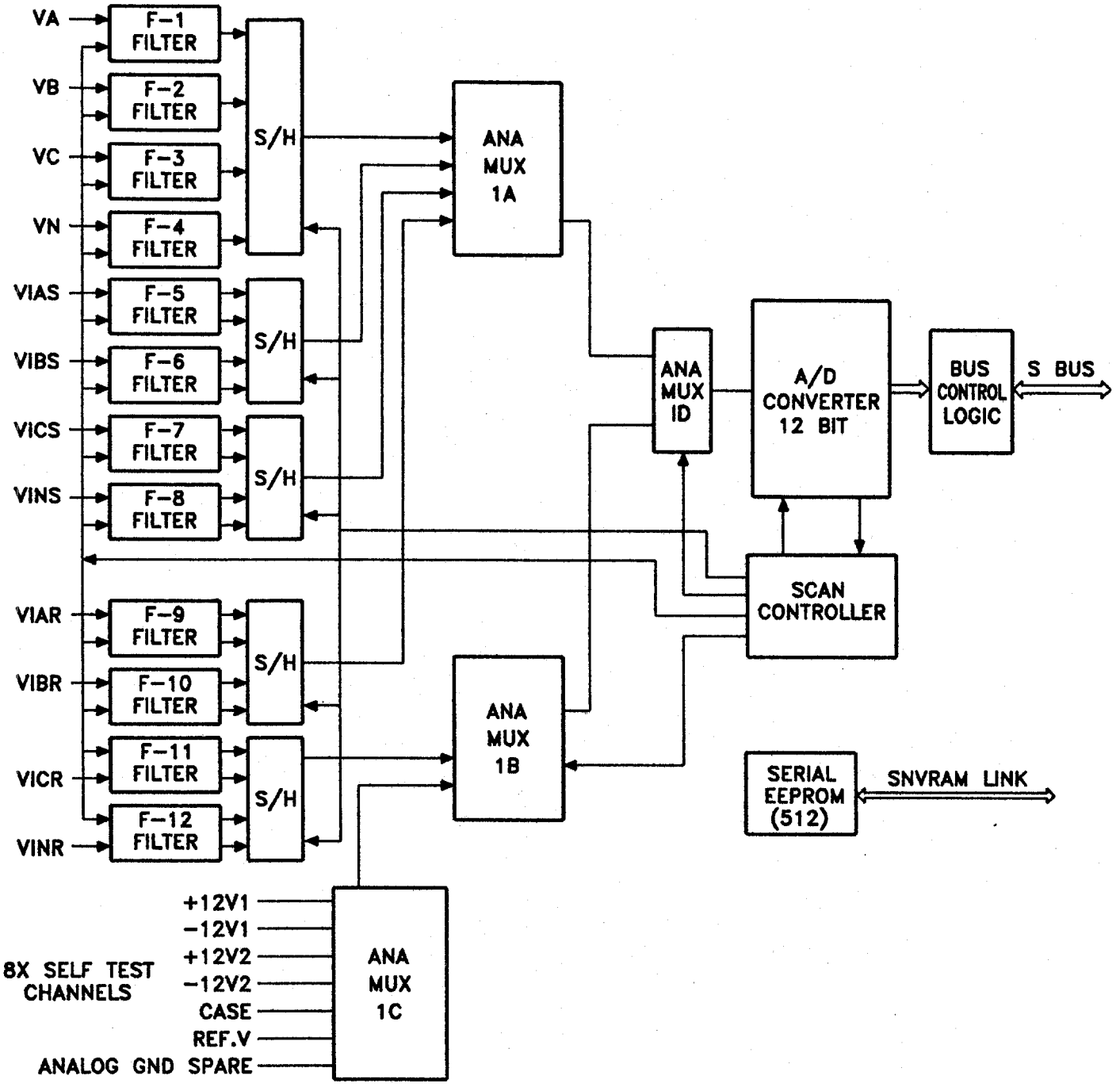


Figure MO-5 (0286A4911 Sh.3) ANI Block Diagram

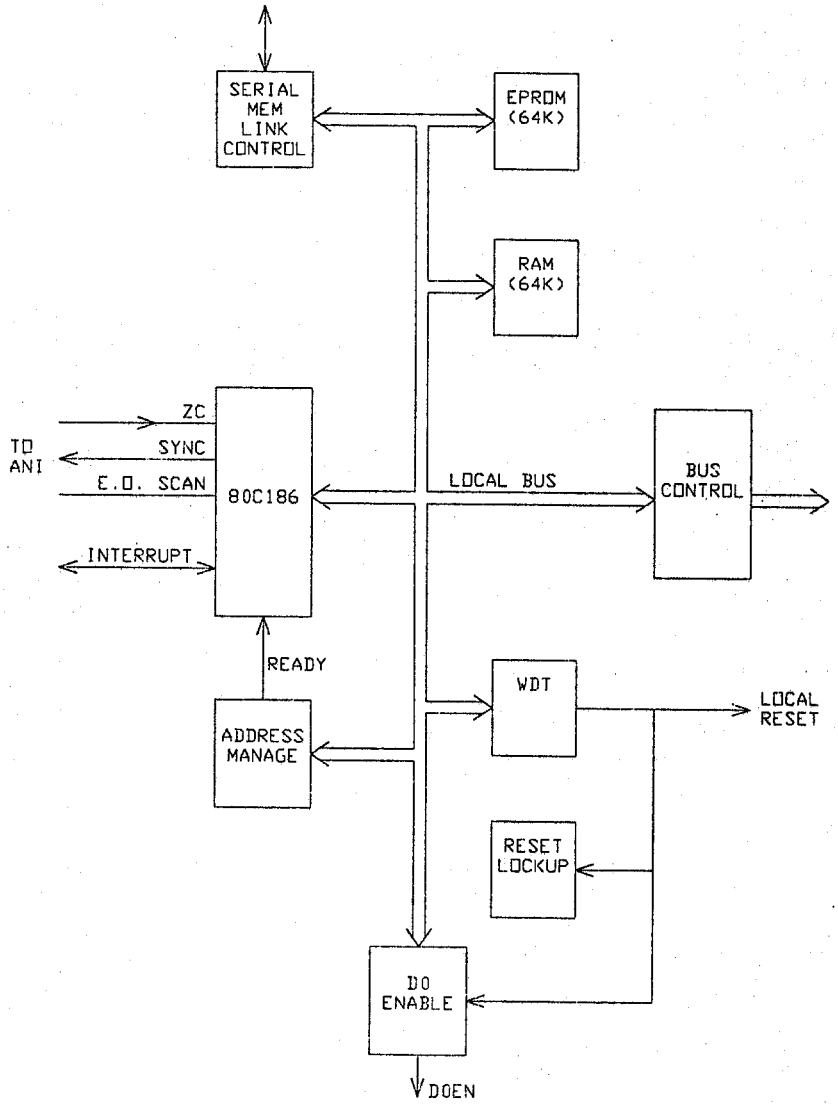


Figure MO-6 (0179C8291 Sh.3) DAP Block Diagram

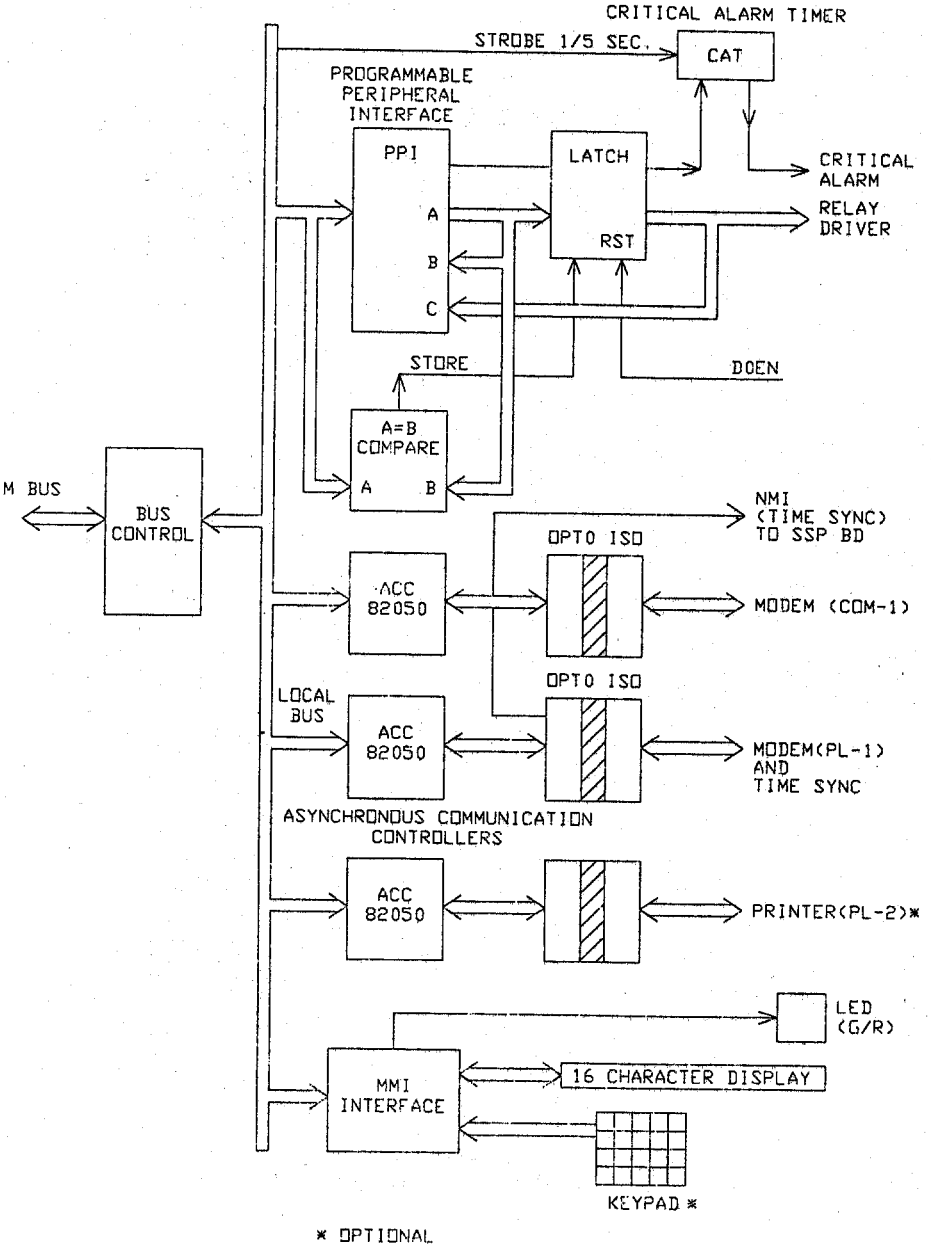


Figure MO-7 (0179C8291 Sh.2) DCI and MMI Block Diagram

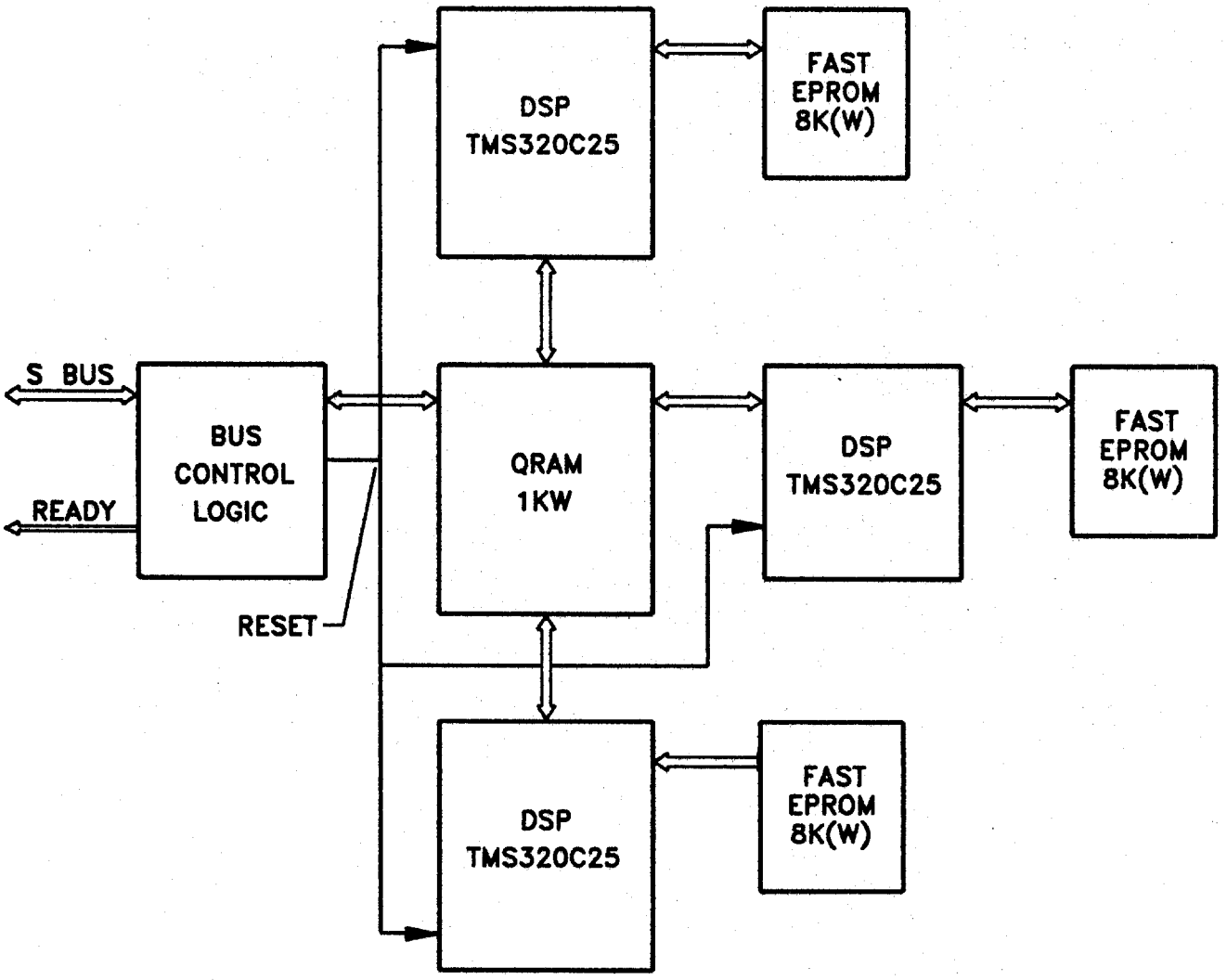


Figure MO-8 (0286A4911 Sh.1 [1]) DSP Block Diagram

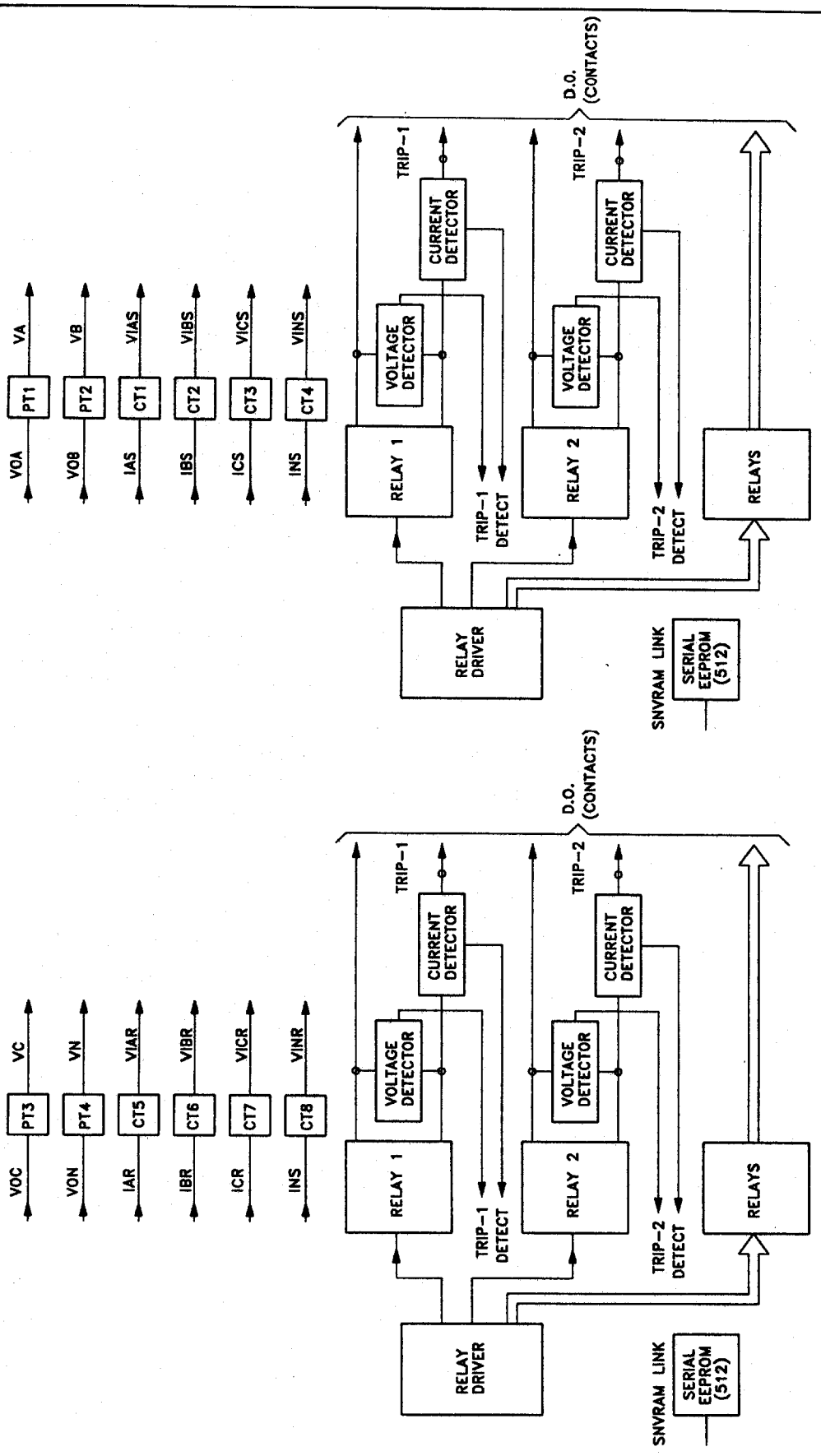


Figure MO-9 (0286A4911 Sh.4 and 5) MGM Block Diagram

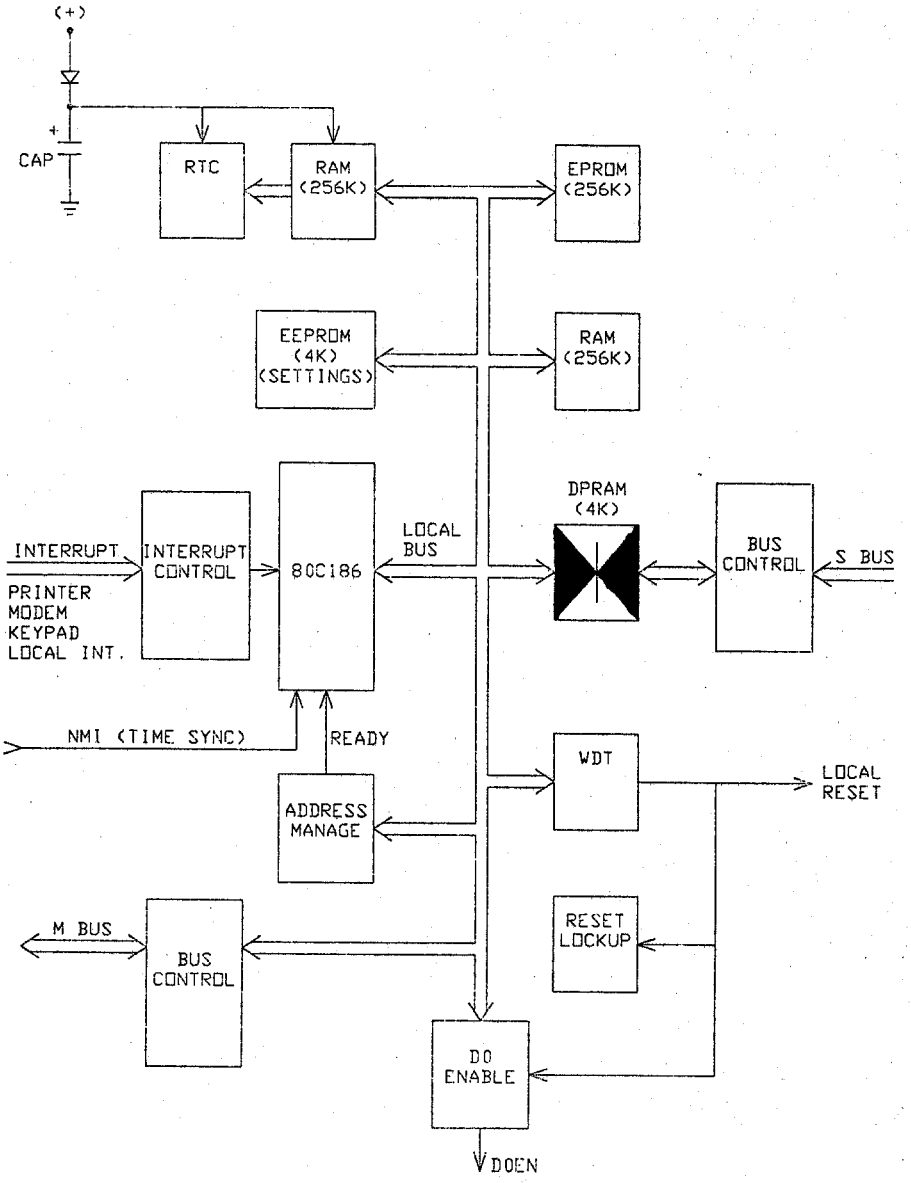


Figure MO-10 (0179C8291 Sh.4) SSP Block Diagram

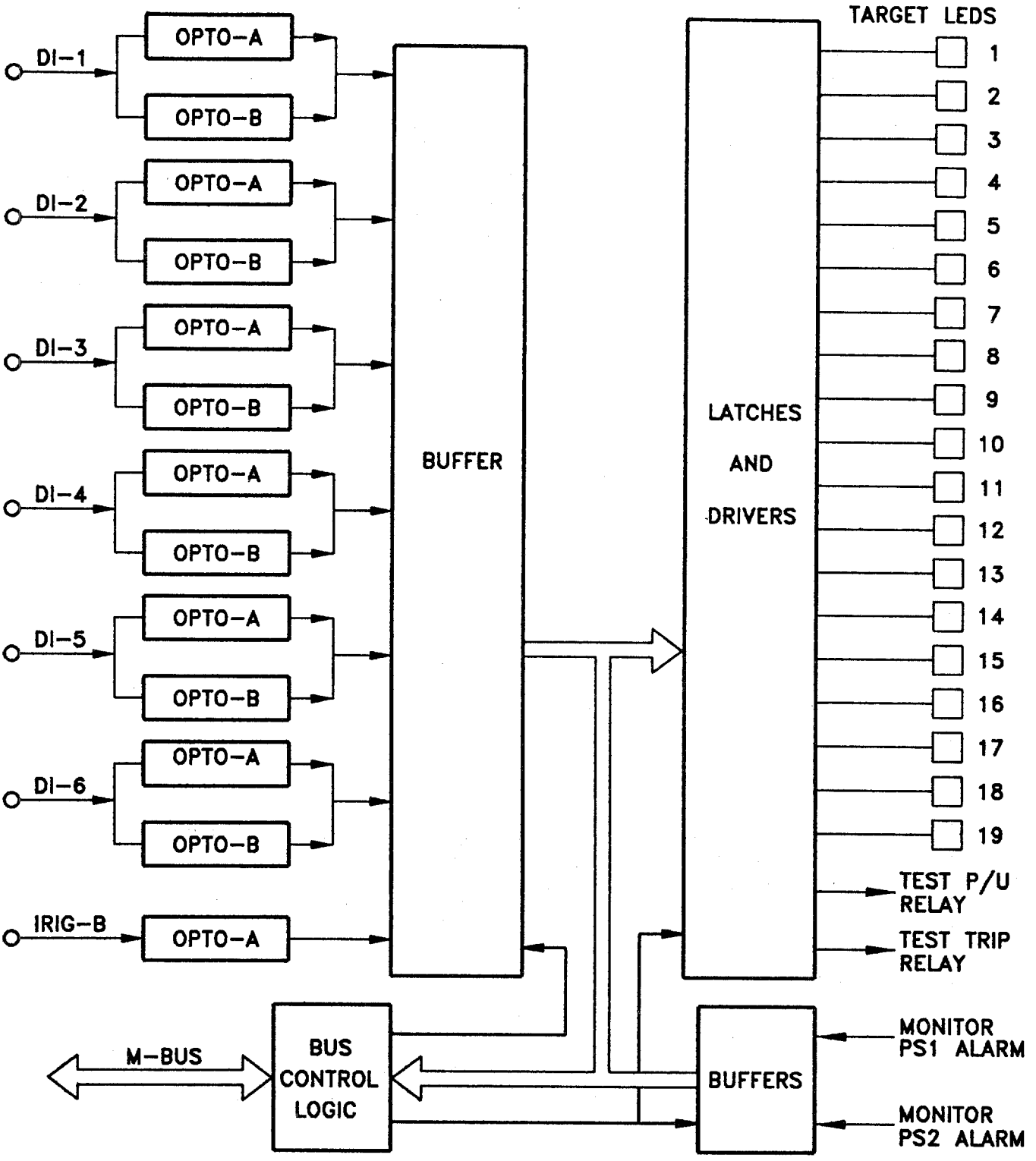


Figure MO-11 (0286A4911 Sh.2) DIT Block Diagram

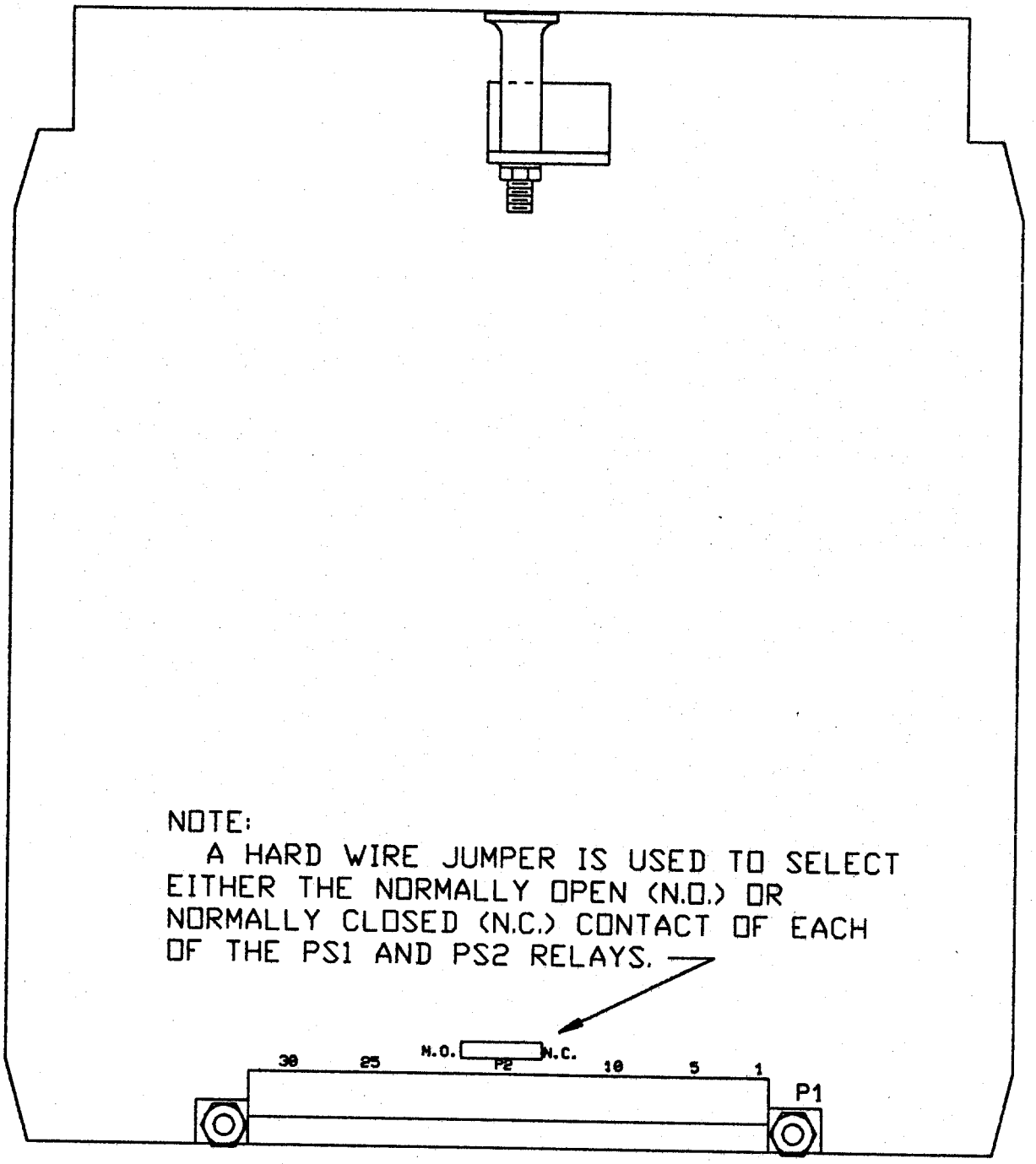


Figure MO-12 (0286A4911 Sh.10) Power Supply Module

ACCEPTANCE TESTS

CAUTION

Power Down the relay by removing a connecting plug before removing or inserting modules. Failure to do so can permanently damage the relay.

GENERAL

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

The following tests include: Relay status self test and display and MMI self test. Tests of the protection functions and measuring accuracy are also included and can be performed at the user's discretion.

General Tests

T1	MMI Status and Display Tests (Self Tests)
T2	Digital Output Tests
T3	Digital Input Tests
T4	AC System Input Test

Protection Functions

T5	Generator Differential, 87G
T6	Current Unbalance Alarm, 46A
T7	Current Unbalance Trip, 46T
T8	Loss of Excitation, 40-1
T9	Loss of Excitation, 40-2
T10	Anti-Motoring, 32-1
T11	Anti-Motoring, 32-2
T12	Time Overcurrent with Voltage Restraint, 51V
T13	Stator Ground Zone1, 64G1
T14	Stator Ground Zone2, 64G2
T15	Overexcitation (Volts/Hz) Alarm, 24A
T16	Overexcitation (Volts/Hz) Trip, 24T
T17	Overvoltage, 59
T18	Underfrequency, 81-1U
T19	Underfrequency, 81-2U
T20	Underfrequency, 81-3U
T21	Underfrequency, 81-4U
T22	Overfrequency, 81-1O
T23	Overfrequency, 81-2O
T24	Overfrequency, 81-3O
T25	Overfrequency, 81-4O
T26	Voltage Transformer Fuse Failure

TEST EQUIPMENT

1. Three-phase source of voltage and current operating from 30 - 80 Hz, with capability to add 3rd harmonic voltage to the fundamental
2. DC Control voltage source
3. Three AC voltmeters
4. Three AC ammeters
5. A continuity tester or Ohm meter
6. An-IBM compatible computer with a serial and mouse port
7. An RS232 null modem cable to connect the PC to the DGP
8. A Precision Timer for testing timed events.

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

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** (PD), and the **CALCULATION OF SETTINGS** (CS) sections.

Drawings:

1. The Elementary Diagram
2. The Logic Diagrams

References:

1. **SOFTWARE** section of this manual
2. Default Relay Settings

EQUIPMENT GROUNDING

All equipment used in testing the DGP relay should be connected to a common grounding point, to provide noise immunity. This includes the voltage and current sources, as well as the DGP itself. The common for surge protection is terminal BH14.

REQUIRED SETTINGS

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

For periodic testing purposes, see the **PERIODIC TESTS** Section. It provides details on performing the relay test with user-specific settings.

GENERAL INSTRUCTIONS

1. To remove power from the relay, remove at least one of the connection plugs (see Figure MO-1).

2. The DGP is tested in the "test mode" of operation. This mode allows the internal measuring units and functions to be brought out and viewed. The measuring units and functions are actually internal to the software. There are no individual hardware modules that are responsible for the specific measuring functions.

   The test mode selects and isolates various test functions and measuring units, and routes their status to the Digital Output Test Pickup and Test Trip (DOR12 and DOR13) contacts. When the particular function under test has picked up, DOR12 (AF6-AG6) will operate. When the particular function under test has tripped, DOR13 (AF5-AG5) will operate.

   For the remainder of this test DOR12 will be referred to as "test pickup" and DOR13 as "test trip".

CAUTION

The Digital Output contacts will chatter when the unit under test is near its threshold. DO NOT let it continue. Remove the test current. A single contact closure is enough to determine that the unit picked up.

   A continuity tester with high-input impedance, such as a Digital Ohmmeter, should be used to monitor the contacts during the testing of the relay.

   NOTE: SELECTED TRIP AND ALARM CONTACTS WILL OPERATE IN THE TEST MODE.

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 disabled. Also, the currents should always be set at or near zero (0) whenever a current source is powered on or off.

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 alpha numeric 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 facilitate direct access to the setting. This is performed by pressing the [SET] key, the setting number (nnnn), and [ENT]. The new setting may then be entered.

   At the end of testing, make sure that all settings are returned to initial values. Print them out, and verify them, before placing the relay in service. If a printer is not available, scroll through all settings with the MMI Display and verify each one.

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 set point of the Underfrequency Unit #1 to 62.00 Hz.

1. Apply rated DC and wait for relay initialization to complete, as indicated by the green LED on the MMI.

2. Press the [ACT] "action" key. Scroll with the arrow key until "ACT: ENTER PASSWORD" is displayed, then press the [ENT] "enter" key.

If this is the first time the Settings Level functions are used, the password has the factory value "1234.". This password must be changed before any Setting functions can be accessed. See the **INTERFACE** section for information on how to change the password.

3. Enter the current Settings Level password. If the password is not known, see the **INTERFACE** section for information on how it can be viewed.

When the correct password is entered, "SELECTED" is displayed.

4. Press the [SET] "settings" key.

5. Scroll with the arrow key until "SET: 81-1U" is displayed, then press the [ENT] "enter" key.

6. Scroll through the 81-1U settings until you get to "SET PNT = #.#".

7. Type "62.00" 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.

8. When the correct frequency is entered, press the [ENT] "enter" key. The typed inputs will now be shown on the MMI display at full intensity. This represents that the change is entered into the settings buffer, but not permanently changed in the relay.

9. To finalize the setting change, press the [END] "end" key followed by the [ENT] "enter" key.

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

10. Restore the SET PNT setting back to its original value before beginning the test. It will be necessary to enter the Settings Level password again.

ENTERING THE TEST MODE

Before each test it is necessary to set the relay in the test mode and select the function to be tested. The test mode is set as follows:

1. Apply rated DC and wait for relay initialization to complete, as indicated by the green LED on the MMI.

2. Press the [ACT] "action" key. Scroll with the arrow key until "ACT: ENTER PASSWORD" is displayed, then press the [ENT] "enter" key.

If this is the first time the Control Level functions are used, the password has the factory value "5678.". This password must be changed before any Control functions can be accessed. See the **INTERFACE** section for information on how to change the password.

3. Enter the current Control Level password. If the password is not known, see the **INTERFACE** section for information on how it can be viewed.

When the correct password is entered, "SELECTED" will be displayed.

4. Press the [ACT] "action" key. Scroll with the arrow key until "ACT: RELAY TEST" is displayed, then press the [ENT] "enter" key.

5. Scroll through the different test mode functions or enter the number of the desired test, such as "5" for the 40-1 then press [ENT]. Pressing [ENT] again causes the MMI to display "40-1 ON", and the MMI LED will turn red, indicating that the relay is in the test mode. When the relay picks up or trips for the selected function it will close the DOR12 or DOR13 contacts, respectively.

EXITING THE TEST MODE

6. While in the "TEST MODE", press the [ACT] "Action" key. Scroll with the arrow key until "ACT: Relay Test" is displayed, then press the [ENT] "Enter" key. Scroll until the display shows "END TST MODE?", or press "1" then [ENT]. Then press the [ENT] key. The MMI LED should return to green, indicating that normal operation has resumed.

USING DGP-LINK (Optional)

To test the relay without using the DGP Keypad, communication with the relay is accomplished via a PC with the program DGP-LINK. DGP-LINK is required to establish communications, change the password, change settings for the tests, and place the unit into test mode. Once in test mode, current and voltages are applied to the relay to simulate the desired system conditions.

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

Hardware Setup

The hardware, specifically the cable to connect your PC to the relay, depends on the connection the PC requires and that of the DGP. The DGP port PL-1 accepts a 25 pin male D-connector. Port COMM accepts a 9 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 DGP with a 9-pin-to-25-pin and a 25-pin-to-25-pin setup.

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

PC Software Setup

The Software setup 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 DGP.

Load & Start DGP-LINK

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

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

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

Set the Local (PC) Configuration

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

Select the **SETUP** heading. Refer to the **SOFTWARE** section for information on how to select items using the keyboard or a mouse.

The SETUP menu will now be displayed.

Select **Communication port number.**

The default communications port will be displayed.

Type in the port number that matches the PC port connected to the DGP.

If port 3 or 4 is selected, the IRQ number must also be selected.

Select "OK" when the port is configured.

Set Up a Test Unit Description

The next step is to create a new "Unit Description" that matches the DGP's baud rate, phone number, and switch code. The DGP is accessed locally during testing, therefore the PHONE NUMBER and the SWITCH CODE will not be set. The BAUD RATE will be set to the factory setting of 2400 with one stop bit and no parity.

Select the **Add relay to list** heading from the **SETUP** menu.

When prompted for the UNIT DESCRIPTION, type "TEST" and select "OK".

A new unit description called "TEST" is created and must now have parameters set for it. The RELAY PARAMETERS menu appears with spaces for PHONE NUMBER, SWITCH CODE, BAUD RATE, STOP BITS, and PARITY.

At the PHONE NUMBER prompt, press [TAB]. (This is the default used when there is no phone.)

At the SWITCH CODE prompt, press [TAB]. (This is the default value for no switch.)

At the BAUD RATE prompt, select "2400" and press [TAB].

At the STOP BITS prompt, select "1" and press [TAB].

At the PARITY prompt, select "None" and press [TAB].

The Unit Description for "TEST" is complete.

Enter "OK" to return to the **SETUP** menu.

Relay Setup

Before shipment, the relay is set with factory default settings. These include the UnitID, the Baud Rate, and the Factory Passwords. The default communications parameters are:

Setting		Default (from the factory)
UNIT ID	0	(CONFIG setting)
VIEW PASSWORD	VIEW!	(Local Communication ACTION)
CONTROL PASSWORD	CTRL!	(Local Communication ACTION)
SETTINGS PASSWORD	SETT!	(Local Communication ACTION)
BAUD RATE	2400	(CONFIG setting)

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

Logging Into the Relay

Select **Login** from the **RELAY FUNCTIONS** menu.

Select the relay login data for "TEST" just created.

DGP-LINK will prompt for a password. If this is the first login to the relay, the passwords are those listed in the table above, and must be changed before any of the relay functions except CHANGE PASSWORD and LOGOUT will operate. See the **SOFTWARE** section of this manual for information on how to change a password.

Type in the current password and press [TAB].

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

DGP-LINK will prompt for the unit ID.

Type in "0" and press [TAB].

Select "OK".

DGP-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 DGP menus.

Select **Logout** from the **RELAY FUNCTIONS** menu and select "OK".

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 DGP **RELAY FUNCTIONS 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 settings changes** from the DGP **RELAY FUNCTIONS Settings** menu after all settings changes for a particular test are completed. This is necessary because settings are stored in a buffer so that they can all be downloaded at once. Selecting **End settings changes** changes the settings in the relay itself.

Entering the Test Mode

Before most tests it is necessary to set the relay in the test mode according to the function to be tested. The test mode is set as follows:

Select **Change access level** from the **RELAY FUNCTIONS** menu.

Enter the Control Access password. If the password is not known, see the **INTERFACE** section for information on how it can be viewed.

When the password is accepted, "CONTROL ACCESS" will appear at the bottom of the screen.

Select **Relay test** from the DGP **Actions** menu.

The Test Mode list box appears.

Select the test you wish to enter from the menu and then select "OK".

The MMI LED will change from green to red when the DGP is in the test mode.

Exiting the Test Mode

The test mode is ended, and the relay protection turned on, by selecting **End test mode** from the Test Mode list box and then selecting "OK". The MMI LED changes from red to green and "Relay Not in Test Mode" will appear at the bottom of the screen, indicating that normal operation has resumed.

INITIAL TEST SETUP

Before beginning the test, the relay settings should be printed for reference and verification. The factory settings are listed in the **CALCULATION OF SETTINGS** section. If no printer is available, scroll through each setting and make sure they all match the default settings listed.

If testing with DGP-LINK, the relay settings should be uploaded from the DGP and printed for reference and verification. Verify that each DGP 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 DGP settings can be saved to a disk file so that they can be reloaded back into the DGP when testing is completed. Use the **Save DGP settings to file** command in the DGP **RELAY FUNCTIONS Settings** menu. DGP-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 RELAY TESTS

NOTE: All Settings or Control changes must have their respective passwords entered before any changes can be made. After all of the settings changes have been entered, the key-sequence, "END" followed by "ENT", must be entered so that the relay can accept and operate with the new settings.

T1 - MMI Status and Display Testing

The Relay's Status is reported through the MMI, the non-critical alarm contact, and the critical alarm contact. If a system error caused relaying functions to cease, the LED on the MMI would turn red, a "FAIL" message would be displayed on the MMI, and the critical alarm relay would de-energize. A failure that did not interrupt relaying would be indicated by energizing the non-critical alarm relay, and by a "WARN" message on the MMI display.

Status Check

This test will demonstrate the use of the MMI to check relay status. See the **SERVICING** section for further information.

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. Enter the "Setting Level" password. Press the [SET] key followed by "103" to change the setting for the trip circuit monitor. For the setting SEL TVM enter "0000".

   NOTE: Press "END" "ENTER" after each setting change.

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

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

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

Warning Status

5. Enter the "Setting Level" password. Press the [SET] key followed by "103" to change the setting for the trip circuit monitor. For the setting SEL TVM enter "1111". When this is done, the relay expects wetting voltage across the trip contacts.

   NOTE: Press "END" "ENTER" after each setting change.

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

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

   The display should be "STATUS: WARN".

8. Scroll with the arrow keys until the heading "94G TRP CIR OPN" is displayed. Continue scrolling through the remaining trip circuit outputs (94G1, 94G2, 94G3). This verifies that the relay detected the absence of wetting voltage across the trip contacts.

9. Enter the "Setting Level" password. Press the [SET] key followed by "103" to change the setting for the trip circuit monitor. For the setting SEL TVM enter "0000".

   NOTE: Press "END" "ENTER" after each setting change.

Display Test

The MMI test is built into the software. It allows the user to test the keypad, the printer, and the display. If no printer is to be used with your relay, then skip the printer port testing.

1. 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.

   If the green LED is on, it will be extinguished and the red LED will be lit. If the red LED is lit, it will be extinguished and the green LED will be lit. The Target LED's will then flash on/off 4 times. Then each Target LED will be lit individually. When the test is over the Target LED's will be returned to their original state.
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.

PRINTER TEST (skip this if you do not have a printer).

10. The display prompt will be "PRINTER TST?". If you do not have a printer, then press the [3/N] followed by the [ENT] key. If you have a printer, press the [1/Y] followed by the [ENT] key.

    The printout will be 40 characters that include the alphabet, the numbers 0 through 9, and the :=/. characters. Forty lines will be printed.

T2 - Digital Output Tests

This test is used to check all outputs of the relay. It is a convenient way to determine proper system connections and verify the operation of all relay contacts, without having to apply currents and voltages to simulate faults.

Protection can be enabled or disabled, as deemed necessary by the user.

Output Test

1. Connect the relay as shown in Figure AT-1.
2. Enter the "Control Level" password.
3. Press the [ACT] key and then select "DIG OUT TEST". Press the [ENT] key.
4. Select the output to test by using the arrow keys to scroll to the desired output, such as 94G, and press the [ENT] key.

   Before the contact is allowed to close you will be prompted to turn protection off during the test. The prompt is: "DISABLE PROT?". Press the [1/Y] key followed by the [ENT] key to turn protection off. Protection will remain off until the test mode is ended. (If desired, protection can be left enabled during the test.)

   Once the protection choice is chosen, the "relay output" selected will close.

   Verify that the output under test has closed, using an ohm meter or other suitable device.
5. After the output is tested, scroll to the next output to test, then press the [ENT] key. This output will close and the previously selected output will open. Continue in this fashion until all outputs are tested.
6. End the test mode by scrolling to the "END TEST MODE" selection, then press the [ENT] key. Alternatively, [END] followed by the [ENT] can be pressed to end the test and re-enable protection.

T3 - Digital Input Tests

This test is used to check all digital inputs of the relay. It is a convenient way to determine proper system connections and verify the operation of all dual optically isolated digital inputs. All digital inputs should be between 35 and 300 VDC.

Protection can be enabled or disabled, as deemed necessary by the user.

Input Test

1. Connect the relay as shown in Figure AT-2.
2. Apply DC across DI1 (BG8-BG7). Using the MMI and the INFORMATION - VALUES command, verify that GEN = OFF-LINE.

3. Remove DC from DI1 (BG8-BG7). Using the MMI and the INFORMATION - VALUES command, verify that GEN = ON-LINE.

4. Apply DC across DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=CLOSED.

5. Remove DC from DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=OPEN.

6. Apply DC across DI3 (BG4-BG3). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 3 = CLOSE.

7. Remove DC from DI3 (BG4-BG3). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 3 = OPEN.

8. Apply DC across DI4 (BG2-BG1). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 4 = CLOSE.

9. Remove DC from DI4 (BG2-BG1). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 4 = OPEN.

10. Apply DC across DI5 (BE4-BE3). Using the MMI and the INFORMATION - VALUES command, verify that OSC TRIG = CLOSE.

11. Remove DC from DI5 (BE4-BE3). Using the MMI and the INFORMATION - VALUES command, verify that OSC TRIG = OPEN.

12. Apply DC across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

13. Remove DC from DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = OPEN.

T4 - AC System Input Test

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

1. Connect the relay as shown in Figure AT-3.

2. Using a 60 Hz source set the current inputs to: IA = 0.5 A rms 0°, IB = 2.0 A rms -120°, and IC = 15.0 A rms -240° and set the voltage inputs to: VA = 20 V rms 0°, VB = 70 V rms -120°, and VC = 120 V rms -240°.

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:

IAS
ANGLE IAS
IBS
ANGLE IBS
ICS
ANGLE ICS
IAR
ANGLE IAR
IBR
ANGLE IBR
ICR
ANGLE ICR
VAN
ANGLE VAN
VBN
ANGLE VBN
VCN
ANGLE VCN
GEN FREQ

Check that all frequency measurements are within 0.01 Hz and all voltage and current measurements are within 3% of their set amplitude and 1 degree of their set phase.

Note: Other quantities are listed between the values of ANGLE VCN and GEN FREQ. These will be tested in another section.

If a printer is available, press the [PRT] key while in the VALUES category and all present values will be printed. Alternately, whenever the MMI display is blank, pressing the [CLR] key will automatically scroll through all of the present values.

5. Repeat steps 2 through 4 using the following frequencies for your source: 30.5 and 79.5.

PROTECTION FUNCTIONS

NOTE: All Settings or Control changes must have their respective passwords entered before any changes can be made. After all of the settings changes have been entered, the key sequence, "END" followed by "ENT", must be entered so that the relay can accept and operate with the new settings.

Before starting the Protection Functions test, input the following settings into the Configuration category.

Settings:
CONFIG
(102) SYSFREQ = 60
(103) SEL TVM = 0000
(104) SEL TCM = 0000
(105) SELPRIM =SECNDRY (1)
(106) CT RATIO = 1
(107) VT RATIO =1.0
(109) PHASE =A-B-C
(114) NOM VOLT = 120.0
(115) RATEDCUR = 5.00

Protection Function testing can be done by two methods. In protection mode, all outputs are directed to the selected Trip/Alarm output contacts. In test mode all outputs are directed to the test-output contacts (DOR12-test pickup, DOR13-test trip), along with the selected Trip/Alarm contacts. Test pickup has a normally open (AF6-AG6) and a normally closed (AF6-AE6) contact. Test trip also has a normally open (AF5-AG5) and a normally closed (AF5-AE5) contact.

To enter test mode, first input the Control Level password. Press the [ACT] "action" key, then scroll until the heading "ACT:RELAY TEST" is displayed. Press the [ENT] "enter" key. Scroll through the different functions until you reach the function to be tested. Press the [ENT] key. The status light will turn red and the MMI will display "ON" next to the function to be tested.

Note: Although the status light is red the protection functions are still ON while the relay is in test mode.

T5 - Generator Differential Test, 87G

Settings:
87G
(203) **K1** =5
(204) **PICKUP** =0.2

1. Connect the relay as shown in Figure AT-4.
2. Set up relay in test mode for the 87G function; "87G ON" will be displayed on the MMI.
3. Set the current of IAR to 5 A rms and IAS to 5 A rms. The test pickup and test trip contacts should not operate. Increase IAS to 7 A rms and test pickup and test trip should operate. Set IAS to 5 A rms and test pickup and test trip should not operate. Decrease IAS to 3 A rms and test pickup and test trip should operate.
4. Repeat the above test for phases B (IBR,IBS) and C (ICR,ICS).

T6 - Current Unbalance Alarm, 46A

Settings:
46A
(302) **PICKUP** = 0.05
(303) **TL14** = 1

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

2. Set up relay in test mode for the 46A function; "46A ON" will be displayed on the MMI.

3. Set the current inputs to: IAS = 0.4 A rms 0°, IBS = 0.4 A rms -120°, and ICS = 0.4 A rms -240°. Test pickup and test trip should not operate. Change the current inputs to: IAS = 0.25 A rms 0°, IBS = 0.0 A rms -120°, and ICS = 0.0 A rms -240° and test pickup should operate immediately and test trip should operate in 1.00 to 1.03 seconds.

T7 - Current Unbalance Trip, 46T

Settings:
46T
(403) **PICKUP** = 2.0
(404) **K2** = 1.0

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

2. Set up relay in test mode for the 46T function; "46T ON" will be displayed on the MMI.

3. Set the current inputs to: IAS = 2.0 A rms 0°, IBS = 2.0 A rms -120°, and ICS = 2.0 A rms -240°. Test pickup and test trip contacts should not operate. Change the current inputs to: IAS = 6.3 A rms 0°, IBS = 0.0 A rms -120°, and ICS = 0.0 A rms -240° and test pickup and test trip should operate in 5.5 to 5.7 seconds.

NOTE: If this test is repeated, the operate time of the trip contact will change according to how soon the test is repeated. The trip time can be calculated according to the following equation:

$$\text{New Trip Time} = (X/230)*(\text{Original Trip Time})$$

where X = the time between successive tests and Original Trip Time = the 5.5 to 5.7 seconds it originally took to trip the relay. If the time between successive trips is greater than 230 seconds, the relay will trip in the original trip time.

T8 - Loss of Field Protection Zone 1, 40-1

Settings:
40
(501) **SELV2SUP** = DISABLE (0)

Settings:
40-1
(603) **CENTER** = 11
(604) **RADIUS** = 8.5
(605) **TL12** = 0.01

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 40-1 function; "40-1 ON" will be displayed on the MMI. Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = OPEN.

3. Using a 60 Hz source set the voltage inputs to: VA = 35 V rms 0°, VB = 35 V rms -120°, and VC = 35 V rms -240°.

   Set the current inputs according to Table AT-1.

TABLE AT-1

	Phase A		Phase B		Phase C	
Test	Magnitude	Phase	Magnitude	Phase	Magnitude	Phase
A.	14.5	90	14.5	-30	14.5	-150
B.	12.5	90	12.5	-30	12.5	-150
C.	1.7	90	1.7	-30	1.7	-150
D.	1.8	90	1.8	-30	1.8	-150

4. The following results should be obtained for the inputs of Table AT-1:

TEST	RESULTS
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 20 to 40 ms.
C	Test pickup and test trip do not operate.
D	Test pickup operates immediately and test trip operates in 20 to 40 ms.

5. Apply DC voltage across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

6. Repeat test D from Table AT-1 and verify that the test pickup operates and the test trip does not operate.

7. Remove DC from DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = OPEN.

8. Change the following setting:

   Settings:
   40
   (501) SELV2SUP = ENABLE (1)

9. Repeat test D from Table AT-1 with 70 V rms in phase A and 0 V rms in phases B and C. Verify that the test pickup and test trip do not operate.

T9 - Loss of Field Protection Zone 2, 40-2

Settings:
40-2
(703) **CENTER** = 11
(704) **RADIUS** = 8.5
(705) **TL13** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 40-2 function; "40-2 ON" will be displayed on the MMI.
3. Using a 60 Hz source set the voltage inputs to: VA = 35 V rms 0°, VB = 35 V rms -120°, and VC = 35 V rms -240°.

   Set the current inputs according to Table AT-1.
4. The following results should be obtained for the inputs of Table AT-1:

TEST	RESULTS
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 2.0 to 2.1 seconds.
C	Test pickup and test trip do not operate.
D	Test pickup operates immediately and test trip operates in 2.0 to 2.1 seconds.

T10 - Anti-Motoring with Accidental Energization and Sequential Trip Supervision, 32-1

Settings:
32-1
(803) **TRIP ENA** = YES (1/Y)
(804) **REV PWR** = 1.5
(805) **TL1** = 5
(806) **TL3 D.O.** = 0.25

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 32-1 function; "32-1 ON" will be displayed on the MMI.
3. Using a 60 Hz source set the voltage inputs to: VA = 20 V rms 0°, VB = 20 V rms -120°, and VC = 20 V rms -240° and set the current input to IA = 0.1 A rms 180°. Phases B and C should have no current.
4. Apply DC across DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=CLOSED. Repeat the above test and verify that the test pickup operates immediately and the test trip operates in 5.0 to 5.05 seconds.
5. Leaving all of the AC signals applied; remove DC from DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=OPEN. Check that the test trip contact has dropped out.

6. Change the following setting:

   Settings:
   32-1
   (803) **TRIP ENA** = NO (3/N)

   Leaving all of the AC signals applied, notice that the test pickup operates immediately and the test trip operates in 5.0 - 5.1 seconds.

T11 - Anti-Motoring, 32-2

Settings:
32-2
(903) **REV PWR** = 1.5
(904) **TL2** = 1

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 32-2 function; "32-2 ON" will be displayed on the MMI.
3. Using a 60 Hz source set the voltage inputs to: VA = 20 V rms 0°, VB = 20 V rms -120°, and VC = 20 V rms -240° and set the current input to IA = 0.1 A rms -180°. Set phases B and C to 0 A rms.

   Apply voltages and currents simultaneously. Verify that the test pickup operates immediately and test trip operates in 1.00 - 1.05 seconds.

T12 - Time Overcurrent with Voltage Restraint, 51V

Settings:
51V
(1003) **PICKUP** = 0.5
(1004) **TIME FAC** = 0.1

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 51V function; "51V ON" will be displayed on the MMI.
3. Using a 60 Hz source set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240°.

   Set the current inputs according to Table AT-2.

TABLE AT-2

Test	Phase A Magnitude	Phase A Phase	Phase B Magnitude	Phase B Phase	Phase C Magnitude	Phase C Phase
A.	.45	0	.45	-120	.45	-240
B.	1.0	0	1.0	-120	1.0	-240

4. The following results should be obtained for the inputs of Table AT-2:

TEST	RESULTS
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 230 to 250 ms.

5. Apply DC voltage across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

6. Repeat test B from Table AT-2 but use 10 A rms in each phase. Verify that the test pickup operates but the test trip does not operate.

7. While continuing to input the current, remove the DC from DI6 (BE2-BE1). The test pickup operates immediately and test trip operates in 30 to 50 ms.

8. Remove all phase currents. Reapply each phase current separately and verify that both test contacts operate for each phase, as in step 7.

T13 - Accidental Energization, AE

Settings:
AE
(2703) AE ARM = AND (0)

1. Connect the relay as shown in Figure at-6. Uses the same settings as used in T12.

2. Set up relay in test mode for the AE function; "AE ON" will be displayed.

3. Apply the AC signals as in Test B of T12. The test pickup operates immediately.

4. Apply DC voltage across DI1 (B68-B67). Using the MMI and the INFORMATION VALUES command, verify that GEN=OFF LINE. The test trip operates in 5.00 - 5.05 seconds.

5. Remove DC from DI1 (B68-B67). Using the MMI and the INFORMATION VALUES command, verify that GEN= ON LINE. Notice that the test trip drops out in .25-.30 seconds.

6. Change the following setting:

Settings:
AE
(2703) AE - ARM = OR (1)

Leave the signals applied as in Step 3; the test trip should operate in 5.00 - 5.05 seconds.

T14 - Fundamental Frequency Neutral Overvoltage, 64G1

Settings:
64G1
(1103) **PICKUP** = 4.0
(1104) **TL4** = 0.1

1. Connect the relay as shown in Figure AT-7.

2. Set up relay in test mode for the 64G1 function; "64G1 ON" will be displayed on the MMI.

3. Set all current inputs to 0. Set the voltage inputs according to Table AT-3.

TABLE AT-3

Test	Phase A Magnitude	Phase A Phase	Phase B Magnitude	Phase B Phase	Phase C Magnitude	Phase C Phase
A.	70	0	70	-120	3.8	-240
B.	70	0	70	-120	4.2	-240

4. The following results should be obtained for the inputs of Table AT-3:

TEST	RESULTS
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 110 to 130 ms.

T15 - Percentage of 3rd Harmonic in the Neutral, 64G2

Note: For this test the voltage source must be capable of outputting a controllable amount of 3rd harmonic component.

Settings:
64G2
(1203) **TL5** = 0.1
DIG INP
(2501) **SELBKDI1** = NO BLK (0)

1. Connect the relay as shown in Figure AT-7.

2. Set up relay in test mode for the 64G2 function; "64G2 ON" will be displayed on the MMI.

3. Set the following inputs using 60 Hz for phase A and 180 Hz for phases B and C.

TABLE AT-4

Test	Phase A Magnitude	Phase A Phase	Phase B Magnitude	Phase B Phase	Phase C Magnitude	Phase C Phase
A.	100	0	10	0	1	0
B.	100	0	10	0	0.5	0

4. The following results should be obtained for the inputs of step 3:

TEST	RESULT
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 110 to 130 ms.

5. Change the following setting:

Settings:
DIG INP
(2501) **SELBKDI1** = BLK64G2 (2)

6. Apply DC voltage across DI1 (BG8-BG7). Repeat test B and verify that the test contacts do not operate. Remove DC from DI1 (BG8-BG7) and verify that test pickup operates immediately and test trip operates in 110 to 130 ms.

T16 - Volt/Hertz Overexcitation Alarm, 24A

Settings:
24A
(1302) **PICKUP** = 1.5
(1303) **TL6** = 1

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 24A function; "24A ON" will be displayed on the MMI.
3. Set all current inputs to 0. Set the voltage inputs according to Table AT-5.

TABLE AT-5

	Phase A		Phase B		Phase C		Frequency
Test	Magnitude	Phase	Magnitude	Phase	Magnitude	Phase	
A.	69	0	69	-120	69	-240	60
B.	114	0	69	-120	69	-240	60
C.	69	0	114	-120	69	-240	60
D.	69	0	69	-120	114	-240	60
E.	69	0	69	-120	69	-240	39

4. The following results should be obtained for the inputs of Table AT-4:

TEST	RESULT
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 1.00 - 1.05 seconds.
C	Test pickup operates immediately and test trip operates in 1.00 - 1.05 seconds.
D	Test pickup operates immediately and test trip operates in 1.00 - 1.05 seconds.
E	Test pickup operates immediately and test trip operates in 1.20 - 1.40 seconds.

T17 - Volt/Hertz Overexcitation Trip, 24T

Settings:
24T
(1404) **INV CURV** = 1
(1405) **INV PU** = 1.5
(1406) **TIME FAC** = 99.99
(1407) **INST PU** = 1.5
(1408) **TL7** = 1
(1409) **RESET** = 1

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 24T function; "24T ON" will be displayed on the MMI.

3. Set all current inputs to 0. Using a 60 Hz source, set the voltage inputs according to Table AT-6.

TABLE AT-6

	Phase A		Phase B		Phase C	
Test	Magnitude	Phase	Magnitude	Phase	Magnitude	Phase
A.	114	0	69	-120	69	-240
B.	69	0	114	-120	69	-240
B.	69	0	69	-120	114	-240

4. Verify that for all tests in Table AT-6, test pickup operates immediately and test trip operates in 1.0 to 1.05 seconds.

5. Change the following setting:

Settings:
24T
(1406) **TIME FAC** = 1
(1408) **TL7** = 9.9

6. Set all current inputs to 0. Using a 60 Hz source set the voltage inputs according to Table AT-6.

7. Verify that for all tests in Table AT-6, test pickup operates immediately and test trip operates in 5.0 to 5.5 seconds.

NOTE: If this test is repeated, the operate time of the trip contact will change according to how soon the test is repeated. The trip time can be calculated according to the following equation:

New Trip Time = (X/Reset)*(Original Trip Time)

where X = the time between successive tests, Original Trip Time = the 5.0 to 5.5 seconds it originally took to trip the relay, and Reset = Setting (1409). If the time between successive trips is greater than the Reset time, the relay will trip in the original trip time.

T18 - Positive Sequence Overvoltage, 59

Settings:
59
(1503) **PICKUP** = 120
(1504) **TIME FAC** = 1

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 59 function; "59 ON" will be displayed on the MMI.
3. Set all current inputs to 0. Using a 60 Hz source set the voltage inputs according to Table AT-7.

TABLE AT-7

	Phase A		Phase B		Phase C	
Test	Magnitude	Phase	Magnitude	Phase	Magnitude	Phase
A.	65	0	65	-120	65	-240
B.	100	0	100	-120	100	-240
C.	200	0	200	-120	200	-240

4. The following results should be obtained for the inputs of Table AT-7:

TEST	RESULT
A	Test pickup and test trip do not operate.
B	Test pickup operates immediately and test trip operates in 2.18 to 2.32 seconds.
C	Test pickup operates immediately and test trip operates in 540 to 570 ms.

NOTE: When conducting Underfrequency testing, apply a test frequency above the Set Point and trigger the timer to start on the change of frequency.

T19 - Underfrequency Unit #1, 81-1U

Settings:
81
(1601) **CUTOFF** = 90
81-1U
(1703) **SET PNT** = 60
(1704) **TL8** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-1U function; "81-1U ON" will be displayed on the MMI.
3. Set all current inputs to 0. Using a 61 Hz source, set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240°.
4. Verify that test pickup and test trip do not operate
5. Change the frequency of the voltage inputs to 59 Hz.
6. Verify that test pickup operates immediately and test trip operates in 2.0 to 2.1 seconds.

T20 - Underfrequency Unit #2, 81-2U

Settings:
81-2U
(1803) **SET PNT** =60
(1804) **TL9** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-2U function; "81-2U ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T18.

T21 - Underfrequency Unit #3, 81-3U

Settings:
81-3U
(1903) **SET PNT** =60
(1904) **TL10** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-3U function; "81-3U ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T18.

T22 - Underfrequency Unit #4, 81-4U

Settings:
81-4U
(2003) **SET PNT** =60
(2004) **TL11** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-4U function; "81-4U ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T18.

NOTE: When conducting Overfrequency testing, apply a test frequency below the Set Point and trigger the timer on the change of frequency.

T23 - Overfrequency Unit #1, 81-1O

Settings:
81-1O
(2103) **SET PNT** =60
(2104) **TL15** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-1O function; "81-1O ON" will be displayed on the MMI.
3. Set all current inputs to 0. Using a 59 Hz source set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240°.
4. Verify that the test pickup and test trip do not operate.
5. Change the frequency of the voltage inputs to 61 Hz.
6. Verify test pickup operates immediately and test trip operates in 2.0 to 2.1 seconds.

T24 - Overfrequency Unit #2, 81-2O

Settings:
81-2O
(2203) **SET PNT** =60
(2204) **TL16** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-2O function; "81-2O ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T22.

T25 - Overfrequency Unit #3, 81-3O

Settings:
81-3O
(2303) **SET PNT** =60
(2304) **TL17** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-3O function; "81-3O ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T22.

T26 - Overfrequency Unit #4, 81-4O

Settings:
81-4O
(2403) **SET PNT** = 60
(2404) **TL18** = 2

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 81-4O function; "81-4O ON" will be displayed on the MMI.
3. Repeat steps 3 thru 6 in test T22.

T27 - Voltage Transformer Fuse Failure, VTFF

Settings:
DIG INP
(2501) **SELBKDI1** = NO BLK (0)
VTFF
(2601) **VTFF** = ENABLE (1)

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the VTFF function; "VTFF ON" will be displayed on the MMI.
3. Set the current inputs to: IAS = 0.5 A rms 90°, IBS = 0.5 A rms -30°, and ICS = 0.5 A rms -150°. Set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240°. Verify that neither the test pickup nor the test trip operates.
4. Decrease the voltage in all three phases to 49 V rms. Verify that test pickup and test trip operate in 12.4 to 13.0 seconds.

END OF TEST

Make sure that the relay is no longer in test mode; select END TEST MODE from the test mode menu.

Print out or scroll through all of the settings. Compare them with the initial Settings of the relay, and change to initial values.

If the initial settings were saved to a disk file before testing using DGP-LINK, download the file to the relay.

DIGITAL OUTPUTS	X	Y
94G	BE10	BF10
94G1	BE9	BF9
94G2	BE8	BF8
94G3	BE7	BF7
74A	AF14	AG14
74B	AF13	AG13
74C	AF12	AG12
74D	AF11	AG11
74CR	AF7	AG7
74NC	AF8	AG8
74FF	AF10	AG10
TEST PICKUP	AF6	AG6
TEST TRIP	AF5	AG5

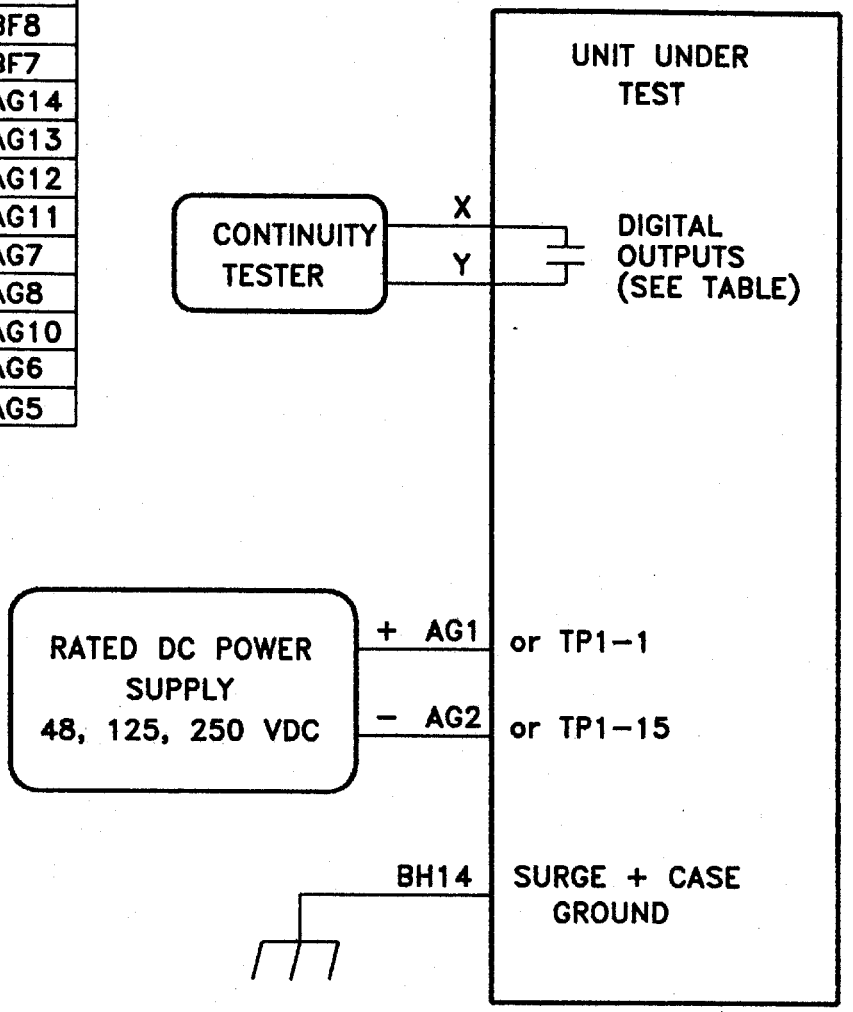


Figure AT-1 (0286A4948 Sh.1) Digital Output Test Connections

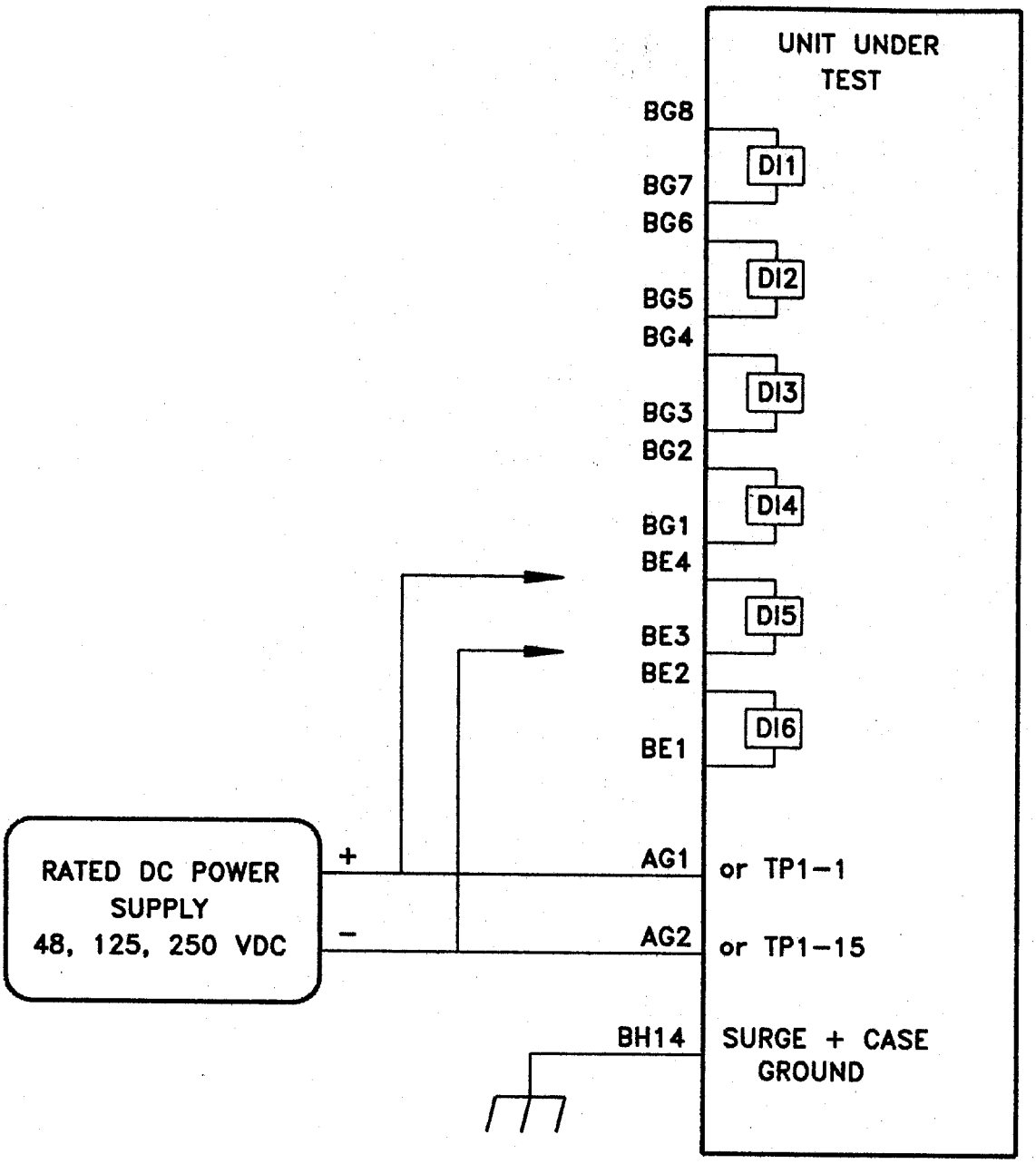


Figure AT-2 (0286A4948 Sh.2) Digital Input Test Connections

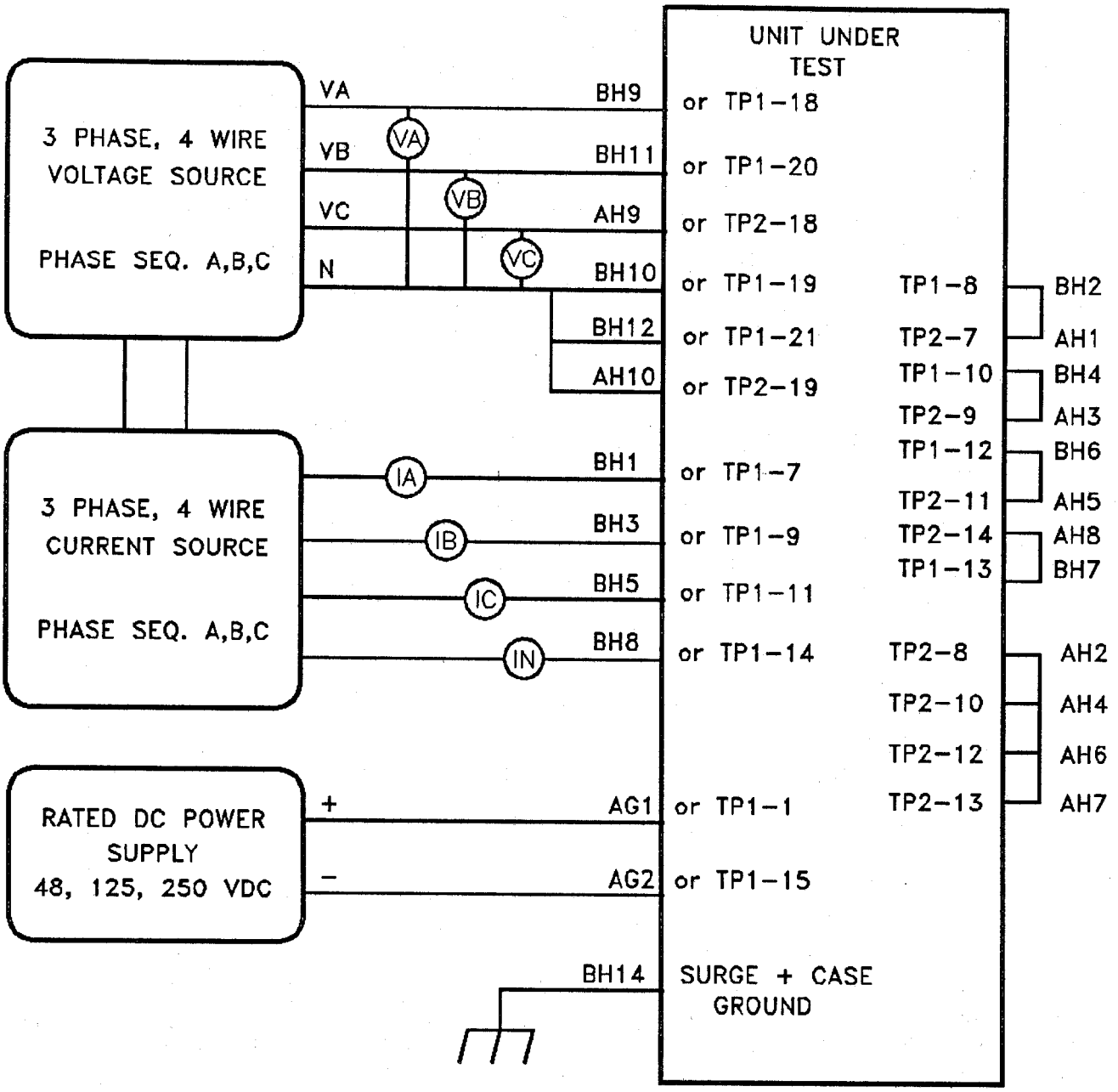
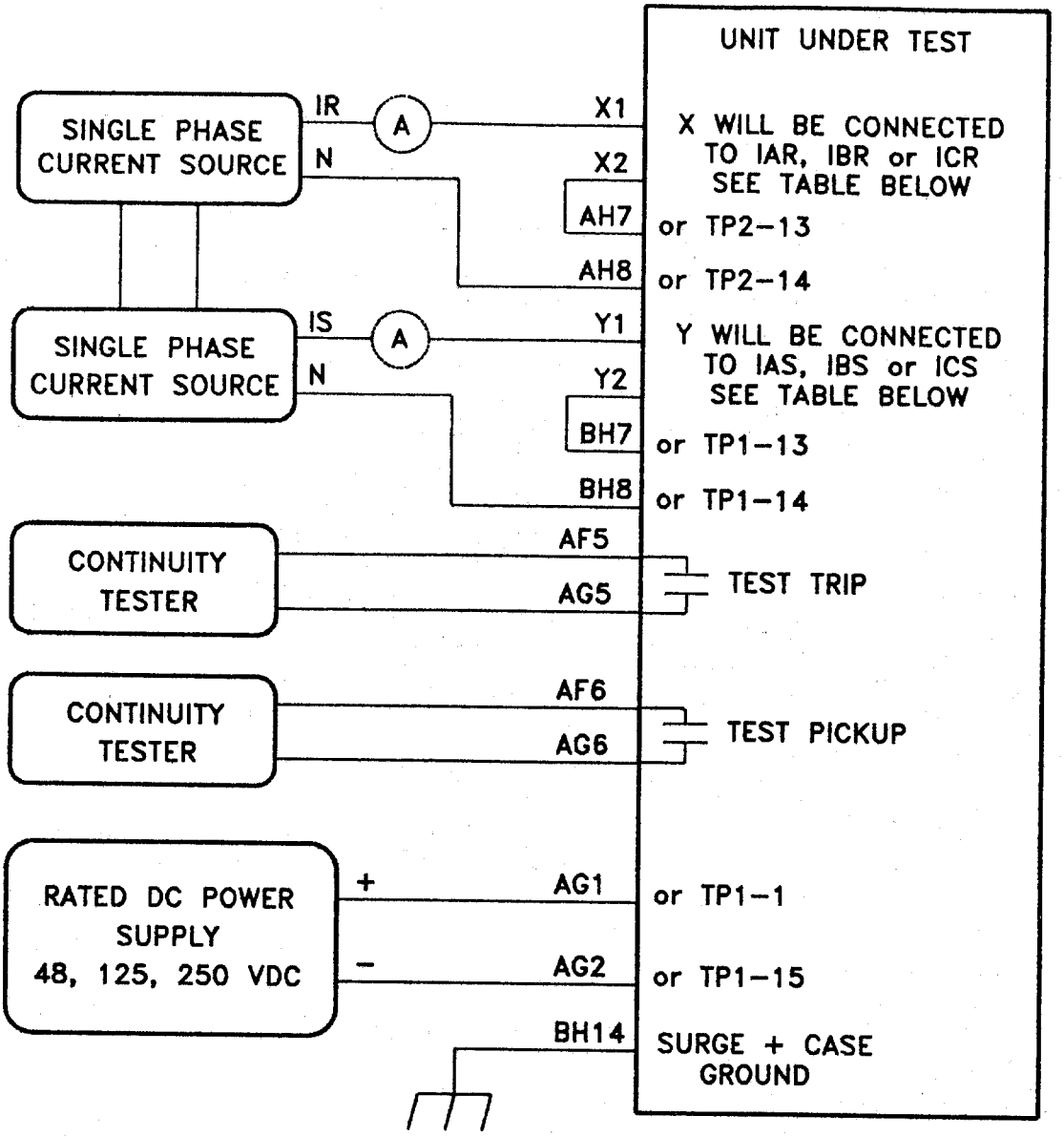


Figure AT-3 (0286A4948 Sh.3 [1]) AC System Input Test Connections



	INPUT X1		INPUT X2		INPUT Y1		INPUT Y2	
PHASE UNDER TEST	TERMINAL BLOCK NUMBER	XTM TERMINAL NUMBER	TERMINAL BLOCK NUMBER	XTM TERMINAL NUMBER	TERMINAL BLOCK NUMBER	XTM TERMINAL NUMBER	TERMINAL BLOCK NUMBER	XTM TERMINAL NUMBER
A	AH1	TP2–7	AH2	TP2–8	BH1	TP1–7	BH2	TP1–8
B	AH3	TP2–9	AH4	TP2–10	BH3	TP1–9	BH4	TP1–10
C	AH5	TP2–11	AH6	TP2–12	BH5	TP1–11	BH6	TP1–12

Figure AT-4 (0286A4948 Sh.4) Generator Differential Test Connections

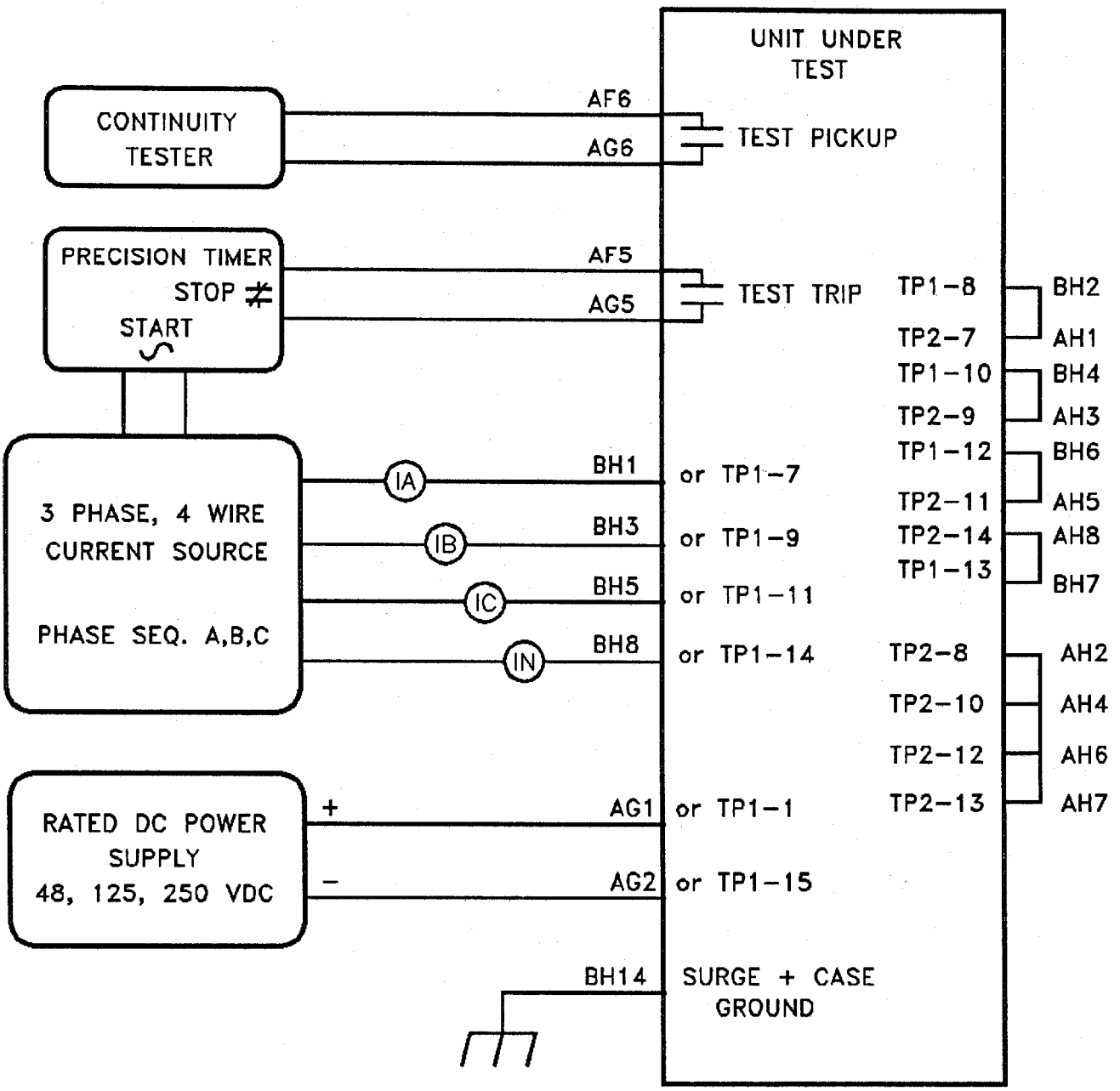


Figure AT-5 (0286A4948 Sh.5 [1]) Current Unbalance Test Connections

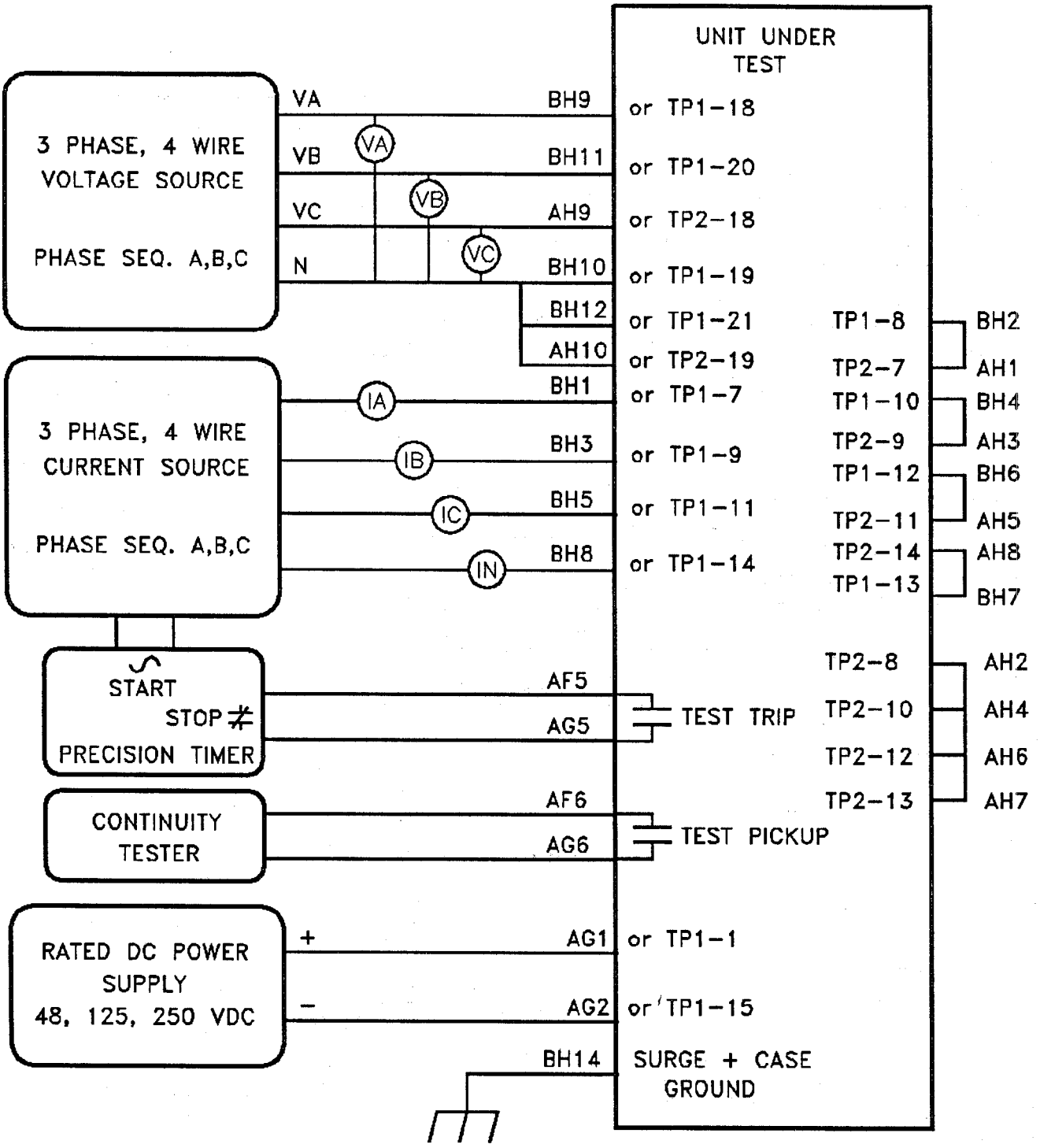


Figure AT-6 (0286A4948 Sh.6 [1]) Standard Functional Test Connections

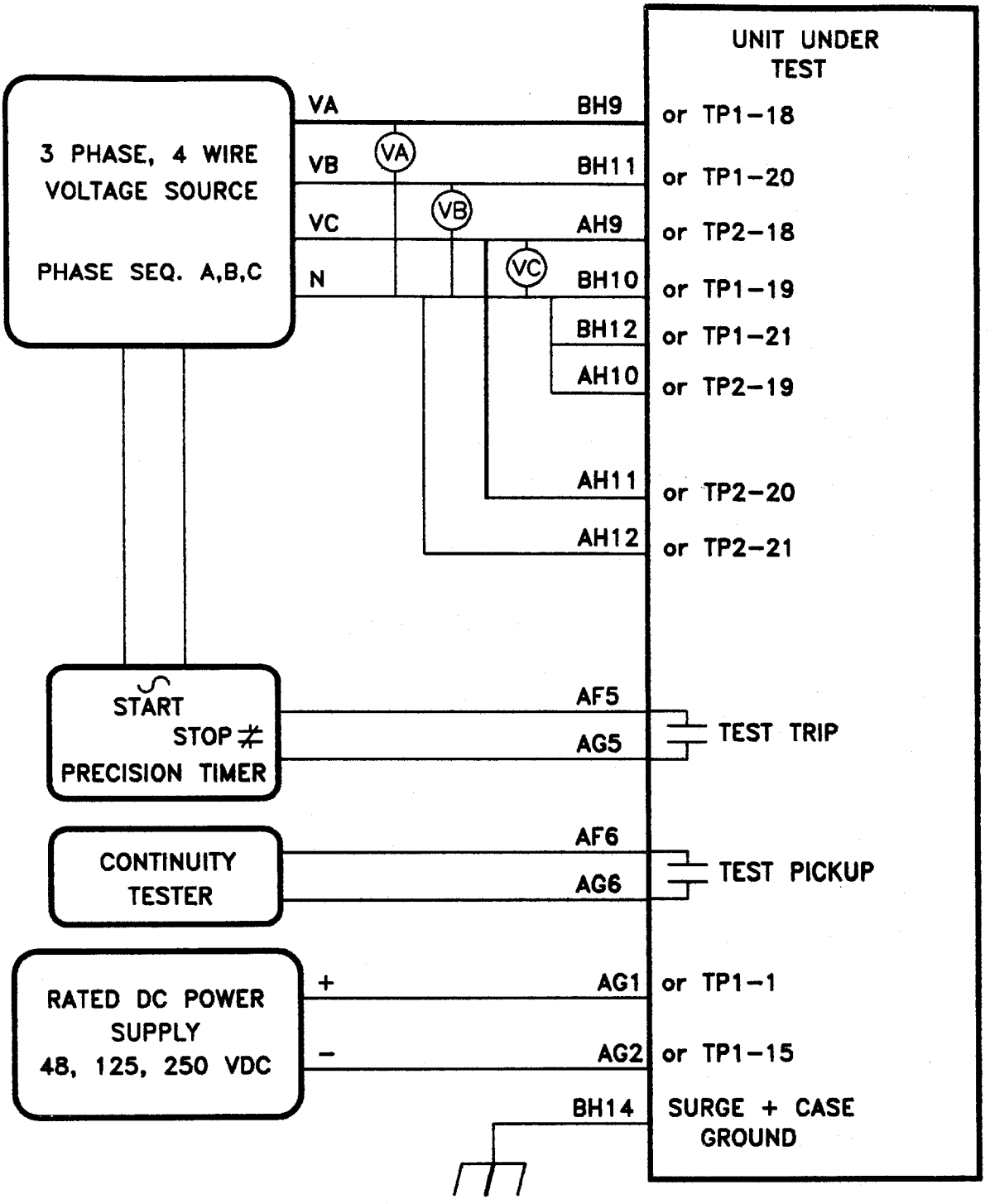


Figure AT-7 (0286A4948 Sh.7 [1]) Percentage of Third Harmonic In the Neutral

PERIODIC TESTS

CAUTION

Power Down the relay by removing the test plugs before removing or inserting modules. Failure to do so can permanently damage the relay.

PERIODIC TESTING OF THE DGP

The formulas below will permit the calculation of pickup currents and voltages for testing the DGP with settings specific to a particular application. The test circuits and procedures are the same as used and illustrated in the **ACCEPTANCE TESTS** section of this book.

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

However, it is suggested that the relay's built-in "Self Tests" be incorporated into the user's test procedures. They will give the operational status of the unit.

It is assumed that the user is familiar with testing the DGP. If not, refer to the **ACCEPTANCE TEST** section for details.

General Tests

T1	MMI Status and Display Tests (Self Tests)
T2	Digital Output Test
T3	Digital Input Test
T4	AC System Input Test

Protection Functions

T5	Generator Differential, 87G
T6	Current Unbalance Alarm, 46A
T7	Current Unbalance Trip, 46T
T8	Loss of Excitation, 40-1
T9	Anti-Motoring with Accidental Energization and Sequential Trip Supervision, 32-1
T10	Time Overcurrent with Voltage Restraint, 51V
T11	Stator Ground Zone1, 64G1
T12	Stator Ground Zone2, 64G2
T13	Overexcitation (Volts/Hz) Alarm, 24A
T14	Overexcitation (Volts/Hz) Trip, 24T
T15	Overvoltage, 59
T16	Underfrequency, 81-1U
T17	Overfrequency, 81-1O
T18	Voltage Transformer Fuse Failure, VTFF

DRAWINGS AND REFERENCES:

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

Drawings:

1. The Elementary Diagram
2. The Logic Diagrams

References:
1. **SOFTWARE** section of this manual.

GENERAL INSTRUCTIONS

1. To remove power from the relay, remove at least one of the connection plugs (see Figure MO-1).

2. The DGP is tested in the "test mode" of operation. This mode allows the internal measuring units and functions to be brought out and viewed. The measuring units and functions are actually internal to the software. There are no individual hardware modules that are responsible for the specific measuring functions.

   The test mode selects and isolates various test functions and measuring units, and routes their status to the Digital Output Spare 2 and 3 (DOR12 and DOR13) contact. When the particular function under test has picked up, DOR12 (AF6-AG6) will operate. When the particular function under test has tripped, DOR13 (AFG-AG5) will operate.

   For the remainder of this test DOR12 will be referred to as "test pickup" and DOR13 as "test trip".

CAUTION

The test contacts will chatter when the unit under test is near its threshold. DO NOT LET IT CONTINUE. REMOVE THE TEST CURRENT. A single contact closure is enough to determine that the unit picked up or tripped.

NOTE: TRIPPING CONTACTS WILL OPERATE IN THE TEST MODE.

ENTERING THE TEST MODE

Before each test it is necessary to set the relay in the test mode, and select the function to be tested. The test mode is set as follows:

1. Apply rated DC and wait for relay initialization to complete, as indicated by the green LED on the MMI.

2. Press the [ACT] "action" key. Scroll with the arrow key until "ACT: ENTER PASSWORD" is displayed, then press the [ENT] "enter" key.

3. Enter the Control Level password (see the **INTERFACE** section for a description of MMI passwords).

When the correct password is entered, "SELECTED" will be displayed.

4. Press the [ACT] "action" key. Scroll with the arrow key until "ACT: RELAY TEST" is displayed, then press the [ENT] "enter" key.

5. Scroll through the different test mode functions or enter the number of the desired test, such as "12" for the 24A. Then press [ENT] and the display will indicate "24A ON", and the MMI LED will turn red, indicating that the relay is in the test mode. When the relay picks up for the selected function it will operate the test pickup relay and when the relay trips for the selected function it will operate the test trip relay.

Exiting The Test Mode

6. While in the "TEST MODE", press the [ACT] key. Scroll with the arrow key until "ACT:RELAY TEST" is displayed, then press the [ENT] key. Scroll until the display shows "END TST MODE?" or enter "1". Then press the [ENT] key. The MMI LED should return to green, indicating that normal operation has resumed.

INITIAL TEST SET UP

Before beginning the test, the relay settings should be printed for reference and verification. If no printer is available, scroll through each setting and make sure they match the required settings of the relay.

At the beginning of each test in the text that follows, beginning with T5, there is space provided to record the user-specific setting for the function under test.

USING DGP-LINK

To test the relay without the DGP Keypad, communication with the relay is accomplished via a PC with the program DGP-LINK. DGP-LINK is required to establish communications, change the password, change settings for the tests, and place the unit into test mode. Once in test mode, current and voltages are applied to the relay to simulate the desired system conditions.

Follow the procedure specified in the **ACCEPTANCE TEST** section to test the relay with DGP-LINK.

RELAY TESTS

T1 - MMI Relay Status

The Relay's Status is reported through the MMI, the non-critical alarm contact, and the critical alarm contact. If a system error caused relaying functions to cease, the LED on the MMI would turn red, a "FAIL" message would be displayed on the MMI, and the critical alarm relay would de-energize. A failure that did not interrupt relaying would be indicated by energizing the non-critical alarm relay, and by a "WARN" message on the MMI display.

If a STATUS error is detected, see the **SERVICING** section for further information.

1. 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 relay is operational and there are no internal errors.

Display Test

The MMI test is built into the software. It allows the user to test the keypad, the printer, and the display. If no printer is to be used with your relay, then skip the printer port testing.

1. 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.

   If the green LED is on, it will be extinguished and the red LED will be lit. If the red LED is lit, it will be extinguished and the green LED will be lit. The Target LED's will then flash on/off 4 times. Then each Target LED will be lit individually. When the test is over the Target LED's will be returned to their original state.

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.

   PRINTER TEST (skip this if you do not have a printer)

10. The display prompt will be "PRINTER TST?". If you do not have a printer, the press the [3/N] followed by the [ENT] key. If you have a printer, press the [1/Y] followed by the [ENT] key.

    The printout will be 40 characters, which include the alphabet, the numbers 0 through 9, and the :=/. characters. Forty lines will be printed.

T2 - Digital Output Test

This test is used to check all outputs of the relay. It is a convenient way to determine proper system connections and verify the operation of all relay contacts, without having to apply currents and voltages to simulate faults.

Protection can be enabled or disabled, as deemed necessary by the user.

Output Test

1. Connect the relay as shown in Figure AT-1.
2. Enter the "Control Level" password.
3. Press the [ACT] key and then select "DIG OUT TEST". Press the [ENT] key.
4. Select the output to test. Use the arrow keys to scroll to the desired output, such as 94G, and press the [ENT] key.

   Before the contact is allowed to close, you will be prompted to turn protection off during the test. The prompt is: "DISABLE PROT?". Press the [1/Y] key followed by the [ENT] key to turn protection off. Protection will remain off until the test mode is ended. (If desired, protection can be left enabled during the test.)

   Once the protection choice is chosen, the "relay output" selected will close.

   Verify that the output under test has closed, using an ohm meter or other suitable device.
5. After the output is tested, scroll to the next output to test, then press the [ENT] key. This output will close and the previously selected output will open. Continue in this fashion until all outputs are tested.
6. End the test mode by scrolling to the "END TEST MODE" selection, then press the [ENT] key. Alternatively, [END] followed by the [ENT] can be pressed to end the test and re-enable protection.

T3 - Digital Input Test

This test is used to check all digital inputs of the relay. It is a convenient way to determine proper system connections and verify the operation of all dual optically isolated digital inputs. All digital inputs should be between 35 and 300 VDC.

Protection can be enabled or disabled, as deemed necessary by the user.

1. Connect the relay as shown in Figure AT-2.
2. Apply DC across DI1 (BG8-BG7). Using the MMI and the INFORMATION - VALUES command, verify that GEN = OFF-LINE.
3. Remove DC from DI1 (BG8-BG7). Using the MMI and the INFORMATION - VALUES command, verify that GEN = ON-LINE.
4. Apply DC across DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=CLOSED.
5. Remove DC from DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=OPEN.
6. Apply DC across DI3 (BG4-BG3). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 3 = CLOSE.
7. Remove DC from DI3 (BG4-BG3). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 3 = OPEN.

8. Apply DC across DI4 (BG2-BG1). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 4 = CLOSE.

9. Remove DC from DI4 (BG2-BG1). Using the MMI and the INFORMATION - VALUES command, verify that DIG IN 4 = OPEN.

10. Apply DC across DI5 (BE4-BE3). Using the MMI and the INFORMATION - VALUES command, verify that OSC TRIG = CLOSE.

11. Remove DC from DI5 (BE4-BE3). Using the MMI and the INFORMATION - VALUES command, verify that OSC TRIG = OPEN.

12. Apply DC across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

13. Remove DC from DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = OPEN.

T4 - AC System Input Test

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

1. Connect the relay as shown in Figure AT-3.

2. Using a 60 Hz source set the current inputs to: IA = 0.5 Arms 0°, IB = 2.0 Arms -120°, and IC = 15.0 Arms -240° and set the voltage inputs to: VA = 20 Vrms 0°, VB = 70 Vrms -120°, and VC = 120 Vrms -240°.

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:

IAS
ANGLE IAS
IBS
ANGLE IBS
ICS
ANGLE ICS
IAR
ANGLE IAR
IBR
ANGLE IBR
ICR
ANGLE ICR
VAN
ANGLE VAN
VBN
ANGLE VBN
VCN
ANGLE VCN
GEN FREQ

check that all frequency measurements are within 0.01 Hz and all voltage and current measurements are within 3% of their set amplitude and 1 degree of their set phase.

Note: Other quantities are listed between the values of ANGLE VCN and GEN FREQ these will be tested in another section.

If a printer is available, press the [PRT] key while in the VALUES category and all present values will be printed. Alternately, whenever the MMI display is blank, pressing the [CLR] key will automatically scroll through all of the present values.

5. Repeat steps 2 through 4 using the following frequencies for your source: 30.5 and 79.5.

MEASURING UNIT TESTS

CAUTION
The test contacts will chatter when the unit under test is near its threshold. DO NOT LET IT CONTINUE. REMOVE THE TEST CURRENT. A single contact closure is enough to determine that the unit has picked up or tripped.

Prior to each test there is space provided to record the user specific setting for the function under test.

T5 - Generator Differential Test, 87G

Settings:
87G
(203) **K1** = [_____] %
(204) **PICKUP** = [Differential Current Threshold = _____] A rms

Differential Protection is calculated with the following equation:

$$|IAR - IAS|^2 > (K1/100)*(IAR*IAS) \quad (1)$$

IAR and IAS are the return and source current for phase A.

The unit should pick up when equation (1) is true and the differential is greater than the pickup setting.

1. Connect the relay as shown in Figure AT-4.
2. Set up relay in test mode for the 87G function; "87G ON" will be displayed on the MMI.
3. Set the currents of IAR and IAS to make equation (1) true. This should operate the test pickup and test trip relays. Set the currents of IAR and IAS to make equation (1) false. This should not operate the test pickup and test trip relays.
4. Return all settings to their original values.

T6 - Current Unbalance Alarm, 46A

Settings:
46A
(302) **PICKUP** = [Magnitude of Negative Sequence Current = _____] A rms
(303) **TL14** = [Current Unbalance Alarm Delay = _____] seconds

Current Unbalance Alarm is calculated with the following equation:

$$I2 > PICKUP \quad (2)$$

I2 is equal to the negative-sequence current. The unit should pick up when I2 > PICKUP. The unit should trip TL14 seconds after it has picked up.

1. Connect the relay as shown in Figure AT-5.
2. Set up relay in test mode for the 46A function; "46A ON" will be displayed on the MMI.
3. Set the negative-sequence current to [**PICKUP+0.1** = _____] A rms and apply to the relay. The test pickup relay should operate and TL14 seconds later the test trip relay should operate. Lower the negative-sequence current to [**PICKUP – 0.1** = _____] A rms and the test pickup and test trip relays should not operate.
4. Return all settings to their original values.

T7 - Current Unbalance Trip, 46T

Settings:
46T
(403) **PICKUP** = [Magnitude of Negative Sequence Current = _____] A rms
(404) **K2** = [Time Factor = _____] seconds

Current Unbalance Trip is calculated with the following equation:

$$\text{Trip Time} = K2/(I2/Irated)^2 \quad (3)$$

I2 is equal to the negative-sequence current, K2 is equal to the time factor, and Irated is equal to the rated current setting (115). The unit should pick up when I2 > PICKUP. If the unit has been picked up for a time equal to the Trip Time, the test trip relay will operate.

1. Connect the relay as shown in Figure AT-5.
2. Set up relay in test mode for the 46T function; "46T ON" will be displayed on the MMI.
3. Set the negative-sequence current to [**PICKUP+0.1** = _____] A rms and apply to the relay. The test pickup relay should operate and the test trip relay should operate after the Trip Time has expired. Lower the negative-sequence current to [**PICKUP – 0.1** = _____] A rms and the test pickup and test trip relays should not operate.
4. Return all settings to their original values.

NOTE: If this test is repeated, the operate time of the trip contact will change according to how soon the test is repeated. The trip time can be calculated according to the following equation:

$$\text{New Trip Time} = (X/230)*(\text{Original Trip Time})$$

where X = the time between successive tests, and Original Trip Time = the time it took to trip the relay the first time the test was run. If the time between successive trips is greater than 230 seconds, the relay will trip in the original trip time.

T8 - Loss of Excitation, 40-1

Settings:
40
(501) **SELV2SUP** = DISABLE (0)

Settings:
40-1
(603) **CENTER** = [Center of the 1st Zone of Protection = _____]
(604) **RADIUS** = [Radius of the 1st Zone of Protection = _____]
(605) **TL12** = [Loss of Excitation Delay = _____]

Loss of Excitation is calculated with the following equation:

$$Z = (Va - Vb)/(Ia - Ib) \quad (4)$$

Va and Vb are vector-phase voltages, Ia and Ib are vector-phase currents, and Z is the corresponding impedance. If the value of Z falls within the Mho circle of the relay, the test pickup will operate and the test trip will operate TL12 seconds later.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 40-1 function; "40-1 ON" will be displayed on the MMI. Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = OPEN.

3. Using a 60 Hz source set the voltage inputs to: VA = 35 V rms 0°, VB = 35 V rms -120°, and VC = 35 V rms -240°.

4. Set the phase current so that the impedance falls within the Mho circle and apply to the relay. The test pickup relay should operate immediately and TL12 seconds later the test trip relay should operate. Change the phase current so that the impedance falls outside the Mho circle, and apply to the relay. The test pickup and test trip relays should not operate.

5. Apply DC voltage across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

6. Reapply the above phase current that placed the impedance inside the Mho circle. Verify that the test pickup operates and the test trip does not operate.

7. Return all settings to their original values.

T9 - Anti-Motoring with Accidental Energization and Sequential Trip Supervision,32-1

Settings:
32-1
(803) **TRIP ENA** = [Sequential Trip Enable = _____] (Y/N)
(804) **REV PWR** = [Allowable Amount of Reverse Power = _____]
(805) **TL1** = [Anti-Motoring Delay = _____]

Anti-Motoring is calculated with the following equation:

$$P + jQ = Va*Isa^{*} + Vb*Isb^{*} + Vc*Isc^{*} \quad (5)$$

Va, Vb, and Vc are vector-phase voltages, Isa, Isb and Isc are vector-phase currents, P is the real output power, and Q is the imaginary output power. If the value of P is greater than the REV PWR setting, the test pickup will operate. Depending on the state of DI1, DI2, and the Sequential Trip Enable setting, the test trip will, or will not, operate.

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the 32-1 function; "32-1 ON" will be displayed on the MMI.
3. Set setting (803) TRIP ENA to YES (1/Y).
4. Set the phase voltages and currents to [**REV PWR+0.1**=_____] Watt and apply to the relay. The test pickup relay should operate immediately.
5. Apply DC to DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV = CLOSED.
6. The test pickup relay should operate immediately and TL1 seconds later the test trip relay should operate.
7. Leaving all of the AC signals applied, remove DC from DI2 (BG6-BG5). Using the MMI and the INFORMATION - VALUES command, verify that INLET VLV=OPEN. Check that the test trip contact has dropped out.
8. Change setting (803) TRIP ENA to NO (3/N). Leaving all of the AC signals applied, notice that the test pickup operates immediately and the test trip operates in 5.0 - 5.1 seconds.
9. Return all settings to their original values.

T10 - Time Overcurrent with Voltage Restraint, 51V

Settings:
51V
(1003) **PICKUP** = [Magnitude of Phase Current Needed for Pickup = _____] amps
(1004) **TIME FAC** = [Time Factor = _____] seconds

Time Overcurrent is calculated with the following equation:

$$\text{Trip Time} = (\text{Time Fac})/[(\text{Phase Current}*\text{Nom Volt})/(\text{Ratedcur}*\text{Phase Voltage})]^{.5} - 1 \qquad (6)$$

Time Fac is setting (1004), Phase Current is the current applied to any one phase, Nom Volt is setting (114), Ratedcur is setting (115), Pickup is setting (1003), and Phase Voltage is the voltage in the corresponding phase. If the value of Phase Current is greater than the Pickup setting, the test pickup will operate. If the Phase Current is above the Pickup setting for a time equal to Trip Time, the test trip relay will operate.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 51V function; "51V ON" will be displayed on the MMI.

3. Using a 60 Hz source set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240° and set the current input to [**PICKUP+0.1** = _____] A rms and apply to the relay. The test pickup relay should operate immediately and the test trip relay should operate after the Trip Time has expired. Lower the negative-sequence current to [**PICKUP - 0.1** = _____] A rms and the test pickup and test trip relays should not operate.

4. Apply DC voltage across DI6 (BE2-BE1). Using the MMI and the INFORMATION - VALUES command, verify that EXT VTFF = CLOSE.

5. Set the current input to [**PICKUP+0.1** = _____] A rms and apply to the relay. Verify that the test pickup operates but the test trip does not operate.

6. While continuing to input the current, remove the DC from DI6 (BE2-BE1). The test pickup operates immediately and test trip operates after TRIP TIME expires.

7. Return all settings to their original values.

T11 - Fundamental Frequency Neutral Overvoltage, 64G1

Settings:
64G1
(1103) **PICKUP** = [Magnitude of Phase Voltage Needed for Pickup = _____] V rms
(1104) **TL4** = [Neutral Overvoltage Delay = _____] seconds

Fundamental Frequency Neutral Overvoltage is calculated with the following equation:

$$Vn > \text{Pickup} \qquad (7)$$

Vn is equal to the neutral voltage. The unit should pick up when Vn > Pickup. The unit should trip TL4 seconds after it has picked up.

1. Connect the relay as shown in Figure AT-7.

2. Set up relay in test mode for the 64G1 function; "64G1 ON" will be displayed on the MMI.

3. Using a 60 Hz source, set the voltage inputs to: VA = 70 V rms 0° and VB = 70 V rms −120°. Set the VC (paralleled with Vn) to [**PICKUP+0.1** = _____] V rms and apply to the relay. The test pickup relay should operate and TL4 seconds later the test trip relay should operate. Lower the VC voltage to [**PICKUP − 0.1** = _____] V rms and the test pickup and test trip relays should not operate.

4. Return all settings to their original values.

T12 - Percentage of 3rd Harmonic in the Neutral, 64G2

Note: For this test the voltage source must be capable of outputting a controllable amount of 3rd harmonic component.

Settings:
64G2
(1203) **TL5** = [3rd Harmonic in the Neutral Delay = _____] seconds
DIG INP
(2501) **SELBKDI1** = [3rd Harmonic Blocking Scheme = _____]

Percentage of 3rd Harmonic in the Neutral is calculated with the following equation:

$$Vn3/(Vp3/3 + Vn3) < 0.15 \quad (8)$$

Vn3 is equal to the 3rd harmonic voltage in the neutral, and Vp3 is equal to the sum of all the 3rd harmonic voltages in all phases. The unit should pick up when equation (8) is true. The unit should trip TL5 seconds after it has picked up.

1. Connect the relay as shown in Figure AT-7.

2. Set up relay in test mode for the 64G2 function; "64G2 ON" will be displayed on the MMI.

3. Set setting (2501) SELBKDI1 to NO BLK (0). Set the AC inputs using 60 Hz for phase A and 180 Hz for phases B and C. The phases for all three signals should be 0°. Va should be 100 V rms and Vb and Vc (paralleled with Vn) should be changed to make equation (8) true. This will cause the test pickup relay to operate and TL5 seconds later the test trip will operate.

4. Set setting (2501) SELBKDI1 to BLK64G2 (2). Apply DC voltage across DI1 (BG8-BG7). Reapply the AC inputs of step 3 and verify that only the test pickup operates. Remove DC from DI1 (BG8-BG7) and verify that test pickup operates immediately and test trip operates TL5 seconds later.

5. Return all settings to their original values.

T13 - Volt/Hertz Overexcitation Alarm, 24A

Settings:
24A
(1302) **PICKUP** = [The Ratio of Voltage to Frequency Needed for Pickup = _____]
(1303) **TL6** = [Volt/Hertz Overexcitation Alarm Delay = _____] seconds

Volt/Hertz Overexcitation Alarm is calculated with the following equation:

$$\text{Trip Time} = TL6/[(\text{Phase Voltage}/\text{Phase Freq})/(\text{Nom Volt}/\text{Sysfreq})]^2 - 1 \quad (9)$$

TL6 is setting (1303), Phase Voltage is the voltage applied to any one phase, Phase Freq is frequency applied to any phase, Pickup is Phase Voltage/Phase Freq for any one phase, Nom Volt is setting (114) and Sysfreq is setting (102). If the value of Phase Voltage/Phase Freq is greater than the Pickup setting, the test pickup will operate. If the Phase Voltage/Phase Freq is above the Pickup setting for a time equal to Trip Time, the test trip relay will operate.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 24A function; "24A ON" will be displayed on the MMI.

3. Set all current inputs to 0. Set VA = 70 Vrms 0°, VB = 70 Vrms -120°, and VC = 70 Vrms -240°. Change the voltage of any one phase until Phase Voltage/Phase Freq is equal to [**PICKUP+0.1** = _____]; this will cause the test pickup relay to operate, and the test trip relay will operate after the Trip Time has expired. Change the voltage of any one phase until Phase Voltage/Phase Freq is equal to [**PICKUP - 0.1** = _____]; the test pickup and test trip relays will not operate.

4. Return all settings to their original values.

T14 - Volt/Hertz Overexcitation Trip, 24T

Settings:
24T
(1404) **INV CURV** = [Curve Type = _____]
(1405) **INV PU** = [The Ratio of Voltage to Frequency Needed for Pickup = _____]
(1406) **TIME FAC** = [Equivalent to TL6 in Equation (9) = _____]
(1407) **INST PU** = [The Ratio of Voltage to Frequency Needed for Pickup = _____]
(1408) **TL7** = [Definite Time Delay Used in the Instantaneous Branch of 24T = _____]
(1409) **RESET** = [The Required Waiting Time Between Successive Trips = _____]

Volt/Hertz Overexcitation Trip is calculated with the following equation:

$$\text{Trip Time} = \text{Time}/[(\text{Phase Voltage}/\text{Phase Freq})/(\text{Nom Volt}/\text{Sysfreq})]^2 - 1 \quad (10)$$

Time is equivalent to either setting (1406) or setting (1408). Both forms of the equation are calculated and the relay trips whenever either Trip Time has expired. Phase Voltage is the voltage applied to any one phase, Phase Freq is frequency applied to any phase, Inv Pu or Inst Pu is Phase Voltage/Phase Freq for any one phase, Nom Volt is setting (114) and Sysfreq is setting (102). If the value of Phase Voltage/Phase Freq is greater than the Inv Pu or Inst Pu settings, the test pickup will operate. If the Phase Voltage/Phase Freq is above the Inv Pu or Inst Pu settings for a time equal to Trip Time, the test trip relay will operate.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 24T function; "24T ON" will be displayed on the MMI.

3. Set all current inputs to 0. Set VA = 70 Vrms 0°, VB = 70 Vrms -120°, and VC = 70 Vrms -240°. Change the voltage of any one phase until Phase Voltage/Phase Freq is equal to [**INV PU or INST PU +0.1** = _____]. This will cause the test pickup relay to operate and the test trip relay will operate after the Trip Time has expired. Change the voltage of any one phase until Phase Voltage/Phase Freq is equal to [**INV PU** or **INST PU – 0.1** = _____]. The test pickup and test trip relays will not operate.

4. Return all settings to their original values.

NOTE: If this test is repeated, the operate time of the trip contact will change according to how soon the test is repeated. The trip time can be calculated according to the following equation:

New Trip Time = (X/Reset)*(Original Trip Time)

where X = the time between successive tests, Original Trip Time = the time it originally took to trip the relay, and Reset = Setting (1409). If the time between successive trips is greater than the Reset time, the relay will trip in the original trip time.

T15 - Positive Sequence Overvoltage, 59

Settings:
59
(1503) **PICKUP** = [Mag. of Positive Sequence, Phase to Phase Voltage = _____] V rms
(1504) **TIME FAC** = [Positive Sequence Overvoltage Delay = _____] seconds

Positive Sequence Overvoltage is calculated using equation (11):

Trip Time = Time Fac/[(Phase Voltage/Pickup) - 1] (12)

Time Fac is equivalent to setting (1504), Phase Voltage is the voltage applied to any one phase, and Pickup is equivalent to setting (1503). If the value of Phase Voltage is greater than Pickup, the test pickup will operate. If the Phase Voltage is greater than Pickup for a time equal to Trip Time, the test trip relay will operate.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 59 function; "59 ON" will be displayed on the MMI.

3. Set all current inputs to 0. Apply a signal to all three phases with a positive-sequence voltage equal to [**PICKUP+2** = _____]. This will cause the test pickup to operate and the test trip will operate after the Trip Time has expired. Lower the positive-sequence voltage to [**PICKUP – 2** = _____]. This will prevent the test pickup and the test trip relays from operating.

4. Return all settings to their original values.

T16 - Underfrequency Unit #1, 81-1U

Settings:
81-1U
(1703) **SET PNT** = [Set Point for Minimum Frequency = _____] Hz
(1704) **TL8** = [Delay for Underfrequency Unit = _____] seconds

Underfrequency is calculated with the following equation:

Input Frequency < SET PNT (13)

Input Frequency is equal to the frequency in any phase. The unit should pick up when equation (13) is true. The unit should trip TL8 seconds after it has picked up.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 81-1U function; "81-1U ON" will be displayed on the MMI.

3. Set all current inputs to 0. Set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms −120°, and VC = 70 V rms −240°. Have the frequency set at [**SET PNT+.04** = _____]. This will prevent the test pickup and the test trip from operating. Change the frequency to [**SET PNT− .04** = _____]. This will cause the test pickup relay to operate and the test trip relay will operate TL8 seconds later.

4. Return all settings to their original values.

T17 - Overfrequency Unit #1, 81-1O

Settings:
81-1O
(2103) **SET PNT** = [Set Point for Maximum Frequency = _____] Hz60
(2104) **TL15** = [Delay for Overfrequency Unit = _____] seconds

Overfrequency is calculated with the following equation:

Input Frequency > SET PNT (14)

Input Frequency is equal to the frequency in any phase. The unit should pick up when equation (13) is true. The unit should trip TL15 seconds after it has picked up.

1. Connect the relay as shown in Figure AT-6.

2. Set up relay in test mode for the 81-1O function; "81-1O ON" will be displayed on the MMI.

3. Set all current inputs to 0. Set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms −120°, and VC = 70 V rms −240°. Have the frequency set at [**SET PNT−.04** = _____]. This will prevent the test pickup and the test trip from operating. Change the frequency to [**SET PNT+.04** = _____]. This will cause the test pickup relay to operate and the test trip relay will operate TL8 seconds later.

4. Return all settings to their original values.

T18 - Voltage Transformer Fuse Failure, VTFF

Settings:
DIG INP
(2501) **SELBKDI1** = NO BLK (0)
VTFF
(2601) **VTFF** = ENABLE (1)

1. Connect the relay as shown in Figure AT-6.
2. Set up relay in test mode for the VTFF function; "VTFF ON" will be displayed on the MMI.
3. Set the current inputs to: IAS = 0.5 A rms 90°, IBS = 0.5 A rms -30°, and ICS = 0.5 A rms -150°. Set the voltage inputs to: VA = 70 V rms 0°, VB = 70 V rms -120°, and VC = 70 V rms -240°. Verify that neither the test pickup nor the test trip operates.
4. Decrease the voltage in all three phases to 49 V rms. Verify that test pickup operates, and that test trip operates in 12.4 to 13.0 seconds.

END OF TEST

Make sure that the relay is no longer in test mode; select END TEST MODE from the test mode menu.

Print out or scroll through all of the settings. Compare them with the initial Settings of the relay, and change to initial values.

If the initial settings were saved to a disk file before testing using DGP-LINK, download the file to the relay.

CAUTION

When testing is completed, verify that all settings are returned to your specified values. It is helpful to print out the settings and check them one by one.

SERVICING

SPARES

There are two possible servicing methods for the DGP. They are: spare module replacement and component level repair. The preferred method is module replacement using the DGP'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 relay 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. MGM781

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. 0215B8012G001.

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

CAUTION

Power down the relay by removing the test plugs before removing or inserting modules. Failure to do so can permanently damage the relay.

SERVICING WITH THE RELAY SELF-TEST

The DGP automatically performs tests of major functions and critical hardware components and reports their status via the MMI Display/LED and the non-critical and critical alarm contacts. The failure report is dependent on the type or level of the failure. Some failures will operate the critical alarm contact and the MMI LED, while others will only operate the non-critical alarm contact.

There are three levels of self-test performed by the relay. The first level indicates severe relaying failures. They are indicated by a "FAIL" message on the MMI, a de-energizing of the "critical alarm" relay, and by the MMI LED turning red. These failures are the most critical because they indicate that the relay is not providing protection.

The second level of self-test displays warning messages. They are indicated by a "WARN" message on the MMI, and energizing of the "non-critical alarm" relay. These failures are a less critical condition, where the relay is still providing some degree of protection.

The third level of tests indicate "System Status" errors that are due to power system errors (Trip Circuit Open), or caused by the use of a DGP command that disables the relay (Disable Outputs).

They are indicated by the "non-critical alarm" relay being energized, a red LED, or by the "critical alarm" relay being de-energized. However, no MMI display is provided until the "Information Status" command is used.

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 SE-1. The components tested during run time background and foreground self-tests are listed in Tables SE-2 and SE-3, respectively.

TABLE SE-1 Start-Up Self Tests

COMPONENT	METHOD	PROCESSOR	NATURE
PROM	CRC-type check on DAP and SSP; checksum on DSP	All	Critical
Local RAM	Patterns to check for stuck bits, stuck address lines, cross-talk between adjacent bits	All	Critical
Shared RAM	Same as Local RAM	All	Critical
Non-volatile RAM	CRC-type check on settings area; CRC-type check on serial NVRAM in DAP; checksum on fault storage area	SSP DAP	Critical if settings area or Serial NVRAM
Timer Chip	Test all processor timers and their interrupts	DAP SSP	Critical if DAP, Non-Critical if SSP
Interrupt Chips	Test all processor and external Interrupt Controllers	DAP SSP	Critical
Serial Chips	Wrap around and Interrupt tests for serial interface	SSP	Non-Critical
A/D Controller	DMA Interface	DAP	Critical, DGP will restart
Digital Output Circuitry	Loop-back via parallel port	SSP	Critical, DGP will restart
Real Time Clock	Test of real time clock Operation and Interrupts	SSP	Non-Critical
LED display	Self-test built in by manufacturer	SSP	Non-critical

TABLE SE-2 Run Time Background Self Tests

COMPONENT	METHOD	PROCESSOR	NATURE
PROM	CRC-type check on DAP and SSP; checksum on DSP	All	Critical, Restart
RAM	CRC-type check on areas holding settings	All	Critical, Restart
Non-volatile RAM	CRC-type check on settings area; checksum on fault storage area	SSP	Critical if settings area
Timer Chip	Test that all timers are counting	DAP SSP	Critical if DAP, Non-Critical if SSP
Power Supply	Monitor Supply Health contact output	SSP	Critical if no backup supply

TABLE SE-3 Run Time Foreground Self Tests

COMPONENT	METHOD	PROCESSOR	NATURE
A/D Controller	DMA Interface	DAP	Critical
Digital Input Circuitry	Comparison of bits read via 2 separate opto-couplers	DAP SSP	Non-Critical
Digital Output Circuitry	Loop-back via parallel port	SSP	Critical, Restart
Trip Voltage Monitor	Bit read via parallel port	SSP	Non-Critical
MMI	Operator-initiated, visual feedback	SSP	Non-Critical
DSP and DAP Communication	DSP finished flag	DAP	Critical
ANI	Current Summation Check	DSP	Critical
ANI	Ground and Reference range check	DAP	Critical
Power Supply	Range check +12V, −12V	DAP SSP	Critical if no backup supply

TROUBLE SHOOTING

Trouble shooting the relay requires three steps. The first step is to determine the type of failure. The type is either a critical, non-critical, or a system-status failure. Next, the list of failure codes, warning 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 Critical Failure "FAIL"
2. Servicing a Non-Critical Failure "WARN"
3. Servicing a System Status Failure

NOTE: Refer to the **ACCEPTANCE TEST** section for test of the MMI display, keypad, and printer port, and of the measuring units.

Using the Information Status Command

Tables SE-6 and SE-7 have been provided as a listing of all the "FAIL" and "WARN" messages. They can be used to decode "Fail xxx" and "Warn 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 relay site, or remotely over a modem link.

The INFORMATION STATUS command is invoked as follows:

1. Apply rated DC power to the relay and wait for initialization to complete.
2. Press the "Information" key. Then scroll with the arrow keys until the heading "INF: STATUS" is displayed. (If you have a printer, press the {PRT} "print" key.)
3. Press the [ENT] "enter" key.

   The display will indicate that there is a failure with the words "STATUS: FAIL".
4. Press the "Up Arrow" key to get a detailed report of the failure. A complete list of the possible errors is shown in Tables SE-4,5,and 6 below.

The "FAIL" and "WARN" messages are also included. Their descriptions can also be displayed on the MMI, by using the "Information Status" command.

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 fault data will be reset.

TABLE SE-4 System Status Error Messages

SYSTEM STATUS ERROR	INDICATION	DESCRIPTION
WARN	NCA	WARN condition, press up arrow
FAIL	CA/LED	FAIL condition, press up arrow
MISC	LED	Miscellaneous condition, press up arrow

NOTE: LED = A red LED on the MMI,
NCA = energizing the non-critical alarm relay,
CA = de-energizing the critical alarm relay

SERVICING A CRITICAL FAILURE "FAIL"

A critical failure indicates total interruption of the protection function. When a failure occurs on one of the modules (excluding the power supply) the critical alarm contact will open, 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 DGP 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 DGP restarts successfully (with no self-test failures).

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 Tables SE-6 or SE-7, 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.

SERVICING A NON-CRITICAL FAILURE "WARN"

A non-critical failure indicates a possible interruption in the relay's protection, but not a total loss. When a "WARN" condition occurs, the DGP's non-critical alarm contact will close. The LED will remain green. Turn off the DC input power, then re-apply. The "WARN XXX" message should appear if the failure still exists.

The Warn message has the format "WARN xxx". The "xxx" field following the word "WARN" is the numeric code that indicates the nature of the failure. The WARN message remains on the display until a key is pressed or until the DGP restarts successfully (with no self-test failures). See Table SE-6 for the list of Warning 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 Tables SE-6 or SE-7, 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 WARN message should clear. If the "WARN" message is gone, then the unit has been successfully repaired. If the message has changed, it is possible that another module requires replacement.

TABLE SE-5 Miscellaneous Messages

Miscellaneous Message	Description	Indication
PROT OFF	Protection off	LED
DIS OUTS	Outputs Disabled	LED
RELAY TEST	Relay in Test Mode	LED
D O TEST	Digital Output test	LED

SERVICING SYSTEM "STATUS" FAILURES

A system failure is one that indicates a failure of a power system input, or indicates that the relay has been disabled by a user command. They are indicated by the "non-critical alarm" contact closing, by a red LED, or by the "critical alarm" contact closing. However, no MMI display is provided until the "Information Status" command is used.

Turn off the DC input power, then re-apply. The non-critical alarm contact will be closed if the failure still exists. Use the "Information Status" to determine the cause of the trouble.

TABLE SE-6 Error Messages at Startup

Err#	Board	Alarm	Inf Status/Display	Inf Status/Print
100	DAP	Critical	DAP:PROM	DAP BOARD:PROM
101	DAP	Critical	DAP:LOCAL RAM	DAP BOARD:LOCAL RAM
103	DAP	Critical	DAP:DSPRAM	DAP BOARD:DSPRAM
104	DAP	Critical	DAP:SYSRAM	DAP BOARD:SYSRAM
105	DAP	Critical	DAP:INTERRUPT	DAP BOARD:INTERUPT
106	DAP	Critical	DAP:TIMER	DAP BOARD:TIMER
124	DAP	Critical	DAP:VERSION NUM	DAP BOARD:VERSION NUMBER
207	DSP	Critical	DSP1:PROM	DSP BOARD1:PROM
208	DSP	Critical	DSP1:LOCAL RAM	DSP BOARD1:LOCAL RAM
209	DSP	Critical	DSP1:DSPRAM	DSP BOARD1:DSPRAM
210	DAP	Remcrit	DAP:NO DSP 1 RSP	DAP BOARD:NO DSP 1 RESPONSE
225	DSP	Critical	DSP1:VERSION NUM	DSP BOARD:DSP1 VERSION NUMBI
226	DSP	Critical	DSP2:PROM	DSP BOARD:DSP2 PROM
227	DSP	Critical	DSP2:LOCAL RAM	DSP BOARD:DSP2 LOCAL RAM
228	DSP	Critical	DSP2:DSPRAM	DSP BOARD:DSP2 DSPRAM
229	DAP	Remcrit	DAP:NO DSP 2 RSP	DAP BOARD:NO DSP 2 RESPONSE
230	DSP	Critical	DSP2:VERSION NUM	DSP BOARD:DSP2 VERSION NUMBI
231	DSP	Critical	DSP3:PROM	DSP BOARD:DSP3 PROM
232	DSP	Critical	DSP3:LOCAL RAM	DSP BOARD:DSP3 LOCAL RAM
233	DSP	Critical	DSP3:DSPRAM	DSP BOARD:DSP3 DSPRAM
234	DAP	Remcrit	DAP:NO DSP 3 RSP	DAP BOARD:NO DSP 3 RESPONSE
235	DSP	Critical	DSP3:VERSION NUM	DSP BOARD:DSP3 VERSION NUMBI
311	ANI	Critical	ANI:CONTROLLER	ANI BOARD:CONTROLLER
312	ANI	Critical	ANI:SERIAL MEMRY	ANI BOARD:SERIAL MEMORY
336	ANI	Critical	ANI:GROUND	ANI BOARD:GROUND FAILURE
414	MGM	Critical	MGM1:SERIAL MEM	MGM BOARD1:SERIAL MEMORY
422	MGM	Critical	MGM1:MODEL NUM	MGM BOARD1:MODEL NUMBER
449	MGM	Critical	MGM2:SERIAL MEM	MGM BOARD2:SERIAL MEMORY
450	MGM	Critical	MGM2:MODEL NUM	MGM BOARD2:MODEL NUMBER
515	SSP	Critical	SSP:PROM	SSP BOARD:PROM
516	SSP	Critical	SSP:LOCAL RAM	SSP BOARD:LOCAL RAM
518	SSP	Critical	SSP:SYSRAM	SSP BOARD:SYSRAM
519	SSP	Critical	SSP:INTERRUPT	SSP BOARD:INTERRUPT
520	SSP	Remcrit	SSP:EEPROM	SSP BOARD:EEPROM
523	SSP	Critical	SSP:VERSION NUM	SSP BOARD:VERSION NUMBER
556	SSP	Noncrit	SSP:TIMER	SSP BOARD:TIMER
557	SSP	Noncrit	SSP:CAPRAM	SSP BOARD:CAPRAM
558	SSP	Noncrit	SSP:CLOCK	SSP BOARD:REAL TIME CLOCK
621	MMI	Critical	MMI:DIG OUT	MMI BOARD:DIGITAL OUTPUT
655	MMI	Noncrit	MMI:SERIAL CHP 1	MMI BOARD:SERIAL CHIP #1
659	MMI	Noncrit	MMI:LED DISPLAY	MMI BOARD:LED DISPLAY
663	MMI	Noncrit	MMI:SERIAL CHP 2	MMI BOARD:SERIAL CHIP #2
664	MMI	Noncrit	MMI:SERIAL CHP 3	MMI BOARD:SERIAL CHIP #3

TABLE SE-7 Error Messages at Runtime

Err#	Board	Alarm	Inf Status/Display	Inf Status/Print
60	MISC	Noncrit	LOGON FAILURE	LOGON FAILURE
71	MISC	Noncrit	CASE GND SHORTED	CASE TO GND SHORTED
100	DAP	Crit+Wdreset	DAP:PROM	DAP BOARD:PROM
102	DAP	Crit+Wdreset	DAP:DSPRAM	DAP BOARD:DSPRAM
106	DAP	Crit+Wdreset	DAP:TIMER	DAP BOARD:TIMER
207	DSP	Remcrit	DSP1:PROM	DSP BOARD1:PROM
209	DSP	Remcrit	DSP1:DSPRAM	DSP BOARD1:DSPRAM
210	DAP	Remcrit	DAP:NO DSP 1 RSP	DAP BOARD:NO DSP 1 RESPONSE
226	DSP	Remcrit	DSP2:PROM	DSP BOARD2:PROM
228	DSP	Remcrit	DSP2:DSPRAM	DSP BOARD2:DSPRAM
229	DAP	Remcrit	DAP:NO DSP 2 RSP	DAP BOARD:NO DSP 2 RESPONSE
231	DSP	Remcrit	DSP3:PROM	DSP BOARD3:PROM
233	DSP	Remcrit	DSP3:DSPRAM	DSP BOARD3:DSPRAM
234	DAP	Remcrit	DAP:NO DSP 3 RSP	DAP BOARD:NO DSP 3 RESPONSE
246	DSP	Remcrit	DSP1:SET CHKSUM	DSP BOARD1:SETTING VERSION
247	DSP	Remcrit	DSP2:SET CHKSUM	DSP BOARD2:SETTING VERSION
248	DSP	Remcrit	DSP3:SET CHKSUM	DSP BOARD3:SETTING VERSION
313	ANI	Remcrit	ANI:REFERENCE	ANI BOARD:REFERENCE
336	ANI	Remcrit	ANI:GROUND	ANI BOARD:GROUND FAILURE
351	ANI	Remcrit	ANI:CURRENT SUM	ANI BOARD:CURRENT SUM FAILURE
352	ANI	Crit+Wdreset	ANI:CHAN SATURAT	ANI BOARD:CHANNEL SATURATED
515	SSP	Crit+Wdreset	SSP:PROM	SSP BOARD:PROM
517	SSP	Crit+Wdreset	SSP:SYSRAM CRC	SSP BOARD:SYSRAM CRC
520	SSP	Noncrit	SSP:EEPROM	SSP BOARD:EEPROM
556	SSP	Noncrit	SSP:TIMER	SSP BOARD:TIMER
557	SSP	Noncrit	SSP:CAPRAM	SSP BOARD:CAPRAM
621	MMI	Crit+Wdreset	MMI:DIG OUT	MMI BOARD:DIGITAL OUTPUT
737	PS	Remcrit	PS1 + 2: SELFTEST	POWER SUPPLY 1 & 2: FAILURE SELFTEST
738	PS	Remcrit	PS1+2:+12V BAD	POWER SUPPLY 1 AND 2:(FAIL) +12V BAD
739	PS	Remcrit	PS1+2:-12V BAD	POWER SUPPLY 1 AND 2:(FAIL) -12V BAD
740	PS	Remcrit	PS1 + 2: SELFTEST	POWER SUPPLY 1 & 2: FAILURE SELFTEST
741	PS	Remcrit	PS1+2:+12V BAD	POWER SUPPLY 1 AND 2:(FAIL) +12V BAD
742	PS	Remcrit	PS1+2:-12V BAD	POWER SUPPLY 1 AND 2:(FAIL) -12V BAD
743	PS	Remcrit	PS:SELFTEST	POWER SUPPLY:(FAILURE) SELFTEST
744	PS	Remcrit	PS:+12V BAD	POWER SUPPLY:(FAILURE) +12V BAD
745	PS	Remcrit	PS:-12V BAD	POWER SUPPLY:(FAILURE) -12V BAD
765	PS	Remnoncrit	PS1:SELFTEST	POWER SUPPLY 1:(WARNING SELFTEST)
766	PS	Remnoncrit	PS1:+12V BAD	POWER SUPPLY 1:(WARNING) +12V BAD
767	PS	Remnoncrit	PS1:-12V BAD	POWER SUPPLY 1:(WARNING) -12V BAD
768	PS	Remnoncrit	PS2:SELFTEST	POWER SUPPLY 2:(WARNING SELFTEST)
769	PS	Remnoncrit	PS2:+12V BAD	POWER SUPPLY 2:(WARNING) +12V BAD
770	PS	Remnoncrit	PS2:-12V BAD	POWER SUPPLY 2:(WARNING) -12V BAD
972	DIT	Noncrit	DIT:DIG INP	DIT BOARD:DIGITAL INPUT

SPECIFICATIONS

RATINGS

Nominal Frequency	50 or 60 Hertz
Nominal Voltage (phase to phase)	140 VAC
Rated Current	In = 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 (one per hour)	3.5 X Rated
Ambient temperature Range	
Storage	−30C to + 70C
Operation	−20C to + 55C
Humidity	95% without condensation
Insulation Test Voltage	2kV 50/60 Hz, one minute 2.8kVDC, one minute
Impulse Voltage Withstand	5kV peak, 1.2/50 microseconds, 0.5 joules
Interference Test Withstand	SWC, per ANSI C37.90.1 IEC 255-5

BURDENS

Current Circuits	0.022 ohm, 5 DEG, In = 5 amps
Voltage Circuits	.30 VA, 60 Hz .40 VA, 50 Hz
DC Battery (for contact converters)	2.5 milliamperes at rated DC Input voltage
DC Battery (power supply)	19 Watts with 1 supply 25 Watts with 2 supplies

CONTACT DATA

Trip Outputs	4 Programmable Relays with 2 Contacts Each
Trip Output Contacts	Continuous Rating=5 amperes Make and carry for tripping duty: = 30 amperes, (per ANSI C37.90). Break 180 VA resistive @125/250 Vdc Break 60 VA inductive @125/250 Vdc
Alarm Outputs	4 Programmable Relays with 1 Contact Each 1 Critical Self-Test Alarm 1 Non-Critical Self-Test Alarm 1 VT Fuse Failure Alarm 1 Power Supply Alarm per Power Supply (2 Power Supply Alarms Max)
Auxiliary Contacts (Including Alarms)	Continuous Rating=3 amperes Make and carry for 30 seconds=5 amperes Break 25 watts inductive @125/250 Vdc; maximum 250 volts or 0.5 amperes
Trip Current Monitor Sensitivity	150mA
Trip Voltage Monitor	38-300 VDC
Digital Inputs	38-300 VDC, 1-3 mA

INTERFACE DATA

System Interface	IRIG-B for Time Synchronization RS232 port-rear panel RS232 port-front panel Printer Interface-rear panel

ACCURACY

RMS Measurements	±3% of setting
Phase Measurements	±1 degree of setting
Frequency Measurements	±.01 Hz of setting
Timers	±3% of setting
Data Sample Time Tag Resolution	±1 msec
Analog (CT CKT) Supervision	0.2 Amp rms or 20% current, whichever is higher

DIMENSIONS

Height	14 inches (352 millimeters) Standard 8 rack unit
Width	19.0 inches (484 millimeters) Standard 19 inch rack
Depth	14 inches (356 millimeters)

WEIGHT

Weight	51 pounds (23 kilograms)

ALARMS

Self-Test	Critical Non-critical
VT Fuse Failure	
Loss of Power Supply	Power Supply No. 1 Power Supply No. 2

TABLE SP-1 PROTECTION FUNCTIONS AND SETTINGS RANGES

FUNCTION	SETTING	RANGE	STEP
Generator Differential (87G)	Differential Current Pickup	0.2-1.0 A	.1
Current Unbalance (46)	Negative Sequence Current	.05-2.99 A	.01
	Machine Constant - K2	1.0 - 50.0	.1
Loss of Excitation (40) (Two Independent Zones)	Zone 1 & Zone 2 Center	2.5-60 ohms	.01
	Zone 1 & Zone 2 Radius	2.5-60 ohms	.01
	Zone 1 & Zone 2 Timer	0-9.99 S	.01
Anti-Motoring (32) (Two Independent Steps)	Reverse Power No.1 & 2	0.5-99.9 W	.1
	Time Delay	1-60 S	1
100% Stator Ground (64G)	Zone 1 Neutral OV Pickup	4-40 V	.1
	Zone 1 Timer (Fundamental)	0.1-9.9 S	.1
	Zone 2 Timer (3rd Harmonic)	0.1-9.9 S	.1
Overexcitation (24)	V/Hz Pickup (Inverse)	1-1.99 PU	.01
	Time Factor (Inverse)	0.1-99.99 S	.01
	V/Hz Pickup (Instantaneous)	1-1.99 PU	.01
	Timer (Instantaneous)	0-9.9 S	.1
	Rate of Reset Timer	9.9 sec./%	

TABLE SP-1 PROTECTION FUNCTIONS AND SETTINGS RANGES, continued

FUNCTION	SETTING	RANGE	STEP
Overvoltage (59)	Voltage Pickup	100-200 V	1
	Time Factor	0.10-99.99 S	.01
Over and Underfrequency (81) (Four Independent Steps)	Set Point (Under)	40.0-65.0 Hz	.1
	Set Point (Over)	45.0-79.9 Hz	.1
	Timer (Each Step)	.05-99.99 S	.01
System Backup (51V)	Phase Time OC Pickup	0.5-16 A	.1
	Time Factor	0.1-99.99 S	.01

INTERFACE

LOCAL MAN MACHINE INTERFACE (MMI) OPERATION

DISPLAY

The display consists of 16 LED alphanumeric character positions arranged side-by-side horizontally. The display is actually comprised of two 8-position displays, mounted to look as if there is no break between them. There are also 19 Target LEDs and 1 Status LED.

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

All messages on the display are the result of some keyboard action, with four exceptions: the Trip message when the DGP has caused a protective trip, the Fail message when the DGP has discovered a critical self-test failure, the Warning message when the DGP has discovered a non-critical self-test failure, and the Initialization message when the DGP is initializing during a power up.

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

The Trip message is displayed at highest intensity and has the following format: "TRIP xxx xxx". The word "TRIP" blinks to indicate that the DGP has caused a protective trip. The two fields of information following the word "TRIP" are non-blinking and contain the following information: a three-character fault type (e.g. ABC) and a three-character trip type (see section 2, **Request Fault Information** in the **INFORMATION Key** section for a list of the trip types). The message will remain on the display permanently until removed by a keyboard operation. If the DGP restarts or is powered down and up, the trip indicator is remembered and redisplayed. As soon as any key is pressed, the Trip message is removed and no longer remembered.

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

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

The Initialization message has the format "INITIALIZING" and is displayed while the DGP is initializing itself 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. The time-out interval is set to 10 seconds when the END and ENT keys are pressed successively; at the end of this time-out interval, the display is blanked. Time-out also causes the MMI access privilege to be set at View Level.

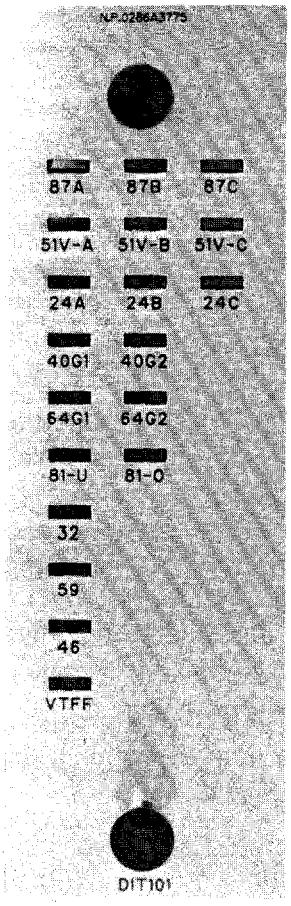


Figure IN-1 (8919548)
DGP Target LEDs

TARGET LEDs

There are 19 LEDs that indicate all of the protection functions that operated during a fault. The Target LEDs display the information for the TRIP message that is currently on the display (See Figure IN-1).

TARGET RESET KEY

The Target Reset Key is located on the front cover. Pressing it is equivalent to pressing the CLR key on the keyboard. Operation of the CLR key is explained in the section below.

KEYBOARD

The MMI keyboard is an interface method on the DGP. The keyboard is comprised of twenty keys; a 10-key numeric pad, a decimal point, and nine function keys (See Figure IN-2).

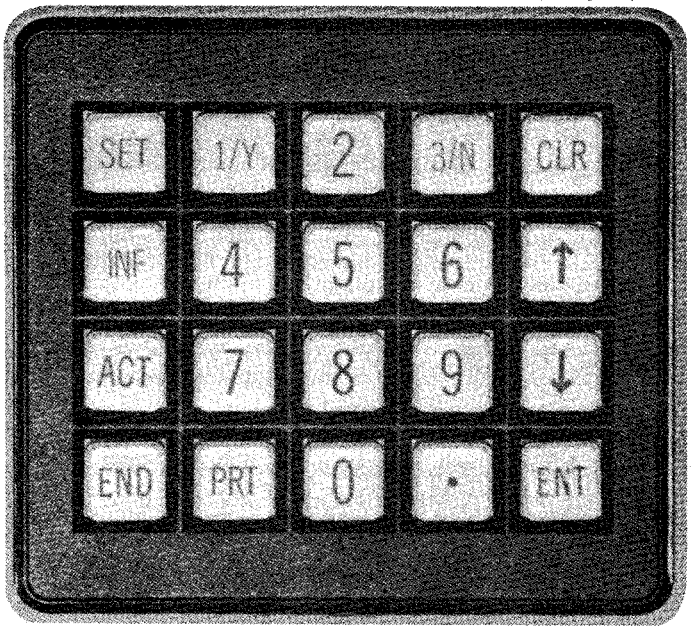


Figure IN-2 (8043811) DGP MMI Keyboard

The twenty keys are divided into three groups.

A) Control Keys - those keys that cause the display to be altered:

1. CLEAR (CLR)
2. PRINT (PRT)
3. UP ARROW
4. DOWN ARROW
4. ENTER (ENT)

B) Data Entry Keys - those keys that enter data into the DGP:

1. All numeric keys, including the decimal point

C) Command Keys - those keys that begin a command sequence:

1. END
2. SETTINGS (SET)
3. ACTIONS (ACT)
4. INFORMATION (INF)

In the following description, it is useful to think of the Command keys SET, INF, and ACT, taking the user into a list of categories, and each category being comprised of one or more items. For example, the INF key gives the user access to several categories of information: Request Present Values, Request Fault Information, etc. The Present Value Category then contains further items: Ia, Angle of Ia, Ib, Angle of Ib, Ic, Angle of Ic, etc.

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 DGP will expect a Command key to be pressed.

If the user presses the CLR key after pressing the PRT key (with no other intervening key presses), printing will be terminated. By this means, the user can halt a long printout if the PRT key was unintentionally pressed.

If a Trip, Fail, or Warn message is being displayed, the user must press the CLR key to blank the error 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.

Fault data can be displayed by pressing the CLEAR key while a TRIP message is on display. Only target information (TRIP messages) and the time of the trips, for the accumulated faults are displayed. Pressing CLEAR while the current TRIP message is displayed shows its time of occurrence. Pressing CLEAR again shows the date. Pressing CLEAR again shows target information for the previous fault. This continues until the information is displayed for all of the accumulated faults. At this point the display becomes blank. TRIP messages for the recorded faults are displayed in normal intensity and not blinking, in order to distinguish them from the latest TRIP message, which is blinking in high intensity. The Target LEDs display the protection functions that operated for the TRIP message that is currently on the display.

Present Values Scrolling is activated by pressing the CLEAR key when the display is blank (items displayed are described later under INF command key processing). Each item is displayed for 4 seconds before proceeding to the next item. After scrolling through all of the items, the display is blanked.

Both the fault data display and the Present Value display are stopped by one of the following: TRIP or a key being pressed.

PRINT Key (PRT)

The PRT key is used to direct information to the printer instead of to the display. When information is sent to the display, only one item at a time is displayed. When information is sent to the printer, all items within a category (or, in the case of settings, all settings) are printed. When the PRT key is pressed, the characters "PRT" will appear in the display.

While the DGP is printing, other MMI commands may be entered except for another print command. Another PRINT command will cause an error message to be displayed. That is, the user must wait for printing to be completed before issuing another PRINT command. To stop a print, once started, press the CLR key.

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 (e.g., "STATUS") on the display. Pressing the UP-ARROW key will then produce the name of the second category (e.g., "FAULT") on the display. When the user reaches the desired category, pressing the ENT key will then produce the first item of that category on the display. From that point on, pressing the UP-ARROW key will produce each subsequent item in the category on the display.

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

When the user is scrolling through a list of categories or items with the UP-ARROW key and gets to the last entity in the list, pressing the UP-ARROW key again will produce the first category or item on the display (wrap-around). Using the DOWN-ARROW key will likewise wrap around from the first category or item to the last. If the user is scrolling through items within a category and wants to get out of that category, pressing the 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 enter a choice. When a category name is shown on the display (as the result of pressing a Command key followed by zero or more ARROW key presses) and the user presses the ENT key, he is "choosing" that category to begin scrolling through. When the user is establishing or changing a setting, he uses the numeric keys and decimal point to indicate the value; after the last digit, he presses the ENT key to indicate "this is the value to use". When the display prompts the user to enter a number (e.g., for Fault Information, that of the 3 stored faults), the user enters the number that represents his choice, followed by the ENT key.

DATA ENTRY KEYS

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

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

END Key

The END key causes two actions. First it is used to indicate that no more setting changes will be made. 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 settings are enabled, if they were previously locked by the MMI.

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, the DGP takes no action in response to the END/ENT key sequence other than to enable action items locked previously by the MMI, to allow action commands from remote communications to be executed.

2. If the Digital Output Test was activated from the MMI, pressing the END/ENT key sequence will deactivate the test and turn protection on. This will also set the MMI Privilege Level to View Level.

3. If settings have been changed, the END/ENT key sequence will cause the DGP to reinitialize itself to use the new settings and the Event message "SETTING CHANGE DONE" will be printed. The DGP then checks whether or not outputs have been disabled by the user. If outputs have been disabled, the MMI LED (LED on the MMI panel) will remain red. If outputs are enabled, and there are no critical self-test failures of the DGP, the MMI LED will turn green. The DGP protection software reinitializes itself to use the new setting values. The displayed message changes to "ENDED". The MMI unlocks the settings lock to allow remote communication to display and change settings from the DGP.

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.

Passwords

There are two sets of passwords, MMI and Communications. Passwords are needed to perform certain operations with the DGP. A password for actions and settings is entered by selecting the ENTER PASSWD category under ACTION, and entering the password after the prompt (See the **ACTIONS Key** section below). If an action or setting change is not performed for a period of 15 minutes, the password becomes inactive. For settings, after the key sequence END ENT is pressed, the password privileges become inactive. The settings and actions may be viewed at any time but may only be changed if the password for that function is active. Refer to **Enter Password** in the **ACTIONS Key** section.

There are two MMI passwords, one for Actions and one for Settings access at the keypad. These passwords are limited to the numeric digits on the keypad. The MMI passwords are different from the Communications passwords, which are for logging into the relay, remote settings changes, and performing remote actions. The communication passwords can contain any of the allowable alpha-numeric characters in Table IN-9. All 5 types of password are listed below:

MMI Passwords	(Default)	Communications Passwords	(Default)
Actions	5678.	Actions	CTRL!
Setting Changes	1234.	Setting Changes	SETT!
		Viewing	VIEW!

The communications passwords can only be viewed at the MMI using the Information key, and the MMI passwords can only be viewed from the Information Menu under Relay Functions in DGP-LINK. All passwords are displayed in encoded form. Use Table IN-9 to decode the passwords.

SETTINGS Key (SET)

The SET key is used to display, change, or print settings. Settings are divided into categories; the categories are defined in Appendix I. For example, one category is Configuration Settings, which includes items such as user-assigned Unit ID Number, Baud Rate, etc. The categories, and the settings within each category, can be walked through using the ARROW keys. For convenience, each setting within a category is assigned a number so that the user may go directly to the setting to be viewed or changed. If the settings password is not active, the setting may only be viewed.

When the user presses the SET key, the display shows:

SET:CONFIG

If the user wants the first category, he presses the ENT key to display the first item; otherwise, the ARROW keys are used 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 and its value. Some examples are:

UNITID = 1234
SYSFREQ = 60

When the user presses one or more digits following the SET key, the name of the category is blanked and the digits are displayed starting in position 5. 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.

When the user presses the PRT key, the display says "PRT" in the rightmost positions. All settings will be printed, regardless of whether a setting number was entered. The printout will be arranged by categories.

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 present value of the setting displayed, he then uses the Data Entry keys to enter the new value. When the first Data Entry key is pressed, the abbreviated name remains on the display 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 pushed, 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 DGP stores the new value as the value of the setting. If the user presses any Command key, the PRT key, either 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.

If the user presses the ENT key, two checks are made before proceeding: privilege level must be Setting Level, and Communication must not be in the process of changing settings. If the check fails, then an error message is displayed and the setting is not entered.

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 DGP. Also, the first time a setting is successfully changed (the setting is accepted by the relay but not yet used for protection functions), it will be reported on the printer as follows:

DATE/TIME
LOCAL - SETTINGS CHANGE STARTED

After changing the value of a setting, the setting name and the new value remain 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 user presses the SET key, the current category will be 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 DGP will not stop its Protection activities. Settings are stored in a temporary buffer until the user presses END, ENT key sequence. This will cause a transfer of settings from the buffer to EEPROM, and re-initialization of protection. If the END, ENT sequence is not performed and the DGP is allowed to time out, all of the settings in the temporary storage will be lost.

ACTIONS Key (ACT)

The ACT key is used to perform actions. The categories can be scrolled through, using the ARROW keys. The 11 possible categories are listed below. The names of the categories displayed at the MMI are in parentheses. For convenience, each category has also been assigned a number so that the user may go directly to the desired category. The key sequence for selecting actions is: ACT n [ENT]

n =	1: Disable Outputs	(DISABLE)
	2: Enable Outputs	(ENABLE)
	3: Trip	(TRIP)
	4: Reset	(RESET)
	5: Enter Date and Time	(DATE/TIME)
	6: Relay Test	(RELAY TEST)
	7: MMI Test	(MMI TEST)
	8: Fix Up Settings CRC	(COMPUTE CRC)
	9: Enter Password	(ENTER PASSWORD)
	10: Change Password	(CHANGE PASSWORD)
	11: Digital Output Test	(DIG OUTPUT TEST)

"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.

When the user presses the ENT key following the displayed name of a category, the first item or prompt in that category is displayed. If the item selected was "disable", "enable", or "trip" the MMI will attempt to acquire the action lock. The action lock will lock remote communications from performing those functions. If remote communications already has the action lock, the MMI will display the "remote link active" message.

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 automatically displayed. The DGP performs the appropriate action after the last prompt has been satisfied. As soon as the action is complete, the user will be taken back to the beginning of the category (where the category name is displayed, and the DGP is expecting the ENT key to produce the first prompt, an ARROW key to move to another category, or a Command key).

1. Disable Outputs

This category is used to inhibit the DGP from energizing any of the Digital Output channels. This only includes the four Trip outputs, the four Alarm outputs, and the VTFF output. After the ENT key is pressed, the display prompts the user with the message "DIS OUTPUTS?". The user presses the 3/N key for NO or the 1/Y key for YES and then presses the ENT key (The response is echoed on the display as "NO" or "YES"). If the user responds with a NO, the message "CANCELLED" appears on the display, and no DGP action occurs. If the user responds with YES, the action is performed, the message "OUTPUTS DISABLED" appears on the display, the MMI LED (LED on the MMI panel) turns red, and the printer reports:

TIME/DATE
LOCAL - DISABLE OUTPUTS

If the user responds with a Data Entry key other than the 3/N or 1/Y keys, an error message is displayed and outputs are not disabled.

2. **Enable Outputs**

This category is used to permit the DGP to energize all of the Digital Output channels. After the ENT key is pressed, the display prompts the user with the message "EN OUTPUTS?". The user presses the 3/N key for NO or the 1/Y key for YES and then presses the ENT key (The response is echoed on the display as "NO" or "YES"). If the user responds with a NO, the message "CANCELLED" appears on the display, and no DGP action occurs. If the user responds with a YES, the action is performed, the message "OUTPUTS ENABLED" appears on the display, the MMI LED (LED on the MMI panel) turns green, and the printer reports:

TIME/DATE
LOCAL - ENABLE OUTPUTS

If the user responds with a Data Entry key other than the 3/N or 1/Y keys, an error message is displayed and outputs are not enabled.

3. **Trip**

This category is used to manually operate any one of the four output relays.

When the ENT key is pressed, the display prompts the user with the message "WHICH RLY?". The user enters the number of the desired Trip output and then presses the ENTER key. The number for each Trip contact is shown in the following table:

Input #	Trip Contact
0	94G
1	94G1
2	94G2
3	94G3

Any other Data Entry key will cause an error message to be displayed. The display then prompts the user with the message "TRIP XXXX?" (XXXX is the name of the Trip Contact). The user presses a N for NO or a Y for YES and then presses the ENT key. If the user responded with N, the message "CANCELLED" appears on the display, and no DGP action occurs. If the user responded with Y, two checks are performed: privilege level must be Control level, and Communication must not be in the process of manipulating outputs. If the checks fail, then an error message is displayed and the action is not performed. If the checks pass, then the action is performed and the message "XXXX TRIPPED" appears on the display, and the printer reports:

TIME/DATE
LOCAL - MANUAL TRIP

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 Trip contact output is not tripped. The trip command is issued for approximately .5 to 1 second.

4. **Reset**

This category is used to clear out various pieces of information stored in the DGP memory. The following information can be cleared.

FAULT REPORTS
SEQUENCE OF EVENTS

When the ENT key is pressed, the display prompts the user with the message "RST WHAT?". The user presses a 0 for FAULT REPORTS or a 1 for SEQUENCE OF EVENTS (any other Data Entry key will cause an error message to be displayed) to indicate which information is to be reset, and then presses the ENT key. The display then prompts the user with the message "RST FLT RPT?" or "RST SOE?". 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 DGP action occurs. If the user responds with a YES, the action is performed and the message "FLT RPT RESET" or "SOE RESET" is displayed, and the printer reports either:

TIME/DATE
LOCAL - FAULT REPORTS RESET

or

TIME/DATE
LOCAL - SEQUENCE OF EVENTS RESET

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 data is not reset.

5. **Date/Time**

This category is used to display or change the current date and/or time stored in the DGP. 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 01/01/90. All event and fault 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.

6. **Relay Test**

This category is used to test the relay functions of the DGP. After the ENT key is pressed, if the DGP is already in Test Mode, the display will show the current Test Mode selection. When not in Test Mode the display will show the first item, "END TEST MODE", in the list below. The user may then select a test or cancel a test either by using the UP-ARROW and DOWN-ARROW keys or entering the number corresponding to the test followed by the ENT key. The test that is being displayed is selected for execution by pressing the ENT key. At this point two checks are performed: privilege level must be Control level, and Communication must not be in the process of performing an action. If the checks fail, then an error message is displayed and the test is not selected. When the test is selected, the word "ON" will be displayed in the rightmost two characters of the display. When Test Mode has been selected (see **ACCEPTANCE TESTS** section) the pickup of the selected function will result in the output of a signal on the DOR12 contact output. The trip of the selected function will result in the output of a signal on the DOR13 contact output. The user will be able to monitor only one function at a time. That is, if a user selects a function to monitor, any previously selected function will no longer be monitored. Each test function may be selected by scrolling through the Menu, or entering the test number and pressing ENT.

To remove the DGP from test mode, the user can either press the ARROW keys until "END TEST MODE" is displayed, then press the ENT key, or press the 1/Y key followed by the ENT key twice; the currently selected function will stop being monitored.

The available tests and their corresponding numbers are shown in Table IN-1:

TABLE IN-1 TEST MODES

1: END TEST MODE
2: 87G
3: 46A
4: 46T
5: 40-1
6: 40-2
7: 32-1
8: 32-2
9: 51V
10: 64G1
11: 64G2
12: 24A
13: 24T
14: 59
15: 81-1U
16: 81-2U
17: 81-3U
18: 81-4U
19: 81-1O
20: 81-2O
21: 81-3O
22: 81-4O
23: VTFF
24: AE

7. MMI Test

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

If the user presses the PRT key, an error message is displayed, since this category does not have an option of printing or displaying.

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 LED test is skipped. If the user presses the 1/Y key followed by the ENT key, the LED's will be tested. If the green LED is on, it will be extinguished and the red LED will be lit. If the red LED is lit, it will be extinguished and the green LED will be lit. The Target LED's will flash on/off 4 times. Then each Target LED will be lit individually. When the test is over, the Target LED's will be returned to their original state.

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 has skipped the keyboard test), the display prompts with "PRINTER TEST?". If the user presses the 3/N key followed by the ENT key, the printer test is skipped and the MMI test is terminated. If the user presses the 1/Y key followed by the ENT key, the printer is tested. Patterns containing all printable characters (upper and lower case, and punctuation) will be printed in all possible columns.

If, during the above sequence, the user presses any Command key or Control key other than the ENT key, the test will be terminated. If the user presses any Data Entry key other than 1/Y or 3/N, an error message will be displayed.

8. Fix Up Settings CRC

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

After the ENT key is pressed, the display prompts the user with the message "RECALC CRC?". 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, two checks are performed: privilege level must be Setting or Control level, and Communication must not be in the process of changing settings. If the checks fail, then an error message is displayed and the action is not performed. If the checks pass, then the setting's CRC code is recalculated, the message "CHECK SETTINGS" appears on the display, and the printer reports:

TIME/DATE
LOCAL - SETTINGS CHANGE DONE

Once the setting's CRC code has been calculated and **EVERY DGP SETTING HAS BEEN EXAMINED**, then the user must press the END key and the ENT key to resume Protection. 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.

9. **Enter Password**

This category is used to enter the MMI password that activates one of the two areas of input. The first area of input allows the user to change settings (Settings Level). The second area of input allows the user to access control actions (Control Level). The privilege level reverts back to View Level when the MMI becomes idle, either by using the END key or if the MMI is allowed to time out. When the privilege level is View, values can be viewed but none can be changed.

Although the passwords are given "level" names their is no overlap in what each password can change (i.e. the things that can be done with the Settings Level password can not be done with the Control Level password, and vice versa).

After the ENTER key is pressed, the display prompts the user with the message "ENTER PASSWORD". The user responds by pressing digit keys that represent the password. The digits are echoed with "*". The user then presses the ENTER key, which displays "SELECTED" if the password was valid or "REQUEST INVALID" if it was not. MMI privilege is set to the level associated with the selected password.

NOTE: When a DGP is first shipped, special Control and Setting passwords are provided. Selecting these passwords does not increase your privilege level, but only allows you to change the password in the next item, and thereby obtain the higher levels.

10. **Change Password**

This category is used to change the password that is currently in effect. A password becomes effective through selection of Enter Password in this category.

After ENTER is pressed, the display prompts the user with the message "NEW PASSWORD". The user presses digit keys that represent the new password. The digits are echoed with "*". The user then presses the ENTER key and he is prompted with the message "REPEAT". The user must enter the new password again, then press the ENTER key. If the two entered passwords are exactly the same, then the message "CHANGED" is displayed. If they are not the same, then "NOT CHANGED" message is displayed and the old password remains selected.

11. Digital Output Test

This category is used to test digital outputs of the DGP.

After the ENTER key is pressed, the display will show the first item, "END TEST MODE", in the list below. The user may then display a test name either by using the ARROW keys or entering the number corresponding to the test, followed by the ENTER key. The test that is being displayed is selected for execution by pressing the ENTER key again.

Note: At this point the privilege level must be Control level. If the privilege level is wrong, then an error message is displayed and the test is not performed.

Now digital outputs are checked to verify that they are enabled. If they are not, then the message: ENABLE OUTPUTS is displayed and test selection is canceled.

If outputs are enabled, then the user must indicate if he wants to disable protection. The message "DISABLE PROT?" is displayed. The user presses 1 for YES or 3 for NO followed by ENTER. If the user indicated NO, then the message CANCELLED is displayed and test selection is stopped. If user indicated YES, then the test name will be redisplayed. The word "ON" will also be shown in the rightmost two characters of the display and the test will be performed.

The user will be able to control only one signal at a time. That is, if a user selects a signal to control, then any previously selected signal will no longer be monitored.

To stop the digital output test, and re-enable protection, the user presses the ARROW keys until "END TEST MODE" is displayed, or enters "1" followed by the ENTER key. He then presses ENTER.

The user can also stop the test by pressing END ENT key sequence, which ends the DGP session.

The available digital output tests and their corresponding numbers are shown in Table IN-2.

TABLE IN-2 DIGITAL OUTPUT TESTS

1:	END TEST MODE
2:	94G
3:	94G1
4:	94G2
5:	94G3
6:	74A
7:	74B
8:	74C
9:	74D
10:	74CR
11:	74NC
12:	74FF
13:	TEST PICKUP
14:	TEST TRIP

INFORMATION Key (INF)

The INF key is used to request information. The 8 categories are listed below. The names displayed at the MMI are in parentheses. The categories can be scrolled through, using the ARROW keys. For convenience, however, each category is also assigned a number so that the user may go directly to the category he wants.

The key sequence for requesting information is: INF n [ENT or PRT]

n =	1: Status Info	(STATUS)
	2: Fault Info	(FAULT)
	3: Present Values	(VALUES)
	4: Events	(EVENTS)
	5: Password	(PASSWORD)
	6: Model	(MODEL)
	7: Station Id	(STATION ID)
	8: Generator Id	(GENERATOR ID)

"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. Then when the user presses 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.

When the user presses the PRT key, the resultant display and DGP action are dependent upon the category displayed (see below).

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 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 either the ENT or the PRT key, the next prompt (if any) will be automatically displayed. The DGP displays or prints 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 DGP is expecting the ENT key to produce the first prompt, an ARROW key to move to another category, or a Command key).

1. **Request DGP Status Information**

This category is used to display or print the present status of the DGP (see **SERVICING** section).

If the user presses the ENT key, the first item displayed is the overall status of the DGP. If the DGP is working properly and protecting the generator, the display will be "STATUS: OK". If there is a critical failure, the display will be "STATUS: FAIL". If there is a non-critical failure, the display will be "STATUS: WARN". If the DGP hardware is working properly, there may be miscellaneous status, displayed under the heading "STATUS: MISC". The above order is the order in which the overall status will be displayed. For example, if there is a critical alarm and a non-critical alarm the display will be "STATUS: FAIL", indicating the critical alarm.

The user may use the arrow keys for further information if the status is a critical failure, a non-critical failure, or not protecting the generator. If the DGP is working properly and protecting the generator, however, the use of the arrow keys will result in an error message being displayed. If the status indicates a critical failure, boards containing critical failures will be reported in the following order: SSP processor board (displayed as SSP), DAP processor board (displayed as DAP), DSP processor board (displayed as DSP1,DSP2, DSP3), analog interface board (displayed as ANI), digital communications interface board and the MMI board (both displayed as MMI), and the magnetics module (displayed as MGM1 and MGM2). The last group of critical failures to be displayed are those that are not related to a board. If the user presses the UP-ARROW key, the first critical failure will be displayed, based on the above board order. Successive presses of the UP-ARROW key will display additional critical failures until there are no more critical failures. If the user continues to press the UP-ARROW key, any non-critical failures will be displayed, based on the above board order. When all critical and non-critical failures have been displayed and the user presses the UP-ARROW key again, the overall DGP 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 a non-critical failure, the same method as above is used to scroll through the non-critical failures. In this case, there will be no critical failures.

If the user presses the PRT key (rather than the ENT key, as above), the following lines are printed first:

STATUS

STATION: xxxxxxx
GENERATOR: xxxxxxx
UNIT ID: xxxx

DATE: xx/xx/xx
TIME: xx:xx:xx

If the DGP is working properly and protecting the line, the DGP will print the following line:

DGP STATUS: OK

If there is a critical failure, the DGP will print the following line:

DGP STATUS: FAILURE

If there is a non-critical failure, the DGP will print the following line:

DGP STATUS: WARNING

If the DGP hardware is working properly but miscellaneous status information is present, then the DGP will print the following line.

DGP STATUS: MISC

Critical failures, non-critical failures and miscellaneous status messages will be printed in the same order as they are displayed.

2. Request Fault Information

This category is used to display or print information associated with any of the last 3 faults that the DGP has stored.

When either the ENT key or the PRT key is pressed, the display will prompt by adding the characters "#?" after the message on the display. The user presses a digit (1 to 3), then presses the ENT key. (NOTE: 1 = most recent fault, 2 = second most recent fault, etc.). If there is no valid fault information available for that fault, the message "NO FAULT DATA" will be displayed. If the user presses any number not between 1 and 3, an error message is displayed. If the user enters the fault number followed by the PRT key, the message "INF: FAULT PRT" is shown on the display. The printed output for the fault occurrence chosen is described in Table IN-6.

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

DATE: xx/xx/xx
TIME: xx:xx:xx
OP TIME: xx (time in ms)
FAULT TYPE: xxx (examples: ABC,AB,AC)
TRIP TYPE: xxx (see the list below)

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.

Note: OP TIME is the time difference between any protection function pickup and any protection function trip, without the dropout of all protection functions at any one time. The OP TIME counter will reset if all protection functions are reset at the same time.

The abbreviations for the trip and trigger types (see the **PRODUCTS DESCRIPTION** section for fuller descriptions) are as follows:

87G
46A
46T
40-1
40-2
32-1
32-2
51V
64G1
64G2
24A
24I
24T
59
81-1O
81-2O
81-3O
81-4O
81-1U
81-2U
81-3U
81-4U
VTFF
AE
OSC
DI3
DI4

3. Request Present Values

This category is used to display or print the present analog values and the status of the contact inputs that the DGP is monitoring.

If the user presses the PRT key, the characters "PRT" are displayed in the rightmost positions, and the following is printed:

PRESENT VALUES

STATION: xxxxxxx
GENERATOR: xxxxxxx
UNIT ID: xxxx

DATE: xx/xx/xx
TIME: xx:xx:xx

IAS = xxx.xx A
ANGLE IAS = xxx.xx
IBS = xxx.xx A
ANGLE IBS = xxx.xx
ICS = xxx.xx A
ANGLE ICS = xxx.xx
IAR = xxx.xx A
ANGLE IAR = xxx.xx
IBR = xxx.xx A
ANGLE IBR = xxx.xx
ICR = xxx.xx A
ANGLE ICR = xxx.xx
I2 = xx.x %
VAN = xxx.x V
ANGLE VAN = xxx.xx
VBN = xxx.x V
ANGLE VBN = xxx.xx
VCN = xxx.x V
ANGLE VCN = xxx.xx
3RD HRM PH = xx.x %
3RD HRM N = xx.x %
WATTS = xxxxxx
VARS = xxxxxx
GEN FREQ = xx.xx
SMPL FREQ = xxx.x
GEN = ON-LINE
INLET VLV = OPEN
DIG IN 3 = OPEN
DIG IN 4 = OPEN
OSC TRIG = OPEN
EXT VTFF = OPEN

Note: Currents and voltages are RMS values and are either primary or secondary, as the user selected.

Note: Phase angles go from 0° to 180° or −1° to −179° referenced to phase A voltage. VA must be present for this function to operate.

Note: I2 = (Negative-Sequence Current/Rated Current)*100

Note: For delta connected VT, the voltages are displayed as VAB, VBC, and VCA, with angle VAB as reference.

Note: The 3rd Harmonic is displayed as a percentage of the fundamental.

Note: Watts and Vars are primary or secondary. Watts and Vars are prefixed with a "K" for kilo and an "M" for mega.

If the user presses the ENT key, the first item is displayed as "IAS = xxx.xx". Pressing the UP-ARROW key will produce "ANGLE IAS = xxx.xx" on the display, etc. Continuing to press the UP-ARROW key will display each of the quantities shown in the description of PRESENT VALUES in turn. Pressing the UP-ARROW key after the last value will return to the first quantity in the list (IAS). The DOWN-ARROW key can be used to scroll backwards through the items.

The values are periodically updated while on display.

4. **Request Events**

This category is used to print Sequence-of-Events information. The occurrence of any of the following events is saved in memory.

- Trip signal (A,B,C,D) ON/RESET
- Protection element ACTIVE/INACTIVE
- OPERATE/RESET of each digital input
- VT fuse failure DETECTED/NOT DETECTED
- Trip voltage lost or restored (A,B,C,D)
- Trip circuit ENERGIZED/NOT ENERGIZED
- LOCAL/REMOTE Password changed
- Outputs ENABLED/DISABLED
- Settings changed
- Hardware failure message
- Hardware warning message
- Login failure

If the user presses the PRT key, the characters "PRT" are displayed in the rightmost positions, and the following kinds of messages are printed:

EVENTS

STATION: xxxxxxx
GENERATOR: xxxxxxx
UNIT ID: xxxx

DATE: xx/xx/xx
TIME: xx:xx:xx

xx/xx/xx xx:xx:xx.xxx
FAIL - ANI BOARD:CURRENT SUM

xx/xx/xx xx:xx:xx.xxx
ANI BOARD: CURRENT SUM FAILURE CLEARED

xx/xx/xx xx:xx:xx.xxx
GENERATOR OFF-LINE

xx/xx/xx xx:xx:xx.xxx
FUEL VALVE OPENED

xx/xx/xx xx:xx:xx.xxx
OUTPUTS ENABLED

xx/xx/xx xx:xx:xx.xxx
SSP BOARD: LOCAL RAM

(If the user presses the ENT key, an error message is displayed, since Events can only be printed.)

5. **View Password**

This category is used to view the remote communication passwords in encrypted form.

If the user presses the ENTER key, a check is made to verify that Communication is not in the process of changing the passwords. If the check fails, then an error message is displayed and the action is not performed. If the check passes, then the word VIEW is displayed. Pressing the UP ARROW key displays the View level password. Pressing the UP-ARROW repeatedly displays the word SETTING, then the Setting level password; finally the word CONTROL, followed by the Control level password, and back to the word VIEW. All passwords are displayed in encrypted form.

(If the user presses the PRINT key, an error message is displayed, since the communication password can only be displayed.)

6. **Request DGP Model/Version**

This category is used to display or print the DGP model number and the PROM version number.

If the user presses the PRT key, the characters "PRT" are displayed in the rightmost positions, and the following is printed:

DGP MODEL AND VERSION

STATION: xxxxxxx
GENERATOR: xxxxxxx
UNIT ID: xxxx

DATE: xx/xx/xx
TIME: xx:xx:xx
MODEL NUMBER: DGPXXXXXX
PROM VERSION NUMBER: VXXX.XXXXXX

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.

7. **Station Id**

This category is used to view the 32-character Station Id string that was downloaded by the Remote Communication link. Station Id is printed out with all MMI reports.

If the user presses the ENTER key, a check is made to verify that Communication is not in the process of changing the Station Id. If the check fails, then an error message is displayed and the action is not performed.

If the check passes, then the first 16 characters of the Station Id are displayed. Pressing the UP- or DOWN-ARROW displays the next 16 characters of the Station Id.

If the user presses the PRINT key, an error message is displayed. It is possible to have Station Id printed out, however, by requesting any of the DGP reports.

8. **Generator Id**

This category is used to view the 32-character Line Id string that was downloaded by the Remote Comm. The Line Id is printed out with all MMI reports.

If the user presses the ENTER key, a check is made to verify that Communication is not in the process of changing the Generator Id. If the check fails, then an error message is displayed and the action is not performed.

If the check passes, then the first 16 characters of the Generator Id are displayed. Pressing the UP- or DOWN-ARROW displays the next 16 characters of the Id.

If the user presses the PRINT key, an error message is displayed. It is possible to have Line Id printed out, however, by requesting any of the DGP reports.

ERRORS

If the user enters a wrong response (either data or a choice), an error message will be displayed. See Table IN-5 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 then press the CLR key to blank the error message (all other keys will be ignored). When the error message is blanked, the last message will be re-displayed, allowing the user to re-enter the correct response.

If the setting's 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 recalculate the CRC. Once the setting's CRC has been recalculated by issuing the COMPUTE CRC 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 IN-3 ACCESS LEVEL INPUT

DGP Operation	Required Access Level
Change Password	Any Level
Trip Breaker	Actions Level
Enable Outputs	Actions Level
Disable Outputs	Actions Level
Change Time and Date	Settings Level
Calculate CRC	Any Level
Relay Test	Actions Level
Digital Output Test	Actions Level
Perform Settings Changes	Settings Level
Data Reset	Actions Level

TABLE IN-4 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
ENT	UNITID =1
UP-ARROW	SYSFREQ =60
5	SYSFREQ :5
0	SYSFREQ :50
ENT	SYSFREQ =50

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

KEY	DISPLAY
SET	SET:CONFIG
1	SET:1
0	SET:10
2	SET:102
ENT	SYSFREQ =50
5	SYSFREQ :5
0	SYSFREQ :50
ENT	SYSFREQ =50

The following key sequences show how each action is accomplished.

ACTION	KEY	DISPLAY
DISABLE OUTPUTS	ACT	ACT:DISABLE
	ENT	DIS OUTPUTS?
	1/Y	DIS OUTPUTS? YES
	ENT	OUTPUTS DISABLED

ENABLE OUTPUTS	ACT	ACT:DISABLE
	2	ACT:2
	ENT	EN OUTPUTS?
	1/Y	EN OUTPUTS? YES
	ENT	OUTPUTS ENABLED
TRIP	ACT	ACT:DISABLE
	3	ACT:3
	ENT	WHICH RLY?
	2	WHICH RLY? 94G2
	ENT	TRIP 94G2?
	1/Y	TRIP 94G2? YES
	ENT	94G2 TRIP ISSUED
RESET	ACT	ACT:DISABLE
	4	ACT:4
	ENT	RST WHAT?
	0	RST WHAT?FLT RPT
	ENT	RST FLT RPT?
	1/Y	RST FLT RPT?YES
	ENT	FLT RPT RESET
DATE/TIME	ACT	ACT:DISABLE
	5	ACT:5
	ENT	DATE: 08/29/88
	0	DATE: 0 / /
	3	DATE: 03/ /
	0	DATE: 03/0 /
	3	DATE: 03/03/
	6	DATE: 03/03/6
	3	DATE: 03/03/63
	ENT	DATE= 03/03/63
	UP-ARROW	TIME: 12:34:55
	0	TIME: 0 : :
	9	TIME: 09: :
	2	TIME: 09:2 :
	4	TIME: 09:24:
	1	TIME: 09:24:1
	6	TIME: 09:24:16
	ENT	TIME= 09:24:16
RELAY TEST	ACT	ACT:DISABLE
	6	ACT:6
	ENT	END TEST MODE
	UP-ARROW	87G
	UP-ARROW	46A
	ENT	46A ON

MMI TEST	ACT	ACT:DISABLE
	7	ACT:7
	ENT	########NEXT?
	1/Y	########NEXT?YES
	ENT	LED TST?########
	3/N	LED TST?#####NO
	ENT	KEYBRD TEST?
	3/N	KEYBRD TEST?NO
	ENT	PRINTER TEST?
	3/N	PRINTER TEST?NO
	ENT	ACT:MMI TEST
COMPUTE CRC	ACT	ACT:DISABLE
	8	ACT:8
	ENT	RECALC CRC?
	1/Y	RECALC CRC?YES
	ENT	CHECK SETTINGS
ENTER PASSWORD	ACT	ACT:DISABLE
	9	ACT:9
	ENT	ENTER PASSWORD
	n..n	********
	ENT	SELECTED
CHANGE PASSWORD	ACT	ACT:DISABLE
	10	ACT:10
	ENT	NEW PASSWORD
	n..n	********
	ENT	REPEAT
	n..n	********
	ENT	CHANGED
DIGITAL OUTPUT TEST	ACT	ACT:DISABLE
	11	ACT:11
	ENT	END TEST MODE
	UP-ARROW	94G
	UP-ARROW	94G1
	UP-ARROW	94G2
	ENT	DISABLE PROT?
	1/Y	DISABLE PROT?YES
	ENT	94G2 ON

The following key sequences show how information is retrieved.

INFORMATION	**KEY**	**DISPLAY**
STATUS	INF	INF:STATUS
	ENT	STATUS: WARN
	UP-ARROW	LOGIN FAILURE

CATEGORY: 46T -- Current Unbalance Trip

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0401	Trip Output 46T	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0402	Alarm Output 46T	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0403	Negative Sequence Curr Pickup	PICKUP	Arms	0.05 - 2.99	x.xx
0404	Machine Constant	K2	Sec	1.0 - 50.0	xx.x

CATEGORY: 40 -- Loss-of-Field Protection Supervision

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
0501	Negative Sequence Voltage Supervision	SELV2SUP	N/A	0 or 1	x
	- Disable	DISABLE	N/A	0	
	- Enable	ENABLE	N/A	1	

CATEGORY: 40-1 -- Loss-of-Field Protection Zone 1

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0601	Trip Output 40-1	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0602	Alarm Output 40-1	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0603	Zone 1 Center	CENTER	Ohms	2.5 - 60.00	xx.xx
0604	Zone 1 Radius	RADIUS	Ohms	2.5 - 60.00	xx.xx
0605	Timer	TL12	Sec	0.01 - 9.99	x.xx

CATEGORY: 40-2 -- Loss-of-Field Protection Zone 2

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0701	Trip Output 40-2	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0702	Alarm Output 40-2	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0703	Zone 2 Center	CENTER	Ohms	2.5 - 60.00	xx.xx
0704	Zone 2 Radius	RADIUS	Ohms	2.5 - 60.00	xx.xx
0705	Timer	TL13	Sec	0.01 - 9.99	x.xx

CATEGORY: 32-1 -- Anti-Motoring with Accidental Energization and Sequential Trip Supervision

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0801	Trip Output 32-1	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0802	Alarm Output 32-1	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0803	Sequential Trip Enable	SQ TR EN	N/A	YES or NO	YES/NO
	- Disable	DISABLE	N/A	3/N	
	- Enable	ENABLE	N/A	1/Y	
0804	Reverse Power	REV PWR	Watts	0.5 - 99.9	xx.x
0805	Pickup Timer	TL1	Sec	1 - 60	xx

CATEGORY: 32-2 -- Anti-Motoring

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0901	Trip Output 32-2	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0902	Alarm Output 32-2	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0903	Reverse Power	REV PWR	Watts	0.5 - 99.9	xx.x
0904	Pickup Timer	TL2	Sec	1 - 60	xx

CATEGORY: 51V -- Overcurrent with Voltage Restraint

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1001	Trip Output 51V	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1002	Alarm Output 51V	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1003	Overcurrent Pickup	PICKUP	Arms	0.5 - 16	xx.x
1004	Time Factor	TIME FAC	Sec	0.1 - 99.99	xx.xx

CATEGORY: 64G1 -- Fundamental Frequency Neutral Overvoltage

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1101	Trip Output 64G1	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1102	Alarm Output 64G1	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1103	Neutral Overvoltage Pickup	PICKUP	Vrms	4.0 - 40.0	xx.x
1104	Pickup Timer	TL4	Sec	0.1 - 9.9	x.x

CATEGORY: 64G2 -- Percentage of 3rd Harmonic in the Neutral

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1201	Trip Output 64G2	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1202	Alarm Output 64G2	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1203	Pickup Timer	TL5	Sec	0.1 - 9.9	x.x

CATEGORY: 24A -- Volt/Hertz Overexcitation Alarm

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1301	Alarm Output 24A	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1302	V/Hz Pickup	PICKUP	P.U.	1.0 - 1.99	x.xx
1303	Pickup Timer	TL6	Sec	0 - 9.9	x.x

CATEGORY: 24T -- Volt/Hertz Overexcitation Trip

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1401	Trip Output 24T (Online)	TRIP ON	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1402	Trip Output 24T (Offline)	TRIP OFF	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1403	Alarm Output 24T	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1404	Curve Number	CURVE #	N/A	1 - 4	x
	- Inverse Curve	INVERSE	N/A	1	
	- Very Inverse Curve	VRY INV	N/A	2	
	- Extremely Inverse Curve	EXT INV	N/A	3	
	- Definite Time	DF TIME	N/A	4	
1405	V/Hz Pickup (Inverse)	INV PU	P.U.	1.0 - 1.99	x.xx
1406	Time Factor (Inverse)	TIME FAC	Sec	0.1 - 99.99	xx.xx
1407	V/Hz Pickup (Instantaneous)	INST PU	P.U.	1.0 - 1.99	x.xx
1408	Timer	TL7	Sec	0 - 9.9	x.x
1409	Rate of Reset Timer	RESET	Sec	0 - 999	xxx

CATEGORY: 59 -- Positive Sequence Overvoltage

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1501	Trip Output 59	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1502	Alarm Output 59	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1503	Positive Sequence Volts PU	PICKUP	Vrms	100 - 200	xx.x
1504	Time Factor	TIME FAC	Sec	0.1 - 99.99	xx.xx

CATEGORY: 81 -- Undervoltage Cutoff for All 81 Functions

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
1601	Under Voltage Cutoff	UVCUTOFF	%	35 - 99	xx

CATEGORY: 81-1U -- Underfrequency Unit #1

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1701	Trip Output 81-1U	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1702	Alarm Output 81-1U	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1703	Underfrequency Set Point #1	SET PNT	Hz	40.00 - 65.00	xx.xx
1704	Timer	TL8	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-2U -- Underfrequency Unit #2

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1801	Trip Output 81-2U	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1802	Alarm Output 81-2U	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1803	Underfrequency Set Point #2	SET PNT	Hz	40.00 - 65.00	xx.xx
1804	Timer	TL9	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-3U -- Underfrequency Unit #3

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
1901	Trip Output 81-3U	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
1902	Alarm Output 81-3U	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
1903	Underfrequency Set Point #3	SET PNT	Hz	40.00 - 65.00	xx.xx
1904	Timer	TL10	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-4U -- Underfrequency Unit #4

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
2001	Trip Output 81-4U	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2002	Alarm Output 81-4U	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2003	Underfrequency Set Point #4	SET PNT	Hz	40.00 - 65.00	xx.xx
2004	Timer	TL11	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-1O -- Overfrequency Unit #1

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
2101	Trip Output 81-1O	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2102	Alarm Output 81-1O	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2103	Overfrequency Set Point #1	SET PNT	Hz	45.00 - 79.99	xx.xx
2104	Timer	TL15	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-2O -- Overfrequency Unit #2

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
2201	Trip Output 81-2O	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2202	Alarm Output 81-2O	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2203	Overfrequency Set Point #2	SET PNT	Hz	45.00 - 79.99	xx.xx
2204	Timer	TL16	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-3O -- Overfrequency Unit #3

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
2301	Trip Output 81-3O	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2302	Alarm Output 81-3O	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2303	Overfrequency Set Point #3	SET PNT	Hz	45.00 - 79.99	xx.xx
2304	Timer	TL17	Sec	0.05 - 99.99	xx.xx

CATEGORY: 81-4O -- Overfrequency Unit #4

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
2401	Trip Output 81-4O	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2402	Alarm Output 81-4O	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2403	Overfrequency Set Point #4	SET PNT	Hz	45.00 - 79.99	xx.xx
2404	Timer	TL18	Sec	0.05 - 99.99	xx.xx

CATEGORY: DIG INP -- Digital Input Configuration

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
2501	DI1 Blocking Selection for VTFF/64G2	SELBKDI1	N/A	0 - 3	x
	- No Blocking by DI1	NO BLK	N/A	0	
	- Block VTFF by DI1	BLKVTFF	N/A	1	
	- Block 64G2 by DI1	BLK64G2	N/A	2	
	- Block VTFF & 64G2 by DI1	BLKBOTH	N/A	3	
2502	Trip Output DI3	DI3 TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2503	Alarm Output DI3	DI3 ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	

FAULT	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	ENT	FAULT #?
	1	FAULT #? 1
	ENT	DATE: MM/DD/YY
	UP-ARROW	TIME: HH:MM:SS
	UP-ARROW	OP TIME: xx
	UP-ARROW	FAULT TYPE: AB
	UP-ARROW	TRIP TYPE : 87G
VALUES	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	ENT	IAS = x.xx A
	UP-ARROW	ANGLE IAS = xxxx
	UP-ARROW	IBS = x.xx A
	UP-ARROW	ANGLE IBS = xxxx
EVENTS	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:EVENTS
	PRT	INF:EVENTS PRT
PASSWORD	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:EVENTS
	UP-ARROW	INF:PASSWORD
	ENT	VIEW
	UP-ARROW	!A@1#$45%*T()
	UP-ARROW	SETTING
	UP-ARROW	!@#$%%^&*((()
	UP-ARROW	CONTROL
	UP-ARROW	&^$%#%^&*(()@
MODEL	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:EVENTS
	UP-ARROW	INF:PASSWORD
	UP-ARROW	INF:MODEL
	ENT	MD:DGPXXXXXX
	UP-ARROW	VER:V001.XXXX
STATION ID	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:EVENTS
	UP-ARROW	INF:PASSWORD
	UP-ARROW	INF:MODEL
	UP-ARROW	INF:STATION ID
	ENT	MALVERN

GENERATOR ID	INF	INF:STATUS
	UP-ARROW	INF:FAULT
	UP-ARROW	INF:VALUES
	UP-ARROW	INF:EVENTS
	UP-ARROW	INF:PASSWORD
	UP-ARROW	INF:MODEL
	UP-ARROW	INF:STATION ID
	UP-ARROW	INF:GENERATOR ID
	ENT	MODEL GENERATOR

TABLE IN-5 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. Some examples are: The PRT key is pressed for an action item. The ENT key is pressed to view events. 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.
DATE INVALID	The day, month, and/or year are not valid.
TIME INVALID	The hour, minute, and/or second are not valid.
FAULT # INVALID	A fault number greater than the number of faults selected, or 0, was entered.
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 setting's CRC code is in error.

TABLE IN-6 FAULT REPORT

```
------------------------------------------------------------
                       FAULT REPORT
------------------------------------------------------------

STATION: MALVERN
GENERATOR: MODEL GENERATOR
UNIT ID: 1234

          FAULT DATE:  07/20/90
          FAULT TIME: 13:01:23.205
          SYSTEM OPERATING TIME: 0
          FAULT TYPE: ABC
          TRIP TYPE: 24I

          PREFAULT IA: x.xx A
          PREFAULT IB: x.xx A
          PREFAULT IC: x.xx A

          FAULT VAN: xx.x V
          FAULT VBN: xx.x V
          FAULT VCN: xx.x V

          PREFAULT WATTS: +xx.x WATTS
          PREFAULT VARS: +xx.x VARS
          PREFAULT FREQ:  xx.xx Hz

          FAULT VAN: xx.xx V
          FAULT VBN: xx.xx V
          FAULT VCN: xx.xx V
          FAULT VN: xx.xx V

          FAULT IAS: xx.xx A
          FAULT IBS: xx.xx A
          FAULT ICS: xx.xx A
          FAULT INS: xx.xx A

          FAULT IAR: xx.xx A
          FAULT IBR: xx.xx A
          FAULT ICR: xx.xx A
          FAULT INR: xx.xx A


xx/xx/xx  xx:xx:xx.xxx
24I PHASE A ON

xx/xx/xx  xx:xx:xx.xxx
94G  TRIP SIGNAL ON

xx/xx/xx  xx:xx:xx.xxx
24I PHASE C ON

xx/xx/xx  xx:xx:xx.xxx
24I PHASE B ON
```

xx/xx/xx xx:xx:xx.xxx
24T PHASE C ON

xx/xx/xx xx:xx:xx.xxx
24T PHASE B ON

xx/xx/xx xx:xx:xx.xxx
24T PHASE A ON

xx/xx/xx xx:xx:xx.xxx
24T PHASE A OFF

xx/xx/xx xx:xx:xx.xxx
24I PHASE A OFF

xx/xx/xx xx:xx:xx.xxx
24T PHASE C OFF

xx/xx/xx xx:xx:xx.xxx
24I PHASE C OFF

xx/xx/xx xx:xx:xx.xxx
24T PHASE B OFF

xx/xx/xx xx:xx:xx.xxx
24I PHASE B OFF

xx/xx/xx xx:xx:xx.xxx
94G TRIP SIGNAL RESET

TABLE IN-7 EVENT MESSAGES

The following is the list of events printed by the DGP:

24A PHASE A ON
24A PHASE B ON
24A PHASE C ON
24A PHASE A OFF
24A PHASE B OFF
24A PHASE C OFF
24I PHASE A ON
24I PHASE B ON
24I PHASE C ON
24I PHASE A OFF
24I PHASE B OFF
24I PHASE C OFF
24T PHASE A ON
24T PHASE B ON
24T PHASE C ON
24T PHASE A OFF
24T PHASE B OFF
24T PHASE C OFF
51V PHASE A ON
51V PHASE B ON
51V PHASE C ON
51V PHASE A OFF
51V PHASE B OFF
51V PHASE C OFF
87G PHASE A ON
87G PHASE B ON
87G PHASE C ON
87G PHASE A OFF
87G PHASE B OFF
87G PHASE C OFF

46A ON
46A OFF
46T ON
46T OFF
59 ON
59 OFF
64G1 ON
64G1 OFF
64G2 ON
64G2 OFF
32-1 ON
32-1 OFF
32-2 ON
32-2 OFF
40-1 ON
40-1 OFF
40-2 ON
40-2 OFF

81-1O ON
81-1O OFF
81-2O ON
81-2O OFF
81-3O ON
81-3O OFF
81-4O ON
81-4O OFF
81-1U ON
81-1U OFF
81-2U ON
81-2U OFF
81-3U ON
81-3U OFF
81-4U ON
81-4U OFF

94G TRIP SIGNAL ON
94G1 TRIP SIGNAL ON
94G2 TRIP SIGNAL ON
94G3 TRIP SIGNAL ON
94G TRIP SIGNAL RESET
94G1 TRIP SIGNAL RESET
94G2 TRIP SIGNAL RESET
94G3 TRIP SIGNAL RESET
94G TRIP CIRCUIT ENERGIZED
94G1 TRIP CIRCUIT ENERGIZED
94G2 TRIP CIRCUIT ENERGIZED
94G3 TRIP CIRCUIT ENERGIZED
94G TRIP CIRCUIT NOT ENERGIZED
94G1 TRIP CIRCUIT NOT ENERGIZED
94G2 TRIP CIRCUIT NOT ENERGIZED
94G3 TRIP CIRCUIT NOT ENERGIZED
94G TRIP CIRCUIT OPEN ALARM ON
94G1 TRIP CIRCUIT OPEN ALARM ON
94G2 TRIP CIRCUIT OPEN ALARM ON
94G3 TRIP CIRCUIT OPEN ALARM ON
94G TRIP CIRCUIT OPEN ALARM OFF
94G1 TRIP CIRCUIT OPEN ALARM OFF
94G2 TRIP CIRCUIT OPEN ALARM OFF
94G3 TRIP CIRCUIT OPEN ALARM OFF

GENERATOR OFF-LINE
GENERATOR ON-LINE
TURBINE INLET VALVE CLOSED
TURBINE INLET VALVE OPENED
DIGITAL INPUT 3 CLOSED
DIGITAL INPUT 4 CLOSED
DIGITAL INPUT 3 OPENED
DIGITAL INPUT 4 OPENED
OSC TRIGGER
VT FUSE FAILURE ALARM ON
VT FUSE FAILURE ALARM OFF
EXTERNAL VTFF CLOSED
EXTERNAL VTFF OPEN

REMOTE - PASSWORD CHANGED
REMOTE - MANUAL TRIP
REMOTE - ENABLE OUTPUTS
REMOTE - DISABLE OUTPUTS
REMOTE - SETTINGS CHANGE STARTED
REMOTE - SETTINGS CHANGE DONE
REMOTE - MANUAL TRIP ATTEMPT
REMOTE - PROTECTION TURNED ON
REMOTE - PROTECTION TURNED OFF
REMOTE - FAULT REPORTS RESET
REMOTE - SEQUENCE OF EVENTS RESET

LOCAL - MANUAL TRIP
LOCAL - ENABLE OUTPUTS
LOCAL - DISABLE OUTPUTS
LOCAL - SETTINGS CHANGE STARTED
LOCAL - SETTINGS CHANGE DONE
LOCAL - MANUAL TRIP ATTEMPT
LOCAL - PROTECTION TURNED ON
LOCAL - PROTECTION TURNED OFF
LOCAL - FAULT REPORTS RESET
LOCAL - SEQUENCE OF EVENTS RESET

DAP BOARD: PROCESSOR FAILURE CLEARED
DSP1 BOARD: FAILURE CLEARED
DSP2 BOARD: FAILURE CLEARED
DSP3 BOARD: FAILURE CLEARED
DSP1 BOARD: NO RESPONSE CLEARED
DSP2 BOARD: NO RESPONSE CLEARED
DSP3 BOARD: NO RESPONSE CLEARED
SSP BOARD: FAILURE CLEARED
SSP BOARD: QUEUES REINITIALIZED
DCI BOARD: FAILURE CLEARED
MGM1 BOARD: FAILURE CLEARED
MGM2 BOARD: FAILURE CLEARED
ANI BOARD: FAILURE CLEARED
ANI BOARD: REFERENCE CORRECTED
ANI BOARD: GROUND FAILURE CLEARED
ANI BOARD: CURRENT SUM FAILURE CLEARED
MMI BOARD: FAILURE CLEARED
DIT BOARD: DIGITAL INPUT CORRECTED
PS1 BOARD: LOGIC FAILURE CLEARED
PS1 BOARD: +12V FAILURE CLEARED
PS1 BOARD: -12V FAILURE CLEARED
PS2 BOARD: LOGIC FAILURE CLEARED
PS2 BOARD: +12V FAILURE CLEARED
PS2 BOARD: -12V FAILURE CLEARED
PS BOARD: LOGIC FAILURE CLEARED
PS BOARD: +12V FAILURE CLEARED
PS BOARD: -12V FAILURE CLEARED
CASE TO GROUND SHORT REMOVED

FAIL - DAP BOARD: PROM
FAIL - DAP BOARD: LOCAL RAM
FAIL - DAP BOARD: DSPRAM CRC
FAIL - DAP BOARD: DSPRAM
FAIL - DAP BOARD: SYSRAM
FAIL - DAP BOARD: INTERRUPT
FAIL - DAP BOARD: TIMER
FAIL - DAP BOARD: VERSION NUMBER
FAIL - DSP 1 BOARD: PROM
FAIL - DSP 1 BOARD: LOCAL RAM
FAIL - DSP 1 BOARD: SHARED RAM
FAIL - DSP 1 BOARD: INTERRUPT
FAIL - DSP 1 BOARD: VERSION NUMBER
FAIL - DSP 2 BOARD: PROM
FAIL - DSP 2 BOARD: LOCAL RAM
FAIL - DSP 2 BOARD: SHARED RAM
FAIL - DSP 2 BOARD: INTERRUPT
FAIL - DSP 2 BOARD: VERSION NUMBER
FAIL - DSP 3 BOARD: PROM
FAIL - DSP 3 BOARD: LOCAL RAM
FAIL - DSP 3 BOARD: DSPRAM
FAIL - DSP 3 BOARD: INTERRUPT
FAIL - DSP 3 BOARD: VERSION NUMBER
FAIL - ANI BOARD: CONTROLLER
FAIL - ANI BOARD: SERIAL MEMORY
FAIL - ANI BOARD: REFERENCE
FAIL - MGM 1 BOARD: SERIAL MEMORY
FAIL - MGM 1 BOARD: MODEL NUMBER
FAIL - MGM 2 BOARD: SERIAL MEMORY
FAIL - MGM 2 BOARD: MODEL NUMBER
FAIL - SSP BOARD: PROM
FAIL - SSP BOARD: LOCAL RAM
FAIL - SSP BOARD: SYSRAM CRC
FAIL - SSP BOARD: SYSRAM
FAIL - SSP BOARD: INTERRUPT
FAIL - SSP BOARD: EEPROM
FAIL - SSP BOARD: VERSION NUMBER
FAIL - MMI BOARD: DIGITAL OUTPUT
FAIL - PS1 BOARD: LOGIC VOLTAGE FAILED
FAIL - PS1 BOARD: +12 VOLTAGE FAILED
FAIL - PS1 BOARD: -12 VOLTAGE FAILED
FAIL - PS2 BOARD: LOGIC VOLTAGE FAILED
FAIL - PS2 BOARD: +12 VOLTAGE FAILED
FAIL - PS2 BOARD: -12 VOLTAGE FAILED
FAIL - ANI BOARD: CURRENT SUM
FAIL - ANI BOARD: CHANNEL SATURATED

WARN - ANI BOARD: GROUND REFERENCE
WARN - SSP BOARD: TIMER
WARN - SSP BOARD: CAPRAM
WARN - SSP BOARD: REAL TIME CLOCK
WARN - MMI BOARD: LED DISPLAY
WARN - MMI BOARD: FRONT SERIAL CHIP
WARN - MMI BOARD: BACK SERIAL CHIP
WARN - MMI BOARD: PRINT SERIAL CHIP
WARN - PS1 BOARD: LOGIC VOLTAGE FAILED
WARN - PS1 BOARD: +12 VOLTAGE FAILED
WARN - PS1 BOARD: -12 VOLTAGE FAILED
WARN - PS2 BOARD: LOGIC VOLTAGE FAILED
WARN - PS2 BOARD: +12 VOLTAGE FAILED
WARN - PS2 BOARD: -12 VOLTAGE FAILED
WARN - DIT BOARD: DIGITAL INPUT FAIL
WARN - CASE TO GROUND SHORTED
WARN - SPURIOUS TIME STROBES
WARN - REMOTE COMM LOGIN FAILED

Note: If the 3rd login attempt fails, this message will be evented (i.e. bad password).

The list of MMI messages under the STATUS category is as follows:

DAP:PROM
DAP:LOCAL RAM
DAP:DSPRAM CRC
DAP:SYSRAM
DAP:INTERRUPT
DAP:TIMER
DAP:VERSION NUM
DAP:NO DSP 1 RSP
DAP:NO DSP 2 RSP
DAP:NO DSP 3 RSP
DAP:NO SSP INT

DSP1:PROM
DSP1:LOCAL RAM
DSP1:DSPRAM
DSP1:VERSION NUM
DSP1:SET CHKSUM
DSP2:PROM
DSP2:LOCAL RAM
DSP2:DSPRAM
DSP2:VERSION NUM
DSP2:SET CHKSUM
DSP3:PROM
DSP3:LOCAL RAM
DSP3:DSPRAM
DSP3:VERSION NUM
DSP3:SET CHKSUM

ANI:CONTROLLER
ANI:SERIAL MEMRY
ANI:GROUND
ANI:REFERENCE
ANI:CURRENT SUM
ANI:NO DMA INT
ANI:CHAN SATURAT

SSP:PROM
SSP:LOCAL RAM
SSP:SYSRAM
SSP:INTERRUPT
SSP:EEPROM
SSP:VERSION NUM
SSP:TIMER
SSP:CAPRAM
SSP:CLOCK
SSP:NO DAP INT

MMI:DIG OUT
MMI:LED DISPLAY
MMI:SERIAL CHP 1
MMI:SERIAL CHP 2
MMI:SERIAL CHP 3

MGM1:SERIAL MEMR
MGM1:MODEL NUMB
MGM2:SERIAL MEMR
MGM2:MODEL NUMB

DIT:DIG INP
DIT:DIG INP COR

PS1&2:+12V FAIL
PS1&2:–12V FAIL
PS:FAILED
PS:+12V FAILED
PS:–12V FAILED
PS1:FAILED
PS1:+12V FAILED
PS1:–12V FAILED
PS2:FAILED
PS2:+12V FAILED
PS2:–12V FAILED

FUSE FAILURE
LOGON FAILURE
RELAY TEST
PROT OFF
DIS OUTS
CASE GND SHORTED
D O TEST
TIME STROBE FAIL
94G TRP CIR OPN
94G1 TRP CIR OPN
94G2 TRP CIR OPN
94G3 TRP CIR OPN

TABLE IN-8 DGP SETTINGS

CATEGORY: CONFIG -- Configuration

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
0101	Unit Identification	UNITID	N/A	0 - 9999	xxxx
0102	System Frequency	SYSFREQ	Hz	50 or 60	xx
0103	Select Trip Volt Monitor	SEL TVM	N/A	0000 - 1111	xxxx
	- Select TVM1			1xxx	
	- Unselect TVM1			0xxx	
	- Select TVM2			x1xx	
	- Unselect TVM2			x0xx	
	- Select TVM3			xx1x	
	- Unselect TVM3			xx0x	
	- Select TVM4			xxx1	
	- Unselect TVM4			xxx0	
0104	Select Trip Cur Monitor	SEL TCM	N/A	0000 - 1111	xxxx
	- Select TCM1			1xxx	
	- Unselect TCM1			0xxx	
	- Select TCM2			x1xx	
	- Unselect TCM2			x0xx	
	- Select TCM3			xx1x	
	- Unselect TCM3			xx0x	
	- Select TCM4			xxx1	
	- Unselect TCM4			xxx0	
0105	Select Pri/Sec Units	SELPRIM	N/A	0 or 1	x
	- Primary	PRIMARY	N/A	0	
	- Secondary	SECNDRY	N/A	1	
0106	CT Ratio	CT RATIO	N/A	1 - 9999	xxxx
0107	VT Ratio	VT RATIO	N/A	1 - 240	xxx
0108	Communication Port Setting	COMMPORT	N/A	See Below	xxyz
	- 300 Baud (xx=03)			03yz	
	- 1200 Baud (xx=12)			12yz	
	- 2400 Baud (xx=24)			24yz	
	- 4800 Baud (xx=48)			48yz	
	- 9600 Baud (xx=96)			96yz	
	- No Parity (y=0)			xx0z	
	- Odd Parity (y=1)			xx1z	
	- Even Parity (y=2)			xx2z	
	- One Stop Bit (z=1)			xxy1	
	- Two Stop Bits (z=2)			xxy2	
0109	Phase Designation	PHASE	N/A	0 or 1	x
	- (A-B-C)	A-B-C		0	
	- (A-C-B)	A-C-B		1	
0110	Select Time Synch	TIMESYN	N/A	0,1,2	x
	- Internal	NONE		0	
	- IRIG-B	IRIG-B		1	
	- G-NET	G-NET		2	
0111	Select # of Faults Stored	NUM FLTS	N/A	1 - 3	x
0112	Select # of Prefault Cycles Stored per Fault	PREFLT	CYCLE	1 - 20	xx

0113	External trigger to store oscillography data	OSC TRIG	N/A	0 or 1	x
	- Enabled	DI ENA	N/A	0	
	- Disabled	DI DIS	N/A	1	
0114	Nominal Generator Voltage	NOM VOLT	Vrms	100 - 140	xxx.x
0115	Nominal Generator Current	RATEDCUR	Arms	0.1 - 9.99	x.xx
0116	VT Connection Type	VT CONN	N/A	0 or 1	x
	- Wye	WYE		0	
	- Delta	DELTA		1	

CATEGORY: 87G -- Stator Differential

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0201	Trip Output 87G	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
0202	Alarm Output 87G	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0203	Differential % K1	K1	%	1 - 10	xx.x
0204	Differential Current Pickup	PICKUP	Arms	0.2 - 1.0	x.x

CATEGORY: 46A -- Current Unbalance Alarm

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE(LOW-HIGH)	FORMAT
0301	Alarm Output 46A	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
0302	Negative Sequence Curr Pickup	PICKUP	Arms	0.05 - 2.99	x.xx
0303	Timer	TL14	Sec	1 - 5	x

2504	Trip Output DI4	TRIP	N/A	0000 - 1111	xxxx
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2505	Alarm Output DI4	ALARM	N/A	0000 - 1111	xxxx
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	

CATEGORY: VTFF -- Voltage Transformer Fuse Failure

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
2601	Voltage Transformer Fuse Failure	VTFF	N/A	0 or 1	x
	- Disable	DISABLE	N/A	0	
	- Enable	ENABLE	N/A	1	

CATEGORY: AE -- Accidental Energization

SETT #	DESCRIPTION	ABBREV.	UNITS	RANGE (LOW-HIGH)	FORMAT
2701	Trip Output AE	TRIP	N/A	0000 - 1111	
	- Select 94G			1xxx	
	- Unselect 94G			0xxx	
	- Select 94G1			x1xx	
	- Unselect 94G1			x0xx	
	- Select 94G2			xx1x	
	- Unselect 94G2			xx0x	
	- Select 94G3			xxx1	
	- Unselect 94G3			xxx0	
2702	Alarm Output AE	ALARM	N/A	0000 - 1011	
	- Select 74A			1xxx	
	- Unselect 74A			0xxx	
	- Select 74B			x1xx	
	- Unselect 74B			x0xx	
	- Select 74C			xx1x	
	- Unselect 74C			xx0x	
	- Select 74D			xxx1	
	- Unselect 74D			xxx0	
2703	Accidental Energization	AE ARM	N/A	0 or 1	
	- AND	AND		0	
	- OR	OR		1	

TABLE IN-9 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				

PRINTER INTERFACE

The required pin-to-pin connections for the cable that connects the printer to plug PL2 on the back of the DGP are shown in Figure IN-3A. Virtually any ASCII character printer may be used, provided it contains a serial interface. In addition, the printer's serial interface must be programmable to 1200 baud, 8 character bits, 1 stop bit, and no parity. The printer's handshaking mode must be set to either XON/XOFF or DTR Ready. **The DGP printer port (plug PL2) is fixed at 1200 baud.** The DGP setting COMMPORT affects the baud rate of the RS232 port (plug PL1) but not the printer port.

Recommended printer

If the printer is to be installed permanently at the DGP location, then the following RADIX thermal printer is recommended because of its temperature range specification.

RADIX PRINTER ORDER INFORMATION

Part No.	Description	VENDOR
100700.001	FP40 Printer	RADIX
100890.001	FC401 Single unit battery charger	RADIX
105050.000	FC405 Multi-unit battery charger (optional)	RADIX
0246A9866 P2	GE PRINTER CABLE	GE
Printer Paper	8" paper for Radix FP40	Lord Label

ADDRESS: RADIX Corporation (Printer)
4855 Wiley Post Way
Salt Lake City, UT 84116
PHONE #: 800-453-5195

ADDRESS: Lord Label & MFG. (Paper)
3435 W. Madison
Skokie, IL 60076
PHONE #: 800-621-9301

REMOTE COMMUNICATION INTERFACE

HARDWARE JUMPERS

There are two factory-installed hardware jumpers in the MMI module (see **MODULES** section) set to **inhibit** the ability to perform the Remote Manual Control function, the Remote Change DGP Settings function, the Remote Disable Outputs function, and the Remote Enable Outputs function.

These hardware jumpers will need to be removed to perform those functions.

CAUTION

Power Down the relay by removing the test plugs before removing or inserting modules. Failure to do so can permanently damage the relay.

The hardware jumpers are defined as follows:

Hardware Jumper J1 = Manual Control.
Hardware Jumper J2 = Change DGP Settings, Disable Outputs and Enable Outputs functions.
Hardware Jumper J3 = Spare (not used)

MODEM CONNECTIONS AND SETTINGS

When establishing communication between the DGP and a remote PC, two modems connected via a phone line are required; one modem is located at the DGP and the other modem is located at the PC. The cable that connects the modem with either the DGP or the PC is shown in Figure IN-3B. Each of these modems must be "Hayes-compatible" meaning that they must accept configuration commands first developed by Hayes. This is necessary since the DGP-LINK communications software that runs on the PC sends a Hayes-compatible command string to the modem located at the PC. The DGP does not send any configuration commands to its modem. **Both, the DGP modem and the PC modem must be uniquely configured to permit the user to log into and communicate with the DGP using DGP-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 of your modem for an explanation of this syntax.

PC Modem

The PC modem must be configured for "intelligent" operation (i.e., command recognition enabled). For the Hayes V-Series 2400 SmartModem this setting is made via an internal jumper. The default settings listed above are valid for DGP-LINK. Those configuration settings critical to the operation of DGP-LINK are changed by DGP-LINK. The configuration commands sent to the modem from DGP-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.

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

&D3	-	causes the modem to reset on the ON-to-OFF transition of DTR (Data Terminal Ready)
&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 DGP-LINK setting establishes the baud rate, which must match the baud-rate setting of the DGP. DGP-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.

DGP Modem

The DGP 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 DGP does not send any configuration commands to its modem, the required configuration settings must be made prior to connecting the modem to the DGP. **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 may not answer, the DGP may not connect properly, or the user may not be able to log into the DGP.

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

Table IN-10 is a listing of the modem command set required to communicate to the DGP from a remote PC.

TABLE IN-10 MODEM SETUP CRITERIA (Hayes Compatible)

Function	DGP 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)

CONNECTION to GNET (optional)

The GNET host computer provides a complete communication package to send and retrieve information automatically from the DGP. The pin-to-pin connections to the GNET host are shown in Figure IN-3E. Refer to the GNET Instruction Book (GEK-100642) for complete information on GNET Host Computer cable connections and operation.

NULL MODEM CONNECTIONS

A PC can be connected to a DGP 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 are shown in Figure IN-3C. The pin-to-pin connections for a null modem cable to connector Comm on the MMI are shown in Figure IN-3D. Neither null modem cable should exceed 50 feet in length.

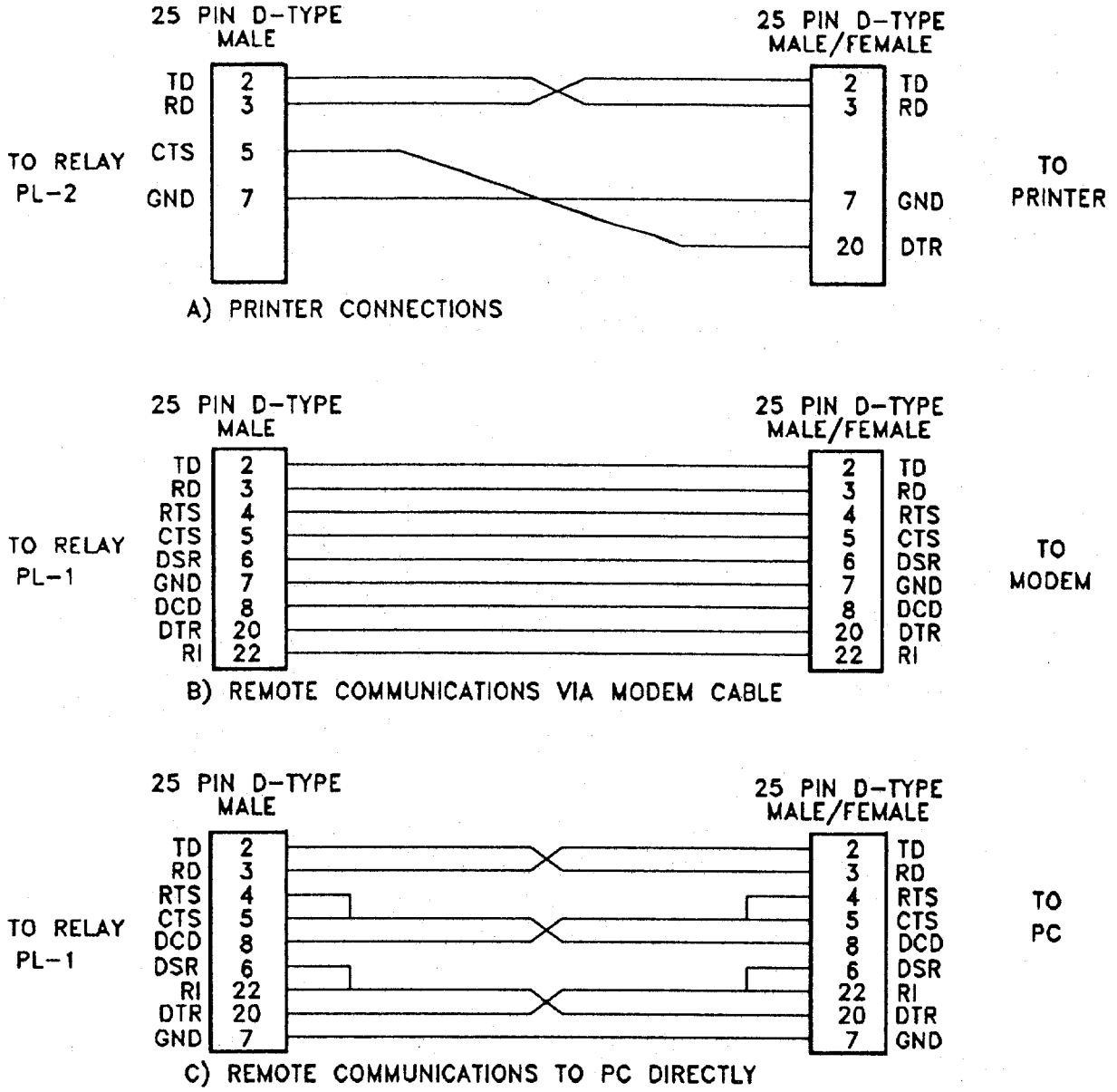
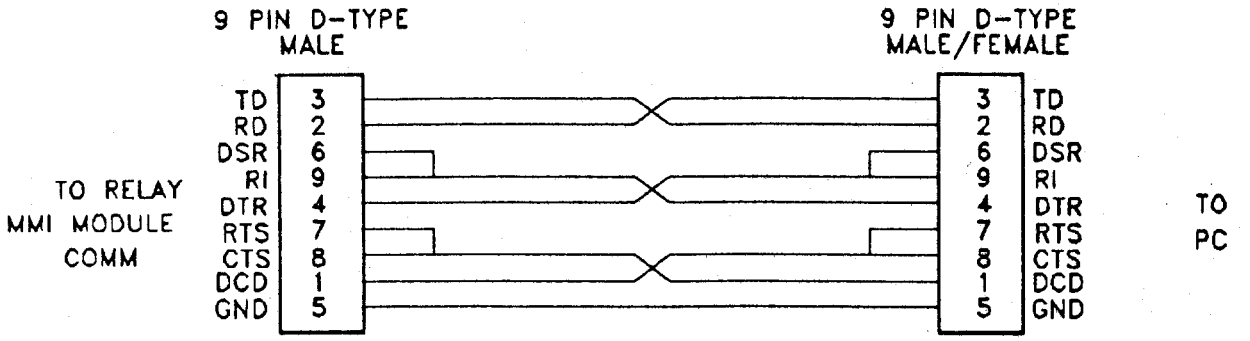
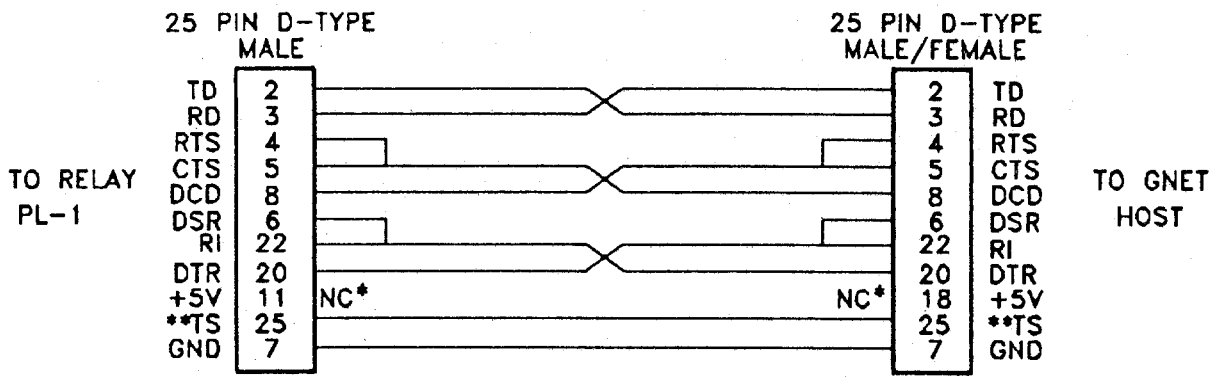


Figure IN-3 (0286A4821 Sh.1 [1]) DGP Communications



D) REMOTE COMMUNICATIONS FROM MMI MODULE TO PC



* +5V IS FOR FIBER OPTIC ADAPTER USE ONLY

** TS = TIME SYNC SIGNAL RS-232 LEVEL 200 uS POSITIVE GOING PULSE

E) REMOTE COMMUNICATIONS TO GNET HOST

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

Figure IN-3 (0286A4821 Sh.2[1]) DGP Communications, continued

DGP-LINK SOFTWARE

OVERVIEW

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

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 500K bytes of free memory (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. To run the software, type "DG-LINK" followed by an ENTER.

GENERAL OPERATION

Protection Jumpers

In order to have complete remote control of the unit, the factory-installed jumpers, J1 and J2, must be removed. Installing J1 disables remote closing of all of the output relays. Installing J2 will disable all remote setting changes and the disable/enable of outputs (see Figure MO-3).

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 on 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 then 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 using it to move the cursor 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.

Relay Functions	ALT-R
Local Functions	ALT-L
Setup	ALT-S
Help	ALT-H

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

RELAY FUNCTIONS

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

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

Login

Login is used to gain access to the relay. When logging into a DGP 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 log out. The factory password is changed to the user's password by selecting the **change Password** menu item from the **Actions** menu item from the **RELAY 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 DGPs, a place to enter the password, a place to enter the unit ID, a button for adding a new DGP to the configured DGP list, an OK button and a CANCEL button.

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

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

Once a relay is selected from the list of relays, 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 relay. Any of the three passwords for Communications can be used to log in to the relay. (See PASSWORDS in the **INTERFACE** section.) The password used will determine the access level when the login procedure is complete. For example, if settings changes will be performed, then the password could be the Settings access password. Another method of logging in would be to use the View access password to log into the DGP, and change the access level when settings changes are needed. See **Change access level** below for more information.

Note: If an incorrect password is entered on three consecutive tries using DGP-LINK, the MMI will show: "WARN GO" and the 74NC relay will operate. To remove this condition, the user must log in and log out correctly, using DGP-LINK.

lOgout

Logout disables access to the relay. A check is made to determine the status of protection at the DGP (ON or OFF). The status is displayed in the dialog box. Selecting the OK button logs out of the relay. Selecting the CANCEL button leaves the user logged in to the relay. 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 **RELAY FUNCTIONS** menu.

Change access level

Change access level allows the user to enter another password so that the settings can be changed or actions can be performed. When the user logs in to the relay, the password level is set to View access. The access level is displayed on the bottom line of the display. The password used to log in to the relay is also the password to return to View access.

To choose **Change access level**, move the mouse cursor to the item and click on it with the left mouse button or use the hot key ALT-C. A dialog box will appear, with space to enter a password. The user can change the access level by entering a password for one of the other levels and selecting the OK button, by clicking on it with the left mouse button or using the ALT-O hot key. Selecting the CANCEL button will exit **Change access level** without changing the level. Once the level has been changed, the new level will be displayed at the bottom of the screen. The following table contains operations performed by DGP-LINK and the associated password level required to perform the operation. All settings can be viewed at any level, but only changed with the Settings access level displayed.

DGP-LINK Operation	Required Access Level
Change Password	Any Level
Trip Breaker	Actions Level
Enable Outputs	Actions Level
Disable Outputs	Actions Level
Change Time and Date	Settings Level
Change Station/Generator Id	Settings Level
Calculate CRC	Any Level
Relay Test	Actions Level
Digital Output Test	Actions level
Perform Settings Changes	Settings Level
Data Reset	Actions Level

Hang up phone

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

Actions...

change Password	ALT-P
Manual trip	ALT-M
Enable outputs	ALT-E
Disable outputs	ALT-D
change Time and date	ALT-T
change station/Generator id	ALT-G
cAlculate CRC	ALT-A
Relay test mode	ALT-R
digital Output test	ALT-O
data reSet	ALT-S

change Password

This item allows the user to change the password in the DGP. 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 operate the output relays manually. Each of the four output relays (94G-94G3) being controlled by the DGP can be operated individually. Note that the relays cannot be operated if the appropriate jumper is installed (see Figure 3 in the **MODULES** 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 output relay to trip by using the UP and DOWN ARROW keys or clicking on the selection with the left mouse button.

When the user selects the OK button and an output relay is selected, the user is asked to confirm the action. If the user selects the OK button, the relay is operated and the user is returned to the previous screen. Selecting the CANCEL button from the confirmation dialog box will return the user to the output-relay-selection dialog box, without operating the selected relay. Selecting the CANCEL button from the output relay-selection dialog box returns the user to the **Actions** menu.

Enable outputs

This item allows the user to permit the DGP to energize the relay outputs. Note that the digital outputs cannot be enabled remotely if the appropriate jumper is installed (see the **MODULES** section for the location and function description of the jumpers on the MMI board). 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 digital outputs, and the previous dialog box will be displayed.

Disable outputs

This item allows the user to inhibit the DGP from energizing any of the relay outputs except for the Critical Alarm output, the Non-critical Alarm output, the Test Pickup output, and the Test Trip output. Note that the digital outputs cannot be disabled if the appropriate jumper is installed (see the **MODULES** section for the location and function description of the jumpers). 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 digital outputs, 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 DGP to the current time and date. Changing the time and date through this menu does not affect the time and date in the PC.

First the DGP'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: 06/16/93). 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 DGP.

change station/Generator id

This dialog box displays the station and generator ID for the relay to which the user is logged in. The IDs can be up to 32 characters long and must be all printable characters. To change an ID, select the desired ID with the TAB key or click on it with the left mouse button. Once the correct ID has been selected, use the insert, delete and backspace keys to edit and enter data. After the correct data has been entered, select the OK button by clicking on it with the left mouse button or using the ALT-O hot key. The user will be asked to confirm the IDs before sending them to the DGP. Selecting the OK button again will send the IDs to the DGP.

Selecting the CANCEL button in the confirmation dialog box will return the user to the dialog box with the Station and Generator IDs. Selecting the CANCEL button in the **Station/Generator** ID dialog box before sending the IDs to the relay will exit the dialog box without sending the IDs to the DGP. Selecting the CANCEL button after sending the IDs to the relay will simply return the user to the **Actions** menu.

cAlculate CRC

This item allows the user to recalculate the settings CRC code in non-volatile RAM. cAlculate CRC is selected by using the ALT-A hot key or clicking on the menu item with the left mouse button. Once cAlculate CRC 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 prior settings have been uploaded previous to 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.

Relay test mode

This item allows the user to test the relay functions of the DGP. **Relay test mode** is selected with the ALT-R hot key or by placing the mouse cursor over the menu item and clicking on the left mouse button. Once **Relay test mode** has been selected, the test functions are displayed in a list box. Since there are 22 test entries in the list box, only a few will be seen at one time. To find the desired test, use the PAGE UP/DOWN and UP/DOWN ARROW keys or use the mouse on the scroll bar. See **List Boxes** under **GENERAL OPERATION** in this **DGP-LINK SOFTWARE** section for more information.

The user selects the desired test function to perform by clicking on it with the left mouse button, or hitting the ENTER key once the correct test has been highlighted. If the user selects the OK button, another dialog box will be displayed to confirm the test. If the user again selects the OK button, the test is performed. This will put the relay in test mode for the selected test. If the CANCEL button is selected, then the relay will not be put in test mode for the selected test, and the user will be returned to the previous dialog box.

If the user selects the CANCEL button from the dialog box with the list of tests, the user will be returned to the **Actions** menu box. To put the relay back in operating mode, "End test mode" is selected from the list of tests.

digital Output test

This item allows the user to perform digital output tests in the relay. The tests are displayed in a list box.

The user selects the test to perform. When the user selects the OK button, the user is asked to confirm the test. If the user again selects the OK button, the test is performed. This will put the relay in test mode. To put the relay back in operating mode, the user executes "End test mode".

data reSet

This item allows the user to reset various data items contained in the relay. The data items are displayed in a list box.

The user selects the data item to reset by using the UP/DOWN ARROW keys or clicking on the **data reSet** selection with the left mouse button.

When the user selects the OK button after a data item has been selected, the user is asked to confirm the action. If the user selects the OK button, the selected **data reSet** item is cleared from the relay and the user is returned to the previous screen. Selecting the CANCEL button from the confirmation dialog box will return the user to the **data reSet** selection dialog box, without clearing the data items from the relay. Selecting the CANCEL button from the **data reSet** selection dialog box returns the user to the **Actions** menu.

Information...

request Present values	ALT-P
request fault report Identification	ALT-I
request Fault report	ALT-F
request Events	ALT-E
request Oscillography data	ALT-O
request dgp Status	ALT-S
request dgp Model	ALT-M
request station/Generator id	ALT-G
request MMI pAssword	ALT-A

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 then 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 relay.

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

After all the choices have been made, click on the OK button, or use the ALT-O hot key, to retrieve the report from the relay. Selecting the CANCEL button will return to the **Information** menu without any further action. If the report is displayed, either click on the small box in the upper left corner with the left mouse button when finished, 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 0105.

request fault report Identification

This item allows the user to display and/or print the identification of each fault report, which includes the time, date, and trip type for each fault. This information allows the user to determine easily which fault 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 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 fault report identifications to be retrieved from the relay.

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the identifications from the relay. (Selecting the CANCEL button will return to the **Information** menu without any further action.) If the identifications have been displayed, either click on the small box in the upper left corner with the left mouse button when finished, 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 **fault report Identification** dialog box will be redisplayed. Use the ALT-C hot key or click on the CANCEL button to exit.

request Fault report

This item allows the user to display, print and/or file a fault 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 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 one of the selections and the UP/DOWN ARROW keys to choose one of the three choices. An X in the brackets indicates that choice has been selected and no X indicates that choice has not been selected. Use the space bar to change any of the choices. At least one must be chosen for the fault report to be retrieved from the relay. The user must enter the fault report number (from 1 to 3) in the box supplied on the first line of the **Fault 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 fault report from the relay. (Selecting the CANCEL button will return to the **Information** menu without any further action.) To clear the fault 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 fault report has been cleared from the screen, the **Fault 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 fault. 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 relay. 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 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 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 relay.

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the events from the relay. 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 fault. 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 fault 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 fault number associated with the oscillography data (1 to 3) and the file name for the data **must** be supplied, to have the oscillography data retrieved from the relay.

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

The oscillography data is an ASCII text file consisting of the fault report, the events associated with the fault 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 dgp Status

This item allows the user to display, print and/or file the DGP 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 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 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 relay.

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the status from the relay. (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 DGP itself (described in the **SERVICING** section).

request dgp Model

This item allows the user to display, print and/or file the DGP model and PROM version number. 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 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 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 relay.

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

After all the choices have been made, click on the OK button or use the ALT-O hot key to retrieve the model and PROM version from the relay. 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 station/Generator id

To select this menu item, either click on it with the left mouse button or use the ALT-G hot key. This dialog box displays the station and generator ID of the relay from which information is being uploaded from the relay with the settings. Both the station ID and generator ID can only be viewed with this item. To change the station ID and generator ID select **Change station/generator id** from the **Actions** menu. When finished viewing the IDs, click on the OK button or use the ALT-O hot key.

request mmi pAssword

To select this menu item, either click on it with the left mouse button or use the ALT-A hot key. The dialog box displays the MMI passwords in encrypted form. These passwords are the ones to

be used at the MMI. These are not the Communications password used with DGP-LINK. The MMI passwords can only be **viewed** from this item. The MMI passwords can only be changed at the MMI keypad. For more information see the **INTERFACE** section. When finished viewing the passwords, click on the OK button with the left mouse button or use the hot key ALT-O.

Settings...

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

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

Upload dgp settings

This menu item uploads the settings from the DGP. 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.

If the access level is not Settings, the option to **Download changed settings to the DGP** will not be available.

Print dgp 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 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 **Settings** menu without any further action.

If the access level is not Settings, the option to **Download changed settings to the DGP** will not be available.

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 DGP, 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 by clicking on them 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 **DGP-LINK SOFTWARE** 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.

If the access level is not Settings, the option to **Download changed settings to the DGP** will not be available.

Download changed settings to dgp

This item allows the user to transmit all the changed settings to the DGP. Note that if the appropriate jumper is installed, the DGP 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.

End setting changes

This item is selected after downloading settings to tell the DGP 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 DGP, 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 dgp 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 (DGP-LINK). Use **Print dgp 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
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
Save local settings to file	ALT-S
Model/version number	ALT-M
station/Generator id	ALT-G
Download local settings to dgp	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 (DGP-LINK) 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 dgp settings to file** menu item), or a partial file name may be entered 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 DGP-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 settings having been changed.

view/change Individual local setting

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 DGP 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 **DGP-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 settings having been changed.

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. 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 relay to which you wish to send the local settings. If they do not match, the local settings download **will fail.**

station/Generator ID

This entry displays the station and generator IDs of the relay from which the settings were retrieved. These IDs can be used to identify the relay that the settings in the file match. This menu item is selected by clicking on the menu item with the left mouse button, or using the ALT-G hot key.

Download local settings to DGP

This item will appear on the menu only if the Communications access level is Settings.

This item allows the user to transmit all the local settings to the DGP. 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 DGP in order to use this menu item. Note that if the appropriate jumper is installed, the DGP 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 relay 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 relay, 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 DGP that settings changes are complete and protection should be re-enabled. This item is not necessary if the option to 'end settings changes automatically' 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.

Graph oscillography data

The optional program DGDATA will be started (if present) if this entry is chosen. This enables the user to graph oscillography data without leaving DGP-LINK. The DOS path for the DGDATA 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 DGDATA, refer to the pages describing DGDATA at the end of this **SOFTWARE** section.

go to DOS

This choice enables the user to temporarily leave DGP-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
Relay parameters	ALT-R
Add relay to list	ALT-A
dElete relay from list	ALT-E
Set path for DGDATA	ALT-G
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 DGP, or the modem used to talk to the DGP, must be entered before logging in to the relay. If the port chosen is not COM1(1) or COM2(2), the IRQ number for the port chosen must be entered. Use the TAB key to move between the port and IRQ fields and the buttons, or click on the desired field with the left mouse button.

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

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 types 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 DGP-LINK to wait for the modem to make a connection. To select this item, either click on it with the left mouse button or use the ALT-M hot key. The modem connection time can be set for any time up to 999 seconds, provided the modem being used will accommodate that long a time-out period. This setting is useful for applications where the modem is set to pick up after a large number of rings, especially if the phone system takes a long time to make 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.

Relay parameters

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

Once a relay unit description has been picked, another window appears with the phone number, switch code, baud rate, number of stop bits and the parity for the selected relay unit description. Any of the entry values may be selected by clicking on it with the mouse or using the TAB key to move between the items, and then using the UP and DOWN ARROW keys to select the value for

that item. To exit the dialog box for that unit description, select either the OK button or the CANCEL button. The OK button will accept the values in the dialog box and store them. Selecting the CANCEL button will exit the dialog box and will use the values that were already present when the unit description was selected.

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

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

Add relay to list

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

After the new unit description has been accepted, a dialog box will appear with the phone number, switch code, baud rate, stop bits 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 relay from list

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

The user selects the desired relay from a list box displaying the unit descriptions and logon parameters, by using the UP and DOWN ARROW keys to highlight the desired relay and pressing

the ENTER key, or moving the mouse cursor to the desired relay and clicking on it with the left mouse button. Selecting the OK button with the ALT-O hot key or clicking on it with the left mouse button will mark the unit description for deletion. Selecting the CANCEL button will exit without deleting any relay unit descriptions. If the OK button is selected, the user is asked to confirm the deletion of the unit description. Selecting the OK button will delete the relay unit description. Selecting the CANCEL button will return to the list box without deleting any relay unit description. Selecting the CANCEL button in the list box will exit from the menu entry.

set path for DGDATA

DGDATA (optional) can be started from DGP-LINK from the **LOCAL FUNCTIONS** pull-down menu. The DOS path must first be set so DGP-LINK knows where to start the program from. To set the path, select this menu item by using the hot key ALT-G, 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 DGP-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 DGP-LINK

There are two ways to exit DGP-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 DGP-LINK. Selecting the CANCEL button will return to 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 DGP-LINK. Selecting the CANCEL button will return to the program without exiting.

NOTE: To exit DGP-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.