

**Digital transmission line relaying system
for single and 3 pole tripping applications.**



DESCRIPTION

The DLPD provides distance protection for HV and EHV transmission lines. It may be used for single or three phase tripping applications. It includes four zones of distance protection. User selectable pilot schemes are provided with step distance backup. Ground instantaneous and time overcurrent functions are independently selectable to be directional or non-directional. Phase overcurrent backup consists of a non-directional instantaneous function. Undervoltage is provided as well as potential fuse failure detection logic. The DLPD has high speed tripping, typically 0.75 to 1.5 cycles, and out of step blocking.

Four separate groups of protection settings may be stored in the DLPD's non-volatile memory. A two shot recloser can be provided for single pole or three pole models. Three of the inputs and six of the outputs are user configurable. Two breakers may be tripped manually.

The DLPD provides metering values based on the phasor value of the

phase currents and voltages. The unit provides reliable fault location and fault reports. The last 100 events are stored in memory time stamped to the nearest millisecond. The DLPD captures oscillography data at 16 samples per cycle. Two to fourteen oscillography records can be stored in the memory, with each record from 72 to 9 cycles depending on the number of events selected. Self-tests are run at power up and during operation. Any self-test problem causes an alarm.

Local user interface is provided by a 20 button keypad and a 16 character LED display. A front RS232 port provides easy local computer access. Two rear RS232 ports are provided for remote communication. Data transmission rates are from 300 to 9600 bps. GE and ASCII protocols are provided. Communication and control software is included with each relay.

The DLPD is packaged in a compact three RU 19" drawout case. Models are available for horizontal or vertical mounting.

DLPD

Digital Line Protection System

Applications

- Distance protection for transmission lines
- Single and three phase tripping

Protection and Control

- Four zones of distance functions
- Pilot protection, step distance backup
- Out of step blocking and tripping
- Phase instantaneous overcurrent
- Ground instantaneous overcurrent
- Time overcurrent backup
- Ground directional overcurrent
- Potential fuse failure function
- High speed tripping
- Optional two shot recloser
- Protection schemes user selectable
- Configurable inputs (3) and outputs (6)
- 4 settings groups
- Manual breaker control

Monitoring and Metering

- Integrated metering
- Fault location
- Fault reporting of last 5 faults
- Event reporting of last 100 events
- Trip circuit monitor
- Flexible oscillography
- Self-test diagnostics
- Continuous monitoring

User Interfaces

- Keypad and LED display
- Two color LED for relay status
- Three RS232 communication ports
- GE and ASCII protocols
- IRIG-B time synchronization input

Features

- Compact 19" drawout case



PROTECTION AND CONTROL

Step Distance

The DLPD provides four zones of phase and ground distance functions. Functions are positive sequence voltage polarized mho characteristics. In addition ground zone 1 functions may be set as adaptive reactance characteristics. The reactance characteristics include an independent supervising mho characteristic with a load compensating adaptive reach.

Zone 4 is reversible for use as a blocking zone. Zones 2, 3, and 4 each include independent timers for phase and ground step distance protection.

7 Out of step blocking logic is present to detect a swing condition and either block tripping or block reclose initiation.

Directional Ground Overcurrent

Ground directional overcurrent functions can be used either in place of or in conjunction with the overreaching ground distance functions in a pilot scheme. The ground directional functions are forward and reverse negative sequence current and voltage operated with both instantaneous and TOC functions. These functions will be disabled during an open pole period.

Overcurrent Backup

The phase overcurrent backup consists of a non-directional instantaneous function.

Ground overcurrent backup consists of instantaneous overcurrent (IOC) and time overcurrent (TOC) functions. The TOC function includes four curves (inverse, very inverse, extremely inverse, and definite time) plus a programmable curve. The ground overcurrent functions can be controlled by the directional functions. Both IOC and TOC functions can be independently selectable to be non-directional or directional.

These functions provide an adaptive sensitive current disturbance detector (fault detector) using I_2 , I_0 and ΔI_1 . They also allow the DLPD to provide overcurrent supervision of distance functions. Both trip and block units are available for use in ground directional overcurrent pilot schemes.

An unbalanced current alarm is provided to indicate sustained unbalanced current conditions such as an open or shorted current transformer.

Voltage

A positive sequence undervoltage detector is provided.

The DLPD has potential transformer fuse failure (PTFF) detection logic to detect a full or partial loss of AC potential and to block tripping of the distance and directional functions.

A line pickup function provides tripping if the breaker is closed into a zero-voltage bolted fault when line-side potential is used.

Scheme Logics

The scheme logics provided in the DLPD include:

- Zone 1 extension
- Blocking
- Permissive underreach transfer trip (PUTT)
- Permissive overreach transfer trip (POTT)
- Hybrid (POTT plus echo and weak in-feed tripping)
- Step distance backup (non-pilot)

Pilot Channels

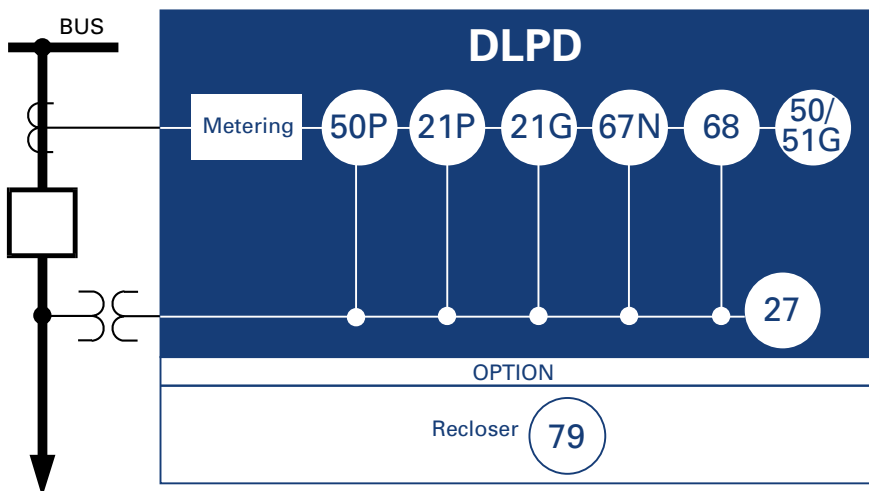
The DLPD uses contact interface to the pilot channel so that the relay may be applied with a wide variety of pilot channel equipment. Typical channels include AM and FSK via power line carrier (PLC), FSK via microwave, and FSK via multiplexed fiber optic.

Two Shot Recloser

An optional two shot recloser is provided with reclose programs for both single phase and three phase tripping applications. Reclosing may be initiated from the DLPD protection functions, or via external contact inputs. In addition to a reclose initiation input the DLPD recloser also has inputs for reclose inhibit, reclose cancel, and recloser reset. Output contacts are provided for breaker close, reclose in progress, and recloser in lockout.

Units are provided with a recloser manual lockout feature. A toggle switch for this function is supplied on the front of the unit.

FUNCTIONAL BLOCK DIAGRAM



706753A4.CDR

DEVICE	PROTECTION
21P, 21G	Phase & Ground Distance
27	Undervoltage (V_1)
50P, 50G	Instantaneous Overcurrent
51G	Time Overcurrent
67NT, 67NB	Directional Overcurrent
68	Out of Step
79	Recloser

MONITORING AND METERING

Manual Breaker Control

The relay allows the user to manually trip or close a circuit breaker both locally or remotely.

Multiple Settings Groups

Four separate groups of protection settings may be stored in the DLPD's non-volatile memory. The active settings group may be selected via the keypad, remote communications or contact inputs.

Inputs and Outputs

The DLPD has 7 fixed inputs for the three phase tripping model and 10 fixed inputs for the single phase model.

It also has three configurable inputs. Nine possible combinations of settings determine how these inputs are used. These inputs are:

- Receiver for a pilot scheme
- Stop carrier signal
- Block pilot tripping

It has 11 fixed outputs for the three phase model and 22 fixed outputs for the single phase model.

It also has 6 configurable outputs. Each output has a unique settings category comprising nine settings. These outputs are:

- 2 reclose initiate
- 2 breaker control
- 1 reclose cancel
- 1 line overload

Fault Location

Proven algorithms provide reliable fault location reporting. The DLPD will display the fault location in miles, kilometers, or percent of line impedance. The fault location estimate is shown on the LCD along with the trip targeting, and is included in the fault report and oscillography files.

Fault Report

When a fault occurs pertinent information is stored in memory. The five most recent fault events are stored. The information includes:

- Unit ID
- Date and time
- Operating time
- Prefault currents
- Fault currents and voltages
- Fault type
- Trip type
- Distance to fault
- Selected events

Trip Circuit Monitor

The DLPD can monitor the continuity of the breaker trip circuit. It checks for the presence of DC battery voltage across each open trip contact (or SCR) and triggers and alarm when the voltage becomes virtually zero. It also has a current sensor in series with each trip contact (or SCR) to log an event message indicating whether or not DC trip current was flowing following a relay trip.

Metering

The DLPD provides the following metering values:

- Current (I_a, I_b, I_c, I_n)
- Voltage (V_a, V_b, V_c)
- Watts (3 phase)
- Vars (3 phase)

The DLPD metering values are based on the phasor value (magnitude and angle) of the phase currents and voltages.

Event Reporting

The DLPD stores up to 100 events with the date and time stamped to the nearest millisecond. This provides the user with the information to determine the sequence of events, speeding diagnosis and system recovery. Events consist of a broad range of change of state occurrences including pickup, trips, contact operations, alarms, setting changes, and self test status.

The DLPD can store up to 100 events.

DATE	TIME	EVENTS
05/28/96	09:56:54	PROT: TRIP SIGNALS ON
05/28/96	09:19:34	PROT: TRIP SIGNALS RESET
05/28/96	09:19:34	PROT: RECEIVE CARRIER OFF
05/28/96	09:19:34	PROT: TRIP SIGNALS ON
05/28/96	09:19:34	PROT: TRIP SIGNALS ON
05/28/96	09:19:34	PROT: TRIP CIRCUIT #1 ENERGIZED
05/28/96	09:19:34	PROT: TRIP CIRCUIT #2 ENERGIZED
05/28/96	09:19:34	PROT: TRIP CIRCUIT #3 ENERGIZED
05/28/96	09:19:34	PROT: TRIP CIRCUIT #4 ENERGIZED
05/28/96	09:19:34	PROT: RECEIVE CARRIER ON
05/28/96	09:19:27	PROT: KEY TRANSMITTER ON
05/28/96	09:19:26	PROT: TRIP CIRCUIT #2 MONITOR ALARM ON
05/28/96	09:19:26	STAT: PROTECTION REINITIALIZATION SERVICED
05/28/96	09:19:26	MMI: SETTINGS CHANGE DONE
05/28/96	09:19:19	MMI: SETTINGS CHANGE STARTED
05/28/96	09:17:16	PROT: RECEIVE CARRIER OFF
05/28/96	09:17:16	PROT: TRIP SIGNALS RESET
05/28/96	09:17:16	PROT: TRIP SIGNALS ON
05/28/96	09:17:16	PROT: RECEIVE CARRIER ON
05/28/96	09:07:32	PROT: TRIP SIGNALS ON
05/28/96	09:07:32	PROT: TRIP SIGNALS RESET

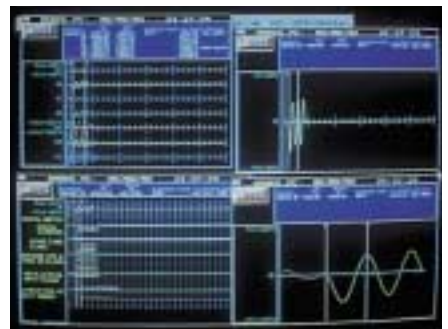
Press 'ENTER' to continue, 'B' to go to previous screen or 'ESC' to quit.

Oscillography

The DLPD captures current and voltage waveforms, DLPD measuring functions, and selected internal logic signals at 16 samples per cycle. The unit can store from 2 events of 72 cycles each to 14 events of 9 cycles each. The time, date, active settings, and fault report are stored with the data capture. Prefault data can be set from 1 to 8 cycles.

Oscillography can be triggered either by internal signals or external signals. Internal signals include a trip output or a user configurable signal.

The DLPD can store oscillography data for 2 to 14 events.



Self Test Diagnostics

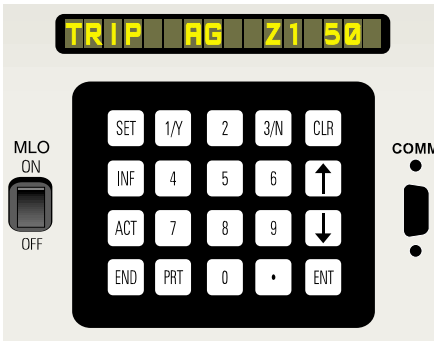
Comprehensive self test diagnostics occur both at power up and continuously in the background while the unit is operating. Upon relay initialization a complete self test is performed which includes checking the magnetics calibration, A-D converters, RAM, ROM, serial ports, input/output contacts, and MMI. During operation self tests are performed and any problem causes an alarm and an event log.

USER INTERFACES

Keypad and Display

The front of the DLPD has a 20 button keypad and a 16 character LED display. This allows the user to easily interrogate the relay, change settings, display metering data, and display event information.

A keypad and display are provided for local user interface.



LED Indication

The DLPD has a two color LED (red and green) that indicates the relay status. Under normal conditions the LED is green. If the unit detects a self test failure the LED will turn red, indicating that the relay is out of service.

Time Synchronization

An IRIG-B input is provided which permits the relay to synchronize its clock to the satellite time clock. This insures that all event time stamping is consistent across the entire system.

Front Serial Port

A nine pin RS232 serial port is located on the front of the relay. It allows the user easy local access with a laptop computer. This port uses GE modem protocol. A communications program using this protocol is supplied with every DLPD.

A front serial port allows easy local computer access.

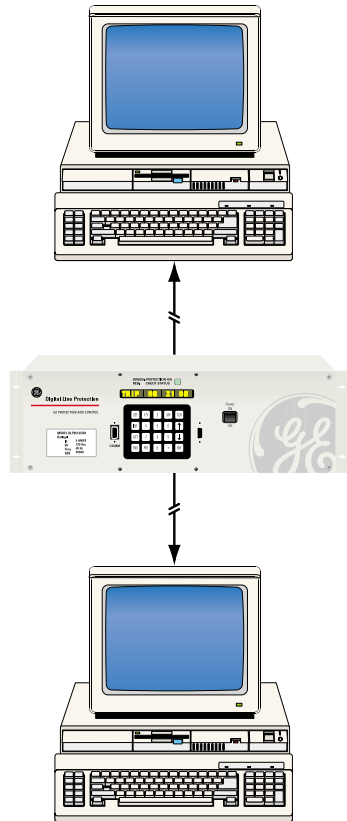


Rear Serial Ports

Two serial ports are provided on the rear of the unit. One is a full function GE modem communications port. The other uses an ASCII protocol and offers access to retrieve event data, fault reports, and metering data. The ASCII port does not allow settings changes or control capability. The ASCII protocol allows the user to access the DLPD

with any general purpose PC communications program. The ports use the same data rates which can be set from 300 to 9,600 bps.

Two remote computers can be hooked up, one with full access, and one which only allows data retrieval.



Security

Changing settings and initiating control functions from the keypad are protected from unauthorized access via two levels of password protection. Metering and fault data may be viewed without a password.

All computer communication with the relay is protected from unauthorized access by three levels of password protection. There are separate passwords which permit view only, view and settings changes, or view and control capability.

Software Tools

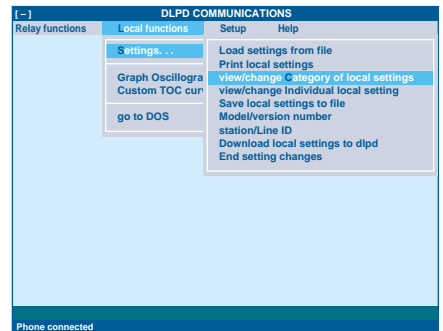
Three DOS based software packages are included in the DLPD instruction book.

- DLP-LINK is a communications program which allows the user to communicate with the relay using GE modem protocol.

- DLP-SET aids the user in calculating the settings and creates a settings file that may be down loaded to the DLPD.
- DLP-TEST may be used to calculate the expected operating voltages for the mho distance functions for the applied settings and test conditions.

In addition the user may purchase DL-DATA, an oscillography data analysis program.

Software packages with easy to use pull down menus are provided with the DLP.



SCADA Digital to Analog (DTA) Interface

An internal DTA function provides an analog output proportional to the distance from the relay to the fault and four contact outputs that provide fault-type information. The output can be connected to the analog port of a SCADA RTU to provide remote indication of the distance to the fault.

HARDWARE

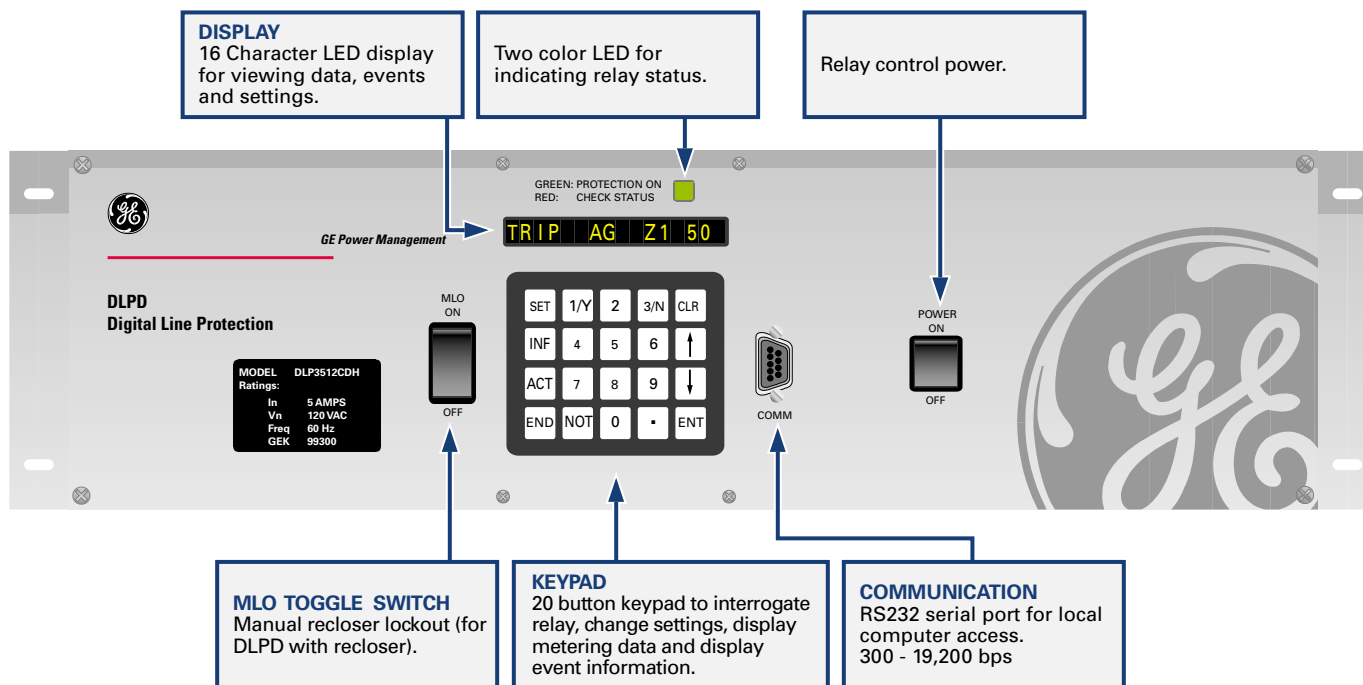
The DLPD is packaged in a compact three RU high 19 inch rack mount case. Models are available for either horizontal or vertical mounting. The drawout construction of the case allows for all of the printed circuit boards to be withdrawn from the front of the relay with only the highly reliable magnetics remaining in the case. The magnetics module can easily be removed from the case if necessary.

The printed circuit boards can be easily withdrawn from the case.

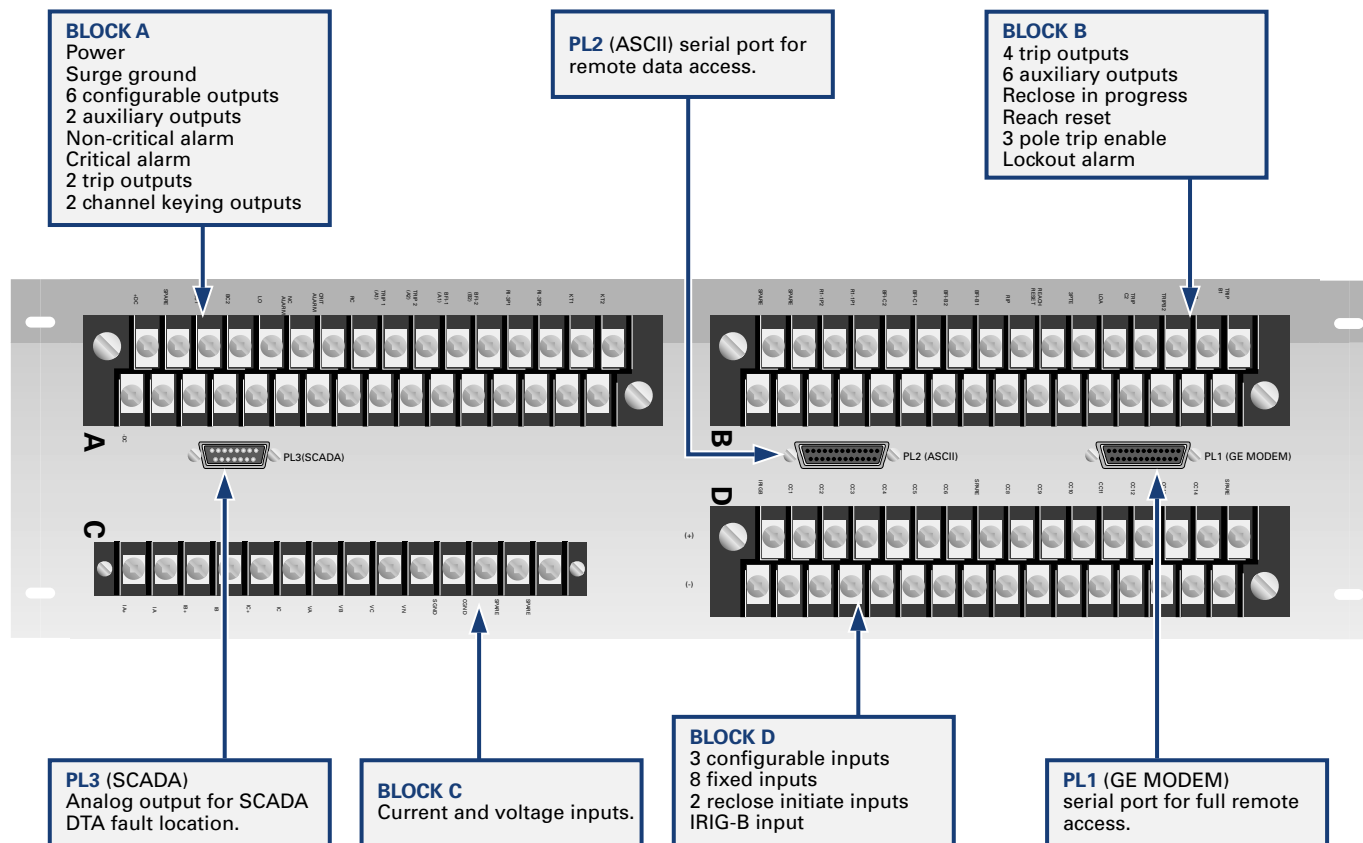


FEATURES

Front View

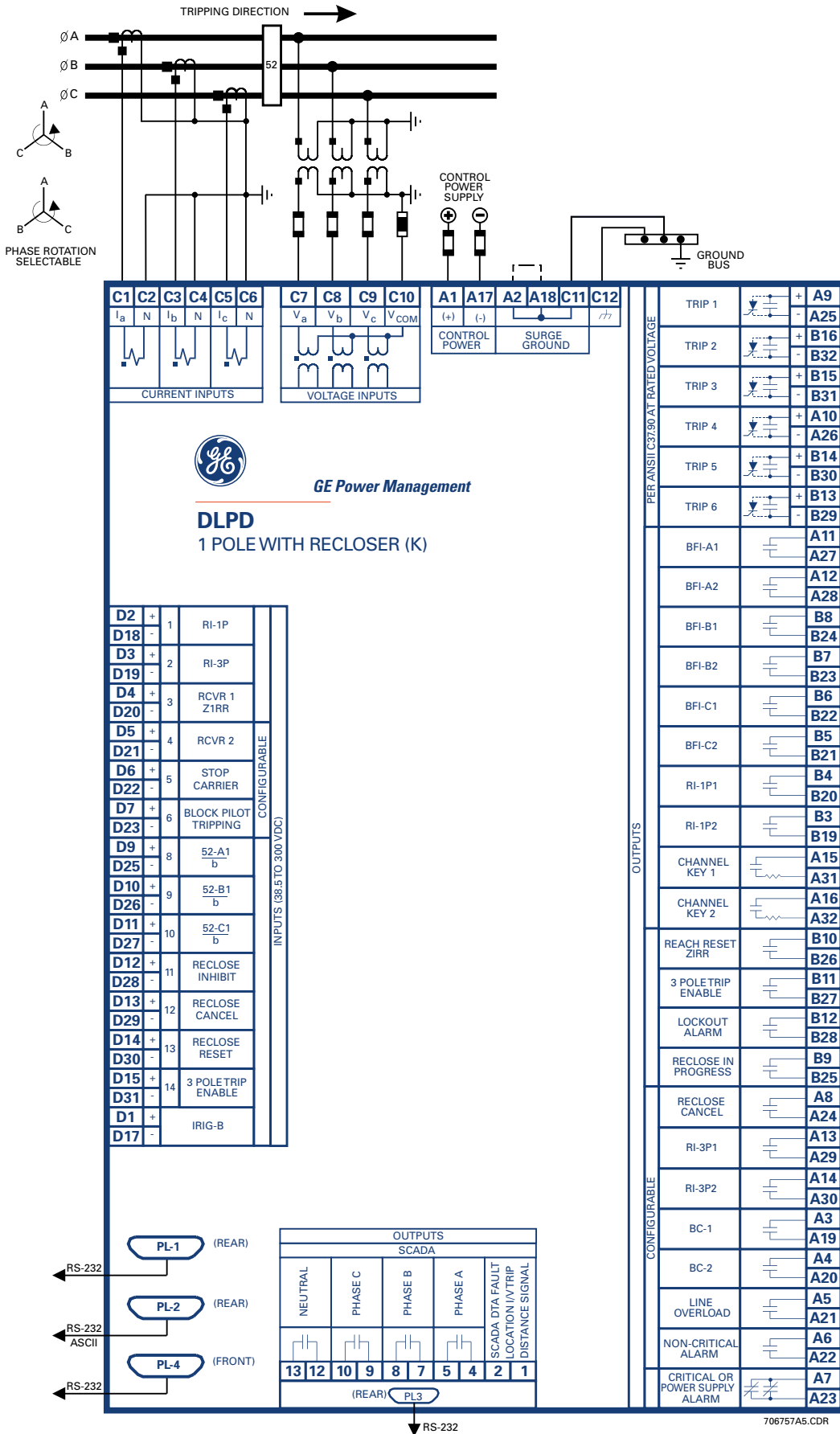


Rear View



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TYPICAL WIRING



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DLPD TECHNICAL SPECIFICATIONS

PROTECTION		
	$I_n = 1$	$I_n = 5$
Positive Sequence Angle:	45 - 90°	45 - 90°
Zero Sequence Angle:	45 - 90°	45 - 90°
Zero Sequence Current:	1.00 - 7.00	1.00 - 7.00
Compensation (K _Ω):		
Zone 1, 2, 3, 4 Reach:	0.05-250 Ω	0.01-50 Ω
Zone 4 Offset Reach:	0.00 - 0.40	0.00 - 0.40
(Zone 4 is reversible)		
Zone 2 Timer:	0.10 - 3.00 sec	0.10 - 3.00 sec
Zone 3 & 4 Timers:	0.10 - 10.0 sec	0.10 - 10.0 sec
Phase Inst. O/C:	0.4-20 A	2.0-100.0 A
Ground Inst. O/C:	0.1-16.0A	0.5-80.0 A
Ground TOC:	0.04-3.00 A	0.20-15.00 A
TOC Curves:	Inverse, Very Inverse, Extremely Inverse, Definite, and Custom	
RECLOSER (OPTIONAL)		
Reclose Attempts:	2	
Modes of Operation:	8 for single pole, 4 for three pole	

METERING	
Frequency:	50 or 60 Hz
Voltage (ph-ph):	100 - 120 VAC
Current (I _n):	1 or 5 A
Maximum Permissible Current:	
Continuous:	2 A for I _n = 1 A
	10 A for I _n = 5 A
Three Sec:	50 X I _n
One Sec:	100 X I _n
Maximum Permissible AC Voltage:	
Continuous:	2 x rated
One Min:	3.5 x rated
Metering (at rated voltage and current):	current ± 5%, voltage ± 2V

MONITORING	
OSCILLOGRAPHY	
Records:	2 - 14
Record Length:	72 - 9 cycles
Pre-fault Cycles:	1 - 8
Samples Per Cycle:	16

INPUTS	
Contact Converter Inputs:	38.5 - 300 VDC
BURDENS	
Current Circuits:	
I _n = 1	0.12 Ω at 30°
I _n = 5	0.02 Ω at 5°
Voltage Circuits:	
50 Hz	0.20 VA
60 Hz	0.15 VA
DC Battery:	
Power Supply:	< 20 W
Contact Converters:	2.5 mA each

OUTPUTS	
CONTACT RATINGS	
Trip Contact:	Continuous = 5 A Make & Carry = 30 A per ANSI C37.90 Interrupting = 180 VA resistive at 125/250 VDC 60 VA inductive at 125/250 VDC
Trip SCR:	Pickup < 5 ms Continuous = 5 A Make & Carry = 30 A per ANSI C37.90
Auxiliary:	Continuous = 3 A Make & Carry = 30 A Interrupting = 25 VA inductive at 125/250 VDC Pickup < 8 ms
Maximum Control:	Maximum = 50 mA Max. Voltage = 280 VDC Pickup < 0.5 ms

COMMUNICATIONS	
Protocol:	ASCII and GE-modem
Ports:	
Front:	1 DB9, RS232 GE-modem protocol
Rear:	1 DB25, RS232 GE modem protocol 1 DB25, RS232, ASCII protocol
Display:	16 character LED Display Standard
Keypad:	Full numeric keypad Standard

POWER SUPPLY	
Control Voltage:	Range:
48 VDC	38.5 - 60.0 VDC
110/125 VDC	88 - 150 VDC
220/250 VDC	176 - 300 VDC

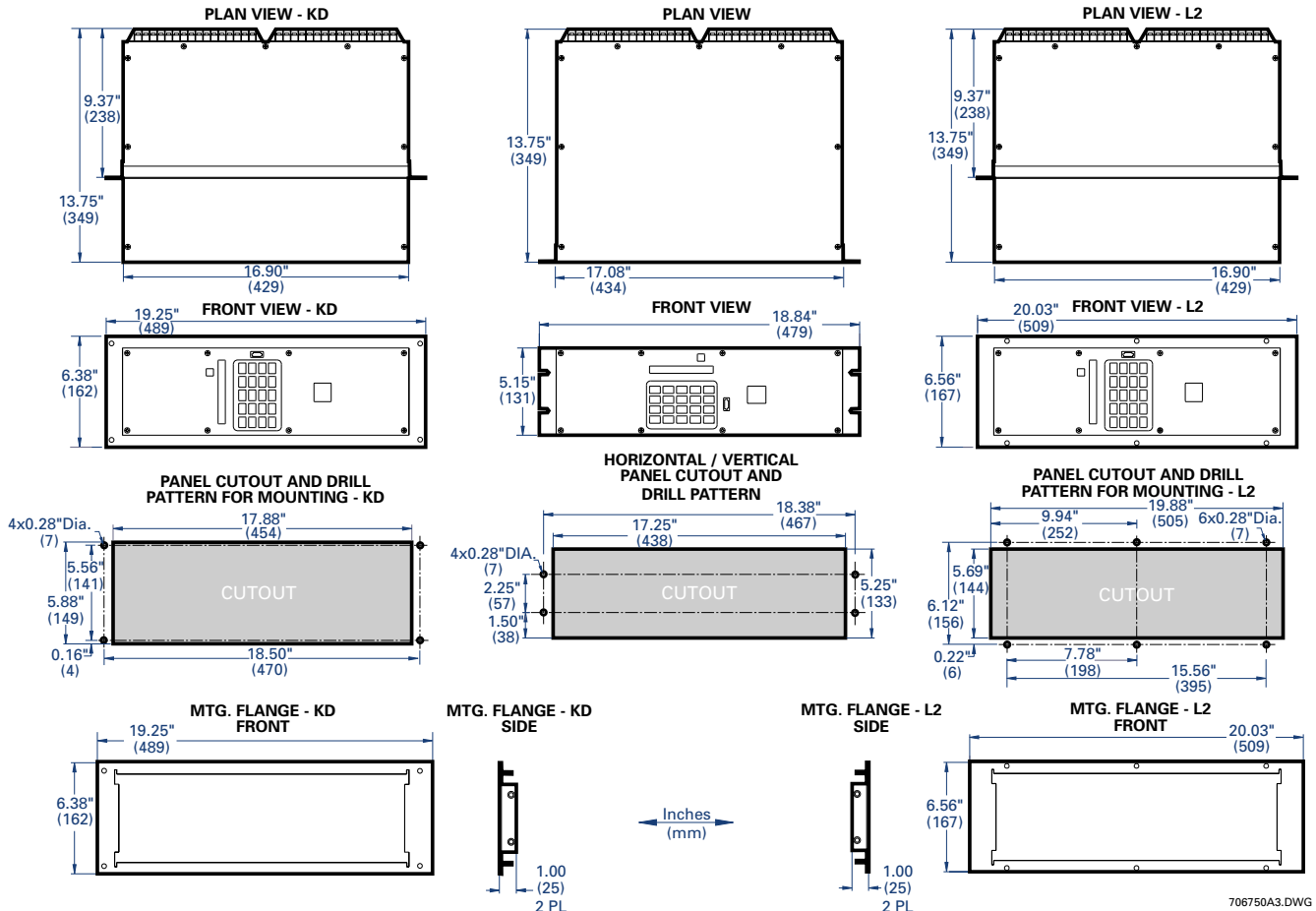
PACKAGING	
Weight:	23 lbs (10.4 kg)
Dimensions:	
Vertical:	16.9" x 5.15" x 13.75" (42.92 cm x 13.08 cm x 34.92 cm)
Horizontal:	5.15" (SRU) x 19" x 13.75" (13.08 cm x 48.26 cm x 34.92 cm)

ENVIRONMENTAL	
Ambient Temperature Range:	
Storage:	-30° C to +75° C
Operation:	-20° C to +55° C
Humidity:	95% without condensation

TYPE TESTS	
Insulation Test Voltage:	3 kV DC, 1 min (Hi-Pot) ANSI C37.90
Impulse Voltage Withstand Fast Transient:	5 kV peak, 1.2/50 μs, 0.5 Joules IEC 255-4 ANSI C37.90.1
Surge Withstand Capability (SWC):	ANSI C37.90.1 IEC 255-22-1
Radio Frequency Interference Withstand (RFI):	ANSI C37.90.2 IEC 255-22-3
Electrostatic Discharge (ESD):	IEC 255-22-2

*Specifications subject to change without notice.

DIMENSIONS



706750A3.DWG

GUIDEFORM SPECIFICATIONS

Transmission line protection, fault location, control, monitoring, and metering shall be supplied as a digital relay system. It shall use one or more micro-processors and waveform sampling of the current and voltage inputs to provide the features described below. The sampling rate of the relay shall be at least 16 samples per cycle. The typical operating time of the relay (excluding the output relay) shall be 1.5 cycles or less.

Three phase tripping logic or single phase tripping logic shall be available. With single phase tripping logic the relay shall trip only the faulted phase for a single-phase-to-ground fault. The relay shall trip three-phase for all other fault types.

Protection functions shall include:

- Four zones of phase and ground distance functions
- Phase selector function to determine the faulted phases
- Out of step blocking
- Ground directional overcurrent functions
- Ground overcurrent backup, both IOC and TOC with 4 time curves
- Phase overcurrent backup, instantaneous function
- Overvoltage and potential fuse failure
- Line pickup function
- Setting selectable scheme logics: step distance, POTT, PUTT, blocking, hybrid

An optional built-in reclosing function shall be available. The reclosing function shall provide one or two reclosing attempts and allow the selection of eight different modes of operation for single pole and four modes of operation for three pole.

Provision to manually trip and close up to two local breakers via the relay shall be provided.

Four separate groups of settings shall be provided, with the active group selectable either locally or remotely.

To provide flexible use of the relay user configurable digital inputs and outputs shall be provided. At least 3 of the inputs and 6 of the outputs shall be user configurable.

Fault location shall be provided by a single-ended fault location algorithm which shall display the distance from the relay to the fault in miles, kilometers, or percent of line impedance. A digital to analog interface shall be available to provide an analog output proportional to the fault location estimate. Four normally open contacts shall be provided to indicate the phases involved in the fault.

A trip circuit monitor shall be provided which shall monitor the continuity of the breaker trip circuit.

RMS metering shall include:

- Individual phase currents and voltages (magnitude and angle)
- Watts
- Vars

Flexible oscillography (instantaneous values of current and voltage) storage shall be provided. Sufficient memory shall be present to permit storage from 2 events of 72 cycles each to 14 events of 9 cycles each.

Oscillography storage shall always be triggered when the relay trips and can also be triggered via other internal signals or an external contact.

Self tests shall be performed at start-up and run in the background during operation. Self test failures shall be split into critical failures, which shall disable the relay, and non-critical failures. The two types of failures will operate separate alarm contacts.

An events log shall be maintained containing the last 100 events time stamped to the nearest millisecond. A fault report shall be generated for each detected fault.

A 20 button keypad and 16 character LED display shall be located on the front of the unit. Three RS232 serial ports shall be provided, one on the front and two on the rear of the unit. The front port and one of the rear ports use GE Modem protocol, and communication software shall be provided. The second rear port uses ASCII protocol and shall be used to retrieve fault and metering data and to view settings. Password protection shall be provided for both keypad and computer communication. An IRIG-B input shall be available for time synchronization.

The relay shall be packaged in a three RU high 19 inch rack mount case. Vertical and horizontal models shall be available. The unit shall be available with drawout construction.

ORDERING

To order select the basic model and the desired features from the Selection Guide below.

DLP	*	*	*	*	*	*	*	
DLP								Basic unit digital line protection system
	1							Single phase tripping logic
	3							Three phase tripping logic
		1						1 Amp rated current
		5						5 Amp rated current
			0					48 VDC battery voltage
			1					110/125 VDC battery voltage
			2					220/250 VDC battery voltage
				1				SCR trip outputs and contact channel interface
				2				Contact trip outputs and contact channel interface
					C			Three phase tripping without recloser
					J			Single Phase tripping without recloser
					K			Single or three phase tripping with recloser
						D		Revision Level
							H	Horizontal mounting
							V	Vertical mounting

Faster orders
via the web
www.GEindustrial.com/pm