



*For high-speed transmission line protection.*

### Features and Benefits

- Waveform sampling of current and voltage inputs
- High-resolution oscillography and playback
- Four zones of phase and ground mho distance functions
- User-selectable pilot schemes with step distance backup
- Out-of-step tripping and blocking available
- Phase and ground IOC backup
- Ground TOC backup
- User-configurable I/Os
- Integrated RMS metering
- Horizontal and vertical models

### Applications

- Distance protection for transmission lines or system backup
- Single or three-phase tripping applications
- enerVista.com compatible (see page 275)

### Protection and Control

- Out-of-step tripping
- Over and undervoltage functions

### Monitoring and Metering

- Fault location, event and fault recording
- Currents, voltages, watts, vars and frequency

### User Interfaces

- LCD and keypad
- RS232 and RS485 serial ports



## Protection and Control

The LPS-D provides high speed transmission line protection for single or three-phase tripping. Advanced protection functions include:

### Distance

The LPS-D provides four zones of phase and ground distance functions. Functions are positive sequence voltage polarized mho characteristics. Ground Zone 1 functions may be set as adaptive reactance characteristics, including 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 protection.

Out-of-step blocking detects a swing condition and blocks either tripping or reclose initiation. A choice of two or three characteristics are provided, with adjustable characteristic shapes.

The LPS-DB modification offers four zones of quadrilateral ground characteristics.

### Directional Ground Overcurrent

This function can replace or be used with overreaching ground distance functions in a pilot scheme. Forward and reverse negative sequence current and voltage operate the functions.

### Overcurrent Backup

The LPS-D provides instantaneous phase and ground overcurrent functions.

The instantaneous phase function can be controlled by Zone 2 distance functions. The ground function consists of IOC and TOC functions with four selectable and one programmable curve. The ground overcurrent functions can be controlled by the directional functions. IOC and TOC functions can be set as non-directional or directional.

The LPS-D also provides an adaptive sensitive current disturbance detector (fault detector). Overcurrent supervision of distance functions is included. Both trip and block units can be used in ground directional overcurrent pilot schemes.

An unbalanced current alarm is provided to detect open or shorted CT leads.

### Voltage

Three single-phase under and overvoltage detectors and a positive sequence overvoltage detector are provided.

Fuse failure logic detects a full or partial loss of AC potential and blocks tripping of distance and directional functions.

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

The LPS-D has a four-wire voltage input suitable for wye connected

VTs, plus an optional synchronization check voltage for use with the recloser.

### Scheme Logics

The scheme logics include:

- Blocking
- Permissive Underreach Transfer Trip (PUTT)
- Permissive Overreach Transfer Trip (POTT1 and POTT2)
- Hybrid (POTT plus echo and weak in-feed tripping)
- Step distance backup (non-pilot)

The LPS-D provides programmable logic with up to 40 gates and eight timers.

### Pilot Channels

Typical pilot channels include AM and FSK via Power Line Carrier (PLC), FSK via microwave, and FSK via multiplexed fiber optic. Optional 5 V / 20 mA hardware allows connection to older GE carrier sets.

### Four-Shot Recloser

This option is available with reclosure programs for single and three-phase tripping applications. Reclosing may be initiated from LPS-D protection functions, or via external contact inputs. The unit features recloser inputs for initiation, inhibit cancel and reset. Output contacts allow breaker close, reclosure in progress, and recloser in lockout.

### Manual Breaker Control

Manual circuit breaker tripping or closing can be done locally or remotely.

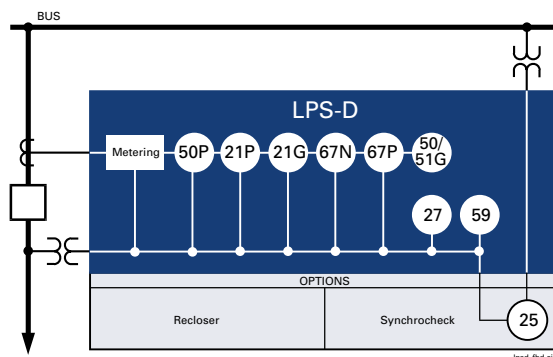
### Multiple Settings Groups

Four separate groups of protection settings may be stored in the LPS-D non-volatile memory. The active settings group can be selected by the user.

### Configurable I/O

All 12 contact converter inputs and 24 contact outputs (except for two fixed alarms) are user-configurable. SCR tripping outputs are available for high speed operation.

## Functional Block Diagram



## Monitoring and Metering

The LPS-D provides sophisticated monitoring and metering functions that include:

### Fault Location

Proven algorithms provide reliable fault location, reports in miles, kilometers, or percent of line impedance. The location and trip target are available locally, and are included in the fault reports and oscillography files.

### Trip Circuit Monitor

DC battery voltage is monitored across each open trip contact, triggering an alarm when the voltage nears zero. A current sensor in series with each trip contact is provided, to log an event message on the DC trip current status following the trip.

### Metering

The LPS-D provides the following RMS metering values:

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

The currents and voltages are calculated for each phase to an accuracy of 1% of their rating. The phasor value (magnitude and angle) of the phase currents and voltages are also displayed.

### Event Recording

The LPS-D stores up to 150 time stamped events. This aids the user with troubleshooting and recovery.

### Oscillography

The LPS-D captures current and voltage waveforms and selected internal logic signals at 64 samples per cycle. The unit can store from six events of 72 cycles each to 36 events of 12 cycles each. The time, date, active settings, and fault re-

port are stored with the data capture. Prefault data can be set from one to eight cycles.

Oscillography can be triggered by internal signals such as trip outputs and programmable logic, or external signals. The LPS-D has

the capability to store the oscillography files in Comtrade format.

The LPS-D relay can playback stored waveform files allowing the user to playback faults with different settings.

## Typical Wiring

