



# Transmission Line Protection Relay

# L-PRO 4500

## Product Overview

The L-PRO provides easy to use, state of the art comprehensive distance and backup directional line protection for all voltages including Extra High Voltage transmission lines using communication based schemes. It provides control, automation, metering, monitoring, DFR-quality fault oscillography, dynamic swing recording, fault logging, sequence of event logging with advanced communication features in a flexible, cost effective package.

L-PRO can be for High Speed Protection and Complete Control in Multi breaker Applications to all bus types such as ring or breaker-and-a-half arrangements. The L-PRO takes into effect the influence of adjacent parallel lines through mutual coupling settings.

- Easy-to-use, intuitive setting and analysis software
- IEC 61850 communication along with Optional PRP (IEC 62439-3) via optical/copper ports
- Selectable single and 3 pole trip and reclose
- High-Speed Five Zone User defined Mho or Quad Characteristics for Phase and Ground Distance Protection
- High quality fault recording, swing and event log
- Single and Multi Breaker Applications (i.e, Ring Bus and Breaker and Half Configurations including Individual Breaker Failure)
- 4 shot recloser with dead line/dead bus control and Sync Check
- 8 setting groups to accommodate for various operating conditions



## Application

- Suitable for Overhead lines and underground cables (using pilot protection schemes)
- Backup protection for generators, transformers and reactors
- Ideal for multi-circuit line applications (to monitor mutual coupling via additional CT inputs)
- Suitable for Series compensated Lines

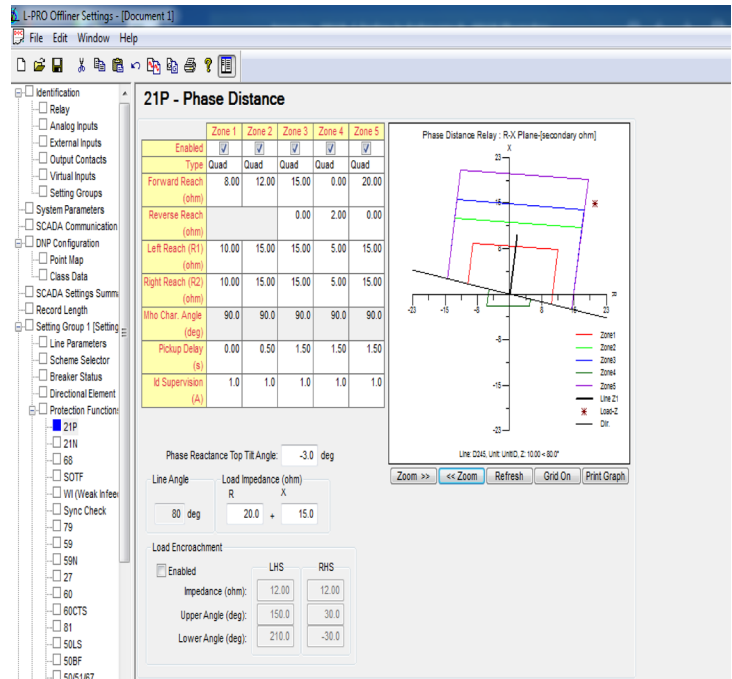
## Protection & Control

- Protection functions - 21P, 21N, 27, 50BF, 50LS, 50/51/67, 50N/51N/67, 50G/51G/67, 46-50/46-51/67, 59, 59N, 60, 60CTS, 68, 79, 81/81R, 25/27/59 (Check Sync), Dead Line Pickup (SOTF), Weak In feed, Mutual Compensation and Series Compensation
- High-speed 5 zones of phase and ground distance functions - user-defined Mho shapes or Quadrilateral phase and ground distance protection and communication based schemes
- Operating Time < 25 msec typical
- Selectable single and 3 pole trip and reclose
- CCVT compensation
- Individual breaker failure
- 4 shot recloser with dead line/dead bus control and sync check
- Enhanced user-configurable logic - with ProLogic™ which includes 24 control logic statements
- 8 setting groups with unique Group Logic Control Statements - full Boolean graphics to create logic for setting groups switching based on a combination of given conditions

## Features & Benefits

### Ease of Use

- Easy-to-use, install and maintain
- Easy to order - no complex product codes
- User-friendly, Windows®-based relay setting and record analysis software
- Setting software tool - relay specific application
- Online setting tool
- Flexible programmable logic for building customized schemes with ProLogic™ statements - 24 control logic statements (total of 192 statements)



## Reduce Installation and Operation Cost

- Substation automation cost – includes IEC 61850 protocol along with Optional PRP to display and transfer operational data via LAN/DAN for local HMI and wide-area network (WAN) for remote monitoring SCADA
- Engineering, installation and commissioning cost - IEC 61850 GOOSE messages communicate high-speed information between IEDs on the substation LAN/DAN
- Product setting time – 128 X 64 LCD graphical user interface provides convenient means to verify / change specific settings and parameters
- Front panel indicators – 18 user-configurable LEDs, and Fixed 4 LEDs - Relay Functional, IRIG-B Functional, Service Required, Test Mode.

## Flexible Communications

- 100BASE-TX RJ-45 or 100BASE-FX 1300 nm multimode optical with ST style connector
- Ethernet ports with PRP compliant (Optional)
- Front panel USB interface

## Substation Automation - Ethernet Ready

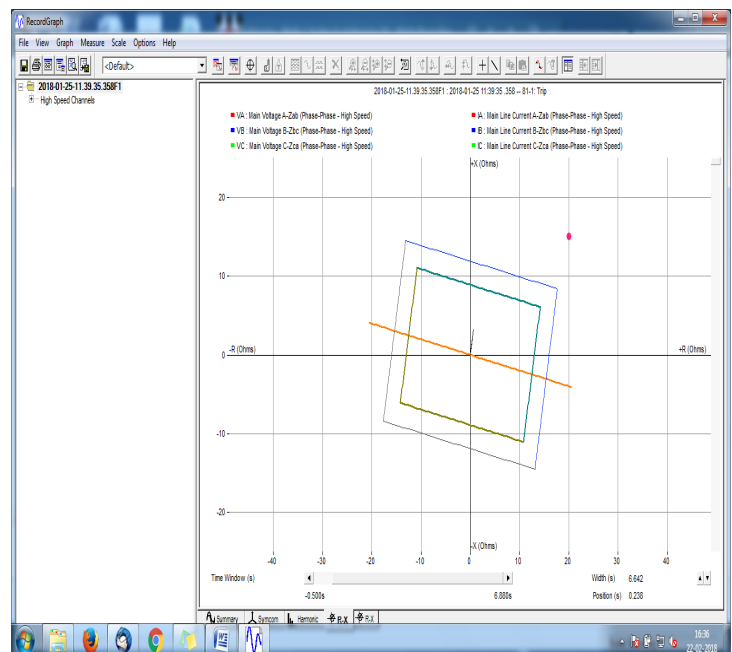
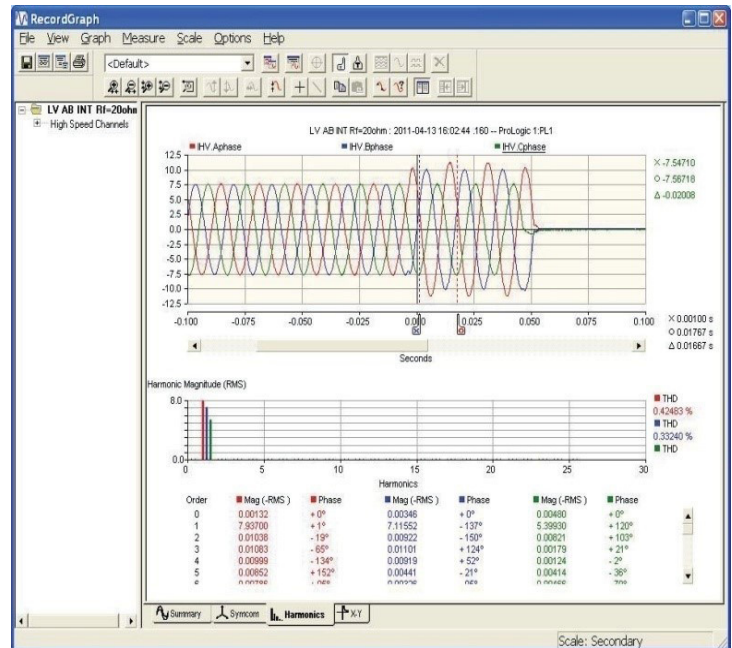
- Standard IEC 61850 Station Bus & Optional PRP (IEC 62439-3) on a dedicated Optical/Copper Ethernet port
- Enhanced DNP3 SCADA communication protocol including user-selectable point lists, class support and multiple master station support
- Modbus SCADA communication protocol
- 30 virtual inputs for local and remote control

## Multi-Functional Recording and Event Logging

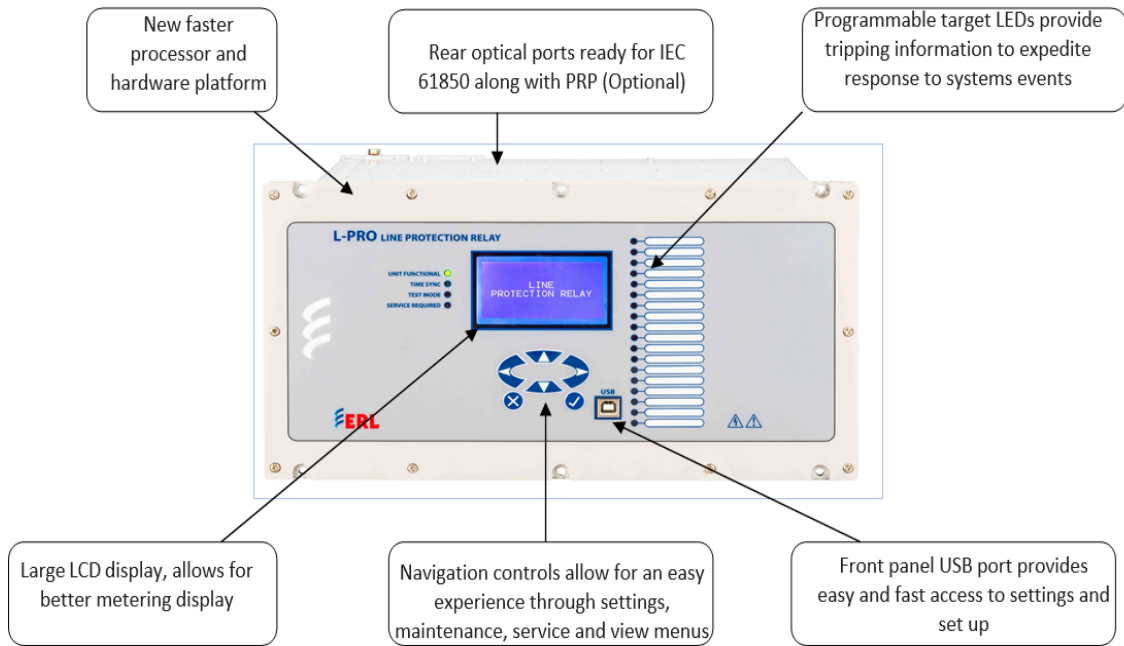
- Exceptional fault recording capabilities (with 128 samples/cycle)
- User selectable pre-fault and total record length of maximum 10 seconds/record with a total memory of 150 seconds, records can have a combination of transient/event & swing records.
- Swing recording characteristics with 1 sample/cycle, Record Length from 60 to 120 second with pre trigger of 30 seconds
- Metering functions for each input connection
- Sequence of Event Recorder - 250 events with 1 ms resolution (a compressed sequence of event file is created approximately every 230 events)

## RecordGraph™ and RecordBase View™

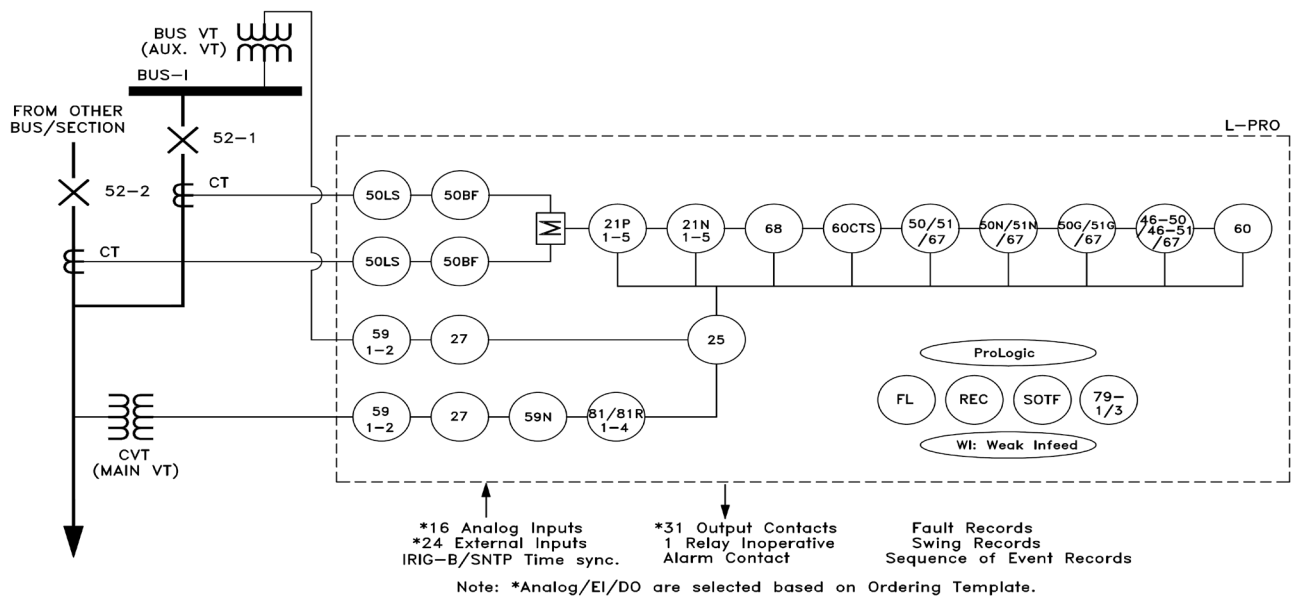
- Display multiple channels simultaneously and combine records
- Display multiple component voltage, current or summed channels
- Display THD, harmonic magnitude
- Display sub-harmonic THD, sub-harmonic magnitude
- Zoom, alignment, scaling, unit functions
- Record summaries including event list
- COMTRADE, PTI and MS Excel export functions



## Best in Class Human-Machine Interface



## Protection & Control Function Diagram



## Detailed Specifications

### L-PRO 4500 Transmission Line Protection Relay

Item	Quantity/Specs	Notes
<b>General</b>		
Nominal Frequency	50 or 60 Hz	
Operating Time	< 25 msec typical	Including relay output operation
Power Supply	Range: 20 - 60 Vdc / 20 – 60 Vac, 80 - 300 Vdc / 80 – 250 Vac	Power Consumption: 20 - 30 W/VA
Memory	Settings and records are stored in non-volatile memory	Records are stored in FIFO method
<b>Protection Functions</b>		
21P, 21N, 27, 50BF, 81/81R, 50LS, 50/51/67, 50N/51N/67, 50G/51G/67, 46-50/46-51/67, 59, 59N, 60, 60CTS, 68, 79, Sync Check, Switch On To Fault, Weak In Feed, Mutual Compensation and Series Compensation	2x 3-phase voltage inputs for synchronizing during reclosing 2 x 3-phase current inputs for protection 2X 1-phase current for Measured Ground protection 2X 1- phase current for Mutual Compensation	Suitable for All Type of Bus Configuration including Ring Bus and Breaker and Half
ProLogic™	24 statements per setting group	5 inputs per ProLogic™ statement
Group Logic	16 statements per setting group	5 inputs per group logic statement
<b>Recording</b>		
Transient (Fault)	128 s/c oscillography of all analog and external input channels	User-configurable 0.2 to 10 seconds record length and 0.1 to 2.0 seconds pre trigger record length
Swing	1 s/c oscillography	User-configurable 60 to 120 seconds record length with 30 seconds pre trigger
Sequence of Events Recorder	250 events circular log with 1ms resolution	When “event auto save” is enabled, a compressed event record is created every 230 events.
Record Capacity	Up to 150 sec (15 x 10 seconds) transient records, swing and event records	
<b>Input and Output</b>		
Analog Voltage Inputs 2 sets of 3-phase voltage inputs	Nominal Voltage Continuous Rating Over Voltage Maximum Over-scale Thermal Rating Burden	Vn = 69 Vrms 2 x Vn = 138 Vrms 3 x Vn = 207 Vrms for 10 seconds < 0.15VA @ 69 Vrms
Analog Current Inputs (2 sets of 3-phase current inputs 2 x 2 sets of 1-phase current inputs)	Nominal Current Full Scale/Continuous Maximum Full-Scale Rating Thermal Rating Burden	In = 1 and 5 Arms (Site Selectable) 4 x In 40 x In 100 X In rms for 1 second <0.25 VA @ 5 Arms <0.10 VA @ 1 Arms
Analog Sampling Rate	128 samples/cycle for recording 8 samples/cycle for protection	Records up to 33rd harmonic
External Inputs (digital)	24 isolated inputs	24/48/110/220 Vdc nominal (Ordering Option) Externally wetted
Output Relays (contacts)	Burden Isolation 31 programmable outputs and 1 relay inoperative contact (N.C.)	Burden resistance: > 200 k ohms 2 kV optical isolation Externally wetted Make: 30 A as per IEEE C37.90 Carry: 8 A Break: 0.9 A at 125 Vdc resistive 0.35 A at 250 Vdc resistive
Virtual Inputs	30 Virtual Inputs	

## L-PRO 4500 Transmission Line Protection Relay

Item	Quantity/Specs	Notes
<b>Interface &amp; Communication</b>		
Front Display	128 x 64 pixels graphics LCD	
Front Panel Indicators	22 LEDs: 17 programmable and 5 fixed	Target (17), Unit Functional, Time Sync, Test Mode, Service Required, Alarm
Front User Interface	USB port	Full Speed USB 2.0, RJ-45
Rear User Interface	LAN Port 1: 100BASE – Copper or Optical 1300 nm LAN Port 2: 100BASE – Copper or Optical 1300 nm	Copper: RJ-45, 100BASE-T Optical: 100BASE-FX, Multimode ST style connector
SCADA Interface	One serial RS-485 ports IEC 61850 PRP (IEC 62439-3) DNP3 (RS-485 or Ethernet) or Modbus (RS-485)	300 – 57600 Baud Rate Rear port
Time Sync	IRIG-B, BNC connector B003, B004, B123 and B124 Time Codes SNTP	Modulated or unmodulated
Self Checking/Relay Inoperative	1 contact	Through Ethernet Ports Closed when relay inoperative
<b>Physical</b>		
Weight	16.0 kgs (approximately)	
Dimensions	177 mm (H) x 339.50 mm (W) x 262 mm (D)	
<b>Time Synchronization and Accuracy</b>		
External Time Source	Synchronized using IRIG-B input (modulated or un-modulated) and SNTP	In the absence of an external time source, the relay maintains time with an internal RTC. The relay can detect loss of re-establishment of external time source and automatically switch between internal and external time.
Synchronization Accuracy	Sampling clocks synchronized with the time source (internal or External)	
<b>Overall L-PRO 4500 Accuracies</b>		
Current	±2.5% of inputs from 0.1 to 1.0 x nominal current (In) ±1.0% of inputs from 1.0 to 40.0 x nominal current (In)	
Voltage	±1.0% of inputs from 0.01 to 2.0 x nominal voltage (Vn)	
Differential Element	±5.0% of set value I <sub>o min</sub> from 0.10 to 1.0 per unit (pu)	
Directional Phase Angle	±2.5% or > 2.0 of set value from 0.01 to 360.0	
Frequency Elements	±0.001 Hz (for 81U/O) ±0.05 Hz (for 81R)	
Inverse Overcurrent Timers	±2.5% or 1 cycle of selected curve	
Timers	±3 ms of set value	

## Detailed Environmental Tests

Test	Description of the Test	Test Points	Test Level
IEC 60255-26:2013 Cl.No.7.1.2	Radiated Emissions	Enclosure ports	Class A: 30 – 6000 MHz
IEC 60255-26:2013 Cl.No.7.1.3	Conducted Emissions	AC/DC power ports	Class A: 0.15 – 30 MHz
IEC 60255-26:2013 Cl.No.7.2.3	Electrostatic Discharge	Enclosure air Enclosure contact	+/- 8 kV +/- 6 kV
IEC 60255-26:2013 Cl.No.7.2.4	Radiated Interference	Enclosure ports	10 v/m : 80-1000 MHz : 1.4 GHz - 2.7 GHz
IEC 60255-26:2013 Cl.No.7.2.5	Electrical Fast transient	AC/DC power ports AC voltage & current ports External I/P & O/P ports Comm./signal ports	+/- 4 kV +/- 4 kV +/- 4 kV +/- 2 kV
IEC 60255-26:2013 Cl.No.7.2.6	Slow Damped Oscillatory / High Frequency Disturbance / 1 MHz Burst Disturbance	AC/DC power ports AC voltage & current ports External I/P & O/P ports Comm./signal ports	+/- 2.5kV(CM), +/- 1kV(DM) +/- 2.5kV(CM), +/- 1kV(DM) +/- 2.5kV(CM), +/- 1kV(DM) +/- 1 kV (CM)
IEC 60255-26:2013 Cl.No.7.2.8	Conducted Interference	AC/DC power ports External I/P & O/P Comm./signal ports	0.15 - 80 MHz
IEC 60255-26:2013 Cl.No.7.2.9	Power Frequency Immunity	External input	Class A: 150 Vrms (DM) 300 Vrms (CM)
IEC 60255-26:2013 Cl.No.7.2.10	Power Frequency Magnetic Field	Enclosure ports	30A /m continuous 300 A/m 1 – 3 S
IEC 60255-26:2013 Cl. No. 7.2.11	Voltage Dips & Interrupts	ac power port  dc power port	30% for 1 period, 60% for 50 periods 100% for 5 periods, 100% for 50 periods  30% for 0.1 s, 60% for 0.1 s, 100% for 0.05 s
IEC 60068-2-1, 2	Ambient Temperature		-40°C to 85°C for 16 hours -40°C to 70°C continuous LCD contrast impaired for temperatures below -20°C and above 70° C
IEC 60068-2-30	Humidity		Up to 95% without condensation
IEC 60255-21-1, IEC 60068-26, Class 1	Sinusoidal Vibration		10 Hz to 150 Hz, 1.0 octave/min, 40 sweeps
IEC 60255-21-2 IEC 60068-2-27: Class 1	Shock & Bump		5 g and 15 g

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The specifications and product information contained in this document are subject to change without notice.  
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