

Feeder Protection Relay

F-PRO 4500

Product Overview

The F-PRO provides complete feeder protection with current, voltage and frequency elements that meet the requirements of many power automation systems. It provides control, automation, metering, monitoring, DFR-quality fault oscillography, dynamic swing recording, fault logging, and sequence of event logging with advanced communication features in a flexible, cost-effective package. It is available in both Flush mount (E12) and Rack mount (19") mechanical enclosure.

- Easy-to-use, intuitive setting and analysis software
- IEC 61850 Edition 2 communication along with Optional PRP (IEC 62439-3) via optical/copper ports
- Selectable single and 3 pole trip and reclose
- High quality fault recording, swing and event log
- 4 shot recloser with dead line/dead bus control and Sync Check
- 8 setting groups to accommodate for various operating conditions

F-PRO 4500 E12 Case



F-PRO 4500 19 inch Case



Features & Benefits

Protection & Control

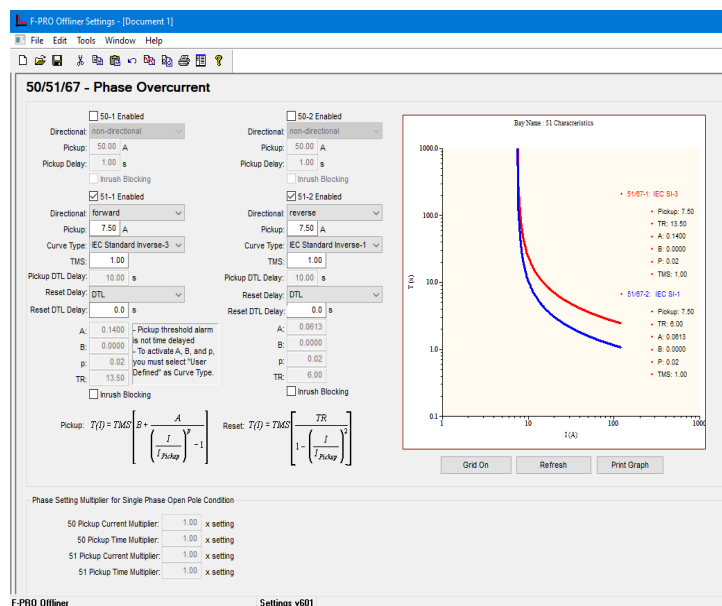
- Protection functions - 27, 59, 24, 47, 59N, 50BF, 50LS, 50/51/67, 50N/51N/67N, 50G/51G/67G, 50SEF/51SEF/67SEF, 46-50/46- 51/67, 60VTS, 60CTS, 79, 81U/81O/81R, 32, 49, 37, 74TCS, THD, I^Δ2t, 25/27/59 (Check Sync)
- Selectable single and 3 pole trip and reclose
- 4 shot recloser with dead line/dead bus 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

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 & Operation Cost

- Substation automation cost – includes IEC 61850 Edition 2 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, IIRIG-B Functional, Service Required, Test Mode.

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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

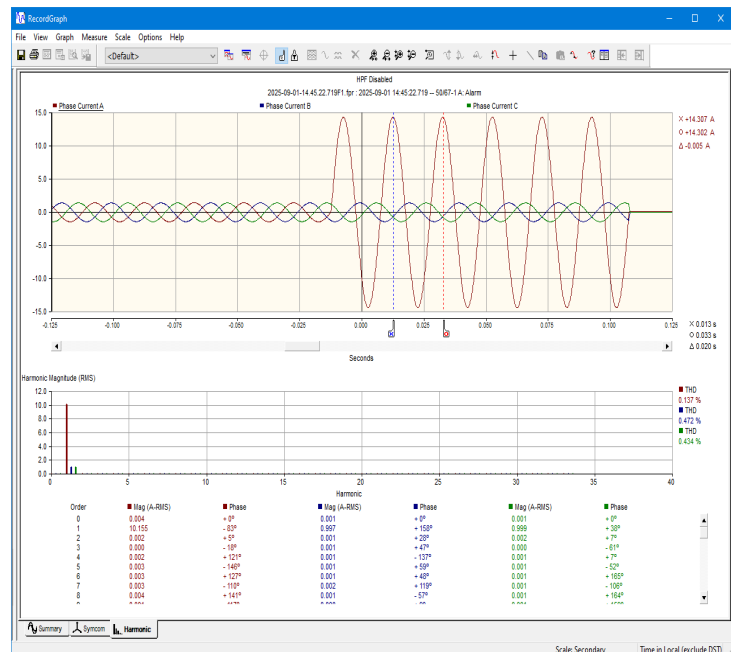
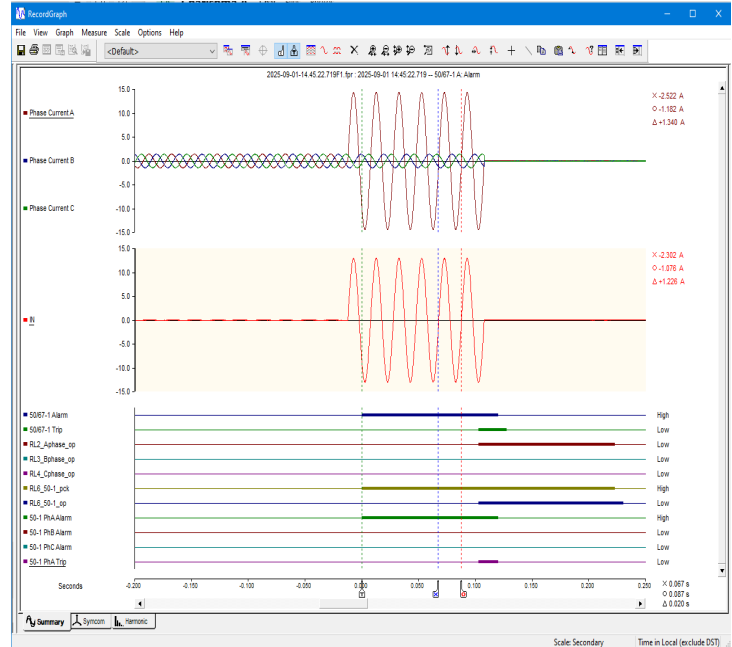
- Standard IEC 61850 Edition 2 Station Bus & Optional PRP (IEC 62439-3) on a dedicated Optical/Copper Ethernet port
- Enhanced DNP3 SCADA communication protocol including user-selectable point lists, class support and multiple master station support
- Modbus SCADA communication protocol
- 30 virtual inputs for local and remote control

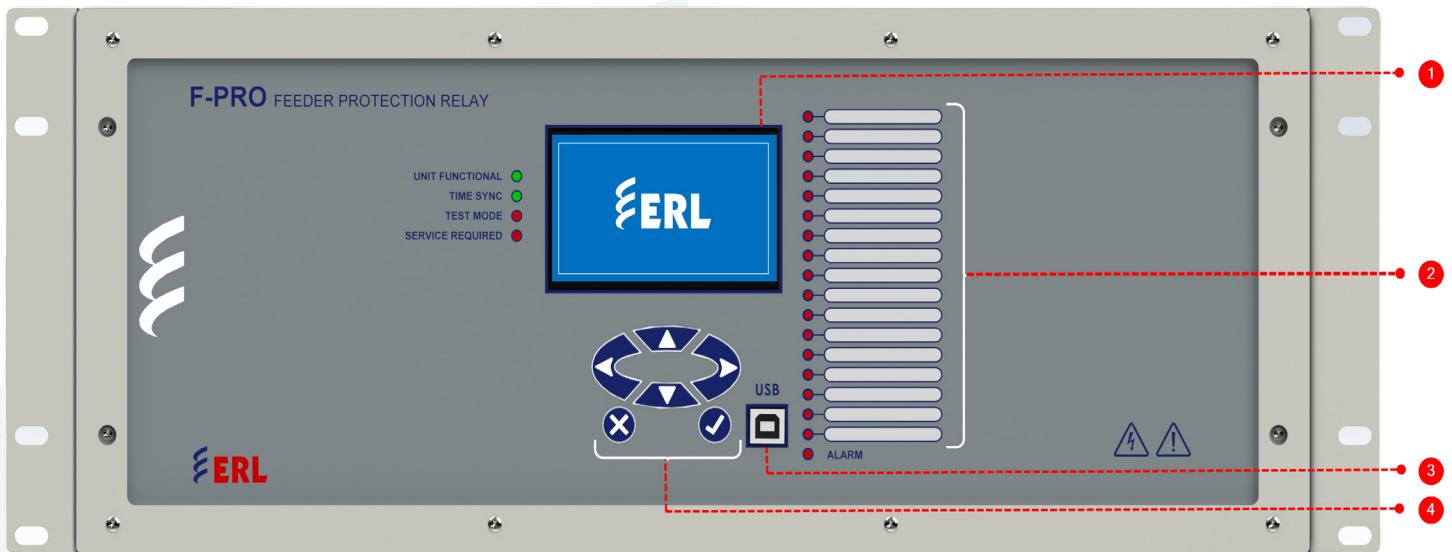
Multi-Functional Recording and Event Logging

- 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 (with 4 sec record length). 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™

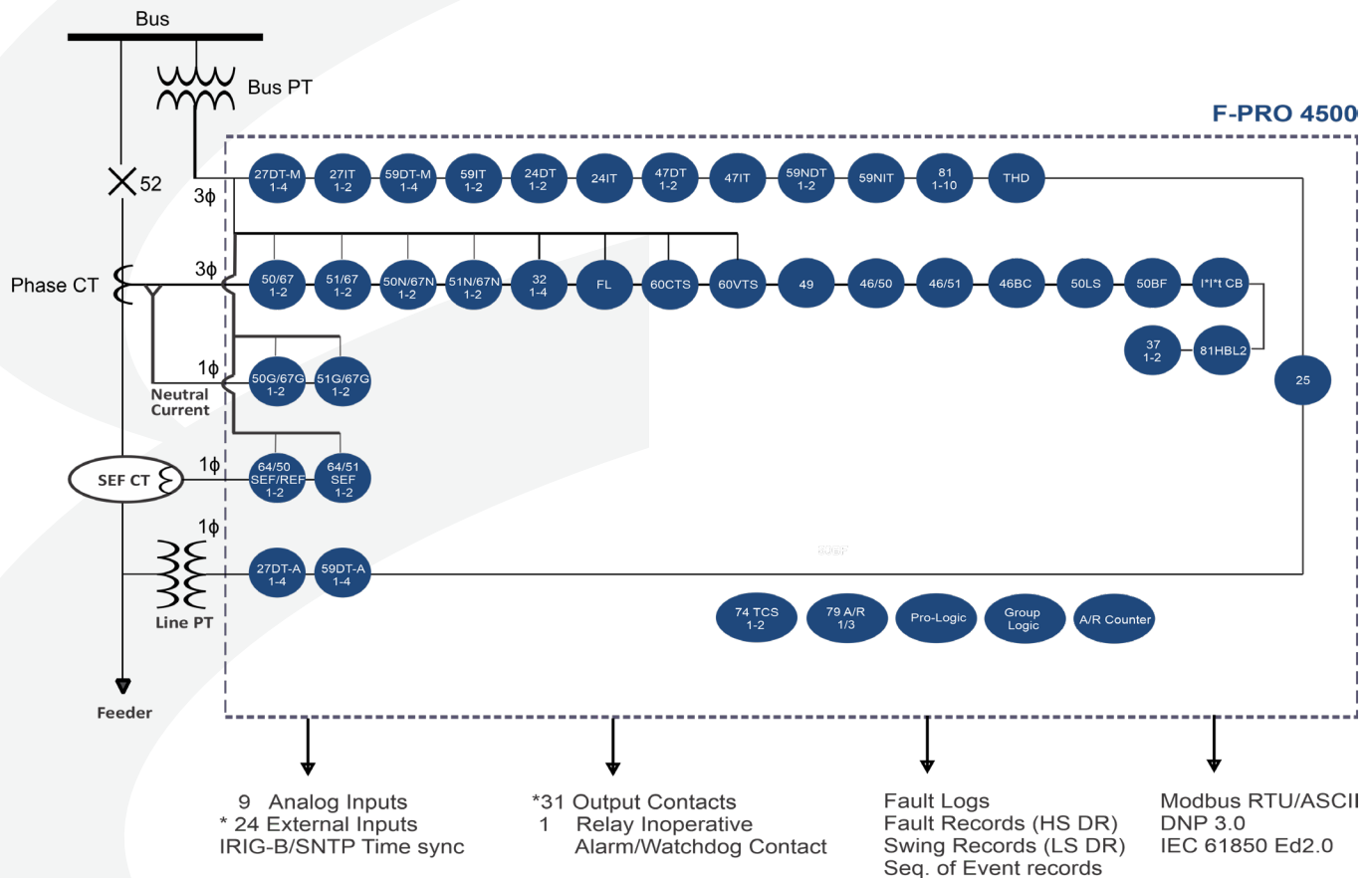
- Display multiple channels simultaneously and combine records
- Display multiple component voltage, current or summed channels
- Display THD, harmonic magnitude
- Display sub-harmonic THD, sub-harmonic magnitude
- Zoom, alignment, scaling, unit functions
- Record summaries including event list
- COMTRADE,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





- 1 Large LCD Display, Allows for better metering display
- 2 Programmable target LEDs provide tripping information to expedite response to system events
- 3 Front Panel USB Port provides easy access to settings and setup
- 4 Navigation controls allow for an easy experience through settings, maintenance, service and view menu

Protection & Control Function Diagram



Note: *EI/DO are selected based on ordering template

Detailed Specifications

Item	Quantity/Specs	Notes
General		
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
Protection Functions		
27, 59, 24, 47, 59N, 50BF, 50LS, 50/51/67, 50N/51N/67N, 50G/51G/67G, 50SEF/51SEF/67SEF, 46-50/46- 51/67, 60VTS, 60CTS, 79, 81U/81O/81R, 32, 49, 37, 74TCS, THD, I ^Δ 2t, 25/27/59 (Check Sync)	1 x 3-phase voltage input for protection 1 x 1-phase voltage input for protection and check synchronizing 1 x 3-phase current inputs for protection 1 x 1-phase current for Measured Ground protection 1 x 1-phase current for SEF/REF protection	
ProLogic™	24 statements per setting group	5 inputs per ProLogic™ statement
Group Logic	16 statements per setting group	5 inputs per group logic statement
Recording		
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	Maximum of 150 total records (Fault, Swing and Event) is possible with 4 second record length. Fault Records with 10 second duration are the largest records.	
Inputs and Outputs		
Analog Voltage Inputs 1 set of 3-phase voltage inputs 1 set of 1-phase voltage input	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 (1 sets of 3-phase current inputs 2 x 1 sets of 1-phase current inputs)	Nominal Current Continuous Rating	In = 1 and 5 Arms (Site Selectable) 4 x In (for Phase and neutral CT), 2 x In (for SEF CT)
	Maximum Full-Scale Rating	40 x In (for Phase and neutral CT), 4 x In (for SEF CT)
	Thermal Rating	100 x In rms for 1 second (for Phase and neutral CT) 10 x In rms for 1 second (for SEF CT)
	Burden	<0.25 VA @ 5 Arms, <0.10 VA @ 1 Arms (for Phase and neutral CT), <1VA @ 1 Arms, <2VA @ 5Arms (for SEF CT)
External Inputs (digital)	24 isolated inputs	24/48/110/220 Vdc nominal (Ordering Option) Externally wetted
	Burden	Burden resistance: > 200 k ohms
	Isolation	2 kV optical isolation

Item	Quantity/Specs	Notes
Inputs and Outputs (cont.)		
Output Relays (contacts)	31 programmable outputs and 1 relay inoperative contact (N.C.)	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	
Interface & Communication		
Front Display	128 x 64 pixels graphics LCD	
Front Panel Indicators	22 LEDs: 18 programmable and 4 fixed	Target (18), Unit Functional, Time Sync, Test Mode, Service Required
Front User Interface	USB port	Full Speed USB 2.0
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
	One serial RS-485 ports	300 – 57600 Baud Rate
SCADA Interface	IEC 61850 Edition 2, DNP3 (RS-485 or Ethernet) or Modbus (RS-485)	Rear port
Time Sync	IRIG-B, BNC connector B003, B004, B123 and B124 Time Codes	Modulated or unmodulated
	SNTP	Through Ethernet Ports
Self Checking/Relay Inoperative	1 contact	Closed when relay inoperative
Physical		
Weight	E12 case: 11 kg (approximately) 19" case: 9.5 kg (approximately)	
Dimensions	E12 case: 177 mm (H) x 340 mm (W) x 283 mm (D) 19" case: 175 mm (H) x 486 mm (W) x 276 mm (D)	
Time Synchronization and Accuracy		
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)	
Overall F-PRO 4500 Accuracies		
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)	
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	

Type Tests

Test	Description		Test Level
	Type Test	Test Points	
Electromagnetic Compatibility			
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	Power supply 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 @ 5 kHz +/- 4 kV @ 5 kHz +/- 4 kV @ 5 kHz +/- 2 kV @ 5 kHz
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	10 Vrms: 0.150 - 80 MHz 10 Vrms: 0.150 - 80 MHz 10 Vrms: 0.150 - 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	30 A /m continuous 300 A/m 1 – 3 s
IEC 60255-26:2013 Cl. No. 7.2.11	Voltage Dips & Interrupts	AC power port	30% for 25 cycles, 60% for 10 cycles, 100% for 2.5 cycles, 100% for 250 cycles.
		DC power port	30% for 0.1 s, 60% for 0.1 s, 100% for 0.05 s
Environmental			
IEC 60068-2-1, 2	Ambient Temperature		-40°C to 70°C for storage -25°C to 55°C operational
IEC 60068-2-30	Humidity		Up to 95% without condensation
Mechanical			
IEC 60255-21-1, IEC 60068-26, Class 1	Sinusoidal Vibration		10 Hz to 150 Hz, 1.0 octave/min, 20 sweeps
IEC 60255-21-2 IEC 60068-2-27: Class 1	Shock & Bump		5 g, 10 g and 15 g

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