



Feeder Protection Relay

F-PRO

Product Overview

The F-PRO family of numerical multifunction relays provides protection for a range of transmission, distribution and industrial applications. F-PRO relays provide complete feeder protection with current, voltage and frequency elements that meet requirements of many power automation systems. This product family includes metering, communications, fault logs, disturbance recordings and sequence of events with 1ms time stamp resolution for analysis.

Flexible I/O options, draw out construction of the relay cases, easy mounting and user-friendly settings make maintenance easy, saving time for end users.

F-PRO can be integrated into serial (IEC 60870-5-103, Modbus RTU/ASCII, DNP3 Level2) and Ethernet-based communication (IEC 61850, DNP3 Level2 TCP/UDP) via selectable electrical or fiber ports. This product is also enabled with Parallel Redundancy Protocol (PRP, IEC 62439-3), optional at time of order.

Application

F-PRO provides current, voltage and frequency protection for a range of applications including lines, generators, bus bars, reactors, capacitors. Rear side communication capability allows integration into a smart grid for substation automation, monitoring systems and SCADA.



Features & Benefits

Measurement & Monitoring

- Phase voltages and currents
- Phase to phase voltages
- Residual voltage and current
- Sequence voltages and currents
- Frequency and phase angles
- Active power, reactive power and power factor
- Total harmonic distortion (THD)
- I² t accumulated for circuit breaker maintenance
- I² t for last operation
- Percentage thermal state
- Monitoring - status of external Inputs and relay outputs
- Monitoring - status of Prologic outputs and virtual inputs

Communication Interface

Front: USB 2.0 port

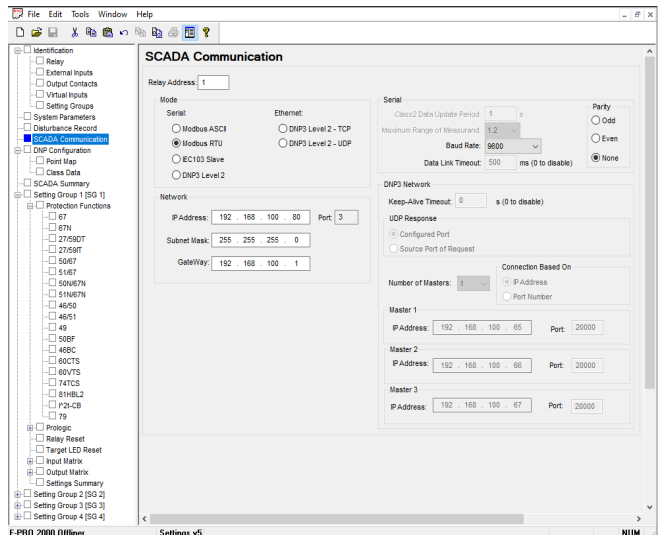
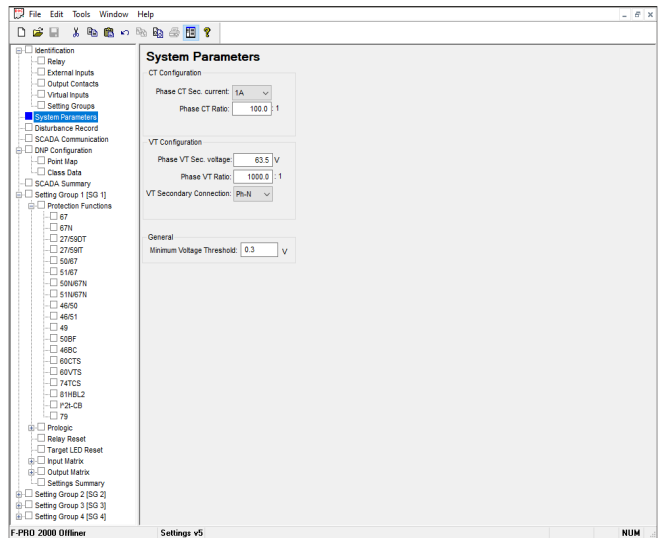
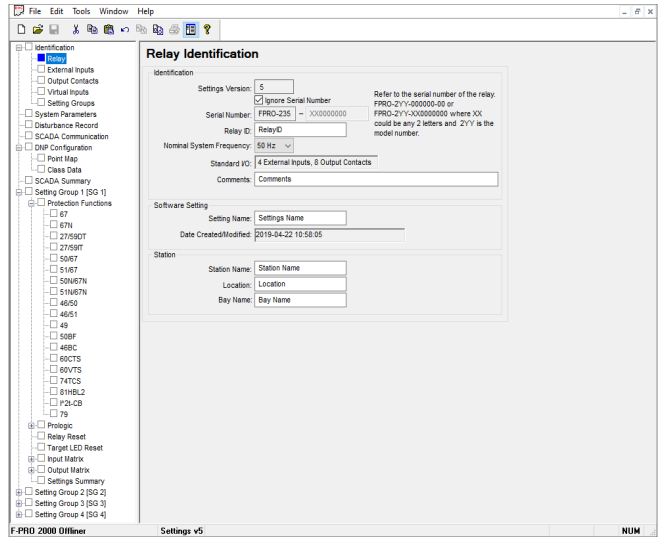
Rear: RS485, Ethernet - copper / fiber optic (refer to ordering sheet)

Communication Protocol

- Modbus RTU/ASCII
- IEC60870-5-103
- DNP3 Level2 Serial/TCP/UDP
- IEC 61850
- IEC 62439-3 (PRP) (only for F-PRO 297 and 298)

Protection Functions

- Site selectable 1A or 5A CT secondary ratings
- Programmable VT secondary ratings
- Programmable IEC and ANSI inverse/DT/user-defined curves
- Programmable self/hand reset output contacts
- Programmable self and hand reset LEDs
- 20 fault logs
- 1000 event records with 1ms time tag
- 20 disturbance records
- 4 or 8 setting groups
- Multi-level password protection
- 7/13 programmable LEDs and 1 fixed LED to indicate IED status
- Programmable frequency (50 Hz or 60 Hz)
- 2 X 16 character alphanumeric LCD (for F-PRO 216 and 235)
- 128 X 64 graphical LCD (For F-PRO 297 and 298)
- 4/14 programmable external inputs
- 8/14 programmable output contacts
- Time synchronization through PPM/SNTP/IRIG-B
- Modulated/un-modulated IRIG-B inputs are user configurable

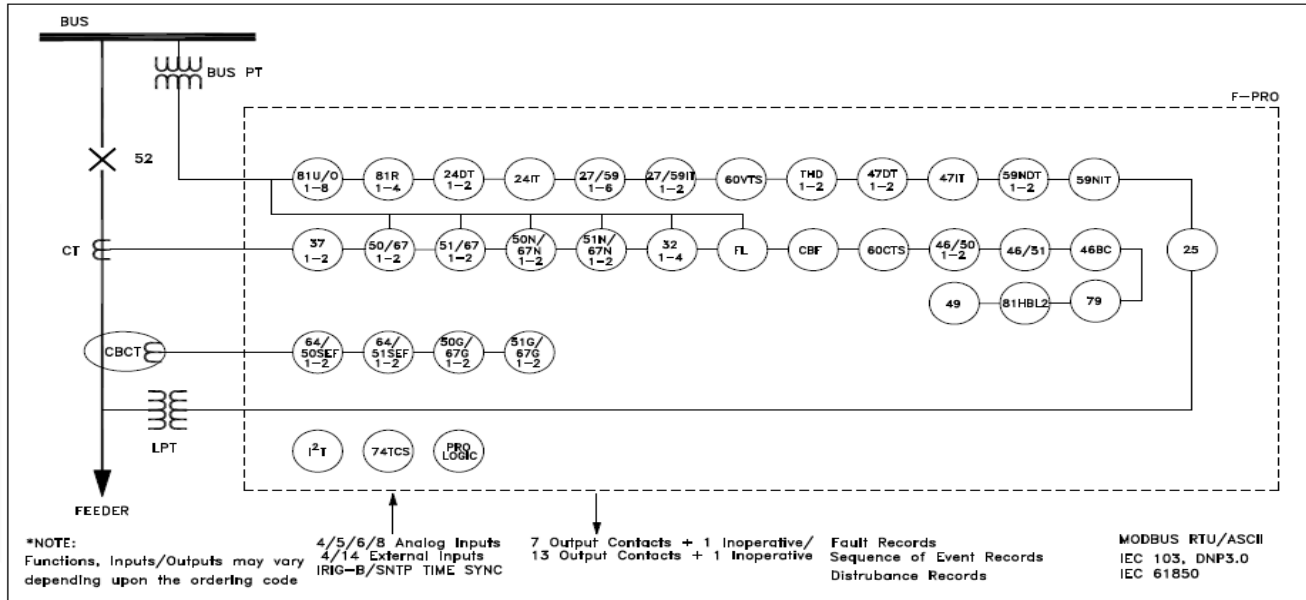


Variants & Protection Functions

SL. NO.	ANSI NO.	PROTECTION FUNCTION DETAILS	F-PRO 216	F-PRO 235	F-PRO 297	F-PRO 298
1	24DT	Definite Time Over Flux			✓ (2)	✓ (2)
2	24IT	Inverse Time Over Flux			✓ (1)	✓ (1)
3	25/27/59	Synchro Check				✓ (1)
4	27/59 DT	Phase Definite Time Under/Over Voltage		✓ (6)	✓ (6)	✓ (6)
5	27/59 IT	Phase Inverse Time Under/Over Voltage		✓ (2)	✓ (2)	✓ (2)
6	46/50	Instantaneous Negative Sequence Over Current	✓ (1)	✓ (1)	✓ (1)	✓ (1)
7	46/51	IDMTL Negative Sequence Over Current	✓ (1)	✓ (1)	✓ (1)	✓ (1)
8	46BC	Broken Conductor (I2/I1)	✓ (1)	✓ (1)	✓ (1)	✓ (1)
9	47DT	Negative Sequence Definite Time Over Voltage			✓ (2)	✓ (2)
10	47IT	Negative Sequence Inverse Time Over Voltage			✓ (1)	✓ (1)
11	49	Thermal Over Load	✓ (1)	✓ (1)	✓ (1)	✓ (1)
12	37	Instantaneous Phase Undercurrent			✓ (2)	✓ (2)
13	50	Instantaneous Phase Over Current	✓ (2)			
14	50BF	Breaker Failure	✓ (1)	✓ (1)	✓ (1)	✓ (1)
15	50G	Measured Instantaneous Neutral Over Current	✓ (2)			
16	50N	Derived Instantaneous Neutral Over Current	✓ (2)			
17	50/67	Instantaneous Directional Phase Over Current		✓ (2)	✓ (2)	✓ (2)
18	50G/67G	Measured Instantaneous Directional Neutral Over Current			✓ (2)	
19	50N/67N	Derived Instantaneous Directional Neutral Over Current		✓ (2)	✓ (2)	✓ (2)
20	51	IDMTL Phase Over Current	✓ (1)			
21	51/67	IDMTL Directional Phase Over Current		✓ (2)	✓ (2)	✓ (2)
22	51G	Measured IDMTL Neutral Over Current	✓ (1)			
23	51G/67G	Measured IDMTL Directional Over Current			✓ (2)	
24	51N	Derived IDMTL Neutral Over Current	✓ (1)			
25	51N/67N	Derived IDMTL Neutral Over Current		✓ (2)	✓ (2)	✓ (2)
26	59NDT	Derived Residual Definite Time Over Voltage			✓ (2)	✓ (2)
27	59NIT	Derived Residual Inverse Time Over Voltage			✓ (1)	✓ (1)
28	60CTS	Current Transformer Supervision		✓ (1)	✓ (1)	✓ (1)
29	60VTS	Voltage Transformer Supervision		✓ (1)	✓ (1)	✓ (1)
30	64/50SEF	Instantaneous SEF/REF	✓ (2)		✓ (2)	✓ (2)
31	64/51SEF	IDMTL SEF/REF	✓ (2)		✓ (2)	✓ (2)
32	67	Directional Function for Phase Over Current		✓ (1)	✓ (1)	✓ (1)
33	67SEF	Directional Function for SEF			✓ (1)	
34	67N	Directional Function for Derived Neutral Over Current		✓ (1)		
35	67N/67G	Measured IDMTL Neutral Over Current			✓ (1)	✓ (1)
36	74TCS	Trip Circuit Supervision	✓ (2)	✓ (2)	✓ (2)	✓ (2)
37	79	Multishot Auto Reclose	✓ (1)	✓ (1)	✓ (1)	✓ (1)
38	81HBL2	Inrush Detection	✓ (1)	✓ (1)	✓ (1)	✓ (1)
39	81R	Rate of Change of Frequency Protection			✓ (4)	✓ (4)
40	81 U/O	Under/ Over Frequency Protection			✓ (8)	✓ (8)
41	32	Directional Power Protection			✓ (4)	✓ (4)
42	I ² t	CB Monitoring	✓ (1)	✓ (1)	✓ (1)	✓ (1)
43	THD	THD Measurements			✓ (2)	✓ (2)
44		Fault Locator				✓ (1)
45	Hardware	No. of CT'S	5	3	5	4
46		No. of VT'S		3	3	4
47		No. of LED'S	8	8	14	14
48		No. of Output Relays	8	8	14	14
49		No. of External Inputs	4	4	14	14
50		Enclosure Size	E6	E6	E8	E8

Note: (✓) denotes number of stages.

Protection & Control Function Diagram



Detailed Specifications

F-PRO: Feeder Protection Relay

Item	Quantity/Specs	Notes
General		
Operate Time	1.0 to 1.5 cycles	Including relay output operation
Memory	Settings and records are stored in non-volatile memory Records are stored in a circular buffer	
ProLogic™	20 statements per setting group	5 inputs per ProLogic™ statement
Recording		
Transient (Fault)	32 s/c oscillography of all analog, external input and internal function status channels	Record Length: 1 to 10/20 sec Pre-fault Length: 0.1 to 0.5 sec
Events	1000 events with 1 ms resolution	A compressed event record can be created for 1000 events with manual trigger
Record Capacity	20 records of a combination of transient and event records	
Auxiliary Power Supply		
Nominal	Operating Range	
24 Vdc and 48 Vdc	20 to 60 Vdc	Rated current (In) 1A or 5A AC (site selectable)
110 Vdc and 220 Vdc	80 to 300 Vdc 80 to 250 Vac	Rated voltage (Vn) 63.5/69V AC PN or 110/120V AC PP
		Frequency 50Hz / 60Hz (site selectable)

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External Inputs

4/14 External Inputs	Pick-up level
24 Vdc	19 Vdc
48 Vdc	38 Vdc
110 Vdc	88 Vdc
220 Vdc	175 Vdc

Continuous Rating

CT Circuit	4 X In AC (4A for 1A CT) (20A for 5A CT)
SET CT Circuit	2 X In AC
VT Circuit	175 VAC

Burden

AC Current Input	<0.1VA @ 1A; <0.5VA @ 5A
AC SEF Current	<1VA @1A, <2VA@5A
AC Voltage Input	<0.15VA @ 63.5V AC <0.3VA @ 110V DC
External Input	<0.2W @ 110V DC
Power Consumption	<12VA (AC) & <12W (DC)

Note:

1. All dimension are in mm and are measured equidistant from center line
2. Maximum depth of equipment inside the panel is 225.0 mm

Overall F-PRO Accuracies

Current	± 2.5% of inputs from 0.1 to 1.0 x nominal current (In) ± 1.0% of inputs from 1.0 to 4.0 x nominal current (In)
Voltage	± 1.0% of inputs from 0.01 to 2.0 x nominal voltage (Vn)
Directional Phase Angle	± 3.0° of set value
Frequency Elements	± 0.01 Hz (fixed level) ±0.01 Hz/sec (df/dt)
Sync Check Elements	± 0.2 degrees
Timers	± 3ms of set value
Inverse Overcurrent Timers	± 2.5% or ±1 cycle of selected curve
Definite Overcurrent Timers	± 2.5% or ±1 cycle non-directional ± 2.5% or ±1 cycle directional
Frequency Timer	±2.5% of set value plus 2.5 cycles of inherent delay (fixed level) non-directional at 2x pickup, error <40 ms (df/dt) at 0.1 Hz/s above pickup, error <100 ms

Digital Outputs

Carry Continuous	8A AC or DC
Make and Carry	30 AC or DC for 0.2 seconds 5000VA AC resistive load 1250VA AC resistive load 50W DC inductive load @L/R <40msec with 110V DC
Break	

Short-time Thermal Rating

CT Circuit	100A for 1 sec (1A CT) & 200A for 2 sec (5A CT)
SEF CT Circuit	4 x In for 1 sec
VT Circuit	200 VAC for 10 sec

Physical Dimensions

Weight	E6 case: 4.50 kg (for F-PRO 216 and 235) E8 case: 6.0 kg (for F-PRO 297 and 298)
Dimensions	E6 case: 177 mm (H) x 155.5 mm (W) x 225.0 mm (D) E8 case: 177 mm (H) x 207.5 mm (W) x 225.0 mm (D)

Detailed Environmental Tests

F-PRO: Feeder Protection Relay

Test	Description	Test Points	Test Level
	Type Test		
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 (electromagnetic field immunity)	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 and current ports External I/P and O/P ports	+/- 4 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 and current ports External I/P and O/P ports	+/- 2.5kV (CM) +/-1kV (DM)
IEC 60255-27:2013 Cl.No.10.6.4.2	Impulse voltage	AC/DC power ports AC voltage and current ports External I/P and O/P ports	+/- 5 kV
IEC 60255-27:2013 Cl.No.10.6.4.3	AC dielectric voltage	AC/DC power ports AC voltage and current ports External I/P and O/P ports	2kVrms/min, 50/60Hz
IEC 60255-27:2013 Cl.No.10.6.4.4	Insulation resistance test	AC/DC power ports AC voltage and current ports External I/P and O/P ports	>100MΩ @ 500V/min
IEC 60068-2-1	Cold test - operational		-25°C for 16hr
IEC 60068-2-1	Cold test - storage		-40°C for 16hr
IEC 60068-2-2	Dry heat test - operational		+55°C for 16hr
IEC 60068-2-2	Dry heat test - storage		+70°C for 16hr
IEC 60068-2-14	Change of temperature		-25°C and +55°C for 5 cycles
IEC 60068-2-30	Cyclic temperature		+55°C for 5 cycles
IEC 60068-2-78	Damp heat - steady state		at +40°C for 240 hrs
IEC 60255-21-1 Class 1	Vibration		10Hz to 150Hz, 1.0g, 1.0 octave/min, 20 sweep cycle/axis
IEC 60255-21-2 Class 1	Shock and Bump		5g and 15g
IEC 60255-21-3 Class 1	Seismic		5Hz to 35Hz, 1.0g, 1.0 octave/min, 1 sweep cycle/axis

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