



Bus Bar Protection Relay

B-PRO 4000

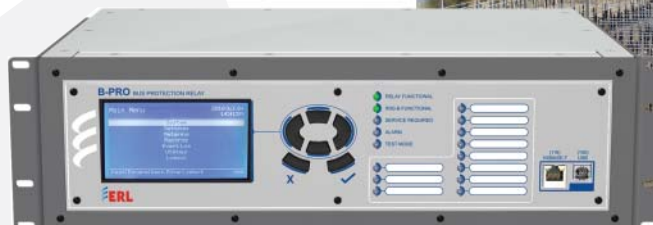
Product Overview

The IEC 61850 station bus embedded B-PRO 4000 relay provides complete bus and substation differential protection (low impedance) with CT saturation security for MV, HV and EHV bus-bars. It provides control, automation, metering, monitoring, DFR-quality fault oscillography, event logging and dynamic swing recording with advanced communications in a flexible, cost effective package.

Apply the B-PRO 4000 relay for re-configurable simple bus applications, up to 6 feeders and 2 differential zones with breaker failure or 4 feeders and 1 transformer including separate transformer differential protection.

- Easy-to-use, intuitive setting and analysis software
- Up to 6 CTs can be configured as current inputs for the bus differential element, controlled by external inputs identifying breaker status
- IEC 61850 communication via optical ports
- Ethernet ports with 2 unique MAC addresses accommodate network access security needs
- Transformer zone with internal magnitude and phase shift compensation, eliminating requirements for external CT connections and auxiliary CTs
- Transformer zone with 2nd and 5th harmonic restraint algorithm improves security for energization and inrush
- High quality fault recording and event log

**IEC 61850
Compliant!**



Distributed
Network
Protocol

**10 Year
WARRANTY**

Application

Re-configurable simple bus applications for up to 6 feeders and 2 differential zones with breaker failure or for 4 feeders and 1 transformer including separate transformer differential protection.

Protection & Control

- 6 sets of CT inputs for differential protection (18 currents) using percentage slope characteristic for security on external faults
- Protection functions include IEEE devices 87B, 27, 59, 60, 81, 87T, 50LS, 50BF, 50/51/67, 50N/51N/67, 46/50/51/67
- Multiple zones of protection — transformer, bus and dual bus zones
- Backup overcurrent and breaker failure for each input current
- User-defined directional control of overcurrent functions for networked lines
- User-configurable logic – with ProLogic™ which includes 15 control logic statements
- 1 Setting group

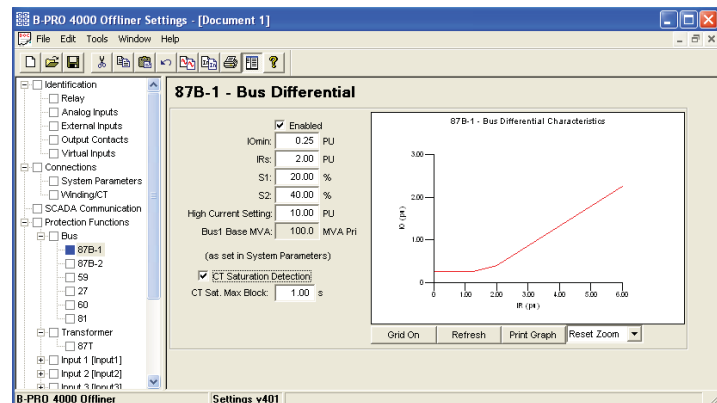
Features & Benefits

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
- On-Line setting Tool – terminal emulator (VT100)
- Flexible programmable logic for building customized schemes with ProLogic™ statements – 15 control logic statements (total of 120 statements)

Reduced Installation and Operation Cost

- Substation automation cost – includes IEC 61850 protocol to display and transfer operational data via local-area network (LAN) 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 such as transfer trips, interlocking, load-shedding and commands
- Product setting time – 240 x 128 LCD graphical user interface provides convenient means to check/change specific settings and parameters

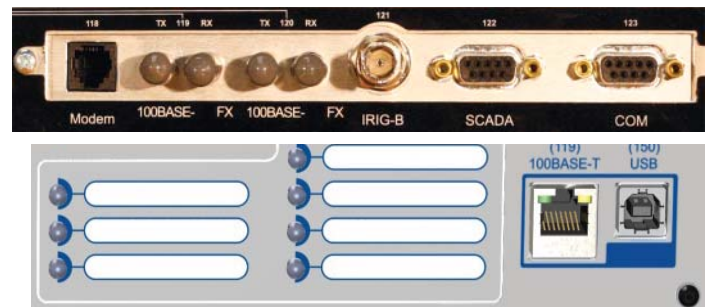


- Front panel indicators – 11 user configurable LEDs, Relay Functional, IRIG-B Functional, Service Required, Test Mode, Alarm



Flexible Communications

- 2 rear ports, 100BASE-TX RJ-45 or 100BASE-FX 1300 nm multimode optical with ST style connector
- Ethernet ports with 2 unique MAC addresses that easily accommodate network access security needs
- Front panel USB and 100BASE-TX RJ-45 Ethernet port interfaces



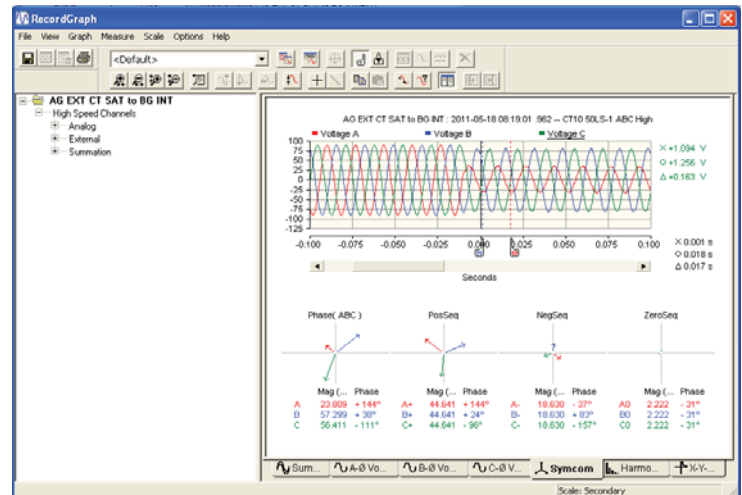
Substation Automation – Ethernet Ready

- IEC 61850 Station Bus 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

- IRIG-B port (through BNC connector) for precise time stamping and sample synchronization
- Serial communication port
- 30 virtual inputs for local and remote control
- Optional internal modem

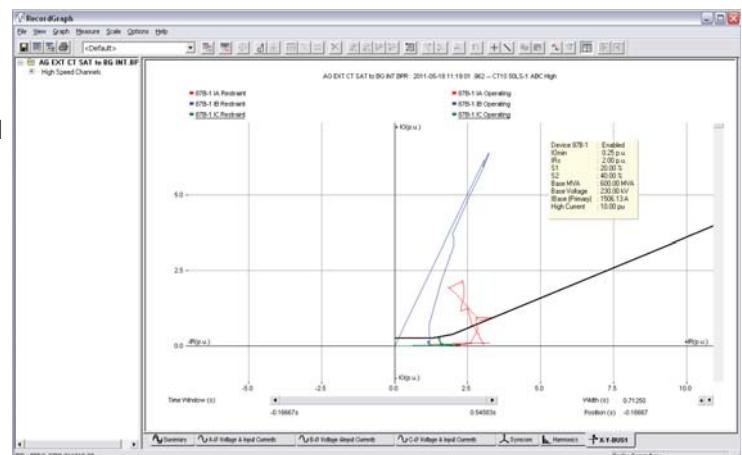
Multi-Functional Recording and Event Logging

- Exceptional fault recording capabilities (with 96 samples/cycle or 5760 Hz) and dynamic swing recording (at nominal frequency)
- Up to 75 x 2 second transient records, or up to 150 x 120 seconds swing records, or combination of transient, swing and optional event records
- Metering functions for each input connection
- Sequence of event recorder – 250 events with 1 ms resolution
- Compressed event record capabilities – 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
- Zoom, alignment, scaling, unit functions
- Record summaries including event lists
- COMTRADE, PTI and MS Excel export



Best in Class Human-Machine Interface

Large LCD display, allows for better metering display

Navigation controls allow for an easy experience through settings, maintenance, service and view menus

Programmable target LEDs provide tripping information to expedite response to system events

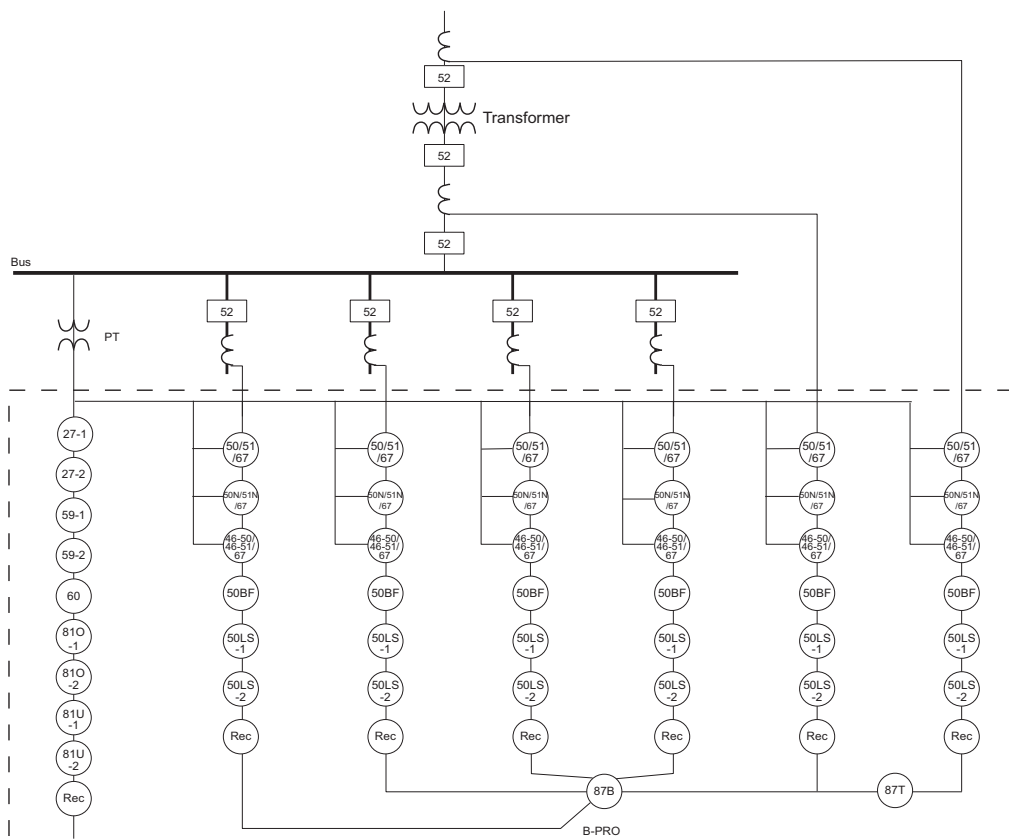


New faster processor and hardware platform

Rear optical ports ready for IEC 61850

Unique front panel USB and Ethernet ports provide easy and fast access to settings and set up

Protection & Control Function Diagram



Detailed Specifications

B-PRO 4000 Bus Protection Relay

Item	Quantity/Specs	Notes
General		
Nominal Frequency	50 or 60 Hz	
Operating Time	87B: 16 – 25 ms typical 87T: 12 – 24 ms typical	Including relay output operation
Sampling Rate	96 samples/cycle	Records up to 25th harmonic
Power Supply	Range: 43 – 275 Vdc, 90 – 265 Vac	Power Consumption: 25 – 35 VA (ac) 25 – 35 W (dc)
Protection Functions		
IEEE Device 87B, 87T, 27, 59, 60, 81, 50BF, 50LS, 50/51/67, 50N/51N/67, 46/50/51/67	6 x 3-phase current inputs (18 current channels) 1 x 3-phase voltage inputs (3 voltage channels)	Fault protection, monitoring and dynamic swing recording
ProLogic	15 statements/setting group	5 inputs/statement
Setting Groups	1 setting group	
Recording		
Record Capacity	Up to 75 x 2 second transient records or up to 150 x 120 seconds swing records or combination of transient, swing and optionally event records with a total number of records limited to 150	Transient record length is user-configurable (range from 0.2 to 2 seconds); transient record pre-fault time is user-configurable (range from 0.10 to 0.5 seconds) Swing record length is user-configurable (range from 60 – 120 seconds); swing record pre-trigger time is fixed at 30 seconds Viewing software provides waveform, symmetrical components and harmonic analysis
Transient	96 s/c oscillography of all analog and external input digital channels	
Dynamic Swing	1 sample/cycle or 60 samples/second	Line positive sequence voltage, current and frequency, W Var and Z for each of the 6 feeder input. Each swing record can be up to maximum 120 seconds
Events	250 events	1 ms resolution. When “event auto save” is enabled, a compressed event record is created is created approximately every 230 events.
A/D Resolution	16 bits, 65536 counts full scale peak – peak	
Input & Output		
Analog Voltage Inputs 1 set of 3-phase voltage inputs (3 voltage channels)	Nominal voltage Continuous rating over voltage Maximum over-scale thermal rating Thermal Rating Burden	$V_n = 69 \text{ Vrms}$ $2x V_n = 138 \text{ Vrms}$ $3x V_n = 207 \text{ Vrms}$ for 10 seconds 400 Arms for 1 second <0.15 VA @ 69 Vrms
Analog Current Inputs 6 sets of 3-phase current inputs (18 current channels)	Nominal current Full scale/continuous Maximum full-scale rating Burden	$I_n = 5$ or 1 Arms $3x I_n = 15$ or 3 Arms $40x I_n = 200$ Arms or 40 Arms symmetrical <0.25 VA @ 5 Arms

B-PRO 4000 Bus Protection Relay

Item	Quantity/Specs	Notes
Input & Output		
External Inputs (digital)	9 inputs	Optional 48/125/250 Vdc nominal, externally wetted
Output (contacts)	14 programmable outputs and 1 relay inoperative output (N.C.) (3U model)	Externally wetted Make: 30 A as per IEEE C37.90 Carry: 8 A Break: 0.9 A at 125 Vdc 0.35 A at 250 Vdc
Interface & Communication		
Front Display	240 x 128 pixels graphics LCD	
Front Panel Indicators	16 LEDs: 11 programmable and 5 fixed	Target, Relay Functional, IRIG-B Functional, Service Required, Test Mode, Alarm
Front User Interfaces	USB port and 100BASE-TX Ethernet port	USB 2.0, RJ-45
Rear User Interfaces	LAN Port 1: 100BASE – copper or optical LAN Port 2: 100BASE – copper or optical	Copper: RJ-45, 100BASE-TX Optical: 100BASE-FX, Multimode, 1300 nm, ST style connector
Internal Modem	Two Serial RS-232 ports to 115 kbd 33.6 Kbps, V.32 bis	Com port can support an external modem Optional internal modem
SCADA Interface	DNP3 or Modbus	DNP3: Ethernet or RS-232, Modbus: RS-232
Time Sync	IRIG-B, BNC connector	Modulated or unmodulated, auto-detect
Self Checking/Relay Inoperative	1 contact	Closed when relay inoperative
Environmental		
Ambient Temperature Range	-40°C to 85°C for 16 hours -40°C to 70°C continuous	IEC 60068-2-1, 2
Humidity	Up to 95% without condensation	IEC 60068-2-30
Insulation Test (Hi-Pot)	Power supply, analog inputs, external inputs, output contacts at 1.5 kV, 50/60 Hz, 1 minute	IEC 60255-5, ANSI/IEEE C37.90
Electrical Fast Transient	Tested to level 4 – 4.0 kV 2.5/5 kHz on power and I/O lines	IEEE C37.90.1: 4kV / IEC 60255-22-4 Class 3 / IEC 61000-4-4: Level 3
Oscillatory Transient	Test level = 2.5 kV	IEEE C37.90.1: 2.5 kV / IEC 60255-22-1: Level 3 / IEC 61000-4-12): Level 3
RFI Susceptibility	10 V/m modulated, 35 V/unmodulated	IEEE C37.90.2:35 V/m / (IEC 60255-22-3/ IEC61000-4-3): Level 3
Vibration, Shock and Bump	5 g and 15 g	(IEC 60255-21-1,2 / IEC60068 2-6, 27): Class 1
Conducted RF Immunity		(IEC 60255-22-6 / IEC 61000-4-6): Level 3
Voltage Interruptions	200 ms interrupt	IEC 60255-11 / IEC 61000-4-11
Physical		
Weight	9.55 kg	21 lbs
Dimensions	13.2 cm height x 48.26 cm width x 32.8 cm depth	5.2" height x 19" width x 12.9" depth
Time Synchronization and Accuracy		
External Time Source	Synchronized using IRIG-B input (modulated or unmodulated) auto detect	

B-PRO 4000 Bus Protection Relay

Detailed Environmental Tests

Test	Description	Test Points	Test Level
FCC Part 15	Type Test RF emissions Conducted emissions	Enclosure ports ac/dc power ports	Class A: 30 – 1000 MHz Class A: 0.15 – 30 MHz
IEC/EN 60255-25	RF emissions Conducted emissions	Enclosure ports ac/dc power ports	Class A: 30 – 1000 MHz Class A: 0.15 – 30 MHz
IEC/EN 61000-3-2	Power line harmonics	ac power port	Class D: max.1.08, 2.3, 0.43, 1.14, 0.3, 0.77, 0.23 A.... for 2nd to nth harmonic
IEC/EN 61000-3-3	Power line fluctuations	dc power port ac power port dc power port	N/A THD/ 3%; $P_{st} < 1$, $P_{it} < 0.65$ N/A
IEC/EN 61000-4-2 IEC/EN 60255-22-2	ESD	Enclosure contact Enclosure air	+/- 6 kV +/- 8 kV
IEEE C37.90.3	ESD	Enclosure contact Enclosure air	+/- 8 kV +/- 15 kV
IEC/EN 61000-4-3 IEC/EN 60255-22-3	Radiated RFI	Enclosure ports	10 V/m: 80 – 1000 MHz
IEEE C37.90.2	Radiated RFI	Enclosure ports	35 V/m: 25 – 1000 MHz
IEC/EN 61000-4-4 IEC/EN 60255-22-4 IEEE C37.90.1	Burst (fast transient)	Signal ports ac power port dc power Port Earth ground ports Communication ports	+/- 4 kV @2.5 kHz +/- 4 kV +/- 4 kV +/- 4 kV +/- 1 kV L-PE
IEC/EN 61000-4-5 IEC/EN 60255-22-5	Surge	Signal ports ac power port dc power port	+/- 4 kV L-PE, +/-2 kV L-L +/- 4 kV L-PE, +/-2 kV L-L +/- 2 kV L-PE, +/-1 kV L-L
IEC/EN 61000-4-6 IEC/EN 60255-22-6	Induced (conducted) RFI	Signal ports ac power port dc power port Earth ground ports	10 Vrms: 0.150 – 80 MHz 10 Vrms: 0.150 – 80 MHz 10 Vrms: 0.150 – 80 MHz 10 Vrms: 0.150 – 80 MHz
IEC/EN 60255-22-7	Power frequency	Binary input ports: Class A	Differential = 150 Vrms Common = 300 Vrms
IEC/EN 61000-4-8	Magnetic field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s
IEC/EN 61000-4-11 IEC/EN 61000-4-29	Voltage dips & interrupts	ac power port	30% for 1 period, 60% for 50 periods 100% for 5 periods, 100% for 50 periods
IEC 60255-11	Voltage dips & interrupts	dc power port dc power port	30% for 0.1 s, 60% for 0.1 s, 100% for 0.05 s 100% reduction for up to 200 ms

B-PRO 4000 Bus Protection Relay

Detailed Environmental Tests

Test	Description Type Test	Test Points	Test Level
IEC/EN 61000-4-12 IEC/EN 60255-22-1	Damped oscillatory	Communication ports Signal ports ac power port dc power port	1.0kV Common, 0 kV Diff 2.5kV Common, 1 kV Diff 2.5kV Common, 1 kV Diff 2.5kV Common, 1 kV Diff
IEEE C37.90.1	Oscillatory	Signal ports ac power port dc power port	2.5kV Common, 0 kV Diff 2.5kV Common, 0 kV Diff 2.5kV Common, 0 kV Diff
IEC/EN 61000-4-16	Mains frequency voltage	Signal ports ac power port	30V continuous, 300V for 1s 30V continuous, 300V for 1s
IEC/EN 61000-4-17	Ripple on dc power supply	dc power port	10%

NOTE:

The B-PRO 4000 is available with 5 or 1 amp current input. All current specifications change accordingly.

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The specifications and product information contained in this document are subject to change without notice.
In case of inconsistencies between documents, the version at www.erlphase.com will be considered correct. (D02744R13)

