

E-Series protective relays

Feeder distribution relays
Motor relays
Transformer relays

Generator relays
Bus relays

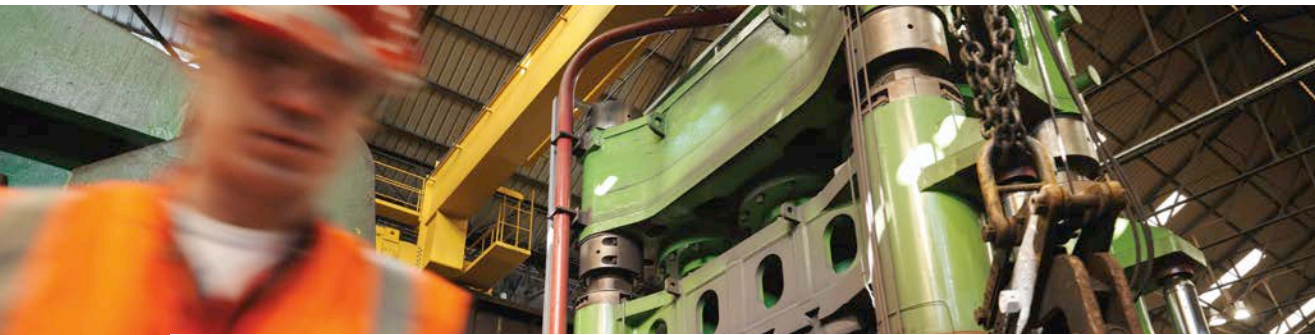
E-Series protective relay family

Reliable protection for every application



EATON

Powering Business Worldwide



Eaton's E-Series protective relays

Eaton's E-Series microprocessor-based protective relays offer reliable, secure and complete protection and control of power generation and distribution systems. The hardware and software commonality across the E-Series family platform makes it easy for users to program simple to complex settings or schemes for each of their unique applications. The powerful multi-core processors and intuitive user interface provide for flexible configurations and simple alarming and notifications.

Common features across the E-Series relay family include:

Protection/security

- Maintenance mode
- Zone selective interlocking
- Multi-level password protected
- Self-shorting/finger-safe/removable terminals

Control

- Programmable relay outputs
- Digital inputs with adjustable thresholds
- Eight common pushbuttons
- Programmable logic elements (up to 80)
- Wide ac/dc power supply range

Information

- Device setting and waveform software
- USB front access port
- High-contrast, illuminated HMI
- Programmable LEDs
- Cause-of-Trip indication

Common software tools

All E-Series relays use the same software interface for easy access to information and programming of settings. Whether you are using the front panel or the external software, the interface is the same on all models.



Operation



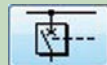
System Parameters



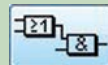
Protection Parameters



Device Parameters



Control



Logic



Device Planning



Service

Download PowerPort-E software and device models including Quality Manager at www.eaton.com/pr





EDR-5000

Feeder distribution relay

Feeder distribution relays provide complete protection for medium-voltage feeder distribution lines.

- Models include:
- EDR-3000
 - EDR-5000



EGR-5000

Generator relay

Generator protection relays can be used to protect any size generators. They may be used as primary or backup protection in standby generators and cogeneration applications.

- Models include:
- EGR-5000



EMR-3000

Motor relay

Motor relays provide complete and reliable motor protection for any size motor at different voltage levels, including diagnostics, monitoring and starting control functions.

- Models include:
- EMR-3000
 - EMR-4000
 - EMR-5000



**EBR-3Z/
EBR-3000
+ EBR-Z**

High-impedance bus differential relay

High-impedance bus differential relays can be used to protect switchgear bus and transformers. The EBR-3000 relay, combined with an EBR-Z (EBR-3Z) is a simple solution for differential protection.

- Models include:
- EBR-3Z (dual-mounted EBR-3000 and EBR-Z)
 - EBR-3000 + EBR-Z (separately mounted impedance module)



ETR-5000

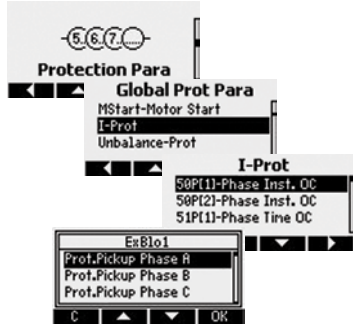
Transformer relay

Transformer relays provide primary protection, control and backup protection of transformers, including current differential, restricted ground differential and overcurrent protection.

- Models include:
- ETR-4000
 - ETR-5000

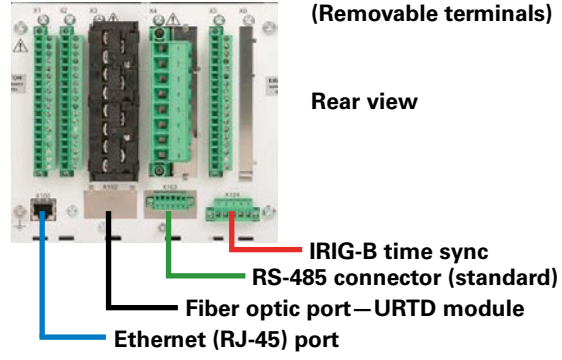
Common features

Front panel access



HMI and software display the same folder structure

Communication and connection interfaces

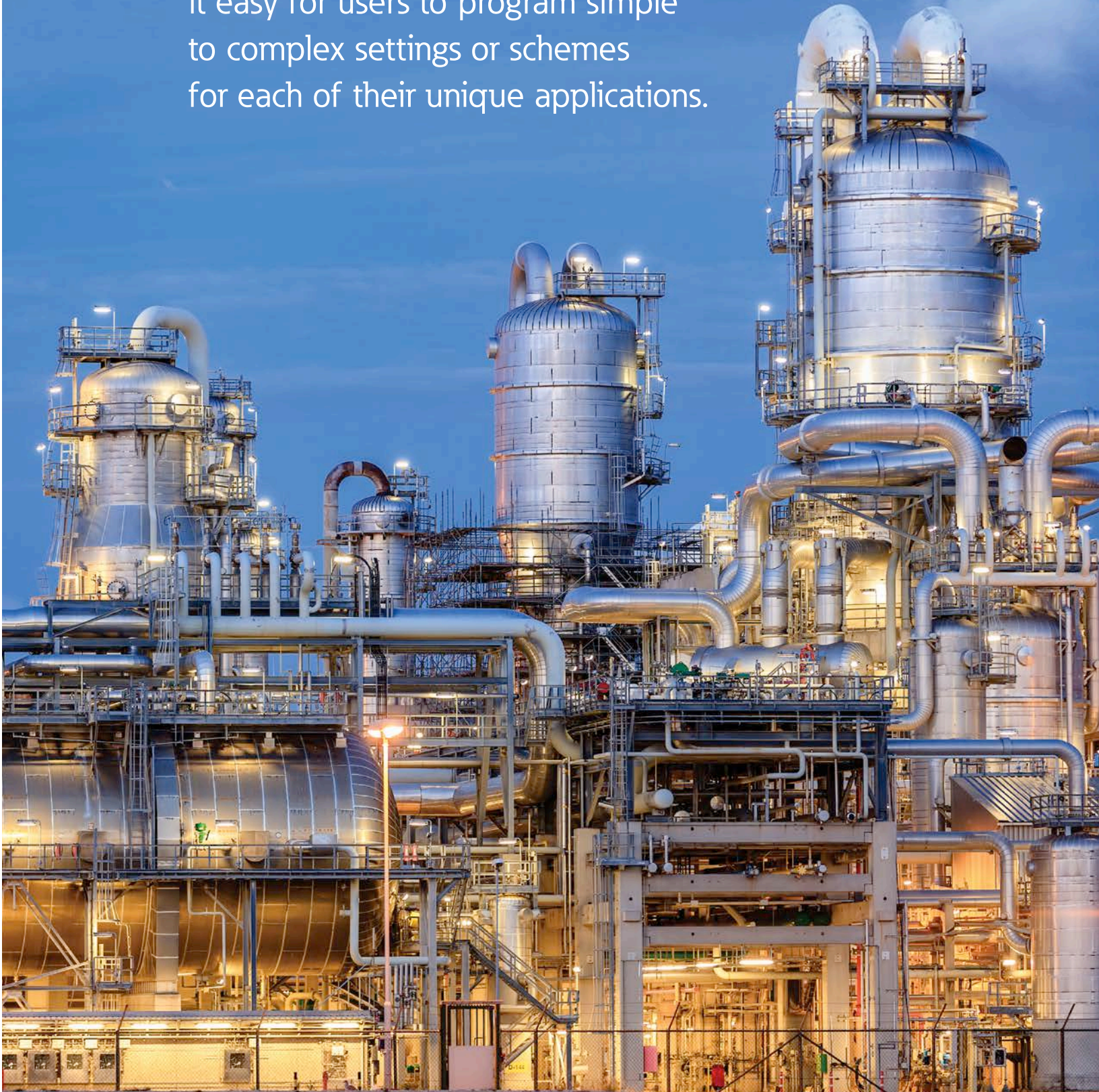


Reference order guide for availability by model.

E-Series relay family feature comparison chart

Description	EDR-3000	EDR-5000	EMR-3000	EMR-4000	EMR-5000	ETR-4000	ETR-5000	EGR-5000	EBR-3000
Metering and monitoring features									
Current (pos., neg. and zero seq.)	■	■	■	■	■	■	■	■	—
Current unbalance % (I2/I1)	■	■	■	■	■	■	■	■	—
Differential current	—	—	—	—	■	■	■	■	■
Voltage (L-L, L-N, pos., neg. and zero seq.)	—	■	—	■	■	—	■	■	—
Voltage unbalance % (V2/V1)	—	■	—	■	■	—	■	■	—
Phase angles	■	■	■	■	■	■	■	■	—
Volt-amps, watts, volt-amps reactive	—	■	—	■	■	—	■	■	—
kWh (forward, reverse and net)	—	■	—	■	■	—	■	■	—
kVAh (lead, lag and net)	—	■	—	■	■	—	■	■	—
Power factor	—	■	—	■	■	—	■	■	—
Frequency	—	■	—	■	■	—	■	■	—
Volts/Hz	—	—	—	—	■	—	■	■	—
2nd harmonic current % (H2/fund.)	—	—	—	—	—	■	■	—	—
3rd harmonic voltage	—	—	—	—	—	—	—	■	—
THD current (% and magnitude)	■	■	■	■	■	■	■	■	—
THD voltage (% and magnitude)	—	■	—	■	■	—	■	■	—
Minimum/maximum recording	■	■	■	■	■	■	■	■	—
Sync values	—	■	—	—	—	—	—	■	—
Temperature with remote URTD module	—	—	■	■	■	■	■	■	—
Trip circuit monitoring	■	■	■	■	■	■	■	■	■
Breaker wear and general counters	■	■	■	■	■	■	■	■	—
CT supervision	■	■	■	■	■	■	■	■	■
VT supervision	—	■	—	■	■	—	—	■	—
Waveform recorder (7200 cycles total storage)	■	■	■	■	■	■	■	■	■
Fault recorder (20 events)	■	■	■	■	■	■	■	■	■
Sequence of events recorder (300 events)	■	■	■	■	■	■	■	■	■
Trend recorder	■	■	■	■	■	■	■	■	■
Motor history, start trending, thermal capacity	—	—	■	■	■	—	—	—	—
Generator hours of operation	—	—	—	—	—	—	—	■	—
Programmable logic equations (up to 80)	■	■	■	■	■	■	■	■	■
Communications protocols									
Modbus RTU or DNP3 RTU over RS-485	■	■	■	■	■	■	■	■	■
Modbus TCP or DNP3 TCP/UDP over Ethernet RJ-45	■	■	■	■	■	■	■	■	■
PROFIBUS-DP over fiber optic ST	■	■	■	■	■	■	■	■	■
PROFIBUS-DP over D-Sub / RS-485	■	■	■	■	■	■	■	■	■
Modbus RTU or DNP3 RTU over fiber optic ST	■	■	■	■	■	■	■	■	■
Modbus RTU or DNP3 RTU over D-Sub / RS-485	■	■	■	■	■	■	■	■	■
IEC 61850 or Modbus TCP or DNP3 TCP/UDP over Ethernet RJ-45	■	■	■	■	■	■	■	■	■
Modbus RTU or DNP3 RTU over RS-485 or Modbus TCP or DNP3 TCP/UDP over Ethernet RJ-45	■	■	■	■	■	■	■	■	■
IEC 61850 or Modbus TCP or DNP3 TCP/UDP over LC duplex fiber optic Ethernet	■	■	■	■	■	■	■	■	■
Modbus TCP or DNP3 TCP/UDP over LC duplex fiber optic Ethernet	■	■	■	■	■	■	■	■	■

The E-Series family platform makes it easy for users to program simple to complex settings or schemes for each of their unique applications.

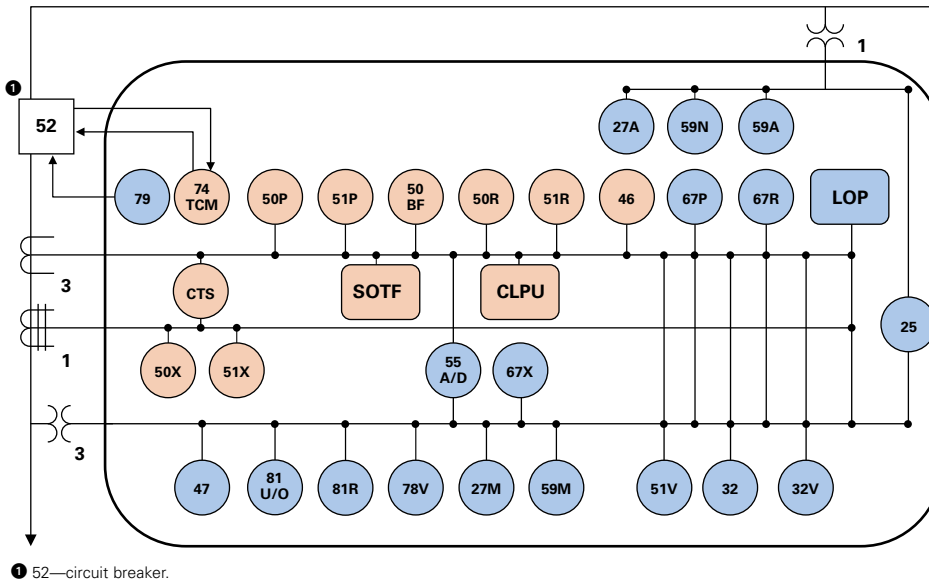


Eaton's distribution relay family—EDR Series

Model comparison guide—protective functions

EDR-3000	EDR-5000
Protection functions 46—Current unbalance elements 50BF—Breaker failure 50P—Phase instantaneous overcurrent elements 50R—Calculated ground or neutral instantaneous overcurrent elements 50X—Measured ground or neutral instantaneous overcurrent elements 51P—Phase overcurrent protection per time-current curve elements 51R—Calculated ground fault protection per time-current curve elements 51X—Measured ground or neutral fault protection per time-current curve elements CLPU—Cold load pickup SOTF—Switch on to fault CTS—Current transformer supervision 74TCM—Trip coil monitor (option) ZI—Zone selective interlocking (option)	The EDR-5000 has all of the same protection functions as the EDR-3000 with additional features. Enhanced protection functions 27A/M—Auxiliary and main three-phase undervoltage elements 47—Voltage unbalance elements 55A/D—Apparent and displacement power factor elements 59A/M—Auxiliary and main three-phase overvoltage elements 59N—Ground fault overvoltage elements 67P—Directional overcurrent elements 67X—Calculated directional overcurrent elements 78V—Vector surge element 81U/O/R—Under and over and rate of change frequency elements LOP—Loss of potential 25—Sync check 32—Forward and reverse watts elements 32V—Forward and reverse VARs elements 51V/M—Auxiliary and main three-phase undervoltage elements 79—Auto-reclosing 27T—Low voltage ride-through (LVRT) 27Q—Reactive power and undervoltage

Typical one-line example—ANSI protective elements guide

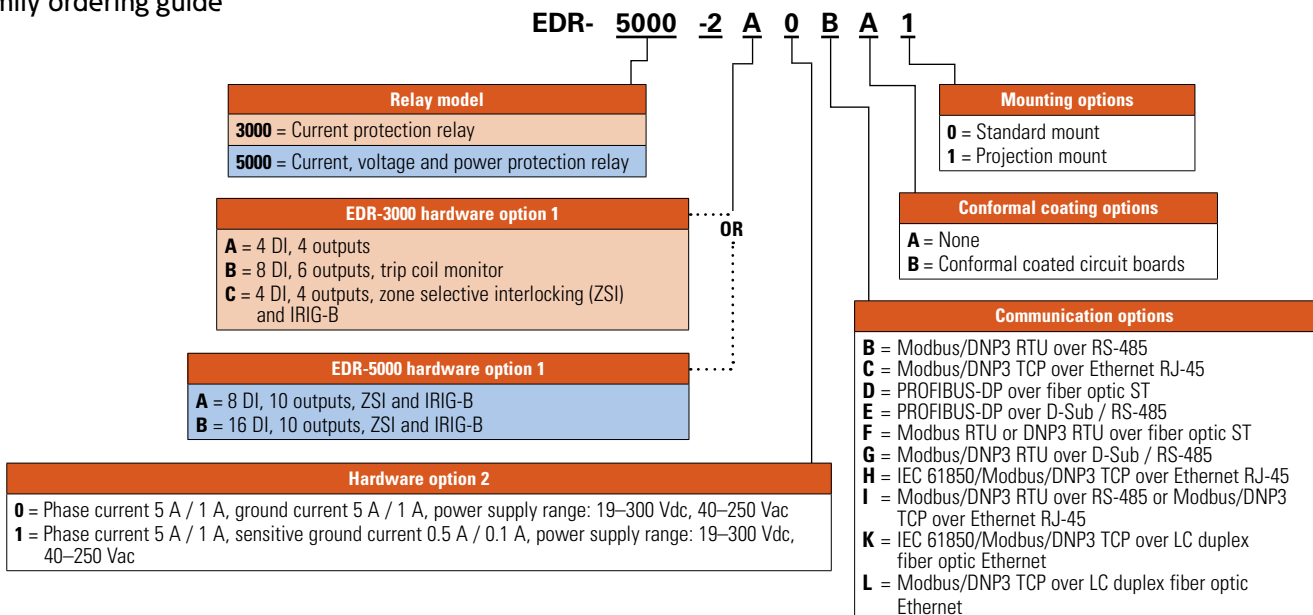


Protective elements key

- = Elements available on EDR-3000 and EDR-5000
- = Elements available on EDR-5000

See **Page 4** for metering features.

EDR family ordering guide

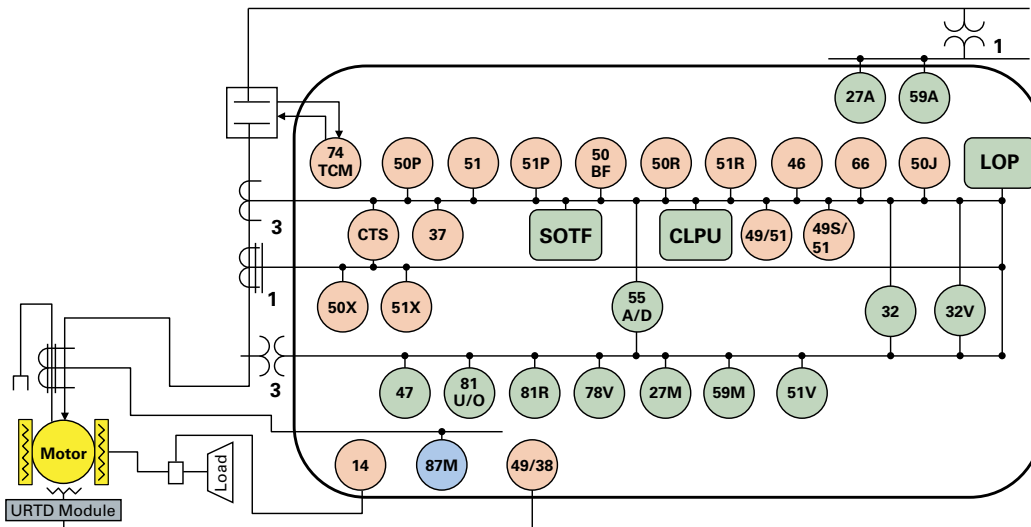


Eaton's motor relay family—EMR Series

Model comparison guide—protective functions

EMR-3000	EMR-4000	EMR-5000
Protection functions 50BF —Breaker failure 50P —Phase instantaneous overcurrent elements 50R —Calculated ground or neutral instantaneous overcurrent elements 50X —Measured ground or neutral instantaneous overcurrent elements 51P —Phase overcurrent protection per time-current curve elements 51R —Calculated ground fault protection per time-current curve elements 51X —Measured ground or neutral fault protection per time-current curve elements 46 —Current unbalance elements 49/38 —Thermal protection using optional URTD module 49/51 —Thermal overload protection (IFT) 49S/51 —Locked rotor 50J —Jam or stall protection 37 —Underload protection 66 —Starts per time period 14 —Underspeed CTS —Current transformer supervision 74TCM —Trip coil monitor (option) ZI —Zone selective interlocking (option) 86 —Lockout protection	The EMR-4000 has all of the same protection functions as the EMR-3000 with additional features. Enhanced protection functions 27A/M —Auxiliary and main three-phase undervoltage elements 47 —Voltage unbalance elements 55A/D —Apparent and displacement power factor elements 59A/M —Auxiliary and main three-phase overvoltage elements 59N —Ground fault overvoltage elements 32/32V —Forward and reverse watts and VARs elements 51V —Voltage restraint elements 78V —Vector surge element 81U/O/R —Under and over and rate of change frequency elements LOP —Loss of potential CLPU —Cold load pickup SOTF —Switch on to fault BRB —Broken rotor bar detection	The EMR-5000 has all of the same protection functions as the EMR-4000 with additional features. Enhanced protection functions 87M —Differential current elements

Typical one-line example—ANSI protective elements guide

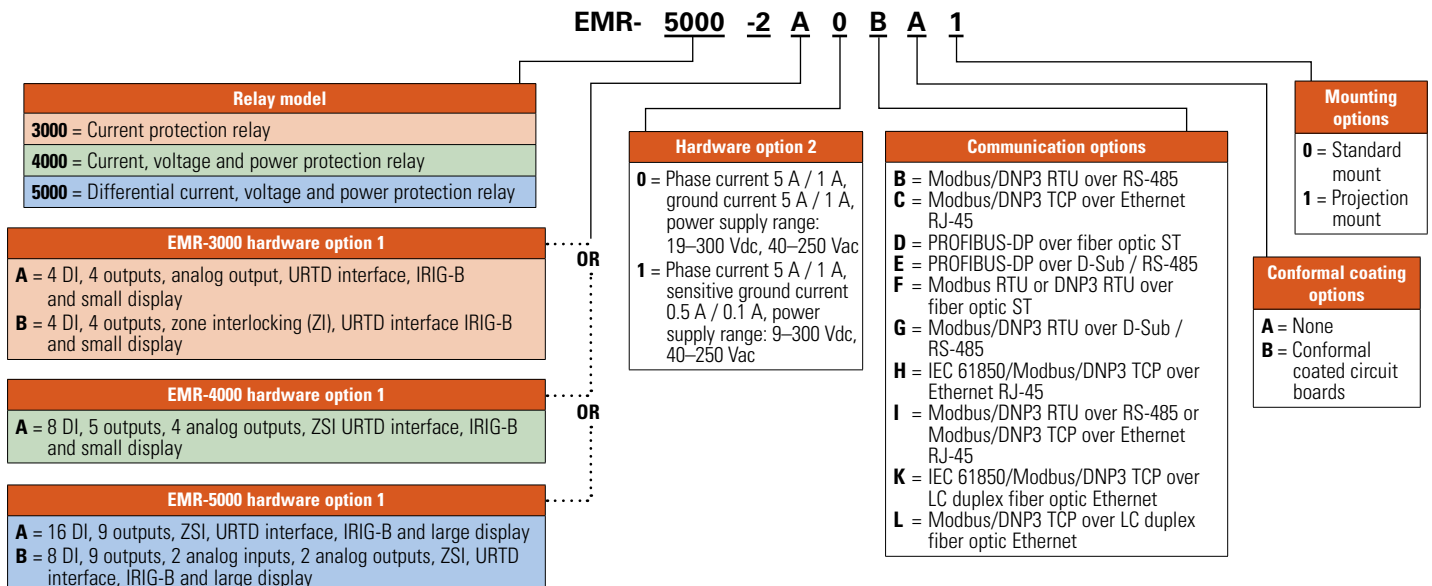


Protective elements key

- = Elements available on all EMR models
- = Elements available on EMR-4000 and EMR-5000
- = Elements available on EMR-5000

See **Page 4** for metering features.

EMR family ordering guide

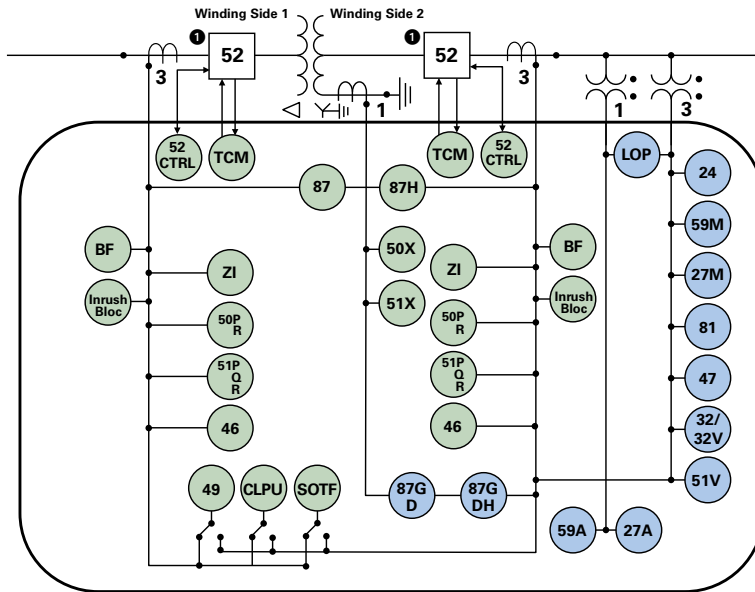


Eaton's transformer relay family—ETR Series

Model comparison guide—protective functions

ETR-4000	ETR-5000
Protection functions 46 —Current unbalance elements 87R —Dual-slope percentage restrained current differential with magnetizing inrush and over-excitation blocking 87H —Unrestrained current differential 87GD —Restricted ground fault / ground differential 50P —Instantaneous overcurrent elements with timers 50R —Instantaneous calculated elements with timers 50X —Instantaneous measured elements with timers 51P —Inverse time overcurrent elements 51Q —Negative sequence phase overcurrent elements 51R —Inverse time overcurrent calculated elements 51X —Inverse time overcurrent measured elements BF —Breaker failure elements 49 —Temperature protection SOTF —Switch onto fault protection CLPU —Cold load pickup 74TCM —Trip coil monitor ZI —Zone selective interlocking for bus protection BF —Breaker failure	The ETR-5000 has all of the same protection functions as the ETR-4000 with additional features. Enhanced protection functions 47 —Voltage unbalance elements 27M/59M —Main three-phase under/overvoltage protection 27A/59A —Auxiliary single-phase under/overvoltage protection 81 —Frequency elements that can be assigned to: overfrequency, underfrequency, rate of change or vector surge 32 —Forward and reverse watts protection 32V —Forward and reverse VARs protection 24 —Over-excitation, volts-per-hertz protection 86 —Lockout protection 51V —Voltage restraint elements 27T —Low voltage ride-through (LVRT) 27Q —Reactive power and undervoltage LOP —Loss of potential

Typical one-line example—protection function guide



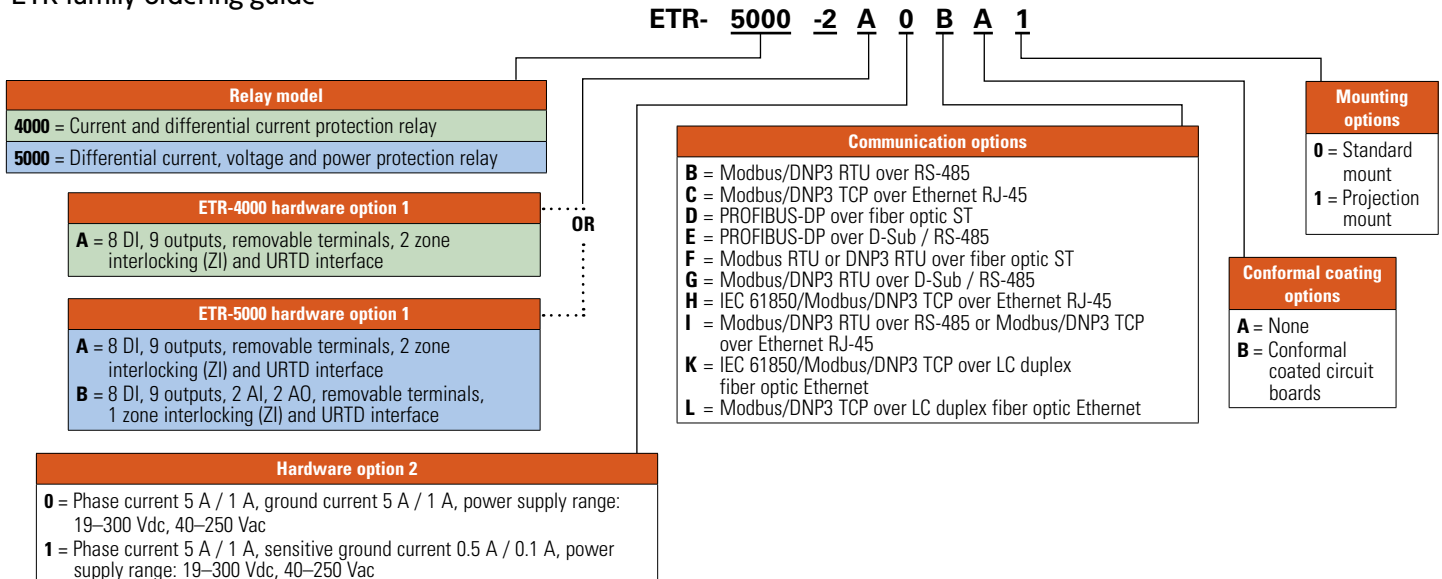
① 52—circuit breaker.

Protective elements key

- = Functions on ETR-4000
- = Functions on ETR-4000 and ETR-5000

See **Page 4** for metering features.

ETR family ordering guide



Eaton's generator relay family—EGR Series

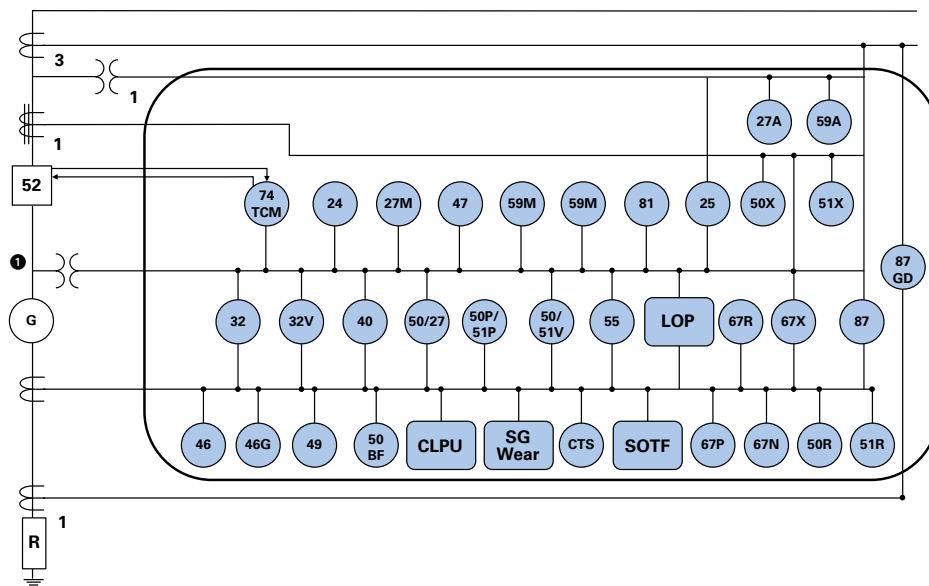
Model comparison guide—protective functions

EGR-5000

Protection functions

<p>50BF—Breaker failure</p> <p>50P—Phase instantaneous overcurrent elements</p> <p>50R—Calculated ground or neutral instantaneous overcurrent elements</p> <p>50X—Measured ground or neutral instantaneous overcurrent elements</p> <p>51P—Phase overcurrent protection per time-current curve elements</p> <p>51V—Voltage restraint elements</p> <p>51R—Calculated ground fault protection per time-current curve elements</p> <p>51X—Measured ground or neutral fault protection per time-current curve elements</p> <p>49/51—Thermal protection element</p>	<p>67P/67R/67X—Directional overcurrent elements</p> <p>46—Current unbalance elements</p> <p>47—Voltage unbalance elements</p> <p>27A/27M—Auxiliary and main three-phase undervoltage elements</p> <p>59A/59M—Auxiliary and main three-phase overvoltage elements</p> <p>59N—Ground fault overvoltage element</p> <p>81U/O—Underfrequency and overfrequency elements</p> <p>78V—Vector surge element</p> <p>55A/55D—Apparent and displacement power factor elements</p> <p>32—Forward and reverse watts elements</p> <p>32V—Forward and reverse VARs elements</p> <p>24—Over-excitation, volts-per-hertz</p> <p>27T—Low voltage ride-through (LVRT)</p> <p>27Q—Reactive power and undervoltage</p>	<p>(64S) 27TN/59N—Stator ground fault</p> <p>46G—Generator unbalance</p> <p>40—Loss of excitation</p> <p>25—Sync check</p> <p>79—Auto-reclosing</p> <p>86—Lockout</p> <p>LOP—Loss of potential</p> <p>CLPU—Cold load pickup</p> <p>SG Wear—Switchgear wear</p> <p>SOTF—Switch on to fault</p> <p>CTS—Current transformer supervision</p> <p>74TCM—Trip coil monitor</p> <p>ZI—Zone selective interlocking</p>	<p>87—Phase current differential protection</p> <p>87H—Unrestrained high-set differential current protection</p> <p>87GD—Restricted ground fault protection</p> <p>87GDH—High set restricted ground fault protection</p> <p>50/27—Inadvertent energization</p>
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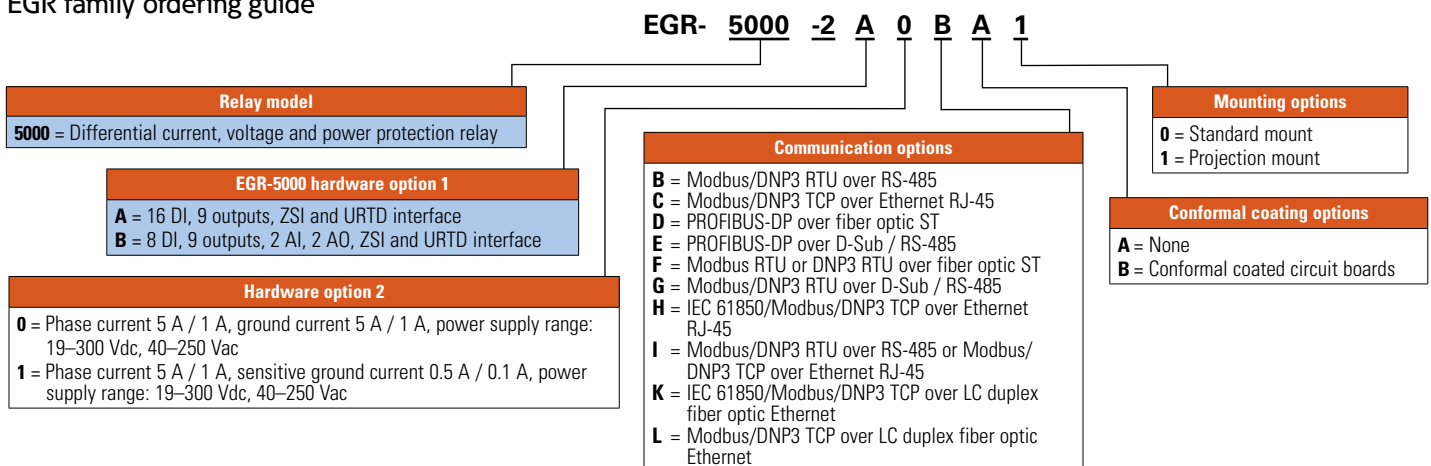
Typical one-line example—ANSI protective elements pictorial guide



Protective functions key

■ = EGR-5000 Functions
See **Page 4** for metering features.

EGR family ordering guide

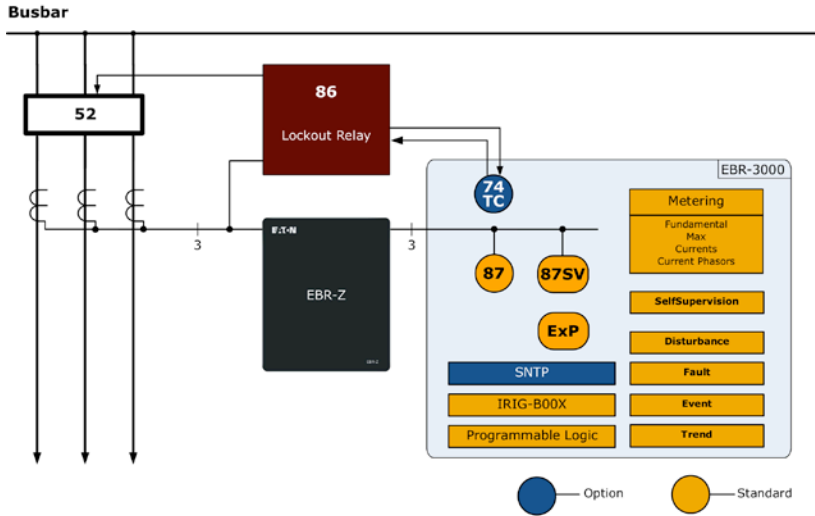


Eaton's bus differential relay—EBR Series

Model comparison guide—protective functions

EBR-3000	EBR-Z (Required for protecting EBR-3000)
Protection functions 87 —Differential protection 87SV —Open CT supervision 74TCM —Trip coil monitor	Protection functions High-impedance and MOV protection for the EBR-3000 relay CT inputs

Typical one-line example—ANSI protective elements guide



Protective elements key

■ = Standard

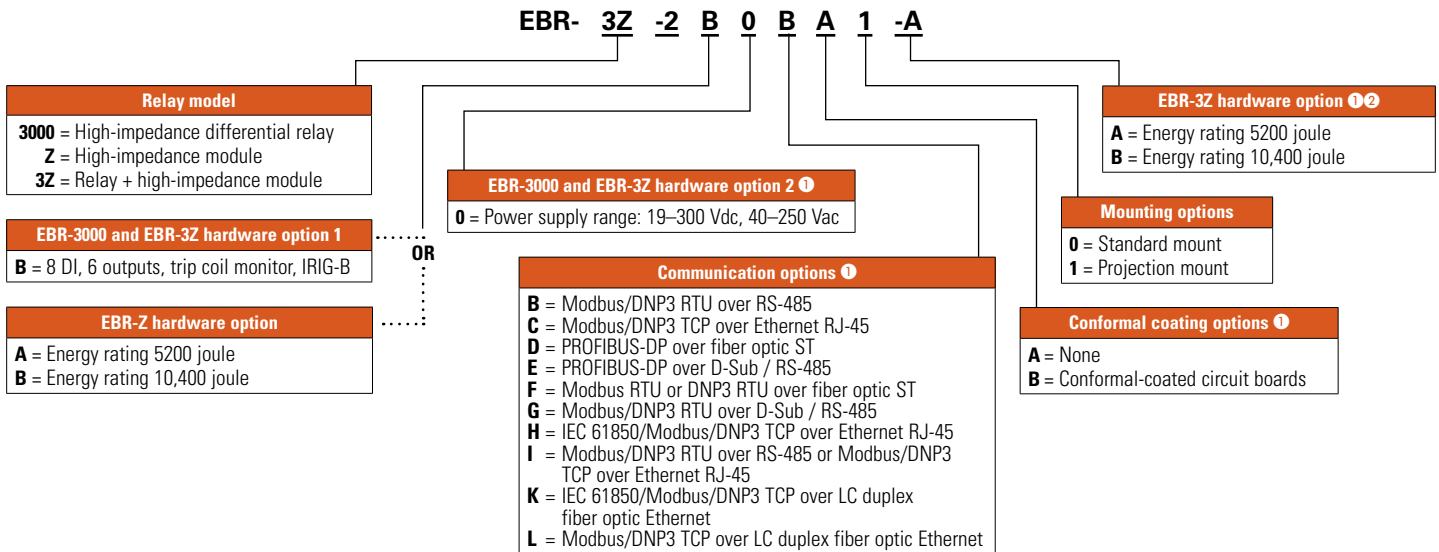
■ = Option

See **Page 4** for metering features.

EBR family ordering guide

Separate mounting—both EBR-3000 and EBR-Z are required for operation

Group mounting—both EBR-3000 and EBR-Z are installed in one bezel



① Not applicable for EBR-Z catalog numbers.

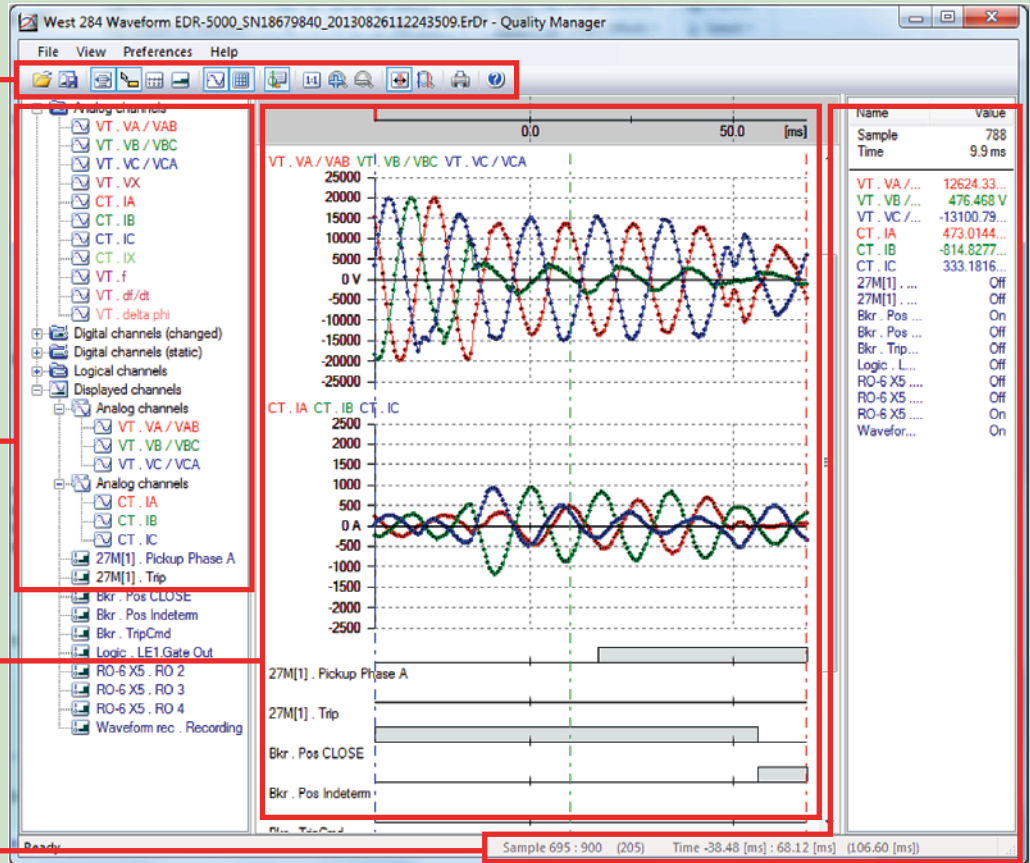
② Not applicable for EBR-3000 catalog numbers.

Common software tools

Quality Manager is a powerful waveform and events analysis software tool. Quality Manager allows the user to review and customize the waveform disturbance records downloaded from any of the E-Series family models.

Features

- Zoom, scale and edit preferences for easy viewing and reporting
- 10 seconds maximum per record and 120 seconds total data storage (customizable)
- Select and group desired measurement channels for analysis
- Organize desired internal relay logic and I/O on the same timeline as the measurement channels for detailed sequence of events analysis
- Easily monitor the sampled values of the waveform record



Download PowerPort-E software and device models including Quality Manager at www.eaton.com/pr



E-Series relay family standard accessories

Description	Catalog number
Universal RTD module with Modbus RTU 48–240 Vac / 48–250 Vdc	URTDII-01
Universal RTD module with Modbus RTU 24–48 Vdc	URTDII-02
1 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPFO-1
5 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPFO-5
10 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPFO-10
25 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPFO-25
75 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPFO-75
E-Series 3000 IQ adapter kit, projection mounted. For retrofitting MP and DT series relays to EMR-3000 and EDR-3000 relays	ER-IQRETROKIT
E-Series mini USB cable 6 ft	ESERIESUSBCBL
FP-5000 to EDR-5000 retrofit adapter plate projection mount	ER-FP5KRETROKIT

We make what matters work.*

* At Eaton, we believe that power is a fundamental part of just about everything people do. Technology, transportation, energy and infrastructure—these are things the world relies on every day. That's why Eaton is dedicated to helping our customers find new ways to manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. To improve people's lives, the communities where we live and work, and the planet our future generations depend upon. Because that's what really matters. And we're here to make sure it works.

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