

**E-Series protective relays**

Feeder distribution relays  
Motor relays  
Transformer relays

Generator relays  
Bus relays

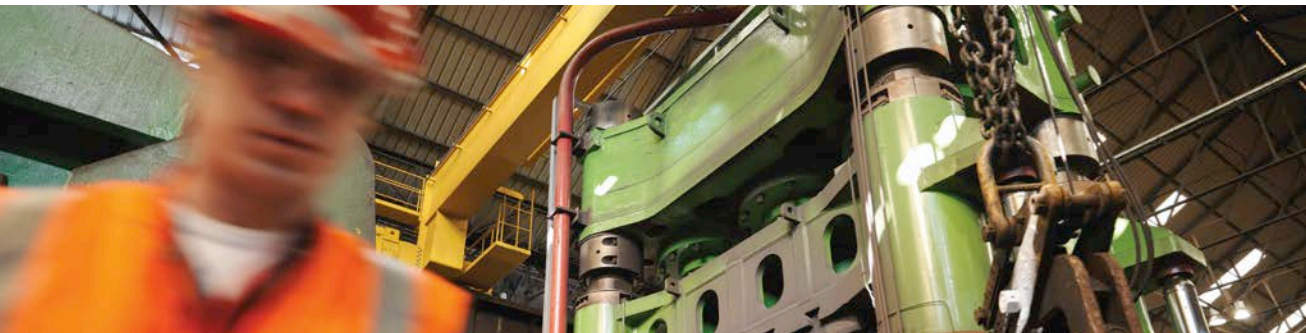
# E-Series protective relay family

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



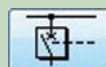
System Parameters



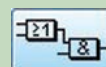
Protection Parameters



Device Parameters



Control



Logic



Device Planning



Service

Download PowerPort-E software and device models including Quality Manager at [www.eaton.com/pr](http://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.

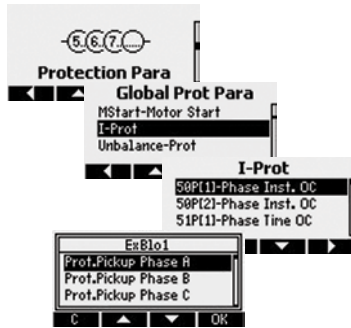
Models include:

- ETR-4000
- ETR-5000



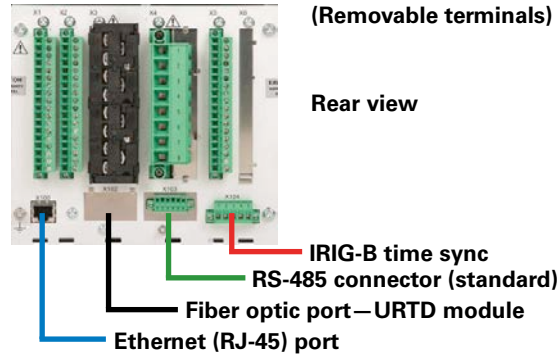
# Common features

## Front panel access



HMI and software display the same folder structure

## Communication and connection interfaces



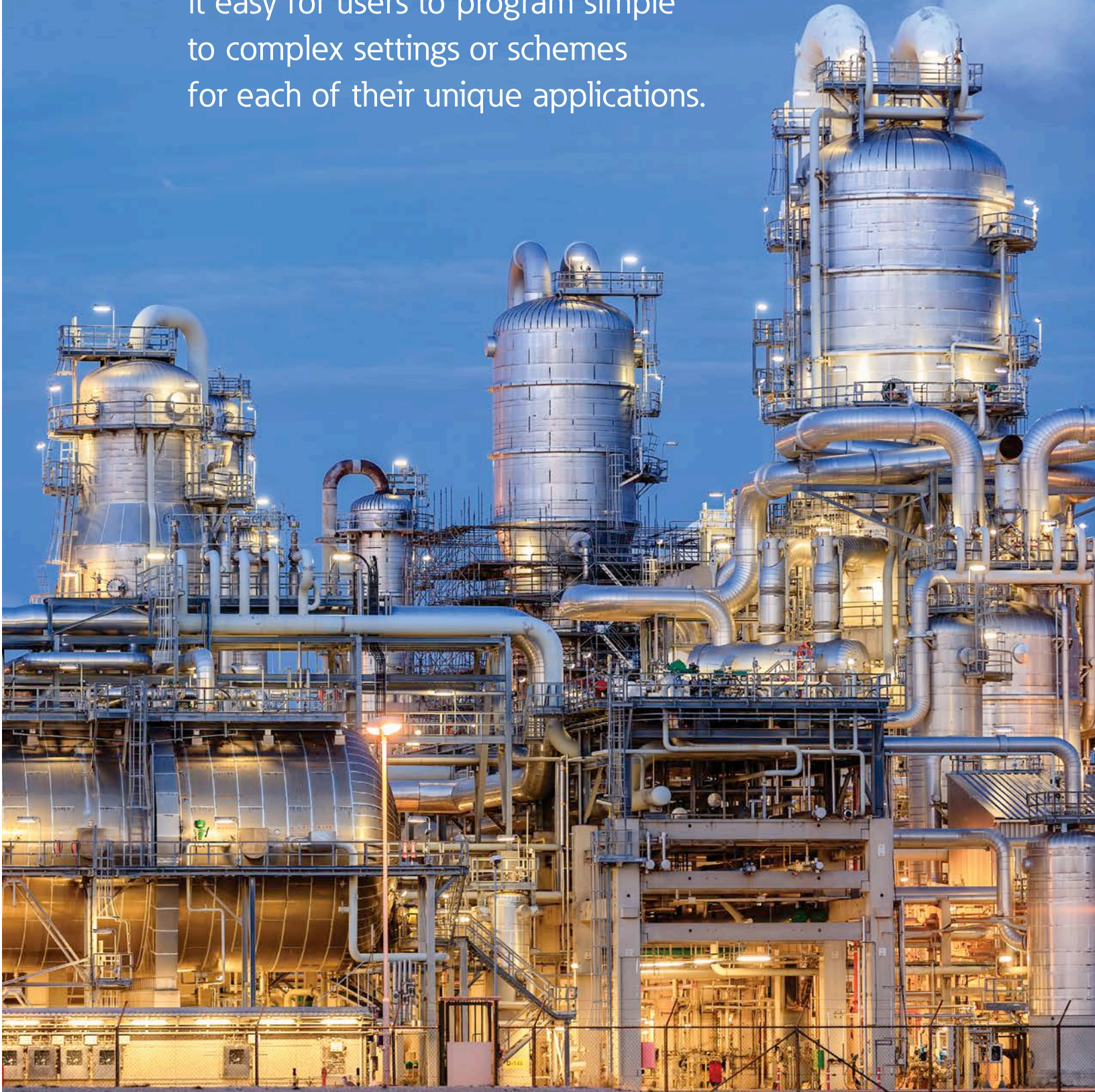
Reference order guide for availability by model.

## 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
<b>Metering and monitoring features</b>									
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)	—	■	—	■	■	—	■	■	—
kVARh (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)	■	■	■	■	■	■	■	■	■
<b>Communications protocols</b>									
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.



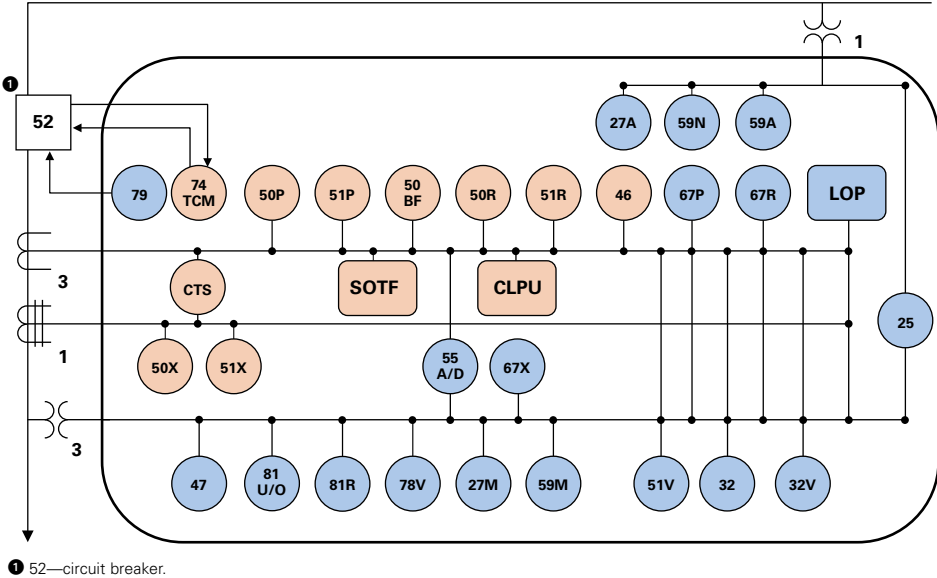


# Eaton's distribution relay family—EDR Series

## Model comparison guide—protective functions

EDR-3000	EDR-5000
<b>Protection functions</b> 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. <b>Enhanced protection functions</b> 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—Voltage restraint elements 79—Auto-reclosing 27T—Low voltage ride-through (LVRT) 27Q—Reactive power and undervoltage

## Typical one-line example—ANSI protective elements guide

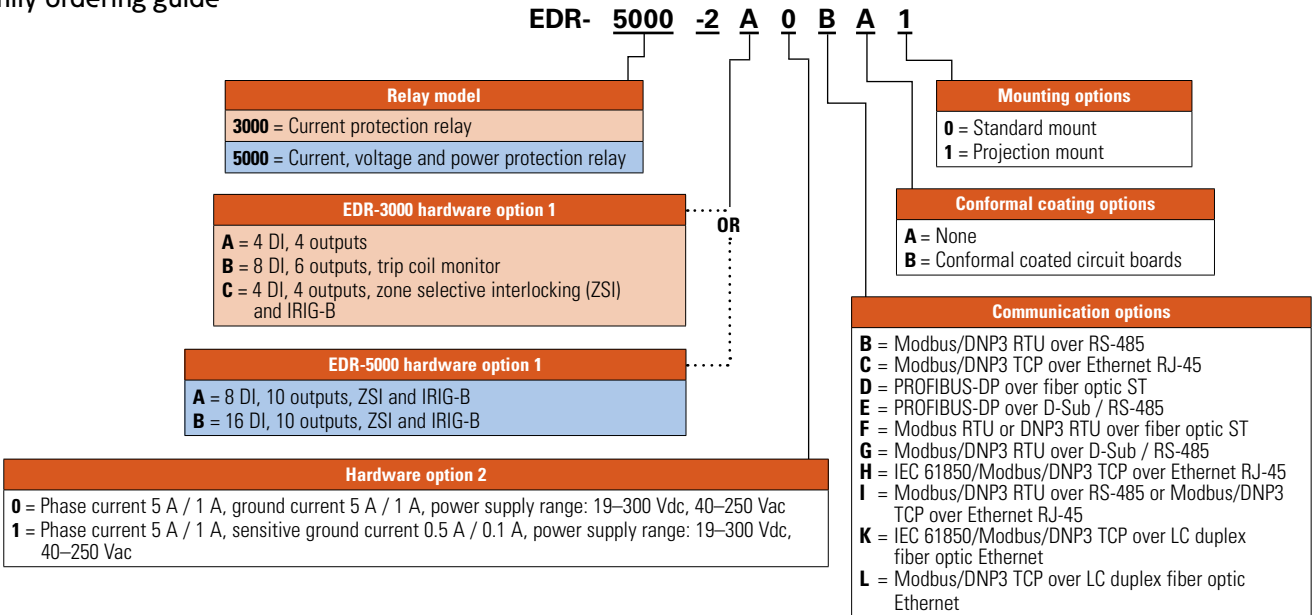


### Protective elements key

- Orange circle = Elements available on EDR-3000 and EDR-5000
- Blue circle = Elements available on EDR-5000

See **Page 4** for metering features.

## EDR family ordering guide

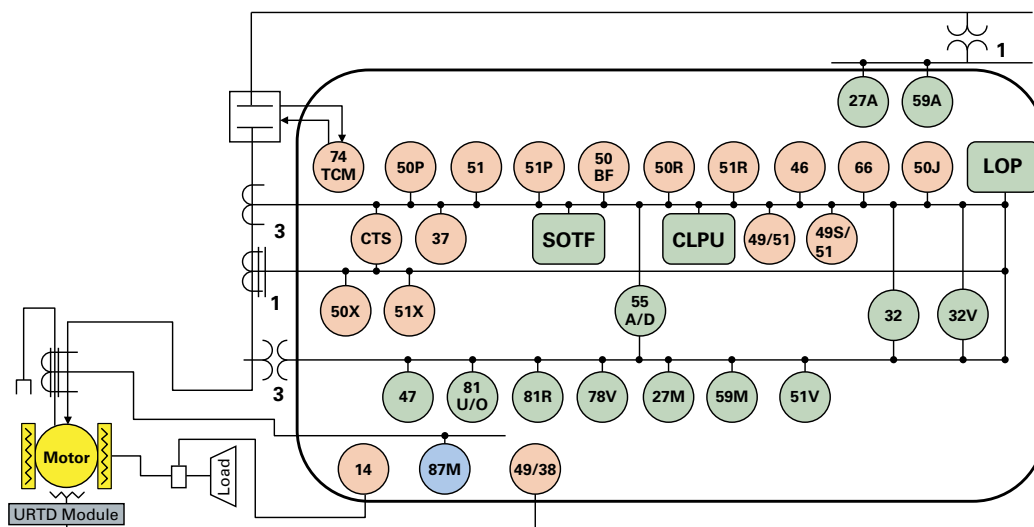


# Eaton's motor relay family—EMR Series

## Model comparison guide—protective functions

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

## Typical one-line example—ANSI protective elements guide

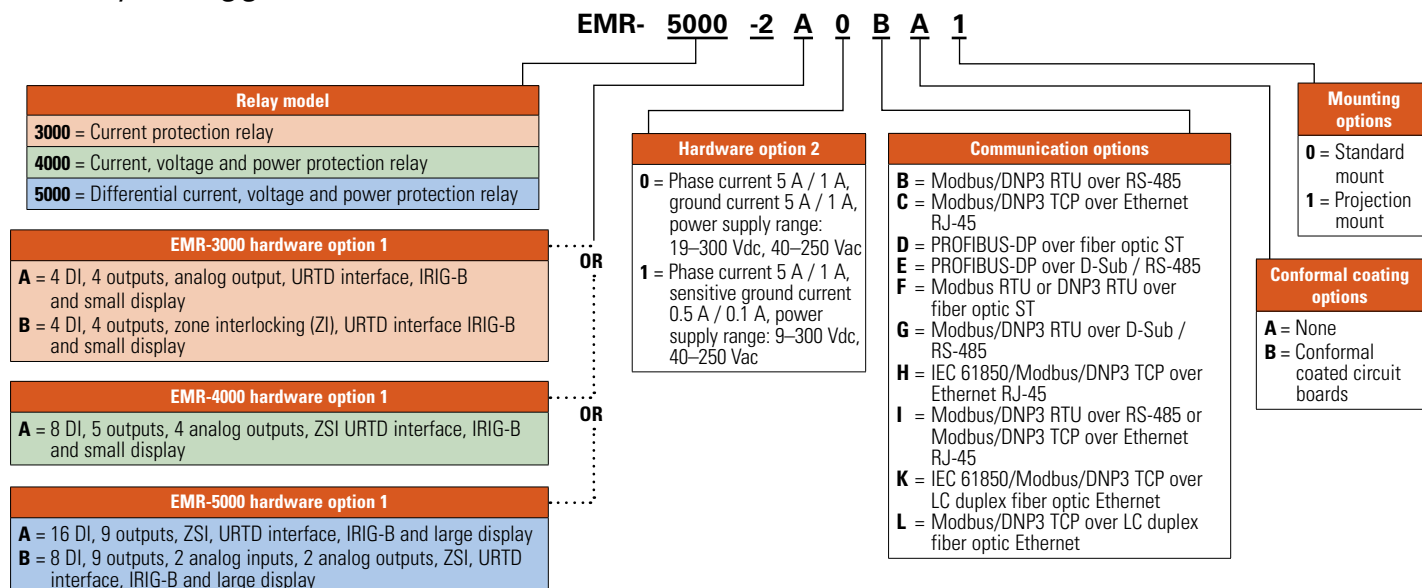


### Protective elements key

- Orange square = Elements available on all EMR models
- Green square = Elements available on EMR-4000 and EMR-5000
- Blue square = Elements available on EMR-5000

See **Page 4** for metering features.

## EMR family ordering guide



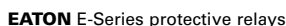
## Model comparison guide—protective functions

### Typical one-line example—protection function guide



See **Page 4** for metering features.

**ETR- 5000 -2 A 0 B A 1**





# Eaton's generator relay family—EGR Series

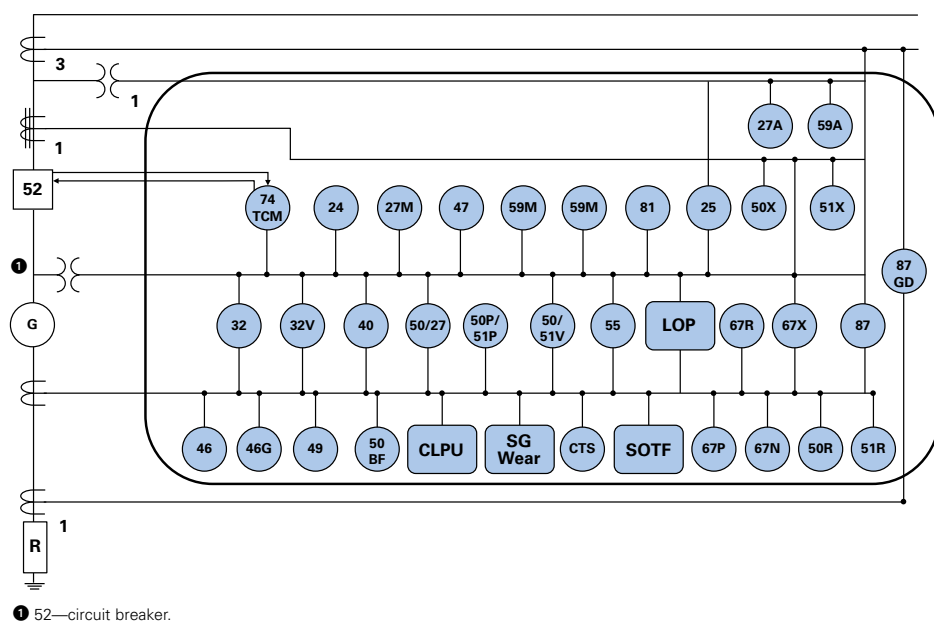
## Model comparison guide—protective functions

### EGR-5000

#### Protection functions

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

## Typical one-line example—ANSI protective elements pictorial guide

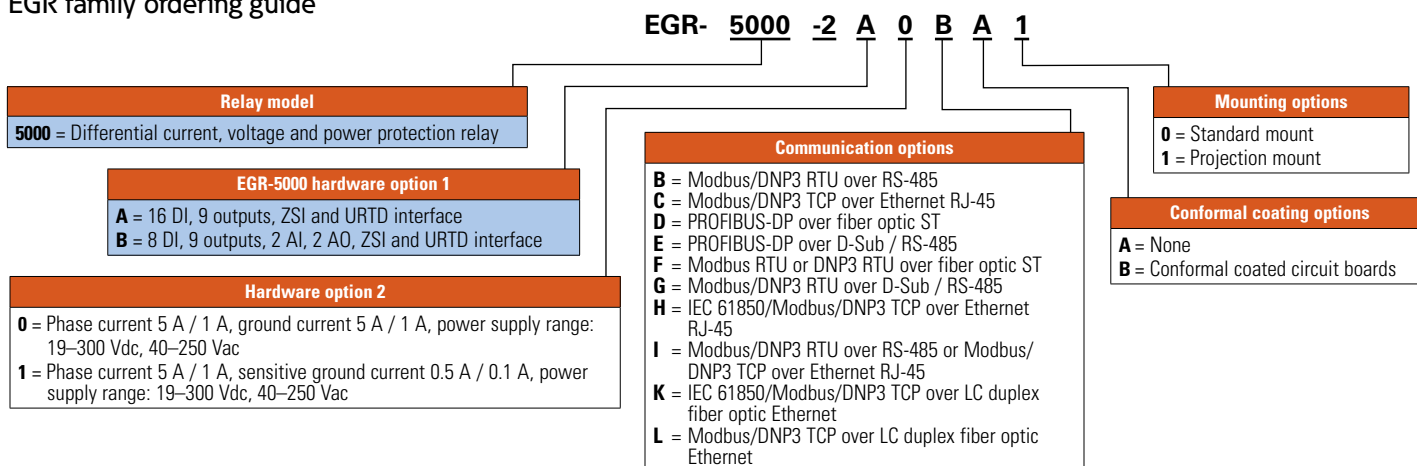


### Protective functions key

■ = EGR-5000 Functions

See **Page 4** for metering features.

## EGR family ordering guide

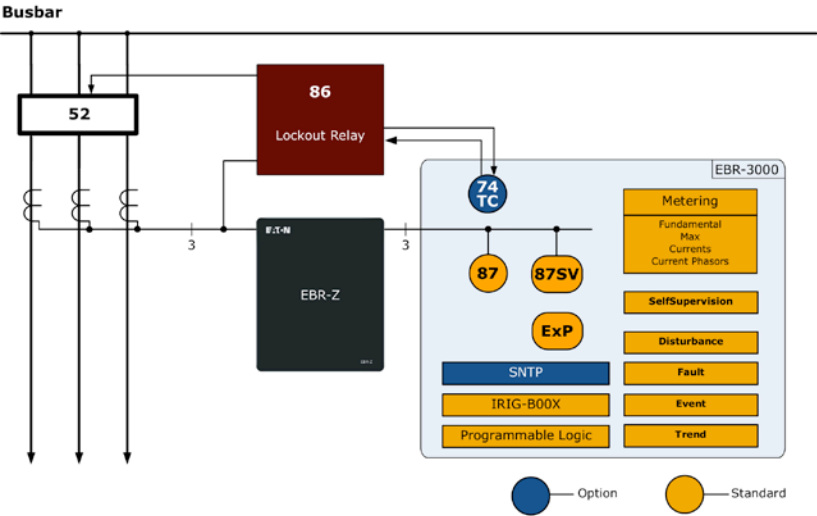


# Eaton's bus differential relay—EBR Series

## Model comparison guide—protective functions

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

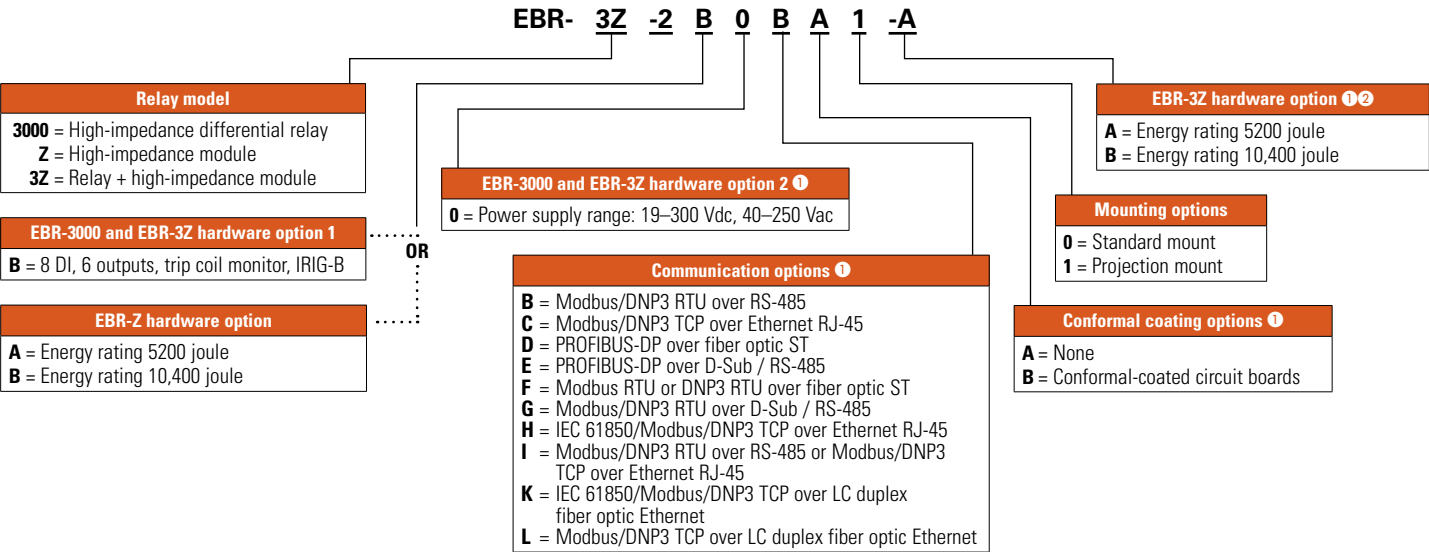
## Typical one-line example—ANSI protective elements guide



## 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

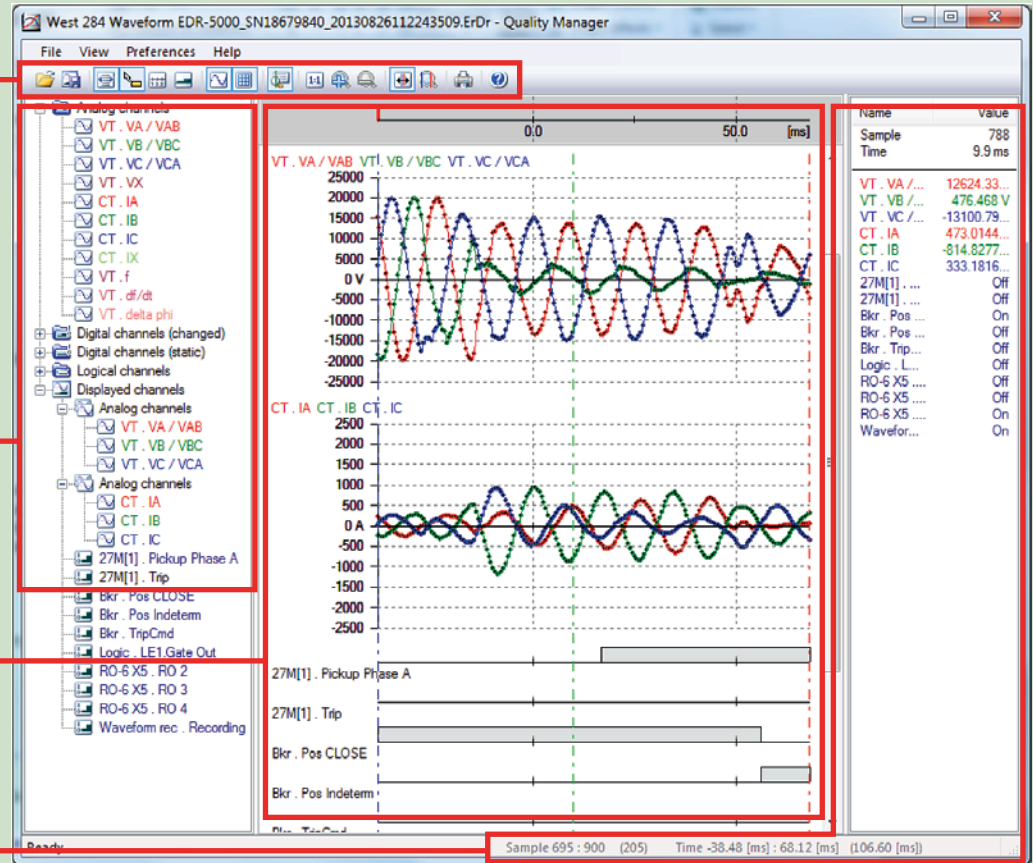


## Common software tools

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



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### 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	MPF0-1
5 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPF0-5
10 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPF0-10
25 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPF0-25
75 m fiber optic cable for EMR, ETR or EGR relays / URTD communications	MPF0-75
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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