E-Series protective relay family
Reliable protection for every application
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:

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<td>• Digital inputs with adjustable thresholds</td>
<td>• USB front access port</td>
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<td>• Eight common pushbuttons</td>
<td>• High-contrast, illuminated HMI</td>
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<td>• Self-shorting/finger-safe/removable terminals</td>
<td>• Programmable logic elements (up to 80)</td>
<td>• Programmable LEDs</td>
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<td>• Wide ac/dc power supply range</td>
<td>• Cause-of-Trip indication</td>
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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.

Download PowerPort-E software and device models including Quality Manager at www.eaton.com/pr
Feeder distribution relay
Feeder distribution relays provide complete protection for medium-voltage feeder distribution lines. Models include:
- EDR-3000
- EDR-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

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

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)

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

- **USB port (standard)**

HMI and software display the same folder structure

### Communication and connection interfaces

- **Ethernet (RJ-45) port**
- **Fiber optic port—URTDT module**
- **IRIG-B time sync**
- **(Removable terminals)**

Reference order guide for availability by model.

## E-Series relay family feature comparison chart

### Description

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<tr>
<td>Voltage unbalance % (V2/V1)</td>
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<td>Breaker wear and general counters</td>
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</tbody>
</table>

### Communications protocols

- Modbus RTU or DNP3 RTU over RS-485
- Modbus TCP or DNP3 TCP/UDP over Ethernet RJ-45
- PROFINET-DP over fiber optic ST
- PROFINET-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
- Modbus TCP over DNP3 TCP/UDP over Ethernet RJ-45
- IEC 61850 or Modbus TCP over DNP3 TCP/UDP over Ethernet RJ-45
- Modbus RTU over RS-485 or Modbus TCP over DNP3 TCP/UDP over Ethernet RJ-45
- IEC 61850 or Modbus TCP over 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.
**EDR-3000**

**Protection functions**

- 46 — Current unbalance elements
- 50BF — Breaker failure
- 50P — Phase instantaneous overcurrent elements
- 50R — Calculated 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)

**EDR-5000**

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

**Protective elements key**

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

See Page 4 for metering features.

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

1. **52** — Circuit breaker.

2. **79** — Calm load pickup
3. **74** — Cold load pickup
4. **50P** — Phase instantaneous overcurrent elements
5. **51R** — Calculated ground fault protection per time-current curve elements
6. **51X** — Measured ground or neutral fault protection per time-current curve elements
7. **50BF** — Breaker failure
8. **50P** — Phase instantaneous overcurrent elements
9. **51P** — Phase overcurrent protection per time-current curve elements
10. **51R** — Calculated ground fault protection per time-current curve elements
11. **51X** — Measured ground or neutral fault protection per time-current curve elements
12. **47** — Voltage unbalance elements
13. **55A/D** — Apparent and displacement power factor elements
14. **59A/M** — Auxiliary and main three-phase overvoltage elements
15. **59N** — Ground fault overvoltage elements
16. **67P** — Directional overcurrent elements
17. **67X** — Calculated directional overcurrent elements
18. **78V** — Vector surge element
19. **81U/O/R** — Under and over and rate of change frequency elements
20. **LOP** — Loss of potential
21. **25** — Sync check
22. **32** — Forward and reverse watts elements
23. **32V** — Forward and reverse vars elements

---

**EDR family ordering guide**

**EDR 5000**

- **Relay model**
  - 3000 = Current protection relay
  - 5000 = Current, voltage and power protection relay

- **EDR-3000 hardware option 1**
  - A = 4 DI, 4 outputs
  - B = 8 DI, 6 outputs, trip coil monitor
  - C = 4 DI, 4 outputs, zone selective interlocking (ZSI) and IRIG-B

- **EDR-5000 hardware option 1**
  - A = 8 DI, 10 outputs, ZSI and IRIG-B
  - B = 16 DI, 10 outputs, ZSI and IRIG-B

- **Hardware option 2**
  - 0 = Phase current 5 A / 1 A, ground current 5 A / 1 A, power supply range: 19—300 Vdc, 40—250 Vac
  - 1 = Phase current 5 A / 1 A, sensitive ground current 0.5 A / 0.1 A, power supply range: 19—300 Vdc, 40—250 Vac

**Mounting options**

- 0 = Standard mount
- 1 = Projection mount

**Conformal coating options**

- A = None
- B = Conformal coated circuit boards

**Communication options**

- B = Modbus/DNP3 RTU over RS-485
- C = Modbus/DNP3 TCP over Ethernet RJ-45
- D = PROFIBUS-DP over fiber optic ST
- E = PROFIBUS-DP over D-Sub / RS-485
- F = Modbus RTU or DNP3 RTU over fiber optic ST
- G = Modbus/DNP3 RTU over D-Sub / RS-485
- H = IEC 61850/Modbus/DNP3 TCP over Ethernet RJ-45
- I = Modbus/DNP3 RTU over RS-485 or Modbus/DNP3 TCP over Ethernet RJ-45
- K = IEC 61850/Modbus/DNP3 TCP over LC duplex fiber optic Ethernet
- L = Modbus/DNP3 TCP over LC duplex fiber optic Ethernet
Eaton’s motor relay family—EMR Series

Model comparison guide—protective functions

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Enhanced protection functions

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<td>Loss of potential</td>
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<tr>
<td>CLPU</td>
<td>Cold load pickup</td>
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<tr>
<td>SOTF</td>
<td>Switch on to fault</td>
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</tbody>
</table>

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

Relay model

- 3000 = Current protection relay
- 4000 = Current, voltage and power protection relay
- 5000 = Differential current, voltage and power protection relay

EMR-3000 hardware option 1

- A = 4 DI, 4 outputs, analog output, URTD interface, IRIG-B and small display
- B = 4 DI, 4 outputs, zone interlocking (ZI), URTD interface IRIG-B and small display

EMR-4000 hardware option 1

- A = 8 DI, 5 outputs, 4 analog outputs, URTD interface, IRIG-B and small display

EMR-5000 hardware option 1

- A = 16 DI, 9 outputs, 2 zones, URTD interface, IRIG-B and large display
- B = 8 DI, 9 outputs, 2 analog inputs, 2 analog outputs, URTD interface, IRIG-B and large display

Hardware option 2

- 0 = Phase current 5 A / 1 A, ground current 5 A / 1 A, power supply range: 19–300 Vdc, 40–250 Vac (sensitive ground current 0.5 A / 0.1 A, power supply range: 9–300 Vdc, 40–250 Vac) and small display

Communication options

- B = Modbus/DNP3 RTU over RS-485
- C = Modbus/DNP3 TCP over Ethernet RJ-45
- D = PROFINET-DP over fiber optic ST
- E = PROFINET-DP over D-Sub / RS-485
- F = Modbus RTU or DNP3 RTU over fiber optic ST
- G = Modbus/DNP3 RTU over D-Sub / RS-485
- H = IEC 61850/Modbus/DNP3 TCP over Ethernet RJ-45
- I = Modbus/DNP3 RTU over RS-485 or Modbus/DNP3 TCP over Ethernet RJ-45
- K = IEC 61850/Modbus/DNP3 TCP over LC duplex fiber optic Ethernet
- L = Modbus/DNP3 TCP over LC duplex fiber optic Ethernet

Mounting options

- 0 = Standard mount
- 1 = Projection mount

Conformal coating options

- A = None
- B = Conformal coated circuit boards

EATON E-Series protective relays
Eaton’s transformer relay family—ETR Series

Model comparison guide—protective functions

### ETR-4000

**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

### ETR-5000

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
- **51V**: Voltage restraint elements
- **59A/27A**: Low voltage ride-through (LVRT)
- **27A**: Low voltage ride-through (LVRT)
- **LOP**: Loss of potential

**BF**: Breaker failure

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

![Typical one-line example](image)

**Protective elements key**
- ■ = Functions on ETR-4000
- ■ = Functions on ETR-4000 and ETR-5000

See Page 4 for metering features.

### ETR family ordering guide

**Relay model**
- **ETR-4000**: Current and differential current protection relay
- **ETR-5000**: Differential current, voltage and power protection relay

**ETR-4000 hardware option 1**
- **A**: 8 DI, 9 outputs, removable terminals, 2 zone interlocking (ZI) and URTD interface

**ETR-5000 hardware option 1**
- **A**: 8 DI, 9 outputs, removable terminals, 2 zone interlocking (ZI) and URTD interface
- **B**: 8 DI, 9 outputs, 2 A I, 2 AO, removable terminals, 1 zone interlocking (ZI) and URTD interface

**Communication options**
- **B**: Modbus/DNP3 RTU over RS-485
- **C**: Modbus/DNP3 TCP over Ethernet RJ-45
- **D**: PROFINET over fiber optic ST
- **E**: PROFINET over D-Sub / RS-485
- **F**: Modbus RTU or DNP3 RTU over fiber optic ST
- **G**: Modbus/DNP3 RTU over D-Sub / RS-485
- **H**: IEC 61850/Modbus/DNP3 TCP over Ethernet RJ-45
- **I**: Modbus/DNP3 RTU over RS-485 or Modbus/DNP3 TCP over Ethernet RJ-45
- **K**: IEC 61850/Modbus/DNP3 TCP over LC duplex fiber optic Ethernet
- **L**: Modbus/DNP3 TCP over LC duplex fiber optic Ethernet

**Hardware option 2**
- **0**: Phase current 5 A / 1 A, ground current 5 A / 1 A, power supply range: 19–300 Vdc, 40–250 Vac
- **1**: Phase current 5 A / 1 A, sensitive ground current 0.5 A / 0.1 A, power supply range: 19–300 Vdc, 40–250 Vac

**Mounting options**
- **0**: Standard mount
- **1**: Projection mount

**Conformal coating options**
- **A**: None
- **B**: Conformal coated circuit boards
### Eaton’s generator relay family—EGR Series

#### Model comparison guide—protective functions

**EGR-5000**

**Protection functions**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>50BF</td>
<td>Breaker failure</td>
</tr>
<tr>
<td>50P</td>
<td>Phase instantaneous overcurrent elements</td>
</tr>
<tr>
<td>50R</td>
<td>Calculated ground or neutral instantaneous overcurrent elements</td>
</tr>
<tr>
<td>50X</td>
<td>Measured ground or neutral instantaneous overcurrent elements</td>
</tr>
<tr>
<td>51P</td>
<td>Phase overcurrent protection per time-current curve elements</td>
</tr>
<tr>
<td>51V</td>
<td>Voltage restraint elements</td>
</tr>
<tr>
<td>51R</td>
<td>Calculated ground fault protection per time-current curve elements</td>
</tr>
<tr>
<td>51X</td>
<td>Measured ground or neutral fault protection per time-current curve elements</td>
</tr>
<tr>
<td>49/51</td>
<td>Thermal protection element</td>
</tr>
</tbody>
</table>

**50/27**

- **50**—Inadvertent energization
- **27**—Low voltage ride-through (LVRT)

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

**Protective functions key**
- **#** = EGR-5000 Functions

**Hardware options**
- **A** = 16 DI, 9 outputs, ZSI and URTD interface
- **B** = 8 DI, 9 outputs, 2 AI, 2 AO, ZSI and URTD interface

**Communication options**
- **B** = Modbus/DNP3 RTU over RS-485
- **C** = Modbus/DNP3 TCP over Ethernet RJ-45
- **D** = PROFIBUS-DP over fiber optic ST
- **E** = PROFIBUS-DP over D-Sub / RS-485
- **F** = Modbus RTU or DNP3 RTU over fiber optic ST
- **G** = Modbus/DNP3 RTU over D-Sub / RS-485
- **H** = IEC 61850/Modbus/DNP3 TCP over Ethernet RJ-45
- **I** = Modbus/DNP3 RTU over RS-485 or Modbus/DNP3 TCP over Ethernet RJ-45
- **K** = IEC 61850/Modbus/DNP3 TCP over LC duplex fiber optic Ethernet
- **L** = Modbus/DNP3 TCP over LC duplex fiber optic Ethernet

**Conformal coating options**
- **A** = None
- **B** = Conformal coated circuit boards

**Mounting options**
- **0** = Standard mount
- **1** = Projection mount

---

### EGR family ordering guide

**Relay model**

- **5000** = Differential current, voltage and power protection relay

**Hardware option 1**

- **A** = 16 DI, 9 outputs, ZSI and URTD interface
- **B** = 8 DI, 9 outputs, 2 AI, 2 AO, ZSI and URTD interface

**Hardware option 2**

- **0** = Phase current 5 A / 1 A, ground current 5 A / 1 A, power supply range: 19–300 Vdc, 40–250 Vac
- **1** = Phase current 5 A / 1 A, sensitive ground current 0.5 A / 0.1 A, power supply range: 19–300 Vdc, 40–250 Vac

---

**EGR-5000 ordering guide**

**EGR-5000**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
<td>Differential current, voltage and power protection relay</td>
</tr>
</tbody>
</table>

---

**EATON E-Series protective relays**
Eaton’s bus differential relay—EBR Series

Model comparison guide—protective functions

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

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

Relay model

- **3000** = High-impedance differential relay
- **3Z** = Relay + high-impedance module

EBR-3000 and EBR-3Z hardware option 1

- **B** = 8 DI, 6 outputs, trip coil monitor, IRIG-B

EBR-3000 and EBR-3Z hardware option 2

- **B** = Power supply range: 19–300 Vdc, 40–250 Vac

EBR-3Z hardware option

- **A** = Energy rating 5200 joule
- **B** = Energy rating 10,400 joule

Mounting options

- **0** = Standard mount
- **1** = Projection mount

Conformal coating options

- **A** = None
- **B** = Conformal-coated circuit boards

### Protective elements key

- ■ = Standard
- ■ = Option

See Page 4 for metering features.

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Not applicable for EBR-Z catalog numbers.

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Catalog number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal RTD module with Modbus RTU 48–240 Vac / 48–250 Vdc</td>
<td>URTDI-01</td>
</tr>
<tr>
<td>Universal RTD module with Modbus RTU 24–48 Vdc</td>
<td>URTDI-02</td>
</tr>
<tr>
<td>1 m fiber optic cable for EMR, ETR or EGR relays / URTD communications</td>
<td>MPF0-1</td>
</tr>
<tr>
<td>5 m fiber optic cable for EMR, ETR or EGR relays / URTD communications</td>
<td>MPF0-5</td>
</tr>
<tr>
<td>10 m fiber optic cable for EMR, ETR or EGR relays / URTD communications</td>
<td>MPF0-10</td>
</tr>
<tr>
<td>25 m fiber optic cable for EMR, ETR or EGR relays / URTD communications</td>
<td>MPF0-25</td>
</tr>
<tr>
<td>75 m fiber optic cable for EMR, ETR or EGR relays / URTD communications</td>
<td>MPF0-75</td>
</tr>
<tr>
<td>E-Series 3000 I/O adapter kit, projection mounted. For retrofitting MP and DT series relays to EMR-3000 and EDR-3000 relays</td>
<td>ER-IQRETKIT</td>
</tr>
<tr>
<td>E-Series mini USB cable 6 ft</td>
<td>ESERIESUSBCLBL</td>
</tr>
<tr>
<td>FP-5000 to EDR-5000 retrofit adapter plate projection mount</td>
<td>ER-FPSKRETKIT</td>
</tr>
</tbody>
</table>
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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