

EDR-3000

Eaton Distribution Relay



Contents

Description	Page
General Description	2
Applications	3
Dimensions	5
Wiring Diagram	6
Specifications	7
Ordering Information	11



Powering Business Worldwide

Applications

- Provides reliable 3-phase and ground overcurrent protection for all voltage levels
- Primary feeder circuit protection
- Primary transformer protection
- Backup to differential protection
- May be used where instantaneous and/or time overcurrent protection is required
- Ground element capable of residual, zero sequence or external source connections

Protection Functions

- Breaker failure (50BF)
- Phase overcurrent protection per time-current curve (51-1, 51-2, 51-3)
- Current unbalance (46)
- Calculated ground fault protection per time-current curve (51R-1, 51R-2)
- Independent measured ground or neutral fault protection per time-current curve (51X-1, 51X-2)
- Phase instantaneous overcurrent (50-1, 50-2, 50-3)
- Calculated ground or neutral instantaneous overcurrent (50R-1, 50R-2)
- Independent measured ground or neutral instantaneous overcurrent (50X-1, 50X-2)
- Curve shapes: ANSI, IEC, or thermal curves (11 thermal curves)
- Instantaneous or time delay reset
- True RMS or fundamental sensing of each phase and ground current
- Zone selective interlocking (phase and ground) or reverse blocking for bus protection¹

Metered Values

- RMS and fundamental phase currents
- RMS and fundamental ground currents
- Maximum, minimum, and average RMS and fundamental phase currents
- Maximum, minimum, and average RMS and fundamental ground currents

Fault and Waveform Monitoring

- Trip circuit monitoring¹
- Breaker wear (accumulated interrupted current)
- Fault data logs (up to 20 events)
- Sequence of event recorders (up to 300 events)
- Waveform capture (7,200 cycles total, customized file size)
- CT supervision

Control Functions

- Remote open/close
- Programmable I/O
- Programmable LEDs
- Multiple setting groups (up to 4)

Communication (Note 1)

- Local HMI
- Front USB Communication port
- Remote communication port
 - RS-485 Terminals
 - Ethernet RJ45
 - Fiber Optic ST
 - RS-485 D-SUB
 - LC Duplex Fiber Optic
- IRIG-B
- Protocols
 - Modbus RTU
 - Modbus TCP
 - IEC 61850 (MMS and GOOSE)
 - DNP3-RTU
 - DNP3-TCP/UDP
 - Profibus-DP

Physical Characteristics

- Height: 8.62 in. (218.948 mm)
- Width: 6.82 in. (173.228 mm)
- Depth: 7.49 in. (190.246 mm), 5.56 in* (141.224 mm*)
 - * Depth behind panel with projection mounted enclosure

Listings/Certification

- UL, CSA, CE

General Description

The EDR-3000 Protective Relay is a multifunction, microprocessor based overcurrent relay designed for both ANSI and IEC applications. It is a panel-mounted, self-contained unit which operates from either ac or dc control power. The EDR-3000 design provides true RMS and fundamental sensing of each phase and ground current. Only one unit is required for each 3-phase circuit.

Current monitoring and operator selectable protective functions are integral to each relay. The EDR-3000 relay operates from the 5 amperes or 1 ampere secondary output of standard current transformers. Current transformer ratio information is quickly programmed into the unit via settings. This enables the relay to display metered current in primary amperes, secondary amperes or per unit values. The EDR-3000 features a user friendly operations panel to monitor and program the relay. The cause for trips and alarms are automatically displayed on the LCD after events. Three levels of password protection can be customized for both protection and control features. The common PowerPort-E software is used for configuring the relay settings, and the Quality Manager software provides access to the 7200 cycles of disturbance waveform data stored in the relay.

Arc flash reduction is accomplished through Maintenance Mode and the use of either blocking elements or separate settings groups. Maintenance Mode is easily programmed, engaged and indicated through the front panel HMI, the programmable I/O, or over communications.

¹ Refer to the Ordering Information and Table 2 for optional features.

Applications

General

The EDR-3000 microprocessor based relay provides reliable 3-phase and ground overcurrent protection for all voltage levels. It can be used for any application where instantaneous and/or time overcurrent protection is required. It is most commonly used as primary feeder circuit protection, (see Figure 1).

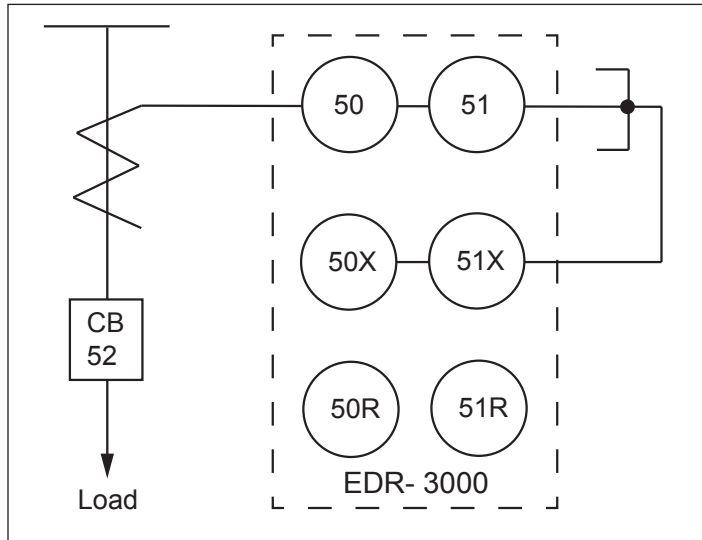


Figure 1. Primary Feeder Circuit Protection.

The EDR-3000 may be applied as the primary or backup transformer overcurrent protection (see Figure 2).

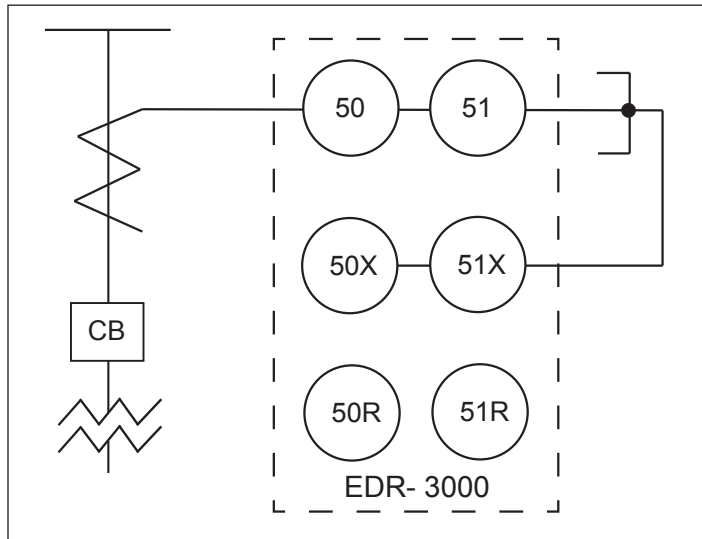


Figure 2. Transformer Overcurrent Protection.

The EDR-3000 may be used as primary or backup protection on the secondary side of a resistance grounded transformer (i.e. Delta-Wye transformer with high-resistance ground system). In this application, the sensitive ground ordering option is required for use with lower CT ratios and more sensitive pickup settings.

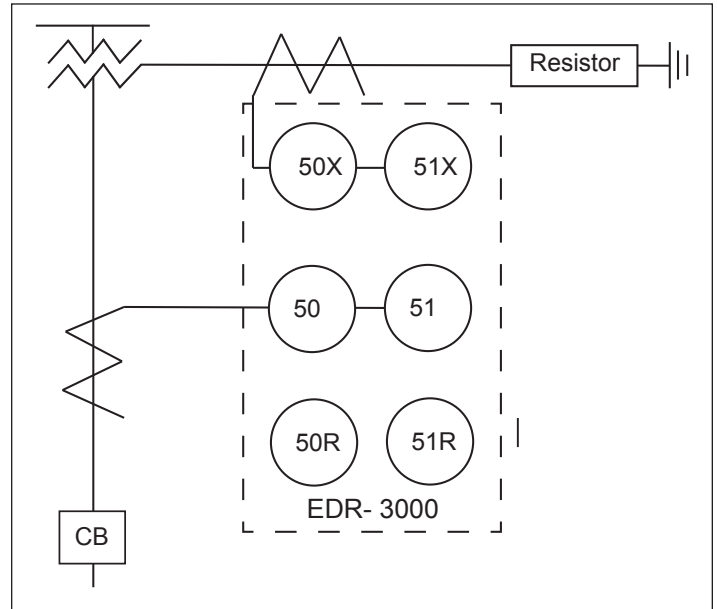


Figure 3. Transformer Secondary Protection with Neutral CT Connection.

The EDR-3000 relay has special provisions for connection in a Zone Interlocking scheme which can be used for bus protection or to improve protection coordination in a tight or close system. Zone Interlocking is described in following sections.

Overcurrent Protection

The EDR-3000 provides complete 3-phase and ground overcurrent protection. The separate protection elements and settings are fully programmable using either 5A or 1A secondary current transformers. The CT ratios are set independently for phase and ground allowing the ground element to be connected using either the residual connection of the phase inputs or a separate ground CT. (refer to Figures 4 and 5).

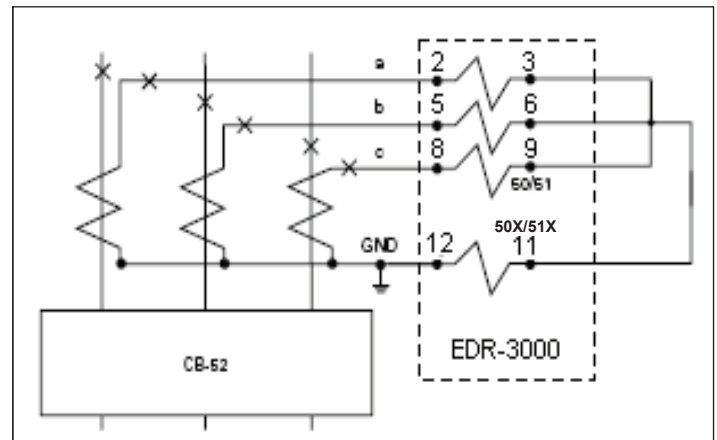


Figure 4. Residual Ground Connection.

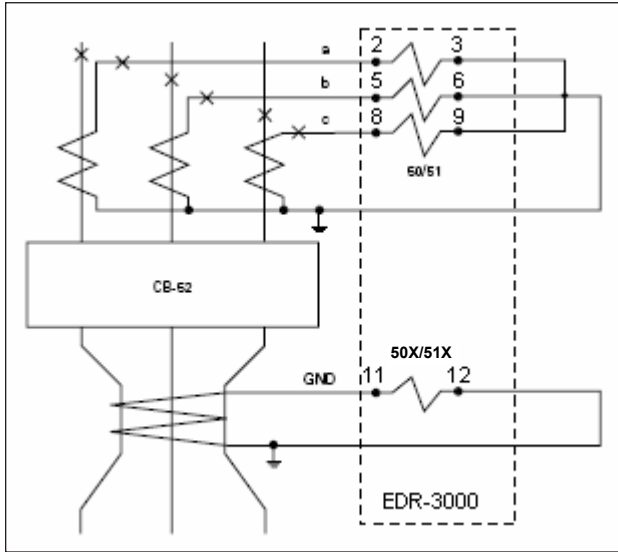


Figure 5. Separate Zero Sequence Ground CT Connection.

Zone Selective Interlocking¹ (Phase and Ground)

Zone Selective interlocking is a protection function to minimize equipment damage resulting from a phase or a ground fault in an area where long time and/or short time delay is in use.

When the "Ground Zone Interlocking" feature is utilized, an immediate trip is initiated when the fault is in the breaker's zone of protection, regardless of its preset time delay. When the "Phase Zone Interlocking" feature is utilized, the time overcurrent elements work as follows. The instantaneous phase element will initiate an immediate trip when the fault is in the breaker's zone of protection, regardless of its preset time delay. For the time overcurrent phase element, the current sensed by the EDR-3000 must exceed 1.5 times the pickup setting for the zone selective interlocking to initiate an immediate trip signal when the fault is in the breaker's zone of protection.

Upstream EDR-3000 protected breakers are restrained from tripping immediately by an interlocking signal from the downstream EDR-3000 relay. This interlocking signal requires only a pair of wires from the downstream breaker to the upstream breaker. It provides standard coordinated tripping when the fault is located outside the zone of protection.

In the sample zone interlocking system shown in Figure 6, circuit breakers A, B, and C are equipped with EDR-3000 overcurrent relays.

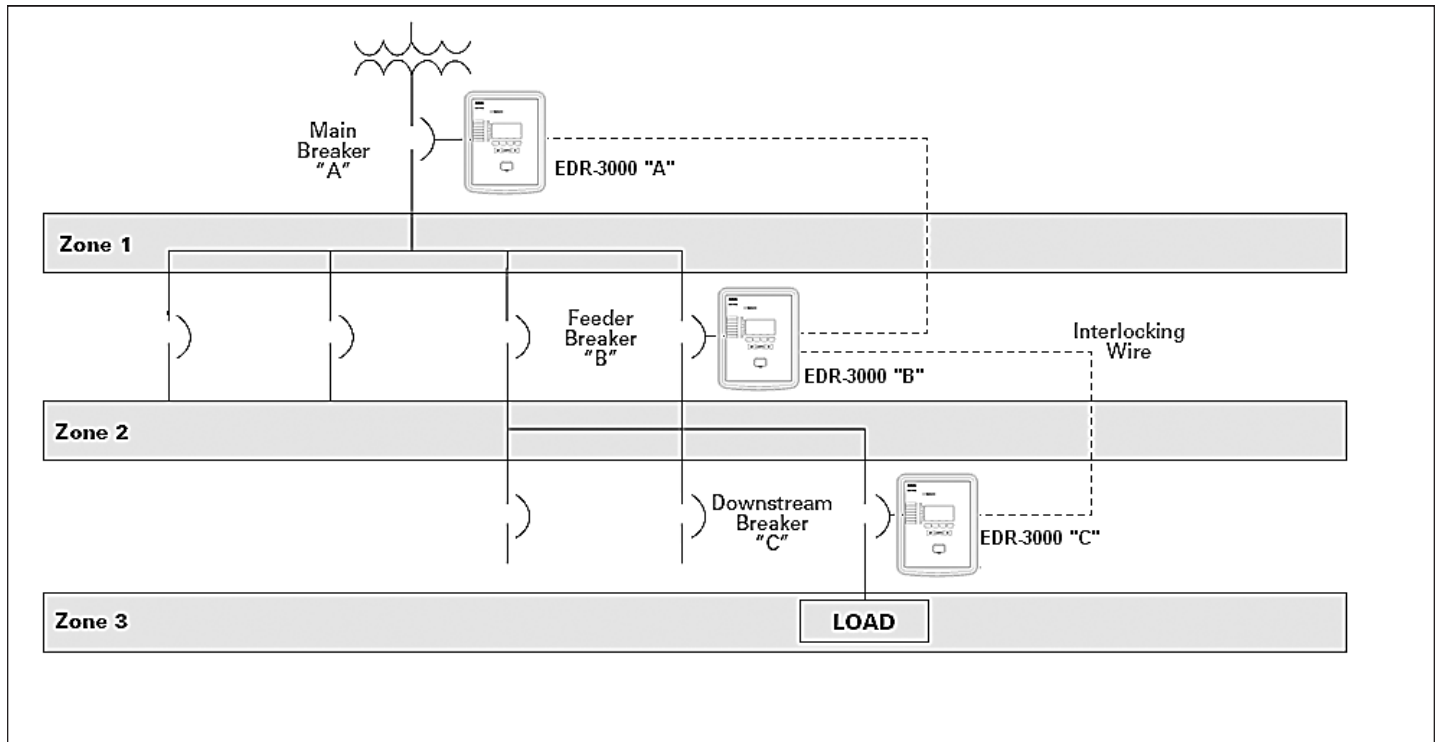


Figure 6. Sample Zone Selective Interlocking System.

¹ Refer to the Ordering Information and Table 2 (Catalog Ordering Information for EDR-3000 Eaton Distribution Relay Removable Terminals) for optional features.

Fault Location Zone 3*

If a fault occurs at a point in Zone 3, the EDR-3000 of downstream breaker C senses the fault and sends a restraining signal to the upstream EDR-3000 of feeder breaker B. Having received this signal, the EDR-3000 of feeder breaker B withholds its trip command. As a result, only downstream breaker C is tripped.

Fault Location Zone 2*

If a fault occurs at a point in Zone 2, the EDR-3000 of feeder breaker B senses the fault and sends a restraining signal to the upstream EDR-3000 of main breaker A. The EDR-3000 of the downstream breaker C does not see this fault since it is situated on the downstream side of the fault. As a result, the EDR-3000 of downstream breaker C does not send a restraining signal to the EDR-3000 of feeder breaker B. Since it did not receive a restraining signal from the EDR-3000 of downstream breaker C, the EDR-3000 of feeder breaker B identifies that the fault is in Zone 2 and immediately trips feeder breaker B, regardless of its time setting.

Fault Location Zone 1*

If a fault occurs in Zone 1, no restraining signal is received by the Digitrip of main breaker A. As a result, main breaker A is immediately tripped by its EDR-3000 overcurrent relay, regardless of its time setting.

* For the time overcurrent phase element, the current sensed by the EDR-3000 must exceed 1.5 times the pickup setting for the zone selective interlocking to initiate an immediate trip signal when the fault is in the breaker's zone of protection.

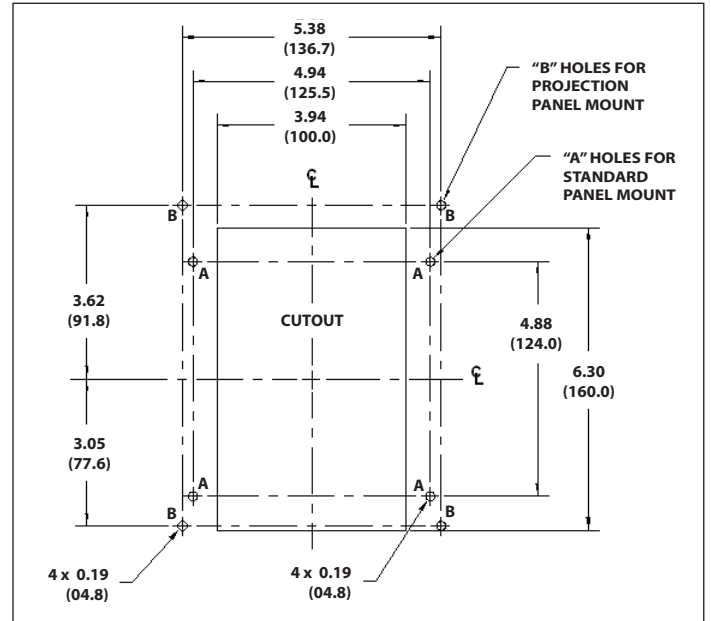


Figure 7. Drilling Pattern.

Dimensions

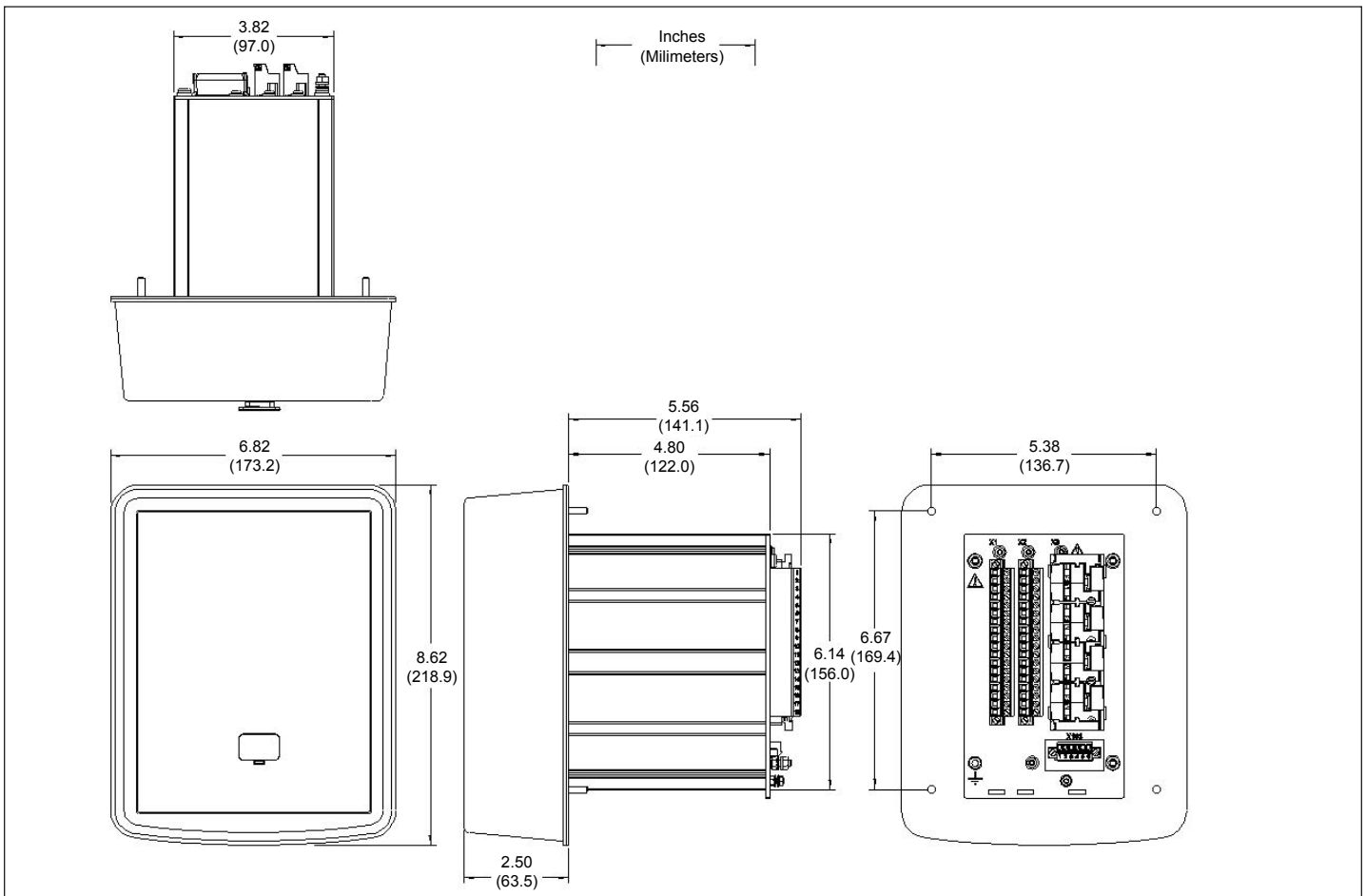


Figure 8. Projection Mounting.

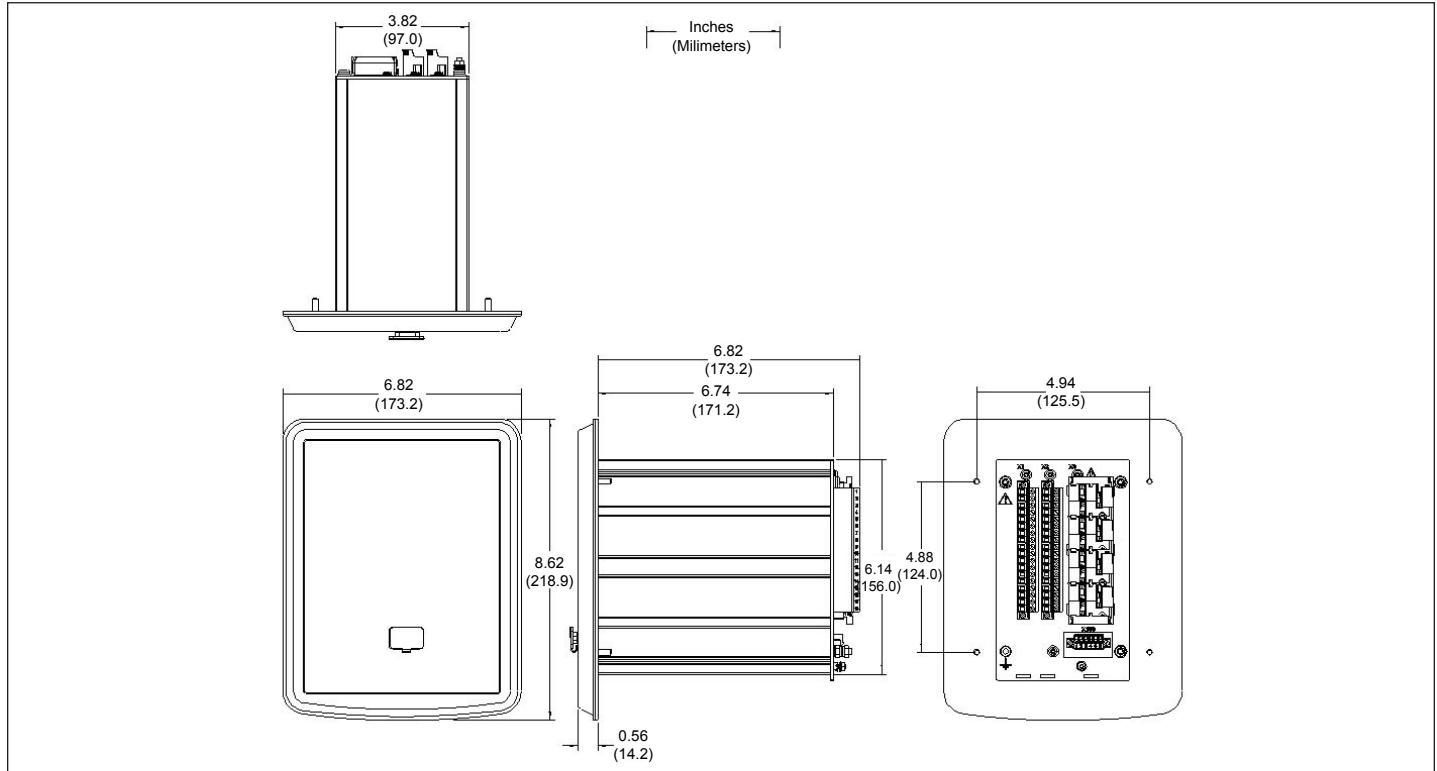


Figure 9. Standard Mounting.

Wiring Diagram

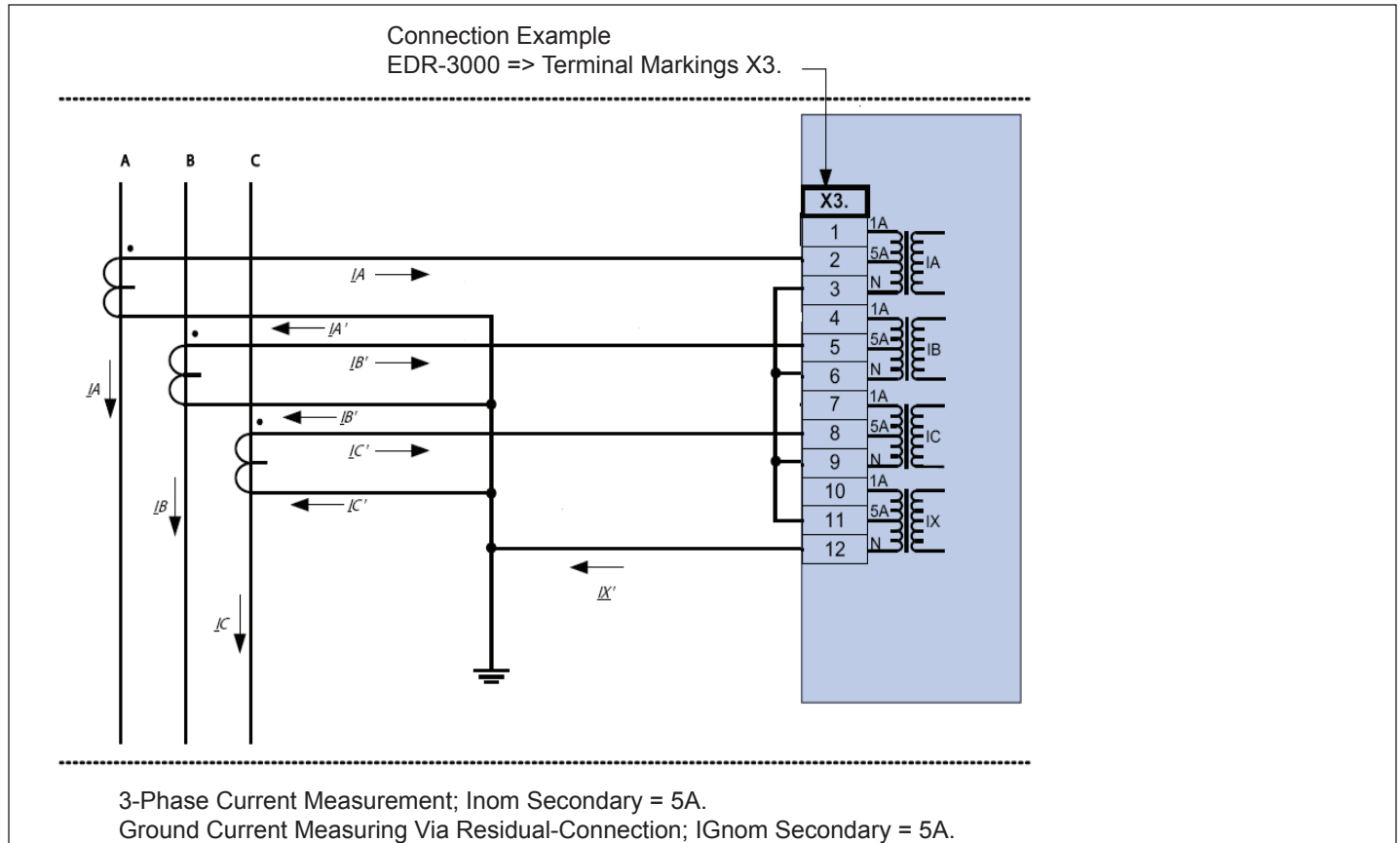


Figure 10. EDR-3000 Typical Wiring Diagram.

Specifications

Climatic Environmental Conditions

- Storage Temperature: -25°C up to +70°C (-13°F to 158°F)
- Operating Temperature: -20°C up to +60°C (-4°F to 140°F)
- Permissible Humidity at Ann. Average: <75% rel. (on 56d up to 95% rel.)
- Permissible Installation Altitude: <2000 m (6561.67 ft) above sea level
- If 4000 m (13123.35 ft) altitude apply, a changed classification of the operating and test voltages may be necessary

Degree of Protection EN 60529

- HMI front panel with seal IP54
- Rear side terminals IP30

Routine Test

- Insulation test acc. to IEC60255-5: All tests to be carried out against ground and other input and output circuits
- Aux. voltage supply, digital inputs, current measuring inputs, signal relay outputs: 2.5 kV (eff) / 50 Hz
- Voltage measuring inputs: 3.0 kV (eff) / 50 Hz
- All wire-bound communication interfaces: 1.5 kV dc

Housing

- Housing B1: height/width 183 mm (7.205 in.)/ 141.5 mm (5.571 in.)
- Housing depth (incl. terminals): 208 mm (8.189 in.)
- Material, housing: Aluminum extruded section
- Material, front panel: Aluminum/foil front
- Mounting position: Horizontal ($\pm 45^\circ$ around the X-axis must be permitted)
- Weight: EDR-3000 housing B1: approx. 2.4 kg (5.291 lb)

Plug-in Connector with integrated Short-Circuiter (Conventional Current Inputs)

- Nominal current: 1 A and 5 A
- Continuous loading capacity: 4 x In/continuously
- Overcurrent withstand: 30 x In/ 10 s
- 100 x In/1 s
- 250 x In/10 ms (1 half-wave)
- Screws: M4, captive type acc. to VDEW
- Connection cross-sections:
 - 2 x 2.5 mm² (2 x AWG 14) with wire end ferrule
 - 1 x or 2 x 4.0 mm² (2 x AWG 12) with ring cable sleeve or cable sleeve
 - 1 x or 2 x 6 mm² (2 x AWG 10) with ring cable sleeve or cable sleeve

Voltage Supply

- Aux. Voltage: 19 - 300 Vdc/40 - 250 Vac
- Buffer time in case of supply failure: ≥ 50 ms at minimal aux. voltage communication is permitted to be interrupted
- Max. permissible making current:
 - 18 A peak value for <0.25 ms
 - 12 A peak value for <1 ms

- The voltage supply must be protected by a fuse of:
 - 2.5 A time-lag miniature fuse 5 x 20 mm (approx. 1/5 in. x 0.8 in.) according to IEC 60127
 - 3,5 A time-lag miniature fuse 6.3 x 32 mm (approx. 1/4 in. x 1 1/4 in.) according to UL 248-14

Power Consumption

- Power supply range:
 - 19-300 Vdc: 6 W idle mode/ 8 W max. power
 - 40-250 Vac: 6 W idle mode/ 8 W max. power
- (For frequencies of 40-70 Hz)

Real Time Clock

- Running reserve of the real time clock: 1 year min.

Display

- Display type: LCD with LED background illumination
- Resolution graphics display: 128 x 64 pixel
- LED-Type: Two colored: red/green
- Number of LEDs, Housing B1: 8

Digital Inputs

- Max. input voltage: 300 Vdc/270 Vac
- Input current: <4 mA
- Reaction time: <20 ms
- Fallback time: <30 ms
- (Safe state of the digital inputs)
- 4 Switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac/dc, 230 Vac/dc Un = 24 Vdc
- Switching threshold 1 ON:
- Switching threshold 1 OFF:
 - Min. 19.2 Vdc
 - Max. 9.6 Vdc
 - Un = 48 V/60Vdc
- Switching threshold 2 ON:
- Switching threshold 2 OFF:
 - Min. 42.6 Vdc
 - Max. 21.3 Vdc
 - Un = 110/120 Vac/dc
- Switching threshold 3 ON:
- Switching threshold 3 OFF:
 - Min. 88.0 Vdc/88.0 Vac
 - Max. 44.0 Vdc/44.0 Vac
 - Un = 230/240 Vac/dc
- Switching threshold 4 ON:
- Switching threshold 4 OFF:
 - Min. 184 Vdc/184 Vac
 - Max. 92 Vdc/92 Vac
- Terminals: Screw-type terminal

Current and Ground Current Measurement

- Nominal currents: 1 A / 5 A
- Max. measuring range:
 - up to 40 x I_n (phase currents)
 - up to 25 x I_n (ground current standard)
 - up to 2.5 x I_n (ground current sensitive)
- Continuous loading capacity: 4 x I_n/continuously
- Overcurrent proof:
 - 30 x I_n/10 s
 - 100 x I_n/1 s
 - 250 x I_n/10 ms (1 half-wave)
- Power consumption: Phase current inputs
 - at I_n = 1A Burden = 0.15 mVA
 - at I_n = 5A Burden = 0.15 mVA
- Ground current input
 - at I_n = 1A Burden = 0.35 mVA
 - at I_n = 5A Burden = 0.35 mVA
- Frequency range: 50 Hz / 60 Hz ±10%
- Terminals: Screw-type terminals with integrated short-circuiters (contacts)

Binary Output Relays

- Continuous current: 5 A ac/dc
- Switch-on current: 25 A ac/dc for 4 s
- Max. breaking current: 5 A ac up to 125 Vac
- 5 A dc up to 50 V (resistive)
- 0.2 A dc at 300 V
- Max. switching voltage: 250 Vac/300 Vdc
- Switching capacity: 2000 VA
- Contact type: 1 changeover contact
- Terminals: Screw-type terminals

RS485

- Master/Slave: Slave
- Connection: 6 screw-clamping terminals RM 3.5 mm (138 MIL) (terminating resistors internal)

Design Standards

- Generic standard EN 61000-6-2
- EN 61000-6-3
- Product standard EC 60255-6
- EN 50178
- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 14-95 (Industrial Control Equipment)
- ANSI C37.90

Tolerances of the Real Time Clock

- Resolution: 1 ms
- Tolerance: <1 minute / month (+20°C [68°F])

Measuring Accuracy

- Max measuring range: up to 40 x I_n (phase currents)
- up to 25 x I_n (ground current standard)
- Frequency range: 50 Hz / 60 Hz ± 10%
- Accuracy: Class 0.5
- Amplitude error if I < I_n: ±0.5% of the rated value
- Amplitude error if I > I_n: ±0.5% of the measured value
- Amplitude error if I > 2 I_n: ±1.0% of the measured value
- Resolution: 0.01 A
- Harmonics up to 20% 3rd harmonic ±2% up to 20% 5th harmonic ±2%
- Frequency influence < ±2% / Hz in the range of ±5 Hz of the parameterized nominal frequency
- Temperature influence <±1% within the range of 0°C up to +60°C (32°F up to +140°F)

Protection Stages Tolerances

The tripping delay relates to the time between pickup and trip. The tolerance of the operating time relates to the time between the measured value has exceeded the threshold until the protection stage is alarmed.

Table 1. Protection Stages Tolerances.

Overcurrent Protection Stages: 50P(x), 51P(x)		Range	Step	Tolerance
Pickup	If the Pick-up Value is Exceeded the Module/Stage is Started.	0.01...40.00 × In	0.01 × in	±1.5% of the Setting Value Resp. 1% In
Resetting Ratio		97% or 0.5% × In		
t	Tripping Delay	0.00...300.00 × s	0.01 × s	DEFT ±% resp. ±10 ms
Operating Time	Starting from I Higher than 1.1 × I _b			<+35ms
DisengagingTime				<+45 ms
t-Multiplier	Time multiplier/tripping characteristic factor IEC NINV IEC VINV IEC EINV IEC LINV ANSI MINV ANSI VINV ANSI EINV Flat I _t I _{2t} I _{4t}	0.05...2.00	0.01	±5%
Reset Mode	Only Available if IEC Characteristics IEC NINV IEC VINV IEC EINV IEC LINV	0.00...60.00	0.01 × s	±1% resp ±10 ms.
	Reset Curves if ANSI Characteristics ANSI MINV ANSI VINV ANSI EINV Flat I _t I _{2t} I _{4t}			5%

Table 1. Protection Stages Tolerances (Continued).

Ground Current Stages: 50G(x), 50N(x), 51G(x), 51N(x)		Range	Step	Tolerance
Pickup	If the Pick-up Value is Exceeded the Module/Stage will be Started.	$0.01...20.00 \times I_n$	$0.01 \times I_n$	$\pm 1.5\%$ of the Setting Value Resp. $1\% I_n$
Resetting Ratio		97% or $0.5\% \times I_n$		
t	Tripping Delay	$0.00...300.00 \times s$	$0.01 \times s$	DEFT
$\pm\%$ Resp.. ± 10 ms				
Operating Time	Starting from IG Higher than $1.1 \times I_G >$			$<+35$ ms
DisengagingTime				$<+45$ ms
t-Multiplier	Tripping Characteristic Factor IEC NINV IEC VINV IEC EINV IEC LINV ANSI MINV ANSI VINV ANSI EINV Flat I _t I ² t I ⁴ t	0.05...2.00	0.01	$\pm 5\%$
Reset Mode	Only Available if IEC Characteristics IEC NINV IEC VINV IEC EINV IEC LINV	0.00...60.00	$0.01 \times s$	$\pm 1\%$ resp. ± 10 ms
	Reset Curves if ANSI Characteristics ANSI MINV ANSI VINV ANSI EINV Flat I _t I ² t I ⁴ t			5%
Circuit Breaker Failure Protection 50BF				
I-CBF>	If the Pick-up Value is Exceeded, the Module/Stage Will Be Started.	$0.0...0.1 \times 1$	$0.01 \times I_n$	$\pm 1.5\%$ of the Setting Value Resp. $1\% I_n$
Resetting Ratio		$0.5\% \times I_n$		
t-CBF	If the delay time is expired, an CBF alarm is given out.			$<+40$ ms
Operating Time	Starting From I Higher than $1.3 \times I\text{-CBF}>$			$<+40$ ms
Disengaging Time				$<+40$ ms

Ordering Information

Sample Catalog Number

The catalog number identification chart defines the electrical characteristics and operation features included in the EDR-3000. For example, if the catalog number were EDR-3000-2A0BA1, the device would have the following:

EDR-3000

(A) - 4 Digital Inputs, 3 Output Relays

(0) - Phase Current 5A/1A, Ground Current 5A/1A, Power Supply: 19-300 Vdc, 40-250 Vac

(B) - Modbus-RTU or DNP3 RTU (RS-485)

(A) - Without Conformal Coating

(1) - Projection Panel Mount

Table 2. Catalog Ordering Information for EDR-3000 Eaton Distribution Relay Removable Terminals.

EDR-3000 Eaton Distribution Relay Removable Terminals						
	EDR-3000-2	A	0	B	A	1
Choose from the following options.						
Hardware Option 1						
4 DI, 3 Outputs, Removable Terminals		A				
8 DI, 5 Outputs, Removable Terminals, Trip Coil Monitor and IRIG-B		B				
4 DI, 3 Outputs, Removable Terminals, Zone Interlocking, and IRIG-B		C				
Hardware Option 2						
Phase Current 5A/1A, Ground Current 5A/1A, Power Supply Range: 19-300 Vdc, 40-250 Vac			0 (Zero)			
Phase Current 5A/1A, Sensitive Ground Current 0.5A/0.1A, Power Supply Range:19-300 Vdc, 40-250 Vac			1			
Communication Options						
Modbus RTU or DNP3 RTU over RS485				B		
Modbus TCP or DNP3 TCP/UDP over Ethernet RJ45				C		
Profibus-DP over Fiber Optic ST				D		
Profibus-DP over D-SUB / RS485				E		
Modbus RTU or DNP3 RTU over Fiber Optic ST				F		
Modbus RTU or DNP3 RTU over D-SUB / RS485				G		
IEC61850 or Modbus TCP or DNP3 TCP/UDP over Ethernet RJ45				H		
Modbus RTU or DNP3 RTU over RS485 or Modbus TCP or DNP3 TCP/UDP over Ethernet RJ45				I		
IEC61850 or Modbus TCP or DNP3 TCP/UDP over LC duplex FO Ethernet				K		
Modbus TCP or DNP3 TCP/UDP over LC duplex FO Ethernet				L		
Conformal Coating Options						
None					A	
Conformal Coated Circuit Boards					B	
Mounting Options						
Standard Mount						0 (Zero)
Projection Mount						1

Standard Accessories EDR-3000

Catalog Number	Description
ER-IQRETROKIT	E-SERIES 3000 IQ ADAPTER KIT PROJECTION MOUNTED*
ESERIESUSBCBL	E-Series mini USB cable 6 foot

* Retrofit mounting plate for a DT-3000 relay replacement. Projection mount option required.

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