Metering Devices, Protective Relays, Software and Connectivity

9.1 Metering Devices

Product Overview V3-T9-2
PXM350 . . . . . V3-T9-9
PXM1000 . . . . . V3-T9-16
Power Xpert Meter 2000 Series V3-T9-24
PXM3000 . . . . . V3-T9-33
Power Xpert Meter 4000/6000/8000 Series V3-T9-39
Power Xpert Branch Circuit Monitor (PXBCM) V3-T9-52
Power Xpert Multi-Point Meter V3-T9-56
Current Transformers (CTs) V3-T9-68
Enclosed Meters V3-T9-78

9.2 Protective Relays

Product Selection Guide V3-T9-100
Arc Flash Relay V3-T9-106
EDR-3000 Feeder Protection V3-T9-108
EDR-5000 Distribution Protection Relay V3-T9-117
EBR—Line Differential Relay V3-T9-130
EMR-3MP0 Motor Protection Relay V3-T9-132
EMR-3000 Motor Protection Relay V3-T9-134
EMR-4000 Motor Protection Relay V3-T9-134
EMR-5000 Motor Protection Relay V3-T9-159
ETR-4000 Transformer Protection Relay V3-T9-171
ETR-5000 Transformer Protection Relay V3-T9-183
EGR-5000 Generation Protection Relay V3-T9-196
Universal RTD Module V3-T9-209

9.3 Connectivity Options

Power Xpert Gateway V3-T9-213
PXM1K-ETHMULTI Card for PXM1000 Devices V3-T9-222
mMINT V3-T9-224
I/O Devices Digital Input Module (DIM) V3-T9-226
Addressable Relay II V3-T9-228

Metering Products Family



Contents

Description	*Page*
Metering Products Family Product Selection Guide	**V3-T9-3**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Power Xpert Multi-Point Meter	**V3-T9-56**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

Product Overview

Eaton's metering products provide solutions needed to monitor and manage all aspects of an electrical distribution system.

When greater reliability, increased productivity and significant cost savings are called for to remain competitive in today's market, Eaton's metering products fit the bill. These innovative meters and communications systems, along with Power Management software, make it possible to successfully take control of the electrical distribution system.

Power Xpert Meters

Power Xpert® Meters are the benchmark for intelligent web-enabled top-quality metering devices for the power system. Power Xpert Meters provide measurement of the critical elements found in the power system, whether that be voltage, power, current, transients, harmonics or even time. Power Xpert Meters provide web-enabled communications for use with the Power Xpert Insight™. All Power Xpert Meters provide a standard communications protocol for easy integration into other systems.

Features and Benefits

Greater Reliability

Eaton's metering products give the ability to receive an early warning of potential problems, eliminate unnecessary trips, isolate faults to ensure minimum downtime and shed or equalize loads while a problem is being corrected.

Increased Productivity

Equipment downtime resulting from voltage or frequency variations can be very costly to an operation. Monitoring power quality with Eaton's metering products throughout the electrical distribution system provides data to identify, isolate and correct problems quickly and efficiently.

Reduced Energy and Operating Costs

When we think about meters and power quality, the common thread throughout the basket of solutions is information. Collecting, monitoring and managing data from the electrical distribution system can help reduce costs for those facilities prepared to define and analyze present electrical energy usage levels and patterns. Data provided by Eaton's metering products comprise the data for verifying utility bills for energy management and lowering operating costs. Deregulation in some geographical locations permits energy users to select a utility provider and negotiate rate structures. For large users with heavy utility bills, this may be an incentive to verify the utility bill, identify an opportunity for savings, negotiate a better utility rate and apply the savings directly to the bottom line. Users are also empowered to decrease energy consumption, thereby lowering peak demand charges and decreasing operating costs.

When an Eaton meter is used with Eaton trip units and relays incorporating built-in metering capabilities, the entire electrical distribution system can be cost-effectively managed.

Eaton is an industry leader offering a complete integrated solution to oversee your entire electrical distribution system. As a global manufacturer of low and medium voltage electrical distribution system equipment and components, Eaton is an experienced innovator of metering products that incorporate cutting-edge technology. These innovations result from our scientific and engineering expertise, physical resources and the ongoing R&D programs at our technology centers.

Product Selection Guide

Metering Selection Chart

PXM350



PXM1000



Power Xpert Meter 2000 Series



Section Page Number	V3-T9-9	V3-T9-16	V3-T9-24
Electrical Parameters			
Volts	±0.5% of RV	±0.2% RV	0.1% of RV
Amperes	±0.5% of RV	±0.2% RV	0.1% of RV
Current range (% of nominal)	0.1–200%	0.1–200%	0.1–200%
Watts	±0.5% of RV	±0.2% of RV	0.2% of RV
Vars	±0.5% of RV	±0.2% of RV	0.2% of RV
VA	±0.5% of RV	±0.2% of RV	0.2% of RV
PF-apparent	±0.5% of RV	±0.2% of RV	0.2% of RV
PF-displacement	±0.5% of RV	—	—
Frequency	0.12 Hz	±0.12 Hz	±0.03 Hz
THD-voltage	—	63rd ①②③④	40th ②③④⑤
THD-current	—	63rd ①②③④	40th ②③④⑤
Watthours	±0.5% per ANSI C12.20 0.5 class	±0.2% per ANSI C12.20 0.2 class	±0.2% per ANSI C12.20 0.2 Class ①
Varhours	±0.5%	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
VA-hours	±0.5%	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Ampere-demand	±0.5%	±0.2%	±0.1% per ANSI C12.20 0.2 Class
Watt-demand	±0.5% per ANSI C12.20 0.5 class	±0.2% per ANSI C12.20 0.2 class	±0.2% per ANSI C12.20 0.2 Class ①
Var-demand	±0.5%	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
VA-demand	±0.5%	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Revenue accuracy	—	—	ANSI C12.20 (0.2%)
Individual ampere harmonics	—	63rd (50 Hz or 60 Hz), 15th (400 Hz) ①②③④	40th ③④⑤
Individual voltage harmonics	—	63rd (50 Hz or 60 Hz), 15th (400 Hz) ①②③④	40th ③④⑤
Interharmonics	—	—	—
Minimum and/or Maximum Values			
Volts	—	L-L, L-N	L-L, L-N
Current	—	A, B, C, N ⑥	A, B, C, N
Power	—	Watt, var, VA	Watt, var, VA
Power factor	—	Apparent	Apparent
Frequency	—	Hertz	Hertz
THD	—	Amperes/volts ①②③	Amperes/volts ②③④⑤
Demand values	kW, kvar, kVA, amperes	kW, kvar, kVA, amperes, TOU ②	kW, kvar, kVA, amperes
Trend analysis	—	8 MB ②③ / 16 MB ④ / 8 GB ⑤	256 / 512 ② / 768 ③④⑤ MB
Event logging	20 alarms/15 events with timestamp	16 alarms/50,000 events with timestamp	100,000 alarms/events with timestamp
Disturbance recording	—	8 MB ②③ / 16 MB ④, 20 cycles per waveform	768 MB ④⑤ up to 64 cycles per event ④⑤

Notes

① PXM1000 only.
② PXM1100 only.
③ PXM1200 only.
④ PXM1300 only.
⑤ Optional communication module PXM1K-ETHMULTI.
⑥ Calculated neutral.

Legend: PG = Programmable
FS = Full scale
RV = Read value
Auxiliary voltage (optional) = Provides three additional voltage inputs to the meter: Va2, Vb2, Vc2.
Interharmonics = Power Xpert Meter 6000/8000 supported.

Metering Selection Chart, continued

PXM350



PXM1000



Power Xpert Meter 2000 Series



Section Page Number	V3-T9-9	V3-T9-16	V3-T9-24
Other Features			
Storage	8 KB	8 MB ①②/ 16 MB ③ / Additional 8 GB to the meter ④	256 / 512 ③ / 768 ④ MB Standard
PG output relays	Form A, 5 A	5 A ⑤	Optional (2) Form C, 5 A or (4) Form A, 120 mA
PG analog outputs	—	Optional 0–20 mA or 4–20 mA or 0–5 V or 1–5 V ⑤	Optional (4) 4–20 mA or (4) 0–1 mA
Discrete contact inputs	—	Optional 4 or 6, 2 mA ⑤	Optional (2) or (4)
Analog inputs	—	Optional 0–20 mA or 4–20 mA or 0–5 V or 1–5 V ⑤	—
Synch-input kW utility	—	Via end of interval pulse with optional digital inputs	Via end of interval pulse with optional digital inputs
Auxiliary voltage ⑤	—	—	—
kWh pulse initiator	Yes, 10 mA, 250 Vac	Yes	Yes
Waveform display	—	Web pages ③④	⑥
Waveform capture, samples/cycle	—	Yes, up to 64 ③	Yes, up to 64 ⑦, up to 512 ⑧
Frequency distribution display	—	—	—
Display type	Backlit LCD	Backlit LCD ⑥	Red LED
Display lines/character	1 line, 7 characters	5 line, 4 characters	3 lines, 4 characters
Display character height	7.85 mm	10 mm	0.56 (14.2) H
Communications	Serial: Modbus RTU, BACnet MS/TP	Serial: Modbus RTU, DNP3.0 Network ④⑦: Modbus TCP/IP, BACnet/IP, EtherNet/IP,HTTPS, HTTPS Post, FTP, sFTP, IPV6, SNMP, NTP, COMTRADE, 8 GB datalogging, trendlog display	Serial: Modbus RTU, Modbus ASCII, DNP 3.0 Network: Modbus TCP, BACnet/IP, Ethernet TCP/IP, HTTP, HTTPS, SNMP, SMTP, ⑦⑧ Waveform FTP
Setup configuration	Via configuration software/display	Via configuration software/display Via web browser	Via web browser/display
Dimensions	3.54 (90.0) H x 4.25 (108.0) W x 2.46 (62.5) D	Meter: 3.77 (96.0) H x 3.77 (96.0) W x 2.50 (63.5) D Display: 3.77 (96.0) H x 3.77 (96.0) W x 2.31 (58.7) D	Refer to TD02601017E
Operating temperature range	–25 °C to +70 °C	–25 °C to +70 °C	–20 °C to +70 °C
Reference literature	TD150024EN	TD026079EN	TD02601017E

Notes

① PXM1100 only.
② PXM1200 only.
③ PXM1300 only.
④ Optional communication module PXM1K-ETHMULTI.
⑤ Up to 3 I/O modules can be installed
Relay outputs—up to 6 total
Analog outputs—up to 6 total
Discrete contact inputs—up to 16 total
Analog inputs—up to 6 total
⑥ Available transducer version with remote display.
⑦ Optional.

Legend: PG = Programmable
FS = Full scale
RV = Read value
Auxiliary voltage (optional) = Provides three additional voltage inputs to the meter: Va2, Vb2, Vc2.
Interharmonics = Power Xpert Meter 6000/8000 supported.

Metering Selection Chart, continued

	PXM3000	Power Xpert Meter 4000/6000/8000 Series
		
Section Page Number	**V3-T9-33**	**V3-T9-39**
Electrical Parameters		
Volts		0.1% of RV + 0.02% FS
Amperes	±0.1% of RV	0.05% of RV + 0.01% FS
Current range (% of nominal)	±0.1% of RV	0.005–20 A (400%)
Watts	0.1–200%	0.1% of RV + 0.0025% FS
Vars	±0.2% of RV	0.1% of RV + 0.0025% FS
VA	±0.2% of RV	0.1% of RV + 0.0025% FS
PF-apparent	±0.2% of RV	0.1%
PF-displacement	±0.2% of RV	0.1%
Frequency	—	±0.01 Hz
THD-voltage	±0.12 Hz	127th
THD-current	63rd	127th
Watthours	63rd	±0.2% per ANSI C12.20 0.2 Class ①
Varhours	±0.2% per ANSI C12.20 0.2 class	±0.2% per ANSI C12.20 0.2 Class ①
VA-hours	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Ampere-demand	±0.2%	0.05% of RV + 0.01% FS
Watt-demand	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Var-demand	±0.2% per ANSI C12.20 0.2 class	±0.2% per ANSI C12.20 0.2 Class ①
VA-demand	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Revenue accuracy	±0.2%	±0.2% per ANSI C12.20 0.2 Class ①
Individual ampere harmonics	—	85th ⑦
Individual voltage harmonics	63rd (50 Hz or 60 Hz), 15th (400 Hz)	85th ⑦
Interharmonics	63rd (50 Hz or 60 Hz), 15th (400 Hz)	Yes
Minimum and/or Maximum Values		
Volts		L-L, L-N, N-G, VAUX L-L
Current	L-L, L-N	A, B, C, N, G
Power	A, B, C, N ⑥	Watt, var, VA
Power factor	Watt, var, VA	Apparent/displacement
Frequency	Apparent	Hertz
THD	Hertz	Amperes/volts (L-L, L-N, AUX L-L)
Demand values	Amperes/volts	kW, kvar, kVA, amperes
Trend analysis	kW, kvar, kVA, amperes, TOU	2 / 4 ⑧ / 8 ⑨ GB
Event logging	16 MB	2 / 4 ⑧ / 8 ⑨ GB
Disturbance recording	16 alarms/50,000 events with timestamp	2 / 4 ⑧ / 8 ⑨ GB 60 cycles per event

Notes

① Under typical operating conditions.
② PXM 2260 only.
③ PXM 2270 only.
④ PXM 2280 only.
⑤ PXM 2290 only.
⑥ IQ 260 only.
⑦ Individual values reported to 85th harmonic; anti-alias filtering prevents higher frequencies from distorting readings (see IEC 61000-4-7).
⑧ PMX 6000 only.
⑨ PXM 8000 only.
⑩ Optional.
⑪ At computer only.

Legend: PG = Programmable
FS = Full scale
RV = Read value
Auxiliary voltage (optional) = Provides three additional voltage inputs to the meter: Va2, Vb2, Vc2.
Interharmonics = Power Xpert Meter 6000/8000 supported.

Metering Selection Chart, continued

PXM3000



Power Xpert Meter 4000/6000/8000 Series



Section Page Number	V3-T9-33	V3-T9-39
Other Features		
Storage	1.5 GB	2 / 4 ① / 8 ② GB
PG output relays	5 A ⑤	5 maximum
PG analog outputs	Optional 0–20 mA or 4–20 mA or 0–5 V or 1–5 V ⑤	—
Discrete contact inputs	Optional 4 or 6 ⑤	8
Analog inputs	Optional 0–20 mA or 4–20 mA or 0–5 V or 1–5 V ⑤	—
Synch-input kW utility	Via end of interval pulse with optional digital inputs	Via status input
Auxiliary voltage ⑤	—	Yes
kWh pulse initiator	Yes	Yes
Waveform display	Web pages	Local/computer
Waveform capture, samples/cycle	Yes, up to 128	Yes, 512 (4096 oversampling)
Frequency distribution display	—	—
Display type	Backlit LCD ⑥	LCD ⑨
Display lines/character	5 line, 4 characters	Color graphic
Display character height	10 mm	—
Communications	Serial: Modbus RTU Network: Modbus TCP/IP, BACnet/IP, HTTPS, HTTPS Post, FTP, sFTP, IPV6, SNMP, NTP, COMTRADE	Serial: Modbus RTU, Modbus ASCII ⑨ Network: Modbus TCP, Ethernet TCP/IP, HTTP, SNMP, SMTP, FTP, DNP 3.0
Setup configuration	Via configuration software/display Via web browser	Via web browser
Dimensions	Meter: 3.77 (96.0) H x 3.77 (96.0) W x 2.50 (63.5) D Display: 3.77 (96.0) H x 3.77 (96.0) W x 2.31 (58.7) D	Refer to TD02601007E
Operating temperature range	–25 °C to +70 °C	–20 °C to +60 °C display unit –20 °C to +70 °C meter base unit
Reference literature	TD0262032EN	TD02601007E

Notes

① PXM 6000 only.
② PXM 8000 only.
③ PXM 2260 only.
④ PXM 2270 only.
⑤ The auxiliary voltage option adds three additional voltage input channels to Power Xpert Meters.
⑥ At computer only.
⑦ PXM 2280 only.
⑧ PXM 2290 only.
⑨ Optional.

Legend: PG = Programmable
FS = Full scale
RV = Read value
Auxiliary voltage (optional) = Provides three additional voltage inputs to the meter: Va2, Vb2, Vc2.
Interharmonics = Power Xpert Meter 6000/8000 supported.

Metering Selection Chart, continued

	Power Xpert Branch Circuit Monitor (PXBCM)	Power Xpert Multi-Point Meter
		
Section Page Number	**V3-T9-52**	**V3-T9-56**
Electrical Parameters		
Volts		±0.2% RV
Amperes		±0.2% RV
Current range (% of nominal)		—
Watts		±0.5% RV
Vars		±0.5% RV
VA		±0.5% RV
PF-apparent		±0.5% RV
PF-displacement		—
Frequency		±0.1 Hz
THD-voltage		—
THD-current		—
Watthours		±0.5% per ANSI C12.20 0.5 class
Varhours		±0.5% per ANSI C12.20 0.5 class
VA-hours		±0.5% per ANSI C12.20 0.5 class
Ampere-demand		—
Watt-demand		±0.5% per ANSI C12.20 0.5 class
Var-demand		±0.5% per ANSI C12.20 0.5 class
VA-demand		±0.5% per ANSI C12.20 0.5 class
Revenue accuracy		ANSI C12.20 (0.5%)
Individual ampere harmonics		—
Individual voltage harmonics		—
Interharmonics		—
Minimum and/or Maximum Values		
Volts		L-L, L-N
Current		A, B, C
Power		Watts, vars, VA
Power factor		Apparent
Frequency		Hertz
THD		—
Demand values		Watts (Delivered & Received), Watts (Q1–Q4), VA (Q1, Q4), VA (Q2, Q3)
Trend analysis		Interval data
Event logging		20 latest events and historical
Disturbance recording		—

Notes

① From 3–300% of FS.
② At unity power factory and 5–300% of FS.
③ At a power factor <±0.5 and 5–300% of FS.
④ At computer only.

Legend: PG = Programmable
FS = Full scale
RV = Read value

Metering Selection Chart, continued

Section Page Number	Power Xpert Branch Circuit Monitor (PXBCM) V3-T9-52	Power Xpert Multi-Point Meter V3-T9-56
		
Other Features		
Storage		256 MB standard, 2 GB optional
PG output relays		1 standard, 8 each module ①
PG analog outputs		3 standard, 8 each module ①
Discrete contact inputs		—
Analog inputs		Via communications and digital input
Synch-input kW Utility		—
Auxiliary voltage		Aggregate or main-digital output, LED output on meter modules (accuracy check)
kWh pulse initiator		—
Waveform display		—
Waveform capture, samples/cycle		—
Frequency distribution display		—
Display type		LCD color touchscreen ①
Display lines/character		6-inch diagonal
Display character height		Graphics
Communications		Serial: Modbus RTU ① Network: Modbus TCP, BACnet/IP, Ethernet TCP/IP, HTTP, HTTPS, SNMP, SMTP, SFTP
Setup configuration		Via PXMP configuration software
Dimensions		Refer to TD150006EN (see Page V3-T9-110)
Operating temperature range		–20 °C to +70 °C
Reference literature		TD150006EN

Notes

① Relays programmable to operate on any measured function.
② Optional.
③ An IPONI is required.
④ IQ 230M only.

Legend: PG = Programmable
FS = Full scale
RV = Read value

PXM350



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

An Eaton Green Solution

9

PXM350

Product Description

Eaton's Power Xpert Meter 350 (PXM350) is a compact and powerful revenue-grade energy meter. It combines exceptional performance with easy installation to deliver a cost-effective solution for energy and power monitoring applications, as well as submetering applications.

This DIN rail mounted, three-phase energy meter provides high accuracy in a small form factor, making it an ideal solution for panelboard applications to monitor the main power coming into the panelboard. Multiple current sensor options make the PXM350 ideal for energy code monitoring field retrofit installations using split core 333 mV or Rogokswi coil current sensors.

The PXM350 comes with a built-in LCD display for local reading. The Modbus RTU and BACnet MSTP communications allow for a seamless integration with building management and data acquisition systems. A NEMA® 4X enclosure is available as an accessory. This combination is perfect for retrofit metering applications.

Application Description

The PXM350 delivers you a cost-effective solution for energy and submetering applications.

- Commercial submetering
- Energy management
- Industrial monitoring
- Cost allocation
- Data center
- Light commercial
- Industrial
- Institutions

The PXM350 helps meet the Measurement and Verification points required by the LEED® and U.S. Green Building Council. The PXM350 can be factory installed in panelboards to help comply with ASHRAE 90.1, ASHRAE 189.1, IECC and IGCC

Features and Benefits

- Economical and compact watthour meter with demand measurement
- Revenue grade accuracy—IEC 62053-22 0.5s Class/ANSI C12.20 0.5 Class
- Multiple current sensor input options compatible with any current transformer: 5 A/1 A, 333 mV, flexible Rogowski coil, 80/100/200 mA
- 10–690 Vac direct voltage input, one model for most low voltage circuits
- Compatible with both 50 Hz and 60 Hz systems
- Built-in energy pulse output and alarm output
- Compatible with the Power Xpert Gateway for remote monitoring
- Monitors:
  - Voltage, current, power factor, frequency
  - Power: real, reactive and apparent
  - Energy: real, reactive and apparent
- Demand measurement of current, real power, reactive power and apparent power
- Peak demand
- Built-in Modbus RTU, BACnet MSTP and pulse output

Additional Features

Four channel CT input

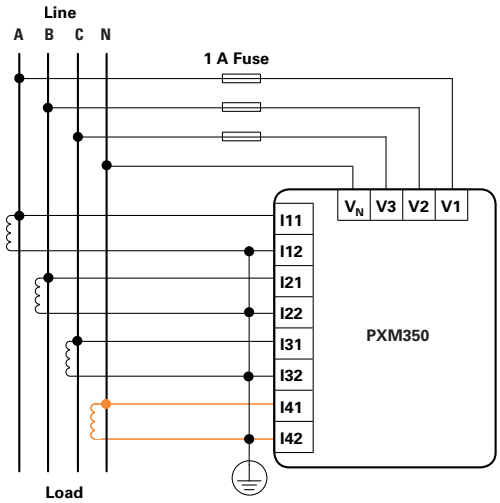
Accurately measure neutral current with 4th CT and provide residual current measurement.

Auto phase-check

Designed to automatically check most common wiring mistakes such as CT polarity, voltage and current phase alignment.

Supports standard electrical system configurations

Three-phase three-wire (3P3W), three-phase four-wire (3P4W), single-phase three-wire (1P3W two element), single-phase two-wire (1P2W one element) and more.



Features of PXM350 MA 6x2x and PXM350 MA 6x4x

Feature	PXM350 MA 6x2x	PXM350 MA 6x4x
Bi-directional energy measurement	■	■
Active energy	■	■
Reactive energy	■	■
Apparent energy	■	■
Time-of-use	■	■
Power demand	■	■
Peak power demand	■	■
Predictive demand	■	■
Current demand	■	■
Peak current demand	■	■
Voltage	■	■
Current	■	■
Neutral current	Calculated	■
Residual current	■	Calculated
Active power	■	■
Reactive power	■	■
Apparent power	■	■
Power factor	■	■
Frequency	■	■
Clock	■	■
Running time	■	■
Energy pulse output	■	■
Relay output (alarm or control)	■	■
RS-485 Modbus-RTU or BACnet MSTP	■	■
Wiring check	■	■
Temperature (internal)	■	■
SunSpec	■	■
Current transformer (CT) input	5 A/1 A: Field-configurable CT input 333 mV: CT Input flexible Rogowski coil CT Input 80/100/200 mA: field-configurable CT input	5 A/1 A: Field-configurable CT input 333 mV: CT Input flexible Rogowski coil CT Input 80/100/200 mA: field-configurable CT input
I/O	One relay output for alarm or remote control	One relay output for alarm or remote control

Catalog Number Selection

Power Xpert Meter 350

PXM 350 MA 6 3 2 1

Current Input
3 = 333 mV **5** = 5 A/1 A configurable **R** = Rogowski coil (bidirectional energy only. No 4th CT input.)

Relay Output
1 = 1 relay output

Model Type
2 = Pulse output, Modbus, BACnet MSTP, TOU **4** = Pulse output, Modbus, BACnet MSTP, TOU, Bidirectional energy, 4th current input

Accessories

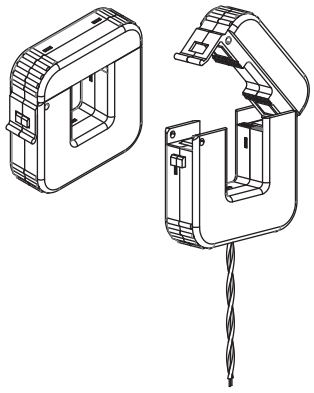
PXM350 Plastic NEMA 4X Enclosure

The PXM350-ENC enclosure offers a mounting option for PXM350 series energy meters that helps protect from tampering and the elements. The enclosure is equipped with DIN rail mounting hardware for easy installation, and a NEMA 4X rating ensures durability. The swing panel kit and multiple locking options provide additional security from unwanted tampering.

Description	Dimension in Inches	Catalog Number
PXM350 Enclosure, NEMA 4X_	6x6x4	**PXM350-ENC**

Current Sensors

333 mV Current Sensors



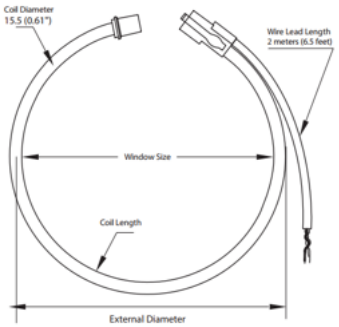
PXM350 is compatible with 333 mV output current transformer for low-cost energy efficiency and energy management systems. A variety of window sizes and ratios are available for split-core 333 mV sensors. Refer to the Current Sensors section of this catalog for ordering information.

5A/1A Current Sensors

Field-configurable CT input that suits any industrial and revenue-grade current transformer.

A variety of window sizes and ratios are available. Refer to the Current Sensors section of this catalog for ordering information.

Rogowski Coil



Rogowski coils are available in multiple lengths and flexible, rope-like form factor is ideal for measurement around irregularly shaped conductors or in crowded electrical panels.

A variety of window sizes, length of coils and ratios are available. Refer to the Current Sensors section of this catalog for ordering information.

9

Technical Data and Specifications

Metering

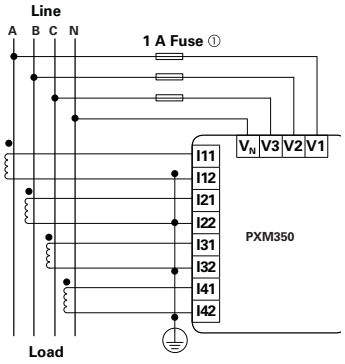
Parameter	Accuracy	Resolution	Range
Active energy	0.5%	1 Wh	0–999999999
Reactive energy	0.5%	1 varh	0–999999999
Apparent energy	0.5%	1 VAh	0–999999999
Voltage	0.5%	0.1	10 V—1000 kV
Current	0.5%	0.001 A	10 mA—500000 A
Active power	0.5%	1 W	–99–99 MW
Reactive power	0.5%	1 var	–99–99 Mvar
Apparent power	0.5%	1 VA	–99–99 MVA
Power factor	0.5%	0.001	–0.001 to 1.000 to +0.001
Frequency	0.5%	0.01 Hz	50/60
Power demand	0.5%	1 W/var/VA	99 MW/Mvar/MVA
Current demand	0.5%	0.001 A	10 mA—5000 A

Specifications

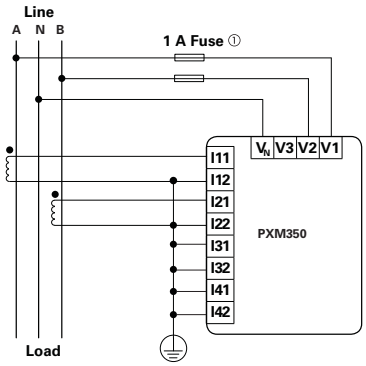
Description	Specification
Voltage	
Rated voltage	400 Vac L-N 690 Vac L-L
Input impedance	2 MΩ/phase
Measurement frequency	50/60 Hz
Accuracy	0.5%
Current Input	
Stated current (IN)	5 Aac/1 Aac
Start current	10 mA
Accuracy	0.5%
Pulse Output	
Isolation voltage	2500 Vac
Load voltage	0–250 Vac
Load current	100 mA (maximum)
Power Supply	
Working power supply	100–415 Vac, 50/60 Hz, 100–300 Vdc
Power consumption	<2 W or 10 VA
Relay Output	
Load voltage	250 Vac 30 Vdc
Max. load current	5 A (resistant load)
Isolation voltage	2000 Vac (1 minimum.)
Action time	10 ms
Mechanical life	20 million times
Electrical life	Above 50,000 times (5 A, 250 Vac, resistant load)
Communication	
RS-485 baud rate	1200–34800
Communication protocol	Modbus-RTU or BACnet MSTP
Environment	
Operating temperature	–25 to +70 °C (–13 to +158 °F)
Storage temperature	–40 to +85 °C (–40 to +185 °F)

Wiring Diagrams

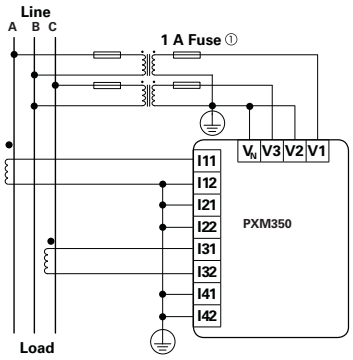
Typical Wiring for 5 A/1 A Current Input



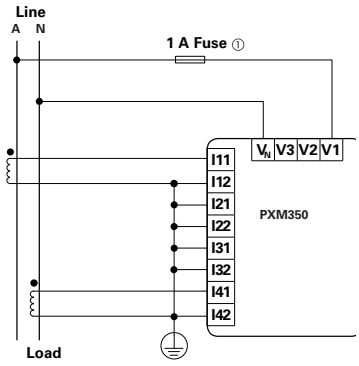
Select 3LN, 3CT configuration option.



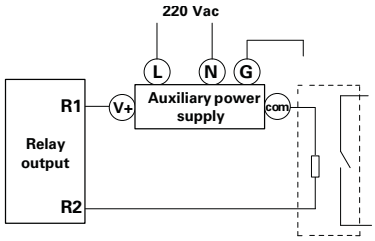
Select 1LL, 2CT configuration option.



Select 2LL, 2CT configuration option.



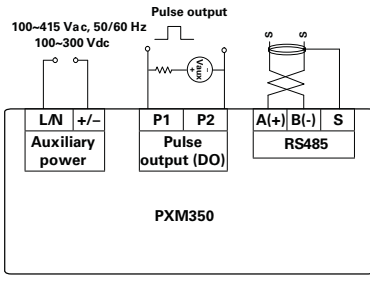
Select 1LN, 1CT configuration option.



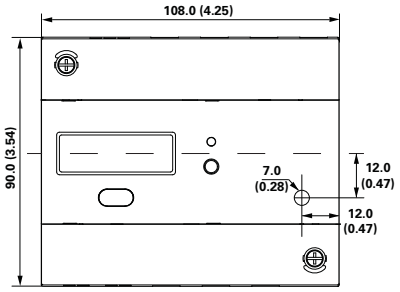
Relay output

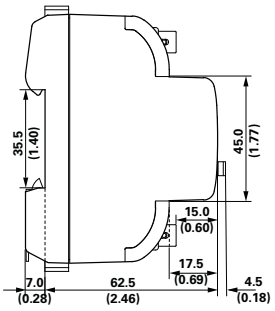
Note: Optional interposing relay, not included with meter.

Units: mm (in)



Auxiliary power + pulse + RS485



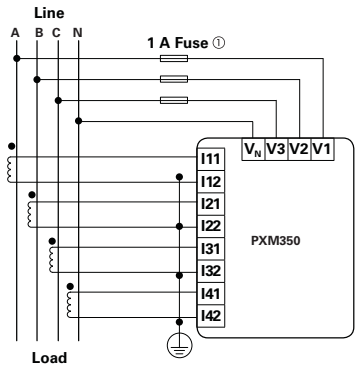


Dimensions

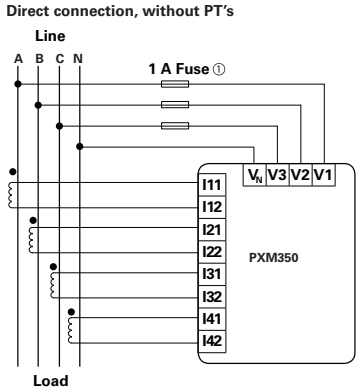
① Fuse rating should be selected to protect the secondary instrumentation wiring.

Note: CT shorting terminal blocks are required but not shown in the diagrams.

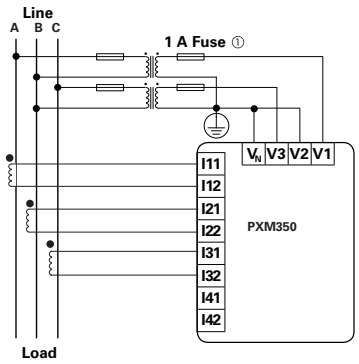
Typical Wiring for RCT/mV/mA Current Input



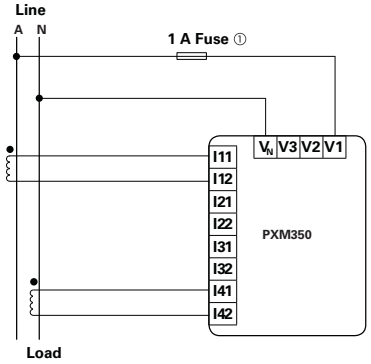
Select 3LN, 3CT configuration option.



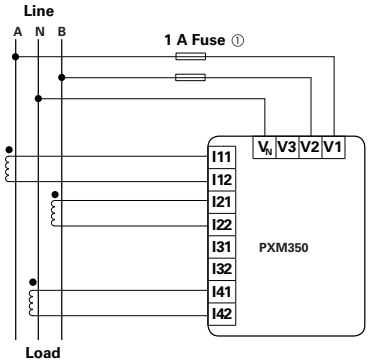
Select 3LN, 3CT configuration option.



Select 2LL, 3CT configuration option.



Select 1LN, 1CT configuration option.



Select 1LL, 2CT configuration option.

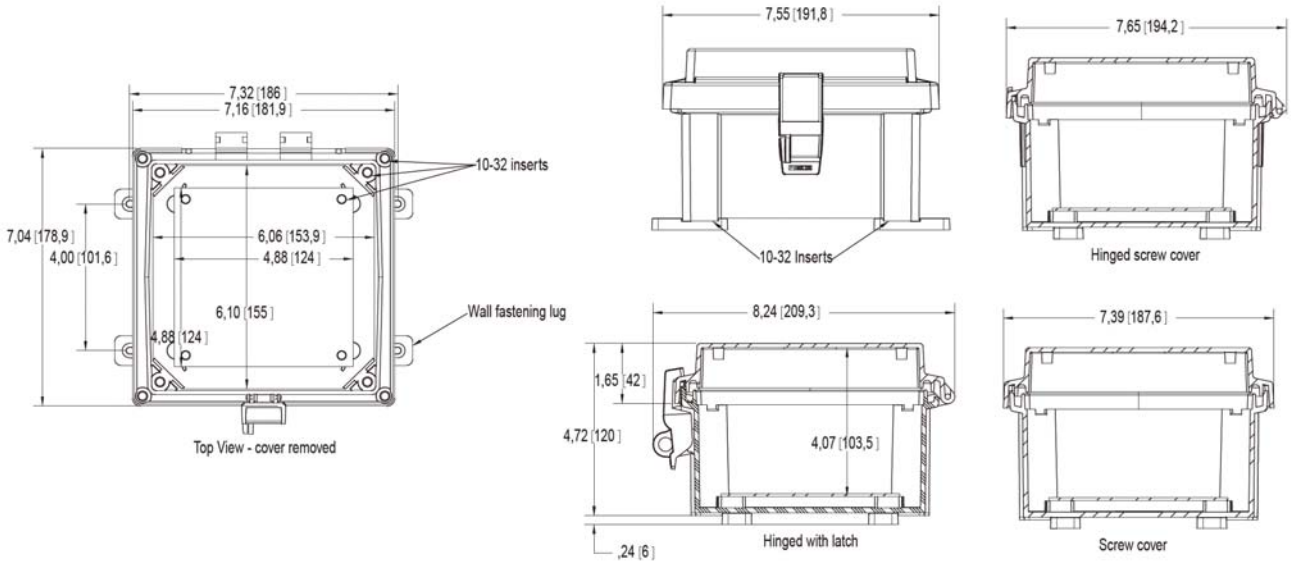
① Fuse rating should be selected to protect the secondary instrumentation wiring.

Note: CT shorting terminal blocks are required when using mA output current sensors, but are not shown in the diagrams..

Dimensions

Approximate Dimensions in Inches (mm)

PXM350



PXM1000



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

An Eaton Green Solution

9

PXM1000

Product Description

The Power Xpert Meter 1000 Series (PXM1000) power and energy meters monitor the most critical aspects of an electrical distribution system. This premier metering instrument uses the latest in advanced technology to make it simple to use, powerful, scalable and highly flexible.

The PXM1000 offers a new level of accessibility to the critical information required to manage electrical distribution systems from anywhere in the world. This three-phase meter provides high accuracy and advanced features in the standard 4-inch form factor and can be expanded with multiple modular analog and digital I/O options.

Application Description

Identify power quality problems to help:

- Protect motors from damage
- Preserve the integrity of processes and batches
- Prevent blown capacitor bank fuses
- Protect transformers and conductors from overheating

Monitor circuit loading to help:

- Avoid overloads and nuisance overload trips
- Maximize equipment utilization
- Manage emergency overloads

Manage energy utilization to help:

- Reduce peak demand charges and power factor penalties
- Identify excessive energy consumption

Features and Benefits

- ANSI C12.20 (0.2 Class) and IEC 62053-22 (0.2S Class)
- 100 ms refresh, true rms measurement
- Measure individual harmonics from 2nd to 63rd
- Modular design with three optional I/O and communication modules
- Power quality analysis and waveform capture
- Data logging
- Over/under limit alarm
- Rated frequency is adjusted automatically to local frequency such as 50 Hz or 60 Hz
- TOU (time of use), 4 tariffs, 12 seasons, 14 schedules
- Compatible with different current transformers such as 5 A, 1 A, 333 mV and Rogowski
- Up to 8 GB memory

Input Output Modules

Integrate data to/from other devices with field-expandable plug-in I/O modules. A maximum of three I/O cards may be added to the PXM1000 meter. Different I/O cards available:

- Six digital inputs, 24 Vdc power for digital inputs, two relay outputs
- Four digital inputs, two digital outputs, two analog outputs
- Four digital inputs, two relay outputs, two analog inputs
- Analog inputs and outputs are available in:
  - 4–20 mA
  - 0–20 mA
  - 1–5 V
  - 0–5 V

Communications Capabilities

- Standard Modbus RTU and DNP 3.0
- With addition of communication cards—Optional Modbus TCP/BACnet/IP, HTTP/HTTPS, EtherNet/IP, IPv6, WiFi, SMTP (Simple Mail Transfer Protocol) and SNMP (Simple Network Management Protocol), V2, V3 can be available
- Ability to connect to Eaton's Power Xpert Gateway 900/950

Displayed Information

- Monitored information is available locally through the display, the web browser or system power management software
- True rms values through 63rd harmonic
- ANSI C12.20 Class 0.2% revenue metering specification

Display

- Clear and large character LCD screen display with white backlight
- Wide environmental temperature endurance
- Display load percentage, four quadrant power and load nature outline
- Small size 96 × 96 DIN or 4-inch ANSI round

Additional Features

Features of PXM1000, PXM1100, PXM1200 and PXM1300

Category	Item	Parameters	PXM1000	PXM1100	PXM1200	PXM1300
Metering			■	■	■	■
Real-time metering	Phase voltage	V1, V2, V3, VLnavg	■	■	■	■
	Line voltage	V12, V23, V31, VIlavg	■	■	■	■
	Current	I1, I2, I3, In, Iavg	■	■	■	■
	Power	P1, P2, P3, Psum	■	■	■	■
	Reactive power	Q1, Q2, Q3, Qsum	■	■	■	■
	Apparent power	S1, S2, S3, Ssum	■	■	■	■
	Power factor	PF1, PF2, PF3, PF	■	■	■	■
	Frequency	F	■	■	■	■
Energy and demand	Energy	Ep_imp, Ep_exp, Ep_total, Ep_net, Epa_imp, Epa_exp, Epb_imp, Epb_exp, Epc_imp, Epc_exp	■	■	■	■
	Reactive energy	Eq_imp, Eq_exp, Eq_total, Eq_net, Eqa_imp, Eqa_exp, Eqb_imp, Eqb_exp, Eqc_imp, Eqc_exp	■	■	■	■
	Apparent energy	Es, Esa, Esb, Esc	■	■	■	■
	Demand	Dmd_P, Dmd_Q, Dmd_S, Dmd_I1, Dmd_I2, Dmd_I3	■	■	■	■
TOU			■	■	■	■
Time of use	Energy/max. demand	TOU, 4 tariffs, 12 seasons, 14 schedules	—	—	■	—
Daylight saving time	Two adjustable formats	Month/day/hour/minute Month/week/first few weeks/hour/minute	—	—	■	—
Monitoring			—	—	—	■
Waveform capture	Voltage and current waveform ①	Trigger, manual, DI change, sag/dips, swell, overcurrent	■	■	■	■
Power quality	Voltage unbalance factor	U_unbl	■	■	■	■
	Current unbalance factor	I_unbl	■	■	■	■
	Voltage THD	THD_V1,THD_V2,THD_V3, THD_Vavg	■	■	■	■
	Current THD	THD_I1, THD_I2, THD_I, THD_Iavg	■	■	■	■
	Individual harmonics	Harmonics 2nd to 63rd (50 Hz or 60 Hz) Harmonics 2nd to 15th (400 Hz)	■	■	■	■
	Voltage crest factor	Crest factor	■	■	■	■
	TIF	Telephone Interference Factor	■	■	■	■
	Current K factor	K factor	■	■	■	■
Statistics	MAX with time stamp MIN with time stamp	Each phase of V & I; Total of P, Q, S, PF & F; demand of I1, I2, I3, P, Q&S; each phase THD of V & I; unbalance factor of V and I	■	■	■	■
Others			■	■	■	■
Alarm	Over/under limit alarm	V, I, P, Q, S, PF, V_THD and I_THD each phase and total or average; unbalance factor of V and I; load type; analog input of each channel; demand of I1, I2, I3, P, Q&S; reverse phase sequence; DI1~DI28	■	■	■	■
Power quality event logging	Sag/dips, swell	Voltage	—	—	—	■
Data logging	Data logging 1 Data logging 2 Data logging 3	F, V1/2/3/avg, V12/23/13/avg, I1/2/3/n/avg, P1/2/3/ sum, Q1/2/3/sum, S1/2/3/sum, PF1/2/3, PF, U_unbl, I_unbl, Load Type, Ep_imp, Ep_exp, Ep_total, Ep_net, Eq_imp, Eq_exp, Eq_total, Eq_net, Es, Epa_imp, Epa_exp, Epb_imp,Epb_exp, Epc_imp, Epc_exp, Eqa_imp, Eqa_exp, Eqb_imp, Eqb_exp, Eqc_imp, Eqc_exp, Esa, Esb, Esc, THD_V1/2/3/avg, THD_I1/2/3/avg, harmonics 2nd to 63rd, crest factor, THFF, K factor, sequence and phase angles, DI counter, AI, AO, Dmd P/Q/S, Dmd I1/2/3	—	■	■	■
Onboard memory size	Memory	Bytes	—	8 MB	8 MB	16 MB
	Optional communication modules	PXM1K-MTCPP and PXM1K-BIPP 4GB	■	■	■	■
	Optional communication modules	PXM1K-ETHMULTI 8GB	■	■	■	■
Communication	RS-485 port, half duplex, optical isolated	Modbus-RTU protocol/DNP3.0	■	■	■	■
Time	Real-time clock	Year, month, date, hour, minute, second	■	■	■	■

① The PXM1300 takes 512 samples per cycle. For the waveform capture function on the PXM1300 the sample rate is 64 samples.

Standards and Certifications

- Measurement standard: IEC 62053-22; ANSI C12.20
- Environmental standard: IEC 60068-2
- Safety standard: IEC 61010-1, UL 61010-1, IEC 61557-12
- EMC standard: IEC 61000-4/-2-3-4-5-6-8-11, CISPR 22, IEC 61000-3-2, IEC 61000-6-2/4
- Outlines standard: DIN 43700, ANSI C39.1

Catalog Number Selection

Power Xpert Meter 1000

PXM 1000 M A 1 5 - 1

Current Input
1000 = Multifunctional meter **1100** = Plus data logging **1200** = Plus data logging and time of use **1300** = Plus data logging, waveform capture, and PQ logging

Meter Type
M = Meter (with integral display) **T** = Transducer only (no display)

Power Supply
1 = 100–415 Vac or 100–300 Vdc **4** = 20–60 Vdc

Current Input
1 = 1 A secondary **3** = 333 mV secondary **5** = 5 A secondary **R** = Rogowski coil

Ring Terminal
Blank = No ring terminal **1** = Ring terminal

Ordering Information

To order a Power Xpert Meter 1000, the catalog number should be determined using the table above. The table illustrates how to include the desired factory options as part of a catalog number. I/O and communication option modules are separate and field installable. Up to three I/O modules per meter can be installed. While installing communication module up to two I/O modules per meter can be installed.

Power Xpert Meter modules include panel mounting brackets.

Example 1: PXM1000MA15 (PXM 1000 meter/display, 5 A, 100–415 Vac or 100–300 Vdc)

Example 2: PXM1300MA13 (PXM 1300 meter/display, 333 mV, 100–415 Vac or 100–300 Vdc)

Accessories

Power Xpert Meter 1000 Accessories

Description	Catalog Number
PXM1000 panel mount remote display for DIN rail mount transducer version; include one 6 ft cable	**PXM1K-DISP-3**
PXM1000 DIN rail mounting adapter	**PXM1K-DINADPT**
PXM1000 Terminal plug kit PXM1K-TPK	**PXM1K-TPK**
PXM1000 Display cable (15 ft)	**PXM1K-DISPCBL-15**

Power Xpert Meter 1000 and 3000 I/O Modules

Integrate data to/from other devices with field-expandable plug-in I/O modules. A maximum of three I/O cards may be added to the PXM1000 meter.

Description	Catalog Number
PXM1000 I/O module logic address 1; 2 RO, 6DI with DI power supply 24 Vdc	**PXM1K-110**
PXM1000 I/O module logic address 2; 2 RO, 6DI with DI power supply 24 Vdc	**PXM1K-120**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (4–20 mA)	**PXM1K-210**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (0–20 mA)	**PXM1K-211**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (1–5 V)	**PXM1K-212**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (0–5 V)	**PXM1K-213**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (4–20 mA)	**PXM1K-220**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (0–20 mA)	**PXM1K-221**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (1–5 V)	**PXM1K-222**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (0–5 V)	**PXM1K-223**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (4–20 mA)	**PXM1K-310**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (0–20 mA)	**PXM1K-311**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (1–5 V)	**PXM1K-312**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (0–5 V)	**PXM1K-313**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (4–20 mA)	**PXM1K-320**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (0–20 mA)	**PXM1K-321**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (1–5 V)	**PXM1K-322**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (0–5 V)	**PXM1K-323**

Communications Modules

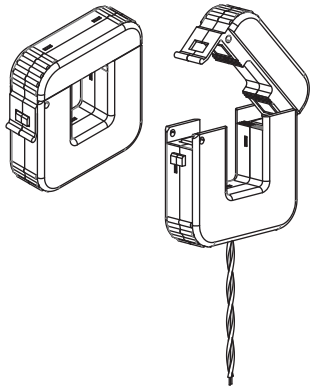
Description	Catalog Number
PXM1000 Modbus TCP with Web/HTTP Push	**PXM1K-MTCPP**
PXM1000 BACnet/IP and Modbus TCP with Web/HTTP Push	**PXM1K-BIPP**
PXM1000 Dual-port Ethernet accessory module ①	**PXM1K-ETHMULTI**

Note

① Antenna is not included with the module. An antenna with RP-SMA(f) connector and supporting 2.4 GHz will work. Additional details on the module are available in the user manual (MN150013EN).

Current Sensors

333 mV Current Sensors



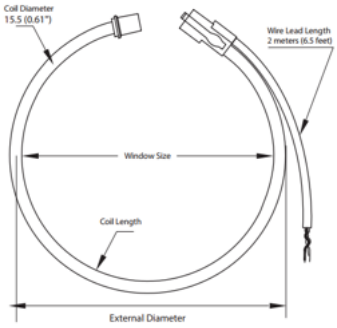
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5A/1A Current Sensors

Field-configurable CT input that suits any industrial and revenue-grade current transformer.

A variety of window sizes and ratios are available. Refer to the Current Sensors section of this catalog for ordering information.

Rogowski Coil



Rogowski coils are available in multiple lengths and flexible, rope-like form factor is ideal for measurement around irregularly shaped conductors or in crowded electrical panels.

A variety of window sizes, length of coils and ratios are available. Refer to the Current Sensors section of this catalog for ordering information.

Technical Data and Specifications

Current Inputs (Each Channel)

Nominal secondary sensor settings:

Current Sensor Input Options	5 A	1 A	333 mV	100 mV Rope CT
Nominal configuration selection	5 A	1 A	1 A	1 A
Metering range (% of nominal)	200%	200%	120%	120%
Pickup current (% of nominal)	0.1%	0.1%	0.5%	0.5%

Specifications

Description	Specification
Input	
Withstand	20 A rms continuous, 100 A rms for 1 second, non-recurring
Burden	0.05 VA (typical) at 5 A rms
Accuracy	0.2% full scale
Voltage Inputs (Each Channel)	
Nominal full scale	400 Vac L-N, 690 Vac L-L (+20%)
Withstand	1500 Vac continuous, 2500 Vac, 50/60 Hz for 1 minute
Input impedance	2 mohm per phase
Metering frequency	45–65 Hz, 300–500 Hz
Pickup voltage	10 Vac
Accuracy	0.2 full scale
Energy Accuracy	
Active	Class 0.2 s (according to IEC 62053-22), Class 0.2 s (according to ANSI C12.20)
Reactive	Class 2 (according to IEC 62053-23)
Harmonic Resolution	
Metered value	63rd harmonic (50 Hz or 60 Hz type), 15th harmonic (400 Hz type)
Communication	
RS-485 (Standard)	
Modbus RTU and DNP 3.0	
Two-wire shielded twisted pair cable connection	
Baud rate: 1200–38,400 bps	
Ethernet (optional)	
10M/100MBASE-T	
Modbus TCP/IP	
BACnet-IP	
EtherNet/IP	
IPv6	
SNMP	
HTTP/HTTPs Webserver	
HTTP/HTTPs, FTP data post	
SMTP	
NTP	
Standard Compliance	
Measurement standard	IEC 62053-22; ANSI C12.20
Environmental standard	IEC 60068-2
Safety standard	IEC 61010-1, UL 61010-1, IEC 61557-12
EMC standard	IEC 61000-4/-2-3-4-5-6-8-11, CISPR 22, IEC 61000-3-2, IEC 61000-6-2/4
Outlines standard	DIN 43700, ANSI C39.1

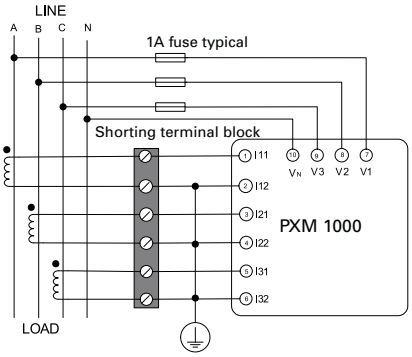
Specifications

Description	Specification
Operating Environment	
Operation temperature	–25 °C to +70 °C
Storage temperature	–40 °C to +85 °C
Relative humidity	5% to 95% noncondensing
Protection level	IP54 (front), IP30 (cover)
I/O Option	
Input voltage range	20–160 Vac/Vdc
Input current (max.)	2 mA
Start voltage	15 V
Stop voltage	5 V
Pulse frequency (max.)	100 Hz, 50% duty ratio (5 ms ON and 5 ms OFF)
SOE resolution	2 ms
Digital Output (DO) (Photo-MOS)	
Voltage range	0–250 Vac/Vdc
Load current	100 mA (max.)
Output frequency	25 Hz, 50% duty ratio (20 ms ON, 20 ms OFF)
Isolation voltage	2500 Vac
Relay Output (RO)	
Switching voltage (max.)	250 Vac, 30 Vdc
Load current	5 A (resistive), 2 A (inductive)
Set time	10 ms (max.)
Contact resistance	30 mohm (max.)
Isolation voltage	2500 Vac
Mechanical life	1.5 x 107
Analog Output (AO)	
Output range	0–5 V / 1–5 V, 0–20 mA / 4–20 mA (optional)
Accuracy	0.5%
Temperature drift	50 ppm / °C typical
Isolation voltage	500 Vdc
Open circuit voltage	15 V
Analog Input (AI)	
Input range	0–5 V / 1–5 V, 0–20 mA / 4–20 mA (optional)
Accuracy	0.2%
Temperature drift	50 ppm / °C typical
Isolation voltage	500 Vdc
Power Supply for DI (24 Vdc)	
Output voltage	24 Vdc
Output current	42 mA
Load (max.)	21 DIs
Control Power	
Universal	AC or DC
AC/DC Control Power	
Operating range	100–415 Vac, 50/60 Hz; 100–300 Vdc
Burden	5 W
Frequency	50/60 Hz
Withstand	3250 Vac, 50/60 Hz for 1 minute
Installation Category III (distribution)	
Low Voltage DC Control Power (Optional)	
Operating range	20–60 Vdc
Burden	5 W

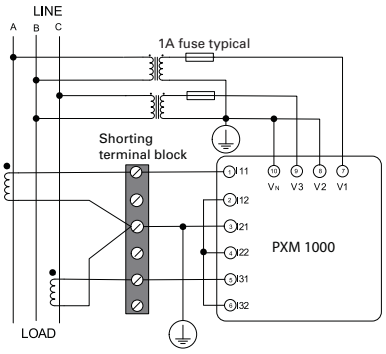
Wiring Diagrams

Meter Input Wiring

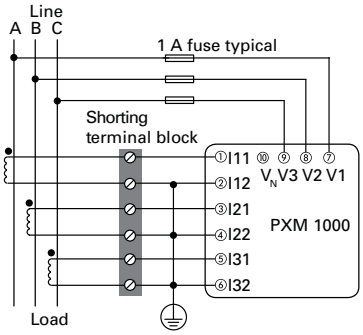
Three-Phase, Four-Wire (3LN, 3CT)



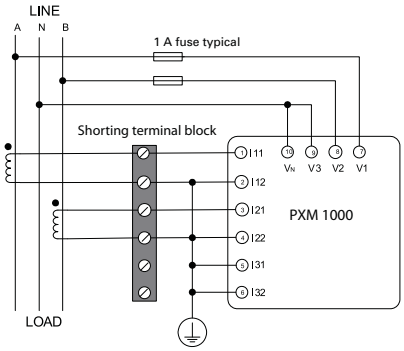
Three-Phase, Three-Wire with PT and 2CT (2LL, 3CT)



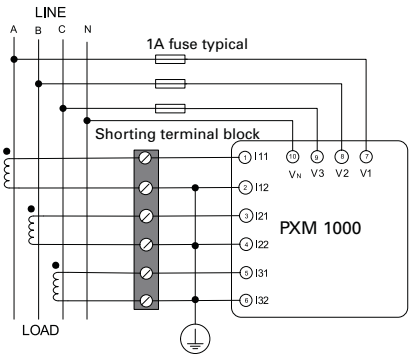
Three-Phase, Three-Wire (3LL, 3CT)



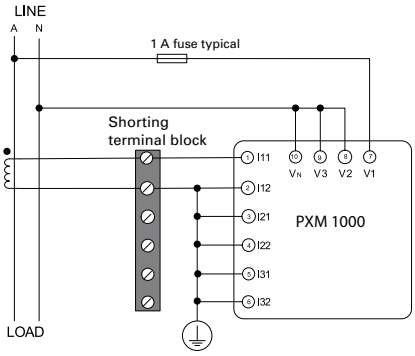
Single-Phase, Three-Wire (1LL, 2CT)



Three-Phase, Four-Wire with PT (3LN, 3CT)



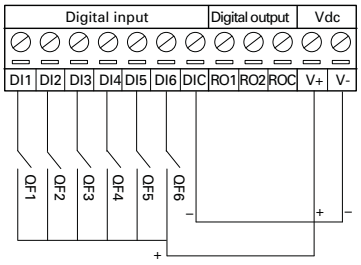
Single-Phase, Two-Wire (1LN, 1CT)



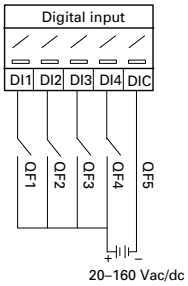
Note: Shorting terminal block not required when used with voltage input current sensors. For meters used with voltage input current sensors, unused channels need to be tied to ground as shown in the figures. If meters are used with amperage input current sensors, then the unused channels do not need to be tied to ground.

I/O Cards Wiring

PXM1K-X1X



PXM1K-X2X/X3X

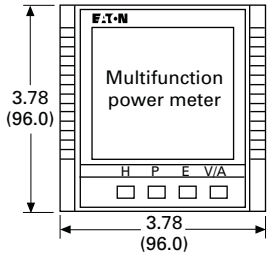


Dimensions

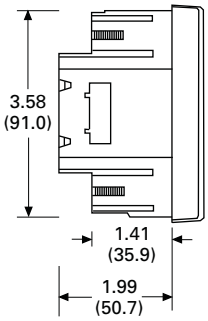
Approximate Dimensions in Inches (mm)

9

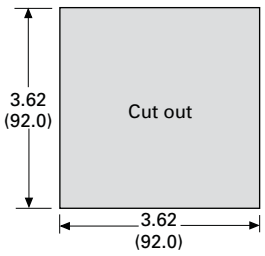
PXM1000 Front and Side View

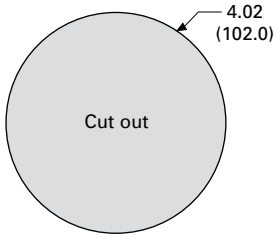


Front view



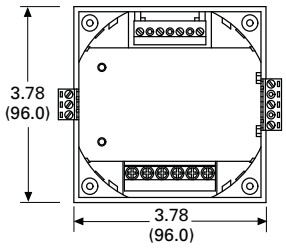
Side view



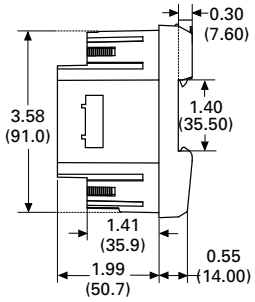


Cut out

DIN Mount Meter Rear and Side View

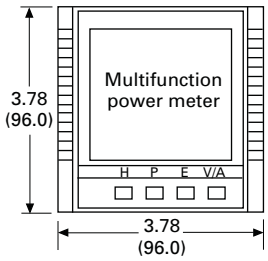


Rear view

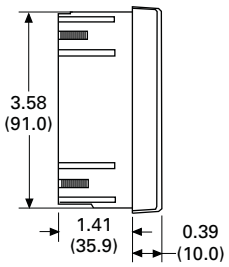


Side view

External Display Module Front and Side View



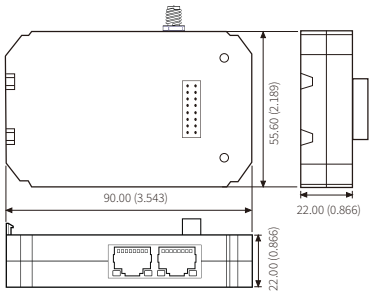
Front view



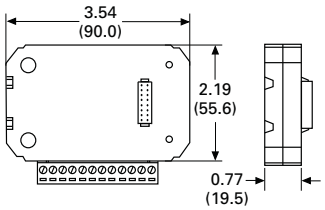
Side view

Note: Display module is connected with a 6 ft 10-pin RJ45 cable. Display module opening size and PXM 1000 body openings are exactly the same size.

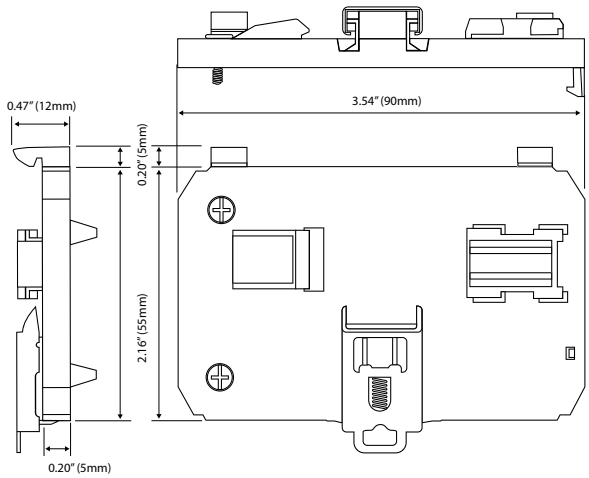
PXM1K-ETHMULTI



I/O Module



PXM1K DIN Rail Mounting Adapter



Power Xpert Meter 2000 Series



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

An Eaton Green Solution

Power Xpert Meter 2000 Series

Product Description

The Power Xpert Meter 2000 Series power quality instrument monitors the most critical aspects of an electrical distribution system. This premier power quality metering instrument uses the latest in advanced technology to make it simple to use, powerful, scalable and highly flexible. The Power Xpert Meter 2000 offers the same level of intuitive user interface design as the Power Xpert Meter 4000/6000/8000, presenting critical electrical distribution system information in a simple to navigate and easy-to-understand information architecture.

The embedded web server displays comprehensive power quality data using standard Internet browsers and allows for device configuration from the browser. The embedded web server presents real time, historical and event information in a browser-style graphical format to help the user interpret information such as current loading, voltage and power levels, power factor, energy usage, I/O status, power quality measurements, as well as harmonic plots. The embedded web server also allows for waveform capture and for visualizing steady-state harmonic content that is critical for power quality analysis.

The web server provides the energy and demand readings required to help manage the cost of energy.

Application Description

Identify Power Quality Problems to Help:

- Protect motors from damage
- Preserve the integrity of processes and batches
- Prevent blown capacitor bank fuses
- Protect transformers and conductors from overheating

Monitor Circuit Loading to Help:

- Avoid overloads and nuisance overload trips
- Maximize equipment utilization
- Manage emergency overloads

Manage Energy Utilization to Help:

- Reduce peak demand charges and power factor penalties
- Identify excessive energy consumption

Features, Benefits and Functions

Metered/Monitored Parameters

Note: See Table on **Page V3-T9-26**.

- Volts: L-L, L-N, Avg. L-L, Avg. L-N
- Phase and neutral currents
- Power: real, reactive and apparent
- Frequency
- Power factor: apparent
- Energy: real, forward, reverse, sum
- Demand: peak with date and time
- % THD
- Minimum and maximum values
- Harmonics
- Individual harmonics
- Demand comparisons
- Phasors

Accuracy

Note: Under typical operating conditions.

- Currents: 0.1% RV
- Voltage: 0.1% RV
- Energy and demand power: 0.2% in accordance with ANSI C12.20
- Frequency: ±0.03 Hz
- Power factor: 0.2% RV

Communications

Multiple communications ports including:

Standard

- RS-485 Modbus RTU slave port
- 10/100BASE-T Ethernet network port

Communication Protocols Supported

- Modbus RTU
- Modbus TCP
- BACnet/IP
- Ethernet TCP/IP
- HTTP, HTTPS
- NTP (Network Time Protocol)
- SMTP (Simple Mail Transfer Protocol)
- SNMP (Simple Network Management Protocol) v1, v3
- DNP 3.0

Physical Characteristics

Format

- Power Xpert Meter 2000 with integral display
- Power Xpert Meter 2000 transducer only (no display) meter module
- NEMA rating: NEMA 12, IP42 front of panel rating

Inputs and Outputs

Power Xpert Meter 2000 is available with a standard KYZ output and optional digital I/O cards that includes:

- Two relay outputs/two status inputs
- Four KYZ pulses/four status inputs
- Four analog outputs 0–1 mA
- Four analog outputs 4–20 mA

Inputs can also be configured for demand synch and pulse counting. Inputs selected for pulse counting can be scaled. Accumulated pulse recordings are maintained in profile memory. Outputs can be used for alarm annunciation.

Ratings

- Application to any PT ratio, no PTs required to 600 Vac
- CT ratios to any CT ratio
- CT inputs available as 5 or 1 A secondary
- Separate source control power input:
  - 90–265 Vac or 100–370 Vdc
  - Low voltage 18–60 Vdc

Displayed Information

- Monitored information is available locally through the display, the web browser or system power management software
- True rms values through 40th harmonic
- ANSI C12.20 Class.2% revenue metering specification

Relay Outputs

The optional I/O card includes two 5 A Form C relay outputs rated for 240 Vac or 30 Vdc or four Form A solid-state outputs. These outputs can be used for applications such as:

- Alarm annunciation
- KYZ pulse output

Alarm outputs can be driven from triggers based on metering values.

Analog Outputs

The optional IO card includes either four 4–20 mA outputs or 0–1 mA outputs. These outputs can be used for applications such as:

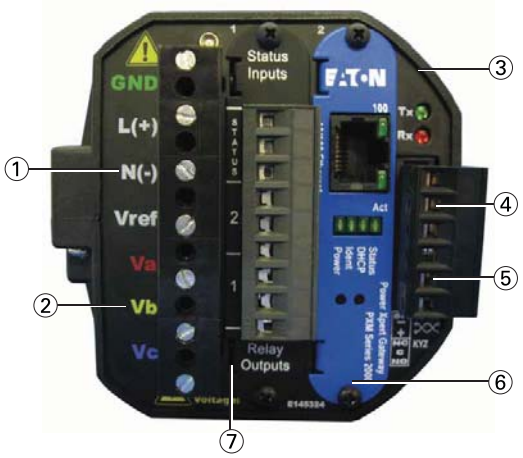
- Input to BMS or PLC systems for tracking a measured meter parameter

Standard Communications Card

The standard communications card provides one Ethernet connection and 10/100BASE-T port (copper only) that can be used for the following applications:

- Monitoring, managing and configuring the meter remotely using a standard web browser interface
- Alarm notifications via email, SMTP
- Providing Modbus TCP/IP, RTU and BACnet/IP communications to BMS systems
- Providing SNMP communications to NMS systems
- Synchronizing with an NTP server
- Asset management
- Updating firmware on the meter

PXM 2000 Rear View



① Power supply inputs
② System voltage inputs
③ NEMA 12 gasket
④ RS-485
⑤ KYZ out
⑥ Meter gateway card
⑦ I/O slot

Power Xpert Meter 2250

- Measures basic meter parameters
- 256 MB for data logging
- Ethernet
- On-board gateway card limits/alarms

Power Xpert Meter 2260

Features of PXM 2250 plus:

- Harmonics
- On-board meter hardware limits to activate optional relay outputs
- Visual indication of limits exceeded at meter face
- 512 MB for data logging

Power Xpert Meter 2270

Features of PXM 2260 plus:

- Harmonics, including individual
- Waveform view to visualize steady-state harmonic content
- 768 MB for data logging

The Power Xpert Meter 2280

Features of PXM 2270 plus:

- Records waveforms at up to 64 samples per cycles
- Configures the total, pre- and post-event cycles

Power Xpert Meter 2290

Features of PXM 2280 plus:

- Records waveforms at up to 512 samples per cycles

Power Xpert Meters 2250/2260/2270/2280/2290

Feature	Power Xpert Meter 2250	2260	2270	2280	2290	Benefit
General						
Embedded web server	■	■	■	■	■	Use a standard web browser to monitor and manage the meter over the network
Firmware flash upgrade support	■	■	■	■	■	Enables you to flash the meter with the latest firmware upgrades
Power, Energy and Demand						
Voltage, current: per phase minimum, maximum, average, trend graph analysis, export, print	■	■	■	■	■	Review voltage and current trends, export, print and analyze parameters right on the meter or external software
Demand: forward, reverse, net sum, profile, export, print, plot comparisons month-to-month, week-to-week	■	■	■	■	■	Plot two months or two weeks for vivid demand comparison, receive emails with trend logs
Power, apparent, real, reactive, power factor	■	■	■	■	■	Review power usage and power factor and avoid potential PF penalties
Energy: forward, reverse, net, sum	■	■	■	■	■	Keep track of your energy usage, identify peaks to conserve energy usage, receive emails with trend logs
Power Quality Analysis						
Statistical analysis (min., max., average)	■	■	■	■	■	Review statistical trends, identify past and future problem areas
Sampling rate, maximum samples/cycle	400	400	400	400	400	High sampling rate resulting in high accuracy
Security						
Secure two level user access privileges	■	■	■	■	■	Define appropriate security access level per user
Communications						
Modbus TCP	■	■	■	■	■	Easy integration with standard protocol to power management and other software
Modbus RTU	■	■	■	■	■	Integrate meters to existing Modbus networks, daisy chain several (1–32) meters together
BACnet/IP	■	■	■	■	■	Easily integrate into existing building management systems without the need for external protocol adapters
HTTP, HTTPS	■	■	■	■	■	Communicate to the meter over the Internet via standard web browser
SNMP (Simple Network Management Protocol)	■	■	■	■	■	Communicate with the meter via Simple Network Protocol; hook to existing NMS system
SMTP (Simple Mail Transfer Protocol)	■	■	■	■	■	Send email messages via standard Simple Mail Transfer Protocol
NTP (Network Time Protocol)	■	■	■	■	■	Network Time Protocol support enables the meter to synchronize time over the network
DNP 3.0	■	■	■	■	■	Easy integration with DNP networks (serial)
Trend measurements CSV file export	■	■	■	■	■	Easily export trend measurements to third-party applications, in standard CSV file format

Note

These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and User Manual for detailed specifications.

Power Xpert Meters 2250/2260/2270, continued

Feature	Power Xpert Meter 2250	2260	2270	2280	2290	Benefit
Logs						
Trend logging	■	■	■	■	■	Log trend information for easy statistical analysis
Load profile	■	■	■	■	■	Review the load profile graph to get a better understanding of your electrical load versus time
Event logging	■	■	■	■	■	Log events for retrospective event analysis
Memory and Storage						
Memory, MB	256	512	768	768	768	Store trend data and events for historical analysis
Harmonics						
Harmonic levels		40th	40th	40th	40th	Allows you to identify potential harmful harmonics
Total harmonic distortion (THD)		■	■	■	■	Review the total harmonic distortion level directly on the meter
Individual harmonics			■	■	■	Provides simple metric for power quality viewable from the embedded web server
Waveform						
Waveform display			■	■	■	A single-cycle waveform view on a PC, through embedded web server, to visualize steady-state harmonic content to identify power quality issues
Waveform recording				64	512	Ability to record waveforms up to specified samples/cycle
I/O						
I/O (two relay outputs/two status inputs, four KYZ pulses/four status inputs, four analog outputs 0–1 mA, four analog outputs 4–20 mA)	Opt	Opt	Opt	Opt	Opt	The Power Xpert meter 2000 I/O Cards are extremely flexible and can be used in a large variety of different applications. Digital inputs and relay outputs can be programmed to interact during various conditions defined by the user. Various third-party devices, such as alarms, pulse meters, trip units and sensors, can be easily integrated to the Power Xpert Meter 2000. Triggers and events can be tied to the meter's standard functions such as email, logs and trends. Analog outputs can be programmed to output meter parameters to BMS or PLC systems

Note

These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and User Manual for detailed specifications.

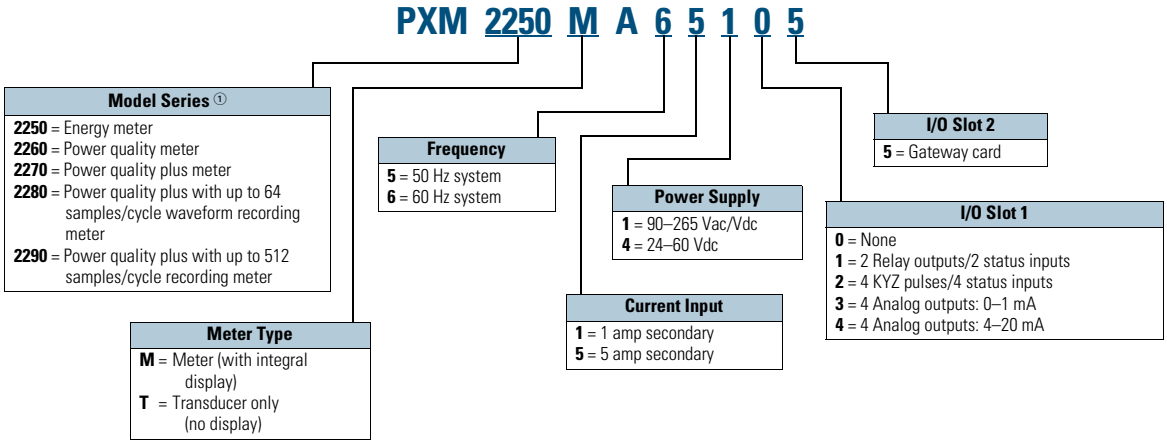
Standards and Certifications

- UL/cUL Electrical and Electronic Measuring and Test Equipment 22CZ
- Accuracy: IEC/EN60687 0.2 Class, ANSI C12.20 0.2 Class
- ANSI C62.41 Burst
- CE Mark

Listed Listed

Catalog Number Selection

Power Xpert Meter 2000



Example 1:**PXM2270MA65145** (PXM 2270 Meter/Display 60 Hz, 5 A, 90–265 Vac/Vdc W/4AO)
Example 2:**PXM2250MA65105** (PXM 2250 Meter/Display 60 Hz, 5 A, 90–265 Vac/Vdc)

Note

① Refer to **Page V3-T9-27** for model-specific features.

To order a Power Xpert Meter 2000, the catalog number should be determined using the chart shown above. The chart illustrates how to include the desired factory options as part of a catalog number. Option cards that are selected at time of order entry will be installed at the factory. Option cards are also field installable for future upgrades.

Power Xpert meter modules include panel mounting brackets.

Example 1:
PXM2270MA65145 (PXM 2270 Meter/Display 60 Hz, 5 A, 90–265 Vac/Vdc W/4AO).

Example 2:
PXM2250MA65105 (PXM 2250 Meter/Display 60 Hz, 5 A, 90–265 Vac/Vdc).

Accessories

Power Xpert Meter 2000

Description	Catalog Number
Panel mounting bracket assembly for retrofitting a PXM 2000 to an IQ Analyzer/IQ DP4000/IQ data cutout	**IQ250-PMAK**
PXM 2000 Gateway card kit to upgrade an IQ 250/260 to a PXM 2000	**PXM2000-GCK**

Power Xpert Meter 2000 I/O Cards

Description	Catalog Number
PXM 2000 I/O card—2 relay outputs/2 status inputs	**IQ250/260-IO1**
PXM 2000 I/O card—4 KYZ Pulses/4 status inputs	**IQ250/260-IO2**
PXM 2000 I/O card—4 analog outputs—0–1 mA	**IQ250/260-IO3**
PXM 2000 I/O card—4 analog outputs—4–20 mA	**IQ250/260-IO4**

Technical Data and Specifications

PXM 2250/2260/2270 Electronic Power Meter Technical Information

Current Inputs

- Class 10: 5 amp nominal, 10 amp maximum
- Class 2: 1 amp nominal, 2 amp maximum
- Fault current withstand:
  - 100 amps for 10 seconds
  - 300 amps for 3 seconds
  - 500 amps for 1 second
- Continuous current withstand: 20 amps for screw terminated or pass-through connections
- Programmable current: full scale to any CT ratio
- Burden: 0.005 VA per phase maximum at 11 amps
- Pickup current: 0.1% of nominal
  - Class 10: 5 mA
  - Class 2: 1 mA
- Connections:
  - Pass-through wire gauge dimension: 0.177 inches (4.5 mm)
  - Quick connect: 0.25-inch (6.35 mm) male tab

Voltage Inputs

- Range:
  - Line-to-neutral 20–576 Vac
  - Line-to-Line 0–721 Vac
- Programmable voltage range: full scale to any PT ratio
- Supported systems:
  - Three element wye, 2.5 element wye
  - Two element delta, four-wire delta systems
- Input impedance: 1 megohm/phase.
- Burden: 0.36 VA/phase maximum at 600 V; 0.014 VA at 120 V
- Connection: 7-pin 0.400-inch pluggable terminal block, AWG #12–26 (0.129–3.31 mm^2)

Isolation

- All inputs and outputs are galvanically isolated to 2500 volts

Environmental Ratings

- Operating temperature: –20 °C to +70 °C
- Storage temperature: –20 °C to +70 °C
- Operating humidity: to 95% RH noncondensing
- Faceplate rating:
  - NEMA 12
  - Mounting gasket included

Sensing Method

- Voltage, current: true rms
- Power: sampling at over 400 samples per cycle on all channels
- Harmonics resolution: 40th order

Update Rate

- Watts, vars and VA: 100 msec at 60 Hz
- All other parameters: 1 second at 60 Hz

Power Supply

- AC/DC voltage option: 90–265 Vac at 50/60 Hz or 100–370 Vdc, universal AC/DC supply
- DC voltage option: 18–60 Vdc
- Burden: 10 VA maximum

Serial Communications Format

- Connection type: RS-485 (through back plate)
- Com port baud rate: 9600–57,600 bauds
- Com port address: 01–247
- Data format: 8-bit, no parity
- Protocols: Modbus ASCII, RTU or DNP 3.0

Network Communications Format

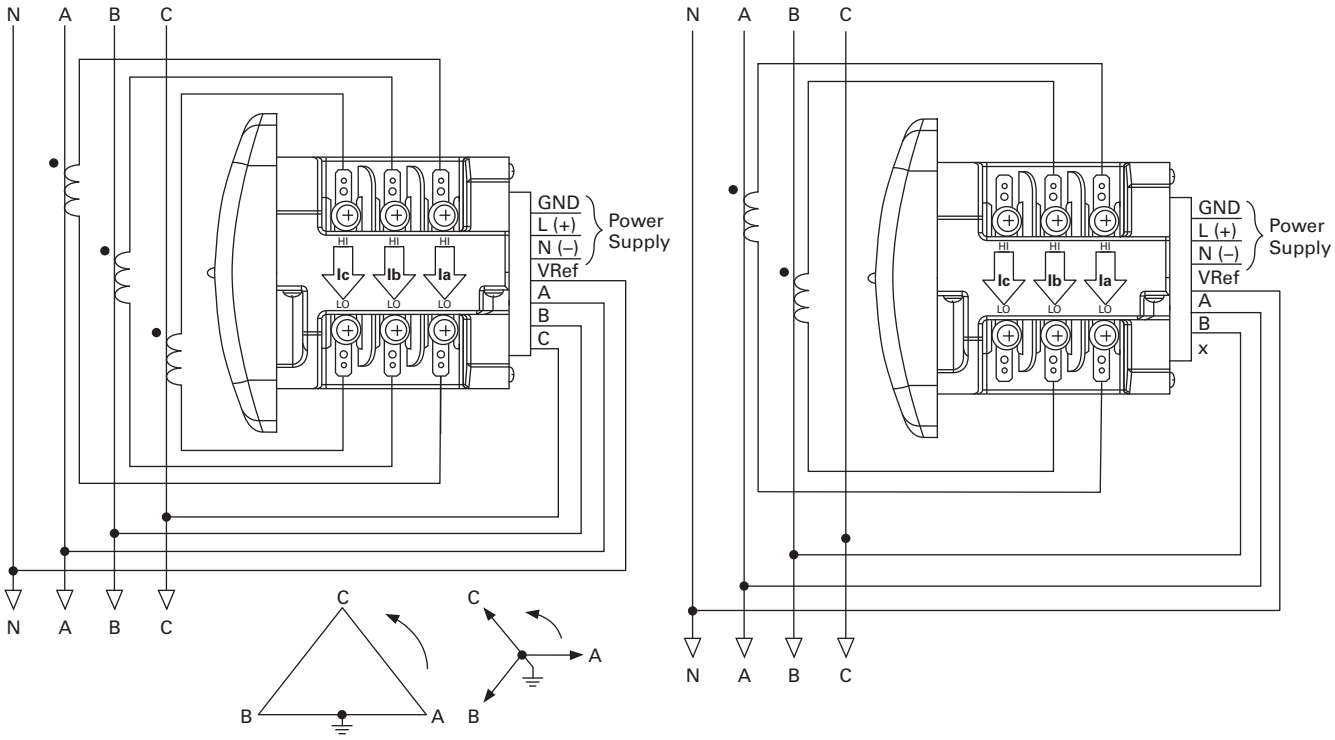
- Connection type: RJ-45 10/100BASE-T Ethernet network port
- Protocols: Ethernet TCP/IP, Modbus TCP, BACnet/IP, HTTP, HTTPS, NTP, SMTP, SNMP

KYZ Pulse

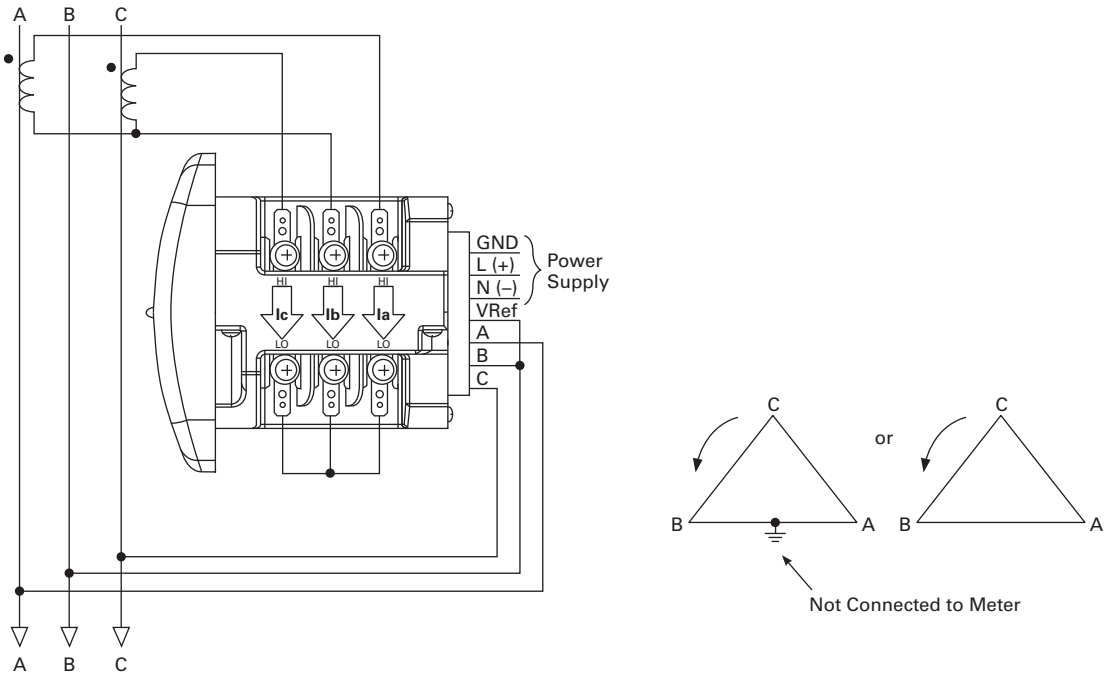
- Contacts: one Form A
- On resistance, maximum: 35 ohms
- Peak switching voltage: 350 Vdc
- Continuous load current: 120 mA
- Peak load current: 350 mA (10 ms)
- Off-state leakage current at 350 Vdc: 1 uA
- Opto-isolation: 3750 Vac

Wiring Diagrams

Service: Wye or Delta, Four-Wire with No PTs, Two or Three CTs



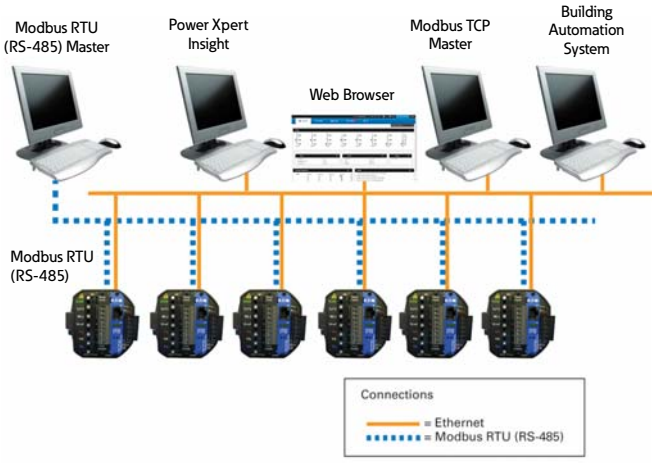
Service: Delta, Three-Wire with No PTs, 2 CTs



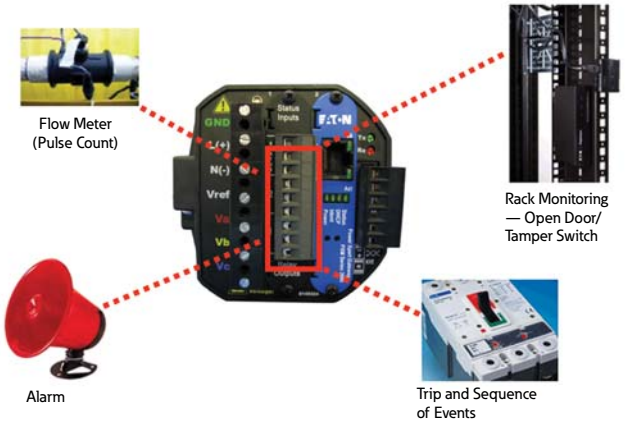
Note: Based upon the voltage rating, you may need a control power transformer for the control power.

Power Xpert Meters Configuration and Wiring Examples

PXM 2000 Display Front View



Accessories—I/O Cards (Option)



- Two relay programmable outputs/two programmable inputs
- Four KYZ pulses/four programmable inputs
- Four programmable analog outputs

IT Configuration Examples—Accessories—I/O Cards (Option)



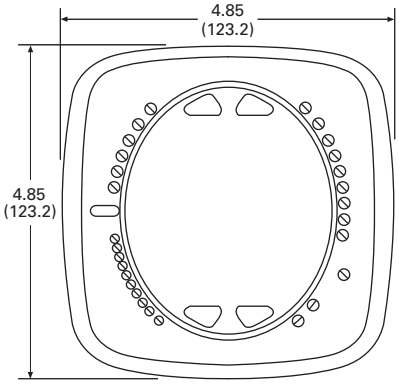
- Two relay programmable outputs/two programmable inputs
- Four KYZ pulses/four programmable inputs
- Four programmable analog outputs

9

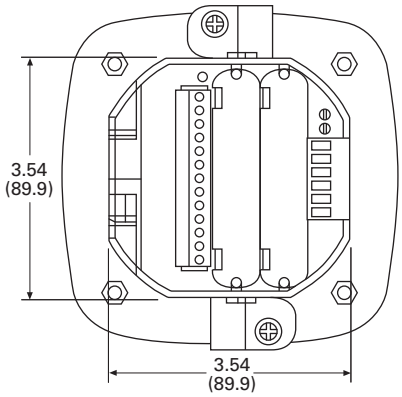
Dimensions

Approximate Dimensions in Inches (mm)

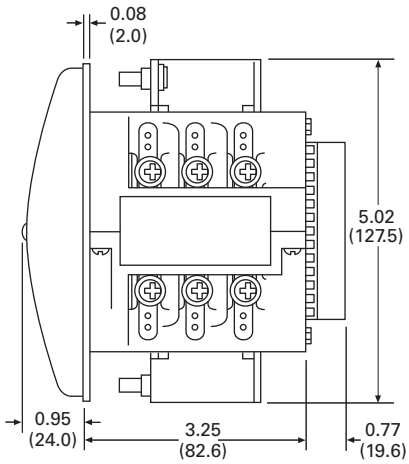
PXM 2000 Display Front View



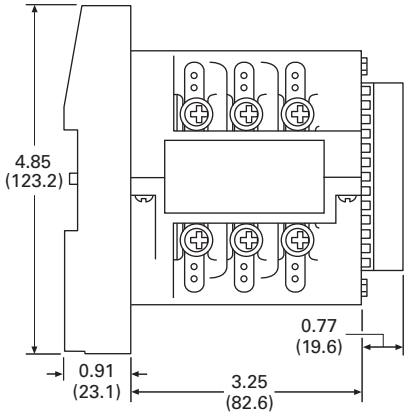
PXM 2000 Rear View



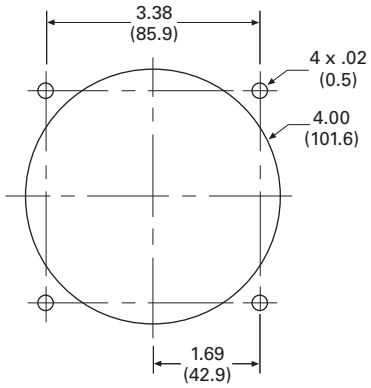
PXM 2000 Meter/Display Side View



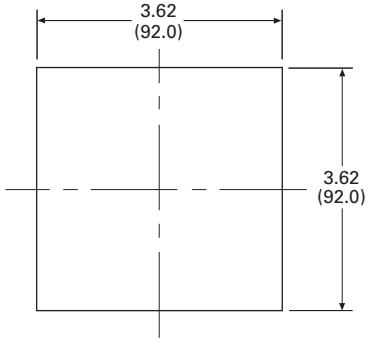
PXM 2000 Transducer Only Side View



ANSI Mounting Panel Cutout



DIN Mounting Cutout



Description	Specifications
Weight	2 lb (0.9 kg)
Basic unit	5.00 (127.0) H x 4.90 (124.5) W x 5.00 (127.0) L
PXM 2250/2260/2270	Mounts in 3.62-inch (92.0 mm) DIN and ANSI C39.1 round cut-outs
Shipping container dimensions	6-inch cube
Tolerance	±0.1 inches (2.54 mm)
Projection in front of panel surface	4.85 (123.2) H x 4.85 (123.2) W x 1.01 (25.6) L
Projection behind panel surface	4.85 (123.2) H x 4.85 (123.2) W x 1.01 (25.6) L

PXM3000



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

An Eaton Green Solution

9

PXM3000

Product Description

Eaton's Power Xpert Meter 3000 (PXM3000) offers comprehensive world-class power and energy measurement and monitoring that reduce day-to-day operating costs and help avoid costly business interruptions. Meters can be used in various applications, including energy management, monitoring circuit loading, and identifying power quality problems.

Application Description

Identify power quality problems to help:

- Protect motors from damage
- Preserve the integrity of processes and batches
- Prevent blown capacitor bank fuses
- Protect transformers and conductors from overheating

Monitor circuit loading to help:

- Avoid overloads and nuisance overload trips
- Maximize equipment utilization
- Manage emergency overloads

Manage energy utilization to help:

- Reduce peak demand charges and power factor penalties
- Identify excessive energy consumptio

Features and Benefits

- ANSI C12.20 and IEC 62053-22 revenue grade accuracy will help meet stringent customer specifications
- Available in 1 A/5 A CT type inputs for ease of use in traditional installations
- Combines state-of-the-art technology with harmonic viewing, data trending, performance benchmarking and waveform recording through an embedded web server accessible from any location via a standard web browser
- The embedded web server supports viewing of triggered waveforms one channel at a time, including the ability to zoom and to scroll horizontally using a slider bar. Waveforms are stored in the meter's nonvolatile flash memory using an industry standard COMTRADE format, allowing you to view and analyze the waveforms in any standard free-of-charge or commercial COMTRADE file viewer
- Offers maximum flexibility in waveform recording by allowing the number of recorded waveform cycles, number of pre- and post-event cycles, and sampling rate to be configured to your system requirements
- Multiple communication protocols including Modbus TCP, BACnet/IP and with available HTTP push allowing to send data to the cloud helps meet energy code data storage requirements
- Designed to easily integrate into Eaton's Power Xpert Energy Visualization & Analytics (PXEVA) software, helping to meet ASHRAE 90.1 compliance for commercial properties

Input Output Modules

Integrate data to/from other devices with field expandable plug-in I/O modules. Different I/O cards available:

- Six digital inputs, 24 Vdc power for digital inputs, two relay outputs
- Four digital inputs, two digital outputs, two analog outputs
- Four digital inputs, two relay outputs, two analog inputs. Analog Inputs and Outputs are available in:
  - 4–20 mA
  - 0–20 mA
  - 1–5 V
  - 0–5 V

Communications Capabilities

Multiple communications ports including:

- Standard RS-485 Modbus RTU
- 10/100BASE-T Ethernet network port

Communication protocols supported:

- Modbus TCP, BACnet/IP, Ethernet TCP/IP, HTTP, HTTPS, NTP, SMTP (Simple Mail Transfer Protocol), SNMP (Simple Network Management Protocol) v1, v3 and DNP 3.0

Displayed Information

- Monitored information is available locally through the display, the web browser or system power management software
- True rms values through 63rd harmonic
- ANSI C12.20 Class 0.2% revenue metering specification

Display

- Clear and large character LCD screen display with white backlight
- Wide environmental temperature endurance
- Display load percentage, four quadrant power, and load nature outline
- Small size 96 × 96 DIN or 4-inch ANSI round

Additional Features

Parameters

Category	Item	Parameters	PXM 3000
Metering			■
Real-time metering	Phase voltage	V1, V2, V3, VLnavg	■
	Line voltage	V12, V23, V31, Vllavg	■
	Current	I1, I2, I3, In, Iavg	■
	Power	P1, P2, P3, Psum	■
	Reactive power	Q1, Q2, Q3, Qsum	■
	Apparent power	S1, S2, S3, Ssum	■
	Power factor	PF1, PF2, PF3, PF	■
	Frequency	F	■
Energy and demand	Energy	Ep_imp, Ep_exp, Ep_total, Ep_net, Epa_imp, Epa_exp, Epb_imp, Epb_exp, Epc_imp, Epc_exp	■
	Reactive energy	Eq_imp, Eq_exp, Eq_total, Eq_net, Eqa_imp, Eqa_exp, Eqb_imp, Eqb_exp, Eqc_imp, Eqc_exp	■
	Apparent energy	Es, Esa, Esb, Esc	■
	Demand	Dmd_P, Dmd_Q, Dmd_S, Dmd_I1, Dmd_I2, Dmd_I3	■
TOU			■
Time of use	Energy/max. demand	TOU, 4 tariffs, 12 seasons, 14 schedules	—
Daylight saving time	Two adjustable formats	Month/day/hour/minute Month/week/first few weeks/hour/minute	—
Monitoring			—
Waveform capture	Voltage and current waveform ①	Trigger, manual, DI change, sag/dips, swell, overcurrent	■
Power quality	Voltage unbalance factor	U_unbl	■
	Current unbalance factor	I_unbl	■
	Voltage THD	THD_V1,THD_V2,THD_V3, THD_Vavg	■
	Current THD	THD_I1, THD_I2, THD_I, THD_Iavg	■
	Individual harmonics	Harmonics 2nd to 63rd (50 Hz or 60 Hz) Harmonics 2nd to 15th (400 Hz)	■
	Voltage crest factor	Crest factor	■
	TIF	Telephone Interference Factor	■
	Current K factor	K factor	■
Statistics	MAX with time stamp MIN with time stamp	Each phase of V and I; Total of P, Q, S, PF and F; demand of I1, I2, I3, P, Q&S; each phase THD of V and I; unbalance factor of V and I	■
Others			■
Alarm	Over/under limit alarm	V, I, P, Q, S, PF, V_THD and I_THD each phase and total or average; unbalance factor of V and I; load type; analog input of each channel; demand of I1, I2, I3, P, Q&S; reverse phase sequence; DI1~DI28	■
Power quality event logging	Sag/dips, swell	Voltage	■
Data logging	Data logging 1 Data logging 2 Data logging 3	F, V1/2/3/avg, V12/23/13/avg, I1/2/3/n/avg, P1/2/3/ sum, Q1/2/3/ sum, S1/2/3/sum, PF1/2/3, PF, U_unbl, I_unbl, Load Type, Ep_imp, Ep_exp, Ep_total, Ep_net, Eq_imp, Eq_exp, Eq_total, Eq_net, Es, Epa_imp, Epa_exp, Epb_imp,Epb_exp, Epc_imp, Epc_exp, Eqa_imp, Eqa_exp, Eqb_imp, Eqb_exp, Eqc_imp, Eqc_exp, Esa, Esb, Esc, THD_V1/2/3/avg, THD_I1/2/3/avg, harmonics 2nd to 63rd, crest factor, THFF, K factor, sequence and phase angles, DI counter, AI, AO, Dmd P/Q/S, Dmd I1/2/3	■
Onboard memory size	Memory	Bytes	1.5 GB
Communication	RS-485 port, half duplex, optical isolated, RJ-45 Ethernet, Micro USB	Modbus-RTU protocol/DNP3.0, Modbus TCP, BACNet IP	■
Time	Real-time clock	Year, month, date, hour, minute, second	■

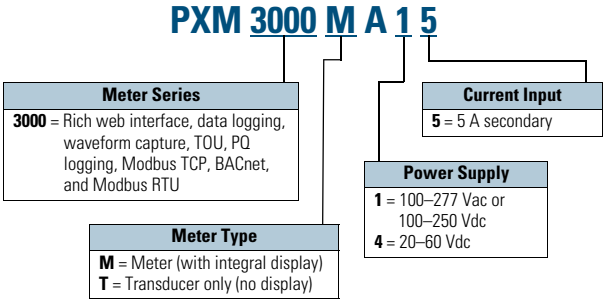
① The PXM1300 takes 512 samples per cycle. For the waveform capture function on the PXM1300, the sample rate is 64 samples.

Standards and Certifications

- Measurement standard: IEC 62053-22; ANSI C12.20
- Environmental standard: IEC 60068-2
- Safety standard: IEC 61010-1, UL 61010-1, IEC 61557-12
- EMC standard: IEC 61000-4/-2-3-4-5-6-8-11, CISPR 22, IEC 61000-3-2, IEC 61000-6- 2/4
- Outlines standard: DIN 43700, ANSI C39.1

Catalog Number Selection

Power Xpert Meter 3000



Ordering Information

To order a Power Xpert Meter 3000, the catalog number should be determined using the table above. The table illustrates how to include the desired factory options as part of a catalog number. Option cards are separate and field installable.

Power Xpert Meter modules include panel mounting brackets.

Example: PXM3000MA15 (PXM 3000 meter/display, 5 A, 100–277 Vac or 100–250 Vdc)

Accessories

Power Xpert Meter 3000 Accessories

Description	Catalog Number
PXM3000 panel mount remote display for DIN rail mount transducer version; include one 6 ft cable	**PXM3K-DISP-3**
PXM1000 DIN rail mounting adapter	**PXM1K-DINADPT**
PXM1000 terminal plug kit	**PXM1K-TPK**
PXM1000 Display cable (6 ft)	**PXM1K-DISPCBL-6**
PXM1000 Display cable (15 ft)	**PXM1K-DISPCBL-15**

Power Xpert Meter 1000 and 3000 I/O Modules

Integrate data to/from other devices with field expandable plug-in I/O modules. A maximum of two I/O cards may be added to the PXM3000 meter.

Description	Catalog number
PXM1000 I/O module logic address 1; 2 RO, 6DI with DI power supply 24 Vdc	**PXM1K-110**
PXM1000 I/O module logic address 2; 2 RO, 6DI with DI power supply 24 Vdc	**PXM1K-120**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (4–20 mA)	**PXM1K-210**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (0–20 mA)	**PXM1K-211**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (1–5 V)	**PXM1K-212**
PXM1000 I/O module logic address 1; 4 DI, 2 DO, 2 AO (0–5 V)	**PXM1K-213**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (4–20 mA)	**PXM1K-220**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (0–20 mA)	**PXM1K-221**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (1–5 V)	**PXM1K-222**
PXM1000 I/O module logic address 2; 4 DI, 2 DO, 2 AO (0–5 V)	**PXM1K-223**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (4–20 mA)	**PXM1K-310**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (0–20 mA)	**PXM1K-311**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (1–5 V)	**PXM1K-312**
PXM1000 I/O module logic address 1; 4 DI, 2 RO, 2 AI (0–5 V)	**PXM1K-313**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (4–20 mA)	**PXM1K-320**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (0–20 mA)	**PXM1K-321**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (1–5 V)	**PXM1K-322**
PXM1000 I/O module logic address 2; 4 DI, 2 RO, 2 AI (0–5 V)	**PXM1K-323**

Technical Data and Specifications

Current Inputs (Each Channel)

Nominal secondary sensor settings:

Current Sensor Input Options	5 A	1 A
Nominal configuration selection	5 A	1 A
Metering range (% of nominal)	200%	200%
Pickup current (% of nominal)	0.1%	0.1%

Specifications

Description	Specification
Input	
Withstand	20 A rms continuous, 100 A rms for 1 second, non-recurring
Burden	0.05 VA (typical) at 5 A rms
Accuracy	0.2% IEC 61557-12 class 0.2
Voltage Inputs (Each Channel)	
Nominal full scale	400 Vac L-N, 690 Vac L-L (+20%)
Withstand	1500 Vac continuous, 2500 Vac, 50/60 Hz for 1 minute
Input impedance	2 mohm per phase
Metering frequency	45–65 Hz, 300–500 Hz
Pickup voltage	10 Vac
Accuracy	0.2 IEC 61557-12 Class 0.2
Energy Accuracy	
Active	Class 0.2 s (according to IEC 62053-22), Class 0.2 s (according to ANSI C12.20)
Reactive	Class 2 (according to IEC 62053-23)
Harmonic Resolution	
Metered value	63rd harmonic (50 Hz or 60 Hz type), 15th harmonic (400 Hz type)
Communication	
RS-485 (Standard)	
Modbus RTU and DNP 3.0	
Two-wire shielded twisted pair cable connection	
Baud rate: 1200–38,400 bps	
Second RS-485 Port (Optional)	
(Same as RS-485 standard contents)	
Ethernet (optional)	
10M/100MBASE-T	
Modbus TCP/IP	
BACnet-IP	
EtherNet/IP	
IPv6	
SNMP	
HTTP/HTTPs Webserver	
HTTP/HTTPs, FTP data post	
SMTP	
NTP	
Standard Compliance	
Measurement standard	IEC 62053-22; ANSI C12.20
Environmental standard	IEC 60068-2
Safety standard	IEC 61010-1, UL 61010-1, IEC 61557-12
EMC standard	IEC 61000-4/-2-3-4-5-6-8-11, CISPR 22, IEC 61000-3-2, IEC 61000-6-2/4
Outlines standard	DIN 43700, ANSI C39.1

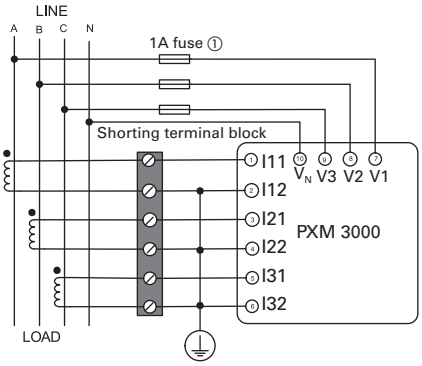
Specifications

Description	Specification
Operating Environment	
Operation temperature	–25 °C to +70 °C
Storage temperature	–40 °C to +85 °C
Relative humidity	5% to 95% noncondensing
Protection level	IP54 (front), IP30 (cover)
Approvals	
UL File E18555	
RoHS	
I/O Option	
Input voltage range	20–160 Vac/Vdc
Input current (max.)	2 mA
Start voltage	15 V
Stop voltage	5 V
Pulse frequency (max.)	100 Hz, 50% duty ratio (5 ms ON and 5 ms OFF)
SOE resolution	2 ms
Digital Output (DO) (Photo-MOS)	
Voltage range	0–250 Vac/Vdc
Load current	100 mA (max.)
Output frequency	25 Hz, 50% duty ratio (20 ms ON, 20 ms OFF)
Isolation voltage	2500 Vac
Relay Output (RO)	
Switching voltage (max.)	250 Vac, 30 Vdc
Load current:	5 A (resistive), 2 A (inductive)
Set time	10 ms (max.)
Contact resistance	30 mohm (max.)
Isolation voltage	2500 Vac
Mechanical life	1.5×10^7
Analog Output (AO)	
Output range	0–5 V / 1–5 V, 0–20 mA / 4–20 mA (optional)
Accuracy	0.5%
Temperature drift	50 ppm / °C typical
Isolation voltage	500 Vdc
Open circuit voltage	15 V
Analog Input (AI)	
Input range	0–5 V / 1–5 V, 0–20 mA / 4–20 mA (optional)
Accuracy	0.2%
Temperature drift	50 ppm / °C typical
Isolation voltage	500 Vdc
Power Supply for DI (24 Vdc)	
Output voltage	24 Vdc
Output current	42 mA
Load (max.)	21 DIs
Control Power	
Universal	AC or DC
AC/DC Control Power	
Operating range	100–415 Vac, 50/60 Hz; 100–300 Vdc
Burden	5 W
Frequency	50/60 Hz
Withstand	3250 Vac, 50/60 Hz for 1 minute
Installation Category III (distribution)	

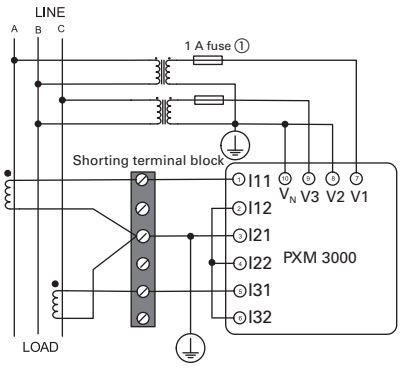
Wiring Diagrams

Meter Input Wiring

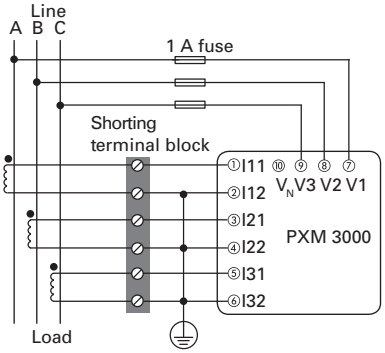
Three-Phase, Four-Wire (3LN, 3CT)



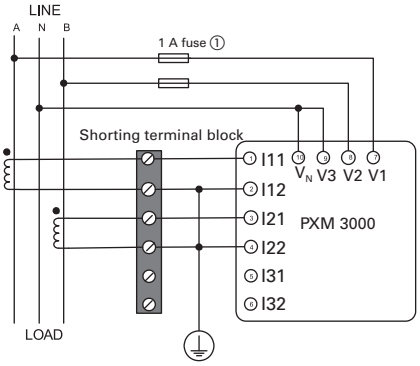
Three-Phase, Three-Wire with PT and 2CT (2LL, 3CT)



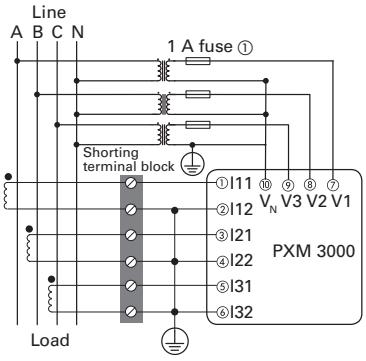
Three-Phase, Three-Wire (3LL, 3CT)



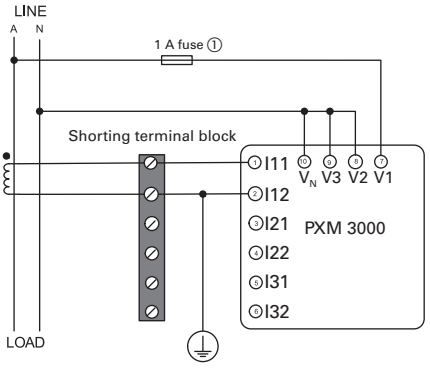
Single-Phase, Three-Wire (1LL, 2CT)



Three-Phase, Four-Wire with PT (3LN, 3CT)



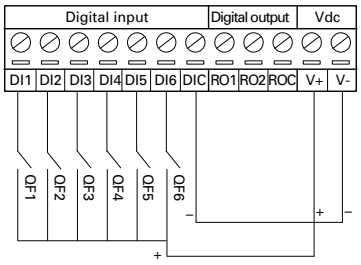
Single-Phase, Two-Wire (1LN, 1CT)



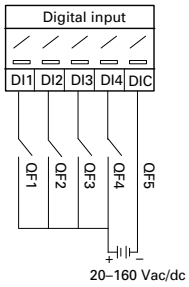
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I/O Cards Wiring

PXM1K-X1X



PXM1K-X2X/X3X

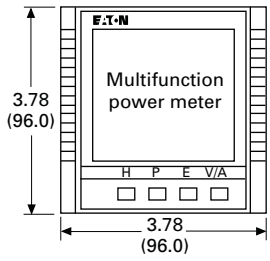


Dimensions

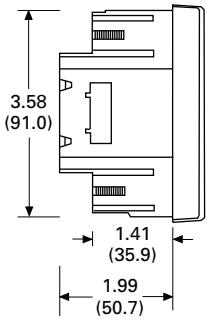
Approximate Dimensions in Inches (mm)

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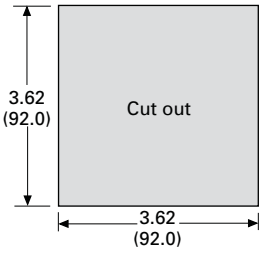
PXM 3000

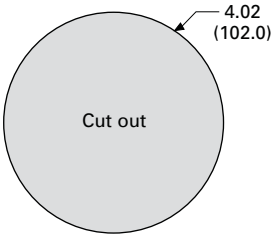


Front view



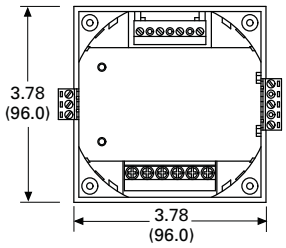
Side view



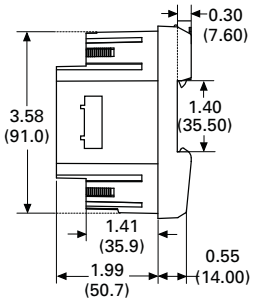


Cut out

DIN Mount Meter Rear and Side View

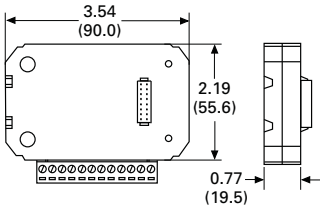


Rear view



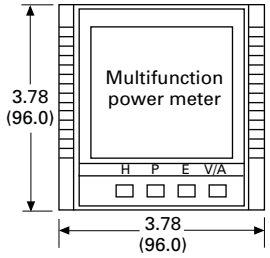
Side view

I/O Module

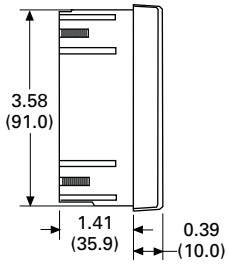


Note: Display module is connected with a 6 ft 10-pin RJ45 cable. Display module opening size and PXM1000 body openings are exactly the same size.

External Display Module Front and Side View



Front view



Side view

Power Xpert 4000/6000/8000 Series Display and Meter



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

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9

Power Xpert Meter 4000/6000/8000 Series

Product Description

The Power Xpert Meter 4000/6000/8000 Series monitors the critical aspects of an electrical distribution system. This premier power quality metering instrument is simple to use, powerful, scalable and highly flexible.

The Power Xpert Meter 4000/6000/8000 offers a new level of intuitive user interface design, presenting critical electrical distribution system information in simple-to-navigate and easy-to-understand information architecture. The Power Xpert Meter 4000/6000/8000 graphic display visualizes the information from up to 16 meter modules. The embedded web server displays complex power quality data using standard Internet browsers and allows for device configuration from the browser.

Both the local display and the embedded web server present real time, historical and event information in a browser-style graphical format to help the user interpret key circuit information, such as:

- Current loading
- Voltage and power levels
- Power factor
- Energy usage
- I/O status
- Power quality measurements
- Harmonic plots
- Disturbance and transient waveforms
- ITIC disturbance summary screen

The Power Xpert Meter 4000/6000/8000 color touchscreen displays allow the user to easily view meter parameters and historical data.

The web server provides the energy and demand readings required to help manage the cost of energy. It also provides critical information regarding power quality, such as harmonic distortion, flicker, crest factor, K-factor and more.

Note: Features and functionality may vary depending on the meter model and options being used. Review the Features and Benefits chart on **Page V3-T9-42** for details.

Standards and Certifications

- Safety: EN61010-1, UL®/cUL® 61010-1
- Accuracy: IEC/EN60687 0.2 Class, ANSI C12.20 0.2 Class
- EMC: FCC Part 15 Subpart B Class A EN55011 Class A
- Measurement Canada Approval No. AE-1898 (4000/6000 meters)
- Immunity IEC 61326
- CE Mark

Listed Listed

Application Description

Identify Power Quality Problems to Help:

- Identify harmonics, sags, swells and transients damaging or disrupting sensitive, mission-critical IT equipment
- Boost IT equipment's service life to the maximum
- Analyze sequence of events up to 1 millisecond time resolution
- Protect motors from damage
- Preserve the integrity of processes and batches
- Prevent blown capacitor bank fuses
- Protect transformers and conductors from overheating

Detect and Record High-Speed Transients to Help:

- Avoid equipment damage and disruption
- Identify equipment malfunction

Monitor Circuit Loading to Help:

- Avoid overloads and nuisance overload trips
- Maximize equipment utilization
- Manage emergency overloads

Manage Energy Utilization to Help:

- Reduce peak demand charges and power factor penalties
- Identify excessive energy consumption

Metered/Monitored Parameters

Note: See **Page V3-T9-42**.

- Volts: L-L, L-N, Avg. L-L, Avg. L-N, N-G
- Phase neutral and ground currents
- Power: real, reactive and apparent
- Frequency
- Power factor: apparent and displacement
- Energy
- Demand
- % THD
- Minimum and maximum values
- Harmonics
- Flicker
- Individual harmonics
- Interharmonics
- % TDD
- ITIC events plot, duration, magnitude
- Energy comparisons
- Demand comparisons
- Event calendar
- Event timeline and sequence
- Number of 9s of availability
- Phasors
- Sequence components
- Crest factor
- K-factor
- PQ Index

Accuracy

- Currents: 0.05% RV + 0.025% FS
- Voltage: 0.1% RV + 0.025% FS
- Energy and demand power: 0.2% in accordance with ANSI C12.20
- Frequency: ±0.01 Hertz
- Power factor:
  - 0.10% at Unity PF
  - 0.30% at 0.5 PF

Communications

Multiple communications ports including:

Standard

- RS-485 remote display port
- RS-485 Modbus® RTU slave port
- RJ-45 10/100BASE-T local configuration port (local web server connection)
- HTTP (local), FTP, COMTRADE

Optional

- Communications Expansion Card (CEC)
  - Selectable 100FX or 10/100BASE-T Ethernet network port
  - RS-485 Modbus RTU selectable master/slave port
  - RS-232 Modbus RTU slave port

Communication Protocols Supported

- Modbus RTU
- Modbus TCP
- EtherNet TCP/IP
- HTML
- NTP (Network Time Protocol)
- FTP (File Transfer Protocol)
- SMTP (Simple Mail Transfer Protocol)
- SNMP (Simple Network Management Protocol)
- COMTRADE (IEEE® C37.111-1999)
- DNP 3.0 over Ethernet (Distributed Network Protocol)

Display/Meter Mounting Options

- The 6-inch color touchscreen display can be mounted back-to-back with one Power Xpert meter module on opposite sides of a panel

Meter Base Unit Characteristics

- NEMA® rating: NEMA 1, IP30

Display Unit Characteristics

- NEMA rating: NEMA 12, IP42 front of panel rating

Power Xpert Meter 4000/6000/8000 Displays (Option)

The Power Xpert Meter 4000/6000/8000 has two display options: a 6-inch color touchscreen display (PXM468K-DISP-6) and a 12-inch advanced color touchscreen display (PXM468K-DISP-12).

The 6-inch color touchscreen display allows access to real-time metered values, min/max values, power quality, I/O (input/output), events and graphical trend charts.

The advanced 12-inch touchscreen display provides access to all measured and stored parameters in the meter. It supports graphical real-time information, trend charts of key circuit measurements, waveforms, harmonics and calendar displays.

All meter setup and programming can be performed through the display.

Inputs and Outputs

Power Xpert Meter 4000/6000/8000 is available with an optional digital I/O card, which includes:

- Eight digital inputs—self sourced 24 Vdc
- Three relay outputs—5 A max. continuous, 240 Vac max., 30 Vdc max.
- Two solid-state outputs—80 mA max. continuous, 30 Vdc max.

Each of the 8 inputs are interrupt driven, allowing for 1 ms accuracy of digital events time stamps (1 ms accuracy requires local NTP TimeServer). Inputs can also be configured for demand synch and pulse counting. Inputs selected for pulse counting can be scaled. Interval by interval pulse recordings are maintained in profile memory and can be displayed graphically. Outputs can be used for KYZ, or alarm annunciation.

Ratings

- Application to 500 kV, no PTs to 600 V
- CT ratios selectable from standard 120/600 Vac line
- CT inputs accept 5 A secondary
- Power supply:
  - Standard 120/240 Vac or 110/250 Vdc

Storage Capacity

Power Xpert Meter 4000/6000/8000 Estimated Memory and Storage Capacity with 2/4/8 GB Memory Capacity

				Occurrence Per Month ①		Memory Usage (MB)		Months of Capacity ②	
Model	**Memory**	**Event**	**File Size (KB)**	**Typical**	**Severe**	**Typical**	**Severe**	**Typical**	**Severe**
PXM 4000	2 GB	Subcycle Disturbance	1260	10	60	12.3	73.8	166	28
PXM 6000	4 GB	ITIC Event	1260	5	20	6.2	24.6	666	166
		Subcycle Disturbance	1260	10	60	12.3	73.8	333	55
		ITIC + Subcycle Disturbance	Total--->	15	80	18.5	98.4	222	42
PXM 8000	8 GB	ITIC Event	1260	5	20	6.2	24.6	1332	333
		Subcycle Disturbance	1260	10	60	12.3	73.8	666	111
		Transients	2048	3	30	6.0	60.0	1365	137
		ITIC + Subcycle Disturbance + Transients	Total--->	18	110	24.5	158.4	335	52

Notes

① The typical and server power quality event occurrences are estimates and may vary depending on the electrical environment.

② Memory is not allocated by event category; memory is used first come, first served.

Features and Benefits

Power Xpert Meter 4000

- Harmonics, including individual harmonics
- Disturbance capture
- Low frequency transient detection and capture
- Standard power quality index

Power Xpert Meter 6000

- Interharmonics
- Flicker calculations
- ITIC performance curve
- Event calendar view
- Events timeline view
- Sequence of events waveform plot
- Enhanced power quality index

Power Xpert Meter 8000

- Impulsive transient capture at 6 MHz
- 100,000 samples per cycle
- Premium power quality index

Power Xpert Meter 4000/6000/8000

	Power Xpert Meter			
Feature	**4000**	**6000**	**8000**	**Benefit**
General				
Embedded web server	■	■	■	Use a standard web browser to monitor and manage the meter over the network, Internet
TOU metering support	■	■	■	Time of usage can be set up to support 4 different schedules
Firmware flash update support	■	■	■	Enables you to flash the meter with the latest firmware updates
Self-learning capability (characterizes "normal" per circuit)	■	■	■	The meter can automatically adjust to the environment and alarm only when "real" events occur
Power, Energy and Demand				
Voltage, current: per phase minimum, maximum, average, trend graph analysis, export, print	■	■	■	Review voltage and current trends, export, print and analyze parameters right on the meter or external software
Energy and demand plot comparisons month-to-month, week-to-week	■	■	■	Plot two months or two weeks for vivid energy or demand comparison
Power: power factor, apparent, real, reactive, frequency	■	■	■	Review power usage and power factor and avoid potential PF penalties
Energy, demand: forward, reverse, net, sum, tou, profile, previous month comparison, graph analysis, export, print	■	■	■	Keep track of your energy usage, compare time of usage and usage against previous month, identify peaks to conserve energy usage
Power Quality Analysis				
Statistical analysis (min., max., average)	■	■	■	Review statistical trends, identify past and future problem areas
Sag and swell monitoring, management and recording	■	■	■	Capture electrical sags and swells and analyze the waveforms
Symmetrical Components: Zero, Negative, Positive	■	■	■	Analyze possibly unbalanced three-phase power systems
Low frequency transient detection and capture	■	■	■	Capture lower frequency transient waveforms for retrospective analysis or emailing
Sampling rate, maximum samples/cycle	4096 ①	4096 ①	100,000	Extremely high sampling rate will effectively capture impulsive transients
"Number of Nines" uptime data (e.g., 6 nines = 99.9999%)	■	■	■	Review uptime availability per cent
K-factor	■	■	■	Review the ratio of eddy current losses, e.g., when driving nonlinear and linear loads
Crest factor	■	■	■	Review the peak-to-average ratio of the waveform
Security				
Secure 5 level user access privileges	■	■	■	Define appropriate security access level per user
Communications and I/O				
Modbus TCP	■	■	■	Easy integration with standard protocol to power management and other software
Modbus RTU	■	■	■	Integrate meters to existing Modbus networks, daisy chain several (1–16) meters together
HTML	■	■	■	Communicate to the meter over the Internet via standard web browser
SNMP (simple network management protocol)	■	■	■	Communicate with the meter via Simple Network Protocol; hook to existing NMS system
SMTP (simple mail transfer protocol)	■	■	■	Send email messages via standard Simple Mail Transfer Protocol
FTP (file transfer protocol)	■	■	■	Access, copy, paste, cut waveform capture files on the meter with an FTP Client
NTP (network time protocol)	■	■	■	Network Time Protocol support enables the meter to synchronize time over the network up to the 1 millisecond resolution
COMTRADE, open IEEE Standard file format for waveform capture export	■	■	■	Import waveform captures in standard IEEE (C37.111-1999) COMTRADE file format to third-party software
DNP 3.0 over Ethernet (Distributed Network Protocol)	■	■	■	Communicate with the meter via DNP 3.0 over Ethernet; hook to existing utility systems

Notes

These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and User Manual for detailed specifications.

① Delta-Sigma A/D oversampling rate.

Power Xpert Meter 4000/6000/8000, continued

Feature	Power Xpert Meter 4000	6000	8000	Benefit
Communications and I/O (continued)				
Trend measurements CSV file export	■	■	■	Easily export trend measurements to third-party applications, e.g., Microsoft Excel in standard CSV file format
I/O (8 digital inputs, 3 relay outputs, 2 solid-state KYZ outputs)	■	■	■	The Power Xpert I/O Card is extremely flexible and can be used in a large variety of different applications. Digital inputs and relay outputs can be programmed to interact during various conditions defined by the user. Various third-party devices, such as alarm, pulse meters, trip units, sensors can be easily integrated to the Power Xpert Meter. Triggers and events can be tied to the meters standard functions such as email, logs and trends
Time Synchronization				
NTP time synchronization up to 1 millisecond accuracy	■	■	■	Network Time Protocol support enables the meter to synchronize time over the network up to the 1 millisecond resolution
GPS time synchronization up to 1 millisecond accuracy	■ ①	■ ①	■ ①	The GPS option allows the meter to synchronize time over the GPS satellite positioning system up to the 1 millisecond resolution
Logs				
Trend logging	■	■	■	Log trend information for easy statistical analysis
Load profile	■	■	■	Review the load profile graph to get a better understanding of your electrical load versus time
Event logging	■	■	■	Log events for retrospective event analysis
Memory and Storage				
Standard memory, GB	2	4	8	Store large amounts of waveform captures and events for historical analysis
Harmonics				
Harmonic levels	127	127	127	Provides extremely fast, high resolution D/A conversion
Total harmonic distortion (THD)	■	■	■	Review the total harmonic distortion level directly on the meter
Delta-Sigma D/A conversion technology	■	■	■	Provides extremely fast, high resolution D/A conversion
Harmonics over-sampling (4096 samples per cycle)	■	■	■	Over-sampling enables the usage of Anti-Aliasing technology, increasing accuracy
Anti-alias filtering	■	■	■	Technology to remove out-of-band signal components resulting in more accurate data
Individual harmonics	■	■	■	Review individual harmonic levels directly on the meter
Total demand distortion (TDD)	■	■	■	Identify harmful harmonics in e.g. lightly loaded variable-speed drive environments where THD may be high but not relative
Interharmonics		■	■	Interharmonics allow you to see what is going on between the integer multiples of the fundamental. Zoom in on the harmonics trend graph and review frequency content every 5 Hz instead of every 60 Hz
Highlights				
Sub-cycle disturbance capturing	■	■	■	Capture fast voltage changes/low frequency transient (e.g. capacitor switching transient)
dV/dt triggers for sub-cycle oscillatory transients	■	■	■	Detect and record a large magnitude oscillation transient resulting in equipment damage
Absolute threshold and dV/dt triggering	■	■	■	Detect and record if a surge suppressor is necessary
Power quality index—standard (includes dv/dt count, %TDDi and %THDv)	■	■	■	Complex power quality data put into simple graphic format
Power quality index—enhanced (includes Standard Index plus Sag level, Swell level and Flicker)		■	■	Complex power quality data put into simple graphic format (includes ITIC events and flicker calculations)
Flicker calculations		■	■	Detect and quantify low frequency rms voltage variations causing incandescent lighting flicker
Automatic trigger setting		■	■	Trigger thresholds are automatically set according to ITIC (CBEMA) standard, no need to figure this out by yourself
Automatic event severity analysis		■	■	Automatically analyze the severity of the event with the ITIC (CBEMA) performance curve plot, see where the event actually hit

Notes

These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and User Manual for detailed specifications.

① When used with third-party device and I/O option.

Power Xpert Meter 4000/6000/8000, continued

Feature	Power Xpert Meter 4000	6000	8000	Benefit
Highlights, continued				
Event severity counters		■	■	An ITIC (CBEMA) event counter keeps track of the number of all sags, swells and transients
ITIC (Information Technology Industry Council), previously CBEMA performance curve		■	■	ITIC (Information Technology Industry Council), previously CBEMA performance curve for easy power problem evaluation
Custom ITIC (CBEMA) plot with individual event magnitude and duration		■	■	Review custom ITIC (CBEMA) plots of individual events showing you the actual magnitude, duration and hit are in a simple graphical representation
Event calendar view		■	■	The Events Timeline calendar view provides instant insight to the frequency of power events and helps detect reoccurring problems
Events timeline view		■	■	View and understand the sequence of events that have occurred during a period of time
Sequence of events and events plot on waveform		■	■	Plot color-coded events on a captured waveform to gain insight into the sequence of events cycle per cycle
Power quality index—premium (at-a-glance "thermometer" view of power quality)			■	Complex power quality data put into simple graphic format (includes ITIC events and flicker calculations)
High-Speed Transient Capture and Detection				
6 MHz capture of impulsive transients			■	Capture impulsive transients by taking 6 samples every millionth of a second
Transient Capture Duration: ~20 ms/6 MHz ~120 ms/1 MHz			■	Record and analyze transients during a longer timeframe
Waveform recorded at 100,000 samples per cycle			■	High-speed ensures impulsive transients are correctly captured (fast rise time)
Three-phase voltage and neutral-to-ground fast transient capture			■	Capture impulsive transients on all 4 channels

Discrete Contact Inputs

The optional PXMIO-B expansion card offers 8 digital inputs that are useful for a variety of applications such as:

- Status indication with time stamping of transitions (1 ms precision).
- Pulse counting of KYZ or other utility pulses such as air, water or gas.
- High-speed triggering of waveforms based on events such as breaker trips or static transfers
- Demand interval timing taken from a master utility meter end of interval pulse

Status inputs are self sourced providing a nominal 24 Vdc (20–30 Vdc) across the circuit.

Names can be configured for each input for ease of use.

Relay Outputs

The optional PXMIO-B card includes three 5 A form C relay outputs rated for 240 Vac or 30 Vdc. These outputs can be used for applications such as:

- Alarm annunciation
- KYZ pulse output

Alarm outputs can be driven from triggers based on metering values. Output modes include:

- Normal—relay energized during alarm condition
- Latched—relay energized by event trigger, de-energized by acknowledgement
- Timed—relay energized by event trigger, maintained for a programmed interval.

Communications Expansion Card (CEC)

The optional PXMCE-B Card offers two Ethernet connection options, 10/100BASE-T and a fiber-optic port that can be used for the following applications:

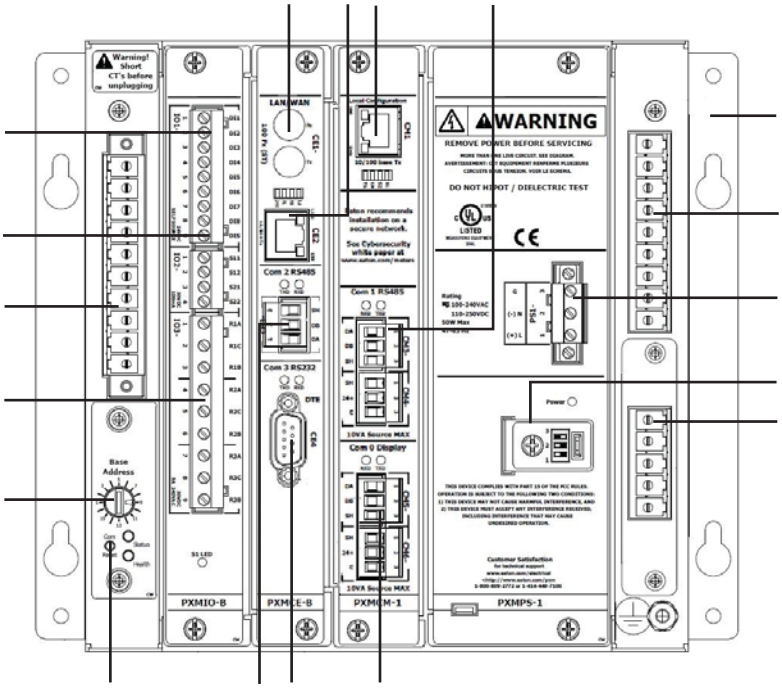
- Monitoring, managing and configuring the meter remotely using a standard web browser interface like Microsoft Internet Explorer
- Alarm notifications via email, SMTP
- Enabling access to the meter's FTP server (energy, trend and waveform logs)
- Providing Modbus TCP/IP or RTU communications to BMS systems
- Providing DNP 3.0 over Ethernet to utility systems
- Providing SNMP communications to NMS systems
- Synchronizing with an NTP server for 1 ms timestamping resolution
- Asset management via SNMP to Network Management Systems
- Updating firmware on the meter

Notes

These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list.

Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and User Manual for detailed specifications.

Power Xpert Meter 4000/6000/8000 Module Layout



I/O Card

① Digital inputs 1–8 (option)
② Solid-state outputs 1–2 (option)
③ Relay outputs 1–3 (option)

CT and Voltage Connections

④ CT input connections
⑤ Standard three-phase voltage phase inputs
⑥ Aux. channel voltage inputs (option)

Communication Expansion Card (LAN/WAN Ethernet Networking)

⑦ 100FX ST-type Ethernet (multi-mode) (option)
⑧ 10/100BASE-T Ethernet (option)
⑨ RS-485 (two-wire w/shield)—24 V accessory power (com 2)

Standard Features

⑩ Local RJ-45 config. port (non-networkable Ethernet)
⑪ RS-485 (two-wire w/shield) Modbus RTU (com 1)
⑫ Meter mounting brackets
⑬ Sealable mode switch cover
⑭ Control power (100–240 Vac and 110–250 Vdc) (±20%)
⑮ Display RS-485 Network port (up to 15 meters)—24 V accessory power (com 0)
⑯ RS-232 (Tx Rx) Modbus RTU (com 3) (option)
⑰ Meter base address
⑱ Com Reset Button

Catalog Number Selection

To order a Power Xpert Meter 4000/6000/8000, the catalog number should be determined using the chart shown below. The chart illustrates how to include the desired factory options as part of a catalog number. Option cards that are selected at time of order entry will be installed at the factory. Option cards are also field installable for field upgrades.

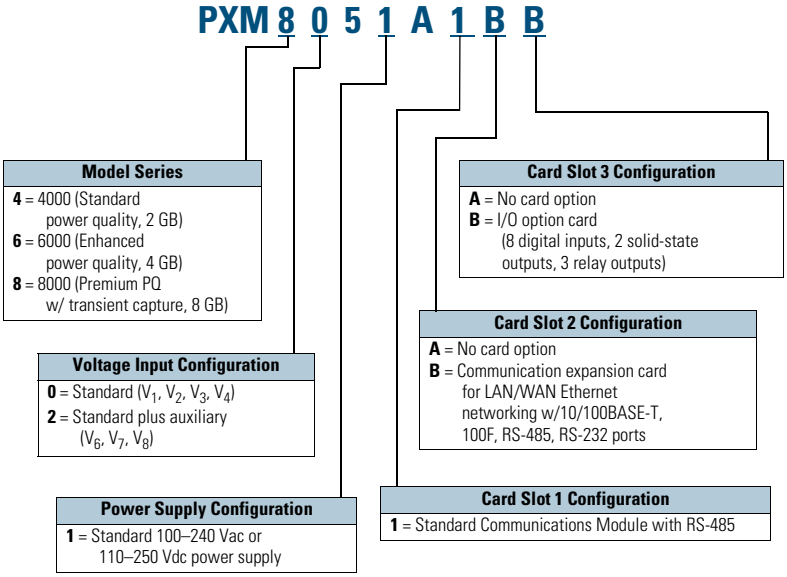
If a display is required, it should be ordered separately. Power Xpert Meter modules include panel mounting brackets. The color touchscreen displays are designed to mount separately. If back-to-back meter to display panel mounting is desired, a mounting bracket kit is available (**PX-PMBD**) for the 6-inch color touchscreen display. The 12-inch advanced color touchscreen display cannot be back-to-back mounted.

Example 1: PXM8251A1BB (PXM 8000 Meter, w/ VAUX, Std. Pwr, Com. Exp. & I/O Cards)

Example 2: PXM6251A1BA (PXM 6000 Meter, w/ VAUX, Std. Pwr, Com. Exp. Card)

9

Power Xpert Meter 4000/6000/8000



Example 1: **PXM8251A5BB** (PXM 8000 meter, w/ VAUX, std. pwr., com. exp. and I/O cards)
Example 2: **PXM6251A6BA** (PXM 6000 meter, w/ VAUX, std. pwr., com. exp.card)

Accessories

Power Xpert Meter 4000/6000/8000

Description	Catalog Number
6-inch color touchscreen display	**PXM468K-DISP-6**
12-inch advanced color touchscreen display	**PXM468K-DISP-12**
Communication expansion card for LAN/WAN Ethernet networking: 100FX fiber-optic, 10/100T, RS-485, RS-232	**PXMCE-B** ①
Digital I/O card: eight digital input, two solid-state output, three relay output	**PXMIO-B** ①
Panel mounting bracket assembly for back-to-back meter to 6-inch color touchscreen display mounting	**PX-PMBD**
Panel mounting bracket assembly for retrofitting a 6-inch color touchscreen display to IQ Analyzer cutout	**PX-PMBE**
Panel mounting bracket assembly for retrofitting a 6-inch color touchscreen display to PXD-MMG cutout	**PX-PMBF**

Notes

① These items can be ordered separately or preinstalled in the meter by selecting option B in the model number.

Communication cable (standard Modbus RTU) is not included in the package for meter module connection.

Technical Data and Specifications

Environmental Conditions

- Operating temperature:
  - Meter: –20 °C to +70 °C
  - Display: –20 °C to +60 °C operating
  - Storage temperature: –40 °C to +85 °C
  - Operating humidity: 5% to 95% condensing
  - Device weight: 7.1 lb—meter 2.1 lb—display
  - Meter and back of display are pollution degree 2
  - Elevation to 6562 ft (2000 m)

Current Inputs (Each Channel)

- Conversion: 4096 samples per cycle delta-sigma converter digitally filtered down to 512 samples per cycle
- CT Input: 4096 rms samples per cycle delta-sigma converter digitally filtered down to 512 samples per cycle for anti-aliasing
- Burden: less than 10 milliohms
- Overload withstand: 500 A for 1 second, non-repeating
- Range: 0.005–20 A continuous
- Accuracy: 0.05% or reading plus 0.01% of full scale (from 50 milliamps to 20 A)

Voltage Inputs (Each Channel)

- Conversion: 4096 rms samples per cycle delta-sigma converter digitally filtered down to 512 samples per cycle for anti-aliasing
- PT input: 120–500,000 V primary
- Input range: 600 V L-L, 347 L-N direct connect
- Nominal full scale: 1000 V rms
- Input impedance: 2 megohms

Frequency Range

- 47–63 Hz

Harmonic Response (Voltage, Current)

- 127th harmonic

Accuracy

- ANSI C12.20 0.2 Class
- IEC 687 0.2 Class

Discrete Inputs

- Self sourced: 24 Vdc

Relay Output Contacts

- 5 A maximum, 240 Vac maximum, 30 Vdc maximum
- Lifetime: 1,000,000 no load operations
- 100,000 under rated voltage and load

Solid-State Outputs

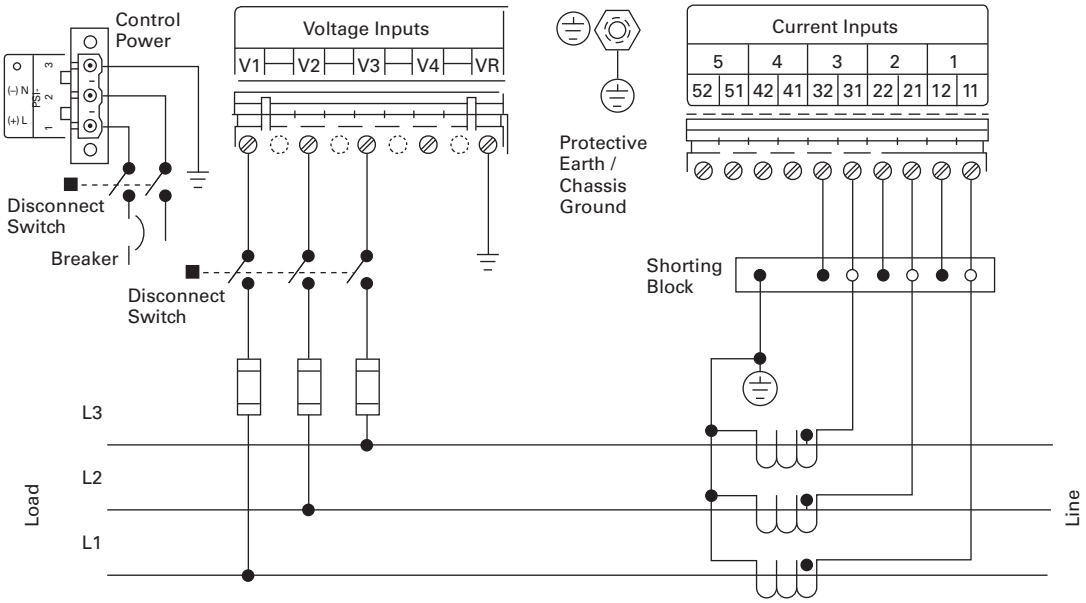
- Maximum load: 100 milliamps
- Maximum voltage: 30 V (externally sourced)

Control Power Input

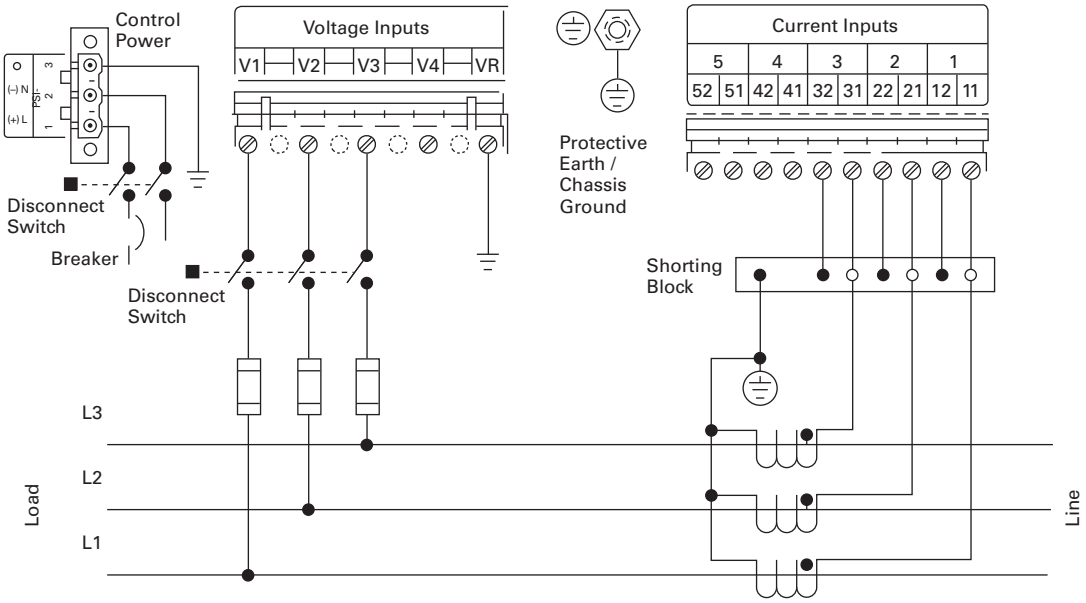
- Input range AC: 100–240 Vac (±20%)
- Frequency range: 47–63 Hz
- Input range DC: 110–250 Vdc ±20%
- Burden 50 VA
- Ride-through: 1–5 s

Wiring Diagrams

Three-Phase, Three-Wire Delta (Up to 600 Volts)



Three-Phase, Three-Wire Delta (Above 600 Volts)

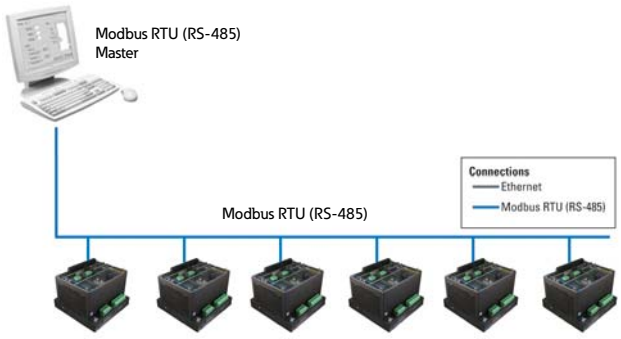


Note

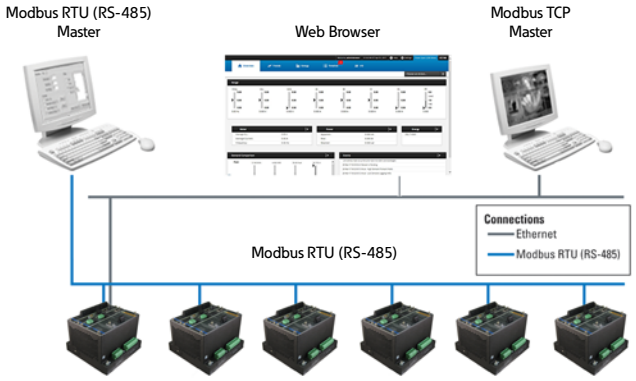
Based upon the voltage rating, you may need a control power transformer for the control power.

Power Xpert Meters Configuration and Wiring Examples

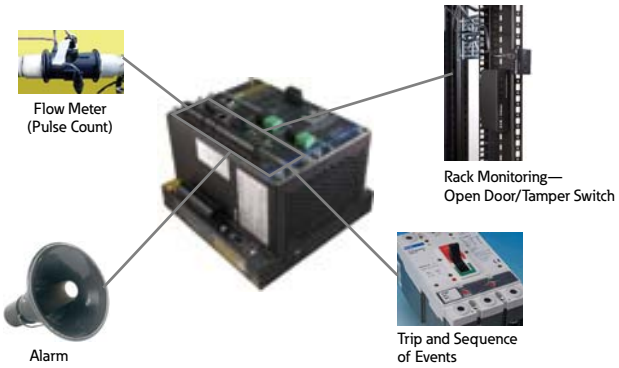
Modbus RTU (RS-485)—Non-Web Enabled



Web Enabled—Browser and Modbus TCP

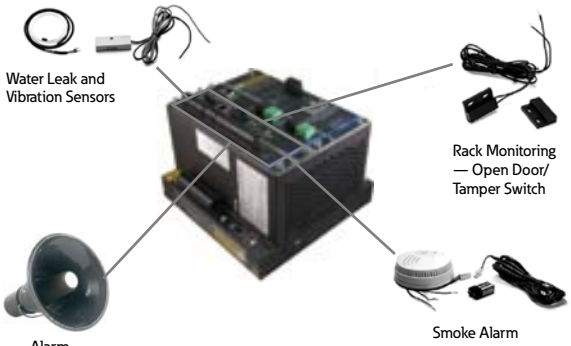


Accessories—I/O Card (Option)



- Eight Programmable Digital Inputs
- Two Solid-State Programmable Outputs
- Three Relay Programmable Outputs

IT Configuration Examples—Accessories—I/O Card (Option



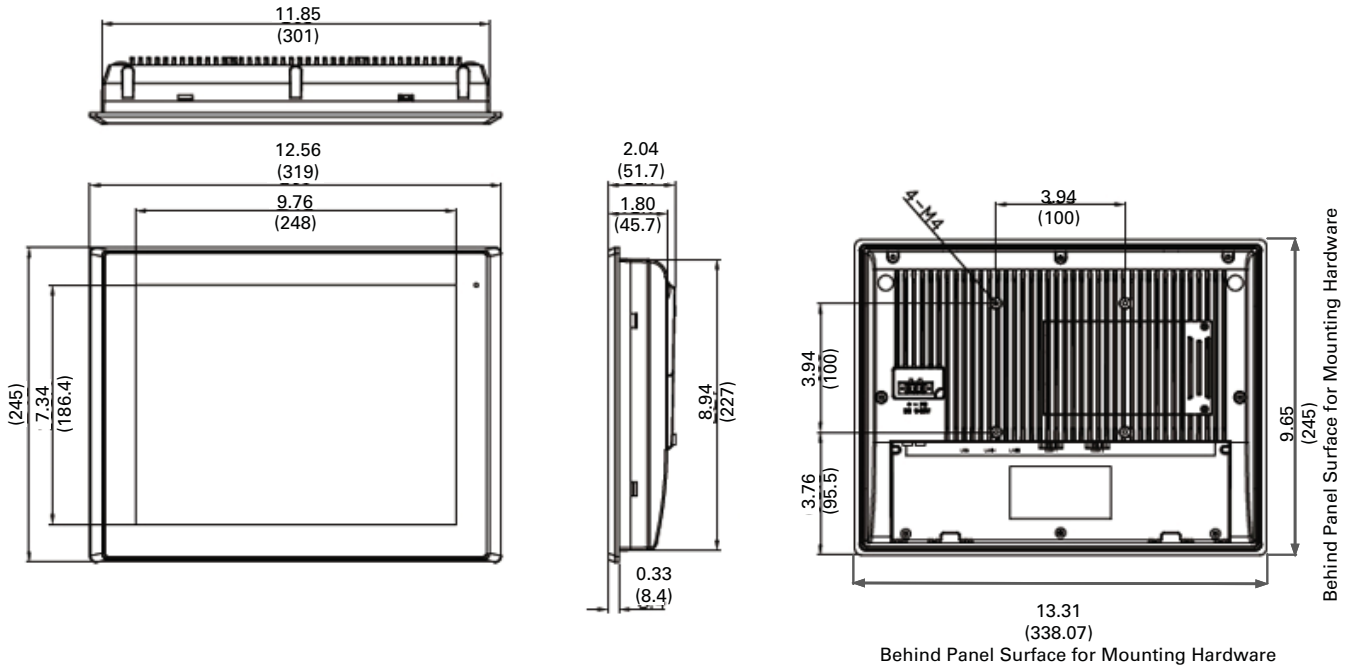
- 8 Programmable Digital Inputs
- 2 Solid-State Programmable Outputs
- 3 Relay Programmable Outputs

9

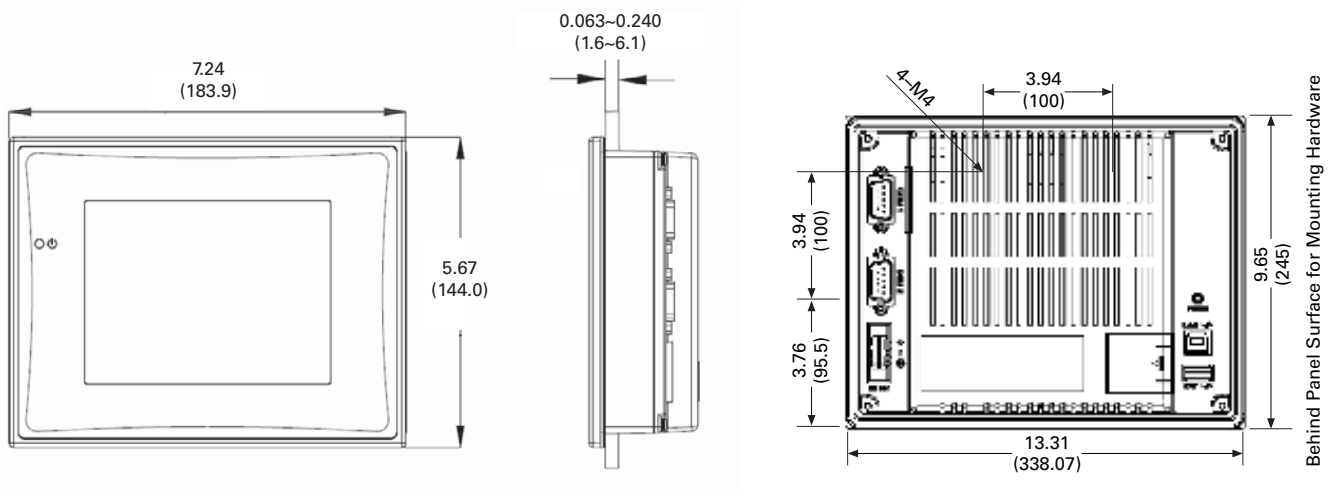
Dimensions

Approximate Dimensions in Inches (mm)

Power Xpert Meter 4000/6000/8000 12-Inch Advanced Color Touchscreen Display (PXM468K-DISP-12)—Sold Separately

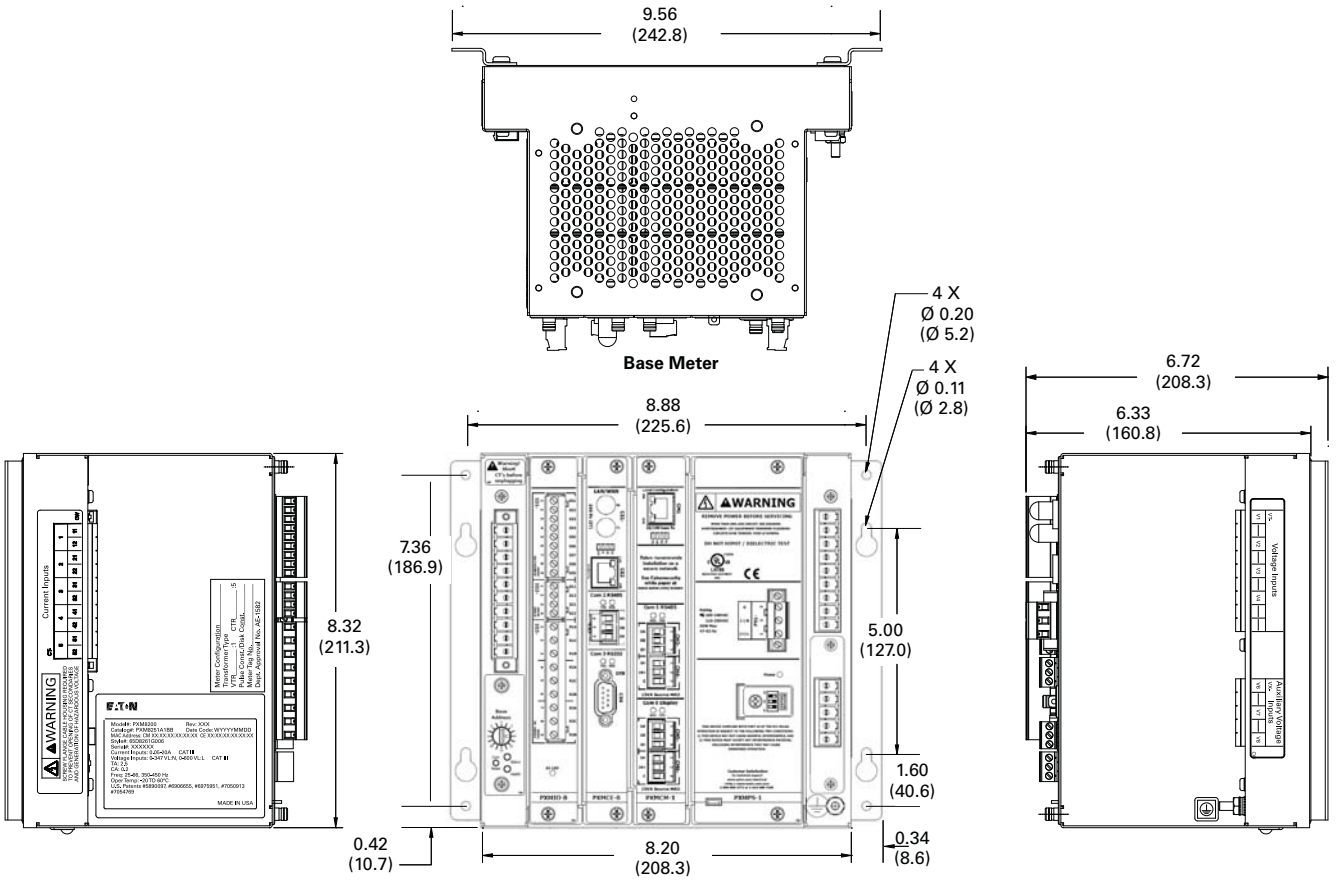


Power Xpert Meter 4000/6000/8000 6-Inch Color Touchscreen Display (PXM468K-DISP-6)—Sold Separately



Approximate Dimensions in Inches (mm)

Power Xpert Meter 4000/6000/8000 Module



Meter Base Unit

Width	Height	Depth
9.56 (242.8)	8.88 (225.6)	6.72 (170.8) ①

Display Unit

Height	Width	Depth
Projection In Front of Panel Surface		
9.02 (229.0)	7.80 (198.1)	1.04 (26.3)
Behind Panel Surface		
9.02 (229.0)	7.80 (198.1)	1.45 (36.8)

Note

① Including optional wall mounting brackets.

Power Xpert Branch Circuit Monitor (PXBCM)



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	
Power Xpert Multi-Point Meter	**V3-T9-56**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

Power Xpert Branch Circuit Monitor (PXBCM)

Product Description

Eaton's Power Xpert Branch Circuit Monitor (PXBCM) provides Ethernet access to current, voltage, power and energy readings. BACnet/IP and Modbus TCP protocols enable simple integration into facility building management and power monitoring systems.

The PXBCM provides ANSI C12.20 0.5% revenue accuracy for panelboard applications and satisfies energy code requirements to meter energy by branch circuit and report energy consumption by load group.

Overload alerts empower high-performance customers, such as data centers, optimize server capacity and avoid costly downtime due to unexpected circuit breaker overload trips.

Application Description

PXBCM is ideally suited to handle submetering in low-voltage power distribution equipment applications such as distribution boards in residential or multi-tenant buildings, PDUs in data center applications, and separately installed enclosures for retrofit metering needs.

Meter module strips support 1-inch pole spacing for branch circuits up to 100 A and are available with up to 21current transformers (CTs). External meter modules support flexible design with 333 mV or 100 mA current sensors for up to 100 circuits. The modular form factor makes PXBCM easy to scale for 18-, 30-, 42- and 84-circuit panelboard applications.

Circuits can be grouped into virtual meters representing tenants or branch circuits as follows:

- 100, two-wire (single-pole)
- 48, three-wire (two-pole)
- 32, four-wire (three-pole)

Features and Benefits

- Intuitive, secure web interface provides the ability to access live energy readings remotely and facilitates data integration
- Downtime is minimized or prevented by overload alerts that indicate when the circuit is close to exceeding its threshold
- Energy usage can be confidently tracked with ANSI C12.20 (0.5%) system accuracy for cost allocation
- Modular form factor supports design flexibility and cost efficiency by only monitoring what is needed (from 25 to 100 circuits per system)
- Supports ASHRAE 90.1 compliance by providing end users the ability to monitor branch circuits and aggregate loads by type

Standards and Certifications

PXBCM is designed and tested to meet the stringent requirements for:

- UL 61010-1
- CAN/C22.2
- CE mark
- EMC EN61326
- IEC 61000-4-X level 3

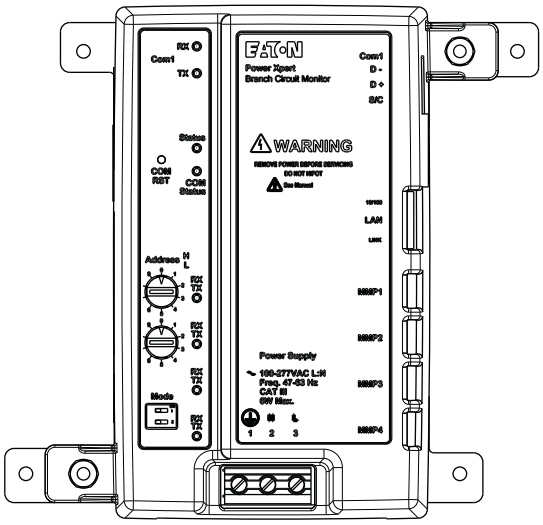
Product Selection

Meter Base

Each PXBCM system requires one meter base. Each meter base can accept up to four meter module options. Meter bases are available in two versions:

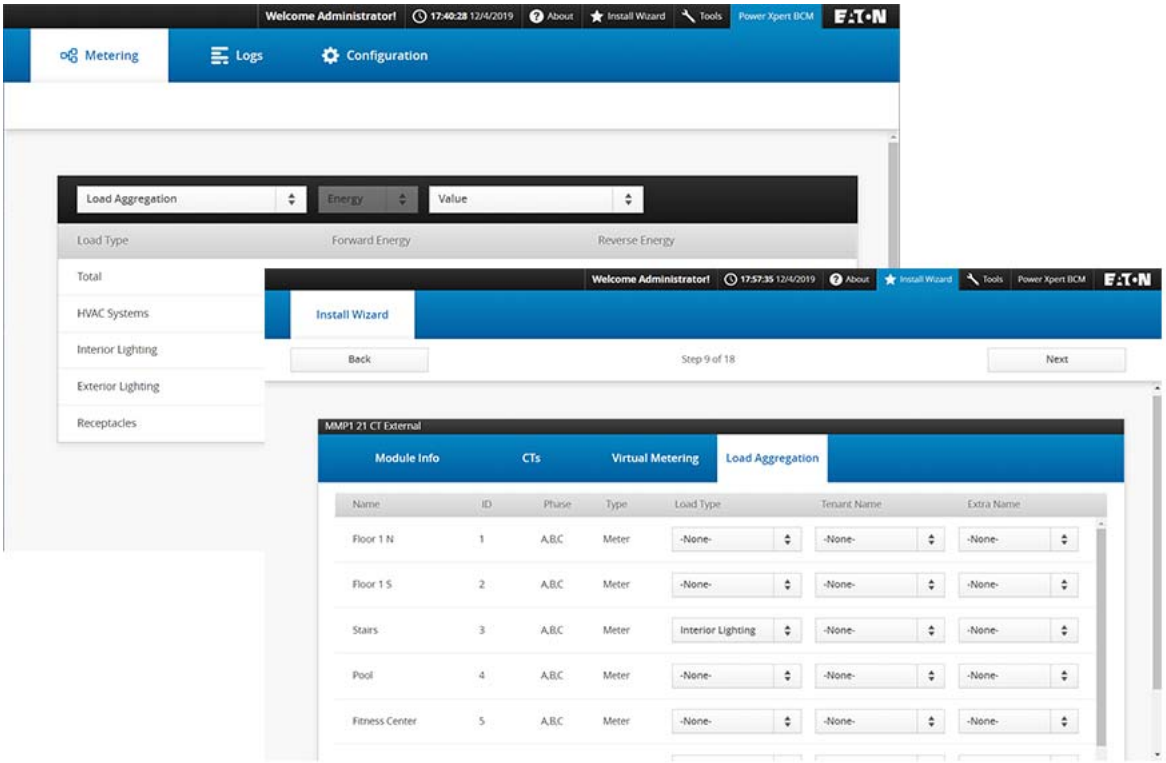
- **BASIC (PXBCM-MB-BASIC)**
  The economy high-density panelboard meter.
  - Provides essential monitoring (volts, amps, watts, VA, power factor, demand)
  - Scalable for up to 100 circuits
  - Secure onboard web interface for monitoring
- **ENERGY CODE (PXBCM-MB-ENERGY)**
  The panelboard meter designed for tenant metering applications.
  - Includes all the functionality of the PXBCM-MB-BASIC
  - Log data and export as CSV
  - 15-minute data logging retained for 3 years:
    - Virtual meter power demand
    - Virtual meter forward and reverse energy
  - Aggregate virtual meters into ASHRAE 90.1 or California Title 24 load groups

Meter Base Mounting Drawing



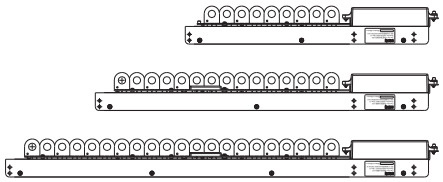
Energy Code Load Grouping Configuration and Reporting

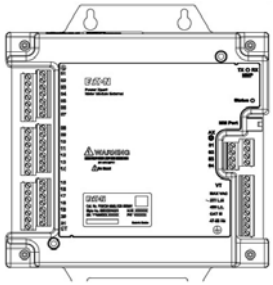
Load aggregation support for energy code requirements in PXBCM-MB-ENERGY.

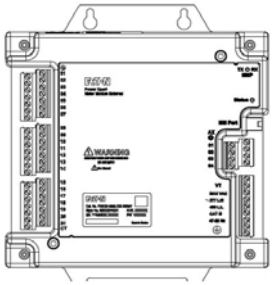


Meter Modules

Up to four metering options can be selected for each meter base. Each requires a meter module port cable to connect to the meter base. Meter module strips are available in left or right versions, designating the edge of the module the CT strip aligns.







Description	PXBCM-MMS-LXX-A PXBCM-MMS-RXX-A	PXBCM-MME-X25-333MV	PXBCM-MME-X21-100MA
100% breaker current rating	100 A	Up to 2000 A	100 A, 200 A
Breaker pole-to-pole spacing	1 inch	Flexible	Flexible
CT type	Solid	Split	Solid
Current sensor inputs	9, 15 or 21 pre-mounted current sensors 4 auxiliary (333 mV)	Up to 21 feeders (333 mV) 4 auxiliary (33 3 mV)	Up to 21 feeders (333 mV) 4 auxiliary (333 mV)
Accuracy	ANSI C12.20 0.5%	ANSI C12.20 0.5%	ANSI C12.20 0.5%
Best for	Lighting, plug loads, small motors (PRL 1a, 2a, 3e panelboards, Pow-R-Command) CTEP certified	Retrofit for branch circuit monitoring/ energy code compliance Large ampacity circuits (mains or large feeders)	Regulated tenant metering applications

Note: 333 mV metered channels: ANSI C12.20 0.5% class transformer rated meter accuracy.
For PXBCM-MMS, substitute 09, 15 or 21 for XX to designate number of mounted CTs (e.g., PXBCM-MMS-L21-A; PXBCM-MMS-R09-A).

Meter Module Port Cable

Each meter module strip or meter module external requires a meter module port cable to connect to the meter base. No more than two packs are required for each meter base. All cables are sold in packs of two.

Catalog Number	Length
PXBCM-MMP-CBL6I	6 inches
PXBCM-MMP-CBL01	1 ft
PXBCM-MMP-CBL02	2 ft
PXBCM-MMP-CBL03	3 ft
PXBCM-MMP-CBL04	4 ft
PXBCM-MMP-CBL06	6 ft
PXBCM-MMP-CBL08	8 ft
PXBCM-MMP-CBL12	12 ft
PXBCM-MMP-CBL16	16 ft
PXBCM-MMP-CBL20	20 ft
PXBCM-MMP-CBL28	28 ft
PXBCM-MMP-CBLEX08	8 ft extension
PXBCM-MMP-CBLEX16	16 ft extension

Accessories

Display

A local display option is available for the PXBCM. This display includes one 4 ft data cable to connect between the PXBCM-MB and the display.

- 640 x 480 pixel backlit VGA touch screen display
- Power: 24 Vdc input
- Height: 5.24 in (133 mm)
- Width: 6.81 in (173 mm)
- Depth: 1.54 in (39 mm)
- Weight: 1.32 lb (600 g)
- Cutout dimensions: 4.61 x 6.18 inches (117.0 x 157.0 mm)

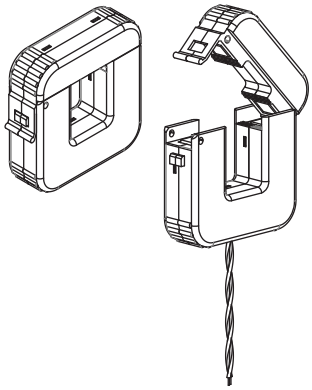
Description	Dimensions	Catalog Number
BCM local display	5.7-inch diameter display	**PXBCM-DISP-6-XV**
BCM replacement local display cable	4 ft length	**PXBCM-DISP6XV-DAT**

Cables

For replacement cables to connect between the local display and PXBCM, reference Display. For cables to connect between the PXBCM Meter Base and PXBCM Meter Modules (strips or external), reference Meter Module Port Cable.

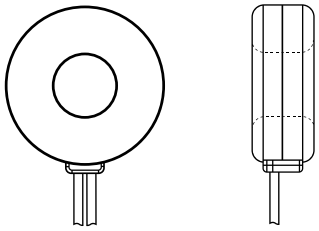
Current Sensors

333 mV Current Sensors



Split-core 333 mV sensors can be connected to the four auxiliary current inputs on the BCM-MMS or BCM-MME as well as any of the 21 current inputs on the PXBCM-MME-X25-333MV. A variety of window sizes and ratios are available.

100 mA Current Sensors



100 mA current sensors can be connected to any of the 21 current inputs on the PXBCM-MME-X21-100MA. A selection of solid core 100 mA sensors are available. Refer to the Current Sensors section of this catalog for ordering information.

Dimensions

Approximate dimensions in inches. Dimensional drawings and full specifications are available in TD150021EN.

Catalog Number	Dimensions (H x W in inches)
PXBCM-MB	Mounting footprint: 6.25 x 6.95 Chassis: 6.69 x 4.12
PXBCM-MME	Mounting Footprint: 8.53 x 7.66 Chassis: 6.93 x 7.70
PXBCM-MMS-X09-A	Overall: 16.93 x 2.96; includes 5.85 x 2.96 chassis Strip width: 1.37
PXBCM-MMS-X15-A	Overall: 22.93 x 2.96; includes 5.85 x 2.96 chassis Strip width: 1.37
PXBCM-MMS-X21-A	Overall: 28.93 x 2.96; includes 5.85 x 2.96 chassis Strip width: 1.37
PXBCM-DISP-6-XV	5.24 x 6.81 x 1.54

Power Xpert Multi-Point Meter



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Power Xpert Multi-Point Meter Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

Power Xpert Multi-Point Meter

Product Overview

Eaton's Power Xpert Multi-Point Meter is an ANSI C12.20 revenue class web-enabled electronic submetering device that can be mounted in panelboards switchboards or enclosures. When mounted in a panelboard or a switchboard, the Power Xpert Multi-Point Meter provides customers with an integrated power distribution and energy metering solution that saves space, reduces installation labor and lowers total cost.

The Eaton Power Xpert Multi-Point Meter (PXMP Meter) offers a highly modular approach to high-density metering applications in electrical power distribution systems. The PXMP Meter is compatible with most three-phase industrial, commercial and single-phase residential low voltage electrical power systems. The PXMP is equipped with two Modbus® RTU communication ports for local display and remote serial communications. The PXMP also has optional pulse input and digital output modules along with one standard digital output and three digital inputs. The PXMP Energy Portal Module is web enabled, making it suitable for use with Ethernet networks and modems.

Product Description

The Power Xpert Multi-Point Meter can measure up to any of the following number of circuits:

- Sixty single-phase, two-wire (single-pole)
- Thirty single-phase, three-wire (two-pole)
- Twenty three-phase, four-wire (three-pole)

The circuits listed above can be mixed provided that the total number of current sensors does not exceed 60. The meter provides current; voltage; power factor; demand and active, reactive, and real power (VA, var, kW); and active, reactive, and real energy (VA, var, kWh) measurements for each load. The unit also provides up to two years at 15-minute intervals or eight years at one-hour intervals of demand data logging storage in non-volatile memory for up to 60 submeters.

The Power Xpert Multi-Point Meter can be used with three different ratings of current sensors: 100 mA, 10 mA or 333 mV. Switchboard/panelboard applications will use the 100 mA current sensors, which are highly accurate, self-protecting in the event of an open circuit condition under load and are supplied with an integral plug-in connector. The PXMP automatically detects the rating of the current sensor that is connected.

The PXMP can also use 10 mA current sensors that were previously installed for IQMESII retrofit applications. Additionally, the PXMP can use 333 mV split core current sensors for retrofit applications where metering has not previously existed. The 10 mA and 333 mV current sensors are also self-protecting in the event of an open circuit condition under load.

Application Description

The Power Xpert Multi-Point Meter is ideally suited to handle submetering in low voltage power distribution equipment applications such as distribution boards in multi-tenant buildings, comprehensive main and feeder metering in commercial/industrial switchboards or medium voltage distribution equipment with the use of voltage and current transformers.

The Power Xpert Multi-Point Meter provides a cost-effective solution for residential or commercial metering installations. Typical installations include:

- High-rise buildings
- Government institutions
- K–12, universities and campuses
- Office buildings
- Medical facilities
- Apartment and condominium complexes
- Airports
- Shopping malls
- Industrial sites
- Mixed-use facilities

Features

- Monitors power and energy for up to 60 current sensors; space-saving modular design allows measurement from 1 to 60 circuits
- Built-in communication interfaces
- Monitors single-phase and three-phase loads from 120 to 600 Vac
- Monitors current, voltage, power factor, frequency, power and energy
- Stores extensive energy profile data for each metering point; can be used to identify coincidental peak demand contribution
- LEDs provide status of unit communication activity and verify sensor connections
- Meets rigid ANSI C12.20 accuracy specifications for revenue meters
- Three standard digital inputs and eight pulse inputs per optional module to monitor WAGES (water, air, gas, electric, or steam)
- One standard digital output and eight digital outputs per optional module for alarm indication
- Three types of meter modules to support 10 mA, 100 mA or 333 mV sensors
- Can be directly mounted in a UL Listed panelboard, switchboard or enclosure
- 256 MB of memory in meter base for up to two years of 15-minute interval data (eight years of one-hour interval data) for eight demand values up to 60 submeters

Communication Capabilities

With the Power Xpert Multi-Point Meter's built-in communication capabilities, remote meter reading and monitoring functions can be integrated into both new and retrofit applications.

- Standard Modbus RTU
- Optional Modbus TCP / BACnet/IP / SNMP / HTTP / SMTP / NTP /SFTP communications

Software Compatibility

The Power Xpert Multi-Point Meter:

- Can be used as part of an electrical energy monitoring and cost allocation system
- Can be remotely monitored via onboard web pages with Eaton's optional Energy Portal Module
- Is compatible with third-party software platforms and interface devices

Configuration

- The Power Xpert Multi-Point Meter is fully configurable using Power Xpert Multi-Point configuration software that can be down-loaded free from the Eaton website at www.eaton.com/meters
- Each Power Xpert Multi-Point Meter module can be configured for up to six metering points in any combination of single-phase and three-phase metering points corresponding to the voltage wiring of the meter base
- Power Xpert Multi-Point configuration software simplifies system commissioning and startup; PXMP configuration software supports both online and offline configurations

Easy to Install

- UL Listed for mounting inside panelboards (e.g., PRL4), switchboards, and NEMA 12 enclosures
- Quick connect terminals for current sensors, Modbus communications, and bus voltages make wiring the unit quick and easy

Features

Description	Main/Aggregate	Channel Data	Tenant
Instrumentation			
Current, per phase	■ ①	■	—
Voltage, per phase (L-L, L-N)	■	■	—
Frequency	—	■	■
Minimum/maximum readings, V	Per phase	—	—
Minimum/maximum readings, W, var, VA	Total and per phase	—	—
Minimum/maximum readings, PF, F	Total	—	—
Power			
Real, reactive, and apparent power (W, var, VA)	Total and per phase	Total and per phase	Total
Power factor	—	Average	Average
Demand			
Block interval (fixed, sliding)	■	—	—
Real, reactive and apparent power demand	Total and per phase	—	—
Minimum/maximum readings, PF, W, var, VA	Total and per phase	Total	—
Energy			
Real, reactive and apparent energy (Wh, varh, VAh)	Total	—	Total
Real, forward and reverse, and total (Wh)	■	—	■

Note

① Main only.

Standards and Certifications

Environmental

The PXMP Meter and current sensors must be housed in a NEMA or UL enclosure that keeps the internal environment within the PXMP's environmental specification ranges and provides suitable fire and mechanical protection in the end product installation.

- Temperature range: –20 °C to +70 °C (–4 °F to +158 °F)
- Storage temperature range: –40 °C to +85 °C
- Humidity: 5–95% noncondensing environment
- Pollution degree: II
- Elevation: 0 to 9843 ft (0 to 3000 m)
- Housing: IP20
- CE Mark
- EMC EN61326

Emissions Conducted and Radiated

- FCC part 15 Class B
- CISPR 11 Class B

Electromagnetic Immunity

Standard	Description	Level
EN61000-4-2	ESD	3
EN61000-4-3	RF radiated	3
EN61000-4-4	Electrical fast transient	3
EN61000-4-5	Surge	3 ①
EN61000-4-6	RF conducted	3
EN61000-4-11	Volt sag/swell/variation	—

Product Safety

- IEC/EN61010-1
- UL 61010-1 File E185559
- CNL evaluation to CAN/C22.2 No 1010.1.92

Accuracy

- ANSI C12.20—Accuracy Class 0.5% with either CSXXX or PXMP-CSXXX sensors
  - Measurement Canada Approval Pending

UL Listed

Product Selection

The Power Xpert Multi-Point Meter, current sensors, and other accessories can be ordered from Eaton distributors. Refer to the following catalog numbers when ordering.

Power Xpert Multi-Point Meter Products

Product Description	Catalog Number
Meter Bases and Meter Modules with ABCN Voltage Inputs	
PXMP meter base—three-phase with ABCN voltage inputs	**PXMP-MB**
PXMP meter module with six 100 mA inputs for use with PXMP current sensors	**PXMP-MM100MA**
PXMP meter module with six 10 mA inputs for use with IQMESII current sensors	**PXMP-MM10MA**
PXMP meter module with six 333 mV inputs for use with 333 mV current sensors	**PXMP-MM333MV**
Meter Bases and Meter Modules with ABN Voltage Inputs	
PXMP meter base—single-phase, three-wire with ABN voltage inputs	**PXMP-MB-AB**
PXMP meter module with six 100 mA inputs for use with PXMP current sensors	**PXMP-MM100MA-AB**
PXMP meter module with six 10 mA inputs for use with IQMESII current sensors	**PXMP-MM10MA-AB**
PXMP meter module with six 333 mV inputs for use with 333 mV current sensors	**PXMP-MM333MV-AB**
IO Modules	
PXMP meter pulse input module with eight inputs	**PXMP-PIM**
PXMP meter digital output module with eight outputs	**PXMP-DOM**
Communication Module	
PXMP meter energy portal module	**PXMP-EPM**
Current Sensor Kits	
KIT, PXMP CS125 sensor, quantity of 3	**PXMP-CS125-3**
KIT, PXMP CS250 sensor, quantity of 3	**PXMP-CS250-3**
KIT, PXMP CS400 sensor, quantity of 3	**PXMP-CS400-3**
Current Sensor Cable Kits	
KIT, PXMP sensor cable, 4 ft (1.2 m), quantity of 3	**PXMP-SC4-3**
KIT, PXMP sensor cable, 6 ft (1.8 m), quantity of 3	**PXMP-SC6-3**
KIT, PXMP sensor cable, 8 ft (2.4 m), quantity of 3	**PXMP-SC8-3**
KIT, PXMP sensor cable, 12 ft (3.7 m), quantity of 3	**PXMP-SC12-3**
Current Sensor Extension Cable Kits	
KIT, PXMP sensor extension cable, 8 ft (2.4 m), quantity of 3	**PXMP-SCE-8-3**
KIT, PXMP sensor extension cable, 16 ft (4.9 m), quantity of 3	**PXMP-SCE-16-3**
Interface Modules	
PXMP current sensor interface module for 333 mV, kit X 3	**PXMP-IM333MV-3**

Note

Total sensor lead length must not exceed 28 ft (8.5 m).

The Pulse Input Module (PXMP-PIM) can be used to totalize pulse outputs from water meters, gas meters, steam meters or even old electrical meters with KZ pulse outputs. The PXMP-PIM can also be used for status monitoring in applications where status indication updates of 6 seconds over Modbus satisfies the application requirement.

Support products for the Power Xpert Multi-Point Meter include the HMI display, IMPCABLE and power supplies as described in the table below.

Power Xpert Multi-Point Meter Support Products

Product Description	Catalog Number
Communication cable, 1000 ft (305 m), 600 V insulation	**IMPCABLE**
PXMP meter display—6-inch color touchscreen (with cable)	**PXMP-DISP-6**
Power supply—single-phase 90–264 Vac, 24 Vdc at 2.5 A	**PSG60E**
Power supply—three-phase 360–575 Vac, 24 Vdc at 2.5 A	**PSG60F**
Power supply—three-phase 600 Vac, 24 Vdc	**PSS55D**

Meter Selection

	Meter Base		Typical Applications			
Meter Module	Three-Phase Application or Single-Phase with ABCN	Single-Phase Application with ABN	New Switchboards PXMP Current Sensors, Solid Core, PXMP-CSXXX, Ampere Ratings	Retrofit Existing IQMESII Sensors, Solid Core, CS-XXX, Ampere Ratings	Enclosed PXMP 333MV Sensors, Split Core, CS-SP-X-XXXX-333MV, Ampere Ratings	Enclosed PXMP Interface Modules
PXMP-MM100MA	**PXMP-MB**	—	125, 250, 400	—	—	—
PXMP-MM333MV	**PXMP-MB**	—	—	—	100, 200, 300, 400, 600, 800, 1000, 1200, 1600, 2000 ①	**PXMP-IM333MV**
PXMP-MM10MA	**PXMP-MB**	—	—	5, 50, 70, 125, 200, 400	—	—
PXMP-MM100MA-AB	—	**PXMP-MB-AB**	125, 250, 400	—	—	—
PXMP-MM333MV-AB	—	**PXMP-MB-AB**	—	—	100, 200, 300, 400, 600, 800, 1000, 1200, 1600, 2000 ①	**PXMP-IM333MV**
PXMP-MM10MA-AB	—	**PXMP-MB-AB**	—	5, 50, 70, 125, 200, 400	—	—

Note

① For applications requiring more than 2000 A current sensors, use a CS005 with 5 A CT in conjunction with PXMP-MM10MA.

Technical data and Specifications

External Circuit Group Specifications

PXMP-MB (-AB) Meter base

Discrete Output

- Quantity 1—solid-state relay Form A NO Bidirectional FET
- Polarity of external source is not important
- Isolation circuit to ground 2 kV/1 min.
- Maximum external source voltage 28 Vdc
- Line-to-line TVS clamp across switching element at 32 Vdc
- Solid-state relay on resistance 35 ohms maximum
- Maximum load current 80 mA
- Minimum pulse width 20 milliseconds
- Fixed 25 milliseconds for pulse initiator function
- Maximum pulse rate 25 Hz
- Wiring to two-position removable terminal plug
  - 12–18 AWG (3.31–0.82 mm^2), wire ferrules recommended
  - T1 (polarity not important)
  - T2 (polarity not important)

Discrete Inputs

- Quantity 3, common circuits inputs 1–3
- Group isolation 2 kV
  - No input-to-input circuit isolation
- All inputs per module share a common external 24 V (±10%) supply
  - 24 V externally sourced between common and inputs
  - Design to interface with external dry contact
  - Input impedance ~2.2K ohms
  - Input current draw ~10 mA per input
- Minimum pulse width 10 milliseconds
- Maximum pulse rate 20 Hz
- Wiring to four-position removable terminal plug
  - 12–18 AWG (3.31–0.82 mm^2), wire ferrules recommended
  - T3—Common (connect ext. 24 common here)
  - T4—Input 1 (dry contact to 24 V hot)
  - T5—Input 2 (dry contact to 24 V hot)
  - T6—Input 3 (dry contact to 24 V hot)

COM1 and COM2 RS-485 Serial Ports

- No D+/D– biasing reliance on fail-safe driver and biasing at Master
- Baud rate configurable between 9600–115K baud (default)
- Use cable designed for RS-485 communications
  - Low L:L capacitance
  - Impedance of ~100–120 ohms
  - Shield—Mylar for high frequency; Braid for low frequency
  - Separate common and shield for best noise immunity
  - Maximum cable length is 4000 ft (1219.2 m) with 32 nodes at 19.2K baud increased data rates will reduce maximum cable distance
  - 2000 ft (609.6 m) with 32 total nodes at 115.2K baud
- Isolation 300 V to ground due to TVS diode clamps
- Modbus RTU slave protocol, address defined by rotary switch
- Green Rx and Red Tx LEDs per channel
- Data + > Data—during idle marked, logic 1 state
- End of Line Termination resistance should match cable impedance (typ. 100–120 ohms)
- Four-position removable terminal plug 18–22 AWG (0.82–0.33 mm^2) typical, wire ferrules recommended
  - COM1
    - T7—Shield
    - T8—RS-485 common
    - T9—Data –
    - T10—Data +
  - COM2
    - T11—Shield
    - T12—RS-485 common
    - T13—Data –
    - T14—Data +

PXMP-MB Power Supply Input

- 24 Vdc ±20%
- 15W maximum load
- 1 kV isolation barrier internal to PXMP-MB
- Externally fuse circuit to protect wire
- Green power OK LED
- Three-position terminal block 16–12 AWG (1.31–3.31 mm^2), wire ferrules recommended
  - T15—24 Vdc – (common)
  - T16—24 Vdc + (Hot)
  - T17—Shield (optional) capacitively referenced to chassis ground for enhanced EMC performance

Meter Voltage Inputs

- Overvoltage CAT III
- Maximum voltage rating
  - 480VL:G (corner grounded delta)
  - 347VL:N
  - 600VL:L
- Frequency rating 47–63 Hz
- Metering range (temporary transitions)
- 30–700VL:N
- 30–700VL:L
- Abuse withstand rating 1000 V sustained
- High pot withstand rating 2500 V/1min
- Input impedance 4M ohms
- Fuse inputs rated to protect wiring to mains. External fuses
- must be installed between the meter voltage terminal and the mains disconnect switch to the main lines to protect the lines. 600 V 1 A BUSS type KTK-R-1 Fast Acting or equivalent fuses
- are recommended.
- Wiring to removable terminal plug 10–18 AWG (5.26–0.82 mm^2), wire ferrules recommended
- T18—N (VR)
- T19—C (V3)
- T20—B (V2)
- T21—A (V1)

PXMP meter modules (PXMP-MMs)

Compatible with all PXMP Meter Base slots 1–10 LED indicators:

- Health and status green, blink to show activity
- Pulse energy output one red per group of three loads
- Load energy direction red/green pair per load

All variations support six load inputs.

Current sensor connection is one 2 x 2 connector per load.

Compatible with PXMP-SCXX sensor cables, total cable length to the sensor should not exceed 28 ft (8.5 m).

Note that -AB suffix only affects what voltage channels the loads are paired with for metering purposes.

PXMP-MM10MA supports the CSXXX series of 10 mA maximum secondary output current transformers.

PXMP-MM100MA supports the PXMP-CSXXX series of 100 mA maximum secondary output current transformers.

PXMP-MM333MV supports 333 mV maximum secondary output current transformers with the use of the PXMP-IM333MV interface module.

PXMP digital output module (PXMP-DOM)

- Compatible with all PXMP-MB slots 1–10
- LED indicators
  - Health and status green, blink to show activity
  - Output On/Off status one green per output
  - Eight individual solid-state relay outputs
- Each circuit rated for 24 Vdc (±20%) with an 80 mA load maximum
- 24 Vdc is externally sourced
- Group isolation to ground 2 kV
- Each circuit has its own separate common, circuit-to-circuit isolation 120 V
- 16-position removable terminal plug
- 12–18 AWG (3.31–0.82 mm^2), wire ferrules recommended

PXMP pulse input modules (PXMP-PIMs)

- Compatible with all PXMP-MB slots 1–10
- LED indicators
  - Health and status green, blink to show activity
  - Input On/Off status one green per pulse input
- Eight pulse inputs to external dry contacts
- Maximum pulse rate is 20 Hz
- Minimum pulse width is 20 milliseconds
- External circuit groups rated for 24 Vdc (±20%)
  - All circuits share the same electrical common
- External supply connects to the module with a two-position removable terminal plug
- The supply is internally fanned out to all circuits
- Group isolation limited to 300 V to ground due to TVS diode clamp
- Input impedance ~2.2K causing a 10 mA load per input when energized
- External circuit groups connect with a 16-position removable terminal plug
  - Terminals support 12–18 AWG (3.31–0.82 mm^2), wire ferrules recommended

PXMP energy portal module (PXMP-EPM)

- Only functionally compatible with PXMP-MB slot 10
- LED indicators
  - Top health and status green, blink to show activity
  - Com. reset button—reset to defaults
  - Local IP 192/10
  - RJ45 front-facing Ethernet configuration port LEDs
    - Link (Tx/Rx blink)
    - 10/100 speed
- LED four-stack for bottom LAN/WAN Ethernet port
  - Link (Tx/Rx blink)
  - 10/100 speed
  - DHCP/Fixed
  - TX active
- Config. Ethernet RJ45 Cat5 STP/UTP
  - 10BASE-T/100BASE-TX
  - Auto crossover capability supported
  - Java web browser interface
- Bottom facing LAN/WAN Ethernet port
  - RJ45 Cat5 STP/UTP 10BASE-T/100BASE-TX
  - STP required for full electromagnetic immunity
  - Auto crossover capability supported
  - Supports Modbus TCP and Java web browser interface
- Bottom-facing telephone modem interface
  - Modem type V92/56K baud
  - RJ11 field interface

Power Xpert Multi-Point Meter System—Hardware Specifications

Components	Field Circuit	Power Source	Rated Voltage	Rated Current	Circuit Impedance	Isolation	Note 1	Note 2
PXMP-MB PXMP-MB-AB	Digital output	External	24 ±20% ①	0.080 A maximum	35 ohms maximum	2.0 kV	—	—
	Digital input	External	24 ±20% ①	0.01 A	2.22K	2.0 kV	Up to drops supply by 2 V	Group are electrically common
	COM1 RS-485	Internal	5 V ①	—	50–60 ohms	300 V	TVS diode clamped to PE	—
	COM2 RS-485	Internal	5 V ①	—	50–60 ohms	300 V	TVS diode clamped to PE	—
	Power supply input	External	24 ±20% ①	0.7 A maximum	N/A	1.0 kV	Installation Class II input	15W maximum
	Voltage inputs A (V1)/ B (V2)/ C (V3)/ N (VR)	External mains	480 V L:G ②	0.12 mA	4M ohms	N/A	Installation Class III	High pot 2500 V/1 minimum
			347 V L:N ②	0.09 mA	4M ohms	N/A	Installation Class III	High pot 2500 V/1 minimum
			600 V L:L ②	0.09 mA	4M ohms	N/A	Installation Class III	High pot 2500 V/1 minimum
PXMP-MM100MA	CT secondary	External	N/A	100 mA	14.6 ohms	N/A	20% over-range	See sensor for primary isolation
PXMP-MM10MA	CT secondary	External	N/A	10 mA	67 ohms	N/A	20% over-range	See sensor for primary isolation
PXMP-MM333MV	CT secondary	External	0.333 V ②	N/A	50,000 ohms	N/A	20% over-range	See sensor for primary isolation
PXMP-DOM	Digital output	External	24 ±20% ①	0.080 A maximum	10 ohms maximum	2 kV group	120 V isolation circuit-to-circuit	Isolation dependent on external source
PXMP-PIM	Pulse input	External	24 ±20% ①	0.01 A	2.22K ohms	300 V to ground	TVS diode clamped to PE; group isolated, all circuits common to 24 V external source	Note: Opto creates 2.2 V drop sourced by 2.2K ohms; isolation dependent on external source
PXMP-EPM	Ethernet 100 Bt	Internal	—	N/A	N/A	1 kV	—	—
	POT modem	Internal	—	N/A	N/A	—	—	—

Notes

① DC.

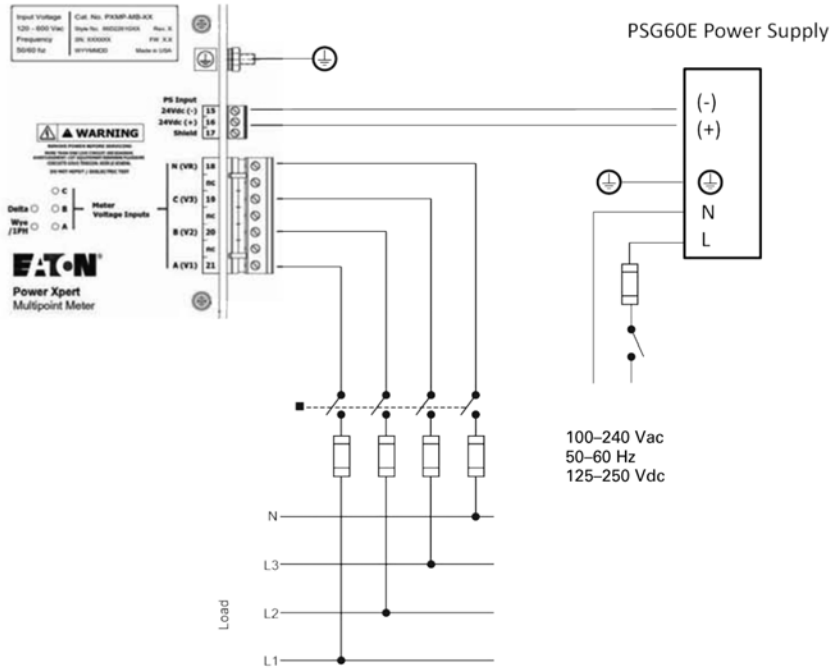
② AC rms.

Wiring Diagrams

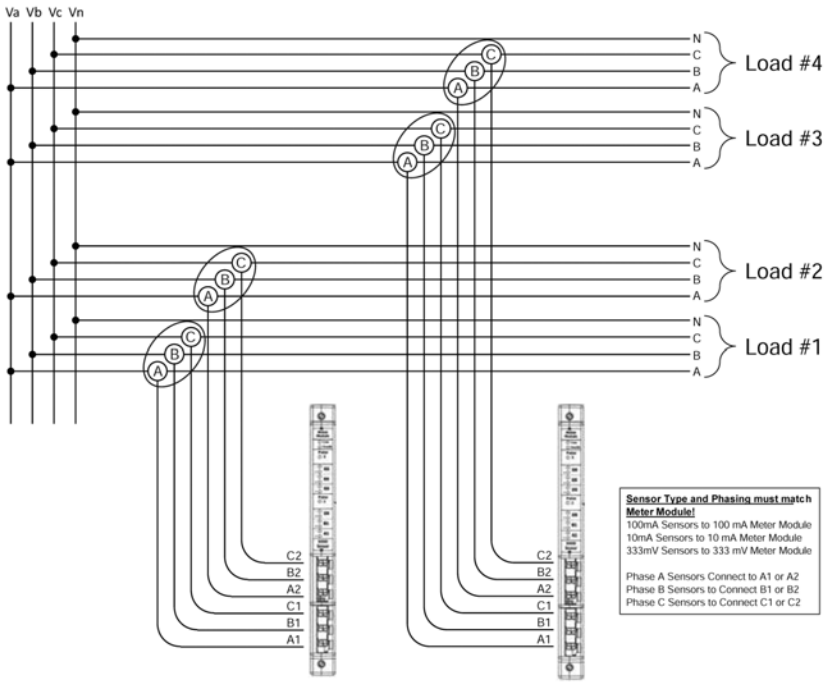
Wiring for PXMB-MB

Note: For all voltage connections—fuses should be sized in accordance with best practices to protect the instrumentation wire.

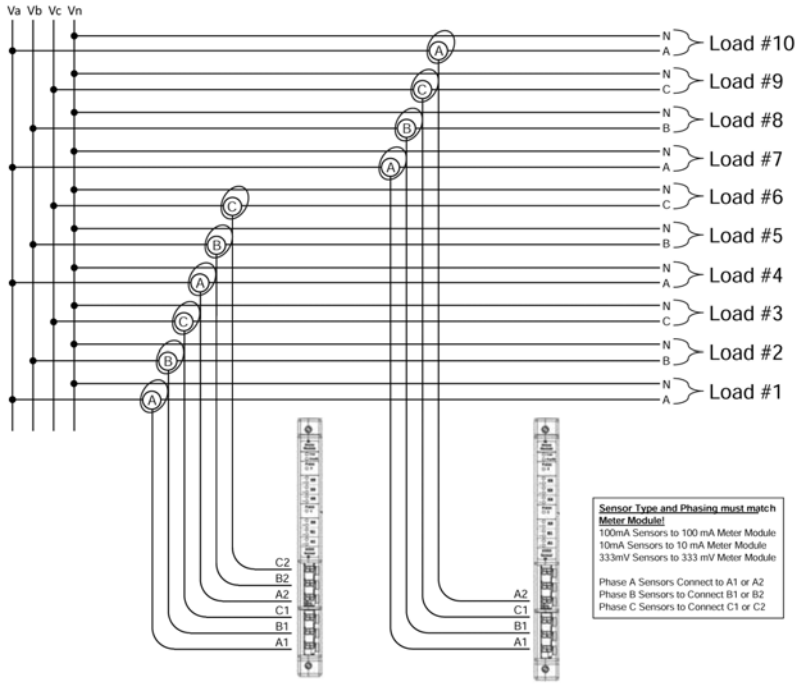
Four-Wire Wye Voltage Connection Inputs



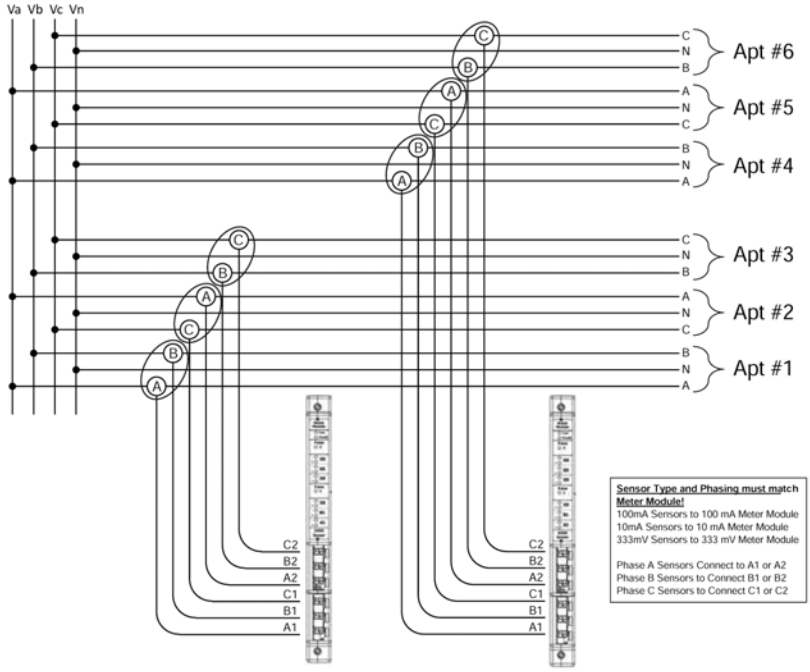
Three-Phase, Four-Wire Service Current Sensor Connections



Three-Phase, Four-Wire Service (Ten Single-Phase, Single-Pole) Current Sensor Connections



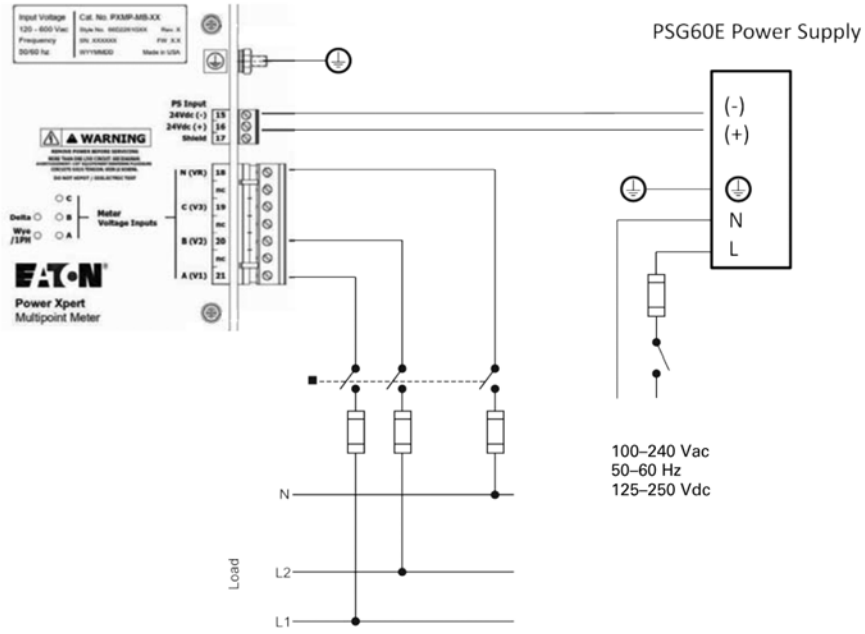
Network 120/208 Three-Wire Apartment Service Current Sensor Connections



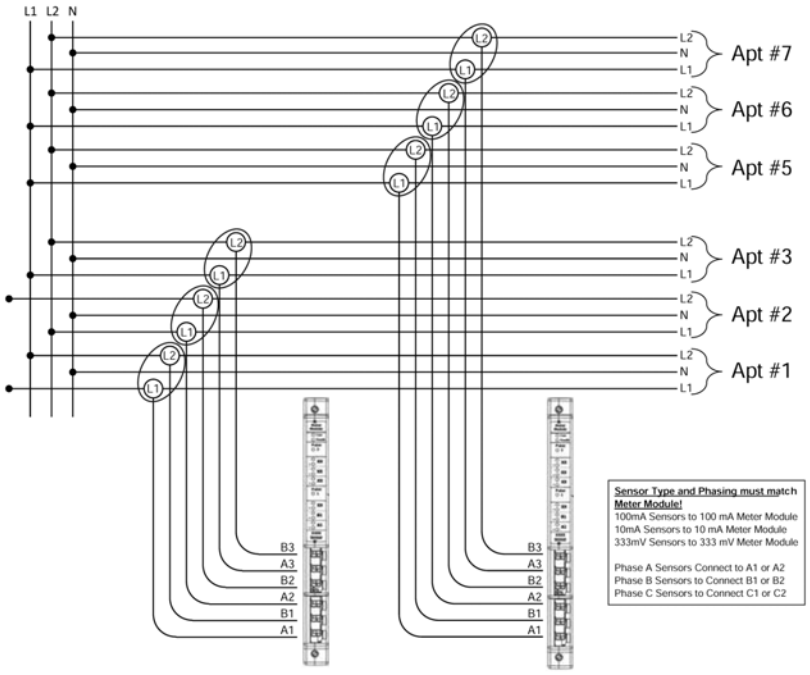
Wiring for PXMB-MB-AB

Note: For all voltage connections—fuses should be sized in accordance with best practices to protect the instrumentation wire.

Single-Phase, Three-Wire 120/240 Voltage Connection Inputs



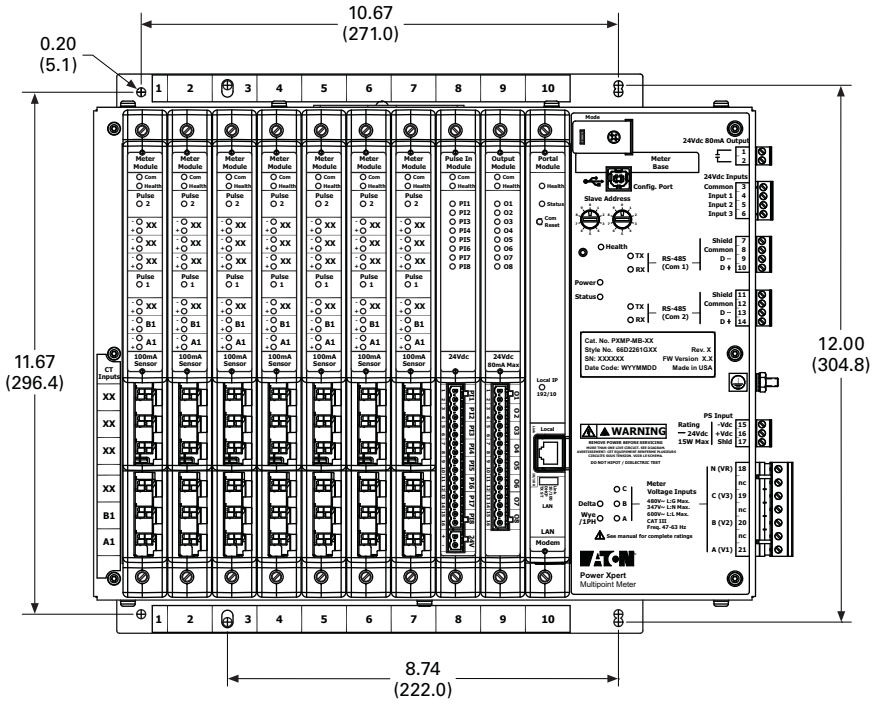
120/240 Single-Phase, Three-Wire Service Current Sensor Connections



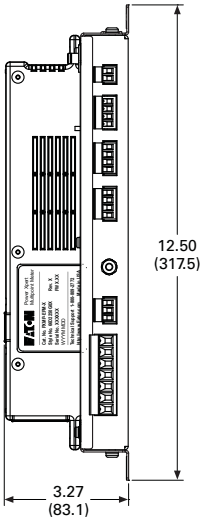
Dimensions

Approximate Dimensions in Inches (mm)

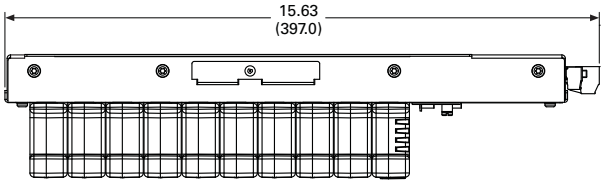
Single Unit—Front View



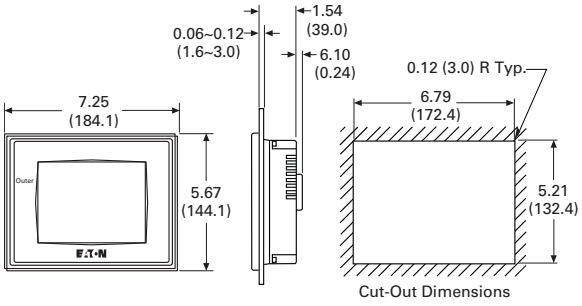
Single Unit—Side View



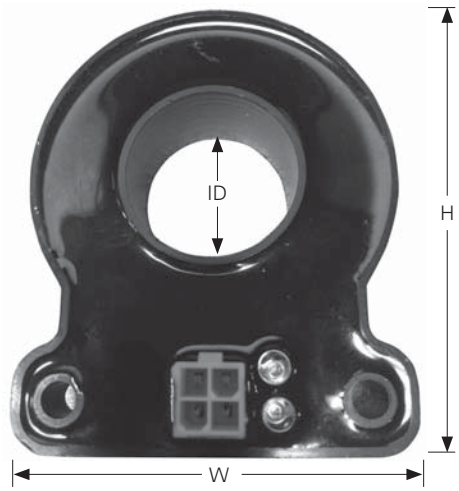
Single Unit—Top View



PXMP Color Touchscreen Display



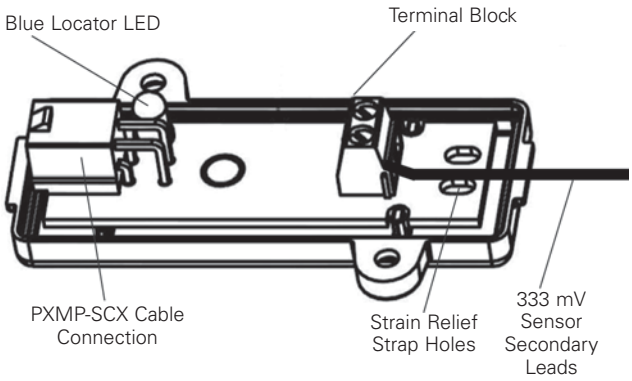
Current Sensor Dimensions



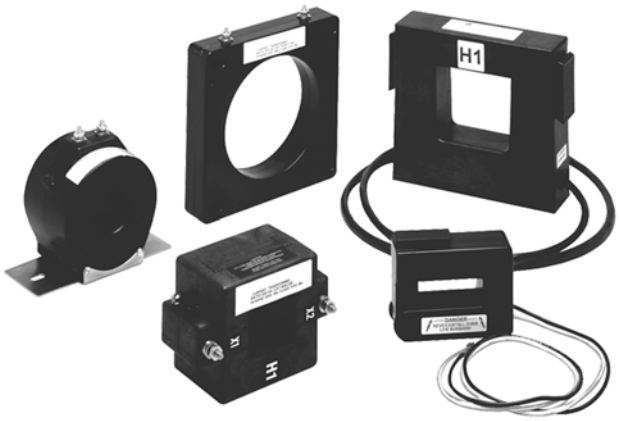
Current Sensor Dimensions

Sensor	H	W	D
PXMP-CS125	2.66 (67.6)	1.66 (42.1)	0.53 (13.5)
PXMP-CS250	2.96 (75.2)	2.42 (61.5)	1.12 (28.4)
PXMP-CS400	3.64 (92.5)	3.03 (73.2)	1.74 (44.2)

Open Interface Module (PXMP-IM333MV)



Current Transformers (CTs)



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Power Xpert Multi-Point Meter	**V3-T9-56**
Current Transformers (CTs)	
Product Selection	**V3-T9-69**
Dimensions	**V3-T9-72**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	**V3-T9-78**

9

Current Transformers (CTs)

Product Description

Eaton's low voltage current transformers are available in both solid core and split core designs. Engineered for electronic metering applications, all solid core designs and selected split core designs offer ANSI metering quality accuracy. The solid core designs also meet ANSI C57.13 relay accuracy requirements including over-ranging capabilities. The current transformer offering has a 5 ampere secondary at the rated primary current.

Split core CTs are specifically designed to be installed around primary conductors without disconnecting wires or breaking the circuit to be monitored. These current transformers are perfect solutions for energy management applications and are manufactured for installation ease.

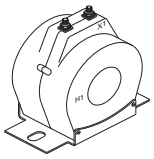
Application Description

For new construction and retrofit applications where no current transformer exists, Eaton offers a complete selection of low voltage (up to 600 V) current transformers. These current transformers can be used in commercial-grade applications, such as control panels and panelboards. Additionally, they can be used for most industrial metering and relaying applications in switchboards, switchgear and motor control centers. These CTs are intended for use with the Power Xpert Meter 2000/4000/6000/8000, IQ 250/260, IQ 130/140/150, IQ Analyzer 6400/6600, IQ DP-4000 and IQ 230 series.

Product Selection

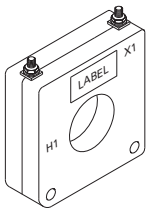
Solid Core ANSI Metering Accuracy

S060



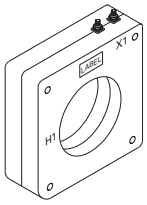
Primary Current Rating	ANSI B0.1 Metering Class at 60 Hz (Accuracy in %)	Window Size in Inches (mm) Diameter	Catalog Number	Mounting Bracket Catalog Number
1.25 (31.8) Window				
50	1.2	1.25 (31.8)	**S060-500**	①
100	0.6	1.25 (31.8)	**S060-101**	①
150	0.3	1.25 (31.8)	**S060-151**	①
200	0.3	1.25 (31.8)	**S060-201**	①

S050



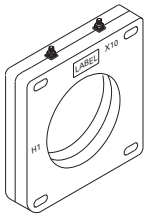
1.56 (39.6) Window				
300	0.3	1.56 (39.6)	**S050-301**	**S050BRAC**
400	0.3	1.56 (39.6)	**S050-401**	**S050BRAC**
500	0.3	1.56 (39.6)	**S050-501**	**S050BRAC**
600	0.3	1.56 (39.6)	**S050-601**	**S050BRAC**
750	0.3	1.56 (39.6)	**S050-751**	**S050BRAC**
800	0.3	1.56 (39.6)	**S050-801**	**S050BRAC**
1000	0.3	1.56 (39.6)	**S050-102**	**S050BRAC**
1200	0.3	1.56 (39.6)	**S050-122**	**S050BRAC**

S080



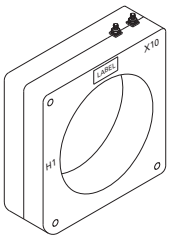
3.25 (82.6) Window				
400	0.3	3.25 (82.6)	**S080-401**	**S080BRAC**
500	0.3	3.25 (82.6)	**S080-501**	**S080BRAC**
600	0.3	3.25 (82.6)	**S080-601**	**S080BRAC**
750	0.3	3.25 (82.6)	**S080-751**	**S080BRAC**
800	0.3	3.25 (82.6)	**S080-801**	**S080BRAC**
1000	0.3	3.25 (82.6)	**S080-102**	**S080BRAC**
1200	0.3	3.25 (82.6)	**S080-122**	**S080BRAC**

S090



4.25 (108.0) Window				
500	0.3	4.25 (108.0)	**S090-501**	**S090BRAC**
600	0.3	4.25 (108.0)	**S090-601**	**S090BRAC**
750	0.3	4.25 (108.0)	**S090-751**	**S090BRAC**
800	0.3	4.25 (108.0)	**S090-801**	**S090BRAC**
1000	0.3	4.25 (108.0)	**S090-102**	**S090BRAC**
1200	0.3	4.25 (108.0)	**S090-122**	**S090BRAC**
1500	0.3	4.25 (108.0)	**S090-152**	**S090BRAC**
1600	0.3	4.25 (108.0)	**S090-162**	**S090BRAC**
2000	0.3	4.25 (108.0)	**S090-202**	**S090BRAC**
2500	0.3	4.25 (108.0)	**S090-252**	**S090BRAC**
3000	0.3	4.25 (108.0)	**S090-302**	**S090BRAC**

S025



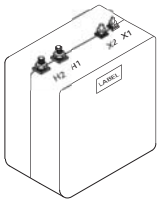
6.31 (160.3) Window				
600	0.3	6.31 (160.3)	**S025-601**	**S025BRAC**
750	0.3	6.31 (160.3)	**S025-751**	**S025BRAC**
800	0.3	6.31 (160.3)	**S025-801**	**S025BRAC**
1000	0.3	6.31 (160.3)	**S025-102**	**S025BRAC**
1200	0.3	6.31 (160.3)	**S025-122**	**S025BRAC**
1500	0.3	6.31 (160.3)	**S025-152**	**S025BRAC**
1600	0.3	6.31 (160.3)	**S025-162**	**S025BRAC**
2000	0.3	6.31 (160.3)	**S025-202**	**S025BRAC**
2500	0.3	6.31 (160.3)	**S025-252**	**S025BRAC**
3000	0.3	6.31 (160.3)	**S025-302**	**S025BRAC**
3500	0.3	6.31 (160.3)	**S025-352**	**S025BRAC**
4000	0.3	6.31 (160.3)	**S025-402**	**S025BRAC**

Note

① Contact Eaton for further information.

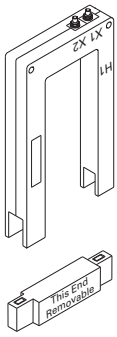
Split Core ANSI Metering Accuracy

W190



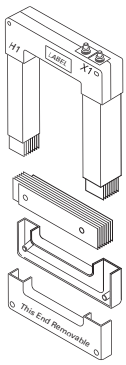
Primary Current Rating	ANSI B0.1 Metering Class at 60 Hz (Accuracy in %)	Window Size in Inches (mm)	Catalog Number
Wound and Primary CTs			
25	0.3	Wound	**W190-025**
50	0.3	Primary	**W190-050**

M000



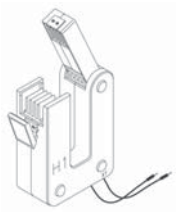
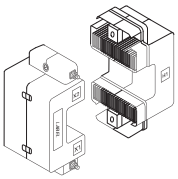
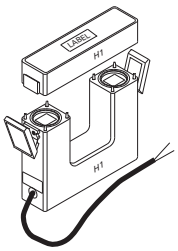
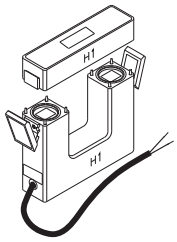
2.00 x 5.50 (50.8 x 139.7)			
400	2.4	2.00 x 5.50 (50.8 x 139.7)	**M000-401**
500	2.4	2.00 x 5.50 (50.8 x 139.7)	**M000-501**
600	2.4	2.00 x 5.50 (50.8 x 139.7)	**M000-601**
800	1.2	2.00 x 5.50 (50.8 x 139.7)	**M000-801**
1000	1.2	2.00 x 5.50 (50.8 x 139.7)	**M000-102**
1200	0.6	2.00 x 5.50 (50.8 x 139.7)	**M000-122**
1500	0.6	2.00 x 5.50 (50.8 x 139.7)	**M000-152**
1600	0.6	2.00 x 5.50 (50.8 x 139.7)	**M000-162**
2000	0.6	2.00 x 5.50 (50.8 x 139.7)	**M000-202**

M050



4.10 x 7.10 (104.1 x 180.3)			
600	4.8	4.10 x 7.10 (104.1 x 180.3)	**M050-601**
750	4.8	4.10 x 7.10 (104.1 x 180.3)	**M050-751**
800	2.4	4.10 x 7.10 (104.1 x 180.3)	**M050-801**
1000	2.4	4.10 x 7.10 (104.1 x 180.3)	**M050-102**
1200	1.2	4.10 x 7.10 (104.1 x 180.3)	**M050-122**
1500	1.2	4.10 x 7.10 (104.1 x 180.3)	**M050-152**
2000	0.6	4.10 x 7.10 (104.1 x 180.3)	**M050-202**
2500	0.6	4.10 x 7.10 (104.1 x 180.3)	**M050-252**
3000	0.6	4.10 x 7.10 (104.1 x 180.3)	**M050-302**
3500	0.6	4.10 x 7.10 (104.1 x 180.3)	**M050-352**
4000	0.3	4.10 x 7.10 (104.1 x 180.3)	**M050-402**

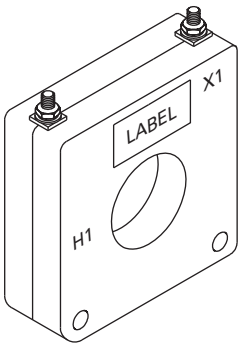
Split Core Current Transformers

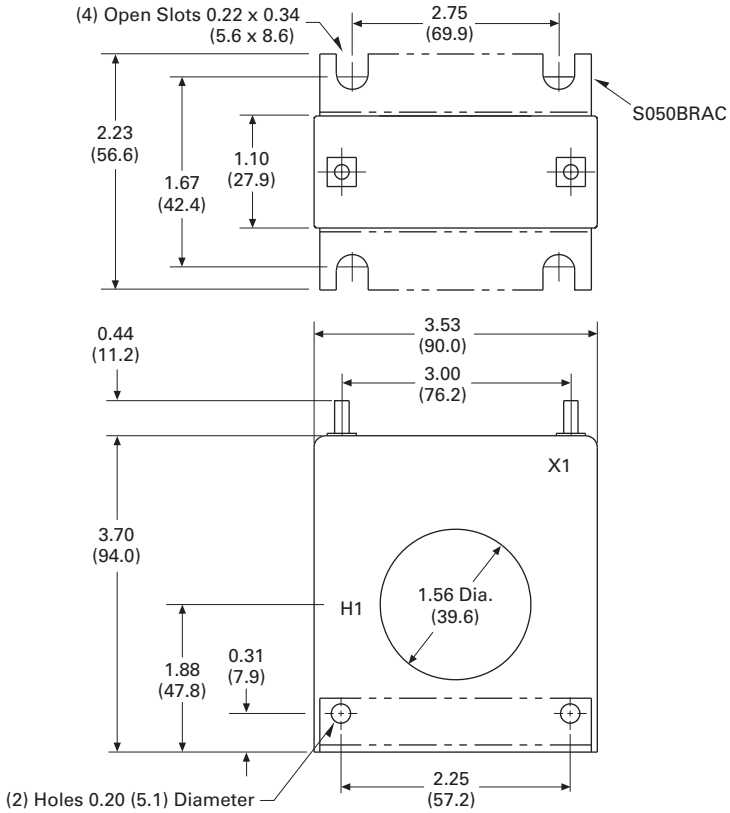
	Primary Current Rating	Accuracy at 60 Hz (in %)	Window Size in Inches (mm)	Catalog Number
M030	**0.80 x 1.95 (20.3 x 49.5)**			
	100	5.0	0.80 x 1.95 (20.3 x 49.5)	**M030-101**
	150	5.0	0.80 x 1.95 (20.3 x 49.5)	**M030-151**
	200	4.0	0.80 x 1.95 (20.3 x 49.5)	**M030-201**
	300	2.0	0.80 x 1.95 (20.3 x 49.5)	**M030-301**
	400	2.0	0.80 x 1.95 (20.3 x 49.5)	**M030-401**
M040	**1.42 x 1.53 (36.1 x 38.9)**			
	100	5.0	1.42 x 1.53 (36.1 x 38.9)	**M040-101**
	150	4.0	1.42 x 1.53 (36.1 x 38.9)	**M040-151**
	200	1.5	1.42 x 1.53 (36.1 x 38.9)	**M040-201**
	300	1.5	1.42 x 1.53 (36.1 x 38.9)	**M040-301**
	400	1.5	1.42 x 1.53 (36.1 x 38.9)	**M040-401**
M060	**2.60 x 2.75 (66.0 x 69.9)**			
	200	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-201**
	300	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-301**
	400	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-401**
	500	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-501**
	600	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-601**
	750	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-751**
	800	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-801**
	1000	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-102**
	1200	1.0	2.60 x 2.75 (66.0 x 69.9)	**M060-122**
M080	**2.60 x 6.25 (66.0 x 158.8)**			
	500	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-501**
	600	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-601**
	800	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-801**
	1000	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-102**
	1200	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-122**
	1500	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-152**
	1600	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-162**
	2000	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-202**
	2500	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-252**
	3000	1.0	2.60 x 6.25 (66.0 x 158.8)	**M080-302**

Dimensions

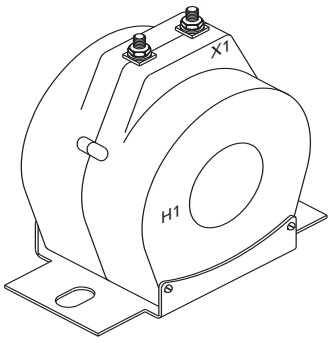
Approximate Dimensions in Inches (mm)

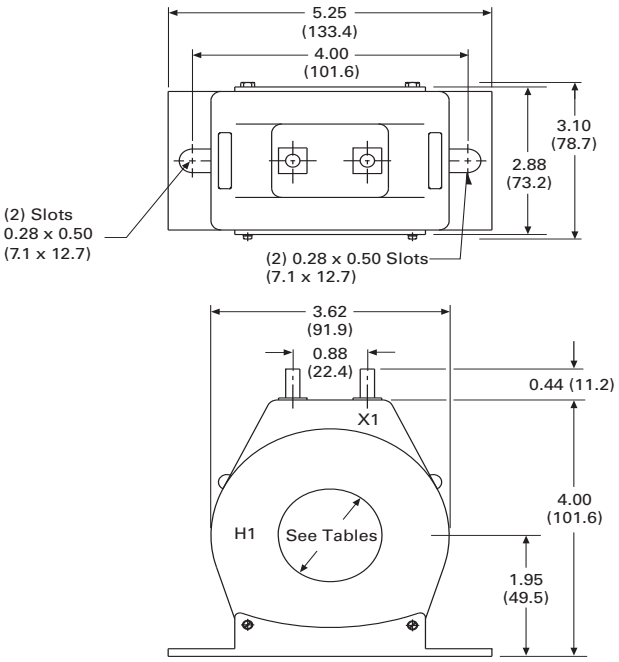
S050





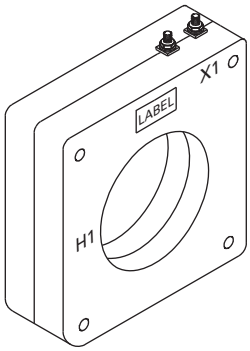
S060

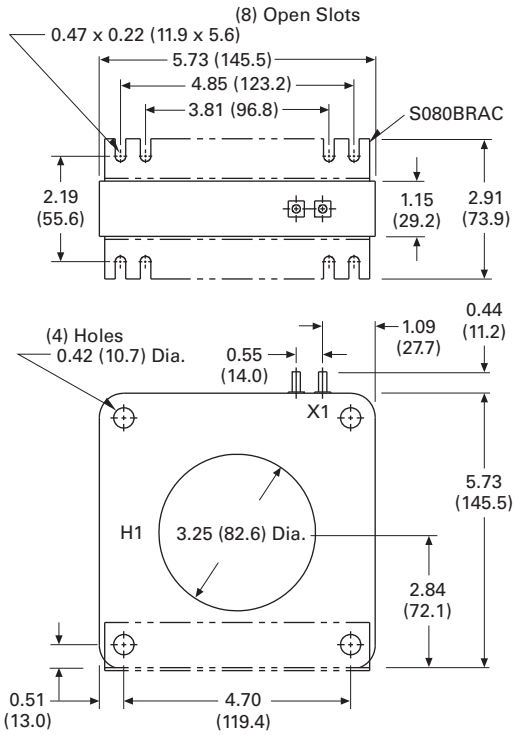




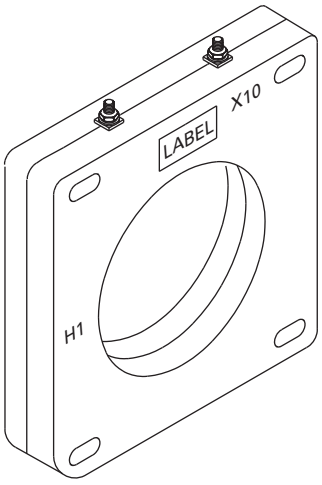
Approximate Dimensions in Inches (mm)

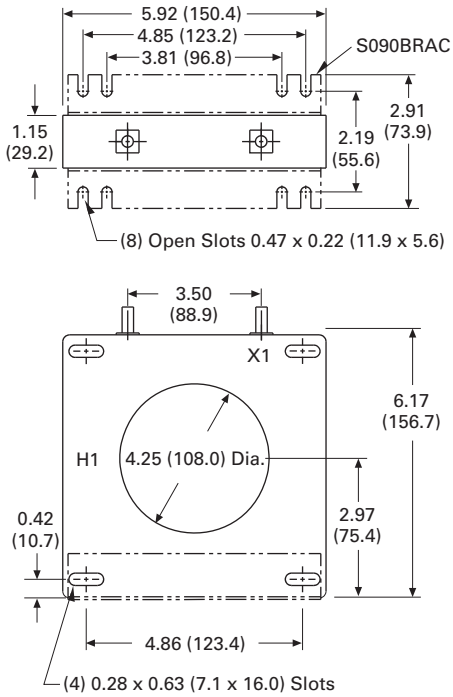
S080





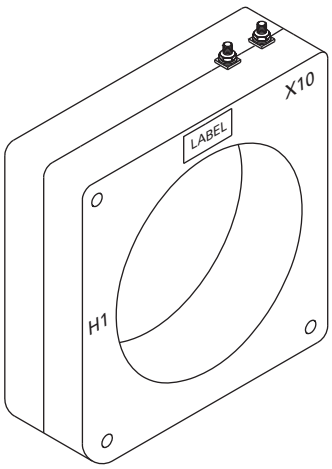
S090

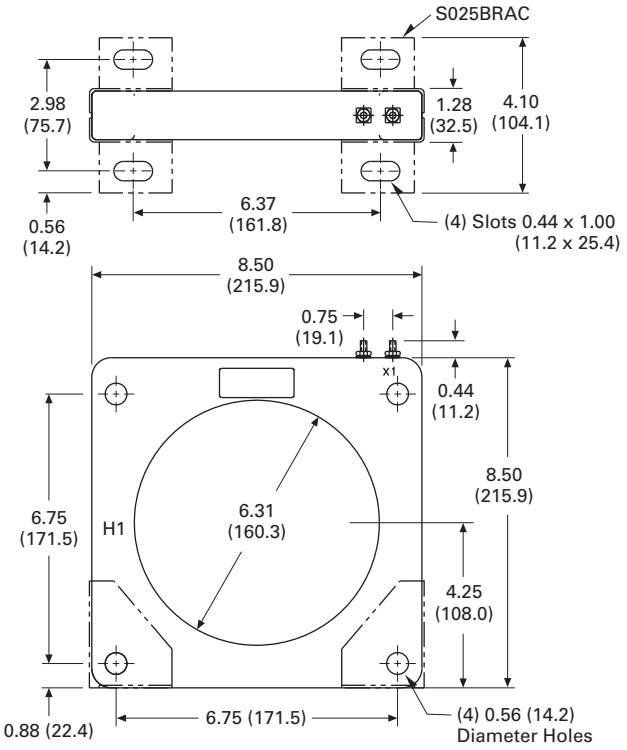




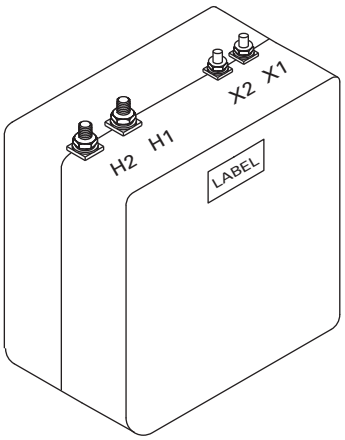
Approximate Dimensions in Inches (mm)

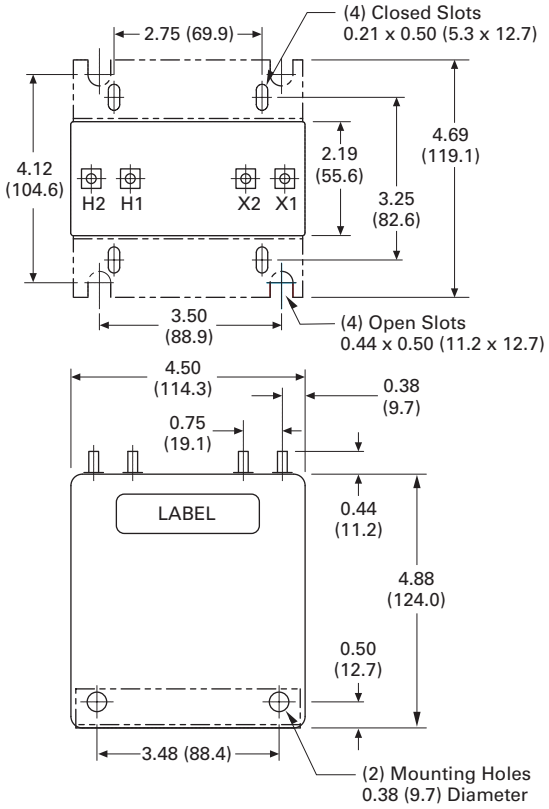
S025





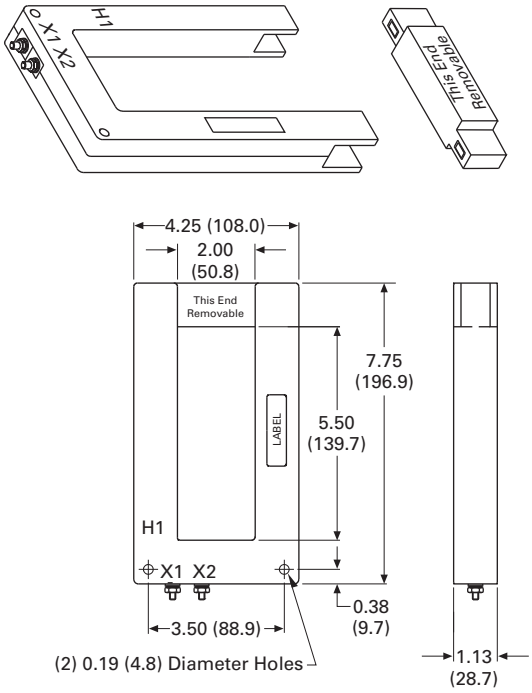
W190



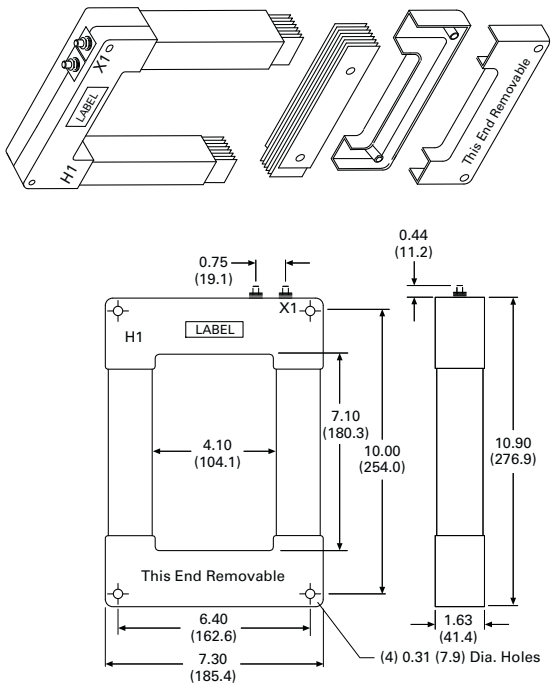


Approximate Dimensions in Inches (mm)

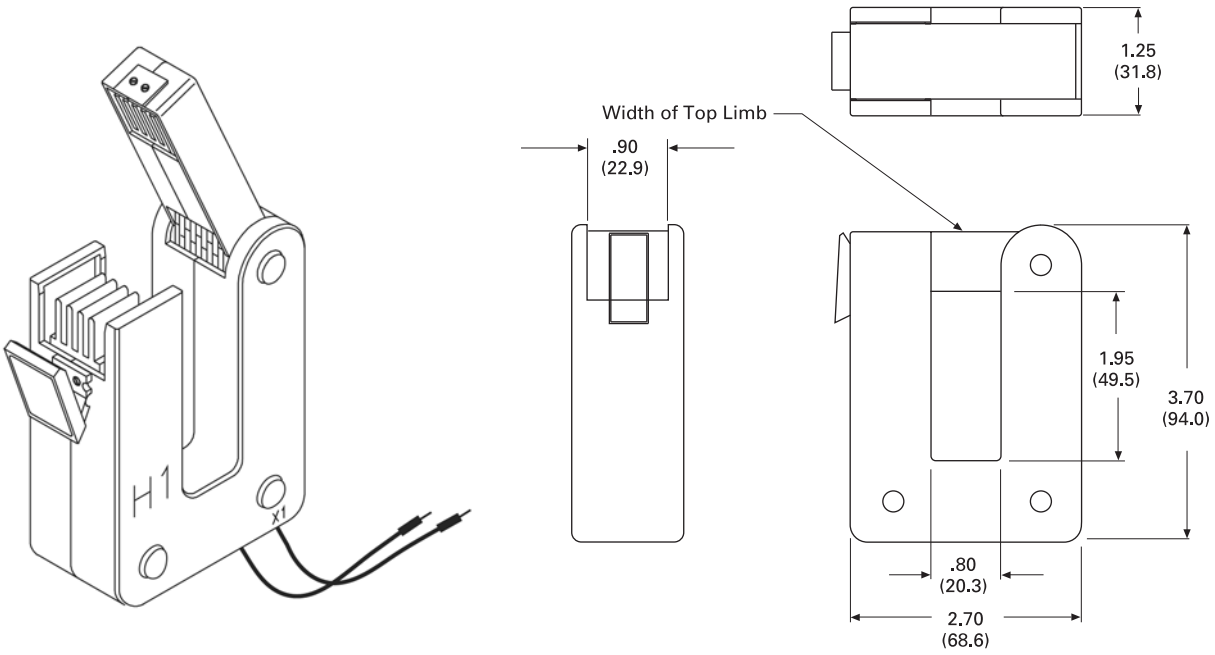
M000



M050

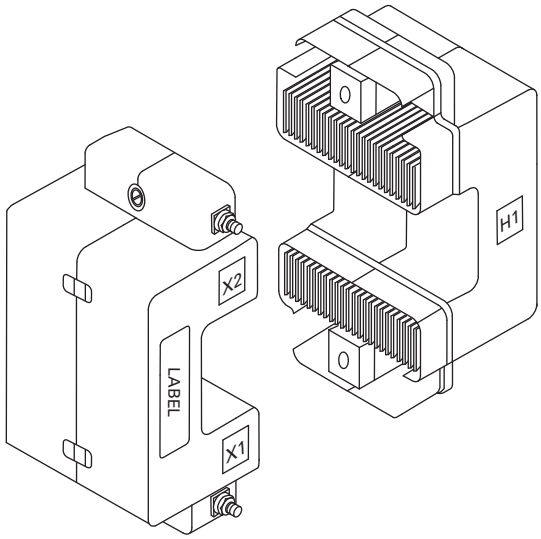


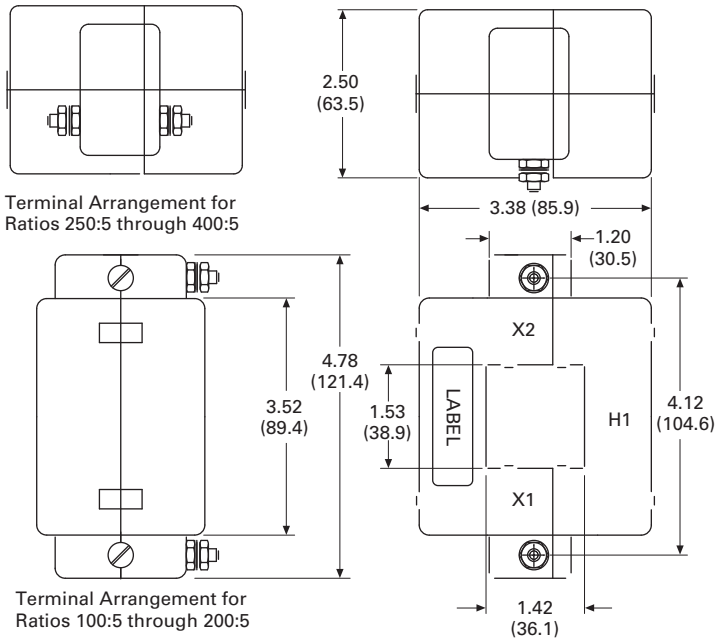
M030



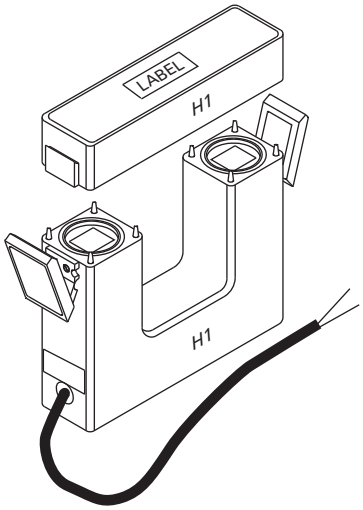
Approximate Dimensions in Inches (mm)

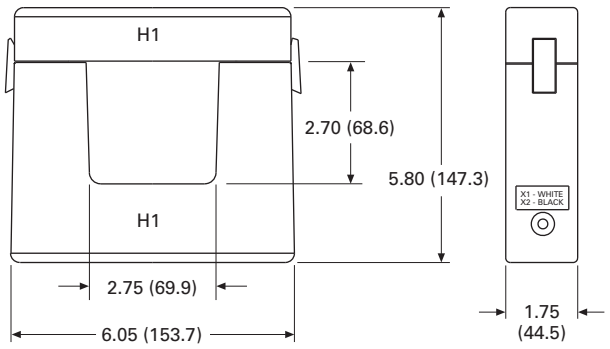
M040



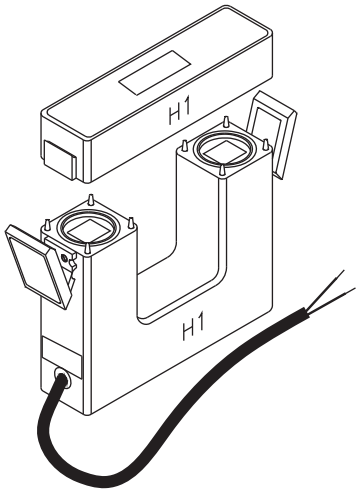


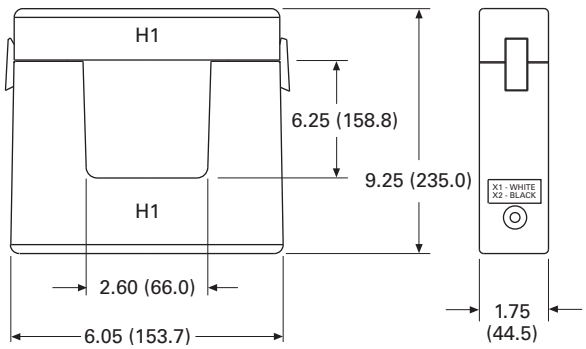
M060





M080





Panel Mounting Adapter Kit for IQ 100/200 Series and PXM 2000 Meters



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Power Xpert Multi-Point Meter	**V3-T9-56**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit Enclosed Meters	**V3-T9-78**

9

Panel Mounting Adapter Kit for IQ 100/200 Series and PXM 2000 Meters

Product Description

The flange adapter plate can be installed as follows:

1. Remove the old meter from the panel or door. Many IQ metering products use the typical IQ drilling pattern shown at right for mounting
2. Install the flange adapter plate. Mount it from the rear using the six screws provided in the kit. The flange adapter plate screw hole pattern shown at right should match the typical IQ drilling pattern. If not, perform the next step
3. Drill six holes in the panel or the door to mount the flange adapter plate. Follow the typical IQ drilling pattern. You need only the top, center and bottom sets of holes
4. Install the new IQ 100/200 Series or PXM 2000 meter in the flange adapter plate. Secure it from behind with four flat washers, lock washers and nuts provided with the meter

Product Selection

Panel Mounting Adapter Kit

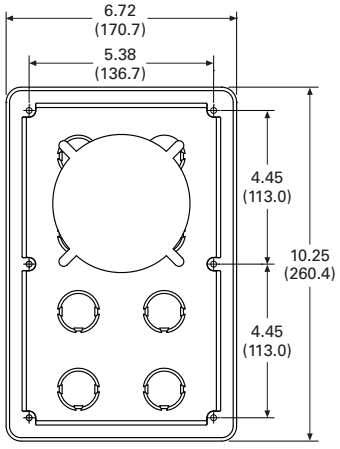


Panel Mounting Adapter Kit

Description	Catalog Number
Panel mounting adapter kit IQ 100/200 and PXM 2000 Series adapter kit to IQ Analyzer/ IQ DP-4000/IQ Data	**IQ250-PMAK**

Dimensions

Flange Adapter Plate Screw Hole Pattern



NEMA 12 Single- and Multi-Unit Enclosed Meters



Contents

Description	*Page*
Metering Products Family	**V3-T9-2**
PXM350	**V3-T9-9**
PXM1000	**V3-T9-16**
Power Xpert Meter 2000 Series	**V3-T9-24**
PXM3000	**V3-T9-33**
Power Xpert Meter 4000/6000/8000 Series	**V3-T9-39**
Power Xpert Branch Circuit Monitor (PXBCM)	**V3-T9-52**
Power Xpert Multi-Point Meter	**V3-T9-56**
Current Transformers (CTs)	**V3-T9-68**
Panel Mounting Adapter Kit	**V3-T9-77**
Enclosed Meters	
Features and Benefits	**V3-T9-79**
Catalog Number Selection	**V3-T9-81**
Product Selection	**V3-T9-82**
Technical Data and Specifications	**V3-T9-82**
Wiring Diagrams	**V3-T9-83**
Dimensions	**V3-T9-93**

Enclosed Meters

Product Description

The Eaton enclosed meter line provides a complete energy metering and data acquisition solution in a single enclosure. Designed for Eaton's IQ 35M, IQ 150, IQ 250/260, and Power Xpert 2000/4000/6000/8000 and Multi-Point Meters, Eaton's enclosed meter line offers mounting and installation flexibility, especially in retrofit applications where no metering compartment or mounting space is available in the existing electrical distribution equipment or where installation time is a premium. Factory designed and wired, Eaton's enclosed meter line offers savings in labor and installation costs because input current and voltage wiring as well as I/O wiring is prewired to terminal blocks inside the enclosure.

The enclosed meter line has two standard offerings: single-, prewired unit (specific IQ 150, IQ 250/260, PXM 2000, PXM 4000/6000/8000 or PXMP) and a multi-unit (specific IQ 150, IQ 250/260 or IQ 35M models). Because the multi-unit can be configured to include Eaton's Power Xpert Gateway 900, it can facilitate measurement and verification of the energy usage on processes and in buildings. This provides a convenient way to monitor energy usage from multiple points, collect and log specific energy use parameters, and display and generate logs for historical energy usage reports. Simply put, Eaton's multi-unit enclosed meter solution helps meet any measurement and verification requirement to show energy efficiency improvements and results. In addition to the standard offering, Eaton can also provide an enclosed metering solution tailored around your project needs.

Application Description

Factory designed and wired to fit various Eaton power and energy meters at varying price points, Eaton's enclosed meter line offers savings in labor and installation costs because input current and voltage wiring, as well as I/O wiring, is prewired to terminal blocks inside the enclosure. Standalone, enclosed meters are ideal for new metering applications where no metering existed previously, for retrofit installations where energy monitoring is a must or where ease of installation is required.

- Health care facilities
- Educational facilities and campuses
- Industrial facilities
- Commercial facilities
- Government facilities

The multi-unit offering consolidates energy-related data available from the meters in the enclosure, but also allows for external meters to be added to the embedded Power Xpert Gateway 900, if selected to be included in the enclosed meter. Through the Power Xpert Gateway 900's embedded web server, information can be presented in a variety of ways; a standard web browser being the most widely used method.

The enclosed product is a standalone solution that is ideal for many infrastructure designs. Further, as needs change and grow, the enclosed product can be integrated through Power Xpert Insight into a broader solution that encompasses other intelligent hardware and can integrate with third-party network management systems (NMS) or building management systems (BMS) for system-wide monitoring and reporting of energy and power.

Features and Benefits

- Saves installation time and cost
- One part number to order; no need to worry that any part has been left out
- Pick the meter or meters you need as it is designed to fit various Eaton power and energy meters, at varying price points

Factory Wired

Most electrical contractors are very familiar with wiring meters. However, it does take time to place the disconnect, the CT shorting blocks, the terminal blocks, the control power transformer and so on, and the associated wiring. It is not uncommon for errors to be introduced during the installation of multiple meters; it's just inherent in wiring. With Eaton's enclosed meter line, everything is wired at the factory—the shorting block, the terminal blocks and so on—assuring that it's done right. Further, to ensure safety, Eaton's enclosed meter line includes a primary fusible disconnect for line voltage, which can be turned off during meter maintenance.

For applications with line voltages above the rated power supply of the meter, an optional control power transformer is supplied in the enclosure. Control voltage can also be supplied via a separate source that is wired to the field installation terminal block. CT inputs for the meter are wired directly to the shorting terminal blocks for easy field installation.

Factory-wired products also save on installation time and costs. The meters are flush mounted on the enclosure door with all inputs/outputs factory wired to the terminal blocks.

A meter subpanel assembly is also available, which includes all the internal components of the single-unit enclosed meter for the IQ 150/250/260 and PXM 2000 Meters wired and mounted on a subpanel to be installed into an existing electrical structure. It comes with a 48-inch lead for flexibility in mounting the meters at various distances.

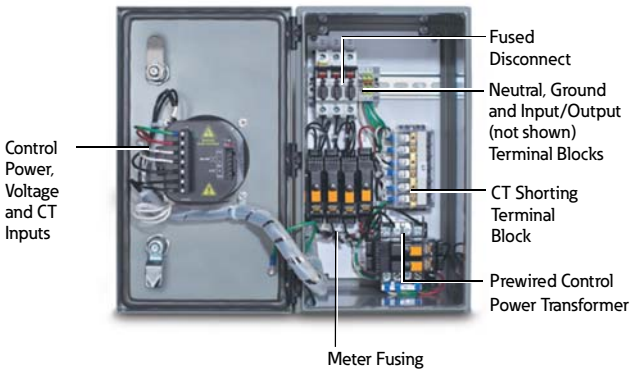
NEMA Rated

NEMA 12 enclosure prevents dust and other materials from entering the equipment. Internal gaskets also prevent air irritants from harming the vital equipment inside. This quality enclosure meets most indoor application needs.

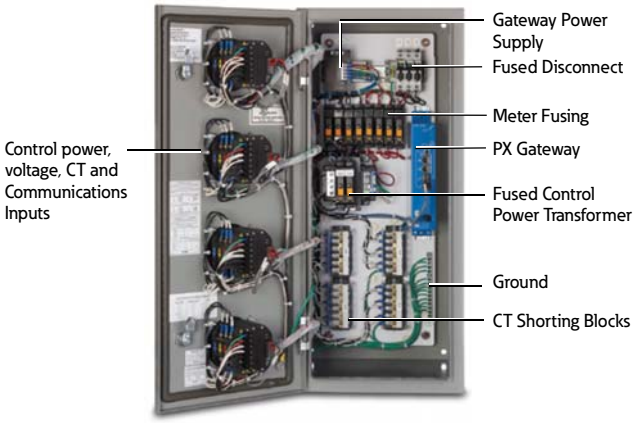
NEMA 3R enclosure is constructed for either indoor or outdoor use. It helps to protect personnel from access to hazardous parts and provides a degree of protection for equipment inside the enclosure against ingress of solid foreign objects (falling dirt), harmful effects of water (rain, sleet, snow) and external formation of ice on the enclosure.

NEMA 4X enclosure provides the same degree of protection as the NEMA 3R with the additional protection against windblown dust, splashing and hose-directed water, and corrosion.

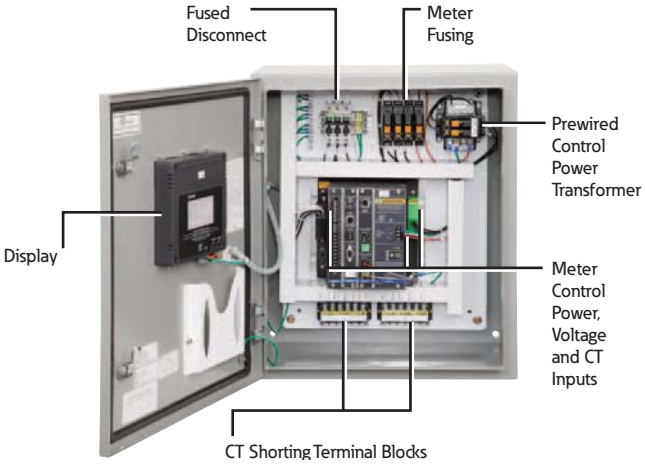
NEMA 12 Front View, Door Open, Prewired and Tested



NEMA 12 Multi-Unit View, Door Open, Prewired and Tested



NEMA 12 Single-Unit Enclosed Meter Inside View, PXM 4000/6000/8000 Series



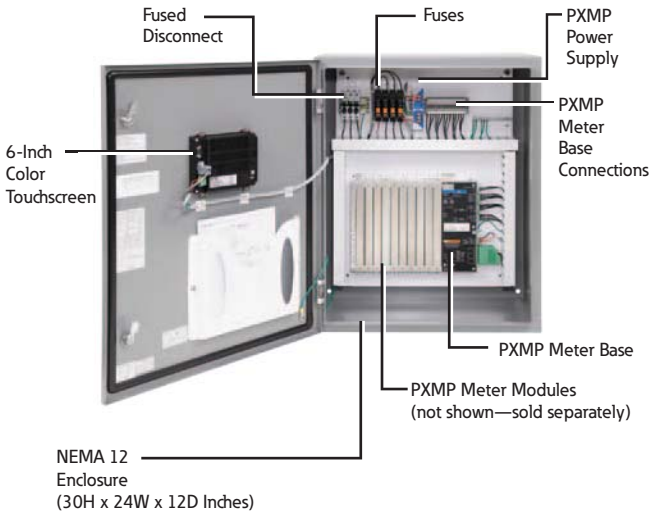
NEMA 3R Single-Unit Closed and Open, IQ 150/250/260 and PXM 2000 Series



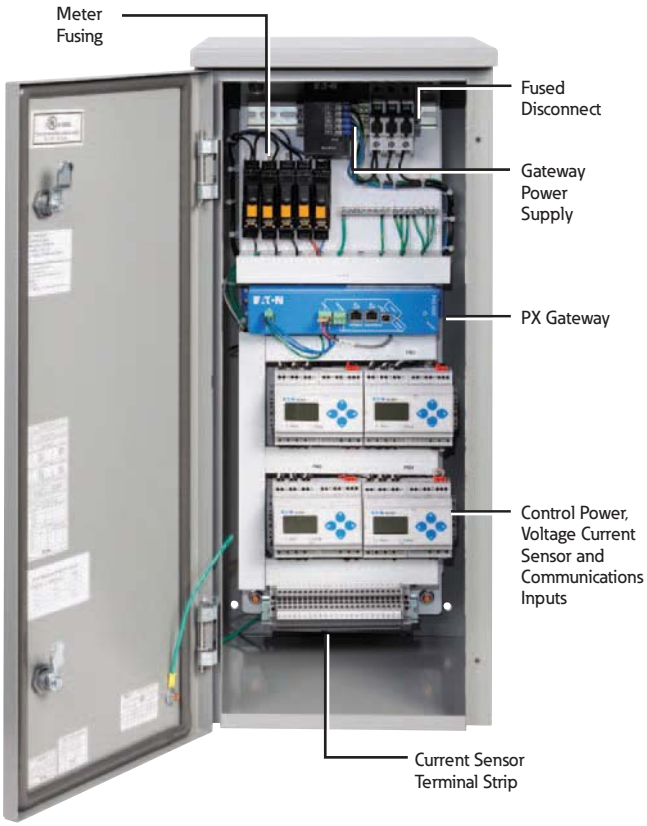
NEMA 4X Single-Unit Closed and Open, IQ 150/250/260 and PXM 2000 Series



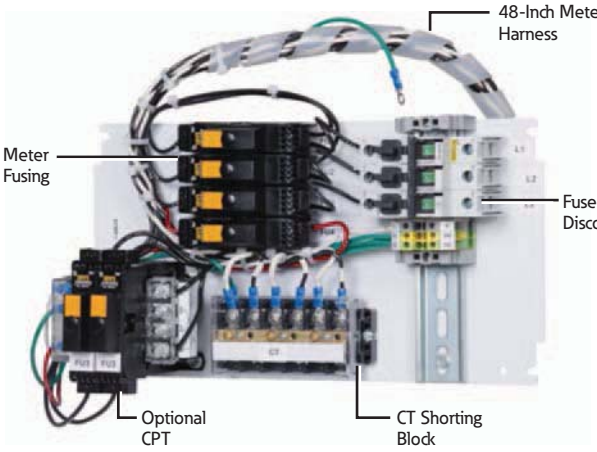
Enclosed Power Xpert Multi-Point Meter



Multi-Unit Enclosed Meter, Inside View of IQ 35M

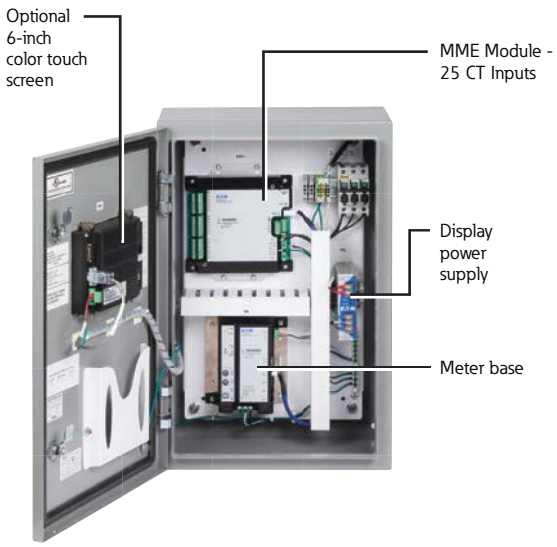


Prewired Meter Backpan, Single Unit



- Prewired panel to save installation time and cost for retrofits into existing equipment
- Designed for Eaton's:
  - IQ 100 Meter Series
  - IQ 250/260
  - Power Xpert Meter 2000 Series
- With or without CPT, depending on voltage
- Order meters separately

Enclosed Power Xpert Branch Circuit Monitor



Enclosed PXMP Meter

PXMP-MB - 2 B D

Meter Type	NEMA Rating	Power Supply	Display
PXMP-MB **PXMP-MB-AB**	**2** = NEMA 12 **3** = NEMA 3R **4** = NEMA 4X	**A** = None **B** = 120/240 Vac **C** = 480 Vac **D** = 600 Vac	**A** = None **D** = 6-inch color touchscreen

Multi Unit Enclosed Meter

PXBCM-MB - 2 1 - A B

Meter Type	NEMA Rating	CPT Option	Display	Display Power Supply
PXBCM-MB (Meter base + MME) **PXBCM-MME** (MME only—no display)	**2** = NEMA 12 **3** = NEMA 3R **4** = NEMA 4X	**1** = 1 MME (21 branch CT inputs, 4 aux. inputs) **2** = 2 MME (42 branch CT inputs, 8 aux. inputs)	**A** = None **D** = 6-inch color touchscreen	**A** = 120–240 V **B** = 480 V

Catalog Number Selection

Single Unit Enclosed Meter

PXM2250MA65105 - 2 B - D6

Meter Type	
PXM4051A1BA	**PXM2270MA65105**
PXM4051A1BB	**PXM2270MA65115**
PXM6051A1BA	**PXM2270MA65145**
PXM6051A1BB	**IQ250MA65100**
PXM8051A1BA	**IQ250MA65110**
PXM8051A1BB	**IQ250MA65114**
PXM2250MA65105	**IQ260MA65100**
PXM2250MA65115	**IQ260MA65110**
PXM2250MA65145	**IQ260MA65114**
PXM2260MA65105	**IQ150MA6511**
PXM2260MA65115	**IQ150MA6512**
PXM2260MA65145	

Display	CPT Option	NEMA Rating
D6 = 6-inch display ① **D12** = 12-inch display	**A** = 120/240 Vac (no CPT) **B** = 480 Vac (control power transformer)	**2** = NEMA 12 **3** = NEMA 3R **4** = NEMA 4X

Multi-Unit Enclosed Meter

IQ150MA6511 - 2 B 4 C

Meter Type	NEMA Rating	CPT Option	Number of Meters	Communications
IQ35MA12 **IQ150MA6511** **IQ250MA65100** **IQ260MA65100**	**2** = NEMA 12 ② **3** = NEMA 3R **4** = NEMA 4X	**A** = 120/240 Vac (no CPT) **B** = 480 Vac ② (control power transformer)	**4** = 4 meters	**C** = Includes PXG-900

Notes

① Only available for the PXM4000/6000/8000.

② Not available with IQ 35M.

Other meter models available upon request in single- and multi-unit enclosed versions.

Product Selection

Meter Subpanel Assembly

Description	Catalog Number
Meter subpanel assembly for PXM 2000 and IQ 150/250/260 Meters	**PXM2K-MSPA-A**
Meter subpanel assembly with CPT for PXM 2000 and IQ 150/250/260 Meters	**PXM2K-MSPA-B**

Technical Data and Specifications

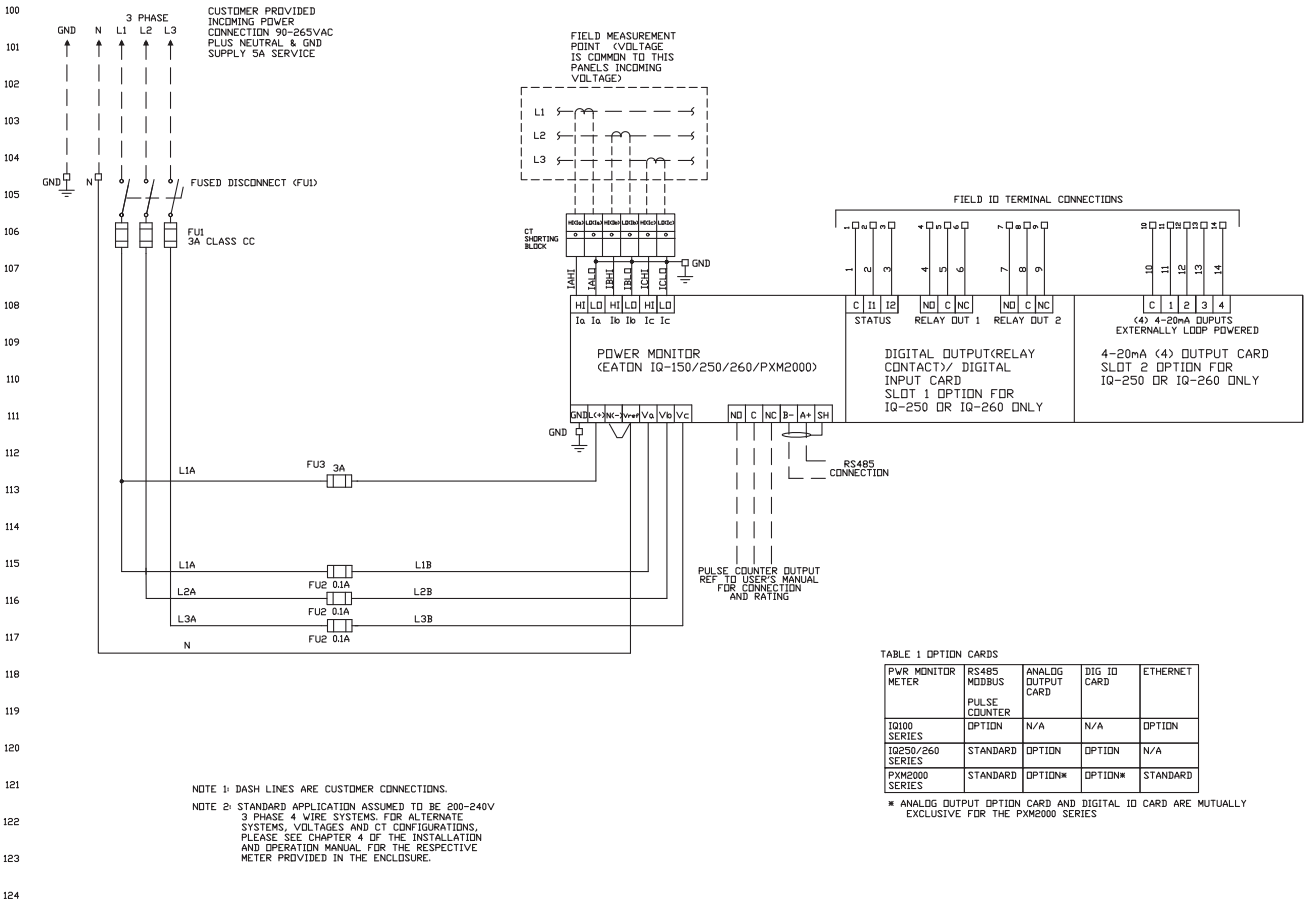
Enclosed Meters

Description	Specification
Enclosure rating	NEMA 12, 3R, 4X
Enclosure operating temperature	–20 °C to +40 °C **Note:** Temperature range of meter is –20 °C to +70 °C. If applied outside, proper precautions should be taken to avoid exceeding the maximum and minimum temperature ratings of the meter.
Dimensions	Single unit (IQ 150/250/260 and PXM 2000): NEMA 12 (8.00 W x 16.30 H x 10.40 D inches), NEMA 3R/4X (8.00 W x 16.30 H x 9.60 D inches) Single MME (PXBCM): NEMA 12 (16.00 W x 16.00 H x 8.00 D inches) NEMA 3R/4X (20.00 W x 16.00 H x 12.00 D inches) Two MME (PXBCM): NEMA 12 (16.00 W x 24.00 H x 8.00 D inches) NEMA 3R/4X (20.00 W x 24.00 H x 12.00 D inches) Single unit (PXMP): NEMA 12/3R/4X (24.00 W x 30.00 H x 12.00 D inches) Single unit (PXM 4000/6000/8000): NEMA 12 (20.00 W x 24.00 H x 14.10 D inches) NEMA 3R/4X (20.20 W x 24.00 H x 13.90 D inches) Multi unit: NEMA 12 (13.00 W x 30.00 H x 15.20 D inches) NEMA 3R (13.20 W x 30.10 H x 14.60 D inches) NEMA 4X (13.00 W x 30.00 H x 14.00 D inches)
Meters	Single unit: IQ 150, IQ 250/260, PXM 2000/4000/6000/8000 and PXMP models Multi unit: IQ 35M, IQ 150 and IQ 250/26060
Communications (multi unit only)	Power Xpert Gateway 900
Control voltage	120–600 V (PXMP)—power supply required 100–277 Vac L:N (PXBCM)—no CPT required Up to 240 V (IQ 35M/150/250/260 and PXM 2000/4000/6000/8000)—no CPT required Greater than 240 V (IQ 150/250/260 and PXM 2000)—CPT required Separate source control—no CPT required
Basic model	Fusible disconnect—primary voltage Shorting block(s)—not required for IQ 35M or PXMP Ground terminal block Neutral terminal block Eight-point terminal block(s) for input/output modules for IQ 250/260 and PXM 2000
Wiring	Wired for three-phase, four-wire applications. Three-phase, three-wire applications—will need to change the wiring for both the voltage and the current per the wiring diagram in the meter instruction manual.
Certifications	UL 508A and cUL
Source control	No separate source control voltage required for applications below 240 Vac (except PXMP)
Prewired	Prewired current transformer, shorting terminal block(s), neutral, ground, voltage, control power, fusible disconnect and input/output terminal block(s)
Latch	Padlocking latch provision
Optional features	Control power transformer—single unit: 50 VA (IQ 150/250/260) and 150 VA (PXM 4000/6000/8000); multi unit: 250 VA control power supply for meter where monitored voltage is 480 Vac (IQ 150/250/260 and PXM 2000/4000/6000/8000)

Note: Specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical data sheet and the user manual for detailed specifications.

Wiring Diagrams

Single Unit Enclosure—200/240 Vac 50/60 Hz, Three-Phase, Four-Wire System with IQ 150/250/260 or PXM 2000 Meter



NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

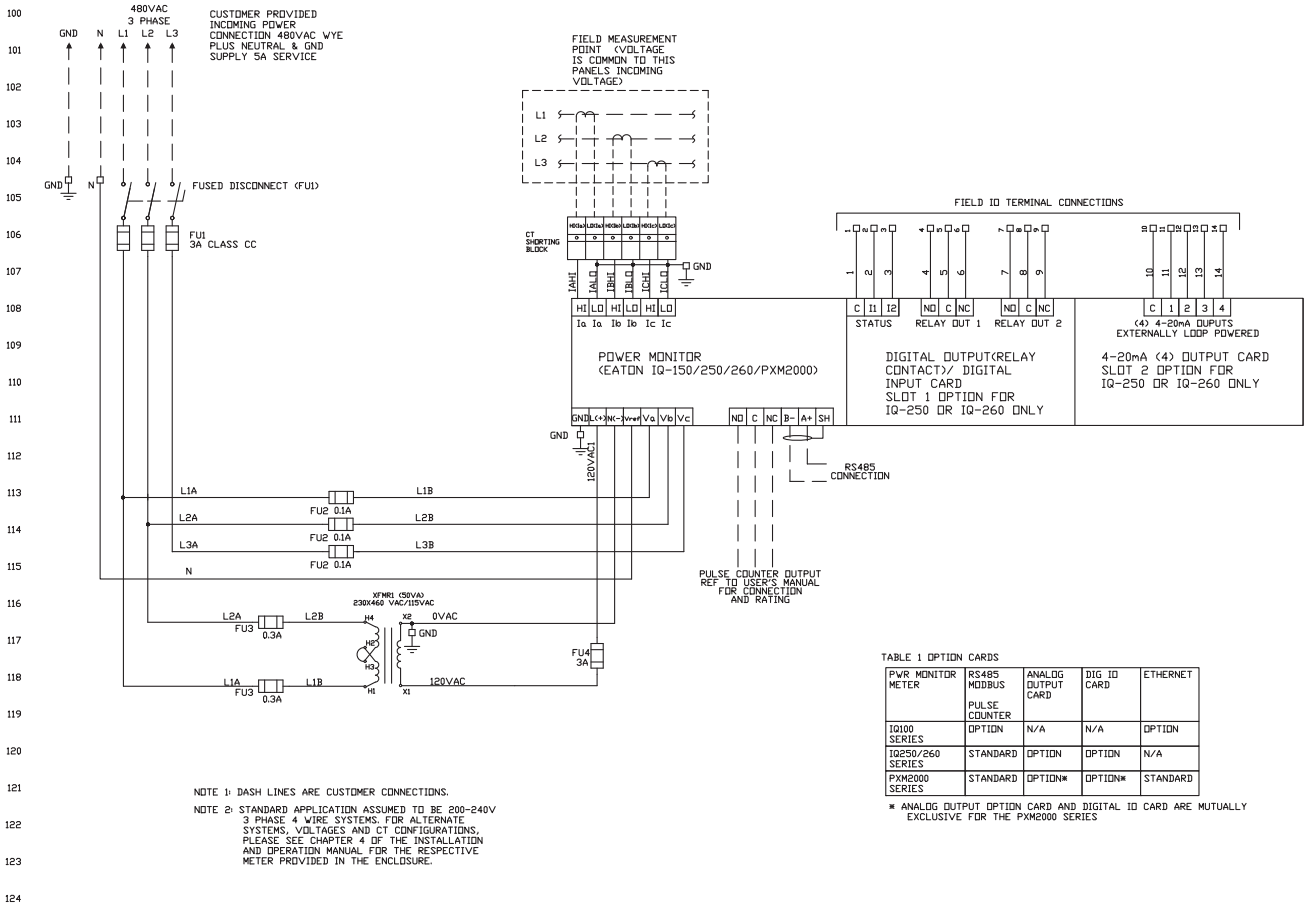
NOTE 2: STANDARD APPLICATION ASSUMED TO BE 200-240V 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE INSTALLATION AND OPERATION MANUAL FOR THE RESPECTIVE METER PROVIDED IN THE ENCLOSURE.

TABLE 1 OPTION CARDS

PWR MONITOR METER	RS485 MODBUS PULSE COUNTER	ANALOG OUTPUT CARD	DIG IO CARD	ETHERNET
IQ100 SERIES	OPTION	N/A	N/A	OPTION
IQ250/260 SERIES	STANDARD	OPTION	OPTION	N/A
PXM2000 SERIES	STANDARD	OPTION*	OPTION*	STANDARD

* ANALOG OUTPUT OPTION CARD AND DIGITAL IO CARD ARE MUTUALLY EXCLUSIVE FOR THE PXM2000 SERIES

Single Unit Enclosure—480 Vac 50/60 Hz, Three-Phase, Four-Wire System with IQ 150/250/260 or PXM 2000 Meter



NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

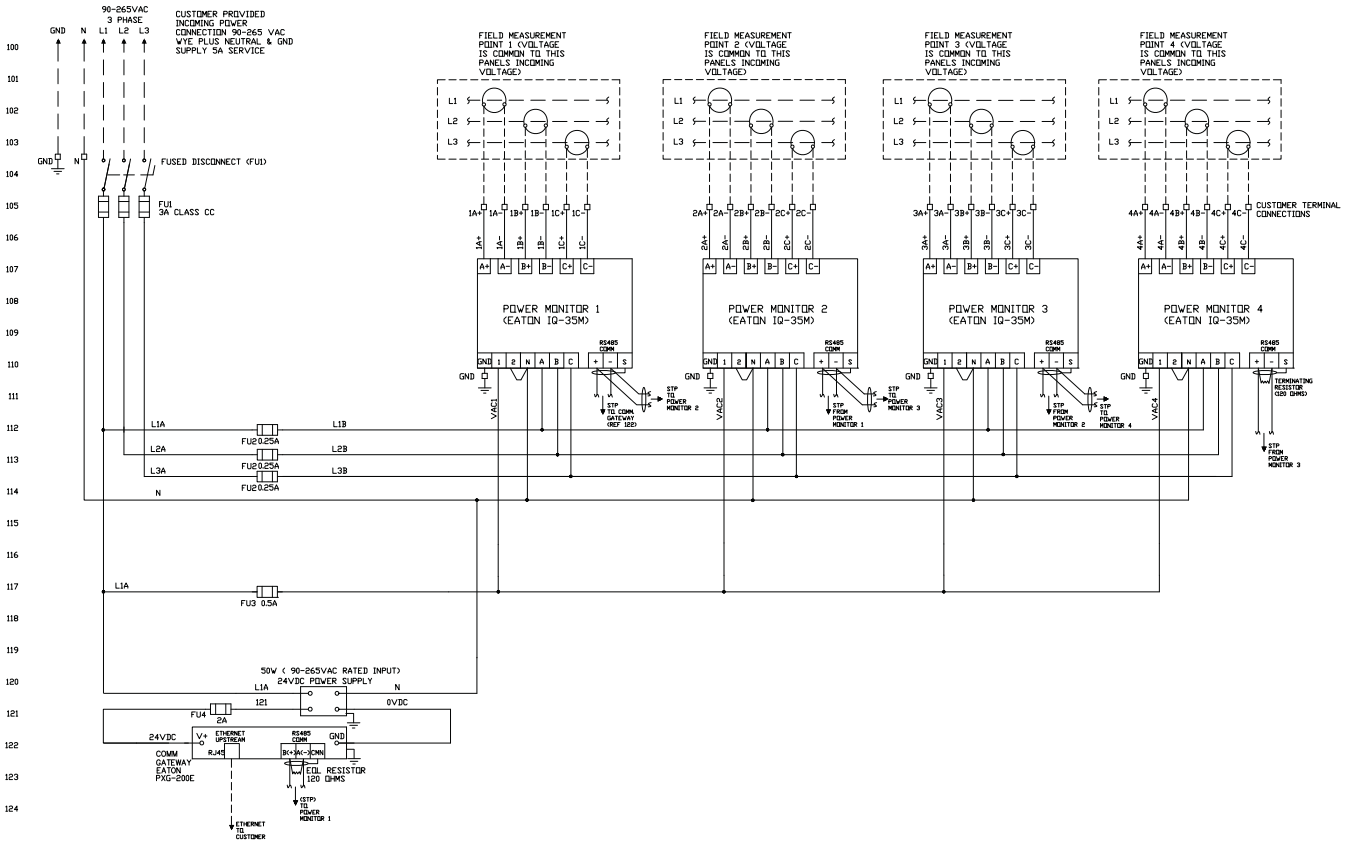
NOTE 2: STANDARD APPLICATION ASSUMED TO BE 200-240V 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE INSTALLATION AND OPERATION MANUAL FOR THE RESPECTIVE METER PROVIDED IN THE ENCLOSURE.

TABLE 1 OPTION CARDS

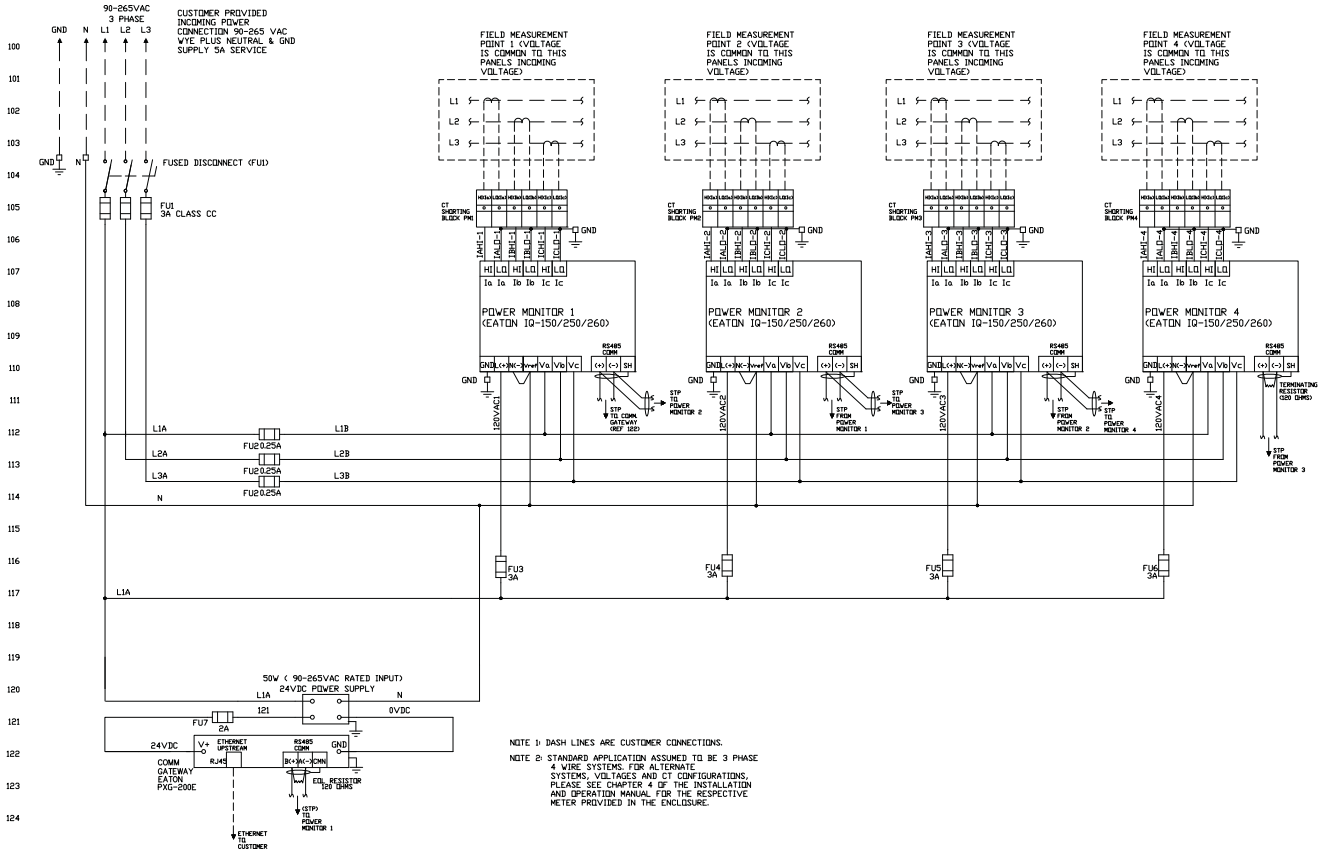
PWR MONITOR METER	RS485 MODBUS PULSE COUNTER	ANALOG OUTPUT CARD	DIG ID CARD	ETHERNET
IQ100 SERIES	OPTION	N/A	N/A	OPTION
IQ250/260 SERIES	STANDARD	OPTION	OPTION	N/A
PXM2000 SERIES	STANDARD	OPTION*	OPTION*	STANDARD

* ANALOG OUTPUT OPTION CARD AND DIGITAL ID CARD ARE MUTUALLY EXCLUSIVE FOR THE PXM2000 SERIES

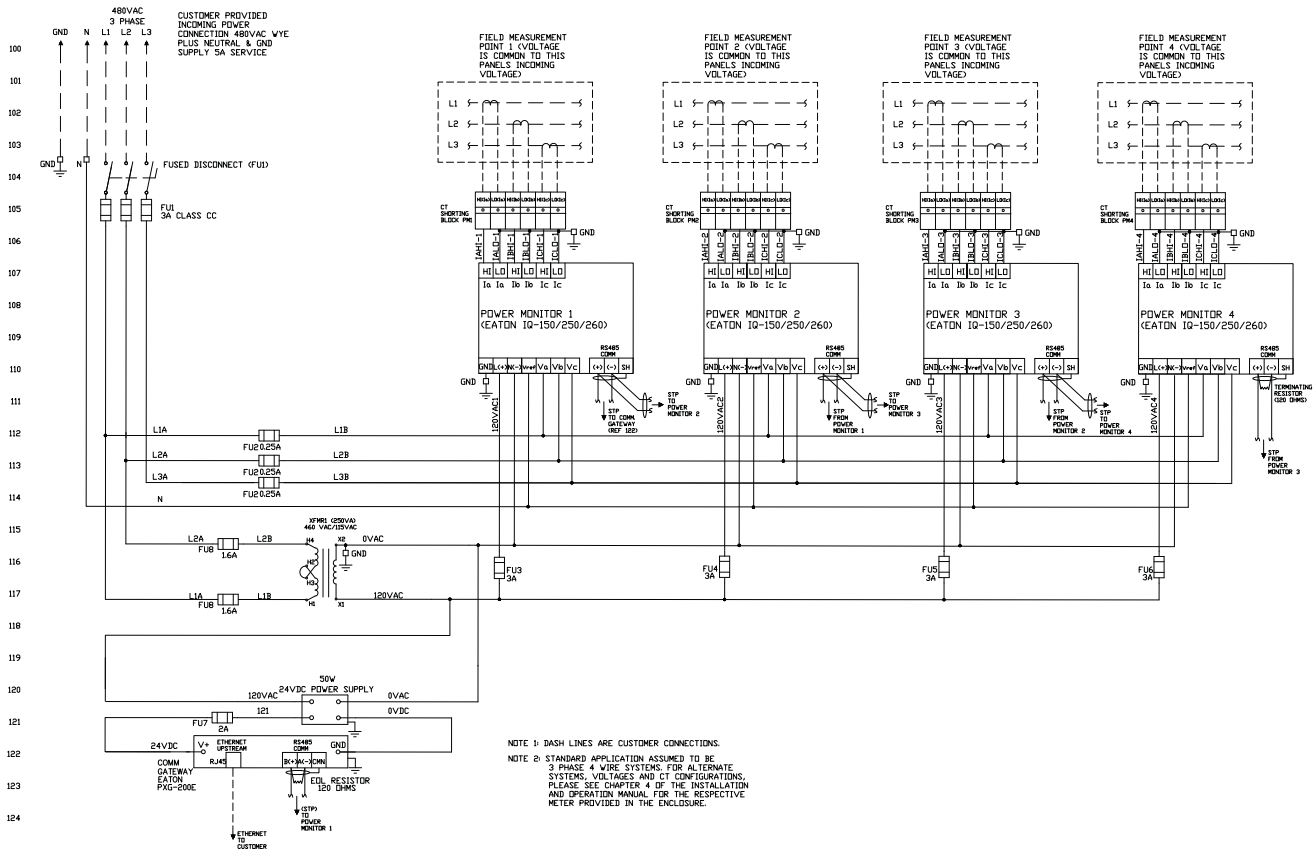
Multi Unit Enclosure—200–240 Vac 50/60 Hz, Three-Phase, Four-Wire System with IQ 35M Meters



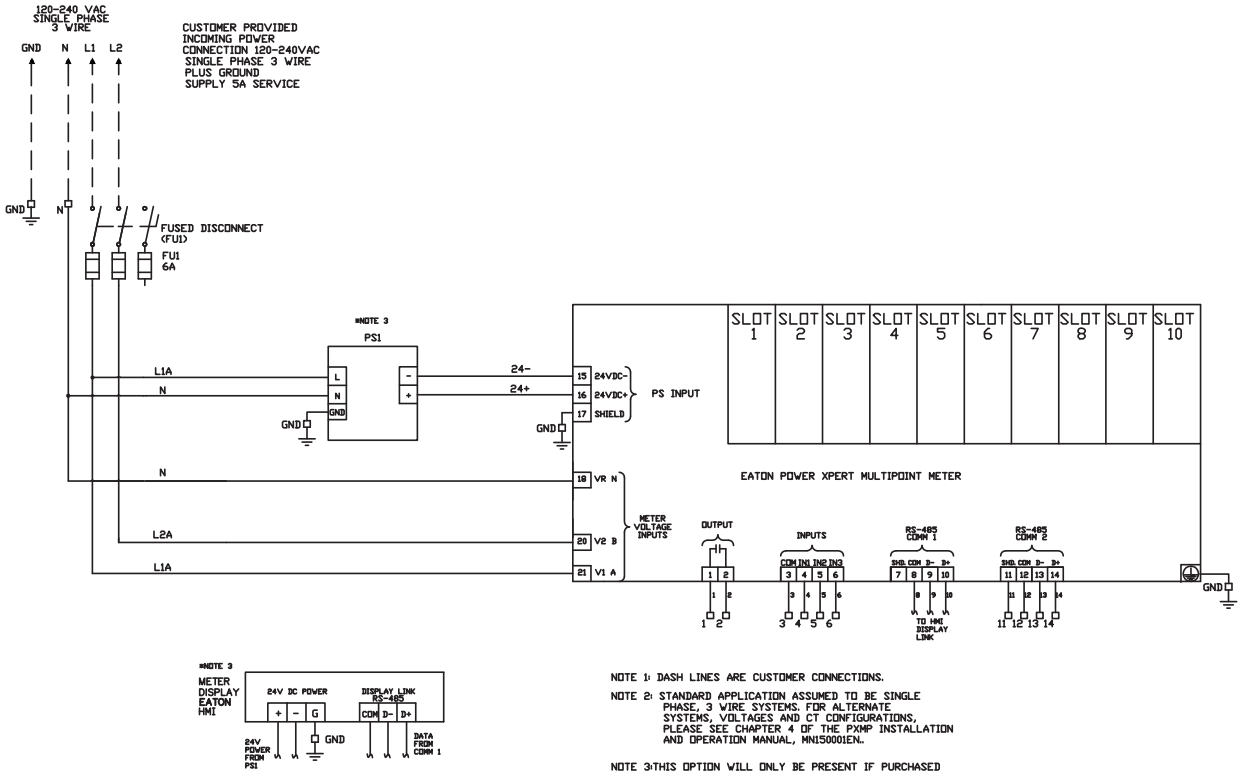
Multi Unit Enclosure—200–240 Vac 50/60 Hz, Three-Phase, Four-Wire System with IQ 150/250/260 Meters



Multi Unit Enclosure—480 Vac 50/60 Hz, Three-Phase, Four-Wire System with IQ 150/250/260 Meters



Single Unit Enclosure—120–240 Vac 50/60 Hz, Three-Wire System with PXMP Meter

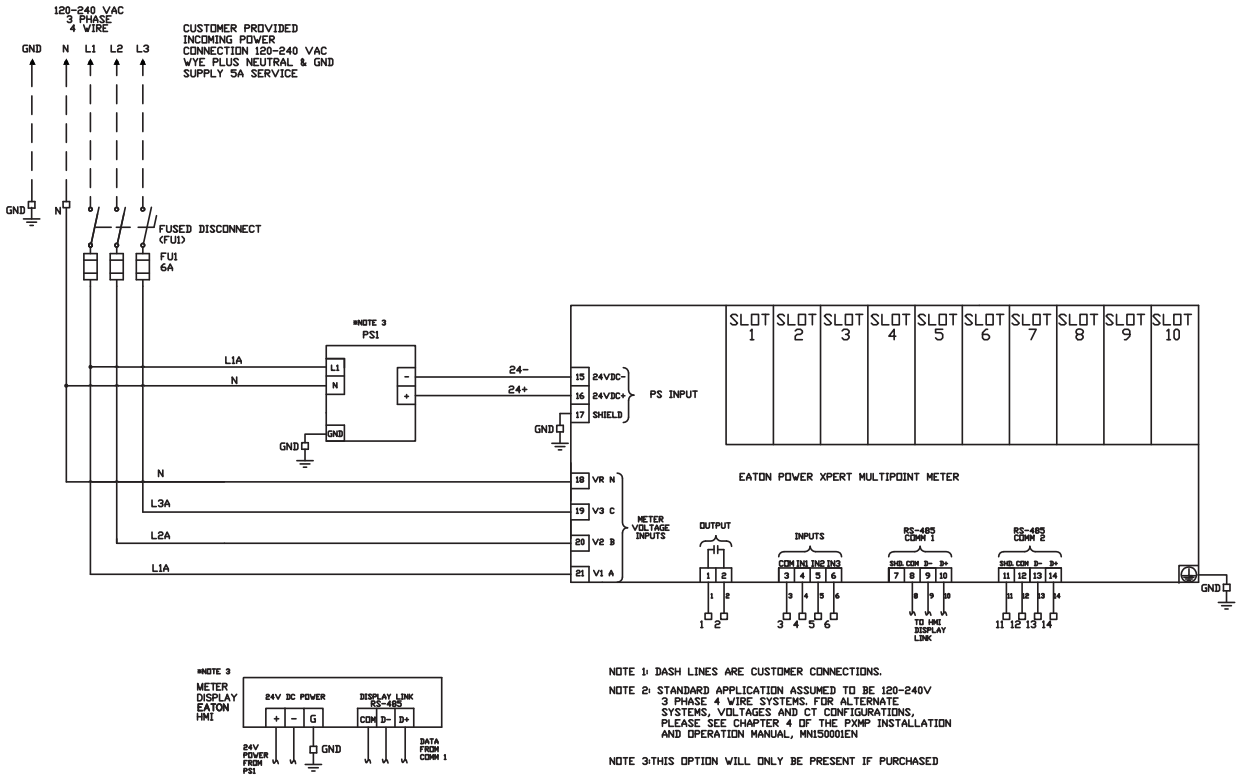


NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

NOTE 2: STANDARD APPLICATION ASSUMED TO BE SINGLE PHASE, 3 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE PXMP INSTALLATION AND OPERATION MANUAL, MN150001EN.

NOTE 3: THIS OPTION WILL ONLY BE PRESENT IF PURCHASED

Single Unit Enclosure—120–240 Vac 50/60 Hz, Three-Phase, Four-Wire Wye System with PXMP Meter

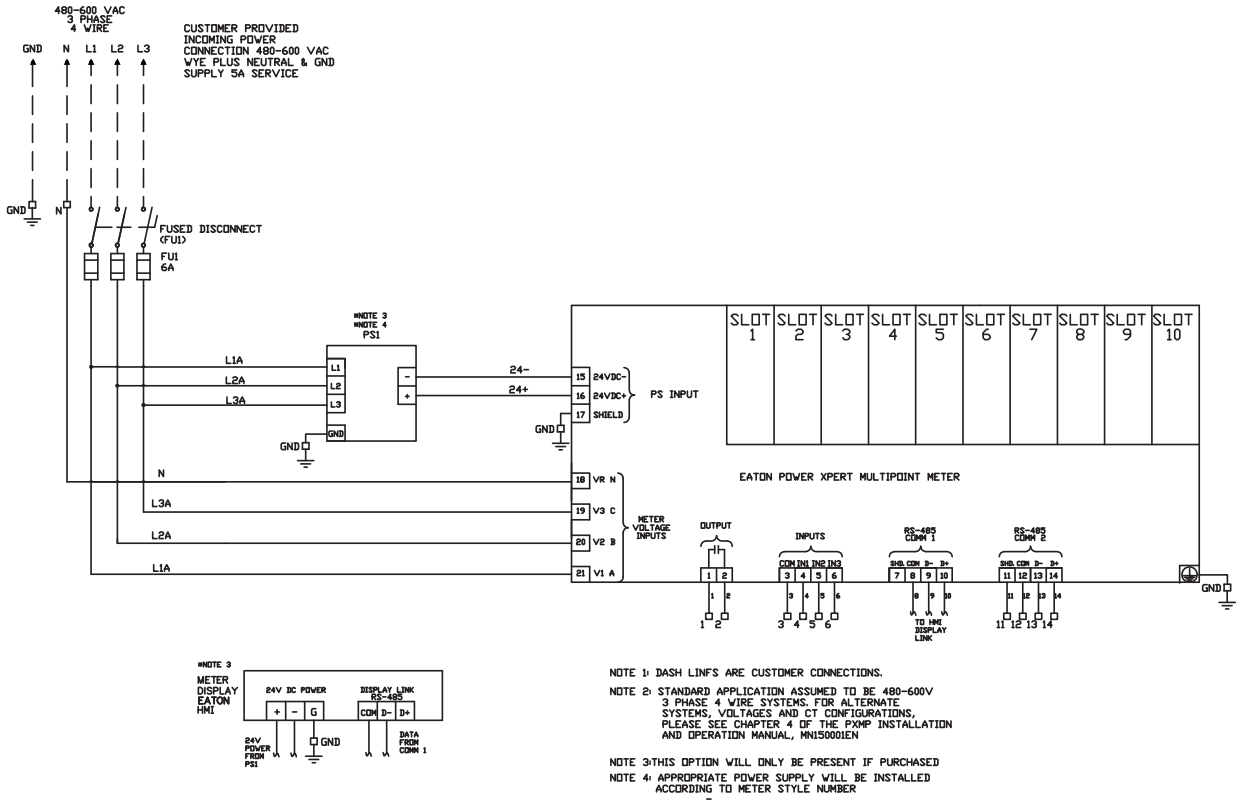


NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

NOTE 2: STANDARD APPLICATION ASSUMED TO BE 120-240V 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE PXMP INSTALLATION AND OPERATION MANUAL, MN150001EN

NOTE 3: THIS OPTION WILL ONLY BE PRESENT IF PURCHASED

Single Unit Enclosure—480–600 Vac 50/60 Hz, Three-Phase, Four-Wire Wye System with PXMP Meter



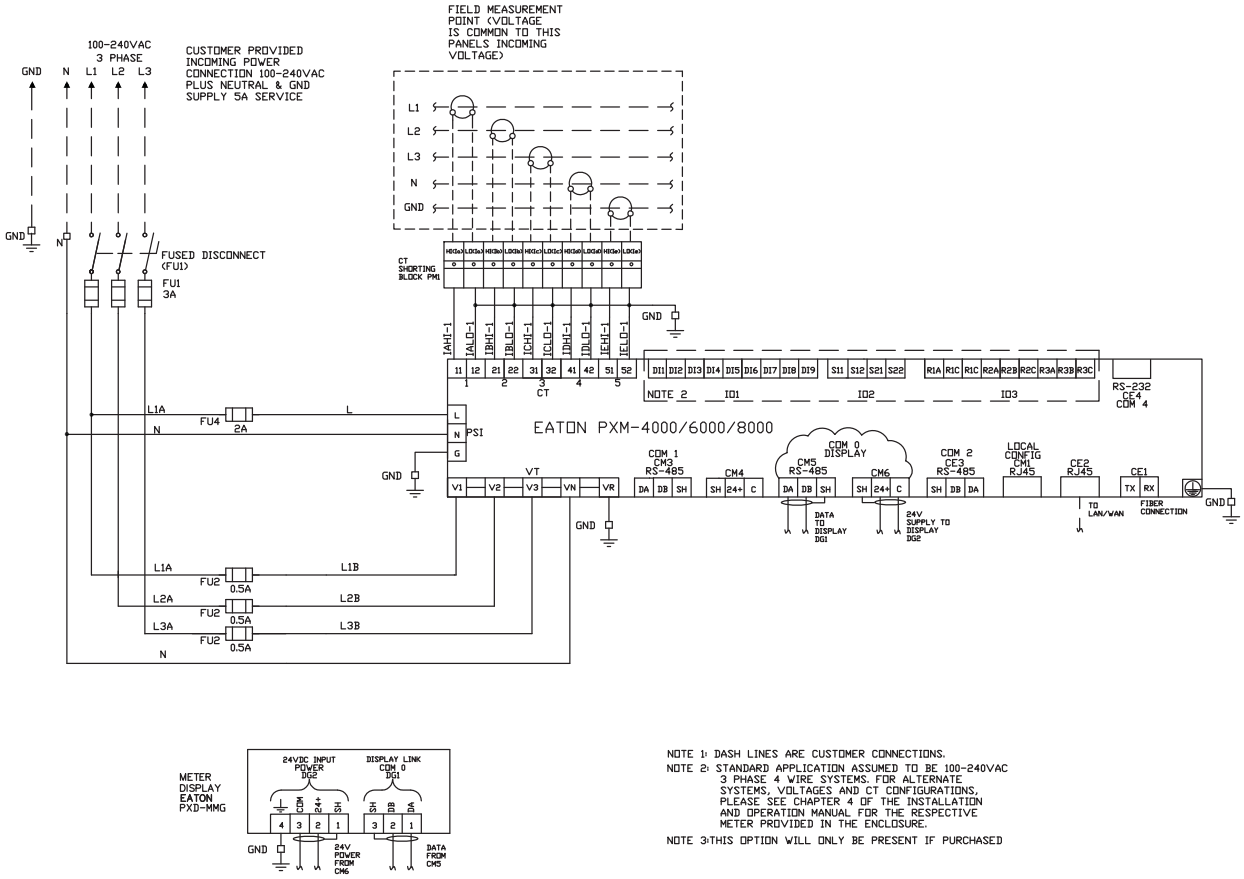
NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

NOTE 2: STANDARD APPLICATION ASSUMED TO BE 480-600V 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE PXMP INSTALLATION AND OPERATION MANUAL, MN150001EN

NOTE 3: THIS OPTION WILL ONLY BE PRESENT IF PURCHASED

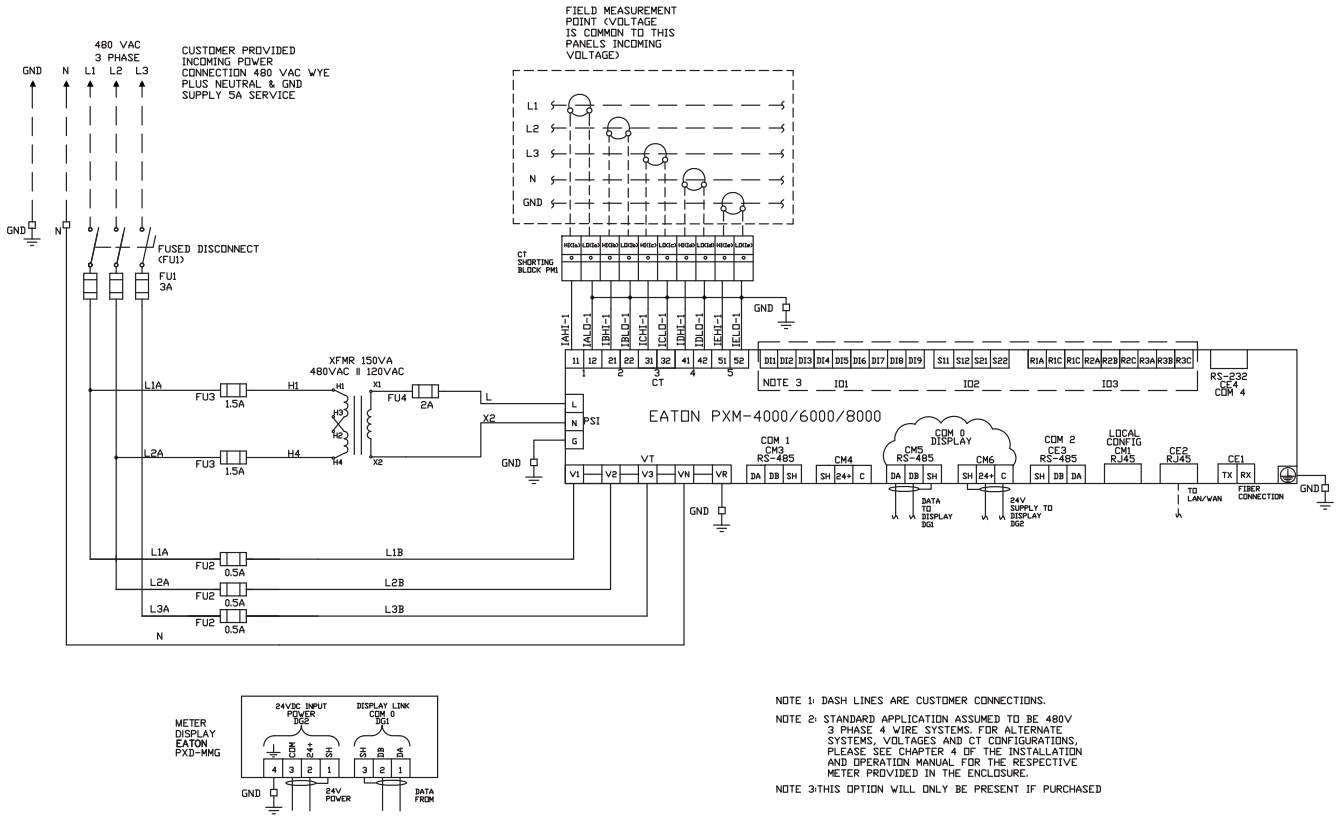
NOTE 4: APPROPRIATE POWER SUPPLY WILL BE INSTALLED ACCORDING TO METER STYLE NUMBER

Single Unit Enclosure—200–240 Vac 50/60 Hz, Three-Phase, Four-Wire System with PXM 4000/6000/8000 Meter



NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.
NOTE 2: STANDARD APPLICATION ASSUMED TO BE 100-240VAC 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE INSTALLATION AND OPERATION MANUAL FOR THE RESPECTIVE METER PROVIDED IN THE ENCLOSURE.
NOTE 3: THIS OPTION WILL ONLY BE PRESENT IF PURCHASED

Single Unit Enclosure—480 Vac 50/60 Hz, Three-Phase, Four-Wire System with PXM 4000/6000/8000 Meter



NOTE 1: DASH LINES ARE CUSTOMER CONNECTIONS.

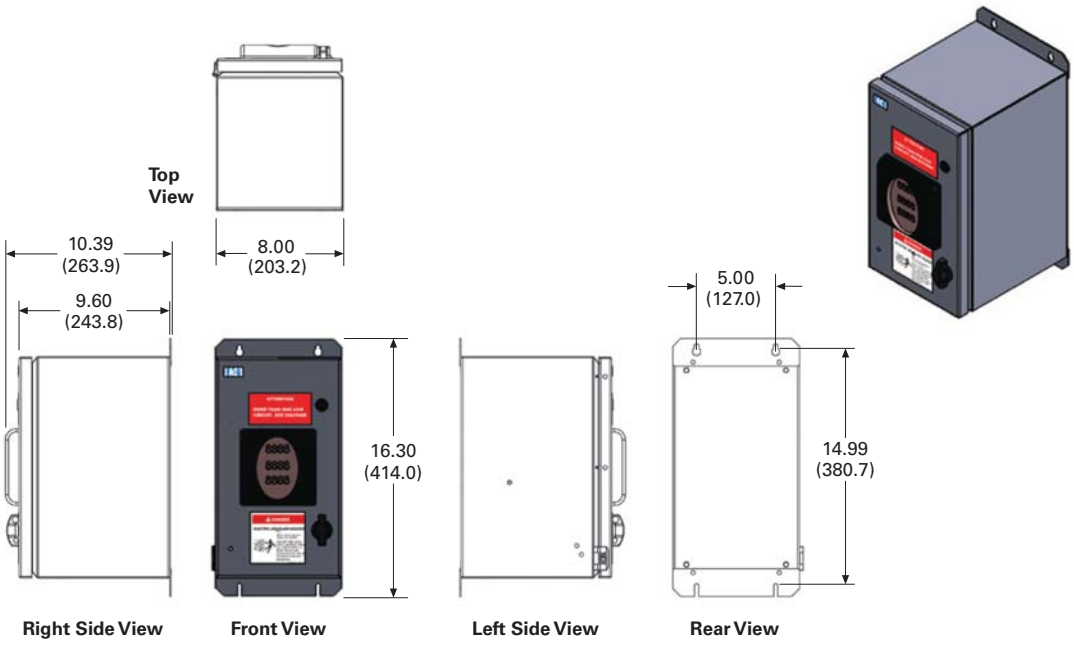
NOTE 2: STANDARD APPLICATION ASSUMED TO BE 480V 3 PHASE 4 WIRE SYSTEMS. FOR ALTERNATE SYSTEMS, VOLTAGES AND CT CONFIGURATIONS, PLEASE SEE CHAPTER 4 OF THE INSTALLATION AND OPERATION MANUAL FOR THE RESPECTIVE METER PROVIDED IN THE ENCLOSURE.

NOTE 3: THIS OPTION WILL ONLY BE PRESENT IF PURCHASED

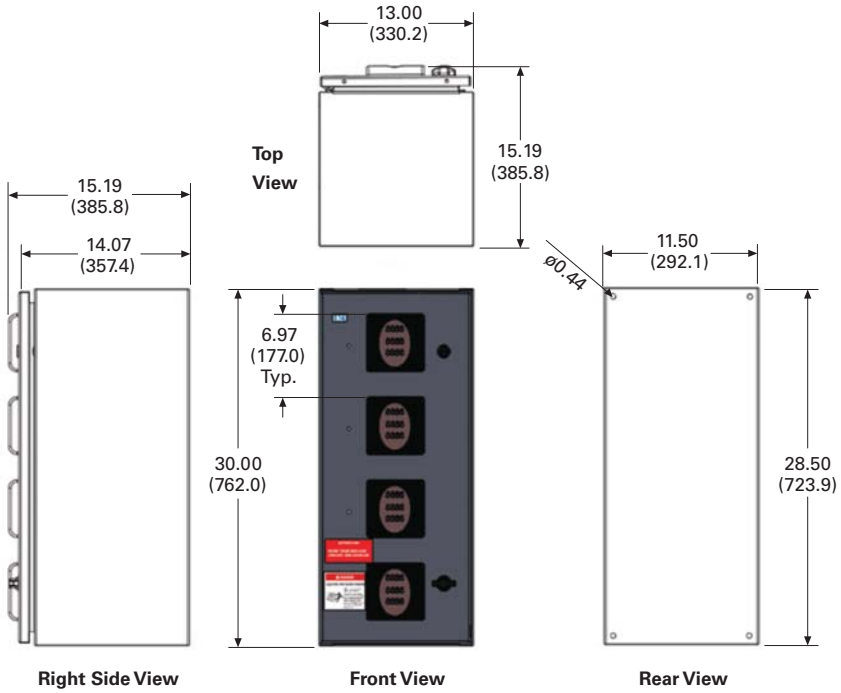
Dimensions

Approximate Dimensions in Inches (mm)

NEMA 12 Single Unit Enclosure

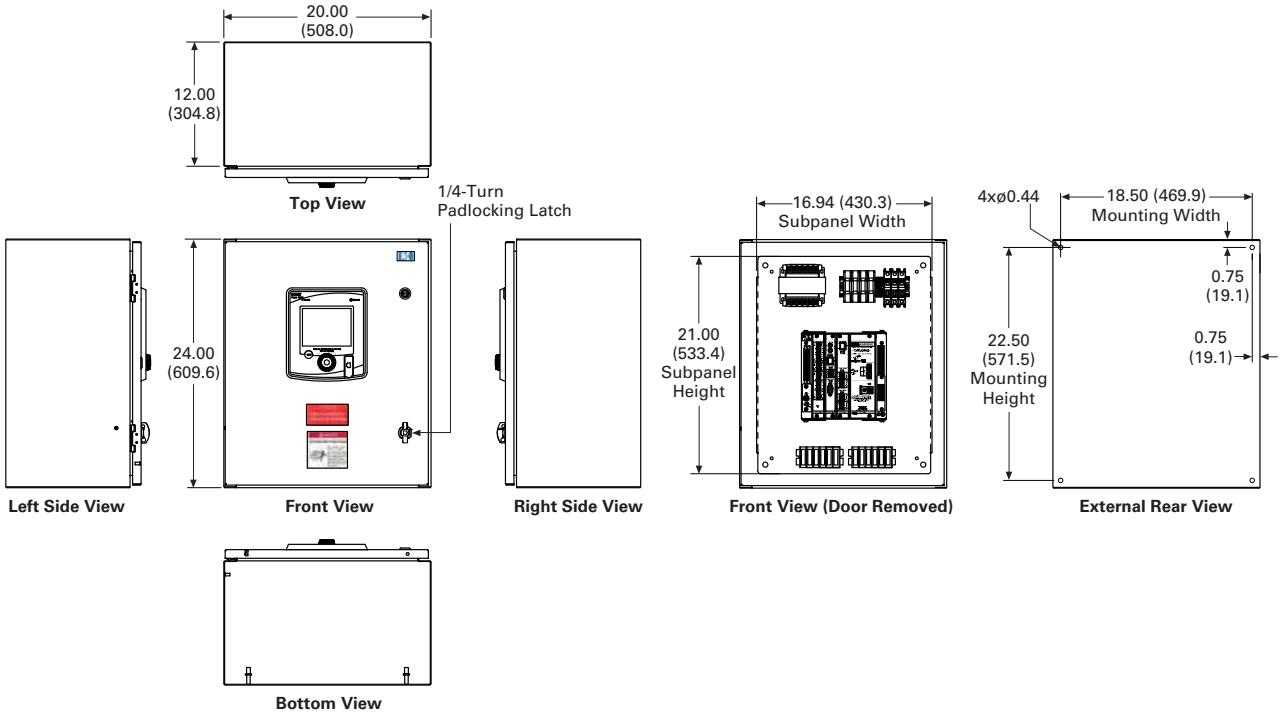


NEMA 12 Multi Unit Enclosure

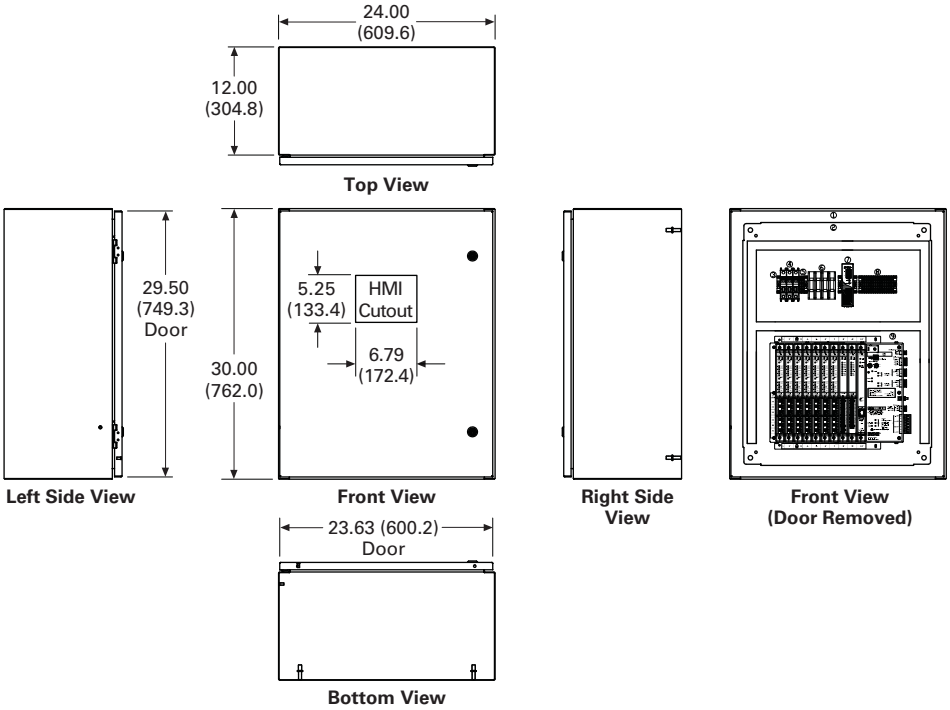


Approximate Dimensions in Inches (mm)

NEMA 12 PXM 4000/6000/8000 Enclosure

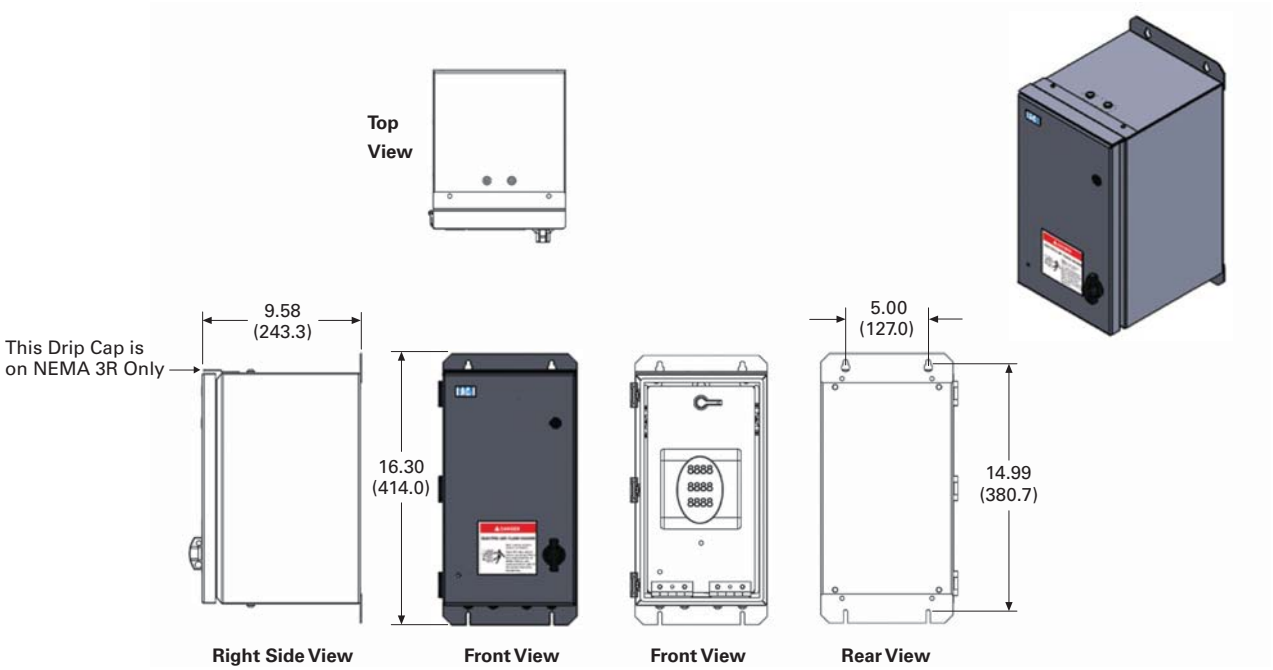


NEMA 12 PXMP Enclosure

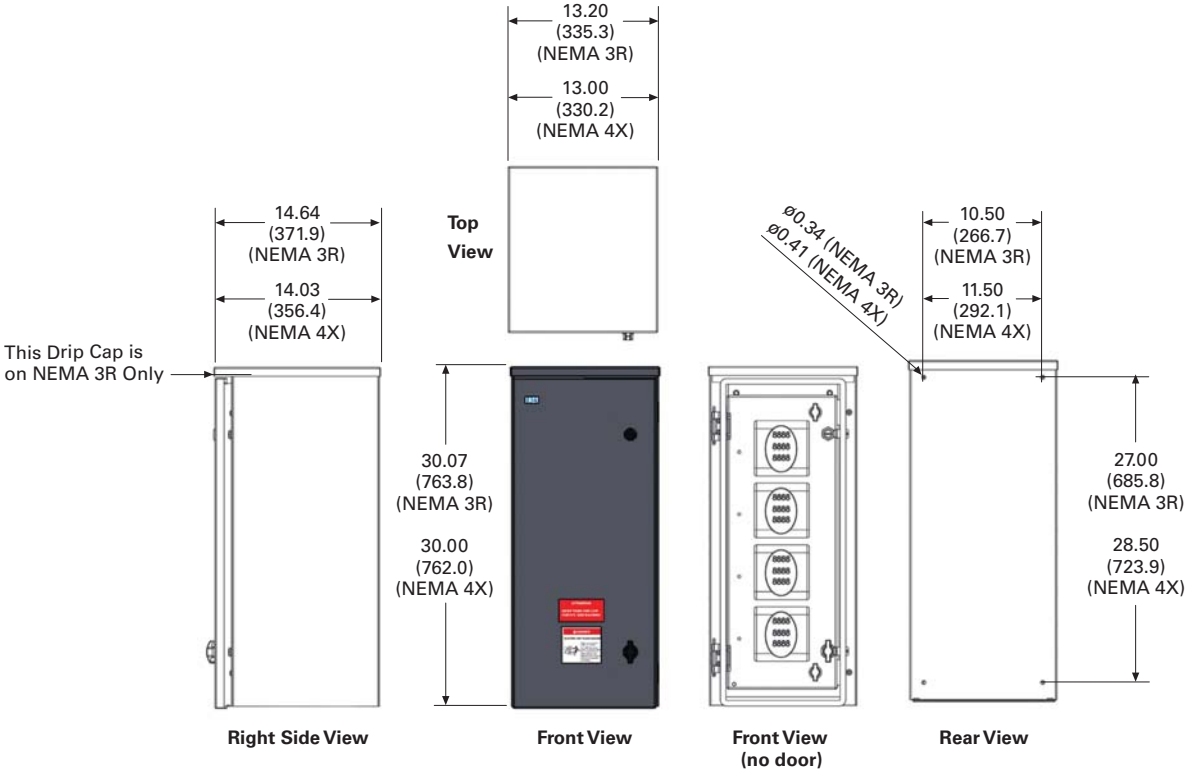


Approximate Dimensions in Inches (mm)

NEMA 3R/4X Single Unit Enclosure

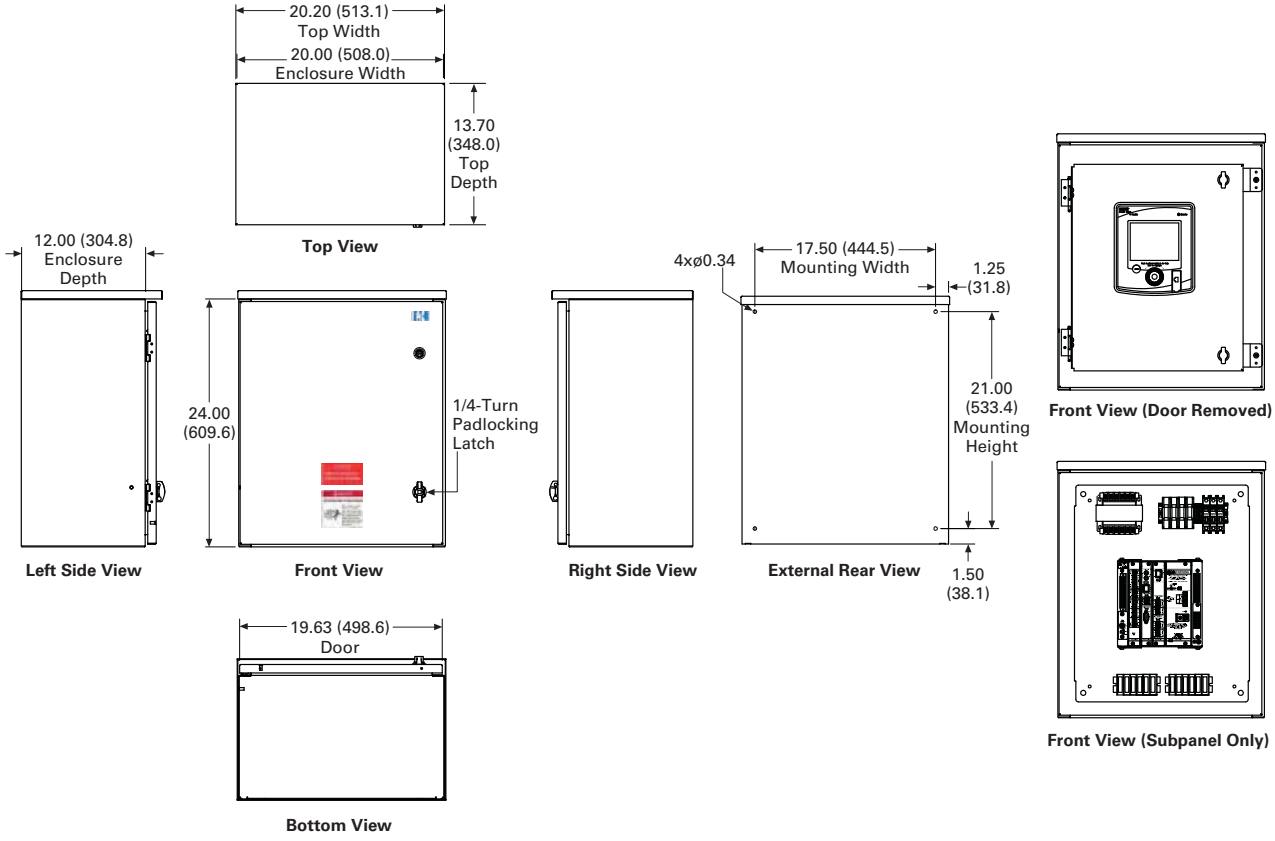


NEMA 3R/4X Multi Unit Enclosure



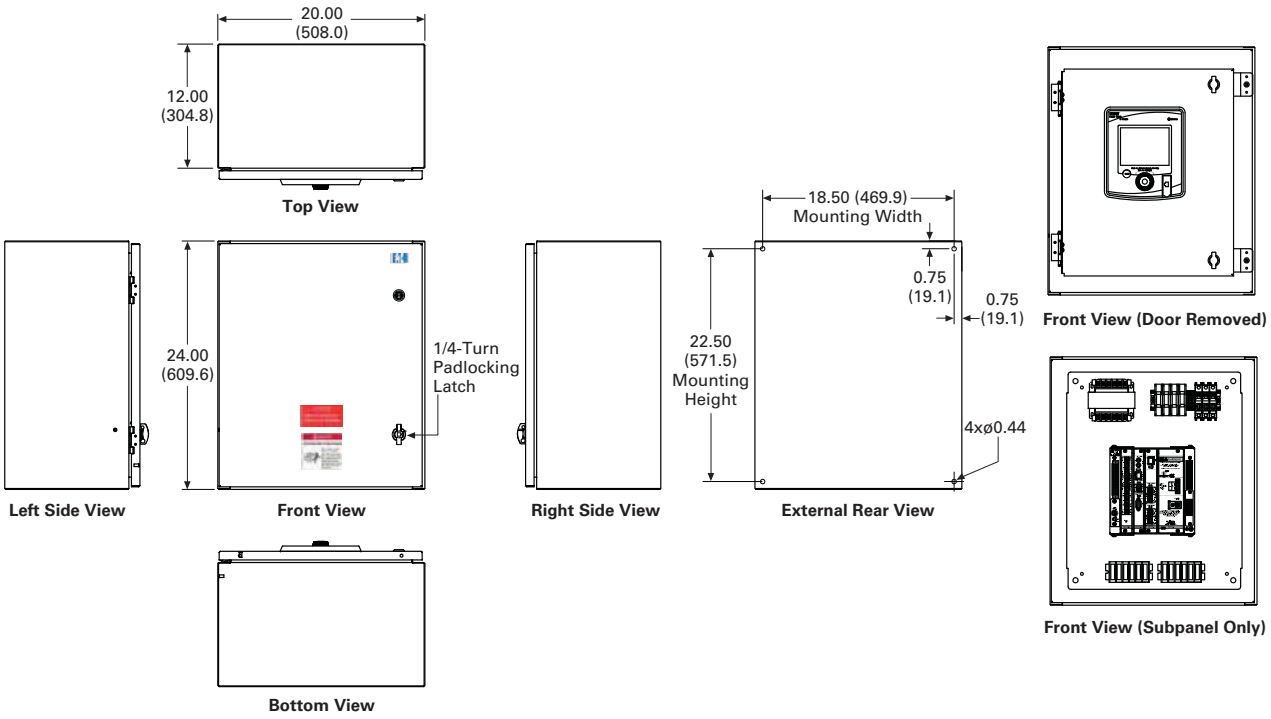
Approximate Dimensions in Inches (mm)

NEMA 3R PXM 4000/6000/8000 Unit Enclosure



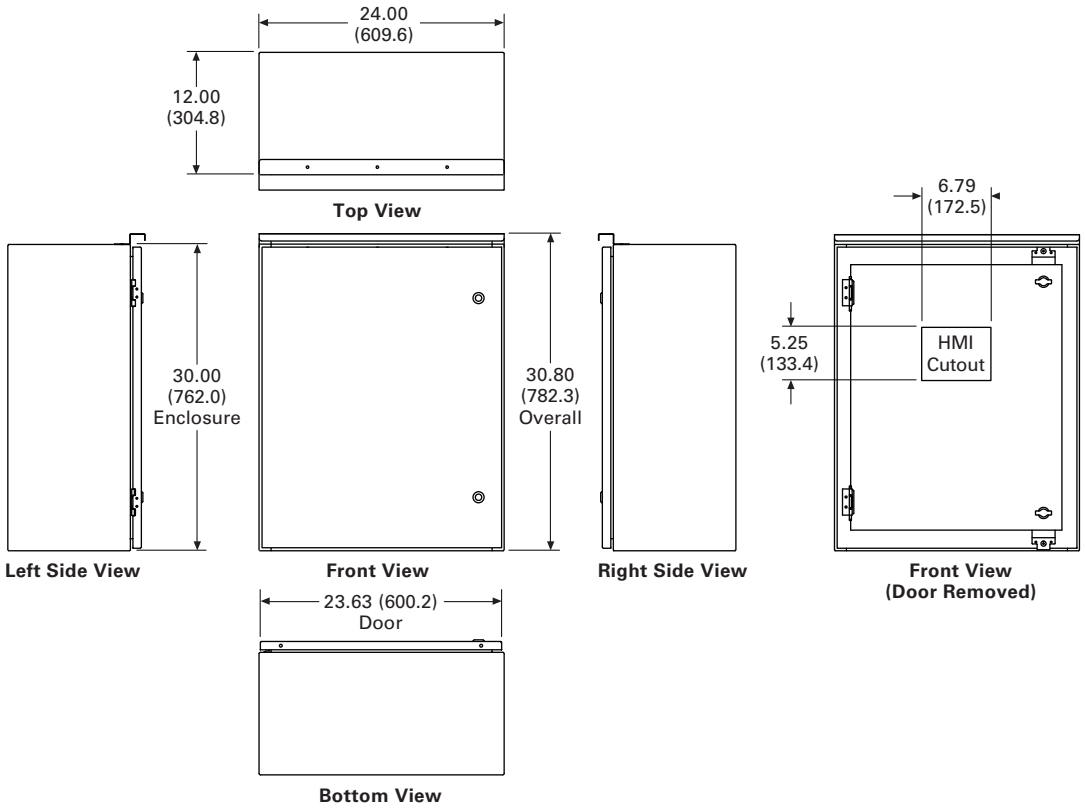
Approximate Dimensions in Inches (mm)

NEMA 4X PXM 4000/6000/8000 Unit Enclosure



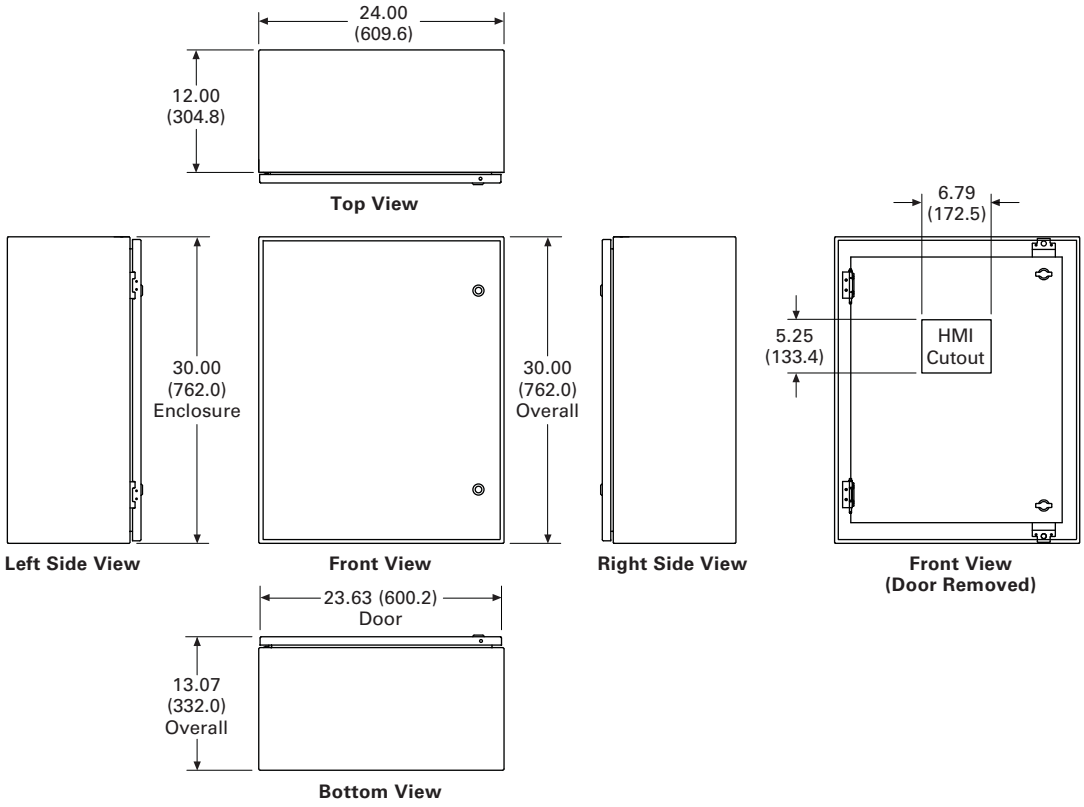
Approximate Dimensions in Inches (mm)

NEMA 3R PXMP Multi Unit Enclosure



Approximate Dimensions in Inches (mm)

NEMA 4X PXMP Multi Unit Enclosure



Contents

Description	*Page*
Product Selection Guide	
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

9

Product Selection Guide

Protective Relay Selection Chart

Protection Functions

		Feeder Protection		Motor Protection				Transformer Protection		Generator Protection
Description	**IEEE Device Number**	**EDR-3000 V3-T9-108**	**EDR-5000 V3-T9-117**	**EMR-3000 V3-T9-134**	**EMR-4000 V3-T9-146**	**EMR-5000 V3-T9-159**	**ETR-4000 V3-T9-171**	**ETR-5000 V3-T9-159**	**EGR-5000 V3-T9-196**
Phase inst. OC	50	■	■	■	■	■	■	■	■
Phase TOC	51	■	■	■	■	■	■	■	■
Ground inst. OC (measured)	50G	■	■	■	■	■	■	■	■
Ground TOC (measured)	51G	■	■	■	■	■	■	■	■
Ground inst. OC (calculated)	50R	■	■	■	■	■	■	■	■
Ground TOC (calculated)	51R	■	■	■	■	■	■	■	■
No. of curves (ANSI/IEC/thermal)		11	11	11	11	11	11	11	11
Zone selective interlocking		■	■	■	■	■	■	■	■
Phase directional control ①	67		■		■	■		■	■
Ground directional control ①	67N		■		■	■		■	■
Phase voltage restrained OC	51VR		■		■	■		■	■
Undervoltage	27		■		■	■		■	■
Current unbalance	46	■	■	■	■	■		■	■

Note

① Directional elements are controlled by reverse, forward, or both directions.

Protection Functions, continued

		Feeder Protection		Motor Protection				Transformer Protection		Generator Protection
Description	IEEE Device Number	EDR-3000 V3-T9-108	EDR-5000 V3-T9-117	EMR-3000 V3-T9-134	EMR-4000 V3-T9-146	EMR-5000 V3-T9-159	ETR-4000 V3-T9-171	ETR-5000 V3-T9-196	EGR-5000 V3-T9-196
Voltage unbalance	47		■		■	■		■	■
Power factor	55		■		■	■			■
Overvoltage	59		■		■	■		■	■
Frequency (over/under)	81		■		■	■		■	■
Rate of change of frequency	81R		■		■	■		■	■
Vector surge	78V		■		■	■		■	■
Forward/reverse power	32		■		■	■		■	■
Forward/reverse vars	32V		■		■	■		■	■
Sync check	25		■						■
Reclosing	79		■					■	■
Ground overvoltage	59N		■						■
Thermal overload ①	49			■	■	■	■	■	■
Underload	37			■	■	■			
Locked rotor	49S/51			■	■	■			
Jam/stall	51R			■	■	■			
Incomplete sequence	48			■	■	■			
Number of starts limit				■	■	■			
Starts per hour	66			■	■	■			
Time between starts				■	■	■			
Long acceleration time				■	■	■			
Emergency override				■	■	■			
Broken rotor bar detection					■	■			
Loss of potential	60LOP		■					■	■
Current transformer supervision		■	■	■	■	■	■	■	■
Cold load pickup		■	■		■	■	■	■	■
Switch on to fault		■	■					■	■
Breaker failure	50BF	■	■	■	■	■	■	■	■
2nd harmonic restraint							■	■	
4th harmonic restraint							■	■	
5th harmonic restraint							■	■	
Differential	87					■	■	■	■
Ground differential	87GD						■	■	■
Trip lock out	86	■	■	■	■	■	■	■	■
Negative sequence current	51Q						■	■	■
External protection		■	■	■	■	■	■	■	■
Overexcitation (Volts/Hz)	24							■	■
Loss of field	40								■
Low voltage ride-through	27T		■					■	■
Reactive power and undervoltage	27Q		■					■	■
Inadvertent energization	50/27								■

Note

① When communicating to an external URTD device.

Control Functions

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
Remote open/close		■	■	■	■	■	■	■	■
Programmable I/O		■	■	■	■	■	■	■	■
Digital inputs		4 or 8	8	4	8	8 or 16	8	8	8 or 16
Relay outputs		3 or 5	10	3	4	8	8	8	8
Supervisory/alarm output		1	1	1	1	1	1	1	1
Programmable logic control		■	■	■	■	■	■	■	■
Multiple settings groups		4	4	4	4	4	4	4	4
Adaptive parameters		■	■	■	■	■	■	■	■
Reduced voltage starting				■	■	■			
Analog outputs					4	Option for 2		Option for 2	Option for 2
Analog inputs						Option for 2		Option for 2	Option for 2

Metering Functions

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
Amperes		■	■	■	■	■	■	■	■
Ampere demand		■	■	■	■	■	■	■	■
Voltage (L-N and L-L)			■		■	■		■	■
Phase angle		■	■	■	■	■	■	■	■
Pos., neg. and zero sequence		■	■	■	■	■	■	■	■
Watts			■		■	■		■	■
Watt demand			■		■	■		■	■
Watthour			■		■	■		■	■
Vars			■		■	■		■	■
Var demand			■		■	■		■	■
Varhour			■		■	■		■	■
VA			■		■	■		■	■
VA Demand			■		■	■		■	■
VA-hour			■		■	■		■	■
Frequency			■		■	■		■	■
Minimum/maximum recording		■	■	■	■	■	■	■	■
Current unbalance		■	■	■	■	■	■	■	■
Voltage unbalance			■		■	■		■	■
Power factor			■		■	■		■	■
Sync values			■						■
Differential currents						■	■	■	■
2nd, 4th, 5th harmonic currents							■	■	
3rd harmonic voltage									■
THD current		■	■	■	■	■	■	■	■
THD voltage			■		■	■		■	■
Volt/Hertz					■	■		■	■
Thermal capacity				■	■	■			■
Generator hours of operation									■

Monitoring Functions

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
Trip circuit monitor	74	■	■	■	■	■	■	■	■
Breaker wear		■	■	■	■	■	■	■	■
Fault recorder		■	■	■	■	■	■	■	■
Waveform recorder		■	■	■	■	■	■	■	■
Sequence of events recorder		■	■	■	■	■	■	■	■
Trend recorder (load profile)		■	■	■	■	■	■	■	■
Clock		■	■	■	■	■	■	■	■
Time synchronization		■	■	■	■	■	■	■	■
RTD temperature ①				■	■	■	■	■	■
Hottest RTD ①				■	■	■	■	■	■

Communications

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
Front access interface									
Local human machine interface		■	■	■	■	■	■	■	■
RS-232		■	■	■	■	■	■	■	■
USB		②	②	②	②	②	②	②	②
Rear communication port interface									
RS-485		Option	Option	Option	Option	Option	Option	Option	Option
Ethernet copper (RJ45)		Option	Option	Option	Option	Option	Option	Option	Option
Fiber optic ST (note)		②	②	②	②	②	②	②	②
Fiber optic LC (note)		②	②	②	②	②	②	②	②
Protocol									
INCOM									
Modbus-RTU		Option	Option	Option	Option	Option	Option	Option	Option
Modbus-TCP		Option	Option	Option	Option	Option	Option	Option	Option
IEC 61850		Option	Option	Option	Option	Option	Option	Option	Option
DNP 3.0 (note)		②	②	②	②	②	②	②	②
PROFIBUS (note)		②	②	②	②	②	②	②	②
IRIG-B		Option	■	■	■	■	■	■	■
SNTP		Option	Option	Option	Option	Option	Option	Option	Option

Notes

① When communicating to an external URTD device.

② Option available beginning in late 2015.

Construction

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
Panel mount case		Semi-flush or projected	Semi-flush or projected	Semi-flush or projected	Semi-flush or projected	Semi-flush or projected	Semi-flush or projected	Semi-flush or projected	Semi-flush or projected
Drawout case		Removable terminals	Removable terminals	Removable terminals	Removable terminals	Removable terminals	Removable terminals	Removable terminals	Removable terminals
Self-shorting CT terminals		■	■	■	■	■	■	■	■
Operating temperature range		–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C	–40 °C to +60 °C
Power supply range (Vac)		40–250 Vac	40–250 Vac	40–250 Vac	40–250 Vac	40–250 Vac	40–250 Vac	40–250 Vac	40–250 Vac
Power supply range (Vdc)		19–300 Vdc	19–300 Vdc	19–300 Vdc	19–300 Vdc	19–300 Vdc	19–300 Vdc	19–300 Vdc	19–300 Vdc
AC current inputs		■	■	■	■	■	■	■	■
AC voltage inputs			■		■	■		■	■
Wye VT configuration			■		■	■		■	■
Open delta VT configuration			■		■	■		■	■
Sensitive ground	50/51G	Option	Option	Option	Option	Option	Option	Option	Option
Local display / HMI		Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons	Backlit LCD w/8 pushbuttons
LEDs (local targets)		Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable	Programmable

Standards

Description	IEEE Device Number	Feeder Protection EDR-3000 V3-T9-108	Feeder Protection EDR-5000 V3-T9-117	Motor Protection EMR-3000 V3-T9-134	Motor Protection EMR-4000 V3-T9-146	Motor Protection EMR-5000 V3-T9-159	Transformer Protection ETR-4000 V3-T9-171	Transformer Protection ETR-5000 V3-T9-196	Generator Protection EGR-5000 V3-T9-196
ANSI		■	■	■	■	■	■	■	■
IEC		■	■	■	■	■	■	■	■
UL		■	■	■	■	■	■	■	■
CE		■	■	■	■	■	■	■	■
CSA		■	■	■	■	■	■	■	■

Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

Arc Flash Relay

Information not available at this time.

Information not available at this time.

EDR-3000



Contents

Description	Page
Product Selection Guide	V3-T9-100
Arc Flash Relay	V3-T9-106
EDR-3000 Feeder Protection	
EDR-5000 Distribution Protection Relay	V3-T9-117
EBR—Line Differential Relay	V3-T9-130
EMR-3MP0 Motor Protection Relay	V3-T9-132
EMR-3000 Motor Protection Relay	V3-T9-134
EMR-4000 Motor Protection Relay	V3-T9-146
EMR-5000 Motor Protection Relay	V3-T9-159
ETR-4000 Transformer Protection Relay	V3-T9-171
ETR-5000 Transformer Protection Relay	V3-T9-183
EGR-5000 Generation Protection Relay	V3-T9-196
Universal RTD Module	V3-T9-209

9

EDR-3000 Feeder Protection

Product 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 that 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 three-phase circuit.

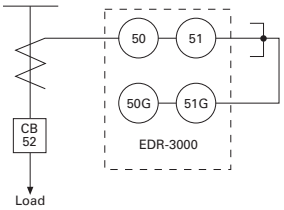
Current monitoring and operator selectable protective functions are integral to each relay. The EDR-3000 relay operates from the 5 A or 1 A secondary output of standard current transformers. Current transformer ratio information is quickly programmed into the unit via settings. This enables the relay 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. Operating parameters and troubleshooting information are displayed in the 128 x 64 LCD. In addition, all data and information can be communicated to a host computer equipped with PowerPort-E™.

A "Communication Trip" and "Communication Close" control command can also be initiated by a host computer with an authorized access code for remote breaker operation.

Application Description

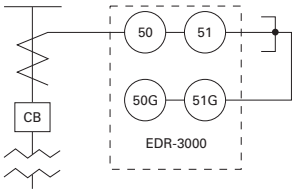
The EDR-3000 microprocessor-based relay provides reliable three-phase and ground overcurrent protection for all voltage levels. It can be used for any application where instantaneous and/or time overcurrent protection is required. It is most commonly used as primary feeder circuit protection, shown below.

Primary Feeder Circuit Protection



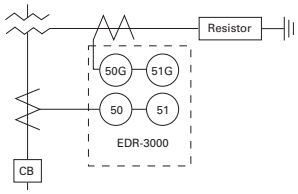
The EDR-3000 may be applied as the transformer primary protection or as backup to the differential protection, see below.

Transformer Overcurrent Protection



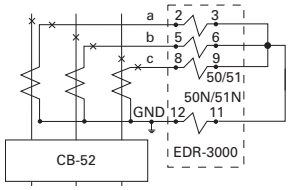
The EDR-3000 may be connected to the secondary side of a delta-wye grounded transformer with the ground element connected to a separate CT in the neutral connection of the transformer. With this connection, a lower CT ratio and a pickup setting can be used to provide more sensitive ground fault protection especially for resistance grounded systems, shown below.

Transformer Secondary Protection with Neutral CT Connection



The EDR-3000 relay has special provisions for connection in a Zone Interlocking scheme that can be used for bus protection or to improve protection coordination in a tight or close system. Zone Interlocking is described in following sections. In addition the EDR-3000 has multiple setting groups that can be used to reduce arc flash hazard with instantaneous elements.

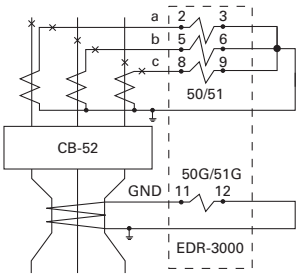
Residual Ground Connection



Overcurrent Protection

The EDR-3000 provides complete three-phase and ground protection with separate elements and settings. The relay can be used with CTs from 1 to 50,000 A of primary current and 1 or 5 A of secondary current. The CT ratio can be set independently for phase and ground, allowing the ground element to be connected in either the residual or the separate ground CT configuration, shown on below.

Separate Zero Sequence Ground CT Connection



Zone Selective Interlocking (Phase and Ground)

Note: Refer to the Ordering Information and (Catalog Ordering Information) for optional features, see **Page V3-T9-111**.

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 below, circuit breakers A, B and C are equipped with EDR-3000 overcurrent relays.

Fault Location Zone 3

Note: 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.

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

Note: 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.

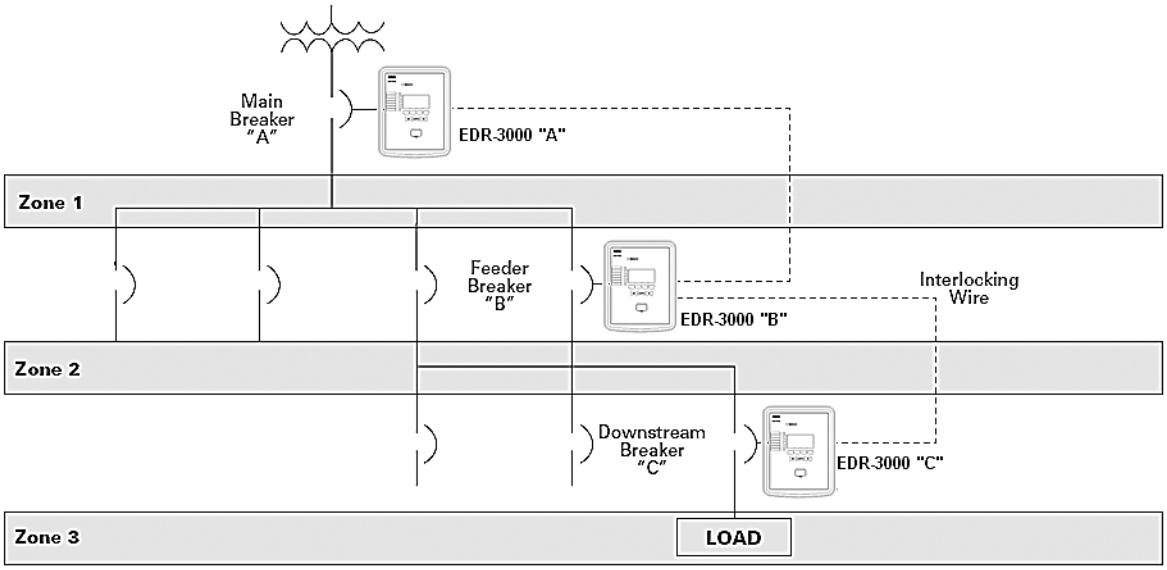
If a fault occurs at a point in Zone 2, the EDR-3000 of feeder breaker B senses the fault and sends a restraining signal to the upstream EDR-3000 of main breaker A. The EDR-3000 of the downstream breaker C does not see this fault since it is situated on the downstream side of the fault. As a result, 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

Note: 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.

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.

Sample Zone Selective Interlocking System



Features, Benefits and Functions

Applications

- Provides reliable three-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)
- 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 protection

Note: Refer to the Ordering Information and **Page V3-T9-111** (Catalog Ordering Information) for optional features.

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

Monitored and Data Recording Values

- Trip circuit monitoring

Note: Refer to the Ordering Information and **Page V3-T9-111** (Catalog Ordering Information) for optional features.

- Breaker wear (accumulated interrupted current)
- Fault data logs (up to 20 events)
- Sequence of event recorder (1 ms time stamp, last 300 events)
- Waveform capture (7200 cycles total)
- Trip Cause displays fault recorder data on HMI after fault event
- CT supervision

Control Functions

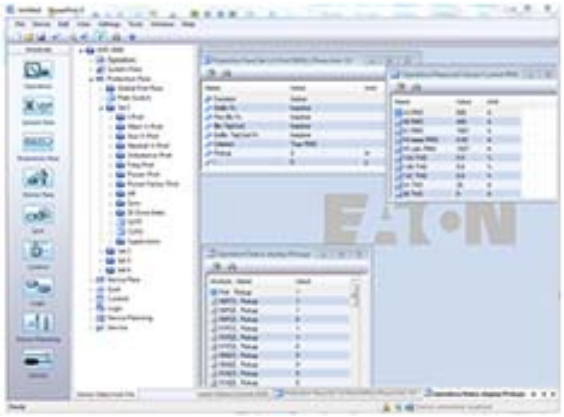
- Remote open/close
- Programmable I/O
- Programmable LEDs
- Multiple setting groups (up to four)

Communication Software

- Local HMI
- Front RS-232 port
- Rear RS-485 port
- Protocols
  - Modbus RTU
  - Modbus TCP (option)
  - IEC 61850 (option)
  - IRIG-B (option)
  - SNTP (option)

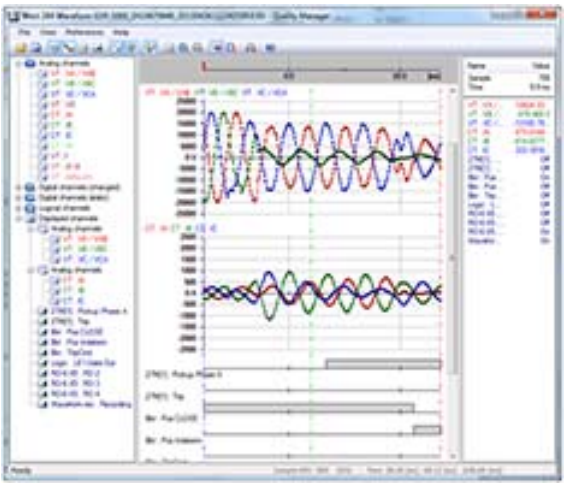
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.



Waveform Capture (Quality Manager)

The EDR-3000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The EDR-3000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles. The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



Standards and Certifications

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

Catalog Number Selection

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

EDR-3000

(A)–Four digital inputs, four output relays

(0)–Phase current 5 A / 1 A, Ground Current 5 A / 1 A, Power supply: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

Relay Removable Terminals

EDR-3000-2A 0 B A 1

Hardware Option 1
- **A** = 4 digital inputs, 4 outputs, removable terminals
- **B** = 8 digital inputs, 6 outputs, removable terminals, trip coil monitor
- **C** = 4 digital inputs, 4 outputs, removable terminals, zone interlocking 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

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 panel mount

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –13 °F to 158 °F (–25 °C to +70 °C)
- Operating temperature: –4 °F to 140 °F (–20 °C to +60 °C)
- 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 (13,123.35 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 according to IEC 60255-5: 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

- Material, housing: aluminum extruded section
- Material, front panel: aluminum/foil front
- Mounting position: horizontal (±45° around the X-axis must be permitted)

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

- Nominal current: 1 A and 5 A
- Continuous loading capacity: 4 x I_n/ continuously
- Overcurrent withstand: 30 x I_n/10 s
- 100 x I_n/1 s
- 250 x I_n/10 ms (1 half-wave)
- Screws: M4, captive type according to VDEW
- Connection cross-sections:
  - 2 x 2.5 mm^2 (2 x AWG 14) with wire end ferrule
  - 1 x or 2 x 4.0 mm^2 (2 x AWG 12) with ring cable sleeve or cable sleeve
  - 1 x or 2 x 6 mm^2 (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: Power consumption in idle mode
- Max. power consumption
- 19–300 Vdc: 6 W 8.5 W
- 40–250 Vac
- For frequencies of 40–70 Hz: 6 W 8.5 W

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)
- Four switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac/Vdc, 230 Vac/Vdc Un = 24 Vdc
  - Switching threshold 1 ON
    - Switching threshold 1 OFF
    - Min. 19.2 Vdc
    - Max. 9.6 Vdc
    - Un = 48 V/60 Vdc
  - Switching threshold 2 ON
    - Switching threshold 2 OFF
    - Min. 42.6 Vdc
    - Max. 21.3 Vdc
    - Un = 110/120 Vac/Vdc
  - 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/Vdc
  - 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 = 1 A S = 0.15 MVA
  - at I_n = 5 A S = 0.15 MVA
- Ground current input
  - at I_n = 1 A S = 0.35 MVA
  - at I_n = 5 A S = 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

Front Interface RS-232

- Baud rates: 115,200 baud
- Handshake: RTS and CT
- Connection: 9-pole D-Sub plug

RS-485

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

Tolerances of the Real-Time Clock

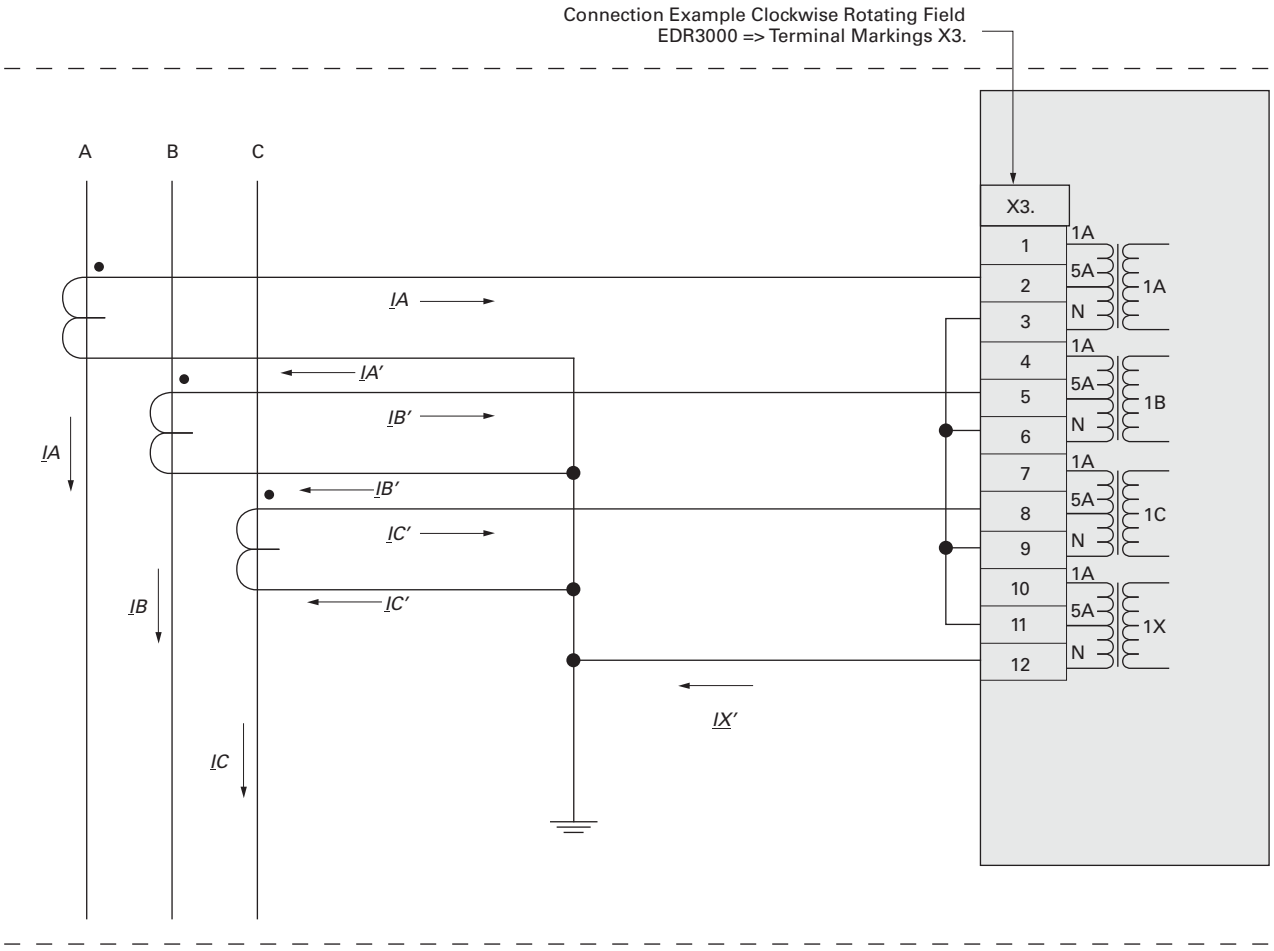
- Resolution: 1 ms
- Tolerance: <1 minute/ month (+20 °C)

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

Wiring Diagrams

EDR-3000

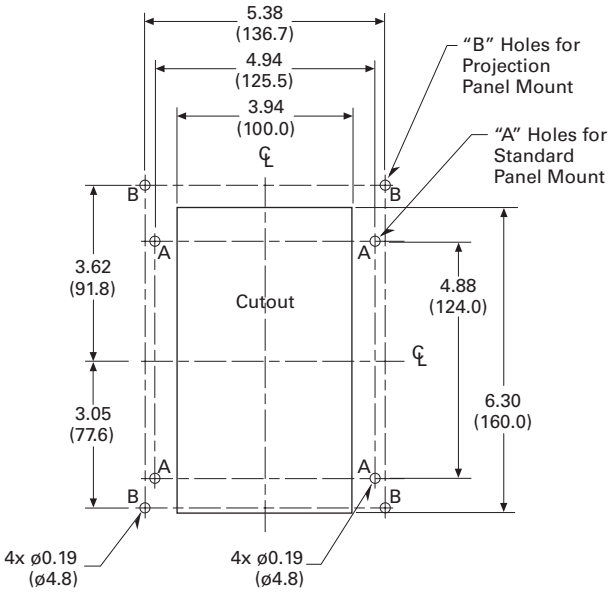


Three-Phase Current Measurement; Inom Secondary = 5 A
Ground Current Measuring via Residual Connection; IGnom Secondary = 5 A

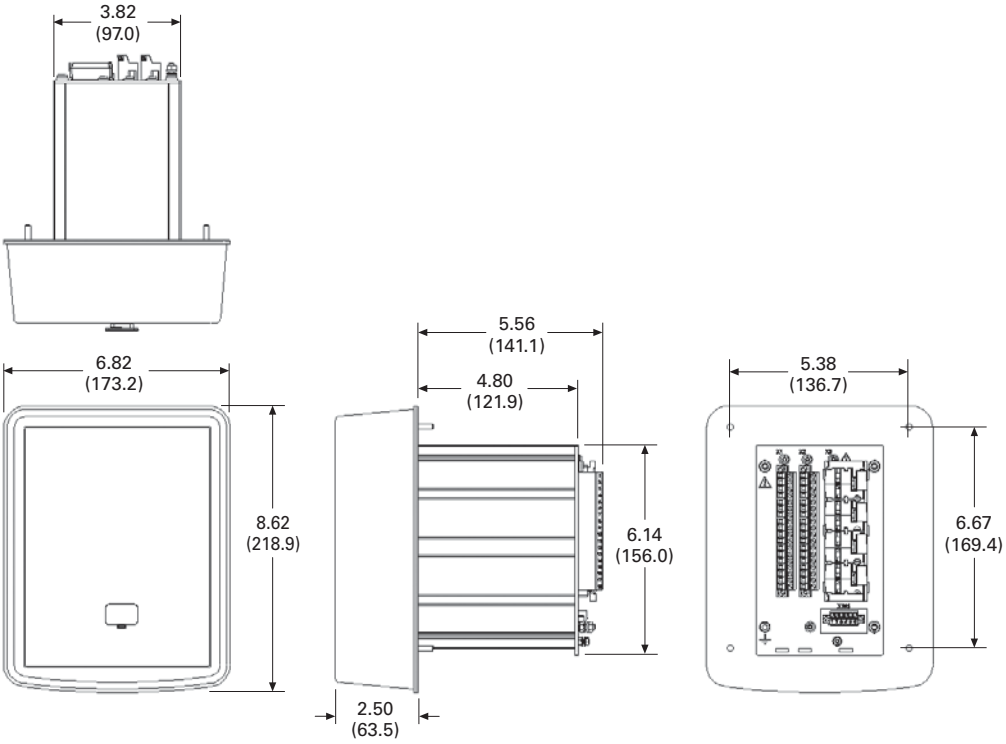
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Pattern

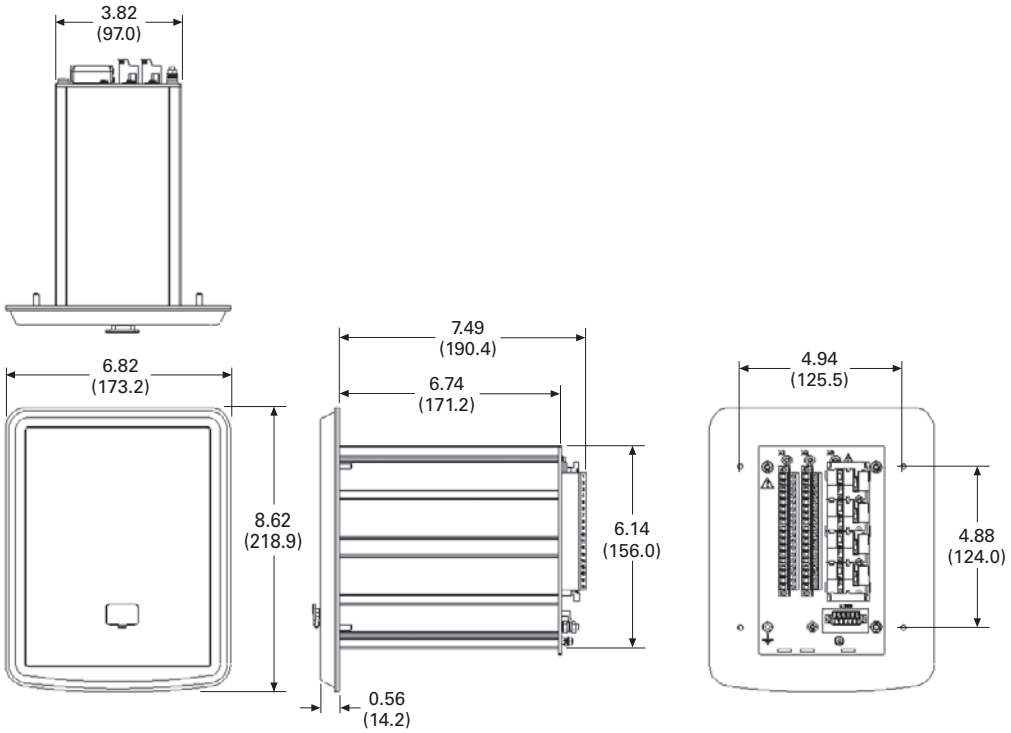


Projection Mounting



Approximate Dimensions in Inches (mm)

Standard Mounting



EDR-3000

Width	Height	Depth
6.82 (173.2)	8.62 (218.9)	7.49 (190.2) ①

EDR-3000 Housing B1

Width	Height	Depth	Shipping Weight Lb (kg)
5.57 (141.5)	7.21 (183.0)	8.19 (208.0) ②	5.3 (2.4)

Notes

① Depth behind panel with projection mounted enclosure.
② Includes terminals.

EDR-5000 Distribution Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

9

EDR-5000 Distribution Protection Relay

Product Description

Eaton's EDR-5000 distribution protection relay is a multi-functional, microprocessor-based relay for feeder circuits of all voltage levels. It may be used as a primary protection on feeders, mains and tie circuit breaker applications; or as backup protection for transformers, high voltage lines and differential protection. The relay is most commonly used on medium voltage switchgear applications.

The EDR-5000 distribution protection relay provides complete current, voltage, and frequency protection and metering in a single, compact case. The relay has four current inputs rated for either 5 amperes or 1 ampere and four voltage inputs. Three of the voltage inputs are to be connected to the three-phase power voltage for voltage protection and for metering. They can be connected in wye-ground or open delta configuration. The fourth voltage is for independent single-phase undervoltage/overvoltage protection, sync-check or ground protection for an ungrounded system.

The maintenance mode password protected soft key can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only. The multiple setting groups can also be changed, via communications or a digital input.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. 14 programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 communication port on the back is standard for local area networking using Modbus-RTU. An optional Ethernet port and protocols are available.

The EDR-5000 distribution protection relay includes programmable logic functions. Logic gates and timers may be defined and arranged for customized applications. Programmable logic control functions make the EDR-5000 relay ideally suited for main-tie-main and main 1/main 2 transfer schemes. Flash memory is used for the programming and all settings are stored in nonvolatile memory.

The relay allows for four preprogrammed setting groups which can be activated through software or contact input.

Flash memory is used for the programming and all settings are stored in nonvolatile memory. The relay allows for four preprogrammed setting groups which can be activated through software, the display or a contact input.

The EDR-5000 distribution protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, breaker wear information and oscillography data.

The EDR-5000 has eight programmable binary inputs, 2 normally opened and 8 Form C heavy-duty outputs and one form C signal alarm relay. It can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

The Eaton's EDR-5000 distribution protection relay has been designed for maximum user flexibility and simplicity. The base relay includes all the standard current and voltage protection and metering functions.

Applications include distribution feeder protection, primary or backup protection for transformers and generators, utility interconnections and transfer schemes.

Features, Benefits and Functions

Directional Overcurrent Protection

The EDR-5000 distribution protection relay provides complete three-phase and ground directional overcurrent protection. There are 8 independent ground overcurrent elements. The ground elements "X" use the independently measured ground (or neutral) current from a separate current-sensing input. The ground elements "R" uses a calculated 3Io residual current obtained from the sum of the three-phase currents. This calculated current could be used for either the neutral or ground current in a three-phase, four-wire system. Each of the phase and ground overcurrent elements can be selected to operate based on fundamental or rms current.

Phase direction is a function used to supervise all phase current elements (50, 51). A quadrature voltage is compared to a corresponding phase current to establish the direction of the fault. This function is selectable to operate in the forward, reverse or both directions. Ground direction is used to supervise ground current elements and is accomplished by using ground, negative sequence or residual currents supervised by zero, negative or positive sequence voltages or ground current. This function is selectable to operate in forward, reverse or both directions.

Voltage Restrained Overcurrent

Voltage restraint reduces the overcurrent pickup level (51P[3]). This modification of the pickup overcurrent level is compared to the corresponding phase input voltage. The EDR-5000 uses the simple linear model below to determine the effective pickup value.

Sync Check

The sync check function is provided for double-ended power source applications. The sync check monitors voltage magnitude, phase angle and slip frequency between the bus and line. It also incorporates breaker close time, dead bus dead line, dead bus live line and live bus live line features.

Reverse Power

Reverse power provides control for power flowing through a feeder. There are three elements to be configured: Operate in forward or reverse; or, under or over power conditions. Reverse power is typically applied to generator or motor applications while under power is generally applied to load or generation loss.

Reverse Vars

Reverse vars can be used to detect loss of excitation in synchronous machines. There are three elements to be configured: operate in forward or reverse; or, under or over vars conditions.

Inverse-Time Characteristics

There are 11 user-selectable inverse-time overcurrent curve characteristics. The user can select from the ANSI, IEC or thermal curve families and can select instantaneous or time delay reset characteristics.

Breaker Failure

The EDR-5000 distribution protection relay includes a breaker failure (50BF, 62BF) function that can be initiated from either an internal or external trip signal. This is an independent element that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Voltage Protection

The EDR-5000 distribution protection relay has four voltage-input circuits. There is a three-phase set designated as Main Voltage (M) and a single-phase voltage circuit designated as Auxiliary Voltage (A). Both include undervoltage (27) and overvoltage (59) protection. The three-phase voltage protection can be set to operate on a single-phase, two out of three phases, or all three-phase logic. The Main VTs also provide phase voltage unbalance/reversal (47 negative sequence) protection. Each element has an independent threshold set point and adjustable time delay.

Ground Voltage Protection

In high impedance grounded systems, ground fault protection is provided by the detection of zero sequence voltage (3Vo) voltage in the neutral of the transformer by an overvoltage element (59N) connected to the secondary of the distribution grounding transformer, or in the secondary of a Wye-Broken Delta transformer used when the neutral is not accessible or in Delta system. In the EDR-5000 we can measure this zero sequence voltage through the 4th voltage input; the 59N element has to be desensitized for 3rd harmonic voltages that can be present in the system under normal operation.

Flexible Phase Rotation

The EDR-5000 distribution protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Frequency Protection

The EDR-5000 relay provides 6 frequency elements than can be used to detect under/over frequency, rate of change, and a vector surge (decoupling of two systems) protection on the Main VT inputs. Each element has an independent threshold set point and adjustable time delay.

Autoreclosing Logic

The EDR-5000 provides a 6 shot-recloser scheme. Autoreclosing is normally used by the utilities in their distribution and transmission lines, but it can be used in commercial and industrial applications with long overhead lines. Nearly 85% of the faults that occur on overhead lines are transient in nature. Tripping of a circuit breaker normally clears a transient fault and reclosing of the circuit breaker restores power back to the circuit.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communication or via a digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Protection Features

- Phase overcurrent elements:
  - Three instantaneous elements with timers (50P[1], 50P[2] and 50P[3])
  - Three inverse time overcurrent elements (51P[1], 51P[2] and 51P[3])
  - 11 standard curves
  - Instantaneous or time delay reset
  - Voltage Restraint (51P[2] and 51P[3])
  - Directional Control (All Elements)
- Ground overcurrent elements:
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
  - Directional control (all elements)
- Breaker failure (50BF)
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Phase voltage unbalance and sequence protection (47[1], 47[2])
- Main three-phase under/overvoltage (27M[1], 27M[2], 59M[1], 59M[2])
- Auxiliary single-phase under/overvoltage (27A[1], 27A[2], 59A[1], 59A[2])
- Ground fault overvoltage relay (59N[1], 59N[2])
- 6 frequency elements that can be assigned to: over frequency, under frequency, rate of change, or vector surge (81[1], 81[2], 81[3], 81[4], 81[5], 81[6])
- Apparent and displacement power factor (55A[1], 55A[2], 55D[1], 55D[2])
- Forward and reverse watts (32[1], 32[2], 32[3])
- Forward and reverse vars (32V[1], 32V[2], 32V[3])
- Sync check (25)
- Autoreclosing (79)
- Zone interlocking for bus protection (87B)
- Switch onto fault protection
- Cold load pickup

Metering Features

- Amperes: Positive, negative and zero sequence
- Ampere demand
- Volts: Positive, negative and zero sequence
- Phase angles
- Volt-amperes and VA demand
- Watts and kW demand
- kWh (forward, reverse, net)
- Vars and kvar demand
- kvarh (lead, leg and net)
- Power factor
- Frequency
- % THD V and I
- Magnitude THD V and I
- Minimum/maximum recording.
- Sync Values
- Trending (load profile over time)

Monitoring Features

- Trip coil monitor
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Clock (1 ms time stamping)
- Trip cause displays fault reorder data on HMI after fault event

Control Functions

- Breaker open/close
- Remote open/close
- Programmable I/O
- Programmable Logic
- Programmable LEDs
- Multiple setting groups
- Cold load pickup
- CT supervision

Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port:
  - RS-232
- Remote communication port:
  - RS-485
  - Ethernet RJ-45
- Protocols:
  - Modbus-RTU
  - Modbus-TCP (optional)
  - IEC-61850 (optional)
- Configuration software

Monitoring and Metering

Sequence of Events Records

The EDR-5000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.

Trip Log

The EDR-5000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

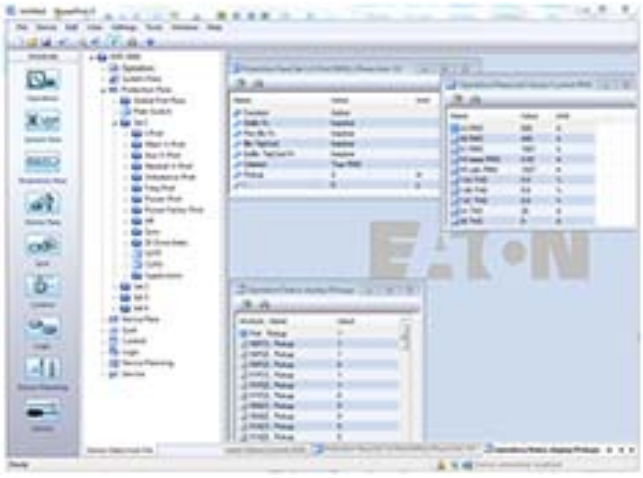
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.

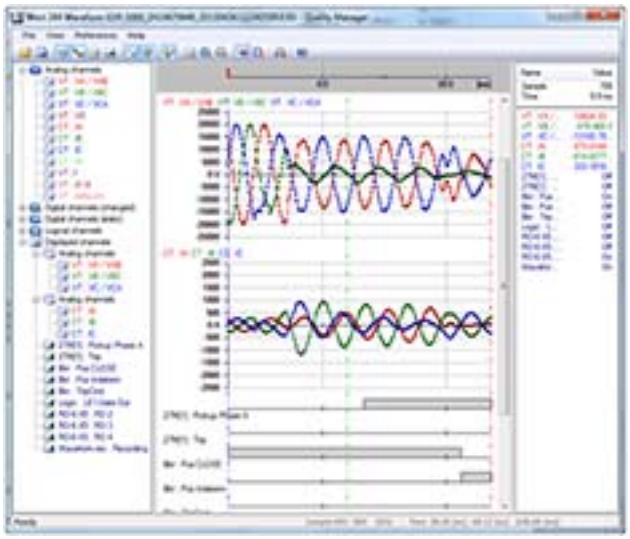
Waveform Capture (Quality Manager)

The EDR-5000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic and contact inputs. The EDR-5000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles.

The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



PowerPort-E



Waveform Capture (Quality Manager)

Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. 17 programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Load Profiling/Trending

The EDR-5000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30 or 60 minutes, depending on the trending report setting.

Programmable I/O

The EDR-5000 distribution protection relay provides heavy-duty, triprated, 2 normally open and 8 Form C contacts. Two isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode.

There are eight user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

Programmable Logic

The EDR-5000 distribution protection relay provides logic gates and timers that the user can customize for special or unique applications. Each gate can be assigned a logic function of either AND, OR, NAND or NOR. Each gate can have a maximum of four input signals and each input signal can be required to be a NOT. Input signals can be external inputs received via the binary inputs or internal values associated with the protection, alarm or metering set points. Each gate has a unique output assignment and designation that can be used as the input to another gate. There are 24 independent timers that have adjustable pickup and dropout delay settings.

Standards and Certifications

Design Standards

- Generic Standard:
  - EN 61000-6-2
  - EN 61000-6-3
- Product Standard:
  - IEC 60255-6
  - EN 50178
  - UL 508 (Industrial Control Equipment)
  - CSA C22.2 No. 14-95 (Industrial Control Equipment)
  - ANSI C37.90
- UL-listed file: e217753

Listed

Standards

High Voltage Tests (IEC 60255-6)

- High frequency interference test:
  - IEC 60255-22-1 Class 3
    - Within one circuit—1 kV/2 s
    - Circuit to ground—2.5 kV/2 s
    - Circuit to circuit—2.5 kV/2 s
- Insulation voltage test:
  - IEC 60255-5, EN 50178
    - All circuits to other circuits and exposed conductive parts: 2.5 kV (eff.)/50 Hz, 1 min.
    - Except interfaces: 1.5 kV DC, 1 min.
    - Voltage measuring input: 3 kV (eff.)/50 Hz, 1 min.
- Impulse voltage test:
  - IEC 60255-5: 5 kV/0.5J, 1.2/50 µs

EMC Immunity Tests

- Fast transient disturbance immunity test (burst):
  - IEC 60255-22-4: Power supply, mains inputs—±4 kV, 2.5 kHz
  - IEC 61000-4-4 Class 4: Other inputs and outputs—±2 kV, 5 kHz (coupling network)
  - ANSI C37.90.1: ±4 kV, 2.5 kHz (coupling clamp)
- Surge Immunity Test:
  - IEC 61000-4-5 Class 4
    - Within one circuit—2 kV
    - Circuit to ground—4 kV
- Electrical discharge immunity test:
  - IEC 60255-22-2: Air discharge—8 kV
  - IEC 61000-4-2 Class 3: Contact discharge—6 kV
- Radiated radio frequency electromagnetic field immunity test
  - IEC 61000-4-3: 26 MHz – 80 MHz—10 V/m
  - Class X: 80 MHz–1 GHz—35 V/m
  - ANSI C37.90.2: 1 GHz–3 GHz—10 V/m
- Immunity to conducted disturbances induced by radio frequency fields:
  - IEC 61000-4-6 Class 3: 10 V
- Power frequency magnetic field immunity test:
  - IEC 61000-4-8: Continuous—30 A/m
  - Class 4: 3 sec—300 A/m

EMC Emission Tests

- Radio interference suppression test:
  - IEC/CISPR11—Limit value class B
- Radio interference radiation test:
  - IEC/CISPR11—Limit value class B

Environmental Tests

Classification

- IEC 60068-1: Climatic—0/055/56
- IEC 60721-3-1:
  - Classification of ambient conditions (storage)—1K5/1B1/1C1L/1S1/1M2 but min. –13 °F (–25 °C)
- IEC 60721-3-2: Classification of ambient conditions (transportation)—2K3/2B1/2C1/2S1/2M2
- IEC 60721-3-3: Classification of ambient conditions (Stationary use at weather protected locations)—3K6/3B1/3C1/3S1/3M2 but min. 32 °F (0 °C) and 3K8H for 2 h

Test ad: Cold

- IEC 60068-2-1:
  - Temperature—–4 °F (–20 °C)
  - Test duration—16 h

Test Bd: Dry heat

- IEC 60068-2-2:
  - Temperature—131 °F (55 °C)
  - Relative humidity—<50%
  - Test duration—72 h

Test cab: Damp heat (steady state)

- IEC 60068-2-78:
  - Temperature—104 °F (40 °C)
  - Relative humidity—93%
  - Test duration—56 d

Test Db: Damp heat (cyclic)

- IEC 60068-2-30:
  - Temperature—131 °F (55 °C)
  - Relative humidity—95%
  - Cycles (12 + 12-hour)—2

Mechanical Tests

Test Fc: Vibration Response Test

- IEC 60068-2-6, IEC 60255-21-1, Class 1:
  - Displacement: (10 Hz–59 Hz)—0.0014 in (0.035 mm)
  - Acceleration: (59 Hz–150 Hz)—0.5 gn
  - Number of cycles in each axis: 1

Test Fc: Vibration Endurance Test

- IEC 60068-2-6, IEC 60255-21-1, Class 1:
  - Acceleration: (10 Hz–150 Hz)—1.0 gn
  - Number of cycles in each axis: 20

Test Ea: Shock Test

- IEC 60068-2-27, IEC 60255-21-2, Class 1
  - Shock response test: 5 gn, 11 ms, 3 impulses in each direction
  - Shock resistance test: 15 gn, 11 ms, 3 impulses in each direction

Test Eb: Shock Endurance Test

- IEC 60068-2-29, IEC 60255-21-2, Class 1
  - Shock endurance test: 10 gn, 16 ms, 1000 impulses in each direction

Test Fe: Earthquake Test

- IEC 60068-3-3, KTA 3503, IEC 60255-21-3, Class 2
  - Single axis earthquake vibration test:
    - 3–7 Hz: Horizontal 0.394 in (10 mm), 1 cycle each axis
    - 7–35 Hz Horizontal: 2 gn, 1 cycle each axis

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the EDR-5000. For example, if the catalog number is EDR-5000-2A0BA1, the device would have the following:

EDR-5000

(A)–8 digital inputs, 11 output relays

(0)–5 A / 1 A phase and ground CTs, power supply range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

Relay Removable Terminals

EDR-5000-2A 0 B A 1

Hardware Option 1
- **A** = 8 digital inputs, 11 outputs, removable terminals, zone interlocking
- **B** = 8 digital inputs, 11 outputs, removable terminals, zone interlocking 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
- **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

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 panel mount

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –22 °F to 158 °F (–30 °C to +70 °C)
- Operating temperature: –4 °F to 140 °F (–20 °C to +60 °C)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible installation altitude:
  - 6,561.67 ft (<2000 m) above sea level
  - If 13,123.35 ft (4000 m) altitude applies, 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: IP20

Routine Test

- Insulation test according to IEC 60255-5: All tests to be carried out against ground and other input and output circuits
- Aux. voltage supply, digital inputs: 2.5 kV (eff.)/50 Hz
- 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 B2: Height / Width 7.205 in (183 mm)/ 8.374 in (212.7 mm)
- Housing Depth (Incl. Terminals): 8.189 in (208 mm)
- Material, housing: Aluminum extruded section
- Material, front panel: Aluminum/foil front
- Mounting position: Horizontal (±45° around the X-axis must be permitted)
- Weight: Approx. 9.259 lb (4.2 kg)

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 = 1 A S = 0.15 MVA
    - At I_n = 5 A S = 0.15 MVA
  - Ground current input
    - At I_n = 1 A S = 0.35 MVA
    - At I_n = 5 A S = 0.35 MVA
- Frequency range: 50 Hz/ 60 Hz ±10%
- Terminals: Screw-type terminals with integrated short-circuiters (contacts)
- Connection cross sections:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

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

- Nominal current: 1 A and 5 A
- Continuous loading capacity: 4 x I_n/ continuously
- Overcurrent withstand:
  - 30 x I_n/10 s
  - 100 x I_n/1 s
  - 250 x I_n/10 ms (1 half-wave)
- Screws: M4, captive type acc. to VDEW
- Connection cross sections:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

Control Power Supply

- Aux. voltage: 24–270 Vdc/ 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure: ≥50 ms at minimal aux. voltage interrupted communication is permitted
- Maximum 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 approx. 0.2 x 0.8 in (5 x 20 mm) according to IEC 60127
  - 3.5 A time-lag miniature fuse approx. 0.25 x 1.25 in (6.3 x 32 mm) according to UL 248-14

Voltage and Residual Voltage Measurement

- Nominal voltages: 100 V/ 110 V/ 230 V/ 400 V (can be configured)
- Max. measuring range: 2 x nominal voltage
- Continuous loading capacity: 2 x nominal voltage (800 Vac)
- Power consumption:
  - at Vn = 100 V S = 0.1 MVA
  - at Vn = 110 V S = 0.1 MVA
  - at Vn = 230 V S = 0.4 MVA
  - at Vn = 400 V S = 1.0 MVA
- Frequency range: 50 Hz or 60 Hz ±10%
- Terminals: screw-type terminals

Frequency Measurement

- Nominal frequencies: 50 Hz / 60 Hz

Voltage Supply

- Aux. voltage: 24–270 Vdc/ 48–230 Vac (–20/+10%)
- 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. 0.2 in x 0.8 in) according to IEC 60127
  - 3.5 A time-lag miniature fuse 6.3 x 32 mm (approx. 0.25 in x 1.25 in) according to UL 248-14

Power Consumption

- Power supply range: 24–270 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 48–230 Vac (for frequencies of 40–70 Hz)
  - Power consumption in idle mode—7 VA
  - Maximum power consumption—13 VA

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 B2: 15

Front Interface

- Baud rates: 115,200 Baud
- Handshake: RTS and CTS
- Connection: 9-pole D-sub plug

Real-Time Clock

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

Digital Inputs

- Maximum input voltage: 300 Vdc/259 Vac
- Input current: <4 mA
- Reaction time: <20 ms
- Fallback time: <30 ms

(Safe state of the digital inputs)

- Four switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac/Vdc, 230 Vac/Vdc
  - Un = 24 Vdc
    - Switching threshold 1 ON: Min. 19.2 Vdc
    - Switching threshold 1 OFF: Max. 9.6 Vdc
  - Un = 48 V / 60 Vdc
    - Switching threshold 2 ON: Min. 42.6 Vdc
    - Switching threshold 2 OFF: Max. 21.3 Vdc
  - Un = 110 / 120 Vac/Vdc
    - Switching threshold 3 ON: Min. 88.0 Vdc / 88.0 Vac
    - Switching threshold 3 OFF: Max. 44.0 Vdc / 44.0 Vac
  - Un = 48–60 Vdc
    - Switching threshold 4 ON: Min. 184 Vdc / 184 Vac
    - Switching threshold 4 OFF: Max. 92 Vdc / 92 Vac
- Terminals: screw-type terminal

Relay Outputs

- Continuous current: 5 A AC/DC
- Maximum make current:
  - 25 A AC / 25 A DC up to 30 V for 4s
  - 30 A/230 Vac according to ANSI IEEE Std. C37.90-2005
  - 30 A/250 Vdc according to ANSI IEEE Std. C37.90-2005
- Maximum breaking current:
  - 5 A AC up to 250 Vac
  - 5 A DC up to 30 V (resistive)
  - 0.3 A DC at 300 V
- Maximum switching voltage: 250 Vac/250 Vdc
- Switching capacity: 1250 VA
- Contact type: Form C or normally open contact
- Terminals: screw-type terminals

Supervision Contact (SC)

- Continuous current: 5 A AC/DC
- Maximum switch-on current: 15 A AC / 15 A DC up to 30 V for 4 s
- Maximum breaking current:
  - 5 A Vac up to 250 Vac
  - 5 A Vdc up to 30 Vdc
  - 0.4 A at 125 Vdc
- Contact type: 1 Form C contact
- Terminals: screw-type

Time Synchronization IRIG-B00X

- Nominal input voltage: 5 V
- Connection: Screw-type terminals (twisted pair)

Zone Interlocking

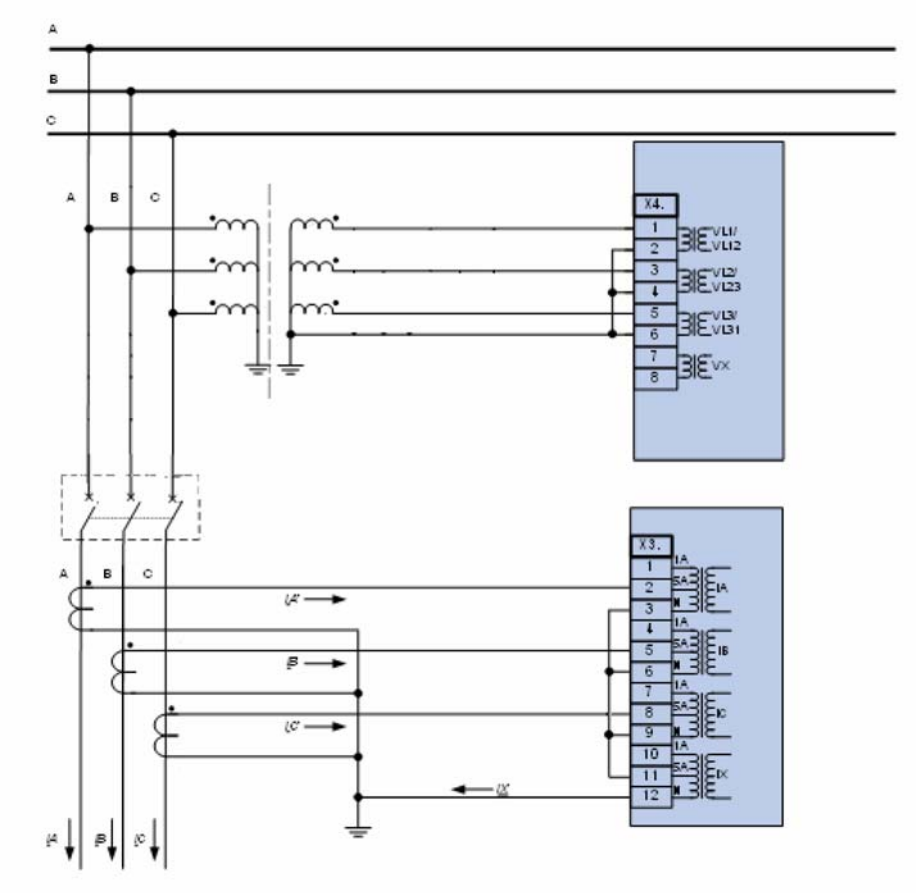
- Zone Out:
  - Output voltage (High) 4.75 to 5.25 Vdc
  - Output voltage (Low) 0.0 to +0.5 Vdc
- Zone In:
  - Nominal input voltage +5 Vdc
  - Max. input voltage +5.5 Vdc
  - Switching threshold ON min. 4.0 Vdc
  - Switching threshold OFF max. 1.5 Vdc
- Galvanic isolation 2.5 kV AC (to ground and other IO)
- Connection: Screw-type terminals (twisted pair)

RS-485

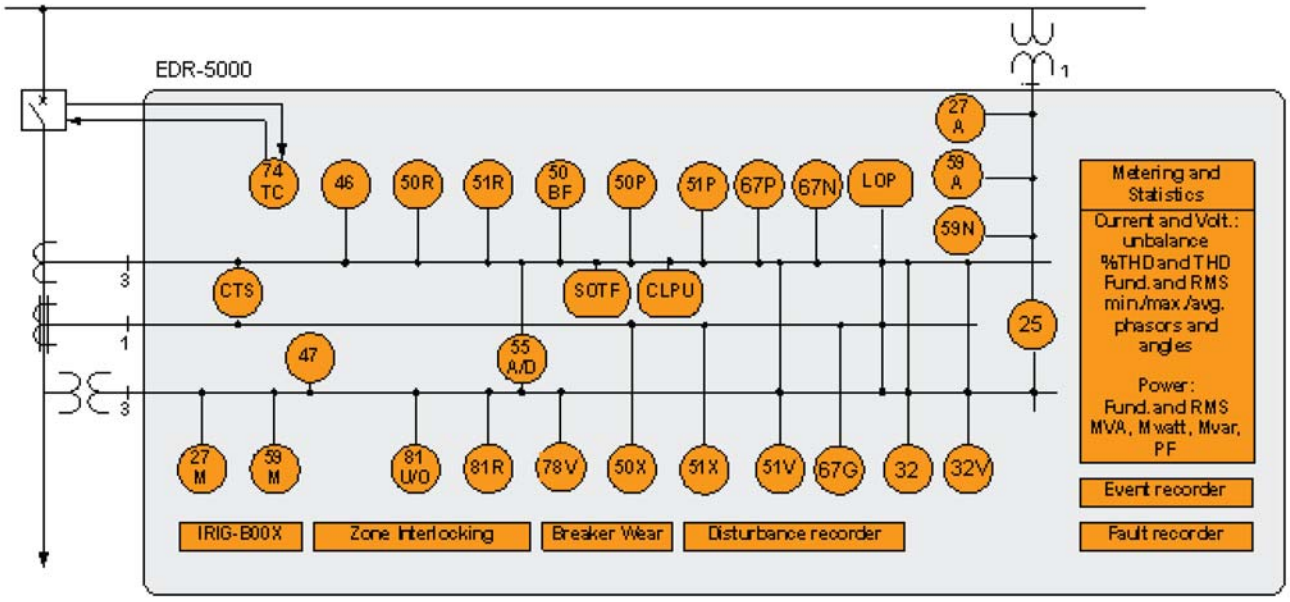
- Master/slave: slave
- Connection: 6 screw-clamping terminals RM 138 MIL (3.5 mm) (terminating resistors internal)

Wiring Diagrams

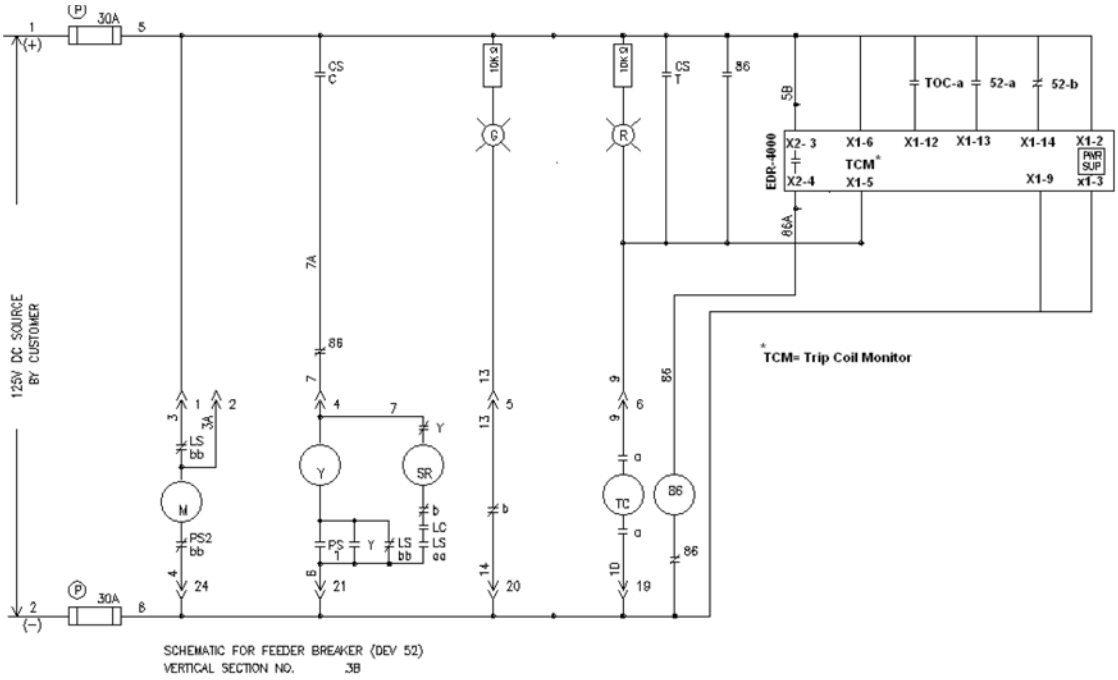
Typical AC Connections—Wye VTs, 5 A CTs and Ground Current Measured by Residual Connection



Typical One-Line Diagram



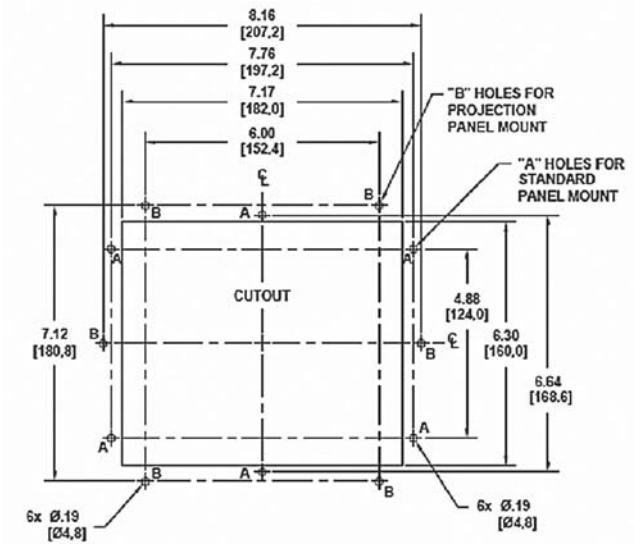
Typical Control Diagram



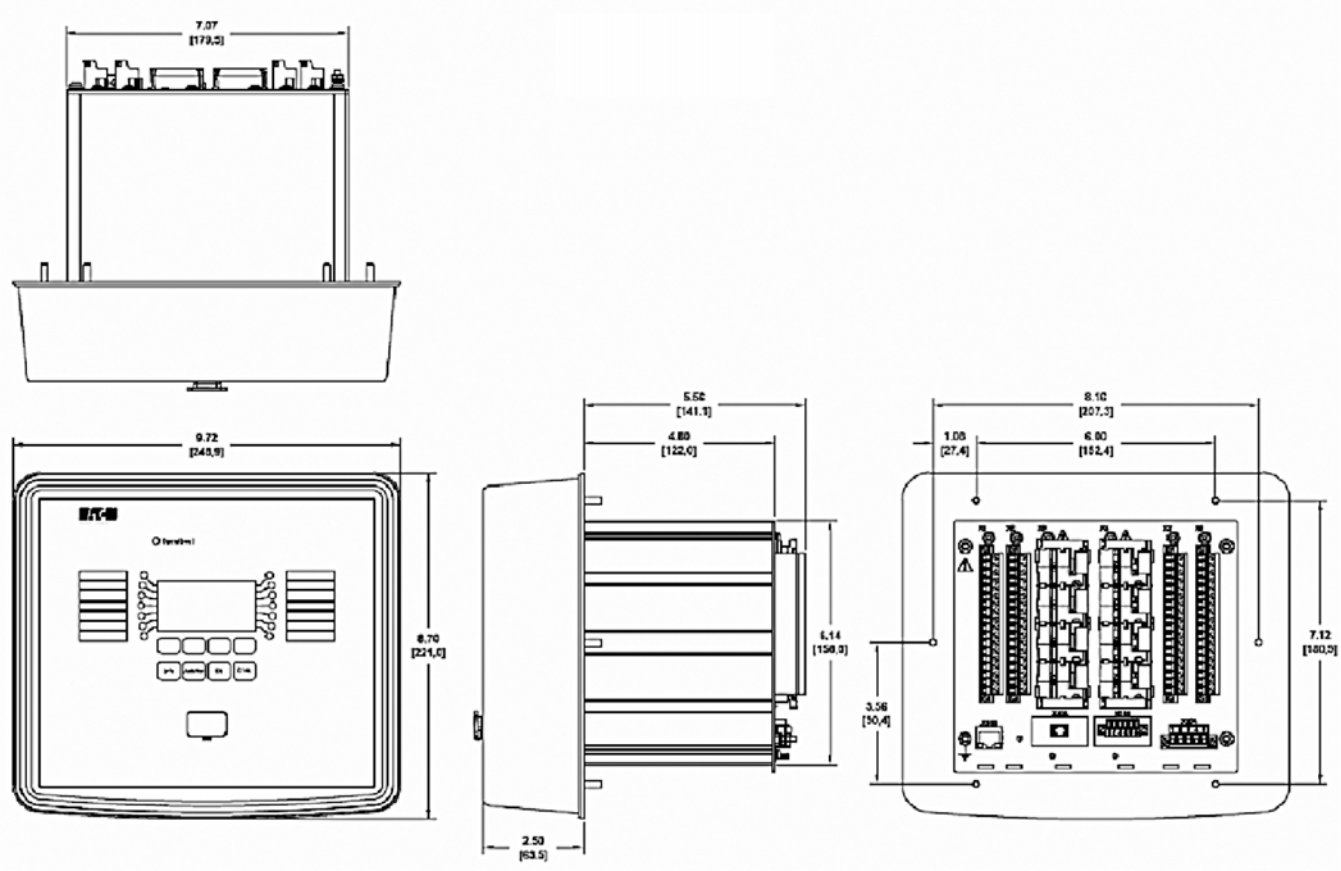
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

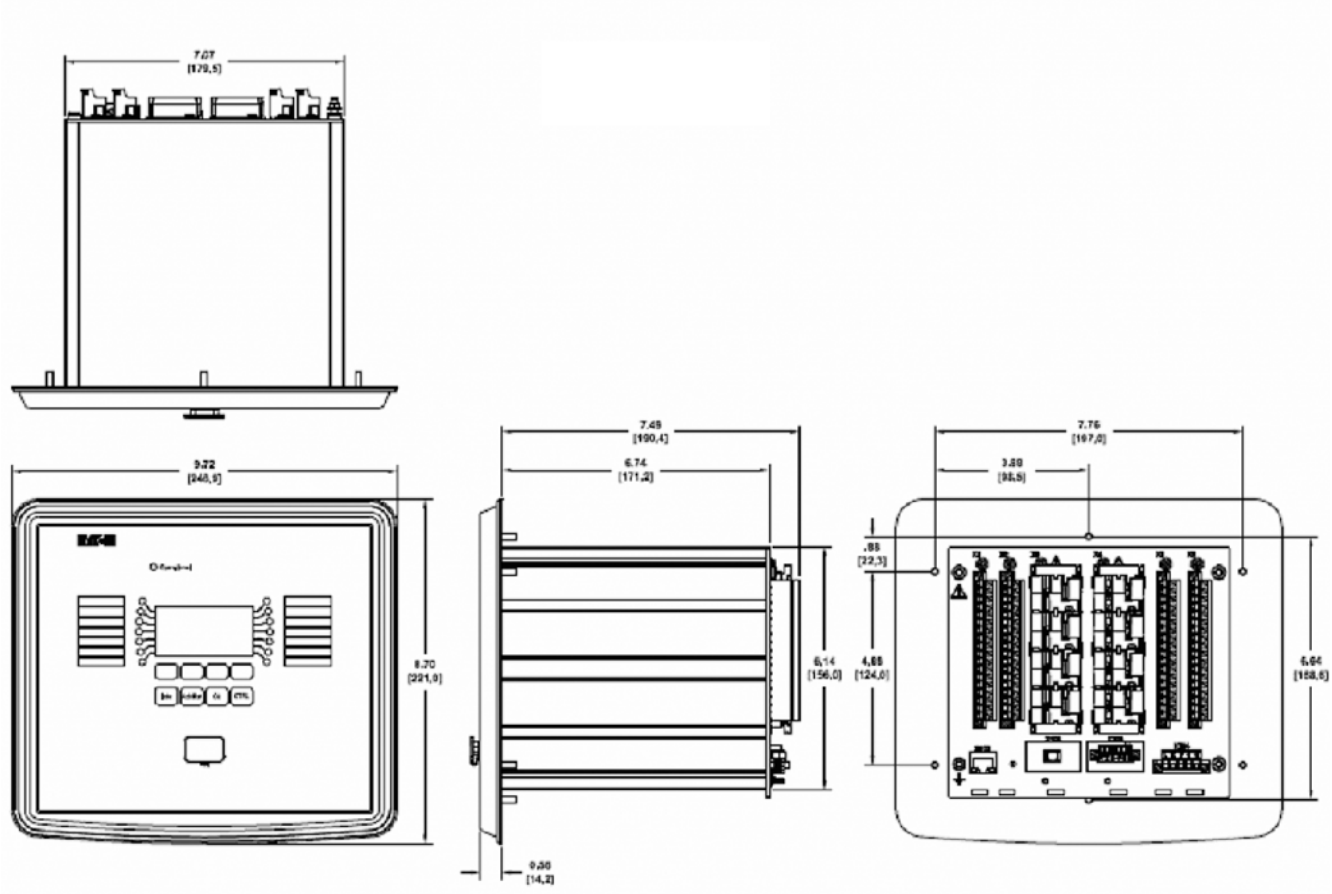


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

EBR—Line Differential Relay

Information not available at this time.

Information not available at this time.

Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
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EMR-3MP0 Motor Protection Relay

Information not available at this time.

Information not available at this time.

EMR-3000 Motor Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
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Universal RTD Module	**V3-T9-209**

9

EMR-3000 Motor Protection Relay

Product Description

Eaton's EMR-3000 motor protection relay is a multifunctional microprocessor-based protective relay for the protection of any size motor at all voltage levels. It is most commonly applied on medium voltage or larger motors. The EMR-3000 relay is a current only device that provides complete and reliable motor protection, monitoring, and starting control functions.

The EMR-3000 motor protection relay has removable terminal blocks, and it has Modbus-RTU communications as standard; and an optional Ethernet port for Modbus-TCP communications. The EMR-3000 motor protection relay has three-phase and one ground current inputs. It can be used with either a 5 A or 1 A CTs. The ground protection can be used with either a zero sequence ground CT or from the residual connection of the phase CTs.

The zero sequence ground CT provides greater ground fault sensitivity than the residual connection. The unit is capable of 60 Hz or 50 Hz operation.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only. The multiple setting groups can also be changed, via communications or a digital input. Flash memory is used for the programming and all settings are stored in nonvolatile memory.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. 14 programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 communication port on the back is standard for local area networking using Modbus-RTU. An optional Ethernet port and protocols are available.

The EMR-3000 motor protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, the 5 latest start profiles, motor trending, breaker wear information and oscillography data.

The EMR-3000 motor protection relay has four discrete inputs and 1 fiber optic input, 1 Form C, and 2 NO programmable contacts, 1 Form C healthy contact. It also has an optional 4–20 mA analog output or zone interlocking card. The relay provides maximum user flexibility to configure the I/O. All inputs and outputs (except the healthy output) are user-programmable. The unit also counts with a test mode to force outputs and simulate currents, to facilitate the commissioning of the unit. It can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

Eaton's EMR-3000 motor protection relay has been designed for maximum motor operation and protection. It permits running the motor close to its design limits while protecting it against excessive heating and damaging overload conditions. The EMR-3000 field-proven protection algorithms were developed based on motor designs and operating parameters for optimum operation and protection while minimizing nuisance tripping. The EMR-3000 motor protection relay utilizes a patented protection algorithm and measurement technique based on proven positive and negative (unbalance) sequence current sampling and true rms calculations.

Features, Benefits and Functions

Protection Features

- Thermal protection (49/51)
  - Locked rotor protection (49S/51)
- Phase overcurrent elements:
  - Two instantaneous elements with timers (50P[1], 50P[2] and 50P[3])
  - Three inverse time overcurrent elements (51P[1], 51P[2] and 51P[3])
  - 11 standard curves
  - Instantaneous or time delay reset
- Ground overcurrent elements:
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Jam or Stall protection (50J[1], 50J[2])
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Underload protection (37[1], 37[2], 37[3])
- Temperature protection with optional URTD (49/38)
- Stars per hour (66)
- Lockout protection (86)
- Breaker failure (50BF)
- Zone interlocking for bus protection (87B)

Metering Features

- Amperes: Positive, negative and zero sequence
- Ampere demand
- % THD I
- Magnitude THD I
- Minimum/maximum recording
- Temperature with remote URTD module

Monitoring Features

- Trip coil monitor
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Trip Cause displays fault recorder data on HMI after fault event
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Trending (load profile over time)
- Motor history
- Records the last 5 motor start profiles
- Motor start trending
- CT supervision
- Clock (1 ms time stamping)

Control Functions

- Transition for reduced voltage starts
- Incomplete sequence delay
- Permits numbers of cold starts
- Limits numbers of starts per hour
- Anti-backspin time delay
- Mechanical load shedding
- Zero speed switch for long acceleration motors
- Motor stop inputs
- Remote trip input
- Differential trip input
- Emergency override
- Breaker/Contactor open-close/stop-start
- Remote open-close (stop-start)
- Programmable I/O
- Programmable LEDs
- Multiple setting groups

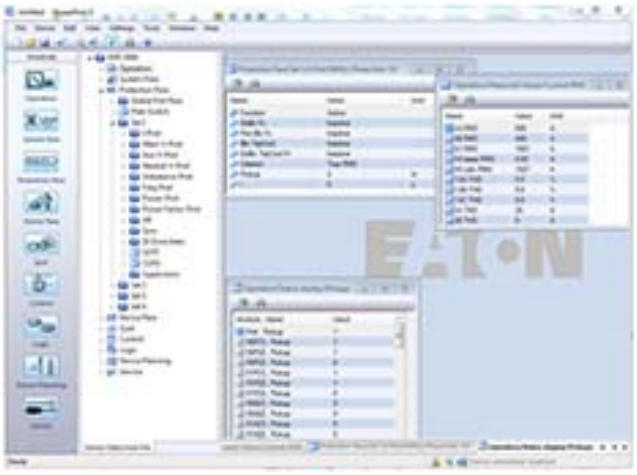
Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port.
  - RS-232
- Remote communication port:
  - RS-485
  - Ethernet port
- Protocols:
  - Modbus-RTU
  - Modbus-TCP (optional)
  - IEC 61850 (optional)
- Configuration software
  - PowerPort-E

Monitoring and Metering

Sequence of Events Records

The EMR-3000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.



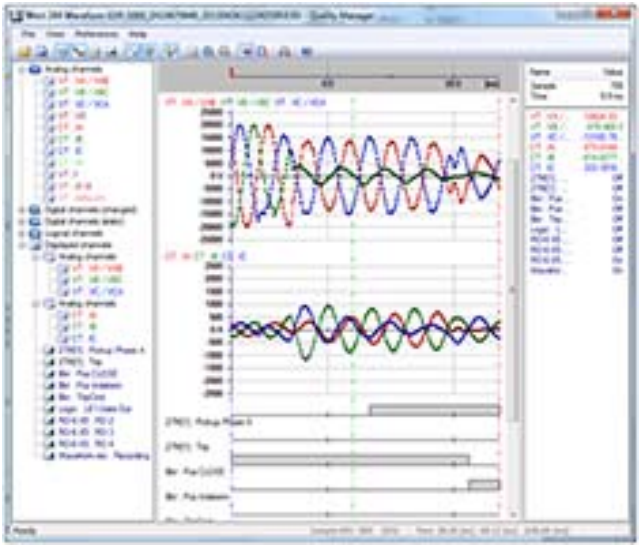
Trip Log

The EMR-3000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

Waveform Capture (Quality Manager)

The EMR-3000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The EMR-3000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles.

The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. Seven programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Starting Profiles

The EMR-3000 records the average current versus time for the last five starting cycles. This information is available via the communications port through PowerPort-E.

Motor Statistics

For each motor start, the EMR-300 stores a motor start report and add this data to the motor statistics buffer. With the motor statistics you can track motor start data for the past eighteen 30-day periods. For each 30-day interval, the relay records the following information:

- The date the interval began
- The total number of starts in the interval
- The averages of the following quantities:
  - Motor Start Time
  - Start % Rotor Thermal Capacity Used
  - Maximum Start Current

Load Profiling/Trending

The EMR-3000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30 or 60 minutes, depending on the trending report setting.

Programmable I/O

The EMR-3000 motor protection relay provides heavy-duty, triprated, 2 normally open and 1 Form C contacts. One isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode. There are 4 eight user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

Intel-I-Trip (I^2t) Overload Protection

The EMR-3000 motor relay features the exclusive Eaton Intel-I-Trip intelligent overload protection system. Intel-I-Trip develops custom overload curves simply from motor nameplate data. Intel-I-Trip protects motors from potentially damaging overload and abnormal operating conditions. The Intel-I-Trip intelligent overload protection feature utilizes field proven measurement techniques and a patented motor thermal protection model. The EMR-3000 motor relay's unique measurement technique samples the current waveforms 36 times per cycle, providing accurate measurements of the positive and negative sequence currents. The negative sequence current causes a greater heating effect on the rotor and has a greater impact on the thermal model in the relay. Intel-I-Trip utilizes these measurements in its motor model to safely protect the motor against the heating effects of these currents.

The motor thermal model is analogous to a bucket that is being filled and drained at the same time. The fill rate is dependent on the motor currents and the drain is based on motor design principles. The size of the bucket is equivalent to the thermal capacity associated with the mass of the motor. Intel-I-Trip integrates these rates and will issue a trip when the thermal capacity is filled.

Intel-I-Trip features adaptive trip characteristics that adjust the trip times based on measured motor temperature when RTDs are used.

Instantaneous Overcurrent

The EMR-3000 motor protection relay provides an instantaneous phase overcurrent function to trip the motor for high fault current levels and save the fuses. This function can be disabled and has an adjustable time delay on starting to avoid nuisance tripping on inrush.

Phase Unbalance Protection

Motor supply circuits are often fed through fuses and can be run with a single-phase fuse blown, referred to as single phasing the motor. The EMR-3000 motor protection relay measures the current unbalance and can be used to alarm or trip the motor before damage occurs. Pickup, start and run timers, and a second element for alarm purposes are provided.

Ground Fault Protection

A separate measuring circuit is used to measure ground current. A ground CT is recommended for more sensitive protection against winding insulation breakdown to ground. The relay ground circuit can be connected residually from the three-phase CTs. The ground fault protection has pickup and time delay set points or can be disabled.

Jam Protection

The user-selectable Jam function protects motors that are running against a sudden mechanical jam or stall condition. The common application is on motors used on crushers, chippers, or conveyors. It detects an increase of motor current to a level above full load. Pickup, start, and run timers and a second element for alarm purposes are provided.

Underload Protection

The user-selectable underload function is used to detect the loss of load on the motor. Coupling failure is a common cause for loss of load. Pickup, start, and run timers and a second element for alarm purposes are provided.

Reduced Voltage Starting

The EMR-3000 motor protection relay provides a transition and incomplete sequence function for reduced voltage starting. The user can select to transition based on the current level and/or on time.

Antibackspin

The stop function is programmable from 2–20%. For certain applications, such as pumping a fluid up a pipe, the motor may be driven backward for a period of time after it stops. The EMR-3000 relay provides an antibackspin timer to prevent starting the motor while it is spinning in the reverse direction. The timer begins counting from the moment a stop is declared by the relay.

Start Control Timers

Motors typically have limits to the number of cold starts, starts per hour period, or time between starts that are permitted without damage. The EMR-3000 motor protection relay incorporates these timers to prevent starting the motor beyond its capabilities.

Load Shedding

The EMR-3000 motor protection relay provides a mechanical load shedding feature that can be used to control an upstream process. The load-shedding function closes a contact on an overload condition to control an upstream process from adding more load until the overload condition is gone.

Emergency Override

The EMR-3000 motor protection relay has a user-programmable feature that will let the operator reset the start inhibitor timers and thermal overload bucket. This function is intended for use in emergency conditions only, and it may result in motor damage or failure.

Long Acceleration Motors

Large motors with a high inertia may experience starting currents that exceed the locked rotor current and time. The EMR-3000 motor protection relay has logic and provisions for a zero speed switch input to differentiate between a stall and start condition. If the motor is spinning, then the relay will not trip on the normal locked rotortime allowing the motor to start.

Remote/Differential Trip

The digital inputs can be programmed to accept a contact input from a separate differential relay or other device to trip the motor. This provides local and remote target information and utilizes the trip contacts of the EMR-3000 motor protection relay. It will also record and log the motor information at the time of the trip.

Breaker Failure or Stuck Contactor

The EMR-3000 motor protection relay includes a breaker failure (50BF, 62BF) function that can be initiated from either an internal or external trip signal. This is an independent element that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Flexible Phase Rotation

The EMR-3000 motor protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communication or via a digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Standards and Certifications

Design Standards

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

Catalog Number Selection

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

EMR-3000

(A)–Four digital inputs, four output relays, 1 4–20 mA analog output, URTD interface

(0)–5 A / 1 A phase and ground CTs, power supply range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

Motor Relay Removable Terminals

EMR-3000-2A 0 B A 1

Hardware Option 1
- **A** = 4 DI, 4 outputs, removable terminals, 1 4–20 mA analog output, URTD interface, IRIG-B small display
- **B** = 4 DI, 4 outputs, removable terminals, zone interlocking, URTD interface, IRIG-B, small 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
- **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

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 panel mount

Accessories

Standard Accessories EMR-3000

Description	Catalog Number
UNVL RTD Mod with Modbus-RTU 48–240 Vac/48–250 Vdc	**URTDII-01** ①
UNVL RTD Mod with Modbus-RTU 24–48 Vdc	**URTDII-02** ①
E-SERIES 3000 IQ adapter kit projection mounted ②	**ER-IQRETROKIT**

Notes

① See URTD section for fiber optic cables required to communicate to the EMR-3000.

② Retrofitting mounting plate MP-3000 relay, projection panel mount necessary.

Technical Data and 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: <2,000 m (6,561.67 ft) above sea level.
- If 4,000 m (13,123.35 ft) altitude applies, 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 IEC 60255-5: 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 (±45° around the X-axis must be permitted)
- Weight EMR-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 I_n/ continuously
- Overcurrent withstand:
  - 30 x I_n/10 s
  - 100 x I_n/1 s
  - 250 x I_n/10 ms (1 half-wave)
- Screws: M4, captive type acc. to VDEW
- Connection cross sections:
  - 1 x or 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: 24–270 Vdc/ 48–230 Vac (–20/+10%)
- 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)
- Switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac / Vdc, 230 Vac / Vdc
  - Un = 24 Vdc
    - Switching threshold 1 ON:
    - Switching threshold 1 OFF:
    - Min. 19.2 Vdc
    - Max. 9.6 Vdc
  - Un = 48 V / 60 Vdc
    - Switching threshold 2 ON:
    - Switching threshold 2 OFF:
    - Min. 42.6 Vdc
    - Max. 21.3 Vdc
  - Un = 110 / 120 Vac/Vdc
    - 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/Vdc
    - 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 In (phase currents)
  - Up to 25 x In (ground current standard)
  - Up to 2.5 x In (ground current sensitive)
- Continuous loading capacity: 4 x In/ continuously
- Overcurrent proof:
  - 30 x In / 10 s
  - 100 x In / 1 s
  - 250 x In / 10 ms (1 half-wave)
- Power consumption: phase current inputs
  - At In = 1 A burden = 0.15 MVA
  - At In = 5 A burden = 0.15 MVA
- Ground current input
  - At In = 1 A burden = 0.35 MVA
  - At In = 5 A 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

Front Interface RS-232

- Baud rates: 115200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

RS-485

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

Tolerances of the Real Time Clock

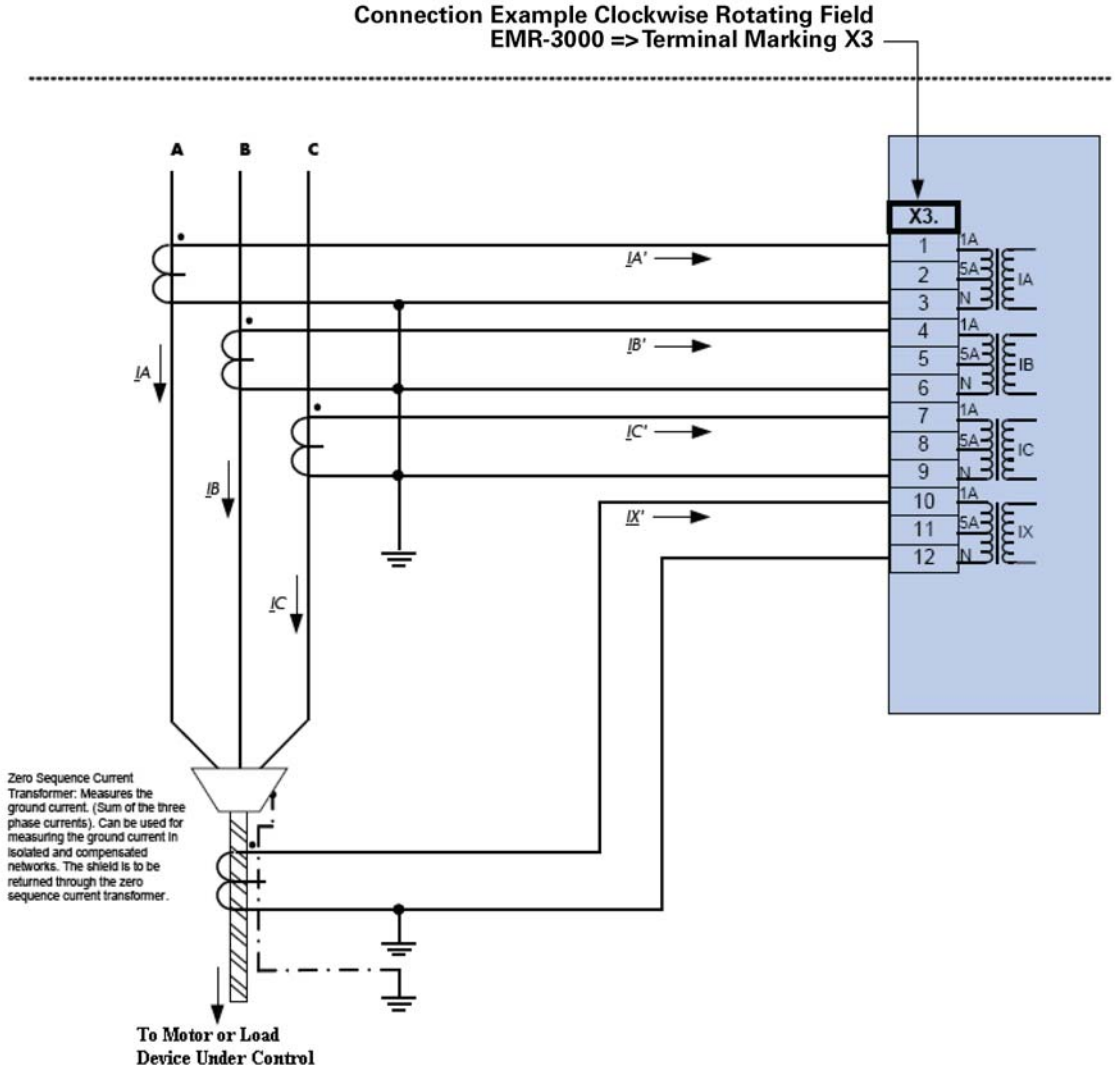
- Resolution: 1 ms
- Tolerance: <1 minute / month (+20 °C)

Measuring Accuracy

- Max. measuring range: Up to 40 x In (phase currents)
- Up to 25 x In (ground current standard)
- Frequency range: 50 Hz / 60 Hz ±10%
- Accuracy: Class 0.5
- Amplitude error if I < 1 In: ±0.5% of the rated value
- Amplitude error if I > In: ±0.5% of the measured value
- Amplitude error if I > 2 In: ±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 parametrized nominal frequency
- Temperature influence: <±1% within the range of 0 °C up to +60 °C

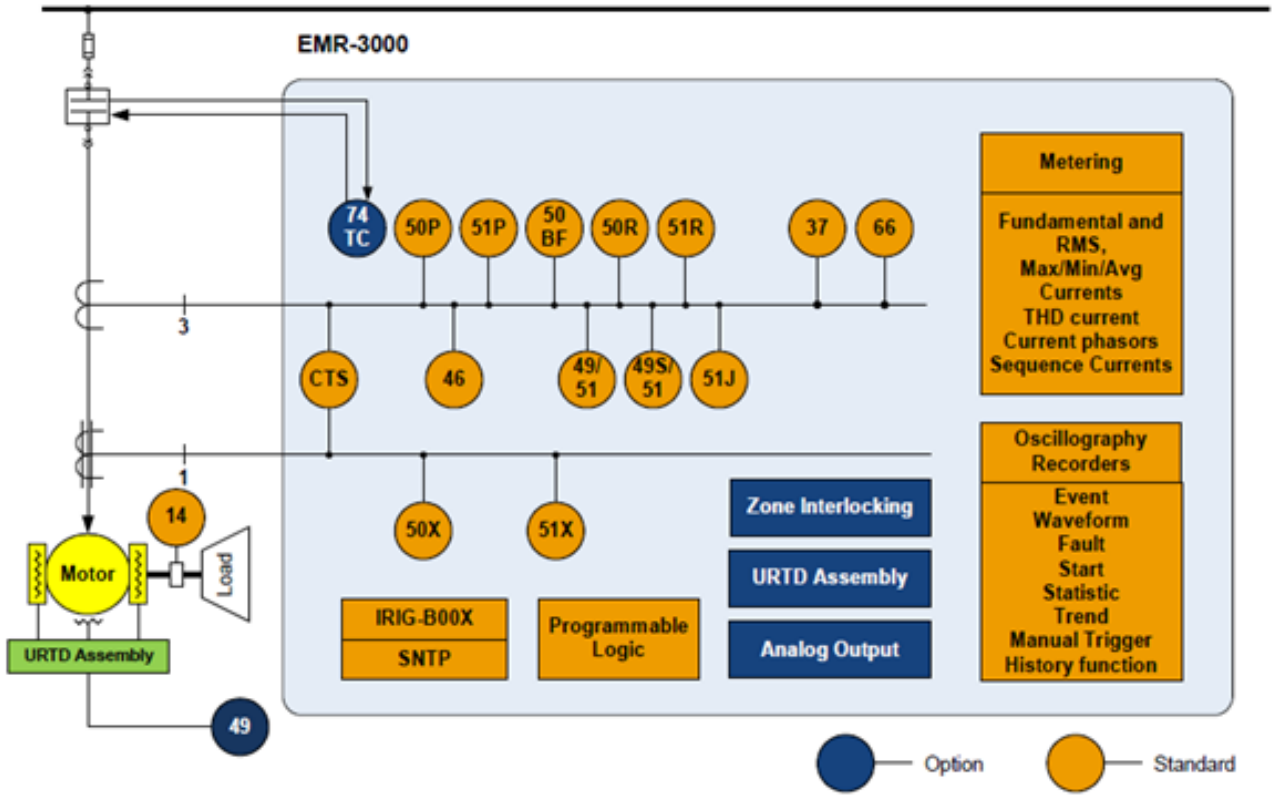
Wiring Diagrams

Typical AC Connections—1 A CTs and Ground Current Measured by Zero Sequence CT

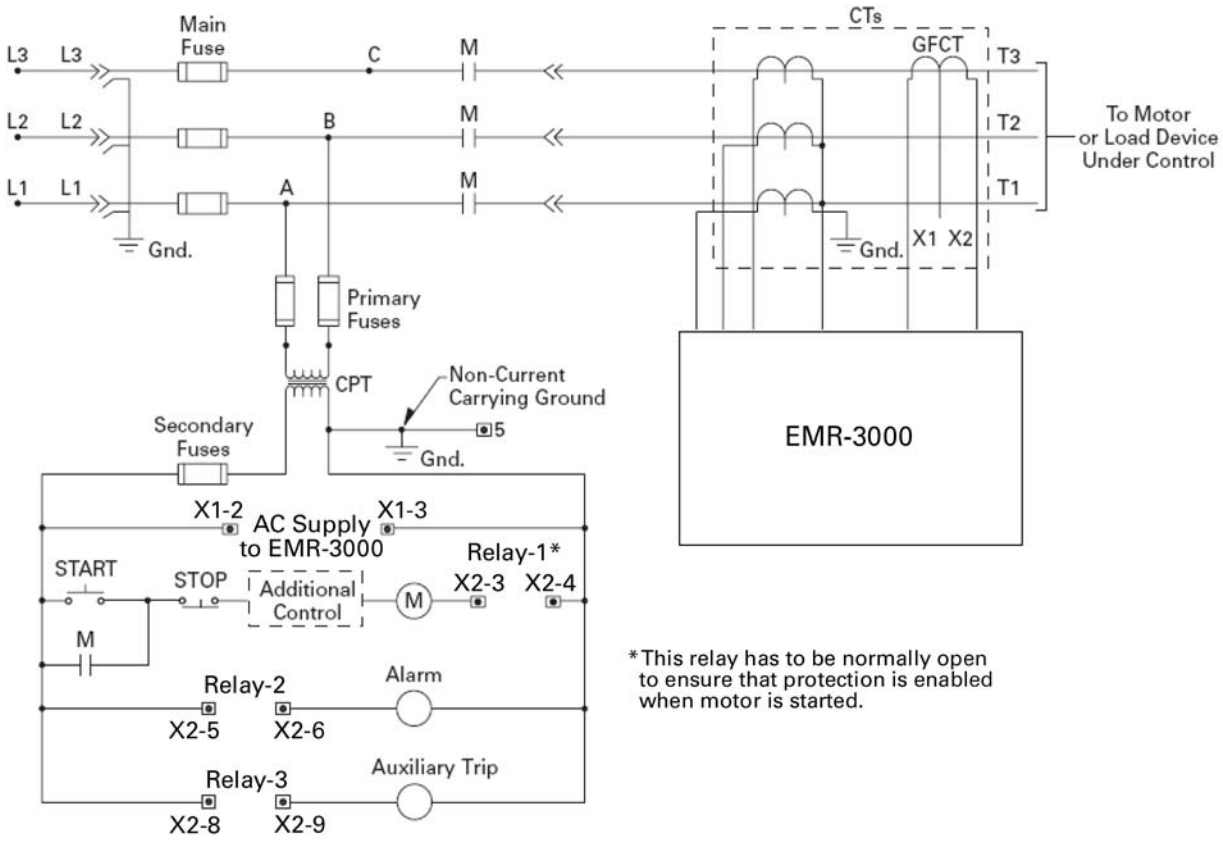


Three Phase Current Measurement; Inom Secondary = 1 A.
Ground Current Measuring via Zero Sequence CT ; IGnom Secondary = 1 A.

Typical One-Line Diagram



Typical Control Diagram



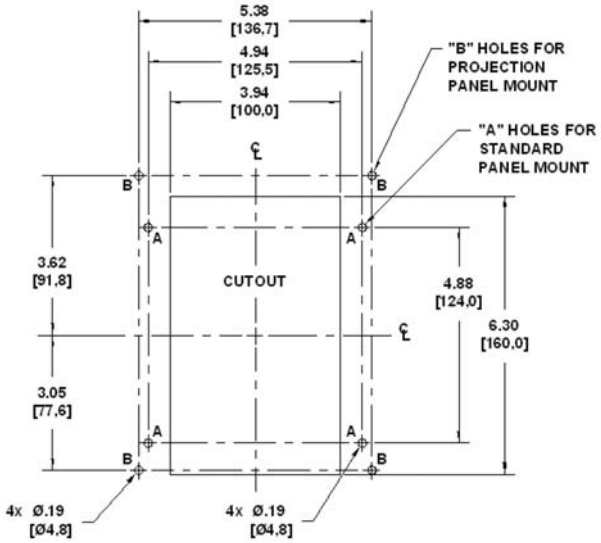
*This relay has to be normally open to ensure that protection is enabled when motor is started.

9

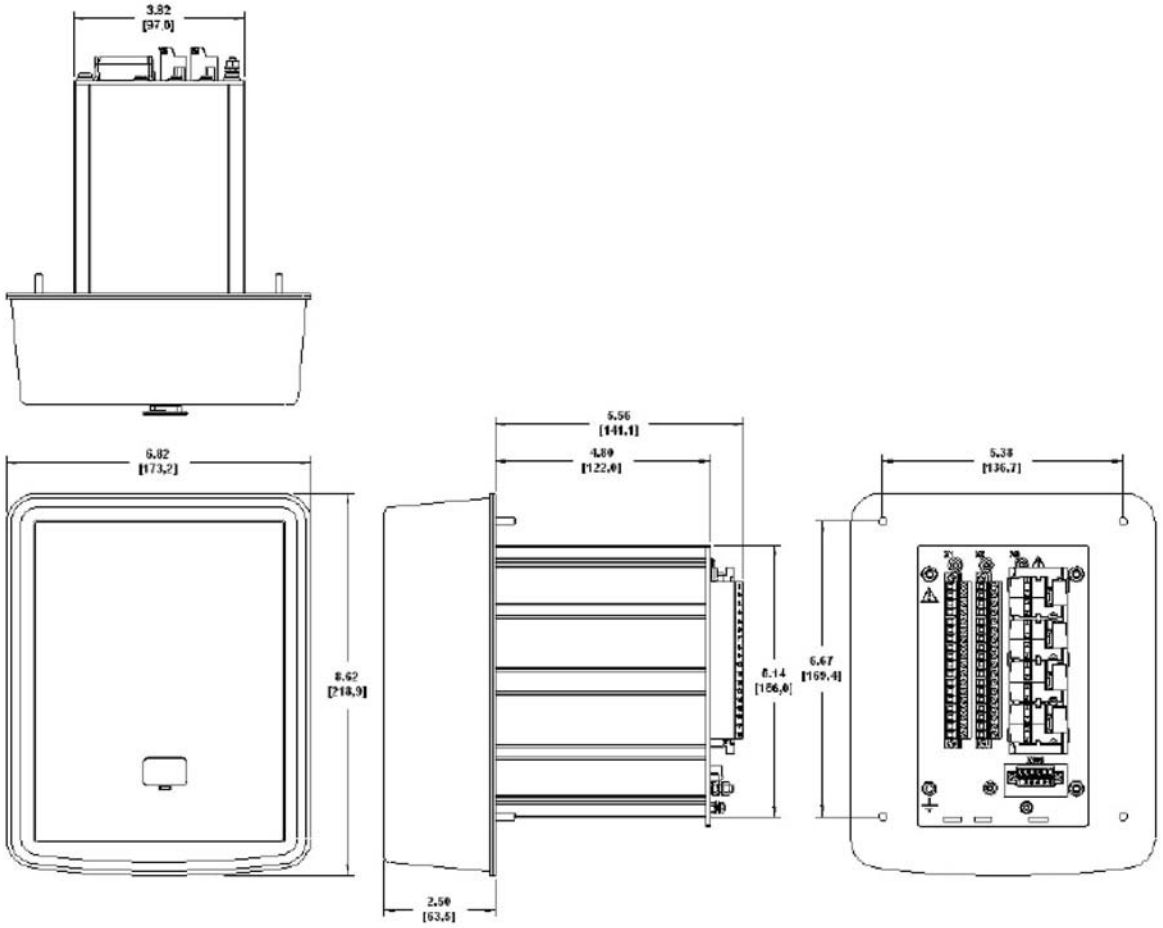
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

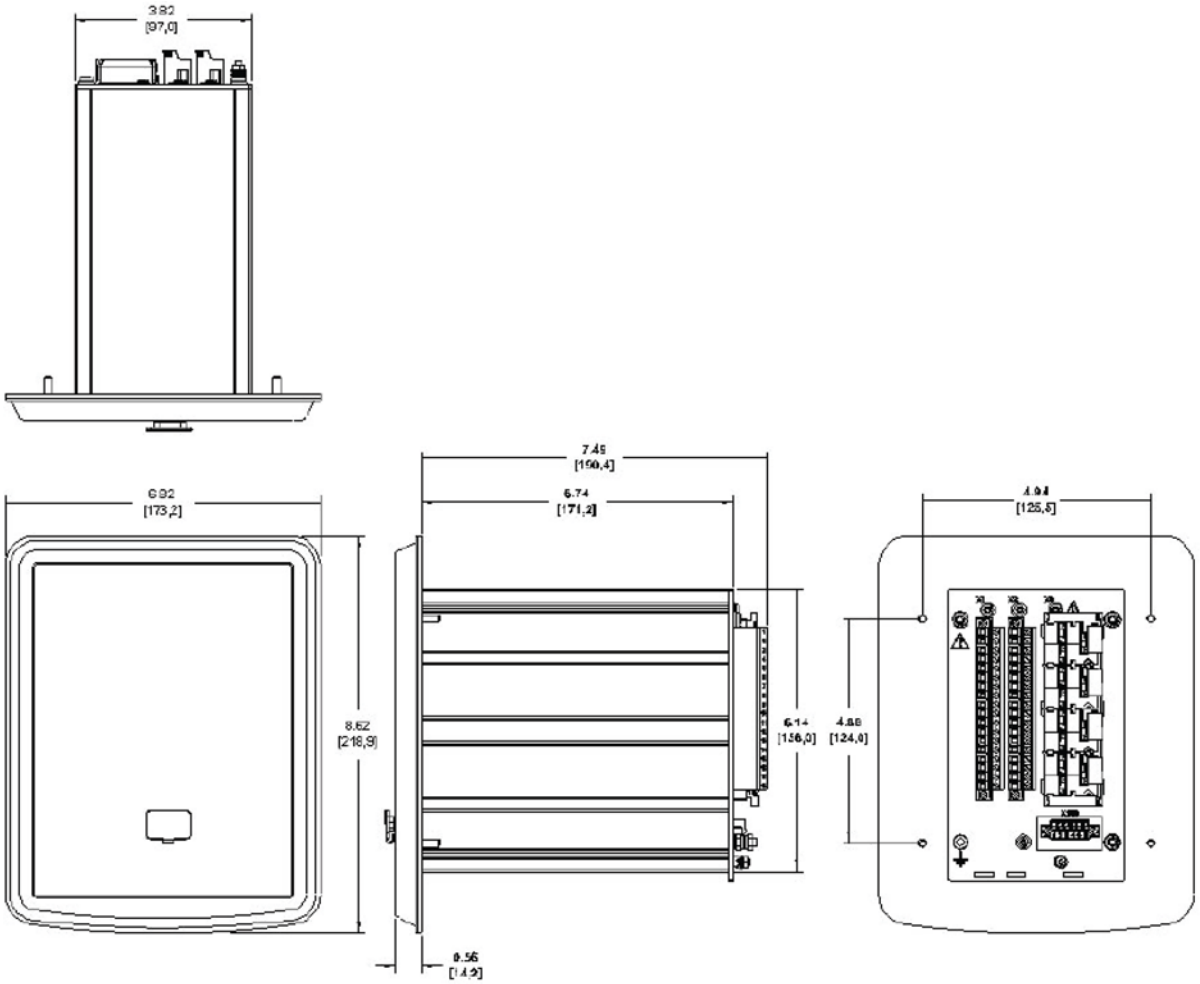


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



EMR-4000 Motor Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

EMR-4000 Motor Protection Relay

Product Description

Eaton's EMR-4000 motor protection relay is a multifunctional microprocessor-based protective relay for the protection of any size motor at all voltage levels. It is most commonly applied on medium voltage or larger motors. The EMR-4000 relay is a current and voltage device that provides complete and reliable motor protection, monitoring, diagnostics, metering and starting control functions.

The EMR-4000 motor protection relay has removable terminal blocks, and it has Modbus-RTU communications as standard; and an optional Ethernet port for Modbus-TCP communications or IEC-61850.

The EMR-4000 motor protection relay provides complete current, voltage, and frequency protection in a single compact case. The relay has four current inputs rated for either 5 amperes or 1 ampere and four voltage inputs. Three of the voltage inputs are to be connected to the three-phase power voltage for voltage protection and for metering.

They can be connected in wye-ground or open delta configuration. The fourth voltage is for independent single-phase undervoltage/ overvoltage protection. The unit is capable of 60 Hz or 50 Hz operation.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only. The multiple setting groups can also be changed, via communications or a digital input. Flash memory is used for the programming and all settings are stored in nonvolatile memory.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. 14 programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 communication port on the back is standard for local area networking using Modbus-RTU. An optional Ethernet port and protocols are available.

The EMR-4000 motor protection relay includes programmable logic functions. Logic gates and timers may be defined and arranged for customized applications. With the programmable logic control functions you can simplify the complexity of your starting schemes by eliminating timers and auxiliary relays. Flash memory is used for the programming and all settings are stored in nonvolatile memory. The relay allows for four preprogrammed setting groups which can be activated through software or contact input.

The EMR-4000 motor protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution.

The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, the 5 latest start profiles, motor trending, breaker/contactor wear information and oscillography data.

The EMR-4000 motor protection relay has eight discrete inputs, 1 fiber optic input, 2 Form C, and 2 NO output programmable contacts, and 1 Form C healthy contact. It also has four 4-20 mA analog outputs and one zone interlocking card. The relay provides maximum user flexibility to configure the I/O. All inputs and outputs (except the healthy output) are user-programmable. The unit also counts with a test mode to force outputs and simulate currents, to facilitate the commissioning of the unit. It can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

Eaton's EMR-4000 motor protection relay has been designed for maximum motor operation and protection. It permits running the motor close to its design limits while protecting it against excessive heating and damaging overload conditions. The EMR-4000 field proven protection algorithms were developed based on motor designs and operating parameters for optimum operation and protection while minimizing nuisance tripping. The EMR-4000 motor protection relay utilizes a patented protection algorithm and measurement technique based on proven positive and negative (unbalance) sequence current sampling and true rms calculations.

Features, Benefits and Functions

Intel-I-Trip (I^2t) Overload Protection

The EMR-4000 motor relay features the exclusive Eaton Intel-I-Trip intelligent overload protection system. Intel-I-Trip develops custom overload curves simply from motor nameplate data. Intel-I-Trip protects motors from potentially damaging overload and abnormal operating conditions. The Intel-I-Trip intelligent overload protection feature utilizes field proven measurement techniques and a patented motor thermal protection model. The EMR-4000 motor relay's unique measurement technique samples the current waveforms 36 times per cycle, providing accurate measurements of the positive and negative sequence currents. The negative sequence current causes a greater heating effect on the rotor and has a greater impact on the thermal model in the relay. Intel-I-Trip utilizes these measurements in its motor model to safely protect the motor against the heating effects of these currents.

The motor thermal model is analogous to a bucket that is being filled and drained at the same time. The fill rate is dependent on the motor currents and the drain is based on motor design principles. The size of the bucket is equivalent to the thermal capacity associated with the mass of the motor. Intel-I-Trip integrates these rates and will issue a trip when the thermal capacity is filled.

Intel-I-Trip features adaptive trip characteristics that adjust the trip times based on measured motor temperature when RTDs are used.

Instantaneous Overcurrent

The EMR-4000 motor protection relay provides an instantaneous phase overcurrent function to trip the motor for high fault current levels and save the fuses. This function can be disabled and has an adjustable time delay on starting to avoid nuisance tripping on inrush.

Phase Unbalance Protection

Motor supply circuits are often fed through fuses and can be run with a single-phase fuse blown, referred to as single phasing the motor. The EMR-4000 motor protection relay measures the current and voltage unbalance and either can be used to alarm or trip the motor before damage occurs. The EMR-4000 has 2 voltage and 2 current unbalance elements. Pickup, start and run timers are provided for each element.

Ground Fault Protection

A separate measuring circuit is used to measure ground current. A ground CT is recommended for more sensitive protection against winding insulation breakdown to ground. The relay ground circuit can be connected residually from the three-phase CTs. The ground fault protection has pickup and time delay set points or can be disabled.

Jam Protection

The user-selectable Jam function protects motors that are running against a sudden mechanical jam or stall condition. The common application is on motors used on crushers, chippers, or conveyors. It detects an increase of motor current to a level above full load. Pickup, start, and run timers and a second element for alarm purposes are provided.

Underload/Underpower Protection

The user selectable underload/underpower function is used to detect the loss of load on the motor. Coupling failure is a common cause for loss of load. Whenever is possible, it is better to use underpower to detect loss of load. Three power elements and two underload elements are provided in the relay for tripping and alarm purposes. Pickup, start, and run timers are provided for each element.

Frequency Protection

The frequency elements provide the ability to detect when the motor is operating at off-nominal frequencies that can do damage to the process or, to signal to upstream protections or controls to implement load shedding actions.

Power Factor Protection

This protection is used in synchronous motors applications to detect out-of-synchronism conditions.

Undervoltage/Overvoltage Protection

Use the voltage protective functions to detect abnormal system voltage conditions potentially hazardous to the motor.

Reduced Voltage Starting

The EMR-4000 motor protection relay provides a transition and incomplete sequence function for reduced voltage starting. The user can select to transition based on the current level and/or on time.

Antibackspin

The stop function is programmable from 2 to 20%. For certain applications, such as pumping a fluid up a pipe, the motor may be driven backward for a period of time after it stops. The EMR-4000 relay provides an antibackspin timer to prevent starting the motor while it is spinning in the reverse direction. The timer begins counting from the moment a stop is declared by the relay.

Start Control Timers

Motors typically have limits to the number of cold starts, starts per hour period, or time between starts that are permitted without damage. The EMR-4000 motor protection relay incorporates these timers to prevent starting the motor beyond its capabilities.

Load Shedding

The EMR-4000 motor protection relay provides a mechanical load shedding feature that can be used to control an upstream process. The load-shedding function closes a contact on an overload condition to control an upstream process from adding more load until the overload condition is gone.

Emergency Override

The EMR-4000 motor protection relay has a user-programmable feature that will let the operator reset the start inhibitor timers and thermal overload bucket. This function is intended for use in emergency conditions only, and it may result in motor damage or failure.

Long Acceleration Motors

Large motors with a high inertia may experience starting currents that exceed the locked rotor current and time. The EMR-4000 motor protection relay has logic and provisions for a zero speed switch input to differentiate between a stall and start condition. If the motor is spinning, then the relay will not trip on the normal locked rotor time allowing the motor to start.

Remote/differential Trip

The digital inputs can be programmed to accept a contact input from a separate differential relay or other device to trip the motor. This provides local and remote target information and utilizes the trip contacts of the EMR-4000 motor protection relay. It will also record and log the motor information at the time of the trip.

Breaker Failure or Stuck Contactor

The EMR-4000 motor protection relay includes a breaker failure (50BF, 62BF) function that can be initiated from either an internal or external trip signal. This is an independent element that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Flexible Phase Rotation

The EMR-4000 motor protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communication or via a digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Diagnostic Features

Broken Rotor Bar

The EMR-4000 provides advanced motor diagnostics including a broken rotor bar detection function. The broken rotor bar detection is a condition maintenance function that continuously monitors the motor's health while in operation. The advanced Motor Current Signature Analysis (MCSA) continuously analyzes the motor current signature and based on preset algorithms will determine when a broken rotor bar is present in the motor.

The broken rotor bar function will provide early detection of any rotor problems and advise maintenance personnel of the impending issue allowing for predictive maintenance of the motor and prevention of catastrophic motor failures.

By providing early indication of potential rotor problems, serious system issues such as: reduced starting torque, overloads, torque and speed oscillation and bearing wear can be avoided. With the advanced broken rotor bar detection system, advanced warning of impending problems reduces catastrophic failures, maximizing motor life and system uptime.

Protection Features

- Thermal protection (49/51)
  - Locked rotor protection (49S/51)
- Phase overcurrent elements:
  - Two instantaneous elements with timers (50P[1], 50P[2] and 50P[3])
  - Three inverse time overcurrent elements (51P[1], 51P[2] and 51P[3])
  - 11 standard curves
  - Instantaneous or time delay reset
- Ground overcurrent elements:
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Jam or Stall protection (50J[1], 50J[2])
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Underload protection (37[1], 37[2])
- Temperature protection with optional URTD (49/38)
- Stars per hour (66)
- Switch onto fault protection
- Phase voltage unbalance and sequence protection (47[1], 47[2])
- Main three-phase under/overvoltage (27M[1], 27M[2], 59M[1], 59M[2])
- Auxiliary single-phase under/overvoltage (27A[1], 27A[2], 59A[1], 59A[2])
- Six frequency elements that can be assigned to: over frequency, under frequency, rate of change, or vector surge (81[1], 81[2], 81[3], 81[4], 81[5], 81[6])
- Apparent and displacement power factor (55A[1], 55A[2], 55D[1], 55D[2])
- Forward and reverse watts (32[1], 32[2], 32[3])
- Forward and reverse vars (32V[1], 32V[2], 32V[3])
- Lockout protection (86)
- Breaker failure (50BF)
- Zone interlocking for bus protection (87B)

Metering Features

- Amperes: Positive, negative and zero sequence
- Volts: Positive, negative and zero sequence
- Phase angles
- Volt-amperes and VA demand
- Watts and kW demand
- kWh (forward, reverse, net)
- Vars and kvar demand
- kvarh (lead, leg and net)
- Power factor
- Frequency
- % THD V and I
- Magnitude THD V and I
- Minimum/maximum recording
- Trending (load profile over time)
- Minimum/maximum recording
- Temperature with remote URTD module

Monitoring Features

- Trip coil monitor
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Trip Cause displays fault recorder data on HMI after fault event
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Trending (load profile over time)
- Motor history
- Records the last 5 motor start profiles
- Motor start trending
- CT supervision
- VT supervision
- Clock (1 ms time stamping)

Diagnostic Features

- Broken rotor bar

Control Functions

- Transition for reduced voltage starts
- Incomplete sequence delay
- Permits numbers of cold starts
- Limits numbers of starts per hour
- Anti-backspin time delay
- Mechanical load shedding
- Zero speed switch for long acceleration motors
- Motor stop inputs
- Remote trip input
- Differential trip input
- Emergency override
- Breaker/contactor open-close/stop-start
- Remote open-close (stop-start)
- Programmable I/O
- Programmable LEDs
- Programmable logic
- Multiple setting groups

Communication Features

- Local HMI
- Password protected
- Addressable.
- IRIG-B
- Local communication port.
  - RS-232
- Remote communication port:
  - RS-485
  - Ethernet port
- Protocols:
  - Modbus-RTU (optional)
  - Modbus-TCP (optional)
  - IEC-61850 (optional)
- Configuration software

Monitoring and Metering

Sequence of Events Records

The EMR-4000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.

Trip Log

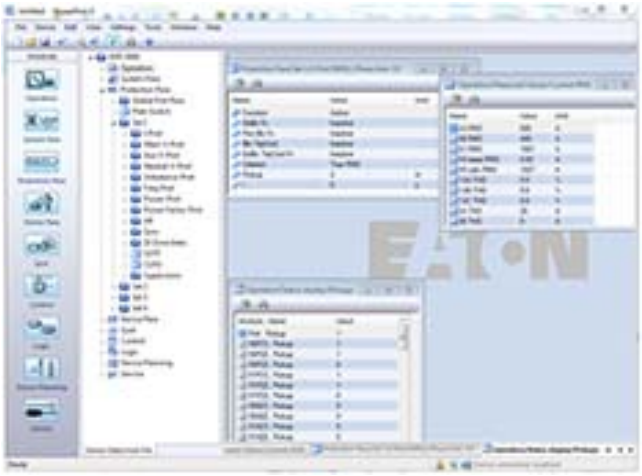
The EMR-4000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

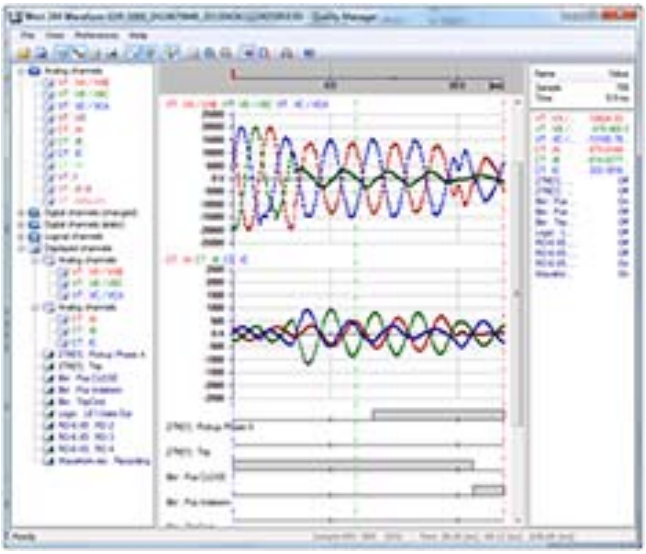
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.

Waveform Capture (Quality Manager)

The EMR-4000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The EMR-4000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles. The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.





Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. Seven programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Starting Profiles

The EMR-4000 records the average current versus time for the last five starting cycles. This information is available via the communications port through PowerPort-E

Motor Statistics

For each motor start, the EMR-4000 stores a motor start report and add this data to the motor statistics buffer. With the motor statistics you can track motor start data for the past eighteen 30-day periods. For each 30-day interval, the relay records the following information:

- The date the interval began
- The total number of starts in the interval
- The averages of the following quantities:
  - Motor start time
  - Start % rotor thermal capacity used
  - Maximum start current

Load Profiling/Trending

The EMR-4000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30, or 60 minutes, depending on the trending report setting.

Programmable I/O

The EMR-4000 motor protection relay provides heavy-duty, trip-rated, 2 normally open and 1 Form C contacts. One isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode. There are 4 eight user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

Programmable Logic

The EMR-4000 motor protection relay provides logic gates and timers that the user can customize for special or unique applications. Each gate can be assigned a logic function of either AND, OR, NAND or NOR. Each gate can have a maximum of four input signals and each input signal can be required to be a NOT. Input signals can be external inputs received via the binary inputs or internal values associated with the protection, alarm or metering set points. Each gate has a unique output assignment and designation that can be used as the input to another gate. There are 80 independent timers that have adjustable pickup and dropout delay settings.

Standards and Certifications

Design Standards

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

9

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the EMR-4000. For example, if the catalog number were EMR-4000-2A0BA1, the device would have the following:

EMR-4000

(A)–Four digital inputs, four output relays, 1 4-20 mA analog output, URTD interface

(0)–5 A / 1 A phase and ground CTs, power supply range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

Motor Relay Removable Terminals

EMR-4000-2A 0 B A 1

Hardware Option 1
A = 8 DI, 5 outputs, 4 AO, removable terminals, zone interlocking, URTD interface, IRIG-B, small 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
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

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 panel mount

Accessories

Standard Accessories EMR-4000

Description	Catalog Number
UNVL RTD Mod with Modbus-RTU 48–240 Vac/48–250 Vdc	**URTDII-01** ①
UNVL RTD Mod with Modbus-RTU 24–48 Vdc	**URTDII-02** ①

Note

① See URTD section for fiber optic cables required to communicate to the EMR-3000.

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –30 °C to +70 °C (–22 °F to +158 °F)
- Operating temperature: –20 °C to +60 °C (–4°F to +140 °F)
- Permissible humidity at ann. average:<75% rel. (on 56d up to 95% rel.)
  - Permissible Installation Altitude: <2,000 m (6,561.67 ft) above sea level
  - If 4,000 m (13,123.35 ft) altitude applies, 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: IP20

Routine Test

- Insulation test acc. to IEC 60255-5: 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 B2: height / width 183 mm (7.205 in)/ 212.7 mm (8.374 in)
- Housing depth (Incl. Terminals): 208 mm (8.189 in)
- Material, housing: aluminum extruded section
- Material, front panel: aluminum/foil front
- Mounting position: horizontal (±45° around the X-axis must be permitted)
- Weight: approx. 4.2 kg (9.259 lb)

Current and Ground Current Measurement

- Nominal currents: 1 A / 5 A
- Max. measuring range:
  - Up to 40 x In (phase currents)
  - Up to 25 x In (ground current standard)
  - Up to 2.5 x In (ground current sensitive)
- Continuous loading capacity: 4 x In/ continuously
- Overcurrent proof:
  - 30 x In / 10 s
  - 100 x In / 1 s
  - 250 x In / 10 ms (1 half-wave)
- Power consumption:
  - Phase current inputs At In= 1 A S=0.15 MVA At In= 5 A S=0.15 MVA
  - Ground Current Input At In= 1 A S=0.35 MVA At In= 5 A S=0.35 MVA
- Frequency range: 50 Hz / 60 Hz ±10%
- Terminals: screw-type terminals with integrated short-circuiters (contacts)
- Connection cross sections:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

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

- Nominal currents: 1 A / 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:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

Control Power Supply

- Aux. voltage: 240–270 Vdc / 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure: ≥50 ms at minimal aux. voltage Interrupted communication is permitted
- 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 approx. 1/5 x 0.8 in (5 x 20 mm) according to IEC 60127
  - 3.5 A time-lag miniature fuse approx. 1/4 x 1 1/4 in (6.3 x 32 mm) according to UL 248-14

Voltage and Residual Voltage Measurement

- Nominal voltages:100 V/ 110 V/ 230 V/ 400 V (can be configured)
- Max. measuring range: 2 x nominal voltage
- Continuous loading capacity: 2 x nominal voltage (800 Vac)
- Power Consumption:
  - at Vn = 100 V S = 0.1 MVA
  - at Vn = 110 V S = 0.1 MVA
  - at Vn = 230 V S = 0.4 MVA
  - at Vn = 400 V S = 1.0 MVA
- Frequency range: 50 Hz or 60 Hz ±10%
- Terminals: screw-type terminals

Frequency Measurement

- Nominal Frequencies: 50 Hz / 60 Hz

Voltage Supply

- Aux. Voltage: 24–270 Vdc / 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure:
  - ≥50 ms at minimal aux. voltage
  - Interrupted communication is permitted.
- 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 approx. 5 x 20 mm (0.2 x 0.8 in) according to IEC 60127
  - 3.5 A time-lag miniature fuse approx. 6.3 x 32 mm (0.25 x 1.25 in) according to UL 248-14

Power Consumption

- Power supply range: 24–270 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 48–230 Vac (for frequencies of 40–70 Hz)
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W

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 B2: 15

Front Interface

- Baud Rates: 115,200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

Real Time Clock

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

Digital Inputs

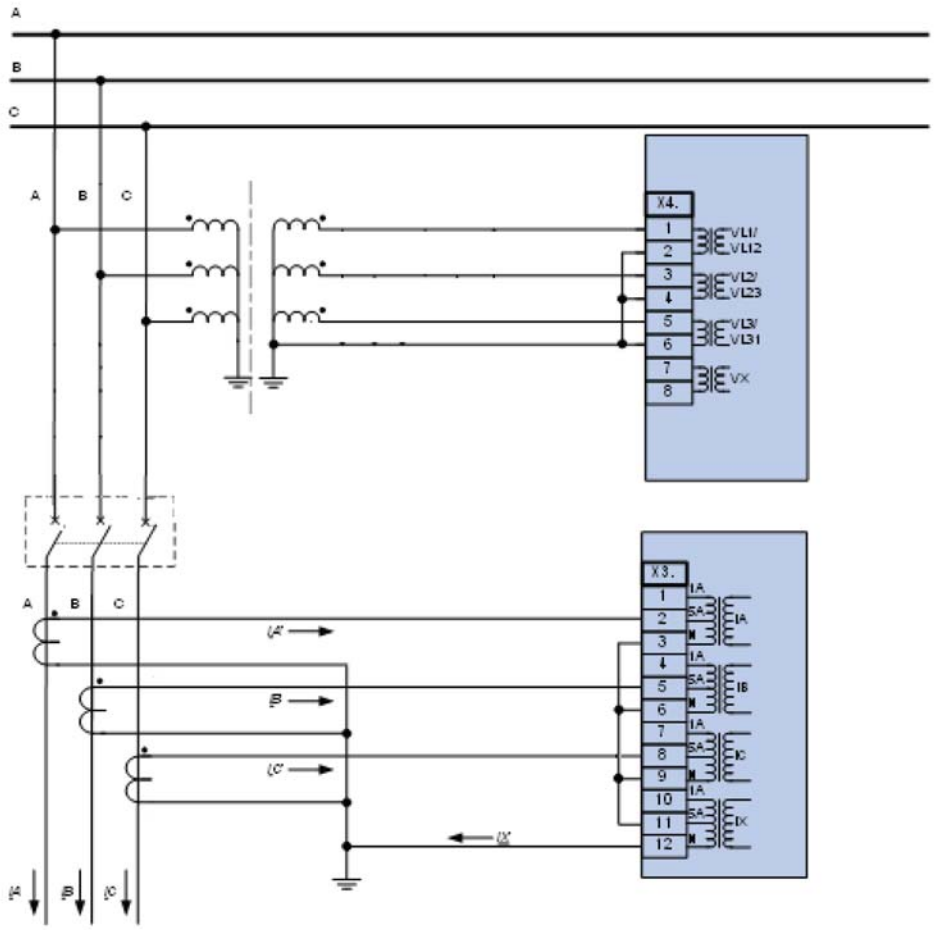
- Max. input voltage: 300 Vdc / 259 Vac
- Input current: <4 mA
- Reaction time: <20 ms
- Fallback time: <30 ms
- (Safe State of the Digital Inputs)
- Four switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac / Vdc, 230 Vac / Vdc
  - Un = 24 Vdc
    - Switching threshold 1 ON: Min. 19.2 Vdc
    - Switching threshold 1 OFF: Max. 9.6 Vdc
  - Un = 48 V / 60 Vdc
    - Switching threshold 2 ON: Min. 42.6 Vdc
    - Switching threshold 2 OFF: Max. 21.3 Vdc
  - Un = 110 / 120 Vac / Vdc
    - Switching threshold 3 ON: Min. 88.0 Vdc / 88.0 Vac
    - Switching threshold 3 OFF: Max. 44.0 Vdc / 44.0 Vac
  - Un = 230 / 240 Vac / Vdc
    - Switching threshold 4 ON: Min. 184 Vdc / 184 Vac
    - Switching threshold 4 OFF: Max. 92 Vdc / 92 Vac
- Terminals: screw-type terminal

Relay Outputs

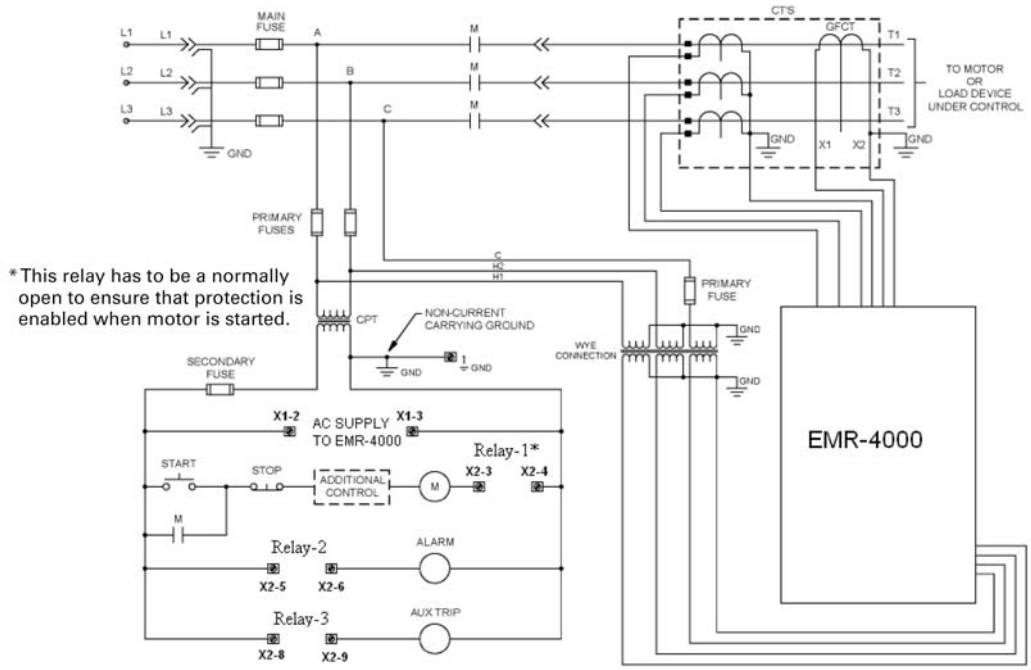
- Continuous current: 5 A AC/DC
- Max. make current:
  - 25 A AC / 25 A DC up to 30 V for 4 s
  - 30 A / 230 Vac according to ANSI IEEE Std C37.90-2005
  - 30 A / 250 Vdc according to ANSI IEEE Std C37.90-2005
- Max. breaking current:
  - 5 A AC up to 250 Vac
  - 5 A DC up to 30 V (resistive)
  - 0.3 A DC at 300 V
- Max. switching voltage: 250 Vac / 250 Vdc
- Switching capacity: 1250 VA
- Contact Type: Form C or normally open contact
- Terminals: screw-type terminals

Wiring Diagrams

Typical AC Connections, Wye VTs 5 A CTs and Ground Current Measured by Residual Connection



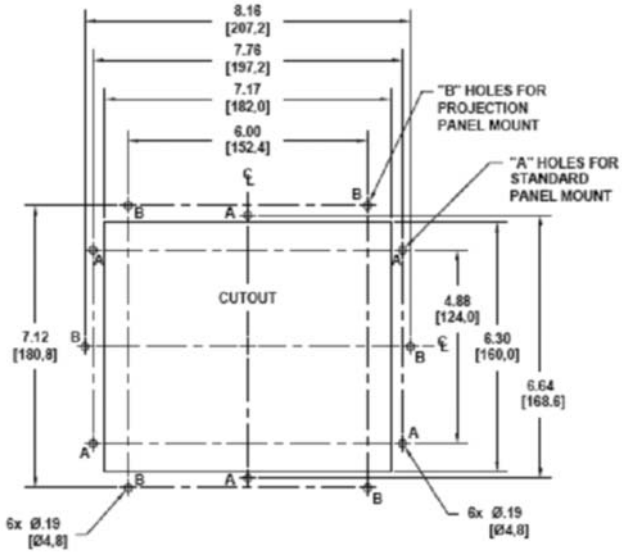
Typical Control Diagram



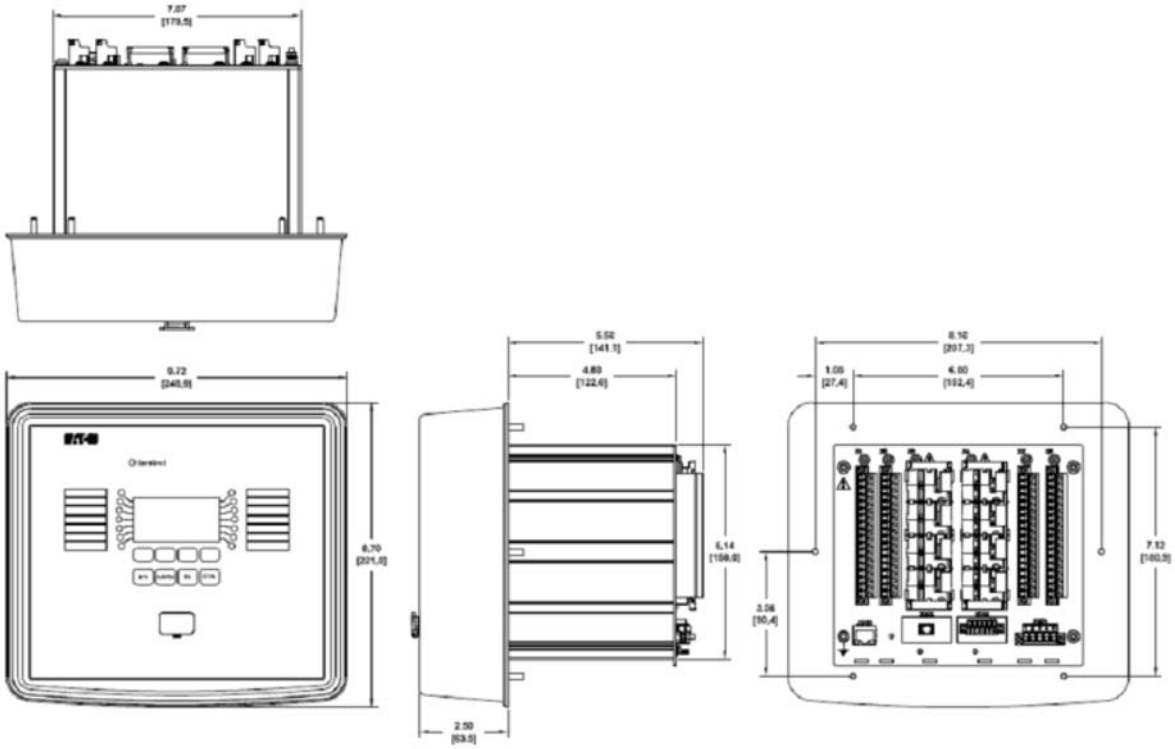
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

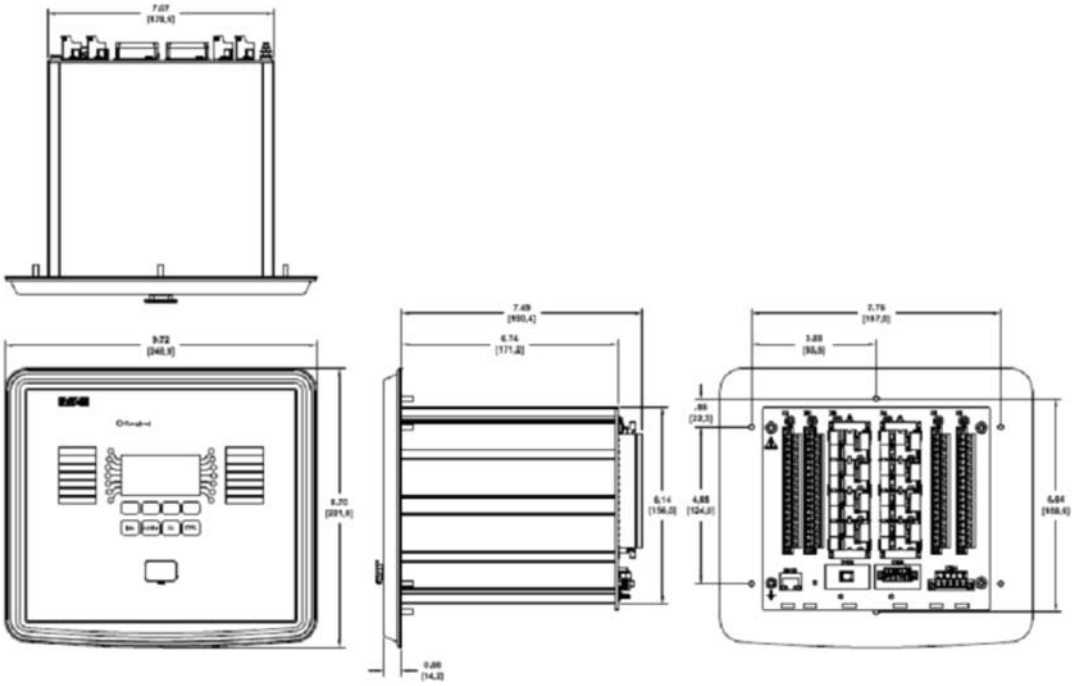


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



EMR-5000 Motor Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

9

EMR-5000 Motor Protection Relay

Product Description

Eaton's EMR-5000 motor protection relay is a multifunctional microprocessor-based protective relay for the protection of any size motor at all voltage levels. It is most commonly applied on medium voltage or larger motors. The EMR-5000 relay is a current and voltage device with built-in differential protection that provides complete and reliable motor protection, monitoring, diagnostics, metering and starting control functions.

The EMR-5000 motor protection relay provides complete current, voltage, and frequency protection in a single compact case. The relay has eight current inputs rated for either 5 amperes or 1 ampere and four voltage inputs. Three of the voltage inputs are to be connected to the three-phase power voltage for voltage protection and for metering. They can be connected in wye-ground or open delta configuration.

The fourth voltage is for independent single-phase undervoltage/overvoltage protection. The unit is capable of 60 Hz or 50 Hz operation.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only. The multiple setting groups can also be changed, via communications or a digital input. Flash memory is used for the programming and all settings are stored in nonvolatile memory.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. Fourteen programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 and an Ethernet ports in the back are optional for local area networking using. Optional Modbus-RTU, Modbus-TCP or IEC-61850 protocols are supported.

The EMR-5000 motor protection relay includes programmable logic functions. Logic gates and timers may be defined and arranged for customized applications. With the programmable logic control functions you can simplify the complexity of your starting schemes by eliminating timers and auxiliary relays. Flash memory is used for the programming and all settings are stored in nonvolatile memory. The relay allows for four preprogrammed setting groups that can be activated through software, manually, or contact input.

The EMR-5000 motor protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, the 5 latest start profiles, motor trending, breaker/contactor wear information and waveform data.

The EMR-5000 has either eight programmable binary inputs, two analog inputs, two analog outputs, or 16 programmable binary inputs. It has 2NO and six Form C heavy-duty outputs and one form C signal alarm relay. The relay provides maximum user flexibility to configure the I/O. All inputs and outputs (except the healthy output) are user-programmable. The unit also counts with a test mode to force outputs and simulate currents, to facilitate the commissioning of the unit. It can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

Eaton's EMR-5000 motor protection relay has been designed for maximum motor operation and protection. It permits running the motor close to its design limits while protecting it against excessive heating and damaging overload conditions. The EMR-5000 field proven protection algorithms were developed based on motor designs and operating parameters for optimum operation and protection while minimizing nuisance tripping. The EMR-5000 motor protection relay utilizes a patented protection algorithm and measurement technique based on proven positive and negative (unbalance) sequence current sampling and true rms calculations.

Intel-I-Trip (I^2t) Overload Protection

The EMR-5000 motor relay features the exclusive Eaton Intel-I-Trip intelligent overload protection system. Intel-I-Trip develops custom overload curves simply from motor nameplate data. Intel-I-Trip protects motors from potentially damaging overload and abnormal operating conditions. The Intel-I-Trip intelligent overload protection feature utilizes field proven measurement techniques and a patented motor thermal protection model. The EMR-5000 motor relay's unique measurement technique samples the current waveforms 36 times per cycle, providing accurate measurements of the positive and negative sequence currents. The negative sequence current causes a greater heating effect on the rotor and has a greater impact on the thermal model in the relay. Intel-I-Trip utilizes these measurements in its motor model to safely protect the motor against the heating effects of these currents.

The motor thermal model is analogous to a bucket that is being filled and drained at the same time. The fill rate is dependent on the motor currents and the drain is based on motor design principles. The size of the bucket is equivalent to the thermal capacity associated with the mass of the motor. Intel-I-Trip integrates these rates and will issue a trip when the thermal capacity is filled.

Intel-I-Trip features adaptive trip characteristics that adjust the trip times based on measured motor temperature when RTDs are used.

Instantaneous Overcurrent

The EMR-5000 motor protection relay provides an instantaneous phase overcurrent function to trip the motor for high fault current levels and save the fuses. This function can be disabled and has an adjustable time delay on starting to avoid nuisance tripping on inrush.

Differential Protection

This protection function is mostly used to protect induction and synchronous motors against phase-to-phase faults. Differential protection may be considered the first line of protection for internal phase to phase or phase to ground faults. In the event of such faults, the quick response of the differential element may limit the damage that may have otherwise occurred to the motor. While this protection is recommended in all motors above 1500 hp, it can be used in smaller motors depending primarily in the importance and the cost of the motor.

Phase Unbalance Protection

Motor supply circuits are often fed through fuses and can be run with a single-phase fuse blown, referred to as single phasing the motor. The EMR-5000 motor protection relay measures the current and voltage unbalance and either can be used to alarm or trip the motor before damage occurs. The EMR-5000 has two voltage and two current unbalance elements. Pickup, start and run timers are provided for each element.

Ground Fault Protection

A separate measuring circuit is used to measure ground current. A ground CT is recommended for more sensitive protection against winding insulation breakdown to ground. The relay ground circuit can be connected residually from the three-phase CTs. The ground fault protection has pickup and time delay set points or can be disabled.

Jam Protection

The user-selectable Jam function protects motors that are running against a sudden mechanical jam or stall condition. The common application is on motors used on crushers, chippers, or conveyors. It detects an increase of motor current to a level above full load. Pickup, start, and run timers and a second element for alarm purposes are provided.

Underload/Underpower Protection

The user selectable underload/underpower function is used to detect the loss of load on the motor. Coupling failure is a common cause for loss of load. Whenever is possible, it is better to use underpower to detect loss of load. Three power elements and two underload elements are provided in the relay for tripping and alarm purposes. Pickup, start and run timers are provided for each element.

Frequency Protection

The frequency elements provide the ability to detect when the motor is operating at off-nominal frequencies that can do damage to the process or, to signal to upstream protections or controls to implement load shedding actions.

Power Factor Protection

This protection is used in synchronous motors applications to detect out-of-synchronism conditions.

Undervoltage/Overvoltage Protection

Use the voltage protective functions to detect abnormal system voltage conditions potentially hazardous to the motor.

Reduced Voltage Starting

The EMR-5000 motor protection relay provides a transition and incomplete sequence function for reduced voltage starting. The user can select to transition based on the current level and/or on time.

Antibackspin

The stop function is programmable from 2–20%. For certain applications, such as pumping a fluid up a pipe, the motor may be driven backward for a period of time after it stops. The EMR-5000 relay provides an antibackspin timer to prevent starting the motor while it is spinning in the reverse direction. The timer begins counting from the moment a stop is declared by the relay.

Start Control Timers

Motors typically have limits to the number of cold starts, starts per hour period, or time between starts that are permitted without damage. The EMR-5000 motor protection relay incorporates these timers to prevent starting the motor beyond its capabilities.

Load Shedding

The EMR-5000 motor protection relay provides a mechanical load shedding feature that can be used to control an upstream process. The load-shedding function closes a contact on an overload condition to control an upstream process from adding more load until the overload condition is gone.

Emergency Override

The EMR-5000 motor protection relay has a user-programmable feature that will let the operator reset the start inhibitor timers and thermal overload bucket. This function is intended for use in emergency conditions only, and it may result in motor damage or failure.

Long Acceleration Motors

Large motors with a high inertia may experience starting currents that exceed the locked rotor current and time. The EMR-5000 motor protection relay has logic and provisions for a zero speed switch input to differentiate between a stall and start condition. If the motor is spinning, then the relay will not trip on the normal locked rotor time allowing the motor to start.

Remote/Differential Trip

The digital inputs can be programmed to accept a contact input from a separate differential relay or other device to trip the motor. This provides local and remote target information and utilizes the trip contacts of the EMR-5000 motor protection relay. It will also record and log the motor information at the time of the trip.

Breaker Failure or Stuck Contactor

The EMR-5000 motor protection relay includes a breaker failure (50BF, 62BF) function that can be initiated from either an internal or external trip signal. This is an independent element that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Flexible Phase Rotation

The EMR-5000 motor protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communication or via a digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Features, Benefits and Functions

Protection Features

- Motor differential protection (87M)
- Thermal protection (49/51)
  - Locked rotor protection (49S/51)
- Phase overcurrent elements:
  - Two instantaneous elements with timers (50P[1], 50P[2] and 50P[3])
  - Three inverse time overcurrent elements (51P[1], 51P[2] and 51P[3])
  - 11 standard curves
  - Instantaneous or time delay reset
- Ground overcurrent elements:
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Jam or Stall protection (50J[1], 50J[2])
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Underload protection (37[1], 37[2])
- Temperature protection with optional URTD (49/38)
- Stars per hour (66)
- Switch onto fault protection
- Phase voltage unbalance and sequence protection (47[1], 47[2])
- Main three-phase under/overvoltage (27M[1], 27M[2], 59M[1], 59M[2])
- Auxiliary single-phase under/overvoltage (27A[1], 27A[2], 59A[1], 59A[2])
- Six frequency elements that can be assigned to: over frequency, under frequency, rate of change, or vector surge (81[1], 81[2], 81[3], 81[4], 81[5], 81[6])
  - Apparent and displacement power factor (55A[1], 55A[2], 55D[1], 55D[2])
- Forward and reverse watts (32[1], 32[2], 32[3])
- Forward and reverse vars (32V[1], 32V[2], 32V[3])
- Lockout protection (86)
- Breaker failure (50BF)
- Zone interlocking for bus protection (87B)

Metering Features

- Amperes: Positive, negative and zero sequence
- Volts: Positive, negative and zero sequence
- Differential current
- Volt-amperes and VA demand
- Watts and kW demand
- kWh (forward, reverse, net)
- Vars and kvar demand
- kvarh (lead, leg and net)
- Power factor
- Frequency
- % THD V and I
- Magnitude THD V and I
- Minimum/maximum recording
- Trending (load profile over time)
- Minimum/maximum recording
- Temperature with remote URTD module

Monitoring Features

- Trip coil monitor
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Trip Cause displays fault recorder data on HMI after fault event
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Trending (load profile over time)
- Motor history
- Records the last 5 motor start profiles
- Motor start trending
- CT supervision
- VT supervision
- Clock (1 ms time stamping)

Diagnostic Features

- Broken rotor bar

Control Functions

- Transition for reduced voltage starts
- Incomplete sequence delay
- Permits numbers of cold starts
- Limits numbers of starts per hour
- Anti-backspin time delay
- Mechanical load shedding
- Zero speed switch for long acceleration motors
- Motor stop inputs
- Remote trip input
- Emergency override
- Breaker/Contactor open-close/stop-start
- Remote open-close (stop-start)
- Programmable I/O
- Programmable LEDs
- Programmable Logic
- Multiple setting groups

Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port:
  - RS-232
- Remote communication port:
  - RS-485
  - Ethernet port
- Protocols:
  - Modbus-RTU (Optional)
  - Modbus-TCP (Optional)
  - IEC-61850 (Optional)
- Configuration software

Diagnostic Features

Broken Rotor Bar

The EMR-5000 provides advanced motor diagnostics including a broken rotor bar detection function. The broken rotor bar detection is a condition maintenance function that continuously monitors the motor's health while in operation. The advanced Motor Current Signature Analysis (MCSA) continuously analyzes the motor current signature and based on preset algorithms will determine when a broken rotor bar is present in the motor.

The broken rotor bar function will provide early detection of any rotor problems and advise maintenance personnel of the impending issue allowing for predictive maintenance of the motor and prevention of catastrophic motor failures.

By providing early indication of potential rotor problems, serious system issues such as: reduced starting torque, overloads, torque and speed oscillation and bearing wear can be avoided. With the advanced broken rotor bar detection system, advanced warning of impending problems reduces catastrophic failures, maximizing motor life and system uptime.

Monitoring and Metering

Sequence of Events Records

The EMR-5000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.

Trip Log

The EMR-5000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

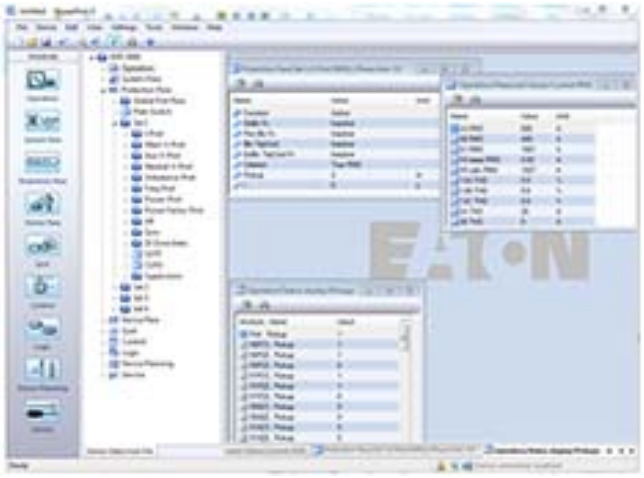
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.

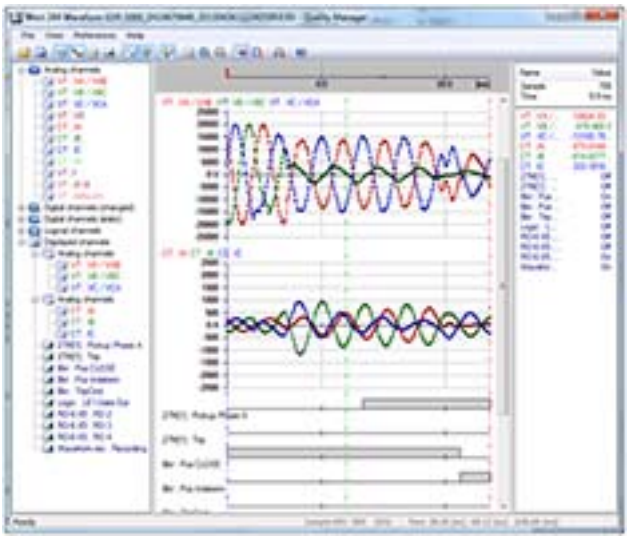
Waveform Capture (Quality Manager)

The EMR-5000relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The EMR-5000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles.

The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



PowerPort-E



Waveform Capture (Quality Manager)

Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. Seven programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Starting Profiles

The EMR-5000 records the average current versus time for the last five starting cycles. This information is available via the communications port through PowerPort-E.

Motor Statistics

For each motor start, the EMR-5000 stores a motor start report and add this data to the motor statistics buffer. With the motor statistics you can track motor start data for the past eighteen 30-day periods. For each 30-day interval, the relay records the following information:

- The date the interval began
- The total number of starts in the interval
- The averages of the following quantities:
  - Motor start time
  - Start % rotor thermal capacity used
  - Maximum start current

9

Load Profiling/Trending

The EMR-5000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30, or 60 minutes, depending on the trending report setting.

Programmable I/O

The EMR-5000 motor protection relay provides heavy-duty, trip-rated, 2 normally open and 1 Form C contacts. One isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode. There are 4 eight user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

Programmable Logic

The EMR-5000 motor protection relay provides logic gates and timers that the user can customize for special or unique applications. Each gate can be assigned a logic function of either AND, OR, NAND or NOR. Each gate can have a maximum of four input signals and each input signal can be required to be a NOT. Input signals can be external inputs received via the binary inputs or internal values associated with the protection, alarm or metering set points. Each gate has a unique output assignment and designation that can be used as the input to another gate.

Standards and Certifications

Approvals

- UL listed file: E217753

Design Standards

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

Listed

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the EMR-5000. For example, if the catalog number is EMR-5000-2A0BA, the device would have the following:

EMR-5000

(A)–Four digital inputs, four output relays, 1 4–20 mA analog output, URTD interface

(0)–5 A / 1 A phase and ground CTs, power supply range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

EMR-5000 Eaton Motor Relay

EMR-5000-2A 0 B A 1

Hardware Option 1
- **A** = 16 DI, 9 outputs, zone interlocking, URTD interface, IRIG-B, large display
- **B** = 8 DI, 9 outputs, 2 AI + 2 AO, zone interlocking, URTD interface, IRIG-B, 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
- **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

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 panel mount

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –30 °C to +70 °C (–22 °F to 158 °F)
- Operating temperature: –20 °C to +60 °C (–4 °F to 140 °F)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible installation altitude:
  - <2,000 m (6,561.67 ft) above sea level
  - If 4,000 m (13,123.35 ft) altitude applies, 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: IP20

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 B2: height / width 183 mm (7.205 in)/ 212.7 mm (8.374 in)
- Housing depth (incl. terminals): 208 mm (8.189 in)
- Material, housing: aluminum extruded section
- Material, front panel: aluminum/foil front
- Mounting position: horizontal (±45° around the X-axis must be permitted)
- Weight: approx. 4.2 kg (9.259 lb)

Current and Ground Current Measurement

Plug-in connector with integrated short-circuiter (Conventional current inputs)

Phase and ground current inputs:

- Nominal currents: 1 A / 5 A
- Max. measuring range:
  - Up to 40 x In (phase currents)
  - Up to 25 x In (ground current standard)
- Capacity: 4 x In/ continuously
- Overcurrent proof:
  - 30 x In / 10 s
  - 100 x In / 1 s
  - 250 x In / 10 ms (1 half-wave)
- Power consumption:
  - Phase current inputs
    - At In = 1 A S = 0.15 MVA
    - At In = 5 A S = 0.15 MVA
  - Ground current inputs
    - At In = 1 A S = 0.35 MVA
    - At In = 5 A S = 0.35 MVA

Sensitive ground current inputs:

- Nominal currents: 1 A / 5 A with 50:0:025 core balance CT
- Max. measuring range: up to 2.5 x In
- Capacity: 2 x In/ continuously
- Overcurrent proof:
  - 10 x In / 10 s
  - 25 x In / 1 s
  - 100 x In / 10 ms (1 half-wave)
- Power consumption:
  - At In= 1 A S=0.35 MVA
  - At In= 5 A S=0.35 MVA
- Frequency range: 50 Hz / 60 Hz ± 10%
- Terminals: screw-type terminals with integrated short-circuiters (contacts)
- Screws: M4, captive type acc. to VDEW
- Connection cross sections:
  - 1 x or 2 x 2.5 mm^2 (2 x AWG 14) with wire end ferrule
  - 1 x or 2 x 4.0 mm^2 (2 x AWG 12) with ring cable sleeve or cable sleeve
  - 1 x or 2 x 6 mm^2 (2 x AWG 10) with ring cable sleeve or cable sleeve
  - The current measuring board's terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

Voltage and Residual Voltage Measurement

- Nominal voltages: 60–520 V (can be configured)
- Max. measuring range: 2 x nominal voltage or 800 V
- Continuous loading capacity: 800 Vac
- Power consumption:
  - at Vn= 100 V S=0.1 MVA
  - at Vn= 110 V S=0.1 MVA
  - at Vn= 230 V S=0.4 MVA
  - at Vn= 400 V S=1.0 MVA
- Nominal voltages: 60–520 V (can be configured)
- Frequency range: 50 Hz or 60 Hz ± 10%
- Terminals: screw-type terminals

Frequency Measurement

- Nominal Frequencies: 50 Hz / 60 Hz

Voltage Supply

- Aux. voltage: 24–270 Vdc/ 48–230 Vac (–20/+10%)
- 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: 24–270 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 48–230 Vac (for frequencies of 50–60 Hz)
  - Power consumption in idle mode—7 VA
  - Maximum power consumption—13 VA

Display

- Display type: LCD with LED background illumination
- Resolution graphics display: 128 x 128 pixel
- LED type: two colored, red/green
- Number of LEDs, housing B2: 15

Front Interface RS-232

- Baud rates: 115,200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

Real-Time Clock

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

Digital Inputs

- Max. Input voltage: 300 Vdc / 259 Vac
- Input current: <4 mA
- Reaction time: <20 ms
- Drop-out time:
  - Shorted inputs: <30 ms
  - Open inputs: <90 ms

Relay Output Contacts

- Continuous current: 5 A AC/DC
- Max. make current:
  - 25 A AC / 25 A DC for 4 s
  - 30 A / 230 Vac according to ANSI IEEE Std C37.90-2005
  - 30 A / 250 Vdc according to ANSI IEEE Std C37.90-2005
- Max. breaking current:
  - 5 A AC up to 240 Vac
  - 5 A DC up to 30 V (resistive)
- Continuous current: 5 A AC/DC
- Contact Type: Form C or normally open contact
- Terminals: screw-type terminals

Supervision Contact (SC)

- Continuous current: 5 A AC/DC
- Max. switch-on current: 15 A AC / 15 A DC for 4 s
- Max. breaking current:
  - 5 A AC up to 250 Vac
  - 5 A DC up to 30 Vdc (resistive)
  - 0.25 A at 250 Vdc (resistive)
- Max. switching voltage: 250 Vac / 250 Vdc
- Switching capacity: 1250 VA
- Contact type: Form C
- Terminals: screw-type terminals

Analog Outputs

The following technical data only apply to devices, which are equipped with analog outputs. Please refer to the order code of your device.

The mode of each output can be individually selected between current or voltage output. Shielded cable for the analog outputs is recommended. The terminals of the HF shield should be used, when connecting the shield to the ground on both sides of the cable is not possible. On one side of the cable the shield has to be directly connected to ground. In case of the use of unshielded twisted pair cables, the length must not exceed 10 m. All analog outputs have a common potential. Each output has an own common terminal.

- Current mode
  - Range: 0–20 mA
  - Max. load resistance: 1 k ohm
- Voltage mode range: 0–10 V maximum output current 20 mA
- Accuracy 0.5% of the nominal value 20 mA resp. 10 V
- Influence of temperature to accuracy: <1% (within the range of 0 °C to +60 °C (+32 °F to +140 °F)
- Test voltage of outputs (one group) against other electrical groups: 2.5 kV
- Test voltage of outputs (one group) against ground: 1.0 kV

Time Synchronization IRIG-B00X

- Nominal Input Voltage: 5 V
- Connection: screw-type terminals (twisted pair)

Zone Interlocking

- Zone Out:
  - Output voltage (High): 4.75 to 5.25 Vdc
  - Output voltage (Low): 0.0 to +0.5 Vdc
- Zone In:
  - Nominal input voltage: +5 Vdc
  - Max. input voltage: +5.5 Vdc
  - Switching threshold ON: min. 4.0 Vdc
  - Switching threshold OFF: max. 1.5 Vdc
- Galvanic isolation: 2.5 kV AC (to ground and other IO)
- Connection: screw-type terminals (twisted pair)

RS-485

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

Fiber Optic

- Master/slave: slave
- Connection: ST-Plug

URTD-Interface

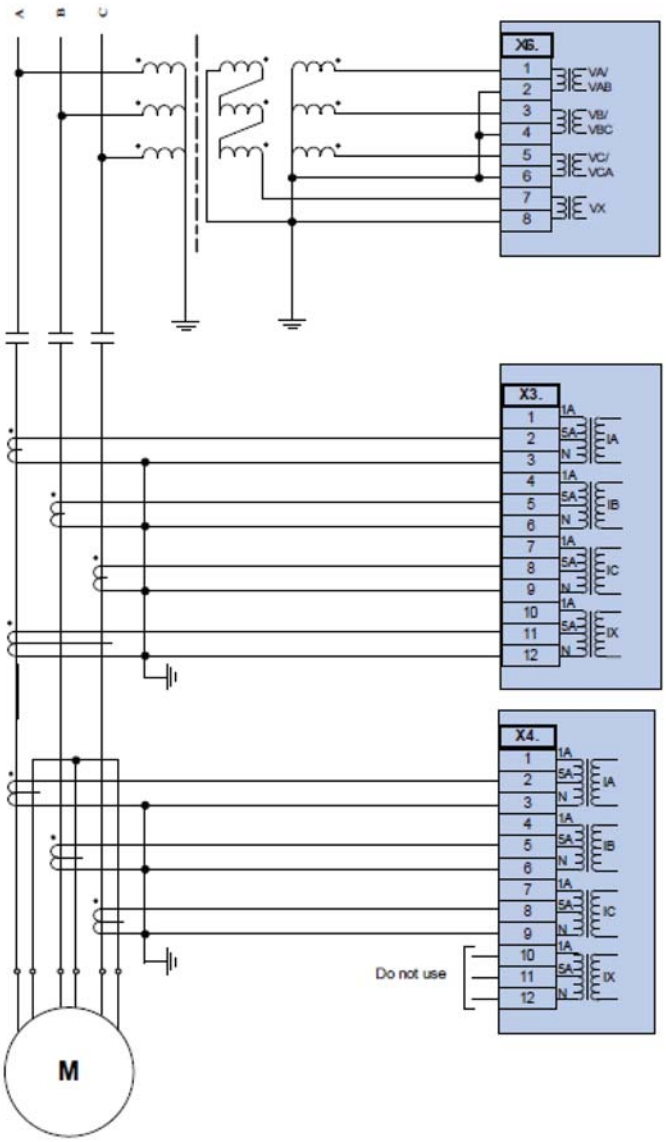
- Connection: versatile link

Boot Phase

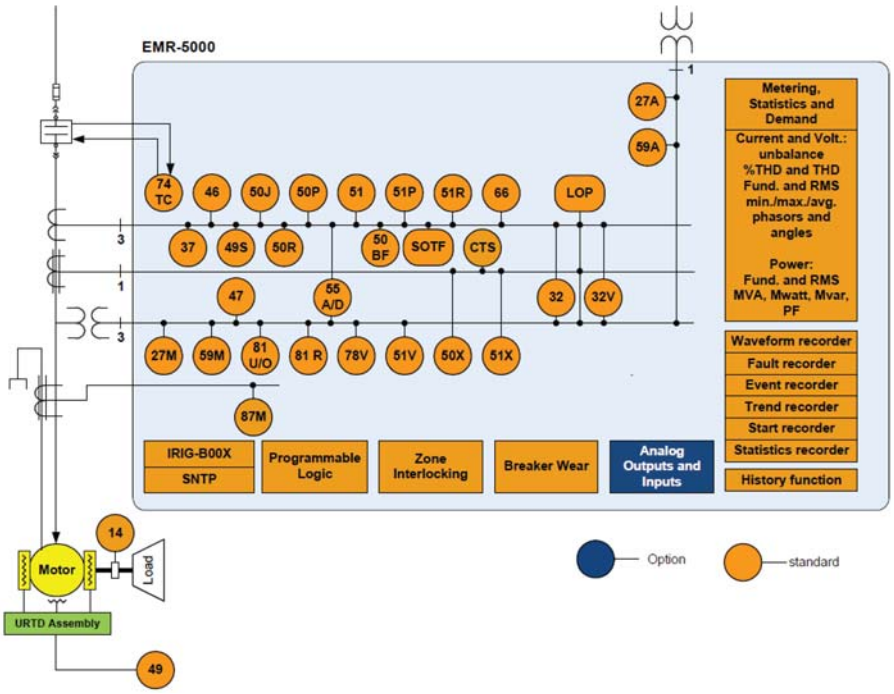
After switching on the power supply, the protection will be available in approximately 19 seconds. After approximately 165 seconds, the boot phase is completed (HMI and communication initialized).

Wiring Diagrams

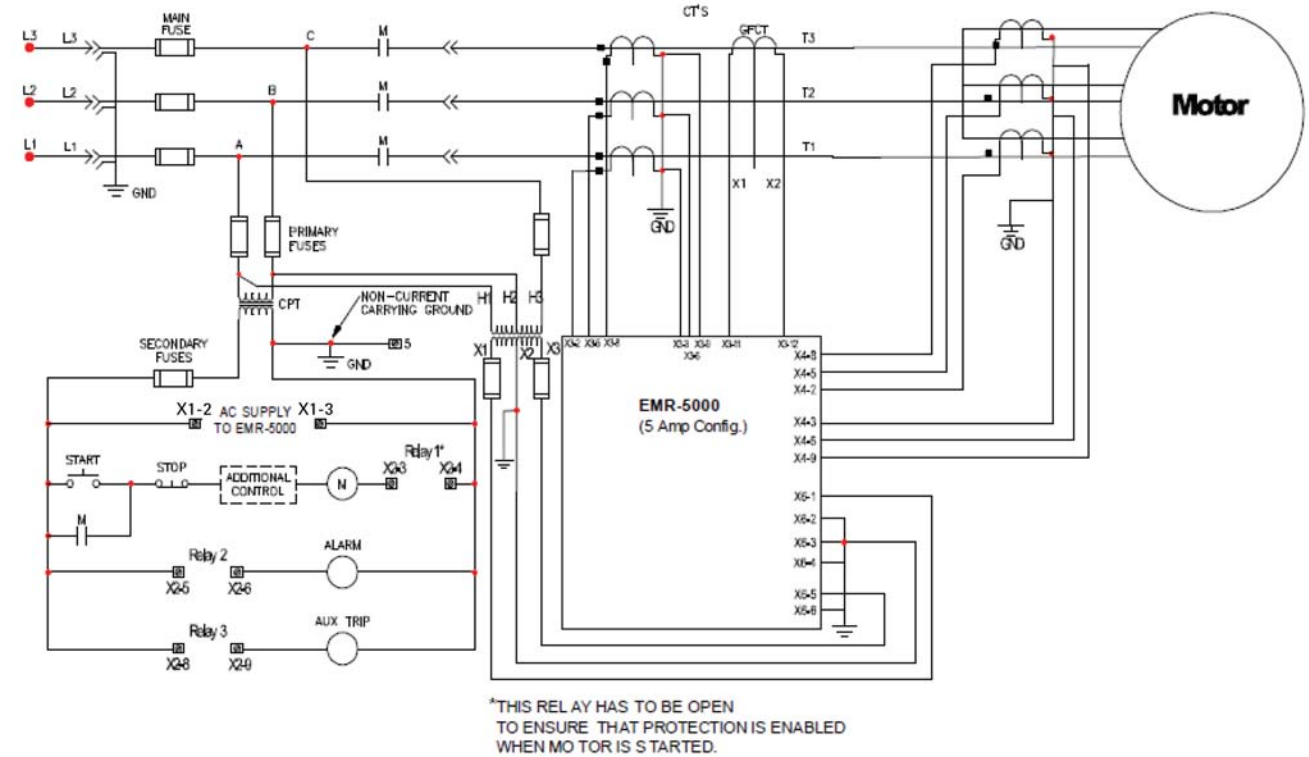
Typical AC Connections—Wye (or Delta) VTs, 5 A CTs, Ground Current Measured by 4th Zero Sequence CT, and 87 Motor Differential



Typical One-Line Diagram



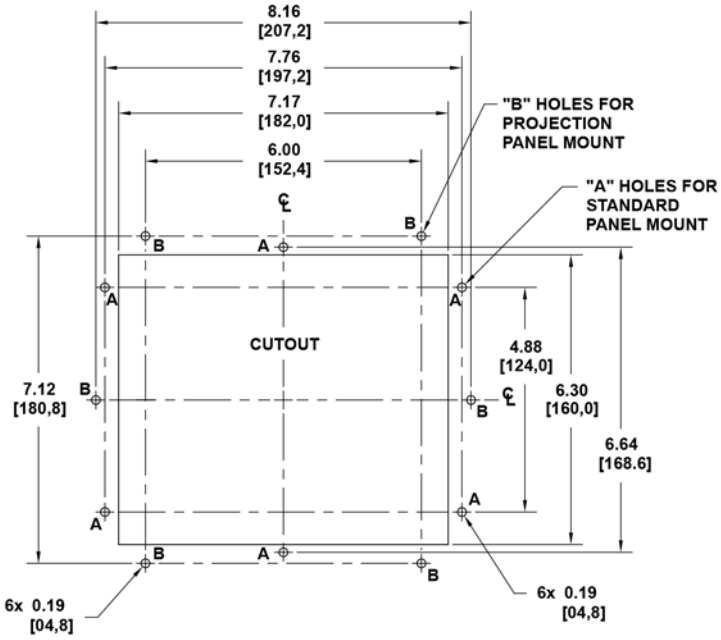
Typical Control Diagram



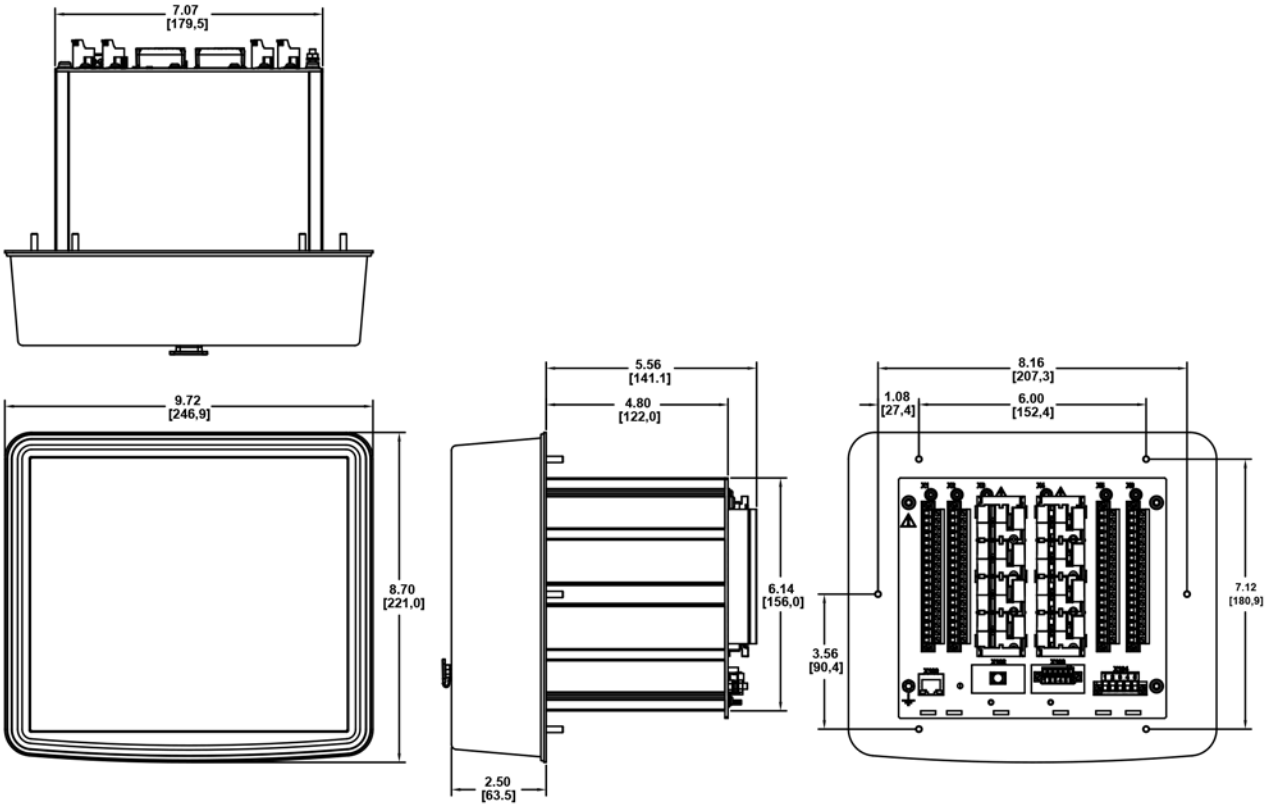
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

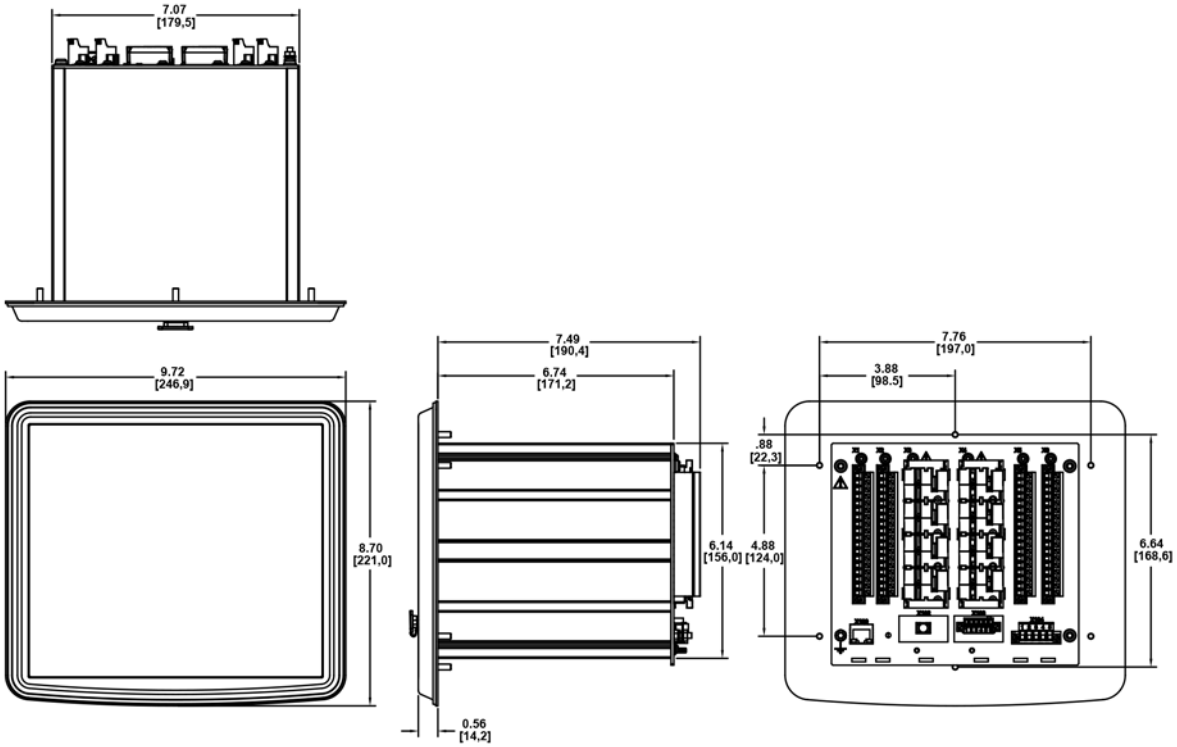


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



ETR-4000



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

9

ETR-4000 Transformer Protection Relay

Product Description

Eaton's ETR-4000 transformer protection relay is a multi-functional, microprocessor-based relay for two winding transformers of all voltage levels. The ETR-4000 provides phase and ground percentage restrained differential protection using a variable dual slope characteristic with phase, negative, residual and neutral overcurrent elements for backup protection. It can also be used to provide restrained differential protection to large motors and generators.

The ETR-4000 has eight current inputs rated for either 5 amperes or 1 ampere to monitor both sides of the transformers. The CTs can be connected in wye in both sides of the transformer; the relay automatically compensates for the connection of the transformer and CT mismatch errors.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. Fourteen programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 communication port on the back is standard for local area networking using Modbus-RTU. An optional Ethernet port and protocols are available.

Flash memory is used for the programming and all settings are stored in nonvolatile memory. The relay allows for four preprogrammed setting groups that can be activated through software, the display or a contact input.

The ETR-4000 transformer protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, breaker wear information and oscillography data.

The ETR-4000 has eight programmable binary inputs, 4 normally opened and 4 Form C heavy-duty outputs and one Form C signal alarm relay. It can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Features, Benefits and Functions

- Flexible phase and ground differential protection for two winding transformers, large motors and generators
- Complete protection and control in a single compact case to reduce panel space, wiring and costs
- Integral test function reduces maintenance time and expense
- Zone selective interlocking improves coordination and tripping time, and saves money compared to a traditional bus differential scheme
- Reduce troubleshooting time and maintenance costs. Trip and event recording in non-volatile memory provides detailed information for analysis and system restoration. 6000 cycles of waveform capture aids in post fault analysis (viewable using PowerPort-E software)
- Minimum replacement time. Removable terminal blocks ideal for industrial environments
- Front RS-232 port and PowerPort-E software provides local computer access and user-friendly Windows-based interface for relay settings, configuration and data retrieval
- Breaker open/close from relay faceplate or remotely via communications
- Fast an easy troubleshooting, improved maintenance procedures and increased device security. Provides detailed traceability for system configuration changes
- Relays self-diagnostics and reporting improves uptime and troubleshooting
- Breaker trip circuit monitoring improves the reliability of the breaker operation

Features

Protection Features

- Dual-slope percentage restrained current differential with magnetizing inrush and overexcitation blocking (87R)
- Unrestrained current differential (87H)
- Restricted ground fault/ Ground Differential (87GD)
- Phase overcurrent (elements can be assigned to either side of the transformer):
  - Four instantaneous elements with timers (50P[1], 50P[2], 50P[3] and 50P[4])
  - Four inverse time overcurrent elements (51P[1], 51P[2], 51P[3] and 51P[4])
  - 11 standard curves
  - Inrush Blocking
  - Instantaneous or time delay reset
- Negative sequence phase overcurrent (elements can be assigned to either side of the transformer):
  - Two inverse time overcurrent elements (51Q[1] and 51Q[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Ground overcurrent (elements can be assigned to either side of the transformer):
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Two breaker failure elements (50BF[1] and 50BF[2])
- Phase transformer overload protection (49)
- Switch onto fault protection
- Cold load pickup
- Zone interlocking for bus protection (87B)

Metering Features

- Amperes: positive, negative and zero sequence
- Ampere demand
- Current phase angles
- % THD I
- Magnitude THD I
- Minimum/maximum recording
- Trending
- RTD Temperatures with remote URTD

Monitoring Features

- Trip coil monitor for both primary and secondary breakers
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Clock (1 ms time stamping)
- Trip Cause displays fault recorder data on HMI after fault event

Control Functions

- Breaker open/close both breakers
- Remote open/close
- Programmable I/O
- Programmable LEDs
- Multiple setting groups
- Cold load pickup
- CT supervision

Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port
- Remote communication port:
  - RS-232
  - RS-485
- Protocols:
  - Modbus-RTU
  - Modbus-TCP (Optional)
- Configuration software

Protection and Control Functions

Eaton's ETR-4000 transformer protection relay has been designed for maximum user flexibility and simplicity. The ETR-4000 is suitable for application on small, medium and large two winding power transformers.

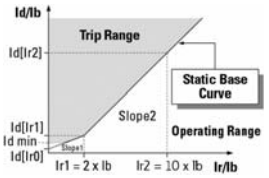
Multiple current inputs are used to provide primary protection, control and back-up protection of transformers, including current differential, restricted ground differential and overcurrent protection.

Dual-Slope Percent Differential Protection

The primary protective element for transformer protection is the percent differential element, which compares the current entering the primary and leaving the secondary of the transformer. The ETR-4000 has built in compensation for the turns-ratio and the phase shift of the transformer, so it's not necessary to compensate for the transformer connection by the connection of the CTs.

The current differential element looks at the vector difference between the current entering and leaving the zone of protection. If the difference exceeds a pre-determined amount, the element will operate.

The operating characteristic of the percent differential element is a dual-slope characteristic to accommodate for CT saturation and CT errors.

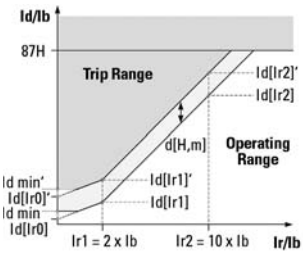


Dual-Slope Operating Characteristic

Harmonic Restraints

There are certain conditions like energizing one side of the transformer with the other side de-energized (inrush currents) or the paralleling of two transformers (sympathetic currents) that can create false differential currents. These differential currents if not recognized can cause a false trip; in the case of inrush conditions or sympathetic currents the differential current is characterized by a heavy content of 2nd and 4th harmonic currents. The percentage differential element is desensitize either permanently (stationary conditions) or temporarily (transient conditions), whenever the 2nd or 4th harmonic exceed the value programmed into the relay.

Another condition that can create a false differential current is a sudden change of voltage or frequency, that can put the transformer in an overexcitation state. In this case there is high content of 5th harmonic currents. The percentage differential element is also desensitized when the 5th harmonic content exceeds a predefined value.



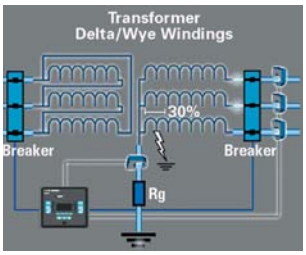
Dynamic Rise of the Operating Characteristic

Unrestrained Differential

An unrestrained differential element is provided for fast tripping on heavy internal faults to limit catastrophic damage to the transformer and minimize risks to the remainder of the power system.

Restricted Ground Fault

Ground differential protection is applied to transformers having impedance grounded wye windings. It is intended to provide sensitive ground fault detection for low magnitude fault currents, which would not be detected by the main percent differential element.



Restricted Ground Fault

Overcurrent Elements

The ETR-4000 can be used to provide backup for transformer and adjacent power system equipment. Instantaneous overcurrent elements can be used for fast clearing of severe internal or external (through) faults. Time overcurrent protection elements per winding allow coordinating with the adjacent protection zones and acting as a backup protection. There are 11 user-selectable inverse-time overcurrent curve characteristics. The user can select from the ANSI, IEC or thermal curve families and can select instantaneous or time delay reset characteristics.

Negative Sequence Overcurrent

Since this element does not respond to balanced load or three-phase faults, the negative-sequence overcurrent element may provide the desired overcurrent protection. This is particularly applicable to delta-wye grounded transformers where only 58% of the secondary p.u. phase-to-ground fault current appears in any one primary phase conductor. Backup protection can be particularly difficult when the wye is impedance grounded. A negative-sequence element can be used in the primary supply to the transformer and set as sensitively as required to protect for secondary phase-to-ground or phase-to-phase faults. This element should be set to coordinate with the low-side phase and ground relays for phase-to-ground and phase-to-phase faults. The negative sequence element must also be set higher than the negative-sequence current due to unbalanced loads.

Breaker Failure

The ETR-4000 transformer protection relay includes two breaker failure (50BF, 62BF) elements that can be initiated from either an internal or external trip signal. These are independent elements that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communications or via a digital input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Monitoring and Metering

Sequence of Events Records

The ETR-4000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.

Trip Log

The ETR-4000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents at the time of the fault.

Waveform Capture

The ETR-4000 transformer protection relay provides oscillography-recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, logic and contact closures. The ETR-4000 relay can record up to 6000 cycles of data. The number of records is proportional to the size of each record; the maximum size per record is 600 cycles. The waveform capture is initiated by up to 8 different triggers; it can also be generated manually through the display or via communications.

Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. Fourteen programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Programmable I/O

The ETR-4000 transformer protection relay provides heavy-duty, trip-rated, 4 normally open and 4 Form C contacts. Two isolated inputs can be used for monitoring the trip circuits. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (fail-safe) mode. There are eight user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

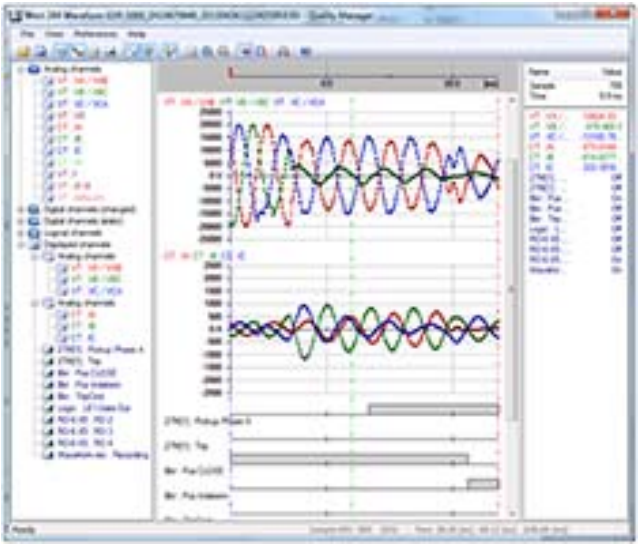
Communication Software

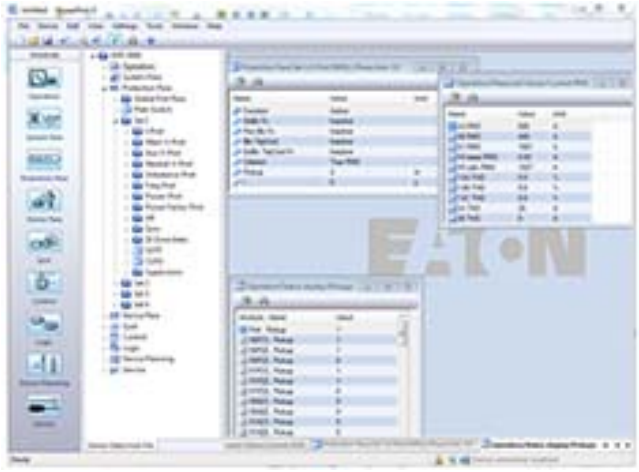
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.

Waveform Capture (Quality Manager)

The ETR-4000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The ETR-4000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles. The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.





Standards and Certifications

Design Standards

- Generic Standard:
  - EN 61000-6-2
  - EN 61000-6-3
- Product Standard:
  - IEC 60255-6
  - EN 50178
  - UL 508 (Industrial Control Equipment)
  - CSA C22.2 No. 14-95 (Industrial Control Equipment)
  - ANSI C37.90
- UL listed file: E217753

Listed

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the ETR-4000. For example, if the catalog number is ETR-4000-2A0BA1, the device would have the following:

ETR-4000

(A)–8 Digital Inputs, 9 Output Relays

(0)–5 A / 1 A phase and ground CTs, Power Supply Range: 19-300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without Conformal Coating

(1)–Projection Panel Mount

ETR-4000 Eaton Transformer Protection Relay

ETR-4000-2A 0 B A 1

Hardware Option 1
- **A** = 8 DI, 9 outputs, removable terminals, 2 zone interlocking, URTD interface, IRIG-B, small display
- **B** = 4 DI, 5 outputs, removable terminals, IRIG-B, small display
- **C** = 8 DI, 5 outputs, removable terminals, 1 zone interlocking, IRIG-B, small 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
- **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

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 panel mount

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –22 °F to +158 °F (–30 °C to +70 °C)
- Operating temperature: –40 °F to +140 °F (–40 °C ① to +60 °C)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible installation altitude:
  - 6,561.67 ft (<2000 m) above sea level
  - If 13,123.35 ft (4000 m) altitude applies, 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 according to IEC 60255-5: All tests to be carried out against ground and other input and output circuits
- Aux. voltage supply, digital inputs: 2.5 kV (eff.)/50 Hz
- 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

- Material, housing: Aluminum extruded section
- Material, front panel: Aluminum/foil front
- Mounting position: Horizontal (±45° around the X-axis must be permitted)

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

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

Control Power Supply

- Aux. voltage: 24–270 Vdc/ 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure: ≥50 ms at minimal aux. voltage interrupted communication is permitted
- Maximum 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 approx. 0.2 x 0.8 in (5 x 20 mm) according to IEC 60127
  - 3.5 A time-lag miniature fuse approx. 0.25 x 1.25 in (6.3 x 32 mm) according to UL 248-14

Note

① Display will stop working at –20 °C.

Power Consumption

- Power supply range: 19–300 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 40–250 Vac (for frequencies of 40–70 Hz)
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W

Real-Time Clock

- Running reserve of the real-time clock: 1 year minimum

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 B2: 15

Digital Inputs

- Maximum 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/Vdc, 230 Vac/Vdc
  - Un = 24 Vdc
    - Switching threshold 1 ON: Min. 19.2 Vdc
    - Switching threshold 1 OFF: Max. 9.6 Vdc
  - Un = 48–60 Vdc
    - Switching threshold 2 ON: Min. 42.6 Vdc
    - Switching threshold 2 OFF: Max. 21.3 Vdc
  - Un = 110/120 Vac/Vdc
    - Switching threshold 3 ON: Min. 88.0 Vdc/88.0 Vac
    - Switching threshold 3 OFF: Max. 44.0 Vdc/44.0 Vac
  - Un = 230/240 Vac/Vdc
    - Switching threshold 4 ON: Min. 184 Vdc/184 Vac
    - Switching threshold 4 OFF: 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 = 1 A S = 0.15 MVA
    - At I_n = 5 A S = 0.15 MVA
  - Ground current input
    - At I_n = 1 A S = 0.35 MVA
    - At I_n = 5 A S = 0.35 MVA
- Frequency range: 50 Hz/60 Hz ±10%
- Terminals: Screw-type terminals with integrated short-circuiters (contacts)

Relay Outputs

- Continuous current: 5 A AC/DC
- Maximum make current:
  - 25 A AC/25 A DC up to 30 V for 4s
  - 30 A/230 Vac according to ANSI IEEE Std. C37.90-2005
  - 30 A/250 Vdc according to ANSI IEEE Std. C37.90-2005
- Maximum breaking current:
  - 5 A AC up to 125 Vac
  - 5 A DC up to 30 V (resistive)
  - 0.3 A DC at 300 V
- Maximum switching voltage: 250 Vac/250 Vdc
- Switching capacity: 1250 VA
- Contact type: changeover contact or normally open contact
- Terminals: screw-type terminals

Supervision Contact (SC)

- Continuous current: 5 A at 120/240 Vac or 30 Vdc
- Maximum switch-on current: 15 A at 120/240 Vac or 30 Vdc (max. 4 s)
- Maximum breaking current:
  - 5 A at 120/240 Vac or 30 Vdc
  - 0.4 A at 125 Vdc
- Contact type: 1 changeover contact
- Terminals: screw-type terminals

Time Synchronization IRIG

- Nominal input voltage: 5 V
- Connection: Screw-type terminals (twisted pair)

Front Interface RS-232

- Baud rates: 115,200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

RS-485

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

Zone Interlocking

- Nominal input level: 5 V
- Nominal output level: 5 V
- Connection: Screw-type terminals (twisted pair)

Standards

High Voltage Tests (IEC 60255-6)

- High frequency interference test:
  - IEC 60255-22-1 Class 3
    - Within one circuit—1 kV/2 s
    - Circuit to ground—2.5 kV/2 s
    - Circuit to circuit—2.5 kV/2 s
- Insulation voltage test:
  - IEC 60255-5, EN 50178
    - All circuits to other circuits and exposed conductive parts: 2.5 kV (eff.)/50 Hz, 1 min.
    - Except interfaces: 1.5 kV DC, 1 min.
    - Voltage measuring input: 3 kV (eff.)/50 Hz, 1 min.
- Impulse voltage test:
  - IEC 60255-5: 5 kV/0.5J, 1.2/50 µs

EMC Immunity Tests

- Fast transient disturbance immunity test (burst):
  - IEC 60255-22-4: Power supply, mains inputs—±4 kV, 2.5 kHz
  - IEC 61000-4-4 Class 4: Other inputs and outputs—±2 kV, 5 kHz (coupling network)
  - ANSI C37.90.1: ± 4 kV, 2.5 kHz (coupling clamp)
- Surge Immunity Test:
  - IEC 61000-4-5 Class 4
    - Within one circuit—2 kV
    - Circuit to ground—4 kV
- Electrical discharge immunity test:
  - IEC 60255-22-2: Air discharge—8 kV
  - IEC 61000-4-2 Class 3: Contact discharge—6 kV
- Radiated radio frequency electromagnetic field immunity test
  - IEC 61000-4-3: 26 MHz – 80 MHz—10 V/m
  - Class X: 80 MHz–1 GHz—35 V/m
  - ANSI C37.90.2: 1 GHz–3 GHz—10 V/m
- Immunity to conducted disturbances induced by radio frequency fields:
  - IEC 61000-4-6 Class 3: 10 V
- Power frequency magnetic field immunity test:
  - IEC 61000-4-8: Continues—30 A/m
  - Class 4: 3 sec—300 A/m

EMC Emission Tests

- Radio interference suppression test:
  - IEC/CISPR11—Limit value class B
- Radio interference radiation test:
  - IEC/CISPR11—Limit value class B

Environmental Tests

Classification

- IEC 60068-1: Climatic—0/055/56
- IEC 60721-3-1:
  - Classification of ambient conditions (storage)—1K5/1B1/1C1L/1S1/1M2 but min. –13 °F (–25 °C)
- IEC 60721-3-2: Classification of ambient conditions (transportation)—2K3/2B1/2C1/2S1/2M2
- IEC 60721-3-3: Classification of ambient conditions (Stationary use at weather protected locations)—3K6/3B1/3C1/3S1/3M2 but min. 32 °F (0 °C) and 3K8H for 2 h

Test ad: Cold

- IEC 60068-2-1:
  - Temperature—–4 °F (–20 °C)
  - Test duration—16 h

Test Bd: Dry heat

- IEC 60068-2-2:
  - Temperature—131 °F (55 °C)
  - Relative humidity—<50%
  - Test duration—72 h

Test cab: Damp heat (steady state)

- IEC 60068-2-78:
  - Temperature—104 °F (40 °C)
  - Relative humidity—93%
  - Test duration—56d

Test Db: Damp heat (cyclic)

- IEC 60068-2-30:
  - Temperature—131 °F (55 °C)
  - Relative humidity—95%
  - Cycles (12 + 12-hour)—2

Mechanical Tests

Test Fc: Vibration response test

- IEC 60068-2-6, IEC 60255-21-1, Class 1:
  - Displacement: (10 Hz–59 Hz)—0.0014 in (0.035 mm)
  - Acceleration: (59 Hz–150 Hz)—0.5 gn
  - Number of cycles in each axis: 1

Test Fc: Vibration endurance test

- IEC 60068-2-6, IEC 60255-21-1, Class:
  - Acceleration: (10 Hz–150 Hz)—1.0 gn
  - Number of cycles in each axis: 20

Test Ea: Shock test

- IEC 60068-2-27, IEC 60255-21-2, Class 1
  - Shock response test: 5 gn, 11 ms, 3 impulses in each direction
  - Shock resistance test: 15 gn, 11 ms, 3 impulses in each direction

Test Eb: Shock endurance test

- IEC 60068-2-29, IEC 60255-21-2, Class 1
  - Shock endurance test: 10 gn, 16 ms, 1000 impulses in each direction

Test Fe: Earthquake test

- IEC 60068-3-3, KTA 3503, IEC 60255-21-3, Class 2
  - Single axis earthquake vibration test:
    - 3–7 Hz: horizontal 0.394 in (10 mm), 1 cycle each axis
    - 7–35 Hz: horizontal: 2 gn, 1 cycle each axis

Tolerances

Tolerances of the Real-Time Clock

- Resolution: 1 ms
- Tolerance:
  - <1 minute/month (68 °F [+20 °C])
  - <±1 ms if synchronized via IRIG-B

Tolerances of the Measured Value Acquisition

Phase and ground current measuring

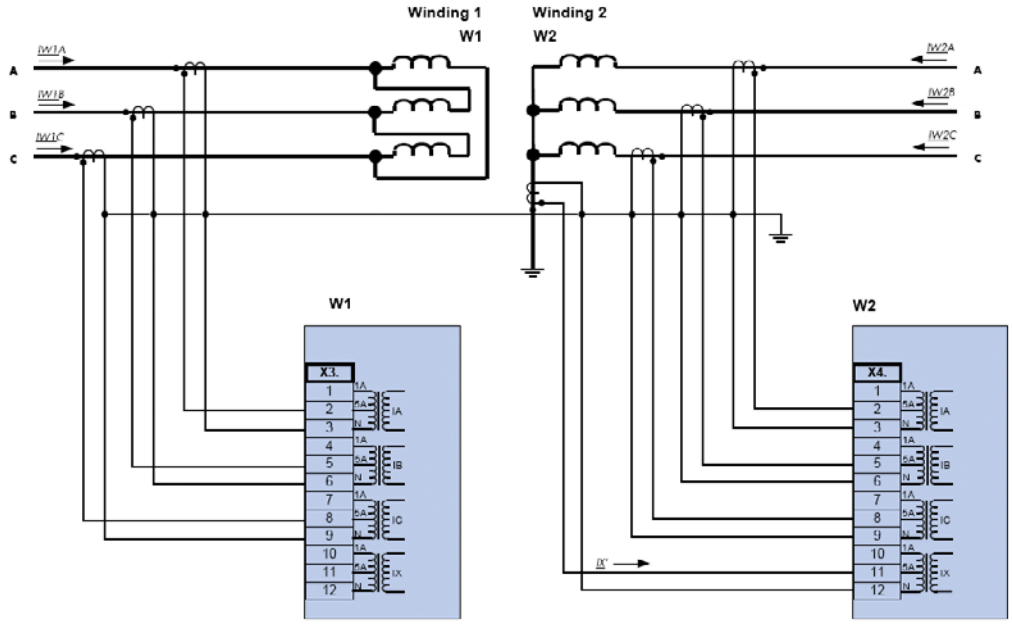
- Maximum measuring range:
  - Up to 40 x I_n (phase currents)
  - Up to 25 x I_n (ground current standard)
  - Up to 2.5 x I_n (earth current sensitive)

Note: The precision does not depend on the nominal value but is referenced to 100 mA (with In =1 A) respectively.
500 mA (with In = 5 A)

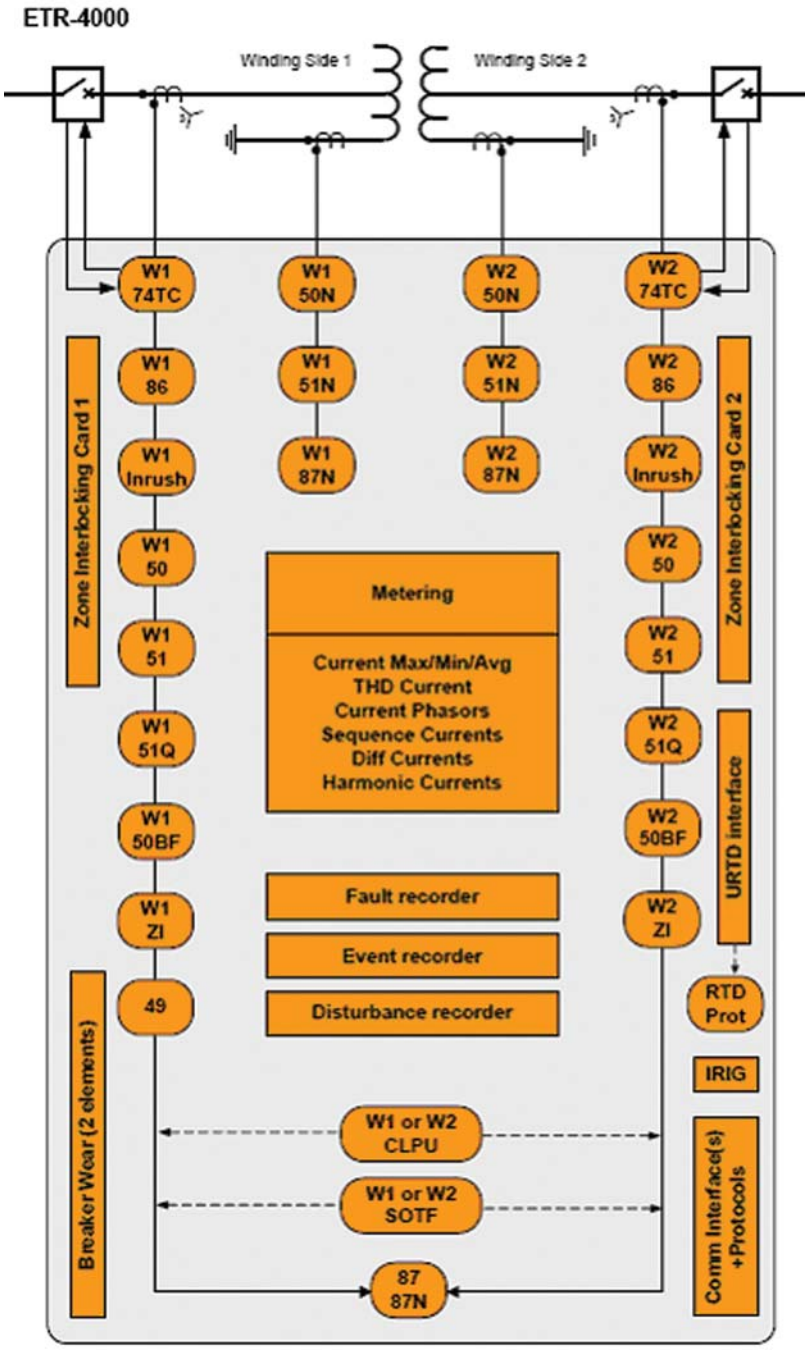
- Frequency range: 50 Hz /60 Hz ±10%
- Accuracy: Class 0.5
- Amplitude Error if I < 1 I_n: ±0.5% of the rated value
- Amplitude Error if I > I_n: ±0.5% of the measured value
- Amplitude Error if I > 2 I_n: ±1.0% of the measured value
- Resolution: 0.01 A
  - Harmonics: Up to 20% 3rd harmonic ±1%
  - Up to 20% 5th harmonic ±1%
- Frequency influence: < ±2% / Hz in the range of ±5 Hz of the parametrized nominal frequency
- Temperature influence: < ±1% within the range of +32 °F to +140 °F (0 °C to +60 °C)

Wiring Diagrams

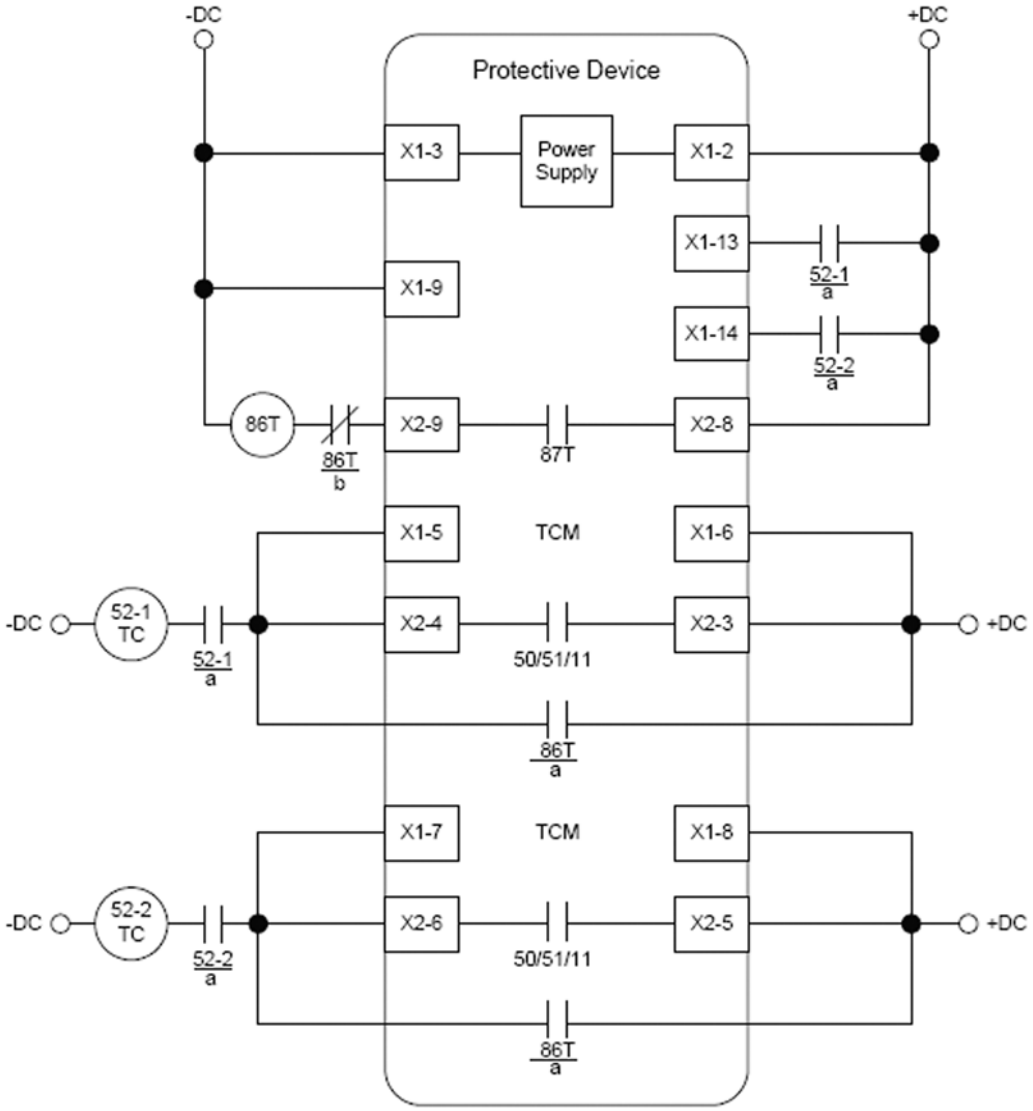
Typical AC Connections Delta-Wye Transformer with Wye CTs and Neutral CT



Typical One-Line Diagram



Typical Control Diagram

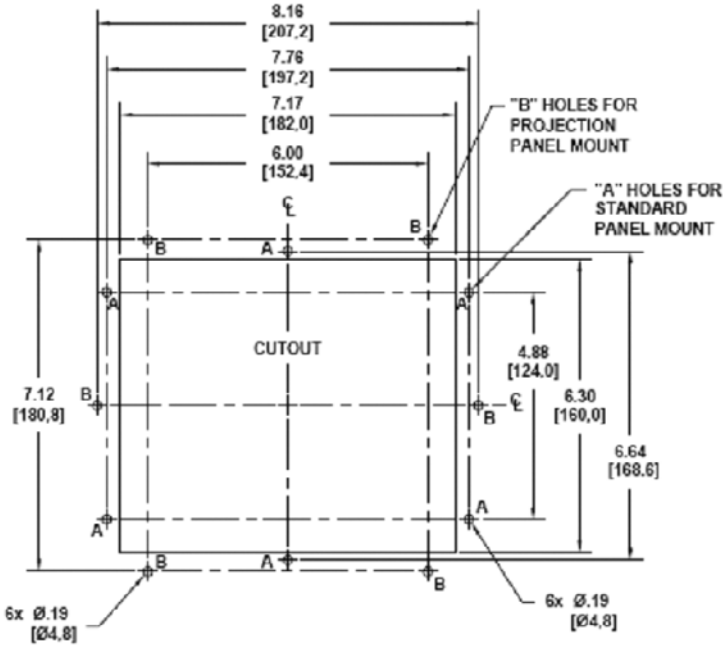


TCM = Trip Coil Monitor

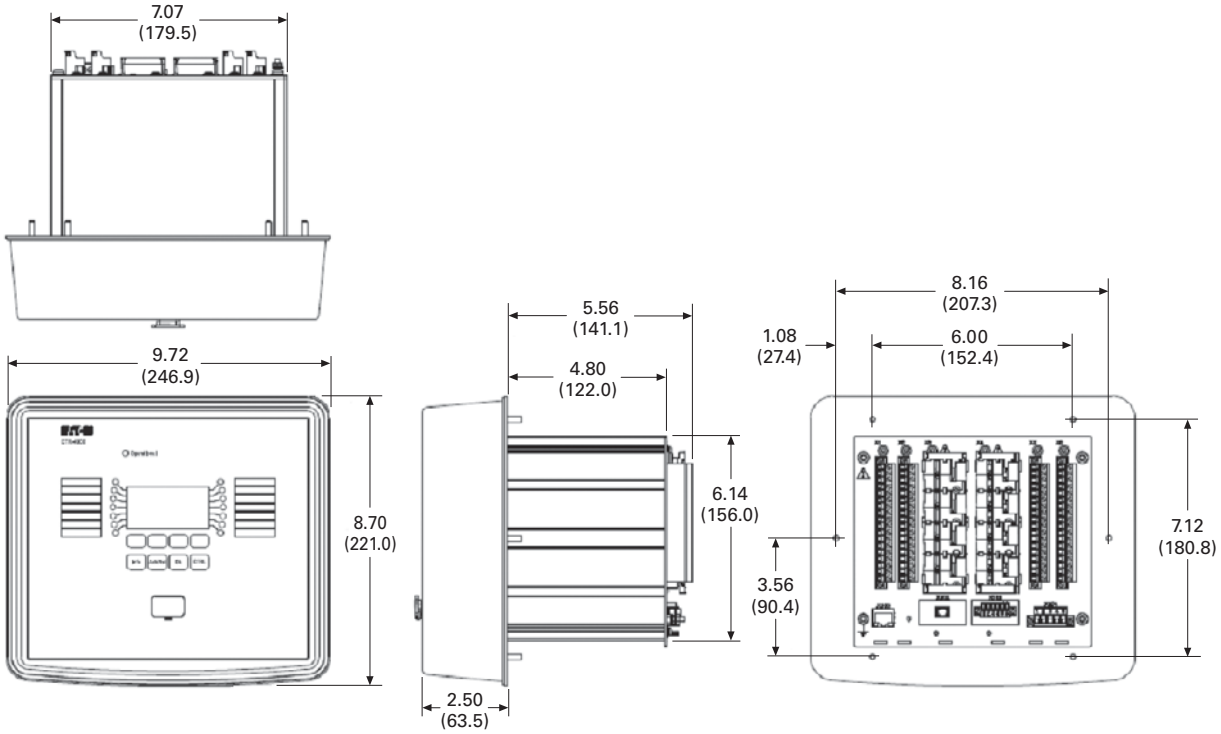
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

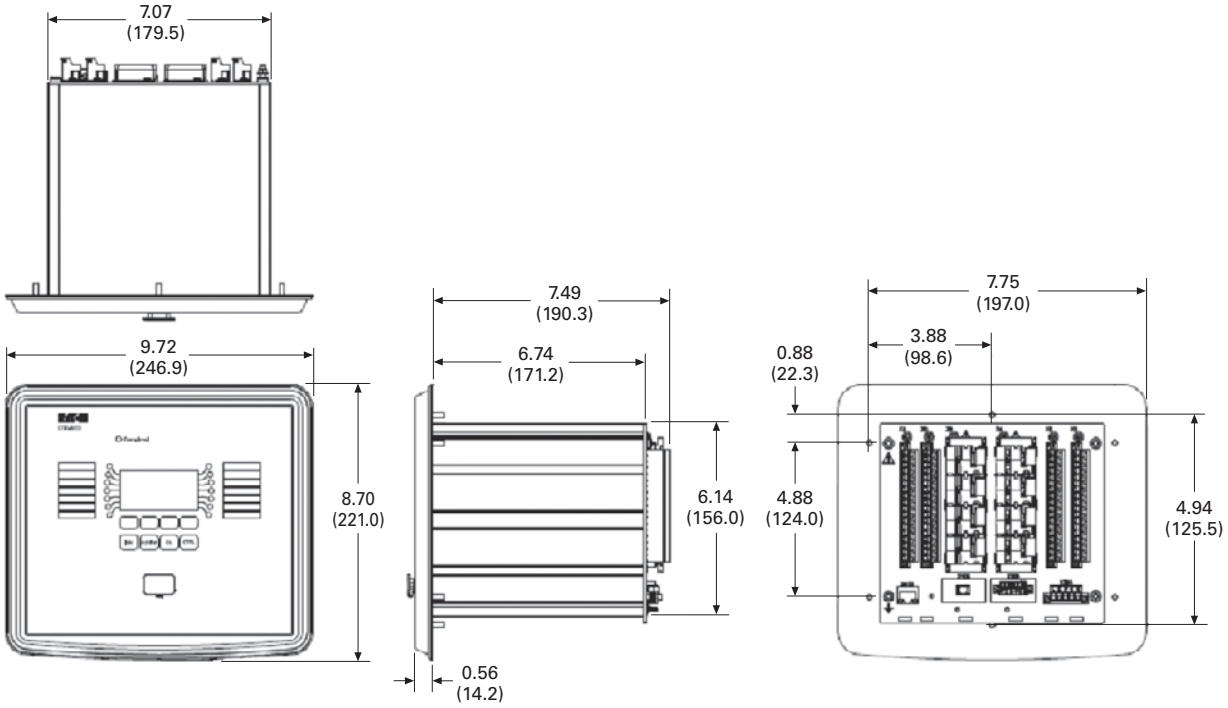


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



ETR-4000 Housing B2

Width	Height	Depth ①	Shipping Weight Lb (kg)
6.81 (173.0)	8.37 (212.7)	8.19 (208.0)	9.3 (4.2)

Note

① Includes terminals.

ETR-5000 Transformer Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	**V3-T9-209**

9

ETR-5000 Transformer Protection Relay

Product Description

Eaton's ETR-5000 transformer protection relay is a multi-functional, microprocessor-based relay for two winding transformers of all voltage levels. The ETR-5000 provides phase and ground percentage restrained differential protection using a variable dual slope characteristic with phase, residual, and neutral directional overcurrent elements for backup protection. Negative sequence overcurrent elements, three-phase overvoltage/undervoltage, voltage unbalance, current unbalance, over/under and rate-of-change frequency, vector surge, directional vars, directional power, and overexcitation are standard functions.

The ETR-5000 transformer relay provides all required protection, control, monitoring and metering for any size two winding transformer in a single, compact case. The relay has eight current inputs rated for either 5 A or 1 A and four voltage inputs. The CTs can be connected in wye in both sides of the transformer; the relay automatically compensates for the connection of the transformer, and CT mismatch errors.

Three of the voltage inputs are to be connected to the three-phase power voltage for voltage protection and for metering. They can be connected in wye-ground or open delta configuration. The fourth voltage is for independent single-phase undervoltage/overvoltage protection.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. Fourteen programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 and an Ethernet ports in the back are optional for local area networking using. Optional Modbus-RTU, Modbus-TCP, or IEC-61850 protocols are supported.

The ETR-5000 transformer protection relay includes programmable logic functions. Logic gates and timers may be defined and arranged for customized applications. Programmable logic control functions make the ETR-5000 very flexible.

Flash memory is used for the programming and all settings are stored in nonvolatile memory.

The ETR-5000 generator protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/maximum values, load profiles, breaker wear information and waveform data.

The ETR-5000 has eight programmable binary inputs, 2 analog inputs, 2 analog outputs, 1 zone intelorking card or eight programmable binary inputs, and 2 zone interlocking cards. It has 2 normally opened and 6 Form C heavy-duty outputs and one Form C signal alarm relay. The ETR-5000 can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

Eaton's ETR-5000 transformer protection relay has been designed for maximum user flexibility and simplicity. The ETR-5000 is suitable for application on small, medium, and large two winding power transformers. Multiple current inputs are used to provide primary protection, control and back-up protection of transformers, including current differential, restricted ground differential, and overcurrent protection.

Dual-Slope Percent Differential Protection

The primary protective element for transformer protection is the percent differential element, which compares the current entering the primary and leaving the secondary of the transformer. The ETR-5000 has built in compensation for the turns-ratio and the phase shift of the transformer, so it's not necessary to compensate for the transformer connection by the connection of the CTs.

The current differential element looks at the vector difference between the current entering and leaving the zone of protection. If the difference exceeds a pre-determined amount, the element will operate.

The operating characteristic of the percent differential element is a dual-slope characteristic to accommodate for CT saturation and CT errors.

Harmonic Restraints

There are certain conditions like energizing one side of the transformer with the other side de-energized (inrush currents) or the paralleling of two transformers (sympathetic currents) that can create false differential currents. These differential currents if not recognized can cause a false trip; in the case of inrush conditions or sympathetic currents the differential current is characterized by a heavy content of 2nd and 4th harmonic currents. The percentage differential element is desensitize either permanently (stationary conditions) or temporarily (transient conditions), whenever the 2nd or 4th harmonic exceed the value programmed into the relay.

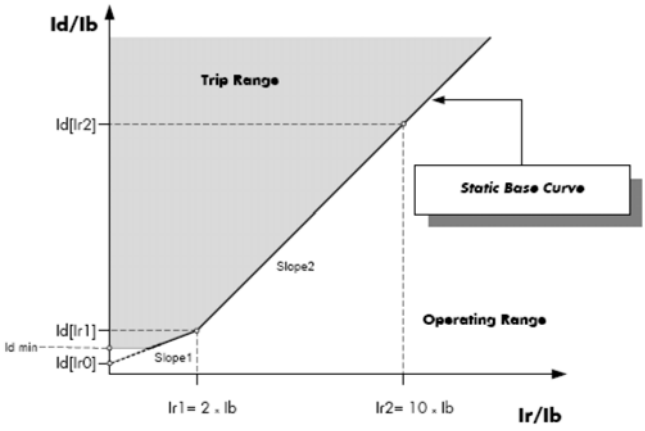
Another condition that can create a false differential current is a sudden change of voltage or frequency, that can put the transformer in an overexcitation state. In this case there is high content of 5th harmonic currents. The percentage differential element is also desensitized when the 5th harmonic content exceeds a predefined value.

Unrestrained Differential

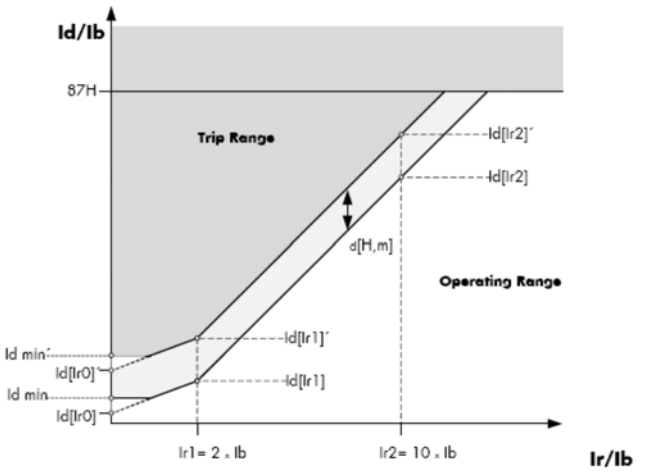
An unrestrained differential element is provided for fast tripping on heavy internal faults to limit catastrophic damage to the transformer and minimize risks to the remainder of the power system.

Restricted Ground Fault

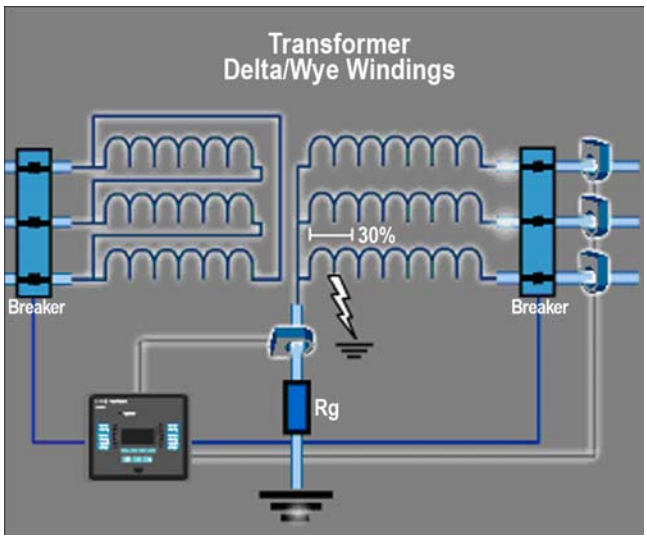
Ground differential protection is applied to transformers having impedance grounded wye windings. It is intended to provide sensitive ground fault detection for low magnitude fault currents, which would not be detected by the main percent differential element.



Dual-Slope Operating Characteristic



Dynamic Rise of the Operating Characteristic.



Restricted Ground Fault

Directional Overcurrent Elements

The ETR-5000 can be used to provide backup for transformer and adjacent power system equipment. Instantaneous overcurrent elements can be used for fast clearing of severe internal or external (through) faults.

Time overcurrent protection elements per winding allow coordinating with the adjacent protection zones and acting as a backup protection. There are 11 user-selectable inverse-time overcurrent curve characteristics. The user can select from the ANSI, IEC or thermal curve families and can select instantaneous or time delay reset characteristics.

Phase direction is a function used to supervise all phase current elements (50, 51). A quadrature voltage is compared to a corresponding phase current to establish the direction of the fault. This function is selectable to operate in the forward, reverse or both directions.

Ground direction is used to supervise ground current elements and is accomplished by using ground, negative sequence or residual currents supervised by zero, negative or positive sequence voltages or ground current. This function is selectable to operate in forward, reverse or both directions.

Directional elements are dependant on the location of the VTs (primary or secondary winding) when voltage is used as the polarizing quantity.

Negative Sequence Overcurrent

Since this element does not respond to balanced load or three-phase faults, the negative-sequence overcurrent element may provide the desired overcurrent protection. This is particularly applicable to delta-wye grounded transformers where only 58% of the secondary p.u. phase-to-ground fault current appears in any one primary phase conductor. Backup protection can be particularly difficult when the wye is impedance grounded. A negative-sequence element can be used in the primary supply to the transformer and set as sensitively as required to protect for secondary phase-to-ground or phase-to-phase faults. This element should be set to coordinate with the low-side phase and ground relays for phase-to-ground and phase-to-phase faults. The negative sequence element must also be set higher than the negative-sequence current due to unbalanced loads.

Overexcitation Protection

Transformer overexcitation occurs when the ratio of voltage versus frequency is too high, and the transformer iron saturates due to high flux density. High flux density results in stray flux in components not designed to carry it, which in turn causes overheating and can potentially damage the transformer. This protection is provided through a Volts/Hertz function with a programmable inverse time characteristic.

Voltage Protection

The ETR-5000 transformer protection relay has four voltage-input circuits. There is a three-phase set designated as Main Voltage (M) and a single-phase voltage circuit designated as Auxiliary Voltage (A). Both include undervoltage (27) and overvoltage (59) protection. The three-phase voltage protection can be set to operate on a single-phase, 2 out of 3 phases, or all three-phase logic. The Main VTs also provide phase voltage unbalance/reversal (47 negative sequence) protection. Each element has an independent threshold set point and adjustable time delay.

Flexible Phase Rotation

The ETR-5000 distribution protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Frequency Protection

The ETR-5000 relay provides six frequency elements than can be used to detect underfrequency/ overfrequency, rate of change, and a vector surge (decoupling of two systems) protection on the Main VT inputs. Each element has an independent threshold set point and adjustable time delay.

Reverse Power

Reverse power provides control for power flowing through a feeder. There are three elements to be configured: operate in forward or reverse; or, under or over power conditions. Reverse power is typically applied to generator or motor applications while under power is generally applied to load or generation loss.

Reverse Vars

Reverse vars can be used to detect loss of excitation in synchronous machines. There are three elements to be configured: operate in forward or reverse; or, under or over vars conditions.

Breaker Failure

The ETR-5000 transformer protection relay includes two breaker failure (50BF, 62BF) elements that can be initiated from either an internal or external trip signal. These are independent elements that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communications or via a digital input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Features, Benefits and Functions

Protection Features

- Dual-slope percentage restrained current differential with magnetizing inrush and overexcitation blocking (87R)
- Unrestrained current differential (87H)
- Restricted ground fault/ Ground Differential (87GD)
- Phase overcurrent (elements can be assigned to either side of the transformer):
  - Four instantaneous elements with timers (50P[1], 50P[2], 50P[3] and 50P[4])
  - Four inverse time overcurrent elements (51P[1], 51P[2], 51P[3] and 51P[4])
  - 11 standard curves;
  - Inrush blocking
  - Instantaneous or time delay reset
  - Voltage restraint (all elements)
  - Directional control (all elements)
- Negative sequence phase overcurrent (elements can be assigned to either side of the transformer):
  - 2 inverse time overcurrent elements (51Q[1] and 51Q[2])
  - 11 standard curves
  - Instantaneous or time delay reset
- Ground overcurrent (elements can be assigned to either side of the transformer):
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
  - Directional control (all elements)
- Two breaker failure elements (50BF[1] and 50BF[2])
- Phase transformer overload protection (49)
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Phase voltage unbalance and sequence protection (47[1], 47[2])
- Main three-phase undervoltage/overvoltage (27M[1], 27M[2], 59M[1], 59M[2])
- Auxiliary single-phase under/overvoltage (27A[1], 27A[2], 59A[1], 59A[2])
- Six frequency elements that can be assigned to: overfrequency, underfrequency, rate of change, or vector surge (81[1], 81[2], 81[3], 81[4], 81[5], 81[6])
- Forward and reverse watts (32[1], 32[2], 32[3])
- Forward and reverse vars (32V[1], 32V[2], 32V[3])
- Overexcitation, volts-per-Hertz (24[1], 24[2])
- Lockout (86)
- Loss of potential-LOP
- Zone interlocking for bus protection (87B)
- Switch onto fault protection
- Cold load pickup

Metering Features

- Phase differential current
- Ground differential current
- Amperes: positive, negative and zero sequence
- Ampere demand
- Volts: positive, negative and zero sequence
- Phase angles
- Volt-amperes and VA demand
- Watts and kW demand
- kWh (forward, reverse, net)
- Vars and kvar demand
- kvarh (lead, leg and net)
- Power factor
- Volts/Hertz
- % THD V and I
- Magnitude THD V and I
- Minimum/maximum recording
- Trending (load profile over time)
- Temperature with remote URTD module

Monitoring Features

- Trip coil monitor for both primary and secondary breakers
- Breaker wear primary and secondary (accumulated interrupted current)
- Oscillography (7200 cycles total)
- Trip Cause displays fault recorder data on HMI after fault event
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Clock (1 ms time stamping)

Control Functions

- Breaker open/close both breakers
- Remote open/close
- Programmable I/O
- Programmable Logic
- Programmable LEDs
- Multiple setting groups
- Cold load pickup
- CT supervision

Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port: RS-232
- Remote communication port:
  - RS-485
  - Ethernet port
- Protocols:
  - Modbus-RTU
  - Modbus-TCP (optional)
  - IEC-61850 (optional)
- Configuration software

Monitoring and Metering

Sequence of Events Records

The ETR-5000 protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO in chronological order.

Trip Log

The ETR-5000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

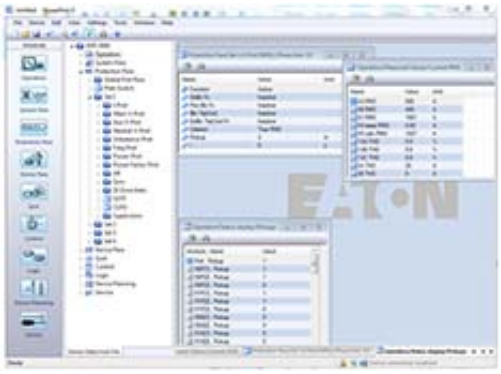
PowerPort-E

PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.

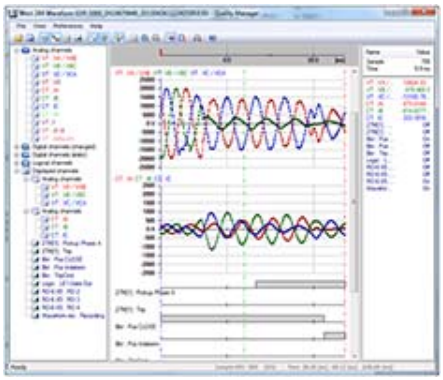
Waveform Capture (Quality Manager)

The ETR-5000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The ETR-5000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles.

The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



PowerPort-E



Waveform Capture (Quality Manager)

Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. 14 programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Load Profiling/Trending

The ETR-5000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30 or 60 minutes, depending on the trending report setting.

Programmable I/O

The ETR-5000 transformer protection relay provides heavy-duty, trip-rated, 2NO and 6 Form C contacts. Two isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode. There are up to 8 user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

The ETR-5000 also offers two optional analog inputs and two optional analog outputs. The analog inputs are available for providing protection. The analog inputs are field programmable to measure transducer signals that operate over a range of 0 to 20 mA, 4 to 20 mA, or 1 to 10V. The two optional analog outputs can be used for signaling the value of measured analog quantities to external process control devices such as PLCs. They can be programmed to operate over a 0 to 20 mA, 4–20 mA, or 1 to 10 V range. The analog outputs can be configured to signal a representation of most analog quantities measured by the ETR-5000 including, current, voltages and RTD temperature.

Programmable Logic

The ETR-5000 transformer protection relay provides logic gates and timers that the user can customize for special or unique applications. Each gate can be assigned a logic function of either AND, OR, NAND or NOR. Each gate can have a maximum of four input signals and each input signal can be required to be a NOT. Input signals can be external inputs received via the binary inputs or internal values associated with the protection, alarm or metering set points. Each gate has a unique output assignment and designation that can be used as the input to another gate.

Standards and Certifications

Approvals

- UL listed file: E217753

Design Standards

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

Listed

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the ETR-5000. For example, if the catalog number is ETR-5000-2A0BA1, the device would have the following:

ETR-5000

(A)–8 Digital Inputs, 9 Output Relays

(0)–5 A / 1 A phase and ground CTs, Power Supply Range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without Conformal Coating

(1)–Projection Panel Mount

ETR-5000 Eaton Transformer Protection Relay

ETR-5000-2A 0 B A 1

Hardware Option 1
- **A** = 8 DI, 9 outputs, removable terminals, 2 zone interlocking, URTD interface
- **B** = 8 DI, 9 outputs, 2 AI, 2 AO, removable terminals, 1 zone interlocking, URTD interface

Hardware Option 2
- **0** = Phase current 5 A / 1 A, W1/W2 ground current 5 A / 1 A, power supply range: 19–300 Vdc, 40–250 Vac
- **1** = Phase current 5 A / 1 A, W1 sensitive ground current 0.5 A 0.1 A, W2 Ground current 5 A/1 A, power supply range: 19–300 Vdc, 40–250 Vac
- **2** = Phase current 5 A / 1 A, W1 sensitive ground current 0.5 A 0.1 A, W2 Ground current 5 A/1 A, power supply range: 19–300 Vdc, 40–250 Vac
- **3** = Phase current 5 A / 1 A, W1 / W2 sensitive ground current 0.5 A / 0.1 A, power supply range: 19–300 Vdc, 40–250 Vac

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 panel mount

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –30 °C to +70 °C (–22 °F to +158 °F)
- Operating temperature: –20 °C 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 (6,561.67 ft) above sea level
  - If 4000 m (13,123.35 ft) altitude applies, 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 IEC 60255-5: All tests to be carried out against ground and other input and output circuits.
- Aux. voltage supply, digital inputs: 2.5 kV (eff.) / 50 Hz
- 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 B2: height/width: 173 mm (6.811 in / 4 U) / 212.7 mm (8.374 in / 42 hp)
- Housing depth (incl. terminals): 208 mm (8.189 in)
- Material, housing: aluminum extruded section
- Material, front panel: aluminum/foil front
- Mounting position: horizontal (±45° around the X-axis must be permitted)
- Weight: ETR-5000 housing B2: approx. 9.259 lb (4.2 kg)

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:
  - 1 x or 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

Control power supply

- Aux. voltage: 24–270 Vdc / 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure:
  - ≥50 ms at minimal aux. voltage
  - Interrupted communication is permitted
- 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 x 0.8 in) according to IEC 60127
  - 3.5 A time-lag miniature fuse 6.3 x 32 mm (approx. 1/4 x 1 1/4 in) according to UL 248-14

Power Consumption

- Power supply range: 19–300 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 40–250 Vac (for frequencies of 40–70 Hz)
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W

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 B2: 15

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: Min. 19.2 Vdc
    - Switching threshold 1 OFF: Max. 9.6 Vdc
  - Un = 48 V / 60 Vdc
    - Switching threshold 2 ON: Min. 42.6 Vdc
    - Switching threshold 2 OFF: Max. 21.3 Vdc
  - Un = 110 / 120 Vac / Vdc
    - Switching threshold 3 ON: Min. 88.0 Vdc / 88.0 Vac
    - Switching threshold 3 OFF: Max. 44.0 Vdc / 44.0 Vac
  - Un = 230 / 240 Vac / dc
    - Switching threshold 4 ON: Min. 184 Vdc / 184 Vac
    - Switching threshold 4 OFF: 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 In (phase currents)
  - Up to 25 x In (ground current standard)
  - Up to 2.5 x In (ground current sensitive)
- Continuous loading capacity: 4 x In/ continuously
- Overcurrent proof:
  - 30 x In / 10 s
  - 100 x In / 1 s
  - 250 x In / 10 ms (1 half-wave)
- Power consumption:
  - Phase current inputs
    - At In = 1 A burden = 0.15 MVA
    - At In = 5 A burden = 0.15 MVA
  - Ground current input
    - At In = 1 A burden = 0.35 MVA
    - At In = 5 A burden = 0.35 MVA
- Frequency range: 50 Hz /60 Hz ±10%
- Terminals: screw-type terminals with integrated short-circuiters (contacts)

Relay Outputs

- Continuous current: 5 A AC/DC
- Maximum make current:
  - 25 A AC/25 A DC up to 30 V for 4 s
  - 30 A/230 Vac according to ANSI IEEE Std. C37.90-2005
  - 30 A/250 Vdc according to ANSI IEEE Std. C37.90-2005
- Maximum breaking current:
  - 5 A AC up to 125 Vac
  - 5 A DC up to 30 V (resistive)
  - 0.3 A DC at 300 V
- Maximum switching voltage: 250 Vac/250 Vdc
- Switching capacity: 1250 VA
- Contact type: changeover contact or NO contact
- Terminals: screw-type terminals

Supervision Contact (SC)

- Continuous current: 5 A at 120/240 Vac or 30 Vdc
- Maximum switch-on current: 15 A 120/240 Vac or 30 Vdc (max. 4 s)
- Maximum breaking current:
  - 5 A Vac up to 2120/240 Vac
  - 5 A Vdc up to 30 Vdc
  - 0.4 A at 125 Vdc
- Contact type: 1 changeover contact
- Terminals: screw-type terminals

Time Synchronization IRIG

- Nominal input voltage: 5 V
- Connection: screw-type terminals (twisted pair)

Front Interface RS-232

- Baud rates: 115,200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

RS-485

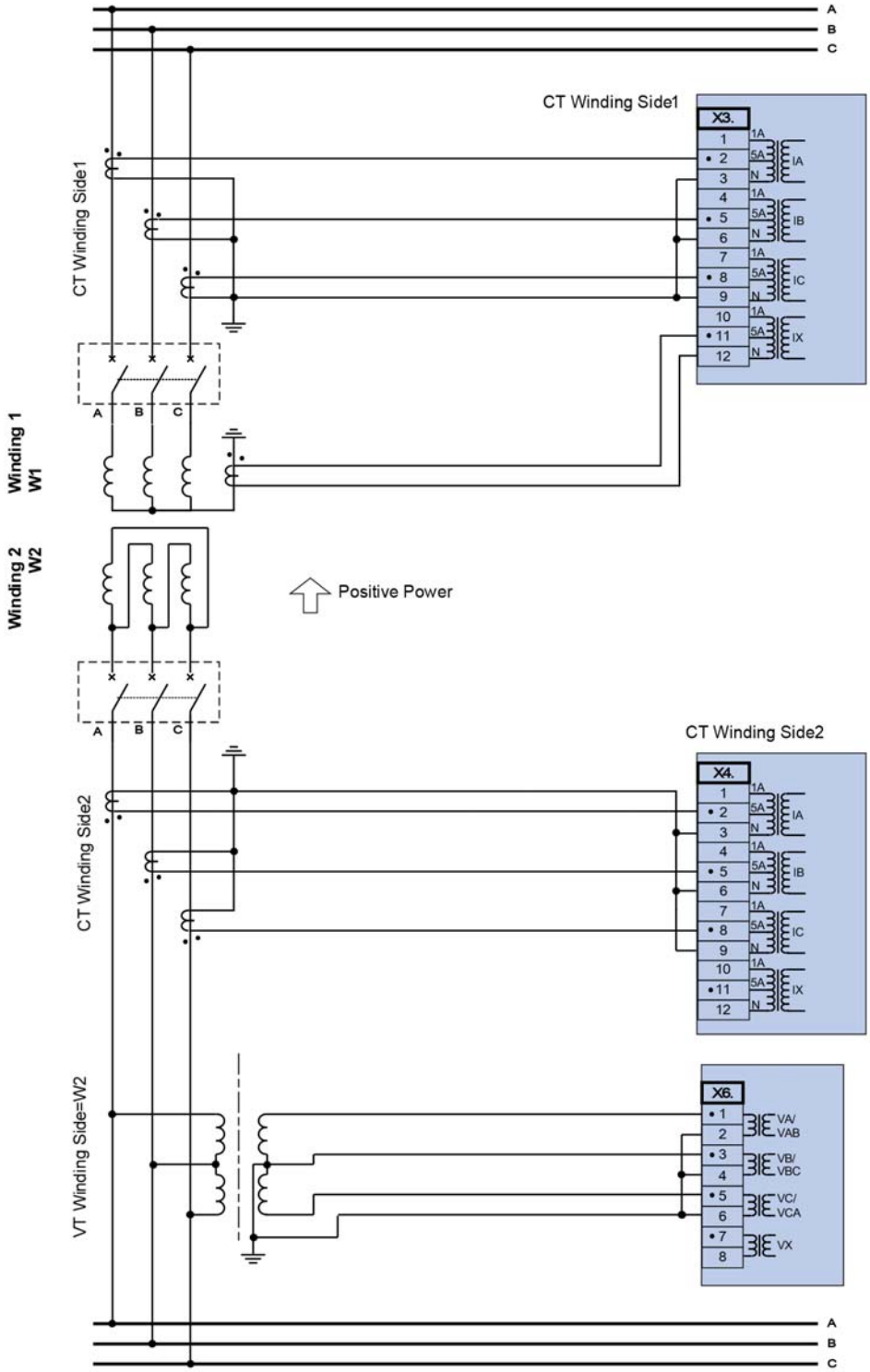
- Master/slave: slave
- Connection: 6 screw-clamping terminals RM 3.5 mm (138 MIL) (terminating resistors internal)

Zone Interlocking

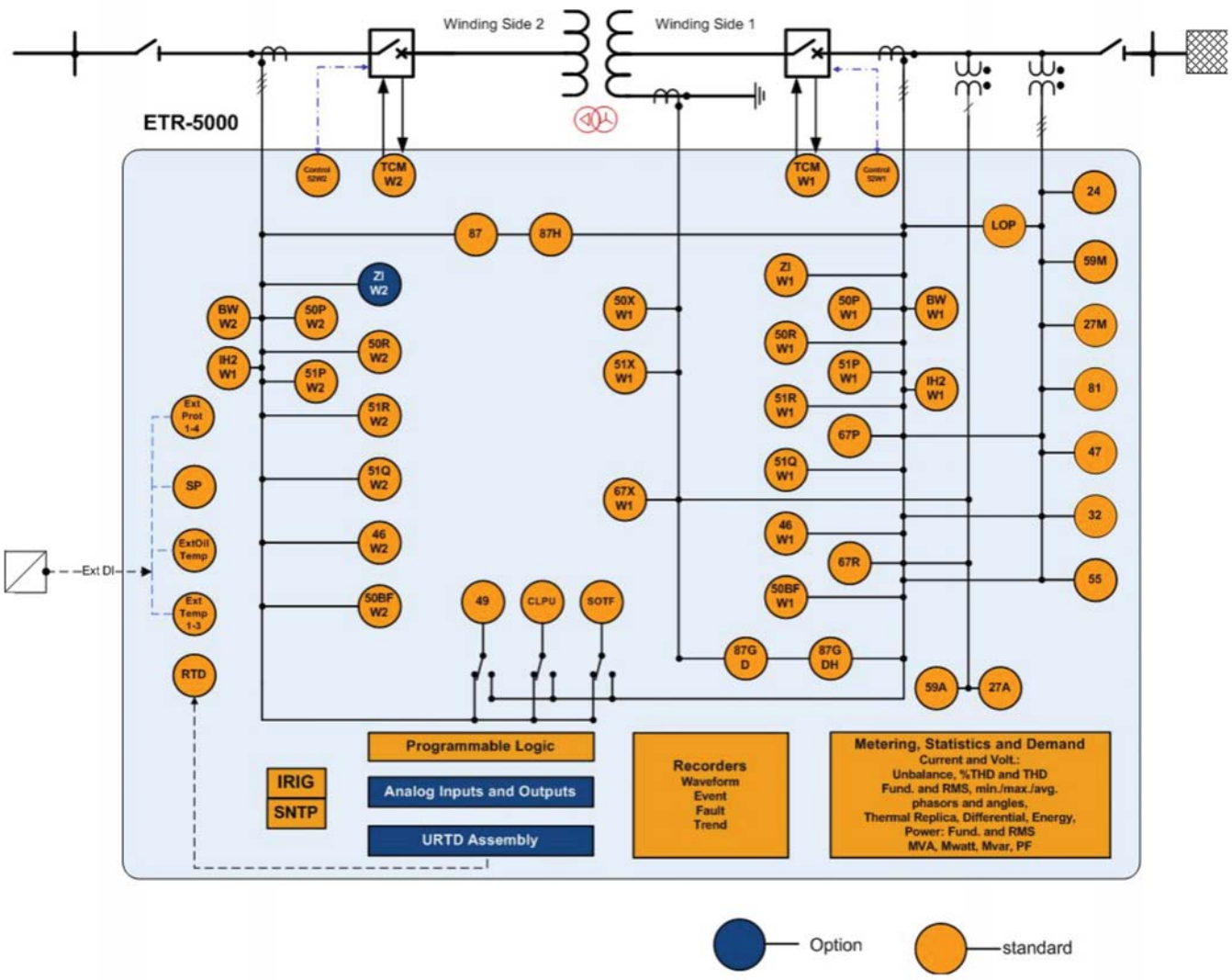
- Nominal input level: 5 V
- Nominal output level: 5 V
- Connection: screw-type terminals (twisted pair)

Wiring Diagrams

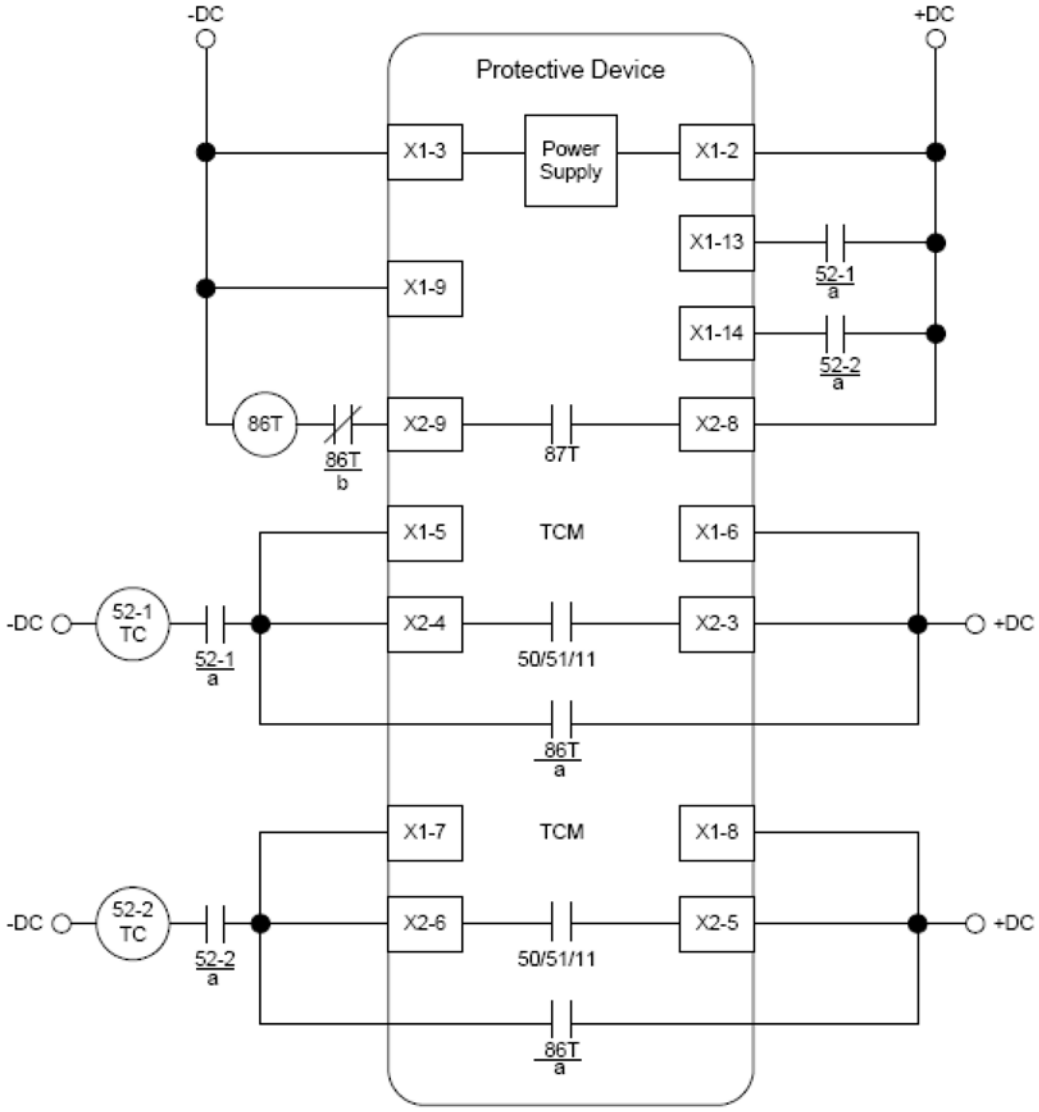
Typical AC Connections—Delta-Wye Transformer with CTs for Phase Overcurrent and Differential on Primary Side (W2) and Secondary Side (W1), Neutral CT for Ground Fault Protection and Open-Delta VT on Primary Side (W2)



Typical One-Line Diagram



Typical Control Diagram

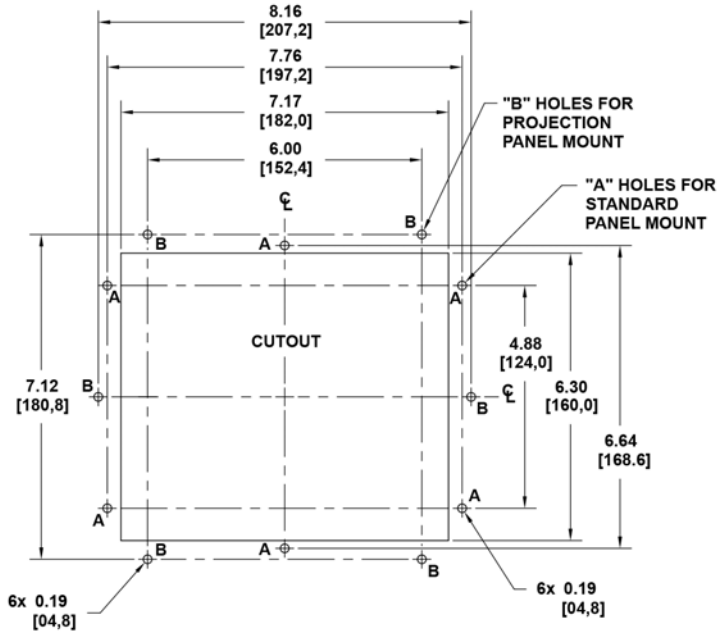


TCM = Trip Coil Monitor

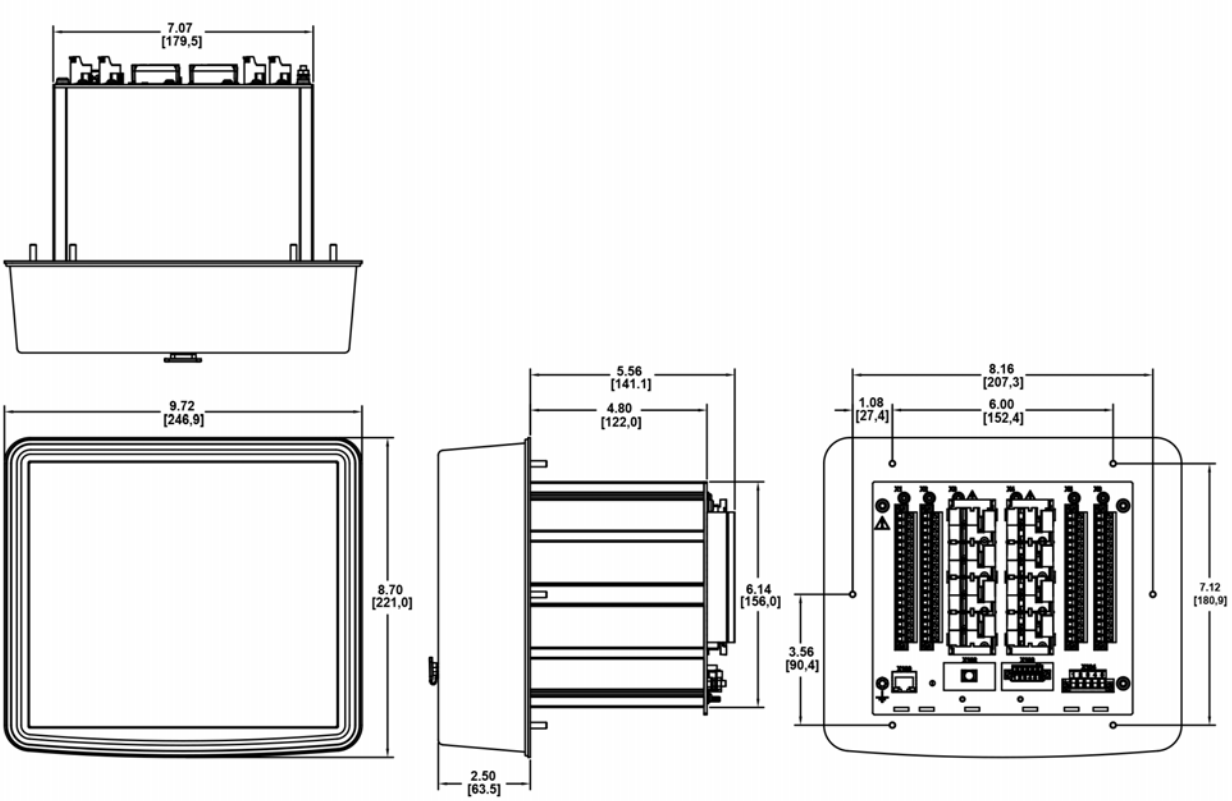
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

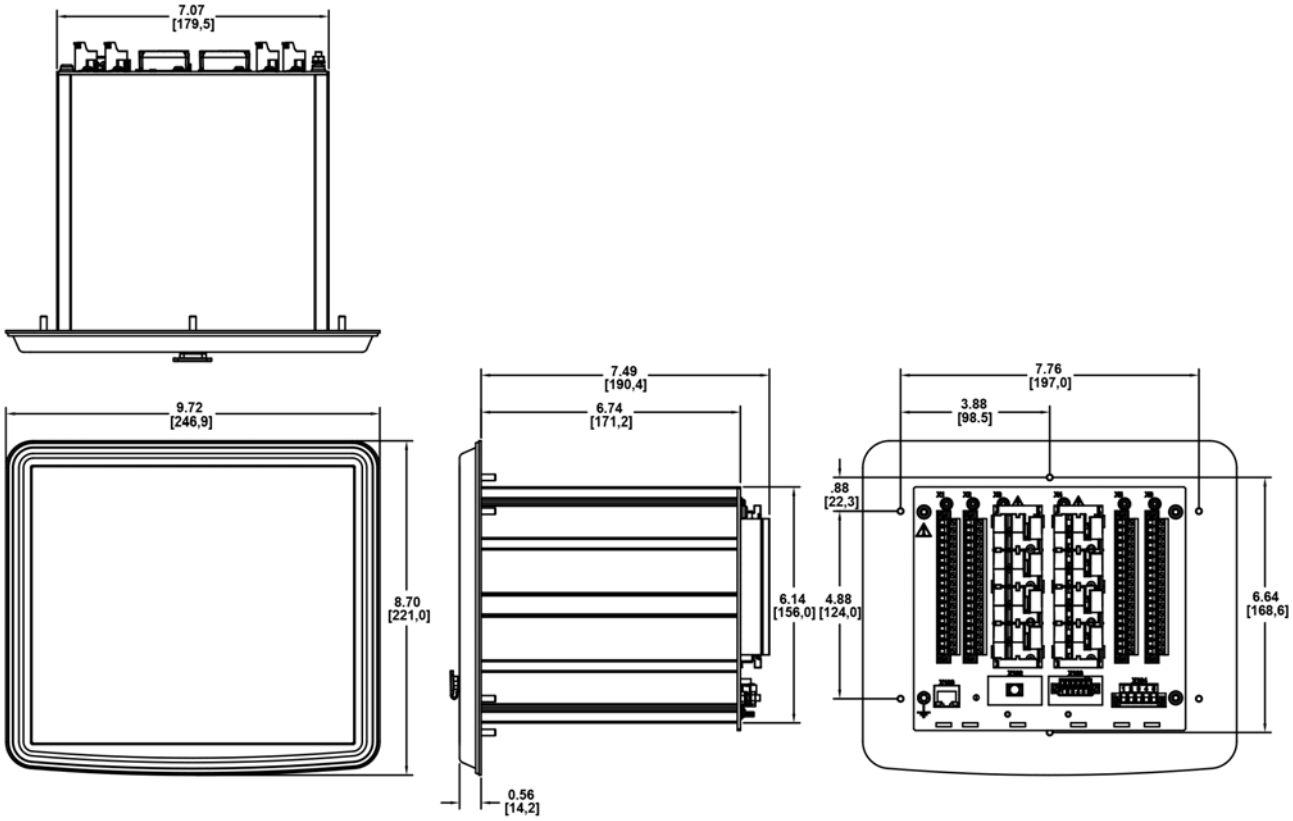


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



EGR-5000 Generation Protection Relay



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay Universal RTD Module	**V3-T9-209**

EGR-5000 Generation Protection Relay

Product Description

Eaton's EGR-5000 generator protection relay is a multi-functional, microprocessor-based relay for any size generators. It may be used as a primary or backup protection in stand by generators, and cogeneration applications. The EGR-5000 generator protection relay provides voltage controlled, voltage restrained, and standard directional three phase overcurrent protection, as well as directional phase-residual and independent ground overcurrent protection, and breaker failure. Three phase over/under voltage, voltage unbalance, current unbalance, over/under and rate-of-change frequency, vector surge, power factor, directional vars, directional power, loss of excitation, overexcitation, phase differential, ground differential, and synch check functions are standard functions.

The EGR-5000 generator relay provides all required protection, control, monitoring and metering for any size generators in a single, compact case. The relay has eight current inputs rated for either 5 amperes or 1 ampere and four voltage inputs. Three of the voltage inputs are to be connected to the three-phase power voltage for voltage protection and for metering. They can be connected in wye-ground or open delta configuration. The fourth voltage is for independent single-phase undervoltage/overvoltage protection, or 100% ground protection for a high resistance grounded generator.

The maintenance mode password protected soft key, can be used for arc flash mitigation to change to an alternate settings group, set to have instantaneous elements only. The multiple setting groups can also be changed, via communications or a digital input.

An integral keypad and display is provided for direct user programming and retrieval of data without the need of a computer. Fourteen programmable LEDs provide quick indication of relay status.

A front port is provided for direct computer connection. An RS-485 and an Ethernet ports in the back are optional for local area networking using. Optional Modbus-RTU, Modbus-TCP, or IEC-61850 protocols are supported.

The EGR-5000 generator protection relay includes programmable logic functions. Logic gates and timers may be defined and arranged for customized applications. Programmable logic control functions make the EGR-5000 very flexible. Flash memory is used for the programming and all settings are stored in nonvolatile memory.

The EGR-5000 generator protection relay has mass memory for data storage and a real-time clock with 1 ms time resolution. The relay will log 300 sequence of event records, 20 detailed trip logs, minimum/ maximum values, load profiles, breaker wear information and waveform data.

The EGR-5000 has either eight programmable binary inputs, 2 analog inputs, 2 analog outputs, or 16 programmable binary inputs. It has 2 normally opened and 6 Form C heavy duty outputs and one Form C signal alarm relay. The EGR-5000 can be powered from 19 Vdc to 300 Vdc or 40 Vac to 250 Vac auxiliary power.

Application Description

Eaton's EGR-5000 generator protection relay has been designed for maximum user flexibility and simplicity. The EGR-5000 provides comprehensive protection, metering, and monitoring for any size synchronous or induction generators operating at 50 or 60 Hz. The base relay includes all the standard protection and metering functions. Protection features found in the EGR-5000 include:

Phase Differential Protection

This protection provides a method for rapidly detecting internal generator phase-to-phase or phase-to-ground faults. After the detection of this fault the generator is quickly removed from service to limit the extent of the damage. The EGR-5000 uses a dual slope percentage differential scheme; advanced CT saturation algorithms maintain immunity against external disturbances and ensures the fault is internal to the generator before triggering it to trip.

Ground Differential Protection

In low resistance grounded generators, ground protection may be provided by the 87GD differential, depending on the fault level and the differential relay sensitivity. Higher sensitivity and fast operation for ground faults may be obtained by an additional zero-sequence differential.

Directional Overcurrent Protection

The EGR-5000 generation protection relay provides complete three-phase and ground directional overcurrent protection There are 14 independent ground overcurrent elements. The ground elements "X" use the independently measured ground (or neutral) current from a separate current-sensing input. The ground elements "R" uses a calculated 3Io residual current obtained from the sum of the three-phase currents. This calculated current could be used for either the neutral or ground current in a three-phase, four-wire system. Each of the phase and ground overcurrent elements can be selected to operate based on fundamental or rms current.

Phase direction is a function used to supervise all phase current elements (50, 51). A quadrature voltage is compared to a corresponding phase current to establish the direction of the fault. This function is selectable to operate in the forward, reverse or both directions.

Ground direction is used to supervise ground current elements and is accomplished by using ground, negative sequence or residual currents supervised by zero, negative or positive sequence voltages or ground current. This function is selectable to operate in forward, reverse or both directions.

Voltage Restrained Overcurrent

Voltage restraint reduces the overcurrent pickup level (51P[2], 51P[3]), to protect the distribution system components against excessive damage and to prevent the generator and its auxiliaries from exceeding their thermal limitations. This modification of the pickup overcurrent level is compared to the corresponding phase input voltage. The EGR-5000 uses the simple linear model below to determine the effective pickup value.

Sync Check

The sync-check function is provided for double-ended power source applications. The sync-check monitors voltage magnitude, phase angle and slip frequency between the bus and line. It also incorporates breaker close time, dead bus dead line, dead bus live line and live bus live line features.

Reverse Power

Reverse power provides control for power flowing through a generator. There are three elements to be configured: operate in forward or reverse; or, under or over power conditions. Reverse power is typically applied to prevent generator motoring that can cause damage to the prime mover; while under power is generally applied to load loss and prevent an overspeed condition that could damage the prime mover.

Reverse Vars

Reverse vars can be used to detect loss of excitation in synchronous machines. There are three elements to be configured: operate in forward or reverse; or, under or over vars conditions.

Inverse Time Characteristics

There are 11 user-selectable inverse-time overcurrent curve characteristics.

The user can select from the ANSI, IEC or thermal curve families and can select instantaneous or time delay reset characteristics.

Breaker Failure

The EGR-5000 generator protection relay includes a breaker failure (50BF, 62BF) function that can be initiated from either an internal or external trip signal. This is an independent element that can be used to operate a lockout relay or trip an upstream breaker. The timer must be longer than the breaker operating time and the protective function reset times.

Voltage Protection

The EGR-5000 generator protection relay has four voltage-input circuits. There is a three-phase set designated as Main Voltage (M) and a single-phase voltage circuit designated as Auxiliary Voltage (A). Both include undervoltage (27) and overvoltage (59) protection. The three-phase voltage protection can be set to operate on a single-phase, two out of three phases, or all three-phase logic. The Main VTs also provide phase voltage unbalance/reversal (47 negative sequence) protection. Each element has an independent threshold set point and adjustable time delay.

100% Ground Stator Protection

In high impedance grounded generators, ground fault protection is provided by the detection of voltage in the neutral of the generator by an overvoltage element (59N) connected to the secondary of the distribution grounding transformer, this overvoltage element has to be desensitized for 3rd harmonic voltages normally present in the generator. Under normal conditions there is no voltage across the secondary of the grounded transformer, when one of the phases goes to ground, voltage appears across the resistor and the overvoltage element operates, indicating a ground conductor. However, the overvoltage element technique described above will protect around 90 percent to 95 percent of the winding. The last 5–10 percent is protected by detecting the decayed of the 3rd harmonic voltage using a undervoltage element (27TN) tuned to the 3rd harmonic voltage. In the EGR-5000 we can provide 100% stator ground protection by measuring the zero sequence voltage through the 4th voltage input, and combining the 59N and 27A elements. The 27A element has to be programmed to operate for 3rd harmonic zero sequence voltages.

Flexible Phase Rotation

The EGR-5000 generator protection relay can be applied on either an A-B-C or A-C-B phase rotation. A user setting permits correct operation and indication of the actual system configuration.

Frequency Protection

Operation of generators at off-nominal frequencies can have extremely detrimental effects on both the generator itself and the associated prime mover, in particular with steam turbine generators operating below normal frequency. The EGR-5000 relay provides six frequency elements han can be used to detect underfrequency/ overfrequency, rate of change, and a vector surge (decoupling of two systems) protection on the Main VT inputs. Each element has an independent threshold set point and adjustable time delay.

Inadvertent Energization

If a generator is inadvertently brought on line with the power system, without being up to speed and synchronized, or it is at standstill when the breaker is closed severe damage could occur. The generator will act as an induction motor and very high currents will be induced in the stator and rotor components, resulting in rapid overheating and damage.

Negative Sequence Protection

Negative sequence overcurrent protection prevents the generators from rotor overheating damage. Unbalanced loads, fault conditions or open phasing will produce a negative sequence current to flow. The unbalanced currents induce double system frequency currents in the rotor, which quickly causes rotor overheating. Serious damage will occur to the generator if the unbalance is allowed to persist. The EGR-5000 provides a negative sequence definite time overcurrent element and a negative sequence timed over current tripping element to ensure the generator stays within it's short time and continuous negative sequence current rated limits.

Overexcitation Protection

Generator overexcitation occurs when the ratio of voltage versus frequency is too high, and the rotor iron saturates due to high flux density. High flux density results in stray flux in components not designed to carry it, which in turn causes overheating and can potentially damage the generator. This protection is provided through a Volts/Hertz function with a programmable inverse time characteristic.

Loss of Excitation

Loss of field protection or loss of excitation is used to avoid unstable operation, potential loss of synchronism, and possible damage to synchronous generators. When a synchronous generator loses its field, the generator can continue to generate power as an induction generator, provided that it can obtain its excitation from the other machines on the system. During this condition, the rotor will quickly overheat due to the slip frequency currents induced in it. Loss of excitation in one machine could jeopardize the operation of other machines beyond their capability, and also the stability of the entire system. The EGR-5000 supports the two typical distance relaying schemes used for detecting the loss excitation. The two schemes differ mainly in that scheme 1 uses a negative offset mho element and scheme 2 uses a positive offset mho element with directional unit supervision.

Maintenance Mode

The Maintenance Mode can improve safety by providing a simple and reliable method to reduce fault clearing time and lower incident energy levels at energized panels. The Maintenance Mode allows the user to switch to more sensitive settings via a password protected soft key, communication or via a digital Input while maintenance work is being performed at an energized panel or device. The more sensitive settings provide greater security for maintenance personnel and helps reduce the possibility of injury.

Features, Benefits and Functions

Protection Features

- Dual-slope percentage restrained phase current differential (87)
- Unrestrained phase current differential (87H)
- Restricted ground fault/ Ground Differential (87GD)
- Unrestrained Restricted ground fault/Ground Differential (87GDH)
- Thermal protection (49/51)
- Phase overcurrent elements:
  - Three instantaneous elements with timers (50P[1], 50P[2] and 50P[3])
  - Three inverse time overcurrent elements (51P[1], 51P[2] and 51P[3])
- 11 standard curves
- Instantaneous or time delay reset
- Voltage restraint (51P[2] and 51P[3])
- Directional control (all elements)
- Ground overcurrent elements:
  - Two instantaneous measured elements with timers (50X[1] and 50X[2])
  - Two instantaneous calculated elements with timers (50R[1] and 50R[2])
  - Two inverse time overcurrent measured elements (51X[1] and 51X[2])
  - Two inverse time overcurrent calculated elements (51R[1] and 51R[2])
  - 11 standard curves
  - Instantaneous or time delay reset
  - Directional control (all elements)
- Breaker failure (50BF)
- Phase unbalance negative sequence overcurrent (46[1], 46[2])
- Phase voltage unbalance and sequence protection (47[1], 47[2])
- Main three-phase under/ overvoltage (27M[1], 27M[2], 59M[1], 59M[2])
- Auxiliary single-phase under/overvoltage (27A[1], 27A[2], 59A[1], 59A[2])
- Ground fault overvoltage relay (59N[1], 59N[2])
- Six frequency elements that can be assigned to: over frequency, under frequency, rate of change, or vector surge (81[1], 81[2], 81[3], 81[4], 81[5], 81[6])
- Apparent and displacement power factor (55A[1], 55A[2], 55D[1], 55D[2])
- Forward and reverse watts (32[1], 32[2], 32[3])
- Forward and reverse vars (32V[1], 32V[2], 32V[3])
- Overexcitation, volts-per-hertz (24[1], 24[2])
- 64S, 100% stator ground fault (27TN/ 59N)
- Generator unbalance (46G[1], 46G[2])
- Loss of excitation (40[1],40[2])
- Sync check (25)
- Inadvertent energization (50/27)
- Lockout (86)
- Loss of Potential-LOP
- Zone interlocking for bus protection (87B)
- Switch onto fault protection
- Cold load pickup

Metering Features

- Generator hours of operation
  - Phase Differential Current
  - Ground Differential Current
- Amperes: positive, negative and zero sequence
- Ampere demand
- Volts: positive, negative and zero sequence
- Phase angles
- Volt-amperes and VA demand
- Watts and kW demand
- kWh (forward, reverse, net)
- Vars and kvar demand
- kvarh (lead, leg and net)
- Power factor
- Frequency
- Volts/Hertz
- 3rd Harmonic Voltage
- % THD V and I
- Magnitude THD V and I
- Minimum/maximum recording
- Sync values
- Trending (load profile over time)
- Temperature with remote URTD module

Monitoring Features

- Trip coil monitor
- Breaker wear
- Oscillography (7200 cycles total)
- Trip cause displays fault recorder data on HMI after fault event
- Fault data logs (up to 20 events)
- Sequence of events report (up to 300 events)
- Clock (1 ms time stamping)

Control Functions

- Breaker open/close
- Remote open/close
- Programmable I/O
- Programmable Logic
- Programmable LEDs
- Multiple setting groups
- Cold load pickup
- CT supervision

Communication Features

- Local HMI
- Password protected
- Addressable
- IRIG-B
- Local communication port:
  - RS-232
- Remote communication port:
  - RS-485
  - Ethernet port
- Protocols:
  - Modbus-RTU (optional)
  - Modbus-TCP (optional)
  - IEC-61850 (optional)
- Configuration software

Monitoring and Metering

Sequence of Events Records

The EGR-5000 generator protection relay records a maximum of 300 events associated with the relay. An event is classified as a change of state as detected by the relay. These include relay pickups, dropouts, trips, contact closure, alarms, setting changes and self-diagnostic failures. Each event is date and time stamped to a 1 ms resolution. The events are stored in a FIFO log in chronological order.

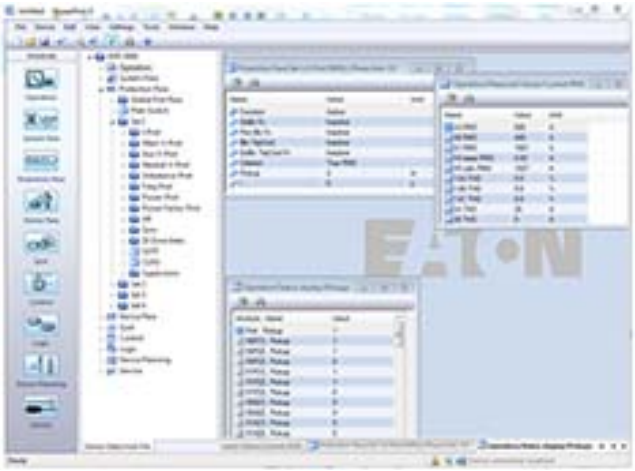
Trip Log

The EGR-5000 protection relay will store a maximum of 20 trip records in a FIFO trip log. Each trip record will be date and time stamped to a 1 ms resolution. The trip log record will include information on the type of fault, protection elements that operated, fault location and currents and voltages at the time of the fault.

9

PowerPort-E

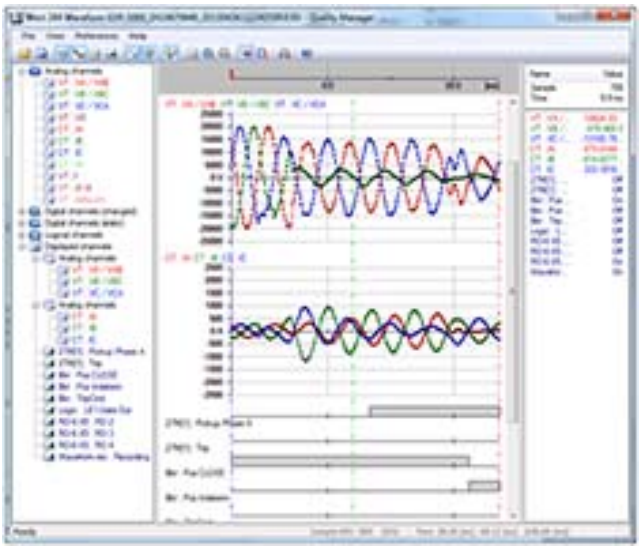
PowerPort-E is the software program used to configure off-line protection setting files for all E-Series relay models. PowerPort-E is also used for viewing measured values of the relays in real-time, uploading/downloading setting files, and retrieving event log and waveform records.



Waveform Capture (Quality Manager)

The EGR-5000 relay provides oscillographic recording capabilities. The relay will record all measured signals along with the binary signals of pickup, trip, internal logic, and contact inputs. The EGR-5000 can record up to 7200 cycles of data. The number of records is proportional to the programmed size of each record; the maximum size per record is 600 cycles.

The waveform capture is initiated by up to 8 different triggers (i.e., trip/alarm events) or manually via communications or the HMI. PowerPort-E setting software is used to retrieve the records. Quality Manager is a separate software program downloaded with PowerPort-E used for analyzing the waveform and trending files retrieved from the relay.



Integral User Interface

The front panel user interface has a 128 x 64 pixel LCD display with background illumination for wide angle viewing in all light conditions. 17 programmable LEDs provide quick and easy visual display of power on, mode of operation, alarm and trip indication. Soft keys are provided for operation mode selection, scrolling through data and settings. In addition, the relay settings and test functions are password protected.

Load Profiling/Trending

The EGR-5000 relay automatically records selected quantities into non-volatile memory every 5, 10, 15, 30 or 60 minutes, depending on the trending report setting.

Programmable I/O

The EGR-5000 generator protection relay provides heavy-duty, triprated, 2NO and 6 Form C contacts. Two isolated inputs can be used for monitoring the trip circuit. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (failsafe) mode. There are up to 16 user-configurable discrete inputs that accept a wet contact and can operate through a wide range of power. Each input and output is user-programmable for maximum application flexibility.

The EGR-5000 also offers two optional analog inputs and two optional analog outputs. The analog inputs are available for providing protection and monitoring of generator bearing vibration. The analog inputs are field programmable to measure transducer signals that operate over a range of 0 to 20 mA, 4 to 20 mA, or 1 to 10 V. The two optional analog outputs can be used for signaling the value of measured analog quantities to external process control devices such as PLCs. They can be programmed to operate over a 0 to 20 mA, 4–20 mA, or 1 to 10 V range. The analog outputs can be configured to signal a representation of most analog quantities measured by the EGR-5000 including, current, voltages, and RTD temperature.

Programmable Logic

The EGR-5000 generator protection relay provides logic gates and timers that the user can customize for special or unique applications. Each gate can be assigned a logic function of either AND, OR, NAND or NOR. Each gate can have a maximum of four input signals and each input signal can be required to be a NOT. Input signals can be external inputs received via the binary inputs or internal values associated with the protection, alarm or metering set points. Each gate has a unique output assignment and designation that can be used as the input to another gate. There are 24 independent timers that have adjustable pickup and dropout delay settings.

Standards and Certifications

Approvals

- UL listed file: E217753

Design Standards

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

Listed

Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the EGR-5000. For example, if the catalog number is EGR-5000-2A0BA1, the device would have the following:

EGR-5000

(A)–16 DI, 9 Outputs, Removable Terminals, Zone Interlocking, URTD Interface

(0)–5 A / 1 A Phase and Ground CTs, Power Supply Range: 19–300 Vdc, 40–250 Vac

(B)–Modbus-RTU (RS-485)

(A)–Without conformal coating

(1)–Projection panel mount

EGR-5000 Eaton Motor Relay

EGR-5000-2A 0 B A 1

Hardware Option 1
- **A** = 16 DI, 9 outputs, removable terminals, zone interlocking, URTD interface
- **B** = 8 DI, 9 outputs, 2 AI, 2 AO, removable terminals, zone interlocking, 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

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 panel mount

9

Accessories

Standard Accessories EGR-5000

Description	Catalog Number
UNVL RTD Mod with Modbus-RTU 48–240 Vac/48–250 Vdc	**URTDII-01** ①
UNVL RTD Mod with Modbus-RTU 24–48 Vdc	**URTDII-02** ①
E-Series RS-232 Null Modem Cable	**66B2214G01**
E-Series USB to RS-232 Converter	**66B2214G02**
E-Series RS-232 Cable and USB to RS-232 Converter	**66B2214G03**

Note

① See URTD section for fiber optic cables required to communicate to the EGR-5000.

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –30 °C to +70 °C (–22 °F to +158 °F)
- Operating temperature: –20 °C to +60 °C (–4 °F to +140 °F)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible installation altitude:
  - <2,000 m (6,561.67 ft) above sea level
  - If 4,000 m (13,123.35 ft) altitude applies, 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: IP20

Routine Test

- Insulation test acc. to IEC 60255-5: 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
- Insulation test acc to IEC60255-5: All tests to be carried out against ground and other input and output circuits

Housing

- Housing B2: height / width 183 mm (7.205 in) / 212.7 mm (8.374 in)
- Housing depth (incl. terminals): 208 mm (8.189 in)
- Material, housing: aluminum extruded section
- Material, front panel: aluminum/foil front
- Mounting position: horizontal (±45° around the X-axis must be permitted)
- Weight: Approx. 4.2 kg (9.259 lb)

Current and Ground Current Measurement

- Nominal currents: 1 A / 5 A
- Max. measuring range:
  - Up to 40 x In (phase currents)
  - Up to 25 x In (ground current standard)
  - Up to 2.5 x In (ground current sensitive)
- Continuous loading capacity: 4 x In / continuously
- Overcurrent proof:
  - 30 x In / 10 s
  - 100 x In / 1 s
  - 250 x In / 10 ms (1 half-wave)
- Power consumption:
  - Phase current inputs
    - At In = 1 A S = 0.15 MVA
    - At In = 5 A S = 0.15 MVA
  - Ground current input
    - At In = 1 A S = 0.35 MVA
    - At In = 5 A S = 0.35 MVA
- Frequency range: 50 Hz /60 Hz ±10%
- Terminals: screw-type terminals with integrated short-circuiters (contacts)
- Connection cross sections:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

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:
  - 1 x or 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
  - The current measuring board´s terminal blocks may be used as with 2 (double) conductors AWG 10,12,14 otherwise with single conductors only

Voltage and Residual Voltage Measurement

- Nominal voltages: 100 V / 110 V / 230 V / 400 V (can be configured)
- Max. measuring range: 2 x nominal voltage
- Continuous loading capacity: 2 x nominal voltage (800 Vac)
- Power consumption:
  - at Vn = 100 V S = 0.1 MVA
  - at Vn = 110 V S = 0.1 MVA
  - at Vn = 230 V S = 0.4 MVA
  - at Vn = 400 V S = 1.0 MVA
- Frequency range: 50 Hz or 60 Hz ±10%
- Terminals: screw-type terminals

Frequency Measurement

- Nominal frequencies: 50 Hz / 60 Hz

Voltage Supply

- Aux. voltage: 24–270 Vdc / 48–230 Vac (–20/+10%)
- Buffer time in case of supply failure:
  - ≥50 ms at minimal aux. voltage
  - Interrupted communication is permitted
- 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. 0.2 x 0.8 in) according to IEC 60127
  - 3.5 A time-lag miniature fuse 6.3 x 32 mm (approx. 0.25 x 1.25 in) according to UL 248-14

Power Consumption

- Power supply range: 24–270 Vdc
  - Power consumption in idle mode—7 W
  - Maximum power consumption—13 W
- Power supply range: 48–230 Vac (for frequencies of 40–70 Hz)
  - Power consumption in idle mode—7 VA
  - Maximum power consumption—13 VA

Display

- Display type: LCD with LED background illumination
- Resolution—graphics display: 128 x 64 pixel

LED

- LED type: two colored: red/green
- Number of LEDs, Housing B2: 15

Front Interface RS-232

- Baud rates: 115,200 baud
- Handshake: RTS and CTS
- Connection: 9-pole D-Sub plug

Real Time Clock

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

Digital Inputs

- Max. input voltage: 300 Vdc / 259 Vac
- Input current: <4 mA
- Reaction time: <20 ms
- Fallback time: <30 ms

(Safe state of the digital inputs)

- Switching thresholds: Un = 24 Vdc, 48 Vdc, 60 Vdc, 110 Vac / Vdc, 230 Vac / Vdc
  - Un = 24 Vdc
    - Switching threshold 1 ON: Min. 19.2 Vd
    - Switching threshold 1 OFF: Max. 9.6 Vdc
  - Un = 48 V / 60 Vdc
    - Switching threshold 2 ON: Min. 42.6 Vdc
    - Switching threshold 2 OFF: Max. 21.3 Vdc
  - Un = 110 / 120 Vac / Vdc
    - Switching threshold 3 ON: Min. 88.0 Vdc / 88.0 Vac
    - Switching threshold 3 OFF: Max. 44.0 Vdc / 44.0 Vac
  - Un = 230 / 240 Vac / Vdc
    - Switching threshold 4 ON: Min. 184 Vdc / 184 Vac
    - Switching threshold 4 OFF: Max. 92 Vdc / 92 Vac
- Terminals: screw-type terminal

Relay Outputs

- Continuous current: 5 A AC/DC
- Max. make current:
  - 25 A AC / 25 A DC up to 30 V for 4 s
  - 30 A / 230 Vac according to ANSI IEEE Std C37.90-2005
  - 30 A / 250 Vdc according to ANSI IEEE Std C37.90-2005
- Max. breaking current:
  - 5 A AC up to 250 Vac
  - 5 A DC up to 30 V (resistive)
  - 0.3 A DC at 300 V
- Max. switching voltage: 250 Vac / 250 Vdc
- Switching capacity: 1250 VA
- Contact type: Form C or normally open contact
- Terminals: screw-type terminals

Supervision Contact (SC)

- Continuous current: 5 A AC/DC
- Max. switch-on current: 15 A AC / 15 A DC up to 30 V for 4 s
- Max. breaking current:
  - 5 A AC up to 250 Vac
  - 5 A DC up to 30 Vdc
  - 0.4 A at 125 Vdc
- Contact type: 1 Form C contact
- Terminals: screw-type terminals

Time Synchronization IRIG-B00X

- Nominal input voltage: 5 V
- Connection: screw-type terminals (twisted pair)

Zone interlocking

Note: Only for zone interlock tripping outputs (zone interlock, semiconductor output): 5 Vdc, <2 mA for connection to electronic inputs only.

- Zone Out:
  - Output voltage (high) 4.75 to 5.25 Vdc
  - Output voltage (low) 0.0 to +0.5 Vdc
- Zone In:
  - Nominal input voltage +5 Vdc
  - Max. input voltage +5.5 Vdc
  - Switching threshold ON min. 4.0 Vdc
  - Switching threshold OFF max. 1.5 Vdc
  - Galvanic isolation 2.5 kV AC (to ground and other IO)
  - Connection: screw-type terminals (twisted pair)

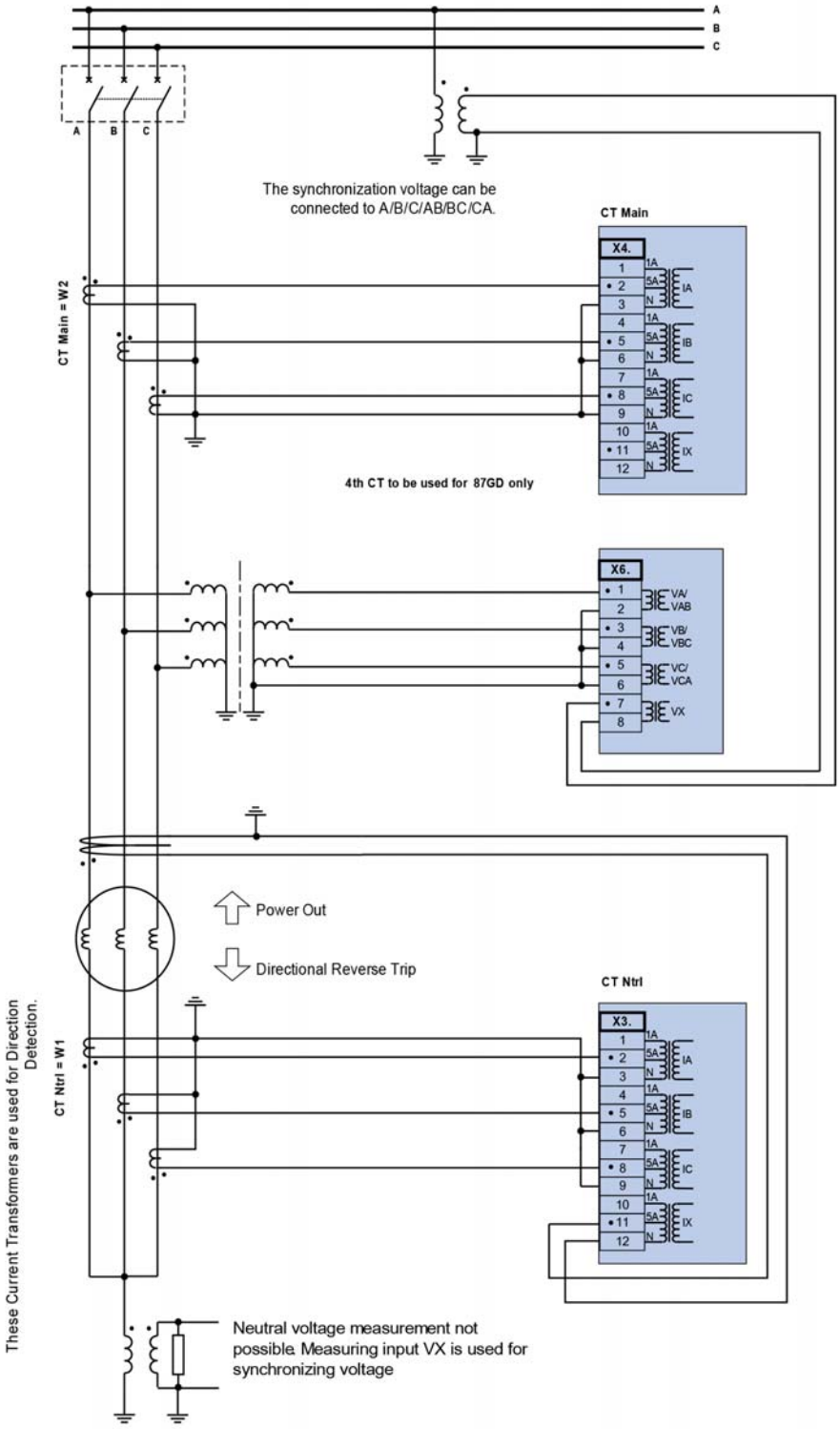
RS-485

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

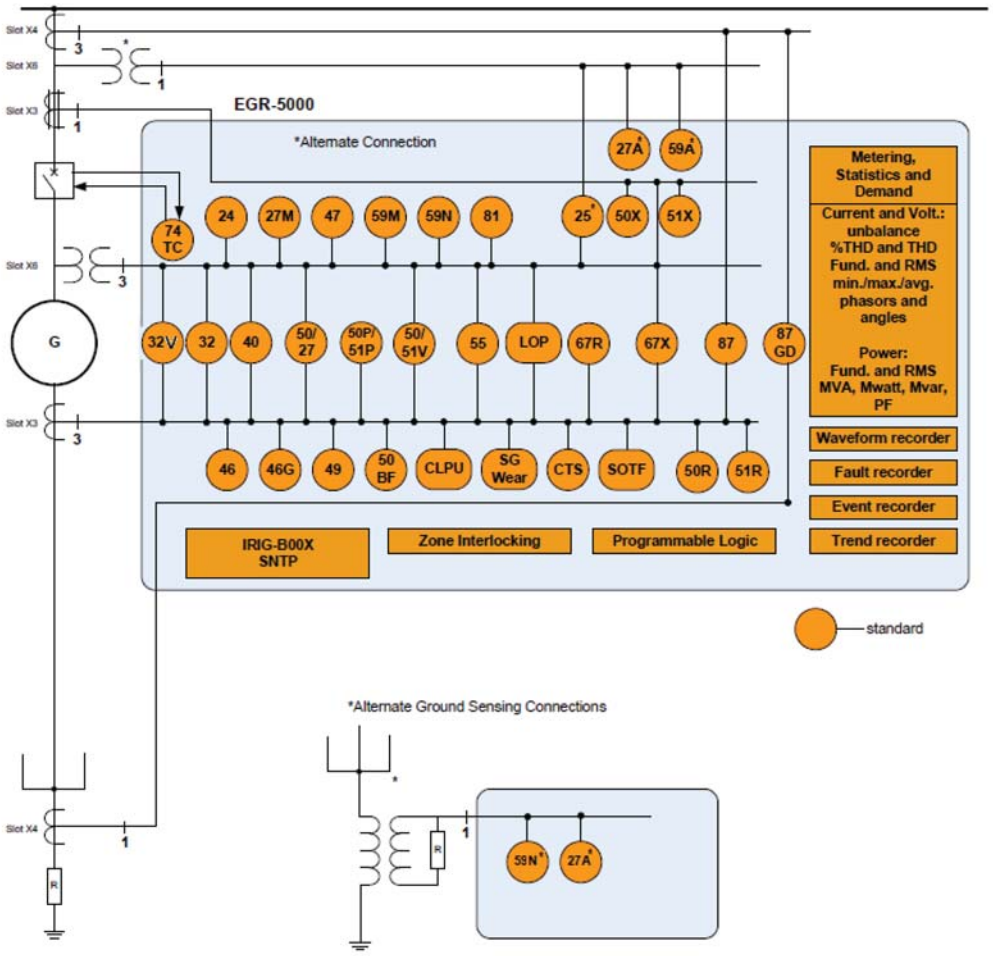
Note: The RS-485 interface is realized via terminals. The communication cable has to be shielded. The shielding has to be fixed at the screw that is marked with the ground symbol (rear side of the device).

Wiring Diagrams

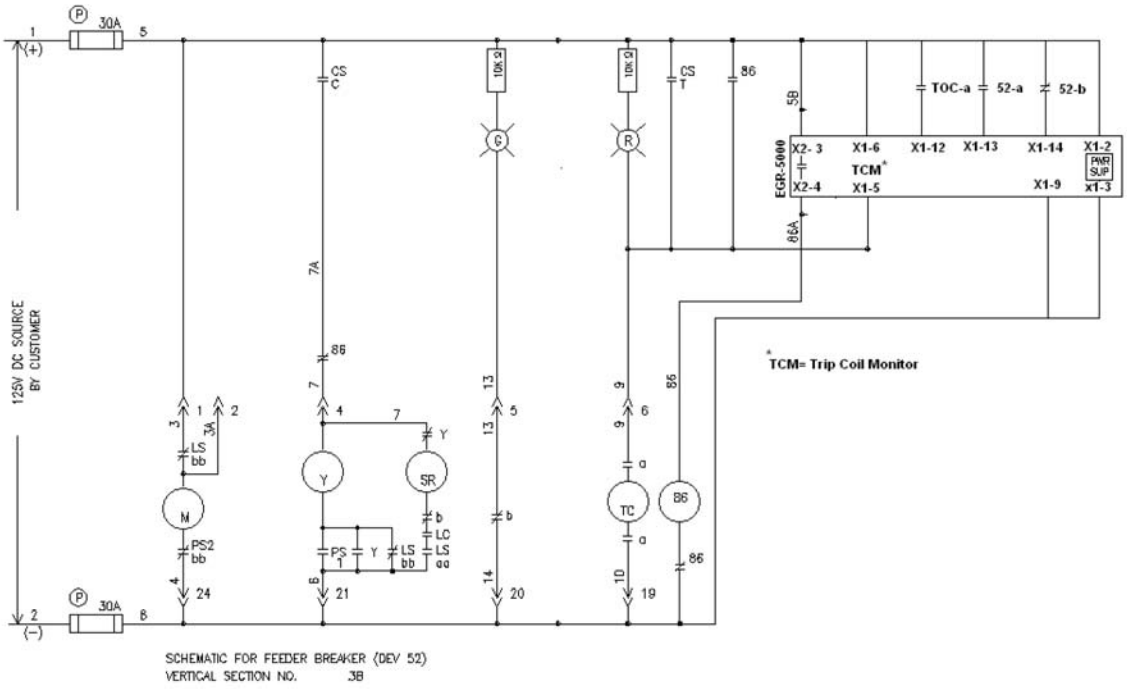
Typical AC Connections—High Impedance Grounded Generator with Phase Differential Protection, Wye VTs, Zero Sequence Ground Protection, and Either Synch-check or 100% Stator Ground Fault Protection



Typical One-Line Diagram



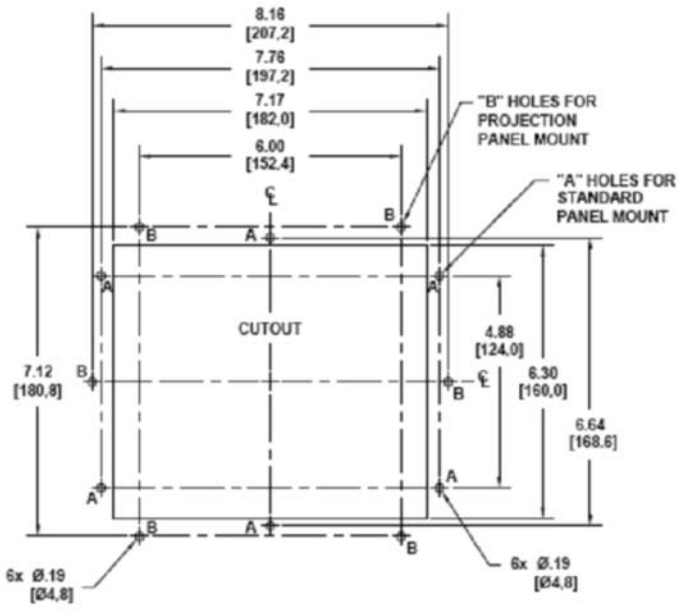
Typical Control Diagram



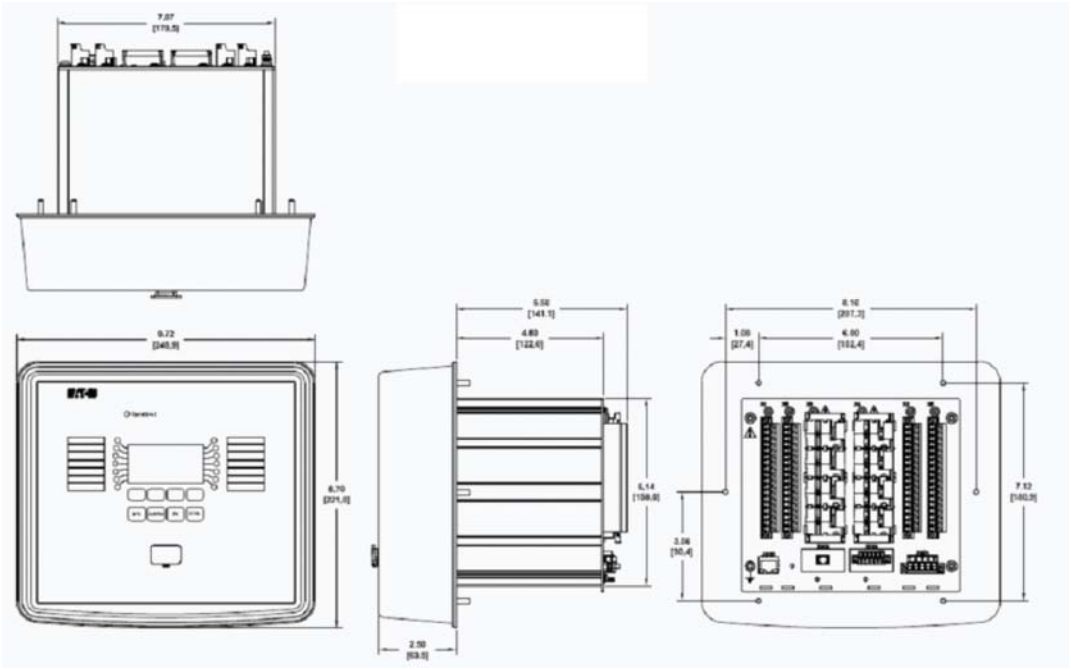
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Plan

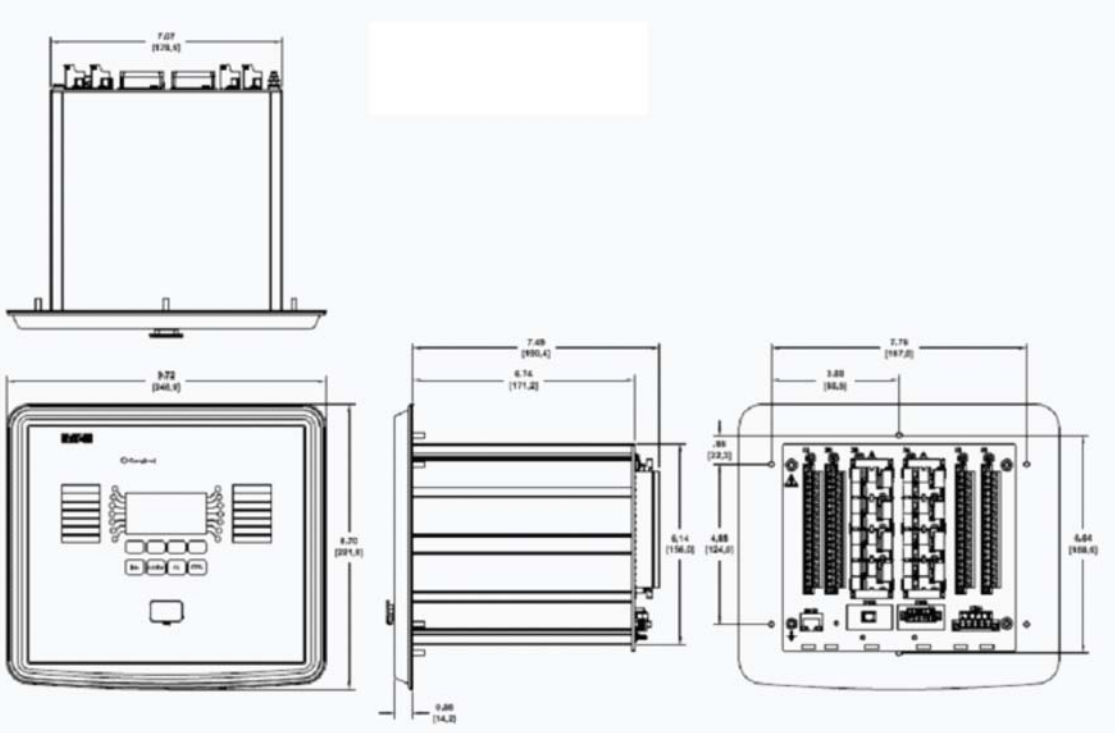


Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



Universal RTD Module



Contents

Description	*Page*
Product Selection Guide	**V3-T9-100**
Arc Flash Relay	**V3-T9-106**
EDR-3000 Feeder Protection	**V3-T9-108**
EDR-5000 Distribution Protection Relay	**V3-T9-117**
EBR—Line Differential Relay	**V3-T9-130**
EMR-3MP0 Motor Protection Relay	**V3-T9-132**
EMR-3000 Motor Protection Relay	**V3-T9-134**
EMR-4000 Motor Protection Relay	**V3-T9-146**
EMR-5000 Motor Protection Relay	**V3-T9-159**
ETR-4000 Transformer Protection Relay	**V3-T9-171**
ETR-5000 Transformer Protection Relay	**V3-T9-183**
EGR-5000 Generation Protection Relay	**V3-T9-196**
Universal RTD Module	

Universal RTD Module

Product Description

- Electronic Resistance Temperature Detector (RTD) provides motor temperature interface for the MP-3000 Motor Protection Relay
- Monitors up to 11 RTDs consisting of six motor windings, two motor bearings, two load bearings and one auxiliary
- Works with 10 ohm copper, 100 ohm platinum, 100 ohm nickel and 120 ohm nickel type RTDs
- Include fiber optic and electrical communication interfaces to the MP-3000 Motor Protection Relay

Application Description

URTD can be used with MP-3000, MP-4000, EMR-3000, EMR-4000, EMR-5000, ETR-4000, ETR-5000, and EGR-5000.

Eaton's URTD Module is most commonly used to provide motor temperature information to the MP-3000 Motor Protection Relay. The MP-3000 Motor Protection uses this information for monitoring, tripping and alarming. The MP-3000 Intel-I-Trip overload algorithm will adjust its trip characteristics based on the actual motor temperature reported by the URTD Module. This improves the protection by using an actual temperature value instead of the assumed NEMA Standard Ambient Temperature.

The URTD Module may be mounted close to the motor or at the protective relay.

Both electrical and fiber optic interface ports are provided to communicate temperature information to the MP-3000 relay. The electrical interface can transmit information using a three-conductor shielded cable with a maximum cable distance of 500 ft (152 m). The fiber optic link has a maximum distance of 400 ft (122 m).

The URTD Module may be used with the IQ-1000 and IQ-1000 II motor relays. It may also be applied as a standalone temperature monitoring device communicating, for example, transformer temperature information back to a remote computer or PLC. An optional PONI (Product Operated Network Interface) is required for standalone applications.

Features, Benefits and Functions

- Universal design works with any RTD type, simplifying installation and operation and reducing inventory
- Standalone design permits mounting the module close to the motor, reducing RTD wiring costs
- RTD diagnostics detects faulty RTDs and wiring, reducing unnecessary tripping and alarming

Product Selection

Universal RTD Module



Universal RTD Module

Description	Catalog Number
Universal RTD Module	**URTD**
48-240 Vac/48-250 Vdc power supply and Modbus-RTU communications	**URTDII-01**
24-48 Vdc and Modbus-RTU communications	**URRDII-02**

Options and Accessories

Additional Related Products from Eaton's Cutler-Hammer Series

Eaton provides fiber optic cables for connecting to the MP-3000 or IQ-1000 II Motor Protection Relays.

Fiber Optic Cables:

Length	Catalog Number
1	**MPF0-1**
5	**MPF0-5**
10	**MPF0-10**
25	**MPF0-25**
50	**MPF0-50**
75	**MPF0-75**
100	**MPF0-100**

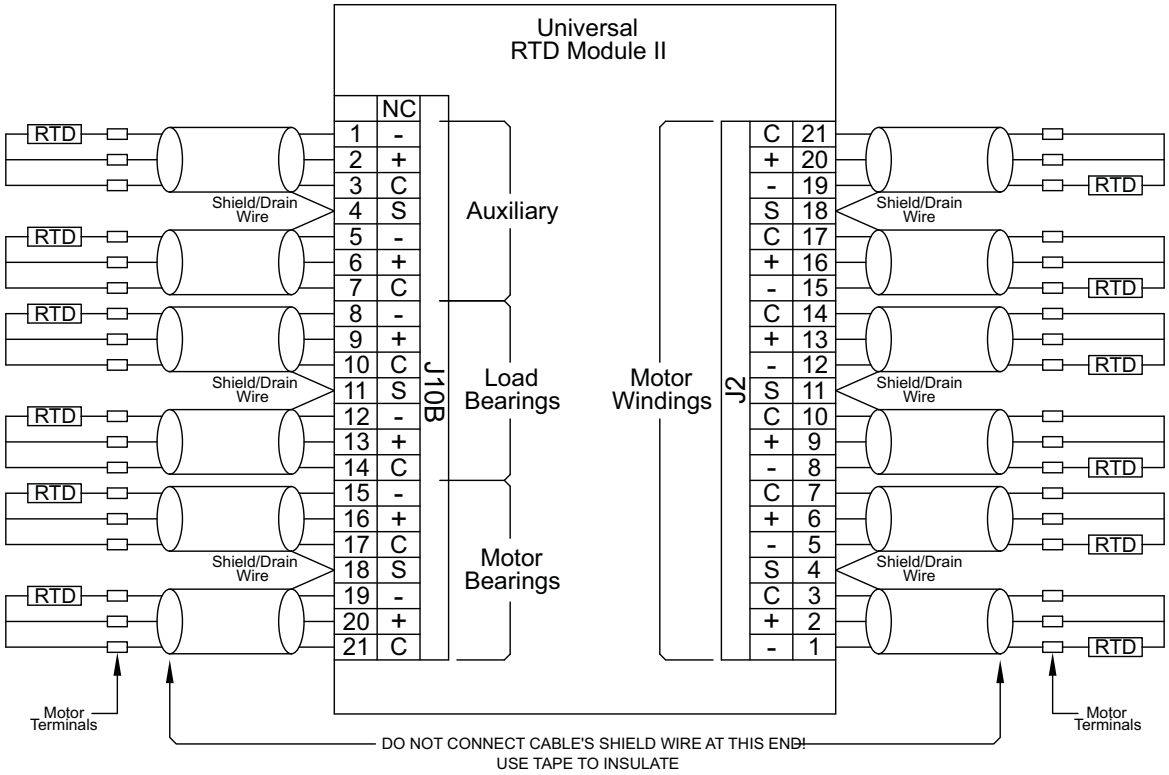
Technical Data and Specifications

Universal RTD Module

Specifications	URTDII-01	URTDII-02
Input power requirements	48–240 Vac / 48–250 Vdc	24–48 Vdc
Frequency	50/60 Hz or DC	DC
Power consumption	3.5 W	1 W
Operating temperature	–20° to +55 °C (–4° to +131 °F)	–20° to +55 °C (–4° to +131 °F)
Storage temperature	–40° to +85 °C (–40° to +185° F)	–40° to +85 °C (–40° to +185 °F)
Humidity	0 to 95% R.H. noncondensing	0 to 95% R.H. noncondensing
Altitude	2000 m	2000 m
Pollution degree	2	2
Installation category	I	I

Wiring Diagram

RTD Wiring (Three-Lead Type)



Note:

1. Each shielded cable conductor must be connected on the URTDII as shown.
2. Use of three-lead RTDs is recommended.
3. RTDs must not be grounded at the motor, and no common connections between RTDs should be made at the motor.
4. A suitable earth ground should be connected to J10B-4, J10B-11, J-10B-18, J2-4, J2-11, or J2-18. It is recommended that a ground connection is made to both sides of the unit.

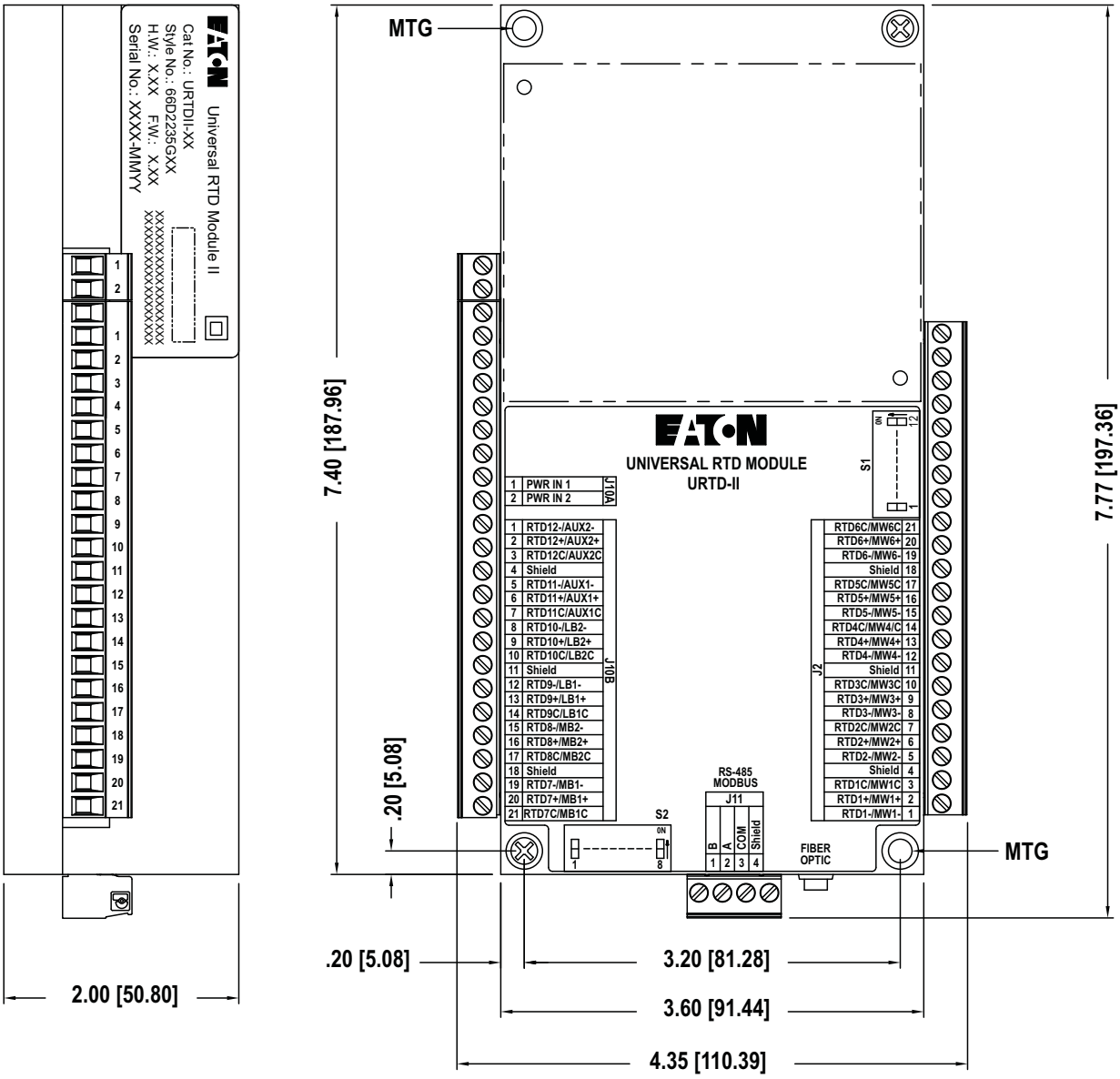
Note

Showing a typical three-lead type RTD wiring connection.

Dimensions

Approximate Dimensions in Inches (mm)

Universal URTD Module



Note

Showing the URTD Module dimensions and terminal designations.

Power Xpert Gateway



Contents

Description	*Page*
Power Xpert Gateway	
Product Selection Guide	**V3-T9-215**
Product Description	**V3-T9-214**
Standards and Certifications	**V3-T9-217**
Product Selection	**V3-T9-217**
Technical Data and Specifications	**V3-T9-218**
Dimensions	**V3-T9-221**
PXM1K-ETHMULTI Card for PXM1000 Devices	**V3-T9-222**
mMINT	**V3-T9-224**
I/O Devices Digital Input Module (DIM)	**V3-T9-226**
Addressable Relay II	**V3-T9-228**

Power Xpert Gateway

Product Overview

- Open communication architecture
  - Connects to both Eaton and third-party electrical equipment; communicates to INCOM™ and Modbus® RTU devices
  - Modbus TCP and BACnet/IP support facilitates integration with third-party monitoring solutions
  - Ethernet/web-based support uses your existing network infrastructure, reducing costs
- Flexible and expandable solutions
  - Stand-alone or small systems benefit from comprehensive, on-board web pages; no additional programming or software is necessary for virtually out-of-the-box, plug-and-play functionality
  - Larger systems, such as campus installations or power systems with remote locations can view multiple PXGs via Power Xpert Insight or a third-party monitoring system
  - Existing equipment can be connected to the PXG to reap the benefits of Power Xpert Architecture at minimal cost, without the need to upgrade
- Information at a glance
  - Using a standard web browser, view the PXG's web interfaces that include a Network tab, Alarms tab, individual device detail pop-outs and One Line graphics tab
  - Comprehensive, well-organized device web pages present measured parameters such as current, voltage, power, energy, frequency, power factor and voltage THD, just to name a few
  - Combine with Power Xpert Insight for viewing multiple gateways and other power system equipment for more extensive energy monitoring and capacity analysis

Product Description

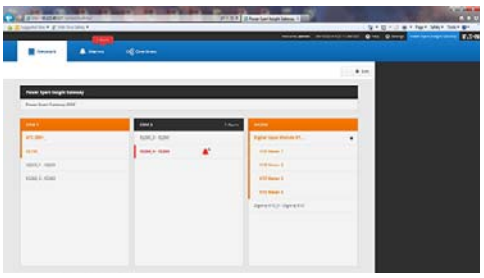
Through standard on-board web pages, Power Xpert Insight, or third-party software, Eaton's Power Xpert Gateway (PXG) 900 allows you to closely monitor the performance of your power and energy efficiency with easily accessed, real-time, web-enabled data. Eaton's PXG 900 provides a central point to connect devices to an Ethernet network. The gateway may be used as a standalone device to view one system or location, or it can be easily integrated into a large, multi-location system.

The PXG is our configurable data acquisition solution for facility equipment like switchgear, switchboards, motor control centers, etc. Power and energy data from the downstream devices are time stamped and stored in non-volatile memory. This interval data can be stored or updated to a destination of the user's choice through CSV. Data can also be accessed through any web browser directly on the PXG. Users can move data into Power Xpert Insight v. 3.2 or higher, BMS, BAS, building dashboards, custom software applications, or virtually any web interface.

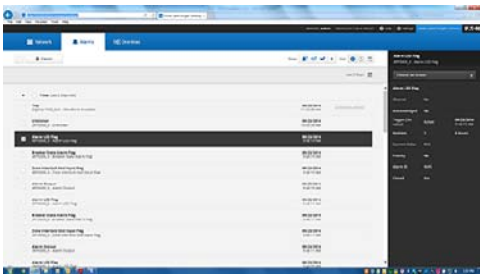
Application Description

The Power Xpert Gateway 900 (PXG 900) has been designed to be installed in electrical assemblies or systems—low and medium voltage switchgear, switchboards panelboards, transfer switches, and motor control centers to acquire and consolidate data available from components such as trip units, meters, relays, drives and I/O.

Power Xpert Gateway Screenshots



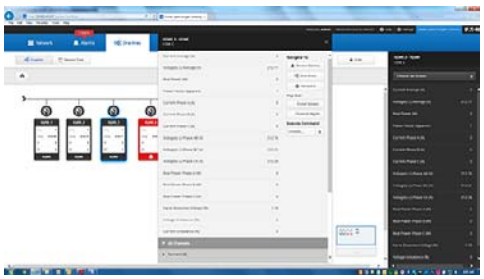
Network Tab



Alarms Tab



One-Lines Tab



Device Details



Trend Viewer

Product Selection Guide

Data acquisition and Integration Table for Supported Devices

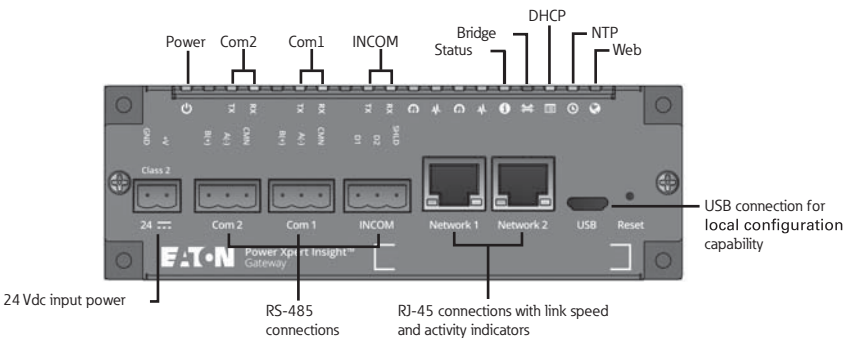
Supported Devices

Protocol									
Family	**Model**	**HTTP (Web Browser)**	**Power Xpert Insight**	**Modbus TCP (BMS and SCADA)**	**Pass-through INCOM (PowerNet)**	**SMTP (Email Client)**	**File Export (CSV File Format)**	**File export (COMTRADE File Format)**	**BACnet/IP**
INCOM									
Accessory	BIM II	■	■	■	■	■	■		■
I/O	DIM	■	■	■	■	■	■		■
I/O	DIM-KYZ	■	■	■	■	■	■		■
Meter	IQ 220 / IQ 320	■	■	■	■	■	■		■
Meter	IQ 230 / IQ 330	■	■	■	■	■	■		■
Meter	IQ Analyzer (6000/6200)	■	■	■	■	■	■		■
Meter	IQ Analyzer (6400/6600)	■	■	■	■	■	■	■	■
Meter	IQ Data Plus II	■	■	■	■	■	■		■
Meter	IQ DP-4000	■	■	■	■	■	■		■
Meter	IQ Energy Sentinel	■	■	■	■	■	■		■
Meter	IQ Power Sentinel	■	■	■	■	■	■		■
Meter	IQMESII	■	■	■	■	■	■		■
Meter	PM3	■	■	■	■	■	■		■
Protection	Digitrip 520MC	■	■	■	■	■	■		■
Protection	Digitrip 810	■	■	■	■	■	■		■
Protection	Digitrip 910	■	■	■	■	■	■		■
Protection	Digitrip 1150/DT1150 V	■	■	■	■	■	■	■	■
Protection	Digitrip 3000	■	■	■	■	■	■		■
Protection	Digitrip 3200	■	■	■	■	■	■		■
Protection	Digitrip MV	■	■	■	■	■	■		■
Protection	Digitrip OPTIM 550	■	■	■	■	■	■		■
Protection	Digitrip OPTIM 750	■	■	■	■	■	■		■
Protection	Digitrip OPTIM 1050	■	■	■	■	■	■		■
Protection	FP-4000	■	■	■	■	■	■	■	■
Protection	FP-5000	■	■	■	■	■	■	■	■
Protection	FP-6000	■	■	■	■	■	■	■	■
Protection	IQ 500	■	■	■	■	■	■		■
Protection	MP-3000	■	■	■	■	■	■		■
Protection	MP-4000	■	■	■	■	■	■		■
Protection	MPCV Relay	■	■	■	■	■	■		■
Protection	NRX520I	■	■	■	■	■	■		■
Protection	NRX1150I	■	■	■	■	■	■		■
Protection	TC50	■	■	■	■	■	■		■
Protection	TC100	■	■	■	■	■	■		■
Protection	Universal RTD	■	■	■	■	■	■		■
Transfer switch	ATC-400	■	■	■	■	■	■		■
Transfer switch	ATC-600	■	■	■	■	■	■		■
Transfer switch	ATC-800	■	■	■	■	■	■		■

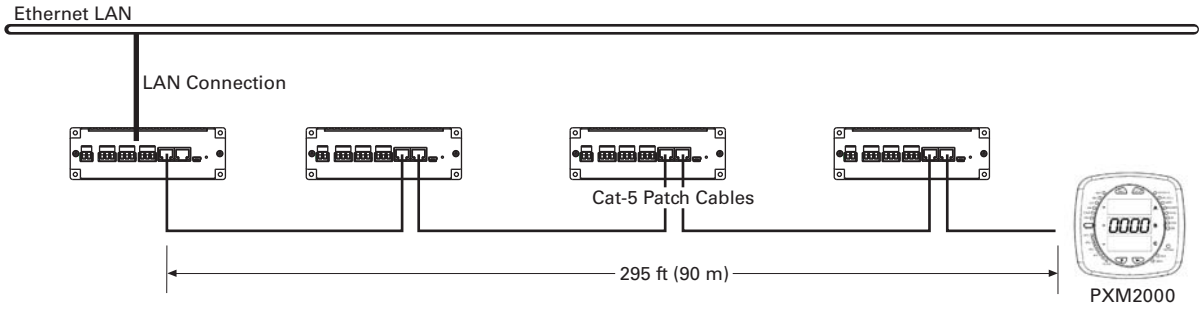
Supported Devices, continued

Protocol		HTTP (Web Browser)	Power Xpert Insight	Modbus TCP (BMS and SCADA)	Pass-through INCOM (PowerNet)	SMTP (Email Client)	File Export (CSV File Format)	File export (COMTRADE File Format)	BACnet/IP
Family	**Model**								
Modbus									
Drive	H-Max	■	■	■		■	■		■
Drive	M-Max	■	■	■		■	■		■
Drive	MVX9000	■	■	■		■	■		■
Drive	SVX9000	■	■	■		■	■		■
Meter	E30/E31A042 1 phase BCM	■	■	■		■	■		■
Meter	EM19_M	■	■	■		■	■		■
Meter	ION 7350	■	■	■		■	■		■
Meter	ION 7550	■	■	■		■	■		■
Meter	ION 7650	■	■	■		■	■		■
Meter	IQ 130	■	■	■		■	■		■
Meter	IQ 140	■	■	■		■	■		■
Meter	IQ 150	■	■	■		■	■		■
Meter	IQ 230M / IQ 330M	■	■	■		■	■		■
Meter	IQ 250	■	■	■		■	■		■
Meter	IQ 260	■	■	■		■	■		■
Meter	IQ35MA1	■	■	■		■	■		■
Meter	IQ35MA2	■	■	■		■	■		■
Meter	Nexus 1200 Series	■	■	■		■	■		■
Meter	PM3_Modbus	■	■	■		■	■		■
Meter	SQD CM3000 Series	■	■	■		■	■		■
Meter	SQD CM4000 Series	■	■	■		■	■		■
Meter	SQD PM700 Series	■	■	■		■	■		■
Meter	SQD PM800 Series	■	■	■		■	■		■
Protection	ABB TPU 2000	■	■	■		■	■		■
Protection	C440	■	■	■		■	■		■
Protection	C441	■	■	■		■	■		■
Protection	EDR-3000	■	■	■		■	■		■
Protection	EDR-5000	■	■	■		■	■		■
Protection	EGR-4000	■	■	■		■	■		■
Protection	EGR-5000	■	■	■		■	■		■
Protection	EMR-3000	■	■	■		■	■		■
Protection	EMR-4000	■	■	■		■	■		■
Protection	EMR-5000	■	■	■		■	■		■
Protection	ETR-4000	■	■	■		■	■		■
Protection	ETR-5000	■	■	■		■	■		■
Protection	GE 369 Motor Relay	■	■	■		■	■		■
Protection	GE 469 Motor Relay	■	■	■		■	■		■
Protection	InsulGard	■	■	■		■	■		■
Protection	NRX520M	■	■	■		■	■		■
Protection	NRX1150M	■	■	■		■	■		■
Protection	Qualitrol 118	■	■	■		■	■		■
Starter	S611	■	■	■		■	■		■
Starter	S811	■	■	■		■	■		■
Transfer switch	ATC-300	■	■	■		■	■		■
Transfer switch	ATC-900	■	■	■		■	■		■

Power Xpert Gateway 900



PXG Daisy Chain Application



Note: In this configuration, if any of the PXG units go offline or lose power, the communication to the downstream Ethernet devices will lose connection to the LAN.

Standards and Certifications

- UL 508, Standard for Programmable Controller Equipment
- FCC, Class A, Part 15, Subpart B, Sections 15.107b and 15.109b
- EN55022: 1994 Class A, Information Technology Equipment
- EN 61000-6-2:2001 Electromagnetic Compatibility (EMC) Party 6-2: Immunity for Industrial Environments

Listed

Product Selection

PXG Part Numbers

	Description	Style Number	Catalog Number
PXG900 	Power Xpert Gateway 900	66D2325G01	**PXG900**
PXG900-2A 	Enclosed version Cost-effective solution to add communications to new or existing equipment that has no physical space to install the PXG in the equipment structure. NEMA 12 enclosure rating. Prewired with a PSG60N24RP power supply and terminal blocks for ease of wiring of incoming power and connected devices.	—	**PXG900-2A**
	Power supply—24 Vdc	PSG60N24RP-A1	**PSG60N24RP**

Technical Data and Specifications

PXG part numbers

Description	Style Number	Catalog Number
Power Xpert Gateway 900	**66D2325G01**	**PXG900**
Power supply—24 Vdc	**PSG60N24RP-A1**	**PSG60N24RP**

Memory
- Flash: 2 GB
- RAM: 1 GB

Communication Ports
- Network ports: Two 10/100BASE-T RJ-45 connectors
- Serial ports
  - Two RS-485 ports for connection to Modbus RTU devices
  - One dedicated RS-485 port for INCOM devices
- Configuration port: One USB port

Network Protocols Supported
- Modbus TCP/IP: Supports data access from Modbus TCP clients
- Web server: Supports data access from web browsers (HTTP and HTTPS)
- DHCP: Supports automatic IP address assignments, if enabled
- NTP: Supports time synchronization via a network time server for PXG synchronization
- SMTP: Supports mail server for email notification
- BACnet/IP: Supports data access from BACnet clients

Serial Protocols Supported
- INCOM
- Modbus RTU

Web Browsers Recommended
- Internet Explorer versions 10 and 11
- Google Chrome

Power Input
- Input voltage, nominal: 24 Vdc; 0.3 A minimum
- Input voltage range: ±10% nominal

Power Consumption
- 8 W maximum

Operating Temperature
- 32 °F to 140 °F (0 °C to 60 °C)

Ambient Storage Temperature
- –40 °F to +185 °F (–40 °C to +85 °C)

Relative Humidity
- 5 to 95% noncondensing at 122 °F (50 °C)

Size (H x D x L) in Inches
- 2.00 x 4.50 x 6.00

Weight
- 1.7 pounds

Supported Devices and Performance

PXG performance will vary depending upon the number and type of connected devices. This is driven by the following:
- Each supported device has a distinct number of channels to report back to the PXG, ranging from as few as 4 to over 900
- The channels are prioritized
- Device protocol, Modbus or INCOM
- Baud rate setting

For this reason, a PXG performance tool has been developed to assist in understanding the expected performance for a given application since all systems are unique. This tool can be found at www.eaton.com/pxg. For a high level performance comparison, see the table below for three examples.

	For This Combination of Devices (All Times in Seconds)		
How Long Does It Take	**64 INCOM / 32 Modbus**	**15 INCOM / 15 Modbus**	**5 INCOM**
Between value change in the UI (INCOM 9600)—Priority 1	21.9	3.7	1.4
Between value change in the UI (Modbus 57600)—Priority 1	3.5	1.6	—
Between value change in the UI (INCOM 9600)—Priority 2	44.3	7.4	2.6
Between value change in the UI (Modbus 57600)—Priority 2	7.0	3.1	—
Modbus server pass-through response time (57600) (local connection)	0.061	0.059	—
For the UI to show an alarm (INCOM device)	17.0	3.0	3.0
To boot up (all devices communicating)	399.0	85.0	51.0

Note: Features and specifications listed in this document are subject to change without notice and represent the maximum capabilities of the product with all options installed. Although every attempt has been made to ensure the accuracy of information contained within, Eaton makes no representation about the completeness, correctness, or accuracy and assumes no responsibility for any errors or omissions. Features and functionality may vary depending on selected options.

General Wiring Guidelines—RS-485 Network

When communicating over RS-485 networks to Eaton products, the following General Wiring Guidelines should be used.

Rule 1: Cable Selection—Twisted Shielded Pair (TSP)

Note: Cables specifically designed for RS-485 applications are highly recommended.

The RS-485 bus is a length of Twisted Shielded Pair (TSP) that includes a third conductor (used for the common wire), a braided shield accompanied by a drain wire, and nominal impedance of 120 ohms.

- Belden Wire and Cable Company Part Number 3106A or equivalent

Rule 2: Cable Intermixing

Any cable in the Belden 3106A family can be intermixed with each other in the Modbus network.

Rule 3: System Topology, Size and Capacity

- Strict daisy chain must be adhered to. A strict daisy chain configuration is one where the transmission line connects from one RS-485 receiver to the next. The transmission line appears as one continuous line to the RS-485 driver
- Maximum 32 devices
- Line termination: Maximum cable lengths of 4000 ft (1219 m); longer bus lengths will slow the data rate

Rule 4: Cable Splicing

The prime goal is to create a secure electrical connection while minimizing exposure to electrical transients. Ferrules are used to dress cable ends. Most devices have built-in terminal blocks that can be used for splicing. Additionally, terminal blocks should be utilized when splicing elsewhere in the gear or facility to ensure a secure electrical connection.

Rule 5: Cable Shielding

The cable shielding and outer jacket should not be stripped back beyond 1-1/2 inches. Three-pole terminal blocks are used to ensure a continuous metallic shield ground path. To ensure a secure electrical connection when daisy chaining devices that have built-in two-pole terminal blocks, mechanically crimp sleeves onto the two shield path drain wires.

Rule 6: Cable Grounding

Ground the communication network at only one point in the network, preferably by terminating the drain wire to ground at the EOL node (same location as the EOLR). A solid earth ground is accomplished by connecting the shield ground path's drain wire to a #14 AWG or larger multi-stranded wire that has an impedance path of 1 ohm or less to a known earth ground.

Note: The building electrical ground may not be effective since it may travel through many connections and considerable distances before reaching earth ground. In such cases, a new ground path will be required since the effectiveness of this shield earth ground connection will affect the integrity of data transferred over the cable.

Rule 7: Cable Termination

End of Line Resistors (EOLR) are necessary to maintain signal strength and minimize reflections. EOLR must match the impedance of the TSP. Two EOLR are needed and should be located at both ends of the RS-485 bus. If there is only one device connected to the Modbus master, it is considered the last device in the network and should be terminated with a 120 ohm 1/4 watt terminating resistor.

Rule 8: Device Addressing

- Each device must have a unique slave address
- No two devices on the same RS-485 network can have the same slave address

Ethernet Cable Specifications

For complete specifications, refer to the IEEE 802.3 Ethernet specification.

9

RS-485 Wiring Guide—Three Terminal Devices

Device Name	A (– Wire)	B (+ Wire)	Common Wire	XCVR Common ①	Data Bias
IQ 230M	12 (MOD2)	11 (MOD1)	10 (INCOM 3)	I 26V	None
IQ 250	(–) Older Models are Marked B (–)	(+) Older Models are Marked A (–) or A(+)	SH	I	None
IQ 260	(–) Older Models are Marked B (–)	(+) Older Models are Marked A (–) or A (+)	SH	I	None
IQ 330M	12 (MOD2)	11 (MOD1)	10 (INCOM 3)	I 26V	None
NETLINK	1 (DATA–)	2 (DATA+)	5 (GND)	E	None
InsulGard ②	B	A	None	Floating	None
Bushing Gard ② (InsulGard G3 ②)	B	A	None	Floating	None
Power Xpert Meter 4000/6000/8000	Data A 750B-S	Data B 750B-S	Shield (COM)	I 300V	750 Ohm Switch Sel
Power Xpert Gateway 400//600	A(–)	B(+)	COM	I	—

Notes

① Transceiver (XCVR) Common Connected to:
I = Isolated
NI = Non Isolated
E = Earth Ground

② Center terminal on InsulGard (marked with Ground symbol) is for shield splicing only and is electrically floating.

INCOM Network

INCOM was specifically designed with the intention of delivering a comprehensive and powerful energy management solution for use in electrical distribution environments while ensuring affordability, flexibility, simplicity and noise immunity. An INCOM network installed per the following rules will allow the user to fully realize all of the above advantages. (Refer to Eaton document TD17513 for specific system layout recommendations and details.)

Rule 1: Cable Selection—Twisted Shielded Pair

Approved cable types:

- Any of the cables in the Belden 9463 family
- Quabbin 6205
- CommScope 9022
- Manhattan Electric M4154
- IMPCABLE—a 600 V rated cable custom designed for INCOM—Style # 2A95705G01

Rule 2: Cable Intermixing

Due to impedance differences between IMPCABLE and the Belden 9463 family, the main cable run(s) should be entirely for the 9463 family OR IMPCABLE: do not alternate between these types. The cable used for taps can be different from the main run.

Rule 3: System Topology, Size and Capacity

Supports daisy chain, star and multi-level network segment topologies.

Note: Star Segment Topology is not recommended for new designs.

See **Page V3-T9-221**. Surge protection is required for FSK networks that leave a building at the egress/ingress of the building.

- Supports distances up to 10,000 ft (3048 m) per segment when designed within the specifications of this guideline
- Supports up to 1000 devices on a single network segment
- Supports sub-network master devices and associated sub-networks
- Supports 1200 or 9600 baud rate
- Attenuation:
  - Total system capacity: 25 dB
  - Attenuation per device: 0.01 dB
  - Attenuation for approved wire types, see tables below

Cable Attenuation

Cable Type	Attenuation/ 1000 ft (305 m)
IMPCABLE	1.6 dB
Belden 9463 family	2.0 dB

Attenuation at Star

Number of Long Lines	Attenuation
3	3.5 dB
4	6 dB
5	8 dB

- Definitions:
  - **Daisy chain**: point-to-point wiring between devices or clusters of devices
  - **Star:** single point with a number of long lines emanating from it
  - **Long line**: >200-foot (61 m) wire run
  - **Simple tap**: <200-foot (61 m) connection to cluster of devices

Rule 4: Cable Splicing

The goal is to create a secure electrical connection while minimizing exposure to electrical transients. Ferrules are used to dress cable ends in order to avoid problems associated with frayed and loose wires. Besides facilitating cable installation, subsequent data line troubleshooting and downtime are minimized. Most INCOM devices have built-in three-pole terminal blocks for data lines and shield. For older INCOM devices that have only two terminals, shield continuity must be ensured by other means. Additional terminal strips should be utilized when splicing elsewhere in the electrical enclosure or facility to ensure secure electrical connections. All devices, End of Line Termination Resistors and Taps should be wired in parallel across the cable.

Rule 5: Cable Shielding

The cable shielding and outer jacket should not be stripped back beyond 1.5 inches (38 mm). Terminal blocks are used at tap points to ensure a continuous metallic shield ground path. To ensure a secure electrical connection when daisy-chaining INCOM devices that have built-in two-pole terminal blocks, use crimp sleeves to join the two shield drain wires. The cable shield ground path for a main network and sub-network must not be joined. Each should have a separate connection to earth ground reference.

Rule 6: Cable Grounding

The shield should be continuous across a network segment and connected to the building's electrical system grounding electrode conductor. The 2005 NEC® provides the following guidance on grounding communication cables:

1. When a communication cable enters a building, a primary protector is required and must be grounded as described in Section 800 IV. Specifically, Paragraphs 800.93 and 800.100 define grounding requirements for the primary protector.
2. Grounding systems are generally covered by Section 250 III. The grounding electrode conductor is specifically covered by Paragraphs 250.62, 250.64, 250.66, 250.68 and 250.70.
3. Bonding requirements between communication systems and the power distribution system is specified by Paragraph 250.94.

A solid earth ground is accomplished by connecting the shield ground path's drain wire to a #14 AWG or larger multi-stranded wire that has an impedance path of 1 ohm or less to the building's grounding electrode conductor.

Rule 7: Cable Termination

Each network segment requires a minimum of two End of Line Termination Resistors (EOLTRs). The EOLTRs maintain signal strength and minimize reflections. The EOLTRs should be 1/2 watt 100 ohm non-inductive resistors, such as carbon composition or metal film. Wire-wound resistors are not acceptable. Taps on network segments should not be terminated. Some INCOM devices have the EOLTR permanently installed and must be located at the end of a main run. Other INCOM devices have an EOLTR that can be switched to optionally terminate the network segment at the device. Care must be exercised when installing devices containing termination resistors that the switches are set appropriately. A minimum of two, up to a maximum of five EOLTRs must be installed on each network segment as dictated by network topology.

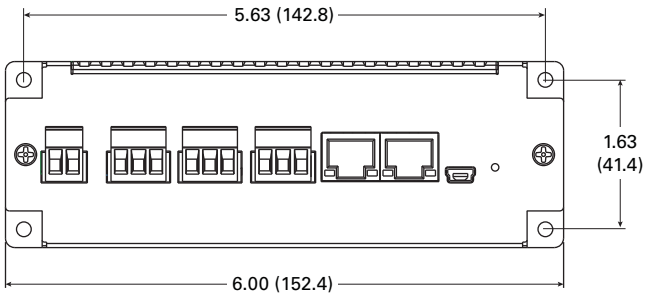
Rule 8: Device Address

In order to avoid the possibility of devices in a Main Network having the same addresses as those in Subnetworks, set Main Network device addresses at 100 or higher excluding addresses 901 to 908.

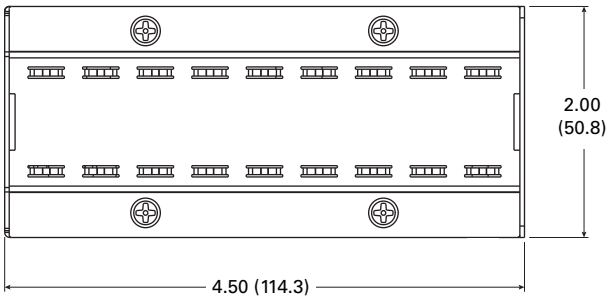
Dimensions

Approximate Dimensions in Inches (mm)

Power Xpert Gateway 900 with Standard Panel Mounting (Brackets Included)

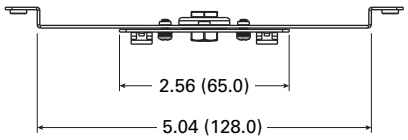


Front View

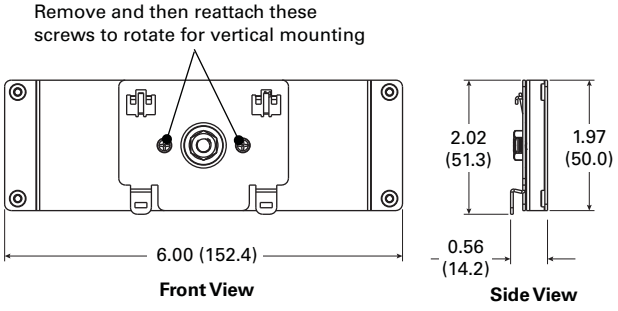


Side View

Power Xpert Gateway 900 with DIN Rail Mounting



Top View



Front View **Side View**

Power Xpert Gateway 900

Width	Height	Depth	Shipping Weight Lbs (kg)
6.00 (152.4)	2.00 (50.8)	4.50 (114.3)	1.70 (0.8)

Contents

Description	*Page*
Power Xpert Gateway	**V3-T9-213**
PXM1K-ETHMULTI Card for PXM1000 Devices mMINT	**V3-T9-224**
I/O Devices Digital Input Module (DIM)	**V3-T9-226**
Addressable Relay II	**V3-T9-228**

PXM1K-ETHMULTI Card for PXM1000 Devices

Information not available at this time.

Information not available at this time.

mMINT Module



Contents

Description	*Page*
Power Xpert Gateway	**V3-T9-213**
PXM1K-ETHMULTI Card for PXM1000 Devices	**V3-T9-222**
mMINT	
Technical Data and Specifications	**V3-T9-225**
I/O Devices Digital Input Module (DIM)	**V3-T9-226**
Addressable Relay II	**V3-T9-228**

mMINT

Product Description

The mMINT (Modbus Master INCOM Network Translator) Module is an Eaton accessory product that provides communication between a Modbus RTU network and an INCOM (INdustrial COMmunications) network (see **Page V3-T9-225**). This module is transparent to the Modbus network. It communicates to a master on the Modbus network using the Modbus RTU (Remote Terminal Unit) protocol. It communicates to slave devices on the INCOM network using the IMPACC (Integrated Monitoring, Protection, And Control Communication) protocol.

Features

The mMINT module is a slave device on the Modbus network and as such requires a master that will exchange register objects with the mMINT module.

- Handles generic pass-through commands (Modbus/INCOM/Modbus)
- Capable of passing Modbus register objects from Eaton's existing products and newer PnP (Plug-n-Play) products to a Modbus RTU master
- Data in IEEE Floating Point format and fixed point
- Modbus RTU communications data transfer rates of 1200, 9600 or 19,200 baud with one start bit, eight data bits, no parity, and either one or two stop bits
- Up to 32 products connected to INCOM network port (246 unique addresses maximum)
- Flashing Status LED to indicate an active module
- LED indicators for INCOM transmit and receive communications exchanges
- LED indicators for Modbus RS-485 transmit and receive communications exchanges
- Input power for the module from either 120 Vac or 24 to 125 Vdc
- DIN rail mount package
- 0 °C to 60 °C ambient operation

Standards and Certifications

- UL
- CSA
- CE mark

Product Selection

The catalog number of this product is mMINT.

Technical Data and Specifications

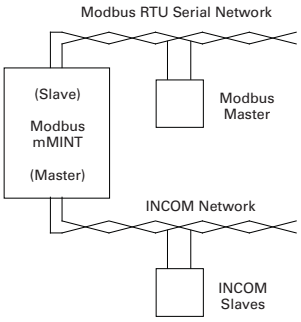
Module Mounting

When mounting the mMINT, verify that an 11 mm H x 28 mm W DIN rail is used and that it is within an enclosed space.

Simplified Wiring Rules

INCOM Network

The following simplified rules apply to a given system consisting of a single daisy-chained main cable link between master and slave devices (see below). For more complex considerations including star configurations, please refer to the IMPACC wiring specification T.D. 17513.



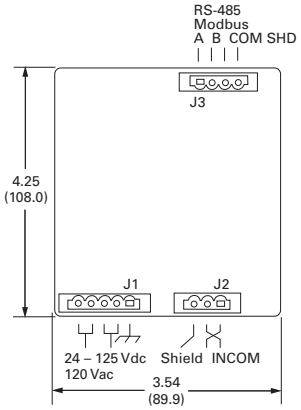
mMINT in a Communications Network

- Recommended INCOM cable styles are Belden 9463 or C-H style 2A957805G01
- The maximum system capacity is 10,000 feet of communications cable and 32 slave devices on the INCOM network under the mMINT
- Non-terminated taps, up to 200 feet in length, off the main link are permitted, but add to the total cable length
- Make sure that there is twisted-pair wire that is recommended for IMPACC network use. Use shielded twisted-pair wire to connect each slave to the INCOM network, daisy-chain style. The polarity of the twisted pair is not important

Modbus RS-485 Network

The following simplified rules apply to a given system consisting of a cable link between master and slave devices (see below). For more complex configurations, please refer to standard Modbus RTU wiring specification rules for the RS-485 network.

- The recommended Modbus cable has twisted-pair wires (24 AWG stranded 7x32 conductors with PVC insulation) having an aluminum/mylar foil shield with drain wire
- The maximum system capacity is 4000 feet of communications cable and 247 devices on the Modbus RTU network
- Make sure that there is twisted-pair wire that is recommended for Modbus RTU network use. Use shielded twisted-pair wire to connect each slave to the Modbus RTU network, daisy-chain style. The polarity of the twisted pair is critically important



mMINT Module Dimensions

Burden

- 24 Vac/dc 3 VA

Communications Speed

- INCOM: 1200, 9600 baud
- N2 Bus: 9600 baud

Note: Contact Eaton for availability and support for the N2 Gateway.

9

Digital Input Module (DIM)



Contents

Description	*Page*
Power Xpert Gateway	**V3-T9-213**
PXM1K-ETHMULTI Card for PXM1000 Devices	**V3-T9-222**
mMINT	**V3-T9-224**
I/O Devices Digital Input Module (DIM)	
Product Selection	**V3-T9-227**
Technical Data and Specifications	**V3-T9-227**
Dimensions	**V3-T9-227**
Addressable Relay II	**V3-T9-228**

I/O Devices Digital Input Module (DIM)

Product Description

Eaton's Digital Input Module is a device that interfaces with up to four standard utility (electric, gas, water) meters or monitors eight digital inputs. It translates KYZ pulses from meters into a register count that is maintained and compiled within the DIM module in non-volatile memory. The pulse count can be accessed from the DIM module remotely using Eaton Power Management Software, including the Energy Billing application.

The DIM can also be used to monitor eight digital inputs from switch closures.

Features, Benefits and Functions

- Reads four separate KYZ equipped utility meters
- Pulse counts stored in non-volatile memory
- Each channel independently monitors KYZ counts, pulse counts, or digital indications
- Monitors a maximum of eight individual digital inputs
- Input channels are isolated
- Isolated 24 Vdc power is provided on the I/O connector
- LED indicators on the input channels indicate when the unit is counting
- 10 LED status indicators, 100 ohm termination DIP switch, address selector switches
- DIN rail mounting

Standards and Certifications

- UL 873
- CE mark (48 Vdc operation)
- FCC Part 15, Class A
- IEC 1000-4-x
- CISPR 22, Class A
- IEC 1000-4-2; 1995, Electro Static Discharge
- IEC 1000-4-3; 1995, Radiated RF Immunity
- IEC 1000-4-6; 1996, Conducted RF Immunity
- FCC Part 15 Class A (10 meters) Radiated Emissions
- CISPR 22, Class A (30 meters); 1991, Radiated Emissions
- CISPR 22, Class A; 1991, Conducted Emissions (PowerPort)

Product Selection

DIM



Ordering Information

Description	Catalog Number
Digital Input Module	**DIM**

Technical Data and Specifications

Specifications

Description	Rating
Operating temperature	–20 °C to +60 °C
Storage temperature	–20 °C to +70 °C
Operating Humidity	5 to 90% maximum noncondensing
Altitude	10,000 ft (3048 m)
Environment	Indoor use only
Transient overvoltage	Category 2
Pollution	1°
Equipment	Class 1

Frequency Range

- 50/60 Hz

Power

- 85 to 138 Vac (120 Vac nominal) 50/60 Hz; 100 mA
- 48–128 Vdc (48 Vdc nominal); 100 mA
- Brownout operation at 50% and 80% of nominal AC and DC ratings
- Power input is provided from a limited source, isolated from the mains by double isolation
- Power for all inputs is supplied from an internal, isolated 24 Vdc power source

Mounting Information

The DIM module is designed to be DIN rail mountable. DIN rail must be 1/3 inches H x 1-3/8 inches W (8.5 mm H x 34.9 mm W).

Communications

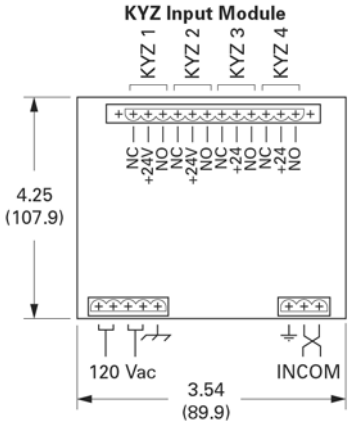
The DIM is a fully compatible Power Management Software communicating device with built-in INCOM communications. The DIM comes complete with a 3-pin connector to receive the shielded twisted pair conductor.

All wiring must be complete as per Instruction Leaflet TD17513, Wiring Specification Base Rules.

Dimensions

Approximate Dimensions in Inches (mm)

KYZ Input Module



KYZ Input Module

Width	Height	Depth
3.54 (89.9)	4.25 (107.9)	3.50 (88.9) ①

Note

① Does include DIN rail.

9

Addressable Relay II



Contents

Description	*Page*
Power Xpert Gateway	**V3-T9-213**
PXM1K-ETHMULTI Card for PXM1000 Devices	**V3-T9-222**
mMINT	**V3-T9-224**
I/O Devices Digital Input Module (DIM)	**V3-T9-226**
Addressable Relay II	
Product Selection	**V3-T9-229**
Technical Data and Specifications	**V3-T9-229**
Dimensions	**V3-T9-229**

Addressable Relay II

Product Description

The Addressable Relay II is designed for use where information or control of non-communicating devices is required remotely. The relays communicate at 9600/1200 baud on the INCOM network. Devices are assigned a three-digit address to uniquely identify them on the daisy-chained twisted shielded pair network.

The Addressable Relay II is a Form C relay on terminals 1, 2 and 3, with output contact ratings as shown in the Contact Ratings table. The Addressable Relay II may be powered by 48–120 Vac or 48–125 Vdc through terminals 11 and 12 of the terminal block. DC polarity is not significant.

Application Description

- Enables remote control of non-communication capable devices on Eaton's PowerNet system
- Monitors two digital status inputs on the PowerNet system

Features, Benefits and Functions

Each Addressable Relay II includes two status indicating circuits (IN1 and IN2) that can be used to transmit the contact status of devices external to the Addressable Relay II. Each input is isolated with its own return. A typical installation using these report-back inputs to the Eaton PowerNet system is shown in the wiring example. Terminals 4 and 5 connect to the status input 1 circuit (IN1) and terminals 6 and 7 connect to the status input 2 circuit (IN2). These status indicating circuits operate with input voltages of 48–120 Vac or 48–125 Vdc circuits.

The Addressable Relay II includes a feature called the "communications watchdog." The communications watchdog monitors communications between the Addressable Relay II and the computer control station. If communications are lost, the communications watchdog will reset the relay to the de-energized (OFF) state. The Addressable Relay II must be updated every 10 seconds when the communications watchdog is enabled or else communications are assumed to be lost. The communications watchdog is enabled when DIP switch 3 is set to the ON position. When the communications watchdog is not enabled, the relay will remain in the state set by the last command issued.

Monitored Parameters

- Output relay energized/de-energized
- Input 1 status
- Input 2 status
- Breaker status open/closed
- Protective relay status normal/tripped

Communications

- Built-in INCOM communications for monitoring in Eaton's PowerNet system

The Addressable Relay II also includes a feature called "relay pulse." The relay pulse feature sets the Addressable Relay II to a pulse mode where the relay is energized (ON) for 10 seconds and then is de-energized (OFF). The relay pulse is enabled when DIP switch 2 is set to the ON position and disabled when DIP switch 2 is set to the OFF position. If this feature is not enabled, the relay will remain in the state set by the last command.

Product Selection

Addressable Relay II



Addressable Relay

Description	Catalog Number
Addressable Relay II	**ARII**

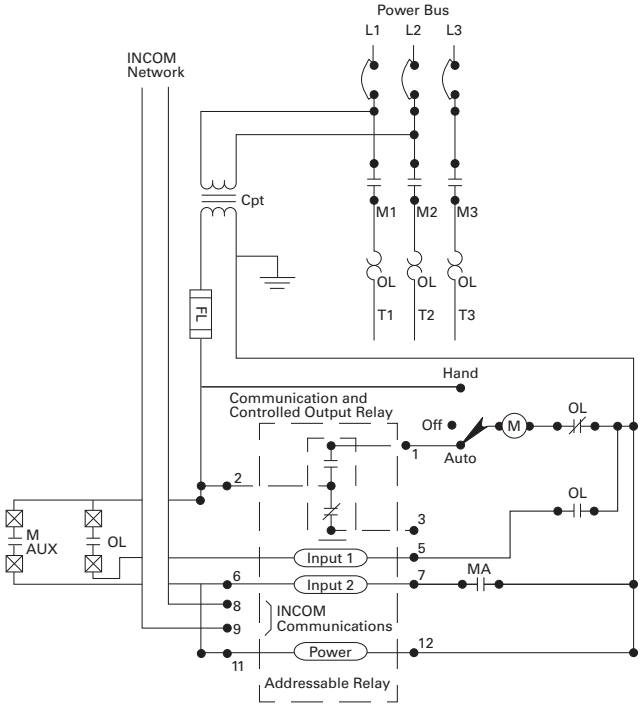
Technical Data and Specifications

- Power: 48–120 Vac; 48–125 Vdc
- Operating temperature range: 32 °F–158 °F (0 °C–70 °C)

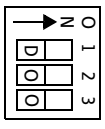
Contact Ratings

Contact Ratings	Make	Break
120–240 Vac	4960 VA	828 VA
24–120 Vac	43 A	7.2 A
30 Vdc	10 A	10 A

Wiring Diagram



DIP Switch Functions

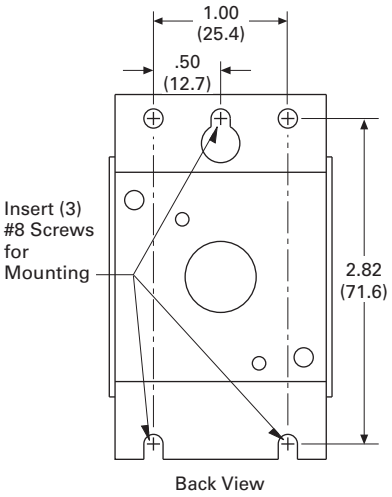


	OFF	ON
Baud Rate	9600	1200
Relay Pulse	Disabled	Enabled
Communications Watchdog	Disabled	Enabled

Dimensions

Approximate Dimensions in Inches (mm)

Mounting



Addressable Relay

Width	Height	Depth
1.75 (44.5)	3.00 (76.2)	4.00 (101.6)

9