

Metering Devices, Protective Relays, Software and Connectivity

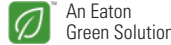
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Power Xpert Architecture



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Introduction

Enabling Power System Management

Eaton's Power Xpert Architecture (PXA) provides a complete hardware/software solution to manage your entire power system. Power Xpert Architecture consists of Power Xpert Meters, Gateways, Switches and Software.

Power Xpert devices are devices that can provide by themselves, or facilitate for others, Ethernet network protocols to communicate with your critical infrastructure components. Power Xpert devices provide the intelligent hardware connectivity layer to allow Web-enabled communications throughout the power system.

Power Xpert Meters

Power Xpert Meters provide measurement of the critical elements found in power systems, including voltage, power, current, transients, harmonics or even time. Power Xpert Meters provide Web-enabled communications for use through a Web browser or with the Power Xpert Software or third-party monitoring systems.

Power Xpert Gateways

Power Xpert Gateways are capable of Web-enabling electrical devices contained in electrical gear via a standard Web-browser on the Ethernet network. Standard on-board Web pages eliminate the need for any customer programming or software.

Power Xpert Software

Power Xpert Software is a comprehensive solution for system-level management of your power infrastructure via a Web-browser. Power Xpert Software provides a clear picture of what is happening at a component, device and system level.

Because no two organization's needs are the same, Power Xpert Software is available in two editions:

Power Xpert Software Professional Edition

Geared toward end users, with built-in support for Eaton power distribution products such as switchgear, UPSs, breakers, PDUs, RPPs, meters, relays, VFDs and MCCs among others.

Eaton products connect with the software directly via an Ethernet connection, while legacy devices use a Power Xpert Gateway to Web-enable their communications.

A subset of third-party meters and devices are supported as standard via the gateway connection.

Power Xpert Software Enterprise Edition

Geared toward advanced power users, system integrators and enterprises with heterogeneous device spectrum and system developers who can take advantage of the included SNMP and Modbus® integration development utilities.

- Extensive support for third-party devices via standard SNMP and Modbus TCP protocols
- Large variety of ready made third-party drop in drivers

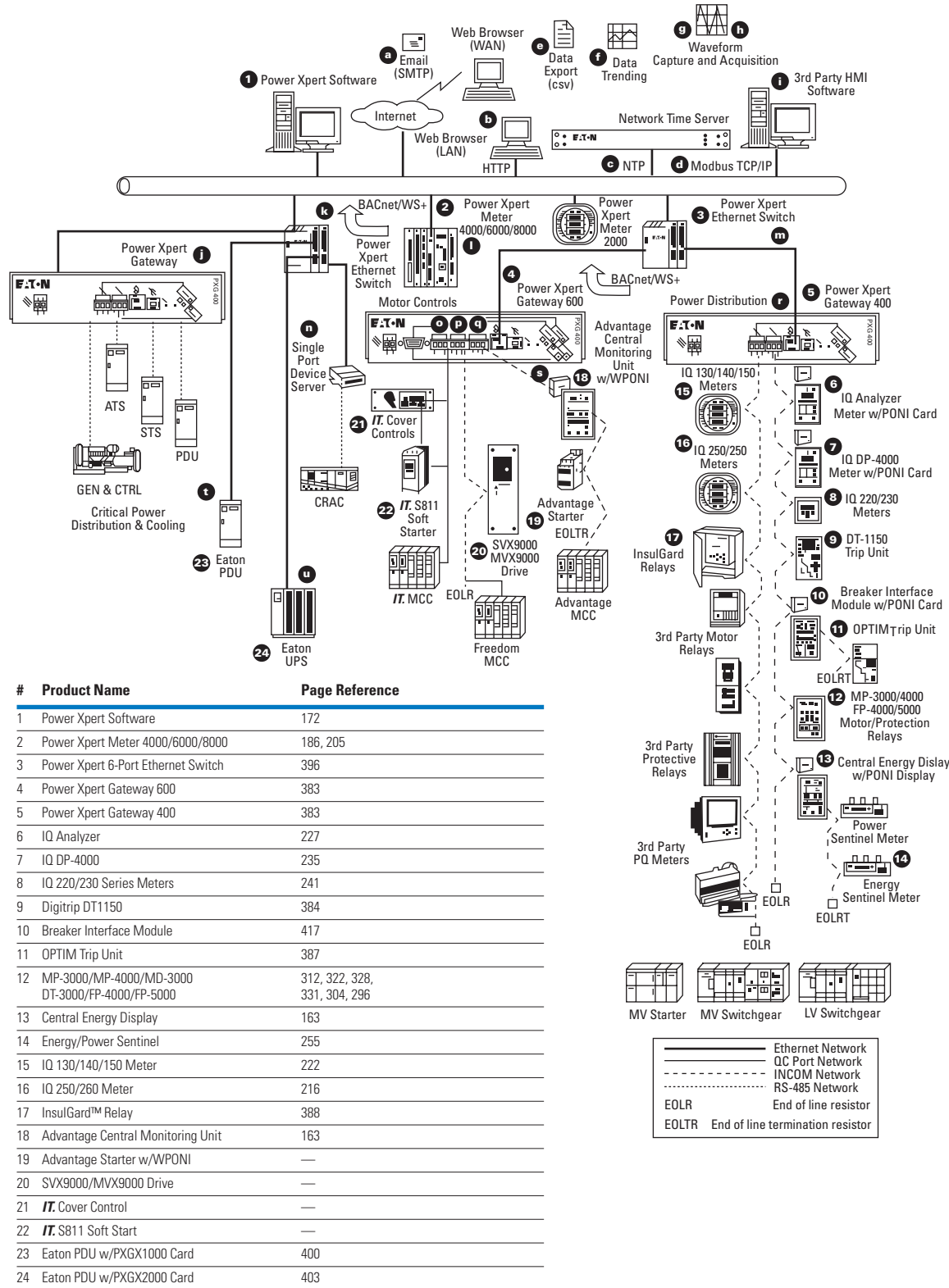
Support for Existing PowerNet Systems

Power Xpert is directly compatible with existing PowerNet™ systems v.3.32 and higher. All communications hardware devices such as NetLink, EMINT, MINT II and EPONI can be connected to Power Xpert Software through the PowerNet server for configuration of the INCOM™ communication devices.

Power Xpert System

See Notes on **Page 162**.

Power Xpert System Overview



Power Xpert Architecture—Notes

- a. Simple Mail Transfer Protocol (SMTP)—Device events and periodic data log file attachments are sent to users in the form of an e-mail from the following Power Xpert products: Power Xpert Software, Power Xpert Meters 2000/4000/6000/8000, Power Xpert Gateway 600 and Power Xpert Gateway Cards 1000/2000 Series.
- b. Hyper Text Transfer Protocol (HTTP)—Web browser access is available on the following Power Xpert products: Power Xpert Software, Power Xpert Meters 2000/4000/6000/8000, Power Xpert Gateway 600 and Power Xpert Gateway Cards 1000/2000 Series.
- c. Network Time Server (NTP)—Network Time Protocol (Client-side) is available on the following Power Xpert products: Power Xpert Software, Power Xpert Meters 2000/4000/6000/8000, Power Xpert Gateway 600 and Power Xpert Gateway Cards 1000/2000 Series.
- d. Modbus TCP/IP—Modbus TCP/IP over Ethernet is available on the following Power Xpert products: Power Xpert Software, Power Xpert Server Core Software, Power Xpert Meters 2000/4000/6000/8000, Power Xpert Gateway 600 and Power Xpert Gateway Cards 1000/2000 Series. Modbus register maps are available online at www.eaton.com/powerxpert.
- e. Data Export—Data files consist of metered data and event log information that is exported from the meter, gateway or software in the form of a .csv (comma separated variable) file. Supported products are: Power Xpert Gateway PXG600, PXGX1000, PXGX2000, Power Xpert Meters 2000/4000/6000/8000 and Power Xpert Software.
- f. Data Trending—Viewing trended data in a standard Web browser interface in the form of a graphed line for one or more data points is available for the following products: Power Xpert Gateway PXG600, PXGX1000, PXGX2000, Power Xpert Meters 2000/4000/6000/8000 and Power Xpert Software.
- g. Waveform Capture—The ability to capture a waveform and/or export the waveform as a standard comtrade file format is available on the following products: Power Xpert Meters 4000/6000/8000.
- h. Waveform Acquisition and Export—The ability to acquire a waveform from another device that natively captures a waveform internally and then export that waveform in a standard comtrade file format is supported by the following devices: PXG600 (provides data acquisition and comtrade conversion for: IQ Analyzer, DT1150 and FP5000).
- i. Third-Party HMI Software Integration—Is achieved through the Modbus TCP/IP interface on all Power Xpert devices. If PowerNet software is utilized in the system, then an OPC Server is available.
- j. Proprietary Serial Device Protocols over Ethernet—The ability to communicate with third-party equipment is achieved through a Power Xpert Gateway via Modbus 485 or Modbus Serial.
- k. BACnet/WS+ — Is based upon the protocol specification developed by the ASHRAE standards group as an Addendum c to Standard 135-2004.

Reference:
[BACnet—A Data Communication Protocol for Building Automation and Control Networks. Public Review Draft, ASHRAE Standard. BSR/ASHRAE Addendum c to ANSI/ASHRAE Standard 135-2004. First Public Review. Released: October 22, 2004. 32 pages. Copyright (c) American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. August 30, 2004.]

This draft shows proposed changes to the current BACnet standard.

Note: Eaton Corporation has extended this protocol addendum with a (+) to signify the addition of an “event-driven” behavior to the existing “polled” data acquisition model. This allows optimization in communications between Power Xpert devices and Power Xpert Software.

Note: The Power Xpert Meters 4000/6000/8000 also export natively captured waveforms as comtrade file format.

- l. CEC (Communications Expansion Card PXMCE-B)—This card must be ordered as an option on the Power Xpert Meters 4000/6000/8000 to provide Ethernet connectivity for use with a Web browser, interface to Power Xpert Software or third-party HMI software.
- m. Ethernet Switch—The Eaton Ethernet Switch provides connectivity between Power Xpert devices on a common subnetwork. The 6-port version of the switch shown provides (6) RJ-45 network ports. As an option, 1 or 2 of these ports can be substituted to be ST-Type Fiber connections.
- n. Single-port Device Server—Is a device that is used to add network connectivity to a single serial device. These device servers offer a single RS-232/485 serial port to connect a variety of serial devices including meter devices, UPS, PDU, Static Switch, Automatic Transfer Switch, generators, Computer Room Air Conditioners, and other commercial, industrial or business automation equipment. The serial ports use standard RJ-45 or DB-9 connectors for convenient cabling, and optional adapters are available as well.
- o. PXG600A COM2 Port—Is used to communicate on a Modbus RS-232/485 network or on an Eaton QC-Port (IT) bus. The user may choose between a DB-9 or terminal strip connector to connect up to 32, RS-45 serial devices.
- p. PXG600A COM1 Port—Is used to communicate on a Modbus RS-232/485 network or on an Eaton QC-Port (IT) bus. A terminal strip connector is provided for this interface. Up to 32 devices may be connected to this port.
- q. PXG600A INCOM Port—Is used to communicate on an Eaton INCOM device network only. Up to 64 devices may be connected to this port.
- r. PXG400 Ports—The ports on the PXG400 operate the same as on the PXG600; however, there is only one RS-232/485 port to be used for Modbus or QC-Port.
- s. PONI (Product Oriented Network Interface)—Is used to connect the Advantage Central Monitoring Unit (18), the Breaker Interface Module (10), and the Central Energy Display (13), an IQ Analyzer (6), and the IQ DP-4000 (7) to an INCOM network.
- t. PXGX1000 Card—Is used to connect an Eaton PDU (Power Distribution Unit) or RPP (Remote Power Panel) to an Ethernet network. Available interfaces are: HTTP (Web) SNMP, SMTP (e-mail), Modbus TCP/IP and BACnet/WS+.
- u. PXGX2000 Card—Is used to connect an Eaton UPS to an Ethernet network. Available interfaces are: HTTP (Web) SNMP, SMTP (e-mail), Modbus TCP/IP and BACnet/WS+.

Important Note: When connecting multiple Modbus RTU devices to either a multiport terminal server or a Power Xpert Gateway 400/600 over an RS-485 daisy chain network, the baud rate, data frame (stop bits, data bits and parity), byte order (standard or reversed) and physical wiring (two-wire or four-wire) must be the same for all devices connected.

Power Xpert Architecture Deployment Levels

1. Web Browser monitoring for a single device
2. Web Browser monitoring for multiple devices
3. Web Browser monitoring with centralized management
4. Customized Web-based graphics and third-party device support

Power Xpert Architecture Hardware/Software Products

Power Xpert hardware/software products were developed to provide a highly intuitive local user interface that simplifies complex real-time data into meaningful information. At a glance, a user can quickly determine if a critical parameter in their power system, (such as voltage, current or kWh), falls within or outside of an acceptable operational range.

Power Xpert devices provide the intelligent hardware connectivity layer to allow Web-enabled communications over an Ethernet TCP/IP network. These devices can act as standalone Web servers or as part of a coordinated system with Power Xpert Software consolidating and analyzing the combined system data. The Power Xpert Meter family and the Power Xpert Gateway family are microprocessor-based, Web-enabled, communicating devices from Eaton Corporation that make up the Power Xpert Architecture.

Power Xpert Meters

Power Xpert Meters 2000/4000/6000/8000 offer Eaton customers a new level of accessibility to the critical information required to manage their electrical distribution system. The meter's embedded Web server includes real-time circuit information in both numeric and graphical visual formats that can be viewed on its local display or through a Web browser via the Internet or a customer's intranet.

The Power Xpert Meters 4000/6000/8000 are the benchmark for intelligent Web-enabled power quality metering instruments. The meters include high-speed sampling and measurement of the critical elements, (i.e., voltage, power, current, transients or harmonics), in a facility's power system. See **Page 179** for detailed information on the Power Xpert Meters.

All Power Xpert Meters provide a standard communications protocol for easy integration into other systems.

Power Xpert Gateways

Power Xpert Gateways are intelligent communication devices that Web-enable one or more electrical devices so they become visible to a browser on an Ethernet network. The Power Xpert Gateways are capable of providing communications conversion from one network field bus protocol to another—for example, INCOM to Ethernet.

Power Xpert Gateway devices are a key component in the Power Xpert Architecture. They allow a user to optimize their existing investment in Eaton's communicating devices such as IQ Meters, Digitrip™ Breaker Trip Units, Protective and Overload Relays and **IT**. Motor Starters. They can also extend state-of-the-art connectivity to third-party devices that communicate using Modbus RTU protocol over an RS-485 field bus. See **Page 383** for detailed information on the Power Xpert Gateways.

Power Xpert Software

Power Xpert Software, an integral part of the overall Power Xpert Architecture, is a comprehensive solution for system-level management of your power infrastructure via a Web-browser, from any desktop, on one screen. Power Xpert Software is designed to take the complexity out of managing your power system and provides a clear picture of what is happening at a component, device and system level. Power Xpert Software provides insight into cost savings and downtime prevention. For detailed information on Power Xpert Software, see **Page 172**.

Power Xpert Architecture Configuration Guidelines

With Power Xpert devices (sophisticated, Web-enabled, high-definition communications) and a simple Web browser, users can interrogate single devices directly, groups of devices connected through gateways, or connect through software managing multiple devices and gateways. Using the Eaton system, users are free to combine ways in which they view their devices. Applications generally fall into four primary categories. Eaton has developed an easy way to provide the preferred solution, using the following configuration deployment strategies as example application categories. See **Page 166**.

Configuration Guidelines

| Application Categories | Level | Description | Implementation Details |
|-----------------------------------|-------|---|---|
| Small/Smart Hardware installation | ① | Web browser access directly to an individual Power Xpert device, i.e., Power Xpert Meter or Eaton UPS w/ optional Power Xpert Gateway Series 2000 card installed. | Easy configuration to enable Web browser monitoring for a single or small amount of Eaton devices, without coordination between devices. |
| Medium installation | ① | Web browser access to multiple Eaton devices and third-party Modbus RTU devices through the Power Xpert Gateway and/or Power Xpert Gateway Cards. | Easy setup to enable Web browser monitoring for multiple Eaton devices, as well as third-party devices that support Modbus RTU. Each Power Xpert Gateway/ Gateway Card acts as a standalone Web server. |
| Sophisticated installation | ② | Web browser access to multiple Eaton and third-party devices through Power Xpert Software. Devices connect to Power Xpert Software by means of either direct Web-enabled cards installed inside or via Power Xpert Gateways. Includes device views for Eaton equipment as standard. | Full suite of tools available to monitor overall system health. Power Xpert provides complete control over centralized alarm notification, reporting and escalation. |
| Tailored solution | ③ | Custom Web interface design using Eaton Electrical Services group. | Integration of third-party devices and custom screens. |

Power Xpert Architecture

Level 0—Small System with Smart Hardware

Example Applications

Power Xpert Meter in low voltage switchgear and UPS.

Description

Configuration Level 0 offers an easy means to Web-enable a single Eaton device provided that it is supported by an optional Web communications card that can be installed directly into the device.

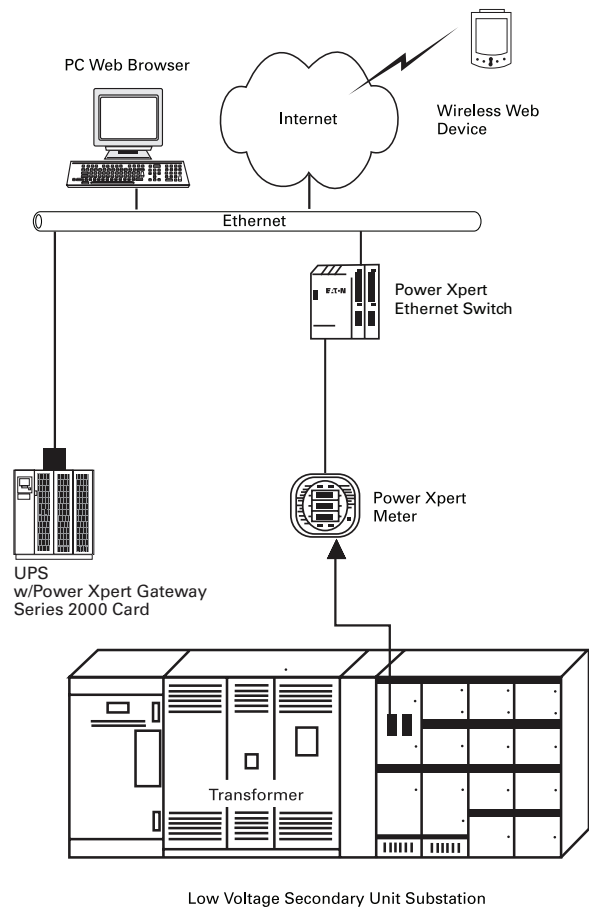
Standard Features

- Real-time monitoring of metered and alarm points
- Alarm history
- E-mail notification
- Communications settings via the Web

Small Installation with Smart Hardware

Functions/Devices

| Drawing Symbol | Function Description | Eaton Device |
|---|--------------------------------------|---|
| Monitoring Equipment | | |
| MM6GWP | Power Quality Meter Analyzer | Power Xpert Meter 4000/6000/8000 |
| MM4&P | Meter Monitor and Protection | IQ DP-4000 |
| MM | Meter Monitor | IQ 100/IQ 200 |
| SMM | Sub-Metering Module | IQ Energy Sentinel |
| Overcurrent/Short Circuit Protection | | |
| MVTU | Medium Voltage Relay (> 600V) | DT-3000, FP-5000 |
| LVTU | Low Voltage Trip Unit (≤ 600V) | Digitrip RMS-810, 910, 520 MC or 1150 Digitrip OPTIM 750 or 1050 |
| Motor Protection and Control | | |
| MPR | Motor Protective Relay | MP-3000 |
| MMS | Microprocessor Motor Starter | IT Starter |
| VFD | Variable Frequency Drive | SVX9000 |
| Central Monitoring Panels | | |
| BIM II | Breaker Interface Module II | BIM II (used with Digitrip OPTIM or Digitrip RMS) |
| LDISP | Local Display and Sub-network Master | Used with IQ Multipoint Energy Submeter II or with Energy/Power Sentinels |
| Other Devices | | |
| ATS | Automatic Transfer Switch | IQ Transfer |
| RTD | Resistance Temperature | Universal RTD Module |
| ADR | Addressable Relay | ADRII |
| C | Product Communication Device | IPONI |
| R | Resistor-End of Line | Resistor |
| ■ | Terminal Block | IP, IN, IS Terminal Designation |
| | Factory Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| | Field Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| ———— | Field Ethernet Backbone | CAT5 or multimode fiber |



Level 1—Using Power Xpert Gateways**Example Applications**

Low and medium voltage switchgear, motor control centers and third-party equipment via Modbus RTU. Recommendation: Use one Power Xpert Gateway device per electrical assembly or switchgear sub-section.

Description

Configuration Level 1 offers an easy means to Web-enable multiple Eaton devices and third-party devices that support Modbus RTU.

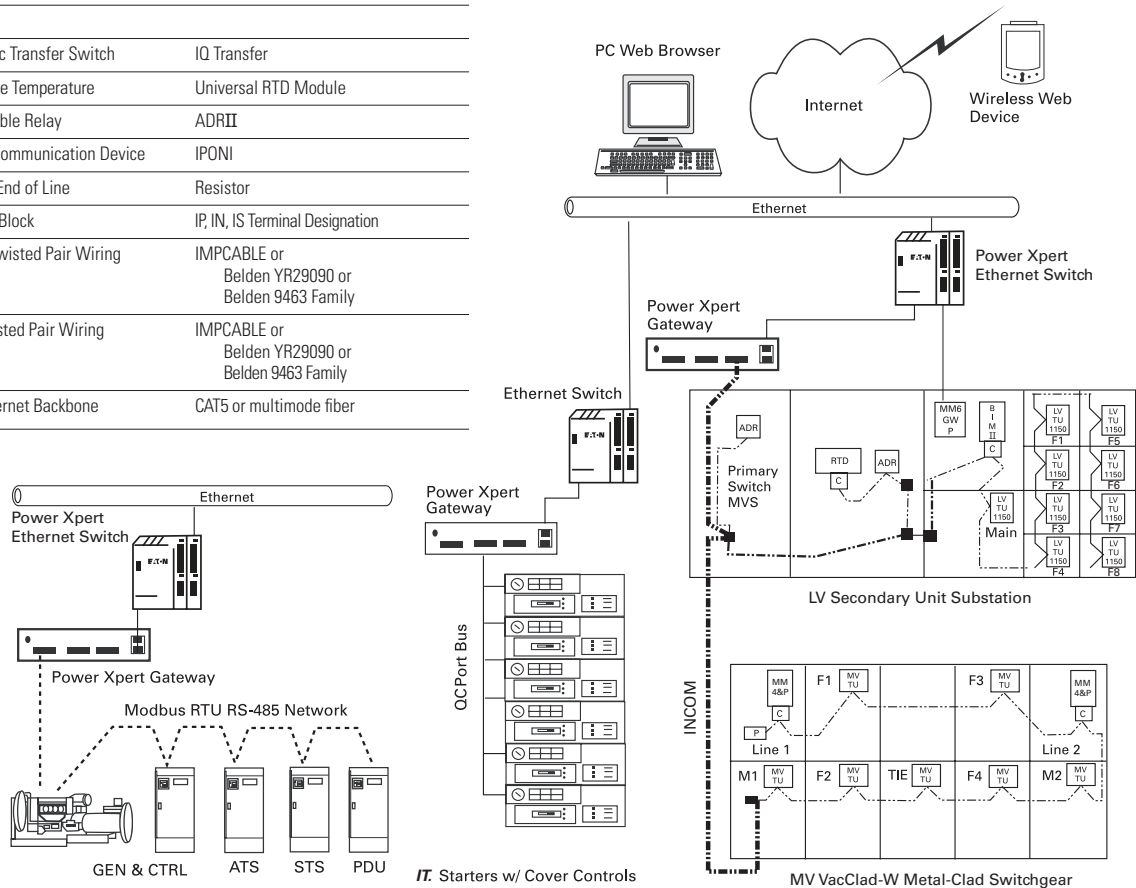
Standard Features

- Real-time monitoring of metered and alarm points
- Communications settings via the Web
- Alarm history
- E-mail notification

Power Xpert Gateway

Functions/Devices

| Drawing Symbol | Function Description | Eaton Device |
|---|--------------------------------------|---|
| Monitoring Equipment | | |
| MM6GW | Power Quality Meter Analyzer | Power Xpert Meter 4000/6000/8000 |
| MM4&P | Meter Monitor and Protection | IQ DP-4000 |
| MM | Meter Monitor | IQ 100/IQ 200 |
| SMM | Sub-Metering Module | IQ Energy Sentinel |
| Overcurrent/Short Circuit Protection | | |
| MVTU | Medium Voltage Relay (> 600V) | DT-3000, FP-5000 |
| LVTU | Low Voltage Trip Unit (≤ 600V) | Digitrip RMS-810, 910, 520 MC or 1150 Digitrip OPTIM 750 or 1050 |
| Motor Protection and Control | | |
| MPR | Motor Protective Relay | MP-3000 |
| MMS | Microprocessor Motor Starter | IT Starter |
| VFD | Variable Frequency Drive | SVX9000 |
| Central Monitoring Panels | | |
| BIM II | Breaker Interface Module II | BIM II (used with Digitrip OPTIM or Digitrip RMS) |
| LDISP | Local Display and Sub-network Master | Used with IQ Multipoint Energy Submeter II or with Energy/Power Sentinels |
| Other Devices | | |
| ATS | Automatic Transfer Switch | IQ Transfer |
| RTD | Resistance Temperature | Universal RTD Module |
| ADR | Addressable Relay | ADRII |
| C | Product Communication Device | IPONI |
| R | Resistor-End of Line | Resistor |
| ■ | Terminal Block | IP, IN, IS Terminal Designation |
| | Factory Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| | Field Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| ———— | Field Ethernet Backbone | CAT5 or multimode fiber |



Level 2—Power Xpert Software**Example Applications**

All Eaton devices and third-party devices that support Modbus TCP and SNMP in addition to third-party Modbus RTU devices via the Power Xpert Gateway.

Description

Configuration Level 2 offers an easy means to Web-enable and centrally manage all Eaton devices that can be connected directly to an Ethernet network or via a Power Xpert Gateway device. Power Xpert Software provides a rich set of standard features, as well as premier value add-on option modules.

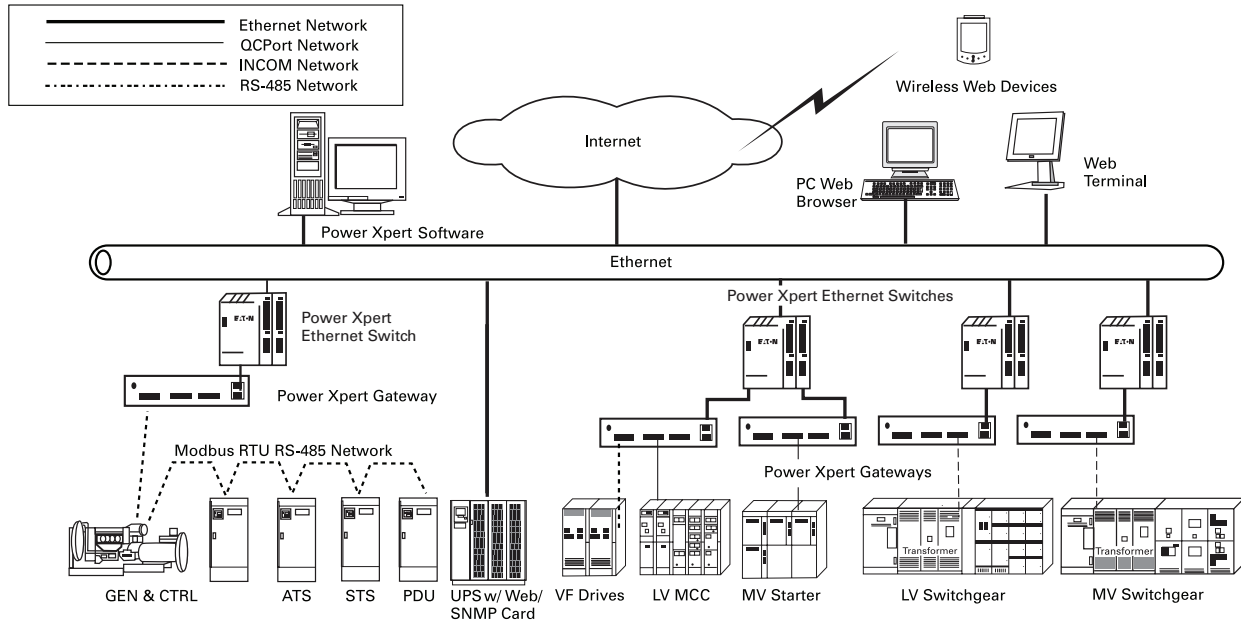
Standard Features

- Real-time monitoring of metered and alarm points
- Full color Web-based graphics package with standard views for all Eaton devices
- E-mail notification
- Data trending and graphing

Optional Add-on Features

- Web-based graphics editor to design floor plan and third-party device views
- Energy consumption analysis and tenant billing
- Power quality analysis and waveform viewing
- Modbus TCP tool to import register maps from various third-party devices
- SNMP tool to compile SNMP MIB (Management Information Base) files from various third-party devices

Power Xpert Software



Functions/Devices

| Drawing Symbol | Function Description | Eaton Device |
|---|--------------------------------------|---|
| Monitoring Equipment | | |
| MM6GWP | Power Quality Meter Analyzer | Power Xpert Meter 4000/6000/8000 |
| MM4&P | Meter Monitor and Protection | IQ DP-4000 |
| MM | Meter Monitor | IQ 100/IQ 200 |
| SMM | Sub-Metering Module | IQ Energy Sentinel |
| Overcurrent/Short Circuit Protection | | |
| MVTU | Medium Voltage Relay (> 600V) | DT-3000, FP-5000 |
| LVTU | Low Voltage Trip Unit (≤ 600V) | Digitrip RMS-810, 910, 520 MC or 1150/Digitrip OPTIM 750 or 1050 |
| Motor Protection and Control | | |
| MPR | Motor Protective Relay | MP-3000 |
| MMS | Microprocessor Motor Starter | IT Starter |
| VFD | Variable Frequency Drive | SVX9000 |
| Central Monitoring Panels | | |
| BIM II | Breaker Interface Module II | BIM II (used with Digitrip OPTIM or Digitrip RMS) |
| LDISP | Local Display and Sub-network Master | Used with IQ Multipoint Energy Submeter II or with Energy/Power Sentinels |
| Other Devices | | |
| ATS | Automatic Transfer Switch | IQ Transfer |
| RTD | Resistance Temperature | Universal RTD Module |
| ADR | Addressable Relay | ADRII |
| C | Product Communication Device | IPONI |
| R | Resistor-End of Line | Resistor |
| ■ | Terminal Block | IP, IN, IS Terminal Designation |
| ----- | Factory Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| ----- | Field Twisted Pair Wiring | IMPCABLE or Belden YR29090 or Belden 9463 Family |
| ----- | Field Ethernet Backbone | CAT5 or multimode fiber |

Level 3—Eaton Electrical Services & Systems (EESS) Customized Software Solutions

Available Applications

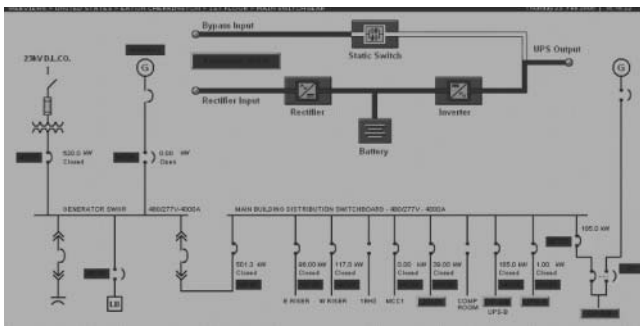
Any manufacturer's equipment that is supported by the EESS extensive device driver support list or request a custom quotation to obtain support.

Description

Configuration Level 3 offers an extensive service offering for the delivery of customized graphics and support for third-party proprietary device driver support.

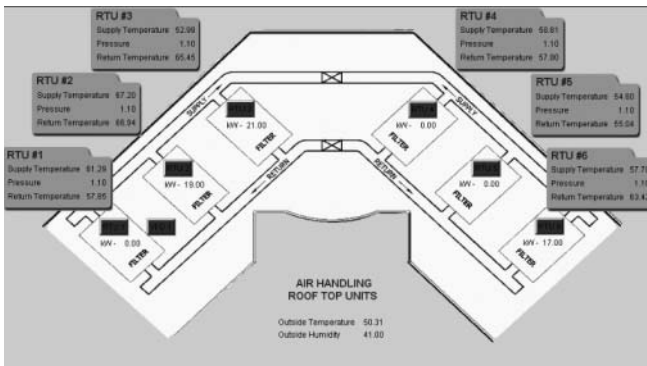
Enhanced Features

- Customized one-line diagrams to portray realistic operation of the complete power distribution system



Power Distribution System One-Line Diagram

- Customized navigation systems to allow the operator to navigate the software in a similar paradigm that is consistent with the way they would describe their organization with a functional or departmental standpoint



Customized Navigation System

Power Xpert Software



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Power Xpert Software

Product Description

Power Xpert Software is the fusion of key components of PowerNet and PowerVision Software into a single power monitoring package, which includes ease of interconnectivity to a wide range of Eaton and third-party communicating devices.

Power Xpert Software provides an easy upgrade path to allow existing PowerNet users to enjoy the benefits of power monitoring through a simple Web browser interface. It provides a complete software solution to manage your power system. Critical components such as metering devices, protective relays, circuit breaker trip units, motor starters and uninterruptible power supplies communicate vital information about the health and status of critical infrastructure devices.

Product Selection Guide

Power Xpert Software Professional Edition

- Geared toward end users, with built-in support for Eaton power distribution products such as switchgear, UPSs, breakers, PDUs, RPPs, meters, relays, VFDs and MCCs, among others
- Eaton products connect with the software directly via an Ethernet connection, while legacy devices use a Power Xpert Gateway to Web-enable their communications
- A subset of third-party meters and devices are supported as standard via the gateway connection

Power Xpert Software Enterprise Edition

- Geared toward advanced power users, system integrators and enterprises with heterogeneous device spectrum and system developers who can take advantage of the included SNMP and Modbus integration development utilities
- Extensive support for third-party devices via standard SNMP and Modbus TCP protocols
- Large variety of ready made, optional third-party drop in drivers available

Power Xpert Software Features

| Feature Sets | Power Xpert Software Professional Edition | Power Xpert Software Enterprise Edition |
|--|---|---|
| Server module | ■ | ■ |
| Trend viewer module | ■ | ■ |
| Layout manager module | ■ | ■ |
| Quality manager module | ■ | ■ |
| Eaton device support (switchgear, UPSs, breakers, ePDUs, meters, relays, VDFs, MCCs, etc.) | ■ | ■ |
| Power Xpert Gateway third-party device support | ■ | ■ |
| SNMP connector | | ■ |
| Modbus connector | | ■ |
| Optional third-party driver support | | ■ |
| Custom third-party device driver support | | ■ |

Features and Benefits

Power Xpert Software

| Feature | Benefit |
|--|--|
| General | |
| Web browser user interface | There is no need to install a separate client piece of software on your computer. Simple and easy access via Web browser from any location in the world. |
| Web-based monitoring capabilities | Monitor all power system equipment through the Internet. |
| Downloadable software version updates | Receive the latest enhancements and versions via downloads available from Eaton's Web site. |
| Event Notification | |
| Event notification via e-mail notification | Receive automatic e-mails when events are triggered. |
| Event notification via pagers, text message or third-party interfaces | Receive alarms on event changes via pagers, text message or third-party interfaces. |
| Alarm state management | Acknowledge, clear and close alarms through Power Xpert Software. |
| Event indicator displayed without Web page active | The Web page you are on does not need to be active to display the event indicator. |
| Alarm/event searching and filtering | Conveniently search and filter alarms and events to quickly find what you are looking for. |
| Waveform attached to applicable power event | Waveforms captured by meters are attached to actual power events, making them easy to understand and interpret. |
| Web browser based waveform viewing | There is no need to install a separate waveform viewer on your computer. Waveforms can be easily reviewed right in your Web browser. |
| Alarm capabilities based on device driven events | Alarms and triggered events come to the software directly from the associated devices, eliminating false alarms. |
| Analysis and Trending | |
| Graphic Trend Viewer | Displays power system device measurements in an easy-to-understand graphical chart format. |
| Chart or data option selection | Conveniently view the data in either spreadsheet type data format or a graphic line chart plot. |
| Multiple trends display | Displaying multiple trends at a time helps analyze event ramifications and impact in more detail. |
| Multiple axis support | Multiple trends can be plotted on multiple x and y axis, displaying pertinent time and scale information. |
| View multiple variables (i.e., Ia, Ib, Ic, Vab, Vbc, etc.) for a single waveform | Multiple waveform variables can be viewed at a time, eliminating the need of changing views frequently. |
| Standard COMTRADE file format support | View, import and open any waveform captures in standard IEEE® (C37.111-1999) COMTRADE file format. |
| Customizable Trend Viewer look and feel | The formatting of the data, and the look and feel of it can be easily customized according to user preferences. |
| Fixed or custom time frames | Information displayed in the Trend Viewer can have either system-defined fixed or user-selected custom time frames. |
| Trend analysis capabilities | Trends can be easily spotted and analyzed on screen or exported to third-party software for further analysis if necessary. |
| Data export | Trend data can be easily exported to Excel for further analysis. |
| Custom Graphics and Layouts | |
| Custom graphics development via Web browser | Customized Web pages can be easily developed using a plain Web browser, eliminating the need to install a separate application to be installed, learned and utilized. |
| Four user view example templates included as standard | Easily use 'as is' or modify as necessary: data center, plant, hospital and geographical layout templates. |
| iFrame capability | iFrames enable embedding browser portals into custom Web page layouts. |
| Browser Portal Widget support | Browser Portal Widgets can be embedded in iFrames to accommodate streaming media feeds. |
| Streaming media support | Multiple streaming media feeds can be embedded into a single Web page, utilizing iFrames technology. |
| Graphic object library included as standard | A large object library including most common power devices is embedded within the system, enabling the user to develop mimic screens from the start. |
| ISO® standard electrical picture objects available | Add ISO standard compliant graphics to one-line diagrams or other layouts for ISO compatibility. |
| Graphic files import capability | Import floor plans, street maps or photographs to be used as background images or mimic objects in Web pages. |
| Graphic object animation capability | Graphics can be animated based on event and threshold changes. An object could change color, for example, when a threshold is reached. |
| Gauge object library support | A multitude of gauges are provided in the standard object library to enable easy Web page custom measurement gauges design. |
| External Web links support | Add Web links to Power Xpert Software pages, which link to any device, Web page on the Internet and network around the globe with a Web user interface. |
| Alarm bubble-up support through several page layers | Alarms can be easily bubbled-up through multiple Web pages with the folder link feature. Event can be seen on the topmost page and the user can drill down for more information. |
| Trend object support | Trend objects can be embedded into the layout, enabling viewing the data directly in the Trend Viewer. |

Power Xpert Software, continued

| Feature | Benefit |
|---|--|
| UPS Shutdown | |
| File saving during shutdown | During an emergency shutdown due to an extended power failure outlasting the UPS battery, open files on the computer systems are closed and saved in an orderly fashion. |
| Automatic, orderly and sequential shutdown | All operating systems running Power Xpert Software Shutdown Agent will be shut down in an orderly and sequential fashion to prevent data loss. |
| Parallel redundant UPS shutdown capability | Built-in software logic will initiate shutdown only after UPS redundancy has been lost and the last UPS is out of runtime. |
| Security and Administration | |
| Windows Authentication Security | Control access to Power Xpert Software via Windows® Authentication Service. |
| Two-tier secure system access support | Access the Power Xpert Software with read or write privileges to prevent unauthorized tampering. |
| SSL | Supported via OpenSSL. |
| Secure Web browser access (support for HTTPS) | Supported via OpenSSL. |
| Time Synchronization | |
| Time synchronization support for connected devices with 1 millisecond time resolution | Millisecond-based timestamp support (when supported by connected device) enables understanding the sequence of rapidly occurring events. |
| Export and Integration | |
| Extended Excel® spreadsheet support | Open report files directly in Excel. |
| SQL database query support | Power Xpert uses standard SQL database format that can be queried by third-party applications for system integration and data exchange. |
| Logs | |
| System Log | The System Log gathers information on system-level events for error and security purposes. |
| Error Log | The Error Log gathers information on errors occurred for diagnostic purposes. |
| Service | |
| Eaton help desk services (1-877-ETN-CARE) | Call Eaton to speak directly to a product specialist providing support for the software. |
| Turnkey startup service | Purchase a 1, 2 or 5-day startup service package from Eaton for turnkey system installation and configuration. |
| System Backup | |
| Power Xpert Software system backup | Easily back up Power Xpert software including configurations, user views and device setups. |
| Documentation and Training Videos | |
| System Administrator's Guide | Guides users on how to administer Power Xpert Software. |
| Power Xpert Software User's Guide | Detailed information of Power Xpert Software features and functionality along with screenshots and references. |
| Layout Manager Guide | Detailed information on how to use Layout Manager's features and functionality to create custom graphic system pages. |
| Quick Start Guide | Takes the guesswork out of initial software installation and configuration with clear step-by-step instructions on how to get started. |
| Power Xpert Software Introduction and Training Video | Learn the main features and functionality of Power Xpert Software by watching a hands-on video showing you how to install, configure and use the software. |
| Power Xpert Reporting Introduction and Training Video | Learn the main features and functionality of Power Xpert Reporting by watching a hands-on video showing you how to install and configure reporting. Included are step-by-step instructions on how create reporting hierarchies and pull data out of different databases. |

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 and product model. Please refer to the technical data sheet and user manual for detailed specifications.

Communication Protocol Support

| Communication Protocol | Description |
|-----------------------------------|---|
| Dry-contact/contact closure/relay | Contact closure support is enabled via various Eaton Gateway devices. Please refer to Power Xpert Software Hardware Compatibility List for details. |
| BACnet WS+ | BACnet WS+ |
| Modbus RTU | Modbus RTU |
| Modbus TCP | Modbus Protocol over TCP |
| TCP/IP | Transmission Control Protocol |
| SNMP | Simple Network Management Protocol |
| SMTP | Simple Mail Transfer Protocol |
| INCOM | Eaton Legacy Protocol |
| HTTP | Hypertext Transfer Protocol |
| HTTPS | Hypertext Transfer Protocol with SSL |
| SSL | Secure Sockets Layer |

Power Xpert Reporting—the perfect complement

Power Xpert Reporting helps bring information from the software together. Power Xpert Software brings together your power system information from around the floor to around the world—data and information that is invaluable. Power Xpert Reporting brings all the power system information together to compare, contrast and generally give you the big picture. Power Xpert Reporting provides a standard set of reports, including:

- **Data Center Efficiency Report:** A summary of data center infrastructure efficiency and power usage effectiveness, including such information as temperature and humidity, and energy consumption
- **Greenhouse Gas Report:** Captures the six offensive greenhouse gasses: Carbon Dioxide, Sulfur Dioxide, Nitrogen Oxide, Mercury, Methane and Nitrous Oxide broken down by selected locations within a facility
- **Utilities Report:** Captures consumption of water, air, gas, electricity and steam (WAGES)
- **Capacity Summary Report:** The summary of top- and bottom-loaded circuits, as well as loading details for each circuit according to user-defined date/time range and facility hierarchy location
- **Branch Circuit Monitoring Report:** Determine branch circuit loading levels at a glance with color-coded graphics indicating loading status against capacity. Redundant sources can be reviewed, as well as single source loads
- **Energy Summary Report:** The summary of consumption (kWh) and demand (kW) for a user-defined date/time range and facility hierarchy location
- **Energy Cost Allocation Report:** The total energy bill dollar value or a cost per kWh across a facility hierarchy for a user-defined date/time range
- **Power Quality Report:** The distribution and trend for amps, volts and THD according to user-defined date/time ranges and facility hierarchy location
- **Event Summary Report:** Provides a Pareto chart of events according to user-defined date/time ranges and facility hierarchy location
- **Joint Commission Report:** Standard Joint Commission compliant report supports hospital power test requirements. It checks events, key metrics of generators and automatic transfer switches (ATS) during generator testing at user-defined date/time ranges and facility hierarchy location



Product Selection

Power Xpert Software

| Description | Catalog Number |
|---|--------------------|
| Power Xpert Software Professional Edition | |
| Power Xpert Software Professional Edition | PXS-PRO |
| Power Xpert Software Professional Edition w/ 1-day startup | PXS-PROn1S |
| Power Xpert Software Professional Edition w/ 2-day startup | PXS-PROn2S |
| Power Xpert Software Professional Edition w/ 5-day startup | PXS-PROn5S |
| Power Xpert Software Professional Edition and Power Xpert Reporting | PXS-PROnPXR |
| Power Xpert Software Enterprise Edition | |
| Power Xpert Software Enterprise Edition | PXS-ENT |
| Power Xpert Software Enterprise Edition w/ 1-day startup | PXS-ENTn1S |
| Power Xpert Software Enterprise Edition w/ 2-day startup | PXS-ENTn2S |
| Power Xpert Software Enterprise Edition w/ 5-day startup | PXS-ENTn5S |
| Power Xpert Reporting | |
| Power Xpert Reporting—single source DB connection | PXR |
| Power Xpert Reporting—up to 2 source DB connections | PXR-2DB |
| Power Xpert Reporting—up to 5 source DB connections | PXR-5DB |
| Power Xpert Reporting—up to 10 source DB connections | PXR-10DB |
| Power Xpert Reporting—up to 25 source DB connections | PXR-25DB |
| Power Xpert Reporting—up to 50 source DB connections | PXR-50DB |
| Service Packs | |
| Power Xpert 1-day startup Service Pack | PX-1S |
| Power Xpert 2-day startup Service Pack | PX-2S |
| Power Xpert 5-day startup Service Pack | PX-5S |

Technical Data and Specifications

Hardware Requirements

Power Xpert Software (PXS) requires a server-class machine with the following minimum hardware specifications:

| Hardware | Specification |
|-------------------------------------|---|
| Processor | 2.8 GHz, dual-core processor |
| Memory | 2 GB allocated for PXS (allocate 3 GB of memory to a virtual machine session running PXS) |
| Disk space required for application | The PXS application itself requires 190 MB of disk storage |
| Disk space required for database | A typical database will grow to 2 GB within a year. If you have a large number of devices, reserve additional storage space |
| Video resolution | 1280 by 1024 pixels or higher |
| Removable media | DVD R0 drive |

You may wish to add the following hardware as well:

- Local printer
- Sound card (if sounds are assigned to specific alarm conditions)
- Modem (for remote alarm notification to machines not available via your network)

Software Requirements

Supported operating systems

- Microsoft® Windows Server 2003 R2 (Standard or Enterprise) 32-bit edition
- Microsoft Windows XP Professional (32-bit) with Service Pack 3, 32-bit
- Windows Server 2008 (Standard or Enterprise), 32-bit or 64-bit
- Windows Server 2008 R2 (Server or Enterprise), 32-bit or 64-bit
- Windows 7 Professional, Ultimate or Enterprise editions, either 32-bit or 64-bit

Software components

- IIS 5.0 or higher (must be installed prior to installing PXS; for Windows 7 and Windows Server 2008, this is installed automatically)
- Microsoft Internet Explorer® 7.0 or 8.0

Third-Party Software Installed

The following Microsoft software is also installed during the PXS installation.

- .NET Framework 3.5 SP1
- Windows Installer 4.5
- C++ Runtime Library 2008
- Microsoft Data Access 2.8
- SQL Server 2008 Express SP2
- SQL Server 2005 Express Management Studio SP2

Metering Products Family



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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 Software. 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

Power Xpert Meter 4000/6000/8000 Series



Power Xpert Meter 2000 Series



IQ 250/260 Series



Device Name
Accessories
See Page 274

| Section Page Number | 186 | 205 | 216 |
|--------------------------------------|---|---|---|
| Electrical Parameters | | | |
| Volts | 0.1% of reading + 0.02% FS | 0.1% of reading | 0.1% of reading |
| Amperes | 0.05% of reading + 0.01% FS | 0.1% of reading | 0.1% of reading |
| Current range (% of nominal) | 0.005–20A (400%) | 0.1–200% | 0.1–200% |
| Watts | 0.1% of reading + 0.0025% FS | 0.2% of reading | 0.2% of reading |
| Vars | 0.1% of reading + 0.0025% FS | 0.2% of reading | 0.2% of reading |
| VA | 0.1% of reading + 0.0025% FS | 0.2% of reading | 0.2% of reading |
| PF-apparent | 0.1% | 0.2% of reading | 0.2% of reading |
| PF-displacement | 0.1% | — | — |
| Frequency | ± 0.01 Hz | ± 0.03 Hz | ± 0.03 Hz |
| THD-voltage | 127th | 40th ^{②③} | 40th ^④ |
| THD-current | 127th | 40th ^{②③} | 40th ^④ |
| Watt-hours | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| VAR-hours | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| VA-hours | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| Ampere-demand | 0.05% of reading + 0.01% FS | ± 0.1% per ANSI C12.20 0.2 Class | ± 0.1% per ANSI C12.20 0.2 Class |
| Watt-demand | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| VAR-demand | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| VA-demand | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① | ± 0.2% per ANSI C12.20 0.2 Class ^① |
| Revenue accuracy | ± 0.2% per ANSI C12.20 0.2 Class ^① | ANSI C12.20 (0.2%) | ANSI C12.20 (0.2%) |
| Individual ampere harmonics | 85th ^⑤ | 40th ^③ | — |
| Individual voltage harmonics | 85th ^⑤ | 40th ^③ | — |
| Interharmonics | Yes | — | — |
| Minimum and/or Maximum Values | | | |
| Volts | L-L, L-N, N-G, VAUX L-L | L-L, L-N | L-L, L-N |
| Current | A, B, C, N, G | A, B, C, N | A, B, C |
| Power | Watt, VAR, VA | Watt, VAR, VA | Watt, VAR, VA |
| Power Factor | Apparent/displacement | Apparent | Apparent |
| Frequency | Hertz | Hertz | Hertz |
| THD | Amperes/volts (L-L, L-N, AUX L-L) | Amperes/volts ^{②③} | Amperes/volts ^④ |
| Demand values | kW, kVAR, kVA, amperes | kW, kVAR, kVA, amperes | kW, kVAR, kVA, amperes |
| Trend analysis | 2 / 4 ^⑥ / 8 ^⑦ GB | 256 / 512 ^② / 768 ^③ MB | ^⑧ |
| Event logging | 2 / 4 ^⑥ / 8 ^⑦ GB | 100,000 alarms/events with timestamp | ^⑧ |
| Disturbance recording | 2 / 4 ^⑥ / 8 ^⑦ GB 60 cycles per event | — | — |

Notes

- ① Under typical operating conditions.
- ② PXM 2260 only.
- ③ PXM 2270 only.
- ④ IQ 260 only.
- ⑤ Individual values reported to 85th harmonic; anti-alias filtering prevents higher frequencies from distorting readings (see IEC61000-4-7).
- ⑥ PXM6000 only.
- ⑦ PXM8000 only.
- ⑧ 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

Power Xpert Meter 4000/6000/8000 Series



Power Xpert Meter 2000 Series



IQ 250/260 Series



Device Name
Accessories
See Page 274

Section Page Number

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Other Features

| | | | |
|--------------------------------|--|---|--|
| Storage | 2 / 4 ^① / 8 ^② GB | 256 / 512 ^③ / 768 ^④ MB Standard | — |
| PG output relays | 5 maximum | Optional (2) Form C, 5 A or (4) Form A, 120 mA | Optional (2) Form C, 5 A or (4) Form A, 120 mA |
| PG analog outputs | — | Optional (4) 4–20 mA or (4) 0–1 mA | Optional (4) 4–20 mA or (4) 0–1 mA |
| Discrete contact inputs | 8 | Optional (2) or (4) | Optional (2) or (4) |
| Analog inputs | — | — | — |
| Synch-input kW utility | Via status input | Via end of interval pulse with optional digital inputs | Via end of interval pulse with optional digital inputs |
| Auxiliary voltage ^⑤ | Yes | — | — |
| kWh pulse initiator | Yes | Yes | Yes |
| Waveform display | Local/computer | ^⑥ | — |
| Waveform capture | Yes | — | — |
| Frequency distribution display | — | — | — |
| Display type | LCD | Red LED | Red LED |
| Display lines/character | Graphic (320 x 240 pixels) | 3 lines, 4 characters | 3 lines, 4 characters |
| Display character height | 5.5 mm H x 4 mm W | 0.56 (14.2) H | 0.56 (14.2) H |
| Communications | Serial: Modbus RTU, Modbus ASCII Network: Modbus TCP, Ethernet TCP/IP, HTTP, SNMP, SMTP, FTP | Serial: Modbus RTU, Modbus ASCII, DNP 3.0 Network: Modbus TCP, Ethernet TCP/IP, HTTP, HTTPS, SNMP, SMTP | Serial: Modbus RTU, Modbus ASCII, DNP 3.0 Network: Modbus TCP via Power Xpert Gateway |
| Setup configuration | Via Web Browser/Display | Via Web Browser/Display | Via configuration software/display |
| Dimensions | Refer to TD02601007E | Refer to TD02601017E | Refer to TD02601016E |
| Operating temperature range | –20° to 60°C display unit –20° to 70°C Meter Base Unit | –20° to 70°C | –20° to 70°C |

Notes

- ① PX6000 only.
- ② PX8000 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.

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

IQ Analyzer 6000 Series



IQ DP-4000 Series



IQ 210/220/230 Series



Device Name
Accessories
See Page 274

Section Page Number

227

235

241

Electrical Parameters

| | | | |
|------------------------------|----------------------|------------|---------------------|
| Volts | ± 0.2% FS ① | ± 0.3% FS | ± 0.5% FS |
| Amperes | ± 0.2% FS ① | ± 0.3% FS | ± 0.5% FS |
| Current range (% of nominal) | 3–800% | 10–250% | 1–200% |
| Watts | 0.4% FS, 6 Reading ② | ± 0.6% FS | ± 0.40% FS |
| VARs | 0.4% FS, 6 Reading ③ | ± 0.6% FS | ± 1.0% FS |
| VA | 0.4% FS, 6 Reading ② | ± 0.6% FS | ± 1.0% FS |
| PF-apparent | 0.8% FS ① | ± 1.0% FS | ± 2.0% FS |
| PF-displacement | 0.8% FS ① | ± 1.0% FS | ± 2.0% FS |
| Frequency | 0.04% ① or 0.01 Hz | ± 0.17% FS | ± 0.1% Hz |
| THD-voltage | 50th | 31st | — |
| THD-current | 50th | 31st | — |
| Watt-hours | 0.5% reading ② | ± 0.6% FS | ± 1.0% per ANSI C12 |
| Var-hours | 1% reading ③ | ± 0.6% FS | ± 1.0% per ANSI C12 |
| VA-hours | 0.5% reading ② | ± 0.6% FS | ± 1.0% per ANSI C12 |
| Ampere-demand | ± 0.2% FS ① | ± 0.3% | ± 0.5% per ANSI C12 |
| Watt-demand | ± 0.4% FS ① | ± 0.6% | ± 1.0% per ANSI C12 |
| VAR-demand | ± 0.4% FS ① | ± 0.6% | ± 1.0% per ANSI C12 |
| VA-demand | ± 0.4% FS ① | ± 0.6% | ± 1.0% per ANSI C12 |
| Revenue accuracy | ANSI C12.20 (0.5%) | — | ANSI C12.1 (1%) |
| Individual ampere harmonics | 50th | — | — |
| Individual voltage harmonics | 50th | — | — |
| Interharmonics | — | — | — |

Minimum and/or Maximum Values




| | | | |
|-----------------------|------------------------|-----------------------|-----------------------|
| Volts | L-L, L-N | L-L, L-N | L-L, L-N |
| Current | A, B, C, N, G | A, B, C | A, B, C |
| Power | Watt, VAR, VA | Watt, VAR, VA | Watt, VAR, VA |
| Power factor | Apparent/displacement | Apparent/displacement | Apparent/displacement |
| Frequency | Hertz | Hertz | Hertz |
| THD | Amperes/volts | Amperes/volts | — |
| Demand values | All | All | All |
| Trend analysis | Time/date | 2 alarms | ④ |
| Event logging | 504 events w/timestamp | ④ | ④ |
| Disturbance recording | 10 waveform events | — | — |

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

| | IQ Analyzer 6000 Series  | IQ DP-4000 Series  | IQ 210/220/230 Series  |
|---|--|--|--|
| Device Name Accessories See Page 274 | | | |
| Section Page Number | 227 | 235 | 241 |
| Other Features | | | |
| Storage | 90 kB | 15 parameters | — |
| PG output relays | (4) 10 A Form C ① | (3) 10 A Form C ② | (2) 100 mA Form A ③ |
| PG analog outputs | (4) 0–10/4–20 mA | — | — |
| Discrete contact inputs | (3) + 30 Vdc differential | (1) kW Demand ② | (2) +30 Vdc differential ③ |
| Analog inputs | (1) 0–20/4–20 mA | — | (1) 4–20 mA ③ |
| Synch-input kW Utility | At device or via communications | At device or via communications ② | Via communications only ④ |
| Auxiliary voltage | — | — | — |
| kWh pulse initiator | Yes | Yes ② | Yes ④ |
| Waveform display | Local ②/computer | — | — |
| Waveform capture | Yes | — | — |
| Frequency distribution display | Local ②/computer | — | — |
| Display type | Graphic LCD with LED backlight | 7 Segment LED | Backlit LCD |
| Display lines/character | 7 lines, 147 characters | 1 line, 7 characters | 4 lines, 20 characters |
| Display character height | Up to 7 lines | 1 line | 1.60 (40.6) H x.09 (2.3) W |
| Communications | Serial: INCOM ⑤ Network: via Power Xpert Gateway ⑤ | Serial: INCOM ⑤ Network: via Power Xpert Gateway ⑤ | Serial: INCOM ④, Modbus RTU ⑥ Network: via Power Xpert Gateway |
| Setup configuration | Via configuration software/display | Via configuration software/display | Via configuration software/display |
| Dimensions | Refer to TD1702BTE | Refer to TD1703ATE | Refer to TD1706ATE |
| Operating temperature range | –20° to 70°C | –20° to 70°C | 0° to 50°C |

Notes

- ① Relays programmable to operate on any measured function.
- ② Optional.
- ③ IQ 230/230M only.
- ④ IQ 220 and IQ 230 models only.
- ⑤ An IPONI is required.
- ⑥ IQ 230M only.

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

Metering Selection Chart, continued

IQ 130/140/150 Series



IQ Multipoint Energy Submeter II



IQ Energy/Power Sentinel



Device Name
Accessories
See Page 274

Section Page Number

222

248

255

Electrical Parameters

| | | | |
|------------------------------|-------------------------------------|---------------------|-------------|
| Volts | 0.25% of reading | ± 0.5% FS | ± 0.5% FS ① |
| Amperes | 0.25% of reading | — | ± 0.5% FS ① |
| Current range (% of nominal) | 0.1–200% | — | — |
| Watts | 0.5% of reading ② | ± 1.0% FS | ± 1.0% FS |
| VARs | 0.5% of reading ② | — | ± 1.0% FS ① |
| VA | 0.5% of reading ② | — | ± 1.0% FS ① |
| PF-apparent | 0.5% of reading ② | — | ± 2.0% FS ① |
| PF-displacement | — | — | ± 2.0% FS ① |
| Frequency | ± 0.03 Hz ② | — | ± 0.1% FS ① |
| THD-voltage | — | — | — |
| THD-current | — | — | — |
| Watt-hours | ± 0.2% per ANSI C12.20 0.5 Class ③ | ± 1.0% per ANSI C12 | ± 1.0% FS |
| VAR-hours | ± 0.5% per ANSI C12.20 0.5 Class ③ | — | — |
| VA-hours | ± 0.5% per ANSI C12.20 0.5 Class ③ | — | — |
| Ampere-demand | ± 0.25% per ANSI C12.20 0.5 Class ③ | — | — |
| Watt-demand | ± 0.5% per ANSI C12.20 0.5 Class ③ | ± 1.0% per ANSI C12 | ± 1.0% FS |
| VAR-demand | ± 0.5% per ANSI C12.20 0.5 Class ③ | — | — |
| VA-demand | ± 0.5% per ANSI C12.20 0.5 Class ③ | — | — |
| Revenue accuracy | ANSI C12.20 (0.5%) | ANSI C12.1 (1%) | — |
| Individual ampere harmonics | — | — | — |
| Individual voltage harmonics | — | — | — |
| Interharmonics | — | — | — |

Minimum and/or Maximum Values




| | | | |
|-----------------------|--------------------------|---|---|
| Volts | L-L, L-N | — | — |
| Current | A, B, C | — | — |
| Power | Watt, VAR, VA ② | — | — |
| Power factor | Apparent ② | — | — |
| Frequency | Hertz ② | — | — |
| THD | — | — | — |
| Demand values | kW, kVAR, kVA, amperes ③ | — | — |
| Trend analysis | ④ | ④ | ④ |
| Event logging | ④ | ④ | ④ |
| Disturbance recording | — | — | — |

Notes

- ① IQ Power Sentinel only.
- ② IQ 140/150 only.
- ③ IQ 150 only.
- ④ At computer only.

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

Metering Selection Chart, continued

| |  IQ 130/140/150 Series |  IQ Multipoint Energy Submeter II |  IQ Energy/Power Sentinel |
|--------------------------------|--|---|---|
| Device Name | | | |
| Accessories | | | |
| See Page 274 | | | |
| Section Page Number | 222 | 248 | 255 |
| Other Features | | | |
| Storage | — | — | — |
| PG output relays | — | — | — |
| Discrete contact inputs | — | — | — |
| Analog inputs | — | — | — |
| Synch-input kW utility | — | Via communications only | Via communications only |
| Auxiliary voltage | — | — | — |
| kWh pulse initiator | ① | — | — |
| Waveform display | — | — | — |
| Waveform capture | — | — | — |
| Frequency distribution display | — | — | — |
| Display type | Red LED | — | — |
| Display lines/character | 3 lines, 4 characters | — | — |
| Display character height | 0.56 (14.2) H | — | — |
| Communications | Serial: Modbus RTU, Modbus ASCII ① Network: via Power Xpert Gateway | Serial: INCOM Network: via Power Xpert Gateway | Serial: INCOM Network: via Power Xpert Gateway |
| Setup configuration | Via configuration software | Via configuration software | Via configuration software |
| Dimensions | Refer to TD02601015E | Refer to TD17C02TE | Refer to TD1707TE |
| Operating temperature range | -20° to 70°C | -25° to 70°C | -25° to 70°C |

Note

① Optional.

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

Power Xpert 4000/6000/8000 Series Display and Meter



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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 graphic 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 graphic display uses a simple “twist and click” navigation control dial to easily navigate the menus and drill down into increasing levels of important detail. A “back” key enhances the browser-like navigation of the graphic display.

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 191** 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-1582
- Immunity IEC 61326
- CE Mark



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 191**.

- 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% reading + 0.025%FS
- Voltage: 0.1 % reading + 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 browser connection)

Optional

- Selectable 100FX or 10/100Base-T Ethernet network port
- RS-485 Modbus RTU selectable master/ slave port
- RS-232 Modbus RTU slave port

Graphic Display

Note: Display ports provide access to up to 16 Power Xpert 4000/6000/8000 Meter modules located on the display RS-485 network.

- RS-485 meter display network port
- RJ-45 10/100Base-T for access to Local Display Power Xpert network

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 (-99)

Physical Characteristics

Two-Piece Design

- Power Xpert 4000/6000/8000 Meter modules
- Power Xpert Meter 4000/6000/8000 Graphic Display 320 x 240 pixel backlight LCD remote graphics display (supports up to 16 Power Xpert 4000/6000/8000 Meter modules)

Display/Meter Mounting Options

- Display remotely mounted up to 2000 ft (1219m) away from up to 16 Power Xpert Meter modules
- Display and Power Xpert Meter modules mounted together on opposite sides of a panel (15 additional meter modules can still be remotely mounted).

Meter Base Unit Characteristics

- NEMA rating: NEMA 1, IP3Ø

Display Unit Characteristics

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

Ease-of-Use—Power Xpert Meter 4000/6000/8000 Graphic Display (Option)

The Power Xpert Meter 4000/6000/8000 display features a large easy-to-read white backlit graphic LCD. The information presented by the display is organized into an information architecture that is easy-to-navigate and organized for simplicity. Screen navigation is accomplished using a navigation control dial and a “back” button. The user simply twists the knob on the navigation control dial to move between menu selections and drill down links on the screen. When the selection is highlighted, pressing the dial makes the selection. Information is displayed from a single meter or an RS-485 daisychain of up to 16 meters. The display features a rich set of screens including real-time data, trend plots, waveform views and an ITIC Plot. The graphic display allows basic device setup and password protected resets. An audible alarm is available to announce alarm conditions.

Power Xpert Meter 4000/6000/8000 Embedded Web Server

The Power Xpert Meter 4000/6000/8000 embedded Web server offers Eaton customers a new level of accessibility to the critical information required to manage their electrical distribution system. The Web server includes real-time circuit information in both numeric and graphical visual formats to help monitor circuit parameters such as current loading, voltage and power levels, power factor, THD, Flicker and more. The Web server also provides energy and demand readings with graphic usage plots to help analyze energy usage patterns. Energy readings include kWh, kVARh, delivered and received and kVAh with time of use and RTP displays. The interval energy usage plot includes the ability to do week-to-week and month-to-month energy consumption graphical comparisons for benchmarking purposes.

Both the Power Xpert Meter 4000/6000/8000 embedded Web server and the local graphic display support graphical trend charts of key circuit measurements such as current, voltage, power and energy. The trend chart supports a zoom feature that allows the user to view data over a short period of 16 hours up to 4 years. The trend chart includes zoom in/out buttons and a horizontal slider bar control to manage scrolling forward and backward through the data. Trend charts of basic readings include minimum, maximum and average readings. Trend charts of interval by interval energy data also display peak demand.

Note: For remote access and networking capabilities such as connecting to a LAN/WAN, use the optional Communications Expansion Card (CEC).

Sag/Swell/Transient Capture and Recording

60 cycles of waveform are oversampled at 4096 samples per cycle (Power Xpert Meter 4000/6000), filtered through anti-aliasing and recorded at 512 samples per cycle and post event data. The Power Xpert Meter 8000 samples at a rate of 100,000 samples per cycle. Embedded Web server supports viewing of triggered waveforms one channel at a time and includes the ability to zoom and to scroll horizontally using a slider bar.

The Power Xpert Meter 6000/8000 Series have preconfigured (600 volts and below) trigger settings for sags, swells and transients, and do not require additional setup by the user. Waveforms are stored in non-volatile flash memory using an industry standard COMTRADE format. Waveforms can be automatically sent out as COMTRADE attachments to an e-mail following an event, or can be retrieved from an FTP (File Transfer Protocol) directory structure in the Power Xpert meter module's memory.

Historical Trend Logging

The Power Xpert Meter 4000/6000/8000 records historical data for graphical viewing from the Local display or the embedded Web server. Graphical views of historical data support pan and zoom. 145 standard metering parameters are logged as part of the standard meter functionality including min./max. and average for each parameter. The averages are calculated over the interval period. The minimum and maximum readings are based on 200 ms calculations.

Storage capacity for standard trend plots includes all of the following intervals:

- Every 5 minutes for 48 hours (2 days)
- Every 15 minutes for 192 hours (4 days)
- Every hour for 28 days (4 weeks)
- Every 8 hours for 56 weeks
- Every week for 44 months

Note: Trend plot data can be easily exported to third-party applications, such as Microsoft Excel in csv-file format.

In addition, metered parameters are automatically stored on the built-in FTP Servers, where they can be easily copied and imported into third-party applications for benchmarking and analysis. Logs on the FTP Server include the min./max. and average for 145 standard metering parameters at 5-minute intervals.

Storage capacity for trend data:

- 6 days of 5-minute interval trend data
- Capacity=18,144 intervals

Energy Profile Data

The Power Xpert Meter 4000/6000/8000 records Real and Reactive energy forward, reverse, net and absolute sum, as well as Apparent energy (kVAH). Up to 8 status inputs can be configured as energy accumulators for counting KYZ pulse inputs (option). These readings are stored over a configurable interval from 1 to 60 minutes, as well as in daily and weekly totals.

With the optional LAN/WAN Ethernet Communication Expansion Card (CEC), users can easily configure the meters to send periodic e-mails at user-defined intervals of energy consumption and power demand. E-mails contain a summary of readings per rate structures and also have the actual measurements attached to the E-mail's body as a CSV file in a ZIP container.

In addition, metered parameters are automatically stored on the built-in FTP Server, where they can be easily copied and imported into third-party applications for benchmarking and analysis. Logs on the FTP Server include energy consumption logs, one for every month in CSV file format, trended measurement logs also in CSV file format and waveform captures in COMTRADE file format.

Storage capacity for energy profile data:

- 62 days of 15 minute interval energy and pulse interval data.
- Fixed interval capacity = 5952 intervals. Configurable intervals from 1 to 60 min
- 372 days of 1 day accumulated energy and pulse interval data
- 208 weeks of 1 week accumulated energy and pulse interval data

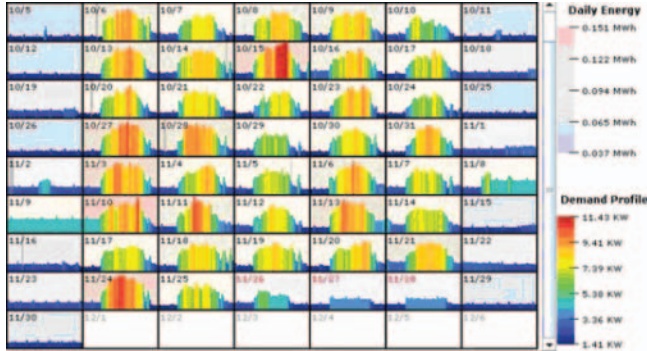
Energy and Demand Comparisons

Energy and demand usage patterns can be analyzed with the month-to-month, week-to-week comparison chart built into the meter. Raw data can be exported with the "Save Table" option to other applications, such as Excel, for further analysis and graphing.

Power Xpert Meter Profiler—Free Download

The Power Xpert Meter Profiler software allows you to compare “expected” energy consumption patterns to present usage and flag

areas of concern. It is also a predictor. It can predict what energy consumption would be expected later in a day.



Event Triggers

The Power Xpert Meter 4000/6000/8000 supports five types of configurable event triggers:

- Out of limits (4000/6000/8000)
- Demand overload (4000/6000/8000)
- Sub-cycle disturbance (4000/6000/8000)
- ITIC (6000/8000)
- Fast transient (8000)

These triggers permit pickup, reset and pickup delay to be configured by the user. When a trigger occurs, actions include Performance Monitoring (#9’s analysis), Capturing Waveform, Capture Parameters, Send E-mail and Operate a Relay Output. The Graphic Display flashes an LED to annunciate the alarm condition. An audible alarm is also available.

Trigger options include:

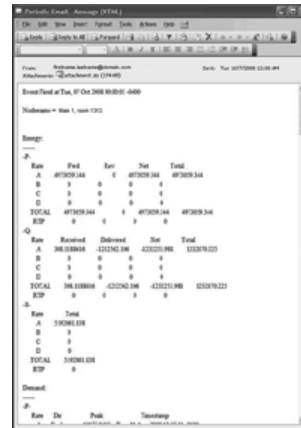
- Out of limits: over 100 triggers
- Demand overload: 10 triggers
- ITIC: 8 triggers
- Fast transient: dV/dT and absolute per phase
- Sub-cycle disturbance—dV/dT and absolute

Event Logging

The optional Power Xpert Meter 4000/6000/8000 Local graphic display or the embedded Web server both allow the user to view a list of triggered events along with any captured parameters, event details and triggered waveforms. In addition, a separate event log includes a variety of activities including acknowledged triggers, new min. and max. events, and system operations such as resets. The size of the event log is virtually unlimited based only on the memory option selected.

E-mail Notification

With the optional LAN/WAN Ethernet Communication Expansion Card (CEC) attached to the Power Xpert Meter 4000/6000/8000’s, the users can easily configure the meters to send periodic e-mails at user-defined intervals for energy consumption and power demand. E-mails contain a summary of readings per rate structures and also have the actual measurements attached to the E-mail’s body as a CSV file in a ZIP container. Prompt alarm e-mails can also be sent for any event condition either standard in the meter or ones set up by the user based on thresholds, dV/dt triggers or IO status changes with the optional IO Card. Alarm e-mails can be configured to have the COMTRADE waveform capture attached to the e-mail’s body.



Periodic E-Mail Message

ITIC Analysis Plot

The Power Xpert Meter graphic display (option) and Web server include a graphic representation of the ITIC plot (Power Xpert Meter 6000/8000) with counts of disturbances and transients that have occurred. The ITIC plot organizes events into 8 distinct disturbance zones corresponding to severity and a 9th zone for transients. A pass/fail count is displayed to indicate how many events are outside the ITIC limits. Clicking on any counter in the ITIC Web page will link the user to the event view and display all triggered events in the selected zone. This

makes it simple to view disturbance waveforms associated with the ITIC plot.

A separate ITIC graph is available to review individual ITIC events. This graph will show the user the event hit position on the graph and the event duration and magnitude.

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 600V
- CT ratios selectable from standard 120/600 Vac line
- CT inputs accept 5A secondary
- Power supply:
 - Standard 120/240 Vac or 110/250 Vdc
 - Low voltage 24–48 Vdc (contact Eaton for availability)

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

| Model | Memory | Event | File Size (KB) | Occurrence Per Month ^① | | Memory Usage (MB) | | Months of Capacity ^② | |
|---------|--------|--|----------------|-----------------------------------|--------|-------------------|--------|---------------------------------|--------|
| | | | | Typical | Severe | Typical | Severe | Typical | Severe |
| PXM4000 | 2 GB | Subcycle Disturbance | 1260 | 10 | 60 | 12.3 | 73.8 | 166 | 28 |
| PXM6000 | 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 |
| PXM8000 | 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

| Feature | Power Xpert Meter | | | Benefit |
|--|-------------------|-------------------|---------|--|
| | 4000 | 6000 | 8000 | |
| 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 e-mailing |
| 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 e-mail 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 |

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 | | | Benefit |
|--|-------------------|----------------|----------------|--|
| | 4000 | 6000 | 8000 | |
| 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 e-mail, 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 | | | Benefit |
|--|-------------------|------|------|---|
| | 4000 | 6000 | 8000 | |
| 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 |

Notes

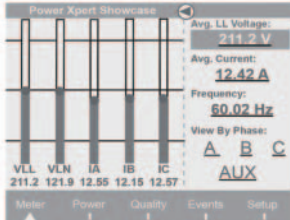
These specifications are subject to change without notice and represent the maximum capabilities of the product with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options, firmware version and product model. Please refer to the technical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

Power Xpert 4000/6000/8000 Graphic Display (Option) Features

A menu-driven graphical display with information organized into a user-friendly information architecture.

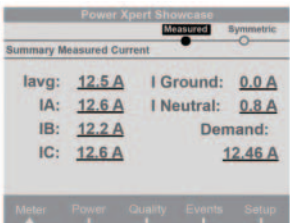
The homepage (see below) offers:

- Graphical level indicator based on a statistical analysis for three-phase line-to-line and line-to-neutral voltage and per phase currents to quickly indicate out of normal readings
- Large easy-to-read average L-L voltage average phase currents and system frequency can be highlighted and selected using the navigation control dial to drill down for additional detail
- Menu selections for meter, power, quality, events and setup are shown for ease of navigation into display for more detail, or basic device setup



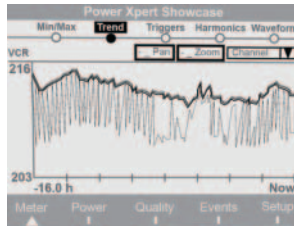
Homepage

Highlighting a field such as the avg. current value and pressing the navigation control dial brings up a detail screen like the one below.



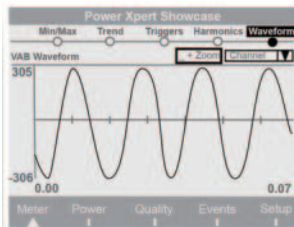
Current Summary

Highlighting an individual reading on the detail summary level screen and selecting it drills down to a level including links to min./max., historical trend plots, triggers, harmonic spectral data and waveform viewing. Selecting the trend plot for a given parameter displays a historical graph of the selected parameter over the last 16 hours. The zoom buttons change the time scale to one of several data views based on historical averages with min./max. The Pan button allows scrolling within the selected view.

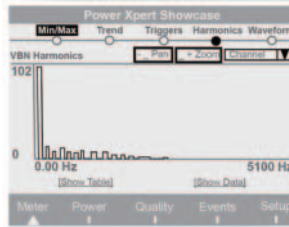


Trend Plot

Waveforms can be displayed for currents and voltages. The waveforms can be viewed on demand for steady-state conditions. Triggered waveforms can also be displayed to view sag/swell or transient data.

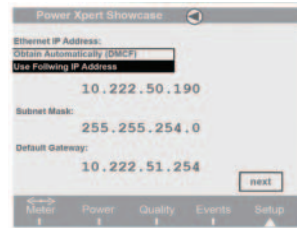


Waveform Viewer



Harmonic Spectrum

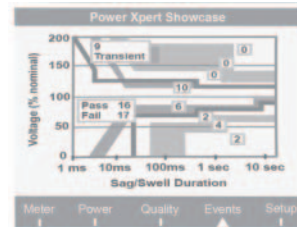
The harmonic spectral plot displays both harmonics and interharmonics up to the 85th order. A detailed table also includes individual magnitudes and angles of current and voltage harmonics, as well as a harmonic power calculation at each frequency.



Ethernet Settings

Ethernet and other settings can be input or verified via the Power Xpert Meter LCD display.

Note: Some of the other settings are specific only to the Web Browser GUI.



ITIC Plot (Power Xpert 6000/8000)

The Power Xpert Meter classifies disturbances and summarizes the results graphically using the ITIC plot. The number of ITIC sags and swells are indicated for each of nine severity levels. A pass/fail summary is shown to indicate how many events are outside the ITIC pass zone.

Power Xpert Graphic Display (Option) Screens

Meter Top Level Screen

V-LL avg, V-LN avg, IA, IB, IC, Iavg, freq.

Meter Detail Screens

Per phase detail L-L, L-N, Symmetrical Comp, Aux. Channels, Min./Max. with date/time of occurrence, Trend Plots, Triggers, Phasors.

Power Top Level Screen

Three-Phase Power Factor, kWhr, kWd, Real-Time kW, kVAR, kVA, Load Profile Link.

Power Detail Screens

Per phase detail, kVA, kVAR, kW, Min./Max. with date/time of occurrence, Trend Plots, Triggers.

Quality Top Level Screen

10 min. and 24 hr. PQIndex, THDI, THDV, K-factor, Crest Factor, Flicker Pst, %9's of Reliability.

Quality Detail Screens

Per phase detail L-L, L-N, V aux, Odd, Even, Interharmonics, Present, Min/Max, Trend Plots, Harmonic spectrum plots, waveform plots.

Events Top Level Screen

Active/Acknowledged Event list, Trigger List, System Log, ITIC Curve Link.

Event Detail Screens

Event List, Condition, Acknowledge Button, Trigger Date/Time, Trigger description.

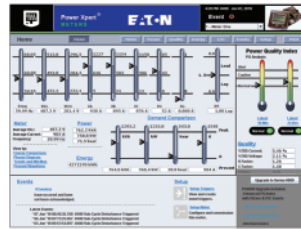
Setup Top Level Screen

View setup, Edit setup, Login, Logout.

Setup Detail Screens

Quick Setup, Trigger setup, Detail setting.

Power Xpert 4000/6000/8000 Web Browser Views

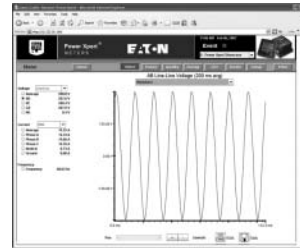


Power Xpert 4000/6000/8000 Web Browser Homepage (Note: 4000 does not include flicker, ITIC)

Power Xpert Meter 4000/6000/8000's embedded Web server offers Eaton customers a new level of accessibility to the critical information required to manage the electrical distribution system. The embedded Web server includes real-time circuit information in both numeric and graphical formats to help monitor circuit parameters such as current loading, voltage and power levels, power factor.

The Web server also provides the energy and demand readings required to help manage the cost of energy. Readings include kWh, kVARh, delivered and received and kVAh with time-of-use and separate status input controlled energy accumulation to account for energy during special times such as rate alert periods or stand-by generator times of operation.

The Web server also includes critical information regarding Power Quality such as harmonic distortion, flicker (Power Xpert Meter 6000/8000), crest factor, K-Factor and more.



Steady-State Waveform

The Web server allows the user to view waveforms of the voltage and current to spot power quality problems such as notching.



Events Timeline (Power Xpert 6000/8000)

View and understand the sequence of events that have occurred during a period of time. Plot color-coded events on captured waveforms to gain insight into the sequence of events from one single cycle to the next one. This provides the user an excellent vantage point to review and compare multiple events at an unprecedented resolution.



Harmonic Spectral Plot

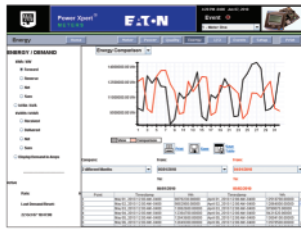
The harmonic spectral plot displays both harmonics and interharmonics up to the 85th order. A detailed table also includes individual magnitudes and angles of current and voltage harmonics, as well as a harmonic power calculation at each frequency. Even, odd and total THD are displayed for diagnostic purposes. In addition, the Power Xpert 6000/8000 provides interharmonics, which allow users to see what is going on between the integer multiples of the fundamental.



Historical Trend Plot

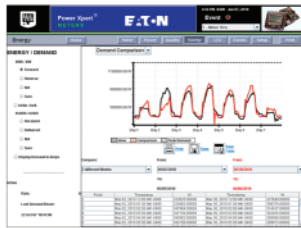
Graphical Trending of Data

The Power Xpert Meter 4000/6000/8000 embedded Web server supports graphical trend charts of key circuit measurements such as current, voltage, power and energy. The trend chart supports a zoom feature that allows the user to view data over a short period of 16 hours or a longer period of 48 months. The trend chart has a horizontal slider bar control to manage scrolling forward and backward through the data. Trend charts of basic readings include minimum, maximum and average readings. Trend charts of energy data also display demand values.

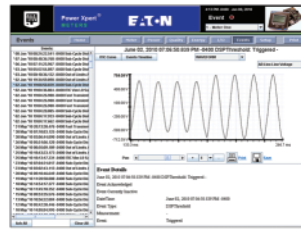
**Energy Comparison**

Energy usage patterns can be effortlessly analyzed with the month-to-month, week-to-week comparison chart. Raw data can be easily exported with the “Save Table” option to other applications such as Excel for further analysis or graphing (firmware version 12.x.x and higher only).

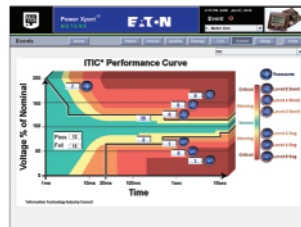
Note: All data logging for trend plotting is automatically preconfigured in all of the Power Xpert Meter 4000/6000/8000 meters. In addition, the 6000 and 8000 Series meters have sag, swell and transient triggers built-in according to the ITIC (CBEMA) standard.

**Demand Comparison**

Demand comparison compares power consumption day-to-day, month-to-month or week-to-week. Power Xpert Meters can set to measure demand at 1 to 60 minute intervals. Both sliding and fixed interval windows are supported for maximum flexibility.

**Disturbance Recording****Sag/Swell Recording**

60 cycles of waveform are recorded at 256 samples per cycle including 30 cycles of pre- and post-trigger data. The Power Xpert Meter 4000/6000/8000 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 Power Xpert Meter's 4000/6000/8000 non-volatile flash memory using an industry standard Comtrade format. Waveforms can be automatically sent out by e-mail following an event, or can be retrieved from an FTP directory structure in the meter module's memory.

**ITIC Analysis Plot
(Power Xpert Meter 6000/8000)**

The ITIC Web page includes counters to track the occurrence of disturbances and a pass/fail summary. In addition, selecting any disturbance counter links to a detailed event view of the disturbances in that ITIC category. Disturbance waveforms can be viewed from the browser.

**Events Calendar
(Power Xpert 6000/8000)**

The Events Timeline calendar view provides instant insight to the frequency of power events and helps detect reoccurring problems. Color-coded events can be filtered to detect specific issues.

**Configuration Page****Web Server Device Configuration**

Special software is not required to configure a Power Xpert Meter 4000/6000/8000. The embedded Web server includes comprehensive device set-up capability.

Discrete Contact Inputs

The optional PXIO-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 PXIO-B card includes three 5A 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:

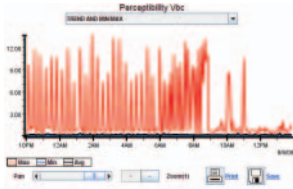
- Normal—relay energized during alarm condition
- Latched—relay energized by event trigger, de-energized by acknowledgement
- Timed—relay energized by event trigger, maintained for a programmed interval.

Communications Expansion Card (CEC)

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

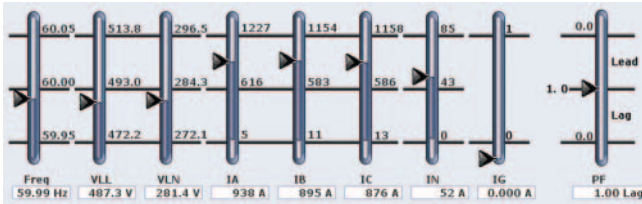
- Monitoring, managing and configuring the meter remotely using a standard Web browser interface like Microsoft Internet Explorer
- Alarm notifications via e-mail, SMTP
- Enabling access to the meter's FTP server (energy, trend and waveform logs)
- Providing Modbus TCP/IP or RTU communications to BMS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

Flicker (EN61000-4-15; Power Xpert Meter 6000/8000)



Flicker values for perceptibility, PST and PLT are calculated based on EN61000-4-15 guidelines.

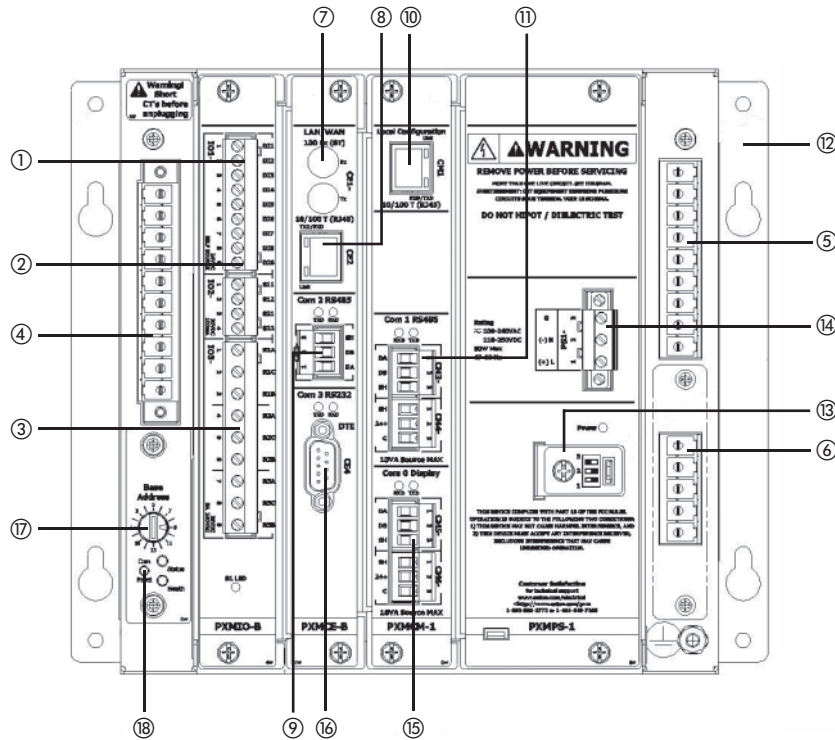
Power at a Glance



Easily Upgrade Your Power Xpert Meter 4000 to a 6000

Eaton understands that our customers' needs change over time. That's why we've developed meters that can grow with you. Once a Power Xpert Meter is purchased, you have the ability to upgrade to a Power Xpert Meter 6000, with no intervention from Eaton, when needed. All the features of the Power Xpert Meter 4000 that you have been using and depend on remain, however, once updated, all the additional features of the Power Xpert Meter 6000 are available. The self-upgrade is available on Eaton's Web site. You'll need a credit card, your Power Xpert Meter 4000 serial number and data code (you will be presented with this information if you are using the upgrade link directly from your Power Xpert Meter) and your e-mail address. Once you have completed the purchase, we will send you your new license key information via e-mail that will allow you to complete the upgrade.

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)—24V 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) ($\pm 20\%$)
- ⑮ Display RS-485 Network port (up to 15 meters)—24V 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.

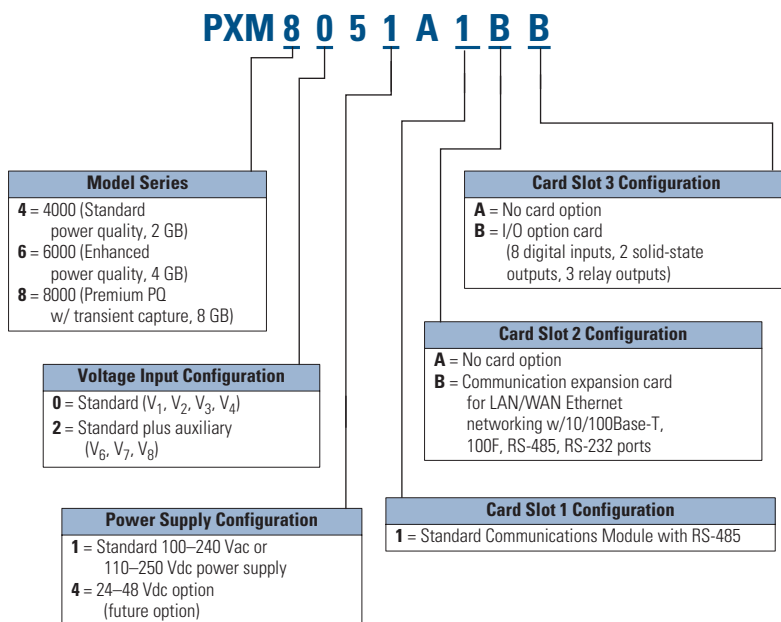
If a display is required, it should be ordered separately. The multi-meter graphic display is capable of displaying data from an RS-485 daisychain of up to 16 Power Xpert Meter 4000/

6000/8000 modules over a distance of up to 1000 ft. Power Xpert Meter modules include panel mounting brackets. The multi-meter graphic display is designed to mount separately. If back-to-back meter to display panel mounting is desired, a mounting bracket kit is available (**PX-PMBA**).

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)

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 |
|--|------------------|
| Graphic display module | PXD-MMG |
| Communication expansion card for LAN/WAN Ethernet networking: 100FX fiber-optic, 10/100T, RS-485, RS-232 | PXCE-B ① |
| Digital I/O card: eight digital input, two solid-state output, three relay output | PXIO-B ① |
| Panel mounting bracket assembly for back-to-back meter to graphic display mounting | PX-PMBA |
| Panel mounting bracket assembly for retrofitting a graphic display to an IQ Analyzer cutout | PX-PMBB |
| Panel mounting bracket assembly for reduced graphic display rear clearance | PX-PMBC |
| Power Xpert Meter 4000 to 6000 license upgrade key | PXM-4KUPG |

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

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: 500A for 1 second, non-repeating
- Range: 0.005–20A continuous
- Accuracy: 0.05% or reading plus 0.01% of full scale (from 50 milliamps to 20A)

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: 120V–500,000V primary
- Input range: 600V L-L, 347 L-N direct connect
- Nominal full scale: 1000V rms
- Input impedance: 2 mega ohms

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

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

Solid-State Outputs

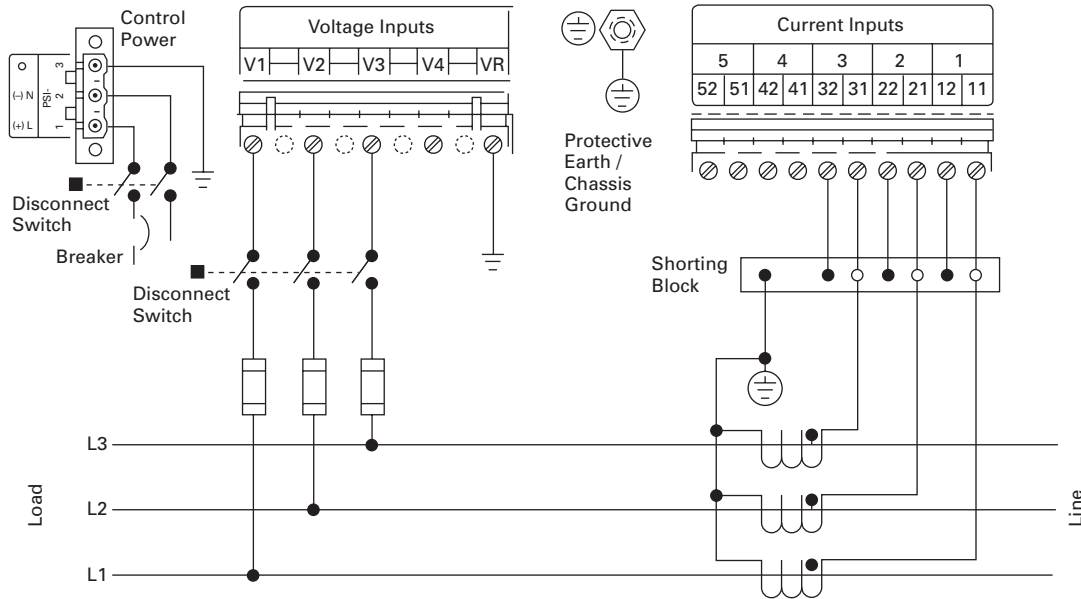
- Maximum load: 100 milliamps
- Max. voltage: 30V (externally sourced)

Control Power Input

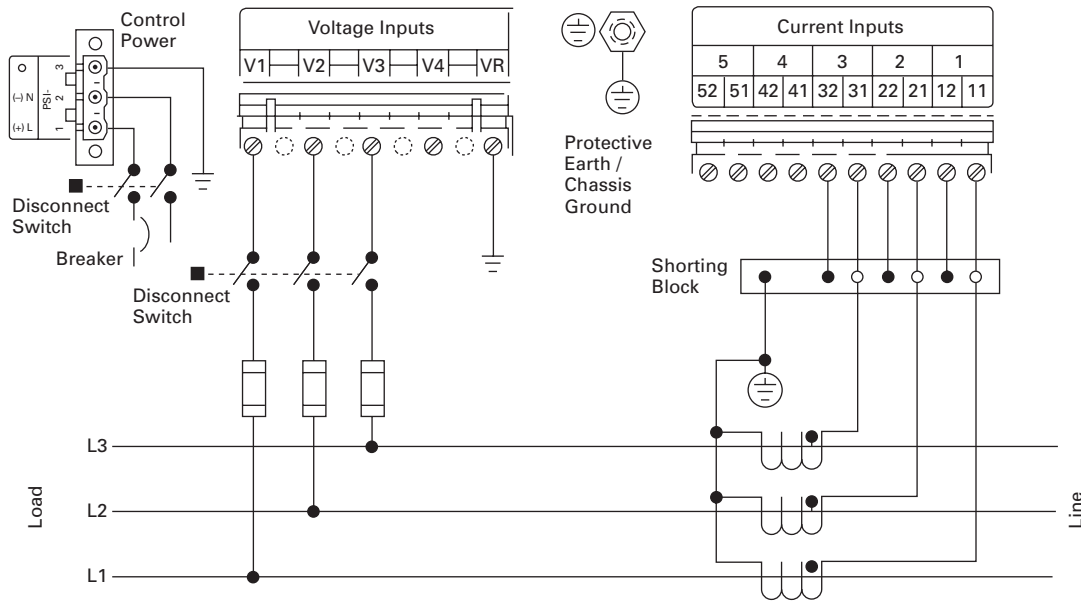
- Input range AC: 100–240 Vac ($\pm 20\%$)
- Frequency range: 47–63 Hz
- Input range DC: 110–250 Vdc $\pm 20\%$
- Burden 50 VA
- Ride-through: 1–5s

Wiring Diagrams

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



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



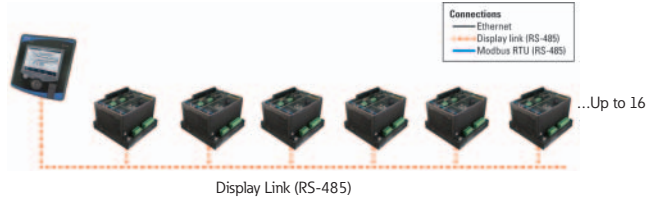
Note

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

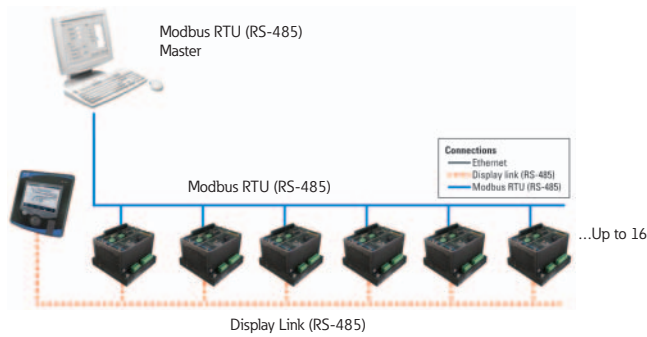
Power Xpert Meters Configuration and Wiring Examples

Display Link

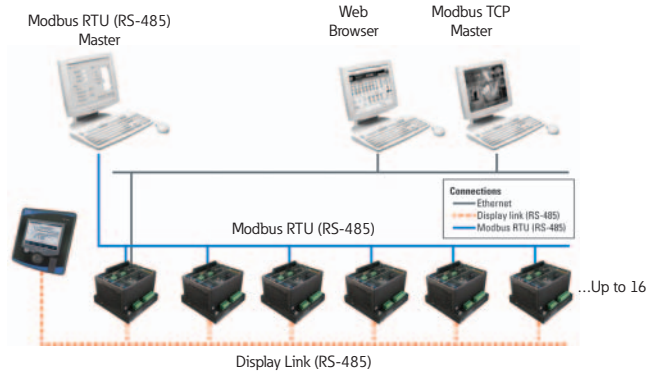
Up to 16 Meters can be Daisy-Chained to a Single Power Xpert Meter LCD Display



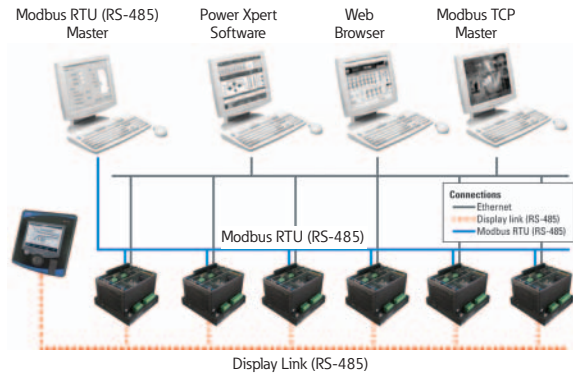
Modbus RTU (RS-485)—Non-Web Enabled



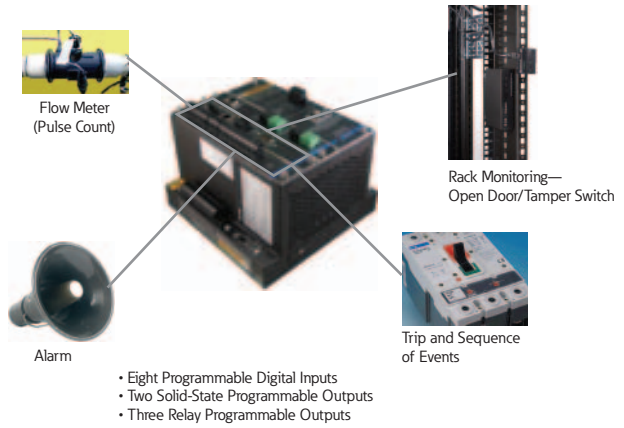
Web Enabled—Browser and Modbus TCP



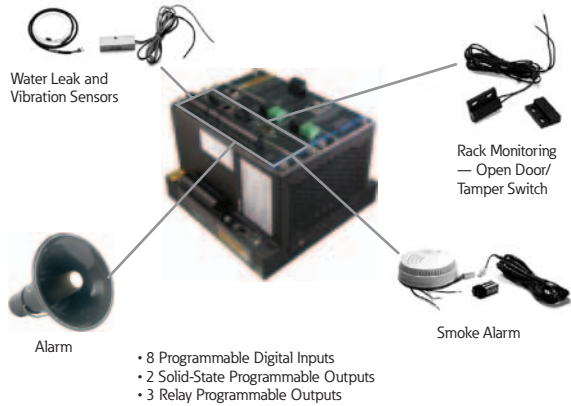
Web Enabled—Advanced System Functionality



Accessories—I/O Card (Option)



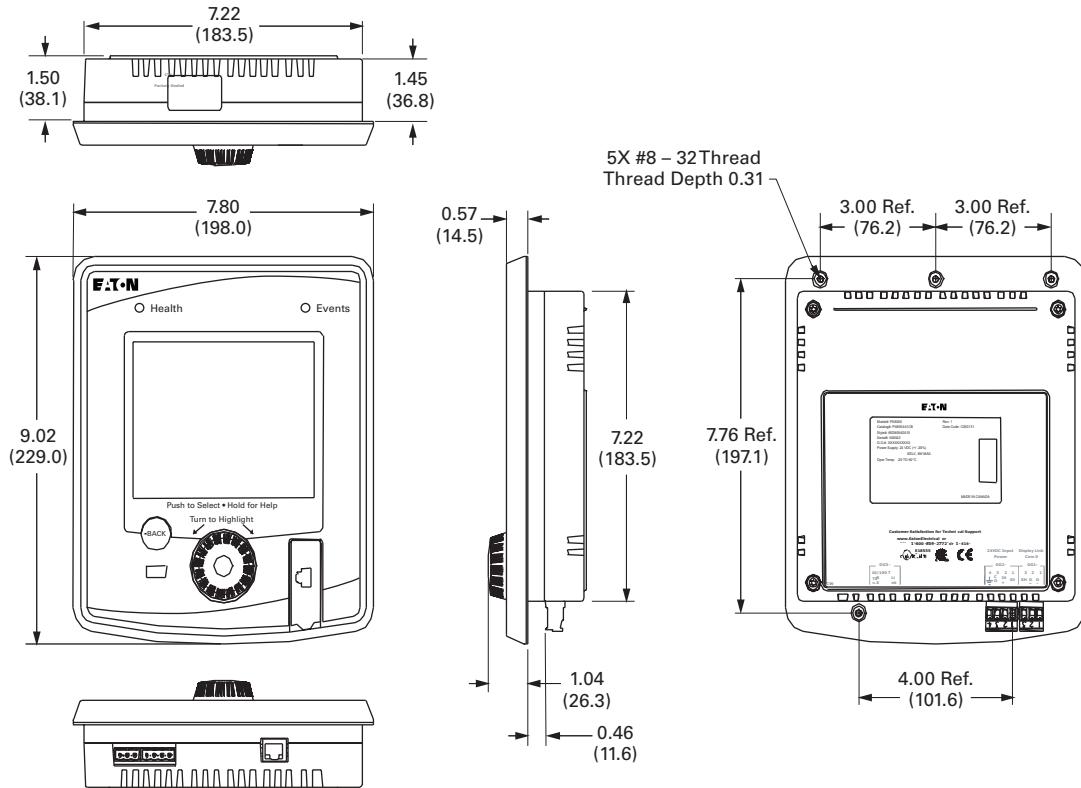
IT Configuration Examples—Accessories—I/O Card (Option)



Dimensions

Approximate Dimensions in Inches (mm)

Power Xpert Meter 4000/6000/8000 Multimeter Graphic Display (PXD-MMG)—Sold Separately, Supports up to 16 Power Xpert Meter 4000/6000/8000 Modules



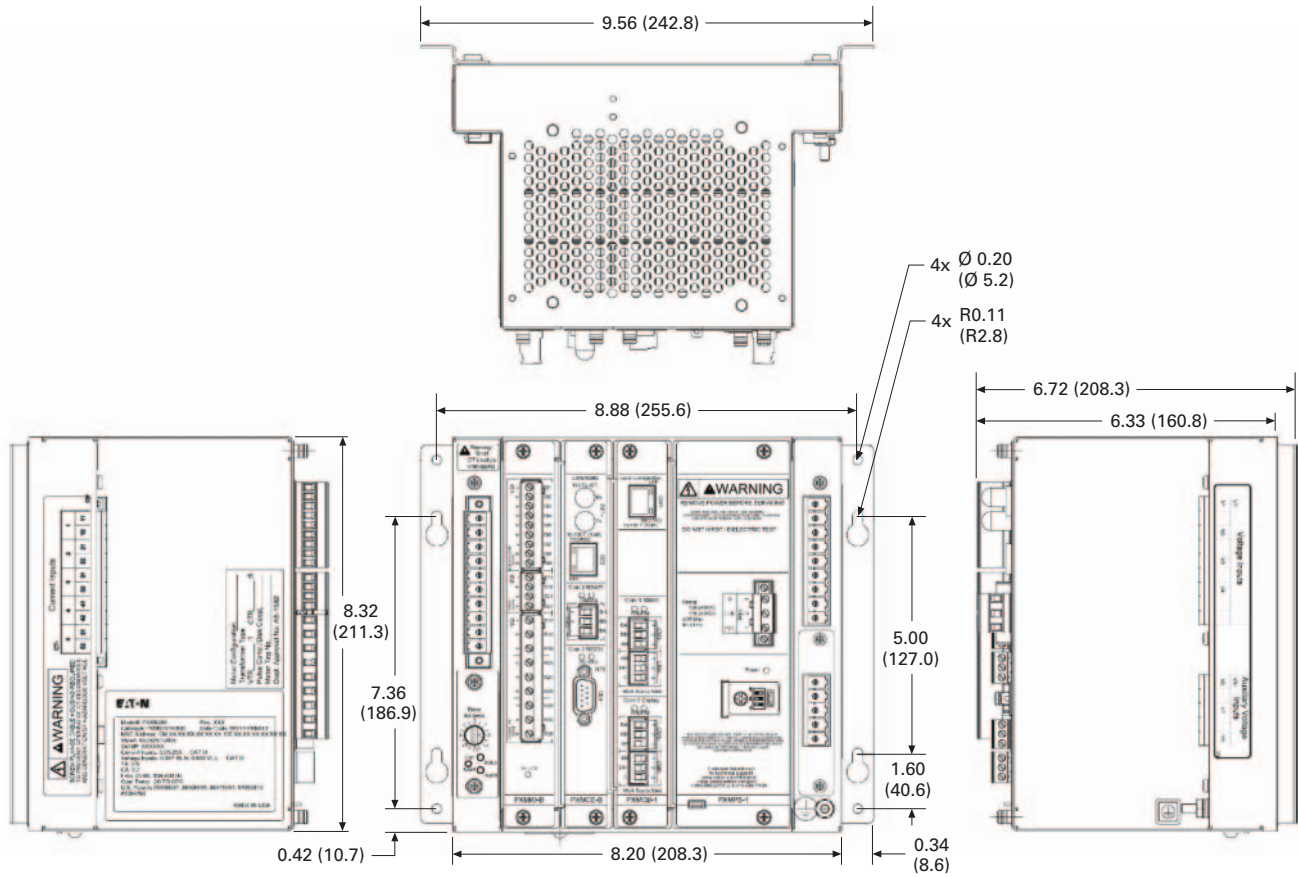
22.3

Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

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 Meter 2000 Series



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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 offers a waveform view to visualize steady-state harmonic content which 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 209**.

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

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
- 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

Power Xpert 2000 Embedded Web Server

The Power Xpert Meter 2000 embedded Web server offers Eaton customers a new level of accessibility to the critical information required to manage their electrical distribution system. The Web server includes real-time information in both numeric and graphical visual formats to help monitor parameters such as current loading, voltage and power levels, power factor, THD and more. The Web server also provides energy and demand readings with graphic usage plots to help analyze energy usage patterns. Energy readings include kWh, kVARh, delivered and received and kVAh with time.

The Power Xpert Meter 2000 embedded Web server supports graphical trend charts of key measurements such as current, voltage, power and energy. The trend chart supports a zoom feature that allows the user to view data over predefined ranges from as little as 16 hours to as much as 4 years. The trend chart includes zoom in/out buttons and a horizontal slider bar control to manage scrolling forward and backward through the data. Trend charts of basic readings include minimum, maximum and average readings. Trend charts of interval by interval energy data also display peak demand.

Waveform Display

60 cycles of waveform are sampled at 400 samples per cycle. The Power Xpert Meter 2000 embedded Web server offers a waveform view to visualize steady-state harmonic content.

Historical Trend Logging

The Power Xpert Meter 2000 records historical data for graphical viewing from the embedded Web server. Graphical views of historical data support pan and zoom. Over 100 standard metering parameters are logged as part of the standard meter functionality including min./max. and average for each parameter. The averages are calculated over the interval period.

Energy Profile Data

The Power Xpert Meter 2000 records Real and Reactive energy forward, reverse, net and absolute sum, as well as apparent energy (kVAH). These readings are stored on a fixed 5 minute interval. Up to 4 status inputs can be configured as energy accumulators for counting KYZ pulse inputs.

Demand Comparisons

Demand usage patterns can be analyzed with the month-to-month, week-to-week comparison chart built into the meter. Raw data can be exported as a.csv file with the "Save Table" option to other applications for further analysis and graphing.

Event Triggers

The Power Xpert Meter 2000 has two levels of configurable event triggers:

- On-board meter limits (PXM 2260 and PXM 2270 only)
- On-board gateway card limits

The on-board meter limits can be set for any measured parameter, for up to 16 limits. If either of the 16 limits are exceeded, an alarm condition will be present and illuminate one of the LEDs on the meter faceplate. The on-board meter out of limits can also be used to energize a relay output, if so equipped.

The on-board gateway limits can trigger an alarm off of any measured parameter on any

of the PXM 2000 model series. These triggers permit pickup, reset and pickup delay to be configured by the user.

Event Logging

The Power Xpert Meter 2000 embedded Web server allows the user to view a list of triggered events. In addition, a separate system log records system operations such as resets.

E-mail

The Power Xpert Meter 2000 contains the ability to send e-mails based on an event that has been triggered or cleared along with the option to send an event or data log file. The Power Xpert Meter 2000 also has the ability to send a configurable periodic e-mail with meter information.

Inputs and Outputs

Power Xpert Meter 2000 is available with a standard KYZ output and optional digital I/O cards which 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 1A 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

Power Xpert 2000 Web Browser Views



Power Xpert Meter 2000 Web Browser

Power Xpert Meter 2000's embedded Web server offers Eaton customers a new level of accessibility to the critical information required to manage the electrical distribution system. The embedded Web server includes real time circuit information in both numeric and graphical formats to help monitor parameters such as current loading, voltage and power levels and power factor. The Web server also provides the energy and demand readings required to help manage the cost of energy. Readings include kWh, kVARh, delivered and received and kVAh. The Web server also includes critical information regarding power quality such as harmonic distortion.



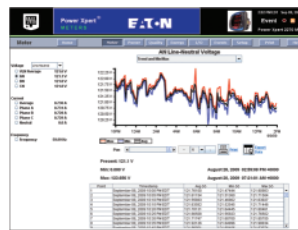
Real-Time Visualization of Harmonic Content

The Web server offers a waveform view to visualize steady-state harmonic content of the voltage and current to spot power quality problems.



Harmonic Spectral Plot

The harmonic spectral plot displays harmonics up to the 40th order. A detailed table also includes individual magnitudes and angles of current and voltage harmonics, at each frequency. Individual and total THD are displayed for diagnostic purposes.



Historical Trend Plot

Graphical Trending of Data

The Power Xpert Meter 2000 embedded Web server supports graphical trend charts of key circuit measurements such as current, voltage, power and energy. The trend chart supports a zoom feature that allows the user to view data over a short period of 16 hours or a longer period of 48 months. The trend chart has a horizontal slider bar control to manage scrolling forward and backward through the data. Trend charts of basic readings include minimum, maximum and average readings. Trend charts of energy data also display demand values.



Energy Demand Profile

Energy managers can view load profile data compared against the peak demand. The plot allows comparison of present and past months' usage.

Web Server Device Configuration

Special software is not required to configure a Power Xpert Meter 2000. The embedded Web server includes a comprehensive device configuration engine.

Discrete Contact Inputs

The optional I/O expansion cards offers two or four digital inputs that are useful for a variety of applications such as:

- Pulse counting of KYZ or other utility pulses such as air, water or gas
- Demand interval timing taken from a master utility meter end of interval pulse

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

Relay Outputs

The optional I/O card includes two 5A 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

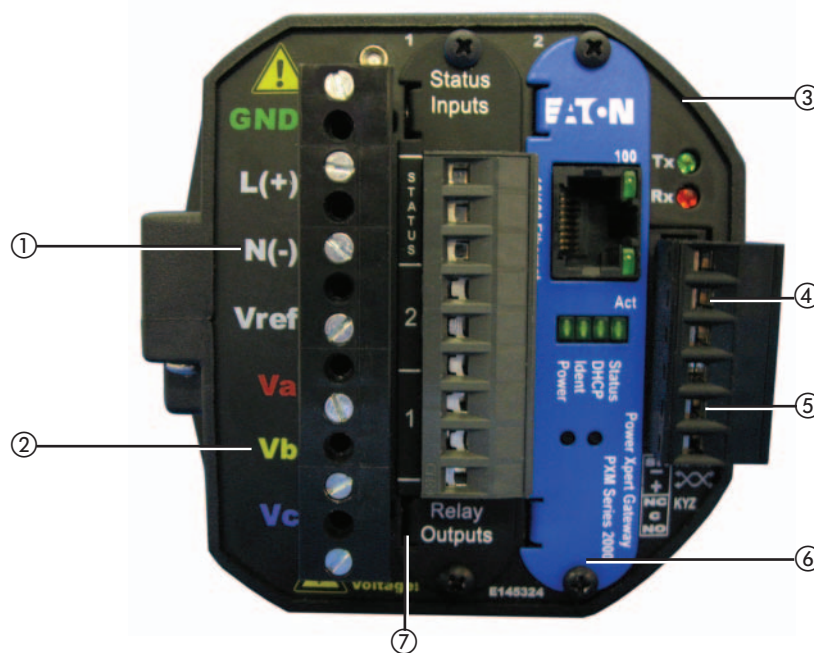
The optional IO card includes either four 4–20 mA outputs or 0–1 mA outputs. These outputs can be used for applications such as:

- 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 or RTU 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

Easily Upgrade Your Power Xpert Meter 2000 (Future, Contact Factory for Availability)

Eaton understands that our customers' needs change over time. That's why we've developed meters that can grow with you. Once a Power Xpert Meter 2000 is purchased, you have the ability to upgrade to a higher feature set Power Xpert Meter 2000, with no additional assistance required from Eaton, when needed. When the Power Xpert Meter 2000 is updated, all the features previously used will remain intact.

The self-upgrade is available on Eaton's Web site. You'll need a credit card, your Power Xpert Meter 2000 serial number (you will be presented with this information if you are using the upgrade link directly from your Power Xpert meter) and your e-mail address. Once you have completed the purchase, we will send you your new license key information via e-mail that will allow you to complete the upgrade. See table on **Page 209** for the list of features available with each model.

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

Power Xpert Meters 2250/2260/2270

| Feature | Power Xpert Meter | | | Benefit |
|--|-------------------|------|------|---|
| | 2250 | 2260 | 2270 | |
| General | | | | |
| Embedded Web server | ■ | ■ | ■ | Use a standard Web browser to monitor and manage the meter over the network, Internet |
| 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 plot comparisons month-to-month, week-to-week | ■ | ■ | ■ | Plot two months or two weeks for vivid demand comparison. |
| Power, apparent, real, reactive, power factor | ■ | ■ | ■ | Review power usage and power factor and avoid potential PF penalties |
| Energy, demand: forward, reverse, net, sum, TOU, profile, export, print | ■ | ■ | ■ | Keep track of your energy usage, identify peaks to conserve energy usage |
| 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 | 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 |
| 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 e-mail 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 |
| 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 | | | Benefit |
|--|-------------------|------|------|---|
| | 2250 | 2260 | 2270 | |
| 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, MB | | | | |
| Standard memory, MB | 256 | 512 | 768 | Store trend data and events for historical analysis |
| Harmonics | | | | |
| Harmonic levels | | 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 | | | ■ | Waveform view on a PC to visualize steady-state harmonic content through embedded Web server to identify power quality issues |
| 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 | 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 e-mail, 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.

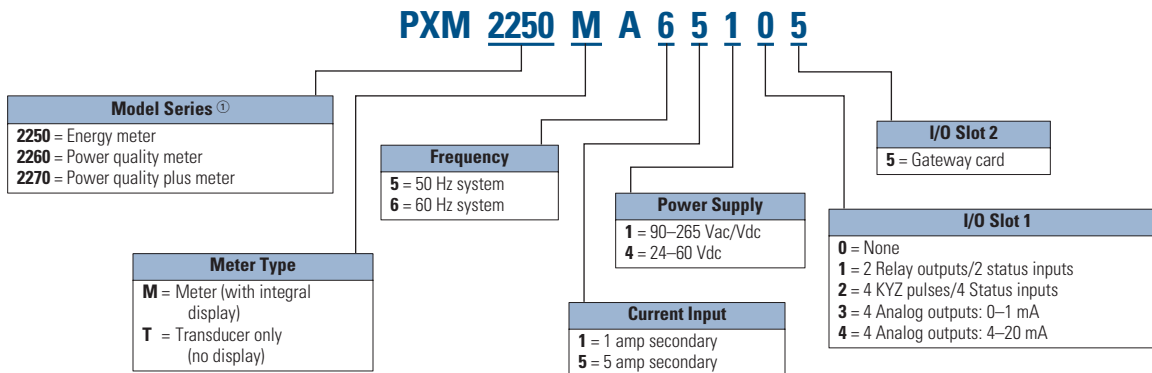
Standards and Certifications

- 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



Catalog Number Selection

Power Xpert Meter 2000



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

Note

① Refer to **Page 210** 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, 5A, 90–265 Vac/Vdc W/4AO).

Example 2:
 PXM2250MA65105 (PXM 2250 Meter/Display 60 Hz, 5A, 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 |

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 meg ohm/phase.
- Burden: 0.36 VA/phase maximum at 600V; 0.014 VA at 120V
- Connection: 7-pin 0.400-inch pluggable terminal block, AWG #12–26 (0.129–3.31 mm²)

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, VAR 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

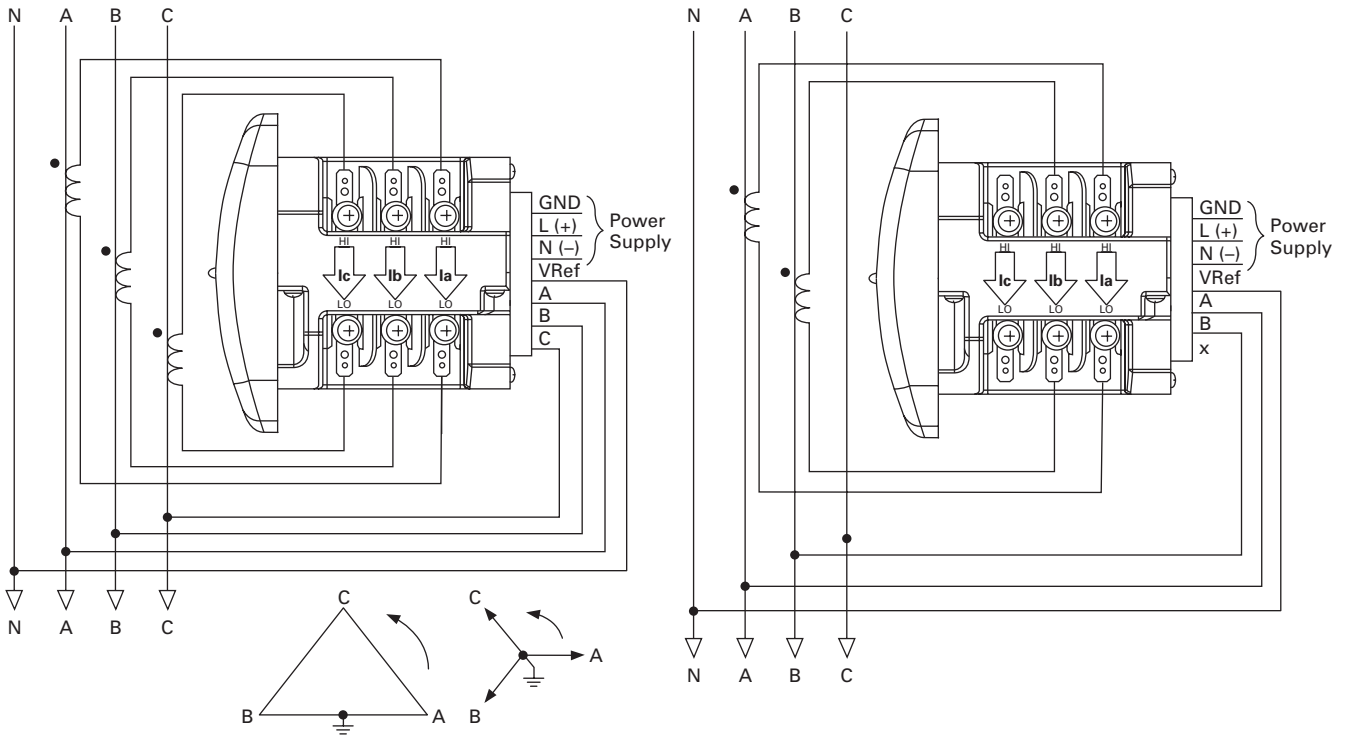
- Connection type: RJ-45 10/100Base-T Ethernet network port
- Protocols: Ethernet TCP/IP, Modbus TCP, HTTP, HTTPS, NTP, SMTP, SNMP

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 μ A
- Opto-isolation: 3750 Vac

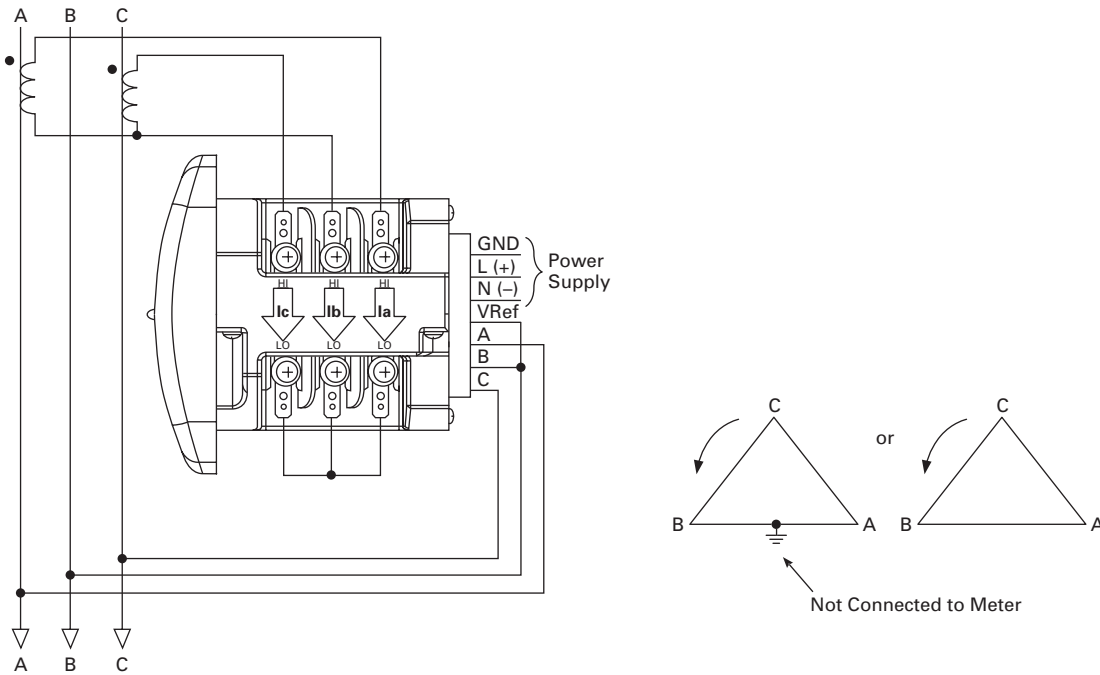
Wiring Diagrams

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



22

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.

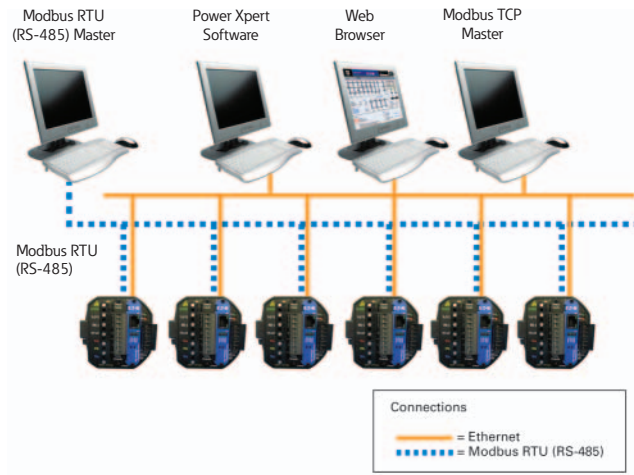
22.3

Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

Power Xpert Meters Configuration and Wiring Examples

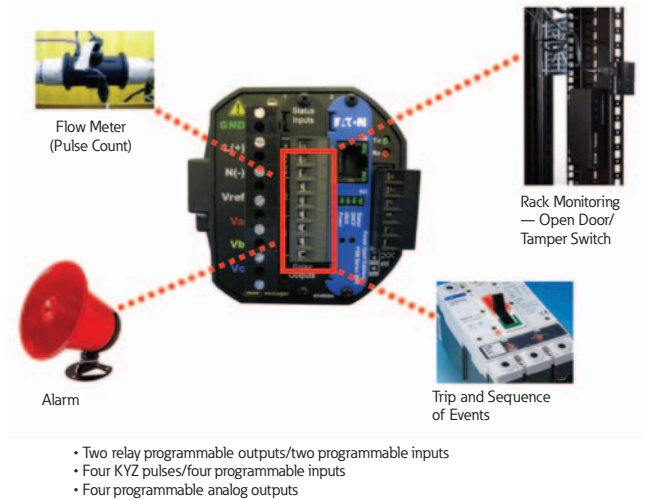
PXM 2000 Display Front View



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



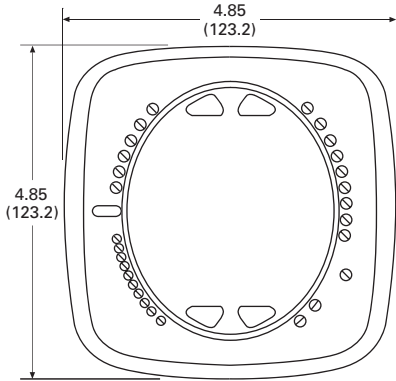
Accessories—I/O Cards (Option)



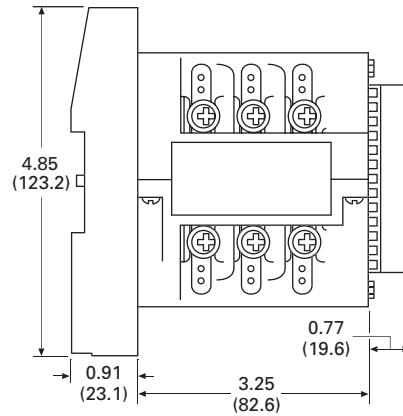
Dimensions

Approximate Dimensions in Inches (mm)

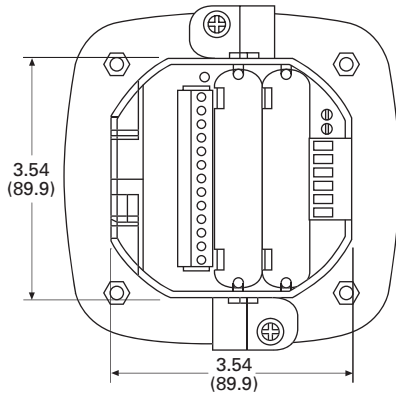
PXM 2000 Display Front View



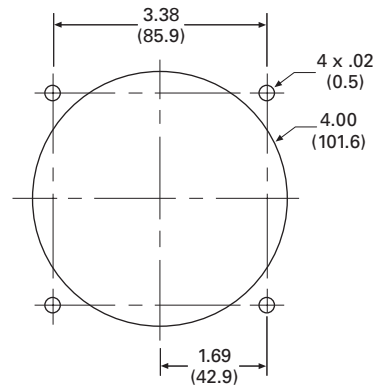
PXM 2000 Transducer Only Side View



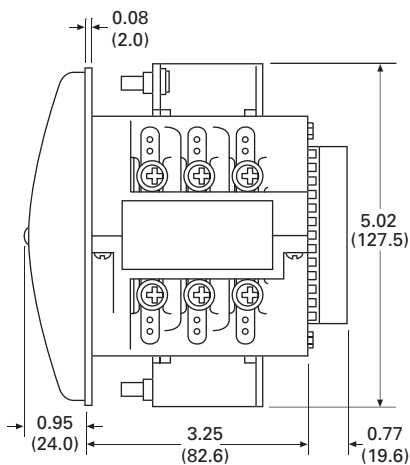
PXM 2000 Rear View



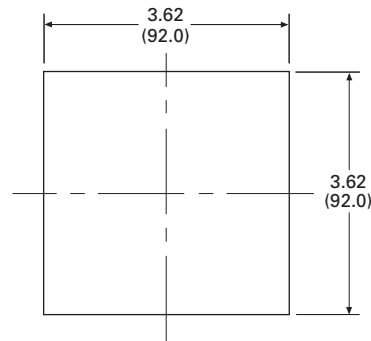
ANSI Mounting Panel Cutout



PXM 2000 Meter/Display Side View



DIN Mounting Cutout



| Description | Specifications |
|--------------------------------------|---|
| Weight | 2 lbs (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 |

IQ 250 and 260 Electronic Power Meters



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IQ 250/260 Series Electronic Power Meters

Product Description

The IQ 250 and IQ 260 Meters provide capabilities you would not normally expect in affordable, ultra-compact meters, such as fast sampling rate and accurate metering for a full range of power attributes. Providing the first line of defense against costly power problems, Eaton's IQ 250 and IQ 260 electronic power meters can perform the work of an entire wall of legacy metering equipment using today's technology.

When space is at a premium, yet you need ANSI C12.20 accuracy, the IQ 250/260 series fit the bill. These meters are ideal for electrical equipment assemblies, machine control panels, such as panelboard and switchboard mains and feeders, low voltage metal-enclosed switchgear feeders and motor control centers. Requiring far less space than other meters with similar functionality, IQ 250/260 series fit into a standard ANSI or IEC cutout on a panelboard or other electrical equipment, and therefore fit easily into retrofit applications.

Application Description

- Utility and commercial metering
- Substations, industrial facilities, power generation sites and campuses
- Sub-metering
- Load studies and voltage recording
- Analog meter replacement

Features and Benefits

- Measure and display real-time information about critical power parameters with a sampling rate of 400 samples per cycle
- Monitor power utilization and quality with ANSI C12.20 accuracy (0.2 percent)
- Verify meter accuracy with KYZ test pulse self-certification capabilities
- Standard Modbus RTU communications
- Available as transducer only or with display
- Designed to accommodate upgrades
- Integrate into Eaton's Power Xpert architecture for a holistic system-level view

Additional Features

Features of IQ 250 and IQ 260 Electronic Power Meters

| Features | IQ 250 | IQ 260 |
|--|--------|--------|
| Instrumentation | | |
| Current, per phase | ■ | ■ |
| Current demand | ■ | ■ |
| Calculated neutral current | ■ | ■ |
| Voltage, per phase (L-L, L-N) | ■ | ■ |
| Frequency | ■ | ■ |
| Power, Energy and Demand | | |
| Real, reactive and apparent power, total and per phase (kW, kVAR, kVA) | ■ | ■ |
| Real, reactive and apparent energy, total and per phase (kWh, kVARh, kVAh) | ■ | ■ |
| Real, reactive and apparent power demand | ■ | ■ |
| Power factor, total and per phase | ■ | ■ |
| Min./max. readings, I, V, PF, F, THD (IQ 260), kW, kVAR, kVA | ■ | ■ |
| Demand Methods | | |
| Block interval (sliding, fixed) | ■ | ■ |
| Communications | | |
| RS-485 | ■ | ■ |
| KYZ output | ■ | ■ |
| Modbus RTU | ■ | ■ |
| Modbus ASCII | ■ | ■ |
| DNP 3.0 | ■ | ■ |
| I/O | | |
| Two digital in /two digital out ^① | Opt. | Opt. |
| Four digital in/four KYZ out | Opt. | Opt. |
| Four analog output (4–20 mA) ^② | Opt. | Opt. |
| Four analog output (0–1 mA) | Opt. | Opt. |
| Power Quality Analysis | | |
| Total harmonic distortion (THD) voltage and current per phase | | ■ |
| Alarming | | |
| Set point driven alarm | | ■ |

Notes

- ① Digital out with IQ 250 requires external command.
- ② Requires external power supply.

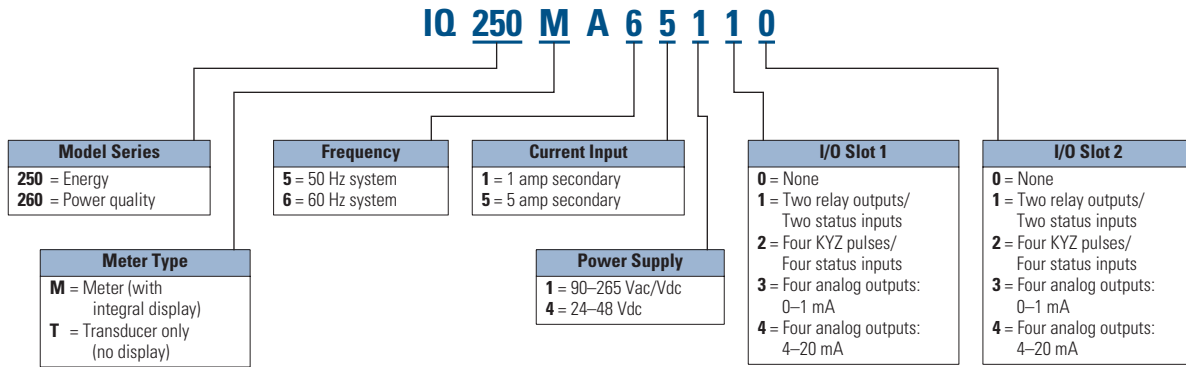
Standards and Certifications

- IEC 687: 0.2% accuracy
- ANSI C12.20: 0.2% accuracy
- ANSI C62.41: Burst
- UL/cUL: Electrical and electronic measuring and test equipment 22CZ



Catalog Number Selection

IQ 250/260 Meter



Accessories

IQ 250/260 Meter

| Description | Catalog Number |
|---|--------------------|
| Panel mounting adapter for retrofitting an IQ 250/260 to an IQ Analyzer/IQ DP-4000/IQ data cutout | IQ250-PMAK |
| PXM 2000 Gateway card kit to upgrade an IQ250/260 to a PXM 2000 | PXM2000-GCK |

Technical Data and Specifications
IQ 250/260 Electronic Power Meter

| Description | Specifications |
|---|---|
| Current Inputs | |
| Class 10 | 5 amp nominal, 10 amp max. |
| Class 2 | 1 amp nominal, 2 amp max. |
| 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 max. 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 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 | 3 element wye, 2.5 element wye, 2 element delta, four-wire delta systems |
| Input impedance | 1 meg ohm/phase |
| Burden | 0.36 VA/phase max. at 600V; 0.014 VA at 120V |
| 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 Water-resistant Mounting gasket included |

| Description | Specifications |
|---------------------------------------|---|
| Sensing Method | |
| Voltage, current | True rms |
| Power | Sampling at over 400 samples per cycle on all channels |
| Harmonics resolution | 40th order |
| Update Rate | |
| Watts, VAR 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 max. |
| Standard 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 |
| KYZ Pulse | |
| Contacts | 1 Form A |
| On resistance, max. | 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 μ A |
| Opto-isolation | 3750 Vac |

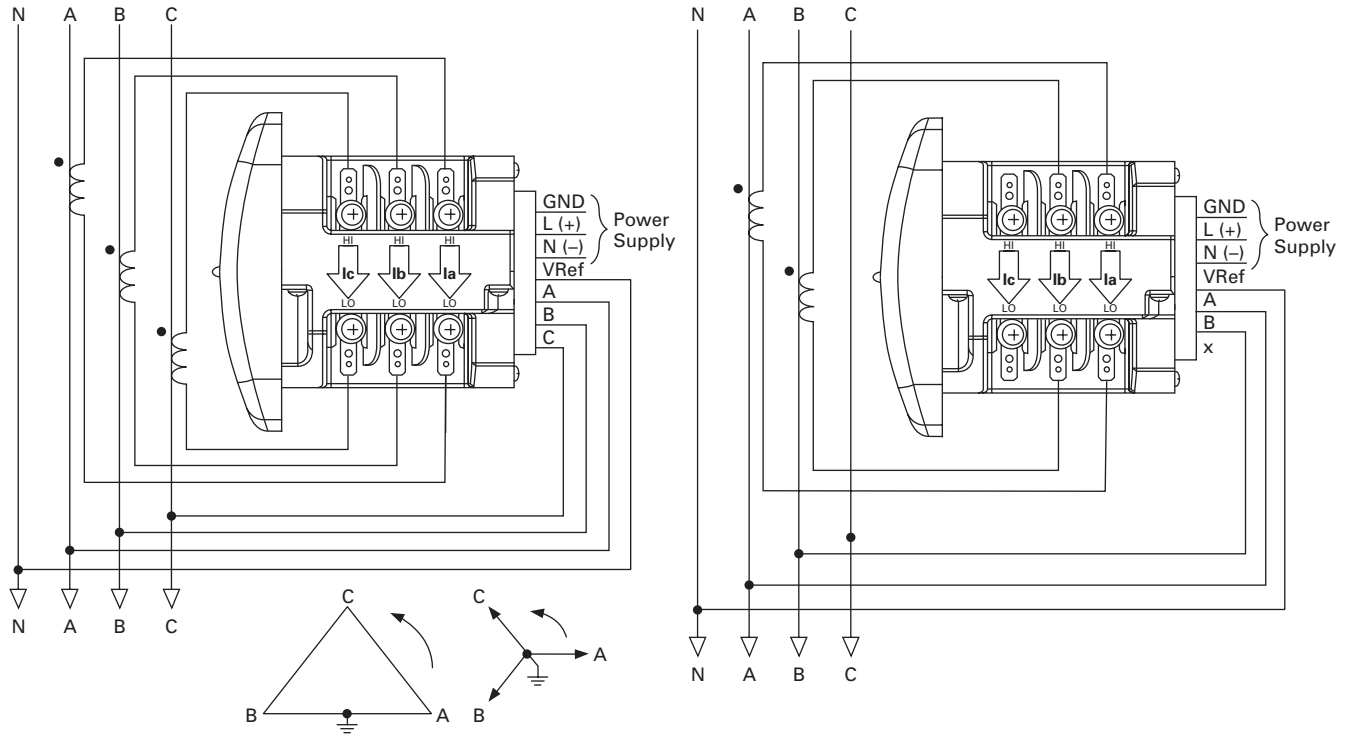
22.3

Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

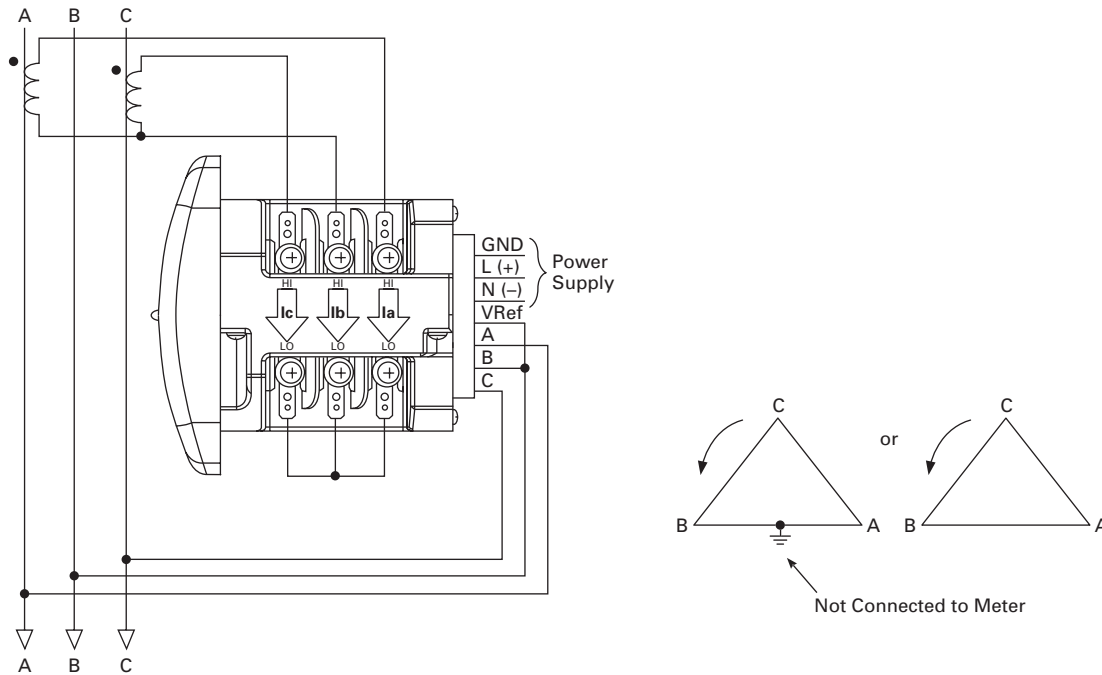
Wiring Diagrams

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



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

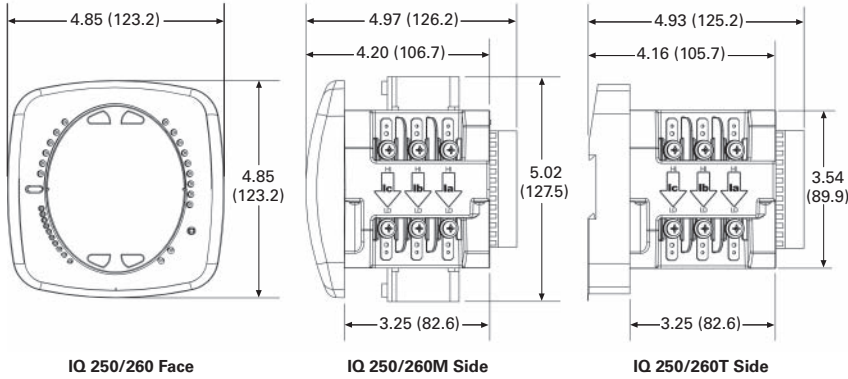


Note: Based upon the voltage rating, you may need a control power transformer for the control power.

Dimensions

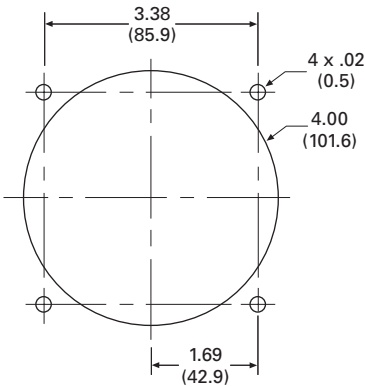
Approximate Dimensions in Inches (mm)

IQ 250/260 Meter—Face and Side Views

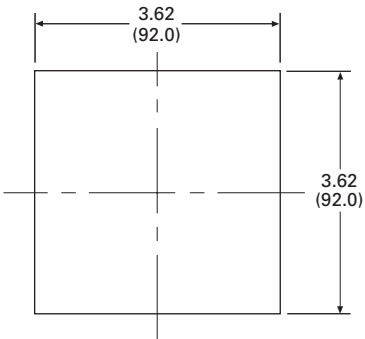


Expandable IQ Componentry

ANSI Mounting Panel Cutout



DIN Mounting Cutout



| Description | Specifications |
|--------------------------------------|---|
| Weight | 2 lbs (0.9 kg) |
| Basic unit | 5.00 (127.0) H x 4.90 (124.5) W x 5.00 (127.0) L |
| IQ 250/260 | Mounts in 92 mm DIN and ANSI C39.1 round cut-outs |
| Shipping container dimensions | 6-inch cube |
| Tolerance | ±0.1 inches (2.54 mm) |
| PXM 2250/2260/2270 | Mounts in 3.62-inch (92.0) mm DIN and ANSI C39.1 round cut-outs |
| 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 |

IQ 100



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IQ 130/140/150 Series Electronic Power Meters

Product Description

The IQ 100 Meter family provides capabilities you would not normally expect in affordable, compact meters, such as fast sampling rate and accurate metering for a full range of power attributes. Providing the first line of defense against costly power problems, Eaton's IQ 100 series electronic power meters can perform the work of an entire wall of legacy metering equipment utilizing today's technology.

When space is at a premium, yet you need ANSI C12.20 accuracy, the IQ 100 series fit the bill. These meters are ideal for electrical equipment assemblies, machine control panels, such as panelboard and switchboard mains and feeders, low voltage metal-enclosed switchgear feeders and motor control centers. Requiring far less space than other meters with similar functionality, IQ 100 series fit into a standard ANSI or IEC cutout on a panelboard or other electrical equipment, and therefore fit easily into retrofit applications.

Application Description

- Utility and commercial metering
- Substations, industrial facilities, power generation sites and campuses
- Sub-metering
- Load studies and voltage recording
- Analog meter replacement

Features and Benefits

- Measure and display real-time information about critical power parameters with a sampling rate of 400 samples per cycle
- Monitor power utilization and quality with ANSI C12.20 accuracy (0.5%)
- Verify meter accuracy with KYZ test pulse self-certification capabilities
- Optional Modbus RTU communications
- Available as transducer only or with display
- Designed to accommodate upgrades
- Integrate into Eaton's Power Xpert Architecture for a holistic system-level view

IQ 100 Electronic Power Meters

| Features | IQ 130 | IQ 140 | IQ 150 |
|--|--------|--------|--------|
| Instrumentation | | | |
| Current, per phase | • | • | • |
| Current demand | • | • | • |
| Calculated neutral current | • | • | • |
| Voltage, per phase (L-L, L-N) | • | • | • |
| Min./max. readings, I, V | • | • | • |
| Min./max. readings, I, V, PF, F, W, VAR, VA | | • | • |
| Frequency | | • | • |
| Power | | | |
| Real, reactive and apparent power, total (W, VAR, VA) | | • | • |
| Power factor, total | | • | • |
| Real, reactive and apparent power demand | | • | • |
| Demand Methods | | | |
| Block interval (sliding, fixed) | | • | • |
| Energy | | | |
| Real, reactive and apparent energy, total (Wh, VAR, VAh) | | | • |
| Communications | | | |
| RS-485, Modbus RTU, Modbus ASCII, KYZ output | Opt. | Opt. | Opt. |

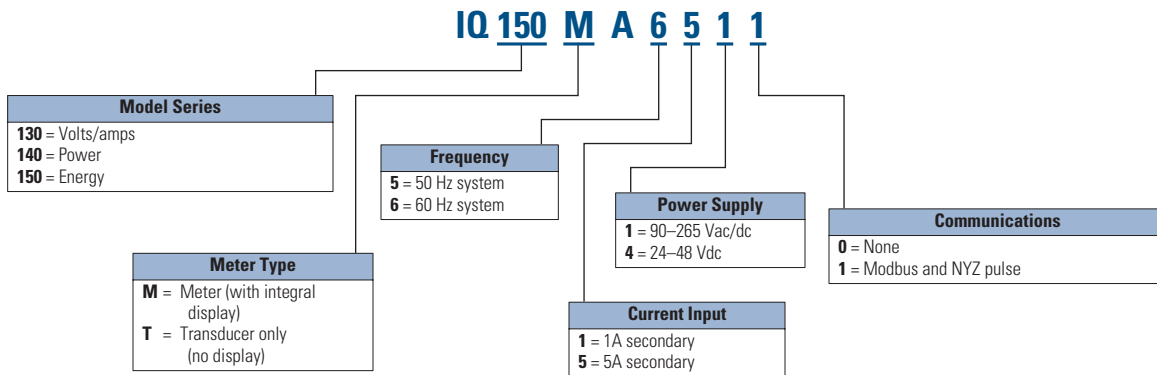
Standards and Certifications

- IEC 687: 0.5% accuracy
- ANSI C12.20: 0.5% accuracy
- ANSI C62.41: Burst
- UL/cUL/CE: Electrical and Electronic Measuring and Test Equipment 22CZ



Catalog Number Selection

IQ 100 Meter



Accessories

IQ 100 Meter

| Description | Catalog Number |
|---|-------------------|
| Panel Mounting Adapter for retrofitting an IQ 100 to an IQ Analyzer/IQ DP-4000/IQ Data Cutout | IQ250-PMAK |

Technical Data and Specifications

IQ 100 Electronic Power Meters

| Description | Specifications |
|---|---|
| Current Inputs | |
| Class 10 | 5A nominal, 10A max. |
| Class 2 | 1A nominal, 2A max. |
| Fault current withstand | |
| 100A for: | 10 seconds |
| 300A for: | 3 seconds |
| 500A for: | 1 second |
| Continuous current withstand | 20A for screw terminated or pass-through connections |
| Programmable current | Full scale to any CT ratio |
| Burden | 0.005 VA per phase max. at 11A |
| Pickup current | 0.1% of nominal |
| Class 10 | 5 mA |
| Class 2 | 1 mA |
| Connections | |
| Pass-through wire gauge dimension | 0.177-inch (4.5 mm) |
| Quick connect | 0.25-inch male tab |
| Voltage Inputs | |
| Range | |
| Line-to-neutral | 20–416 Vac |
| Line-to-line | 20–721 Vac |
| Programmable voltage range | Full scale to any PT ratio |
| Supported systems | 3 element wye, 2.5 element wye, 2 element delta, four-wire delta systems |
| Input impedance | 1 Meg Ohm/Phase |
| Burden | 0.36 VA/phase max. at 600V; 0.014 VA at 120 volts |
| 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 | –40°C to +85°C |
| Operating humidity | To 95% RH noncondensing |
| Faceplate rating | NEMA 12 water-resistant mounting gasket included |

IQ 100 Electronic Power Meters, continued

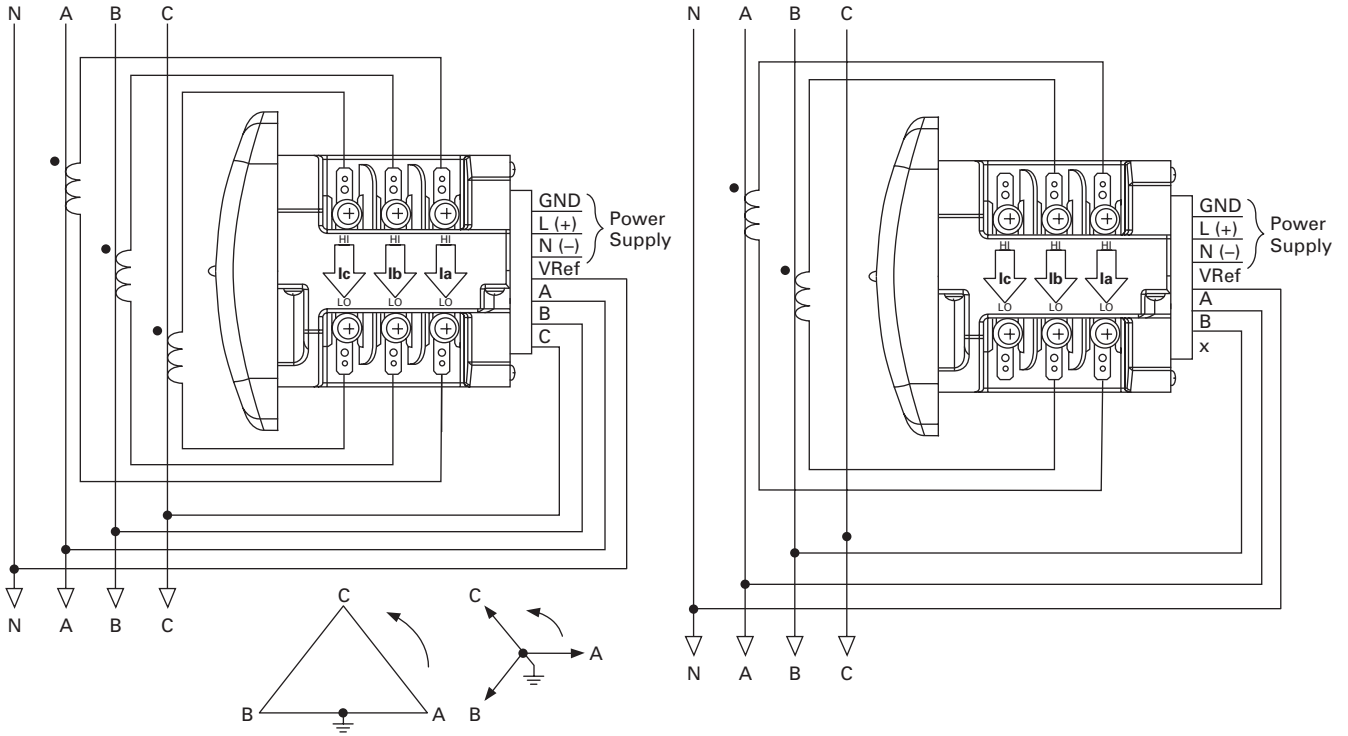
| Description | Specifications |
|---------------------------------------|--|
| Sensing Method | |
| Voltage, current | True rms |
| Power | Sampling at over 400 samples per cycle on all channels |
| Update Rate | |
| Watts, VAR and VA | 100 msec at 60 Hz |
| All other parameters | 1 second at 60 Hz |
| 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 max. |
| Optional 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 |
| Optional KYZ Pulse | |
| Contacts | 1 Form A |
| On resistance, max. | 35 ohms |
| Peak switching voltage | 350 Vdc |
| Continuous load current | 350 mA (10 ms) |
| Off-state leakage current at 350 Vdc | 1 uA |
| Opto-isolation | 3750 Vac |

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.

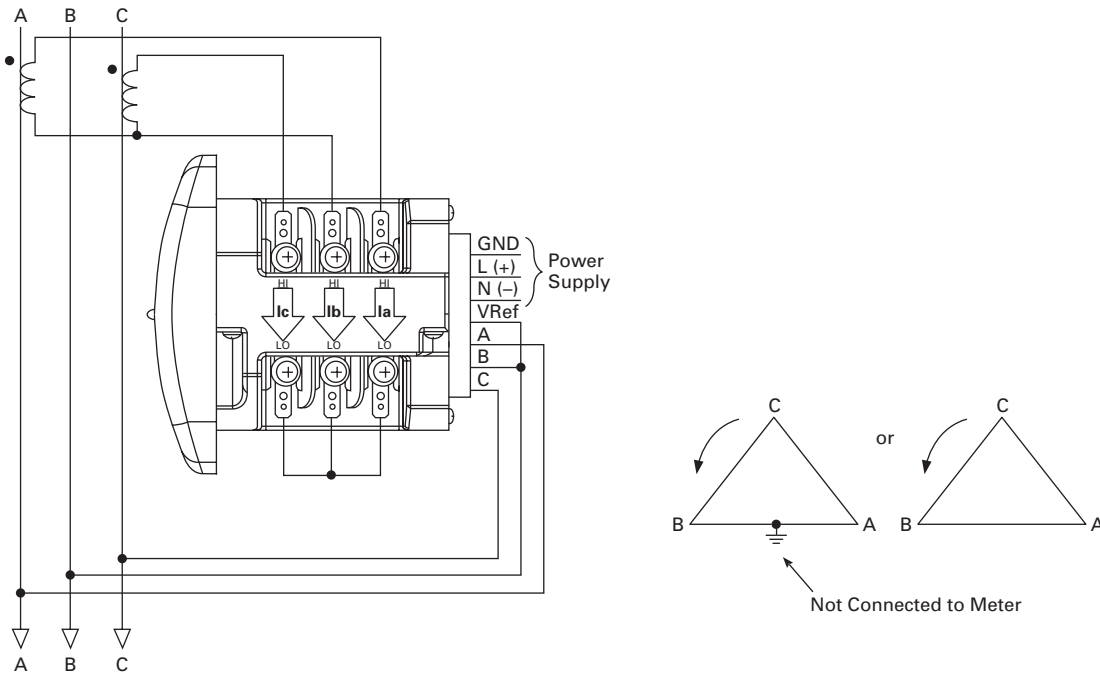
Wiring Diagrams

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



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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.

22.3

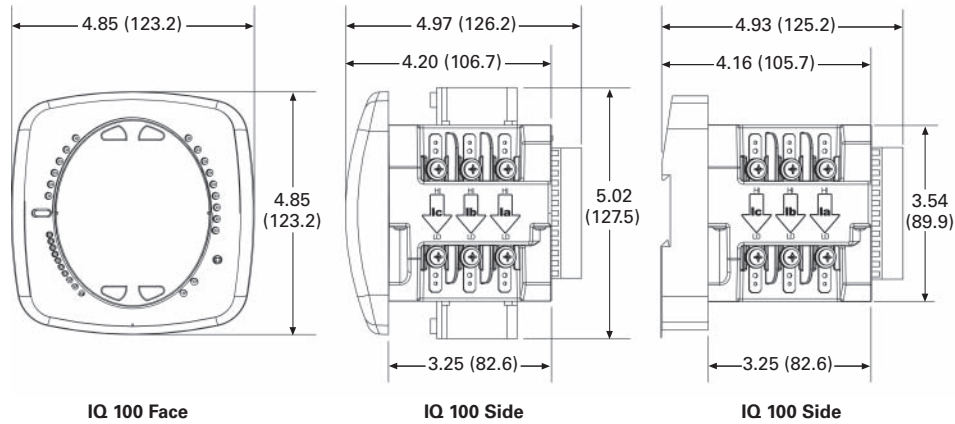
Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

Dimensions

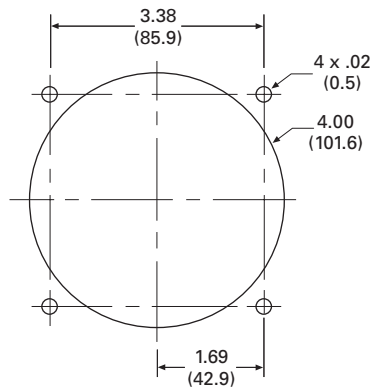
Approximate Dimensions in Inches (mm)

IQ 100 Meter—Face and Side Views

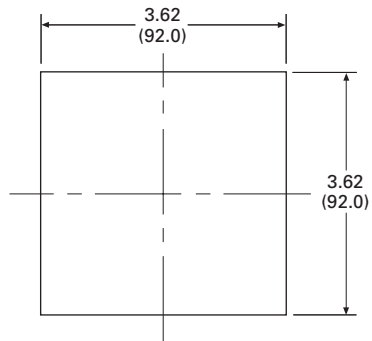


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ANSI Mounting Panel Cutout



DIN Mounting Cutout



| Description | Specifications |
|-------------------------------|---|
| Weight | 2 lbs (0.9 kg) |
| Basic unit | 5.00 (127.0) H x 4.90 (124.5) W x 5.00 (127.0) L |
| IQ 100 | Mounts in 92 mm DIN and ANSI C39.1 round cut-outs |
| Shipping container dimensions | 6-inch cube |
| Tolerance | ±0.1 inches (2.54 mm) |

IQ Analyzer 6400/6600 Series



**IQ Analyzer—
Comprehensive Electrical
Distribution Monitoring**

IQ Analyzer 6400/6600 Series

Product Description

Eaton’s IQ Analyzer is a complete solution for users who want to monitor and manage all aspects of their electrical distribution system. Based on input from customers and consultants, it provides extensive metering, power quality analysis, remote input monitoring, control relaying, analog input/outputs and communications capability.

Its high performance metering exceeds ANSI C12.16 (1%) specification for revenue meters and meets ANSI C12.20 Class 0.5%, provides quality true rms readings through the 50th harmonic, accurately measures nonsinusoidal waveforms up to a 3.0 crest factor, and displays even and odd multiples of the fundamental current and voltage through the 50th harmonic. Both magnitude and phase angle of the harmonics are displayed.

The unique operator interface, which includes a reverse mode LCD display, easy to use *Meter Menu* screens and detailed *Analysis* screens, is designed to allow a wealth of real-time and recorded information to be accessed easily by an operator. All programming can be accomplished through the faceplate or the communications port. The comprehensive on-line Help feature provides useful information on device operation, programming and troubleshooting.

Application Description

- Monitoring of over 150 electrical parameters
- Power quality management
- Energy management

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| IQ Energy Sentinel™ and IQ Power Sentinel | 255 |
| Current Transformers (CTs) | 265 |
| Clamp-On Current Transformers | 274 |
| IQ Flange | 277 |
| Enclosed Meters | 278 |

Features, Benefits and Functions

Metered and Monitored Parameters

- rms sensing
- Phase neutral, and ground currents
- Volts: L-L, L-N, Avg. L-L, Avg. L-N, N-G
- Power: real, reactive, apparent (system and per phase)
- Frequency
- Power factor: apparent and displacement (system and per phase)
- Energy and demand (forward, reverse, net) real, reactive apparent at four different utility rates
- Individual current and voltage harmonics: magnitude, phase angle
- % THD: current and voltage
- Waveform capture

- Minimum and maximum values
- Event logging/disturbance recording
- ANSI C12.20 Class 0.5% revenue metering accuracy, IEC687 Class 0.5%
- Industry Canada 0.5% revenue accuracy

Communications

- Optional interface capability to computer network for data collection, storage and/or printout via Eaton’s Power Management Software

Physical Characteristics

- Graphical reverse mode LCD display with LED backlight
- Up to seven lines of information
- Membrane faceplate NEMA 3R and 12 rated

Disturbance Information

With the communications option and Eaton's Power Management Software and Waveform Display software, a *Waveform Analysis* will construct waveforms of up to 56 cycles of all currents and voltages (including neutral and ground) to help troubleshoot undervoltage/sag and overvoltage/swell conditions. (See CBEMA Trend Logging section, next page.) By programming a reset threshold, the duration of the voltage disturbance can also be indicated.

The IQ Analyzer 6600 series with Graphic Waveform Display offers the ability to view the captured waveform right at the device. The 6600 series also offers the ability to detect and capture sub-cycle voltage disturbances.

Extensive Harmonic Distortion Analysis

Current and voltage distortion data are displayed at the device and accessible through the communications port. This includes % THD, K-Factor, Crest Factor, CBEMA factor, and both magnitudes and phase angles of all harmonics through the 50th. A snapshot sample of this information may be activated by user commands, discrete inputs or programmable thresholds to capture distortion data during conditions of real interest. To help eliminate nuisance alarms, harmonic distortion information can be captured and relay outputs activated when THD exceeds a programmable percentage of fundamental or a programmable magnitude (e.g., amperes) threshold.

Time-of-Use Metering

The IQ Analyzer offers the ability to store energy usage data for time of use revenue metering. It can be programmed for any combination of weekday, Saturday, Sunday, 22 holidays, 8 seasons,

32 schedules and 10 time periods per schedule. The IQ Analyzer will keep track of the following parameters for four different utility rates:

- Watthours
- VAR hours
- VA hours
- Current demand
- Watt demand
- VA demand
- VAR demand

Historical Trend Logging

The IQ Analyzer is equipped with onboard logging capability, which includes the ability to log a total of 24 parameters with intervals ranging from 0.13 seconds (every eight cycles) to twice a week (5040 minutes). The trending function can begin immediately or can be triggered upon receipt of a discrete input into the IQ Analyzer. Onboard logging provides a cost-effective means of distributed data storage where real-time communications may not be feasible or for applications where data storage redundancy is desired. Four trend data logs are stored in non-volatile memory aboard the IQ Analyzer and can be retrieved at the display or via communications for viewing using Eaton's Power Management Software.

- Up to 24 parameters with storage capacity for up to 90,000 data points
- Up to 234 days of data can be stored when recording a parameter every 15 minutes
- Trends 1, 2 and 3 can save data on a discrete contact input
- Trend 4 can save data on a power quality or meter event
- Minimum and maximum recording (minimum and maximum three-phase average current, maximum I_G , minimum and maximum three-phase average V_{LL} and V_{LN} , maximum V_{NG} , maximum

system watts, VARs and VA, minimum and maximum apparent and displacement PF). Using this feature, minimum and maximums reached during each trend interval are recorded.

CBEMA Trend Logging

The IQ Analyzer can be configured to store the necessary data so that the software can display a sag or swell voltage event on the industry standard CBEMA (now ITIC) curve for predictive maintenance and troubleshooting. This application utilizes the IQ Analyzer waveform capture for high-speed events along with historical trend logging for longer term voltage disturbances. Once this data is uploaded to a PC running the Power Management Software's Event Viewer the information is analyzed, displayed and stored. Automatic uploading of CBEMA events can be selected in the software. A three-phase event will be correctly displayed as a single point on the CBEMA curve.

Event Logging

The IQ Analyzer will store in non-volatile memory the time and reason for last 504 events. These events can be viewed from the graphical display or accessed via communications. In addition to all of the meter events listed in the Event Conditions section (**Page 229**), the following events are entered into the event log:

Time and date of:

- Alarms
- Meter power up
- All resets
- All setting changes
- Communications established or lost

Event logging is another powerful troubleshooting tool within the IQ Analyzer.

Extensive I/O and Communications Capability

One analog and three digital inputs are provided to interface with sensors and transducers. Three analog outputs and four relay contacts are furnished to share data with PLCs and control systems and to actuate alarms and control relays. Terminals are captive clamp type and finger safe. With the communications option, the device can be remotely monitored, controlled and programmed.

Ratings

- Application to 500 kV, no PTs to 600 volts
- CT ratios selectable from 5:5A to 10,000:5A
- Standard 120/600 Vac line
- Three-phase power supply module, 100–600 Vac. Separate source power supply module available, 100–240 Vac or 100–250 Vdc
- DC only separate source power module also available, 24–48 Vdc

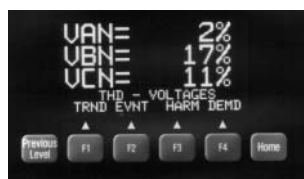
Displayed Information Features

- All information accessible at device or through communications port via Eaton's Power Management Software
- Quality true rms readings through 50th harmonic
- Complies with the accuracy portion of ANSI C12.20 Class 0.5% revenue metering specification
- Accurate readings for nonsinusoidal waveforms with up to 3.0 crest factor
- Screens display auto ranging units, kilo units, mega units as needed
- 10-digit energy readings
- Displays multiple parameters at the same time
- Programmable custom screens

Meter Menu Screens



Meter Menu



Examples of Meter Menu



Custom Screen



Custom Screen

The IQ Analyzer allows a user to view commonly used parameters by scrolling through its LED indicator Meter Menu.

Meter Menu Displayed Information

- Current
 - Phases A, B, C, average
 - Neutral
 - Ground (separate CT)
- Voltage
 - Phases A-B, B-C, C-A, average
 - Phases A-N, B-N, C-N, average
 - Neutral-ground
- Power
 - Real (watts)
 - Reactive (VARs)
 - Apparent (VA)
 - Phases A, B, C and system

- Energy (forward, reverse and net)
 - Real (kWh)
 - Reactive (kVARh)
 - Apparent (kVAh)—no reverse or net
- Frequency, time and date
- Demand
 - System current (amperes)
 - Systems real power (kW)
 - System reactive power (kVAR)
 - System apparent power (kVA)
- Power factor (Phases A, B, C and system)
 - Displacement
 - Apparent
- %THD current
 - Phases A, B, C, N
- %THD voltage
 - Phases A-B, B-C, C-A
 - Phases A-N, B-N, C-N
- K-factor
- CBEMA (ITIC) derating factor (displayed as “Z”)
- Crest Factor
- Discrete input and output status
- Analog input reading
- Custom—user may program four screens to show any combination of seven Meter Menu parameters per screen

Harmonic Analysis Screens



Harmonic Spectrum Available with Model 6600

Minimum and Maximum Values

- Current
 - Phases A, B, C, N, G
- Voltage
 - Phases A-B, B-C, C-A
 - Phases A-N, B-N, C-N, N-G

- Power
 - Real (Watts)
 - Reactive (VARs)
 - Apparent (VA)
 - Phases A, B, C and System
- Power factor
 - Apparent and Displacement (three-phase and system)
- Frequency
- THD (amperes, volts and %):
 - Current (Phases A, B, C, N)
 - Voltage (Phases A-B, B-C, C-A, A-N, B-N, C-N)

All minimum/maximum values may be reset via reset pushbutton on faceplate, discrete input or communications command. Values are updated at least once every 16 line cycles.

The F3 function key accesses the Harmonic Analysis screens. Two cycles of data sampled at 128 **samples/cycle** are **simultaneously** recorded for:

- Current
 - Phases A, B, C, N, G
- Voltage
 - Phases A-B, B-C, C-A
 - Phases A-N, B-N, C-N
 - Neutral to Ground

Magnitudes (or % of fundamental) of odd **and even** multiples of the fundamental from 2nd–50th are displayed. The phase angle associated with each multiple of the fundamental is also displayed.

Event/Alarm Analysis Screens



Example of Event Analysis Screens



Waveform Screen Available with Model 6600

Pressing the F2 function key accesses the Event Analysis screens. These display the following data for up to ten event/alarm conditions:

- Description, date and time of event/alarm with 10 millisecond resolution
- Current, voltages, power readings, demand readings, frequency and % THD at time of event/alarm
- Current and voltage distortion information available on Harmonic Analysis screens

Event data is stored in non-volatile memory. If a reset threshold is programmed, the *duration* of the event (e.g., undervoltage) is also displayed. With Eaton’s communications option and software, waveforms and harmonic profiles may be displayed on a PC.

Event Conditions

Events may be triggered by up to seven of any of the following conditions:

Voltage Disturbances

- Undervoltage/sag—any V_{L-L} , V_{L-N} (40–100%)

Note: 60% minimum for self-powered unit.

- Overvoltage/swell—any V_{L-L} , V_{L-N} (100–750%)

If zero time delay is programmed, any disturbance lasting two cycles (less if magnitude is sufficient to effect rms readings) will trigger a voltage disturbance event/alarm.

- Sub-cycle transient capture/excess dv/dt on V_{A-N} , V_{B-N} , V_{C-N}

Note: 6600 series only.

- Sub-cycle voltage interruption on V_{A-N} , V_{B-N} , V_{C-N}

Note: 6600 series only.

Maximum Threshold Exceeded

- Currents—phases A, B, C, Neutral and Ground
- Voltage—Neutral to Ground
- System Power—Watts, VA, VARs
- System Power Factor—Displacement and Apparent
- Demand
- Currents—Phase A, B, C and AVG
- System Power—Watts, VARs, VA
- Frequency
- Percent Total Harmonic Distortion or Magnitude Total Harmonic Distortion:
 - Currents—Phases A, B, C, Neutral
 - Voltage— V_{A-N} , V_{B-N} , V_{C-N} , V_{A-B} , V_{B-C} , V_{C-A}

Minimum Threshold Exceeded

- Currents—Phases A, B, C
- System Power—Watts, Vars, VA
- System Power Factor—Displacement and Apparent
- Frequency

Voltage Phase Unbalance

- Voltage L-L, L-N

Current Phase Unbalance

- Current—Phases A, B, C

Discrete Input Energized

- Input 1, 2, 3
- Remote command through communications port or front panel

All trigger conditions have programmable time delays from 0.1–60 seconds in 0.1 second increments (except Voltage Disturbances—programmable from 2–3600 cycles in two-cycle increments, and Eaton's Power Management Software commands—no programmable delay).

Demand Recording

Peak Demands are date and time stamped for:

- Current Phases A, B, C and Average
- System Power:
 - Real (watts)
 - Reactive (VARs)
 - Apparent (VA)

Input/Output

Extensive input/output capability is standard on the IQ Analyzer. In addition to monitoring three-phase currents and voltages, separate inputs are provided for both ground and neutral currents. Voltage of neutral-to-ground is also monitored to indicate the presence of harmonics and potential downstream grounding problems. Analog and digital I/O provide interfaces for transducers, relays, PLCs and control systems.

Current Inputs

Five ampere secondary CT connections for:

- Phases A, B, C
- Ground
- Neutral
- Separate ground and neutral CT inputs
- CT range 5:5–10,000: 5 (any integer)

Voltage Inputs

- Phases A, B, C (from 120 Vac–500 kV AC)
- 120/240 Vac control power input standard—not required with optional line power module
- Separate ground-to-neutral voltage reference
- PT range 120:120–500,000:120 (any integer)

External 120-volt secondary PTs are required above 600 Vac, optional from 120–600 Vac.

Discrete Contact Inputs

Three dry contact discrete inputs may be programmed by the user to:

- Trigger Event Analysis—the information described in “Event Analysis Screens,” including Harmonic Analysis information, can be recorded when external devices trip or change state by wiring their auxiliary contacts into these inputs
- Act as a synch.-pulse input to synchronize power demand windows with utility provided synch. pulse
- Actuate a relay output
- Reset relay output, peak demands, Trend Analysis records and Event Analysis records
- With communications option, provide remote status indication on Eaton's communication network
- Status of input contacts is displayed in the Meter Menu Custom screen

Relay Output Contacts

Four Form-C (NO/NC) relay contacts may be independently programmed to:

- Act as a kWh, kVARh or kVAh pulse initiator output
- Actuate on one or more event conditions—including discrete input software commands (through communications port)
- Reverse sequence alarm

Each relay may be set for Auto or Manual Reset with 0–30 minute release delay (one second increments). Relays are Form-C NO/NC. Relay(s) programmed to actuate on undervoltage also have a programmable 0–30 minute delay on power-up for transfer applications.

Analog Input and Outputs

One analog input and four analog outputs may be configured as 0–20 or 4–20 mA. The analog input is displayed at the device as a percentage and is accessible through the communications port. The analog input provides an interface with gas flow meters, temperature transducers or other analog devices.

The analog outputs may be programmed to reflect any of the following:

- Current—Phases A, B, C, Average, N, G
- Voltage—L-L, L-N, N-G
- Power:
 - Real (watts)
 - Reactive (VARs)
 - Apparent (VA)
 - Phases A, B, C and System
- % THD:
 - Current (Phases A, B, C, N)
 - Voltage (L-L, L-N)
- Frequency—System
- Power Factor:
 - System Displacement PF
 - System Apparent PF

Standards and Certifications

- UL listed, File E62791, NKCR File E185559 (CE versions)
- cUL listed #1010.1 C22.2
- CE mark EN61010-1 (1993) EN50082-2 (1994)
- Measurement Canada Electricity Meter AE-0782
- CSA approved



Product Selection

IQ Analyzer



IQ Analyzer

| Description | Catalog Number |
|---|-------------------|
| IQ Analyzer, separate source power module | IQA6410 |
| IQ Analyzer, 24–48 Vdc power module | IQA6420 |
| IQ Analyzer, three-phase power module | IQA6430 |
| IQ Analyzer, separate source power module with waveform display and sub-cycle voltage disturbance capture | IQA6610 |
| IQ Analyzer, 24–48 Vdc power module with waveform display and sub-cycle voltage disturbance capture | IQA6620 |
| IQ Analyzer, three-phase power module with waveform display and sub-cycle voltage disturbance capture | IQA6630 |
| IQ Flange, to provide extra clearance when mounting | IQFLANGE |
| 45-inch (1143.0 mm) extension cable for remote mounting of power module | IQA45CABLE |
| 24–48 Vdc separate source power module | IQMDCPM |
| 100–240 Vac and 100–250 Vdc separate source power module | IQMSSPM |
| Three-phase, self-powered power module | IQM3PPM |
| INCOM communication module | IPONI |
| RS-485 communication module with Modbus protocol | MPONI |

Accessories

IQ Analyzer Auxiliary Power Supply

The optional IQ Analyzer Auxiliary Power Supply allows set point programming of the IQ meter while the monitored line power is turned off and locked out, thus eliminating the presence of dangerous line voltages. The Auxiliary Power Supply is easy to install and has been specifically designed to connect to the power supply connector on the IQ meter and then plug into a standard electrical wall outlet.

Technical Data and Specifications

IQ Analyzer 6400/6600 Series

Fuses

- Self-powered units with IQMSSPM have 3/4 ampere, 600 volts Bus Type KTK-R-3/4 fuses (three required).
- Separate source dual-voltage units with IQMSSPM have a single 5 x 20 mm 1/4 ampere fuse
- Separate source DC units with IQMDCPM do not have user replaceable fuses

Environmental Conditions

- Operating temperature: -20°–70°C
- Storage temperature: -30°–85°C
- Operating humidity: 5–95% relative humidity

Current Inputs (Each Channel)

- Conversion: true rms, 32 sample/cycle (all samples used in all rms calculations)
- CT input: 5 ampere secondary (any integer 5:5 to 10,000:5)
- Burden: 0.05 VA
- Overload withstand: 40 amperes AC continuous, 300 amperes AC 1 second
- Range: 8 x CT continuous
- Accuracy: 0.1% of CT primary rating, 0.2% of reading above 150% of rating, sinusoidal (see accuracy below for non-sinusoidal specifications)
- Input impedance: 0.002 ohm

Voltage Inputs (Each Channel)

- Conversion: True rms, 32 sample/cycle (all samples used in all rms calculations)
- PT input: direct or any integer 120:120–500,000:120
- Range: 30–660 Vac (separate source and DC source)
- Nominal full scale: 100–600 Vac
- Burden: 21 VA (self-powered only)
- Overload withstand: 635 Vac, continuous 700 Vac, 1 second
- Input impedance: 1 megohm

Frequency Range

- 20–66 Hz fundamental (up to 50th harmonic)

Harmonic Response (Voltages, Currents)

- 50th harmonic

Accuracy (in Percent Full Scale)

Accuracy from 3–300% of Full Scale and from -0.5. to 1.00 to 0.5 power factor

- Current and voltage: $\pm 0.20\%$
- Power, energy and demand: 0.40%
- Frequency: 0.04%
- Power factor: 0.80%
- THD: 1.00%

Specific Current Accuracies

- $\pm 0.20\%$ of full scale to 200% of full scale and 150% crest factor
- $\pm 0.20\%$ of full scale to 150% of full scale and 200% crest factor
- $\pm 0.20\%$ of full scale to 100% of full scale and 300% crest factor
- $\pm 0.40\%$ of reading for currents to 800% of full scale
- Power and energy: Start recording with an average of 3 mA secondary current

Discrete Inputs (Dry Contact)

- +30 Vdc differential across each discrete input pair of terminals. Minimum pulse width: 1.6 msec
- Optically isolated inputs to protect IQ Analyzer circuitry

Analog Outputs (4)

- 0–20 mA/4–20 mA into maximum 750 ohm load. Accuracy: 1%

Analog Input (1)

- 0–20 mA/4–20 mA into 200 ohm load. Accuracy: 1%

Relay Output Contacts (4)

- Form C Dry Contact: 10 amperes at 120/240 Vac (Resistive) 10A at 30 Vdc (Resistive) 30A make (50 mS) at 240 Vac/240 Vdc
- Minimum pulse width: 4 cycles (68 mS)

- Withstand rating: 1000 Vac, 1 minute across contacts 5000 Vac (contacts to coil, 1 minute) 10,000 Vac (contacts to coil, surge voltage)

Relay Response Time

(Excluding programmed time delays):

- Two line cycles for Discrete Input, Eaton's software commands (communications port)
- Four to five line cycles for Voltage Disturbance, Voltage Unbalance
- Nine to 10 line cycles for all others

IQ Analyzer Auxiliary Power Supply

- Input voltage: 100–250 Vac
- Input frequency: 50/60 Hz
- Output voltage/current: +24 Vdc at 0–0.45A
- Output ripple: 100 mV maximum (peak to peak)
- Rated output power: 10.8 watts
- Turn on/turn off overshoot 5% maximum
- Turn on delay: 0.5 second maximum
- Operating temperature: 0°–40°C
- Storage temperature: -40°–80°C

Control Power Input

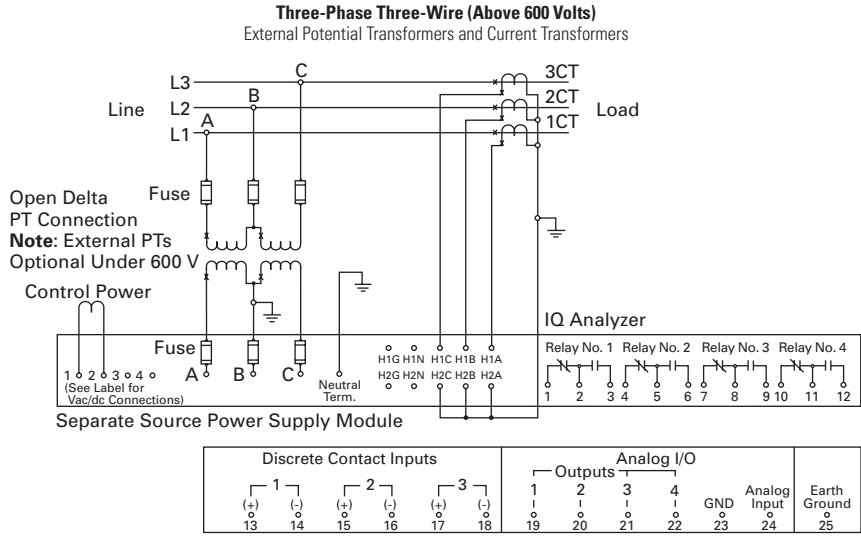
| Description | Separate Source | Self Powered ^① | DC Source |
|-----------------|------------------------|---------------------------|----------------------|
| Input range, AC | 110–240 Vac $\pm 10\%$ | 110–600 Vac $\pm 10\%$ | N/A |
| Frequency range | 45–66 Hz | 45–66 Hz | N/A |
| Input range, DC | 110–250 Vdc $\pm 10\%$ | N/A | 24–48 Vdc $\pm 20\%$ |
| Burden | 21 VA | 21 VA | 21 VA |

Note

^① When directly wired to 480 Vac, IQ Analyzer can ride through a continuous sag that is 20% of rated voltage.

Wiring Diagram

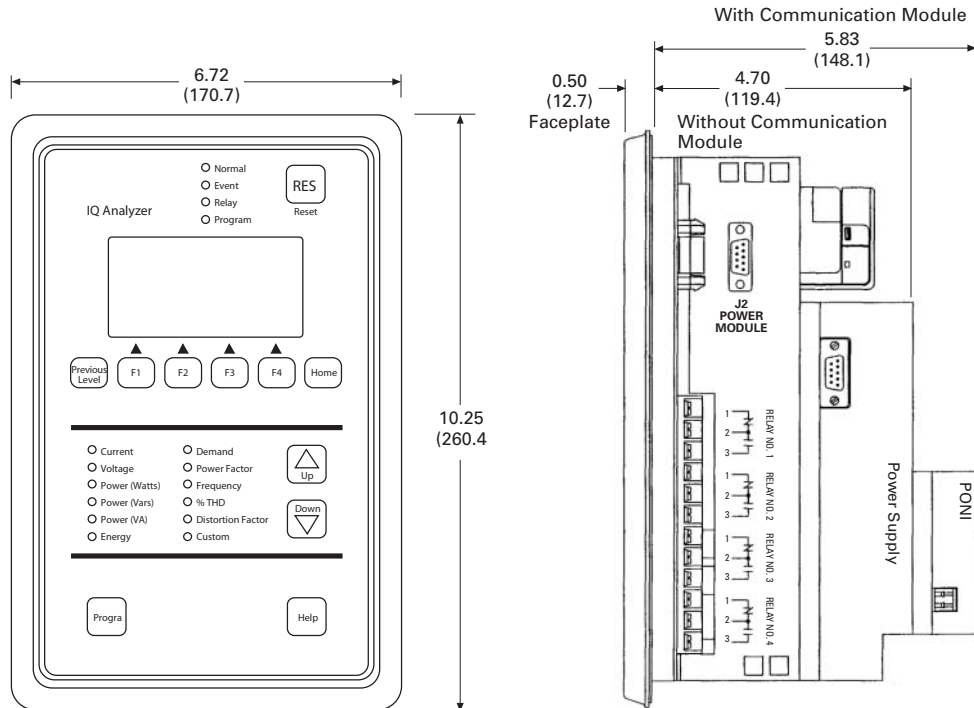
Field Wiring Connections—Separate Source Power Supply Shown Here
(For Three-Phase Power Supply, No Separate Control Power is Required)



Dimensions

Approximate Dimensions in Inches (mm)

IQ Analyzer 6000 Series



22.3

Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

Approximate Dimensions in Inches (mm)

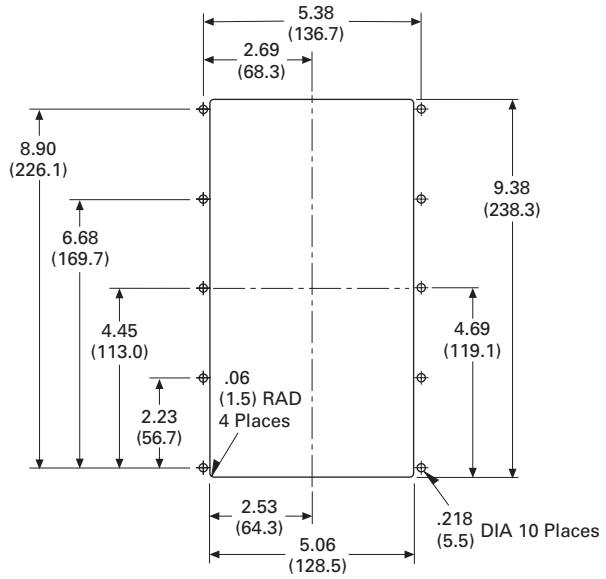
IQ Analyzer Auxiliary Power Supply

| Width | Height | Depth | Shipping Weight Lbs (kg) |
|-------------|--------------|-------------|-----------------------------|
| 2.40 (61.0) | 4.00 (101.6) | 1.11 (28.2) | 5.8 (3.6) |

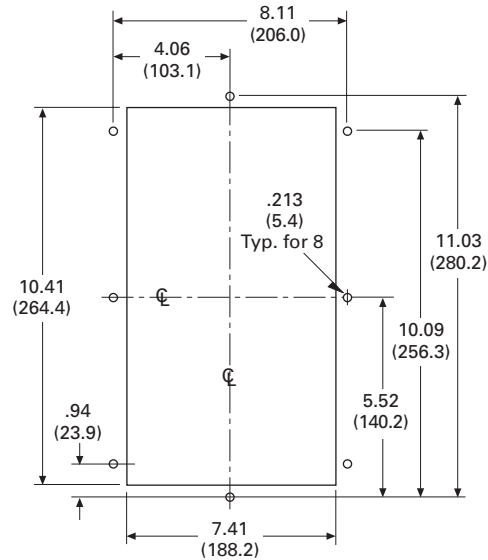
IQ Analyzer 6000 Series

| Height | Width | Depth |
|---------------------|--------------|--------------|
| Without PONI | | |
| 10.25 (260.4) | 6.72 (170.7) | 4.70 (119.4) |
| With PONI | | |
| 10.25 (260.4) | 6.72 (170.7) | 5.83 (148.1) |

Drilling Pattern



Drilling Pattern for Flange Mounting



IQ DP-4000



IQ DP-4000 Series

Product Description

Eaton’s IQ DP-4000 is a microprocessor-based monitoring and protective device that provides complete electrical metering and system voltage protection. In one compact, standard package, the IQ DP-4000 will provide an alternative to individually mounted and wired conventional meters and switches. The DP-4000 also monitors Apparent Power (VA), Reactive Energy (VAR-hours), Apparent Energy (VA-hours) and percent THD to provide the user with basic power quality information. The IQ DP-4000 meets and surpasses UL/CSA/CE standards.

The IQ DP-4000’s rugged construction is designed to withstand harsh conditions such as temperature variations, outdoor applications and industrial environments. The membrane faceplate pushbuttons are easy to use and both the parameter LED and window displays are easily visible.

Application Description

- Monitoring of all common electrical parameters
- Optional protective alarm functions

Retrofit Opportunities

- Retrofit of existing electrical distribution systems with the IQ DP-4000 for power, quality, load and energy monitoring
- Mounting flange option for application where additional door mounting space is required; see **Page 277**

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Features, Benefits and Functions

Historical Values

- Present demand current (per phase) 5, 10, 15, 20, 25, 30, 45 or 60 minute windows
- Present demand watts, VARs and VA 5, 10, 15, 20, 25, 30, 45 or 60 minute windows:
 - Sliding or fixed window for power Sync pulse input (Model 4100) Eaton's PowerNet broadcast demand sync
- Minimum and maximum values current (per phase):
 - Voltage (per phase, L-L, L-N)
 - Watts, VARs and VA
 - Power factor (displacement and apparent)
 - Frequency
- Peak values:
 - Percent THD parameters
 - Demand parameters

Protective and Event Alarming

- Undervoltage
- Overvoltage
- Current phase loss
- Voltage phase loss
- Phase reversal
- Phase unbalance
- Optional current and powerdemand threshold

Metered and Monitored Parameters

- rms sensing
- Phase currents
- Volts: L-L, L-N
- Power: real, reactive, apparent
- Energy: real, reactive, apparent
- Frequency
- Power factor
- % THD: current and voltage
- Minimum and maximum values
- Fixed or sliding demand windows

Communications

- Optional interface capability to computer network for data collection, storage and/or printout via Eaton's Power Management Software

Physical Characteristics

- Large visible LED display
- Membrane Faceplate NEMA 3R and 12 rated

Alarm and Protective Functions

- Alarm/Protective functions (all models) include:
 - Overvoltage
 - Undervoltage
 - Current phase loss
 - Voltage phase loss
 - Phase unbalance
 - Phase reversal
- User-programmable alarm and reset threshold levels and delay intervals
- Optional current and power demand threshold

Description of Protection Functions

Overvoltage

Range 105–140% (5% increments).

Undervoltage

Range 60–95% (5% increments).

Phase Unbalance

Deviation between any two phases percentage of nominal line voltage preset by DIP switches. Range 5–40% (5% increments).

Phase Reversal

Any two phases become reversed for the selected delay.

Voltage Phase Loss

Less than 50% of the nominal line voltage detected.

Current Phase Loss

Smallest phase current is less than 1/16 of the largest phase current.

Delay

Allows a delay before an alarm occurs. (Range 1–20 seconds in 1 second increments.)

Note: Unit must be powered for this to occur.

Inputs and Outputs (4100 Model)

- Three Form C relay outputs selectable: Trip, Alarm, kWh pulse initiator
- One synch input for kW utility demand sync

Standards and Certifications

Listings and Certifications

- UL/cUL/CSA listed
- CE mark EN61010-1, EN50082-2



Product Selection

IQ DP-4000

IQ DP-4000



Description

| Description | Catalog Number |
|---|-------------------|
| 4 indicates an IQ DP-4000 model | IQDP4XY0 |
| x = 0 indicates no I/O; x = 1 indicates I/O | |
| y = 1 indicates separate source supply, 110–240 Vac and 110–250 Vac | |
| y = 2 indicates 24–48 Vdc power supply, | |
| y = 3 indicates three-phase power supply, 110–600 Vac | |
| Separate source control power without I/O | IQDP4010 |
| Separate source control power without I/O, DC supply | IQDP4020 |
| Three-phase power supply without I/O | IQDP4030 |
| Separate source control power with three Form C relay output contacts and one sync pulse input | IQDP4110 |
| Separate source control power with three Form C relay output contacts and one sync pulse input, DC supply | IQDP4120 |
| Three-phase power supply with three Form C relay output contacts and one sync pulse input | IQDP4130 |
| 2 Form C relay outputs for protective alarming functions, 1 Form C relay output selectable for KYZ pulse output or load shedding, 1 demand sync pulse input | DP410MOD |
| IQ flange, to provide extra clearance when mounting | IQFLANGE |
| 45-inch (1143.0 mm) extension cable for remote mounting of power module | IQA45CABLE |
| 24–48 Vdc separate source power module | IQMDCPM |
| 100–240 Vac and 100–250 Vdc separate source power module | IQMSSPM |
| Three-phase, self-powered power module | IQM3PPM |
| INCOM communication module | IPONI |
| RS-485 communication module with Modbus protocol | MPONI |

Accessories

IQ DP-4000 I/O Module

For applications where field modification to add or change Input/Output (I/O) capability to the IQ DP-4000 is required, Eaton offers I/O cards. These field-installable modules can be easily inserted into an existing IQ DP-4000 where input/output application needs change.

- Power requirements: 10 VA
- Frequency: 50/60 Hz
- Operating temperature: 25°–70°C
- Operating humidity: 0–95% noncondensing
- Dry contact input: 24 Vdc differential across input pair of terminals; minimum pulse width, 50 mS

Technical Data and Specifications

Accuracy

- Maintained from 10–250% of CT primary rating

Current Inputs (Each Channel)

- Nominal full scale current: 5 amperes AC
- Current range for rated accuracy: 0–15 amperes AC
- Overload withstand: 15 amperes ac continuous 300 amperes AC 1 second
- Burden: 0.003 VA

Voltage Inputs (Each Channel)

- Voltage range (nominal): 90–600 Vac
- Nominal full scale voltage: 120–600 Vac
- Overload withstand: 660 Vac continuous 4 kV 1.2/50 μ s
- Burden: three-phase power module 10 VA

Fuses

Supplied with three-phase power module only. 3/4 ampere, 600 volt bus type KTK-R-3/4 (three required).

Contact Rating (Model 4100)

- 10 amperes at 120/240 Vac (resistive)
- 10 amperes at 30 Vdc (resistive)

Compatible with the Following Systems

- Three-phase, three-wire
- Three-phase, four-wire

Ratings

- Application to 500 kV, no PTs to 600 volts
- CT ratios selectable from 5:5 A to 12800: 5A
- Standard 120/600 Vac line three-phase power supply module. Two separate source power supply modules available. One module from 110–240 Vac and 110–250 Vdc; the other module 24–48 Vdc only

Model 4100 Input and Output

| Model | Input | Output |
|-------|-------------------------|----------|
| 4000 | 0 | 0 |
| 4100 | 1 digital (dry contact) | 3 relays |

Control Power Input

| Description | Separate Source | Self Powered | DC Source |
|------------------------------------|-----------------------------------|-----------------------------------|------------------------------|
| Input range, AC Frequency range | 110–240 Vac \pm 10% 45–66 Hz | 110–600 Vac \pm 10% 45–66 Hz | N/A N/A |
| Input range, DC Burden | 110–250 Vac \pm 10% 10 VA | N/A 10 VA | 24–48 Vdc \pm 20% 10 VA |

Displayed Values

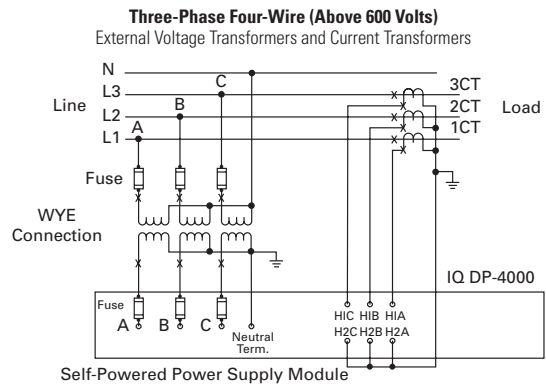
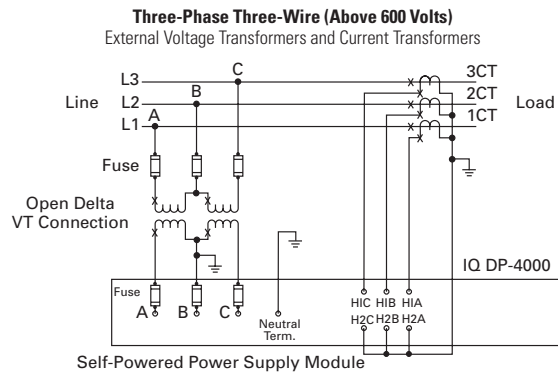
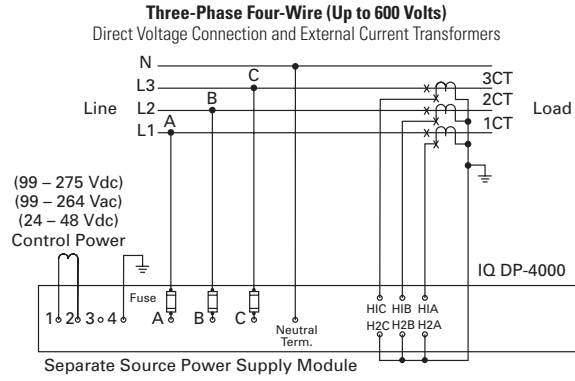
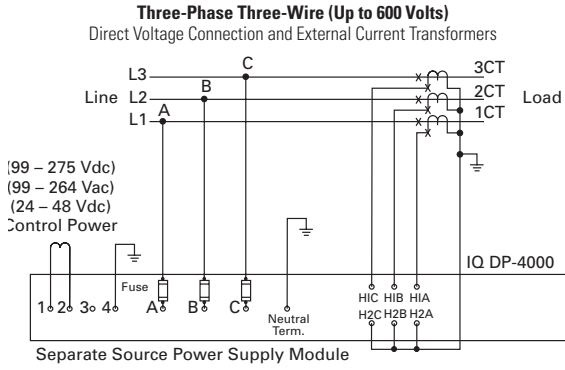
| Description | Displayed Through Eaton's PowerNet System | Local Display |
|---------------------------------|---|--------------------------|
| AC amperes, phases A, B, C | \pm 0.3% | \pm 0.3% \pm 1 digit |
| AC voltage, phase A-B, B-C, C-A | \pm 0.3% | \pm 0.3% \pm 1 digit |
| Phase A-N, B-N, C-N | \pm 0.3% | \pm 0.3% \pm 1 digit |
| Watts | \pm 0.6% | \pm 0.6% \pm 1 digit |
| Vars | \pm 0.6% | \pm 0.6% \pm 1 digit |
| VA | \pm 0.6% | \pm 0.6% \pm 1 digit |
| Watt-hours | \pm 0.6% | \pm 0.6% \pm 1 digit |
| VAR-hours | \pm 0.6% | \pm 0.6% \pm 1 digit |
| VA-hours | \pm 0.6% | \pm 0.6% \pm 1 digit |
| Power factor | \pm 1% | \pm 1% |
| Frequency | \pm 0.1 Hz | \pm 0.1 Hz |
| % THD | Through 31st harmonic | Through 31st harmonic |

Note

All accuracy is measured as a percentage of full scale.

Wiring Diagrams

Field Wiring Connections



22.3

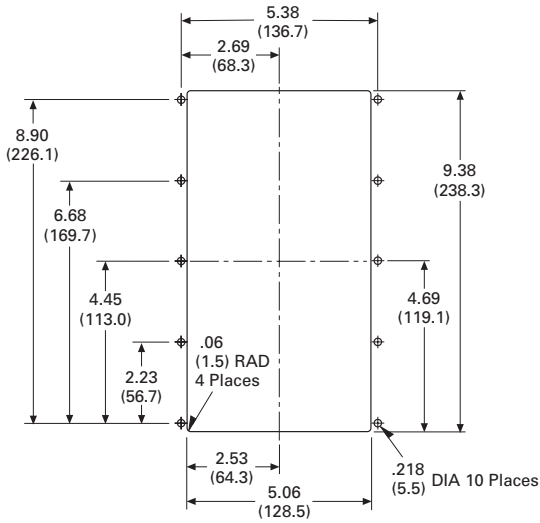
Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

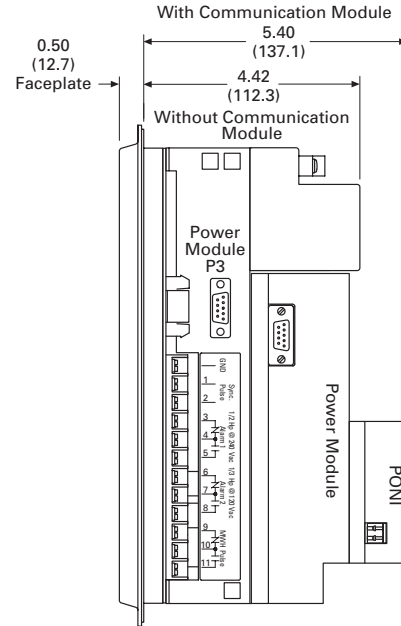
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Pattern



IQ DP-4000 Side View



LED Display

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|---------------------|--------------|--------------|-----------------------------|
| PONI | | | |
| 10.25 (260.4) | 6.72 (170.7) | 5.40 (137.2) | 6.50 (3.0) |
| Without PONI | | | |
| 9.02 (229.0) | 7.80 (198.1) | 4.42 (112.3) | 12.5 (5.7) |

IQ DP-4000 Auxiliary Power Supply

| Width | Height | Depth |
|-------------|--------------|-------------|
| 2.40 (61.0) | 4.00 (101.6) | 1.11 (28.2) |

IQ 220 Digital Meter



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IQ 210/220/230 Meters

Product Description

The IQ 200 is a family of microprocessor-based metering and monitoring devices. Its compact size and flexible mounting capabilities make it suitable for machine control panels such as panelboard and switchboard mains and feeders, low voltage metal-enclosed switchgear feeders and motor control centers. The IQ 200 series meter includes a base module and a display module. The IQ 200 base module has the flexibility to be directly mounted to the display or separately panel mounted. The display is integrally designed to fit a standard 1/4 DIN or a 100 mm ANSI cutout for new retrofit applications.

Application Description

The IQ 200 is ideal for individual load monitoring or provides an alternative to multiple ammeters, voltmeters, ammeter and voltmeter switches, wattmeters, varmeters, power factor meters, frequency meters, watthour and demand meters. ANSI C12 Class 10 revenue metering accuracy make the IQ 200 ideal for sub-metering and sub-billing applications.

Features

The IQ 200 can be easily programmed from the display keypad, which features a 4 line x 20 character LED backlit LCD display. This menu driven device displays a variety of selectable electrical system values and may be programmed for password protection.

The IQ 200 series includes four variations all containing the same display module. The IQ 210 base module is a reduced function variation, while the IQ 220, IQ 230 and IQ 230M offer additional functionality. The IQ 220 contains a wider ranging power supply, built-in INCOM communications and a KYZ pulse output. The IQ 230 provides all the same functionality of the IQ 220 but adds digital inputs, digital outputs and an analog input. The IQ 230M includes all the benefits of the IQ 230 but replaces INCOM communication with Modbus®.

- Five different mounting options
- 1/4 DIN standard 3.60 inches (91.4 mm) x 3.60 inches (91.4 mm) cutout that meets global standards
- One meter style with multiple mounting choices—mount on panel, DIN rail or back of meter
- Autoranging power supply; one style for any voltage up to 600 Vac (IQ 220 and IQ 230 only)
- Direct connection up to 600 Vac. PTs are not required
- AC or DC powered
- Polarity sensing for errors such as improper wiring or forward and reverse power flow
- Membrane faceplate designed and tested to meet NEMA® 12 and IP52
- Nonvolatile storage of all set points and recorded peaks and minimums
- Built-in INCOM or Modbus® communications capability (IQ 220 and IQ 230 only)
- Digital and analog I/O (IQ 230 only)
- Utility seal provision (IQ 230 only)

Monitored Values

- Phase currents
- Voltage, L-L, L-N
- System and per-phase power including watthours, varhours and VA-hours
- System demand including watt demand, VA demand and VAR demand
- Apparent and displacement power factor
- Frequency
- True rms metering of distorted currents and voltages up to the 31st harmonic
- KYZ pulse output is available for use with a watthour pulse recorder or totalizer (IQ 220 and IQ 230 only)
- Recorded minimums and maximums of most values

Standards and Certifications

- UL and cUL listed
- UL file number E185559
- CSA certified (not ANSI revenue certified as a single-phase meter)
- CE mark for applications where European compliance is required
- IEC 1010-1 (1990) incl. amend. 1 and 2 (1995)
- EN61010-1 (1993)
- CSA C22.2 #1010.1 (1992)
- UL 3111



Product Selection

IQ 210/220/230 Meters



IQ 210/220/230 Meters

| Description | Catalog Number |
|---|-------------------|
| IQ 230 complete meter Includes base, display and 14-inch cable with INCOM Communications, KYZ output, digital inputs, digital outputs, analog input and utility seal provision | IQ230 |
| IQ 230M complete meter Includes base, display and 14-inch cable with Modbus communications, KYZ output, digital inputs, digital outputs, analog input and utility seal provision | IQ230M |
| IQ 230 base module | IQ230TRAN |
| IQ 230M base module | IQ230MTRAN |
| IQ 220 complete meter Includes base, display module and 14-inch (355.6 mm) cable with INCOM communications and KYZ output | IQ220 |
| IQ 210 complete meter Includes base, display and 14-inch (355.6 mm) cable | IQ210 |
| IQ 220 transducer base only with INCOM communications and KYZ output | IQ220TRAN |
| IQ 200D IQ 210/220 display module | IQ200D |
| 3-foot (0.9 m) category 5 cable | IQ230CABLE |
| 6-foot (1.8 m) category 5 cable | IQ26CABLE |
| 10-foot (3.0 m) category 5 cable | IQ210CABLE |

Technical Data and Specifications

Compatible with the Following Systems:

- Three-phase, three-wire
- Three-phase, four-wire
- Single-phase, two-wire
- Single-phase, three-wire

Current Input (Each Channel)

- Current range: 2 times
- Nominal full scale current: 5 amperes AC
- Overload withstand: 10 amperes AC continuous
150 amperes AC, 1 second
- Input impedance: 0.01 ohms
- Burden: 0.025 VA

Voltage Input (Each Channel)

- Voltage range (nominal): 90–600/347 Vac
- Nominal full scale voltage: 120–600/347 Vac
- Overload withstand: 660 Vac continuous,
800 Vac 1 second
- Input impedance: 2 megohm

CT (Primary) Settings

Select from 256 values ranging from 5–8000 amperes

- PT Primary 256 values with ratios up to 200 kV

Environmental Conditions

| | Base | Display |
|---------------------------|---------------------------|---------------|
| Operating temperature | –20°C to 50°C | 0°C to 50°C |
| Storage temperature | –30°C to 85°C | –20°C to 60°C |
| Operating humidity | 0.0% to 95% noncondensing | — |
| Maximum relative humidity | 80% up to 31°C | — |

Frequency Range

50/60 Hz

Control Power Input

| | Vac | Vdc |
|-----------------|---------------|--------------|
| IQ 210 | 110–240 ±10% | 125–250 ±10% |
| IQ 220 | 100–600 ±10% | 48–250 ±10% |
| IQ 230 | 100–600 ±10% | 48–250 ±10% |
| Frequency range | 50–60 Hz ±10% | — |
| Burden | 180 mA | 700W |

EMC

- Emissions
FCC Part 15 Class A
CISPR 11 (1990)/EN55011 (1991) Group 1 Class A
- Immunity
Electrostatic discharge
EN61000-4-2 (1995)/EN50082-2 (1995)
4 kV contact discharge
8 kV air discharge
Electrical fast transient
EN61000-4-4 (1995)/EN50082-2 (1995)
2 kV power lines
2 kV signal lines
Radiated immunity
EN61000-4-3 (1997)/EN50082-2 (1995)
10V/m
Conducted immunity
EN61000-4-6 (1996)/EN50082-2 (1995)
10V rms
Power frequency magnetic field
EN61000-4-8 (1995)
30 A/m

Metered Values and Accuracies at Full Scale

| | | Accuracy |
|--------------|-------------------------------------|----------|
| AC ampere | Phase A Phase B Phase C | ± 0.5% |
| AC voltage | Phase A-B Phase B-C Phase C-A | ± 0.5% |
| Watts | | ± 1.0% |
| VARs | | ± 1.0% |
| VA | | ± 1.0% |
| Watt-hours | | ± 1.0% |
| VAR-hours | | ± 1.0% |
| VA-hours | | ± 1.0% |
| Power factor | | ± 2.0% |
| Frequency | | ± 0.1% |

Communications

INCOM compatible 1200/9600 baud

- (IQ 220 only—does not require IPONI)

Modbus compatible 9600/19200 baud

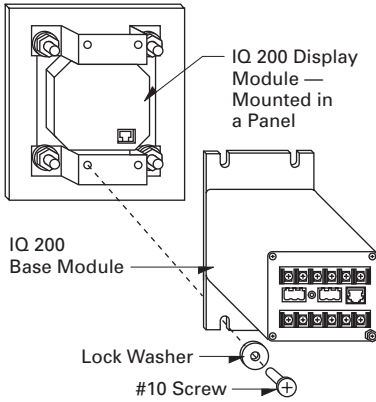
- (IQ 230M only—does not require PONI)

Input/Output

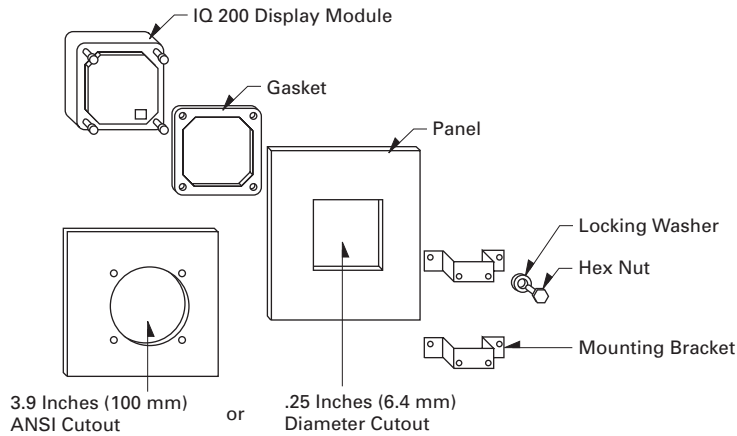
KYZ solid-state relay output

- 96 mA at 240 Vac/300 Vdc (IQ 220 and IQ 230 only)
- Digital input 96 mA at 12–48 Vdc (IQ 230 only)
- Digital output 96 mA at 125 Vac/176 Vdc (IQ 230 only)
- Analog input 4–20 mA (IQ 230 only)

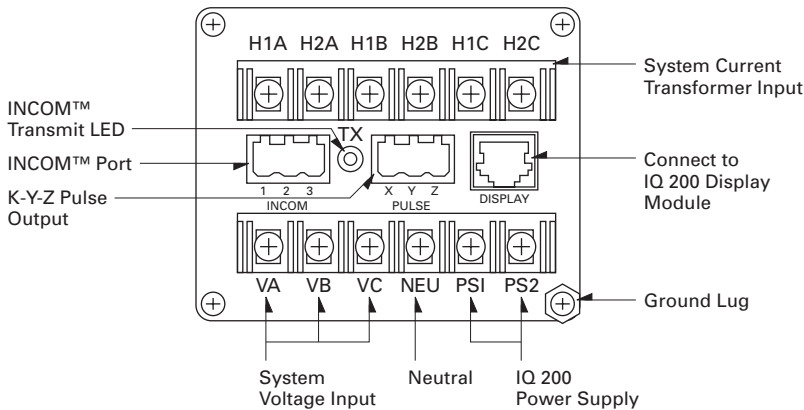
Mounting the IQ 200 Base Module to the IQ 200 Display Module



Display Mounting Options



IQ 220 Base Connections

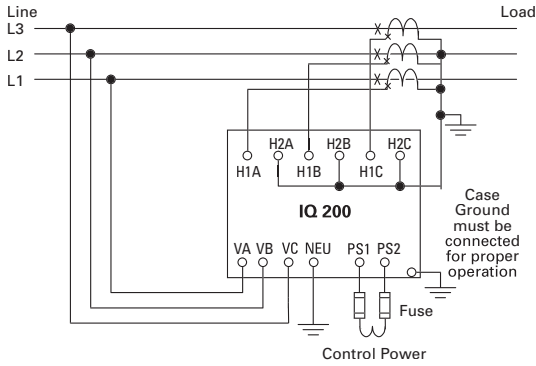


Wiring Diagrams

Typical Field Wiring Connections

Three-Phase Three-Wire (up to 600 Volts)

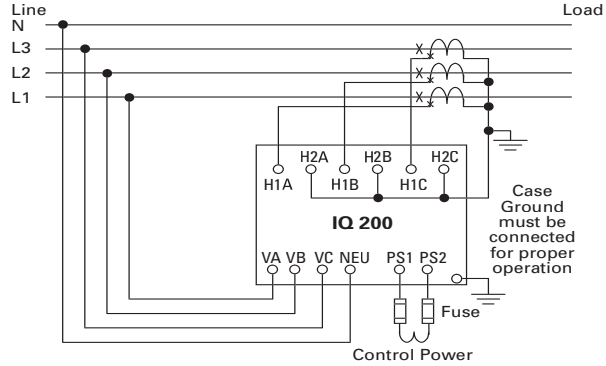
Proper CT polarity is critical to the proper operation of the meter



| | |
|---------------|---------------|
| IQ 220 | IQ 210 |
| 90 – 600 Vac | 110 – 240 Vac |
| 48 – 250 Vdc | 125 – 250 Vdc |

Three-Phase Four-Wire (up to 600 Volts)

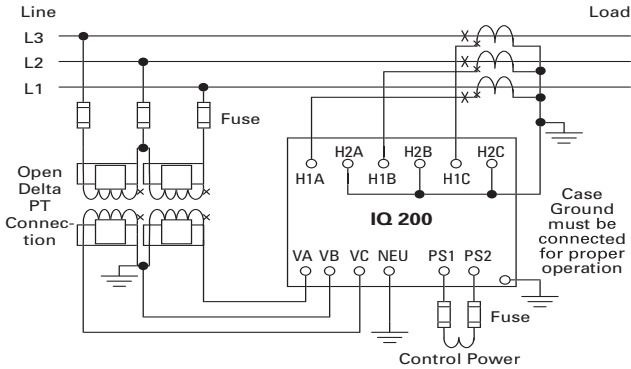
(Line Powered) Proper CT polarity is critical to the proper operation of the meter



| | |
|---------------|---------------|
| IQ 220 | IQ 210 |
| 90 – 600 Vac | 110 – 240 Vac |
| 48 – 250 Vdc | 125 – 250 Vdc |

Three-Phase Three-Wire (above 600 Volts)

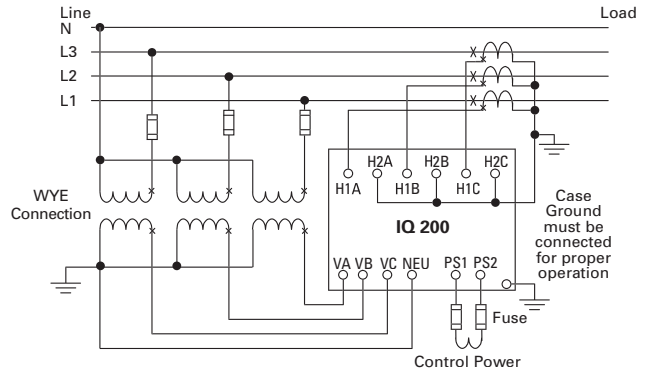
Proper CT polarity is critical to the proper operation of the meter



| | |
|---------------|---------------|
| IQ 220 | IQ 210 |
| 90 – 600 Vac | 110 – 240 Vac |
| 48 – 250 Vdc | 125 – 250 Vdc |

Three-Phase Four-Wire (above 600 Volts)

Proper CT polarity is critical to the proper operation of the meter

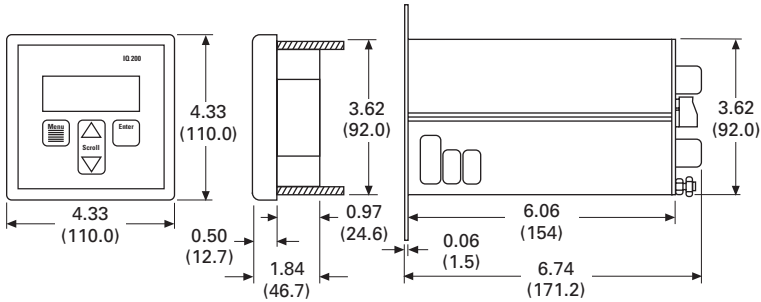


| | |
|---------------|---------------|
| IQ 220 | IQ 210 |
| 90 – 600 Vac | 110 – 240 Vac |
| 48 – 250 Vdc | 125 – 250 Vdc |

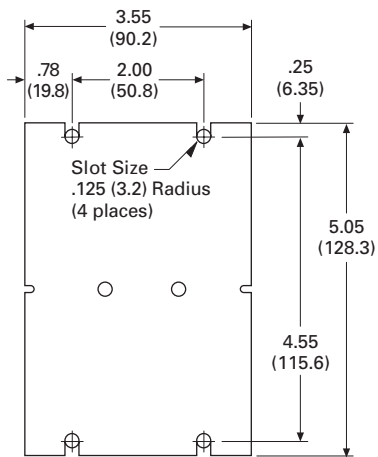
Dimensions

Approximate Dimensions in Inches (mm)

IQ 220



Mounting Hole Pattern for the IQ 200 Base Module



IQ Multipoint Energy Submeter II



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IQ Multipoint Energy Submeter II

Product Description

Eaton's IQ Multipoint Energy Submeter II is a revenue class electronic submetering device that can be mounted in panelboards or switchboards. When mounted in a panelboard or switchboard, the IQ Multipoint Energy Submeter II provides customers with an integrated power distribution and energy metering solution that saves space, reduces installation labor and lowers total cost.

Application Description

The IQ Multipoint Energy Submeter II provides a cost-effective solution for residential or commercial metering installations. Typical installations include:

- High-rise buildings
- Government institutions
- Universities and campuses
- Office buildings
- Medical facilities
- Apartment and condominium complexes
- Airports
- Shopping malls
- Industrial parks
- Mixed-use facilities

The IQ Multipoint Energy Submeter II provides cost-effective and space-saving energy submetering for a wide variety of applications. The IQ Multipoint Energy Submeter II is ideally suited for energy metering of multi-tenant buildings. It can also be used to monitor energy to any load up to 600 volts for energy billing or cost allocation. Built-in communication capabilities

enable an IQ Multipoint Energy Submeter II to be networked to a local PC or via modem to a remote master PC or energy service provider.

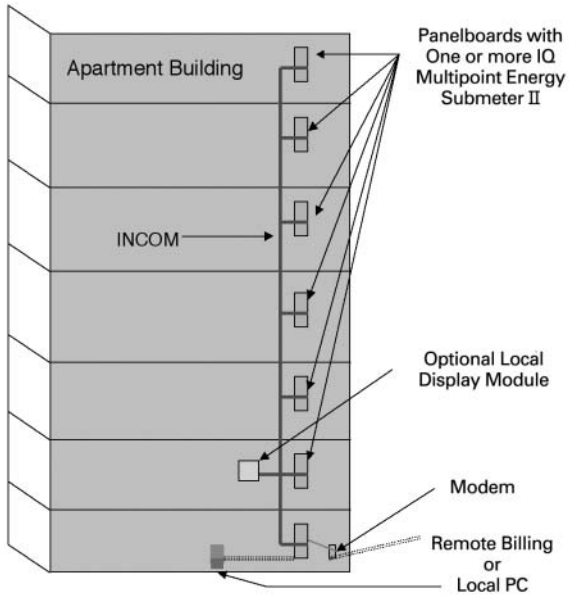
The IQ Multipoint Energy Submeter II is ideal for multi-tenant applications in which property managers are interested in measuring tenant energy usage for the purposes of monthly energy cost allocation. As such, its customers include apartment complex owners, office owners, tenant building managers and meter reading companies. The IQ Multipoint Energy Submeter II can measure any of the following number of circuits:

- 16 single-phase, two-wire (single-pole).
- Eight single-phase, three-wire (two-pole)
- Five three-phase, four-wire (three-pole)

Any of the circuits listed can be mixed provided the total number of Current Sensors does not exceed 16. The meter provides instantaneous (kW), demand and cumulative (kWh) measurements for each load. The unit also provides interval energy data logging, time of use energy registers, coincident peak demand storage and scheduled remote meter reading data in non-volatile memory. Bus voltage is also measured.

The IQ Multipoint Energy Submeter II uses highly accurate Current Sensors to monitor each load. Current Sensors can be provided in a number of ratings and are supplied with integral cable and plug-in connector. All Current Sensors are self-protecting in the event of an open circuit condition under load. The IQ Multipoint Energy Submeter II automatically detects the rating of each Current Sensor that is connected.

Typical Building Installation



Features

The IQ Multipoint Energy Submeter II offers low-cost metering of kW and kWh for multiple tenants of residential and commercial office buildings for one- to three-phase voltage loads not exceeding 347/600 volts. The IQ Multipoint Energy Submeter II contains INCOM networking to chain together multiple meters in locations throughout the facility. See above for a typical apartment building layout.

- Multipoint electrical energy metering
- Built-in communication interface
- Flexible metering configuration
- Monitors single-phase and three-phase loads from 120 Vac to 600 Vac in three voltage ranges
- Monitors power in watts and energy in watthours for up to 16 Current Sensors
- Very low profile design, less than 1.50 inches (38.1 mm) in height
- Energy values stored in non-volatile memory
- Stores extensive energy profile data for each metering point. Can be used to identify coincidental peak demand contribution
- Space-saving stacking design allows two units to be mounted together
- Supports Time-of-Use energy monitoring
- Demand interval adjustable from 5 to 60 minutes
- Measures bus voltage
- Front panel LEDs provide status of unit and communication activity
- Meets rigid ANSI C12.1 and IEC 61036 accuracy specifications for revenue meters
- Can be directly mounted in a UL-approved panelboard or switchboard

Communication Capabilities

With the IQ Multipoint Energy Submeter II's built-in communication capabilities, remote meter reading and monitoring functions can be integrated into both new and retrofit applications.

Eaton's INCOM communications is built into each IQ Multipoint Energy Submeter II for chaining them together on a robust, field-proven, communications architecture. INCOM can be used to communicate to the complete line of Eaton's metering products and is also useful for those projects requiring local communications to Power Xpert Power Management system.

In addition **Page 252** lists several Gateway products to enable communications to RS-232 Ethernet or RS-485 with Modbus protocol.

Software Compatibility

- The IQ Multipoint Energy Submeter II is fully compatible with Eaton's PowerNet software platform including the E-Bill cost allocation software
- The IQ Multipoint Energy Submeter II can be utilized as part of an electrical energy monitoring and billing system
- The IQ Multipoint Energy Submeter II can be remotely monitored via Eaton's FetchIT software package
- The IQ Multipoint Energy Submeter II is compatible with third-party software platforms and interface devices

Configuration

- The IQ Multipoint Energy Submeter II is fully configurable using Power Xpert or free PowerPort configuration software
- PowerPort can be downloaded free from either the Internet or the Eaton Intranet
- Each IQ Multipoint Energy Submeter II can be configured for up to 16 metering points in any combination of single-phase and three-phase metering points
- PowerPort is used to assign Current Sensors to metering points
- Either PowerPort or Power Xpert can be used to configure the built-in data logs for energy profiling
- Both Power Xpert and PowerPort can be used to set up the Time-of-Use energy registers and the Automatic Meter Reading schedule

Wiring

- The Current Sensor cable is rated 600 volts and is recognized by UL as Class 1 wiring
- IMPCABLE used for INCOM communication between devices is rated 600 volts and is recognized by UL as Class 1 wiring
- Consult TD17513 Wiring Specification Base Rules for detailed information on proper installation and termination of INCOM communications network cable

Easy to Install

- Approved by UL for mounting inside panelboards and switchboards
- Stacking design allows two units to be mounted in a panelboard using less than 8 inches (203.2 mm) of vertical space
- For retrofit applications, the IQ Multipoint Energy Submeter II can be mounted in an external auxiliary enclosure
- Quick connect terminals for Current Sensors, INCOM communications and bus voltages make wiring the unit quick and easy

Reduced Equipment Space

The IQ Multipoint Energy Submeter II consumes 80% less wall space compared to glass bulb meters that must be individually or group mounted independent of the loadcenter or panelboard. By installing the meter in the loadcenter and providing Current Sensors to each load within the panelboard, less real estate is occupied, not only in the ground floor, but at individual tenant floor spaces. A typical integrated distribution and metering solution using the IQ Multipoint Energy Submeter II uses 45% less wall space than separately mounted submeters.

Reduced Wiring and Cost

Because Current Sensors are provided with pre-wired leads and connectors for each load in the panelboard, there is 60% less field wiring to be performed on site, greatly reducing cost, time and potential for errors in the field.

High Accuracy

ANSI and IEC revenue-grade accuracy for each metering point permits the facility owner to charge each tenant confidently.

Time-of-Use Metering

The IQ Multipoint Energy Submeter II will keep track of four different utility rates for four (4) changes of rate seasons with separate weekday, weekend and holiday rates. The Time-of-Use logging supports eight (8) rate changes per day and also stores the peak demand for each rate period. All Time-of-Use information is stored in non-volatile memory.

Automatic Meter Reading

The IQ Multipoint Energy Submeter II can be configured for easy remote reading by saving just the needed energy information in a separate memory location. This location can be set up to save all of the necessary energy data for a periodic monthly read with a set day of the month and time of that day. Additionally the user can program up to six specific dates and times to save meter readings. The IQ Multipoint Energy Submeter II then stores the total energy and peak demand for each Time-of-Use rate for each meter point so that all of this information can be effortlessly downloaded to a remote system. The IQ Multipoint Energy Submeter II saves all of this data for up to 13 months in non-volatile memory.

Standards and Certifications

The IQ Multipoint Energy Submeter II is UL listed as a Class 1 device.

- UL listed under UL 8N83
- Current Sensors are UL-recognized components
- UL listed under file number E166079
- CSA approved
- Complies with UL 991 radiated susceptibility requirements
- Third-party tested for ANSI C12.1 (1%) accuracy
- Complies with FCC emission standard Part 15, Subpart B



Product Selection

The IQ Multipoint Energy Submeter II, Current Sensors and other accessories can be ordered from Eaton distributors. Refer to the following catalog numbers when ordering.

IQ Multipoint Energy Submeter II**IQ Multipoint Energy Submeter II Products**

| Product Description | Catalog Number |
|--|------------------|
| IQ Multipoint Energy Submeter II 120V with INCOM | IQMESIIN1 |
| IQ Multipoint Energy Submeter II 277V with INCOM | IQMESIIN2 |
| IQ Multipoint Energy Submeter II 347V with INCOM | IQMESIIN3 |
| Current Sensors—5 amperes, Qty. 3 | CS005 |
| Current Sensors—50 amperes, Qty. 6 | CS050 |
| Current Sensors—70 amperes, Qty. 6 | CS070 |
| Current Sensors—125 amperes, Qty. 3 | CS125 |
| Current Sensors—200 amperes, Qty. 3 | CS200 |
| Current Sensors—400 amperes, Qty. 3 | CS400 |
| Current Sensor Extensions—4 feet (1.2m), Qty. 6 | CSET04 |
| Current Sensor Extensions—8 feet (2.4m), Qty. 3 | CSET08 |
| Current Sensor Extensions—16 feet (4.9m), Qty. 3 | CSET16 |

Note: Total sensor lead length must not exceed 20 ft (6m).

Support products for the IQ Multipoint Energy Submeter II include the Digital Input Module (DIM), the Local Display Module, IMPCABLE and a number of communications converters, as described below.

IQ Multipoint Energy Submeter II**IQ Multipoint Energy Submeter II Support Products**

| Product Description | Catalog Number |
|---|-----------------|
| INCOM communication cable, 1000 feet (305m), 600 volts insulation | IMPCABLE |
| Subnetwork master local display allows local access to energy information (120 Vac) | LDISP120 |
| Subnetwork master local display allows local access to energy information (24 Vac/DC) | LDISP24 |
| INCOM to RS-232 Communication Gateway | MINTII |
| Power Xpert Gateway 400 | PXG400 |
| Power Xpert Gateway 600 (Data Logging and E-mail) | PXG600A |
| INCOM to RS-485 Communication Gateway with Modbus protocol | MMINT |
| Digital input module—supports four pulse inputs or eight status inputs | DIM |

All of the gateway products above can support the conversion of multiple IQ Multipoint Energy Submeter II meters to another communication network. The MINT II can support up to 1000 units, the mMINT supports up to 32 units, the PXG400 and PXG600A support up to 64 units (sum of meter modules and current sensors).

The Digital Input Module (DIM) can be used to totalize pulse outputs from water meters, gas meters, steam meters or even old electrical meters with KYZ pulse outputs. The DIM can then be connected to the same INCOM network as the IQ Multipoint Energy Submeter II and this information can then be used in Power Management software packages.

Technical Data and Specifications

IQ Multipoint Energy Submeter II—Current Sensor



Voltages

Three models are available, each covering a specific voltage range.

- Model 1—120/240/208 volts:
 - 120 volt single-phase
 - 120/240 volt single-phase
 - 120/208 volt three-phase Y
- Model 2—277/480 volts:
 - 277 volt single-phase
 - 277/480 volt three-phase Y
- Model 3—347/600 volts:
 - 347 volt single-phase
 - 347/600 volt three-phase Y

Current Sensors

- 0 to 50 amperes
- 0 to 70 amperes
- 0 to 125 amperes
- 0 to 200 amperes
- 0 to 400 amperes
- 0 to 5 amperes for use with an external current transformer with 5A secondary. (ANSI C12 Class 10.) (Catalog number: **CS005**.)

Metering Accuracy

The IQ Multipoint Energy Submeter II meets the rigid ANSI C12.1 and IEC 61036—1.0% metering accuracy requirements.

- <2% error at 1% of full scale
- <1% error at 1.5% of full scale
- <1% error at 90% to 110% of rated voltage
- <1% error at 57 and 63 Hz
- <2% error at 0.5 lagging PF

Environmental

- Operating temperature: -20°C to +50°C
- Humidity: 0% to 95%

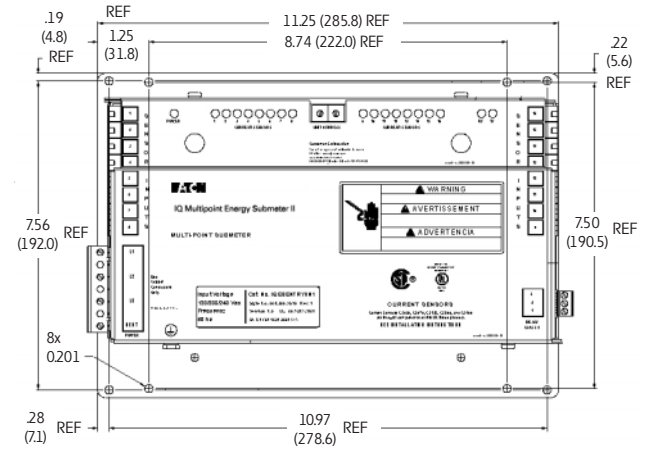
Power

- There are three power supply options:
 - 120 Vac, 57 to 63 Hz, 6 VA
 - 277 Vac, 57 to 63 Hz, 6 VA
 - 347 Vac, 47 to 63 Hz, 6 VA

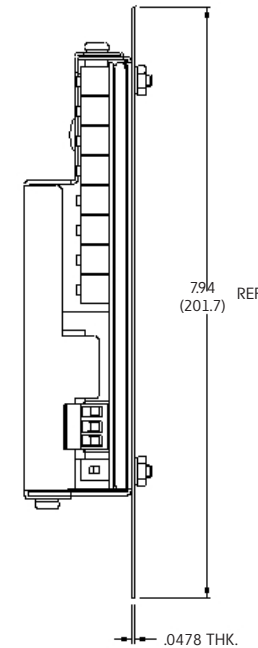
Dimensions

Approximate Dimensions in Inches (mm)

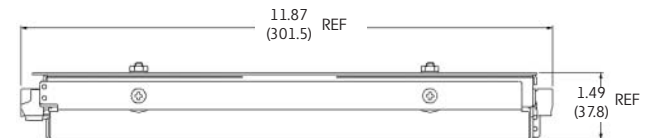
Single Unit—Front View



Single Unit—Side View



Single Unit—Top View

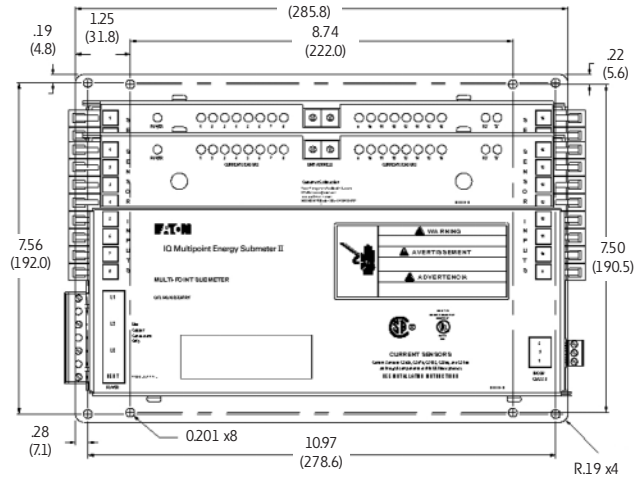


22.3

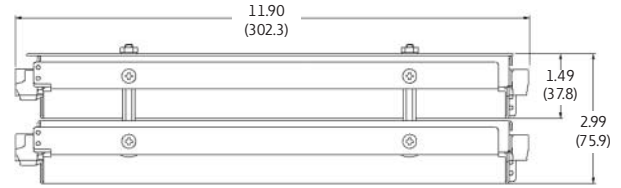
Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

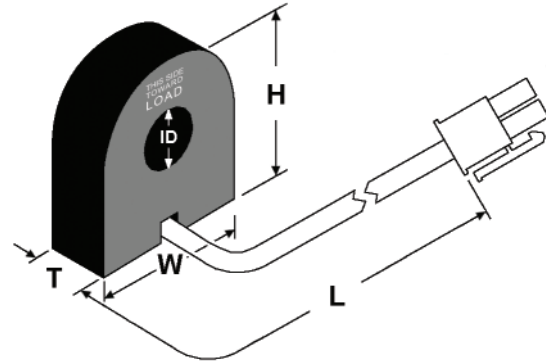
Double Unit—Front View



Double Unit—Top View



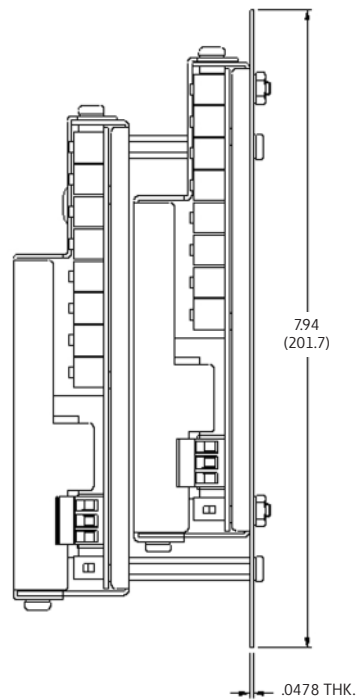
Current Sensor Dimensions



Current Sensor

| Sensor | H | W | T | ID | L |
|--------|--------------|-------------|-------------|-------------|----------------|
| CS005 | 2.28 (57.9) | 0.60 (15.2) | N/A | N/A | 2.60 (66.0) |
| CS050 | 1.55 (39.4) | 1.18 (30.0) | 0.50 (12.7) | 0.32 (8.1) | 36.00 (914.4) |
| CS070 | 2.10 (53.4) | 1.73 (44.0) | 0.58 (14.7) | 0.55 (14.0) | 36.00 (914.4) |
| CS125 | 2.10 (53.4) | 1.73 (44.0) | 0.58 (14.7) | 0.55 (14.0) | 45.00 (1143.0) |
| CS200 | 3.06 (77.7) | 2.69 (68.3) | 0.75 (19.1) | 1.25 (31.8) | 45.00 (1143.0) |
| CS400 | 4.33 (110.0) | 3.42 (86.9) | 1.08 (27.4) | 1.50 (38.1) | 72.00 (1828.8) |

Double Unit—Side View



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IQ Sentinel



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IQ Energy Sentinel™ and IQ Power Sentinel

Product Description

IQ Sentinels

IQ Sentinels are microprocessor-based submeters, designed to monitor power, energy, currents, voltages, power factor, frequency, apparent power and reactive power. They represent an alternative to installing separate wattmeters, watthour meters, watt demand meters, ammeters, voltmeters and more.

IQ Sentinels are available with two different capabilities:

- The Energy Sentinel version that monitors watts, watthour and watt demand
- The Power Sentinel version that monitors watts, watthour, watt demand, currents, voltages, power factor, frequency, apparent power and reactive power

Key advantages include unmatched savings in space, lower installation costs and the capability to communicate data readings in a variety of ways.

IQ Sentinels with built-in CTs and communications have the added benefit of greater overall system accuracy. Conventional metering often is less accurate since external CTs and separate transducers may each have inaccuracies of 1% or more.

Eaton’s IQ Sentinels provide a unique cost-effective method to implement energy submetering at lower levels in the distribution system.

The ability to monitor power distribution systems down to the machine or process level at an industrial facility has become essential to provide key benefits such as to verify the accuracy of the utility bill, identify and track energy usage to the loads that consume it, develop a facility energy profile to establish a baseline, allocate energy costs to create accountability, etc.

An optional door-mounted interface, the Subnetwork Master Local Display, is available to display the energy parameters monitored by the IQ Sentinels.

Submetering application examples for the IQ Sentinels include energy demand monitoring, product cost analysis, process machine tool efficiency and productivity improvement, and energy cost allocation or tenant billing for commercial, industrial, recreational and residential facilities.

Note: For customer billing applications, consult local utility for metering requirements.

Commercial applications include energy cost allocation within convention halls, office buildings, shopping malls, hospitals, warehouses and storage facilities.

Industrial applications include departmental billing and process/assembly line energy cost analysis. IQ Energy Sentinels may be substituted for watt transducers when monitoring machine tool and equipment performance within plants.

Recreational facilities include sports arenas, camping grounds, trailer parks and marinas.

The IQ Sentinel may be applied on three-phase (three- or four-wire), as well as single-phase (three-wire) systems.

IQ Sentinels may be applied on either 50 or 60 Hz systems.

Application Description

The IQ Energy Sentinel is available in three different package versions: breaker mounted, universal breaker with internal CTs, and universal breaker with external CTs.

Designed for mounting on Eaton's Series C® Circuit Breakers utilized in Eaton assemblies such as:

- Pow-R-Line four panelboards—feeder circuits
- Pow-R-Line C™ switchboards—feeder circuits
- Motor control centers and enclosed control with circuit breaker disconnects—starter or feeder circuits
- Enclosed Motor Control
- Enclosed circuit breakers
- Pow-R-Way III® bus plugs with circuit breaker disconnects

**Breaker Mount Applications
New Equipment****F-Frame Breaker with IQ Sentinel****Retrofitting**

The space-saving design characteristics of the breaker mount IQ Energy Sentinels allow them to be added to existing Eaton circuit breakers at any time, often with no additional space or modifications required.

Or they may be installed when upgrading from older circuit breakers, often with no additional space or modifications required.

Universal Mount Applications**Universal Mount with Internal CTs**

The universal mount IQ Energy Sentinel with internal CTs includes integral 400A CTs and may be applied on loads up to 400A. The universal mount IQ Energy Sentinels with internal CTs may be utilized wherever breaker mounting is not feasible or possible.

The universal mount IQ Energy Sentinel with provisions for external CTs may be applied on loads up to 4000A. They are usually utilized for monitoring loads larger than 400 amperes, on power cable sizes larger than 500 kcmil or on circuits containing more than one conductor per phase.

IQ Power Sentinel

Like the IQ Energy Sentinel, the IQ Power Sentinel is a highly accurate microprocessor-based submeter designed to monitor power and energy. In addition to watts, watt-hour and watt-demand, the IQ power sentinel monitors current, voltage, reactive power (VARs), apparent power (VA), power factor and frequency. The IQ Power Sentinel offers an accurate and economic alternative to separate meters and transducers.

The IQ Power Sentinel is only available in the universal mount with internal CTs up to 400 amperes.

Features

IQ Energy and Power Sentinel Features

IQ Energy Sentinel Features

- Monitors (accuracy stated full scale)
 - Kilowatts ±1.0%
 - Kilowatts demand ±1.0%
 - Kilowatt Hour ±1.0%
- Built-in CTs version up to 400 amperes or external CTs version up to 4000 amperes
- Breaker, panel or DIN rail mounted
- Powered directly off the line
- Built-in communication capability
 - Address set by DIP switches
 - Communication at 9600 baud
 - Noise immune INCOM protocol
- Choice of operator interfaces
 - Subnetwork Master Local Display
 - Breaker Interface Module (BIM)
 - Power Management Energy Billing software
 - Power Management Software

IQ Power Sentinel Features

- Monitors (accuracy stated full scale)
 - AC line current (each phase) ±0.5%
 - AC line-to-line voltage ±0.5%
 - AC line-to-neutral voltages ±0.5%
 - Watts (each phase and total) ±1.0%
 - VARs (each phase and total) ±1.0%
 - VA (each phase and total) ±1.0%
 - Apparent Power Factor (each phase and total) ±0.5%
 - Displacement Power Factor (each phase and total) ±0.5%
 - Demand (total watts) ±1.0%
 - Frequency ±0.5%
 - Watthours ±1.0%
- Built-in CTs version up to 400 amperes
- Panel or DIN rail mounted
- Powered directly off the line
- Built-in communication capability
 - Address set by DIP switches
 - Communication at 9600 baud
 - Noise immune INCOM protocol
- Choice of operator interfaces
 - Subnetwork Master Local Display
 - Breaker Interface Module
 - Power Management Energy Billing software
 - Power Management Software
- UL and CSA listed
- CE mark

IQ Sentinel Benefits

- One device replaces multiple meters and/or transducers
- Improved system accuracy
- Savings in product cost
- Savings in space
- Savings in installation cost
- No external power source is needed
- Permits remote monitoring and interconnection with programmable logic controllers and building management systems. For further information see section on Power Management Software Systems
- Designed to interface directly with Power Management Software Energy Billing software
- Flexibility—displays what is needed where it is needed
- Power Management Software

Note

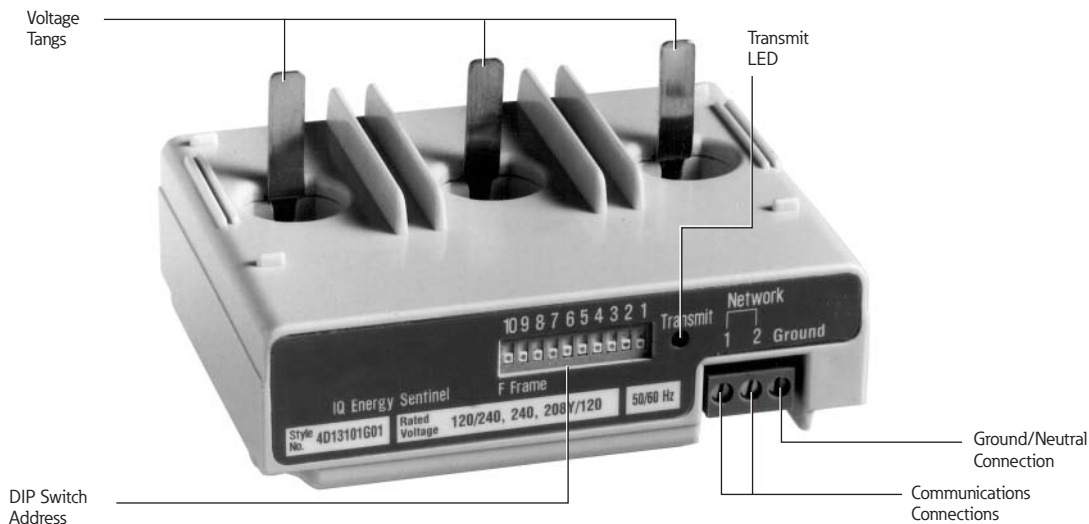
The Power Sentinel is available only in the Universal Mount version with internal CTs.

Eaton's Breaker Mount

Eaton's breaker mount IQ Energy Sentinel installs in less than 10 minutes on the load side of an Eaton

F-Frame (150 ampere), J-Frame (250 ampere), or K-Frame (400 ampere) circuit breaker.

Note: The Power Sentinel is available only in the Universal Mount version with internal CTs.



Energy Sentinel Features

22.3

Metering Devices, Protective Relays, Software and Connectivity

Metering Devices

Universal Mount with Internal CTs—(UI)

The Universal Mount IQ Energy Sentinel with internal CTs may be panel-mounted or DIN rail mounted on disconnects or other circuits up to 400 amperes. A pull-apart terminal block is provided on the device for connection of the system voltage reference wiring.

Note: Only the Universal Mount with Internal CTs is available in both IQ Power Sentinel and IQ Energy Sentinel versions. The location of the ground/neutral connection differs on Breaker Mount IQ Energy Sentinels from the location of the ground/neutral connection on Universal Mount IQ Sentinels. Incorrect wiring to the ground/neutral and communications connections may result in accuracy and communication errors.

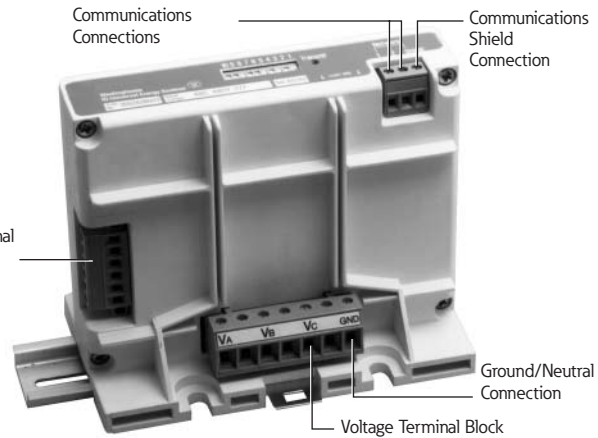
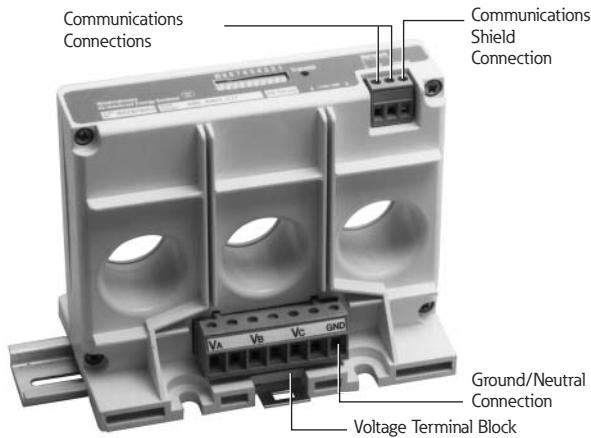
Universal Mount for External CTs—(UE)

The Universal Mount IQ Energy Sentinel for external CTs may be panel-mounted or DIN rail mounted on circuits up to 4000 amperes.

A pull-apart terminal block is provided on the device for connection of the system voltage reference wiring as well as another terminal block

for connection to the user's existing 5-ampere secondary CTs that may range in standard ratios from 25:5 up to 4000:5.

Note: If the device will be disconnected without interruption of the monitored load, the use of a CT shorting block is advised.



Energy and Power Sentinel Features

Standards and Certifications

Energy Sentinel

- UL listed, File E64983
- CSA approved, File LR106359-1

Power Sentinel

- UL listed, File E185559
- CSA listed
- CE Mark



Product Selection

IQ Energy Sentinels

IQ Energy Sentinels



| Description | Voltage Rating—Vac | Current Rating Maximum Amperes | Catalog Number |
|-----------------------------|---------------------------|-----------------------------------|-------------------|
| For F-Frame breakers | 120/240, 240, 208Y/120 | 150 | IQESF208 |
| For F-Frame breakers | 220/380, 230/400, 240/415 | 150 | IQESF400 |
| For F-Frame breakers | 480, 480Y/277 | 150 | IQESF480 |
| For F-Frame breakers | 600, 600Y/347 | 150 | IQESF600 |
| For J-Frame breakers | 120/240, 240, 208Y/120 | 250 | IQESJ208 |
| For J-Frame breakers | 220/380, 230/400, 240/415 | 250 | IQESJ400 |
| For J-Frame breakers | 480, 480Y/277 | 250 | IQESJ480 |
| For J-Frame breakers | 600, 600Y/347 | 250 | IQESJ600 |
| For K-Frame breakers | 120/240, 240, 208Y/120 | 400 | IQESK208 |
| For K-Frame breakers | 220/380, 230/400, 240/415 | 400 | IQESK400 |
| For K-Frame breakers | 480, 480Y/277 | 400 | IQESK480 |
| For K-Frame breakers | 600, 600Y/347 | 400 | IQESK600 |
| Universal with internal CTs | 120/240, 240, 208Y/120 | 400 | IQESUI208 |
| Universal with internal CTs | 220/380, 230/400, 240/415 | 400 | IQESUI400 |
| Universal with internal CTs | 480, 480Y/277 | 400 | IQESUI480 |
| Universal with internal CTs | 600, 600Y/347 | 400 | IQESUI600 |
| Universal for external CTs | 120/240, 240, 208Y/120 | 4000 | IQESUE208 |
| Universal for external CTs | 220/380, 230/400, 240/415 | 4000 | IQESUE400 |
| Universal for external CTs | 480, 480Y/277 | 4000 | IQESUE480 |
| Universal for external CTs | 600, 600Y/347 | 4000 | IQESUE600 |

IQ Power Sentinels

IQ Power Sentinels



| Description | Voltage Rating—Vac | Current Rating Maximum Amperes | Catalog Number |
|-----------------------------|---------------------------|-----------------------------------|-------------------|
| Universal with internal CTs | 120/240, 240, 208Y/120 | 400 | IQPSUI208 |
| Universal with internal CTs | 220/380, 230/400, 240/415 | 400 | IQPSUI400 |
| Universal with internal CTs | 480, 480Y/277 | 400 | IQPSUI480 |
| Universal with internal CTs | 600, 600Y/347 | 400 | IQPSUI600 |

Technical Data and Specifications

Terminal, Cable and Wiring Guidelines

| Sentinel | Eaton's Series C Terminal | Wire Size (Single Conductor) | Wire Types |
|---|---------------------------|--|-----------------|
| F-Frame | 624B100G02, G17, G18, G19 | #14–1/0, #4–4/0, #4–4/01, #14–1/0 AWG | THW, THHN, XHHW |
| J-Frame | T250KB, TA250KB | #4–350 kcmil | THW, THHN, XHHW |
| K-Frame | T350K, TA350KB | #250–500 kcmil | THW, THHN, XHHW |
| Universal Energy Sentinel with internal CTs | T350K, TA350KB | #250–500 kcmil | THW, THHN, XHHW |
| Universal Power Sentinel with internal CTs | T350K, TA350KB | #250–500 kcmil | THW, THHN, XHHW |
| System Voltage Reference Wiring | | | |
| Energy Sentinel with internal or external CTs | | #24–#10 AWG | |
| Power Sentinel with internal CTs | | #24–#10 AWG | |
| Current Transformer Wiring | | | |
| Universal with external CTs | | #12 AWG (maximum) | |
| Ground Reference Wiring | | | |
| Energy Sentinel with internal or external CTs | | #22–#12 AWG (minimum 600 volt rated) | |
| Power Sentinel with internal CTs | | #22–#12 AWG (minimum 600 volt rated) | |
| Communications Wiring | | | |
| Energy Sentinel with internal or external CTs | | Eaton's IMPCABLE or Belden 9463 family | |
| Power Sentinel with internal CTs | | Eaton's IMPCABLE or Belden 9463 family | |
| F-Frame | | Eaton's IMPCABLE or Belden 9463 family | |
| J-Frame | | Eaton's IMPCABLE or Belden 9463 family | |
| K-Frame | | Eaton's IMPCABLE or Belden 9463 family | |

Energy Sentinel

Current Input

Current range: 1% to 125% of current rating
Burden: 1 VA

Voltage Input

Voltage Range: ± 20% of voltage rating

Frequency

50 or 60 Hz

Power Factor Range

All (-1 to +1)

Communications

Protocol: INCOM
Speed: 9600 baud
Compatibility: Power Management Software compatible

Environmental Conditions

Operating temperature: -25°C to 70°C ①
(-13°F to 158°F)
Storage temperature: -40°C to 85°C ①
(-40°F to 185°F)
Operating humidity: 5% to 95% relative humidity noncondensing

System Voltage Considerations (Application Note)

The Ground (GND) terminal of the IQ Energy Sentinel should be connected to the ground bus or other non-current carrying ground with 600V rated wire to ensure accuracy.

Power Sentinel

Nominal Full Scale Current

400 amperes

Current Accuracy Range

1%–125% of full scale

Current Overload Capability

250% of full scale

Power Factors

All

Nominal Operating Line-to-Line Voltages

| | |
|---------|---------|
| G01 208 | G03 480 |
| G02 400 | G04 600 |

Maximum Operating Voltage Fluctuation

| | |
|----------|----------|
| G01 ±20% | G03 ±10% |
| G02 ±10% | G04 ±10% |

Maximum Power Consumption

| | |
|----------|----------|
| G01 2 VA | G03 5 VA |
| G02 5 VA | G04 6 VA |

Frequency

50/60 Hz

Communication

Protocol: INCOM
Speed: 9600 baud
Compatibility: Power Xpert Power Management Software compatible

Environment

Indoor use only

Maximum Operating Altitude

2000 meters

Operating Temperatures

-13°F to 158°F (-25°C to 70°C)

Storage Temperatures

-40°F to 185°F (-40°C to 85°C)

Maximum Relative Humidity

80% for temperatures up to 31°C decreasing linearly to 50% at 70°C

Transient Overvoltage Category

Overvoltage Category III

Pollution Degree

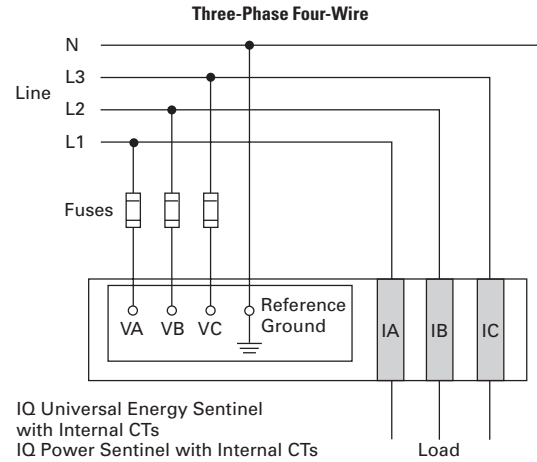
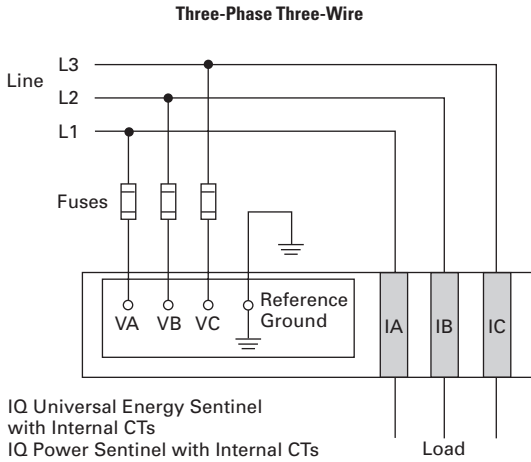
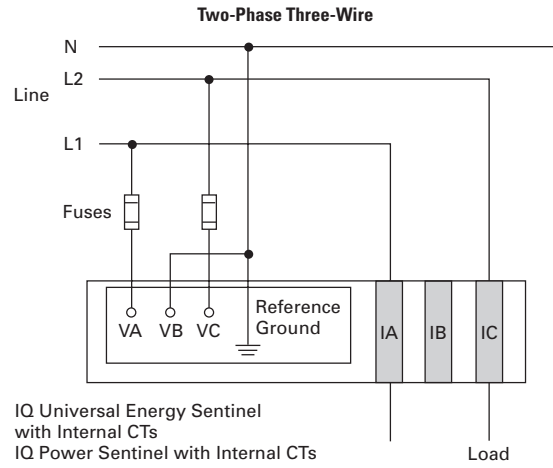
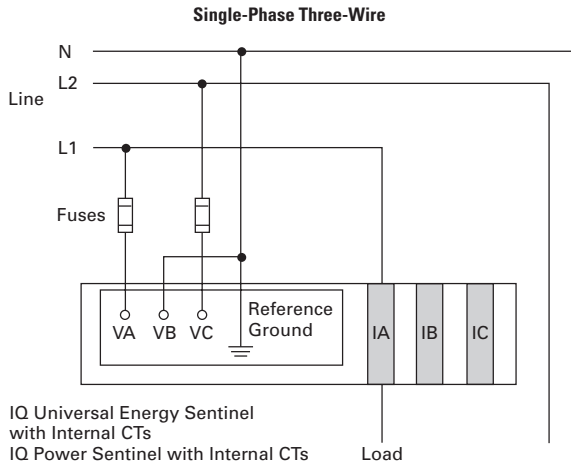
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Note

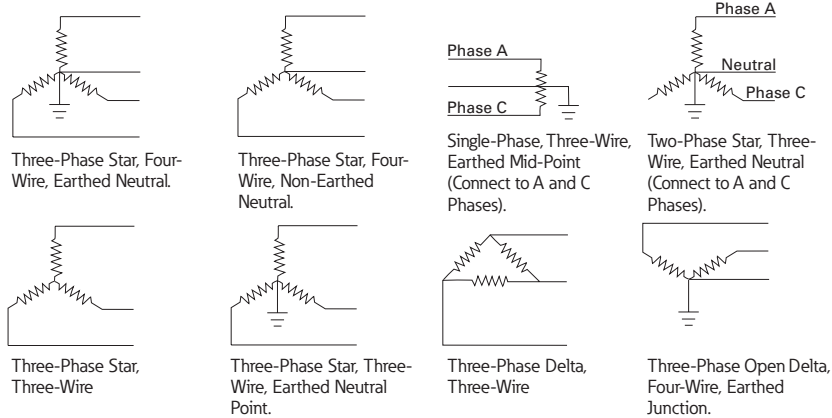
① 40°C (standard) maximum for Series C circuit breakers.

Wiring Diagrams

Field Wiring—IQ Universal Energy Sentinel with Internal CTs—IQ Power Sentinel with Internal CTs



Acceptable System Configurations



Note: Acceptable for Universal IQ Energy Sentinels only.

Dimensions

Approximate Dimensions in Inches (mm)

Energy Sentinel

| Frame Type | D | W | H | CT Window Size ^① | Hole Clearance | Weight Lbs (kg) |
|------------|--------------|--------------|-------------|-----------------------------|----------------|--------------------|
| F | 3.20 (81.3) | 4.12 (104.6) | 1.30 (33.0) | 0.59 (15.0) | — | 0.65 (0.3) |
| J | 4.04 (102.6) | 4.12 (104.6) | 1.28 (32.5) | 0.77 (19.6) | — | 0.69 (0.3) |
| K | 4.04 (102.6) | 5.31 (134.9) | 1.25 (31.8) | 0.96 (24.4) | — | 0.87 (0.4) |
| UI | 4.36 (110.7) | 5.31 (134.9) | 3.00 (76.2) | — | 1.17 (29.7) | 1.10 (0.5) |
| UE | 4.36 (110.7) | 5.31 (134.9) | 3.00 (76.2) | — | — | 1.10 (0.5) |

Power Sentinel

| D | W | H | Weight Lbs (kg) |
|--------------|--------------|-------------|--------------------|
| 4.36 (110.7) | 5.31 (134.9) | 3.00 (76.2) | 1.10 (0.5) |

Note

① Acceptable for Universal IQ Energy Sentinels only.

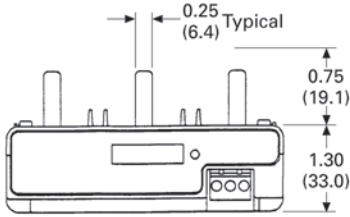
22.3

Metering Devices, Protective Relays, Software and Connectivity

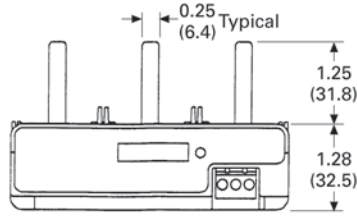
Metering Devices

IQ Sentinel

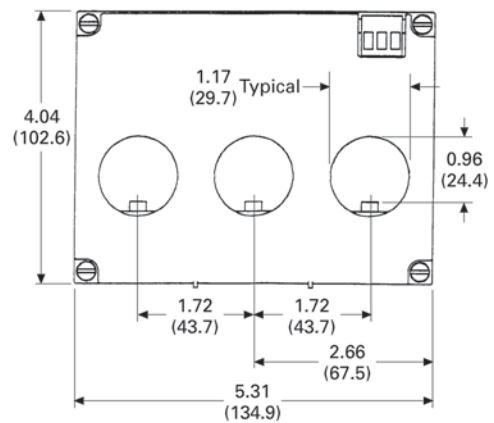
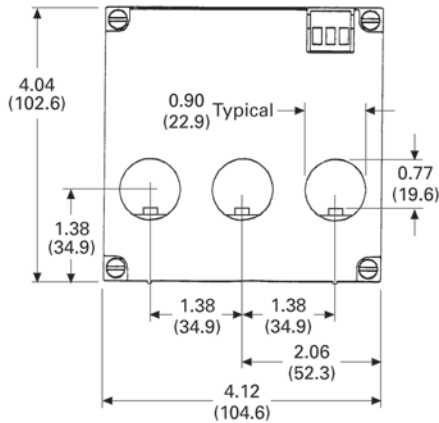
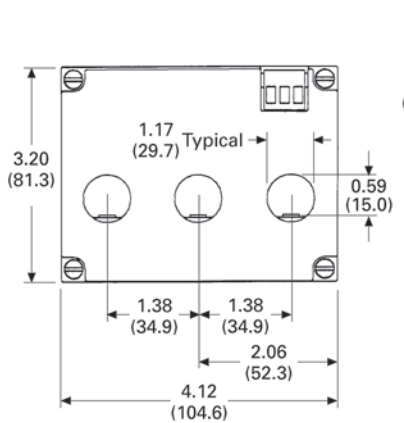
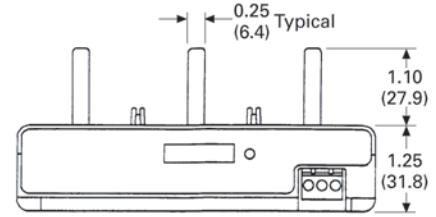
F-Frame Energy Sentinels



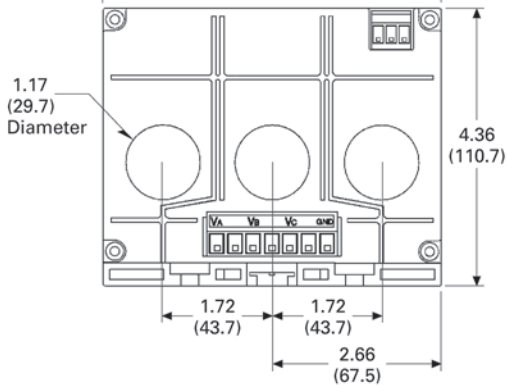
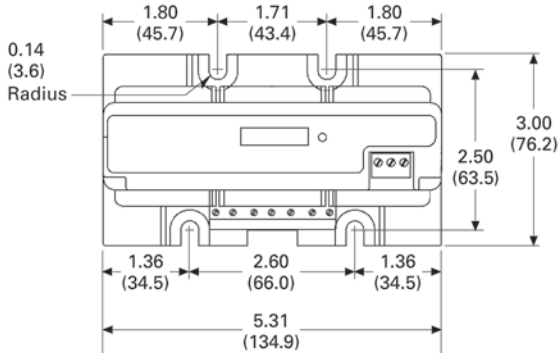
J-Frame Energy Sentinels



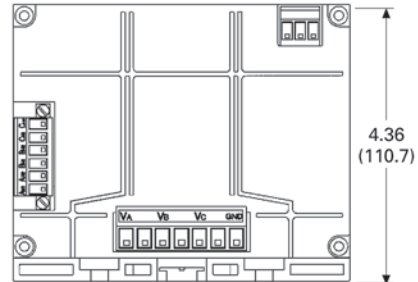
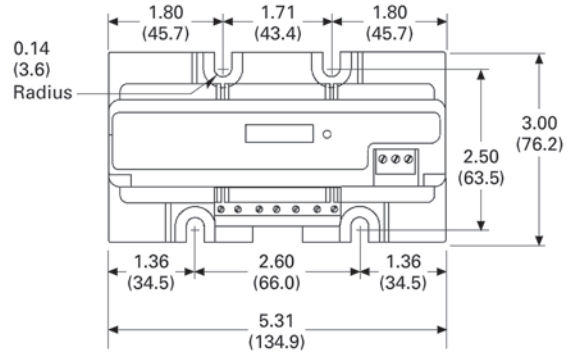
K-Frame Energy Sentinels



Universal with Internal CTs Energy and Power Sentinels

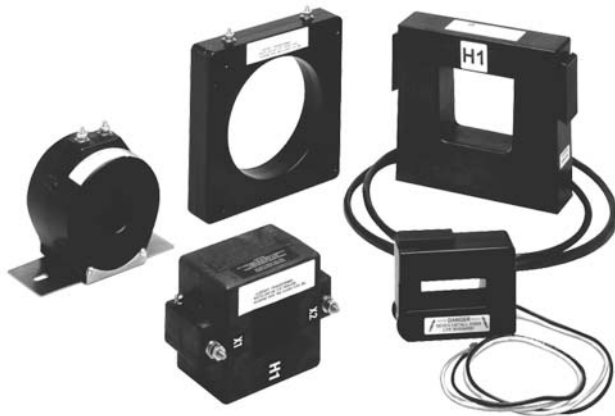


Universal with External CTs Energy and Power Sentinels



22

Current Transformers (CTs)



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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 600V) 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.

Product Selection

Solid Core ANSI Metering A

| 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 |
|------------------------|---|-------------------------------------|----------------|---------------------------------|
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 25 | 0.3 | Wound | W190-025 | W190BRAC |
| 50 | 0.3 | Primary | W190-050 | W190BRAC |

Note

① Contact Eaton for further information.

Split Core ANSI Metering Accuracy

| Primary Current Rating | ANSI B0.1 Metering Class at 60 Hz (Accuracy in %) | Window Size in Inches (mm) | Catalog Number |
|-------------------------------|--|-----------------------------------|-----------------------|
| 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 |
| 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 |

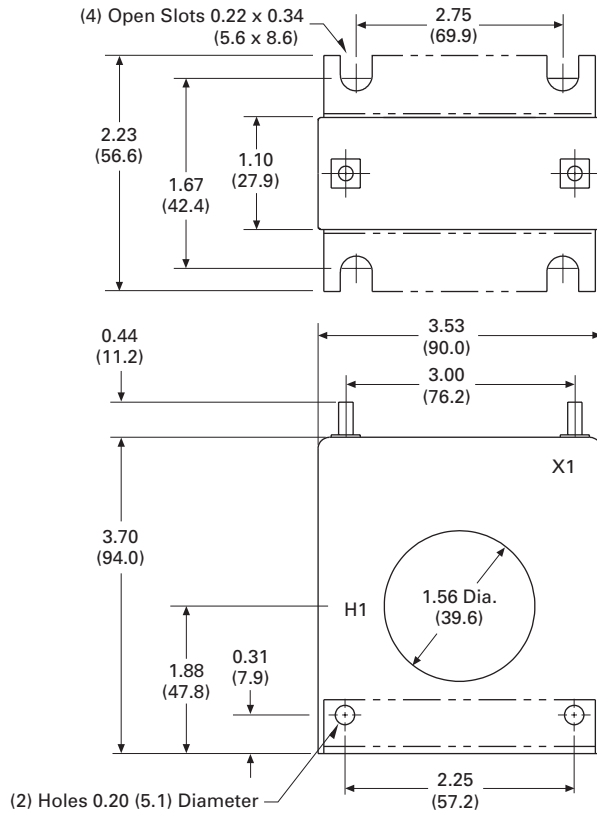
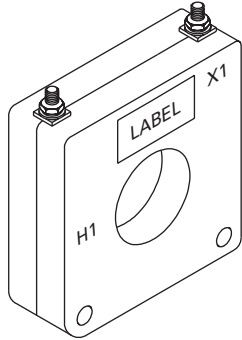
Split Core Current Transformers

| Primary Current Rating | Accuracy at 60 Hz (in %) | Window Size in Inches (mm) | Catalog Number |
|------------------------|--------------------------|----------------------------|-----------------|
| 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 |
| 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 |
| 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 |
| 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 |

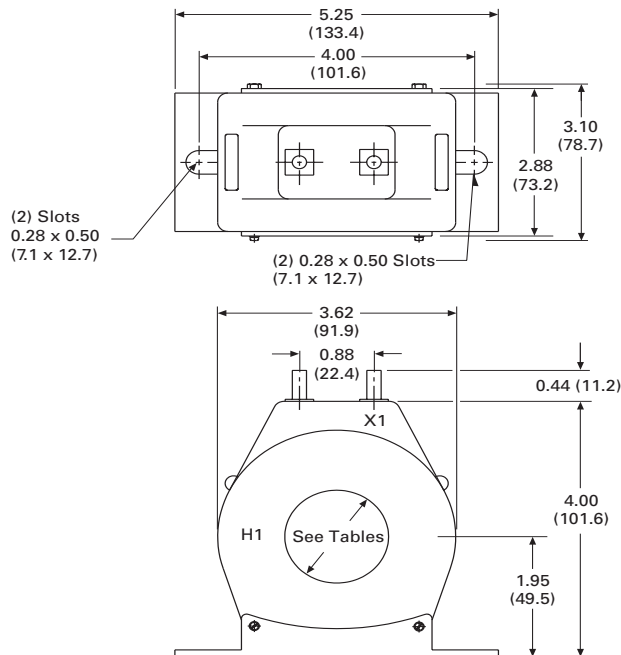
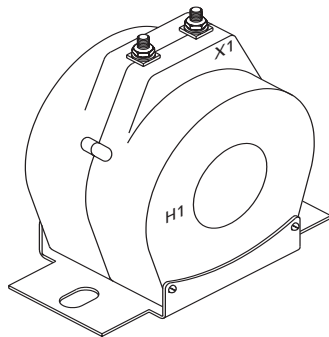
Dimensions

Approximate dimensions in inches (mm)

S050



S060



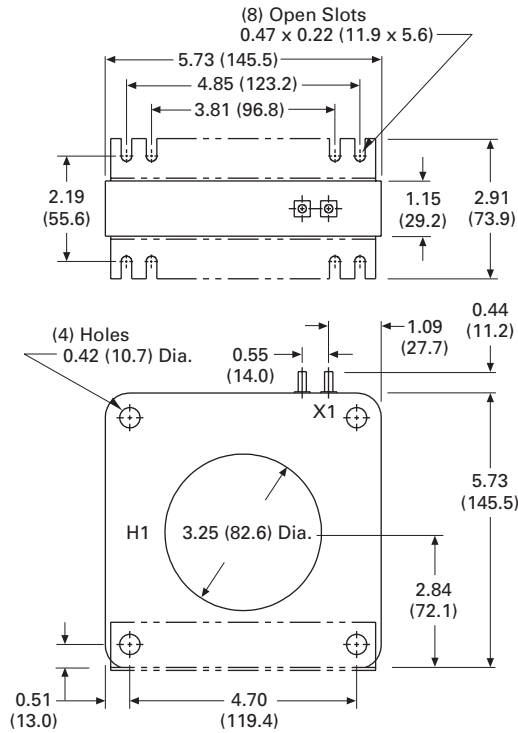
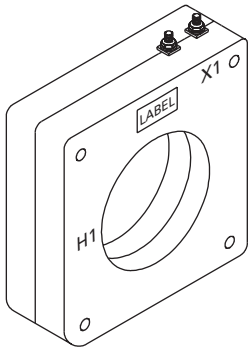
22.3

Metering Devices, Protective Relays, Software and Connectivity

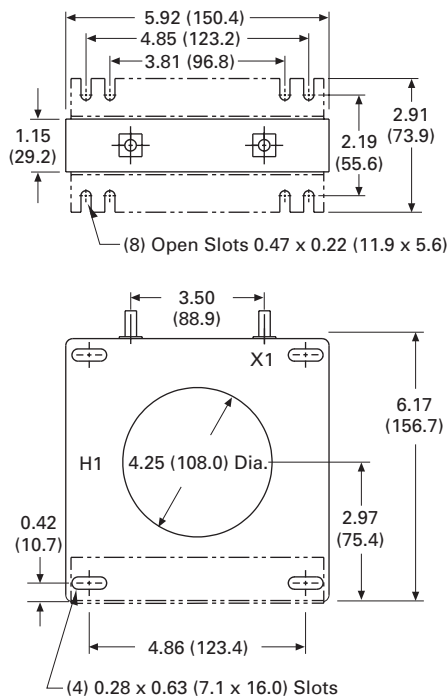
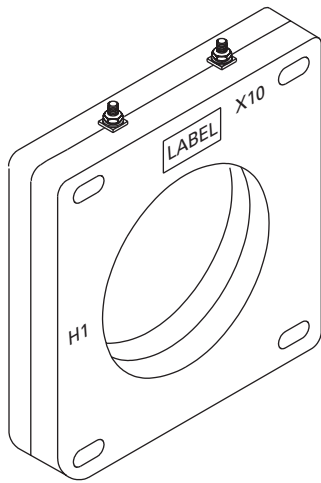
Protective Relays

Approximate dimensions in inches (mm)

S080

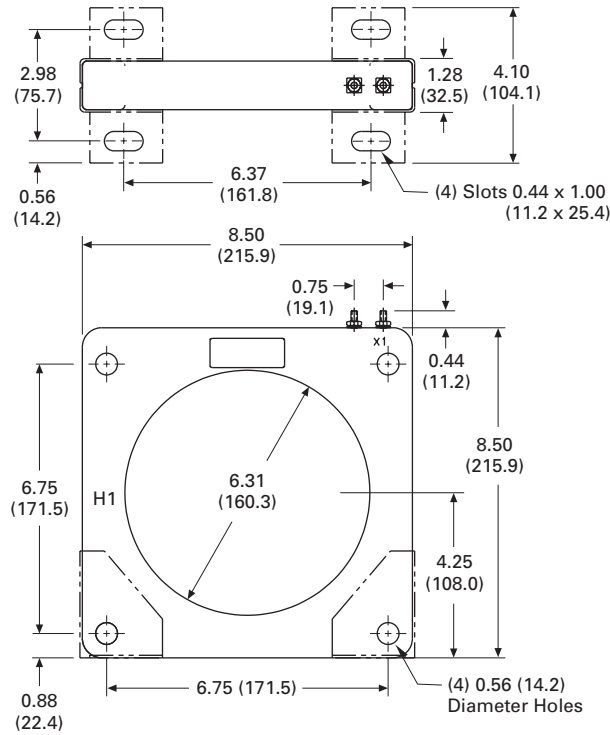
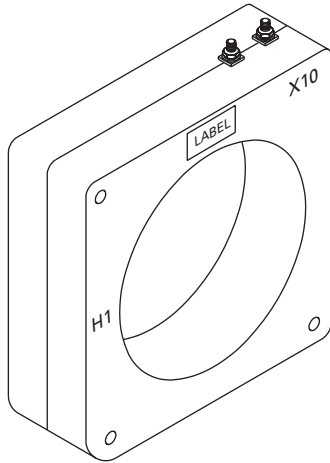


S090

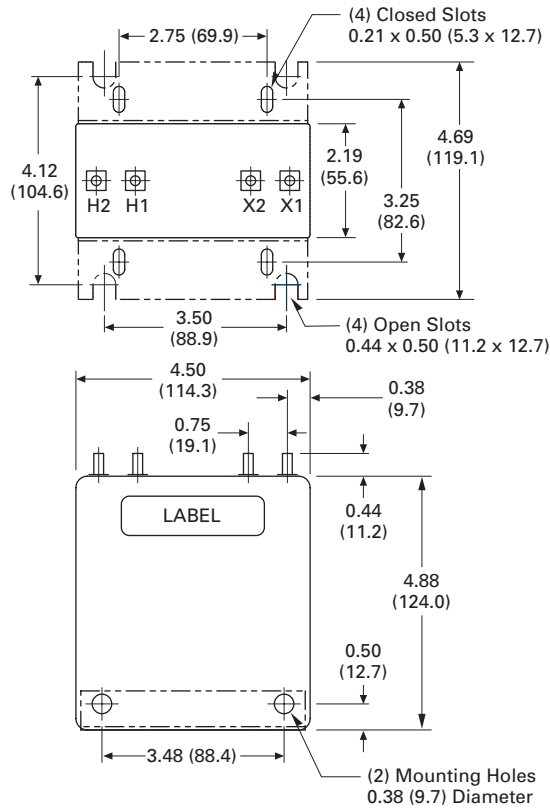
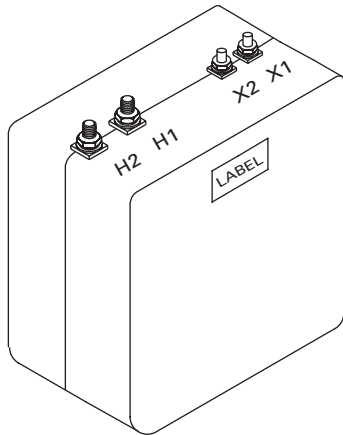


Approximate dimensions in inches (mm)

S025



W190



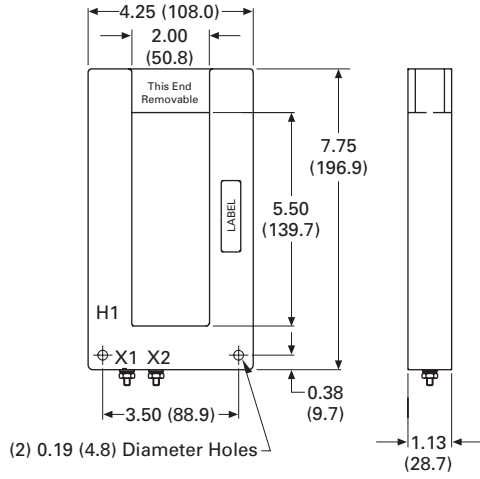
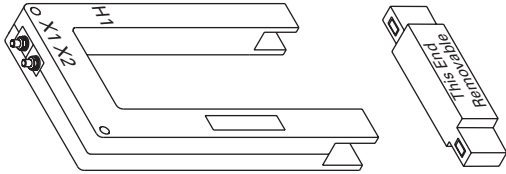
22.3

Metering Devices, Protective Relays, Software and Connectivity

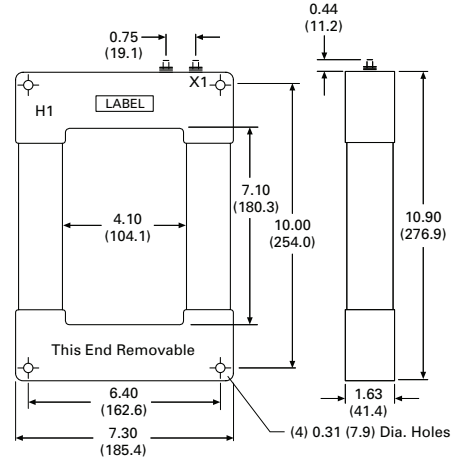
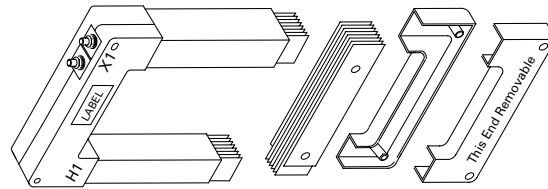
Protective Relays

Approximate dimensions in inches (mm)

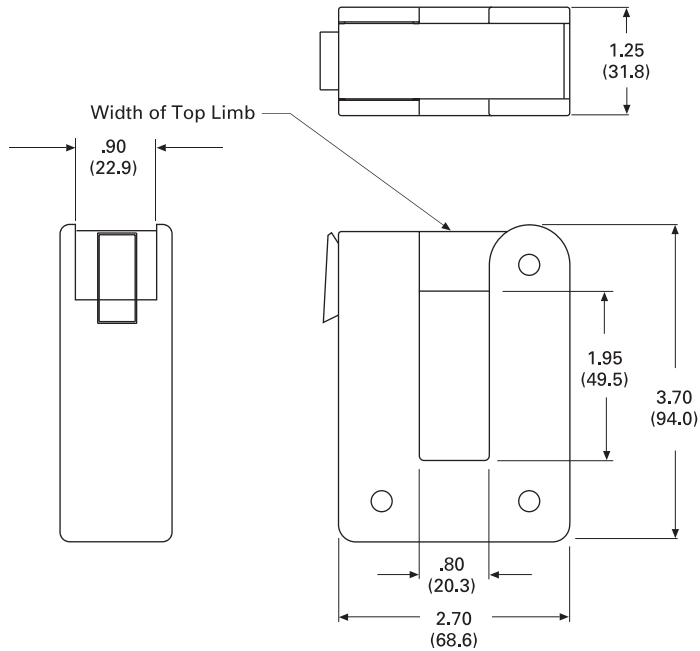
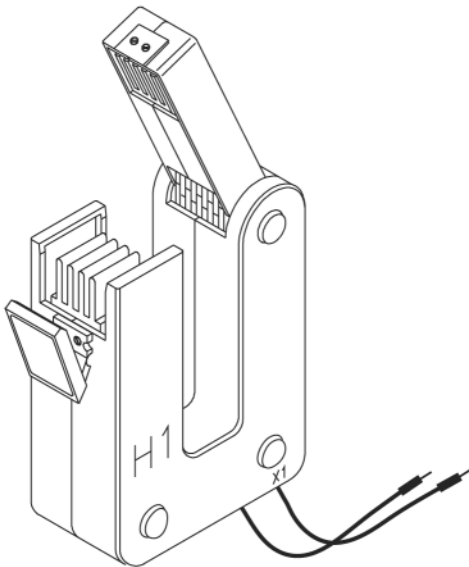
M000



M050

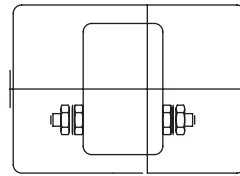
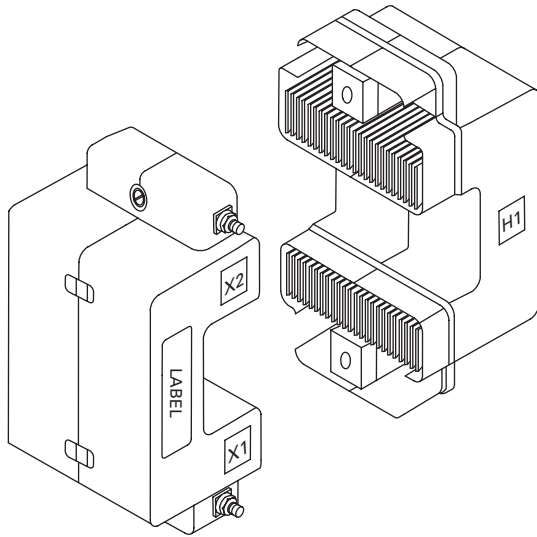


M030

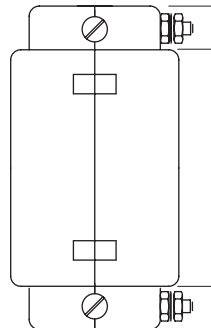


Approximate dimensions in inches (mm)

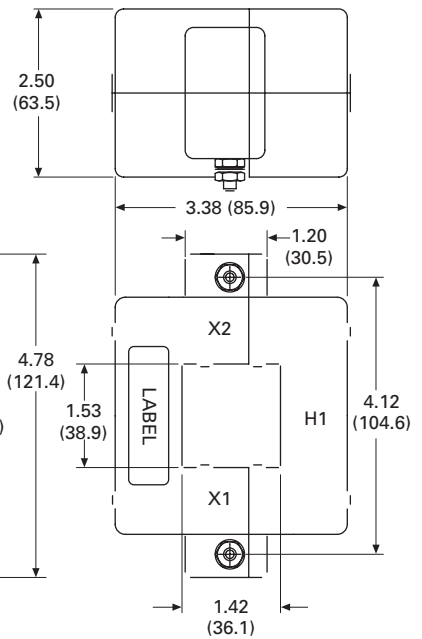
M040



Terminal Arrangement for Ratios 250:5 through 400:5

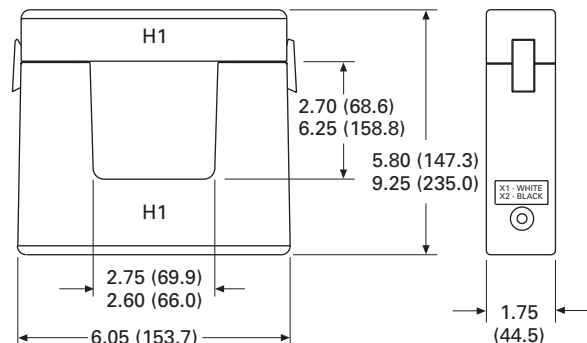
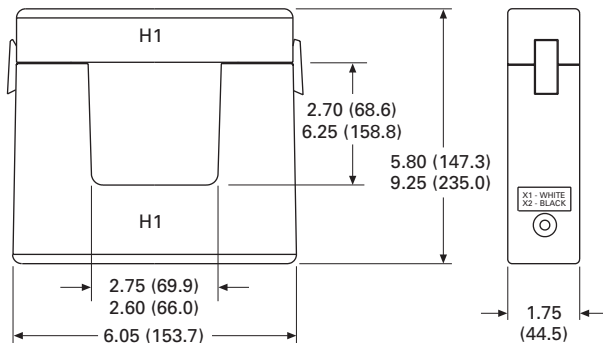
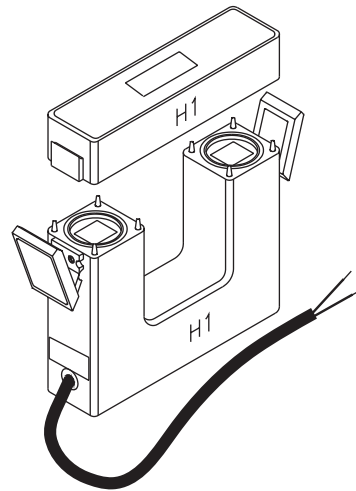
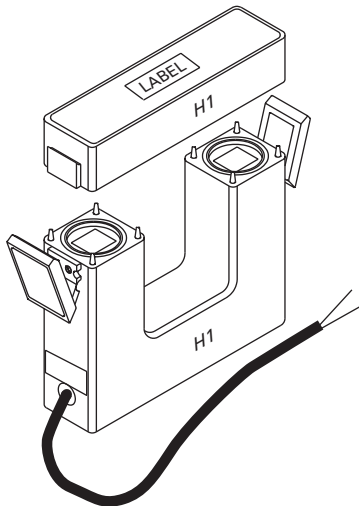


Terminal Arrangement for Ratios 100:5 through 200:5



M060

M080



IQ Accessories—Clamp-On CTs



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Clamp-On Current Transformers

Product Description

Eaton’s optional Clamp-on Current Transformers (CTs) are designed to be used in cases where there are no existing CTs or the existing CTs cannot be accessed, these clamp-on CTs can be used.

These clamp-on CTs are packaged individually. Most applications will require at least three clamp-on CTs, one for each phase.

Application Description

- There are two models that cover current ranges from 150 to 1500 amperes
- These clamp-on CTs are designed to fit around 600 volt insulated cable and bus bar

Features, Benefits and Functions

- Each clamp-on CT comes with a 12-foot (3.7m) cable and twist lock connector
- All models have a 5 ampere output at three different primary current ratings



Standards and Certifications

- Meets IEC 1010-1 Category III
- CE mark for applications where European compliance is required



Product Selection

Ordering Information

| | Current Ranges | Catalog Number |
|---|-----------------------|-----------------------|
|  | 150–300–600A | IQAPORT0600CT |
|  | 500–1000–1500A | IQAPORT1500CT |

Technical Data and Specifications

- Operating temperature: 14°F to 122°F (–10°C to 50°C)
- Operating humidity: 5 to 90% maximum noncondensing
- Altitude: 10,000 ft (3048m)
- Environment: indoor use only
- Operating voltage: 600 Vac maximum
- Isolation test: 5.55 kV for 1 minute
- Current over range: 200% for 3 minutes
- Connector: twist-lock

Current Ranges

Each of the two models of clamp-on CTs has three primary current ranges. The primary current range is selected at the clamp-on by connecting to the indicated terminals.

150A/300A/600A Clamp-On CT Specifications

- Current ratings:
 - 150 to 5 amperes
 - 300 to 5 amperes
 - 600 to 5 amperes

500A/1000A/1500A Clamp-On CT Specifications

- Current ratings:
 - 500 to 5 amperes
 - 1000 to 5 amperes
 - 1500 to 5 amperes

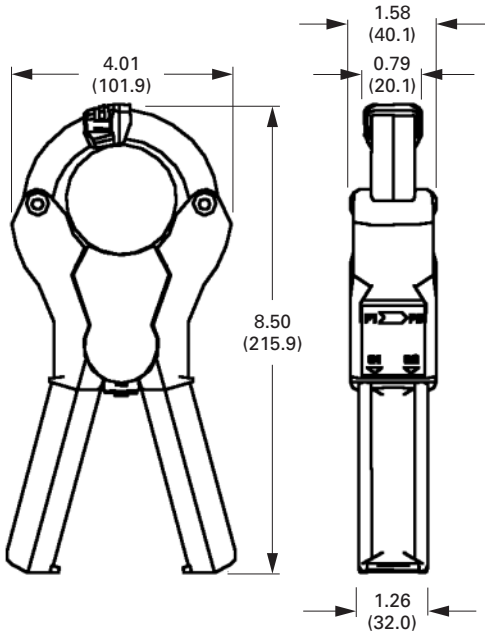
Electrical Characteristics

| Current Ranges | Load (Ohms) | Phase Shift (Degree) | Frequency Range (3%) | Frequency Range (–3 db) |
|-----------------------|--------------------|-----------------------------|-----------------------------|--------------------------------|
| 150–600A | 0.10–1.0 | 0.5–1.0 | 40–5000 | 30–10,000 |
| 500–1500A | 0.01–4.0 | 0.5–1.0 | 40–2000 | 30–5000 |

Dimensions

Approximate Dimensions in Inches (mm)

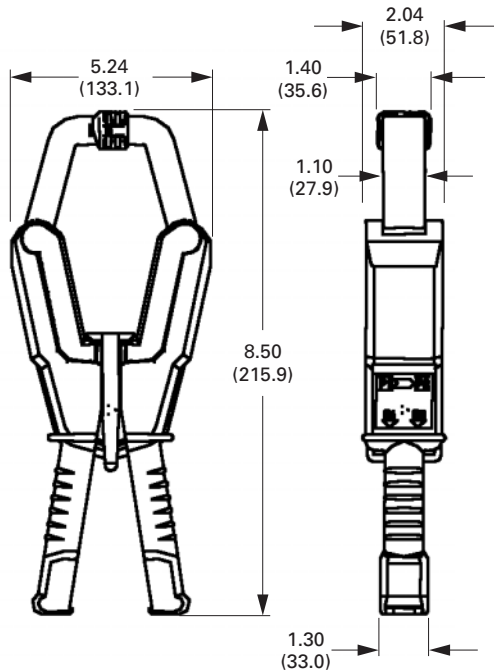
150A/300A/600A Clamp-On CT



150A/300A/600A Clamp-On CT

- Maximum cable size:
 - 2.00 inches (50.8 mm)
- Maximum bus bar size:
 - 2.00 x 0.47 inches (50.8 x 12.0 mm)
 - 1.60 x 1.40 inches (40.6 x 35.6 mm)
- Dimensions (without cable):
 - 4.00 x 8.50 x 1.60 inches (101.6 x 215.9 x 40.6 mm)
- Weight (with cable):
 - 2.0 lbs (0.9 kg)

500A/1000A/1500A Clamp-On CT



500A/1000A/1500A Clamp-On CT

- Maximum cable size:
 - 2.68 inches (68.1 mm)
- Maximum bus bar size:
 - 4.84 x 1.40 (122.9 x 35.6 mm)
 - 4.00 x 1.70 inches (101.6 x 43.2 mm)
- Dimensions (without cable):
 - 5.20 x 13.20 x 2.00 inches (132.1 x 335.3 x 50.8 mm)
- Weight (with cable):
 - 6.0 lbs (2.7 kg)

IQ Accessories—IQ Flange



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IQ Flange

Product Description

Eaton’s IQ Flange is intended for use with the IQ Data, IQ Generator, IQ Data Plus II, IQ Analyzer and any other such device sharing the same mounting dimensions.

The door mounting flange provides extra depth behind a panel if there is not enough clearance to accommodate the device.

Application Description

Retrofit Applications

For applications where extra door mounting space is required, a flange-mounting unit is available. The IQ Flange provides an extra 2.5 inches (63.5 mm) of clearance for the device. The IQ Flange can be used with any IQ device with a 5.38-inch (136.7 mm) x 9.38-inch (238.0 mm) cutout.

Product Selection

IQ Flange



IQ Flange

| Description | Catalog Number |
|-------------|----------------|
| IQ Flange | IQFLANGE |

Enclosed Meters



22

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Enclosed Meters

Product Description

Everything is in the box

Designed for Eaton's IQ 100 (130/140/150), IQ 250/260, and Power Xpert 2000 Meters, Eaton's Enclosed Meter 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 offers savings in labor and installation costs because input current and voltage wiring as well as I/O wiring is pre-wired to terminal blocks inside the enclosure.

To ensure safety, Eaton's Enclosed Meter includes a primary fusible disconnect for line voltage that can be turned off during meter maintenance.

For applications with line voltages above 265 Vac, 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 shorting terminal blocks for easy field installation.

Factory Wired

Most electrical contractors are very familiar with wiring meters. However, it does take time to place the disconnect, CT shorting blocks, terminal blocks, control power transformer, etc. and 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, everything is wired at the factory: the shorting block, terminal blocks, etc. Therefore you can be sure it's done right.

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 terminal blocks.

NEMA Rated

NEMA 12 enclosure prevents dust and other materials from entering. 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 to provide a degree of protection to personnel against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt); to provide a degree of protection with respect to harmful effects on the equipment due to the ingress

of water (rain, sleet, snow); and that will be undamaged by the 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 protection against corrosion.

Application Description

- Stand-alone, enclosed meters are ideal for new metering applications where no metering existed previously, retrofit installations or where ease of installation is required
- Service entrance applications where energy supplier verification monitoring is desired

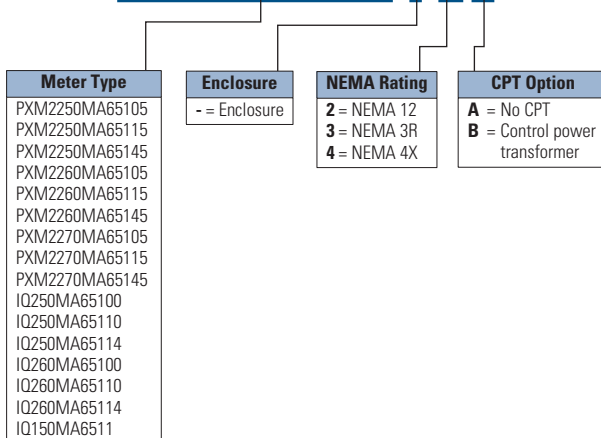
Features and Benefits

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

Catalog Number Selection

Enclosed Meter

PXM2250MA65105 - 2 B



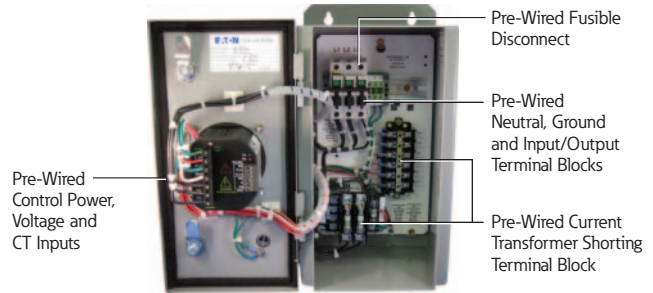
Technical Data and Specifications

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 | NEMA 12 (8.00 inches wide x 16.12 inches high x 8.36 inches deep) NEMA 3R/4X (8.00 inches wide x 16.12 inches high x 9.75 inches deep) |
| Meters | IQ 250/260, PXM 2000 and IQ 130/140/150 models |
| Control voltage | Up to 265V—no CPT required Greater than 265V—CPT required Separate source control—no CPT required |
| Basic model | Fusible disconnect—primary voltage 6 point shorting block Ground terminal block Neutral terminal block 8 point terminal block 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 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 265 Vac |
| Rating | 600V rated power voltage terminal block and wiring |
| Pre-wire | Pre-wired current transformer, shorting terminal block, neutral, ground, voltage, control power, fusible disconnect, and input/output terminal blocks |
| Latch | Padlocking latch provision |
| Optional features | Control power transformer—50 VA control power supply for meter where monitored voltage is above 265 Vac |

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 User Manual for detailed specifications.

NEMA 12 Front View, Door Open

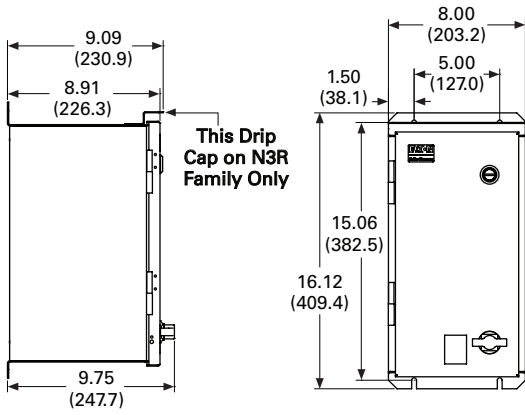
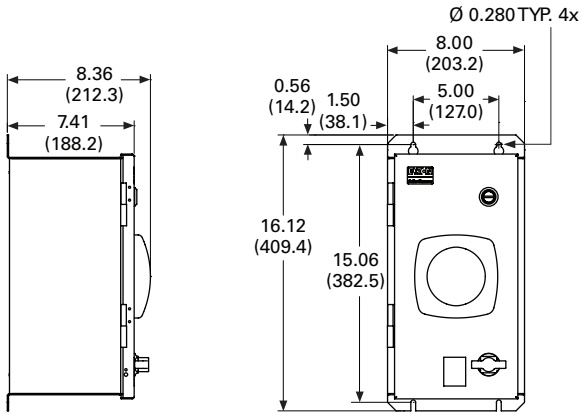


NEMA 3R Open and Folded Out



Dimensions

Approximate Dimensions in Inches (mm)



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Product Selection Guide

Protective Relay Selection Chart

Protection Functions

| Description Section Page Number | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|------------------------------------|--------------------------|----------------------|-----------------|----------------|----------------|----------------|---------------------|----------------|----------------|-----------------------|---------------------------|-----------------|
| | | DT-3000 331 | EDR-3000 350 | FP-4000 304 | FP-5000 296 | FP-6000 286 | MP-3000 312 | MP-4000 322 | MD-3000 328 | VR-300 341 | DP-300 345 | ETR-4000 361 |
| Phase inst. OC | 50 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | |
| Phase TOC | 51 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | |
| Ground inst. OC (measured) | 50G | ■ | ■ | ■ | ■ | ■ | | | | | ■ | |
| Ground TOC (measured) | 51G | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | |
| Phase directional control ① | 67 | | | | ■ | ■ | | | | | | |
| Ground directional control ② | 67N | | | | ■ | ■ | | | | | | |
| Phase voltage restrained OC | 51VR | | | | ■ | ■ | | | | | | |
| No. of curves (ANSI/IEC/thermal) | | 11 | 11 | 10 | 10 | 10 | | | | | 11 | |
| Zone interlocking | | ■ | ■ | ■ | ■ | ■ | | | | | ■ | |
| Thermal overload | 49 | | | | | ■ | ■ | ■ | | | ■ | |
| Locked rotor | 49S/51 | | | | | ■ | ■ | ■ | | | | |
| Jam/stall | 51R | | | | | ■ | ■ | ■ | | | | |
| Undervoltage | 27 | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Current unbalance | 46 | | | ■ | ■ | ■ | ■ | ■ | | | | |
| Negative sequence voltage | 47 | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Power factor | 55 | | | ■ | ■ | ■ | | ■ | | | | |
| Overvoltage | 59 | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Frequency (over/under) | 81 | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Forward/reverse VARs | 32V | | | | | ■ | | | | ■ | | |

Notes

- ① The 50 and 51 protective functions can be controlled for reverse, forward or both directional protection.
- ② The 50N, 51N, 50G and 51G protective functions can be controlled for reverse, forward or both directional protection.

Protection Functions, continued

| Description Section Page Number | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|------------------------------------|--------------------------|----------------------|-----------------|----------------|----------------|----------------|---------------------|----------------|----------------|-----------------------|---------------------------|-----------------|
| | | DT-3000 331 | EDR-3000 350 | FP-4000 304 | FP-5000 296 | FP-6000 286 | MP-3000 312 | MP-4000 322 | MD-3000 328 | VR-300 341 | DP-300 345 | ETR-4000 361 |
| Differential | 87 | ■ ^① | | ■ ^① | ■ ^① | ■ ^① | | | ■ ^② | | ■ ^③ | ■ ^④ |
| Forward/reverse power | 32 | | | | ■ | ■ | | ■ | | | | |
| Sync check | 25 | | | | ■ | ■ | | | ■ | | | |
| Reclosing | 79 | | | | | ■ | | | | | | |
| Loss of potential block | LOP | | | | ■ | ■ | | | | | | |
| Cold load pickup | | | | | ■ | ■ | | | | | | ■ |
| Breaker failure | 50BF | | ■ | ■ | ■ | ■ | | | | | | ■ |
| 2 nd harmonic restrain | | | | | | | | | | | ■ | ■ |
| 5 th harmonic restrain | | | | | | | | | | | ■ | ■ |
| 4 th harmonic restrain | | | | | | | | | | | | ■ |
| 87 GD ground differential | | | | | | | | | | | | ■ |

Control Functions

| Description Section Page Number | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|------------------------------------|--------------------------|----------------------|-----------------|----------------|----------------|----------------|---------------------|----------------|----------------|-----------------------|---------------------------|-----------------|
| | | DT-3000 331 | EDR-3000 350 | FP-4000 304 | FP-5000 296 | FP-6000 286 | MP-3000 312 | MP-4000 322 | MD-3000 328 | VR-300 341 | DP-300 345 | ETR-4000 361 |
| Remote open/close | | ■ | ■ | ■ | ■ | ■ | (Trip only) | ■ | ■ | | | ■ |
| Programmable I/O | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Programmable logic control | | | | ■ | ■ | ■ | | | | | | |
| Multiple settings groups | | | 4 | 4 | 4 | 4 | | | | | | 4 |
| Number of starts limit | | | | | | | ■ | ■ | | | | |
| Starts per hour | | | | | | | ■ | ■ | | | | |
| Time between starts | | | | | | | ■ | ■ | | | | |
| Emergency override | | | | | | | ■ | ■ | | | | |
| Reduced voltage starting | | | | | | | ■ | ■ | | | | |
| Trip lock out | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ |

Notes

- ① 87B using zone selective interlocking.
- ② 87M or 87G (motor or generator differential).
- ③ 87M, 87T or 87G (motor, transformer or generator differential).
- ④ 87T (transformer differential).

Metering Functions

| Description Section Page Number | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|--------------------------------------|--------------------------|----------------------|-----------------|----------------|----------------|----------------|---------------------|----------------|----------------|-----------------------|---------------------------|---------------|
| | | DT-3000 331 | EDR-3000 350 | FP-4000 304 | FP-5000 296 | FP-6000 286 | MP-3000 312 | MP-4000 322 | MD-3000 328 | | VR-300 341 | DP-300 345 |
| Amperes | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | ■ ^① | ■ |
| Ampere demand | | ■ | ■ | ■ | ■ | ■ | | ■ | | | | ■ |
| Volts | | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Phase angle (current and voltage) | | | | ■ | ■ | ■ | | ■ | | | | Current only |
| Positive, negative and zero sequence | | | ■ | ■ | ■ | ■ | | ■ | | | | ■ |
| Watts | | | | ■ | ■ | ■ | | ■ | | | | |
| Watt Demand | | | | ■ | ■ | ■ | | ■ | | | | |
| Watt-hour | | | | ■ | ■ | ■ | | ■ | | | | |
| VARs | | | | ■ | ■ | ■ | | ■ | | | | |
| VAR demand | | | | ■ | ■ | ■ | | ■ | | | | |
| VAR-hour | | | | ■ | ■ | ■ | | ■ | | | | |
| VA | | | | ■ | ■ | ■ | | ■ | | | | |
| VA Demand | | | | ■ | ■ | ■ | | ■ | | | | |
| VA-hour | | | | ■ | ■ | ■ | | ■ | | | | |
| Frequency | | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Trending (load profile) | | | | ■ | ■ | ■ | | | | | | |
| Minimum/maximum recording | | | ■ | ■ | ■ | ■ | Max. only | ■ | | | | ■ |

Monitoring Functions

| Description Section Page Number | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|------------------------------------|--------------------------|----------------------|-----------------|----------------|----------------|----------------|---------------------|-------------------|-------------------|-----------------------|---------------------------|------------------|
| | | DT-3000 331 | EDR-3000 350 | FP-4000 304 | FP-5000 296 | FP-6000 286 | MP-3000 312 | MP-4000 22-322 | MD-3000 22-328 | | VR-300 22-341 | DP-300 22-345 |
| Trip circuit monitor | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Breaker wear | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Failure to close | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Oscillography | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Sequence of events | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ |
| Trip target data | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Clock | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ |
| Number of starts | | | | | | ■ | ■ | ■ | | | | |
| Acceleration time | | | | | | ■ | ■ | ■ | | | | |
| RTD temperature | | | | | | ■ | ■ | ■ | | | | ■ |
| Hottest RTD | | | | | | ■ | ■ | ■ | | | | ■ |

Note

① Differential and restrain current only.

Communications

| Description | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|-------------------------------|--------------------|-------------------|----------|---------|---------|---------|------------------|---------|---------|--------------------|------------------------|----------|
| | | DT-3000 | EDR-3000 | FP-4000 | FP-5000 | FP-6000 | MP-3000 | MP-4000 | MD-3000 | VR-300 | DP-300 | ETR-4000 |
| Section Page Number | | 331 | 350 | 304 | 296 | 286 | 328 | 22-322 | 22-328 | 22-341 | 22-345 | 361 |
| Local human machine interface | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Remote communication port | | | | | | | | | | | | |
| RS-232 | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| RS-485 | | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Ethernet copper | | | ■ | | | | | | | | | ■ |
| Frequency shift key | | ■ | | ■ | ■ | ■ | Optional | | | | | |
| Addressable Protocols | | ■ | | ■ | ■ | ■ | ■ | ■ | | | | |
| INCOM | | ■ | | ■ | ■ | ■ | ■ | ■ | | | | |
| Modbus-RTU | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ |
| Modbus-TCP | | | ■ | | | | | | | | | ■ |

22

Construction

| Description | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|-----------------------------|--------------------|-------------------|---------------------|-----------------|-----------------|-----------------|------------------|-------------|-------------|--------------------|------------------------|---------------------|
| | | DT-3000 | EDR-3000 | FP-4000 | FP-5000 | FP-6000 | MP-3000 | MP-4000 | MD-3000 | VR-300 | DP-300 | ETR-4000 |
| Section Page Number | | 331 | 350 | 304 | 296 | 286 | 312 | 322 | 328 | 341 | 345 | 361 |
| Panel mount case | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Drawout | | Optional | Removable terminals | ■ | Optional | Optional | Optional | Optional | Optional | | | Removable terminals |
| Operating temperature range | | -30°-55°C | -40°-60°C | -40°-60°C | -40°-60°C | -40°-60°C | -20°-60°C | -20°-60°C | -30°-55°C | -20°-70°C | 20°-70°C | -40°-60°C |
| Power supply options | | 120-240 Vac | 19-300 Vdc | 48-125 Vac/Vdc | 48-125 Vac/Vdc | 48-125 Vac/Vdc | 120-240 Vac | 120-240 Vac | 120-240 Vac | 40-250 Vac | 40-250 Vac | 19-300 Vdc |
| | | 24-250 Vdc | 40-250 Vac | 100-240 Vac/Vdc | 100-240 Vac/Vdc | 100-240 Vac/Vdc | | | 24-250 Vdc | 90-250 Vdc | 90-250 Vdc | 40-250 Vac |
| AC current inputs | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | ■ |
| AC voltage inputs | | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Wye PTs | | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Delta/open delta PTs | | | | ■ | ■ | ■ | | ■ | | ■ | | |
| Binary inputs | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Alarm outputs | | 2 Form C | 1 Form C | 2 Form C | 2 Form C | 2 Form C | 3 | ■ | 2 Form C | 1 Form C | 1 NO | 1 Form C |
| Trip outputs | | 2 | 3 | 5 | 5 | 5 | ■ | ■ | ■ | ■ | ■ | ■ |
| Analog outputs | | | | | | | ■ | ■ | | | | ■ |
| Local display | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| LEDs (local targets) | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

Standards

| Description | IEEE Device Number | Feeder Protection | | | | | Motor Protection | | | Voltage Protection | Transformer Protection | |
|---------------------|--------------------|-------------------|----------|---------|---------|---------|------------------|---------|---------|--------------------|------------------------|----------|
| | | DT-3000 | EDR-3000 | FP-4000 | FP-5000 | FP-6000 | MP-3000 | MP-4000 | MD-3000 | VR-300 | DP-300 | ETR-4000 |
| Section Page Number | | 331 | 350 | 304 | 296 | 286 | 312 | 322 | 328 | 341 | 345 | 361 |
| ANSI | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| IEC | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| UL | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| CE | | DT-3030 only | ■ | ■ | ■ | ■ | | | | | | ■ |
| CSA | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |

Feeder Protection FP-6000



Contents

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| MP-3000 Motor Protection | 312 |
| MP-4000 Motor Protection | 322 |
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FP-6000 Feeder Protection

Product Description

- Microprocessor-based protection with monitoring and control for medium voltage main and feeder applications
- Current, voltage, frequency and power protection for electric power distribution systems
- Complete metering of voltage, currents, power, energy, minimum/maximum and demand functions
- Programmable logic control functions for main-tie-main and main-main transfer schemes
- Trip logs, event logs and waveform capture for better fault analysis and system restoration
- Data Logger to provide energy usage profiles for better planning, utilization and energy usage
- Compact, drawout case design or fixed case design
- Meets ANSI and UL

Application Description

Eaton's FP-6000 Protection Relay provides complete three-phase and ground overcurrent, voltage, frequency and power protection plus metering in a single, compact drawout case. It may be used as a reclosing relay; primary protection on feeders; mains and tie circuit breaker applications; or as backup protection for transformers, high voltage lines and differential protection.

The FP-6000 takes full advantage of its microprocessor technology, providing the user new freedom and a wealth of data-gathering features. The relay performs self-checking of all major hardware and firmware protection elements to ensure their operation in the event of a system or component electrical failure or fault. Protection functions are well suited for main and distribution feeder circuit applications. Programmable logic control functions make the FP-6000 relay ideally suited for main-tie-main and main 1/main two transfer schemes.

The FP-6000 is the only relay in its class that offers a flexible, yet simple reclosing control. Its compact design makes it ideal for polemounted recloser controls. The zone interlocking feature can be utilized for bus protection instead of an expensive and complicated bus differential (87B) scheme. The FP-6000 works directly with the FP-5000, FP-4000, Digitrip® 3000 and Digitrip MV relays. The breaker failure protection provides faster remote backup clearing times for stuck breaker operation. In addition to the breaker failure protection, the FP-6000 can be programmed to detect residual current when the breaker is open to detect flashover conditions. The FP-6000 provides trip circuit monitoring and alarming features. It continually monitors the trip circuit for continuity and readiness to trip. Open and close pushbuttons are conveniently located on the front of the relay for local breaker operation.

When an electrical fault or disturbance occurs, the FP-6000 begins to store the following in non-volatile memory:

- Voltage and current sampled data
- Calculated values
- Status of internal protection functions, logic, contact inputs and outputs

Retrieval and viewing of the data is easy, aiding in the quick analysis and restoration of your electric power system.

When the FP-6000 isn't responding to disturbances in the power system, it's providing valuable metering information at the relay and remotely. It provides energy usage and demand reading, and can alarm when usage reaches a set value. Power factor measurements can be used for cap bank switching to control kVAR demand. Onboard data trending can provide load profiles for up to 40 days.

Features, Benefits and Functions

- Complete protection, metering and control in a single compact case to reduce panel space, wiring and costs
- Flexible current, voltage and frequency protection and programmability to cover a broad range of applications while simplifying relay ordering and reducing inventory
- Integral test function reduces maintenance time and expense
- Relay self-diagnostics and reporting improves uptime and troubleshooting
- Breaker trip circuit monitoring improves the reliability of the breaker operation
- Programmable LEDs and logic control features that can replace and eliminate external auxiliary relays, timers, light and wiring
- Zone selective interlocking improves coordination and tripping times and saves money compared to a traditional bus differential scheme
- Trip and event recording in non-volatile memory provides detailed information for analysis and system restoration
- 256 cycles of waveform capture aids in post fault analysis (viewable using PowerNet and NPWAVEFORM component)
- Front RS-232 port and PowerPort software provides local computer access and a user-friendly, Windows-based interface for relay settings, and configuration and data retrieval
- Drawout case design for quick and easy relay removal and replacement
- Breaker open/close control from relay faceplate or remotely via communications
- Remote communications to Eaton PowerNet monitoring system or PC

- Free PowerPort utility software for local PC interface to the FP-6000 for relay settings, monitoring and control

The protection functions are listed below and shown on **Page 292**.

The FP-6000 provides phase overcurrent (forward, reverse or both):

- Two-stage instantaneous with timers (50P-1 and 50P-2)
- Inverse time overcurrent (51P)
- Directional control (67P)
- 10 standard curves
- Instantaneous or time delay reset
- Voltage restrained inverse time overcurrent (51P2)

The FP-6000 provides two ground overcurrent elements, one measured (IX) and one calculated (IR):

- Independent measured ground or neutral directional overcurrent elements:
 - Two-stage instantaneous with timers (50X-1 and 50X-2)
 - Inverse time overcurrent (51X)
 - Ground directional polarizing (67N) -3vo and negative sequence
 - 10 standard curves
 - Instantaneous or time delay reset

- Independent calculated ground or neutral directional overcurrent elements:
 - Two-stage instantaneous with timers (50R-1 and 50R-2)
 - Inverse time overcurrent (51R)
 - Ground directional polarizing (67N) -3vo, I pol and negative sequence
 - 10 standard curves
 - Instantaneous or time delay reset

The FP-6000 also provides the following protective features:

- Breaker failure (50BF)
- Phase unbalance negative sequence overcurrent (46-1, 46-2)
- Phase voltage unbalance and sequence protection (47-1, 47-2)
- Main 3-phase under/overvoltage (27M-1, 27M-2, 59M-1, 59M-2)
- Under/overfrequency (81U-1, 81U-2, 81O-1, 81O-2)
- Auxiliary single-phase under/overvoltage (27A-1, 27A-2, 59A-1, 59A-2)
- Neutral voltage (59N-1, 59N-2)
- Apparent and displacement power factor (55A, 55D)
- Forward/reverse power protection (32-1, 32-2, 32-3)
- Forward/reverse VAR protection (32V-1, 32V-2, 32V-3)
- Thermal Protection (49DT, 49MT, 49DA, 49MA)
- Sync check (25)
- Zone interlocking for bus protection (87B). The FP-6000 feeder relay includes a zone selective interlocking feature that can be used with other Eaton devices like the Digitrip 3000 overcurrent relay

The FP-6000 provides the following metering functions:

- Amperes (rms, phasor and sequence)
- Amperes demand and peak demand.
- Volts (rms, phasor and sequence).
- VA and VA demand
- Watts and kW demand and peak demand.
- Forward/reverse/net kWh
- Vars and kVAR demand and peak demand
- Lead/lag/net kVARh
- Power factor
- Frequency
- Voltage and current %THD and magnitude THD
- RTD

- Minimum/maximum recording with date/time stamp
- Trending (load profile over time)

The FP-6000 provides the following monitoring and data recording functions that enhance the security of the protection system and provides useful information for scheduling maintenance:

- Trip circuit monitoring
- Breaker wear (accumulated interrupted current)
- Waveform capture (256 cycles total, up to 16 events)
- Fault data logs (up to 16 events).
- Sequence of events report (up to 100 events)
- Clock (1ms stamping)

The FP-6000 provides standard control functions plus userconfigurable custom control capabilities. This logic can be used for applications such as main-tie-main transfer schemes.

- Remote open/close.
- Optional local open/close
- Programmable I/O
- Programmable logic gates and timers
- Multiple setting groups (up to four)
- Bus transfer logic
- Cold load pickup
- Loss of potential (PT blown fuses)
- Autoreclose Function (79)
- Auto Zone Coordination

The FP-6000 supports the following communication options:

- Local HMI
- Password protected
- Addressable
- Front RS-232 port
- Rear RS-485 port
- Rear FSK port
- Protocols:
 - INCOM
 - Modbus RTU

Communication Software

Eaton provides two types of communication software. The first is PowerPort. It runs on a PC or laptop for easy access to a single relay to change set points or configuration and to view metered values and stored data. PowerPort is free and can be downloaded from the Eaton Web site at the following URL: www.eaton.com; search for "PowerPort."

The second package is PowerNet. PowerNet is a power management software package that is designed for continuous, remote monitoring of many devices. It provides all the functionality of PowerPort plus additional functions such as billing, trending and graphics. Contact your local Eaton representative for more information on PowerNet software.

Standards and Certifications**Compliance**

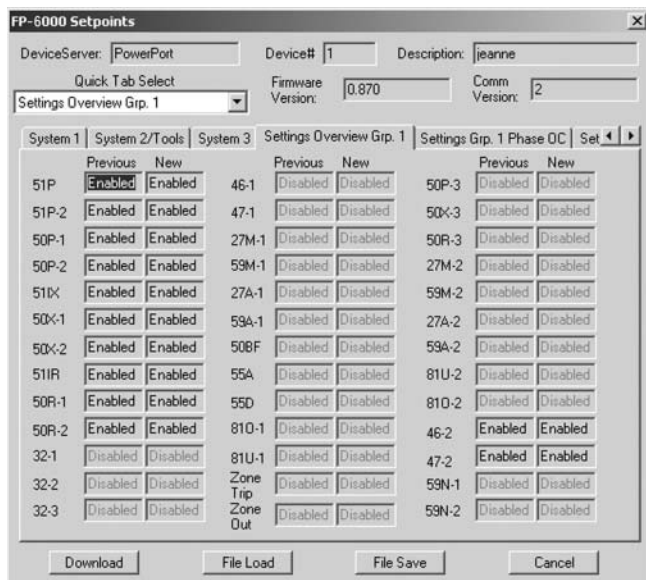
- UL recognized, File # E154862 (FP6200-00 5A CT model only)
- UL 1053 (1994) recognized
- ANSI C37.90 (1989)
- EN 55011 (1991)
- EN 61000-6-2 (1999)

**Emission Tests**

- EN 55011 (1991): Group 1 Class A (CISPR-11, Class A)
- FCC 47 CFR Chapter 1: Part 15 Subpart b Class A

Immunity Tests

- ANSI C37.90.1 (1989): surge withstand capability
- ANSI C37.90.2 (1995): EMI immunity to 35 V/m
- EN 61000-4-2 (1995): ESD Rating of 8 kV
- EN 61000-4-3 (1997): radiated EM field at 10 V/m
- EN 61000-4-4 (1995): fast transient burst at 2 kV
- EN 61000-4-5 (1995): surge immunity test
- EN 61000-4-6 (1996): conducted RF at 10 V/m
- EN 61000-4-8: power frequency magnetic field immunity
- EN 61000-4-11 (1994): voltage dips and variations



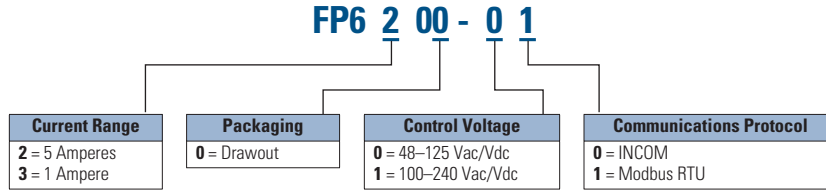
PowerPort and PowerNet Protection Overview Screen

Reference Information

| Description | Style Number | Pub Number |
|---------------------|--------------|-------------|
| Instruction booklet | 66A2347H01 | IB02602004E |

Catalog Number Selection

FP-6000 Feeder Protection



Product Selection

FP-6000



FP-6000 Catalog Numbers

| Option Description | Style Number | Catalog Number |
|---|--------------|------------------|
| 5A CT 48–125 Vdc, 100–120 Vac power supply Standard communication board | 66D2167G01 | FP6200-00 |
| 1A CT 48–125 Vdc, 100–120 Vac power supply Standard communication board | 66D2167G02 | FP6300-00 |
| 5A CT 100–250 Vdc, 100–240 Vac power supply Standard communication board | 66D2167G04 | FP6200-10 |
| 1A CT 100–250 Vdc, 100–240 Vac power supply Standard communication board | 66D2167G05 | FP6300-10 |
| 5A CT 100–250 Vdc, 100–240 Vac power supply Modbus communication board | 66D2167G06 | FP6200-11 |
| 1A CT 100–250 Vdc, 100–240 Vac power supply Modbus communication board | 66D2167G07 | FP6300-11 |
| 5A CT 48–125 Vdc, 100–120 Vac power supply Modbus communication board | 66D2167G08 | FP6200-01 |
| 1A CT 48–125 Vdc, 100–120 Vac power supply Modbus communication board | 66D2167G09 | FP6300-01 |

Technical Data and Specifications

Protective Functions

Phase and Ground Overcurrent Protection

- Inverse characteristics: Mod, Very, Extremely, IECA, IECB, IECC, It, I²t, I⁴t, Flat
- TOC (51) pickup range: 0.02 to 4.0 per unit in 0.01 steps
- Time multipliers: 0.05 to 10.0 in 0.01 steps
- IOC (50) pickup range: 0.1 to 20.0 per unit in 0.01 steps
- Pickup accuracy: $\pm 1\%$ (at 0.1 to 2 per unit)
- Time delay: 0 to 9999 cycles in 1 cycle steps
- Time accuracy: $\pm 3\%$ or ± 30 ms
- Directional (67, 67N, 67G): forward, reverse or both

Voltage Unbalance (47)

- Threshold (minimum voltage) 1 to 100 volts in 1 volt steps
- % V₂/V₁: 2 to 40% in 1% steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Current Unbalance (46)

- Threshold (minimum current) 0.1 to 20.0 per unit in 0.01 steps
- % I₂/I₁: 2 to 40% in 1% steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Under/Overtension Protection (27/59)

- Pickup range: 10 to 150 volts in 1 volt steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Neutral Voltage Protection (59N)

- Source: calculated, measure
- Criterion: phasor, rms
- Pickup range: 5 to 250 volts in 1 volt steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Under/Over Frequency Protection (81U/O)

- Pickup range: 45 to 65 Hz in 0.01 Hz steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Breaker Failure Protection (50BF)

- Pickup range: 0.02 to 5.0 per unit in 0.01 steps
- Time delay: 0 to 9999 cycles in 1 cycle steps

Power Factor (55)

- Trigger/reset threshold: -0.5 to 1 lag; 0.5 to 0.99 lead in 0.01 steps
- Time delay: 0 to 1000 seconds in 1 second steps

Power Protection (32)

- Direction: forward/reverse
- Criterion: over/under
- Pickup range: 0.02 to 4 pu

Note: 1 pu = 3 x CT secondary rating x VT secondary rating for wye; the square root of 3 x VT secondary rating x CT secondary rating for open delta.

- Pickup accuracy: $\pm 1.0\%$
- Trip time accuracy: 0 to 2 cycles or 0.1%, whichever is greater

VAR Protection (32V)

- Direction: forward/reverse
- Criterion: over/under
- Pickup range: 0.02 to 4 pu

Note: 1 pu = 3 x CT secondary rating x VT secondary rating for wye; the square root of 3 x VT secondary rating x CT secondary rating for open delta.

- Pickup accuracy: $\pm 1.0\%$
- Trip time accuracy: 0 to 2 cycles or 0.1%, whichever is greater

Thermal Protection (49)

- Pickup range: 0°F to 390°F or 0°C to 199°C
- Time delay: 0.1 to 3600 seg

Sync Check (25)

- Phase angle: 1 to 60°
- Slip frequency: 0.1 to 2 Hz
- Voltage differential: 1 to 100 volts
- Breaker close time: 0 to 9999 cycles

Discrete Inputs

- Number of contact inputs: 8
- Rating: 48 Vdc wetting voltage provided with internal ground only

Output Contacts

- Number of output contacts: Five Form A and two Form C

Rating of Output Contacts

- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc (resistive)
 - Break 5A at 120/240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc

Logic and Control Functions

- Six programmable logic gates for AND, OR, NAND, NOR operation
- Two latching (flip/flop) gates
- Six timer gates provide on/off delays

INCOM Communications

- Baud rate: 9600 fixed
- Maximum distance: 10,000 feet (3,048 m)
- Protocol: INCOM

RS-232 Communications, Front Panel

- Baud rate: 38.4K, 19.2K, 9.6K
- Connector standard 9-pin subminiature, three-wire
- Protocol: INCOM

RS-485 Communications, Rear Panel

- Baud rate: 19.2K, 9.6K
- Protocol: Modbus RTU

Environmental Ratings

- Operating temperature: -40°F to $+140^{\circ}\text{F}$ (-40°C to $+60^{\circ}\text{C}$)
- Storage temperature: -40°F to $+185^{\circ}\text{F}$ (-40°C to $+85^{\circ}\text{C}$)
- Humidity: 5% to 95% relative humidity (non-condensing)
- Altitude: 0 to 6,350 feet (0 to 1,935 m) above Mean Sea Level

Control Power

- Control voltage:
 - 48–125 Vdc/100–120 Vac
 - 100–250 Vdc/100–240 Vac
- Operating voltage:
 - 38–150 Vdc/55–132 Vac
 - 80–308 Vdc/55–264 Vac
- Interruption ride-through time:
 - 83 ms at 120V, 60 Hz AC
 - 250 ms at 110 Vdc/
300 ms at Vac
- Power consumption:
 - 20 VA maximum
 - 22 VA maximum

Current Inputs

- CT rating:
 - 2 x In at 5 amperes continuous
 - 3 x In at 1 ampere continuous
 - 80 x In at 5 amperes for 1 second
 - 100 x In at 1 ampere for 1 second
- CT burdens:
 - < 0.25 VA at 5A (nominal)
 - < 0.05 VA at 1A (nominal)

Voltage Transformer Inputs

- Nominal: 0–120 Vac line to common
- Operating range: 0–144 Vac (+20%) line to common
- Burden: 1 mega ohm input impedance

Metering Accuracy

- Input signal frequency necessary for accurate operation:
 - 60 Hz Nominal, 57–63 Hz (5%)
 - 50 Hz Nominal, 47–53 Hz (5%)
- Frequency measurement accuracy:
 - ± 0.02 Hz
- Clock accuracy:
 - Free running ± 1 minute/month at 77°F (25°C)
 - Automatically updated by PowerNet host when present

22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

FP-6000 Specifications

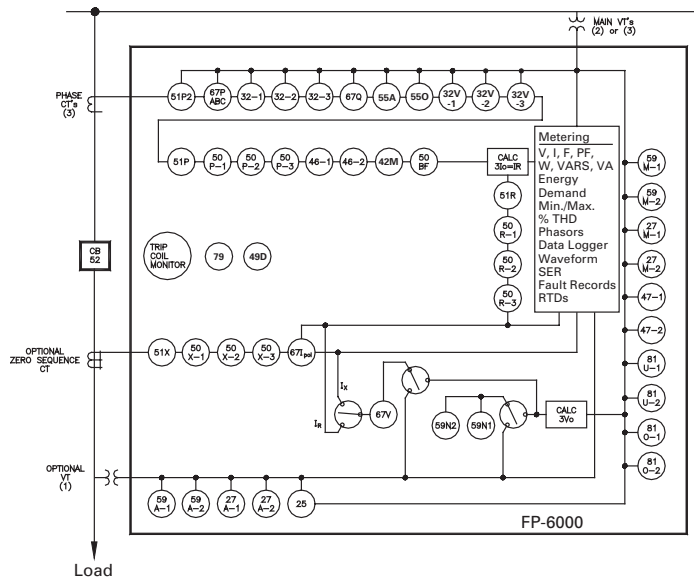
| Principal Parameters | Range | Accuracy |
|--------------------------------------|---------------------|--|
| Current (amperes) Ia, Ib, Ic, Ir, Ix | 0.02 to 20 per unit | at < 2 x CT rating: $\pm 0.5\%$ of CT rating at > 2 x CT rating: $\pm 0.5\%$ of reading |
| Sequence currents | 0.02 to 20 per unit | $\pm 1\%$ of nominal |
| Main voltage | 0 to 160V | $\pm 0.5\%$ of nominal $\pm 0.2V$ |
| Sequence voltages | 0 to 160V | $\pm 1\%$ of nominal |
| Auxiliary voltage | 0 to 250V | $\pm 1\%$ of nominal |
| Phase angle for I and V | 0 to 360° | $\pm 1^\circ$ at nominal voltage |
| System frequency | 45 to 65 Hz | ± 0.02 Hz |
| Ampere demand | 0.02 to 20 per Unit | $\pm 0.5\%$ |
| Watt demand | 0 to 4000 MW | $\pm 1.0\%$ FS for PF = unity ① $\pm 1.5\%$ FS for PF = -0.5 to 0.5 ① |
| Watts | 0 to 4000 MW | — |
| Watt-hours | 0 to 999.999 MWh | — |
| VAR demand | 0 to 4000 MVAR | $\pm 1.5\%$ FS for PF = -0.5 to 0.5 ① |
| VARs | 0 to 4000 MVAR | — |
| VAR-hours | 0 to 999.999 Mvarh | — |
| VA demand | 0 to 4000 MVA | $\pm 1\%$ FS ① |
| VA | 0 to 4000 MVA | — |
| VA-hours | 0 to 999,999 MVAh | — |
| Apparent power factor | -1 to +1 | ± 0.02 for load currents above 20% rated |
| Displacement power factor | -1 to +1 | ± 0.02 for load currents above 20% rated |
| Total harmonic distortion | 0 to 9999 | $\pm 1\%$ |
| Other metering accuracy | | $\pm 1\%$ |

Note

① FS (Full Scale) = 3 x CT Rating x Nominal L-N Voltage.

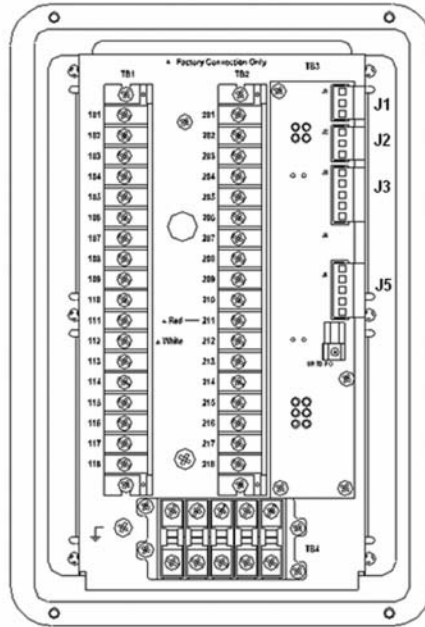
Wiring Diagrams

FP-6000 One-Line Drawing



FP-6000 Rear View and Terminal Designations

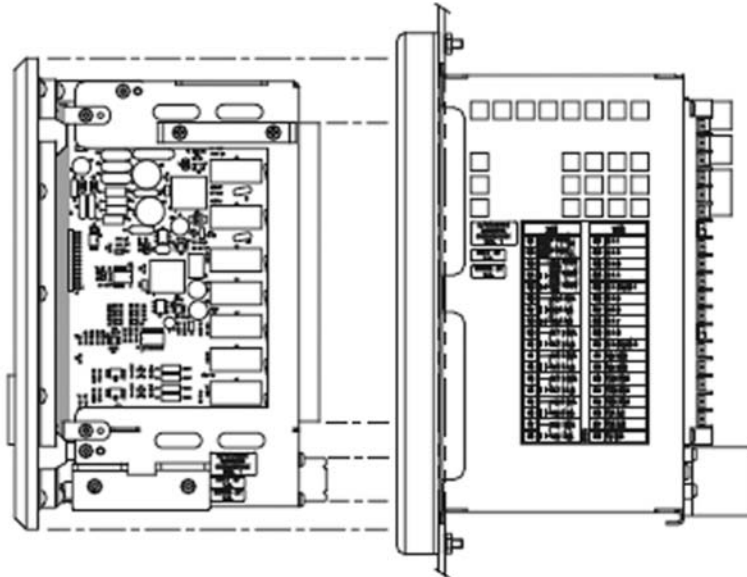
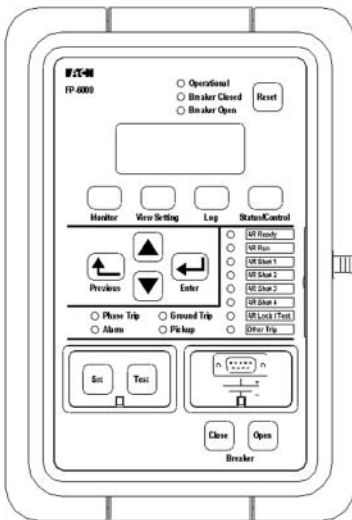
| TB1 | | TB2 | |
|-----|------------------------|-----|---------------|
| 101 | Power Supply Input (+) | 201 | C In 1 |
| 102 | Power Supply Input (-) | 202 | C In 2 |
| 103 | RLY Healthy Com. | 203 | C In 3 |
| 104 | RLY Healthy N.O. | 204 | C In 4 |
| 105 | RLY Healthy N.C. | 205 | C In Source 1 |
| 106 | Alarm Com. | 206 | C In 5 |
| 107 | Alarm N.O. | 207 | C In 6 |
| 108 | Alarm N.C. | 208 | C In 7 |
| 109 | RLY 5 Com. | 209 | C In 8 |
| 110 | RLY 5 N.O. | 210 | C In Source 2 |
| 111 | RLY 4 Com. | 211 | Not Used |
| 112 | RLY 4 N.O. | 212 | Not Used |
| 113 | RLY 3 Com. | 213 | VA(+) Main |
| 114 | RLY 3 N.O. | 214 | VB(+) Main |
| 115 | Trip 2 Com. | 215 | VC(+) Main |
| 116 | Trip 2 N.O. | 216 | Vx1 Aux |
| 117 | Trip 1 Com. | 217 | Vx2 Aux |
| 118 | Trip 1 N.O. | 218 | Vg Main |



| TB3 | |
|------|-----------------|
| J1-1 | PowerNet |
| J1-2 | PowerNet |
| J1-3 | PowerNet Shield |
| J3-1 | Zone Out |
| J3-2 | Zone Com. |
| J3-3 | Zone Shield |
| J3-4 | Zone In |
| J3-5 | Zone Com. |
| J4-1 | |
| J4-2 | |
| J4-3 | |
| J5-1 | RS485 (+) ① |
| J5-2 | RS485 (-) ① |
| J5-3 | RS485 Com. ① |
| J5-4 | RS485 Shield ① |

| | | | | |
|----|----|----|----|------|
| A1 | B1 | C1 | X1 | N.C. |
| A2 | B2 | C2 | X2 | N.C. |

FP-6000 Front View and Drawout Case Side View



Note

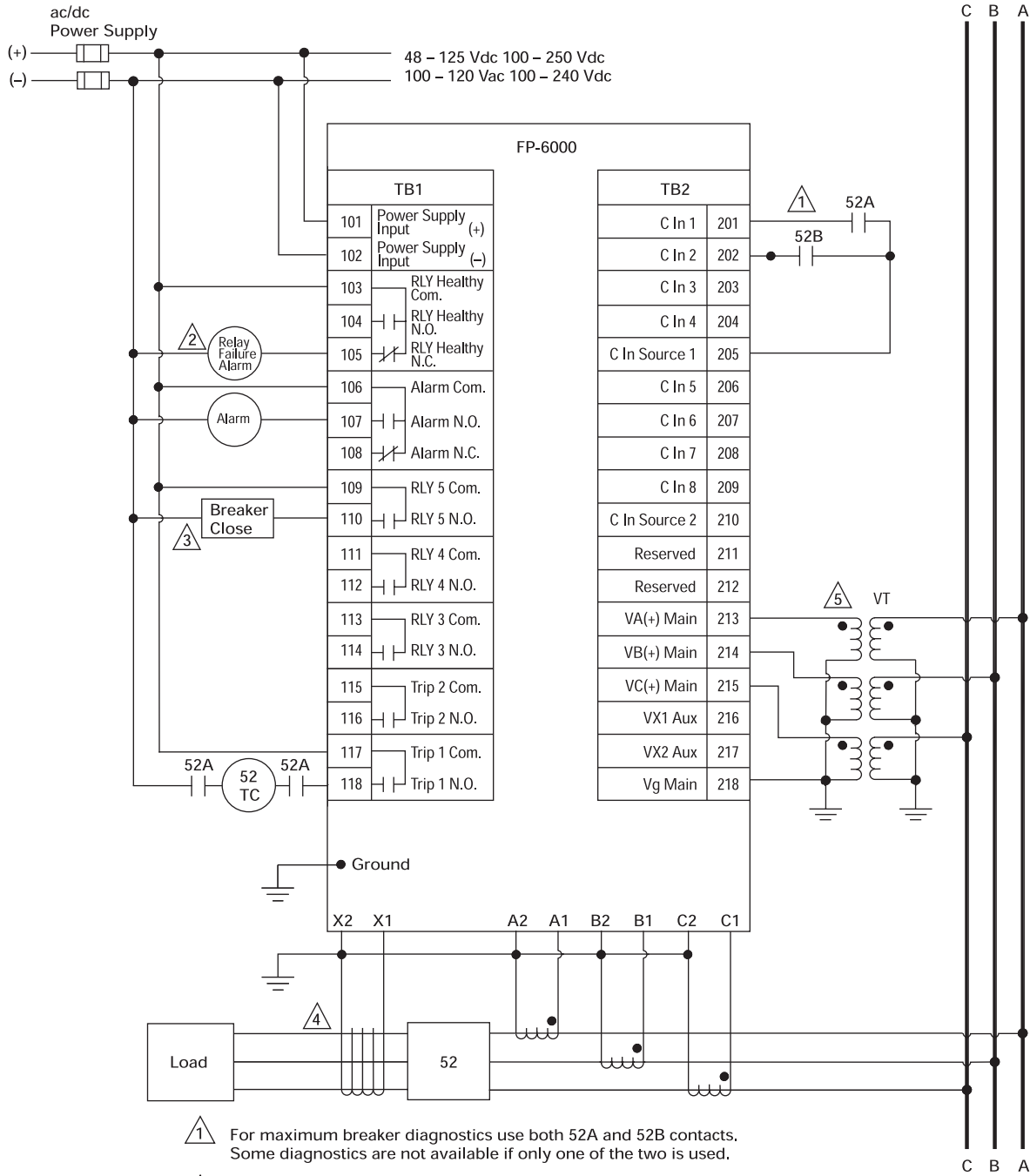
① Available with Modbus-RTU communications.

22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

FP-6000 Typical Connection Drawing Using Wye PTs



- 1 For maximum breaker diagnostics use both 52A and 52B contacts. Some diagnostics are not available if only one of the two is used.
- 2 A relay failure alarm should provide immediate attention as circuit is no longer protected. Relay failure output is normally energized.
- 3 FP-6000 can initiate a breaker close via the front panel interface and/or remote activation through communication or discrete input.
- 4 Residual connection may be used in place of zero sequence CT.
- 5 Delta or open delta PT connection may be used in place of wye-ground connection.

Dimensions

Approximate Dimensions in Inches (mm)

FP-6000 Feeder Protection Relay

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|--------------------------|--------------|--------------|-----------------------------|
| In Front of Panel | | | |
| 11.34 (288.0) | 7.72 (196.1) | 0.80 (20.3) | 12.5 (5.7) |
| Behind Panel | | | |
| 6.70 (170.2) | 5.30 (134.6) | 6.90 (175.3) | 12.5 (5.7) |

Feeder Protection FP-5000



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| DP-300 Current Differential Protection Relay | 345 |
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| Ground Fault Relay | 374 |
| Universal RTD Module | 378 |
| IQ 125 Volt DC Power Supply | 382 |

FP-5000 Feeder Protection

Product Description

- Microprocessor-based protection with monitoring and control for medium voltage main and feeder applications
- Current, voltage, frequency and power protection for electric power distribution systems
- Complete metering of voltage, currents, power, energy, minimum/maximum and demand functions
- Programmable logic control functions for main-tie-main transfer schemes
- Trip logs, event logs and waveform capture for better fault analysis and system restoration
- Data Logger to provide energy usage profiles for better planning, utilization and energy usage
- Compact, drawout case design
- Meets ANSI, CE and CSA standards
- Multiple settings groups
- ANSI, IEC and thermal protection curves for greater flexibility

Application Description

Eaton's FP-5000 Feeder Protection relay provides complete three-phase and ground overcurrent and voltage protection plus metering in a single, compact drawout case. It may be used as primary protection on feeders, mains and tie circuit breaker applications, and as backup protection for transformers, high voltage lines and differential protection. The relay is most commonly used on medium voltage switchgear applications.

The FP-5000 takes full advantage of its microprocessor technology providing the user new freedoms and a wealth of data-gathering features. The relay performs self-checking of all major hardware and firmware protection elements to ensure their operation in the event of a system or component electrical failure or fault. Protection functions are well suited for main and distribution feeder circuit applications. Programmable logic control functions make

the FP-5000 relay ideally suited for main-tie-main and main 1/main 2 transfer schemes.

The Zone Interlocking feature can be utilized for bus protection instead of an expensive and complicated bus differential (87B) scheme. The FP-5000 works directly with Eaton's Digitrip 3000 and Digitrip MV relays. New breaker failure logic provides faster remote backup clearing times for stuck breaker operation.

The multiple settings groups can be utilized for arc flash mitigation when an alternative setting group, set to have instantaneous elements only is activated using a selector switch and the programmable I/O in the FP-5000.

The FP-5000 provides trip and close circuit monitoring and alarming features. It continually monitors the complete trip and close circuits for continuity and readiness to trip. Open and close pushbuttons are

conveniently located on the front of the relay for local breaker operation.

Loss-of-vacuum monitoring is activated when the breaker is open. Residual current is monitored and alarmed if detected.

When an electrical fault or disturbance occurs, the FP-5000 begins to store the following in non-volatile memory:

- Voltage and current sampled data
- Calculated values
- Status of internal protection functions, logic, contact inputs and outputs

Retrieval and viewing of the data is easy, aiding in the quick analysis and restoration of your electric power system.

Features, Benefits and Functions

When the FP-5000 isn't responding to disturbances in the power system, it's providing valuable metering information at the relay and remotely. It provides energy usage and demand reading, and can alarm when usage reaches a set value. Power factor measurements can be used for cap bank switching to control kVAR demand. Onboard data trending can provide load profiles for up to 40 days.

The protection functions are listed below and shown on **Page 301**.

- Complete protection, metering and control in a single compact case to reduce panel space, wiring and costs
 - Flexible current, voltage and frequency protection and programmability to cover a broad range of applications while simplifying relay ordering and reducing inventory
 - Integral test function reduces maintenance time and expense
 - Relay self-diagnostics and reporting improves uptime and troubleshooting
 - Breaker trip circuit monitoring improves the reliability of the breaker operation
 - Programmable logic control features that can replace and eliminate external auxiliary relays, timers and wiring
 - Zone-selective interlocking improves coordination and tripping times and saves money compared to a traditional bus differential scheme
 - Trip and event recording in non-volatile memory provides detailed information for analysis and system restoration
 - 256 cycles of waveform capture aids in post fault analysis
 - Front RS-232 port and PowerPort software provides local computer access and a user-friendly, Windows®-based interface for relay settings, and configuration and data retrieval
 - Drawout case design for quick and easy relay removal and replacement
 - Breaker open/close control from relay faceplate or remotely via communications
 - Remote communications to Eaton's PowerNet monitoring system or PC
 - Free PowerPort utility software for local PC interface to the FP-5000 for relay settings, monitoring and control
- Phase Overcurrent (Forward, Reverse or Both)**
- Two-stage instantaneous with timers (50P-1 and 50P-2)
 - Two inverse time overcurrent (51P-1 and 51P-2)
 - Directional control
 - 10 standard curves
 - Instantaneous or time delay reset
 - Voltage restrained time overcurrent (51VR)
 - Two independent ground directional overcurrent elements, one measured (IX) and one calculated (IR)
 - Two-Stage instantaneous with timers (50X-1 and 50X-2) (50R-1 and 50R-2)
 - Inverse time overcurrent (51X and 51R)
 - Ground directional polarizing (67N) -3_{vo} , I_{pol} , negative sequence
 - 10 standard curves
 - Instantaneous or time delay reset
 - Voltage restrained time overcurrent (51VR)
 - 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/over-voltage (27A-1, 27A-2, 59A-1, 59A-2)
 - Under/over frequency (81U-1, 81U-2, 81O-1, 81O-2)
 - Reverse/forward power (32-1, 32-2)
 - Sync check (25)
 - Power factor (55)
 - Zone interlocking for bus protection (87B). The FP-5000 feeder relay includes a zone selective interlocking feature that can be used with other Eaton devices like the Digitrip 3000 overcurrent relay

The FP-5000 provides the following metering functions:

- Amperes (rms, phasor and sequence)
- Amperes demand and peak demand
- Volts (rms, phasor and sequence)
- VA and VA demand
- Watts and kW demand and peak demand
- Forward/reverse/net kWh
- VARs and kVAR demand and peak demand
- Lead/lag/net kVARh
- Power factor
- Frequency
- Voltage and current
- %THD and magnitude THD
- Minimum/maximum recording with date/time stamp
- Trending (load profile over time)

The FP-5000 provides the following monitoring and data recording functions that enhance the security of the protection system and provides useful information for scheduling maintenance:

- Trip circuit monitoring
- Close circuit monitoring
- Loss-of-vacuum monitoring
- Breaker wear (accumulated interrupted current)

- Waveform capture (256 cycles total, up to 16 events)
- Fault data logs (up to 16 events)
- Sequence of events report (up to 100 events)
- Clock

The FP-5000 provides standard control functions plus user-configurable custom control capabilities. This logic can be used for applications such as main-tie-main transfer schemes.

- Remote open/close
- Programmable I/O
- Programmable logic gates and timers
- Multiple setting groups (up to four)
- Bus transfer logic
- Cold load pickup
- Loss of potential (PT blown fuses)

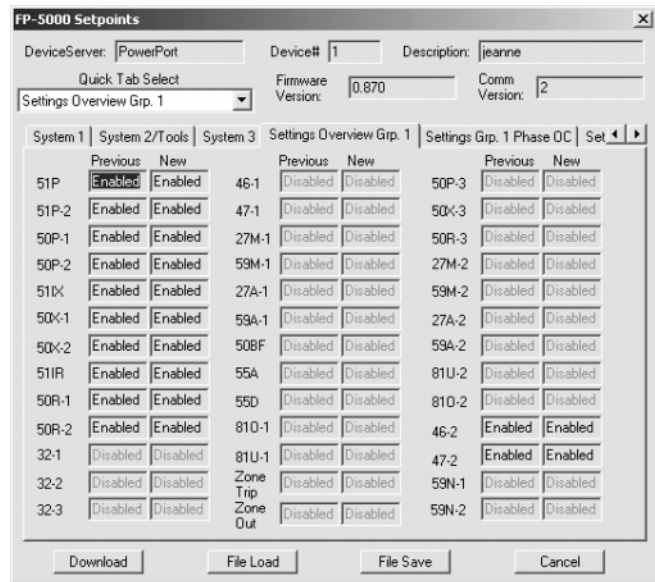
The FP-5000 supports the following communication options:

- Local HMI
- Password protected
- Addressable
- Local communication port
- Remote communication port:
 - FSK
 - RS-232
 - RS-485
- Protocols:
 - INCOM
 - Modbus
- Configuration software

Communication Software

Eaton provides two types of communication software. The first is PowerPort. It runs on a PC or laptop for easy access to a single relay to change set points or configuration and to view metered values and stored data. PowerPort is free and can be downloaded from www.eaton.com; search for 'PowerPort,' then click the download search result.

The second package is PowerNet. PowerNet is a power management software package that is designed for continuous, remote monitoring of many devices. It provides all the functionality of PowerPort plus additional functions such as billing, trending and graphics. Contact your local Eaton representative for more information on PowerNet software.



PowerPort and PowerNet Protection Overview Screen

Standards and Certifications

Compliance

- UL Recognized, File # E154862
- UL 1053 (1994) recognized
- ANSI C37.90 (1989)
- EN 55011 (1991)
- EN 61000-6-2 (1999)

Emission Tests

- EN 55011 (1991)—Group 1 Class A (CISPR-11, Class A)
- FCC 47 CFR Chapter 1—Part 15 Subpart b Class A

Immunity Tests

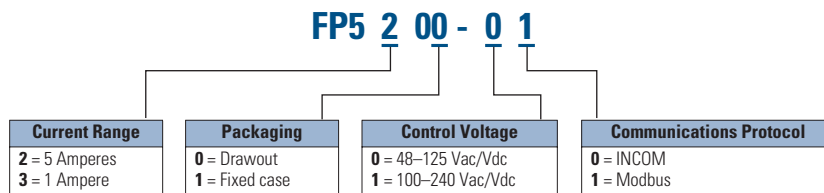
- ANSI C37.90.1 (1989)—Surge Withstand Capability
- ANSI C37.90.2 (1995)—EMI Immunity to 35V/m
- EN 61000-4-2 (1995)—ESD Rating of 8 kV
- EN 61000-4-3 (1997)—Radiated EM Field at 10V/m
- EN 61000-4-4 (1995)—Fast Transient Burst at 2 kV
- EN 61000-4-5 (1995)—Surge Immunity Test

- EN 61000-4-6 (1996)—Conducted RF at 10V/m
- EN 61000-4-11 (1994)—Voltage Dips and Variations
- EN 61000-4-8—Power Frequency Magnetic Field Immunity



Catalog Number Selection

FP-5000 Feeder Protection



Technical Data and Specifications**Control Power**

- Control voltage:
 - 48–125 Vac/Vdc
 - 100–240 Vac/Vdc
- Operating voltage:
 - 55–264 Vac
 - 38–300 Vdc
- Interruption ride-through time: 20 cycle interruption of nominal ac supply
- Power consumption: 20 VA maximum

Current Inputs

- Nominal (I_n): 1A or 5A
- CT rating:
 - $2 \times I_n$ continuous
 - $80 \times I_n$ for 1 second
- CT burdens:
 - < 0.25 VA at 5A (nominal)
 - < 0.05 VA at 1A (nominal)

Voltage Transformer Inputs

- Nominal: 120 Vac
- Operating range: 69–150 Vac
- Burden:
 - <0.015 at 120 Vac
 - 1 megaohm

Metering Accuracy

- Phase current:
 - $\pm 0.5\%$ or $\pm 0.025A$ from 0.02–20 per unit fully offset current waveform
- Ground current:
 - $\pm 0.5\%$ of full scale (I_n) from 0.02–2.0 per unit fully offset current waveform
- Phase voltage: $\pm 0.5\%$ or $\pm 0.2V$ from 0–160 Vac
- Frequency measurement accuracy: ± 0.02 Hz
- Phase angle: $\pm 1^\circ C$
- Power metering accuracy: $\pm 1.5\%$
- Metering accuracy temperature range: 32°F to 122°F (0°C to 50°C)
- Temperature range: $\pm 5\%$ for operation below 32°F (0°C) and above 122°F (50°C)
- Relay outputs:
 - 2 Form C, NO and NC
 - 5 Form A, NO only

- Input signal frequency necessary for accurate operation:
 - 60 Hz nominal, 57–63 Hz ($\pm 5\%$)
 - 50 Hz nominal, 47–53 Hz ($\pm 5\%$)
- Clock accuracy:
 - Free running ± 1 minute/month at 25°C
 - Clock automatically updated by PowerNet host when present

Protective Functions**Phase and Ground Overcurrent Protection**

- Inverse characteristics: Mod, Very, Extremely, IECA, IECB, IECC, It, I²t, I⁴t, Flat
- TOC (51) pickup range: 0.1–4.0 per unit in 0.01 steps
- Time multipliers: 0.05–10.0 in 0.01 steps
- IOC (50) pickup range: 0.1–20.0 per unit in 0.01 steps
- Pickup accuracy: $\pm 1\%$ (at 0.1–2 per unit)
- Time delay: 0–9999 cycles in 1 cycle steps
- Time accuracy: $\pm 3\%$ or ± 30 ms
- Directional (67, 67N, 67G): forward, reverse or both

Voltage Unbalance (47)

- Threshold (minimum voltage) 1–100 volts in 1 volt steps
- % V₂/V₁: 4–40% in 1% steps
- Time delay: 0–9999 cycles in 1 cycle steps

Current Unbalance

- Threshold (minimum current) 0.1–20.0 per unit in 0.01 steps
- % I₂/I₁: 4–40% in 1% steps
- Time delay: 0–9999 cycles in 1 cycle steps

Under/Overvoltage Protection

- Pickup range: 10–150 volts in 1 volt steps
- Time delay: 0–9999 cycles in 1 cycle steps

Under/Over Frequency Protection

- Pickup range: 45–65 Hz in 0.01 Hz steps
- Time delay: 0–9999 cycles in 1 cycle steps

Breaker Failure Protection

- Pickup range: 0.1–5.0 per unit in 0.01 steps
- Time delay: 0–9999 cycles in 1 cycle steps

Power Protection (32)

- Forward/reverse: over/under
- Pickup accuracy: $\pm 1.0\%$
- Trip time accuracy: 0 to 12 cycles or 0.1%, whichever is greater

Sync Check (25)

- Phase angle: 1 to 60°C
- Slip frequency: 0.1 to 2 Hz
- Voltage differential: 1 to 100 volts
- Breaker close time: 0 to 9999 cycles

Power Factor

- Trigger/reset threshold: 0.5 lag to 0.5 lead in 0.01 steps
- Time delay: 0–1000 seconds in 1 second steps

Discrete Inputs

- Number of contact inputs: 8
- Rating: 48 Vdc wetting voltage provided with internal ground only

Output Contacts

- Number of output contacts: Five Form A and two Form C

Rating of Output Contacts

- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc (resistive)
 - Break 5A at 120/240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc

Logic and Control Functions

- Six programmable logic gates for AND, OR, NAND, NOR operation
- Two latching (flip/flop) gates
- Six timer gates provide on/off delays

INCOM Communications

- Baud rate: 9600 fixed
- Maximum distance: 10,000 feet (3,048m)
- Protocol: INCOM

RS-485 Communications, Rear Panel

- Baud rate: 19.2K, 9.6K
- Protocol: Modbus RTU

RS-232 Communications, Front Panel

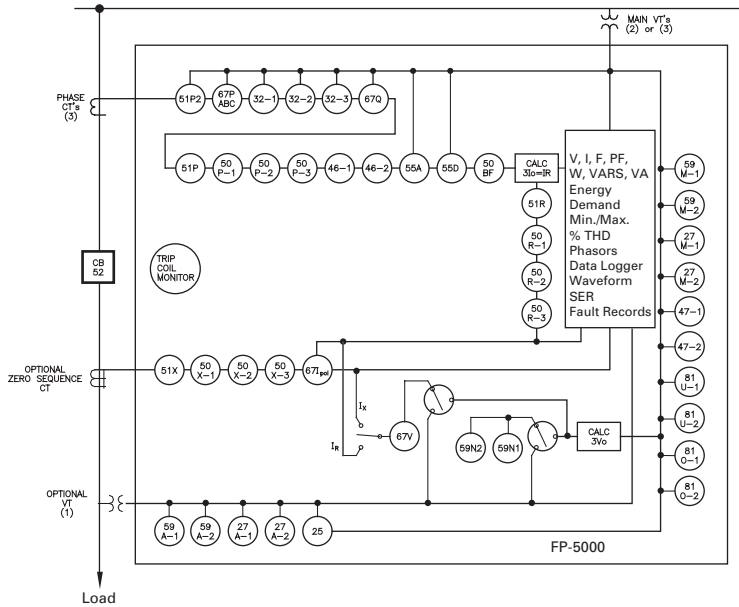
- Baud rate: 38.4K, 19.2K, 9.6K
- Connector standard 9-pin subminiature, three-wire
- Protocol: INCOM

Environmental Ratings

- Operating temperature: –0°F to +140°F (–40°C to +60°C) Product tested to +185°F (+85°C)
- Storage temperature: –40°F to +185°F (–40°C to +85°C)
- Humidity: 5–95% relative humidity (noncondensing)
- Altitude: 0–6350 feet (0–1935m) above Mean Sea Level

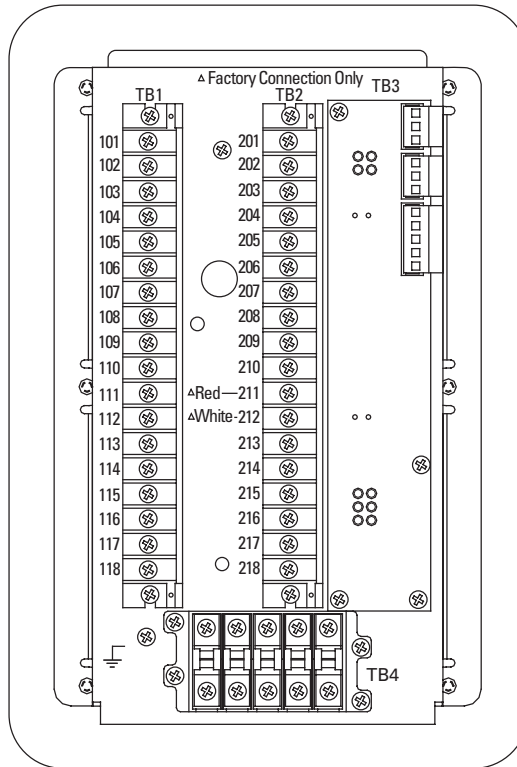
Wiring Diagrams

FP-5000 One-Line Drawing



FP-5000 Rear View and Terminal Designations

| TB1 | | TB2 | |
|-----|------------------------|-----|---------------|
| 101 | Power Supply Input (+) | 201 | C In 1 |
| 102 | Power Supply Input (-) | 202 | C In 2 |
| 103 | RLY Healthy Com. | 203 | C In 3 |
| 104 | RLY Healthy N.O. | 204 | C In 4 |
| 105 | RLY Healthy N.C. | 205 | C In Source 1 |
| 106 | Alarm Com. | 206 | C In 5 |
| 107 | Alarm N.O. | 207 | C In 6 |
| 108 | Alarm N.C. | 208 | C In 7 |
| 109 | RLY 5 Com. | 209 | C In 8 |
| 110 | RLY 5 N.O. | 210 | C In Source 2 |
| 111 | RLY 4 Com. | 211 | Not Used |
| 112 | RLY 4 N.O. | 212 | Not Used |
| 113 | RLY 3 Com. | 213 | VA(+) Main |
| 114 | RLY 3 N.O. | 214 | VB(+) Main |
| 115 | Trip 2 Com. | 215 | VC(+) Main |
| 116 | Trip 2 N.O. | 216 | Vx1 Aux |
| 117 | Trip 1 Com. | 217 | Vx2 Aux |
| 118 | Trip 1 N.O. | 218 | Vg Main |



| TB3 | |
|------|----------------------|
| J1-1 | PowerNet |
| J1-2 | PowerNet |
| J1-3 | PowerNet Shield |
| J2-1 | Accessory Bus |
| J2-2 | Accessory Bus |
| J2-3 | Accessory Bus Shield |
| J3-1 | Zone Out |
| J3-2 | Zone Com. |
| J3-3 | Zone Shield |
| J3-4 | Zone In |
| J3-5 | Zone Com. |
| J4-1 | |
| J4-2 | |
| J4-3 | |
| J5-1 | RS485(+) |
| J5-2 | RS485(-) |
| J5-3 | RS485com |
| J5-4 | RS485shield |

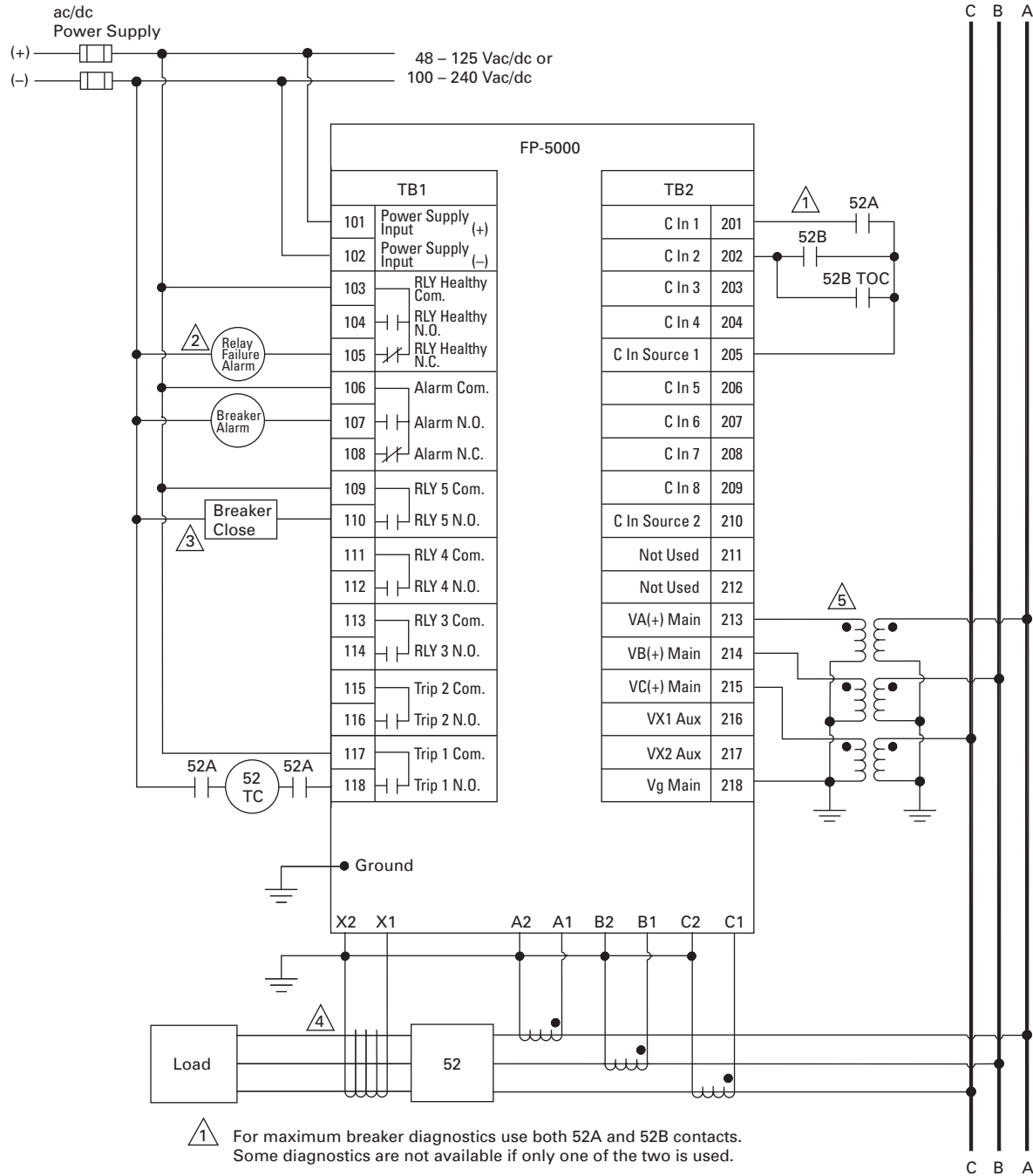
| | | | | |
|----|----|----|----|--------|
| A1 | B1 | C1 | X1 | N.C. 1 |
| A2 | B2 | C2 | X2 | N.C. 2 |

22.4

Metering Devices, Protective Relays, Software and Connectivity

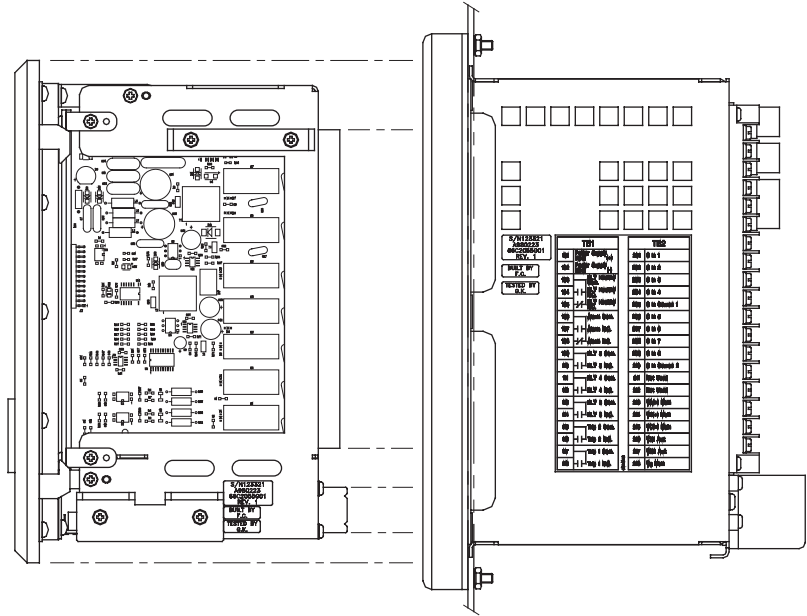
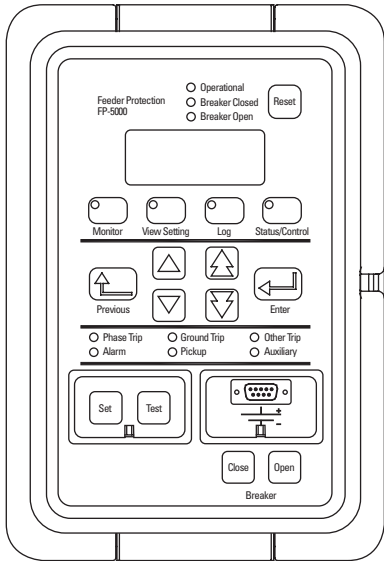
Protective Relays

FP-5000 Typical Connection Drawing Using Wye PTs



- 1 For maximum breaker diagnostics use both 52A and 52B contacts. Some diagnostics are not available if only one of the two is used.
- 2 A relay failure alarm should provide immediate attention as circuit is no longer protected. Relay failure output is normally energized.
- 3 FP-5000 can initiate a breaker close via the front panel interface and/or remote activation through communication or discrete input.
- 4 Residual connection may be used in place of zero sequence CT.
- 5 Delta or open delta PT connection may be used in place of wye-ground connection.

FP-5000 Front View and Drawout Case Side View



Dimensions

Approximate Dimensions in Inches (mm)

FP-5000 Feeder Protection Relay

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|--------------------------|--------------|--------------|-----------------------------|
| In Front of Panel | | | |
| 11.34 (288.0) | 7.72 (196.1) | 0.80 (20.3) | 12.5 (5.7) |
| Behind Panel | | | |
| 6.70 (170.2) | 5.30 (134.6) | 6.90 (175.3) | 12.5 (5.7) |

Feeder Protection FP-4000



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| Digitrip 3000 | 331 |
| VR-300 Multifunctional Voltage Relay | 341 |
| DP-300 Current Differential Protection Relay | 345 |
| EDR-3000 Feeder Protection | 350 |
| ETR-4000 Transformer Protection Relay | 361 |
| Ground Fault Relay | 374 |
| Universal RTD Module | 378 |
| IQ 125 Volt DC Power Supply | 382 |

FP-4000 Feeder Protection

Product Description

- Microprocessor-based protection with monitoring and control for medium voltage main and feeder applications
- Current, voltage, frequency and power protection for electric power distribution systems
- Complete metering of voltage, currents, power, energy, minimum/maximum and demand functions
- Programmable logic control functions for main-tie-main transfer schemes
- Trip logs, event logs and waveform capture for better fault analysis and system restoration
- Data logger to provide energy usage profiles for better planning, utilization and energy usage
- Compact, drawout case design
- Meets ANSI, CE and CSA standards
- Multiple settings groups
- ANSI, IEC and thermal protection curves for greater flexibility

Application Description

Eaton's FP-4000 Feeder Protection relay provides complete three-phase and ground overcurrent and voltage protection plus metering in a single, compact drawout case. It may be used as primary protection on feeders, mains and tie circuit breaker applications, and as backup protection for transformers, high voltage lines and differential protection. The relay is most commonly used on medium voltage switchgear applications.

The FP-4000 takes full advantage of its microprocessor technology providing the user new freedoms and a wealth of at-a-gathering features. The relay performs self-checking of all major hardware and firmware protection elements to ensure their operation in the event of a system or component electrical failure or fault. Protection functions are well suited for main and distribution feeder circuit applications. Programmable logic control functions make the FP-4000 relay ideally suited for main-tie-main and main 1/main 2 transfer schemes.

The Zone-Interlocking feature can be utilized for bus protection instead of an expensive and complicated bus differential (87B) scheme. The FP-4000 works directly with Eaton's Digitrip 3000 and Digitrip MV relays. New breaker failure logic provides faster remote backup clearing times for stuck breaker operation.

The multiple settings groups can be utilized for arc flash mitigation when an alternative setting group, set to have instantaneous elements only is activated using a selector switch and the programmable I/O in the FP-4000.

The FP-4000 provides trip and close circuit monitoring and alarming features. It continually monitors the complete trip and close circuits for continuity and readiness to trip. Open and close pushbuttons are conveniently located on the front of the relay for local breaker operation.

Loss-of-vacuum monitoring is activated when the breaker is open. Residual current is monitored and alarmed if detected.

When an electrical fault or disturbance occurs, the FP-4000 begins to store the following in non-volatile memory:

- Voltage and current sampled data
- Calculated values
- Status of internal protection functions, logic, contact inputs and outputs

Retrieval and viewing of the data is easy, aiding in the quick analysis and restoration of your electric power system.

Features, Benefits and Functions

When the FP-4000 isn't responding to disturbances in the power system, it's providing valuable metering information at the relay and remotely. It provides energy usage and demand reading, and can alarm when usage reaches a set value. Power factor measurements can be used for cap bank switching to control kVAR demand. Onboard data trending can provide load profiles for up to 40 days.

- Complete protection, metering and control in a single compact case to reduce panel space, wiring and costs
- Flexible current, voltage and frequency protection and programmability to cover a broad range of applications while simplifying relay ordering and reducing inventory
- Integral test function reduces maintenance time and expense
- Relay self-diagnostics and reporting improves uptime and troubleshooting
- Breaker trip circuit monitoring improves the reliability of the breaker operation
- Programmable logic control features that can replace and eliminate external auxiliary relays, timers and wiring
- Zone selective interlocking improves coordination and tripping times and saves money compared to a traditional bus differential scheme
- Trip and event recording in non-volatile memory provides detailed information for analysis and system restoration
- 256 cycles of waveform capture aids in post fault analysis
- Front RS-232 port and PowerPort software provides local computer access and a user-friendly, Windows®-based interface for relay settings, and configuration and data retrieval
- Breaker open/close control from relay faceplate or remotely via communications
- Remote communications to Eaton PowerNet monitoring system or PC
- Free PowerPort utility software for local PC interface to the FP-4000 for relay settings, monitoring and control

The protection functions are listed below and shown on **Page 309**.

Phase Overcurrent

- Two-stage instantaneous with timers (50P-1 and 50P-2)
- Inverse time overcurrent (51P-1)
- 10 standard curves
- Instantaneous or time delay reset
- Two independent directional overcurrent elements, one measured (IX) and one calculated (IR)
 - Two-stage instantaneous with timers (50X-1 and 50X-2) (50R-1 and 50R-2)
 - Inverse time overcurrent (51X and 51R)
 - 10 standard curves
 - Instantaneous or time delay reset
- 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)
- Under/overfrequency (81U-1, 81U-2, 81O-1, 81O-2)
- Power factor (55)
- Zone interlocking for bus protection (87B). The FP-4000 feeder relay includes a zone selective interlocking feature that can be used with other Eaton devices like the Digitrip 3000 overcurrent relay

The FP-4000 provides the following metering functions:

- Amperes (rms, phasor and sequence)
- Amperes demand and peak demand
- Volts (rms, phasor and sequence)
- VA and VA demand
- Watts and kW demand and peak demand
- Forward/reverse/net kWh
- VARs and kVAR demand and peak demand
- Lead/lag/net kVARh
- Power factor
- Frequency
- Voltage and current
- %THD and magnitude THD
- Minimum/maximum recording with date/time stamp
- Trending (load profile over time)

The FP-4000 provides the following monitoring and data recording functions that enhance the security of the protection system and provides useful information for scheduling maintenance:

- Trip circuit monitoring
- Close circuit monitoring
- Loss-of-vacuum monitoring
- Breaker wear (accumulated interrupted current)

- Waveform capture (256 cycles total, up to 16 events)
- Fault data logs (up to 16 events)
- Sequence of events report (up to 100 events)
- Clock

The FP-4000 provides standard control functions plus user-configurable custom control capabilities. This logic can be used for applications such as main-tie-main transfer schemes.

- Remote open/close
- Programmable I/O
- Programmable logic gates and timers
- Multiple setting groups (up to four)
- Bus transfer logic

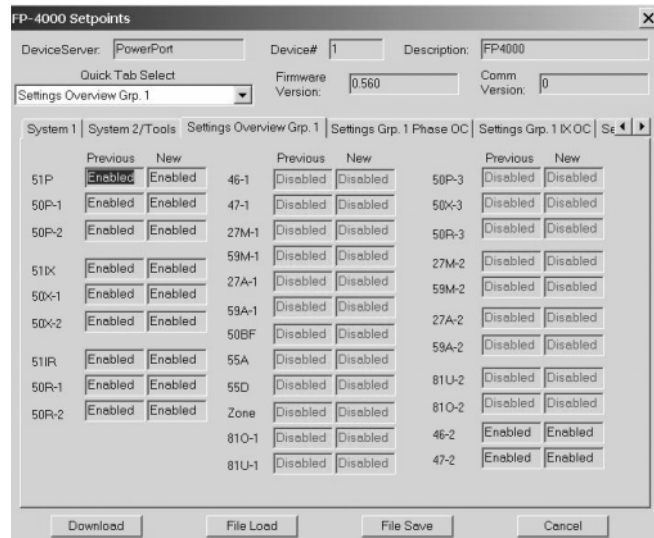
The FP-4000 supports the following communication options:

- Local HMI
- Password protected
- Addressable
- Local communication port
- Remote communication port:
 - FSK
 - RS-232
 - RS-485
- Protocols:
 - INCOM
 - Modbus
- Configuration software

Communication Software

Eaton provides two types of communication software. The first is PowerPort. It runs on a PC or laptop for easy access to a single relay to change set points or configuration and to view metered values and stored data. PowerPort is free and can be downloaded from www.eaton.com; search for 'PowerPort,' then click the download search result.

The second package is PowerNet. PowerNet is a power management software package that is designed for continuous, remote monitoring of many devices. It provides all the functionality of PowerPort plus additional functions such as billing, trending and graphics. Contact your local Eaton representative for more information on PowerNet software.



PowerPort and PowerNet Protection Overview Screen

Standards and Certifications

Compliance

- UL Recognized, File # E154862
- UL 1053 (1994) recognized
- ANSI C37.90 (1989)
- EN 55011 (1991)
- EN 61000-6-2 (1999)

Emission Tests

- EN 55011 (1991)—Group 1 Class A (CISPR-11, Class A)
- FCC 47 CFR Chapter 1—Part 15 Subpart b Class A

Immunity Tests

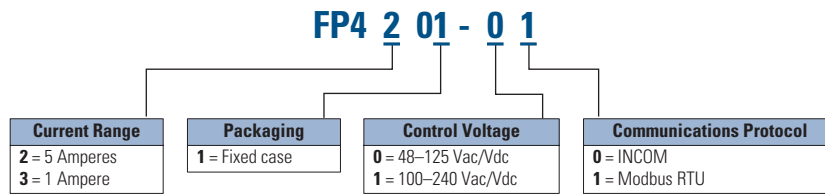
- ANSI C37.90.1 (1989)—Surge Withstand Capability
- ANSI C37.90.2 (1995)—EMI Immunity to 35V/m.
- EN 61000-4-2 (1995)—ESD Rating of 8 kV
- EN 61000-4-3 (1997)—Radiated EM Field at 10V/m
- EN 61000-4-4 (1995)—Fast Transient Burst at 2 kV
- EN 61000-4-5 (1995)—Surge Immunity Test
- EN 61000-4-6 (1996)—Conducted RF at 10V/m

- EN 61000-4-11 (1994)—Voltage Dips and Variations
- EN 61000-4-8—Power Frequency Magnetic Field Immunity



Catalog Number Selection

FP-4000 Feeder Protection



Technical Data and Specifications

Control Power

- Control voltage:
 - 48–125 Vac/dc
 - 100–240 Vac/dc
- Operating voltage:
 - 55–264 Vac
 - 38–300 Vdc
- Interruption ride-through time: 20 cycle interruption of nominal ac supply
- Power consumption: 20 VA maximum

Current Inputs

- Nominal (I_n): 1A or 5A
- CT rating:
 - $2 \times I_n$ continuous
 - $80 \times I_n$ for 1 second
- CT burdens:
 - < 0.25 VA at 5A (nominal)
 - < 0.05 VA at 1A (nominal)

Voltage Transformer Inputs

- Nominal: 120 Vac
- Operating range: 69–150 Vac
- Burden:
 - <0.015 at 120 Vac
 - 1 megaohm

Metering Accuracy

- Phase current:
 - $\pm 0.5\%$ or $\pm 0.025A$ from 0.02–20 per unit fully offset current waveform
- Ground current:
 - $\pm 0.5\%$ of full scale (I_n) from 0.02–2.0 per unit fully offset current waveform
- Phase voltage: $\pm 0.5\%$ or $\pm 0.2V$ from 0–160 Vac
- Frequency measurement accuracy: ± 0.02 Hz
- Phase angle: $\pm 1^\circ C$
- Power metering accuracy: $\pm 1.5\%$
- Metering accuracy temperature range: 32°F to 122°F (0°C to 50°C)
- Temperature range: $\pm 5\%$ for operation below 32°F (0°C) and above 122°F (50°C)
- Relay outputs:
 - 2 Form C, NO and NC
 - 5 Form A, NO Only

- Input signal frequency necessary for accurate operation:
 - 60 Hz nominal, 57–63 Hz ($\pm 5\%$)
 - 50 Hz nominal, 47–53 Hz ($\pm 5\%$)
- Clock accuracy:
 - Free running ± 1 minute/month at 77°F (25°C)
 - Clock automatically updated by PowerNet host when present

Protective Functions

Phase and Ground Overcurrent Protection

- Inverse characteristics: Mod, Very, Extremely, IECA, IECB, IECC, It, I²t, I⁴t, Flat
- TOC (51) pickup range: 0.1–4.0 per unit in 0.01 steps
- Time multipliers: 0.05–10.0 in 0.01 steps
- IOC (50) pickup range: 0.1–20.0 per unit in 0.01 steps
- Pickup accuracy: $\pm 1\%$ (at 0.1–2 per unit)
- Time delay: 0–9999 cycles in 1 cycle steps
- Time accuracy: $\pm 3\%$ or ± 30 ms

Voltage Unbalance (47)

- Threshold (minimum voltage) 1–100 volts in 1 volt steps
- % V_2/V_1 : 4–40% in 1% steps
- Time delay: 0–9999 cycles in 1 cycle steps

Current Unbalance

- Threshold (minimum current) 0.1–20.0 per unit in 0.01 steps
- % I_2/I_1 : 4–40% in 1% steps
- Time delay: 0–9999 cycles in 1 cycle steps

Under/Overvoltage Protection

- Pickup range: 10–150 volts in 1 volt steps
- Time delay: 0–9999 cycles in 1 cycle steps

Under/Overfrequency Protection

- Pickup range: 45–65 Hz in 0.01 Hz steps
- Time delay: 0–9999 cycles in 1 cycle steps

Breaker Failure Protection

- Pickup range: 0.1–5.0 per unit in 0.01 steps
- Time delay: 0–9999 cycles in 1 cycle steps

Power Factor

- Trigger/reset threshold: 0.5 lag to 0.5 lead in 0.01 steps
- Time delay: 0–1000 seconds in 1 second steps

Discrete Inputs

- Number of contact inputs: 8
- Rating: 48 Vdc wetting voltage provided with internal ground only

Output Contacts

- Number of output contacts: Five Form A and two Form C

Rating of Output Contacts

- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc (resistive)
 - Break 5A at 120/240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc
 - Logic and Control Functions
- Six programmable logic gates for AND, OR, NAND, NOR operation
- Two latching (flip/flop) gates
- Six timer gates provide on/off delays

INCOM Communications

- Baud rate: 9600 fixed
- Maximum distance: 10,000 feet (3048 m)
- Protocol: INCOM

RS-485 Communications, Rear Panel:

- Baud rate: 19.2K, 9.6K
- Protocol: Modbus RTU

RS-232 Communications, Front Panel

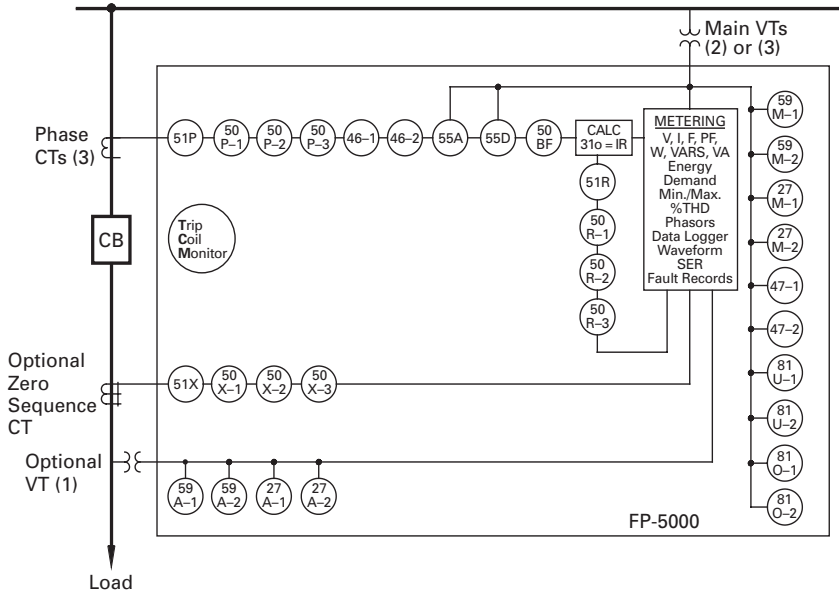
- Baud rate: 38.4K, 19.2K, 9.6K
- Connector standard 9-pin subminiature, three-wire
- Protocol: INCOM

Environmental Ratings

- Operating temperature: –40°F to +140°F (–40°C to +60°C) Product tested to +185°F (+85°C)
- Storage temperature: –40°F to +185°F (–40°C to +85°C)
- Humidity: 5–95% relative humidity (noncondensing)
- Altitude: 0–6350 feet (0–1935m) above Mean Sea Level

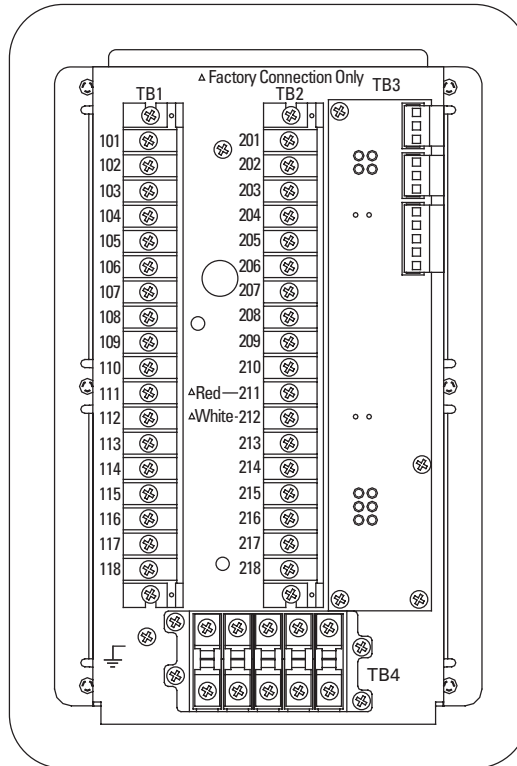
Wiring Diagrams

FP-4000 One-Line Drawing



FP-4000 Rear View and Terminal Designations

| TB1 | | TB2 | |
|-----|------------------------|-----|---------------|
| 101 | Power Supply Input (+) | 201 | C In 1 |
| 102 | Power Supply Input (-) | 202 | C In 2 |
| 103 | RLY Healthy Com. | 203 | C In 3 |
| 104 | RLY Healthy N.O. | 204 | C In 4 |
| 105 | RLY Healthy N.C. | 205 | C In Source 1 |
| 106 | Alarm Com. | 206 | C In 5 |
| 107 | Alarm N.O. | 207 | C In 6 |
| 108 | Alarm N.C. | 208 | C In 7 |
| 109 | RLY 5 Com. | 209 | C In 8 |
| 110 | RLY 5 N.O. | 210 | C In Source 2 |
| 111 | RLY 4 Com. | 211 | Not Used |
| 112 | RLY 4 N.O. | 212 | Not Used |
| 113 | RLY 3 Com. | 213 | VA(+) Main |
| 114 | RLY 3 N.O. | 214 | VB(+) Main |
| 115 | Trip 2 Com. | 215 | VC(+) Main |
| 116 | Trip 2 N.O. | 216 | Vx1 Aux |
| 117 | Trip 1 Com. | 217 | Vx2 Aux |
| 118 | Trip 1 N.O. | 218 | Vg Main |



| TB3 | |
|------|----------------------|
| J1-1 | PowerNet |
| J1-2 | PowerNet |
| J1-3 | PowerNet Shield |
| J2-1 | Accessory Bus |
| J2-2 | Accessory Bus |
| J2-3 | Accessory Bus Shield |
| J3-1 | Zone Out |
| J3-2 | Zone Com. |
| J3-3 | Zone Shield |
| J3-4 | Zone In |
| J3-5 | Zone Com. |
| J4-1 | |
| J4-2 | |
| J4-3 | |
| J5-1 | RS485(+) |
| J5-2 | RS485(-) |
| J5-3 | RS485com |
| J5-4 | RS485shield |

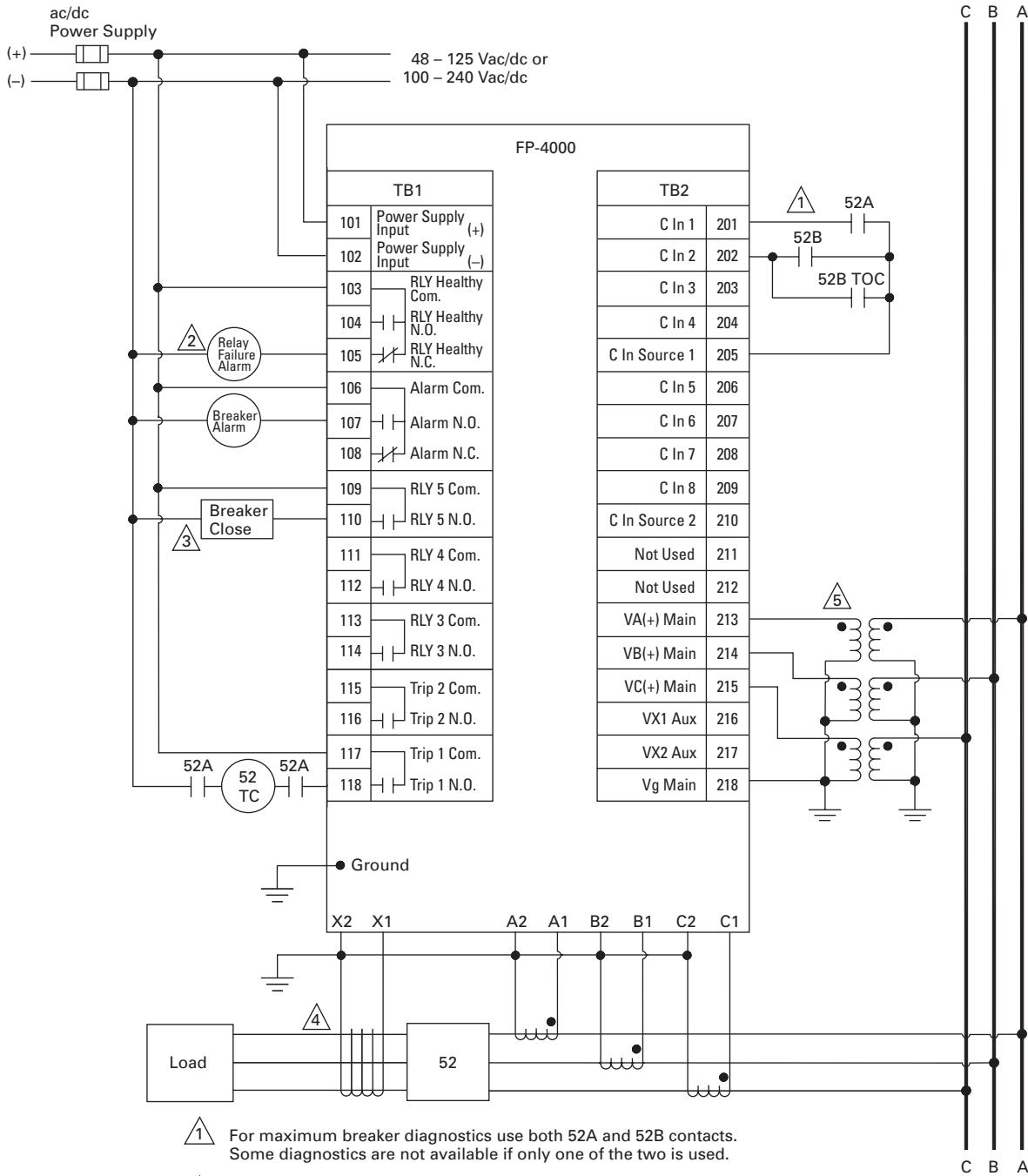
| | | | | |
|----|----|----|----|--------|
| A1 | B1 | C1 | X1 | N.C. 1 |
| A2 | B2 | C2 | X2 | N.C. 2 |

22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

FP-4000 Typical Connection Drawing Using Wye PTs



- 1 For maximum breaker diagnostics use both 52A and 52B contacts. Some diagnostics are not available if only one of the two is used.
- 2 A relay failure alarm should provide immediate attention as circuit is no longer protected. Relay failure output is normally energized.
- 3 FP-4000 can initiate a breaker close via the front panel interface and/or remote activation through communication or discrete input.
- 4 Residual connection may be used in place of zero sequence CT.
- 5 Delta or open delta PT connection may be used in place of wye-ground connection.

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Dimensions

Approximate Dimensions in Inches (mm)

FP-4000 Feeder Protection Relay

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|--------------------------|--------------|--------------|-----------------------------|
| In Front of Panel | | | |
| 10.15 (257.9) | 7.62 (193.5) | 0.62 (15.7) | 9.0 (4.1) |
| Behind Panel | | | |
| 10.15 (257.9) | 7.62 (193.5) | 7.48 (190.0) | 9.0 (4.1) |

MP-3000



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Contents

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| MP-3000 Motor Protection | |
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MP-3000 Motor Protection

Product Description

- Microprocessor-based, multi-function motor protection
- Current only device—no need to add PTs
- Intel-I-Trip™ overload protection based on motor data
- Event recording and operational logging
- Motor Start Profile™
- Optional Quick Release Drawout Case
- Used on AMPGARD® and medium voltage assemblies
- “Help” menu provides user operational assistance

Application Description

Eaton’s MP-3000 motor protection relay is a multifunctional microprocessor-based protective relay for the protection of three-phase AC motors. The MP-3000 motor relay may be applied to any size motor at any voltage level. It is most commonly used on large, medium voltage three-phase induction motors. It has also been widely used on important low voltage (480 volt) motor applications and synchronous motors.

The MP-3000 motor relay is a current only device that monitors three-phase and ground currents. It provides motor overload, stall, short circuit, phase unbalance, single phasing and ground fault motor protection.

It can also be used to provide protection for a load jam or loss of load condition. Please refer to **Page 316**.

The MP-3000 motor relay provides start control logic to protect the motor against excessive starts or starting the motor before it has had sufficient time to cool down. The MP-3000 motor relay may be applied to either across the line starters or reduced voltage starters. On reduced voltage starters, the MP-3000 relay can control the switch from reduced voltage to full voltage based on time and/or motor transition. The MP-3000 can protect the starter against failure to transition to full voltage through contact feedback and an incomplete sequence function.

The MP-3000 motor relay is generally used on a motor starter or a breaker used for a motor load. The MP-3000 motor relay provides the intelligence to protect and control the motor against abnormal operating conditions. It monitors the currents from either a 5A or 1A secondary of a CT circuit. Ground current may be obtained from either a ground CT or from the residual connection of the phase CTs. It provides a Form C contact output for controlling the starter contacts or breaker operation.

Features, Benefits and Functions

- Complete motor protection and control in a single compact case reduces panel space requirements and wiring costs
- Microprocessor design with self diagnostics eliminates calibration and reduces installation, commissioning and maintenance
- Programmable stop 2–20% of PCT
- Intel-I-Trip overload protection develops customized curve from manufacturer's supplied motor data
- Intel-I-Trip overload protection provides adaptive trip characteristics based on motor temperature when motor RTDs are connected through an optional URTD module
- Meets UL 1053 ground fault protection standards that eliminates the need for a separate ground relay saving cost, space, wiring and time
- Voltage dip/loss ride through capability reduces unnecessary trips caused by poor power quality
- Motor currents, temperatures and conditions are monitored and displayed either locally or remotely
- Event log provides motor operating records for the most recent 20 Trip or Alarm events with date and time stamping. This information can improve troubleshooting and reduce downtime
- Log book records the most recent 100 events such as motor START/STOP and set point changes to provide a log of motor operation with date and time stamping
- RTD diagnostics reduces unnecessary tripping caused by faulty RTD, RTD wiring or communications
- Arm/Disarm feature improves security for critical motor applications
- Motor Start profile verifies protection and motor starting coordination. This feature can be used to develop protection settings on old motors where data is not available
- Optional communication module and Eaton's software simplifies setting, configuration, monitoring, commissioning and data retrieval either locally or remotely
- Optional Quick Release Drawout Case construction simplifies relay removal and replacement

The protection functions are listed below.

- I²t overload protection (49/51)
- Locked rotor (49S/51)
- Ultimate trip current (51)
- Negative sequence phase unbalance (46)
- Instantaneous overcurrent (50)
- Ground fault protection (50G)
- RTD trip and alarm with URTD module (49/38)
- Underload trip (37)
- Starts per time (66)
- Jam or stall (51R)
- Auto or manual reset (86)
- Fail-safe or non-fail-safe trip modes

The metering functions are:

- Motor currents:
 - Average current (I_{ave})
 - Individual phase and ground current in primary amperes
 - Percent of full load
 - Percent of phase unbalance
- RTD temperatures:
 - Individual winding
 - Motor bearing
 - Load
 - Auxiliary temperatures
- Motor conditions:
 - Percent of I²t thermal bucket
 - Time before start
 - Remaining starts allowed
 - Oldest start time

Standards and Certifications

The MP-3000 motor protection was designed to meet the industry standards for protective relays. It is recognized under UL 1053 Ground Fault Protection Standard.

- UL recognized (File No. E154862)
- UL 1053 recognized
- UL 508 recognized
- ANSI C37.90, C37.90.1
- cUL
- CSA



Product Selection

MP-3000



MP-3000

| Description | Catalog Number |
|---|----------------|
| MP-3000 Drawout, 5A with RS-232 | MP3011 |
| MP-3000 Drawout, INCOM, 5A with RS-232 | MP3012 |
| MP-3000 Drawout, Modbus, 5A with RS-232 | MP3013 |
| MP-3000 Drawout, DeviceNet, 5A with RS-232 | MP3014 |
| MP-3000 Drawout, 1A with RS-232 | MP3111 |
| MP-3000 Drawout, INCOM, 1A with RS-232 | MP3112 |
| MP-3000 Drawout, Modbus, 1A with RS-232 | MP3113 |
| MP-3000 Drawout, DeviceNet, 1A with RS-232 | MP3114 |
| MP-3000 Fixed Case, 5A with RS-232 | MP3010 |
| MP-3000 Fixed Case, INCOM, 5A with RS-232 | MP3010-INCOM |
| MP-3000 Fixed Case, Modbus, 5A with RS-232 | MP3010MODBUS |
| MP-3000 Fixed Case, DeviceNet, 5A with RS-232 | MP3010DEVICEN |
| MP-3000 Fixed Case, 1A with RS-232 | MP3110 |
| MP-3000 Fixed Case, INCOM, 1A with RS-232 | MP3110-INCOM |
| MP-3000 Fixed Case, Modbus, 1A with RS-232 | MP3110MODBUS |
| MP-3000 Fixed Case, DeviceNet, 1A with RS-232 | MP3110DEVICEN |
| MP-3000 Fixed Case, INCOM, 5A with RS-232, URTD | MP3010VPI |
| MP-3000 Fixed Case, Modbus, 5A with RS-232, URTD | MP3010VPM |
| MP-3000 Fixed Case, DeviceNet, 5A with RS-232, URTD | MP3010VPD |
| MP-3000 Fixed Case, INCOM, 1A with RS-232, URTD | MP3110VPI |
| MP-3000 Fixed Case, Modbus, 1A with RS-232, URTD | MP3110VPM |
| MP-3000 Fixed Case, DeviceNet, 1A with RS-232, URTD | MP3110VPD |

Options and Accessories

Additional Related Products by Eaton Corporation's Cutler-Hammer® Series

The MP-3000 is available in either a fixed mount or Quick Release Drawout Case. Both mountings use the same panel cutout. **Page 319** shows cutout dimensions. **Page 316** shows a typical fixed mount wiring diagram for a medium voltage motor starter application. **Page 317** shows the fixed mount terminal designation. **Page 319** shows the drawout case panel mounting, and shows the drawout case terminal designation.

The Universal RTD module (URTD) is required when the motor is equipped with RTDs that you wish to monitor and use for protection. The URTD can be mounted near the motor to reduce RTD wiring and costs. **Page 318** shows MP-3000 and URTD inter-connection wiring. Please refer to the URTD information described elsewhere in this catalog.

The MP-3000 motor protection is designed to operate from 120 Vac or 240 Vac auxiliary control power. The MP-3000 motor relay can be used with DC control power with the addition of the IQDCPS. The IQDCPS is an inverter from DC to AC.

Technical Data and Specifications
Control Power

- Nominal rating:
 - 120 Vac or 240 Vac
 - +10%, -25%
- Operating range:
 - 120 Vac: 90 132 Vac
 - 240 Vac: 180 264 Vac
- Frequency: 50 or 60 Hz
- Power use:
 - 20 VA maximum
 - URTD: 6 VA maximum
 - IPONI: 1 VA maximum
- Ride-through time: 30 cycles from nominal Vac

Current Inputs

- Nominal (I_n): 1A or 5A
- CT rating:
 - 2 x I_n continuous
 - 50 x I_n for 1 second
- Burdens:
 - < 0.25 VA at 5A
 - < 0.05 VA at 1A

Metering Accuracy

- Phase current: $\pm 1\%$ of I_n (5–100%)
- Ground current: $\pm 1.5\%$ of I_n (0–55%)

Discrete Inputs

- Number of inputs: two programmable
- Ratings:
 - 1.2 VA at 120 Vac
 - Maximum off = 36 Vac
 - Minimum on = 86 Vac

Output Contacts

- Number of outputs: four Form C, programmable
- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc (resistive)
 - Break 5A at 120 240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc

Analog Output

- Rating: ± 4 –20 mA programmable
- Maximum load: 1K ohm
- Accuracy: 1%

Motor Overload Protection (I^2t)

- Full load amperes: 10–3000A
- Locked rotor current: 300–1200% FLA
- Locked rotor time: 1–120 seconds
- Ultimate trip current: 85–150% FLA
- Phase CT ratio: 10–4000 (I_n)
- Ground CT ratio: 10–4000 (I_n)
- Timing accuracy: $\pm 2.5\%$ or ± 30 mS for $I > 1.1x$ U.T.C

Trip Setting Range

- Ground fault (GF): Off, 2–55% CT ratio
- GF start time delay: 2–60 cycles
- GF run time delay: 0–60 cycles
- Timer accuracy: ± 20 mS
- Instantaneous O.C.: Off, 300–1600% FLA
- IOC start time delay: 2–60 cycles
- Timer accuracy: ± 20 mS
- JAM trip: Off, 100–1200% FLA
- Underload trip: Off, 1–90% FLA
- Phase unbalance trip: Off, 4–40% I_{neg}/I_{pos}
- Start delay timers:
 - 0–120 seconds (underload and phase unbalance)
 - 0–1200 seconds (jam)
- Run delay timers: 0–240 seconds
- Timer accuracy: $\pm 0.5\%$ +100 mS

Alarm Setting Range

- Ground fault: Off, 2–55% CT ratio
- Overload I^2t : Off, 60–99% I^2t
- JAM: Off, 100–1200% FLA
- Underload: Off, 1–90% FLA
- Phase unbalance: Off, 4–40% I_{neg}/I_{pos}
- Run delay timers: 0–240 seconds

Start Control Functions

- Starts per time: 1–10 starts
- Time for starts per time: Off, 1–240 minutes
- Time between starts: Off, 1–240 minutes
- Number of cold starts: 1–5 starts
- Motor transition current: 10–300% FLA
- Time for transition: 0–1200 seconds
- Inc. sequence timer: Off, 1–240 seconds
- Long acceleration timer: Off, 1–1200 seconds
- Anti-Backspin timer: Off, 1–3600 minutes

RTD Inputs (Requires URTD module)

- Sensor types:
 - 10 ohm copper
 - 100 ohm nickel
 - 120 ohm nickel
 - 100 ohm platinum

URTD Module Communications

- Interface:
 - Electrical (three-wire)
 - Fiber optic (preferred)
- Fiber optic cable: Type HBFR-ERS or EUS

Clock

- Accuracy: ± 1 minute/month at 77°F (25°C)

IPONI Communications

- Type: two-wire, FSK
- Baud rate: 1200 or 9600 baud
- Protocol: INCOM
- Functions:
 - Read/write set points
 - Read metered values
 - Read trip/alarms
 - Read events/history
 - View starting profile

MPONI Communications

- Type: 5-wire, 485
- Baud rate: 1200 or 9600 baud
- Protocol: Modbus RTU
- Functions:
 - Read/write set points
 - Read metered values
 - Read trip/alarms
 - Read events/history
 - View starting profile

DPONI Communications

- Type: J-wire
- Baud rate: 500k, 250k, 125k
- Protocol: DeviceNet
- Functions:
 - Read metered values
 - Read trip/alarms

Logging

- Log book: 100 events
- Log event: 20 trips and alarms
- Log start: last four starts
- Start profile: last four starts (communication only)
- History records: motor, trips, alarms and total records

Environmental Conditions

- Operating temperature: -4°F to 140°F (-20°C to +60°C)
- Storage temperature: -49°F to +185°F (-45°C to +85°C)
 - Humidity: 0–95% noncondensing

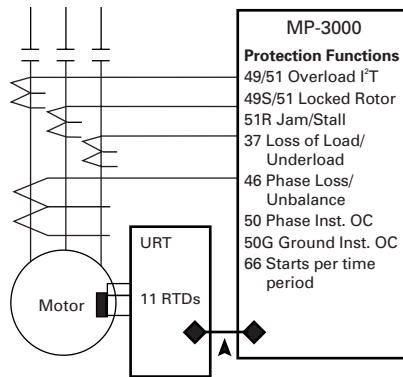
22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

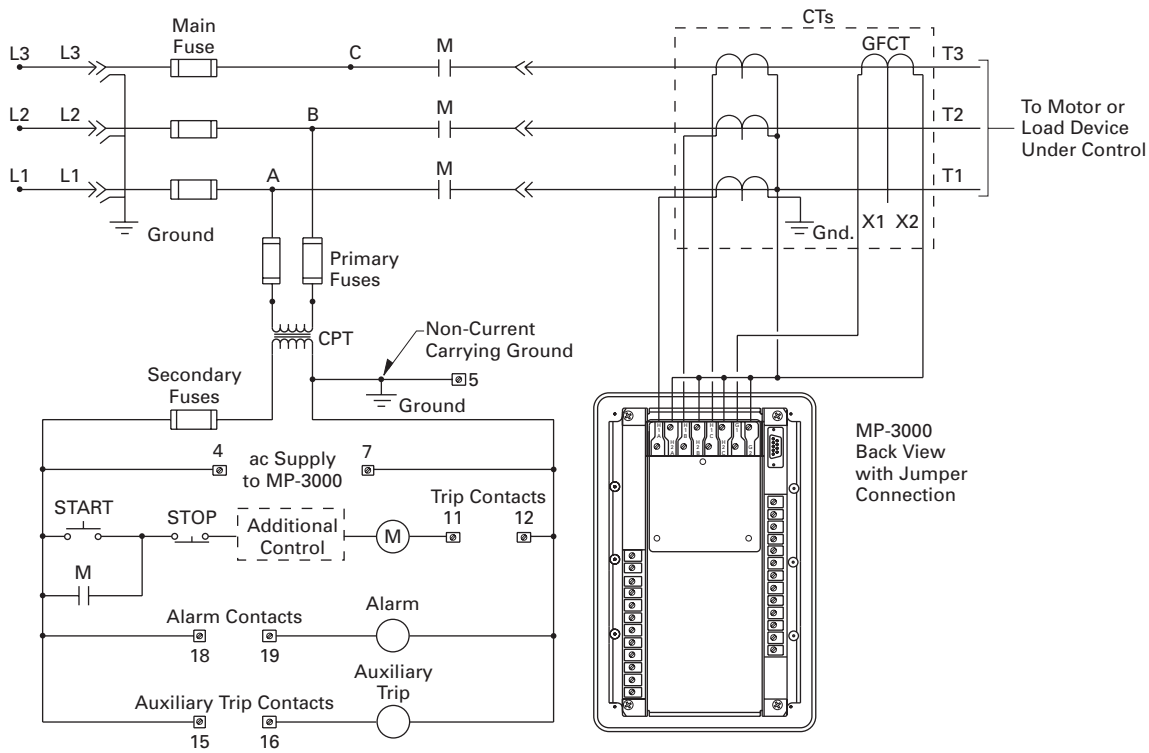
Wiring Diagrams

MP-3000 Motor Relay Protection Functions

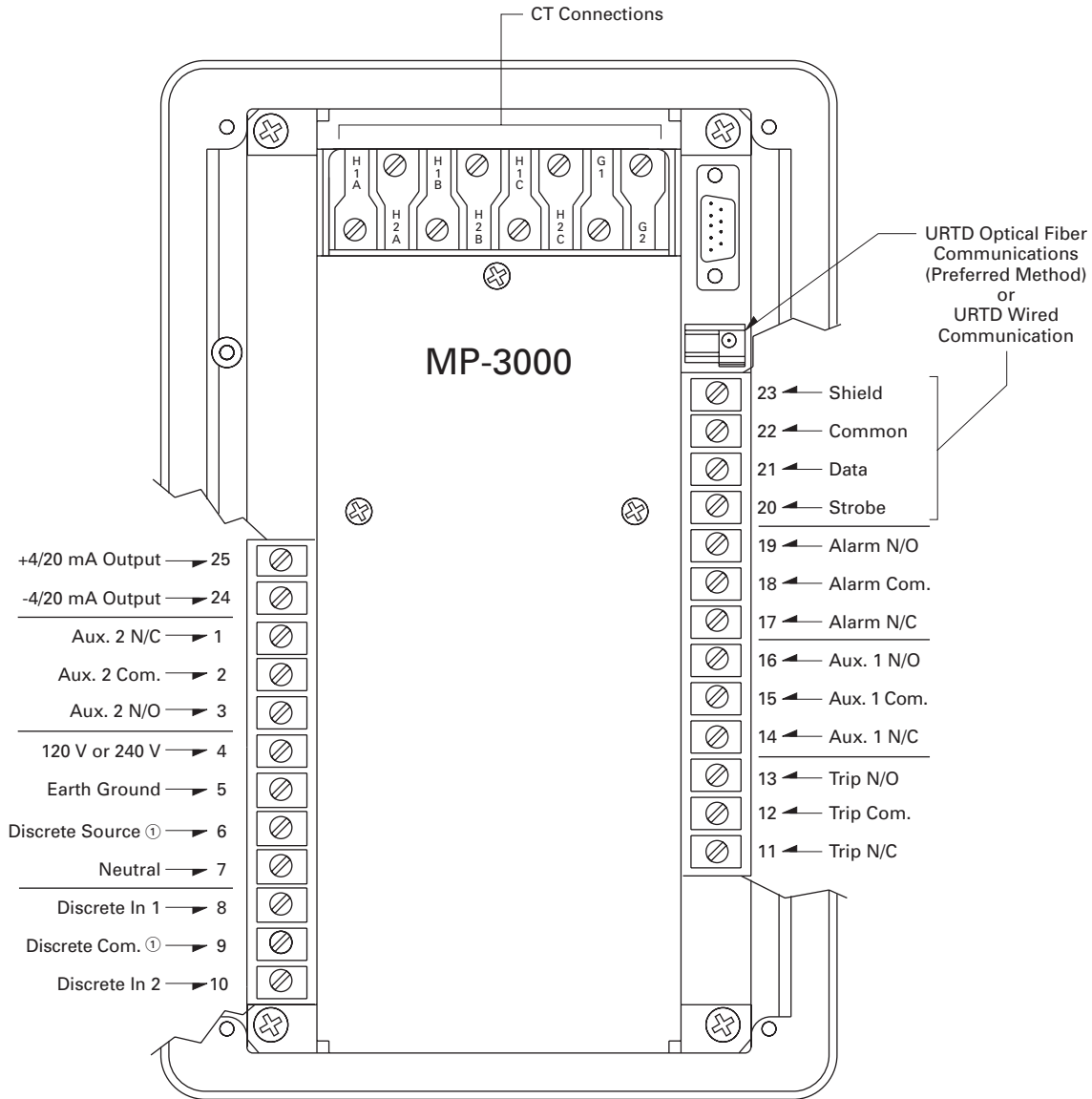


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MP-3000 Fixed Mount Typical



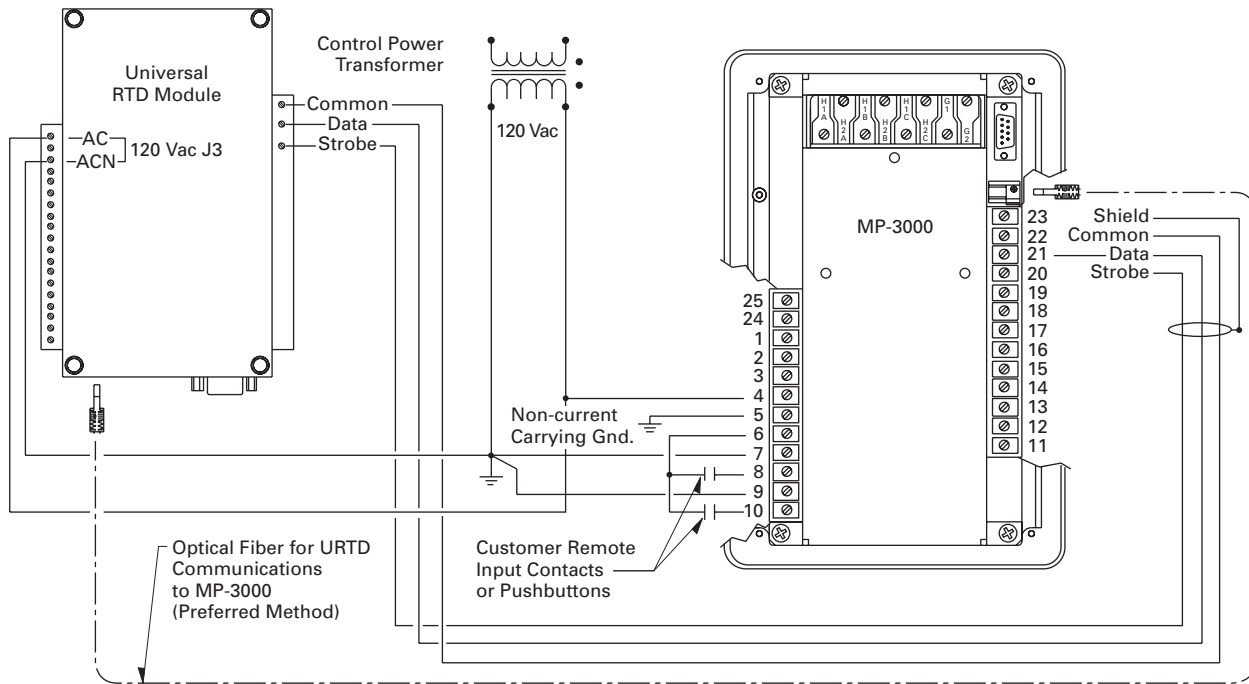
MP-3000 Terminal Identification



Note

① **Caution:** Do not connect terminals 6 and 9 together.

MP-3000 Control and URTD Wiring



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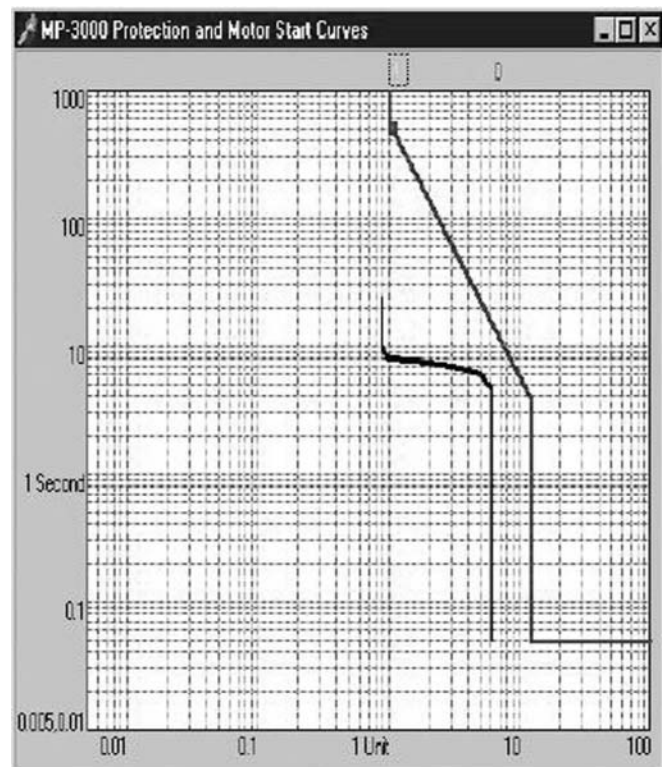
Trip Curve Chart

The MP-3000 motor relay records information on the most recent four starts. It records currents, percent of I^2t used, percent unbalance, RTD temperatures and time to transition and run. In addition, a motor start profile can be downloaded and displayed using Eaton's PowerPort or PowerNet Software. The starting profile shows the motor starting current plotted against the relay protection curve. This provides a quick view of the coordination between the protection and actual motor start current.

When communications are desired, an optional communication module or PONI (Product Operated Network Interface) is required. The MP-3000 is compatible with an INCOM (IPONI), Modbus RTU (MPONI) or Ethernet (EPONI). Future communication modules are planned to interface with other systems using other protocols. Please consult factory for availability of other communication options. **Page 321** shows typical mounting of MP-3000 with optional PONI and with URTD module and PONI.

When the MP-3000 is supplied in the optional drawout case, then the INCOM (IPONI) is the only communication option available. The communication option must be selected at the time of order.

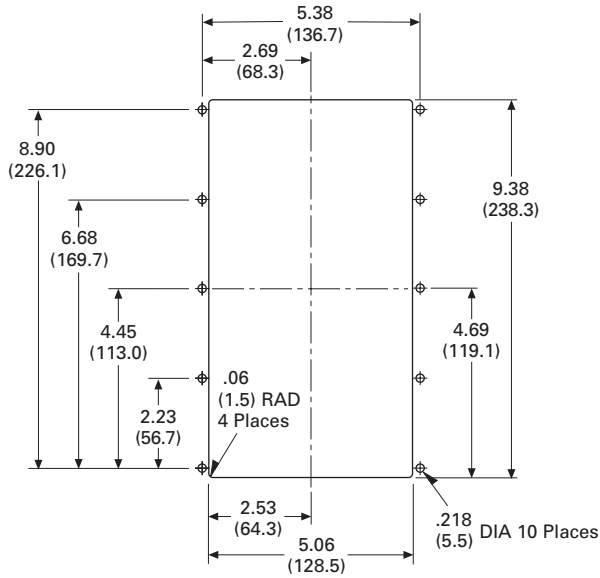
Motor Starting Profile Time/Current Chart



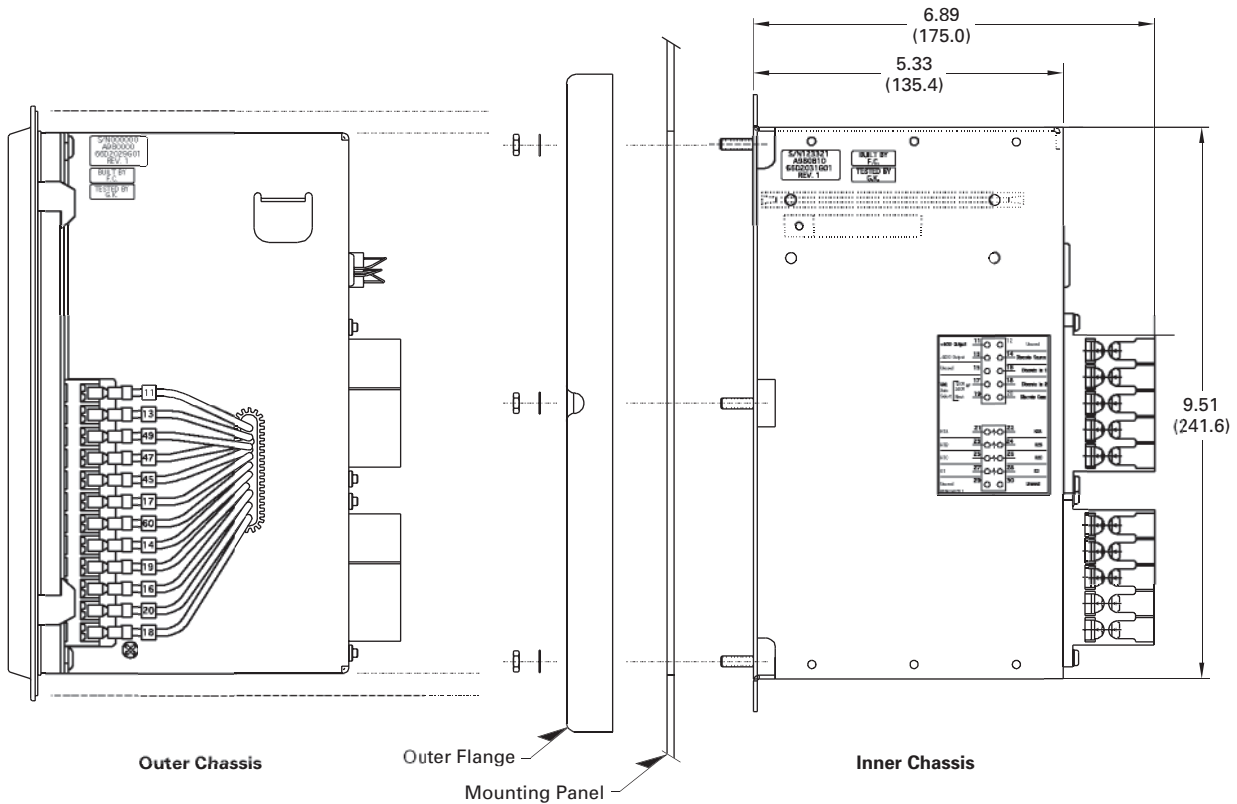
Dimensions

Approximate Dimensions in Inches (mm)

Panel Cutout Diagram



MP-3000 Drawout Panel Mounting



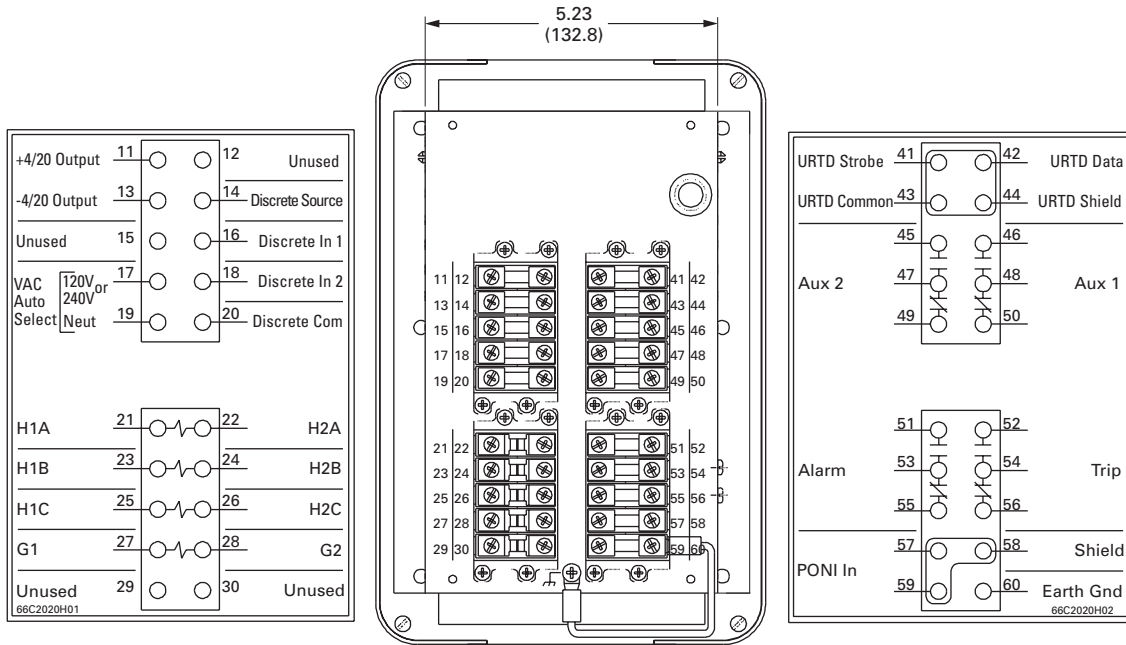
22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

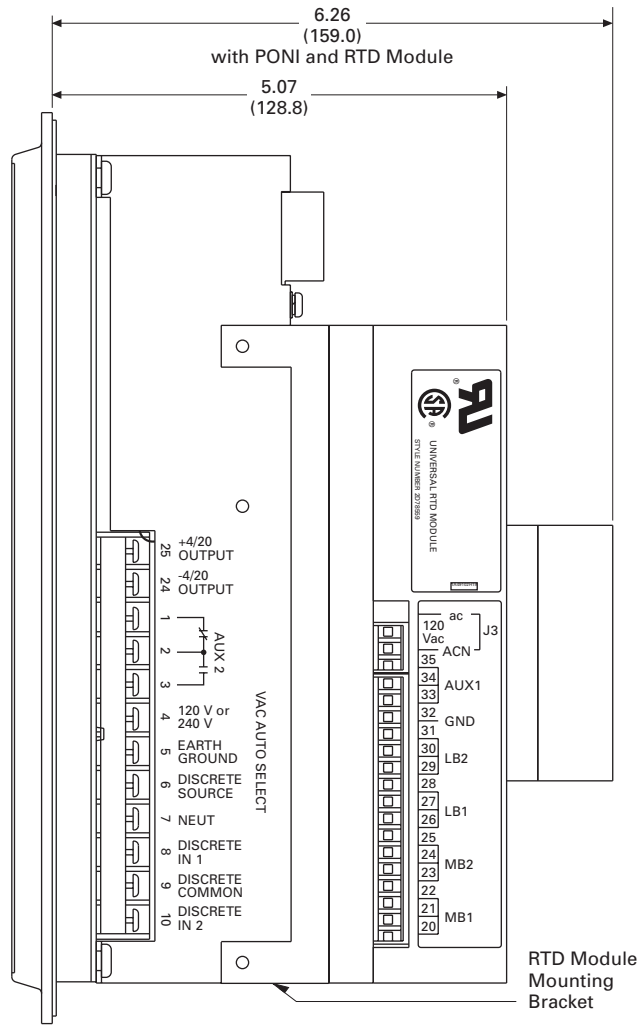
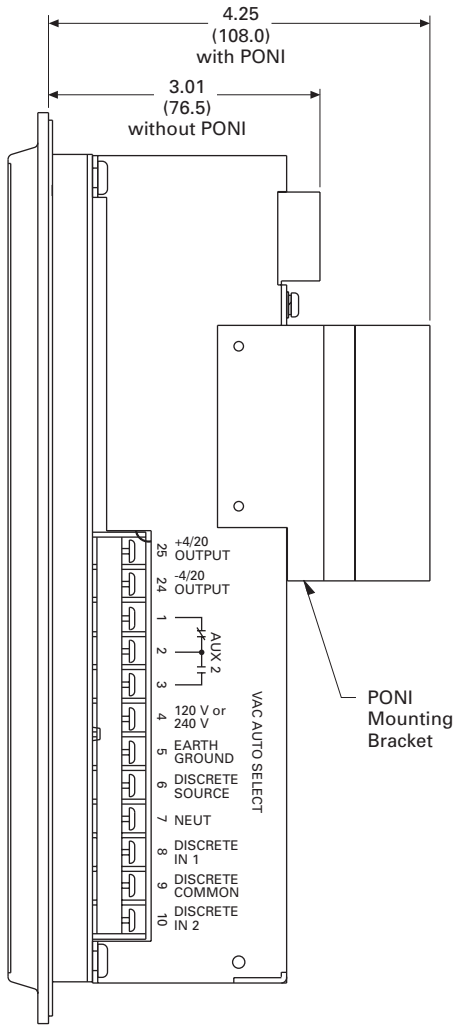
Approximate Dimensions in Inches (mm)

Rear View of MP-3000 Drawout Outer Case



Approximate Dimensions in Inches (mm)

MP-3000 PONI and URD Mounting



FP-3000 Feeder Protection Relay

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|---------------|--------------|-------------|-----------------------------|
| 10.25 (260.4) | 6.72 (170.7) | 3.70 (94.0) | 7.0 (3.2) |

MP-4000



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MP-4000 Motor Protection

Product Description

- Microprocessor-based, multi-function motor protection
- Intel-I-Trip overload protection based on motor data
- Event recording and operational logging
- Motor Start Profile
- Optional Quick Release Drawout Case
- Used on AMPGARD and medium voltage assemblies
- “Help” menu provides user operational assistance

Application Description

Eaton’s MP-4000 motor protection relay is a multifunctional microprocessor-based protective relay for the protection of three-phase ac motors. The MP-4000 motor relay may be applied to any size motor at any voltage level. It is most commonly used on large, medium voltage three-phase induction motors. It has also been widely used on important low voltage (480 volt) motor applications and synchronous motors.

The MP-4000 motor relay monitors three-phase and ground currents, and three-phase voltages. It provides motor overload, stall, short circuit, phase unbalance, single phasing over/undervoltage, underpower, power factor and ground fault motor protection.

It can also be used to provide protection for a load jam or loss of load condition.

The MP-4000 motor relay provides start control logic to protect the motor against excessive starts or starting the motor before it has had

sufficient time to cool down. The MP-4000 motor relay may be applied to either across the line starters or reduced voltage starters. On reduced voltage starters, the MP-4000 relay can control the switch from reduced voltage to full voltage based on time and/or motor transition. The MP-4000 can protect the starter against failure to transition to full voltage through contact feedback and an incomplete sequence function.

The MP-4000 motor relay is generally used on a motor starter or a breaker used for a motor load. The MP-4000 motor relay provides the intelligence to protect and control the motor against abnormal operating conditions. It monitors the currents from either a 5A or 1A secondary of a CT circuit. Ground current may be obtained from either a ground CT or from the residual connection of the phase CTs. It provides a form C contact output for controlling the starter contacts or breaker operation.

Features, Benefits and Functions

- Complete motor protection and control in a single compact case reduces panel space requirements and wiring costs
 - Microprocessor design with self diagnostics eliminates calibration and reduces installation, commissioning and maintenance
 - Programmable stop 2–20% of PCT
 - Intel-I-Trip overload protection develops customized curve from manufacturer's supplied motor data
 - Intel-I-Trip overload protection provides adaptive trip characteristics based on motor temperature when motor RTDs are connected through an optional URTD module
 - Meets UL 1053 ground fault protection standards that eliminates the need for a separate ground relay saving cost, space, wiring and time
 - Voltage dip/loss ride through capability reduces unnecessary trips caused by poor power quality
 - Motor currents, temperatures and conditions are monitored and displayed either locally or remotely
 - Event log provides motor operating records for the most recent 20 Trip or Alarm events with date and time stamping. This information can improve troubleshooting and reduce downtime
 - Log book records the most recent 100 events such as motor START/STOP and set point changes to provide a log of motor operation with date and time stamping
 - RTD diagnostics reduces unnecessary tripping caused by faulty RTD, RTD wiring or communications
 - Arm/Disarm feature improves security for critical motor applications
 - Motor Start profile verifies protection and motor starting coordination. This feature can be used to develop protection settings on old motors where data is not available
 - Optional communication module and Eaton's software simplifies setting, configuration, monitoring, commissioning and data retrieval either locally or remotely
 - Optional Quick Release Drawout Case construction simplifies relay removal and replacement
- The protection functions are listed below:
- I²t overload protection (49/51)
 - Locked rotor (49S/51)
 - Ultimate trip current (51)
 - Negative sequence phase unbalance (46)
 - Instantaneous overcurrent (50)
 - Ground fault protection (50G)
 - Undervoltage (27)
 - Overvoltage (59)
 - Under power (32)
 - Negative sequence voltage unbalance (47)
 - Power factor (55)
 - RTD trip and alarm with URTD module (49/38)
 - Underload trip (37)
 - Starts per time (66)
 - Jam or stall (51R)
 - Auto or manual reset (86)
 - Fail-safe or non-fail-safe trip modes

The metering functions are:

- Metering:
 - Average current
 - Amperes: magnitude and angle in primary values
 - Amperes: positive, negative and zero sequence
 - Average voltage (V ave)
 - Voltage: magnitude and angle
 - Voltage: positive, negative and zero sequence
 - % of full load
 - % current unbalance
 - % voltage unbalance
 - Power, vars and VA
 - Power factor
 - Frequency
 - Energy metering with time and date stamps
- RTD temperatures:
 - Individual winding
 - Motor bearing
 - Load
 - Auxiliary temperatures
- Motor conditions:
 - Percent of I²t thermal bucket
 - Time before start
 - Remaining starts allowed
 - Oldest start time

Standards and Certifications

The MP-4000 motor protection was designed to meet the industry standards for protective relays. It is recognized under UL 1053 Ground Fault Protection Standard.

- UL recognized (File No. E154862)
- UL 1053 recognized
- UL 508 recognized
- ANSI C37.90, C37.90.1
- cUL
- CSA



Reference Information

Cross-Reference

Westinghouse®/Cutler-Hammer

Eaton's Cutler-Hammer MP-3000 motor relay supersedes the Cutler-Hammer (formerly Westinghouse) IQ 1000 II motor relay and can replace the earlier IQ 1000 motor relay version sold under the Westinghouse name. The MP-3000 motor relay fits in the same cut out and provides the protection functions of these older models. The MP-3000 relay provides numerous enhancements and new features over the superseded

models. The most notable enhancements are UL 1053 ground fault protection certified, voltage loss ride through capability, data logging, communications features and the addition of a clock for date and time stamping of events.

GE Multilin™

GE Multilin has several product offerings for motor protection. The 269 PLUS is the equivalent model to the MP-3000 with optional URTD module. Eaton offers MP-

3000 value packs that include an MP-3000, PONI, URTD module and fiber optic cable at competitive prices.

GE Multilin has both lower and higher end products. The MP-3000 can be used in place of their 239 motor relay. The MP-3000 offers more capabilities than the 239 for a slightly higher price.

GE Multilin 369 and 469 are upgraded end products. The MP-3000 relay offers equivalent overload and current protection functions.

It also provides equivalent start control functions. Both the 369 and 469 offer voltage protection and metering functions. An Eaton meter and/or other manufacturers' protective relays may be needed to satisfy the customer's motor protection requirements. The 469 adds differential protection. This function must be supplied by others in addition to the MP-3000 motor relay.

Cross-Reference

| New Eaton's Series | Old Cutler-Hammer (Westinghouse) | GE Multilin |
|-------------------------|----------------------------------|--------------------------|
| MP-3000 (URTD module) ① | IQ 1000 II, IQ 1000 | 269, 269+, 239, base 369 |
| MP-4000 (URTD module) ① | — | 369 with voltage option |
| MP-4000 + MP-3000 | — | 469 |

Note

① If RTD monitoring required.

Product Selection

MP-4000



MP-4000 Ordering Information

| Description | Catalog Number |
|---|----------------------|
| MP-4000 drawout, 5A with RS-232 | MP4011 |
| MP-4000 drawout, INCOM, 5A with RS-232 | MP4012 |
| MP-4000 drawout, Modbus, 5A with RS-232 | MP4013 |
| MP-4000 drawout, DeviceNet, 5A with RS-232 | MP4014 |
| MP-4000 drawout, 1A with RS-232 | MP4111 |
| MP-4000 drawout, INCOM, 1A with RS-232 | MP4112 |
| MP-4000 drawout, Modbus, 1A with RS-232 | MP4113 |
| MP-4000 drawout, DeviceNet, 1A with RS-232 | MP4114 |
| MP-4000 fixed case, 5A with RS-232 | MP4010 |
| MP-4000 fixed case, INCOM, 5A with RS-232 | MP4010INCOM |
| MP-4000 fixed case, Modbus, 5A with RS-232 | MP4010MODBUS |
| MP-4000 fixed case, DeviceNet, 5A with RS-232 | MP4010DEVICEN |
| MP-4000 fixed case, 1A with RS-232 | MP4110 |
| MP-4000 fixed case, INCOM, 1A with RS-232 | MP4110INCOM |
| MP-4000 fixed case, Modbus, 1A with RS-232 | MP4110MODBUS |
| MP-4000 fixed case, DeviceNet, 1A with RS-232 | MP4110DEVICEN |
| MP-4000 fixed case, INCOM, 5A with RS-232, URTD | MP4010VPI |
| MP-4000 fixed case, Modbus, 5A with RS-232, URTD | MP4010VPM |
| MP-4000 fixed case, DeviceNet, 5A with RS-232, URTD | MP4010VPD |
| MP-4000 fixed case, INCOM, 1A with RS-232, URTD | MP4110VPI |
| MP-4000 fixed case, Modbus, 1A with RS-232, URTD | MP4110VPM |
| MP-4000 fixed case, DeviceNet, 1A with RS-232, URTD | MP4110VPD |

Options and Accessories

Additional Related Products by Eaton Corporation's Cutler-Hammer Series

The MP-4000 is available in either a fixed mount or Quick Release Drawout Case. Both mountings use the same panel cutout.

The Universal RTD module (URTD) is required when the motor is equipped with RTDs that you wish to monitor and use for protection. The URTD can be mounted near the motor to reduce RTD wiring and costs.

The MP-4000 motor protection is design-ed to operate from 120 Vac or 240 Vac auxiliary control power. The MP-4000 motor relay can be used with dc control power with the addition of the IQDCPS. The IQDCPS is an inverter from DC to AC.

Technical Data and Specifications

Control Power

- Nominal rating:
 - 120 Vac or 240 Vac
 - +10%, -25%
- Operating range:
 - 120 Vac: 90 132 Vac
 - 240 Vac: 180 264 Vac
- Frequency: 50 or 60 Hz
- Power use:
 - 20 VA maximum
 - URTD: 6 VA maximum
 - IPONI: 1 VA maximum
- Ride-through time: 30 cycles from nominal Vac

Current Inputs

- Nominal (I_n): 1A or 5A
- CT rating:
 - 2 x I_n continuous
 - 50 x I_n for 1 second
- Burdens:
 - < 0.25 VA at 5A
 - < 0.05 VA at 1A

Voltage Inputs

- Nominal: 120 Vac
- Operating range: 69 to 150 Vac
- Burden: 2 VA

Metering Accuracy

- Phase current: $\pm 1\%$ of I_n (5–100%)
- Ground current: $\pm 1.5\%$ of I_n (0–55%)

Discrete Inputs

- Number of inputs: two programmable
- Ratings:
 - 1.2 VA at 120 Vac
 - Maximum off = 36 Vac
 - Minimum on = 86 Vac

Output Contacts

- Number of outputs: four Form C, programmable.
- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc (Resistive)
 - Break 5A at 120 240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc

Analog Output

- Rating: ± 4 –20 mA programmable
- Maximum load: 1K ohm
- Accuracy: 1%

Motor Overload Protection (I^2t)

- Full load amperes: 10–3000
- Locked rotor current: 300–1200% FLA
- Locked rotor time: 1–120 seconds
- Ultimate trip current: 85–150% FLA
- Phase CT ratio: 10–4000 (I_n)
- Ground CT ratio: 10–4000 (I_n)
- Timing accuracy: $\pm 2.5\%$ or ± 30 mS for $I > 1.1x$ U.T.C.

Trip Setting Range

- Ground fault (GF): Off, 2–55% CT ratio
- GF start time delay: 2–60 cycles
- GF run time delay: 0–60 cycles
- Timer accuracy: ± 20 mS
- Instantaneous O.C.: Off, 300–1600% FLA
- IOC start time delay: 2–60 cycles
- Timer accuracy: ± 20 mS
- JAM trip: Off, 100–1200% FLA
- Underload trip: Off, 1–90% FLA
- Current unbalance trip: Off, 4–40% I_{neg}/I_{pos}
- Start delay timers:
 - 0–120 seconds (underload and phase unbalance)
 - 0–1200 seconds (jam)
- Run delay timers: 0–240 seconds
- Timer accuracy: $\pm 0.5\%$ +100 mS
- Voltage unbalance: Off, 1 to 100V
- % V2/V1: 4% + 40%
- Voltage unbalance time delay: 0 to 1200 sec.
- Under/overvoltage time delay: Off, 10 to 150V
- Under/overvoltage time delay: 0 to 1200 sec

- Under/overfrequency: Off, 15 to 60 Hz
- Under/overfrequency time delay: 0 to 60 sec
- Power protection: Off, 0.06 to .90 + FLA VT
- Power time delay: 0 to 1200 sec
- Power factor: Off, 0.05 lag to 0.99 lead
- Power factor time delay: 0 to 60 sec

Alarm Setting Range

- Ground fault: Off, 2–55% CT ratio
- Overload I^2t : Off, 60–99% I^2t
- JAM: Off, 100–1200% FLA
- Underload: Off, 1–90% FLA
- Phase unbalance: Off, 4–40% I_{neg}/I_{pos}
- Run delay timers: 0–240 seconds

Start Control Functions

- Starts per time: 1–10 starts
- Time for starts per time: Off, 1–240 minutes
- Time between starts: Off, 1–240 minutes
- Number of cold starts: 1–5 starts
- Motor transition current: 10–300% FLA
- Time for transition: 0–1200 seconds
- Inc. sequence timer: Off, 1–240 seconds
- Long acceleration timer: Off, 1–1200 seconds
- Anti-Backspin timer: Off, 1–3600 minutes

RTD Inputs (Requires URTD module)

- Sensor types:
 - 10 ohm copper
 - 100 ohm nickel
 - 120 ohm nickel
 - 100 ohm platinum

URTD Module Communications

- Interface:
 - Electrical (three-wire)
 - Fiber optic (preferred)
- Fiber optic cable: Type HBRF-ERS or EUS

Clock

- Accuracy: ± 1 minute/month at 77°F (25°C)

PONI Communications

- Type: two-wire, FSK
- Baud rate: 1200 or 9600 baud
- Protocol: INCOM
- Functions:
 - Read/write set points
 - Read metered values
 - Read trip/alarms
 - Read events/history
 - View starting profile

MPONI Communications

- Type: five-wire, 485
- Baud rate: 1200 or 9600 baud
- Protocol: Modbus RTU
- Functions:
 - Read metered values
 - Read trip/alarms

DPONI Communications

- Type: J-wire
- Baud rate: 500k, 250k, 125k
- Protocol: DeviceNet
- Functions:
 - Read metered values
 - Read trip/alarms

Logging

- Log book: 100 events
- Log event: 20 trips and alarms
- Log start: last four starts
- Start profile: last four starts (communication only)
- History records: motor, trips, alarms and total records

Environmental Conditions

- Operating temperature: -4°F to +140°F (-20°C to +60°C)
- Storage temperature: -49°F to +185°F (-45°C to +85°C)
- Humidity: 0–95% noncondensing

Dimensions

Approximate Dimensions in Inches (mm)

MP-4000 Feeder Protection Relay

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|---------------|--------------|-------------|-----------------------------|
| 10.25 (260.4) | 6.72 (170.7) | 3.70 (94.0) | 7.0 (3.2) |

MD-3000



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MD-3000 Motor/Generator Differential Relay

Product Description

Eaton's MD-3000 Protective Relay is a microprocessor-based sensitive three-phase instantaneous OC-trip relay designed for both ANSI and IEC applications. The MD-3000 is suitable for use as a motor/generator differential relay.

The MD-3000 Relay operates from the 5 ampere secondary output of standard current transformers. Current transformer ratio information is quickly programmed into the unit via settings. The MD-3000 features a user-friendly operator panel to monitor, program and test the relay. Operating parameters and troubleshooting information are displayed in the two display windows.

Application Description

The MD-3000 microprocessor-based relay provides reliable instantaneous trip protection for all voltage levels. It is most commonly used as motor differential protection relay.

Features, Benefits and Functions

- ANSI or IEC applications
- Phase differential currents
- Monitoring and reporting of magnitude and phase of current causing trip
- Relay failure alarm contact
- Trip alarm contact
- User-friendly front panel
- Non-volatile memory
- View settings any time
- Set CT ratios
- Integral test mode (phase and ground)
- Program and test mode security access cover with meter seal provision
- Continuous internal circuitry self-testing
- Programmable lockout/self reset after trip

System Protection

- Instantaneous sensitive phase overcurrent trip
- Configurable trip outputs

Information and Data Delivery

- Displays current transformer ratio
- Data/information transmission

Standards and Certifications

- ANSI C37.90 (1989), C37.90.1 (1989), C37.90.2 (1995)
- IEC 255
- UL 1053



Product Selection

MD-3000



Catalog Numbers

| Description | Catalog Number |
|--------------|----------------|
| Fixed Case | MD3000 |
| Drawout Case | MD3001 |

Technical Data and Specifications

Product Specifications

Current Inputs

- CTs: 5A secondary
- CT burden:
 - <0.004 ohm at rated current (5A)
 - <0.1 VA at rated current (5A)
- I_n: 5A (Secondary) or CT (Primary)
- Saturation: 30 x I_n
- CT thermal ratings:
 - 10A continuous
 - 500A for 1 second

CT (Primary) Settings Available

- Phase: 5/10/25/50/75/100/150/200/250/300/400/500/600/630/800/1000/1200/1250/1500/1600/2000/2400/2500/3000/3200/4000/5000

Input Voltage

- Nominal:
 - 48–250 Vdc
 - 120–240 Vac 50/60 Hz
- Operating range:
 - 28–280 Vdc
 - 90–254 Vac 50/60 Hz

Power Consumption

| 24 | 48 | 125 | 250 | 120 | 240 |
|------------|------------|------------|------------|--------------|--------------|
| Vdc 10W | Vdc 10W | Vdc 10W | Vdc 10W | Vac 10 VA | Vac 18 VA |

Output Trip Contacts

- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc
 - Break 5A at 120/240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc
 - Meets ANSI C37.90, Paragraph 6.7

Environmental Conditions

- Operating temperature: –22°F to +131°F (–30°C to +55°C)
- Operating humidity: 0–95% relative humidity (noncondensing)
- Storage temperature: –40°F to +158°F (–40°C to +70°C)

Auxiliary Alarm Contacts

- 5A continuous at 120/240 Vac, 30 Vdc
- 5A break at 120/240 Vac, 30 Vdc

Tests

- Dielectric strength, current inputs:
 - 3000 Vac for 1 minute
 - Phase-to-phase
- Seismic test: Meets requirements for UBC® and California Building Code Zone 4. ZPA = 3.5

Communications

- Eaton’s PowerNet compatible
- Built-in INCOM
- Data rate is 1200 or 9600 baud

Drawout Case

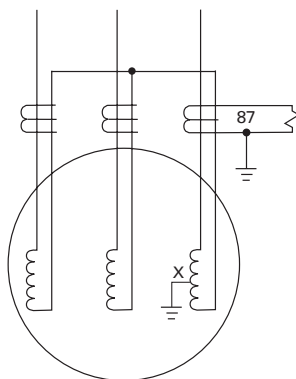
- Refer to **Page 339** for drawout case dimensions

Terminal Block

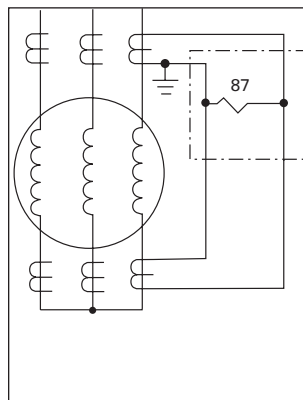
- Make/break rating:
 - 10A at 240 Vac nominal
 - 0.25A at 280 Vdc maximum
- Terminal wire gauge: No. 14 to No. 10 AWG
- Screw torque requirements: 18-inch-pounds

Wiring Diagrams

Self-Balancing Differential Protection



Conventional Phase Differential Protection



22.4

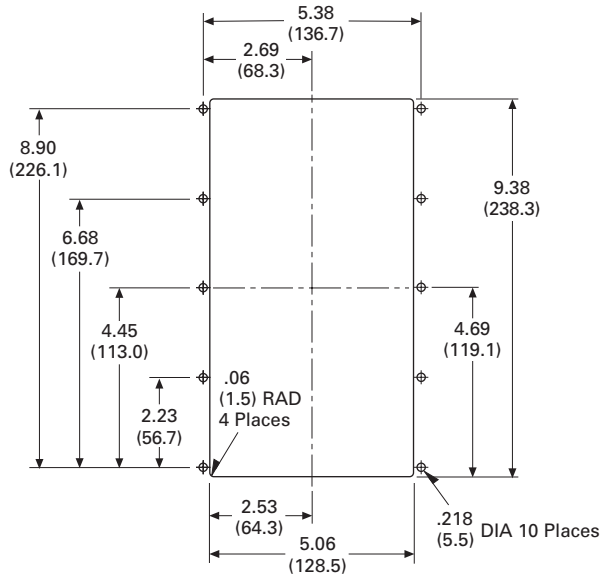
Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

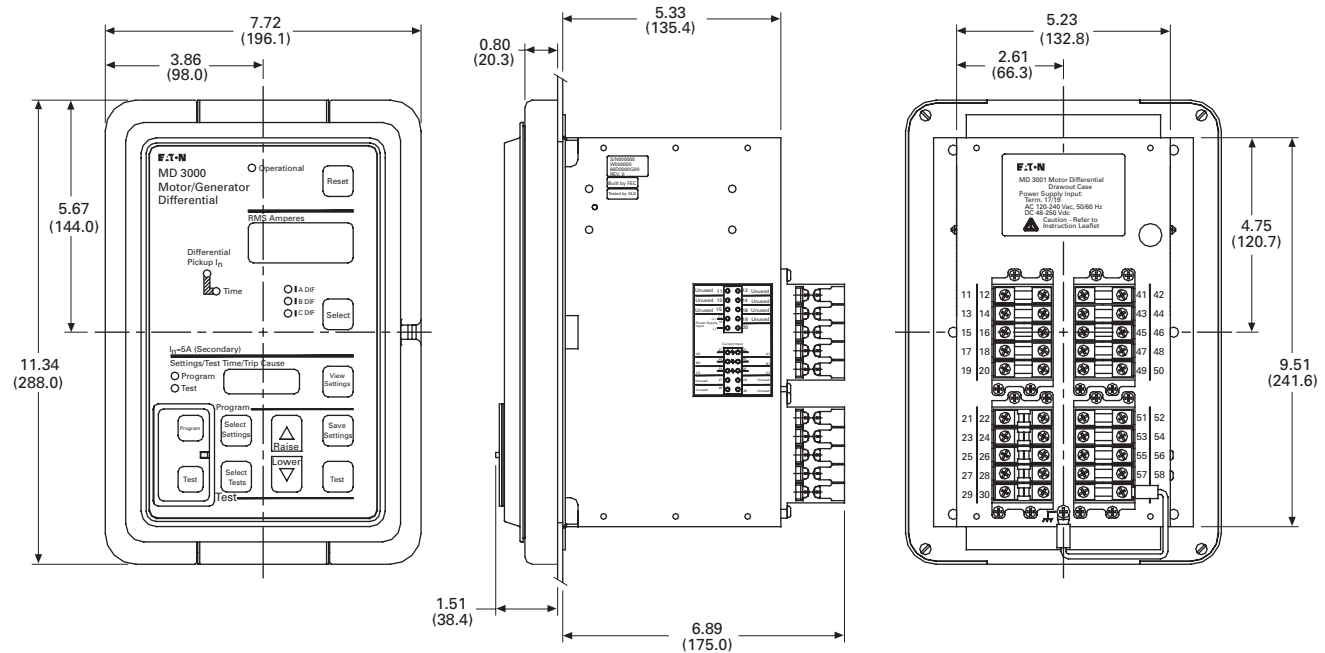
Dimensions

Approximate Dimensions in Inches (mm)

Drilling Pattern



MD-3000



MD-3000 Feeder Protection Relay (Fixed Case)

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|---------------|--------------|-------------|-----------------------------|
| 10.25 (260.4) | 6.72 (170.7) | 3.70 (94.0) | 7.0 (3.2) |

DT-3000



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Digitrip 3000

Product Description

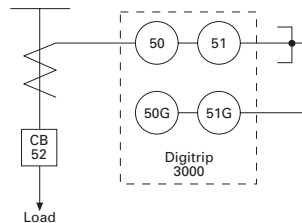
- Microprocessor-based, three-phase and ground overcurrent relay
- Independent phase and ground measuring circuits and operation
- Inverse time (51), short delay (50, 2) and instantaneous (50) protection
- Eleven time overcurrent characters including ANSI, IEC and thermal protection curves
- Phase and ground ammeter and peak demand functions
- INCOM communication port
- Fixed mount or optional quick release drawout case design
- Dual-source power supply option for AC control power applications

Application Description

Eaton’s Digitrip 3000 microprocessor-based relay provides reliable three-phase and ground overcurrent protection for all voltage levels. It can be used for

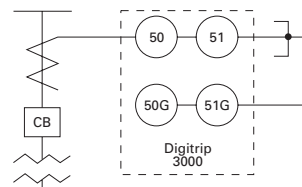
any application where instantaneous and/or time overcurrent protection is required. It is most commonly used as primary feeder circuit protection, see figure below.

Primary Feeder Circuit Protection



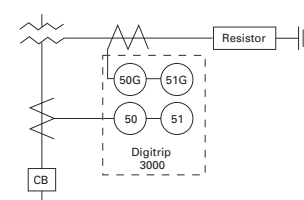
The Digitrip 3000 may be applied as the transformer primary protection or as backup to the differential protection, see figure below.

Transformer Overcurrent Protection



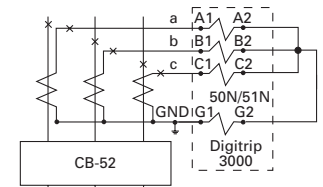
The Digitrip 3000 may be connected to the secondary side of a delta-wye grounded transformer with the ground element connected to a separate CT in the neutral connection of the transformer. With this connection, a lower CT ratio and a pickup setting can be used to provide more sensitive ground fault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

Transformer Secondary Protection with Neutral CT Connection

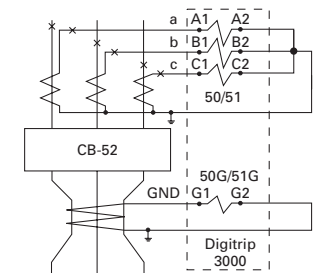


The Digitrip 3000 ground overcurrent element can be connected in the residual circuit of the phase CTs as shown in the top figure or to a separate ground CT as shown in last figure.

Residual Ground Connection



Separate Zero Sequence Ground CT Connection



Zone Selective Interlocking (Phase and Ground)

Note: For the phase time overcurrent element, the current sensed by the Digitrip 3000 must exceed 300% ($3 \times I_n$) for the zone selective interlocking to initiate an immediate trip signal.

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 and short delay phase elements work as follows. The short delay 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 Digitrip 3000 must exceed 300% ($3 \times I_n$) for the

zone selective interlocking to initiate an immediate trip signal when the fault is in the breaker’s zone of protection.

Upstream Digitrip 3000 protected breakers are restrained from tripping immediately by an interlocking signal from the downstream Digitrip 3000 relay. This interlocking signal requires only a pair of wires from the downstream breaker to the upstream breaker. The Upstream Digitrip 3000 provides time delayed 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 Digitrip 3000 overcurrent relays.

Fault Location Zone 3

Note: For the phase time overcurrent element, the current sensed by the Digitrip 3000 must exceed 300% ($3 \times I_n$) for the zone selective interlocking to initiate an immediate trip signal.

If a fault occurs at a point in Zone 3, the Digitrip 3000 of Downstream Breaker C senses the fault and sends a restraining signal to the upstream Digitrip 3000 of Feeder Breaker B.

Having received this signal, the Digitrip 3000 of Feeder Breaker B begins timing for normal final delay tripping. As a result, only Downstream Breaker C is tripped.

Fault Location Zone 2

Note: For the phase time overcurrent element, the current sensed by the Digitrip 3000 must exceed 300% ($3 \times I_n$) for the zone selective interlocking to initiate an immediate trip signal.

If a fault occurs at a point in Zone 2, the Digitrip 3000 of Feeder Breaker B senses the fault and sends a restraining signal to the upstream Digitrip 3000 of Main Breaker A.

The Digitrip 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 Digitrip 3000 of Downstream Breaker C does not send a restraining signal to the Digitrip 3000 of Feeder Breaker B.

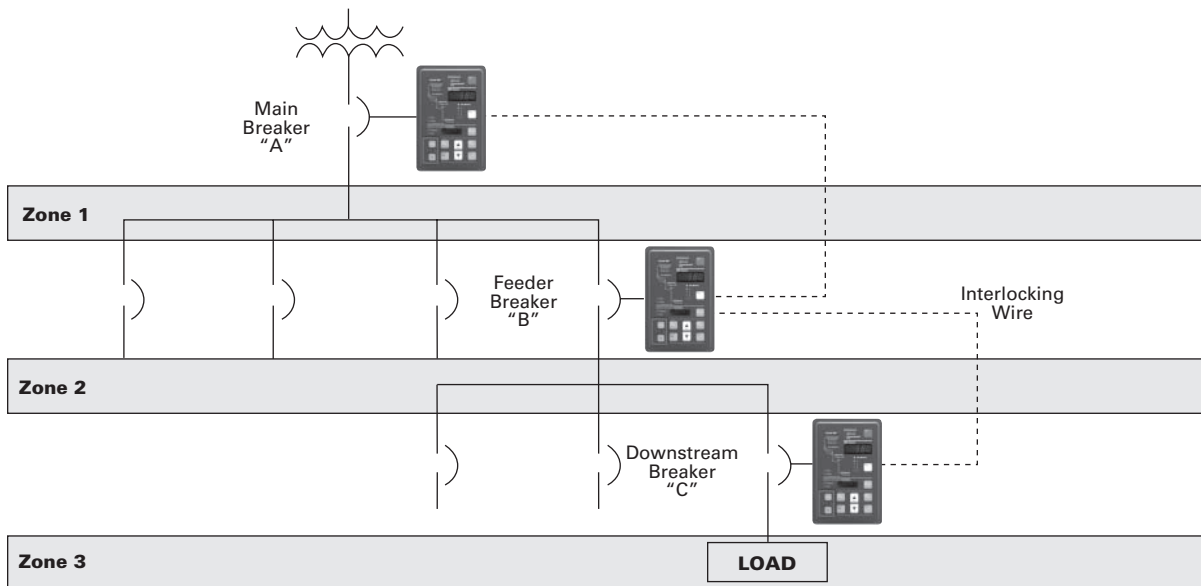
Since there is no restraining signal from the Digitrip 3000 of Downstream Breaker C, the Digitrip 3000 of Feeder Breaker B identifies that the fault is in Zone 2 and immediately trips Feeder Breaker B, regardless of its time setting.

Fault Location Zone 1

Note: For the phase time overcurrent element, the current sensed by the Digitrip 3000 must exceed 300% ($3 \times I_n$) for the zone selective interlocking to initiate an immediate trip signal.

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 Digitrip overcurrent relay, regardless of its time setting.

Sample Zone Selective Interlocking System



Features, Benefits and Functions

- Complete current protection and metering in a single compact case reduces panel space, wiring and cost
- Selectable trip characteristics simplify ordering and reduces inventory
- Optional drawout case provides easy and quick removal and replacement of the relay
- Optional dual-source power supply provides reliable protection when applied with ac control power, eliminating the need for batteries or UPS
- Integral ampmeter and display replaces separate meter and switch, saving panel space, wiring and money
- Zone selective interlocking improves coordination and tripping times and can save money by using in place of traditional bus differential
- Integral test function and microprocessor design can reduce maintenance time and expense

Standards and Certifications

- UL recognized
- UL 1053 recognized
- ANSI C37.90
- ANSI C37.90.1 (1989)
- ANSI C37.90.2 (1995)

Note: Fixed case versions meet 35V/m. Drawout case versions meet 28V/m.

- IEC 255
- CE (DT3030/3031 version only)



Product Selection

DT-3000



DT-3000

| Description | Catalog Number |
|---|----------------|
| DT-3000 protective relay | DT3000 |
| DT-3000 protective relay Chicago version | DT3100 |
| DT-3030 protective relay (24–48 Vdc CE Mark version) | DT3030 |
| DT-3000 drawout case protective relay | DT3001 |
| DT-3000 Chicago version drawout case protective relay | DT3101 |
| DT-3030 drawout case protective relay (24–48 Vdc CE Mark version) | DT3031 |
| DT-3000 protective relay with 120 Vac dual-source power supply | DT3010 |
| DT-3000 protective relay with 240 Vac dual-source power supply | DT3020 |

Options and Accessories

Additional Products by Eaton Corporation's Cutler-Hammer Series

Dual-Source Power Supply Option

The Digitrip 3000 with Dual-Source Power Supply (DSPS) is available in two versions, DT-3010 and DT-3020. They include an integral power supply module that:

- Powers the relay from nominal 120 Vac, 50/60 Hz (DT-3010 model) or 240 Vac, 50/60 Hz (DT-3020 model) auxiliary power, which is normally connected and available.
- Operates solely from the main current transformers (CTs) during a fault if the normally connected auxiliary ac voltage is not available, like an electromechanical relay or an electronic "self-powered" relay.

Functional Description

The integral Dual-Source Power Supply (DSPS) contains one AC voltage transformer and three AC current transformers. The AC voltage transformer is used to supply nominal ac control power to the unit. The current transformers are used to power the unit from the line current. Normally, the unit will operate from the AC auxiliary voltage.

Because this voltage is usually obtained from the system containing the circuit that the relay is protecting, a fault on the protected line could cause the AC voltage to drop below an acceptable operating level. Below approximately 70 volts for DT-3010 or 140 volts for DT-3020, the DSPS switches over to current powering.

All three current transformer secondaries are connected in series to supply this power. The DSPS will supply enough power to operate the Digitrip 3000 overcurrent relay in the tripped state with currents greater than 1.8 per unit rated secondary current, or 9A, in a single-phase. The DSPS will operate with three-phase currents in a tripped state with currents greater than 1.2 per unit or 6A rated secondary current.

Note: There will be no effect to the DT-3000 relay trip time accuracy when the Dual-Source Power Supply switches from normal ac voltage to fault-current power.

Burden Data

In normal operating conditions, the burden is <0.08 ohms with three-phase 1 A CT current, or 0.2 per unit, and drops to less than 0.04 ohms at high current levels. Present CT burden data in ohms and volt-amperes, see **Page 336**. In these cases, the burden shown is the total CT terminal value, which is the DSPS plus the relay measuring circuits, for the indicated operating condition.

The trip curve on **Page 336**, right, shows burden impedance magnitude in ohms. The two lower curves are the values with AC power applied; the upper two are with CT powering only. For each of these pairs, one curve shows the burden for a single-phase current (representing a single-phase-to-ground fault) and the other for three balanced phases with normally arrayed 120-degree phase angle increments. There is no phase sequence sensitivity.

Page 336, trip curve, upper left, shows the burden in volt-amperes for the same four cases.

Digitrip 3000 Optional Drawout Case

The Digitrip 3000 overcurrent protective relay is available in a new drawout case for quick release, removal and replacement of the unit without disruption of the wiring. The CT circuits are self-shortening to prevent damaging voltages from existing across-the-current transformer windings. All voltage inputs, discrete inputs and contact inputs are disconnected while maintaining security against false tripping.

The terminal blocks feature a two-stage disconnect operation. Removal of the DT-3000 Inner Chassis will disconnect the trip circuits and short the CT secondaries before the unit control power is disconnected. Upon insertion of the Inner Chassis, the control power connections are made before the trip circuits are activated.

This feature provides added security against false tripping.

Technical Data and Specifications

Current Inputs

- CTs: 5A secondary
- CT Burden:
 - <0.004 ohm at rated current (5A)
 - <0.1 VA at rated current (5A)
 - I_n : 5A (Secondary) or CT (Primary)
- Saturation: 30 x I_n
- CT thermal ratings:
 - 10A continuous
 - 500A for 1 second

CT (Primary) Settings Available

- Phase and ground: 5/10/25/50/75/100/150/200/250/300/400/500/600/630/800/1000/1200/1250/1500/1600/2000/2400/2500/3000/3200/4000/5000

Input Voltage DT-300X

- Nominal:
 - 48–250 Vdc
 - 120–240 Vac 50/60 Hz
- Operating range:
 - 28–280 Vdc
 - 90–254 Vac 50/60 Hz

Power Consumption

| | 24 | 48 | 125 | 250 | 120 | 240 |
|-----|-----|-----|-----|-----|-------|-------|
| Vdc | Vdc | Vdc | Vdc | Vdc | Vac | Vac |
| 10W | 10W | 10W | 10W | 10W | 10 VA | 18 VA |

Input Voltage Digitrip 3030/3031

| Description | DT-3010 | DT-3020 |
|-------------------|------------|-------------|
| Nominal | 120 Vac | 240 Vac |
| Operating Range | 70–132 Vac | 140–264 Vac |
| Power Consumption | 15 VA | 15 VA |

Output Trip Contacts (Trip OC/Comm., Trip Inst. and Comm. Close)

- Momentary:
 - Make 30A AC/DC for 0.25 seconds
 - Break 0.25A at 250 Vdc
 - Break 5A at 120/240 Vac
- Continuous:
 - 5A at 120/240 Vac
 - 5A at 30 Vdc
 - Meets ANSI C37.90, Paragraph 6.7

Environmental Conditions

- Operating temperature: –22°F to +131°F (–30°C to +55°C)
- Operating humidity: 0–95% relative humidity (noncondensing)
- Storage temperature: –40°F to +185°F (–40°C to +70°C)

Auxiliary Alarm Contacts

- 5A continuous at 120/240 Vac, 30 Vdc
- 5A break at 120/240 Vac, 30 Vdc

Tests

- Dielectric strength, current inputs:
 - 3000 Vac for 1 minute
 - Phase-to-phase
- Seismic test: Meets requirements for UBC® and California Building Code Zone 4. ZPA = 3.5

Phase and Ground Time-Current Curves

- Thermal:
 - I_t (Moderately Inverse)
 - I^2t (Very Inverse)
 - I^4t (Extremely Inverse)
 - FLAT (Definite Time)
- ANSI (Per ANSI C37.112, 1996):
 - Moderately Inverse
 - Very Inverse
 - Extremely Inverse

- IEC (Per IEC 255-3, 1989):
 - IEC-A (Moderately Inverse)
 - IEC-B (Very Inverse)
 - IEC-C (Extremely Inverse)
 - IEC-D (Definite Time)

Overcurrent Functions and Pickup Ranges

Note: Consult factory for sensitive ground fault.

- Long Delay or Inverse Time Overcurrent:
 - Phase: (0.2–2.2) x I_n (29 settings)
 - Ground: (0.1–2.0) x I_n , None (26 settings)
- Short Delay:
 - Phase: (1–11) x I_n , None (25 settings)
 - Ground: (0.1–11) x I_n , None (45 settings)
- Instantaneous:
 - Phase: (1–25) x I_n , None (30 settings)
 - Ground: (0.5–11) x I_n , None (33 settings)

Time Delay Settings

- Inverse Time Overcurrent Time Multiplier:
 - Thermal: 0.2–40 (47 settings)
 - FLAT: 0.2–2 (21 settings)
 - ANSI (all): 0.1–5.0 (50 settings)
 - IEC (all): 0.05–1.00 (20 settings)
- Short Delay Time: 0.05–1.5 seconds (22 settings)

Current Monitoring

Note: Consult factory for sensitive ground fault.

- True rms sensing: three-phase and ground
- Display accuracy:
 - ±1% of Full Scale [I_n] from 0.04 x I_n to 1 x I_n
 - ±2% of Full Scale [I_n] from 1 x I_n to 2 x I_n
- Ampere demand: Average demand over 5 minute sampling window
- High load (with selectable output): 85% of Inverse Time Overcurrent setting

Timing Accuracy

- Inverse Time Overcurrent: ±10% at >1.5 x Pickup
- Short Delay Time: ±50 mS

Communications

- Eaton's PowerNet Compatible
- Built-in INCOM
- Data rate is 1200 or 9600 baud

Drawout Case

- Refer to **Page 339** for Drawout Case Dimensions

Terminal Block

- Make/Break rating:
 - 10A at 240 Vac nominal
 - 0.25A at 280 Vdc maximum
- Terminal wire gauge: No. 14 to No. 10 AWG
- Screw torque requirements: 18-inch-pounds

Reference Information

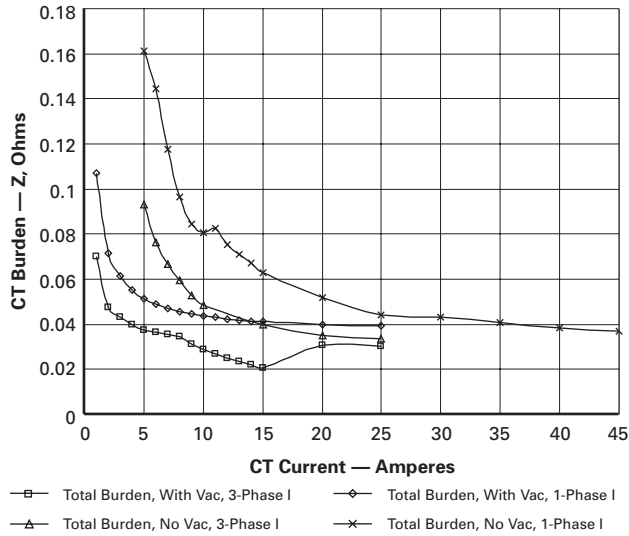
Cross-Reference

There are several products that are equivalent to the Digitrip 3000. The following lists the competitor's name and equivalent product to the Digitrip 3000. In general, the Digitrip 3000 can be used in place of the competitive product.

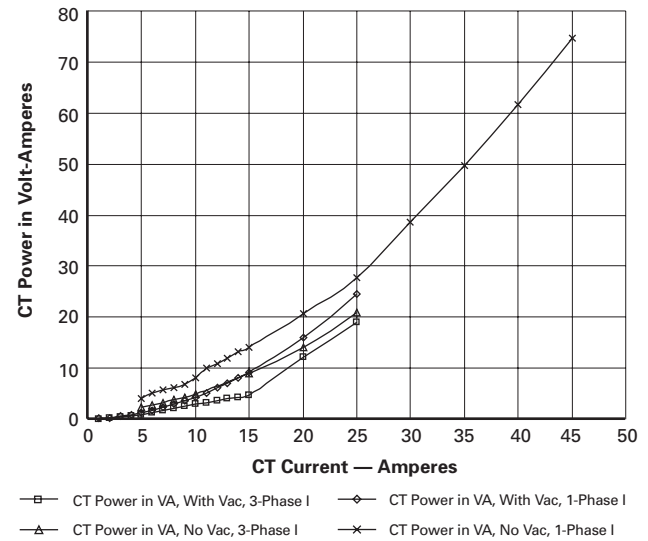
- ABB® MMCO, 51
- Basler Electric® BEI-51
- GE Multilin MDP, 735, 737
- Siemens® 7SJ 511, 7SJ 60

Trip Curve Charts

Digitrip 3000 With Dual-Source Power Supply Burden Curves



Digitrip 3000 With Dual-Source Power Supply CT Power Volt-Ampere Curves

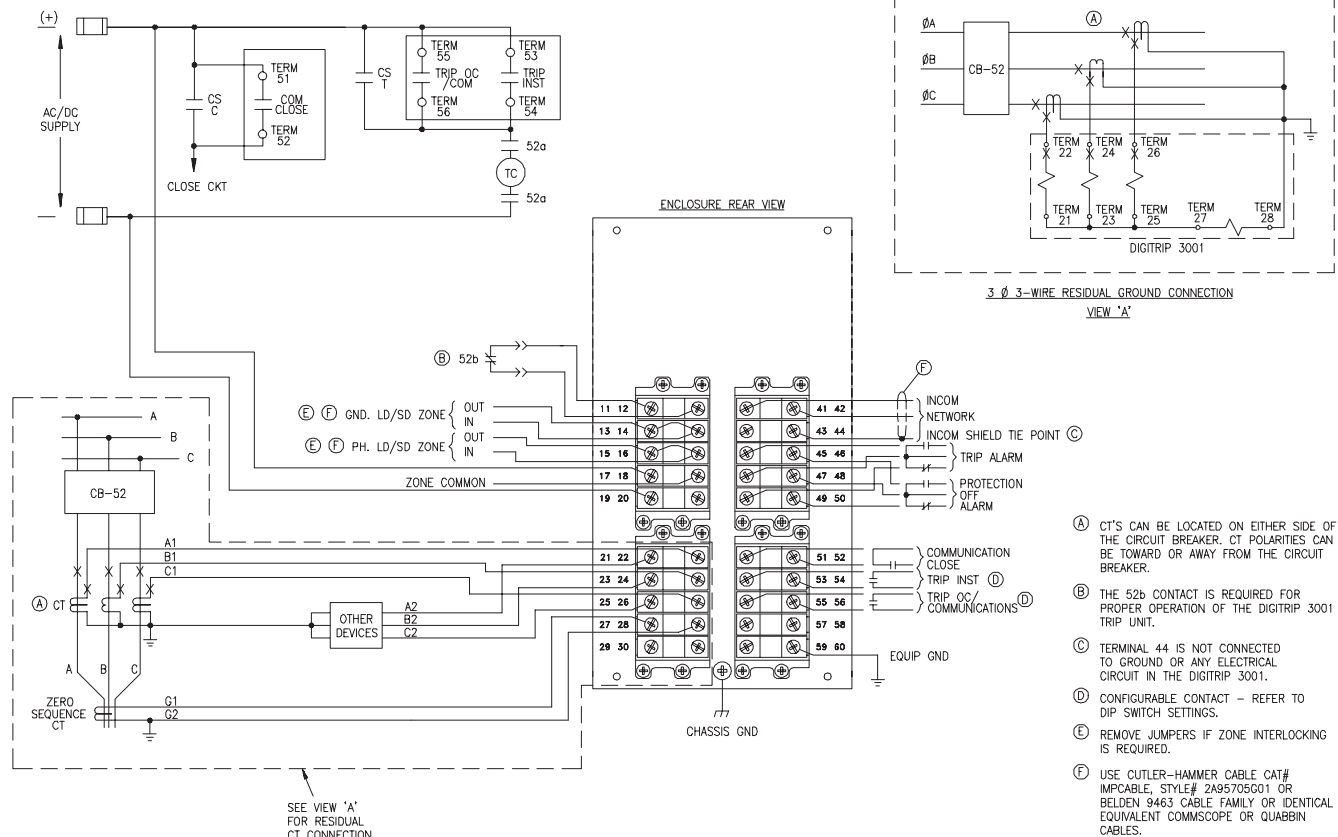


22

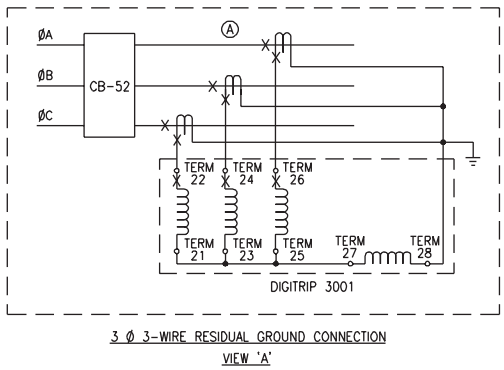
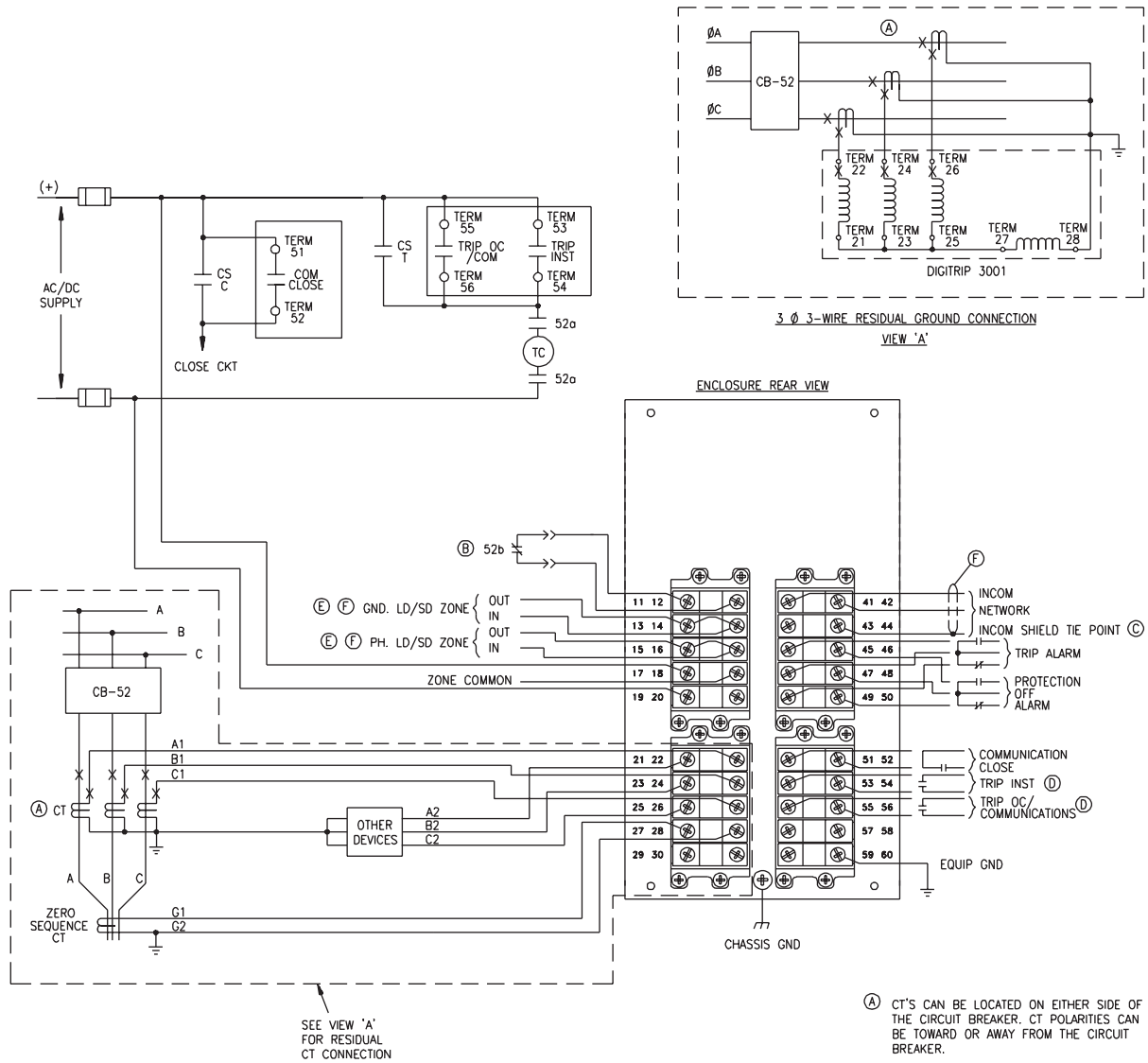
Wiring Diagrams

Digitrip 3001

Typical wiring diagram for the fixed mount version.



Digitrip 3000 Typical Wiring System



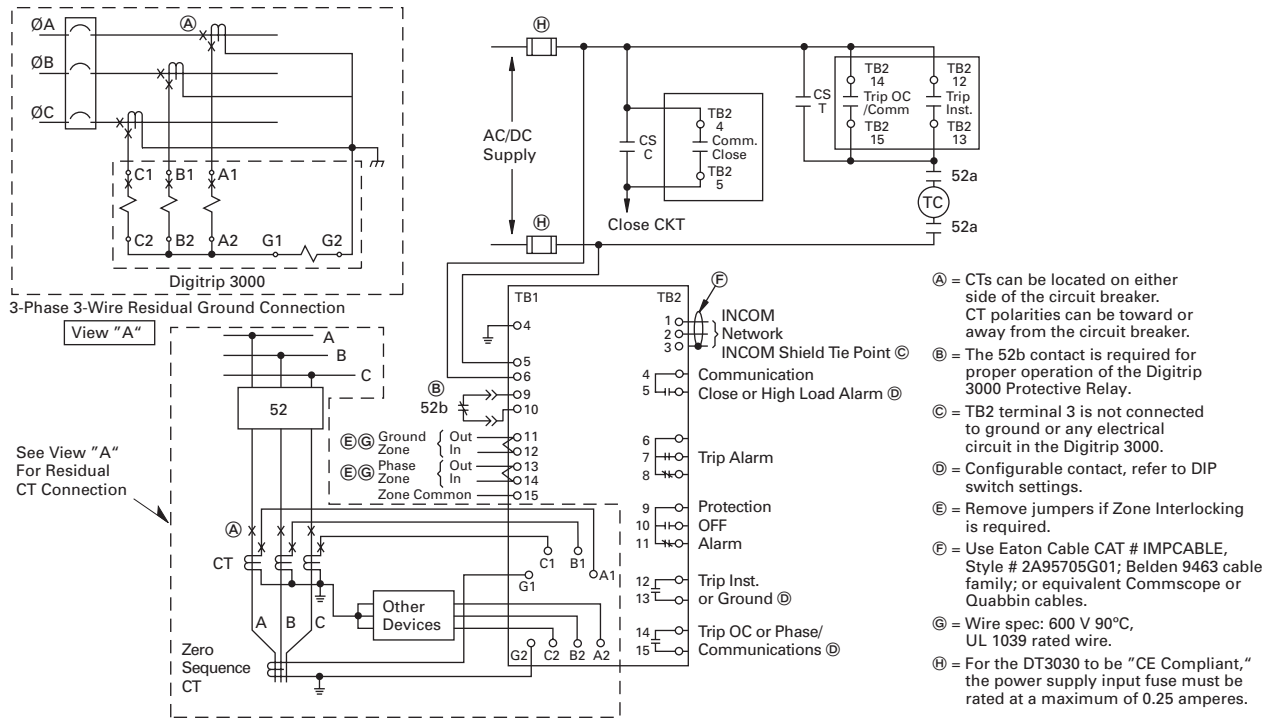
- (A) CT'S CAN BE LOCATED ON EITHER SIDE OF THE CIRCUIT BREAKER. CT POLARITIES CAN BE TOWARD OR AWAY FROM THE CIRCUIT BREAKER.
- (B) THE 52b CONTACT IS REQUIRED FOR PROPER OPERATION OF THE DIGITRIP 3001 TRIP UNIT.
- (C) TERMINAL 44 IS NOT CONNECTED TO GROUND OR ANY ELECTRICAL CIRCUIT IN THE DIGITRIP 3001.
- (D) CONFIGURABLE CONTACT - REFER TO DIP SWITCH SETTINGS.
- (E) REMOVE JUMPERS IF ZONE INTERLOCKING IS REQUIRED.
- (F) USE CUTLER-HAMMER CABLE CAT# IMPCABLE, STYLE# 2A95705G01 OR BELDEN 9463 CABLE FAMILY OR IDENTICAL EQUIVALENT COMMSCOPE OR QUABBIN CABLES.

22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

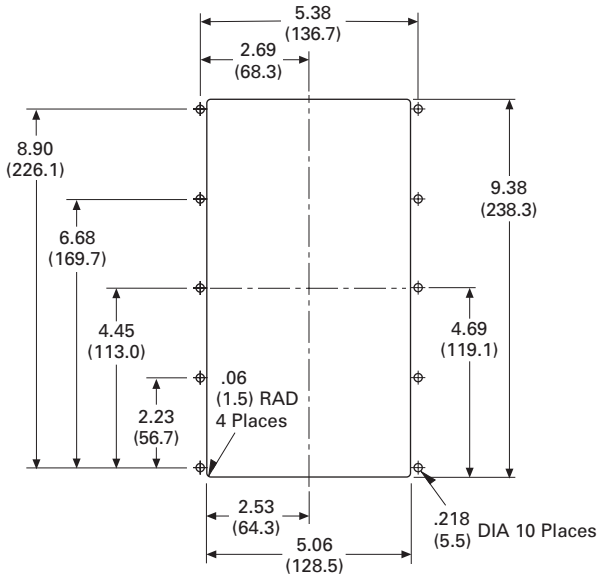
Digitrip 3000 Typical Wiring Diagram



Dimensions

Approximate Dimensions in Inches (mm)

Drilling Pattern

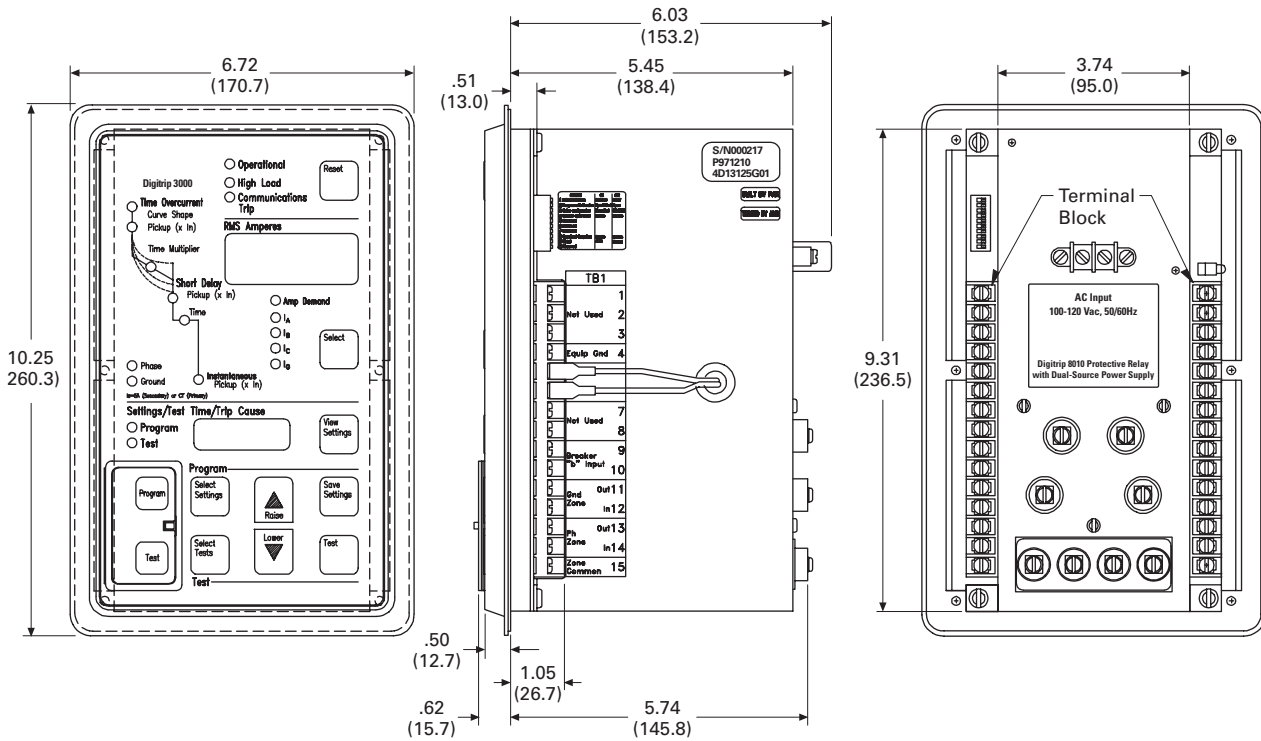


Note

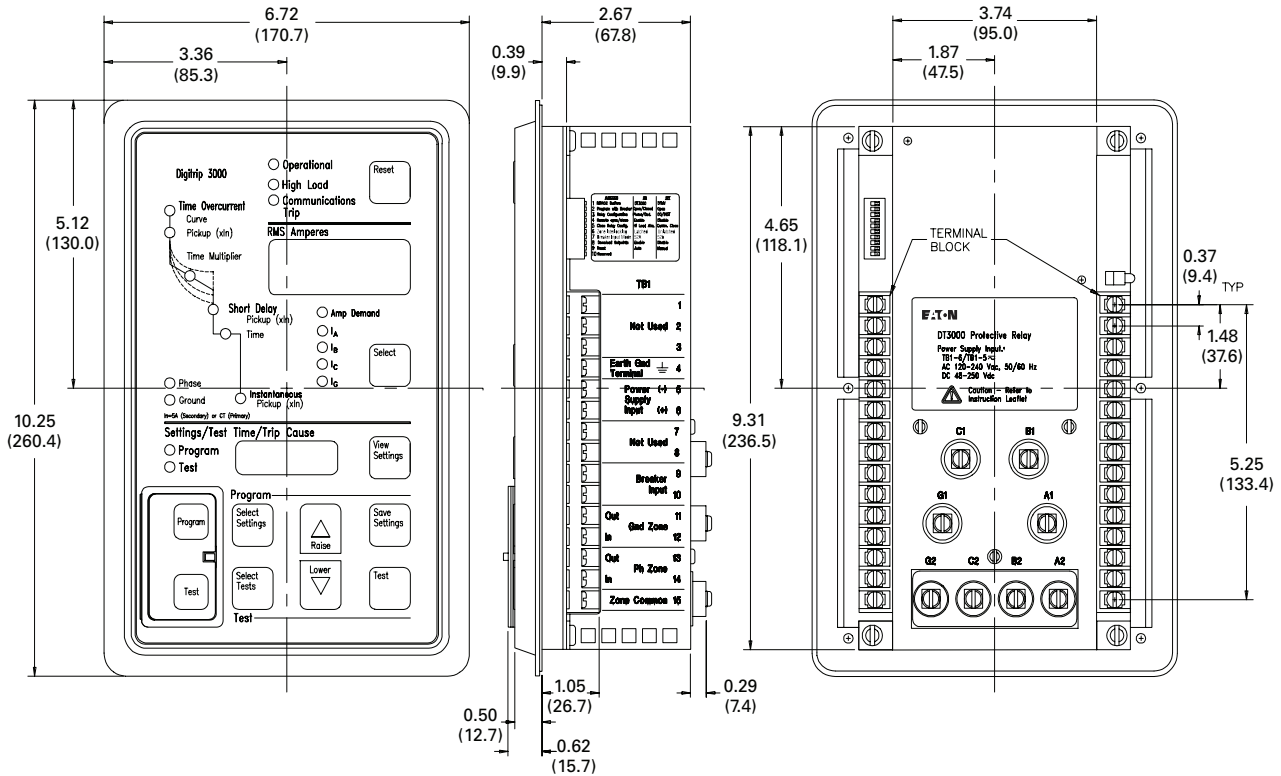
Panel cutout dimensions for all versions of the Digitrip 3000 relay.

Approximate Dimensions in Inches (mm)

Digitrip 3010/3020



Digitrip 3000



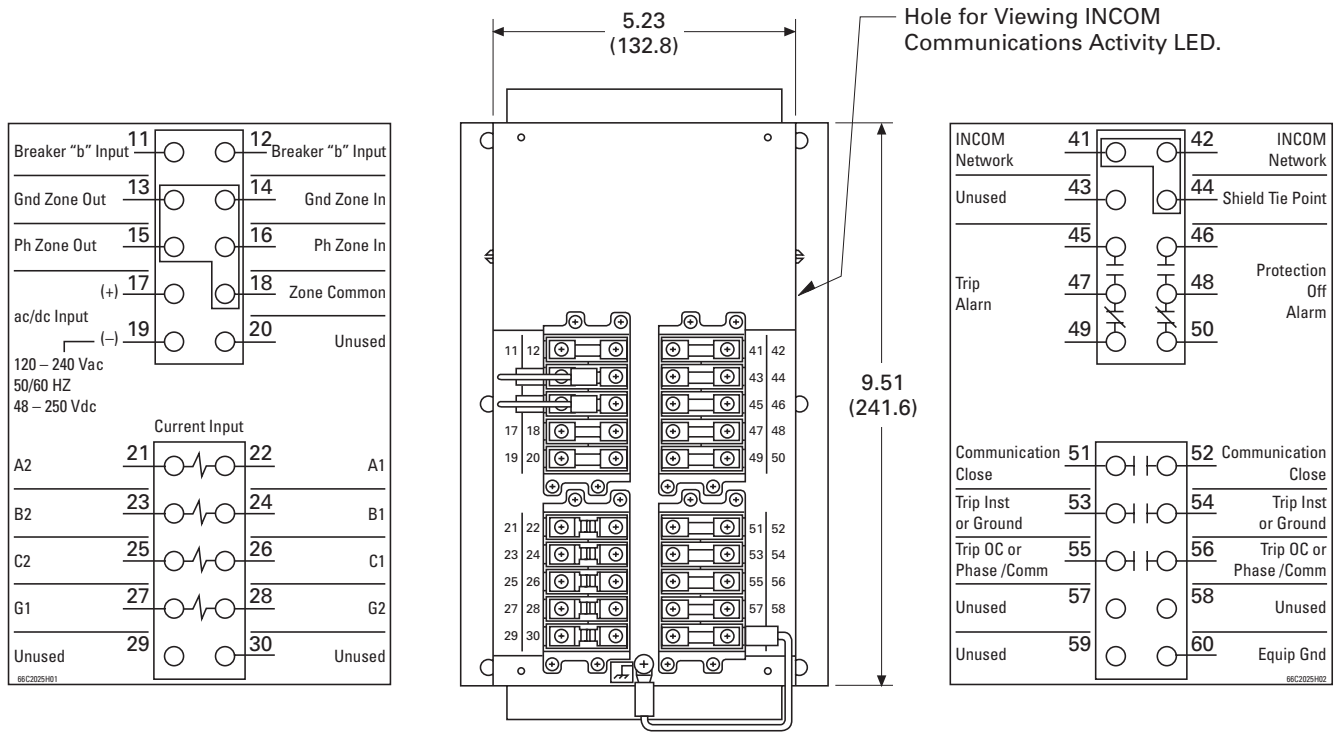
22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

Approximate Dimensions in Inches (mm)

Rear View of Digitrip 3001 Drawout Outer Case Terminal Layout



Digitrip-3000 Feeder Protection Relay (Fixed Case)

| Height | Width | Depth | Shipping Weight Lbs (kg) |
|---------------|--------------|-------------|-----------------------------|
| 10.25 (260.4) | 6.72 (170.7) | 2.96 (75.2) | 0.0 (0.0) |

VR-300



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VR-300 Multifunctional Voltage Relay

Product Description

The VR-300 is an industrial grade protective relay that offers multiple protective features in a single package, ideal for standalone protection or for the implementation of transfer schemes.

Using a digital processor to measure true rms values enables a high degree of measuring accuracy

regardless of harmonics, transients or disturbing pulses.

The compact size and multiple functions of the VR-300 help to simplify switchgear design. The digital display offers a user-friendly interface to set up the unit as well as monitor the operation and display any alarms.

Features, Benefits and Functions

- Over-/undervoltage monitoring (59/27)
- Over-/underfrequency monitoring (81O/U)
- Voltage asymmetry monitoring (47)
- Synch-check (25) fixed to relay 3
- Zero voltage monitoring: dead bus start functionality (close CB to dead bus)
- Two configurable relays
- Discrete input for blocking of protective functions or remote acknowledgment

Standards and Certifications

- EMC-Test (CE): Tested according to applicable EN guidelines
- Listings: CE Marking; UL listing for ordinary locations, UL/cUL listed, ordinary locations, File No.: E231544
- Additional approvals: IEEE C37.90.1 and C37.90.2



Technical Data and Specifications

Measuring Voltage

- Standard (V_{rated}) delta: 66/115 Vac
- Maximum value V_{ph-ph} max., (UL/cUL): Max. 150 Vac
- Rated voltage $V_{ph-ground}$: 50 Vac/2.5 kV
- Rated surge voltage: 2.5 kV
- Measuring frequency: 40.0 to 80.0 Hz
- Accuracy: Class 1
- Linear measuring range: $1.3 \times V_{rated}$
- Input resistance: 0.21 M ohms
- Maximum power consumption per path: < 0.15W

Ambient Variables

- Wide range power supply: 90 to 250 Vac/Vdc
- Intrinsic consumption: Max. 12 VA
- Ambient temperature:
 - Storage: -22°F to 176°F (-30°C to 80°C)
 - Operational: -4°F to 158°F (-20°C to 70°C)
- Ambient humidity: 95%, noncondensing
- Maximum altitude: 6562 ft (2000m)
- Degree of pollution: 2

Discrete Inputs—Isolated

- Input range ($V_{Cont, Discrete Input}$): Rated voltage 18 to 250 Vac/Vdc
- Input resistance: Approximately 68 K ohms

Relay Outputs—Potential Free

- Contact material: AgCdO
- General purpose (GP) ($V_{Cont, Relay Output}$):
 - AC: 2.00 Aac at 250 Vac
 - DC: 2.00 Adc at 24 Vdc, 0.22 Adc at 125 Vdc, 0.10 Adc at 250 Vdc
- Pilot duty (PD) ($V_{Cont, Relay Output}$):
 - AC: B300
 - DC: 1.00 Adc at 24 Vdc, 0.22 Adc at 125 Vdc, 0.10 Adc at 250 Vdc

Housing

- Type: APRANORM DIN 43 700
- Wiring: Screw-type, terminals 2.5 mm² (0.0039 in.²)
- Recommended tightening torque: 0.5 Nm (0.369 ft/lbs). Use 140/167°F (60/75°C) Copper Wire Only. Use Class 1 Wire Only (or Equivalent)

Protection

- Protection system: IP42 from front with correct mounting
 - IP54 from front with gasket
 - (Gasket: P/N 8923-1036) IP20 from back
- Front foil: Insulating surface

Typical Nameplate

Typical VR-300 Nameplate



| Terminal | Label | Description |
|----------|---------|---------------------------|
| 1 | S/N | Serial number (numerical) |
| 2 | S/N | Date of production (YYMM) |
| 3 | S/N | Serial number (Barcode) |
| 4 | P/N | Item number |
| 5 | REV | Item revision number |
| 6 | Details | Technical data |
| 7 | Type | Description (long) |
| 8 | Type | Description (short) |
| 9 | UL | UL sign |

Reference Information

Reference Conditions

| Measuring Value | Display Range | Accuracy |
|---------------------------------|----------------------|----------|
| Frequency | | |
| fl1, fl2, fl3 | 40.0 to 80.0 Hz | 0.05 Hz |
| Voltage | | |
| VL1, VL2, VL3, VL12, VL23, VL31 | 0 to 520, 0 to 65 kV | 1% ① |

The data apply to the following reference conditions:

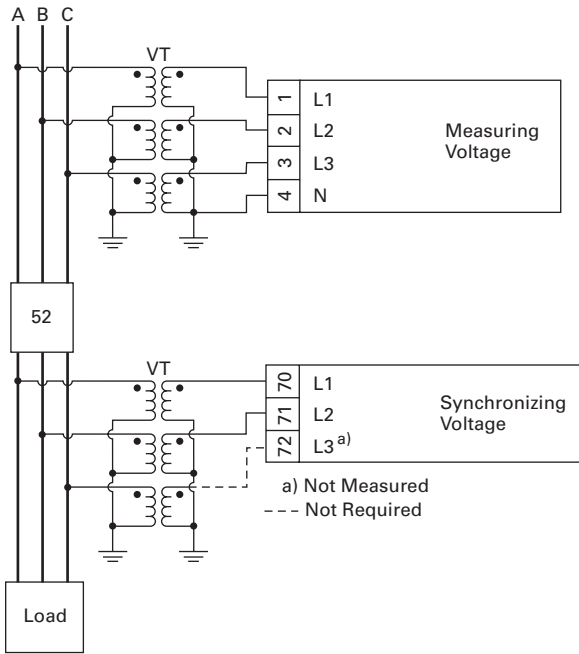
- Input voltage = Sinusoidal rated voltage
- Frequency = Rated frequency $\pm 2\%$
- Power supply = Rated voltage $\pm 2\%$
- Power factor $\cos \phi = 1$
- Ambient temperature = 73°F (23°C) $\pm 2K$
- Warm-up period = 20 minutes

Note

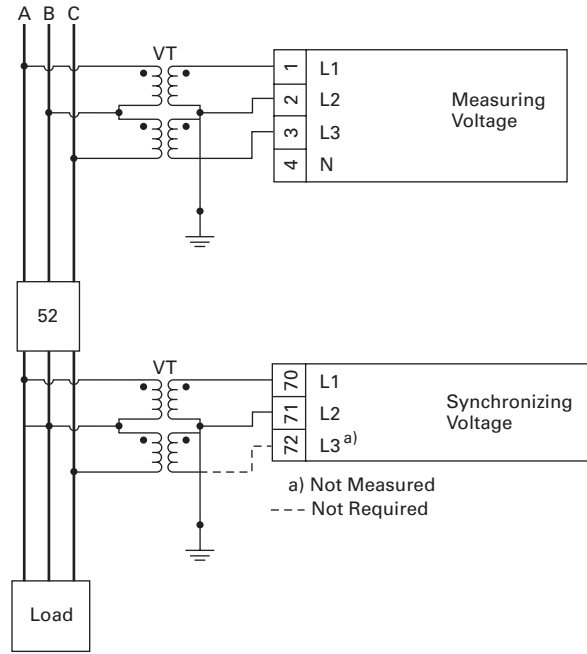
- ① Accuracy depending on the configured transformer ratio.

Wiring Diagrams

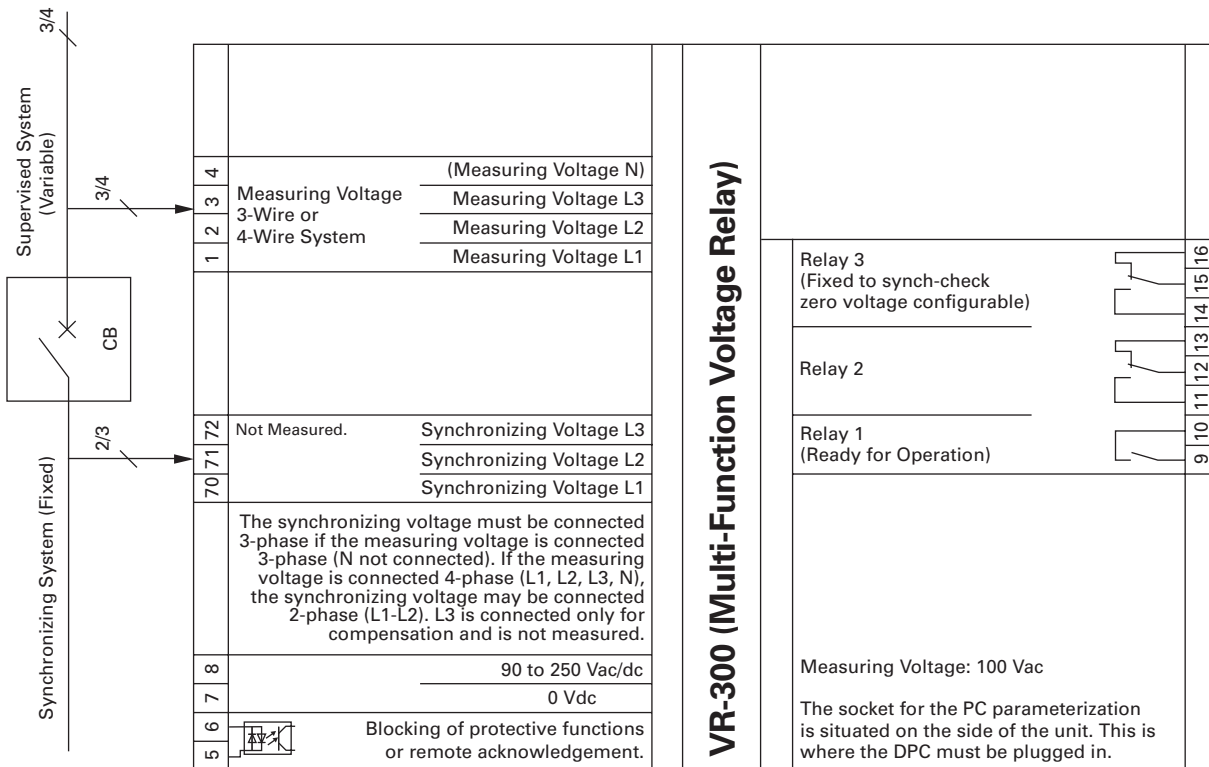
Three-Line Wye



Three-Line Delta



VR-300



Subject to Technical Modifications.

22.4

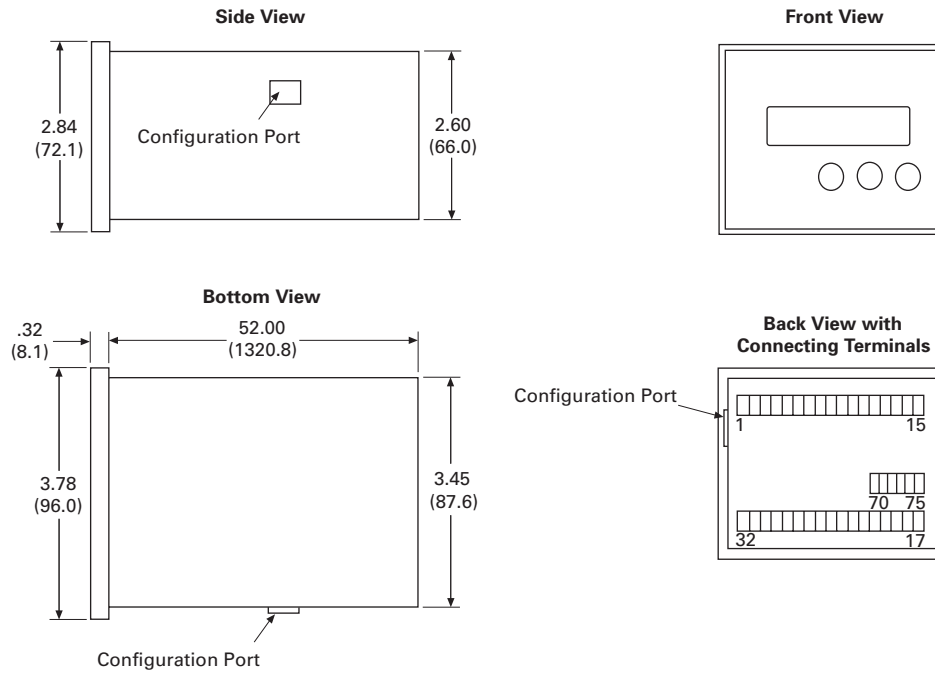
Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

Dimensions

Approximate Dimensions in Inches (mm)

VR-300



Front Panel Cutout

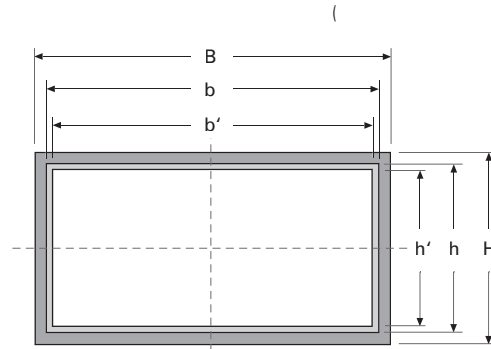
| Width | Height |
|----------------------------|----------------------------|
| 3.62 [+0.03] (92.0 [+0.8]) | 2.68 [+0.03] (68.0 [+0.7]) |

VR-300 Dimensions

| Width | Height | Depth | Shipping Weight Lbs (kg) |
|-------------|-------------|--------------|-----------------------------|
| 3.78 (96.0) | 2.84 (72.1) | 5.20 (132.1) | 2.14 (0.97) |

VR-300 Panel Cutout

| Measure | Description | Dimensions in Inches (mm) | Tolerance in Inches (mm) |
|------------------------------------|-------------------|------------------------------|-----------------------------|
| Height | | | |
| H | Total | 2.83 (71.9) | — |
| h | Panel cutout | 2.68 (68.1) | 0.03 (+0.7) |
| h' | Housing dimension | 2.60 (66.0) | — |
| Width | | | |
| B | Total | 3.78 (96.0) | — |
| b | Panel cutout | 3.62 (91.9) | 0.03 (+0.8) |
| b' | Housing dimension | 3.54 (89.9) | — |
| Depth (Including Terminals) | | | |
| | Total | 6.30 (160.0) | — |



The maximum permissible corner radius for cutout is 0.08 inches (2.0 mm).

DP-300



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DP-300 Current Differential Protection Relay

Product Description

The current flowing in the individual conductors is measured by means of current transformers installed on both sides of the protection zone. These transformers form the limits of the protection zone. By means of freely configurable relays, the unit will indicate if any of the adjusted fault current limits have been exceeded. The unit counts with a slope characteristic to prevent operation due to CT ratio mismatches, CT ratio errors, CT saturation and errors because of tap changes.

For transformer applications, the unit has 2nd and 5th harmonic restraints to prevent misoperation in case of inrush currents caused for energization or over excitation of the transformer.

When used in transformer applications, the DP-300 allows you to change the phase shift of the transformer, without having to worry about changing the connection of the external CTs, via selecting the vector group in the display. The different nominal currents of the high and low voltage side of the transformer, as well as the transformer ratio, may be configured. Every measuring point may be set separately. These features permit the DP-300 to be universal in its applications.

The DP-300 permits design simplification of the switchgear cabinet, facilitates the commissioning, ensures the operation of the system, is user friendly and increases the availability of the system.

Application Description

The DP-300 offers a three-phase current differential protection for generators, motors and two winding transformers, see **Page 347**.

Features, Benefits and Functions

- True rms 6 x current measurement, three-phase system on both sides of the protected zone
- Secondary current transformer output available as: /1A or /5A
- Configurable trip set points for:
 - Differential current (Id)
 - Restrain current (Is)
- Configurable delays
- Four alarm relays
- Three discrete inputs (for blocking, acknowledgment and configuration)
- Two-line LC display
- Configurable transformer ratio
- Configurable vector group
- Transformer inrush detection/suppression
- Individual configuration of the nominal current for the high- and low-voltage side of the transformer
- Configurable transformer ratio separated for currents of high- and low-voltage side of the transformer

Standards and Certifications

- Listings: CE marking; UL listing for ordinary locations, UL/cUL listed, ordinary locations, File No.: E231544
- Additional Approvals: IEEE C37.90.1 and C37.90.2

- EMC-Test (CE): Tested according to applicable EN guidelines



Technical Data and Specifications

Measurements, Currents—Isolated

- Measured currents (Nominal value IN): /5A
- Measuring frequency: 40.0 to 70.0 Hz
- Accuracy: Class 1
- Linear measuring range: 5.0 x IN
- Maximum power consumption per path: < 0.15 VA
- Rated short time current (1s): 30.0 x IN

Ambient Conditions

- Voltage supply: 90 to 250 Vac/Vdc
- Intrinsic consumption: Max. 10 VA
- Ambient temperature storage: -22°F to 176°F (-30°C to 80°C)
- Operational: -4°F to 158°F (20°C to 70°C).
- Ambient humidity: 95%, noncondensing
- Maximum altitude: 6562 ft (2000m)
- Degree of pollution: 2

Digital Inputs—Isolated

- Input range (V_{Cont, Digital Input}):
 - Nominal voltage
 - 18 to 250 Vac/Vdc
- Input resistance: Approximately 68 K ohms

Relay Outputs—Isolated

- Contact material: AgCdO
- Resistive load (GP) (V_{Cont, Relay Output}):
 - AC: 2.00 Aac @ 250 Vac
 - DC: 2.00 Adc @ 24 Vdc, 0.36 Adc @ 125 Vdc, 0.18 Adc @ 250 Vdc
- Inductive load (PD) (V_{Cont, Relay Output}):
 - AC: B300
 - DC: 1.00 Adc @ 24 Vdc, 0.22 Adc @ 125 Vdc, 0.10 Adc @ 250 Vdc

Protective Functions

- Operating Time: Minimum 100ms
- Differential current: Minimum 10%

Housing

- Type: APRANORM DIN 43 700
- Terminals: Screw-type, terminals depending on connector, 0.00388 in.² (2.5 mm²) or 0.00620 in.² (4.0 mm²)
- Recommended tightening torque:
 - 4.43 in./lbs / [0.00620 in.²] 5.3 in./lbs)
 - [2.5 mm²] 0.5 Nm / [4.0 mm²] 0.6 Nm ([0.00388 in.²])
- Use 140°F/167°F (60°C/75°C) copper wire only
- Use Class 1 wire only (or equivalent)

Housing Protection

- Protection system:
 - IP42 from front with correct mounting
 - IP54 from front with gasket
 - Gasket: P/N 8923-1038)
 - IP20 from back
- Front foil: Insulating surface

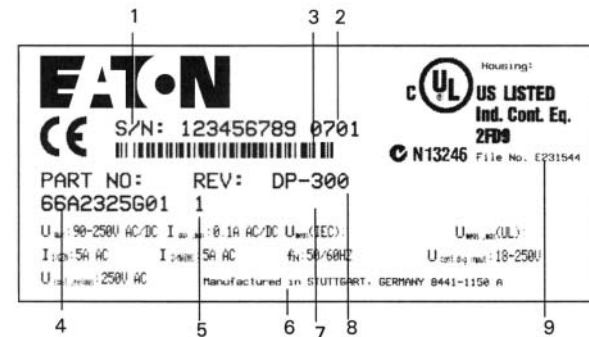
Transformer Vector Groups

Transformer Vector Groups

| Vector Group | Description |
|--------------|---|
| Yd5 | HV: λ-Circuit Arrangement, LV: Δ-Circuit Arrangement, 5 x 30° = 150° |
| Yy0 | HV: λ-Circuit Arrangement, LV: λ-Circuit Arrangement, 0° |
| Dy5 | HV: Δ-Circuit Arrangement, LV: λ-Circuit Arrangement, 5 x 30° = 150° |
| Dd0 | HV: Δ-Circuit Arrangement, LV: Δ-Circuit Arrangement, 0° |
| Yz5 | HV: λ-Circuit Arrangement, LV: Z-Circuit Arrangement, 5 x 30° = 150° |
| Dz0 | HV: Δ-Circuit Arrangement, LV: Z-Circuit Arrangement, 0° |
| Yd11 | HV: λ-Circuit Arrangement, LV: Δ-Circuit Arrangement, 11 x 30° = 330° |
| Yy6 | HV: λ-Circuit Arrangement, LV: λ-Circuit Arrangement, 6 x 30° = 180° |
| Dy11 | HV: Δ-Circuit Arrangement, LV: λ-Circuit Arrangement, 11 x 30° = 330° |
| Dd6 | HV: Δ-Circuit Arrangement, LV: Δ-Circuit Arrangement, 6 x 30° = 180° |
| Yz11 | HV: λ-Circuit Arrangement, LV: Z-Circuit Arrangement, 11 x 30° = 330° |
| Dz6 | HV: Δ-Circuit Arrangement, LV: Z-Circuit Arrangement, 6 x 30° = 180° |

Typical Nameplate

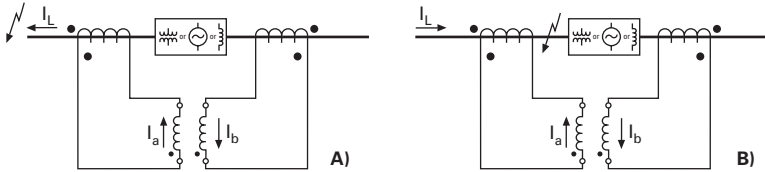
Typical DP-300 Nameplate



| | | |
|---|---------|---------------------------|
| 1 | S/N | Serial Number (Numerical) |
| 2 | S/N | Date of Production (YYMM) |
| 3 | S/N | Serial Number (Bar Code) |
| 4 | P/N | Item Number |
| 5 | REV | Item Revision Number |
| 6 | Details | Technical Data |
| 7 | Type | Description (Long) |
| 8 | Type | Description (Short) |
| 9 | UL | UL Sign |

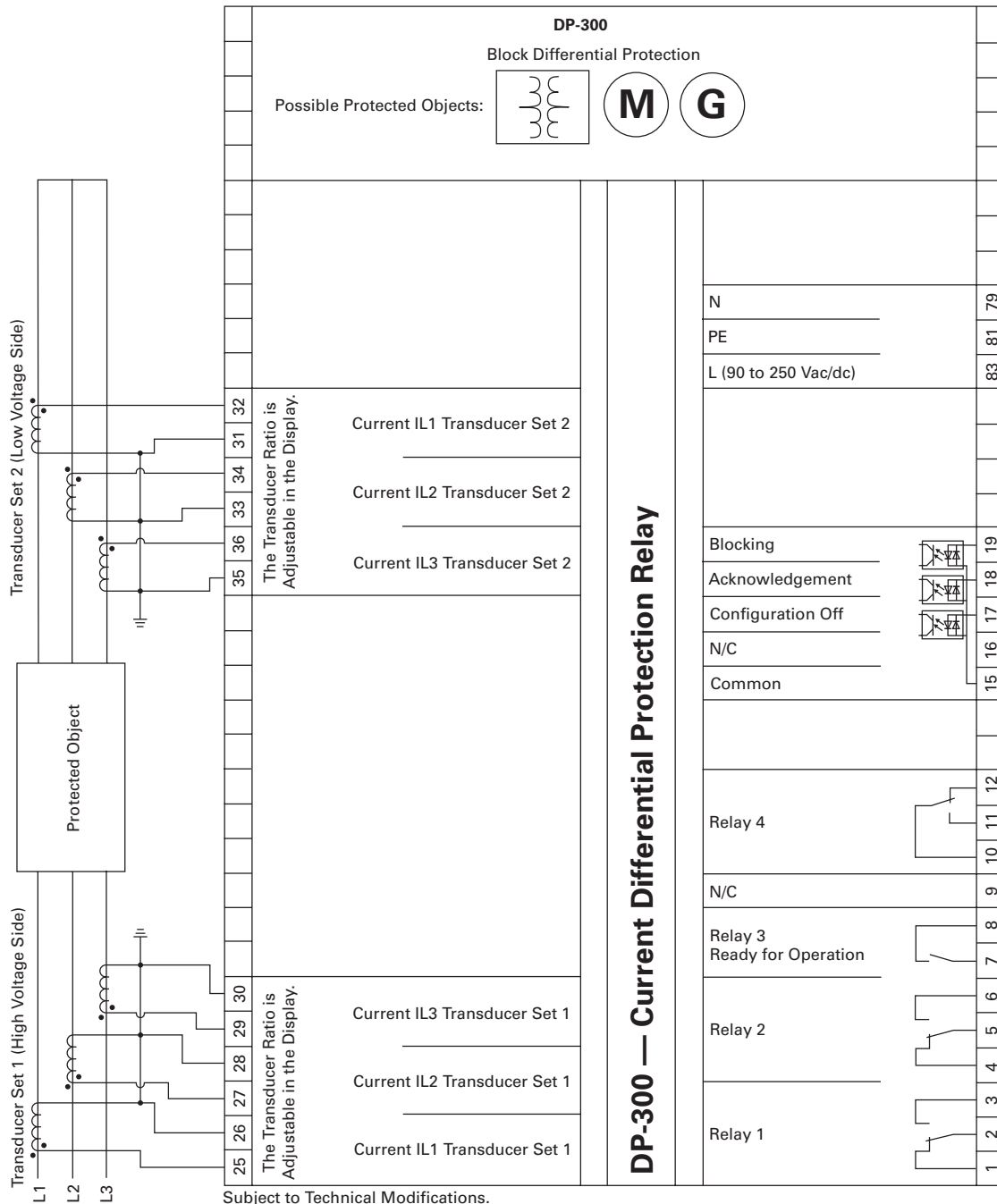
Wiring Diagrams

Protected Area Principle—Fault “A” Outside = No Alarm, Fault “B” Inside = Alarm



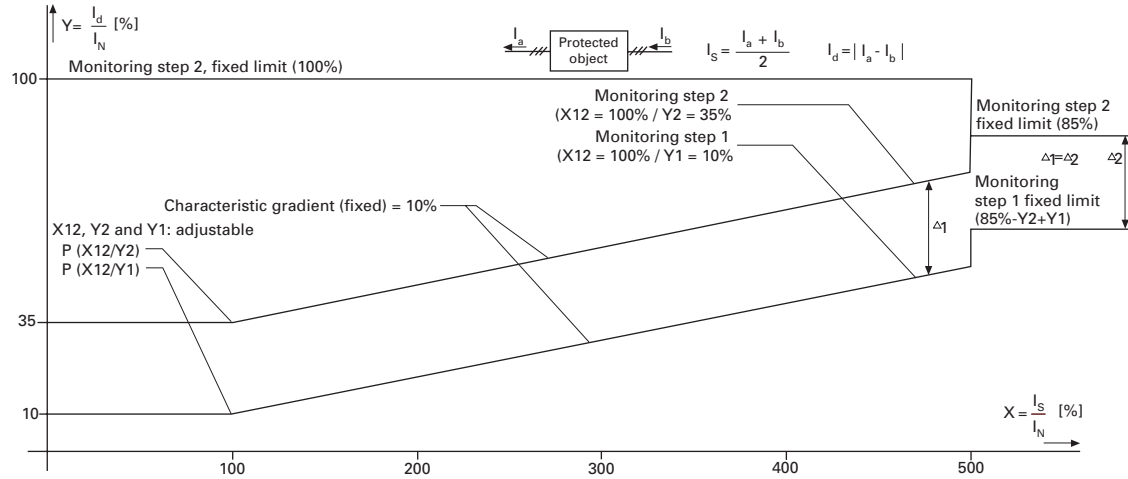
Schematic Circuit Diagrams (Single-Phase Version):
 A) Fault Outside the Protection Area
 B) Fault Inside the Protection Area

DP-300



Tripping Characteristics

DP-300



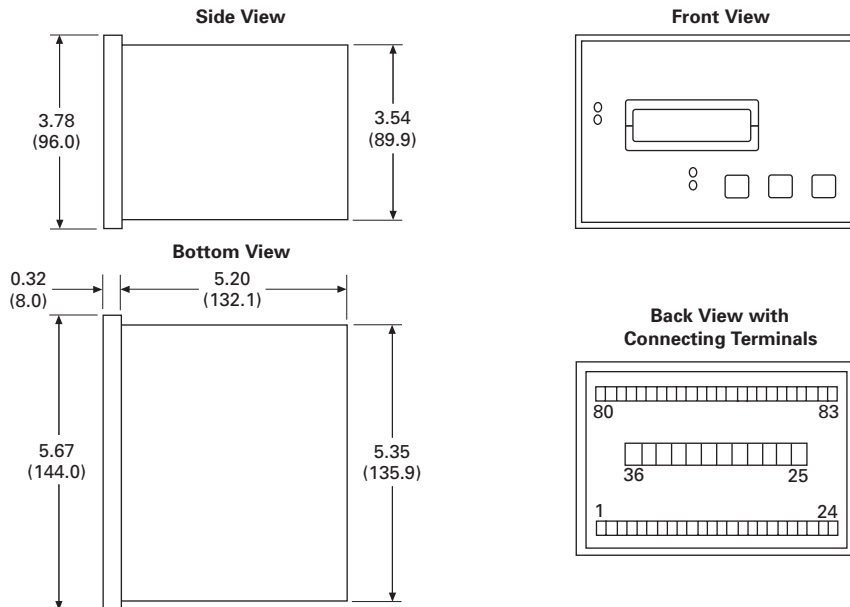
Dimensions

Approximate Dimensions in Inches (mm)

DP-300

| Width | Height | Depth | Shipping Weight Lbs (kg) |
|--------------|-------------|--------------|-----------------------------|
| 5.67 (144.0) | 3.78 (96.0) | 5.20 (132.1) | 2.2 (0.99) |

DP-300



Approximate Dimensions in Inches (mm)

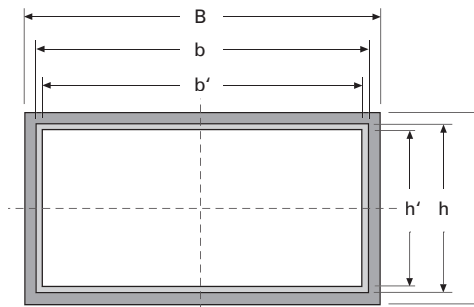
Front panel cutout

| Width | Height |
|------------------------------|-----------------------------|
| 5.43 [+0.039] (138.0 [+1.0]) | 3.63 [-0.031] (92.0 [+0.8]) |

DP-300 Panel Cutout

| Measure | Description | Dimensions | Tolerance |
|------------------------------------|-------------------|--------------|-------------|
| Height | | | |
| H | Total | 3.78 (96.0) | — |
| h | Panel cutout | 3.62 (91.9) | 0.03 (+0.8) |
| h' | Housing dimension | 3.54 (89.9) | — |
| Width | | | |
| B | Total | 5.67 (144.0) | — |
| b | Panel cutout | 5.43 (137.9) | 0.04 (+1.0) |
| b' | Housing dimension | 5.35 (135.9) | — |
| Depth (Including Terminals) | | | |
| | Total | 6.30 (160.0) | — |

The maximum permissible corner radius for cutout is 0.08 inches (2.0 mm).



EDR-3000



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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.

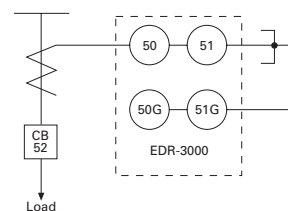
Current monitoring and operator selectable protective functions are integral to each relay. The EDR-3000 relay operates from the 5A or 1A secondary output of standard current transformers. Current transformer ratio information is quickly programmed into the unit via settings. This enables the relay to 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

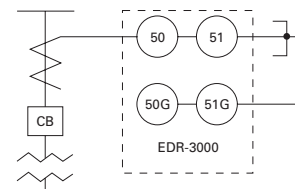
The EDR-3000 microprocessor-based relay provides reliable three-phase and ground overcurrent protection for all voltage levels. It can be used for any application where instantaneous and/or time overcurrent protection is required. It is most commonly used as primary feeder circuit protection, shown below.

Primary Feeder Circuit Protection



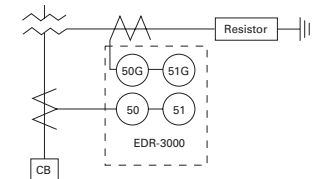
The EDR-3000 may be applied as the transformer primary protection or as backup to the differential protection, see below.

Transformer Overcurrent Protection



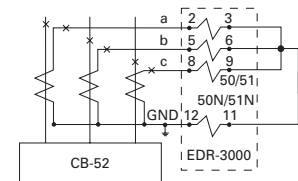
The EDR-3000 may be connected to the secondary side of a delta-wye grounded transformer with the ground element connected to a separate CT in the neutral connection of the transformer. With this connection, a lower CT ratio and a pickup setting can be used to provide more sensitive ground fault protection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

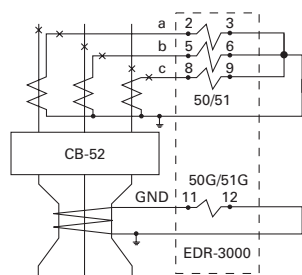
Residual Ground Connection



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 50,000A of primary current and 1 or 5A 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 353**.

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.

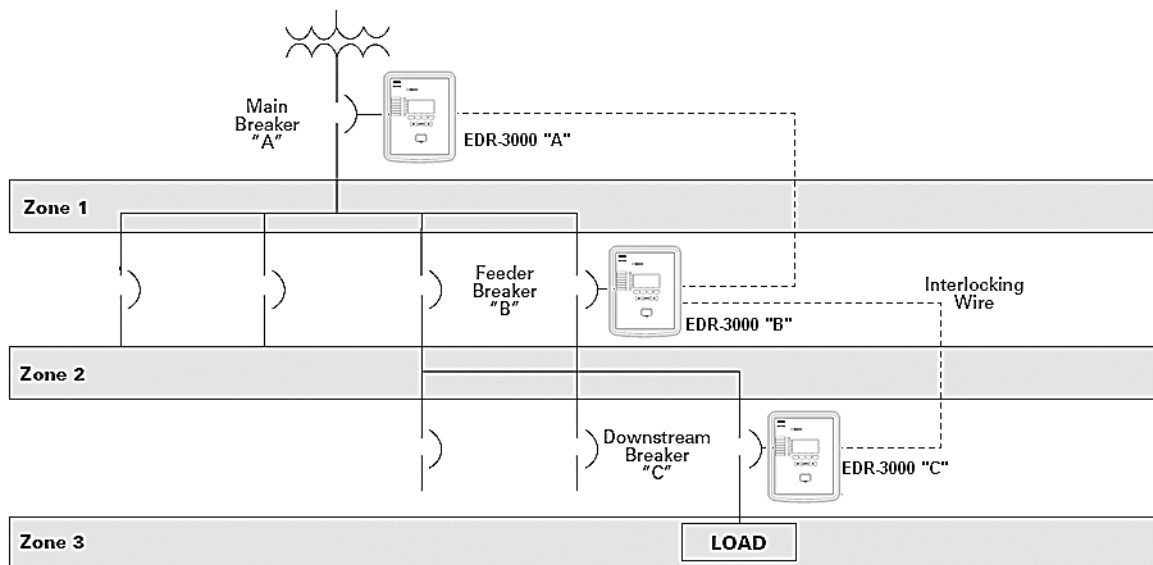
If a fault occurs at a point in Zone 2, the EDR-3000 of feeder breaker B senses the fault and sends a restraining signal to the upstream EDR-3000 of main breaker A. The EDR-3000 of the downstream breaker C does not see this fault since it is situated on the downstream side of the fault. As a result, 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 353** (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 353** (Catalog Ordering Information) for optional features.

- Breaker wear (accumulated interrupted current)
- Fault data logs (up to 20 events)
- Sequence of event recorders (up to 300 events)
- Waveform capture (3600 cycles total)
- CT supervision

Control Functions

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

Communication

- Local HMI
- Front RS-232 port
- Rear RS-485 port
- IRIG-B11
- Protocols
 - Modbus RTU

Standards and Certifications

- Generic standard:
 - EN 61000-6-2
 - EN 61000-6-3
- Product standard:
 - EC 60255-6
 - EN 50178
- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 14-95 (Industrial Control Equipment)
- ANSI C37.90
- 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 were EDR3000-A0BA1, the device would have the following:

EDR-3000

(A)—Four digital inputs, four output relays

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

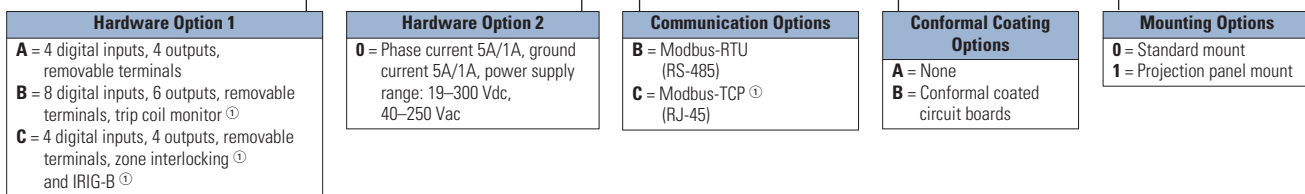
(B)—Modbus-RTU (RS-485)

(A)—Without conformal coating

(1)—Projection panel mount

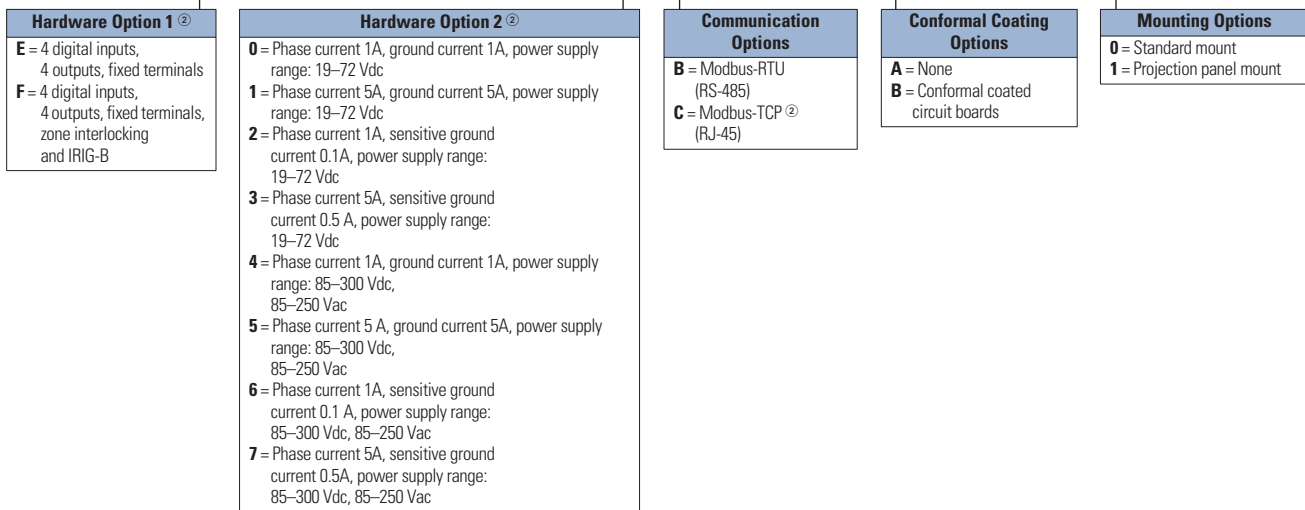
Relay Removable Terminals

EDR3000 A 0 B A 1



Relay Fixed Terminals ②

EDR3000 E 0 B A 1



Notes

- ① Consult factory for the availability of eight digital inputs, six outputs, trip coil monitor, zone interlocking, IRIG-B and Modbus-TCP.
- ② Consult factory for the availability of fixed terminals.

Technical Data and Specifications

Climatic Environmental Conditions

- Storage temperature: –13°F to 158°F (–25°C up to +70°C)
- Operating temperature: –4°F to 140°F (–20°C up to +60°C)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible Installation altitude:
 - <2000m (6561.67 ft) above sea level
 - If 4000m (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 ($\pm 45^\circ$ around the X-axis must be permitted)

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

- Nominal current: 1A and 5A
- Continuous loading capacity: $4 \times I_N$ /continuously
- Overcurrent withstand: $30 \times I_N/10s$
- $100 \times I_N/1s$
- $250 \times I_N/10ms$ (1 half-wave)
- Screws: M4, captive type according to VDEW
- Connection cross-sections:
 - $2 \times 2.5 \text{ mm}^2$ (2 x AWG 14) with wire end ferrule
 - $1 \times$ or $2 \times 4.0 \text{ mm}^2$ (2 x AWG 12) with ring cable sleeve or cable sleeve
 - $1 \times$ or $2 \times 6 \text{ mm}^2$ (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: $\geq 50ms$ at minimal aux. voltage communication is permitted to be interrupted
- Max. permissible making current:
 - 18A peak value for <0.25 ms
 - 12A peak value for <1 ms
- The voltage supply must be protected by a fuse of:
 - 2.5A time-lag miniature fuse $5 \times 20 \text{ mm}$ (approx. $1/5 \text{ in.} \times 0.8 \text{ in.}$) according to IEC 60127
 - 3.5A time-lag miniature fuse $6.3 \times 32 \text{ mm}$ (approx. $1/4 \text{ in.} \times 1 \frac{1}{4} \text{ in.}$) according to UL 248-14

Power Consumption

- Power supply range: Power consumption in idle mode
- Max. power consumption
- 19–300 Vdc: 6W 8.5W
- 40–250 Vac
- For frequencies of 40–70 Hz: 6W 8.5W

Real-Time Clock

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

Display

- Display type: LCD with LED background illumination
- Resolution graphics display: 128×64 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: $U_N = 24 \text{ Vdc}, 48 \text{ Vdc}, 60 \text{ Vdc}, 110 \text{ Vac/dc}, 230 \text{ Vac/Vdc}$ $U_N = 24 \text{ Vdc}$
 - Switching threshold 1 ON
 - Switching threshold 1 OFF
 - Min. 19.2 Vdc
 - Max. 9.6 Vdc
 - $U_N = 48 \text{ V}/60 \text{ Vdc}$
 - Switching threshold 2 ON
 - Switching threshold 2 OFF
 - Min. 42.6 Vdc
 - Max. 21.3 Vdc
 - $U_N = 110/120 \text{ Vac/dc}$
 - Switching threshold 3 ON
 - Switching threshold 3 OFF
 - Min. 88.0 Vdc/88.0 Vac
 - Max. 44.0 Vdc/44.0 Vac
 - $U_N = 230/240 \text{ Vac/Vdc}$
 - 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: 1A/5A
- Max. measuring range:
 - up to $40 \times I_n$ (phase currents)
 - up to $25 \times I_n$ (ground current standard)
 - up to $2.5 \times I_n$ (ground current sensitive)
- Continuous loading capacity: $4 \times I_n$ /continuously
- Overcurrent proof:
 - $30 \times I_n/10s$
 - $100 \times I_n/1s$
 - $250 \times I_n/10 ms$ (1 half-wave)
- Power consumption: Phase current inputs
 - at $I_n = 1A S = 0.15 mVA$
 - at $I_n = 5A S = 0.15 mVA$
- Ground current input
 - at $I_n = 1A S = 0.35 mVA$
 - at $I_n = 5A S = 0.35 mVA$
- Frequency range: 50 Hz/60 Hz $\pm 10\%$
- Terminals: Screw-type terminals with integrated short-circuiters (contacts)

Binary Output Relays

- Continuous current: 5A AC/DC
- Switch-on current: 25A AC/DC for 4s
- Max. breaking current: 5A AC up to 125 Vac
- 5A DC up to 50V (resistive)
- 0.2A DC at 300V
- 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 $40 \times I_n$ (phase currents) up to $25 \times I_n$ (ground current standard)
- Frequency range: 50 Hz/60 Hz $\pm 10\%$
- Accuracy: Class 0.5
- Amplitude error if $I < I_n$: $\pm 0.5\%$ of the rated value
- Amplitude error if $I > I_n$: $\pm 0.5\%$ of the measured value
- Amplitude error if $I > 2 I_n$: $\pm 1.0\%$ of the measured value
- Resolution: 0.01A
- Harmonics up to 20% 3rd harmonic $\pm 2\%$ up to 20% 5th harmonic $\pm 2\%$
- Frequency influence < $\pm 2\%/Hz$ in the range of $\pm 5 Hz$ of the parameterized nominal frequency
- Temperature influence < $\pm 1\%$ within the range of 0°C up to +60°C

Protection Stages Tolerances**Overcurrent Protection Stages 50P(X), 51P(X)**

| Description | | Range | Step | Tolerance |
|------------------|--|------------------------------|-----------------------|--|
| Pickup | If the pick-up value is exceeded, the module/stage is started. | 0.01–40.00 x I _n | 0.01 x I _n | ±1.5% of the setting value resp. 1% I _n |
| Resetting ratio | | 97% or 0.5% x I _n | — | — |
| t | Tripping delay | 0.00–300.00 x s | 0.01 x s | DEFT ±% resp. ±10 ms |
| Operating time | Starting from I higher than 1.1 x I _{>} | — | — | <+35 ms |
| Disengaging time | | — | — | <+45 ms |
| t-multiplier | Time multiplier/tripping characteristic factor | 0.05–2.00 | 0.01 | ±5% |
| | IEC NINV | 0.05–2.00 | 0.01 | ±5% |
| | IEC VINV | 0.05–2.00 | 0.01 | ±5% |
| | IEC EINV | 0.05–2.00 | 0.01 | ±5% |
| | IEC LINV | 0.05–2.00 | 0.01 | ±5% |
| | ANSI MINV | 0.05–2.00 | 0.01 | ±5% |
| | ANSI VINV | 0.05–2.00 | 0.01 | ±5% |
| | ANSI EINV | 0.05–2.00 | 0.01 | ±5% |
| | Flat | 0.05–2.00 | 0.01 | ±5% |
| | I _t | 0.05–2.00 | 0.01 | ±5% |
| | I ² _t | 0.05–2.00 | 0.01 | ±5% |
| | I ⁴ _t | 0.05–2.00 | 0.01 | ±5% |
| Reset mode | Only available if IEC characteristics | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC NINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC VINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC EINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC LINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | Reset curves if ANSI characteristics | — | — | 5% |
| | ANSI MINV | — | — | 5% |
| | ANSI VINV | — | — | 5% |
| | ANSI EINV | — | — | 5% |
| | Flat | — | — | 5% |
| | I _t | — | — | 5% |
| | ANSI MINV | — | — | 5% |
| | I ² _t | — | — | 5% |
| | I ⁴ _t | — | — | 5% |

Note

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

Ground Current Stages 50G(X), 50N(X), 51G(X), 51N(X)

| Description | | Range | Step | Tolerance |
|------------------|--|------------------------------|-----------------------|--|
| Pickup | If the pick-up value is exceeded, the module/stage is started. | 0.01–40.00 x I _n | 0.01 x I _n | ±1.5% of the setting value resp. 1% I _n |
| Resetting ratio | | 97% or 0.5% x I _n | — | — |
| t | Tripping delay | 0.00–300.00 x s | 0.01 x s | DEFT ±% resp. ±10 ms |
| Operating time | Starting from IG higher than 1.1 x I> | — | — | <+35 ms |
| Disengaging time | | — | — | <+45 ms |
| t-multiplier | Tripping characteristic factor | 0.05–2.00 | 0.0 | ±5% |
| | IEC NINV | 0.05–2.00 | 0.0 | ±5% |
| | IEC VINV | 0.05–2.00 | 0.0 | ±5% |
| | IEC EINV | 0.05–2.00 | 0.0 | ±5% |
| | IEC LINV | 0.05–2.00 | 0.0 | ±5% |
| | ANSI MINV | 0.05–2.00 | 0.0 | ±5% |
| | ANSI EINV | 0.05–2.00 | 0.0 | ±5% |
| | Flat | 0.05–2.00 | 0.0 | ±5% |
| | I _t | 0.05–2.00 | 0.0 | ±5% |
| | I ² t | 0.05–2.00 | 0.0 | ±5% |
| | I ⁴ t | 0.05–2.00 | 0.0 | ±5% |
| Reset mode | Only available if IEC characteristics | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC NINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC VINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC EINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | IEC LINV | 0.00–60.00 | 0.01 x s | ±1% resp. ±10 ms |
| | Reset curves if ANSI characteristics | — | — | 5% |
| | ANSI MINV | — | — | 5% |
| | ANSI VINV | — | — | 5% |
| | ANSI EINV | — | — | 5% |
| | Flat | — | — | 5% |
| | I _t | — | — | 5% |
| | I ² t | — | — | 5% |
| | I ⁴ t | — | — | 5% |

Circuit Breaker Failure Protection 50BF

| Description | | Range | Step | Tolerance |
|------------------|---|-----------------------|-----------------------|--|
| I-CBF> | If the pick-up value is exceeded, the module/stage will be started. | 0.0–0.1 x 1 | 0.01 x I _n | ±1.5% of the setting value resp. 1% I _n |
| Resetting ratio | | 0.5% x I _n | — | — |
| t-CBF | If the delay time is expired, an CBF alarm is given out. | — | — | <+40 ms |
| Operating time | Starting from I higher than 1.3 x I-CBF> | — | — | <+40 ms |
| Disengaging time | | — | — | <+40 ms |

Note

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

22.4

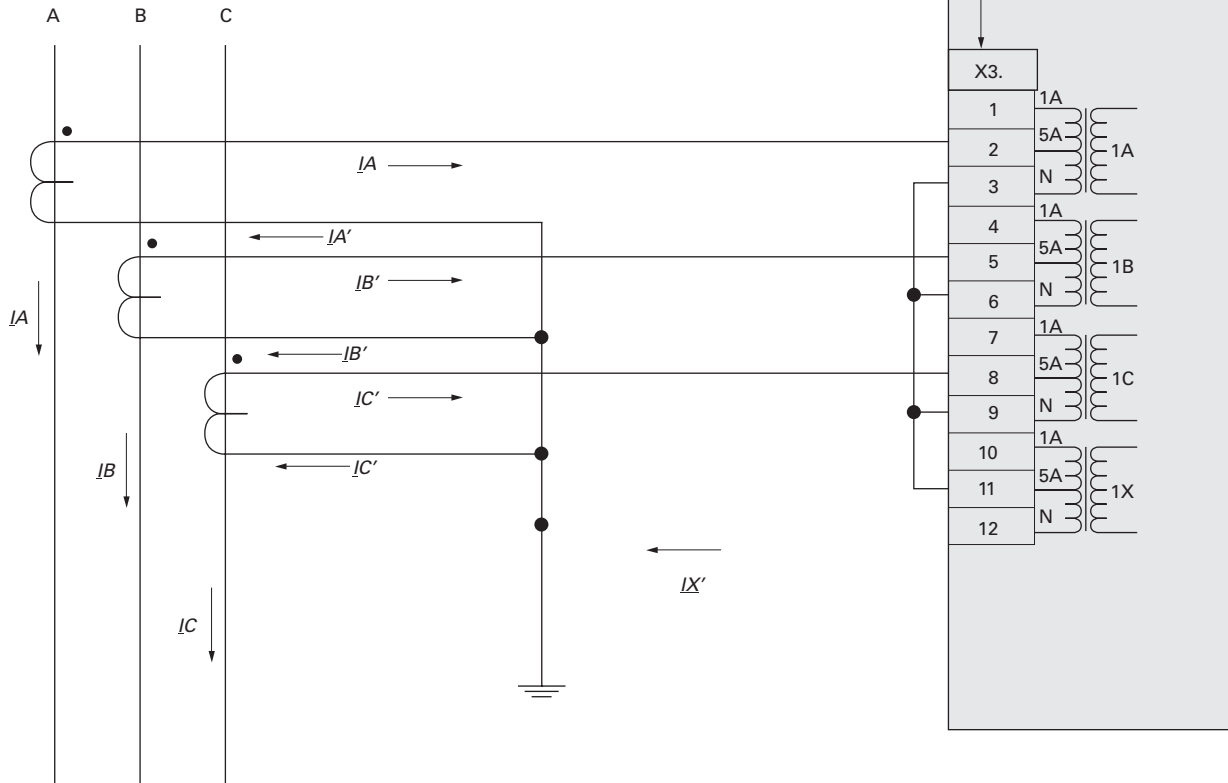
Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

Wiring Diagrams

EDR-3000

Connection Example Clockwise Rotating Field
EDR3000 => Terminal Markings X3.

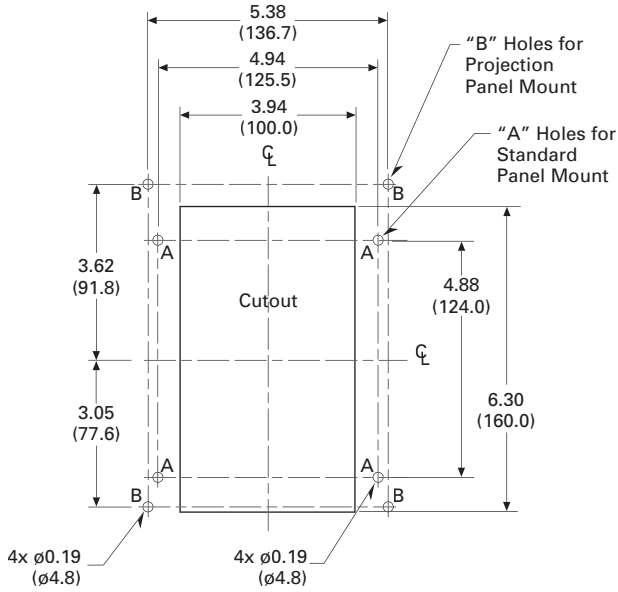


Three-Phase Current Measurement; I_{nom} Secondary = 5A
Ground Current Measuring via Residual Connection; I_{Gnom} Secondary = 5A

Dimensions

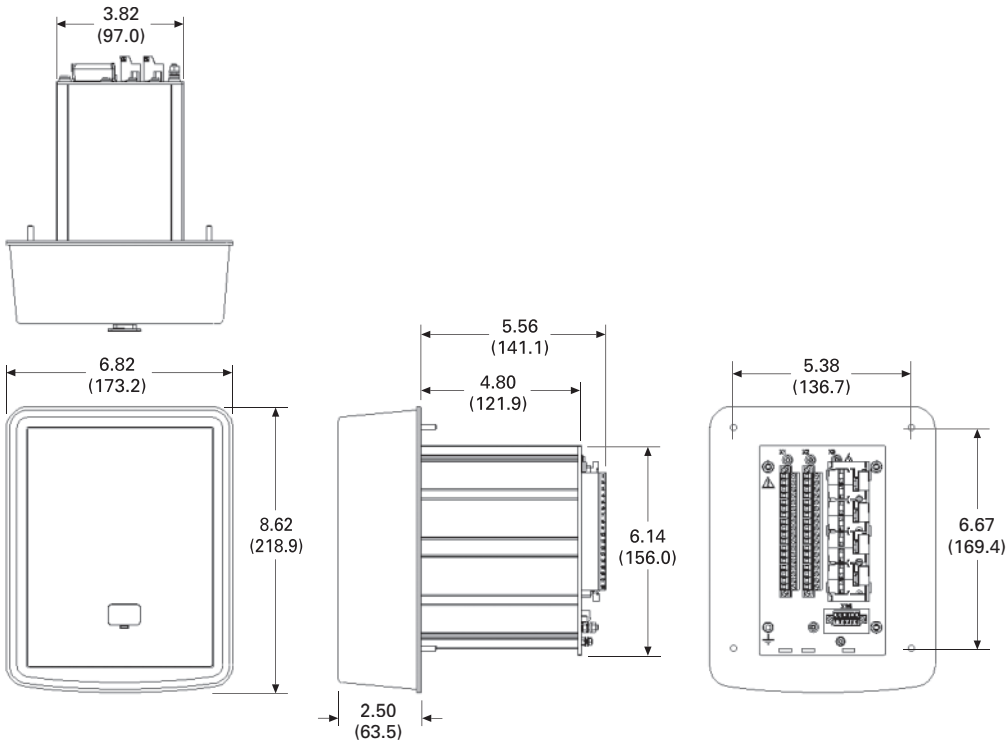
Approximate Dimensions in Inches (mm)

Drilling Pattern



22

Projection Mounting



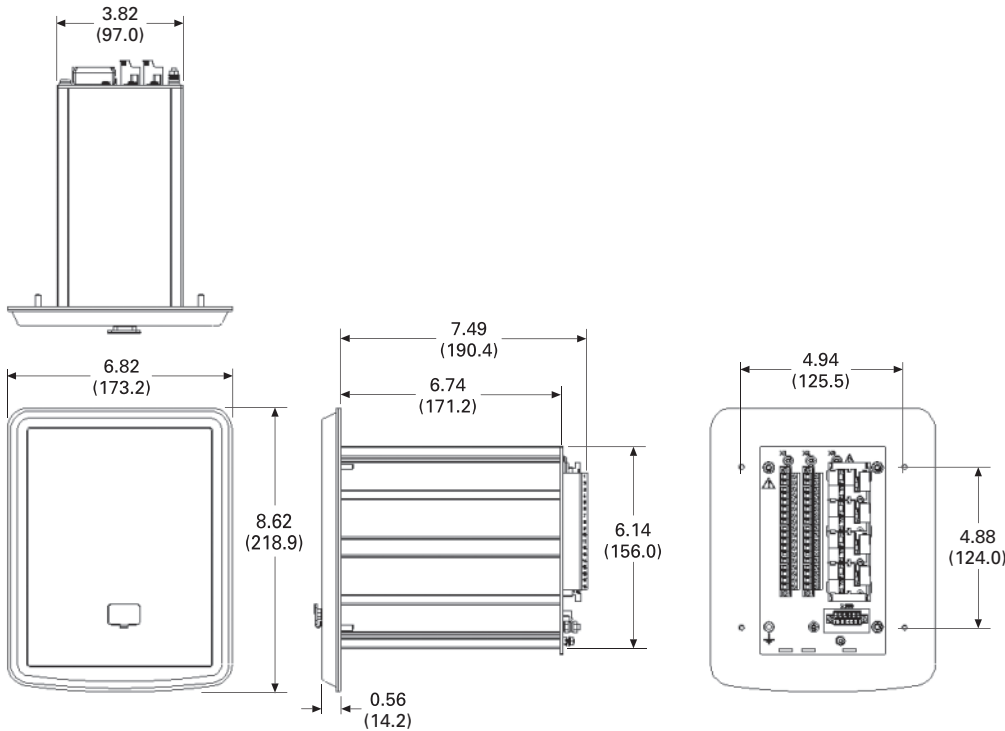
22.4

Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

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 Lbs (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.

ETR-4000



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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. 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.

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 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 (6000 cycles total)
- 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 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.

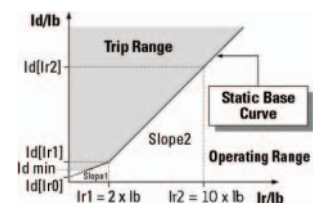
Multiple current inputs are used to provide primary protection, control and back-up protection of transformers, including current differential, restricted ground differential and overcurrent protection.

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.

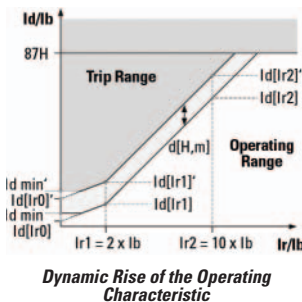


Dual-Slope Operating Characteristic

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 desensitized 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.



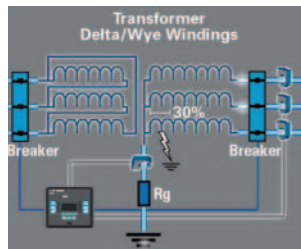
Dynamic Rise of the Operating Characteristic

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. 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.

Programmable I/O

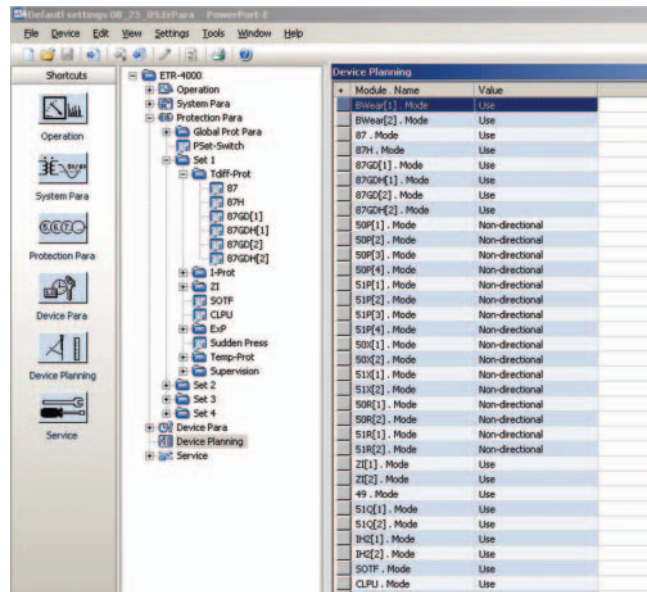
The ETR-4000 transformer protection relay provides heavy-duty, trip-rated, 4 normally open and 4 Form C contacts. Two isolated inputs can be used for monitoring the trip circuits. One Form C contact is dedicated to the relay failure alarm function and is operated in a normally energized (fail-safe) mode. 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

Eaton provides two types of communication software. The first is PowerPort-E. It runs on a PC or laptop for easy access to a single relay to change set points or configuration and to view metered values and stored data. PowerPort-E is free and can be downloaded from the Eaton Web site at the following URL:

<http://www.Eaton.com/pr>

The second package is Power Xpert Software. Power Xpert Software is a power management software package that is designed for continuous, remote monitoring of many devices. It provides additional functions such as billing, trending and graphics. Contact your local Eaton representative for more information on Power Xpert software.



PowerPort-E- ETR-4000 Device Planning

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

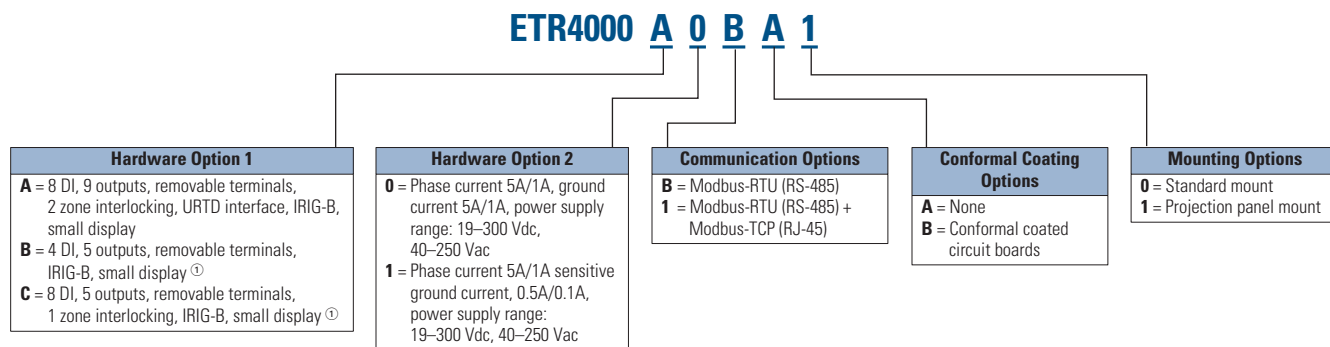


Catalog Number Selection

The catalog number identification chart defines the electrical characteristics and operation features included in the ETR-4000. For example, if the catalog number were ETR-3000A0BA1, the device would have the following:

- ETR-4000
- (A)–8 Digital Inputs, 9 Output Relays
- (B)–Modbus-RTU (RS-485)
- (0)–5A/1A phase and ground CTs, Power Supply Range: 19-300 Vdc, 40–250 Vac
- (A)–Without Conformal Coating
- (1)–Projection Panel Mount

ETR-4000 Eaton Transformer Protection Relay



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 ② to +60°C)
- Permissible humidity at ann. average: <75% rel. (on 56d up to 95% rel.)
- Permissible installation altitude:
 - 6,561.67 ft (<2,000m) above sea level
 - If 13,123.35 ft (4,000m) 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: 1A and 5A
- Continuous loading capacity: 4 x I_N/continuously
- Overcurrent withstand:
 - 30 x I_N/10s
 - 100 x I_N/1s
 - 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 mm²) with wire end ferrule
 - 2 x AWG 12 (1 x or 2 x 4.0 mm²) with ring cable sleeve or cable sleeve
 - 2 x AWG 10 (1 x or 2 x 6 mm²) 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:
 - 18A peak value for <0.25 ms
 - 12A peak value for <1 ms
- The voltage supply must be protected by a fuse of:
 - 2.5A time-lag miniature fuse approx. 0.2 x 0.8 in. (5 x 20 mm) according to IEC 60127
 - 3.5A time-lag miniature fuse approx. 0.25 x 1.25 in. (6.3 x 32 mm) according to UL 248-14

Notes

- ① Consult factory for the availability of 4 Inputs/5 Outputs, 8 Inputs/5 Outputs and sensitive ground.
- ② Display will stop working at –20°C.

Power Consumption

- Power supply range: 19–300 Vdc
 - Power consumption in idle mode—7W
 - Maximum power consumption—13W
- Power supply range: 40–250 Vac (for frequencies of 40–70 Hz)
 - Power consumption in idle mode—7W
 - Maximum power consumption—13W

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: $U_n = 24$ Vdc, 48 Vdc, 60 Vdc, 110 Vac/Vdc, 230 Vac/Vdc
- $U_n = 24$ Vdc
 - Switching threshold 1 ON: Min. 19.2 Vdc
 - Switching threshold 1 OFF: Max. 9.6 Vdc
- $U_n = 48$ –60 Vdc
 - Switching threshold 2 ON: Min. 42.6 Vdc
 - Switching threshold 2 OFF: Max. 21.3 Vdc

- $U_n = 110/120$ Vac/Vdc
 - Switching threshold 3 ON: Min. 88.0 Vdc/88.0 Vac
 - Switching threshold 3 OFF: Max. 44.0 Vdc/44.0 Vac
- $U_n = 230/240$ 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: 1A/5A
- Max. measuring range:
 - Up to $40 \times I_n$ (phase currents)
 - Up to $25 \times I_n$ (ground current standard)
 - Up to $2.5 \times I_n$ (ground current sensitive)
- Continuous loading capacity: $4 \times I_n$ /continuously
- Overcurrent proof:
 - $30 \times I_n/10$ s
 - $100 \times I_n/1$ s
 - $250 \times I_n/10$ 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 $\pm 10\%$
- Terminals: Screw-type terminals with integrated short-circuiters (contacts)

Relay Outputs

- Continuous current: 5A AC/DC
- Maximum make current:
 - 25A AC/25A DC up to 30V for 4s
 - 30A/230 Vac according to ANSI IEEE Std. C37.90-2005
 - 30A/250 Vdc according to ANSI IEEE Std. C37.90-2005
- Maximum breaking current:
 - 5A AC up to 125 Vac
 - 5A DC up to 30V (resistive)
 - 0.3A DC at 300V
- 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: 5A at 120/240 Vac or 30 Vdc
- Maximum switch-on current: 15A at 120/240 Vac or 30 Vdc (max. 4s)
- Maximum breaking current:
 - 5A at 120/240 Vac or 30 Vdc
 - 0.4A at 125 Vdc
- Contact type: 1 changeover contact
- Terminals: Screw-type terminals

Time Synchronization IRIG

- Nominal input voltage: 5V
- 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: 5V
- Nominal output level: 5V
- 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/2s
 - Circuit to ground—2.5 kV/2s
 - Circuit to circuit—2.5 kV/2s
- 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 μ s

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 in- 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 2h

Test ad: Cold

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

Test Bd: Dry heat

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

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 [$+20^{\circ}\text{C}$])
 - $<\pm 1$ ms if synchronized via IRIG-B

Tolerances of the Measured Value Acquisition

Phase and ground current measuring

- Maximum measuring range:
 - Up to $40 \times I_n$ (phase currents)
 - Up to $25 \times I_n$ (ground current standard)
 - Up to $2.5 \times I_n$ (earth current sensitive)

Note: The precision does not depend on the nominal value but is referenced to 100 mA (with $I_n = 1$ A) respectively, 500 mA (with $I_n = 5$ A)

- Frequency range: 50 Hz / 60 Hz $\pm 10\%$
- Accuracy: Class 0.5
- Amplitude Error if $I < 1 I_n$: $\pm 0.5\%$ of the rated value
- Amplitude Error if $I > I_n$: $\pm 0.5\%$ of the measured value
- Amplitude Error if $I > 2 I_n$: $\pm 1.0\%$ of the measured value
- Resolution: 0.01A
 - Harmonics: Up to 20% 3rd harmonic $\pm 1\%$
 - Up to 20% 5th harmonic $\pm 1\%$
- Frequency influence: $< \pm 2\%$ / Hz in the range of ± 5 Hz of the parametrized nominal frequency
- Temperature influence: $< \pm 1\%$ within the range of $+32^{\circ}\text{F}$ to $+140^{\circ}\text{F}$ (0°C to $+60^{\circ}\text{C}$)

Protection Elements Tolerances

Notice: The tripping delay relates to the time between alarm and trip. The tolerance of the operating time relates to the time between when the measured value has exceeded the threshold until the protection element is picked up.

| Description | Tolerance | |
|--|--|-----------------------------|
| Differential Protection Stages: 87[x] | | |
| $I_d > 0.1 I_d[x]$ | $\pm 3\%$ of the setting value resp. $1\% I_n$ | |
| Operating time | $I_d > 0.3 \times I_n$ | < 35 ms |
| | $I_d > 0.5 \times I_n$ | < 25 ms |
| | $I_d > 1.5 \times I_n$ | < 20 ms |
| Ground Differential Protection Stages: 87GD[x] | | |
| $I_{dG} > 0.1 I_{dG}[x]$ | $\pm 3\%$ of the setting value resp. $1\% I_n$ | |
| Operating time | $I_{dG} > 0.3 \times I_n$ | < 35 ms |
| | $I_{dG} > 0.5 \times I_n$ | < 25 ms |
| | $I_{dG} > 1.5 \times I_n$ | < 20 ms |
| Overcurrent Protection Elements: 50P[x], 51P[x] | | |
| Pickup | $\pm 1.5\%$ of the setting value resp. $1\% I_n$ | |
| Resetting ratio | 97% or $0.5\% \times I_n$ | |
| t | DEFT $\pm 1\%$ resp. ± 10 ms | |
| Operating time | Starting from I higher than $1.1 \times I >$ | <+35 ms |
| | | |
| Disengaging time | <+45 ms | |
| t-Multiplier | $\pm 5\%$ | |
| | IEC NINV | |
| | IEC VINV | |
| | IEC EINV | |
| | IEC LINV | |
| | ANSI MINV | |
| | ANSI VINV | |
| | ANSI EINV | |
| | Flat | |
| | It | |
| | I ² t | |
| | I ⁴ t | |
| | Reset Mode | $\pm 1\%$ resp. ± 10 ms |
| | | IEC NINV |
| | | IEC VINV |
| IEC EINV | | |
| IEC LINV | | |
| 5% | | |
| ANSI MINV | | |
| ANSI VINV | | |
| ANSI EINV | | |
| Flat | | |
| It | | |
| I ² t | | |
| I ⁴ t | | |

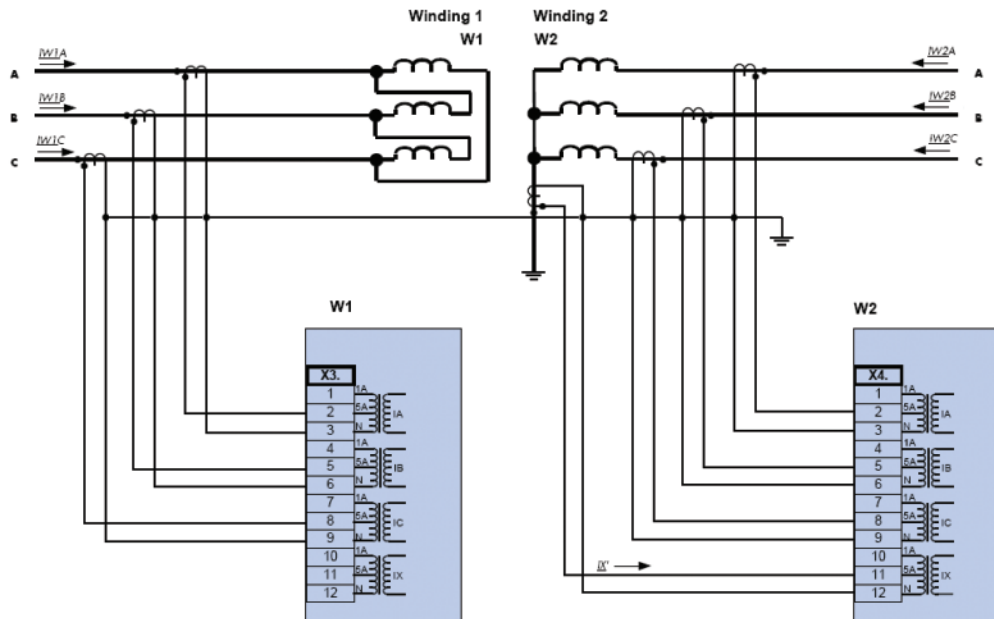
| Description | Tolerance | |
|--|--|---------------------|
| Ground Current Elements: 50G[x], 50N[x], 51G[x], 51N[x] | | |
| Pickup | $\pm 1.5\%$ of the setting value resp. $1\% I_n$ | |
| Resetting ratio | 97% or $0.5\% \times I_n$ | |
| t | DEFT | |
| | $\pm 1\%$ resp. | |
| | ± 10 ms | |
| Operating time | Starting from IE Higher than $1.1 \times I E >$ | <+35 ms |
| Disengaging time | | <+45 ms |
| t-Multiplier | $\pm 5\%$ | |
| | IEC NINV | |
| | IEC VINV | |
| | IEC EINV | |
| | IEC LINV | |
| | ANSI MINV | |
| | ANSI VINV | |
| | ANSI EINV | |
| | Flat | |
| | It | |
| | I ² t | |
| | I ⁴ t | |
| | Reset mode | IEC characteristics |
| | | IEC NINV |
| | | IEC VINV |
| IEC EINV | | |
| IEC LINV | | |
| 5% | | |
| Reset curves if ANSI characteristics | | |
| ANSI MINV | | |
| ANSI VINV | | |
| ANSI EINV | | |
| Flat | | |
| It | | |
| I ² t | | |
| I ⁴ t | | |
| Thermal Replica: ThR | | |
| Ib | $\pm 2\%$ of the setting value Resp. $1\% I_n$ | |
| K | | |
| Pickup ThR | $\pm 1.5\%$ of the setting value | |

| Description | Tolerance |
|---------------------------------|---|
| Unbalanced Load: 51Q[x] | |
| $I_{2>}$ | $\pm 2\%$ of the setting value resp. $1\% I_n$ |
| Resetting ratio | 97% or $0.5\% \times I_n$ |
| t | DEFT |
| | $\pm 1\%$ resp. |
| Tripping delay time (DEFT) | ± 10 ms |
| Operating time | Starting from I_2 higher than $1.3 \times I_{2>}$ $<+60$ ms |
| Release time | $<+40$ ms |
| k | $\pm 5\%$ INV |
| T-cool | $\pm 5\%$ INV |
| Inrush Supervision IH2 ① | |
| I_{H2}/I_n | $\pm 1\% I_n$ |
| Resetting ratio | $1\% \times I_n$ or $5\% \times I_{H2}$ |

| Description | Tolerance |
|--|--|
| Breaker Failure Protection 50BF | |
| $I-BF>$ | $\pm 1.5\%$ of the setting value resp. $1\% I_n$ |
| Resetting ratio | t-BF $\pm 1\%$ resp. |
| | ± 10 ms |
| Operating time | Starting from I Higher than $1.3 \times I-BF>$ $<+40$ ms |
| Disengaging time | $<+40$ ms |
| Trip Circuit Monitoring TCM | |
| t-TCM | $\pm 1\%$ resp |
| | ± 10 ms. |
| Current Transformer Supervision CTS | |
| Delta | $\pm 2\%$ of the setting value resp. $1.5\% I_n$ |
| Resetting ratio | 94% |
| t | $\pm 1\%$ resp. ± 10 ms |

Wiring Diagrams

Typical AC Connections Delta-Wye Transformer with Wye CTs and Neutral CT



Note

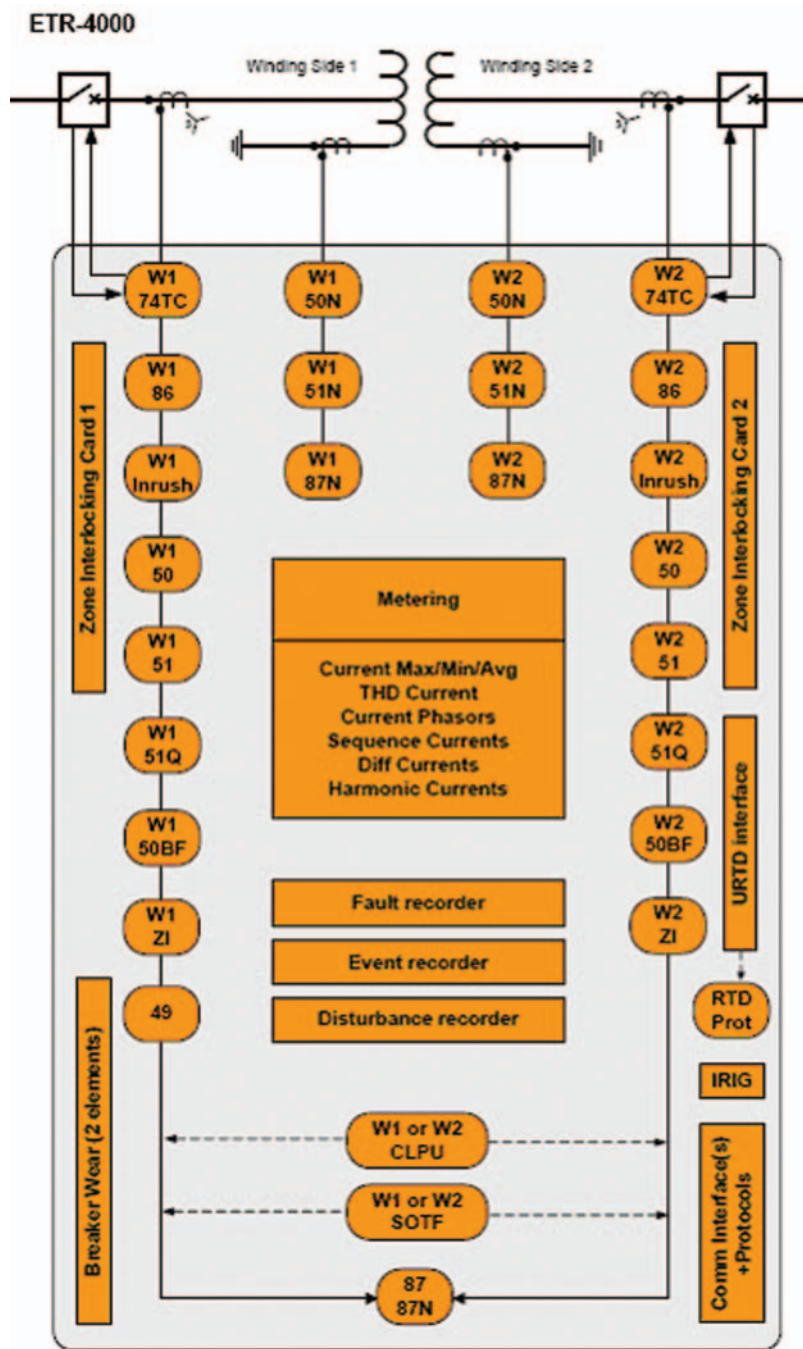
① Inrush supervision is possible, if the fundamental Harmonic $> 0.1 \times I_n$ and 2nd Harmonic $> 0.01 \times I_n$.

22.4

Metering Devices, Protective Relays, Software and Connectivity

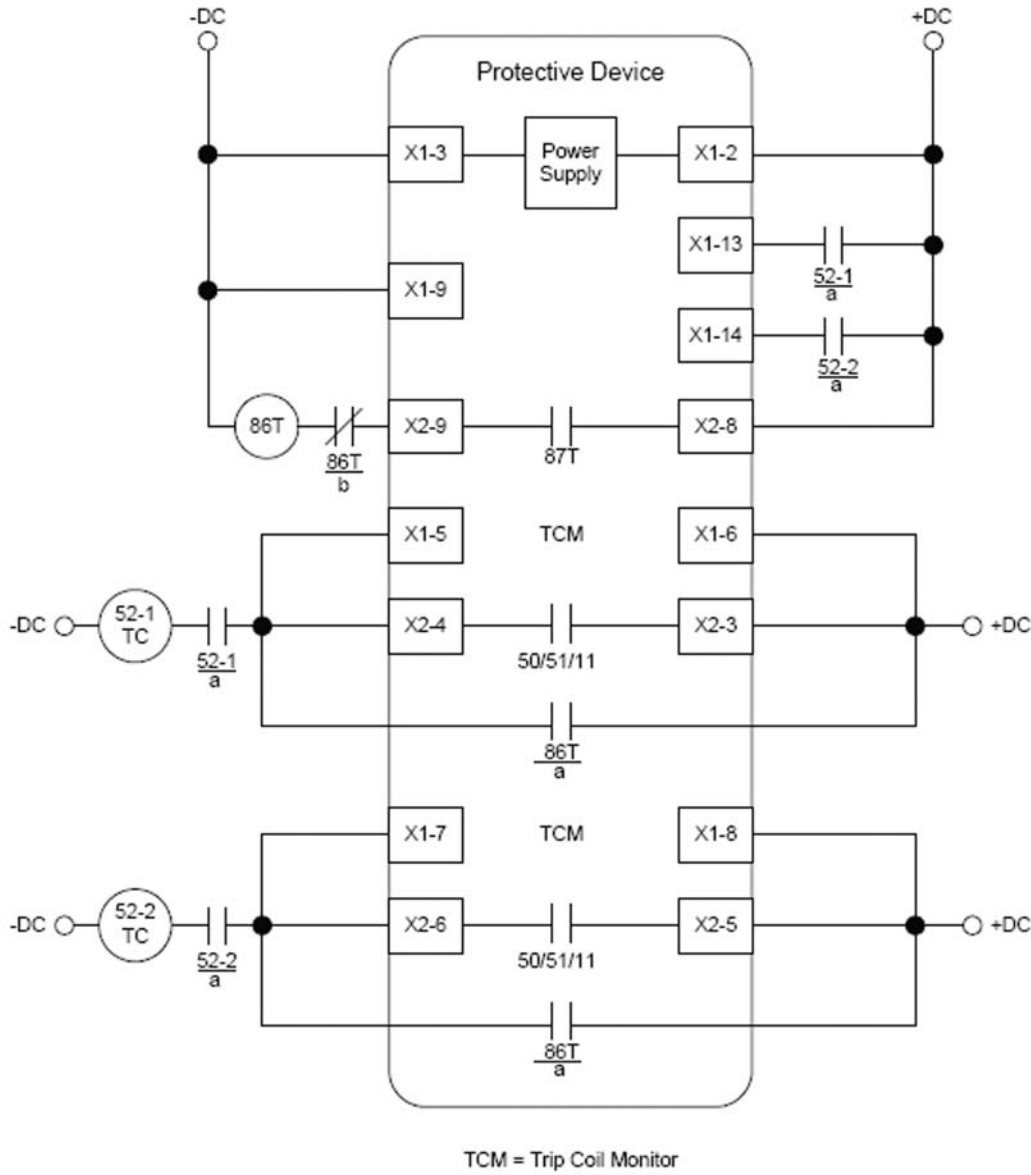
Protective Relays

Typical One-Line Diagram



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Typical Control Diagram



22.4

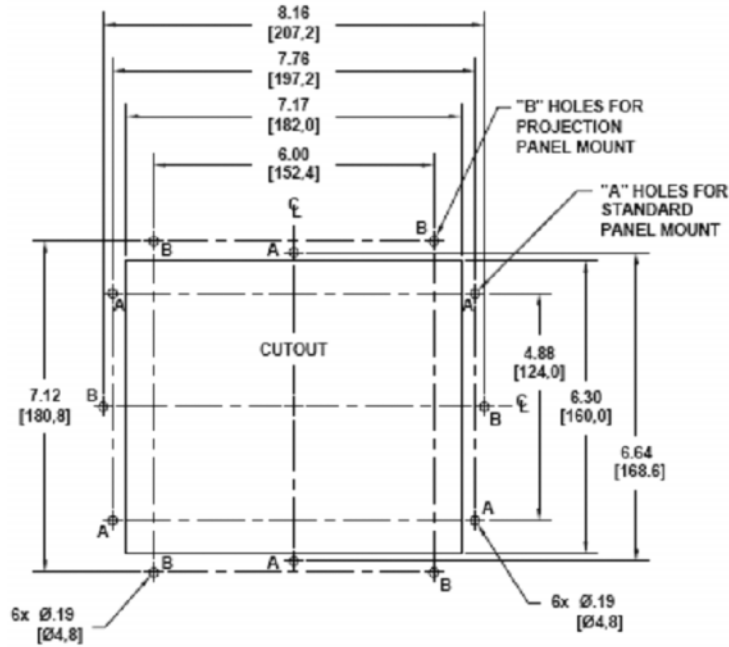
Metering Devices, Protective Relays, Software and Connectivity

Protective Relays

Dimensions

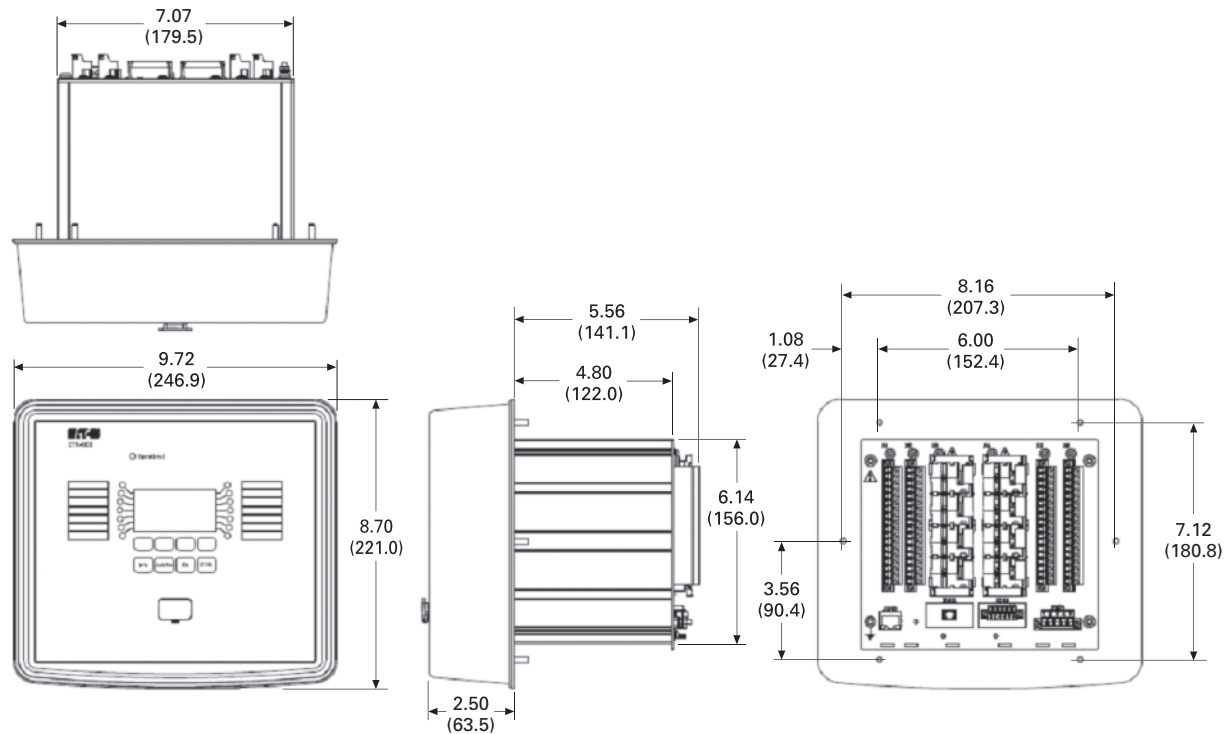
Approximate Dimensions in Inches (mm)

Drilling Plan



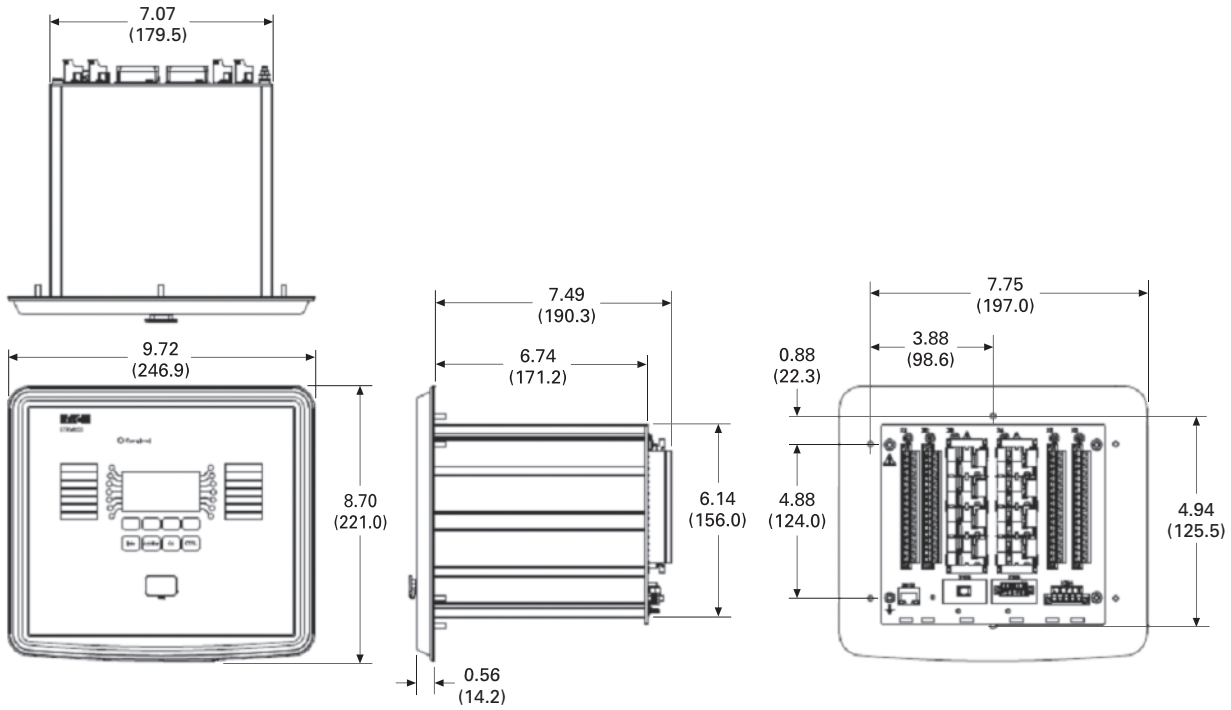
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Projection Mount Front and Side Views



Approximate Dimensions in Inches (mm)

Standard Mount Front and Side Views



ETR-4000 Housing B2

| Width | Height | Depth ^① | Shipping Weight Lbs (kg) |
|--------------|--------------|--------------------|-----------------------------|
| 6.81 (173.0) | 8.37 (212.7) | 8.19 (208.0) | 9.3 (4.2) |

Note

^① Includes terminals.

Ground Fault Relay



22

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| MP-4000 Motor Protection | 322 |
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| Digitrip 3000 | 331 |
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Ground Fault Relay

Product Description

A Type GFR ground fault protection system, when properly installed on a grounded electrical system, will sense phase-to-ground fault currents. When the level of fault current is in excess of the pre-selected current pickup and time delay settings, the GFR relay will initiate a trip action of a disconnect device, which will open the faulted circuit and clear the fault.

The GFR devices are UL Class 1 devices designed to protect electrical equipment against extensive damage from arcing ground faults.

A basic Type GFR ground fault protection system consists of a ground fault relay, a ground fault current sensor and a disconnect device equipped with a shunt trip device. This disconnect device can be a molded case circuit breaker, a power circuit breaker, a bolted pressure switch or other fusible disconnect device, suitable for application with UL Class 1 Ground Fault Sensing and Relaying equipment.

Standards and Certifications

Eaton's GFR ground fault relays, current sensors, test panels and accessory devices are UL listed by Underwriters Laboratories in accordance with their standard for Ground Fault Sensing and Relaying Equipment, UL 1053, under File No. E48381.

Note: Relays are also listed with CSA under File No. 43357.



Product Selection

Each installation requires:

- One relay unit (select trip ampere as required)
- One current sensor (select configuration required)
- One circuit breaker or disconnect device with shunt trip, or a shunt trip attachment for mounting in existing breaker
- Test panel (optional)

GFR Relay



GFR Relay

| GFR Relay Types | Ground Fault Pickup Amperes | | |
|--|-----------------------------|-----------------------------|---------------------------------|
| | 1–12 Catalog Number ① | 5–60 Catalog Number ① | 100–1200 Catalog Number ① |
| For 120 Volt 50/60 Hz Control | | | |
| Electrical reset with zone interlocking | GFR12EI | GFR60EI | GFR1200EI |
| Electrical reset without zone interlocking | GFR12E | GFR60E | GFR1200E |
| Mechanical reset with zone interlocking | GFR12MI | GFR60MI | GFR1200MI |
| Mechanical reset without zone interlocking | GFR12M | GFR60M | GFR1200M |
| For 120 Vdc Control | | | |
| Mechanical reset without zone interlocking | — | — | GFR1200MD |

Current Sensor

| Description—Window Size in Inches (mm) | Catalog Number |
|--|-------------------|
| Used with Relays Rated 1–12 Amperes | |
| 5.50 (139.7) inside diameter | 1283C45G01 |
| Used with Relays Rated 5–60 Amperes | |
| 2.50 (63.5) inside diameter | 179C768G01 |
| 5.50 (139.7) inside diameter | 1256C13G01 |
| 7.81 x 11.00 (198.4 x 279.4) rectangular ① | 1257C88G04 |
| 3.31 x 24.94 (84.1 x 760.5) rectangular ① | 1257C92G03 |
| Used with Relays Rated 100–1200 Amperes | |
| 2.50 (63.5) inside diameter | 179C768G02 |
| 5.50 (139.7) inside diameter | 1256C13G02 |
| 8.25 (209.6) inside diameter | 179C767G02 |
| 7.81 x 11.00 (198.4 x 279.4) rectangular ① | 1257C88G03 |
| 9.94 x 16.94 (252.5 x 430.3) rectangular ① | 1257C90G02 |
| 9.94 x 23.94 (252.5 x 608.1) rectangular ① | 1257C91G02 |
| 15.94 x 19.94 (404.9 x 506.4) rectangular ① | 1257C89G02 |
| 3.31 x 24.94 (84.1 x 633.5) rectangular ① | 1257C92G04 |
| 6.75 x 29.64 (171.5 x 752.9) rectangular ① | 1255C39G03 |

Note

① Suitable for either surface or semi-flush mounting.

Options and Accessories

Test Panel (120 Vac)

Used to test the ground fault system, to give an indication the relay has tripped the breaker, and to reset the relay after tripping. These functions may be separately mounted pilot devices.

Note: When a mechanically reset relay is used with a test panel, both the relay and test panel must be reset following either a simulated ground fault test or actual ground fault. Not UL listed.

Ground Fault Warning Indicator

This is an accessory item for use with GFR relays with interlocking circuitry. At approximately 30–50% of the relay pickup setting, the indicator switches separate 120 Vac control power to a

lamp or relay (not included) to give an indication of a ground fault. The indicator is rated 110/120 Vac 50/60 Hz for a maximum indicator load of 0.5 amperes.

Indicating Ammeter

The optional indicating ammeter connects to the sensor terminals through a momentary contact pushbutton, and will indicate (in amperes) any ground fault current flowing through the sensor. Kit includes the ammeter and pushbutton.

Not UL listed.

Shunt Trip Attachments

Use 120 Vac shunt trips.

Face Plate

Recommended when these relays are semi-flush mounted, to close the door cutout opening.

Options

Additional optional equipment can be added to the protection system to meet the requirements of the specifying engineer, including:

- Ground fault test panel
- Ground fault warning indicator relay
- Ground fault indicating ammeter

GFR relays are available with zone selective interlocking circuitry to interlock several relays within the same

system. This allows the relay, which detects a ground fault, to instantly clear the fault by tripping the disconnect device. The relay simultaneously sends a signal to relay units “upstream” from the fault to time delay or to block their operation completely. Current sensors in various designs provide a range of “window” sizes to accommodate standard bus and cable arrangements.

Shunt trip attachments may be ordered for field mounting in Eaton’s molded case circuit breakers, or may be ordered factory installed in the breaker.

Optional Test Panel

| Control | Test | Catalog Number |
|-------------------|-------------------|----------------|
| 120 volt 50/60 Hz | 120 volt 50/60 Hz | GFRTP |

Ground Fault Warning Indicator

| Description | Catalog Number |
|----------------|----------------|
| Manual reset | 1234C67G01 |
| Self-resetting | 1234C67G02 |

Ammeter Kit

| GFR System Used with | Kit Catalog Number |
|----------------------|--------------------|
| 1–12 amperes | 752B820G01 |
| 5–60 amperes | 752B820G02 |
| 100–1200 amperes | 752B820G03 |

Face Plate

| Description | Catalog Number |
|-------------|----------------|
| Face plate | 752B410G01 |

Note

① One end removable for installation.

Instruction Leaflet 15321 available as a PDF at www.eaton.com (Go to Advanced Search and enter 15321).

**Technical Data
and Specifications*****GFR Relay***

- Ground fault detection ranges:
 - 1–12 amperes
 - 5–60 amperes
 - 100–1200 amperes
- Output contacts:
 - 240 Vac, 50/60 Hz:
3 amperes
 - 120 Vac, 50/60 Hz:
6 amperes
 - 28 Vdc: 3 amperes
 - 125 Vdc: 0.5 amperes
- Control power requirements:
 - 120V, 50/60 Hz:
0.125 amperes, or
125 Vdc (optional)

Current Sensor

- 600 volt, 50/60 Hz
maximum system voltage

Universal RTD Module



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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

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 feet (152m). The fiber optic link has a maximum distance of 400 feet (122m).

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

Universal RTD Module

Catalog Number

URTD

Options and Accessories

Additional Related Products from Eaton Corporation's Cutler-Hammer Series

The URTD Module must be operated with an MP-3000 Motor Protection Relay, computer or programmable controller. Please refer to the MP-3000 Motor Protection, PONI and PowerNet sections for additional related product information.

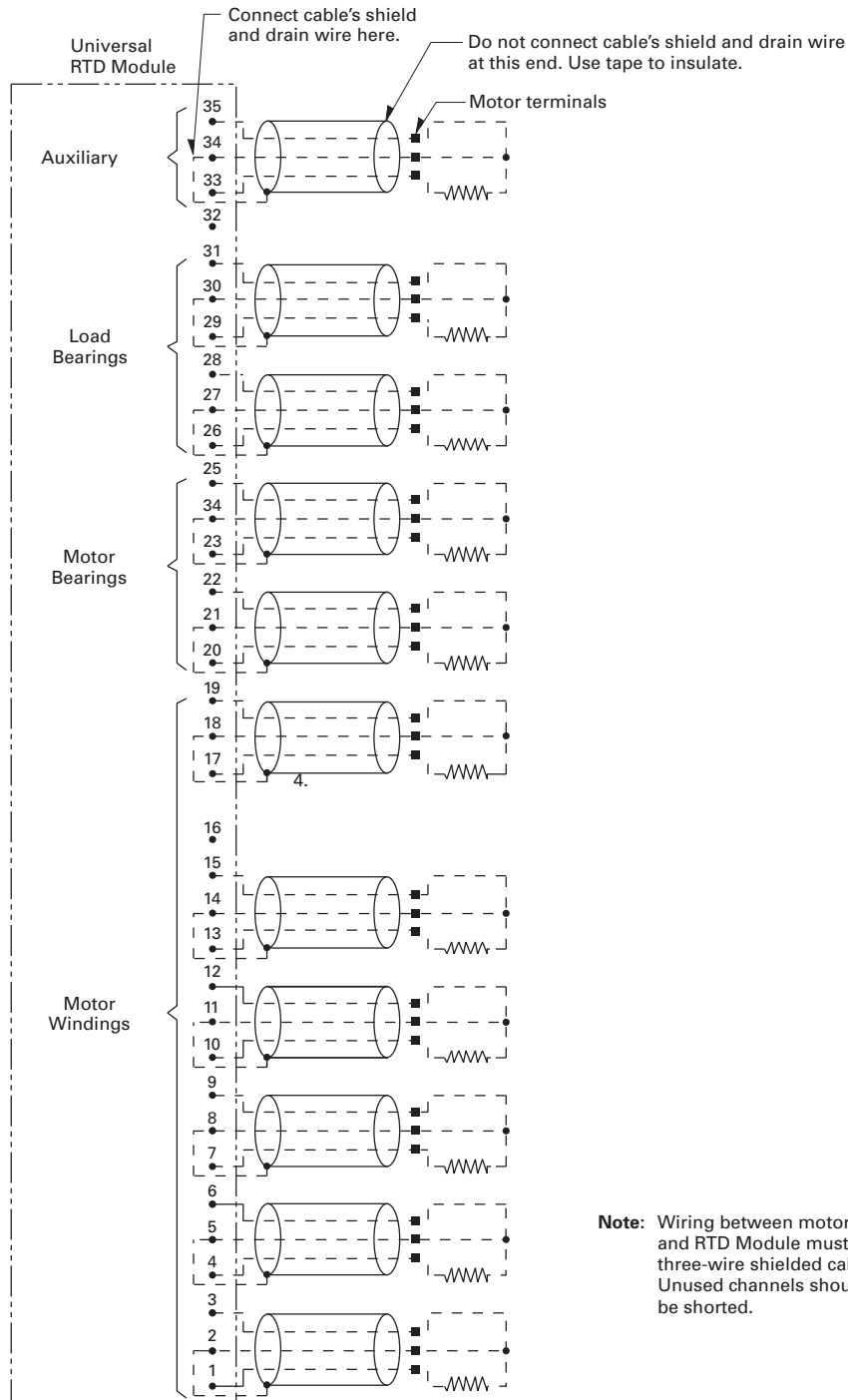
Eaton provides fiber optic cables for connecting to the MP-3000 or IQ-1000 II Motor Protection Relays.

Technical Data and Specifications

- Input power requirements: 120 Vac (±15%)
- Frequency: 50/60 Hz
- Power consumption: 6 VA
- Operating temperature: 32°–158°F (0°–70°C)
- Storage temperature: –4°–185°F(–20°–85°C)
- Humidity: 0–95% R.H. noncondensing
- Enclosure: Type 1

Wiring Diagram

RTD Wiring (Three-Lead Type)



Note: Wiring between motor RTDs and RTD Module must be three-wire shielded cable. Unused channels should be shorted.

1. Each shielded cable's conductors must be connected on Universal RTD Module 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 Universal RTD Module or the motor.
Terminal 16 or 32 should be connected to a suitable earth ground.

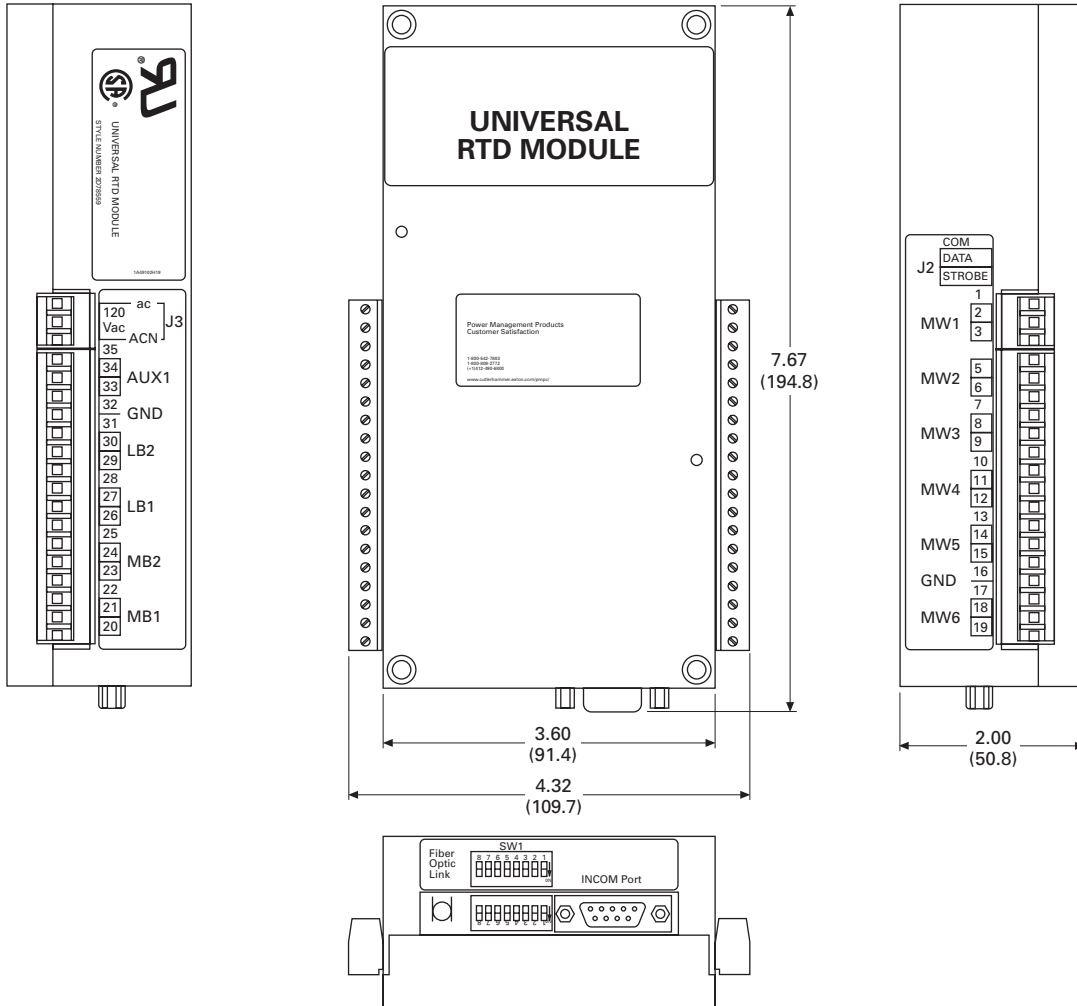
Note

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.

IQ DC Power Supply



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IQ 125 Volt DC Power Supply

Product Description

Eaton's IQ DC Power Supply is a DC to AC inverter module intended for use where DC power is available, but some AC is required. The unit will operate Eaton's MP-3000, or other AC powered IQ devices requiring no more than 75 VA of power at any power factor.

The IQ DC power supply is available in two styles, one to be used with the MP-3000 and one for all other products.

Features, Benefits and Functions

- Single, two-wire input—no need to set switches or adjust jumpers
- Four connections—two for DC in, two for AC out
- AC output is isolated from the incoming power
- Built-in protection features protect against short circuits while providing ample power to start loads
- Sinusoidal wave

Product Selection

IQ DC Power Supply IQ DC Power Supply



| Description | Catalog Number |
|---------------------------|----------------|
| IQ DC power supply module | IQDCPS |

Technical Data and Specifications

- Input voltage ranges from 105 Vdc to 140 Vdc
- Rated power output—75 VA at any power factor
- Operating temperature—-4°F to 140°F (-20°C to 60°C)

Power Xpert Gateways



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Power Xpert Gateways

Product Description

The Power Xpert Gateway 400/600 is typically installed in an electrical assembly—a motor control center, low/medium voltage switchgear or switchboard to consolidate data available from components such as trip units, meters, motor controllers and protective relays.

Power Xpert Gateways provide a cost-effective method to easily Web-enable Eaton and third-party products.

The Gateway consists of an embedded Web server that allows the user to connect to Eaton products such as breakers, meters and relays found in MCCs, LV and MV Switchgear and switchboards—to name a few—that communicate via Eaton protocols INCOM and QCPort, in addition to third-party products that communicate via Modbus RTU. The Gateway provides the central connection point for the power metering/monitoring/protective devices, allowing their parameters to be monitored via the Web.

Power Xpert Gateways provide data communications to Eaton’s Power Xpert Software to facilitate centralizing and gathering data for long-term data archival, analysis and trending features.

The PXG is compatible with and facilitates integration with many third-party building and factory automation systems via Modbus TCP and Web Services.

The PXG600 allows you to enable pre-selected parameters to be trended for each supported device. Selecting the trend symbol will generate a real-time graph for that parameter and can be viewed for the past 24 hours, seven days, 30 days or all past history.

The PXG600 also offers direct e-mail notifications to up to 10 users. Select from event notifications, data logs, event logs and heartbeat e-mails.

Information is presented in organized, user-friendly Web pages and includes, but is not limited to, the following:

- Device status
- Comm status

- Voltage
- Current
- Power
- Power factor
- Energy
- Power quality
- Temperature
- I/O states

Power Xpert Gateway Screenshots



Home Page



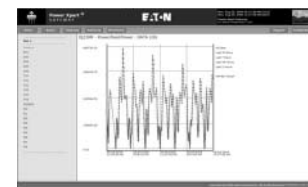
Main Page



Bus Page



Device Page



Trending Page (PXG600 Only)

Product Selection Guide

Data Acquisition and Integration Table for Supported Devices

Supported Devices



PXG 400 and PXG 600

PXG 600 Only

| Device Type | Device Name | HTTP (Web Browser) | Web Services (Power Xpert Software) | Modbus TCP (BMS & SCADA) | Pass-Through INCOM (PowerNet) | Pass-Through QCPort (CHStudio) | SNMP (NMS) | SMTP (E-mail Client) | File Export (Data File Format) | File Export (Waveform File Export) |
|--------------|---------------------------|--------------------|-------------------------------------|--------------------------|-------------------------------|--------------------------------|------------|----------------------|--------------------------------|------------------------------------|
| INCOM | | | | | | | | | | |
| Drive | Accutrol 400 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Drive | AF97 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| I/O | Universal RTD | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| I/O | DIM | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| I/O | DIM KYZ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ DP-4000 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ Energy Sentinel | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ 220/IQ 320 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ 230/IQ 330 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ Analyzer (6000/6200) ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Meter | IQ Analyzer (6400/6600) ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Meter | IQ Data ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ Data Plus ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ Data Plus II ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | Power Manager | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter | IQ Power Sentinel | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Meter Point | IQ MES II | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip 3000 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip 3200 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | FP-5000 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Protective | FP-4000 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Protective | FP-6000 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Protective | MP-3000 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | MP-4000 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip 520MC | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | NRX520 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | IQ 500 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | MPCV Relay | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip 1150/DT1150V | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Protective | Digitrip 810 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip 910 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip MV | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip OPTIM 1050 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Protective | Digitrip OPTIM 550 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Protective | Digitrip OPTIM 750 | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Starter | Advantage ② | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |
| Starter | Advantage ACM ② | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | |

Notes

① Required IPONI for connection to the Power Xpert Gateway.

② Required a WPONI for connection to the Power Xpert Gateway.

Information subject to change without notice. Visit www.eaton.com for latest up-to-date details on connectivity.

Data Acquisition and Integration Table for Supported Devices, continued

Supported Devices



| Device Type | Device Name | PXG 400 and PXG 600 | | PXG 600 Only | | | | | |
|--------------------------------|--------------------|---------------------|-------------------------------------|--------------------------|-------------------------------|--------------------------------|------------|----------------------|--------------------------------|
| | | HTTP (Web Browser) | Web Services (Power Xpert Software) | Modbus TCP (BMS & SCADA) | Pass-Through INCOM (PowerNet) | Pass-Through QCPort (CHStudio) | SNMP (NMS) | SMTP (E-mail Client) | File Export (Data File Format) |
| INCOM, continued | | | | | | | | | |
| Sub-network Master | AEM II ① | ■ | ■ | ■ | ■ | | ■ | ■ | |
| Sub-network Master | BIM II ① | ■ | ■ | ■ | ■ | | ■ | ■ | |
| Sub-network Master | CMU ② | ■ | ■ | ■ | ■ | | ■ | ■ | |
| Sub-network Master | IQ CED II ① | ■ | ■ | ■ | ■ | | ■ | ■ | |
| Sub-network Master | IQ MES II | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Transfer Switch | ATC-400 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ |
| Transfer Switch | ATC-600 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ |
| Transfer Switch | ATC-800 ① | ■ | ■ | ■ | ■ | | ■ | ■ | ■ |
| Modbus | | | | | | | | | |
| Drive | MVX9000 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Drive | SVX9000 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Insulation Monitor | InsulGard | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 130 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 140 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 150 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 230M/IQ 330M | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 250 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | IQ 260 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | Nexus 1262 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | SQD CM3000 Series | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | SQD CM4000 Series | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | SQD PM710 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | SQD PM850 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | PML 7350 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | PML 7550 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Meter | PML 7650 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Protective | GE 369 Motor Relay | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Protective | GE 469 Motor Relay | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Protective | FP-4000/FP-5000 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Protective | FP-6000 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Overload Relay | C441 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Temp Monitor | Qualitrol 118 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| Transformer Differential Relay | ABB TPU 2000 | ■ | ■ | ■ | | | ■ | ■ | ■ |
| QCPort | | | | | | | | | |
| I/O | D77A-A116 | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| I/O | D77A-A18 | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| I/O | D77A-D116 | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| I/O | D77A-D18 | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Starter | IT S811 (MV811) | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Starter | IT Starter ③ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |
| Starter | IT Starter QSNAP ③ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ |

Notes

- ① Required IPONI for connection to the Power Xpert Gateway.
- ② Required a WPONI for connection to the Power Xpert Gateway.
- ③ Requires a QSNAP for connection to the Power Xpert Gateway.

Information subject to change without notice. Visit www.eaton.com for latest up-to-date details on connectivity.

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Metering Devices, Protective Relays, Software and Connectivity

Connectivity Options

The table below represents many of the parameters displayed on the Web page for a given device, however it is not exhaustive. For the complete list of parameters display, per device, refer to the Device Data Map file at HYPERLINK <http://www.eaton.com/powerxpert> www.eaton.com/powerxpert.

Web UI Device Parameters Displayed via Power Xpert Gateway

| | | IQ Meters | | | | | | | | | | | | | | | | | | | |
|------------------------|------|-----------|---------|---------|------|----------|----------|-----|------|------|------|-----|-----|-----|-----|-----|----|----------|----------|---------|-------|
| | | IQ | IQ Data | IQ Data | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | IQ | Power | IQ | Power |
| Units | | MES II | Plus II | Plus | Data | Analyzer | Analyzer | DP- | 220/ | 230/ | 230/ | 130 | 140 | 150 | 250 | 260 | | Sentinel | Sentinel | Manager | |
| | | 6000/ | 6400/ | 4000 | 320 | 330 | 330M | | | | | | | | | | | | | | |
| Voltage | | | | | | | | | | | | | | | | | | | | | |
| Average | V | | | | | ■ | ■ | | | | | | | | | | | | | | |
| Voltage (Line-Line) | V | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Voltage (Line-Neutral) | V | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Current | | | | | | | | | | | | | | | | | | | | | |
| Average | A | | | | | ■ | ■ | | | | | | | | | | | | | | |
| Phase | A | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Ground | A | | | | | ■ | ■ | | | | | ■ | | | | | | | | | |
| Neutral | A | | | | | ■ | ■ | | | | | ■ | | | | ■ | ■ | | | | |
| Peak | A | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Demand | A | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Power | | | | | | | | | | | | | | | | | | | | | |
| Apparent | VA | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | | | ■ | ■ | | |
| Reactive | VAR | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Real | W | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Power Factor | | | | | | | | | | | | | | | | | | | | | |
| Apparent | PF | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Displacement | PF | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | ■ | | | |
| Energy | | | | | | | | | | | | | | | | | | | | | |
| Real | Wh | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Forward | Wh | ■ | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Reverse | Wh | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Apparent | Vah | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | | | | |
| Reactive | VARh | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | | | | |
| Leading | VARh | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | | | | |
| Lagging | VARh | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | | | | |
| Power Quality | | | | | | | | | | | | | | | | | | | | | |
| THD | % | | | | | | ■ | | | | | | | | | | | | | | |
| Current THD | % | | | | | | | | | | | | | | | | | | | | ■ |
| Voltage THD | % | | | | | | | | | | | | | | | | | | | | ■ |
| Frequency | Hz | | ■ | ■ | ■ | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Waveform Capture | N/A | | | | | ■ | ■ | ■ | | | | | | | | | | | | | |
| Temperature | | | | | | | | | | | | | | | | | | | | | |
| Ambient | C | | | | | | | | | | | | | | | | | | | | |
| Auxiliary | C | | | | | | | | | | | | | | | | | | | | |
| Load Bearing | C | | | | | | | | | | | | | | | | | | | | |
| Motor Bearing | C | | | | | | | | | | | | | | | | | | | | |
| Winding | C | | | | | | | | | | | | | | | | | | | | |
| Phase (L, C, R) | C | | | | | | | | | | | | | | | | | | | | |
| Terminal Block | C | | | | | | | | | | | | | | | | | | | | |
| Input Status | | | | | | | | | | | | | | | | | | | | | |
| Number of Inputs | | | | | | ■ | ■ | | | | | | | | | | | | | | |
| Status/cause of trip | | | | | | | | | | | | | | | | | | | | | |
| Thermal memory | | | | | | | | | | | | | | | | | | | | | |
| Pole temperature | | | | | | | | | | | | | | | | | | | | | |
| Winding temperature | | | | | | | | | | | | | | | | | | | | | |
| Fan status | | | | | | | | | | | | | | | | | | | | | |
| Alarm/trip relay | | | | | | | | | | | | | | | | | | | | | |

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The table below represents many of the parameters displayed on the Web page for a given device, however it is not exhaustive. For the complete list of parameters display, per device, refer to the Device Data Map file at HYPERLINK <http://www.eaton.com/powerxpert> www.eaton.com/powerxpert.

Web UI Device Parameters Displayed via Power Xpert Gateway, continued

| | Units | Circuit Breaker Trip Units | | | | | | | Protective Relays | | | | | | | | | | |
|------------------------|-------|----------------------------|----------------|--------|------------------|------------------|---------------------|--------------------|--------------------|-------------|---------------|--------|-------------|---------|---------|---------|---------|---------|---|
| | | Digitrip 1150 | Digitrip 520MC | NRX520 | Digitrip RMS 910 | Digitrip RMS 810 | Digitrip OPTIM 1050 | Digitrip OPTIM 550 | Digitrip OPTIM 750 | Digitrip MV | Digitrip 3000 | IQ 500 | MPVCV Relay | FP-4000 | FP-5000 | FP-6000 | MP-3000 | MP-4000 | |
| Voltage | | | | | | | | | | | | | | | | | | | |
| Average | V | | | | | | | | | | | | ■ | ■ | ■ | | | ■ | |
| Voltage (Line-Line) | V | ■ | | | ■ | | | | | | | | ■ | ■ | ■ | | | ■ | |
| Voltage (Line-Neutral) | V | | | | | | | | | | | | ■ | ■ | ■ | ■ | | ■ | |
| Current | | | | | | | | | | | | | | | | | | | |
| Average | A | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | |
| Phase | A | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Ground | A | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | ■ | ■ | |
| Neutral | A | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | ■ | |
| Peak | A | ■ | | | | | | | | | | | ■ | ■ | ■ | | | | |
| Demand | A | ■ | | | | | | | | | | | | | | ■ | ■ | | |
| Power | | | | | | | | | | | | | | | | | | | |
| Apparent | VA | ■ | | | | | | | | | | | | ■ | ■ | ■ | | ■ | |
| Reactive | VAR | ■ | | | | | | | | | | | ■ | ■ | ■ | ■ | | ■ | |
| Real | W | ■ | | | ■ | ■ | ■ | | | | | | ■ | ■ | ■ | ■ | | ■ | |
| Power Factor | | | | | | | | | | | | | | | | | | | |
| Apparent | PF | ■ | | | | | | | | | | | | ■ | ■ | ■ | | ■ | |
| Displacement | PF | | | | | | | | | | | | | ■ | ■ | ■ | | ■ | |
| Energy | | | | | | | | | | | | | | | | | | | |
| Real | Wh | | | | ■ | ■ | ■ | | | | | | ■ | ■ | ■ | | | ■ | |
| Forward | Wh | ■ | | | ■ | ■ | ■ | | | | | | ■ | ■ | ■ | | | ■ | |
| Reverse | Wh | ■ | | | ■ | ■ | ■ | | | | | | ■ | ■ | ■ | | | ■ | |
| Apparent | Vah | ■ | | | | | | | | | | | | ■ | ■ | ■ | | ■ | |
| Reactive | VARh | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Leading | VARh | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Lagging | VARh | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Power Quality | | | | | | | | | | | | | | | | | | | |
| THD | % | | | | | | | | | | | | | | | | ■ | | |
| Current THD | % | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Voltage THD | % | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Frequency | Hz | | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Waveform Capture | N/A | ■ | | | | | | | ■ | | | | | ■ | ■ | ■ | | | |
| Temperature | | | | | | | | | | | | | | | | | | | |
| Ambient | C | | | | | | | | | | | | | | | | | | |
| Auxiliary | C | | | | | | | | | | | | | | | | | | |
| Load Bearing | C | | | | | | | | | | | | | | | | ■ | ■ | |
| Motor Bearing | C | | | | | | | | | | | | | | | | ■ | ■ | |
| Winding | C | | | | | | | | | | | | | | | | ■ | ■ | |
| Phase (L, C, R) | C | | | | | | | | | | | | | | | | | | |
| Terminal Block | C | | | | | | | | | | | | | | | | | | |
| Input Status | | | | | | | | | | | | | | | | | | | |
| Number of inputs | | | | | | | | | | | | | | ■ | ■ | ■ | 2 | 2 | 2 |
| Status/cause of trip | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Thermal memory | | | | | | | | | | | | | | | | | | | |
| Pole temperature | | | | | | | | | | | | | | | | | | | |
| Winding temperature | | | | | | | | | | | | | | | | | | | |
| Fan status | | | | | | | | | | | | | | | | | | | |
| Alarm/trip relay | | | | | | | | | | | | | | | | | ■ | | |

Web UI Device Parameters Displayed via Power Xpert Gateway, continued

| | Units | Insulation Monitor InsulGard | Motor Starters & VFDs Accutrol 400 | AF97 | Advantage Starters | /T. S811 | /T. Starters/ QSNAP | SVX & MVX Drives | Transfer Switches ATC-400 | ATC-600 | ATC-800 |
|------------------------|-------|---------------------------------|---------------------------------------|------|--------------------|----------|------------------------|------------------|------------------------------|---------|---------|
| Voltage | | | | | | | | | | | |
| Average | V | ■ | ■ | | | | | ■ | | | |
| Voltage (Line-Line) | V | | | | | ■ | | | ■ | ■ | ■ |
| Voltage (Line-Neutral) | V | | | | | | | | | | |
| Current | | | | | | | | | | | |
| Average | A | ■ | ■ | | | ■ | ■ | ■ | | | |
| Phase | A | | | ■ | ■ | ■ | | | | | |
| Ground | A | | | | | | | | | | |
| Neutral | A | | | | | | | | | | |
| Peak | A | | | | | | | | | | |
| Demand | A | | | | | | | | | | |
| Power | | | | | | | | | | | |
| Apparent | VA | | ■ | | | | | | | | |
| Reactive | VAR | | | | | | | | | | |
| Real | W | | | | | | | | | | |
| Power Factor | | | | | | | | | | | |
| Apparent | PF | | | | | | | | | | |
| Displacement | PF | | | | | | | | | | |
| Energy | | | | | | | | | | | |
| Real | Wh | | | | | | | | | | |
| Forward | Wh | | | | | | | | | | |
| Reverse | Wh | | | | | | | | | | |
| Apparent | Vah | | | | | | | | | | |
| Reactive | VARh | | | | | | | | | | |
| Leading | VARh | | | | | | | | | | |
| Lagging | VARh | | | | | | | | | | |
| Power Quality | | | | | | | | | | | |
| THD | % | | | | | | | | | | |
| Current THD | % | | | | | | | | | | |
| Voltage THD | % | | | | | | | | | | |
| Frequency | Hz | ■ | ■ | | | | | ■ | ■ | ■ | ■ |
| Waveform Capture | N/A | | | | | | | | | | |
| Temperature | | | | | | | | | | | |
| Ambient | C | ■ | | | | | | ■ | | | |
| Auxiliary | C | | | | | | | | | | |
| Load Bearing | C | | | | | | | | | | |
| Motor Bearing | C | | | | | | | | | | |
| Winding | C | | | | | | | | | | |
| Phase (L, C, R) | C | | | | | | | | | | |
| Terminal Block | C | | | | | | | | | | |
| Input Status | | | | | | | | | | | |
| Number of inputs | | | | | | ■ | ■ | ■ | | | |
| Status/cause of trip | | | | | | ■ | ■ | ■ | | | |
| Thermal memory | | | | | | ■ | ■ | ■ | | | |
| Pole temperature | | | | | | ■ | ■ | ■ | | | |
| Winding temperature | | | | | | | | | | | |
| Fan status | | | | | | | | | | | |
| Alarm/trip relay | | | | | | | | | | | |

Note

Information subject to change without notice. Visit www.eaton.com for latest up-to-date details on connectivity.

Web UI Device Parameters Displayed via Power Xpert Gateway, continued

| | I/O | | Third-Party Devices | | | | | | | | | | | | | | | | | | | |
|------------------------|-------|---------|---------------------|----------------------|-----------|----------|-----------|----------|----------------|---------------------|--------------------|--------------------|------------|------------|----------|----------|----------|--------------------|--------------------|--------------|---------------|-----------------|
| | Units | DIM KYZ | EDR-3000 | Digital Input Module | D77A-AI16 | D77A-AI8 | D77A-DI16 | D77A-DI8 | Uni-versal RTD | C441 Overload Relay | SQD CM 3000 Series | SQD CM 4000 Series | SQD PM 710 | SQD PM 850 | PML 7350 | PML 7550 | PML 7650 | GE 369 Motor Relay | GE 469 Motor Relay | ABB TPU 2000 | Qualitrol 118 | Nexus 1262/1272 |
| Voltage | | | | | | | | | | | | | | | | | | | | | | |
| Average | V | | | | | | | | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Voltage (Line-Line) | V | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | ■ |
| Voltage (Line-Neutral) | V | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | | ■ |
| Current | | | | | | | | | | | | | | | | | | | | | | |
| Average | A | | | | | | | | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Phase | A | | ■ | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Ground | A | | | | | | | | ■ | ■ | ■ | | | | | | | ■ | ■ | | | |
| Neutral | A | | | | | | | | | ■ | ■ | ■ | | | | | | | | | | ■ |
| Peak | A | | ■ | | | | | | | ■ | | ■ | ■ | | | | | | | | | ■ |
| Demand | A | | ■ | | | | | | | ■ | | | | | | | | | | | | ■ |
| Power | | | | | | | | | | | | | | | | | | | | | | |
| Apparent | VA | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | | ■ |
| Reactive | VAR | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | | ■ |
| Real | W | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | | ■ |
| Power Factor | | | | | | | | | | | | | | | | | | | | | | |
| Apparent | PF | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | | ■ |
| Displacement | PF | | | | | | | | | ■ | ■ | ■ | | | | | | | | | | |
| Energy | | | | | | | | | | | | | | | | | | | | | | |
| Real | Wh | ■ | | | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | ■ | | ■ |
| Forward | Wh | | | | | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Reverse | Wh | | | | | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Apparent | Vah | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Reactive | VARh | | | | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | | |
| Leading | VARh | | | | | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Lagging | VARh | | | | | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | | | | | | ■ |
| Power Quality | | | | | | | | | | | | | | | | | | | | | | |
| THD | % | | | | | | | | | | | | ■ | | | | | | | | | |
| Current THD | % | | | | | | | | | | | | | | | | | | | | | ■ |
| Voltage THD | % | | | | | | | | | | | | | | | | | | | | | ■ |
| Frequency | Hz | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | ■ |
| Waveform Capture | N/A | | | | | | | | | | | | | | | | | | | | | |
| Temperature | | | | | | | | | | | | | | | | | | | | | | |
| Ambient | C | | | | | | | | | | | | | | | | | | | | | |
| Auxiliary | C | | | | | | | ■ | | | | | | | | | | | | | | |
| Load Bearing | C | | | | | | | ■ | | | | | | | | | ■ | ■ | | | | |
| Motor Bearing | C | | | | | | | ■ | | | | | | | | | ■ | ■ | | | | |
| Winding | C | | | | | | | ■ | | | | | | | | | ■ | ■ | | | | |
| Phase (L, C, R) | C | | | | | | | | | | | | | | | | | | | | ■ | |
| Terminal Block | C | | | | | | | | | | | | | | | | | | | | ■ | |
| Input Status | | | | | | | | | | | | | | | | | | | | | | |
| Number of inputs | | 4 | 8 | 16 | 8 | 16 | 8 | | | | | | | | | | | | | | | 8 |
| Status/cause of trip | | | | | | | | ■ | | | | | | | | | | ■ | ■ | | | |
| Thermal memory | | | | | | | | ■ | | | | | | | | | | | | | | |
| Pole temperature | | | | | | | | | | | | | | | | | | | | | | |
| Winding temperature | | | | | | | | | | | | | | | | | | | | | ■ | ■ |
| Fan status | | | | | | | | | | | | | | | | | | | | | ■ | ■ |
| Alarm/trip relay | | | ■ | | | | | | | | | | | | | | | | | | ■ | ■ |

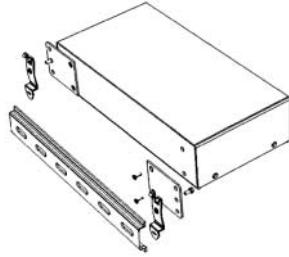
Note

Information subject to change without notice. Visit www.eaton.com for latest up-to-date details on connectivity.

Features

The Eaton Power Xpert Gateway 400/600 Includes:

- The Power Xpert Gateway Module
- Mounting provisions and required hardware for panel and DIN rail mounting
- CD-ROM: contains the User Manual, Modbus Register Maps, USB Driver and other associated files

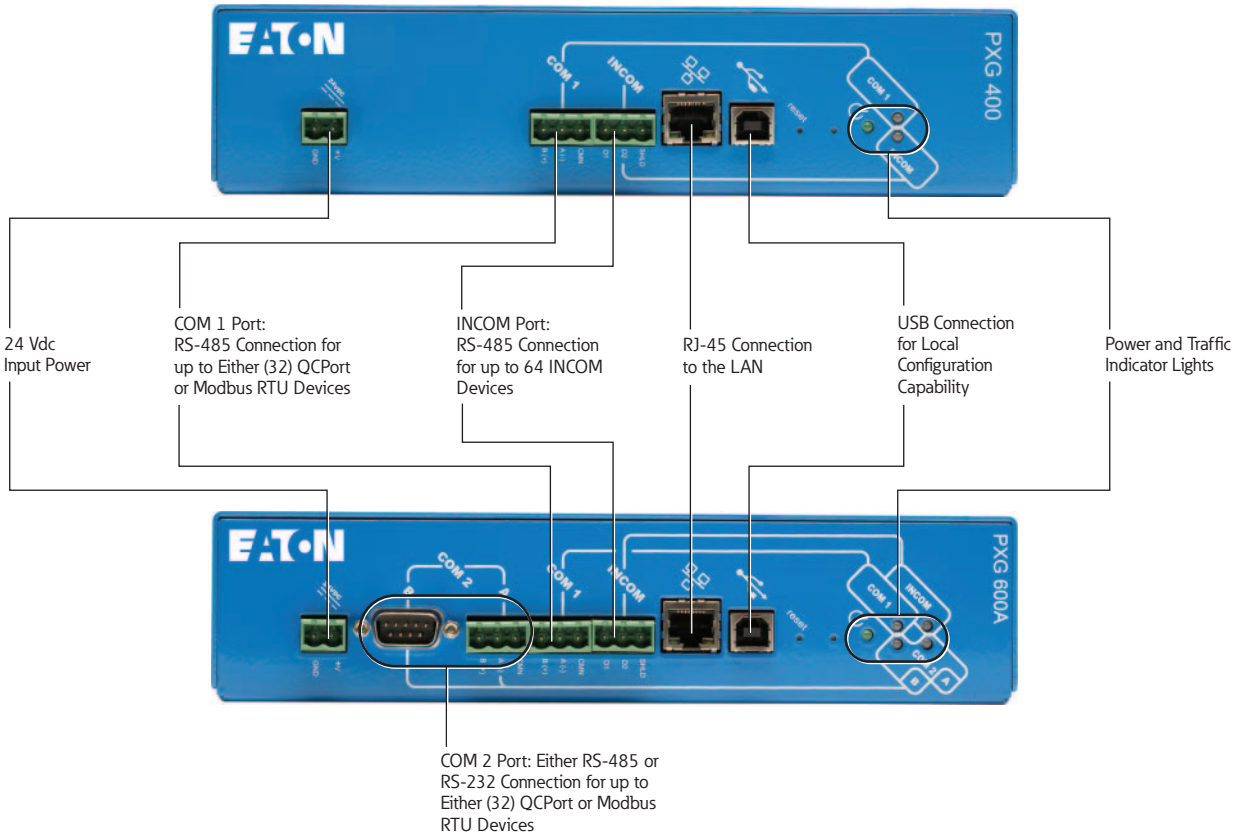


Power Xpert Gateway 400 with DIN Rail Mounting (Brackets Included)

Features of the Power Xpert Gateway 400 vs. 600

| Features | PXG 400 | PXG 600 |
|---|---------|---------|
| Total number of supported devices | 64 | 96 |
| Maximum number of INCOM devices supported | 64 | 64 |
| Protocols supported on downstream devices: INCOM, QCPort and Modbus RTU | Yes | Yes |
| Number of downstream communication ports | 2 | 3 |
| Number of downstream protocols supported simultaneously | 2 | 3 |
| USB port for configuration | Yes | Yes |
| Modbus TCP/IP protocols supported | Yes | Yes |
| SNMP client access | Yes | Yes |
| INCOM slave action commands supported | Yes | Yes |
| INCOM date and time settings supported | Yes | Yes |
| Modbus writes supported | Yes | Yes |
| Device summary screen per communication port | Yes | Yes |
| Device waveform access and storage—COMTRADE file format | No | Yes |
| Set user-defined events | No | Yes |
| Trend graphs displayed | No | Yes |
| Data logs—csv file format, downloadable to Excel | No | Yes |
| Interval logs—csv file format, downloadable to Excel | No | Yes |
| Event notification via the Web interface | Yes | Yes |
| Event logs—csv file format, downloadable to Excel | No | Yes |
| E-mail notification on events and threshold alarms | No | Yes |
| Secure ethernet communications—SSL encryption | Yes | Yes |
| Secure communication ports via access control/trusted host list | Yes | Yes |
| Save and restore configuration file | Yes | Yes |

Power Xpert Gateway 400/600





Standards and Certifications

- UL 508, Standard for Programmable Controller Equipment
- FCC, Class A, Part 15, Subpart B, Sections 15.107b & 15.109b
- EN55022: 1994 Class A, Information Technology Equipment
- EN 61000-6-2:2001 Electromagnetic Compatibility (EMC) Party 6-2: Immunity for Industrial Environments



Product Selection

PXG Part Numbers

| | Description | Style Number | Catalog Number |
|---|----------------------------------|--------------|----------------|
|  | Power Xpert Gateway 400 | 66D2145G01 | PXG400 |
|  | Power Xpert Gateway 600 | 66D2146G01 | PXG600 |
| | Power supply—24 Vdc | ELC-PS02 | ELC-PS02 |
| | Low profile mounting bracket kit | 66B2146G01 | PXGACC01 |

Technical Data and Specifications**Memory**

- Flash: 128 MB
- RAM: 64 MB

Communication Ports

- Network port: one 10/100Base-T RJ-45 connector
- Configuration port: one USB port
- Serial ports PXG 400
 - One dedicated RS-485 port for connection to INCOM devices
 - One RS-485 port for connection to either QCPort or Modbus RTU devices
- Serial ports PXG 600
 - One dedicated RS-485 port for connection to INCOM devices
 - One RS-485 port for connection to either QCPort or Modbus RTU devices
 - One RS-485 or RS-232 (software selectable) port for connection to either QCPort or Modbus RTU devices

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
- SNMP: Supports common network management tools
- NTP: Supports time synchronization via a network time server for PXG synchronization
- SMTP: Supports mail server for e-mail notification

Serial Protocols Supported

- INCOM
- QCPort
- Modbus RTU

Supported Devices

Refer to www.eaton.com/powerxpert for most current list. Call for information on additional devices.

Web Browsers Recommended

- IE 6.0 or higher
- Mozilla Firefox 2.0 or higher

Number of Devices Supported

- PXG 400
 - 64 total with INCOM port + COM 1 port not to exceed 64. Port limitations are as follows:
 - INCOM port: Up to 64 INCOM devices
 - COM 1 port: Up to 32 QCPort or Modbus RTU devices
- PXG 600
 - 96 total with INCOM port + COM 1 port + COM 2 port not to exceed 96. Port limitations are as follows:
 - INCOM port: Up to 64 INCOM devices
 - COM 1 port: Up to 32 QCPort or Modbus RTU devices
 - COM 2 port: Up to 32 QCPort or Modbus RTU devices

Power Input

- Input voltage, nominal: 24 Vdc; 0.8 A
- Input voltage range: $\pm 20\%$ nominal

Power Consumption

- 8 watts maximum

Operating Temperature

- 32 to 140°F (0 to 60°C)

Ambient Storage Temperature

- –40 to 185°F (–40 to 85°C)

Relative Humidity

- 5 to 95% noncondensing at 50°C

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 feet (1219m); 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.

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 600V 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 395**. 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 (3048m) 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 Feet (305m) |
|--------------------|----------------------------------|
| 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 (61m) wire run
 - **Simple tap:** <200-foot (61m) 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.

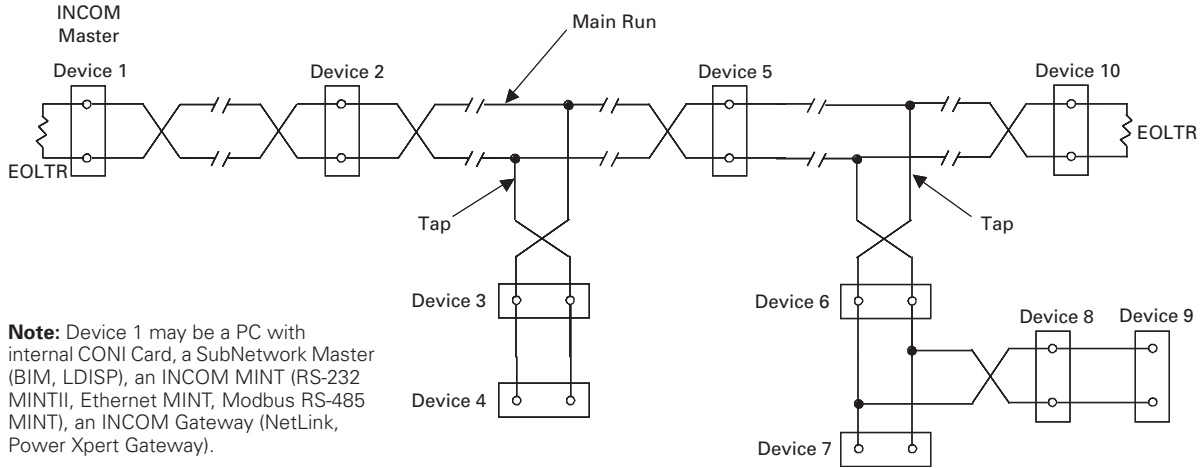
Rule 7: Cable Termination

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.

Daisy Chain Segment Topology

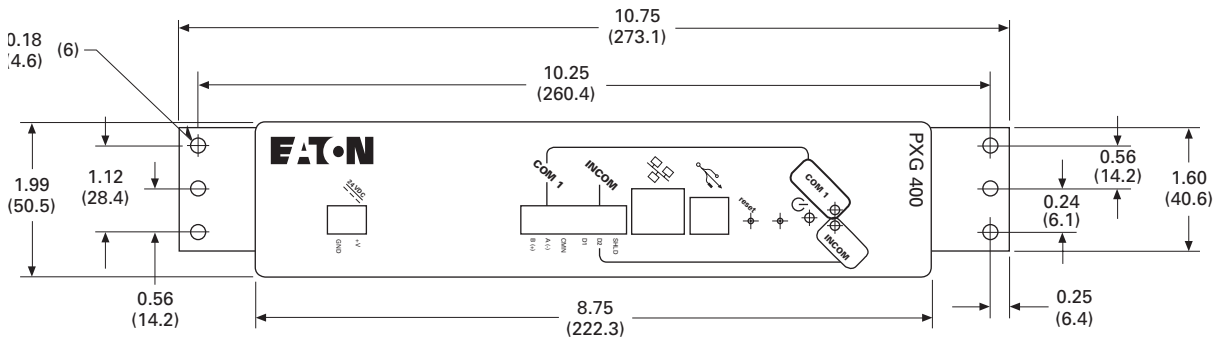


Note: Device 1 may be a PC with internal CONI Card, a SubNetwork Master (BIM, LDISP), an INCOM MINT (RS-232 MINTII, Ethernet MINT, Modbus RS-485 MINT), an INCOM Gateway (NetLink, Power Xpert Gateway).

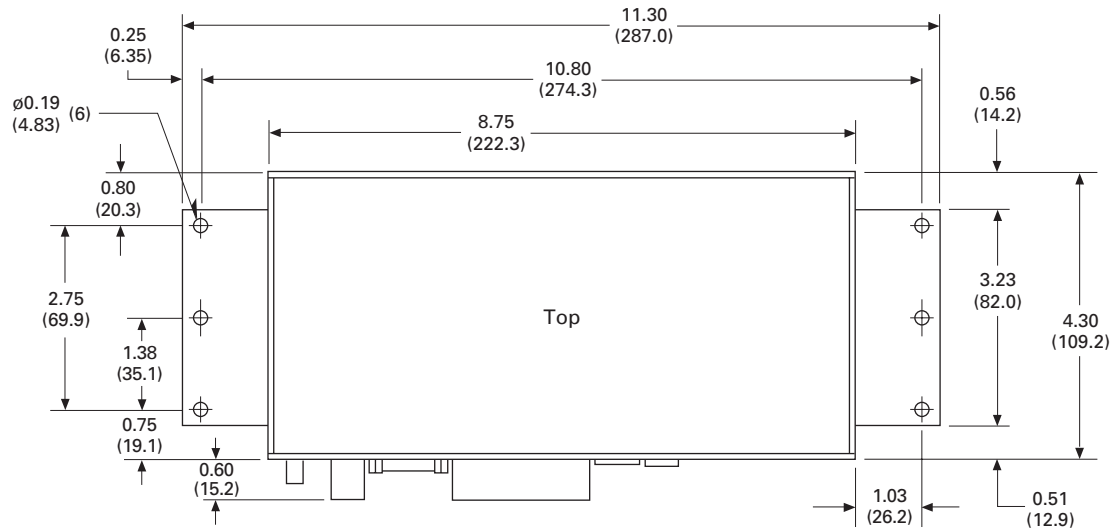
Dimensions

Approximate Dimensions in Inches (mm)

Power Xpert Gateway 400/600 with Standard Panel Mounting (Brackets Included)



Power Xpert Gateway 400/600 with Low Profile Mounting (Optional Bracket Kit Available)



Power Xpert Gateway 400/600

| Width | Height | Depth | Shipping Weight Lbs (kg) |
|--------------|-------------|--------------|--------------------------|
| 8.90 (226.1) | 2.10 (53.3) | 4.50 (114.3) | 1.50 (0.6) |

Power Xpert Ethernet Switches



Convenient Network Expansion

Power Xpert Ethernet Switches

Product Description

Eaton's Power Xpert Ethernet Switches are ideal for extending Ethernet networks via CAT5 wiring or fiber in harsh, industrial environments. Built with high-grade components and constructed using special thermal techniques, PXE Switches can withstand the unpredictable conditions of such environments.

Features

- Simultaneous, full-duplex, high-speed communication on all ports—no network performance bottlenecks
- Hardened for factory floor—ideal for both industrial or data center applications
- Unmanaged, plug-and-play implementation—no software or additional hardware required for configuration
- Seamlessly integrates into Eaton's Power Xpert Architecture—quality and reliability of Eaton guaranteed
- Mounting options include standalone panel-mounting, DIN rail mounting, or 19-inch standard rack mounting

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Standards and Certifications

- UL Listed (UL 60950)
- cUL
- CE
- Emissions meet FCC Part 15, Class A



PXES 6-Port Switch—10/100 Mb with Optional 100 Mb Fiber

This compact switch provides six Ethernet ports, with flexible configurations. The base models have one of three options:

- Two 100 Mb fiber and four 10/100 copper ports
- One fiber and five copper ports
- Six copper ports

PXES 4-Port Switch—10/100 Mb

For smaller applications requiring fewer connection points and no fiber, the 4-port Power Xpert Ethernet Switch is a versatile option. It provides edge access Ethernet ports in a convenient and compact package.

Product Selection

Ethernet Switch



Power Xpert Ethernet Switches

| Description | Catalog Number |
|--|----------------|
| 4-port Ethernet switch—copper only | PXES4P24V |
| 6-port Ethernet switch—copper only | PXES6P24V |
| 6-port Ethernet switch—5 copper/1 fiber (ST connector) | PXES6P24V1ST |
| 6-port Ethernet switch—4 copper/2 fiber (ST connector) | PXES6P24V2ST |

Accessories

Ethernet Switch



Power Xpert Ethernet Switches

| Description | Catalog Number |
|---|----------------|
| Power supply (preferred)—100–240 Vac input DIN rail mount with screw—24 Vdc output terminals | ELC-PS02 |
| Power supply (alternate)—120 Vac input Wall plug-in type with 6 ft cord—12 Vdc output | PXESPS12V |
| DIN rail mounting bracket | PXESDINRL |
| 19-inch rack mount tray | PXESTRAY |

Technical Data and Specifications

Operating Environment

| Description | Specifications |
|-----------------------------|---|
| Ambient temperature ratings | –25°C to 60°C long-term per independent agency tests (UL), or –40°C to 85°C short-term per IEC type tests |
| Storage temperature | –40° to 185°F (–40°C to 85°C) |
| Cold start | to –20°C |
| Ambient relative humidity | 5%–95% (noncondensing) |
| Altitude | –200 to 50,000 ft (–60 to 15,000m) |
| MTBF | > 15 years |

Network Standards

| Description |
|---|
| Ethernet IEEE 802.3, IEEE 802.3u; IEEE 802.1p, 100Base-TX, 10Base-T, 100Base-FX |

Power Consumption

| Description |
|-----------------------------------|
| 7.0 watts typical—9 watts maximum |

Packaging

| Description | Specifications |
|----------------|----------------------------|
| Enclosure | Robust sheet metal (steel) |
| Cooling method | Case used as a heat sink |

Mounting

| Description | Specifications |
|----------------------------|----------------|
| Metal panel mounting clips | Included |
| DIN rail mounting | Optional |
| 19-inch rack mount | Optional |

Copper Ethernet Cable Wiring Guidelines

The following information can be used as a guide when designing an Ethernet system using Copper Ethernet Cable.

- Cables should not be routed near equipment that generates strong electric or magnetic fields such as motors, drive controllers, arc welders and conduit
- Ethernet cable insulation has a voltage rating of 300 Vac. Use of barriers, cable trays or high voltage sheathing with STP Ethernet cable may be required in installations with cables carrying voltages greater than 300 Vac. This may also be necessary in order to comply with UL requirements. In installations where the cable cannot be physically separated from the power cables (where a physical barrier is not practical) fiber optic cable should be used
- When crossing power conductors with Ethernet cable, cross at right angles
- Shielded Twisted Pair (STP) Ethernet cable should be specified for use in high noise environments. Shielded shrouded connectors must be used and the shield must be connected at both ends of the wire. The mating plug must have a shielded shroud that is terminated to ground at both ends. Where there is a possibility of a difference in ground potential (common mode) voltages between the two terminated ends, fiber optic cable is recommended
- When using conduit or a metal cable tray, each section of the conduit or tray must be bonded to each adjacent section and the conduit or tray needs to be bonded to earth ground. Do not allow the shields to touch the conduit or metal tray at any point
- Only shielded (STP) Ethernet cables should be placed into metal conduit. Some UTP cables may not function properly when installed in conduit, as the metal conduit can affect the electrical properties of an unshielded cable. Consult the cable manufacturer when installing UTP cables in conduit
- As a general rule for noise protection, Ethernet Cable should maintain a minimum distance of 3 inches (8 cm) from electric power conductors for up to 100 volts and 1 inch (3 cm) for each additional 100 volts up to 400 volts. STP cable is recommended
- For Ethernet cable run within conduit, but near conductors with potentially noisy power conductors carrying currents of greater than 20A or voltages greater than 400V, maintain the following distances. STP cable is required.
 - Conductors of less than 20A = 3 inches
 - Conductors of 20A or more and up to 100 kVA = 6 inches
 - Conductors greater than 100 kVA = 12 inches
- For Ethernet cable run near conductors with potentially noisy power conductors carrying currents of greater than 20A or voltages greater than 400V, maintain the following distances. STP cable is recommended
 - Conductors of less than 20A = 6 inches
 - Conductors of 20A or more and up to 100 kVA = 12 inches
 - Conductors greater than 100 kVA = 24 inches
- Route Ethernet cable at least 5 feet (1.5m) from sources of rf/microwave radiation. STP cable is required
- Do not cascade more than four Ethernet repeaters (router, switch or hub) within a network segment
- Environmentally sealed connectors should be specified for cables used in outdoor installations
- Avoid pinching the cable when using cable ties
- Total distance between an Ethernet Transmitter and Receiver at the end points of the network should not exceed 328 feet (100m)
- Total distance from a patch panel to a wall jack (using solid cable) shall not exceed 295 feet (90m). Splices are not permitted
- Patch cords used as cross-connect jumpers in a patch panel should not exceed 20 feet (6m)
- Patch cords from a wall jack to the work area PC (or device) shall not exceed 16 feet (5m)
- Ethernet cable used in harsh environments must be selected to withstand the following conditions: vibration, air born contaminants, chemicals, temperature, electromagnetic interference, combustible atmospheres and local regulatory standards such as UL and NEMA
- Ethernet connectors used in harsh environments must be robust enough to withstand vibration, multiple connection cycles, temperature changes, and provide a proper seal to protect against moisture, dust/dirt and chemical attack
- Different cable media support different bandwidth capabilities. When installing cable in a network, care should be taken to install the cable that will fill current network loading requirements and future expansion needs. In general, fiber optic cable can support the greatest bandwidth (upward of 25,000 gigabits) and UTP has the lowest. CAT5e cabling is designed to operate at bit rates up to 1000 Mb and CAT6 cable up to 2000 Mb
- Operating your cable at maximum speed reduces the distance between network segments. Check with your cable supplier for specifications regarding segment distance vs. speed
- Cable with 5% impedance mismatch or return loss of 27 to 32 dB is recommended. Ethernet cable impedance can vary by as much as 15% (85 to 115 ohms). Average Ethernet cable with 15% impedance variation can have up to 10 dB additional return loss. This discontinuity is referred to as return loss, since it causes some of the signal to be reflected back down the cable instead of propagating forward. It is measured in decibels or ratio of transmitted versus reflected signal

Fiber Optic Technology

The use of fiber optics in telecommunications and wide area networking has been common for many years, but more recently fiber optics have become increasingly prevalent in industrial data communications systems as well. High data rate capabilities, noise rejection and electrical isolation are just a few of the important characteristics that make fiber optic technology ideal for use in industrial and commercial systems.

Although often used for point-to-point connections, fiber optic links are being used to extend the distance limitations of RS-232, RS-422/485 and Ethernet systems while ensuring high data rates and minimizing electrical interference.

Conventional electrical data signals are converted into a modulated light beam, introduced into the fiber and transported via a very small diameter glass or plastic fiber to a receiver that converts the light back into electrical signals.

Optical fibers allow data signals to propagate through them by ensuring that the light signal enters the fiber at an angle greater than the critical angle of the interface between two types of glass.

Optical fiber is actually made up of three parts. The center core is composed of very pure glass. Core dimensions are usually in the range of 50 to 125 um for multi-mode cables and 8-9 um for single-mode cables. The surrounding glass, called cladding, is a slightly less pure glass. The diameter of the core and cladding together is in the range of 125 to 440 um.

Surrounding the cladding is a protective layer of flexible silicone called the sheath.

Fiber Optic Cable Wiring Guidelines

The following information can be used as a guide when designing an Ethernet system using Fiber Optic Ethernet Cable:

- Select a fiber cable that is suited for the application, e.g., outdoor, aerial, duct, intra-building, risers, general building and plenum applications
- Fiber optic cable is useful in applications where the environment is combustible, electrically noisy, the cable must be bundles with high voltage wires or where common mode voltages may exist between the earth ground points of the terminating connectors

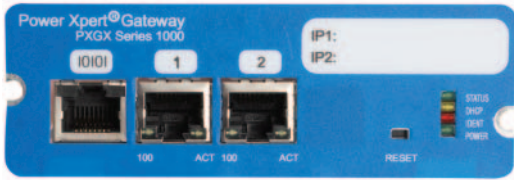
- Fiber optic cable is available in various operating temperature ranges. Care should be taken to match the temperature rating of the fiber to the environment it will be exposed to. The temperature specification for fiber may be narrower than copper cable. Consult the cable manufacturer for temperature specifications of your cable type
- Sealed fiber connectors are available for use in harsh environments to prevent contamination from entering the connector and fiber. The type of seal required will be application dependant and can vary from dust- and moisture-proof to water-tight
- Mixing fiber cable types is not permitted. The same core dimensions and mode must be used within cable segments
- Care should be taken when purchasing connectors to include strain relief, which reduces mechanical strain (vibration) within the cable, as well as the connector. Strain relief also provides support to the cable to ensure proper bend radius at the connector
- Single-Mode Fiber is used for long distance transmission of up to 120 km. Distance may vary depending on speed and type of converter used.
- Multi-Mode Graded-Index Fiber Cable is used for communication over shorter distances of up to 2 km
- Fiber cable is composed of glass and is not well suited for applications requiring tight bend radiuses. Cable radius dimensions vary per manufacturer. If the manufacturer does not provide a bend radius, a typical rule of thumb is a radius not less than 15x the cable diameter
- Fiber cable to connector terminations can be performed in the field using special equipment. This method is not recommended
 - Tier One testing is recommended when diagnosing system irregularities and should be performed in all new installations
 - Tier Two testing is recommended to certify that a system complies with standards set forth by the owner/installer

Dimensions

Packaging

| Description | Specifications |
|--|---|
| Dimensions of PXES4P series Weight of PXES4P series | 3.5 in H x 3.0 in W x 1.0 in D (8.9 cm x 7.6 cm x 2.5 cm) 8.6 oz. (243g) |
| Dimensions of PXES6P series Weight of PXES6P series | 3.6 in H x 3.0 in W x 1.7 in D (9.2 cm x 7.6 cm x 4.3 cm) 13 oz. (370g) |

Power Xpert Gateway Series 1000 Card



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Power Xpert Gateway Series 1000 Card—Power Distribution Unit

Product Description

The Power Xpert Gateway Series 1000 Card (PXGX 1000) provides Web-enabled, real-time monitoring of Powerware Power Distribution Units (PDUs), Rack Power Modules (RPM) and Powerware Remote Power Panels (RPPs) through standard on-board Web pages, Power Xpert software or third-party software.

An integral part of the Power Xpert Architecture, which provides end-to-end PowerChain Management® solutions, the PXGX 1000 provides a central point to connect distribution products to an Ethernet network.

Information is presented in organized, user-friendly Web pages and include the following:

- PDU system identification
- Graphic panel layouts
- Voltage
- Current
- Frequency
- Energy
- Power
- THD (current and voltage)

Features

- Web-enabled monitoring of power quality data down to the branch circuit level—Data can be viewed from any location with a Web browser
- Configure and edit the EMS remotely via the Web interface—supports remote configuration, including naming, alarm and warning set points and percentages
- Data, interval and event logging with time stamp—accurate logging for power quality analysis
- Modbus TCP/IP and SNMP Support—open communication protocol facilitates integration with standard building management systems and network management systems
- Customized e-mail messaging for events notification, including data and event logs and periodic “heartbeat” e-mails—direct alarm and event notification to the appropriate person(s) in the organization
- Easy integration into existing Ethernet infrastructure—minimize installation cost
- Securely access and view information—password authentication is required at two levels. The card also supports secure Web-based communication via SSL
- Generate Modbus Register Maps on the fly—all of the data specific to the system is immediately available and can be generated with one click of the mouse

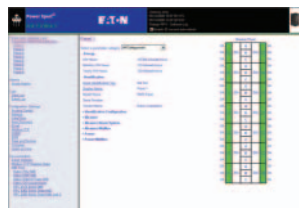
- Save and Restore settings—configuring a large PDU with EMS can take time. Once the effort is complete, the configuration can be saved for later use. It also allows the user to duplicate panel identical configurations in minimal time
- Supports the Environmental Monitoring Probe—temperature, humidity and contact status can be viewed through the Web page

Standards and Certifications

- FCC Part 15, Class A
- CISPR 22, Class A
- ROHS Compliant
- Telecom conducted via EU Standard
 - EN 55022:1988+A1:2000+A2:2003, Class A/EN55022:1988+A1:2000+A2:2003



PDU or RPP System Summary Page



PDU or RPP Panel Page



RPM Panel Page

Product Selection

Power Xpert Gateway Series 1000 Card



Ordering Information

| Description | Style Number | Catalog Number |
|--|----------------|----------------|
| Power Xpert Gateway Series 1000 Card for use with Eaton PDUs, RPPs, RPMs, PDRs and EMS-UGK | 103005741-5591 | PXGX1000 |

Technical Data and Specifications

The Power Xpert Gateway Series 1000 Card Kit Includes

- Power Xpert Gateway Series 1000 Card
- Ethernet cable
- Local configuration cable
- Quick start guide

Devices Supported

- Powerware Power Distribution Units with X-Slot® compatibility
- Powerware Remote Power Panels with X-Slot compatibility
- Powerware Rack Power Modules with X-Slot compatibility

Communication Ports

- Ethernet ports: Two independent RJ-45 ports: supports 10/100Base-T for redundant network configurations
- Serial ports: One RJ-45 console port: supports local configuration and optional connection to an Environmental Monitoring Probe (EMP)

Communication Protocols Supported

- Web server: supports data access from Web browsers (HTTP and HTTPS)
- Modbus TCP/IP: supports data access from Modbus TCP clients
- SNMP: supports common network management tools
- SMTP: supports e-mail notification
- NTP: supports time synchronization via an NTP server for card and PDU synchronization
- DHCP: supports automatic IP address assignments, if enabled

Supported MIBs

- Eaton PDU MIB
- Eaton EMP MIB
- Eaton alarms and traps MIB
- RFC 4133 Entity MIB
- RFC 4268 Entity State MIB
- RFC 4268 Entity State MIB Part II
- RFC 1213 MIB II

Web Browsers Supported

- IE
- Mozilla Firefox

Environmental Specifications

- Ambient operating: 0 to +40°C (32 to 104°F)
- Relative humidity: 10 to 80%, noncondensing
- Altitude: 10,000 ft
- Enclosure rating: indoor use only

Mounting Configuration

- X-Slot form factor fits directly into PDU/RPP/RPM chassis

Power Supply

- Nominal input voltage: 12 Vdc, unregulated (provided by PDU/RPP)
- Input voltage range: 8–25 Vdc, unregulated

Power Consumption

2.0 watts

Note: Features and specifications listed in this document are subject to change without notice and represent the maximum capabilities of the software and products with all options installed. This is not a complete feature list. Features and functionality may vary depending on selected options.

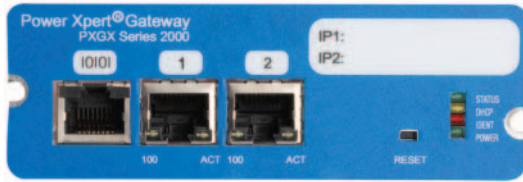
Dimensions

Approximate Dimensions in Inches (mm)

Physical Characteristics

| Height | Width | Depth | Weight Lbs (kg) |
|-------------|--------------|--------------|--------------------|
| 1.50 (39.0) | 4.70 (120.0) | 4.50 (114.0) | 0.44 (0.2) |

Power Xpert Gateway Series 2000 Card



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| IMPCABLE | 423 |

Power Xpert Gateway Series 2000 Card—Uninterruptible Power Supplies

Product Description

The Power Xpert Gateway Series 2000 Card (PXGX 2000) provides Web-enabled, real-time monitoring of Powerware Uninterruptible Power Supplies (UPS) through standard on-board Web pages, Power Xpert software or third-party software.

An integral part of the Power Xpert Architecture, which provides end-to-end PowerChain Management solutions, the PXGX 2000 provides a central point to connect distribution products to an Ethernet network.

Information is presented in organized, user-friendly Web pages and include the following:

- UPS system identification
- Voltage
- Current
- Frequency
- Energy
- Output Power
- Power—full load %
- Battery information
 - History and maintenance
 - Run time remaining
 - Voltage
 - % battery left

Features

- Web-enabled monitoring of power quality data—data can be viewed from any location with a Web browser
- Data, event and system logging with time stamp—accurate logging for power quality analysis
- Modbus TCP/IP and SNMP Support—open communication protocol facilitates integration with standard building management systems and network management systems
- Intelligent email communications—two options for alarm and event e-mail notification, individual e-mails for each alarm or event, or collective notification, providing the same information with a drastically reduced number of e-mails
- Easy integration into existing Ethernet infrastructure—minimize installation cost
- Securely access and view information—password authentication is required at two levels. The card also supports secure Web-based communication via SSL
- Generate Modbus Register Maps on the fly—all of the data specific to the UPS is immediately available and can be generated with one click of the mouse
- Save and Restore settings—once the configuration effort is complete, it can be saved for later use

- Supports the Environmental Monitoring Probe—temperature, humidity and contact status can be viewed through the Web page
- Two independent, redundant Ethernet ports—designed to support high reliability systems

**UPS Summary Page****Alarm Summary Page****NetWatch Support Page****Standards and Certifications**

- FCC Part 15, Class A
- CISPR 22, Class A
- ROHS Compliant
- Telecom conducted via EU Standard
 - EN 55022:1988+A1:2000+A2:2003, Class A/EN55022:1988+A1:2000+A2:2003



Product Selection

Power Xpert Gateway Series 2000 Card



Ordering Information

| Description | Style Number | Catalog Number |
|--|----------------|----------------|
| Power Xpert Gateway Series 2000 Card for use with Powerware UPSs | 103005868-5591 | PXGX 2000 |

Technical Data and Specifications

The Power Xpert Gateway Series 2000 Card Kit Includes

- Power Xpert Gateway Series 2000 Card
- Ethernet cable
- Local configuration cable
- Quick start guide

Devices Supported

- Powerware uninterruptible power supplies with X-Slot compatibility; these include the Powerware 5115 RM, 5125, 9125, 9140, 9155, 9315, 9355, 9330, 9390, 9395, BladeUPS®

Communication Ports

- Ethernet ports: two independent RJ-45 ports: supports 10/100Base-T for redundant network configurations
- Serial ports: one RJ-45 console port supports local configuration and optional connection to an Environmental Monitoring Probe (EMP)

Communication Protocols Supported

- Web server: supports data access from Web browsers (HTTP and HTTPS)
- Modbus TCP/IP: supports data access from Modbus TCP clients
- SNMP: supports common network management tools
- SMTP: supports e-mail notification
- NTP: supports time synchronization via an NTP server for card and UPS synchronization
- DHCP: supports automatic IP address assignments, if enabled

Supported MIBs

- Eaton Power MIB
- RFC 1628 UPS MIB
- Eaton EMP MIB
- Eaton alarms and traps MIB
- RFC 4133 Entity MIB
- RFC 4268 Entity State MIB; RFC 4268 Entity State MIB Part 2
- RFC 1213 MIB II

Web Browsers Supported

- IE
- Mozilla Firefox

Environmental Specifications

- Ambient operating: 0 to +40°C (32 to 104°F)
- Relative humidity: 10 to 80%, noncondensing
- Altitude: 10,000 ft
- Enclosure rating: indoor use only

Mounting Configuration

- X-Slot form factor fits directly into UPS chassis

Power Supply

- Nominal input voltage: 12 Vdc, unregulated (provided by UPS)
- Input voltage range: 8–25 Vdc, unregulated

Power Consumption

- 2.0 watts

Dimensions

Approximate Dimensions in Inches (mm)

Physical Characteristics

| Height | Width | Depth | Weight Lbs (kg) |
|-------------|--------------|--------------|-----------------|
| 1.50 (39.0) | 4.70 (120.0) | 4.50 (114.0) | 0.44 (0.2) |

mMINT Module



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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 407**). 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**

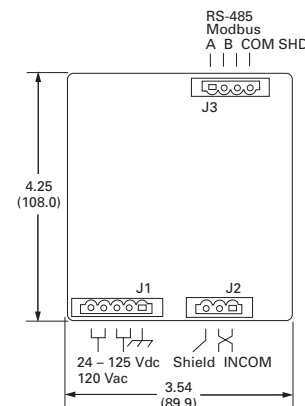
The following simplified rules apply to a given system consisting of a single daisy-chained main cable link between master and slave devices (see below). For more complex considerations including star configurations, please refer to the IMPACC wiring specification T.D. 17513.

- 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

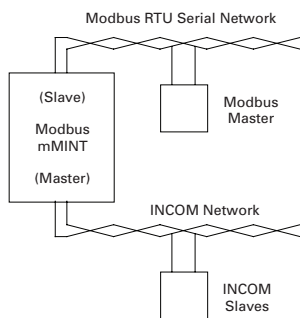
Burden

- 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.



mMINT in a Communications Network

MINTII RS-232 Converter



MINTII RS-232 Converter

Product Description

Converts a network of Power Management Software devices to ASCII RS-232 format for access through a serial port of a personal computer, laptop, or Programmable Logic Controller.

Displayed Parameters

- Eaton's MINTII provides access to all parameters monitored over the Power Management Software network
- Supports INCOM networks up to 8500 feet (2590m) in distance and device counts up to 1000

Application Description

The Master INCOM Network Translator II (MINTII) converts the twisted shielded pair network of INCOM devices to an RS-232 signal. This signal can be accessed by PLCs, computer serial ports, building management system serial interface cards. The MINTII is also often applied as an interface to standard line drivers and converters to allow communication through dedicated telephone lines, dial-up modems, fiber-optic line drivers, radio frequency or wireless modems.

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Product Selection

MINTII RS-232 Converter

| Description | Catalog Number |
|------------------------------------|----------------|
| Master INCOM Network Translator II | MINTII |

Technical Data and Specifications

- Temperature**
- 0°C to 60°C
- Humidity**
- 0% to 95%
- Power**
- 120V
- Speed**
- 1200, 2400 and 9600 baud (INCOM), 19.2K baud (RS-232)
- Communications**
- INCOM, RS-232

Dimensions

- Suitable for panel mounting or desktop use
- 120 Vac power cord included for plug-in to standard duplex receptacle
- Height: 2.25 inches (57.2 mm)
- Width: 11.5 inches (292.1 mm)
- Depth: 4.25 inches (108.0 mm)

IPONI Communication Module



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IPONI

Product Selection Guide

IPONI Selection Chart

| Description | IPONI | INCOM on Product | MPONI |
|----------------------------------|-------|------------------|-------|
| IQ Analyzer | ≥1.06 | — | ■ |
| IQ DP-4000 | ■ | — | ■ |
| IQ 200 | — | ■ | — |
| IQ Multipoint Energy Submeter II | — | ■ | — |
| Energy Sentinel | — | ■ | — |
| Power Sentinel | — | ■ | — |
| IQ Generator | ■ | — | — |
| IQ Data | ■ | — | — |
| IQ Data Plus II | — | — | — |
| IQ 500 | — | — | — |
| IQ Transfer | ■ | — | — |
| AEMII | ■ | — | — |
| BIM II | ■ | — | — |
| CMU | ■ | — | — |
| CED | ■ | — | — |
| MP-3000 | ■ | — | ■ |
| Digitrip 3000 | — | ■ | — |
| FP-5000 | — | ■ | — |

Product Description

The INCOM Product Operated Network Interface card, or IPONI card, adds communication capability to various Eaton products. Each IPONI has three 16-digit address switches to uniquely identify each device on the network. IPONIs are designed to be daisy-chained throughout a unit substation or equipment room to a master device such as a mMINT, MINTII or Power Xpert Gateway. From the master computer, information is distributed through the facility's TCP/IP Ethernet network. A twisted shielded pair network connecting IPONIs may extend up to 10,000 feet (3048m) before terminating a master device. The IPONI comes with mounting hardware and attaches to the back of its associated device.

Technical Data and Specifications

Temperature

- -20°C to 70°C

Humidity

- 5%–95% noncondensing

Power

- 20–30 Vdc maximum, 50 mA nominal, 100 mA maximum

Speed

- 1200 and 9600 baud

Communications

- Three-position removable terminal block for twisted shielded pair INCOM

Product Selection

IPONI Card **PONI Communication Modules**



| Description | Catalog Number |
|-------------|----------------|
| INCOM PONI | IPONI |

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DPONI

Product Description

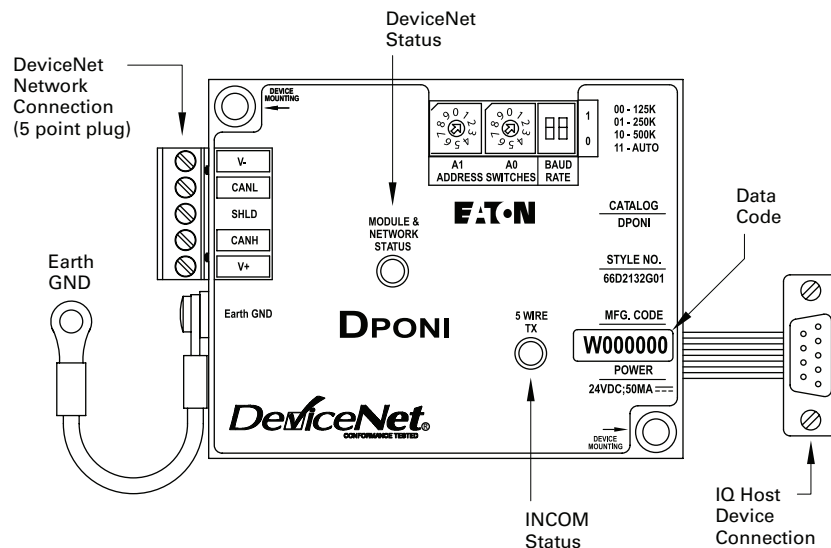
The DeviceNet Product Operated Network Interface (DPONI) enables communication between a DeviceNet network master station and a host device in a Master/Slave format over a DeviceNet network. The DPONI is compatible with the MP-3000 and the MP-4000. The DPONI is powered both by the host product to which it is attached and by the DeviceNet network. The DPONI uses opto-couplers to isolate the two power systems.

The DPONI communicates at 125, 250 or 500 Kbps selected via a front panel DIP switch. All products on the DeviceNet network must be set at the same communication rate.

The DPONI has a bi-color network/module status LED that functions in accordance with the DeviceNet specification. An additional monochrome LED flashes while the DPONI is receiving a message from the host device.

Features

Eaton's DPONI



Product Selection

DPONI

| Description | Catalog Number |
|--|----------------|
| The DeviceNet Product Operated Network Interface | DPONI |

Technical Data and Specifications

- | | | |
|---|---|--|
| <p>Temperature</p> <ul style="list-style-type: none"> • -20°C to 70°C <p>Humidity</p> <ul style="list-style-type: none"> • 5%–90% noncondensing | <p>Power</p> <ul style="list-style-type: none"> • 11–27 Vdc, 40 mA maximum <p>Speed</p> <ul style="list-style-type: none"> • 125, 250 or 500 Kbps | <p>Communications</p> <ul style="list-style-type: none"> • Standard five-wire CAN connection |
|---|---|--|

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MPONI

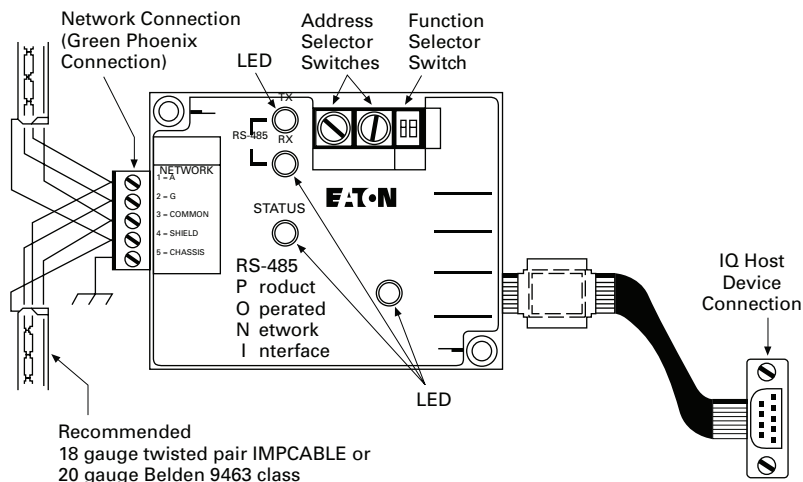
Product Description

The MPONI Product Operated Network Interface card, or MPONI card, enables Modbus communication capability to various Eaton products. Each MPONI contains two rotary address switches to uniquely identify each device on the network and a baud rate DIP switch. A 5-pin connector is provided for wiring to the RS-485 network. Various baud rates are available for networking flexibility, and onboard LEDs indicate operation, error and communication status. The MPONI is applied where a device network exists connected by a dedicated shielded twisted pair conductor. Modbus RS-485 allows a single device or multiple units in a daisy-chain configuration to communicate with another local or remote device and may extend up to 4000 feet (1219m) without a repeater. The MPONI comes with mounting hardware and attaches to the back of its associated device.

Note: Please see IL for detailed register support information for each supported product. Not all device functionality is supported with the RS-485 PONI over the Modbus Protocol.

Features

MPONI



Product Selection

MPONI

| Description | Catalog Number |
|--|----------------|
| Modbus Product Operated Network Interface Card | MPONI |

Digital Input Module (DIM)



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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. (3048m) |
| 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

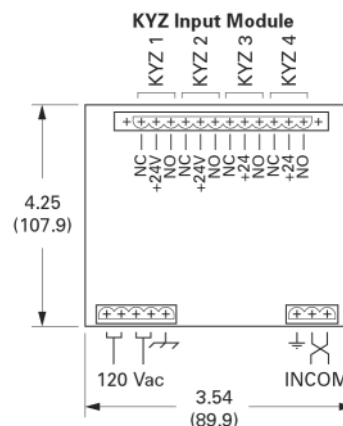
The DIM is a fully compatible Power Management Software communicating device with built-in INCOM communications. The DIM comes complete with a 3-pin connector to receive the shielded twisted pair conductor.

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.

Addressable Relay II



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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. **See 420** for DIP switch configuration.

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 |

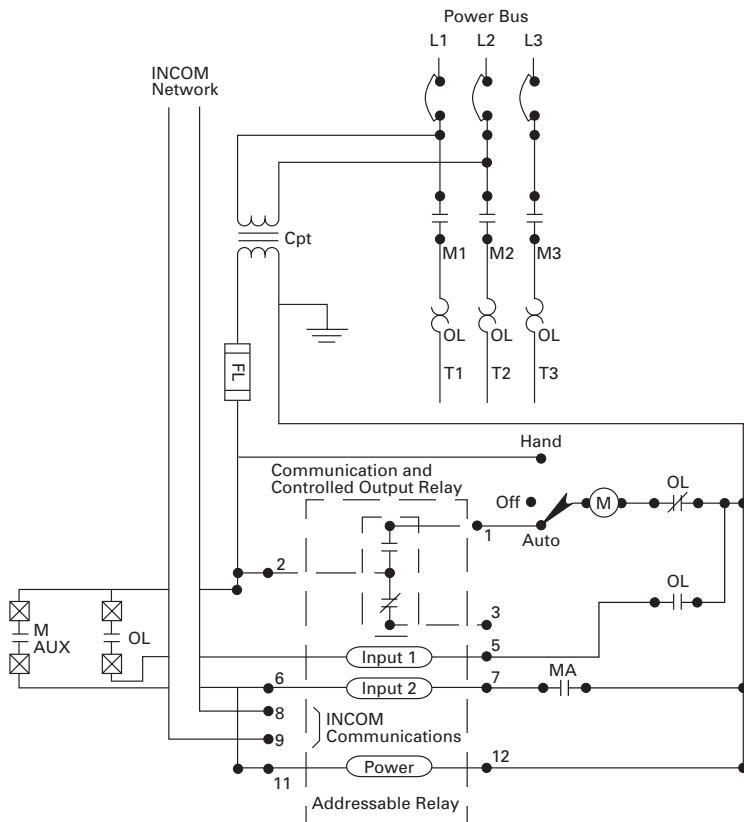
Technical Data and Specifications

- Power: 48–120 Vac; 48–125 Vdc
- Operating temperature range: 32°–158°F (0°–70°C)

Contact Ratings

| Contact Ratings | Make | Break |
|-----------------|---------|--------|
| 120–240 Vac | 4960 VA | 828 VA |
| 24–120 Vac | 43A | 7.2A |
| 30 Vdc | 10A | 10A |

Wiring Diagram



DIP Switch Functions

| | OFF | ON |
|-------------------------|----------|---------|
| Baud Rate | 9600 | 1200 |
| Relay Pulse | Disabled | Enabled |
| Communications Watchdog | Disabled | Enabled |

22.5

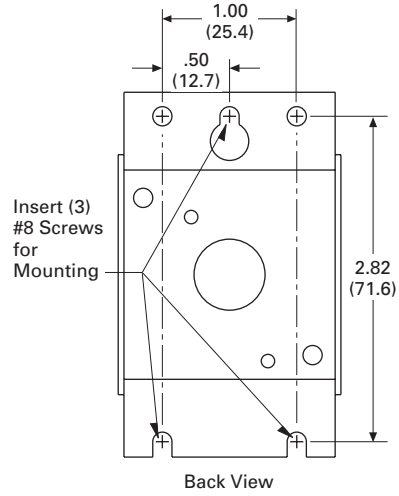
Metering Devices, Protective Relays, Software and Connectivity

Connectivity Options

Dimensions

Approximate Dimensions in Inches (mm)

Mounting



Addressable Relay

| Width | Height | Depth |
|-------------|-------------|--------------|
| 1.75 (44.5) | 3.00 (76.2) | 4.00 (101.6) |

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Breaker Interface Module II (BIM II)



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Breaker Interface Module II (BIM II)

Product Description

Eaton’s Breaker Interface Module is a panel-mounted device that displays the following parameters.

- Phase current
- Energy
- Present demand watts
- Peak demand watts
- Average demand current
- Cause and magnitude of trip
- Trip history
- % Total Harmonic Distortion (THD) for each phase
- % Harmonic Content for each phase (1st–27th harmonic)
- Custom circuit description

Note: The Breaker Interface Module displays only a portion of the information it receives from the Digitrip RMS 910, 1150 and Power Sentinels. The balance of the information (such as Waveform Analysis and Power Factor) can be passed through the unit to a master computer, where it can be viewed.

Application Description

- 810, 910, 750, 1050, 550, 1150, 520MC, IQ Energy Sentinels and Power Sentinels
 - Event logging
 - Alarming
 - High load indication
 - Peak exceeded alarm
 - Grouping of meters
- An operator can use the Breaker Interface Module to:
- Complete Initial System Setup:
 - Select system frequency (50/60 Hz)
 - Set password
 - Configure OPTIM Protective Settings.
 - Select protection options
 - Select alarm levels
 - Display Information:
 - Metered values
 - Trip event information
 - Breaker information
 - Time-current set points

- Test OPTIM Trip Unit Performance:
 - Phase and ground
 - Trip/no trip
- Expanded Energy Monitoring:
 - Set addresses for group energy monitoring
 - Group energy readings
- Local and Remote Indication:
 - Remote indication/ alarming
 - Breaker status LED indication
- Expanded Communications:
 - Communicate with:
 - OPTIM Trip Units
 - Digitrip RMS 810, 910 and 1150 Trip Units
 - IQ Energy Sentinels and Universal IQ Energy Sentinels
 - A total of 50 devices

Features, Benefits and Functions

- Monitors and displays parameters from any combination of Digitrip RMS 810, 910, 1150 and Digitrip OPTIM Trip Units, F-/J-/K-Frame Energy Sentinels, and Universal Energy Sentinels, supporting as many as 50 of these devices up to 10,000 feet (3048 m) away
- Communicates the information from these protective and energy monitoring devices over Eaton INCOM network to a computer or PLC
- Continuously monitors breakers recording and time-stamping trip events along with approximate fault currents. Events are logged into non-volatile RAM

Physical Characteristics

- Graphical, glass plasma display
- Up to seven lines of information
- Membrane faceplate NEMA 3R and 12 rated

Communications

Depending upon the type of communication protocol used by the main network, an appropriate PON1 module can be easily field-mounted to the back of the Breaker Interface Module, enabling the unit to pass the information from its subnetwork to a remote master control unit up to 10,000 feet (3048 m) away.

No reprogramming of the unit is required when the PON1 is added.

The Breaker Interface Module can be mounted directly on the assembly or at a remote location and can be used to access and configure and display information from OPTIM Trip Units.

Password Protection

A user-defined password is included for added security when changing settings or performing breaker tests.

Non-Volatile Memory

The programmed functions, addresses and circuit descriptions are stored in non-volatile memory.

External Power

A 24 Vdc supply is required for the BIM II. (No external power supply is required for the PON1 Card.) A 120 or 240 Vac supply is required for the BIMPS.

Rear Access Area

All wiring connections to the Breaker Interface Module are made at the chassis' rear and include:

- Relay connection for "alarm" condition, "high load" condition, "peak exceed" for device or group, and watthour pulse
- Initiator
- 24 Vdc input—BIM II
- 120 or 240 Vac input—BIMPS
- DIP switches for selecting an operating mode
- Three-contact connector with subnetwork
- Connector for PON1 card for remote communications Local Display Units

Product Selection

Breaker Interface Module II (BIM II)



Breaker Interface Module

| Description | Catalog Number |
|--------------------------|----------------|
| Breaker Interface Module | BIMII |
| | BIMPSII |

Technical Data and Specifications

Power Requirement

- 15 VA maximum

Input Voltage

- 24 Vdc $\pm 5\%$ —BIM II
- 120 or 240 Vac $\pm 10\%$ —BIMPS

Operating Temperature

- 0°C to 70°C (32°C to 158°F)

Humidity

- 5% to 95% R.H. (noncondensing)

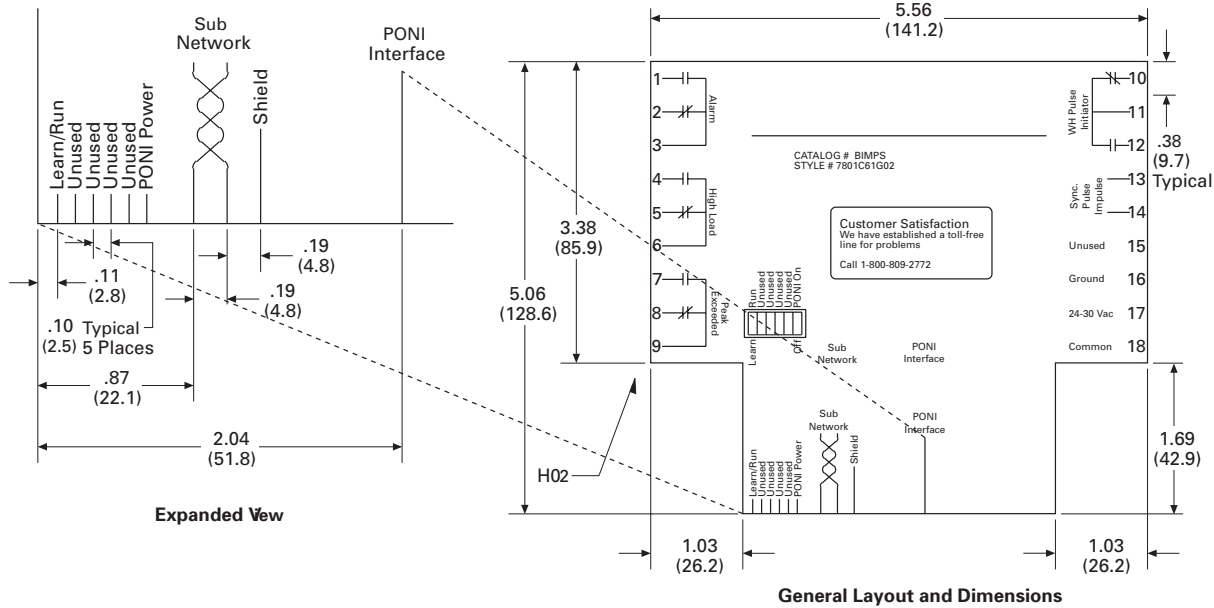
Alarm Contact Ratings

- 10A at 277 Vac (resistive)
- 10A at 30 Vdc (resistive)
- 1/3 hp at 125, 250 Vac

Dimensions

Approximate Dimensions in Inches (mm)

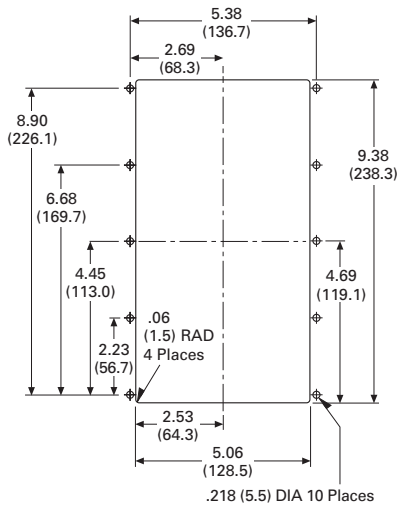
Connections and DIP Switch Rear Label Diagram



Breaker Interface Module

| Height | Width | Depth |
|------------------------------------|---------------|-------------|
| Without Communications Card | | |
| 6.72 (170.7) | 10.25 (260.4) | 2.60 (66.0) |
| With Communications Card | | |
| 6.72 (170.7) | 10.25 (260.4) | 3.85 (97.8) |

Drilling Pattern



Sub-Network Master Local Display)



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Sub-Network Master Local Display (SMLD)

Product Description

Eaton’s Sub-Network Master Local Display (SMLD) is an electronic submetering device that provides users the ability to view information from sub-network connected devices locally at switchgear, switchboards, panelboards, motor control centers and control panels, nearby or thousands of feet away. The SMLD has a built-in LCD display with navigations for configuring, as well as monitoring. Auto-learn capabilities complete the configuration requirements, enabling customization by use of user-defined descriptions, as well as adding and deleting meters.

The SMLD can be operated standalone or in parallel with the new FetchIT™ software application or the Power Xpert complete energy monitoring system solution software.

Application Description

- Acquire and display data (no control) from up to 100 devices that can communicate on Eaton’s INCOM network, used in the PowerNet monitoring system

Features, Benefits and Functions

- Auto-learn connected devices
- Configuration stored in non-volatile memory
- Host communications arbitration algorithm enables seamless integration into existing communication networks
- Functions standalone or networked

- Following devices are supported:
 - IQ 200
 - IQ Multipoint Energy Submeter II
 - IQ Energy Sentinel (F, J, K Frames)
 - Universal Internal Energy Sentinel
 - Universal External Energy Sentinel
 - IQ Power Sentinel
 - Digitrip OPTIM 1050L

Standards and Certifications

- Safety Standards—UL 61010B-1
- EMC Susceptibility Standards—IEC 1000-4-3, 1995 Radiated RF Immunity
- EMC Emissions Standards—FCC Part 15, Class B Radiated Emissions



Physical Characteristics

- Keypad functions:
 - Menu
 - Scroll up
 - Scroll down
 - Enter
- Backlit LCD, 4-line x 20 character

Product Selection

Sub-Network Master Local Display



Ordering Information

| Description | Catalog Number |
|-------------------------------|----------------|
| Local Display (120 Vac) | LDISP120 |
| Local Display (24 Vac or Vdc) | LDISP24 |

Technical Data and Specifications

Frequency Range

- 50/60 Hz

Power

- Power consumption: 200 mA (maximum) at 24 Vac, 24 Vdc
- Power connector rating: 24 Vac or 24 Vdc at 1 ampere
- Power source: 120 Vac or 24 Vdc, UL Class 2 or CSA Class III SELV transformer in accordance with C22.2 No. 1010-1. The voltage range is 18 to 24 Vac or Vdc, 200 mA (maximum)

Ratings

- Operating temperature: 0°C to 60°C
- Storage temperature: -20°C to 70°C
- Operating humidity: 5 to 90% maximum non-condensing
- Altitude: 10,000 feet (3048m)
- Environment: indoor use only

Mounting Information

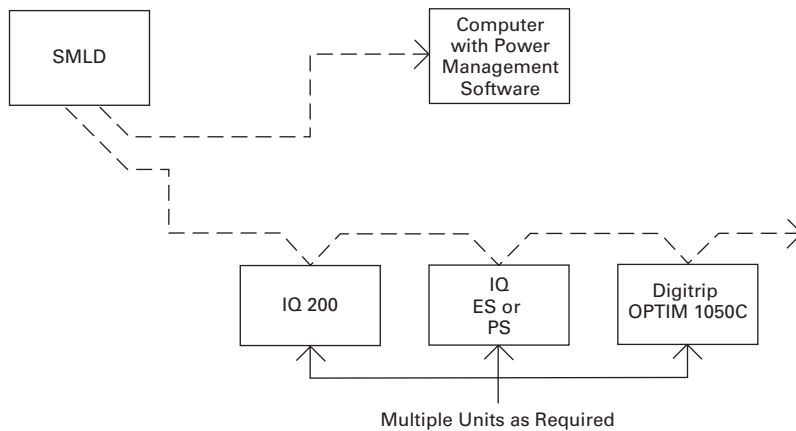
- 4.37 H x 4.37 W x 1.50 D inches (111.0 H x 111.0 W x 38.1 D mm)
- Door mount or panel mount

Communications

- INCOM Frequency Shift Key (FSK) network compatible 9600 baud
- Non-intrusive arbitration algorithm
- Passive monitoring automatically enabled by arbitration algorithm while host PC is communicating
- Master on INCOM network upon data request from front panel if host PC is not communicating
- Addresses for sub-network devices can be 001-044 hex (1-255 decimals)

22

Typical Use Diagram of SMLD



Dimensions

Approximate Dimensions in Inches (mm)

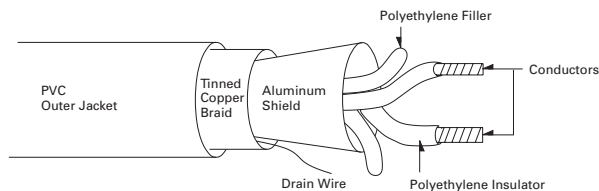
Meter Base Unit

| Width | Height | Depth |
|--------------|--------------|-------------|
| 4.37 (111.0) | 4.37 (111.0) | 1.50 (38.1) |

Note

DIN (92 mm x 92 mm) access cutout.

IMPCABLE



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IMPCABLE

Product Description

The IMPCABLE is an 18 AWG cable with a 100 ohm impedance at 100 kHz tuned to work optimally with the FSK signal from Eaton’s devices. The cable has been designed with characteristics that allow up to 1000 devices or distances up to 10,000 feet (3048m) from the master.

Please refer to Eaton’s wiring specification for instructions on cable runs and calculating maximum distances and devices on a given network.

Application Description

Eaton’s IMPCABLE was designed to be run in switchgear where codes require a 600 volt insulation rating. Typical “blue hose” cables are rated at 300 volts.

Features

Physical Characteristics

- Twisted shielded pair with drain wire
- 600 volt at 80°C
- 18 AWG, 20 AWG drain UL AWM 20253

Standards and Certifications

- UL AWM 20253
- NEC® CM
- CSA
- PCC-FT1
- P-MSHA



Product Selection

IMPCABLE

| Description | Catalog Number |
|-------------|----------------|
| IMPCABLE | IMPCABLE |

Technical Data and Specifications

- INCOM signal: attenuation 1.6 db/1000 feet (305m)
- Long communication runs
- 600 volt required ratings

22.5

Metering Devices, Protective Relays, Software and Connectivity

Connectivity Options

22