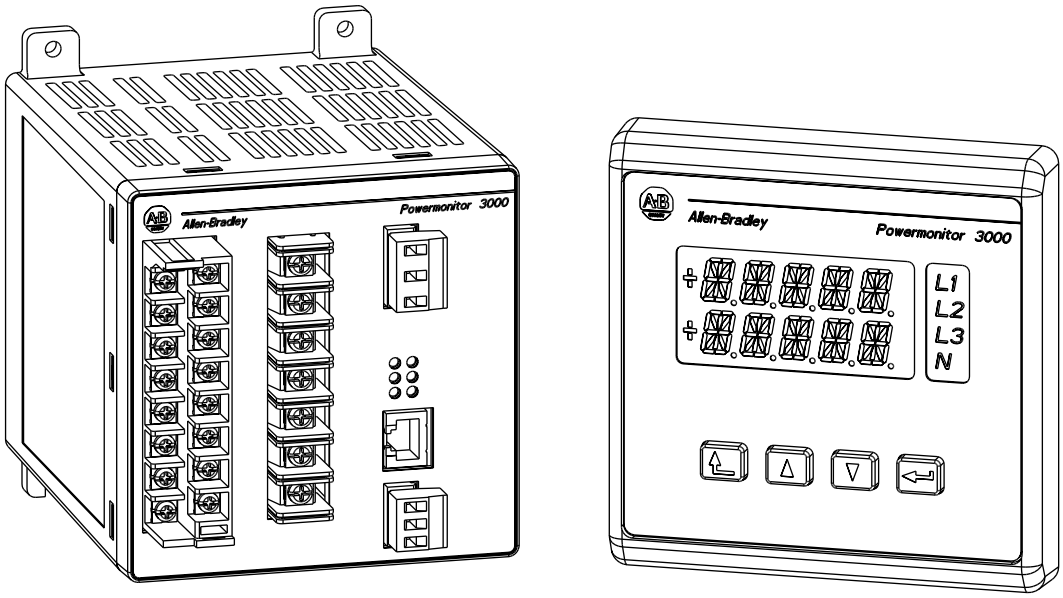
Installation Instruction

Powermonitor 3000

(Catalog Numbers: 1404-M4, 1404-M5, 1404-M6, 1404-M8)



Inside. . .

Publication 1404-IN007D-EN-P - October 2004

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.ab.com/manuals/gi) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual we use notes to make you aware of safety considerations.

WARNING

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

SHOCK HAZARD

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

BURN HAZARD

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.

European Communities (EC) Directive Compliance

If this product has the CE mark, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet the Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2 EMC — Generic Emission Standard, Part 2 — Industrial Environment
- EN 50082-2 EMC — Generic Immunity Standard, Part 2 — Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of IEC 1010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.

This equipment is classified as an open style device. Open style devices must be provided with environmental and safety protection by proper mounting in enclosures designed for specific application conditions. See NEMA Standards publication 250 and IEC publication 529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Using This Installation Instruction

What This Manual Doesn't Contain

This manual does not contain the following information. Except as noted, refer to the Powermonitor 3000 User Manual, Publication 1404-UM001 for detailed information on the topics in this list.

- Information on metering functionality and measurements
- Use of the Display Module for configuration, monitoring and commands
- Discussion of communications options, functionality, configuration and operation
- Setpoint configuration and operation
- Discrete I/O configuration and operation
- Data logging including Event Log, Trend Log, Min/Max Log, Load Factor Log
- Advanced features including Oscillography, Harmonic Analysis and Transient Detection
- Powermonitor 3000 data tables
- Sample ladder diagrams for communicating with the Powermonitor 3000 using various communications options
- Display module installation instructions (refer to Publication 1404-IN005)

For More Information on Additional Power Quality Products

Table 1 Related Documentation

For this information:	Refer to Publication:
Powermonitor 3000 User Manual	1404-UM001
Powermonitor 3000 Display Module Installation Instructions	1404-IN005
Bulletin 1403 Powermonitor II Tutorial	1403–1.0.2
Ethernet Series B Release Note	1404-RN008

Terms and Conventions

In this manual, the following terms and conventions are used:

Table 2

Abbreviation	Term
AWG	American Wire Gage
CSA	Canadian Standards Association
CT	Current Transformer
DM	Display Module
EMI	Electromagnetic Interference
ID	Identification
IEC	International Electrotechnical Commission
LED	Light Emitting Diode
NEMA	National Electrical Manufacturers Association
PLC	Programmable Logic Controller
PT	Potential Transformer (Also known as VT in some countries)
RAM	Random Access Memory
RFI	Radio Frequency Interference
R I/O	Remote Input/Output
RMS	Root–mean–square
SLC	Small Logic Controller
SPDT	Single Pole Double Throw
UL	Underwriters Laboratories
VA	Volt–ampere
VAR	Volt–ampere Reactive
CIP	Control and Information Protocol
NAP	Network Access Port

Safety Considerations

ATTENTION

Only qualified personnel, following accepted safety procedures, should install, wire and service the Powermonitor 3000 and its associated components. Before beginning any work, disconnect all sources of power and verify that they are de-energized and locked out. Failure to follow these instructions may result in personal injury or death, property damage or economic loss.

ATTENTION

Never open a current transformer (CT) secondary circuit with primary current applied. Wiring between the CTs and the Powermonitor 3000 should include a shorting terminal block in the CT secondary circuit. Shorting the secondary with primary current present allows other connections to be removed if needed. An open CT secondary with primary current applied produces a hazardous voltage, which can lead to personal injury, death, property damage or economic loss.

IMPORTANT

The Powermonitor 3000 is not designed for nor intended for use as a circuit protective device. Do not use this equipment in place of a motor overload relay or circuit protective relay.

IMPORTANT

The relay output contacts and solid-state KYZ output contacts on the Powermonitor 3000 may be used to control other devices through setpoint control or communications. The response of these outputs to a communications failure is configurable by the user. Refer to Publication 1404-UM001 for information on configuring the outputs. Be sure to evaluate the safety impact of the output configuration on your plant or process.

Other Warnings

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors. Follow these guidelines when you handle the module.

- Touch a grounded object to discharge static potential.
- Wear an approved wrist strap-grounding device.
- Do not open the module or attempt to service internal components.
- If available, use a static safe workstation.
- When not in use, keep the module in its static shield bag.

Product Description

The Bulletin 1404 Powermonitor 3000 is uniquely designed and developed to meet the needs of both producers of and users of electric power. A Powermonitor 3000 system consists of:

- Master Module which provides metering and native RS-485 communications
- Optional Display Module for configuration, commands and data display
- Optional communications port to serve data to other devices using a choice of networks
- Optional external devices and applications that display and utilize data for reporting, control and management of power and energy usage

The Powermonitor 3000 is a microprocessor-based monitoring and control device ideally suited for a variety of applications including:

- Load Profiling - Using the configurable trending utility to log power parameters such as real power, apparent power and demand, for analysis of power usage by loads over time.
- Demand Management - Understanding when and why demand charges occur allows you to make informed decisions that reduce your electrical power costs.
- Cost Allocation - Knowing your actual energy costs promotes manufacturing efficiencies.

- Distribution System Monitoring - Using power parameters to show power flow, system topology and distribution equipment status.
- Emergency Load Shedding - Monitoring power usage to preserve system stability in the event of sudden utility outage.
- Power System Control - Managing system voltage, harmonic distortion and power factor.

The Powermonitor 3000 is a sophisticated modern alternative for traditional electro-mechanical metering devices. A single Powermonitor 3000 can replace many individual transducers and meters. The Powermonitor 3000 is operator-friendly and provides the user with easy to understand, accurate information in a compact economical package.

Master Module

The Master Module contains the main microprocessor-based monitoring functions, including terminations for power system connections, status inputs, control outputs, a native RS-485 communications port and a port for the Display Module

Configuration

Although the Powermonitor 3000 ships from the factory with default settings, you will need to configure it for your particular requirements. You may configure the Powermonitor 3000 using the optional Display Module. Alternately, you may use an external device or application to write configuration, operational parameters and commands to the Master Module through its native or optional communications port. Refer to the Powermonitor 3000 User Manual, publication 1404-UM001 for additional detail.

Optional external applications that you may use for Powermonitor 3000 configuration include RSPower32™ and RSEnergyMetrix™ software operating on a personal computer. Contact your local Rockwell Automation sales office or distributor, or visit http://www.software.rockwell.com/ for more information on available software packages.

Communications

Every Powermonitor 3000 comes with a native RS-485 communications port. The RS-485 port may be configured to use the Allen-Bradley DF1 half-duplex slave protocols or Modbus™ RTU slave. The native port is suitable for communicating to master devices including:

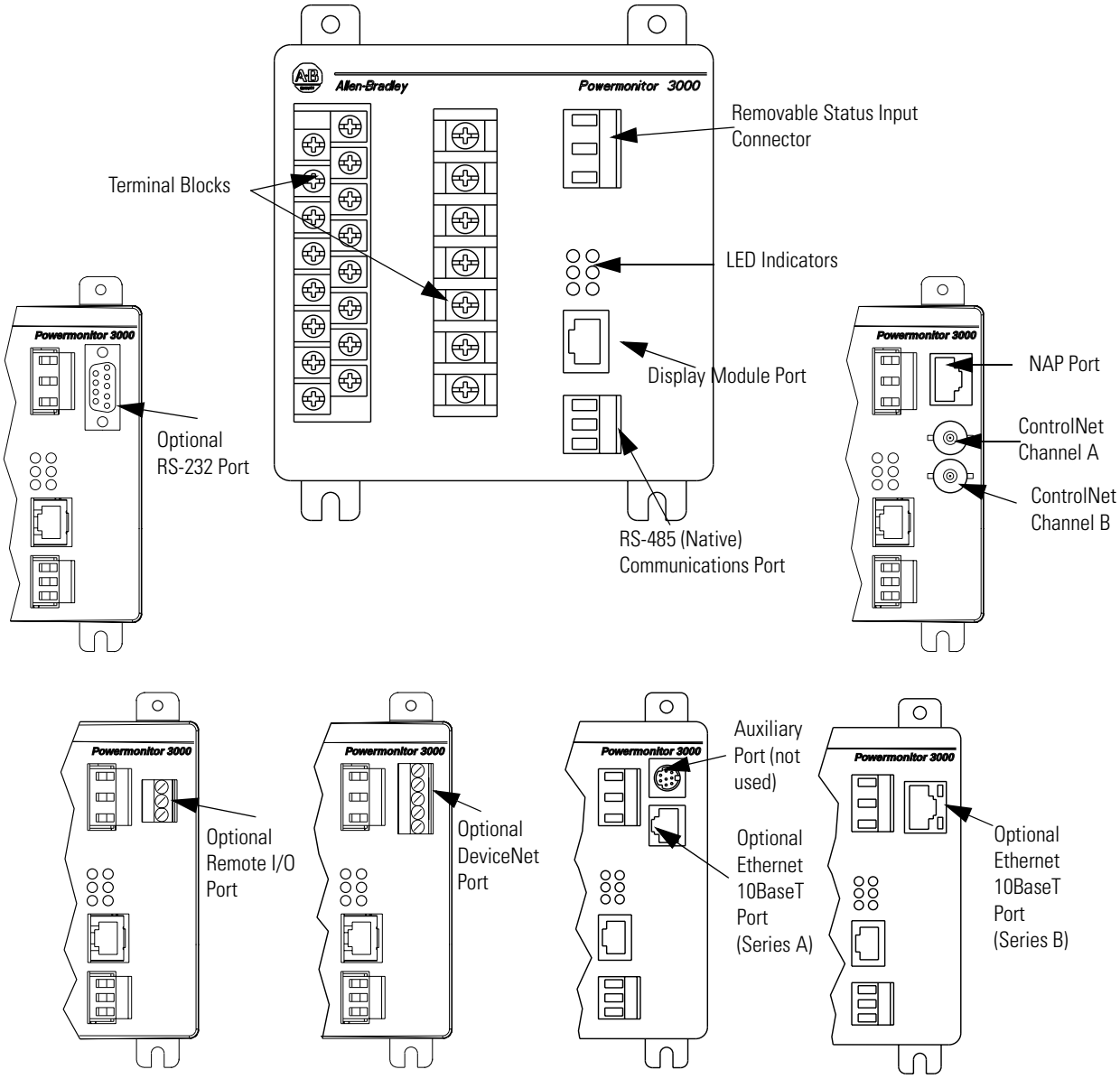
- PLC-5®, SLC 500™ and ControlLogix™ processors
- RSLinx™ software with DDE/OPC server functionality
- Modbus RTU Master devices
- Other third-party devices
- Software that you develop

You may also specify Powermonitor 3000 units with optional communications ports including:

- Serial RS-232 (DF1 half-duplex or Modbus RTU slave)
- Remote I/O
- DeviceNet™
- EtherNet/IP
- ControlNet™

A Powermonitor 3000 may be easily integrated into a programmable controller or computer based control and monitoring system, using any of the communications methods listed above.

Figure 3 Master Module with Communication Options



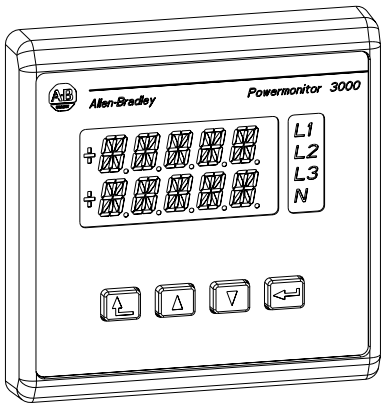
Display Module

The Bulletin 1404 Display Module is an optional user interface device. The Display Module provides the most economical and simplest method for setting up and configuring the Master Module for operation.

The Display Module has a highly visible, two-line LED display and four operator buttons with tactile feedback. Use the buttons and display to navigate through a series of menus for configuration, commands and data display.

The Display Module is shipped with a 3-meter (10 ft) long, shielded 4-pair cable that provides power and serial communications between the Master Module and the Display Module. The Display Module fits into a standard ANSI four inch analog meter cutout for panel mounting. Only one Display Module may be connected to a Master Module, although you may use one Display Module to configure and monitor any number of Master Modules; one at a time.

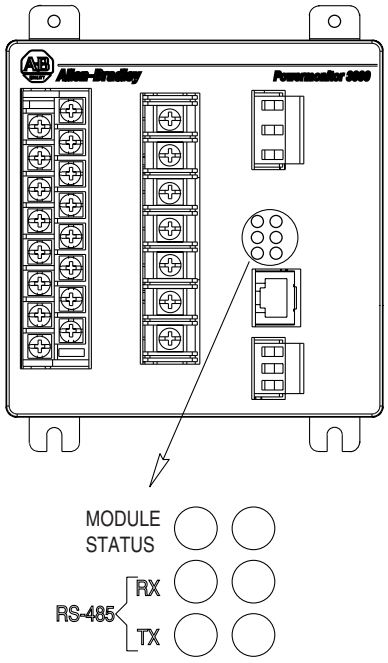
Figure 4 Display Module



LED Indicators

The Powermonitor 3000 is equipped with six bi-color light emitting diodes (LED's) arranged as shown in Figure 5.

Figure 5 LED Indicators



The three LED's on the left display the same information on Powermonitor 3000 modules with any communication option including native RS-485 communications only. The three LED's on the right have different labels and different indications depending on the communications option selected, as shown in the charts below.

Table 6 LED Indicators All Powermonitor 3000 Models

LED	LED Color	LED State and Communications Condition
Module Status	Off	Control power is off or insufficient
	Steady Red	Major fault; internal self-test has failed. If a power cycle does not correct the problem, call customer support
	Steady Green	Powermonitor 3000 is operating normally
RS-485 RX	Off	The RS-485 bus is idle; no active data is present
	Flashing Green	Active data is present on the RS-485 bus
RS-485 TX	Off	Powermonitor 3000 is not transmitting data onto the RS-485 bus
	Flashing Green	Powermonitor 3000 is transmitting data onto the RS-485 bus

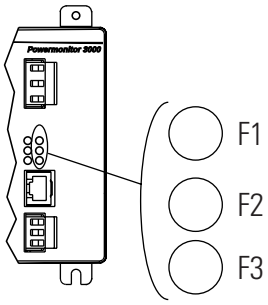


Table 7 Native RS-485 Communications only (catalog numbers ending in -000)

LED	LED Color	LED State and Communications Condition
F1	Off	Not Used
F2	Off	Not Used
F3	Off	Not Used

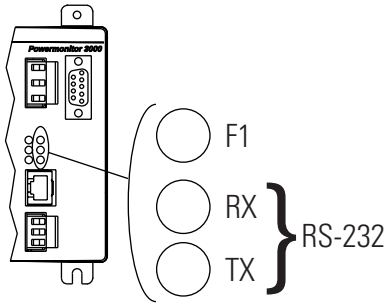


Table 8 RS-232 Optional Communications (catalog numbers ending in -232)

LED	LED Color	LED State and Communications Condition
F1	Off	Not Used
RS-232 RX	Off	The RS-232 bus is idle; no active data is present
	Flashing Green	Powermonitor 3000 is receiving data.
RS-232 TX	Off	The Powermonitor 3000 is not transmitting any data onto the RS-232 bus
	Flashing Green	The Powermonitor 3000 is transmitting data.

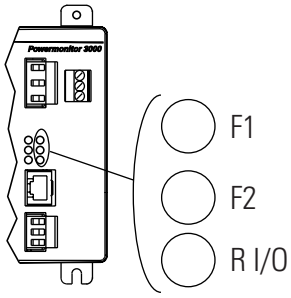


Table 9 Remote I/O Optional Communications (catalog numbers ending in -RIO)

LED	LED Color	LED State and Communications Condition
F1	Off	Not Used
F2	Off	Not Used
R I/O	Off	Remote I/O communications has not been established
	Flashing Green	Remote I/O communications has been established but there are errors
	Steady Green	Remote I/O communications has been established

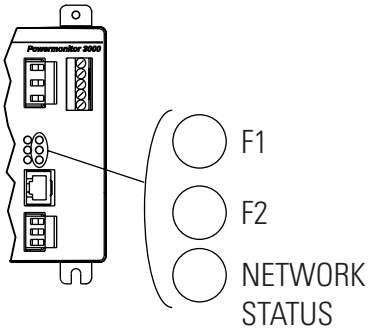


Table 10 DeviceNet Optional Communications (catalog numbers ending in -DNT)

LED	LED Color	LED State and Communications Condition
F1	Off	Not Used
F2	Off	Not Used
NETWORK STATUS	Off	Power is off or the Powermonitor 3000 is not online
	Flashing Green	Network status is OK, no connections established
	Steady Green	Network status is OK, connections established
	Flashing Red	Recoverable communications failure; port is restarting
	Steady Red	Non-recoverable communications error; check wiring and configuration parameters

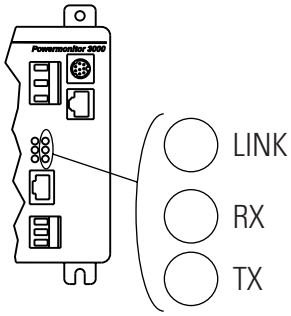


Table 11 Ethernet Optional Communications (Series A catalog numbers ending in -ENT)

LED	LED Color	LED State and Communications Condition
LINK	Off	Ethernet connection is inactive
	Steady Green	Ethernet connection is active
RX	Off	Ethernet is idle, no active data present on port
	Flashing Red	Active data is present on Ethernet port
TX	Off	Powermonitor 3000 is not transmitting any data through the Ethernet port
	Flashing Red	Powermonitor 3000 is transmitting data

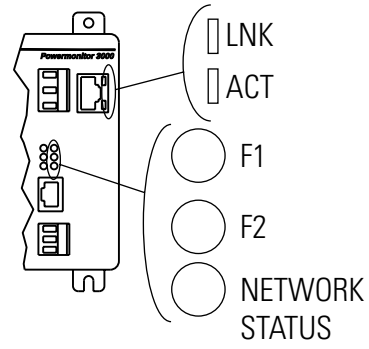


Table 12 Ethernet/IP Optional Communications (Series B catalog numbers ending in -ENT)

LED	LED Color	LED State and Communications Condition
LNK	Off	No valid physical Ethernet connection
	Steady Green	Valid physical Ethernet connection
ACT	Strobing or Solid Yellow	Powermonitor 3000 transmitting onto Ethernet
F1	Off	Not Used
F2	Off	Not Used
NETWORK STATUS	Off	No power
	Flashing Green	No established connections
	Steady Green	Connected; has at least one established connection
	Flashing Red	Connection timeout; one or more connections to this device has timed-out
	Steady Red	Duplicate IP; the IP address assigned to this device is already in use
	Flashing Green/Red	Selftest; this device is performing a power-up self test

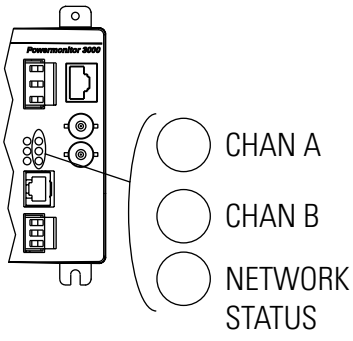


Table 13 ControlNet Optional Communications (catalog numbers ending in -CNT)

LED	LED Color	LED State and Communications Condition
CHAN A and CHAN B	Off	No power or Channel disabled
	Steady Red	Faulted unit
	Alternating red/green	Self-test
	Alternating red/off	Incorrect node configuration
	Steady green	Normal operation
	Flashing green/off	Temporary errors or node is not configured to go on-line
	Flashing red/off	Media fault or no other nodes present on network
	Flashing red/green	Incorrect network configuration
Status	Off	Normal operation
	Flashing green	Communication card power-up self-test

Quick Start Guidelines

The Powermonitor 3000 may be used in many electric power monitoring and control systems. Whether your Powermonitor 3000 is a complete power and energy monitor or a component in a plant- or enterprise-wide energy management system, there are a few basic steps to follow to make your unit operational.

1. Install your Powermonitor 3000 master module within a suitable enclosure. Refer to Installation on page 15.

2. Install your optional Display Module. Refer to the Installation Instructions included with the Display Module, publication 1404-IN005.

3. Determine your Wiring Mode and install wiring between the Powermonitor 3000 and your power system. Connect control power wiring, preferably from a separate source of control power. If used, connect wiring to the status inputs, Form C control relay, and KYZ solid-state outputs. Refer to Wiring of Master Module on page 20.

4. Configure the potential transformer (PT) and current transformer (CT) ratios to match those used in your power system connections. Configure the Voltage Mode of the Powermonitor 3000 to match your power system configuration.

5. Configure Powermonitor 3000 communications. This step varies depending upon the communications option you have selected.

6. Configure other optional performance features such as Setpoint Control, Data Logging, etc.

Refer to the Powermonitor 3000 User Manual, publication 1404-UM001, for complete information on configuring and operating your Powermonitor 3000.

Installation

Only qualified personnel should install, wire, service and maintain this equipment. Refer to and follow the safety guidelines found starting at page 6 and pay attention to all warnings and notices in these instructions.

Prevent Electrostatic Discharge

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors. Follow these guidelines when you handle the module.

- Touch a grounded object to discharge static potential.
- Wear an approved wrist strap grounding device.
- Do not open the module or attempt to service internal components.
- If available, use a static safe work station.
- When not in use, keep the module in its static shield bag.

Mounting of Master Module

Mount the Powermonitor 3000 Master Module in a suitable protective enclosure. Select an enclosure that will protect the Master Module from atmospheric contaminants such as oil, water, moisture, dust corrosive vapors and other harmful airborne substances. The enclosure should also protect against personnel contact with energized circuits. The ambient temperature within the enclosure must remain within the limits listed in the Specifications, page 61.

Select an enclosure that will provide adequate clearance for ventilation and wiring for the Powermonitor 3000 and other equipment to be installed within the enclosure. See Figure 41 and Figure 42 for dimensions and spacing guidelines for the Powermonitor 3000.

Mount the Master Module so that the metal grounding clips on the bottom of the mounting feet make direct contact with the enclosure mounting panel. If the mounting panel is painted, scrape or sand the paint down to bare metal. Use star washers to assure good long-term electrical contact with the mounting panel. Ensure that the mounting panel is properly connected to a low-impedance earth ground.

Mount the enclosure in a position that allows full access to the Powermonitor 3000 Master Module. Install the Master Module with the ventilation slots in the bottom and top of the unit unobstructed to assure adequate free convection cooling of its internal electronic components.

IMPORTANT Use caution not to block the ventilation slots of the Master Module. All wiring and other obstructions must be a minimum of 50 mm (2.0 inches) from the top and bottom of the unit.

See Figure 41 on page 56 for mounting hole dimensions. Mount the Master Module with four (4) No. 8-32 UNC or M4 screws with flat washers and lock washers.

System Accuracy Considerations

User supplied potential transformers (PTs) and current transformers (CTs), as well as wiring from the CTs to the Powermonitor, may reduce the accuracy of your Powermonitor 3000 system. The quality of the Powermonitor 3000's measurements can be no better than the quality of the signals presented to its input terminals. It is the user's responsibility to select transformers that are adequate for the desired metering accuracy.

ANSI/IEEE C57.13, Requirements for Instrument Transformers, defines three classes of transformer accuracy: class 1.2, class 0.6, and class 0.3. The application should dictate the transformer accuracy class to be used.

PTs and CTs may introduce errors in three areas: ratio errors, phase errors, and bandwidth errors.

Ratio Errors

The voltage ratio of a PT is the number of primary turns of wire divided by the number of secondary turns. Manufacturing tolerances may cause the ratio to be slightly different than the design specifies, causing an error affecting the voltage input to the Powermonitor 3000.

Likewise, the current ratio of a CT is a function of the ratio of the number of turns of wire on the primary and secondary. Some error in this ratio is quite common in commercial grade PTs and CTs.

Other errors include magnetic core losses, winding impedance, and the burden, or load, on the transformer secondary. The combination of these errors is known as "Ratio Error". You may compensate for Ratio Error, if known, by adjusting the Basic Configuration entries for PT and CT primary or secondary voltages.

For a PT the Ratio Error increases as the transformer's load current increases, so its total load impedance should be as high as possible. Conversely, a CT's Ratio Error increases as the voltage supported by the transformer secondary increases, so its total load impedance, including the impedance of the wire connecting the CTs to the metering device, should be as low as possible. This is why #12 AWG or larger is usually recommended for wiring CTs with a 5 amp secondary rating.

Phase Error

Phase shift between the primary to secondary signals is another source of inaccuracy introduced by the user-supplied PTs and CTs. Phase shift is generally not of concern for simple voltage or current measurements. When these signals are combined, for instance when calculating line to line voltage or phase power, the effect of phase shift can become significant. The difference in phase error among different transformers causes measurement errors. If all the PTs and CTs introduced a five-degree phase shift, there would be no error in the measured quantities. If on the other hand the PTs had a phase error of one degree and the CTs had a phase error of six degrees, there would be a five-degree phase error in the power calculation. This would show up as power factor and reactive power (VAR) errors. Phase errors can not be corrected by adjusting the Powermonitor 3000 configuration since the errors change based on varying conditions of the power system.

A typical PT phase error varies from ±1° to ±0.25° depending on the PT's accuracy class. Applying higher than rated voltage increases the phase error and may saturate the transformer and cause even larger errors.

The phase error in a CT increases as its current decreases, and is lowest when the current is greater than 80% of the CT rating. Because significant phase error can occur when CT current is less than 20% of rated current, CTs sized for protection do not perform well when used for metering.

The phase error of both PTs and CTs are also affected by the power factor of the load on the secondary. For best accuracy, loads should be resistive, with PT loads as high as possible and CT loads as low as possible.

Bandwidth Error

For fundamental 50 Hz or 60 Hz measurements, bandwidth error has no affect on accuracy. However, for waveforms with significant harmonic content, the user-supplied PTs and CTs may attenuate higher harmonics. Most instrument quality PTs have a flat frequency response out to 3 kHz, or the 50th harmonic on a 60 Hz system. Current transformers, especially older, existing units, tend to be less linear, with a flat response only out to 300 Hz, or the fifth (60 Hz) harmonic. Wide-band instrument CTs are available for improved frequency response. Bandwidth error cannot be corrected by adjusting the Powermonitor 3000 configuration.

In addition, operation of either the PTs or CTs at extremely low frequencies may also cause saturation and resulting magnitude and phase errors.

For more detailed information on instrument transformer accuracy and power measurement, refer to publication 1403-1.0.2, “Bulletin 1403 Powermonitor II Tutorial”.

Wiring

ATTENTION

Only qualified personnel, following accepted safety procedures, should install, wire and service the Powermonitor 3000 and its associated components. Before beginning any work, disconnect all sources of power and verify that they are de-energized and locked out. Failure to follow these instructions may result in personal injury or death, property damage or economic loss.

Wiring of the Powermonitor 3000 includes the following steps:

- Connection of voltage and current signals from PTs and CTs
- Connection of control power
- Connection of status inputs and status/control outputs
- Communications wiring

Please follow these guidelines to help assure reliable, trouble-free operation of your Powermonitor 3000.

- Install and connect all wiring in a neat and workmanlike manner. Use wire tags to identify connections. Bundle wiring neatly and maintain a minimum of 50 mm (2.0 inches) clearance from the Master Module ventilation slots to avoid a buildup of heat within the unit
- Furnish and install properly-selected fuses for voltage signals and control power
- Use 600 volt wiring rated at 75°C (167°F) or higher. We strongly recommend the use of flame-retardant wire rated VW-1 by Underwriters Laboratories
- Use a shorting terminal block (provided by customer) for CT wiring, to permit servicing connected equipment such as the Powermonitor 3000 Master Module without de-energizing the power system
- Use ring lugs or locking spade lugs for voltage and current connections to provide additional wiring security and safety
- Pay careful attention to correct phasing and polarity for proper operation
- Connect the Master Module to a low-impedance earth ground using its grounding terminal and a dedicated grounding wire at least as large as the largest current-carrying wire connected to the Master Module. Keep grounding wiring as short as possible. To obtain maximum EMI immunity, the Master Module mounting feet should make electrical contact with the mounting panel. Refer to Mounting of Master Module on page 16 for additional information.
- Connect all equipment ground terminals (Master Module, PT and CT secondary) to a single point, low impedance earth ground

For information on wire sizes and types for grounding electrical equipment, refer to publication 1770-4.1, Industrial Automation Wiring and Grounding Guidelines for Noise Immunity or the National Electric Code published by National Fire Protection Association (NFPA).

Wiring of Master Module

Terminal Blocks Wire Sizes and Screw Torques - Observe all wire lug sizes and screw torques. Refer to Technical Specifications on page 59.

Voltage and Current Inputs

Voltage Input and PT Selection

The Powermonitor 3000 is designed to connect directly to power system rated up to 600 volts line-to-line (347 volts line-to-neutral). Higher system voltages require the use of user-supplied PTs. Typical secondary voltage on a PT is 120V ac. Select the PT primary voltage to match the nominal voltage of your power system.

Connect user-furnished short circuit protection between the power system and the Powermonitor 3000. If PTs are used, install the user-furnished short circuit protection on the high-voltage side of the PTs.

Current Inputs and Current Transformer (CT) Selection

The current input on the Powermonitor 3000 is designed for a 5 amp nominal current signal. User-supplied CTs are required to connect your power system to the input of the Powermonitor 3000. Select the CT primary current to match the nominal current of your power system.

ATTENTION

Never open a current transformer secondary circuit with primary current applied. Wiring between the CTs and the Powermonitor 3000 should include a shorting terminal block in the CT secondary circuit. Shorting the secondary with primary current present allows other connections to be removed if needed. An open CT secondary with primary current applied produces a hazardous voltage, which can lead to personal injury, death, property damage of economic loss.

The shorting terminal block should be located adjacent to the Powermonitor 3000 Master Module so that it is readily accessible should service be needed. Use #14 AWG (2.5 mm^2) wire for the short run between the Powermonitor 3000 and the shorting terminal block. Use wiring of #12 AWG (4 mm^2) or larger between the shorting terminal block and the CT so that the additional load of the wiring does not overload the CT and reduce its accuracy.

IMPORTANT You may install either two or three CTs for any of the Delta or Open Delta wiring or voltage modes. Refer to Figure 21, Figure 23, or Figure 26 for wiring of a 2 CT configuration. Whether there are two or three CTs in a circuit does not affect the voltage wiring. Refer to the User Manual, publication 1404-UM001.

Do not install fuses or other overcurrent protection in the secondary circuit of a CT.

Refer to System Accuracy Considerations on page 17 for guidelines on PT and CT selection.

Refer to Technical Specifications on page 59 for information on voltage isolation levels and wire termination recommendations.

The wiring diagrams depict wiring methods for a variety of power system configurations. You will need to configure your Powermonitor 3000 to match the power system configuration for correct operation. Refer to the Powermonitor 3000 User Manual, publication 1404-UM001, for detailed instructions on unit configuration.

Wiring Diagrams

Figure 14 Single Phase Direct Connection Wiring Diagram (Systems ≤ 600 Volts Nominal L-L)

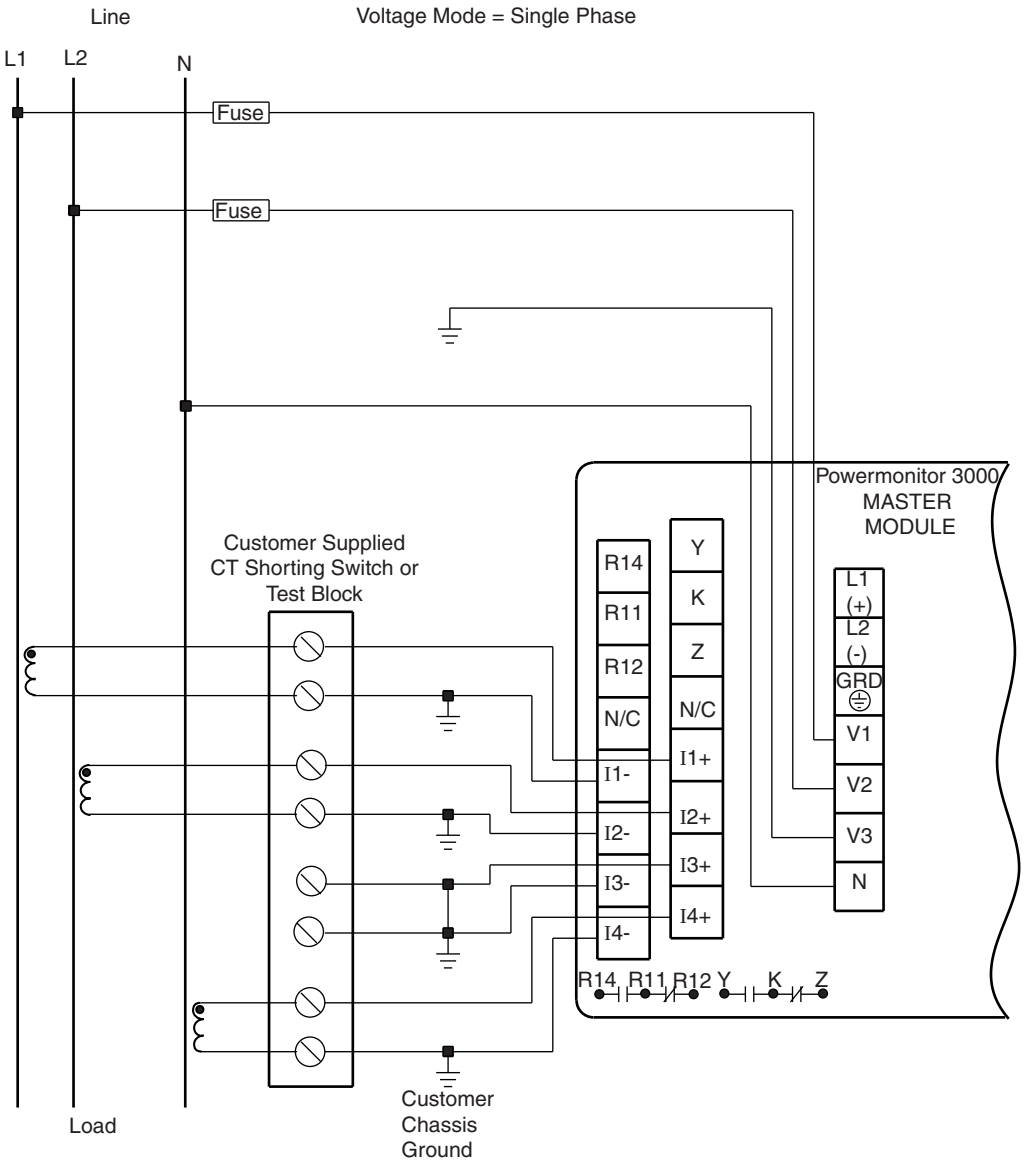


Figure 15 Single Phase with PTs Wiring Diagram

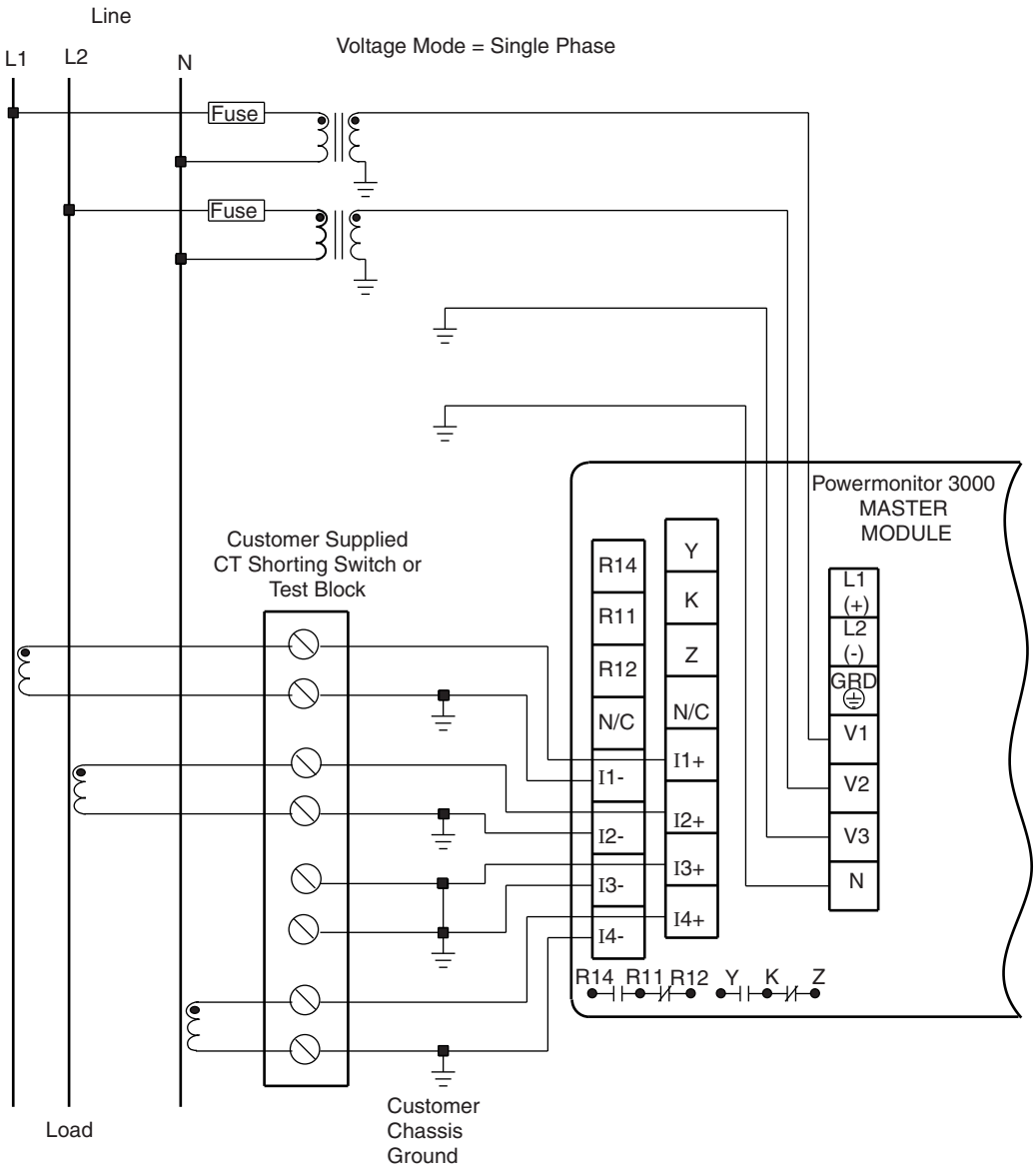


Figure 16 3-Phase 4-Wire Wye Direct Connect Wiring Diagram (Systems ≤ 600 Volts Nominal L-L)

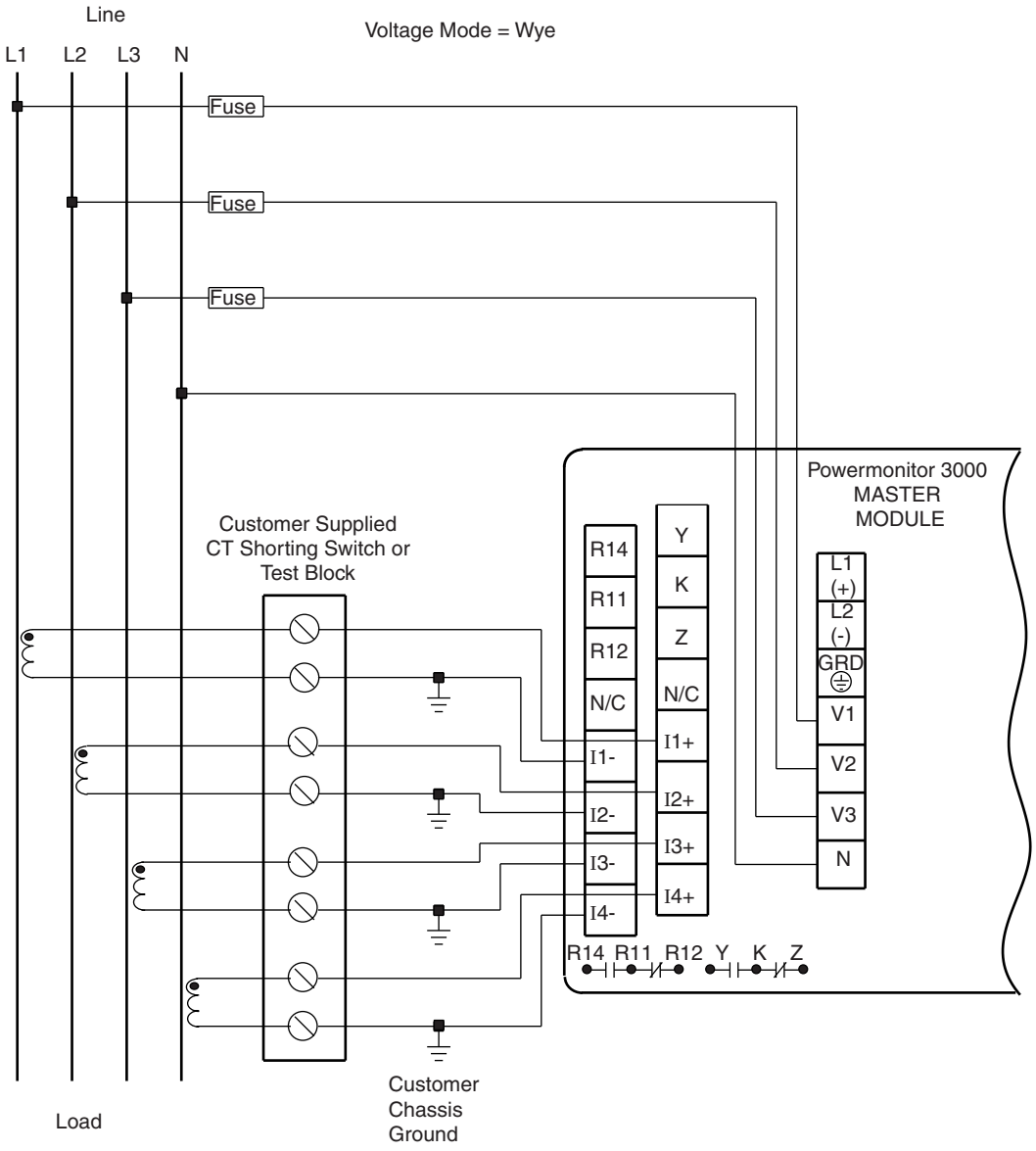


Figure 17 3-Phase 4-Wire with PT's Wiring Diagram

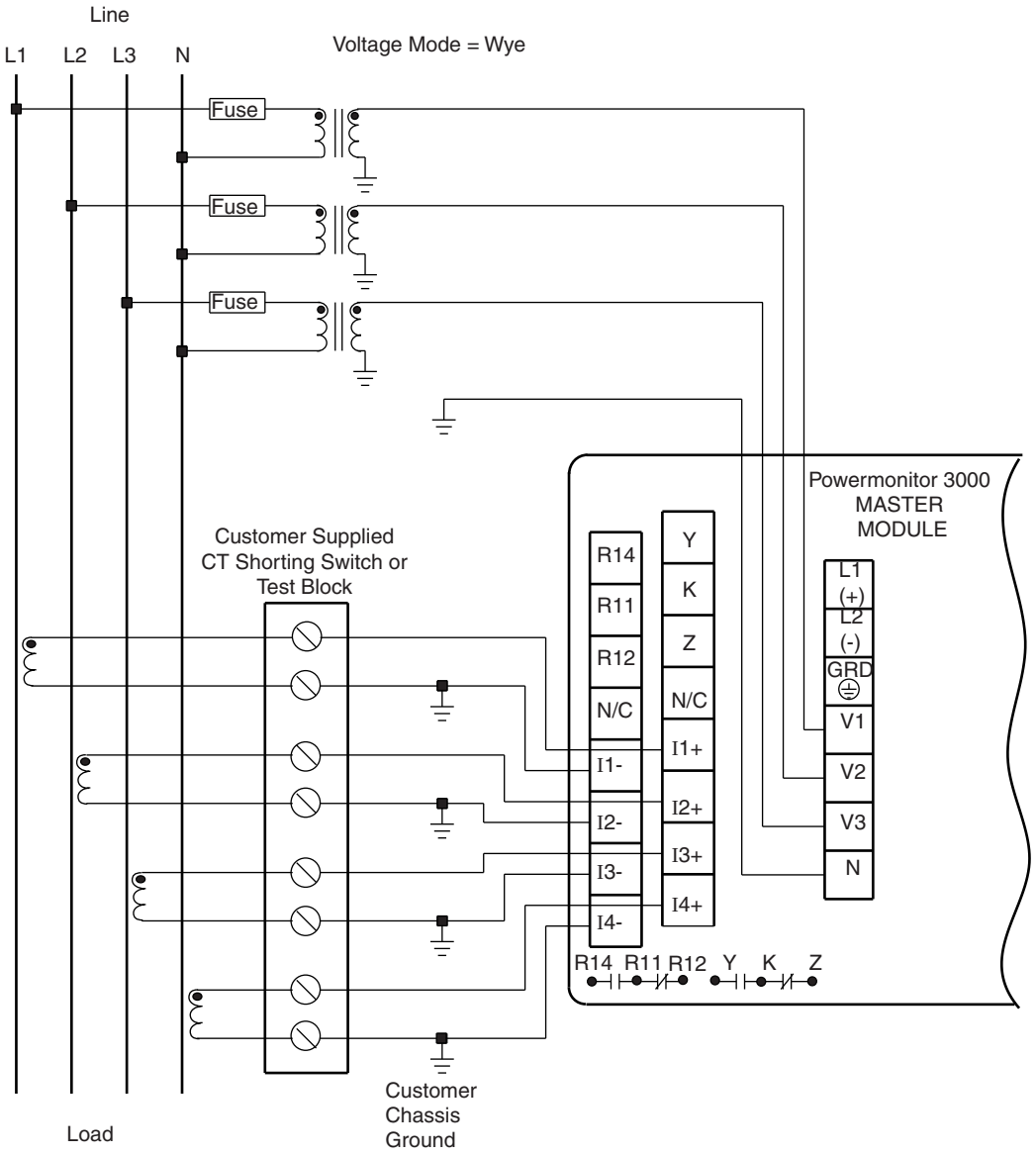


Figure 18 3-Phase 3-Wire Grounded Wye Direct Connection Wiring Diagram (Systems ≤ 600 Volts Nominal L-L)

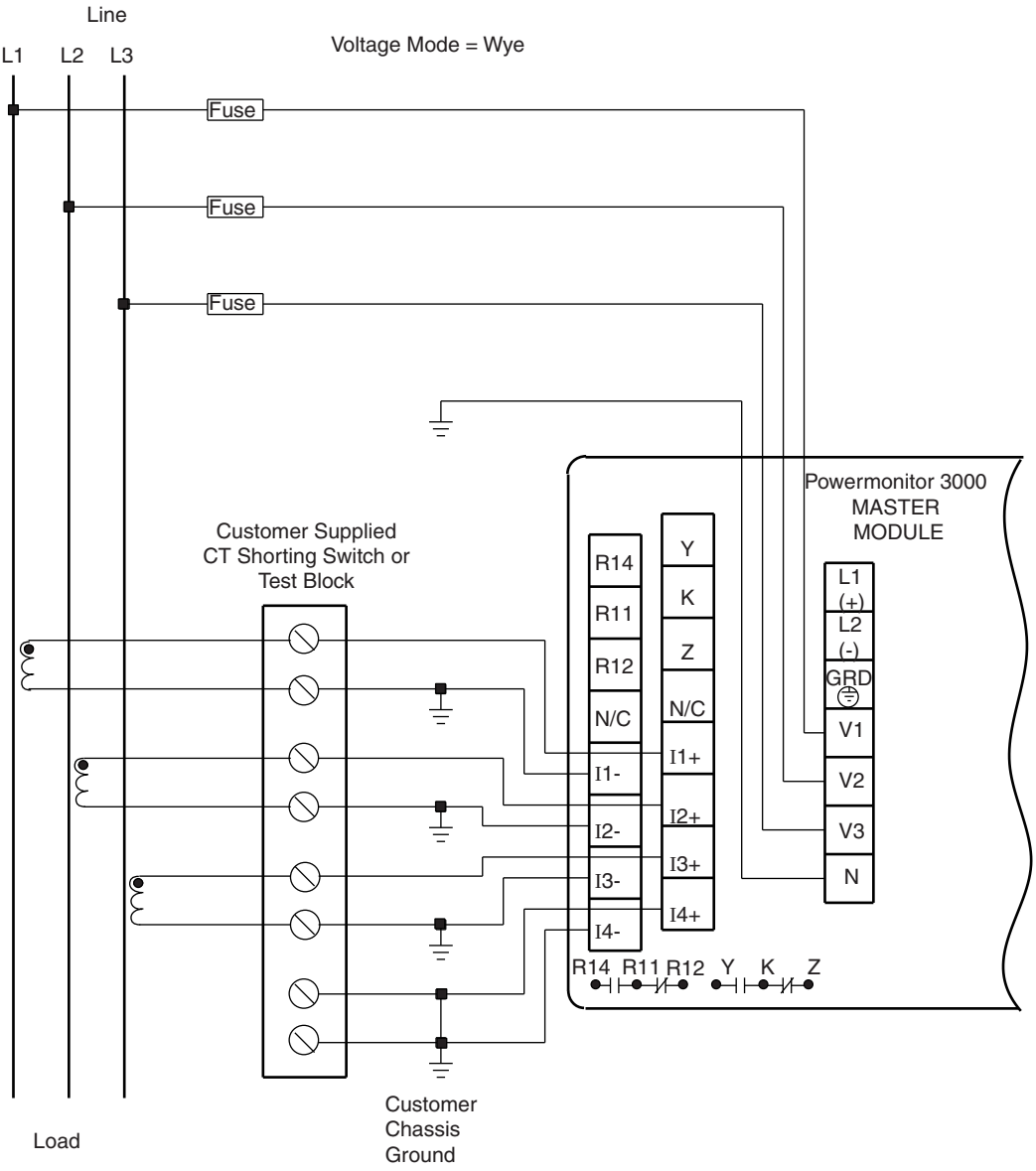


Figure 19 3-Phase 3-Wire Grounded Wye with PT's Wiring Diagram

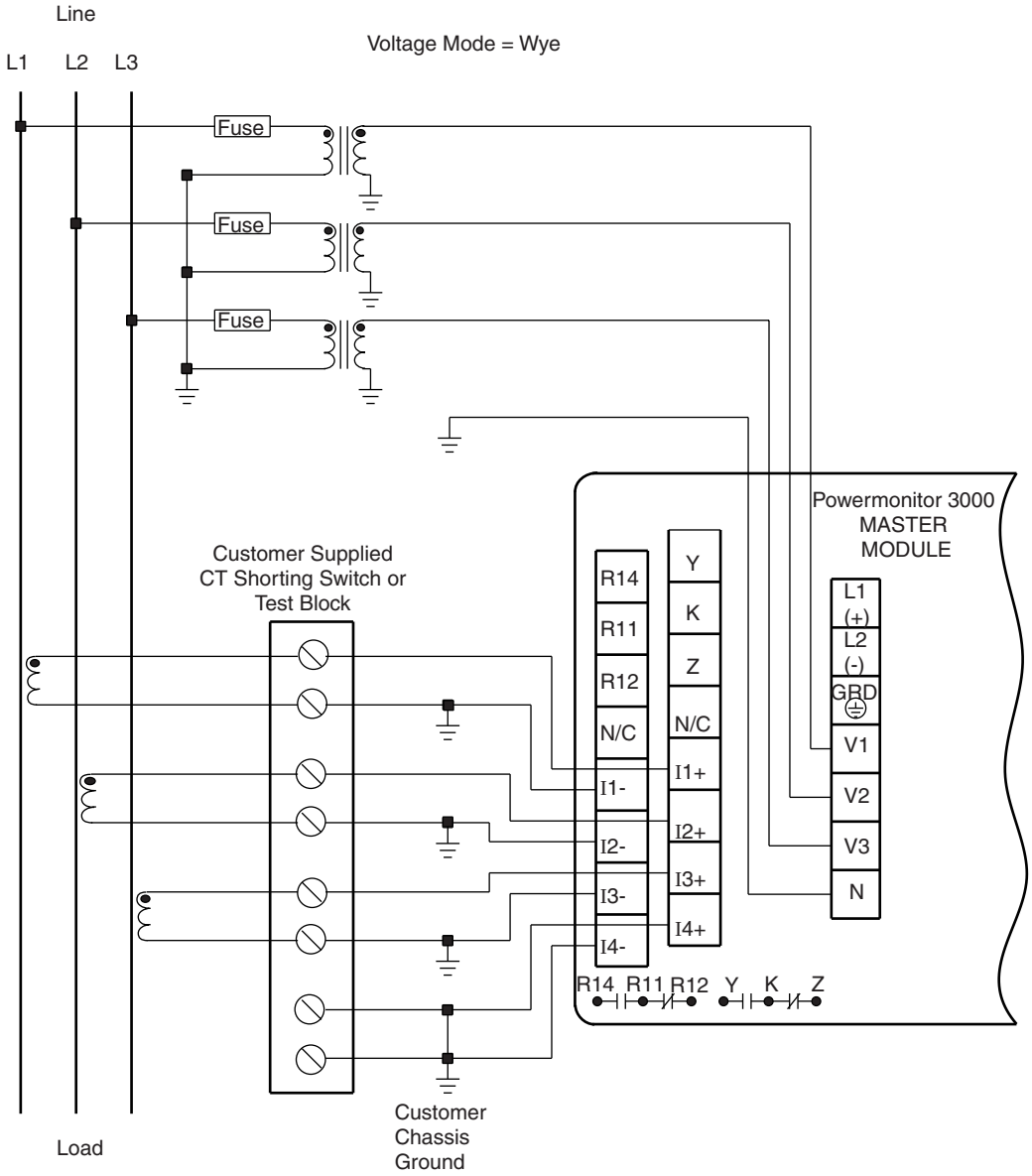


Figure 20 3-Phase 3-Wire Delta with Three PT's and Three CT's Wiring Diagram

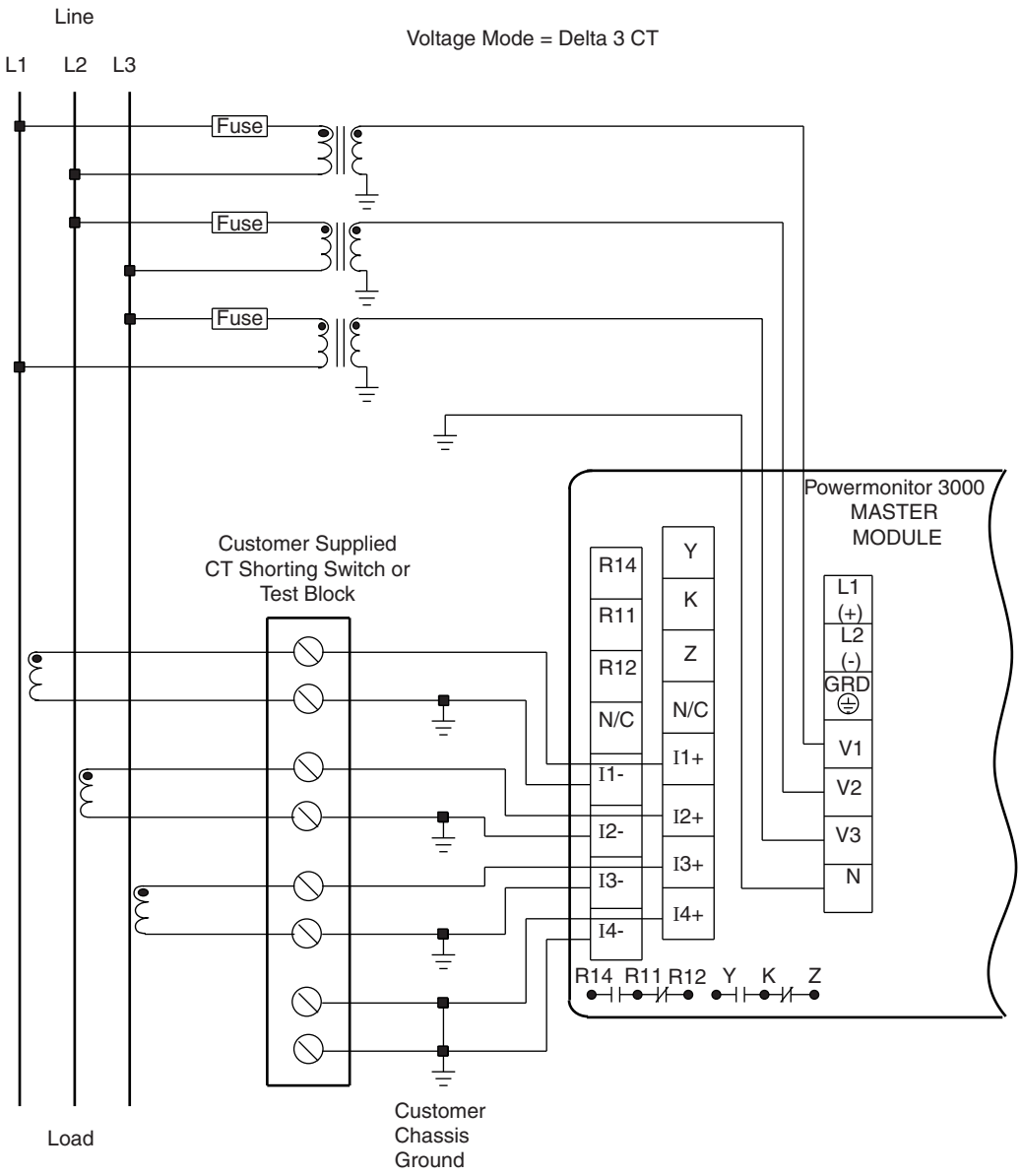


Figure 21 3-Phase 3-Wire Delta with Three PT's and Two CT's Wiring Diagram

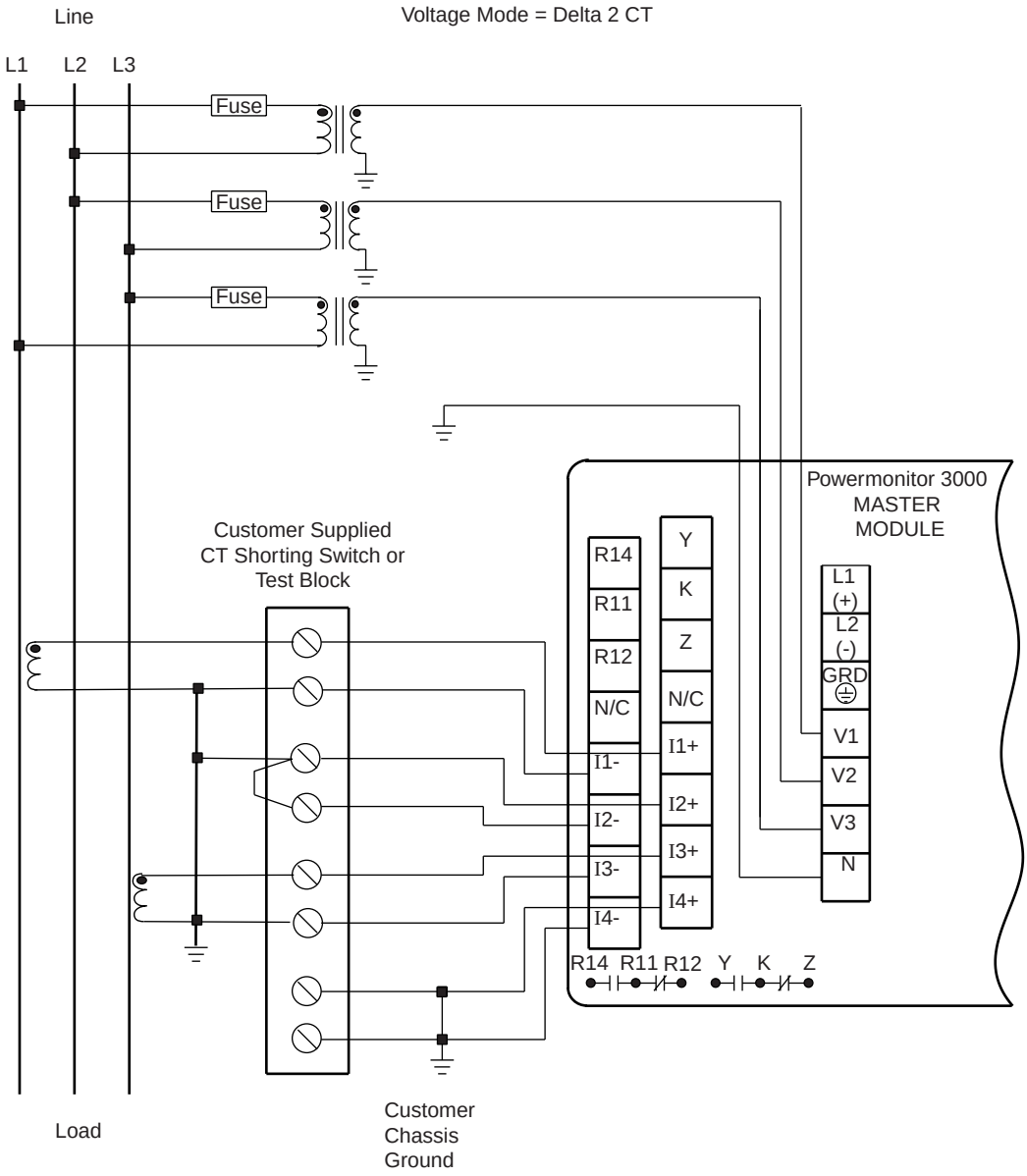


Figure 22 3-Phase 3-Wire Open Delta with Two PT's and Three CT's Wiring Diagram

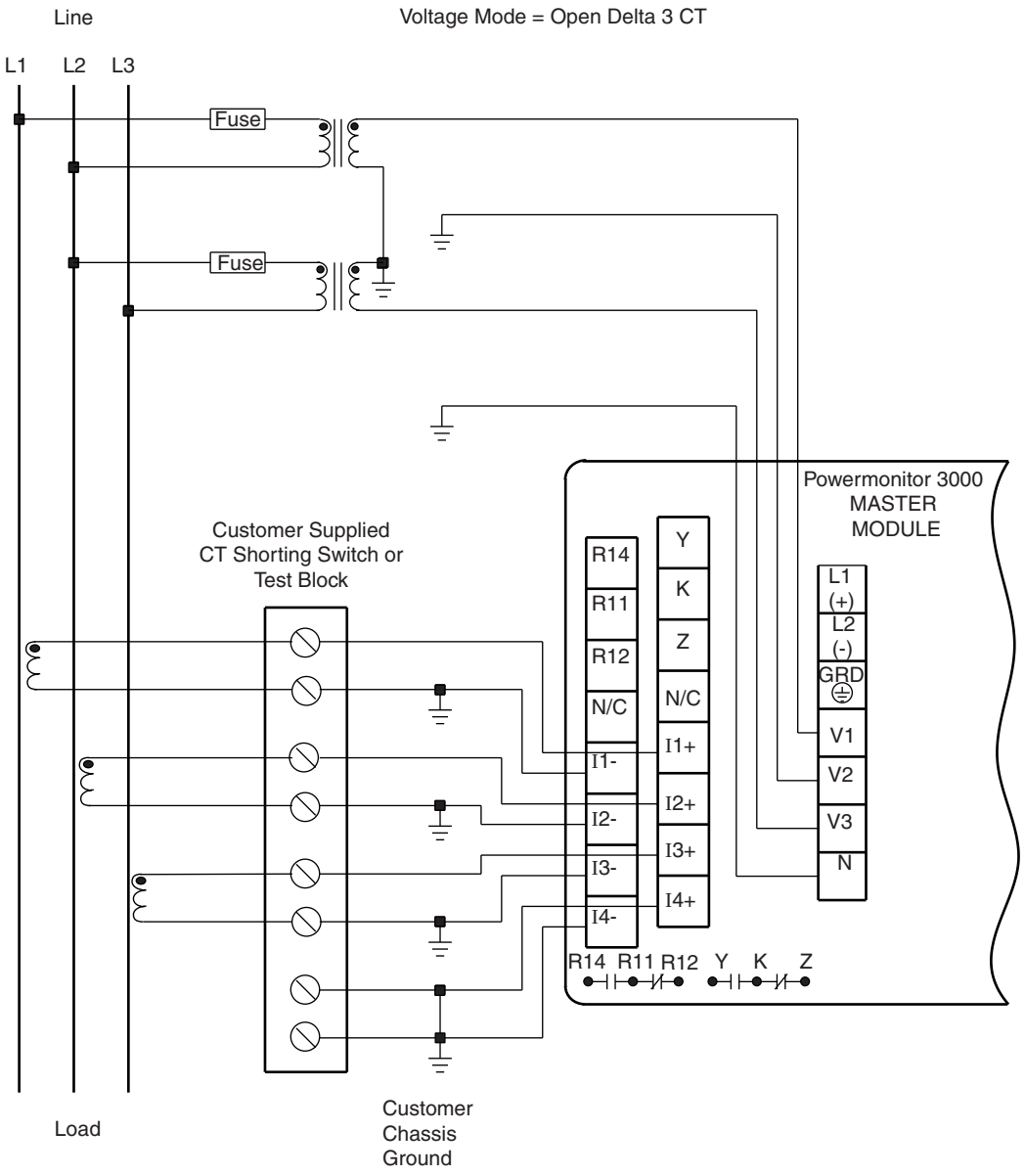


Figure 23 3-Phase 3-Wire Open Delta with Two PT's and Two CT's Wiring Diagram

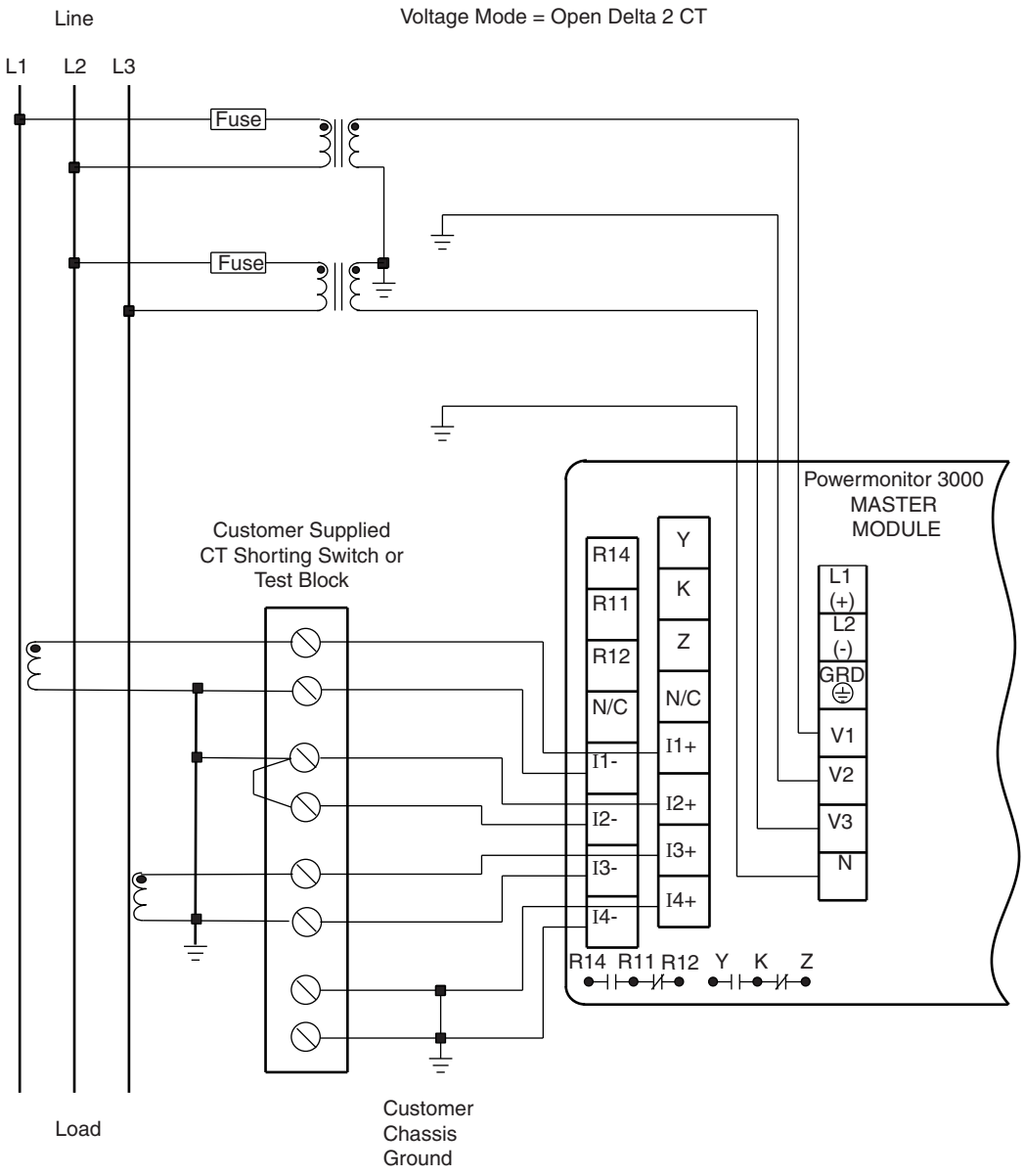


Figure 24 3-Phase 3-Wire Grounded L2(B) Phase Open Delta Direct Connect with Three CT's Wiring Diagram(Systems ≤ 600 Volts Nominal L-L)

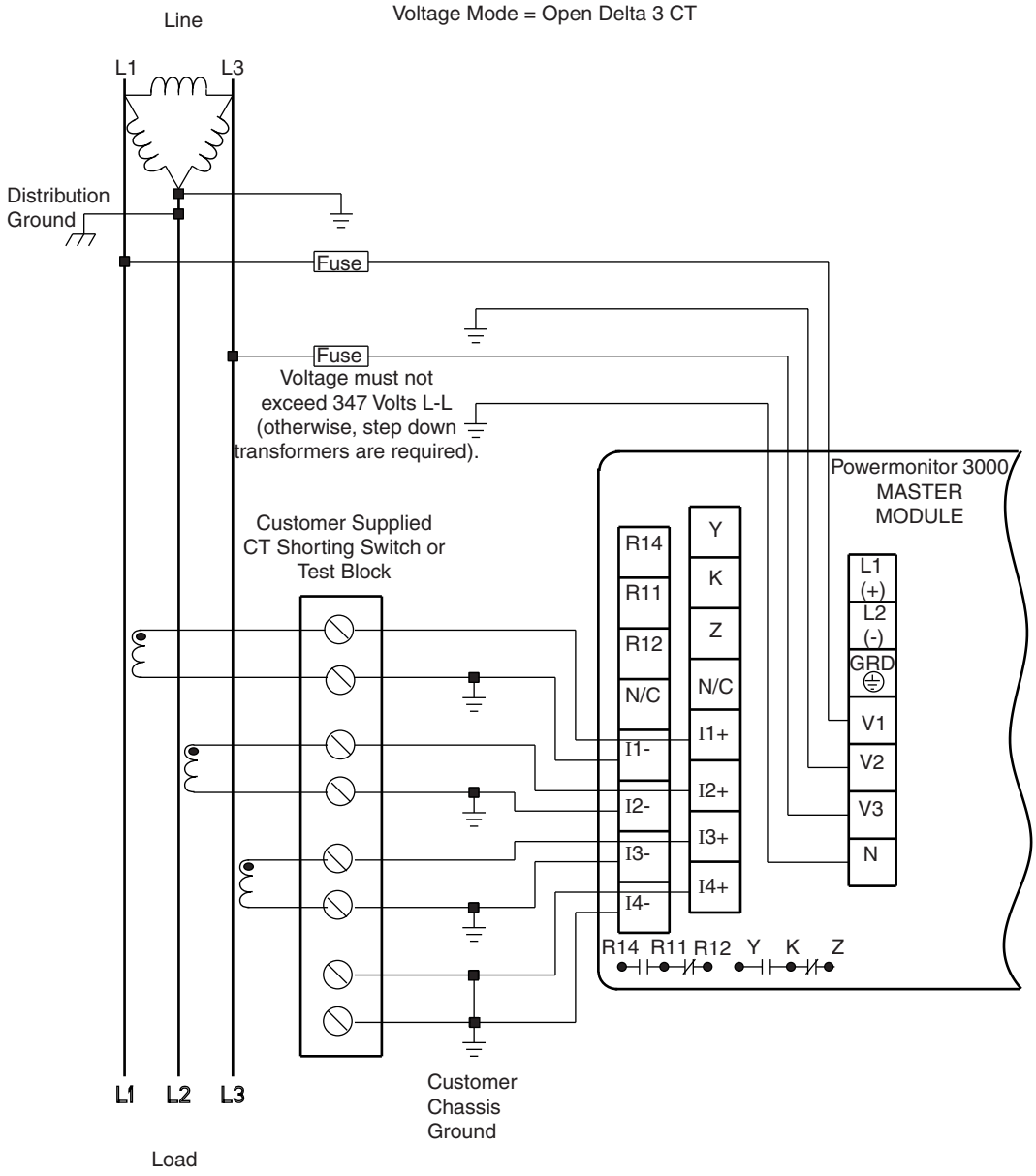


Figure 25 3-Phase 3-Wire Delta Direct Connect with Three CT's Wiring Diagram (Systems ≤ 600 Volts Nominal L-L)

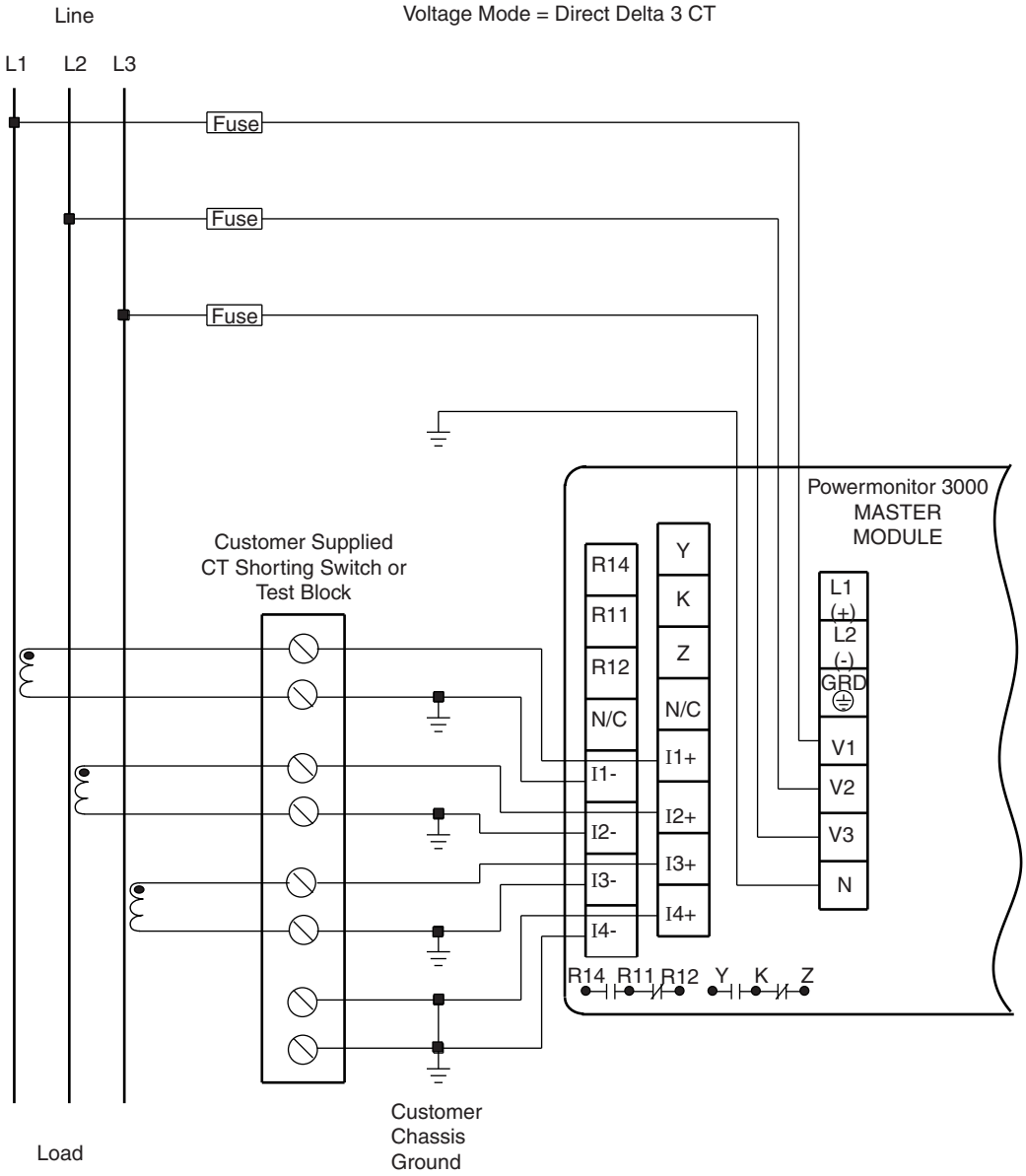
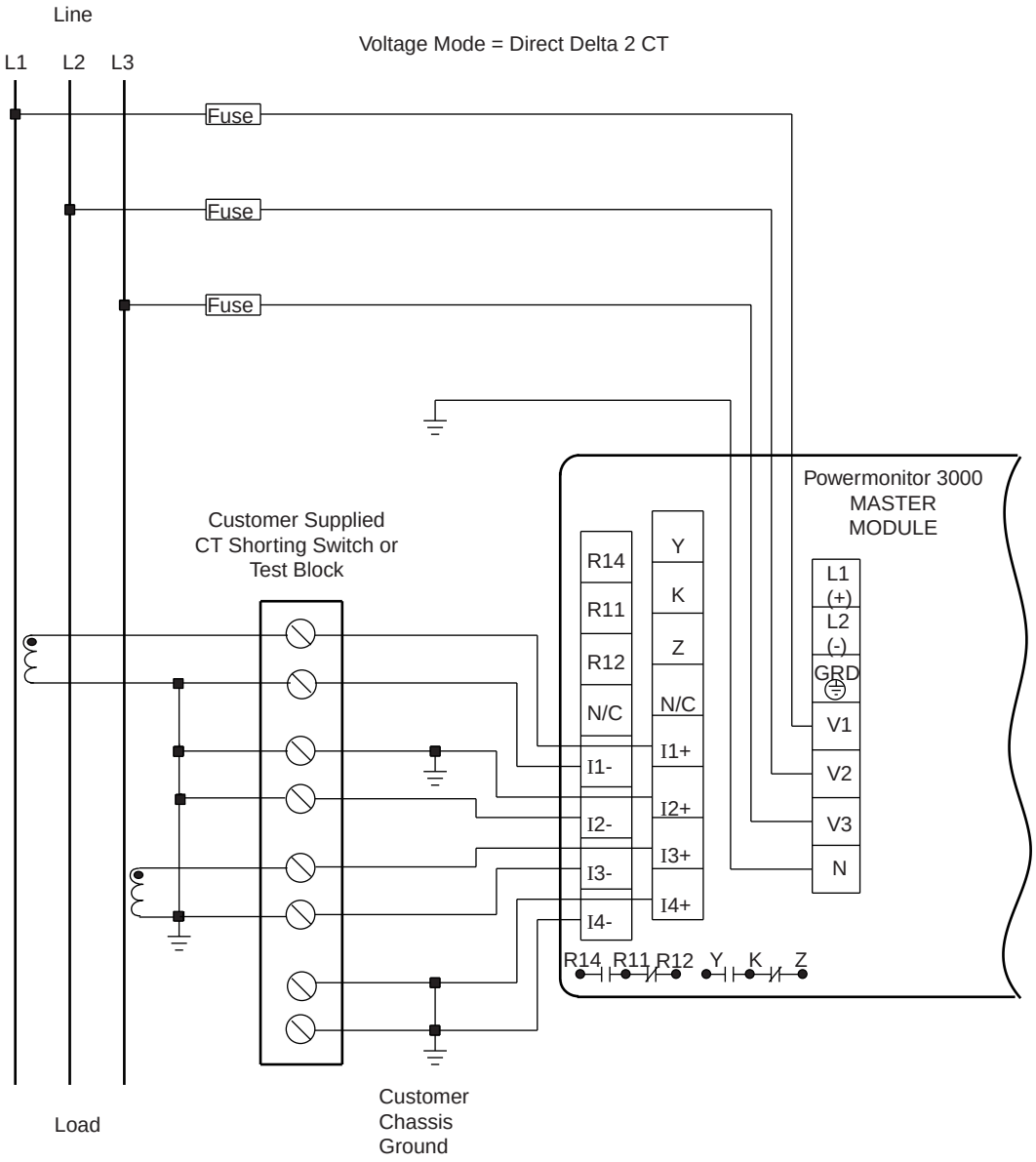
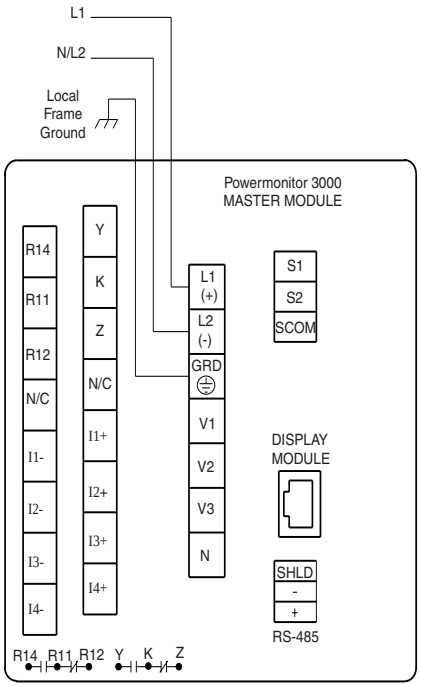


Figure 26 3-Phase 3-Wire Delta Direct Connect with Two CT's Wiring Diagram (Systems ≤ 600 Volts Nominal L-L)



Control Power

Figure 27 Control Power



The Powermonitor 3000 draws a nominal 15VA control power. Catalog numbers 1404-MxxxA-xxx require nominal control power of 120 to 240V ac or 125 to 250V dc. The power supply is self-scaling. Catalog number 1404-MxxxB-xxx require nominal control power of 24V dc. Refer to Technical Specifications on page 59 for acceptable control voltage ranges and wiring termination information.

We strongly recommend the use of a separate source of control power from the power system being monitored. For applications where power system information is critical, consider the use of a user-supplied uninterruptible power supply so that the Powermonitor 3000 continues to operate during power system events such as significant sags, swells, and transient disturbances.

It is required to connect your Powermonitor 3000 control power through user-supplied disconnecting means and overcurrent protection.

Status Inputs

ATTENTION

Do not apply an external voltage to a Status Input. These inputs have an internal source and are intended for dry contact input only. Applying a voltage may damage the associated input or internal power supply.

All Status Inputs are common to an internal 24VDC source on the SCOM terminal. Status input terminals S1 and S2 are positive polarity and SCOM is negative polarity.

For optimal EMC performance, we recommend wiring the status inputs using shielded cable, Belden™ 8771 or equivalent, with the cable shield grounded at both ends where possible. See Figure 28.

Figure 28 Status Input Connections

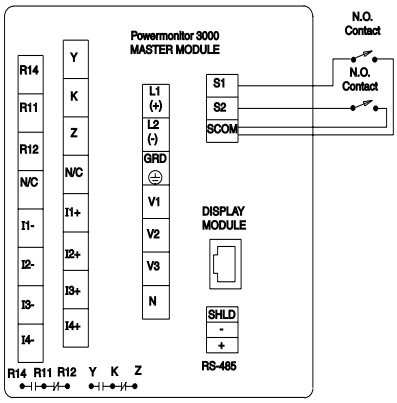


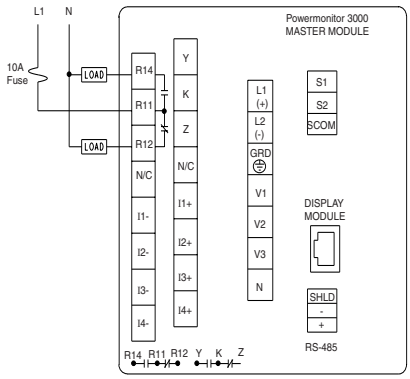
Table 29

Parameter	Condition 1	Condition 2
Applied resistance verses status state	3.5K Ohms or less = ON	5.5K Ohms or greater = Off

Isolation Voltage 500V status input to case; 500V status input to internal digital circuitry.

TIP Status Input S2 can be configured for external demand pulse input. See Powermonitor 3000 User Manual, publication 1404-UM001, for more information.

Figure 30 Control Relay Connections



Relay and KYZ Outputs

Figure 30 shows the Form C relay output connections and an example of customer wiring to a supply voltage and two loads. Terminal R11 is the common connection, R14 is the normally-open connection and R12 is the normally-closed connection. You must supply the wetting voltage and overcurrent protection for the circuit connected to the relay output. Refer to Technical Specifications on page 59 for further information.

The KYZ output is a solid-state relay designed for low-current switching and long life. Its normal application is to provide a pulse based on energy usage (or one of five other parameters) to an external pulse accumulator. Terminal K is common, Y is normally-open, and Z is normally-closed.

Refer to Powermonitor 3000 User Manual, publication 1404-UM001, for further information on the application and operation of relay and KYZ outputs.

Communication Wiring

Methods for connecting communications wiring vary from option to option. This section provides guidelines for installing dependable communications wiring for your Powermonitor 3000 system for each communications option including the native RS-485 communications port that is part of every Powermonitor 3000.

ATTENTION

The user must supply and install special high level isolation when the possibility of high ground potential differences exists. This may occur when communicating with a unit connected to a power ground mat. Failure to install such isolation may lead to personal injury or death, property damage or economic loss.

IMPORTANT

You will need to configure communications for each communications option. Refer to the Powermonitor 3000 User Manual, publication 1404-UM001, for detailed communications configuration instructions.

Native RS-485 Communications Wiring

Every Powermonitor 3000 Master Module is equipped with a native RS-485 communications port. The RS-485 communications standard supports multi-drop communications among as many as 32 stations or nodes. The RS-485 port supports Allen-Bradley DF1 half-duplex slave and Modbus RTU slave communications at data rates of 1200 to 19.2k baud.

RS-485 port is also used for Master Module firmware upgrades in the field.

The native RS-485 communications wiring should be installed in a daisy-chain configuration. We recommend the use of Belden 9841 2-conductor shielded cable or equivalent. The maximum cable length is 1,219 meters (4,000 feet). Use of a star or bridging topology is not recommended and will result in signal distortion unless impedance is matched for each spur (star topology) or network (bridge topology).

If required, install suitable terminating resistors at the ends of the daisy-chain cable. For RS-485, install a 150 ohm, 1/4 watt terminating resistor (refer to the wiring diagram). Note that some RS-485 conversion devices are equipped with internal terminating resistors. Contact the manufacturer of the converter for additional information.

At each end of each cable segment, connect the cable shields to the SHLD terminal of the Master Module RS-485 port or the converter. The SHLD connection provides a low-impedance ground for high-frequency noise while attenuating DC or line-frequency signals.

The RS-485 port in the Master Module presents a standard load impedance to the RS-485 network, allowing the standard 32 nodes on a network.

Configuration options for the native RS-485 port include the protocol, device address and the data rate. Defaults are:

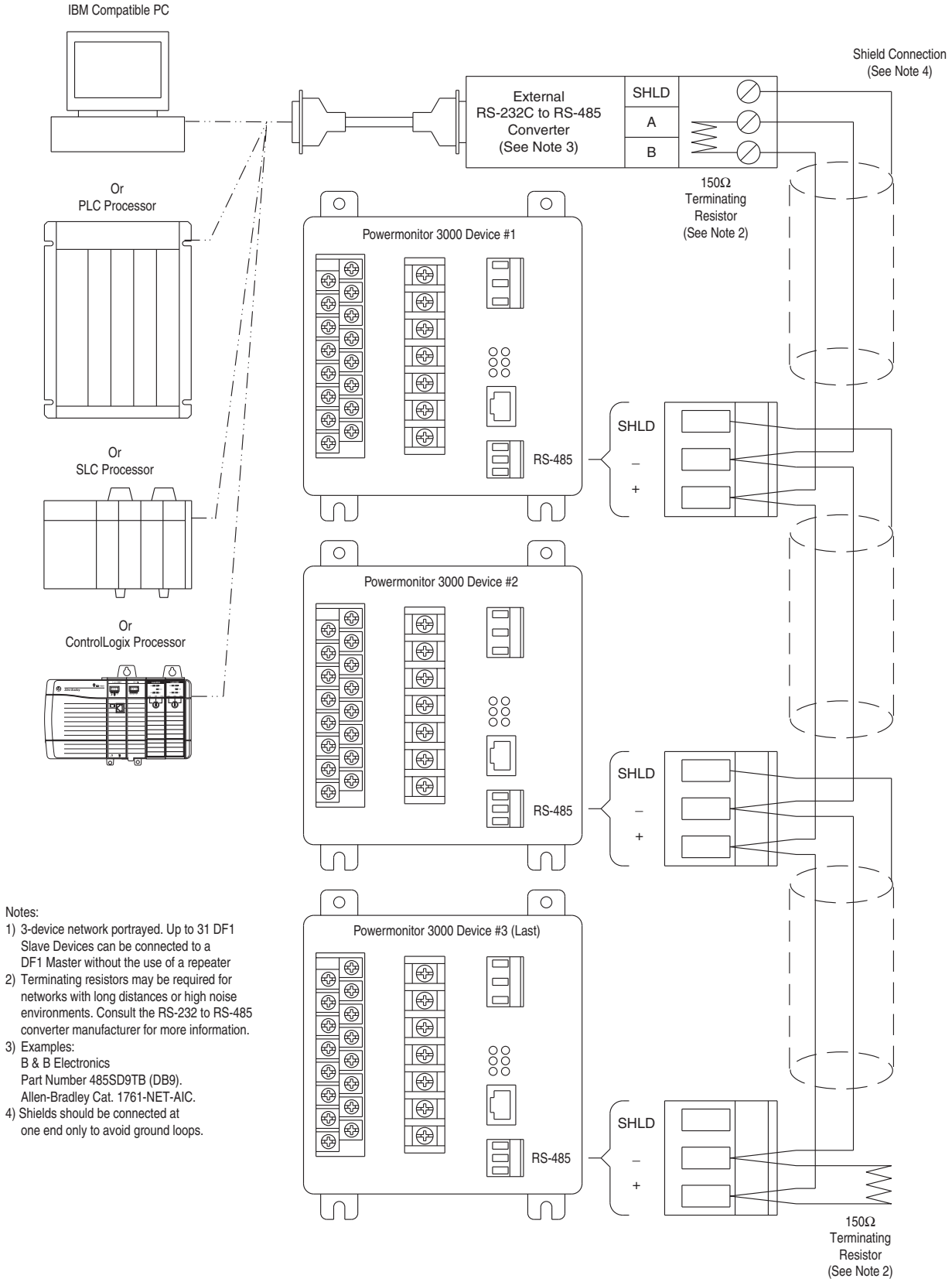
- Auto-detect protocol
- Device address = the Device ID assigned at the factory in the range 1 to 254
- Baud rate = 9600

Use of RS-232 to RS-485 converter

You need a user-supplied RS-232 to RS-485 converter for communication between the Powermonitor 3000 native RS-485 port and an external device such as a computer or programmable controller RS-232 port. Examples of these include:

- B&B Electronics, Inc. part number 485SD9TB (DB-9 connection)
- Allen-Bradley catalog number 1761-NET-AIC

Figure 31 RS-485 Connections



Notes:
1) 3-device network portrayed. Up to 31 DF1 Slave Devices can be connected to a DF1 Master without the use of a repeater
2) Terminating resistors may be required for networks with long distances or high noise environments. Consult the RS-232 to RS-485 converter manufacturer for more information.
3) Examples:
   B & B Electronics
   Part Number 485SD9TB (DB9).
   Allen-Bradley Cat. 1761-NET-AIC.
4) Shields should be connected at one end only to avoid ground loops.

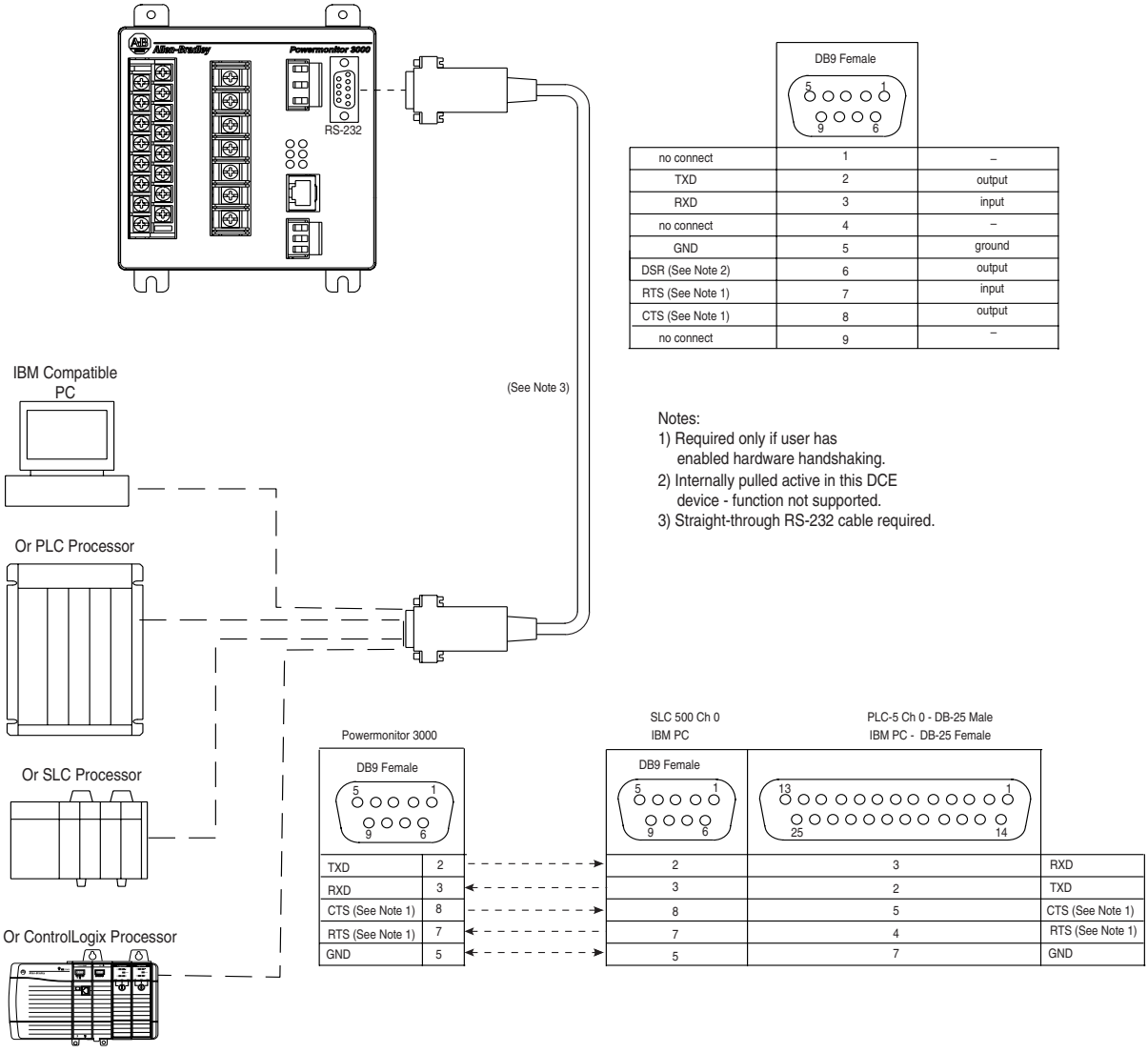
Optional RS-232 Communications

Powermonitor 3000 units with a catalog number ending in -232 are equipped with an RS-232 serial communications port in addition to the native RS-485 port. The RS-232 communications standard supports point-to-point communications among two stations or nodes. The RS-232 port supports Allen-Bradley DF1 half-duplex slave and Modbus RTU slave communications at data rates of 1200 to 19.2k baud. You must select either optional RS-232 communications or native RS-485 communications. The two ports do not operate at the same time.

The optional RS-232 communications port is a DCE (data communications equipment) type device. It requires a straight-through RS-232 cable to connect with personal computers, programmable controller serial ports, and other DTE (data terminal equipment) devices. It requires a crossover cable for connection to a modem or other DCE devices. No terminating resistor is required.

The maximum cable length is 15.24 meters (50.0 feet). Refer to the following wiring diagrams for cable pinout information for constructing your own cable using DB-9 and/or DB-25 connectors.

Figure 32 Connecting Powermonitor 3000 to Computer Communications Port



Optional Remote I/O Communications

Powermonitor 3000 units with a catalog number ending in -RIO are equipped with a Remote I/O port in addition to the native RS-485 port. Allen-Bradley Remote I/O is a robust, widely used industrial data network that uses twinaxial cable as its physical media. The Powermonitor 3000 emulates a logical quarter rack and supports both polled I/O and block transfer communications. The Remote I/O port and the native RS-485 port may be used simultaneously, although overall data throughput may be reduced.

Remote I/O communications wiring should be installed in a daisy-chain configuration. We recommend the use of Belden 9463 twinaxial cable or equivalent. The maximum cable length is shown in

Table 33 and varies with the data rate. Use of a star or bridging topology is not recommended and will result in signal distortion unless impendance is matched for each spur (star topology) or network (bridge topology).

Ensure that all devices on your Remote I/O network are capable of operation at the desired baud rate. Certain legacy devices may not support a 230.4k baud rate.

Table 33 Remote I/O Capabilities

Baud Rate	Maximum Distance	Terminating Resistor
57.6k	3048m (10,000 ft)	150 ohm, 1/4 watt
115.2k	1524m (5,000 ft)	150 ohm, 1/4 watt
230.4k	762m (2,500 ft)	84 ohm, 1/4 watt

Install suitable terminating resistors at the ends of the Remote I/O network.

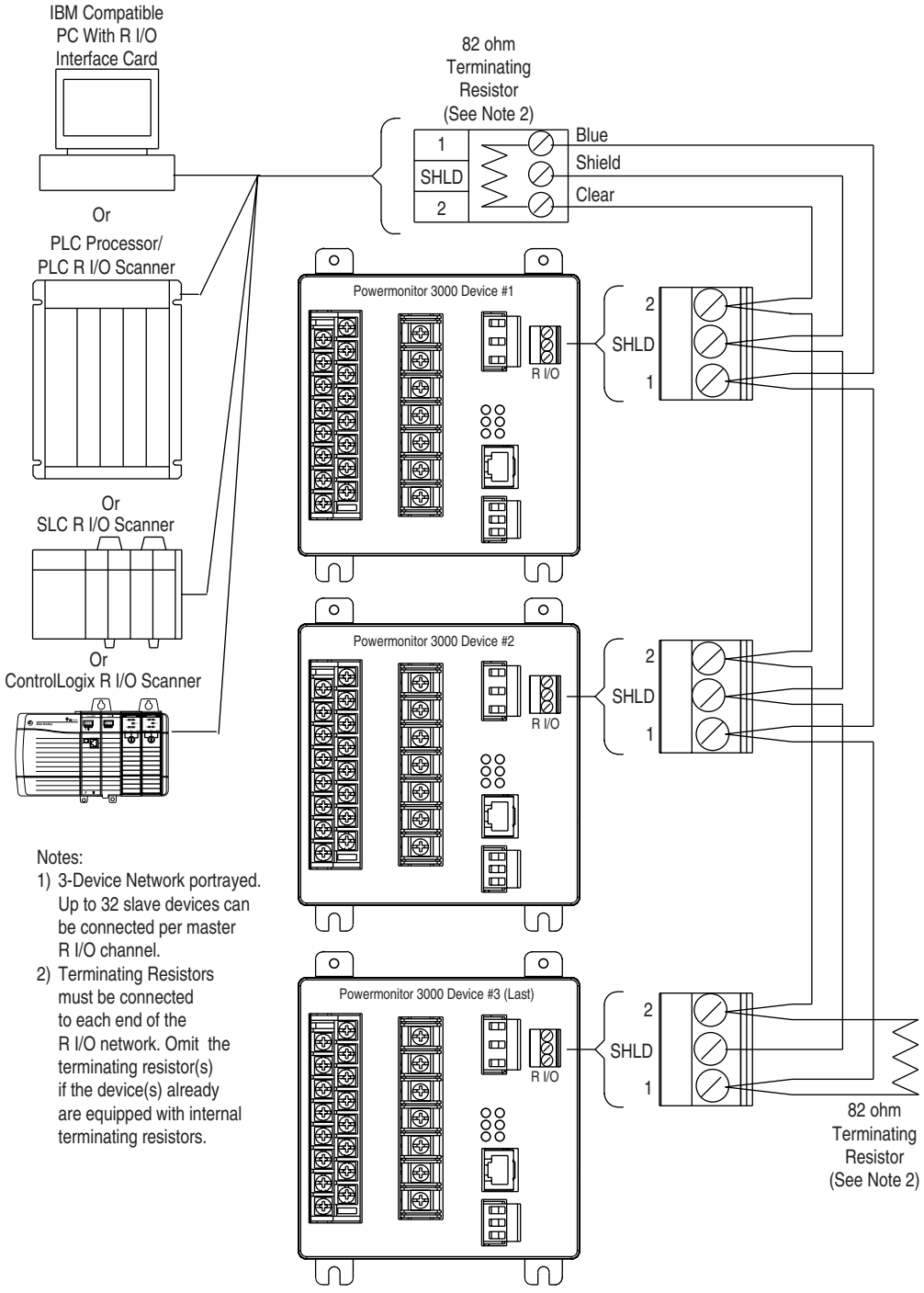
TIP Some Remote I/O devices are equipped with internal terminating resistors.

At each end of each cable segment, connect the cable shields to the SHLD terminal of the Remote I/O port connector. The SHLD connection provides a low-impedance ground for high-frequency noise while attenuating dc or line-frequency signals. We recommend that you follow the standard blue/shield/clear color scheme for Remote I/O to differentiate it from Data Highway Plus (clear/shield/blue).

Configuration options for optional Remote I/O communications include the logical rack address and module group (the Powermonitor 3000 is always one-quarter rack), and data rate. Defaults are rack 1, group 0, 57.6k baud. Refer to the Powermonitor 3000 User Manual, publication 1404-UM001.

Refer to the note at the beginning of Communication Wiring page 38.

Figure 34 Connecting Powermonitor 3000 to Remote I/O Scanner



Optional DeviceNet Communications

Powermonitor 3000 units with a catalog number ending in -DNT are equipped with a DeviceNet port in addition to the native RS-485 port. DeviceNet is an open-standard, multi-vendor, industrial device data network that uses a variety of physical media. DeviceNet also provides 24V dc power to devices connected to the network. The DeviceNet port and the native RS-485 port may be used simultaneously, although overall data throughput may be reduced.

For detailed DeviceNet system installation information, including cable lengths, the placement of terminating resistors, power supplies and other media components, refer to publication DN-6.7.2, DeviceNet cable System Planning and Installation Manual.

Refer to the note at the beginning of Communication Wiring page 38.

Install suitable terminating resistors at the ends of the DeviceNet cable.

TIP Some DeviceNet devices are equipped with internal terminating resistors.

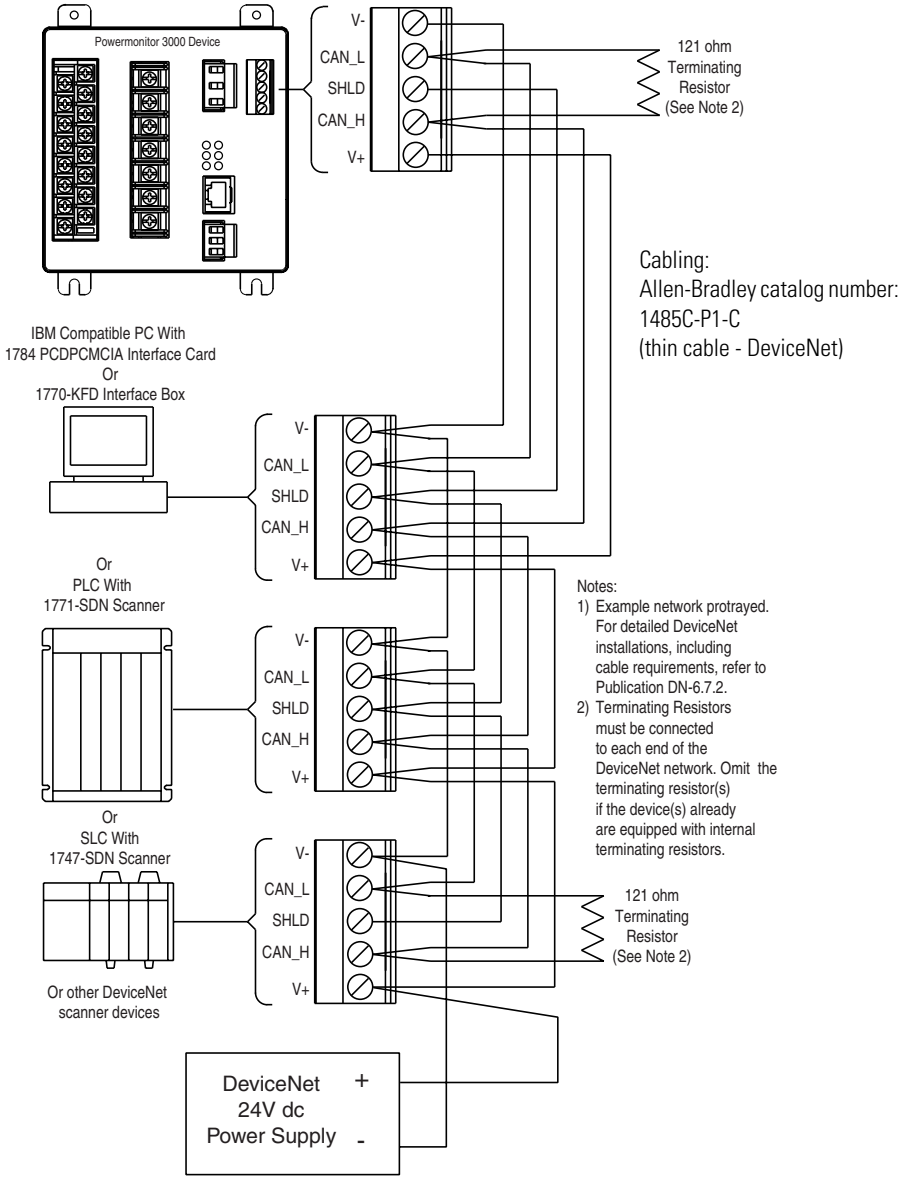
IMPORTANT You must install and wire a suitable 24V dc power supply to the V+ and V- conductors in the DeviceNet cable. The Powermonitor 3000 consumes less than 100 mA from the DeviceNet 24V dc supply.

Configuration options for optional DeviceNet Communications include the node address (MAC ID) and data rate. Defaults are node 63 and 125k baud. Refer to the Powermonitor 3000 User Manual, publication 1404-UM001.

Table 35 DeviceNet Terminal Block Wiring Connections

Terminal	Signal	Function	Color
1	COM (V-)	Common	Black
2	CAN_L	Signal Low	Blue
3	SHIELD	Shield	Uninsulated
4	CAN_H	Signal High	White
5	VDC+ (V+)	Power Supply	Red

Figure 36 Connecting Powermonitor 3000 to other DeviceNet Devices



Optional Ethernet Communications

Powermonitor 3000 units with catalog numbers ending in -ENT are equipped with an industry standard Ethernet 10baseT port. Your Powermonitor 3000 may contain one of two hardware versions of the Ethernet port. The catalog number series determines which hardware version the product contains. Table 37 below indicates the differences.

Table 37 Ethernet Hardware Versions

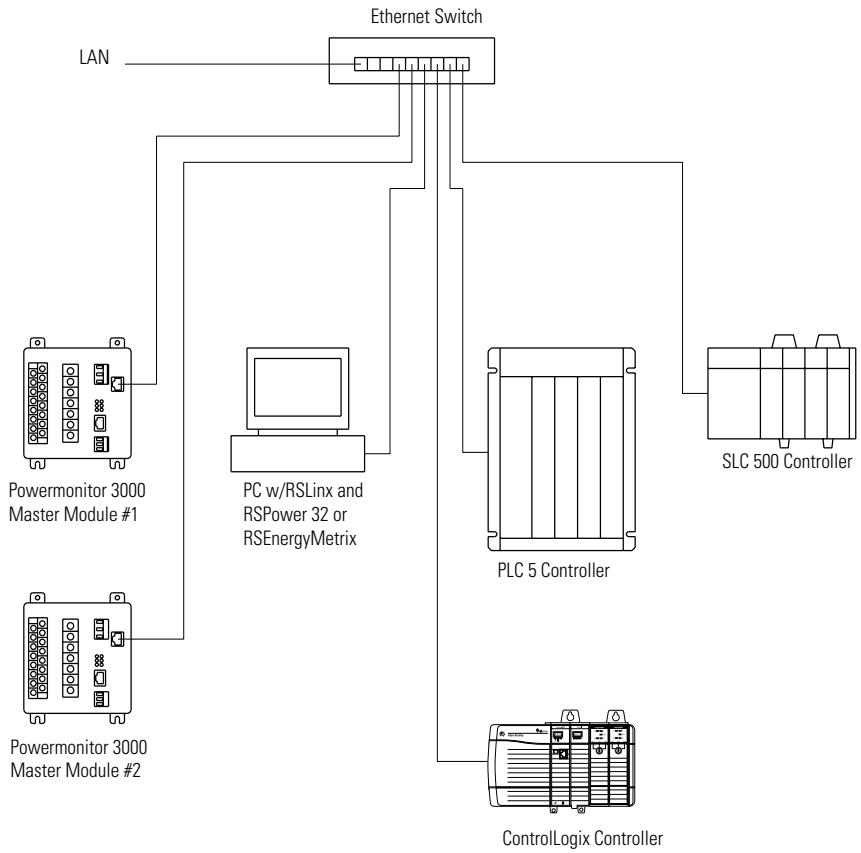
	Series A	**Series B**
Data Rate	10M Bit only	10/100M bit
Protocol Supported	EtherNet/IP and CSP	EtherNet/IP
Built-in Web Page	Yes, fixed	Yes, configurable
Supports CIP Class 1 Connnection (I/O Data)	No	Yes
Supports Control FLASH	No	Yes

The Powermonitor 3000 is designed to connect easily to industry-standard Ethernet hubs and switches using standard UTP (unshielded twisted-pair) cables with RJ-45 connectors. Table 38 shows the cable and connector pin assignments and Figure 39 shows a typical star network topology.

Table 38 Ethernet Wiring Connections

Terminal	**Signal**	**Function**
1	TX+	TX+
2	TX-	TX-
3	RX+	RX+
4		
5		
6	RX-	RX-
7		
8		

Figure 39 Powermonitor 3000 Ethernet Network Example



Refer to the note at the beginning of Communication Wiring page 38.

Configuration options for optional Ethernet communications include the IP (Internet Protocol) address, subnet mask, default gateway IP address and protocol.

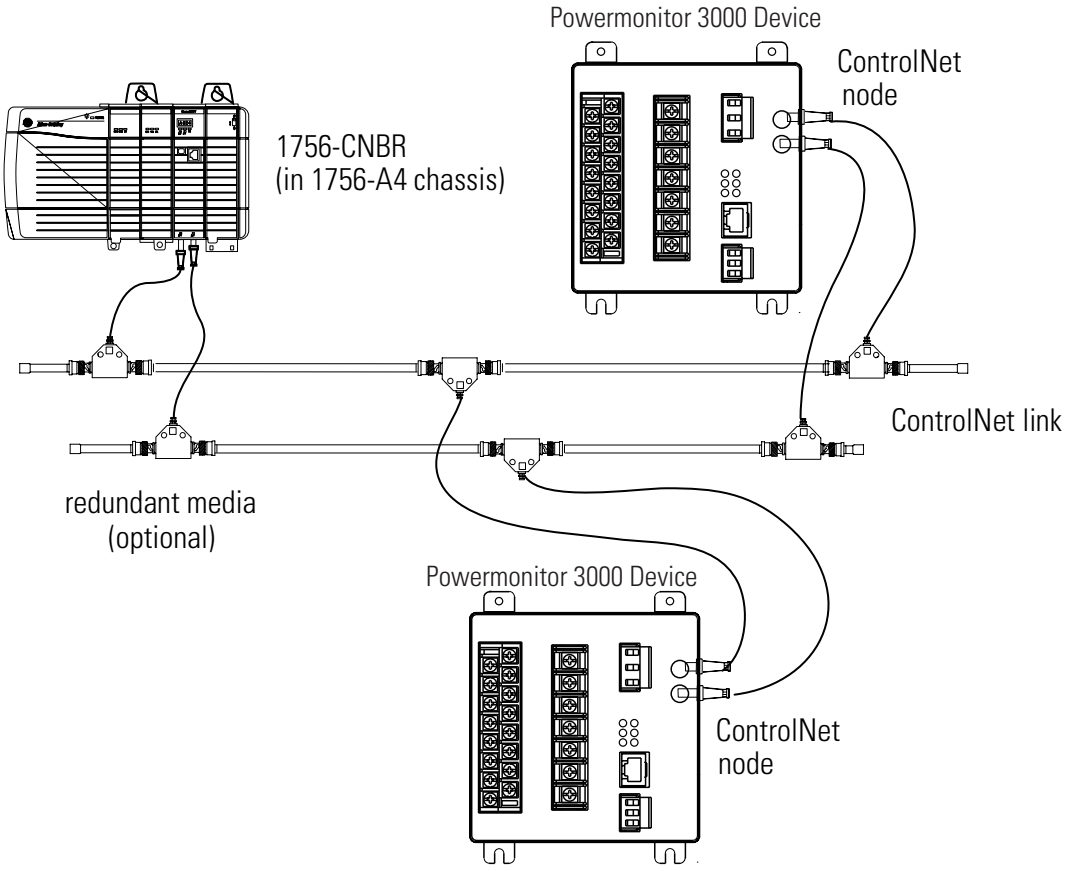
Defaults are:

- IP address: 128.1.1.xxx where xxx is the Device ID assigned at the factory in the range 1 to 254.
- Subnet mask: 255.255.0.0
- Default gateway IP address: 128.1.1.1
- Protocol: CSP (PCCC)/CIP (EtherNet/IP) dual stack (Series A), CIP (EtherNet/IP) (Series B)

Optional ControlNet Communications

Powermonitor 3000 units with catalog numbers ending in -CNT are equipped with a ControlNet communications interface. The ControlNet Powermonitor 3000 can be connected in a single media or redundant media network. Figure 40 shows an example ControlNet network using redundant media.

Figure 40 Powermonitor 3000 ControlNet Network Example



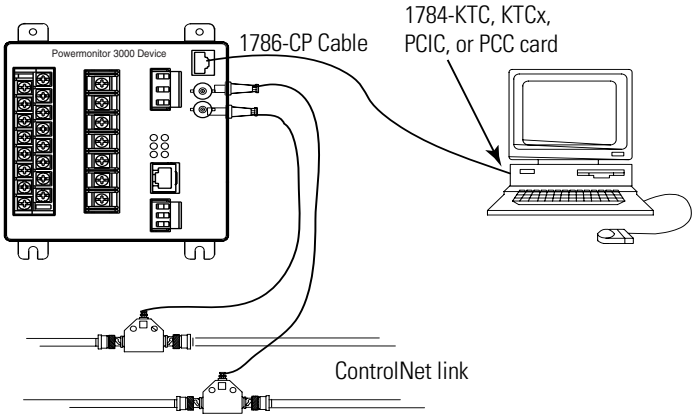
Refer to the following documentation for ControlNet network wiring requirements and general ControlNet information.

- ControlNet Cable System Planning and Installation Manual, publication 1786-6.2.1
- ControlNet Coax Tap Installation Instructions, publication 1786-5.7
- ControlNet Coax Media Planning and Installation Guide, publication CNET-IN002.

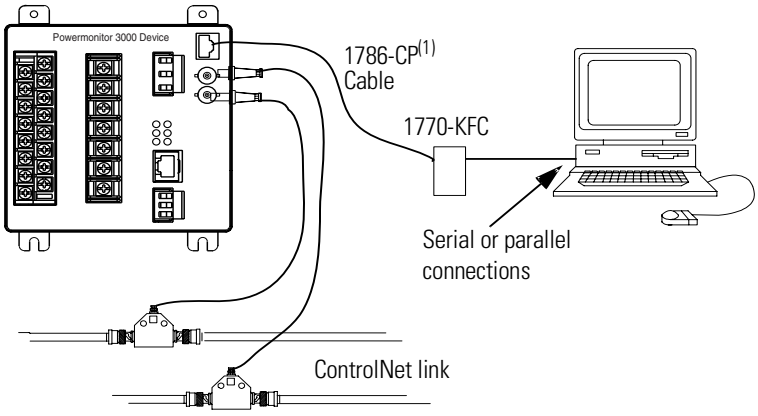
Connecting a Programming Terminal to the Network Using 1786-CP Cable

To connect a programming terminal to the network using a 1786-CP cable, you have the following options:

1. Using a 1784-KTC, -KTCx, or -PCC communication card and a 1786-CP cable:



2. Using a 1770-KFC communication interface, a serial or parallel connection, and a 1786-CP cable:



The 1786-CP cable can be plugged into any ControlNet product's NAP to provide programming capability on the ControlNet network. A programming terminal connected through this cable is counted as a node and must have a unique network address.

ATTENTION

Use a 1786-CP cable when connecting a programming terminal to the network through NAPs. Using a commercially available RJ-style cable could result in network failure.

Maintenance

Accessing Self-test/Diagnostic Data using Display Module

You can access valuable diagnostic information using the optional Display Module. Connect the Display Module to the Master Module using the Display Module cable. Using the four control keys, navigate through the menus to “Display” - “Status” and select using the Enter key. The Display Module then displays the following data. Use the up and down arrow keys to step through the status data.

- CAT NO - the unit catalog number and series revision letter.
- ACC CLASS - displays the revenue meter accuracy class.
- WIN NO - the unit’s unique Warranty Identification Number (needed for service and optional firmware enhancements).
- HW REV - displays details of the digital board, analog board, and ASIC revisions.
- FRN MASTER MODULE - shows the Master Module firmware revision.
- DEVICE ID - shows the units device ID number assigned at the factory. This number is also used in the default address for native RS-485, and optional RS-232 and Ethernet communications.
- SELFTEST STATUS - displays a status code bitfield as a hex number. A non-zero value indicates a problem.
- CODE FLASH - indicates the health of the flash memory code area.
- RAM - indicates the health of the random-access memory.
- DATA FLASH - indicates the health of the flash memory data area.
- NVRAM - indicates the health of the super-cap backed non-volatile random access memory.
- D ACQ - indicates the data acquisition system health.
- W DOG - indicates the system watchdog timer status.
- CLOCK - indicates the health of the real-time clock.
- COMM - displays the firmware revision of the optional communications card (if applicable).
- COMM - displays the optional communication card type.

- COMM - displays the optional communications status bitfield as a hex number (0000 hex is normal for -232 and -RIO units, and 9001 hex is normal for -DNT and -ENT units).
- DMSTA - displays the Display Module status bitfield as a hex number. A non-zero value may indicate a problem, although a non-zero value may appear if a Display Module is connected to an operating Master Module.
- DM FRN - indicates the Display Module firmware revision.
- MM/DD/YYYY - displays the current Date.
- HH/MM/SS - displays the current Time.
- RELAY - shows the status of the Form 4C relay.
- KYZ - shows the status of the KYZ output.
- S1 STATUS - shows the status of Status Input 1.
- S1 COUNT - shows the accumulated value of Status Input 1 counter, since last cleared.
- S2 STATUS - shows the status of Status Input 2, since last cleared.
- S2 COUNT - shows the accumulated value of Status Input 2 counter.
- OUTWD - displays the output word bitfield as a hex number.

Refer to the Powermonitor 3000 User Manual, publication 1404-UM001 for information on using the Display Module.

Calibration

To meet general operating requirements, regular recalibration is not necessary.

For special customer requirements, contact your Rockwell Automation representative for calibration or service information.

Cleaning Instructions

ATTENTION

Electrostatic discharge can damage integrated circuits or semiconductors. Follow these guidelines when you handle the module.

- Touch a grounded object to discharge static potential.
- Wear an approved wrist strap grounding device.
- Do not open the module or attempt to service internal components.
- If available, use a static safe work station.
- When not in use, keep the module in its static shield bag.
- Disconnect and lock out all power sources and short all current transformer secondaries before servicing. Failure to comply with these precautions can lead to personal injury or death, property damage or economic loss.

1. Turn off all electrical power supplied to the Master Module.

2. If necessary, clean the Master Module with a dry, anti-static, lint-free cloth. Remove all dust and any obstructions from the cooling air vents on the upper, lower, and ends of the module. Ensure that the nameplate is clean and in good condition.

3. If necessary, clean the Display Module with a dry, anti-static, lint-free cloth. Remove all dust and any foreign material(s) from the exterior of the module. Ensure that the graphic front panel overlay and back nameplate are clean and in good condition.

Field Service Considerations

If the Powermonitor 3000 requires servicing, please contact your nearest Allen-Bradley Sales Office. To minimize your inconvenience, the initial installation should be performed in a manner which makes removal easy.

1. A CT shorting block should be provided to allow the Powermonitor 3000 Master Module current inputs to be disconnected without making the user-supplied CT's an open circuit. The shorting block should be wired to prevent any effect on the external protective relays.

2. All wiring should be routed to allow easy maintenance at connections to the Powermonitor 3000 terminal strips and the Powermonitor 3000 itself.

ATTENTION

Never open a current transformer (CT) secondary circuit with primary current applied. Wiring between the CTs and the Powermonitor 3000 should include a shorting terminal block in the CT secondary circuit. Shorting the secondary with primary current present allows other connections to be removed if needed. An open CT secondary with primary current applied produces a hazardous voltage, which can lead to personal injury, death, property damage or economic loss.

Firmware Upgrades

Powermonitor 3000 firmware upgrades are of two types. Service upgrades are those that occur from time-to-time to improve operation and resolve issues. Product upgrades are optional firmware enhancements that you may purchase to convert your M5 Master module to an M6 or M8, or your M6 to an M8.

Service upgrades may be available at no charge. Contact your local Rockwell Automation representative for information or visit the Internet at http://www.ab.com/PEMS.

Product upgrades are available for purchase. Contact your Rockwell Automation representative for additional information.

Master Module firmware upgrades (of either type) are performed using the native RS-485 communications port. Firmware upgrades may be performed without removing the Powermonitor 3000 from its

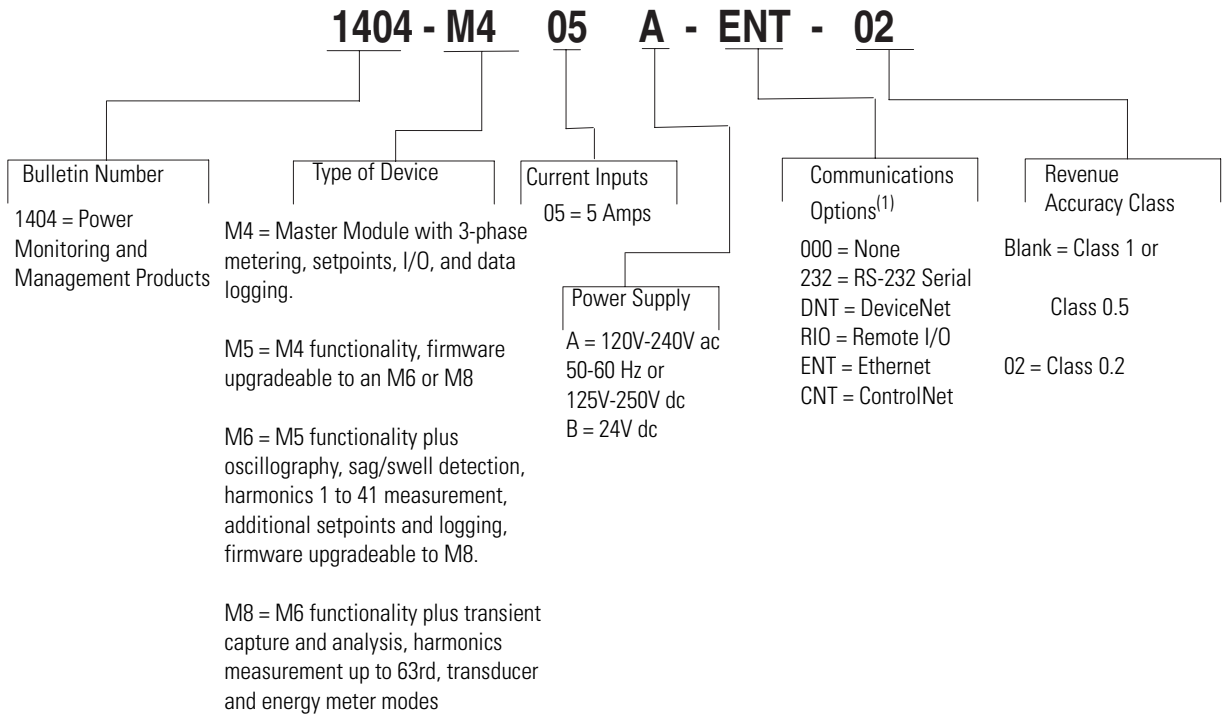
installation. An RS-485 to RS-232 converter is required to connect between the Powermonitor 3000 and your personal computer communications port. Cycling power to the Powermonitor 3000 may be required to complete the firmware upgrade.

Factory-Installed Communication Cards

The RS-485 communications is integral to the Master Module and can not be removed. Adding or changing a second communication card to a Powermonitor 3000 must be done at the factory and is not field upgradeable.

Catalog Number Explanation

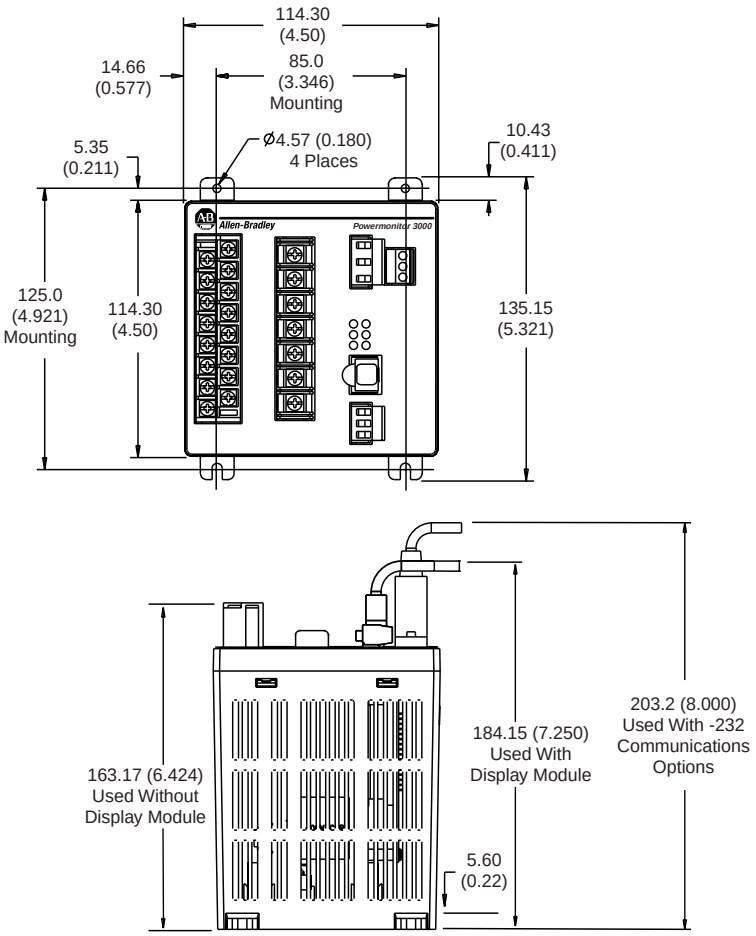
Master Module



(1) In addition to Native RS-485 port.

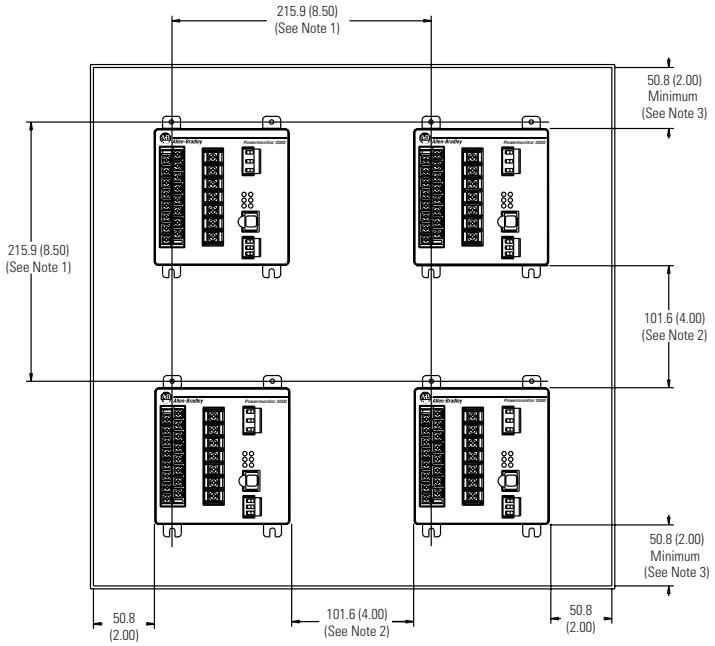
Dimension Drawings

Figure 41 Master Module Dimensions



All dimensions are in mm (inches).

Figure 42 Master Module Spacing



General Notes:

1. Recommended spacing provides reasonable wiring clearance and ventilation.
2. Maintain approximately 102 mm (4.00 in.) clearance between master modules and other electrical equipment.
3. Do not block cooling vents. Wiring and other obstructions must be 50 mm (2.00 in.) minimum from top and bottom of unit.
4. Mount with ventilation openings in top and bottom to provide optimum free convection cooling.
5. Refer to Specifications for ambient temperature requirements.

Product Approvals

EtherNet/IP Conformance Testing

All Series B Powermonitor products equipped with an EtherNet/IP communications port bear the mark shown below. This mark indicates the Powermonitor 3000 has been tested at an Open Device Vendor Association (ODVA) independent test lab and has passed the EtherNet/IP conformance test. This test provides a level of assurance that the Powermonitor 3000 will interoperate with other conformance tested EtherNet/IP devices (including devices from other vendors). Two representative devices from the Powermonitor 3000 EtherNet/IP family of devices; the 1404-M405A-ENT B and the 1404-M8805A-ENT B have been tested by ODVA using EtherNet/IP Conformance Test version A2.8. The ODVA website (www.odva.org) maintains a list of products that have passed the conformance test at one of their test labs.

ControlNet Conformance Testing

All Powermonitor products equipped with a ControlNet communications port bear the mark shown below. This mark indicates the Powermonitor 3000 has been tested at a ControlNet International (CI) independent test lab and has passed the ControlNet conformance test. This test provides a level of assurance that the Powermonitor 3000 will interoperate with other conformance tested ControlNet devices (including devices from other vendors). Two representative device from the Powermonitor 3000 ControlNet family of devices; the 1404-M405A-CNT A and the 1404-M805A-CNT A have been tested by CI using ControlNet Conformance Test version 12. The CI website (www.ControlNet.org) maintains a list of products that have passed the conformance test at one of their test labs.

UL/CUL

UL 508 listed, File E96956, for Industrial Control Equipment and CUL Certified.

CE Certification

If this product bears the CE marking, it is approved for installation within the European Union and EEA regions. It has been designed to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole, documented in a technical construction file:

- EN 50081-2 - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2 - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of IEC 1010-1.

This equipment is classified as open equipment and must be installed (mounted) in an enclosure during operation as a means of providing safety protection.

International Standard IEC 529 / NEMA / UL 508 Degree of Protection

The Bulletin 1404 Master Module is rated as IP10 degree of protection per International Standard IEC 529. It is considered an open device per NEMA and UL 508.

The Bulletin 1404 Display Module is rated as IP65 degree of protection per International Standard IEC 529. It is rated as Type 4 (Indoor) per NEMA and UL 508.

Follow the recommended installation guidelines to maintain these ratings.

ANSI/IEEE Tested

Meets or exceeds the Surge Withstand Capability (SWC) C37.90.1 - 1989 for protective relays and relay systems on all power connection circuit terminations.

Technical Specifications

Measurement Accuracy and Range

See table below for the rating of each parameter

Table 43 Measurement Accuracy and Range

Parameter	Accuracy in % of Full Scale at +25°C 50/60 Hz Unity Power Facator				Nominal/Range
	M4	M5	M6	M8	
Voltage Sense Inputs: V1, V2, V3	±0.2%	±0.05%	±0.05%	±0.05%	347V/15 to 399V $_{L-N}$ RMS 600V/26 to 691V $_{L-L}$ RMS
Current Sense Input: I1, I2, I3, I4	±0.2%	±0.05%	±0.05%	±0.05%	5A/50 mA – 10.6A RMS
Frequency	±0.05 Hz	±0.05 Hz	±0.05 Hz	±0.05 Hz	50 or 60 Hz/40 to 75 Hz
Power Functions: kW, kVA, kVAR Demand Functions: kW, kVA Energy Functions: kWH, kVAH	ANSI C12.16 and EN 61036 Class 1 Accuracy	ANSI C12.20 and EN 60687 Class 0.5 Accuracy (Class 0.2 is also available)	ANSI C12.20 and EN 60687 Class 0.5 Accuracy (Class 0.2 is also available)	ANSI C12.20 and EN 60687 Class 0.5 Accuracy (Class 0.2 is also available)	
Metering Update Rates	55 to 80 ms	45 to 70 ms	45 to 75 ms	40to 90 ms	

General Input, Output, and Environmental Ratings

Table 44 Input and Output Ratings

Control Power	1404-xxxxA-xxx	102V-264V ac 47-63 Hz or 106V-275V dc (0.2 Amp maximum loading)
	1404-xxxxB-xxx	18V to 50V dc (15 VA maximum loading)
Voltage Sense Inputs: V1, V2, V3	Input Impedance: 1M ohm minimum, 399V ac maximum; V1, V2 and V3 to N.	

Table 44 Input and Output Ratings

Current Sense Inputs: I1, I2, I3, I4	Overload Withstand: 15 Amps Continuous, 200 Amps for one second Burden: 0.05 VA Impedance: 0.002 ohms Maximum Crest Factor at 5A is 3 Starting Current: 5 mA
Status Inputs	Contact Closure (Internal 24Vdc)
Control Relay KYZ Output	(1) ANSI C37.90-1989 trip duty (1) Solid State KYZ - 80mA at 240Vdc-300Vdc

Table 45 Control Relay(1)

Rating	50/60 Hz AC rms	DC
Maximum Resistive Load Switching	10A at 250V (2500VA)	10A at 30V and 0.25A at 250V
Minimum Load Switching	10mA at 24V	10mA at 24V
UL 508, CSA 22.2, IEC Rating Class	B300	Q300
Maximum Make Values (Inductive Load)	30A at 120V 15A at 240V (3600VA)	0.55A at 125V 0.27A at 250V (69VA)
Maximum Break Values (Inductive Load)	3A at 120V 1.5A at 240V (360VA)	0.55A at 125V 0.27A at 250V (69VA)
Maximum Motor Load Switching	1/3 HP at 125V 1/2 HP at 250V	

(1) Meets ANSI/IEEE C37.90-1989 standards for trip duty.

Table 46 Relay Life(1)

Parameter	Number of Operations
Mechanical	5×10^6
Electrical	1×10^5

(1) Meets ANSI/IEEE C37.90-1989 standards for trip duty.

Table 47 General Specifications

Dielectric Withstand	Control Power	2000 Volts
	Voltage Inputs	2000 Volts
	Current Inputs	2000 Volts
	Status Inputs	500 Volts
	Control Relays	1600 Volts
Terminal Blocks	Power Supply and Voltage input Terminals	12 AWG (4 mm2) max., 9 lb-in (1.02 Nm) Torque., 75°C or Higher Copper Wire only
	Relay, KYZ outputs, Current input terminals(1)	14 AWG (2.5 mm2) max., 10.4 lb-in (1.18 Nm) Torque., 75°C or Higher Copper Wire only
	Status inputs, RS485	14 AWG (2.5 mm2) max., 5 lb-in (0.56 Nm) Torque
	RIO, DNT (When present)	14 AWG (2.5 mm2) max., 5 lb-in (0.56 Nm) Torque
Operating Temperature	-20°C to +60°C (-40°F to +140°F) Cat. No. 1404-DM, 1404-Mxxxx-000, 1404-Mxxxx-DNT +0°C to +55°C (+32°F to +131°F) 1404-Mxxxx-232, -RIO, -ENT, -CNT	
Storage Temperature	-40°C to +85°C (-40°F to +185°F)	
Humidity	5% to 95%, Noncondensing	
Vibration	10 to 500 Hz: 2G Operational (±0.012 in.)	
Shock	1/2 Sine Pulse, 11 ms duration: 30G Operational and 30G Nonoperational	

(1) Recommended Ring lug: AMP part # 320634

Rockwell Automation Support

Rockwell Automation provides technical information on the web to assist you in using our products. At http://support.rockwellautomation.com, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration and troubleshooting, we offer TechConnect Support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://support.rockwellautomation.com.

Installation Assistance

If you experience a problem with a hardware module within the first 24 hours of installation, please review the information that's contained in this manual. You can also contact a special Customer Support number for initial help in getting your module up and running:

United States	1.440.646.3223 (for failures within the first 24 hours of installation) 1.440.646.5800 (for installation assistance) Monday – Friday, 8am – 5pm EST
Outside United States	Please contact your local Rockwell Automation representative for any technical support issues.

New Product Satisfaction Return

Rockwell tests all of our products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned:

United States	Contact your distributor. You must provide a Customer Support case number (see phone number above to obtain one) to your distributor in order to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for return procedure.

www.rockwellautomation.com

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