**Instruction Bulletin**
**3020IM9503R6/98**
**December 1998**
(Replaces 3020IM9503R8/97 dated October 1997)


# PowerLogic®
# Power Meter
## Class 3020

SQUARE D

## NOTICE

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages appear throughout this bulletin to warn of potential hazards.

| ⚠ DANGER |
|---|
| Used where there is a hazard of severe bodily injury or death. Failure to follow a "DANGER" instruction ***will*** result in death or ***severe*** bodily injury. |

| ⚠ WARNING |
|---|
| Used where there is a hazard of bodily injury or death. Failure to follow a "WARNING" instruction can result in death or bodily injury. |

| ⚠ CAUTION |
|---|
| Used where there is a hazard of equipment damage. Failure to follow a "CAUTION" instruction can result in damage to equipment. |

**FCC NOTICE:** This equipment complies with the requirements in Part 15 of FCC rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception, requiring the operator to take whatever steps are necessary to correct the interference.

**PLEASE NOTE:** Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient for those who are not otherwise qualified to operate, service, or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Square D for any consequences arising out of the use of this material.


## TECHNICAL SUPPORT

**For technical support, contact the**

**Power Monitoring and Control Systems Technical Support Center.**

**Hours are 7:30 A.M. to 4:30 P.M., Central Time, Monday through Friday.**

**www.powerlogic.com** **BBS: (615) 287-3414**

**Fax: (615) 287-3404** **Phone: (615) 287-3400**

## Register your Power Meter

*Please fill out, detach, and mail the postage paid card below. Fill out only one registration card, even if you have purchased multiple POWERLOGIC Power Meters.*

# Registration Card

**Register your POWERLOGIC Power Meter today and get:**

- Free expert technical phone support—just call (615) 287-3400
- Advance notice on product upgrades and new product releases
- Advance notice on special product offers and price discounts

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# CHAPTER 1—INTRODUCTION

## WHAT IS THE POWER METER?

The POWERLOGIC® Power Meter is a compact, low-cost power meter for basic industrial power monitoring applications. The power meter has been designed for ease of installation in industrial retrofit applications. Power meter applications include new equipment such as switchboards, panelboards, and Low Voltage Drawout (LVDO) feeders, and it can be used in POWERLINK installations for metering the main. Additionally, the power meter can be used for Motor Control Centers (MCCs) and busway.

The power meter can be purchased with an optional display for local display and setup. Also, the display can be purchased separately to be used as a power meter programmer. The display fits standard 4-1/4" (108 mm) ammeter and voltmeter cutouts. It connects to the power meter by a cable that supplies both communications and power.

All power meter modules can be mounted up to 50 feet (15.2 m) from the display. You can mount them on an enclosure floor or wall, on a horizontal 35 mm DIN rail, or directly behind the display on the panel door.

The power meter is completely supported in POWERLOGIC System Manager Software releases SMS-3000, SMS-1500 and PMX-1500, including setup and resets. SMS-770/700 v. 2.23 and EXP-550/500 v. 1.23 provide limited support, including real-time and historical data monitoring and PC-based alarming and trending.

Some of the power meter's features include:

- ANSI C12.16 Revenue Accuracy
- True RMS Metering (31st Harmonic)
- Accepts Standard CT and PT Inputs
- Direct Connect up to 600 V
- Fits Standard 1% Ammeter/Voltmeter Mounting Holes
- Optional Display to View Meter Values
- Power Quality Readings—THD (Voltage and Current)
- On-board Clock/Calendar
- Easy Setup through Remote Display (Password Protected)
- RS-485 Communications Standard
- System Connections
  – 3-Phase, 3-Wire Delta (Metered or Calculated B Phase)
  – 3-Phase, 4-Wire Wye
- Operating Temperature Range (0°C to +60°C)

Table 1-1 below summarizes the power meter instrumentation common to all three models. Table 1-2 describes the three power meter models and accessories. You can assemble custom length cables using the components specified in Table 1-3. Table 1-4 compares features of those models.

**Table 1-1**
**Summary of Power Meter Instrumentation**

| |
|---|
| **Real-Time Readings**<br>• Current (per phase)<br>• Voltage (L-L, L-N)<br>• Real Power (per phase and 3Ø total)<br>• Reactive Power (per phase and 3Ø total)<br>• Apparent Power (per phase and 3Ø total)<br>• Power Factor, true (per phase, 3Ø)<br>• Frequency |
| **Energy Readings**<br>• Accumulated Energy, real 3Ø total<br>• Accumulated Energy, reactive 3Ø total<br>• Accumulated Energy, apparent 3Ø total |

**Table 1-2**
**Class 3020 Power Meters and Accessories**

| Type | Description |
|---|---|
| PM-600 | Instrumentation, 0.3% accuracy |
| PM-620 | PM-600 features, plus date/time stamp, THD/thd, neutral current, demand values |
| PM-650 | PM-620 features, plus alarms, min/max values, data and event logs |
| PMD-32 | Power Meter Display (optional) with 1-ft. (0.3 m) cable |
| SC-104 | 4-ft (1.2 m) cable (optional) |
| SC-112 | 12-ft. (3.7 m) cable (optional) |
| SC-130 | 30-ft. (9.1 m) cable (optional) |

**Table 1-3**
**Components for Assembling Custom Length Cables**

| Description | Mfr./Part Number | Quantity |
|---|---|---|
| RJ-11, 6-position, 4-conductor ① Round Cable Modular Plug | Mouser 154-UL6234 or AMP 5-569031-3 | 2 plugs |
| Signal and Control Cable | Olflex 602604 or Unitronic 190 (4-wire/26 AWG) | 50-ft. (15.2 m) Maximum Length |

① Assemble with manufacturer's recommended crimping tool.

**Table 1-4**
**Power Meter Feature Comparison**

| Feature | PM-600 | PM-620 | PM-650 |
|---|---|---|---|
| Full Instrumentation | ✘ | ✘ | ✘ |
| RS-485 Communications Port | ✘ | ✘ | ✘ |
| Wiring Diagnostics | ✘ | ✘ | ✘ |
| ANSI C12.16 Accuracy | ✘ | ✘ | ✘ |
| Current Demand (per phase, neutral) | | ✘ | ✘ |
| Power Demand (3-phase total, present) | | ✘ | ✘ |
| Peak Power & Current Demand | | ✘ | ✘ |
| Date/Time Stamping | | ✘ | ✘ |
| THD or thd (Voltage and Current) | | ✘ | ✘ |
| Calculated Neutral Current | | ✘ | ✘ |
| Onboard Alarms | | | ✘ |
| Min/Max Readings | | | ✘ |
| Predicted Power Demand | | | ✘ |
| Data Log | | | ✘ |
| Event Log | | | ✘ |
| Demand Interval Synch to Comms | | | ✘ |
| Rolling Block Demand | | | ✘ |

## USING THIS BULLETIN

This document provides the information required to install and operate the power meter. The document consists of a table of contents, chapters, several appendices, and an index. To locate information on a specific topic, refer to the table of contents or the index.

### Notational Conventions

This document uses the following notational conventions:

- **Procedures**. Each procedure begins with a statement of the task, followed by a numbered list of steps. Procedures require you to take action.
- **Bullets**. Bulleted lists, such as this one, provide information but not procedural steps. They do not require you to take action.
- **Cross-References.** Cross-references to other sections in the document appear in boldface. Example: see **Power Meter Connections** in **Chapter 3**.

### Not Covered in this Bulletin

Some of the power meter's features, such as PC-based logging, onboard logging for the PM-650, trending, and PC-based alarming, must be set up using POWERLOGIC application software. For instructions on setting up these features, refer to the application software instruction bulletin.

***Note:*** *The PM-650 is supported by POWERLOGIC System Manager Software (SMS)-3000 v. 3.1 (and higher).*

# CHAPTER 2—SAFETY PRECAUTIONS

## ⚠ DANGER

**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**

- Only qualified electrical workers should install this equipment. Such work should be performed only after reading this entire set of instructions.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.

**Failure to observe these precautions will result in death, severe personal injury, or equipment damage!**

# CHAPTER 3—HARDWARE DESCRIPTION

## DISPLAY

The optional power meter display is designed for maximum ease of use. The display has the following modes of operation:

- Setup—for setting up power meter
- Resets—to perform resets of peak demands①, accumulated energy, and min/max②
- Diagnostics—for troubleshooting, read-only registers
- Summary—displays commonly viewed metered values
- Power—displays power values
- Energy—displays energy values
- Demand①—displays demand values
- Power Quality①—displays power quality values
- Alarm Log②—displays and acknowledges onboard alarms
- Alarm Setup②—for setting up onboard alarms
- Min/Max②—displays minimum and maximum values

For details on how to use the optional display, see **Chapter 7—Display Operation**.

① When used with PM-620 and PM-650.

② When used with PM-650.

Figure 3-1 shows the power meter display. Display components are listed below:

① **2-Line Liquid Crystal Display.** For local display of metered values.

② **Arrow Buttons.** Press to move through meter display screens. In Setup, Resets, and Diagnostic modes, press to change values and, on the PM-650 only, Alarm Setup and Alarm Log.

③ ***Mode* Button.** Press to scroll through the available modes.

④ **Contrast Button.** Press to change the contrast of the display.

⑤ ***Select* Button.** Press to select modes and Setup, Resets, and Diagnostic values. On the PM-650 only, use this button to select Alarm values.

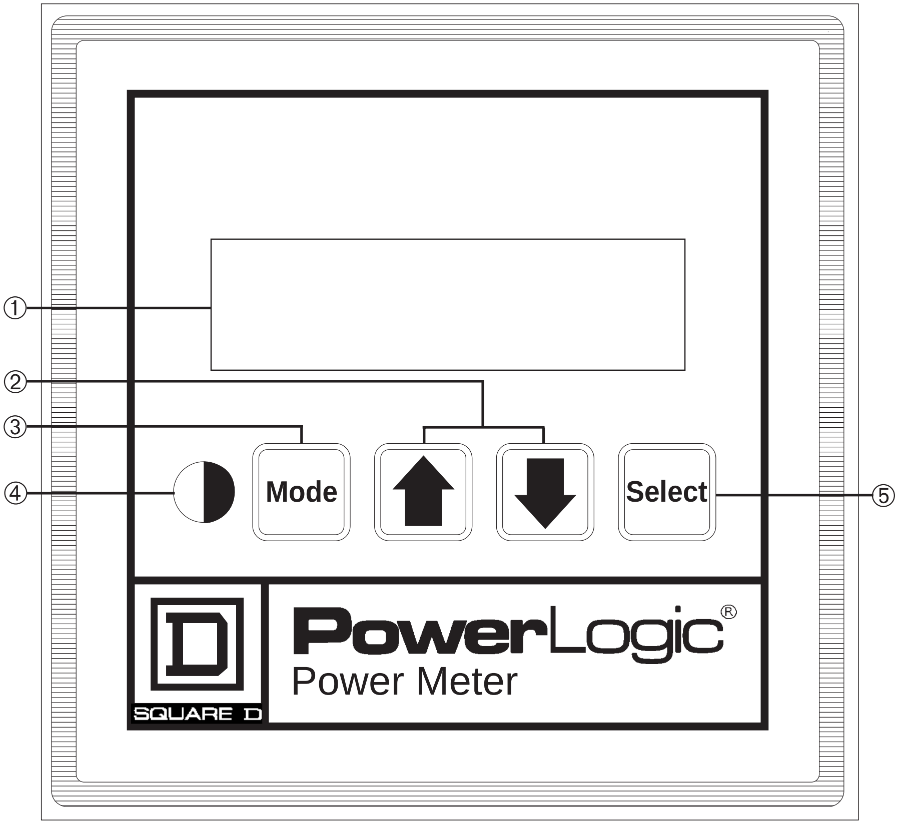



*Figure 3-1: Power meter display components*

The display connects to the power meter via the display cable. One display communications port is located on the back of the display (figure 3-2, below). The other display communications port is located on the meter connections end of the power meter (figure 3-3).

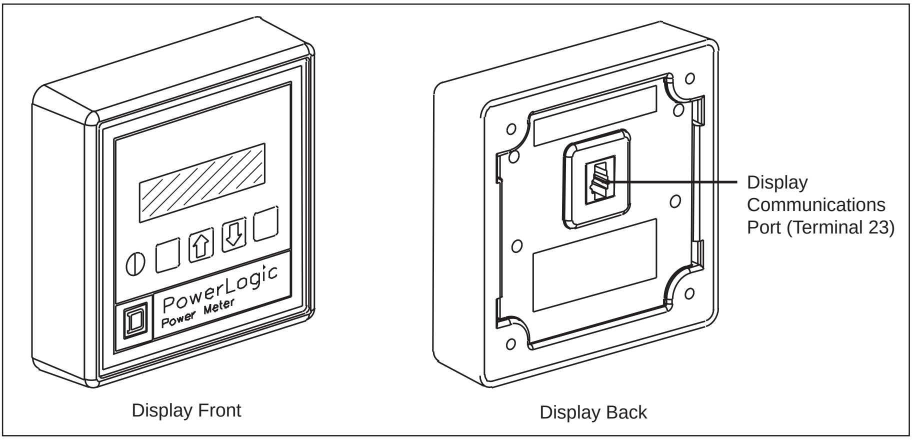



*Figure 3-2: Power meter display, front and back*

## POWER METER CONNECTIONS

Figure 3-3 shows the front of the power meter and the label on the terminal shield. Identified parts are as follows:

① 3-Phase Voltage Inputs

② Control Power Terminals

③ KYZ Pulse Output

④ 3-Phase Current Inputs

⑤ Display Communications Port

⑥ RS-485 Communications Terminals

***Note**: See **Chapter 5—Wiring** for wiring instructions.*

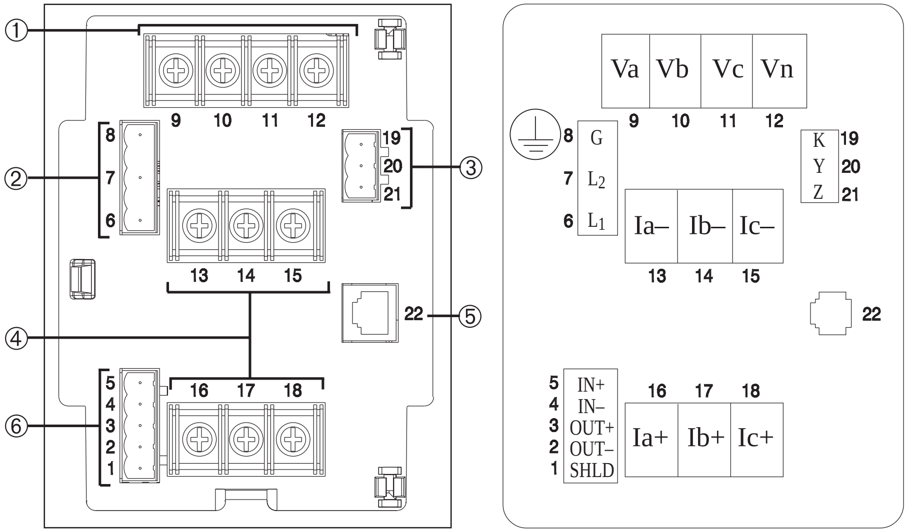



*Figure 3-3: Front of power meter and terminal shield label*

# CHAPTER 4—INSTALLATION

## ⚠ DANGER

**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**

Only qualified electrical workers should install and wire this equipment. Perform such work only after reading this complete set of instructions.

**Failure to observe these precautions will result in death or severe personal injury!**

## ⚠ CAUTION

**HAZARD OF EQUIPMENT DAMAGE.**

When mounting the power meter module, provide the following clearances (from enclosure walls or other objects): terminal end: 4" (102 mm); vented sides: 3" (76 mm). No clearance is necessary on the non-vented sides.

**Failure to observe this precaution can result in equipment damage.**

## POWER METER/DISPLAY MOUNTING OPTIONS

There are several options for mounting the power meter module and display:

- display mounted on front of a power equipment panel; power meter module mounted on back of panel (figure 4-1, page 15)
- display mounted on front of panel; power meter mounted remotely inside of equipment, with the terminals
  - up, mounted to bottom (floor) of equipment, or
  - perpendicular, mounted on side pan (figure 4-2, page 17)
- display mounted on front of panel, with the power meter module mounted on a 35 mm DIN rail (figure 4-4, page 19)
- no display; power meter mounted in one of the above locations

Mounting instructions for each of these options are described in this section.

When choosing a mounting location, consider the following:

- Allow for easy access to the meter connections end (where terminals are located) of the power meter module.
- Allow extra space for all wires, shorting blocks, or other components.

- Be sure that ambient conditions fall within the acceptable range: operating temperature 0°C to +60°C, relative humidity 5–95%, non-condensing.

***Note:*** *Always refer to local and state electrical safety standards before mounting the power meter or display.*

## MOUNTING THE DISPLAY

The display can be mounted in the following locations:

- in a standard 1% ammeter/voltmeter panel cutout
- on an equipment panel where it will be necessary to cut a hole before mounting the display

Table 4-1 below shows possible locations for mounting the display.

**Table 4-1**
**Typical Locations for Mounting Display**

| Equipment Type | Mounting Location |
|---|---|
| QED Switchboards | Disconnect Door |
| POWER-ZONE® III Switchgear | Main Instrument Compartment Door |
| HVL and VISI/VAC® Switchgear | 9-inch Front Panel or Instrument Door |
| Metal-Clad and Substation CBs | Standard Relaying Locations |
| ISO-FLEX® Medium Voltage MCCs | Low Voltage Door |
| Model 6 MCCs | Main Meter Location or Auxiliary Section |

### In Existing 1% Ammeter/Voltmeter Cutout

To mount the display in a standard 1% ammeter/voltmeter cutout, follow these steps:

1. Turn off all power supplying the equipment before working on it. Following all safety precautions, remove the existing ammeter/voltmeter.
2. Position the display against the front of the panel. From the other side of the panel, line up the mounting holes in the panel with the mounting holes in the display (see figure 4-1, page 15).

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

Use only the power meter display mounting screws included in the mounting hardware kit. Use of any other screws for display mounting voids the warranty and may damage the display.

**Failure to observe this precaution can result in equipment damage.**

3a. **If a power meter will be attached to the display**, insert display mounting screws into only the top two holes; tighten until approximately 1/4" of each screw protrudes from the panel. See **Directly Behind the Display,** page 14, for remaining instructions. Begin with step 3.

b. **If a power meter will not be attached directly to the display** (behind the panel door), insert one display mounting screw (included in hardware kit) through each of the four mounting holes. Tighten all screws to 6–9 lb-in (0.7–1.0 N•m).

## On Panel Without Existing 1% Ammeter/Voltmeter Cutout

To mount the display on a panel without an existing cutout for an ammeter/voltmeter, follow these steps:

1. Turn off all power supplying the equipment before working on it. Follow all safety precautions.
2. Tape the template shipped with the display to the panel in the desired location; make sure the template is level. (Hole positions and dimensions are shown in figure 4-3, page 17.) Make sure no wires or equipment on the other side of the panel will be damaged, then drill through the panel at the 4 holes marked *A* on the template. Use a 3/16" drill bit.
3. Drill or punch a hole 2 to 4 inches (51–102 mm) in diameter through the panel at the center of the template (center of hole is marked on the template).
4. Position the display against the front of the panel. From the other side of the panel, line up the mounting holes in the panel with the mounting holes in the display.

5a. **If a power meter will be attached directly to the display,** insert screws into only the top two holes; tighten until approximately 1/4" of each screw protrudes from the panel. See **Directly Behind the Display**, page 14, for remaining instructions. Begin with step 3.

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

Use only the power meter display mounting screws included in the mounting hardware kit. Use of any other screws for display mounting voids the warranty and may damage the display.

**Failure to observe this precaution can result in equipment damage.**

b. **If a power meter will not be attached directly to the display** (behind the panel door), insert one display mounting screw (included in hardware kit) through each of the four mounting holes. Tighten all screws to 6–9 lb-in (0.7–1.0 N•m). ***Note:*** *See CAUTION statement above.*

## MOUNTING THE POWER METER

Power meter mounting options are described in this section.

**DANGER**

**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**

Only qualified electrical workers should install and wire this equipment. Perform such work only after reading this complete set of instructions.

**Failure to observe these precautions will result in death or severe personal injury!**

**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

When mounting the power meter module, provide the following clearances (from enclosure walls or other objects): terminal end: 4" (102 mm); vented sides: 3" (76 mm). No clearance is necessary on the non-vented sides.

**Failure to observe this precaution can result in equipment damage.**

### Directly Behind the Display

To mount the power meter directly behind the display, follow these steps:

1. Turn off all power supplying the equipment before working on it. Follow all safety precautions.
2. Mount the display. See **Mounting the Display**, page 12, for instructions.
3. Plug one end of the 1-foot communications cable provided with the display into the display communications port (terminal 23, figure 4-1) on the back of the display.
4. Hook the power meter mounting feet onto the top two display mounting screws protruding from the back of the door or panel. Route the cable to the right (hinged side) so it is not pinched between the power meter module and the panel (figure 4-1).

## ⚠ CAUTION

**HAZARD OF EQUIPMENT DAMAGE.**

Use only the power meter display mounting screws included in the mounting hardware kit. Use of any other screws for display mounting voids the warranty and may damage the display.

**Failure to observe this precaution can result in equipment damage.**

5. Using the screws in the display hardware kit, secure the power meter to the display through the bottom two mounting feet holes. Tighten all screws to 6–9 lb-in (0.7–1.0 N•m).
6. Plug the other end of the communications cable into the display communications port (terminal 22, figure 4-1) on the power meter.

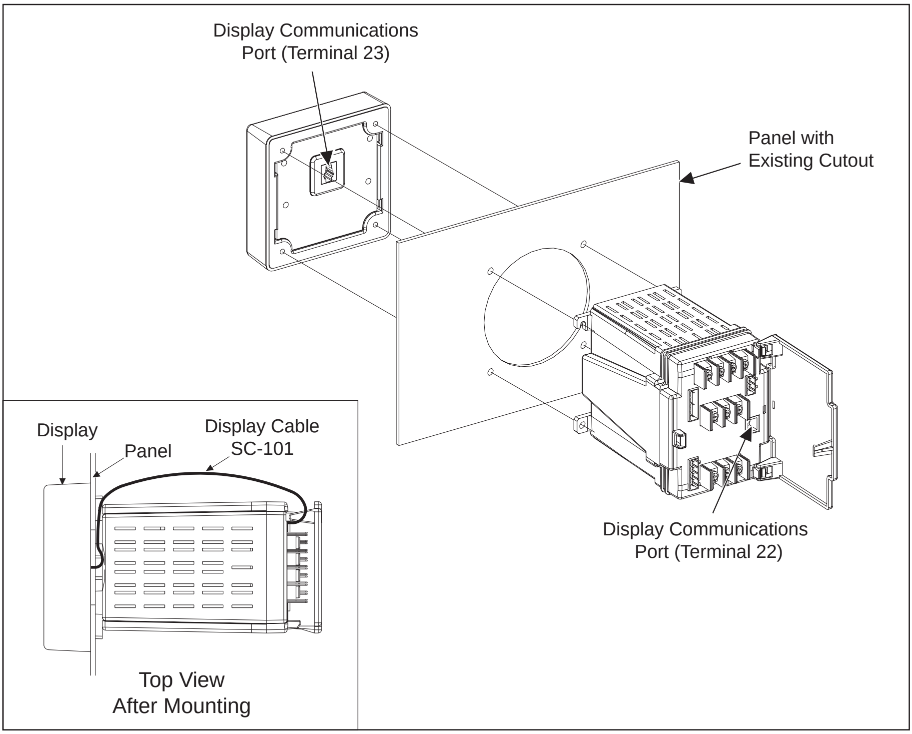



*Figure 4-1: Mounting power meter and display on panel with existing ammeter/voltmeter cutout*

## Remote Mounting

To mount the power meter remotely (inside an enclosure), follow these steps:

**⚠ DANGER**

**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**

Only qualified electrical workers should install and wire this equipment. Perform such work only after reading this complete set of instructions.

**Failure to observe these precautions will result in death or severe personal injury!**

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

When mounting the power meter module, provide the following clearances (from enclosure walls or other objects): terminal end: 4" (102 mm); vented sides: 3" (76 mm). No clearance is necessary on the non-vented sides.

**Failure to observe this precaution can result in equipment damage.**

1. Turn off all power supplying the equipment before working on it. Follow all safety precautions.
2. Select a mounting location on the floor or wall of the enclosure, ensuring that there are adequate clearances, that the terminals are accessible, and that the location complies with local and state electrical codes.
3. Tape the template shipped with the module to the panel in the desired location (see figure 4-2, page 17); make sure the template is level. (Hole positions and dimensions are shown in figure 4-3, page 17.) Make sure no wires or equipment on the other side of the panel will be damaged, then drill through the panel at the 4 holes marked *A* on the template. Use a 3/16" drill bit.
4. Place the power meter mounting feet holes over the drilled holes and secure the power meter to the enclosure panel using No. 6 (maximum) screws or bolts suitable for the panel. Tighten to 6–9 lb-in (0.7–1.0 N•m).

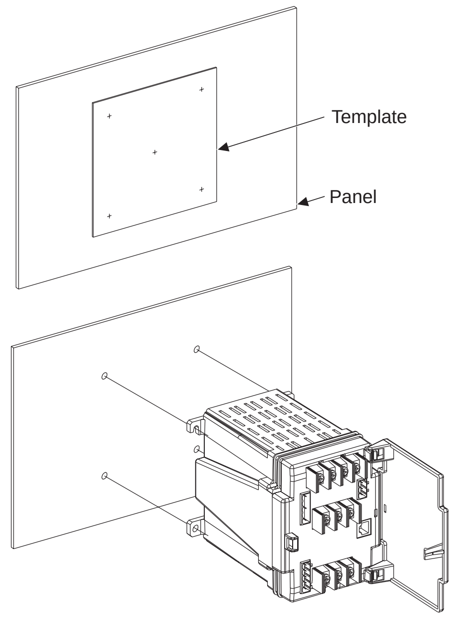
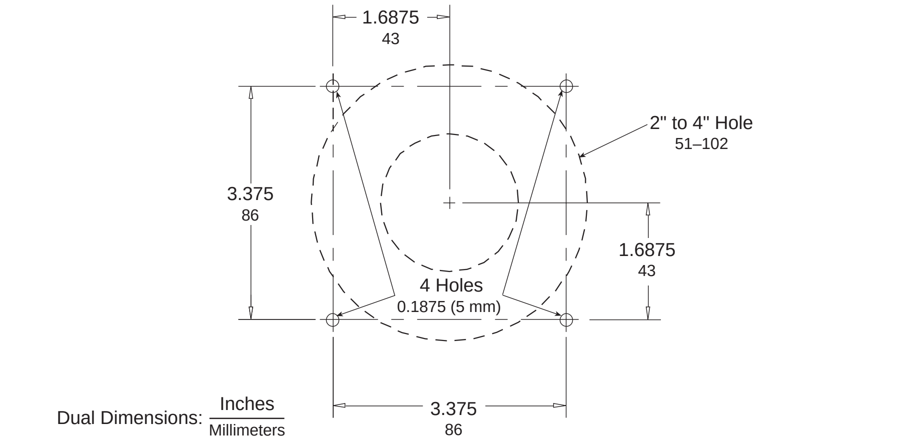



*Figure 4-2: Mounting power meter on panel with no existing cutout*




***Note:*** *The dimensions and positions of the 4 display holes shown above are identical for the power meter module.*

*Figure 4-3: Panel mount for the power meter display*

## DIN Rail Mounting

To mount the power meter onto 35 mm DIN rail, follow these steps:

**⚠ DANGER**

**HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION.**

Only qualified electrical workers should install and wire this equipment. Perform such work only after reading this complete set of instructions.

**Failure to observe these precautions will result in death or severe personal injury!**

1. Turn off all power supplying the equipment before working on it. Follow all safety precautions.
2. Mount a piece of 35 mm DIN rail in the desired location. ***Note:*** *The DIN rail* ***must*** *be horizontal.* Position the power meter in front of and slightly above the DIN rail (figure 4-4).

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

When mounting the power meter module, provide the following clearances (from enclosure walls or other objects): terminal end: 4" (102 mm); vented sides: 3" (76 mm). No clearance is necessary on the non-vented sides.

**Failure to observe this precaution can result in equipment damage.**

3. Slip the two DIN rail hooks, located on the power meter case, onto the upper edge of the rail.
4. Rotate the power meter down and press it against the 35 mm DIN rail until the power meter snaps into place.

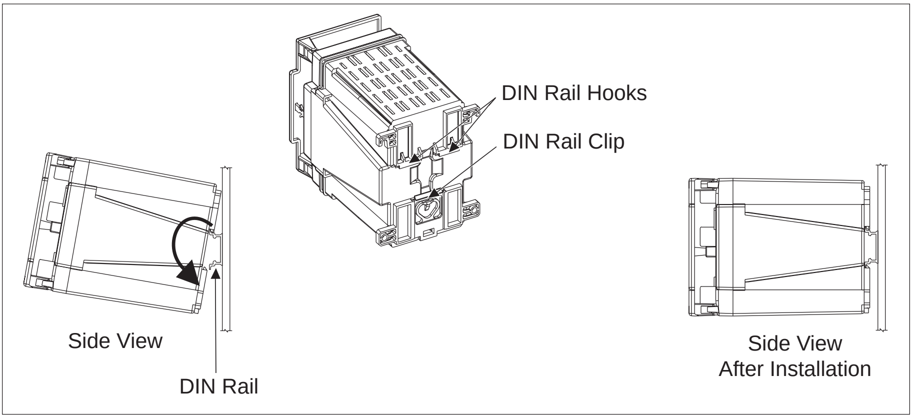



*Figure 4-4: Mounting power meter on 35 mm DIN rail*

# CHAPTER 5—WIRING

**⚠ DANGER**

**HAZARD OF PERSONAL INJURY OR DEATH.**

Only qualified electrical workers should install and wire this equipment. Such work should be performed only after reading this complete set of instructions. Follow proper safety procedures regarding CT secondary wiring. Never open circuit the secondary of a CT.

**Failure to observe this precaution will result in death or severe personal injury!**

## WIRING CTs, PTs, AND CONTROL POWER

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

External fusing (customer-supplied) is *required* for control power inputs.

**Failure to observe this precaution can result in equipment damage.**

The power meter supports a variety of 3-phase power system wiring connections, including 3-wire delta, and 4-wire wye. Table 5-1 lists some of the most widely used system connections. Additional system connections are shown in **Appendix D**.

**Table 5-1**
**System Connection Types**

| System Type | Sys ID | # CTs | # PTs① | PT Conn. | Currents | Voltages | Figure # |
|---|---|---|---|---|---|---|---|
| 3Ø, 3W Delta Calculated B | 30 | 2 | 0 or 2 | Open Delta | A, B②, C | A-B, C-B, C-A② | 5-3, 5-4 |
| 3∅, 3W Delta Metered B Phase | 31 | 3 | 0 or 2 | Open Delta | A, B, C | A-B, C-B, C-A② | 5-5 |
| 3∅, 4W Wye | 40 | 3 | 0 or 3 | Wye-Wye | A, B, C, N③ | A-N, B-N, C-N A-B④, B-C④, C-A④ | 5-6, 5-7 |

① PTs not required at 600 volts (line-to-line) or below.
② Calculated.
③ Calculated, PM-620 and PM-650.
④ Line-to-line voltage in the 4-wire mode is calculated and fundamental only.

## Control Power Transformer (CPT) Sizing

If you are using control power transformers (CPTs), refer to table 5-2 below. It shows CPT sizing for various quantities of power meter modules.

**Table 5-2**
**Control Power Transformer Sizing**

| Number of Power Meter Modules | Size of CPT |
|---|---|
| 1–10 | 100 VA |
| 11–20 | 150 VA |
| 21–30 | 200 VA |
| 31–40 | 250 VA |

## Control Power Fuses

The control power input(s) of each power meter module *must* be individually fused under all circumstances. When using a control power transformer where the secondary is 120 Vac, or when deriving control power from metering potential transformers, use a standard 250 V, 100 mA, fast-acting fuse. If control power is derived directly from the line voltage (600 V or less), each power meter module control input must be fused using a 1/2 amp Bussman FNQ-R fuse (or equivalent).

## Metering Potential Transformers (PTs)

No potential transformers are required on the voltage metering inputs for wye-connected and ungrounded delta circuits with line-to-line voltages of 600 V or less; connect the voltage metering inputs directly to the line voltages. However, for power systems with voltages higher than 600 V line-to-line, or corner-grounded delta circuits, potential transformers *must* be used. To set up the appropriate voltage range, see page 50.

## CE Compliance

To comply with CE Electromagnetic Compatibility Requirements, the power meter must be installed in a metallic enclosure, i.e., switchgear. Install the clamp-on ferrite provided in the hardware kit around all three control power input leads close to the power meter (figure 5-1). To open the clamp-on ferrite prior to installation, follow the instructions in figure 5-2.

For CE compliance, a Merlin Gerin Disconnect Breaker Type P25M #21104 or IEC 947 equivalent must be connected directly to the metering voltage and control power inputs (figure 5-1). ***Note:*** *The disconnect switch must be placed within reach of the power meter and labeled "Disconnect Switch for Power Meter."*

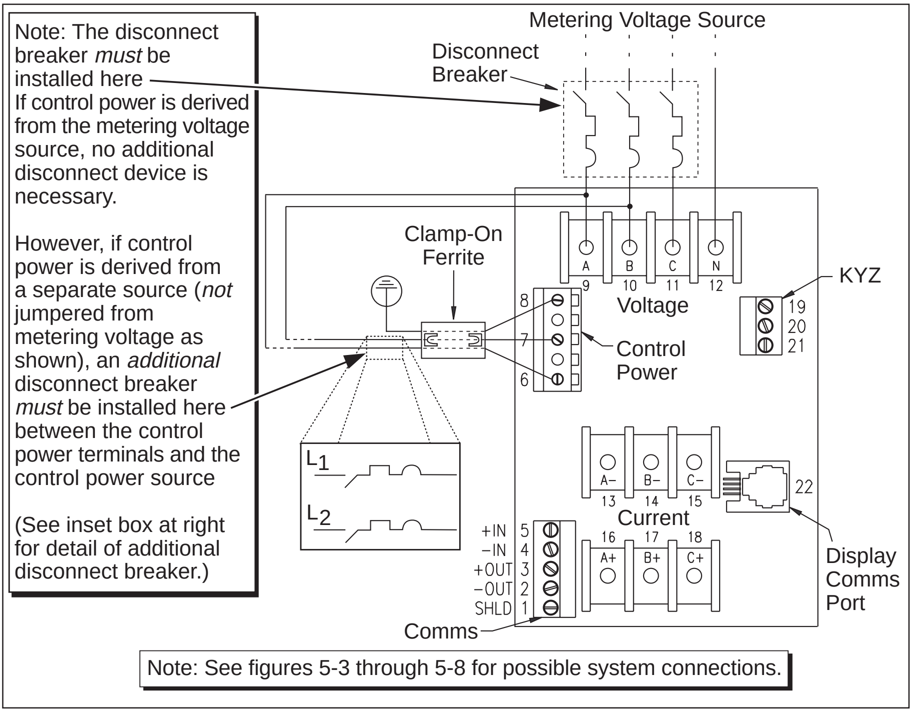
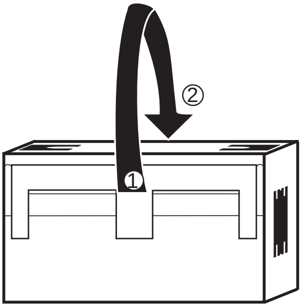


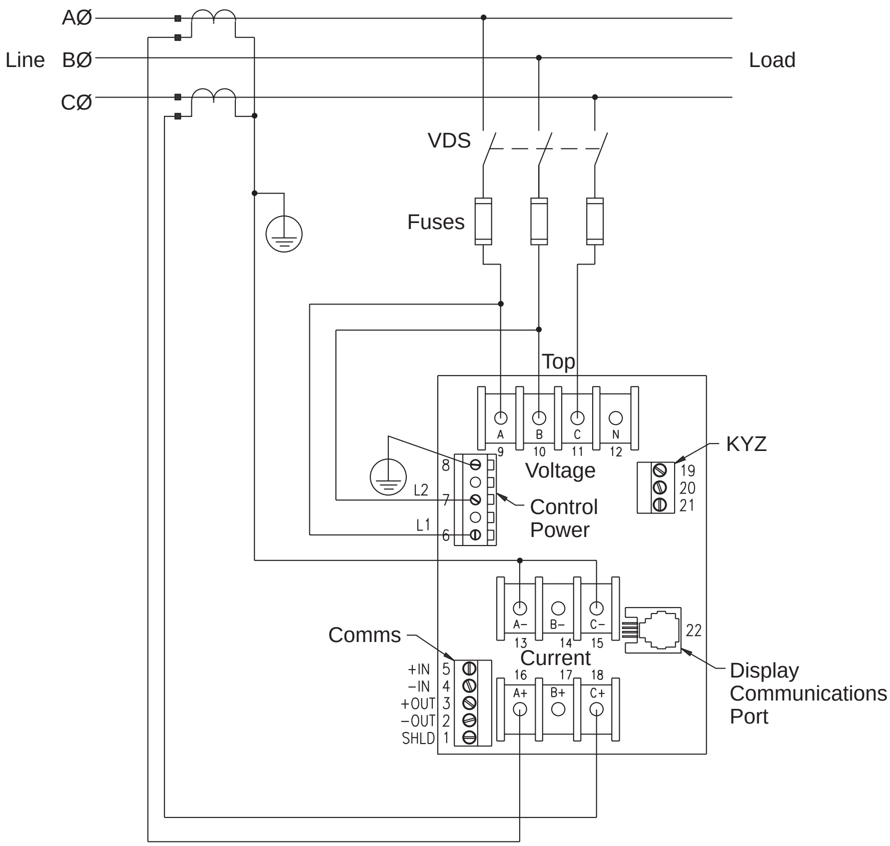

*Figure 5-1: Clamp-on ferrite and disconnect breaker for CE compliance (4-wire system shown)*




To open the clamp-on ferrite prior to installation, follow these steps:

1. Using a small screwdriver or similar device, gently pry open the ferrite case at location ① above.
2. Flip open the top of the ferrite case in the direction shown (②).
3. After routing control leads through the middle of the ferrite, snap the ferrite case closed; make sure you do not crimp the control wires when closing the ferrite case.

*Figure 5-2: Opening the clamp-on ferrite*



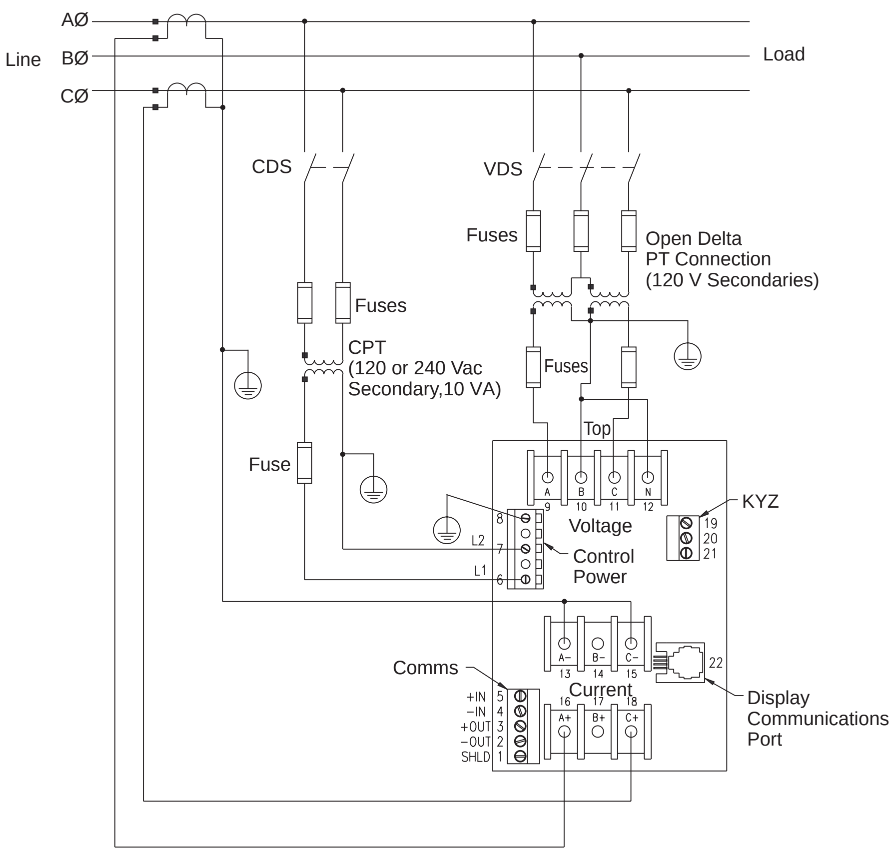

**Note:** Control power can be drawn from fused voltage inputs L-L or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

For ungrounded delta systems only.

*Figure 5-3: 3-phase, 3-wire delta direct voltage connection with 2 CTs*

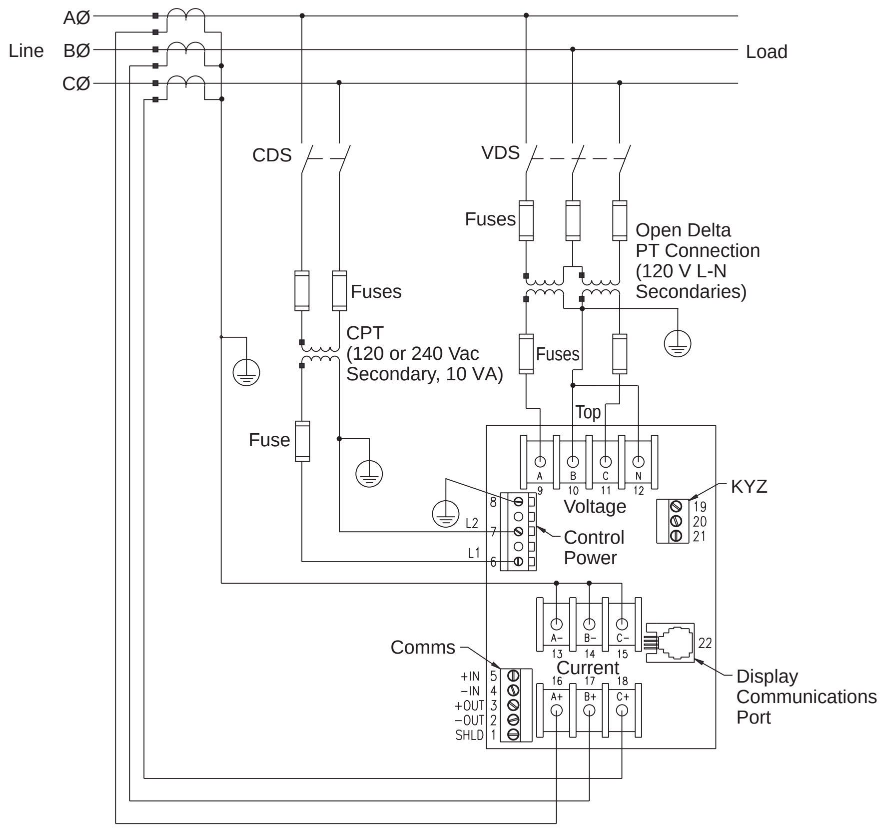



**Note:** Control power can be drawn from fused voltage inputs L-L or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure 5-4: 3-phase, 3-wire delta with 2 PTs and 2 CTs*



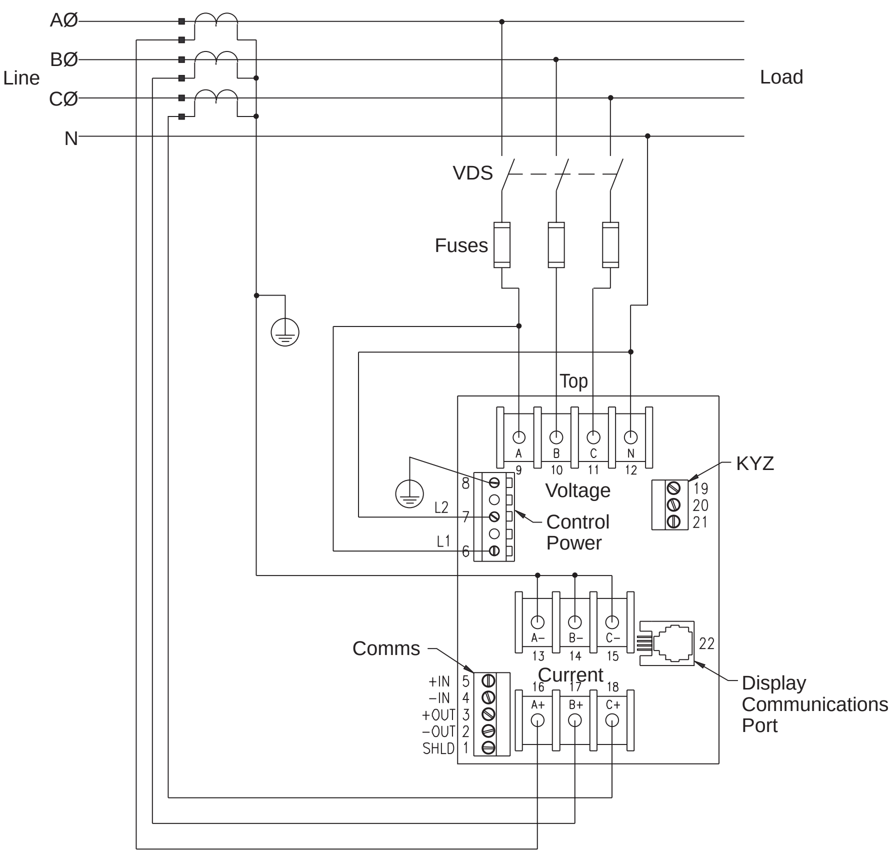

**Note:** Control power can be drawn from fused voltage inputs L-L or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure 5-5: 3-phase, 3-wire delta with 2 PTs and 3 CTs*

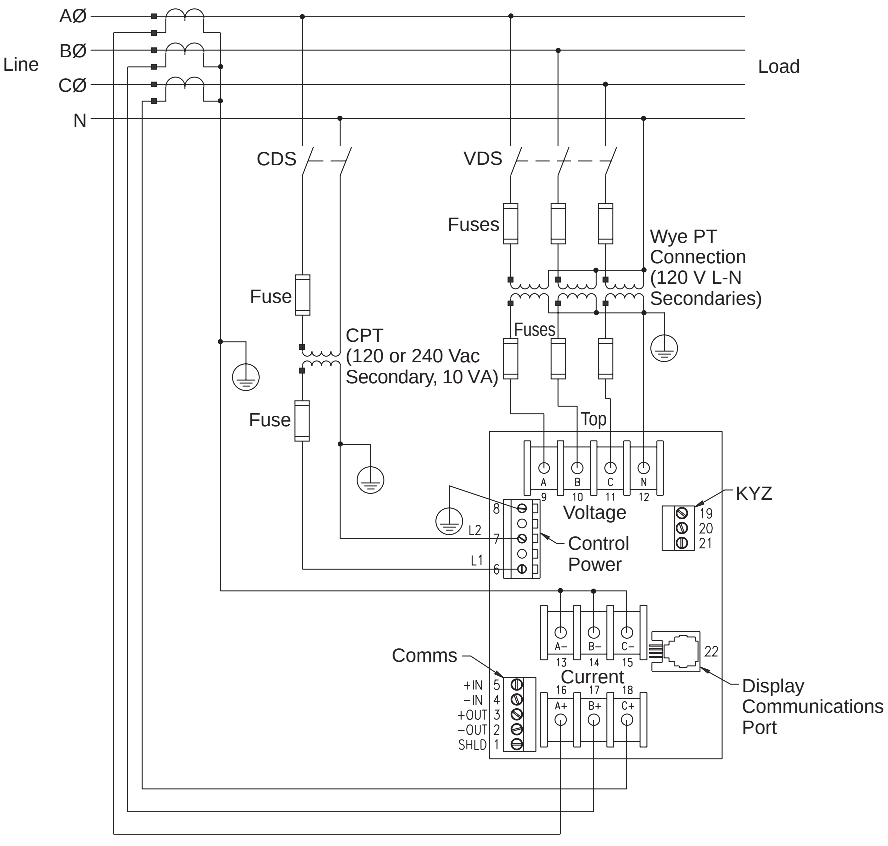



**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure 5-6: 3-phase, 4-wire wye, ground and direct voltage connection, with 3 CTs*



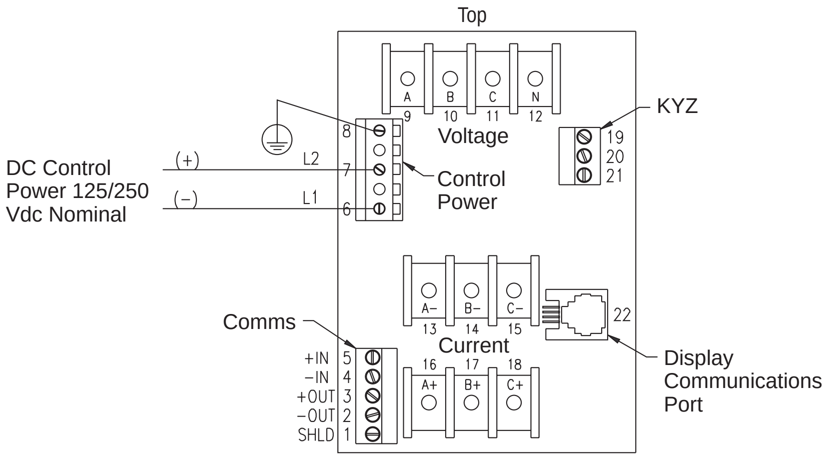

**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure 5-7: 3-phase, 4-wire wye, ground connection, with 3 PTs and 3 CTs*



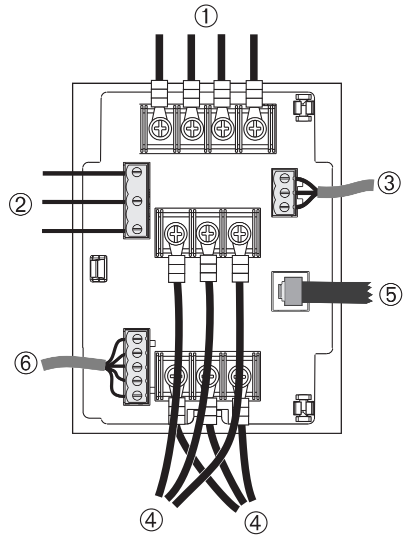

**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure 5-8: DC control power wiring*

Typical power meter module wire routing is shown in figure 5-9 below.




① 3-Phase Voltage Inputs
② Control Power Terminals
③ KYZ Output
④ 3-Phase Current Inputs
⑤ Communications Connection to Display
⑥ RS-485 Communications Terminals

*Figure 5-9: Power meter wire routing*

## ⚠ DANGER

**HAZARD OF ELECTRICAL SHOCK, BURN, OR EXPLOSION.**

- Before removing the terminal shield or making connections, turn off all power supplying this equipment.
- Refer to the terminal identifications label on the terminal shield for proper wiring polarities.
- Refer to page 22 for CPT and fuse recommendations.
- Snap terminal shield into closed position before turning power on.

**Failure to observe these precautions will result in death or severe personal injury!**

To wire the power meter, follow these steps:

1. Strip 0.25" (6 mm) of insulation from the end of all wires. Using a suitable crimping tool, attach the spade connectors (in hardware kit) to the voltage and current input wires (up to 12 AWG) as shown in figure 5-9.

2. Connect the spade connectors to the 3-phase voltage input terminals (①, figure 5-9) and the 3-phase current input terminals (④, figure 5-9). Tighten the terminal block screws to 9 lb-in (1.0 N•m).

3. Insert 14 AWG control power wires into the control power terminal block as shown in figure 5-9. Derive control power from one of these sources:
   – a stable ac source
   – phase voltage inputs
   – dc power source

   Tighten terminal screws to 4 lb-in (0.45 N•m).

4. Ground the power meter. See **Grounding the Power Meter** in this chapter for instructions.

5. If all wiring is complete, snap the terminal shield into the closed position.

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE.**

External fusing is required when bringing line voltages to the power meter or other metering device.

**Failure to observe this precaution can result in equipment damage.**

## Deriving Control Power from Phase Voltage Inputs

Whenever possible, derive power meter control power from a stable voltage source. If such a source is unavailable, the power meter can derive control power from the metered circuit up to 600 V, or from its phase PT inputs. Due to the wide range of permissible control power inputs, the power meter can accept either L-N or L-L control power inputs up to 600 V.

**⚠ DANGER**

**HAZARD OF ELECTRICAL SHOCK, BURN, OR EXPLOSION.**

- Turn off all power supplying this equipment before opening the terminal shield or making connections.
- Snap terminal shield into closed position before turning power on.

**Failure to observe these precautions will result in death or severe personal injury!**

***Note:*** *Before wiring, see fuse recommendations on page 22.*

Follow these steps to derive control power from phase PT inputs:

1. Connect the Va terminal (terminal 9) to the L1 terminal (terminal 6).
2. For L-N control power (see figure 5-6, page 27), connect the Vn terminal (terminal 12) to the L2 terminal (terminal 7). For L-L control power (see figure 5-3, page 24), connect the Vb terminal (terminal 10) to the L2 terminal (terminal 7).
3. If all wiring is complete, snap the terminal shield into the closed position.

## GROUNDING THE POWER METER

For optimal grounding, connect the power meter to a true earth ground.

To ground the power meter, follow these steps:

1. Connect the ground terminal (terminal 8) to a true earth ground, using #14 AWG wire.
2. After grounding, snap the terminal shield into the closed position.

***Note:*** *The power meter* ***must*** *be grounded as described in these instructions. Failure to properly ground the power meter may induce noise on the power conductor.*

## SOLID-STATE KYZ PULSE OUTPUT

**⚠ DANGER**

**HAZARD OF ELECTRICAL SHOCK, BURN, OR EXPLOSION.**

- Turn off all power supplying this equipment before opening the terminal shield or making connections.
- Snap terminal shield into closed position before turning power on.

**Failure to observe these precautions will result in death or severe personal injury!**

The KYZ output can be wired to a 2-wire or 3-wire pulse receiver. To wire to a 2-wire pulse receiver, use the K and Y terminals only (figure 5-10). When wiring the KYZ pulse output, use 14 to 18 AWG wire. Strip 0.25" (6 mm) of insulation from the end of each wire being connected to the KYZ connector. Insert the wires into the KYZ output terminal block. Tighten the terminal block screws to 5–7 lb-in (0.56–0.79 N•m).

***Note:*** *Set up the KYZ by using either the Setup mode on the power meter display or the setup screen in SMS-3000, SMS-1500, or PMX-1500 software. See page 65 for instructions for determining the pulse constant.*

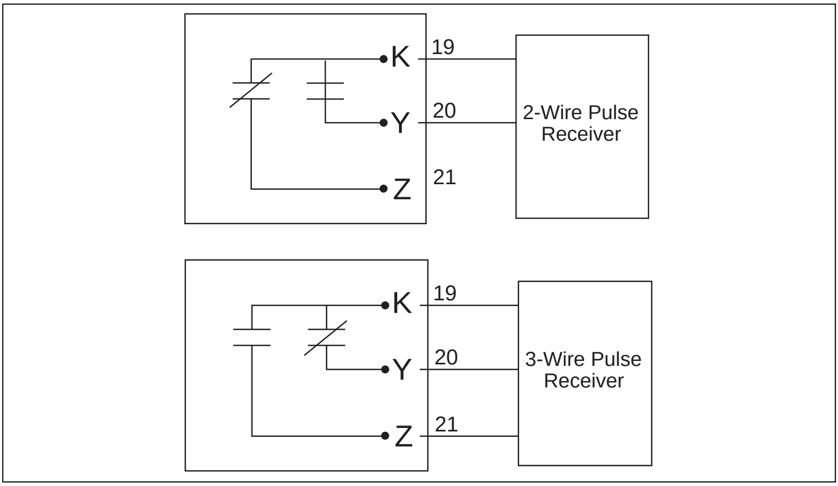



*Figure 5-10: KYZ pulse output*

For the PM-650 only, the KYZ output can also be wired as an alarm contact (figure 5-11). When wiring the KYZ output, use 14 to 18 AWG wire. Strip 0.25" (6 mm) of insulation from the end of each wire being connected to the KYZ connector. Insert the wires into the KYZ output terminal block. Tighten the terminal block screws to 5–7 lb-in (0.56–0.79 N•m).

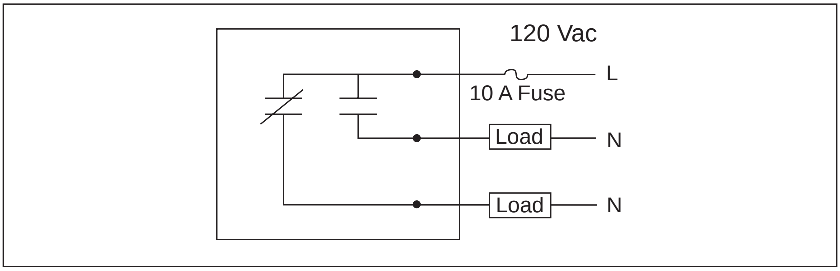



*Figure 5-11: Typical KYZ output connection for use as an alarm contact*

# CHAPTER 6—COMMUNICATIONS

## PROTOCOLS

POWERLOGIC Power Meters can communicate using three different protocols:

- POWERLOGIC
- Modbus
- Jbus

During setup, select which protocol will be used.

Descriptions of the connections that can be used with each protocol follow.

***Note:*** *For 2-wire Modbus and Jbus information, see* **Appendix H—2-Wire Modbus and Jbus**.

## POWERLOGIC PROTOCOL COMMUNICATIONS WIRING

POWERLOGIC devices are equipped with RS-485 communications. You can daisychain up to 32 POWERLOGIC (or Power Monitoring and Control System [PM&CS]) compatible devices to a single communications port. This document refers to a chain of PM&CS devices connected by communications cable as a *communications link*.

A PM&CS communications link can consist of up to 32 PM&CS-compatible devices connected to a communications port on one of the following:

- Personal computer
- POWERLOGIC Network Interface Module (PNIM)
- SY/MAX® programmable controller
- POWERLOGIC Ethernet Gateway
- Other host devices with a POWERLOGIC-compatible port

Figures 6-1 through 6-3 show power meters (other PM&CS-compatible devices can be substituted) connected in typical systems. The accompanying text describes important considerations for each connection alternative.

The figures also show the placement of communications adapters and terminators. For additional information on using the communications adapter and terminator, see **Terminating the Communications Link**, and **Biasing the Communications Link** in this chapter.

## Connecting to a Personal Computer via POWERLOGIC Communications

- Connect up to 32 PM&CS devices to a personal computer (figure 6-1). See **Length of the Communications Link** in this chapter for distance limitations at varying baud rates.
- PM&CS devices can be connected to a SY/LINK card installed in the personal computer. To do this, connect the PM&CS devices to the RS-422 port (female DB-9 connector) of the SY/LINK card.
- PM&CS devices can be connected to a serial communications port on the personal computer. To do this, the PM&CS devices must be connected to an RS-232-to-RS-422/RS-485 converter, which is connected to the personal computer. POWERLOGIC offers a converter kit for this purpose (Class 3090 Type MCI-101; refer to the instruction bulletin included with the MCI-101 for connection instructions).

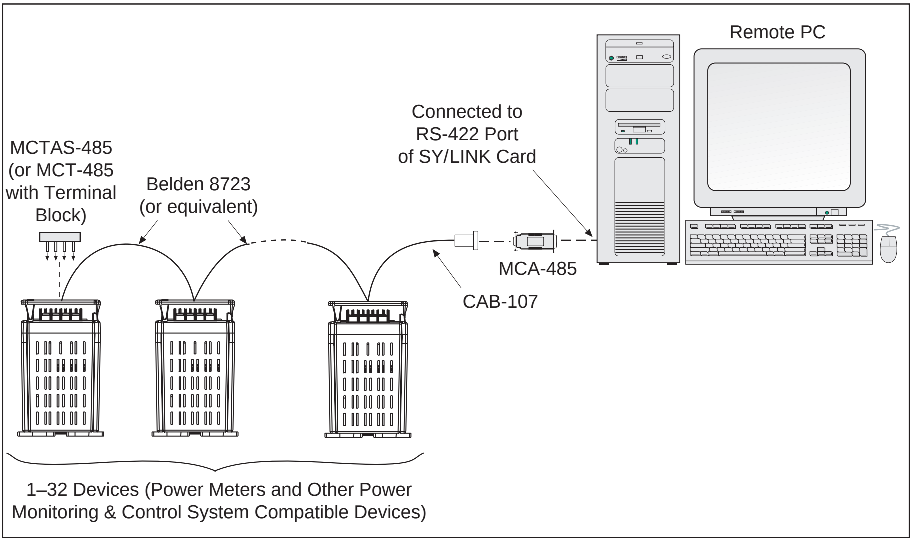



*Figure 6-1: Power meters connected to a personal computer via SY/LINK card*

## Connecting to a POWERLOGIC Network Interface Module (PNIM) Using POWERLOGIC Communications

- Connect up to 32 PM&CS devices to a PNIM. See **Length of the Communications Link** in this chapter for distance limitations at different baud rates.
- Connect PM&CS devices to PNIM port 0 (top RS-485 port) only.
- Configure PNIM port 0 for "POWERLOGIC" mode (see side of PNIM for instructions on setting dip switches).
- Configure the baud rate of PNIM port 0 to match the baud rate of the PM&CS devices on the communications link.
- Refer to the PNIM instruction bulletin for detailed instructions on configuring the PNIM.

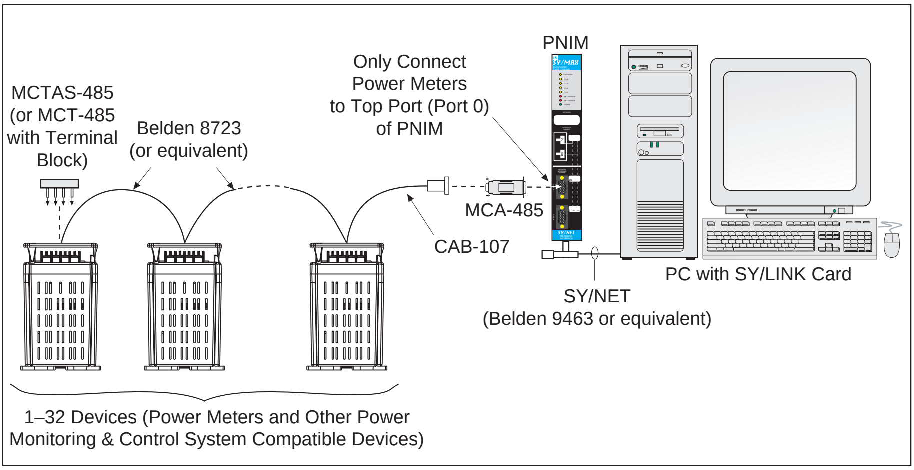



*Figure 6-2: Power meters connected to a PNIM*

## Connecting to a SY/MAX Programmable Controller Using POWERLOGIC Communications

- Connect up to 32 PM&CS devices to a programmable controller. See **Length of the Communications Link** in this chapter for distance limitations at different baud rates.
- Connect PM&CS devices to the RS-422 port of the programmable controller.
- The programmable controller must contain a program to access POWERLOGIC device data.
- Configure the baud rate of the programmable controller's port to match the baud rate of the POWERLOGIC devices on the communications link.
- Refer to the programmable controller instruction manual for detailed instructions on configuring the programmable controller.

***Note:*** *PM&CS devices can be connected to other manufacturers' systems using available communication interfaces. For further information, contact the POWERLOGIC Technical Support Center.*

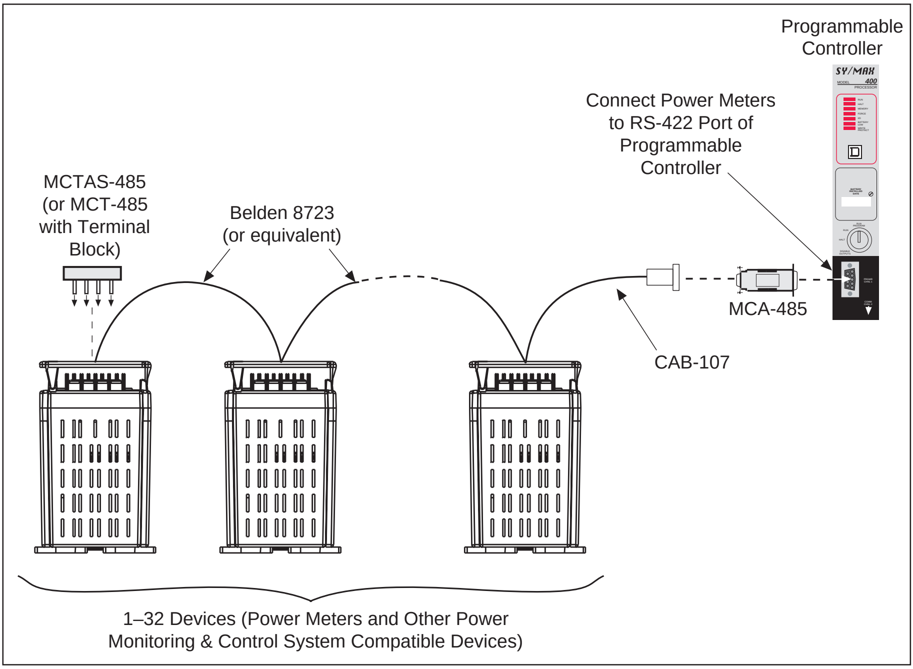



*Figure 6-3: Power meters connected to a SY/MAX programmable controller*

## MODBUS RTU PROTOCOL

Alternately, power meters can communicate using the Modbus RTU protocol. Using 4-wire Modbus, you can daisychain up to 32 power meters to a single communications port. When using 2-wire Modbus communications, a maximum of 16 power meters can be daisychained to a single communication port.

***Note:*** *See* ***Appendix H*** *for 2-wire Modbus wiring and distance limits.*

A power meter Modbus communications link can be connected to a communications port on any of the following:

- personal computer
- Modicon programmable controller
- other host devices with a Modbus-compatible port

## JBUS PROTOCOL

Jbus is the third protocol by which power meters can communicate. When using 4-wire Jbus, up to 32 power meters can be daisychained from a single communications port. For 2-wire Jbus, a maximum of 16 power meters can be daisychained.

***Note:*** *See* ***Appendix H*** *for 2-wire Jbus wiring and distance limits.*

You can connect a power meter Jbus communications link to any host device with a Jbus-compatible port.

## CONNECTING TO A PC USING MODBUS OR JBUS COMMUNICATIONS

- Connect up to 32 Modbus or Jbus devices to a personal computer (figure 6-4). See **Length of the Communications Link** in this chapter for distance limitations at varying baud rates.
- Power meters configured for Modbus or Jbus can be connected to a serial communications port on the personal computer. To do this, the power meters must be connected to an RS-232-to-RS-422/RS-485 converter, which is connected to the personal computer. POWERLOGIC offers a converter kit for this purpose (Class 3090 Type MCI-101; refer to the instruction bulletin included with the MCI-101 for connection instructions).

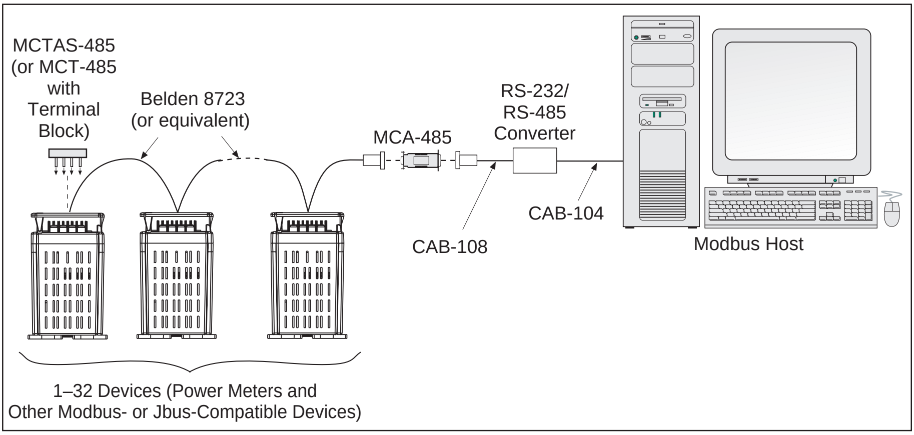



*Figure 6-4: Power meters connected to a personal computer via serial port*

## LENGTH OF THE COMMUNICATIONS LINK (POWERLOGIC, MODBUS, OR JBUS)

The length of the communications link cannot exceed 10,000 feet (3,048 m). This means that the total length of the communications cable from the PNIM, personal computer, or PLC, to the last device in the daisychain, cannot exceed 10,000 feet. The maximum distance may be shorter, depending on the baud rate. Table 6-1 shows the maximum distances at different baud rates.

**Table 6-1**
**Maximum Distances of Comms Link at Different Baud Rates**

| Baud Rate | Maximum Distances | |
|---|---|---|
| | 1–16 devices | 17–32 devices |
| 1200 | 10,000 ft. (3,048 m) | 10,000 ft. (3,048 m) |
| 2400 | 10,000 ft. (3,048 m) | 5,000 ft. (1,524 m) |
| 4800 | 10,000 ft. (3,048 m) | 5,000 ft. (1,524 m) |
| 9600 | 10,000 ft. (3,048 m) | 4,000 ft. (1,219 m) |
| 19200 | 5,080 ft. (1,548 m) | 2,500 ft. (762 m) |

***Note:*** *See* Appendix H *for 2-wire Modbus and Jbus wiring distance limits.*

## DAISYCHAINING PM&CS DEVICES (POWERLOGIC, MODBUS, OR JBUS)

***Note:*** *To daisychain the power meter with other PM&CS, Modbus, or Jbus devices, use a communications cable containing two twisted-shielded pairs (Belden 8723 or equivalent). Strip back the cable sheath 2″ (51 mm) on each end of the cable, and strip back the insulation 0.25″ (6 mm) from the end of each wire. Then follow daisychaining instructions in this section. Torque terminal block screws to 5–7 lb-in (0.56–0.79 N•m).*

Each communicating power meter has a 5-position plug-in RS-485 terminal block for connection to a PM&CS, Modbus, or Jbus communications link. On all PM&CS devices, the terminals are labeled IN+, IN-, OUT+, OUT-, and SHLD. On the power meter, the IN+, IN-, OUT+, OUT-, and SHLD terminals are numbered 5, 4, 3, 2, and 1, respectively.

To daisychain a power meter to another PM&CS, Modbus, or Jbus device, wire the power meter's RS-485 communications terminals to the matching communications terminals of the next device (wire the IN+ terminal of the power meter to the IN+ terminal of the next device, wire IN- to IN-, OUT+ to OUT+, OUT- to OUT-, and SHLD to SHLD). See figure 6-5.

If the power meter is the last device on the daisychain, use a terminator at the end of the link. See **Terminating the Communications Link** in this chapter for instructions. If the power meter is the first device on the daisychain, connect it to the PNIM, personal computer, or programmable controller using a CAB-107 or equivalent cable and a Multipoint Communications Adapter. See **Biasing the Communications Link** in this chapter for instructions. See **Appendix C** for the CAB-107 pinout.

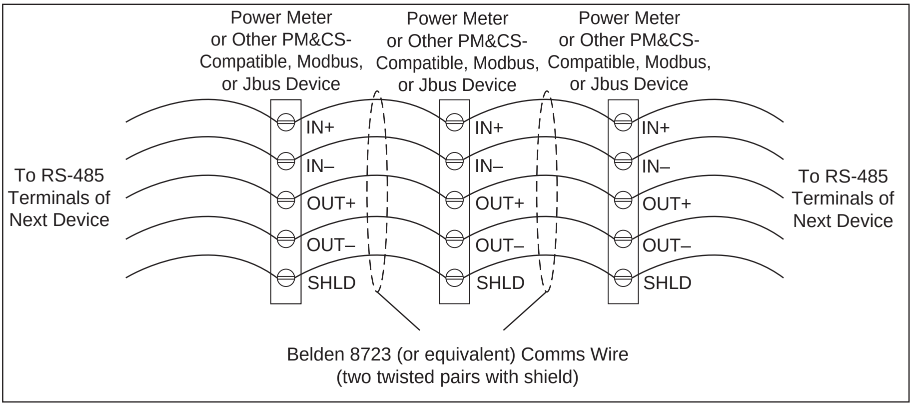



*Figure 6-5: Daisychaining the RS-485 communications terminals*

## BIASING THE COMMUNICATIONS LINK (POWERLOGIC, MODBUS, OR JBUS)

For proper RS-485 communications performance, the communications link must be biased (figure 6-6) using a POWERLOGIC Multipoint Communications Adapter (Class 3090 Type MCA-485). The adapter is placed between the first device on the link and the communications port of a PNIM, SY/LINK card, or other host device.

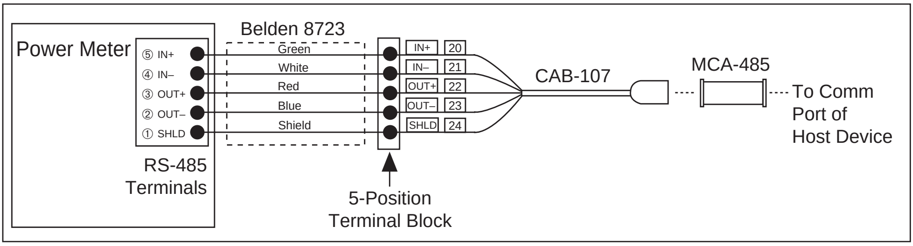



*Figure 6-6: Connecting the power meter as the first device on a PM&CS or Modbus communications link*

To bias the communications link, refer to figure 6-6 and follow these steps:

1. Install the 5-position terminal block in a convenient location.

   ***Note:*** *The CAB-107 cable is 10 feet (3 m) long. If the terminal block must be located farther than 10 feet from the host device, build a custom cable using Belden 8723 cable and a male DB-9 connector. See the CAB-107 pinout, page 74.*

2. Plug the male end of the Multipoint Communications Adapter (MCA-485) into the communications port of the PNIM, SY/LINK board, or other host device.

   ***Note:*** *When connecting to a PNIM, connect the power meter to the top RS-422 port, labeled port 0. This port* ***must*** *be configured for POWERLOGIC mode.*

3. Carefully mark the flying leads on the CAB-107 as indicated in table 6-2 below. For example, mark the green wire, labeled 20, as “IN+”; mark the white wire, labeled 21, as “IN–”; and so on.

**Table 6-2**
**Labeling the CAB-107 Leads**

| Existing Label | Wire Color | Mark As |
|---|---|---|
| 20 | Green | IN+ |
| 21 | White | IN– |
| 22 | Red | OUT+ |
| 23 | Black | OUT– |
| 24 | Silver | SHLD |

4. Attach the male DB-9 connector on the CAB-107 to the multipoint communications adapter.

5. Connect the CAB-107 spade connectors to the 5-position terminal block. See figure 6-8, page 45, for terminal identification.

6. Cut a length of Belden 8723 (or equivalent) cable that is long enough to reach from the terminal block to the first power meter. Strip back the cable sheath 1-1/4" (32 mm) from both ends.

7. On one end of the Belden 8723 (or equivalent) cable, carefully strip .25" (6 mm) of insulation from the end of each wire to be connected. Using a suitable crimping tool, securely attach a forked terminal (spade connector) to each wire.

8. Connect the cable end with attached spade connectors to the terminal block. See figure 6-8, page 45, for terminal identification. Tighten all terminal screws to 6–9 lb-in (0.68–1 N•m).

9. On the other cable end, carefully strip .4"–.45" (10–11 mm) of insulation from the end of each wire to be connected.

10. Connect this end of the Belden 8723 (or equivalent) cable to the power meter RS-485 terminals; see figure 6-8, page 45, for communications terminal identification. Be sure to connect the terminal accepting the IN– wire on the CAB-107 to the IN– terminal on the power meter, the terminal accepting the IN+ wire on the CAB-107 to the IN+ terminal on the power meter, and so on. Tighten the RS-485 terminal screws to 5–7 lb-in (0.56–0.79 N•m).

***Note:*** *An alternative to using a terminal block and a CAB-107 is to build a custom cable using Belden 8723 cable (or equivalent) and a male DB-9 connector. When building a cable, follow the CAB-107 pinout shown in* ***Appendix C****.*

## Terminating the Communications Link (POWERLOGIC, Modbus, or Jbus)

For proper RS-485 communications performance, terminate the last device on a PM&CS or Modbus communications link. To terminate the last device, use a POWERLOGIC Multipoint Communications Terminator.

Terminate the power meter using one of the following methods:

- MCTAS-485. This terminator plugs directly into the power meter communications port (RS-485 terminals in figure 6-7 below).
- Terminal block and MCT-485. In this method, communications wires route from the last power meter on a daisychain to a 5-position terminal block. A terminator attaches to the terminal block. See figure 6-8.

Figures 6-1 to 6-4 show the terminator applied in typical systems.

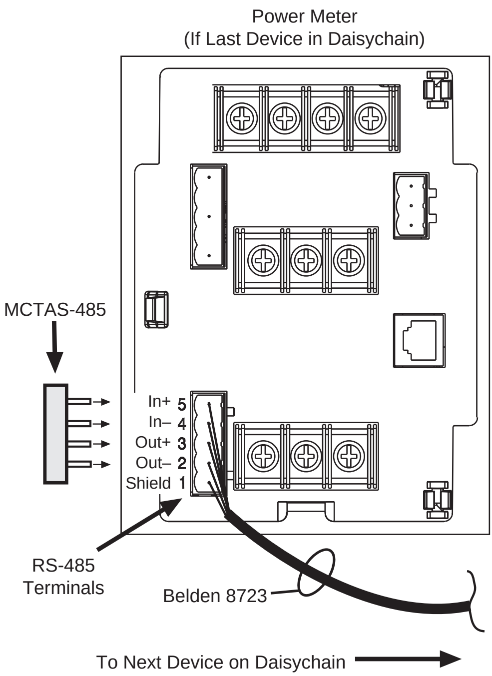



*Figure 6-7: Terminating power meter with MCTAS-485*

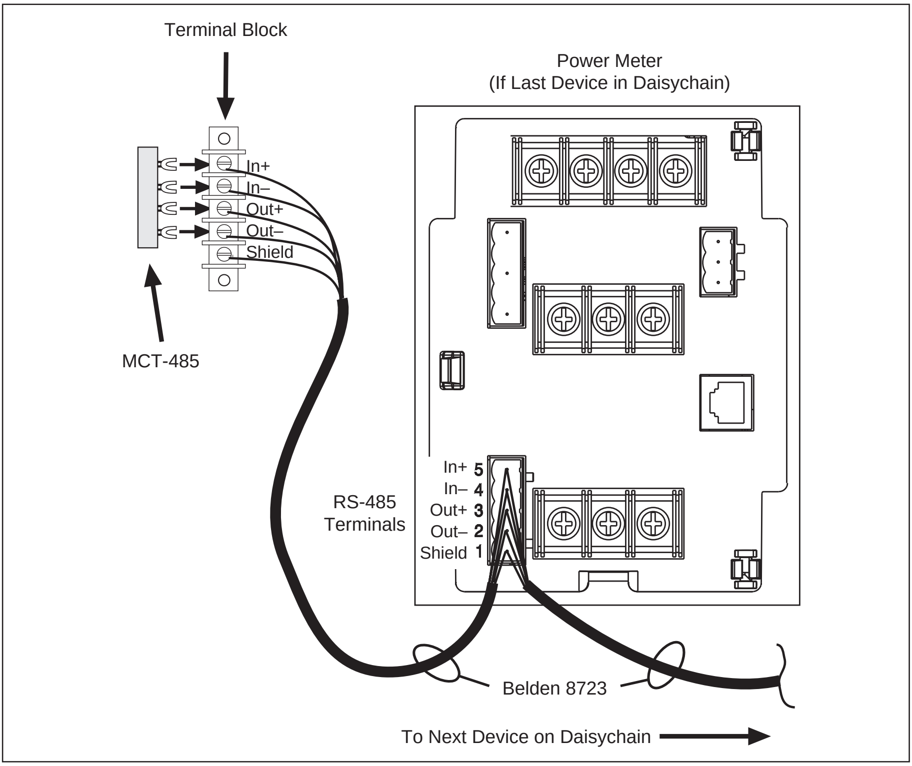



*Figure 6-8: Terminating power meter with terminal block and MCT-485*

# CHAPTER 7—DISPLAY OPERATION

## INTRODUCTION

This chapter tells how to set up the power meter from the display only. You can also set up the power meter using POWERLOGIC *SMS-3000*, *SMS-1500*, or *PMX-1500* software. Refer to the software instruction bulletin(s) for specific instructions.

## MODES

The power meter has the following modes. Each mode is detailed in this section.

- Summary
- Power
- Energy
- Demand ①
- Power Quality ①
- Min/Max ②
- Alarm Setup ②
- Alarm Log ②
- Setup
- Resets
- Diagnostics

① PM-620 and PM-650.

② PM-650 only.

## Accessing a Mode

To access a mode, refer to figure 7-1 while following these steps:

1. Press the *Mode* button until the desired mode appears (①, figure 7-1).
2. Press *Select* to enter the desired mode.
3. For Setup, Resets, Diagnostics, Alarm Log**, or Alarm Setup** modes, press the *Select* button to select a field (②), and move through screens in that mode.

   For Summary, Power, Energy, Demand*, Power Quality* (PQ), and Min/Max** modes, press *Select* to enter a display mode, then use the arrow buttons to move through the display screens (③).

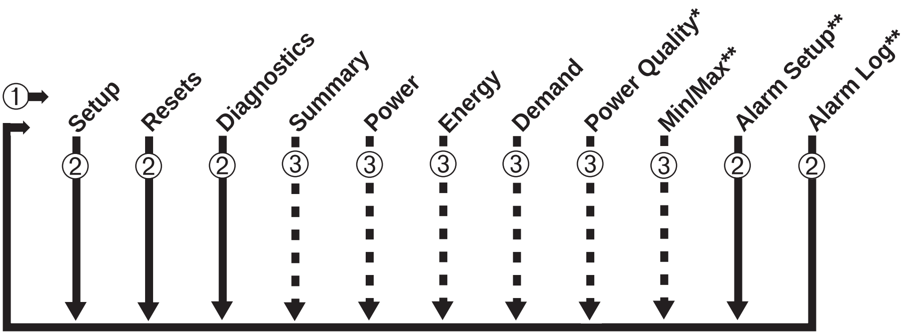



*Figure 7-1: Navigating power meter parameters*

* PM-620 and PM-650.

** PM-650 only.

## Setup Mode

The Setup mode lets you configure the following parameters:

- Protocol
- Device Address
- Baud Rate
- Parity (even or none)
- CT Primary
- CT Secondary
- Voltage Range
- PT Primary
- PT Secondary
- System Type
- Frequency
- Power Demand Interval①
- KYZ Mode
- Pulse Constant②
- THD/thd①

You can also set the date①, time①, master password, and reset password.

① PM-620 and PM-650.
② The pulse constant parameter is displayed only when the KYZ mode is enabled (KWH, KVAH, or KVARH energy mode).

***Note:*** *Because the power meter can directly meter up to 600 V line-to-line without using potential transformers, you* must *specify the appropriate voltage range during the setup procedure. To determine what voltage range to enter during setup, find your system voltage in table 7-1 below. Enter the corresponding voltage range.*

*If your specific system voltage is not listed, use the next highest voltage range. If your system voltage is greater than 600 $V_{L-L}$ or 347 $V_{L-N}$, then you must use PTs and select 208/120 V as the voltage range.*

**Table 7-1**
**Selecting Voltage Ranges for System Types**

| System Voltage | Set Power Meter Voltage Range To: |
|---|---|
| **4-wire:** | |
| 208/120 V | 208/120 V |
| 480/ 277 V | 480/277 V |
| 600/347 V | 600/347 V |
| >600/347 V | 208/120 V with PTs ① |
| **3-wire (Delta)②:** | |
| 240 V | 480/277 V |
| 480 V | 480/277 V |
| 600 V | 600/347 V |
| >600 V | 208/120 V with PTs ① |

① Note: Set PT ratios.
② For 3Ø, 3-wire delta corner-grounded applications, install two line-to-line rated PTs. Set the voltage range to 208/120 V with PTs.

## Resets Mode

The Resets mode allows you to reset energy, demand③, and min/max values④. See **Performing Resets**, page 54, for more information.

## Diagnostics Mode

The Diagnostics mode displays the model number and serial number of your power meter, as well as firmware versions and a read-only register interface. For more information, see **Viewing Diagnostic Information**, page 55.

## Display Modes

The display modes—Summary, Power, Energy, Demand③, Power Quality③, and Min/Max④—each display information indicated by their titles.

③ PM-620 and PM-650.
④ PM-650 only.

## How the Buttons Work

The buttons on the power meter display (figure 7-2) function differently in Setup, Resets, Diagnostics, Alarm Log[1], and Alarm Setup[1] than they do in the display modes.

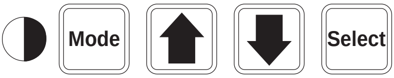



*Figure 7-2: Power meter display buttons*

### *Mode* Button

This button lets you scroll through available modes. You can also use this button to exit a mode after making all desired changes. For example, after making all desired changes in Setup mode, press the *Mode* button. The power meter then prompts you to accept or reject your changes.

### Arrow Buttons

Use these buttons to increase or decrease the displayed parameter. Also, use these buttons to toggle between *Yes* and *No* when required.

### *Select* Button

This button allows you to enter a selected mode and scroll through fields within that mode. Also use this button as an “Enter” key to accept a new configuration value and move to the next field.

### Contrast Button

This button allows you to adjust the contrast of the display screen.

[1] PM-650 only.

## SETTING UP THE POWER METER

To set up the power meter, follow these steps:

1. Press the *Mode* button until "Mode: Setup" is displayed on the screen.
2. Press the *Select* button. At the "Enter Password" prompt, press the up arrow button once to enter the default password *0* (if you have set up a different password, use that instead).
3. Press *Select* until the desired setup parameter is displayed. Change the value using the up and down arrow buttons.
4. Repeat step 3 until all desired changes are made. Table 7-2 below shows setup parameters, the factory default for each, and the allowable range of values.
5. After making all desired changes, press the *Mode* button. The display reads "Save Changes? NO."
6. To reject changes, press the *Select* button once.
7. To accept changes, press an arrow button to change from "NO" to "YES." Then press the *Select* button.
8. The power meter accepts the setup changes and restarts.

**Table 7-2**
**Factory Defaults for Power Meter Setup Parameters**

| Parameter | Allowed Values | Default |
|---|---|---|
| Protocol | POWERLOGIC, Modbus, or JBus | POWERLOGIC |
| Network Address | 0 to 199 | 1 |
| Baud Rate | 1200–19200 | 9600 |
| Parity | even, none | even |
| CT Primary (3-Phase) | 1 to 32,767 | 5 |
| CT Secondary | 1, 5 | 5 |
| Voltage Range ① | 208/120 V, 480/277 V, 600/347 V | 208/120 V |
| PT Primary 3-Phase | 1 to 1,700,000 | 120 |
| PT Secondary | 100, 110, 115, 120 | 120 |
| System Type | 40, 4-wire; 31, 3-wire (3 CT); 30, 3-wire (2 CT) | 40, 4-wire |
| Frequency (Nominal) | 50, 60 Hz | 60 Hz |
| Demand Interval (Power) ② | 1 to 60 min. | 15 |
| KYZ Mode | kWH, KYZ Disabled ③, kVAH, kVARH Alarm Mode ④ | kWH |
| Pulse Constant (WH/Pulse Output [KVARH, KVAH]) | 0 to 327.67 kWH | 0 |
| THD ② | THD (United States) thd (European) | THD (United States) |
| Password (Master and Reset) | 0 to 9998 | 0 |

① See note on voltage range selection, page 50.
② PM-620 and PM-650.
③ PM-600 and PM-620.
④ PM-650 only.

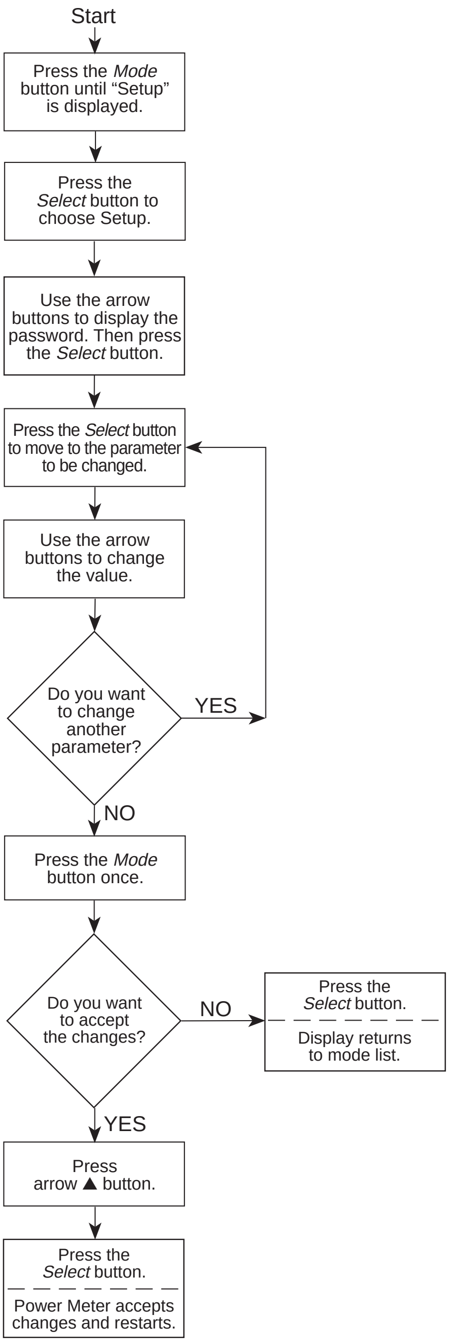



*Figure 7-3: Power meter setup flowchart*

## PERFORMING RESETS

To reset energy, demand①, and min/max② values using the display, follow these steps:

1. Press the *Mode* button until "Resets" is displayed.
2. Press the *Select* button to enter the Resets mode. The display shows the password prompt.
3. Use the arrow buttons to enter the Reset Password; press the *Select* button.
4. Press the *Select* button to find the value you want to reset.
5. Press either arrow key to change from "no" to "yes."
6. Repeat steps 4 and 5 until all desired resets have been made.
7. After enabling all desired resets, press the *Mode* button. The display reads "RESET NOW? NO."
8. To reject resets, press the *Select* button once.
9. To accept resets, press either arrow button to change "NO" to "YES." Then press the *Select* button. You'll see a brief message: "Resetting, Please Wait…" as the changes are made.

① Demand values available on models PM-620 and PM-650.

② Min/max values available on model PM-650 only.

## VIEWING DIAGNOSTIC INFORMATION

To view diagnostic information via the display, follow these steps:

1. Press the *Mode* button until “Diagnostics” is displayed.
2. Press the *Select* button to enter the Diagnostics mode. As you continue to press the Select button, you’ll scroll through these screens: Model Number, Serial Number, and four F/W (firmware operating) Version screens.
3. Press the *Select* button again to go into the register read-only screen.
4. Press the arrow keys to scroll through available registers.
5. Press the *Modes* button to return to the modes list.

Refer to **Appendix F—Register List** for additional register information.

## USING DISPLAY MODES

The general procedure for displaying data is as follows:

1. Press the *Mode* button to scroll to one of the six available display modes (Summary, Power, Energy, Demand①, Power Quality①, or Min/Max②).
2. Press the *Select* button to select a mode.
3. Press arrow buttons to scroll through metered values.

## SETTING UP ONBOARD ALARMS (PM-650 ONLY)

To set up alarming via the display, follow these steps:

1. Press the *Mode* button until “Alarm Setup” is displayed.
2. Press the *Select* button to enter the Alarm Setup mode. The display shows the password prompt.
3. Use the arrow buttons to enter the password (factory default = 0); press the *Select* button.
4. Use the arrow keys to scroll through the available alarms. When you reach the desired alarm, press the *Select* button.
5. Press either arrow key to change from “Disabled” to “Enabled”; press the *Select* button.
6. The display shows the appropriate scale factor for the pickup value. Multiply the desired pickup value by the scale factor shown on the screen (see **Scaling Alarm Setpoints** in **Appendix I—Alarm Setup** for an explanation of scale factors); press the *Select* button.
7. Use the arrow keys to increase or decrease the displayed value until the desired scaled pickup value is reached; press the *Select* button.

① PM-620 and PM-650.

② PM-650 only.

8. Use the arrow keys to increase or decrease the displayed value until the desired pickup delay is reached; press the *Select* button.
9. The display shows the appropriate scale factor for the dropout value. Multiply the desired dropout value by the scale factor shown on the screen; press the *Select* button.
10. Use the arrow keys to increase or decrease the displayed value until the desired scaled dropout value is reached; press the *Select* button.
11. Use the arrow keys to increase or decrease the displayed value until the desired dropout delay is reached; press the *Select* button.
12. Use the arrow keys to select either "Output: Enabled" or "Output: Disabled"; press the *Select* button.

    ***Note:*** *The output selection is not available if the KYZ output has been enabled in the Setup mode.*
13. Repeat steps 4–12 above for each additional alarm that you'd like to set up.
14. Press the *Mode* button.
15. To save the changes you've just made, press the up arrow button to change from "No" to "Yes." Then press the *Select* button.

    To discard the changes, press the *Select* button while "No" is displayed. The Power Meter will reset.

## VIEWING ACTIVE ALARMS (PM-650 ONLY)

To view the active alarms, follow these steps:

1. Press the *Mode* button until "Alarm Log" is displayed.
2. Press the *Select* button to enter the alarm log.
3. Use the arrow keys to scroll through the alarms. The last 10 alarms are listed, starting with the most recent alarm. Alarms that are currently active will flash. To acknowledge the alarms, press the *Mode* key.
4. Use the arrow keys to change from "No" to "Yes."
5. Press the *Select* button. The screen will flash "Acknowledging Alarms."

   The Power Meter returns to "Alarm Log" mode.

# CHAPTER 8—METERING CAPABILITIES

## REAL-TIME READINGS

The power meter measures currents and voltages and reports rms values for all three phases and a calculated neutral current①. In addition, the power meter calculates true power factor, real power, reactive power, and more. Table 8-1 lists the real-time readings and their reportable ranges.

**Table 8-1**
**Real-Time Readings**

| Real-Time Reading | Reportable Range |
|---|---|
| Current | |
| Per-Phase | 0 to 32,767 A |
| Neutral ① | 0 to 32,767 A |
| Voltage | |
| Line-to-Line, Per-Phase | 0 to 3,276,700 V |
| Line-to-Neutral, Per-Phase | 0 to 3,276,700 V |
| Real Power | |
| 3-Phase Total | 0 to +/- 3,276.70 MW |
| Per-Phase | 0 to +/- 3,276.70 MW |
| Reactive Power | |
| 3-Phase Total | 0 to +/- 3,276.70 MVAr |
| Per-Phase | 0 to +/- 3,276.70 MVAr |
| Apparent Power | |
| 3-Phase Total | 0 to 3,276.70 MVA |
| Per-Phase | 0 to 3,276.70 MVA |
| Power Factor (True) | |
| 3-Phase Total | –0.200 to 1.000 to +0.200 |
| Per-Phase | –0.200 to 1.000 to +0.200 |
| Frequency | |
| 50/60 Hz | 45.00 to 66.00 Hz |

## MIN/MAX VALUES (PM-650 ONLY)

The power meter stores the following minimum and maximum values in nonvolatile memory:

- Frequency
- Current Phase A, B, C, and Neutral
- Voltage Phase A, Phase B, Phase C, A–B, B–C, C–A
- Power Factor Phase A, Phase B, Phase C, 3-Phase
- kW Phase A, Phase B, Phase C, 3-Phase Total
- kVAr Phase A, Phase B, Phase C, 3-Phase Total

① PM-620 and PM-650.

- kVA Phase A, Phase B, Phase C, 3-Phase Total
- THD/thd Current Phase A, Phase B, Phase C
- THD/thd Voltage Phase A, Phase B, Phase C

You can view these values using the power meter display, and reset them using the Reset mode (see **Performing Resets** in **Chapter 7**).

Using POWERLOGIC application software you can:

- view all min/max values
- upload min/max values from the power meter and save them to disk
- reset min/max values

For instructions on viewing, saving, and resetting min/max data using POWERLOGIC software, refer to the instruction bulletin included with the software.

## POWER FACTOR MIN/MAX CONVENTIONS

All running min/max values, with the exception of power factor, are arithmetic minimums and maximums. For example, the minimum phase A–B voltage is simply the lowest value in the range 0 to 3,276,700 V that has occurred since the min/max values were last reset. In contrast, power factor min/max values—since the meter's midpoint is unity—are not true arithmetic minimums and maximums. Instead, the minimum value represents the measurement closest to –0 on a continuous scale of –0 to 1.00 to +0. The maximum value is the measurement closest to +0 on the same scale.

Figure 8-1 shows the min/max values in a typical environment, assuming a positive power flow. In figure 8-1, the minimum power factor is –.7 (lagging) and the maximum is .8 (leading). It is important to note that the minimum power factor need not be lagging, and the maximum power factor need not be leading. For example, if the power factor values ranged from –.75 to –.95, then the minimum power factor would be –.75 (lagging) and the maximum power factor would be –.95 (lagging). Likewise, if the power factor ranged from +.9 to +.95, the minimum would be +.95 (leading) and the maximum would be +.90 (leading).

See **Changing the VAR Sign Convention** in **Appendix E** for instructions on changing the sign convention over the communications link.

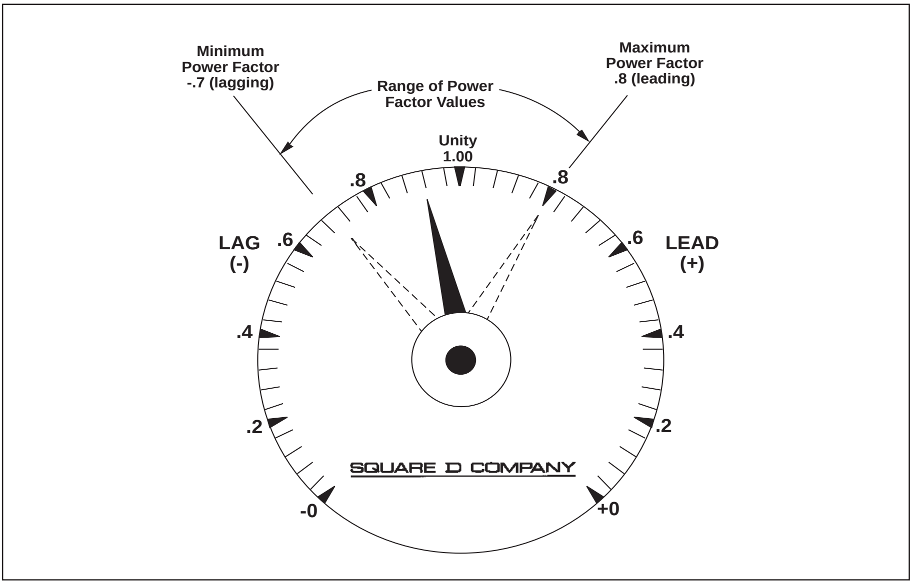



*Figure 8-1: Power factor min/max example*

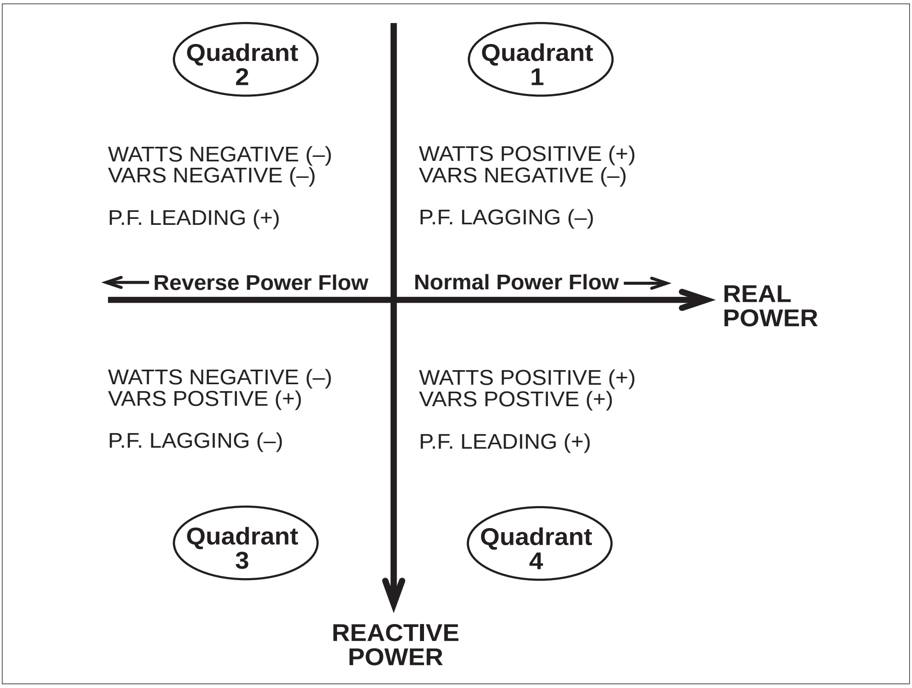



*Figure 8-2: Default VAR sign convention*

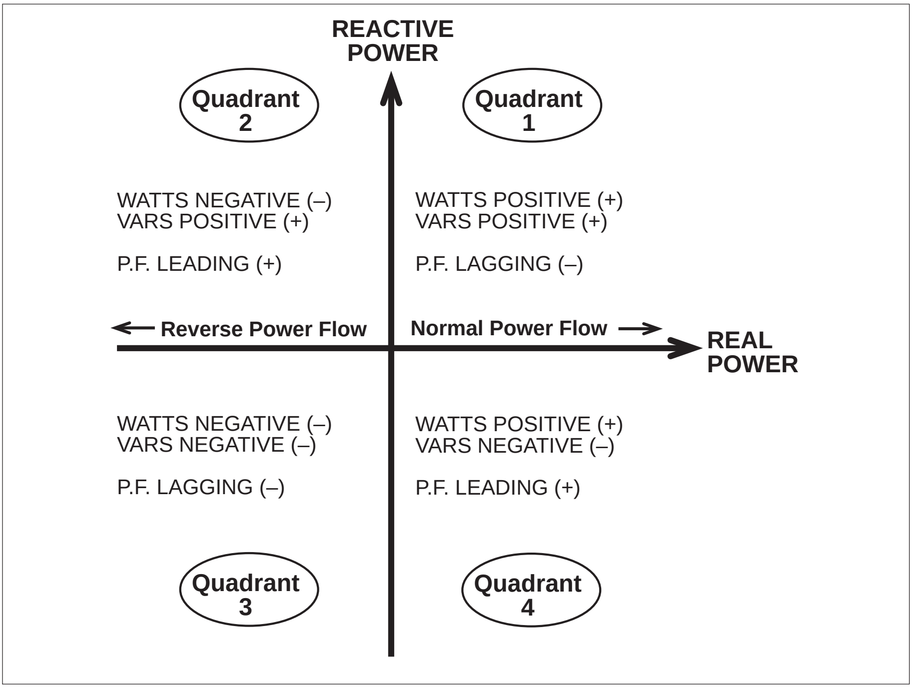



*Figure 8-3: Alternate VAR sign convention*

# ENERGY READINGS

The power meter provides 3-phase total energy values for kWh, kVARh, and kVAh (table 8-2). These values can be displayed on the power meter display, or read over the communications link. In the default mode (unsigned), the power meter accumulates energy as positive, regardless of the direction of power flow (i.e., the energy value increases, even during reverse power flow as in a tie breaker application).

Using POWERLOGIC® System Manager™ Software *SMS-3000*, *SMS-1500,* or *PMX-1500,* the power meter can be configured to accumulate kWh and kVARh in one of three additional modes: signed, energy in, and energy out. In signed mode, the power meter considers the direction of power flow, allowing the accumulated energy magnitude to both increase and decrease. The power meter can also be configured to accumulate kWh and kVARh as either energy into the load only or energy out of the load only. The default accumulation mode is unsigned (absolute).

The power meter also calculates a 3-phase total apparent energy value. All energy values are stored in nonvolatile memory.

**Table 8-2**
**Energy Readings**

| Energy Reading, 3-Phase | Reportable Range |
|---|---|
| Accumulated Energy | |
| Real (Signed/Absolute/In/Out) | 0 to 9,999,999,999,999,999 Wh |
| Reactive (Signed/Absolute/In/Out) | 0 to 9,999,999,999,999,999 VARh |
| Apparent | 0 to 9,999,999,999,999,999 VAh |

## POWER ANALYSIS VALUES

The power meter provides power analysis values that can be used to detect power quality problems, diagnose wiring problems, and more. Table 8-3 summarizes the power analysis values.

**Table 8-3**
**Power Analysis Values**

| Value | Reportable Range |
|---|---|
| THD-Voltage, Current (per phase) ① | 0 to 3,276.7% |
| Fundamental Voltages (per phase) ② | |
| Magnitude | 0 to 3,276,700 V |
| Angle | 0.0 to 359.9° |
| Fundamental Currents (per phase) ② | |
| Magnitude | 0 to 32,767 A |
| Angle | 0.0 to 359.9° |

① PM-620 and PM-650.
② Via communications only.

**THD**—Total Harmonic Distortion (THD) is a quick measure of the total distortion present in a waveform. It provides a general indication of the “quality” of a waveform. Power meter models PM-620 and PM-650 use the following equation to calculate THD:

$$\text{THD} = \frac{\sqrt{H_2^2 + H_3^2 + H_4^2 + \cdots}}{H_1} \times 100\%$$

**thd**—An alternate method for calculating Total Harmonic Distortion, used widely in Europe. Power meter models PM-620 and PM-650 use the following equation to calculate thd:

$$\text{thd} = \frac{\sqrt{H_2^2 + H_3^2 + H_4^2 + \cdots}}{\text{Total rms}} \times 100\%$$

# DEMAND READINGS (PM-620 AND PM-650 ONLY)

Power meter models PM-620 and PM-650 provides both current and power demand readings (table 8-4).

**Table 8-4**
**Demand Readings**

| Demand Reading | Reportable Range |
|---|---|
| Demand Current, Per-Phase & Neutral | |
| Present | 0 to 32,767 A |
| Peak | 0 to 32,767 A |
| Demand Real Power, 3Ø Total | |
| Present | 0 to +/-3,276.70 MW |
| Peak | 0 to +/-3,276.70 MW |
| Demand Reactive Power, 3Ø Total | |
| Present | 0 to +/-3,276.70 MVAr |
| Peak | 0 to +/-3,276.70 MVAr |
| Demand Apparent Power, 3Ø Total | |
| Present | 0 to 3,276.70 MVA |
| Peak | 0 to 3,276.70 MVA |
| Predicted Real Power Demand ①② | 0 to ±32,767 kW ③ |
| Predicted Reactive Power Demand ①② | 0 to 32,767 kVAr ③ |
| Predicted Apparent Power Demand ①② | 0 to 32,767 KVA ③ |

① PM-650 only.
② Via communications only.
③ 3-phase total.

## Demand Power Calculation Methods

To be compatible with electric utility billing practices, the power meter provides the following types of demand power calculations:

- Sliding Block Interval Demand (PM-620 and PM-650 only)
- Block Interval Demand with Rolling Subinterval (PM-650 only)
- Synch to Comms (PM-650 only)

Block interval demand can be set up using the power meter display. Block interval demand with a subinterval and sync to comms must be set up over the communications link. A brief description of these three demand power calculations follows.

### Sliding Block Interval Demand

The block interval demand mode supports a sliding block interval calculation. The default interval is 15 minutes.

In the sliding block interval mode, you can select a demand interval from 1 to 60 minutes in 1-minute increments. (The demand interval is set in the Setup Mode. See Chapter 7 for details.) If you specify an interval of 1 to 15 minutes, the demand calculation updates every 15 seconds on a sliding window basis.

If the interval is between 16 and 60 minutes, the demand calculation updates every 60 seconds on a sliding window basis. The present demand value displayed by the power meter is the value for the last completed interval.

### Block Interval Demand with Subinterval Option (PM-650 Only)

When using POWERLOGIC software, you must select both a block interval and a subinterval length. The default subinterval length is 0 minutes. At this default setting, the sliding block interval calculation described above is performed. If you set the subinterval to the value of the block interval, a fixed block calculation is performed and the demand calculation is updated every interval. If you set the subinterval to a value other than 0 or the block interval value, the power meter performs a rolling block demand calculation and updates the demand calculation at every subinterval.

### Synch to Comms (PM-650 Only)

If you set the demand to 0 using POWERLOGIC software, the synch to comms demand calculation is used. See **Appendix E** for more information.

## Predicted Demand (PM-650 Only)

Predicted demand is the average rate of power use during the most recent one-minute interval. It is called predicted demand because the best estimate of future power use is the power used in the most recent past.

The power meter calculates predicted demand for kW, kVAr, and kVA, updating the readings every 15 seconds. The predicted demand value does not predict the outcome of the present demand interval. Rather, since it represents only the most recent 1 minute interval, it is more responsive to recent increases or decreases in power than the present demand calculation.

## Peak Demand

The power meter maintains, in nonvolatile memory, a “peak demand” for each average demand current and average demand power value. It also stores the date and time of each peak demand. In addition to the peak demand, the power meter stores the coinciding average (demand) 3-phase power factor. The average 3-phase power factor is defined as “demand kW/demand kVA” for the peak demand interval.

Peak demand values can be reset using the power meter display, or over the communications link using POWERLOGIC application software. To reset peak demand values using the power meter display, see **Performing Resets** on page 54.

# KYZ PULSE OUTPUT

This section describes the power meter's pulse output capability. For wiring instructions, see **Chapter 5—Wiring**. The KYZ output is a Form-C contact with a maximum rating of 96 mA.

## Calculating the Pulse Constant

This section shows an example of how to calculate the pulse constant (in this case, a watthour-per-pulse value). To calculate this value, first determine the highest kW value you can expect and the required pulse rate. In this example, the following assumptions are made:

- The metered load should not exceed 1500 kW.
- The KYZ pulses should come in at about two pulses per second at full scale.

**Step 1:** Translate 1500 kW load into kWH/second.

(1500 kW) (1 Hr) = 1500 kWH

$$\frac{(1500\text{ kWH})}{1\text{ hour}} = \frac{\text{“X” kWH}}{1\text{ second}}$$

$$\frac{(1500\text{ kWH})}{3600\text{ seconds}} = \frac{\text{“X” kWH}}{1\text{ second}}$$

X = 1500/3600 = 0.4167 kWH/second

**Step 2:** Calculate the kWH required per pulse.

$$\frac{0.4167\text{ kWH/second}}{2\text{ pulses/second}} = 0.2084\text{ kWH/pulse}$$

**Step 3:** Round to the nearest hundredth, since the power meter accepts 0.01 kWH increments.

Ke = 0.21 kWH/pulse

**Summary:**

- 3-wire basis—0.21 kWH/pulse will provide approximately 2 pulses per second at full scale.
- 2-wire basis—0.11 kWH/pulse will provide approximately 2 pulses per second at full scale. (To convert to the kWH/pulse required on a 2-wire basis, divide Ke by 2. This is necessary since the power meter Form-C relay generates two pulses—KY and KZ—for every pulse that is counted on a 2-wire basis.)

# CHAPTER 9—ONBOARD ALARMING (PM-650 ONLY)

The power meter 650 has 30 alarm conditions available onboard, including over/under conditions and unbalance conditions (See **Alarm Conditions and Alarm Codes** in **Appendix I** for a complete list of alarm conditions.) The power meter maintains a counter for each alarm to keep track of the total number of occurrences.

These alarm conditions are tools that enable the power meter to execute tasks automatically. Using POWERLOGIC application software, each alarm condition can be assigned one or more of the following tasks:

- Force data log entries in the data log file
- Operate the KYZ relay output

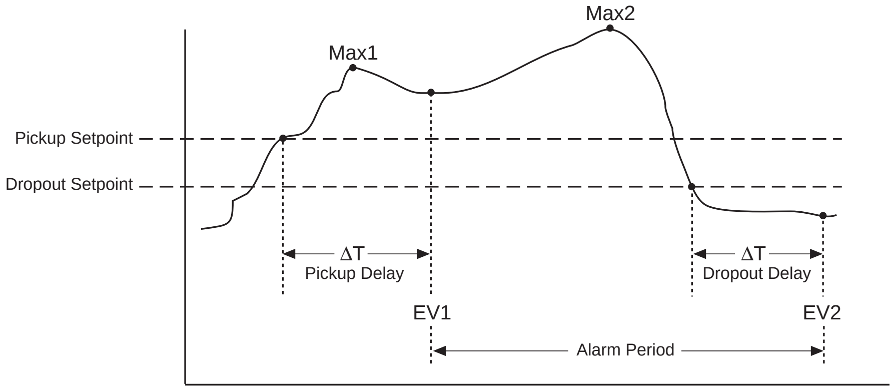
## SETPOINT-DRIVEN ALARMS

All of the alarm conditions require that you define the following setpoints:

- Pickup Setpoint
- Pickup Delay (in seconds)
- Dropout Setpoint
- Dropout Delay (in seconds)

For instructions on setting up alarm/relay functions from the power meter display, see **Setting Up Onboard Alarms** on page 55.

Figure 9-1 below illustrates how the power meter 650 handles setpoint-driven alarms.

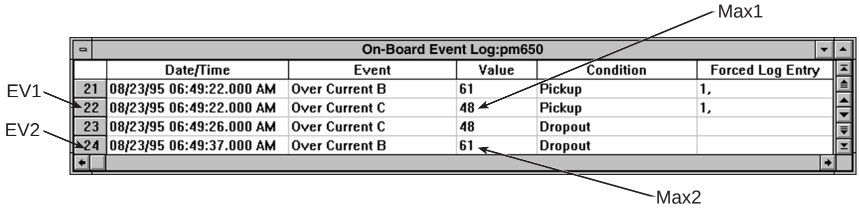



**EVI—** Power meter 650 records the date/time that the pickup setpoint and time delay were satisfied, and the maximum value reached (Max1) during the pickup delay period (ΔT). Also, the power meter performs any tasks—forced data log entries, relay output operations—assigned to the event.

**EV2—** Power meter 650 records the date/time dropout setpoint and time delay were satisfied, and the maximum value reached (Max2) during the alarm period.

*Figure 9-1: How the power meter handles setpoint-driven alarms*

Figure 9-2 shows the event log entries for figure 9-1 displayed by POWERLOGIC application software.


On-Board Event Log:pm650

| | Date/Time | Event | Value | Condition | Forced Log Entry |
|---|---|---|---|---|---|
| 21 | 08/23/95 06:49:22.000 AM | Over Current B | 61 | Pickup | 1, |
| 22 | 08/23/95 06:49:22.000 AM | Over Current C | 48 | Pickup | 1, |
| 23 | 08/23/95 06:49:26.000 AM | Over Current C | 48 | Dropout | |
| 24 | 08/23/95 06:49:37.000 AM | Over Current B | 61 | Dropout | |



*Figure 9-2: Sample event log entries*

## SETPOINT-CONTROLLED RELAY FUNCTIONS

The KYZ output can be used to operate an alarm horn or bell to annuciate the alarm condition or as an input into a building management system. For instructions on wiring the KYZ output as an alarm contact, see **Chapter 5—Wiring**.

## Undervoltage

- Pickup and dropout setpoints are entered in volts. Very large values may require scale factors. Refer to **Appendix I—Alarm Setup**.
- The per-phase overvoltage alarm occurs when the per-phase voltage is equal to or above the pickup setpoint for the specified pickup delay period (in seconds).
- When the overvoltage alarm occurs, the power meter operates the KYZ output (if the output is enabled).
- The relay remains closed until the overvoltage alarm clears. The alarm clears when the phase voltage remains below the dropout setpoint for the specified dropout delay period.

## Unbalance Current:

- Pickup and dropout setpoints are entered in tenths of percent, based on the percentage difference between each phase current with respect to the average of all phase currents. For example, enter an unbalance of 16.0% as 160.
- The unbalance current alarm occurs when the phase current deviates from the average of the phase currents, by the percentage pickup setpoint, for the specified pickup delay (in seconds).
- When the unbalance current alarm occurs, the power meter operates the KYZ output (if the output is enabled).
- The relay remains closed until the unbalance current alarm clears. The alarm clears when the percentage difference between the phase current and the average of all phases remains below the dropout setpoint for the specified dropout delay period.

## Unbalance Voltage

Pickup and dropout setpoints are entered in tenths of percent, based on the percentage difference between each phase voltage with respect to the average of all phase voltages. For example, enter an unbalance of 16.0% as 160.

- The unbalance voltage alarm occurs when the phase voltage deviates from the average of the phase voltages, by the percentage pickup setpoint, for the specified pickup delay (in seconds).
- When the unbalance voltage alarm occurs, the power meter operates the KYZ output (if the output is enabled).
- The relay remains closed until the unbalance voltage alarm clears. The unbalance voltage alarm clears when the percentage difference between the phase voltage and the average of all phases remains below the dropout setpoint for the specified dropout delay period.

# CHAPTER 10—LOGGING (PM-650 ONLY)

## ALARM LOG

The PM-650 has an alarm log viewable only from the power meter display. The alarm log stores the last 10 alarms that occurred and indicates whether each of those alarms has been acknowledged. The alarm log and event log are two separate logs.

## EVENT LOG

Power meter model 650 also provides an event log to record onboard events. (An event occurs when the pickup or dropout setpoint of an alarm is reached; see **Chapter 9** for more information.) The event log holds a user-configurable number of alarm events in FIFO (first-in-first-out) or Fill/Hold order. The event log is factory pre-configured to hold 20 events. Using POWERLOGIC application software, you can upload the event log for viewing, save it to disk, and clear the power meter's event log memory.

## DATA LOG

The PM-650 is equipped with nonvolatile memory for storing meter readings at regular intervals. One data log is provided for user configuration. The following items can be configured for the data log file:

- Logging interval—1 minute to 24 hours in 1 minute increments
- Offset time
- First-In-First-Out (FIFO), or Fill & Hold
- Values to be logged

The data log is pre-configured to log each of the following hourly:

- Per-phase quantities: present current demand (including neutral) and line-to-line voltages
- 3-phase quantities: true power factor, kW demand total, kVAr demand total, and kVA demand total

For instructions on setting up and clearing data log files, refer to the POWERLOGIC application software instruction bulletin.

## ALARM-DRIVEN DATA LOG ENTRIES

Using POWERLOGIC application software, you can select an alarm condition such as "Overcurrent Phase A" and set up the power meter to force data log entries into the log file each time the alarm condition occurs.

## STORAGE CONSIDERATIONS

The PM-650 has 1K of nonvolatile memory allocated for the event log and the data log. See **Appendix J—Calculating Log File Size** for additional information on the event and data logs.

# APPENDIX A—SPECIFICATIONS

**Metering Specifications**

| | |
|---|---|
| Current Inputs | |
| Current Range | 0–10.0 A ac |
| Nominal Current | 5 A ac |
| Voltage Inputs | |
| Voltage Range (line to line) | 35–600 Vac |
| Voltage Range (line to neutral) | 20–347 Vac |
| Nominal Voltage (typical) | 208/120, 480/277, 600/347 Vrms |
| Frequency Range (50/60 Hz) | 45 to 66 Hz |
| Harmonic Response—Voltage, Current | |
| Frequency 45–65 Hz | 31st harmonic |
| Accuracy | |
| Current① | ±0.25% reading②③ |
| Voltage | ±0.25% reading③ |
| Power | ±0.5% reading②③ |
| Energy④ | ±0.5% reading②③ |
| Demand④ | ±0.5% reading②③ |
| Power Factor | ±1.00% |
| Frequency 50/60 Hz | ±0.02 Hz |

**Metering Input Electrical Specifications**

| | |
|---|---|
| Current Inputs | |
| Nominal Full Scale | 5 A |
| Metering Over-Range | 2x |
| Overcurrent Withstand | 500 A, 1 second |
| Input Impedance | 1.5 milliohms |
| Burden | 0.15 VA |
| Isolation | 600 V |
| Voltage Inputs | |
| Nominal Full Scale | 208/120, 480/277, 600/347 V |
| Metering Over-Range | 20% |
| Input Impedance | Greater than 2 megohms |

① Any CT secondary currents less than 20 mA are reported as zero.
② From 20% nominal current to 150% nominal current.
③ For readings less than 20% nominal, add ±0.05 full scale error.
④ Satisfies applicable ANSI C12.16 revenue accuracy requirements.

## Control Power Input Specifications

Input Range, ac .......... 90–600 Vac
Burden .......... 90 Vac–264 Vac, 10 VA
265 Vac–600 Vac, 30 VA
Frequency Range .......... 45–66 Hz
Isolation .......... 2000 Vac/60 seconds
Ride-through on Power Loss .......... 100 ms at 115 Vac
Input Range, dc .......... 100–300 Vdc
Burden .......... 6 watts
Isolation .......... 1000 Vdc
Ride-through on Power Loss .......... 100 ms at 125 Vdc
Main's Supply Voltage Fluctuations .......... not to exceed +/– 10%

## Relay Output Specifications

KYZ .......... 96 mA max. at 240 Vac/300 Vdc

## Environmental Specifications (Indoor Use Only)

Operating Temperature—Meter .......... 0 to +60°C
Operating Temperature—Display .......... 0 to +55°C
Storage Temperature .......... –20 to +70°C
Humidity Rating .......... 5–95% (non-condensing) @ 30°C
Pollution Degree .......... 2
Installation Category .......... II
Altitude Rating .......... 0 to 4,570 m (15,000 ft.)

## Physical Specifications

Weight
Module .......... 17.6 oz. (500g)
Display .......... 7.1 oz. (202g)
Dimensions .......... See Appendix B

## Regulatory/Standards Compliance

Electromagnetic Interference
Radiated .......... EN55011 & EN55022, FCC Part 15 Class A
Conducted .......... EN55011 & EN55022, FCC Part 15 Class A
Immunity .......... IEC 1000-4-3 Level 3
Electrostatic Discharge (Air Discharge) .......... IEC 1000-4-2 Level 3
Electrical Fast Transient .......... IEC 1000-4-4 Level 4
Immunity to Surge .......... IEC 1000-4-5 Level 4
Safety .......... CSA, UL 508, CE, EN61010-1

# APPENDIX B—DIMENSIONS

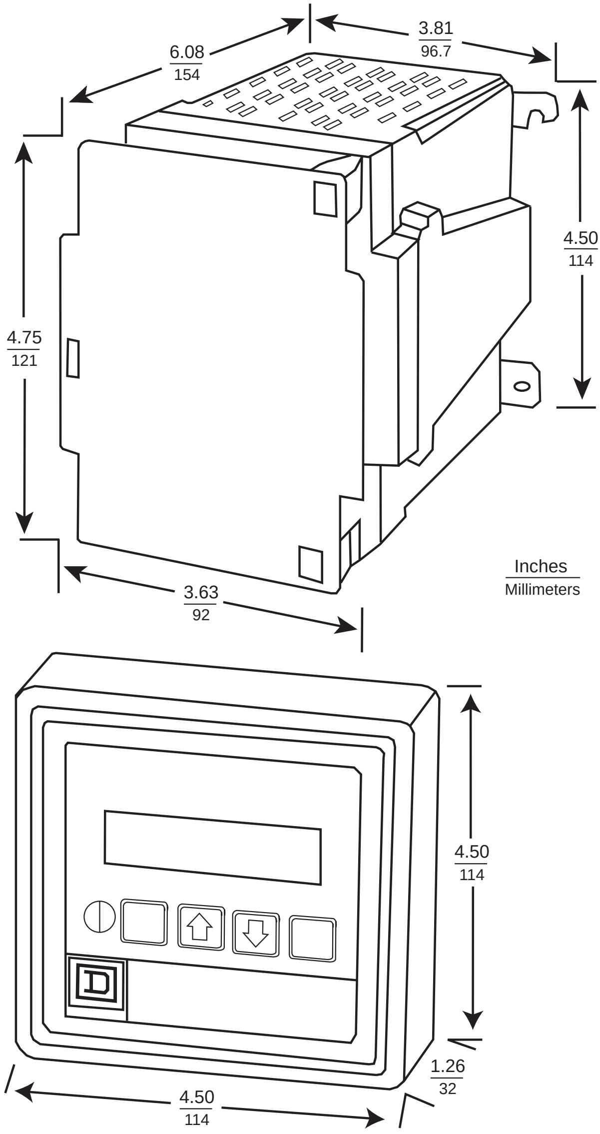
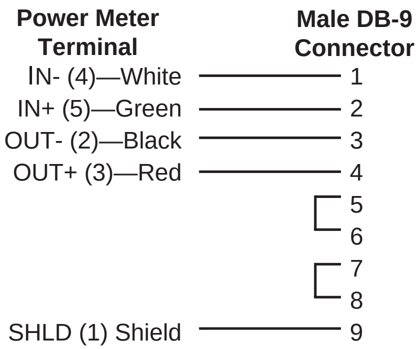


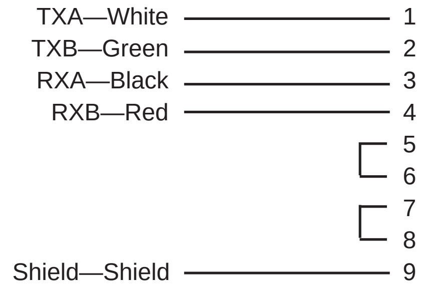

*Figure B-1: Dimensions of power meter and display*

# APPENDIX C—COMMUNICATION CABLE PINOUTS

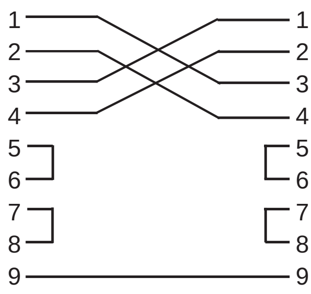
### CAB-107



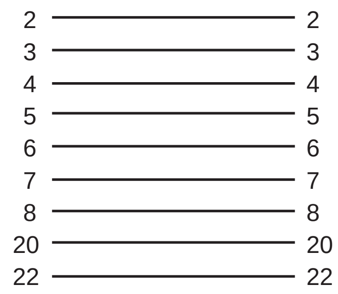

### CAB-108




### CC-100




### CAB-102, CAB-104



# APPENDIX D—ADDITIONAL WIRING DIAGRAMS

**⚠ DANGER**

**HAZARD OF ELECTRICAL SHOCK, BURN, OR EXPLOSION.**

- Turn off all power supplying this equipment before opening the terminal shield or making connections.
- Close and snap the terminal shield before turning power on.

**Failure to observe these precautions will result in death or severe personal injury!**

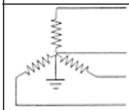
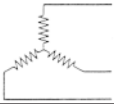
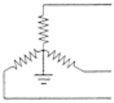
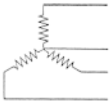
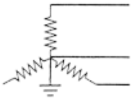
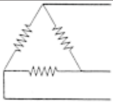
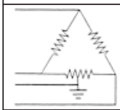
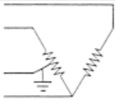
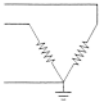
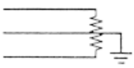
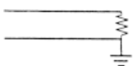
## SUPPORTED WIRING CONNECTIONS

Table D-1 on the following page describes various power systems supported by the power meter. The table also shows which power meter system type should be used (system I.D.) and how the power meter should be wired.

Figures D-1, D-2, and D-3 show CT, PT, and control power wiring. See **Chapter 5** for other wiring diagrams.

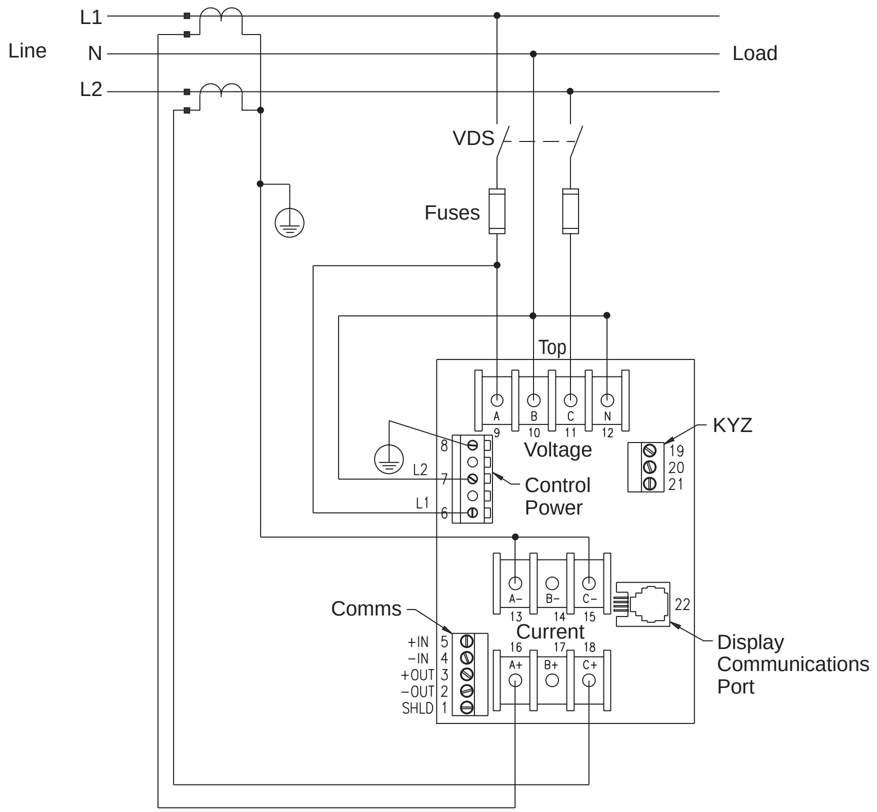
To comply with CE, see **CE Compliance**, page 22.

**Table D-1**
**Power Meter System Wiring Connections**

| System Wiring | | Power Meter System I.D.① | Wiring for Power Meter | Notes |
|---|---|---|---|---|
|  | 3Ø, 4W wye grounded neutral | 40 | 3Ø, 4W wye figure 5-6 or 5-7 | |
|  | 3Ø, 3W wye | 30 or 31 | 3Ø, 3W delta figure 5-3, 5-4, or 5-5 | |
|  | 3Ø, 3W wye, grounded neutral | 40 | 3Ø, 4W wye figure 5-6 or 5-7 | 1. Connect GND to neutral voltage terminal.<br>2. Line to neutral voltage may be unbalanced due to potential difference between GND at transformer & GND at meter. |
|  | 3Ø, 4W wye | 40 | 3Ø, 4W wye figure 5-6 or 5-7 | |
|  | 2Ø, 3W wye, grounded neutral | 40 | 1Ø, 3W figure D-1 | 1. Jumper input of phase not being metered to neutral voltage input. |
|  | 3Ø, 3W delta ② | 30 or 31 | 3Ø, 3W delta figure 5-3 | 1. For ungrounded delta systems only. |
|  | 3Ø, 4W delta, grounded mid-tap | 40 | 3Ø, 4W figure D-2 | 1. Per phase power factor will be determined with respect to neutral.<br>2. Always use 480/277 voltage range on the power meter. |
|  | 3Ø, 4W open delta, grounded mid-tap | 40 | 3Ø, 4W figure D-2 | 1. Per phase power factor will be determined with respect to neutral.<br>2. Always use 480/277 voltage range on the power meter. |
|  | 3Ø, 3W open delta, corner grounded | 30 or 31 | 3Ø, 3W delta figure 5-4 or 5-5 | 1. Wire grounded corner into B phase voltage input. |
|  | 1Ø, 3W grounded mid-tap | 40 | 1Ø, 3W figure D-1 | 1. B phase readings will be zero.<br>2. Always use 208/120 voltage range on the power meter. |
|  | 1Ø, 2W grounded end of phase mid-tap | 40 | 1Ø, 3W figure D-1 | 1. Use only $L_1$-N PT and $L_1$ CT.<br>2. B & C phase readings will be zero.<br>3. Always use 208/120 voltage range on the power meter. |

① System type as shown on power meter setup screen.

② For 3Ø, 3W delta corner-grounded applications, install two L-L rated PTs as shown in figures 5-4 and 5-5.



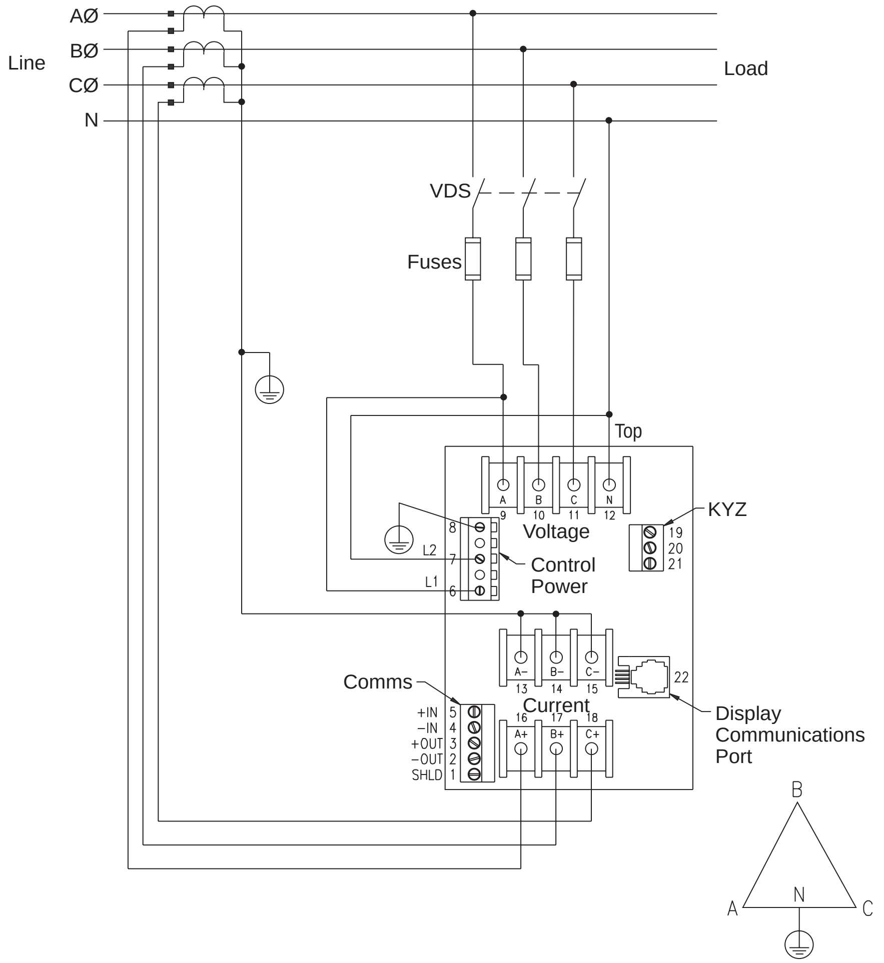

**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

When configuring the power meter, set system type to 4-wire (40) and PT ratio to 120:120.

Installation Category II

*Figure D-1: 240/120 V 1-phase, 3-wire direct voltage connection with 2 CTs*




**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

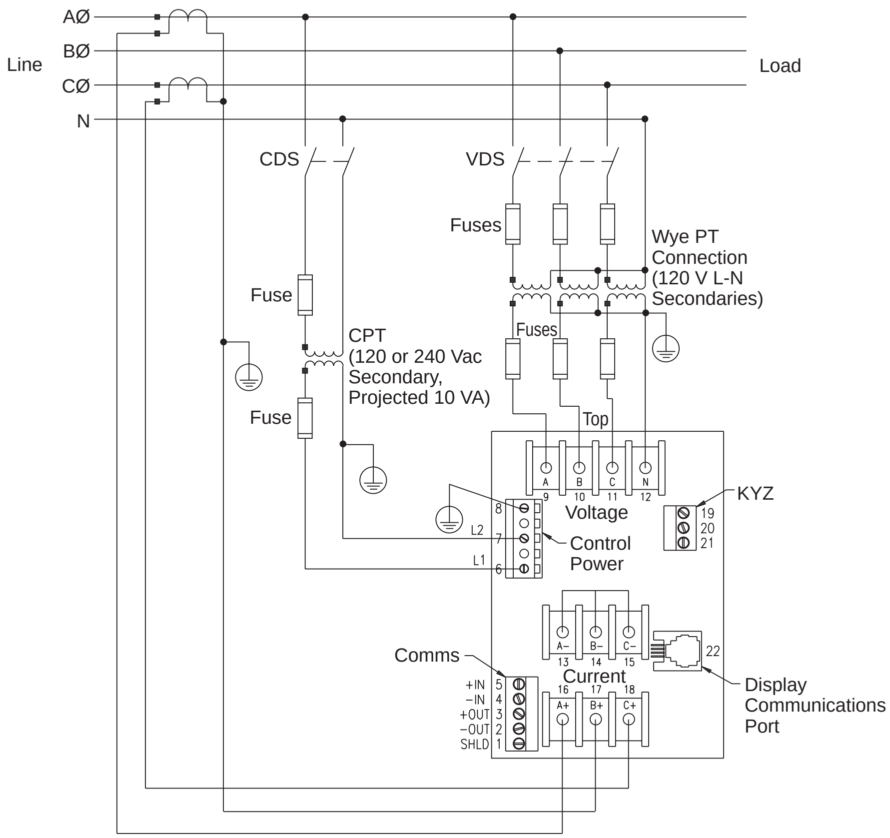
Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Use at 480/277 volt range for 240/120 V and 480/240 V systems.

Use system type 40.

Installation Category II

*Figure D-2: 3-phase, 4-wire delta with 3 PTs and 3 CTs*




**Note:** Control power can be drawn from fused voltage inputs L-L, or L-N, or an external source. See page 22 for CPT and fuse recommendations.

Control power range: L1-L2 90–600 Vrms
90–300 Vdc

Installation Category II

*Figure D-3: 3-phase, 4-wire wye, 3-wire load with 3 PTs and 2 CTs*

# APPENDIX E—USING THE COMMAND INTERFACE

## RESETTING DEMAND AND ENERGY VIA COMMUNICATIONS

Using System Manager Software (*SMS-3000*, *SMS-1500*, or *PMX-1500*), you can reset Peak Demand Currents, Peak Demand Powers, Min/Max and the associated power factors. You can also clear accumulated energies. If you are not using one of these software packages, you can perform these functions via communications by entering the desired command code (see below) to register 7700.

| Command Code | Description |
|---|---|
| 4110 | Reset min/max (PM-650 only) |
| 5110 | Reset peak demand currents |
| 5120 | Reset peak demand powers and associated average power factors |
| 6210 | Clear all accumulated energies |

## CHANGING THE VAR SIGN CONVENTION

The power meter offers two VAR sign conventions (see figures 8-2 and 8-3 in **Chapter 8**). The procedures below tell how to change the sign convention via communications.

To change to the alternate sign convention, complete the following steps:

1. (SY/MAX or POWERLOGIC protocol only) Read register 7715.
2. Read register 2028, the value of the system password.
3. Write the value in register 2028 into register 7721.
4. Write the decimal value 2020 into register 7720.
5. Change to binary mode and read register 7755.
6. Change bit 0, the least significant or right-most bit, to a 1 and write the new value back to register 7755.
7. Change back to decimal mode and read register 2028.
8. Write the value of register 2028 into register 7721.
9. Write the decimal value 2050 into register 7720. The changes are saved and the power meter resets.

To return to the default sign convention, complete the following steps:

1. (SY/MAX or POWERLOGIC protocol only) Read register 7715.
2. Read register 2028, the value of the system password.

3. Write the value in register 2028 into register 7721.
4. Write the decimal value 2020 into register 7720.
5. Change to binary mode and read register 7755.
6. Change bit 0, the least significant or right-most bit, to a 0 and write the new value back to register 7755.
7. Change back to decimal mode and read register 2028.
8. Write the value of register 2028 into register 7721.
9. Write the decimal value 2050 into register 7720. The changes are saved and the power meter resets.

## SYNCH TO COMMS (PM-650 Only)

Using command 5910, it is possible to synchronize the demand intervals of multiple meters on a communications network. For example, a PLC input could be monitoring the utility revenue meter's end-of-demand-interval pulse. The PLC can be programmed to issue command 5910 to multiple meters whenever the utility meter starts a new demand interval. This technique causes the demand readings of each meter to be calculated over the same fixed block interval.

Enter the command code to register 7700 via communications.

| Command Code | Description |
|---|---|
| 5910 | Start a new demand interval (if demand interval is 0) |

# APPENDIX F—REGISTER LIST

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| **REAL TIME METERED VALUES** | | | |
| 1000 | Update Interval | 1000ths of a second | 0 to 10,000 |
| 1001 | Frequency | .01 Hertz/Scale Factor F | 4500 to 6600 (45–66Hz) Range |
| 1002 | Unused | | |
| 1003 | Current, Phase A | Amps/Scale Factor A | 0 to 32,767 |
| 1004 | Current, Phase B | Amps/Scale Factor A | 0 to 32,767 |
| 1005 | Current, Phase C | Amps/Scale Factor A | 0 to 32,767 |
| 1006 ② | Current, Calculated Neutral | Amps/Scale Factor A | 0 to 32,767 |
| 1007–1009 | Unused | | |
| 1010 | Current Unbalance, Phase A | Percent in 10ths | 0 to ±1000 |
| 1011 | Current Unbalance, Phase B | Percent in 10ths | 0 to ±1000 |
| 1012 | Current Unbalance, Phase C | Percent in 10ths | 0 to ±1000 |
| 1013 | Current Unbalance, Worst | Percent in 10ths | 0 to ±1000 |
| 1014 | Voltage, Phase A to B | Volts/Scale Factor D | 0 to 32,767 |
| 1015 | Voltage, Phase B to C | Volts/Scale Factor D | 0 to 32,767 |
| 1016 | Voltage, Phase C to A | Volts/Scale Factor D | 0 to 32,767 |
| 1017 | Unused | | |
| 1018 | Voltage, Phase A to Neutral | Volts/Scale Factor D | 0 to 32,767 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-620 and PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1019 | Voltage, Phase B to Neutral | Volts/Scale Factor D | 0 to 32,767 |
| 1020 | Voltage, Phase C to Neutral | Volts/Scale Factor D | 0 to 32,767 |
| 1021 | Reserved | | |
| 1022 | Voltage Unbalance, Phase A-B | Percent in 10ths | 0 to ±1000 |
| 1023 | Voltage Unbalance, Phase B-C | Percent in 10ths | 0 to ±1000 |
| 1024 | Voltage Unbalance, Phase C-A | Percent in 10ths | 0 to ±1000 |
| 1025 | Voltage Unbalance, L-L Worst | Percent in 10ths | 0 to ±1000 |
| 1026 | Voltage Unbalance, Phase A | Percent in 10ths | 0 to ±1000 |
| 1027 | Voltage Unbalance, Phase B | Percent in 10ths | 0 to ±1000 |
| 1028 | Voltage Unbalance, Phase C | Percent in 10ths | 0 to ±1000 |
| 1029 | Voltage Unbalance, L-N Worst | Percent in 10ths | 0 to ±1000 |
| 1030 | Reserved | | |
| 1031 | True Power Factor, Phase A | In 1000ths | –100 to +1000 to +100 |
| 1032 | True Power Factor, Phase B | In 1000ths | –100 to +1000 to +100 |
| 1033 | True Power Factor, Phase C | In 1000ths | –100 to +1000 to +100 |
| 1034 | True Power Factor, 3-Phase Total | In 1000ths | –100 to +1000 to +100 |
| 1035–1038 | Unused | | |
| 1039 | Real Power, Phase A | kW/Scale Factor E | 0 to ±32,767 |
| 1040 | Real Power, Phase B | kW/Scale Factor E | 0 to ±32,767 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1041 | Real Power, Phase C | kW/Scale Factor E | 0 to ±32,767 |
| 1042 | Real Power, 3-Phase Total | kW/Scale Factor E | 0 to ±32,767 |
| 1043 | Reactive Power, Phase A | kVAr/Scale Factor E | 0 to ±32,767 |
| 1044 | Reactive Power, Phase B | kVAr/Scale Factor E | 0 to ±32,767 |
| 1045 | Reactive Power, Phase C | kVAr/Scale Factor E | 0 to ±32,767 |
| 1046 | Reactive Power, 3-Phase Total | kVAr/Scale Factor E | 0 to ±32,767 |
| 1047 | Apparent Power, Phase A | kVA/Scale Factor E | 0 to +32,767 |
| 1048 | Apparent Power, Phase B | kVA/Scale Factor E | 0 to +32,767 |
| 1049 | Apparent Power, Phase C | kVA/Scale Factor E | 0 to +32,767 |
| 1050 | Apparent Power, 3-Phase Total | kVA/Scale Factor E | 0 to +32,767 |
| 1051 ② | THD/thd A Current | % in 10ths | 0 to 10,000 |
| 1052 ② | THD/thd B Current | % in 10ths | 0 to 10,000 |
| 1053 ② | THD/thd C Current | % in 10ths | 0 to 10,000 |
| 1054 | Reserved | | |
| 1055 ② | THD/thd A Voltage | % in 10ths | 0 to 10,000 |
| 1056 ② | THD/thd B Voltage | % in 10ths | 0 to 10,000 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-620 and PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1057 ② | THD/thd C Voltage | % in 10ths | 0 to 10,000 |
| 1058–1077 | Unused | | |
| 1078 | A Current Fundamental RMS Magnitude | Amps/Scale Factor A | 0 to 32,767 |
| 1079 | A Current Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1080 | B Current Fundamental RMS Magnitude | Amps/Scale Factor A | 0 to 32,767 |
| 1081 | B Current Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1082 | C Current Fundamental RMS Magnitude | Amps/Scale Factor A | 0 to 32,767 |
| 1083 | C Current Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1084–1087 | Unused | | |
| 1088 | A Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1089 | A Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1090 | B Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1091 | B Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-620 and PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1092 | C Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1093 | C Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1094 | A-B Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1095 | A-B Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1096 | B-C Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1097 | B-C Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1098 | C-A Voltage Fundamental RMS Magnitude | Volts/Scale Factor D | 0 to 32,767 |
| 1099 | C-A Voltage Fundamental Coincident Angle | 10ths of Degrees | 0 to 3,599 |
| 1200 ② | Minimum Update Interval | In 1000ths of a second | 0 to 10,000 |
| 1201 ② | Minimum Frequency | Hertz/Scale Factor F | 4500 to 6600 |
| 1202 ② | Reserved | | |
| 1203 ② | Minimum Current, Phase A | Amps/Scale Factor A | 0 to 32,767 |
| 1204 ② | Minimum Current, Phase B | Amps/Scale Factor A | 0 to 32,767 |
| 1205 ② | Minimum Current, Phase C | Amps/Scale Factor A | 0 to 32,767 |
| 1206 ② | Minimum Current Neutral, Calculated | Amps/Scale Factor A | 0 to 32,767 |
| 1207 ② | Reserved | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1208 ② | Reserved | | |
| 1209 ② | Reserved | | |
| 1210 ② | Minimum Current Unbalance, Phase A | Percent in 10ths | 0 to ±1000 |
| 1211 ② | Minimum Current Unbalance, Phase B | Percent in 10ths | 0 to ±1000 |
| 1212 ② | Minimum Current Unbalance, Phase C | Percent in 10ths | 0 to ±1000 |
| 1213 ② | Minimum Current Unbalance, Worst | Percent in 10ths | 0 to ±1000 |
| 1214 ② | Minimum Voltage, Phase A to B | Volts/Scale Factor D | 0 to 32,767 |
| 1215 ② | Minimum Voltage, Phase B to C | Volts/Scale Factor D | 0 to 32,767 |
| 1216 ② | Minimum Voltage, Phase C to A | Volts/Scale Factor D | 0 to 32,767 |
| 1217 ② | Reserved | | |
| 1218 ② | Minimum Voltage, Phase A | Volts/Scale Factor D | 0 to 32,767 |
| 1219 ② | Minimum Voltage, Phase B | Volts/Scale Factor D | 0 to 32,767 |
| 1220 ② | Minimum Voltage, Phase C | Volts/Scale Factor D | 0 to 32,767 |
| 1221 ② | Reserved | | |
| 1222 ② | Minimum Voltage Unbalance, Phase A-B | Percent in 10ths | 0 to ±1000 |
| 1223 ② | Minimum Voltage Unbalance, Ph. B-C | Percent in 10ths | 0 to ±1000 |
| 1224 ② | Minimum Voltage Unbalance, Ph. C-A | Percent in 10ths | 0 to ±1000 |
| 1225 ② | Minimum Volt. Unbalance, Worst L-L | Percent in 10ths | 0 to ±1000 |
| 1226 ② | Minimum Voltage Unbalance, Ph. A | Percent in 10ths | 0 to ±1000 |
| 1227 ② | Minimum Voltage Unbalance, Ph. B | Percent in 10ths | 0 to ±1000 |
| 1228 ② | Minimum Voltage Unbalance, Ph. C | Percent in 10ths | 0 to ±1000 |
| 1229 ② | Minimum Volt. Unbalance, Worst L-N | Percent in 10ths | 0 to ±1000 |
| 1230 ② | Reserved | | |
| 1231 ② | Minimum True Power Factor, Phase A | In 1000ths | -100 to +1000 to +100 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1232 ② | Minimum True Power Factor, Phase B | In 1000ths | –100 to +1000 to +100 |
| 1233 ② | Minimum True Power Factor, Phase C | In 1000ths | –100 to +1000 to +100 |
| 1234 ② | Minimum True Power Factor, Total | In 1000ths | –100 to +1000 to +100 |
| 1235 ② | Reserved | | |
| 1236 ② | Reserved | | |
| 1237 ② | Reserved | | |
| 1238 ② | Reserved | | |
| 1239 ② | Minimum Real Power, Phase A | kW/ Scale Factor E | 0 to ±32,767 |
| 1240 ② | Minimum Real Power, Phase B | kW/ Scale Factor E | 0 to ±32,767 |
| 1241 ② | Minimum Real Power, Phase C | kW/ Scale Factor E | 0 to ±32,767 |
| 1242 ② | Minimum Real Power, Total | kW/ Scale Factor E | 0 to ±32,767 |
| 1243 ② | Minimum Reactive Power, Phase A | kVAr/Scale Factor E | 0 to ±32,767 |
| 1244 ② | Minimum Reactive Power, Phase B | kVAr/Scale Factor E | 0 to ±32,767 |
| 1245 ② | Minimum Reactive Power, Phase C | kVAr/Scale Factor E | 0 to ±32,767 |
| 1246 ② | Minimum Reactive Power, Total | kVAr/Scale Factor E | 0 to ±32,767 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1247 ② | Minimum Apparent Power, Phase A | kVA/Scale Factor E | 0 to ±32,767 |
| 1248 ② | Minimum Apparent Power, Phase B | kVA/Scale Factor E | 0 to ±32,767 |
| 1249 ② | Minimum Apparent Power, Phase C | kVA/Scale Factor E | 0 to ±32,767 |
| 1250 ② | Minimum Apparent Power, Total | kVA/Scale Factor E | 0 to ±32,767 |
| 1251 ② | Minimum THD/thd Current, Phase A | Percent in 10ths | 0 to 10,000 |
| 1252 ② | Minimum THD/thd Current, Phase B | Percent in 10ths | 0 to 10,000 |
| 1253 ② | Minimum THD/thd Current, Phase C | Percent in 10ths | 0 to 10,000 |
| 1254 ② | Reserved | | |
| 1255 ② | Minimum THD/thd Voltage, Phase A | Percent in 10ths | 0 to 10,000 |
| 1256 ② | Minimum THD/thd Voltage, Phase B | Percent in 10ths | 0 to 10,000 |
| 1257 ② | Minimum THD/thd Voltage, Phase C | Percent in 10ths | 0 to 10,000 |
| 1258 ② | Reserved | | |
| 1259 ② | Reserved | | |
| 1400 ② | Maximum Update Interval | In 1000ths of a second | 0 to 10,000 |
| 1401 ② | Maximum Frequency | Hertz/Scale Factor F | 4500 to 6600 |
| 1402 ② | Reserved | | |
| 1403 ② | Maximum Current, Phase A | Amps/Scale Factor A | 0 to 32,767 |
| 1404 ② | Maximum Current, Phase B | Amps/Scale Factor A | 0 to 32,767 |
| 1405 ② | Maximum Current, Phase C | Amps/Scale Factor A | 0 to 32,767 |
| 1406 ② | Maximum Current Neutral, Calculated | Amps/Scale Factor A | 0 to 32,767 |
| 1407 ② | Reserved | | |
| 1408 ② | Reserved | | |
| 1409 ② | Reserved | | |
| 1410 ② | Maximum Current Unbalance, Ph. A | Percent in 10ths | 0 to ±1000 |
| 1411 ② | Maximum Current Unbalance, Ph. B | Percent in 10ths | 0 to ±1000 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1412 ② | Maximum Current Unbalance, Ph. C | Percent in 10ths | 0 to ±1000 |
| 1413 ② | Maximum Current Unbalance, Worst | Percent in 10ths | 0 to ±1000 |
| 1414 ② | Maximum Voltage, Phase A-B | Volts/Scale Factor D | 0 to 32,767 |
| 1415 ② | Maximum Voltage, Phase B-C | Volts/Scale Factor D | 0 to 32,767 |
| 1416 ② | Maximum Voltage, Phase C-A | Volts/Scale Factor D | 0 to 32,767 |
| 1417 ② | Reserved | | |
| 1418 ② | Maximum Voltage, Phase A | Volts/Scale Factor D | 0 to 32,767 |
| 1419 ② | Maximum Voltage, Phase B | Volts/Scale Factor D | 0 to 32,767 |
| 1420 ② | Maximum Voltage, Phase C | Volts/Scale Factor D | 0 to 32,767 |
| 1421 ② | Reserved | | |
| 1422 ② | Maximum Volt. Unbalance, Ph. A-B | Percent in 10ths | 0 to ±1000 |
| 1423 ② | Maximum Volt. Unbalance, Ph. B-C | Percent in 10ths | 0 to ±1000 |
| 1424 ② | Maximum Volt. Unbalance, Ph. C-A | Percent in 10ths | 0 to ±1000 |
| 1425 ② | Maximum Volt. Unbalance, Worst L-L | Percent in 10ths | 0 to ±1000 |
| 1426 ② | Maximum Volt. Unbalance, Ph. A | Percent in 10ths | 0 to ±1000 |
| 1427 ② | Maximum Volt. Unbalance, Phase B | Percent in 10ths | 0 to ±1000 |
| 1428 ② | Maximum Volt. Unbalance, Phase C | Percent in 10ths | 0 to ±1000 |
| 1429 ② | Maximum Volt. Unbalance, Worst L-N | Percent in 10ths | 0 to ±1000 |
| 1430 ② | Reserved | | |
| 1431 ② | Maximum True Power Factor, Ph. A | In 1000ths | -100 to +1000 to +100 |
| 1432 ② | Maximum True Power Factor, Ph. B | In 1000ths | -100 to +1000 to +100 |
| 1433 ② | Maximum True Power Factor, Ph. C | In 1000ths | -100 to +1000 to +100 |
| 1434 ② | Maximum True Power Factor, Total | In 1000ths | -100 to +1000 to +100 |
| 1435 ② | Reserved | | |
| 1436 ② | Reserved | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1437 ② | Reserved | | |
| 1438 ② | Reserved | | |
| 1439 ② | Maximum Real Power, Phase A | kW/Scale Factor E | 0 to ±32,767 |
| 1440 ② | Maximum Real Power, Phase B | kW/Scale Factor E | 0 to ±32,767 |
| 1441 ② | Maximum Real Power, Phase C | kW/Scale Factor E | 0 to ±32,767 |
| 1442 ② | Maximum Real Power, Total | kW/Scale Factor E | 0 to ±32,767 |
| 1443 ② | Maximum Reactive Power, Phase A | kVAr/Scale Factor E | 0 to ±32,767 |
| 1444 ② | Maximum Reactive Power, Phase B | kVAr/Scale Factor E | 0 to ±32,767 |
| 1445 ② | Maximum Reactive Power, Phase C | kVAr/Scale Factor E | 0 to ±32,767 |
| 1446 ② | Maximum Reactive Power, Total | kVAr/Scale Factor E | 0 to ±32,767 |
| 1447 ② | Maximum Apparent Power, Phase A | kVA/Scale Factor E | 0 to ±32,767 |
| 1448 ② | Maximum Apparent Power, Phase B | kVA/Scale Factor E | 0 to ±32,767 |
| 1449 ② | Maximum Apparent Power, Phase C | kVA/Scale Factor E | 0 to ±32,767 |
| 1450 ② | Maximum Apparent Power, Total | kVA/Scale Factor E | 0 to ±32,767 |
| 1451 ② | Maximum THD/thd Current, Phase A | Percent in 10ths | 0 to 10,000 |
| 1452 ② | Maximum THD/thd Current, Phase B | Percent in 10ths | 0 to 10,000 |
| 1453 ② | Maximum THD/thd Current, Phase C | Percent in 10ths | 0 to 10,000 |
| 1454 ② | Reserved | | |
| 1455 ② | Maximum THD/thd Voltage, Phase A | Percent in 10ths | 0 to 10,000 |
| 1456 ② | Maximum THD/thd Voltage, Phase B | Percent in 10ths | 0 to 10,000 |
| 1457 ② | Maximum THD/thd Voltage, Phase C | Percent in 10ths | 0 to 10,000 |
| 1458 ② | Reserved | | |
| 1459 ② | Reserved | | |
| 1600–1616 | Unused | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| **ENERGY VALUES ②** | | | |
| **Accumulated Energy** | | | |
| 1617–1620 | Apparent Energy 3-Phase Total | VAH | 0 to 9,999,999,999,999,999 |
| 1621–1624 | Real Energy 3-Phase Total | WH | 0 to +/-9,999,999,999,999,999 |
| 1625–1628 | Reactive Energy 3-Phase Total | VArH | 0 to +/-9,999,999,999,999,999 |
| 1629–1663 | Unused | | |
| **DEMAND VALUES ③** | | | |
| **Current Demand** | | | |
| 1700 | Unused | | |
| 1701 | Present Current Demand Phase A | Amps/Scale Factor A | 0 to 32,767 |
| 1702 | Present Current Demand Phase B | Amps/Scale Factor A | 0 to 32,767 |
| 1703 | Present Current Demand Phase C | Amps/Scale Factor A | 0 to 32,767 |
| 1704 | Present Demand Neutral Current | Amps/Scale Factor A | 0 to 32,767 |
| 1705–1708 | Unused | | |
| 1709 | Peak Current Demand Phase A | Amps/Scale Factor A | 0 to 32,767 |
| 1710 | Peak Current Demand Phase B | Amps/Scale Factor A | 0 to 32,767 |
| 1711 | Peak Current Demand Phase C | Amps/Scale Factor A | 0 to 32,767 |
| 1712 | Peak Current Neutral Current | Amps/Scale Factor A | 0 to 32,767 |
| 1730 | Unused | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② Each energy is kept in 4 registers, modulo 10,000 per register.

③ Demand Values available in PM-620 and PM-650 only.

**Power Demand** ②

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1731 | Present Real Power Demand, 3-Phase Total | kW/Scale Factor E | 0 to +/–32,767 |
| 1732 | Present Reactive Power Demand, 3-Phase Total | kVAr/Scale Factor E | 0 to +/–32,767 |
| 1733 | Present Apparent Power Demand 3-Phase Total | kVA/Scale Factor E | 0 to 32,767 |
| 1734 | Peak Real Power Demand, 3-Phase Total | kW/Scale Factor E | 0 to +/–32,767 |
| 1735 | Average Power Factor, @ Peak Real | Percent in 1000ths | –100 to +1000 to +100 |
| 1736–1737 | Unused | | |
| 1738 | Peak Reactive Power Demand 3-Phase Total | kVar/Scale Factor E | 0 to +/–32,767 |
| 1739 | Average Power Factor @ Peak Reactive | Percent in 1000ths | –100 to +1000 to +100 |
| 1740–1741 | Unused | | |
| 1742 | Peak Apparent Power Demand, 3-Phase Total | kVA/Scale Factor E | 0 to 32,767 |
| 1743 | Average Power Factor @ Peak Apparent | Percent in 1000ths | –100 to +1000 to +100 |
| 1744 | Unused | | |
| 1745 | Unused | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② Reactive Demand may be calculated either using the fundamental only (default) or using total harmonics, user selectable.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1746 ② | Predicted Real Power Demand, 3-Phase Total | kW/Scale Factor E | 0 to +/- 32,767 |
| 1747 ② | Predicted Reactive Power Demand, 3-Phase Total | kVAr/Scale Factor E | 0 to 32,767 |
| 1748 ② | Predicted Apparent Power Demand, 3-Phase Total | kVA/Scale Factor E | 0 to 32,767 |
| 1749 | Unused | | |
| 1750 | Unused | | |
| 1751 | Unused | | |
| 1752 | Unused | | |

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|

**DATE/TIME COMPRESSED FORM (3 Registers) ③**

*The date and time in registers 1800–1802 are stored as follows. Other dates and times (through register 1877) are stored in an identical manner. Set date/time by writing to registers 1842–1844.

Register 1800, Month (byte 1) = 1–12, Day (byte 2) = 1–31
Register 1801, Year (byte 1) = 0–199, Hour (byte 2) = 0–23,
Register 1802, Minutes (byte 1) = 0–59, Seconds (byte 2) = 0–59. The year is zero based on the year 1900 in anticipation of the 21st century, (e.g., 1989 would be represented as 89 and 2009 would be represented as 109).

| | | | |
|---|---|---|---|
| 1800–1802 | Last Restart Date/Time | Month, Day, Yr, Hr, Min, Sec | *See note above |
| 1803–1805 | Date/Time Demand of Peak Current Phase A | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1806–1808 | Date/Time Demand of Peak Current Phase B | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1809–1811 | Date/Time Demand of Peak Current Phase C | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1812–1814 | Date/Time of Peak Demand (Average Real Power) | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

③ PM-620 and PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 1815–1817 | Date/Time of Last Reset of Peak Demand Current | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1818–1820 ② | Date/Time of Last Reset of Min/Max Values | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1824–1826 | Date/Time when Peak Power Demands Were Last Cleared | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1827–1829 | Date/Time when Accumulated Energy Last Cleared | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1830–1832 | Date/Time when Control Power Failed Last | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1833–1841 | Unused | | |
| 1842–1844 | Present/Set Date/Time | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1845–1847 | Calibration | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1848–1856 | Unused | | |
| 1857–1859 | Date/Time of Peak Reactive Demand (Reactive Power) | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1860–1862 | Date/Time of Peak Apparent Demand Power | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |
| 1863–1874 | Unused | | |
| 1875–1877 | Date/Time of Peak Demand Neutral Current | Month, Day, Yr, Hr, Min, Sec | Same as Registers 1800–1802 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range | Description |
|---|---|---|---|---|
| **CONFIGURATION (Read Only Registers)** | | | | |
| 2000 | Unused | | | |
| 2001 | System Conn. | None | 30, 31, 40 | |
| 2002 | CT Ratio 3-Phase Primary Ratio Term | None | 1 to 32,767 | |
| 2003 | CT Ratio 3-Phase Secondary Ratio Term | None | 1 or 5 | |
| 2004–2005 | Unused | | | |
| 2006 | PT Ratio 3-Phase Primary Ratio Term | None/ Scale Factor | 1 to 32,767 | |
| 2007 | PT Ratio 3-Phase Primary Scale Factor | None | 0 to 2 | |
| 2008 | PT Ratio 3-Phase Secondary Ratio Term | None | 100, 115, 120 (120 default) | |
| 2009 | Phase A Current Correction Factors | 10,000ths | 5,000–20,000 | |
| 2010 | Phase B Current Correction Factors | 10,000ths | 5,000–20,000 | |
| 2011 | Phase C Current Correction Factors | 10,000ths | 5,000–20,000 | |
| 2012 | Unused | | | |
| 2013 | Phase A Voltage Correction Factors | 10,000ths | 5,000–20,000 | |
| 2014 | Phase B Voltage Correction Factors | 10,000ths | 5,000–20,000 | |
| 2015 | Phase C Voltage Correction Factors | 10,000ths | 5,000–20,000 | |
| 2016 | Nominal System Frequency | — | 50, 60 | |
| 2017 | Device Address | None | 0 to 199<br>1 to 247<br>1 to 255 | SY/Max Device Address<br>Modbus Device Address<br>Jbus Device Address |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

| Reg. No. ① | Register Name | Units | Range | Description |
|---|---|---|---|---|
| 2018 | Device Baud Rate | Baud | 1200, 2400, 4800, 9600, 19,200 | |
| 2019 | Phase Adjust User Correction | In 100ths | ±1000 | |
| 2020 | Scale Group A: Ammeter Per Phase | None | –2 to 0 | Scale Group A: Ammeter Per<br>–2=scale by 0.01<br>–1=scale by 0.10<br>0=scale by 1.00 (default) |
| 2023 | Scale Group D: Voltmeter | None | –1 to 2 | Scale Group D: Voltmeter<br>–1=scale by 0.10<br>0=scale by 1.00 (default)<br>1=scale by 10.0<br>2=scale by 100 |
| 2024 | Scale Group E: kWattmeter, kVarmeter, kVa | None | –3 to 3 | Scale Group E: kWattmeter, kVarmeter, kVA<br>–3=scale by 0.001<br>–2=scale by 0.01<br>–1=scale by 0.1<br>0=scale by 1.0 (default)<br>1=scale by 10<br>2=scale by 100<br>3=scale by 1000 |
| 2026 | Scaling Error | None | 1 to 1F | Possible Scaling Error<br>Bit 0 set if any other bits are set<br>Bit 1 is set for possible phase current scale error<br>Bit 2 unused<br>Bit 3 is set for possible phase voltage scale error<br>Bit 4 is set for possible power scale error |
| 2027 | Unused | | | |
| 2028 | Command Password | None | 0 to +/–32,767 | Command Password (Computed by Power Meter) |
| 2029 | Master Password | None | 0 to 9998 | Full Access Reset & Setup Password |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

| Reg. No. ① | Register Name | Units | Range | Description |
|---|---|---|---|---|
| 2030 | Unused | | | |
| 2031 | Reset Access Password | None | 0 to 9998 | Reset Only Password |
| 2032 | Limited Access Disable Bit Mask | None | 0 to F (Hex) | Limited Display Reset Disable Bit Mask<br>A 1=Disable<br>Bit 0=Disable Demand Amps Reset Capability<br>Bit 1=Disable Demand Power Reset Capability<br>Bit 2=Disable Energy Reset Capability |
| 2040–2041 | Power Meter Label | None | Any Valid Alpha-Numeric | |
| 2042–2049 | Power Meter Nameplate | None | Any Valid Alpha-Numeric | |
| 2077 | Power Demand | Minutes | 1–60 min @ 1 min. Multiples | |
| 2078 ② | Power Demand Sub-Interval | Minutes | 1-60 min @1 min. multiples | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range | Description |
|---|---|---|---|---|
| 2081 | Operating Mode Selections Bitmap | None | 0 to FFFF | Power Meter Operating Mode Selections Bitmap<br>Bit 0 indicates VAr sign convention ②<br>0=CM 1 convention (default)<br>1=alternate convention<br>Bit 1 indicates Reactive Energy and Demand calculation ②<br>0=fundamental only (default)<br>1=include harmonic cross products (displacement & distortion)<br>Bit 2 is unused<br>Bit 3 is unused<br>Bit 4 indicates whether display setup is enabled ②<br>0=display setup enabled (default)<br>1=indicates display setup is disabled<br>Bit 5 is unused<br>Bit 6 indicates parity selection<br>0 =Even<br>1=None<br>Bit 7 indicates protocol selection<br>0=POWERLOGIC (default)<br>1=Modbus/Jbus<br>Bit 8 is unused<br>Bit 9 is unused<br>Bit 10 is unused<br>Bit 11 is unused<br>Bit 12<br>0=THD (default)<br>1=thd<br>All other bits are unused |
| 2082 | Energy Accumulation Method | None | 0–3 | Energy Accumulation Method ②<br>0=Absolute<br>1=Signed<br>2=In only<br>3=Out only |
| 2085 | Square D Product ID Number | None | 0 to 3000 | 481=model 600 power meter<br>482=model 620 power meter<br>483=model 650 power meter |
| 2091 | PMOS-M Revision Level | None | 0 to 32,767 | |
| 2092 | PMOS-D Revision Level | None | 0 to 32,767 | |
| 2093 | PMRS Revision Level | None | 0 to 32,767 | |
| 2094 | Reserved for DL | | | |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② SMS-3000 or SMS-1500 necessary to select alternate.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| **Alarm Configuration ②** | | | |
| 5780 | Event Counter 1 | None | 0–32,767 |
| 5781 | Event Counter 2 | None | 0–32,767 |
| 5782 | Event Counter 3 | None | 0–32,767 |
| 5783 | Event Counter 4 | None | 0–32,767 |
| 5784 | Reserved | | |
| 5785 | Event Counter 6 | None | 0–32,767 |
| 5786 | Event Counter 7 | None | 0–32,767 |
| 5787 | Event Counter 8 | None | 0–32,767 |
| 5788 | Event Counter 9 | None | 0–32,767 |
| 5789 | Event Counter 10 | None | 0–32,767 |
| 5790 | Event Counter 11 | None | 0–32,767 |
| 5791 | Reserved | | |
| 5792 | Event Counter 13 | None | 0–32,767 |
| 5793 | Event Counter 14 | None | 0–32,767 |
| 5794 | Event Counter 15 | None | 0–32,767 |
| 5795 | Event Counter 16 | None | 0–32,767 |
| 5796 | Event Counter 17 | None | 0–32,767 |
| 5797 | Event Counter 18 | None | 0–32,767 |
| 5798 | Event Counter 19 | None | 0–32,767 |
| 5799 | Event Counter 20 | None | 0–32,767 |
| 5800 | Event Counter 21 | None | 0–32,767 |
| 5801 | Event Counter 22 | None | 0–32,767 |
| 5802 | Event Counter 23 | None | 0–32,767 |

① These registers can be used with POWERLOGIC, Modbus, or Jbus protocols. Although POWERLOGIC and Jbus protocols use a zero-based register addressing convention and Modbus uses a one-based register addressing convention, the power meter, when configured for Modbus communications, *automatically compensates* for the Modbus offset of one. Regard all registers as holding registers where a 30,000 or 40,000 offset can be used (e.g., Current, Phase A = 31,003 or 41,003).

② PM-650 only.

| Reg. No. ① | Register Name | Units | Range |
|---|---|---|---|
| 5803 | Event Counter 24 | None | 0–32,767 |
| 5804 | Event Counter 25 | None | 0–32,767 |
| 5805 | Event Counter 26 | None | 0–32,767 |
| 5806 | Event Counter 27 | None | 0–32,767 |
| 5807 | Event Counter 28 | None | 0–32,767 |
| 5808 | Event Counter 29 | None | 0–32,767 |
| 5809 | Event Counter 30 | None | 0–32,767 |
| 5810-5819 | Reserved | | |
| 5820 | Event Counter 41 | None | 0–32,767 |
| 5821 | Event Counter 42 | None | 0–32,767 |

# APPENDIX G—MODBUS AND JBUS FUNCTIONS SUPPORTED

Standard Modbus and Jbus functions supported by the power meter are listed below.

- 3 Read Registers
- 4 Read Registers
- 6 Write Single Register
- 8 Diagnostic Codes:
  - 10 Clear Counters and Diagnostic Registers
  - 11 Returns the number of messages received with correct CRC.
  - 12 Returns the number of messages received with CRC error.
  - 13 Returns the number of exception replies sent.
  - 14 Returns the number of messages sent to this unit.
  - 15 Returns the number of broadcast messages received.
  - 16 Returns slave NAK count.
  - 17 Returns slave busy count.
  - 18 Returns the number of characters received with error.
- 11 Fetch Communications Event Counter
- 16 Write multiple registers
- 17 Report slave identification number (modified; see explanation on next page)
- 22 Single register write with mask
- 23 Block register read/write

## Function 17 (11 Hex)—Report Slave ID

This returns a description of the device present at the slave address. Because POWERLOGIC device IDs consist of two bytes, the slave ID for any POWERLOGIC device will be 100 (64 hex), and the device ID or address will be returned as Additional Data Hi and Lo.

**Query**

| Description | Example (Hex) |
|---|---|
| Slave Address | 11 |
| Function Code | 11 |
| CRC Lo | — |
| CRC Hi | — |

**Response**

| Description | Example (Hex) |
|---|---|
| Slave Address | 11 |
| Function Code | 11 |
| Byte Count | 04 |
| Slave ID | 64 ① |
| Run Indicator Status | FF |
| Additional Data Hi | 01 |
| Additional Data Lo | E1 |
| CRC Lo | — |
| CRC Hi | — |

① For the power meter, this will always be 64. See Additional Data Hi/Lo for POWERLOGIC address.

# APPENDIX H—2-WIRE MODBUS OR JBUS

## COMMUNICATIONS WIRING

When wiring the communications terminals for 2-wire Modbus or Jbus, be sure to jumper IN+ to OUT+ and IN– to OUT– (figure H-1).

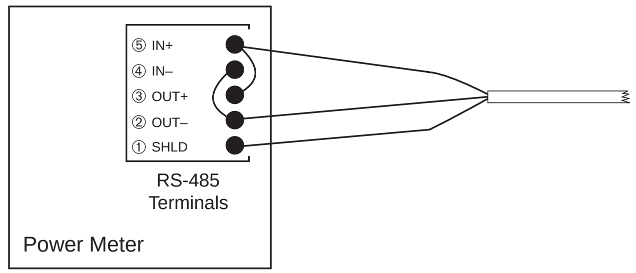



*Figure H-1: 2-wire Modbus or Jbus wiring*

The table below shows the maximum distance that a daisychain of power meters communicating via 2-wire Modbus or Jbus can extend. Baud rate and the number of devices on the daisychain are considerations in calculating the maximum distance.

**Table H-1**
**Maximum Distances of 2-Wire Modbus or Jbus Comms Link at Different Baud Rates**

| Baud Rate | Maximum Distances | |
|---|---|---|
| | 1–8 Devices | 9–16 Devices |
| 1200 | 10,000 ft. (3,048 m) | 10,000 ft. (3,048 m) |
| 2400 | 10,000 ft. (3,048 m) | 5,000 ft. (1,524 m) |
| 4800 | 10,000 ft. (3,048 m) | 5,000 ft. (1,524 m) |
| 9600 | 10,000 ft. (3,048 m) | 4,000 ft. (1,219 m) |
| 19200 | 5,080 ft. (1,548 m) | 2,500 ft. (762 m) |

# APPENDIX I—ALARM SETUP (PM-650 ONLY)

## INTRODUCTION

The power meter is designed to handle a wide range of metering requirements. To handle very large and very small metering values, the power meter uses scale factors to act as multipliers. These scale factors range from 0.001 up to 1000 and are expressed as powers of 10. For example, $0.001 = 10^{-3}$. These scale factors are necessary because the power meter stores data in registers which are limited to integer values between –32,767 and +32,767. When a value is either larger than 32,767, or is a non-integer, it is expressed as an integer in the range of ±32,767 associated with a multiplier in the range of $10^{-3}$ to $10^{3}$.

When POWERLOGIC application software is used to set up alarms, it automatically scales pickup and dropout setpoints.

However, when alarm setup is performed from the power meter's display, you must:

- determine how the corresponding metering value is scaled, and
- take the scale factor into account when entering alarm pickup and dropout settings

## SCALING ALARM SETPOINTS

If you do not have POWERLOGIC software, you must set up alarms from the power meter display. This section explains how to properly scale alarm setpoints so you can do that.

The power meter displays the scale factor needed for the pickup and dropout setpoints in the Alarm Setup mode. Only the pickup and dropout values require scale factors. The pickup and dropout delays are entered in seconds.

After enabling an alarm, the next screen displayed is the scale factor for the alarm pickup value. For example, when setting up an Under Frequency alarm, the screen displays "Enter PU value in FREQUENCY x 100." This means that if you want to set a pickup value of 58 HZ, you must enter the pickup value as 5800. After you enter the pickup value and pickup delay, the next screen displays the proper scaling of the dropout value. Enter the dropout value in the same manner as the pickup value.

As another example, consider an Under Voltage Alarm. For a 480 V system, you might want to enter the pickup value as 455 V. The screen may display "Enter PU value in VOLTS x 1." Therefore, you can enter the pickup value as just 455 since the scale factor is 1.

As one more example, consider an Unbalance Alarm. The power meter prompts you to enter the pickup and dropout values as PERCENT x 10. Therefore, to alarm on an unbalance of 3.5%, enter 35 as the pickup value.

## ALARM CONDITIONS AND ALARM NUMBERS

The power meter‘s predefined alarm conditions are listed below along with the information given for each alarm condition.

| | |
|---|---|
| Alarm No. | A code number used to refer to individual alarms. |
| Alarm Description | A brief description of the alarm condition. |
| Test Register | The register number that contains the value (where applicable) that is used as the basis for a comparison to alarm pickup and dropout settings. |
| Units | The units that apply to the pickup and dropout settings. |
| Scale Group | The Scale Group that applies to the test register’s metering value (A–F). For a description of scale groups, see **Scale Group Definitions** in this section. |
| Alarm Type | A reference to a definition providing details on the operation and configuration of the alarm. For a description of alarm types, see **Alarm Type Definitions** in this section. |

| Alarm No. | Alarm Description | Test Register | Units | Scale Group | Alarm Type |
|---|---|---|---|---|---|
| 01 | Overcurrent Phase A | 1003 | Amps | A | A |
| 02 | Overcurrent Phase B | 1004 | Amps | A | A |
| 03 | Overcurrent Phase C | 1005 | Amps | A | A |
| 04 | Overcurrent Neutral | 1006 | Amps | A | A |
| 05 | Reserved | | | | |
| 06 | Undercurrent Phase A | 1003 | Amps | A | B |
| 07 | Undercurrent Phase B | 1004 | Amps | A | B |
| 08 | Undercurrent Phase C | 1005 | Amps | A | B |
| 09 | Current Unbalance Phase A | 1010 | Tenths % | | A |
| 10 | Current Unbalance Phase B | 1011 | Tenths % | | A |
| 11 | Current Unbalance Phase C | 1012 | Tenths % | | A |
| 12 | Reserved | | | | |
| 13 | Overvoltage Phase A | 1018 | Volts | D | A |
| 14 | Overvoltage Phase B | 1019 | Volts | D | A |
| 15 | Overvoltage Phase C | 1020 | Volts | D | A |
| 16 | Overvoltage Phase A-B | 1014 | Volts | D | A |
| 17 | Overvoltage Phase B-C | 1015 | Volts | D | A |
| 18 | Overvoltage Phase C-A | 1016 | Volts | D | A |
| 19 | Undervoltage Phase A | 1018 | Volts | D | B |
| 20 | Undervoltage Phase B | 1018 | Volts | D | B |
| 21 | Undervoltage Phase C | 1018 | Volts | D | B |
| 22 | Undervoltage Phase A-B | 1014 | Volts | D | B |
| 23 | Undervoltage Phase B-C | 1015 | Volts | D | B |
| 24 | Undervoltage Phase C-A | 1016 | Volts | D | B |
| 25 | Voltage Unbalance Phase A | 1026 | Tenths % | | A |
| 26 | Voltage Unbalance Phase B | 1027 | Tenths % | | A |
| 27 | Voltage Unbalance Phase C | 1028 | Tenths % | | A |
| 28 | Voltage Unbalance Phase A-B | 1022 | Tenths % | | A |
| 29 | Voltage Unbalance Phase B-C | 1023 | Tenths % | | A |
| 30 | Voltage Unbalance Phase C-A | 1024 | Tenths % | | A |
| 31–40 | Reserved | | | | |
| 41 | Overfrequency | 1001 | Hundredths of Hz | F | A |
| 42 | Underfrequency | 1001 | Hundredths of Hz | F | B |

## Scale Group Definitions

### Scale Group A—Phase and Neutral Current

| Amps | Scale Factor |
|---|---|
| 0–327.67 | –2 |
| 0–3276.7 | –1 |
| 0–32767 | 0 (default) |

### Scale Group D—Voltage, L-L, L-N

| Amps | Scale Factor |
|---|---|
| 0–3276.7 | –1 |
| 0–32767 | 0 (default) |
| 0–327.67 | 1 |
| 0–3276.7 | 2 |

### Scale Group E—Power kW, kVAr, kVA

| Power | Scale Factor |
|---|---|
| 0–32.767 kW, kVAr, kVA | –3 |
| 0–327.67 kW, kVAr, kVA | –2 |
| 0–3276.7 kW, kVAr, kVA | –1 |
| 0–32767 kW, kVAr, kVA | 0 (default) |
| 0–327.67 MW, MVAr, MVA | 1 |
| 0–3276.7 MW, MVAr, MVA | 2 |
| 0–32767 MW, MVAr, MVA | 3 |

### Scale Group F—Frequency

| Hertz | Scale Factor |
|---|---|
| 45.00–66.00 | –2 |

## Alarm Type Definitions

| Alarm Type | Alarm Description | Alarm Operation |
|---|---|---|
| A | Overvalue Alarm | If the test register value exceeds the setpoint long enough to satisfy the pickup delay period, the alarm condition will be true. When the value in the test register falls below the dropout setpoint long enough to satisfy the dropout delay period, the alarm will drop out. Pickup and dropout setpoints are positive. Delays are in seconds. |
| B | Undervalue Alarm | If the test register value is below the setpoint long enough to satisfy the pickup delay period, the alarm condition will be true. When the value in the test register rises above the dropout setpoint long enough to satisfy the dropout delay period, the alarm will drop out. Pickup and dropout setpoints are positive. Delays are in seconds. |

# APPENDIX J—CALCULATING LOG FILE SIZE (PM-650 ONLY)

The PM-650 has 1K of memory available for the event log and data log combined. Using POWERLOGIC software, you can configure the sizes of the event log and data log within the available memory.

Data is stored in 16-bit registers (16 bits=2 bytes). Since there are 1024 bytes in 1K of memory, there are 512 registers (1024/2) dedicated to logging in the power meter. Sixteen registers are used by the power meter for memory management; therefore, 496 registers are available for data logging.

Some quantities that you can log require more registers than others. Cumulative energy readings require 4 registers and non-energy meter readings require 1 register. Additional registers are required to log the date and time for each entry. Therefore, the number and type of values you store, and how often you store those values, affect the rate at which the data logging memory fills up. Each event log entry uses 8 registers of memory.

This appendix tells how to calculate the approximate size of the log file using the above information. To see if the log file you've set up will fit in the available logging memory, calculate the size of the log file using the worksheet below. Your total should not exceed 496 registers.

To calculate the size of the log file, follow these steps:

| | | |
|---|---|---|
| 1. Multiply the number of cumulative energy readings by 4 (registers): | 1. | ________ |
| 2. Enter the number of non-energy meter readings: | 2. | ________ |
| 3. Add lines 1 and 2: | 3. | ________ |
| 4. Add 3 to the value on line 3 (for date/time of each entry): | 4. | ________ |
| 5. Multiply line 4 by the maximum number of records in the data log file (how many times you are logging each quantity): | 5. | ________ |
| 6. Multiply the number of events by 8. | 6. | ________ |
| 7. Add lines 5 and 6. | 7. | ________ |

Line 7 should not exceed 496.

For example, suppose you want to log cumulative apparent energy every hour for 2 days and store the last 20 events:

| | |
|---|---|
| 1. Multiply the number of cumulative energy readings by 4 (registers): | 1. 1 x 4 = 4 |
| 2. Enter the number of non-energy meter readings: | 2. 0 |
| 3. Add lines 1 and 2: | 3. 4 |
| 4. Add 3 to the value on line 3. (For date/time of each entry): | 4. 7 |
| 5. Multiply line 4 by the maximum number of records in the data log file (how many times you are logging each quantity): | 5. 24 (hours) x 2 (days) x 7 = 336 |
| 6. Multiply the number of events by 8. | 6. 20 x 8 = 160 |
| 7. Add lines 5 and 6. | 7. 336 + 160 = 496 |

This is a valid log because the total does not exceed 496.

In another example, suppose you want to log current and voltage for each phase every 4 hours for one week and store the last 10 events:

| | |
|---|---|
| 1. Multiply the number of cumulative energy readings by 4 (registers): | 1. 0 |
| 2. Enter the number of non-energy meter readings: | 2. 6 |
| 3. Add lines 1 and 2: | 3. 6 |
| 4. Add 3 to the value on line 3. (For date/time of each entry): | 4. 9 |
| 5. Multiply line 4 by the maximum number of records in the data log file (how many times you are logging each quantity): | 5. 9 x 6 (per day) x 7 (days) = 378 |
| 6. Multiply the number of events by 8: | 6. 10 x 8 = 80 |
| 7. Add lines 5 and 6: | 7. 378 + 80 = 458 |

This is also a valid log.

# Index



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