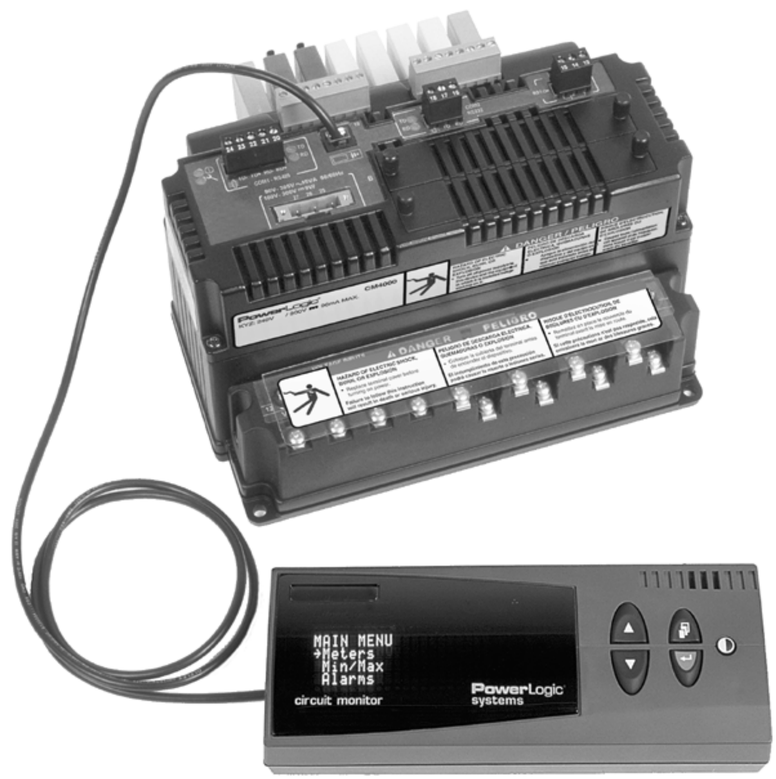
# Instruction Bulletin

63230-300-212
April 2001

# POWERLOGIC® Circuit Monitor
## Series 4000
## Reference Manual

**Retain for future use**

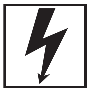



Merlin Gerin
Modicon
Square D
Telemecanique

Schneider Electric

## NOTICE

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.




The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

**⚠ DANGER**

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

**⚠ WARNING**

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

**⚠ CAUTION**

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

**CAUTION**

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

*NOTE: Provides additional information to clarify or simplify a procedure.*

## PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. This document is not intended as an instruction manual for untrained persons. No responsibility is assumed by Square D for any consequences arising out of the use of this manual.

## Class A FCC Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designated to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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# CHAPTER 1—INTRODUCTION

This chapter offers a general description of the Series 4000 Circuit Monitor, tells how to best use this bulletin, and lists related documents.

## CHAPTER CONTENTS

## WHAT IS THE CIRCUIT MONITOR?

The circuit monitor is a multifunction, digital instrumentation, data acquisition and control device. It can replace a variety of meters, relays, transducers and other components. The circuit monitor can be located at the service entrance to monitor the cost and quality of power, and can be used to evaluate the utility service. When located at equipment mains, the circuit monitor can detect voltage-based disturbances that cause costly equipment downtime.

The circuit monitor is equipped with RS-485 and RS-232 communications for integration into any power monitoring and control system. However, System Manager™ software (SMS) from POWERLOGIC, which is written specifically for power monitoring and control, best supports the circuit monitor's advanced features.

The circuit monitor is a true rms meter capable of exceptionally accurate measurement of highly nonlinear loads. A sophisticated sampling technique enables accurate, true rms measurement through the 255th harmonic. You can view over 50 metered values plus extensive minimum and maximum data from the display or remotely using software. Table 1–1 summarizes the readings available from the circuit monitor.

**Table 1–1: Summary of Circuit Monitor Instrumentation**

| Real-Time Readings | Energy Readings |
|---|---|
| • Current (per phase, N, G, 3-Phase)<br>• Voltage (L–L, L–N, N–G, 3-Phase)<br>• Real Power (per phase, 3-Phase)<br>• Reactive Power (per phase, 3-Phase)<br>• Apparent Power (per phase, 3-Phase)<br>• Power Factor (per phase, 3-Phase)<br>• Frequency<br>• Temperature (internal ambient)<br>• THD (current and voltage)<br>• K-Factor (per phase) | • Accumulated Energy, Real<br>• Accumulated Energy, Reactive<br>• Accumulated Energy, Apparent<br>• Bidirectional Readings<br>• Reactive Energy by Quadrant<br>• Incremental Energy<br>• Conditional Energy |
| **Demand Readings** | **Power Analysis Values** |
| • Demand Current (per phase present, 3-Phase avg.)<br>• Demand Voltage (per phase present, 3-Phase avg.)<br>• Average Power Factor (3-Phase total)<br>• Demand Real Power (per phase present, peak)<br>• Demand Reactive Power (per phase present, peak)<br>• Demand Apparent Power (per phase present, peak)<br>• Coincident Readings<br>• Predicted Power Demands | • Crest Factor (per phase)<br>• Displacement Power Factor (per phase, 3-Phase)<br>• Fundamental Voltages (per phase)<br>• Fundamental Currents (per phase)<br>• Fundamental Real Power (per phase)<br>• Fundamental Reactive Power (per phase)<br>• Harmonic Power<br>• Unbalance (current and voltage)<br>• Phase Rotation<br>• Harmonic Magnitudes & Angles (per phase)<br>• Sequence Components |

## Accessories and Options for the Circuit Monitor

The circuit monitor has a modular design to maximize its usability. In addition to the main meter, the circuit monitor has plug-on modules and accessories, including:

- **Current/voltage module (CVM)**. A standard part of the circuit monitor is the current/voltage module where all metering data acquisition occurs.
- **Remote display**. The optional remote 4-line display is available with a back-lit liquid crystal display (LCD) or a vacuum fluorescent display (VFD). The VFD model includes an infrared port that can be used to communicate directly with the circuit monitor from a laptop and can be used to download firmware, which keeps the circuit monitor up to date with the latest system enhancements.
- **I/O Extender**. The I/O extender, located on the side of the circuit monitor, enables you to “plug in” up to 8 industry-standard inputs and outputs. Several preconfigured combinations are available, or you can create a custom configuration.
- **Digital I/O Card**. You can further expand the I/O capabilities of the circuit monitor by adding a digital I/O card (4 inputs and 4 outputs). This card fits into one of the option slots on the top of the circuit monitor.
- **Ethernet Communications Card**. The Ethernet communications card provides an Ethernet port that accepts a 100 Mbps fiber optic cable or a 10/100 Mbps UTP and provides an RS-485 master port to extend the circuit monitor communications options. This card is easily installed into option slot A on the top of the circuit monitor.

Table 1–2 lists the circuit monitor parts and accessories and their associated instruction bulletins.

**Table 1–2: Circuit Monitor Parts, Accessories, and Custom Cables**

| Description | Part Number | Document Number |
|---|---|---|
| Circuit Monitor | CM4000 | 63230-300-200 |
| Current/Voltage Module | CVM | 63230-301-200 |
| VFD Display with infrared (IR) port and proximity sensor | CMDVF | 63230-305-200 |
| LCD Display | CMDLC | |
| Optical Communications Interface (for use with the VFD display only) | OCIVF | 63230-306-200 |
| I/O Extender Module ① | | 63230-302-200 |
| with no preinstalled I/Os, accepts up to 8 individual I/O modules with a maximum of 4 analog I/Os | IOX | |
| with 4 digital inputs (32 Vdc), 2 digital outputs (60 Vdc), 1 analog output (4–20 mA), and 1 analog input (0–5 Vdc) | IOX2411 | |
| with 4 analog inputs (4–20 mA) and 4 digital inputs (120 Vac) | IOX0404 | |
| with 8 digital inputs (120 Vac) | IOX08 | |
| Digital I/O Card<br>Field installable with 4 digital inputs (120 Vac), 3 (10 A) relay outputs (120Vac), 1 pulse output (KYZ) | IOC44 | 63230-303-200 |
| Ethernet Communications Card with<br>100 Mbps fiber or 10/100 Mbps UTP Ethernet port and 1 RS-485 master port | ECC21 | 63230-304-200 |
| Optical Communications Interface | OCIVG | 63230-306-200 |
| Memory Expansion Kit (16 MB and 32 MB kits) | CM4MEM16M<br>CM4MEM32M | 63230-300-205 |

① For parts list of individual inputs and outputs, see Table 5–1 on page 70.

**Table 1–2: Circuit Monitor Parts, Accessories, and Custom Cables**

| | | |
|---|---|---|
| CM4 Mounting Adapters | CM4MA | 63230-204-316<br>63230-300-206<br>63230-305-201 |
| 4-ft display cable (1.2 m) | CAB-4 | N/A |
| 12-ft display cable (3.6 m) | CAB-12 | |
| 30-ft display cable (9.1 m) | CAB-30 | |
| 10-ft RS-232 cable (3 m) | CAB-106 | |

① For parts list of individual inputs and outputs, see Table 5–1 on page 70.

### Features

Some of the circuit monitor's many features include:

- True rms metering to the 255th harmonic
- Accepts standard CT and PT inputs
- 600 volt direct connection on metering inputs
- Certified ANSI C12.20 revenue accuracy and IEC 687.2 class revenue accuracy
- High accuracy—0.04% current and voltage
- Min/max readings of metered data
- Power quality readings—THD, K-factor, crest factor
- Real-time harmonic magnitudes and angles to the 63rd harmonic
- Current and voltage sag/swell detection and recording
- Downloadable firmware
- Easy setup through the optional remote display (password protected) where you can view metered values
- Setpoint-controlled alarm and relay functions
- Onboard alarm and data logging
- Wide operating temperature range –25° to 70°C
- Modular, field-installable digital and analog I/O modules
- Flexible communications—RS-485 and RS-232 communications are standard, optional Ethernet communications card available with fiber optic connection
- Two option card slots for field-installable I/O and Ethernet capabilities
- Standard 8MB onboard logging memory (field upgradable to 16 MB, 32 MB, and higher
- CT and PT wiring diagnostics
- Revenue security with utility sealing capability

## TOPICS NOT COVERED IN THIS BULLETIN

Some of the circuit monitor's advanced features, such as onboard data logs and alarm log files, can only be set up over the communications link using SMS. SMS versions 3.12 and higher support the CM4000 device type.This circuit monitor instruction bulletin describes these advanced features, but does not tell how to set them up. For instructions on using SMS, refer to the SMS online help and the *SMS-3000 Setup Guide,* which is available in English (63220-060-200), French (63220-060-201), and Spanish (63220-060-202). For information about related instruction bulletins, see Table 1–2 on page 3.

## FIRMWARE

This instruction bulletin is written to be used with firmware version 11.000 or higher. See “Identifying the Firmware Version” on page 124 for instructions on how to determine the firmware version.

# CHAPTER 2—SAFETY PRECAUTIONS

This chapter contains important safety precautions that must be followed before attempting to install, service, or maintain electrical equipment. Carefully read and follow the safety precautions outlined below.

**DANGER**

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

- Only qualified workers should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- 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, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Turn off all power supplying this equipment before working on or inside.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Beware of potential hazards, wear personal protective equipment, carefully inspect the work area for tools and objects that may have been left inside the equipment.
- Use caution while removing or installing panels so that they do not extend into the energized bus; avoid handling the panels, which could cause personal injury.
- 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 Dielectric (Hi-Pot) or Megger testing on any equipment in which the circuit monitor is installed, disconnect all input and output wires to the circuit monitor. High voltage testing may damage electronic components contained in the circuit monitor.

**Failure to follow these instructions will result in death or serious injury.**

# CHAPTER 3—OPERATION

This chapter tells how to set up the circuit monitor from the display only. Some advanced features, such as configuring the onboard logs of the circuit monitor, must be set up over the communications link using SMS. Refer to the SMS instruction bulletin and online help file for instructions on setting up advanced features not accessible from the display.

## CHAPTER CONTENTS

## OPERATING THE DISPLAY

The display shows four lines of information at a time. Notice the arrow on the left of the display screen. This arrow indicates that you can scroll up or down to view more information. For example, on the Main Menu you can view the Resets, Setup, and Diagnostics menu options only if you scroll down to display them. When at the top of a list, the arrow moves to the top line. When the last line of information is displayed, the arrow moves to the bottom as illustrated in Figure 3–1.

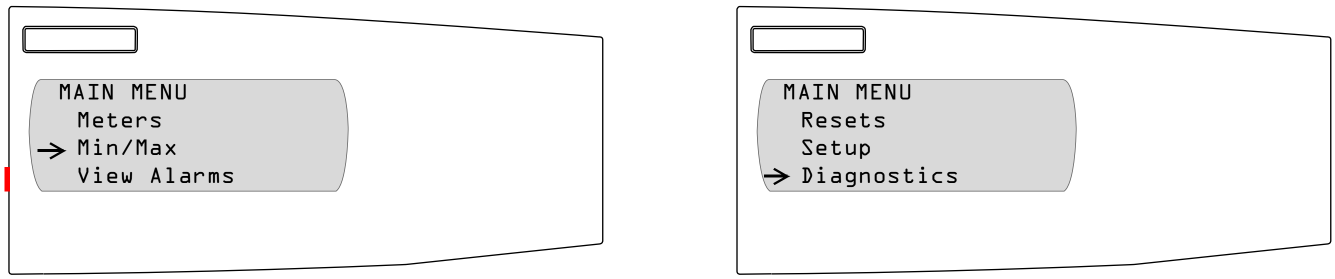



**Figure 3–1: Arrow on the display screen**

### How the Buttons Work

The buttons on the display let you scroll through and select information, move from menu to menu, and adjust the contrast. Figure 3–2 shows the buttons.

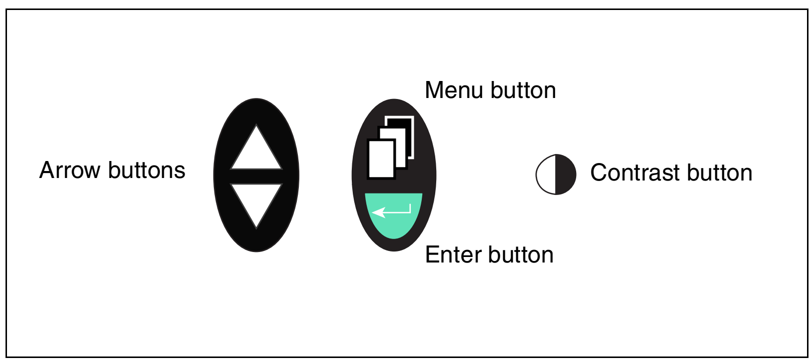



**Figure 3–2: Display buttons**

The buttons are used in the following way:

- **Arrow buttons**. Use the arrow buttons to scroll up and down the options on a menu. Also, when a value can be changed, use the arrow buttons to scroll through the values that are available. If the value is a number, holding the arrow button down increases the speed in which the numbers increase or decrease.
- **Menu button**. Each time you press the menu button, it takes you back one menu level. The menu button also prompts you to save if you've made changes to any options within that menu structure.
- **Enter button**. Use the enter button to select an option on a menu or select a value to be edited.
- **Contrast button**. Press the contrast button to darken or lighten the display. On the LCD model, press any button once to activate the back light.

## Display Menu Conventions

This section explains a few conventions that were developed to streamline instructions in this chapter. Figure 3–3 shows the parts of a menu.

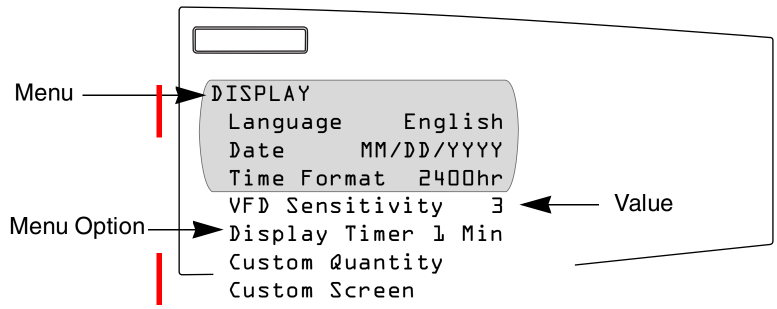



**Figure 3–3: Parts of a menu**

## Selecting a Menu Option

Each time you read “select” in this manual, choose the option from the menu by doing this:

1. Press the arrows to highlight the menu option.
2. Press the enter button to select that option.

## Changing a Value

To change a value, the procedure is the same on every menu:

1. Use the arrow buttons to scroll to the menu option you want to change.
2. Press the enter button to select the value. The value begins to blink.
3. Press the arrow buttons to scroll through the possible values. To select the new value, press the enter button.
4. Press the arrow buttons to move up and down the menu options. You can change one value or all of the values on a menu. To save the changes, press the menu button until the circuit monitor displays:

   “Save changes? No”

   *NOTE: Pressing the menu button while a value is blinking will return that value to its most current setting.*
5. Press the arrow to change to “Yes,” then press the enter button to save the changes.

## MAIN MENU OVERVIEW

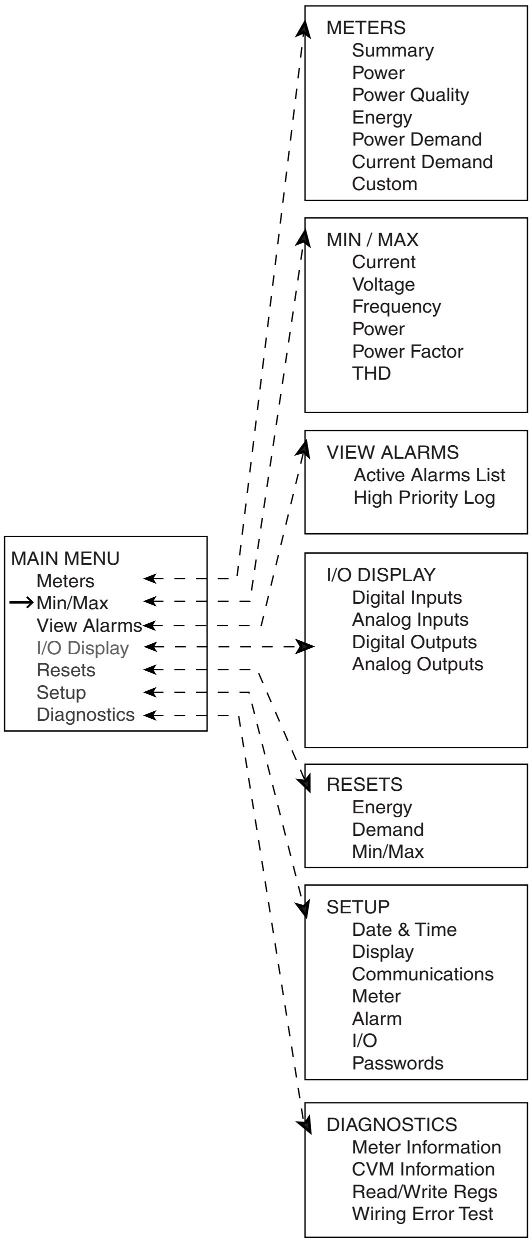



**Figure 3–4: Menu options on the Main Menu**

The Main Menu on the display contains the menu options that you use to set up and control the circuit monitor and its accessories and view metered data and alarms. Figure 3–4 on the left shows the options on the Main Menu. The menus are briefly described below:

- **Meters**. This menu lets you view metered values that provide information about power usage and power quality.
- **Min/Max**. This menu lets you view the minimum and maximum metered values since the last reset of the min/max values with their associated dates and times.
- **View Alarms**. This menu lets you view a list of all active alarms, regardless of the priority. In addition, you can view a log of high priority alarms, which contains the ten most recent high priority alarms.
- **I/O Display**. From this menu, you can view the designation and status of each input or output. This menu will only display the I/Os present, so you might not see all of the available menu items if you do not have a particular I/O installed.
- **Resets**. This menu lets you reset energy, peak demand, and minimum/maximum values.
- **Setup**. From this menu, you define the settings for the display such as selecting the date format to be displayed. Creating custom quantities and custom screens are also options on this menu. In addition, use this menu to set up the circuit monitor parameters such as the CT and PT ratios. The Setup menu is also where you define the communications, alarms, I/Os and passwords.
- **Diagnostics**. From this menu, you can initiate the wiring error test. Also, use this menu to read and write registers and view information about the circuit monitor such as its firmware version and serial number.

## CONFIGURING THE CIRCUIT MONITOR USING THE SETUP MENU

Before you can access the Setup menu from the Main Menu, you must enter the Setup password. The default password is 0. To change the password, see “Setting Up Passwords” on page 27. The Setup menu has the following options:

- Date & Time
- Display
- Communications
- Meter
- Alarm
- I/O
- Passwords

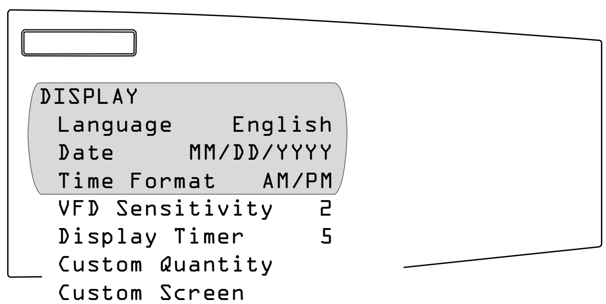
Each of these options is described in the sections that follow.

### Setting Up the Display

Setting up the display involves, for example, choosing a date and time format that you want to be displayed. To set up the display, follow these steps:

1. From the Main Menu, select Setup > Display.

   The Display Setup menu displays. Table 3–1 describes the options on this menu.




2. Use the arrow buttons to scroll to the menu option you want to change.
3. Press the enter button to select the value.The value begins to blink. Use the arrow buttons to scroll through the available values. Then, press the enter button to select the new value.
4. Use the arrow buttons to scroll through the other options on the menu, or if you are finished, press the menu button to save.

**Table 3–1: Factory Defaults for the Display Settings**

| Option | Available Values | Selection Description | Default |
|---|---|---|---|
| Language | English<br>Francais<br>Espanol | Language used by the display. | English |
| Date | MM/DD/YYYY<br>YYYY/MM/DD<br>DD/MM/YYYY | Data format for all date-related values of the circuit monitor. | MM/DD/YYYY |
| Time Format | 2400hr<br>AM/PM | Time format can be 24-hour military time or 12-hour clock with AM and PM. | 2400hr |
| VFD Sensitivity | Off<br>1 = 0–6 ft (0–15 m)<br>2 = 0–12 ft (0–31 m)<br>3 = 0–20 ft (0–51 m) | Sensitivity value for the proximity sensor (for the VFD display only). | 2 |
| Display Timer | 1, 5, 10, or 15 minutes | Number of minutes the display remains illuminated after inactivity. | 5 |
| Custom Quantity | Creating custom quantities is an advanced feature that is not required for basic setup. To learn more about this feature, see “Creating Custom Quantities to be Displayed” on page 28. | | |
| Custom Screen | Creating custom screens is an advanced feature that is not required for basic setup. To learn more about this feature, see “Creating Custom Screens” on page 31. | | |

## Setting Up the Communications

The Communications menu lets you set up the following communications:

- *RS-485* communications for daisy-chain communication of the circuit monitor and other RS-485 devices.
- *RS-232* communications for point-to-point communication between the the circuit monitor and a host device, such as a PC or modem.
- *Infrared Port* communications between the circuit monitor and a laptop computer (available only on the VFD display).
- *Ethernet Options* for Ethernet communications between the circuit monitor and your Ethernet network when an Ethernet Communications Card (ECC) is present.

Each of these options is described in the sections that follow.

### Setting the Device Address

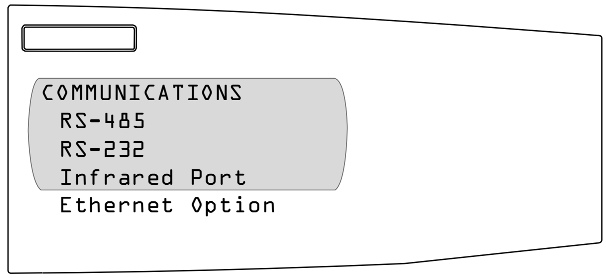
Each POWERLOGIC device on a communications link must have a unique device address. The term communications link refers to 1–32 POWERLOGIC compatible devices daisy-chained to a single communications port. If the communications link has only a single device, assign it address 1. By networking groups of devices, POWERLOGIC systems can support a virtually unlimited number of devices.

**RS-485, RS-232, and Infrared Port Communications Setup**

To set up RS-485, RS-232, or the infrared port communications, set the address, baud rate, and parity. Follow these steps:

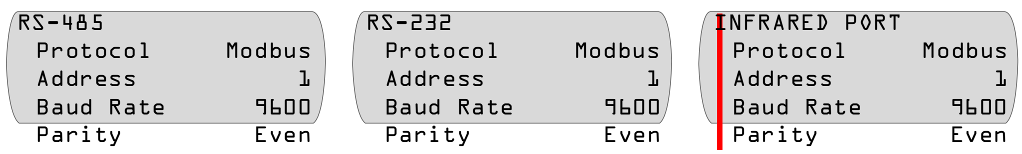
1. From the Main Menu, select Setup > Communications.

   The Communications Setup screen displays.




*NOTE: You can set up infrared communications only if the circuit monitor is equipped with a VFD display. Also, you can set up Ethernet communications only if the circuit monitor is equipped with an ECC card.*

2. From the Comms Setup menu, select the type of communications that you are using. Depending on what you select, the screen for that communications setup displays, as shown below. Table 3–2 describes the options on this menu.




3. Use the arrow buttons to scroll to the menu option you want to change.
4. Press the enter button to select the value.The value begins to blink. Use the arrow buttons to scroll through the available values. Then, press the enter button to select the new value.
5. Use the arrow buttons to scroll through the other options on the menu, or if you are finished, press the menu button to save.

**Table 3–2: Options for Communications Setup**

| Option | Available Values | Selection Description | Default |
|---|---|---|---|
| Protocol | MODBUS<br>JBUS | Select MODBUS or JBUS protocol. | MODBUS |
| Address | 1–255 | Device address of the circuit monitor. See “Setting the Device Address” on page 14 for requirements of device addressing. | 1 |
| Baud Rate | 1200<br>2400<br>4800<br>9600<br>19200<br>38400 | Speed at which the devices will communicate. The baud rate must match all devices on the communications link. | 9600 |

**Table 3–2: Options for Communications Setup**

| | | | |
|---|---|---|---|
| Parity | Even, Odd, or None | Parity at which the circuit monitor will communicate. | Even |

## Ethernet Communications Card (ECC) Setup

Ethernet communications is available only if you have an optional Ethernet Communications Card (ECC) that fits into slot A on the top of the circuit monitor. See “Option Cards” on page 28 in **Chapter 4—Installation** of the installation manual for more information. To set up the Ethernet communications between the circuit monitor and the network, refer to instruction bulletin no. 63230-304-200 provided with the ECC.

## Setting Up the Metering Functions of the Circuit Monitor

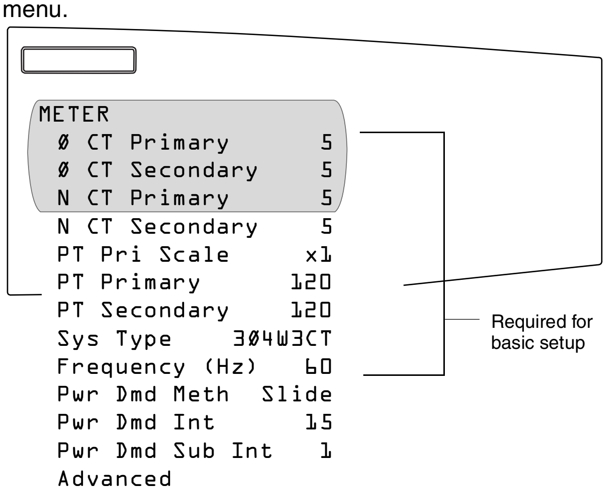
To set up the metering within the circuit monitor, you must configure the following items on the Meter setup screen for basic setup:

- CT and PT ratios
- System type
- Frequency

The power demand method, interval and subinterval, and advanced setup options are also accessible from the Meter Setup menu, but are not required for basic setup if you are accepting the factory defaults already defined in the circuit monitor. Follow these steps to set up the circuit monitor:

1. From the Main Menu, select Setup > Meter.

   The Meter setup screen displays. Table 3–3 describes the options on this menu.




2. Use the arrow buttons to scroll to the menu option you want to change.
3. Press the enter button to select the value. The value begins to blink. Use the arrow buttons to scroll through the available values. Then, press the enter button to select the new value.
4. Use the arrow buttons to scroll through the other options on the menu, or if you are finished, press the menu button to save.

**Table 3–3: Options for Meter Setup**

<table>
<tr><th>Option</th><th>Available Values</th><th>Selection Description</th><th>Default</th></tr>
<tr><td>CT Primary</td><td>1–32,767</td><td>Set the rating for the CT primary. The circuit monitor supports two primary CT ratings: one for the phase CTs and the other for the neutral CT.</td><td>5</td></tr>
<tr><td>CT Secondary</td><td>1 or 5</td><td>Set the rating for the CT secondaries.</td><td>5</td></tr>
<tr><td>PT Pri Scale</td><td>x1<br>x10<br>x100<br>No PT</td><td>Set the value to which the PT Primary is to be scaled if the PT Primary is larger than 32,767. For example, setting the scale to x10 multiplies the PT Primary number by 10.<br>For a direct-current installation, select “No PT.”</td><td>x1</td></tr>
<tr><td>PT Primary</td><td>1–32,767</td><td>Set the rating for the PT primary.</td><td>120</td></tr>
<tr><td>PT Secondary</td><td>100<br>110<br>115<br>120</td><td>Set the rating for the PT secondaries.</td><td>120</td></tr>
<tr><td>Sys Type</td><td>3Ø3W2CT<br>3Ø3W3CT<br>3Ø4W3CT<br>3Ø4W4CT<br>3Ø4W3CT2PT<br>3Ø4W4CT2PT</td><td>3Ø3W2CT is system type 30<br>3Ø3W3CT is system type 31<br>3Ø4W3CT is system type 40<br>3Ø4W4CT is system type 41<br>3Ø4W3CT2PT is system type 42<br>3Ø4W4CT2PT is system type 43<br>Set the system type. A system type code is assigned to each type of system connection. See Table 5–2 on page 38 of the installation manual for a description of system connection types.</td><td>3Ø4W3CT (40)</td></tr>
<tr><td>Frequency (Hz)</td><td>50, 60, or 400 Hz</td><td>Frequency of the system.</td><td>60</td></tr>
<tr><td>Pwr Dmd Meth</td><td colspan="2">Select the power demand calculation method. The circuit monitor supports several methods to calculate average demand of real power. See “Demand Power Calculation Methods” on page 57 for a detailed description.<br>Slide—Sliding Block Demand<br>Slave—Slave Block Demand<br>Therm—Thermal Demand<br>RComms—Command-Synchronized Rolling Block Demand<br>Comms—Command-Synchronized Block Demand<br>RInput—Input-Synchronized Rolling Block Demand<br>Input—Input-Synchronized Block Demand<br>RClock—Clock-Synchronized Rolling Block Demand<br>Clock—Clock-Synchronized Block Demand<br>RBlock—Rolling Block Demand<br>Block—Fixed Block Demand<br>IncEngy—Synch to Incremental Energy Interval</td><td>Slide</td></tr>
<tr><td>Pwr Dmd Int</td><td>1–60</td><td>Power demand interval—set the time in minutes in which the circuit monitor calculates the demand.</td><td>15</td></tr>
<tr><td>Pwr Dmd Sub Interval</td><td>1–60</td><td>Power demand subinterval—period of time within the demand interval in which the demand calculation is updated. Set the subinterval only for methods that will accept a subinterval. The subinterval must be evenly divisible into the interval.</td><td>N/A</td></tr>
<tr><td>Advanced</td><td colspan="3">See “Advanced Meter Setup” on page 34 in this chapter for more information.</td></tr>
</table>

## Setting Up Alarms

This section describes how to setup alarms and create your own custom alarms. For a detailed description of alarm capabilities, see **Chapter 6—Alarms** on page 83. The circuit monitor can detect over 100 alarm conditions, including over/under conditions, status input changes, phase unbalance conditions, and more. Some alarms are preconfigured and enabled at the factory. See “Factory Defaults” on page 11 in **Chapter 3—Getting Started** of the installation manual for information about preconfigured alarms. You can edit the parameters of any preconfigured alarm from the display.

For each alarm that you set up, do the following:

- Select the alarm group that defines the type of alarm:
  - — *Standard speed* alarms have a detection rate of one second and are useful for detecting conditions such as over current and under voltage. Up to 80 alarms can be set up in this group.
  - — *High speed* alarms have a detection rate of 100 milliseconds and are useful for detecting voltage sags and swells that last a few cycles. Up to 20 alarms can be set up in this group.
  - — *Disturbance monitoring* alarms have a detection rate of one cycle and are useful for detecting voltage sags and swells. Up to 20 alarms can be set up in this group.
  - — *Digital* alarms are triggered by an exception such as the transition of a status input or the end of an incremental energy interval. Up to 40 alarms can be set up in this group.
  - — *Boolean* alarms have a detection rate of the alarms used as inputs. They are used to combine specific alarms into summary alarm information.
- Select the alarm that you want to configure. Keep the default name or enter a new name with up to 15 characters.
- Enable the alarm.
- Assign a priority to the alarm. Refer to “Viewing Alarms” on page 41 for information about the alarm priority levels.
- Define any required pickup and dropout setpoints, and pickup and dropout time delays (for standard, high speed, and disturbance alarm groups only, refer to “Setpoint-Driven Alarms” on page 85 in **Chapter 6—Alarms**).

**Creating a New Custom Alarm**

In addition to editing an alarm, you can also create new custom alarms by performing two steps:

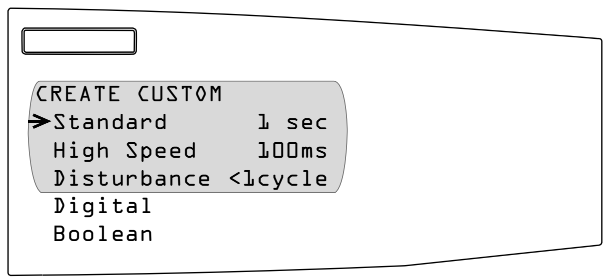
1. Create the custom alarm.
2. Setup and enable the new alarm.

To use custom alarms, you must first create a custom alarm and then set up the alarm to be used by the circuit monitor. Creating an alarm defines information about the alarm including:

- Alarm group (standard, high speed, disturbance, digital, or boolean)
- Name of the alarm
- Type (such as whether it alarms on an over or under condition)
- Register number of the value that will be alarmed upon

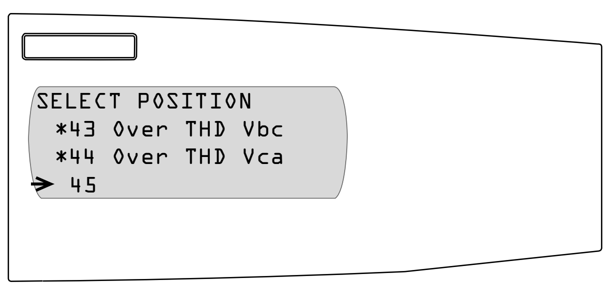
To create an alarm, follow these steps:

1. From the Main Menu, select Setup > Alarm > Create Custom.
   The Create Custom screen displays.




2. Select the Alarm Group for the alarm that you are creating:
   - Standard—detection rate of 1 second
   - High Speed—detection rate of 100 millisecond
   - Disturbance—detection rate of less than 1 cycle
   - Digital—triggered by an exception such as a status input or the end of an interval
   - Boolean—triggered by condition of alarms used as inputs

   The Select Position screen displays and jumps to the first open position in the alarm list.




3. Select the position of the new alarm.
   The Alarm Parameters screen displays.

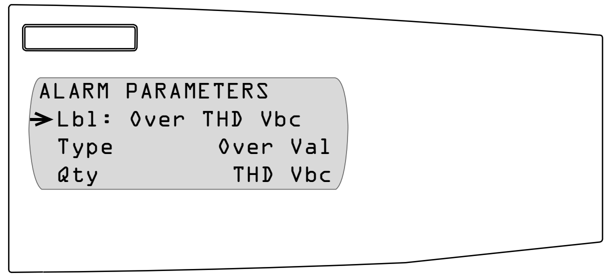



Table 3–4 on page 20 describes the options on this menu.

**Table 3–4: Options for Creating an Alarm**

| Option | Available Values | Selection Description | Default |
|---|---|---|---|
| Lbl | Alphanumeric | Label—name of the alarm. Press the down arrow button to scroll through the alphabet. The lower case letters are presented first, then uppercase, then numbers and symbols. Press the enter button to select a letter and move to the next character field. To move to the next option, press the menu button. | — |
| Type | Select the type of alarm that you are creating.<br>*Note: For digital alarms, the type is either ON state, OFF state, or Unary to describe the state of the digital input. Unary is available for digital alarms only.* ①<br>Over Val—over value<br>Over Pwr—over power<br>Over Rev Pwr—over reverse power<br>Under Val—under value<br>Under Pwr—under power<br>Phs Rev—phase reversal<br>Phs Loss Volt—phase loss, voltage<br>Phs Loss Cur—phase loss, current<br>PF Lead—leading power factor<br>PF Lag—lagging power factor<br>Binary<br>Time of Day<br>See Table 6–4 on page 96 for a description of alarm types. | | Undefined |
| Qty | For standard or high speed alarms this is the quantity to be evaluated. While selected, press the arrow buttons to scroll through the following quantity options: Current, Voltage, Demand, Unbalance, Frequency, Power Quality, THD, Harmonics, Temperature, Custom, and Register. Pressing the enter key while an option is displayed will activate that option's list of values. Use the arrow keys to scroll through the list of options, selecting an option by pressing the enter key. | | Undefined |

① Unary is a special type of alarm used for "end of" digital alarms. It does not apply to setting up alarms for digital inputs.

4. Press the menu button until “Save Changes? No” flashes on the display. Select Yes with the arrow button, then press the enter button to save the changes. Now, you are ready to set up the newly created custom alarm.

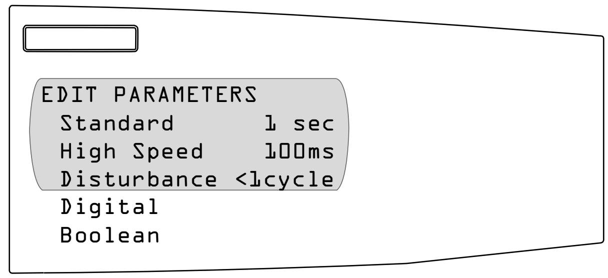
### Setting Up and Editing Alarms

To set up a newly created custom alarm for use by the circuit monitor, use the Edit Parameters option on the Alarm screen. You can also change parameters of any alarm, new or existing. For example, using the Edit option you can enable or disable an alarm, change its priority, and change its pickup and dropout setpoints.

Follow these instructions to set up or edit an alarm:

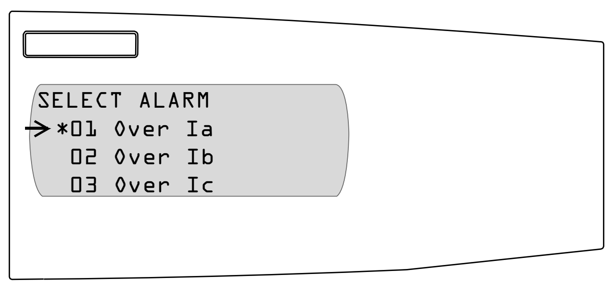
1. From the Main Menu, select Setup > Alarm > Edit Parameters.

   The Edit Parameters screen displays.




2. Select the Alarm Group:
   - Standard
   - High Speed
   - Disturbance
   - Digital
   - Boolean

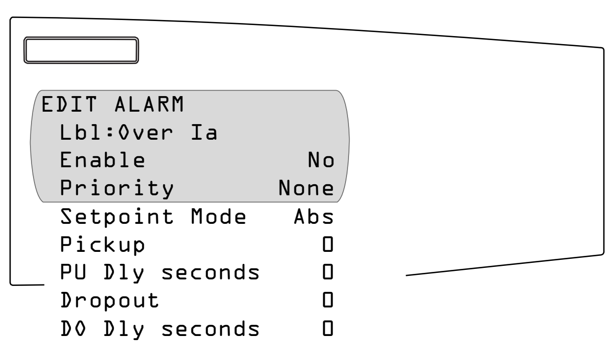
   The Select Alarm screen displays.




*NOTE: If you are setting up or editing a digital alarm, alarm names such as Breaker 1 trip, Breaker 1 reset will display instead.*

3. Select the alarm you want to set up or edit.

   The Edit Alarm screen with the alarm parameters displays. Table 3–5 describes the options on this menu.



*NOTE: If you are setting up or editing a digital alarm, fields related to pickup and dropout are not applicable and will not be displayed.*

4. Use the arrow buttons to scroll to the menu option you want to change, then edit the alarm options.
5. When you are finished with all changes, press the menu button until “Save Changes? No” flashes on the display. Select Yes with the arrow button, then press the enter button to save the changes.

   *NOTE: An asterisk next to the alarm in the alarm list indicates that the alarm is enabled.*

**Table 3–5: Options for Editing an Alarm**

<table>
<tr><th>Option</th><th>Available Values</th><th>Selection Description</th><th>Default</th></tr>
<tr><td>Lbl</td><td>Alphanumeric</td><td>Label—name of the alarm assigned to this position. Press the down arrow button to scroll through the alphabet. The lower case letters are presented first, then uppercase, then numbers and symbols. Press the enter button to select a letter and move to the next character field. To move to the next option, press the menu button.</td><td>Name of the alarm assigned to this position.</td></tr>
<tr><td>Enable</td><td>Yes<br>No</td><td>Select Y to make the alarm available for use by the circuit monitor. On preconfigured alarms, the alarm may already be enabled.<br>Select N to makes the alarm function unavailable to the circuit monitor.</td><td>Depends on individual alarm.</td></tr>
<tr><td>Priority</td><td>None<br>Low<br>Med<br>High</td><td>Low is the lowest priority alarm. High is the highest priority alarm and also places the active alarm in the list of high priority alarms. To view this list from the Main Menu, select Alarms > High Priority Alarms. For more information, see “Viewing Alarms” on page 41.</td><td>Depends on individual alarm.</td></tr>
<tr><td>Setpoint Mode</td><td>Abs<br>Rel</td><td>Selecting Abs indicates that the pickup and dropout setpoints are absolute values. Rel indicates that the pickup and dropout setpoints are a percentage of a running average, the relative value, of the test value.</td><td></td></tr>
<tr><td>Pickup</td><td>1–32,767</td><td rowspan="4">When you enter a delay time, the number is multiples of time. For example, for standard speed the time is 2 for 2 seconds, 3 for 3 seconds, etc. For high speed alarms, 1 indicates a 100 ms delay, 2 indicates a 200 ms delay, and so forth. For disturbance the time unit is 1 cycle. See “Setpoint-Driven Alarms” on page 85 for an explanation of pickup and dropout setpoints.</td><td rowspan="4">Depends on individual alarm.</td></tr>
<tr><td>PU Dly Seconds</td><td>Pickup Delay<br>1–32,767</td></tr>
<tr><td>Dropout</td><td>1–32,767</td></tr>
<tr><td>DO Dly Seconds</td><td>Dropout Delay<br>1–32,767</td></tr>
</table>

## Setting Up I/Os

To set up an I/O, you must do the following:

1. Install the I/O option module following the instructions provided with the product.
2. Use the display to select which IOX option is installed.
3. Use the display to configure each individual input and output. You can also use SMS to configure inputs and outputs.

*NOTE: After selecting which IOX option is installed, you can't configure the module until you have saved the changes. After saving the changes, you then can configure the inputs and outputs.*

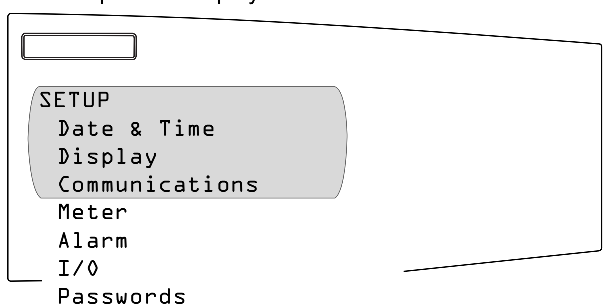
### Selecting I/O Modules

For a description of I/O options, see **Chapter 5—Input/Output Capabilities** on page 69. To view the status of an I/O, see "Viewing I/O Status" on page 43. You need to know the position number of the I/O to set it up. See "I/O Point Numbers" on page 186 to determine this number. To set up an I/O, follow these steps:

1. From the Main Menu, select Setup.

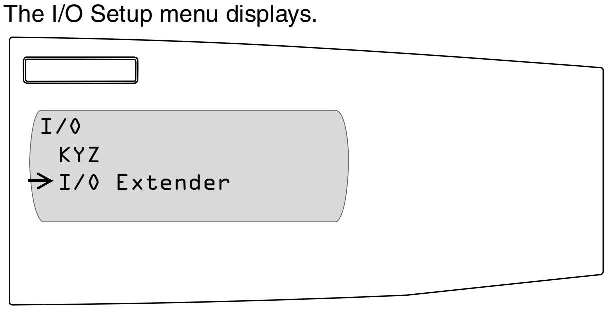
   The password prompt displays.
2. Select your password. The default password is 0.

   The Setup menu displays.




3. Select I/O.

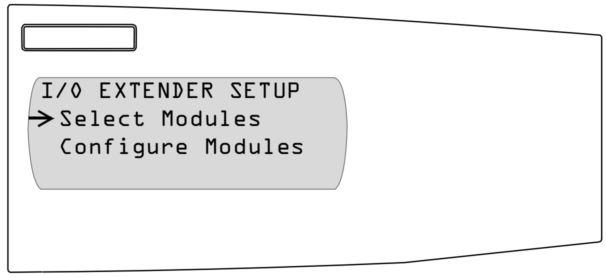
   The I/O Setup menu displays.




*NOTE: Other option modules will be displayed in the I/O menu if they are installed*

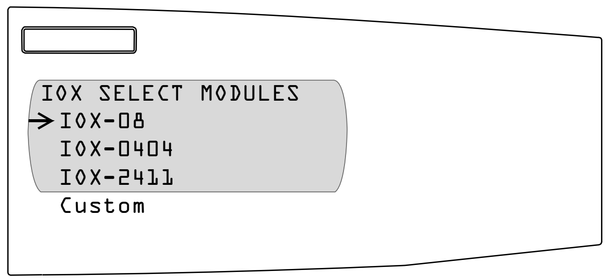
4. Select the I/O option that you have installed. In this example, we selected the I/O Extender.

The I/O Extender Setup menu displays.



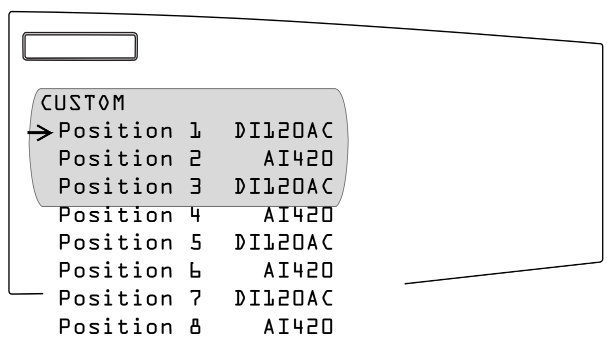

5. Select the Select Modules menu option.

   The IOX Select Modules menu displays.




6. If you have the IOX-08, IOX-0404, or IOX-2411, select the option you have installed. A pound sign (#) appears next to the option to indicate that the circuit monitor has recognized the module. If you installed individual custom I/Os, select Custom on the IOX Select Modules menu.

   The Custom Extender menu displays.




7. Select the position in which the I/O is installed. Then, select which I/O module is located in that position using the arrow keys to scroll through the available I/Os. The individual I/Os are described in Table 3–6.

**Table 3–6: I/O Descriptions**

| I/O Name | Description |
|---|---|
| **Digital I/Os** | |
| DI32DC | 32 Vdc input (0.2ms turn on) polarized |
| DI120AC | 120 Vac input |
| DO120AC | 120 Vac output |
| DI240AC | 240 Vac input |
| DO60DC | 60 Vdc output |
| DO200DC | 200 Vdc output |

**Table 3–6: I/O Descriptions**

| I/O Name | Description |
|---|---|
| DO240AC | 240 Vac output |
| **Analog I/Os** | |
| AI05 | 0 to 5 Vdc analog input |
| AI420 | 4 to 20 mA analog input |
| AO420 | 4 to 20 mA analog output |

8. Press the menu button until “Save Changes? No” flashes on the display. Select Yes with the arrow button, then press the enter button to save the changes.

## Configuring I/O Modules

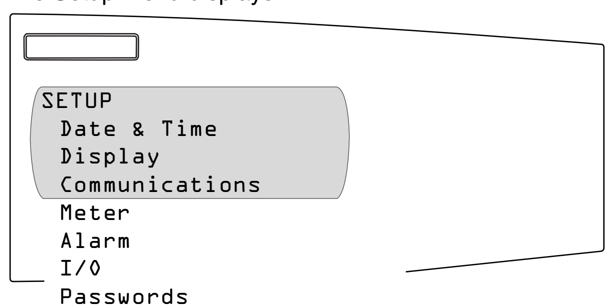
After selecting the I/O modules used with your circuit monitor, you can configure the I/O modules. Follow the steps below to configure the inputs and outputs for the I/O module you selected.

1. From the Main Menu, select Setup.

   The password prompt displays

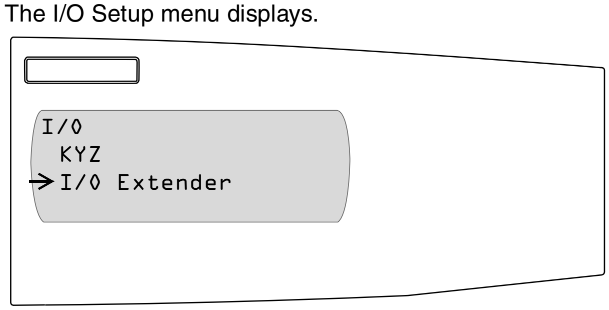
2. Select your password. The default password is 0.

   The Setup menu displays.




3. Select I/O.

   The I/O Setup menu displays.




4. Select the I/O option that you have installed. In this example, we selected the I/O Extender.

The I/O Extender Setup selection menu displays.

```
I/O EXTENDER SETUP
  Select Modules
→ Configure Modules
```

5. Select the Configure Modules menu option.

   The IOX Setup menu displays according to the IOX previously selected. In this example the IOX Custom Setup menu displays.

```
IOX CUSTOM SETUP
→ Position 1
  Position 2
  Position 3
  Position 4
  Position 5
  Position 6
  Position 7
  Position 8
```

6. Select the position in which the I/O is installed.

   The I/O module's setup menu displays based on the type of module installed in the selected position.

```
ANALOG INPUT SETUP
  Lbl:   Analog In C02
  Type    4-20mA Input
  I/O Point #       36
  Multiplier         1
  Lower Limit      400
  Upper Limit     2000
```

```
ANALOG OUTPUT SETUP
  Lbl:    Analog OutC04
  Type    4-20mA Output
  I/O Point #        38
  Reference Reg     100
  Lower Limit       400
  Upper Limit      2000
```

```
DIGITAL INPUT SETUP
  Lbl:        Dig In C01
  Type     120Vac Input
  I/O Point #        35
  Mode           Normal
```

```
DIGITAL OUTPUT SETUP
  Lbl:     Dig Out C03
  Type 120 Vac Output
  I/O Point #       37
  Mode          Normal
  Pulse Const     ****
  Timer (secs)       0
  Control     External
  Associate Alarm
```

*NOTE: For a description of the I/O options displayed above, refer to* **Chapter 5—Input/Output Capabilities** *on page 69.*

## Setting Up Passwords

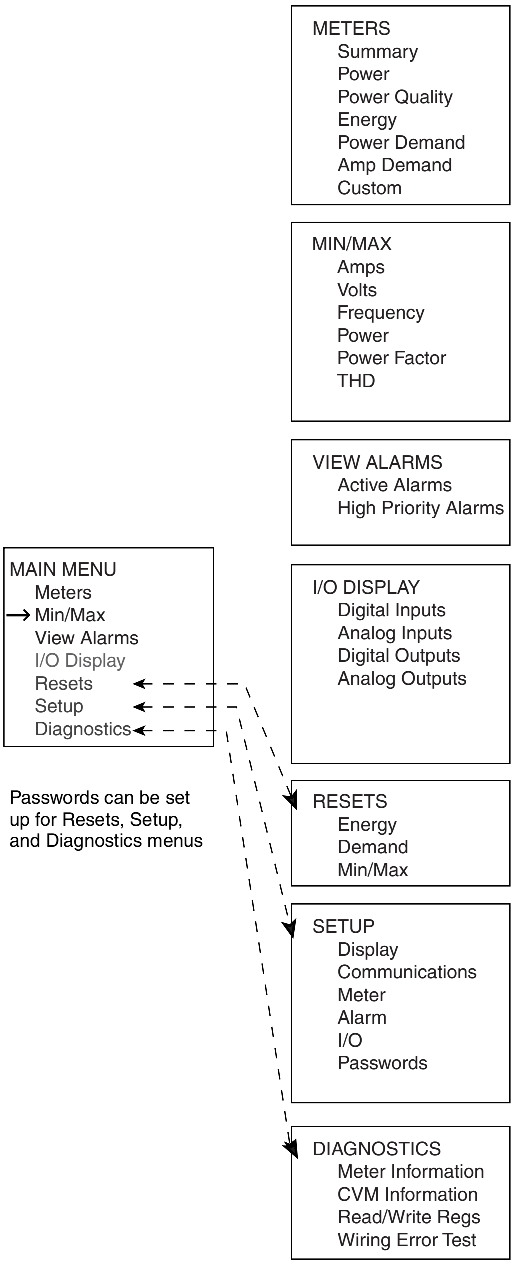



**Figure 3–5: Menus that can be password protected**

A password is always required to access the following menus from the Main Menu:

- Resets (a separate password can be set up for Energy/Demand Reset and Min/Max Reset)
- Setup
- Read/Write Regs on the Diagnostics Menu

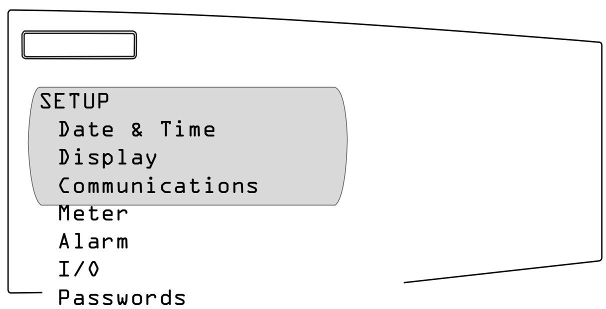
The default password is 0. Therefore, when you receive a new circuit monitor, the password for the Setup, Diagnostics, and Reset menu is 0. If you choose to set up passwords, you can set up a different password for each of the four menus options listed above.

To set up a password, follow these instructions:

1. From the Main Menu, select Setup.

   The password prompt displays.
2. Select 0, the default password.

   The Setup menu displays.




3. Select Passwords.

   The Password Setup menu displays. Table 3–7 describes the options.

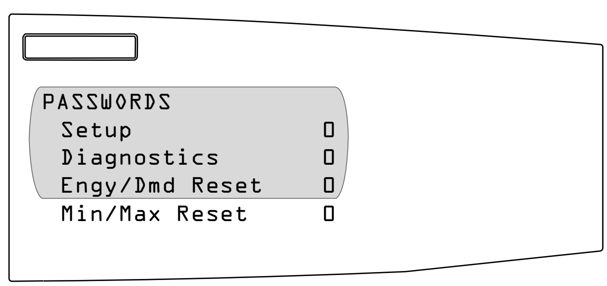



**Table 3–7: Options for Password Setup**

| Option | Available Values | Description |
|---|---|---|
| Setup | 0–9998 | Enter a password in the Setup field to create a password for the Setup option on the Main Menu. |
| Diagnostics | 0–9998 | Enter a password in the Diagnostics field to create a password for the Diagnostics option on the Main Menu. |

Table 3–7: Options for Password Setup

| | | |
|---|---|---|
| Engy/Dmd Reset[①] | 0–9998 | Enter a password in the Engy/Dmd Reset field to create a password for resetting Energy and Demand. These options appear on the Reset menu, and they can also be locked. See “Advanced Meter Setup” on page 34 for instructions. |
| Min/Max Reset[①] | 0–9998 | Enter a password in the Min/Max Reset field to create a password for resetting the Min/Max, which appears on the Reset menu. This option can also be locked. See “Advanced Meter Setup” on page 34 for instructions. |

①The word “Locked” appears next to a reset option that is inaccessible. If all of the reset options are locked, “Locked” will appear next to the Resets option in the Main Menu, and the Resets menu will be inaccessible.

## Advanced Setup Features

The features discussed in this section are not required for basic circuit monitor setup, but can be used to customize your circuit monitor to suit your needs.

### Creating Custom Quantities to be Displayed

Any quantity that is stored in a register in the circuit monitor can be displayed on the remote display. The circuit monitor has a list of viewable quantities already defined such as average current, power factor total, and so forth. In addition to these predefined values, you can define custom quantities that can be displayed on a custom screen. For example, if your facility uses different types of utility services such as water, gas, and steam, you may want to track usage of the three services on one convenient screen. To do this, you could set up inputs to receive pulses from each utility meter, then display the scaled register quantity.

For the circuit monitor display, custom quantities can be used to display a value. Don’t confuse this feature with SMS custom quantities. SMS custom quantities are used to add new parameters which SMS can use to perform functions. SMS custom quantities are defined, for example, when you add a new POWERLOGIC-compatible device to SMS or if you want to import data into SMS from another software package. You can use the SMS custom quantities in custom tables and interactive graphics diagrams, but you cannot use circuit monitor display custom quantities in this way. *Custom quantities that you define for display from the circuit monitor are not available to SMS. They must be defined separately in SMS.*

To use a custom quantity, perform these tasks:

1. **Create the custom quantity** as described in this section.
2. **Create a custom screen** on which the custom quantity can be displayed.

   See “Creating Custom Screens” on page 31 in the following section. You can view the custom screen by selecting from the Main Menu, Meters > Custom. See “Viewing Custom Screens” on page 34 for more information.

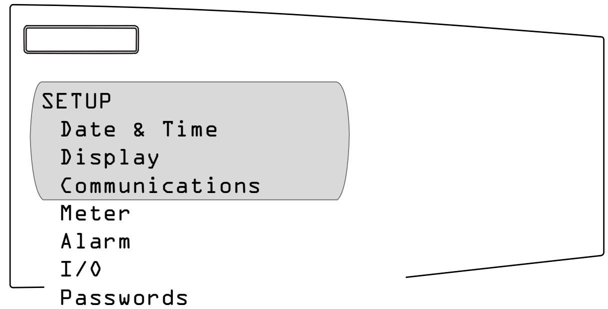
To create a custom quantity, follow these steps:

1. From the Main Menu, select Setup.

   The password prompt displays.

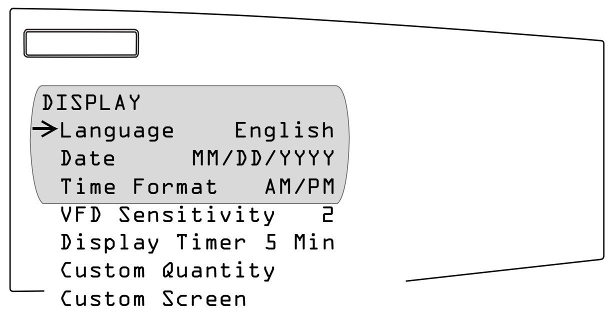
2. Select your password. The default password is 0.

   The Setup menu displays.



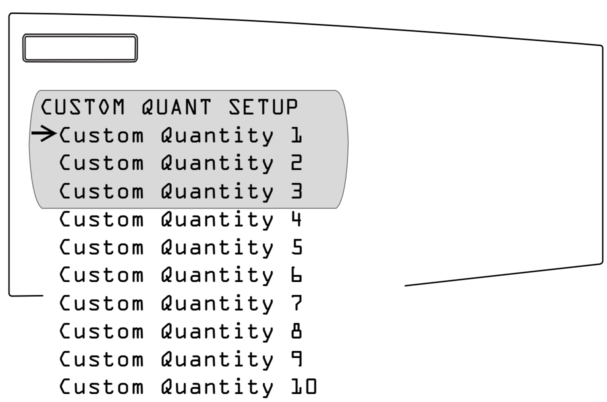

3. Select Display.

   The Display Setup menu displays.



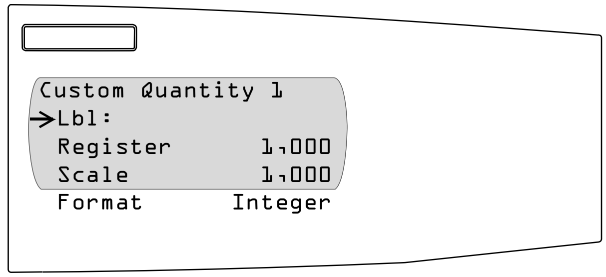

4. Select Custom Quantity.

   The Custom Quantity Setup screen displays.




5. Select a custom quantity.

In this example, we selected Custom Quantity 1. Table 3–8 shows the available values.




6. Use the arrow buttons to scroll to the menu option you want to change.
7. Press the enter button to select the value. The value begins to blink. Use the arrow buttons to scroll through the available values. Then, press the enter button to select the new value.
8. Use the arrow buttons to scroll through the other options on the menu, or if you are finished, press the menu button to save.

**Table 3–8: Options for Custom Quantities**

| Option | Available Values | Default |
|---|---|---|
| Lbl | Name of the quantity up to 10 characters. Press the arrow buttons to scroll through the characters. To move to the next option, press the menu button. | |
| Register | 4- or 5-digit number of the register in which the quantity exists. | 1,000 |
| Scale | Multiplier of the register value can be one of the following: .001, .01, .1, 1.0, 10, 100 or 1,000. See “Scale Factors” on page 91 for more information. | 1,000 |
| Format | Integer<br>D/T—date and time<br>MOD10L4—Modulo 10,000 with 4 registers①<br>MOD10L3—Modulo 10,000 with 3 registers①<br>MOD10L2—Modulo 10,000 with 2 registers①<br>Label ② | Integer |

① Modulo 10,000 is used to store energy. See the SMS online help for more.
② Use the Label format only when a label has been defined with no corresponding register.

An asterisk (*) next to the quantity indicates that the quantity has been added to the list.

9. To save the changes to the Display Setup screen, press the menu button.

The custom quantity is added to the Quantities List in the Custom Screen Setup. The new quantity appears at the end of this list after the standard quantities. After creating the custom quantity, you must create a custom screen to be able to view the new quantity.

## Creating Custom Screens

You choose the quantities that are to be displayed on a custom screen. The quantities can be standard or custom quantities. If you want to display a custom quantity, you must first create the custom quantity so that it appears on the Quantities List. See “Creating Custom Quantities to be Displayed” on page 28 for instructions.

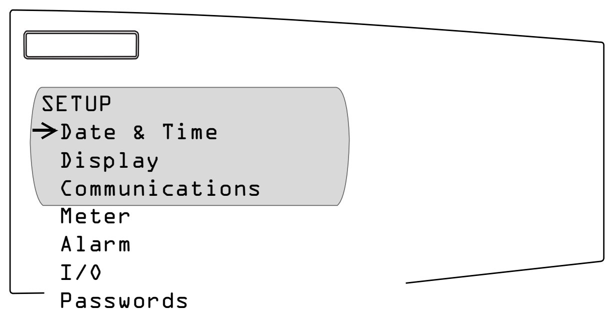
To create a custom screen, follow these steps:

1. From the Main Menu, select Setup.

   The password prompt displays.

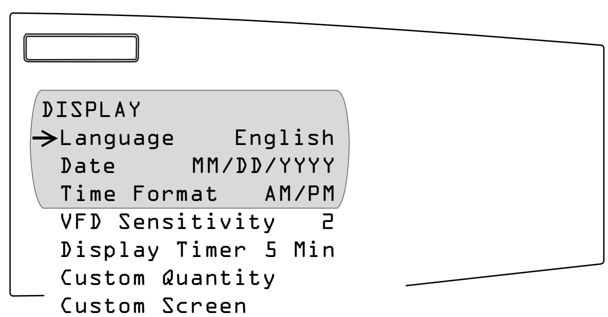
2. Select your password. The default password is 0.

   The Setup menu displays.



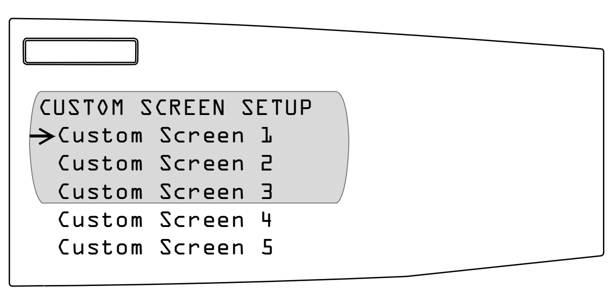

3. Select Display.

   The Display Setup menu displays.



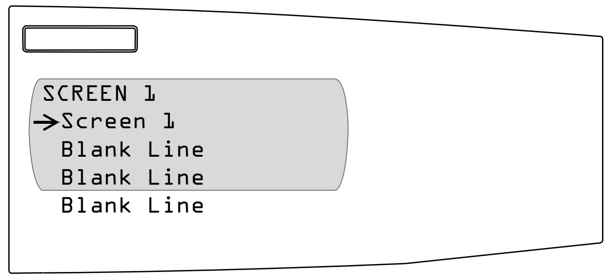

4. Select Custom Screen.

   The Custom Screen Setup screen displays.




5. Select a custom screen.

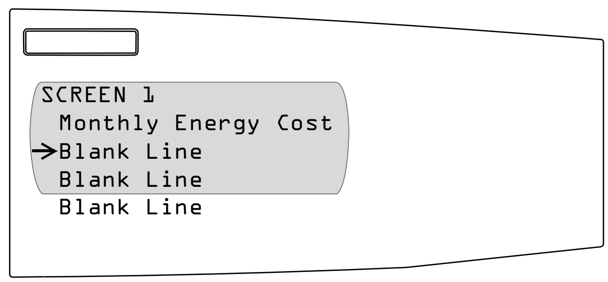
   In this example, we selected Custom Screen 1.




The cursor begins to blink.

6. Create a name for the custom screen. Press the arrow buttons to scroll through the alphabet. Press the enter button to move to the next character field.
7. When you have finished naming the screen, press the menu button, then select the first blank line.

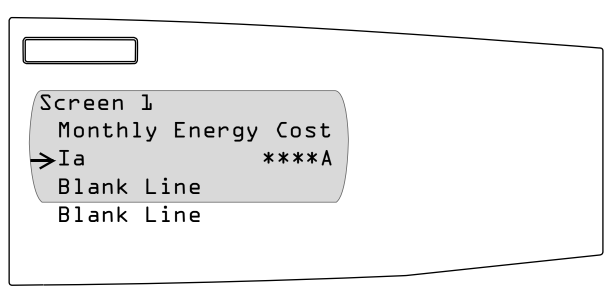
   The first blank line begins to blink.




8. Use the arrow buttons to select one of the following quantity types:
   - Current
   - Voltage
   - Frequency
   - Power Factor
   - Power
   - THD
   - Energy
   - Demand
   - Harmonics
   - Unbalance
   - Custom

   To view the quantities of a quantity type, press the enter button.

   The first quantity flashes on the display.



9. Use the arrow buttons to scroll through the list of quantities. Select the quantity that you want for your custom screen by pressing the enter button.

   Table 3–9 lists the default quantities. If you have created a custom quantity, it will be displayed at the bottom of this list.

**Table 3–9: Available Default Quantities**

| Quantity Type① | Quantity | Label① |
|---|---|---|
| Current | Current A | Ia |
| | Current B | Ib |
| | Current C | Ic |
| | Current N | In |
| | Current G | Ig |
| | Current Average | I Avg |
| Voltage | Voltage A–B | Vab |
| | Voltage B–C | Vbc |
| | Voltage C-A | Vca |
| | Voltage L–L Average | V L-L Avg |
| | Voltage A–N | Van |
| | Voltage B–N | Vbn |
| | Voltage C–N | Vcn |
| | Voltage L–N Average | V L-N Avg |
| Frequency | Frequency | Freq |
| Power Factor | Power Factor Total | PF Total |
| | Displacement Power Factor Total | Dis PF Tot |
| Power | Real Power Total | kW Total |
| | Reactive Power Total | kVAR Total |
| | Apparent Power Total | kVA Total |
| THD | THD Current A | THD Ia |
| | THD Current B | THD Ib |
| | THD Current C | THD Ic |
| | THD Current N | THD In |
| | THD Voltage A–N | THD Van |
| | THD Voltage B–N | THD Vbn |
| | THD Voltage C–N | THD Vcn |
| | THD Voltage A–B | THD Vab |
| | THD Voltage B–C | THD Vbc |
| | THD Voltage C–A | THD Vca |
| Energy | Real Energy, Total | kWHr Tot |
| | Reactive Energy, Total | kVARHr Tot |
| | Apparent Energy, Total | kVAHr Tot |
| Demand | Demand Current Average | Dmd I Avg |
| | Demand Current A | Dmd Ia |
| | Demand Current B | Dmd Ib |
| | Demand Current C | Dmd Ic |
| | Demand Current N | Dmd In |
| | Demand Voltage A–N | Dmd Van |
| | Demand Voltage B–N | Dmd Vbn |
| | Demand Voltage C–N | Dmd Vcn |
| | Demand Voltage L–N Average | Dmd V L-N |
| | Demand Voltage A–B | Dmd Vab |
| | Demand Voltage B–C | Dmd Vbc |
| | Demand Voltage C–A | Dmd Vca |

**Table 3–9: Available Default Quantities**

| Quantity Type① | Quantity | Label① |
|---|---|---|
| | Demand Voltage L–L Avg | Dmd V L-L |
| | Demand Real Power (kWD) | Dmd kW |
| | Demand Reactive Power (kVARD) | Dmd kVAR |
| | Demand Apparent Power (kVA) | Dmd kVA |
| Harmonics | 3rd Harmonic Magnitude Voltage A | Van 3rd |
| | 5th Harmonic Magnitude Voltage A | Van 5th |
| | 7th Harmonic Magnitude Voltage A | Van 7th |
| | 3rd Harmonic Magnitude Voltage B | Vbn 3rd |
| | 5th Harmonic Magnitude Voltage B | Vbn 5th |
| | 7th Harmonic Magnitude Voltage B | Vbn 7th |
| | 3rd Harmonic Magnitude Voltage C | Vcn 3rd |
| | 5th Harmonic Magnitude Voltage C | Vcn 5th |
| | 7th Harmonic Magnitude Voltage C | Vcn 7th |
| Unbalance | Current Unbalance Max | I Unbl Mx |
| | Voltage Unbalance Max L-L | V Unbl Mx L–L |
| | Voltage Unbalance Max L-N | V Unbl Mx L–N |

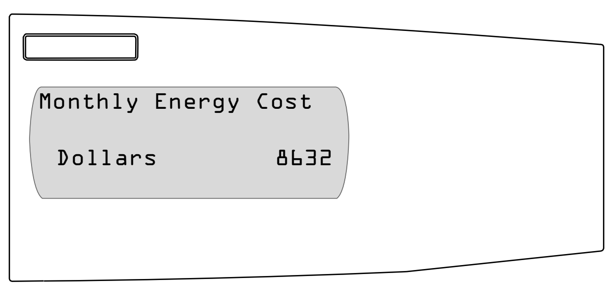
① Displayed on the screen.

10. Press the menu button until “Save Changes? No” flashes on the display. Select Yes, then press the enter button to save the custom screen.

**Viewing Custom Screens**

If you have a custom screen setup, a “Custom” option will be displayed on the Meters menu.

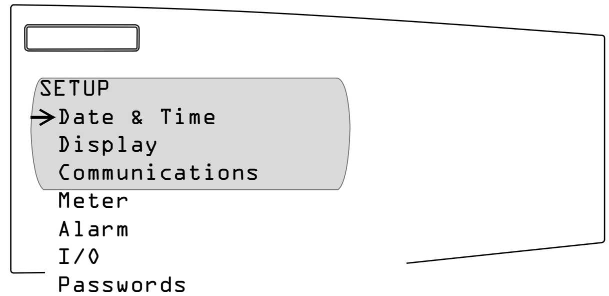
To view a custom screen, from the Main Menu select Meters > Custom. In this example, a custom screen was created for monthly energy cost. Press the arrow button to view the next custom screen. Press the menu button to exit and return to the Meters Menu.




**Advanced Meter Setup**

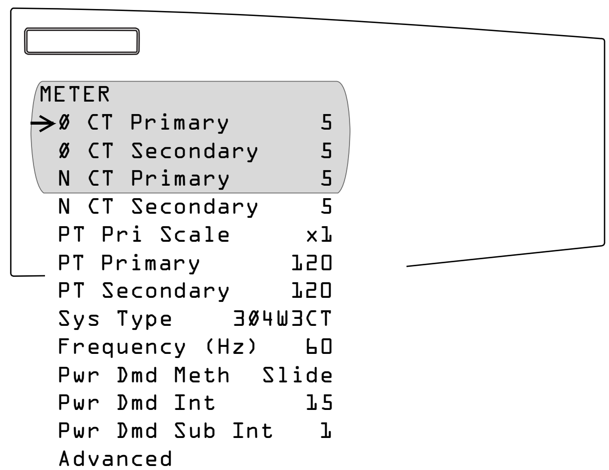
The Advanced option on the Meter Setup screen lets you perform miscellaneous advanced setup functions on the metering portion of the circuit monitor. For example, on this menu you can change the phase rotation or the VAR sign convention. The advanced options are described below.

1. From the Main Menu, select Setup.
   The password prompt displays.
2. Select your password. The default password is 0.
   The Setup menu displays.



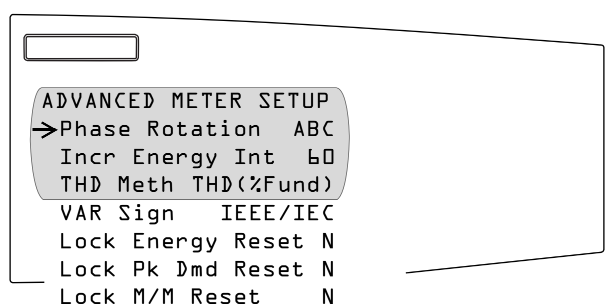

3. Select Meter.

   The Meter Setup screen displays.




4. Scroll to the bottom of the list and select Advanced.

   The Advanced Meter Setup screen displays. Table 3–10 on page 36 describes the options on this menu.




5. Change the desired options and press the menu button to save.

**Table 3–10: Options for Advanced Meter Setup**

| Option | Available Values | Selection Description | Default |
|---|---|---|---|
| Phase Rotation | ABC or CBA | Set the phase rotation to match the system. | ABC |
| Incr Energy Int | 0–1440 | Set incremental energy interval in minutes. The interval must be evenly divisible into 24 hours. | 60 |
| THD Meth | THD(%Fund) or thd(%RMS) | Set the calculation for total harmonic distortion. See “Power Analysis Values” on page 66 for a detailed description. | THD |
| VAR Sign | IEEE/IEC or ALT(CM1) | Set the VAR sign convention. See “VAR Sign Conventions” on page 55 for a discussion about VAR sign convention. | Standard |
| Lock Energy Reset | Y or N | Lock the reset of the accumulated energy. If set to Y (yes), the Energy option on the Reset menu will be locked so that the value cannot be reset from the display, even if a password has been set up for the Reset option. See “Resetting Min/Max, Demand, and Energy Values” on page 37 for more information. | N |
| Lock Pk Dmd Reset | Y or N | Lock the reset of peak demand. If set to Y (yes), the Demand option on the Reset menu will be locked so that the value cannot be reset from the display, even if a password has been set up for the Reset option. See “Resetting Min/Max, Demand, and Energy Values” on page 37 for more information. | N |
| Lock M/M Reset | Y or N | Lock the reset of the min/max values. If set to Y (yes), the Min/Max option on the Reset menu will be locked so that the value cannot be reset from the display, even if a password has been set up for the Reset option. See “Resetting Min/Max, Demand, and Energy Values” on page 37 for more information. | N |

## RESETTING MIN/MAX, DEMAND, AND ENERGY VALUES

A reset clears the circuit monitor's memory of the last recorded value. For example, you might need to reset monthly peak demand power. From the Reset menu, shown in Figure 3–6, you can reset the following values:

- Energy—accumulated energy and conditional energy
- Demand—peak power demand and peak current demand
- Min/Max—minimum and maximum values for all real-time readings

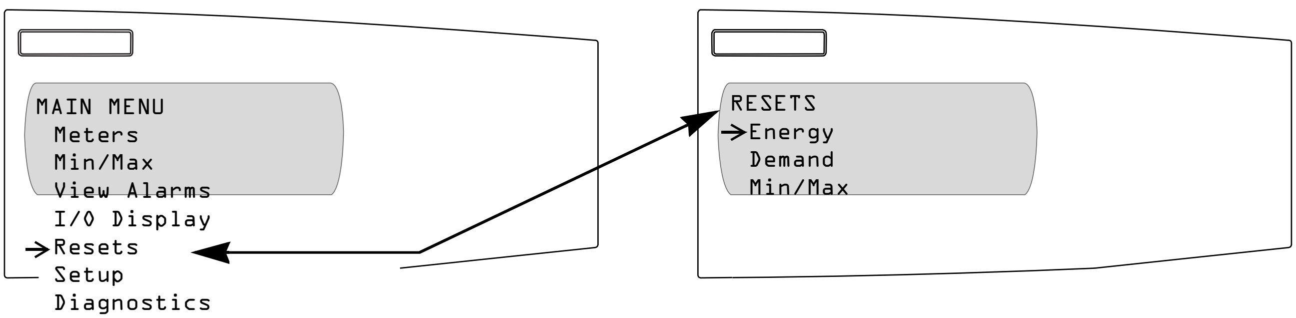



**Figure 3–6: Performing resets from the Reset menu**

A password is required to reset any of the options on the Reset menu. The default password is 0. See "Setting Up Passwords" on page 27 for more information about passwords.

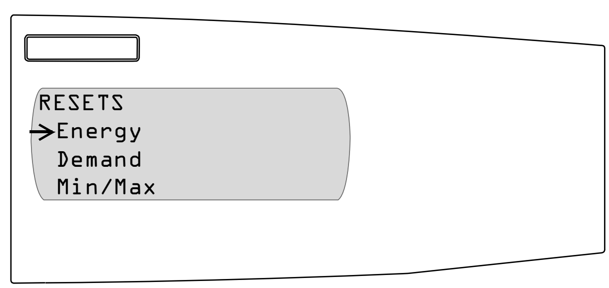
You can perform resets from the circuit monitor as described in this section or if you are using SMS, you can set up a task to perform the reset automatically at a specified time. See the SMS online help for instructions.

*NOTE: To stop users from using the display to reset energy, peak demand, and min/max values, see "Advanced Meter Setup" on page 34 for instructions on using the reset locking feature.*

To perform resets, follow these steps:

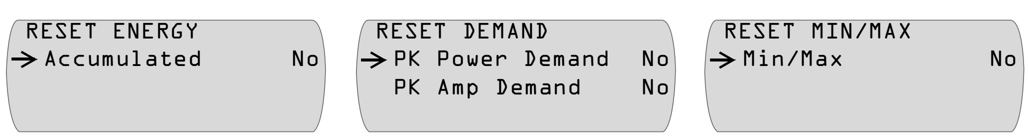
1. From the Main Menu, select Resets.

   The Resets menu displays.




2. Use the arrow buttons to scroll through the menu options on the Resets menu. To select a menu option, press the enter button.

   Depending on the option you selected, the screen for that value displays.



3. Select the option you would like to reset and change No to Yes by pressing the arrow button.
4. Press Enter to move to the next option or press the menu button to reset the value.

## VIEWING METERED DATA

The Meters menu and the Min/Max menu, shown in Figure 3–7, are view-only menus where you can view metered data in real time.

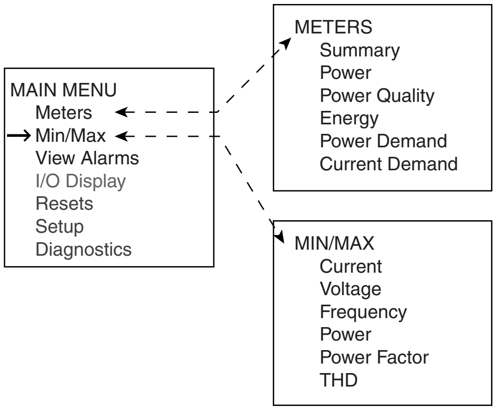



**Figure 3–7: Viewing metered data on the Meters and Min/Max menus**

Use the arrow buttons to scroll through the menu options on the Meters menu. To select a menu option, press the enter button. To select another option, press the menu button.

### Viewing Metered Data from the Meters Menu

From the Meters menu you can view the following information.

- **Summary**—lets you quickly move through and view the following:
  - — Summary total of volts, amperes, and kW.
  - — Amperes and volts for all three phases, neutral and ground, line to line, line to neutral.
  - — Power kW, kVAR, and kVA (real, reactive, and apparent power) 3-phase totals.
  - — Power factor (true and displacement) 3-phase totals.
  - — Total energy kWh, kVARh, and kVAh 3-phase totals (real, reactive, and apparent energy).
  - — Frequency in hertz.
- **Power**—is available only if the circuit monitor is configured for 4-wire system; it will not appear for 3-wire systems. If you are using a 4-wire system, you can view the leading and lagging values for true and displacement power factor. Also this option lets you view power per-phase kW, kVAR, and kVA (real, reactive, and apparent power).
- **Power Quality**—shows the following values per phase:
  - — THD voltage line to neutral and line to line.
  - — THD amperes
  - — K-factor

- — Fundamental volts and phase angle
- — Fundamental amperes and phase angle

- **Energy**—shows accumulated and incremental readings for real and reactive energy into and out of the load, and the real, reactive, and apparent total of all three phases.
- **Power Demand**—displays total and peak power demand kW, kVAR, and kVA (real, reactive, and apparent power) for the last completed demand interval. It also shows the peak power demand kW, kVAR, and kVA with date, time, and coincident power factor (leading and lagging) associated with that peak.
- **Current Demand**—shows total and peak demand current for all three phases, neutral, and ground. It also shows the date and time of the peak demand current.

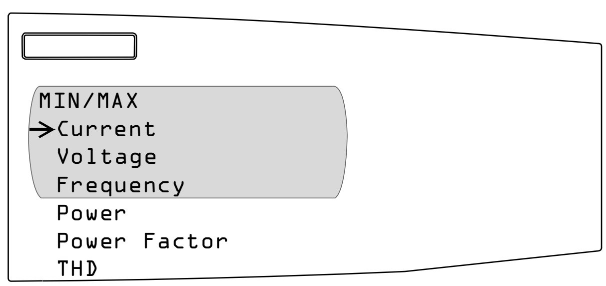
## Viewing Minimum and Maximum Values from the Min/Max Menu

From the Min/Max menu you can view the minimum and maximum values recorded by the circuit monitor, and the date and time when that min or max value occurred. These values that can be view are:

- Current
- Voltage
- Frequency
- Power
- Power Factor
- THD

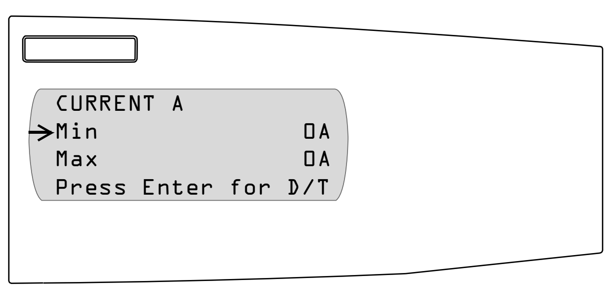
To use the Min/Max menu, follow these steps:

1. Use the arrow buttons to scroll through the menu options on the Min/Max menu.

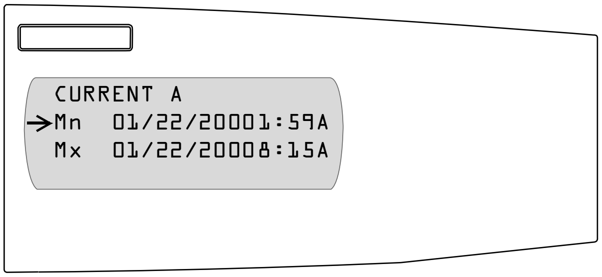



2. To select a menu option, press the enter button.

   The screen for that value displays. Press the arrow buttons to scroll through the min/max quantities.



3. To view the date and time when the minimum and maximum value was reached, press the enter button. Press the arrow buttons to scroll through the dates and times.




4. Press the enter button to return to the Min/Max values
5. Press the menu button to return to the Min/Max menu.

## VIEWING ALARMS

The Alarms menu shown in Figure 3–8, lets you view active and high priority alarms.

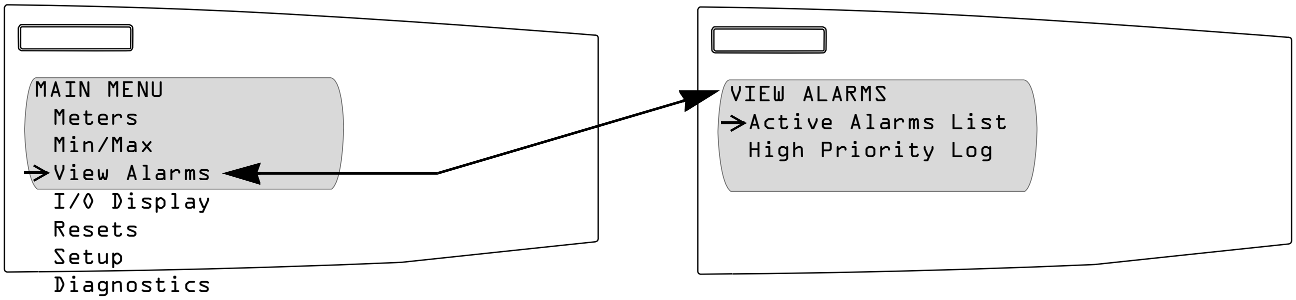



**Figure 3–8: View Alarms menu**

When an alarm is first set up, an alarm priority is selected. Four alarm levels are available:

- **High priority**—if high priority alarm occurs, the display informs you in two ways:
  - — The LED on the display flashes while the alarm is active and until you acknowledge the alarm
  - — A message displays whether the alarm is active or unacknowledged.
- **Medium priority**—if medium priority alarm occurs, the LED flashes and a message displays only while the alarm is active. Once the alarm becomes inactive, the LED and message stop.
- **Low priority**—if low priority alarm occurs, the LED on the display flashes only while the alarm is active. No alarm message is displayed.
- **No priority**—if an alarm is setup with no priority, no visible representation will appear on the display.

If multiple alarms with different priorities are active at the same time, the display shows the alarm message for the last alarm.

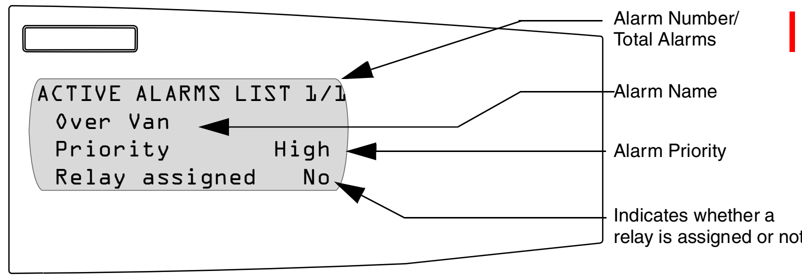
Each time an alarm occurs, the circuit monitor does the following:

- Puts the alarm in the list of active alarms. See “Viewing Active Alarms” on page 42 for more about active alarms.
- Performs any assigned action. The action could be one of the following:
  - — Operate one or more relays (you can view the status from the display)
  - — Force data log entries into the user-defined data log files (1–14 data logs can be viewed from SMS)
  - — Perform a waveform capture (can be viewed from SMS)
- Records the occurrence of high, medium, and low priority events in the circuit monitor’s alarm Log (can be viewed using SMS).

Also, the display LED and alarm messages will operate according to the priority selected when an alarm occurs.

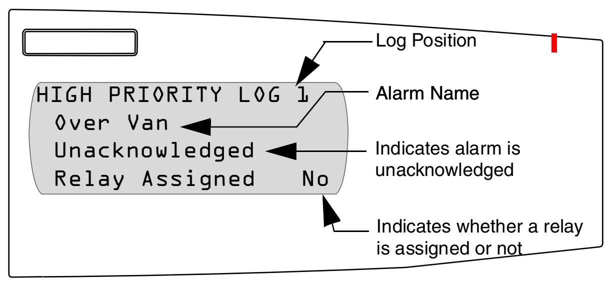
## Viewing Active Alarms

The Active Alarms List displays currently active alarms, regardless of their priority. You can view all active alarms from the Main Menu by selecting View Alarms > Active Alarms List. The Active Alarm screen displays. Use the arrow buttons to scroll through the alarms that are active.




## View and Acknowledging High Priority Alarms

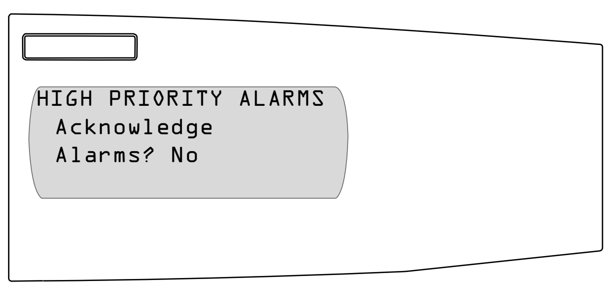
To view high priority alarms, from the Main Menu select View Alarms > High Priority Log. The High Priority Log screen displays. Use the arrow buttons to scroll through the alarms.




The High Priority Alarms screen displays the ten most recent, high-priority alarms. When you acknowledge the high priority alarms, all digital outputs (relays) that are configured for latched mode will be released. To acknowledge all high priority alarms follow these steps:

1. After viewing the alarms, press the menu button to exit.

   The display asks you whether you would like to acknowledge the alarm.




2. To acknowledge the alarms, press the arrow button to change No to Yes. Then, press the enter button.
3. Press the menu button to exit.

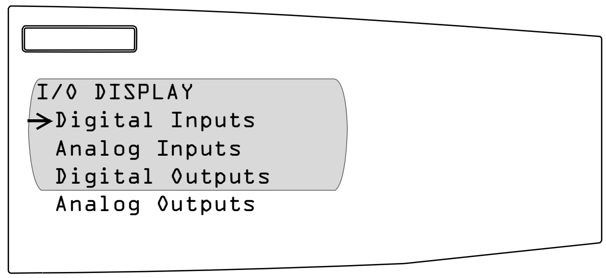
*NOTE: You have acknowledged the alarms, but the LED will continue to flash as long as any high priority alarm is active.*

## VIEWING I/O STATUS

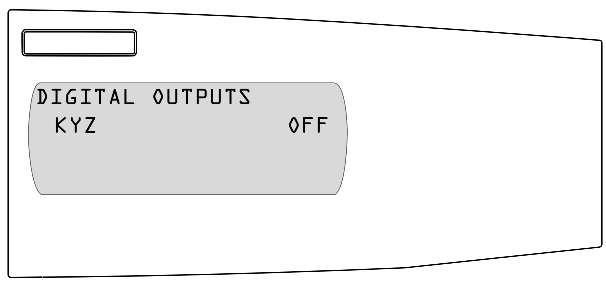
The I/O Display menu shows the ON or OFF status of the digital inputs or outputs. For analog inputs and outputs, it displays the present value. To view the status of inputs and outputs:

1. From the Main Menu, select I/O Display.

   The I/O Display screen displays.




2. Select the input or output on which you'd like to view the status. In this example, we selected Digital Outputs to display the status of the KYZ output.




3. Press the menu button to exit.

## READING AND WRITING REGISTERS

You can access the read and write register menu option on the circuit monitor's display by selecting from the Main Menu > Diagnostics > Read/ Write Regs as shown in Figure 3–9. This option lets you read and write circuit monitor registers from the display. This capability is most useful to users who 1) need to set up an advanced feature which is beyond the circuit monitor's normal front panel setup mode, and 2) do not have access to SMS to set up the feature.

For example, the default operating mode for a circuit monitor relay output is *normal*. To change a relay's operating mode from normal to another mode (for example, latched mode), use either SMS or the Read/Write Regs option of the Diagnostics menu.

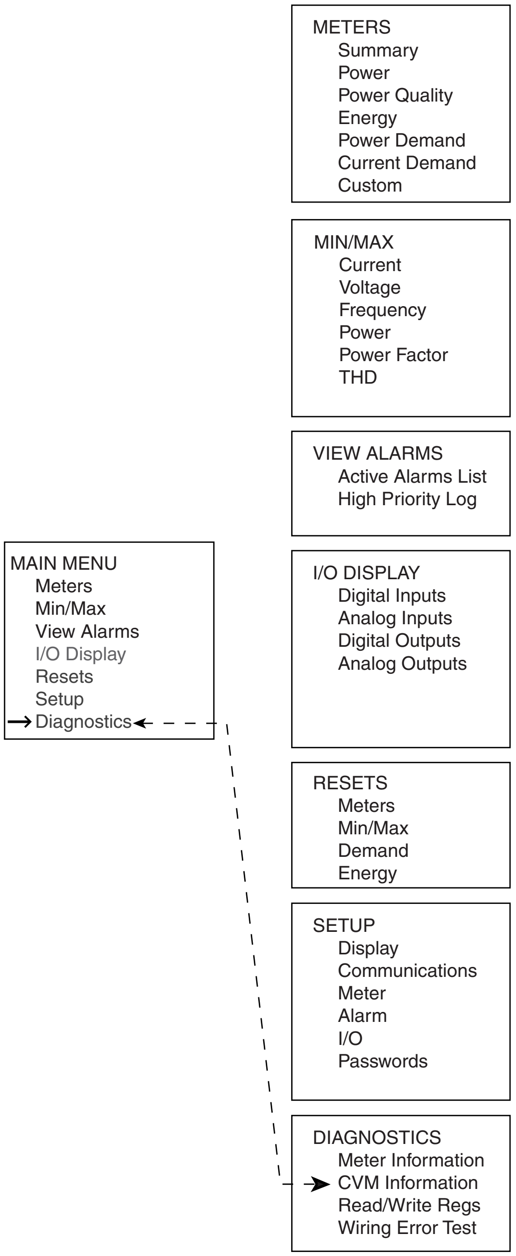


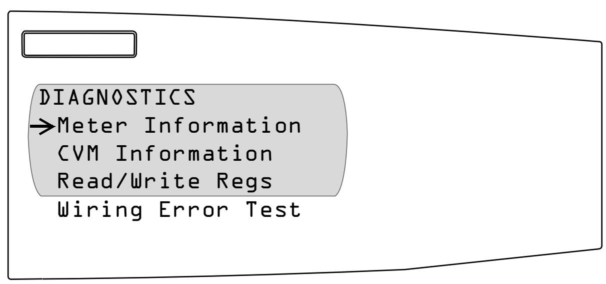

**Figure 3–9: Diagnostics Menu accessed from the Main Menu**

*NOTE: Use this feature with caution. Writing an incorrect value, or writing to the wrong register could affect the intended operation of the circuit monitor or its accessories.*

To read or write registers, follow these steps:

1. From the Main Menu, select Diagnostics.

   The Diagnostics menu displays.




2. Select Read/Write Regs.

   The password prompt displays.

3. Select your password. The default password is 0.

   The Read/Write Registers screen displays. Table 3–11 describes the options on this screen.

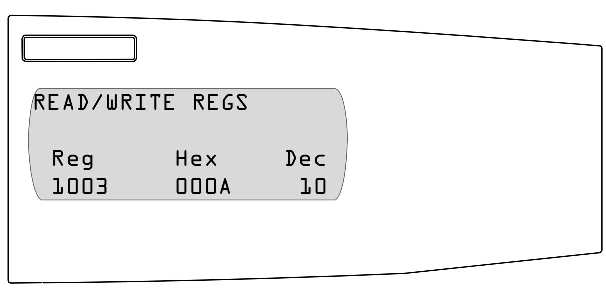



**Table 3–11: Read/Write Register Options**

| Option | Available Values |
|---|---|
| Reg | List the register numbers. |
| Hex | List the hexidecimal value of that register. |
| Dec | List the decimal value of that register. |

If you are viewing a metered value, such as voltage, the circuit monitor updates the displayed value as the register contents change. Note that scale factors are not taken into account automatically when viewing register contents.

4. To scroll through the register numbers, use the arrow buttons.
5. To change the value in the register, press the enter button.
   The Hex and Dec values begin to blink. Use the arrow buttons to scroll through the numeric values available.

   *NOTE: Some circuit monitor registers are **read/write**, some are **read only**. You can write to read/write registers only.*

6. When you are finished making changes to that register, press the enter button to continue to the next register or press the menu button to save the changes.

## PERFORMING A WIRING ERROR TEST

The circuit monitor has the ability to perform a wiring diagnostic self-check when you select the Diagnostic > Wiring Error Test from the Main Menu as shown in Figure 3–10.

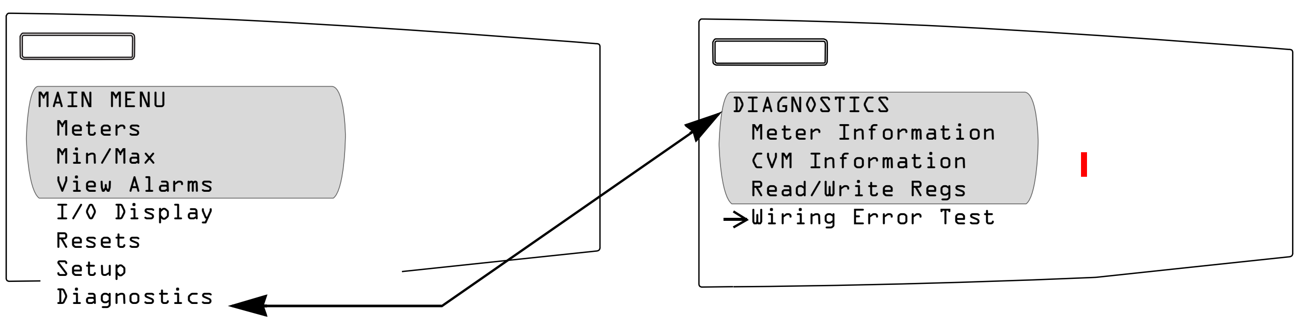



**Figure 3–10: Wiring Error Test option on the Diagnostics menu.**

The circuit monitor can diagnose possible wiring errors when you initiate the wiring test on the Diagnostics menu. Running the test is not required, but may help you to pinpoint a potentially miswired connection. Before running the wiring test, you must first wire the circuit monitor and perform the minimum set up of the circuit monitor, which includes setting up these parameters:

- CT primary and secondary
- PT primary and secondary
- System type
- Frequency

After you have wired and completed the minimum set up, run the wiring test to verify proper wiring of your circuit monitor. The wiring test assumes that the following is true about your system:

- Voltage connection $V_{an}$ (4-wire) or $V_{ab}$ (3-wire) is correct. This connection must be properly wired for the wiring check program to work.
- 3-phase system. The system must be a 3-phase system. You cannot perform a wiring check on a single-phase system.
- System type. The wiring check can be performed only on the six possible system types: 3∅3W2CT, 3∅3W3CT, 3∅4W3CT, 3∅4W4CT, 3∅4W3CT2PT, and 3∅4W4CT2PT (see Table 5–2 on page 38 of the installation manual for a description of system types).
- Expected displacement power factor is between .60 lagging and .99 leading.
- The load must be at least 1% of the CT Primary setting.

This wiring error program is based on the assumptions above and based on a typical wiring system, results may vary depending on your system and some errors may not apply to your system. When the wiring test is run, the program performs the following checks in this order:

1. Verifies that the system type is one of those listed above.
2. Verifies that the frequency is within ±5% of the frequency that you selected in circuit monitor set up.
3. Verifies that the voltage phase angles are 120° apart. If the voltage connections are correct, the phase angles will be 120° apart.

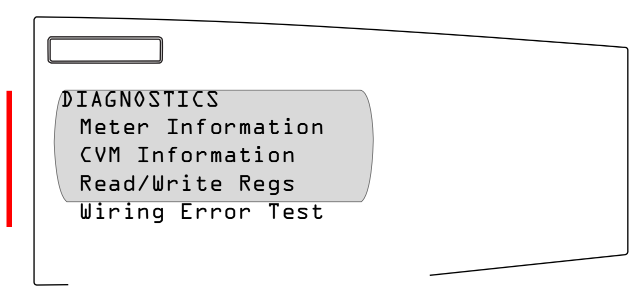
   If the voltage connections are correct, the test continues.
4. Verifies that the measured phase rotation is the same as the phase rotation set up in the circuit monitor.
5. Verifies the magnitude of the currents to see if there is enough load on each phase input to perform the check.
6. Indicates if the 3-phase real power (kW) total is negative, which could indicate a possible wiring error.
7. Compares each current angle to its respective voltage.

## Running the Diagnostics Wiring Error Test

When the circuit monitor detects a possible error, you can find and correct the problem and then run the check again. Repeat the procedure until no error messages are displayed. To perform a wiring diagnostic test, follow these steps:

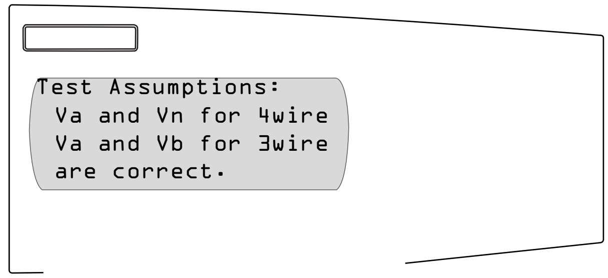
1. From the Main Menu, select Diagnostics.

   The Diagnostics menu displays.



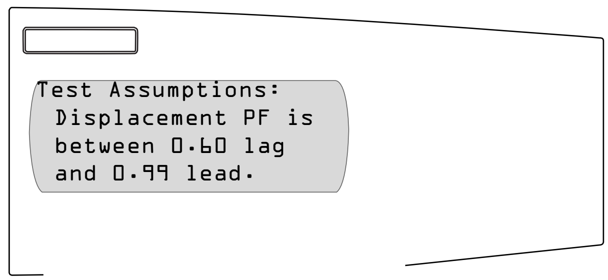
2. Select Wiring Error Test from the menu.

   The circuit monitor asks if the wiring matches the test assumptions.



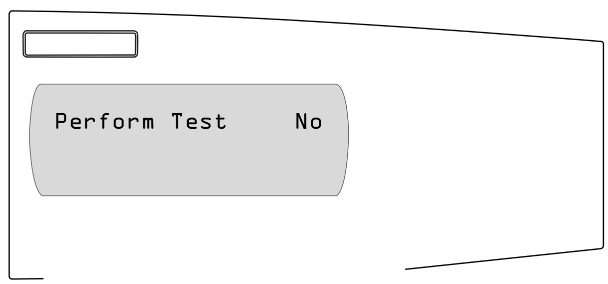

3. Press the down arrow button.

   The circuit monitor asks if the expected displacement power factor is between 0.60 lagging and 0.99 leading.




4. Press the down arrow button, again.

   The circuit monitor asks if you'd like to perform a wiring check.




5. Select "Yes" to perform the test by pressing the up arrow button and then pressing the enter button.

   The circuit monitor performs the wiring test.

   If it doesn't find any errors, the circuit monitor displays "Wire test complete. No errors found!". If it finds possible errors, it displays "Error detected. See following screens for details."

6. Press the arrow buttons to scroll through the wiring error messages.

   Table 3–12 on page 48 explains the possible wiring error messages.

7. Turn off all power supplying the circuit monitor. Verify that the power is off using a properly rated voltage testing device.

**⚠ DANGER**

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

- Turn off all power supplying the circuit monitor and the equipment in which it is installed before working on it.
- Use a properly rated voltage testing device to verify that the power is off.
- Never short the secondary of a PT.
- Never open circuit a CT; use the shorting block to short circuit the leads of the CT before removing the connection from the circuit monitor.

**Failure to follow this instruction will result in death or serious injury.**

8. Correct the wiring errors.
9. Repeat these steps until all errors are corrected.

**Table 3–12: Wiring Error Messages**

| Message | Description |
|---|---|
| Invalid system type | The circuit monitor is set up for a system type that the wiring test does not support. |
| Frequency out of range | Actual frequency of the system is not the same as the selected frequency configured for the circuit monitor. |
| Voltage not present on all phases | No voltage metered on one or more phases. |
| Severe voltage unbalance present | Voltage unbalance on any phase greater than 70%. |
| Not enough load to check wiring | Metered current below deadband on one or more phases. |
| Suspected error: Check meter configuration for direct connection | Set up for voltage input should be “No PT.” |
| Suspected error: Reverse polarity on all current inputs | Check polarities. Polarities on all CTs could be reversed. |
| Phase rotation does not match meter setup | Metered phase rotation is different than phase rotation selected in the circuit monitor set up. |
| Negative kW, check CT & VT polarities | Metered kW is negative, which could indicate swapped polarities on any CT or VT. |
| No voltage metered on V1–n | No voltage metered on V1–n on 4-wire system only. |
| No voltage metered on V2–n | No voltage metered on V2–n on 4-wire system only. |
| No voltage metered on V3–n | No voltage metered on V3–n on 4-wire system only. |
| No voltage metered on V1–2 | No voltage metered on V1–2. |
| No voltage metered on V2–3 | No voltage metered on V2–3. |
| No voltage metered on V3-1 | No voltage metered on V3-1. |
| V2–n phase angle out of range | V2–n phase angle out of expected range. |
| V3–n phase angle out of range | V3–n phase angle out of expected range. |
| V2–3 phase angle out of range | V2–3 phase angle out of expected range. |
| V3–1 phase angle out of range | V3–1 phase angle out of expected range. |
| Suspected error: Reverse polarity on V2–n VT | Polarity of V2–n VT could be reversed. Check polarity. |
| Suspected error: Reverse polarity on V3–n VT | Polarity of V3–n VT could be reversed. Check polarity. |
| Suspected error: Reverse polarity on V2–3 VT | Polarity of V2–3 VT could be reversed. Check polarity. |

### Table 3–12: Wiring Error Messages

| Message | Description |
|---|---|
| Suspected error: Polarity on V3–1 VT | Polarity of V3–1 VT could be reversed. Check polarity. |
| Suspected error: Check V1 input, may be V2 VT | Phase 2 VT may actually be connected to input V1. |
| Suspected error: Check V2 input, may be V3 VT | Phase 3 VT may actually be connected to input V12 |
| Suspected error: Check V3 input, may be V1 VT | Phase 1 VT may actually be connected to input V3. |
| Suspected error: Check V1 input, may be V3 VT | Phase 3 VT may actually be connected to input V1. |
| Suspected error: Check V2 input, may be V1 VT | Phase 1 VT may actually be connected to input V2. |
| Suspected error: Check V3 input, may be V2 VT | Phase 2 VT may actually be connected to input V3. |
| I1 load current less than 1% CT | Metered current on I1 less than 1% of CT. Test could not continue. |
| I2 load current less than 1% CT | Metered current on I2 less than 1% of CT. Test could not continue. |
| I3 load current less than 1% CT | Metered current on I3 less than 1% of CT. Test could not continue. |
| I1 phase angle out of range. Cause of error unknown. | I1 phase angle is out of expected range. Cause of error unable to be determined. |
| I2 phase angle out of range. Cause of error unknown | I2 phase angle is out of expected range. Cause of error unable to be determined. |
| I3 phase angle out of range. Cause of error unknown. | I3 phase angle is out of expected range. Cause of error unable to be determined. |
| Suspected error: Reverse polarity on I1 CT. | Polarity of I1 CT could be reversed. Check polarity. |
| Suspected error: Reverse polarity on I2 CT | Polarity of I2 CT could be reversed. Check polarity. |
| Suspected error: Reverse polarity on I3 CT | Polarity of I3 CT could be reversed. Check polarity. |
| Suspected error: Check I1 input, may be I2 CT | Phase 2 CT may actually be connected to input I1. |
| Suspected error: Check I2 input, may be I3 CT | Phase 3 CT may actually be connected to input I2. |
| Suspected error: Check I3 input, may be I1 CT | Phase 1 CT may actually be connected to input I3. |
| Suspected error: Check I1 input, may be I3 CT | Phase 3 CT may actually be connected to input I1. |
| Suspected error: Check I2 input, may be I1 CT | Phase 1 CT may actually be connected to input I2. |
| Suspected error: Check I3 input, may be I2 CT | Phase 2 CT may actually be connected to input I3. |
| Suspected error: Check I1 input, may be I2 CT with reverse polarity | Phase 2 CT may actually be connected to input I1, and the CT polarity may also be reversed. |
| Suspected error: Check I2 input, may be I3 CT with reverse polarity | Phase 3 CT may actually be connected to input I21, and the CT polarity may also be reversed. |
| Suspected error: Check I3 input, may be I1 CT with reverse polarity | Phase 1 CT may actually be connected to input I3, and the CT polarity may also be reversed. |
| Suspected error: Check I1 input, may be I3 CT with reverse polarity | Phase 3 CT may actually be connected to input I1, and the CT polarity may also be reversed. |
| Suspected error: Check I2 input, may be I1 CT with reverse polarity | Phase 1 CT may actually be connected to input I2, and the CT polarity may also be reversed. |
| Suspected error. Check I3 input, may be I2 CT with reverse polarity | Phase 2 CT may actually be connected to input I3, and the CT polarity may also be reversed. |

# CHAPTER 4—METERING CAPABILITIES

This chapter details the types of meter readings you can obtain from the circuit monitor.

## CHAPTER CONTENTS

## REAL-TIME READINGS

The circuit monitor measures currents and voltages and reports in real time the rms values for all three phases, neutral, and ground current. In addition, the circuit monitor calculates power factor, real power, reactive power, and more.

Table 4–1 lists some of the real-time readings that are updated every second along with their reportable ranges. When you are viewing real-time readings from the remote display or SMS, the circuit monitor is displaying 100-ms readings.

**Table 4–1: One-Second, Real-Time Readings Samples**

| Real-Time Readings | Reportable Range |
|---|---|
| Current | |
| Per-Phase | 0 to 32,767 A |
| Neutral① | 0 to 32,767 A |
| Ground① | 0 to 32,767 A |
| 3-Phase Average | 0 to 32,767 A |
| Apparent rms | 0 to 32,767 A |
| % Unbalance | 0 to ±100.0% |
| Voltage | |
| Line-to-Line, Per-Phase | 0 to 1,200 kV |
| Line-to-Line, 3-Phase Average | 0 to 1,200 kV |
| Line-to-Neutral, Per-Phase① | 0 to 1,200 kV |
| Neutral to Ground① | 0 to 1,200 kV |
| Line-to-Neutral, 3-Phase Average | 0 to 1,200 kV |
| % Unbalance① | 0 to 100.0% |
| Real Power | |
| Per-Phase① | 0 to ± 3,276.70 MW |
| 3-Phase Total | 0 to ± 3,276.70 MW |
| Reactive Power | |
| Per-Phase① | 0 to ± 3,276.70 MVAR |
| 3-Phase Total | 0 to ± 3,276.70 MVAR |
| Apparent Power | |
| Per-Phase① | 0 to ± 3,276.70 MVA |
| 3-Phase Total | 0 to ± 3,276.70 MVA |
| Power Factor (True) | |
| Per-Phase① | –0.010 to 1.000 to +0.010 |
| 3-Phase Total | –0.010 to 1.000 to +0.010 |
| Power Factor (Displacement) | |
| Per-Phase ① | –0.010 to 1.000 to +0.010 |
| 3-Phase Total | –0.010 to 1.000 to +0.010 |
| Frequency | |
| 45–65 Hz | 23.00 to 67.00 Hz |
| 350–450 Hz | 350.00 to 450.00 Hz |
| Temperature (Internal Ambient) | –100.00°C to +100.00°C |

① Wye systems only.

The circuit monitor also has the capability of 100 ms updates. The 100 ms readings listed in Table 4–2 can be communicated over MODBUS TCP and are useful for rms event recording and high-speed alarms.

**Table 4–2: 100 ms Real-Time Readings**

| Real-Time Readings | Reportable Range |
|---|---|
| Current | |
| Per-Phase | 0 to 32,767 A |
| Neutral① | 0 to 32,767 A |
| Ground① | 0 to 32,767 A |
| 3-Phase Average | 0 to 32,767 A |
| Apparent rms | 0 to 32,767 A |
| Voltage | |
| Line-to-Line, Per-Phase | 0 to 1,200 kV |
| Line-to-Line, 3-Phase Average | 0 to 1,200 kV |
| Line-to-Neutral, Per-Phase① | 0 to 1,200 kV |
| Neutral to Ground① | 0 to 1,200 kV |
| Line-to-Neutral, 3-Phase Average① | 0 to 1,200 kV |
| Real Power | |
| Per-Phase① | 0 to ± 3,276.70 MW |
| 3-Phase Total | 0 to ± 3,276.70 MW |
| Reactive Power | |
| Per-Phase① | 0 to ± 3,276.70 MVAR |
| 3-Phase Total | 0 to ± 3,276.70 MVAR |
| Apparent Power | |
| Per-Phase① | 0 to ± 3,276.70 MVA |
| 3-Phase Total | 0 to ± 3,276.70 MVA |
| Power Factor | |
| 3-Phase Total | –0.010 to 1.000 to +0.010 |

① Wye systems only.

## MIN/MAX VALUES FOR REAL-TIME READINGS

When any one-second real-time reading reaches its highest or lowest value, the circuit monitor saves the value in its nonvolatile memory. These values are called the minimum and maximum (min/max) values. Two logs are associated with min/max values. The Min/Max Log stores the minimum and maximum values since the last reset of the min/max values. The other log, the Interval Min/Max/Average Log, determines min/max values over a specified interval and records the minimum, maximum, and average values for pre-defined quantities over that specified interval. For example, the circuit monitor could record the min, max, and average every 1440 minutes (total minutes in a day) to record the daily value of quantities such as kW demand. See **Chapter 7—Logging** on page 99 for more about the Min/Max/Average log.

From the circuit monitor display you can:

- View all min/max values since the last reset and view their associated dates and times. See “Viewing Minimum and Maximum Values from the Min/Max Menu” on page 39 for instructions.
- Reset min/max values. See “Resetting Min/Max, Demand, and Energy Values” on page 37 for reset instructions.

Using SMS you can also upload both onboard logs—and their associated dates and times—from the circuit monitor and save them to disk. For instructions on working with logs using SMS, refer to the SMS online help file included with the software.

## Power Factor Min/Max Conventions

All running min/max values, except for power factor, are arithmetic minimum and maximum values. For example, the minimum phase A–B voltage is the lowest value in the range 0 to 1200 kV that has occurred since the min/max values were last reset. In contrast, because the power factor's midpoint is unity (equal to one), the power factor min/max values are not true arithmetic minimums and maximums. Instead, the minimum value represents the measurement closest to –0 on a continuous scale for all real-time readings –0 to 1.00 to +0. The maximum value is the measurement closest to +0 on the same scale.

Figure 4–1 below shows the min/max values in a typical environment in which a positive power flow is assumed. In the figure, the minimum power factor is –.7 (lagging) and the maximum is .8 (leading). 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). Both would be negative. Likewise, if the power factor ranged from +.9 to +.95, the minimum would be +.95 (leading) and the maximum would be +.90 (leading). Both would be positive in this case.

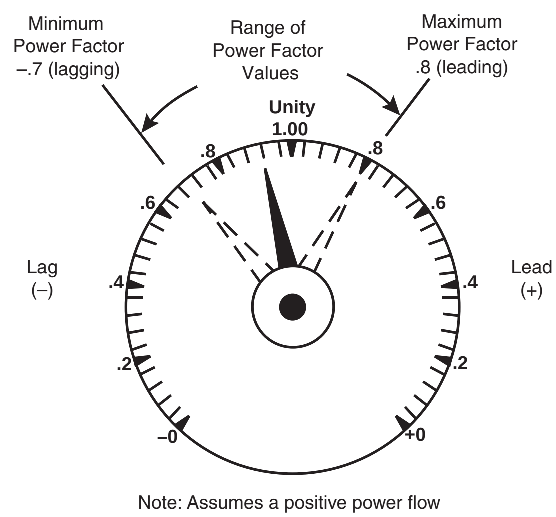



**Figure 4–1: Power factor min/max example**

An alternate power factor storage method is also available for use with analog outputs and trending. See the footnotes in **Appendix A—Abbreviated Register Listing** on page 127 for the applicable registers.

### VAR Sign Conventions

The circuit monitor can be set to one of two VAR sign conventions, the standard IEEE or the ALT (CM1). Circuit monitors manufactured before March 2000 default to the ALT VAR sign convention.The Series 4000 Circuit Monitor defaults to the IEEE VAR sign convention. Figure 4–2 illustrates the VAR sign convention defined by IEEE and the default used by previous model circuit monitors (CM1). For instructions on changing the VAR sign convention, refer to “Advanced Meter Setup” on page 34.

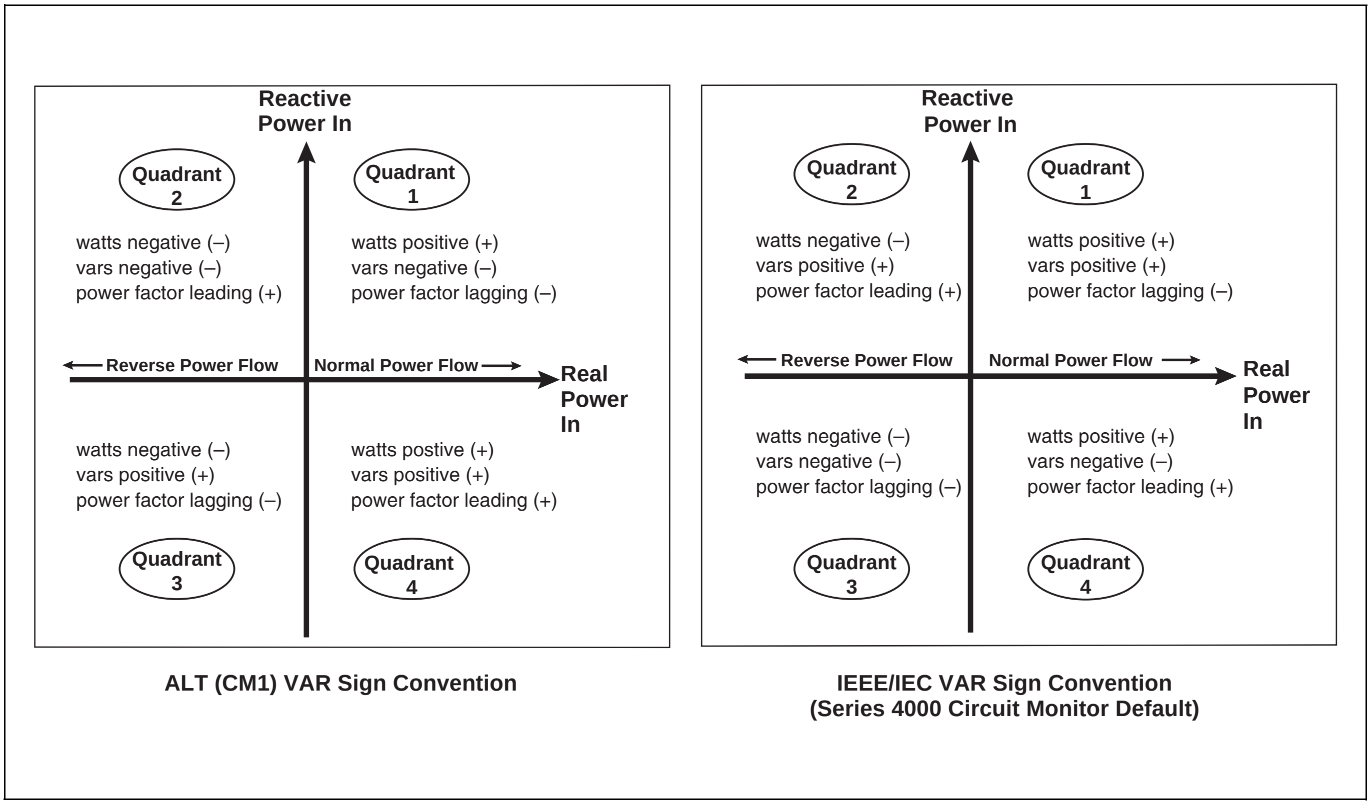



**Figure 4–2: Reactive Power—VAR sign convention**

## DEMAND READINGS

The circuit monitor provides a variety of demand readings, including coincident readings and predicted demands. Table 4–3 lists the available demand readings and their reportable ranges.

**Table 4–3: Demand Readings**

| Demand Readings | Reportable Range |
|---|---|
| Demand Current, Per-Phase, 3Ø Average, Neutral | |
| Last Complete Interval | 0 to 32,767 A |
| Peak | 0 to 32,767 A |
| Demand Voltage, L–N, L–L, Per-phase, Average, N-G | |
| Last Complete Interval | 0 to 1200 kV |
| Minimum | 0 to 1200 kV |
| Peak | 0 to 1200 kV |
| Average Power Factor (True), 3Ø Total | |
| Last Complete Interval | –0.010 to 1.000 to +0.010 |
| Coincident with kW Peak | –0.010 to 1.000 to +0.010 |
| Coincident with kVAR Peak | –0.010 to 1.000 to +0.010 |
| Coincident with kVA Peak | –0.010 to 1.000 to +0.010 |
| Demand Real Power, 3Ø Total | |
| Last Complete Interval | 0 to ± 3276.70 MW |
| Predicted | 0 to ± 3276.70 MW |
| Peak | 0 to ± 3276.70 MW |
| Coincident kVA Demand | 0 to ± 3276.70 MVA |
| Coincident kVAR Demand | 0 to ± 3276.70 MVAR |
| Demand Reactive Power, 3Ø Total | |
| Last Complete Interval | 0 to ± 3276.70 MVAR |
| Predicted | 0 to ± 3276.70 MVAR |
| Peak | 0 to ± 3276.70 MVAR |
| Coincident kVA Demand | 0 to ± 3276.70 MVA |
| Coincident kW Demand | 0 to ± 3276.70 MW |
| Demand Apparent Power, 3Ø Total | |
| Last Complete Interval | 0 to ± 3276.70 MVA |
| Predicted | 0 to ± 3276.70 MVA |
| Peak | 0 to ± 3276.70 MVA |
| Coincident kW Demand | 0 to ± 3276.70 MW |
| Coincident kVAR Demand | 0 to ± 3276.70 MVAR |

## Demand Power Calculation Methods

Demand power is the energy accumulated during a specified period divided by the length of that period. How the circuit monitor performs this calculation depends on the method you select. To be compatible with electric utility billing practices, the circuit monitor provides the following types of demand power calculations:

- Block Interval Demand
- Synchronized Demand

The default demand calculation is set to sliding block with a 15 minute interval. You can set up any of the demand power calculation methods from the display or from SMS. For instructions on how to setup the demand calculation from the display, see “Setting Up the Metering Functions of the Circuit Monitor” on page 16. See the SMS online help to perform the set up using the software.

### Block Interval Demand

In the block interval demand method, you select a “block” of time that the circuit monitor uses for the demand calculation. You choose how the circuit monitor handles that block of time (interval). Three different modes are possible:

- **Sliding Block**. In the sliding block interval, you select an interval from 1 to 60 minutes (in 1-minute increments). If the interval is between 1 and 15 minutes, the demand calculation *updates every 15 seconds*. If the interval is between 16 and 60 minutes, the demand calculation *updates every 60 seconds*. The circuit monitor displays the demand value for the last completed interval.
- **Fixed Block**. In the fixed block interval, you select an interval from 1 to 60 minutes (in 1-minute increments). The circuit monitor calculates and updates the demand at the end of each interval.
- **Rolling Block**. In the rolling block interval, you select an interval and a subinterval. The subinterval must divide evenly into the interval. For example, you might set three 5-minute subintervals for a 15-minute interval. Demand is *updated at each subinterval*. The circuit monitor displays the demand value for the last completed interval.

Figure 4–3 below illustrates the three ways to calculate demand power using the block method. For illustration purposes, the interval is set to 15 minutes.

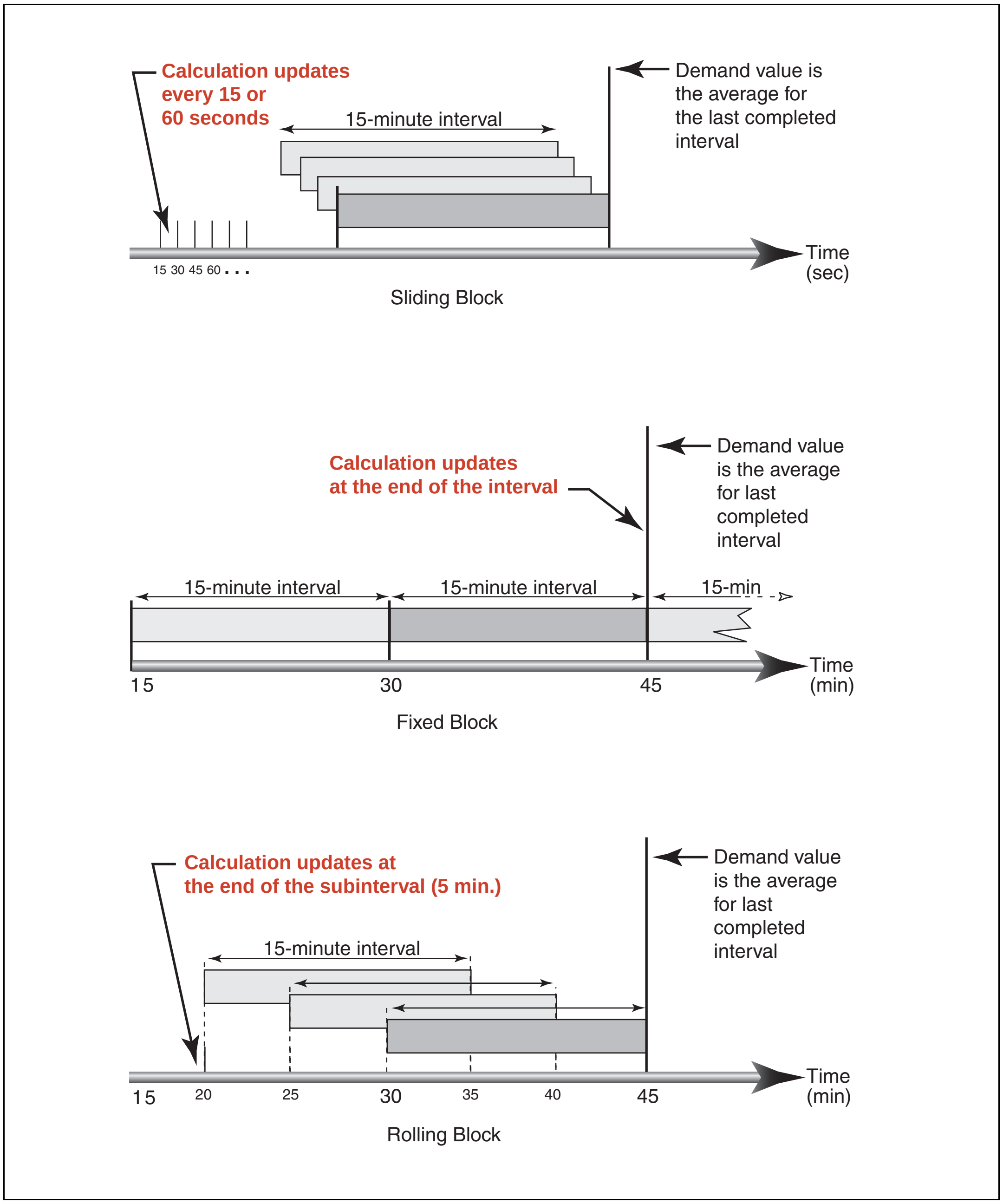



**Figure 4–3: Block Interval Demand Examples**

### Synchronized Demand

The demand calculations can be synchronized by accepting an external pulse input, a command sent over communications, or by synchronizing to the internal real-time clock.

- **Input Synchronized Demand.** You can set up the circuit monitor to accept an input such as a demand synch pulse from an external source. The circuit monitor then uses the same time interval as the other meter for each demand calculation. You can use any digital input installed on the meter to receive the synch pulse. When setting up this type of demand, you select whether it will be input-synchronized block or input-synchronized rolling block demand. The rolling block demand requires that you choose a subinterval.
- **Command Synchronized Demand**. Using command synchronized demand, you can synchronize the demand intervals of multiple meters on a communications network. For example, if a PLC input is monitoring a pulse at the end of a demand interval on a utility revenue meter, you could program the PLC to issue a command to multiple meters whenever the utility meter starts a new demand interval. Each time the command is issued, the demand readings of each meter are calculated for the same interval. When setting up this type of demand, you select whether it will be command-synchronized block or command-synchronized rolling block demand. The rolling block demand requires that you choose a subinterval. See **Appendix B—Using the Command Interface** on page 181 for more information.
- **Clock Synchronized Demand**. You can synchronize the demand interval to the internal real-time clock in the circuit monitor. This enables you to synchronize the demand to a particular time, typically on the hour. The default time is 12:00 am. If you select another time of day when the demand intervals are to be synchronized, the time must be in minutes from midnight. For example, to synchronize at 8:00 am, select 480 minutes. When setting up this type of demand, you select whether it will be clock-synchronized block or clock-synchronized rolling block demand. The rolling block demand requires that you choose a subinterval.

### Demand Current

The circuit monitor calculates demand current using the thermal demand method. The default interval is 15 minutes, but you can set the demand current interval between 1 and 60 minutes in 1-minute increments.

### Demand Voltage

The circuit monitor calculates demand voltage. The default voltage demand mode is thermal demand with a 15-minute demand interval. You can also set the demand voltage to any of the block interval demand modes described in “Block Interval Demand” on page 57.

## Thermal Demand

The thermal demand method calculates the demand based on a thermal response, which mimics thermal demand meters. The demand calculation updates at the end of each interval. You select the demand interval from 1 to 60 minutes (in 1-minute increments). In Figure 4–4 the interval is set to 15 minutes for illustration purposes.

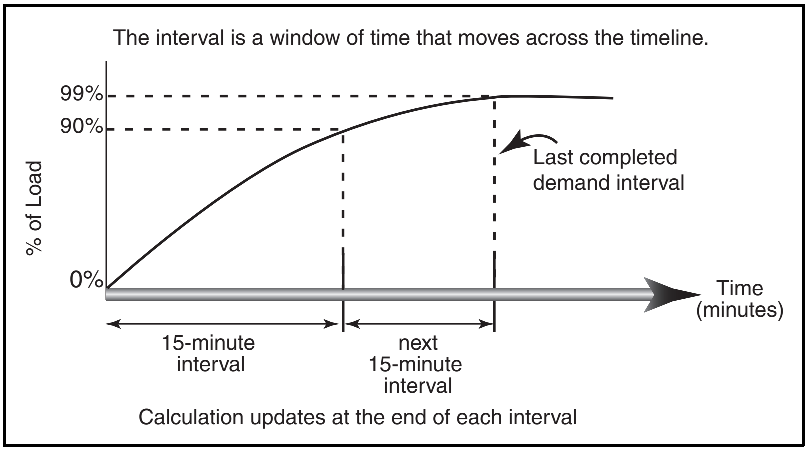



**Figure 4–4: Thermal Demand Example**

## Predicted Demand

The circuit monitor calculates predicted demand for the end of the present interval for kW, kVAR, and kVA demand. This prediction takes into account the energy consumption thus far within the present (partial) interval and the present rate of consumption. The prediction is updated every second.

Figure 4–5 illustrates how a change in load can affect predicted demand for the interval.

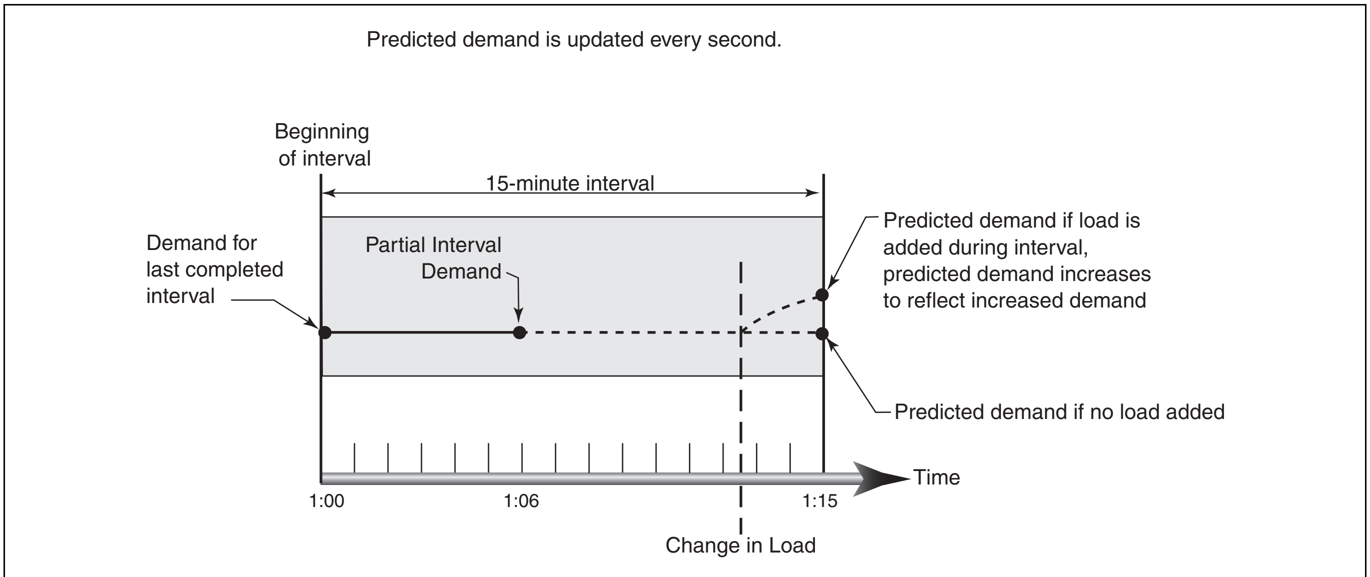



**Figure 4–5: Predicted Demand Example**

### Peak Demand

In nonvolatile memory, the circuit monitor maintains a running maximum for power demand values, called "peak demand." The peak is the highest average for each of these readings: kWD, kVARD, and kVAD since the last reset. The circuit monitor also stores the date and time when the peak demand occurred. In addition to the peak demand, the circuit monitor also stores the coinciding average 3-phase power factor. The average 3-phase power factor is defined as "demand kW/demand kVA" for the peak demand interval. Table 4–3 on page 56 lists the available peak demand readings from the circuit monitor.

You can reset peak demand values from the circuit monitor display. From the Main Menu, select Resets > Demand. You can also reset the values over the communications link by using SMS. See the SMS online help for instructions.

*NOTE: You should reset peak demand after changes to basic meter setup, such as CT ratio or system type.*

The circuit monitor also stores the peak demand during the last incremental energy interval. See "Energy Readings" on page 64 for more about incremental energy readings.

### Generic Demand

The circuit monitor can perform any of the demand calculation methods, described earlier in this chapter, on up to 20 quantities that you choose. In SMS the quantities are divided into two groups of 10, so you can set up two different demand "profiles." For each profile, you do the following in SMS:

- **Select the demand calculation method** (thermal, block interval, or synchronized).
- **Select the demand interval** (from 5–60 minutes in 1–minute increments) and select the demand subinterval (if applicable).
- **Select the quantities** on which to perform the demand calculation. You must also select the units and scale factor for each quantity.

Use the Device Setup > Basic Setup tab in SMS to create the generic demand profiles. For example, you might set up a profile to calculate the 15-minute average value of an analog input. To do this, select a fixed-block demand interval with a 15-minute interval for the analog input.

For each quantity in the demand profile, the circuit monitor stores four values:

- Partial interval demand value
- Last completed demand interval value
- Minimum values (date and time for each is also stored)
- Peak demand value (date and time for each is also stored)

You can reset the minimum and peak values of the quantities in a generic demand profile by using one of two methods:

- Use SMS (see the SMS online help file), or
- Use the command interface.
  Command 5115 resets the generic demand profile 1.
  Command 5116 resets the generic demand profile 2.
  See **Appendix B—Using the Command Interface** on page 181 for more about the command interface.

## Input Pulse Demand Metering

The circuit monitor has ten input pulse metering channels. The channels count pulses received from one or more digital inputs assigned to that channel. Each channel requires a consumption pulse weight, consumption scale factor, demand pulse weight, and demand scale factor. The consumption pulse weight is the number of watt-hours or kilowatt-hours per pulse. The consumption scale factor is a factor of 10 multiplier that determines the format of the value. For example, if each incoming pulse represents 125 Wh, and you want consumption data in watt-hours, the consumption pulse weight is 125 and the consumption scale factor is zero. The resulting calculation is 125 x $10^0$, which equals 125 watt-hours per pulse. If you want the consumption data in kilowatt-hours, the calculation is 125 x $10^{-3}$, which equals 0.125 kilowatt-hours per pulse.

Time must be taken into account for demand data so you begin by calculating demand pulse weight using the following formula:

$$\text{watts} = \frac{\text{watt-hours}}{\text{per pulse}} \times \frac{\text{3600 seconds}}{\text{per hour}} \times \frac{\text{pulse}}{\text{per second}}$$

If each incoming pulse represents 125 Wh, using the formula above you get 450,000 watts. If you want demand data in watts, the demand pulse weight is 450 and the demand scale factor is three. The calculation is 450 x $10^3$, which equals 450,000 watts. If you want the demand data in kilowatts, the calculation is 450 x $10^0$, which equals 450 kilowatts.

The circuit monitor counts each input transition as a pulse. Therefore, for an input transition of OFF-to-ON and ON-to-OFF will be counted as two pulses. For each channel, the circuit monitor maintains the following information:

- Total consumption
- Last completed interval demand—calculated demand for the last completed interval.
- Partial interval demand—demand calculation up to the present point during the interval.
- Peak demand—highest demand value since the last reset of the input pulse demand. The date and time of the peak demand is also saved.
- Minimum demand—lowest demand value since the last reset of the input pulse demand. The date and time of the minimum demand is also saved.

For example, you can use channels to verify utility charges. In Figure 4–6, Channel 1 is adding demand from two utility feeders to track total consumption and demand for the building. This information could be viewed in SMS and compared against the utility charges.

To use the channels feature, first set up the digital inputs from the display or from SMS. See “Setting Up I/Os” on page 23 in **Chapter 3—Operation** for instructions. Then using SMS, you must set the I/O operating mode to Normal and set up the channels. The demand method and interval that you select applies to all channels. See the SMS online help for instructions on device set up of the CM4000 Circuit Monitor.

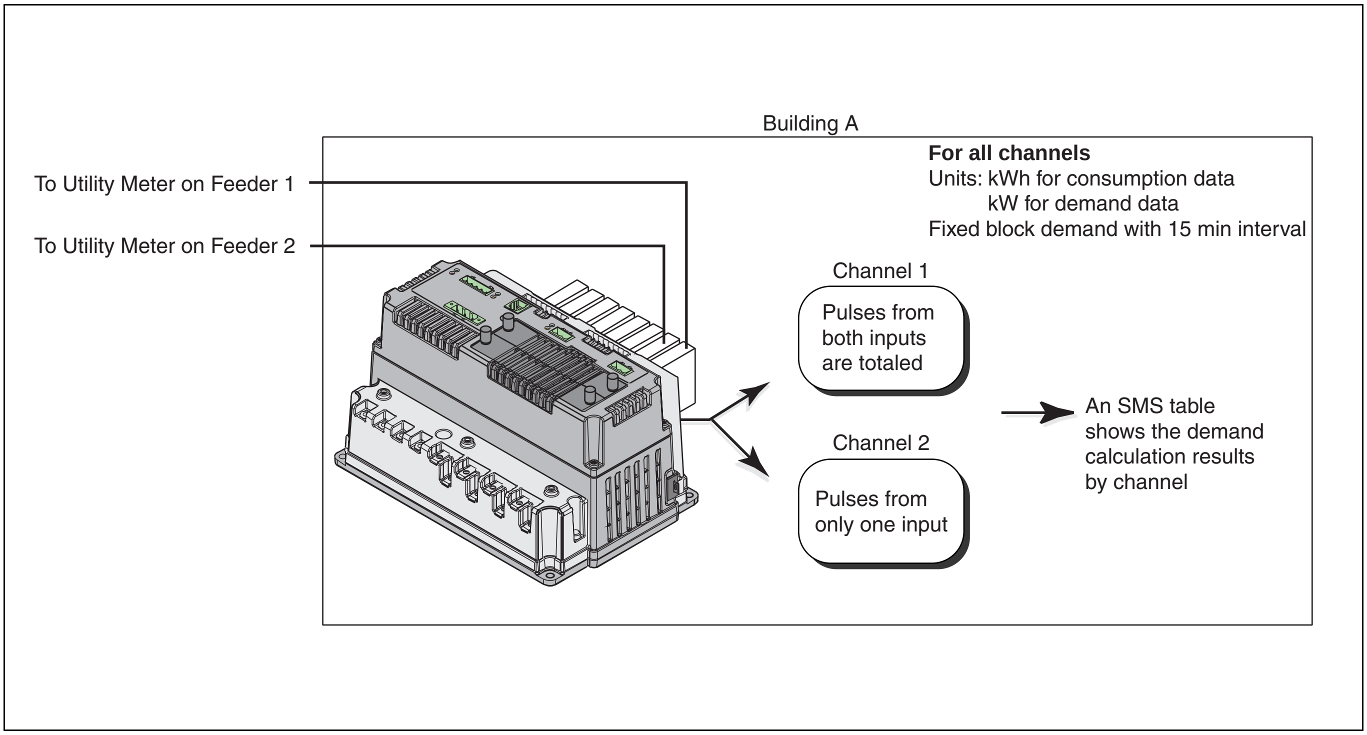



**Figure 4–6: Channel pulse metering example**

## ENERGY READINGS

The circuit monitor calculates and stores accumulated energy values for real and reactive energy (kWh and kVARh) both into and out of the load, and also accumulates absolute apparent energy. Table 4–4 lists the energy values the circuit monitor can accumulate.

**Table 4–4: Energy Readings**

| Energy Reading, 3-Phase | Reportable Range | Shown on the Display |
|---|---|---|
| Accumulated Energy | | |
| Real (Signed/Absolute) | -9,999,999,999,999,999 to 9,999,999,999,999,999 Wh | 0000.000 kWh to 99,999.99 MWh and 0000.000 to 99,999.99 MVARh |
| Reactive (Signed/Absolute) | -9,999,999,999,999,999 to 9,999,999,999,999,999 VARh | |
| Real (In) | 0 to 9,999,999,999,999,999 Wh | 0000.000 kWh to 99,999.99 MWh and 0000.000 to 99,999.99 MVARh |
| Real (Out) | 0 to 9,999,999,999,999,999 Wh | |
| Reactive (In) | 0 to 9,999,999,999,999,999 VARh | |
| Reactive (Out) | 0 to 9,999,999,999,999,999 VARh | |
| Apparent | 0 to 9,999,999,999,999,999 VAh | |
| Accumulated Energy, Conditional | | |
| Real (In) ① | 0 to 9,999,999,999,999,999 Wh | Not shown on the display. Readings are obtained only through the communications link. |
| Real (Out) ① | 0 to 9,999,999,999,999,999 Wh | |
| Reactive (In) ① | 0 to 9,999,999,999,999,999 VARh | |
| Reactive (Out) ① | 0 to 9,999,999,999,999,999 VARh | |
| Apparent ① | 0 to 9,999,999,999,999,999 VAh | |
| Accumulated Energy, Incremental | | |
| Real (In) | 0 to 999,999,999,999 Wh | 0000.000 kWh to 99,999.99 MWh and 0000.000 to 99,999.99 MVARh |
| Real (Out) | 0 to 999,999,999,999 Wh | |
| Reactive (In) | 0 to 999,999,999,999 VARh | |
| Reactive (Out) | 0 to 999,999,999,999 VARh | |
| Apparent | 0 to 999,999,999,999 VAh | |
| Reactive Energy | | |
| Quadrant 1 ① | 0 to 999,999,999,999 VARh | Not shown on the display. Readings are obtained only through the communications link. |
| Quadrant 2 ① | 0 to 999,999,999,999 VARh | |
| Quadrant 3 ① | 0 to 999,999,999,999 VARh | |
| Quadrant 4 ① | 0 to 999,999,999,999 VARh | |

① Values can be displayed on the screen by creating custom quantities and custom displays.

The circuit monitor can accumulate the energy values shown in Table 4–4 in one of two modes: signed or unsigned (absolute). In signed mode, the circuit monitor considers the direction of power flow, allowing the magnitude of accumulated energy to increase and decrease. In unsigned mode, the circuit monitor accumulates energy as a positive value, regardless of the direction of power flow. In other words, the energy value increases, even during reverse power flow. The default accumulation mode is unsigned.

You can view accumulated energy from the display. The resolution of the energy value will automatically change through the range of 000.000 kWh to 000,000 MWh (000.000 to 000,000 MVARh), or it can be fixed.
See **Appendix A—Abbreviated Register Listing** on page 127 for the contents of the registers.

For conditional accumulated energy readings, you can set the real, reactive, and apparent energy accumulation to OFF or ON when a particular condition occurs. You can do this over the communications link, using a command, or from a digital input change. For example, you may want to track accumulated energy values during a particular process that is controlled by a PLC. The circuit monitor stores the date and time of the last reset of conditional energy in nonvolatile memory.

Also, the circuit monitor provides an additional energy reading that is only available over the communications link:

- **Four-quadrant reactive accumulated energy readings**. The circuit monitor accumulates reactive energy (kVARh) in four quadrants as shown in Figure 4–7. The registers operate in unsigned (absolute) mode in which the circuit monitor accumulates energy as positive.

*NOTE: The reactive accumulated energy is not affected by the VAR sign convention and will remain as shown in the image below.*

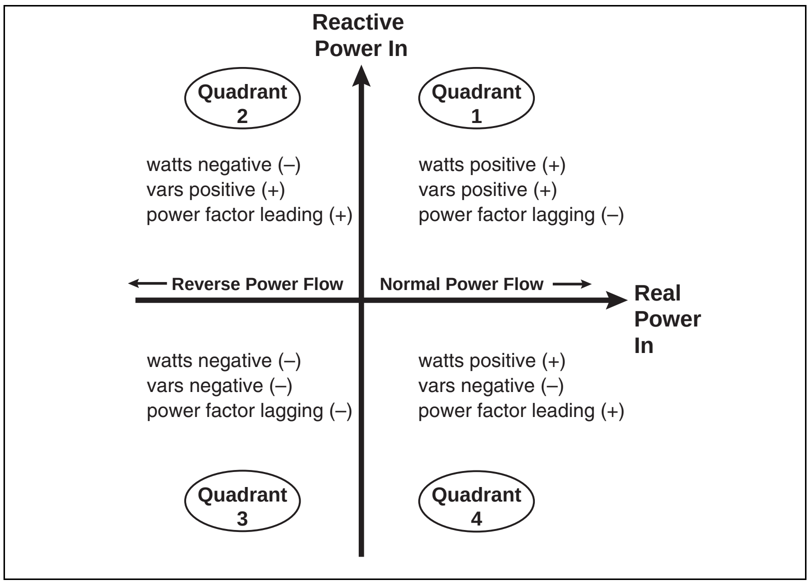



**Figure 4–7: Reactive energy accumulates in four quadrants**

## POWER ANALYSIS VALUES

The circuit monitor provides a number of power analysis values that can be used to detect power quality problems, diagnose wiring problems, and more. Table 4–5 on page 68 summarizes the power analysis values.

- **THD**. Total Harmonic Distortion (THD) is a quick measure of the total distortion present in a waveform and is the ratio of harmonic content to the fundamental. It provides a general indication of the “quality” of a waveform. THD is calculated for both voltage and current. The circuit monitor uses the following equation to calculate THD where H is the harmonic distortion:

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

- **thd**. An alternate method for calculating Total Harmonic Distortion, used widely in Europe. It considers the total harmonic current and the total rms content rather than fundamental content in the calculation. The circuit monitor calculates thd for both voltage and current. The circuit monitor uses the following equation to calculate thd where H is the harmonic distortion:

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

- **TDD.** Total Demand Distortion (TDD) is used to evaluate the harmonic voltages and currents between an end user and a power source. The harmonic values are based on a point of common coupling (PCC), which is a common point that each user receives power from the power source. The following equation is used to calculate TDD where $I_h$ is the magnitude of individual harmonic components, h is the harmonic order, and $I_L$ is the maximum demand load current in register 3233:

$$TDD = \frac{\sqrt{\sum_{h=2}^{255} I_h^2}}{I_L} \times 100\%$$

- **K-factor**. K-factor is a simple numerical rating used to specify transformers for nonlinear loads. The rating describes a transformer’s ability to serve nonlinear loads without exceeding rated temperature rise limits. The higher the K-factor rating, the better the transformer’s ability to handle the harmonics. The circuit monitor uses the following equation to calculate K-factor where $I_h$ is harmonic current and h is the harmonic order:

$$K = \frac{\text{SUM } (I_h^2 \bullet h^2)}{\text{SUM } I_{rms}^2}$$

- **Displacement Power Factor**. Power factor (PF) represents the degree to which voltage and current coming into a load are out of phase. When true power factor is based on the angle between the fundamental components of current and voltage.
- **Harmonic Values**. Harmonics can reduce the capacity of the power system. The circuit monitor determines the individual per-phase harmonic magnitudes and angles through the 63rd harmonic for all currents and voltages. The harmonic magnitudes can be formatted as either a percentage of the fundamental (default) or a percentage of the rms value. Refer to “Setting Up Individual Harmonic Calculations” on page 190 in **Appendix B—Using the Command Interface** for information on how to configure harmonic calculations.
- **Harmonic Power.** Harmonic power is an indication of the non-fundamental components of current and power in the electrical circuit. The circuit monitor uses the following equation to calculate harmonic power.

$$\text{Harmonic Power} = \sqrt{\text{Overall Power}^2 - \text{Fundamental Power}^2}$$

- **Distortion Power Factor.** Distortion power factor is an indication of the distortion power content of non-linear loads. Linear loads do not contribute to distortion power even when harmonics are present. Distortion power factor provides a way to describe distortion in terms of its total contribution to apparent power. The circuit monitor uses the following equation to calculate the distortion power factor.

$$\text{Distortion Power Factor} = \frac{\text{Overall Power Power Factor}}{\text{Fundamental Power Power Factor}}$$

### Table 4–5: Power Analysis Values

| Value | Reportable Range |
|---|---|
| THD—Voltage, Current | |
| 3-phase, per-phase, neutral | 0 to 3,276.7% |
| thd—Voltage, Current | |
| 3-phase, per-phase, neutral | 0 to 3,276.7% |
| Total Demand Distortion | 0 to 10,000 |
| K-Factor (per phase)② | 0.0 to 100.0 |
| K-Factor Demand (per phase)①② | 0.0 to 100.0 |
| Crest Factor (per phase) ① | 0.0 to 100.0 |
| Displacement P.F. (per phase, 3-phase) ① | –0.010 to 1.000 to +0.010 |
| Fundamental Voltages (per phase) | |
| Magnitude | 0 to 1,200 kV |
| Angle | 0.0 to 359.9° |
| Fundamental Currents (per phase) | |
| Magnitude | 0 to 32,767 A |
| Angle | 0.0 to 359.9° |
| Fundamental Real Power (per phase, 3-phase) ① | 0 to 32,767 kW |
| Fundamental Reactive Power (per phase) ① | 0 to 32,767 kVAR |
| Harmonic Power (per phase, 3-phase) ① | 0 to 32,767 kW |
| Phase Rotation | ABC or CBA |
| Unbalance (current and voltage) ① | 0.0 to 100.0% |
| Individual Harmonic Magnitudes ①③ | 0 to 327.67% |
| Individual Harmonic Angles①③ | 0.0° to 359.9° |
| Distortion Power | –32,767 to 32,767 |
| Distortion Power Factor | 0 to 1,000 |

① Readings are obtained only through communications.
② K-Factor not available at 400Hz.
③ Harmonic magnitudes and angles through the 63rd harmonic at 50Hz and 60Hz; harmonic magnitudes and angles through the 7th harmonic at 400Hz.

# CHAPTER 5—INPUT/OUTPUT CAPABILITIES

This chapter explains the input and output (I/O) capabilities of the circuit monitor and its optional I/O accessories. For module installation instructions and detailed technical specifications, refer to the individual instruction bulletins that ship with the product. For a list of these publications, see Table 1–2 on page 3 of this bulletin.

## CHAPTER CONTENTS

## I/O OPTIONS

The circuit monitor supports a variety of input and output options including:

- Digital Inputs
- Analog Inputs
- Mechanical Relay Outputs
- Solid State KYZ Pulse Outputs
- Analog Outputs

The circuit monitor has one KYZ output as standard. You can expand the I/O capabilities by adding the optional I/O Extender (IOX) and the digital I/O option card (IOC-44). Table 5–1 lists the many available I/O options. The I/O options are explained in detail in the sections that follow.

**Table 5–1: I/O Extender Options**

| I/O Extender Options | Part Number |
|---|---|
| with no preinstalled I/Os, accepts up to 8 individual I/O modules with a maximum of 4 analog I/Os | IOX |
| with 4 digital inputs (32 Vdc), 2 digital outputs (60 Vdc), 1 analog output(4–20 mA), and 1 analog input (0–5 Vdc) | IOX2411 |
| with 4 digital inputs (120 Vac) and 4 analog inputs (4–20 mA) | IOX0404 |
| with 8 digital inputs (120 Vac) | IOX08 |
| **Individual I/O Modules①** | **Part Number** |
| **Digital I/Os** | |
| 120 Vac input | DI120AC |
| 240 Vac input | DI240AC |
| 32 Vdc input (0.2ms turn on) polarized | DI32DC |
| 120 Vac output (3.5A maximum) | DO120AC |
| 200 Vdc output (3.5A maximum) | DO200DC |
| 240 Vac output (3.5A maximum) | DO240AC |
| 60 Vdc output (3.5A maximum) | DO60DC |
| **Analog I/Os** | |
| 0 to 5 Vdc analog input | AI05 |
| 4 to 20 mA analog input | AI420 |
| 4 to 20 mA analog output | AO420 |

① The circuit monitor must be equipped with the I/O Extender (IOX) to install the modules.

## DIGITAL INPUTS

The circuit monitor can accept up to 16 digital inputs depending on the I/O accessories you select. Digital inputs are used to detect digital signals. For example, the digital input can be used to determine circuit breaker status, count pulses, or count motor starts. Digital inputs can also be associated with an external relay, which can trigger a waveform capture in the circuit monitor. You can log digital input transitions as events in the circuit monitor's on-board alarm Log. The event is date and time stamped with resolution to the millisecond, for sequence of events recording. The circuit monitor counts OFF-to-ON transitions for each input, and you can reset this value using the command interface.

Digital inputs have four operating modes:

- **Normal**—Use the normal mode for simple on/off digital inputs. In normal mode, digital inputs can be used to count KYZ pulses for demand and energy calculation. Using the input pulse demand feature, you can map multiple inputs to the same channel where the circuit monitor can total pulses from multiple inputs (see“Input Pulse Demand Metering” on page 62 in **Chapter 4—Metering Capabilities** for more information). To accurately count pulses, set the time between transitions from OFF to ON and ON to OFF to at least 20 milliseconds.
- **Demand Interval Synch Pulse**—you can configure any digital input to accept a demand synch pulse from a utility demand meter (see “Demand Synch Pulse Input” on page 72 of this chapter for more about this topic). For each demand profile, you can designate only one input as a demand synch input.
- **Time Synch**—you can configure one digital input to receive a signal from a GPS receiver that provides a serial pulse stream in accordance to the DCF-77 format to synchronize the internal clock of the circuit monitor.
- **Conditional Energy Control**—you can configure one digital input to control conditional energy (see “Energy Readings” on page 64 in **Chapter 4—Metering Capabilities** for more about conditional energy).

To set up a digital input on the I/O extender, you must first define it from the display. From the main menu, select Setup > I/O. Select the appropriate digital input option. For example, if you are using IOX-2411 option of the I/O Extender, select IOX-2411. For detailed instructions, see “Setting Up I/Os” on page 23 in **Chapter 3—Operation**. Then using SMS, define the name and operating mode of the digital input. The name is a 16-character label that identifies the digital input. The operating mode is one of those listed above. See the SMS online help for instructions on device set up of the circuit monitor.

## DEMAND SYNCH PULSE INPUT

You can configure the circuit monitor to accept a demand synch pulse from an external source such as another demand meter. By accepting demand synch pulses through a digital input, the circuit monitor can make its demand interval "window" match the other meter's demand interval "window." The circuit monitor does this by "watching" the digital input for a pulse from the other demand meter. When it sees a pulse, it starts a new demand interval and calculates the demand for the preceding interval. The circuit monitor then uses the same time interval as the other meter for each demand calculation. Figure 5–1 illustrates this point. See "Synchronized Demand" on page 59 in **Chapter 4—Metering Capabilities** for more about demand calculations.

When in demand synch pulse operating mode, the circuit monitor will not start or stop a demand interval without a pulse. The maximum allowable time between pulses is 60 minutes. If 66 minutes (110% of the demand interval) pass before a synch pulse is received, the circuit monitor throws out the demand calculations and begins a new calculation when the next pulse is received. Once in synch with the billing meter, the circuit monitor can be used to verify peak demand charges.

Important facts about the circuit monitor's demand synch feature are listed below:

- Any installed digital input can be set to accept a demand synch pulse.
- Each system can choose whether to use an external synch pulse, but only one demand synch pulse can be brought into the meter for each demand system. One input can be used to synchronize any combination of the demand systems.
- The demand synch feature can be set up from SMS. See the SMS online help for instructions on device set up of the circuit monitor.

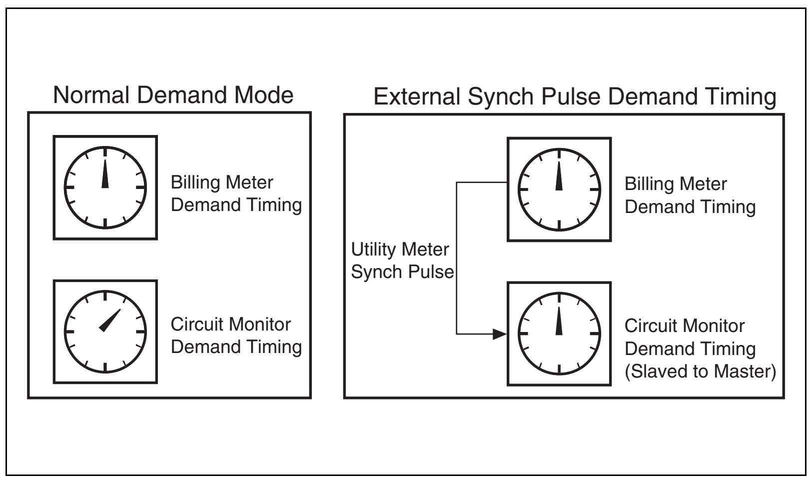



**Figure 5–1: Demand synch pulse timing**

## ANALOG INPUTS

Depending on the I/O modules you select, the circuit monitor can accept either voltage or current signals through its analog inputs. See Table 5–1 on page 70 for a list of I/O options. The circuit monitor stores a minimum and a maximum value for each analog input.

For technical specifications and instructions on installing I/O modules, refer to the instruction bulletin that ships with the I/O (see Table 1–2 on page 3 for a list of these publications). To set up analog inputs, you must first set it up from the display. From the main menu, select Setup > I/O, then select the appropriate analog input option. For example, if you are using the IOX0404 option of the I/O Extender, select IOX-0404. For detailed instructions, see "Setting Up I/Os" on page 23 in **Chapter 3—Operation**. Then, in SMS define the following values for each analog input:

- **Name**—a 16-character label used to identify the analog input.
- **Units—**the units of the monitored analog value (for example, "psi").
- **Scale factor**—multiplies the units by this value (such as tenths or hundreths).
- **Report Range Lower Limit**—the value the circuit monitor reports when the input reaches a minimum value. When the input current is below the lowest valid reading, the circuit monitor reports the lower limit.
- **Report Range Upper Limit**—the value the circuit monitor reports when the input reaches the maximum value. When the input current is above highest valid reading, the circuit monitor reports the upper limit.

For instructions on setting up analog inputs in SMS, see device set up of the circuit monitor in the SMS online help.

## Analog Input Example

Figure 5–2 shows an analog input example. In this example, the analog input has been configured as follows:

Upper Limit: 500

Lower Limit: 100

Units: psi

Table 5–2 shows circuit monitor readings at various input currents.

**Table 5–2: Sample register readings for analog inputs**

| Input Current (mA) | Circuit Monitor Reading (psi) |
|---|---|
| 3 (invalid) | 100 |
| 4 | 100 |
| 8 | 200 |
| 10 | 250 |
| 20 | 500 |
| 21 (invalid) | 500 |

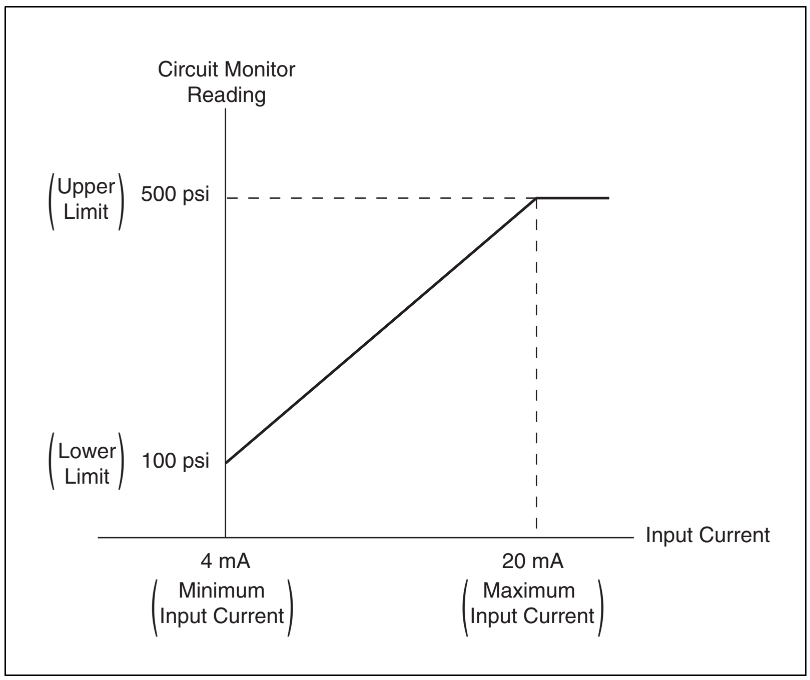



**Figure 5–2: Analog input example**

## RELAY OUTPUT OPERATING MODES

Before we describe the 11 available relay operating modes, it is important to understand the difference between a relay configured for remote (external) control and a relay configured for circuit monitor (internal) control.

Each relay output defaults to external control, but you can choose whether the relay is set to external or internal control:

- **Remote (external) control**—the relay is controlled either from a PC using SMS or a programmable logic controller using commands via communications.
- **Circuit monitor (internal) control**—the relay is controlled by the circuit monitor in response to a set-point controlled alarm condition, or as a pulse initiator output. Once you've set up a relay for circuit monitor control, you can no longer operate the relay remotely. However, you can temporarily override the relay, using SMS.

*NOTE: If any basic setup parameters or I/O setup parameters are modified, all relay outputs will be de-energized.*

The 11 relay operating modes are as follows:

- **Normal**
  - — *Remotely Controlled:* Energize the relay by issuing a command from a remote PC or programmable controller. The relay remains energized until a command to de-energize is issued from the remote PC or programmable controller, or until the circuit monitor loses control power. When control power is restored, the relay will be re-energized.
  - — *Circuit Monitor Controlled:* When an alarm condition assigned to the relay occurs, the relay is energized. The relay is not de-energized until *all* alarm conditions assigned to the relay have dropped out, the circuit monitor loses control power, or the alarms are over-ridden using SMS software. If the alarm condition is still true when the circuit monitor regains control power, the relay will be re-energized.
- **Latched**
  - — *Remotely Controlled:* Energize the relay by issuing a command from a remote PC or programmable controller. The relay remains energized until a command to de-energize is issued from a remote PC or programmable controller, or until the circuit monitor loses control power. When control power is restored, the relay will not be re-energized.
  - — *Circuit Monitor Controlled:* When an alarm condition assigned to the relay occurs, the relay is energized. The relay remains energized—even after all alarm conditions assigned to the relay have dropped out—until a command to de-energize is issued from a remote PC or programmable controller, until the high priority alarm log is cleared from the display, or until the circuit monitor loses control power. When control power is restored, the relay will not be re-energized if the alarm condition is not TRUE.

- **Timed**
  - — *Remotely Controlled:* Energize the relay by issuing a command from a remote PC or programmable controller. The relay remains energized until the timer expires, or until the circuit monitor loses control power. If a new command to energize the relay is issued before the timer expires, the timer restarts. If the circuit monitor loses control power, the relay will be re-energized when control power is restored and the timer will reset to zero and begin timing again.
  - — *Circuit Monitor Controlled:* When an alarm condition assigned to the relay occurs, the relay is energized. The relay remains energized for the duration of the timer. When the timer expires, the relay will de-energize and remain de-energized. If the relay is on and the circuit monitor loses control power, the relay will be re-energized when control power is restored and the timer will reset to zero and begin timing again.
- **End Of Power Demand Interval**

  This mode assigns the relay to operate as a synch pulse to another device. The output operates in timed mode using the timer setting and turns on at the end of a power demand interval. It turns off when the timer expires. Because of it's long life, this mode should be used with solid state relay outputs.
- **Absolute kWh Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kWh per pulse. In this mode, both forward and reverse real energy are treated as additive (as in a tie circuit breaker).
- **Absolute kVARh Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kVARh per pulse. In this mode, both forward and reverse reactive energy are treated as additive (as in a tie circuit breaker).
- **kVAh Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kVAh per pulse. Since kVA has no sign, the kVAh pulse has only one mode.
- **kWh In Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kWh per pulse. In this mode, only the kWh flowing into the load is considered.
- **kVARh In Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kVARh per pulse. In this mode, only the kVARh flowing into the load is considered.
- **kWh Out Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kWh per pulse. In this mode, only the kWh flowing out of the load is considered.
- **kVARh Out Pulse**

  This mode assigns the relay to operate as a pulse initiator with a user-defined number of kVARh per pulse. In this mode, only the kVARh flowing out of the load is considered.

## MECHANICAL RELAY OUTPUTS

The optional Input/Output Card IOC44 provides three Form-C, 10 A mechanical relays that can be used to open or close circuit breakers, annunciate alarms, and more.

The mechanical output relays of the circuit monitor can be configured to operate in one of 11 operating modes:

- Normal
- Latched (electrically held)
- Timed
- End of power demand interval
- Absolute kWh pulse
- Absolute kVARh pulse
- kVAh pulse
- kWh in pulse
- kVARh in pulse
- kWh out pulse
- kVARh out pulse

See the previous section “Relay Output Operating Modes” on page 75 for a description of the modes.

The last seven modes in the list above are for pulse initiator applications. All Series 4000 Circuit Monitors are equipped with one solid-state KYZ pulse output rated at 96 mA and an additional KYZ pulse output is available on the IOC44 card. The solid-state KYZ output provides the long life—billions of operations—required for pulse initiator applications. The mechanical relay outputs have limited lives: 10 million operations under no load; 100,000 under load. For maximum life, use the solid-state KYZ pulse output for pulse initiation, except when a rating higher than 96 mA is required. See“Solid-State KYZ Pulse Output” on page 78 in this chapter for a description of the solid-state KYZ pulse output.

To set up a mechanical relay output, from the Main Menu, select Setup > I/O. Select input option IOC44. For detailed instructions, see “Setting Up I/Os” on page 23 in **Chapter 3—Operation**. Then using SMS, you must define the following values for each mechanical relay output:

- **Name**—A 16-character label used to identify the digital output.
- **Mode**—Select one of the operating modes listed above.
- **Pulse Weight**—You must set the pulse weight, the multiplier of the unit being measured, if you select any of the pulse modes (last 7 listed above).
- **Timer**—You must set the timer if you select the timed mode or end of power demand interval mode (in seconds).
- **Control**—You must set the relay to be controlled either remotely or internally (from the circuit monitor) if you select the normal, latched, or timed mode.

For instructions on setting up digital I/Os in SMS, see the SMS online help on device set up of the circuit monitor.

*NOTE: The IOC44 can be set up using the display or SMS. The IOX must be identified using the display, then set up using the display or SMS.*

### Setpoint-controlled Relay Functions

The circuit monitor can detect over 100 alarm conditions, including over/under conditions, digital input changes, phase unbalance conditions, and more (see **Chapter 6—Alarms** on page 83 for more about alarms). Using SMS, you can configure a relay to operate when an alarm condition is true. For example, you could set up the three relays on the IOC44 card to operate at each occurrence of "Undervoltage Phase A." Then, each time the alarm condition occurs—that is, each time the setpoints and time delays assigned to Undervoltage Phase A are satisfied—the circuit monitor automatically operates relays R1, R2, and R3 according to their configured mode of operation. See "Relay Output Operating Modes" on page 75 of this chapter for a description of the operating modes.

Also, you can assign multiple alarm conditions to a relay. For example, relay AR1 on the IOC-44 card could have "Undervoltage Phase A" and "Undervoltage Phase B" assigned to it. The relay would operate whenever either condition occurred.

*NOTE: Setpoint-controlled relay operation can be used for some types of non-time-critical relaying. For more information, see "Setpoint-Controlled Relay Functions" on page 88 in* **Chapter 6—Alarms**.

## SOLID-STATE KYZ PULSE OUTPUT

This section describes the pulse output capabilities of the circuit monitor. For instructions on wiring the KYZ pulse output, see "Wiring the Solid-State KYZ Output" on page 55 in **Chapter 5—Wiring** of the installation manual.

The circuit monitor is equipped with one solid-state KYZ pulse output located near the option card slots. The IOC44 option card also has a solid-state KYZ output. The solid-state relays provides the extremely long life—billions of operations—required for pulse initiator applications.

The KYZ output is a Form-C contact with a maximum rating of 96 mA. Because most pulse initiator applications feed solid-state receivers with low burdens, this 96 mA rating is adequate for most applications. For applications where a higher rating is required, the IOC44 card provides 3 relays with 10 ampere ratings. Use SMS or the display to configure any of the 10 ampere relays as a pulse initiator output. Keep in mind that the 10 ampere relays are mechanical relays with limited life—10 million operations under no load; 100,000 under load.

To set the kilowatthour-per-pulse value, use SMS or the display. When setting the kWh/pulse value, set the value based on a 3-wire pulse output. For instructions on calculating the correct value, see "Calculating the Kilowatthour-Per-Pulse Value" on page 80 in this chapter.

The circuit monitor can be used in 2-wire or 3-wire pulse initiator applications. Each of these applications is described in the sections that follow.

The KYZ pulse output can be configured to operate in one of 11 operating modes. See "Relay Output Operating Modes" on page 75 for a description of the modes.

The setup in SMS or at the circuit monitor display is the same as a mechanical relay. See the previous section "Mechanical Relay Outputs" on page 77, for the values you must set up in SMS.

## 2-Wire Pulse Initiator

Most digital inputs in energy management systems use only two of the three wires provided with a KYZ pulse initiator. This is called a 2-wire pulse initiator application. Figure 5–3 shows a pulse train from a 2-wire pulse initiator application.

In a 2-wire application, the pulse train looks like the alternating open and closed states of a Form-A contact. Most 2-wire pulse initiator applications use a Form-C contact, but tie into only one side of the Form-C contact where the pulse is the transition from OFF to ON of that side of the Form-C relay. In Figure 5–3, the transitions are marked as 1 and 2. Each transition represents the time when the relay transitions from KZ to KY. Each time the relay transitions, the receiver counts a pulse. The circuit monitor can deliver up to 25 pulses per second in a 2-wire application.

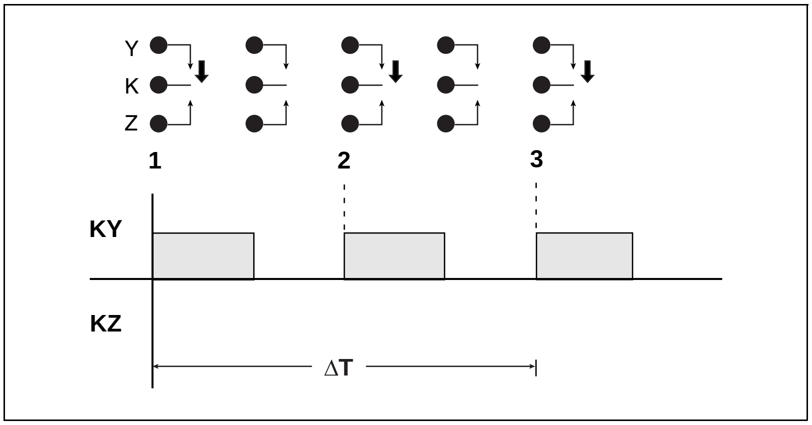



**Figure 5–3: Two-wire pulse train**

## 3-Wire Pulse Initiator

Some applications require the use of all three wires provided with the KYZ pulse initiator. This is called a 3-wire pulse initiator application. Figure 5–4 shows a pulse train for a 3-wire pulse initiator application.

Three-wire KYZ pulses are the transitions between KY and KZ. These transitions are the alternate contact closures of a Form-C contact. In Figure 5–4, the transitions are marked as 1, 2, 3, and 4. The receiver counts a pulse at each transition. That is, each time the Form-C contact changes state from KY to KZ, or from KZ to KY, the receiver counts a pulse.The circuit monitor can deliver up to 50 pulses per second in a 3-wire application.

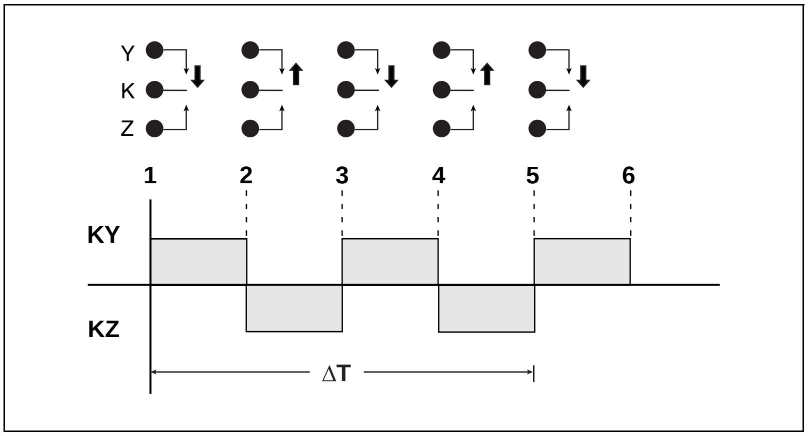



**Figure 5–4: Three-wire pulse train**

## CALCULATING THE KILOWATTHOUR-PER-PULSE VALUE

This section shows an example of how to calculate kilowatthours per pulse. 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 1600 kW.
- About two KYZ pulses per second should occur at full scale.

**Step 1:** Convert 1600 kW load into kWh/second.

$$(1600\ \text{kW})\ (1\ \text{Hr}) = 1600\ \text{kWh}$$

$$\frac{(1600\ \text{kWh})}{1\ \text{hour}} = \frac{\text{“X” kWh}}{1\ \text{second}}$$

$$\frac{(1600\ \text{kWh})}{3600\ \text{seconds}} = \frac{\text{“X” kWh}}{1\ \text{second}}$$

$$X = 1600/3600 = 0.4444\ \text{kWh/second}$$

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

$$\frac{0.4444\ \text{kWh/second}}{2\ \text{pulses/second}} = 0.2222\ \text{kWh/pulse}$$

**Step 3:** Round to nearest hundreth, since the circuit monitor only accepts 0.01 kWh increments.

$$\text{Ke} = 0.22\ \text{kWh/pulse}$$

Summary:

- 3-wire application—**0.22** kWh/pulse provides approximately 2 pulses per second at full scale.
- 2-wire application—**0.11** kWh/pulse provides approximately 2 pulses per second at full scale. (To convert to the kWh/pulse required for a 2-wire application, divide Ke by 2. This is necessary because the circuit monitor Form C relay generates two pulses—KY and KZ—for every pulse that is counted.)

## ANALOG OUTPUTS

This section describes the circuit monitor's analog output capabilities. For technical specifications and instructions on installing the I/O Extender or analog output modules, refer to the instruction bulletin that ships with the I/O (see Table 1–2 on page 3 for a list of these publications).

To set up analog outputs, you must first define it from the display. From the main menu, select Setup > I/O. Select the appropriate analog output option. For example, if you are using the IOX0404 option of the I/O Extender, select IOX0404. For detailed instructions, see "Setting Up I/Os" on page 23 in **Chapter 3—Operation**. Then using SMS, you must define the following values for each analog output:

- Name—A 16-character label used to identify the output. Default names are assigned, but can be customized
- Output register**—**The circuit monitor register assigned to the analog output.
- Lower Limit—The value equivalent to the minimum output current. When the register value is below the lower limit, the circuit monitor outputs the minimum output current.
- Upper Limit—The value equivalent to the maximum output current. When the register value is above the upper limit, the circuit monitor outputs the maximum output current.

For instructions on setting up an analog output in SMS, see the SMS online help on device set up of the circuit monitor.

**CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

Each analog output represents an individual 2-wire current loop; therefore, use an isolated receiver for *each* individual analog output on the I/O Extender (IOX).

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

## Analog Output Example

Figure 5–5 illustrates the relationship between the output range of current (in milliamperes) and the upper and lower limit of power usage (real power in kW). In this example, the analog output has been configured as follows:

Register Number: 1143 (Real Power, 3-Phase Total)

Lower Limit: 100 kW

Upper Limit: 500 kW

Table 5–3 shows the output current at various register readings.

**Table 5–3: Sample register readings for analog output**

| Register Reading (kW) | Output Current (mA) |
|---|---|
| 50 | 4 |
| 100 | 4 |
| 200 | 8 |
| 250 | 10 |
| 500 | 20 |
| 550 | 20 |

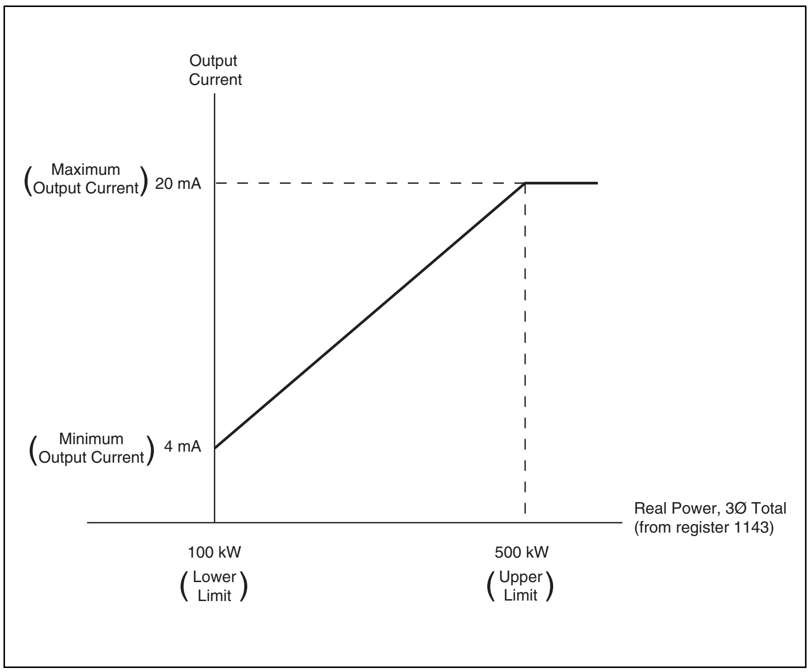



**Figure 5–5: Analog output example**

# CHAPTER 6—ALARMS

This chapter provides a detailed discussion of the alarm capabilities of the circuit monitor.

## CHAPTER CONTENTS

## ABOUT ALARMS

The circuit monitor can detect over 100 alarm conditions, including over or under conditions, digital input changes, phase unbalance conditions, and more. It also maintains a counter for each alarm to keep track of the total number of occurrences. A complete list of default alarm configurations are described in Table 6–3 on page 94. In addition, you can set up your own custom alarms and set up relays to operate on alarm conditions.

When one or more alarm conditions are true, the circuit monitor will execute a task automatically. Using SMS or the display, you can set up each alarm condition to perform these tasks:

- Force data log entries in up to 14 user-defined data log files. See **Chapter 7—Logging** on page 99 for more about data logging.
- Perform event captures. See **Chapter 8—Waveform and Event Capture** on page 107 for more about event recording.
- Operate relays. Using SMS you can assign one or more relays to operate when an alarm condition is true. See the SMS online help for more about this topic.

### Alarms Groups

Whether you are using a default alarm or creating a custom alarm, you first choose the alarm group that is appropriate for the application. Each alarm condition is assigned to one of these alarm groups:

- **Standard**—Standard alarms have a detection rate of 1 second and are useful for detecting conditions such as over current and under voltage. Up to 80 alarms can be set up in this alarm group
- **High Speed**—High speed alarms have a detection rate of 100 milliseconds and are useful for detecting voltage sags and swells lasting only a few cycles. Up to 20 alarms can be set up in this group.
- **Disturbance**—Disturbance alarms have a detection rate one cycle and are useful for detecting voltage sags and swells. Up to 20 alarms can be set up in this group. See **Chapter 9—Disturbance Monitoring** on page 113 for more about disturbance monitoring.
- **Digital**—Digital alarms are triggered by an exception such as the transition of a digital input or the end of an incremental energy interval. Up to 40 alarms can be set up in this group.
- **Boolean**—Boolean alarms use Boolean logic to combine up to four enabled alarms. You can choose from the Boolean logic operands: AND, NAND, OR, NOR, or XOR to combine your alarms. Up to 15 alarms can be set up in this group.

Use either SMS or the display to set up any of the alarms.

## Setpoint-Driven Alarms

Many of the alarm conditions require that you define setpoints. This includes all alarms for over, under, and phase unbalance alarm conditions. Other alarm conditions such as digital input transitions and phase reversals do not require setpoints. For those alarm conditions that require setpoints, you must define the following information:

- Pickup Setpoint
- Pickup Delay (depending on the alarm group, you choose the time in seconds, 100 ms increments, or cycles)
- Dropout Setpoint
- Dropout Delay (depending on the alarm group, you choose the time in seconds, 100 ms increments, or cycles)

*NOTE: Alarms with both Pickup and Dropout setpoints set to zero are invalid.*

To understand how the circuit monitor handles setpoint-driven alarms, see Figure 6–2 on page 86. Figure 6–1 shows what the actual alarm Log entries for Figure 6–2 might look like, as displayed by SMS.

*NOTE: The software does not actually display the codes in parentheses—EV1, EV2, Max1, Max2. These are references to the codes in Figure 6–2.*

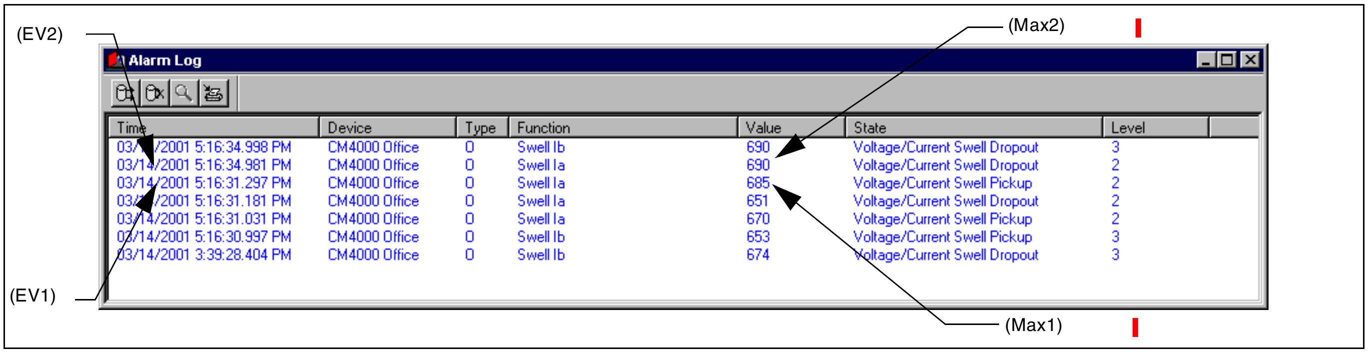



**Figure 6–1: Sample alarm log entry**

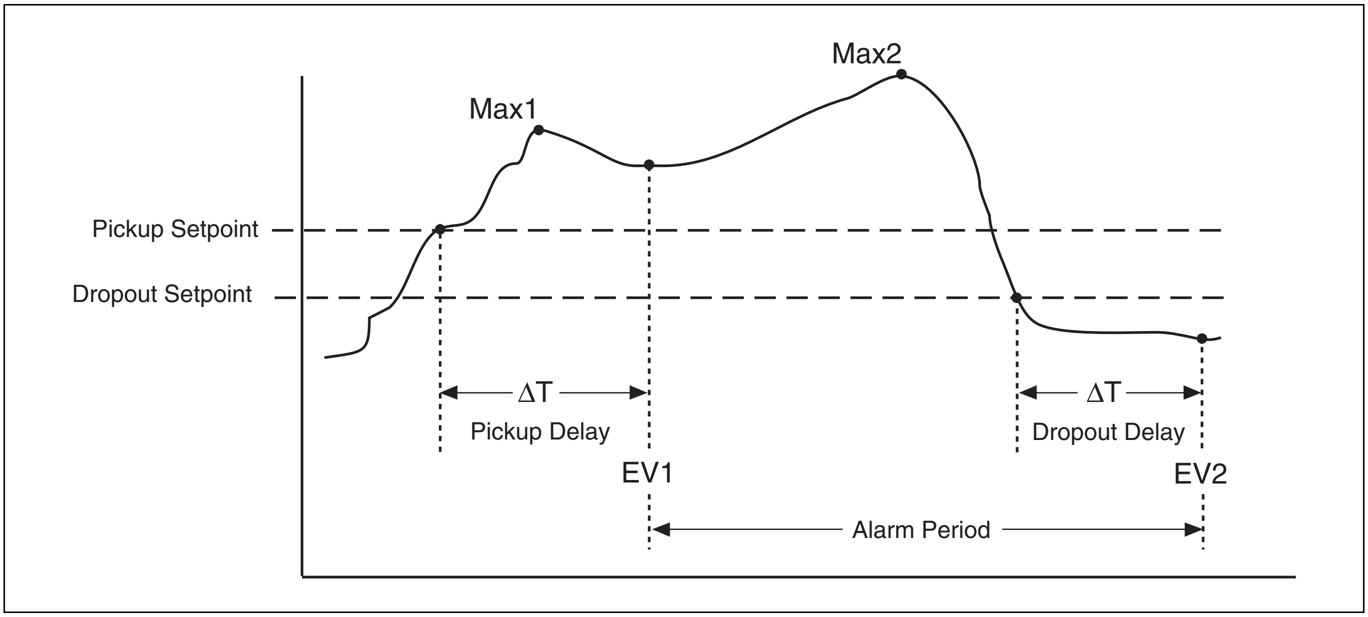



**Figure 6–2: How the circuit monitor handles setpoint-driven alarms**

**EV1**—The circuit monitor records the date and time that the pickup setpoint and time delay were satisfied, and the maximum value reached (Max1) during the pickup delay period (ΔT). Also, the circuit monitor performs any tasks assigned to the event such as waveform captures or forced data log entries.

**EV2**—The circuit monitor records the date and time that the dropout setpoint and time delay were satisfied, and the maximum value reached (Max2) during the alarm period.

The circuit monitor also stores a correlation sequence number (CSN) for each event (such as *Under Voltage Phase A Pickup, Under Voltage Phase A Dropout*). The CSN lets you relate pickups and dropouts in the alarm log. You can sort pickups and dropouts by CSN to correlate the pickups and dropouts of a particular alarm. The pickup and dropout entries of an alarm will have the same CSN. You can also calculate the duration of an event by looking at pickups and dropouts with the same CSN.

## Priorities

Each alarm also has a priority level. Use the priorities to distinguish between events that require immediate action and those that do not require action.

- **High priority**—if a high priority alarm occurs, the display informs you in two ways: the LED on the display flashes until you acknowledge the alarm and a message displays while the alarm is active.
- **Medium priority**—if a medium priority alarm occurs, the LED flashes and a message displays only while the alarm is active. Once the alarm becomes inactive, the LED stops flashing.
- **Low priority**—if a low priority alarm occurs, the LED on the display flashes only while the alarm is active. No alarm message is displayed.
- **No priority**—if an alarm is setup with no priority, no visible representation will appear on the display. Alarms with no priority are not entered in the Alarm Log. See **Chapter 7—Logging** for alarm logging information.

If multiple alarms with different priorities are active at the same time, the display shows the alarm message for the last alarm that occurred. For instructions on setting up alarms from the circuit monitor display, see “Setting Up and Editing Alarms” on page 21.

## Alarm Levels

From the display or SMS, multiple alarms can be set up for one particular quantity (parameter) to create alarm “levels”. You can take different actions depending on the severity of the alarm.

For example, you could set up two alarms for kW Demand. A default alarm already exists for kW Demand (no. 26 in the alarm list), but you could create another custom alarm for kW Demand, selecting different pickup points for it. The custom kW Demand alarm, once created, will appear in the standard alarm list. For illustration purposes, let’s set the default kW Demand alarm to 120 kW and the new custom alarm to 150 kW. One alarm named *kW Demand*; the other *kW Demand 150kW* as shown in Figure 6–3. Note that if you choose to set up two alarms for the same quantity, use slightly different names to distinguish which alarm is active. The display can hold up to 15 characters for each name. You can create up to 10 alarm levels for each quantity.

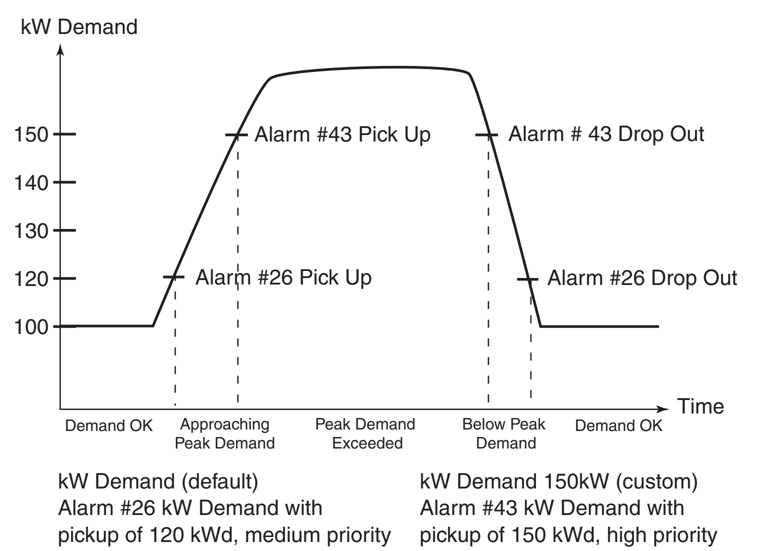



**Figure 6–3: Two alarms set up for the same quantity with different pickup and dropout set points**

## CUSTOM ALARMS

The circuit monitor has many pre-defined alarms, but you can also set up your own custom alarms. For example, you may need to alarm on the ON-to-OFF transition of a digital input. To create this type of custom alarm:

1. Select the appropriate alarm group (digital in this case).
2. Select the type of alarm (described in Table 6–4 on page 96).
3. Give the alarm a name.

After creating a custom alarm, you can configure it by applying priorities, setting pickups and dropouts (if applicable), and so forth. For instructions on creating custom alarms, see “Creating a New Custom Alarm” on page 19 in **Chapter 3—Operation**.

*NOTE: The circuit monitor will automatically create alarms for the IOC44 and the IOX when the modules are identified. These are OFF-to-ON alarms.*

## SETPOINT-CONTROLLED RELAY FUNCTIONS

A circuit monitor can mimic the functions of certain motor management devices to detect and respond to conditions such as phase loss, undervoltage, or reverse phase relays. While the circuit monitor is not a primary protective device, it can detect abnormal conditions and respond by operating one or more Form-C output contacts. These outputs can be used to operate an alarm horn or bell to annunciate the alarm condition.

*NOTE: The circuit monitor is not designed for use as a primary protective relay. While its setpoint-controlled functions may be acceptable for certain applications, it should not be considered a substitute for proper circuit protection.*

If you determine that the circuit monitor’s performance is acceptable for the application, the output contacts can be used to mimic some functions of a motor management device. When deciding if the circuit monitor is acceptable for these applications, keep the following points in mind:

- Circuit monitors require control power to operate properly.
- Circuit monitors may take up to 5 seconds after control power is applied before setpoint-controlled functions are activated. If this is too long, a reliable source of control power is required.
- When control power is interrupted for more than approximately 100 milliseconds, the circuit monitor releases all energized output contacts.
- Standard setpoint-controlled functions may take 1–2 seconds to operate, in addition to the intended delay.
- A password is required to program the circuit monitor’s setpoint controlled relay functions.
- Changing certain setup parameters after installation may operate relays in a manner inconsistent with the requirements of the application.

For instructions on configuring setpoint-controlled alarms or relays from the circuit monitor’s display, see “Setting Up and Editing Alarms” on page 21. The types of available alarms are described later in this chapter in Table 6–3 on page 94.

## Types of Setpoint-Controlled Relay Functions

This section describes some common motor management functions to which the following information applies:

- Values that are too large to fit into the display may require scale factors. For more information on scale factors, refer to “Changing Scale Factors” on page 191 in **Appendix B—Using the Command Interface**.
- Relays can be configured as normal, latched, or timed. See “Relay Output Operating Modes” on page 75 in **Chapter 5—Input/Output Capabilities** for more information.
- When the alarm occurs, the circuit monitor operates any specified relays. There are two ways to release relays that are in latched mode:
  - — Issue a command to de-energize a relay. See **Appendix B—Using the Command Interface** on page 181 for instructions on using the command interface, or
  - — Acknowledge the alarm in the high priority log to release the relays from latched mode. From the main menu of the display, select View Alarms > High Priority Log to view and acknowledge unacknowledged alarms. See “Viewing Alarms” on page 41 for detailed instructions.

The list that follows shows the types of alarms available for some common motor management functions:

*NOTE: Voltage base alarm setpoints depend on your system configuration. Alarm setpoints for 3-wire systems are $V_{L-L}$ values while 4-wire systems are $V_{L-N}$ values.*

**Undervoltage**:

Pickup and dropout setpoints are entered in volts. The per-phase undervoltage alarm occurs when the per-phase voltage is equal to or below the pickup setpoint long enough to satisfy the specified pickup delay (in seconds). The undervoltage alarm clears when the phase voltage remains above the dropout setpoint for the specified dropout delay period.

**Overvoltage**:

Pickup and dropout setpoints are entered in volts. The per-phase overvoltage alarm occurs when the per-phase voltage is equal to or above the pickup setpoint long enough to satisfy the specified pickup delay (in seconds). The overvoltage 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 7% as 70. 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. 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 7% as 70. 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. The 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 (in seconds).

**Phase Loss—Current**:

Pickup and dropout setpoints are entered in amperes. The phase loss current alarm occurs when any current value (but not all current values) is equal to or below the pickup setpoint for the specified pickup delay (in seconds). The alarm clears when one of the following is true:

- All of the phases remain above the dropout setpoint for the specified dropout delay, or
- All of the phases drop below the phase loss pickup setpoint.

If all of the phase currents are equal to or below the pickup setpoint, during the pickup delay, the phase loss alarm will not activate. This is considered an under current condition. It should be handled by configuring the under current protective functions.

**Phase Loss—Voltage**:

Pickup and dropout setpoints are entered in volts. The phase loss voltage alarm occurs when any voltage value (but not all voltage values) is equal to or below the pickup setpoint for the specified pickup delay (in seconds). The alarm clears when one of the following is true:

- All of the phases remain above the dropout setpoint for the specified dropout delay (in seconds), OR
- All of the phases drop below the phase loss pickup setpoint.

If all of the phase voltages are equal to or below the pickup setpoint, during the pickup delay, the phase loss alarm will not activate. This is considered an under voltage condition. It should be handled by configuring the under voltage protective functions.

**Reverse Power**:

Pickup and dropout setpoints are entered in kilowatts or kVARs. The reverse power alarm occurs when the power flows in a negative direction and remains at or below the negative pickup value for the specified pickup delay (in seconds). The alarm clears when the power reading remains above the dropout setpoint for the specified dropout delay (in seconds).

**Phase Reversal**:

Pickup and dropout setpoints and delays do not apply to phase reversal. The phase reversal alarm occurs when the phase voltage rotation differs from the default phase rotation. The circuit monitor assumes that an ABC phase rotation is normal. If a CBA phase rotation is normal, the user must change the circuit monitor's phase rotation from ABC (default) to CBA. To change the phase rotation from the display, from the main menu select Setup > Meter > Advanced. For more information about changing the phase rotation setting of the circuit monitor, refer to "Advanced Meter Setup" on page 34.

## SCALE FACTORS

A scale factor is the multiplier expressed as a power of 10. For example, a multiplier of 10 is represented as a scale factor of 1, since $10^1=10$; a multiplier of 100 is represented as a scale factor of 2, since $10^2=100$. This allows you to make larger values fit into the register. Normally, you do not need to change scale factors. If you are creating custom alarms, you need to understand how scale factors work so that you do not overflow the register with a number larger than what the register can hold. When SMS is used to set up alarms, it automatically handles the scaling of pickup and dropout setpoints. When creating a custom alarm using the circuit monitor's display, do the following:

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

Pickup and dropout settings must be integer values in the range of -32,767 to +32,767. For example, to set up an under voltage alarm for a 138 kV nominal system, decide upon a setpoint value and then convert it into an integer between -32,767 and +32,767. If the under voltage setpoint were 125,000 V, this would typically be converted to 12500 x 10 and entered as a setpoint of 12500.

Six scale groups are defined (A through F). The scale factor is preset for all factory-configured alarms. Table 6–1 lists the available scale factors for each of the scale groups. If you need either an extended range or more resolution, select any of the available scale factors to suit your need. Refer to "Changing Scale Factors" on page 191 in **Appendix B—Using the Command Interface**.

**Table 6–1: Scale Groups**

| Scale Group | Measurement Range | Scale Factor |
|---|---|---|
| Scale Group A—Phase Current | Amperes | |
| | 0–327.67 A | –2 |
| | 0–3,276.7 A | –1 |
| | 0–32,767 A | 0 (default) |
| | 0–327.67 kA | 1 |
| Scale Group B—Neutral Current | Amperes | |
| | 0–327.67 A | –2 |
| | 0–3,276.7 A | –1 |
| | 0–32,767 A | 0 (default) |
| | 0–327.67 kA | 1 |
| Scale Group C—Ground Current | Amperes | |
| | 0–327.67 A | –2 |
| | 0–3,276.7 A | –1 |
| | 0–32,767 A | 0 (default) |
| | 0–327.67 kA | 1 |

**Table 6–1: Scale Groups**

| Scale Group | Measurement Range | Scale Factor |
|---|---|---|
| Scale Group D—Voltage, L–L | Voltage | |
| | 0–3,276.7 V | –1 |
| | 0–32,767 V | 0 (default) |
| | 0–327.67 kV | 1 |
| | 0–3,276.7 kV | 2 |
| Scale Group E—Neutral Voltage, L–N, N–G | Voltage | |
| | 0–3,276.7 V | –1 (default) |
| | 0–32,767 V | 0 |
| | 0–327.67 kV | 1 |
| | 0–3,276.7 kV | 2 |
| Scale Group F—Power kW, kVAR, kVA | Power | |
| | 0–32.767 kW, kVAR, kVA | –3 |
| | 0–327.67 kW, kVAR, kVA | –2 |
| | 0–3,276.7 kW, kVAR, kVA | –1 |
| | 0–32,767 kW, kVAR, kVA | 0 (default) |
| | 0–327.67 MW, MVAR, MVA | 1 |
| | 0–3,276.7 MW, MVAR, MVA | 2 |
| | 0–32,767 MW, MVAR, MVA | 3 |

## SCALING ALARM SETPOINTS

This section is for users who do not have SMS and must set up alarms from the circuit monitor display. It explains how to scale alarm setpoints.

When the circuit monitor is equipped with a display, the display area is 4 x 20 characters, which limits the displaying of most metered quantities to five characters (plus a positive or negative sign). The display will also show the engineering units applied to that quantity.

To determine the proper scaling of an alarm setpoint, view the register number for the associated scale group. The scale factor is the number in the Dec column for that register. For example, the register number for Scale D to Phase Volts is 3212. If the number in the Dec column is 1, the scale factor is 10 ($10^1$=10). Remember that scale factor 1 in Table 6–1 on page 91 for Scale Group D is measured in kV. Therefore, to define an alarm setpoint of 125 kV, enter 12.5 because 12.5 multiplied by 10 is 125. Below is a table listing the scale groups and their register numbers.

**Table 6–2: Scale Group Register Numbers**

| Scale Group | Register Number |
|---|---|
| Scale Group A—Phase Current | 3209 |
| Scale Group B—Neutral Current | 3210 |
| Scale Group C—Ground Current | 3211 |
| Scale Group D—Voltage, L–L | 3212 |
| Scale Group E—Neutral Voltage, L–N, N–G | 3213 |
| Scale Group F—Power kW, kVAR, kVA | 3214 |

## ALARM CONDITIONS AND ALARM NUMBERS

This section lists the circuit monitor's predefined alarm conditions. For each alarm condition, the following information is provided.

- **Alarm No.**—a position number indicating where an alarm falls in the list.
- **Alarm Description**—a brief description of the alarm condition
- **Abbreviated Display Name**—an abbreviated name that describes the alarm condition, but is limited to 15 characters that fit in the window of the circuit monitor's display.
- **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 unit that applies 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 Factors" on page 91**.**
- **Alarm Type**—a reference to a definition that provides details on the operation and configuration of the alarm. For a description of alarm types, refer to Table 6–4 on page 96.

Table 6–3 on page 94 lists the preconfigured alarms by alarm number.

Table 6–3: List of Default Alarms by Alarm Number

| Alarm Number | Alarm Description | Abbreviated Display Name | Test Register | Units | Scale Group | Alarm Type ① |
|---|---|---|---|---|---|---|
| **Standard Speed Alarms (1 Second)** | | | | | | |
| 01 | Over Current Phase A | Over Ia | 1100 | Amperes | A | 010 |
| 02 | Over Current Phase B | Over Ib | 1101 | Amperes | A | 010 |
| 03 | Over Current Phase C | Over Ic | 1102 | Amperes | A | 010 |
| 04 | Over Current Neutral | Over In | 1103 | Amperes | B | 010 |
| 05 | Over Current Ground | Over Ig | 1104 | Amperes | C | 010 |
| 06 | Under Current Phase A | Under Ia | 1100 | Amperes | A | 020 |
| 07 | Under Current Phase B | Under Ib | 1101 | Amperes | A | 020 |
| 08 | Under Current Phase C | Under Ic | 1102 | Amperes | A | 020 |
| 09 | Current Unbalance, Max | I Unbal Max | 1110 | Tenths % | — | 010 |
| 10 | Current Loss | Current Loss | 3262 | Amperes | A | 053 |
| 11 | Over Voltage Phase A–N | Over Van | 1124 | Volts | D | 010 |
| 12 | Over Voltage Phase B–N | Over Vbn | 1125 | Volts | D | 010 |
| 13 | Over Voltage Phase C–N | Over Vcn | 1126 | Volts | D | 010 |
| 14 | Over Voltage Phase A–B | Over Vab | 1120 | Volts | D | 010 |
| 15 | Over Voltage Phase B–C | Over Vbc | 1121 | Volts | D | 010 |
| 16 | Over Voltage Phase C–A | Over Vca | 1122 | Volts | D | 010 |
| 17 | Under Voltage Phase A | Under Van | 1124 | Volts | D | 020 |
| 18 | Under Voltage Phase B | Under Vbn | 1125 | Volts | D | 020 |
| 19 | Under Voltage Phase C | Under Vcn | 1126 | Volts | D | 020 |
| 20 | Under Voltage Phase A–B | Under Vab | 1120 | Volts | D | 020 |
| 21 | Under Voltage Phase B–C | Under Vbc | 1121 | Volts | D | 020 |
| 22 | Under Voltage Phase C–A | Under Vca | 1122 | Volts | D | 020 |
| 23 | Voltage Unbalance L–N, Max | V Unbal L-N Max | 1136 | Tenths % | — | 010 |
| 24 | Voltage Unbalance L–L, Max | V Unbal L-L Max | 1132 | Tenths % | — | 010 |
| 25 | Voltage Loss (loss of A,B,C, but not all) | Voltage Loss | 3262 | Volts | D | 052 |
| 26 | Phase Reversal | Phase Rev | 3228 | — | — | 051 |
| 27 | Over kVA Demand | Over kVA Dmd | 2181 | kVA | F | 011 |
| 28 | Over kW Demand | Over kW Dmd | 2151 | kW | F | 011 |
| 29 | Over kVAR Demand | Over kVAR Dmd | 2166 | kVAR | F | 011 |
| 30 | Over Frequency | Over Freq. | 1180 | Hundredths of Hertz | — | 010 |
| 31 | Under Frequency | Under Freq. | 1180 | Hundredths of Hertz | — | 020 |
| 32 | Lagging true power factor | Lag True PF | 1163 | Thousandths | — | 055 |
| 33 | Leading true power factor | Lead True PF | 1163 | Thousandths | — | 054 |
| 34 | Lagging displacement power factor | Lag Disp PF | 1171 | Thousandths | — | 055 |
| 35 | Leading displacement power factor | Lead Disp PF | 1171 | Thousandths | — | 054 |
| 36 | Over Current Demand Phase A | Over Ia Dmd | 1961 | Amperes | A | 010 |
| 37 | Over Current Demand Phase B | Over Ib Dmd | 1971 | Amperes | A | 010 |
| 38 | Over Current Demand Phase C | Over Ic Dmd | 1981 | Amperes | A | 010 |
| 39 | Over THD Voltage A–N | Over THD Van | 1207 | Tenths % | — | 010 |
| 40 | Over THD Voltage B–N | Over THD Vbn | 1208 | Tenths % | — | 010 |
| 41 | Over THD Voltage C–N | Over THD Vcn | 1209 | Tenths % | — | 010 |
| 42 | Over THD Voltage A–B | Over THD Vab | 1211 | Tenths % | — | 010 |

① Alarm Types are described in Table 6–4 on page 96.

**Table 6–3: List of Default Alarms by Alarm Number**

| Alarm Number | Alarm Description | Abbreviated Display Name | Test Register | Units | Scale Group | Alarm Type ① |
|---|---|---|---|---|---|---|
| 43 | Over THD Voltage B–C | Over THD Vbc | 1212 | Tenths % | — | 010 |
| 44 | Over THD Voltage C–A | Over THD Vca | 1213 | Tenths % | — | 010 |
| 45-80 | Reserved for custom alarms. | — | — | — | — | — |
| **High Speed Alarms (100 ms)** | | | | | | |
| 01 | Over Current A | Over Ia HS | 1,000 | Amperes | A | 010 |
| 02 | Over Current B | Over Ib HS | 1001 | Amperes | A | 010 |
| 03 | Over Current C | Over Ic HS | 1002 | Amperes | A | 010 |
| 04 | Over Current N | Over In HS | 1003 | Amperes | B | 010 |
| 05 | Over Current G | Over Ig HS | 1004 | Amperes | C | 010 |
| 06 | Over Voltage A–N | Over Van HS | 1024 | Volts | D | 010 |
| 07 | Over Voltage B–N | Over Vbn HS | 1025 | Volts | D | 010 |
| 08 | Over Voltage C–N | Over Vcn HS | 1026 | Volts | D | 010 |
| 09 | Over Voltage A-B | Over Vab HS | 1020 | Volts | D | 010 |
| 10 | Over Voltage B-C | Over Vbc HS | 1021 | Volts | D | 010 |
| 11 | Over Voltage C-A | Over Vca HS | 1022 | Volts | D | 010 |
| 12 | Over Voltage N-G | Over Vng HS | 1027 | Volts | E | 010 |
| 13 | Under Voltage A–N | Under Van HS | 1024 | Volts | D | 020 |
| 14 | Under Voltage B–N | Under Vbn HS | 1025 | Volts | D | 020 |
| 15 | Under Voltage C–N | Under Vcn HS | 1026 | Volts | D | 020 |
| 16 | Under Voltage A-B | Under Vab HS | 1020 | Volts | D | 020 |
| 17 | Under Voltage B–C | Under Vbc HS | 1021 | Volts | D | 020 |
| 18 | Under Voltage C–A | Under Vca HS | 1022 | Volts | D | 020 |
| 19-20 | Reserved for custom alarms | — | — | — | — | — |
| **Disturbance Monitoring (1/2 Cycle)** | | | | | | |
| 01 | Voltage Swell A | Swell Van | 4 | Volts | D | 080 |
| 02 | Voltage Swell B | Swell Vbn | 5 | Volts | D | 080 |
| 03 | Voltage Swell C | Swell Vcn | 6 | Volts | D | 080 |
| 04 | Voltage Swell N–G | Swell Vng | 7 | Volts | E | 080 |
| 05 | Voltage Swell A–B | Swell Vab | 1 | Volts | D | 080 |
| 06 | Voltage Swell B–C | Swell Vbc | 2 | Volts | D | 080 |
| 07 | Voltage Swell C–A | Swell Vca | 3 | Volts | D | 080 |
| 08 | Voltage Sag A–N | Sag Van | 4 | Volts | D | 090 |
| 09 | Voltage Sag B–N | Sag Vbn | 5 | Volts | D | 090 |
| 10 | Voltage Sag C–N | Sag Vcn | 6 | Volts | D | 090 |
| 11 | Voltage Sag A–B | Sag Vab | 1 | Volts | D | 090 |
| 12 | Voltage Sag B–C | Sag Vbc | 2 | Volts | D | 090 |
| 13 | Voltage Sag C–A | Sag Vca | 3 | Volts | D | 090 |
| 14 | Current Swell A | Swell Ia | 8 | Amperes | A | 080 |
| 15 | Current Swell B | Swell Ib | 9 | Amperes | A | 080 |
| 16 | Current Swell C | Swell Ic | 10 | Amperes | A | 080 |
| 17 | Current Swell N | Swell In | 11 | Amperes | B | 080 |
| 18 | Current Sag A | Sag Ia | 8 | Amperes | A | 090 |
| 19 | Current Sag B | Sag Ib | 9 | Amperes | A | 090 |
| 20 | Current Sag C | Sag Ic | 10 | Amperes | A | 090 |

① Alarm Types are described in Table 6–4 on page 96.

### Table 6–3: List of Default Alarms by Alarm Number

| Alarm Number | Alarm Description | Abbreviated Display Name | Test Register | Units | Scale Group | Alarm Type ① |
|---|---|---|---|---|---|---|
| **Digital** | | | | | | |
| 01 | End of incremental energy interval | End Inc Enr Int | N/A | — | — | 070 |
| 02 | End of power demand interval | End Power Dmd Int | N/A | — | — | 070 |
| 03 | End of 1-second update cycle | End 1s Cyc | N/A | — | — | 070 |
| 04 | End of 100ms update cycle | End 100ms Cyc | N/A | — | — | 070 |
| 05 | Power up/Reset | Pwr Up/Reset | N/A | — | — | 070 |
| 06-40 | Reserved for custom alarms | — | — | — | — | — |

① Alarm Types are described in Table 6–4 on page 96.

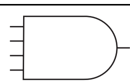
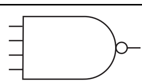
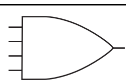
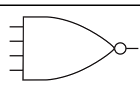
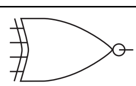
### Table 6–4: Alarm Types

| Type | Description | Operation |
|---|---|---|
| **Standard Speed** | | |
| 010 | Over Value 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 dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 011 | Over Power Alarm | If the absolute value in the test register 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 dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 012 | Over Reverse Power Alarm | If the absolute value in the test register 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 dropout. This alarm will only hold true for reverse power conditions. Positive power values will not cause the alarm to occur. Pickup and dropout setpoints are positive, delays are in seconds. |
| 020 | Under Value 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 dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 021 | Under Power Alarm | If the absolute value in the test register 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 dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 051 | Phase Reversal | The phase reversal alarm will occur whenever the phase voltage waveform rotation differs from the default phase rotation. The ABC phase rotation is assumed to be normal. If a CBA phase rotation is normal, the user should reprogram the circuit monitor's phase rotation ABC to CBA phase rotation. The pickup and dropout setpoints and delays for phase reversal do not apply. |
| 052 | Phase Loss, Voltage | The phase loss voltage alarm will occur when any one or two phase voltages (but not all) fall to the pickup value and remain at or below the pickup value long enough to satisfy the specified pickup delay. When all of the phases remain at or above the dropout value for the dropout delay period, or when all of the phases drop below the specified phase loss pickup value, the alarm will dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 053 | Phase Loss, Current | The phase loss current alarm will occur when any one or two phase currents (but not all) fall to the pickup value and remain at or below the pickup value long enough to satisfy the specified pickup delay. When all of the phases remain at or above the dropout value for the dropout delay period, or when all of the phases drop below the specified phase loss pickup value, the alarm will dropout. Pickup and dropout setpoints are positive, delays are in seconds. |

## Table 6–4: Alarm Types

| Type | Description | Operation |
|---|---|---|
| 054 | Leading Power Factor | The leading power factor alarm will occur when the test register value becomes more leading than the pickup setpoint (such as closer to 0.010) and remains more leading long enough to satisfy the pickup delay period. When the value becomes equal to or less leading than the dropout setpoint, that is 1.000, and remains less leading for the dropout delay period, the alarm will dropout. Both the pickup setpoint and the dropout setpoint must be positive values representing leading power factor. Enter setpoints as integer values representing power factor in thousandths. For example, to define a dropout setpoint of 0.5, enter 500. Delays are in seconds. |
| 055 | Lagging Power Factor | The lagging power factor alarm will occur when the test register value becomes more lagging than the pickup setpoint (such as closer to –0.010) and remains more lagging long enough to satisfy the pickup delay period. When the value becomes equal to or less lagging than the dropout setpoint, that is 1.000, and remains less lagging for the dropout delay period, the alarm will dropout. Both the pickup setpoint and the dropout setpoint must be positive values representing lagging power factor. Enter setpoints as integer values representing power factor in thousandths. For example, to define a dropout setpoint of –0.5, enter 500. Delays are in seconds. |
| **High Speed** | | |
| 010 | Over Value 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 dropout. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |
| 011 | Over Power Alarm | If the absolute value in the test register 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 dropout. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |
| 012 | Over Reverse Power Alarm | If the absolute value in the test register 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 dropout. This alarm will only hold true for reverse power conditions. Positive power values will not cause the alarm to occur. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |
| 020 | Under Value 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 dropout. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |
| 021 | Under Power Alarm | If the absolute value in the test register 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 dropout. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |
| 051 | Phase Reversal | The phase reversal alarm will occur when ever the phase voltage waveform rotation differs from the default phase rotation. The ABC phase rotation is assumed to be normal. If a CBA normal phase rotation is normal, the user should reprogram the circuit monitor’s phase rotation ABC to CBA phase rotation. The pickup and dropout setpoints and delays for phase reversal do no apply. |
| 052 | Phase Loss, Voltage | The phase loss voltage alarm will occur when any one or two phase voltages (but not all) fall to the pickup value and remain at or below the pickup value long enough to satisfy the specified pickup delay. When all of the phases remain at or above the dropout value for the dropout delay period, or when all of the phases drop below the specified phase loss pickup value, the alarm will dropout. Pickup and dropout setpoints are positive, delays are in seconds. |
| 053 | Phase Loss, Current | The phase loss current alarm will occur when any one or two phase currents (but not all) fall to the pickup value and remain at or below the pickup value long enough to satisfy the specified pickup delay. When all of the phases remain at or above the dropout value for the dropout delay period, or when all of the phases drop below the specified phase loss pickup value, the alarm will dropout. Pickup and dropout setpoints are positive, delays are in hundreds of milliseconds. |

**Table 6–4: Alarm Types**

| Type | Description | Operation |
|---|---|---|
| 054 | Leading Power Factor | The leading power factor alarm will occur when the test register value becomes more leading than the pickup setpoint (closer to 0.010) and remains more leading long enough to satisfy the pickup delay period. When the value becomes equal to or less leading than the dropout setpoint, that is 1.000, and remains less leading for the dropout delay period, the alarm will dropout.Both the pickup setpoint and the dropout setpoint must be positive values representing leading power factor. Enter setpoints as integer values representing power factor in thousandths. For example, to define a dropout setpoint of 0.5, enter 500. Delays are in hundreds of milliseconds. |
| 055 | Lagging Power Factor | The lagging power factor alarm will occur when the test register value becomes more lagging than the pickup setpoint (closer to –0.010) and remains more lagging long enough to satisfy the pickup delay period. When the value becomes equal to or less lagging than the dropout setpoint, that is. 1.000 and remains less lagging for the dropout delay period, the alarm will dropout. Both the pickup setpoint and the dropout setpoint must be positive values representing lagging power factor. Enter setpoints as integer values representing power factor in thousandths. For example, to define a dropout setpoint of –0.5, enter 500. Delays are in hundreds of milliseconds. |
| **Disturbance** | | |
| 080 | Voltage/Current Swell | The voltage and current swell alarms will occur whenever the continuous rms calculation is above the pickup setpoint and remains above the pickup setpoint for the specified number of cycles. When the continuous rms calculations fall below the dropout setpoint and remain below the setpoint for the specified number of cycles, the alarm will dropout. Pickup and dropout setpoints are positive and delays are in cycles. |
| 090 | Voltage/Current Sag | The voltage and current sag alarms will occur whenever the continuous rms calculation is below the pickup setpoint and remains below the pickup setpoint for the specified number of cycles. When the continuous rms calculations rise above the dropout setpoint and remain above the setpoint for the specified number of cycles, the alarm will drop out. Pickup and dropout setpoints are positive and delays are in cycles. |
| **Digital** | | |
| 060 | Digital Input On | The digital input transition alarms will occur whenever the digital input changes from off to on. The alarm will dropout when the digital input changes back to off from on. The pickup and dropout setpoints and delays do not apply. |
| 061 | Digital Input Off | The digital input transition alarms will occur whenever the digital input changes from on to off.The alarm will dropout when the digital input changes back to on from off. The pickup and dropout setpoints and delays do not apply. |
| 070 | Unary | This is a internal signal from the circuit monitor and can be used, for example, to alarm at the end of an interval or when the circuit monitor is reset. The pickup and dropout delays do not apply. |
| **Boolean** | | |
| 100 | Logic AND  | The AND alarm will occur when *all* of the combined enabled alarms are true (up to 4). The alarm will dropout when *any* of the enabled alarms drops out. |
| 101 | Logic NAND  | The NAND alarm will occur when *any, but not all,* or *none* of the combined enabled alarms are true. The alarm will dropout when *all* of the enabled alarms drop out, or *all* are *true*. |
| 102 | Logic OR  | The OR alarm will occur when *any* of the combined enabled alarms are true (up to 4). The alarm will dropout when *all* of the enabled alarms are *false*. |
| 103 | Logic NOR  | The NOR alarm will occur when *none* of the combined enabled alarms are true (up to 4). The alarm will dropout when *any* of the enabled alarms are *true*. |
| 104 | Logic XOR  | The XOR alarm will occur when *only one* of the combined enabled alarms is true (up to 4). The alarm will dropout when *the enabled alarm drops out* or when more than one alarm becomes *true*. |

# CHAPTER 7—LOGGING

This chapter briefly describes the following logs of the circuit monitor:

- Alarm log
- User-defined data logs
- Min/Max log and Interval Min/Max/Average log
- Maintenance log

Logs are files stored in the nonvolatile memory of circuit monitor and are referred to as "onboard logs." Use SMS to set up and view all the logs. See the SMS online help for information about working with the circuit monitor's onboard logs. Waveform captures and the 100-ms rms event recording are not logs, but the information is also saved in the circuit monitor's memory. See "Memory Allocation" on page 104 for information about shared memory in the circuit monitor. For information about default circuit monitor settings, see "Factory Defaults" on page 11 of the installation manual.

## CHAPTER CONTENTS

## ALARM LOG

Using SMS, you can set up the circuit monitor to log the occurrence of any alarm condition. Each time an alarm occurs it is entered into the alarm log. The alarm log in the circuit monitor stores the pickup and dropout points of alarms along with the date and time associated with these alarms. You select whether the alarm log saves data as first-in-first-out (FIFO) or fill and hold. You can also view and save the alarm log to disk, and reset the alarm log to clear the data out of the circuit monitor's memory.

### Alarm Log Storage

The circuit monitor stores alarm log data in nonvolatile memory. You define the size of the alarm log (the maximum number of events). When determining the maximum number of events, consider the circuit monitor's total storage capacity. See "Memory Allocation" on page 104 for additional memory considerations.

## DATA LOGS

The circuit monitor records meter readings at regularly scheduled intervals and stores the data in up to 14 independent data log files in its memory. Some data log files are preconfigured at the factory. You can accept the preconfigured data logs or change them to meet your specific needs. You can set up each data log to store the following information:

- Timed Interval—1 second to 24 hours (how often the values are logged)
- First-In-First-Out (FIFO) or Fill and Hold
- Values to be logged—up to 96 registers along with the date and time of each log entry

Use SMS to clear each data log file, independently of the others, from the circuit monitor's memory. For instructions on setting up and clearing data log files, refer to the SMS online help file.

## Alarm-Driven Data Log Entries

The circuit monitor can detect over 100 alarm conditions, including over/under conditions, digital input changes, phase unbalance conditions, and more. (See **Chapter 6—Alarms** on page 83 for more information.) Use SMS to assign each alarm condition one or more tasks, including forcing data log entries into one or more data log files.

For example, assume that you've defined 14 data log files. Using SMS, you could select an alarm condition such as "Overcurrent Phase A" and set up the circuit monitor to force data log entries into any of the 14 log files each time the alarm condition occurs.

## Organizing Data Log Files

You can organize data log files in many ways. One possible way is to organize log files according to the logging interval. You might also define a log file for entries forced by alarm conditions. For example, you could set up four data log files as follows:

**Data Log 5:** Log voltage every minute. Make the file large enough to hold 60 entries so that you could look back over the last hour's voltage readings.

**Data Log 6:** Log voltage, current, and power hourly for a historical record over a longer period.

**Data Log 7:** Log energy once every day. Make the file large enough to hold 31 entries so that you could look back over the last month and see daily energy use.

**Data Log 8:** Report by exception. The report by exception file contains data log entries that are forced by the occurrence of an alarm condition. See the previous section "Alarm-Driven Data Log Entries" for more information.

*NOTE: The same data log file can support both scheduled and alarm-driven entries.*

## Data Log Storage

Each defined data log file entry stores a date and time and requires some additional overhead. To minimize storage space occupied by dates, times, and file overhead, use a few log files that log many values, as opposed to many log files that store only a few values each.

Consider that storage space is also affected by how many data log files you use (up to 14) and how many registers are logged in each entry (up to 96) for each data log file. See "Memory Allocation" on page 104 for additional storage considerations.

## MIN/MAX LOGS

There are two Min/Max logs:

- Min/Max log
- Interval Min/Max/Average log

### Min/Max Log

When any real-time reading reaches its highest or lowest value, the circuit monitor saves the value in the Min/Max log.You can use SMS to view and reset this log. For instructions, refer to the SMS online help. You can also view the min/max values from the display. From the Main Menu, select Min/Max and then select the value you'd like to view, such as amperes, volts, or frequency. See “Viewing Minimum and Maximum Values from the Min/Max Menu” on page 39 in this manual for detailed instructions. The Min/Max log cannot be customized.

### Interval Min/Max/Average Log

In addition to the Min/Max log, the circuit monitor has a Min/Max/Average log. The Min/Max/Average log stores 23 quantities, which are listed below. At each interval, the circuit monitor records a minimum, a maximum, and an average value for each quantity. It also records the date and time for each interval along with the date and time for each minimum and maximum value within the interval. For example, every hour the default log will log the minimum voltage for phase A over the last hour, the maximum voltage for phase A over the last hour, and the average voltage for phase A over the last hour. All 23 values are preconfigured with a default interval of 60 minutes, but you can reset the interval from 1 to 1440 minutes. To setup, view, and reset the Min/Max/Average log using SMS, see ”Reading and Writing Registers” in the SMS online help. The following values are logged into the Min/Max/ Average log:

- Voltage Phase A–B
- Voltage Phase B–C
- Voltage Phase C–A
- Voltage N–G
- Current Phase A
- Current Phase B
- Current Phase C
- Current Phase N
- Current Phase G
- kW 3-Phase Average
- kVAR 3-Phase Average
- kVA 3-Phase Average
- kW Demand 3-Phase Average
- kVAR Demand 3-Phase Average
- kVA Demand 3-Phase Average
- THD Voltage A–N
- THD Voltage B–N
- THD Voltage C–N
- THD Voltage A–B
- THD Voltage B–C
- THD Voltage C–A
- True Power Factor 3-Phase Total
- Displacement Power Factor 3-Phase Total

### Interval Min/Max/Average Log Storage

When determining storage space among the logs, consider that storage space is affected by how often the circuit monitor is logging min/max/average values and how many entries are stored.

## MAINTENANCE LOG

The circuit monitor stores a maintenance log in nonvolatile memory. Table 7–1 describes the values stored in the maintenance log. These values are cumulative over the life of the circuit monitor and cannot be reset.

Use SMS to view the maintenance log. Refer to the SMS online help for instructions.

**Table 7–1: Values Stored in Maintenance Log**

| Value Stored | Description |
|---|---|
| Number of Demand Resets | Number of times demand values have been reset. |
| Number of Energy Resets | Number of times energy values have been reset. |
| Number of Min/Max Resets | Number of times min/max values have been reset. |
| Number of Output Operations | Number of times a digital output has operated. This value is stored for each digital output. |
| Number of Power Losses | Number of times circuit monitor has lost control power. |
| Number of Firmware Downloads | Number of times new firmware has been downloaded to the circuit monitor over communications. |
| Number of I/R Comms Sessions | Number of times the I/R communications port has been used. (Available only with VFD display.) |
| Highest Temperature Monitored | Highest temperature reached inside the circuit monitor. |
| Lowest Temperature Monitored | Lowest temperature reached inside the circuit monitor. |
| Number of GPS time syncs | Number of syncs received from the global positioning satellite transmitter. |
| Number of option card changes | Number of times the option card has been changed. Stored for both option card slots. |
| Number of I/O extender changes | Number of times the I/O extender has been changed. |
| Number of times KYZ pulse output overdriven | Number of times the KYZ pulse output is overdriven |
| Number of input metering accumulation resets | Number of times input pulse demand metering has been reset. |

## MEMORY ALLOCATION

The circuit monitor's standard, nonvolatile memory is 8MB and can be upgraded to 16MB, 32MB, and higher. See "Upgrading Memory in the Circuit Monitor" on page 123 for more information about upgrading memory.

When using SMS to set up a circuit monitor, you must allocate the total data storage capacity between the following logs and recorded information:

- Alarm log
- Steady-state waveform capture
- Disturbance waveform capture (cycles)
- Adaptive waveform capture (seconds)
- 100-ms rms event recording
- Up to 14 data logs
- Min/Max/Average log

In addition, the choices you make for the items listed below directly affect the amount of memory used:

- The number of data log files (1 to 14)
- The registers logged in each entry (1 to 96), for each data log file.
- The maximum number of entries in each data log file.
- The maximum number of events in the alarm log file.
- The maximum number of waveform captures in each of the waveform capture files. Consider that you set the maximum number for three different waveform captures: steady-state, disturbance waveform (cycles), and adaptive waveforms (seconds) plus a 100 ms rms event recording.

The number you enter for each of the above items depends on the amount of the memory that is still available, and the available memory depends on the numbers you've already assigned to the other items.

With a minimum of 8 MB of memory, it is unlikely that you will use all the circuit monitor's memory, even if you use all 14 data logs and the other recording features. However, it is important to understand that memory is shared by the alarm logs, data logs, and waveform captures. Figure 7–1 on the left shows how the memory might be allocated.

In Figure 7–1, the user has set up an adaptive waveform (seconds), a 100 ms event recording, an alarm log, and three data logs (two small logs, and one larger log). Of the total available nonvolatile memory, about 25% is still available. If the user decided to add a fourth data log file, the file could be no larger than the space still available—25% of the circuit monitor's total storage capacity. If the fourth file had to be larger than the space still available, the user would have to reduce the size of one of the other files to free up the needed space.

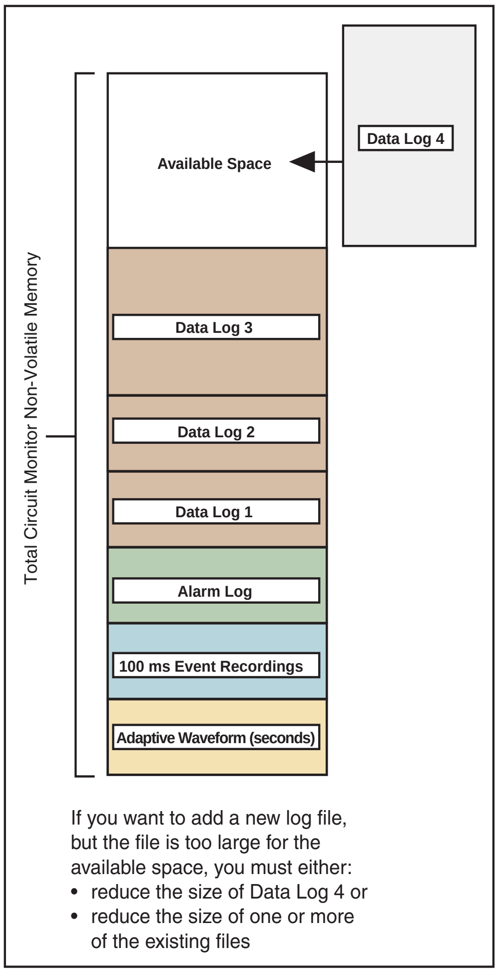



**Figure 7–1: Memory allocation example**

SMS displays the memory allocation statistics in the OnBoard Files dialog box shown in Figure 7–2. Color blocks on the bar show the space devoted to each type of log file, while black indicates memory still available. For instructions on setting up log files using SMS, refer to SMS online help file included with the software.

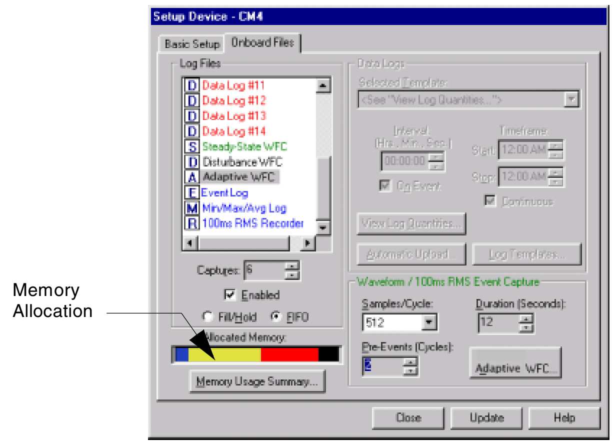



**Figure 7–2: Memory allocation in SMS**

# CHAPTER 8—WAVEFORM AND EVENT CAPTURE

This chapter explains the waveform and event capture capabilities of the circuit monitor.

## CHAPTER CONTENTS

## TYPES OF WAVEFORM CAPTURES

Using waveform captures you can monitor power sags and swells that may be produced, for example, when an X-ray machine and an elevator are used at the same time, or more commonly, when lightning strikes the distribution system that feeds the facility. The system's alarms can be programmed to detect and record such fluctuations, enabling you to determine an appropriate strategy for corrective action.

Circuit monitors use a sophisticated, high-speed sampling technique to simultaneously sample up to 512 samples per cycle on all current and voltage channels. From this sampling, the circuit monitor saves waveform data into its memory. These waveform captures can be graphically displayed using SMS. The circuit monitor has one type of waveform capture that you initiate manually; the other three event captures are associated with and triggered by an event such as a digital input transition or over/under condition. These event recordings help you understand what happened during an electrical event. Using event captures you can analyze power disturbances in detail, identify potential problems, and take corrective action. See **Chapter 9—Disturbance Monitoring** on page 113 for more about disturbance monitoring. The types of event captures are described in the sections that follow.

### Steady-state Waveform Capture

The steady-state waveform capture can be initiated manually to analyze steady-state harmonics. This waveform provides information about individual harmonics, which SMS calculates through the 255th harmonic. It also calculates total harmonic distortion (THD) and other power quality parameters. The waveform capture records one cycle at 512 samples per cycle simultaneously on all metered channels.

#### Initiating a Steady-state Waveform

Using SMS from a remote PC, initiate a steady-state waveform capture manually by selecting the circuit monitor and issuing the acquire command. SMS will automatically retrieve the waveform capture from the circuit monitor. You can display the waveform for all three phases, or zoom in on a single waveform, which includes a data block with extensive harmonic data. See the SMS online help for instructions.

### Disturbance Waveform Capture

Use the disturbance waveform capture to record events that may occur within a short time span such as multiple sags or swells. The circuit monitor initiates a disturbance waveform capture automatically when an alarm condition occurs (if the alarm is set up to perform the waveform capture). The trigger may be from an external device such as an protective relay trip contact connected to a digital input or voltage sag alarm, or you can also initiate the waveform capture manually from SMS at any time.

In SMS, for the disturbance waveform capture, you select the sample rate and how many cycles and pre-event cycles the circuit monitor will capture (see Table 8–1):

**Table 8–1: Available Resolutions for Disturbance Waveform Captures**

| Samples per Cycle (Resolution) | Max Duration |
|---|---|
| 16 | 915 cycles |
| 32 | 457 cycles |
| 64 | 228 cycles |
| 128 | 114 cycles |
| 256 | 57 cycles |
| 512 | 28 cycles |

See the SMS online help for instructions on setting up disturbance waveform captures.

## Adaptive Waveform Capture

The adaptive waveform capture is used to record longer events than can't be recorded with the disturbance waveform capture. For example, using the adaptive waveform capture you could get a detailed view of an entire recloser sequence. Each time a sag or swell is detected, the circuit monitor triggers the waveform capture. The circuit monitor initiates an adaptive waveform capture automatically when an alarm condition occurs, or the waveform capture can also be triggered by an external device such as a protective relay. The unique feature of the adaptive waveform capture is that it can be enabled to stop recording at the dropout of the alarm, which allows you to capture data while the alarm is true. You can also initiate this waveform capture at any time.

In SMS, for the adaptive waveform capture, you select the sample rate, and how many seconds of the event the circuit monitor will capture (see Table 8–2). You can also select how many channels to record. Selecting fewer channels lets you record more seconds.

**Table 8–2: Available Resolutions for Adaptive Waveform Captures**

| Samples per Cycle (Resolution) | Max. Duration (with per-phase current and voltage channels) |
|---|---|
| 16 | 110 seconds |
| 32 | 55 seconds |
| 64 | 27 seconds |
| 128 | 13 seconds |
| 256 | 6 seconds |
| 512 | 3 seconds |

Choose fewer samples per cycle when you want to see more total seconds; choose fewer channels to see a longer duration. See the SMS online help for instructions on setting up adaptive waveform captures.

*NOTE: The circuit monitor also records the status of up to 16 digital inputs that can be displayed along with the waveform capture. This is configured by default.*

## 100ms rms Event Recording

The 100ms rms event capture gives you a different view of an event by recording 100ms data for the amount of time you specify. Table 8–3 lists all the quantities captured. This type of event capture is useful for analyzing what happened during a motor start or recloser operation because it shows a long event without using a significant amount of memory. The circuit monitor initiates the event capture automatically when an alarm condition occurs, or an external device can also trigger the event capture. You select the duration of the event recording (up to 300 seconds) and the number of pre-event seconds (1–10) that the circuit monitor will capture.

**Table 8–3: 100ms rms Quantities**

| |
|---|
| Current<br>Per-Phase<br>Neutral① |
| Voltage<br>Line-to-Neutral, Per-Phase①<br>Line-to-Line, Per-Phase |
| Real Power<br>Per-Phase①<br>3-Phase Total |
| Reactive Power<br>Per-Phase①<br>3-Phase Total |
| Apparent Power<br>3-Phase Total |
| Power Factor (True)<br>3-Phase Total |

①4-wire systems only

## SETTING UP THE CIRCUIT MONITOR FOR AUTOMATIC EVENT CAPTURE

There are two ways to set up the circuit monitor for automatic event capture:

- Use an alarm to trigger the waveform capture.
- Use an external trigger such as a relay.

This section provides an overview of the steps you perform in SMS to setup these event captures.

### Setting Up Alarm-Triggered Event Capture

To set up the circuit monitor for automatic event capture, use SMS to perform the following steps:

*NOTE: For detailed instructions, refer to the SMS online help.*

1. Select the type of event capture (disturbance, adaptive, or 100ms) and set up the number of samples per cycle, pre-event cycles or seconds, and duration.
2. Select an alarm condition.
3. Define the pick up and dropout setpoints of the alarm, if applicable.
4. Select the automatic waveform capture option (Capture Waveform on Event). Check the pickup-to-dropout box if you want it to use it for an adaptive waveform capture.
5. Repeat these steps for the desired alarm conditions.

### Setting Up Input-Triggered Event Capture

When the circuit monitor is connected to an external device such as a protective relay, the circuit monitor can capture and provide valuable information on short duration events such as voltage sags. The circuit monitor must be equipped with digital inputs on an IOX Extender, or an IOC-44 Digital I/O Card.

To set up the circuit monitor for event capture triggered by an input, use SMS to perform the following steps:

*NOTE: For detailed instructions, refer to the SMS online help.*

1. Select the type of event capture (disturbance, adaptive, or 100ms) and set up the number of samples per cycle, pre-event cycles or seconds, and duration.
2. Create a digital alarm for the input.
3. Select the alarm.
4. Choose the type of event recording you would like.

## WAVEFORM STORAGE

The circuit monitor can store multiple captured waveforms in its nonvolatile memory. The number of waveforms that can be stored is based on the amount of memory that has been allocated to waveform capture. However, the maximum number of stored waveforms is eighty of each type. All stored waveform data is retained on power-loss.

## HOW THE CIRCUIT MONITOR CAPTURES AN EVENT

When the circuit monitor senses the trigger—that is, when the digital input transitions from OFF to ON, or an alarm condition is met—the circuit monitor transfers the cycle data from its data buffer into the memory allocated for event captures. The number of cycles or seconds it saves depends on the number of cycles or seconds you selected.

Figure 8–1 shows an event capture. In this example, the circuit monitor was monitoring a constant load when a utility fault occurred, followed by a return to normal.

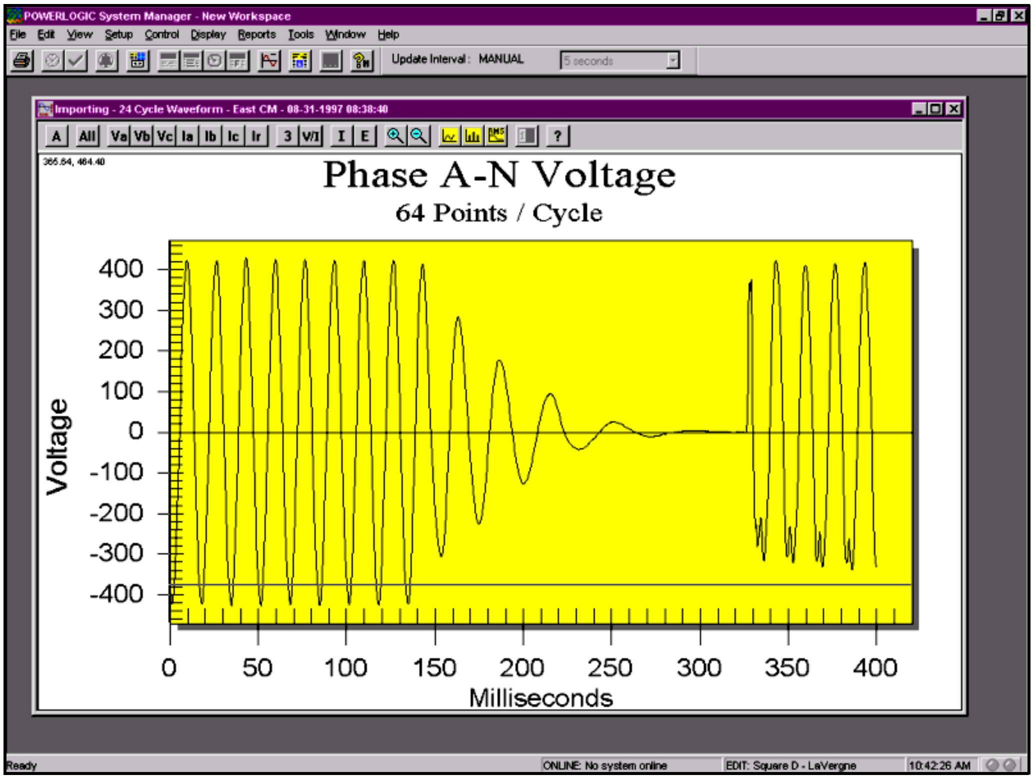



**Figure 8–1: Event capture initiated from a high-speed input**

# CHAPTER 9—DISTURBANCE MONITORING

This chapter gives you background information about disturbance monitoring and describes how to use the circuit monitor to continuously monitor for disturbances on the current and voltage inputs. It also provides an overview of using SMS to gather data when a disturbance event occurs.

## CHAPTER CONTENTS

## ABOUT DISTURBANCE MONITORING

Momentary voltage disturbances are an increasing concern for industrial plants, hospitals, data centers, and other commercial facilities because modern equipment used in those facilities tends to be more sensitive to voltage sags, swells, and momentary interruptions. The circuit monitor can detect these events by continuously monitoring and recording current and voltage information on all metered channels. Using this information, you can diagnose equipment problems resulting from voltage sags or swells and identify areas of vulnerability, enabling you to take corrective action.

The interruption of an industrial process because of an abnormal voltage condition can result in substantial costs, which manifest themselves in many ways:

- labor costs for cleanup and restart
- lost productivity
- damaged product or reduced product quality
- delivery delays and user dissatisfaction

The entire process can depend on the sensitivity of a single piece of equipment. Relays, contactors, adjustable speed drives, programmable controllers, PCs, and data communication networks are all susceptible to transient and short-duration power problems. After the electrical system is interrupted or shut down, determining the cause may be difficult.

Several types of voltage disturbances are possible, each potentially having a different origin and requiring a separate solution. A momentary interruption occurs when a protective device interrupts the circuit that feeds a facility. Swells and overvoltages can damage equipment or cause motors to overheat. Perhaps the biggest power quality problem is the momentary voltage sag caused by faults on remote circuits.

A voltage sag is a brief (1/4 cycle to 1 minute) decrease in rms voltage magnitude. A sag is typically caused by a remote fault somewhere on the power system, often initiated by a lightning strike. In Figure 9–1, the utility circuit breaker cleared the fault near plant D. The fault not only caused an interruption to plant D, but also resulted in voltage sags to plants A, B, and C.

*NOTE: The CM4000 is able to detect sag and swell events less than 1/4 cycle duration. However, it may be impractical to have setpoints more sensitive than 10% for voltage and current fluctuations.*

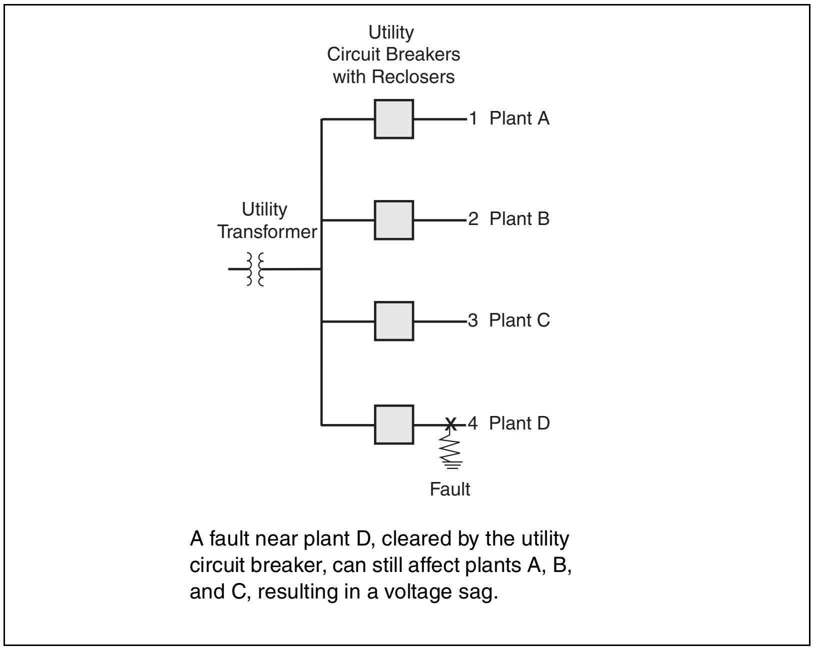



**Figure 9–1: A fault can cause voltage sag on the whole system.**

System voltage sags are much more numerous than interruptions, since a wider part of the distribution system is affected. And, if reclosers are operating, they may cause repeated sags. The circuit monitor can record recloser sequences, too. The waveform in Figure 9–2 shows the magnitude of a voltage sag, which persists until the remote fault is cleared.

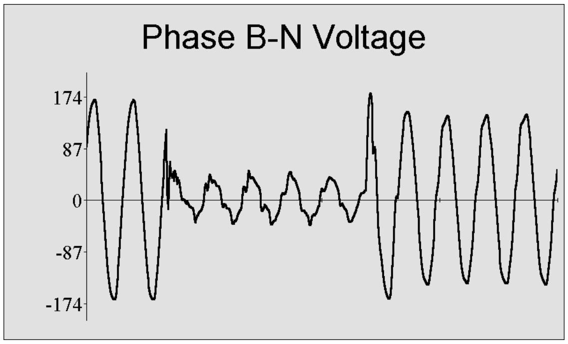



**Figure 9–2: Waveform showing voltage sag, which was caused by a remote fault and lasted five cycles.**

With the information obtained from the circuit monitor during a disturbance, you can solve disturbance-related problems, including the following:

- Obtain accurate measurement from your power system
  - Identify the number of sags, swells, or interruptions for evaluation
  - Determine the source (user or utility) of sags or swells
  - Accurately distinguish between sags and interruptions, with accurate recording of the time and date of the occurrence
  - Provide accurate data in equipment specification (ride-through, etc.)
- Determine equipment sensitivity
  - Compare equipment sensitivity of different brands (contactor dropout, drive sensitivity, etc.)
  - Diagnose mysterious events such as equipment failure, contactor dropout, computer glitches, etc.
  - Compare actual sensitivity of equipment to published standards
  - Use waveform capture to determine exact disturbance characteristics to compare with equipment sensitivity
  - Justify purchase of power conditioning equipment
  - Distinguish between equipment failures and power system related problems
- Develop disturbance prevention methods
  - Develop solutions to voltage sensitivity-based problems using actual data
- Work with the utility
  - Discuss protection practices with the serving utility and negotiate suitable changes to shorten the duration of potential sags (reduce interruption time delays on protective devices)
  - Work with the utility to provide alternate “stiffer” services (alternate design practices)

## CAPABILITIES OF THE CIRCUIT MONITOR DURING AN EVENT

The circuit monitor calculates rms magnitudes, based on 128 data points per cycle, every 1/2 cycle. This ensures that even sub-cycle duration rms variations are not missed. Table 9–1 shows the capability of the circuit monitor to measure electromagnetic phenomena in a power system as defined in IEEE Recommended Practice for Monitoring Electric Power Quality (IEEE Standard 1159-95).

**Table 9–1: Capability of the circuit monitor to measure electromagnetic phenomena**

| Categories | CM-4000 |
|---|---|
| Short Duration Variations | |
| Instantaneous | ✓ |
| Momentary | ✓ |
| Temporary | ✓ |
| Long Duration Variations | ✓ |
| Voltage Imbalance | ✓ |
| Waveform Distortion | ✓ |
| Voltage Fluctuations | ✓ |
| Power Frequency Variations | ✓ |

When the circuit monitor detects a sag or swell, it can perform the following actions:

- **Perform a waveform capture** with a resolution up to 512 samples per cycle on all channels of the metered current and voltage inputs. Three types of automatic event captures are possible: disturbance, adaptive, and 100 ms. See “Types of Waveform Captures” on page 108 in **Chapter 8—Waveform and Event Capture** for more about waveform and event captures. Use SMS to setup the event capture and retrieve the waveform.
- **Record the event in the alarm log**. When an event occurs, the circuit monitor updates the alarm log with an event date and time stamp with 1 millisecond resolution for a sag or swell pickup, and an rms magnitude corresponding to the most extreme value of the sag or swell during the event pickup delay. Also, the circuit monitor can record the sag or swell dropout in the alarm Log at the end of the disturbance. Information stored includes: a dropout time stamp with 1 millisecond resolution and a second rms magnitude corresponding to the most extreme value of the sag or swell. Use SMS to view the alarm log.
- **Force a data log entry** in up to 14 independent data logs. Use SMS to set up and view the data logs.
- **Operate any output relays** when the event is detected.
- **Indicate the alarm** on the display by flashing the alarm LED to show that a sag or swell event has occurred. From the circuit monitor’s display, a list of up to 10 of the previous alarms in the high priority log is available. You can also view the alarms in SMS.

## USING THE CIRCUIT MONITOR WITH SMS TO PERFORM DISTURBANCE MONITORING

This section gives you an overview of the steps to set up the circuit monitor for disturbance monitoring. For detailed instructions, see the SMS online help. In SMS under Setup > Devices Routing, the Device Setup dialog box contains the tabs for setting up disturbance monitoring. After you have performed basic set up of the circuit monitor, perform three setup steps:

1. Define the storage space for the alarm log, waveform capture, and any forced data logs using the Onboard Files tab in SMS. This sets up the amount of circuit monitor memory that the logs and waveform capture will use.

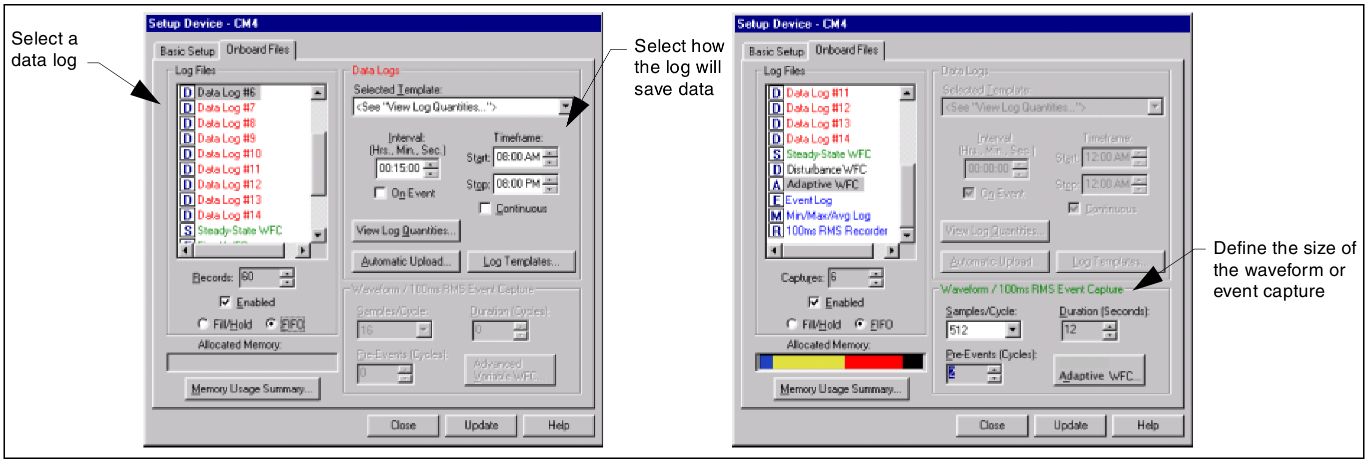



**Figure 9–3: Onboard Files tab**

2. Associate an alarm with data logs and waveform/event captures using the Onboard Alarms/Events tab.

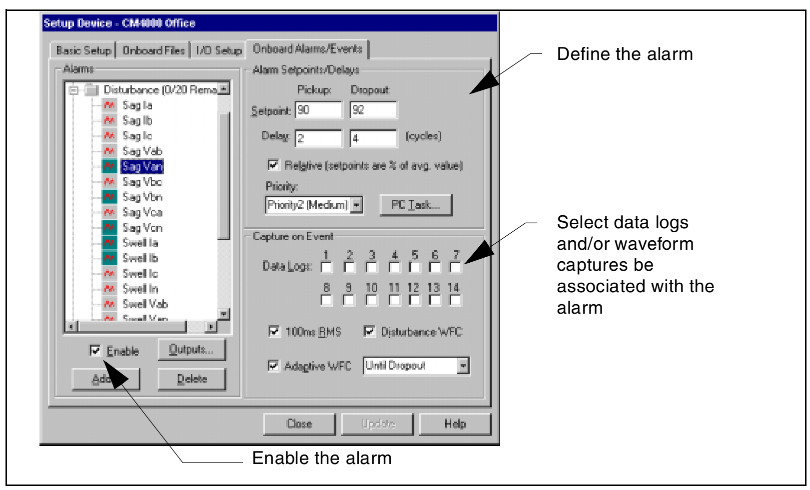



**Figure 9–4: Onboard Alarms/Events tab**

3. In addition, you can set up a relay to operate upon an event using the I/O tab in SMS.

   *NOTE: For the I/O Extender, you must define the relay from the display before SMS can recognize it. See “Setting Up I/Os” on page 23 of this bulletin for instructions.*

## UNDERSTANDING THE ALARM LOG

Pickups and dropouts of an event are logged into the onboard alarm log of the circuit monitor as separate entries. Figure 9–5 illustrates an alarm log entry sequence. In this example, two events are entered into the alarm log:

- Alarm Log Entry 1—The value stored in the alarm log at the end of the pickup delay is the furthest excursion from normal during the pickup delay period *t1*. This is calculated using 128 data point rms calculations.
- Alarm Log Entry 2—The value stored in the alarm log at the end of the dropout delay is the furthest excursion from normal during period *t2* from the end of the pickup delay to the end of the dropout delay.

The time stamps for the pickup and dropout reflect the actual duration of these periods.

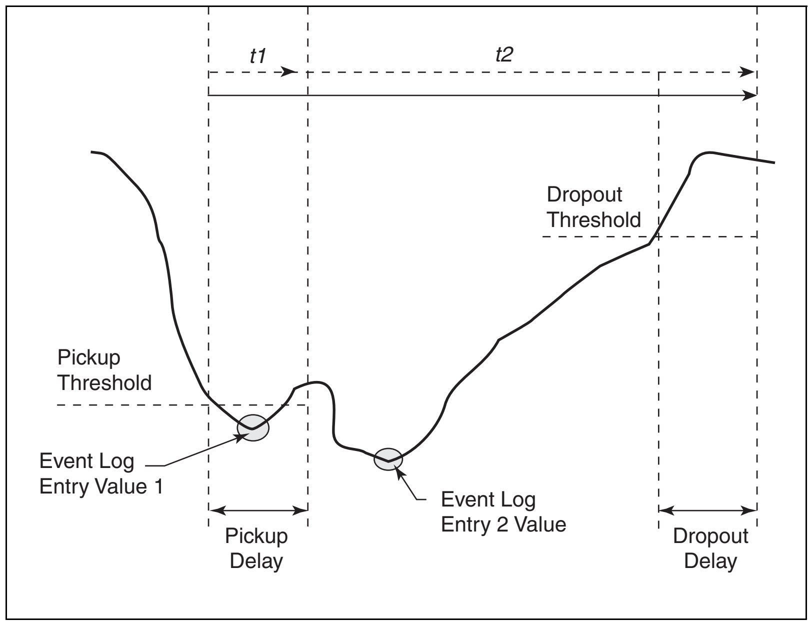
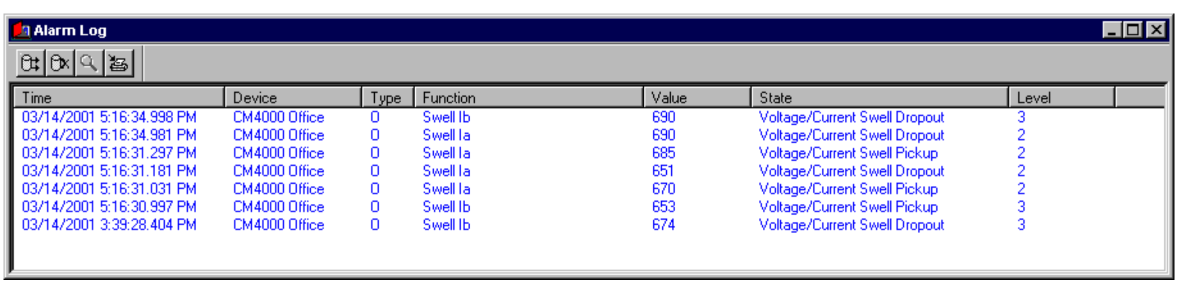



**Figure 9–5: Event log entries example**

Once the alarm has been recorded, you can view the alarm log in SMS. A sample alarm log entry is shown in Figure 9–6. See SMS online help for instructions on working with the alarm log.




| Time | Device | Type | Function | Value | State | Level |
|---|---|---|---|---|---|---|
| 03/14/2001 5:16:34.998 PM | CM4000 Office | 0 | Swell Ib | 690 | Voltage/Current Swell Dropout | 3 |
| 03/14/2001 5:16:34.981 PM | CM4000 Office | 0 | Swell Ia | 690 | Voltage/Current Swell Dropout | 2 |
| 03/14/2001 5:16:31.297 PM | CM4000 Office | 0 | Swell Ia | 685 | Voltage/Current Swell Pickup | 2 |
| 03/14/2001 5:16:31.181 PM | CM4000 Office | 0 | Swell Ia | 651 | Voltage/Current Swell Dropout | 2 |
| 03/14/2001 5:16:31.031 PM | CM4000 Office | 0 | Swell Ia | 670 | Voltage/Current Swell Pickup | 2 |
| 03/14/2001 5:16:30.997 PM | CM4000 Office | 0 | Swell Ib | 653 | Voltage/Current Swell Pickup | 3 |
| 03/14/2001 3:39:28.404 PM | CM4000 Office | 0 | Swell Ib | 674 | Voltage/Current Swell Dropout | 3 |

**Figure 9–6: Sample alarm log entry**

# CHAPTER 10—MAINTENANCE AND TROUBLESHOOTING

This chapter describes information related to maintenance of your circuit monitor.

## CHAPTER CONTENTS

The circuit monitor does not require regular maintenance, nor does it contain any user-serviceable parts. If the circuit monitor requires service, contact your local sales representative. Do not open the circuit monitor. Opening the circuit monitor voids the warranty.

**⚠ DANGER**

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

Do not attempt to service the circuit monitor. CT and PT inputs may contain hazardous currents and voltages. Only authorized service personnel from the manufacturer should service the circuit monitor.

**Failure to follow this instruction will result in death or serious injury.**

**⚠ CAUTION**

**HAZARD OF EQUIPMENT DAMAGE**

Do not perform a Dielectric (Hi-Pot) or Megger test on the circuit monitor. High voltage testing of the circuit monitor may damage the unit. Before performing Hi-Pot or Megger testing on any equipment in which the circuit monitor is installed, disconnect all input and output wires to the circuit monitor.

**Failure to follow this instruction can result in injury or equipment damage.**

## CIRCUIT MONITOR MEMORY

The circuit monitor uses its nonvolatile memory (RAM) to retain all data and metering configuration values. Under the operating temperature range specified for the circuit monitor, this nonvolatile memory has an expected life of up to 100 years. The circuit monitor stores its data logs on a memory chip, which has a life expectancy of up to 20 years under the operating temperature range specified for the circuit monitor. The life of the circuit monitor's internal battery-backed clock is over 20 years at 25°C.

*NOTE: Life expectancy is a function of operating conditions; this does not constitute any expressed or implied warranty.*

### Upgrading Memory in the Circuit Monitor

The circuit monitor standard memory is 8MB, but can be easily expanded to 16 MB, 32 MB, and higher. Contact your local Square D/Schneider Electric representative for availability of the memory upgrade chips. The memory chip is accessible through the access door on the side of the circuit monitor as illustrated in Figure 10–1. See the instruction bulletin provided with the memory expansion kit for instructions on removal and installation of the memory chip.

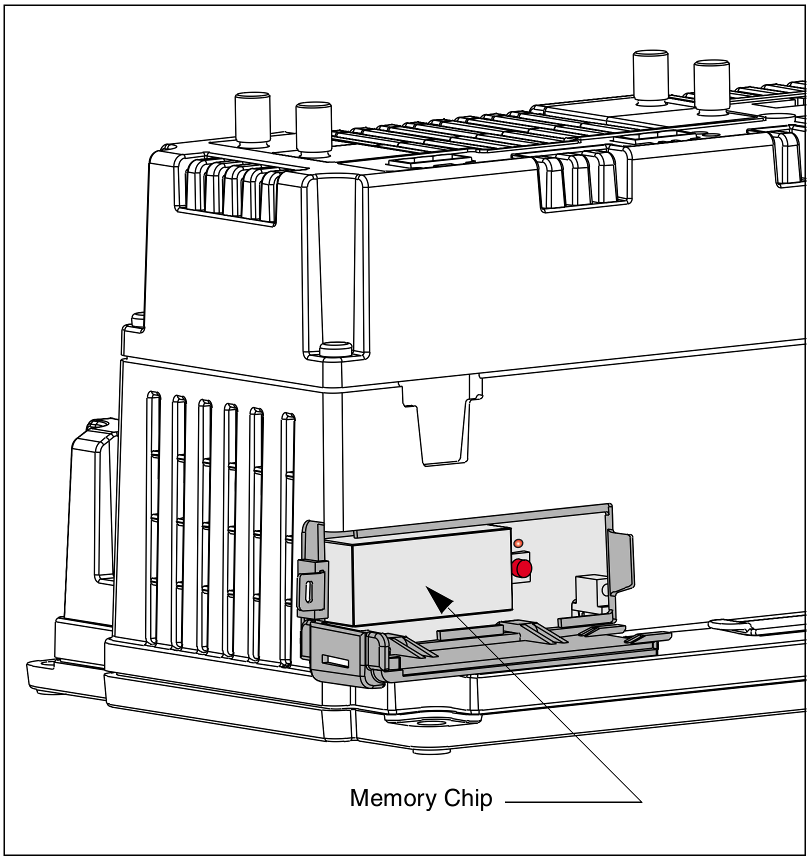



**Figure 10–1: Memory chip location in the circuit monitor**

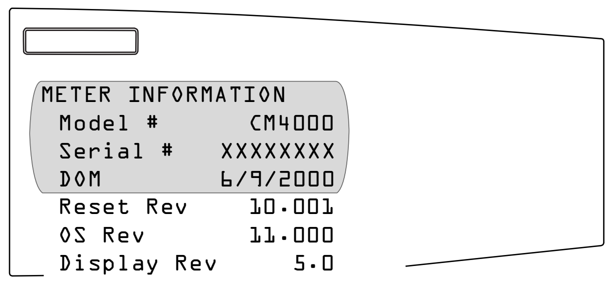
## IDENTIFYING THE FIRMWARE VERSION

You can upgrade the circuit monitor's firmware through any of these ports:

- RS-485 port
- RS-232 port
- Infrared ports on the VFD display
- Ethernet communications card

To determine the firmware version of the circuit monitor's operating system from the remote display, do this:

From the main menu, select Diagnostics > Meter Information. The information about your meter displays on the Meter Information screen. Your screen may vary slightly.




To determine the firmware version over the communication link, use SMS to perform a System Communications Test. The firmware version is listed in the firmware revision (F/W Revision) column.

## VIEWING THE DISPLAY IN DIFFERENT LANGUAGES

The Series 4000 Circuit Monitor can be configured to display text in various languages. Language files are installed using the DLF-3000 software applicaton. To obtain and use language files, refer to the DLF-3000 documentation.

## CALIBRATION OF THE CURRENT/VOLTAGE MODULE (CVM)

Contact your local sales representative for information on calibration of the CVM module on the circuit monitor.

## GETTING TECHNICAL SUPPORT

Please refer to the *Technical Support Contacts* provided in the circuit monitor shipping carton for a list of support phone numbers by country.

## TROUBLESHOOTING

The information in Table 10–1 describes potential problems and their possible causes. It also describes checks you can perform or possible solutions for each. After referring to this table, if you cannot resolve the problem, contact the your local Square D/Schneider Electric sales representative for assistance.

**⚠ DANGER**

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

- Beware of potential hazards, wear personal protective equipment, carefully inspect the work area for tools and objects that may have been left inside the equipment.
- Use caution while removing or installing panels so that they do not extend into the energized bus; avoid handling the panels, which could cause personal injury.

**Failure to follow this instruction will result in death or serious injury.**

**Table 10–1: Troubleshooting**

| Potential Problem | Possible Cause | Possible Solution |
|---|---|---|
| The red maintenance LED is illuminated on the circuit monitor. | When the red maintenance LED is illuminated, it indicates a potential hardware or firmware problem in the circuit monitor. | Contact your local sales representative for assistance. |
| The green control power LED is not illuminated on the circuit monitor. | The circuit monitor is not receiving the necessary power. | Verify that the circuit monitor line (L) and neutral (N) terminals (terminals 25 and 27) are receiving the necessary power. |
| The display is blank after applying control power to the circuit monitor. | The display is not receiving the necessary power or communications signal from the circuit monitor. | Verify that the display cable is properly inserted into the connectors on the display and the circuit monitor. |
| The data being displayed is inaccurate or not what you expect. | Circuit monitor is grounded incorrectly. | Verify that the circuit monitor is grounded as described in “Grounding the Circuit Monitor” on page 54 of the installation manual. |
| | Incorrect setup values. | Check that the correct values have been entered for circuit monitor setup parameters (CT and PT ratings, System Type, Nominal Frequency, and so on). See “Setting Up the Metering Functions of the Circuit Monitor” on page 16 for setup instructions. |
| | Incorrect voltage inputs. | Check circuit monitor voltage input terminals (9, 10, 11,12) to verify that adequate voltage is present. |
| | Circuit monitor is wired improperly. | Check that all CTs and PTs are connected correctly (proper polarity is observed) and that they are energized. Check shorting terminals. See “Wiring CTs, PTs, and Control Power to the Circuit Monitor” on page 38 of the installation manual for wiring diagrams. Initiate a wiring check from the circuit monitor display. |

**Table 10–1: Troubleshooting**

| | | |
|---|---|---|
| Cannot communicate with circuit monitor from a remote personal computer. | Circuit monitor address is incorrect. | Check to see that the circuit monitor is correctly addressed. See “RS-485, RS-232, and Infrared Port Communications Setup” on page 15 for instructions. |
| | Circuit monitor baud rate is incorrect. | Verify that the baud rate of the circuit monitor matches the baud rate of all other devices on its communications link. See “RS-485, RS-232, and Infrared Port Communications Setup” on page 15 for instructions. |
| | Communications lines are improperly connected. | Verify the circuit monitor communications connections. Refer to **Chapter 6—Communications Connections** of the installation manual for instructions. |
| | Communications lines are improperly terminated. | Check to see that a multipoint communications terminator is properly installed. See “Terminating the Communications Link” on page 67 of the installation manual for instructions. |
| | Incorrect route statement to circuit monitor. | Check the route statement. Refer to the SMS online help for instructions on defining route statements. |

# APPENDIX A—ABBREVIATED REGISTER LISTING

This appendix contains information about the registers of the circuit monitor.

## CONTENTS



## ABOUT REGISTERS

The four tables in this appendix contain an abbreviated listing of circuit monitor registers:

- Table A–3, beginning on page 130, identifies registers for these values:
  - — Real-Time Metered Values including 100 ms and 1 second
  - — Power Quality
  - — Minimum Real-Time Meter Values
  - — Maximum Real-Time Meter Values
  - — Accumulated Energy Values
  - — Demand Values
  - — Phase Extremes
  - — System Configuration
  - — Current and Voltage Module (CVM) Configuration
  - — Metering Configuration
  - — Communications
- Table A–4 on page 166 lists the register numbers related to the set up of inputs and outputs.
- Table A–5 on page 173 identifies the alarm position register numbers.
- Table A–6 on page 178 lists the registers used for the individual per-phase harmonic magnitudes and angles through the 63rd harmonic for all currents and voltages.

For registers defined in bits, the rightmost bit is referred to as bit 00. Figure A–1 shows how bits are organized in a register.

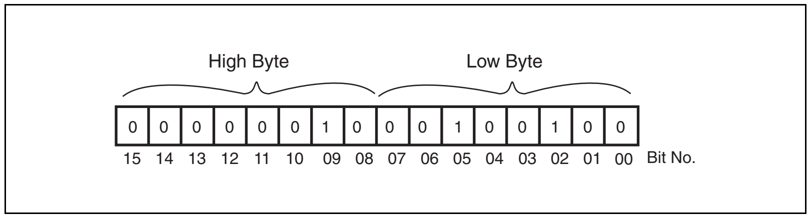



**Figure A–1: Bits in a register**

The circuit monitor registers can be used with MODBUS or JBUS protocols. Although the MODBUS protocol uses a zero-based register addressing convention and JBUS protocol uses a one-based register addressing convention, the circuit monitor 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. For example, Current Phase A will reside in register 31,000 or 41,000 instead of 1,000 as listed in Table A–3.

## HOW POWER FACTOR IS STORED IN THE REGISTER

Each power factor value occupies one register. Power factor values are stored using signed magnitude notation (see Figure A–2 below). Bit number 15, the sign bit, indicates leading/lagging. A positive value (bit 15=0) always indicates leading. A negative value (bit 15=1) always indicates lagging. Bits 0–9 store a value in the range 0–1,000 decimal. For example the circuit monitor would return a leading power factor of 0.5 as 500. Divide by 1,000 to get a power factor in the range 0 to 1.000.

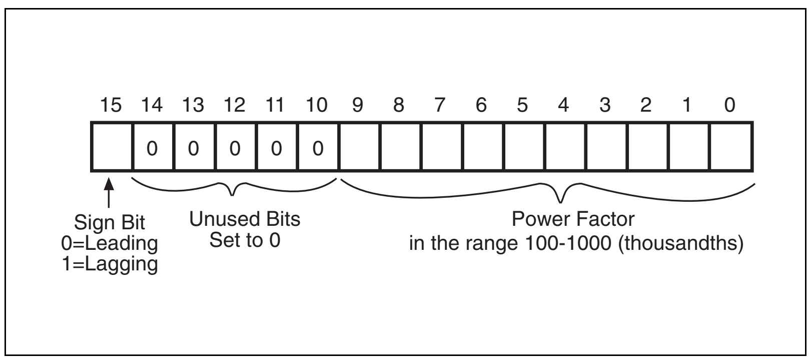



**Figure A–2: Power factor register format**

When the power factor is lagging, the circuit monitor returns a high negative value—for example, -31,794. This happens because bit 15=1 (for example, the binary equivalent of -31,794 is 1000001111001110). To get a value in the range 0 to 1,000, you need to mask bit 15. You do this by adding 32,768 to the value. An example will help clarify.

Assume that you read a power factor value of -31,794. Convert this to a power factor in the range 0 to 1.000, as follows:

-31,794 + 32,768 = 974

974/1,000 = .974 lagging power factor

## HOW DATE AND TIME ARE STORED IN THE REGISTER

The date and time are stored in a four-register compressed format. Each of the four registers, such as registers 1810 to 1813, contain a high and low byte value to represent the date and time in hexadecimal. Table A–1 lists the register and the portion of the date or time it represents.

**Table A–1:Date and Time Format**

| Register | Hi Byte | Lo Byte |
|---|---|---|
| Register 1 | Month (1-12) | Day (1-31) |
| Register 2 | Year (0-199) | Hour (0-23) |
| Register 3 | Minute (0-59) | Second (0-59) |
| Register 4 | Milliseconds | |

For example, if the date was 01/25/00 at 11:06:59.122, the Hex value would be 0119, 640B, 063B, 007A. Breaking it down into bytes we have the following:

**Table A–2:Date and Time Byte Example**

| Hexadecimal Value | Hi Byte | Lo Byte |
|---|---|---|
| 0119 | 01 = month | 19 = day |
| 640B | 64 = year | 0B = hour |
| 063B | 06 = minute | 3B = seconds |
| 007A | 007A = milliseconds | |

## REGISTER LISTING

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| **100 ms Real-Time Readings** | | | | |
| 1000 | Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1001 | Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1002 | Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1003 | Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1004 | Current, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1005 | Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 1006 | Current, Apparent RMS | A | Amps/Scale | 0 to 32,767 |
| 1020 | Voltage, A-B | D | Volts/Scale | 0 to 32,767 |
| 1021 | Voltage, B-C | D | Volts/Scale | 0 to 32,767 |
| 1022 | Voltage, C-A | D | Volts/Scale | 0 to 32,767 |
| 1023 | Voltage, L-L Average | D | Volts/Scale | 0 to 32,767 |
| 1024 | Voltage, A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1025 | Voltage, B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1026 | Voltage, C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1027 | Voltage, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1028 | Voltage, L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 1040 | Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1041 | Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1042 | Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1043 | Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1044 | Reactive Power, Phase A | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1045 | Reactive Power, Phase B | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1046 | Reactive Power, Phase C | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1047 | Reactive Power, Total | F | kVAr/Scale | -32,767 to 32,767 |
| 1048 | Apparent Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1049 | Apparent Power, Phase B | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1050 | Apparent Power, Phase C | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1051 | Apparent Power, Total | F | kVA/Scale | -32,767 to 32,767 |
| 1060 | True Power Factor, Phase A | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1061 | True Power Factor, Phase B | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1062 | True Power Factor, Phase C | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1063 | True Power Factor, Total | — | 0.001 | -100 to 1,000 to 100 ① |
| 1064 | Alternate True Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1065 | Alternate True Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1066 | Alternate True Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1067 | Alternate True Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| **1-Second Real-Time Readings** | | | | |
| 1100 | Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1101 | Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1102 | Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1103 | Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1104 | Current, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1105 | Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 1106 | Current, Apparent RMS | A | Amps/Scale | 0 to 32,767 |
| 1107 | Current, Unbalance, Phase A | — | 0.10% | -1,000 to 1,000 |
| 1108 | Current, Unbalance, Phase B | — | 0.10% | -1,000 to 1,000 |
| 1109 | Current, Unbalance, Phase C | — | 0.10% | -1,000 to 1,000 |
| 1110 | Current, Unbalance, Max | — | 0.10% | -1,000 to 1,000 |
| 1120 | Voltage, A-B | D | Volts/Scale | 0 to 32,767 |
| 1121 | Voltage, B-C | D | Volts/Scale | 0 to 32,767 |
| 1122 | Voltage, C-A | D | Volts/Scale | 0 to 32,767 |
| 1123 | Voltage, L-L Average | D | Volts/Scale | 0 to 32,767 |
| 1124 | Voltage, A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1125 | Voltage, B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1126 | Voltage, C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1127 | Voltage, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1128 | Voltage, L-N Average | D | Volts/Scale | 0 to 32,767 |
| 1129 | Voltage, Unbalance, A-B | — | 0.10% | -1,000 to 1,000 |
| 1130 | Voltage, Unbalance, B-C | — | 0.10% | -1,000 to 1,000 |
| 1131 | Voltage, Unbalance, C-A | — | 0.10% | -1,000 to 1,000 |
| 1132 | Voltage, Unbalance, Max L-L | — | 0.10% | -1,000 to 1,000 |
| 1133 | Voltage, Unbalance, A-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1134 | Voltage, Unbalance, B-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1135 | Voltage, Unbalance, C-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1136 | Voltage, Unbalance, Max L-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1140 | Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1141 | Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1142 | Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1143 | Real Power, Total | F | kW/Scale | -32,767 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1144 | Reactive Power, Phase A | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1145 | Reactive Power, Phase B | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1146 | Reactive Power, Phase C | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1147 | Reactive Power, Total | F | kVAr/Scale | -32,767 to 32,767 |
| 1148 | Apparent Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1149 | Apparent Power, Phase B | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1150 | Apparent Power, Phase C | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1151 | Apparent Power, Total | F | kVA /Scale | -32,767 to 32,767 |
| 1160 | True Power Factor, Phase A | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1161 | True Power Factor, Phase B | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1162 | True Power Factor, Phase C | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1163 | True Power Factor, Total | — | 0.001 | -100 to 1,000 to 100 ① |
| 1164 | Alternate True Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1165 | Alternate True Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1166 | Alternate True Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1167 | Alternate True Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| 1168 | Displacement Power Factor, Phase A | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1169 | Displacement Power Factor, Phase B | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1170 | Displacement Power Factor, Phase C | — | 0.001 | -100 to 1,000 to 100 ① ④ |
| 1171 | Displacement Power Factor, Total | — | 0.001 | -100 to 1,000 to 100 ① |
| 1172 | Alternate Displacement Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1173 | Alternate Displacement Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1174 | Alternate Displacement Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1175 | Alternate Displacement Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| 1180 | Frequency | — | 0.01 Hertz<br>0.1 Hertz | (50/60) 2,300 to 6,700<br>(400) 3,500 to 4,500 |
| 1181 | Temperature | — | 0.1 °C | -1,000 to 1,000 |
| 1190 | Auxiliary Analog Input Value, User-Selected Input 1 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1191 | Auxiliary Analog Input Value, User-Selected Input 2 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1192 | Auxiliary Analog Input Value, User-Selected Input 3 | — | Refer to Analog Input Setup | -32,767 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1193 | Auxiliary Analog Input Value, User-Selected Input 4 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1194 | Auxiliary Analog Input Value, User-Selected Input 5 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1195 | Auxiliary Analog Input Value, User-Selected Input 6 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1196 | Auxiliary Analog Input Value, User-Selected Input 7 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1197 | Auxiliary Analog Input Value, User-Selected Input 8 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1198 | Auxiliary Analog Input Value, User-Selected Input 9 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1199 | Auxiliary Analog Input Value, User-Selected Input 10 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| **Power Quality** | | | | |
| 1200 | THD/thd Current, Phase A | — | 0.10% | 0 to 32,767 |
| 1201 | THD/thd Current, Phase B | — | 0.10% | 0 to 32,767 |
| 1202 | THD/thd Current, Phase C | — | 0.10% | 0 to 32,767 |
| 1203 | THD/thd Current, Neutral | — | 0.10% | 0 to 32,767 ④ |
| 1204 | THD/thd Current, Ground | — | 0.10% | 0 to 32,767 ④ |
| 1207 | THD/thd Voltage, Phase A-N | — | 0.10% | 0 to 32,767 ④ |
| 1208 | THD/thd Voltage, Phase B-N | — | 0.10% | 0 to 32,767 ④ |
| 1209 | THD/thd Voltage, Phase C-N | — | 0.10% | 0 to 32,767 ④ |
| 1210 | THD/thd Voltage, Phase N-G | — | 0.10% | 0 to 32,767 ④ |
| 1211 | THD/thd Voltage, Phase A-B | — | 0.10% | 0 to 32,767 |
| 1212 | THD/thd Voltage, Phase B-C | — | 0.10% | 0 to 32,767 |
| 1213 | THD/thd Voltage, Phase C-A | — | 0.10% | 0 to 32,767 |
| 1218 | K-Factor, Current, Phase A | — | 0.10 | 0 to 10,000 |
| 1219 | K-Factor, Current, Phase B | — | 0.10 | 0 to 10,000 |
| 1220 | K-Factor, Current, Phase C | — | 0.10 | 0 to 10,000 |
| 1221 | Crest Factor, Current, Phase A | — | 0.01 | 0 to 10,000 |
| 1222 | Crest Factor, Current, Phase B | — | 0.01 | 0 to 10,000 |
| 1223 | Crest Factor, Current, Phase C | — | 0.01 | 0 to 10,000 |
| 1224 | Crest Factor, Current, Neutral | — | 0.01 | 0 to 10,000 |
| 1225 | Crest Factor, Voltage, A-N/A-B | — | 0.01 | 0 to 10,000 |
| 1226 | Crest Factor, Voltage, B-N/B-C | — | 0.01 | 0 to 10,000 |
| 1227 | Crest Factor, Voltage, C-N/C-A | — | 0.01 | 0 to 10,000 |
| 1230 | Current Fundamental RMS Magnitude, Phase A | A | Amps/Scale | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1231 | Current Fundamental Coincident Angle, Phase A | — | 0.1 ° | 0 to 3,599 |
| 1232 | Current Fundamental RMS Magnitude, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1233 | Current Fundamental Coincident Angle, Phase B | — | 0.1 ° | 0 to 3,599 |
| 1234 | Current Fundamental RMS Magnitude, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1235 | Current Fundamental Coincident Angle, Phase C | — | 0.1 ° | 0 to 3,599 |
| 1236 | Current Fundamental RMS Magnitude, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1237 | Current Fundamental Coincident Angle, Neutral | — | 0.1 ° | 0 to 3,599 ④ |
| 1238 | Current Fundamental RMS Magnitude, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1239 | Current Fundamental Coincident Angle, Ground | — | 0.1 ° | 0 to 3,599 ④ |
| 1244 | Voltage Fundamental RMS Magnitude, A-N/A-B | D | Volts/Scale | 0 to 32,767 |
| 1245 | Voltage Fundamental Coincident Angle, A-N/A-B | — | 0.1 ° | 0 to 3,599 |
| 1246 | Voltage Fundamental RMS Magnitude, B-N/B-C | D | Volts/Scale | 0 to 32,767 |
| 1247 | Voltage Fundamental Coincident Angle, B-N/B-C | — | 0.1 ° | 0 to 3,599 |
| 1248 | Voltage Fundamental RMS Magnitude, C-N/C-A | D | Volts/Scale | 0 to 32,767 |
| 1249 | Voltage Fundamental Coincident Angle, C-N/C-A | — | 0.1 ° | 0 to 3,599 |
| 1250 | Voltage Fundamental RMS Magnitude, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1251 | Voltage Fundamental Coincident Angle, N-G | — | 0.1 ° | 0 to 3,599 ④ |
| 1255 | Fundamental Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1256 | Fundamental Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1257 | Fundamental Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1258 | Fundamental Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1259 | Fundamental Reactive Power, Phase A | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1260 | Fundamental Reactive Power, Phase B | F | kVAr/Scale | -32,767 to 32,76 ④ |
| 1261 | Fundamental Reactive Power, Phase C | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1262 | Fundamental Reactive Power, Total | F | kVAr/Scale | -32,767 to 32,767 |
| 1264 | Distortion Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1265 | Distortion Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1266 | Distortion Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1267 | Distortion Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1268 | Distortion Power Factor, Phase A | — | 0.10% | 0 to 1,000 ④ |
| 1269 | Distortion Power Factor, Phase B | — | 0.10% | 0 to 1,000 ④ |
| 1270 | Distortion Power Factor, Phase C | — | 0.10% | 0 to 1,000 ④ |
| 1271 | Distortion Power Factor, Total | — | 0.10% | 0 to 1,000 |
| 1274 | Harmonic Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1275 | Harmonic Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1276 | Harmonic Current, Phase C | A | Amps/Scale | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1277 | Harmonic Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1278 | Harmonic Voltage, A-N/A-B | D | Volts/Scale | 0 to 32,767 |
| 1279 | Harmonic Voltage, B-N/B-C | D | Volts/Scale | 0 to 32,767 |
| 1280 | Harmonic Voltage, C-N/C-A | D | Volts/Scale | 0 to 32,767 |
| 1281 | Total Demand Distortion | — | 0.1% | 0 to 1,000 |
| 1284 | Current, Positive Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1285 | Current, Positive Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1286 | Current, Negative Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1287 | Current, Negative Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1288 | Current, Zero Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1289 | Current, Zero Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1290 | Voltage, Positive Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1291 | Voltage, Positive Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1292 | Voltage, Negative Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1293 | Voltage, Negative Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1294 | Voltage, Zero Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1295 | Voltage, Zero Sequence, Angle | — | 0.1° | 0 to 3,599 |
| 1296 | Current, Sequence, Unbalance | — | 0.10% | 0 to 32,767 |
| 1297 | Voltage, Sequence, Unbalance | — | 0.10% | 0 to 32,767 |
| **Real to Time Minimum Metered Values** | | | | |
| 1300 | Minimum Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1301 | Minimum Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1302 | Minimum Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1303 | Minimum Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1304 | Minimum Current, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1305 | Minimum Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 1306 | Minimum Current, Apparent RMS | A | Amps/Scale | 0 to 32,767 |
| 1307 | Minimum Current Unbalance, Phase A | — | 0.10% | -1,000 to 1,000 |
| 1308 | Minimum Current Unbalance, Phase B | — | 0.10% | -1,000 to 1,000 |
| 1309 | Minimum Current Unbalance, Phase C | — | 0.10% | -1,000 to 1,000 |
| 1310 | Minimum Current Unbalance, Max | — | 0.10% | -1,000 to 1,000 |
| 1320 | Minimum Voltage, A-B | D | Volts/Scale | 0 to 32,767 |
| 1321 | Minimum Voltage, B-C | D | Volts/Scale | 0 to 32,767 |
| 1322 | Minimum Voltage, C-A | D | Volts/Scale | 0 to 32,767 |
| 1323 | Minimum Voltage, L-L Average | D | Volts/Scale | 0 to 32,767 |
| 1324 | Minimum Voltage, A-N | D | Volts/Scale | 0 to 32,767 ④ |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1325 | Minimum Voltage, B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1326 | Minimum Voltage, C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1327 | Minimum Voltage, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1328 | Minimum Voltage, L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 1329 | Minimum Voltage Unbalance, A-B | — | 0.10% | -1,000 to 1,000 |
| 1330 | Minimum Voltage Unbalance, B-C | — | 0.10% | -1,000 to 1,000 |
| 1331 | Minimum Voltage Unbalance, C-A | — | 0.10% | -1,000 to 1,000 |
| 1332 | Minimum Voltage Unbalance, Max L-L | — | 0.10% | -1,000 to 1,000 |
| 1333 | Minimum Voltage Unbalance, A-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1334 | Minimum Voltage Unbalance, B-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1335 | Minimum Voltage Unbalance, C-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1336 | Minimum Voltage Unbalance, Max L-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1340 | Minimum Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1341 | Minimum Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1342 | Minimum Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1343 | Minimum Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1344 | Minimum Reactive Power, Phase A | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1345 | Minimum Reactive Power, Phase B | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1346 | Minimum Reactive Power, Phase C | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1347 | Minimum Reactive Power, Total | F | kVAr/Scale | -32,767 to 32,767 |
| 1348 | Minimum Apparent Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1349 | Minimum Apparent Power, Phase B | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1350 | Minimum Apparent Power, Phase C | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1351 | Minimum Apparent Power, Total | F | kVA /Scale | -32,767 to 32,767 |
| 1360 | Minimum True Power Factor, Phase A | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1361 | Minimum True Power Factor, Phase B | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1362 | Minimum True Power Factor, Phase C | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1363 | Minimum True Power Factor, Total | — | 0.001 | 1,000 -100 to 100 ① |
| 1364 | Minimum Alternate True Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1365 | Minimum Alternate True Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1366 | Minimum Alternate True Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1367 | Minimum Alternate True Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| 1368 | Minimum Displacement Power Factor, Phase A | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1369 | Minimum Displacement Power Factor, Phase B | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1370 | Minimum Displacement Power Factor, Phase C | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1371 | Minimum Displacement Power Factor, Total | — | 0.001 | 1,000 -100 to 100 ① |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1372 | Minimum Alternate Displacement Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1373 | Minimum Alternate Displacement Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1374 | Minimum Alternate Displacement Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1375 | Minimum Alternate Displacement Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| 1380 | Minimum Frequency | — | 0.01 Hertz<br>0.1 Hertz | (50/60) 2,300 to 6,700<br>(400) 3,500 to 4,500 |
| 1381 | Minimum Temperature | — | 0.1 °C | -1,000 to 1,000 |
| 1390 | Minimum Auxiliary Analog Input Value, User-Selected Input 1 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1391 | Minimum Auxiliary Analog Input Value, User-Selected Input 2 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1392 | Minimum Auxiliary Analog Input Value, User-Selected Input 3 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1393 | Minimum Auxiliary Analog Input Value, User-Selected Input 4 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1394 | Minimum Auxiliary Analog Input Value, User-Selected Input 5 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1395 | Minimum Auxiliary Analog Input Value, User-Selected Input 6 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1396 | Minimum Auxiliary Analog Input Value, User-Selected Input 7 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1397 | Minimum Auxiliary Analog Input Value, User-Selected Input 8 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1398 | Minimum Auxiliary Analog Input Value, User-Selected Input 9 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1399 | Minimum Auxiliary Analog Input Value, User-Selected Input 10 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1400 | Minimum THD/thd Current, Phase A | — | 0.10% | 0 to 32,767 |
| 1401 | Minimum THD/thd Current, Phase B | — | 0.10% | 0 to 32,767 |
| 1402 | Minimum THD/thd Current, Phase C | — | 0.10% | 0 to 32,767 |
| 1403 | Minimum THD/thd Current, Phase N | — | 0.10% | 0 to 32,767 ④ |
| 1404 | Minimum THD/thd Current, Ground | — | 0.10% | 0 to 32,767 ④ |
| 1407 | Minimum THD/thd Voltage, A-N | — | 0.10% | 0 to 32,767 ④ |
| 1408 | Minimum THD/thd Voltage, B-N | — | 0.10% | 0 to 32,767 ④ |
| 1409 | Minimum THD/thd Voltage, C-N | — | 0.10% | 0 to 32,767 ④ |
| 1410 | Minimum THD/thd Voltage, N-G | — | 0.10% | 0 to 32,767 ④ |
| 1411 | Minimum THD/thd Voltage, A-B | — | 0.10% | 0 to 32,767 |
| 1412 | Minimum THD/thd Voltage, B-C | — | 0.10% | 0 to 32,767 |
| 1413 | Minimum THD/thd Voltage, C-A | — | 0.10% | 0 to 32,767 |
| 1418 | Minimum Current K-Factor, Phase A | — | 0.10 | 0 to 10,000 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1419 | Minimum Current K-Factor, Phase B | — | 0.10 | 0 to 10,000 |
| 1420 | Minimum Current K-Factor, Phase C | — | 0.10 | 0 to 10,000 |
| 1421 | Minimum Crest Factor, Current, Phase A | — | 0.01 | 0 to 10,000 |
| 1422 | Minimum Crest Factor, Current, Phase B | — | 0.01 | 0 to 10,000 |
| 1423 | Minimum Crest Factor, Current, Phase C | — | 0.01 | 0 to 10,000 |
| 1424 | Minimum Crest Factor, Current, Neutral | — | 0.01 | 0 to 10,000 ④ |
| 1425 | Minimum Crest Factor, Voltage A-N/A-B | — | 0.01 | 0 to 10,000 |
| 1426 | Minimum Crest Factor, Voltage B-N/B-C | — | 0.01 | 0 to 10,000 |
| 1427 | Minimum Crest Factor, Voltage C-N/C-A | — | 0.01 | 0 to 10,000 |
| 1430 | Minimum Current Fundamental RMS Magnitude, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1431 | Minimum Current Fundamental Coincident Angle, Phase A | — | 0.1 ° | 0 to 3,599 |
| 1432 | Minimum Current Fundamental RMS Magnitude, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1433 | Minimum Current Fundamental Coincident Angle, Phase B | — | 0.1 ° | 0 to 3,599 |
| 1434 | Minimum Current Fundamental RMS Magnitude, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1435 | Minimum Current Fundamental Coincident Angle, Phase C | — | 0.1 ° | 0 to 3,599 |
| 1436 | Minimum Current Fundamental RMS Magnitude, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1437 | Minimum Current Fundamental Coincident Angle, Neutral | — | 0.1 ° | 0 to 3,599 ④ |
| 1438 | Minimum Current Fundamental RMS Magnitude, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1439 | Minimum Current Fundamental Coincident Angle, Ground | — | 0.1 ° | 0 to 3,599 ④ |
| 1444 | Minimum Voltage Fundamental RMS Magnitude, A-N/A-B | D | Volts/Scale | 0 to 32,767 |
| 1445 | Minimum Voltage Fundamental Coincident Angle, A-N/A-B | — | 0.1 ° | 0 to 3,599 |
| 1446 | Minimum Voltage Fundamental RMS Magnitude, B-N/B-C | D | Volts/Scale | 0 to 32,767 |
| 1447 | Minimum Voltage Fundamental Coincident Angle, B-N/B-C | — | 0.1 ° | 0 to 3,599 |
| 1448 | Minimum Voltage Fundamental RMS Magnitude, C-N/C-A | D | Volts/Scale | 0 to 32,767 |
| 1449 | Minimum Voltage Fundamental Coincident Angle, C-N/C-A | — | 0.1 ° | 0 to 3,599 |
| 1450 | Minimum Voltage Fundamental RMS Magnitude, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1451 | Minimum Voltage Fundamental Coincident Angle, N-G | — | 0.1 ° | 0 to 3,599 ④ |
| 1455 | Minimum Fundamental Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1456 | Minimum Fundamental Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1457 | Minimum Fundamental Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1458 | Minimum Fundamental Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1459 | Minimum Fundamental Reactive Power, Phase A | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1460 | Minimum Fundamental Reactive Power, Phase B | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1461 | Minimum Fundamental Reactive Power, Phase C | F | kVAr/Scale | -32,767 to 32,767 ④ |
| 1462 | Minimum Fundamental Reactive Power, Total | F | kVAr/Scale | -32,767 to 32,767 |
| 1464 | Minimum Distortion Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1465 | Minimum Distortion Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1466 | Minimum Distortion Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1467 | Minimum Distortion Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1468 | Minimum Distortion Power Factor, Phase A | — | 0.10% | 0 to 1,000 ④ |
| 1469 | Minimum Distortion Power Factor, Phase B | — | 0.10% | 0 to 1,000 ④ |
| 1470 | Minimum Distortion Power Factor, Phase C | — | 0.10% | 0 to 1,000 ④ |
| 1471 | Minimum Distortion Power Factor, Total | — | 0.10 | 0 to 1,000 |
| 1474 | Minimum Harmonic Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1475 | Minimum Harmonic Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1476 | Minimum Harmonic Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1477 | Minimum Harmonic Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1478 | Minimum Harmonic Voltage, A-N/A-B | D | Volts/Scale | 0 to 32,767 |
| 1479 | Minimum Harmonic Voltage, B-N/B-C | D | Volts/Scale | 0 to 32,767 |
| 1480 | Minimum Harmonic Voltage, C-N/C-A | D | Volts/Scale | 0 to 32,767 |
| 1481 | Minimum Total Demand Distortion | — | 0.01 | 0 to 10,000 |
| 1484 | Minimum Current, Positive Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1485 | Minimum Current, Positive Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1486 | Minimum Current, Negative Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1487 | Minimum Current, Negative Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1488 | Minimum Current, Zero Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1489 | Minimum Current, Zero Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1490 | Minimum Voltage, Positive Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1491 | Minimum Voltage, Positive Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1492 | Minimum Voltage, Negative Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1493 | Minimum Voltage, Negative Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1494 | Minimum Voltage, Zero Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1495 | Minimum Voltage, Zero Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1496 | Minimum Current, Sequence, Unbalance | — | 0.10% | -1,000 to 1,000 |
| 1497 | Minimum Voltage, Sequence, Unbalance | — | 0.10% | -1,000 to 1,000 |
| **Real to Time Maximum Metered Values** | | | | |
| 1500 | Maximum Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1501 | Maximum Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1502 | Maximum Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1503 | Maximum Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1504 | Maximum Current, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1505 | Maximum Current, 3 Phase Average | A | Amps/Scale | 0 to 32,767 |
| 1506 | Maximum Current, Apparent RMS | A | Amps/Scale | 0 to 32,767 |
| 1507 | Maximum Current Unbalance, Phase A | — | 0.10% | -1,000 to 1,000 |
| 1508 | Maximum Current Unbalance, Phase B | — | 0.10% | -1,000 to 1,000 |
| 1509 | Maximum Current Unbalance, Phase C | — | 0.10% | -1,000 to 1,000 |
| 1510 | Maximum Current Unbalance, Max | — | 0.10% | -1,000 to 1,000 |
| 1520 | Maximum Voltage, A-B | D | Volts/Scale | 0 to 32,767 |
| 1521 | Maximum Voltage, B-C | D | Volts/Scale | 0 to 32,767 |
| 1522 | Maximum Voltage, C-A | D | Volts/Scale | 0 to 32,767 |
| 1523 | Maximum Voltage, L-L Average | D | Volts/Scale | 0 to 32,767 |
| 1524 | Maximum Voltage, A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1525 | Maximum Voltage, B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1526 | Maximum Voltage, C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1527 | Maximum Voltage, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1528 | Maximum Voltage, L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 1529 | Maximum Voltage Unbalance, A-B | — | 0.10% | -1,000 to 1,000 |
| 1530 | Maximum Voltage Unbalance, B-C | — | 0.10% | -1,000 to 1,000 |
| 1531 | Maximum Voltage Unbalance, C-A | — | 0.10% | -1,000 to 1,000 |
| 1532 | Maximum Voltage Unbalance, Max L-L | — | 0.10% | -1,000 to 1,000 |
| 1533 | Maximum Voltage Unbalance, A-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1534 | Maximum Voltage Unbalance, B-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1535 | Maximum Voltage Unbalance, C-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1536 | Maximum Voltage Unbalance, Max L-N | — | 0.10% | -1,000 to 1,000 ④ |
| 1540 | Maximum Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1541 | Maximum Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1542 | Maximum Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1543 | Maximum Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1544 | Maximum Reactive Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1545 | Maximum Reactive Power, Phase B | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1546 | Maximum Reactive Power, Phase C | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1547 | Maximum Reactive Power, Total | F | kVA/Scale | -32,767 to 32,767 |
| 1548 | Maximum Apparent Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1549 | Maximum Apparent Power, Phase B | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1550 | Maximum Apparent Power, Phase C | F | kVA /Scale | -32,767 to 32,767 ④ |
| 1551 | Maximum Apparent Power, Total | F | kVA /Scale | -32,767 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1560 | Maximum True Power Factor, Phase A | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1561 | Maximum True Power Factor, Phase B | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1562 | Maximum True Power Factor, Phase C | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1563 | Maximum True Power Factor, Total | — | 0.001 | 1,000 -100 to 100 ① |
| 1564 | Maximum Alternate True Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1565 | Maximum Alternate True Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1566 | Maximum Alternate True Power Factor, Phase C | — | 0.001 | 0 to 2,000 ② ④ |
| 1567 | Maximum Alternate True Power Factor, Total | | 0.001 | 0 to 2,000 ② |
| 1568 | Maximum Displacement Power Factor, Phase A | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1569 | Maximum Displacement Power Factor, Phase B | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1570 | Maximum Displacement Power Factor, Phase C | — | 0.001 | 1,000 -100 to 100 ① ④ |
| 1571 | Maximum Displacement Power Factor, Total | — | 0.001 | 1,000 -100 to 100 ① |
| 1572 | Maximum Alternate Displacement Power Factor, Phase A | — | 0.001 | 0 to 2,000 ② ④ |
| 1573 | Maximum Alternate Displacement Power Factor, Phase B | — | 0.001 | 0 to 2,000 ② ④ |
| 1574 | Maximum Alternate Displacement Power Factor, Phase C | | 0.001 | 0 to 2,000 ② ④ |
| 1575 | Maximum Alternate Displacement Power Factor, Total | — | 0.001 | 0 to 2,000 ② |
| 1580 | Maximum Frequency | — | 0.01 Hertz<br>0.1 Hertz | (50/60) 2,300 to 6,700 (400)<br>3,500 to 4,500 |
| 1581 | Maximum Temperature | — | 0.1 °C | -1,000 to 1,000 |
| 1590 | Maximum Auxiliary Analog Input Value, User-Selected Input 1 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1591 | Maximum Auxiliary Analog Input Value, User-Selected Input 2 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1592 | Maximum Auxiliary Analog Input Value, User-Selected Input 3 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1593 | Maximum Auxiliary Analog Input Value, User-Selected Input 4 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1594 | Maximum Auxiliary Analog Input Value, User-Selected Input 5 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1595 | Maximum Auxiliary Analog Input Value, User-Selected Input 6 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1596 | Maximum Auxiliary Analog Input Value, User-Selected Input 7 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1597 | Maximum Auxiliary Analog Input Value, User-Selected Input 8 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1598 | Maximum Auxiliary Analog Input Value, User-Selected Input 9 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1599 | Maximum Auxiliary Analog Input Value, User-Selected Input 10 | — | Refer to Analog Input Setup | -32,767 to 32,767 |
| 1600 | Maximum THD/thd Current, Phase A | — | 0.10% | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1601 | Maximum THD/thd Current, Phase B | — | 0.10% | 0 to 32,767 |
| 1602 | Maximum THD/thd Current, Phase C | — | 0.10% | 0 to 32,767 |
| 1603 | Maximum THD/thd Current, Phase N | — | 0.10% | 0 to 32,767 ④ |
| 1604 | Maximum THD/thd Current, Ground | — | 0.10% | 0 to 32,767 ④ |
| 1607 | Maximum THD/thd Voltage, Phase A-N | — | 0.10% | 0 to 32,767 ④ |
| 1608 | Maximum THD/thd Voltage, Phase B-N | — | 0.10% | 0 to 32,767 ④ |
| 1609 | Maximum THD/thd Voltage, Phase C-N | — | 0.10% | 0 to 32,767 ④ |
| 1610 | Maximum THD/thd Voltage, Phase N-G | — | 0.10% | 0 to 32,767 ④ |
| 1611 | Maximum THD/thd Voltage, Phase A-B | — | 0.10% | 0 to 32,767 |
| 1612 | Maximum THD/thd Voltage, Phase B-C | — | 0.10% | 0 to 32,767 |
| 1613 | Maximum THD/thd Voltage, Phase C-A | — | 0.10% | 0 to 32,767 |
| 1618 | Maximum Current K-Factor, Phase A | — | 0.10 | 0 to 10,000 |
| 1619 | Maximum Current K-Factor, Phase B | — | 0.10 | 0 to 10,000 |
| 1620 | Maximum Current K-Factor, Phase C | — | 0.10 | 0 to 10,000 |
| 1621 | Maximum Crest Factor, Current, Phase A | — | 0.01 | 0 to 10,000 |
| 1622 | Maximum Crest Factor, Current, Phase B | — | 0.01 | 0 to 10,000 |
| 1623 | Maximum Crest Factor, Current, Phase C | — | 0.01 | 0 to 10,000 |
| 1624 | Maximum Crest Factor, Current, Neutral | — | 0.01 | 0 to 10,000 ④ |
| 1625 | Maximum Crest Factor, Voltage A-N/A-B | — | 0.01 | 0 to 10,000 |
| 1626 | Maximum Crest Factor, Voltage B-N/B-C | — | 0.01 | 0 to 10,000 |
| 1627 | Maximum Crest Factor, Voltage C-N/C-A | — | 0.01 | 0 to 10,000 |
| 1630 | Maximum Current Fundamental RMS Magnitude, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1631 | Maximum Current Fundamental Coincident Angle, Phase A | — | 0.1 ° | 0 to 3,599 |
| 1632 | Maximum Current Fundamental RMS Magnitude, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1633 | Maximum Current Fundamental Coincident Angle, Phase B | — | 0.1 ° | 0 to 3,599 |
| 1634 | Maximum Current Fundamental RMS Magnitude, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1635 | Maximum Current Fundamental Coincident Angle, Phase C | — | 0.1 ° | 0 to 3,599 |
| 1636 | Maximum Current Fundamental RMS Magnitude, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1637 | Maximum Current Fundamental Coincident Angle, Neutral | — | 0.1 ° | 0 to 3,599 ④ |
| 1638 | Maximum Current Fundamental RMS Magnitude, Ground | C | Amps/Scale | 0 to 32,767 ④ |
| 1639 | Maximum Current Fundamental Coincident Angle, Ground | — | 0.1 ° | 0 to 3,599 ④ |
| 1644 | Maximum Voltage Fundamental RMS Magnitude, A-N/A-B | D | Volts/Scale | 0 to 32,767 |
| 1645 | Maximum Voltage Fundamental Coincident Angle, A-N/A-B | — | 0.1 ° | 0 to 3,599 |
| 1646 | Maximum Voltage Fundamental RMS Magnitude, B-N/B-C | D | Volts/Scale | 0 to 32,767 |
| 1647 | Maximum Voltage Fundamental Coincident Angle, B-N/B-C | — | 0.1 ° | 0 to 3,599 |
| 1648 | Maximum Voltage Fundamental RMS Magnitude, C-N/C-A | D | Volts/Scale | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1649 | Maximum Voltage Fundamental Coincident Angle, C-N/C-A | — | 0.1 ° | 0 to 3,599 |
| 1650 | Maximum Voltage Fundamental RMS Magnitude, N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 1651 | Maximum Voltage Fund. Coincident Angle, N-G | — | 0.1 ° | 0 to 3,599 ④ |
| 1655 | Maximum Fundamental Real Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1656 | Maximum Fundamental Real Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1657 | Maximum Fundamental Real Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1658 | Maximum Fundamental Real Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1659 | Maximum Fundamental Reactive Power, Phase A | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1660 | Maximum Fundamental Reactive Power, Phase B | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1661 | Maximum Fundamental Reactive Power, Phase C | F | kVA/Scale | -32,767 to 32,767 ④ |
| 1662 | Maximum Fundamental Reactive Power, Total | F | kVA/Scale | -32,767 to 32,767 |
| 1664 | Maximum Distortion Power, Phase A | F | kW/Scale | -32,767 to 32,767 ④ |
| 1665 | Maximum Distortion Power, Phase B | F | kW/Scale | -32,767 to 32,767 ④ |
| 1666 | Maximum Distortion Power, Phase C | F | kW/Scale | -32,767 to 32,767 ④ |
| 1667 | Maximum Distortion Power, Total | F | kW/Scale | -32,767 to 32,767 |
| 1668 | Maximum Distortion Factor, Phase A | F | 0.10 | 0 to 1,000 ④ |
| 1669 | Maximum Distortion Factor, Phase B | F | 0.10 | 0 to 1,000 ④ |
| 1670 | Maximum Distortion Factor, Phase C | F | 0.10 | 0 to 1,000 ④ |
| 1671 | Maximum Distortion Factor, Total | F | 0.10 | 0 to 1,000 |
| 1674 | Maximum Harmonic Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1675 | Maximum Harmonic Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1676 | Maximum Harmonic Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1677 | Maximum Harmonic Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1678 | Maximum Harmonic Voltage, A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1679 | Maximum Harmonic Voltage, B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1680 | Maximum Harmonic Voltage, C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 1681 | Maximum Total Demand Distortion | — | 0.01 | 0 to 10,000 |
| 1684 | Maximum Current, Positive Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1685 | Maximum Current, Positive Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1686 | Maximum Current, Negative Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1687 | Maximum Current, Negative Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1688 | Maximum Current, Zero Sequence, Magnitude | A | Amps/Scale | 0 to 32,767 |
| 1689 | Maximum Current, Zero Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1690 | Maximum Voltage, Positive Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1691 | Maximum Voltage, Positive Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1692 | Maximum Voltage, Negative Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1693 | Maximum Voltage, Negative Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1694 | Maximum Voltage, Zero Sequence, Magnitude | D | Volts/Scale | 0 to 32,767 |
| 1695 | Maximum Voltage, Zero Sequence, Angle | — | 0.1 | 0 to 3,599 |
| 1696 | Maximum Current, Sequence, Unbalance | — | 0.10% | -1,000 to 1,000 |
| 1697 | Maximum Voltage, Sequence, Unbalance | — | 0.10% | -1,000 to 1,000 |
| **Accumulated Energy** | | | | |
| 1700 to 1703 | Energy, Real In | — | WH | 0 to 9,999,999,999,999,999 |
| 1704 to 1707 | Energy, Reactive In | — | VArH | 0 to 9,999,999,999,999,999 |
| 1708 to 1711 | Energy, Real Out | — | WH | 0 to 9,999,999,999,999,999 |
| 1712 to 1715 | Energy, Reactive Out | — | VArH | 0 to 9,999,999,999,999,999 |
| 1716 to 1719 | Energy, Real Total (signed/absolute) | — | WH | -9,999,999,999,999,999 to 9,999,999,999,999,999 |
| 1720 to 1723 | Energy, Reactive Total (signed/absolute) | — | VArH | -9,999,999,999,999,999- 9,999,999,999,999,999 |
| 1724 to 1727 | Energy, Apparent | — | VAH | 0 to 9,999,999,999,999,999 |
| 1728 to 1731 | Energy, Conditional Real In | — | WH | 0 to 9,999,999,999,999,999 |
| 1732 to 1735 | Energy, Conditional Reactive In | — | VArH | 0 to 9,999,999,999,999,999 |
| 1736 to 1739 | Energy, Conditional Real Out | — | WH | 0 to 9,999,999,999,999,999 |
| 1740 to 1743 | Energy, Conditional Reactive Out | — | VArH | 0 to 9,999,999,999,999,999 |
| 1744 to 1747 | Energy, Conditional Apparent | — | VAH | 0 to 9,999,999,999,999,999 |
| 1748 to 1750 | Energy, Incremental Real In, Last Complete Interval | — | WH | 0 to 999,999,999,999 |
| 1751 to 1753 | Energy. Incremental Reactive In, Last Complete Interval | — | VArH | 0 to 999,999,999,999 |
| 1754 to 1756 | Energy, Incremental Real Out, Last Complete Interval | — | WH | 0 to 999,999,999,999 |
| 1757 to 1759 | Energy, Incremental Reactive Out, Last Complete Interval | — | VArH | 0 to 999,999,999,999 |
| 1760 to 1762 | Energy, Incremental Apparent, Last Complete Interval | — | VAH | 0 to 999,999,999,999 |
| 1763 to 1766 | Last Complete Interval Date/Time | — | See template | See template |
| 1767 to 1769 | Energy, Incremental Real In, Present Interval | — | WH | 0 to 999,999,999,999 |
| 1770 to 1772 | Energy. Incremental Reactive In, Present Interval | — | VArH | 0 to 999,999,999,999 |
| 1773 to 1775 | Energy, Incremental Real Out, Present Interval | — | WH | 0 to 999,999,999,999 |
| 1776 to 1778 | Energy, Incremental Reactive Out, Present Interval | — | VArH | 0 to 999,999,999,999 |
| 1779 to 1781 | Energy, Incremental Apparent, Present Interval | — | VAH | 0 to 999,999,999,999 |
| 1782 to 1784 | Energy, Reactive, Quadrant 1 | — | VArH | 0 to 999,999,999,999 |
| 1785 to 1787 | Energy, Reactive, Quadrant 2 | — | VArH | 0 to 999,999,999,999 |
| 1788 to 1790 | Energy, Reactive, Quadrant 3 | — | VArH | 0 to 999,999,999,999 |
| 1791 to 1793 | Energy, Reactive, Quadrant 4 | — | VArH | 0 to 999,999,999,999 |
| 1794 | Conditional Energy Control Status | — | — | 0 = OFF<br>1 = ON |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| **Demand** | | | | |
| 1800 ③ | Demand Calculation Mode, Current<br>0 = Thermal Demand (default) | — | — | 0 |
| 1801 ③ | Demand Interval, Current | — | Minutes | 1 to 60, Default = 15 |
| 1802 ③ | Demand Subinterval, Current | — | Minutes | 1 to 60, Default = 1 |
| 1803 ③ | Demand Sensitivity, Current<br>Adjusts the sensitivity of the thermal demand calculation. | — | 1% | 1 to 99, Default = 90 |
| 1805 ③ | Short Demand Interval, Current<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1806 | Time Elapsed in Present Demand Interval, Current | — | Seconds | 0 to 3,600 |
| 1807 | Time Elapsed in Present Demand Subinterval, Current | — | Seconds | 0 to 3,600 |
| 1808 | Interval Count, Current | — | 1.0 | 0 to 32,767 |
| 1809 | Subinterval Count, Current | — | 1.0 | 0 to 60 |
| 1810 to 1813 | Min/Max Reset Date/Time, Current | — | See Template | See Template |
| 1814 | Min/Max Reset Count, Current | — | 1.0 | 0 to 32,767 |
| 1820 ③ | Demand Calculation Mode, Voltage<br>0 = Thermal Demand (default)<br>1 = Timed Interval Sliding Block<br>2 = Timed Interval Block<br>4 = Timed Interval Rolling Block<br>8 = Input Synchronized Block<br>16 = Input Synchronized Rolling Block<br>32 = Command Synchronized Block<br>64 = Command Synchronized Rolling Block<br>128 = Clock Synchronized Block<br>256 = Clock Synchronized Rolling Block<br>512 = Slave to Power Demand Interval<br>1024 = Slave to Incremental Energy Interval | — | — | 0 to 1024 |
| 1821 ③ | Demand Interval, Voltage | — | Minutes | 1 to 60, Default = 15 |
| 1822 ③ | Demand Subinterval, Voltage | — | Minutes | 1 to 60, Default = 1 |
| 1823 ③ | Demand Sensitivity, Voltage<br>Adjusts the sensitivity of the thermal demand calculation. | — | 1% | 1 to 99, Default = 90 |
| 1825 ③ | Short Demand Interval, Voltage<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1826 | Time Elapsed in Interval, Voltage | — | Seconds | 0 to 3,600 |
| 1827 | Time Elapsed in Subinterval, Voltage | — | Seconds | 0 to 3,600 |
| 1828 | Interval Count, Voltage | — | 1.0 | 0 to 32,767 |
| 1829 | Subinterval Count, Voltage | — | 1.0 | 0 to 60 |
| 1830 to 1833 | Min/Max Reset Date/Time, Voltage | — | See Template | See Template |
| 1834 | Min/Max Reset Count, Voltage | — | 1.0 | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1840 ③ | Demand Calculation Mode, Power<br>0 = Thermal Demand (default)<br>1 = Timed Interval Sliding Block<br>2 = Timed Interval Block<br>4 = Timed Interval Rolling Block<br>8 = Input Synchronized Block<br>16 = Input Synchronized Rolling Block<br>32 = Command Synchronized Block<br>64 = Command Synchronized Rolling Block<br>128 = Clock Synchronized Block<br>256 = Clock Synchronized Rolling Block<br>1024 = Slave to Incremental Energy Interval | — | — | 0 to 1024 |
| 1841 ③ | Demand Interval, Power | — | Minutes | 1 to 60, Default = 15 |
| 1842 ③ | Demand Subinterval, Power | — | Minutes | 1 to 60, Default = 1 |
| 1843 ③ | Demand Sensitivity, Power<br>Adjusts the sensitivity of the thermal demand calculation. | — | 1% | 1 to 99, Default = 90 |
| 1844 ③ | Predicted Demand Sensitivity, Power<br>Adjusts sensitivity of predicted demand calculation to recent changes in power consumption. | — | 1.0 | 1 to 10, Default = 5 |
| 1845 ③ | Short Demand Interval, Power<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1846 | Time Elapsed in Interval, Power | — | Seconds | 0 to 3,600 |
| 1847 | Time Elapsed in Subinterval, Power | — | Seconds | 0 to 3,600 |
| 1848 | Interval Count, Power | — | 1.0 | 0 to 32,767 |
| 1849 | Subinterval Count, Power | — | 1.0 | 0 to 60 |
| 1850 to 1853 | Min/Max Reset Date/Time, Power | — | See Template | See Template |
| 1854 | Min/Max Reset Count, Power | — | 1.0 | 0 to 32,767 |
| 1860 ③ | Demand Calculation Mode, Input Pulse Metering<br>0 = Thermal Demand (default)<br>1 = Timed Interval Sliding Block<br>2 = Timed Interval Block<br>4 = Timed Interval Rolling Block<br>8 = Input Synchronized Block<br>16 = Input Synchronized Rolling Block<br>32 = Command Synchronized Block<br>64 = Command Synchronized Rolling Block<br>128 = Clock Synchronized Block<br>256 = Clock Synchronized Rolling Block<br>512 = Slave to Power Demand Interval<br>1024 = Slave to Incremental Energy Interval | — | — | 0 to 1024 |
| 1861 ③ | Demand Interval, Input Pulse Metering | — | Minutes | 1 to 60, Default = 15 |
| 1862 ③ | Demand Subinterval, Input Pulse Metering | — | Minutes | 1 to 60, Default = 1 |
| 1863 ③ | Demand Sensitivity, Input Pulse Metering | — | 1% | 1 to 99, Default = 90 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1865 ③ | Short Demand Interval, Input Pulse Metering<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1866 | Time Elapsed in Interval, Input Pulse Metering | — | Seconds | 0 to 3,600 |
| 1867 | Time Elapsed in Subinterval, Input Pulse Metering | — | Seconds | 0 to 3,600 |
| 1868 | Interval Count, Input Pulse Metering | — | 1.0 | 0 to 32,767 |
| 1869 | Subinterval Count, Input Pulse Metering | — | 1.0 | 0 to 60 |
| 1870 to 1873 | Min/Max Reset Date/Time, Input Pulse Metering | — | See Template | See Template |
| 1874 | Min/Max Reset Count, Input Pulse Metering | — | 1.0 | 0 to 32,767 |
| 1880 ③ | Demand Calculation Mode, Generic Group 1<br>0 = Thermal Demand (default)<br>1 = Timed Interval Sliding Block<br>2 = Timed Interval Block<br>4 = Timed Interval Rolling Block<br>8 = Input Synchronized Block<br>16 = Input Synchronized Rolling Block<br>32 = Command Synchronized Block<br>64 = Command Synchronized Rolling Block<br>128 = Clock Synchronized Block<br>256 = Clock Synchronized Rolling Block<br>512 = Slave to Power Demand Interval<br>1024 = Slave to Incremental Energy Interval | — | — | 0 to 1024 |
| 1881 ③ | Demand Interval, Generic Group 1 | — | Minutes | 1 to 60, Default = 15 |
| 1882 ③ | Demand Subinterval, Generic Group 1 | — | Minutes | 1 to 60, Default = 1 |
| 1883 ③ | Demand Sensitivity, Generic Group 1<br>Adjusts the sensitivity of the thermal demand calculation. | — | 1% | 1 to 99, Default = 90 |
| 1885 ③ | Short Demand Interval, Generic Group 1<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1886 | Time Elapsed in Interval, Generic Group 1 | — | Seconds | 0 to 3,600 |
| 1887 | Time Elapsed in Subinterval, Generic Group 1 | — | Seconds | 0 to 3,600 |
| 1888 | Interval Count, Generic Group 1 | — | 1.0 | 0 to 32,767 |
| 1889 | Subinterval Count, Generic Group 1 | — | 1.0 | 0 to 60 |
| 1890 to 1893 | Min/Max Reset Date/Time, Generic Group 1 | — | See Template | See Template |
| 1894 | Min/Max Reset Count, Generic Group 1 | — | 1.0 | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1900 ③ | Demand Calculation Mode, Generic Group 2<br>0 = Thermal Demand (default)<br>1 = Timed Interval Sliding Block<br>2 = Timed Interval Block<br>4 = Timed Interval Rolling Block<br>8 = Input Synchronized Block<br>16 = Input Synchronized Rolling Block<br>32 = Command Synchronized Block<br>64 = Command Synchronized Rolling Block<br>128 = Clock Synchronized Block<br>256 = Clock Synchronized Rolling Block<br>512 = Slave to Power Demand Interval<br>1024 = Slave to Incremental Energy Interval | — | — | 0 to 1024 |
| 1901 ③ | Demand Interval, Generic Group 2 | — | Minutes | 1 to 60, Default = 15 |
| 1902 ③ | Demand Subinterval, Generic Group 2 | — | Minutes | 1 to 60, Default = 1 |
| 1903 ③ | Demand Sensitivity, Generic Group 2<br>Adjusts the sensitivity of the thermal demand calculation. | — | 1% | 1 to 99, Default = 90 |
| 1905 ③ | Short Demand Interval, Generic Group 2<br>Sets the interval for a running average demand calculation of short duration. | — | Seconds | 0 to 60, Default = 15 |
| 1906 | Time Elapsed in Interval, Generic Group 2 | — | Seconds | 0 to 3,600 |
| 1907 | Time Elapsed in Subinterval, Generic Group 2 | — | Seconds | 0 to 3,600 |
| 1908 | Interval Count, Generic Group 2 | — | 1.0 | 0 to 32,767 |
| 1909 | Subinterval Count, Generic Group 2 | — | 1.0 | 0 to 60 |
| 1910 to 1913 | Min/Max Reset Date/Time, Generic Group 2 | — | See Template | See Template |
| 1914 | Min/Max Reset Count, Generic Group 2 | — | 1.0 | 0 to 32,767 |
| 1920 ③ | Demand Forgiveness Duration<br>Duration of time after a power outage, during which power demand is not calculated | — | Seconds | 0 to 3600 |
| 1921 ③ | Demand Forgiveness Outage Definition<br>Duration of time that metered voltage must be lost to be considered a power outage for demand forgiveness | — | Seconds | 0 to 3600 |
| 1923 ③ | Clock Sync Time of Day<br>Time of day, in minutes from midnight, to which the demand interval is to be synchronized. Applies to demand intervals configured as Clock Synchronized. | — | Minutes | 0 to 1440 |
| 1924 | Power Factor Average Over Last Power Demand Interval | — | 0.001 | 1,000 -100 to 100 ① |
| 1925 to 1928 | Cumulative Demand Reset Date/Time | — | See Template | See Template |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 1929 to 1932 | Cumulative Input Pulse Metering Reset Date/Time | — | See Template | See Template |
| 1940 | Last Incremental Energy Interval, Real Demand Peak | F | kW/Scale | -32,767 to 32,767 |
| 1941 to 1944 | Last Incremental Energy Interval, Real Demand Peak Date/Time | — | See Template | See Template |
| 1945 | Last Incremental Energy Interval, Reactive Demand Peak | F | kVAr/Scale | -32,767 to 32,767 |
| 1946 to 1949 | Last Incremental Energy Interval, Reactive Demand Peak Date/Time | — | See Template | See Template |
| 1950 | Last Incremental Energy Interval, Apparent Demand Peak | F | kVA/Scale | 0 to 32,767 |
| 1951 to 1954 | Last Incremental Energy Interval, Apparent Demand Peak Date/Time | — | See Template | See Template |
| 1960 | Last Demand Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1961 | Present Demand Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1962 | Running Average Demand Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1963 | Peak Demand Current, Phase A | A | Amps/Scale | 0 to 32,767 |
| 1964 to 1967 | Peak Demand Date/Time Current, Phase A | — | See Template | See Template |
| 1970 | Last Demand Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1971 | Present Demand Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1972 | Running Average Demand Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1973 | Peak Demand Current, Phase B | A | Amps/Scale | 0 to 32,767 |
| 1974 to 1977 | Peak Demand Date/Time Current, Phase B | — | See Template | See Template |
| 1980 | Last Demand Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1981 | Present Demand Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1982 | Running Average Demand Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1983 | Peak Demand Current, Phase C | A | Amps/Scale | 0 to 32,767 |
| 1984 to 1987 | Peak Demand Date/Time Current, Phase C | — | See Template | See Template |
| 1990 | Last Demand Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1991 | Present Demand Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1992 | Running Average Demand Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1993 | Peak Demand Current, Neutral | B | Amps/Scale | 0 to 32,767 ④ |
| 1994 to 1997 | Peak Demand Date/Time Current, Neutral | — | See Template | See Template ④ |
| 2000 | Last Demand Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 2001 | Present Demand Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 2002 | Running Average Demand Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 2003 | Peak Demand Current, 3-Phase Average | A | Amps/Scale | 0 to 32,767 |
| 2004 to 2007 | Peak Demand Date/Time Current, 3-Phase Average | — | See Template | See Template |
| 2010 | Last Demand Voltage A-B | D | Volts/Scale | 0 to 32,767 |
| 2011 | Present Demand Voltage A-B | D | Volts/Scale | 0 to 32,767 |
| 2012 | Running Average Demand Voltage A-B | D | Volts/Scale | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2013 | Maximum Demand Voltage A-B | D | Volts/Scale | 0 to 32,767 |
| 2014 to 2017 | Maximum Demand Date/Time Voltage A-B | — | See Template | See Template |
| 2018 | Minimum Demand Voltage A-B | D | Volts/Scale | 0 to 32,767 |
| 2019 to 2022 | Minimum Demand Date/Time Voltage A-B | — | See Template | See Template |
| 2025 | Last Demand Voltage B-C | D | Volts/Scale | 0 to 32,767 |
| 2026 | Present Demand Voltage B-C | D | Volts/Scale | 0 to 32,767 |
| 2027 | Running Average Demand Voltage B-C | D | Volts/Scale | 0 to 32,767 |
| 2028 | Maximum Demand Voltage B-C | D | Volts/Scale | 0 to 32,767 |
| 2029 to 2032 | Maximum Demand Date/Time Voltage B-C | — | See Template | See Template |
| 2033 | Minimum Demand Voltage B-C | D | Volts/Scale | 0 to 32,767 |
| 2034 to 2037 | Minimum Demand Date/Time Voltage B-C | — | See Template | See Template |
| 2040 | Last Demand Voltage C-A | D | Volts/Scale | 0 to 32,767 |
| 2041 | Present Demand Voltage C-A | D | Volts/Scale | 0 to 32,767 |
| 2042 | Running Average Demand Voltage C-A | D | Volts/Scale | 0 to 32,767 |
| 2043 | Maximum Demand Voltage C-A | D | Volts/Scale | 0 to 32,767 |
| 2044 to 2047 | Maximum Demand Date/Time Voltage C-A | — | See Template | See Template |
| 2048 | Minimum Demand Voltage C-A | D | Volts/Scale | 0 to 32,767 |
| 2049 to 2052 | Minimum Demand Date/Time Voltage C-A | — | See Template | See Template |
| 2055 | Last Demand Voltage L-L Average | D | Volts/Scale | 0 to 32,767 |
| 2056 | Present Demand Voltage L-L Average | D | Volts/Scale | 0 to 32,767 |
| 2057 | Running Average Demand Voltage L-L Average | D | Volts/Scale | 0 to 32,767 |
| 2058 | Maximum Demand Voltage L-L Average | D | Volts/Scale | 0 to 32,767 |
| 2059 to 2062 | Maximum Demand Date/Time Voltage L-L Average | — | See Template | See Template |
| 2063 | Minimum Demand Voltage L-L Average | D | Volts/Scale | 0 to 32,767 |
| 2064 to 2067 | Minimum Demand Date/Time Voltage L-L Average | — | See Template | See Template |
| 2070 | Last Demand Voltage A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2071 | Present Demand Voltage A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2072 | Running Average Demand Voltage A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2073 | Maximum Demand Voltage A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2074 to 2077 | Maximum Demand Date/Time Voltage A-N | — | See Template | See Template ④ |
| 2078 | Minimum Demand Voltage A-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2079 to 2082 | Minimum Demand Date/Time Voltage A-N | — | See Template | See Template ④ |
| 2085 | Last Demand Voltage B-N | D | Volts/Scale | 0 to 32,767 ④ |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2086 | Present Demand Voltage B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2087 | Running Average Demand Voltage B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2088 | Maximum Demand Voltage B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2089 to 2092 | Maximum Demand Date/Time Voltage B-N | — | See Template | See Template ④ |
| 2093 | Minimum Demand Voltage B-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2094 to 2097 | Minimum Demand Date/Time Voltage B-N | — | See Template | See Template ④ |
| 2100 | Last Demand Voltage C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2101 | Present Demand Voltage C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2102 | Running Average Demand Voltage C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2103 | Maximum Demand Voltage C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2104 to 2107 | Maximum Demand Date/Time Voltage C-N | — | See Template | See Template ④ |
| 2108 | Minimum Demand Voltage C-N | D | Volts/Scale | 0 to 32,767 ④ |
| 2109 to 2112 | Minimum Demand Date/Time Voltage C-N | — | See Template | See Template ④ |
| 2115 | Last Demand Voltage N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 2116 | Present Demand Voltage N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 2117 | Running Average Demand Voltage N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 2118 | Maximum Demand Voltage N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 2119 to 2122 | Maximum Demand Date/Time Voltage N-G | — | See Template | See Template ④ |
| 2123 | Minimum Demand Voltage N-G | E | Volts/Scale | 0 to 32,767 ④ |
| 2124 | Minimum Demand Date/Time Voltage N-G | — | See Template | See Template ④ |
| 2130 | Last Demand Voltage L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 2131 | Present Demand Voltage L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 2132 | Running Average Demand Voltage L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 2133 | Maximum Demand Voltage L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 2134 | Maximum Demand Date/Time Voltage L-N Average | — | See Template | See Template ④ |
| 2138 | Minimum Demand Voltage L-N Average | D | Volts/Scale | 0 to 32,767 ④ |
| 2139 to 2142 | Minimum Demand Date/Time Voltage L-N Average | — | See Template | See Template ④ |
| 2150 | Last Demand Real Power, 3-Phase Total<br>3-Phase total present real power demand for last completed demand interval, updated every sub-interval | F | kW/Scale | -32,767 to 32,767 |
| 2151 | Present Demand Real Power, 3-Phase Total | F | kW/Scale | -32,767 to 32,767 |
| 2152 | Running Average Demand Real Power, 3-Phase Total | F | kW/Scale | -32,767 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2153 | Predicted Demand Real Power, 3-Phase Total<br>Predicted real power demand at the end of the present interval | F | kW/Scale | -32,767 to 32,767 |
| 2154 | Peak Demand Real Power, 3-Phase Total | F | kW/Scale | -32,767 to 32,767 |
| 2155 to 2158 | Peak Demand Date/Time Real Power, 3-Phase Total | — | See Template | See Template |
| 2159 to 2160 | Cumulative Demand Real Power, 3-Phase Total | F | kW/Scale | -2147483648 to 2147483647 |
| 2161 | Power Factor, Average @ Peak Demand, Real Power | — | 0.001 | 1,000 -100 to 100 ① |
| 2162 | Power Demand, Reactive @ Peak Demand, Real Power | F | kVAr/Scale | -32,767 to 32,767 |
| 2163 | Power Demand, Apparent @ Peak Demand, Real Power | F | kVA/Scale | 0 to 32,767 |
| 2165 | Last Demand Reactive Power, 3-Phase Total | F | kVAr /Scale | -32,767 to 32,767 |
| 2166 | Present Demand Reactive Power, 3-Phase Total | F | kVAr /Scale | -32,767 to 32,767 |
| 2167 | Running Average Demand Reactive Power, 3-Phase Total | F | kVAr /Scale | -32,767 to 32,767 |
| 2168 | Predicted Demand Reactive Power, 3-Phase Total<br>Predicted reactive power demand at the end of the present interval | F | kVAr /Scale | -32,767 to 32,767 |
| 2169 | Peak Demand Reactive Power, 3-Phase Total | F | kVAr /Scale | -32,767 to 32,767 |
| 2170 to 2173 | Peak Demand Date/Time Reactive Power, 3-Phase Total | — | See Template | See Template |
| 2174 to 2175 | Cumulative Demand Reactive Power, 3-Phase Total | F | kVAr /Scale | -2147483648 to 2147483647 |
| 2176 | Power Factor, Average @ Peak Demand, Reactive Power | — | 0.001 | 1,000 -100 to 100 ① |
| 2177 | Power Demand, Real @ Peak Demand, Reactive Power | F | kW/Scale | -32,767 to 32,767 |
| 2178 | Power Demand, Apparent @ Peak Demand, Reactive Power | F | kVA/Scale | 0 to 32,767 |
| 2180 | Last Demand Apparent Power 3-Phase Total | F | kVA /Scale | -32,767 to 32,767 |
| 2181 | Present Demand Apparent Power, 3-Phase Total | F | kVA /Scale | -32,767 to 32,767 |
| 2182 | Running Average Demand Apparent Power, 3-Phase Total | F | kVA /Scale | -32,767 to 32,767 |
| 2183 | Predicted Demand Apparent Power, 3-Phase Total<br>Predicted apparent power demand at the end of the present interval | F | kVA /Scale | -32,767 to 32,767 |
| 2184 | Peak Demand Apparent Power, 3-Phase Total | F | kVA /Scale | -32,767 to 32,767 |
| 2185 to 2188 | Peak Demand Date/Time Apparent Power, 3-Phase Total | — | See Template | See Template |
| 2189 to 2190 | Cumulative Demand Apparent Power, 3-Phase Total | F | kVA /Scale | -2147483648 to 2147483647 |
| 2191 | Power Factor, Average @ Peak Demand, Apparent Power | — | 0.001 | 1,000 -100 to 100 ① |
| 2192 | Power Demand, Real @ Peak Demand, Apparent Power | F | kW/Scale | -32,767 to 32,767 |
| 2193 | Power Demand, Reactive @ Peak Demand, Apparent Power | F | kVAr/Scale | 0 to 32,767 |
| 2200 ③ | Unit Code, Input Channel #1<br>For software use only | — | — | 0 to 99 |
| 2201 ③ | Scale Code, Input Channel #1 | — | — | -3 to 3, Default = 0 |
| 2202 | Last Demand, Input Channel #1 | — | — | 0 to 32,767, Default = 0 |
| 2203 | Present Demand, Input Channel #1 | — | — | 0 to 32,767 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2204 | Running Average Demand Input Channel #1 | — | — | 0 to 32,767 |
| 2205 | Peak Demand, Input Channel #1<br>Channel #1 peak demand since last Min/Max demand reset | — | — | 0 to 32,767 |
| 2206 to 2209 | Peak Demand Date/Time, Input Channel #1<br>Date/Time of peak demand since last peak demand reset | — | See Template | See Template |
| 2210 | Minimum Demand, Input Channel #1<br>Channel #1 minimum since last Min/Max demand reset | — | — | 0 to 32,767 |
| 2211 to 2214 | Minimum Demand Date/Time, Input Channel #1<br>Date/Time of minimum demand since last Min/Max reset | — | See Template | See Template |
| 2215 to 2219 | Cumulative Usage, Input Channel #1 | — | — | 0 to 9,999,999,999,999,999 |
| 2220 to 2239 | Input Channel #2<br>Same as registers 2200 to 2219 except for Channel #2 | | | |
| 2240 to 2259 | Input Channel #3<br>Same as registers 2200 to 2219 except for Channel #3 | | | |
| 2260 to 2279 | Input Channel #4<br>Same as registers 2200 to 2219 except for Channel #4 | | | |
| 2280 to 2299 | Input Channel #5<br>Same as registers 2200 to 2219 except for Channel #5 | | | |
| 2,300 to 2319 | Input Channel #6<br>Same as registers 2200 to 2219 except for Channel #6 | | | |
| 2320 to 2339 | Input Channel #7<br>Same as registers 2200 to 2219 except for Channel #7 | | | |
| 2340 to 2359 | Input Channel #8<br>Same as registers 2200 to 2219 except for Channel #8 | | | |
| 2360 to 2379 | Input Channel #9<br>Same as registers 2200 to 2219 except for Channel #9 | | | |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2380 to 2399 | Input Channel #10<br>Same as registers 2200 to 2219 except for Channel #10 | | | |
| 2400 ③ | Input Register, Generic Channel #1<br>Register selected for generic demand calculation | — | — | 1,000 to 32,767 |
| 2401 ③ | Unit Code, Generic Channel #1<br>For software use only | — | — | 0 to 99 |
| 2402 ③ | Scale Code, Generic Channel #1 | — | — | -3 to 3 |
| 2403 | Last Demand, Generic Channel #1 | — | — | 0 to 32,767 |
| 2404 | Present Demand, Generic Channel #1 | — | — | 0 to 32,767 |
| 2405 | Running Average, Demand Generic Channel #1 | — | — | 0 to 32,767 |
| 2406 | Peak Demand, Generic Channel #1<br>Channel #1 peak demand since last Min/Max demand reset | — | — | 0 to 32,767 |
| 2407 to 2410 | Peak Demand Date/Time, Generic Channel #1<br>Date/Time of peak demand since last peak demand reset | — | See Template | See Template |
| 2411 | Minimum Demand, Generic Channel #1<br>Channel #1 minimum since last Min/Max demand reset | — | — | 0 to 32,767 |
| 2412 to 2415 | Minimum Demand Date/Time, Generic Channel #1<br>Date/Time of minimum demand since last Min/Max reset | — | See Template | See Template |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2420 to 2439 | Generic Channel #2<br>Same as registers 2400 to 2419 except for Channel #2 | | | |
| 2440 to 2459 | Generic Channel #3<br>Same as registers 2400 to 2419 except for Channel #3 | | | |
| 2460 to 2479 | Generic Channel #4<br>Same as registers 2400 to 2419 except for Channel #4 | | | |
| 2480 to 2499 | Generic Channel #5<br>Same as registers 2400 to 2419 except for Channel #5 | | | |
| 2500 to 2519 | Generic Channel #6<br>Same as registers 2400 to 2419 except for Channel #6 | | | |
| 2520 to 2539 | Generic Channel #7<br>Same as registers 2400 to 2419 except for Channel #7 | | | |
| 2540 to 2559 | Generic Channel #8<br>Same as registers 2400 to 2419 except for Channel #8 | | | |
| 2560 to 2579 | Generic Channel #9<br>Same as registers 2400 to 2419 except for Channel #9 | | | |
| 2580 to 2599 | Generic Channel #10<br>Same as registers 2400 to 2419 except for Channel #10 | | | |
| 2600 to 2619 | Generic Channel #11<br>Same as registers 2400 to 2419 except for Channel #11 | | | |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 2620 to 2639 | Generic Channel #12<br>Same as registers 2400 to 2419 except for Channel #12 | | | |
| 2640 to 2659 | Generic Channel #13<br>Same as registers 2400 to 2419 except for Channel #13 | | | |
| 2660 to 2679 | Generic Channel #14<br>Same as registers 2400 to 2419 except for Channel #14 | | | |
| 2680 to 2699 | Generic Channel #15<br>Same as registers 2400 to 2419 except for Channel #15 | | | |
| 2700 to 2719 | Generic Channel #16<br>Same as registers 2400 to 2419 except for Channel #16 | | | |
| 2720 to 2739 | Generic Channel #17<br>Same as registers 2400 to 2419 except for Channel #17 | | | |
| 2740 to 2759 | Generic Channel #18<br>Same as registers 2400 to 2419 except for Channel #18 | | | |
| 2760 to 2779 | Generic Channel #19<br>Same as registers 2400 to 2419 except for Channel #19 | | | |
| 2780 to 2799 | Generic Channel #20<br>Same as registers 2400 to 2419 except for Channel #20 | | | |
| **Phase Extremes** | | | | |
| 2800 | Current, Highest Phase Value | A | Amps/Scale | 0 to 32,767 |
| 2801 | Current, Lowest Phase Value | A | Amps/Scale | 0 to 32,767 |
| 2802 | Voltage, L-L, Highest Value | D | Volts/Scale | 0 to 32,767 |
| 2803 | Voltage, L-L, Lowest Value | D | Volts/Scale | 0 to 32,767 |
| 2804 | Voltage, L-N, Highest Value | D | Volts/Scale | 0 to 32,767 ④ |
| 2805 | Voltage, L-N, Lowest Value | D | Volts/Scale | 0 to 32,767 ④ |
| **System Configuration** | | | | |
| 3000–3001 ③ | Circuit Monitor Label | — | — | — |
| 3002–3009 ③ | Circuit Monitor Nameplate | — | — | — |
| 3014 | Circuit Monitor Present Operating System Firmware Version | — | — | 0x0000 to 0xFFFF |
| 3034–3037 | Present Date/Time | — | See Template | See Template |
| 3039-3042 | Last Unit Restart Date/Time | — | See Template | See Template |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3050 | Self-Test Results<br>0 = Normal<br>1 = Error<br>Bit 00 = Is set to "1" if any failure occurs<br>Bit 01 = RTC failure<br>Bit 02 = MCF Uart #1 failure<br>Bit 03 = MCF Uart #2 failure<br>Bit 04 = PLD Uart failure<br>Bit 05 = Metering Collection overrun failure<br>Bit 06 = Metering Process 0.1 overrun failure<br>Bit 07 = Metering Process 1.0 overrun failure<br>Bit 08 = Disk-on-Chip failure<br>Bit 09 = Display failure<br>Bit 10 = CV Module failure<br>Bit 11 = Aux Plug EEPROM failure<br>Bit 12 = Flash Memory failure<br>Bit 13 = Dram Memory failure<br>Bit 14 = Simtek Memory failure<br>Bit 15 = RTC Memory failure | — | — | 0x0000 to 0xFFFF |
| 3051 | Self Test Results<br>0 = Normal<br>1 = Error<br>Bit 00 = Aux IO failure<br>Bit 01 = Option Slot A module failure<br>Bit 02 = Option Slot B module failure<br>Bit 03 = IOX module failure<br>Bit 08 = OS Create failure<br>Bit 09 = OS Queue overrun failure<br>Bit 13 = Systems shut down due to continuous reset<br>Bit 14 = Unit in Download, Condition A<br>Bit 15 = Unit in Download, Condition B | — | — | 0x0000 to 0xFFFF |
| 3053 | Installed Log Memory | — | Clusters | 0 to 65,535 |
| 3054 | Free Log Memory | — | Clusters | 0 to 65,535 |
| 3093 | Present Month | — | Months | 1 to 12 |
| 3094 | Present Day | — | Days | 1 to 31 |
| 3095 | Present Year | — | Years | 2000 to 2043 |
| 3096 | Present Hour | — | Hours | 0 to 23 |
| 3097 | Present Minute | — | Minutes | 0 to 59 |
| 3098 | Present Second | — | Seconds | 0 to 59 |
| 3099 | Day of Week<br>1 = Sunday, 2 = Monday, etc. | — | — | 1 to 7 |
| **Current and Voltage Module Configuration** | | | | |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3100 | Current-Voltage Module Product ID Number<br>0 = Not present<br>1 = Standard CVM<br>2 = Overrange CVM<br>3 = CVMT | — | — | 0 to 3 |
| 3137 | CVMT Operating System Firmware Revision | — | | |
| 3138 ③ | CT Ratio, Phase A Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3139 ③ | CT Ratio, Phase B Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3140 ③ | CT Ratio, Phase C Correction Factor | — | 0.00001 | -20,000 to 20,000,Default = 0 |
| 3141 ③ | CT Ratio, Neutral Correction Factor | — | 0.00001 | -20,000 to 20,000,Default = 0 |
| 3142 ③ | PT Ratio, Phase A Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3143 ③ | PT Ratio, Phase B Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3144 ③ | PT Ratio, Phase C Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3145 ③ | Neutral-Ground Correction Factor | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3154 ③ | Phase A Current Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3155 ③ | Phase B Current Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3156 ③ | Phase C Current Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3157 ③ | Neutral Current Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3158 ③ | Phase A Voltage Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3159 ③ | Phase B Voltage Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3160 ③ | Phase C Voltage Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3161 ③ | Neutral-Ground Voltage Field Calibration Coefficient | — | 0.00001 | -20,000 to 20,000, Default = 0 |
| 3170 ③ | CT Phase Shift Correction @ 1 amp<br>CT phase shift correction, for user instrumentation, in the range of -10º to +10º. A negative shifts in the lag direction. | — | — | -1,000 to 1,000, Default = 0 |
| 3171 ③ | CT Phase Shift Correction @ 5 amps<br>CT phase shift correction, for user instrumentation, in the range of -10º to +10º. A negative shifts in the lag direction. | — | — | -1,000 to 1,000, Default = 0 |
| 3174 | CVMT Mode<br>0 = Undefined<br>1 = Waiting for download<br>2 = Waiting for meter initialization<br>3 = Normal operation<br>4 = Calibration<br>5 = Firmware download | — | — | 0 to 5 |
| 3175 | CVMT Diagnostics<br>Bit 00 = Summary bit<br>Bit 01 = Invalid Mode<br>Bit 02 = Read error<br>Bit 03 = Write error<br>Bit 04 = Invalid CVMT firmware version | — | — | 0x0000 to 0xFFFF |
| 3176 | CVMT Reset Firmware Revision | — | — | 0x0000 to 0xFFFF |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

## Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| **Metering Configuration** | | | | |
| 3200 ③ | Metering System Type<br>System Connection<br>30 = 3PH3W2CT<br>31 = 3PH3W3CT<br>40 = 3PH4W3CT (default)<br>41 = 3PH4W4CT<br>42 = 3PH4W3CT2PT<br>43 = 3PH4W4CT2PT | — | — | 30,31, 40,41,42,43 |
| 3201 ③ | CT Ratio, Phase Primary | — | Amps | 1 to 32,767, Default = 5 |
| 3202 ③ | CT Ratio, Phase Secondary | — | Amps | 1, 5, Default = 5 |
| 3203 ③ | CT Ratio, Neutral Primary | — | Amps | 1 to 32,767, Default = 5 |
| 3204 ③ | CT Ratio, Neutral Secondary | — | Amps | 1, 5, Default = 5 |
| 3205 ③ | PT Ratio, Phase Primary | — | Volts/Scale | 1 to 32,767, Default = 120 |
| 3206 ③ | PT Ratio, Phase Primary Scale Factor<br>-1 = Direct Connect | — | — | -1 to 2, Default = 0 |
| 3207 ③ | PT Ratio, Phase Secondary | — | Volts | 100, 110, 115, 120;<br>Default = 120 |
| 3208 ③ | Nominal System Frequency | — | Hertz | 50,60,400; Default = 60 |
| 3209 ③ | Scale A to Phase Amps | — | — | -2 to 1, Default = 0 |
| 3210 ③ | Scale B to Neutral Amps | — | — | -2 to 1, Default = 0 |
| 3211 ③ | Scale C to Ground Amps | — | — | -2 to 1, Default = 0 |
| 3212 ③ | Scale D to Phase Volts | — | — | -1 to 2, Default = 0 |
| 3213 ③ | Scale E to Neutral Volts | — | — | -1 to 2, Default = -1 |
| 3214 ③ | Scale F to Power | — | — | -3 to 3, Default = 0 |
| 3216 ③ | Scale H to Transient Voltages | — | — | 0 to 3, Default = 1 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3227 ③ | Operating Mode Parameters<br>Mode Control Bits (Default = 0)<br>Bit 00 = Reserved<br>Bit 01 = Reactive Energy & Demand Accumulation<br>0 = Fund. Only ; 1 = Harmonics Included<br>Bit 02 = VAR/PF Sign Convention<br>0 = Standard IEEE Convention<br>1 = CM1 Convention<br>Bit 03 = Reserved<br>Bit 04 = Reserved<br>Bit 05 = Reserved<br>Bit 06 = Conditional Energy Accumulation Control<br>0 = Inputs; 1 = Command<br>Bit 07 = Reserved<br>Bit 08 = Display Setup<br>0 = Enabled; 1 = Disabled<br>Bit 09 = Normal Phase Rotation<br>0 = ABC; 1 = CBA<br>Bit 10 = Large or Small THD<br>0 = THD; 1 = thd<br>Bit 11 = Generate Phase Loss Voltage<br>0 = Disabled; 1 = Enabled | — | Bitmap | 0x0000 to 0x0FFF |
| 3228 | Metered Phase Rotation Direction<br>0 = ABC; 1 = CBA | — | — | 0 to 1 |
| 3229 ③ | Incremental Energy Interval<br>0 = Continuous Accumulation | — | Minutes | 0 to 1440, Default = 60 |
| 3230 ③ | Incremental Energy Interval Start Time<br>Value is time represented in minutes from midnight | — | Minutes | 0 to 1440, Default = 0 |
| 3231 ③ | Incremental Energy Interval End Time<br>Value is time represented in minutes from midnight | — | Minutes | 0 to 1440, Default = 1440 |
| 3232 ③ | Energy Accumulation Mode<br>Real and Reactive Energy Accumulation Mode<br>0 = Absolute (default); 1 = Signed | — | — | 0 to 1 |
| 3233 | Peak Current Demand Over Last Year<br>Entered by the user for use in calculation of Total Demand Distortion.<br>0 = Calculation not performed (default) | — | Amps | 0 to 32,767 |
| 3234 ③ | Nominal System Line-to-Line Voltage<br>Used for diagnostics and alarm | D | Volts/Scale | 0 to 32,767 |
| 3235 ③ | Nominal Circuit Current<br>Used for diagnostics and alarms | A | Amps/Scale | 0 to 32,767 |
| 3240 ③ | Harmonic Quantity Selection<br>0 = Disabled<br>1 = Harmonic magnitudes only (default)<br>2 = Harmonic magnitudes and angles | — | — | 0 to 2 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3241 ③ | Harmonic Magnitude Format<br>0 = % of Fundamental (default)<br>1 = % of RMS | — | — | 0 to 1 |
| 3242 ③ | Harmonic Refresh Interval | — | Seconds | 10 to 60, Default = 30 |
| 3243 | Time Remaining Until Harmonic Refresh | — | Seconds | 10 to 60 |
| 3270 to 3273 | Minimum/Maximum Reset Date/Time | — | See Template | See Template |
| 3274 to 3277 | Accumulated Energy Reset Date/Time | — | See Template | See Template |
| 3278 to 3281 | Conditional Energy Reset Date/Time | — | See Template | See Template |
| 3282 to 3285 | Incremental Energy Reset Date/Time | — | See Template | See Template |
| 3286 to 3289 | Input Metering Accumulation Reset Date/Time | — | See Template | See Template |
| 3290 to 3293 | Accumulated Energy Preset Date/Time | — | See Template | See Template |
| 3299 | Average/Min/Max Log Number of Data Items<br>Number of Quantities for which Average/Min/Max calculations are made and logged. | — | 1 | 25 |
| 3300 ③ | Average/Min/Max Log Interval<br>Must be evenly divisible into 1440. | — | Minutes | 1 to 1440, Default = 60 |
| 3301 ③ | Average/Min/Max Log Channel #1 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1100 Current, Phase A |
| 3302 ③ | Average/Min/Max Log Channel #2 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1101 Current, Phase B |
| 3303 ③ | Average/Min/Max Log Channel #3 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1102 Current, Phase C |
| 3304 ③ | Average/Min/Max Log Channel #4 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1103 Current, Neutral |
| 3305 ③ | Average/Min/Max Log Channel #5 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1104 Current, Ground |
| 3306 ③ | Average/Min/Max Log Channel #6 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1120 Voltage, A-B |
| 3307 ③ | Average/Min/Max Log Channel #7 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1121 Voltage B-C |
| 3308 ③ | Average/Min/Max Log Channel #8 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1122 Voltage C-A |
| 3309 ③ | Average/Min/Max Log Channel #9 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1127 Voltage N-G |
| 3310 ③ | Average/Min/Max Log Channel #10 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1143 Real Power, Total |
| 3311 ③ | Average/Min/Max Log Channel #11 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1147 Reactive Power, Total |
| 3312 ③ | Average/Min/Max Log Channel #12 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1151 Apparent Power, Total |
| 3313 ③ | Average/Min/Max Log Channel #13 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1163 True Power Factor, Total |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3314 ③ | Average/Min/Max Log Channel #14 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1171 Displacement Power Factor, Total |
| 3315 ③ | Average/Min/Max Log Channel #15 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1207 THD/thd Voltage Phase A-N |
| 3316 ③ | Average/Min/Max Log Channel #16 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1208 THD/thd Voltage Phase B-N |
| 3317 ③ | Average/Min/Max Log Channel #17 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1209 THD/thd Voltage Phase C-N |
| 3318 ③ | Average/Min/Max Log Channel #18 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1211 THD/thd Voltage Phase A-B |
| 3319 ③ | Average/Min/Max Log Channel #19 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1212 THD/thd Voltage Phase B-C) |
| 3320 ③ | Average/Min/Max Log Channel #20 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 1213 THD/thd Voltage Phase C-A |
| 3321 ③ | Average/Min/Max Log Channel #21 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 2150 Last Demand, Real Power, 3-Phase Total |
| 3322 ③ | Average/Min/Max Log Channel #22Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 2165 Last Demand, Reactive Power, 3-Phase Total |
| 3323 ③ | Average/Min/Max Log Channel #23 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 2180 Last Demand, Apparent Power, 3-Phase Total |
| 3324 ③ | Average/Min/Max Log Channel #24 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 0 |
| 3325 ③ | Average/Min/Max Log Channel #25 Meter Register<br>0 = No calculation for this channel | — | — | 0, 1100 to 2999; Default = 0 |
| 3350 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 00<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 00.<br>0 = none, default = 3 (Dig In A-S1) | — | — | 0 to 66 |
| 3351 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 01<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 01.<br>0 = none, default = 4 (Dig In A-S2) | — | — | 0 to 66 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3352 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 02<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 02.<br>0 = none, default = 5 (Dig In A-S3) | — | — | 0 to 66 |
| 3353 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 03<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 03.<br>0 = none, default = 6 (Dig In A-S4) | — | — | 0 to 66 |
| 3354 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 04<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 04.<br>0 = none, default = 19 (Dig In B-S1) | — | — | 0 to 66 |
| 3355 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 05<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 05.<br>0 = none, default = 20 (Dig In B-S2) | — | — | 0 to 66 |
| 3356 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 06<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 06.<br>0 = none, default = 21 (Dig In B-S3) | — | — | 0 to 66 |
| 3357 ③ | me<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 07.<br>0 = none, default = 22 (Dig In B-S4) | — | — | 0 to 66 |
| 3358 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 08<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 08.<br>0 = none, default = 35 (Dig In C1) | — | — | 0 to 66 |
| 3359 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 09<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 09.<br>0 = none, default = 36 (Dig In C5) | — | — | 0 to 66 |
| 3360 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 10<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 10.<br>0 = none, default = 37 (Dig In C3) | — | — | 0 to 66 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–3:Abbreviated Register List

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3361 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 11<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 11.<br>0 = none, default = 38 (Dig In C4) | — | — | 0 to 66 |
| 3362 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 12<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 12.<br>0 = none, default = 39 (Dig In C5) | — | — | 0 to 66 |
| 3363 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 13<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 13.<br>0 = none, default = 40 (Dig In C6) | — | — | 0 to 66 |
| 3364 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 14<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 14.<br>0 = none, default = 41 (Dig In C7) | — | — | 0 to 66 |
| 3365 ③ | Discrete Input Point Assignment to Discrete Input Status Bitmap Bit 15<br>IO Point Number for Discrete Input to include in Discrete Input Status Bitmap: Bit 15.<br>0 = none, default = 42 (Dig In C8) | — | — | 0 to 66 |
| **Communication** | | | | |
| 3400 ③ | RS-485 Comm Port #1 Operation Mode<br>0 = Modbus Slave (default)<br>1 = Jbus Slave | — | — | 0 to 1 |
| 3401 ③ | RS-485 Comm Port #1 Address<br>Valid Addresses: (Default = 1)<br>Modbus: 0 to 247<br>Jbus: 0 to 255 | — | — | 0 to 255 |
| 3402 ③ | RS-485 Comm Port #1 Baud Rate<br>0 = 1200<br>1 = 2400<br>2 = 4800<br>3 = 9600 (default)<br>4 = 19200<br>5 = 38400 | — | — | 0 to 5 |
| 3403 ③ | RS-485 Comm Port #1 Parity<br>0 = Even (default)<br>1 = Odd<br>2 = None | — | — | 0 to 2 |
| 3430 | RS-485 Comm Port #2 Operation Mode<br>0 = Modbus Slave (default)<br>1 = Jbus Slave | — | — | 0 to 1 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

**Table A–3:Abbreviated Register List**

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 3431 ③ | RS-485 Comm Port #2 Address<br>Modbus: 0 to 247<br>Jbus : 0 to 255 | — | — | 0 to 255, Default = 1 |
| 3432 ③ | RS-485 Comm Port #2 Baud Rate<br>0 = 1200<br>1 = 2400<br>2 = 4800<br>3 = 9600 (default)<br>4 = 19200<br>5 = 38400 | — | — | 0 to 5 |
| 3433 ③ | RS-485 Comm Port #2 Parity<br>0 = Even (default)<br>1 = Odd<br>2 = None | — | — | 0 to 2 |
| 3460 ③ | Infrared Comm Port, Operation Mode<br>0 = Modbus Slave (default)<br>1 = Jbus Slave | — | — | 0 to 1 |
| 3461 ③ | Infrared Comm Port, Address<br>Modbus: 0 to 247<br>Jbus : 0 to 255 | — | — | 0 to 255, Default = 1 |
| 3462 ③ | Infrared Comm Port, Baud Rate<br>3 = 9600<br>4 = 19200<br>5 = 38400 (default) | — | — | 3 to 5 |
| 3463 ③ | Infrared Comm Port, Parity<br>0 = Even (default)<br>1 = Odd<br>2 = None | — | — | 0 to 2 |

①See “How Power Factor is Stored in the Register” on page 128.

②The alternate storage method for power factor (PF) is useful for outputting PF on analog outputs. The PF value is stored as a positive value between 0 and 2, centered around 1 (unity). A value of 0 lagging maps to 0; -0.999 maps to 0.999;0.999 leading maps to 1.001; and 0 leading maps to 2. The alternate PF is also stored with a scale factor 0.001.

③ These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

④ Quantity available for 4-wire system only. Value set to -32,768 if not available.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| 4001 | Digital Input Status Option Slot A | — | 0x0000 to 0xFFFF | Bitmap of On/Off status for the digital inputs in Option Slot A:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 3 (A01)<br>Bit 01 = On/Off Status of IO Point 4 (A02)<br>Bit 02 = On/Off Status of IO Point 5 (A03)<br>Bit 03 = On/Off Status of IO Point 6 (A04) |
| 4002 | Digital Input Status Option Slot B | — | 0x0000 to 0xFFFF | Bitmap of On/Off status for the digital inputs in Option Slot B:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 19 (B01)<br>Bit 01 = On/Off Status of IO Point 20 (B02)<br>Bit 02 = On/Off Status of IO Point 21 (B03)<br>Bit 03 = On/Off Status of IO Point 22 (B04) |
| 4003 | Digital Input Status Pluggable IO | — | 0x0000 to 0x00FF | Bitmap of On/Off status for the digital inputs in Pluggable IO:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 35 (C01)<br>Bit 01 = On/Off Status of IO Point 36 (C02)<br>Bit 02 = On/Off Status of IO Point 37 (C03)<br>Bit 03 = On/Off Status of IO Point 38 (C04)<br>Bit 04 = On/Off Status of IO Point 39 (C05)<br>Bit 05 = On/Off Status of IO Point 40 (C06)<br>Bit 06 = On/Off Status of IO Point 41 (C07)<br>Bit 07 = On/Off Status of IO Point 42 (C08) |
| 4005 | Digital Output Status (KYZ) | — | 0x0000 to 0x0001 | Bitmap of On/Off status for the standard digital output:<br>0 = Off, 1 = On<br>Bit 00 = Standard digital output (KYZ)<br>Remaining bits not used. |
| 4006 | Digital Output Status Option Slot A | — | 0x0000 to 0xFFFF | Bitmap of On/Off status for the digital outputs in Option Slot A:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 3 (A01)<br>Bit 01 = On/Off Status of IO Point 4 (A02)<br>Bit 02 = On/Off Status of IO Point 5 (A03)<br>Bit 03 = On/Off Status of IO Point 6 (A04) |
| 4007 | Digital Output Status Option Slot B | — | 0x0000 to 0xFFFF | Bitmap of On/Off status for the digital outputs in Option Slot B:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 19 (B01)<br>Bit 01 = On/Off Status of IO Point 20 (B02)<br>Bit 02 = On/Off Status of IO Point 21 (B03)<br>Bit 03 = On/Off Status of IO Point 22 (B04) |
| 4008 | Digital Output Status Pluggable IO | — | 0x0000 to 0x00FF | Bitmap of On/Off status for the digital outputs in Pluggable IO:<br>0 = Off, 1 = On<br>Bit 00 = On/Off Status of IO Point 35 (C01)<br>Bit 01 = On/Off Status of IO Point 36 (C02)<br>Bit 02 = On/Off Status of IO Point 37 (C03)<br>Bit 03 = On/Off Status of IO Point 38 (C04)<br>Bit 04 = On/Off Status of IO Point 39 (C05)<br>Bit 05 = On/Off Status of IO Point 40 (C06)<br>Bit 06 = On/Off Status of IO Point 41 (C07)<br>Bit 07 = On/Off Status of IO Point 42 (C08) |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| 4016 | Time Sync Signal Health Status | — | 0x0000 to 0xFFFF | Bitmap of Time Sync Signal Health Status:<br>0 = OK, 1 = Error<br>Bit 00 = Summary Bit , time sync signal fatal error<br>Bit 01 = Lost time sync signal<br>Bit 02 = Summary Bit , invalid data<br>Bit 12 = Good time sync signal received<br>Bit 13 = Reserve antenna in use<br>Bit 14 = DST warning<br>Bit 15 = DST in effect |
| 4017 | GPS Time Sync Accuracy | milli-seconds | 0 to 1,000 | GPS Time Sync Accuracy |
| 4021 | Present Module Type Option Slot A | — | 0 to 7 | Indicates the type of Option Module present in Option Slot A.<br>0 = Not Installed<br>1 = IOC44<br>6 = Ethernet Option Module |
| 4022 | Present Module Type Option Slot B | — | 0 to 7 | Indicates the type of Option Module present in Option Slot B.<br>0 = Not Installed<br>1 = IOC44<br>6 = Ethernet Option Module |
| 4023 | Present Module Type Pluggable IO | — | 0, 5 | Indicates the presence of the pluggable IO rack.<br>0 = No module present<br>5 = Pluggable IO rack present |
| 4200–4299 ③ | Digital Output/Alarm Table | — | 0 to 17081 | Table of digital output/alarm associations. Upper byte is IO Point Number (1 to 66). Lower byte is Alarm Index Number (1 to 185). |
| 4300–4329 | IO Point Number 1 Standard Digital Output (KYZ) | | | Refer to digital Output template below. |
| 4360–4389 | IO Point Number 3 (A01) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4390–4419 | IO Point Number 4 (A02) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4420–4449 | IO Point Number 5 (A03) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4450–4479 | IO Point Number 6 (A04) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4480–4509 | IO Point Number 7 (A05) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4510–4539 | IO Point Number 8 (A06) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4540–4569 | IO Point Number 9 (A07) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4570–4599 | IO Point Number 10 (A08) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4840–4869 | IO Point Number 19 (B01) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4870–4899 | IO Point Number 20 (B02) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4900–4929 | IO Point Number 21 (B03) | | | Register contents depend on IO Point Type. Refer to templates below. |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| 4930–4959 | IO Point Number 22 (B04) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4960–4989 | IO Point Number 23 (B05) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 4990–5019 | IO Point Number 24 (B06) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5020–5049 | IO Point Number 25 (B07) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5050–5079 | IO Point Number 26 (B08) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5320–5349 | IO Point Number 35 (C01) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5350–5379 | IO Point Number 36 (C02) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5380–5409 | IO Point Number 37 (C03) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5410–5439 | IO Point Number 38 (C04) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5440–5469 | IO Point Number 39 (C05) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5470–5499 | IO Point Number 40 (C06) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5500–5529 | IO Point Number 41 (C07) | | | Register contents depend on IO Point Type. Refer to templates below. |
| 5530–5559 | IO Point Number 42 (C08) | | | Register contents depend on IO Point Type. Refer to templates below. |
| **Digital Input Template** | | | | |
| Base ① | IO Point Type | — | 100 to 199 | First digit (1) indicates point is digital input.<br>Second digit indicates module type<br>0 = Generic digital input<br>1 = DI120AC Pluggable Module<br>2 = DI240AC Pluggable Module<br>3 = DI32DC Pluggable Module<br>Third digit indicates input type<br>1 = AC<br>2 = DC |
| Base + 1 ① | IO Point Label | Alpha-Numeric | — | 16-character label |
| Base + 9 ① | Mode | — | 0 to 3 | digital Input Operating Mode<br>0 = Normal (default)<br>1 = Demand Interval Sync Pulse<br>2 = Time Sync<br>3 = Conditional Energy Control<br><br>Only one Time Sync input and one Conditional Energy Control are allowed. If the user attempts to configure more than one of each of these modes, the lowest IO Point Number will take precedence. The modes of the other points will be set to default. Time sync input signal must be pulse duration method (PDM) as from the Modicon GPS Receiver (470 GPS 001 00). |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| Base + 10① | Demand Interval Sync System Assignments | — | 0x0000 to 0x003F | Bitmap indicting Demand System(s) to which input is assigned. (Default = 0x003F)<br>Bit 00 = Power Demand<br>Bit 01 = Current Demand<br>Bit 02 = Voltage Demand<br>Bit 03 = Input Metering Demand<br>Bit 04 = Generic Demand 1<br>Bit 05 = Generic Demand 2<br><br>Only one Demand Sync Pulse per Demand System is allowed. If the user attempts to configure more than one input for each system, the lowest IO Point Number will take precedence. The corresponding bits of the other points will be set to 0. |
| Base + 11① | Digital Input Options | — | 0x0000 to 0x0001 | Bitmap of digital Input Options. (Default = 0)<br>Bit 00 = Debounce time (0 = 5msec, 1 = 50msec) |
| Base + 14① | Metering Pulse Channel Assignments | — | 0x0000 to 0x03FF | Bitmap indicting metering pulse channel(s) to which input is assigned. (Default = 0)<br>Bit 00 = Channel 1<br>Bit 01 = Channel 2<br>Bit 02 = Channel 3<br>Bit 03 = Channel 4<br>Bit 04 = Channel 5<br>Bit 05 = Channel 6<br>Bit 06 = Channel 7<br>Bit 07 = Channel 8<br>Bit 08 = Channel 9<br>Bit 09 = Channel 10 |
| Base + 15① | Metering Pulse Weight, Demand | 1.0 | 1- 32,767 | Pulse weight associated with the change of state of the input. Used for demand metering. (Default = 1) |
| Base + 16① | Metering Pulse Scale Factor, Demand | 1.0 | -3 to 3 | Pulse weight scale factor (power of 10) to apply to metering pulse weight. Used for demand metering. (Default = 0) |
| Base + 17① | Metering Pulse Weight, Consumption | 1.0 | 1- 32,767 | Pulse weight associated with the change of state of the input. Used for consumption metering. (Default = 1) |
| Base + 18① | Metering Pulse Scale Factor, Consumption | 1.0 | -3 to 3 | Pulse weight scale factor (power of 10) to apply to metering pulse weight. Used for consumption metering. (Default = 0) |
| Base + 22 | IO Point Diagnostic Bitmap | — | 0x0000 to 0xFFFF | IO Point Diagnostic Bitmap:<br>0 = OK, 1 = Error<br>Bit 00 = IO Point diagnostic summary<br>Bit 01 = Configuration invalid to default value used |
| Base + 25 | Digital Input On/Off Status | — | 0 to 1 | digital input Off/On status: 0 = Off, 1 = On |
| Base + 26 | Count | — | 0 to 99,999,999 | Number of times input has transitioned from Off to On |
| Base + 28 | On Time | Seconds | 0 to 99,999,999 | Duration that digital input has been On |
| **Digital Output Template** | | | | |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| Base① | IO Point Type | — | 200 to 299 | IO Point Type to digital Output<br><br>First digit (2) indicates point is digital output.<br>Second digit indicates module type<br>0 = Generic digital output<br>1 = DO120AC Pluggable Module<br>2 = DO200DC Pluggable Module<br>3 = DO240AC Pluggable Module<br>4 = DO60DC Pluggable Module Third digit indicates output type<br>1 = solid state relay<br>2 = electromechanical relay |
| Base + 1① | IO Point Label | Alpha-Numeric | — | 16-character label |
| Base + 9① | Mode | — | 0 to 11 | digital Output Operating Mode<br>0 = Normal (default)<br>1 = Latched<br>2 = Timed<br>3 = Absolute kWh pulse<br>4 = Absolute kVARh pulse<br>5 = kVAh pulse<br>6 = kWh In pulse<br>7 = kVARh In pulse<br>8 = kWh out pulse<br>9 = kVARh out pulse<br>10 = Register-based pulse (future)<br>11 = End of power demand interval |
| Base + 10① | On Time For Timed Mode | Seconds | 1 to 32,767 | The time for the output to remain energized when the output is in timed mode or end of power demand interval. (Default = 1) |
| Base + 11① | Pulse Weight | KWH/ Pulse kVarH/ Pulse kVAH/ Pulse in 100ths | 1 to 32,767 | Specifies the kWh, kVARh and kVAh per pulse for output when in these modes. (Default = 1) |
| Base + 12① | Internal/External Control | — | 0 to 1 | Indicates active output state.<br>0 = Internal Control<br>1 = External Control (default) |
| Base + 13① | Normal/Override Control | — | 0 to 1 | Indicates active output state.<br>0 = Normal Control (default)<br>1 = Override Control |
| Base + 22 | IO Point Diagnostic Bitmap | — | 0x0000 to 0x000F | IO Point Diagnostic Bitmap:<br>0 = OK, 1 = Error<br>Bit 00 = IO Point diagnostic summary<br>Bit 01 = Configuration invalid to default value used<br>Bit 02 = digital output energy pulse to time between transitions exceeds 30 seconds<br>Bit 03 = digital output energy pulse to time between transitions limited to 20 milliseconds<br><br>Remaining bits not used. |
| Base + 25 | Digital Output On/Off Status | — | 0 to 1 | digital output Off/On status: 0 = Off, 1 = On |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| Base + 26 | Count | — | 0 to 99,999,999 | Number of times output has transitioned from Off to On |
| Base + 28 | On Time | Seconds | 0 to 99,999,999 | Duration that digital output has been On |
| **Analog Input Template** | | | | |
| Base① | IO Point Type | — | 300 to 399 | First digit (3) indicates point is analog input.<br>Second digit indicates the range of analog I/O values (used without units)<br>1 = 0 to 5<br>5 = 4 to 20<br><br>Third digit indicates the digital resolution of the I/O hardware. The user must select from one of these standard ranges.<br>2 = 12-Bit , unipolar |
| Base + 1① | IO Point Label | Alpha-Numeric | — | 16-character label |
| Base + 9① | Units Code | — | 0 to 99 | Analog input units code placeholder for a code used by software to identify the SI units of the analog input being metered, i.e. kW, V, etc. |
| Base + 10① | Scale Code | — | -3 to 3 | Analog input scale code. |
| Base + 12① | Analog Input Minimum | — | 0 to ±32,767 | Minimum value of the scaled register value for the analog input. (Only if Metering Register Number is not 0.) |
| Base + 13① | Analog Input Maximum | — | 0 to ±32,767 | Maximum value of the scaled register value for the analog input. (Only if Metering Register Number is not 0.) |
| Base + 14① | Lower Limit Analog Value | — | 0 to ±327 | Lower limit of the analog input value. Default value based on IO Point Type. |
| Base + 15① | Upper Limit Analog Value | — | 0 to ±327 | Upper limit of the analog input value. Default value based on IO Point Type. |
| Base + 16① | Lower Limit Register Value | — | 0 to ±32,767 | Lower limit of the register value associated with the lower limit of the analog input value. |
| Base + 17① | Upper Limit Register Value | — | 0 to ±32,767 | Upper limit of the register value associated with the upper limit of the analog input value. |
| Base + 18① | Metering Register Number | — | 0, 1190 to 1199 | Register where Present Scaled Value is copied. This register is included in the Min/Max determination for metered values. |
| Base + 19① | User Gain Adjustment | 0.0001 | 8,000 to 12,000 | Analog input user gain adjustment in 100ths of a percent. Default = 10,000. |
| Base + 20① | User Offset Adjustment | — | 0 to ±30,000 | Analog input user offset adjustment in Bits of digital resolution. Default = 0. |
| Base + 22 | IO Point Diagnostic Bitmap | — | 0x0000 to 0x0007 | IO Point Diagnostic Bitmap:<br>0 = OK, 1 = Error<br>Bit 00 = IO Point diagnostic summary<br>Bit 01 = Configuration invalid to default value used<br>Bit 02 = M-Bus communications error Remaining bits not used. |
| Base + 23 | Lower Limit Digital Value | — | 0 to ±32,767 | Lower limit of the digital value associated with the lower limit of the analog input value. Value based on IO Point Type. |
| Base + 24 | Upper Limit Digital Value | — | 0 to ±32,767 | Upper limit of the digital value associated with the upper limit of the analog input value. Value based on IO Point Type. |
| Base + 25 | Present Raw Value | — | 0 to ±32,767 | Raw digital value read from analog input. |
| Base + 26 | Present Scaled Value | — | 0 to ±32,767 | Raw value corrected by calibration gain and offset adjustments and scaled based on range of register values. |
| **Analog Output Template** | | | | |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup-mode commands.

### Table A–4:Abbreviated Register List for I/O Status

| Register Number | Name | Units | Range | Description |
|---|---|---|---|---|
| Base① | IO Point Type | — | 400 to 499 | First digit (4) indicates point is analog output.<br>Second digit indicates the range of analog I/O values (used without units).<br>5 = 4 to 20<br>Third digit indicates the digital resolution of the I/O hardware. The user must select from one of these standard ranges.<br>2 = 12-Bit , unipolar |
| Base + 1① | IO Point Label | Alpha-Numeric | — | 16-character label |
| Base + 12① | Output Enable | — | 0 to 1 | Analog output control<br>0 = Enable (default)<br>1 = Disable |
| Base + 14① | Lower Limit Analog Value | — | 0 to ±327 | Lower limit of the analog output value. Default value based on IO Point Type. |
| Base + 15① | Upper Limit Analog Value | — | 0 to ±327 | Upper limit of the analog output value. Default value based on IO Point Type. |
| Base + 16① | Lower Limit Register Value | — | 0 to ±32,767 | Lower limit of the register value associated with the lower limit of the analog output value. |
| Base + 17① | Upper Limit Register Value | — | 0 to ±32,767 | Upper limit of the register value associated with the upper limit of the analog output value. |
| Base + 18① | Reference Register Number | — | 1,000 to 32,767 | Register location of value upon which to base the analog output. |
| Base + 19① | User Gain Adjustment | 0.0001 | 8000 to 12,000 | Analog output user gain adjustment in 100ths of a percent. Default = 10,000. |
| Base + 20① | User Offset Adjustment | — | 0 to ±30000 | Analog output user offset adjustment in Bit s of digital resolution. Default = 0. |
| Base + 23 | Lower Limit Digital Value | — | 0 to ±32,767 | Lower limit of the digital value associated with the lower limit of the analog output value. Value based on IO Point Type. |
| Base + 24 | Upper Limit Digital Value | — | 0 to ±32,767 | Upper limit of the digital value associated with the upper limit of the analog output value. Value based on IO Point Type. |
| Base + 25 | Present Analog Value | 0.01 | 0 to ±32,767 | Analog value expected to be present at the output terminals of the analog output module. |
| Base + 26 | Present Raw (Register) Value | — | 0 to ±32,767 | Value in Reference Register. |
| Base + 27 | Calibration Offset | — | 0 to ±32,767 | Analog output offset adjustment in Bit s of digital resolution. |
| Base + 28 | Calibration Gain (Voltage) | 0.0001 | 8000 to 12,000 | Analog output gain adjustment in 100ths of a percent. |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup-mode commands.

## Table A–5:Registers for Alarm Position Counters

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 10000 to 10009 | P1 Alarm Queue<br>Queue of last ten active priority 1 alarms | — | — | 1 to 185 |
| 10010 | P1 Acknowledge Status<br>Acknowledge status for each of the P1 alarms in the queue | — | Bitmap | 0x0000 to 0x03FF |
| 10011 to 10022 | Active Alarm Map<br>Each bit corresponds to an Alarm Type:<br>Bit00 = Alarm #01<br>Bit01 = Alarm #02 ... etc. | — | Bitmap | 0x0000 to 0xFFFF |
| 10023 | Active Alarm Status<br>Active Alarms:<br>Bit00 = 1 if any priority 1-3 alarm is active<br>Bit01 = 1 if a "High" (1) priority alarm is active<br>Bit02 = 1 if a "Medium" (2) priority alarm is active<br>Bit03 = 1 if a "Low" (3) priority alarm is active<br><br>Remaining bits not used. | — | Bitmap | 0x0000 to 0x000F |
| 10024 | Latched Active Alarm Status<br>Latched Active Alarms: (from the last time the register was cleared)<br>Bit00 = 1 if any priority 1-3 alarm is active<br>Bit01 = 1 if a "High" (1) priority alarm is active<br>Bit02 = 1 if a "Medium" (2) priority alarm is active<br>Bit03 = 1 if a "Low" (3) priority alarm is active<br><br>Remaining bits not used. | — | Bitmap | 0x0000 to 0x000F |
| 10025 | Total Counter<br>Total alarm counter, including all priorities 1, 2 and 3 | — | 1.0 | 0 to 32,767 |
| 10026 | P3 Counter<br>Low alarm counter, all priority 3s | — | 1.0 | 0 to 32,767 |
| 10027 | P2 Counter<br>Medium alarm counter, all priority 2s | — | 1.0 | 0 to 32,767 |
| 10028 | P1 Counter<br>High alarm counter, all priority 1s | — | 1.0 | 0 to 32,767 |
| 10029 to 10040 ① | Pickup Mode Selection<br>Selection of absolute or relative pickup test for each of the Alarm Types (if applicable, based on type)<br>0 = Absolute (default), 1 = Relative<br>Bit00 = Alarm #01<br>Bit01 = Alarm #02 ... etc. | — | Bitmap | 0x0 to 0xFFFF |
| 10115 | Alarm Type #001 Counter | — | 1.0 | 0 to 32,767 |
| 10116 | Alarm Type #002 Counter | — | 1.0 | 0 to 32,767 |
| 10117 | Alarm Type #003 Counter | — | 1.0 | 0 to 32,767 |
| 10118 | Alarm Type #004 Counter | — | 1.0 | 0 to 32,767 |
| 10119 | Alarm Type #005 Counter | — | 1.0 | 0 to 32,767 |
| 10120 | Alarm Type #006 Counter | — | 1.0 | 0 to 32,767 |
| 10121 | Alarm Type #007 Counter | — | 1.0 | 0 to 32,767 |
| 10122 | Alarm Type #008 Counter | — | 1.0 | 0 to 32,767 |
| 10123 | Alarm Type #009 Counter | — | 1.0 | 0 to 32,767 |
| 10124 | Alarm Type #010 Counter | — | 1.0 | 0 to 32,767 |
| 10125 | Alarm Type #011 Counter | — | 1.0 | 0 to 32,767 |
| 10126 | Alarm Type #012 Counter | — | 1.0 | 0 to 32,767 |
| 10127 | Alarm Type #013Counter | — | 1.0 | 0 to 32,767 |
| 10128 | Alarm Type #014 Counter | — | 1.0 | 0 to 32,767 |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup to mode commands.

### Table A–5:Registers for Alarm Position Counters

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 10129 | Alarm Type #015 Counter | — | 1.0 | 0 to 32,767 |
| 10130 | Alarm Type #016 Counter | — | 1.0 | 0 to 32,767 |
| 10131 | Alarm Type #017 Counter | — | 1.0 | 0 to 32,767 |
| 10132 | Alarm Type #018 Counter | — | 1.0 | 0 to 32,767 |
| 10133 | Alarm Type #019 Counter | — | 1.0 | 0 to 32,767 |
| 10134 | Alarm Type #020 Counter | — | 1.0 | 0 to 32,767 |
| 10135 | Alarm Type #021 Counter | — | 1.0 | 0 to 32,767 |
| 10136 | Alarm Type #022 Counter | — | 1.0 | 0 to 32,767 |
| 10137 | Alarm Type #023 Counter | — | 1.0 | 0 to 32,767 |
| 10138 | Alarm Type #024 Counter | — | 1.0 | 0 to 32,767 |
| 10139 | Alarm Type #025 Counter | — | 1.0 | 0 to 32,767 |
| 10140 | Alarm Type #026 Counter | — | 1.0 | 0 to 32,767 |
| 10141 | Alarm Type #027 Counter | — | 1.0 | 0 to 32,767 |
| 10142 | Alarm Type #028 Counter | — | 1.0 | 0 to 32,767 |
| 10143 | Alarm Type #029 Counter | — | 1.0 | 0 to 32,767 |
| 10144 | Alarm Type #030 Counter | — | 1.0 | 0 to 32,767 |
| 10145 | Alarm Type #031 Counter | — | 1.0 | 0 to 32,767 |
| 10146 | Alarm Type #032 Counter | — | 1.0 | 0 to 32,767 |
| 10147 | Alarm Type #033 Counter | — | 1.0 | 0 to 32,767 |
| 10148 | Alarm Type #034 Counter | — | 1.0 | 0 to 32,767 |
| 10149 | Alarm Type #035 Counter | — | 1.0 | 0 to 32,767 |
| 10150 | Alarm Type #036 Counter | — | 1.0 | 0 to 32,767 |
| 10151 | Alarm Type #037 Counter | — | 1.0 | 0 to 32,767 |
| 10152 | Alarm Type #038 Counter | — | 1.0 | 0 to 32,767 |
| 10153 | Alarm Type #039 Counter | — | 1.0 | 0 to 32,767 |
| 10154 | Alarm Type #040 Counter | — | 1.0 | 0 to 32,767 |
| 10155 | Alarm Type #041 Counter | — | 1.0 | 0 to 32,767 |
| 10156 | Alarm Type #042 Counter | — | 1.0 | 0 to 32,767 |
| 10157 | Alarm Type #043Counter | — | 1.0 | 0 to 32,767 |
| 10158 | Alarm Type #044 Counter | — | 1.0 | 0 to 32,767 |
| 10159 | Alarm Type #045 Counter | — | 1.0 | 0 to 32,767 |
| 10160 | Alarm Type #046 Counter | — | 1.0 | 0 to 32,767 |
| 10161 | Alarm Type #047 Counter | — | 1.0 | 0 to 32,767 |
| 10162 | Alarm Type #048 Counter | — | 1.0 | 0 to 32,767 |
| 10163 | Alarm Type #049 Counter | — | 1.0 | 0 to 32,767 |
| 10164 | Alarm Type #050 Counter | — | 1.0 | 0 to 32,767 |
| 10165 | Alarm Type #051 Counter | — | 1.0 | 0 to 32,767 |
| 10166 | Alarm Type #052 Counter | — | 1.0 | 0 to 32,767 |
| 10167 | Alarm Type #053Counter | — | 1.0 | 0 to 32,767 |
| 10168 | Alarm Type #054 Counter | — | 1.0 | 0 to 32,767 |
| 10169 | Alarm Type #055 Counter | — | 1.0 | 0 to 32,767 |
| 10170 | Alarm Type #056 Counter | — | 1.0 | 0 to 32,767 |
| 10171 | Alarm Type #057 Counter | — | 1.0 | 0 to 32,767 |
| 10172 | Alarm Type #058 Counter | — | 1.0 | 0 to 32,767 |
| 10173 | Alarm Type #059 Counter | — | 1.0 | 0 to 32,767 |
| 10174 | Alarm Type #060 Counter | — | 1.0 | 0 to 32,767 |
| 10175 | Alarm Type #061 Counter | — | 1.0 | 0 to 32,767 |
| 10176 | Alarm Type #062 Counter | — | 1.0 | 0 to 32,767 |
| 10177 | Alarm Type #063Counter | — | 1.0 | 0 to 32,767 |
| 10178 | Alarm Type #064Counter | — | 1.0 | 0 to 32,767 |
| 10179 | Alarm Type #065 Counter | — | 1.0 | 0 to 32,767 |
| 10180 | Alarm Type #066 Counter | — | 1.0 | 0 to 32,767 |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup to mode commands.

### Table A–5:Registers for Alarm Position Counters

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 10181 | Alarm Type #067 Counter | — | 1.0 | 0 to 32,767 |
| 10182 | Alarm Type #068 Counter | — | 1.0 | 0 to 32,767 |
| 10183 | Alarm Type #069 Counter | — | 1.0 | 0 to 32,767 |
| 10184 | Alarm Type #070 Counter | — | 1.0 | 0 to 32,767 |
| 10185 | Alarm Type #071 Counter | — | 1.0 | 0 to 32,767 |
| 10186 | Alarm Type #072 Counter | — | 1.0 | 0 to 32,767 |
| 10187 | Alarm Type #073Counter | — | 1.0 | 0 to 32,767 |
| 10188 | Alarm Type #074 Counter | — | 1.0 | 0 to 32,767 |
| 10189 | Alarm Type #075 Counter | — | 1.0 | 0 to 32,767 |
| 10190 | Alarm Type #076 Counter | — | 1.0 | 0 to 32,767 |
| 10191 | Alarm Type #077 Counter | — | 1.0 | 0 to 32,767 |
| 10192 | Alarm Type #078 Counter | — | 1.0 | 0 to 32,767 |
| 10193 | Alarm Type #079 Counter | — | 1.0 | 0 to 32,767 |
| 10194 | Alarm Type #080 Counter | — | 1.0 | 0 to 32,767 |
| 10195 | Alarm Type #081 Counter | — | 1.0 | 0 to 32,767 |
| 10196 | Alarm Type #082 Counter | — | 1.0 | 0 to 32,767 |
| 10197 | Alarm Type #083Counter | — | 1.0 | 0 to 32,767 |
| 10198 | Alarm Type #084 Counter | — | 1.0 | 0 to 32,767 |
| 10199 | Alarm Type #085 Counter | — | 1.0 | 0 to 32,767 |
| 10200 | Alarm Type #086 Counter | — | 1.0 | 0 to 32,767 |
| 10201 | Alarm Type #087 Counter | — | 1.0 | 0 to 32,767 |
| 10202 | Alarm Type #088 Counter | — | 1.0 | 0 to 32,767 |
| 10203 | Alarm Type #089 Counter | — | 1.0 | 0 to 32,767 |
| 10204 | Alarm Type #090 Counter | — | 1.0 | 0 to 32,767 |
| 10205 | Alarm Type #091 Counter | — | 1.0 | 0 to 32,767 |
| 10206 | Alarm Type #092 Counter | — | 1.0 | 0 to 32,767 |
| 10207 | Alarm Type #093Counter | — | 1.0 | 0 to 32,767 |
| 10208 | Alarm Type #094 Counter | — | 1.0 | 0 to 32,767 |
| 10209 | Alarm Type #095 Counter | — | 1.0 | 0 to 32,767 |
| 10210 | Alarm Type #096 Counter | — | 1.0 | 0 to 32,767 |
| 10211 | Alarm Type #097 Counter | — | 1.0 | 0 to 32,767 |
| 10212 | Alarm Type #098 Counter | — | 1.0 | 0 to 32,767 |
| 10213 | Alarm Type #099 Counter | — | 1.0 | 0 to 32,767 |
| 10214 | Alarm Type #100 Counter | — | 1.0 | 0 to 32,767 |
| 10215 | Alarm Type #101 Counter | — | 1.0 | 0 to 32,767 |
| 10216 | Alarm Type #102 Counter | — | 1.0 | 0 to 32,767 |
| 10217 | Alarm Type #103 Counter | — | 1.0 | 0 to 32,767 |
| 10218 | Alarm Type #104 Counter | — | 1.0 | 0 to 32,767 |
| 10219 | Alarm Type #105 Counter | — | 1.0 | 0 to 32,767 |
| 10220 | Alarm Type #106 Counter | — | 1.0 | 0 to 32,767 |
| 10221 | Alarm Type #107 Counter | — | 1.0 | 0 to 32,767 |
| 10222 | Alarm Type #108 Counter | — | 1.0 | 0 to 32,767 |
| 10223 | Alarm Type #109 Counter | — | 1.0 | 0 to 32,767 |
| 10224 | Alarm Type #110 Counter | — | 1.0 | 0 to 32,767 |
| 10225 | Alarm Type #111 Counter | — | 1.0 | 0 to 32,767 |
| 10226 | Alarm Type #112 Counter | — | 1.0 | 0 to 32,767 |
| 10227 | Alarm Type #113 Counter | — | 1.0 | 0 to 32,767 |
| 10228 | Alarm Type #114 Counter | — | 1.0 | 0 to 32,767 |
| 10229 | Alarm Type #115 Counter | — | 1.0 | 0 to 32,767 |
| 10230 | Alarm Type #116 Counter | — | 1.0 | 0 to 32,767 |
| 10231 | Alarm Type #117 Counter | — | 1.0 | 0 to 32,767 |
| 10232 | Alarm Type #118 Counter | — | 1.0 | 0 to 32,767 |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup to mode commands.

### Table A–5:Registers for Alarm Position Counters

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 10233 | Alarm Type #119 Counter | — | 1.0 | 0 to 32,767 |
| 10234 | Alarm Type #120 Counter | — | 1.0 | 0 to 32,767 |
| 10235 | Alarm Type #121 Counter | — | 1.0 | 0 to 32,767 |
| 10236 | Alarm Type #122 Counter | — | 1.0 | 0 to 32,767 |
| 10237 | Alarm Type #123 Counter | — | 1.0 | 0 to 32,767 |
| 10238 | Alarm Type #124 Counter | — | 1.0 | 0 to 32,767 |
| 10239 | Alarm Type #125 Counter | — | 1.0 | 0 to 32,767 |
| 10240 | Alarm Type #126 Counter | — | 1.0 | 0 to 32,767 |
| 10241 | Alarm Type #127 Counter | — | 1.0 | 0 to 32,767 |
| 10242 | Alarm Type #128 Counter | — | 1.0 | 0 to 32,767 |
| 10243 | Alarm Type #129 Counter | — | 1.0 | 0 to 32,767 |
| 10244 | Alarm Type #130 Counter | — | 1.0 | 0 to 32,767 |
| 10245 | Alarm Type #131 Counter | — | 1.0 | 0 to 32,767 |
| 10246 | Alarm Type #132 Counter | — | 1.0 | 0 to 32,767 |
| 10247 | Alarm Type #133 Counter | — | 1.0 | 0 to 32,767 |
| 10248 | Alarm Type #134 Counter | — | 1.0 | 0 to 32,767 |
| 10249 | Alarm Type #135 Counter | — | 1.0 | 0 to 32,767 |
| 10250 | Alarm Type #136 Counter | — | 1.0 | 0 to 32,767 |
| 10251 | Alarm Type #137 Counter | — | 1.0 | 0 to 32,767 |
| 10252 | Alarm Type #138 Counter | — | 1.0 | 0 to 32,767 |
| 10253 | Alarm Type #139 Counter | — | 1.0 | 0 to 32,767 |
| 10254 | Alarm Type #140 Counter | — | 1.0 | 0 to 32,767 |
| 10255 | Alarm Type #141 Counter | — | 1.0 | 0 to 32,767 |
| 10256 | Alarm Type #142 Counter | — | 1.0 | 0 to 32,767 |
| 10257 | Alarm Type #143 Counter | — | 1.0 | 0 to 32,767 |
| 10258 | Alarm Type #144 Counter | — | 1.0 | 0 to 32,767 |
| 10259 | Alarm Type #145 Counter | — | 1.0 | 0 to 32,767 |
| 10260 | Alarm Type #146 Counter | — | 1.0 | 0 to 32,767 |
| 10261 | Alarm Type #147 Counter | — | 1.0 | 0 to 32,767 |
| 10262 | Alarm Type #148 Counter | — | 1.0 | 0 to 32,767 |
| 10263 | Alarm Type #149 Counter | — | 1.0 | 0 to 32,767 |
| 10264 | Alarm Type #150 Counter | — | 1.0 | 0 to 32,767 |
| 10265 | Alarm Type #151 Counter | — | 1.0 | 0 to 32,767 |
| 10266 | Alarm Type #152 Counter | — | 1.0 | 0 to 32,767 |
| 10267 | Alarm Type #153 Counter | — | 1.0 | 0 to 32,767 |
| 10268 | Alarm Type #154 Counter | — | 1.0 | 0 to 32,767 |
| 10269 | Alarm Type #155 Counter | — | 1.0 | 0 to 32,767 |
| 10270 | Alarm Type #156 Counter | — | 1.0 | 0 to 32,767 |
| 10271 | Alarm Type #157 Counter | — | 1.0 | 0 to 32,767 |
| 10272 | Alarm Type #158 Counter | — | 1.0 | 0 to 32,767 |
| 10273 | Alarm Type #159 Counter | — | 1.0 | 0 to 32,767 |
| 10274 | Alarm Type #160 Counter | — | 1.0 | 0 to 32,767 |
| 10275 | Alarm Type #161 Counter | — | 1.0 | 0 to 32,767 |
| 10276 | Alarm Type #162 Counter | — | 1.0 | 0 to 32,767 |
| 10277 | Alarm Type #163 Counter | — | 1.0 | 0 to 32,767 |
| 10278 | Alarm Type #164 Counter | — | 1.0 | 0 to 32,767 |
| 10279 | Alarm Type #165 Counter | — | 1.0 | 0 to 32,767 |
| 10280 | Alarm Type #166 Counter | — | 1.0 | 0 to 32,767 |
| 10281 | Alarm Type #167 Counter | — | 1.0 | 0 to 32,767 |
| 10282 | Alarm Type #168 Counter | — | 1.0 | 0 to 32,767 |
| 10283 | Alarm Type #169 Counter | — | 1.0 | 0 to 32,767 |
| 10284 | Alarm Type #170 Counter | — | 1.0 | 0 to 32,767 |

① These configuration registers require that you enter the setup mode to change the register’s contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See “Using the Command Interface to Change Configuration Registers” on page 187 for instructions on how to use the setup to mode commands.

### Table A–5:Registers for Alarm Position Counters

| Register Number | Description | Scale Factor | Units | Register Range |
|---|---|---|---|---|
| 10285 | Alarm Type #171 Counter | — | 1.0 | 0 to 32,767 |
| 10286 | Alarm Type #172 Counter | — | 1.0 | 0 to 32,767 |
| 10287 | Alarm Type #173 Counter | — | 1.0 | 0 to 32,767 |
| 10288 | Alarm Type #174 Counter | — | 1.0 | 0 to 32,767 |
| 10289 | Alarm Type #175 Counter | — | 1.0 | 0 to 32,767 |

① These configuration registers require that you enter the setup mode to change the register's contents. Issue command 9020 to enter setup mode and 9021 to exit setup mode. See "Using the Command Interface to Change Configuration Registers" on page 187 for instructions on how to use the setup to mode commands.

## Table A–6:Spectral Components

| Register Number | Description | Units | Range |
|---|---|---|---|
| 28672 | Harmonic Magnitudes and Angles, Voltage A-B | See Template | See Template |
| 28800 | Harmonic Magnitudes and Angles, Voltage B-C | See Template | See Template |
| 28928 | Harmonic Magnitudes and Angles, Voltage C-A | See Template | See Template |
| 29056 | Harmonic Magnitudes and Angles, Voltage A-N | See Template | See Template |
| 29184 | Harmonic Magnitudes and Angles, Voltage B-N | See Template | See Template |
| 29312 | Harmonic Magnitudes and Angles, Voltage C-N | See Template | See Template |
| 29440 | Harmonic Magnitudes and Angles, Voltage N-G | See Template | See Template |
| 29568 | Harmonic Magnitudes and Angles, Current, Phase A | See Template | See Template |
| 29696 | Harmonic Magnitudes and Angles, Current, Phase B | See Template | See Template |
| 29824 | Harmonic Magnitudes and Angles, Current, Phase C | See Template | See Template |
| 29952 | Harmonic Magnitudes and Angles, Current, Neutral | See Template | See Template |
| 30080 | Harmonic Magnitudes and Angles, Current, Ground | See Template | See Template |
| 30720–30847 | Harmonic Sample Data, Voltage A-B | Counts | +/- 32, 767 |
| 30848–30975 | Harmonic Sample Data, Voltage B-C | Counts | +/- 32, 767 |
| 30976–31103 | Harmonic Sample Data, Voltage C-A | Counts | +/- 32, 767 |
| 31104–31231 | Harmonic Sample Data, Voltage A-N | Counts | +/- 32, 767 |
| 31232–31359 | Harmonic Sample Data, Voltage B-N | Counts | +/- 32, 767 |
| 31360–31487 | Harmonic Sample Data, Voltage C-N | Counts | +/- 32, 767 |
| 31488–31615 | Harmonic Sample Data, Voltage N-G | Counts | +/- 32, 767 |
| 31616–31743 | Harmonic Sample Data, Current Phase A | Counts | +/- 32, 767 |
| 31744–31871 | Harmonic Sample Data, Current Phase B | Counts | +/- 32, 767 |
| 31872–31999 | Harmonic Sample Data, Current Phase C | Counts | +/- 32, 767 |
| 32000–32127 | Harmonic Sample Data, Current Neutral | Counts | +/- 32, 767 |
| 32128–32255 | Harmonic Sample Data, Current Ground | Counts | +/- 32, 767 |
| **Template** | | | |
| Base | Reference Magnitude | Volts/Scale Amps/Scale | 0 to 32,767 |
| Base + 1 | Scale Factor | 1.0 | -3 to 3 |
| Base + 2 | H1 Magnitude | 0.01% | 0 to 32,767 |
| Base + 3 | H1 Angle | 0.1 ° | 0 to 3,599 |
| Base + 4 | H2 Magnitude | 0.01% | 0 to 32,767 |
| Base + 5 | H2 Angle | 0.1 ° | 0 to 3,599 |
| Base + 6 | H3 Magnitude | 0.01% | 0 to 32,767 |
| Base + 7 | H3 Angle | 0.1 ° | 0 to 3,599 |
| Base + 8 | H4 Magnitude | 0.01% | 0 to 32,767 |
| Base + 9 | H4 Angle | 0.1 ° | 0 to 3,599 |
| Base + 10 | H5 Magnitude | 0.01% | 0 to 32,767 |
| Base + 11 | H5 Angle | 0.1 ° | 0 to 3,599 |
| Base + 12 | H6 Magnitude | 0.01% | 0 to 32,767 |
| Base + 13 | H6 Angle | 0.1 ° | 0 to 3,599 |
| Base + 14 | H7 Magnitude | 0.01% | 0 to 32,767 |
| Base + 15 | H7 Angle | 0.1 ° | 0 to 3,599 |
| Base + 16 | H8 Magnitude | 0.01% | 0 to 32,767 |
| Base + 17 | H8 Angle | 0.1 ° | 0 to 3,599 |
| Base + 18 | H9 Magnitude | 0.01% | 0 to 32,767 |
| Base + 19 | H9 Angle | 0.1 ° | 0 to 3,599 |
| Base + 20 | H10 Magnitude | 0.01% | 0 to 32,767 |
| Base + 21 | H10 Angle | 0.1 ° | 0 to 3,599 |
| Base + 22 | H11 Magnitude | 0.01% | 0 to 32,767 |
| Base + 23 | H11 Angle | 0.1 ° | 0 to 3,599 |
| Base + 24 | H12 Magnitude | 0.01% | 0 to 32,767 |
| Base + 25 | H12 Angle | 0.1 ° | 0 to 3,599 |
| Base + 26 | H13 Magnitude | 0.01% | 0 to 32,767 |
| Base + 27 | H13 Angle | 0.1 ° | 0 to 3,599 |
| Base + 28 | H14 Magnitude | 0.01% | 0 to 32,767 |

## Table A–6:Spectral Components

| Register Number | Description | Units | Range |
|---|---|---|---|
| Base + 29 | H14 Angle | 0.1 ° | 0 to 3,599 |
| Base + 30 | H15 Magnitude | 0.01% | 0 to 32,767 |
| Base + 31 | H15 Angle | 0.1 ° | 0 to 3,599 |
| Base + 32 | H16 Magnitude | 0.01% | 0 to 32,767 |
| Base + 33 | H16 Angle | 0.1 ° | 0 to 3,599 |
| Base + 34 | H17 Magnitude | 0.01% | 0 to 32,767 |
| Base + 35 | H17 Angle | 0.1 ° | 0 to 3,599 |
| Base + 36 | H18 Magnitude | 0.01% | 0 to 32,767 |
| Base + 37 | H18 Angle | 0.1 ° | 0 to 3,599 |
| Base + 38 | H19 Magnitude | 0.01% | 0 to 32,767 |
| Base + 39 | H19 Angle | 0.1 ° | 0 to 3,599 |
| Base + 40 | H20 Magnitude | 0.01% | 0 to 32,767 |
| Base + 41 | H20 Angle | 0.1 ° | 0 to 3,599 |
| Base + 42 | H21 Magnitude | 0.01% | 0 to 32,767 |
| Base + 43 | H21 Angle | 0.1 ° | 0 to 3,599 |
| Base + 44 | H22 Magnitude | 0.01% | 0 to 32,767 |
| Base + 45 | H22 Angle | 0.1 ° | 0 to 3,599 |
| Base + 46 | H23 Magnitude | 0.01% | 0 to 32,767 |
| Base + 47 | H23 Angle | 0.1 ° | 0 to 3,599 |
| Base + 48 | H24 Magnitude | 0.01% | 0 to 32,767 |
| Base + 49 | H24 Angle | 0.1 ° | 0 to 3,599 |
| Base + 50 | H25 Magnitude | 0.01% | 0 to 32,767 |
| Base + 51 | H25 Angle | 0.1 ° | 0 to 3,599 |
| Base + 52 | H26 Magnitude | 0.01% | 0 to 32,767 |
| Base + 53 | H26 Angle | 0.1 ° | 0 to 3,599 |
| Base + 54 | H27 Magnitude | 0.01% | 0 to 32,767 |
| Base + 55 | H27 Angle | 0.1 ° | 0 to 3,599 |
| Base + 56 | H28 Magnitude | 0.01% | 0 to 32,767 |
| Base + 57 | H28 Angle | 0.1 ° | 0 to 3,599 |
| Base + 58 | H29 Magnitude | 0.01% | 0 to 32,767 |
| Base + 59 | H29 Angle | 0.1 ° | 0 to 3,599 |
| Base + 60 | H30 Magnitude | 0.01% | 0 to 32,767 |
| Base + 61 | H30 Angle | 0.1 ° | 0 to 3,599 |
| Base + 62 | H31 Magnitude | 0.01% | 0 to 32,767 |
| Base + 63 | H31 Angle | 0.1 ° | 0 to 3,599 |
| Base + 64 | H32 Magnitude | 0.01% | 0 to 32,767 |
| Base + 65 | H32 Angle | 0.1 ° | 0 to 3,599 |
| Base + 66 | H33 Magnitude | 0.01% | 0 to 32,767 |
| Base + 67 | H33 Angle | 0.1 ° | 0 to 3,599 |
| Base + 68 | H34 Magnitude | 0.01% | 0 to 32,767 |
| Base + 69 | H34 Angle | 0.1 ° | 0 to 3,599 |
| Base + 70 | H35 Magnitude | 0.01% | 0 to 32,767 |
| Base + 71 | H35 Angle | 0.1 ° | 0 to 3,599 |
| Base + 72 | H36 Magnitude | 0.01% | 0 to 32,767 |
| Base + 73 | H36 Angle | 0.1 ° | 0 to 3,599 |
| Base + 74 | H37 Magnitude | 0.01% | 0 to 32,767 |
| Base + 75 | H37 Angle | 0.1 ° | 0 to 3,599 |
| Base + 76 | H38 Magnitude | 0.01% | 0 to 32,767 |
| Base + 77 | H38 Angle | 0.1 ° | 0 to 3,599 |
| Base + 78 | H39 Magnitude | 0.01% | 0 to 32,767 |
| Base + 79 | H39 Angle | 0.1 ° | 0 to 3,599 |
| Base + 80 | H40 Magnitude | 0.01% | 0 to 32,767 |
| Base + 81 | H40 Angle | 0.1 ° | 0 to 3,599 |
| Base + 82 | H41 Magnitude | 0.01% | 0 to 32,767 |
| Base + 83 | H41 Angle | 0.1 ° | 0 to 3,599 |

### Table A–6:Spectral Components

| Register Number | Description | Units | Range |
|---|---|---|---|
| Base + 84 | H42 Magnitude | 0.01% | 0 to 32,767 |
| Base + 85 | H42 Angle | 0.1 ° | 0 to 3,599 |
| Base + 86 | H43 Magnitude | 0.01% | 0 to 32,767 |
| Base + 87 | H43 Angle | 0.1 ° | 0 to 3,599 |
| Base + 88 | H44 Magnitude | 0.01% | 0 to 32,767 |
| Base + 89 | H44 Angle | 0.1 ° | 0 to 3,599 |
| Base + 90 | H45 Magnitude | 0.01% | 0 to 32,767 |
| Base + 91 | H45 Angle | 0.1 ° | 0 to 3,599 |
| Base + 92 | H46 Magnitude | 0.01% | 0 to 32,767 |
| Base + 93 | H46 Angle | 0.1 ° | 0 to 3,599 |
| Base + 94 | H47 Magnitude | 0.01% | 0 to 32,767 |
| Base + 95 | H47 Angle | 0.1 ° | 0 to 3,599 |
| Base + 96 | H48 Magnitude | 0.01% | 0 to 32,767 |
| Base + 97 | H48 Angle | 0.1 ° | 0 to 3,599 |
| Base + 98 | H49 Magnitude | 0.01% | 0 to 32,767 |
| Base + 99 | H49 Angle | 0.1 ° | 0 to 3,599 |
| Base + 100 | H50 Magnitude | 0.01% | 0 to 32,767 |
| Base + 101 | H50 Angle | 0.1 ° | 0 to 3,599 |
| Base + 102 | H51 Magnitude | 0.01% | 0 to 32,767 |
| Base + 103 | H51 Angle | 0.1 ° | 0 to 3,599 |
| Base + 104 | H52 Magnitude | 0.01% | 0 to 32,767 |
| Base + 105 | H52 Angle | 0.1 ° | 0 to 3,599 |
| Base + 106 | H53 Magnitude | 0.01% | 0 to 32,767 |
| Base + 107 | H53 Angle | 0.1 ° | 0 to 3,599 |
| Base + 108 | H54 Magnitude | 0.01% | 0 to 32,767 |
| Base + 109 | H54 Angle | 0.1 ° | 0 to 3,599 |
| Base + 110 | H55 Magnitude | 0.01% | 0 to 32,767 |
| Base + 111 | H55 Angle | 0.1 ° | 0 to 3,599 |
| Base + 112 | H56 Magnitude | 0.01% | 0 to 32,767 |
| Base + 113 | H56 Angle | 0.1 ° | 0 to 3,599 |
| Base + 114 | H57 Magnitude | 0.01% | 0 to 32,767 |
| Base + 115 | H57 Angle | 0.1 ° | 0 to 3,599 |
| Base + 116 | H58 Magnitude | 0.01% | 0 to 32,767 |
| Base + 117 | H58 Angle | 0.1 ° | 0 to 3,599 |
| Base + 118 | H59 Magnitude | 0.01% | 0 to 32,767 |
| Base + 119 | H59 Angle | 0.1 ° | 0 to 3,599 |
| Base + 120 | H60 Magnitude | 0.01% | 0 to 32,767 |
| Base + 121 | H60 Angle | 0.1 ° | 0 to 3,599 |
| Base + 122 | H61 Magnitude | 0.01% | 0 to 32,767 |
| Base + 123 | H61 Angle | 0.1 ° | 0 to 3,599 |
| Base + 124 | H62 Magnitude | 0.01% | 0 to 32,767 |
| Base + 125 | H62 Angle | 0.1 ° | 0 to 3,599 |
| Base + 126 | H63 Magnitude | 0.01% | 0 to 32,767 |
| Base + 127 | H63 Angle | 0.1 ° | 0 to 3,599 |

# APPENDIX B—USING THE COMMAND INTERFACE

This appendix describes how to use the command interface to perform various operations.

## CONTENTS

## OVERVIEW OF THE COMMAND INTERFACE

The circuit monitor provides a command interface, which you can use to issue commands that perform various operations such as controlling relays. Table B– 2 on page 183 lists the available commands. The command interface is located in memory at registers 8000–8149. Table B– 1 lists the definitions for the registers.

**Table B– 1: Location of the command interface**

| Register | Description |
|---|---|
| 8000 | This is the register where you write the commands. |
| 8001–8015 | These are the registers where you write the parameters for a command. Commands can have up to 15 parameters associated with them. |
| 8017 | Status pointer to the user area. The status of the last command processed is placed in this register. |
| 8018 | Results pointer to the user area. When an error occurs, the error code is placed in this register. |
| 8019 | I/O data pointer to the user area. Use this register to point to data buffer registers where you can send additional data or return data. |
| 8020–8149 | These registers are for you (the user) to write information. Depending on which pointer places the information in the register, the register can contain status (from pointer 8017), results (from pointer 8018), or data (from pointer 8019). The registers will contain information such as whether the function is enabled or disabled, set to fill and hold, start and stop times, logging intervals, and so forth. By default, return data will start at 8020 unless you specify otherwise. |

When registers 8017–8019 are set to zero, no values are returned. When any or all of these registers contain a value, the value in the register “points” to a target register, which contains the status, error code, or I/O data (depending on the command) when the command is executed. Figure B–1 shows how these registers work.

*NOTE: You determine the register location where results will be written. Therefore, take care when assigning register values in the pointer registers; values may be corrupted when two commands use the same register.*

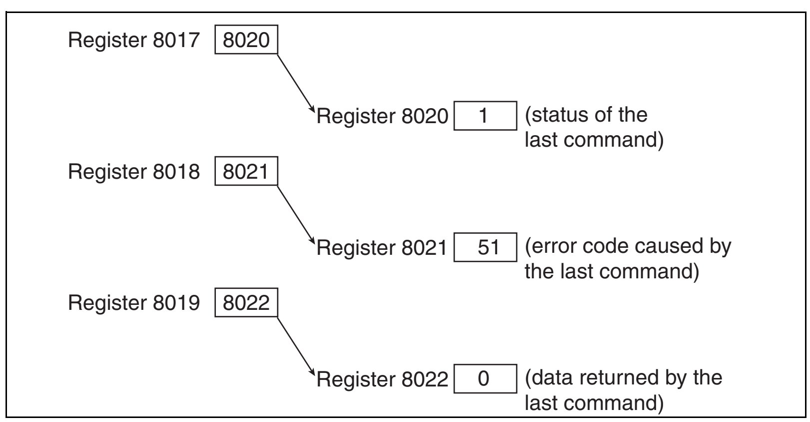



**Figure B–1: Command Interface Pointer Registers**

## Issuing Commands

To issue commands using the command interface, follow these general steps:

1. Write the related parameter(s) to the command parameter registers 8001–15.
2. Write the command code to command interface register 8000.

If no parameters are associated with the command, then you need only to write the command code to register 8000. Table B– 2 lists the command codes that can be written to the command interface into register 8000. Some commands have an associated registers where you write parameters for that command. For example, when you write the parameter 9999 to register 8001 and issue command code 3351, all relays will be energized if they are set up for external control.

**Table B– 2: Command Codes**

| Command Code | Command Parameter Register | Parameters | Description |
|---|---|---|---|
| 1110 | None | None | Causes soft reset of the unit (re-initializes the circuit monitor). |
| 1210 | None | None | Clears the communications counters. |
| 1310 | <br>8001<br>8002<br>8003<br>8004<br>8005<br>8006 | <br>Month<br>Day<br>Year<br>Hour<br>Minute<br>Second | Sets the system date and time. Values for the registers are:<br>Month (1–12)<br>Day (1–31)<br>Year (4-digit, for example 2000)<br>Hour (Military time, for example 14 = 2:00pm)<br>Minute (1–59)<br>Second (1–59) |
| 1410 | None | None | Disables the revenue security switch. |
| 1411 | None | None | Enables the revenue security switch. |
| **Relay Outputs** | | | |
| 3310 | 8001 | Relay Output Number ① | Configures relay for external control. |
| 3311 | 8001 | Relay Output Number ① | Configures relay for internal control. |
| 3320 | 8001 | Relay Output Number ① | De-energizes designated relay. |
| 3321 | 8001 | Relay Output Number ① | Energizes designated relay. |
| 3330 | 8001 | Relay Output Number ① | Releases specified relay from latched condition. |
| 3340 | 8001 | Relay Output Number ① | Releases specified relay from override control. |
| 3341 | 8001 | Relay Output Number ① | Places specified relay under override control. |
| 3350 | 8001 | 9999 | De-energizes all relays. |
| 3351 | 8001 | 9999 | Energizes all relays. |
| 3361 | 8001 | Relay Output Number ① | Resets operation counter for specified relay. |
| 3362 | 8001 | Relay Output Number ① | Resets the turn-on time for specified relay. |
| 3363 | 8001 | None | Resets the operation counter for all relays. |
| 3364 | 8001 | None | Resets the turn-on time for all relays. |
| 3365 | 8001 | Input Number ① | Resets the operation counter for specified input. |
| 3366 | 8001 | Input Number ① | Resets turn-on time for specified input. |
| 3367 | 8001 | None | Resets the operation counter for all inputs. |

① You must write to register 8001 the number that identifies which output you would like to use. To determine the identifying number, refer to “I/O Point Numbers” on page 186 for instructions.

② Data buffer location (register 8019) is the pointer to the first register where data will be stored. By default, return data begins at register 8020, although you can use any of the registers from 8020–8149. *Take care when assigning pointers. Values may be corrupted if two commands are using the same register.*

### Table B– 2: Command Codes

| Command Code | Command Parameter Register | Parameters | Description |
|---|---|---|---|
| 3368 | 8001 | None | Resets turn-on time for all inputs. |
| 3369 | 8001 | None | Resets all counters and timers for all I/Os. |
| 3370 | 8001 | Analog Output Number ① | Disables specified analog output. |
| 3371 | 8001 | Analog Output Number ① | Enables specified analog output. |
| 3380 | 8001 | 9999 | Disables all analog outputs. |
| 3381 | 8002 | 9999 | Enables all analog outputs. |
| **Resets** | | | |
| 4110 | None | None | Resets min/max. |
| 4210 | 8001 | 1 = Voltage<br>2 = Current<br>3 = Both | Resets the register-based alarm logs. |
| 5110 | None | None | Resets all demand registers. |
| 5111 | None | None | Resets current demand. |
| 5112 | None | None | Resets voltage demand. |
| 5113 | None | None | Resets power demand. |
| 5114 | None | None | Resets input demand. |
| 5115 | None | None | Resets generic 1 demand for first group of 10 quantities. |
| 5116 | None | None | Resets generic 2 demand for second group of 10 quantities. |
| 5210 | None | None | Resets all min/max demand. |
| 5211 | None | None | Resets current min/max demand. |
| 5212 | None | None | Resets voltage min/max demand. |
| 5213 | None | None | Resets power min/max demand. |
| 5214 | None | None | Resets input min/max demand. |
| 5215 | None | None | Resets generic 1 min/max demand. |
| 5216 | None | None | Resets generic 2 min/max demand. |
| 5910 | 8001 | Bitmap | Start new demand interval.<br>Bit0 = Power Demand<br>1 = Current Demand<br>2 = Voltage Demand<br>3 = Input Metering Demand<br>4 = Generic Demand Profile 1<br>5 = Generic Demand Profile 2 |

① You must write to register 8001 the number that identifies which output you would like to use. To determine the identifying number, refer to "I/O Point Numbers" on page 186 for instructions.
② Data buffer location (register 8019) is the pointer to the first register where data will be stored. By default, return data begins at register 8020, although you can use any of the registers from 8020–8149. *Take care when assigning pointers. Values may be corrupted if two commands are using the same register.*

**Table B– 2: Command Codes**

| Command Code | Command Parameter Register | Parameters | Description |
|---|---|---|---|
| 6209 | 8019 | I/O Data Pointer ② | Preset Accumulated Energies<br>Requires the IO Data Pointer to point to registers where energy preset values are entered. All Accumulated energy values must be entered in the order in which they occur in registers 1700 to 1727. |
| 6210 | None | None | Clears all energies. |
| 6211 | None | None | Clears all accumulated energy values. |
| 6212 | None | None | Clears conditional energy values. |
| 6213 | None | None | Clears incremental energy values. |
| 6214 | None | None | Clears input metering accumulation. |
| 6220 | None | None | Clears all conditional energy values. |
| 6320 | None | None | Disables conditional energy accumulation. |
| 6321 | None | None | Enables conditional energy accumulation. |
| 6910 | None | None | Starts a new incremental energy interval. |
| **Files** | | | |
| 7510 | 8001 | Files 1–16 to trigger | Triggers data log entry. Bitmap where Bit 0 = Data Log 1, Bit 1 = Data Log 2, Bit 2 = Data Log 3, etc. |
| 7511 | 8001 | File Number | Triggers single data log entry. |
| **Setup** | | | |
| 9020 | None | None | Enter into setup mode. |
| 9021 | 8001 | 1 = Save<br>2 = Do not save | Exit setup mode and save all changes. |

① You must write to register 8001 the number that identifies which output you would like to use. To determine the identifying number, refer to “I/O Point Numbers” on page 186 for instructions.

② Data buffer location (register 8019) is the pointer to the first register where data will be stored. By default, return data begins at register 8020, although you can use any of the registers from 8020–8149. *Take care when assigning pointers. Values may be corrupted if two commands are using the same register.*

## I/O POINT NUMBERS

All inputs and outputs of the circuit monitor have a reference number and a label that correspond to the position of that particular input or output.

- The reference number is used to manually control the input or output with the command interface.
- The label is the default identifier that identifies that same input or output. The label appears on the display, in SMS, on the option card, and on the I/O extender.

Figure B–2 shows the reference number and its label equivalent.

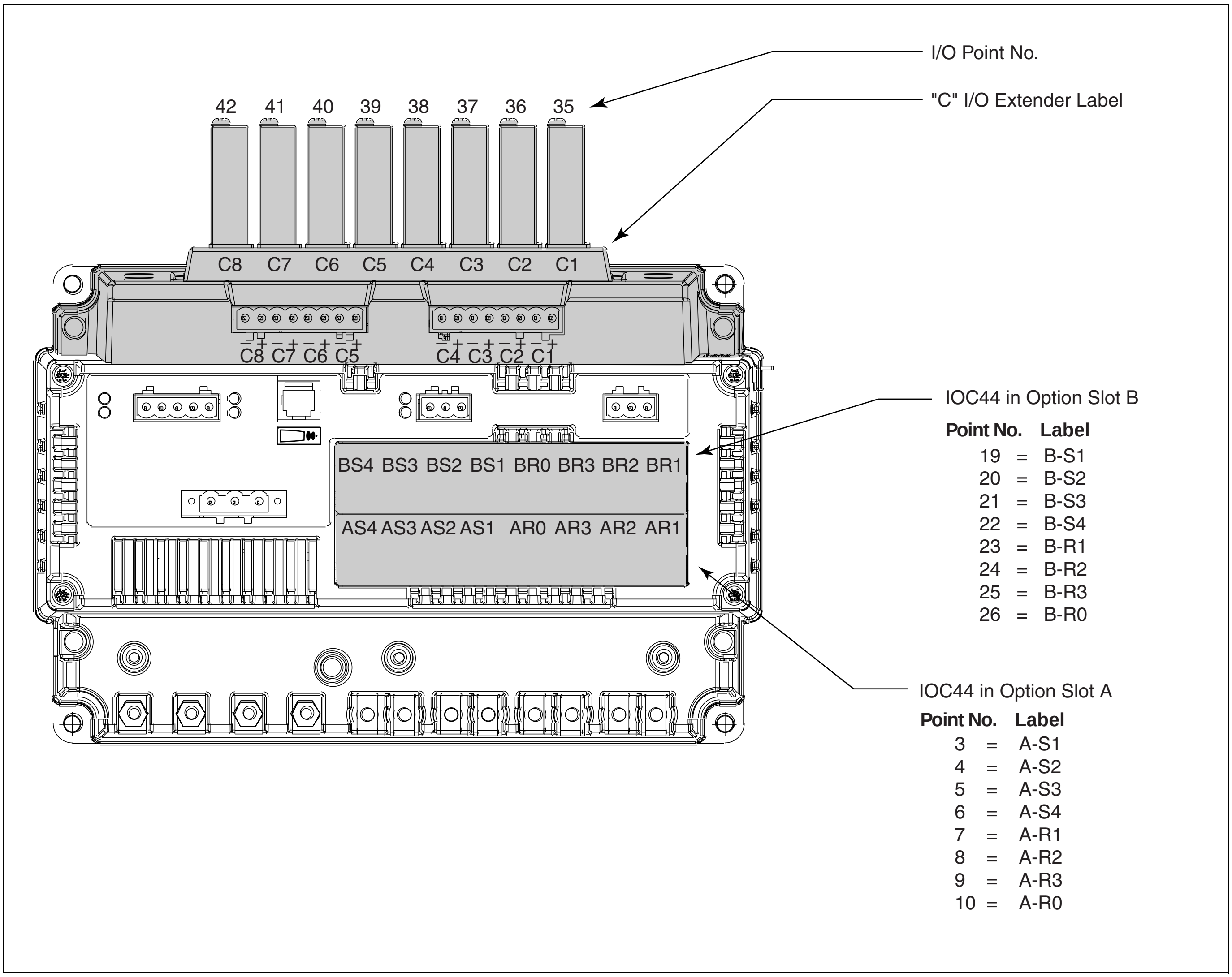



**Figure B–2: Identifying I/Os for the command interface**

## OPERATING OUTPUTS FROM THE COMMAND INTERFACE

To operate an output from the command interface, first identify the relay using the *I/O point number*. Then, set the output to external control. For example, to energize the last output on Option Card B, write the commands as follows:

1. Write number 26 to register 8001.
2. Write command code 3310 to register 8000 to set the relay to external control.
3. Write command code 3321 to register 8000.

If you look in Table B– 2 on page 183, you'll see that command code 3310 sets the relay to external control and command code 3321 is listed as the command used to energize a relay. Command codes 3310–3381 are for use with inputs and outputs.

## USING THE COMMAND INTERFACE TO CHANGE CONFIGURATION REGISTERS

You can also use the command interface to change values in selected metering-related registers, such as synchronizing the time of day of the clock or resetting generic demand.

Two commands, 9020 and 9021, work together as part of the command interface procedure when you use it to change circuit monitor configuration. You must first issue command 9020 to enter into setup mode, change the register, and then issue 9021 to save your changes and exit setup mode.

Only one setup session is allowed at a time. While in this mode, if the circuit monitor detects more than two minutes of inactivity, that is, if you do not write any register values or press any buttons on the display, the circuit monitor will timeout and restore the original configuration values. All changes will be lost. Also, if the circuit monitor loses power or communications while in setup mode, your changes will be lost.

The general procedure for changing configuration registers using the command interface is as follows:

1. Issue command 9020 in register 8000 to enter into the setup mode.
2. Make changes to the appropriate register by writing the new value to that register. Perform register writes to all registers that you want to change. For instructions on reading and writing registers, see “Reading and Writing Registers” on page 44 in **Chapter 3—Operation**.
3. To save the changes, write the value 1 to register 8001.

   *NOTE: Writing any other value except 1 to register 8001 lets you exit setup mode without saving your changes.*
4. Issue command 9021 in register 8000 to initiate the save and reset the circuit monitor.

For example, the procedure to change the demand interval for current is as follows:

1. Issue command code 9020.
2. Write the new demand interval to register 1801.
3. Write 1 to register 8001.
4. Issue command code 9021.

See **Appendix A—Abbreviated Register Listing** on page 127 for those registers that require you to enter setup mode to make changes to the registers.

## CONDITIONAL ENERGY

Circuit monitor registers 1728–1744 are conditional energy registers.

Conditional energy can be controlled in one of two ways:

- Over the communications link, by writing commands to the circuit monitor's command interface, or
- By a digital input—for example, conditional energy accumulates when the assigned digital input is on, but does not accumulate when the digital input is off.

The following procedures tell how to set up conditional energy for command interface control, and for digital input control. The procedures refer to register numbers and command codes. For a listing of circuit monitor registers, see **Appendix A—Abbreviated Register Listing** on page 127. For a listing of command codes, see Table B– 2 on page 183 in this chapter.

### Command Interface Control

**Set Control**—To *set control* of conditional energy to the command interface:

1. Write command code 9020 to register 8000.
2. In register 3227, set bit 6 to 1 (preserve other bits that are ON).
3. Write 1 to register 8001.
4. Write command code 9021 to register 8000.

**Start**— To *start* conditional energy accumulation, write command code 6321 to register 8000.

**Verify Setup**—To *verify proper setup*, read register 1794. The register should read 1, indicating conditional energy accumulation is ON.

**Stop**—To *stop* conditional energy accumulation, write command code 6320 to register 8000.

**Clear**—To *clear* all conditional energy registers (1728-1747), write command code 6212 to register 8000.

### Digital Input Control

**Set Control**—To configure conditional energy for digital input control:

1. Write command code 9020 to register 8000.
2. In register 3227, set bit 6 to 0 (preserve other bits that are ON).
3. Configure the digital input that will drive conditional energy accumulation. For the appropriate digital input, write 3 to the *Base +9* register. See the digital input templates in Table A–4 on page 166 in **Appendix A—Abbreviated Register Listing**.
4. Write 1 to register 8001.
5. Write command code 9021 to register 8000.

**Clear**—To clear all conditional energy registers (1728–1747), write command code 6212 to register 8000.

**Verify Setup**—To *verify proper setup*, read register 1794. The register should read 0 when the digital input is off, indicating that conditional energy accumulation is off. The register should read 1 when conditional energy accumulation is on.

## INCREMENTAL ENERGY

The circuit monitor's incremental energy feature allows you to define a start time, end time, and time interval for incremental energy accumulation. At the end of each incremental energy period, the following information is available:

- Wh IN during the last completed interval (reg. 1748–1750)
- VARh IN during the last completed interval (reg. 1751–1753)
- Wh OUT during the last completed interval (reg. 1754–1756)
- VARh OUT during the last completed interval (reg. 1757–1759)
- VAh during the last completed interval (reg. 1760–1762)
- Date/time of the last completed interval (reg. 1763–1766)
- Peak kW demand during the last completed interval (reg. 1940)
- Date/Time of Peak kW during the last interval (reg. 1941–1944)
- Peak kVAR demand during the last completed interval (reg. 1945)
- Date/Time of Peak kVAR during the last interval (reg. 1946–1949)
- Peak kVA demand during the last completed interval (reg. 1950)
- Date/Time of Peak kVA during the last interval (reg. 1951–1954)

The circuit monitor can log the incremental energy data listed above. This logged data provides all the information needed to analyze energy and power usage against present or future utility rates. The information is especially useful for comparing different time-of-use rate structures.

When using the incremental energy feature, keep the following points in mind:

- Peak demands help minimize the size of the data log in cases of sliding or rolling demand. Shorter incremental energy periods make it easier to reconstruct a load profile analysis.
- Since the incremental energy registers are synchronized to the circuit monitor clock, it is possible to log this data from multiple circuits and perform accurate totalizing.

### Using Incremental Energy

Incremental energy accumulation begins at the specified start time and ends at the specified end time. When the start time arrives, a new incremental energy period begins. The start and end time are specified in minutes from midnight. For example:

Interval: 420 minutes (7 hours)
Start time: 480 minutes (8:00 a.m.)
End time = 1440 minutes (12:00 p.m.)

The first incremental energy calculation will be from 8:00 a.m. to 3:00 p.m. (7 hours) as illustrated in Figure B–3. The next interval will be from 3:00 p.m. to 10:00 p.m., and the third interval will be from 10 p.m. to 12:00 p.m. because 12:00 p.m. is the specified end time. A new interval will begin on the next day at 8:00 a.m. Incremental energy accumulation will continue in this manner until the configuration is changed or a new interval is started by a remote master.

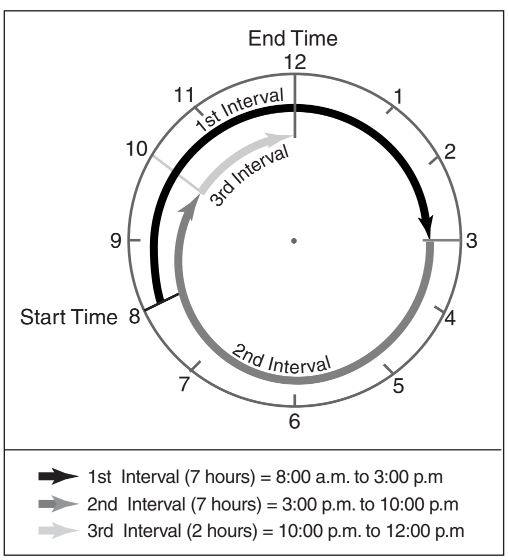



**Figure B–3: Increment Energy Example**

**Set up**—To set up incremental energy:

1. Write command code 9020 to register 8000.
2. In register 3230, write a start time (in minutes-from-midnight).
   For example, 8:00 am is 480 minutes.
3. In register 3231, write an end time (in minutes-from-midnight).
4. Write the desired interval length, from 0–1440 minutes, to register 3229.
   If incremental energy will be controlled from a remote master, such as a programmable controller, write 0 to the register.
5. Write 1 to register 8001.
6. Write command code 9021 to register 8000.

**Start**—To start a new incremental energy interval from a remote master, write command code 6910 to register 8000.

## SETTING UP INDIVIDUAL HARMONIC CALCULATIONS

The circuit monitor can perform harmonic magnitude and angle calculations for each metered value and for each residual value. The harmonic magnitude can be formatted as either a percentage of the fundamental (THD) or as a percentage of the rms values (thd). The harmonic magnitude and angles are stored in a set of registers: 28,672–30,719. During the time that the circuit monitor is refreshing harmonic data, the circuit monitor posts a value of 0 in register 3245. When the set of harmonic registers is updated with new data, the circuit monitor posts a value of 1 in register 3245. The circuit monitor can be configured to hold the values in these registers for up to 60 metering update cycles once the data processing is complete.

The circuit monitor has three operating modes for harmonic data processing: disabled, magnitude only, and magnitude and angles. Because of the extra processing time necessary to perform these calculations, the factory default operating mode is magnitudes only.

To configure the harmonic data processing, write to the registers described in Table B– 3:

**Table B– 3: Registers for Harmonic Calculations**

| Reg No. | Value | Description |
|---|---|---|
| 3240 | 0, 1, 2 | Harmonic processing;<br>0 = disabled<br>1 = magnitudes only enabled<br>2 = magnitudes and angles enabled |
| 3241 | 0, 1 | Harmonic magnitude formatting;<br>0 = % of fundamental (default)<br>1 = % of rms |
| 3242 | 10–60 seconds | Harmonics Refresh Interval<br>Default = 30 seconds |
| 3243 | 10–60 seconds | This register shows the time remaining before the next update (of harmonic data). |
| 3245 | 0,1 | This register indicates whether harmonic data processing is complete:<br>0 = processing incomplete<br>1 = processing complete |

## CHANGING SCALE FACTORS

The circuit monitor stores instantaneous metering data in 16-bit single registers. A value held in each register must be an integer between –32,767 and +32,767. Because some values for metered current, voltage, and power readings fall outside this range, the circuit monitor uses multipliers, or scale factors. This enables the circuit monitor to extend the range of metered values that it can record.

The circuit monitor stores these multipliers as scale factors. A scale factor is the multiplier expressed as a power of 10. For example, a multiplier of 10 is represented as a scale factor of 1, since $10^1$=10; a multiplier of 100 is represented as a scale factor of 2, since $10^2$=100.

You can change the default value of 1 to other values such as 10, 100, or 1,000. However, these scale factors are automatically selected when you set up the circuit monitor, either from the display or by using SMS.

If the circuit monitor displays “overflow” for any reading, change the scale factor to bring the reading back into a range that fits in the register. For example, because the register cannot store a number as large as 138,000, a 138 kV system requires a multiplier of 10. 138,000 is converted to 13,800 x 10. The circuit monitor stores this value as 13,800 with a scale factor of 1 (because $10^1$=10).

Scale factors are arranged in scale groups. The abbreviated register list in **Appendix A—Abbreviated Register Listing** on page 127 shows the scale group associated with each metered value.

You can use the command interface to change scale factors on a group of metered values. However, be aware of these important points if you choose to change scale factors:

*Notes:*

- *We **strongly recommend** that you do not change the default scale factors, which are automatically selected by POWERLOGIC hardware and software.*
- *When using custom software to read circuit monitor data over the communications link, you must account for these scale factors. To correctly read any metered value with a scale factor other than 0, multiply the register value read by the appropriate power of 10.*
- *As with any change to basic meter setup, when you change a scale factor, all min/max and peak demand values should be reset.*

# GLOSSARY

**accumulated energy**—energy can accumulates in either signed or unsigned (absolute) mode. In signed mode, the direction of power flow is considered and the accumulated energy magnitude may increase and decrease. In absolute mode, energy accumulates as a positive regardless of the power flow direction.

**address**—see *device address*. See also *Ethernet address*.

**ANSI**—American National Standards Institute.

**baud rate**—specifies how fast data is transmitted across a network port.

**block interval demand**— power demand calculation method for a block of time and includes three ways to apply calculating to that block of time using the sliding block, fixed block, or rolling block method.

**coincident readings**—two readings that are recorded at the same time.

**command interface**—used to issue commands such as reset commands and to manually operate relays contained in registers 8000–8149.

**communications link**—a chain of devices such as circuit monitors and power meters that are connected by a communications cable to a communications port.

**conditional energy**—energy accumulates only when a certain condition occurs.

**control power**—provides power to the circuit monitor.

**crest factor (CF)**—crest factor of voltage or current is the ratio of peak values to rms values.

**current unbalance**—percentage difference between each phase voltage with respect to the average of all phase currents.

**CVM**—current/voltage module that is an interchangeable part of the circuit monitor where all metering data acquisition occurs.

**default**—a value loaded into the circuit monitor at the factory that you can configure.

**demand**—average value of a quantity, such as power, over a specified interval of time.

**device address**—defines where the circuit monitor (or other devices) reside in the power monitoring system.

**displacement power factor (dPF)**—cosine of the angle between the fundamental components of current and voltage, which represents the time lag between fundamental voltage and current.

**Ethernet address**—a unique number that identifies the device in the Ethernet network and is always written as combination of eleven numbers such as 199.186.195.23.

**event**—the occurrence of an alarm condition, such as *Undervoltage Phase A*, configured in the circuit monitor.

**firmware**—operating system within the circuit monitor

**frequency**—number of cycles in one second.

**fundamental**—value of voltage or current corresponding to the portion of the signal at the power frequency (50, 60, or 400 Hz).

**generic demand profile—**up to 10 quantities on which any of the demand calculations can be performed (thermal demand, block interval demand, or synchronized demand). Two generic demand profiles can be set up in the circuit monitor.

**harmonic power**—difference between total power and fundamental power. A negative value indicates harmonic power flow out of the load. A positive value indicates harmonic power flow into the load.

**harmonics**—the circuit monitor stores in registers the magnitude and angle of individual harmonics up to the 63rd harmonic. Distorted voltages and currents can be represented by a series of sinusoidal signals whose frequencies are multipliers of some fundamental frequency, such as 60 Hz.

**holding register**—register that holds the next value to be transmitted.

**IEC**—International Electrotechnical Commission

**incremental energy**—accumulates energy during a user-defined timed interval.

**IOX**—input/output extender that is an optional part of the circuit monitor where up to eight analog or digital I/O modules can be added to expand the I/O capabilities of the circuit monitor.

**K-factor**—a numerical rating used to specify power transformers for non linear loads. It describes a transformer's ability to serve nonlinear loads without exceeding rated temperature rise limits.

**KYZ output**—pulse output from a metering device where each pulse has a weight assigned to it which represents an amount of energy or other value.

**LCD**—liquid crystal display.

**line-to-line voltages**—measurement of the rms line-to-line voltages of the circuit.

**line-to-neutral voltages**—measurement of the rms line-to-neutral voltages of the circuit.

**logging**—recording data at user-defined intervals in the circuit monitor's nonvolatile memory.

**maximum value**—highest value recorded of the instantaneous quantity such as Phase A Current, Phase A Voltage, etc., since the last reset of the minimums and maximums.

**minimum value**—lowest value recorded of the instantaneous quantity such as Phase A Current, Phase A Voltage, etc., since the last reset of the minimums and maximums.

**nominal**—typical or average.

**onboard**—refers to data stored in the circuit monitor.

**option cards**—optional, field-installable accessories for the circuit monitor that expand the I/O and Ethernet communications capabilities because they can be inserted into slots in the circuit monitor.

**overvoltage**—increase in effective voltage to greater than 110 percent for longer than one minute.

**parity**—refers to binary numbers sent over the communications link. An extra bit is added so that the number of ones in the binary number is either even or odd, depending on your configuration). Used to detect errors in the transmission of data.

**partial interval demand**—calculation of energy thus far in a present interval. Equal to energy accumulated thus far in the interval divided by the length of the complete interval.

**peak demand current**—highest demand current measured in amperes since the last reset of demand. See also *peak value*.

**peak demand real power**—highest demand real power measured since the last rest of demand.

**peak demand voltage**—highest demand voltage measured since the last reset of demand voltage. See also *peak value*.

**peak demand**—highest demand measured since the last reset of peak demand.

**peak value**—of voltage or current is the maximum or minimum crest value of a waveform.

**phase currents (rms)**—measurement in amperes of the rms current for each of the three phases of the circuit. See also *peak value*.

**phase rotation**—phase rotations refers to the order in which the instantaneous values of the voltages or currents of the system reach their maximum positive values. Two phase rotations are possible: A-B-C or A-C-B.

**potential transformer (PT)**—also known as a voltage transformer

**power factor (PF)**—true power factor is the ratio of real power to apparent power using the complete harmonic content of real and apparent power. Calculated by dividing watts by volt amperes. Power factor is the difference between the total power your utility delivers and the portion of total power that does useful work. Power factor is the degree to which voltage and current to a load are out of phase. See also *displacement power factor*.

**predicted demand**—the circuit monitor takes into account the energy consumption thus far in the present interval and the present rate of consumption to predict demand power at the end of the present interval.

**quantity**—a parameter that the circuit monitor can measure or calculate such as current, voltage, power factor, etc.

**real power**—calculation of the real power (3-phase total and per-phase real power calculated) to obtain kilowatts.

**recloser sequenc**e—a series of voltage sags caused by a utility breaker opening a number of consecutive times in an effort to clear a fault. See also *sag/swell*.

**rms**—root mean square. Circuit monitors are true rms sensing devices. See also *harmonics (rms*).

**sag/swell**—fluctuation (decreasing or increasing) in voltage or current in the electrical system being monitored. See also, *voltage sag* and *voltage swell*.

**scale factor**—multipliers that the circuit monitor uses to make values fit into the register where information is stored.

**SMS**—see System Manager Software.

**synchronized demand**—demand intervals in the circuit monitor that can be synchronized with another device using an external pulse, a command sent over communications, or the circuit monitor's internal real-time clock.

**System Manager Software (SMS)—**software designed by POWERLOGIC for use in evaluating power monitoring and control data.

**system type**—a unique code assigned to each type of system wiring configuration of the circuit monitor.

**thermal demand**—demand calculation based on thermal response.

**TIF/IT**—telephone influence factor used to assess the interference of power distribution circuits with audio communications circuits.

**Total Harmonic Distortion (THD or thd)**—indicates the degree to which the voltage or current signal is distorted in a circuit.

**total power factor**—*see power factor*.

**transient**—sudden change in the steady-state condition of voltage or current.

**troubleshooting**—evaluating and attempting to correct problems with the circuit monitor's operation.

**true power factor**—see *power factor*.

**undervoltage**—decrease in effective voltage to less than 90% for longer than one minute.

**VAR**—volt ampere reactive.

**VFD**—vacuum fluorescent display.

**voltage interruption**—complete loss of power where no voltage remains in the circuit.

**voltage sag**—a brief decrease in effective voltage lasting more than one minute.

**voltage swell**—increase in effective voltage for up to one minute in duration.

**voltage transformer (VT)**—see *potential transformer*.

**voltage unbalance**—percentage difference between each phase voltage with respect to the average of all phase voltages.

**waveform capture**—can be done for all current and voltage channels in the circuit monitor.

# INDEX

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