



Capacitor Bank Controller

Catalog Number 1413-CAP



Important User Information

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

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

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

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



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



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence



SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.



BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

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

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Read this to familiarize yourself with the rest of the manual. It provides information concerning the following:

- Who should use this manual
- Where to go for more information

Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting the Capacitor Bank Controller system.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Additional Resources

Please refer to the following publications for additional information on how to assemble, install, connect, operate, and maintain your capacitor bank controller.

Resource	Description
MicroLogix 1400 Programmable Controllers Installation Instructions, publication 1766-IN001	Provides procedures you use to install and wire your controller.
MicroLogix 1400 Programmable Controllers User Manual, publication 1766-UM001	Provides procedures you use to install, wire, and troubleshoot your controller.
PowerMonitor 1000 Installation Manual, publication 1408-IN001	Provides product description and functionality.
PowerMonitor 1000 User Manual, publication 1408-UM001	Provides a guide to set up communication with the 1408 PowerMonitor 1000 unit by using other applications and controllers.
PanelView Component Installation Instructions, publication 2711C-IN001	Provides instructions for installing a PanelView Component terminal.
PanelView Component User Manual, publication 2711C-UM001	Provides information for configuring a PanelView Component terminal.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at <http://www.rockwellautomation.com/literature/>. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

Notes:

General Information

Introduction

The capacitor bank controller is intended for standard, fixed-function capacitor banks. The controller consists of standard, off-the-shelf, Allen-Bradley hardware with the application ladder code necessary to perform power factor correction. The controller is designed to provide the same base functionality as a fixed-function capacitor bank controller.

Description of the Capacitor Bank Controller

The capacitor bank controller is a pre-engineered control system containing a MicroLogix 1400 controller, one or more PowerMonitor 1000 modules, and an optional human-machine interface (HMI). Pre-engineered ladder logic code in the controller gathers real and reactive power data from up to four power feeds (utility feeds and/or generators). The logic operates on the data in standard engineering units of kVAR and kW and minimizes imported and exported reactive power by switching up to 10 steps of capacitance. This strategy controls power factor while reducing the likelihood of voltage surge caused by excessive kVAR export.

Functions

- Auto configure
- Manual configure
- Discharge timer on each step
- Selectable operating modes
 - Manual operation
 - First In, Last Out (FILO)
 - Balanced, level-out usage of capacitor steps
 - Best fit, finds best match of capacitor step to system kVAR needs

- Alarms
 - Bad step, indicates blown fuse, capacitor failure
 - Target power factor not achieved
 - High / Low voltage
 - Metering
 - Communication loss
- PowerMonitor data concentrated into the MicroLogix 1400 controller
- Phase current, line voltage, frequency, real and reactive power, and power factor

Options

- Up to three additional PowerMonitor 1000 meters to aggregate up to four total feeds
- The PanelView Component C600 Touch HMI terminal with Ethernet communication provides ease of navigation, viewing, and configuration of the capacitor bank controller application

Installation

The capacitor bank controller system is supplied as a number of components that you assemble, install, and connect in a suitable enclosure.

System Components

The key number in the component lists are referenced in the illustrations that follow.

Table 1 - Base Configurations

Key	Quantity	Cat. No.	Description
1	1	1408-EM3-ENT-A	PowerMonitor 1000 unit
2	1	1766-L32BWA	MicroLogix 1400 controller
3			Ethernet cable (customer supplied)

Table 2 - Optional Components

Key	Quantity	Cat. No.	Description
4	1	2711C-T6M	PanelView Component C600 Touch Terminal

IMPORTANT The PanelView Component terminal can be powered through a 24V DC, 10 W (minimum) power supply that you provide. We recommend an Allen-Bradley Bulletin 1606 power supply.

Table 3 - Customer Supplied Components (optional)

Quantity	Cat. No.	Description
1	-	Ethernet cable 3.05 m (10 ft)
1	-	Ethernet switch

IMPORTANT Use standard Ethernet cable (Cat 5 10Base-T) with the Ethernet switch.

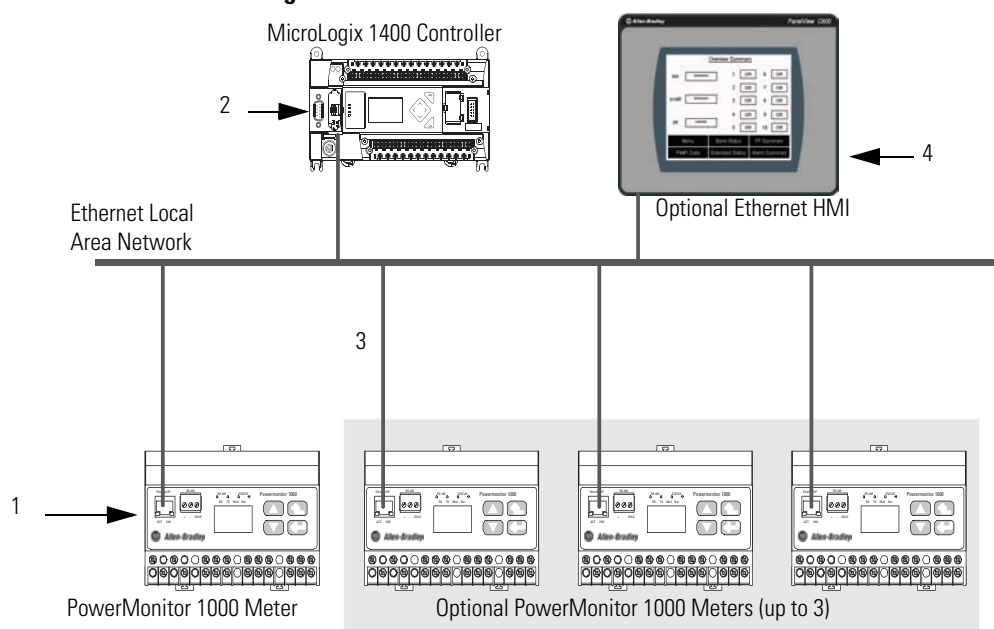
Optional Additional PowerMonitor 1000 Meters

The controller is designed to operate with up to three additional PowerMonitor 1000 meters. Additional PowerMonitor 1000 meters must be ordered separately. Please contact your local Rockwell Automation distributor for information.

System Architecture

This section illustrates the base system with Ethernet communication.

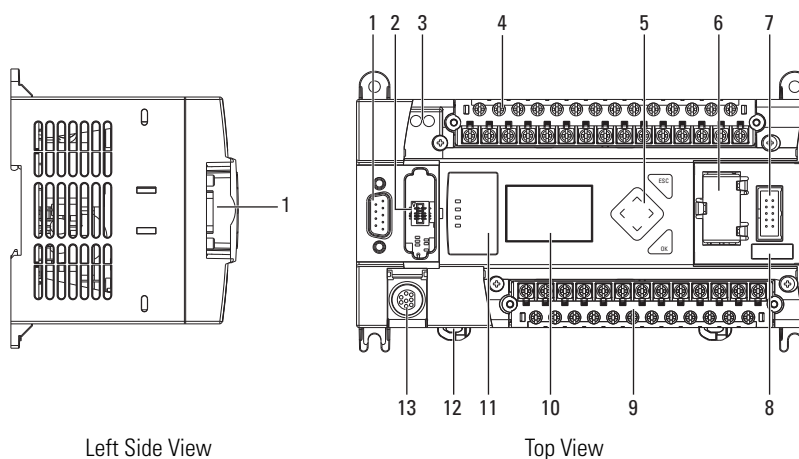
Figure 1 - Local Area Network Connection



Mount and Connect Your Controller

This section describes how to mount the MicroLogix 1400 controller and connect it to a PanelView Component module for use with the capacitor bank controller.

Figure 2 - Controller Description



	Description
1	Comm port 2 - 9-pin D-Shell RS-232C connector
2	Memory module (refer to MicroLogix 1400 Memory Module Installation Instructions, publication 1766-IN010 , for instructions on installing the memory module).
3	Output $\pm 24V$ DC, 240 mA
4	Input terminal block
5	LCD display keypad (ESC, OK, Up, Down, Left, Right)
6	Battery compartment
7	1762 expansion bus connector
8	Battery connector
9	Output terminal block
10	LCD display
11	Indicator status indicator panel
12	Comm port 1 - RJ45 connector
13	Comm port 0 - 8-pin mini DIN RS-232C/RS-485 connector

Table 4 - Controller Input and Output Description

Cat. No.	Description				
	Input Power	User Power	Embedded Discrete I/O	Embedded Analog I/O	Comm. Ports
1766-L32BWA	100/240V AC	24V DC, 240 mA	12 Fast 24V DC Inputs 8 Normal 24V DC Inputs 12 Relay Outputs	None	1 RS232/RS485 1 Ethernet/IP 1 RS232

Mount the Controller

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the Industrial Automation Wiring and Grounding Guidelines, publication [1770-4.1](#).



ATTENTION: Mount the controller horizontally only. Vertical mounting is not supported due to thermal considerations.



ATTENTION: Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller could cause damage. Do not drill holes above a mounted controller if the protective debris strips have been removed.

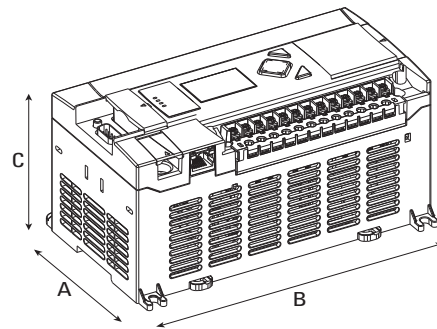


WARNING: Do not place the MicroLogix 1400 Programmable Controller in direct sunlight. Prolonged exposure to direct sunlight could degrade the LCD display.



WARNING: The local programming terminal port is intended for temporary use only and must not be connected or disconnected unless the area is assured to be nonhazardous.

Mounting Dimensions

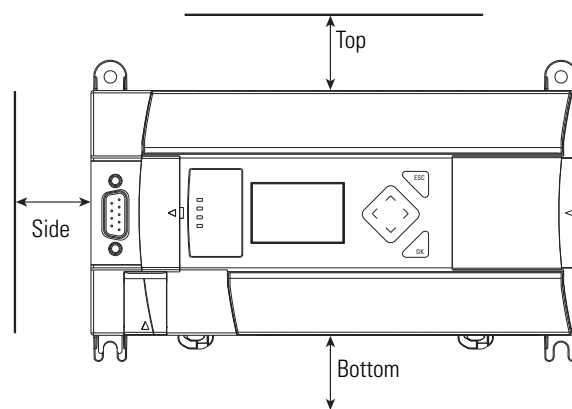


1766-L32BWA, 1766-L32AWA, 1766-L32BxB,
1766-L32BWAA, 1766-L32AWAA, 1766-L32BxBA

Dimension	Height
A	90 mm (3.5 in.)
B	180 mm (7.087 in.)
C	87 mm (3.43 in.)

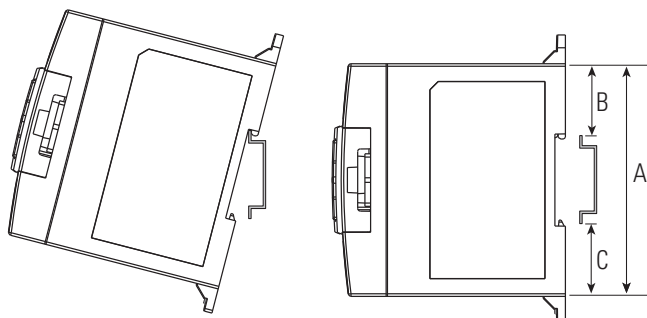
Controller Spacing

The controller mounts horizontally, with the expansion I/O extending to the right of the controller. Allow 50 mm (2 in.) of space on all but the right side for adequate ventilation, as shown below.



DIN Rail Mounting

The maximum extension of the latch is 14 mm (0.55 in.) in the open position. A screwdriver is required for removal of the controller. The controller can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.



Dimension	Height
A	90 mm (3.5 in.)
B	27.5 mm (1.08 in.)
C	27.5 mm (1.08 in.)

Follow these steps to install your controller on the DIN rail.

1. Mount your DIN rail. Make sure that the placement of the controller on the DIN rail meets the recommended spacing requirements (see [Controller Spacing on page 13](#) for more information).

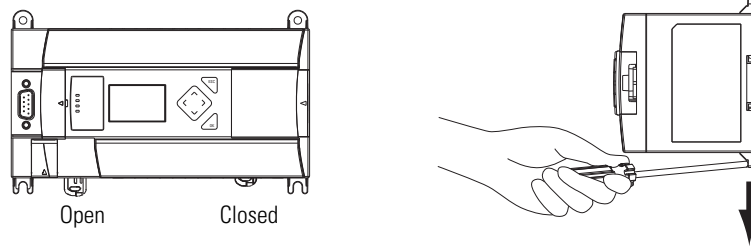
Refer to the mounting template inside the back cover of this document.

2. If it is open, close the DIN latch.
3. Hook the top slot over the DIN rail.
4. While pressing the controller down against the top of the rail, snap the bottom of the controller into position.
5. Leave the protective debris strip attached until you are finished wiring the controller and any other devices.

Follow these steps to remove your controller from the DIN rail.

1. Place a screwdriver in the DIN rail latch at the bottom of the controller.
2. Holding the controller, pry downward on the latch until the latch locks in the open position.
3. Repeat steps 1 and 2 for the second DIN rail latch.

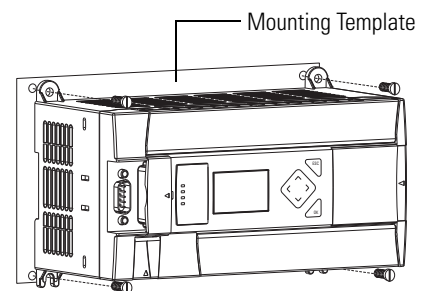
4. Unhook the top of the DIN rail slot from the rail.



Panel Mounting

Mount to panel by using #8 screws. Follow these steps to install your controller with mounting screws.

1. Remove the mounting template from inside the back cover of this document.
2. Secure the template to the mounting surface, making sure your controller is spaced properly (see [Controller Spacing on page 13](#) for more information).
3. Drill holes through the template.
4. Remove the mounting template.
5. Mount the controller.
6. Leave the protective debris strip in place until you are finished wiring the controller and any other devices



Using the Battery

The MicroLogix 1400 controller is equipped with a replaceable battery (catalog number 1747-BA). The Battery Low indicator on the LCD display of the controller shows the status of the replaceable battery. When the battery is low, the indicator is set (displayed as a solid rectangle). This means that either the battery wire connector is disconnected, or the battery may fail within 2 days if it is connected.



This product contains a sealed lithium battery which may need to be replaced during the life of the product.

At the end of its life, the battery contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

IMPORTANT The MicroLogix 1400 controller ships with the battery wire connector connected.

Be sure that the battery wire connector is inserted into the connector port if your application needs battery power. For example, when using a real-time clock (RTC).

Replacing the battery when the controller is powered down will lose all user application memory. Replace the battery when the controller is powered on.

Refer to the SLC 500 Lithium Battery Installation Instructions, publication [1747-IN515](#), for more information on installation, handling, usage, storage, and disposal of the battery.

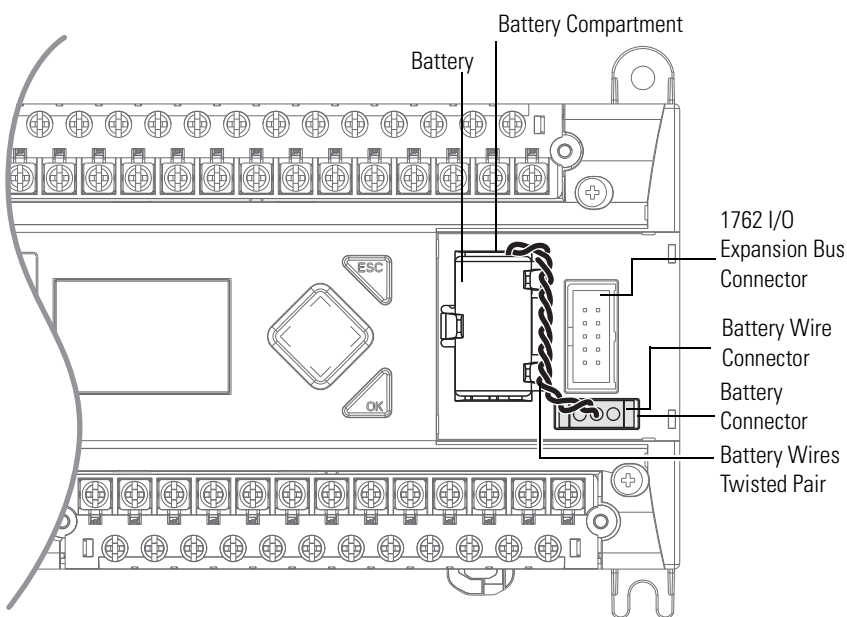


WARNING: When you connect or disconnect the battery an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that the area is nonhazardous before proceeding.

For Safety information on the handling of lithium batteries, including handling and disposal of leaking batteries, see Guidelines for Handling Lithium Batteries, publication [AG-5.4](#).

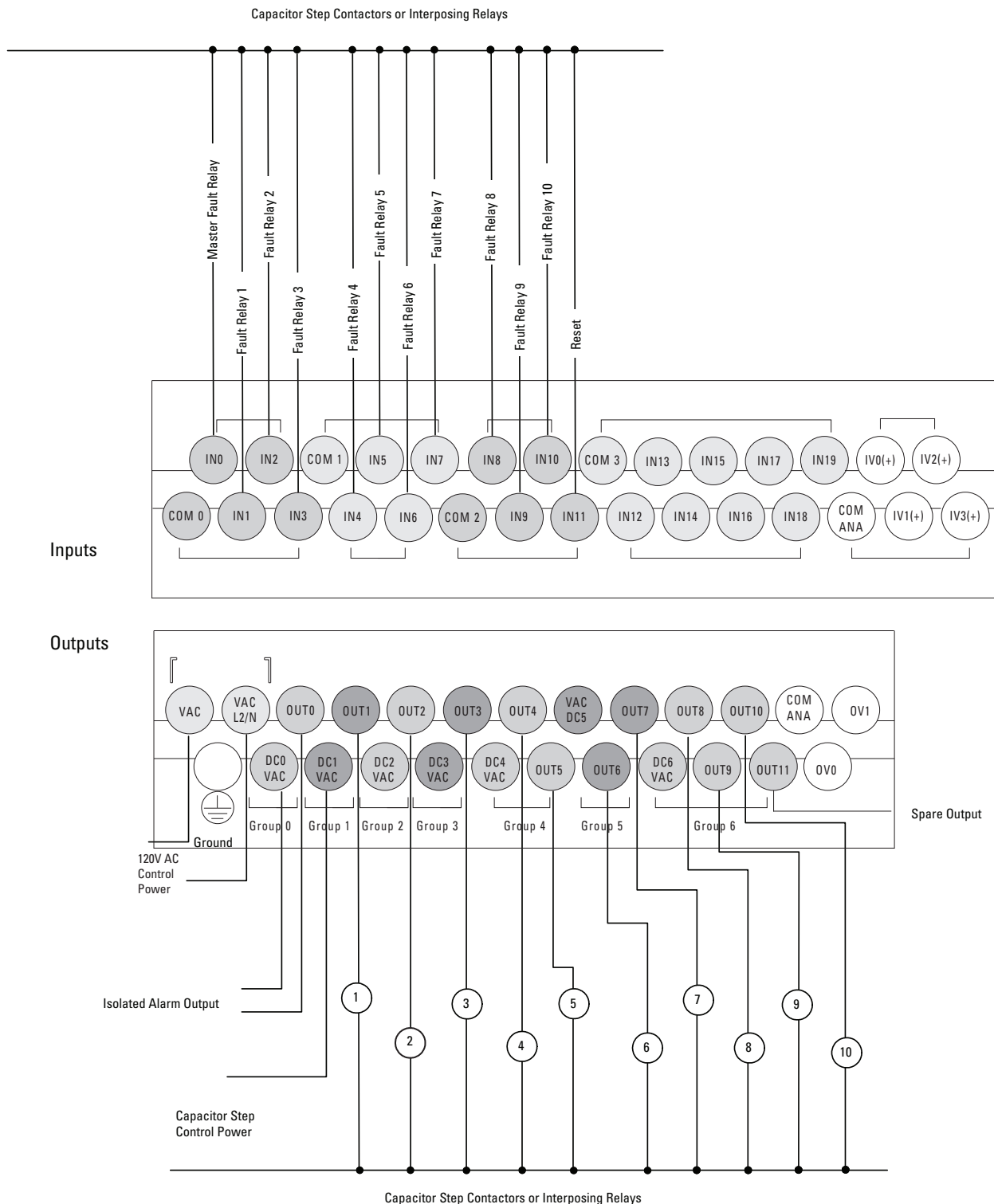
Follow these steps to connect the replaceable battery.

1. Insert the replaceable battery wire connector into the controller's battery connector.
2. Secure the battery connector wires so that it does not block the 1762 expansion bus connector as shown below.



Wire the MicroLogix 1400 Controller

Follow the diagram to wire the MicroLogix 1400 controller to the capacitor bank controller.

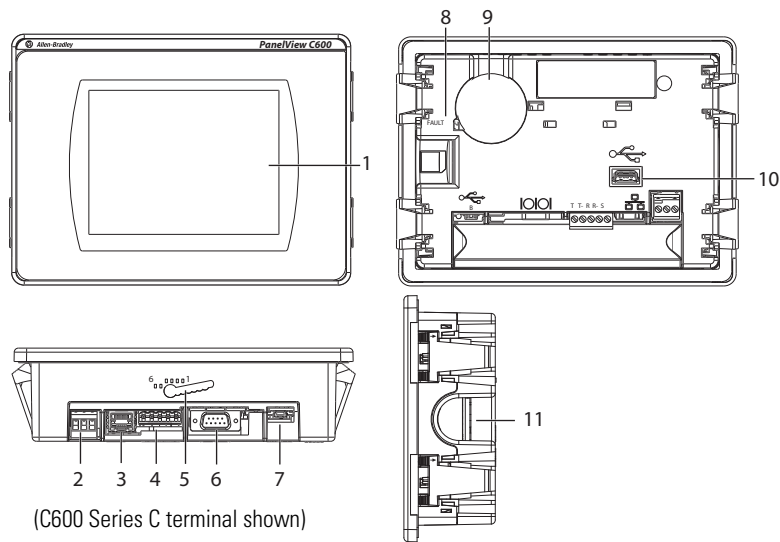


Install the PanelView Component C600 Touch Terminal

Before installing the terminal in a panel, review minimum clearances, panel guidelines, panel cutout dimensions, and product dimensions.

IMPORTANT The capacitor bank controller is compatible with the PanelView Component C600 terminal firmware revision 1.3 or later.

Figure 3 - PanelView Component C600 Terminal



Item	Description	Item	Description
1	Touch display	7	USB device port
2	24V DC power input	8	Diagnostic status indicator
3	10/100 MBit Ethernet port	9	Replaceable real-time clock battery
4	RS-422 or RS-485 port	10	USB host port
5	Mounting slots (for 2711C-T6M, -T6C Series C or later, 2711C-T6T Series A or later only)	11	Secure digital (SD) card slot
6	RS-232 serial port		

Parts List

PanelView Component terminals ship with these items:

- Power terminal block
- RS-422/RS-485 5-pin terminal block
- Panel cutout template
- Accessory CD
- A pair of mounting levers (for PanelView Component C600 terminals — 2711C-T6M, 2711C-T6C Series C or later, 2711C-T6T Series A or later)

Minimum Spacing

Plan for adequate space around the terminal, inside the enclosure, for ventilation and cabling. Consider heat produced by other devices in the enclosure. The ambient temperature around the terminal must be 0...50 °C (32...122 °F).

PanelView Component	Top	Bottom	Sides	Back
C200 and C300 Keypad C600 Touch	51 mm (2 in.)	51 mm (2 in.)	25 mm (1 in.)	13 mm (0.5 in.)

TIP The minimum spacing requirements are sufficient for connecting cables and inserting or removing a memory card. Plan for additional clearance if using the USB host port on the back of the unit.

Mounting Angle

You can mount the terminal vertically against the panel, or tilted forward or backwards, up to a 45° angle. For mounting angles greater than 45°, the operating temperature is restricted to 40 °C (104 °F).

Panel Guidelines

Supporting panels must be at least 16 gauge to provide proper sealing against water and dust and to provide proper support. The panel surface must be flat and free of imperfections to maintain an adequate seal and NEMA Type ratings.

Panel Cutout Dimensions

Use the template shipped with your terminal to mark the cutout dimensions.

PanelView Component Terminal	Height, Approx., mm (in.)	Width, Approx., mm (in.)
C600 Touch	135.0 ± 1.0 (5.31 ± 0.04)	189.0 ± 1.0 (7.44 ± 0.04)

Mount the PanelView Component C600 Terminal

PanelView Component C600 terminals install easily in a panel without any tools or hardware. The terminals have panel clamps that automatically latch when the terminal is pushed into the panel opening.

**ATTENTION:**

- Disconnect all electrical power from the panel before making the panel cutout.
- Make sure the area around the panel cutout is clear.
- Take precautions so metal cuttings do not enter any components already installed in the panel.
- Failure to follow these instructions may result in personal injury or damage to panel components.

Follow these steps to mount the terminal in a panel.

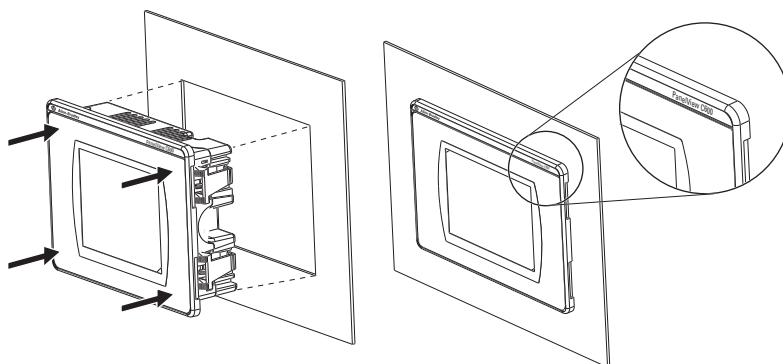
1. Cut an opening in the panel by using the template shipped with the terminal.
2. Make sure the sealing gasket is properly positioned on the terminal.

This gasket forms a compression type seal. Do not use sealing compounds.

3. Place the terminal in the panel cutout.

IMPORTANT The terminal temperature must be greater than 0 °C (32 °F) during panel installation.

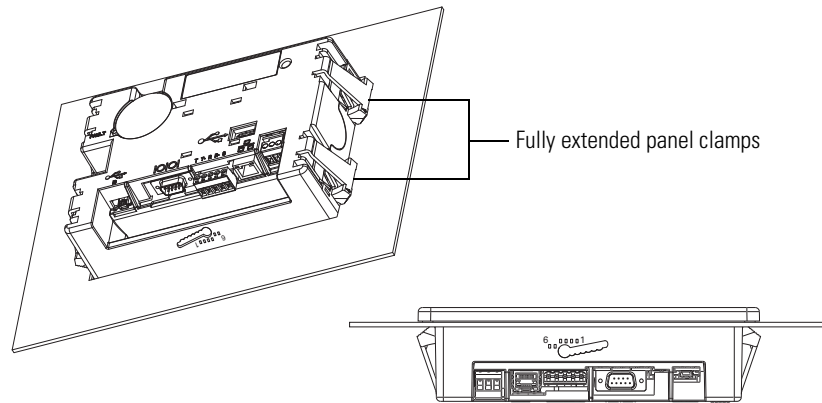
4. Push the terminal firmly into the cutout on all sides and corners until the plastic bezel contacts the enclosure and the gasket is fully compressed.



You will hear a series of clicks as the clamps self-adjust to the panel thickness.

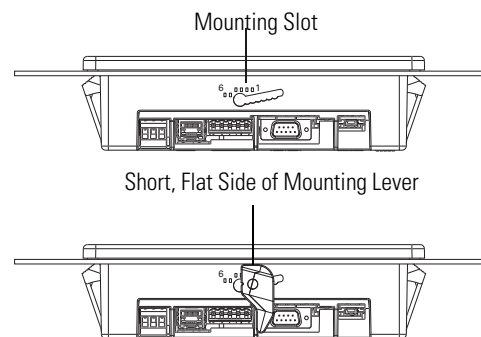
IMPORTANT Do not push on the display when pushing the terminal into the panel or you may damage the display.

These views show the panel clamps fully extended to secure the terminal against the rear of the panel.

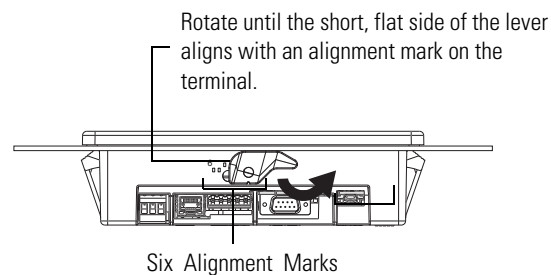


ATTENTION: Follow the instructions to provide a proper seal and to prevent potential damage to the terminal. Allen-Bradley assumes no responsibility for water or chemical damage to the terminal or other equipment within the enclosure because of improper installation.

5. Insert a mounting lever into each mounting slot on the terminal, sliding each lever until the short, flat side of the lever touches the surface of the panel.



6. When both levers are in place, slide each lever an additional notch or two until you hear a click.
7. Rotate each lever in the direction indicated until it is in the final latch position.



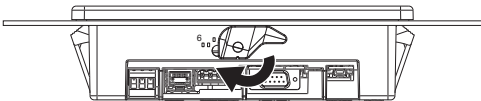
Use this table as a guide to provide an adequate gasket seal between the terminal and the panel.

Terminal Markings for Alignment	Lever Position	Panel Thickness Range	Typical Gauge
	1	1.52...2.01 mm (0.060...0.079 in.)	16
	2	2.03...2.64 mm (0.08...0.104 in.)	14
	3	2.67...3.15 mm (0.105...0.124 in.)	12
	4	3.17...3.66 mm (0.125...0.144 in.)	10
	5	3.68...4.16 mm (0.145...0.164 in.)	8/9
	6	4.19...4.75 mm (0.165...0.187 in.)	7

Remove the PanelView Component C600 Terminal from the Panel

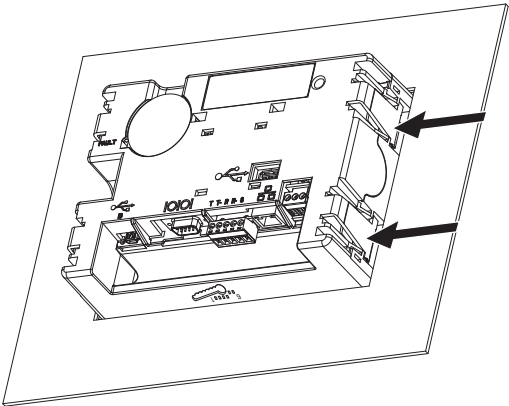
Follow these steps to remove the terminal from the panel.

- 1. Disconnect power to the terminal.
- 2. Release the mounting lever by rotating it in the direction indicated, slide it to the bottom of the mounting slot, and remove it.

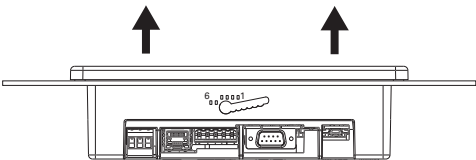


- 3. Push each panel clamp in until it is fully depressed and locked.

Depressed and locked, the panel clamps provide adequate clearance to remove the terminal.



- 4. Grip the sides of the bezel and gently pull the terminal out of the panel opening.

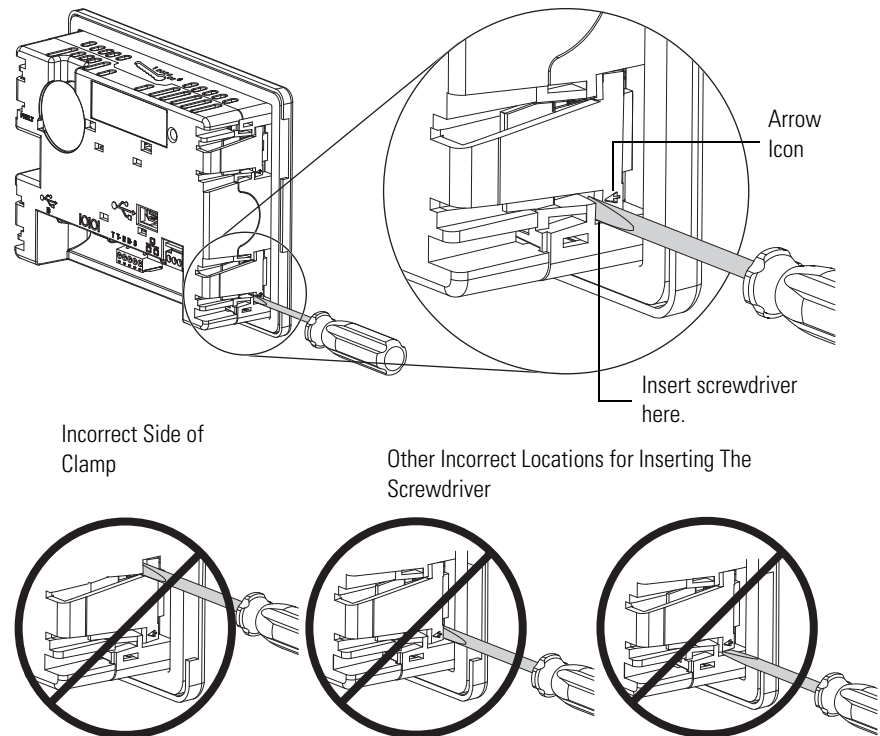


Before reinstalling the terminal in the panel opening, you must release each panel clamp from its locked position. Do this as soon as possible after the removing the terminal from the panel.

Follow these steps to unlock each panel clamp.

1. Insert the tip of a #3 - #6, screwdriver, approximately 5 mm (0.20 in.), into the location shown on each clamp, next to the arrow icon , and pull the screwdriver straight out.

IMPORTANT Take care to insert the screwdriver in the correct orientation and on the correct side of each clamp, as indicated by the arrow icon. Do not pry the plastic with the screwdriver or you may damage the clamp.



The panel clamp will release and return to its unlocked position.

2. Reinstall the terminal in the panel after unlocking all the panel clamps.

Connect Power

The PanelView Component terminal connects to a customer supplied 24V DC, 10 W (minimum) power source⁽¹⁾. The table shows the power rating.

Table 5 - Power Ratings

PanelView Component	Input Voltage Range	Power Consumption, Max
C600	18...30V DC (24V DC nom)	10 W (0.42 A)

The internal, nonisolated power supply is protected against reverse polarity of the DC+ and DC- connections.



ATTENTION: Connecting DC+ or DC- source to the functional earth terminal may damage the device. Miswiring the DC+ source to the DC- input while connected to other equipment through nonisolated ports may cause a ground loop current and damage the device.

The input power terminal block supports these wire sizes.

Table 6 - Wire Specifications for Input Power Terminal Block

Wire Type		Dual-wire Gauge ⁽¹⁾	Single-wire Gauge	Terminal Screw Torque
Stranded or solid	Cu 90 °C (194 °F)	0.33...1.31 mm ² (22...16 AWG)	0.33...2.08 mm ² (22...14 AWG)	0.45...0.56 N•m (4...5 lb•in)

(1) Two-wire maximum per terminal.



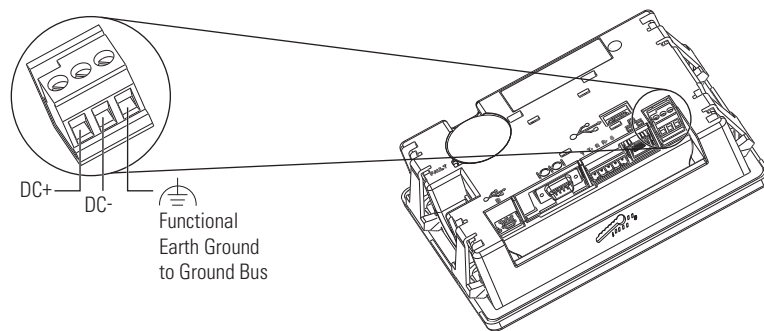
ATTENTION: Disconnect all power before installing or replacing components. Failure to disconnect power may result in electrical shock or damage to the terminal.

Follow these steps to connect power.

1. Verify that the terminal is not connected to a power source.
2. Secure the 24V DC power wires to the terminal block.
3. Secure the functional earth ground wire to the functional earth ground terminal screw on the terminal block.

(1) We recommend an Allen-Bradley Bulletin 1606 power supply.

4. Apply 24V DC power to the terminal.



Mount the PowerMonitor 1000 Unit

The PowerMonitor 1000 unit can be mounted on a panel or a DIN rail.

Panel Mount

Follow these steps to mount the unit on a panel or any flat surface.

1. Extend the top and bottom DIN-rail clips to the panel mount position.
2. Insert a small screwdriver under the spring pin to move the clip, lift it, and pull the clip forward until it extends approximately 6 mm (0.25 in.) from the enclosure.
3. Release the pin and lock the clip in the panel mount position.
4. Mount the unit by using three #8 machine screws.

DIN-rail Mount

You can mount the unit on standard 35 x 7.5 mm (EN 50 022 – 35 x 7.7) DIN-rail. To mount on a DIN-rail, leave the mounting clips retracted so the mounting holes are hidden behind the unit.

Install on a DIN-rail

Follow these steps to mount the unit on a DIN-rail.

1. Tilt the bottom of the unit slightly away from the rail until the notches grab onto the top flange of the DIN-rail.
2. Push the bottom of the enclosure forward towards the DIN-rail.

The spring-loaded clip snaps onto the bottom of the rail and holds the unit firmly in place.

Remove from a DIN Rail

Follow these steps to remove the unit from a DIN-rail.

1. Insert a small screwdriver into the exposed slot in the tab to remove the unit from the DIN rail.
2. Pull enclosure forward and remove from the rail.

Connect the Controller, PanelView Component Terminal, and the PowerMonitor 1000 Meter

Follow these steps to connect the Capacitor Bank controller parts.

1. Connect a source of 120/230V AC to the control power terminals on the MicroLogix 1400 controller.

See the MicroLogix 1400 Programmable Controllers Installation Instructions, publication [1766-IN001](#), for wiring recommendations.

2. Connect a source of 24V DC to the PanelView Component terminal.

The 24V DC power can be obtained from a 24V DC, 10 W (minimum) power supply⁽¹⁾ that you provide.

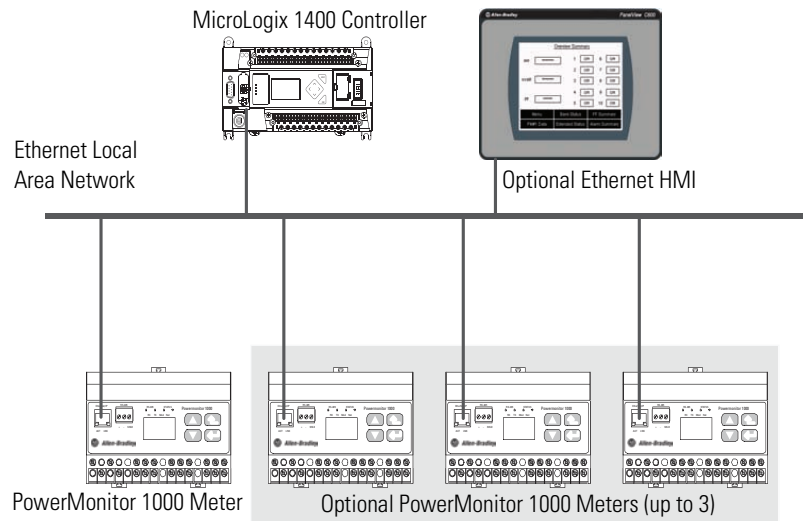
See the PanelView Component Installation Instructions, publication [2711C-IN001](#), for wiring recommendations.

3. Connect the PowerMonitor 1000 meter to the power circuit, control power, and earth ground.

IMPORTANT	Verify that the PowerMonitor 1000 meter is wired properly and that the power metering is correct. Incorrect wiring of the PTs and CTs will cause unpredictable capacitor bank control.
------------------	--

(1) We recommend an Allen-Bradley Bulletin 1606 power supply.

See the PowerMonitor 1000 Installation Instructions, publication [1408-IN001](#) for wiring recommendations.



4. Connect the communication cable between the components and the local area Ethernet network or the optional Ethernet switch that you provide.

Notes:

Configuration

Overview

The capacitor bank controller base unit has been set up to require minimal out-of-box configuration.

The base system has default communication settings. Certain circumstances and options require additional communication configuration, which may include the use of programming software not included with the controller.

You are required to configure the PowerMonitor 1000 meters to coordinate them to the power circuit in the base unit and all options. Configuration of the PowerMonitor 1000 meter is performed by using the display on the meter.

The MicroLogix 1400 controller requires configuration to coordinate it to the number and size of steps that exist in the capacitor bank being controlled, as well as the desired operating mode and other selections. Use the built-in LCD interface on the MicroLogix 1400 controller or the optional PanelView Component C600 terminal to configure the controller.



ATTENTION: Do not operate the capacitor bank controller without first configuring it to suit the controlled capacitor bank and system options. Unpredictable operation, including undesirable power system effects, may result.

IMPORTANT

The capacitor bank controller is compatible with the PanelView Component C600 terminal firmware revision 1.3 or later.

Communication Settings

The following sections provide information on configuring communication for the components.

Base Unit

Communication settings are factory configured. The MicroLogix 1400 controller settings are contained in the EEPROM memory module. PowerMonitor 1000 meter settings are stored in onboard nonvolatile memory (NVRAM). Configuration settings are listed below.

Table 7 - Communication Settings

Device/Parameter	MicroLogix 1400 Controller	PowerMonitor Meter 1
Protocol	EtherNet/IP	EtherNet/IP

Ethernet HMI Option

This option allows the PanelView Component C600 terminal to connect to your Ethernet network. The PanelView Component C600 Touch HMI terminal with Ethernet communication provides ease of navigation, viewing, and configuration of the capacitor bank controller application.

Default communication settings are factory configured.

Table 8 - PanelView Component C600 Ethernet Configuration Settings

Device/Parameter	MicroLogix 1400 Controller	PanelView Componet C600 Operator Terminal	PowerMonitor 1000 Meter 1 ⁽²⁾
IP Address	192.168.254.100 ⁽¹⁾	192.168.254.105	192.168.254.64
Subnet Mask	255.255.0.0	255.255.0.0	255.255.0.0

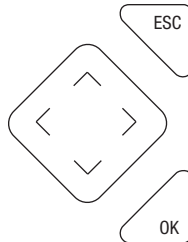
(1) See MicroLogix 1400 Controller Installation Instructions, publication [1766-UM001](#) for instructions on changing the controller's IP Address. If you change the controller's IP Adress, make sure all of the Capacitor Bank devices are on the same network or IP Address range.

(2) The default Gateway for the PowerMonitor 1000 is 128.1.1.1.

MicroLogix 1400 Controller

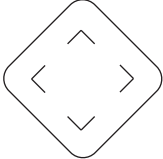
This section describes how to use the LCD and keypad on the MicroLogix 1400 controller.

Operating Buttons

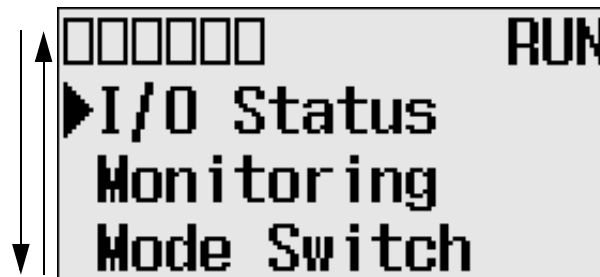
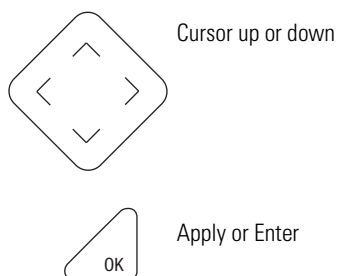


Button	Function
Cursor Buttons	Move cursor
	Select menu item
	Choose file numbers, values, etc.
OK	Next menu level, store your entry, apply the changes
ESC	Previous menu level, cancel your entry

Using Menus to Choose Values

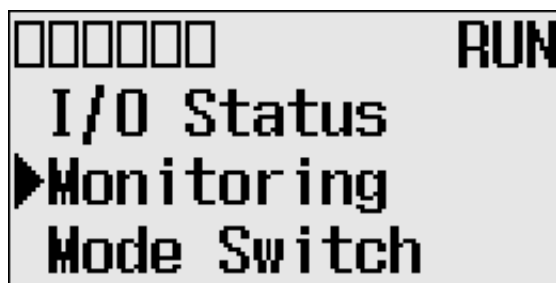
Press	To
	- Go to next menu level. - Store your entry. - Apply the changes.
	- Go to previous menu level. - Cancel your entry since the last <i>Ok</i>. - Press repeatedly to go to the main menu.
	- Change menu item. - Change value. - Change position.

Selecting Between Menu Items



The symbol "█" is used as the cursor.

Cursor Display



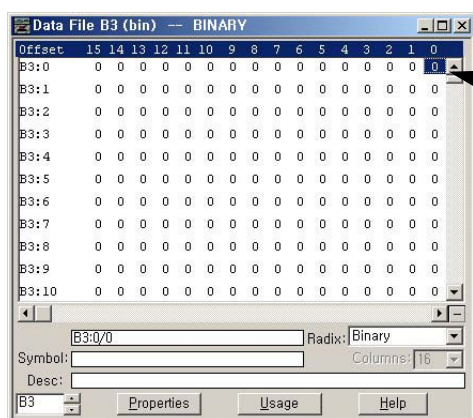
There are two different cursor types:

Selection cursor (the symbol "█") is displayed left to the selected item.

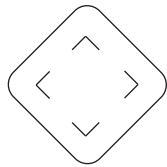
- Move cursor with the up/down arrows

Full block navigation is shown as a flashing block:

- Change position with left/right arrows
- Change values with up/down arrows



Setting Values



Change value = up/down arrows
Move cursor between digits = left/right arrows



Stores Entries



Retain previous value

Offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
B3:0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B3:10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Left/right arrow moves the cursor between the digits of the value .

Up/down arrow changes the value.

Up arrow = increment

Down arrow = decrement

Controller Configuration

You may view and edit the Capacitor Bank Controller parameters by using the LCD interface. The optional PanelView Component terminal provides configuration screens for viewing and editing the parameters, as indicated in the Control and Status Parameter table (Screens: 1 = Configuration, X1 = Extended Configuration 1, X2 = Extended Configuration 2). The range of each integer parameter is 0 ... 32,768 unless otherwise specified. The parameters are stored in contiguous locations in data files N7 and N139 (integer) and B3 (Boolean) in the controller.

Use the LCD Interface for Configuration

The LCD interface provides a basic configuration interface for the capacitor bank controller. In Integer mode, the LCD interface provides read/write access to the configuration parameters listed in the Control and Status Parameters table.

Use the LCD interface to manually change the controller configuration parameters.

1. Scroll to and select the desired configuration parameter.

Refer to the Control and Status Parameters table on [page 34](#).

2. Press the Enter key to edit the parameter.
3. Use the up/down keys to change the value of the parameter.

TIP If the data is protected or undefined, pressing the up/down key scrolls to the next data element.

4. Press the Enter key to store the new value.

Esc key will discard the new value.

5. Repeat steps 2...5 as needed.

Table 9 - Control and Status Parameters

Address	Parameter	Unit	Description	Configurable	Range	Default	PanelView Component Screen
N7:0	Capacitor Step 1 - Measured Size	kVAR	Measured and averaged capacitor size for each step	No		-	Configuration
N7:1	Capacitor Step 2 - Measured Size	kVAR		No		-	Configuration
N7:2	Capacitor Step 3 - Measured Size	kVAR		No		-	Configuration
N7:3	Capacitor Step 4 - Measured Size	kVAR		No		-	Configuration
N7:4	Capacitor Step 5 - Measured Size	kVAR		No		-	Configuration
N7:5	Capacitor Step 6 - Measured Size	kVAR		No		-	Configuration
N7:6	Capacitor Step 7 - Measured Size	kVAR		No		-	Configuration
N7:7	Capacitor Step 8 - Measured Size	kVAR		No		-	Configuration
N7:8	Capacitor Step 9 - Measured Size	kVAR		No		-	Configuration
N7:9	Capacitor Step 10 - Measured Size	kVAR		No		-	Configuration

Table 9 - Control and Status Parameters

Address	Parameter	Unit	Description	Configurable	Range	Default	PanelView Component Screen
N7:10	Capacitor Step 1 - Effective Size	kVAR	Nameplate capacitor size for each step	Yes		50	Configuration
N7:11	Capacitor Step 2 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:12	Capacitor Step 3 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:13	Capacitor Step 4 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:14	Capacitor Step 5 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:15	Capacitor Step 6 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:16	Capacitor Step 7 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:17	Capacitor Step 8 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:18	Capacitor Step 9 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:19	Capacitor Step 10 - Effective Size	kVAR		Yes ⁽²⁾		50	Configuration
N7:30	Capacitor Discharge Time	seconds	The amount of time after a capacitor step is turned off, before a capacitor step is considered fully discharged	Yes		60	Configuration
N7:31	Nominal Voltage	volts	The nominal bus voltage of the system	Yes		480	Ext Configuration 1
N7:32	Voltage Threshold - High and Low	%	The voltage percentage from nominal, that will determine high and low limits for alarming	Yes	1...10	5	Ext Configuration 1
N7:34	Lead Deadband	kVAR	The leading kVAR limit allowed for the system, before the controller acts to correct lead, typically 33% of smallest capacitor step	Yes		20	Configuration
N7:35	Lag Deadband	kVAR	The lagging kVAR limit allowed for the system, before the controller acts to correct lag, typically 66% of largest capacitor step	Yes		35	Configuration
N7:36	Step Tolerance Low Limit	%	The kVAR percentage of effective, that will determine low limits for each capacitor step	Yes	0...10	5	Ext Configuration 2
N7:37	Power Factor Out-of-Range Time	seconds	The amount of time the system kVAR must be out of the range of the lead or lag deadband, before the controller acts to correct	Yes		60	Ext Configuration 1
N7:39	Step Tolerance Time	seconds	The amount of time after a capacitor step is actuated, before taking a sample reading of the system kVAR difference, to determine if the capacitor step is above the step tolerance low limit	Yes		30	Ext Configuration 2
N7:40	Voltage High In-Range Time	seconds	The amount of time the bus voltage must be below the high limit before resetting the Voltage High Alarm	Yes		120	Ext Configuration 1
N7:41	Voltage Low In-Range Time	seconds	The amount of time the bus voltage must be above the low limit before resetting the Voltage Low Alarm	Yes		120	Ext Configuration 1

Table 9 - Control and Status Parameters

Address	Parameter	Unit	Description	Configurable	Range	Default	PanelView Component Screen
N7:42	Voltage In-Range Time	seconds	The amount of time after the Voltage High and Voltage Low alarms have been reset, before signifying that the voltage is in an acceptable range	Yes		120	Ext Configuration 1
N7:43	Control Word ⁽¹⁾		This is the control word for the capacitor bank controller. Bit 4 is used to initiate a restore of factory defaults. This should be treated as a momentary state. Bit 5 is used to initiate the step size buffer. This bit should also be treated as a momentary state. Bit 6 is used for disabling step tolerance. The BCD value for each bit is available for easy setup	Yes See Table 10, Control Word (N7:43) for more information.			Ext Configuration 2
N7:45	Number of PowerMonitor 1000 meters		The number of PowerMonitor meters to include in the aggregate kW and kVAR calculations	Yes	1...4	1	Configuration
N7:46	Number of Capacitor Steps		The number of capacitor steps to be controlled	Yes	1...10	10	Configuration
N7:47	Operating Mode		The operating mode: 0 - Manual 1 - FILO 2 - Balanced 3 - Best Fit	Yes	0...3	0	Configuration
N7:56	Nominal Voltage Scale		Multiplier scale 1, 10, 100, or 1000	Yes		1	Ext Configuration 1
N7:59	Number of Samples		The number of kVAR samples to average together when auto-configuring capacitor step sizes	Yes	1...10	5	Ext Configuration 1
N139:10	Write IP address		Writes IP address for the PowerMonitor 1000 meter to MicroLogix 1400 controller for messaging (Bit 0), toggle bit 0 to 1 to 0	Yes			Admin
N139:12	PowerMonitor 1 IP Byte A		1st byte (octet) of PowerMonitor IP Address	Yes	0...255	192	Admin
N139:13	PowerMonitor 1 IP Byte B		2nd byte (octet) of PowerMonitor IP Address	Yes	0...255	168	Admin
N139:15	PowerMonitor 1 IP Byte C		3rd byte (octet) of PowerMonitor IP Address	Yes	0...255	254	Admin
N139:16	PowerMonitor 1 IP Byte D		4th byte (octet) of PowerMonitor IP Address	Yes	0...255	64	Admin
N139:22	PowerMonitor 2 IP Byte A		1st byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	192	Admin
N139:23	PowerMonitor 2 IP Byte B		2nd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	168	Admin
N139:25	PowerMonitor 2 IP Byte C		3rd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	254	Admin
N139:26	PowerMonitor 2 IP Byte D		4th byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	65	Admin
N139:32	PowerMonitor 3 IP Byte A		1st byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	192	Admin
N139:33	PowerMonitor 3 IP Byte B		2nd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	168	Admin

Table 9 - Control and Status Parameters

Address	Parameter	Unit	Description	Configurable	Range	Default	PanelView Component Screen
N139:35	PowerMonitor 3 IP Byte C		3rd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	254	Admin
N139:36	PowerMonitor 3 IP Byte D		4th byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	66	Admin
N139:42	PowerMonitor 4 IP Byte A		1st byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	192	Admin
N139:43	PowerMonitor 4 IP Byte B		2nd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	168	Admin
N139:45	PowerMonitor 4 IP Byte C		3rd byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	254	Admin
N139:46	PowerMonitor 4 IP Byte D		4th byte (octet) of PowerMonitor IP Address	Yes ⁽³⁾	0...255	67	Admin
N139:52	Reset Input		Reset all the Inputs. Bit 1 (write a value of 2, and then back to 0 will Reset all inputs)	Yes			Ext Configuration 2
N139:99	Wiring diagnostic		Performs wiring diagnostic for the PowerMonitor wiring (Bit 0)	Yes			Admin

(1) See [Table 10, Control Word \(N7:43\)](#) for more information.

(2) Depends on the number of capacitor steps in N7:46.

(3) Depends on the number of PowerMonitor 1000 meters in N7:45.

Table 10 - Control Word (N7:43)

Bit	Parameter	BCD Value
4	Restore Factory Defaults	16
5	Initialize Step Buffer	32
6	Disable Step Tolerance; 0 = False, 1 = True	64
7	Enable Input Mode; 0 = False, 1 = True	128

Table 11 - Binary (bit) Elements

Address	Parameter	Configurable	Value	PanelView Component Terminal Screen
B3:0/0	Capacitor Step 1 - Status	No	0 = Off, 1 = On	Bank Status
B3:0/1	Capacitor Step 2 - Status	No		
B3:0/2	Capacitor Step 3 - Status	No		
B3:0/3	Capacitor Step 4 - Status	No		
B3:0/4	Capacitor Step 5 - Status	No		
B3:0/5	Capacitor Step 6 - Status	No		
B3:0/6	Capacitor Step 7 - Status	No		
B3:0/7	Capacitor Step 8 - Status	No		
B3:0/8	Capacitor Step 9 - Status	No		
B3:0/9	Capacitor Step 10 - Status	No		
B3:0/10	Capacitor Step 1 - Alarm	No	0 = No Alarm, 1 = In Alarm	
B3:0/11	Capacitor Step 2 - Alarm	No		
B3:0/12	Capacitor Step 3 - Alarm	No		
B3:0/13	Capacitor Step 4 - Alarm	No		
B3:0/14	Capacitor Step 5 - Alarm	No		
B3:0/15	Capacitor Step 6 - Alarm	No		
B3:1/0	Capacitor Step 7 - Alarm	No		
B3:1/1	Capacitor Step 8 - Alarm	No		
B3:1/2	Capacitor Step 9 - Alarm	No		
B3:1/3	Capacitor Step 10 - Alarm	No		
B3:1/4	Capacitor Step 1 - Mode	Yes	0 = Manual, 1 = Auto	Step Control
B3:1/5	Capacitor Step 2 - Mode	Yes ⁽¹⁾		
B3:1/6	Capacitor Step 3 - Mode	Yes ⁽¹⁾		
B3:1/7	Capacitor Step 4 - Mode	Yes ⁽¹⁾		

Table 11 - Binary (bit) Elements

Address	Parameter	Configurable	Value	PanelView Component Terminal Screen
B3:1/8	Capacitor Step 5 - Mode	Yes ⁽¹⁾	0 = Manual, 1 = Auto	Step Control
B3:1/9	Capacitor Step 6 - Mode	Yes ⁽¹⁾		
B3:1/10	Capacitor Step 7 - Mode	Yes ⁽¹⁾		
B3:1/11	Capacitor Step 8 - Mode	Yes ⁽¹⁾		
B3:1/12	Capacitor Step 9 - Mode	Yes ⁽¹⁾		
B3:1/13	Capacitor Step 10 - Mode	Yes ⁽¹⁾		
B3:1/14	Capacitor Step 1 - Manual Command	Yes	0 = Command Off, 1 = Command On	
B3:1/15	Capacitor Step 2 - Manual Command	Yes ⁽¹⁾		
B3:2/0	Capacitor Step 3 - Manual Command	Yes ⁽¹⁾		
B3:2/1	Capacitor Step 4 - Manual Command	Yes ⁽¹⁾		
B3:2/2	Capacitor Step 5 - Manual Command	Yes ⁽¹⁾		
B3:2/3	Capacitor Step 6 - Manual Command	Yes ⁽¹⁾		
B3:2/4	Capacitor Step 7 - Manual Command	Yes ⁽¹⁾		
B3:2/5	Capacitor Step 8 - Manual Command	Yes ⁽¹⁾		
B3:2/6	Capacitor Step 9 - Manual Command	Yes ⁽¹⁾		
B3:2/7	Capacitor Step 10 - Manual Command	Yes ⁽¹⁾		
B3:2/8	Auto Configure Capacitor Step Sizes	Yes	Set to 1 to initiate	Configuration
B3:2/9	System Alarm	No	0 = No Alarm, 1 = In Alarm	Alarm Summary
B3:2/10	Bad Step Alarm	No		
B3:2/11	Power Factor Not Achieved Alarm	No		
B3:2/12	Voltage Alarm	No		

(1) Depends on the number of capacitor steps in N7:46.

View MicroLogix 1400 Controller Ethernet Status

The Ethernet configuration screen of the LCD displays the MAC and IP addresses assigned to the MicroLogix 1400 controller.

Follow these steps to view the Ethernet configuration for your controller.

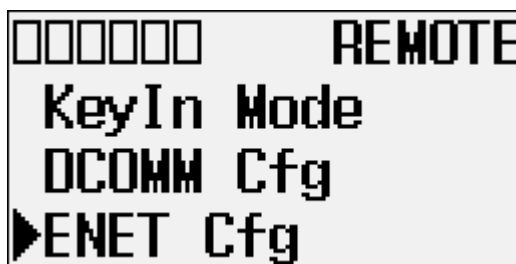
1. On the Main Menu screen, select Advanced Set by using the Up and Down keys on the LCD keypad, as shown below.

If the menu items shown in the figure below are not displayed on the Main Menu screen, you need to scroll down the screen by pressing the Down key.



2. Press the OK key on the LCD keypad.

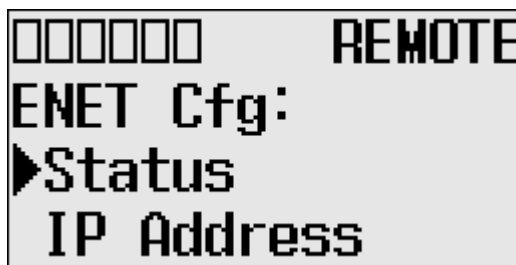
The Advanced Set Menu screen is displayed, as shown below.



3. If ENET Cfg is selected, press the OK key, otherwise, select ENET Cfg by using the Up and Down keys, and then press the OK key.

The Ethernet Configuration screen is displayed.

4. Press the OK key on the LCD Status menu.



When an IP address is not yet assigned to your controller, only the MAC address that is assigned to your controller, represented as XXXXXXXXXXXX below, is displayed.

A MAC address is a 12-digit hexadecimal number. Your controller ships with a unique MAC address assigned in the factory. You can identify the MAC address of your controller by opening the expansion module cover on your controller.



□□□□□□ REMOTE
ENET Mode: bootp
MAC=XXXXXXXXXXXXXXXX
IP=-. -. -. -

When an IP address is assigned to your controller, both the MAC and IP addresses of your controller are displayed, as shown below. In this example, the MAC address is represented as XXXXXXXXXXXXXXXX. The IP address is represented as xxx.xxx.xxx.xxx, where each xxx is a decimal number between 0...255.



□□□□□□ REMOTE
ENET Mode: bootp
MAC=XXXXXXXXXXXXXXXX
xxx. xxx. xxx. xxx

5. Press the ESC key to return to the Advanced Set Menu screen, as shown in [step 2](#).

PowerMonitor 1000 Meter Configuration

The table below lists the configuration parameters that must be set up for correct operation of the capacitor bank controller.

For additional information regarding PowerMonitor 1000 meter configuration, please refer to the PowerMonitor 1000 User Manual, publication [1408-UM001](#).

Table 12 - PowerMonitor Meter Configuration Parameters

Parameter	PowerMonitor 1	PowerMonitor 2	PowerMonitor 3	PowerMonitor 4
Wiring mode				
PT (VT) primary voltage				
PT (VT) secondary voltage				
CT primary current				
I4 primary current				
IP address	192.168.254.64	192.168.254.65 ⁽¹⁾	192.168.254.66 ⁽¹⁾	192.168.254.67 ⁽¹⁾
Subnet mask	255.255.0.0			
Default gateway address	128.1.1.1			

(1) This IP Address is not the default configuration.

TIP When using multiple PowerMonitor meters, they all must be installed on the same bus voltage level.

Parameter Descriptions

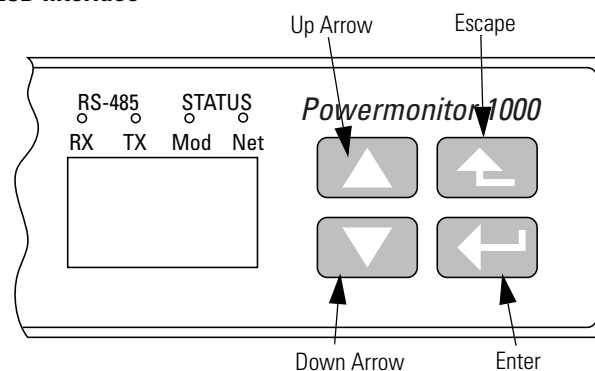
- Wiring mode – selected to match the physical connections to the power system
 - Direct Delta
 - Open Delta
 - Wye
 - Single phase
 - 1 PT 1 CT - LL
 - 1 PT 1 CT - LN
- **PT (VT) primary voltage** – reflects the voltage rating on the high side of the potential/voltage transformers. Range 1...50,000V, default 480V
- **PT (VT) secondary voltage** – reflects the voltage rating on the low side of the potential/voltage transformers. Range 1...600 V, default 480V
- **CT primary current** – reflects the current rating on the high side of the phase current transformers. Range 1...50,000 A, default 5. The CT secondary current is also adjustable but the default value of 5 A is standard
- **IP address, subnet mask, default gateway** – Ethernet port settings required for communications with the user's local area network

Set Parameters with the PowerMonitor 1000 Unit

The Basic Configuration table contains the configuration parameters needed for initial setup of the PowerMonitor meter in the base system.

The diagram and table shows the LCD interface buttons and their functions.

Figure 4 - LCD Interface



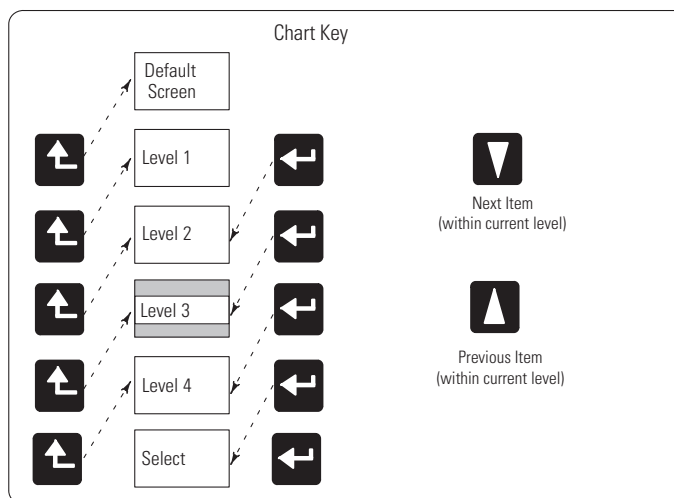
The buttons function differently in each mode. The PowerMonitor 1000 unit enters into Display mode by default.

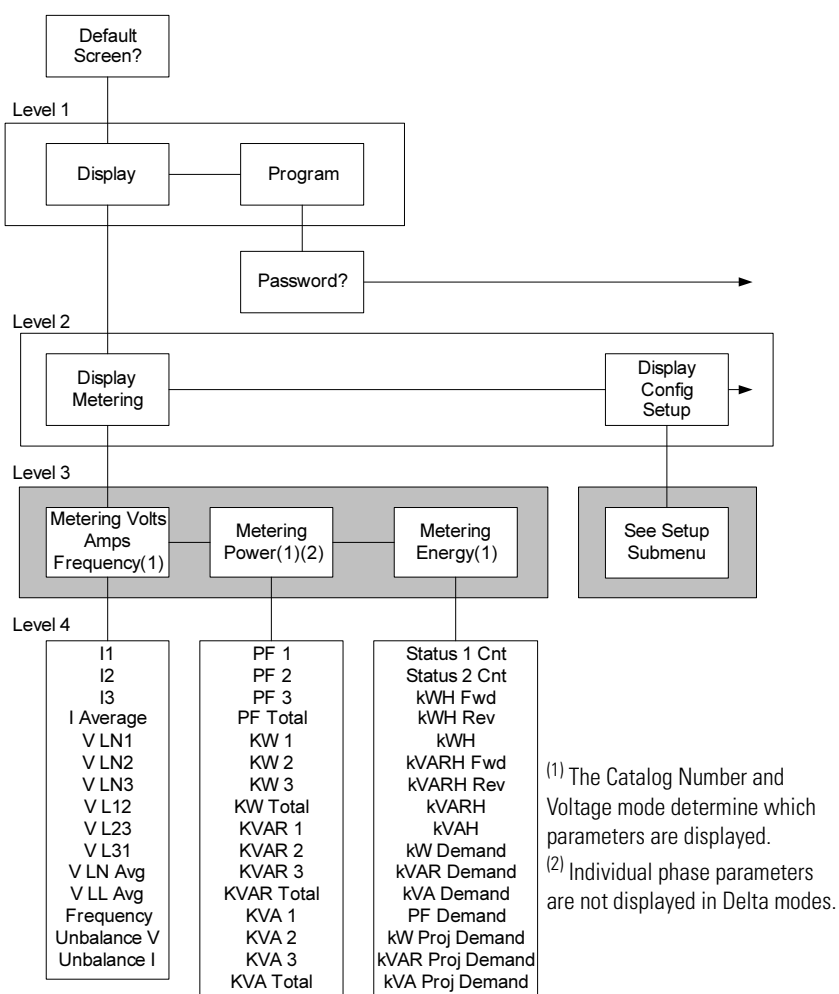
Table 13 - Button Function

Button	Mode		
	Display	Program	Edit
Escape	Returns to parent menu At top menu, selects default screen		Cancels changes to the parameter and returns to Program mode
Up arrow	Steps back to the previous parameter or menu item		Increments the value of the highlighted digit
Down arrow	Steps forward to the next parameter or menu item		Decrements the value of the highlighted digit
Enter	Steps into a sub-menu or sets default screen	Steps into a sub-menu, selects the parameter to be modified or changes to Edit mode	Saves the parameter change and returns to Program mode
Up and down arrows together	Refreshes the display	No effect	Moves the highlight cursor one character to the left

User choices for display and configuration are organized in a hierarchical menu system within the PowerMonitor 1000 unit.

This diagram shows how to navigate in the display and configuration menu.

Figure 5 - Menu Navigation

*LCD Screen Display and Configuration Menu Map***Figure 6 - Main Menu, Page 1**

Default Screen

The PowerMonitor 1000 unit lets you select and navigate to a default screen. The default screen displays at startup and is displayed after the display has been dormant for approximately 30 minutes. To set the current screen as the default, press Enter and click Yes. If you're in another menu and want to get back to the default screen, continue pressing Escape until you are prompted To Default Screen? Click Yes to display the default screen.

Figure 7 - Main Menu, Page 2

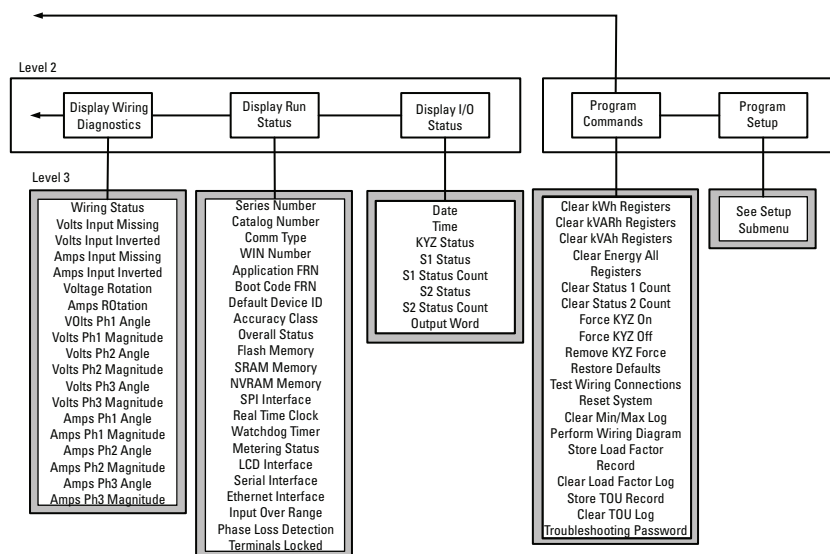
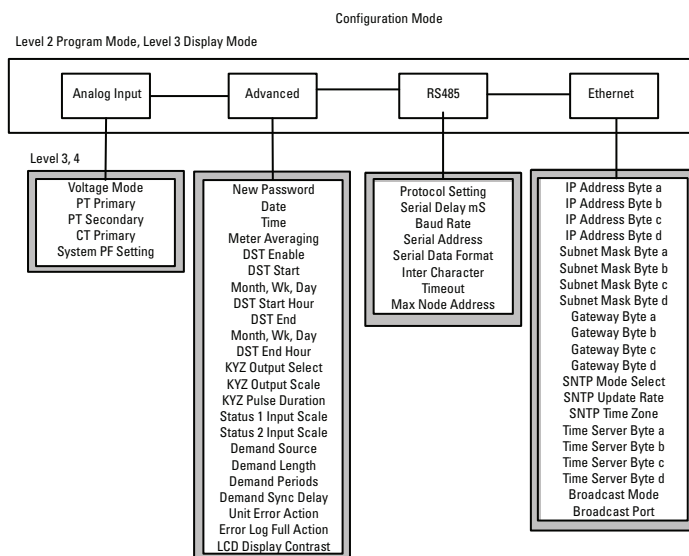


Figure 8 - Setup Submenu



Edit a Parameter

Follow these guidelines to edit a parameter:

- Press <up> or <down> to change the highlighted digit.
- Press <up> and <down> together to move the highlight cursor one place to the left, and press <up> or <down> to set the selected digit's value.

Continue in the same way until the correct value is entered then press <enter> when done.

Configuration with the PanelView Component C600 Terminal (optional HMI only)

The optional PanelView Component C600 terminal provides you with a more user-friendly interface to the capacitor bank controller. Use the navigation buttons on the bottom of each screen to navigate through the screens.

TIP If the Capacitor Bank HMI screens are not showing up, you will need to run the application through the PanelView Component terminal menu. The application project name is 1413-CAP-V3.

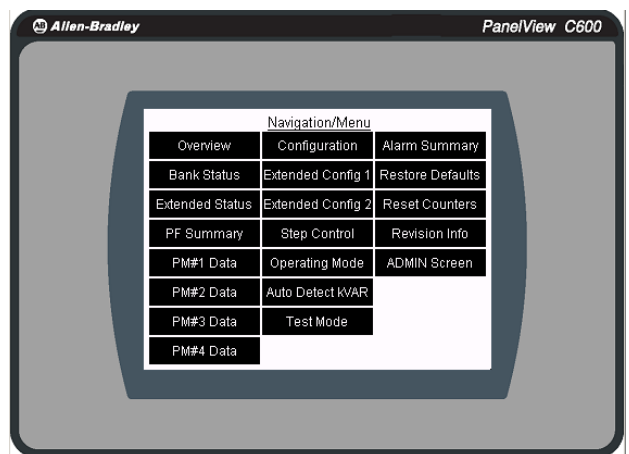
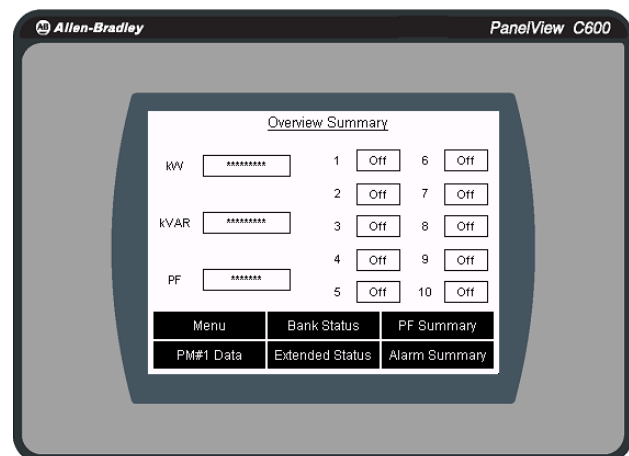
TIP Only solid fields are configurable; that is, the values in solid fields can be changed.

These images show the navigation through the PanelView Component terminal.

Clicking each button provides navigation to the configuration and metering screens.

This screen shows current realtime Power (kW, kVAR, and powerfactor) and displays the status of which capacitor bank steps are currently On or OFF.

The Navigation/Menu screen provides navigation to the different screens.

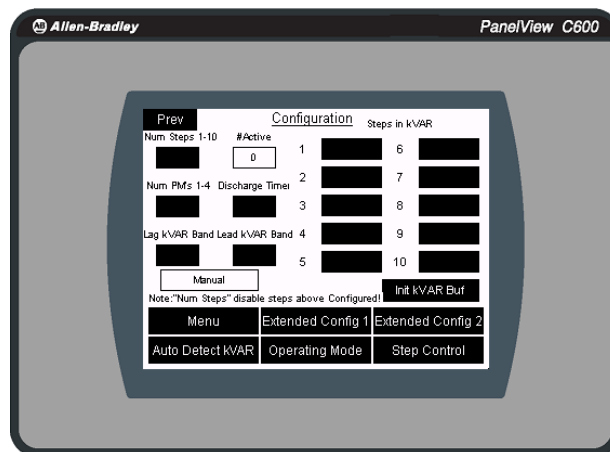


Configure the capacitor bank controller by using the optional PanelView terminal.

1. Press Menu to view the Menu from the Overview screen.
2. Press Configuration to view the Configuration screen from the Menu.

In this screen you can configure:

- the number of steps. The default value is 10; that will show all 10 steps. **Num Step** is between 1 and 10.
- **Number of PowerMonitors** from 1...4. Default is 1. At least one PowerMonitor unit must be configured.
- **Steps in kVAR**. This is the size of each capacitor. Step 1 is wired to Output 1 (Capacitor Bank step 1 contact) of the MicroLogix controller and step 10 is wired to output 10 (Capacitor Bank step 10 contact).



IMPORTANT Stages and/or sizes of the Capacitor Bank typically require a Power Quality study. The Capacitor Bank modes are Manual, FILO, Balanced, and Best Fit.

IMPORTANT For Discharge Time, check with the Capacitor Bank vendor for the appropriate value. One discharge Capacitor Bank value applies to all capacitor steps.

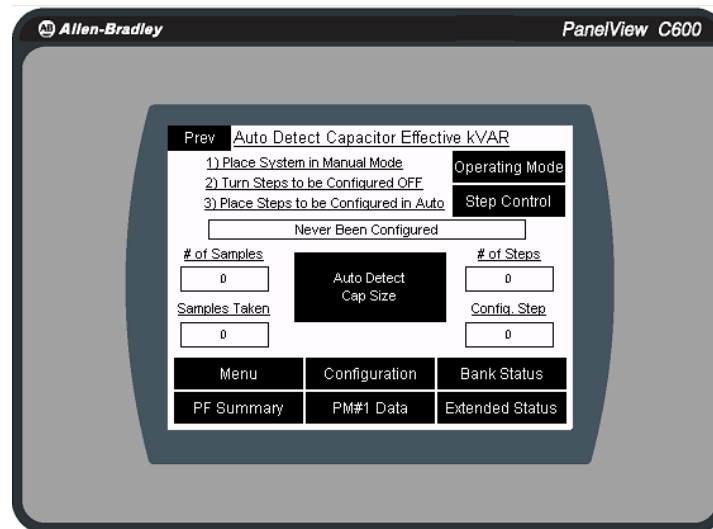
3. To edit a value, touch the desired field and the keypad appears.
4. Enter the desired value by using the keypad and press Enter to store the new value.

Pressing ESC cancels a change.

TIP This Auto Detect kVAR feature is used in the commissioning phase. It is recommended that the only load is the capacitor bank while using this feature. It may require physically installing the current transformers only for the capacitors. After running this feature, install your Current Transformers to your power side.

5. Press Auto Detect kVAR to navigate to the Auto Configure Effective kVAR process.

TIP The number of measurements to average for each step is entered on the Extended Configuration Screen #2 (F10).



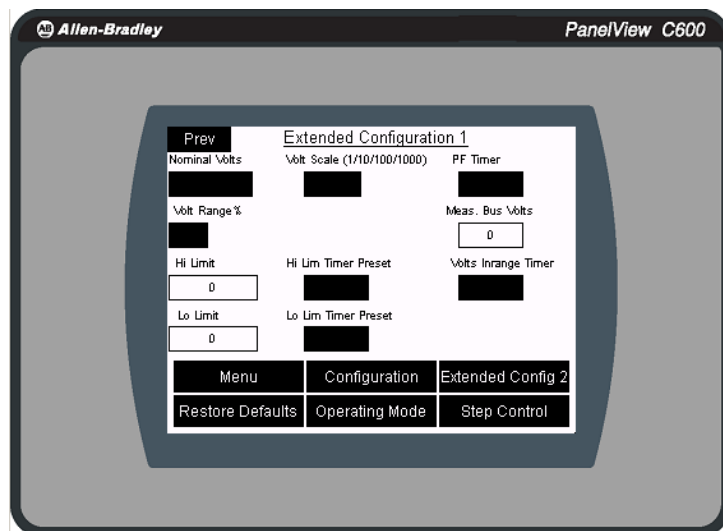
6. Follow steps 1...3 on this screen, then press Auto Detect Cap Size to initiate the auto-configuration process.
7. Navigate to the Extended Status screen and write down the Measured kVAR for each of your capacitor banks.
8. Navigate to the Configuration screen and configure the steps with the measured kVAR data.

9. Navigate to Menu then to Extended Configuration 1.

This screen operates in the same way as the initial configuration screen.

These guidelines apply in the Configuration screen:

- **Nominal Volts** is a number between 0 and 9999 using the scale 1/10/100/1000. Therefore, a voltage of 13,400V would be entered as 1340.
- **Volt Range %** is used for voltage high/low alarms.
- **Timer preset** is for **high and low values** for the high/low voltage alarms.
- **PF timer** is used to generate alarm if Powerfactor is not achieve in that time.

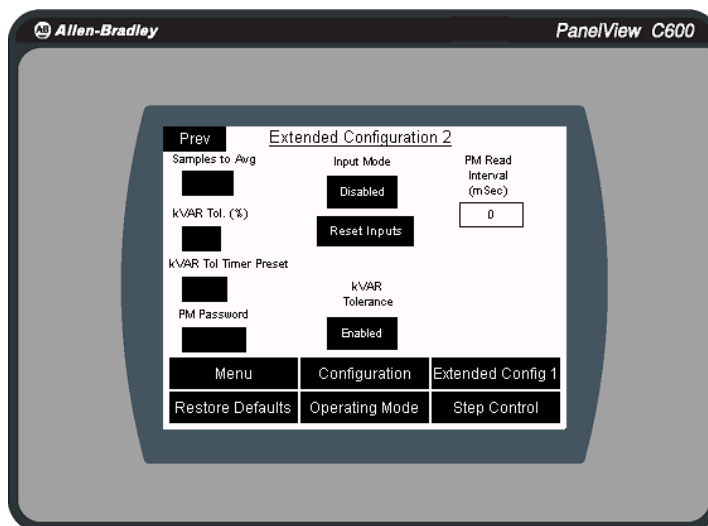


TIP All timers are in seconds.

10. Press Extended Config 2 to navigate to the Extended Configuration 2 screen from the Extended Configuration 1 screen.

These guidelines apply in the Configuration screen:

- The **Samples to Avg** number is between 5 and 10.
- The **kVAR tolerance %** of each capacitor to trigger alarming.
- **Input mode** is disabled by default. If you are using fault relays for respective steps, we recommend that you use Input mode. Reset inputs will clear controller alarms.



TIP The leading kVAR limit allowed for the system, before the controller acts to correct lead, typically is 33% of smallest capacitor step. The lagging kVAR limit allowed for the system, before the controller acts to correct lag, typically is 66% of largest capacitor step.

11. Set the Step Control to Manual or Auto.

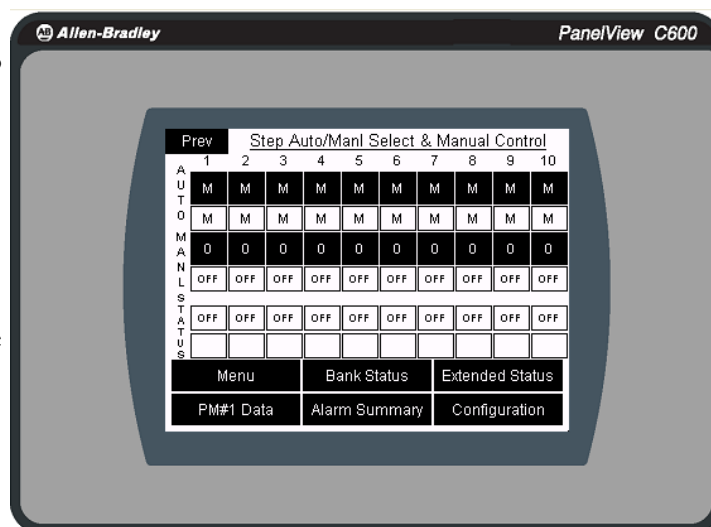
This screen shows the step control of the Capacitor Bank controller. Step Control screens let you place a step in Auto (A) or Manual (M) mode.

When using the Balanced, Best Fit, or FILO operating mode, make sure all the steps are in Auto mode. Just pressing the step will toggle the step in Auto (A) or Manual (M) mode.

The first row (from the left) is to configure the step; the second row is the status of step (A or M).

The third row is Manual command. You can press the respective step and if it is in Manual mode you can turn that step On or Off.

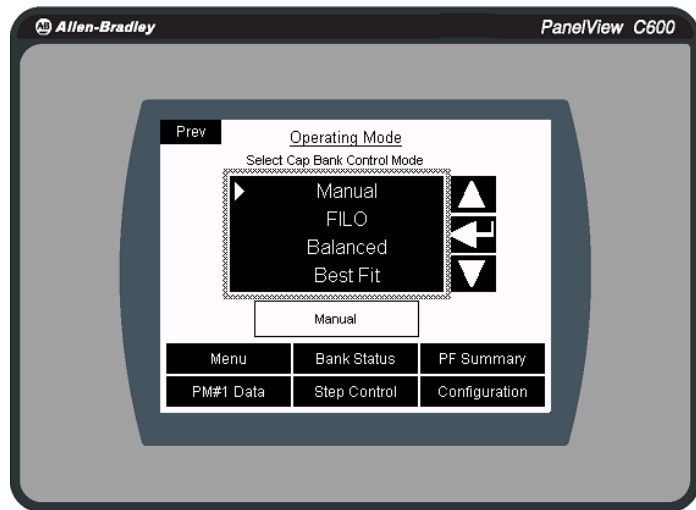
The second-last row indicates On/Off status of each step. The last row shows discharging status. If a Capacitor Bank is discharging, it will show a flashing 'D'.



12. Navigate to Menu then to Operating Mode and select your operating mode.

This screen shows the Operating mode. Verify your steps are configured properly before making Operating mode selections:

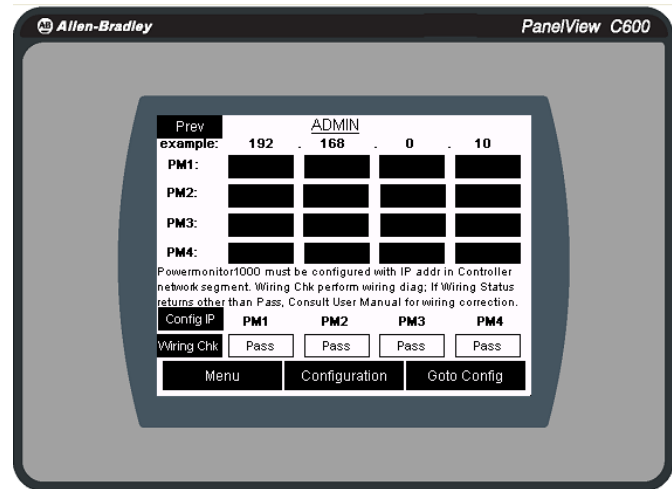
- Manual (mode = 0) – This mode disables all automatic operating modes. Manual mode is the default configuration. All capacitor steps have a default configuration of auto.
- FILO (mode = 1) – This mode of operation switches the capacitor steps on and off in first-in, last-out (FILO) order. That is, the first step on is the last step turned off. This is most useful when all the capacitor steps are of similar size.
- Balanced (mode = 2) – This mode counts the number of opening operations on each capacitor step and switch-capacitor steps to balance the number of opening operations equally across all of the employed capacitor steps. This mode is also most useful when all of the steps are of similar size.
- Best Fit (mode = 3) – This mode selects capacitor steps to be switched on and off to most closely achieve the target power factor and kVAR needs of the system. When the system's kVAR needs to increase, the available step or steps with the closest (aggregated) kVAR rating is added. On decreasing kVAR demand, steps are switched off in similar fashion.



13. Navigate to Menu then to ADMIN Screen.

The Admin screen provides the IP address of the PowerMonitor units used in the Capacitor Bank controller.

The default IP address for the Powermointor 1000 unit in this application is 192.168.254.64. After changing the IP address, you must press Config IP for the controller to change the IP address in the explicit messaging.



ATTENTION: Changing the IP address causes all of the capacitors to turn off and that can cause a power disturbance.

Capacitor Bank Commissioning Checklist

Follow this checklist prior to using the Capacitor Bank:

- Wear proper personal protective equipment (PPE).
- Complete a Power Quality study to understand the power profile to staging the right step sizes of the Capacitor Bank.
- Check that the PowerMonitor unit is wired correctly.
- Check that the Overview screen shows valid Power data (kW, kVar, and Powerfactor). If no data is displayed, go to the Admin screen and verify the IP address of the PowerMonitor unit.

As a minimum, the following configurations are required.

- Configuration is the number of steps configured with Discharge time, lead and/or lag settings.
- Configuration 1 and 2 are Nominal voltage, Voltage high/low limits, Powerfactor timers, samples to average, and Input modes.
- Step Control configures all the steps in the appropriate mode.
- Operating mode is one of the three Automatic modes, FILO, Balanced, or Best Fit.

Operation

Introduction

The capacitor bank controller gathers real- and reactive-power data by using one or more PowerMonitor meters. The processor manipulates data in engineering units of kVAR and kW. The unit does not directly control power factor, but rather works to actively minimize imported and exported kVAR. The net result of this philosophy indirectly controls power factor and minimizes voltage excursions associated with excessive kVAR export.

The capacitor bank controller can accommodate up to four different utility feeds and/or generators. Each feed requires an individual PowerMonitor 1000 meter. The unit sums the kW and kVAR readings from each of the PowerMonitor 1000 meters to arrive at an aggregate kVAR so that a single capacitor bank could be used to compensate several feeds simultaneously.

The traditional C/k ratio is not required for the capacitor bank controller because we are working in engineering units within the processor.

Aggregate Power Factor is calculated and displayed by using this formula:

$$PF_{Aggregate} = \frac{KW_{Aggregate}}{\sqrt{KW_{Aggregate}^2 + KVAR_{Aggregate}^2}}$$

The PowerMonitor 1000 meter data is gathered over Ethernet by using the MicroLogix 1400 controller.

Operating Modes

Each capacitor step can be individually selected to on, off, or auto status. The capacitor discharge-timer interlock is in effect in Manual mode to prevent capacitor bank damage. In Auto mode, a step is available to any of the automatic sequences described below. In the On or Off mode, a step is unavailable to any automatic operating mode:

- **Manual** (mode = 0) – This mode disables all automatic operating modes. Manual mode is the default configuration. All capacitor steps have a default configuration of auto.
- **FILO** (mode = 1) – This mode of operation switches the capacitor steps on and off in first-in, last-out (FILO) order. That is, the first step on is the last step turned off. This is most useful when all the capacitor steps are of similar sized.

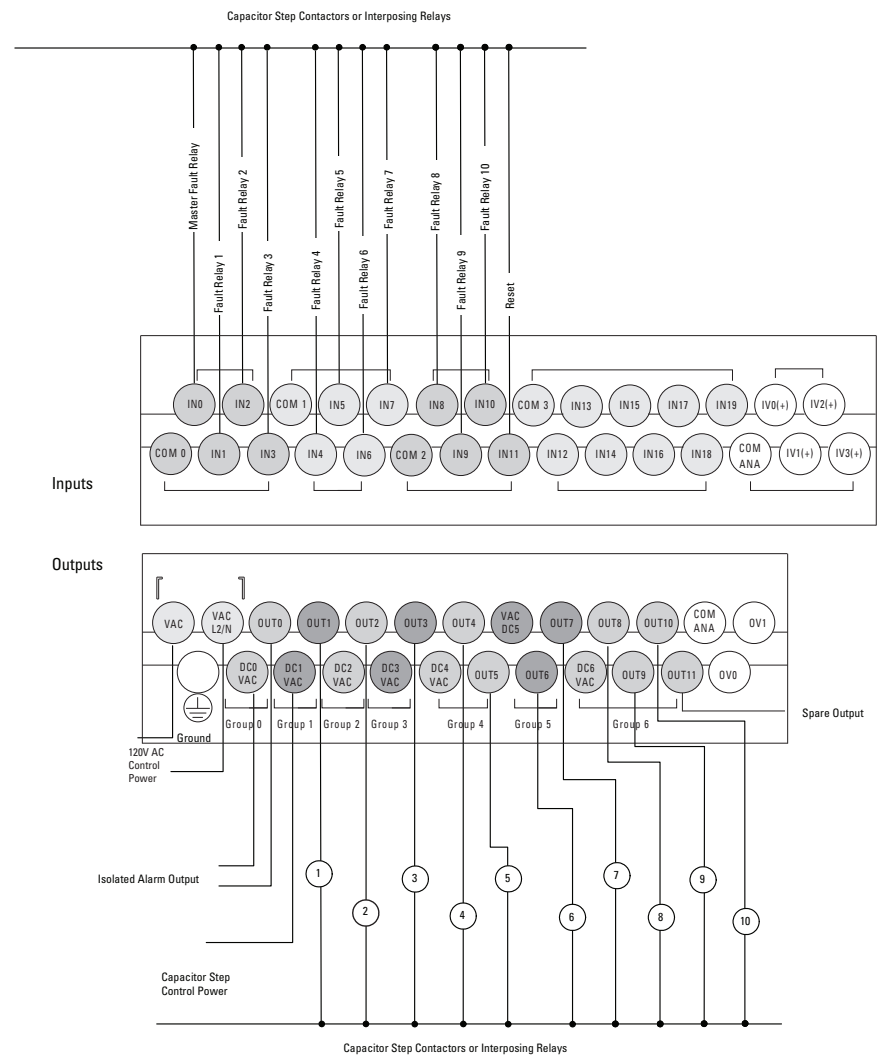
- **Balanced** (mode = 2) – This mode counts the number of opening operations on each capacitor step and switch-capacitor steps to balance the number of opening operations equally across all of the employed capacitor steps. This mode is also most useful when all of the steps are of similar size.
- **Best Fit** (mode = 3) – This mode selects capacitor steps to be switched on and off to most closely achieve the target power factor and kVAR needs of the system. When the system's kVAR needs increase, the available step or steps with the closest (aggregated) kVAR rating is added. On decreasing kVAR demand, steps are switched off in similar fashion.

Fault Relay Operation

Fault-protection relays can be used to immediately discharge all or specific capacitor steps during a fault occurrence. Input 0 is wired to a normally closed fault-protection relay and discharges all capacitor steps during a fault occurrence (low-state condition). Inputs 1... 10 are wired to normally closed fault-protection relays, and discharges its respective capacitor step during a fault occurrence (low-state condition). If fault protection is not being used for a specific capacitor step, then that respective input is wired closed by using the controller supplied 24V DC power.

A normally-open momentary pushbutton is wired to Input 11. This pushbutton is used to reset the controller after a fault occurrence.

Output 0 is used as an alarm relay and is wired normally open to an external alarm indicator. Outputs 1...10 are wired to normally-open contactors for each respective capacitor step.

Figure 9 - Controller Wiring Diagram

Input Interlock Mode

The Input Interlock mode allows fault protection for each capacitor step through the use of fault-protection relays. Wire normally closed fault-protection relays to each input from 0...10 of the controller. Wire a normally-open momentary pushbutton to Input 11. This pushbutton serves as a reset button.

During a fault occurrence, the controller discharges and locks-out the respective capacitor step associated with the fault relay that tripped. The fault-protection relay wired to Input 0 discharges and locks-out all capacitor steps. The remaining fault-protection relays discharge and lock-out their respective capacitor step (that is, Input 1 discharges and locks-out capacitor step 1).

In order to place a capacitor step back into the sequence, a fault must not be present for that step, and a reset must be initiated by pushing the Reset pushbutton.

Alarms

The capacitor bank controller offers these alarms:

- **Bad Step** - This alarm indicates a blown fuse and/or loss of capacitor condition. The controller measures actual VAR output from a capacitor step, averages, and compares this value with the original effective capacitor value. When actual VAR is more than the user-configurable StepKvarTolerance (default 5%) below the effective step size for a user-configurable delay (default 30 seconds), the alarm is activated. The alarm is reset when actual VAR output is greater than or equal to the setpoint for the same delay. The step will be latched as tripped/offline if the VAR output falls below 90% of nominal.
- **Target power factor not achieved** - If actual power is less than setpoint for a user-adjustable number of seconds, then the alarm flag is set.
- **PowerMonitor Communication Loss** - If the MicroLogix controller loses communication with the PowerMonitor meter, then the alarm flag is set.
- **High and Low Voltage** - If BusVolts is outside either limit, this alarm is activated immediately. After the voltage returns to the proper range for a configurable amount of time, this alarm is reset.

Edit and View Data

You can use the MicroLogix 1400 controller to edit and view Integer and Bit files. The PanelView Component C600 terminal provides an operator interface.

MicroLogix 1400 Controller

The LCD interface provides access to all data registers.

The Binary (bit) Elements and Integer (Word) Elements tables define how these register assignments are made.

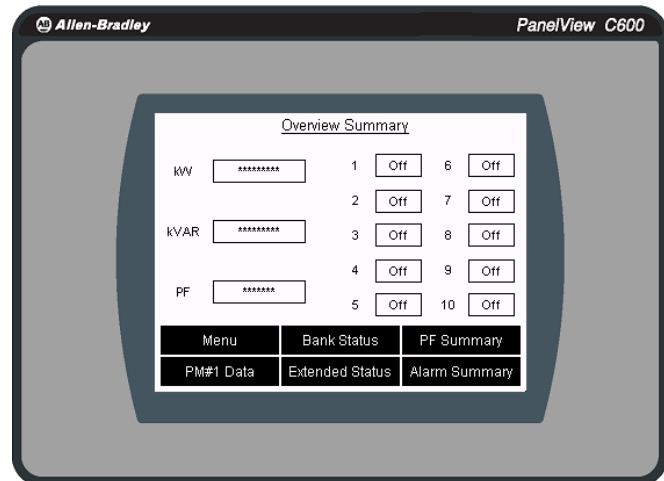
See [page 34](#) for the Integer (word) Elements and [page 38](#) for the Binary (bit) Elements.

Refer to pages [31...33](#) for information on using the LCD to edit configuration parameters.

Optional PanelView Component C600 HMI

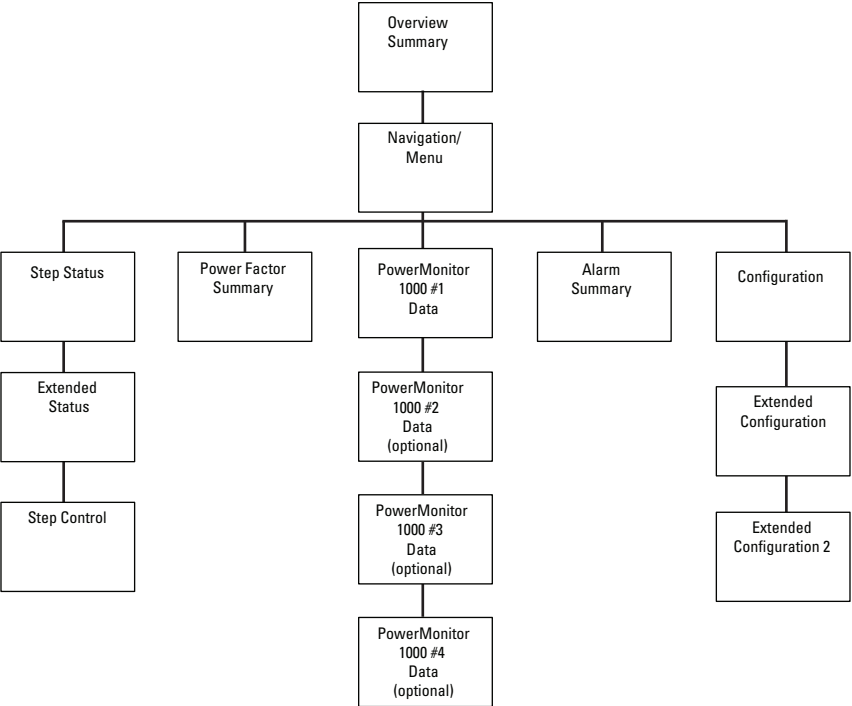
The optional PanelView Component C600 HMI provides you with a user interface. During operation these screens are provided:

- Overview Summary
- Navigation/Menu
- Bank Status
- Extended Status
- Step Control
- Power Factor Summary
- Powermonitoring Data x4
- Alarm Summary
- System Configuration

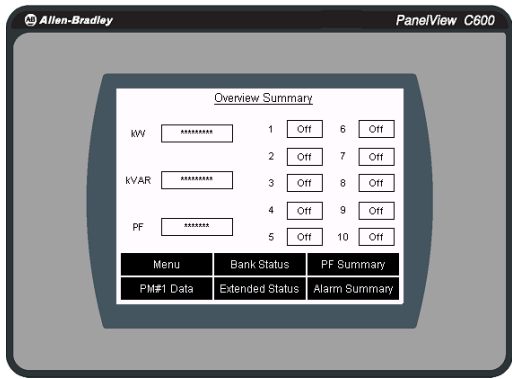


These status screens show the operation of the capacitor bank controller.

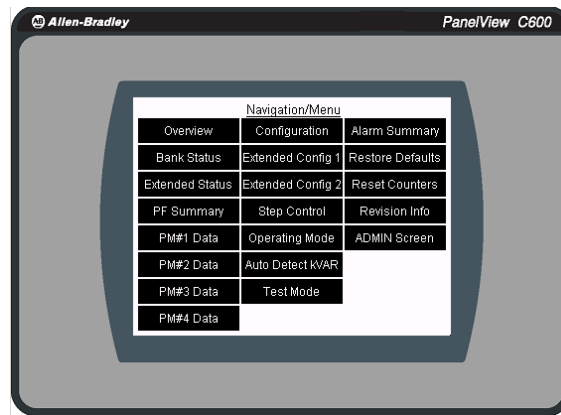
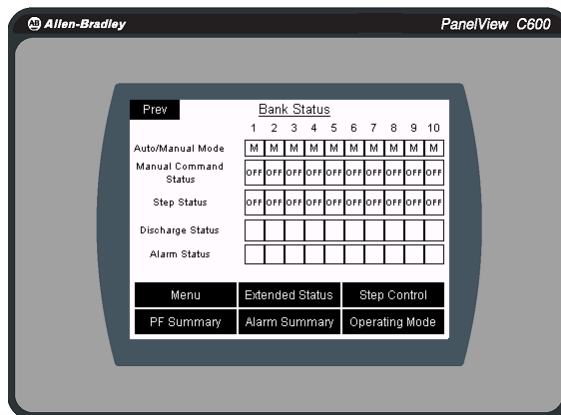
Screen Navigation Tree



Overview Summary Screen



This is the home screen and displays after you apply power. Press Menu to navigate to the Menu screen.

Navigation/Menu Screen*Bank Status Screen*

The status for the steps is listed in vertical columns from 1...10. There are no configurations on this screen. It displays status data only.

Mode: A = Automatic, which means the step is controlled based on the operation mode selected. M = Manual, which means you can force the step on or off via the keypad.

Step Status: 1 = On, 0 = Off.

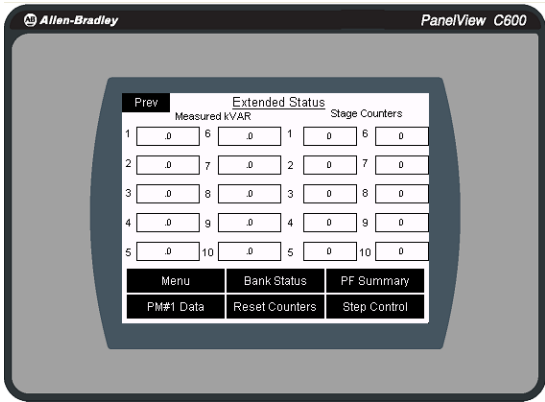
Discharge Status: ' ' = Not Discharging, D = Discharging.

Alarm: ' ' = No Alarm, 'A' = In Alarm.

You can press Extended Status to navigate to the Extended Status Screen.

Press Menu then Overview to return to the Overview Summary Screen.

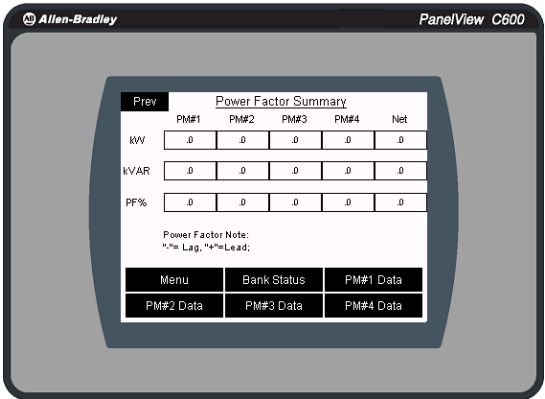
Extended Status Screen



Press Reset Counters to navigate to the Reset Counters screen.

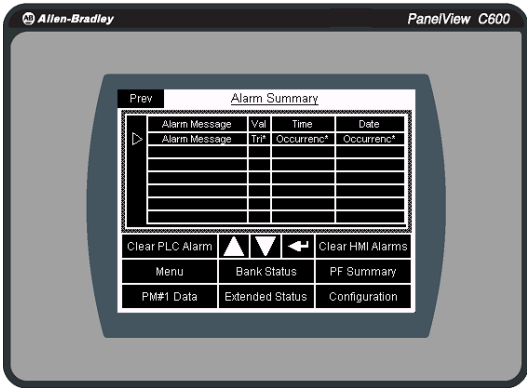
There are no other user-configurable fields on this screen. Press Menu and then Overview to return to the Overview Summary Screen.

Power Factor Summary Screen



There are no user-configurable fields on this screen. Press Menu then Overview to return to the Overview Summary Screen.

Alarm Summary Screen

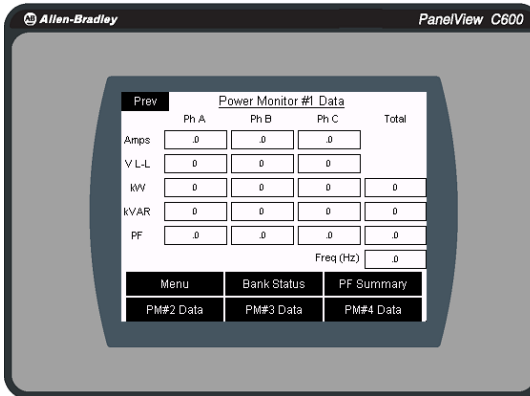


Alarms are listed in the center of the screen. Alarms can be cleared at the PLC or HMI level by using the corresponding buttons on this screen.

Press Menu then Overview to return to the Overview Summary Screen.

PowerMonitor Meter Screen

There are four instances of this screen, one for each of the PowerMonitor meters.



There are no user-configurable fields on this screen. Use the navigation buttons on the bottom of the screen to navigate to each PowerMonitor Data Screen. Press Menu then Overview to return to the Overview Summary Screen.

Notes:

SCADA Interface

Power-circuit Parameters

The capacitor bank controller reads power-circuit parameters from the PowerMonitor meters and makes that data available in its data table for use by other applications such as SCADA or HMI systems.

This table lists the PowerMonitor meter data available in the controller. The symbol x indicates the PowerMonitor meter number. Addresses related to PowerMonitor meter no. 1 begin with F11:0, addresses related to PowerMonitor meter no. 2 begin with F12:0.

Table 14 - Available PowerMonitor Meter Data

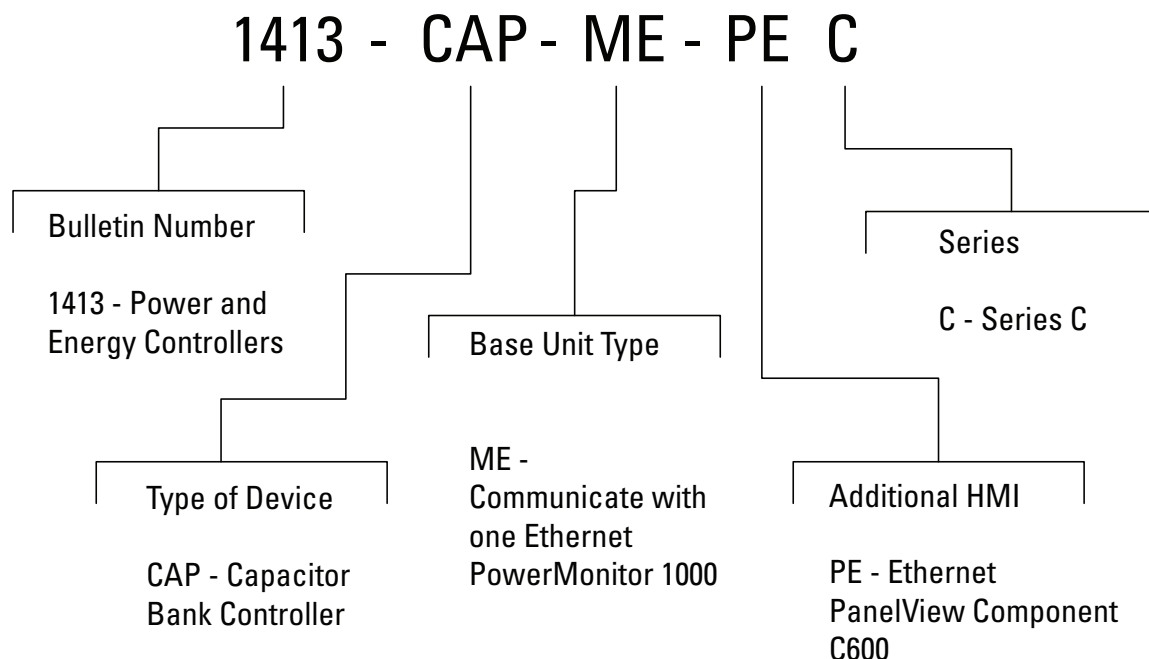
Address	Parameter
F1x:0	L1 Current
F1x:1	L2 Current
F1x:2	L3 Current
F1x:3	L1-L2 Voltage
F1x:4	L2-L3 Voltage
F1x:5	L3-L1 Voltage
F1x:6	Frequency
F1x:7	L1 Real Power
F1x:8	L2 Real Power
F1x:9	L3 Real Power
F1x:10	Total Real Power
F1x:11	L1 Reactive Power
F1x:12	L2 Reactive Power
F1x:13	L3 Reactive Power
F1x:14	Total Reactive Power
F1x:15	L1 Power Factor
F1x:16	L2 Power Factor
F1x:17	L3 Power Factor
F1x:18	Total Power Factor

Additional data is available in systems with the Ethernet PowerMonitor meter option.

In these systems, all PowerMonitor meter data may be accessed by using the Ethernet communications port integral to the PowerMonitor meter.

Please refer to the PowerMonitor 1000 User Manual, publication [1408-UM001](#), for further information.

Catalog Number Explanation



Base Unit with Ethernet 1413-CAP-ME PowerMonitor Meter

This includes a base controller and one PowerMonitor 1000 meter on the Ethernet network. Note that ME = Ethernet meter communication. Communication between the MicroLogix controller and the PowerMonitor meter are through the Ethernet network. The MicroLogix 1400 controller LCD interface is used to configure the capacitor bank. There is no HMI terminal for viewing or configuring data with this option.

Ethernet Base Unit with 1413-CAP-ME-PE Ethernet HMI

To add PanelView Component C600 terminal to the system, add PE to the catalog number. A PE indicates HMI with Ethernet communications.

This option includes a PanelView Component terminal as the HMI to configure or view the capacitor bank controller in addition to the MicroLogix 1400 controller and the PowerMonitor 1000 meter. This option provides access for quick configurations.

Table 15 - Summary

Cat. No.	PowerMonitor Meters	PanelView Terminals	MicroLogix Controller to PowerMonitor Communication	MicroLogix Controller to SCADA Communication
1413-CAP-ME C	Ethernet	None	Ethernet	Ethernet
1413-CAP-ME-PE C	Ethernet	Ethernet	Ethernet	Ethernet

The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication [AG-7.1](#).

Bank An overall capacitor or tuned-filter assembly. This controller is designed to manage and control one bank consisting of 10 steps.

Instance An instance of an object represents a complete iteration of an object and all of its attributes and methods. For example, the vacuum switch describes a typical vacuum switch. Each physical switch would result in one instance of a vacuum switch object. Each instance of an object must be managed independently in the software.

PM See PowerMonitor meter.

PowerMonitor meter The power measuring device located at the plant mains. There may be more than one PowerMonitor meter in a system depending on the number of electrical feeds into the plant.

Step A single switched circuit in a capacitor or filter bank. There are up to 10 steps in a bank. Others in the industry may also refer to these as stages.

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.

At <http://www.rockwellautomation.com/support/>, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

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

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html , or contact your local Rockwell Automation representative.

New Product Satisfaction Return

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

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

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication [RA-DU002](#), available at <http://www.rockwellautomation.com/literature/>.

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