

Eaton® PDI PowerPak Remote Power Panel

Installation and Operation Manual



p/n: P-164001112
Revision 01



Dear Customer,

On behalf of everyone at Eaton, we thank you for partnering with us, and trusting us to maintain your business continuity and preventing downtime at your facility.

Our suite of backup power, power distribution and power management products are designed to protect you from a host of threats including power outages, surges, lightning strikes, and enable you to monitor and control your power infrastructure.

We trust that your Eaton Uninterruptible Power Supply system and Accessory Products, will deliver high quality, reliable backup power for your business, and we are committed to your success.

Please read this Installation and Operation Manual, which details the installation, and operation processes for your uninterruptible power supply system.

Thank you for choosing Eaton!

Eaton reserves the right to change specifications without prior notice. Eaton is a registered trademark of Eaton. PDI, JCOMM, Quad-Wye, ToughRail Technology, and WaveStar are registered trademarks of Power Distribution Inc. All other trademarks are held by their respective owners. All other trademarks are property of their respective companies.

©Copyright 2023 Eaton, Raleigh, NC, USA. All rights reserved. No part of this document may be reproduced in any way without the express written approval of Eaton.

Table of Contents

1 Safety	1
2 Installation Planning	3
2.1 PowerPak RPP Summary	3
2.2 Typical PowerPak RPP Internal Feature Configurations	4
2.3 PowerPak RPP Specification	4
2.4 Installing PowerPak RPP Cabinets	5
2.5 External Cabinet Configurations	6
2.5.1 Floor Mount Cabinet – 24" W x 24" D x 83" H	6
2.5.2 Floor Mount Cabinet – 24" W x 38" D x 83" H	7
2.5.3 Wall Mount Cabinet – 26" W x 9" D x 72.5" H	8
2.5.4 Wall Mount Cabinet – 39" W x 12" D x 72.5" H	9
2.6 PowerPak RPP Electrical Configurations	10
3 Installation	11
3.1 Receiving and Unpacking Unit(s)	11
3.2 Move the Unit to the Installation Location	11
3.3 Installing PowerPak RPP Cabinets	12
3.4 Power Wiring	12
3.4.1 Cable Entry/Exit	12
3.4.2 Input Power Connections	14
3.4.3 Output Power Connections	16
4 Initial Startup	17
4.1 Pre-Startup Inspection	17
4.2 Startup	17
5 Operating Procedures	19
5.1 Initial System Startup	19
5.2 Normal System Startup	19
5.3 Normal Shutdown	19
5.4 Mission Critical Dual Input Transfer Procedures	19
5.4.1 Normal Operation	20
5.4.2 Transfer from Primary Source to Alternate Source	20
5.4.3 Transfer from Alternate Source to Primary Source	21
6 Monitoring	23
6.1 BCMS	23
6.2 Color Monitor and Protocols	23
6.3 Customer Network Connections	24
6.3.1 Modbus Connections	24
6.3.2 Ethernet Upstream Cables	24

Table of Contents

6.4 Modbus Addressing	25
6.5 Network Connections Details	26
6.5.1 Color Monitor Network Connections	26
6.5.2 Modbus RTU Ports.....	26
6.5.3 Modbus RTU 2-Wire vs. 4-Wire Configuration	27
6.5.4 Modbus RTU Upstream Cable Specification	27
6.5.5 Modbus RTU Cable Biasing and Termination	28
7 Resources	29
7.1 Bibliography	29
7.2 Getting Help	29
7.3 Warranty and End User License Agreement	30
7.4 Equipment Registration	30

List of Figures

Figure 1.	PowerPak RPP Sections with Features Summary.....	4
Figure 2.	RPP Outline Drawing – 24" W x 24" D x 83" H.....	6
Figure 3.	RPP Outline Drawing – 24" W x 38" D x 83" H	7
Figure 4.	RPP Outline Drawing – 26" W x 9" D x 72.5" Wall Mount.....	8
Figure 5.	RPP Outline Drawing – 39" W x 12" D x 72.5" H Wall Mount.....	9
Figure 6.	PowerPak RPP Electrical Configurations.....	10
Figure 7.	24" W x 24" D Bottom Conduit Plate	13
Figure 8.	24" W x 38" D Bottom Conduit Plate	14
Figure 9.	PowerPak RPP Typical Component Layouts.....	15
Figure 10.	Typical Mission Critical Transfer Controls	20
Figure 11.	Modbus Terminal Block	24
Figure 12.	Modbus Addressing.....	25
Figure 13.	Color Monitor Backpanel Network Connections	26

List of Figures

List of Tables

Table 1.	PowerPak RPP Location Planning Information	5
Table 2.	Pin-Out for Modbus Headers.....	27

List of Tables

Chapter 1 Safety

Please pay special attention to the use of “Danger” symbols throughout this manual indicating electrical or other safety hazards. Following these safety instructions is extremely important to avoid possible injury or death.



This symbol is used throughout this manual to indicate the presence of high voltages, representing a hazard for electric shock, burn or explosion. Follow the instructions carefully to avoid serious or fatal injury.

Follow safe electrical work practices:

- Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel and in accordance with all local safety codes. Eaton assumes no responsibility for any consequences arising out of the use of this manual. This document should not be viewed as sufficient by otherwise non-qualified personnel to operate, service, or maintain the equipment discussed.
- Disconnect and lock-out all power supplying equipment before working on or installing PowerPak Remote Power Panel components. Use a properly rated voltage sensing device to confirm power is OFF.
- Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel and in accordance with all local safety codes. Eaton assumes no responsibility for any consequences arising out of the use of this manual. This document should not be viewed as sufficient by otherwise non-qualified personnel to operate, service, or maintain the equipment discussed.
- Read, understand, and follow the instructions before installing this product.
- Install device in an appropriate electrical enclosure per local regulations.
- ESD sensitive equipment. Ground yourself, discharge any static charge and ensure that the device is effectively grounded before handling the unit.

An installed PowerPak Remote Power Panel must be securely fastened to a leveled floor.

Chapter 2 Installation Planning

2.1 PowerPak RPP Summary

The Eaton® PDI PowerPak Remote Power Panel (RPP) is a versatile RPP with a small footprint:

- PowerPak RPPs come in the following cabinet sizes:
 - 24" W x 24" D x 83" H Floor Mount
 - 24" W x 38" D x 83" H Floor Mount
 - 26" W x 9" D x 72.5" Wall Mount
 - 39" W x 9" D x 72.5" H Wall Mount
- Internal feature sets can be selected and combined for nearly any RPP application.
- A single WaveStar® Color Monitor can display Branch Circuit Monitoring System (BCMS) power monitoring information for up to four (4) panelboards. Alternative Eaton and Square D monitoring systems are also available.

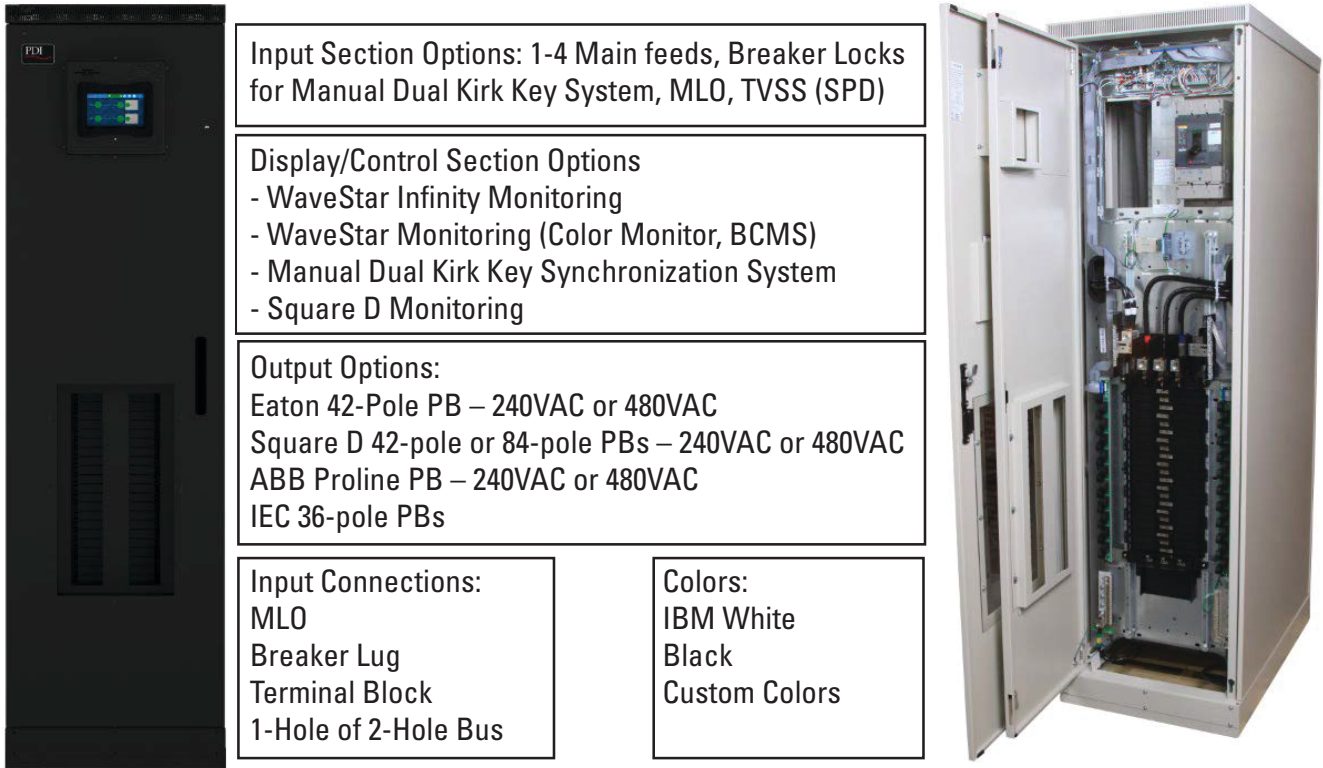
The PowerPak RPP is certified through ETL for these standards: UL 60950, UL 891, CS 22.2, and EN/IEC 60950.

**NOTE**

The term PDI in this manual refers to products previous manufactured by Power Distribution, Inc. All service and support for these features are now supplied by Eaton.

2.2 Typical PowerPak RPP Internal Feature Configurations

Figure 1. PowerPak RPP Sections with Features Summary



Units are manufactured using predefined kits that provide easy combination of features. Configurations are collections of kits laid out in four PowerPak RPP sections: Input, Display/Control, Output A, and Output B. Internal features and electrical configurations are independent of the way the unit is mounted.

2.3 PowerPak RPP Specification

All cabinets have the same dimensions and clearances and similar weights.

Table 1. PowerPak RPP Location Planning Information

PowerPak RPP Single Unit Location Specifications		
Dimensions:	24" W x 24" D x 83" H Floor Mount 24" W x 38" D x 83" H Floor Mount 26" W x 9" D x 72.5" H Wall Mount 39" W x 9" D x 72.5" H Wall Mount	
Clearances:		
Front:	36" (service and ventilation)	
Back:	36" (service and ventilation)	If Optional Rear Mounted Panelboards Installed.
Top:	18" (ventilation)	
Underfloor:	12" (for cabling, if bottom entry)	
Weight:	Approximately 225 lbs.- maximum 600 lbs.	Weight varies by unit configuration.
Environmental Requirements:		
Storage temperature	-55°C and +85°C (-67°F to 185°F)	Units should be stored in an area with uniform temperature and continuous air flow to minimize condensation.
Operating temperature	0°C to 40°C (32°F to 104°F)	
Relative humidity	0% to 95% non-condensing	
Altitude	Maximum 3,300 ft. (1,000m)	Call Factory is operated above 3,300 feet (1,000m)

2.4 Installing PowerPak RPP Cabinets

PowerPak RPPs can be mounted on floors, on floor tiles with cutouts for bottom cabling, or on floor tile stringers, or wall-mounted based on the cabinet style.

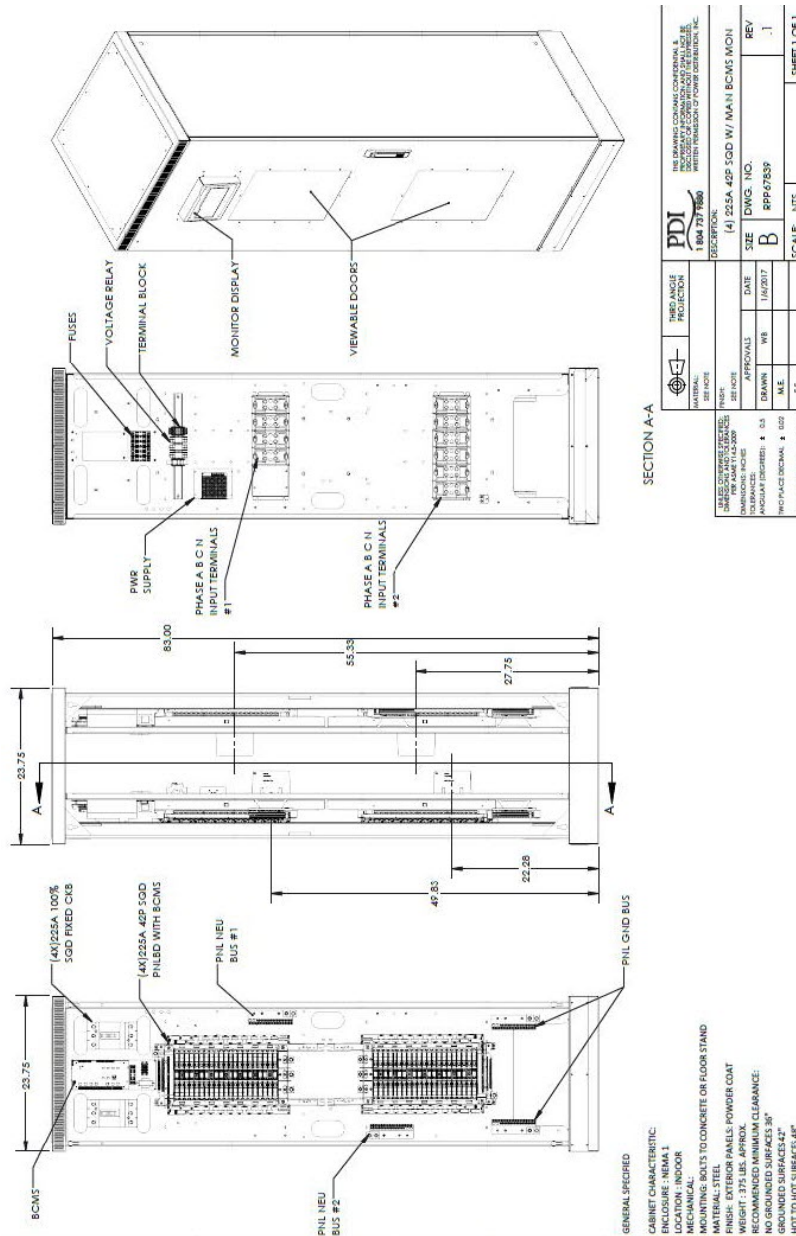
Floor Mount Units have pre-cut bolt holes for attaching to floors, Wall Mount Units have pre-cut bolt holes for attaching to walls.

2.5 External Cabinet Configurations

2.5.1 Floor Mount Cabinet – 24" W x 24" D x 83" H

The 24" W x 24" D x 83" H PowerPak RPP typical features and dimensions are shown in [Figure 2](#). PowerPak RPPs are not free-standing and must be attached to a wall or other vertical support or be secured to the floor.

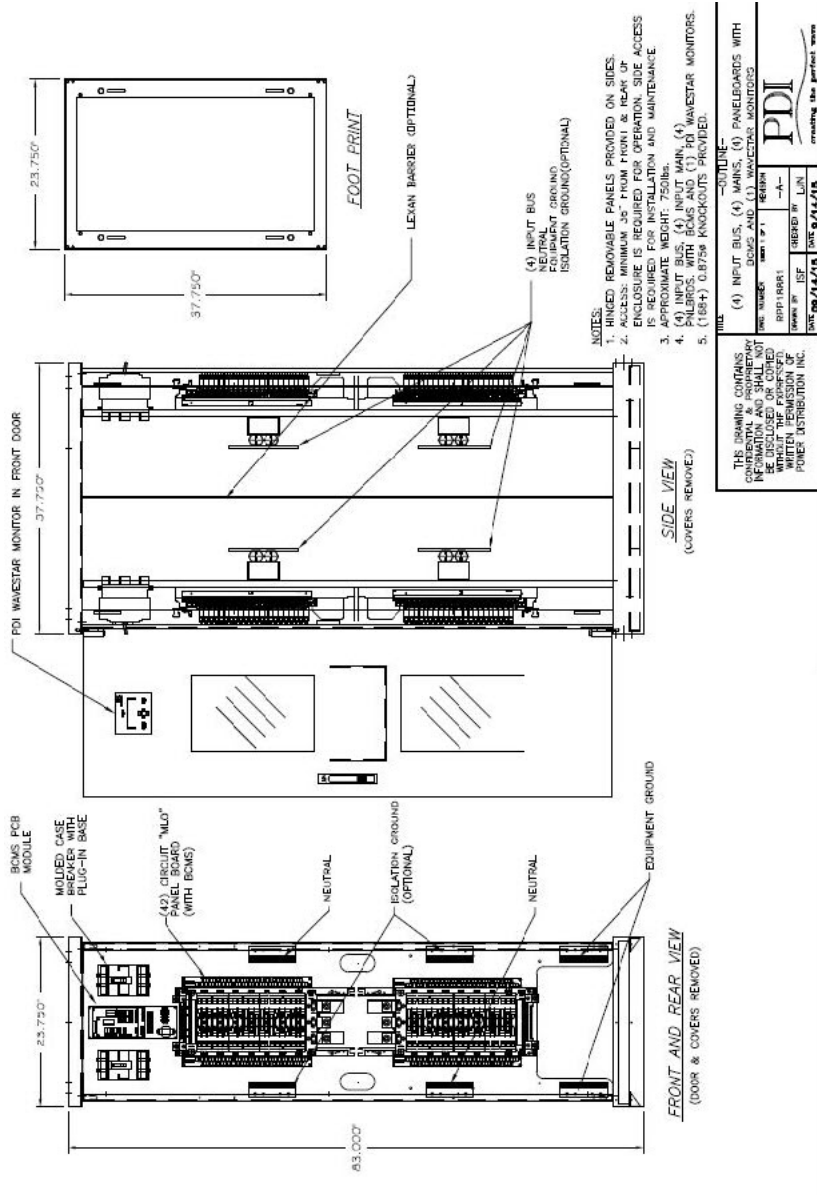
Figure 2. RPP Outline Drawing – 24" W x 24" D x 83" H



2.5.2 Floor Mount Cabinet – 24" W x 38" D x 83" H

The 24" W x 38" D x 83" H PowerPak RPP typical features and dimensions are shown in [Figure 3](#). PowerPak RPPs are not free-standing and must be attached to a wall or other vertical support or be secured to the floor.

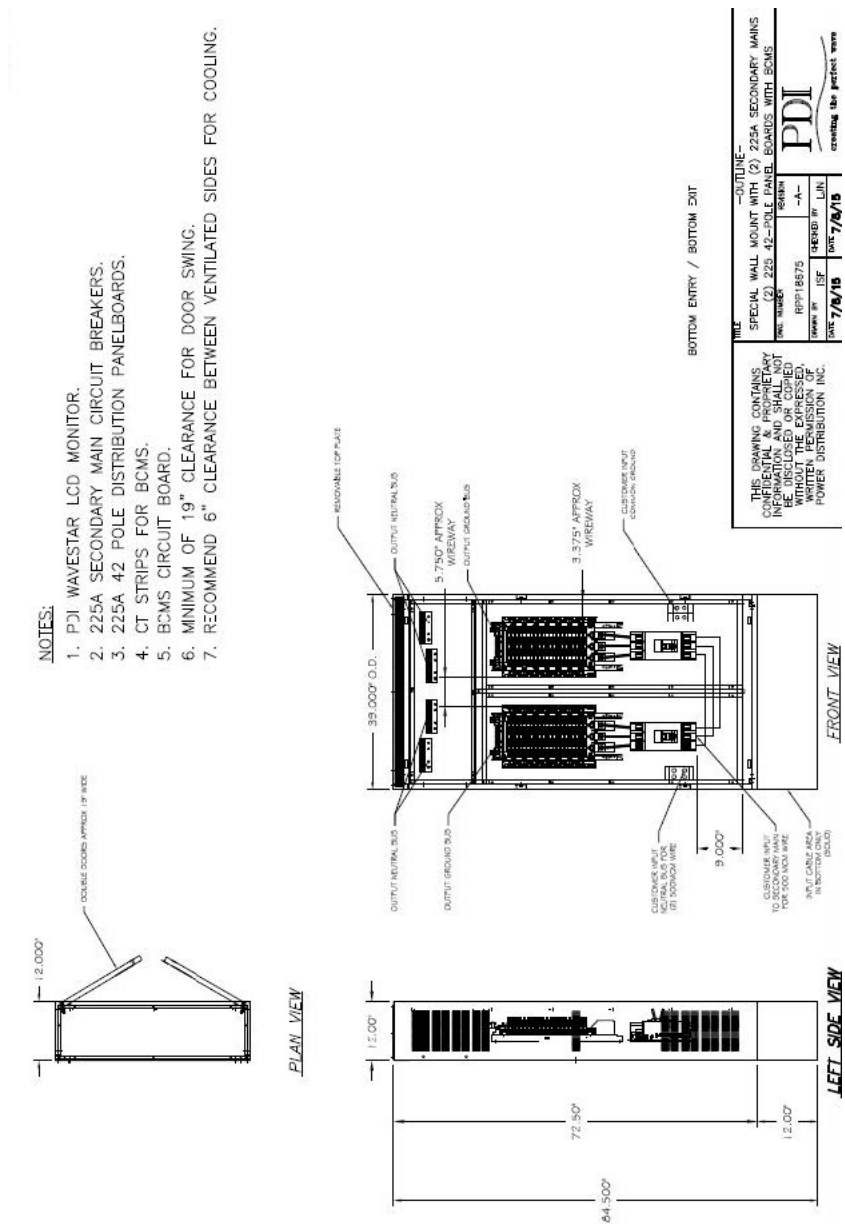
Figure 3. RPP Outline Drawing – 24" W x 38" D x 83" H



2.5.4 Wall Mount Cabinet – 39" W x 12" D x 72.5" H

The 39" W x 12" D x 72.5" H PowerPak RPP dimensions and mounting bolt holes are shown in [Figure 5](#). PowerPak RPPs are not free-standing and must be attached to a wall or other vertical support or be secured to the floor.

Figure 5. RPP Outline Drawing – 39" W x 12" D x 72.5" H Wall Mount

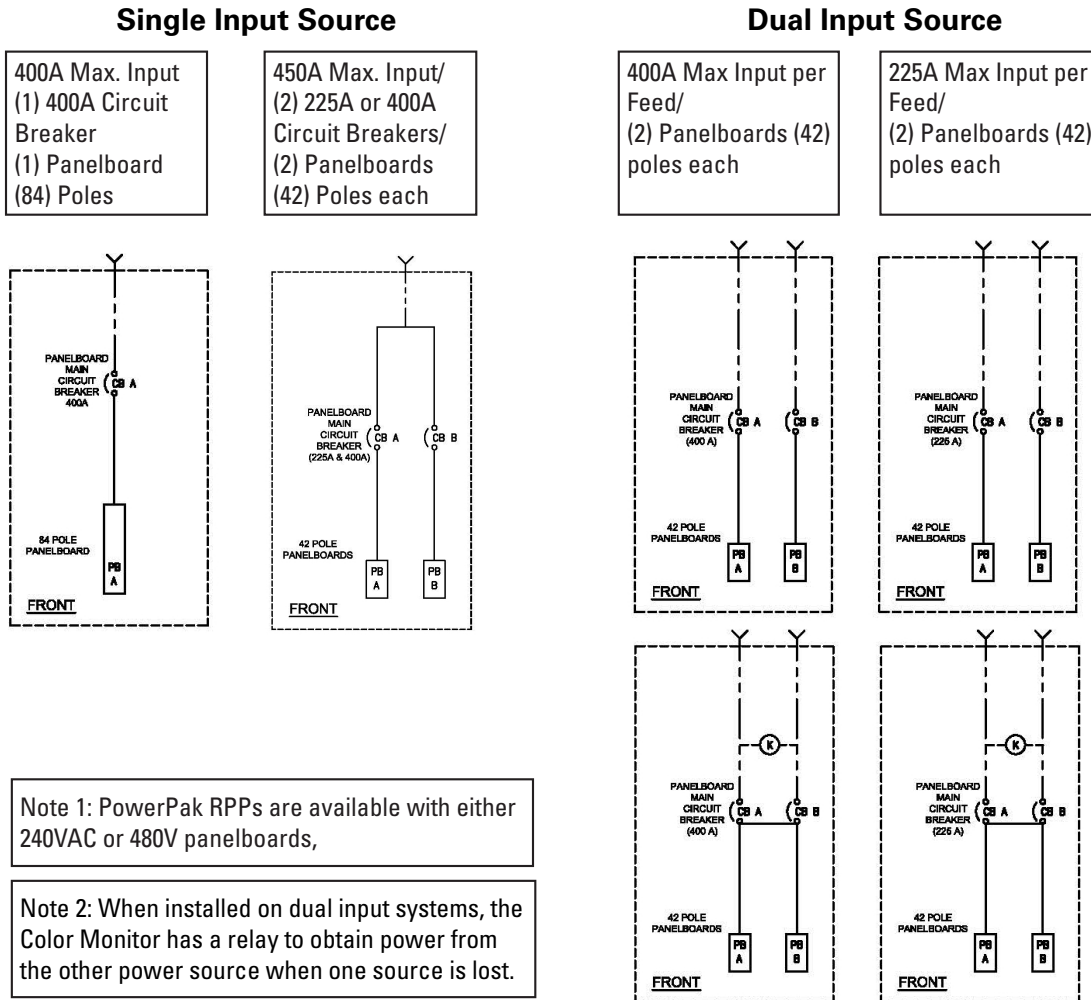


2.6 PowerPak RPP Electrical Configurations

PowerPak RPPs can have a variety of power configurations. The configurations below are created using Eaton or Square D panelboards. Other configurations are available using Eaton, Square D NF, IEC (SEA), and ABB Proline panelboards. Amperages and voltages vary by configurations.

Consult your PDI sales representative for configuration options. PDI Application Engineering can assist you in creating PowerPak RPP configurations suitable to your applications.

Figure 6. PowerPak RPP Electrical Configurations



Mission Critical Modular Compact RPPs

Mission Critical PowerPak RPPs are created by adding the Kirk-Key feature to dual input source PowerPak RPPs.

Chapter 3 Installation

⚠ DANGER

- A licensed electrician must install each unit. Startup by a PDI certified technician is also required to validate the warranty.
 - Severe or fatal injury can result from electrical shock during contact with high voltage conductors, monitoring PCBs, or similar equipment.
 - Disconnect power before drilling holes, attaching cables or conduit, or connecting Modular Compact RPPs to other power distribution equipment.
 - Use Lock Out/Tag Out procedures.
 - Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
 - Leave ample space for attaching and routing wires.
-

3.1 Receiving and Unpacking Unit(s)

PowerPak RPPs are shipped standing upright and attached to pallets with wood screws.

Upon receiving a PowerPak RPP pallet and before removing packaging, inspect packaging for visible damage that could affect the PowerPak RPP(s). If damage is evident, notify PDI and the shipping company (see below).

Carefully cut retaining bands and remove packaging from units, but leave units attached to their pallets. Use care to not puncture or scratch the PowerPak RPP cabinets with cutting tools.

⚠ CAUTION

Retaining bands are under tension; cut them carefully. Wear eye protection and protective clothing when cutting bands.

After removing packaging, check units again for damage, such as scratches, dents, or cracks.



NOTE

If any damage is evident during unpacking, notify the shipping company and PDI. Claims should be filed with the shipping company at time of delivery. Damage must be noted on the bill of lading. Failure to properly document damage may void the warranty.

See paragraph [7.2 Getting Help](#) for contact information.

3.2 Move the Unit to the Installation Location

Before moving a unit, plan the path from the receiving area to its installation location. Review obstacles, floor weight capacity, corners, etc.

Using a forklift or pallet jack, move the unit(s) (still secured to their shipping pallet) as close to the installation location as possible over your pre-planned route.

3.3 Installing PowerPak RPP Cabinets

Remove the wood screws attaching the unit(s) to the pallet. Make sure units do not tip over.

Slide or lift each unit or bolted-together pair carefully off the pallet onto the correct predetermined location. Individual units can usually be lifted by three or four persons. (Check the weight of your unit(s) given in your submittal package). Take care not to scratch or damage the unit(s). Units do not have casters and cannot be rolled.

- If mounting on a floor tile, the floor tile cutout should be made in advance.
- If mounting to a wall or vertical support, place the unit in the correct position and bolt to the support.
- If mounting to a floor stand, the floor stand should be installed in advance.

Once each RPP is in its final position, inspect for loose connections or displacement caused by shipping. Ensure all lug connections in ground bus, neutral bus, terminal blocks, etc. are tight and secured.

Check the main input feeder connections at the main breaker to be sure vibration has not loosened the terminal screws. Check the feeders from the load side of the main breaker to the client side of the panels.

Important: Customers are responsible for securing units to vertical supports, floor or floor stand. Refer to installation planning information in [Chapter 2 Installation Planning](#) for physical configurations and mounting information.

Customers must supply their own hardware for attaching units to the floor, stringers, or a wall.

3.4 Power Wiring

Power wiring must comply with NEC and applicable local codes and should be wired by licensed electricians. Reference your submittal package for 1-line drawings specific to your PowerPak RPP configuration.

3.4.1 Cable Entry/Exit

Cable entry/exit can be from top and/or bottom. Top and bottom plates can be interchanged at time of order according to customer cabling requirements.

- Bottom plates have pre-punched knockouts for 1/2" conduit.
 - 24" W x 24" D have 172 knockouts for 1/2" conduit (0.88" dia.) (see [Figure 7](#)).
 - 24" W x 38" D have 287 knockouts for 1/2" conduit (0.88" dia.) (see [Figure 8](#)).
 - Wall Mount Cabinets utilize solid plates with optional knockout plates.
- The top plate can be used for cutouts.

Open or remove door and execute knockouts for an appropriate number of conduits for intended cable connections.

Figure 7. 24" W x 24" D Bottom Conduit Plate

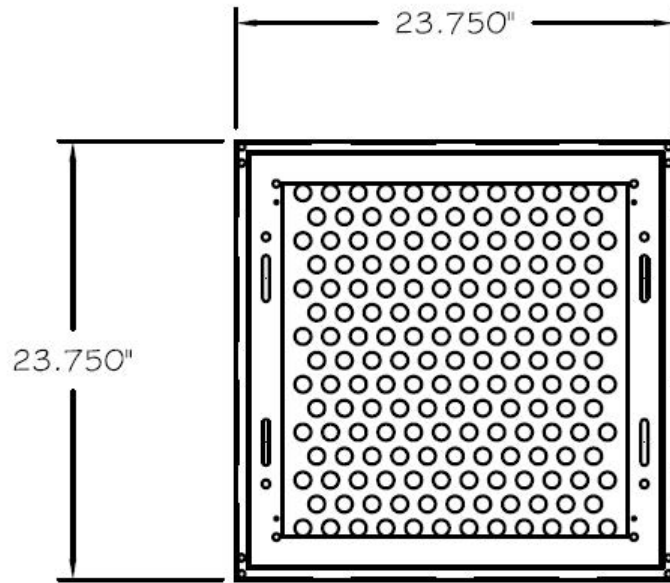
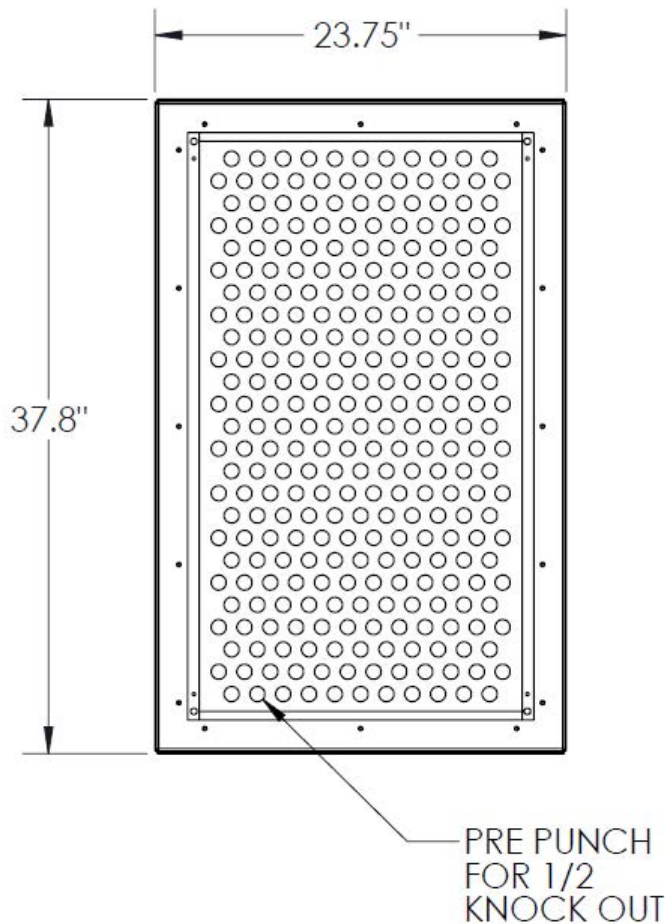


Figure 8. 24" W x 38" D Bottom Conduit Plate



3.4.2 Input Power Connections

[Figure 9](#) shows typical component locations for 42-pole panelboards, neutral and ground busbar connections. PowerPak RPPs are specifically engineered for unique applications and offer a wide variety of Input Power Connection types including terminal block and busbars.

CAUTION

Power wiring and grounding for this equipment must comply with NEC and local building and electrical codes.

The following provides cable size recommendations:

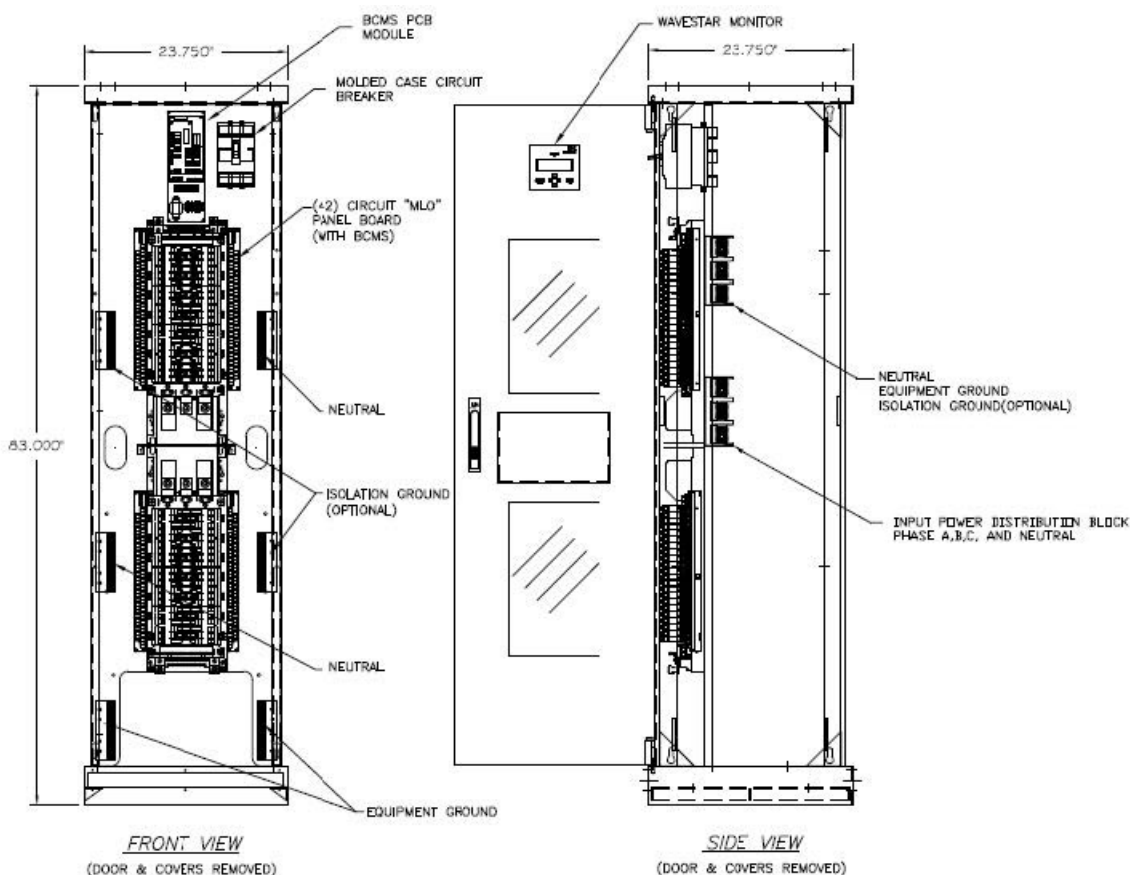
- Maximum cable sizes: 250 kcmil (MCM) Copper.
- Minimum recommended wire sizes:
 - Main feed input:
 - 225A main feed input: 4/0 wire (rated for 230A @75°C) for each phase
 - 400A or 450A main feed input: (2) x 4/0 (rated for 450A @75°C), (2) cables per phase.

- Neutral Busbar, neutrals are sized at 200% phase cables and need double-sized wires:
 - o 225A: (2) x 250 kcmil (MCM) or (2) x 4/0 wire (rated for 230A @75°C)
 - o 400A: (4) x 250 kcmil (MCM) or (4) x 4/0 wire (rated for 450A @75°C)
- Ground Busbar:
 - o 225A: #4 AWG Copper or #2 AWG Aluminum
 - o 400A: #3 AWG Copper or #1 AWG Aluminum
- Isolated Ground (optional): Use same wire size as ground.
- Maximum main feed conduit size: (2) conduits, 4-in. maximum, sized for (6)-wires 3P + 2N + 1G (Oversized neutral requires (2) cables.)

Pull input power conduit through knockouts.

Pull cables through units to main breaker lugs. Connect input cables to main circuit breaker lugs and torque lugs to circuit breaker manufacturer's specification.

Figure 9. PowerPak RPP Typical Component Layouts



3.4.3 Output Power Connections

PowerPak RPPs are usually shipped without installed panelboard circuit breakers. Customers are responsible for installing panelboard circuit breakers, running single phase wires through CT strips, and connecting circuit breakers to ground strips, neutral strips, and optional isolated ground strips.

The output panel boards should have all the output loads balanced at the panelboards to place equivalent current wave forms and magnitude on each output. Distributing the 3-pole breakers by ampacity evenly across matched panelboards provides optimum balancing. Single phase loads with high third harmonics should also be evenly balanced across the panelboards. Follow these steps to properly balance circuits.

1. Divide all output into three (3) categories by breaker pole position (1, 2, 3 pole).
2. Subdivide the three categories by breaker size (ampacity).
3. Assign the largest 3-pole breaker to panelboard #1.
4. If there is an even number of the larger 3-pole breakers, assign them evenly between the panel boards. If you are unable to assign them evenly, then assign smaller 3 pole breakers to the panel having fewer breakers.
5. Repeat steps 3 and 4 until all 3-pole breakers are installed.

When determining distribution cable length between panelboard circuit breakers and load equipment, provide sufficient cable length to avoid stress at the connection point between panelboard breakers and distribution cables.

When cabling, do not block access to ground and neutral terminals.

Chapter 4 Initial Startup

**WARNING**

At the initial startup of the Remote Power Panel, an Eaton factory-authorized technician must validate correct operation of the RPP.

The product warranty may be voided if the correct start-up procedures are not followed.

4.1 Pre-Startup Inspection

1. Before applying power to the PowerPak RPP, inspect wiring and connections. Incoming power to main feeds or MLO lugs should be de-energized and locked out before making this inspection.
2. Inspect wiring, components, and cabinet for damage.
3. Inspect all power connections for tight connections:
 - a. Ensure that all power lug connections in ground bus, neutral bus, and terminal blocks are tight and secured.
 - b. Check main feed terminal screws.
 - c. Check the main feed connections from the load side of the main breaker to the primary side of the panels.
 - d. Torque connections as follows:
 - i. For circuit breakers use manufacturer's recommendations.
 - ii. For other connections, see the torque table on a label on the inside door of the unit.
4. Inspect unit for debris or foreign objects and remove if present.
5. Check that ventilation openings are clean.
6. Check that service and ventilation clearances satisfy code requirements.

4.2 Startup

Before turning on power to the unit:

1. Confirm that the RPP main feed circuit breaker(s) are in the OFF position. (If a breaker has been tripped, reset the breaker to the OFF position.)
2. Lock out input power to the unit (PDU, UPS, or building power).
3. Ensure that all of the RPP output circuit breakers are in the OFF position.
4. Visual voltage label check: Verify that the input voltage to the unit matches the input voltage rating of the unit as identified on the system's legend label affixed to the interior of the front door.

Check input power:

1. Turn ON input power to one main breaker. (Note: if a main breaker trips to OFF when energized, it may indicate a fault in the unit. Contact PDI Service at (800)-225-4838.)
2. Measure and record voltages at input to the main feed(s): A-to-B, B-to-C, C-to-A. Incoming voltage should be + 5% to -10% of the unit's nominal rating.
3. Check for clockwise phase rotation and voltage at the input main feed circuit breaker(s).
4. Repeat steps 1-3 for second main feed breaker if present.

Check monitoring:

1. WaveStar Infinity Monitoring: The Infinity Monitor should turn on and display the Home screen when the power is applied to the main feed from which it receives power.
2. WaveStar Monitoring: The Color Monitor should turn on when power is applied to the main feed from which it receives power. Display panelboard screens for your configuration, but without load, most readings will be zero.



NOTE

On dual input systems, the Color Monitor has a relay to obtain power from the second power source, when its primary source loses power or is not enabled.

Sequentially energize loads by turning ON individual panelboards circuit breakers.

Chapter 5 Operating Procedures

5.1 Initial System Startup

Perform initial system startup as described in [Chapter 4 Initial Startup](#),

- after a PowerPak RPP is first installed, or
- after a PowerPak RPP has been subsequently relocated, or
- after a PowerPak RPP has been upgraded or had maintenance performed, or
- after a PowerPak RPP has been de-energized for a significant period of time.

Perform all checklist steps in [Chapter 4 Initial Startup](#).

5.2 Normal System Startup

Verify that all PowerPak RPP circuit breakers are turned OFF, both main feeds and panelboard circuit breakers.

Turn ON main feed circuit breaker(s).

- If a main feed circuit breaker has been tripped OFF, first reset the breaker by turning it OFF then ON.
- If a main feed circuit breaker trips OFF when energized, a fault may be present in the unit. Contact Eaton Help Desk, see paragraph [7.2 Getting Help](#) for contact information.

Turn ON power to loads by sequentially turning ON panelboard circuit breakers.

- Follow manufacturers' startup recommendations for load equipment

5.3 Normal Shutdown

The normal shutdown procedure for an RPP is to first shut down the PowerPak RPP's load equipment according to the equipment manufacturers' instructions. For example, shut down the operating system on a server, including powering down the server.

Then, turn OFF the associated panelboard circuit breakers on the PowerPak RPP.

After all panelboard breakers have been turned OFF, turn OFF the main feeds(s) to the PowerPak RPP panelboard(s).

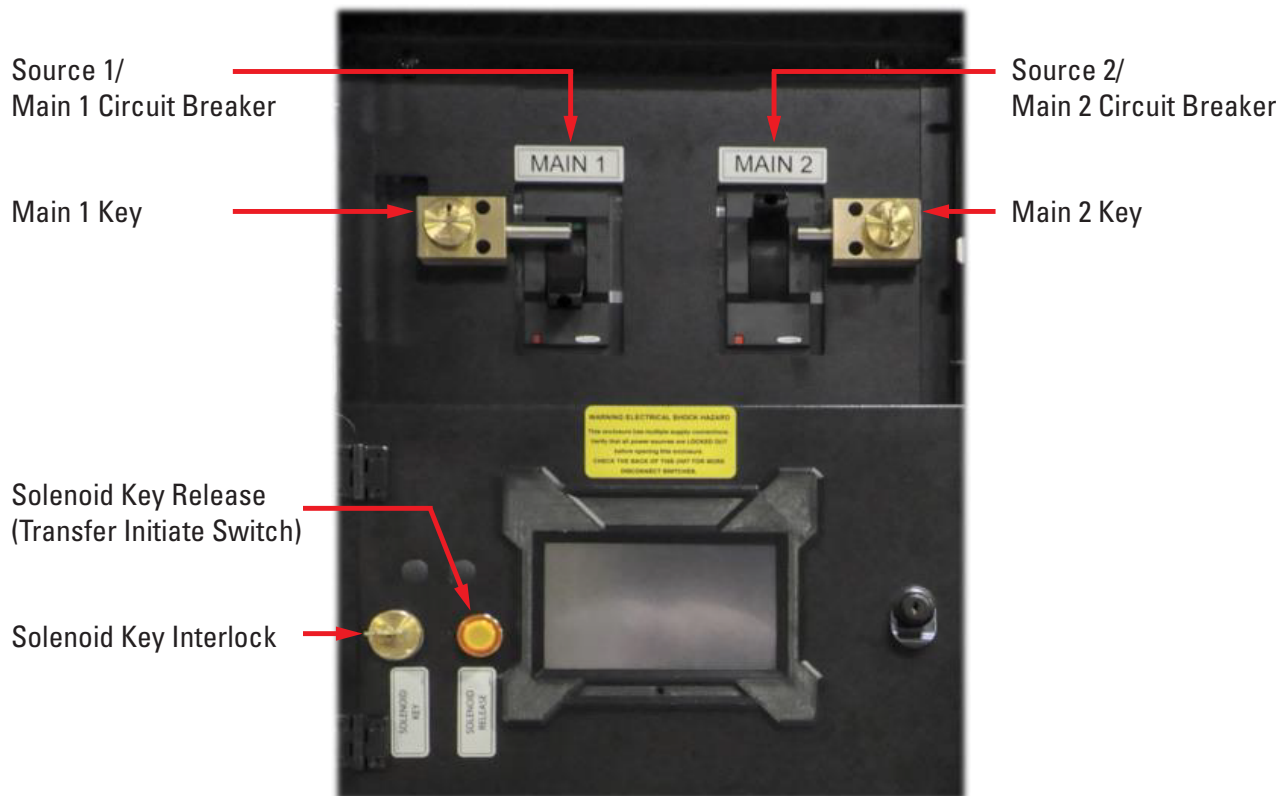
If the PowerPak RPP is to be moved or upgraded, also turn OFF PDU or building power to the main feeds and lock out power to the PowerPak RPP.

5.4 Mission Critical Dual Input Transfer Procedures

A Mission-Critical PowerPak RPP has dual voltage inputs, but only one at a time supplies power to the RPP. Voltage can be continuously supplied to the load while one main feed and panelboard are effectively offline. The dual inputs are switched manually using Trapped Keys with a Solenoid Key Release (transfer initiate switch). See [Figure 10](#). Arrangement of Input Breakers with Interlocks, Solenoid Key Release and Solenoid Key Interlock will vary in location based on the engineered design.

- Circuit breaker Main 1 is for the Primary Source (1).
- Circuit breaker Main 2 is for the Alternate Source (2).

Figure 10. Typical Mission Critical Transfer Controls



5.4.1 Normal Operation

The normal status for voltage input is as follows:

1. The Primary Source (1) is supplying power to the critical load.
2. Circuit Breaker Main 1 (Primary Source) is closed and its key is trapped.
3. Circuit Breaker Main 2 (Alternate Source) is locked open with no key trapped.
4. Solenoid Key Interlock is DE-ENERGIZED and the interlock key is trapped.

When the Solenoid Key Release button is lighted, the two sources are synchronized and power can be transferred from one source to another.

5.4.2 Transfer from Primary Source to Alternate Source

To transfer power input from the Primary Source to the Alternate Source:

1. Depress the Solenoid Key Release (transfer initiate switch). Unlock and remove the key from the Solenoid Key Interlock.
2. Insert the key into Main 2. Unlock and close Main 2.
3. Open circuit breaker Main 1 and lock open. Remove the key from Main 1.

4. Insert the key into the key interlock and turn to lock.

5.4.3 Transfer from Alternate Source to Primary Source

To transfer power input from the Alternate Source to the Primary Source:

1. Depress the Solenoid Key Release (transfer initiate switch). Unlock and remove the key from the Solenoid Key Interlock.
2. Insert the key into the Main 1 lock. Unlock and close circuit breaker Main 1.
3. Open circuit breaker Main 2 and lock open. Remove the key from Main 2.
4. Insert the key into the key interlock and turn to lock.

Chapter 6 Monitoring

PowerPak RPPs have several monitoring options:

- WaveStar Monitoring with Color Monitor and Branch Circuit Monitoring System (BCMS)
- BCMS only
- Square D monitoring
- No monitoring

WaveStar monitoring components—the Color Monitor and BCMS—should be ordered with the unit and installed at the factory.

6.1 BCMS

Each PowerPak RPP can have one (1) BCMS PCB, which can monitor up to 2 x 42-pole panelboards or 1 x 84-pole panelboard with their main feeds.

Each panelboard with its associated main feed is represented by a points list. A 42-pole panelboard is represented by a single panelboard points list. An 84-pole panelboard is represented by two (2) panelboard points lists.

Points lists are loaded onto BCMS PCBs at the factory. Several points lists are available:

- **BCMS Normal** panelboard points list allows customization of circuit breaker alarms and warnings for each panelboard circuit.
- **BCMS KWH** points list provides accumulated KWH measurements and other detailed power information for each panelboard circuit.
- **BCMS IEC** panelboard points list is for IEC format panelboards with 36 or 72 1P circuits.

See paragraph [7.1 Bibliography](#) for information on downloading points lists from the Eaton website.

6.2 Color Monitor and Protocols

When PowerPak RPPs are combined in a modular cluster, a single Color Monitor can display power information for up to (7) PowerPak RPP units or up to (14) panelboards.

The Color Monitor supports several protocols, which can all be used simultaneously.

Downstream Protocol The downstream device network has fixed parameters of Modbus RTU, 9600 baud, EVEN parity.

Upstream Protocols The Monitor has separate upstream ports for Modbus RTU and Ethernet, supporting these protocols:

- Modbus RTU
- Ethernet port
 - TCP/IP, used by the Color Monitor's web page server
 - Modbus TCP/IP
 - SNMP Version 1

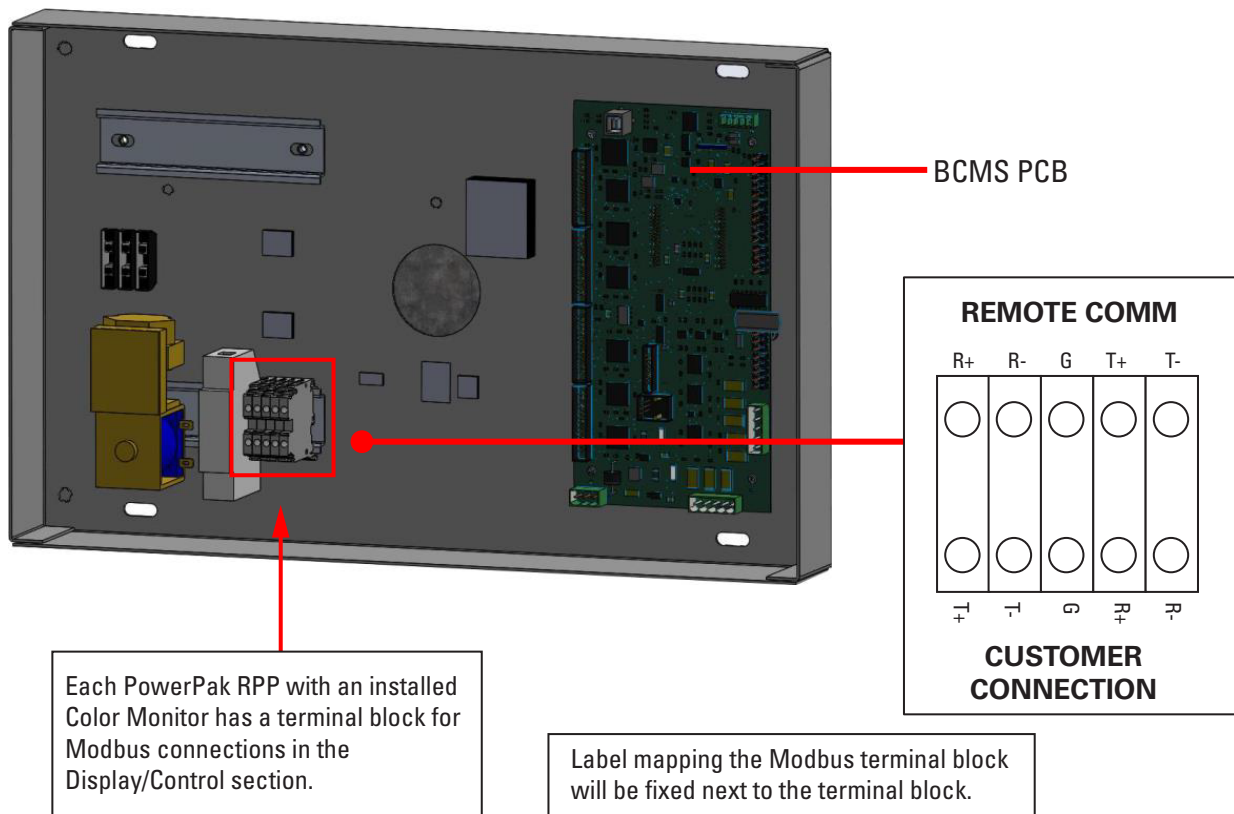
For in-depth information on the Color Monitor, including setup, networking, commands and replies, screens, and web pages, refer to the *WaveStar Color Monitor, Setup and Operation Manual*, see [7.1 Bibliography](#) for more information.

6.3 Customer Network Connections

6.3.1 Modbus Connections

Each PowerPak RPP with an installed Color Monitor has a terminal block for connecting Modbus RTU wiring. The Color Monitor is connected via Modbus RTU to the terminal block, allowing customers to make upstream connections without touching a BCMS PCM or Color Monitor backpanel. A label is attached next to the terminal block showing Modbus connections.

Figure 11. Modbus Terminal Block

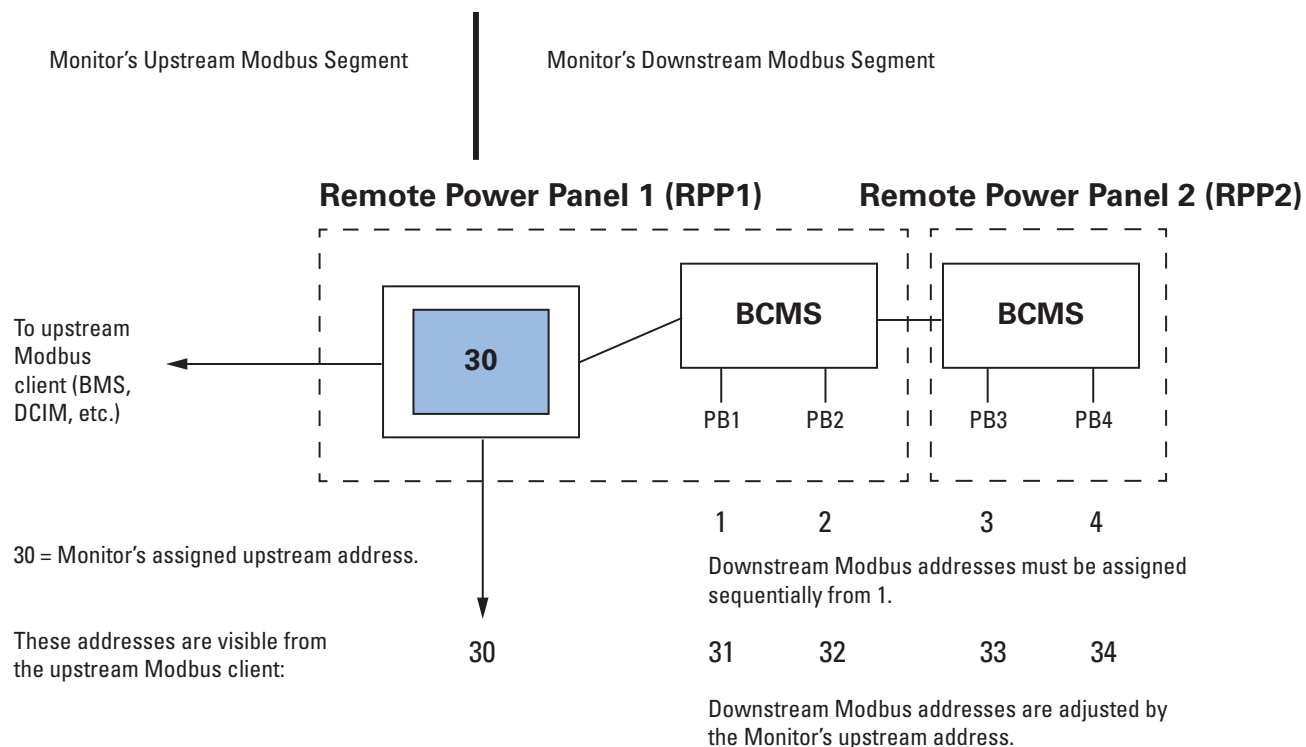


6.3.2 Ethernet Upstream Cables

The customer network Ethernet cable must be connected directly to the Color Monitor backpanel (see [Figure 13](#)). The customer's choice of Ethernet cable determines the maximum length of Ethernet cable.

6.4 Modbus Addressing

Figure 12. Modbus Addressing



Refer to [Figure 12](#) with the following bullet points:

- The Monitor is a Modbus client to its downstream devices. The upstream Modbus client cannot directly address these devices, but rather addresses them through the Monitor. Upstream and downstream are separate Modbus segments.
- The Monitor's upstream address can be set to from 1 to 255, but you must leave enough addressing capacity for downstream devices. The monitor will not respond to a command sent to address 0. The address is set during Monitor Setup.
- The Monitor's downstream devices must be assigned consecutive addresses starting at address 1. Modbus addresses must be assigned in BCMS setup and will be done initially at the factory. Modbus addresses cannot be assigned by, for example, the BMS.
- For upstream addressing these device addresses are remapped as successor addresses to the Monitor. If the Monitor has upstream address 30, the downstream addresses 1, 2, 3, 4 are remapped to 31, 32, 33, 34 as seen from the BMS or other Modbus client.
- Modbus addressing is the same for Modbus RTU and Modbus TCP/IP.

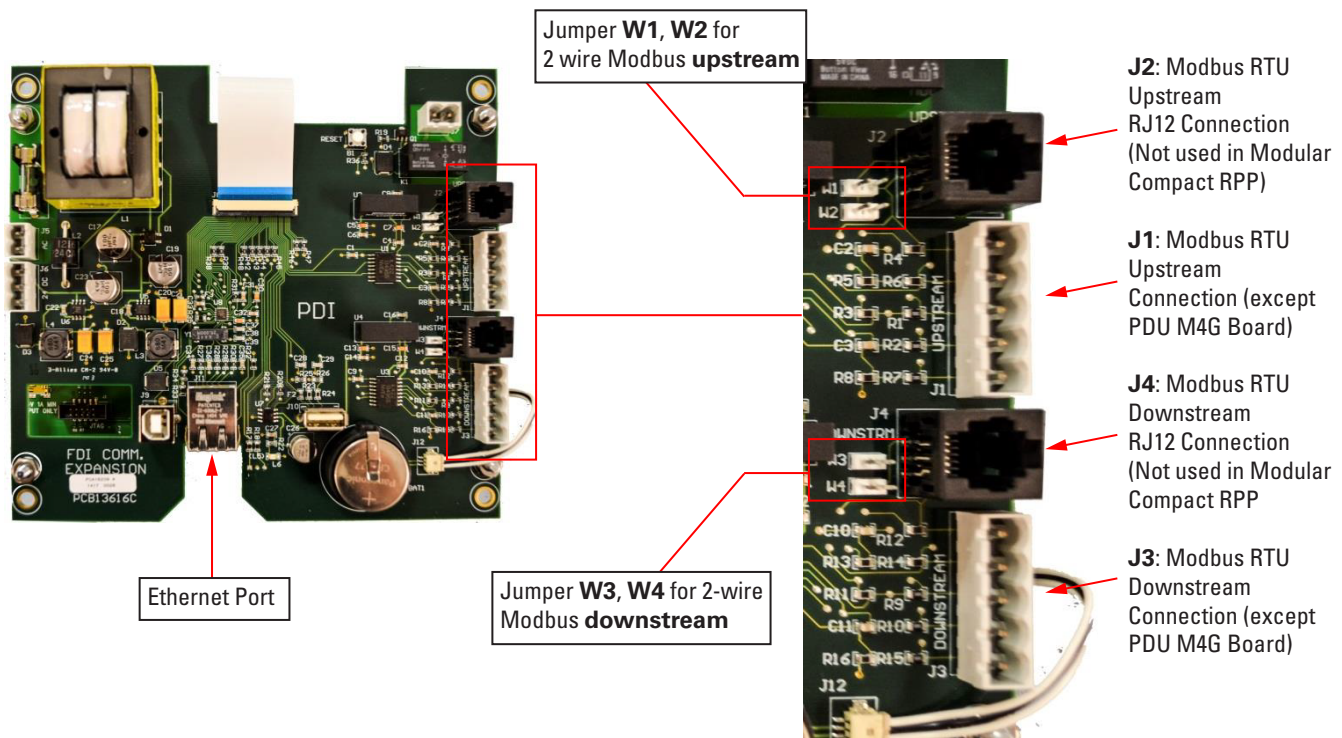
6.5 Network Connections Details

6.5.1 Color Monitor Network Connections

The Color Monitor's backpanel has Modbus RTU and Ethernet ports (Figure 14).

Modbus RTU backpanel connections are typically made in manufacturing and extended to a terminal block or external panel for convenient customer access. The customer's Ethernet cable is connected directly to the Monitor's Ethernet port.

Figure 13. Color Monitor Backpanel Network Connections



6.5.2 Modbus RTU Ports

The Color Monitor has four (4) paralleled Modbus ports:

1. J1 and J3 are header/plug connections for connecting to most devices.
 - a. J1 is the upstream port.
 - b. J3 is the downstream port.
2. J2 and J4 accept standard RJ12 phone cable plugs for connection to an M4G PDU board.
 - a. J2 is the upstream port.
 - b. J4 is the downstream port.

The Modbus RTU interface is isolated, and pin designations are given in Table 2:

Table 2. Pin-Out for Modbus Headers

Pin	J1, J3
1	Ground
2	RX-
3	RX+
4	TX-
5	TX+

6.5.3 Modbus RTU 2-Wire vs. 4-Wire Configuration

Eaton devices have two (2) jumpers near their Modbus ports for configuring 2-wire vs. 4-wire Modbus RTU (see [Figure 13](#)). The Monitor's 2-wire configuration jumpers are W1 and W2 (upstream) and W3 and W4 (downstream). Upstream and downstream chains can be differently configured.

For 2-wire configuration:

- At least one device in a device chain must have both jumpers jumped on its Modbus connection. If any device in the chain has jumpers installed for 2-wire, all of the device chain is 2-wire. To avoid confusion when troubleshooting, all of the devices in the chain should be jumped in the same way.
- TX+ or RX+ on the Monitor (either one, because the on-board 2-wire jumpers short them together) wires to TX+ or RX+ on downstream devices.
- TX- or RX- on the Monitor wires to TX- or RX- on downstream devices.
- The + and - signal wires should comprise of a (twisted) wire pair residing in the same shield.

For 4-wire configuration:

- All of these jumpers must be removed from every device in the chain.
- TX+ on the first device PCB wires to RX+ on a second PCB.
- TX- from the first device PCB wires to RX- of the second PCB.
- A second pair of wires connects the other pair of TX+ / RX+ & TX- / RX-.
- The TX+ & TX- going to the RX+ & RX- should be in the same shield. Do not run the +'s in one shield and the -'s in another. Doing so may lead to sporadic communication.
- Run a dedicated ground wire with the signal wires and only ground the shield at one end.

6.5.4 Modbus RTU Upstream Cable Specification

RS485/RS422 cable length can be up to 4000 ft. if you use the proper cable:

1. The cable resistance should be ≤ 27 ohms/1000ft @ 1 kHz and the mutual capacitance should be ≤ 14 pf/ft. @ 1 kHz.
2. 4-wire cabling:
 - a. RS422 is typically 4-wire.
 - b. Use a shielded cable with two (2) twisted pairs and a shield/ground wire.
 - c. The two transmit lines must be in one twisted pair and the two receive lines in the other twisted pair.
3. 2-wire cabling:
 - a. RS485 is typically 2-wire and is slower than RS422.

- b. Use a shielded cable with one (1) twisted pair and a shield/ground wire.

6.5.5 Modbus RTU Cable Biasing and Termination

Eaton devices have soft biasing (27K pull-up and pull-down resistors) on the + and – transmit and receive lines. Therefore, if the customer's client device allows for control, Eaton recommends that the user turn on biasing and turn off termination, which may "fight" the biasing. Biasing the client device's lines is not critical because the Color Monitor is already biasing the lines. If termination is needed because of an extremely long cable run, Eaton recommends that a small capacitor be put in series with the terminating resistor.

Chapter 7 Resources

7.1 Bibliography

Points Lists

For BCMS points lists, Contact Eaton Service, See paragraph [7.2 Getting Help](#):

Once the software file is received, unzip the file and open the directory \Points List for BCMS Version to find the following points lists and use the latest revision given:

- **BCMS Normal** panelboard points list is “BCMSII points list”.
- **BCMS KWH** panelboard points list is “BCMSII plus points list Power KWH”.
- **BCMS IEC** panelboard points list (for IEC format panelboards with 36 or 72 1P circuits) is “72 BCMSII plus points list Europe KWH”.

Eaton manufactures a variety of power distribution products. Product documentation can be downloaded from Eaton website:

<https://www.eaton.com/us/en-us/products/backup-power-ups-surge-it-power-distribution/power-distribution-for-it-equipment.html>

7.2 Getting Help

If help is needed with any of the following:

- Scheduling initial startup
- Regional locations and telephone numbers
- A question about any of the information in this manual
- A question this manual does not answer

Please call the Help Desk at:

United States:	1-800-843-9433
Canada:	1-800-461-9166 ext 260
All other countries:	Call your local service representative

Please use the following e-mail address for manual comments, suggestions, or to report an error in this manual:

E-ESSDocumentation@eaton.com

7.3 Warranty and End User License Agreement

To view the warranty please click on the link or copy the address to download from the Eaton website:

[Eaton Product Warranty](#)

<https://www.eaton.com/content/dam/eaton/products/backup-power-ups-surge-it-power-distribution/backup-power-ups/portfolio/eaton-three-phase-ups-warranty.pdf>

To view the End User License Agreement please click on the link or copy the address to download from the Eaton website:

[Eaton End User License Agreement](#)

<https://www.eaton.com/content/dam/eaton/products/support-systems/software-and-cad-registration-form/eaton-end-user-software-license-agreement.pdf>

7.4 Equipment Registration

Please visit www.eaton.com/pg/register to register your new Eaton UPS / Eaton UPS Accessory.

Model Number:

Serial Number:



P-164001112 01