Eaton© PowerPak 2 Power Distribution Unit 100 – 400 kVA

Installation and Operation Manual

Powering Business Worldwide

p/n: 164001124
Revision 04

IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

This manual contains important instructions that you should follow during installation and maintenance of the equipment. Please read all instructions before operating the equipment and save this manual for future reference.

CONSIGNES DE SÉCURITÉ IMPORTANTES – CONSERVER CES INSTRUCTIONS

Ce manuel contient des instructions importantes que vous devez suivre lors de l'installation et de la maintenance de l'équipement. Veuillez consulter entièrement ces instructions avant de faire fonctionner l'équipement et conserver ce manuel afin de pouvoir vous y reporter ultérieurement.

⚠WARNING

This is a product for restricted sales distribution to informed partners (EN/IEC 62040-2). Installation restrictions or additional measures may be needed to prevent electromagnetic disturbances.

Dear Customer,

On behalf of everyone at Eaton, we thank you for partnering with us, for trusting us to maintain your business continuity and for 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, and lighting strikes, and enable you to monitor and control your power infrastructure.

We trust that our products will deliver high quality, reliable power for your business, and we are committed to your success.

Please read this manual, which details the installation and operation processes for your new Eaton product.

Thank you for choosing Eaton!

Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

The PowerPak 2 Power Distribution Unit (PDU) is a 100-400 kVA PDU with a small main cabinet footprint. The PowerPak 2 PDU is highly customizable with numerous transformer sizes and options, electrical configurations, panelboard and circuit breaker configurations, front- and side-facing side cars, cabling options, and mounting options. You should consult with your sales representative and with Eaton Engineering to select a PDU package that meets your application needs.

The main cabinet is true front-access only for all routine maintenance. PDU capacity can be extended with optional side-cars that are front-access or front-and-side-access.

Side cars are always installed and configured at the factory. The PDU is shipped as a fully integrated PDU.

PDU 100-400 kVA transformers are DOE2016-compliant with many options.

For safety, monitoring components have their own compartment, isolating them from high-power input and high-power output components in the main cabinet.

An optional patent-pending 3D scan window allows infrared scanning of the transformer from the front of the PDU.

Eaton PDI's Branch Circuit Monitoring System (BCMS) can be deployed in the Main Cabinet and Side Cars with measurements and alarms displayed on the 7"-diagonal WaveStar® Color Monitor touchscreen. Monitoring data can also uploaded to customer Building Management Systems or other Modbus master devices through several standard open protocols, including Modbus RTU, Modbus TCP/IP, and SNMP or to webpages with TCP/IP. A PDU dry contact network supplements BCMS.

The following installation planning information provides background information on the many options and factors involved in selecting a specific PowerPak 2 PDU configuration.

1.1 Using This Manual

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up, operate or carry out any maintenance work on this Eaton product.

Read through each procedure before beginning the procedure. Perform only those procedures that apply to the unit being installed or operated.

1.2 Conventions Used in This Manual

This manual uses these type conventions:

NOTE Some conventions only apply to display screens (if installed).

- **Bold type** highlights important concepts in discussions, key terms in procedures, and menu options, or represents a command or option that you type or enter at a prompt.
- *Italic type* highlights notes and new terms where they are defined.
- `Screen type` represents information that appears on the screen or LCD.

Icon	Description
	Information notes call attention to important features or instructions.
[Keys]	Brackets are used when referring to a specific key, such as [Enter] or [Ctrl].

1.3 Symbols, Controls, and Indicators

The following are examples of symbols used on the PDU or accessories to alert you to important information:

RISK OF ELECTRIC SHOCK - Observe the warning associated with the risk of electric shock symbol.

CAUTION: REFER TO OPERATOR'S MANUAL - Refer to your operator's manual for additional information, such as important operating and maintenance instructions.

This symbol indicates that you should not discard waste electrical or electronic equipment (WEEE) in the trash. For proper disposal, contact your local recycling/reuse or hazardous waste center.

1.4 Getting Help

NOTE References to PDI (Power Distribution, Inc.) may appear in this manual. Service, warranties and support for these components are obtained from Eaton.

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 Eaton Help Desk at:

United States:**1-800-843-9433** or **1-919-870-3028**

Canada:**1-800-461-9166 ext 260**

All other countries:**Call your local service representative**

Please use the following e-mail for manual comments, suggestions, or to report a technical error in this manual.

Eaton Pak 2 website:Eaton PowerPak2 PDU

E-ESSDocumentation@eaton.com

1.5 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

https://www.eaton.com/content/dam/eaton/products/backup-power-ups-surge-it-power-distribution/backuppower-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

Chapter 2 Safety

⚠WARNING

Follow safe electrical work practices:

- 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 conduit, and attaching WaveStar® Color Monitors to PDUs, RPPs, or other power distribution equipment.
- Disconnect and lock-out all power supplying equipment before working on or installing components.
- Use a properly rated voltage sensing device to confirm power is OFF.
- Leave ample space for attaching and routing wires.
- Use Lock Out/Tag Out procedures.
- Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
- Install equipment in an appropriate electrical environment per local regulations.
- ESD sensitive equipment. Ground yourself, discharge any static charge and ensure that the device is effectively grounded before handling the unit.

Chapter 3 Installation Planning

3.1 Transformer Parameters and Options

The PDU is fed from an integral 3-phase, copper or aluminum, high isolation transformer. The transformer is specifically designed for the PDU and its applications, providing voltage transformation, voltage adjustment, high isolation, conditioning, and shielding. Each transformer is complete with electrostatic shielding and uses a universal footing template inside the PDU to secure the transformer to its base.

Standard transformers with DOE2016 efficiency and K-Factor K13 are offered at 100, 150, 225, 300, or 400 kVA. Table 1 lists transformer parameters:

- Standard transformer parameters are applicable to all standard transformers at 100, 150, 225, 300, and 400 kVA.
- Non-DOE2106 transformer efficiency standards are offered for customers outside the US and for certain exempt categories in the US.

Table 1. Transformer Parameters

Parameter	Standard Transformer	Options
Input Voltage	480V Delta	400 – 600V
Output Voltage	208 /120V Wye	208 – 600V
Frequency	60 Hz	50 Hz
Impedance	2.5 – 5%	Up to 6%
Efficiency	DOE2016	Non-DOE2016 or non-TP1 offered for certain exempt categories, CEC, CSA, NEMA Premium, or customer-requested efficiency values.
K-Factor	K13	K4, K9, K20
Conductor Material	Copper (CU)	Aluminum (AL)
Inrush	8 – 10x	5x
Taps (100-300 kVA)	+2, -4 x 2.5%	±2 x 2.5%, custom taps or no taps designs also available
Taps (400 kVA)	±2 x 2.5%	±2 x 2.5%, custom taps or no taps designs also available
Temperature Rise	150ºC	115ºC, 130ºC
Vector	Delta-Wye	Delta Zig-Zag Delta Quad-Wye
Average sound level	NEMA ST-20	NEMA ST-20
Applicable Standard	DOE2016, UL-1561 IEEE Standard C57.12.01	IEC 60076, CSA22.2 No 66, CEC 400

3.2 Transformer BTUs

The following table shows **Transformer BTU** output at the kVA values offered for standard K13-rated transformers:

Table 2. Standard Transformer BTU Values by kVA

kVA	BTUs/Hour
100	9,284
150	14,296
225	20,536
300	22,483
400	34,825

3.3 Environmental Specifications

3.3.1 Operating Limits

- Operating ambient temperature range: 0ºC to 40ºC (32ºF to 104ºF).
- Relative humidity range from 0% to 95% non-condensing.
- Altitude: Standard: 3000 ft. Maximum altitude 10,000 ft. For altitudes above 10,000 ft contact Eaton PDI.

Transformers generate heat, which should be considered in placing the PDU. BTUs for standard transformers offered at 100, 150, 225, 300, and 400 kVA are given in 3.2 *Transformer BTUs*.

3.3.2 Storage Conditions

If the PDU is not to be immediately installed and energized, it should be carefully stored in a warm, dry environment, preferably a heated building with a uniform temperature and air circulation to prevent condensation. It is especially important that the transformer be free of condensation and protected from contamination. The transformer and PDU should be stored in their factory protective coverings.

Storage temperature range must be within these extremes: -36ºC to +70ºC (-33ºF to 158ºF).

If the transformer has been exposed to moisture, it should be dried out before being energized. Consult Eaton Service if the PDU or transformer have been exposed to moisture or contamination.

3.4 PDU Dimensions

The PDU main cabinet can have a side car on one or both sides. Side cars are independently configurable; either side can be a 24" or 12" side car.

Main cabinet	42"W x 84"H x 40"D
Add-on side car(s) 24" (Either side)	24"W x 84"H x 40"D
Add-on side car(s) 12" (Either side)	12"W x 84"H x 40"D

3.5 PDU Weight

The PowerPak 2 PDU weight varies by configuration and the configuration is highly customizable. The following are approximate PDU weights:

- Main Cabinet with 400 kVA transformer, approximately 3000 lbs.
- 24" Side Car, approximately 585 lbs.

- 12" Side Car, approximately 500 lbs.
- Weights vary by selection of components.

Floor stands are available for supporting the main cabinet, which houses the transformer and therefore most of the PDU's weight. See .

3.6 PDU Layouts

Figure 1. Main Cabinet

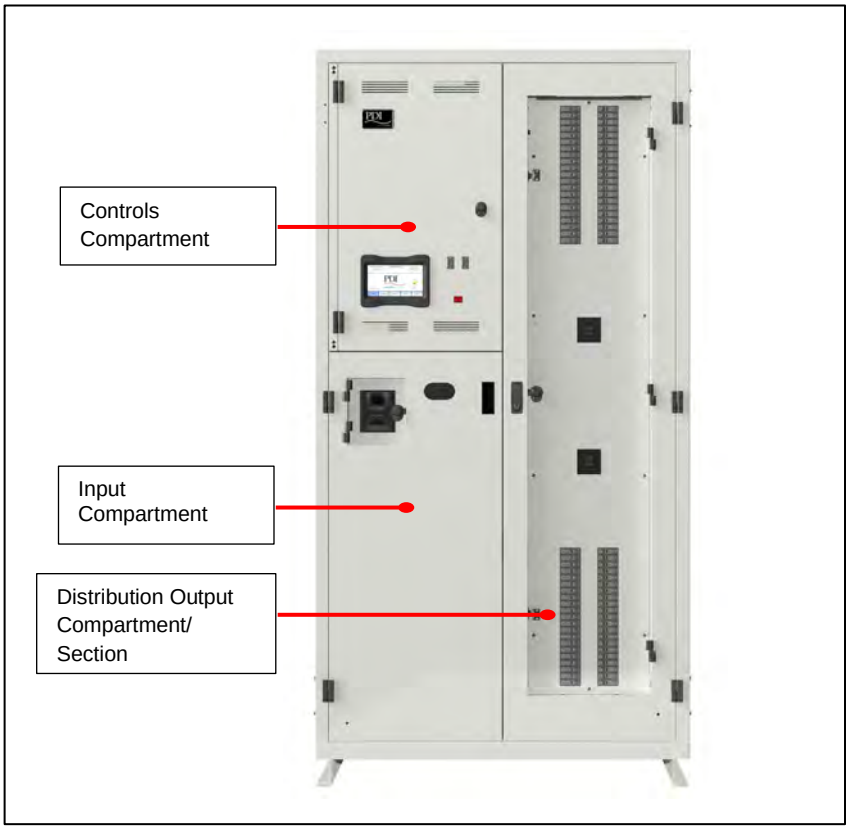


Figure 2. Main Cabinet with 12-in and 24-in Side Cars

The PDU has numerous configurations as Main Cabinet only or Main Cabinet plus 12" or 24" Side Cars on either side. Figures Figure 1 to Figure 6 show layout possibilities.

Figure 3. Main Cabinet Layout

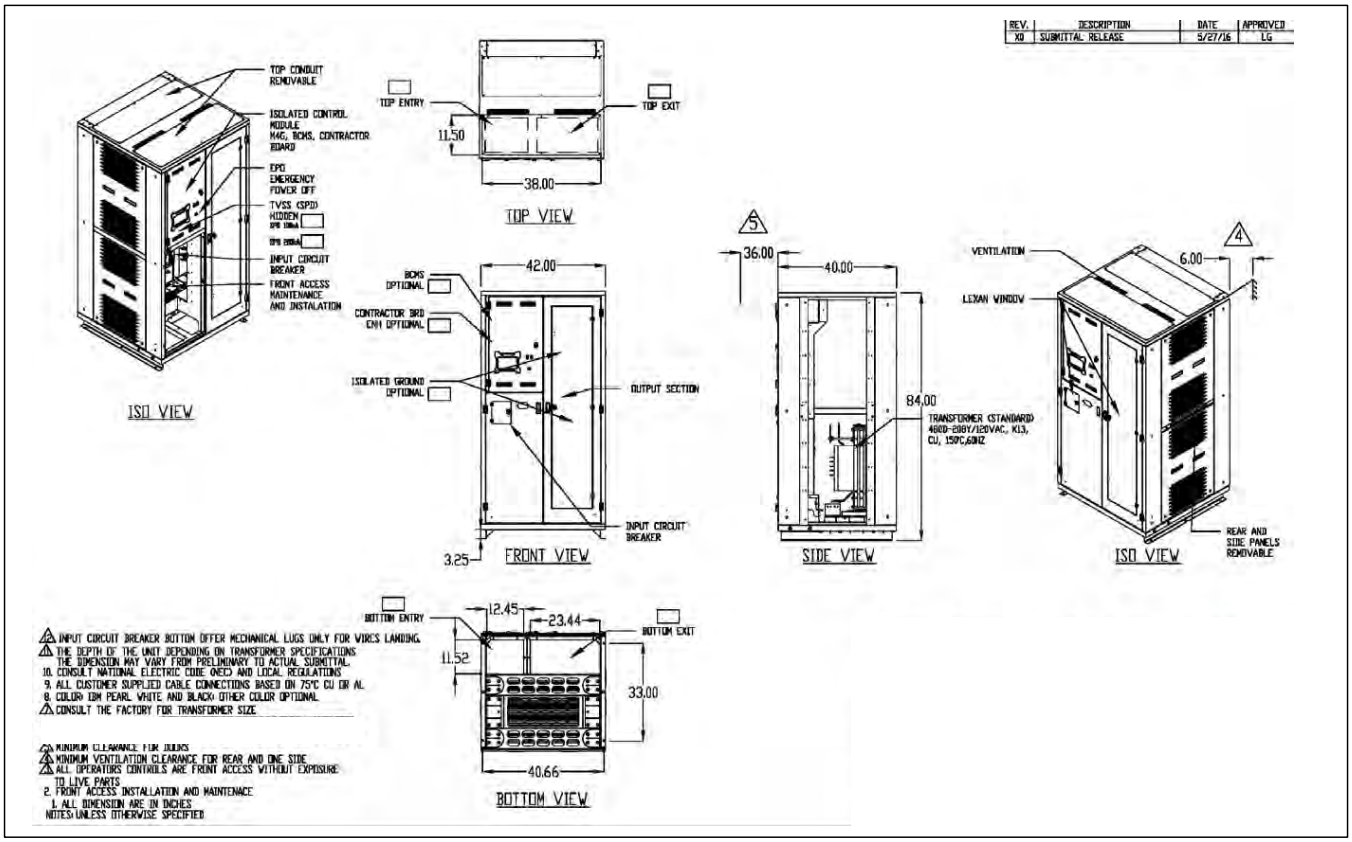
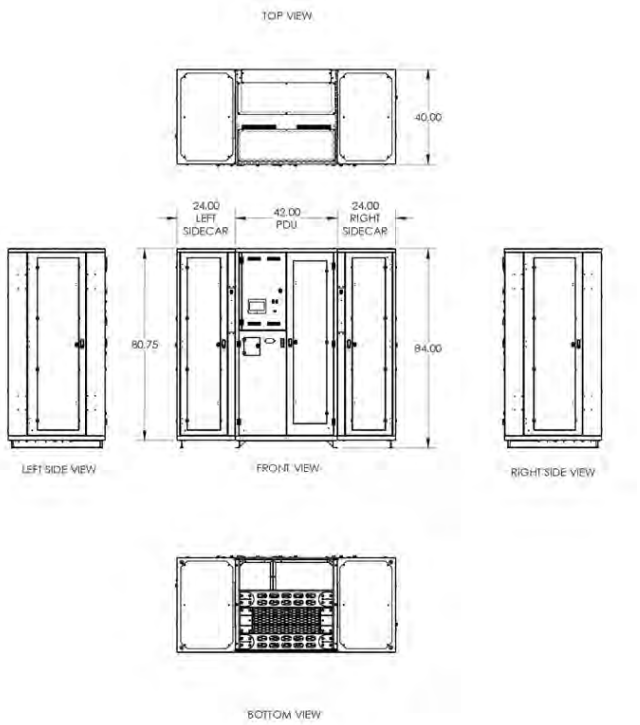


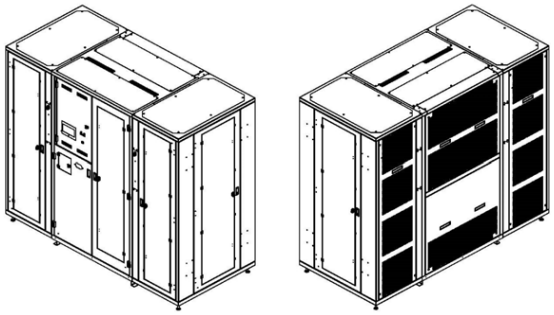
Figure 4. Main Cabinet with 24-in Side Cars



24-in Side Cars can have one front-facing section and one side-facing section.

Side-facing Side Car sections have a side access door and require 36" side clearance. If a side-facing section is not installed, only 6" side ventilation clearance is required.

Without side-facing sections, the PDU with one or two front-facing 24" Side Cars is a front-access only PDU.



Front ISO View

Back ISO View

Figure 5. Main Cabinet with 12-in Side Cars

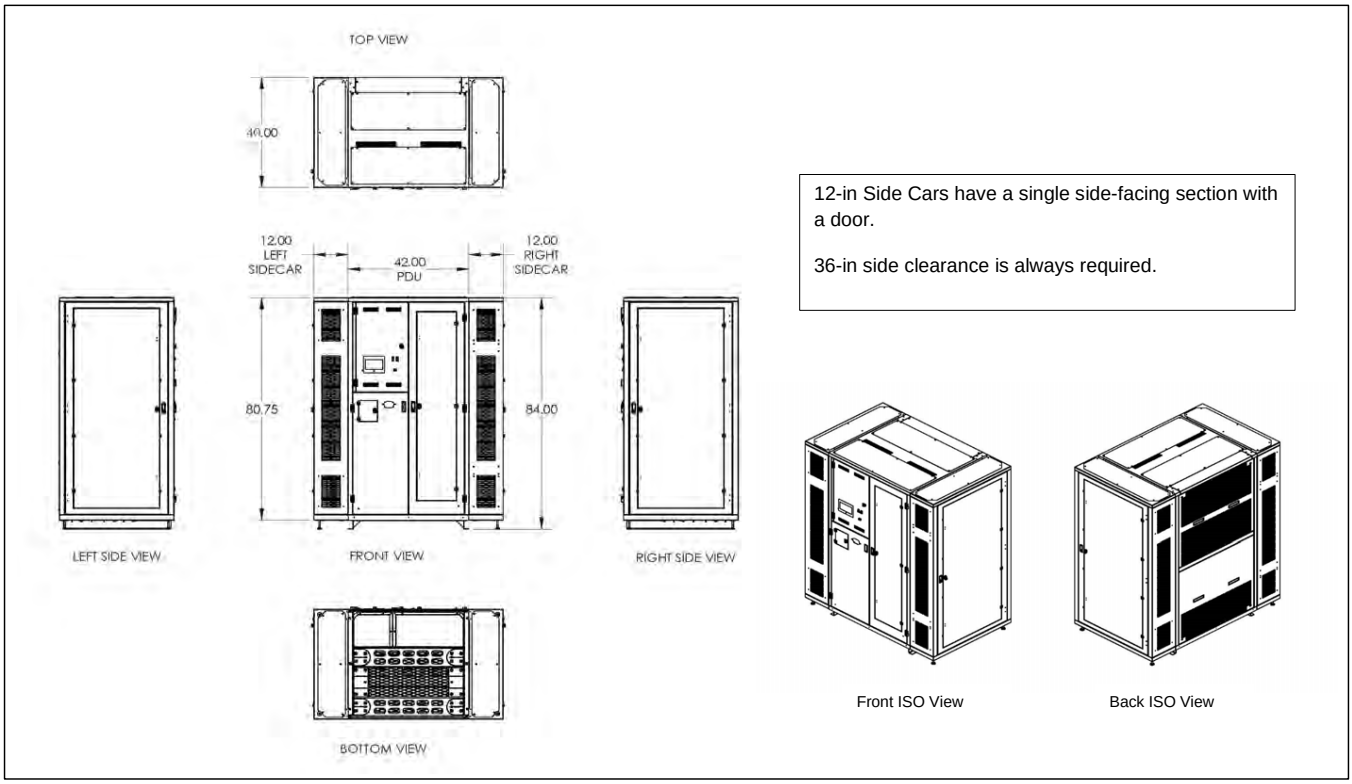
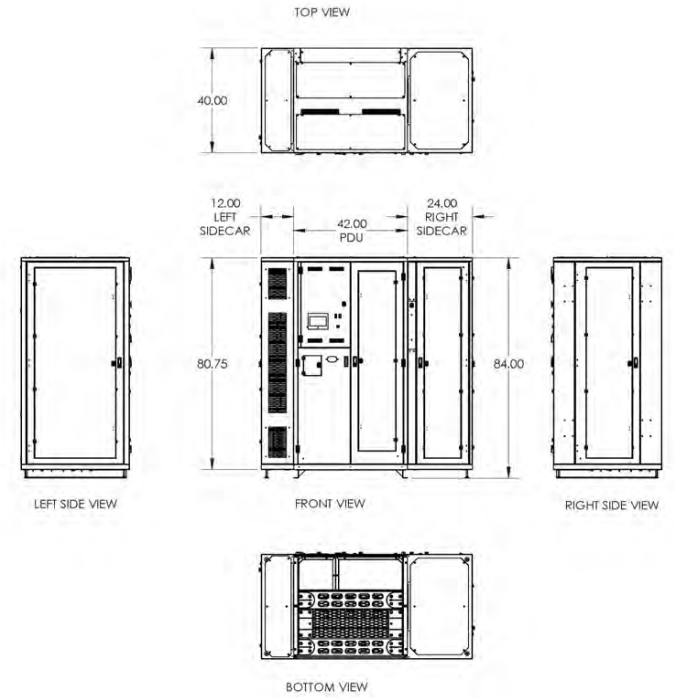


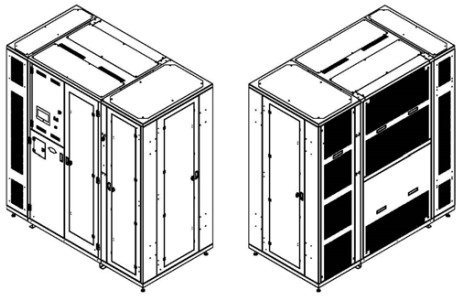
Figure 6. Main Cabinet with Mixed Side Car Types



Side Car` types can be mixed on the same PDU. The Main Cabinet can have 12-in or 24-in Side Cars on either side.

The 12-in Side Car Distribution Output section is always side-facing and requires 36-in side clearance.

The 24-in Side Car side-facing Distribution Output section, if installed, requires 36-in side clearance.



Front ISO View

Back ISO View

3.7 Clearances

- **Ventilation clearances**: recommended 6" minimum ventilation clearance on rear and bothsides; 18" overhead clearance recommended.
- **Service clearance**: 36" required front access; 36" required side clearance for Side Cars withside access.
- **Cabling** 12" underfloor cabling clearance is recommended for raised floor.

3.8 Front and Side-Access Configurations

The PDU can be flexibly configured as a front-access-only PDU or as a front- and side-access PDU.

Front access PDU:

- The Main Cabinet is always true front-access for all routine maintenance, including easycircuit breaker replacement, extension of circuit breaker capacity, and infrared scanning of thetransformer.
- 24" Side Cars are front-access only, if only the front-facing Distribution Output Section isinstalled.

Front and side access PDU:

- 24" Side Cars using the side-facing Distribution Output Section require side access and 36"clearance on that side.
- 12" Side Cars always require side access and 36" side clearance on that side.

3.9 Mounting Options

The PDU can be installed on both fixed floor or on a floor stand in a raised floor environment. The PDU alone or the PDU with floor stand conforms to seismic zone four requirements, California standard, per **IBC 2010**.

The following mounting options are available for the Main Cabinet:

- **Floor Stand** - an optional universal floor stand 12-48" H is available for the Main Cabinet with heights from 12-48" H to match raised floor height. The floor stand can be adapted to PDUs with or without casters. See .
- **Casters** Heavy duty casters are optional.
- **Skirt** An off-the-shelf skirt providing air closure around the PDU is optional.
- **Floor mounting brackets** are standard with or without the optional floor stand.
- **Side Cars** have leveling feet.

Chapter 4 Installation Planning: Electrical

The PDU segregates controls and monitoring from high-power input or output components into separate compartments for safety, as follows:

- Input high-power compartment: Main Cabinet main input circuit breaker and optional SPD(TVSS)
- Output high-power compartments:
  - Main Cabinet Distribution Output Section: subfeeds and/or panelboards
  - Side Car Distribution Output Section(s): subfeeds and/or panelboards
- Controls compartment: monitoring components

4.1 Input Section

4.1.1 Main Input Circuit Breaker

A main input circuit breaker to the transformer is installed in the Input Section of the Main Cabinet.

The Main Input Circuit Breaker can be Square D Fixed Mounted H-Frame, J-Frame, L-Frame, M-frame, or P-frame depending on circuit breaker voltage, amperage, and percent rating. Table 3 shows input circuit breaker sizes by transformer kVA and input voltage.

1. Input Circuit Breaker Amperes is 25% greater than the Transformer Input Amperes as required by the NEC. However, if the frame trip value does not exactly match the required NEC amperage, the input circuit breaker may be oversized to the next available breaker size.
2. Square D breakers at 80% and 100% ratings are shown matching Input Circuit Breaker Amperes.
3. Use the input circuit breaker amperage for planning input conduit size.

Table 3. Input Circuit Breaker Sizing for PDUs with Standard Transformers

kVA	Voltage	Transformer Input Amperes	Input Circuit Breaker Amperes	Input Circuit Breaker 80% Rated	Input Circuit Breaker 100% Rated
100	480	120	175	JGL36175	JGL36175C
100	575	100	150	HGL36150	HGL36150C
100	600	96	125	HGL36125	HGL36125C
150	480	180	225	JGL36225	JGL36250CU31 X
150	575	151	200	JGL36200	JGL36250CU31 X
150	600	144	200	JGL36200	JGL36250CU31 X
225	480	271	350	MGL36350	LGL36400CU31 X
225	575	226	300	MGL36300	LGL36400CU31 X
225	600	217	300	MGL36300	LGL36400CU31 X
300	480	361	500	MGL36500	PGL36060CU31 A
300	575	301	400	MGL36400	LGL36400CU31 X
300	600	289	400	MGL36400	LGL36400CU31 X
400	480	481	700	MGL36700	PGL361 OOCU31A

Table 3. Input Circuit Breaker Sizing for PDUs with Standard Transformers (Continued)

kVA	Voltage	Transformer Input Amperes	Input Circuit Breaker Amperes	Input Circuit Breaker 80% Rated	Input Circuit Breaker 100% Rated
400	575	402	600	MGL36600	PGL36060CU31 A
400	600	385	500	MGL36500	PGL36060CU31 A

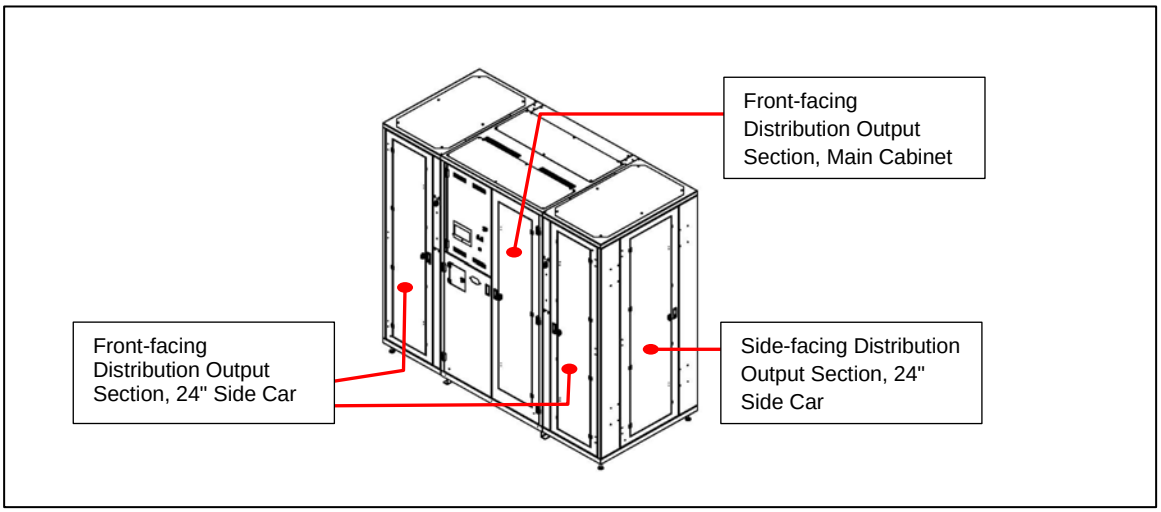
4.1.2 Surge Suppression

A Surge Protective Device (SPD) or Transient Voltage Surge Suppressor (TVSS) is an option. When selected, it is installed in the Input Section next to the Main Input Circuit Breaker. SPD status lights are visible through a viewing panel in the input section's door. The following SPD or TVSS selections are available:

- 120/208V 3Y 100kAIC
- 120/208V 3Y 200kAIC
- 277/480V 3Y 100kAIC
- 277/480V 3Y 200kAIC
- 480V 3D 200kAIC
- No SPD/TVSS

4.2 Distribution Output Sections

Figure 7. Distribution Output Sections



Distribution Output subfeeds and panelboards are placed in Distribution Output Sections, as shown above in Figure 7. The number of available Distribution Output Sections is shown in Figure 7 and below in Table 4.

Table 4. Distribution Output Sections

Frame	Number of Output Distribution Sections
Main Cabinet	1 Front-facing Section
12" Side Car	1 Side-facing Section
24" Side Car	1 Front-facing and/or 1 Side-facing Section

4.2.1 Distribution Output Modules

Each Distribution Output Section has separate A and B output modules or a full-section combined output module. Full-section modules are for larger components.

A module may contain a panelboard or a set of subfeed circuit breakers. Standard circuit breakers are 80% rated; 100% rated circuit breakers are also available.

The following tables show standard configuration options. Other options require the approval of Eaton Engineering.

Table 5. Main Cabinet, Distribution Output Sections

Main Cabinet			
Front-Facing Options - Pick up to 1x A# Option and up to 1x B# Option.			
A# (Top Section)		**B# (Bottom Section)**	
A1	1x 225A 42-Pole Panelboard	**B1**	1x 225A 42-Pole Panelboard
A2	1x 400A 42-Pole Panelboard	**B2**	1x 400A 42-Pole Panelboard
A3	Up to 4x 225A Sub Feed Breakers (J-Frame)	**B3**	Up to 4x 225A Sub Feed Breakers (J-Frame)
A4	Up to 2x 400A Sub Feed Breakers (L-Frame)	**B4**	Up to 2x 400A Sub Feed Breakers (L-Frame)
A5	1x 600A Sub Feed Breaker (L-Frame)	**B5**	1x 600A Sub Feed Breaker (L-Frame)
A6	3x 600A Sub Feed Breakers*		
A7	1x 400A 84-Pole Panelboard*		
*Cannot be combined with B# options.			

Table 6. 24-inch Side Car, Front-Facing Section, Distribution Output Configurations

24" Side Car, Front-Facing Section			
Front-Facing Options - Pick up to 1x FA# Option and up to 1x FB# Option.			
FA# (Top Front Section) FB# (Bottom Front Section)		**FA# (Top Front Section) FB# (Bottom Front Section)**	
FA1	1x 225A 42-Pole Panelboard	**FB1**	1x 225A 42-Pole Panelboard
FA2	1x 400A 42-Pole Panelboard	**FB2**	1x 400A 42-Pole Panelboard
FA3	Up to 4x 225A Sub Feed Breakers (J-Frame)	**FB3**	Up to 4x 225A Sub Feed Breakers (J-Frame)
FA4	Up to 2x 400A Sub Feed Breakers (L-Frame)	**FB4**	Up to 2x 400A Sub Feed Breakers (L-Frame)
FA5	1x 600A Sub Feed Breaker (L-Frame)	**FB5**	1x 600A Sub Feed Breaker (L-Frame)

Table 6. 24-inch Side Car, Front-Facing Section, Distribution Output Configurations (Continued)

24" Side Car, Front-Facing Section	
FA6	3x 600A Sub Feed Breakers*
FA7	1x 400A 84-Pole Panelboard*
*Cannot be combined with FB# options.	

Table 7. 24-in Side Car, Side-Facing Section

24" Side Car, Side-Facing Section			
Side-Facing Options - Pick up to 1x SA# Option and up to 1x SB# Option.			
SA# (Top Side Section)		**SB# (Bottom Side Section)**	
SA1	1x 225A 42-Pole Panelboard	**SB1**	1x 225A 42-Pole Panelboard
SA2	1x 400A 42-Pole Panelboard	**SB2**	1x 400A 42-Pole Panelboard
SA3	Up to 4x 225A Sub Feed Breakers (J-Frame)	**SB3**	Up to 4x 225A Sub Feed Breakers (J-Frame)
SA4	Up to 2x 400A Sub Feed Breakers (L-Frame)	**SB4**	Up to 2x 400A Sub Feed Breakers (L-Frame)
SA5	1x 600A Sub Feed Breaker (L-Frame)	**SB5**	1x 600A Sub Feed Breaker (L-Frame)
SA6	3x 600A Sub Feed Breakers*		
SA7	1x 400A 84-Pole Panelboard*		
*Cannot be combined with B# options.			

Table 8. 12-in Side Car, Side Facing Section

12" Side Car, Side-Facing Section			
Side-Facing Options - Pick up to 1x A# Option and up to 1x B# Option.			
A# (Left Section)		**B# (Right Section)**	
A1	1x 225A 42-Pole Panelboard	**B1**	1x 225A 42-Pole Panelboard
A2	1x 400A 42-Pole Panelboard	**B2**	1x 400A 42-Pole Panelboard
A3	Up to 4x 225A Sub Feed Breakers (J-Frame)	**B3**	Up to 4x 225A Sub Feed Breakers (J-Frame)
A4	Up to 2x 400A Sub Feed Breakers (L-Frame)	**B4**	Up to 2x 400A Sub Feed Breakers (L-Frame)
A5	1x 600A Sub Feed Breaker (L-Frame)	**B5**	1x 600A Sub Feed Breaker (L-Frame)
A6	1x 400A 84-Pole Panelboard*		
*Cannot be combined with B# options.			

4.3 Controls Section

The Main Cabinet has a Controls Section containing the PDU's monitoring components. See Chapter 9 *Monitoring Components*.

4.4 One-Line Drawings

One-Line Drawings specific to your PDU configuration will be included in your submittal package. Because many configurations are possible with the PowerPak 2 PDU, it is not possible to show here a standard one-line drawing suitable for most customer configurations.

Chapter 5 Installation: PDU Placement

DANGER

- A licensed electrician must install each unit.
- Startup by an Eaton certified technician is 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 PDUs 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.

5.1 Receiving and Unpacking the PDU

PowerPak 2 PDUs are shipped as fully assembled units with optional side cars attached and internal cabling completed. Units are strapped to shipping pallets, but not bolted to pallets, and are protected by external covering.

1. Upon receiving a PowerPak 2 PDU pallet and before removing packaging, inspect packaging for visible damage that could affect the PDU. If damage is evident notify Eaton and the shipping company (see below).
2. Carefully remove the outer layer of protective shrink wrap from the unit. Use care to notpuncture or scratch the Modular Compact RPP cabinets with cutting tools.

NOTE Do not cut the retaining bands until the PDU has been moved on its pallet close to its installation location.

3. After removing external packing, check the unit's exterior panels and doors for any visible damage such as scratches dents, cracks. If any damage is noted, please call the Eaton Service Team at 1-800-843-9433.
4. If any damage is evident during unpacking, notify the shipping company and Eaton:
   - File a claim with the shipping company at the time of delivery. Damage must be noted on the bill of lading. Failure to properly document all damage may result in the unit's warranty being voided.
   - Notify the Eaton Service Department.

5.2 Placing the PDU

WARNING

- Do not remove the retaining bands securing the PDU to its pallet until the PDU is near its final position and you are ready to remove the PDU from its pallet.
- Retaining bands are under tension; cut them carefully. Wear eye protection and protective clothing when cutting bands.

1. Move the PDU, still secured to its pallet, to as near its operating position as is practicable with a forklift truck or pallet jack.
2. Carefully cut the safety bands, making sure that they do not scrape the exterior of the unit or scratch the paint. Use eye, face, and hand protections to guard against injury when bands are cut.
3. Remove the PDU from its pallet using a forklift truck. Take care that the unit is properly centered on the forks.
4. Once the unit is completely off the pallet, carefully remove the plastic under layer (protective bag). The unit is now ready to be placed in its final position and prepared for installation.

If you have questions or need further assistance, call the Eaton Service Team at 1-800-843-9433.

5.3 Pre-Placement Inspection

The installer or installing contractor should perform a complete internal inspection of the PDU after the PDU has been placed in its approximate operating position and before electrical hookup. The following items must be included in the inspection checklist:

1. Transformers: Inspect the transformers for any loose connections or displacement during shipment. Check to make sure all terminal lugs are tight and secure.
2. Internal feeders: Ensure all lug connections are tight and secure.
3. Main input feeder:
   a. Check the main input feeder connections at the main breaker to be sure vibration has not loosened the terminal screws.
   b. Check the feeders from the load side of the main breaker to the primary side of both transformers.
4. Check all other lugs (i.e. neutral bus, ground bus, terminal blocks, etc.).

5.4 Placing Directly on Floor or Raised Floor

The PDU can be moved on a fork lift or pallet jack and placed directly on a floor or raised floor. The floor must be capable of supporting the PDU's weight. See 3.5 *PDU Weight* for approximate weights. See your submittal package for specific information for your PDU's configuration.

Check that required clearances are met when the PDU is placed in its operating position.

5.5 Placing PDU on Optional Floor Stand

The PDU can be placed on an optional floor stand that will support the main cabinet, which houses the transformer and the bulk of the PDU's weight. The floor stand is available in several heights to match the height of your installation's raised floor, ranging from 12" to 52".

At time of order, select the floor stand that matches your raised floor height. Several floor stands are height-adjustable ±4". (See figures Figure 8 to Figure 10).

To install:

1. Remove floor tiles and/or make floor tile cutouts to match the width and depth of the floor stand.
2. On adjustable floor stands, adjust the bottom height adjustment screws to adjust the floor stand height to match your raised floor height.
3. Place the floor stand within the raised floor opening and bolt securely to the subfloor.
4. The floor stand has removable front and rear plates for cable entry/exit and air flow. Remove plates as desired before placing the PDU.

5. The floor stand has removable two removable ramps. If the PDU has casters, it can be rolled onto the floor stand using these ramps. If the PDU does not have casters, remove the ramps.
6. Carefully place the PDU with a fork lift or pallet jack over the floor stands bolt holes.

Figure 8. Floor Stand for PDU without Casters

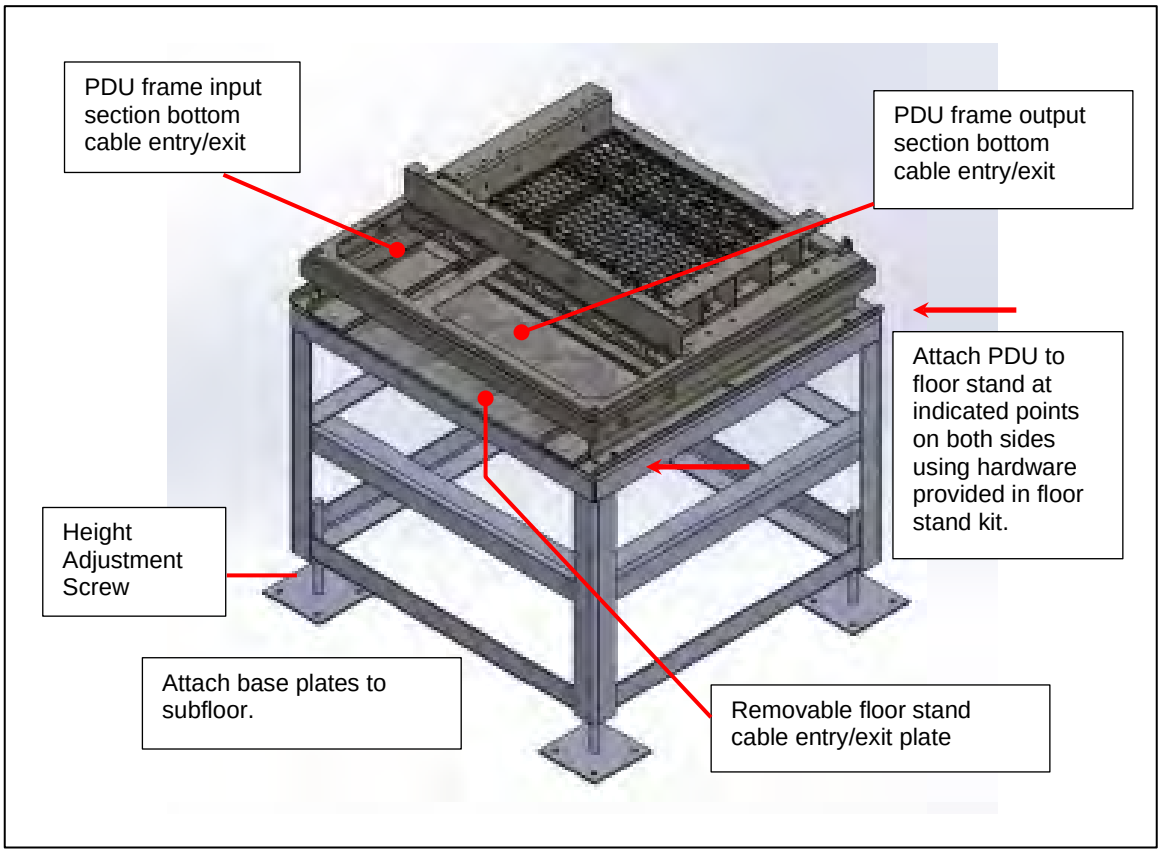


Figure 9. Main Cabinet Floor Stand

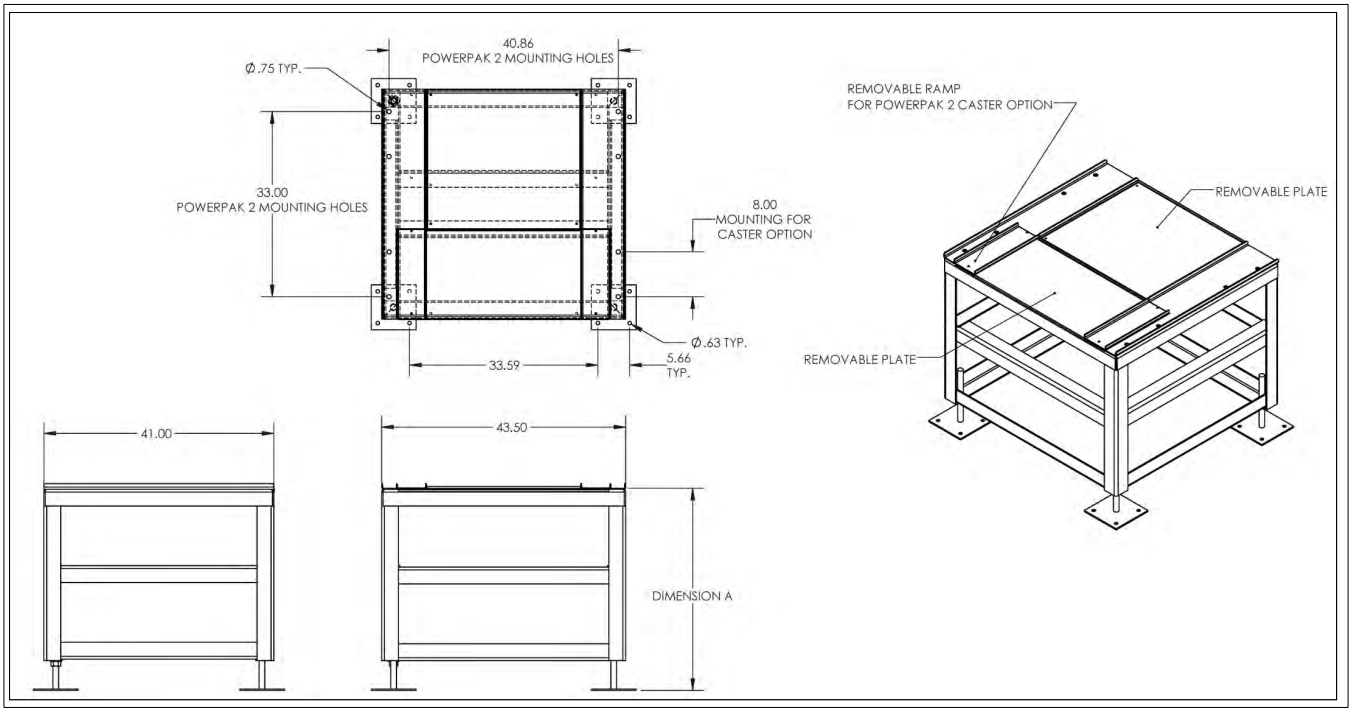
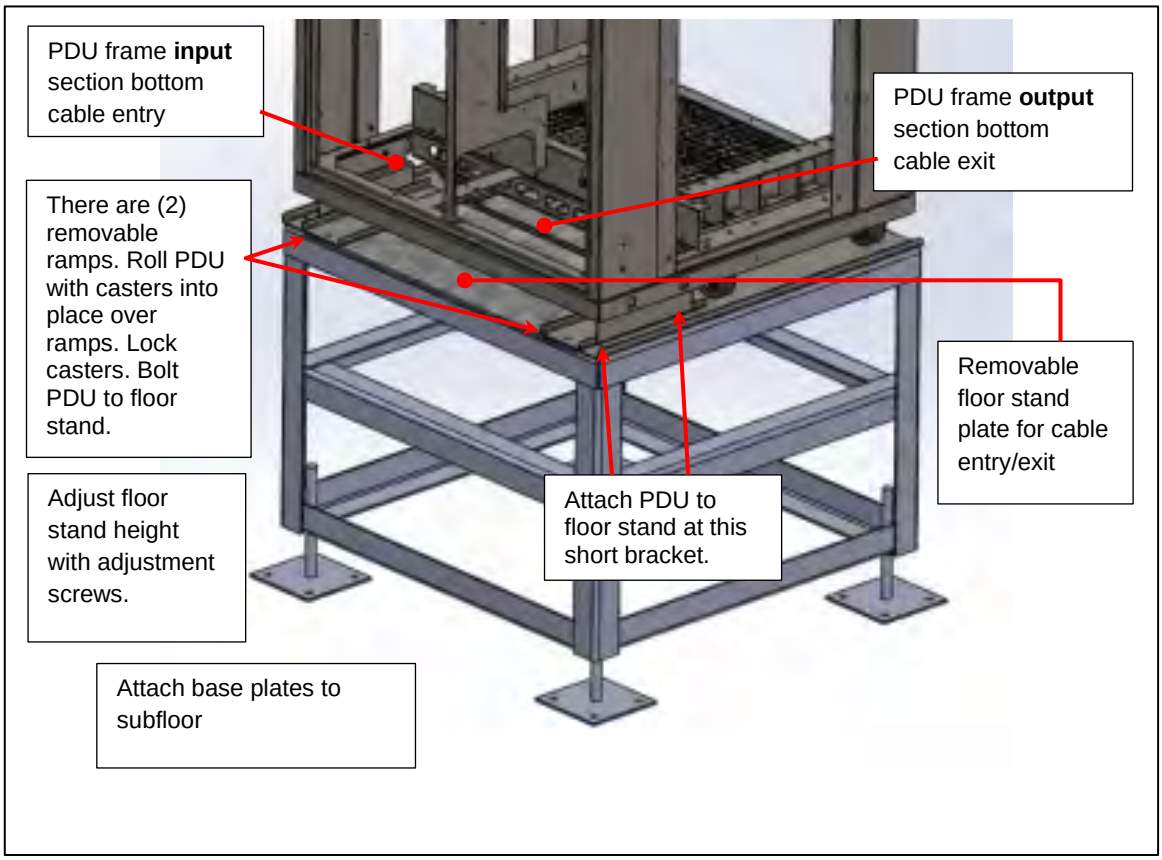


Figure 10. Floor Stand and PDU Frame with Casters



Match the PDU's support bolt holes to the floor stand openings.

Chapter 6 Installation: Power Cabling

The PowerPak 2 PDU allows top or bottom cable entry/exit. Customers must specify top or bottom cable entry/exit at time of order. The position of ground and neutral busbars can change as the result of this choice.

Input and output cable entry/exit is shown on the PDU Outline Drawings (Figure 3 to Figure 6). For top cable entry, input and output share the same plate, which may have solid plate for input and for output solid plate or panelboard knockouts (KOs).

6.1 Power Wiring

IMPORTANT

- 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 PDU configuration.
- Grounding for this equipment must comply with NEC and local building and electrical codes.

IMPORTANT

6.2 Input Power Wiring

6.2.1 Main Input Circuit Breaker

3-phase input power cables are connected to the main input circuit breaker in the main cabinet inputsection.

Customers must make their own cutouts for input cable and conduit. Pull input power conduit through cutouts. Connect input phase cables directly to main circuit breaker lugs. Torque lugs to the circuit breaker manufacturer's specification, which are typically given on the circuit breaker.

In bottom entry, customer phase connections are made to the bottom of the main input circuit breaker. In top entry, phase connections are made to the top of the circuit breaker. Ground busbar and transformer connections to the main input circuit breaker are reversed for top cable entry. (see Figure 11.)

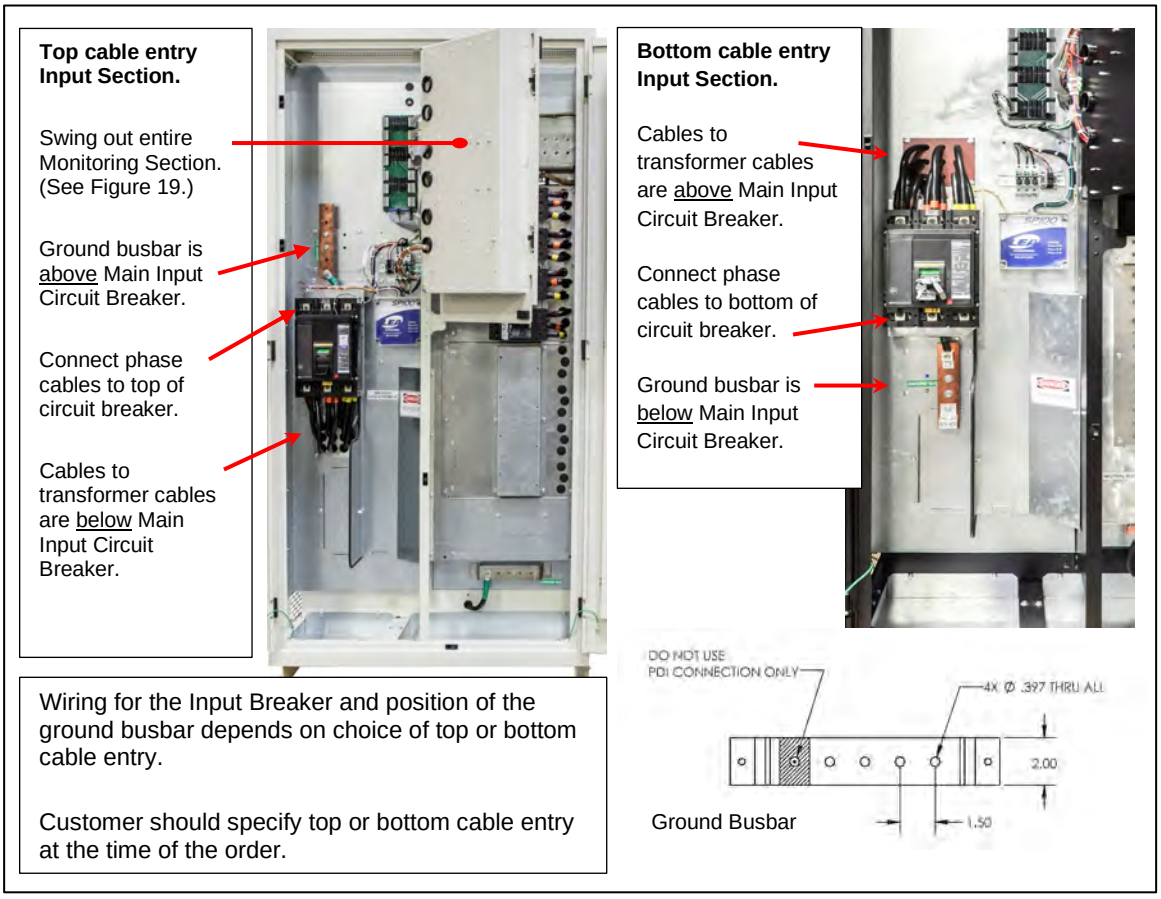
There is no input neutral busbar for delta power input.

6.3 Cable Entry: Input Power

Input power is cabled into the Main Cabinet Input section. The bottom input power cable plate is solid and customers should make their own cutout(s) for cables or conduit. See Figure 13.

If cable entry is from the top of the unit, input cables must be run behind the Controls Compartment. The entire Controls Compartment must be swung open to run input power cables to the Main Input Circuit Breaker.

Figure 11. Input Section: Top and Bottom Cable Entry

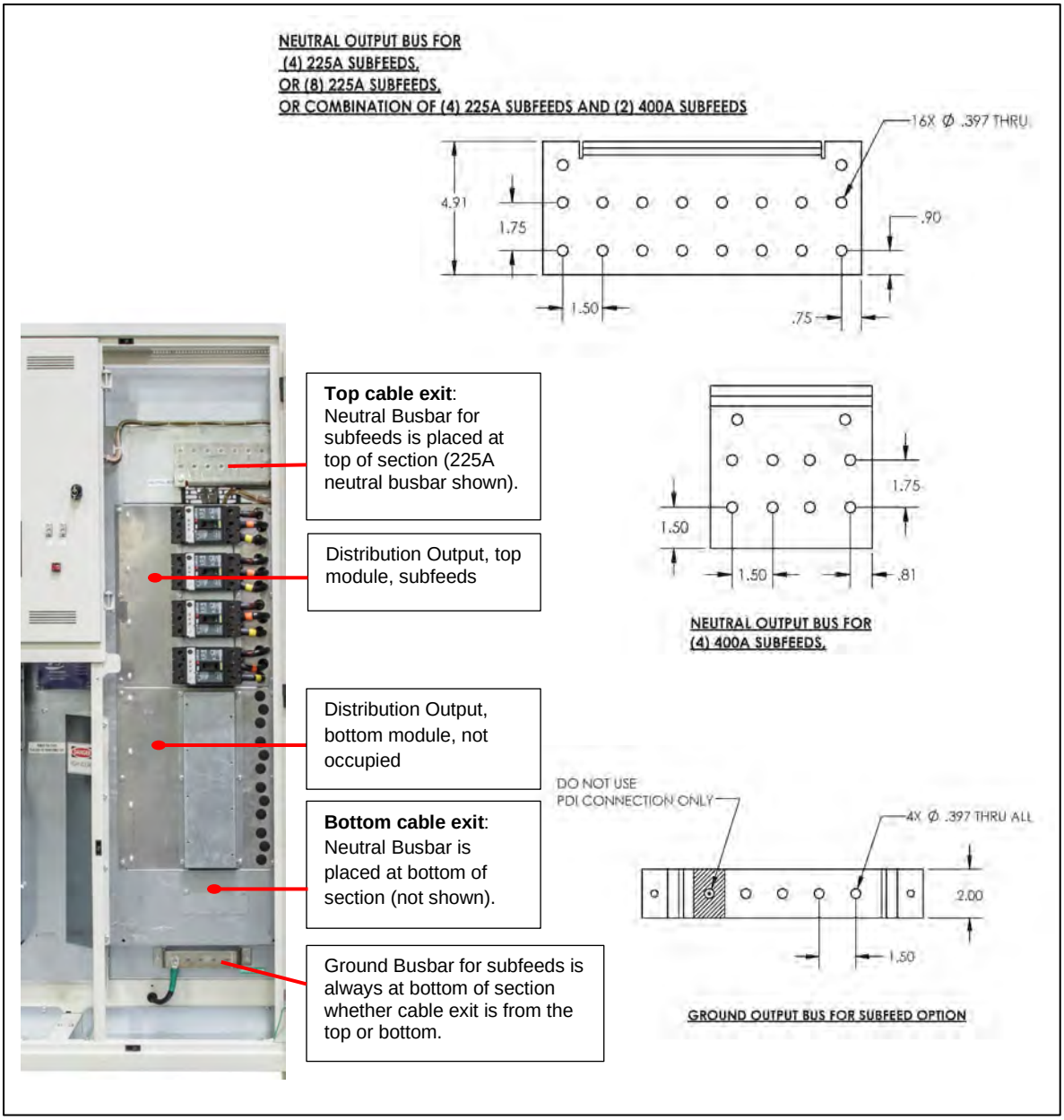


6.4 Output Power Connections

Each Distribution Output Section has its own ground and neutral output connections. (See Figure 12.)

- Bottom cable exit: ground and neutral busbars are located at the bottom of the section.
- Top cable exit: neutral busbar for subfeeds is at top of section; ground busbar is at bottom ofsection.
- Panelboard ground and neutral strips are always at the sides of the panelboards.

Figure 12. Distribution Output Section with Subfeeds: Ground and Neutral Busbars



6.5 Cable Entry/Exit Knockout Plates

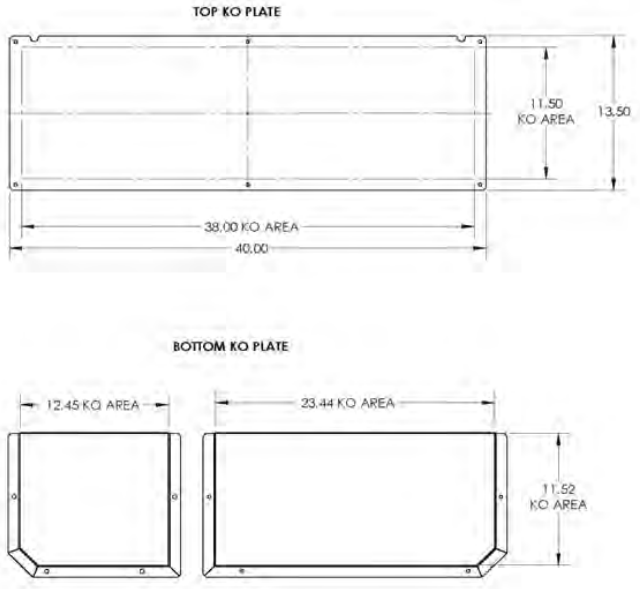
Different cable entry/exit knockout plates are provided for different Distribution Output Section configurations. Knockouts (KOs) are provided for panelboards. Solid plate is provided for large (input or output) cables or pilot holes allowing expansion of the opening for output subfeeds. Mixed solid plate and KOs are provided when the output has both subfeeds and panelboards.

KO plates are specifically designed for the Main Cabinet, 24" Side Car, and 12" Side Car as shown in Figure 13 to Figure 15.

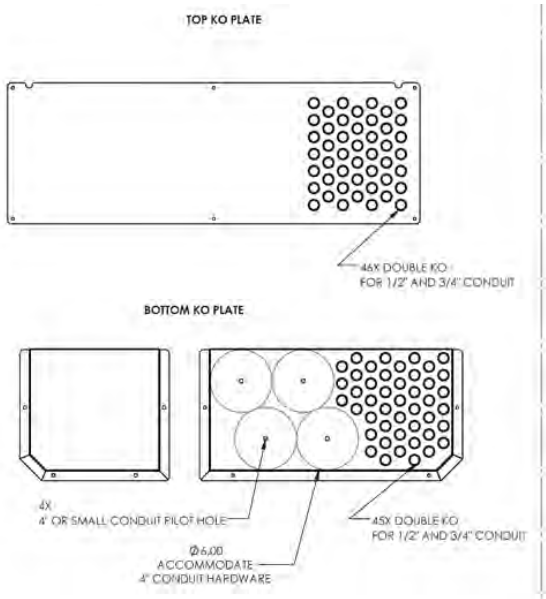
Figure 13. Main Cabinet Knock-out Plates

Cable Entry/Exit Plates (Knock-Out Plates or KO Plates) are different according to the configuration of the Distribution Output Column's modules:

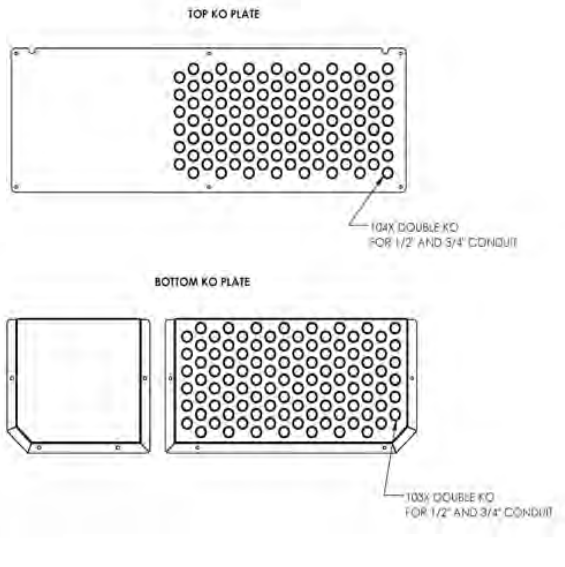
- Blank KO plates are for an all subfeed configuration (customer creates cutouts).
- Mixed KO plates are for panelboard in one module and subfeeds in the other module.
- Panelboard KO plates are for panelboards in both of the column's modules or a combined top/bottom module with an 84-pole panelboard.
- The Input Power KO area is always solid plate.



Standard Blank KO Plates



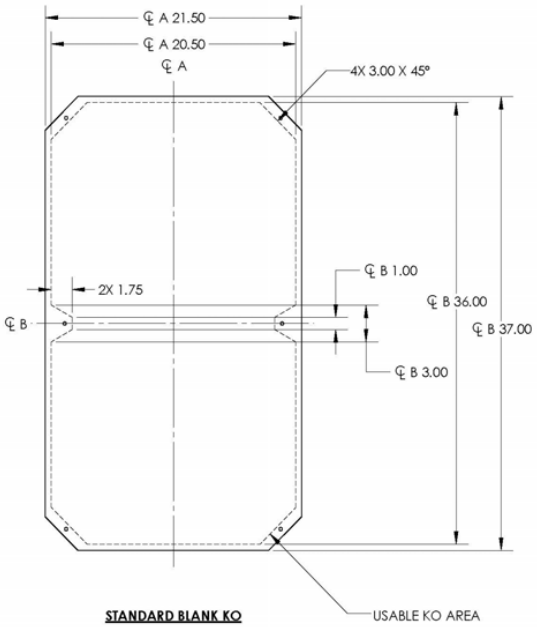
Mixed KO Plates for 42-pole panelboard and (4) subfeeds



Panelboard KO Plates for 84-pole panelboard or (2) x 42-pole panelboards

Figure 14. 24-inch Side Car Knock-Out Plates

Top and bottom cable plates match in dimensions.



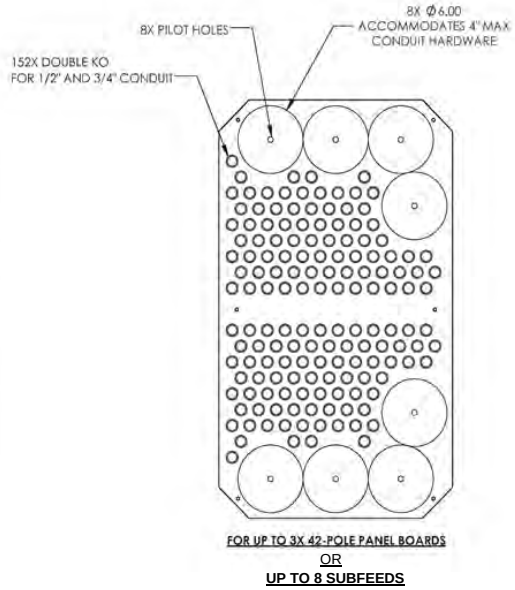
A 24" side car can have one or two columns, or up to four (4) modules.

Different KO plates are available for different side car configurations:

- Standard Blank KO Plate
- All Panelboard KO Plate
- Mixed Subfeed-Panelboards Plate

Top and bottom cable plates match in dimensions.

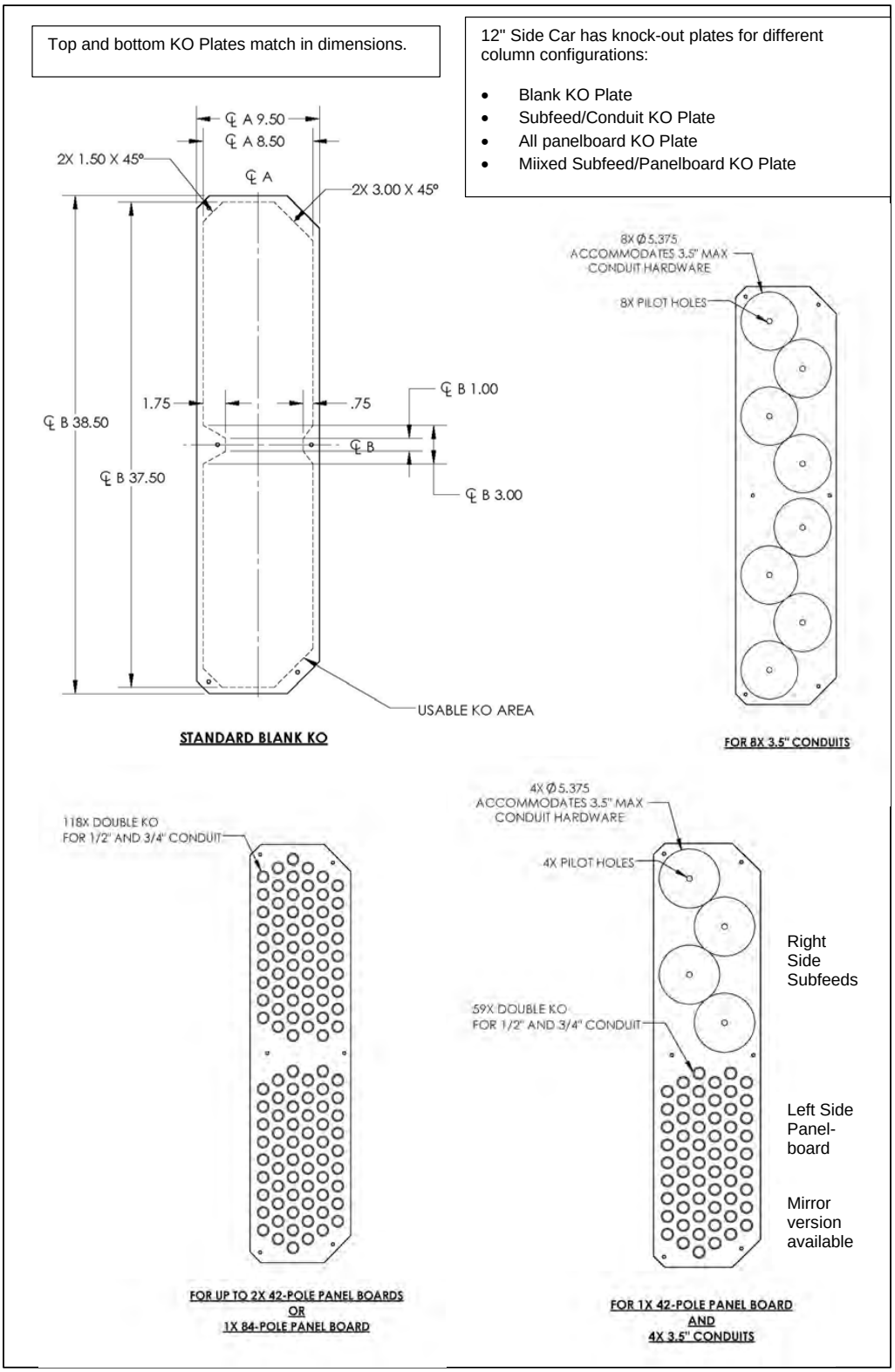
24" side car has all panelboards.



24" side car has mixed panelboards and subfeeds

Additional KO Plate designs may be available.

Figure 15. 12-inch Side Car Knockout Plates



Chapter 7 PDU Initial Start-Up

IMPORTANT

At the initial startup of the PDU, an Eaton factory-authorized technician must validate correct operation of the PDU. The product warranty may be voided if the correct start-up procedures are not followed.

When applying utility power to the PDU for the first time, an Eaton factory-authorized technician must validate correct operation of the PDU. PDU start-up typically includes the following procedures.

7.1 PDU Post-Installation Inspection

After placing the PDU and attaching cables, re-inspect the PDU, as follows:

1. Visually inspect for and remove any debris that may have fallen into the PDU duringin stallation.
2. Transformer: Inspect the transformer for any loose connections or displacement during shipment. Check to make sure all terminal lugs are tight and secure.
3. Internal feeders: Ensure all lug connections are tight and secure.
4. Main input feeder:
   a. Check the main input feeder connections at the main breaker to be sure vibration has not loosened the terminal screws.
   b. Check the feeders from the load side of the main breaker to the primary side of the transformer.
5. Check all other lugs (i.e. neutral bus, ground bus, terminal blocks, etc.).

7.2 Initial Start-Up Procedure

The following steps should be performed:

1. Confirm that the PDU's main input circuit breaker is in the OFF position.
2. Ensure that all of the PDU's output circuit breakers are in the OFF position.
3. Verify that the input voltage to the unit matches the input voltage rating of the unit as identified on the PDU nameplate found on the outside of the front door.
4. Ensure that the input voltage has proper phase rotation and safe grounding practices.

WARNING

- Steps 1-4 must be executed before applying incoming power to the PDU.
- Energizing the PDU can create inrush. Verify that the upstream UPS is in bypass mode or can handle inrush from the PDU.

5. Apply power to the unit.
6. Measure for correct PDU input voltage, which should match the unit's rating within + 5% to -10% of nominal rating.
7. Check for correct phase rotation (clockwise) and voltage.
8. Energize the PDU by setting the Main Input Circuit Breaker to the ON position.

NOTE If the main breaker trips when energized, it may indicate a fault in the unit. Contact Eaton Service at 1-800-843-9433 for diagnostic assistance.

9. Perform an EPO check: Depress the external EPO button and verify that the Main Input Circuit Breaker shunt trips.
10. Manually reset the Main Input Circuit Breaker to the ON position. You may have to first manually trip the lever all the way to the OFF position.
11. Verify that the output voltages are correct for the PDU.
12. Sequentially turn ON the distribution circuit breakers.

NOTE Equipment energized by the PDU may require special start-up procedures. Consult the equipment manufacturer's instructions for start-up procedures.

Chapter 8 PDU Procedures

8.1 Normal Start-Up

After initial PDU startup, you can use the following abbreviated procedure to start up the PDU and its downstream equipment:

1. Confirm that the PDU's main input circuit breaker is in the OFF position.
2. Confirm that all of the PDU's output circuit breakers are in the OFF position.
3. Apply power to the unit.
4. Set the Main Input Circuit Breaker to the ON position. You may have to first manually trip the lever all the way to the OFF position.
5. Sequentially energize the distribution output circuit breakers, following any special procedures required by equipment attached to the PDU. Consult the individual manufacturer's instructions for these requirements.

8.2 Normal Shutdown Procedure

1. Shutdown equipment connected to the PDU's distribution output circuits, following any special procedures that the equipment manufacturer has specified.
2. Turn off the Distribution Output Circuit Breakers feeding the equipment.
3. When ALL output circuit breakers have been turned OFF, turn the Main Input Circuit Breaker to the OFF position.

8.3 Shutdown Signals

The PDU can be shut down by the PDU M4G Board with a signal to trip the main breaker. The trip signal is sent using either the 170VDC or 24VDC output connections.

The PDU board will trip the main breaker if it receives any of the following signals (refer to Figure 20, for connections):

- Local EPO signal to the PDU board
- Remote EPO (REPO) signal from the Contractor Board to the PDU board. The customer REPO signal is terminated at the Contractor Board.
- Thermal wires register a temperature in the PDU transformer core that exceeds the transformer temperature limit specified.

8.4 Manual or Automatic Restart

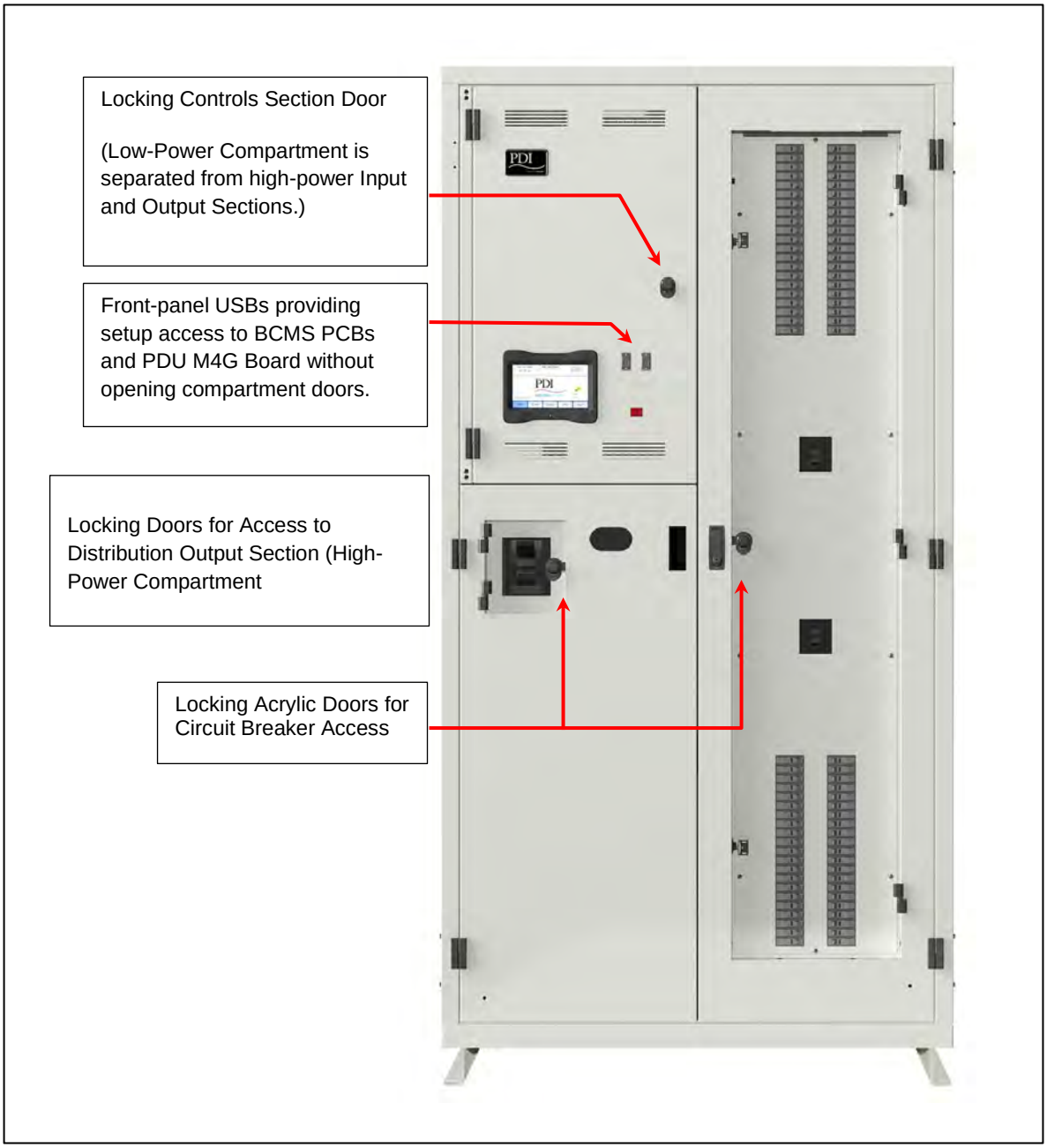
The **Restart Switch** on the PDU board determines if restart is automatic after a voltage loss. The **170 VDC** output connection on the PDU M4G Board must be connected to the main breaker trip unit for the Restart Switch to function —the Restart Switch does not work with the 24 VDC voltage connection.

- If the Restart Switch is set to **Manual (down)** (or away from the PDU Board transformer), the main breaker is tripped when the PDU loses voltage. When the PDU receives voltage again,the main breaker must then be manually reset and closed to power up the PDU and resume operation. This is the default position: the PDU is shipped with the Restart Switch set to Manual.
- If the Restart Switch is set to **Automatic (up)** (or towards the PDU Board transformer), the main breaker is not tripped on a voltage loss. The PDU resumes operation if voltage is in the correct range.
- See 9.3.1 *PDU M4G Board* and associated illustration for location of the Restart Switch.

8.5 PDU Compartment Access

The PDU provides secure front access to compartments and internal functions that limits exposure to high-power components.

Figure 16. PDU Access

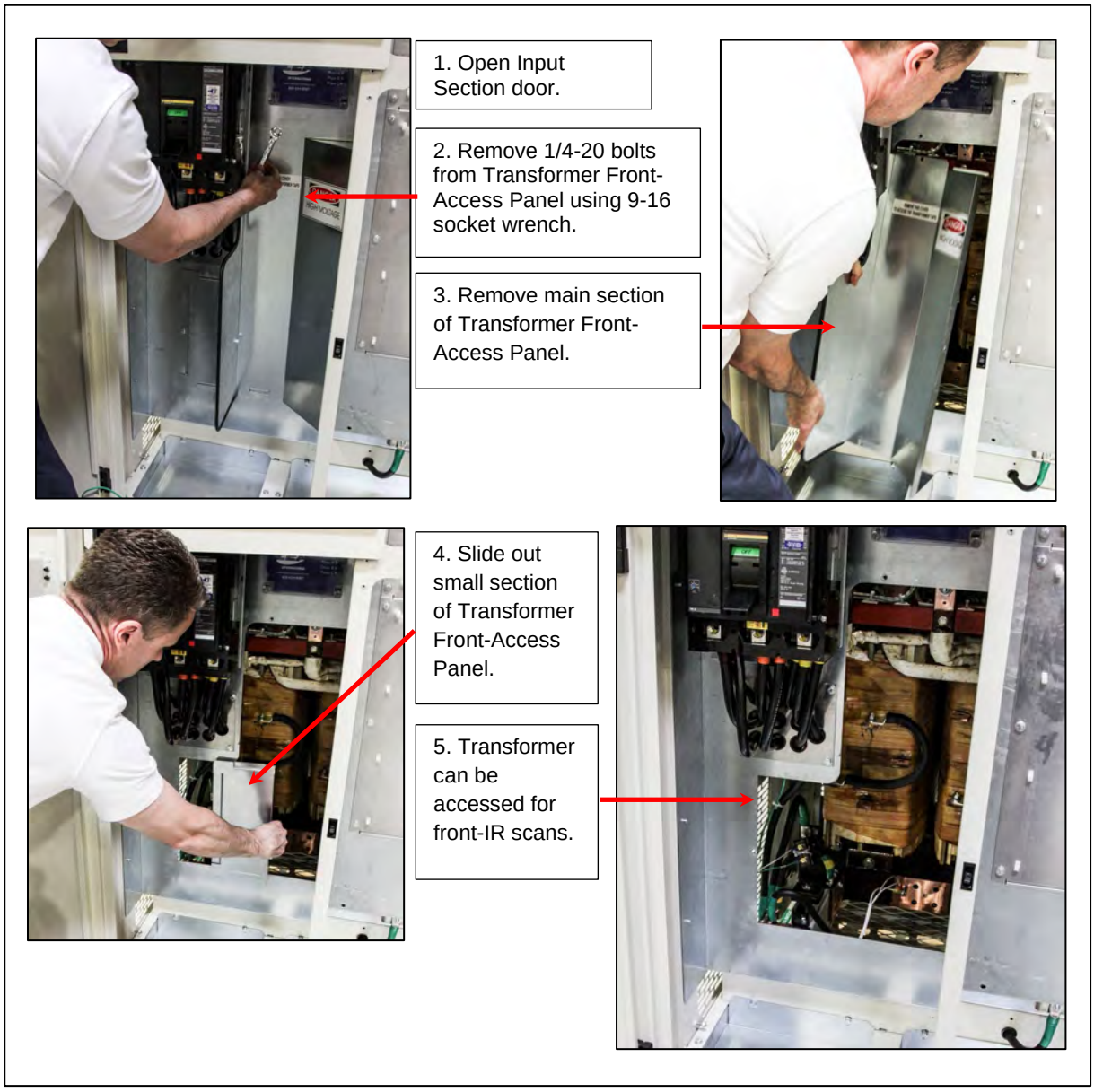


8.6 Removing Transformer Front Access Panel

The PDU Main Cabinet has a removable Transformer Front Access Panel in the Input Section which provides front access to the transformer for infrared scanning or changing the optional transformer taps.

Figure 17 shows the steps in removing the transformer front access panel.

Figure 17. Removing Transformer Front Access Panel



Chapter 9 Monitoring Components

9.1 Controls Compartment

Monitoring components are separated from high-power input and output components to allow maintenance on monitoring components during PDU operation. Monitoring components are contained in the Controls Compartment of the Main Cabinet. Additional BCMS components are located in the Distribution Output sections of the Side Cars that they monitor.

Monitoring components are contained on the Controls Compartment door and inside the compartment (Figure 18). The compartment also swings out as a unit (Figure 19), which shows the Resistor Board, an intermediate connection PCB between subfeed CTs and a BCMS PCB.

Figure 18. Controls Compartment Components

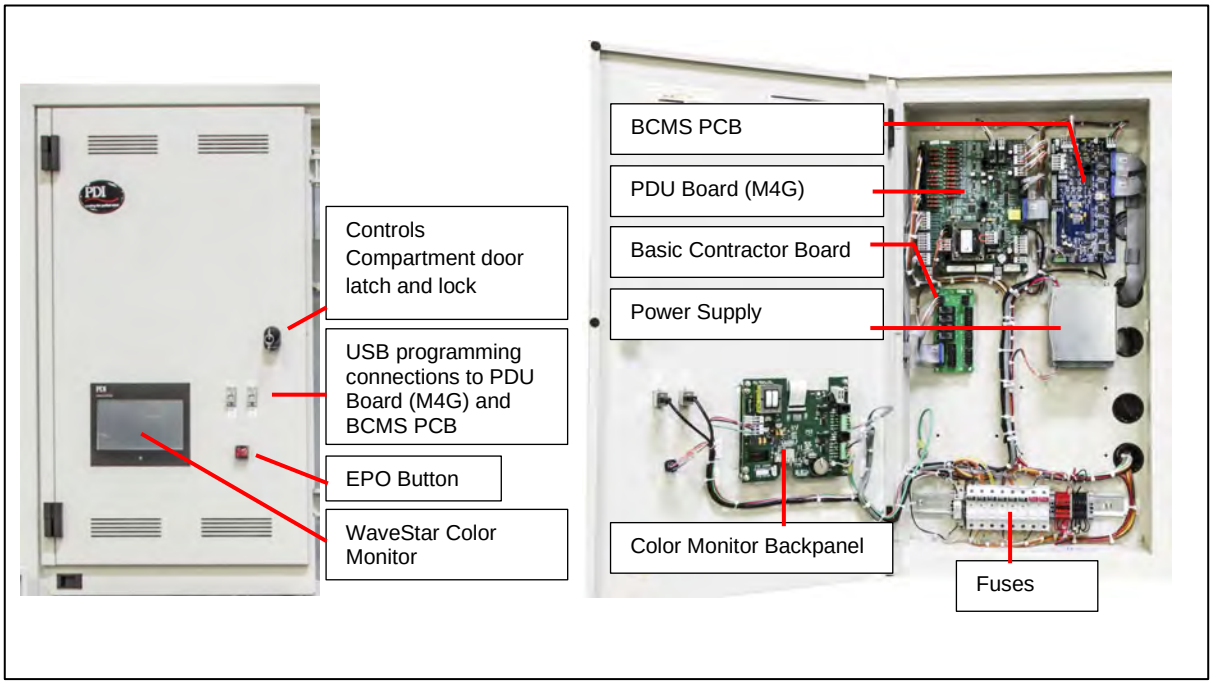
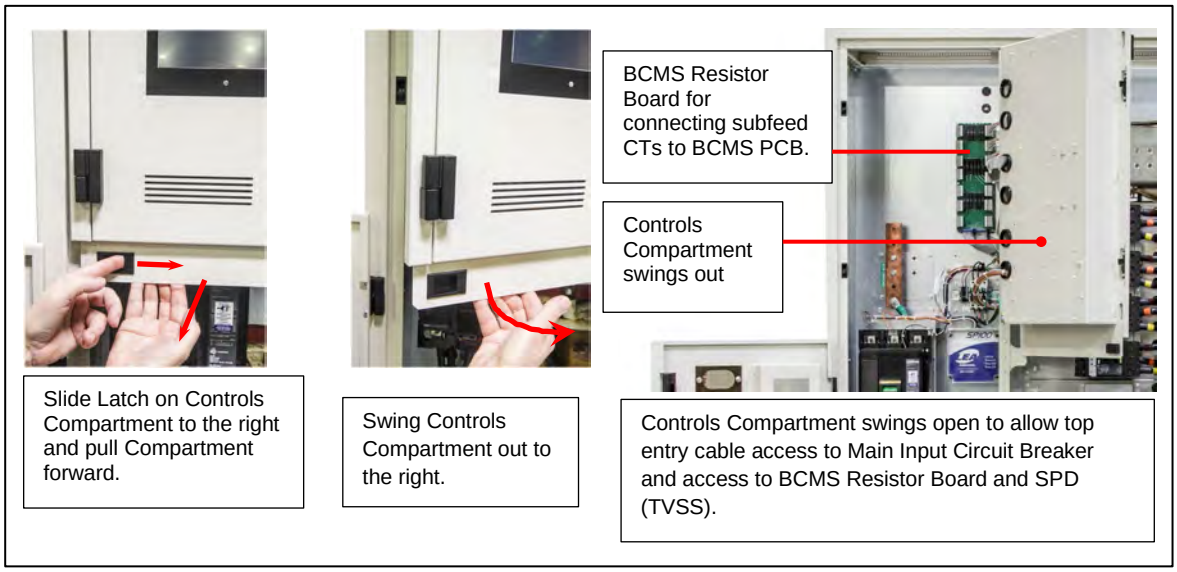


Figure 19. Controls Compartment Swings Out as Unit



9.2 WaveStar Monitoring Component Summary

WaveStar Monitoring components include the following:

- PDU Board or M4G Board sets PDU parameters and monitors the transformer.
- A Contractor Board is an extension of the PDU Board for external connections.
- Current transformers (CTs) measure current in the transformer and subfeeds; CT stripsmeasure current in panelboard circuits.
- Branch Circuit Monitoring System (BCMS) PCB
  - Is loaded with a points list appropriate to its monitored devices.
  - Collects current information from CT strips on panelboards and CTs on subfeeds(through the Resistor Board) and voltage information.
  - Processes data and sets warnings and alarms according its setup parameters.
  - Passes data upstream to the Color Monitor.
- A Resistor board is intermediate between subfeed CTs and a BCMS PCB. It is used only with subfeeds.
- WaveStar® Color Monitor
  - Displays power information about monitored PDU devices using their points lists.
  - Passes points list information to upstream Modbus master devices, such as a Building Management System or Data Center Infrastructure Management (DCIM).
  - Displays power information about monitored PDU devices on web pages for suitably configured customer networks.

9.3 PDU Board and Contractor Boards

The **PDU Board** (also called the M4G board) sets PDU parameters and monitors the PDU's transformer. Internal PDU signaling, such as the four Digital Inputs, is terminated to the PDU (M4G) Board.

Every PDU also has a **Contractor Board**, which is logically part of the PDU Board, functioning as a terminal block to the PDU Board. The PDU's Contractor Board is directly connected by a ribbon cable to the PDU Board. The customer has a choice of two (2) Contractor Boards, which act as an extension of the PDU M4G Board for making customer connections for remote control and monitoring:

- Basic Contractor Board
- Enhanced Contractor Board, which can connect twice as many output relays and building alarms

External signaling, such as the customer's REPO signal, is terminated to the Contractor Board:

- All dry contact signals for Remote Emergency Power Off (REPO), building alarms, output relays, communication ports, and other control wiring must be terminated onto a Contractor Board.
- All interface wiring (for building alarms, AC alarms, halon alarms, remote power off systems, etc.) should be run within the PDU cabinet for termination on the Contractor Board.
- All interface wiring and contacts are to be provided by others.

Setup of the PDU and Contractor Boards is performed during manufacturing. These boards can be programmed through a USB programming link on the front door of the Monitoring Compartment. The PDU board's points list values are also accessible through the customer's BMS, but most points cannot and should not be set by the customer, as incorrect settings can cause PDU malfunctions.

Measurement values in the PDU Board's points list can also be viewed on the Color Monitor.

9.3.1 PDU M4G Board

For the following connections, reference Figure 20.

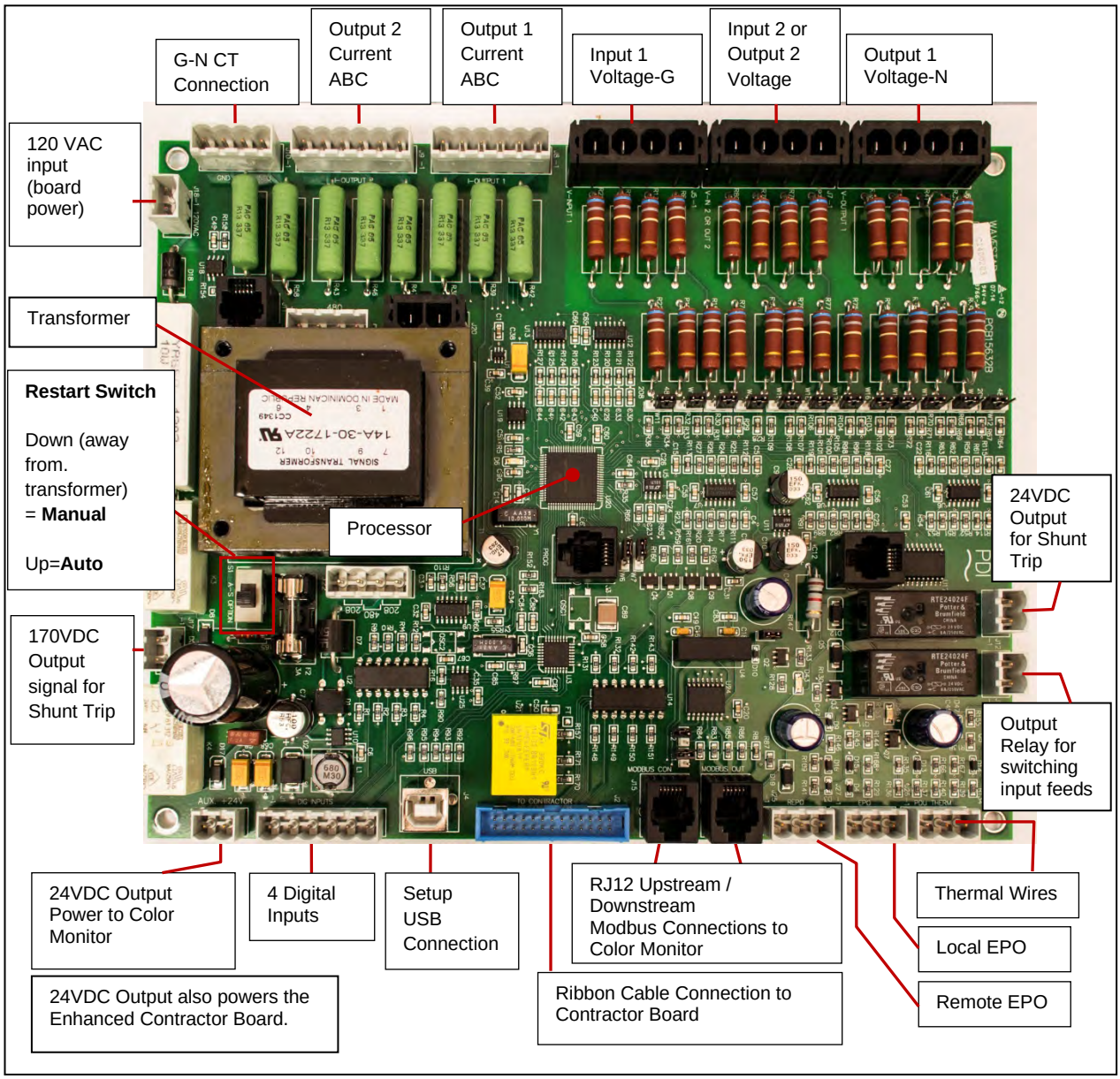
Transformer CT (current) and voltage connections (top edge of Figure 20):

- CT connections, output current (ABC), Output 1 and Output 2
- CT Connection G-N:
  - Pins 1-2: Ground CT connection
  - Pins 3-4: Neutral CT connection
- Input 1 Voltage-G connection: Input Delta connection is 3-wire plus ground (no neutral).
- Output 1 Voltage-N connection: Output Wye connection is 4-wire plus ground.
- Input 2 or Output 2 Voltage provides a configurable second input or output voltage, used with dual input or output PDUs.

Power and Power Signals

- **120VAC Input Power** connection provides power to the PDU M4G Board.
- **24VDC Output Power** connection provides power to WaveStar Color Monitor or Monitor
- **Power Off Controls:**
  - Remote EPO connection from the Contractor REPO Connection (J6), see Figure 20. Customer REPO dry contact connection is to the Contractor Board.
  - Local EPO connection
  - Thermal wires for transformer temperature measurements, which can cause PDU shutdown.
- **Shunt Trip**: The board outputs two voltages for tripping the Main Breaker Shunt Trip:
  - 170VDC: 170 VDC is rectified from 120VAC input power
  - 24VDC

Figure 20. PDU (M4G) Board



NOTE The PDU Board is rotated 90° counter clockwise in the PowerPak 2 PDU Monitoring Compartment compared to the orientation in Figure 20.

- The Restart Switch determines whether restart is automatic or manual after a voltage loss.
  - Switch down (away from on-board transformer) PDU restart must be done manually after voltage is restored.
  - Switch up: PDU restart is automatic after power is restored.
  - See section 8.4 *Manual or Automatic Restart* for additional information.

NOTE The Restart Switch requires 170VDC input to the main breaker shunt tripto function. It is not operable with the 24VDC input to the main breaker shunt trip.

Other Input and Output Signals

- Four Digital Inputs or Alarms: Digital inputs or alarms are primarily used for internal PDU signalling, such as a Surge Protective Device signal or Door Open condition. Digital feeds can be assigned by Eaton during M4G board setup, when names can also be assigned to the inputs. These inputs turn on bits in the M4G points list. See PDU M4G Board Points List, Modbus Register 90. Defaults are:
  - Digital Input 1
  - Digital Input 2
  - Digital Input 3
  - Door Open
- **Output Relay**: Output relay: used with a dual input PDU to signal transfer of input feed to theother feed; a phase synchronization check is performed before enabling the relay.

Setup/USB Connection: Used by Eaton representatives to program set points, contractor board relays, etc., the PDU M4G and Contractor Boards. PDU board set points cannot be altered through normal Modbus register access to prevent registers being accidentally altered. See M4G points list for further information.

RJ12 Modbus Connections on the PDU M4G board are to/from the Color Monitor.

Replaceable Parts

Battery:

⚠WARNING

The battery used in this device may present a risk of fire or a chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F) or incinerate. To be carried out by authorized trained personnel only.

Use of another battery may present a risk of fire or explosion. Dispose of battery properly.

There are two battery options on the board and only one will be present:

- Designator U21: Yellow Tophat
  - Replace with STMicroelectronics M4T32-BR12SH1 only.
- Alternate Designator BH1: Coin Cell
  - Replace with Murata CR2032, 3V, 220mAh or any equivalent UL1642 BBCV2 recognized/listed make with same voltage and current rating only.

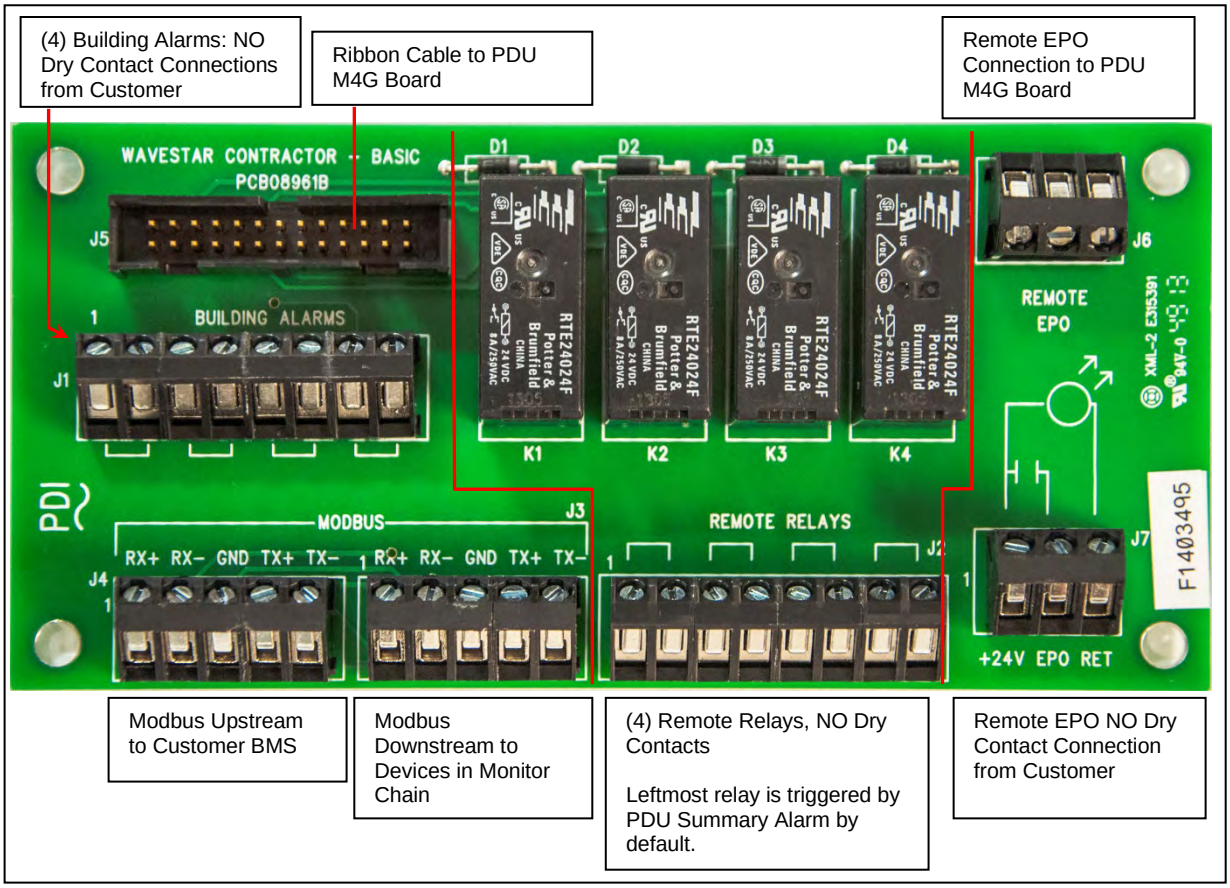
Fuses:

To be carried out by authorized trained personnel only.

- Designator F1:
  - Replace with 2A, 125V Littelfuse 39512000440 or UL recognized, IEC compliant fuse of the same type only.
- Designator F2:
  - Replace with 2A, 250V Bel Fuse 5TT 3-R or UL recognized, IEC compliant fuse of the same type only.

9.3.2 Basic Contractor Board

Figure 21. Basic Contractor Board



The Basic Contractor Board has these connections (Figure 21):

Inputs:

- Remote EPO: Dry contact connection point for input of an REPO signal. Connect external dry contacts to terminals marked **+24V EPO RET** (Figure 21). The REPO signal is sent to the PDU Board via the **REMOTE EPO** connection, which is not a customer connection point.

⚠CAUTION

Connection of voltage to this point can cause damage to the unit/

- Four (4) Building Alarms (Figure 19). Alarm names can be specified by Eaton PDI in PDU Board setup.

Outputs:

- Four (4) remote relays that output dry contact (NO) signals (Figure 21). (Note: Remote relay scan accept dry contacts rated up to 2A/250V.)

  - Relays are programmable using the USB setup connection on the PDU M4G Board. Eaton PDI programs the relay inputs, usually in manufacturing. So for example, a relay can be programmed to turn on when a specific Building Alarm, such as a fire alarm, is received. The building management system or other control system receives the relay input and can cause PDU shutdown with an REPO signal.
  - By default, the first, left-most relay is programmed to close when the PDU Summary Alarm, PDU Board points list, Modbus Register 70, is in alarm (Figure 21).

- **Modbus Connection**: 4-wire configuration connection is located on the customer connection terminal block.
- **Modbus Connections**: The board has customer connections for upstream and downstream 4-wire Modbus (Figure 21).

9.3.3 Enhanced Contractor Board

The Enhanced Contractor Board (Figure 22) provides twice as many relays and building alarms as the Basic Contractor Board. The Enhanced Contractor Board is used in other Eaton PDI products and many of the connectors are not used on PDUs.

24VDC Power Input: Unlike the Basic Contractor Board, the Enhanced Contractor Board has a processor and uses 24VDC power from the PDU M4G Board.

Inputs:

- Remote EPO: Dry contact connection point for input of a REPO signal to system. Connection of voltage to this point can cause damage to the unit. Connect external dry contacts to terminals marked **+24V EPO RET** Figure 22. The REPO signal is sent to the PDU Board via the REMOTE EPO connection, which is not a customer connection point.
- Eight (8) Building Alarms (Figure 22). Alarm names can be specified by Eaton PDI in PDU Board setup.

Outputs:

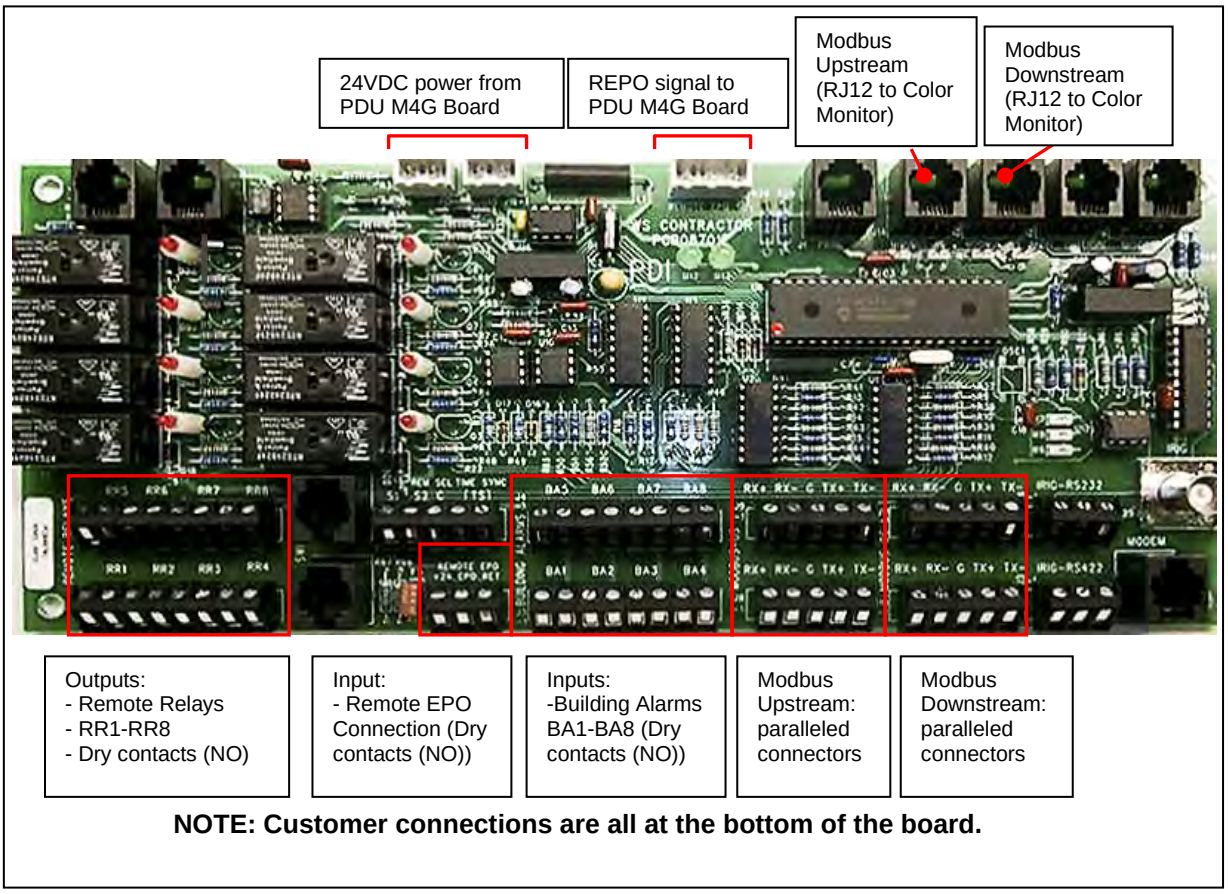
- Eight (8) remote relays that output dry contact (NO) signals (Figure 22).

NOTE Remote relay scan accept dry contacts rated up to 2A/250V.

  - Relays are programmable using the USB setup connection on the PDU M4G Board. Eaton PDI programs the relay inputs, usually in manufacturing. So for example, a relay can be programmed to turn on when a specific Building Alarm, such as a fire alarm, is received. The building management system (BMS) or other control system receives the relay input, receives the signal and can cause PDU shutdown with an REPO signal.
  - By default, the first relay **RR1** is programmed to close when the PDU Summary Alarm, PDU Board points list, Modbus Register 70, is in alarm.

Modbus Connection: 4-wire configuration connection is located on the customer connection terminal block.

Figure 22. Enhanced Contractor Board



9.3.4 PDU M4G Board Points

The PDU M4G Points List contains measurements and set points for the PDU M4G Acquisition Board and its associated Contractor Board. It has two groups of data

- Measurements and Alarms
  - Current and voltages measurements from the critical load transformer
  - Alarms from PDU M4G Board and Contractor Board
- set points for
  - Alarm thresholds
  - Contractor board setup, such as enabling building alarms and specifying names

Eaton representatives must specify Modbus register set points or Contractor Board setup options using a special setup program connected to the M4G USB port.

The PDU M4G Board points list can be downloaded from the Smiths Power website.

9.4 BCMS

BCMS can monitor panelboards or subfeeds, but only one kind of points list (or Modbus register map) can be loaded into a BCMS PCB at the same time. For example, if subfeeds and panelboards are mixed in the same Distribution Output section, two BCMS PCBs are required for that section. To minimize BCMS PCBs, keep panelboards or subfeeds together wherever possible in the same Distribution Output Section.

The layout of a BCMS PCB is shown in Figure 22.

9.4.1 Panelboard Monitoring

A single BCMS PCB can monitor

- (2) x 42-pole panelboards, or
- (1) x 84-pole panelboard, plus
- The main feed(s) associated with each panelboard.

Layout of a BCMS LV/HV board (BCMS PCB) is shown in Figure 23.

9.4.2 Subfeed Monitoring

PDU subfeeds are monitored as follows:

1. Each subfeed must have a CT for monitoring ABC phases and, if monitored, NG.
2. Subfeed CTs are terminated onto a Resistor Board. One Resistor Board can connect upto (14) 3-phase circuits (ABC) or (10) circuits if neutrals are also monitored (ABCN) and is sufficient for a single Distribution Output Section.
3. The Resistor Board is connected to a single BCMS PCB using the same connections as panelboard BCMS. (See Figure 19 for location behind the Controls Compartment.) The Resistor Board is an intermediate board between subfeed CTs and the BCMS PCB.
4. The BCMS board is loaded with the Enhanced Subfeeds (ESF) Points List.

9.4.3 BCMS Points Lists

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 andwarnings for each panelboard circuit.
- **BCMS KWH** points list provides accumulated KWH measurements and other detailed powerinformation for each panelboard circuit.
- **BCMS IEC** panelboard points list is for IEC format panelboards with 36 or 72 1P circuits.
- **BCMS Enhanced Subfeeds (ESF)** points list for subfeeds.

See the for information on downloading points lists from the Smiths Power website.

9.5 Customer Access to Monitoring Compartment

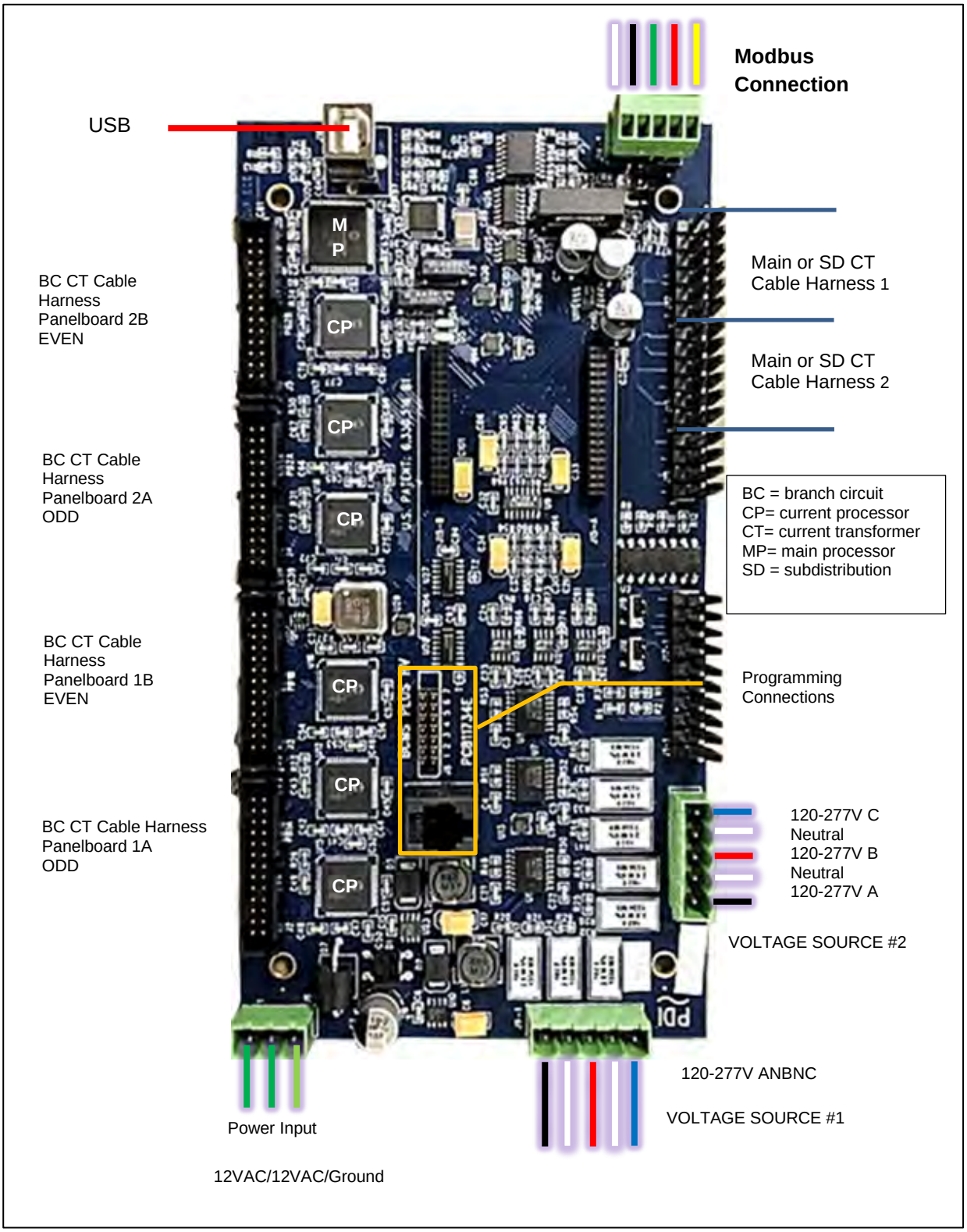
Customers should not have to access components in the Monitoring Compartment except for the following:

- Contractor Board for customer external connections, such as the REPO signal and Modbus RTU connection.
- The Color Monitor for Ethernet connection to the customer's upstream network and Color Monitor Summary alarm.

- Dry contact connections (see 9.6 *Dry Contact Network*).

Even these connections can be set up during PDU installation so that customers need not access the Monitoring Compartment during PDU operation.

Figure 23. BCMS LV/HV Board



9.6 Dry Contact Network

In addition to the internal Modbus RTU network, the PDU has a network of dry contacts providing input signals and alarm and status annunciation. Dry contact connections to the Color Monitor, PDU M4G Boa10rd, and Contractor Board(s) are standard. Optional dry contacts for subfeed circuit breaker (trip, trip alarm, and aux status) and SPD/TVSS status are also available.

Table 9 lists available dry contact input and output signals.

Table 9. Available Dry Contacts

Device	Input Signals	Output Signals	Signal Meaning	Dry Contact Spec NA=Not Applicable
Color Monitor		Summary Alarm	An alarm is present on a device in the Monitor's device chain.	0.5A @ 120VAC 0.5A @ 30VDC
PDU board	4 Digital Inputs		Signals internal to PDU with assignable meanings. Digital Input 4 = PDU door open (default assignment).	NA
PDU (Contractor Board)	Remote Emergency Power Off (REPO)		Signal to immediately power down PDU.	NA
PDU (Contractor Board)	4-8 Building Alarms		Assignable meanings.	NA
PDU (Contractor Board)		4-8 Remote Relays	Assignable meanings Relay 1 = Summary Alarm for PDU by default	Up to 2A/250V
Subfeed breaker(s) (optional)	Breaker trip		Trip subfeed circuit breaker	Max 5A/600V 24VDC recommended
Subfeed breaker(s) (optional)		Breaker trip alarm	Signals that subfeed circuit breaker has tripped or has been reset	Max 5A/600V 24VDC recommended
Subfeed breaker(s) (optional)		Auxiliary contacts	Signals that subfeed circuit breaker contacts have changed state (open or closed)	Max 5A/600V 24VDC recommended
Surge Protective Device (SPD) (optional)		OK/not OK signal	NC contact is closed when SPD is functional and powered.	600V wire required. Contact ratings: 0.3 A @ 125VDC 0.3 A @ 110 VDC 1.0 A @ 30 VDC

9.6.1 Dry Contacts for Subfeed Circuit Breakers (optional)

Subfeeds can have optional dry contacts to

- trip a circuit breaker remotely,

- present a trip alarm, or
- present circuit breaker status.

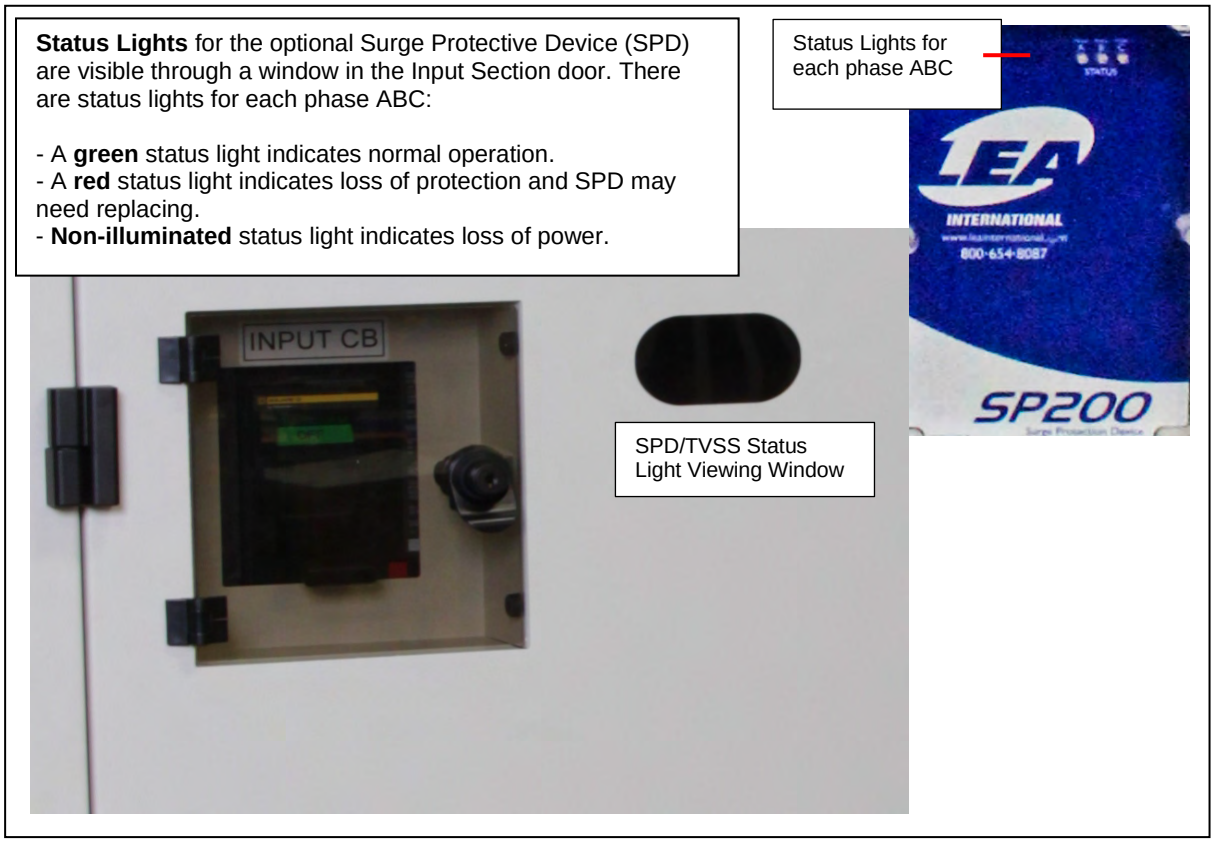
Dry contacts are wired directly to the subfeed circuit breaker. Alternatively, a set of terminal blocks can be installed adjacent to the circuit breakers providing an intermediate connection point between the circuit breaker and the customer's dry contact network.

9.6.2 Surge Protective Device Status

The optional SPD/TVSS incorporates a remote signaling dry contact and visual status indicators. The Input Section has a viewing panel for the SPD status lights.

The SPD (LEA SP100 or SP200) has a dry contact that is closed when the SPD is powered and functional. (See Table 9.) For dry contact wiring information, see the cut sheet for the specific SPD you are using. The correct cut sheet should be included in your submittal package.

Figure 24. SPD/TVSS Status Lights



Chapter 10 PDU Network

The PDU's network is centered on the Color Monitor, which stands at the dividing point between the PDU's internal or downstream network and the network upstream or external to the PDU.

The Color Monitor is the Modbus master device to all downstream devices in the PDU. Upstream Modbus master devices, such as the Building Management System (BMS), request data from the PDU's monitored components only through the Color Monitor.

The Monitor communicates to these upstream Modbus requesters using any of several protocols.

10.1 Color Monitor and Protocols

The Color Monitor supports the following protocols, which can all be used simultaneously:

Downstream Protocol The downstream PDU 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, see *WaveStar® Color Monitor, Setup and Operation, P-164001109*.

10.2 Customer Network Connections

Customer Modbus RTU network connection are made to the Contractor Board. See 9.3.2 *Basic Contractor Board* and 9.3.3 *Enhanced Contractor Board*. The Customer Ethernet connection is made to the Color Monitor back panel. See 8.4 Color Monitor Network Connections.

10.3 Modbus Addressing

Refer to Figure 26 with the following bullet points:

- The internal PDU network uses Modbus RTU protocol to connect the PDU board and BCMS cards to the Color Monitor.
- The Color Monitor is the **Modbus master** to its downstream devices. The upstream Modbus master (such as the BMS) cannot directly address these devices, but rather addresses them through the Monitor. Upstream and downstream from the Monitor are separate Modbus segments.
- The Monitor's upstream address can be set to from 1 to 255, but you must leave enoughaddressing capacity for downstream devices. The monitor will not respond to a commandsent to address 0. The address is set during Monitor Setup.
- The Monitor's downstream devices must be assigned consecutive addresses starting ataddress 1 for the PDU Board. Modbus addresses must be assigned in BCMS setup and willbe done initially at the factory. Modbus addresses cannot be assigned by, for example, theBMS.
- For upstream addressing these device addresses are remapped as successor addresses tothe Monitor. (This is often confusing, but it is important to understand.) If the Monitor hasupstream address 30, the downstream addresses 1, 2, 3, 4, 5, 6, 7 are remapped to 31, 32,33, 34, 35, 36, 37 as seen from the BMS or other Modbus Master.

- Modbus addressing is the same for Modbus RTU and Modbus TCP/IP.

10.4 Color Monitor Network Connections

The Color Monitor's backpanel has Modbus RTU and Ethernet ports (Figure 25).

Modbus RTU backpanel connections are typically made in manufacturing. (Customer Modbus RTU connections are made to a Contractor Board.) However, the customer's Ethernet cable is connected directly to the Monitor's Ethernet port.

Figure 25. Color Monitor Network Connections

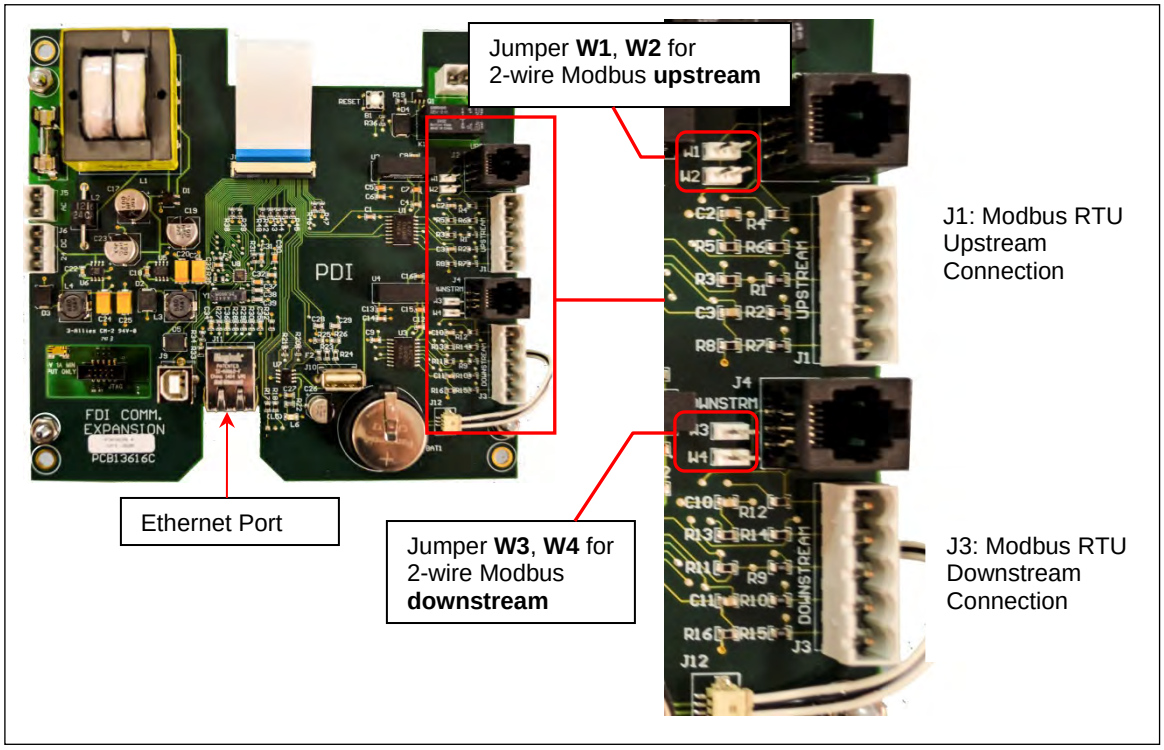
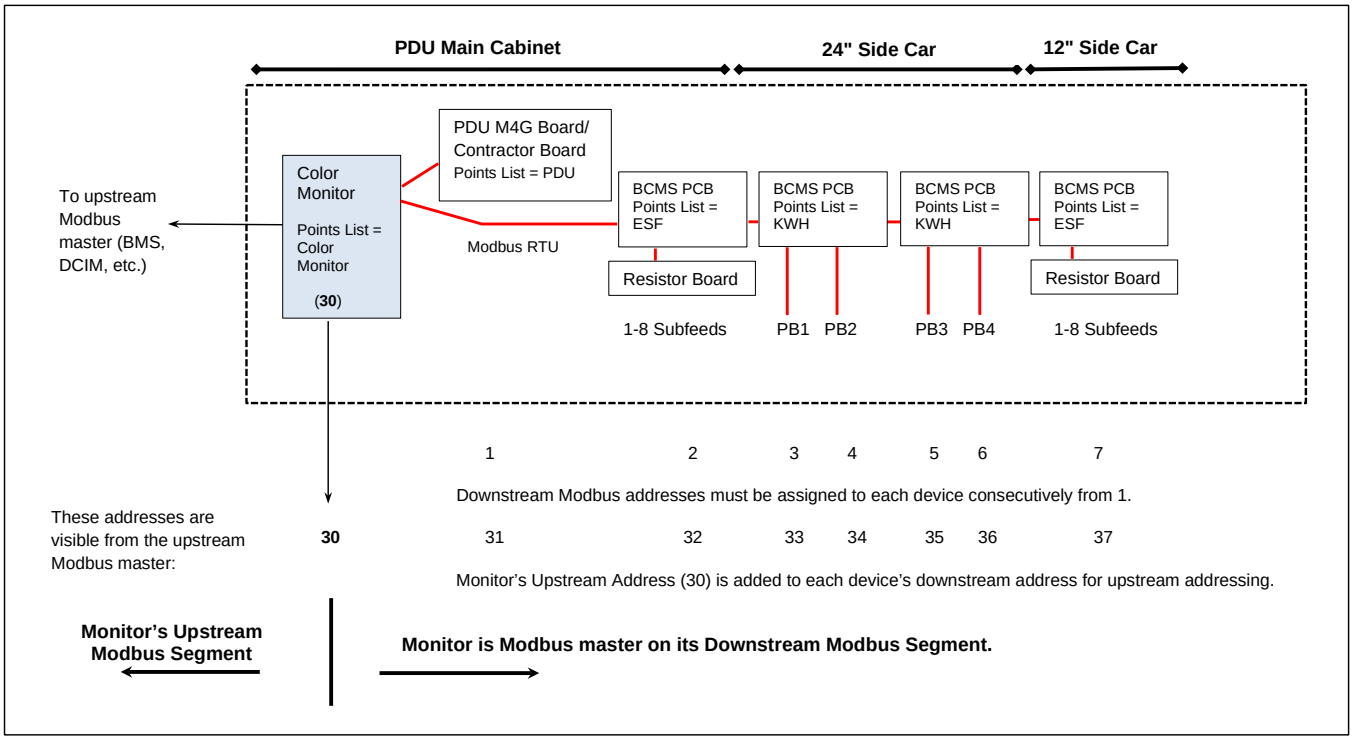


Figure 26. Internal PDU Network, Modbus Addressing, Example



10.4.1 Modbus RTU Ports

Table 10. Pin-Out for Modbus Headers

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

The Color Monitor has two (2) paralleled Modbus ports:

- J1 and J3 are header/plug connections for connecting to most devices.
  - J1 is the upstream port.
  - J3 is the downstream port.

The Modbus RTU interface is isolated, and pin designations are given in Table 10.

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

Eaton PDI devices have two (2) jumpers near their Modbus ports for configuring 2-wire vs. 4-wire Modbus RTU (see Figure 25). 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 Monitor's PCB or on the customer Building Management System (BMS) wires to RX+ on a device PCB (Figure 25).
- TX- from the Monitor or BMS wires to RX- on device PCB (Figure 25).
- 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.

10.5 Modbus RTU Cables

10.5.1 Cable Specification

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

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

10.5.2 Cable Biasing and Termination

Eaton PDI devices have soft biasing (27K pull-up and pull-down resistors) on the + and – transmit and receive lines. Therefore, if the customer's Master device allows for control, Eaton recommends that the user turn on biasing and turn off termination, which may "fight" the biasing. Biasing the Master 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.

10.6 Ethernet Cables

The maximum length of Ethernet cable depends upon the customer's choice of Ethernet cable.

Chapter 11 Alarms

11.1 WaveStar Monitoring

Alarms can be issued from WaveStar monitoring components through their points lists:

- The PDU (M4G) Board points list monitors the transformer and inputs from the Contractor Board.
- BCMS:
  - Panelboard points lists (KWH or Normal) monitor the panelboard main feeds andbranch circuits.
  - Enhanced Subfeeds (ESF) points list monitors large subfeeds up to 250A.
  - IEC panelboard points list monitors IEC format panelboards.
- The WaveStar Color Monitor also has a points list and can present a basic communication alarm for each device in its Modbus chain.

Alarms can be read in two ways:

- **Color Monitor**. Alarms for each device can be displayed on the Alarm Screen.
- **Modbus**. A BMS or other Modbus master device can read the points list for each component.

11.2 Reading Alarms with Modbus

Each device has its own points list with summary alarm Modbus registers indicating that an alarm is present on that device. The user can check alarm specifics through the BMS or go to the PDU and check the WaveStar Monitor Banner/Alarm Screen.

The BMS should read these summary alarm registers regularly to be appraised of power conditions requiring immediate attention.

11.3 Summary Alarms

The Color Monitor has a summary alarm that is issued whenever a device in its chain has an alarm or warning. Summary alarms can be issued in the following ways:

- Dry contact connection on the Monitor back panel
- Modbus Points List, summary alarm point or register: the summary alarm is point is in the Alarm Register (register 01), which can be read with Modbus RTU.
- SNMP trap

When a summary alarm is issued, an operator can go to the Monitor to check the list of active alarms or check the Monitor's web pages.

Alarms in the Monitor points list are for communication failures with devices in its Modbus chain. These and the summary alarm are contained in the Monitor's Alarm Register (register 01).

The Basic and Enhanced Contractor Boards also have a PDU summary alarm defined by default as the leftmost remote relay. Relays are programmable and the definition of this relay can be changed. See 9.3.2 *Basic Contractor Board* and 9.3.3 *Enhanced Contractor Board*.

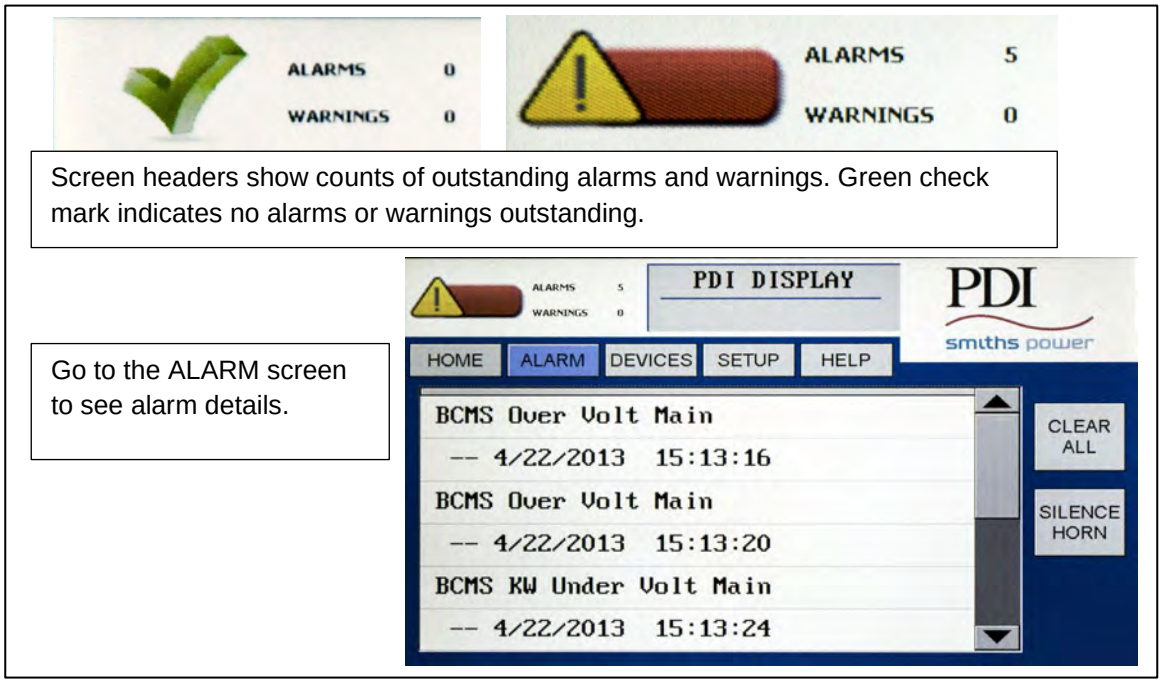
PDU The PDU M4G Board points list has Summary Alarm and Summary Alarm Latched registers (registers 70-71, Rev E). The points list covers both the PDU board and its associated Contractor Board.

Subfeeds The Enhanced Subfeeds points list has a Latched Summary Alarm Register (504).

11.4 Reading Alarms at the Color Monitor

Alarms for all devices in the Monitor's downstream Modbus chain are reflected to the Monitor and displayed on the Alarm Screen. Alarm tables by device type (such as Monitor, PDU, subfeeds) are listed in *WaveStar® Color Monitor, Setup and Operation, P-164001109*.

Figure 27. Color Monitor Alarms and Warnings



Chapter 12 Eaton Service Contracts

Eaton Service contracts help to provide the added insurance that the reliability of your critical power systems is intact. By following our stringent maintenance procedures, Eaton's factory trained Customer Support Engineers provide the added assurance for the availability of critical systems, thereby maximizing the company's profitability. See below for further details.

12.1 The Service Promise

With factory-trained technicians in every major city in North America, Eaton can respond rapidly and provide on-site assistance in emergency down time situations. Eaton provides telephone support 24 hours a day, 7 days a week with a direct line to Service (1-800-843-9433).

12.2 Preventive Maintenance

During a preventive maintenance visit, Eaton technicians inspect, test, calibrate, update and clean components, as well as update software as applicable. You'll receive a report at the end of the visit detailing the results of the inspection and specific recommendations for remedial actions, proactive replacements, and upgrades.

12.3 Eaton Provides Flexibility and Commitment

- We understand that service plans are not "one size fits all." That's why we offer a broad range of service options, designed to meet the varied requirements and applications of businesses of all shapes and sizes. Eaton can modify your contract on variables such as number of PM visits per year, scope of coverage, response time and length of contract.
- Eaton employs 250+ field technicians with an average tenure of more than ten years. Eaton CSEs are experts on Eaton products and receive ongoing product training and certification. Our technicians have expertise in power, electrical engineering, software and connectivity, batteries, UPSs and related products, and can deliver advanced troubleshooting and a reduced mean time to repair.
- When you rely on an Eaton service plan, rest assured that every factory-trained field technician stocks a solid inventory of parts to remedy emergencies.

12.4 Time and Materials

In most cases the customer will be covered by startup service or Maintenance Contracts, however, there may be times when the customer needs Eaton service and lacks the benefits that these two packages provide. Therefore, Eaton provides Time and Material coverage for those in need of our customer support engineers.

164001124 04