WaveStar

PowerPak
Power Distribution Unit

50 – 300 kVA
Installation and Operation

Ctrl Nr: PM375118
Revision: 003
Thank you for your recent purchase of a WaveStar PowerPak Power Distribution Unit from Power Distribution, Inc.

For safety reasons as well as to ensure optimal performance of your PowerPak Power Distribution Unit, please carefully read the instructions before trying to install, operate, service, or maintain the system.

For any questions regarding the installation, operation, service, or maintenance of your PowerPak Power Distribution Unit, please contact us:

Power Distribution, Inc. | 4200 Oakleys Court | Richmond, VA 23223
+1 804 737 9880 | +1.800.225.4838
pdicorp.com | service@pdicorp.com

WaveStar PowerPak Power Distribution Unit
Installation and Operation
Ctrl Nr: PM375118-003

Release Date: March 2018
© 2018 Power Distribution, Inc. All rights reserved.

Cover Photo: PowerPak PDU with Two 21-inch Side Cars

PDI, JCOMM, Quad-Wye, ToughRail Technology, and WaveStar are registered trademarks of Power Distribution Inc. All other trademarks are held by their respective owners.

Power Distribution, Inc. (PDI)
Power Distribution, Inc. (PDI) designs, manufactures, and services mission critical power distribution, static switches, and power monitoring equipment for corporate data centers, alternative energy, industrial and commercial customers around the world. For over 30 years, PDI has served the data center and alternative energy markets providing flexible solutions with the widest range of products in the industry.
Contents

Safety .................................................................8

1 Introduction ..........................................................9
  1.1 PowerPak PDU Summary ........................................ 9
  1.2 Standards ................................................................ 9
  1.3 Environmental Requirements .................................... 10
    1.3.1 Operating Limits ............................................. 10
    1.3.2 Storage Conditions ........................................... 10

2 Installation Planning: PDU Layouts .............................11
  2.1 PDU Enclosure .................................................... 11
    2.1.1 PDU Dimensions ............................................. 11
    2.1.2 Spacers .......................................................... 11
  2.2 PDU Weights ........................................................ 11
  2.3 Mounting Options ................................................ 12
  2.4 Clearances .......................................................... 12
  2.5 PDU Layouts ........................................................ 12
  2.6 PDU Service Access Configurations ........................... 18
    2.6.1 Front Access Only .......................................... 18
    2.6.2 Front and Side Access Only ............................... 19
    2.6.3 Front and Rear Access Only ............................... 19
    2.6.4 Front, Rear, and Side Access ............................. 20

3 Installation Planning: Electrical .................................21
  3.1 PDU Electrical Specification ..................................... 21
  3.2 Transformer ........................................................ 21
    3.2.1 Transformer Parameters and Options ........................ 21
    3.2.2 Transformer BTUs ............................................. 22
    3.2.3 Transformer Voltage Compensation Taps ................. 22
    3.2.4 Transformer Temperature Alarms ........................... 22
    3.2.5 Infrared Scan Windows ...................................... 23
    3.2.6 Front-Facing Transformer ................................... 23
  3.3 One-Line Overview ............................................... 23
  3.4 Main Input Circuit Breaker ...................................... 23
  3.5 Surge Protective Devices ........................................ 23
  3.6 Subfeed and Panelboard Capacity ............................. 25

4 Installation: Placing the PDU ....................................26
  4.1 Receiving and Unpacking the PDU .............................. 26
  4.2 Placing the PDU ................................................... 26
4.3 Pre-Placement Inspection ................................................................. 27
4.4 Placing Directly on Floor or Raised Floor ......................................... 27
4.5 Placing PDU on Optional Floor Stand ............................................. 27

5 Installation: Power Cabling ............................................................. 32
  5.1 Input Power Cabling ......................................................................... 32
  5.2 Input Power Junction Box Option ..................................................... 39
  5.3 Input Power Wiring ......................................................................... 41
  5.4 Distribution Cabling ........................................................................ 42
    5.4.1 Subfeeds .................................................................................. 42
    5.4.2 Distribution Panelboards .......................................................... 42
    5.4.3 Square D I-Line Subfeed Panelboards ....................................... 42
    5.4.4 Installing Current Transformers for I-Line Subfeeds .................. 44

6 PDU Initial Start-Up ............................................................................ 46
  6.1 PDU Post-Installation Inspection ..................................................... 46
  6.2 Initial Start-Up Procedure ............................................................... 46

7 PDU Procedures ................................................................................ 48
  7.1 Normal Start-Up ............................................................................. 48
  7.2 Normal Shutdown Procedure .......................................................... 48
  7.3 Automatic Shutdown Signals ........................................................... 48
  7.4 Manual or Automatic Restart .......................................................... 48
  7.5 Changing Transformer Taps ............................................................. 49

8 Monitoring: Components ................................................................... 51
  8.1 Monitoring Component Summary .................................................. 51
  8.2 Customer Connections ................................................................... 51
  8.3 PDU Board and Contractor Boards ............................................... 52
    8.3.1 PDU M4G Board .................................................................... 52
    8.3.2 Basic Contractor Board ............................................................ 55
    8.3.3 Enhanced Contractor Board ..................................................... 56
    8.3.4 PDU M4G Board Points List .................................................... 57
  8.4 Branch Circuit Monitoring System (BCMS) ....................................... 57
    8.4.1 Panelboard and Subfeed Monitoring ......................................... 57
    8.4.2 BCMS Points Lists .................................................................. 58
  8.5 Dry Contact Network ..................................................................... 59
    8.5.1 Dry Contacts for Subfeed Circuit Breakers (optional) ............... 60
    8.5.2 Surge Protective Device Status ................................................. 60
  8.6 Subfeed Circuit Breaker Trip ............................................................ 60

9 Monitoring: PDU Network ............................................................... 62
  9.1 Color Monitor and Protocols ............................................................ 62
9.2 Customer Network Connections ..................................................... 62
9.3 Modbus Addressing ................................................................... 62
9.4 Color Monitor Network Connections .......................................... 63
  9.4.1 Modbus RTU Ports................................................................. 65
  9.4.2 Modbus RTU 2-Wire vs. 4-Wire Configuration ..................... 65
9.5 Modbus RTU Cables .................................................................. 66
  9.5.1 Cable Specification................................................................. 66
  9.5.2 Cable Biasing and Termination ............................................... 66
9.6 Ethernet Cables ......................................................................... 66
9.7 Setting Color Monitor Network Parameters .............................. 66
  9.7.1 Downstream Modbus Device Chain Setup ............................ 67
  9.7.2 Modbus RTU Setup ................................................................ 68
  9.7.3 TCP/IP and Modbus TCP/IP Setup ....................................... 68
  9.7.4 SNMP Setup ......................................................................... 69
9.8 Device Settings .......................................................................... 69
  9.8.1 PDU Device Settings ............................................................. 70
9.9 Device Readings ......................................................................... 70

10 Monitoring: Alarms ...................................................................... 72
  10.1 Summary Alarm Indicators ...................................................... 72
  10.2 Alarm Screen and Alarm List .................................................. 72
  10.3 Alarms by Device Type ............................................................ 74
    10.3.1 Color Monitor Alarms ......................................................... 74
    10.3.2 PDU Alarms ...................................................................... 74
    10.3.3 Enhanced Subfeeds ............................................................ 77
    10.3.4 BCMS Panelboard—Typical Alarms ................................. 78

11 Manual Dual PDU Option .............................................................. 79
  11.1 Initial Status: Circuit Breakers and Kirk Keys ......................... 79
  11.2 Permissive Signal Options ....................................................... 80
  11.3 Customer Wiring for Permissive Signals ................................... 80
    11.3.1 Internal Permissive Signal ................................................ 80
    11.3.2 External Permissive Signals .............................................. 80
    11.3.3 Dry Contact External Permissive Signal ......................... 80
    11.3.4 120VAC External Permissive Signal ............................... 81
  11.4 Using Cam Locks with Alternate Power Source (Optional) ...... 81
  11.5 Dual Input Source Transfer Procedures ................................... 82
    11.5.1 Transfer Procedure: Internal Permissive Signal Only ....... 82
    11.5.2 Transfer Procedure: External Permissive Signal Only ...... 84
    11.5.3 Transfer Procedure: External Plus Internal Permissive Signals... 85
11.6 Open Transition Transfer ................................................................. 86

12 Service ............................................................................................... 88

12.1 Start Up ............................................................................................. 88
12.2 Service Contracts ............................................................................. 88
  12.2.1 Standard Warranty ...................................................................... 88
  12.2.2 Extended Warranty ...................................................................... 88
12.3 Maintenance Contracts ................................................................. 88
12.4 Time and Materials .......................................................................... 89
12.5 Spare Parts Kits .................................................................................. 89

Bibliography ............................................................................................ 90

Glossary ..................................................................................................... 91

Tables

Table 1 PDU Dimensions by Enclosure Type .............................................. 11
Table 2 Sample PDU Weights ................................................................. 11
Table 3 Transformer Parameters .............................................................. 22
Table 4 BTUs per Hour for Selected K13 Transformers .............................. 22
Table 5 PDU Subfeed Capacities by Amperage ......................................... 24
Table 6 PDU Panelboard Capacities at 208VAC ....................................... 25
Table 7 PDU Panelboard Capacities at 480VAC ....................................... 25
Table 8 Square D I-Line Subfeed Circuit Breaker Capacities ................... 25
Table 9 Input Cable Entry Options .......................................................... 33
Table 10 Power J-Box and Power Cable Sizing Chart ............................... 40
Table 11 Dry Contact Signals .................................................................. 61
Table 12 Pin-Out for Modbus Headers .................................................... 65
Table 13 Spare Parts Kits for PowerPak PDU ............................................ 89

Figures

Figure 1 Main Cabinet with 3-in Side Spacer ........................................... 11
Figure 2 PDU 50-150 kVA Main Cabinet with Panelboards (Example) ...... 13
Figure 3 PDU 200-300 kVA with 9-in Side Car and Four Panelboards (Example) ................................................................. 14
Figure 4 PDU 200-300 kVA with 21-in Side Car and Front-Facing Transformer Taps (Example) ...................................................... 15
Figure 5 Main Cabinet and 12-in Side Car with 1000A I-Line Panelboard (Example) ................................................................. 16
Figure 6 Front-Access PDU: Main Cabinet and Extension with 1000A I-Line Panelboard (Example) ................................................................. 17
Figure 7 PowerPak Front-Access PDU with Two 21-in Side Cars ............. 18
Figure 8 PowerPak PDU, Front and Rear Access, Main Cabinet with Two Panelboards, Doors Off ... 19
Figure 9 One-Line for PDU with Single Main Input Circuit Breaker ........... 24
Figure 10 PDU Floor Stand with Height Options ........................................ 29
Figure 11 PDU Floor Stand Detail .............................................................. 30
Figure 12 Mounting PDU on Floor Stand ................................................... 31
Figure 13 Bottom Rear Cable Entry to Terminal Block with Compression Lugs ................................................................. 34
Figure 14 Bottom Rear Cable Entry to Terminal Block with Mechanical Lugs ................................................................. 35
Figure 15 Bottom Rear Cable Entry through Floor Stand ......................... 36
Figure 16 Bottom Front Cable Entry to Staggered Busbars ....................... 37
Figure 17 Top Cable Entry ....................................................................... 38
Figure 18 Power J-Box
Figure 19 Ground Connections for Front-Access Only PDU
Figure 20 Distribution Ground and Neutral Busbars
Figure 21 Underfloor Junction Box for 1000A I-Line Panelboard in 12-in Side Car
Figure 22 I-Line Subfeed CT Sets and Labeling
Figure 23 Resistor Board
Figure 24 Resistor Board Layout Label
Figure 25 Transformer Taps
Figure 26 Open Controls Compartment
Figure 27 PDU (M4G) Board
Figure 28 Basic Contractor Board
Figure 29 Enhanced Contractor Board
Figure 30 BCMS HV Board
Figure 31 SPD/TVSS Status Lights
Figure 32 Color Monitor Network Connections
Figure 33 Internal PDU Network, Modbus Addressing, Example
Figure 34 Color Monitor SETUP Screen
Figure 35 Modbus RTU Setup
Figure 36 Modbus TCP/IP and SNMP Setup
Figure 37 Settings: PDU Device
Figure 38 Readings: PDU
Figure 39 Alarm and Warning Summary Status Icons
Figure 40 ALARM Screen with an Alarm List
Figure 41 Finding the Circuits in an Alarm Condition
Figure 42 PDU Internal Panel, Kirk Keys
Figure 43 Dry Contact External Permissive Signal Connection
Figure 44 120V External Permissive Signal Connection
Figure 45 Optional Cam Locks for Second Power Source
Figure 46 Color Monitor Synch Screen
Figure 47 Transfer Procedure Using Internal Permissive Signal
Figure 48 Two-Stage Permissive Signal: External plus Internal
Figure 49 One-Line Manual Dual PDU with Permissive Signal Wiring Variations
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.

The PowerPak Power Distribution Unit must be installed by licensed electricians or by PDI-authorized technicians.

Follow safe electrical work practices:

• Read, understand, and follow the instructions before installing this product.
• Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel and in accordance with all local safety codes. Power Distribution, Inc. 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 components. Use a properly rated voltage sensing device to confirm power is OFF.
• 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.

DANGER!
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, or connecting power cables or control wiring.

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.
1 Introduction

1.1 PowerPak PDU Summary

The WaveStar® PowerPak Power Distribution Unit (PDU) is a versatile and highly configurable 50-300 kVA PDU. Features and options include the following:

- 50-300 kVA DOE transformer with a choice of transformer sizes, vectors, taps, and options, including the option of non-DOE efficiency standards for exempt and non-US customers.
- Wide variety of electrical, panelboard, and circuit breaker configurations.
- Top, bottom rear, and bottom front cable entry/exit.
- Manual dual PDU configuration with Kirk Key lockouts and choice of different permissive signals.
- Oversized neutrals.
- Optional Surge Protective Devices (SPDs) (or Transient Voltage Surge Suppressor (TVSS)) on input and output.
- Front- and side-facing Side Cars:
  - Up to (10) panelboards or (420) 1P branch circuits can be installed with Side Cars.
  - Up to (12) 250A subfeeds can be installed with Side Cars.
  - Square D I-Line subfeed panelboards (800A, 1000A, and 1200A) can be installed in specially designed Side Cars or Main Cabinet Extensions.
- Physically configurable for service access as front-only, front-and-rear, or front-rear-side(s).
- Can be integrated with WaveStar® Static Transfer Switches in Primary or Secondary Systems.
- Extensive monitoring capabilities:
  - WaveStar® Color Monitor as local PDU display.
  - Monitoring for transformer, main power feeds, subfeeds, panelboards, and other PDU functions.
  - Integration with the PDI family of Branch Circuit Monitoring System (BCMS) monitoring products.
  - Support for Modbus RTU, Modbus TCP/IP, and SNMP protocols through the Color Monitor, providing communications with Building Management Systems and Data Center Infrastructure Management (DCIM) Systems.
  - Extensive dry contact network.

You should consult with your PDI sales representative and with PDI Applications Engineering to select a PDU package that meets your application needs.

1.2 Standards

The PowerPak PDU is certified through ETL for the following standards:
- UL 60950-1
- CS 22.2

In addition, the PowerPak PDU is designed, manufactured, tested, and installed in compliance with the following standards:
- UL67
- UL50
- UL489
- UL 891
- UL1561
- NFPA
The PowerPak PDU complies with the latest FCC Part 15 EMI emission standard for Class A computing devices.

1.3 Environmental Requirements

1.3.1 Operating Limits

- Operating ambient temperature range: 0°C to 40°C (32°F to 104°F).
- Relative humidity range from 0% to 95% non-condensing.
- Maximum altitude 6,600 ft. For installation above 6,600 ft., consult with the factory for de-rating information.

1.3.2 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 limits: -36°C to +70°C (-33°F to 158°F).

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

The PDU has a NEMA 1 enclosure with removable front, side, and rear panels. A NEMA 3R enclosure is optional. Advanced door catches ensure positive door closure.

2.1.1 PDU Dimensions

Table 1 below gives dimensions for the various PDU frames. Because frames are combined in different configurations, your actual PDU dimensions will vary by side car options and transformer size. Your submittal package will include drawings for your PDU's layout. To determine your PDU’s footprint, you must also account for clearances (see below, Section 2.4 Clearances).

<table>
<thead>
<tr>
<th>PDU Configuration</th>
<th>Transformer</th>
<th>Approximate Weight (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Cabinet, no side cars, 2 panelboards</td>
<td>75 kVA</td>
<td>1300</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 9&quot; side car, 2 panelboards</td>
<td>125 kVA</td>
<td>1610</td>
</tr>
<tr>
<td>Main Cabinet, no side cars, 4 subfeeds</td>
<td>150 kVA</td>
<td>1705</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 9&quot; side car, 4 panelboards</td>
<td>150 kVA</td>
<td>1785</td>
</tr>
</tbody>
</table>

* Includes height of PDU with casters.

Note: See sample PDU layout drawings (Figures 2-6) for dimensions on several PDU configurations.

12" side cars and the Main Cabinet extension can also be used for larger 400A panelboards.

2.1.2 Spacers

In some cases, spacers are used to extend the PDU enclosure:

- A 6.25" rear spacer is added for larger transformers, 200-300 kVA (see above, Table 1).
- A 3" side spacer is used for monitoring components when a dense PDU configuration leaves no room inside the Main Cabinet (Figure 1).

Your submittal drawings will show dimensions for your specific PDU.

2.2 PDU Weights

PDU weight varies by configuration, especially by transformer size.
### PDU Configuration

<table>
<thead>
<tr>
<th>PDU Configuration</th>
<th>Transformer</th>
<th>Approximate Weight (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Cabinet, no side cars, 6 subfeeds.</td>
<td>225 kVA</td>
<td>2010</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 9&quot; side car, 2 panelboards.</td>
<td>225 kVA</td>
<td>2205</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 21&quot; side car, 6 subfeeds.</td>
<td>300 kVA</td>
<td>2470</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 21&quot; side car, 6 subfeeds.</td>
<td>300 kVA</td>
<td>2695</td>
</tr>
<tr>
<td>Main Cabinet, 1 x 21&quot; side car, 2 subfeeds, 4 panelboards</td>
<td>300 kVA</td>
<td>2840</td>
</tr>
</tbody>
</table>

Note 1: Weights are from actual shipments. Weights vary by the PDU’s component characteristics. 
Note 2: Floor stands are not included in the PDU weight. Floor stand weights in the above examples are about 200-400 lbs.

PDU shipping weight is given on the bill of lading.

### 2.3 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:

- **Heavy duty casters and leveling feet** are standard on the Main Cabinet. Casters can support the weight of the PDU.
- **An optional universal floor stand** is available with heights from 11-76”H to match raised floor height. See Section 4.5 Placing PDU on Optional Floor Stand. Fixed height floor stands are also available for 8-11” heights.
- **An optional skirt** provides air closure around the PDU.

### 2.4 Clearances

- **Ventilation clearance**: recommended 6” minimum ventilation clearance on rear and both sides; 18” overhead clearance also recommended.
- **Service clearance**: 36” required front access; 36” required side clearance for Side Cars with side access. 36” service clearance is also required in PDU rear to access transformer taps and infrared scanning unless the transformer is rotated.
- **Cabling**: 12” underfloor cabling clearance is recommended for raised floor.

### 2.5 PDU Layouts

The PDU has many possible configurations as Main Cabinet only or Main Cabinet plus Side Cars on either side or with a Main Cabinet Extension. Figures 2-6 show selected layouts.
PDUs with distribution panelboards have pre-punched cable exit trays. Pre-punched knock-outs are 7/8" dia. for 1/2" dia. conduit.

Customer connects input power to PDU terminal block, shown here with mechanical lugs.

Figure 2 PDU 50-150 kVA Main Cabinet with Panelboards (Example)
PDUs with 200-300 kVA transformers have 6.25" rear spacers.

PDUs with distribution panelboards have pre-punched cable exit trays.

Pre-punched knock-outs are 7/8" dia. for 1/2" dia. conduit.

Figure 3 PDU 200-300 kVA with 9-in Side Car and Four Panelboards (Example)
PDUs with 200-300 kVA transformers have 6.25" rear spacers.

PDUs with subfeeds have solid cable trays above or below the subfeeds. Customers provide their own conduit or cable cut-outs.

Side Cars can be installed on one or both sides of the Main Cabinet.

9" and 12" Side Cars are side-facing only.

21" Side Cars are both front- and side-facing and can be used as front-only.

Neutral and ground bus bar are installed in the Side Car for subfeed connections. Holes are 3/8" or 1/2" dia.

NOTES:
1. OPERATOR INTERFACE PANEL.
2. 500A MAIN INPUT BREAKER.
3. 6 (225A) SUBFEEDS.
4. INPUT CONNECTION LOCATION.
5. MINIMUM OF 36" CLEARANCE FOR DOOR SWING.
6. RECOMMEND 6" CLEARANCE BETWEEN VENTILATED SIDES AND WALL FOR PROPER COOLING.
7. UNIT SHIPPED ASSEMBLED.
8. ESTIMATED SHIPPING WEIGHT 2680#.

Figure 4 PDU 200-300 kVA with 21-in Side Car and Front-Facing Transformer Taps (Example)
Figure 5 Main Cabinet and 12-in Side Car with 1000A I-Line Panelboard (Example)
A Main Cabinet Extension can accommodate 1000A and 1200A I-Line Panelboards without an underfloor distribution junction box. Neutral and ground busbars are contained in the Extension.

The Main Cabinet Extension can also be used to provide front-access to Square D I-Line Panelboards, for customers needing a front-access-only PDU.

36" front clearance is required. (Door swing clearance is not sufficient service access clearance.)

Figure 6 Front-Access PDU: Main Cabinet and Extension with 1000A I-Line Panelboard (Example)
2.6 PDU Service Access Configurations

The PDU can be flexibly configured for different service access requirements:

- Front access only PDU
- Front and side access only (one or both sides)
- Front and rear access only
- Front, side, and rear access PDU (one or both sides)

2.6.1 Front Access Only

The PDU can be made front-access for routine maintenance, including easy circuit breaker replacement, and extension of circuit breaker capacity.

The transformer can as an option be turned 180° making transformer taps and infrared scanning front-accessible. Distribution should be in the Side Cars. Rear service access is not required; only 6” ventilation clearance is required at the rear or sides.

Figure 7 PowerPak Front-Access PDU with Two 21-in Side Cars

Front access PDUs can have the following:

- Main Cabinet should have front-facing transformer for front access to taps and infrared scanning.
- 21” front- and side-facing Side Cars, using front access only to Side Cars.
• (Optional) Main Cabinet Extension for 1000A or 1200A Square D I-Line panelboards.

### 2.6.2 Front and Side Access Only

Front and side-access PDUs (one or both sides) can have the following:

- Main Cabinet with front-facing transformer.
- 21" front- and side-facing Side Cars, requiring 36" side service clearance if side access is used.
- 9" side-facing Side Car(s), requiring 36" service clearance on sides with this Side Car.
- 12" side-facing Side Car for I-Line panelboards.

### 2.6.3 Front and Rear Access Only

Front and rear access PDUs can have the following:

- Main Cabinet with rear-facing transformer taps
- 21" Side Car(s), if side access is not used.

9" and 12" Side Cars are not allowed.

**Figure 8 PowerPak PDU, Front and Rear Access, Main Cabinet with Two Panelboards, Doors Off**
2.6.4 Front, Rear, and Side Access

Front, side (one or both sides), and rear access PDUs:

- Main Cabinet with rear-facing transformer
- All Side Car configurations and Main Cabinet Extension configurations are allowed.
3 Installation Planning: Electrical

3.1 PDU Electrical Specification

- Input: 3-phase, 3 wire plus ground
- Input Voltage
  - @ 50 Hz: 415VAC or 380VAC
  - @ 60 Hz: 600, 480 or 208V
- Output: 3-phase, 4 wire plus ground
- Output Voltage
  - @ 50 Hz: 575, 415/240, or 380/220V
  - @ 60 Hz: 600, 575, 480, or 208/120V
- Output:
  - Neutral: computer grade neutrals for subfeeds and panelboards
    - 200%-rated neutral busbars
    - 173%-rated panelboard neutrals
  - Ground: Computer-grade single point safety ground
  - Isolated ground available as option
- Emergency Power Off (EPO) button on front-mounted Color Monitor bezel

3.2 Transformer

3.2.1 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.

Each transformer is tested to the C57.121.91 standard.

Standard transformers with DOE2016 efficiency and K-Factor K13 are offered at 150, 225, and 300 kVA. Table 3 lists transformer parameters.

- Standard transformer parameters are applicable to all standard transformers at 150, 225, and 300 kVA,
- Non-DOE2106 transformer efficiency standards are offered for customers outside the US and for certain exempt categories in the US.
Table 3 Transformer Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Standard Transformer</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>480V Delta</td>
<td>400 – 600V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>208 /120V Wye</td>
<td>208 – 600V</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Impedance</td>
<td>2.5 – 5%</td>
<td>Up to 6%</td>
</tr>
<tr>
<td>Efficiency</td>
<td>DOE2016</td>
<td>Non-DOE2016 or non-TP1 offered for certain exempt categories, CEC, CSA, NEMA Premium, or customer-requested efficiency values.</td>
</tr>
<tr>
<td>K-Factor</td>
<td>K13</td>
<td>K4, K9, K20</td>
</tr>
<tr>
<td>Conductor Material</td>
<td>Copper (CU)</td>
<td>Aluminum (AL)</td>
</tr>
<tr>
<td>Inrush</td>
<td>8 – 10x</td>
<td>5x</td>
</tr>
<tr>
<td>Taps (150-300 kVA)</td>
<td>+2, -4 x 2.5%</td>
<td>±2 x 2.5%, custom taps or no taps designs also available</td>
</tr>
<tr>
<td>Temperature Rise</td>
<td>150°C</td>
<td>115°C, 130°C</td>
</tr>
<tr>
<td>Vector</td>
<td>Delta-Wye</td>
<td>Delta Zig-Zag, Delta Quad-Wye</td>
</tr>
<tr>
<td>Average sound level</td>
<td>NEMA ST-20</td>
<td>NEMA ST-20</td>
</tr>
<tr>
<td>Applicable Standard</td>
<td>DOE2016, UL-1561</td>
<td>IEC 60076, CSA22.2 No 66, CEC 400</td>
</tr>
<tr>
<td>Insulation</td>
<td>240°C Class S</td>
<td></td>
</tr>
</tbody>
</table>

3.2.2 Transformer BTUs

Transformers generate heat, which should be considered in placing the PDU. The following table shows transformer BTU output at the kVA values offered for standard K13-rated transformers:

Table 4 BTUs per Hour for Selected K13 Transformers

<table>
<thead>
<tr>
<th>kVA</th>
<th>BTUs/Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>14,296</td>
</tr>
<tr>
<td>225</td>
<td>20,536</td>
</tr>
<tr>
<td>300</td>
<td>22,483</td>
</tr>
</tbody>
</table>

3.2.3 Transformer Voltage Compensation Taps

The PDU has six (6) transformer voltage compensation taps (4FCBN, 2FCAN). Section 7.6 Changing Transformer Taps has the procedure for changing taps.

3.2.4 Transformer Temperature Alarms

A standard transformer has six (6) thermal overload devices to monitor core temperature in each winding.

- **180°F warning**: The first set of thermal devices is calibrated to 180°F, the warning threshold.
  If any winding reaches 180°C core temperature, the thermal overload protection device closes a set of contacts for annunciation of a potential over-temperature condition.
• **195°F shutdown**: The second set of thermal devices is calibrated to 195°F, the shutdown threshold. If any winding reaches 195°F core temperature, the thermal overload protection device closes a set of contacts for annunciation of an over-temperature condition and initiates an automatic PDU shutdown.

• **Settings adjustment**: Temperature warning and alarm levels can be adjusted by PDI at customer request.

### 3.2.5 Infrared Scan Windows

Optional 3" infrared scan windows are available for side or rear transformer thermal scanning.

### 3.2.6 Front-Facing Transformer

The transformer can be rotated 180° to make transformer taps and transformer infrared scanning accessible from the front of the PDU. Only 6" rear ventilation clearance is required instead of 36" service clearance. Because the main cabinet’s Component Mounting Plate is removed, distribution must be placed in side cars. Alternatively, a half-height Component Mounting Plate can be provided, allowing (1) 250A panelboard or up to (3) 250A subfeeds in the Main Cabinet.

### 3.3 One-Line Overview

Figure 9 is a general one-line diagram showing the most common electrical layout with optional SPD/TVSS devices and input wire specifications.

One-line diagram for manual dual PDUs showing permissive signal connections for the Solenoid Key Release Unit (SKRU) is in Chapter 11, Manual Dual PDU Option (Figure 46).

### 3.4 Main Input Circuit Breaker

The standard Main Input Circuit Breaker is as follows:

- < 225kVA: thermal magnetic circuit rated 80% at 480VAC with 35 kAIC and matched to the transformer size.
- 225kVA – 3000 kVA: fixed (non-adjustable) electronic trip circuit breaker rated 80% at 480VAC with 35 kAIC and matched to the transformer size.

The PDU has many Main Input Circuit Breaker options with different PDU voltages, amperages, kAIC ratings, and trip settings. Consult with your sales representative or PDI Applications Engineering for options.

### 3.5 Surge Protective Devices

SPD/TVSS devices can optionally be installed on the primary and/or secondary sides of the transformer. SPDs are listed to UL 1449 3rd Edition and have the following ratings:

- LEA SP100 providing 100,000 Amps maximum surge current dissipation per phase.
- LEA SP200 providing 200,000 Amps maximum surge current dissipation per phase.

See SPD/TVSS locations in Figure 9, “One Line for PDU with Single Main Input Circuit Breaker.”
Figure 9 One-Line for PDU with Single Main Input Circuit Breaker

Notes:
1. = Customer connections.
2. = Factory connections.
3.6 Subfeed and Panelboard Capacity

The following tables provide general guidance on PDU physical configuration possibilities. PDU capacity depends both on physical configurability and on the electrical limits of the transformer.

Table 5 PDU Subfeed Capacities by Amperage

<table>
<thead>
<tr>
<th></th>
<th>250A Subfeeds</th>
<th>400A Subfeeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cabinet</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>9” Side-facing side car</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>21” Front-and-side facing side car</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Maximum total PDU capacity</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: Subfeed circuit breakers are all 600V rated.

Table 6 PDU Panelboard Capacities at 208VAC

<table>
<thead>
<tr>
<th></th>
<th>225A Panelboards at 208VAC</th>
<th>400A Panelboards at 208VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cabinet</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>9” Side-facing side car</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>21” Front-and-side facing side car</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Maximum total PDU capacity</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: Each panelboard is protected by a 3-pole secondary main circuit breaker.

Table 7 PDU Panelboard Capacities at 480VAC

<table>
<thead>
<tr>
<th></th>
<th>225A Panelboards at 480VAC</th>
<th>400A Panelboards at 480VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main cabinet</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9” Side-facing side car</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>21” Front-and-side facing side car</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximum total PDU capacity</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Each panelboard is protected by a 3-pole secondary main circuit breaker.

Table 8 Square D I-Line Subfeed Circuit Breaker Capacities

<table>
<thead>
<tr>
<th></th>
<th>225A Frame Circuit Breakers</th>
<th>400A Frame Circuit Breakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>800A MLO (12” side-facing side car)</td>
<td>10</td>
<td>N/A</td>
</tr>
<tr>
<td>1000A MLO (12” side-facing side car) (includes underfloor power junction box)</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>1200A MLO (requires 46.7”W main cabinet front-facing extension frame)</td>
<td>11</td>
<td>8</td>
</tr>
</tbody>
</table>
4 Installation: Placing the PDU

4.1 Receiving and Unpacking the PDU

PowerPak 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 two layers of external plastic covering. The PDU is first covered by a large plastic bag and then shrink-wrapped.

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

2. Carefully remove the outer layer of protective shrink wrap from the unit, but leave the interior plastic covering intact. Use care to not puncture or scratch the PDU 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 the outer external packaging, check the unit’s exterior panels and doors for any visible damage such as scratches dents, cracks. If any damage is noted, please call PDI Service at (800) 225-4838.

4. If any damage is evident during unpacking, notify the shipping company and PDI:
   a. 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 damages may result in the unit’s warranty being voided.
   b. Notify PDI Service at
      Power Distribution Inc.
      4200 Oakleys Court
      Richmond, Virginia 23223
      (800)-225-4838
      service@pdicorp.com

4.2 Placing the PDU

**Danger!**

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 protective clothing and use eye, face, and hand protection 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 fork-lift truck. Take care that the unit is properly centered on the forks.
4. Once the unit is completely off the pallet, carefully remove the large plastic bag covering the PDU. 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 PDI Service at (800) 225-4838.

4.3 Pre-Placement Inspection

The installer 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.).

4.4 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 Section 2.2 PDU Weights for approximate weights. PDUs are weighed when shipped and actual PDU weight is given on the bill of lading.

Check that required clearances are met when the PDU is placed in its operating position (see Section 2.4 Clearances).

4.5 Placing PDU on Optional Floor Stand

The PDU can be placed on an optional floor stand that will support the PDU’s weight. Floor stands are available in several heights to match the height of your installation’s raised floor, ranging from 11” to 76”.

Each floor stand provides a height range and is adjustable within that range. Center supports are provided on the larger floor stands (48”, 60”, and 72” height). (See Figures 10-11.) Fixed-height floor stand are also available in 8-11” heights. At time of order, select the floor stand that matches your raised floor height.

To install, follow these steps:

1. Remove floor tiles and/or make floor tile cutouts to match the width and depth of the floor stand (Figure 10).
2. Place the floor stand within the raised floor opening and bolt feet securely to the subfloor. See leg detail in Figure 11.
3. To adjust the floor stand height, adjust the bottom height-adjustment screws. To prevent air flow escaping around the base of the PDU, choose one of these options:
   a. Option 1: Reduce the height of the floor stand so that the top of the floor stand is about 1½” below the top of the raised floor. When the PDU is placed on the floor stand, the PDU base should be even with the floor.
b. Option 2: Match the floor stand to your raised floor height. Install an optional PDU skirt to minimize loss of air flow.

4. The floor stand has removable front and rear cover plates for cable entry/exit and air flow. To provide adequate air flow, remove cover plates before placing the PDU on the floor stand. (See Figure 11, “PDU Floor Stand Detail.”)

5. To stabilize the PDU on the floor stand, there are two options:
   a. Option 1: Remove the PDU leveling feet, allowing the PDU to rest on its casters. (The casters rotate 360° but do not lock.) Bolt the PDU to the floor stand using 1/2" all-thread (Figure 11). Some customers invert the removed leveling feet and use them to attach the PDU to the floor stand.
   b. Option 2: Adjust the main cabinet leveling feet so that they all rest firmly on the floor stand (Figure 12).

6. With a fork lift or pallet jack, carefully position the PDU over the floor stand. The main cabinet should be centered directly over the floor stand. If you are using the main cabinet leveling feet, they should all be positioned within the borders of the floor stand’s top plate.
**Important!**

To provide adequate air flow, remove cover plates before placing the PDU on the floor stand.

<table>
<thead>
<tr>
<th>Height Options</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>41.25&quot;</td>
<td>65.25&quot;</td>
</tr>
<tr>
<td>44.00&quot;</td>
<td>68.00&quot;-76.00&quot;</td>
</tr>
<tr>
<td>47.25&quot;</td>
<td>53.25&quot;</td>
</tr>
<tr>
<td>49.00&quot;</td>
<td>56.00&quot;-64.00&quot;</td>
</tr>
<tr>
<td>51.25&quot;</td>
<td>35.25&quot;</td>
</tr>
<tr>
<td>53.00&quot;</td>
<td>41.00&quot;-46.00&quot;</td>
</tr>
<tr>
<td>55.25&quot;</td>
<td>29.25&quot;</td>
</tr>
<tr>
<td>57.00&quot;</td>
<td>32.00&quot;-40.00&quot;</td>
</tr>
<tr>
<td>59.25&quot;</td>
<td>23.25&quot;</td>
</tr>
<tr>
<td>61.00&quot;</td>
<td>26.00&quot;-34.00&quot;</td>
</tr>
<tr>
<td>63.25&quot;</td>
<td>14.25&quot;</td>
</tr>
<tr>
<td>65.00&quot;</td>
<td>17.00&quot;-25.00&quot;</td>
</tr>
<tr>
<td>67.25&quot;</td>
<td>8.25&quot;</td>
</tr>
<tr>
<td>69.00&quot;</td>
<td>11.00&quot;-14.00&quot;</td>
</tr>
</tbody>
</table>

**NOTES:**
1. STANDS ARE MADE OF 1/4" FORMED ANGLE.
2. SUPPLIED WITH (8) HEXNUTS & (8) WASHERS.
3. OTHER STAND SIZES AVAILABLE UPON REQUEST.
4. FLOOR STAND COVER PLATES PROVIDED TO COVER OPENINGS.

Figure 10 PDU Floor Stand with Height Options
Important!
To provide adequate air flow, remove cover plates before placing the PDU on the floor stand.

Figure 11 PDU Floor Stand Detail

NOTES:
1. STANDS ARE MADE OF 1/4" FORMED ANGLE.
2. SUPPLIED WITH (8) HEXNUTS & (8) WASHERS.
3. OTHER STAND SIZES AVAILABLE UPON REQUEST.
4. FLOOR STAND COVER PLATES PROVIDED TO COVER OPENINGS.
To stabilize the PDU on the floor stand:

Remove leveling feet and bolt the PDU to the floor stand, OR

Adjust PDU leveling feet so that the PDU rests firmly on floor stand and does not move.

Casters do not lock.

Figure 12 Mounting PDU on Floor Stand
5 Installation: Power Cabling

DANGER!

- Severe or fatal injury can result from electrical shock during contact with high voltage conductors, monitoring PCBs, or similar equipment.
- A licensed electrician must install each unit.
- Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
- Disconnect power before drilling holes, attaching cables or conduit, or connecting PDUs to other power distribution equipment.
- Use Lock Out/Tag Out procedures.
- Leave ample space for attaching and routing wires.

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.

Important!

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

5.1 Input Power Cabling

Input cable entry to the PDU can be from the bottom rear, bottom front, or top.

Input power cables can be landed in several ways:

- To a terminal block in the top right of the Main Cabinet. Input cables are terminated to mechanical lugs or optionally to compression lugs.
- To staggered busbars, for front bottom cable entry.
- For manual dual PDUs, directly to the main input circuit breakers.
- To an optional J-Box (junction box) that can be up to 6' from the PDU. The J-Box is in turn cabled to the PDU's input terminal block or input busbars.
### Table 9 Input Cable Entry Options

<table>
<thead>
<tr>
<th>Cable Entry Location in PDU</th>
<th>Cable/Conduit Entry Holes</th>
<th>Cable Landing</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom Rear</td>
<td>Three (3) pilot holes provided in bottom rear. Customer can enlarge pilot holes to match conduit size.</td>
<td>Terminal Block in top right of PDU:  - Compression lugs or  - Mechanical Lugs</td>
<td>Typically used when main cabinet has panelboards and bottom front cable tray has pre-punched holes for distribution.</td>
</tr>
<tr>
<td>Top</td>
<td>Solid plate provided in top of PDU. Customer makes own cut-outs for cable/conduit entry.</td>
<td>Terminal Block in top right of PDU:  - Compression lugs or  - Mechanical Lugs</td>
<td></td>
</tr>
<tr>
<td>Bottom Front</td>
<td>Solid plate provided in bottom of PDU. Customer makes own cut-outs for cable/conduit.</td>
<td>Staggered busbar with mechanical or compression lugs on right front of PDU.</td>
<td>Commonly used with front-facing transformers.</td>
</tr>
<tr>
<td>Manual Dual PDU, choose from these options:  - Bottom Rear  - Top</td>
<td>Choose from above according to cable entry location.</td>
<td>Directly to Main Circuit Breakers</td>
<td></td>
</tr>
</tbody>
</table>
Figure 13 Bottom Rear Cable Entry to Terminal Block with Compression Lugs
Customer can enlarge pilot holes in bottom rear of PDU.

Mechanical lugs are standard for the PDU cable entry terminal block (shown in this diagram).

Compression lugs are optional.

Transformer is shown facing rear of PDU.

Figure 14 Bottom Rear Cable Entry to Terminal Block with Mechanical Lugs
For Floor Stand Heights, see Figure 10, “PDU Floor Stand with Height Options.”

**NOTES:**
1. STANDS ARE MADE OF 1/4” FORMED ANGLE.
2. SUPPLIED WITH (8) HEXNUTS & (8) WASHERS.
3. OTHER STAND SIZES AVAILABLE UPON REQUEST.
4. FLOOR STAND COVER PLATES PROVIDED TO COVER OPENINGS.

See also:
- Figure 11, “PDU Floor Stand Detail”
- Figure 13, “Bottom Rear Cable Entry to Terminal Block with Compression Lugs”
- Figure 14, “Bottom Rear Cable Entry to Terminal Block with Mechanical Lugs”

**Figure 15 Bottom Rear Cable Entry through Floor Stand**
For front bottom access, phase cables are landed to staggered busbars allowing 2-hole compression or mechanical lugs.

Front bottom access is most often used with forward-facing transformer taps (shown).

Customer makes own cable entry cutouts in bottom front solid plate.

Figure 16 Bottom Front Cable Entry to Staggered Busbars
Top cable entry plate is solid plate. Customers must make their own cut-outs.

Mechanical lugs are standard for the PDU cable entry terminal block (see Figure 12). Compression lugs are optional.

PDU is shown with front-facing transformer taps.

Figure 17 Top Cable Entry
5.2 Input Power Junction Box Option

PDI offers an input power junction box (J-Box) as an option (Figure 18). The J-Box provides an intermediate connection point between building power and the PDU. Customers may wish to connect building power to the J-Box before the PDU is installed, possibly shortening installation time.

**DANGER!**

A power J-Box and power cable assembly must be installed in accordance with all applicable NEC and local electrical codes.

The power J-Box must be installed by a qualified electrician.

Disconnect power before drilling holes, attaching conduit, or attaching the J-Box to a PDU, building power, or 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.

---

H x W x D correspond to dimensions of the J-Box given in the sizing chart (Table 8).

**Figure 18 Power J-Box**
The power J-Box must be located within six (6) feet of the PDU and should remain accessible after the PDU has been installed. If the PDU has its rear panel against a wall, the power J-Box must be installed at least 36” away from the wall and must allow future accessibility.

The J-Box should not restrict the positioning of any power cabling and should not obstruct the floor tiles located directly above the power J-box.

PDI recommends that power cables from the power J-Box enter the PDU through the floor tile cutouts. If cable entry to the PDU uses bottom rear cable entry, the one or more pilot holes are enlarged for conduit coming from the J-Box.

J-Boxes come in three sizes. Wire size must be matched to Main Input Circuit Breaker amperage and conduit to wire size as given in Table 10.

### Table 10 Power J-Box and Power Cable Sizing Chart

<table>
<thead>
<tr>
<th>Main Input Circuit Breaker Size (Amps)</th>
<th>Input Power Cable Wire Size (Phase &amp; Ground) (# - Size)</th>
<th>Input Power Cable Conduit Size (# - Size)</th>
<th>Junction Box Size (H x W x D)</th>
<th>Input Junction Box Terminal Block Size (# Poles - Wire Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1 x 8 AWG</td>
<td>1 x 1&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>30</td>
<td>1 x 6 AWG</td>
<td>1 x 1&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>40</td>
<td>1 x 6 AWG</td>
<td>1 x 1&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>50</td>
<td>1 x 6 AWG</td>
<td>1 x 1&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>60</td>
<td>1 x 6 AWG</td>
<td>1 x 1&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>70</td>
<td>1 x 4 AWG</td>
<td>1 x 1 1/4&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>80</td>
<td>1 x 4 AWG</td>
<td>1 x 1 1/4&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>90</td>
<td>1 x 3 AWG</td>
<td>1 x 1 1/4&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>100</td>
<td>1 x 3 AWG</td>
<td>1 x 1 1/4&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>110</td>
<td>1 x 2 AWG</td>
<td>1 x 1 1/4&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>125</td>
<td>1 x 1 AWG</td>
<td>1 x 1 1/2&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>150</td>
<td>1 x 1/0 AWG</td>
<td>1 x 1 1/2&quot;</td>
<td>12&quot; x 10&quot; x 5&quot;</td>
<td>4 Pole - # 12 x 2/0</td>
</tr>
<tr>
<td>175</td>
<td>1 x 2/0 AWG</td>
<td>1 x 2&quot;</td>
<td>16&quot; x 14&quot; x 6&quot;</td>
<td>4 Pole - # 6 x 350 MCM</td>
</tr>
<tr>
<td>200</td>
<td>1 x 3/0 AWG</td>
<td>1 x 2&quot;</td>
<td>16&quot; x 14&quot; x 6&quot;</td>
<td>4 Pole - # 6 x 350 MCM</td>
</tr>
<tr>
<td>225</td>
<td>1 x 4/0 AWG</td>
<td>1 x 2&quot;</td>
<td>16&quot; x 14&quot; x 6&quot;</td>
<td>4 Pole - # 6 x 350 MCM</td>
</tr>
<tr>
<td>250</td>
<td>1 x 250 MCM AWG</td>
<td>1 x 2 1/2&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - # 6 x 350 MCM</td>
</tr>
<tr>
<td>300</td>
<td>2 x 3/0 AWG</td>
<td>1 x 3&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - # 6 x 350 MCM</td>
</tr>
<tr>
<td>350</td>
<td>2 x 4/0 AWG</td>
<td>2 x 2&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - # 4 x 500 MCM</td>
</tr>
<tr>
<td>400</td>
<td>2 x 4/0 AWG</td>
<td>2 x 2&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - #4 x 500 MCM</td>
</tr>
<tr>
<td>500</td>
<td>2 x 250 MCM AWG</td>
<td>2 x 2 1/2&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - #4 x 500 MCM</td>
</tr>
</tbody>
</table>
Installation: Power Cabling

<table>
<thead>
<tr>
<th>Main Input Circuit Breaker Size (Amps)</th>
<th>Input Power Cable Wire Size Phase &amp; Ground (# - Size)</th>
<th>Input Power Cable Conduit Size (# - Size)</th>
<th>Junction Box Size (H x W x D)</th>
<th>Input Junction Box Terminal Block Size (# Poles - Wire Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>2 x 350 MCM AWG</td>
<td>2 x 3&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - #4 x 500 MCM</td>
</tr>
<tr>
<td>700</td>
<td>2 x 500 MCM AWG</td>
<td>2 x 3&quot;</td>
<td>24&quot; x 18&quot; x 6&quot;</td>
<td>4 Pole - #4 x 500 MCM</td>
</tr>
<tr>
<td>800</td>
<td>3 x 300 MCM AWG</td>
<td>3 x 2 1/2&quot;</td>
<td>Special</td>
<td>Special</td>
</tr>
</tbody>
</table>

### 5.3 Input Power Wiring

Customers must make their own cut-outs for input cable and conduit. Pull input power conduit through cut-outs. Connect input phase and ground cables to the PDU input terminal block or, for Manual Dual PDUs, directly to main input circuit breaker lugs. Torque lugs to the circuit breaker manufacturer’s specification, which are typically given on the circuit breaker.

For top cable entry, input and output share the same plate, which for input may have solid plate and for output solid plate or panelboard knockouts (KOs).

*Figure 19 Ground Connections for Front-Access Only PDU*

The customer safety ground is typically connected to the Component Mounting Plate in the Main Cabinet with mechanical lugs. Busbar ground connections can be optionally specified.
For front-access transformers, the Component Mounting Plate is removed. A ground connection is typically provided in the input cable tray. Alternatively, ground connection can be made to the PDU Input Terminal Block (Figure 19).

5.4 Distribution Cabling

5.4.1 Subfeeds

Neutral busbars are rated 200%. Neutral wires must be twice the size of phase cables.

Neutral and ground busbars have two-hole compression lug connections. Holes can be 3/8" dia. or 1/2" dia. (Figure 20).

Location of busbars depends on customer’s top or bottom cable exit.

Solid plate is provided at the bottom or top of the main cabinet or side car for cable exit. Customers must execute their own cut-outs for solid plate cable exit trays.

5.4.2 Distribution Panelboards

Standard panelboards are Square D or GE bolt-on or snap-on circuit breaker panels.

Square D and GE 225A panelboards for 208VAC or 480VAC are protected by a 3-pole 225A secondary main circuit breaker. 400A panelboards for 208VAC or 480VAC are protected by a 3-pole 400A secondary main circuit breaker.

Panelboards have 173%-rated neutrals.

42-position ground and neutral strips are provided for each multiple of a 42-circuit panelboard. Optional 42-position isolated ground strips are available.

Pre-punched cable exit trays are provided at the top or bottom of the main cabinet or side car housing the panelboard(s). Pre-punched distribution cable exit holes are 7/8" dia. for 1/2" dia. conduit.

5.4.3 Square D I-Line Subfeed Panelboards

Square D I-Line subfeed panelboards are also available, requiring at minimum their own 12" side cars.

800A and 1000A I-Line panelboards can be installed in 12" side cars. 1000A I-Line panelboards require an underfloor junction box for distribution cabling. The junction box has the neutral and ground busbars for the Side Car and cable exit panels on three sides (Figure 21).

1000A and 1200A I-Line panelboards can be installed in a Main Cabinet Extension (Figure 6). Neutral and ground busbars are in the Extension and no underfloor junction box is required.
Figure 21 Underfloor Junction Box for 1000A I-Line Panelboard in 12-in Side Car

Junction box height matches floor stand height.

Junction box has removable panels on three sides for distribution cables.

Neutral and ground busbars for the Side Car are located in the junction box.
5.4.4 Installing Current Transformers for I-Line Subfeeds

CTs for I-Line subfeeds cannot be factory installed because the internal (line) side of each I-Line CB is connected to a bus bar rather than to cables. Consequently, CTs must be installed over the load cables when the customer’s installer attaches them to the I-Line circuit breakers.

CT sets for I-Line subfeeds are shipped unattached in the I-Line Side Car or Main Cabinet Extension.

**Current Transformer Sets**

CTs for I-Line subfeeds are packaged together in sets of three (3), one (1) set for each subfeed breaker (Figure 22).

Each CT is labeled by phase (ABC) with an arrow indicating direction of current flow. The arrow should point in the direction of the load when the CT is installed.

Each of the (3) CTs in a set has (2) 7’ wires which are wired together to a 6-pin connector for connection to the BCMS monitoring system. The wires at the BCMS Connector end are also labeled by phase.

**Figure 22 I-Line Subfeed CT Sets and Labeling**

For each load cable into a circuit breaker, install the CT matching that phase over the cable with the arrow pointing towards the load. **(Note: The ordering of I-Line CBs (CB1, CB2, etc.) is determined by the customer.)**
The BCMS Connector must be connected to the corresponding breaker socket on a “Resistor Board” (Figure 23). A label in the I-Line section shows the Resistor Board connector positions for each breaker (Figure 24).

Usually the Resistor Board cannot be placed in the I-Line section itself because of space limitations. However, the Resistor Board will be placed as close as possible to the I-Line section although the exact position depends on the layout of the PDU.

*The face of each CT has an “H1” imprint that should face towards the breaker. The arrow label on the CT side should point towards the load.

Figure 23 Resistor Board

Figure 24 Resistor Board Layout Label
6 PDU Initial Start-Up

Important!

At the initial startup of the PDU, a PDI 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, a PDI factory-authorized technician must validate correct operation of the PDU. PDU start-up typically includes the following procedures.

6.1 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 during installation.
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.).

6.2 Initial Start-Up Procedure

Warning!

Steps 1-4 below 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.

1. Confirm that the PDU’s main input circuit breaker (or both breakers for Manual Dual PDU) 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.
5. Apply building 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 PDI Service at (800) 225-4838 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.
7 PDU Procedures

7.1 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.

7.2 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 load equipment.
3. When ALL output circuit breakers have been turned OFF, turn the Main Input Circuit Breaker to the OFF position.

7.3 Automatic Shutdown Signals

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

The PDU board will shunt-trip the main breaker if it receives any of the following signals (refer to Figure 27, “PDU M4G Board”, for connections):

- Local EPO signal to the PDU board from the front panel EPO button.
- Remote EPO (REPO) signal from the Contractor Board to the PDU Board. The customer REPO signal is terminated at the Contractor Board.
- Thermal wires registering a temperature in the PDU transformer core that exceeds the transformer temperature limit specified.
- Optional shutdown signals: the customer can elect to shut down the PDU on the following conditions. These optional shutdown conditions are programmed into the PDU M4G Board in manufacturing and should be selected at time of order:
  - Output over-voltage or under-voltage on pre-programmed limits.
  - Improper phase rotation.
  - Ground fault interrupt: ground fault current rises above programmed levels.
  - Building alarm. A 10-second time delay for shutting down the PDU can also be set.

7.4 Manual or Automatic Restart

The Restart Switch on the PDU board determines if restart is automatic after a voltage loss. The 170VDC 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 24VDC 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.
- 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. This is the default position: the PDU is shipped with the Restart Switch set to Automatic.
- See Section 8.3.1 PDU M4G Board and associated illustration for location of the Restart Switch.

### 7.5 Changing Transformer Taps

Transformers have jumper cables on each phase connecting one tap position to another. Changing the tap jumper cable connection changes the transformer voltage output by a predefined percentage. Each transformer has a label showing the voltage adjustment provided by a specific tap connection. Default connection is 100% of the transformer rating.

The Tap Adjustment Table is found on the transformer label.

Torque connections to 72-in-lbs or 6 ft-lbs.

Tap connection numbers are clearly labeled.

**Figure 25 Transformer Taps**

To change transformer taps on the PDU follow these steps (To change transformer taps on PDU with front-facing taps, the procedure is the same except that the customer need only open front panel doors.):

1. Make sure that the PDU is powered off.
2. Lock out power to the PDU at main circuit breaker(s).
3. Remove rear panels or, if transformer is front-accessible, open PDU front doors.
4. Read label on transformer and select the voltage adjustment that is closest to the adjustment you require.
5. Disconnect one or both jumper ends as needed to match tap jumper numbers, retaining bolts and nuts.
6. Reconnect jumpers to correct numbered positions. Jumpers use 1/4-20 x 1” hex head bolts. Torque bolts to 72 inch-pounds or 6 foot-pounds. Apply torque seal. The bolt size and torque specifications are the same for all standard transformers.
7. Replace panels or close doors.
8 Monitoring: Components

8.1 Monitoring Component Summary

WaveStar monitoring components include the following:

- **PDU M4G Board** sets PDU parameters and monitors the transformer. Each PDU has a **Contractor Board** which is an extension of the PDU Board.
- **Branch Circuit Monitoring System (BCMS) PCBs** collect readings from CT strips on panelboard current transformer (CT) strips and subfeed CTs and voltage measurements.
- **A Resistor Board** is intermediate between subfeed CTs and a BCMS PCB. It is used only with subfeeds.
- The **WaveStar® Color Monitor** displays power information about monitored PDU devices and passes their points list information to upstream Modbus master devices, such as a Building Management System or Data Center Infrastructure Management (DCIM).

Monitoring components are mostly located in the Controls Compartment at the top of the Main Cabinet. BCMS PCBs are also placed in Side Cars for monitoring panelboards or subfeeds in the Side Car.

The PDU also has an extensive dry contact network. See Table 11, “Dry Contact Signals.”

![Figure 26 Open Controls Compartment](image)

8.2 Customer Connections

Customer connections are made only to the following:

- A **Contractor Board**, for Modbus RTU network connections, REPO, and remote relays. (See Figure 28, Basic Contractor Board,” and Figure 29, “Enhanced Contractor Board.”)
- **Color Monitor backpanel** for Ethernet cable connection (see Figure 32, “Color Monitor Network Connections.”)
• Other dry contact connections (see Table 11, “Dry Contact Signals”).
• External permissive signals (see Section 1.3 Customer Wiring for External Permissive Signals.)

Customers can also specify specific values, such as Digital Inputs or Alarms, which are programmed by PDI in manufacturing.

Other information in this chapter is provided for reference.

8.3 PDU Board and Contractor Boards

The PDU (M4G) Board sets PDU parameters and monitors the PDU’s transformer.

Every PDU also has a Contractor Board, which functions as a terminal block to the PDU Board and 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

Internal PDU signaling, such as the four Digital Inputs, is terminated to the PDU (M4G) Board.

External signaling, such as the customer’s REPO signal, is terminated to the Contractor Board.

Setup of the PDU and Contractor Boards is performed during manufacturing. These boards can be programmed through a USB programming board the PDU Board.

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. Measurements values in the points list can also be viewed on the Color Monitor.

8.3.1 PDU M4G Board

For the following connections, reference Figure 27, “PDU M4G Board”.

Transformer CT (current) and voltage connections (top edge of Figure 27):

• 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
• Power Off Controls:
Monitoring: Components

- Remote EPO connection from the Contractor REPO Connection (J6), see Figure 28. 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; 170VDC must be used for Restart Switch to function.
- 24VDC

**CT Measurements**

![CT Measurements Diagram](image)

- 120VAC input from PDU transformer power to 170VDC shunt trip.
- Transformer
- Restart Switch
  - Down (away from transformer) = Manual
  - Up = Automatic (default)
- 170VDC Output signal for Shunt Trip to Main Breaker
- 24VDC Output for Shunt Trip to Main Breaker
- Output relay to release SKRU key for Manual Dual PDU
- 24VDC Output Power to Color Monitor
- 4 Digital Inputs
- Setup USB Connection
- RJ12 Upstream / Downstream Modbus Connections to Color Monitor
- Ribbon Cable Connection to Contractor Board
- Thermal Wires
- Local EPO
- Remote EPO

**Figure 27 PDU (M4G) Board**

- The **Restart Switch** determines whether restart is automatic or manual after a voltage loss.
  - Manual: Switch down (away from on-board transformer): PDU restart must be done manually after voltage is restored.
- **Automatic**: Switch up (towards on-board transformer): PDU restart is automatic after power is restored. **Automatic** Restart is the default setting.
- See section 7.4 **Manual or Automatic Restart** for additional information.
- **NOTE**: The Restart Switch requires 170VDC input to the main breaker shunt trip to 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 used for signalling internal to the PDU, such as a Door Open condition. Digital Inputs can be assigned by PDI during PDU M4G Board setup, when names can also be assigned to the inputs. These inputs turn on bits in PDU M4G Board Points List, Modbus Registers 90-91.
  - Default assignments for single input PDU are as follows:
    - Digital Input 1: Unassigned
    - Digital Input 2: SPD Primary Device 1 not operational (if installed)
    - Digital Input 3: SPD Secondary Device 2 not operational (if installed)
    - Digital Input 4: Door Open
  - Default assignments for Manual Dual PDU are as follows:
    - Digital Input 1: Main Input Circuit Breaker 1 is closed.
    - Digital Input 2: Main Input Circuit Breaker 2 is closed.
    - Digital Input 3: SPD Secondary Device 1 or 2 not operational (if installed)
    - Digital Input 4: Door Open

- **Output Relay**: On a Manual Dual PDU, this relay is triggered when prerequisite conditions for a transfer are met and the operator presses the **KEY RELEASE** button on the Color Monitor’s Sync screen. The relay signal is transmitted to the Solenoid Key Release Unit (SKRU). A phase synchronization check is performed before enabling the relay. (See Section 11.5 **Dual Input Source Transfer Procedures** and Figure 46, “Transfer Procedure Using Internal Permissive Signal”.)

**Setup/USB Connection**: Used by PDI representatives to program setpoints, contractor board relays, etc., in the PDU M4G and Contractor Boards. PDU board setpoints cannot be altered through normal Modbus register access to prevent registers being accidentally altered. See PDU M4G Board points list for further information. (See **Bibliography** for information on downloading points lists.)

**RJ12 Modbus Connections** on the PDU M4G board are to/from the Color Monitor.
8.3.2 Basic Contractor Board

The Basic Contractor Board has these connections (Figure 28):

**Inputs:**

- Remote EPO: Customer dry contact connection point for input of an REPO signal. Connect external dry contacts to terminals marked +24V EPO RET (Figure 28). The external REPO signal is passed to the PDU Board via the REMOTE EPO connection, which is not a customer connection point. A small indicator light can be powered from the +24V and the return.

  **Warning!**

  Connecting a voltage to the +24V EPO RET dry contact connection can cause damage to the unit.

- Four (4) Building Alarms (Figure 28). Alarm names can be specified by PDI in PDU Board setup. Building alarms turn on alarm bits in the PDU M4G Board points list (Modbus registers 88-89), but do not shut down the PDU. However, the customer can specify that a specific building alarm shuts down the PDU. The shut-down option must be programmed into the PDU M4G Board in manufacturing. (See Section 7.3 Automatic Shutdown Signals.)

**Outputs:**

- Four (4) remote relays that output dry contact (NO) signals (Figure 28).
Relays are programmable using the USB setup connection on the PDU M4G Board. PDI programs the relay inputs, usually in 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 28).

**Modbus Connections:** The board has customer connections for upstream and downstream 4-wire Modbus (Figure 28, J3 and J4). 2-wire Modbus can be set with jumpers on the Color Monitor and other boards in the Modbus RTU chain.

### 8.3.3 Enhanced Contractor Board

The Enhanced Contractor Board (Figure 29) provides twice as many relays and building alarms as the Basic Contractor Board. The Enhanced Contractor Board is used in other 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 29). The REPO signal is sent to the PDU Board via the REMOTE EPO connection, which is not a customer connection point. A small indicator light can be powered from the +24V and the return.

  **Warning!**  
  Connecting a voltage to the +24V EPO RET dry contact connection can cause damage to the unit.

- Eight (8) Building Alarms (Figure 29). Alarm names can be specified by PDI in PDU Board setup. Building Alarms turn on alarm bits in the PDU M4G Board points list (Modbus registers 88-89), but do not shut down the PDU. However, the customer can specify that a specific Building Alarm shuts down the PDU. The shut-down option must be programmed into the PDU M4G Board in manufacturing. (See section 7.3 Automatic Shutdown Signals.)

**Outputs:**

- Eight (8) remote relays that output dry contact (NO) signals (Figure 29).
  - Relays are programmable using the USB setup connection on the PDU M4G Board. PDI programs the relay inputs, usually in 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.
8.3.4 PDU M4G Board Points List

The PDU M4G Points List contains measurements and setpoints 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
- Setpoints for
  - Alarm thresholds
  - Contractor board setup, such as enabling building alarms and specifying names

PDI representatives must specify Modbus register setpoints 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 PDI website (see Bibliography).

8.4 Branch Circuit Monitoring System (BCMS)
8.4.1 Panelboard and Subfeed 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.
• Two sets of up to (14) subfeeds (or up to (10) subfeeds if neutrals are monitored).

Panelboards must have CT strips covering each panelboard circuit. Subfeeds must have CTs connected to an intermediate Resistor Board.

Layout of a BCMS HV board (BCMS PCB) is shown in Figure 30.

8.4.2 BCMS Points Lists

Points lists are loaded onto BCMS PCBs at the factory. Only one kind of points list can be loaded into a BCMS PCB at the same time, but the PCB can monitor more than device that uses that 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. Panelboard points lists include the following:

• **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.

Subfeeds (including I-Line subfeeds) use this points list:
• **BCMS Enhanced Subfeeds (ESF)** points list for subfeeds.

See the **Bibliography** for information on downloading points lists from the PDI website.
Monitoring: Components

8.5 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 Board, 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 11 lists available dry contact input and output signals.

8.5.1 Dry Contacts for Subfeed Circuit Breakers (optional)

Subfeeds can have optional dry contacts to

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

A set of terminal blocks can be installed in the monitoring compartment providing an intermediate connection point between the circuit breakers and the customer’s dry contact network.

8.5.2 Surge Protective Device Status

The PDU allows optional SPD/TVSS devices on input and/or output. Each SPD/TVSS incorporates a remote signaling dry contact and visual status lights.

The dry contact is closed when the SPD is powered and functional. (See Table 11, “Dry Contact Signals.”) The dry contact is typically wired at the factory to a PDU M4G Board Digital Input.

---

**The optional SPDs are mounted in the Controls Compartment of the main cabinet.**

**Status Lights** are on the device. You must open the front compartment door to see the lights:
- A **green** status light indicates normal operation.
- A **red** status light indicates loss of protection and SPD may need replacing.
- **Non-illuminated** status light indicates loss of power.

---

**Figure 31 SPD/TVSS Status Lights**

8.6 Subfeed Circuit Breaker Trip

A subfeed circuit breaker can optionally be tripped using an applied voltage, 120VDC or 24VDC. 24VDC is recommended.
## Table 11 Dry Contact Signals

<table>
<thead>
<tr>
<th>Device</th>
<th>Input Signals</th>
<th>Output Signals</th>
<th>Signal Meaning</th>
<th>Dry Contact Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Monitor</td>
<td></td>
<td>Summary Alarm</td>
<td>An alarm is present on a device in the Monitor’s device chain.</td>
<td>0.5A @ 120VAC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5A @ 30VDC</td>
</tr>
<tr>
<td>PDU board</td>
<td>4 Digital Inputs</td>
<td></td>
<td>Signals internal to PDU with assignable meanings. Digital Input 4 = PDU door open (default assignment).</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor Board</td>
<td>Remote Emergency Power Off (REPO)</td>
<td></td>
<td>Signal to immediately power down PDU.</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor Board</td>
<td>4-8 Building Alarms</td>
<td></td>
<td>Assignable meanings. Customer can elect to shut down the PDU on a specific building alarm. See Section 7.3 Automatic Shutdown Signals.</td>
<td>NA</td>
</tr>
<tr>
<td>Contractor Board</td>
<td>4-8 Remote Relays</td>
<td></td>
<td>Assignable meanings. Relay 1 = Summary Alarm for PDU by default</td>
<td>Up to 2A/250V</td>
</tr>
<tr>
<td>Subfeed breaker(s) (optional)</td>
<td>Breaker trip alarm</td>
<td></td>
<td>Subfeed circuit breaker has tripped or has been reset</td>
<td>Max 5A/600V</td>
</tr>
<tr>
<td></td>
<td>Auxiliary contacts</td>
<td></td>
<td>Subfeed circuit breaker contacts have changed state (open or closed)</td>
<td>24VDC recommended</td>
</tr>
<tr>
<td>Surge Protective Device (SPD) (optional)</td>
<td>OK/not OK signal</td>
<td></td>
<td>NC contact is closed when SPD is functional and powered. SPD dry contact is usually wired to a Digital Input on the PDU M4G Board. See “Digital Inputs” in Section 8.3.1 PDU M4G Board.</td>
<td>600V wire required. Contact ratings: 0.3 A @ 125VDC</td>
</tr>
<tr>
<td></td>
<td>External signal; may be issued from UPS</td>
<td></td>
<td>Enable the Color Monitor’s internal permissive signal.</td>
<td>0.3 A @ 110 VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0 A @ 30 VDC</td>
</tr>
</tbody>
</table>
9 Monitoring: 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.

9.1 Color Monitor and Protocols

The Color Monitor is the Modbus master device to all devices in the PDU that use WaveStar monitoring. All of these devices are downstream of the Monitor. 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 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*, PM375103.

9.2 Customer Network Connections

Customer Modbus RTU network connections are made to the Contractor Board. See 8.3.2 Basic Contractor Board and 8.3.3 Enhanced Contractor Board.

The Customer Ethernet connection is made to the Color Monitor backpanel. See 9.4 Color Monitor Network Connections.

9.3 Modbus Addressing

Refer to Figure 33, “Internal PDU Network, Modbus Addressing, Example,” with the following bullet points:

- The internal PDU network uses Modbus RTU protocol to connect the PDU board and BCMS PCBs 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 247, 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 for the PDU Board. 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. (This is often confusing, but it is important to understand.) If the Monitor has upstream 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.

9.4 Color Monitor Network Connections

The Color Monitor’s backpanel has Modbus RTU and Ethernet ports (Figure 32).

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 32 Color Monitor Network Connections
PowerPak PDU 50-300 kVA

Figure 33 Internal PDU Network, Modbus Addressing, Example

- **PDU Main Cabinet**
- **24” Side Car**
- **12” Side Car**

- **To upstream Modbus master (BMS, DCIM, etc.)**

- **Color Monitor**
  - Points List = Color Monitor
  - (30)

- **PDU M4G Board/Contractor Board**
  - Points List = PDU

- **Modbus RTU**

- **Resistor Board**
  - 1-8 Subfeeds
  - PB1, PB2, PB3, PB4

- **BCMS PCB**
  - Points List = ESF
  - KWH

- **ESF Resistor Board**

- **1-8 Subfeeds**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
</tbody>
</table>

Downstream Modbus addresses must be assigned to each device consecutively from 1. Monitor’s Upstream Address (30) is added to each device’s downstream address for upstream addressing.

Monitor’s Upstream Modbus Segment

Monitor is Modbus master on its Downstream Modbus Segment.
9.4.1 Modbus RTU Ports

<table>
<thead>
<tr>
<th>Pin</th>
<th>J1, J3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ground</td>
</tr>
<tr>
<td>2</td>
<td>RX-</td>
</tr>
<tr>
<td>3</td>
<td>RX+</td>
</tr>
<tr>
<td>4</td>
<td>TX-</td>
</tr>
<tr>
<td>5</td>
<td>TX+</td>
</tr>
</tbody>
</table>

Table 12 Pin-Out for Modbus Headers

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 12.

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

PDI devices have two (2) jumpers near their Modbus ports for configuring 2-wire vs. 4-wire Modbus RTU (see Figure 32). 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 32).
- TX- from the Monitor or BMS wires to RX- on device PCB (Figure 32).
- 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.
9.5 Modbus RTU Cables

9.5.1 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.
  - Use 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.

9.5.2 Cable Biasing and Termination

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, PDI 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, PDI recommends that a small capacitor be put in series with the terminating resistor.

9.6 Ethernet Cables

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

9.7 Setting Color Monitor Network Parameters

The Color Monitor must be set up to match the customer’s physical network. Touch SETUP on the Color Monitor HOME screen to display buttons for network setup (Figure 34).

Touch buttons in the initial SETUP screen to link to miscellaneous setup functions:

- **PASSWORD**: Keyboard appears, enter password, then type new password.
- **HORN DISABLED**: Toggle Monitor’s audible alarm to ENABLED/DISABLED.
- **BANNER**: Banner setup (here shown as “PDI DISPLAY”) is on same screen as Modbus setup (Figure 7).
- **TIME & DATE**: Set time and date; used on HOME screen and alarm timestamps.
- **CALIBRATE GUI**: See next figure.
A password is required to access and change setup parameters. Enter the password (default is “PDI”). The user can navigate through any of the screens and come back to SETUP without having to re-enter the password for 10 minutes. Touch PASSWORD to change to a new password.

Warning!
Improper configuration of a WaveStar Color Monitor may conflict with other monitors or devices on the network.

9.7.1 Downstream Modbus Device Chain Setup

To set Modbus device chain parameters, touch DEVICES/MODBUS (Figure 35):

- **Number of Devices** should equal the number of devices in the Monitor’s device chain. Up to twenty (20) devices are allowed. The Monitor uses this number to determine how many devices to search for in its downstream chain.
- When you add new devices, increment this counter, then press “ENTER”. The Monitor will automatically start a new search and find all of the downstream devices. The devices will then be listed in the DEVICES Screen, where the added devices will initially show up as generic device names.
- For each new device the user should then enter a unique device name. Unique device names are needed to isolate alarms and measurements to specific devices.

Figure 35 Modbus RTU Setup
9.7.2 Modbus RTU Setup

**Downstream Modbus** settings cannot be changed.

**Upstream Modbus** provides network characteristics on the upstream side of the Monitor.

- **Address** is the address that the upstream Modbus master, such as the Building Management System (BMS), uses to address the Monitor. The downstream device addresses are incremented sequentially from this address. So, if the Monitor has address 20, the next three devices will appear 21, 22, and 23 to the upstream master device. (See Figure 33, “Internal PDU Network, Modbus Addressing, Example.”)
- **Upstream Modbus** settings for **Baud** rate and **Parity** must match those for the upstream Modbus master.

9.7.3 TCP/IP and Modbus TCP/IP Setup

For TCP/IP, the customer must provide an Ethernet cable connected to the Ethernet port (RJ45 header J11) on the Monitor. (See Figure 32, “Color Monitor Network Connections”.)

On the **SETUP** screen, touch **NETWORK/SNMP** to display the network parameters for TCP/IP (Figure 36).

The following must be specified for Modbus TCP/IP:

- IP Address
- Subnet Mask
- Gateway

Each connected monitor must be assigned a unique address. DHCP is not supported.

Touch **RESTART WITH NEW SETTINGS** if any parameter is changed on this screen. The processor will reboot and search the network for connections.
9.7.4 SNMP Setup

To use SNMP, the customer must connect an Ethernet link to the RJ45 header J11 (see Figure 32) on the Monitor using a standard Ethernet cable.

For SNMP setup, on the SETUP screen, touch NETWORK/SNMP to display the network parameters for SNMP (Figure 36).

In addition to the TCP/IP specification, the following must be specified for SNMP:

- Specify the Trap Server IP address
- Toggle ENABLED/DISABLED for the trap server.
- Touch SEND TEST TRAP to verify operation.
- Get Community security string for Get operations.
- Set Community security string for Set operations.

Touch RESTART WITH NEW SETTINGS if any parameter is changed on this screen. The processor will reboot and search the network for connections.

9.8 Device Settings

A “device” is a points list (or Modbus register map) representing a physical monitored entity, such as a panelboard. Each points list instance has a single Modbus address.

Each device has a SETTINGS screen for changing device name, software version, and device configuration. These settings provide information to the Monitor in addition to each device’s own internal setup. Device settings are usually entered by PDI manufacturing or service representatives, but can be entered by customer administrators.
9.8.1 PDU Device Settings

Use the DEVICES screen to show each device in the Color Monitor’s chain. By selecting a device in the list, you can change the generic name (e.g. “PDU”) to a name meaningful to your installation. Accessing the PDU device name is shown below.

![Diagram showing device settings]

- Touch **PDU** (generic name) in device list. Device name turns blue when selected.
- Touch **SETTINGS** to set device name or software versions.

**Set NAME:**
- Touch NAME field (“PDU” in this example):
- A keyboard appears.
- User may be requested to enter password (default is “PDI”).
- Type in device name (up to 16 characters); touch **ENTER**.
- Device Name is put in header under banner and in DEVICES screen device list.

Figure 37 Settings: PDU Device

To change device parameters on other devices in the PDU, such as panelboards or subfeeds, consult the *WaveStar® Color Monitor, Setup and Operation, PM375103.*

9.9 Device Readings

Each device in the Monitor’s device chain has a **READINGS** screen chain, providing power monitoring information.

- Select (touch) **DEVICES** to see the device list and then **READINGS**.
- Use **PREVIOUS/NEXT** to step through the screen chain.

As an example, **READINGS** from the PDU are power measurements at input to and output from the PDU transformer (Figure 38).

Screens for device readings for all devices that can be monitored by the Color Monitor are shown and described in *WaveStar® Color Monitor, Setup and Operation, PM375103.*
Select (touch) **PDU device name** in the device list. Device name turns blue when selected and device name displays in header.

**PDU** is the default generic device name. Users can change the device name in **SETTINGS**.

Touch **READINGS** to see PDU power monitoring data.

**INPUT** to the PDU transformer:
- **Voltage**: AB  BC  CA
- **THD** (total harmonic distortion): AB  BC  CA
- **Frequency**: in Hz
- **Current** A B C (optional)
- **THD** A B C (optional)
- **Ground Current**

**OUTPUT** from the PDU transformer:
- Instantaneous measurements:
  - **Voltage**: AB  BC  CA  AN  BN  CN
  - ABC(N) phase readings and totals:
    - **Current**
    - **KW**
    - **KVA**
    - **KVAR**
    - **PF**
- Cumulative Measurement:
  - **KWH**
  - Touch **Clear** to set KWH to 0.

**Figure 38 Readings: PDU**
10 Monitoring: Alarms

The Color Monitor displays alarms and warnings for all devices in the Monitor's device chain. The Monitor reads the alarms and warnings from the points list (Modbus register map) of each device.

Because the Monitor receives power from the line side of the Main Circuit Breaker, it can be used to monitor power and diagnose power events, both during PDU Start-up or after an outage.

10.1 Summary Alarm Indicators

There are two Summary Alarms:

- PDU Remote Relay Summary Alarm signals that an alarm is present for the PDU M4G Board or Contractor Board.
- Color Monitor Summary Alarm signals that an alarm is presented on any of its downstream connected devices, including the PDU and Contractor Boards and all of the PDU's BCMS devices. It does not include auxiliary contacts for circuit breakers.

The Color Monitor indicates that there are extant alarms with three general indicators:

- The summary count of warnings and alarms for the Monitor's entire device chain is shown on every screen (Figure 39).

When there are no alarms or warnings, a green check mark is displayed.

When alarms are present on any device, a red and yellow icon is displayed with the alarm and warning counts.

![Figure 39 Alarm and Warning Summary Status Icons](image)

- There is also a light under the screen that glows green if none of the devices in the Monitor’s chain has warnings or alarms and red if there are outstanding warnings or alarms (See Figure 47, the light is in the bezel).
- In addition, the Monitor has a dry contact (NO) connection on the backpanel that signals a summary alarm whenever any alarm is present in the Monitor's device chain (See Monitor backpanel, Figure 32).

10.2 Alarm Screen and Alarm List

On any screen, touch the ALARM button to show the ALARM screen.

The ALARM Screen (Figure 40) lists all outstanding warning and alarms by device name with a date-time stamp in a scrollable list. If no alarms are outstanding, there will be only one line, “No Alarms”.

The warning or alarm gives the device name and locates the device component that is the alarm source. For example, for a BCMS panelboard device, the alarm may be located to

- the panelboard, such as “Over Current PB”, or
- the main voltage feed to the panelboard, such as “Over Volt Main,” or
- the individual panelboard circuit, such as “CB 19 Zero Current”.

To further investigate individual circuits in warning/alarm state (Figure 41):

1. Note the device name and the warning/alarm.
2. Touch the **DEVICES** button to show the device list.
3. In the device list, scroll to the **device name** that has the warning/alarm. Touch the device name to show the device’s circuit list.
4. Step through the device’s screen chain with **PREVIOUS/NEXT** to find the **ALARM** heading.
5. Scroll within the circuit list on the first device screen to find circuit or other component in warning/alarm. An alarm may apply to a circuit or to the entire device, such as “Under Current PB.”

![Figure 40 ALARM Screen with an Alarm List](image)

- **Device Name**
  - **BCMS KW** = device (generic panelboard device with KWH points list).
  - Device Name should be changed from generic name to user-specified name on the device’s **SETTINGS** screen.

- **Alarm or Warning Name**
  - “**Under Volt Main**” locates the problem to the main voltage source to the panelboard.

- **Touching **CLEAR ALL** clears all outstanding warnings and alarms on screen and resets corresponding Modbus registers in the device points list. It takes several seconds for alarms to clear.
  - If a warning/alarm condition remains outstanding, the warning/alarm will remain on the **ALARM** screen.

- **Touching **SILENCE HORN** silences the Color Monitor’s audible alarm, which sounds when an alarm is issued.
10.3 Alarms by Device Type

Each device has its own alarm set based on its points list. Warnings and alarms that can be viewed on the Monitor are listed below. The Monitor does not display setpoints from the points lists, such as alarm thresholds.

10.3.1 Color Monitor Alarms

DISPLAY Comm. N Error (N is device number from 1-20): Communication error with one of the devices in the Monitor’s downstream device chain

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPLAY Comm. N Error (N is device number from 1-20):</td>
<td>Communication error with one of the devices in the Monitor’s downstream device chain</td>
</tr>
</tbody>
</table>

10.3.2 PDU Alarms

General PDU Alarms

<table>
<thead>
<tr>
<th>Warning or Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPO</td>
<td>Emergency Power Off on PDU has been engaged. When EPO button is pushed, the alarm is activated and the unit’s main input circuit breaker will then be shunt-tripped off line.</td>
</tr>
</tbody>
</table>
### Monitoring: Alarms

<table>
<thead>
<tr>
<th>Warning or Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote EPO</td>
<td>Remote EPO on PDU can be activated in by closing the contacts on the contractor board. When Remote EPO button is activated, the alarm is activated and the unit’s main input circuit breaker will then be shunt-tripped off line.</td>
</tr>
<tr>
<td>Thermal Overtemp</td>
<td>Stage 1 transformer temperature alarm: 180°F or higher temperature registered in the transformer windings.</td>
</tr>
<tr>
<td>Thermal Hightemp</td>
<td>Stage 2, PDU shutdown on transformer temperature alarm by tripping main PDU input circuit breaker when 195°F or higher temperature is registered in the transformer windings. (Temperature threshold can vary by transformer and PDU.)</td>
</tr>
<tr>
<td>Phase Rotation</td>
<td>Input phase rotation is incorrect.</td>
</tr>
<tr>
<td>S1-S2 Phase Angle</td>
<td>Dual input sources are not synchronized; cannot shutdown one source and transfer load to the alternate source.</td>
</tr>
<tr>
<td>Ground Curr Trip</td>
<td>Ground current above preset level (10A) causes breaker trip (normally disabled, enable as option).</td>
</tr>
<tr>
<td>Phase Rotation Trip</td>
<td>Incorrect phase rotation causes breaker trip (normally disabled, enable as option).</td>
</tr>
<tr>
<td>Over Voltage Trip</td>
<td>Over voltage causes breaker trip (normally disabled, enable as option).</td>
</tr>
<tr>
<td>Under Voltage Trip</td>
<td>Under voltage causes breaker trip (normally disabled, enable as option).</td>
</tr>
</tbody>
</table>

### PDU Transformer Input

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTE: If the PDU is configured for dual inputs, “Input 1” or “Input 2” will prefix the alarm instead of “Input.”</td>
<td></td>
</tr>
<tr>
<td>Input Voltage AB High</td>
<td>Input voltage AB measures above threshold level in points list.</td>
</tr>
<tr>
<td>Input Voltage AB Low</td>
<td>Input voltage AB measures below threshold level in points list.</td>
</tr>
<tr>
<td>Input Voltage BC High</td>
<td>Input voltage BC measures above threshold level in points list.</td>
</tr>
<tr>
<td>Input Voltage BC Low</td>
<td>Input voltage BC measures below threshold level in points list.</td>
</tr>
<tr>
<td>Input Voltage CA High</td>
<td>Input voltage CA measures above threshold level in points list.</td>
</tr>
<tr>
<td>Input Voltage CA Low</td>
<td>Input voltage CA measures below threshold level in points list.</td>
</tr>
<tr>
<td>Input Frequency High</td>
<td>Input frequency measures above threshold level.</td>
</tr>
<tr>
<td>Input Frequency Low</td>
<td>Input frequency measures below threshold level.</td>
</tr>
<tr>
<td>Input Current A High</td>
<td>Input current phase A measures above threshold level (optional).</td>
</tr>
</tbody>
</table>
### Alarm

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current A Low</td>
<td>Input current phase A measures below threshold level (optional).</td>
</tr>
<tr>
<td>Input Current B High</td>
<td>Input current phase B measures above threshold level (optional).</td>
</tr>
<tr>
<td>Input Current B Low</td>
<td>Input current phase B measures below threshold level (optional).</td>
</tr>
<tr>
<td>Input Current C High</td>
<td>Input current phase C measures above threshold level (optional).</td>
</tr>
<tr>
<td>Input Current C Low</td>
<td>Input current phase C measures below threshold level (optional).</td>
</tr>
</tbody>
</table>

### PDU Transformer Output

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NOTE:</strong> If the PDU is configured for dual outputs, “Output 1” or “Output 2” will prefix alarm instead of “Output.”</td>
<td></td>
</tr>
<tr>
<td>Output Voltage AB High</td>
<td>Output voltage AB measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage AB Low</td>
<td>Output voltage AB measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage BC High</td>
<td>Output voltage BC measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage BC Low</td>
<td>Output voltage BC measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage CA High</td>
<td>Output voltage CA measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage CA Low</td>
<td>Output voltage CA measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage AN High</td>
<td>Output voltage AN measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage AN Low</td>
<td>Output voltage AN measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage BN High</td>
<td>Output voltage BN measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage BN Low</td>
<td>Output voltage BN measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage CN High</td>
<td>Output voltage CN measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Voltage CN Low</td>
<td>Output voltage CN measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Current A High</td>
<td>Output current phase A measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Current A Low</td>
<td>Output current phase A measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Current B High</td>
<td>Output current phase B measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Current B Low</td>
<td>Output current phase B measures below threshold level in points list.</td>
</tr>
<tr>
<td>Output Current C High</td>
<td>Output current phase C measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output Current C Low</td>
<td>Output current phase C measures below threshold level in points list.</td>
</tr>
</tbody>
</table>
### Monitoring: Alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output KW A High</td>
<td>Output KW phase A measures above preset level.</td>
</tr>
<tr>
<td>Output KW B High</td>
<td>Output KW phase B measures above preset level.</td>
</tr>
<tr>
<td>Output KW C High</td>
<td>Output KW phase C measures above preset level.</td>
</tr>
<tr>
<td>Output KW Total High</td>
<td>Output KW total measures above threshold level in points list.</td>
</tr>
<tr>
<td>Output KVA A High</td>
<td>Output KVA phase A measures above preset level.</td>
</tr>
<tr>
<td>Output KVA B High</td>
<td>Output KVA phase B measures above preset level.</td>
</tr>
<tr>
<td>Output KVA C High</td>
<td>Output KVA phase C measures above preset level.</td>
</tr>
<tr>
<td>Output KVA Total High</td>
<td>Output KVA Total measures above preset level.</td>
</tr>
<tr>
<td>Neutral Current High</td>
<td>Neutral current measures above preset level.</td>
</tr>
<tr>
<td>Neutral Current Low</td>
<td>Neutral current measures below preset level.</td>
</tr>
<tr>
<td>Ground Current High</td>
<td>Ground current measures above preset level.</td>
</tr>
<tr>
<td>Ground Current Low</td>
<td>Ground current measures below preset level.</td>
</tr>
</tbody>
</table>

### Contractor Board Alarms

<table>
<thead>
<tr>
<th>Alarms</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build N (N = 1-8)</td>
<td>Building alarms, customizable names up to 8 characters can be set in software.</td>
</tr>
<tr>
<td>Digit N (N = 1-4)</td>
<td>Digital alarms, customizable names up to 8 characters can be set in software.</td>
</tr>
</tbody>
</table>

### 10.3.3 Enhanced Subfeeds

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB N Zero Current (N = 1-14)</td>
<td>Circuit N has lost current after previously measuring a minimum current.</td>
</tr>
<tr>
<td>CB N High Current Warning (N = 1-14)</td>
<td>Circuit N has exceeded current warning threshold.</td>
</tr>
<tr>
<td>CB N High Current Alarm (N = 1-14)</td>
<td>Circuit N has exceeded current alarm threshold.</td>
</tr>
<tr>
<td>Over Voltage</td>
<td>Over voltage measured to ESF board as specified in points list.</td>
</tr>
<tr>
<td>Under Voltage</td>
<td>Under voltage measured to ESF board as specified in points list.</td>
</tr>
</tbody>
</table>
### 10.3.4 BCMS Panelboard—Typical Alarms

#### Circuit Alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB N Zero Current (N = 1-336)</td>
<td>Circuit N has lost current after measuring a minimum current.</td>
</tr>
<tr>
<td>CB N High Current Warning (N = 1-336)</td>
<td>Circuit N exceeds high current warning threshold.</td>
</tr>
<tr>
<td>CB N High Current Alarm (N = 1-336)</td>
<td>Circuit N exceeds high current alarm threshold.</td>
</tr>
</tbody>
</table>

**Note:** The Color Monitor can number panelboard circuits sequentially for up to 336 circuits (8 x 42-circuit panelboards) as specified in device setup. Circuit alarms are identified by this number.

#### Panelboard Alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Alarm Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over Current PB</td>
<td>Current feeding one panelboard is above alarm threshold.</td>
</tr>
<tr>
<td>Under Current PB</td>
<td>Current feeding one panelboard is below alarm threshold.</td>
</tr>
<tr>
<td>Over Curr both PBs</td>
<td>A common circuit feeding both panelboards is over alarm threshold.</td>
</tr>
<tr>
<td>Under Curr both PBs</td>
<td>A common circuit feeding both panelboards is under alarm threshold.</td>
</tr>
<tr>
<td>Over Volt Main</td>
<td>Over voltage measured on main voltage source to panelboard.</td>
</tr>
<tr>
<td>Under Volt Main</td>
<td>Under voltage measured on main voltage source to panelboard.</td>
</tr>
<tr>
<td>Over Volt Alt</td>
<td>Over voltage measured on alternate voltage source to panelboard.</td>
</tr>
<tr>
<td>Under Volt Alt</td>
<td>Under voltage measured on alternate voltage source to panelboard.</td>
</tr>
</tbody>
</table>
11 Manual Dual PDU Option

A Power Pak PDU can optionally be configured in manufacturing as a Manual Dual PDU. A Manual Dual PDU has two independent voltage sources, each with its own main input circuit breaker and with lock-outs provided by Kirk Keys. The output load can be manually transferred from one source to the other in a make-before-break closed transition transfer.

11.1 Initial Status: Circuit Breakers and Kirk Keys

The two main input circuit breakers have mechanical interlocks using Kirk Keys controlling access to the breakers and the Solenoid Key Release Unit (SKRU). There are three (3) locks (Figure 42) and two (2) keys. The starting breaker and lock settings for a transfer are as follows:

- **Active power source**: circuit breaker = closed; Kirk Key lock = unlocked; key in lock.
- **Inactive power source**: circuit breaker = open; Kirk Key lock = locked; no key in lock.
- **Solenoid Key Release Unit (SKRU)**: Kirk Key lock = locked; key in lock.
- **SKRU** key is released by a “permissive signal” to the SKRU

Both power sources must be synchronized to perform the transfer.

![Figure 42 PDU Internal Panel, Kirk Keys](image-url)
11.2 Permissive Signal Options

The first step in a make-before-break transfer is sending a “permissive signal” to the SKRU to unlock its key. The PDU can be configured for any one of several mutually exclusive methods for providing a permissive signal. Each method must be selected at time of order and is wired in manufacturing:

- **Internal signal.** An internal permissive signal is generated through the Color Monitor’s Sync Screen. The PDU M4G Board detects that both input sources are synchronized and can be switched, allowing the operator to release the SKRU key using the Color Monitor.

- **External signal.** An external permissive signal provides the SKRU key release directly. The PDU does not check to see that the two power sources are synchronized. Detecting that both power sources are synchronized is the customer’s responsibility.

- **2-Stage External/Internal signal.** An external signal (dry contact or 120VAC) enables the internal signal. The PDU then determines whether both sources are synchronized and, if so, the operator uses the Color Monitor Sync Screen to release the SKRU key.

11.3 Customer Wiring for Permissive Signals

11.3.1 Internal Permissive Signal

An internal permissive signal requires no wiring at the customer site whether used alone or in the two-stage external/internal system.

11.3.2 External Permissive Signals

Customer wiring for an external permissive signal is the same whether the external signal is used alone to release the SKRU key or it is used in a two-stage system to enable the internal signal.

The customer connects either a dry contact or external applied 120VAC connection to a terminal block near the main breakers’ Kirk Keys. The choice of dry contact or 120VAC connection must be selected at time of order.

The customer must independently determine that the sources are synchronized. Typically, the external signal is sent from an Uninterruptible Power Supply (UPS).

11.3.3 Dry Contact External Permissive Signal

The dry contact must be a normally open (NO) dry contact. Closing the contact enables the signal (Figure 43).

In a two-stage external/internal system, if the dry contact is not connected to the terminal block, you can install a jumper in the terminal block to keep the external permission permanently enabled. This effectively reduces the two-stage system to an internal permissive signal only system.
11.3.4 120VAC External Permissive Signal

The 120VAC external signal is connected to a terminal block in the PDU, similarly to the dry contact connection. The 120VAC neutral and hot wires should be connected as shown in Figure 44.

Note for Two-Stage Systems:
If there is no 120V input, installing a jumper from the neutral terminal to the hot terminal will not provide a permanently enabled external permissive signal.

11.4 Using Cam Locks with Alternate Power Source (Optional)

Both power sources are usually hard-wired to the two main circuit breakers. However, some customers optionally elect to connect an alternate power source via cam locks. Cam locks have ABCG input power connections and are color-coded for correct phase and ground connections.
When cables are connected to the cam locks, the PDU M4G board will check that all ABC voltages are within specification (usually ±10%) and then check for correct phase rotation. The PDU will issue an input phase rotation error if the operator has incorrectly connected the cables, such as inserting B-phase into C-phase.

WARNING!
If the customer is using cam locks to connect an alternate power source, it is not recommended that they select the option to shut down the PDU on phase rotation error. If the operator incorrectly wires the phase cables into the cam locks, the PDU will shut down immediately.

11.5 Dual Input Source Transfer Procedures

There are three closed transition transfer procedures:

- Internal permissive signal using Color Monitor to release the SKRU key
- External permissive signal using dry contact or 120V input, bypassing Color Monitor
- Two stage permissive signal: external signal enables internal signal

Select the procedure suitable for your configuration.

11.5.1 Transfer Procedure: Internal Permissive Signal Only

The Monitor checks voltage readings for both sources from the PDU M4G board to determine if the two sources are synchronized. When both voltage sources are in synch, the operator can signal the SKRU to release its key using the Monitor Sync Screen (Figure 46). The operator then removes the SKRU key and inserts it into the Kirk Key lock for the inactive power source, allowing that breaker to be closed.
To manually switch the load from one power source to the other using the Monitor, use the following procedure:

**Figure 46 Color Monitor Synch Screen**

To display this screen, select

**Home → Devices → PDU → Readings**

This **Sync** screen appears as the first “Readings” screen.

**Figure 47 Transfer Procedure Using Internal Permissive Signal**

1. From the Color Monitor **Home** screen, go to **Alarm** screen and clear voltage alarms.
2. From the **Home** screen, touch **Devices**.
3. Select the **PDU** device (customer may have renamed the PDU device to a different name).
4. Touch **Readings**.
5. **Sync** screen appears. **Active** power source shows a closed circuit breaker (red). **Inactive** power source shows an open circuit breaker (green).
6. When the Sync screen is displayed, the active source breaker should be closed (red) and the inactive source breaker open (green). If both sources look to be in sync, touch KEY RELEASE to release the SKRU key.

The SKRU will not release the key if

- any input voltage alarms are present, or
- the phase difference between sources is greater than 20 degrees (value can be set in PDU M4G Board setup).

7. The operator should turn the SKRU (solenoid) key and remove it.

8. The operator should then
   8.1. insert the SKRU key into the circuit breaker lock for the inactive power source (the open circuit breaker, in this example, Source 2);
   8.2. turn the key; and
   8.3. close (turn on) the breaker.

Note: At this point, both synchronized voltage sources are feeding the PDU and both breakers will show closed (red) on the Sync screen.

9. Make the previously active source inactive.
   9.1. Open the circuit breaker for the previously active power source that you are turning off.
   9.2. Turn the key to lock the breaker.

10. Move the key from this breaker to the SKRU (solenoid):
   10.1. Remove the key from the breaker.
   10.2. Insert it into the lock for the SKRU.
   10.3. Turn the key.

Note: Source 2 is now the only active source and shows red on the SYNC screen. Source 1 is locked open (off) and shows green on the SYNC screen.

11.5.2 Transfer Procedure: External Permissive Signal Only

If an external permissive signal is to release the SKRU key, power source synchronization must be independently verified. The PDU does not check sources for synchronization through the SYNC screen; however, the operator must still touch the SYNC screen button to release the SKRU key.

Assuming the active source = Source 1, follow these steps:

1. An external permissive signal must be issued to enable the SKRU key release.
2. The operator should
2.1. Bring up the Color Monitor SYNC screen,
2.2. Touch KEY RELEASE on the Color Monitor SYNC screen to release the SKRU key, and
2.3. Turn the SKRU key and remove it.

3. The operator should then
3.1. Insert the key in the lock for the main breaker of the inactive power source (Source 2),
3.2. Turn the key, and
3.3. Close the breaker.

Note: At this point, both synchronized voltage sources are feeding the PDU.

4. Open the circuit breaker on Source 1.
4.1. Open the circuit breaker for the previously active power source that you are turning off.
4.2. Turn the key to lock the breaker.

5. Remove the key from the Source 1 circuit breaker, insert it into the SKRU lock, and turn the key.

At this point only Source 2 is feeding the PDU, and Kirk Key locks prevent any inadvertent change of sources.

11.5.3 Transfer Procedure: External Plus Internal Permissive Signals

The PDU can also be configured with a two-stage permissive signal (Figure 48):

**Stage 1.** An external permissive signal (120V or dry-contact signal) enables or disables the internal permissive signal to the SKRU key release signal via the Color Monitor.

**Stage 2, internal permissive signal.** The PDU checks sources for synchronization. The operator uses the Color Monitor Sync Screen to release the SKRU key. Use procedure described in Section 10.5.1 Transfer Procedure: Internal Permissive Signal Only.

![Figure 48 Two-Stage Permissive Signal: External plus Internal](image)
11.6 Open Transition Transfer

During maintenance you may wish to switch power sources in an open transition break-before-make transfer. Power continuity from one source to the other is not maintained. The load is dropped. The SKRU key is not used.

To do an open transition transfer from the primary to the alternate source, follow these steps:

- Open (turn off) the primary source circuit breaker.
- Turn the key of the primary circuit breaker lock to extend the bar, locking the breaker. Remove the key.
- Insert the key into the alternate source circuit breaker lock and turn the key to retract the bar.
- Close the alternate circuit breaker, applying power to the PDU from the alternate source voltage.

Warning!

Closing the alternate circuit breaker to re-energize the PDU can result in inrush on the upstream power sources, such as a UPS. Verify that your upstream power sources can handle the inrush or put the upstream UPS in bypass mode.
Figure 49 One-Line Manual Dual PDU with Permissive Signal Wiring Variations
12 Service

12.1 Start Up

PDI START UP is mandatory for all purchased PDU’s and is a sure way of getting your power equipment up and running as you need it. PDI START UP services provide the following:

- A factory-trained customer support engineer to certify that the PDU is functioning correctly in your installation.
- A factory-trained customer support engineers to assist with operational training.

12.2 Service Contracts

12.2.1 Standard Warranty

Standard products manufactured by PDI are warranted to be free from defects in workmanship and material for a period of **twelve (12) months from initial startup or eighteen (18) months from date of shipment, whichever comes first.** After the end of the warranty period, service requests are handled on a time and material basis unless a preventative maintenance contract is in effect.

- U.S. – Full Coverage of Parts and Labor
- International – Parts Only Coverage Standard

12.2.2 Extended Warranty

Please contact a PDI service representative for detailed information about extended warranties.

Tel: (800) 225-4838 | Email: service@pdicorp.com

12.3 Maintenance Contracts

PDI offers maintenance contracts to help ensure the ongoing reliability of critical power systems.

Maintenance contracts are customizable to meet specific needs (number of PM visits per year, scope of coverage (e.g. parts not included), length of contract, etc.).

Maintenance contracts include the following:

- **Rapid Service Response**
  - PDI Maintenance Service responds 24 hours a day, 7 days a week without additional costs for weekends, nights or holidays.

- **Two comprehensive Preventative Maintenance Visits Annually**
  - Infrared Scanners provide information that can determine impending failures on connections and busing.
  - Harmonic Analyzers provide real time information on the effects of harmonic currents on the power distribution system.

- **Other services include:**
  - Thorough visual inspection of all parts (bulbs, displays, missing hardware and cleanliness)
  - Inspection of load balance, KVA usage and building alarms
  - Test and analysis report
• Guaranteed Parts Availability
  o PDI guarantees parts availability to service customer equipment in timely fashion.

Please contact a PDI service representative for detailed information about Preventative Maintenance Contracts.

Tel: (800) 225-4838 | Email: service@pdicorp.com

12.4 Time and Materials

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

12.5 Spare Parts Kits

Spare Parts are available for the PowerPak PDU in three kit levels: A, B, C. To order, call (800) 225-4838 or email service@pdicorp.com.

Table 13 Spare Parts Kits for PowerPak PDU

<table>
<thead>
<tr>
<th>Qty</th>
<th>Spare Parts Kit Components</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Assorted Fuses</td>
<td>A</td>
</tr>
<tr>
<td>1</td>
<td>Control Power Transformer</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>South-co Panel Retainer</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>South-co Panel Clip</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>South-co Panel Fastener</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>South-co Panel Washer</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Panel Guide</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Panel Latch</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Panel Slide Latch</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WaveStar® Data Acquisition Card</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Emergency Power Off Assembly</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WaveStar® Color Monitor</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WaveStar® Contractor Board</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Complete Set of Ribbon Cables (6)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BCMS Board</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Data Module Transformer</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Split Core Hot Fix Board with 6 CT’s</td>
<td></td>
</tr>
</tbody>
</table>

Ctrl Nr: PM375118-003
Bibliography

Points Lists

Points lists for PDUs can be downloaded from the PDI website. Go to Service Software Downloads:

https://www.pdicorp.com/services/service-software-downloads

For the PDU M4G Board points list, download Wavestar® PDU Customer CD, a zip file. Unzip the file and open the directory \Wavestar PDU Customer CD to find the following points lists and use the latest revision given:

PDU M4G Board points list is “M4G acquisition points list”.

For BCMS points lists, download BCMS II Customer CD Info, a zip file. 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 ESF (Enhanced Subfeeds) points list is “BCMS Points List Fourteen Sub”.
- 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”.

Manuals and Other Documentation for PDI Products

Installation and Operation manuals and other documentation for specific products can be downloaded from the product pages on the PDI website. Go to Products and select the appropriate Product Page:

https://www.pdicorp.com/products

For example, documentation for the PDI PowerPak PDU can be downloaded from its product page:

https://www.pdicorp.com/products/distribute/powerpak-pdu

Select the Downloads tab, then select the document you wish to download.
### Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>BCMS</td>
<td>Branch Circuit Monitoring System</td>
</tr>
<tr>
<td>BMS</td>
<td>Building Management System</td>
</tr>
<tr>
<td>CT</td>
<td>Current transformer</td>
</tr>
<tr>
<td>DCIM</td>
<td>Data Center Infrastructure Management</td>
</tr>
<tr>
<td>EPO</td>
<td>Emergency Power Off</td>
</tr>
<tr>
<td>FIPS</td>
<td>Federal Information Processing Standards</td>
</tr>
<tr>
<td>kAIC</td>
<td>Kilo amps interrupting capacity</td>
</tr>
<tr>
<td>KWH</td>
<td>Kilowatt hour</td>
</tr>
<tr>
<td>M4G</td>
<td>PDU (M4G) Board</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturer’s Association</td>
</tr>
<tr>
<td>NC</td>
<td>Normally Closed (dry contact)</td>
</tr>
<tr>
<td>NO</td>
<td>Normally Open (dry contact)</td>
</tr>
<tr>
<td>PDU</td>
<td>Power Distribution Unit</td>
</tr>
<tr>
<td>REPO</td>
<td>Remote Emergency Power Off</td>
</tr>
<tr>
<td>TVSS</td>
<td>Transient Voltage Surge Suppressor (preferred term=Surge Protective Device or SPD)</td>
</tr>
<tr>
<td>SKRU</td>
<td>Solenoid Key Release Unit</td>
</tr>
<tr>
<td>SPD</td>
<td>Surge Protective Device</td>
</tr>
<tr>
<td>UBC</td>
<td>Uniform Building Code</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratories</td>
</tr>
</tbody>
</table>