
PDI PowerPak 2 Power Distribution Unit

Guide Specifications (Revision 002, 6/1/2017)

1 General

1.1 Summary

These specifications describe requirements for a power distribution unit (PDU) distributing power to sensitive loads.

1.2 Standards

The PDI PowerPak 2 PDU shall be certified through ETL for the following standards:

- UL 60950-1
- CS 22.2

In addition, the PowerPak 2 PDU shall be designed, manufactured, tested, and installed in compliance with the following standards:

- UL67
- UL50
- UL489
- UL 891
- NFPA
- IEEE 519-1991
- ANSI C33.4
- NEMA ST-20
- NEMA AB-1
- NEMA-PB-1
- NEC
- ISO 9001:2015

The PDI PowerPak 2 PDU shall comply with the latest FCC Part 15 EMI emission standard for Class A computing devices.

1.3 System Description

1.3.1 Environmental Requirements

The PowerPak 2 PDU shall have the following environmental requirements for operation and storage:

- Acceptable temperature ranges:
 - Storage temperature shall be between -10°C and +70°C (-33°F to 158°F).

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- Operating temperature shall be between 0°C to 40°C (32°F to 104°F).
- Relative humidity range from 0% to 95% non-condensing.
- Altitude to a maximum of 10,000 ft. The PDU is de-rated above 10,000 ft.
- Audible noise: The audible noise level less than 45 dBA.
- Storage and transport: Up to 40,000 ft. (12,200 m) above Mean Sea Level.

1.3.2 Electrical Requirements

The PDU has a kVA rating of 150-400 kVA.

The PDU input frequency shall be 60 Hz \pm 5 Hz or 50 Hz \pm 5 Hz.

The PDU shall accept these 3-phase, 3-wire plus ground input source voltages:

- @ 50 Hz: 380V-415VAC nominal
- @ 60 Hz: 600, 480 or 208VAC nominal

The PDU output voltage shall be the following nominal voltages, 3-phase, 4-wire plus ground:

- @ 50 Hz: 575, 415/240, or 380/230V
- @ 60 Hz: 600, 575, 480, or 208/120V

1.4 Documentation

1.4.1 Drawings

PowerPak 2 PDU 1-line electrical drawings and outline drawings shall be furnished.

1.4.2 Installation and Operations Documentation

A PowerPak 2 PDU Installation and Operations manual shall be furnished. Points lists (Modbus register maps) for monitoring the PDU board, output subfeeds, panelboards, and main feeds to panelboards shall be available for downloading from the PDI website.

1.4.3 Spare Parts

A list of recommended spare parts shall be made available at customer request.

1.4.4 Contact List

A contact list for PDI functions, such as Service and Accounting, shall be provided.

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1.5 Warranty

The manufacturer shall provide a 12-month warranty against defects in material and workmanship for 12 months after initial startup or 18 months after shipping date, whichever comes first.

1.6 Quality Assurance

The PDI PowerPak 2 PDU shall be designed and manufactured according to internationally recognized quality standards, including those listed in section **1.2 Standards**. The manufacturer shall be ISO 9001:2015 certified.

The PDI PowerPak 2 PDU shall be factory tested before shipment. Testing shall include at minimum:

- Quality control checks specific to the unit and its configuration, including function testing to determine that the unit functions as designed.
- Hi-Potential Test at two times the unit's rated voltage plus 1000 volts, per UL 60950-1 requirements.
- Minimum one-half hour of PDU burn-in or longer burn-in at customer request.
- Calibration tests for monitoring.
- Tests for alarm annunciation as designed and/or as the customer requests.

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2 Product

2.1 Components

2.1.1 Enclosure

The main cabinet enclosure shall be constructed of a steel-welded frame. The main cabinet and side cars shall be NEMA Type 1 enclosures and shall meet IP20 requirements.

PDU Physical Configurations The PDU shall consist of a Main Cabinet alone or with one or two Side Cars. The PDU is shipped with optional Side Cars attached.

Compartments Low-voltage monitoring components shall be accessible without exposure to high-voltage components. Low- and high-voltage components shall be segregated into separate compartments in the Main Cabinet.

The Main Cabinet shall have three (3) compartments:

- Input compartment (high-voltage) for the Main Input Circuit Breaker and optional SPD/TVSS.
- Distribution Output section (high-voltage) for output subfeeds and panelboards.
- Monitoring compartment (low-voltage) for the Color Monitor, Branch Circuit Monitoring System (BCMS) PCBs, and related components.

The optional 24" Side Car shall be configurable as follows:

- One front-facing Distribution Output section with front door, and/or
- One side-facing Distribution Output section with side door
- Optional BCMS components shall be embedded into the 24" Side Car frame in one or two pull-out BCMS compartments.

The optional 12" Side Car shall be configurable as follows:

- One side-facing Distribution Output section with side-facing door.
- BCMS components shall be enclosed in an enclosure within the section and shall be accessible without exposure to high voltages.

Enclosure dimensions Enclosure dimensions shall be as follows:

- Main Cabinet, 42"W x 84"H x 40"D
- 24" Side Car, 24"W x 84"H x 40"D
- 12" Side Car, 12"W x 84"H x 40"D

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Enclosure Weights Weights of individual PowerPak 2 enclosure sections shall be as follows:

- Main Cabinet, approximately 3000 lbs.
- 12" Side Car, approximately 500 lbs.
- 24" Side Car, approximately 585 lbs.

Cooling The unit shall be convection cooled and shall have no fans. Heat rejection shall be through ventilation openings. Convection cooling shall be sufficient for full load operation.

Colors The standard color of the enclosure and metal external and internal doors shall be PDI Black or IBM White. Customer may specify alternate color(s) that must be reviewed and approved by PDI Engineering.

2.1.2 PDU Access

Front maintenance only The PowerPak 2 PDU shall require only front access for service and all routine maintenance for the Main Cabinet and 24" Side Car with front-facing section. In these configurations, adding or replacing power distribution cables and circuit breakers shall require only front access. Replacing monitoring components or wiring communications shall require only front access.

Doors and physical access controls The PDU shall have the following physical access controls:

- Locking Low-Voltage (Monitoring) compartment door
- Locking High-Voltage (Distribution Output) section doors on Main Cabinet and Side Cars
- Locking see-through doors for circuit breaker access in Input compartment and Distribution Output sections.
- USB ports on the Low-Voltage (Monitoring) compartment door for programming the PDU board and BCMS board without requiring USB connection to PCBs.
- Optional 3D Access Window for infrared scanning of the transformer.

Clearances The PowerPak 2 PDU shall require the following clearances:

- Front: 36" (service and ventilation)
- Rear and sides (without side-facing Side Cars): 6" ventilation
- Side Cars with side-facing sections (24" and 12" Side Cars): 36" side clearance
- Top: 18" (ventilation)
- Underfloor 12" (recommended cabling clearance if bottom entry)

2.1.3 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**.

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The following mounting options are available:

- An optional universal floor stand 12-48"H is available for the main cabinet with heights from 12-48"H to match raised floor height. The floor stand can be adapted to PDUs with or without casters.
- Heavy duty casters are optional.
- A skirt providing air closure around the PDU is optional.
- Floor mounting brackets are standard with or without the optional floor stand.

2.1.4 Electrical Construction

All wiring shall be rated per the National Electrical Code (NEC 2014).

The PowerPak 2 PDU shall include a single point ground in accordance with FIPS Pub 94 and the requirements of the NEC. Each distribution output section shall have a ground busbar for distribution output subfeeds and panelboard ground strips.

The PDU shall have a 200%-rated neutral copper busbar as standard in each distribution output section or shall have a smaller percentage rated neutral as specified by the customer, subject to approval by PDI Engineering.

Cable entry/exit The PowerPak 2 PDU shall allow both top and bottom cable entry/exit. Top or bottom cable entry and exit plates shall be offered to match the configuration of the unit and are offered as follows:

- Solid plate
- Panelboard knockout plates with double knockouts for 0.5" and 0.75" conduits
- Mixed solid plate (for input conduit and distribution output subfeeds) and panelboard double knockouts for 0.5" and 0.75" conduits.

2.2 Transformer

The PDU shall be fed from an integral 3-phase, copper-wound, high isolation standard transformer rated between 150 kVA and 400 kVA. The transformer shall be specifically designed for the PDU and its applications and provides voltage transformation, voltage adjustment, high isolation, conditioning, and shielding. Each transformer shall be complete with electrostatic shielding and shall use a universal footing template inside the PDU to secure the transformer to its base.

Standard transformers shall be available in kVA ratings of 150, 225, 300, and 400 kVA with K-factor K13 and shall comply with DOE2016 efficiency requirements. Non-DOE2016 transformers shall be available for non-USA customers and certain exempt categories in the USA.

Transformer taps are optional.

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Standard transformers shall be available with the specifications and other options shown in Table 1.

Table 1 Standard Transformer Specifications and Options

Parameter	Standard Transformer	Options
Input Voltage	480V Delta	208V – 600V
Output Voltage ¹	208 /120V Wye	208 – 600V
Frequency	60 Hz	50 Hz
Impedance	2.5 – 5%	Up to 6%
Efficiency	DOE2016	CEC, CSA, NEMA Premium, non-DOE2016 or non-TP1 for certain exempt categories, or custom efficiency as specified by customer.
K-Factor	K13	K9, K20
Conductor Material	Copper (CU)	Aluminum (AL)
Inrush	8 – 10x	5x
Taps 150-300 kVA ²	+2, -4 x 2.5% (optional)	±2 x 2.5%; custom taps available
Taps 400 kVA ²	±2 x 2.5% (optional)	Custom taps available
Temperature Rise	150°C	115°C, 130°C
Vector	Delta-Wye	Delta Zig-Zag Delta Quad-Wye
Average sound level	NEMA ST-20	NEMA ST-20
Applicable Standard	DOE2016, UL-1561 IEEE Standard C57.12.01	IEC 60076, CSA22.2 No 66, CEC 400

¹ Multi-Output Transformer Option allows the PDU output voltage to be field-reconfigurable to alternate voltages.

² Conventional transformer taps are not available if the Multi-Output Transformer Option is installed.

2.2.1 Multi-Output Transformer Option

The Multi-Output Transformer Option shall enable the single output voltage of the PDU to be reconfigured in the field for these alternate voltages at 60 Hz:

- 208/120VAC
- 415/240VAC
- 480/277VAC

PDU's with the Multi-Output Transformer Option shall have large voltage bus bar taps that allow the transformer output to be reconfigured from the rear of the PDU. To access the busbar taps, the PDU shall require 36" rear or side service clearance or the PDU must be moved to reconfigure the taps.

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The following feature shall not be available with the Multi-Output Transformer Option:

- Conventional transformer taps

2.2.2 Transformer Temperature Monitoring

The standard transformer shall have six (6) thermal overload devices to monitor core temperature in each winding.

The first set of thermal devices shall be calibrated to 180°C, the warning threshold. If any winding reaches 180°C core temperature, the thermal overload protection device shall close a set of contacts for remote annunciation of a potential over-temperature condition.

The second set of thermal devices shall be calibrated to 195°C, the shutdown threshold. If any winding reaches 195°C core temperature, the thermal overload protection device shall close a set of contacts for remote annunciation of an over-temperature condition and will initiate an automatic PDU shutdown.

2.3 Power Configurations

2.3.1 Input Power

Each PDU shall have a 600V, 480V, or 400V thermal-magnetic main input circuit breaker with optional electronic trip. The breaker shall be manually operated and sized in compliance with NEC 2014.

The main input breaker shall have these kAIC ratings:

- 600V at 22 kAIC
- 480V at 35 kAIC
- 400V at 35 kAIC

The main input bus shall also be compatible with a main lug only (MLO) power feed—that is, without a main breaker.

The ground conductor shall connect to an insulated ground busbar.

The main input circuit breaker shall be available as 80%-rated or 100%-rated.

2.3.2 Distribution Output Sections

Distribution Output Sections shall be available in the following configurations:

- Main Cabinet : one front-facing section
- 24" Side Car: one front-facing section and/or one side-facing section
- 12" Side Car: one side-facing section

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Each frame's Distribution Output Section shall have separate top and bottom output modules or a full-section combined (top and bottom) output module. The full-section module is for larger components. A module shall contain a panelboard or a set of subfeed circuit breakers. Standard circuit breakers are 80% rated; 100% rated circuit breakers are also available.

A single top module or bottom module shall consist of a 42-pole panelboard or a set of subfeeds, including the following as options:

- Square D 225A 42-pole NQ panelboard with Q-frame circuit breaker
- Square D 225A 42-pole NQ panelboard with J-frame circuit breaker
- Square D 400A 42-pole NQ panelboard with L-frame circuit breaker
- GE 225A 42-pole panelboard with circuit breaker
- Square D 225A J-frame (4 maximum)
- Square D 400A L-frame (2 maximum)
- Square D 600A L-frame (2 maximum)

The combination of top and bottom section options shall require approval by PDI Engineering and Manufacturing.

A full section module (top and bottom combined module for large components) shall consist of 84-pole panelboards, larger 42-pole panelboards, or a set of subfeeds, including the following as options:

- Square D 400A 84-pole NQ panelboard with L-frame circuit breaker
- Square D 225A 42-pole NF panelboard with J-frame circuit breaker
- Square D 400A 42-pole NF panelboard with L-frame circuit breaker
- GE 400A 120V/208V 42-pole panelboard with circuit breaker
- ABB 225A 42-pole Proline panelboard with circuit breaker
- ABB 400A 42-pole Proline panelboard with circuit breaker

Full section options shall require approval by PDI Engineering and Manufacturing.

Other panelboard and subfeed options may become available as approved by PDI Engineering and Manufacturing.

Distribution panelboards shall each be protected by a UL-listed and IEC-rated circuit breaker rated at 80% or 100% of the panelboard's rated amperage.

2.4 PDU Power Features

2.4.1 Emergency Power Off

The PDU shall contain an internally powered 120VAC shunt trip mechanism to operate a local Emergency Power Off (EPO) and to effectively interface with the WaveStar monitoring system. Each PDU shall have a common EPO circuit, designed to accept a normally open (NO) dry contact

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signal. A 24VDC remote shunt trip signal shall be available to interface with Remote Emergency Power Off (REPO) stations.

An optional EPO feature shall be available that provides a guarded illuminated EPO button positioned next to the operator display.

2.4.2 Manual Restart

The PDU shall contain a manual restart circuit to protect the connected load during a system restart sequence. A circuit shall be provided to allow this feature to be field-deactivated.

2.5 Color Monitor

The PowerPak 2 PDU shall mount a WaveStar® Color Monitor, a 7" diagonal color touchscreen on the front of the Monitoring compartment.

The Color Monitor shall be capable of displaying monitoring information from the PDU board, Contractor Board, and all distribution output subfeeds and panelboards.

2.5.1 Color Monitor Protocols

For network communications upstream of the Color Monitor, the Monitor shall communicate using any of the following protocols, which can be used simultaneously. Add-in cards shall not be necessary for the Monitor to communicate upstream in any of these protocols:

- Modbus RTU (2-wire or 4-wire)
- Modbus TCP/IP
- TCP/IP (for Color Monitor web pages)
- SNMP Version 1

For other than Modbus RTU, the Color Monitor shall require a customer Ethernet connection to the customer network.

2.5.2 Color Monitor Web Pages

If the unit has an appropriately configured Ethernet connection from the customer network to the Color Monitor, web pages showing BCMS monitoring data shall be available remotely using TCP/IP.

2.6 Contractor Boards

All Remote Emergency Power Off, building alarms, output relays, communication ports, and other control wiring shall be terminated onto a Contractor Board which is an integral component within the PDU system itself.

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2.6.1 Basic Contractor Board

All Remote Emergency Power Off, building alarms, output relays, communication ports, and other control wiring shall be terminated onto a Contractor Board which is an integral component within the PDU system itself. The Contractor Board shall contain the following:

- Remote emergency power off (REPO) connections
- Four Relay Contacts (NO contacts) (including summary alarm)
- Four Building alarm contacts
- Remote monitoring connection ports (Modbus RTU Protocol, RS-422/485)

2.6.2 Enhanced Contractor Board

The Enhanced Contractor Board shall contain, as a minimum the following:

- Remote emergency power off connections
- Eight Relay Contacts (NO contacts) (including summary alarm)
- Eight Building alarm contacts
- Remote monitoring connection ports (Modbus RTU Protocol, RS-422/485)
- Local monitoring of PDI approved devices (Modbus RTU Protocol, RS-422/485)

2.7 Optional Components

2.7.1 Surge Protective Device

As an optional feature, the PowerPak 2 PDU shall include a single Surge Protective Device (SPD) or Transient Voltage Surge Suppressor (TVSS) rated 100 kA or 200 kA on the input or output to the panelboard. The SPD shall comply with ANSI/UL1449 3rd edition and shall incorporate a remote signaling dry contact. SPD status lights shall be visible through the front input compartment door.

2.7.2 Current Transformers

For monitoring, the PowerPak 2 PDU shall optionally mount current transformer (CT) strips on the sides of the panelboards with high-accuracy 100A current transformers. The PowerPak 2 PDU shall also optionally mount appropriately sized CTs for the Main Input Circuit Breaker, transformer phases, output subfeeds, and main feeds to panelboards.

2.7.3 Branch Circuit Monitoring System

Each unit shall optionally mount BCMS PCBs, allowing monitoring of 42-pole or 36-pole panelboards with their main feeds or 84-pole panelboards or 72-pole IEC panelboard with their main feeds:

The following points lists (Modbus register maps) shall be available:

- Normal, allowing alarm customization for each individual panelboard circuit

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- KWH, allowing KWH accumulation for each individual panelboard circuit.
- IEC, formatted for IEC panelboards.
- Enhanced subfeeds (ESF), for output subfeeds.

The front door of the Monitoring compartment door shall have optional USB ports for software setup.

2.7.4 BCMS Panelboard Monitored Values

BCMS shall monitor the current and voltage of the main feeds and individual panelboard circuits if the correct optional CTs are installed. Measurements shall require installed CTs for current measurements and vary by installed BCMS points lists.

The Color Monitor shall display the following BCMS measurements and warning or alarms by circuit number or panelboard total for connected BCMS devices:

For Normal, KWH, and IEC points lists:

- Total panelboard current ABCNG
- Panelboard percent load, for user-specified maximum load value
- Total current both panelboards
- Panelboard voltage:
 - Line-to-neutral
 - Line-to-line
- Frequency
- Panelboard power measurements by phases ABC and total:
 - KW
 - KVA
 - KVAR
 - Power factor (PF)
 - KWH total since last reset
 - Individual circuit:
 - Circuit breaker amperage rating
 - Last current reading
 - Minimum current read
 - Maximum current read
 - Current on circuit has dropped to zero after reading minimum current
 - Warning outstanding on circuit
 - Alarm outstanding on circuit

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- In addition, the KWH and IEC points lists shall provide the following measurements by individual circuit:
 - KW
 - KVA
 - KVAR
 - Power factor (PF)
 - KWH total since last reset

Alarm values shall be set globally for panelboards and individual circuits. Warning values shall be set by default to 70% of circuit breaker rating. Alarms values shall be set by default to 80% of circuit breaker rating.

Alarm values for each individual panelboard circuit shall be user-adjustable if the Normal points list is used. Alarm values shall be adjustable through the USB setup application or through a Building Management System connected to the Color Monitor through an appropriate link.

2.7.5 BCMS Subfeed Monitored Values

The following shall be monitored and displayed for subfeed circuits with correctly installed CTs: circuit breaker size, current, minimum current, maximum current, KW, KVA, KVAR, power factor (PF), crest factor, percent load, THD, KWH, voltage, frequency, and various alarms and warnings.

2.7.6 Alarm Status

The Color Monitor shall display a count of outstanding alarms and warnings for its downstream devices on monitoring screens.

2.7.7 Dry Contacts

The PowerPak 2 PDU shall optionally provide the following dry contact alarms, if the specified device is installed:

- Color Monitor: Summary alarm, if an alarm or warning is outstanding for any downstream monitored device
- SPD (TVSS): Signal for SPD OK/Not OK.
- Auxiliary Contacts for subfeed circuit breakers.
- Subfeed circuit breaker trip alarms

2.7.8 Trapped Key Interlocks (Kirk Keys®)

As an optional feature, the PowerPak 2 PDU shall allow a make-before-break Trapped Key Interlock or Kirk Key Interlock system with a sync-check relay on dual input systems.

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3 Execution

3.1 Factory Witness Test

PDI shall allow the customer to witness the factory testing of each unit. The factory shall perform its standard witness test to demonstrate that the unit meets PDI's PowerPak 2 PDU specifications.

3.2 Certified Test Report

A certified factory test report shall be provided for each unit.

3.3 Installation

Customer shall be responsible for site preparation and correct installation of the PDU in accordance with provided product data, final shop drawings, and manufacturer's written recommendations and installation instructions.

3.4 Start-Up

A PDI-authorized representative shall validate correct installation and operation of the PDU at initial PDU start-up.