Eaton© PDI PowerHub 2 Power Distribution Unit 400-1125 kVA

Guide Specifications

Powering Business Worldwide

p/n: P-164001207
Revision 01

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Chapter 1 General

1.1 Summary

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

1.2 Standards

The PowerHub 2 PDU shall be listed to the applicable portions of Underwriters Laboratories standards UL 1062 (PDU Standard) and tested to UL 1950.

In addition, the PowerHub 2 PDU shall be designed, manufactured, tested, and installed in compliance with the following standards, guides and codes (As applicable):

- UL67
- UL50
- UL489
- UL891
- NFPA 70E
- IEEE 519-1991
- ANSI C33.4
- NEMA ST-20
- NEMA AB-1
- NEMA-PB-1
- NEC
- IBC 2010, seismic zone 4, California standard
- ISO 9001
- UL1062

1.3 System Description

1.3.1 Environmental Requirements

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

- Acceptable temperature ranges:
  - Storage temperature shall be between -10ºC and 40ºC (-33ºF to 104ºF).
    - For Storage Temperature outside the standard range contact Eaton.
  - Operating temperature shall be between 0ºC and 40ºC (32ºF to 104ºF).
    - Per ANSI/IEEE C57.12.01 - The temperature of the cooling air (ambient temperature) shall not exceed 40ºC, and the average temperature of the cooling air for any 24 hour period shall not exceed 30ºC.
- Relative humidity range from 0% to 95% non-condensing.
- Operating altitude to a maximum of 1,000m (3,300 ft.) For operating the PDU at altitudes over 1,000m (3,300 ft.), the user shall consult the Eaton factory for further information.

- Storage and transport altitude: Up to 12,200m (40,000 ft.) above Mean Sea Level.
- Audible noise: The audible noise level shall comply with the NEMA-ST20 standard.

1.3.2 Electrical Requirements

The PDU has a kVA rating between 400 - 1,250 kVA.

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

The PDU shall accept a 3-phase, 3-wire (plus ground) input voltage source from among these standard voltages:

- @ 50 Hz: 380V-415VAC
- @ 60 Hz: 600, 575, 480, or 208VAC

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

- @ 50 Hz: 415/240VAC, 400/231VAC or 380/220VAC
- @ 60 Hz: 600/346 VAC, 575/332 VAC, 480/277 VAC, 415/240VAC or 208/120VAC

However, if the Multi-Output Transformer Option is installed, the PDU shall be reconfigurable in the field to an output voltage selected from up to three of these voltages at 60 Hz: 480/277, 415/240VAC (or 400/230VAC) or 208/120VAC.

Non-standard input and output voltage options will be available per request.

1.4 Documentation

1.4.1 Drawings

PowerHub 2 PDU one-line electrical drawings and outline or a set of mechanical drawings shall be furnished after Eaton receives a Purchase Order. For quoting prospective sample preliminary submittal drawings with features for 400-1,250 kVA PDUs shall be available.

1.4.2 Installation and Operations Documentation

A *PowerHub 2 Power Distribution Unit, Installation and Operation* manual shall be furnished. Points lists (Modbus register maps) for monitoring the PDU board (including the source main input feed, transformer, and contractor board) and output subfeeds shall be available from Eaton.

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 Eaton functions, such as Service and Accounting, shall be provided.

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 Eaton PowerHub 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 certified.

The Eaton PowerHub 2 PDU shall be factory tested before shipment. Testing shall include at minimum:

- Quality control checks specific to the unit and its configuration, including functional testing to determine that the unit as designed.
- Hi-Potential Test at two times the unit's rated voltage plus 1000 volts, per IEEE C57.12.91 requirements.
- Calibration tests for monitoring.
- Tests for alarm annunciation as designed and/or as the customer requests.
- Optional burn-in testing per customer request.

Chapter 2 Product

2.1 Components: Enclosure

2.1.1 Enclosure Specification

The PDU shall consist of a main cabinet enclosure alone.

The main cabinet enclosure shall be constructed in a modular configuration to NEMA-1 standards and shall meet IP20 requirements.

Enclosure dimensions

The cabinet enclosure dimensions will be the following:

- 60" W x 84" H x 40" D for 400 kVA, if the PDU has the standard transformer.
- 60" W x 84"H x 42" D for 500 kVA, if the PDU has the standard transformer.
- 60" W x 84"H x 48-50"D for 625 – 750 kVA, if the PDU has the standard transformer.
- 86" W x 84"H x 56"D for greater than 750 kVA, if the PDU has the standard transformer.
- Cabinet depth may vary up to 56"D, if required by specific transformer specifications, such as K factor, temperature rise, inrush, impedance, or aluminum windings.

Enclosure weights

- The PDU weight shall depend upon the cabinet size and transformer specifications.
- A typical 500 kVA PDU will weigh approximately 3800 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.

Paint

The cabinet enclosure shall be primed and painted inside and out with a suitable powder coat enamel. The paint color shall be PDI Black or IBM Pearl White (Sherwin Williams PHTI-60016) or "computer hardware off-white" to match other Eaton PDI equipment in appearance, especially the Eaton PDI WaveStar® Static Transfer Switch. Customer may specify alternate color(s) that must be reviewed and approved by Eaton Engineering.

Enclosure modifications

Line and match requirements with static switches shall be met through modification of the static switch enclosure.

2.1.2 PDU Access

Front access only

The PDU shall require only front access for service and all routine maintenance unless the PDU has the Multi-Output Transformer Option.

- Adding or replacing input and output power distribution cables and circuit breakers shall require only front access.
- Wiring communications or replacing components in the Monitoring Compartment shall require only front access.
- The Fuse Panel shall be front-accessible.
- Standard transformer taps shall be adjustable from the front of the PDU.

Rear access

If the PDU has the Multi-Output Transformer Option, 36" rear service access shall be required to change large bus bar transformer taps.

Doors and physical access controls

The PDU shall have the following physical access controls:

- Front doors with lock.
- A **Monitoring Compartment** on the PDU left front door that is accessible by its own lockable door. The Monitoring Compartment shall contain low-power monitoring components segregated from high-power components in the Main Cabinet.
- Circuit breaker access controls:
  - All circuit breakers and switches shall be mounted behind closed doors. The PDU shall have exterior hinged circuit breaker cover doors with transparent windows for main input, optional main output, and distribution subfeed circuit breakers.
  - Each circuit breaker compartment shall be lockable.
  - The PDU shall have dead front panels over the output subfeed circuit breakers. The dead front panels shall allow screw-on plates to cover unused breakers positions.

Panels

All removable PDU panels shall:

- Use non-captive screws and shall either lift off or incorporate ¼ turn latches.
- Incorporate a maximum vent hole size of .44″ x 2″ (UL1062 and UL891).
- Provide minimum 4″ clearance to live components.

Clearances

The PDU shall require the following clearances:

- Service clearances:
  - Front: 36" (service, including ventilation).
  - Rear or side: 36" service clearance shall be required only if the Multi-Output Transformer Option is installed.
- Ventilation clearances:
  - 6" both rear and one side minimum.
  - 18" top.
- Cabling clearance: 12" underfloor clearance recommended if bottom cable entry or exit is used.

2.1.3 Mounting Options

The PDU shall be suitable for installation on both fixed floor or on a floor stand in a raised floor environment. The cabinet shall allow mounting on a 12″ to 60" high floor stand to match 12″ to 60" high raised flooring.

The PDU alone or the PDU with floor stand shall conform to seismic zone four requirements, California standard, per IBC 2010.

- A skirt or kick plate providing air closure around the PDU shall be available as an option.

2.2 Components: Electrical Construction

All wiring shall be rated per applicable NRTL Standard and conform to the National Electrical Code (NEC).

The PDU shall include a computer grade single point ground in accordance the requirements of the NEC. Each distribution output section shall have a ground bus bar for distribution output subfeeds.

The PDU shall have a copper bus connection with 200% neutral that is connected to the transformer and bolted to the PDU bus, which can be implemented variously, as follows:

- All 200% neutral can be on one side of the transformer.
- Both sides of the transformer can each allow 100% neutral.
- Both sides of the transformer can each allow 200% neutral (optional).

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

Cable landing

The PDU shall allow both top and bottom cable input and output on the front half of the cabinet. Top and bottom cable landing panels shall be removable. The top cable landing panel shall be solid plate painted and not pre-punched. Bottom panels shall be solid plate galvanized, not pre-punched, and shall not be painted. If aluminum conductors are used, there may be limitations on conduit.

If the PDU is configured as part of a Primary System with a WaveStar® Static Transfer Switch (STS), side cable access to the Static Transfer Switch shall be provided.

2.3 Components: Transformer

The PDU shall be fed from an integral 3-phase, copper-wound or optionally aluminum-wound, standard isolation transformer rated between 400 kVA and 1,250 kVA. The transformer shall be specifically designed for the PDU will have electrostatic shielding.

2.3.1 Standard Transformers

Standard transformers shall be available with K-factor rating of K9 that comply with DOE2016 efficiency requirements. Other as applicable transformers shall be available with the specifications and options shown in Table 1.

Table 1. Standard Transformer Specifications and Options

Parameter	Standard Transformer	Options
Input Voltage	480V Delta	208 – 600V
Output Voltage[1]	208 /120V Wye	208 – 600V
Frequency	60 Hz	50 Hz
Impedance	2.5 – 5%	Custom (6-8%)
Efficiency	DOE2016 (USA)	Non-DOE2016 as applicable, CEC, CSA, TP1 (CSA), NEMA Premium, or the highest efficiency international standard
K-Factor	K9	K4, K13, K20
Conductor Material	Copper (CU)	Aluminum (AL)

Table 1. Standard Transformer Specifications and Options (Continued)

Parameter	Standard Transformer	Options
Inrush	8 – 10x	5x
Taps[2]	400-500 kVA: ±2 x 2.5-3.5% 625-750 kVA: ±1 x 2.5-3.5% >750 kVA – No Taps	No taps; custom taps available, percentage subject to physical location
Temperature Rise	150ºC	80ºC, 115ºC, 130ºC
Vector	Delta-Wye	Delta Zig-Zag Delta Quad-Wye
Average sound level	NEMA ST-20	NEMA ST-20
Applicable Standard	UL-1561, UL1062 as applicable IEEE Standard C57.12.01	IEC 60076, CSA22.2 No 66, CEC 400
Insulation	Class 240S	
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.		

2.3.2 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

PDUs 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.

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

- Conventional front-accessible transformer taps
- Manual Dual PDU Option

2.3.3 Transformer Temperature Monitoring

The standard transformer shall have two (2) thermal overload devices to monitor temperature.

The first set of thermal devices shall be set to 180ºC, the warning threshold. The thermal overload protection device shall close a set of contacts for remote annunciation of a potential over-temperature condition, when thermal device threshold is met.

The second set of thermal devices shall be set to 200ºC, the shutdown threshold. The thermal overload protection device shall close a set of contacts for remote annunciation of a potential over-temperature condition, when thermal device threshold is met.

2.4 Power Configurations

2.4.1 Main Input Circuit Breaker

Each PDU shall have a 600V, 480V, or 400V thermal-magnetic main input circuit breaker with optional electronic trip. The circuit breaker shall be manually operated and sized in compliance with the NEC. The main input circuit breaker shall be available as 80%-rated or 100%-rated.

The main input circuit breaker shall be rated for different transformer sizes and input voltages as given in the following table:

kVA	CB @ 400VAC	CB @ 480VAC	CB @ 600VAC
400	800A	700A	500A
500	1000A	800A	700A
625	1200A	1000A	800A
750	1600A	1200A	1000A
1000	2500A	1600A	1000A
1125	Call Factory	1600A	1200A
1250	Call Factory	1600A	1600A

The main input circuit breaker shall have these kAIC ratings:

- 600V at 22 kAIC
- 480V at 35 kAIC
- 400V at 35 kAIC
- 380V at 35 kAIC

2.4.2 Input Power

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

The input AC voltage termination from the main input to the transformer primary shall be welded or cabled and shall be accessible from the front of the PDU. The input interrupting current rating shall support up to 65 kAIC at 480VAC.

The ground conductor shall connect to an insulated ground busbar.

2.4.3 Extended Input Bus Option

The PDU shall optionally have an Extended Input Bus, allowing input power connections with double-hole compression lugs and top and bottom connections to the Extended Input Bus.

2.4.4 Transformer Output Circuit Breaker

An optional output circuit breaker off the transformer secondary shall be available, as may be required by the NEC with six or more distribution subfeeds. The standard output circuit breaker shall be a 3-pole circuit breaker rated at 80 percent for up to 600 VAC with interrupting ratings of 65 kAIC@240 VAC, 35 kAIC@400-480VAC, and 18 kAIC@600VAC. Other circuit breakers shall be available that are sized appropriately for the PDU with 80 or 100 percent ratings, various trip options, and various kAIC ratings.

2.4.5 Distribution Output (Subfeeds)

The main output bussing shall be designed for minimum 65 kAIC at 240VAC or 35 kAIC at 400-480VAC. Output circuit breakers shall be available with the minimum kAIC ratings at 240VAC and 480VAC.

Output subfeed circuit breakers shall have these characteristics:

- Output subfeed circuit breakers shall be configured in two columns and shall be of the same frame type throughout both columns.
- Output subfeed circuit breakers shall be offered in 80% ratings (standard) and 100% ratings (optional).
- Electronic trip circuit breakers shall be used where available (see tables below for exceptions).
- Output subfeed circuit breakers shall be available with optional control wiring for these features:
  - Auxiliary status
  - Trip alarm
  - Shunt trip
- The PDU distribution output (subfeed) circuit breakers used in the PDU shall be manufactured by ABB, Eaton, Schneider Electric / SquareD, Siemens or other brands as approved. The PDU shall accommodate frame types and sizes of breakers.

The number of subfeed circuit breakers that can be installed in the PDU per frame type is given in the following tables along with amperage and kAIC ratings (the values in these tables are for copper conductors unless otherwise noted):

Circuit Breaker Frame	ABB XT4, Eaton Power Defense Frame 2, SquareD J-Frame, Siemens VL 25/65/100 kAIC			
Amps	150	175	225	250
Circuit Breaker Quantity	16	16	16	16

Circuit Breaker Frame	ABB T5, Eaton Power Defense Frame 3, SquareD L-Frame, Siemens VL 25/65/100 kAIC			
Amps	250	400	500	600
Circuit Breaker Quantity	12	12	12	9

Circuit Breaker Frame	ABB T6, Eaton Power Defense Frame 4, SquareD M-Frame (Thermal Magnetic Only), Siemens VL 25/65/100 kAIC			
Amps	500	600	700	800
Circuit Breaker Quantity	6	6	6	6

Circuit Breaker Frame	ABB T7, Eaton Power Defense Frame 5, SquareD P-Frame, Siemens VL 25/65/100 kAIC			
Amps	600	800	1000	1200
Circuit Breaker Quantity	4	4	4	4

2.5 PDU Power Features

2.5.1 Emergency Power Off

The PDU shall contain an internally powered 120VAC or 24VDC shunt trip mechanism to operate a local Emergency Power Off (EPO) and effectively interface with the WaveStar® monitoring system. Each PDU shall have a common EPO circuit, designed to accept a normally open (NO) dry contact signal.

A 24VDC, 24VAC, or 120VAC 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.

2.5.2 Manual Restart

The PDU shall contain a manual restart circuit to protect the connected load during a system restart sequence. A switch shall be provided to allow this feature to be set in the field for manual or automatic restart.

2.6 Optional Power Features

2.6.1 Manual Dual PDU

The PDU shall optionally allow manual switching between two input power sources using a make-before-break Trapped Key Interlock or Kirk Key Interlock system with a sync-check relay. The Manual Dual PDU Option shall also allow a secondary dry contact signal that remotely enables the synchronization and switching process.

2.6.2 Surge Protective Device(s)

The PDU shall optionally include a single Surge Protective Device (SPD) or Transient Voltage Surge Suppressor (TVSS) rated 100 kA or 200 kA on the input or output. The SPD shall comply with ANSI/UL1449 3rd edition and shall incorporate a remote signaling dry contact. SPD status lights shall also be visible through the front door. Only one SPD shall be allowed per PDU.

2.7 Monitoring

The PDU shall incorporate an Eaton PDI WaveStar® Monitoring package that can interface to the Eaton PDI WaveStar® Color Monitor, a Building Management System (BMS), or an independent WaveStar® monitor such as a BCMS Hub. The customer may optionally choose no on-board display.

2.7.1 Color Monitor

The PDU shall mount an Eaton WaveStar® Color Monitor, a 7" diagonal color touchscreen on the front of the Monitoring Compartment.

The touchscreen shall be capable of displaying monitoring information from the main input power source, transformer, PDU Board, Contractor Board, and all distribution subfeeds. Monitoring information shall include circuit measurements, alarm display, alarm clearing, audible alarm, and audible alarm silencing. The touchscreen shall also include a sync screen for trapped key release with the Manual Dual PDU Option.

With the touchscreen, the PDU shall also have an annunciation panel with audible alarm and summary alarm indicator showing no alarms, warning condition, or alarm condition.

2.7.2 Monitoring Protocols

For network communications upstream of the touchscreen, the platform shall communicate using any of the following protocols, which can be used simultaneously:

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

Add-in cards shall not be necessary for the Color Monitor to communicate upstream in any of these protocols.

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

2.7.3 Monitor Web Interface

If the PDU has an appropriately configured Ethernet connection from the customer network to the Monitor, a web browser showing PDU monitoring data and optional monitoring data for subfeeds shall be available remotely using TCP/IP.

2.7.4 Monitoring PCBs

The PDU shall monitor the transformer and input or output circuits using the following installed PCBs with appropriate current transformer and voltage connections:

- (1) PDU board allowing monitoring input and output from the transformer and voltage connections (standard).
- (1) Basic Contractor Board (standard) or Enhanced Contractor Board (optional).
- Enhanced Subfeed ("Resistor") Boards allowing large subfeeds to be monitored (14 ABC circuits, or 10 ABCN circuits), provided as needed (with optional BCMS subfeed monitoring).
- (1) or (2) Branch Circuit Monitoring System (BCMS) boards as necessary to monitor PDU subfeeds (with optional BCMS subfeed monitoring).

The monitored data points are those included in the points list or Modbus register maps selected for the PCB's and measured with current transformers (CTs) and voltage connections.

2.7.5 Current Transformers

For monitoring, the PDU shall mount appropriately sized current transformers (CTs) for the transformer secondary phases. Appropriately sized CTs shall be optional on the transformer primary side. The PDU shall also optionally mount appropriately sized CTs for output subfeeds.

2.7.6 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.

The Basic Contractor Board shall contain at the minimum the following:

- Remote emergency power off (REPO) connections
- Four (4) Relay Contacts (NO contacts) (including summary alarm)
- Four (4) Building alarm contacts
- Remote monitoring connection ports (Modbus RTU Protocol, RS-422/485)

The optional Enhanced Contractor Board shall contain at the minimum the following:

- Remote emergency power off (REPO) connections
- Eight (8) Relay Contacts (NO contacts) (including summary alarm)
- Eight (8) Building alarm contacts
- Remote monitoring connection ports (Modbus RTU Protocol, RS-422/485)
- Local monitoring of PDI devices (Modbus RTU Protocol, RS-422/485)

2.7.7 Branch Circuit Monitoring System for Subfeeds

A Eaton WaveStar® Branch Circuit Monitoring System (BCMS) shall be optionally available for monitoring distribution subfeeds. The following shall be monitored 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, total harmonic distortion (THD), KWH, voltage, frequency, and various alarms and warnings.

2.7.8 Points Lists

Points lists (Modbus register maps) shall be available from Eaton.

2.7.9 Dry Contacts

The PDU shall have at a minimum a dry contact network providing input and output signals as given below, if the specified device is installed:

Output:

- Monitor: Summary alarm, if an alarm is outstanding for any downstream monitored device.
- PDU Contractor board: 4-8 remote relays with assignable meaning (Enhanced Contractor Board required for > 4 remote relays)
- Surge Protective Device: SPD OK/Not OK signal.
- Subfeed Circuit Breakers: Breaker trip alarm, auxiliary contacts signaling change of breaker state.

Input:

- PDU: Four (4) digital inputs with assignable meanings.
- PDU and Contractor Board: 4-8 Building Alarms (Enhanced Contractor Board required for > 4 Building alarms)
- Subfeed circuit breakers: Circuit breaker trip signal.

Chapter 3 Execution

3.1 Factory Witness Test

Eaton 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 Eaton PDI's PowerHub 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, a pursuant to local codes and regulations.

3.4 Start-Up

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

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