

# **Dell EMC PowerMax Family Best Practices Guide for AC Power Connections**

PowerMax 2000 and PowerMax 8000

## Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.


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# Preface

As part of an effort to improve its product lines, Dell EMC periodically releases revisions of its software and hardware. Functions that are described in this document may not be supported by all versions of the software or hardware. The product release notes provide the most up-to-date information about product features.

Contact your Dell EMC representative if a product does not function properly or does not function as described in this document.

 **NOTE:** This document was accurate at publication time. New versions of this document might be released on Dell EMC Online Support (<https://www.dell.com/support/home>). Check to ensure that you are using the latest version of this document.

## Purpose

This document describes best practices for connecting AC power to the following PowerMax arrays:

- PowerMax 2000
- PowerMax 8000

## Audience


This document is intended for customers who are installing a PowerMax array and must assure that fault tolerant AC power is supplied to the arrays from independent, customer-supplied, power distribution units (PDUs).

## Related documentation

<b>Dell EMC PowerMax Family Product Guide</b>	Provides information about PowerMax 2000 and 8000 arrays with PowerMaxOS 5978.
<b>Dell EMC PowerMax Family Site Planning Guide</b>	Provides planning information regarding the purchase and installation of a PowerMax 2000, 8000 with PowerMaxOS.
<b>PowerMaxOS 5978.144.144 Release Notes for Dell EMC PowerMax and All Flash</b>	Describes new features and any limitations.
<b>Dell EMC PowerMax Family Security Configuration Guide</b>	Shows how to securely deploy PowerMax arrays running PowerMaxOS.

## Special notice conventions used in this document

Dell EMC uses the following conventions for special notices:

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

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 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

## Typographical conventions

Dell EMC uses the following type style conventions in this document:

**Table 1. Typographical conventions used in this content**

<b>Bold</b>	Used for names of interface elements  Examples: Names of windows, dialog boxes, buttons, fields, tab names, key names, and menu paths (what the user selects or clicks)
<i>Italic</i>	Used for full titles of publications referenced in text
Monospace	Used for: <ul style="list-style-type: none"><li>• System code</li><li>• System output, such as an error message or script</li><li>• Pathnames, filenames, prompts, and syntax</li><li>• Commands and options</li></ul>
<i>Monospace italic</i>	Used for variables
<b>Monospace bold</b>	Used for user input
[ ]	Square brackets enclose optional values.
	A vertical bar indicates alternate selections. The bar means "or".
{ }	Braces enclose content that the user must specify, such as x or y or z.
...	Ellipses indicate nonessential information that is omitted from the example.

## Where to get help

EMC support, product, and licensing information can be obtained as follows:

<b>Product information</b>	Dell EMC technical support, documentation, release notes, software updates, or information about Dell EMC products can be obtained at <a href="https://www.dell.com/support/home">https://www.dell.com/support/home</a> (registration required) or <a href="https://www.dellemc.com/en-us/documentation/vmax-all-flash-family.htm">https://www.dellemc.com/en-us/documentation/vmax-all-flash-family.htm</a> .
<b>Technical support</b>	To open a service request through the Dell EMC Online Support ( <a href="https://www.dell.com/support/home">https://www.dell.com/support/home</a> ) site, you must have a valid support agreement. Contact your Dell EMC sales representative for details about obtaining a valid support agreement or to answer any questions about your account.

## Your comments

Your suggestions help improve the accuracy, organization, and overall quality of the documentation. Send your comments and feedback to: [VMAXContentFeedback@emc.com](mailto:VMAXContentFeedback@emc.com)

# Revision history

**Table 2. Revision history**

Revision	Description and/or change	Date released
7.0	Added 32A circuit breaker voltage for international power connections	March 2021
6.0	Modified figure titles for PowerMax 2000	March 2020
5.0	Clarified AC power specifications.	September 2019
4.0	Added information on line cord power zone labels.	June 2019
3.0	Updated PDU label for PowerMax.	June 2018
2.0	Updated Procedure A, Task 2 for PowerMax 2000.	May 2018
1.0	First release of the <i>Dell EMC Best Practices Guide for AC Power Connections for PowerMax 2000, 8000 with PowerMaxOS</i> .	May 2018

# Best Practices Guide for AC Power Connections

**Topics:**

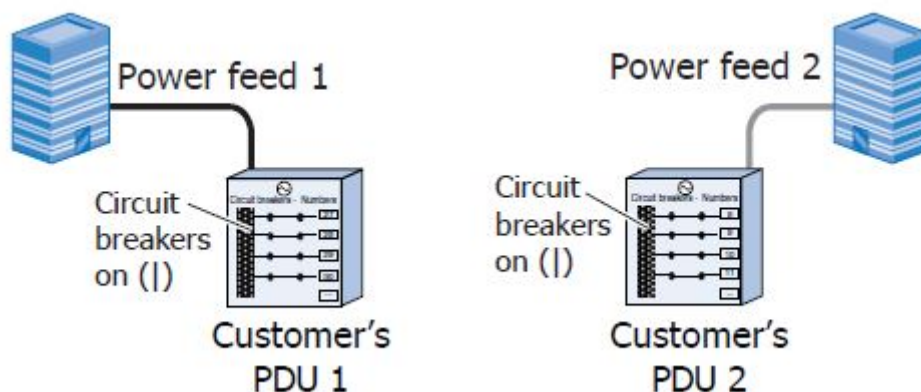
- [Best practices overview for AC power connections](#)
- [Selecting the proper AC power connection procedure](#)
- [Procedure A: Working with the customer's electrician onsite](#)
- [Procedure B: Verify and connect](#)
- [Procedure C: Obtain customer verification](#)
- [PDU labels](#)
- [AC power specifications](#)

# Best practices overview for AC power connections

To assure fault tolerant power, external AC power must be supplied from independent, customer-supplied, power distribution units (PDUs) as shown in [Two independent customer-supplied PDUs](#) on page 8.

For systems operating from three phase AC power, two independent and isolated AC power sources are recommended for the two individual power zones in each rack of the system. This provides for the highest level of redundancy and system availability. If independent AC power is not available, there is a higher risk of data unavailability should a power failure occur, including individual phase loss occurring in both power zones.

Before connecting external AC power to storage bays, verify that the bays have been placed in their final position as explained in the installation guide.



**Figure 1. Two independent customer-supplied PDUs**



# Selecting the proper AC power connection procedure

The Dell EMC Customer Engineer must select the proper AC power connection procedure.

The following table summarizes the three possible scenarios to connect customer AC power to the storage array. Select the procedure that matches the customer's situation.

**Table 3. Procedure options for AC power connection**

Situation on site	Procedure
The customer's electrician is available at the installation site.	<a href="#">Procedure A: Working with the customer's electrician onsite</a> on page 10. This procedure assures fault tolerant power in the storage array.
The customer's electrician is NOT available at the installation site, but you have access to customer-supplied, labeled, power cables (beneath a raised floor or overhead).	<a href="#">Procedure B: Verify and connect</a> on page 18
The customer's electrician is NOT available at the installation site, customer-supplied PDU source cables are already plugged into the PDU and you have no access to the customer-supplied power cables.	<a href="#">Procedure C: Obtain customer verification</a> on page 19

# Procedure A: Working with the customer's electrician onsite

Use this procedure if the customer's electrician is available at the installation site.

This procedure requires three basic tasks that alternate between the customer's electrician, the Dell EMC CE and back to the customer's electrician.

- Task 1: Customer's electrician
- Task 2: Dell EMC Customer Engineer (CE)
- Task 3: Customer's electrician

## Procedure A, Task 1: Customer's electrician

### About this task

**NOTE:** This task is performed by the customer's electrician.

### Steps

1. Verify that the customer-supplied AC source voltage output on each customer-supplied PDU is within the AC power specification shown in [AC power specifications](#) on page 21. Measure the voltage output of each power cable as shown in [Circuit breakers ON — AC power within specification](#) on page 11.
2. Turn **OFF** all the relevant circuit breakers in customer-supplied PDU 1 and customer-supplied PDU 2.
3. Verify that the customer-supplied power cables connected to PDU 1 and PDU 2 have no power as shown in [Circuit breakers OFF — No AC power](#) on page 11.

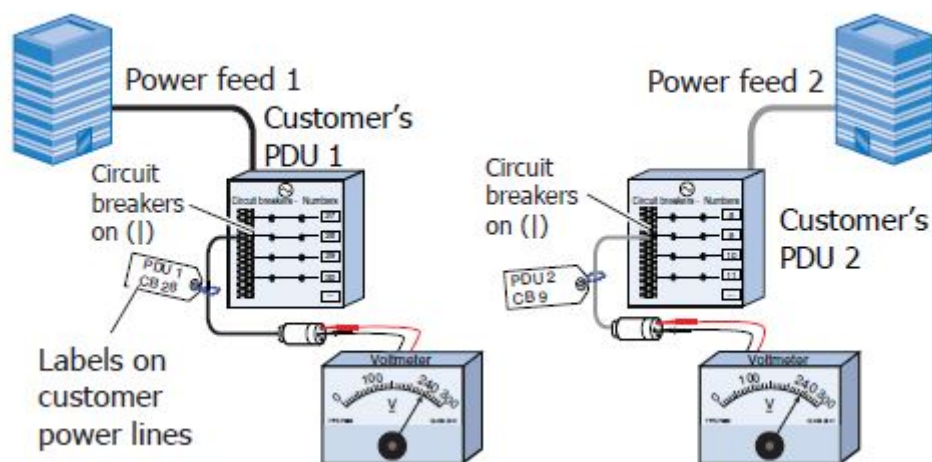


Figure 2. Circuit breakers ON — AC power within specification

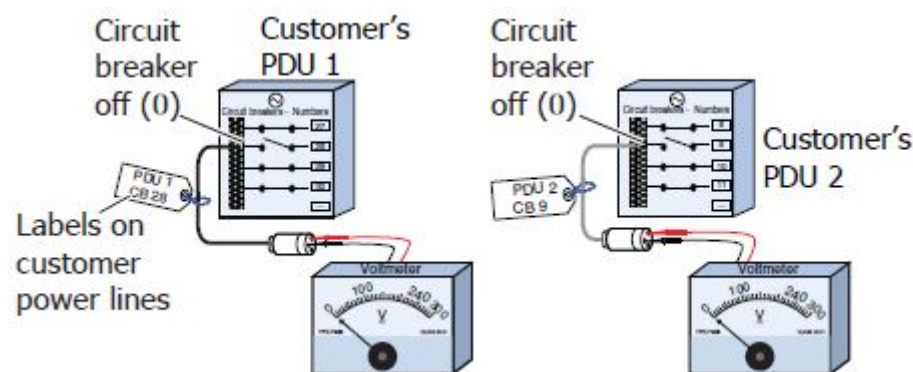


Figure 3. Circuit breakers OFF — No AC power

## Procedure A, Task 2: Dell EMC Customer Engineer

Before connecting power to the PowerMax system, make sure that the power for both zone A and zone B are turned OFF. This task is performed by the Dell EMC Customer Engineer.

**NOTE:** Do not connect storage bay power zone A and power zone B to the same customer-supplied PDU. The customer will lose power redundancy and risk Data Unavailability (DU) if the PDU fails or is turned off during a maintenance procedure.

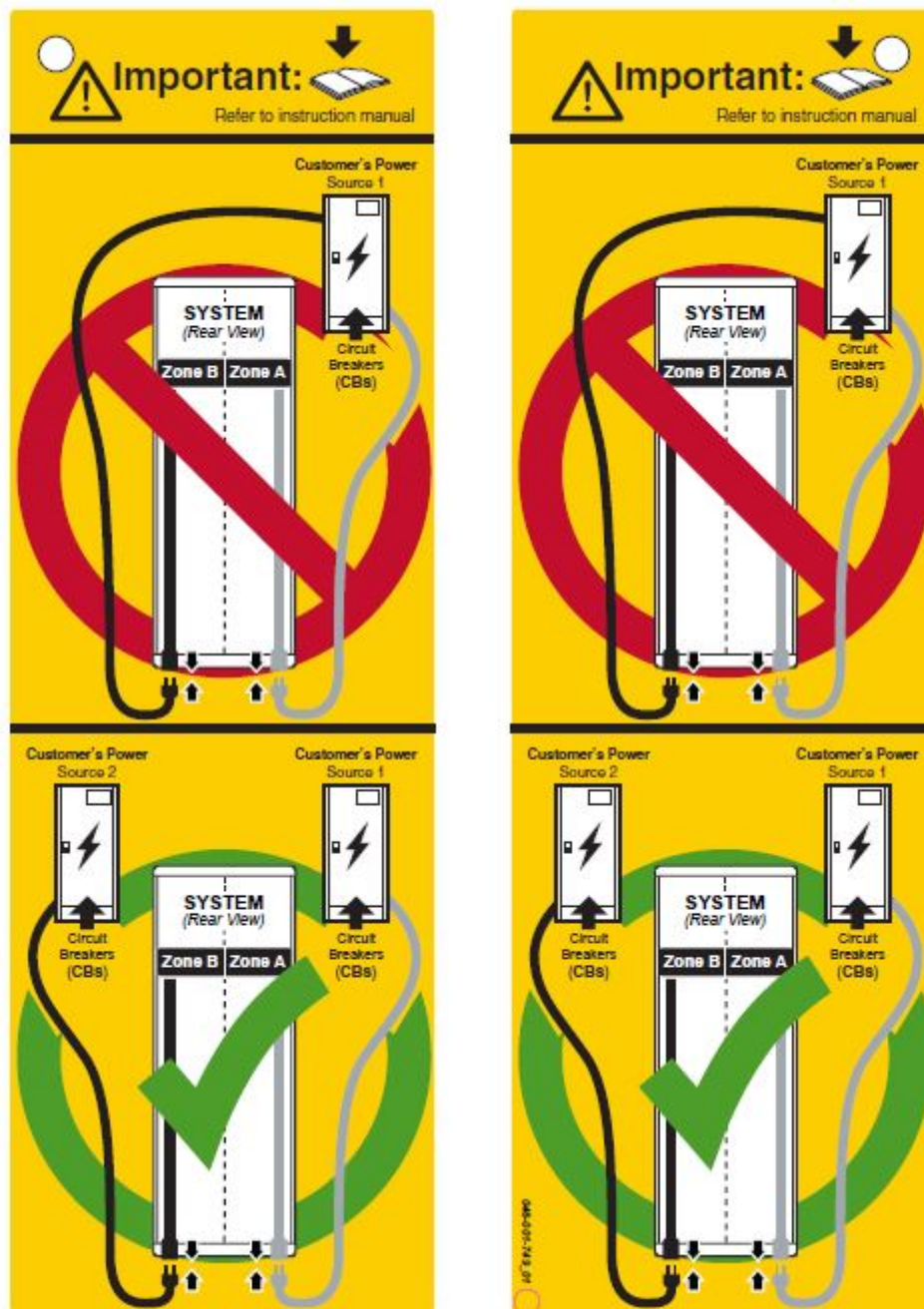


Figure 4. Power zone connections

## Attaching line cord identification labels

### Steps

1. Select the appropriate line cord identification label from the install kit.

**Table 4. Line cord identification label location, Dell EMC racks**

Label part number	Input power	Location
046-007-880	Single phase	OPEN ME FIRST KIT, PN 106-887-026
046-008-425	Three phase	

**Table 5. Line cord identification label location, third party racks**

Label part numbers	Input power	Location
046-007-880	Single phase	PowerMax 2000:
046-008-425	Three phase	HERC ENG 1 PBRICK 3RD PTY INSTALL KIT, PN 106-887-303
		PowerMax 8000:
		ENGINE 1 3RD PTY PBRICK ZEUS, PN106-887-268
		ENGINE 5 3RD PTY PBRICK ZEUS, PN 106-887-270

2. Locate the line cords that connect the customer power cables to the storage array PDUs.
3. Affix the line cord identification labels on the AC input line cords for power zone A and power zone B. Place the labels close to the connectors that connect the line cords to the customer-supplied power cables.



**Figure 5. Line cord identification label**

## Connecting power

### Steps

1. Confirm that the customer-supplied power cables are labeled and that each label contains the relevant customer-supplied PDU and circuit breaker numbers. If power cables are not equipped with labels, alert the customer.
2. Compare the numbers on the customer-supplied power cables for each storage bay to verify that power zone A and power zone B are powered by a different customer-supplied PDU.
3. Do one of the following to connect power zone A and power zone B in each bay:
  - For single-phase power: Connect customer-supplied PDU power cables to the storage bay by connecting to the bay's AC input line cords for power zone A and power zone B as shown below.

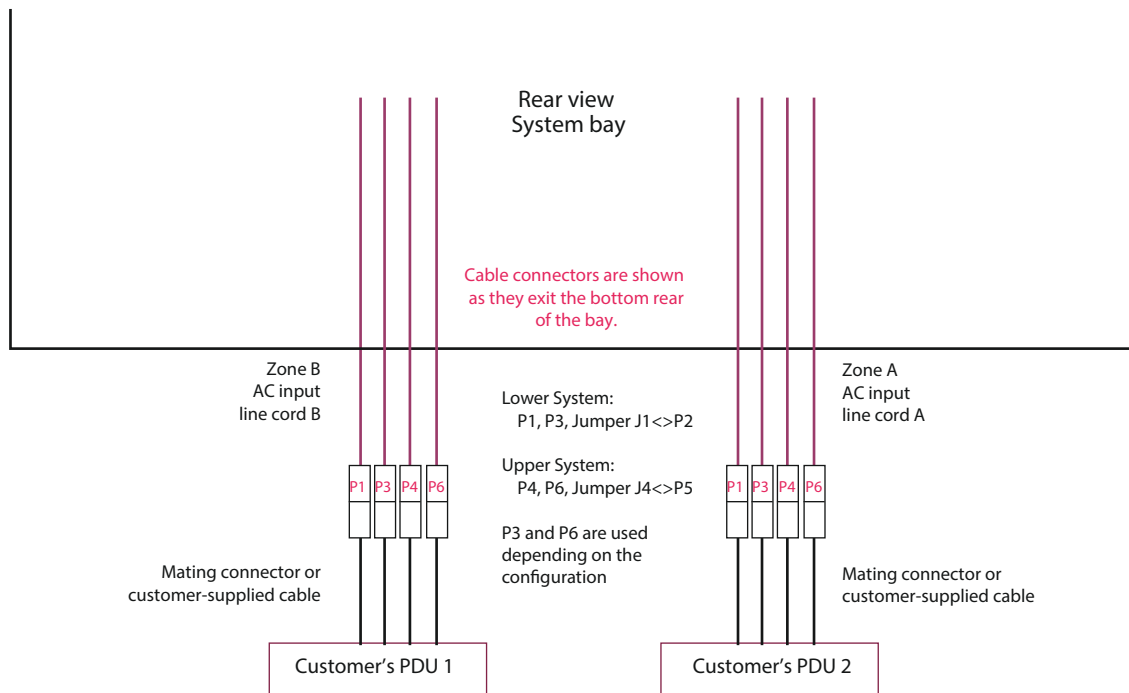
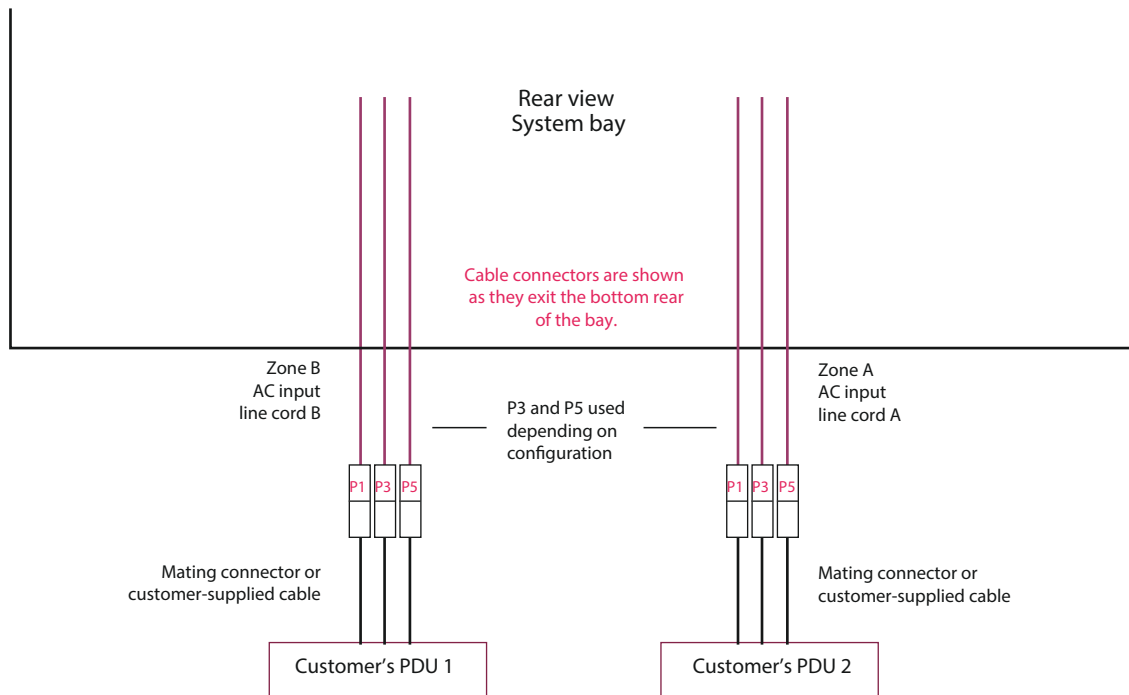
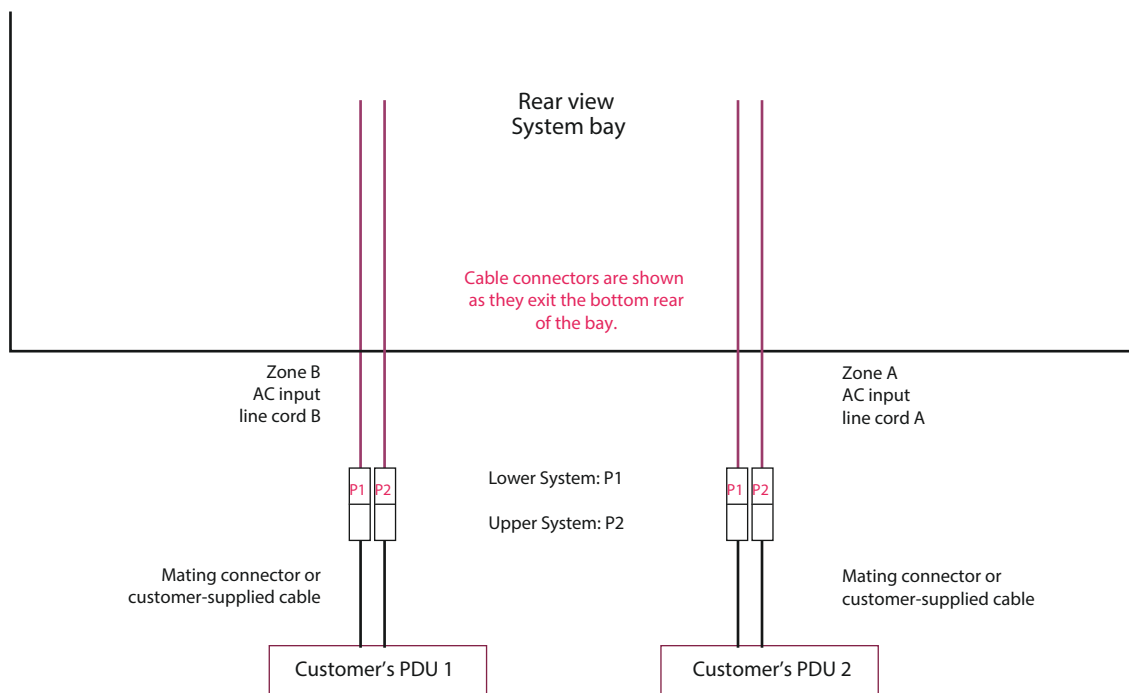


Figure 6. Connecting AC power, single-phase, PowerMax 2000, two dual-engine systems in a rack



**Figure 7. Connecting AC power, single-phase, PowerMax 8000**

- For three-phase power: Connect customer-supplied PDU power cables to the storage bay by connecting to the bay's AC input line cords for power zone A and power zone B as shown below.



**Figure 8. Connecting AC power, three-phase, PowerMax 2000, two dual-engine systems in a rack**

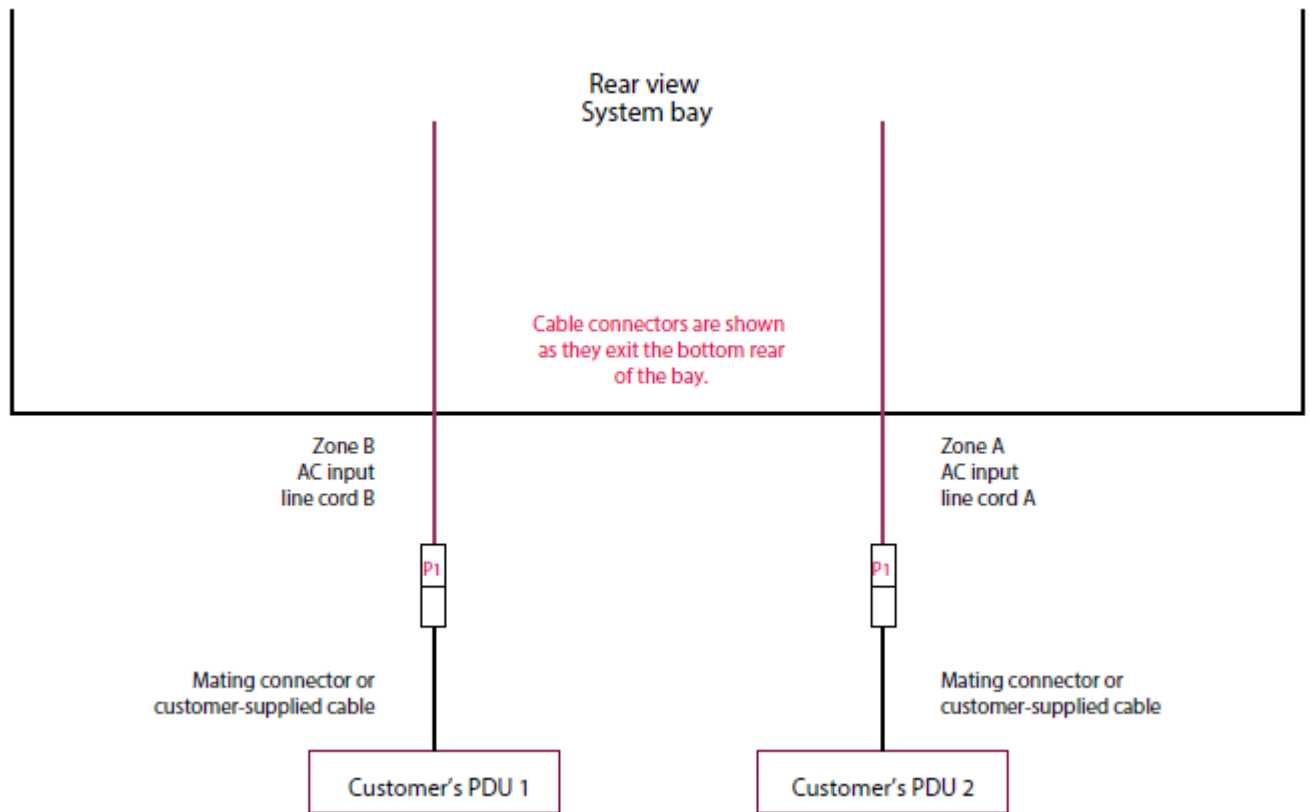



Figure 9. Connecting AC power, three-phase, PowerMax 8000





## Procedure A, Task 3: Customer's electrician

### About this task

 **NOTE:** This task is performed by the customer's electrician.

### Steps

1. Working with the Dell EMC Customer Engineer, turn ON all the relevant circuit breakers in customer-supplied PDU 2.  
Verify that only power supply and/or SPS LEDs in power zone A are ON or flashing green in every bay in the array.  
 **CAUTION:** The bay is incorrectly wired if all (power zone A and B) power supply and/or SPS LEDs in a bay are ON or flashing green. Check that the AC power to both storage bay power zones is not supplied by a single PDU (customer-supplied PDU 2). The wiring must be corrected before moving on to the next step.
2. Turn OFF the relevant circuit breakers in customer-supplied PDU 2.  
Verify that the power supply and/or SPS LEDs that turned green in the previous step changed from green to OFF and/or flashing yellow. The yellow SPS lights flash for a maximum of 5 minutes.  
 **NOTE:** Power supplies connected to an SPS continue to have green lights ON while the SPS yellow light continues to flash indicating the SPS is providing on-battery power.
3. Repeat step 1 and step 2 for power zone B and customer-supplied PDU 1.
4. Turn ON all the relevant circuit breakers in customer-supplied PDU 1 and customer-supplied PDU 2.
5. Label the PDUs as described in [Applying PDU labels](#) on page 19.


# Procedure B: Verify and connect

## About this task

Perform this procedure if the two conditions listed below are true:

- You have access to customer-supplied, labeled, power cables (beneath raised floor or overhead).
- The customer's electrician is not available at the installation site.

This procedure requires the Dell EMC Customer Engineer to verify that the customer's electrician has complied with power specifications. Once verified, the Dell EMC Customer Engineer makes the required power connections overhead or under the floor.

 **NOTE:** Utilize proper strain relief methods when customer-provided power drops are located overhead or wall-mounted.

## Steps

1. Have the customer verify that their electrician has complied with power specifications for voltage levels and redundancy. If the customer cannot verify this, provide them with a copy of Procedure A. Inform the customer that their array may prematurely shut down in the event of a site power issue.
2. Access the labeled, power cables (beneath raised floor or overhead) to verify that the customer-supplied power cables are properly labeled as shown in [Circuit breakers OFF — No AC power](#) on page 11 and described in Procedure A, Task 2.
3. Compare the numbers on the customer-supplied power cables for each storage bay to verify that power zone A and power zone B are powered by a different customer-supplied PDU.
4. Connect the customer's PDU AC cables to the storage bay power zones as described in Procedure A, Task 2.
5. Record the customer-supplied PDU information as described in Procedure A, Task 2.
6. Label the PDUs as described in [Applying PDU labels](#) on page 19.

# Procedure C: Obtain customer verification

## About this task

Perform this procedure if the three conditions listed below are true:

- The customer-supplied PDU source cables are already plugged into the storage bay PDU.
- You have no access to the area below the raised floor.
- The customer's electrician is not available at the installation site.

## Steps

1. Have the customer verify that their electrician has complied with power specifications for voltage levels and redundancy. If the customer cannot verify this, provide them with a copy of Procedure A. Inform the customer that their array may prematurely shut down in the event of a site power issue.
2. Record the customer-supplied PDU information (AC source voltage) as described in step 1 of [Procedure A, Task 1: Customer's electrician](#) on page 11 and label the PDUs as described in [Applying PDU labels](#) on page 19.

## PDU labels

Before applying labels to the sidewalls of the cabinet, one of the following procedures must have been completed:

- [Procedure A: Working with the customer's electrician onsite](#) on page 10
- [Procedure B: Verify and connect](#) on page 18
- [Procedure C: Obtain customer verification](#) on page 19

If necessary, see [Selecting the proper AC power connection procedure](#) on page 9 to select the correct procedure.

## PDU label part number

**Table 6. PDU label part number**

Part Number	Description
046-008-682	LABEL: CUSTOMER 1P 3P PDU INFO WRITEABLE

**Table 7. PDU label location, Dell EMC racks**

Product	Location
PowerMax 2000	OPEN ME FIRST KIT
PowerMax 8000	PN 106-887-026

**Table 8. PDU label location, third-party racks**

Product	Location
PowerMax 2000	HERC ENG 1 PBRICK 3RD PTY INSTALL KIT PN 106-887-303
PowerMax 8000	ENGINE 1 3RD PTY PBRICK ZEUS PN 106-887-268

## Applying PDU labels

### Steps

1. For each bay, locate and complete each PDU label. If necessary, modify the line cord numbers to match your configuration.

**NOTE:** For three-phase power, enter data only in the first column.

2. Place each label on the rear cabinet sidewall for side A and B.

Customer PDU Information			Customer PDU Information				
Power Zone A			Power Zone B				
	P1	P3	P5		P1	P3	P5
PDU				PDU			
Panel				Panel			
CB's				CB's			

Figure 10. PDU label , single-phase and three-phase

3. For third-party racks, do one of the following:
- For three-phase power: Using plastic ties, attach the PDU connection tag to the main AC power cable connected to zone A and B. Place the label close to the plug but on the side of the rack where it will not interfere with any rails.
  - For single-phase power: Using plastic ties, attach the PDU connection tag to the P1 AC power cable connected to zone A and B. Place the label close to the plug but on the side of the rack where it will not interfere with any rails.

# AC power specifications

**Table 9. Input power requirements - Single-phase, North American, International, Australian**

Specification	North American 3-wire connection (2 L & 1 G) <sup>a</sup>	International and Australian 3-wire connection (1 L & 1 N & 1 G) <sup>a</sup>
Input nominal voltage	200–240 VAC ± 10% L- L nom	220–240 VAC ± 10% L- N nom
Frequency	50–60 Hz	50–60 Hz
Circuit breakers	30 A	30/32 A
Power zones	Two	Two
Minimum power requirements per system at customer site	PowerMax 2000: Up to two 30 A or 32 A single-phase line cords per power zone for each system in a rack. PowerMax 8000: Up to three 30 A or 32 A single-phase line cords per power zone.	

a. L = line or phase, N = neutral, G = ground

**Table 10. Input power requirements - Three-phase, North American, International, Australian**

Specification	North American 4-wire connection (3 L & 1 G) <sup>a</sup>	International 5-wire connection (3 L & 1 N & 1 G) <sup>a</sup>
Input voltage <sup>b</sup>	200–240 VAC ± 10% L- L nom	220–240 VAC ± 10% L- N nom
Frequency	50–60 Hz	50–60 Hz
Circuit breakers	50 A	30/32 A
Power zones	Two	Two
Minimum power requirements at customer site	One 50 A three-phase line cord per power zone.	One 30 A or 32 A three-phase line cord per power zone.

a. L = line or phase, N = neutral, G = ground

b. An imbalance of AC input currents may exist on the three-phase power source feeding the array, depending on the configuration. The customer's electrician must be alerted to this possible condition to balance the phase-by-phase loading conditions within the customer's data center.