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As part of an effort to improve its product lines, Dell EMC periodically releases revisions of its software and hardware. Therefore, some functions described in this document might not be supported by all versions of the software or hardware currently in use. The product release notes provide the most up-to-date information on product features.

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Note
This document was accurate at publication time. New versions of this document might be released on Dell EMC Online Support (https://support.emc.com). 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

Dell EMC PowerMax Family Product Guide
Provides information on PowerMax 2000 and 8000 arrays with PowerMaxOS 5978.

Dell EMC PowerMax Family Site Planning Guide
Provides planning information regarding the purchase and installation of a PowerMax 2000, 8000 with PowerMaxOS.

PowerMaxOS 5978.144.144 Release Notes for Dell EMC PowerMax and All Flash
Describes new features and any limitations.

Dell EMC PowerMax Family Security Configuration Guide
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:

⚠️ DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
**WARNING**

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

---

**CAUTION**

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

---

**NOTICE**

Addresses practices not related to personal injury.

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**Note**

Presents information that is important, but not hazard-related.

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**Typographical conventions**

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

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

<table>
<thead>
<tr>
<th><strong>Bold</strong></th>
<th>Used for names of interface elements, such as names of windows, dialog boxes, buttons, fields, tab names, key names, and menu paths (what the user specifically selects or clicks)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Italic</strong></td>
<td>Used for full titles of publications referenced in text</td>
</tr>
<tr>
<td><strong>Monospace</strong></td>
<td>Used for:</td>
</tr>
<tr>
<td></td>
<td>- System code</td>
</tr>
<tr>
<td></td>
<td>- System output, such as an error message or script</td>
</tr>
<tr>
<td></td>
<td>- Pathnames, filenames, prompts, and syntax</td>
</tr>
<tr>
<td></td>
<td>- Commands and options</td>
</tr>
<tr>
<td><strong>Monospace italic</strong></td>
<td>Used for variables</td>
</tr>
<tr>
<td><strong>Monospace bold</strong></td>
<td>Used for user input</td>
</tr>
<tr>
<td><strong>[]</strong></td>
<td>Square brackets enclose optional values</td>
</tr>
<tr>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td><strong>{}</strong></td>
<td>Braces enclose content that the user must specify, such as x or y or z</td>
</tr>
<tr>
<td><strong>...</strong></td>
<td>Ellipses indicate nonessential information omitted from the example</td>
</tr>
</tbody>
</table>

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**Where to get help**

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

**Product information**

Dell EMC technical support, documentation, release notes, software updates, or information about Dell EMC products can be obtained at https://support.emc.com (registration required) or https://www.dellemc.com/en-us/documentation/vmax-all-flash-family.htm.
Technical support
To open a service request through the Dell EMC Online Support (https://support.emc.com) 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 us improve the accuracy, organization, and overall quality of the documentation. Send your comments and feedback to:
VMAXContentFeedback@emc.com
Revision history

Table 2 Revision history

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description and/or change</th>
<th>Date released</th>
</tr>
</thead>
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<tr>
<td>2.0</td>
<td>Updated Procedure A, Task 2 for PowerMax 2000.</td>
<td>May, 2018</td>
</tr>
<tr>
<td>1.0</td>
<td>First release of the <em>Dell EMC Best Practices Guide for AC Power Connections for PowerMax 2000, 8000 with PowerMaxOS.</em></td>
<td>May, 2018</td>
</tr>
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CHAPTER 1

Best Practices Guide for AC Power Connections

- Best practices overview for AC power connections............................14
- Selecting the proper AC power connection procedure.........................15
- Procedure A: Working with the customer's electrician onsite................16
- Procedure B: Verify and connect.........................................................22
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**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 Figure 1 on page 14. 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

Note

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

Table 3 on page 15 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

<table>
<thead>
<tr>
<th>Situation on site</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>The customer’s electrician is available at the installation site.</td>
<td>Procedure A: Working with the customer’s electrician onsite on page 16. This procedure assures fault tolerant power in the storage array.</td>
</tr>
<tr>
<td>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).</td>
<td>Procedure B: Verify and connect on page 22</td>
</tr>
<tr>
<td>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.</td>
<td>Procedure C: Obtain customer verification on page 23</td>
</tr>
</tbody>
</table>
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

NOTICE

This task is performed by the customer's electrician.

Procedure

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 27. Measure the voltage output of each power cable as shown in Figure 2 on page 17.

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 Figure 3 on page 17.

**Figure 2** Circuit breakers ON — AC power within specification

![Figure 2](image1)

**Figure 3** Circuit breakers OFF — No AC power

![Figure 3](image2)
Procedure A, Task 2: Dell EMC Customer Engineer

Before you begin

Before connecting power to the 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.

Procedure

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 cables for power zone A and power zone B as shown below.

   **Figure 4 Connecting AC power, single-phase, PowerMax 2000**
Figure 5 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 cables for power zone A and power zone B as shown below.

Figure 6 Connecting AC power, three-phase
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 7** Power zone connections
Procedure A, Task 3: Customer's electrician

Note
This task is performed by the customer's electrician.

Procedure

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 25.
Procedure B: Verify and connect

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.

Procedure

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 Figure 3 on page 17 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-supplied power 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 25.
Procedure C: Obtain customer verification

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.

Procedure

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 17 and label the PDUs as described in Applying PDU labels on page 25.

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 16
- Procedure B: Verify and connect on page 22
- Procedure C: Obtain customer verification on page 23

If necessary, see Selecting the proper AC power connection procedure on page 15 to select the correct procedure.

PDU label part number

Table 4 PDU label part number

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>046-001-750</td>
<td>LABEL: CUSTOMER 1P 3P PDU INFO WRITEABLE</td>
</tr>
</tbody>
</table>

Table 5 PDU label location, Dell EMC racks

<table>
<thead>
<tr>
<th>Product</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerMax 2000</td>
<td>HERC OPEN ME FIRST KIT  \n</td>
</tr>
<tr>
<td>PowerMax 8000</td>
<td>OPEN ME FIRST FIELD INSTALL KIT  \n</td>
</tr>
</tbody>
</table>
### Table 6: PDU label location, third-party racks

<table>
<thead>
<tr>
<th>Product</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerMax 2000</td>
<td>HERC ENG 1 PBRICK 3RD PTY INSTALL KIT</td>
</tr>
<tr>
<td></td>
<td>PN 106-887-303</td>
</tr>
<tr>
<td>PowerMax 8000</td>
<td>ENGINE 1 3RD PTY PBRICK ZEUS</td>
</tr>
<tr>
<td></td>
<td>PN 106-887-268</td>
</tr>
</tbody>
</table>
Applying PDU labels

Procedure

1. For each bay, locate and complete each PDU label.

   Note

   For three-phase power, enter data only in the P1 column.

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

   Figure 8 PDU label, single-phase and three-phase

   ![Figure 8 PDU label](image)

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.

Ground the cabinet

Equipment correctly installed within the cabinet is grounded through the AC power cables and connectors. In general, supplemental grounding is not required.

If your site requires external grounding (for example, to a common grounding network beneath the site floor), you can use the grounding lugs provided on each of the cabinet’s bottom supports.
Figure 9 Location of cabinet ground lugs
## AC power specifications

Table 7 Input power requirements - Single-phase, North American, International, Australian

<table>
<thead>
<tr>
<th>Specification</th>
<th>North American 3-wire connection (2 L &amp; 1 G)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>International and Australian 3-wire connection (1 L &amp; 1 N &amp; 1 G)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input nominal voltage</td>
<td>200–240 VAC ± 10% L- L nom</td>
<td>220–240 VAC ± 10% L- N nom</td>
</tr>
<tr>
<td>Frequency</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Circuit breakers</td>
<td>30 A</td>
<td>32 A</td>
</tr>
<tr>
<td>Power zones</td>
<td>Two</td>
<td>Two</td>
</tr>
</tbody>
</table>
| Minimum power requirements at customer site | - PowerMax 2000: Up to two 30 A or 32 A single-phase drops per zone.  
- PowerMax 8000: Up to three 30 A or 32 A single-phase drops per zone.  
- Two power zones require 6 drops, each drop rated for 30 A or 32 A. (Maximum PowerMax 8000 configuration.)  
- PDU A and PDU B require three separate single-phase 30 A or 32 A drops for each PDU. | |

a. L = line or phase, N = neutral, G = ground
### Table 8 Input power requirements - Three-phase, North American, International, Australian

<table>
<thead>
<tr>
<th>Specification</th>
<th>North American 4-wire connection (3 L &amp; 1 G)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>International 5-wire connection (3 L &amp; 1 N &amp; 1 G)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage&lt;sup&gt;b&lt;/sup&gt;</td>
<td>200–240 VAC ± 10% L- L nom</td>
<td>220–240 VAC ± 10% L- N nom</td>
</tr>
<tr>
<td>Frequency</td>
<td>50–60 Hz</td>
<td>50–60 Hz</td>
</tr>
<tr>
<td>Circuit breakers</td>
<td>50 A</td>
<td>32 A</td>
</tr>
<tr>
<td>Power zones</td>
<td>Two</td>
<td>Two</td>
</tr>
<tr>
<td>Minimum power requirements at customer site</td>
<td>• Two 50 A, three-phase drops per bay.</td>
<td>Two 32 A, three-phase drops per bay.</td>
</tr>
<tr>
<td></td>
<td>• PDU A and PDU B require one separate three-phase Delta 50 A drops for each.</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> L = line or phase, N = neutral, G = ground  
<sup>b</sup> 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.