Dell PowerMax Family Site Planning Guide

PowerMax 2000 and PowerMax 8000

April 2026
Rev. 23.0

DELL Technologies

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 Technologies 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 Technologies 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 Technologies Online Support (https://www.dell.com/support/home). Check to ensure that you are using the latest version of this document.

Purpose

This document is intended for use by customers and/or company representatives who want to plan the purchase and installation of a PowerMax system.

Audience

This document is intended for use by customers or company representatives.

Related documentation

Dell PowerMax Family Product Guide	Provides information about PowerMax 2500 and 8500 with PowerMaxOS 10, and PowerMax 2000 and 8000 arrays with PowerMaxOS 5978.
Dell EMC Best Practices Guide for AC Power Connections for PowerMax 2000, 8000 with PowerMaxOS	Describes the best practices to assure fault-tolerant power to a PowerMax 2000 or PowerMax 8000 array.
PowerMaxOS 5978.144.144 Release Notes for Dell EMC PowerMax and All Flash	Describes new features and any limitations.
Dell PowerMax Family Security Configuration Guide	Shows how to securely deploy PowerMax arrays running PowerMaxOS.

Typographical conventions

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

Table 1. Typographical conventions used in this content

Font	Description
Bold	Used for names of interface elements

Table 1. Typographical conventions used in this content (continued)

Font	Description
	Examples: Names of windows, dialog boxes, buttons, fields, tab names, key names, and menu paths (what the user selects or clicks)
Italic	Used for full titles of publications referenced in text
`Monospace`	Used for: • System code • System output, such as an error message or script • Pathnames, filenames, prompts, and syntax • Commands and options
Monospace italic	Used for variables
`Monospace bold`	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

Support, product and licensing information can be obtained as follows:

Product information Dell Technologies technical support, documentation, release notes, software updates, or information about Dell Technologies products can be obtained at Dell Technologies Online Support (https://www.dell.com/support/home) (registration required) or on the PowerMax Info Hub (https://www.dell.com/support/kbdoc/en-us/000189115/powermax-info-hub-product-documentation-videos).

Technical support To open a service request through Dell Technologies Online Support (https://www.dell.com/support/home), you must have a valid support agreement. Contact your Dell Technologies sales representative for details about obtaining a valid support agreement or to answer any questions about your account.

Revision history

Table 2. Revision history

Revision	Description	Date released
23.0	Implemented new accessibility requirements for Dell documentation.	April 2026
22.0	Added line cords for Japan.	January 2025
21.0	Updated PDU label.	November 2023
20.0	• Clarified power requirements for customer components in a rack. • Corrected the link to the Power Calculator.	May 2023
19.0	Updated securing kit part numbers.	October 2022
18.0	Formatting.	February 2022
17.0	• Added 30/32 A circuit breaker voltage for international power connections. • Clarified PowerMax 2000 customer rack dimensions.	March 2021
16.0	Changed power connector Hubbell CS-8365C to CS-8365L and Hubbell CS-8364C to CS-8364.	June 2020
15.0	Added new three-phase Wye worldwide model kits.	June 2020
14.0	Clarified PowerMax 2000 customer rack requirements for third-party components.	May 2020
13.0	Added note to provide strain relief when host cabling and power are handled from overhead or wall-mounted.	April 2020
12.0	Added new three-phase Wye model kits.	February 2020
11.0	Clarified component dimensions for PowerMax 2000 and PowerMax 8000 models	January 2020
10.0	• Added component dimensions. • Changed unpowered storage time recommendation to not exceed 3 months.	November 2019
9.0	• Clarified three-phase Wye line cord descriptions. • Clarified AC power specifications.	September 2019
8.0	Added information to Best Practices for AC Power Connections on page 71 on line cord power zone labels.	June 2019
7.0	Added content that Dell PDUs are not designed for use in third-party racks.	March 2019
6.0	Added figure for top routing cover.	March 2019
5.0	Added a line in the grounding chapter that both grounding straps must be installed for chassis to chassis grounding.	January 2019
4.0	• Updated jumper and line cord tables. • Updated power consumption specifications.	October 2018
3.0	• Updated PDU label for PowerMax. • Updated customer rack requirements for rear-facing and inward-facing PDUs: Added power consumption and outlet requirements. • Modified jumper locations for clarification.	August 2018
2.0	• Updated Procedure A, Task 2 for PowerMax 2000. • Minor edits and formatting.	May 2018
1.0	First release of the *Dell PowerMax Family Site Planning Guide for PowerMax 2000 and PowerMax 8000*.	May 2018

1

Before You Begin

Go over all data center requirements and planning tasks before you begin.

Topics:

- Overview of data center requirements
- PowerMax packaging
- Tasks to review

Overview of data center requirements

PowerMax arrays are designed for installation in data centers that provide:

- Sufficient physical space
- Controlled temperature and humidity
- Airflow and ventilation
- Power and grounding
- System cable routing facilities
- Fire protection

Raised floors are preferred.

For information regarding overhead cable routing, see Overhead routing kit on page 69.

To prepare the site for an array, meet with your Dell Systems Engineer and Customer Engineer to determine what is needed to prepare for delivery and installation. One or more sessions may be necessary to finalize installation plans.

PowerMax packaging

The basic building block of a PowerMax array is the PowerMax Brick (on arrays in open systems environments) or PowerMax zBrick (on arrays in a mainframe environment). Depending on the array this consists of:

- An engine with two directors (the redundant data storage processing unit)
- Flash storage in two Drive Array Enclosures (DAEs) each with 24 slots
- Minimum storage capacity:
  - PowerMax 2000: 13 TBu (Terabytes usable)
  - PowerMax 8000 in an open systems environment: 53 TBu
  - PowerMax 8000 in a mainframe environment: 13 TBu
  - PowerMax 8000 in a mixed open systems and mainframe environment: 66 TBu

This document uses the term PowerBrick for planning purposes. All guidelines that apply to PowerBricks also apply to PowerMax zBricks.

Tasks to review

The following table provides a list of tasks to review during the planning process:

Table 3. Planning tasks

Task	Comments, What to Provide
Work with the site electrician to Identify power requirements.	External AC power must be supplied from independent customer-supplied redundant power distribution units (PDUs).

Table 3. Planning tasks (continued)

Task	Comments, What to Provide
	Dell recommends having a customer electrician available at the installation site for regular and third-party rack arrays. If flying leads are used, an electrician must connect the power. The connector type must be verified as part of the installation plan. Best Practices for AC Power Connections on page 71 provides details.
For third-party rack support, see the detailed physical requirements in Third Party Racking Option for PowerMax 2000 on page 54 and Third Party Racking Option for PowerMax 8000 on page 61.	The field representative working the order must: • Review the requisite information regarding the third party racking option. • In PowerSizer, select the configuration. In the **Hardware Options** screen, under **Rack Type**, select **Third Party**.

2

Delivery and Transportation

Components are shipped directly to customer data centers. Arrangements should be made to receive the equipment.

Topics:

- Delivery arrangements
- Pre-delivery considerations
- Moving up and down inclines
- Shipping and storage environmental requirements

Delivery arrangements

Delivery within the United States or Canada is by air-ride truck with custom-designed shipping material. International delivery usually uses air freight.

Unless otherwise instructed, the Dell Traffic Department arranges for delivery directly to the customer data center. To ensure successful delivery of the system, Dell has formed partnerships with specially selected moving companies. These companies have moving professionals that are trained in the proper handling of large, sensitive equipment. They provide the appropriate personnel, floor layouts, and any ancillary moving equipment that is required to facilitate delivery. Moving companies should check general guidelines, weights, and dimensions.

NOTE: Inform Dell of any labor union-based restrictions or security clearance requirements for delivery.

Pre-delivery considerations

Take into account the following considerations prior to the delivery at your site:

- Weight capacities of the loading dock, tailgate, and service elevator if delivery is to a floor other than the receiving floor.
- Length and thickness of covering required for floor protection.
- Equipment ramp availability if the receiving floor is not level with computer room floor.
- Set up the necessary network and gateway access to accommodate Secure Remote Services so that it will be available and operable for the installation date.

Moving up and down inclines

To prevent tipping when moving up and down inclines, close all doors and drawers. Push from the rear of the rack so that the front (side with bezels or a fancy door) goes first.

All portions of the bay will clear ramp and threshold slopes up to 1:10 (rise to run ratio), per Code of Federal Regulations — ADA Standards for Accessible Design, 28 CFR Part 36.

Shipping and storage environmental requirements

The following table provides the environmental requirements for shipping and storage:

Table 4. Shipping and storage environmental requirements

Condition	Setting
Ambient temperature	-40° to 149° F (-40° to 65° C)
Temperature gradient	43.2° F/hr (24° C/hr)
Relative humidity	10% to 90% noncondensing
Storage time (unpowered)	Recommendation: Do not exceed 3 consecutive months of unpowered storage.

3

System Specifications

System specifications include minimum and maximum power consumption and heat dissipation values, temperature and humidity requirements, sound power and pressure levels, and other specifications.

Topics:

- Radio frequency interference
- Power consumption and heat dissipation
- Airflow
- Air volume, air quality, and temperature
- Shock and vibration
- Sound power and sound pressure
- Hardware acclimation times
- Optical multimode cables

Radio frequency interference

Electro-magnetic fields, which include radio frequencies can interfere with the operation of electronic equipment. Dell products have been certified to withstand radio frequency interference (RFI) in accordance with standard EN61000-4-3. In Data Centers that employ intentional radiators, such as cell phone repeaters, the maximum ambient RF field strength should not exceed 3 Volts /meter.

The field measurements should be taken at multiple points in close proximity to Dell equipment. It is recommended to consult with an expert prior to installing any emitting device in the Data Center. In addition, it may be necessary to contract an environmental consultant to perform the evaluation of RFI field strength and address the mitigation efforts if high levels of RFI are suspected.

The ambient RFI field strength is inversely proportional to the distance and power level of the emitting device.

Recommended minimum distance from RF emitting device

The following table provides the recommended minimum distances between Dell arrays and RFI emitting equipment. Use these guidelines to verify that cell phone repeaters or other intentional radiator devices are at a safe distance from the equipment.

Table 5. Minimum distance from RF-emitting devices

Repeater power level[a]	Recommended minimum distance
1 Watt	9.84 ft (3 m)
2 Watt	13.12 ft (4 m)
5 Watt	19.69 ft (6 m)
7 Watt	22.97 ft (7 m)
10 Watt	26.25 ft (8 m)
12 Watt	29.53 ft (9 m)
15 Watt	32.81 ft (10 m)

a. Effective Radiated Power (ERP)

Power consumption and heat dissipation

Use the Dell Power Calculator to refine the power and heat figures to more closely match your array. Contact your sales representative or use the Power Calculator for specific supported configurations. The following table provides calculations of maximum power and heat dissipation.

NOTE: Power consumption and heat dissipation details vary based on the system configuration, I/O activity, and ambient temperatures. Ensure that the installation site meets these worst case requirements. The numbers in Power consumption and heat dissipation on page 14 are for fully stacked bays for a single system.

Table 6. Power consumption and heat dissipation

-	PowerMax 2000		PowerMax 8000	
Maximum power and heat dissipation at <26°C and >35°C [a]	Maximum total power consumption <26°C / >35°C (kVA)	Maximum heat dissipation <26°C / >35°C (Btu/Hr)	Maximum total power consumption <26°C / >35°C (kVA)	Maximum heat dissipation <26°C / >35°C (Btu/Hr)
System bay 1	4.4 / 6.2	14,716 / 21,038	8.4 / 11.8[b]	28,453 / 39,903
System bay 2	N/A		8.0 / 11.4	27,214 / 38,665

a. Power values and heat dissipations shown at >35°C reflect the higher power levels associated with both the battery recharge cycle, and the initiation of high ambient temperature adaptive cooling algorithms. Values at <26°C are reflective of more steady state maximum values during normal operation.
b. Values do not include a 100W power draw for the service tray line cord attached to a customer service laptop.

Adaptive cooling

The systems apply adaptive cooling based on customer environments to save energy. Engines and DAEs access thermal data through components located within their enclosures. Based on ambient temperature and internal activity, they set the cooling fan speeds. As the inlet temperatures increase, the adaptive cooling increases the fan speeds, with the resulting platform power increasing up to the maximum values shown below. These values, along with the SPS recharge power consumption, contribute to the maximum system power consumption values over 35°C shown in Power consumption and heat dissipation on page 14.

PowerMax 2000 and PowerMax 8000

- DAE24 (24 Drives) = 206 VA - 702 BTU/hr
- Engine = 255VA - 870 BTU/hr

Airflow

Systems are designed for typical hot and cold aisle data center cooling environments and installation:

- On raised or nonraised floors
- In hot and cold aisle arrangements

The airflow provides less mixing of hot and cold air, which can result in a higher return temperature to the data center air conditioner (CRAC). Airflow optimization promotes better heat transfer outside the building and achieves higher energy efficiency and lower Power Usage Effectiveness (PUE). Additional efficiency can be achieved by sequestering the exhaust air completely and connecting ducts directly to a CRAC unit or to the outside.

Best practice is to place a perforated floor tile in front of each bay to allow adequate cooling air supply when installing on a raised floor. The following figure shows typical airflow in a hot aisle/ cold aisle environment.

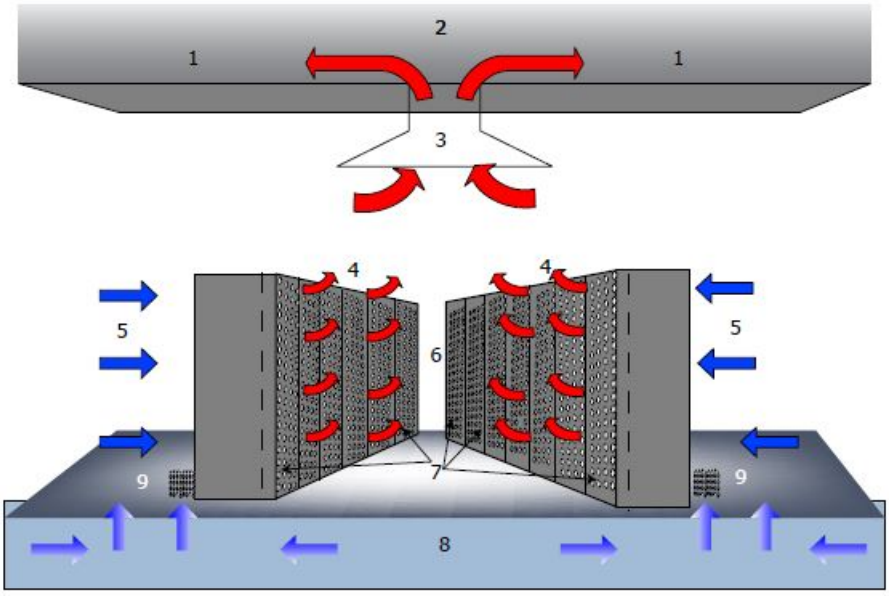


Figure 1. Typical airflow in a hot and cold aisle environment

Table 7. Airflow diagram key

Key	Description
1	To refrigeration unit
2	Suspended ceiling
3	Air return
4	System bays
5	Cold aisle
6	Hot aisle
7	Perforated rear doors
8	Pressurized floor
9	Perforated floor tile

Air volume, air quality, and temperature

The installation site must meet certain recommended requirements for air volume, temperature, altitude, and humidity ranges, and air quality.

Air volume specifications

The following table provides the recommended maximum amount of air volume.

Table 8. Maximum air volume, PowerMax 2000

Number of PowerBricks	Units
1	545 cfm (15.3 m^3/min)
2	1,090 cfm (30.5 m^3/min)

Table 9. Maximum air volume, PowerMax 8000

System Bay	Number of PowerBricks	Units
System Bay 1	1	545 cfm (15.3 m^3/min)
	2	1,002 cfm (28.1 m^3/min)
	3	1,547 cfm (43.3 m^3/min)
	4	1,982 cfm (55.5 m^3/min)
System Bay 2	1	545 cfm (15.3 m^3/min)
	2	980 cfm (27.4 m^3/min)
	3	1,525 cfm (42.7 m^3/min)
	4	1,960 cfm (54.9 m^3/min)

Temperature, altitude, and humidity ranges

The following table provides the recommended environmental operating ranges.

Table 10. Environmental operating ranges

Condition	System
Operating temperature (normal conditions)[a]	10°–32°C (50°–90°F) at 2,286 m (7,500 ft) 10°–35°C (50°–95°F) at 950 m (3,317 ft)
Operating temperature (excursion limit), 24 hours annually	32°–50°C (50°–122°F) at 2,286 m (7,500 ft)
Operating altitude (maximum) and derating	3,048 m (10,000 ft) derate 1.1°C per 305 m above 2,286 m
Operating humidity range	20% to 80% RH non-condensing
Operating temperature rate of change	20°C/hour

a. These values apply to the inlet temperature of any component within the bay.

Temperature and humidity range recommendations

The following table provides the recommended operating and humidity ranges to ensure long-term reliability, especially in environments where air quality is a concern.

Table 11. Temperature and humidity

Condition	System
Operating temperature range	64º-75º F (18º to 24º C)
Operating relative humidity range	40-55%

Air quality requirements

PowerMax arrays are designed to be consistent with the requirements of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Environmental Standard Handbook and the most current revision of Thermal Guidelines for Data Processing Environments, ASHRAE TC 9.9 2011.

The arrays are best suited for Class 1A Datacom environments, which consist of tightly controlled environmental parameters, including temperature, dew point, relative humidity and air quality. These facilities house mission critical equipment and are typically fault tolerant, including the air conditioners. In a data center environment, if the air conditioning fails and the temperature is lost, a vault may occur to protect data.

The data center should maintain a cleanliness level as identified in ISO 14664-1, class 8 for particulate dust and pollution control. The air entering the data center should be filtered with a MERV 11 filter or better. The air within the data center should be continuously filtered with a MERV 8 or better filtration system. In addition, efforts should be maintained to prevent conductive particles, such as zinc whiskers, from entering the facility.

The allowable relative humidity level is 20–80% non condensing, however, the recommended operating environment range is 40–55%. For data centers with gaseous contamination, such as high sulfur content, lower temperatures and humidity are recommended to minimize the risk of hardware corrosion and degradation. In general, the humidity fluctuations within the data center should be minimized. It is also recommended that the data center be positively pressured and have air curtains on entry ways to prevent outside air contaminants and humidity from entering the facility.

For facilities below 40% relative humidity (RH), Dell recommends using grounding straps when contacting the equipment to avoid the risk of electrostatic discharge (ESD), which can harm electronic equipment.

NOTE: As part of an ongoing monitoring process for the corrosiveness of the environment, Dell recommends placing copper and silver coupons (per ISA 71.04-1985, Section 6.1 Reactivity) in airstreams representative of those in the data center. The monthly reactivity rate of the coupons should be less than 300 Angstroms. When monitored reactivity rate is exceeded, the coupon should be analyzed for material species and a corrective mitigation process put in place.

Shock and vibration

The following table provides the platform shock and vibration maximums and the transportation shock and vibration levels (in the vertical direction).

NOTE: The levels that are shown apply to all three axes, and should be measured with an accelerometer in the equipment enclosures within the cabinet.

Table 12. Platform shock and vibration

Platform condition	Response measurement level (should not exceed)
Nonoperational shock	10 Gs, 7-millisecond duration
Operational shock	Three Gs, 11-millisecond duration
Nonoperational random vibration	0.40 Grms, 5-500 Hz, 30 minutes
Operational random vibration	0.21 Grms, 5-500 Hz, 10 minutes
Packaged system condition	
Transportation shock	10 Gs, 12-millisecond duration
Transportation random vibration	1.15 Grms, 1 hour
Frequency range	1-200 Hz

Sound power and sound pressure

PowerMax 8000

Table 13. Sound power and sound pressure levels, A-weighted, PowerMax 8000

Configuration	Sound power levels (LWAd) (B) [a]	Sound pressure levels (LpA) (dB) [b]
System bay (max)	7.76	65.55

a. Declared noise emissions with.3B correction factor added per ISO9296.
b. Measured at the four bystander positions per ISO7779

Hardware acclimation times

Units must acclimate to the operating environment before applying power. This requires the unpackaged system or component to reside in the operating environment for up to 16 hours in order to thermally stabilize and prevent condensation.

Table 14. Hardware acclimation times

Transit/storage environment		Operating environment temperature	Acclimation time
Temperature	Humidity	-	
Nominal 68-72°F (20-22°C)	Nominal 40-55% RH	Nominal 68-72°F (20-22°C) 40-55% RH	0-1 hour
Cold <68°F (20°C)	Dry <30% RH	<86°F (30°C)	4 hours
Cold <68°F (20°C)	Damp ≥30% RH	<86°F (30°C)	4 hours

Table 14. Hardware acclimation times (continued)

Transit/storage environment		Operating environment temperature	Acclimation time
Hot >72°F (22°C)	Dry <30% RH	<86°F (30°C)	4 hours
Hot >72°F (22°C)	Humid 30-45% RH	<86°F (30°C)	4 hours
	Humid 45-60% RH	<86°F (30°C)	8 hours
	Humid ≥60% RH	<86°F (30°C)	16 hours
Unknown		<86°F (30°C)	16 hours

- If there are signs of condensation after the recommended acclimation time has passed, allow an additional 8 hours to stabilize.
- Systems and components must not experience changes in temperature and humidity that are likely to cause condensation to form on or in that system or component. Do not exceed the shipping and storage temperature gradient of 45°F/hr (25°C/hr).

Optical multimode cables

Optical multimode 3 (OM3) and optical multimode 4 (OM4) cables are available for open systems host and SRDF connectivity. To obtain OM3 or OM4 cables, contact your local sales representative.

- OM3 cables are used for SRDF connectivity over: 4, 8, and 16 Gb/s Fibre Channel I/O modules, 10 GbE and 1 GbE I/O modules.
- OM4 cables are used for SRDF connectivity over 16 Gb/s Fibre Channel I/O modules.
- OM4 cables are used with 16 Gb/s Fibre Channel I/O modules to provide Fibre Channel connection to switches. Distances of up to 190 m over 8 Gb/s Fibre Channel and 125 m over 16 Gb/s Fibre Channel modules are supported.

OM2 or OM3 cables can be used, but distance is reduced.

- OM3 cables support 8 and 16 Gb/s Fibre Channel distances up to 150 m or 16 Gb/s Fibre Channel distances up to 100 m.
- OM2 cables support 8 Gb/s Fibre Channel distances up to 50 m or 10 Gb/s Ethernet up to 82 m.

NOTE: OM2 cables can be used, but they will not support 8 Gb/s Fibre Channel (SRDF) distances greater then 50 m. For longer distances, use OM3 cables.

Open systems host and SRDF connectivity

The following table provides the OM3 and OM4 cables.

Table 15. OM3 and OM4 Fibre cables — 50/125 micron optical cable

Model number	Description
SYM-OM3-1M	LC-LC, 1 meter
SYM-OM3-3M	LC-LC, 3 meter
SYM-OM3-5M	LC-LC, 5 meter
SYM-OM3-10M	LC-LC, 10 meter
SYM-OM3-30M	LC-LC, 30 meter
SYM-OM3-50M	LC-LC, 50 meter
SYM-OM3-100M	LC-LC, 100 meter
SYM-OM4-1M	LC- LC, 1 meter
SYM-OM4-3M	LC- LC, 3 meter

Table 15. OM3 and OM4 Fibre cables — 50/125 micron optical cable (continued)

Model number	Description
SYM-OM4-5M	LC- LC, 5 meter
SYM-OM4-10M	LC- LC, 10 meter
SYM-OM4-30M	LC- LC, 30 meter
SYM-OM4-50M	LC- LC, 50 meter
SYM-OM4-100M	LC- LC, 100 meter

4

Data Center Safety and Remote Support

Take necessary safety precautions and enable remote support for assistance.

Topics:

- Fire suppressant disclaimer
- Remote support

Fire suppressant disclaimer

Fire prevention equipment in the computer room should always be installed as an added safety measure. A fire suppression system is the responsibility of the customer. When selecting appropriate fire suppression equipment and agents for the data center, choose carefully. An insurance underwriter, local fire marshal, and local building inspector are all parties that you should consult during the selection of a fire suppression system that provides the correct level of coverage and protection.

Equipment is designed and manufactured to internal and external standards that require certain environments for reliable operation. Compatibility claims and recommendations on fire suppression systems are not provided through Dell. It is not recommended to position storage equipment directly in the path of high-pressure gas discharge streams or loud fire sirens to minimize the forces and vibration adverse to system integrity.

NOTE: The previous information is provided on an as-is basis and provides no representations, warranties, guarantees, or obligations on the part of our company. This information does not modify the scope of any warranty set forth in the terms and conditions of the basic purchasing agreement between the customer and the manufacturer.

Remote support

Secure Remote Services is an IP-based, automated, connect home and remote support solution. Secure Remote Services is the preferred method of connectivity. Two connections with Secure Remote Services are recommended for connection to the redundant management module control station (MMCS).

Customers of Secure Remote Services must provide the following:

- An IP network with Internet connectivity.
- Capability to add Gateway Client servers and Policy Manager servers to the customer network.
- Network connectivity between the servers and Dell devices to be managed by Secure Remote Services.
- Internet connectivity to the Secure Remote Services infrastructure by using outbound ports.
- Network connectivity between Secure Remote Services Client(s) and Policy Manager.

Once installed, Secure Remote Services monitors the array and automatically notifies Dell Customer Service in the event of a problem. If an error is detected, a support professional utilizes the secure connection to establish a remote support session to diagnose, and if necessary, perform a repair.

Customer Service can use Secure Remote Services to:

- Perform downloads of updated software in lieu of a site visit.
- Deliver license entitlements directly to the array.

NOTE: Dell provides an optional modem that uses a regular telephone line or operates with a PBX. Dell recommends using two connections to the redundant management module control station (MMCS).

The *Dell EMC Secure Remote Services Site Planning Guide* provides additional information.

5

Physical Weight and Space

Physical weight and space requirements include floor load-bearing capacity, raised floor requirements and physical space and weight specifications.

Topics:

- Floor load-bearing capacity
- Raised floor requirements
- Physical space and weight
- Component dimensions, PowerMax 2000
- Component dimensions, PowerMax 8000

Floor load-bearing capacity

Storage arrays can be installed on raised floors. Customers must be aware that the load-bearing capacity of the data center floor is not readily available through a visual inspection of the floor. The only definitive way to ensure that the floor is capable of supporting the load associated with the array is to have a certified architect or the data center design consultant inspect the specifications of the floor to ensure that the floor is capable of supporting the array weight.

CAUTION:

- **Customers are ultimately responsible for ensuring that the floor of the data center on which the array is to be configured is capable of supporting the array weight, whether the array is configured directly on the data center floor or on a raised floor supported by the data center floor.**
- **Failure to comply with these floor loading requirements could result in severe damage to the storage array, the raised floor, subfloor, site floor and the surrounding infrastructure should the raised floor, subfloor or site floor fail.**
- **Notwithstanding anything to the contrary in any agreement between Dell and the customer, Dell fully disclaims any and all liability for any damage or injury resulting from the customer's failure to ensure that the raised floor, subfloor and/or site floor are capable of supporting the storage array weight. The customer assumes all risk and liability associated with such failure.**

Raised floor requirements

Best practice is to use 24 x 24 inch heavy-duty, concrete-filled steel floor tiles. If a different size or type of tile is used, the customer must ensure that the tiles have a minimum load rating that is sufficient for supporting the storage array weight. Ensure proper physical support of the system by following requirements that are based on the use of 24 x 24 in. (61 x 61 cm) heavy-duty, concrete-filled steel floor tiles.

Raised floors must meet the following requirements:

- Floor must be level.
- Floor tiles and stringers must be rated to withstand concentrated loads of two casters each that weigh up to 600 lb (272 kg).

NOTE: Caster weights are measured on a level floor. The front of the array weighs more than the rear of the configuration.

- Floor tiles and stringers must be rated for a minimum static ultimate load of 2,500 lb (1,134 kg).
- Floor tiles must be rated for a minimum of 750 lb (340 kg) on rolling load.
- For floor tiles that do not meet the minimum rolling load rate, Dell recommends the use of coverings, such as plywood, to protect floors during system roll.

- Floor tile cutouts weaken the tile. An additional pedestal mount adjacent to the cutout of a tile can minimize floor tile deflection. The number and placement of additional pedestal mounts relative to a cutout should be in accordance with the tile manufacturer's recommendations.
- Take care when positioning the bays to make sure that a caster is not moved into a cutout. Cutting tiles per specifications ensures the proper caster placement.
- Use or create no more than one floor tile cutout that is no more than 8 in. (20 cm) wide by 6 in. (15 cm) deep in each 24 x 24 in. (61 x 61 cm) floor tile.
- Ensure that the weight of any other objects in the data center does not compromise the structural integrity of the raised floor or the sub-floor (non-raised floor) of the data center.

Physical space and weight

The following table provides the physical space, maximum weights, and clearance for service.

PowerMax 2000

Table 16. Space and weight requirements, PowerMax 2000

Bay configurations [a]	Height (in/cm) [b]	Width (in/cm)	Depth (in/cm) [c]	Weight (max lbs/kg)
1 system, 1 PowerBrick	75/190	24/61	42/106.7	620/281
1 system, 2 PowerBricks, or 2 systems, 1 PowerBrick each	75/190	24/61	42/106.7	950/430.9
2 systems, 2 PowerBricks in one system, 1 PowerBrick in other	75/190	24/61	42/106.7	1280/580
2 systems, 2 PowerBricks each system	75/190	24/61	42/106.7	1610/730

a. Clearance for service/airflow is the front at 42 in (106.7 cm) front and the rear at 30 in (76.2 cm).
b. An additional 18 in (45.7 cm) is recommended for ceiling/top clearance.
c. Includes rear door.

PowerMax 8000

Table 17. Space and weight requirements, PowerMax 8000

Bay configurations [a]	Number of PowerBricks	Height (in/cm) [b]	Width (in/cm) [c]	Depth (in/cm) [d]	Weight (max lbs/kg)
System Bay 1	1	75/190	24/61	47/119	805/365
	2	75/190	24/61	47/119	1104/501
	3	75/190	24/61	47/119	1418/643
	4	75/190	24/61	47/119	1667/756
System Bay 2	1	75/190	24/61	47/119	663/301
	2	75/190	24/61	47/119	962/436
	3	75/190	24/61	47/119	1276/579
	4	75/190	24/61	47/119	1525/692

a. Clearance for service/airflow is the front at 42 in (106.7 cm) front and the rear at 30 in (76.2 cm).
b. An additional 18 in (45.7 cm) is recommended for ceiling/top clearance.
c. Measurement includes .25 in. (0.6 cm) gap between bays.
d. Includes front and rear doors.

Component dimensions, PowerMax 2000

The following figure and table provide the height and depth dimensions for each component in a rack:

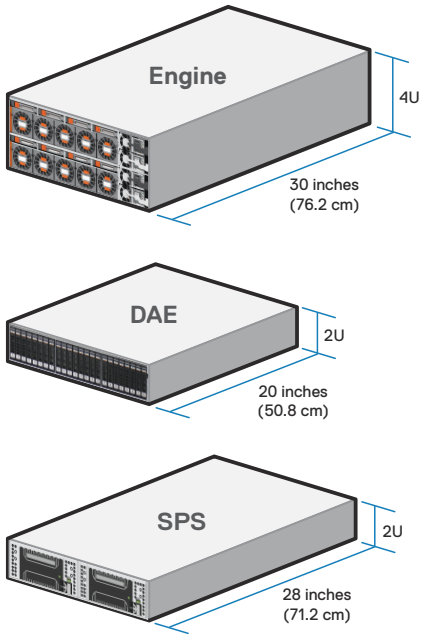


Figure 2. Component dimensions, PowerMax 2000

Table 18. Component dimensions, PowerMax 2000

Component	Height (U-Space)	Depth (in/cm)
Engine	4U	30/76.2
DAE	2U	20/50.8
SPS	2U	28/71.2

NOTE: Component dimensions do not include cable connections and bend radii. Do not use these component dimensions for rack sizing. For information about the total envelope required for the platform, see Third Party Racking Option for PowerMax 2000 on page 54.

Component dimensions, PowerMax 8000

The following figure and table provide the height and depth dimensions for each component in a rack:

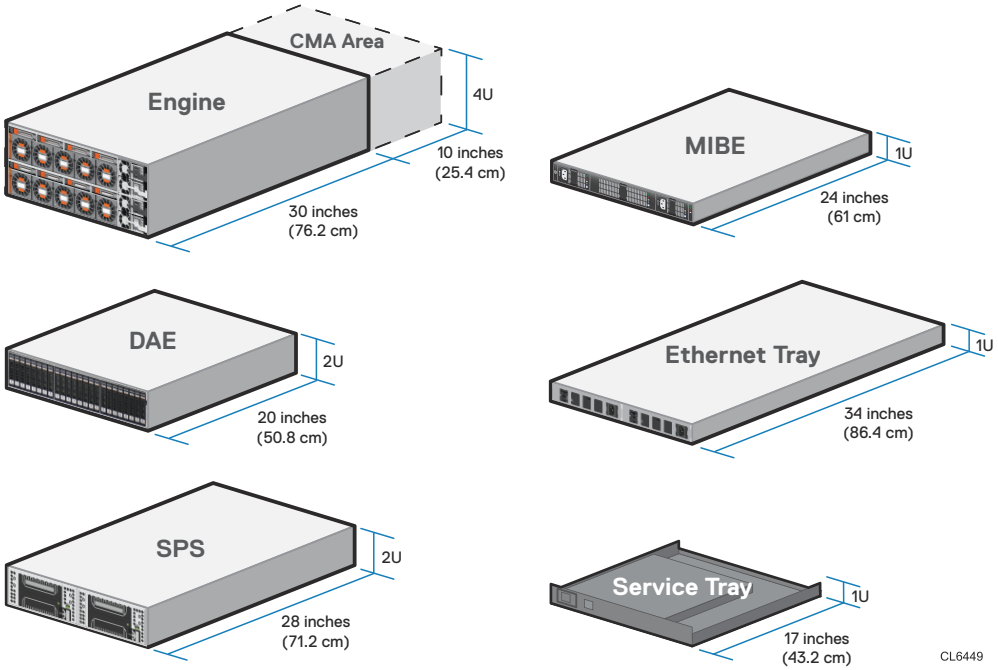


Figure 3. Component dimensions, PowerMax 8000

Table 19. Component dimensions, PowerMax 8000

Component	Height (U-Space)	Depth (in/cm)
Engine	4U	30/76.2
Engine CMA area	4U	10/26.4
DAE	2U	20/50.8
SPS	2U	28/71.2
MIBE	1U (Two units required per system for 2U total)	24/61
Ethernet tray	1U	34/86.4
Service tray	1U	17/43.2

NOTE: Component dimensions do not include cable connections and bend radii. Do not use these component dimensions for rack sizing. For information about the total envelope required for the platform, see Third Party Racking Option for PowerMax 8000 on page 61.

6

Position PowerMax 2000 Bay

Positioning bays includes considering the layout and placement of the bays in the data center and placement on tiles. Each cabinet sits on four caster wheels to aid in positioning the bay. Once the bay is positioned it can be secured with optional mounting bolts.

Topics:

- Bay layout and dimensions
- Tile placement
- Casters and leveling feet
- Cabinet stabilizing

Bay layout and dimensions

To place arrays in the data center, you must understand dimensions, plan for cutouts, and ensure adequate clearance for power and host cables.

- On nonraised floors, cables are routed overhead. An overhead routing bracket is available for purchase to allow easier access of overhead cables into the bay.
- On raised floors, cables are routed across the subfloor beneath the tiles.
- For the system bay, ensure the following:
  - A service area of 42 in (106 cm) for the front.
  - A service area of 30 in (76 cm) for the rear.

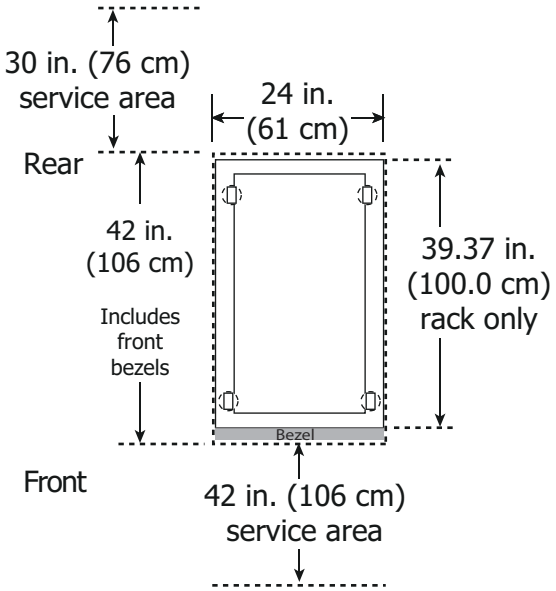


Figure 4. Cabinet dimensions and clearances, floor view

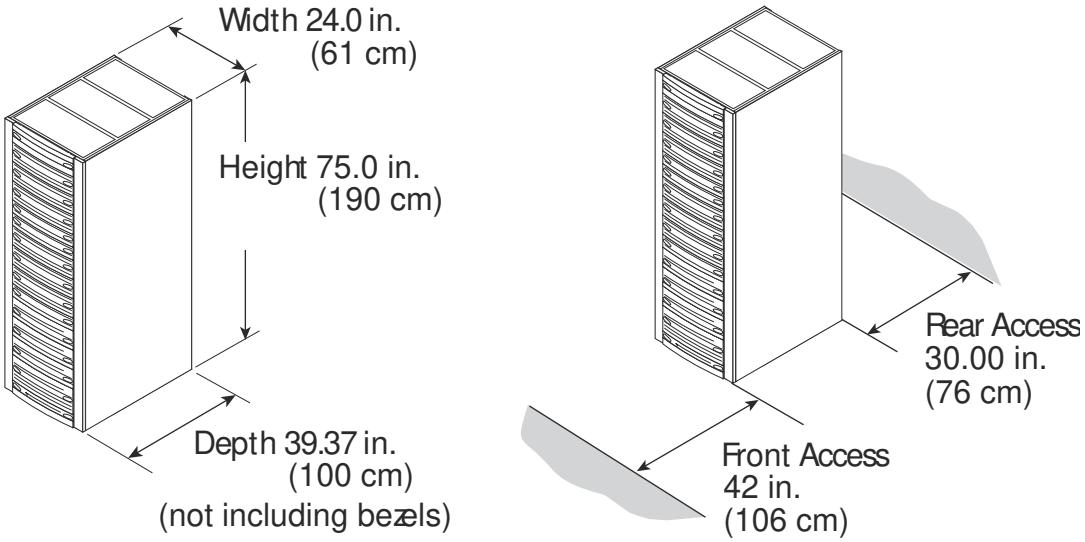


Figure 5. Cabinet dimensions and clearances

Tile placement

You must understand tile placement to ensure that the array is positioned properly and to allow sufficient room for service and cable management.

When placing the array, consider the following:

- Typical floor tiles are 24 in. (61 cm) by 24 in. (61 cm).
- Typical cutouts are:
  - 8 in. (20.3 cm) by 6 in. (15.2 cm) maximum.
  - 9 in. (22.9 cm) from the front and rear of the floor tile.
  - Centered on the tiles, 9 in (22.9 cm) from the front and rear and 8 in (20.3) from the sides.
- Service area of 42 in (106 cm) for the front and 30 in (76 cm) for the rear on the system bays.

The following figure provides tile placement information for all PowerMax 2000 arrays.

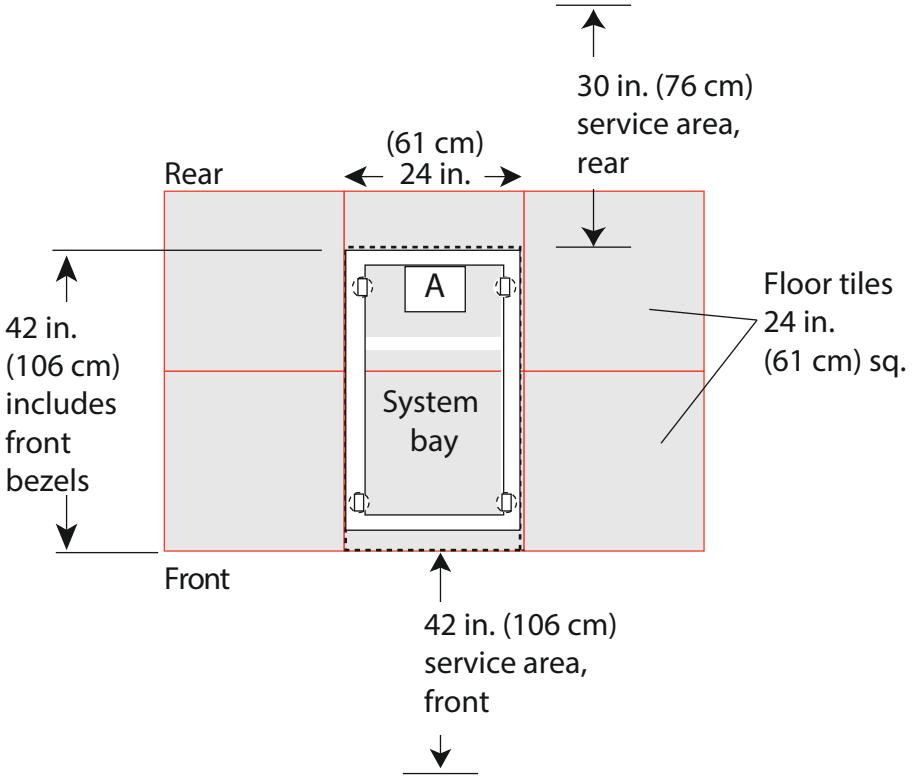


Figure 6. Placement with floor tiles

Casters and leveling feet

The cabinet bottom includes four caster wheels. The front wheels are fixed; the two rear casters swivel in a 1.75-inch diameter. The swivel position of the caster wheels determines the load-bearing points on the site floor, but does not affect the cabinet footprint. Once you have positioned, leveled, and stabilized the cabinet, the four leveling feet determine the final load-bearing points on the site floor.

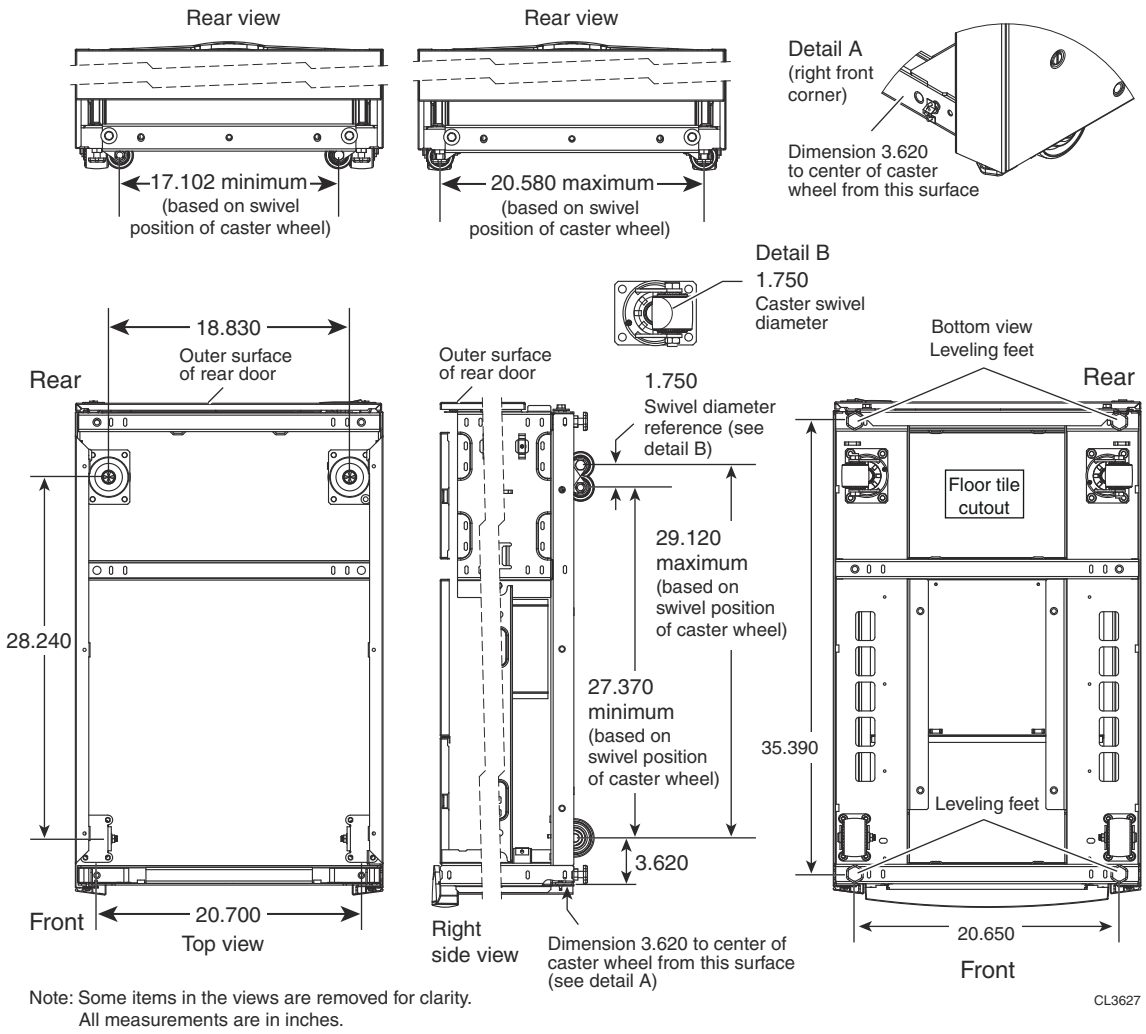


Figure 7. Casters and leveling feet

NOTE: Customers are responsible for ensuring that the data center floor on which the system is to be configured can support the system weight, whether the system is configured directly on the data center floor, or on a raised floor supported by the data center floor. Failure to comply with these floor-loading requirements could result in severe damage to the system, the raised floor, subfloor, site floor and the surrounding infrastructure. Notwithstanding anything to the contrary in any agreement between the manufacturer and customer, the manufacturer fully disclaims any and all liability for any damage or injury resulting from customer's failure to ensure that the raised floor, subfloor, and site floor are capable of supporting the system weight as specified in this guide. The customer assumes all risk and liability associated with such failure.

Cabinet stabilizing

If you intend to secure the optional stabilizer brackets to the site floor, prepare the location for the mounting bolts. The seismic restraint bracket provides protection from moving and tipping, helping to prevent the cabinet from tipping while you service cantilevered levels or from rolling during minor seismic events.

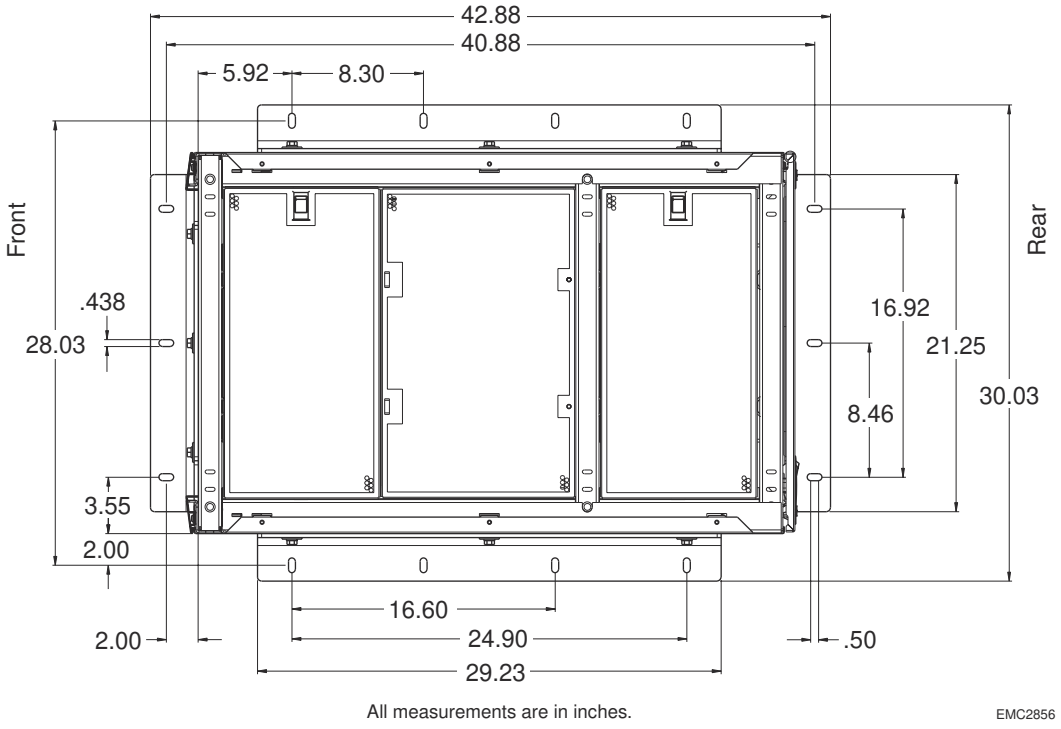


Figure 8. Seismic restraint bracket

7

Position PowerMax 8000 Bay

Positioning bays includes considering the layout and placement of the bays in the data center and placement on tiles. Each cabinet sits on four caster wheels to aid in positioning the bay. Once the bay is positioned it can be secured with optional mounting bolts.

Topics:

- System bay layouts
- Dimensions for array layouts
- Tile placement
- Caster and leveler dimensions
- Cabinet stabilizing

System bay layouts

The number of bays and the system layout depends on the array configuration, the customer requirements, and the space and organization of the customer data center.

Arrays can be placed in the following layouts:

- Adjacent — bays are positioned side-by-side.
- Dispersed — dispersed layouts are provided with longer MIBE optical and Ethernet cable bundles that allow 82 ft (25 m) of separation between System Bay 1 and System Bay 2.

Dispersed system bays require dispersed cable and optics kits. When systems are ordered as dispersed, the dispersed bay is shipped with two side skins installed.

Adjacent layouts, PowerMax 8000

PowerMax 8000 systems with adjacent layouts position System Bay 1 next to System Bay 2.

The following figure shows the adjacent layout. The side skin on System Bay 1 that is next to System Bay 2 is moved to the outer side of System Bay 2.

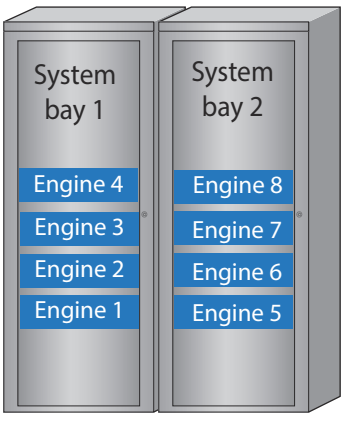


Figure 9. Adjacent layouts, PowerMax 8000

Dispersed layout, PowerMax 8000

Systems with dispersed layouts use 98.4 ft (30m) optical cable bundles (single cable and spare) to connect SIBs to the MIBE and 98.4 ft (30m) copper Ethernet cable bundles (single cable and spare) to connect MMs to the Ethernet switches. Cables

are routed across the subfloor or ceiling to connect the SIB and MM components in System Bay 2 to the MIBE and Ethernet switches in System Bay 1.

The following figure shows a dispersed layout for a PowerMax 8000 array.

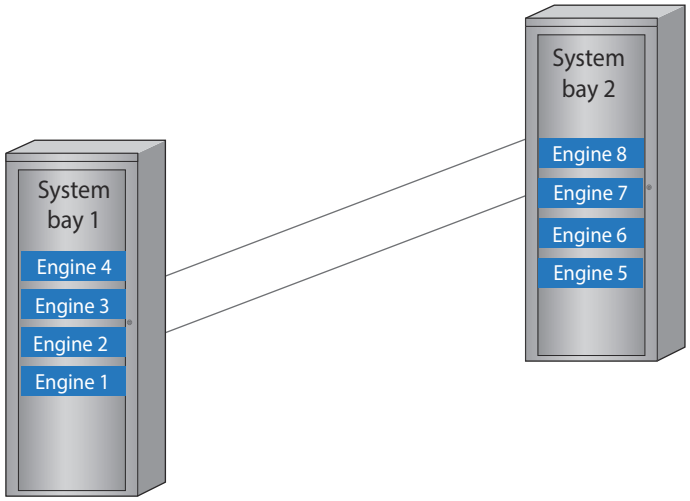


Figure 10. Dispersed layout, PowerMax 8000

Table 20. Fabric dispersion kits for System Bay 2

Kit Part Number	Description
106-887-147	VMAX EVEREST DISPERSION TRANSCEIVER KIT (1 kit per engine required)
106-887-034	Engine 5 Dispersion Kit 30m (Green)
106-887-035	Engine 6 Dispersion Kit 30m (Blue)
106-887-036	Engine 7 Dispersion Kit 30m (Red)
106-887-037	Engine 8 Dispersion Kit 30m (White)

Dimensions for array layouts

Placing arrays in the data center requires understanding dimensions, planning for cutouts, and ensuring clearance for power and host cables.

- On nonraised floors, cables are routed overhead. An overhead routing bracket is provided to allow easier access of overhead cables into the bay.
- On raised floors, cables are routed across the subfloor beneath the tiles.
- Ensure that there is a service area of 42 in (106 cm) for the front and 30 in (76 cm) for the rear of each system bay.

The following figure shows the layout dimensions:

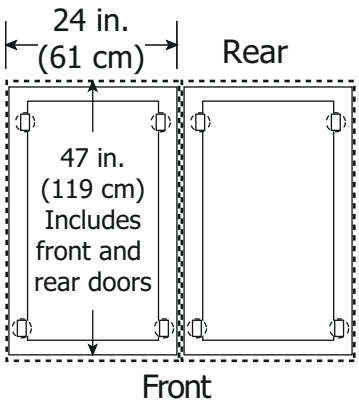


Figure 11. Layout dimensions, PowerMax 8000

Tile placement

You must understand tile placement to ensure that the array is positioned properly and to allow sufficient room for service and cable management.

When placing the array, consider the following:

- Typical floor tiles are 24 in. (61 cm) by 24 in. (61 cm).
- Typical cutouts are:
  - 8 in. (20.3 cm) by 6 in. (15.2 cm) maximum.
  - 9 in. (22.9 cm) from the front and rear of the floor tile.
  - Centered on the tiles, 9 in (22.9 cm) from the front and rear and 8 in (20.3) from sides.
- Service area of 42 in (106 cm) for the front and 30 in (76 cm) for the rear on the system bays.

The following figure provides tile placement information for all arrays (with doors).

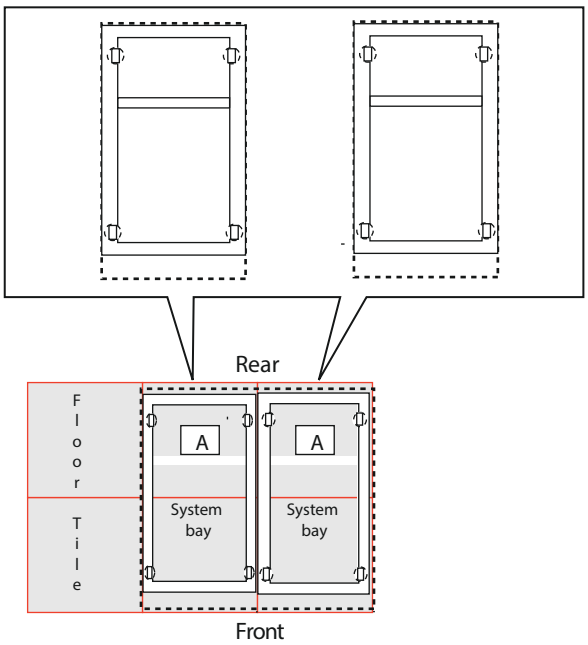


Figure 12. Placement with floor tiles, PowerMax 8000

Caster and leveler dimensions

The bottom of each bay includes four caster wheels. The front wheels are fixed; the two rear casters swivel in a 1.75-in. diameter. Swivel position of the caster wheels determines the load-bearing points on your site floor, but does not affect

the cabinet footprint. Once you have positioned, leveled, and stabilized the bays, the four leveling feet determine the final load-bearing points on your site floor.

The following figure shows caster and leveler dimensions.

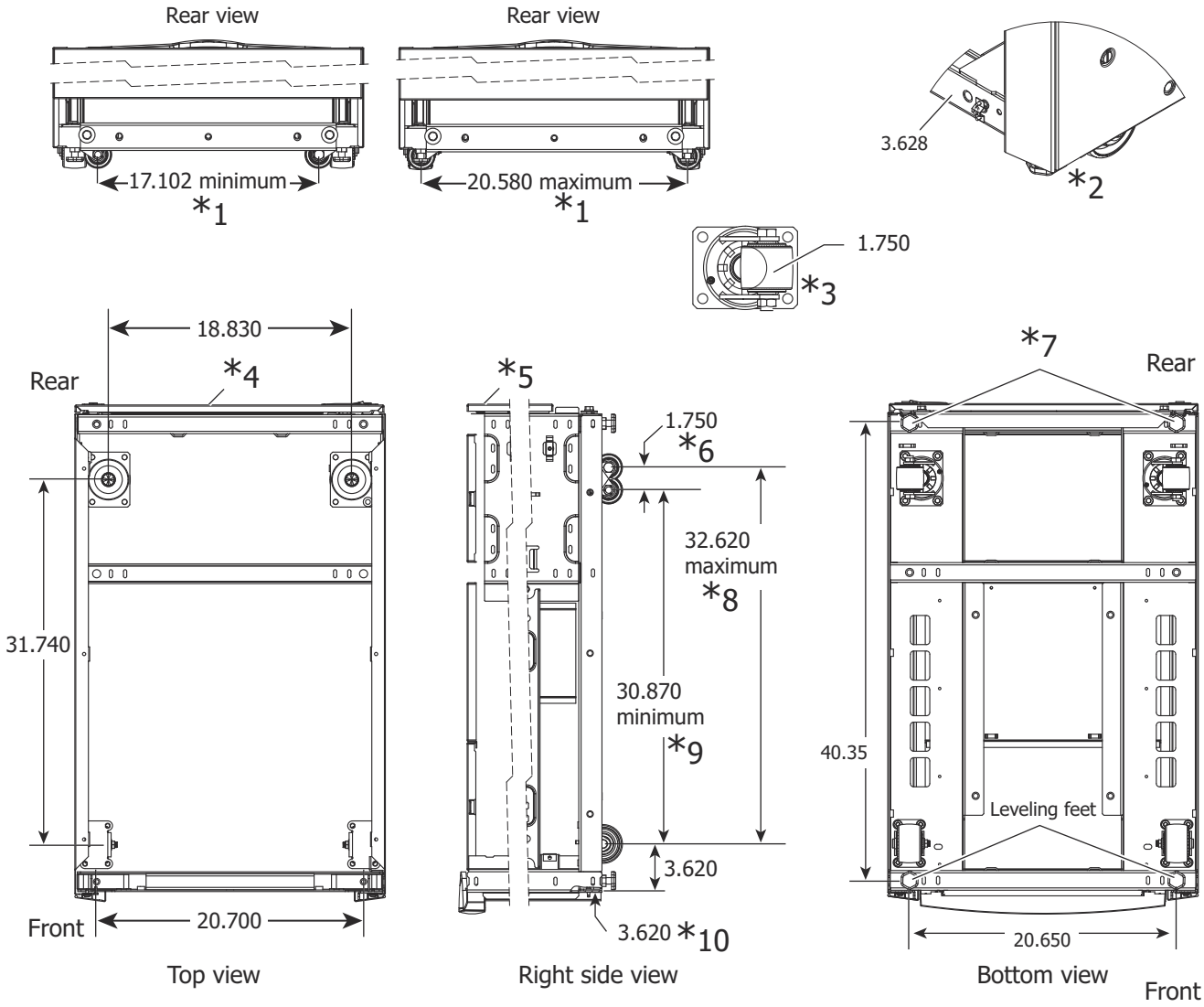


Figure 13. Caster and leveler dimensions

Table 21. Caster and leveler dimensions diagram key

#	Description
*1	Minimum (17.102) and maximum (20.58) distances based on the swivel position of the caster wheel.
*2	Right front corner detail. Dimension (3.628) to the center of caster wheel from surface.
*3	Diameter (1.750) of caster wheel swivel.
*4	Outer surface of rear door.
*5	
*6	Diameter (1.75) of swivel (see detail *3).
*7	Bottom view of leveling feet.
*8	Maximum (32.620) distance based on swivel position of the caster wheel.

Table 21. Caster and leveler dimensions diagram key (continued)

#	Description
*9	Minimum (30.870) distance based on swivel position of the caster wheel.
*10	Distance (3.620) to the center of the caster wheel from the surface (see detail *2).

Cabinet stabilizing

If you intend to secure the optional stabilizer brackets to the site floor, prepare the location for the mounting bolts. The seismic restraint bracket provides protection from moving and tipping, helping to prevent the cabinet from tipping while you service cantilevered levels or from rolling during minor seismic events.

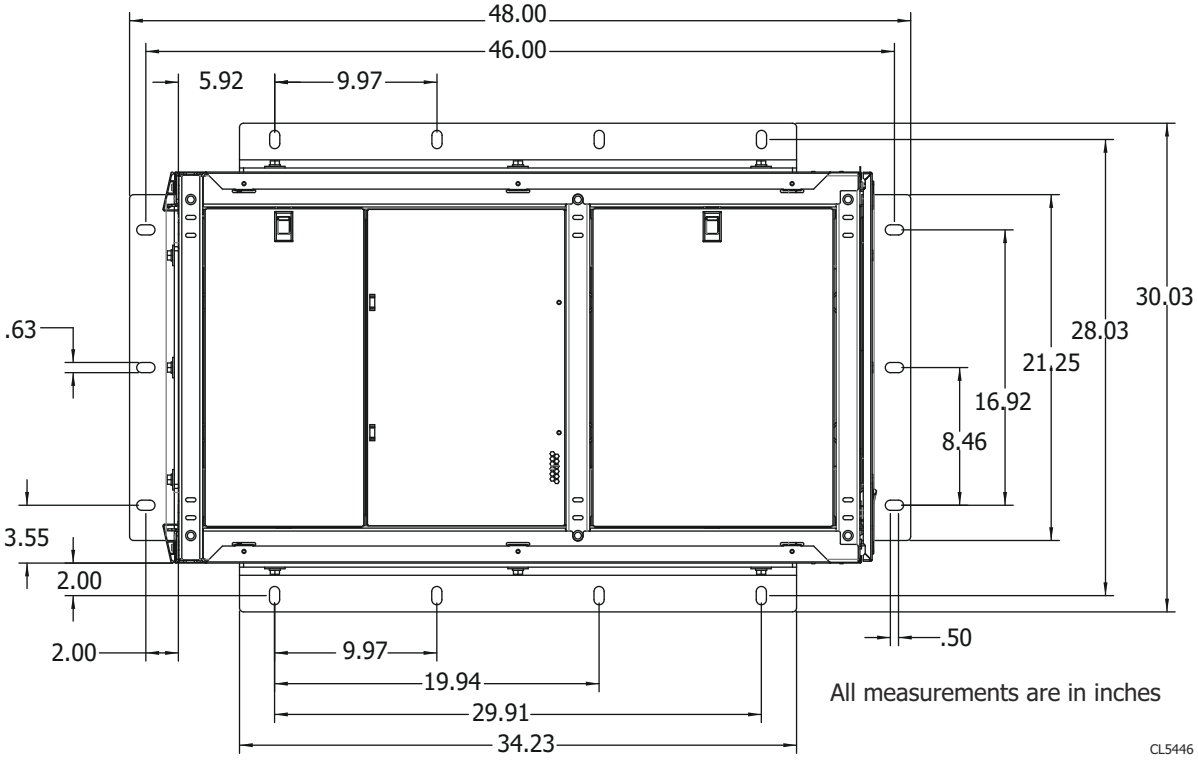


Figure 14. Seismic restraint bracket

For information about the securing kit, see Securing kits on page 70.

8

Power Cabling, Cords and Connectors

PowerMax systems support single-phase, three-phase Delta and three-phase Wye wiring configurations.

Topics:

- Power distribution units
- Power interface
- Customer input power cabling
- Best practices: Power configuration guidelines
- AC power specifications
- Power cords
- PowerMax 2000 line cord and jumper configurations
- PowerMax 8000 line cord and jumper configurations

Power distribution units

CAUTION: Dell PDUs are designed to be mounted securely in Dell racks. They are not intended for third party racks.

PowerMax systems are powered by two redundant power distribution units (PDUs), one for each power zone. The PDUs are available in three wiring configurations:

- Single-phase
- Three-phase Delta
- Three-phase Wye

The AC power cords (single-phase and three-phase) extend above the bay egress for connection to the customer power supply. 15ft (4.57M) power cords that plug into the bottom of the PDUs are provided. For single-phase, more than one power cord per power zone may be required.

The AC cords can be routed out either the bottom or the top of the rack. If the customer requires power to be supplied from overhead, Dell recommends replacing the rear top cover of the bay with the ceiling routing top cover, which allows the power cables inside the machine to be routed out through the top.

A second option is to "drop" the power cables down the hinge side, to the bottom, and route them inside the machine. The cables should be dressed to allow all doors to open freely and space should be provisioned accordingly to accommodate an adjacent cabinet.

If the customer requires power to be supplied from overhead, the Overhead Routing Kit is available to route the power cables inside the machine through the top. Extension cables are not provided. See Optional Kits on page 69 for information on optional kits.

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

Power interface

Data centers must conform to the corresponding specification for arrays installed in North American, International, and Australian sites.

Customers are responsible for meeting all local electrical safety requirements.

Customer input power cabling

Before the array is delivered, the customer must supply and install the required receptacles on their PDUs for zone A and zone B power for each system bay.

Dell recommends that the customer's electrician be present at installation time to work with the Dell customer engineer to verify power redundancy.

Refer to the *Dell EMC Best Practices Guide for AC Power Connections for PowerMax 2000, 8000 with PowerMaxOS* for required items at the customer site.

Best practices: Power configuration guidelines

The following section provides best practice guidelines for evaluating and connecting power, as well as for choosing a UPS component.

Uptime Institute best practices

Follow these best practice guidelines when connecting AC power to the array:

- The Dell customer engineer (CE) should discuss with the customer the need for validating AC power redundancy at each bay. If the power redundancy requirements are not met in each bay, a Data Unavailable (DU) event could occur.
- The customer should complete power provisioning with the data center prior to connecting power to the array.
- The customer‘s electrician or facilities representative must verify that the AC voltage is within specification at each of the power drops being fed to each product bay.
- All of the power drops should be labeled to indicate the source of power (PDU) and the specific circuit breakers utilized within each PDU:
  - Color code the power cables to help achieve redundancy.
  - Clearly label the equipment served by each circuit breaker within the customer PDU.
- The electrician or facilities representative must verify that there are two power drops fed from separate redundant PDUs prior to turning on the array:
  - If both power drops to a bay are connected to the same PDU incorrectly, a DU event will result during normal data center maintenance when the PDU is switched off. The label on the power cables depicts the correct connection.
- The electrician should pay particular attention to how each PDU receives power from each UPS within the data center because it is possible to create a scenario where turning off a UPS for maintenance could cause both power feeds to a single bay to be turned off, creating a DU event.
- The customer’s electrician should perform an AC verification test by turning off the individual circuit breakers feeding each power zone within the bay, while the customer engineer monitors the LED on the SPS modules to verify that power redundancy has been achieved in each bay.

One customer PDU should never supply both power zone feeds to any one rack of equipment.

AC power specifications

Table 22. Input power requirements - Single-phase, North American, International, Australian

Specification	North American 3-wire connection (2 L & 1 G) L = line or phase, N = neutral, G = ground	International and Australian 3-wire connection (1 L & 1 N & 1 G) L = line or phase, N = neutral, G = ground
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.	

Table 23. Input power requirements - Three-phase, North American, International, Australian

Specification	North American 4-wire connection (3 L & 1 G) L = line or phase, N = neutral, G = ground	International 5-wire connection (3 L & 1 N & 1 G) L = line or phase, N = neutral, G = ground
Input voltage[a]	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. 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.

Power cords

Dell power cords connect each storage bay's PDU to the customer's power source. The power cords offer different interface connector options. The number of cords needed is determined by the number of bays in the array and the type of input power source used (single-phase or three-phase).

Single-phase

The following table describes the power cords for single-phase power transmission. Each power cord model contains two (2) 15FT (4.57M) cords.

Single-phase powered systems use a jumper, PN 038-004-186. See PowerMax 2000 line cord and jumper configurations on page 43 and PowerMax 8000 line cord and jumper configurations on page 46 for line cord and jumper configurations.

NOTE: The ordering system defaults to one of the power cord models based on the country of installation. The default value can be overridden in the ordering system.

Table 24. Power cords – Single-phase

Power cord models	Power cable part numbers	Description	Dell power cord plug	Customer PDU receptacle
PowerMax 2000: EH-PW40UASTL PowerMax 8000: EZ-PW40UASTL	038-004-776 (Black) 038-004-777 (Gray)	32A 1PHASE AUSIP57 CLIPSAL 56PA332 (Australia only)	CLIPSAL 56PA332 	CLIPSAL 56CSC332 
PowerMax 2000: EH-PW40UIEC3 PowerMax 8000: EZ-PW40UIEC3	038-004-774 (Black) 038-004-775 (Gray)	32A 1PHASE INTERNATNLIEC309-332P6 (Outside North America, Japan, Australia)	IEC-309 332P6 	IEC-309 332C6 
PowerMax 2000: EH-PW40URUS PowerMax 8000: EZ-PW40URUS	038-004-228 (Black) 038-004-296 (Gray)	30A 1PH RUSSELLSTOLL 3750DP (North America only)	Russellstoll 3750DP 	Russellstoll 9C33U0 
PowerMax 2000: EH-PW40U-US PowerMax 8000: EZ-PW40U-US	038-004-222 (Black) 038-004-293 (Gray)	30A 1PHASE L6-30P (North America only)	NEMA L6-30P 	NEMA L6-30R 
PowerMax 2000, PowerMax 8000: EHZ-1P-L630P-PSE	038-005-039 (Black) 038-005-040 (Gray)	30A 1PHASE L630-P (Japan only)	L630-P 	L630-C 

Three-phase Wye

The following table describes the power cords for three-phase Wye power transmission. Each power cord model contains two (2) 15FT (4.57M) cords.

PowerMax 2000 systems do not require jumpers for three-phase power. PowerMax 8000 systems use a jumper, PN 038-004-481, for three-phase Wye. See PowerMax 8000 line cord and jumper configurations on page 46 for line cord and jumper configurations.

NOTE: The ordering system defaults to one of the power cord models based on the country of installation. The default value can be overridden in the ordering system.

Table 25. Power cords – Three-phase Wye

Power cord models	Power cable part numbers	Description	Dell power cord plug	Customer PDU receptacle
PowerMax 2000: EH-PC3YAFLAI PowerMax 8000: EZ-PC3YAFLAI	038-004-959 (Black) 038-004-960 (Gray)	32A 3PHASE WYE Fly Leads Worldwide	Flying Leads 	Determined by customer
PowerMax 2000: EH-PC3YHBAI PowerMax 8000: EZ-PC3YHBAI	038-004-862 (Black) 038-004-863 (Gray)	N.America/INTL 32 AMP 3PHASE WYE	ABL Sursum - S52S30A or Hubbell - C530P6S (Hubbell is US and international, dual-rated 30 A/32 A) 	ABL Sursum - K52S30A or Hubbell - C530C6S 
PowerMax 2000: EH-PC3YAFLA PowerMax 8000: EZ-PC3YAFLA **NOTE:** These models are being phased out and replaced with models EH-PC3YAFLAI and EZ-PC3YAFLAI.	038-002-499 (Black) 038-002-500 (Gray)	32A 3PHASE WYE CORD SET IEC309-AMERICA UL Listed for use in North America	Flying Leads 	Determined by customer
PowerMax 2000: EH-PC3YAFLE PowerMax 8000: EZ-PC3YAFLE **NOTE:** These models are being phased out and replaced with models EH-PC3YAFLAI and EZ-PC3YAFLAI.	038-002-499 (Black) 038-002-500 (Gray)	32A 3PHASE WYE CRD SET FLY LEAD EUROPE	Flying Leads (International) 	Determined by customer
PowerMax 2000: EH-PCBL3YAG PowerMax 8000: EZ-PCBL3YAG	038-004-778 (Black) 038-004-779 (Gray)	INTL 3PHASE 32 AMP IEC309 TO GARO	ABL Sursum - S52S30A or Hubbell - C530P6S (Hubbell is US and international, dual-rated 30 A/32 A)	ABL Sursum - K52S30A or Hubbell -

Table 25. Power cords – Three-phase Wye (continued)

Power cord models	Power cable part numbers	Description	Dell power cord plug	Customer PDU receptacle
NOTE: These models are being phased out and replaced with models EH-PC3YHBAI and EZ-PC3YHBAI.				C530C6S 

Three-phase Delta

The following table describes the power cords for three-phase Delta power transmission. Each power cord model contains two (2) 15FT (4.57M) cords.

PowerMax 2000 systems do not require jumpers for three-phase power. PowerMax 8000 systems use a jumper, PN 038-004-435, for three-phase Delta. See PowerMax 8000 line cord and jumper configurations on page 46 for line cord and jumper configurations.

The ordering system defaults to one of the power cord models based on the country of installation. The default value can be overridden in the ordering system.

Table 26. Power cords – Three-phase Delta

Power cord models	Power cable part numbers	Description	Dell power cord plug	Customer PDU receptacle
PowerMax 2000: EH-PCBL3DHH PowerMax 8000: EZ-PCBL3DHH	038-004-431 (Black) 038-004-432 (Gray)	PWR CBL HBL-HBL 3D	Hubbell CS-8365L 	Hubbell CS-8364 
PowerMax 2000: EH-PCBL3DHR PowerMax 8000: EZ-PCBL3DHR	038-004-433 (Black) 038-004-434 (Gray)	PWR CBL HBL-RSTOL 3D	Russellstoll 9P54U2 	Russellstoll 9C54U2 

PowerMax 2000 line cord and jumper configurations

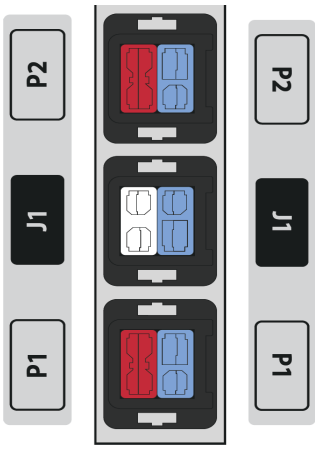
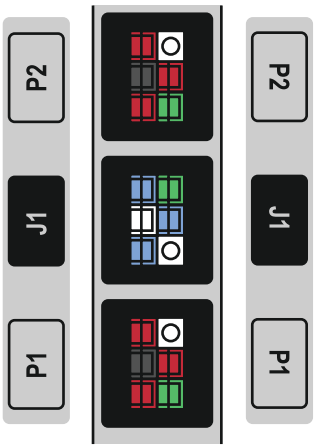
Three-phase power

For a single PowerMax 2000 system in a rack on three-phase power, a line cord in the P1 outlet energizes PDU outlets 1-18 on circuit breakers 1-6. If a second system is added to the rack, you must add a line cord in the P2 outlet to energize PDU outlets 19-37 on circuit breakers 7-12. No jumpers are required for three-phase power.

Table 27. PowerMax 2000 line cord configurations, three-phase

PowerBrick	Components	Line cord location
PowerBrick 2 (Upper System)	DAE 4	No additional line cords required
	DAE 3	
	SPS 2A/2B	
PowerBrick 1 (Upper System)	DAE 2	P2
	DAE 1	
	SPS 3A/3B	
PowerBrick 2 (Lower System)	DAE 4	No additional line cords required
	DAE 3	
	SPS 2A/2B	
PowerBrick 1 (Lower System)	DAE 2	P1
	DAE 1	
	SPS 3A/3B	

Table 28. Input power outlets, three-phase

Three-phase Delta	Three-phase Wye
	
Figure 15. Customer input power outlet, three-phase Delta	**Figure 16. Customer input power outlet, three-phase Wye**

Single-phase power

Each PowerBrick in a PowerMax 2000 system on single-phase power is powered by a separate line cord. Each line cord energizes the circuit breakers and corresponding PDU outlets, as follows:

Table 29. PowerMax 2000 line cord and jumper configurations, single-phase

PowerBrick	Components	Line cord location	Jumper location (from/to)	Circuit breakers	PDU outlets
PowerBrick 2 (Upper System)	DAE 4 DAE 3 SPS 2A/2B	P6	No additional power jumpers required	11-12	31-37
PowerBrick 1 (Upper System)	DAE 2 DAE 1 SPS 3A/3B	P4	J4<>P5 PN: 038-004-186 This jumper must be installed in the field with a second system.	7-10	19-30
PowerBrick 2 (Lower System)	DAE 4 DAE 3 SPS 2A/2B	P3	No additional power jumpers required	5-6	13-18
PowerBrick 1 (Lower System)	DAE 2 DAE 1 SPS 3A/3B	P1	J1<>P2 PN: 038-004-186 This jumper is pre-installed at the factory and should not be removed.	1-4	1-12

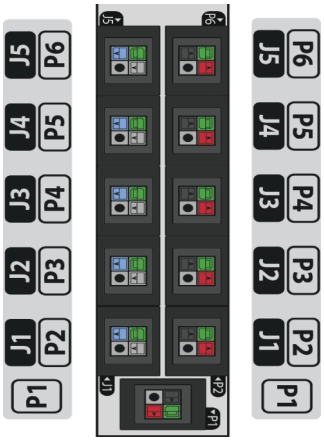


Figure 17. Customer input power outlet, single-phase

PowerMax 8000 line cord and jumper configurations

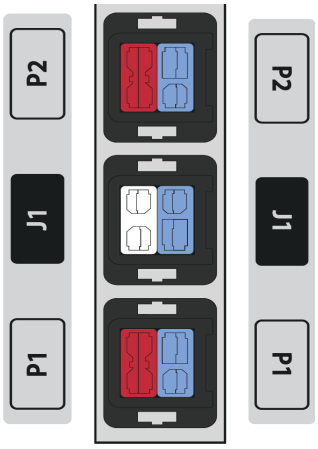
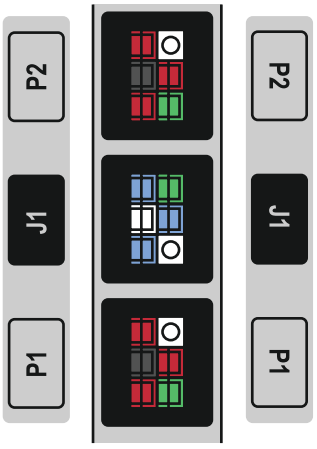
Three-phase power

A PowerMax 8000 system bay on three-phase power requires a line cord in outlet P1 and a power jumper from J1 to P2. The jumper, PN 038-004-435 (3-phase DELTA) or PN 038-004-481 (3-phase WYE), is pre-installed at the factory and should not be removed.

Table 30. PowerMax 8000 line cord configurations, three-phase

PowerBrick	Components	Line cord location
PowerBrick 4/8	DAE 6	No additional line cords required
	SPS 4A/4B	
PowerBrick 3/7	DAE 5	No additional line cords required
	DAE 4	
	SPS 3A/3B	
PowerBrick 2/6	DAE 3	No additional line cords required
	SPS 2A/2B	
PowerBrick 1/5	DAE 2	P1
	DAE 1	
	MIBE A/B (PowerBrick 1 ONLY)	
	Ethernet switch A/B (PowerBrick 1 ONLY)	
	SPS 1A/1B	

Table 31. Input power outlets, three-phase

Three-phase Delta	Three-phase Wye
	
Figure 18. Customer input power outlet, three-phase Delta	**Figure 19. Customer input power outlet, three-phase Wye**

Single-phase power

In a PowerMax 8000 system on single-phase power, line cords are required in outlets P1, P3 and P5 depending on the number of PowerBricks in the system. Refer to PowerMax 8000 line cord configurations, single-phase on page 47 for the location of the line cords required for each PowerBrick.

Two jumpers, PN 038-004-186, are pre-installed at the factory and should not be removed. Jumpers are located in the following locations:

- J1<>P2
- J5<>P6

Each line cord energizes the circuit breakers and corresponding PDU outlets as follows:

Table 32. PowerMax 8000 line cord configurations, single-phase

PowerBrick	Components	Line cord location	Circuit breakers	PDU outlets
PowerBrick 4/8	DAE 6	No additional line cords required	--	--
	SPS 4A/4B			
PowerBrick 3/7	DAE 5	P5	9-12	25-37
	DAE 4			
	SPS 3A/3B			
PowerBrick 2/6	DAE 3	P3	5-6	13-18
	SPS 2A/2B			
PowerBrick 1/5	DAE 2	P1	1-4	1-12
	DAE 1			
	MIBE A/B (PowerBrick 1 ONLY)			
	Ethernet switch A/B (PowerBrick 1 ONLY)			
	SPS 1A/1B			

NOTE: Circuit breakers 7-8 and PDU outlets 19-24 are not energized on a PowerMax 8000 system with single-phase power.

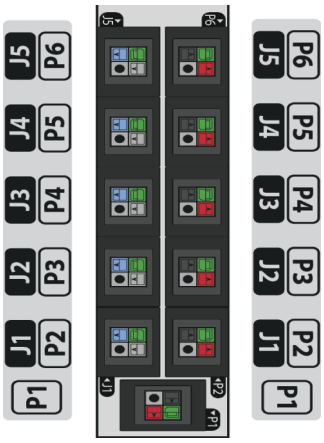


Figure 20. Customer input power outlet, single-phase

9

Grounding Racks

Supplemental rack grounding is not required for single bay configurations. Chassis to chassis grounding is required for systems with multiple bays.

Topics:

- Grounding requirements
- Grounding a single bay
- Chassis to chassis grounding

Grounding requirements

The following table summarizes rack grounding requirements for PowerMax systems.

Table 33. Grounding requirements

Number of racks in the system	Grounding required?	Reference
1	No	Grounding a single bay on page 48
2+	Yes	Chassis to chassis grounding on page 49

Grounding a single bay

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

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.

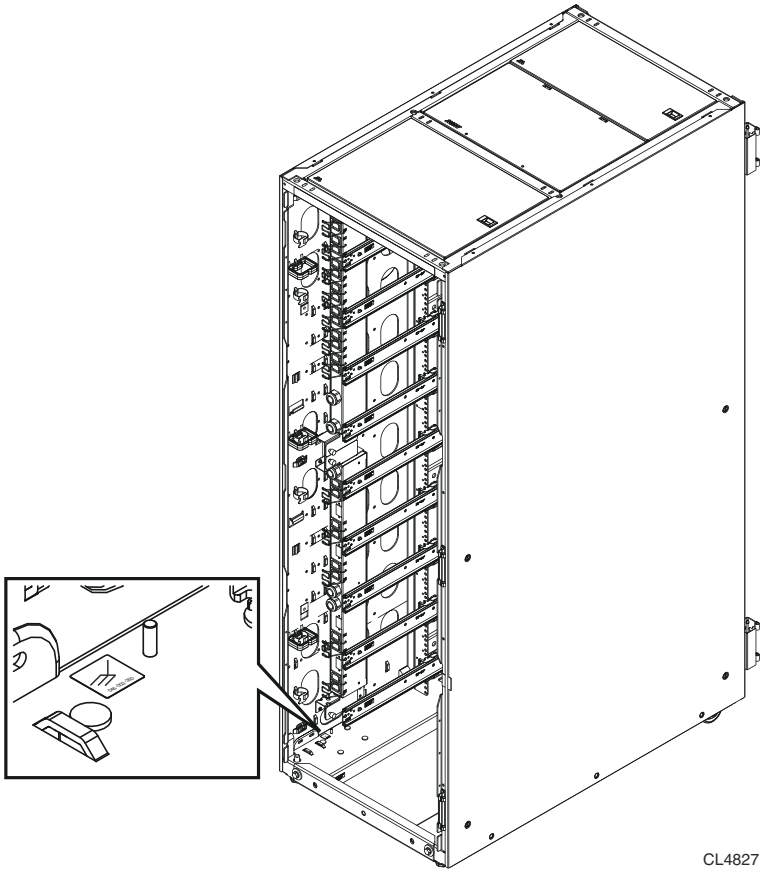


Figure 21. Location of cabinet ground lugs

Chassis to chassis grounding

Rack to rack chassis ground connections are required to mitigate the risk of large AC power transients in the data center affecting system performance. Large AC power transients can occur from one or a combination of: electrical power grid problems feeding a facility; weak facility grounding; powerful lightning storm strikes; or facility power equipment failure.

In multiple bay Dell rack systems, use the rack to rack grounding kit, PN 106-562-209, to provide chassis to chassis grounding. The kit provides straps for both the front and rear of the cabinets. Both straps must be installed to provide chassis to chassis grounding.

In customer rack systems, mechanisms for tying racks together to provide the ground connection can vary based on the rack provided by the customer and site facility preference. PN 106-562-209 is a rack to rack grounding kit for Dell racks. The grounding kit may or may not work on racks provided by the customer due to the variety of ground location positions on racks. If the grounding kit does not work, a site electrician should add a ground cable tying the two racks common frame ground points together with 6AWG wire.

10

Dell Racking for PowerMax 2000

A single rack can contain two distinct systems.

Topics:

- Two system configurations
- Requirements for customer components in a Dell rack

Two system configurations

Two PowerMax 2000 systems can be installed in a rack. Each system can have one or two PowerBricks. The second system must be installed as a field upgrade option.

PowerMax 2000 systems in a Dell rack must conform to the following requirements:

- Lower system: 1U - 20U
- Upper system 21U - 40U

The following diagrams illustrate possible configurations for two PowerMax 2000 systems in a Dell rack.

Two PowerMax 2000 systems - 1 PowerBrick + 1 PowerBrick configuration

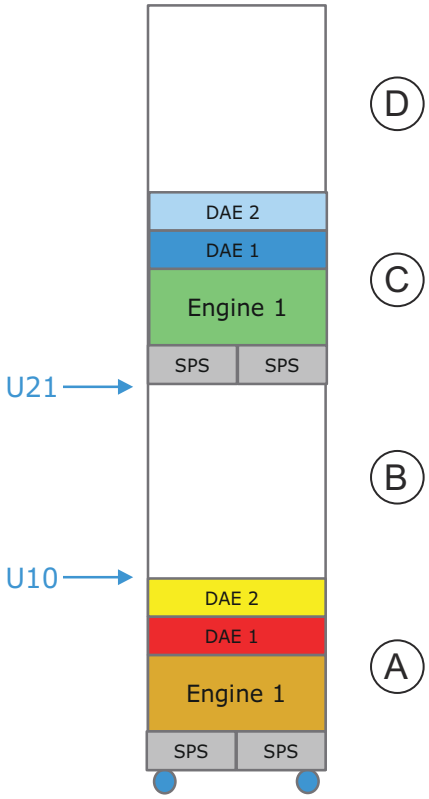


Figure 22. Two PowerMax 2000 systems - 1 PowerBrick + 1 PowerBrick configuration

Table 34. Stack up key

Key	Description
A	Lower system
B	Space for second PowerBrick, lower system
C	Upper system
D	Space for second PowerBrick, upper system

Two PowerMax 2000 systems - 2 PowerBrick + 2 PowerBrick configuration

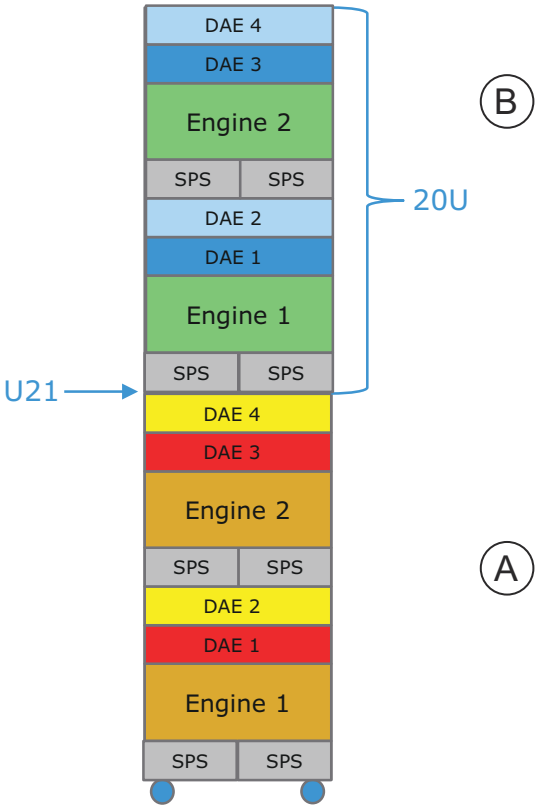


Figure 23. Two PowerMax 2000 systems - 2 PowerBrick + 2 PowerBrick configuration

Table 35. Stack up key

Key	Description
A	Lower system
B	Upper system

Two PowerMax 2000 systems - 2 PowerBrick + 1 PowerBrick configuration

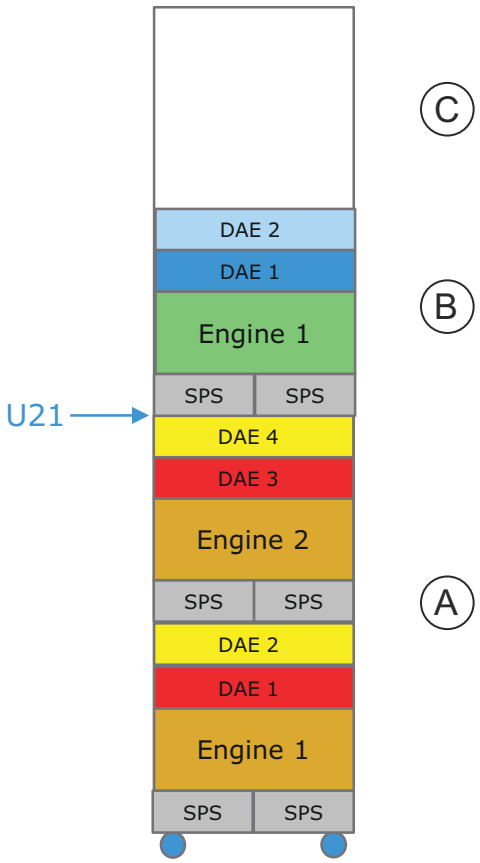


Figure 24. Two PowerMax 2000 systems - 2 PowerBrick + 1 PowerBrick configuration

Table 36. Stack up key

Key	Description
A	Lower system
B	Upper system
C	Space for second PowerBrick, upper system

Two PowerMax 2000 systems - 1 PowerBrick + 2 PowerBrick configuration

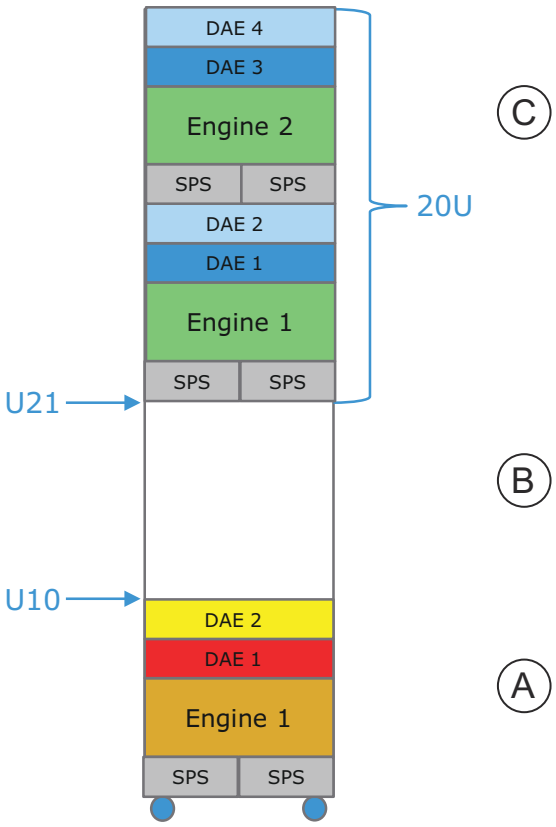


Figure 25. Two PowerMax 2000 systems - 1 PowerBrick + 2 PowerBrick configuration

Table 37. Stack up key

Key	Description
A	Lower system
B	Space for second PowerBrick, lower system
C	Upper system

Requirements for customer components in a Dell rack

Customer components can coexist in a rack with a PowerMax 2000 system. The system must be properly positioned within the rack in accordance with the following rules:

- Dell equipment should stack from the bottom of the rack. Customer equipment must be positioned between U21 and U40.
- A system must exist within contiguous space. Customer equipment must be above a PowerMax 2000 system and not interwoven within the system.
- All customer equipment must be electrically isolated and powered by the upper half of the PDUs and powered by separate power cords. The power cord pairs listed in Power cords on page 39 are available as optional models.
- Racks with two PowerMax 2000 systems cannot have customer components installed in the rack.

11

Third Party Racking Option for PowerMax 2000

The PowerMax 2000 can be installed in a third party rack if computer room, rack and PDU requirements are met.

Topics:

- System room requirements
- Customer rack requirements
- Requirements for customer components in a customer rack
- Third-party rack PDUs

System room requirements

The following system room requirements provide service access and minimize physical disruption:

- A minimum of 42 in (107 cm) front clearance and 30 in (76 cm) rear clearance is required to provide adequate airflow and to allow for system service.

Customer rack requirements

The array components are fully tested at the factory and then transferred to the shipping rack for shipping. Only Customer Support engineers are authorized to install the system into a customer rack. The original shipping rack, when empty, is returned after the installation is complete.

To ensure successful installation and secure component placement, customer racks must conform to the following requirements:

- The National Electrical Manufacturers Association (NEMA) standard for 19-inch cabinets.
- Racks must be at least 38 inches deep as measured from the surface of the front NEMA rail to the rear rack post, and provide 24 to 32-inch front-to-rear NEMA rail depth.
- Systems require a minimum of 10U of continuous space for one PowerBrick (minimum configuration). 20U of continuous space is required for two PowerBricks (maximum configuration).
- Threaded hole racks are not supported.
- The customer rack must have two redundant, customer-supplied PDUs installed, one on each side. Each must be connected to customer power.
- The customer rack must support a minimum 850 lbs (385 kg) of weight plus the weight of any third-party components within the rack.

  NOTE: The customer must ensure that floor load-bearing requirements are met.

- After installation, components and cables within the rack cannot be moved to available space in a different rack or to a different location within the same rack.
- Systems must be properly positioned within the rack in accordance with the following physical placement rules:
  - Customer equipment can co-exist within the same rack. The preferred stack up is for the Dell array to stack from the bottom of the rack and customer equipment from the top of the rack.
  - A Dell system must exist within contiguous space. Customer equipment can be below or above the system, but not interwoven within the system. A single PowerBrick system must occupy 10U of continuous space, and a dual PowerBrick system must occupy 20U of continuous space in the rack.
- Two, independent Dell systems can co-exist in a rack. The recommended configuration is:
  - Lower system: 1U - 20U
  - Upper system 21U - 40U

- Round or square channel openings must support M5 screws that secure rails and components. Clip nuts are provided as required.
- All array components must have proper clearance and air flow. Customer-supplied front doors and standard bezels must include a minimum of 2.5 in (6.3 cm) clearance between the back surface of the door to the front surface of the vertical NEMA rails. Front and rear doors must also provide:
  - A minimum of 60% (evenly distributed) air perforation openings
  - Appropriate access for service personnel, with no items that prevent front or rear access to components
  - Exterior visibility of system LEDs

Requirements for customer components in a customer rack

Customer components can coexist in a rack with a PowerMax 2000 system. The system must be properly positioned within the rack in accordance with the following rules:

- Dell equipment should stack from the bottom of the rack. Customer equipment must be positioned between U21 and U40.
- A system must exist within contiguous space. Customer equipment must be above a PowerMax 2000 system and not interwoven within the system.
- All customer equipment must be electrically isolated and powered by the upper half of the PDUs and powered by separate power cords. The power cord pairs listed in Power cords on page 39 are available as optional models.
- Racks with two PowerMax 2000 systems cannot have customer components installed in the rack.

Third-party rack PDUs

Redundant power distribution units (PDUs) power each system bay. There is one PDU for each power zone. The general requirements for third-party racks with vertical rear-facing or inward-facing PDUs are listed below.

General requirements for vertical PDUs within third-party racks

In addition to meeting standard PowerMax array power requirements, PDUs should abide by the following:

- Both PDUs support AC-line input connectivity and provide outlets for every component in the bay.
- The PDU must be available in the wiring configuration that matches the customer input power configuration. Options include:
  - Single-phase
  - Three-phase Delta
  - Three-phase Wye (International and Domestic)
- Each PDU should meet the following requirements:
  - At a minimum, three (3) C13 power outlets per PowerBrick must be provided.
  - A single two-pole 20 Amp circuit breaker protects each bank of outlets that is connected to individual branch circuits.
  - The PDU capacity should exceed the power requirements that are shown in the tables in PowerMax 2000 power consumption and outlet requirements on page 57 for the specific maximum configuration.
  - The PDU is mounted symmetrically on each side of a rack.

If the customer requires power to be supplied from overhead, Dell recommends one of the following:

- Option 1: If possible, route the power cables from inside the machine through the top of the rack.
- Option 2: "Drop" the power cables down the hinge side, to the bottom, and route them inside the machine.

In either case, dress the power cables to the side walls so they do not get in the way of service. The cables should be dressed to allow all doors to open freely, minimize cable congestion, and provide access to components within the system.

PowerMax 2000 power consumption and outlet requirements

Power values are shown at >35°C to reflect the higher power levels associated with both the battery recharge cycle and the initiation of high ambient temperature adaptive cooling algorithms. Power consumption is listed as the combined value for zone A and zone B outlets together.

NOTE: Engine power cables connect to each SPS, not to PDU outlets.

Table 38. PowerMax 2000: Power consumption for 1 PowerBrick

PowerBrick	Component	Number of C13 outlets required		Maximum total power consumption > 35°C (VA)
		Zone A	Zone B	Zone A + Zone B
PowerBrick 1	DAE 2	1	1	649
	DAE 1	1	1	681
	Engine 1 + SPS	1	1	1769
TOTALS		3	3	3099

Table 39. PowerMax 2000: Power consumption for 2 PowerBricks

PowerBrick	Component	Number of C13 outlets required		Maximum total power consumption > 35°C (VA)
		Zone A	Zone B	Zone A + Zone B
PowerBrick 2	DAE 4	1	1	649
	DAE 3	1	1	681
	Engine 2 + SPS	1	1	1737
PowerBrick 1	DAE 2	1	1	649
	DAE 1	1	1	681
	Engine 1 + SPS	1	1	1769
TOTALS		6	6	6166

PowerMax 2000 rear-facing PDU requirements

If using a rear-facing PDU within a third-party rack, refer to the diagram below to ensure that the minimum width (F) and depth (A) of the rack and PDU combination are sufficient for the array.

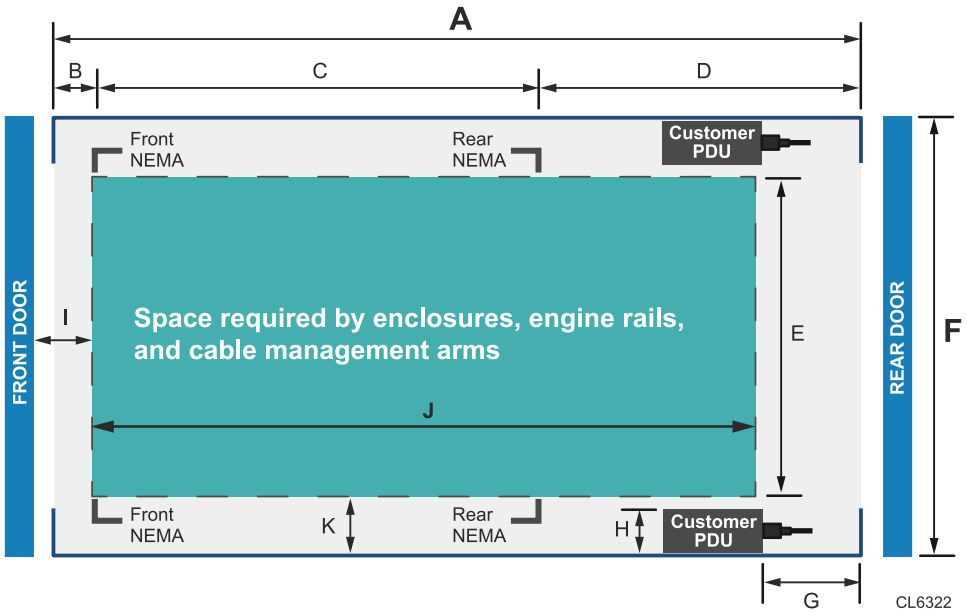


Figure 26. PowerMax 2000: Minimum requirements for third-party racks with rear-facing PDUs

Table 40. Key

Key	Description	Minimum distance (in / cm)
A	Minimum depth of the rack. Total value of **B+C+D** in the diagram.	-
B	Distance between the front surface of the rack post and the NEMA rail.	-
C	Distance between the NEMA rails.	24 / 61
D	Distance between the rear NEMA rails to the exterior, rear surface of the rack.	14 / 35.6
E	NEMA rail spacing.	19 / 48.3
F	Minimum width of the rack. Total value of **E+K+K** in the diagram.	-
G	Distance between the rear-facing surface of the PDU and the surface of the rack post. This space must be large enough to house power cables and route customer host cables.	6 / 15.3
H	PDU width.	-
I	If a front door exists, this is the distance between the back surface of the door and the front surface of the vertical NEMA rail. Space is required to provide clearing for bezel airflow.	2.5 / 6.4
J	Space required for enclosures, rails, and cable management arms.	37 / 94
K	Distance between the rack wall and the NEMA rail spacing. This space must be large enough for the PDU to fit.	-

PowerMax 2000 inward-facing PDU requirements

If using an inward-facing PDU within a third-party rack, refer to the diagram below to ensure that the minimum width (F) and depth (A) of the rack and PDU combination are sufficient for the array. Inward-facing PDUs may encroach into the service area and make serviceability more difficult than rear-facing PDUs.

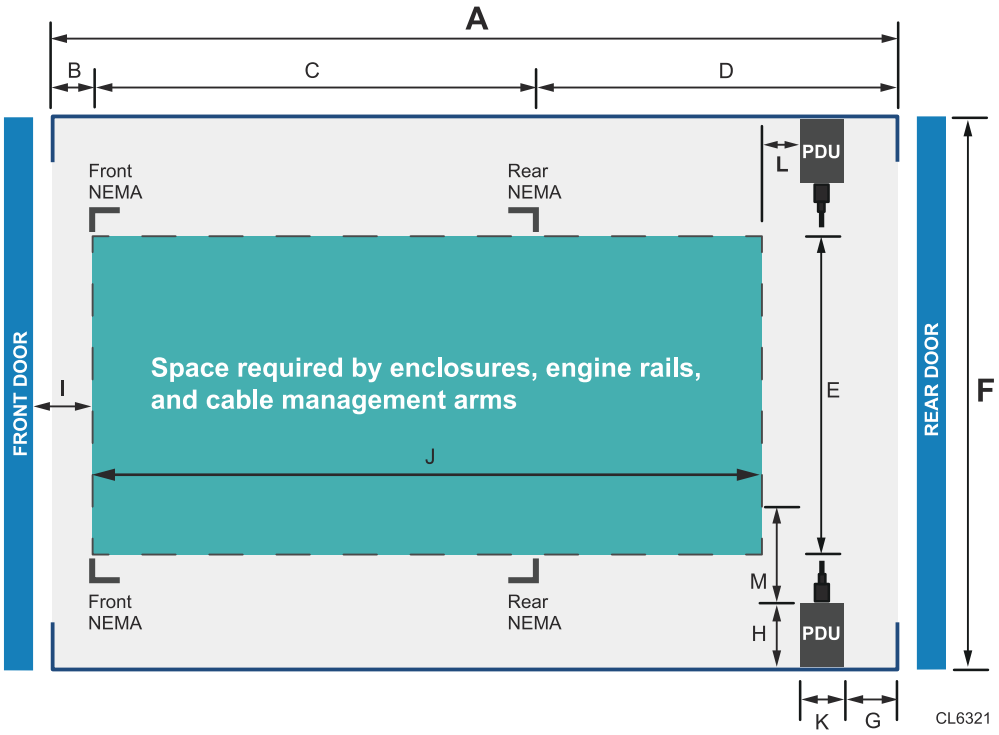


Figure 27. PowerMax 2000: Minimum requirements for third-party racks with inward-facing PDUs

Table 41. Key

Key	Description	Minimum distance (in / cm)
A	Minimum depth of the rack. Total value of **B+J+G+K+L** in the diagram.	-
B	Distance between the front surface of the rack post and the NEMA rail.	-
C	Distance between the NEMA rails.	24 / 61
D	Distance between the rear NEMA rails to the exterior, rear surface of the rack.	17 / 43.2
E	NEMA rail spacing.	19 / 48.3
F	Minimum width of the rack. Total value of **E+H+H+M** in the diagram. Because the AC cable bend radius (M) includes a portion of the equipment enclosure area, only half the distance of (M) on each side of the rack is required to determine the minimum width of the rack. The equation can be thought of as E+H+H+½M+½M.	-
G	Distance between the rear-facing surface of the PDU and the surface of the rack post. This space must be large enough to house power cables and route customer host cables.	3 / 7.7
H	PDU depth from rack sidewall.	-
I	If a front door exists, this is the distance between the back surface of the door and the front surface of the vertical NEMA rail. Space is required to provide clearing for bezel airflow.	2.5 / 6.4
J	Space required for enclosures, rails, and cable management arms.	37 / 94

Table 41. Key (continued)

Key	Description	Minimum distance (in / cm)
K	PDU width.	-
L	Distance from the equipment enclosure area to the front-facing side of the PDU.	0.1 / 0.26
M	AC cable bend radius. The bend radius is expected to encroach into the equipment enclosure area.	4 / 10.2

12

Third Party Racking Option for PowerMax 8000

The PowerMax 8000 can be installed in a third party rack if computer room, rack and PDU requirements are met.

Topics:

- Computer room requirements
- Customer rack requirements
- Third-party rack PDUs

Computer room requirements

The following computer room requirements provide service access and minimize physical disruption:

- To ensure integrity of cables and connections, do not move racks that are secured (bolted) together after installation.
- A minimum of 42 inches (107 cm) front and 30 inches (76 cm) rear clearance is required to provide adequate airflow and to allow for system service.

Customer rack requirements

The array components are fully tested at the factory and then transferred to miniracks for shipping. Only customer support engineers are authorized to install the system into a customer rack. The original shipping rack, when empty, is returned after the installation is complete.

To ensure successful installation and secure component placement, customer racks must conform to the following requirements:

- National Electrical Manufacturers Association (NEMA) standard for 19-inch cabinets.
- Individual racks must be empty at the time of installation.
- Threaded hole racks are not supported.
- The cabinet must be in its final location with stabilizing (anti-tip) brackets installed.
- A separate rack that supports a minimum 1,300 lb/590 kg of equipment weight must be provided for each system bay.

  NOTE: The customer must ensure floor load-bearing requirements are met.

- Components and cables that are installed in customer racks must conform to these configuration rules:
  - The stack up must adhere to the standard configuration. Components and cables within a system bay cannot be moved to available space in a different bay, or to a different location within the same bay.
  - The system must be properly positioned in accordance with physical placement rules.
- The internal depth with the front and rear doors closed must meet minimum requirements for either rear-facing or inward-facing PDUs. This measurement is from the front surface of the NEMA rail to the rear door.
  - Rear-facing PDUs: Minimum 42" depth
  - Inward-facing PDUs: Minimum 44" depth
- Round or square channel openings must support M5 screws that secure rails and components. Clip nuts are provided as required.
- Nondispersed rack-to-rack pass-through cable access of at least 3 in. (7.6 cm) in diameter must be available from side panels or horizontal through openings.
- To ensure proper clearance and air flow to the array components, customer supplied front doors and standard bezels, if used, must include a minimum of 2.5 inch (6.35 cm) clearance between the back surface of the door to the front surface of the vertical NEMA rails. Front and rear doors must also provide:
  - A minimum of 60% (evenly distributed) air perforation openings.
  - Appropriate access for service personnel, with no items that prevent front or rear access to Dell components.

- Exterior visibility of system LEDs.

Third-party rack PDUs

Redundant power distribution units (PDUs) power each system bay. There is one PDU for each power zone. The general requirements for third-party racks with vertical rear-facing or inward-facing PDUs are listed below.

General requirements for vertical PDUs within third-party racks

In addition to meeting standard PowerMax array power requirements, PDUs should abide by the following:

- Both PDUs support AC-line input connectivity and provide outlets for every component in the bay.
- The PDU must be available in the wiring configuration that matches the customer input power configuration. Options include:
  - Single-phase
  - Three-phase Delta
  - Three-phase Wye (International and Domestic)
- PowerMax 8000 power consumption and outlet requirements on page 64 details the number of C13 outlets that are required for each PowerBrick. Each PDU should meet the following requirements:
  - A single two-pole 20 Amp circuit breaker protects each bank of outlets that is connected to individual branch circuits.
  - The PDU capacity should exceed the power requirements that are shown in the tables in PowerMax 8000 power consumption and outlet requirements on page 64 for the specific maximum configuration.
  - The PDU is mounted symmetrically on each side of a rack.

If the customer requires power to be supplied from overhead, Dell recommends one of the following:

- Option 1: If possible, route the power cables from inside the machine through the top of the rack.
- Option 2: "Drop" the power cables down the hinge side, to the bottom, and route them inside the machine.

In either case, dress the power cables to the side walls so they do not get in the way of service. The cables should be dressed to allow all doors to open freely, minimize cable congestion, and provide access to components within the system.

PowerMax 8000 power consumption and outlet requirements

Power values are shown at >35°C to reflect the higher power levels that are associated with both the battery recharge cycle and the initiation of high ambient temperature adaptive cooling algorithms. Power consumption is listed as the combined value for zone A and zone B outlets together.

NOTE: Engine and MIBE power cables connect to SPS components, not to PDU outlets.

Table 42. PowerMax 8000: Power consumption for System Bay 1

PowerBrick	Component	Number of C13 outlets required		Maximum total power consumption > 35°C (VA)
		Zone A	Zone B	Zone A + Zone B
PowerBrick 4	DAE 6	1	1	681
	Engine 4 + SPS	1	1	1860
TOTALS FOR PowerBrick 4		2	2	2541
PowerBrick 3	DAE 5	1	1	584
	DAE 4	1	1	681
	Engine 3 + SPS	1	1	1860
TOTALS FOR PowerBrick 3		3	3	3125
PowerBrick 2	MIBE	0	0	300
	Engine 2 + SPS	1	1	1860
	DAE 3	1	1	681
TOTALS FOR PowerBrick 2		2	2	2841
PowerBrick 1	Service tray	0	1	100
	Ethernet switches	1	1	30
	Engine 1 + SPS	1	1	1893
	DAE 2	1	1	584
	DAE 1	1	1	681
TOTALS FOR PowerBrick 1		4	5	3288
TOTALS FOR SYSTEM BAY 1		11	12	11795

Table 43. PowerMax 8000: Power consumption for System Bay 2

PowerBrick	Component	Number of C13 outlets required		Maximum total power consumption > 35°C (VA)
		Zone A	Zone B	Zone A + Zone B
PowerBrick 8	DAE 6	1	1	681
	Engine 8 + SPS	1	1	1860
TOTALS FOR PowerBrick 8		2	2	2541
PowerBrick 7	DAE 5	1	1	584
	DAE 4	1	1	681
	Engine 7 + SPS	1	1	1860
TOTALS FOR PowerBrick 7		3	3	3125
PowerBrick 6	Engine 6 + SPS	1	1	1860
	DAE 3	1	1	681

Table 43. PowerMax 8000: Power consumption for System Bay 2 (continued)

PowerBrick	Component	Number of C13 outlets required		Maximum total power consumption > 35°C (VA)
		Zone A	Zone B	Zone A + Zone B
TOTALS FOR PowerBrick 6		2	2	2541
PowerBrick 5	Engine 5 + SPS	1	1	1860
	DAE 2	1	1	584
	DAE 1	1	1	681
TOTALS FOR PowerBrick 5		3	3	3125
TOTALS FOR SYSTEM BAY 2		10	10	11332

PowerMax 8000 rear-facing PDU requirements

If using a rear-facing PDU within a third-party rack, refer to the diagram below to ensure that the minimum width (F) and depth (A) of the rack and PDU combination are sufficient for the array.

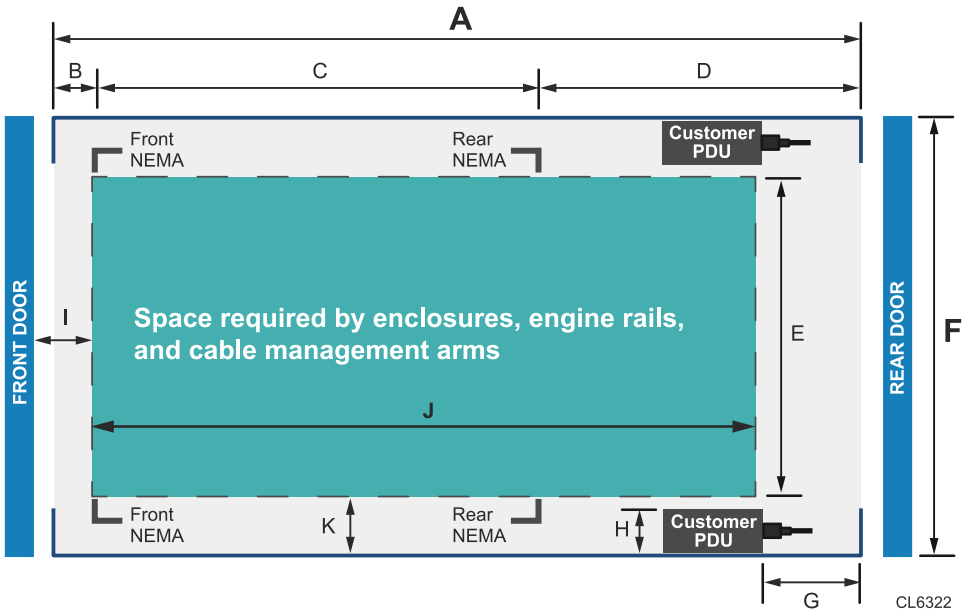


Figure 28. PowerMax 8000: Minimum requirements for third-party racks with rear-facing PDUs

Table 44. Key

Key	Description	Minimum distance (in / cm)
A	Minimum depth of the rack. Total value of **B+C+D** in the diagram.	-
B	Distance between the front surface of the rack post and the NEMA rail.	-
C	Distance between the NEMA rails.	24 / 61
D	Distance between the rear NEMA rails to the exterior, rear surface of the rack.	18 / 45.8
E	NEMA rail spacing.	19 / 48.3
F	Minimum width of the rack. Total value of **E+K+K** in the diagram.	-
G	Distance between the rear-facing surface of the PDU and the surface of the rack post. This space must be large enough to house power cables and route customer host cables.	6 / 15.3
H	PDU width.	-
I	If a front door exists, this is the distance between the back surface of the door and the front surface of the vertical NEMA rail. Space is required to provide clearing for bezel airflow.	2.5 / 6.4
J	Space required for enclosures, rails, and cable management arms.	41 / 104.2
K	Distance between the rack wall and the NEMA rail spacing. This space must be large enough for the PDU to fit.	-

PowerMax 8000 inward-facing PDU requirements

If using an inward-facing PDU within a third-party rack, refer to the diagram below to ensure that the minimum width (F) and depth (A) of the rack and PDU combination are sufficient for the array. Inward-facing PDUs may encroach into the service area and make serviceability more difficult than rear-facing PDUs.

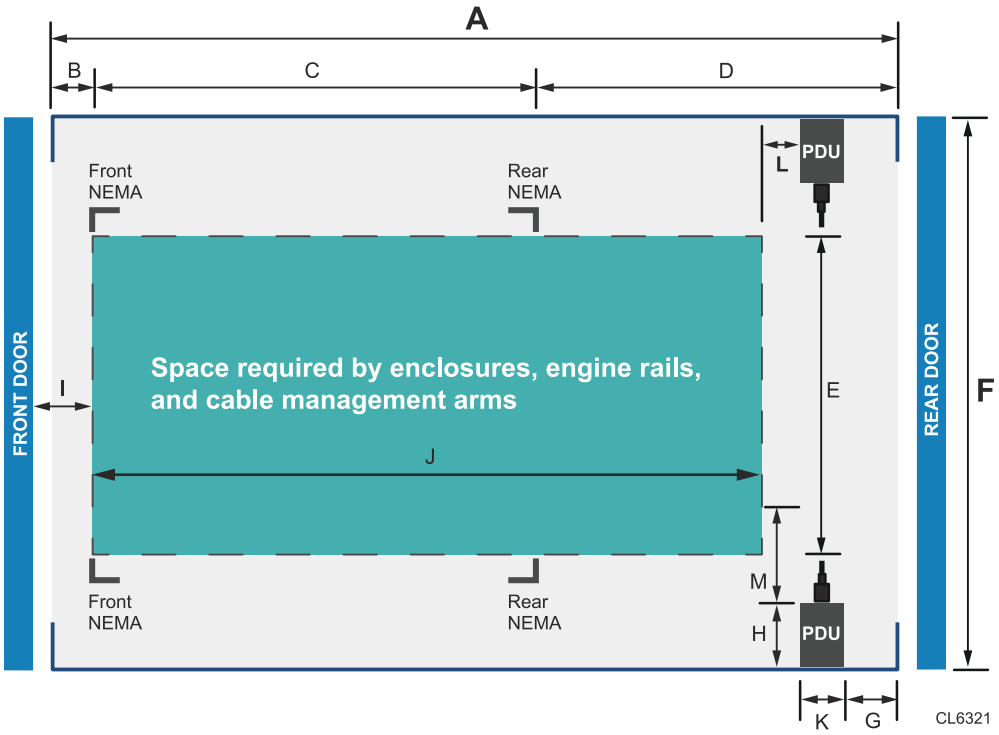


Figure 29. PowerMax 8000: Minimum requirements for third-party racks with inward-facing PDUs

Table 45. Key

Key	Description	Minimum distance (in / cm)
A	Minimum depth of the rack. Total value of **B+J+G+K+L** in the diagram.	-
B	Distance between the front surface of the rack post and the NEMA rail.	-
C	Distance between the NEMA rails.	24 / 61
D	Distance between the rear NEMA rails to the exterior, rear surface of the rack.	20 / 50.8
E	NEMA rail spacing.	19 / 48.3
F	Minimum width of the rack. Total value of **E+H+H+M** in the diagram. Because the AC cable bend radius (M) includes a portion of the equipment enclosure area, only half the distance of (M) on each side of the rack is required to determine the minimum width of the rack. The equation can be thought of as E+H+H+½M+½M.	-
G	Distance between the rear-facing surface of the PDU and the surface of the rack post. This space must be large enough to house power cables and route customer host cables.	3 / 7.7
H	PDU depth from rack sidewall.	-
I	If a front door exists, this is the distance between the back surface of the door and the front surface of the vertical NEMA rail. Space is required to provide clearing for bezel airflow.	2.5 / 6.4
J	Space required for enclosures, rails, and cable management arms.	41 / 104.2

Table 45. Key (continued)

Key	Description	Minimum distance (in / cm)
K	PDU width.	-
L	Distance from the equipment enclosure area to the front-facing side of the PDU.	0.1 / 0.26
M	AC cable bend radius. The bend radius is expected to encroach into the equipment enclosure area.	4 / 10.2

13

Optional Kits

Optional kits are available for top cable routing, to secure single and multiple cabinets, and for dispersed layouts (PowerMax 8000 only).

Topics:

- Overhead routing kit
- Securing kits
- Dispersion kits

Overhead routing kit

When installing an array in non-raised or raised floor environments, the host cabling and power are handled from overhead using the top routing kit.

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

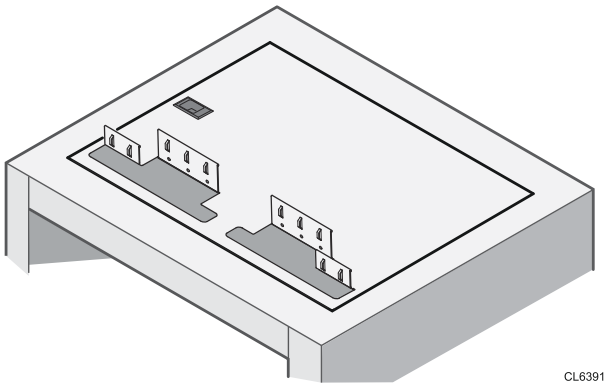


Figure 30. Top routing cover

Table 46. Overhead routing models

Model	Top Routing Kit	SKU#	Description	Part Number
PowerMax 2000	EH-TOP-KIT	783-BBBK	PowerMax 2000 TOP ROUTING KIT	106-886-065
PowerMax 8000	EZ-TOP-KIT	783-BBBO	PowerMax 8000 TOP ROUTING KIT	106-887-232

Securing kits

The securing kits contain heavy brackets plus hardware that is used to attach the brackets to the frames of the system bays. The brackets are attached to the floor using bolts that engage the flooring substructure that the customer provides.

The *Dell EMC VMAX Securing Kit Installation Guide* provides installation instructions.

Table 47. Securing kits

Model	Securing Kit	SKU#	Description	Part Number
PowerMax 2000	EH-SECURE	783-BBBM	Secure kit for single bay	100-561-959
	EH-SECUREJK	738-BBBN	Secure kit for joining bays	100-886-049
PowerMax 8000	EZ-SECURE	783-BBBQ	Secure kit for single bay	106-887-024
	EZ-SECUREADD	783-BBBR	Secure kit for joining bays	106-887-025

Dispersion kits

PowerMax 8000 systems with dispersed layouts use 98.4 ft (30m) optical cable bundles (single cable and spare) to connect SIBs to the MIBE and 98.4 ft (30m) copper Ethernet cable bundles (single cable and spare) to connect MMs to the Ethernet switches. Cables are routed across the subfloor or ceiling to connect the SIB and MM components in System Bay 2 to the MIBE and Ethernet switches in System Bay 1.

Table 48. Fabric dispersion kits for System Bay 2

Kit Part Number	Description
106-887-147	VMAX EVEREST DISPERSION TRANSCEIVER KIT (1 kit per engine required)
106-887-034	Engine 5 Dispersion Kit 30m (Green)
106-887-035	Engine 6 Dispersion Kit 30m (Blue)
106-887-036	Engine 7 Dispersion Kit 30m (Red)
106-887-037	Engine 8 Dispersion Kit 30m (White)

A

Best Practices for AC Power Connections

Select the proper AC power connection procedure depending on the customer's situation on site.

Topics:

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

Best practices overview for AC power connections

External AC power must be supplied from independent, customer-supplied, power distribution units (PDUs) to assure fault-tolerant power. See Two independent customer-supplied PDUs on page 72.

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. Two independent power sources provide the highest level of redundancy and system availability. If independent AC power is not available, there is a higher risk of data unavailability if a power failure occurs, including individual phase loss 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.

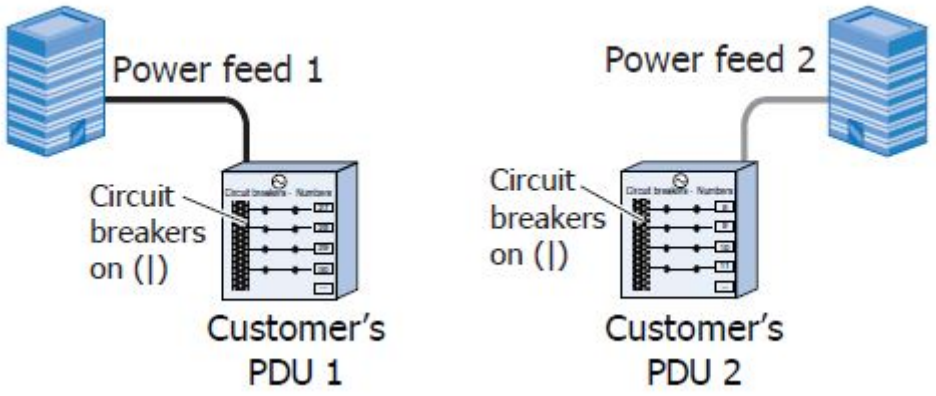


Figure 31. Two independent customer-supplied PDUs

Selecting the proper AC power connection procedure

The Dell 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 situation.

Table 49. Procedure options for AC power connection

Situation on site	Procedure
The customer electrician is available at the installation site.	Procedure A - assures fault-tolerant power in the storage array.
The customer electrician is NOT available at the installation site, but you have access to customer-supplied, labeled, power cables (beneath a raised floor or overhead).	Procedure B
The customer 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.	Procedure C

Procedure A: Working with the customer 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 CE and back to the customer's electrician.

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

Procedure A, Task 1: Customer electrician

About this task

NOTE: The customer's electrician performs this task.

Steps

1. Verify that the customer-supplied AC source voltage output on each customer-supplied PDU is within the AC power specifications. Measure the voltage output of each power cable as shown in Circuit breakers ON — AC power within specification on page 75.
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 75.

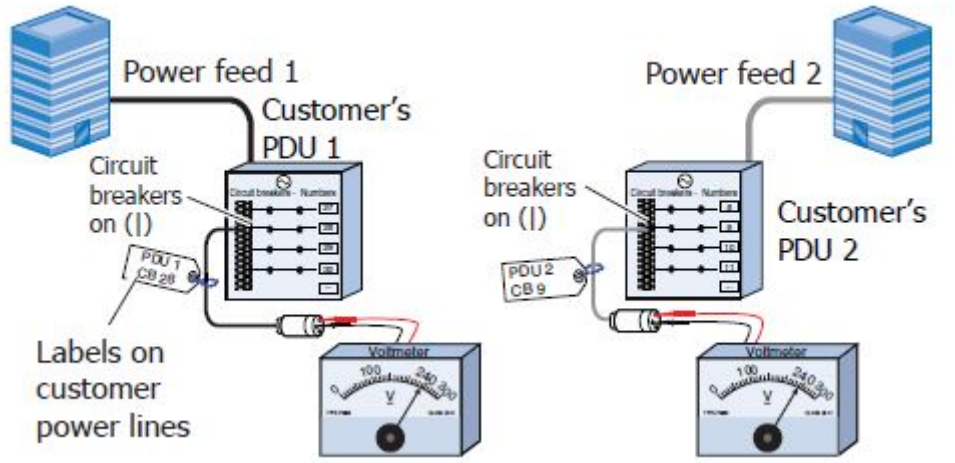


Figure 32. Circuit breakers ON — AC power within specification

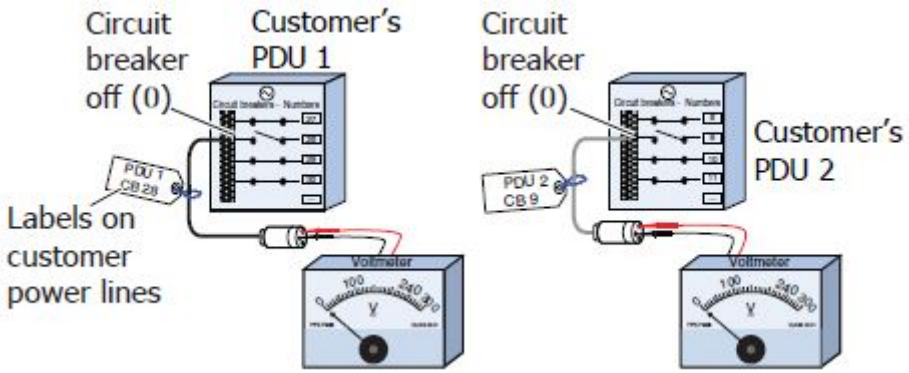


Figure 33. Circuit breakers OFF — No AC power

Procedure A, Task 2: Dell Customer Engineer

Before connecting power to the PowerMax system, ensure that the power for both zone A and zone B is turned OFF. The Dell Customer Engineer performs this task.

WARNING: Do not connect storage bay power zone A and power zone B to the same customer-supplied PDU. If the PDU fails or is turned off during a maintenance procedure, the customer loses power redundancy and risks Data Unavailability (DU).

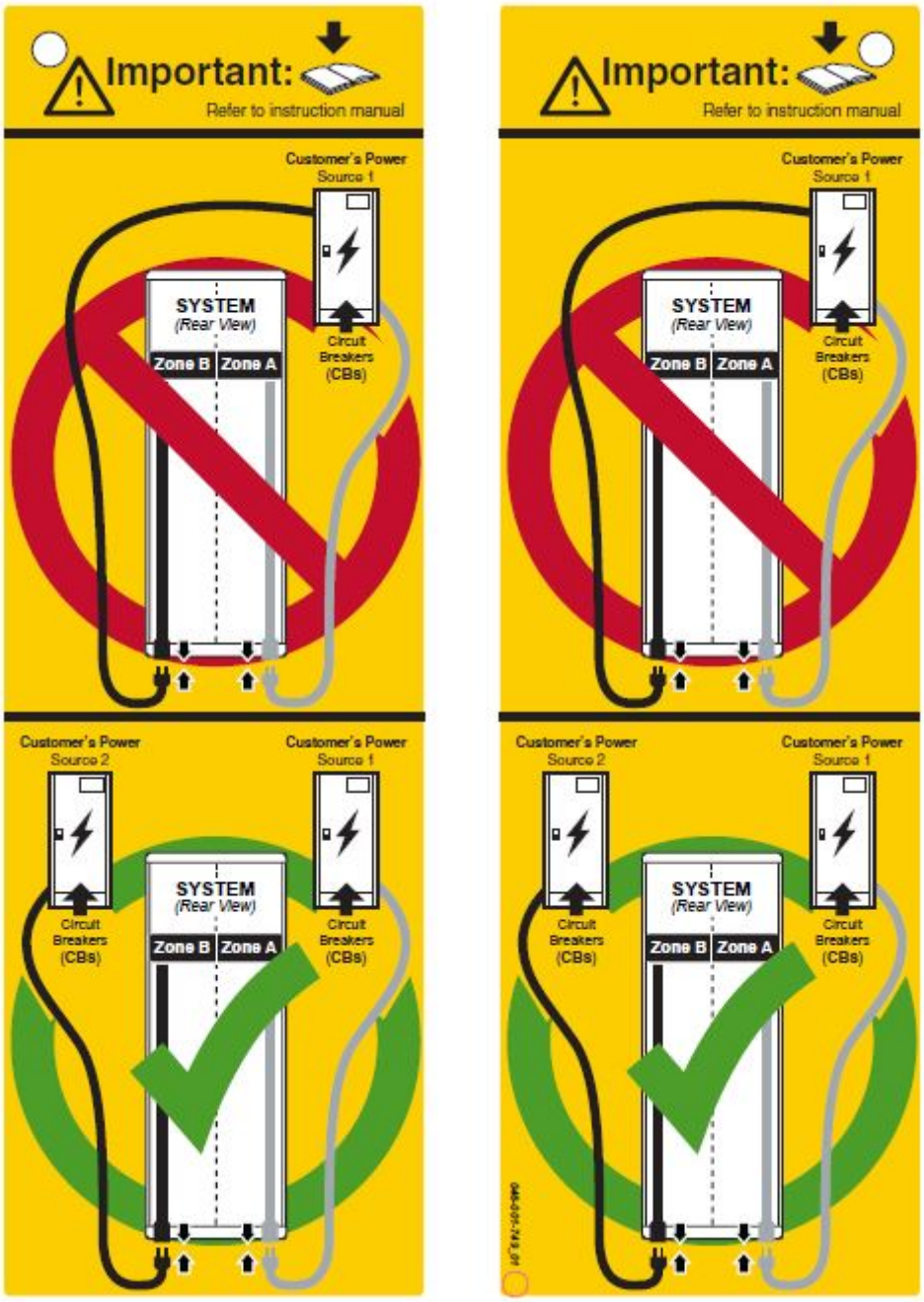


Figure 34. Power zone connections

Attaching line cord identification labels

Steps

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

Table 50. Line cord identification label location, Dell 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 51. Line cord identification label location, third party racks

Label part numbers	Input power	Location
046-007-880	Single phase	PowerMax 2000: 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
046-008-425	Three phase	

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.

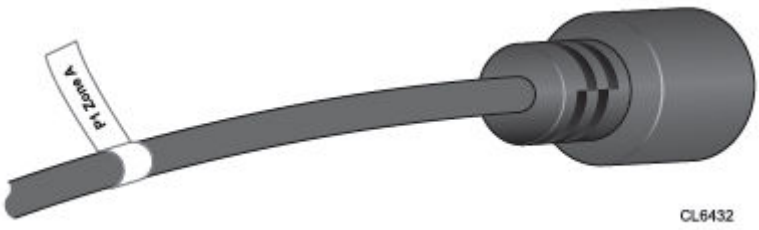


Figure 35. Line cord identification label

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 AC input line cords for power zone A and power zone B as shown below.

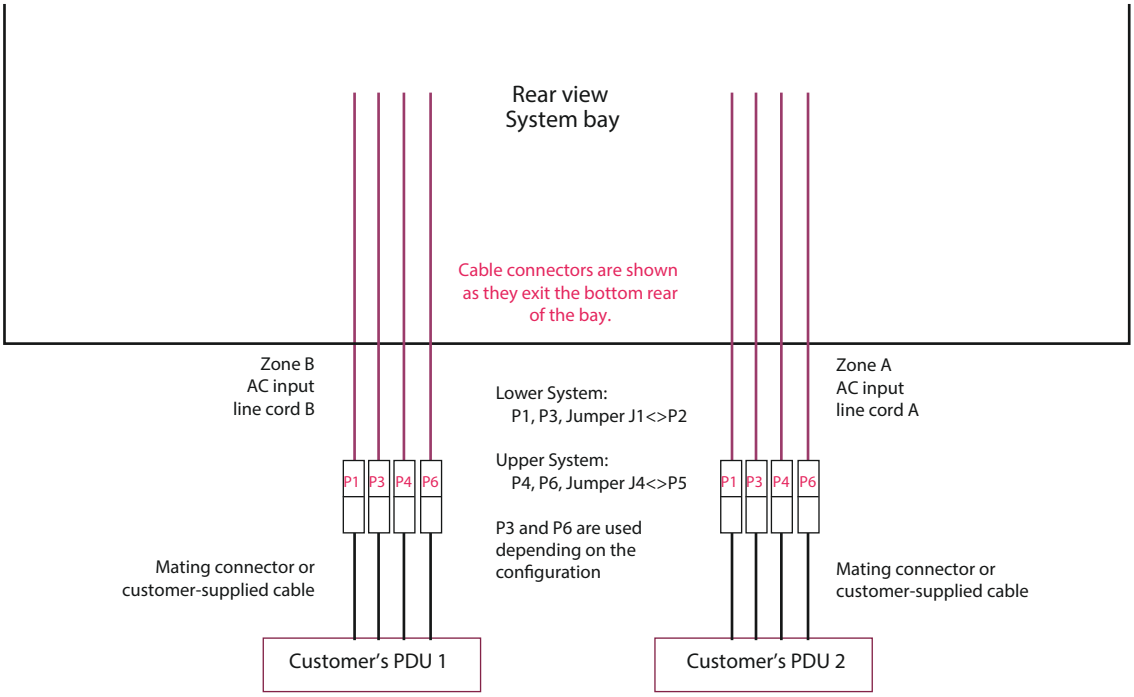


Figure 36. Connecting AC power, single-phase, PowerMax 2000, two dual-engine systems in a rack

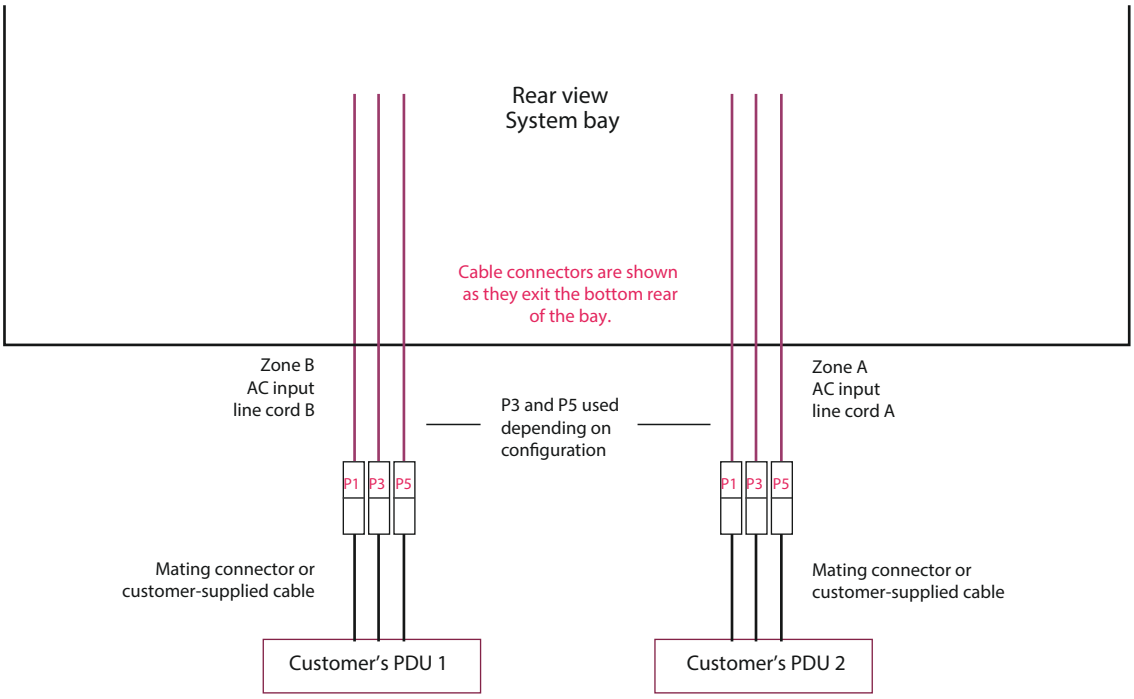


Figure 37. Connecting AC power, single-phase, PowerMax 8000

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

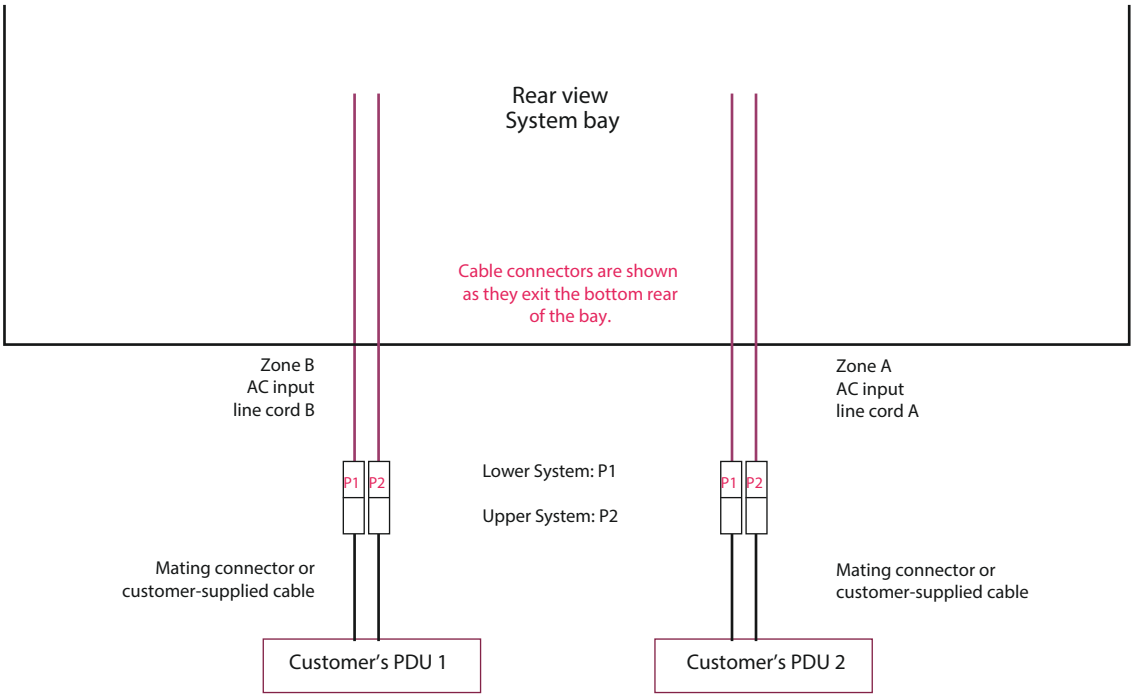


Figure 38. Connecting AC power, three-phase, PowerMax 2000, two dual-engine systems in a rack

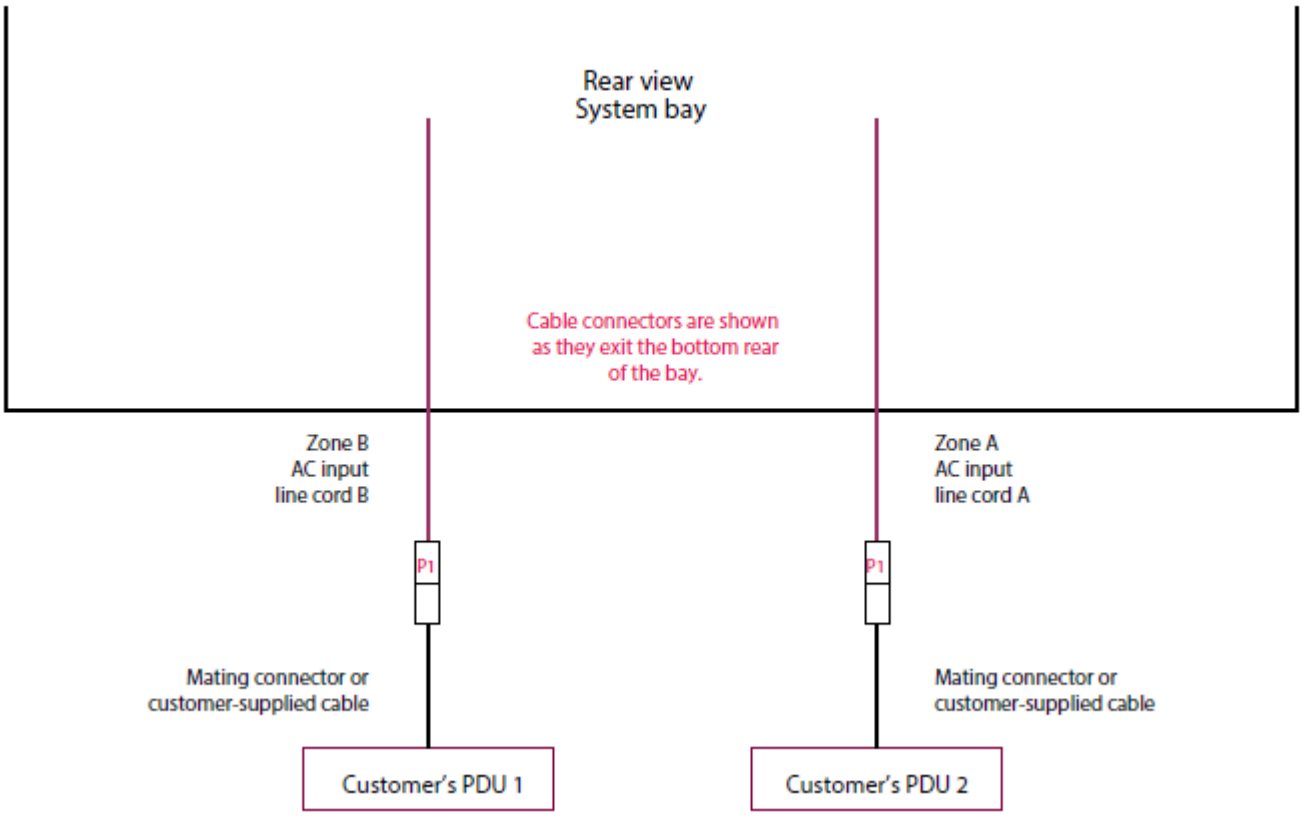


Figure 39. Connecting AC power, three-phase, PowerMax 8000

Procedure A, Task 3: Customer electrician

About this task

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

Steps

1. Working with the Dell 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 82.

Procedure B: Verify and connect

About this task

Verify and connect customer power components if the two conditions that are listed below are true:

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

This procedure requires the Dell Customer Engineer to verify that the customer electrician has complied with power specifications. Once verified, the Dell 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 the power specifications, provide them with a copy of Procedure A. Inform the customer that their array may prematurely shut down if there is 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.

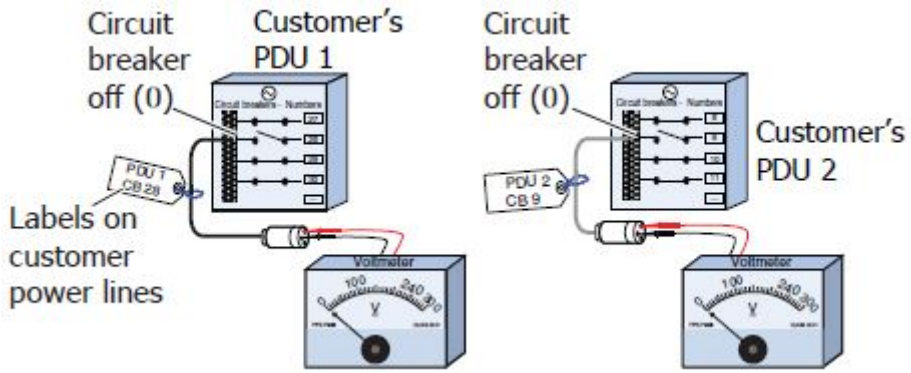


Figure 40. Circuit breakers OFF — No AC power

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 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 82.

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 electrician on page 75 and label the PDUs as described in Applying PDU labels on page 82.

PDU labels

Procedure A, B or C must have been completed before applying labels to the sidewalls of the cabinet. See Selecting the proper AC power connection procedure on page 73 to select the correct procedure.

PDU label part number

Table 52. PDU label part number

Part Number	Description
046-990-814	LABEL: CUSTOMER 1P 3P PDU INFO WRITEABLE

Table 53. PDU label location, Dell racks

Product	Location
PowerMax 2000 PowerMax 8000	OPEN ME FIRST KIT PN 106-887-306

Table 54. 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.

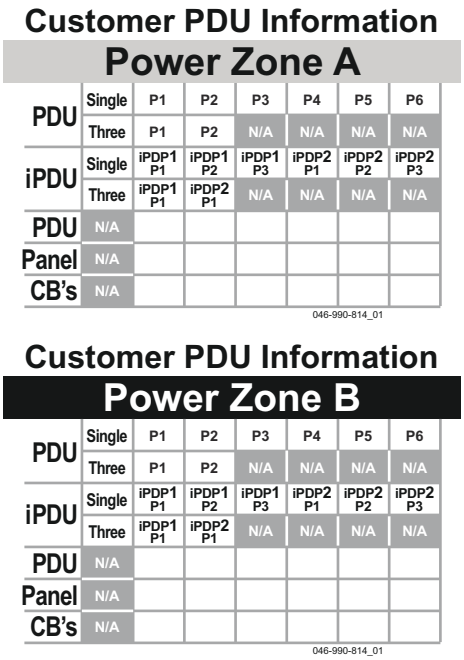


Figure 41. PDU label , single-phase and three-phase

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 does 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 does not interfere with any rails.

AC power specifications

Table 55. Input power requirements - Single-phase, North American, International, Australian

Specification	North American 3-wire connection (2 L & 1 G) L = line or phase, N = neutral, G = ground	International and Australian 3-wire connection (1 L & 1 N & 1 G) L = line or phase, N = neutral, G = ground
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.	

Table 56. Input power requirements - Three-phase, North American, International, Australian

Specification	North American 4-wire connection (3 L & 1 G) L = line or phase, N = neutral, G = ground	International 5-wire connection (3 L & 1 N & 1 G) L = line or phase, N = neutral, G = ground
Input voltage[a]	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. 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.