

Buyer's Guide to Dell Power Distribution Units



Ten reasons to choose the best Dell power distribution unit for your application and five steps to help you get there

With data center devices smaller than ever, often served by dual- or triple-power supplies, a single rack of equipment might produce 80 or more power cords to manage. You want to minimize the number of expensive power drops to each rack, yet power consumption keeps rising—from 600 to 1000 watts per U and growing.

Furthermore, power demands can easily double or triple during peak periods and fluctuate with every move, addition, or change. Adding a 1U or 2U server used to mean drawing 300 to 500 more watts from the branch circuit; now, a new blade server can consume ten times as much current.

Traditional power strips simply do not deliver enough power, flexibility, or control for today's realities. You need an effective way to manage the tangle of power cords, deliver the required power without taking up valuable rack space, and have visibility into current draw at any time.

Dell™ power distribution units (PDUs) were designed with your needs in mind. These rugged, space-saving devices distribute from 3.6kW to 22kW of power (single-phase or three-phase) to up to 42 sockets/receptacles in a single unit, with or without onboard metering and remote communications.

Ten reasons to choose a Dell PDU

Dell PDUs offer the following key advantages:



1. Full integration with Dell hardware and software

Right out of the box, Dell PDUs work seamlessly with your Dell servers, storage, and desktop equipment. All models that support network communications integrate with the Dell Management Console powered by Altiris™ from Symantec™ to enable a consolidated infrastructure overview.

2. Fast and easy installation without tools

Vertical models feature true toolless rack mounting. These slim units snap into button-mount holes on the sides of industry-standard racks. Vertical PDUs are ideal for Dell PowerEdge™ 4220, 2420, and 4820 racks.

3. Choice of installation orientations

Dell vertical PDUs are unique for offering a choice of mounting orientations. For example, you can mount a vertical PDU on its back surface with the receptacles facing the equipment—or you can mount a vertical PDU on its side with the receptacles facing out with the onboard display visible from the aisle.

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4. Visibility into power conditions right at the unit

Dell metered and managed PDUs have an easy-to-read, dual-color LCD that displays important information about power consumption, trends, and conditions. Without having to log into a workstation, technicians can quickly see where it is safe to add a new piece of equipment and how to balance loads to prevent tripped circuits.

5. Color-coded receptacle groups and circuit breakers

Circuit breakers and receptacles are matched by numbering and color coding, so you can clearly see how to balance loads among circuits or identify which equipment may have caused a breaker to trip. For example, if you have twelve power cords to plug into an 18-receptacle PDU, the color coding makes it easy to spread those demands evenly across circuits.



Color coding and numbering of circuit breakers and sockets makes it easy to evenly balance the load

6. Diverse, global portfolio

With choices to meet electrical standards around the world (worldwide IEC-standard outlet connections with regionalized input options), you can standardize on Dell for global organization. That means fewer vendor relationships to manage and simpler portfolio management.

7. Remote power monitoring and management

From anywhere within the reach of a secure Internet connection, technicians can see what is happening inside the rack: how much power is being consumed, where trouble might be looming, or where environmental conditions are suspect. With managed PDUs, you can remotely shut down and reboot servers or lock receptacles to prevent unauthorized use.

8. Built for ruggedness and reliability

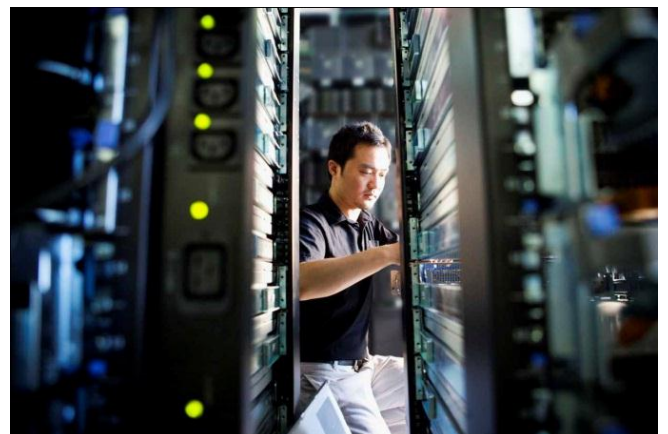
Dell PDUs operate at higher temperatures than the industry average, up to 50°C (122°F). The PDUs described in this guide have been manufactured to Dell's high quality standards.

9. Complete Dell service and support

Only Dell PDUs are completely supported by a Dell three-year warranty (compared to the industry standard of one year) and Dell service for fast, easy, one-stop service and support.

10. Design for your evolving IT realities

Dell engineers designed our PDUs from the ground up with our customers and long-term planning in mind. We understand you may choose to refresh your servers every few years, plus we understand the power requirements of future Dell servers. As new servers become more processing-intensive in smaller packages, our PDUs will provide the power density to match the next generation of Dell servers and prevent potential power limitations in the data center.



Five steps to choosing the right Dell PDU

Because no two scenarios are the same, Dell offers hundreds of PDUs globally, representing a wide range of choice in features, receptacles, power ratings, and deployment options. You can count on Dell for the right PDU for your needs, whether you are powering a home office, a mid-sized business, or an enterprise data center.

How do you choose the right PDU? Dell makes it simple with an easy-to-use, online selector tool at DellPDU.com. Just answer some basic questions, and the tool quickly narrows down the options to help you identify the best PDU models for your situation.

You do not have to know all of the behind-the-scenes details—the selector tool takes care of that for you. However, if you would like to know the specifics, here are five key considerations that weigh into choosing the right PDU model for your needs:

1. What type of input power is available to the facility?
2. How much power do you need in the rack?
3. What types of power connections do you need to support?
4. Where do you plan to install the PDU?
5. How much visibility do you need?

Step 1. What type of input power is available to the facility?

Input power: single-phase or three-phase?

Single-phase power uses one phase of AC (alternating current) power.

Three-phase power uses three single-phase waves together, each wave reaching its peak at offset times. Three-phase power is more efficient for transferring power over long distances and for higher-wattage applications. That is why three-phase power is used in the utility grid, in facilities that power heavy-duty motors and other large loads, and for data centers. Most residences and small business locations have single-phase power.

At the rack level in a typical data center or equipment room, power distribution can be either single-phase or three-phase:

- **Single-phase:** for lower-density applications, such as racks of traditional 1U and 2U servers—a single-phase PDU serves these needs well.
- **Three-phase:** for higher-density racks, such as those with ten PowerEdge™ R710 servers or multiple-blade chassis—a three-phase PDU is a better choice.

You could use several single-phase, 120V PDUs to serve more demanding racks, but there are advantages to using a three-phase, 208V PDU instead. The single-phase PDU may be more economical to purchase, but the three-phase PDU saves you in copper cabling.

Using higher-power PDUs in the rack reduces the number of cables that need to be brought in and managed. Three-phase power distribution can transfer almost twice as much power (1.73 times as much) as equivalent 120V, single-phase circuits on the same size conductors and three times the power of typical 120V, single-phase circuits. When switching from single-phase 208V to three-phase 208V distribution, you only need to run one extra wire in each power drop. You can get 73 percent more power for only 25 to 33 percent more copper.



What is the input voltage?

No matter where you are in the world, you can find a Dell PDU that supports the local voltage. Input voltage is typically 120V or 208V in North America, and 220V and 230V in Europe and Asia. Worldwide, larger data centers are moving towards 400V. Dell PDUs are available in 100V, 120V, 200V, 208V, 208V three-phase, 230V, and 400V models.

Step 2. How much power do you need in the rack?

Two or three years ago, average rack density was 3kW to 4kW. Today, it has increased to 5kW and 6kW. With the growing adoption of blade servers and virtualization, even 8kW to 9kW per rack is becoming more common.



With the power distribution capacity of Dell PDUs, you will not come up short. Our PDU and server development teams work together to plan ahead for the next generation of processing-intensive servers. While other PDU vendors focus on satisfying present-day rack power requirements, Dell develops PDUs with your growing data center in mind, even with a server refresh in the next three or four years.

Dell PDUs come in a broad range of power ratings that are classified into three categories:

- **Standard density PDUs (up to 5kW):** These are ideal for wiring closets and equipment rooms that house traditional servers, network switches, KVM devices, and rack accessories.
- **High-density PDUs (5kW to 10kW):** These offer combinations of receptacle types to support more power-hungry racks, with the ability to power traditional 1U/2U servers (C13 plug) and a blade-server chassis (C19 plug) from the same PDU.
- **Ultra-high-density PDUs (10kW and up):** These offer up to 48 receptacles for racks with multiple-blade chassis and traditional servers, making them ideal for server consolidation.

Within these broad categories, Dell offers twelve options in output power ratings from 2.4kW to 22kW. To simplify selection, we size our PDUs by watts rather than by volt-amperes. Finding the right PDU model for your application is a relatively straightforward calculation:

1. Add up the anticipated or actual power consumption of the equipment to be protected.
2. Allow extra headroom to accommodate derating, growth, and change.
3. Add extra capacity to support redundancy configurations; a PDU might be expected to cover for another PDU that becomes unavailable or loses its power source.

Determine the power consumption of the equipment to be protected

To begin selecting the right PDU for your power-consumption needs, add up the power consumed by the equipment to be protected by the UPS, such as servers, I/O devices, storage devices, and network components. There are several ways to determine how much power the UPS will need to provide.

Option 1: Refer to the equipment's stated power consumption figures.

Most devices have a nameplate or label somewhere on the chassis that indicates how much energy it uses. If the power information is given in amps instead of watts, simply multiple amps by voltage to get a watts figure; for example, $16A \times 240V = 3840W$.

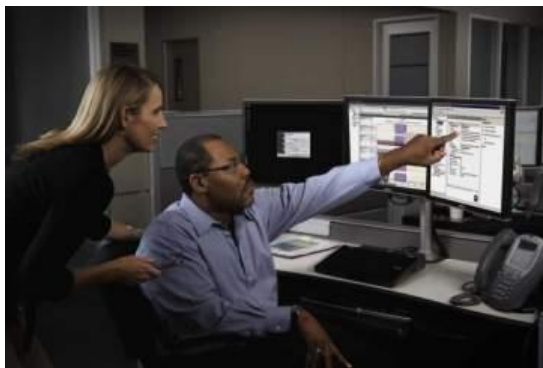
However, the power figure shown in the technical specifications or the equipment label usually does not tell the whole story. Power supplies are sized for the maximum loads expected when the server is fully configured and pressed to its limits. The power figure given for a Dell server is therefore the theoretical maximum, not the typical amount used by the server in day-to-day operation. Actual power consumption will be much lower.



For example, a server with a label or power supply that lists 300W might only use about 70W when it is running at normal load, and only 100W during peak processing and drive usage. Furthermore, when a computer goes into sleep or standby mode, its power consumption is negligible compared to the stated power figure.

To put it in real terms:

- **PCs**—An average home desktop computer uses about 65W to 200W. More powerful computers require more power, naturally. A Dell OptiPlex™ 170L with an Intel® Pentium® 4 processor consumes 80W to 163W when it is running (minimum and maximum power draw), 3.7W in sleep mode, and 2.2W when turned off. A Dell Dimension™ XPS™ 400 computer with a Pentium 4 processor consumes 149W to 258W when operating, 2.0W in sleep mode, and 1.0W when turned off.
- **Monitors**—A common 19-inch to 20-inch LCD monitor uses 35W to 40W of power. A larger 21-inch to 24-inch monitor uses 35W to 65W. Cathode ray tube (CRT) monitors use more power, averaging 80W for a 17-inch screen and 95W for a 19-inch screen.
- **Servers**—Power draw depends on the internal processor(s), total processing capacity, and whether the server has single or multiple power supplies (PSUs). For instance:
 - A Dell PowerEdge T300 tower server with one PSU is rated at 490W or 528W if it has an optional redundant PSU.
 - A Dell PowerEdge M710 blade server supports two or four processors at 60W, 80W, or 95W for a theoretical maximum of 380W.
 - A Dell PowerEdge M905 blade server supports up to four 105W processors for a total rating of 420W.



When sizing your PDU, you would begin your calculations based on theoretical maximum power draw, even though your equipment does not continually operate at maximum level. As stated by the Green Grid, "CPU architectures have been optimized to enable large parts of the silicon to shut down when in idle states. As such, it is unique in being the only component of the system that has a marked effect on system-level power draw based on its utilization. ... [Assuming a linear model], once we know the power draw of a server at peak usage and at idle, it becomes a simple arithmetic operation to estimate power usage at any utilization rate."¹

Option 2: Use the Dell online power calculator.

What could be simpler? Visit Dell.com/Calc to use the free Energy Smart Solution Advisor (ESSA) to calculate energy consumption for any Dell system or a group of Dell systems. Dell also publishes power consumption figures for servers at idle and maximum utilization, so not only can you appropriately size the UPS, but you can also benchmark server purchases against ENERGY STAR® standards.

¹The Green Grid, "Five Ways to Reduce Data Center Power Consumption," White Paper #7, 2008



Option 3: Measure the actual power consumption of equipment in service.

The latest generation of servers features built-in power monitoring using out-of-band management capabilities. For racks that contain a mix of devices, you can use a watt-hour meter to measure the amount of electricity that passes through your equipment at a given moment or over a period of time. Simply plug a server, power strip, or power distribution unit into the meter, plug the meter into the input power source, and read the display. In the data center, use intelligent PDUs to monitor power usage for each outlet in real-time and provide accurate power usage statistics.

Allow extra headroom to accommodate electrical codes, growth, and redundancy.

What are the local industry requirements for sizing electrical gear?

In North America, for example, Underwriters Laboratories requires 20 percent derating. When designing a power distribution setup, it is important not to approach the limits on each phase and each circuit breaker, and to balance the power load equally among phases.

What rate of growth do you anticipate in the next year? In the next five years?

You do not want to outgrow your new PDU within that planning window. Servers can pull almost twice as much power as they did five years ago, so the PDU needs to be sized to consider not only growth in numbers of servers, but in expanded power consumption as older servers are replaced. Adding 30 percent to your present power consumption is good practice.

Does the load include variable-speed drives, printers, or motors?

If the load includes industrial motors and other mechanical equipment, the PDU may need to be sized for inrush, a property of motors that creates an excess of current at startup.

Will the PDU be part of a redundancy scheme?

Critical servers and applications are usually powered by redundant power supplies (PSUs) fed from separate power sources. When sizing a PDU for a redundancy configuration, be sure to plan ahead for the possibility that one PDU might be required to carry the full load for both A and B power supplies.

Step 3. What types of power connections do you need to support?

PDU input power: which type of plug is needed?

Most commercial facilities in Europe and the Americas are built to electrical standards established by the U.S. National Electrical Manufacturers Association (NEMA) or the International Electrotechnical Commission (IEC).

NEMA connectors are commonplace in North America and other countries that have adopted NEMA standards. If you live in the U.S. or Canada, the wall sockets in your home and office are probably NEMA 5-15R—but you would not be likely to use this type of input for powering a rack of equipment. (If you need to plug a PDU into a standard NEMA 5-15 wall socket or UPS receptacle, choose a PDU of 1440W or less. By North American electrical code standards, power draw higher than 1440W requires different plug types.)

More commonly, you would see a locking NEMA connector, such as a NEMA L5 (120V nominal, 125V maximum), NEMA L6 (240V or 208V nominal, 250V maximum), and NEMA L15 (208V or 240V nominal, 250V maximum).

IEC 60309 (formerly IEC 309) is an international standard for plugs, sockets, and couplers that allows AC or DC voltage up to 690V and 250A. These connectors are color coded to indicate the voltage range. Most business and data center applications would fall into the three middle ranges of the specification: 40V-50V (white), 100V-130V (yellow), or 200V-250V (blue). NEMA input connectors are made in current ratings from 15A to 60A; IEC standards allow up to 250A, but for purposes of serving IT equipment, 16A to 63A would be typical.



PDU output power: What type of receptacles does your rack equipment need?

Four types of connectors are commonly used for rack equipment:

- Most 1U, 2U, or 4U servers—as well as personal computers and peripherals—are powered from IEC 60320 (formerly IEC 320) C13, 4A circuits.
- Where higher currents are required, such as for high-power workstations, routers, blade servers, and UPSs, C19 (16A) connectors are typical.
- Other rack equipment, such as simple power meters, testing devices, or environmental probes, may use the NEMA 5-15 or 5-20R connectors that are common in homes and offices.



C13 receptacle



5-15 receptacle



C19 receptacle



5-20R receptacle

Rack IT equipment typically uses C13, NEMA 5-15, C19, or NEMA 5-20R connectors

PDU output power: how many receptacles do you need?

Suppose a rack houses 10 traditional servers, each with dual power supplies. You would need a PDU with at least twenty C13 sockets for those 20 power cords. If you intend to fill your rack with 1U servers, you will need a PDU that can accommodate 42 power cords.

With Dell PDUs, you can easily accommodate these requirements. Dell PDUs are available with as few as four sockets or up to 42 sockets in a single power strip—up to 84 in a single rack—without taking up valuable U space.

A limiting factor for some applications is the growing need for C19 connectors. PDUs from other vendors typically offer up to six C19 connectors. Since each blade server needs a C19 connector, you would be forced to buy a second PDU if you wanted to deploy a second blade chassis. This is not the case with Dell. Understanding how customers are using blade servers, we factored this into the design and created a PDU with twelve C19s that can support a two-blade chassis in a rack with a single strip.

Step 4. Where do you plan to install the PDU?

To meet various requirements, you can choose from several form factors: three sizes in vertical PDUs or a 1U horizontal PDU that can optionally be mounted in 0U space.

Vertical PDUs—half-height, full-height, and extended-height

Vertical-format PDUs, which look like tall power strips, are the preferred form because these PDUs pack a lot of power and receptacles into a slim package and do not take up any U space in the rack.

- **Half-height vertical PDUs (24U tall):** These are suitable for Dell PowerEdge 2420, 4220, and 4820 racks (wide and deep versions).
- **Full-height vertical PDUs (42U tall):** These are suitable for Dell PowerEdge 4220 and 4820 racks (wide and deep versions).
- **Extended-height vertical PDUs (48U tall):** These provide additional sockets for Dell PowerEdge 4820 racks (wide and deep versions).



Vertical PDUs can also be deployed in other racks with a compatible button-mounting system. If you have a rack that does not have a button-mounting system, such as Dell PowerEdge 4210 or 2410 racks, you can add a mounting bracket to install half- or full-height PDUs.



Half-height PDU



Full-height PDU



Extended-height PDU

Half-, full- and extended-height PDUs offer a range of options

Choice of mounting orientation

Vertical PDUs can be mounted by either their back surface or side surface. The standard configuration is to mount the unit by its back surface (180° in relation to the sockets), with the sockets facing toward the equipment. This is a snap-in, toolless installation, using factory-installed mounting pegs that snap into keyholes on the wall of the rack's PDU tray.

To mount a vertical PDU by its side surface (90° in relation to the sockets, sockets facing forward), just install the provided mounting pegs, and then snap the PDU into the mounting keyholes.

The following table show how many PDUs of each form factor can be deployed in various Dell PowerEdge racks. There are several reasons for the differences among racks. For example:

- Shorter racks naturally cannot accommodate extra-tall, 48U PDUs.
- The intention with the deep rack design is to have PDUs on one side and data cabling on the other. There are mounting slots on both sides of the rack, so a rack could have twice as many PDUs as shown in the following table, but you would want to consider the effect on cable management.
- When you install the PDU in its standard orientation, there is extra space in front of the PDU to mount a second PDU. However, if the PDU is mounted with the receptacles facing forward, the power cables occupy this extra space. That is why you see fewer PDUs per rack for that mounting option.



Deployment Options for Dell Vertical PDUs

Standard 180° Mounting	Half-height 24U PDU	Full-height 42U PDU	Extended-height 48U PDU
Dell 4820 Rack—Standard and Wide	4 per side, 8 total	2 per side, 4 total	2 per side, 4 total
Dell 4820 Rack—Deep	8 on one side	4 on one side	4 on one side
Dell 4220 Rack Standard and Wide	4 per side, 8 total	2 per side, 4 total	
Dell 4220 Rack—Deep	8 on one side	4 on one side	
Dell 4210/2410 Racks	2 per side, 4 total	1 per side, 2 total	
Dell 2420 Rack	2 per side, 4 total		
Optional 90° Mounting	Half-height 24U PDU	Full-height 42U PDU	Extended-height 48U PDU
Dell 4820 Rack Standard and Wide	2 per side, 4 total	1 per side, 2 total	1 per side, 2 total
Dell 4820 Rack—Deep	4 on one side	2 on one side	2 on one side
Dell 4220 Rack—Standard and Wide	2 per side, 4 total	1 per side, 2 total	
Dell 4220 Rack—Deep	4 on one side	2 on one side	
Dell 4210/2410 Racks	1 per side, 2 total	1 per side, 2 total	
Dell 2420 Rack	1 per side, 2 total		

For extra protection, you can add cable strain-relief brackets (also known as a cord retention kit) to reduce the chance of cables being accidentally disturbed from their positions.

Horizontal (1U) PDUs

Horizontal PDUs are a great choice for front-end power distribution or where vertical mounting in side or back channels is not an option. Using the provided mounting brackets, these 1U PDUs mount on front or back vertical rack rails in most industry-standard IT racks, such as Dell PowerEdge 2420, 4220, and 4820 racks (Wide and Deep versions).

Horizontal PDUs can also be mounted in the side pocket space of Dell PowerEdge 2410 and 4210 racks using an innovative, toolless mounting bracket. This space-saving installation works well for wide racks or where the side panels can be easily removed for access.



Horizontal PDUs can be mounted in the U space of most racks or on the side panels if cable access is available

Step 5. How much visibility do you need?

If you only need basic power distribution without local or remote power metering

You can economize with a basic PDU that provides reliable power distribution at surprisingly affordable cost.

With Dell PDUs, basic does not necessarily mean limited. The portfolio of Dell basic PDUs includes single-phase options from 3.6kW to 7.3kW and three-phase options from 11kW to 22kW, packed with output receptacles. These PDUs are ideal for larger deployments where cost is an issue.

Basic PDUs are available in half-height and full-height vertical models and a horizontal 0U/1U model for standard cabinets, plus a 48U extended-height model for Dell PowerEdge 4820 racks.

If you need to know how much power is flowing through the PDU

Choose a Dell metered PDU, which continuously measures and records the current flowing through the PDU on each phase. User-defined alarms warn of potential circuit overloads allowing you to take proactive action. With logs of power utilization trends, you can make informed decisions about where equipment can be safely added in a rack.

These three-phase PDUs are ideal for power-dense configurations (11kW to 17.3kW) where tripped circuits are a concern, either because rack equipment is frequently changed or load balancing is required to prevent circuit overloads.

A dual-color, backlit LCD screen on the front of the PDU displays advanced power calculations by phase and for the whole PDU. This display can be rotated 180° to be easily read whether the PDU is installed for top or bottom entry input cabling. The LCD changes color during an alarm condition, so technicians have at-a-glance notification of issues needing attention.

Remote administrators can see into PDU activity and status from anywhere via secure Web, SNMP, or Telnet interfaces. Metered PDUs also integrate with KVM (keyboard/video/mouse) stations and Dell Management Console, which provides a consolidated infrastructure overview.



A dual-color LCD provides critical information and notification of alarm conditions

If you need remote control and metering at the receptacle level

Choose a Dell managed PDU, which provides detailed power information to the level of individual receptacles, so you can see how much each piece of equipment is drawing. Managed PDUs also enable you to remotely power on, power off, or reboot remote servers and other network devices.

With these PDUs, you can truly manage what is going on, have valid information about specific key demands of server processes, turn servers off when idle or under-utilized, and prevent rogue overloading caused by unauthorized plug-ins.



If you need to keep tabs on operating conditions in the rack

Add an environmental monitoring probe as an option to metered or managed PDUs. You can equip the PDU to monitor temperature, or temperature plus humidity, or to work with a dry contact relay sensing device to indicate potential trouble conditions such as an open cabinet door, smoke, dust, or vibration. From anywhere, your administrators can ensure that valuable IT equipment is not being subjected to damaging conditions or security breaches.

Form Factor	Basic PDU	Metered LCD PDU	Managed PDU
Vertical half-height (24U)	✓		
Vertical full-height (42U)	✓	✓	✓
Vertical extended-height (48U)	✓	✓	
Horizontal 0U/1U	✓		✓

Conclusion

Compared to conventional power strips, Dell PDUs cost-effectively improve everything about rack-level power distribution.

- **Get more out of the existing power architecture**—Without giving up any usable rack unit space, you can use available power and outlets more efficiently, even when devices within a rack have diverse power requirements.
- **Create a more manageable, adaptable data center**—The plug-and-play architecture organizes power distribution, simplifies cable management, and enables you to move, add, and change rack equipment without an electrician.
- **Rest assured with the quality and backing of Dell**—When you see the Dell logo, you know you are covered by world-class support and reliability. The PDUs described in this guide have been manufactured to our exacting standards by Eaton, a world leader in power protection and distribution systems, and are covered by Dell's three-year warranty.
- **The right choice for all of your PDU needs**—With hundreds of PDU models to choose from, Dell has the right match for your unique needs—from 2.4kW to 22kW, single-phase or three-phase, basic or with advanced metering and control, with the right combination of input/output connections and form factor.

Many factors weigh into the choice, but you don't need to juggle all the details. Dell makes it easy with an online selector tool at DellPDU.com or DellUPS.com for solutions containing both UPSs and PDUs.

Learn more

Find out more about how Dell PDUs can extend the value of your power systems while improving IT system reliability and availability. Contact your local sales representative, visit DellPDU.com, or visit Dell's [power infrastructure](#) page on Dell.com.

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