PDU Basics: How to Select a Rack PDU

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INTRODUCTION.

The Power Distribution Unit is a device that bridges the gap between your datacenter power infrastructure and your IT equipment in the rack. To bridge the gap effectively and to select a PDU to best fit your needs, you’ll need to understand your detailed requirements and constraints at the PDU’s input and outputs.

PDUs can be complicated. Below is a breakdown of functionality that should be considered:

At the most fundamental level, rack PDUs perform two basic functions:
- **Power distribution** – one input branches out to many outputs
- **Electrical protection** – circuit breakers protect against overcurrent conditions in downstream circuits (optional in low current PDUs)

At a high level, there are two major classes of PDU: Intelligent and Non-intelligent (branded by Methode “Standard” PDUs). Non-intelligent PDUs are relatively simple devices optimized for low cost and basic functionality. Available in a wide variety of mechanical and electrical configurations, they provide power distribution and protection but not much else. As the name implies, Intelligent PDUs are complex devices containing electronics and software to provide a wide range of specialized functions. There are many hundreds of different models of Intelligent and Non-intelligent PDUs available on the market today.
How to select the PDU appropriate for your application? These guidelines should help:

1. Determine the form-factor needed to meet your mechanical-fit requirements.

**Form factor.** Case size and mounting orientation are key considerations for the mechanical fit and location of the PDUs in the rack. Horizontal PDUs mount like standard IT equipment, consuming 1, 2 or more RU (1.75 inches) of space. Vertical PDUs, frequently referred to as “0RU,” mount vertically aligned and therefore consume no RU space which may be valuable or scarce. Vertical PDUs can range in length from compact sub-30-inch units to full size units spanning 70 inches or more.

2. Confirm the PDU voltage, phase, and current input specs match the power feed to your rack.

**Input voltage.** The power feed to the rack will determine the PDU’s required input voltage rating. 208VAC is prevalent in North America, with 230/400VAC used in most of the rest of the world (ROW). Other voltages may also be used, so be sure your PDU input voltage rating matches the power service being supplied to the rack.

Voltages for datacenter products are always assumed to be AC, as opposed to telecom applications, which conventionally use DC voltages. Also note that virtually all PDUs are rated for both 50Hz and 60Hz operation. As such, North American vs. European line frequency should be confirmed but is not expected to be a concern.

**Single-phase vs. Three-phase.** The power feed to the rack will also be rated as either a Single-phase or a Three-phase supply. Your PDU’s input must match that service rating. The phase type is usually specified as part of the voltage rating as in “208VAC 3-phase.” Single-phase power is widespread in today’s data centers but Three-phase use is growing due to rapid increases in rack electrical loads and density.

**Output voltage.** With Three-phase PDUs, be sure you are clear as to what voltages are present at which PDU outlets. It isn’t always obvious that a “208V Wye” input PDU is expected to have both 208V and 120V output receptacles. Or that a “400V 3P+N+E” PDU is expected to supply only 230V to the outlets. PDU specs can be ambiguous in this area and buyers should beware (caveat emptor).

**Input current rating.** The datacenter power infrastructure design will likely have already budgeted the power allocation per rack as well as the means to distribute that power. Each rack power feed will be rated for a maximum current capacity which is capped by its upstream circuit breaker. Your PDU’s input current rating is determined by two factors: (a) its power input circuit design, meaning the whip (input power cord) wire sizes and plug type, or the receptacle type if no whip; and (b) a derating factor of 80% that is applied to North American installations per the National Electrical Code. Your PDU input current rating should match the current capacity of the power feed to the rack. In most cases, this
match is achieved simply by selecting the correct mating input-plug type. A NEMA L6-20 plug for example is rated for 20 Amps.

These input ratings of voltage, phases, and current also define the PDU power rating, a product of power and voltage usually specified as a maximum kW or kVA. This metric can be useful at an aggregate power budget level in aligning rack or IT equipment needs against PDU capabilities. It is generally less useful at the PDU detailed technical review level.

3. Select an input-plug type that will mate properly with the power feed to your rack. Make sure the whip length is sufficient.

Input plug. Most PDUs include an attached whip with a hardwired plug. That plug will likely be an industry standard type defined by the electrical input specs on voltage, phases, and current, and should match your specs in 1 and 2 above. Plugs vary in form factor, with NEMA type plugs used conventionally for North America and IEC 60309 plugs for most of ROW. There are other specialized plugs available as well. The power feed to the rack will determine the plug type required; be sure your plug selection will mate properly. Also confirm the whip length meets your cable management needs.

There are likely to be many PDU models that meet the general criteria of 1-3 above. To narrow the field...

4. Match the types and quantities of PDU outlet receptacles to the IT equipment you need to power.

Outlet receptacles. The types and quantities of PDU outlet receptacles needed are determined by the IT equipment you intend to power. Most modern IT equipment will plug into an IEC 60320 C13 — the most prevalent PDU receptacle type by far. Higher-power equipment will typically plug into an IEC 60320 C19, which is the next most widespread PDU receptacle type being deployed today. Many new PDU designs contain both a large quantity of C13s and a smaller quantity of C19s in the same product. There are other PDU receptacle types available as well, but IEC 60320 truly is a global standard that makes it practical to use C13s or C19s in virtually all geographies.

5. Confirm the circuit breaker protection meets your needs.

Circuit breakers. Most PDU models contain multiple branch circuits, each with a dedicated circuit breaker providing protection from downstream overcurrent conditions. Single-phase PDUs typically contain one-to-three breakers, while three or six breakers are more typical for Three-phase PDUs. A breaker can be loaded with up to 10 or more outlet receptacles, depending on the PDU design. Circuit breakers that meet the stringent requirements of the UL 489 standard are a must in order to meet National Electrical Code requirements in
the U.S.
You’ll need to ensure the cumulative current load, plus some margin to prevent nuisance tripping, of all outlets on each branch circuit will not exceed its breaker rating. Fault-tolerance objectives should also be considered, as a tripped breaker will bring down all devices on its outlets. A PDU architecture with more breakers and fewer outlets per breaker is inherently more fault tolerant with respect to the IT equipment being powered.

6. **Confirm the PDU is agency approved for use in countries where you intend to deploy.**

Agency certifications. PDUs must be agency approved in order to ship or be sold in most countries. Approval certifies that the product meets government agency regulatory standards or specifications concerning safety and/or technical requirements. Many certifications require hands-on lab testing of product samples and some include periodic inspections of the manufacturing plant. A certified approval frequently grants the right (or requirement) to display a mark or statement of compliance on a label affixed to the PDU. Examples of key certifications are UL and cUL (or their ETL equivalent) and FCC for the Americas; CE, CB, CISPR, RoHS, and WEEE for Europe.

7. **Do you need intelligent capability?**

Intelligent PDUs contain all of the capabilities of common Non-intelligent PDUs, but add a smart embedded control system that can support a wide range of hardware- and software-enabled features and functions. Intelligent PDUs can be very complex products, but can be easily categorized by three fundamental capabilities: metering, monitoring, and switching.

Metering. All Intelligent PDUs perform some form of electrical metering, typically of both current and voltage. Feature and cost tradeoffs determine metering location, granularity, and accuracy. A low-end PDU model, for example, may provide coarse data by metering current at the PDU input, thereby providing an aggregate-PDU measure at potentially an 80% accuracy level. A mid-level model might meter the current at each circuit breaker, with higher precision (90%-accurate hardware), providing data of greater granularity and accuracy. A very high-end PDU will meter current with extreme-precision (1% tolerance hardware) at each individual outlet, providing maximum-granularity data with 99% accuracy. These so called “±1% billing grade accuracy” PDUs can legally resell metered power to colo tenants if they are certified to industry metering standards ANSI C12.1-2008 or IEC 62052-11 or 62053-21.
When both voltage and current metering is present, the PDU can calculate and report many valuable derivative parameters of course, such as active power, apparent power, power factor, crest factor, etc. These and similar data can be key inputs to datacenter energy management systems.

**Monitoring** is the ability to communicate with the PDU over a network, typically IP over Ethernet. Most Intelligent PDUs support monitoring, which is also called “remote access.” A host computer can remotely manage and collect data from all monitored PDUs that share a network. A valuable feature of monitored PDUs is the ability to issue a real-time alert, to an IT staff member, providing notification of the risk or occurrence of a problem.

Some low-end Intelligent PDUs do not support monitoring. Instead, the user can communicate only “locally” via a display on the face of the PDU. This requires the user to be in the immediate presence of the PDU, which can be an obvious disadvantage in a large data center.

Note virtually all monitored PDUs include a display, therefore they support both local and remote access.

**Switching.** A switching PDU can turn its receptacle outlets on or off, under software control. This capability is generally reserved for very high-end PDUs that support independent switching of individual outlets. Switching can be useful for: managing rack power allocation (by energizing only select receptacles), remote reboot of IT equipment via power-cycle, sequential power-ups (used for minimizing load inrush currents), or as software (re)settable circuit breakers.
One additional important suggestion:

Qualify your PDU supplier. Methode Electronics’ Data Solutions Group has been shipping rack PDUs in high volume for many years, though almost exclusively through specific OEM relationships. We have significant global engineering and manufacturing capabilities, and can offer a large portfolio of field-proven PDUs in a wide variety of configurations and feature sets. The Methode ISO 9001 management system ensures all products meet the very highest standards of quality, from design through manufacturing. Reliability is a critically important concern for all datacenter equipment, especially for PDUs. It’s a top engineering objective at Methode, designed-in at the “first conceptual” product stages. Independent third-party evaluation confirms each PDU meets its reliability goals, providing confidence of a long and sustained field service life. Methode PDUs are subjected to rigorous qualification testing including environmental stress screening, shock and vibe, and highly accelerated life testing (HALT) to ensure a robust, bullet-proof design. Every Methode PDU is thoroughly factory tested before shipment.

Methode PDUs are in stock and available for immediate delivery. We offer a complete portfolio of both Standard and Intelligent PDUs, as well as a variety of power cords to meet your specifications and needs. Customer support and warranty information is available at: www.methode.com/data (U.S.) and www.methode-datasolutions.co.uk (Europe).

For more product information, call your friendly Methode sales associate today at 888.446.9175.
About Methode Electronics - Data Solutions

Methode Electronics’ Data Solutions Group is a global developer of custom engineered and application-specific Data Center products and solutions. We leverage our experience in automotive design and product development to deliver Data Center solutions that carefully manage risk. Our product portfolio includes everything from integrated cabinet solutions to Standard and Intelligent PDUs, including customizable physical layer infrastructure. Our newest product offering is a maintenance free, in-rack lithium-ion UPS, ideal for customers witnessing frequent power outages.

From an industry perspective, we support the Telecommunications, Data Communications and Data Center industries for clients in the US, Europe and Asia. And we pride ourselves in being a leading Data Center innovator, delivering exceptional quality with every order at a reduced cost point. Our customers demand it... We deliver!

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