

Manage power your way



Powering Business Worldwide

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INTRODUCTION

Optimizing power your way

Modern businesses need a better response to ever-changing market dynamics and competitive pressures. Increasingly, this need is shaping computing infrastructure strategies. Business continuity has never been more critical. Scalable, flexible and compatible IT infrastructures are rising up the agenda. Reducing operational costs and cutting energy consumption remain urgent imperatives.

The response? A fresh focus on high-density computing, advanced networking methodologies, and more efficient ways of managing assets.

Power management is an area which can easily be overlooked in these efforts to optimize the infrastructure. That's a huge mistake: wherever you are, whatever you do, power can fail. What then happens to your IT applications and valuable data? In today's high availability IT environments, unplanned power outages or line quality irregularities can have a highly detrimental impact on IT applications. The cost of network downtime can average €6000 per hour for small businesses (1-100 employees), and €66 000 per hour for medium businesses (100-1000 employees)¹.

With that in mind, organizations need a robust intelligent power management strategy if they want to fully reap the benefits of their modern IT architectures and avoid business continuity risks. A strategy that means the organization can always be confident of efficiency, low costs, and business continuity.

It may sound complicated, but in fact all it takes to build a proper power management solution or optimize the existing one is just five steps.

Five steps to optimize your power management

1 Protect

valuable IT assets from power issues and ensure business continuity.

4 Manage

the power infrastructure and IT equipment through a single pane of glass.

2 Distribute

power intelligently to increase efficiency and reduce operating costs.




5 Maintain

the infrastructure for reliability and greater peace of mind.

3 Organize

IT equipment in a rack reliably and efficiently and reduce cooling costs.

Cost of IT downtime for businesses

Size of business	 Small <100 employees	 Medium 100-1000 employees	 Large >1000 employees
Downtime events / year	1.7	3.5	3.0
Average length of even	2.2 hours	3.4 hours	0.8 hours
Downtime € / hour	€6,170	€66,170	€1,010,390
Downtime € / year	€23,080	€787,390	€2,424,520

¹Source: Eaton and Tech Target survey: How "software defined" is redefining the data center

INTRODUCTION

Top power management considerations

When it comes to defining the optimum power management solution for your IT application, here are some fundamental questions to consider:

Your IT application

- How often do you refresh and maintain your IT hardware (including servers)? What about your UPS and power distribution equipment?
- If you have a converged data-voice network, have you protected all critical switches?
- If you have virtualized your servers, have you considered the impact on your UPS equipment?
- What would happen if the power went out at your facility — right now?
- Have you thought about the impact of damaged or corrupted data?
- How much energy do your UPS units consume? How efficient are they?

Power protection

- What size UPS do you need? (kVA or W)
- What voltage is currently available at your site?
- What voltage do you need?
- What runtime do you want?
- Are there any clearances or size constraints?
- Do you have bypass requirements?
- What types of input and output connections are required?
- Is there a generator on site?
- Does the UPS need to be scalable?
- Do you need redundancy?

Power distribution

- How is power getting from the UPS to your equipment?
- What do you want your power distribution devices to be able to meter, monitor and manage?

Organization

- Do you need racks, enclosures, floor stands or rail kits?
- Is a maintenance bypass switch needed?
- Are unorganized cables hindering your efficiency or becoming a safety concern?

Power management

- Do you need to have orderly scheduled shutdowns?
- Do you want to remotely monitor the UPS and rack power distribution units?
- Would you like to remotely notify others of UPS and rack PDU events?
- How will your UPS software manage virtual servers during an extended power outage?
- Does your power management software integrate easily with your virtualization platforms?

Maintenance

- Do you need immediate factory response once you register some issues with your power management solution?
- What kind of parts and labor coverage do you need?
- Do you want any type of preventive maintenance?
- When's the last time you checked the batteries in your existing UPS units?

PROTECT: KEEP IT ASSETS SAFE FROM POWER ISSUES AND ENSURE BUSINESS CONTINUITY



Why power protection?



A UPS (uninterruptible power supply) protects IT equipment and other electrical loads from problems that interrupt electrical supply, performing the following three basic functions:

- Preventing hardware damage typically caused by surges and spikes. Many UPS models continually condition incoming power as well.
- Preventing data loss and corruption. Without a UPS, devices that are subjected to a hard system shutdown can lose data completely or have it corrupted. In conjunction with power management software, a UPS can facilitate a graceful system shutdown. In virtual environments, UPSs and power management software can initiate migration of virtual machines (VM) to a backup site or cloud.
- Providing availability for networks and other applications while preventing downtime. In some cases, UPSs provide enough battery runtime to ride through brief outages. In others, they provide hours of runtime to ride through extended power outages. UPSs are also paired with generators to provide enough time for them to power up.

Optimize power protection with Eaton



Top UPS design considerations

The following factors outline the key design considerations to take into account when analyzing your needs:

1. Power environment: single-phase and three-phase

Many existing computer rooms and small-to-mid-sized data centers have single-phase loads at the rack level. Ground-up designs are increasingly moving three-phase power to the point of utilization to gain efficiencies and reduce costs, creating an opportunity for three-phase solutions in new constructions.

2. Installation environment

It's imperative to understand how a prospective UPS will be deployed. Since most environments support several different solutions, you may need to evaluate these options.

3. Power load

The VA or watt rating of your power loads is one of the most important factors in identifying the right UPS. After identifying the power environment (if the UPS needs to be single- or three-phase), the size of the UPS further narrows the selection. In single-phase deployments especially, it often makes sense to select a UPS that exceeds current power requirements but offers greater runtimes and allows for future growth.

A power factor of a UPS (a 0 -1.0 numeric relation of real power (W) to apparent power (VA)) is also an important criteria when choosing a right UPS for modern IT applications, as many newer types of IT equipment, such as computer servers, have PF 0.9 or greater. If a UPS power factor is identical to the power factor of the load, users get more useful power out of their UPS and calculations are no longer needed to work out the size of the load the UPS can support.

4. Availability and battery runtime

This is where you need to determine your true runtime requirements. While runtime may seem like a simple thing to quantify, understanding the facts behind the numbers helps contribute to the development of end-to-end solutions.

Generally, the amount of runtime required can significantly affect the solution cost.

There are four basic battery runtime configurations:

- UPS with 10 to 15 minutes of runtime and no generator. You are covered for 90 to 95 percent of power outages. You can either use UPS shutdown clients to save your data or stay online as long as possible before the system crashes.
- UPS with 10 to 15 minutes of runtime and a generator. You have a very reliable setup and most generators will start up within one minute (five minutes maximum). You are covered for most situations.
- Redundant UPSs, generator and two power feeds for dual-corded servers. You have a lot of money and/or are really worried about the power failing. It's time to get a consultant on-site to help you figure it out.
- UPS with two or more hours of battery runtime. In some cases, generators may not be practical and you must rely entirely upon batteries.

5. Form factor

How much space are you willing to designate to your UPS? Where do you plan to install it? Answering these questions will help you determine whether your environment is better suited for a tower or rackmount model. Some UPSs have a 2-in-1 form factor, allowing you to deploy the unit either way.

6. Scalability

It's always important to consider your future expansion needs when evaluating solutions.

For cost-conscious or budget-constrained customers, a UPS with inherent scalability often delivers the best value in the long run, allowing you to increase capacity without purchasing additional hardware. A simple kVA upgrade is all that's needed to enable a UPS with inherent scalability to operate at full capacity.

If you want to service the UPS yourself, look for a unit that allows you to add capacity with power and/or battery modules.

While modular solutions—including multiple, paralleled systems—are often a more affordable option initially, they can be a more expensive solution over the long term due to added hardware and installation costs. Depending on your needs, a larger, centralized, non-modular system with inherent scalability might be a more cost-effective solution.



7. Power distribution

It is important for you to consider how power will be delivered to your critical equipment. In some cases, you may simply plug loads directly into the UPS. In others, you may need power distribution units to distribute power.

8. Manageability

While a UPS protects the attached load during a power outage, power management software is required to ensure that all work-in-progress is saved and that sensitive electronic equipment is gracefully shut down if the power outage exceeds the battery runtime of the UPS. Without software, the UPS simply runs until its batteries are depleted and then drops the load. In addition to this basic functionality of UPS software, you should consider the following monitoring and manageability capabilities:

- Power event notifications, including emails, pop-up alerts and text messages to pre-designated recipients
- Logging of power events
- Advanced capabilities in virtual environments, including integration into virtualization and cloud platforms
- Dedicated battery monitoring and advanced service notifications
- Remote monitoring by service personnel from the UPS manufacturer.

9. Operation and maintenance

While you may value the ability to service your own equipment, the vast majority of IT and facility management professionals prefer the peace of mind that comes with full factory support through on-site service or an advanced UPS exchange agreement. To make an informed decision on service support, you must accurately assess your own technical and service capabilities.

Consider UPS and battery safety as there is an inherent danger in maintaining them. The more complicated the equipment, the more important it is to have experts perform the maintenance.

10. Budget

While the latest performance features of a UPS may fit with what you are looking for, budget constraints can force you to make trade-off decisions. Be prepared to prioritize your needs for redundancy, scalability, efficiency, software management, modularity and serviceability.



Other UPS design considerations

The following design guidelines should be reviewed and followed before committing to any UPS solution.

1. Check to see if there's an adequate electrical supply near the UPS.

Compare UPS fuse ratings (amps) and breaker types and whether any electrical work is needed (i.e. cabling to the UPS terminal block input).

2. Find out the dimensions of the UPS and include any battery cabinets.

Make sure your installation site has enough space available.

3. Ensure the UPS can be easily transported through your building.

Will the UPS components fit through doors? Are there any stairs? Do you have existing racks that the UPS must fit into?

4. Verify that the floor is strong enough to support the UPS and battery cabinets.

The UPS and its battery cabinets can be heavy, so make sure the site has the proper floor loading capacity.

5. Confirm that the UPS will have adequate ventilation.

UPSs are commonly cooled by internal fans. You shouldn't install the UPS in a sealed container or small, sealed room.

6. Hardwired connections.

Hardwired outputs are generally useful if you want the UPS output to be distributed via electrical panels. Using an electrical distribution panel allows for flexibility with receptacle types. If there's no other UPS that fits your receptacle and power requirements, you may need to hardwire it. Hardwired UPS models typically require the use of a certified electrician to wire them to the electrical distribution panel, which could be a costlier option.

7. Installing small UPS models behind larger UPS models.

If you're installing a smaller UPS behind a larger UPS, you must consider the total potential power of the smaller UPS as well as other loads that will be powered by the larger UPS. For example, if you're plugging a 1500 VA UPS into a 10,000 VA UPS, you must consider the load of the smaller UPS rather than just the load that's plugged into it. In addition, the larger UPS must be at least five times larger than the smaller UPS. This design guideline must be followed due to charging capacity that may be required by the smaller UPS, any anomalies associated with the building power, and to avoid overheating or potential overloading of the larger UPS which may result in failure of all UPS models in the string.

8. Using a UPS and generator together.

A UPS provides backup power and actively conditions and regulates voltage. Similarly, an auxiliary generator provides backup power, but typically takes 10-15 seconds to start up, depending on its type. For long-term backup servers and IT equipment, this isn't an optimal situation, so during that downtime the UPS kicks in. Basically, the UPS bridges the power gap between loss of power and the generator coming online.

When choosing your UPS solution, it's important to keep power ratings in mind. You cannot size a generator in a 1:1 match to the UPS and expect successful results. There are two reasons for this: the first is that UPSs aren't 100 percent efficient, and the second is that generators need to account for step loads. In addition, very small generators often don't provide enough kinetic energy to provide a smooth transition. As a rule of thumb, for 20 kVA and above, auxiliary generators should be sized 1.5 times the size of the output rating of the UPS in kW, while for 20 kVA and below, they should be two times larger. It's also important to note that gas-powered generators should be sized a bit larger.

9. Building codes.

Verify that the final UPS solution meets local building codes.

UPS form factors

With applications spanning from desktops to large data centers, UPSs come in a variety of form factors.

1

Desktop and tower UPS

- a. The Eaton 3S UPS fits easily on top of or under a desk.
- b. The Eaton 5P tower UPS fits under a desk or in a network closet.



2

Wall-mount UPS

The Eaton 5P rackmount UPS includes hardware for mounting on a wall.



3

Rackmount UPS

The Eaton 5P rackmount UPS occupies only 2U of rack space.



4

Two-in-one rackmount/tower UPS

The Eaton 5PX UPS can be mounted in a rack or installed as a tower model.



5

5. Scalable UPS

- a. The Eaton BladeUPS is a scalable, redundant rackmount UPS.
- b. The Eaton 93PM is a vertical or horizontal scalable white or grey space solution.



6

Large tower UPS

The Eaton Power Xpert™ 9395 UPS is designed to be a central backup for multiple loads, including data centers.



Step 1

Input plugs and output receptacles

When you receive a UPS, you should be able to plug it in a right way.

For reference we have included the following chart to help you visually confirm input and output plug/outlet options.

Schuko



Terminal block (Hardwired)



IEC-320-C13 (female)



IEC-320-C14 (male)



EC-320-C19 (female)



IEC-320-C20 (male)



FR



BS



IEC-309, 16A



EC-309, 32A





Decentralized or central UPS?

Is a single, large UPS better, or is it best to have multiple, smaller UPSs?

Naturally, the answer is that it depends on a number of factors. In a decentralized (also known as distributed) UPS configuration (see figure 2), multiple UPSs support a handful of devices or perhaps only a single piece of equipment. Decentralized UPSs typically use plug and play connections and are usually less than

or equal to 6 kVA. In a central UPS configuration (see figure 1), a larger UPS supports multiple devices. A centralized UPS is typically hardwired into an electrical panelboard. The following tables include a number of factors to consider when making a decision between a decentralized and central UPS. In the end it's often best to simply go with the strategy that you are comfortable with.

Central UPS

Why you'd choose a central UPS solution

Typically, sales and service life of the UPS is longer.

A single UPS is easier to monitor, service and maintain than lots of smaller UPSs.

A larger UPS will be three-phase, which usually means more efficient operation and lower operating costs.

A central UPS is often housed away from high traffic areas. As a result, it's less easily disrupted, accidentally damaged or maliciously interfered with.

A central UPS can be located where cooling is more tightly controlled. Remember, heat is the enemy of the batteries inside a UPS.

Although a technician may need to replace the batteries, you only have to worry about a single UPS. A distributed UPS configuration may result in various models that require different batteries. When you consider the time it takes to replace the batteries for between 5 and 20 UPSs, you can start to understand the benefits.

Why you wouldn't

A single UPS can mean a single point of failure. You can overcome this concern with an N+1 or N+X UPS for redundancy.

The single UPS may not be close physically to the equipment it will protect. A single electrical distribution panel may not feed all equipment.

There is no space for a large UPS.

A central UPS generally requires a trained service technician or electrician to service, maintain or install.

A central UPS may incur higher installation and wiring costs.

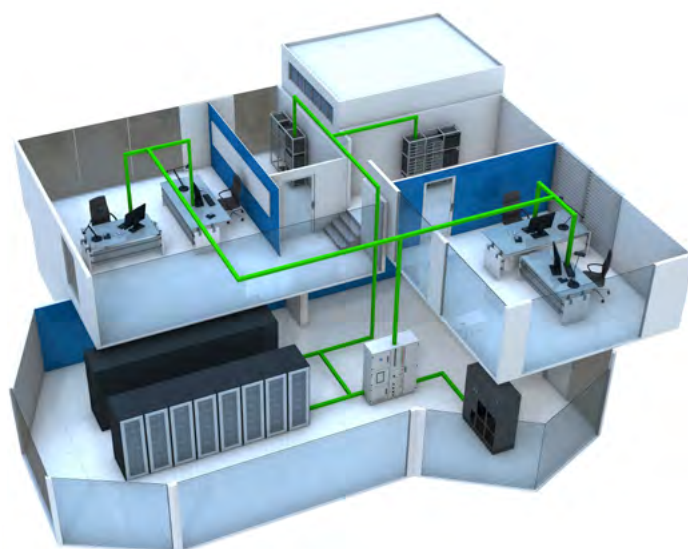


Figure 1

Decentralized UPS

Why you'd choose a decentralized UPS configuration

No rewiring is required and existing wall sockets can be used. Can also be redeployed easily if IT systems are moved.

Requires lower capital outlay and installation costs. Fits within IT manager purchase limits. Will most likely not require additional installation costs from electrician.

Provides room for future capacity growth and avoids being locked into a specific UPS.

You already have a number of smaller UPS units that are fairly new and you don't want to discard them. (Most UPS manufacturers offer a trade-in program.)

Power conditioning is implemented at the point of use, which mitigates any electrical disturbances that may be coupled into the distribution wiring of a centralized system.

Provides flexibility in terms of power protection and functionality. For example, extended runtime can be configured for specific applications, eliminating the need to add additional battery modules for less critical equipment.

Why you wouldn't

If a generator supports the building, smaller standby and line-interactive UPSs may not be able to function while it's running.

No central panelboard exists or there's no room for the UPS.

Time and effort is required to monitor multiple UPS units, to keep up with replacing batteries and maintaining the individual units.

You want a single UPS that can be shut down using emergency power off. Also, a decentralized design may not offer redundancy and other capabilities provided by a larger, central UPS.

Adding redundancy, extended runtime or maintenance bypass functionality to multiple UPSs can be costly.

Multiple audible alarms/alerts may be irritating.

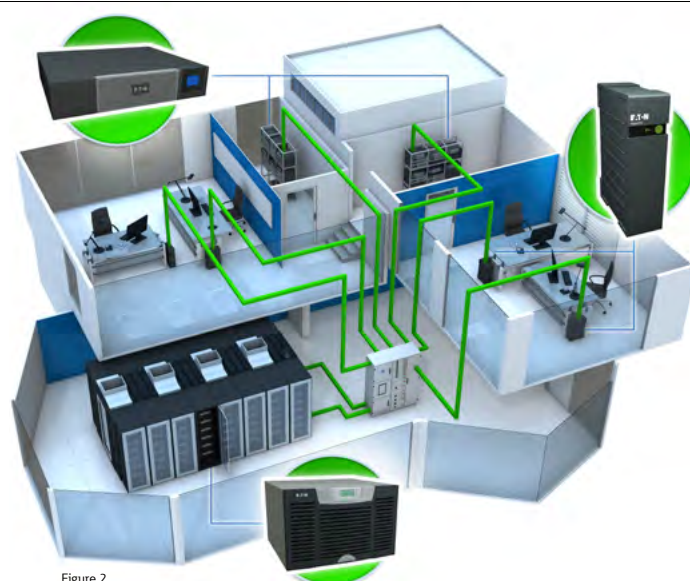


Figure 2

Combining the configurations

It's important to keep in mind that decentralized and centralized power protection deployment strategies aren't necessarily mutually exclusive.

The two strategies can be used in combination to provide redundancy to mission-critical applications. For example, an entire facility may be protected by a large, centralized UPS, but a specific department—such as a 24x7 call center—may have decentralized UPSs as well to provide redundant protection and possibly extend runtime for call center equipment.

The nine power problems

In an ideal world, your wall socket would provide an infinite stream of perfect power, at constant voltage and cycling exactly the same number of times per second. Unfortunately, however, this is not always the case. Get familiar with existing power problems and learn which UPS topologies can protect your equipment from them.

Power problem		Definition	
Power failure		A total loss of utility power.	
Power sag		Short-term low voltage.	
Power surge (spike)		Short-term high voltage more than 110 percent of normal.	
Under-voltage (brownout)		Reduced line voltage for an extended period of a few minutes to a few days.	
Over-voltage		Increased line voltage for an extended period of a few minutes to a few days.	
Electrical line noise		High frequency power wave caused by radio frequency interference (RFI) or electromagnetic interference (EMI).	
Frequency variation		A change in frequency stability	
Switching transient		Instantaneous under-voltage in the range of nanoseconds.	
Harmonic distortion		Distortion of the normal power wave, generally transmitted by unequal loads.	



Choose a passive standby topology (off-line) UPS



Choose line interactive topology UPS



Choose a double-conversion (online) topology UPS

UPS battery overview

It's well known that the battery is the most vulnerable part of a UPS. In fact, battery failure is a leading cause of load loss. Understanding how to properly maintain and manage UPS batteries can extend their service life and help prevent costly downtime.

Valve-regulated lead acid (VRLA) batteries, also known as sealed or maintenance free are most commonly used in UPSs. VRLA batteries are sealed, usually within polypropylene plastic, which offers the advantage of not containing any sloshing liquid that might leak or drip. Because water can't be added to VRLA batteries, recombination of water is critical to their life and health, and any factor that increases the rate of evaporation or water loss—such as temperature or heat from the charging current—reduces battery life.

Factors affecting battery life

All UPS batteries have a limited service life, regardless of how or where the UPS is deployed. While determining battery life can be tricky, there are four primary factors that contribute to a battery's overall lifespan.

1. Ambient temperature

Because the rated capacity of a battery is based on an ambient temperature of 25°C, any variation from this can affect performance and reduce battery life. For every 8.3°C average annual temperature above 25°C, the life of the battery is reduced by 50 per cent.

2. Battery chemistry

Positive grid corrosion has been the most common end-of-life factor for UPS batteries, which is a result of the normal aging process due to UPS battery chemistry and involves the gradual breakdown of the inner segments of the positive grid within the battery.

3. Cycling

After a UPS operates on battery power during a power failure, the battery is recharged for future use, which is called the discharge cycle. At installation, the battery is at 100 per cent of its rated capacity, but each discharge and subsequent recharge slightly reduces the relative capacity of the battery. Once the chemistry is depleted, the cells fail and the battery must be replaced.

4. Maintenance

Battery service and maintenance are critical to UPS reliability. A gradual decrease in battery life can be monitored and evaluated through voltage checks, load testing or monitoring. Periodic preventive maintenance extends battery string life by preventing loose connections, removing corrosion and identifying bad batteries before they can affect the rest of the string. Even though sealed batteries are sometimes referred to as maintenance-free, they still require scheduled maintenance and service. Maintenance-free simply refers to the fact that they don't require added water. Without regular maintenance, a UPS battery can experience heat-generating resistance at the terminals, improper loading, reduced protection and premature failure. With proper maintenance, the end of battery life can be accurately estimated and replacements scheduled without unexpected downtime or loss of backup power.

5. Shelf life, storage and acceptance testing

It's important to ensure that batteries are properly stored prior to being installed and placed into service in order to improve service life expectations and reliability. Storage facilities should be climate controlled with proper ventilation capabilities so batteries can be kept cool and dry. Failure to comply with proper storage can lead to shortened runtimes and reduced capacity. All battery manufacturers have shelf life and storage parameters. In terms of time, a good rule of thumb is no more than six months of storage in a properly designed storage facility. To validate runtime and capacity expectations, an acceptance test should be performed. The acceptance test will be able to determine if there are any flaws within the manufacturing process, improper storage or perhaps even hidden damage as a result of shipping and handling. This test might be the most important procedure any operator can have performed to ensure reliability of the battery systems.

DISTRIBUTE:

IMPROVE POWER DISTRIBUTION
TO INCREASE EFFICIENCY AND
REDUCE OPERATING COSTS

Why intelligent power distribution?



Rack PDUs are a key part of an integrated system that protects the IT equipment within the rack.

The right power distribution unit (PDU) not only distributes power from your UPS to IT appliances safely and efficiently, but also allow you to monitor and control the power at the individual outlet, switch power on and off, remotely shut down the power during an emergency power outage, and help initiate disaster recovery policies on power and environmental events. Rack PDUs can deliver the customization and protection capabilities you need within your rack.

Optimize power
distribution with Eaton



Top rack PDU design considerations

Before committing to any rack PDU solution, review if it serves your needs in the best possible way and offers everything you need for optimal power distribution in IT racks.

1. Enhance the reliability of your IT installation

Even a sophisticated power infrastructure designed to guard against unplanned downtime and data loss can be threatened with a simple accidental plug disconnect. To guard against this, some rack PDU suppliers have developed a plug retention feature that takes up no extra space and delivers maximum reliability with standards IEC cables.

2. Track where your energy is going

Some types of rack PDUs can provide energy monitoring right down to socket level, if required, and they can measure energy usage with ± 1 percent billing grade accuracy. This means users can quickly determine exactly where energy is being used and ensures rogue hardware that's consuming more energy than it should is quickly identified. Accurate metering also simplifies load balancing and reveals locations where there's spare power capacity.

3. Cut your cooling costs

The trend to use less cooling means higher temperatures in the rack enclosure. Older rack PDU systems may not be able to cope and make it necessary to provide additional cooling, but new generation PDUs can work continuously at up to 60°C, following the ASHRAE guidelines.



4. Simplify maintenance and upgrades

The best rack PDUs are easy to install and offer a choice of mounting positions. They're lightweight, yet robust, and their aluminum chassis dissipates heat efficiently, as well as providing excellent ground conductivity. Older rack PDUs often get in the way of other rackmount hardware, making it difficult, for example, to hot-swap server components to maintain operational continuity, or to install hardware upgrades. The latest PDUs have a low-profile design, which allows full access to all rackmount equipment. In addition, they incorporate hot-swappable components, such as meter boards, which can be fitted or exchanged without interrupting the supply to the loads. As an additional benefit, the best rack PDUs are color-coded so maintenance technicians can see at a glance which circuit breaker controls which socket.

5. Take control of your power

With some type of PDUs, users can remotely turn the power on or off to individual socket outlets and set automated sequential restart to avoid inrush current. The switching can be carried out manually or under the control of power management software. This makes it possible to disconnect non-essential loads in the event of mains supply failure, so UPS runtime is maximized. It also means individual servers can be remotely restarted to help restore normal operation after a problem, and servers can be completely shut down when the demand is light, outside normal working hours.

Top rack PDU design considerations

6. Simplify administration of your power system

Today's rack PDUs support mass configuration and updating, which keeps the time needed for power system administration to a minimum. Changes, which occur frequently in today's dynamic IT environments, can be implemented quickly, efficiently and with minimal risk of error.

7. Save money on network components

Network connections are essential for all advanced rack PDUs to provide access to their control and monitoring functions. With older types, a separate network port is needed for each PDU. This arrangement is expensive and unwieldy, as administrators have to deal with multiple IP addresses. The latest rack PDUs reduce physical infrastructure costs with daisy-chain network connectivity, where a single port and just one IP address can be used for multiple PDUs.

8. On-the-spot status information and notifications

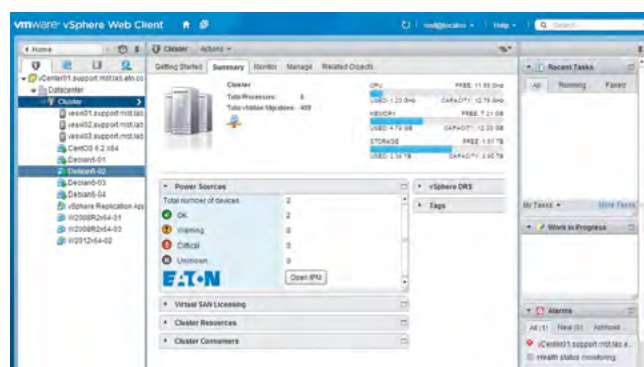
Some rack PDUs have integrated displays that can be rotated to suit the installation orientation and show key information, such as alarms, right on the device. This makes it possible to check the operation of the power system at a glance, and is an important aid to rapid detection and correction of faults. On top of that, alerts can trigger real time notifications.

9. Monitor and collect environmental data

In combination with environmental sensors rack PDUs are able to collect and monitor environmental data and generate temperature/humidity alarms. Those alarms can be used to trigger virtual machine migration to a safer location, in order to reduce the server load, hence limiting the heat in the rack.

10. Integration into virtualization platforms

When paired with a power management software, intelligent rack PDUs can be monitored throughout a virtual platform monitoring system. This feature allows single pane of glass management for both virtual machines infrastructure and power distribution. No extra software is required, when the power management is provided as a virtual appliance.



Choosing appropriate power distribution for your IT application

There are 2 main criteria when choosing a PDU:

Format:

the standard vertical format is called “0U”, because it doesn’t take any U space in the rack. These are the most common ones, and fit the standard 42U racks. 1U and 2U horizontal PDU formats are also available. They usually provide 8 to 16 outlets only, to fit the 1U/2U requirement. They are commonly used in small racks or wall cabinets/boxes of 12, 15, 18 or 22U, or for 42U racks with two or three compartments inside (typical in colocation datacenters).

Technology:

depending on the end-user requirements, rack PDU manufacturers offer a choice of five or six technologies, from the basic outlet strips to the managed ones, where power consumption and control are made at outlet level.

Choose the PDU technology which meet your requirements:

Needs

- Effectively distribute electrical power
- Organize my power distribution strategy
- Simplify load balancing
- Prevent accidental plug disconnects
- Reduce cooling costs and maintain full functionality in high temperatures

All of the above, but also a need to save time with the ability to:

- Optimize power usage with highly accurate power monitoring
- Meter color-coded sections to control power utilization
- Remove meters to make service pain-free and maintain uptime
- Easily access to information, IP set up and troubleshooting
- Share network connection/IP address for multiple PDUs

All of the above, but also a need to save money with the ability to:

- Make better deployment decisions with precise data and energy analysis through outlet-level measurements
- Transform billing into revenue or utility discounts by measuring Level 3 power usage effectiveness (PUE)*

All of the above, but also a need to reduce risk with the ability to:

- Save time by remotely controlling devices by powering on, off or rebooting individual outlets
- Control unauthorized use of unused outlets
- Save time from on-site visits with remote capabilities
- Group multiple power supplies across the PDU to control all with a single action (i.e. save time when rebooting servers with two or more power supplies)

Solution

Choose a basic rack PDU or look for a unit with features like outlet grip plug retention, color-coded outlet sections, a low-profile form factor and high operating temperature capabilities.

Choose a Metered Input rack PDU or look for a unit with features like one percent billing grade accuracy, LCD pixel display, daisy chain capabilities, hot-swap meter, phase and section metering.

Choose a Metered Output rack PDU or look for a unit with features like measurement capabilities at the outlet-level .

Choose a Managed rack PDU or look for a unit with features like outlet switching, turning off unused outlets, remote site management and group reboot for A/B feeds.

ORGANIZE:

ORGANIZE IT EQUIPMENT IN A RACK RELIABLY AND EFFICIENTLY AND REDUCE COOLING COSTS.

Why Racks?

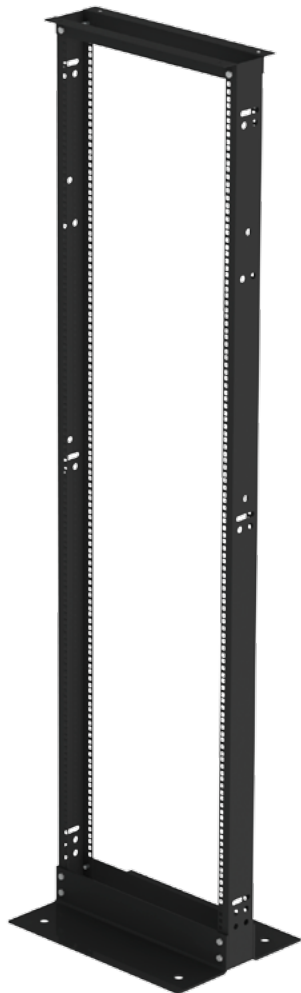


Racks and enclosures are among the first pieces of equipment deployed in a data center or server room and you should ensure that you house your IT system reliably and efficiently. Proper cable management, airflow management and storage accessories are important for keeping rack neat and well organized, when air containment configurations ensure optimized cooling in your data centre.

Optimized housing
of IT equipment
with Eaton:



Two-post rack



The two-post rack is the simplest, featuring an open frame that allows for vertical rack mounting of equipment with full and easy access.

They are an ideal solution for network and telecommunications (VoIP) gear. As the name suggests, the rack is constructed of two vertical steel posts joined together by top and bottom cross members, making installation and equipment maintenance easy. The two-post rack fits in tight spaces and offers flexibility when reconfiguring equipment and cables. Cable management and security products are available to help manage mounted equipment. Most often this solution is used for organizing voice, data, and video (VDV) equipment.

One drawback is that with only two posts, it isn't the most stable solution for rack mounting a lot of equipment. It is therefore recommended that the two-post rack is bolted to the floor structure for the safety of your staff and your mission-critical equipment.

Some highlights of the two-post rack include:

- Quick assembly
- Small footprint
- Lightweight
- Accessible

Enclosure



Enclosures are essentially enclosed four-post racks with front and rear doors as well as side panels.

Using an enclosure increases the security of your rackmount equipment. As you move from the network closet to server rooms and large data centers, enclosures are the primary rackmount solution for servers, uninterruptible power supply (UPS) systems and networking equipment. Removable side panels and doors, as well as rackmount rail kits that allow you to easily move equipment in and out of the enclosure, offer quick access while also protecting equipment from unauthorized entry. Additionally, with rapidly increasing power consumption and escalating heat output from IT equipment, an enclosure platform provides more flexibility to contain and direct the heat through rack- and aisle-based heat containment strategies including enclosure chimneys.

Some highlights of enclosures include:

- Enhanced security
- Controlled thermal management
- Aesthetic appeal
- Broader range of mounting options for accessories

Wall box

If you're running a smaller operation and aren't in need of a full-size rack or enclosure, a wall box may be an appropriate choice. This cost-effective and versatile solution provides secure storage of communications cabling, network gear, and related equipment on a wall—freeing up valuable desktop or counter space.



Sometimes, your “backbone” equipment is placed in a more public space—rather than in a network closet, server room or data center—so aesthetics and security can play larger roles. Wall boxes are an ideal solution for manufacturing and production environments, small/remote offices, retail, security offices, etc.

Some highlights of wall boxes include:

- Protection from tampering and accidental unplugging
- Clear counters, desktops and shelves
- Adequate ventilation to keep equipment cool
- Optional fan kits and intake air filters



Top rack considerations

Racks and enclosures are available in different heights, depths and widths, but one thing is certain: there is a solution for whatever equipment you're looking to store, protect, cool, power, manage, and secure.

Whether you're building a new space or optimizing and retrofitting an existing one, answer these questions to determine the best solution for your specific requirement.

Space and environment

- Where do you need to secure equipment? (e.g. in a separate room or an open area where many people have access.)
- How much open space do you have in this area? (Think in terms of width, depth and height as that will impact your ultimate solution.)
- What set-up do you have in mind? For example, do you want to place multiple racks side-by-side? Or will they be stand-alone?
- Will you need to easily move your rack or enclosure or will it be in a permanent location/layout?
- Are you in a location with significant vibrations? (e.g. near an airport or in an area that's prone to earthquakes.)

Equipment and cabling

- What equipment will go in the rack(s)?
- Will equipment be kept under lock and key at the rack level?
- How wide, deep and tall (U height) is the equipment going into the rack?
- Do you anticipate adding more equipment in the future?
- How are you connecting the equipment together from a cabling perspective?
- Will you need to run cabling across multiple racks? If so, how do you plan on doing that?
- Will you need access to the rack from the bottom or top for cabling purposes?

Other considerations

- Will you use rack power distribution units?
- Will you need back-up power for your IT environment—either rackmount or free-standing?
- Do you have a way to remotely monitor the environment and temperature 24/7?
- Do you have power management software to help monitor equipment and migrate virtual machines in the event of an extended power outage?
- How will you keep equipment at an ideal temperature? Do you need airflow management accessories to manage airflow in your racks?



Tips for cable management

An organized rack decreases human errors, increases efficiency and better protects equipment by increasing effective airflow, particularly in an enclosure. By using the correct cable management accessories to organize, route and remove unnecessary stress on your cables, you can better ensure data integrity.

Racks and enclosures can become disorganized quickly if cable management doesn't remain an ongoing priority. As a critical point of interconnection within your business, follow these tips to ensure optimal performance of your mission-critical IT equipment.

Organization

- Study the different cable accessory options to find out what will work with the equipment in your environment (cable trays vs. lacing bars vs. ring managers, etc.). View the glossary on page 24.
- If you have more than one rack or enclosure, establish a standard for uniformity to keep your operation running smoothly.
- Use Velcro rather than zip ties when bundling cables. It will make removal of cables easier.
- Separate data and power cables to minimize signal interference.
- Avoid running cables across the inside of a rack or enclosure. Instead, bundle cables, and run them vertically up the side of the rack or enclosure and across the top. This is where overhead cable management options come into play.
- Make sure not to block any equipment, as this can hinder serviceability and cause overheating and/or equipment damage.

Documentation

- Label or tag your cables on both ends to make troubleshooting easier.
- Be consistent in your labeling or tagging methodology.
- Group and color code your cables (servers vs. routers, etc.).
- Document your methodology, inventory, IP addresses, serial numbers and the roles of each device.

- Post diagrams on the side of each rack or enclosure.
- Take front and back pictures of the equipment to help with over-the-phone troubleshooting.
- Keep electronic and hard copy versions of your documentation.

Safety

- Limit employee access to racks and enclosures.
- If a cable isn't being used, have it removed. Loose cables are a safety hazard.
- Limit the length of cables (the longer the cables, the greater the chaos).
- Avoid cables that dangle, which are a target for human error.
- Avoid extensive bending of cables; adhere to appropriate bend radius recommendations.
- Properly and securely install power cables to minimize arc flash risk.
- Make sure plugs are secure.
- Ensure cables are protected from sharp objects.
- Study industry standards and regulations on designing, installing and testing structured cable (e.g. TIA/EIA-568-B.1/2/3 bend radius standards).

By employing some of these basic cable management strategies, you will save yourself a lot of headaches when it's time to add, remove or revamp the equipment in your rack or enclosure.

Industry standards and regulations can be found through:

- Telecommunications Industry Association (TIA)
- Electronic Industries Alliance (EIA)
- Electronic Components Industry Association (ECIA)
- International Organization for Standardization (ISO)
- International Electro Technical Commission (IEC)

Blanking panels: a best practice

Today's rapid technology refresh rates result in ever-increasing changes within racks and enclosures.

This can lead to open U-space that allows re-circulation of hot exhaust air to the equipment inlet, particularly in an environment where enclosures are being used. Blanking panels provide a quick, easy and cost-effective solution to optimize air circulation within an enclosure while also maintaining a clean, uniform look within a row of enclosures.

Blanking panels are available in a variety of styles, with the most common being black plastic or steel. However, there are other options available—like adjustable and cable pass-through

configurations—depending on your specific requirements.

In addition to sealing unused U-space in the rack, there are at least five other fault areas of an enclosure that can directly affect airflow management and cooling performance, as well as improve energy efficiency.



Five fault areas of an enclosure

With a goal of zero airflow leakage within an enclosure—particularly in equipment-dense applications—it is important to know the most susceptible areas for the remixing of cold air supply with hot air exhaust from rackmount equipment.

[1] Fault area 1: Under the enclosure (external to enclosure)

The area under the rack, but above the floor deck can be difficult to manage because the height varies based on the size of rack levelers or casters and the manufacturer. This space can contain a substantial amount of uncontrolled air—and can therefore yield a large benefit if it's sealed appropriately.

Typically, there's not a solid panel under the enclosure due to the requirement for power and network connectivity. That also makes this a potential leakage area because hot air from below the enclosure can get trapped and cold air from perforated floor tiles can bypass it.

[2, 3] Fault areas 2 & 3: Left and right side of the front 19" vertical mounting rail (internal to enclosure)

Because of customer demand for adjustable rails and cable pass through capabilities, the areas to the left and right of the front rails on most 19" enclosures are potential leakage points.

The space between the side of the vertical rail and the side of the enclosure frame or side panel is typically wide open, allowing hot air to penetrate or cold air to pass. This can severely compromise a robust blanking panel strategy.

Today's wider racks (i.e. 800 mm) have an additional 100mm on each side of the 19" rails to provide space for cooling side-to-side switches or space for managing a high volume of network cables.

To get out to the side or up to the top, cables are passed through openings that are typically unsealed. These openings should be covered with a material that provides a seal around the cables to minimize air leakage.



Five fault areas of an enclosure

[4,5] Fault areas 4 & 5: Above and below the top and bottom rackmount space (internal to rack)

Areas above the top U space and below the bottom U space are also regions of suspicious leakage. Typically, some amount

of space exists in these areas and varies per rack manufacturer. However, it's not unusual for this space to equal that of a missing blanking panel. This area is susceptible to hot air recirculation and is also more likely to allow bypass of the cool air supply from CRACs.

Rack hygiene

Racks and enclosures are more than a space to store high-performance servers, storage and switches. They have become an instrumental part of today's critical airflow management strategies in the data center.

As virtualization becomes a standard for businesses to reduce the operating costs associated with consolidation of server, storage and network devices, it's further driving the view of an enclosure as an airflow plenum.

The amount of heat has increased within the enclosure and data center too, thanks to new IT technology and smaller rackmount equipment. Additionally, the number of cables within the enclosure has grown significantly, resulting in potential airflow blockages if they are not managed and routed appropriately.

Ideally, cool supply air is drawn into the front of the enclosure to cool equipment and exits via a rack-based chimney at the top rear of the enclosure or into a contained hot aisle.

Equipment becomes less efficient when the hot air travels back to the front of the enclosure and remixes with the cool supply air that's being pulled through the equipment. The more equipment you store in your enclosure, the more you will need to consider this type of inefficiency.

Airflow mismanagement can result in failing hardware and unnecessary facility costs, so here's some guidance to help you avoid it:

What is rack hygiene?

To ensure sufficient device cooling, predictable airflow management is essential, and this means all potential airflow openings must be controlled and managed—which is what rack hygiene is all about. Rack hygiene includes identification, analysis, and repair of hot air leakage paths and cold air bypass routes within and around racks.

Rack hygiene in practice

Implementing rack hygiene starts with measurements to establish a baseline and testing to identify problem areas. Your goal should be zero airflow leakage. Implementing rack hygiene starts with measurements to establish a baseline and testing to identify problem areas. An experienced team trained in containment strategies should analyze the test results and provide detailed recommendations for improvements.

Rack hygiene benefits

Adopting effective rack hygiene eliminates hot spots, which allows equipment to operate optimally, and helps match cooling supply and demand. This saves energy and prevents wasteful recirculation and bypass air streams associated with additional "chaotic cooling" methods. Rack hygiene also helps to prevent aisle and room overheating, a problem that's often rooted in ineffective rack-level airflow management.

Airflow problem areas

Blanking panels must be a best practice in your data center, but are only one component of rack hygiene. Addressing the five typical fault areas can drive true performance gains: optimized enclosures used as an integral element of airflow containment systems can reduce energy usage by as much as 35 percent.

No place for intuition

Relying on intuition and creative problem-solving to achieve effective cooling is no longer a viable approach. Rack hygiene is an essential consideration for all future rack purchases. A smart containment strategy, which always begins with the rack, enables:

- Efficient utilization of existing physical infrastructure and cooling capacity
- Active control and normalization of supply temperature
- Doing more with less in a smaller footprint with increasing heat loads
- Elimination of "stranded" physical, electrical and mechanical capacity

MANAGE:

INTEGRATE YOUR POWER MANAGEMENT INFRASTRUCTURE WITH YOUR VIRTUAL ENVIRONMENT AND MANAGE IT ALL THROUGH A SINGLE PANE OF GLASS

Why intelligent power management?

Intelligent power management is a key component of optimized power infrastructure solution, helping optimize power protection and distribution in IT applications, increase IT efficiency and improve business continuity.

While simple power management software provides safe system shutdown sufficient for users looking for an easy way to enhance the protection capabilities of their UPSs, the advanced power management software goes much further: it ensures high uptime of IT applications and integrity of data and raises business continuity to the next level.



Optimize power management with Eaton



Top power management software considerations

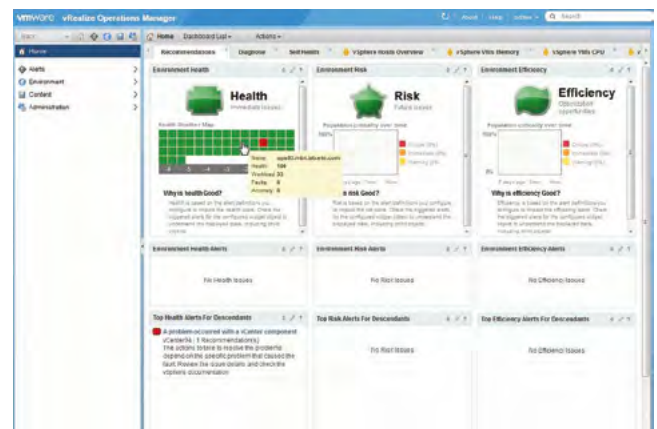
As each solution is different, take time to consider what kind of benefits different power management software products can offer and which of those benefits are important for you.

1. Monitoring

- Power event notifications. Power management software continuously monitors power supply and provide power event notifications as audible alarms, pop-up alerts on a monitor, e-mails to predefined recipients based on the condition, text messages.
- Integration into virtualization platforms for single pane of glass monitoring. Intelligent power management software integrates into virtual machine management systems and ensures that all power devices (UPSs and rack PDUs) in the virtual network can be viewed in the same application, together with network, physical server and storage information. Power system alarms can be then entered into the IT alarm management system.



- UPS/PDU health monitoring. Intelligent power management software keeps a constant watch over power system health through its monitoring and management capabilities. This helps make sure that UPS and its batteries as well as PDUs are in good shape and by notifying administrators of power or equipment failures they make it possible to minimize or prevent downtime.
- Integration into cloud management platforms. The most advanced power management software integrates also in health, performance and capacity management system of cloud platforms and this provides the capability to monitor and manage the health, risk and efficiency of the power infrastructure in cloud environments.

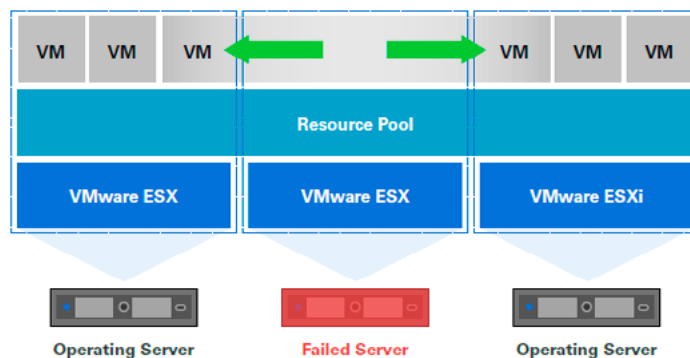


- Energy consumption monitoring. When combined with rack PDUs, power management software can provide energy monitoring right down to a socket level. This means users can quickly determine exactly where energy is being used and ensures rogue hardware that is consuming more energy than it should is quickly identified. Accurate metering also simplifies load balancing and reveals locations where there's spare power capacity.
- Compatibility with power and IT devices of different manufacturers. The more robust and versatile software offerings are compatible with UPSs of different manufacturers. This helps integrate monitoring of existing and new power solutions through the same software.

Top power management software considerations

2. Management

- Graceful shutdown of equipment on power outages. While a UPS protects the attached load during a power outage, power management software is required to ensure that all work in progress is saved and that operating systems are gracefully shut down if the power outage exceeds the battery runtime of the UPS.
- Automation of business continuity policies. Advanced power management software integrates into virtualization platforms and initiates proper disaster recovery policies on power and environmental alerts, including:
 - Shutdown of non-critical equipment to extend runtime of critical equipment and applications
 - Data replication
 - Automatic and targeted migration of virtual machines to the host of the choice
 - Gracefully shutdown of virtual machines in case of prolonged outage
 - Sequential start-up of equipment once power is restored
- Ability to limit power consumption of IT equipment on power and environmental events. Advanced power management software has the capability to limit the power consumption of some IT servers or storages during utility failure in order to maximize the UPS runtime, hence prolonging business continuity.
- Control of rack PDUs. Intelligent power management together with rack PDUs provides outlet level control—turn on, off and reboot—of individual or groups of outlets.



Sophisticated power management solutions maintain business continuity during power failures by automatically migrating virtual machines to unaffected parts of the network or to an offsite backup facility, colocation data centre or cloud computing infrastructure.



Choosing suitable power management software for your virtual environment

If you are leveraging virtualization and need to choose a suitable power management software for your IT infrastructure, consider top two criteria:

1. Establish if power management software integrates with your virtualization platform

When choosing a proper power management software ensure that it integrates into your existing virtualization platform (VMware, Citrix, Microsoft, Red Hat etc)



2. Identify what you want to accomplish with the software.

- Do you want it to plug directly into your virtual dashboard?
- Do you want to initiate planned migrations?
- Do you want to perform load shedding?
- Do you want to remotely shut down a host in a cluster without needing to install shutdown agents on each host or each virtual machine?

Once you've selected a power management software solution that seamlessly integrates into your virtualization platform and meets the needs of your environment, you will be able to enjoy a number of advantages:

Business Continuity and Disaster Recovery

- Data integrity and graceful shutdown in the event of an extended outage
- Initiate planned migrations to a cloud recover site
- Extended runtime to critical applications with load shedding

Management ease

- A global view across the network on one screen, often from any PC with an Internet browser
- A complete log of events and UPS utility data
- Centralized alarms
- Organized data by customized views
- Event logs for preventive maintenance of the entire installed equipment base

Cost savings

- Less hardware, power used, cooling, and management
- Increased productivity – no need to recreate your work-in-progress

MAINTAIN:

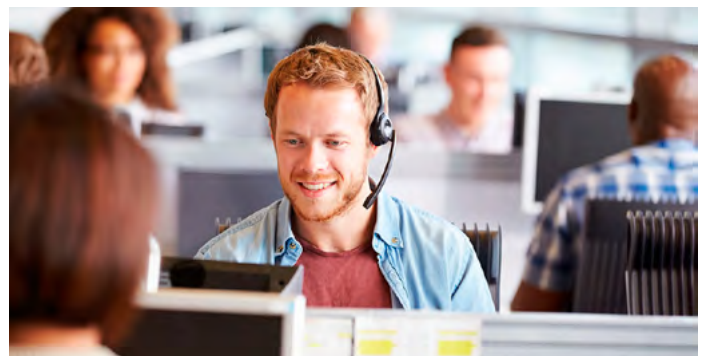
ADD EXTRA PROTECTION TO ENSURE EQUIPMENT PERFORMANCE AND RELIABILITY FOR A GREATER PEACE OF MIND



Why services are important?

Rack-based uninterruptible power supply (UPS) and power distribution units (PDU) provide excellent protection for the IT infrastructure—guarding against power problems that would otherwise impact business continuity. But it's essential to protect the protection. Every UPS and PDU needs attention to stay in tip-top condition.

So, it is essential to give some thoughts to how to ensure optimal operation of these power devices. That is where services become an important part of the optimized power infrastructure solution.



Optimized maintenance
with Eaton



Can modern power devices fail?

While modern UPSs and PDUs are highly reliable, they're also complex pieces of equipment, so the risk of failure can never be completely eliminated. Techniques like redundancy can reduce or even eliminate the impact of failures but, even then, if a fault develops it must be repaired.

The most common causes of UPS failures are:

1. Batteries

Bad batteries are a leading cause of UPS failures, with temperature and cumulative discharges being the primary culprits.

2. Fans

Some fans fail because of their own electrical or mechanical limitations, or because their ball bearings dry out. Some fans may withstand as much as 10 years of continuous use, while others run for only short periods before locking up for mechanical reasons.

3. DC caps

Like batteries, electrolytic capacitors degrade over time. When a capacitor fails, there might not be any immediate visible effects, but over time quality will reduce.

4. Transient spikes

The input side of the UPS (filter/rectifier) may be damaged when a transient spike occurs.

Protection against power device failures

Pay-as-you-go

When a problem occurs, you could simply call your UPS supplier, ask them to visit your site and fix the problem. But, with no pre-defined service plan in place, emergency call-outs to fix problems will be costly and response times won't be guaranteed.

Time and Material (T&M) service is a pay-as-you-go approach in which the service provider carries out a repair only when something breaks. T&M can be carried out either via depot repair or on site, depending on the UPS. This method is not always the best solution, since it is often expensive and has the added uncertainty of not knowing when a field technician will arrive. Because support agreement (contract) customers always take priority, for non-contract customers T&M response times may be as long as several days, depending on the product and location.

A better solution is to take advantage of service agreement options. That way, you benefit from priority access to service and support whenever you need it—and at a predictable and affordable price. Service agreements come in various types, so you can select an option to match your requirements and budget. Power management solution suppliers offer agreements covering anything from a small single-phase plug-and-play UPS right up to the largest custom-designed datacenter power system.

Extension of a standard warranty period

Typically, if you buy a new UPS or PDU and choose to put in place a service agreement at the same time, you can extend the standard warranty very cost effectively. A warranty usually covers specified parts and a pre-paid breakdown visit to site for a fixed period of time, which might vary in length and can be extended. It will not include 24/7 coverage or arrival response times, nor will it include preventive maintenance, although extra services can be purchased in addition to a warranty extension.

Commissioning support

Some suppliers will offer additional on-site support, to provide help with commissioning power devices and related software.

Battery-specific services

UPSs incorporate one key component that's unavoidably subject to ageing—the battery. All batteries eventually need to be replaced, but regular attention greatly extends their lives and ensures that, when a replacement does become necessary, it can be done with minimum disruption. To address this, battery-specific agreements are available that include a fast, efficient replacement service for life-expired or damaged batteries together with environmentally responsible disposal of the old batteries.

Preventive maintenance

A preventive maintenance of your UPS is much like completing routine repairs and inspections on your car.

An effective preventive maintenance strategy can be one of the most cost-effective measures you can take. It can significantly reduce the probability of a load loss event, ensuring the ongoing health of both your critical equipment and your overall business. Service contracts usually combine parts and

labor coverage (electronics, batteries or both), at least one or more UPS preventive maintenance inspections annually, and a combination of coverage hours and arrival response time. Plans can be tailored to meet almost any need. Special features such as remote monitoring, battery replacement insurance and spare part kits can also often be added.

Service methods

Depending on the size of your UPS and PDU, services can be delivered using different methods:

- **Depot exchange repair or replace**

If you have a UPS of up to 3kVA power range, you can contact your UPS service provider to ship the UPS to a repair facility. It will be the service provider's responsibility to return the repaired or refurbished unit.

- **Advance swap depot exchange**

This option allows you to contact the UPS service provider in the instance of a fault; the service provider will ship a refurbished unit to you and return the original UPS unit to a repair facility.

- **On-site repair**

For units bigger than 3kVA this is the best solution. Units of this size are likely to be either hard-wired so can't be unplugged, or are too heavy to be shipped to a service provider. With this option, the UPS service provider will send a factory-trained field technician to diagnose and repair electrical or battery-related problems on site.

Scheduled maintenance through regular service contracts is by far the best option for managing power reliably, offering the strongest opportunity for avoiding the shock of unexpected bills and the danger of interrupted business continuity.

Remote monitoring

Some power management companies also offer remote monitoring services.

Your UPSs are connected to a vendor's remote monitoring system so that their technicians can monitor your system and identify problems before they become load loss events. In the event of incorrect UPS performance, the system

notifies your IT-department (via SMS or email) and the vendor's service technician. You or the vendor can then take immediate corrective action. The system provides 24x7 secure access to critical UPS information, from anywhere in the world, using the Internet. Such services help improve equipment reliability and minimize maintenance costs.

UPS health checklist

Use the following checklist to help keep your UPS in good shape:

1. Make sure your batteries are in good health.

- **Note their age**
 - UPS batteries can last anywhere from 2–5 years, so if yours are four-years old or more, you should begin planning a replacement.
- **Run a UPS battery self-test**
 - Most network-class UPSs have the capability to run a quick self-check from the front menu.
- **Check under the hood**
 - Remove the front bezel and make sure there are no signs of battery swelling or damage.
- **Consider a preventive maintenance visit**
 - For customers with larger, centralized UPSs, consider getting an electrician or factory-authorized technician to test each individual battery, which provides a much more detailed picture of your system reliability.

2. Perform an early spring cleaning.

Clutter, dust and general disorganization can cause unwanted issues and decrease the reliability of your system, so be sure to:

- **Check the air flow**
 - Make sure nothing is blocking air-flow in your IT environment, since heat is one of the biggest reducers of battery life. You should have enough air flow to keep your UPS at room temperature (25°C degrees is optimal).
- **Remove any dust**
 - Caked-on grime can damage fans and cause electronics board damage. A simple wipe down is often all you need. If you have a larger, centralized UPS, you may need to replace or clean your air filter.

3. Verify UPS communication.

Properly configured communications ensure that IT managers can respond to alerts and take corrective actions, so:

- **Run a test email**
 - If your UPS is equipped with a Network Interface Card (NIC), run a trial email. Sometimes changing email servers or domains can cause settings to become out of date.
- **Check the software**
 - Make sure the UPS and NIC both have the most up-to-date versions.

4. Keep service information up-to-date.

Nothing can be more frustrating than finding out your UPS is no longer under warranty after it fails. Be sure to:

- **Double-check your service contract.**
 - Review your coverage and consider storing contract information in one place, either physically or electronically.
- **Register your product**
 - If you do not have a service contract, make sure your UPS is registered with the manufacturer. This helps you stay informed on updates, and allows the manufacturer to respond quickly if an issue does arise.

These simple steps will go a long way toward ensuring the ongoing reliability of your UPS, and in turn, the critical equipment and data it is protecting.

