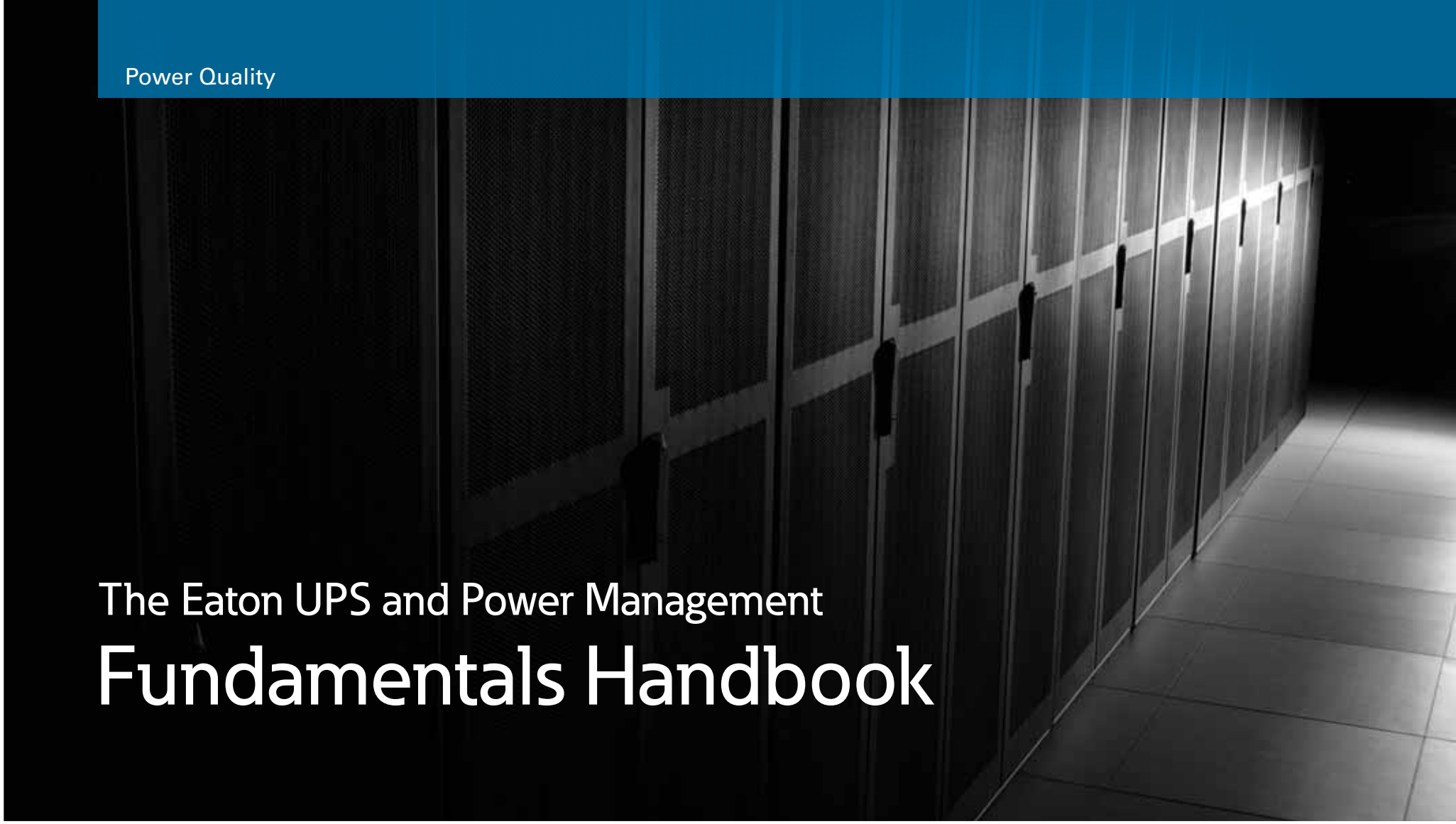
Power Quality



The Eaton UPS and Power Management

Fundamentals Handbook

Powering Business Worldwide

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Introduction

Welcome to the Eaton UPS and Power Management Sales Handbook.

This comprehensive guide includes everything resellers need to understand and sell industry-leading power protection solutions from Eaton®.

From plug and receptacles charts and facts about power problems to an overview of various UPS topologies and factors affecting battery life, you'll find a wealth of pertinent resources designed to help you develop the optimum solution for your customers. We have also included valuable, real-world case studies that showcase exactly how Eaton can help you to develop the best power protection solution for your customers.

Whether you're supplying power protection for small, medium or large data centers, health care facilities, or other environments in which ensuring uptime and safeguarding data are critical, the Eaton UPS and Power Management Sales Handbook is your one-stop source for essential information.

10 UPS design considerations

The following 10 factors outline the key design considerations to take into account when analyzing your customers' needs and presenting the proper Eaton solution. By assessing the information that they provide, you can help them to make important trade-off decisions during the selection and purchase process. To see how to use these design considerations, please see the sample case study on page 32.

1. Power environment: single and three phase

Understanding your customer's existing power infrastructure is a crucial step in the qualification and sales process. While many consultants typically focus on larger, three-phase power systems, the majority of IT managers are dealing primarily with single-phase equipment, often at the rack level.

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

2. Installation environment

It is imperative to understand how a prospective UPS will be deployed. Since most environments support several different solutions, you may need to help the customer evaluate these options. Be prepared to offer value propositions, feature comparisons and pricing for multiple solutions.

Studies have shown that customers generally choose the higher value option when provided a choice. If you fail to offer multiple options, you leave an opening for the competition to gain the customer's trust by offering a different solution that may be presented as a more cost-effective option. Don't leave that opening.

3. Power load

The VA or watt rating of the customer's power load is one of the most important factors in identifying the right UPS for their overall solution.

After identifying the power environment (if the UPS needs to be single-phase or three-phase), the size of the UPS further narrows down the selection. Although many customers have this information readily available, you should be prepared to assist the customer in sizing the power requirements of their equipment. Be sure to take into account the customer's growing power load. In single-phase deployments especially, it often makes sense to select a UPS that exceeds the customer's current power requirements but offers greater runtimes and allows for future growth.

4. Availability

This is where you need to determine the customer's true runtime requirements. While runtime may seem like a simple thing to quantify, understanding the facts behind the numbers can help contribution to the development of an end-to-end solution.

Generally, the amount of runtime required can significantly affect the cost of a solution. However, many Eaton solutions are actually more cost effective in extended runtime applications. Be sure to find out how much runtime a customer needs and why. Evaluate multiple solutions when making recommendations as what is beneficial to the end user.

5. Scalability

It's always important to consider your customer's future expansion needs when evaluating a solution. Eaton's scalable UPS solutions provide a competitive advantage by offering customers a cost-effective way to increase capacity. Virtually all Eaton UPSs with a 6 kVA or greater power rating offer some form of scalability, either through a simple firmware upgrade, the addition of modular hardware components or the paralleling of multiple UPSs.

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

Customers who have an internal IT or facilities staff and service their own equipment may prefer to add capacity by purchasing additional modules that can be added in an expandable chassis or rack as their power load increases.

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 the customer's specific needs, a larger, centralized, non-modular system with inherent scalability might ultimately be the most cost-effective solution.

6. Power distribution

It is imperative to understand your customer's power distribution scheme. Keep in mind that Eaton's larger three-phase PDUs and single-phase PDU products, including ePDUs and rack power modules, can be used with any UPS product.

Just as software, communications and metering can often sell hardware, a well-conceived power distribution and metering scheme can speak directly a customer's

needs, ultimately selling the solution. In some instances, data center managers want to more effectively monitor departmental usage of resources to better allocate overhead for the organization. In deploying metering to the rack level, one Eaton customer was able to track each department's demand and allocate expenses based on meter readings. In addition, the ability to analyze peak hours of usage for computing process and the most efficient servers available enables an IT manager to further increase efficiency.

7. Manageability

Eaton's manageability software and accessories very often help to sell our hardware and can be the key to closing the sale. Eaton's manageability tools should be introduced into every sales opportunity to complete the customer's solution and help lower their total cost of ownership.

Consider a customer who expressed a need for 15 minutes of runtime in order to reach a remote facility he managed approximately 10 minutes away. Based on the salesperson's ability to ascertain the real need, a network interface card for the rack-based UPS was recommended, along with remote management software enabling the UPS to gracefully shut down applications in the event of an extended outage. ePDUs were also employed to deliver multiple levels of monitoring and control.

The customer was so pleased with the ability to remotely monitor his UPSs and reboot his servers—which eliminated his need to drive to the facility in the event of a power disturbance—he purchased all the hardware he needed to obtain that functionality. By understanding his communication and control needs, Eaton was able to provide a complete solution.

8. Operation and maintenance

While many customers value the ability to service their 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.

Understanding a customer's availability requirements and technical proficiency—along with his or her tolerance for risk—can further help reduce the number of viable product options as part of a consultative selling process. In addition, considering the product's up-front costs in combination with Eaton's service level agreements is an integral component of any sales process.

While some IT professionals place a value on being able to independently swap modules or replace batteries within their products, others prefer a hands-off approach to power in their data center. In addition, the type of installation (decentralized or centralized large UPS) may also influence the customer's service preference.

For those who want some level of service autonomy, small single-phase or rack-based equipment with user-serviceable batteries and modules may be the ideal solution. Customers with smaller budgets and higher kVA ratings may prefer a low-cost, centralized, end-of-row solution supported by on-site factory support. Anticipating a customer's budget and support needs leads you in the right direction during a consultative selling approach.

9. Budget

Most customers indicate that redundancy, scalability, modularity and serviceability are all critical components in deciding which UPS to purchase. In turn, the majority of sales people consider these pieces to be critical components of their proposal. However, without first considering the customer's budget, important tradeoff decisions cannot be considered and the proposal may be placed in a poor competitive position.

Since the customer will be focused on numerous features, it is important for the salesperson to ask probing questions that comprehensively evaluate each item and consider its importance relative to its impact on the budget. By proposing multiple options and ranking the importance of each feature as part of a consultative approach, you build trust with the prospect by helping to determine the optimal solution from a value perspective.

Another important budgetary factor that is often overlooked, is identifying the key decision maker within the company. Although a facilities professional or data center manager may be a strong influence, identifying the decision maker can often make or break the deal. By ascertaining who will ultimately approve or allocate funds for the project, a salesperson gains the opportunity to ask additional questions. The ability to talk directly to the decision maker provides a chance to address his or her needs and capitalize on the opportunity to learn their main concerns and custom-tailor a proposal to address those concerns. Failing to do so is a common cause in failing to close an opportunity. By always taking into account a customer's budget, you cover all bases and prevent the competition from offering a lower-cost alternative.

10. Expanding the opportunity

Our broad portfolio of products and capabilities—including single- and three-phase UPSs, power distribution products, connectivity and manageability tools, and world-class service and support—enables Eaton to fulfill all our customer's power quality needs.

When qualifying an opportunity, be sure to speak with all decision makers within the account, including the facility procurement manager and the IT procurement manager. Working with both contacts will help you to identify all potential openings for Eaton power quality solutions.

As a global provider of power quality infrastructure products and services that provide an industry-leading balance of reliability, energy efficiency and value, Eaton is uniquely positioned to help customers around the globe manage all elements of their power systems. Focusing on only one product or business segment is a lost opportunity to complete the customer's solution and grow Eaton's market share.

Other UPS design considerations

The following design guidelines should be reviewed and followed prior to ordering the appropriate UPS solution.

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

Compare UPS fuse ratings (amps) and breaker types and whether any electrical work may be needed (i.e. cabling to the UPS terminal block input). The site may have its own electrical contractors.

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

Make sure that the installation site has enough space available.

3. Ensure that the UPS can be placed in its final position.

Will the UPS components fit through doors? Are there any stairs? Please consult Eaton's website for detailed UPS dimensions and specifications: www.eaton.com/powerquality/SEA.

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.

Eaton UPS models use internal fans to cool the UPS. You should not install the UPS in a sealed container or small, sealed room.

6. Always be sure which wall receptacle is required to plug in the UPS.

For an example, only UPSs with power rating up to 3000VA can be plugged into a standard wall outlet. All others require a larger receptacle, which must be installed by an electrician. Things go more smoothly if your customers are not waiting for this to be done after all of their equipment has arrived. Most small computers and rackmounted computers run on normal 220/230/240 volt, 13 amp (subjected to country's reference) electrical service.

7. Hardwired connections.

Hardwired outputs are generally useful if you want the UPS output to be distributed via electrical panels. Using an electrical distribution panel allow for flexibility with receptacles types. If there is no other UPS that fits your receptacle and power requirements, you may need to hardwire the UPS. Hardwired UPS models typically require the use of a certified electrician to wire the UPS to the electrical distribution panel and this could be a more costly option for some customers.

8. Installing small UPS models behind larger UPS models.

If you are 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 are plugging a 1500 VA UPS into a 10,000 VA UPS, you must consider the 1500 VA load of the smaller UPS rather than just the load that is 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 over loading of the larger UPS which may result in failure of the all UPS models in the string.

9. Using a UPS and a generator together.

A UPS provides backup power and actively conditions and regulates voltage. Similar to a UPS, a generator provides backup power. However, auxiliary generators typically take 10-15 seconds to start up, depending upon generator type. For long term backup servers and IT equipment, this is not an optimal situation, so during this time the UPS kicks in. Basically, the UPS bridges the power gap between loss of power and when the generator comes on-line.

When designing your UPS solution, it is 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: first, UPSs aren't 100% efficient and second, generators need to account for step loads. In addition to accounting for step load, very small generators don't often provide enough kinetic energy to provide a smooth transition. As a rule of thumb, for 20kVA and above, auxiliary generators should be sized 1.5 times the size of the output rating of the UPS in kW, while 20kVA and below should be two times. Also, it is important to note that gas powered generators should be sized a bit larger.

10. Verify that the final UPS solution meets local building codes.

The facility manager is often the best contact to understand local building codes.

Top questions to ask prospective customers

By asking your prospective customers the following questions, you will be fully knowledgeable of their needs and expectations, further enabling you to provide excellent customer service.

UPS

1. What size UPS do you need? (kVA or amperage)
2. What voltage is currently available at the site?
3. What voltage do you need?
4. What runtime do you want?
5. Are there any clearances or size constraints we should know about?
6. What are the bypass requirements?
7. What type of input and output connections are required?
8. Is there a generator on site?
9. Does the UPS need to be scalable?
10. Do you need redundancy?

Accessories

1. How is power getting from the UPS to equipment?
2. Do you have a need for enclosures, communications, seismic mounting, floor stands or rail kits?
3. Is a maintenance bypass switch needed?

Software

1. Is there a need to have orderly scheduled shutdown?
2. Do you want to remotely monitor the UPS?
3. Would you like to remotely notify others of UPS events?

Service

1. Do you need immediate factory response?
2. What kind of parts and labor coverage do you need?
3. Do you want any type of preventive maintenance?

UPS form factors

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

1

a

b

2

a

3

4

a

b

5

a

b

6

1. Desktop and tower UPS

a. The Eaton 9130 tower UPS fits under a desk or in a network closet

b. The NOVA AVR range of UPS fits easily on top or under a desk

2. Wall-mount UPS

a. The Eaton 5115 rackmount UPS includes hardware to mount it to a wall

3. Rackmount UPS

The Eaton 9130 rackmount UPS occupies only 2U of rack space (fits both 2-post and 4-post racks)

4. Two-in-one rackmount/tower UPS

a. The Eaton 5130 UPS can be mounted in a rack or installed as a tower model

b. The Eaton EX UPS is available in tower format or RT2U convertible rack/tower version

5. Scalable UPS

a. The Eaton BladeUPS is a scalable, redundant rackmount UPS

b. The Eaton MX UPS is a scalable optimized rack solution that allows you to add power as your business grows

6. Large tower UPS

The Eaton 9390 UPS is designed to be a central backup for multiple loads, including data centers

The basics of voltage, amperes and frequency

When discussing and dealing with electricity and electrical products, several terms are used to specify electrical characteristics. Three of the most common are voltage, amperes and frequency.

In layman's terms, volts (V) is a measure of the "pressure" with which electricity moves through a wire/circuit, while amperes or amps (A) is a measure of the "volume." Volts and amps are often compared to water in a hose, with volts representing the amount of pressure there is and amps representing the volume of water. When you turn on a garden hose without a nozzle, there is a lot of water (amps) but not much pressure (volts). But by placing your thumb over the end of the hose, you reduce the quantity (amps) but increase the pressure (volts), so it squirts farther.

Applying this analogy to electricity, the number of amps signifies how many electrons are flowing in the wire, while the number of volts characterizes how hard those electrons are being pushed. For an equivalent voltage, a wire carrying more amps needs to be a larger diameter, similar to a fire hose operating at the same pressure as a garden hose would obviously deliver a greater amount of water.

Frequency, on the other hand, is the number of times per second (Hz) that the electrical signal oscillates. Frequency in household voltages may vary based on geographic location, while industrial voltages can often be customized to meet specific site requirements.

Ensuring that the volts, amps and frequency of connected equipment are compatible with the supply of electricity is much like filling up a car with the appropriate type of fuel. Just as diesel fuel would not power a gasoline-driven car, a 120V, 15A, 60 Hz device cannot be connected to a 240V, 15A, 50 Hz outlet.

What is three-phase power?

Three-phase power is the most efficient way to distribute power over long distances, and allows for large industrial equipment to operate more efficiently. While single-phase power is distributed through common household outlets to power everyday equipment such as laptops, lighting and televisions, three-phase power is characterized by three single-phase waves working together. The waves are offset by 120 degrees, or one-third of the sine wave.

With three-phase power, the voltage is always very close to the maximum available voltage because of the 120 degree offset, which is demonstrated in the oscilloscope image in Figure 1.

Conversely, when looking at an oscilloscope image of the voltage coming out of the single-phase outlet in Figure 2, there is a single wave that peaks at 230V and then oscillates between +230V and -230V at 50 Hz (or 50 times a second).

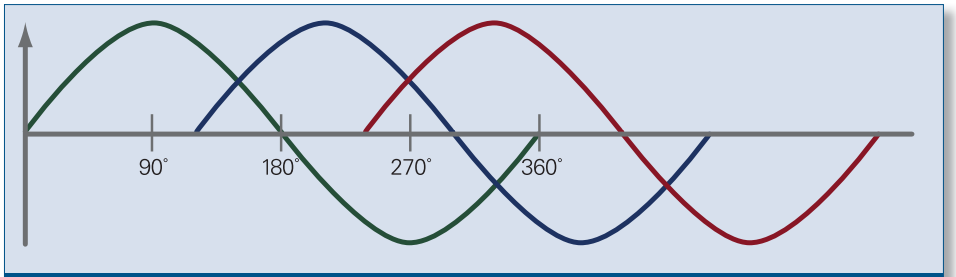


Figure 1. Three-phase power

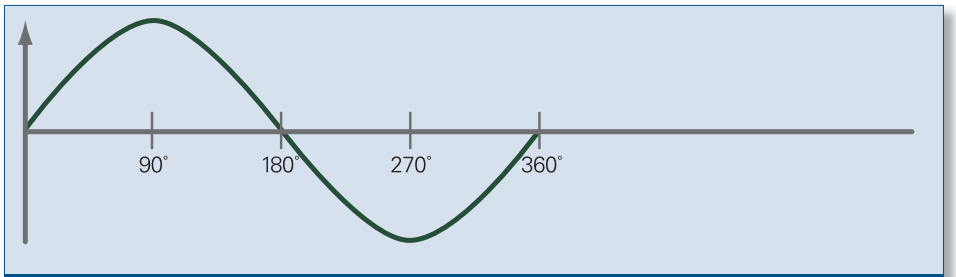


Figure 2. Single-phase power

Input plugs and output receptacles

When your customer receives a UPS, they should be able to plug it in right away. If a customer receives a UPS and can't plug it into the wall socket, or can't plug their equipment into the UPS, you've got a problem.

For an example, any UPS with a rating of 3000 VA or below can be plugged into a standard household receptacle/socket. UPS models with ratings higher than 3000 VA use input plugs that cannot be plugged directly into a standard receptacle. Many higher rated UPSs (above 3000 VA) may also be hardwired directly into the electrical distribution panel at the installation location. This procedure should only be done by a licensed electrician.

Many UPS models offer a fixed set of input and output receptacles. Other UPS models can be configured with a custom set of input and output connections.

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

Input Plug and Output Receptacle Chart

5-15R	5-15P	5-20R	5-20P
L5-30R	L5-30P	6-15R	6-15P
L6-20R	L6-20P	L5-20R	L5-20P
IEC-320-C13 (female)	IEC-320-C14 (male)	IEC-320-C19 (female)	IEC-320-C20 (male)
L14-30R	L14-30P	IEC-309, 16A	IEC-309, 32A
L6-30R	L6-30P	Terminal Block (Hardwired)	

*5-15P can plug into 5-20R

R= Receptacle, P = Plug, L = Locking

The number after the hyphen indicates the amperage. For example, the L5-30R is a 30A receptacle.

1. Fixed

Smaller UPS models like the Eaton 9130 UPS provide a fixed set of output receptacles

2. Customized

UPS models like the Eaton 9355 can be customized with a variety of output receptacles

3. Hardwired

Large UPS models like the Eaton 9390 are hardwired to incoming utility power

4. Additional Receptacles

Eaton ePDU products mount easily into racks and provide additional receptacles

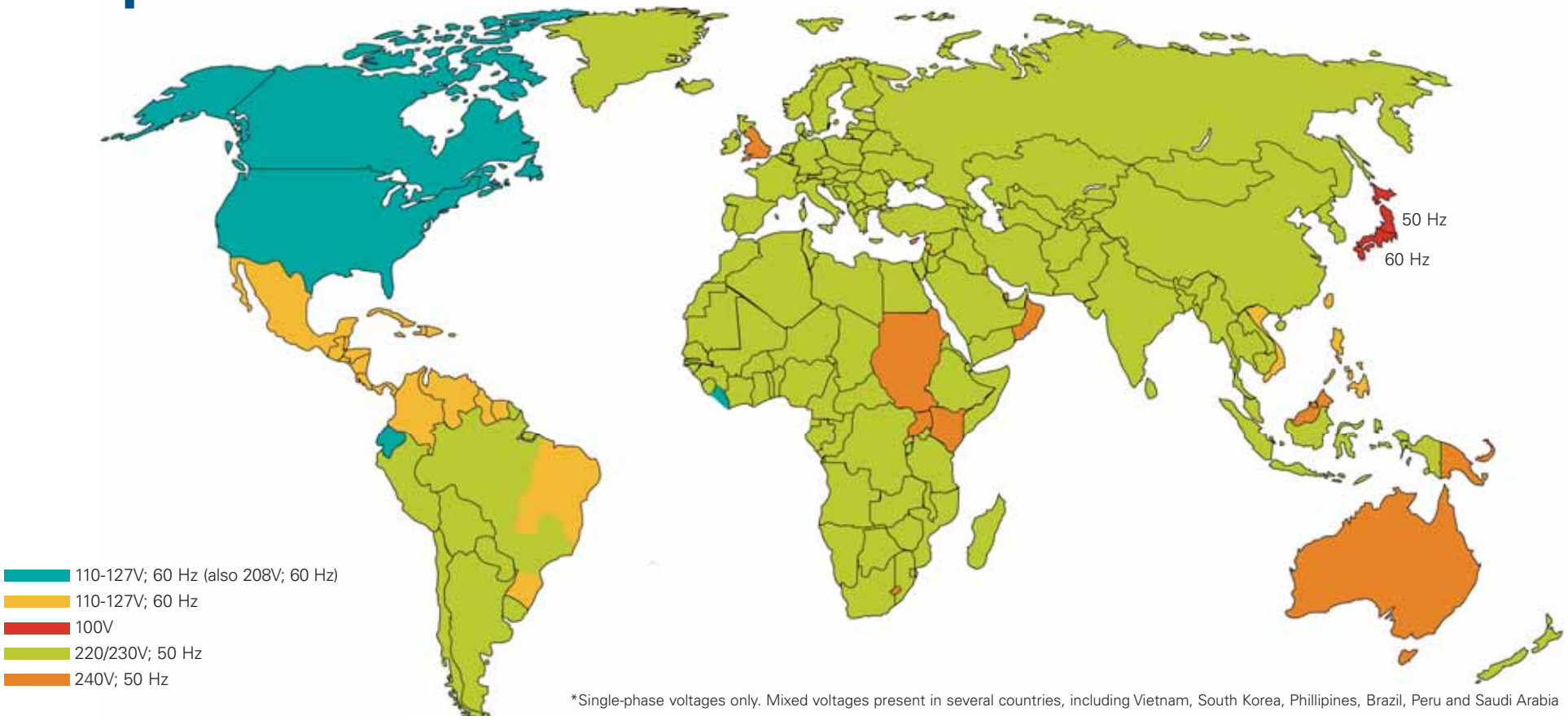
1

2

3

4

Worldwide voltage map and power requirements



*Single-phase voltages only. Mixed voltages present in several countries, including Vietnam, South Korea, Phillipines, Brazil, Peru and Saudi Arabia

Country	Voltage	Frquncy (Hz)
Afghanistan	220	50
Algeria	127/220	50
American Samoa	120/240	60
Angola	220	50
Anguilla (U.K.)	240	50
Antigua	230	60
Argentina	220	50
Aruba	115/127	60
Australia	240	50
Austria	220-230	50
Azores (Portugal)	220	50
Bahamas	120	60
Bahrain	220	50
Bangladesh	220	50
Barbados	115	50
Belgium	220-230	50
Belize	110	60
Benin	220	50
Bermuda	120	60
Bolivia	110-115/220	50
Bosnia-Herzegovina	220	50
Botswana	220	50
Brazil	110-127	60
	220	60
Bulgaria	220	50
BurkinaFaso	220	50
Burma (Myanmar)	230	50
Burundi	220	50
Cambodia	120/220	50
Cameroon	220-230	50
Canada	120	60
Canary Islands (Spain)	220	50
Cape Verde	220	50
Cayman Islands	120	60
Central African Republic	220	50
Chad	220	50

Country	Voltage	Frquncy (Hz)
Channel Islands	240	50
Chile	220	50
China	220	50
Christmas Island	240	50
Cocos Island	240	50
Colombia	110-220	60
Congo	220	50
Cook Islands	240	50
Costa Rica	120	60
Croatia	220	50
Cuba	120	60
Curacao Island	110/220	60
Cyprus	240	50
Czech Republic	220	50
Denmark	220-230	50
Djibouti	220	50
Dominica	230	50
Dominican Republic	110	60
Ecuador	120	60
Egypt	220	50
El Salvador	115	60
England	240	50
Equatorial Guinea	220	50
Estonia	220	50
Ethiopia	220	50
Fiji	240	50
Finland	220-230	50
France	220-230	50
French Guiana	220	50
Gabon	220	50
Gambia	220	50
Germany	220-230	50
Ghana	220	50
Gibraltar	240	50
Greece	220-230	50
Greenland	220	50
Grenada	230	50
Guadeloupe	220	50
Guam	110-120	60
Guatemala	120	60
Guinea	220	50
Guinea-Bissau	220	50
Guyana	110	50-60
Haiti	110-120	50-60
Honduras	11	060
Hong Kong	200	50
Hungary	220	50
Iceland	220	50
India	220-250	50
Indonesia	220	50
Iran	220	50
Iraq	220	50
Ireland	220	50
Isle of Man	240	50
Israel	230	50
Italy	220-230	50
Ivory Coast	220	50
Jamaica	110	50
Japan	100	50&60
Jordan	220	50
Kazakhstan	220	50
Kenya	240	50
Korea, South	220	50&60
Kuwait	240	50
Kyrgystan	220	50
Laos	220	50
Latvia	220	50
Lebanon	110-220	50
Lesotho	240	50
Liberia	120	60
Libya	127-230	50
Liechtenstein	220	50
Lithuania	220	50
Luxembourg	220-230	50
Macao	220	50
Madagascar	220	50
Madeir (Portugal)	220	50
Majorca	220	50
Malawi	230	50
Malaysia	240	50
Maldives	230	50
Mali	220	50
Malta	240	50
Martinique	220	60
Mauritania	220	-
Mauritius	230	50
Mexico	127	50
Moldova	220	50
Monaco	220	–
Mongolia	220	-
Montseurrat	230	60
Morocco	220	50
Mozambique	220	50
Namibia	220-250	50
Nepal	220	50
Netherland Antilles	120-127/220	50/60
Netherlands	220-230	50
New Caledonia	220	50
New Zealand	230	50
Nicaragua	120	60
Niger	220	50
Nigeria	230	50
Northern Ireland	240	50
North Mariana Island	115	60
Norfolk Island	240	50
Norway	220-230	50
Okinawa	110-120	60
Oman	240	50
Pakistan	230	50
Panama	110-120	60
Papua New Guinea	240	50
Paraguay	220	50
Peru	110/220	50/60
Philippines	115	60
Poland	240	50
Portugal	220	50
Puerto Rico	220-230	50
Qatar	240	50
Romania	220	50
Russia	220	50
Rwanda	220	50
Saudi Arabia	127/220	50/60
Scotland	220	50
Senegal	220	50
Seychelles	240	50
Sierra Leone	230	50
Singapore	230	50
Slovakia	220	50
Somalia	110/220	50
South Africa	220-230	50
Spain	220-230	50
Sri Lanka	230	50
St. Kitts & Nevis	230	60
St. Lucia	240	50
St. Pierre & Miquelon	115	60
St. Vincent	230	50
Sudan	240	50
Surinam	115	60
Svalbard	220	50
Swaziland	230	50
Sweden	220-230	50
Switzerland	220-230	50
Syria	220	50
Tahiti	220	50
Taiwan	110	60
Tajikistan	220	50
Tanzania	230	50
Thailand	220/230	50
Togo	220	50
Tonga	115	60
Trinidad & Tobago	115/23	60
Tunisia	220	50
Turkey	220	50
Uganda	240	50
Ukraine	220	50
United Arab Emirates	220/230	50
United Kingdom	240	50
United States	120	60
Uruguay	220	50
Uzbekistan	220	50
Venezuela	120	60
Vietnam	120/220	50
Virgin Islands	120	60
Wales	220	50
Western Samoa	230	50
Yemen	220	50
Yugoslavia	220	50
Zaire	220	50
Zambia	220	50
Zimbabwe	220	5

Nine power problems

And their UPS solutions

Eaton UPSs address any of the nine power protection problems to fulfill power protection, distribution and management needs in the office, computer networking, data center, telecommunications, healthcare and industrial markets. Low-cost products such as the Eaton 5110 and EX UPSs protect general desktop systems for small office/home office (SOHO) applications. The line-interactive and online UPSs such as the Eaton 5125, Evolution, EX, MX, MX Frame and BladeUPS are designed to safeguard a myriad of mission-critical systems including network servers and power hungry blade servers.

Power Problem		Definition*	Cause*	Solution
1 Power Failure		**A total loss of utility power**	Can be caused by a number of events: lightning strikes, downed power lines, grid over-demands, accidents and natural disasters.	Single-phase Series 3 UPS; Single-phase Series 5 UPS; Single- and Three-phase Series 9 UPS
2 Power Sag		**Short-term low voltage**	Triggered by the startup of large loads, utility switching, utility equipment failure, lightning and power service that's too small for the demand. In addition to crashes, sags can damage hardware.	
3 Power Surge (Spike)		**Short-term high voltage above 110% of nominal**	Can be caused by a lightning strike and can send line voltages to levels in excess of 6,000 volts. A spike almost always results in data loss or hardware damage.	
4 Under-voltage (Brownout)		**Reduced line voltage extended periods few minutes to days**	Can be caused by an intentional utility voltage reduction to conserve power during peak demand periods or other heavy loads that exceed supply capacity.	
5 Over-voltage		**Increased line voltage for extended periods of a few minutes to a few days**	Triggered by a rapid reduction in power loads, heavy equipment being turned off, or by utility switching. The results can potentially damage hardware.	
6 Electrical Line Noise		**High frequency waveform caused by EMI interference**	Can be caused by either RFI or EMI interference generated by transmitters, welding devices, SCR driven printers, lightning, etc.	
7 Frequency Variation		**A change in frequency stability**	Resulting from generator or small co-generation sites being loaded and unloaded. Frequency variation can cause erratic operation, data loss, system crashes and equipment damage.	
8 Switching Transient		**Instantaneous and under-voltage (notch) in the range of nanoseconds**	Normal duration is shorter than a spike and generally falls in the range of nanoseconds.	
9 Harmonic Distortion		**Distortion of the normal line waveform, generally transmitted by nonlinear loads**	Switch mode power supplies, variable speed motors and drives, copiers and fax machines are examples of non-linear loads. Can cause communication errors, overheating and hardware damage.	

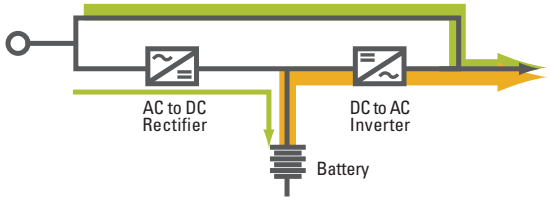
*Reference IEEE E-050R & old FIPS PUB 94

UPS topologies

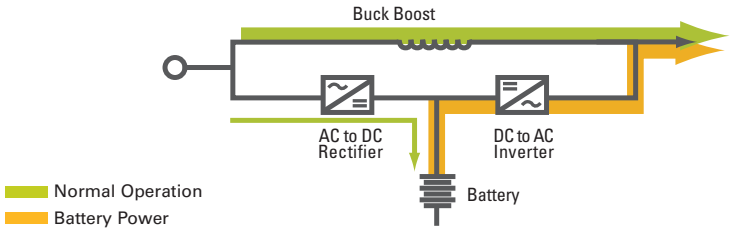
Which UPS is the best fit for your customers?

There are several different UPS topologies that provide varying degrees of protection. Selecting the best fit for your customer depends on several factors, including the level of reliability and availability desired by the customer, the type of equipment being protected and the application/environment. While all four of the most common UPS topologies outlined below meet the input voltage requirements for IT equipment, there are key differences in how the result is achieved, as well as the frequency and duration of demands on the battery.

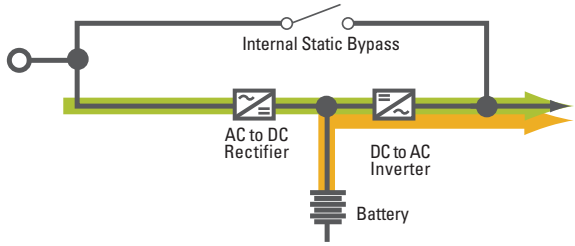
Standby UPSs allow equipment to run off utility power until the UPS detects a problem, at which point the UPS switches to battery power to protect against sags, surges or outages. Because the band of normal operation is typically narrow, the UPS must resort to batteries frequently, which can reduce battery runtime and service life.



Line-interactive UPSs regulate voltage either by boosting or decreasing utility power as necessary before allowing it to pass to the protected equipment or by resorting to battery power. Line-interactive models typically switch to battery mode with a transfer time of 3-8 ms, which is within acceptable limits for most power supplies. Battery usage is lower than a standby UPS, but still higher than an online model.



Online UPSs provide the highest level of protection by isolating equipment from raw utility power—converting power from AC to DC and back to AC again. When input voltage is within preset UPS tolerances, the output is regulated without going to battery. In this manner, the UPS uses the batteries less often and for less time than either standby or line-interactive designs. Many online UPSs allow an even wider input acceptance window when the UPS is below 100% load.



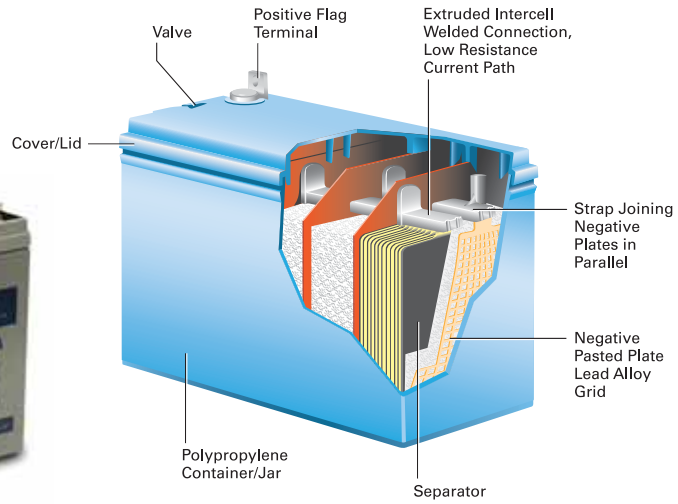
High-efficiency mode UPSs are among the latest generation of UPS models, successfully combining the benefits of both single- and double-conversion technologies. Under normal conditions when power falls within acceptable limits, the multi-mode UPS operates as a high-efficiency, energy-saving system, regulating voltage and resolving common utility power anomalies.

During erratic power or fleeting disturbances when AC input power falls outside of preset tolerances for line-interactive mode, the UPS switches to online double-conversion mode, completely isolating equipment from incoming power. If power is lost altogether, or the input power exceeds the tolerances of the double-conversion rectifier, the UPS relies on the battery to keep loads operating, converting back to high-efficiency mode when it is safe.

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. Yet understanding how to properly maintain and manage UPS batteries can not only extend battery service life, but can also help prevent costly downtime.

VRLA batteries are frequently used in UPS or other high-rate applications.



Internal and external components of a valve-regulated lead acid (VRLA) battery.

The most common type of battery used in UPSs is valve-regulated lead acid (VRLA) batteries, also known as sealed or maintenance free. 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 cannot 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 the life of the battery.

Frequently asked questions: batteries

1. What is the "end of useful life?"

The IEEE defines "end of useful life" for a UPS battery as being the point when it can no longer supply 80 percent of its rated capacity in ampere-hours. When your battery reaches 80 percent of its rated capacity, the aging process accelerates and the battery should be replaced.

2. Is there any difference between the batteries used by smaller UPSs, from 250 VA to 3 kVA, and the ones used by larger UPSs?

While basic battery technology, and the risks to battery life, remains the same regardless of UPS size, there are some inherent differences between large and small applications. First, smaller UPSs typically have only one VRLA battery that supports the load and needs maintenance. As systems get larger, increasing battery capacity to support the load gets more complicated. Larger systems may require multiple strings of batteries, introducing complexity to battery maintenance and support. Individual batteries must be monitored to prevent a single bad battery from taking down an entire string, and putting the load at risk. Also, as systems get larger, wet-cell batteries become much more common.

3. My UPS has been in storage for over a year. Are the batteries still good?

As batteries sit unused, with no charging regimen, their battery life will decrease. Due to the self-discharge characteristics of lead-

acid batteries, it is imperative that they be charged after every six to 10 months of storage. Otherwise, permanent loss of capacity will occur between 18 and 30 months. To prolong shelf life without charging, store batteries at 10°C or less.

4. What the difference between hot-swappable and user-replaceable batteries?

Hot-swappable batteries allow the batteries to be changed out while the UPS is running. User-replaceable batteries are usually found in smaller UPSs and require no special tools or training to replace. Batteries can be both hot-swappable and user-replaceable.

UPS models like the Eaton 9130 feature hot-swappable batteries for maximum uptime

5. How is battery runtime affected if I reduce the load on the UPS?

The battery runtime will increase if the load is reduced. As a general rule, if you reduce the load by half, you triple the runtime.

6. If I add more batteries to a UPS can I add more load?

Adding more batteries to a UPS can increase the battery runtime to support the load. However, adding more batteries to the UPS does not increase the UPS capacity. Be sure your UPS is adequately sized for your load, then add batteries to fit your runtime needs.

Adding extended battery modules increases runtime but does not increase the power rating or capacity of the UPS

7. If my UPS is in storage how often should I charge the batteries?

The batteries should be charged every three or four months to prevent loss of capacity.

8. What is the average lifespan of UPS batteries?

The standard lifespan for VRLA batteries is three to five years. However, expected life can vary greatly due to environmental conditions, number of discharge cycles, and adequate maintenance. Have a regular schedule of battery maintenance and monitoring to ensure you know when your batteries are reaching their end-of-life. The typical life of an Eaton UPS with ABM technology is 50% longer than with standard models.

9. Why are batteries disconnected on small, single-phase UPSs when they are shipped?

This is done to ensure that they are in compliance with the US Department of Transportation regulations.

10. Does the UPS need to have a load on it to charge its batteries?

The UPS should have a minimum of 10% load to charge its batteries. Once connected to a standard supply of electricity (via input plug or hardwiring), your UPS should charge its batteries regardless of how much load, if any, is attached to it

11. How can you be sure UPS batteries are in good condition and ensure they have maximum holdover in the event of a power failure? What preventive maintenance procedures should be done and how often?

The batteries used in the UPS and associated battery modules and cabinets are sealed, lead- acid batteries often referred to as maintenance-free batteries. While this type of battery is sealed and you do not need to check the fluid level in the battery, they do require some attention to assure proper operation. You should inspect the UPS a minimum of once per year by initiating a self-test of the UPS.

12. How long does it take for the UPS batteries to recharge?

On average, it takes 10 times the discharge time for the UPS batteries to recover. (A 30-minute battery discharge requires about 300 minutes to recharge.) After each power outage, the recharge process begins immediately. It is important to note that the load is fully protected while the batteries are recharging. However, if the batteries are needed during the recharge time, the holdover time available will be less than it would have been if the batteries were fully charged.

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 percent.

2. Battery chemistry.

UPS batteries are electro-chemical devices whose ability to store and deliver power slowly decreases over time. Even if all guidelines for storage, maintenance and usage are followed, batteries will still require replacement after a certain period of time.

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 percent 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.

For larger UPS models, service and maintenance of batteries are critical to the reliability of the UPS. Periodic preventive maintenance not only extends battery string life by preventing loose connections and removing corrosion, but can help identify ailing batteries before they fail. Even though sealed batteries are sometimes referred to as "maintenance free," they still require scheduled service, as "maintenance free" refers only to the fact that they do not require replacement fluid.

UPS software overview

Operating a UPS without power management software is kind of like driving in the rain without windshield wipers — you may be protected from the downpour, but your visibility only lasts for so long.

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 facilitating automatic, orderly shutdown of all connected devices during an extended outage, power management software delivers a broad spectrum of other advantages. The perfect complement to any UPS solution, management software keeps a constant pulse on network health through its monitoring and management capabilities.

Most power management software is shipped with the UPS and is usually available as a free download online as well. Power event notifications are available as audible alarms, pop-up alerts on a monitor, e-mails to pre-designated recipients based on the condition, text messages, phone calls from our remote monitoring center, and triggers for a multitude of network and building management systems to initiate the orderly shutdown of equipment.

Some software offerings are capable of delivering a global view across the network — often from any PC with an Internet browser. Software can also provide a complete log of events and of UPS utility data, which is invaluable when debugging a power anomaly. Many power management products have the ability to centralize alarms, organize data by customized views and maintain event logs for preventive maintenance of the entire installed equipment base.

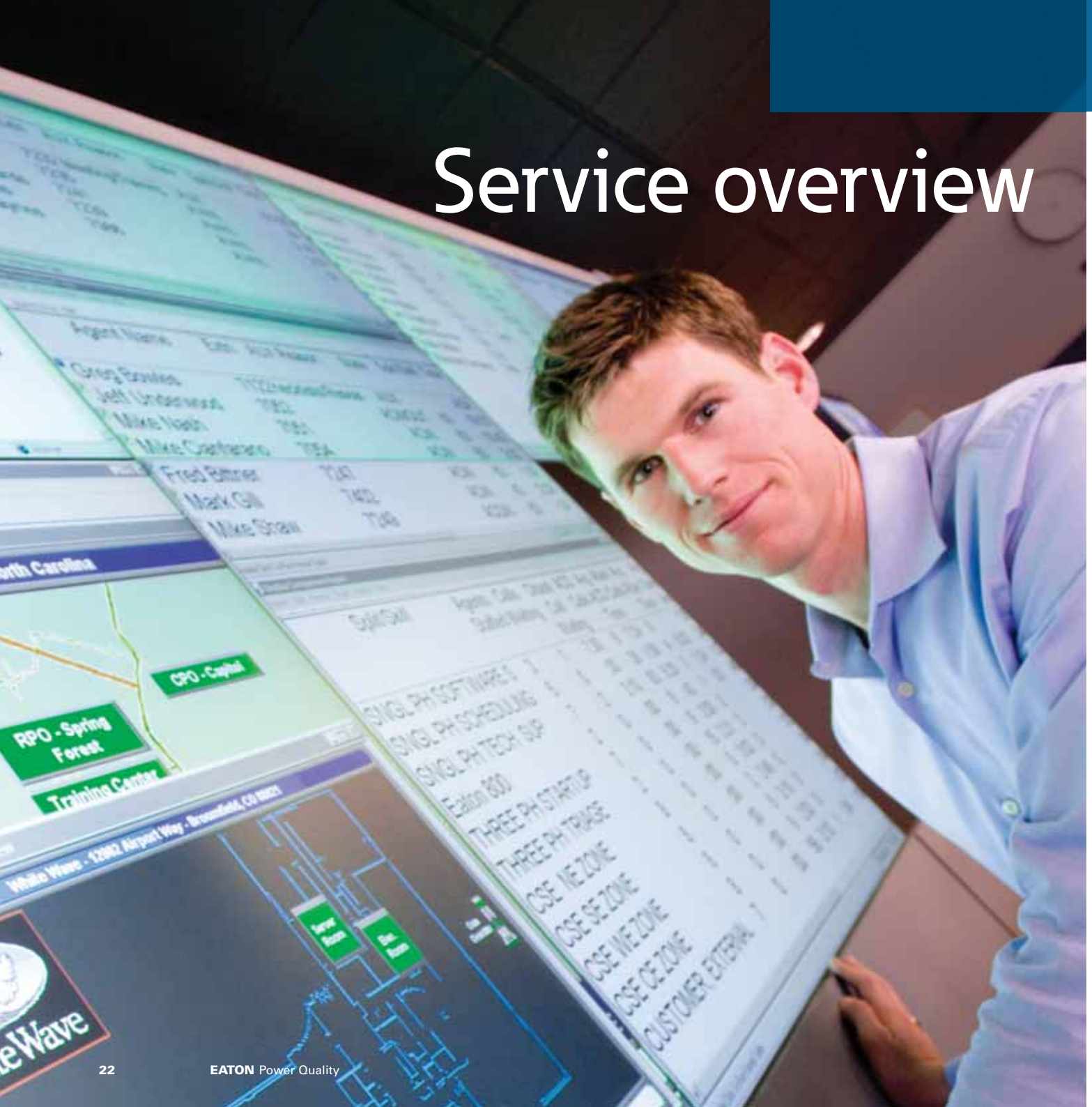
The more robust and versatile software offerings are compatible with devices that support a network interface, including all manufacturers' UPSs, environmental sensors, ePDUs and other devices. Furthermore, power management software enables load segment control for UPS models that support that feature.

Because power protection and management are just as vital for virtual machines as they are for physical servers, new software technologies have been specifically designed to provide monitoring and management capabilities in virtualized environments. Shutdown software is now compatible with VMware's ESXi and vSphere and Microsoft's Hyper-V, enabling graceful shutdown of multiple virtual machines.

To view an online demonstration of Eaton's power management software capabilities, please visit **www.eaton.com/intelligentpowermanager.**

Eaton's Intelligent Power Manager facilitates easy and versatile remote monitoring and management of multiple devices, keeping you apprised of power and environmental conditions.

Service overview



One of the best ways to protect your customers' investment is by including a service plan with your UPS sales. Scheduled preventive maintenance can help detect a wide range of ailments before they become serious and costly issues.

In fact, research indicates that regular preventive maintenance is crucial in order to achieve maximum performance from equipment. Studies show that routine preventive maintenance appreciably reduces the likelihood that a UPS will succumb to downtime. The 2007 Study of Root Causes of Load Losses compiled by Eaton revealed that customers without preventive maintenance visits were almost four times more likely to experience a UPS failure than those who complete the recommended two preventive maintenance visits per year.

All manufacturers' UPSs are complex devices that perform several critical power conditioning and backup supply functions and are subject to failure. Without proper maintenance, all UPSs will eventually fail over their useful life since critical components like batteries and capacitors will wear out from normal use. A good maintenance plan delivered by trained and experienced personnel can greatly minimize this risk of failure.

Types of UPS service

There are several UPS service delivery methods, designed to meet the varied needs of your customers and their applications. These include:

- Depot repair. The customer contacts the UPS service provider and ships the UPS to a repair facility. The service provider returns the repaired unit.
- On-site repair. The customer contacts the UPS service provider and a factory-trained field technician arrives at their site to diagnose and repair electronic or battery-related problems.

Smaller UPS products (below 3000 VA) generally can be repaired at a depot, while products over 3000 VA and up to 15 kVA can either be repaired at a depot or serviced on-site. Larger UPSs that are either hardwired (cannot be unplugged) or too heavy to ship can only be serviced via on-site field technicians.

Smaller UPS models are usually sent to a repair facility

Larger UPS models require on-site preventive maintenance visits for optimal performance

Types of service agreements

A variety of different UPS service options are available, any of which will likely save customers time and money by minimizing business interruption and the costs of downtime, as well as enhancing overall return on investment by extending the lifespan of critical power equipment.

- Support agreements, or 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 like remote monitoring, battery replacement insurance and spare part kits may also be added.
- Extended warranty may also be purchased for many UPS products. A warranty commonly covers specified parts and labor such as electronic components for a fixed period of time, but will not include 7x24 coverage or arrival response times. Nor will warranties include preventive maintenance, although extra services can be purchased in addition to a warranty extension. The more services that are added to a warranty, the closer it becomes to a support agreement.
- Time and Material (T&M) service is a pay-as-you-go approach in which the service provider makes a repair only when something breaks. T&M can be done either via depot repair or on-site, depending on the UPS. This method can be an unacceptable service solution for some customers, since it is often expensive, and there is the uncertainty of not knowing when a field technician will arrive. Because support agreement (contract) customers always take priority, T&M response times can require up to five days, based on the product and location for non-contract customers. It is also subjected to order confirmation for case to case basis.

The Eaton service offering

Eaton offers power quality services for its UPS products, as well as for related equipment such as power distribution units (PDUs) and batteries. Eaton also services products from legacy brands including Powerware, Exide Electronics, Best Power, MGE Office Protection Systems, IPM, Deltec and Lortec. Eaton has more than 40 years of experience designing and servicing industry-leading UPSs for government, healthcare, industrial and data center applications.

Some UPS companies, such as Eaton, provide remote monitoring services

Frequently asked questions

We have compiled the following set of questions based on our extensive experience in dealing with both resellers and end users. For frequently asked questions about UPS batteries, please see UPS battery overview section on page 18.

1. What's the difference between a surge protector and a UPS?

A surge protector provides just that—surge protection. In addition to surge protection, a UPS continually regulates incoming voltage and provides battery backup in the event of a power failure. You'll often see surge protectors plugged into a UPS for added surge protection and additional output receptacles.

2. How much capacity of a UPS should I use?

To allow for future expansion, we recommend that you install a UPS at approximately 75% capacity. In addition, the batteries degrade over time; by oversizing, you provide room for error. In the online Eaton UPS sizing tool **(www.eaton.com/powerquality)** we have included a "capacity used" column.

3. How much UPS battery runtime do I need?

During an outage, you need enough battery runtime to gracefully shut down systems or switch to backup generators. You may add an optional external battery module (EBM) to increase runtime.

4. How is battery runtime impacted if I reduce the load on the UPS?

There can be a significant increase in runtime. Generally speaking, a UPS that provides five minutes at full load will provide 15 minutes at half load.

5. My business is too small for protective measures. Do I really need a UPS?

Power problems are equal-opportunity threats. Your PCs, servers and network are just as critical to your business as a data center is to a large enterprise. Downtime is costly in terms of hardware and potential loss of goodwill, reputation and sales from downtime. Also add in the delays that inevitably occur when rebooting locked-up equipment, restoring damaged files and re-running processes that were interrupted. A sound power protection strategy is cost-effective insurance.

6. Why is power quality such a problem today?

Today's high-tech IT equipment and control units are much more sensitive to electrical disturbances and are more important to the critical functions of many businesses than in the past. As a result, power quality problems today are more frequent and more costly than ever.

7. Are power quality problems always noticeable?

No. In many cases, disturbances can cause imperceptible damage to circuits and other components, a major cause of premature equipment failure and problems like computer lockups. Many power quality problems go unresolved, resulting in lost revenue and data.

8. How are phone systems and IT equipment affected by inconsistent power?

Fluctuating power is a waste of valuable time and money. If customers expose their telephone systems (and any other electronic equipment) to inconsistent utility power, they are vulnerable to hardware and software damage, data corruption and communication breakdown. The time and cost of replacing equipment, as well as the business lost during breakdown and replacement, can greatly affect a company's bottom line.

9. We have a generator—do I still need a UPS?

Many customers do not realize that a generator will NOT protect their equipment against power problems. You need a UPS to guarantee that the equipment stays up until the generator kicks on—which often requires several minutes to stabilize.

10. How much UPS capacity do I need?

Determine the total load (in watts) of the equipment you want to protect. Add 10–20% for future growth and decide the minimum amount of runtime you need. Use the online sizer at **(www.eaton.com/powerquality)** to identify the right solution for your application.

11. I already have surge protection. Why do I need a UPS?

Surge protection will not keep your business and phones operational during a blackout. In addition, surge protectors do nothing to improve the quality of power feeding your sensitive and expensive telecom equipment. The Eaton UPS provides perfect, clean power to your equipment at all times. Over time, poor quality power will degrade your equipment.

12. What happens if the UPS is overloaded? For example, if the protected equipment and/or load draws more current than the UPS can provide.

The UPS transfers the load to bypass (for a few minutes) until the overload condition is reversed. If the overload condition continues, the UPS automatically shuts down.

13. What causes a UPS to be overloaded?

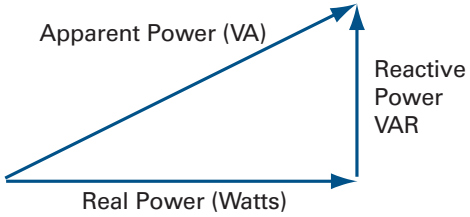
There are two possible answers: (1) the UPS was undersized (e.g. the load is rated at 1200 VA but a 1000 VA UPS was provided), or (2) the customer plugged more equipment into the UPS than it was designed to handle.

14. What's the difference between VA and watts?

In order to correctly size a UPS, it is important to understand the relationship between watts and VA. However, we must have a brief discussion about power terminology first. Real power (measured in watts) is the portion of power flow that results in the consumption of energy. The energy consumed is related to the resistance in an electrical circuit. An example of consumed energy is the filament in a light bulb.

Reactive power (measured in VAR or volt-amps reactive) is the portion of power flow due to stored energy. Stored energy is related to the presence of inductance and/or capacitance in an electrical circuit. An example of stored energy is a charged flash bulb in a camera.

Apparent power (measured in VA or volt-amps) is a mathematical combination of real power and reactive power. The geometric relationship between these apparent power, reactive power and real power is illustrated in the power triangle below:



Mathematically, real power (watts) is related to apparent power (VA) using a numerical ratio referred to as the power factor (PF), which is expressed in decimal format and always carries a value between 0 and 1.0. For many newer types of IT equipment, such as computer servers, the typical PF is 0.9 or greater. For legacy personal computers (PCs), this value can be 0.60 – 0.75.

Using one of the following formulas, a calculation can be made to determine the missing quantity:

Watts = VA * Power Factor or VA = Watts / Power Factor

Since many types of equipment are rated in watts, it is important to consider the PF when sizing a UPS. If you do take PF into account, you may under size your UPS. As an example, a piece of equipment that is rated at 525 watts and has a power factor of 0.7 results in a 750 VA load.

750 VA = 525 Watts / 0.7 PF

Sizing the UPS to operate at 75% capacity results in a UPS with a 1000 VA rating (750 VA / 0.75 = 1000 VA).

15. How do you convert watts to VA?

Divide watts by the power factor 0.7.

1000W = 1429 VA

16. How do you convert amps to VA?

Single phase: Multiply amps by voltage (230 volts). 10A x 123V = 2300VA

Three phase: Amps x volts x 1.732 = VA

17. What is the difference between single-phase and three-phase power?

The AC electric power sent out from a power station is commonly three-phase. Single-phase power can be drawn from a connection across one of these lines and a neutral line. Virtually all PCs and small electrical devices use single-phase power available from standard 10A or 15A power points. Higher power industrial motors or large air-conditioning systems often use three-phase power and cannot be powered by plugging them into standard 10A or 15A power points.

17. How are the phone systems affected by inconsistent power?

Fluctuating power is a waste of valuable time and money. If customers expose their telephone systems (and any other electronic equipment) to inconsistent utility power, they are vulnerable to hardware and software damage, data corruption and communication breakdown. The time and cost of replacing equipment, as well as the business lost during breakdown and replacement, can greatly affect a company's bottom line.

18. What is the difference between a centralized and a decentralized UPS solution?

In a centralized configuration, a larger UPS supports multiple loads from a single point. Centralized UPSs are often hardwired into an electrical panelboard. A decentralized configuration allows multiple UPSs to protect a handful of devices. Decentralized UPSs generally utilize plugs and receptacles for the input and output connections.

19. Why is power management software important?

Although UPSs are typically rugged and reliable, they do require ongoing monitoring and support. Power management software continuously monitors and diagnoses the state of the grid, batteries and power sources, together with the condition of the UPS' internal electronics. Eaton UPS software and connectivity cards enable remote monitoring and management capability, including graceful shutdown and load segment control.

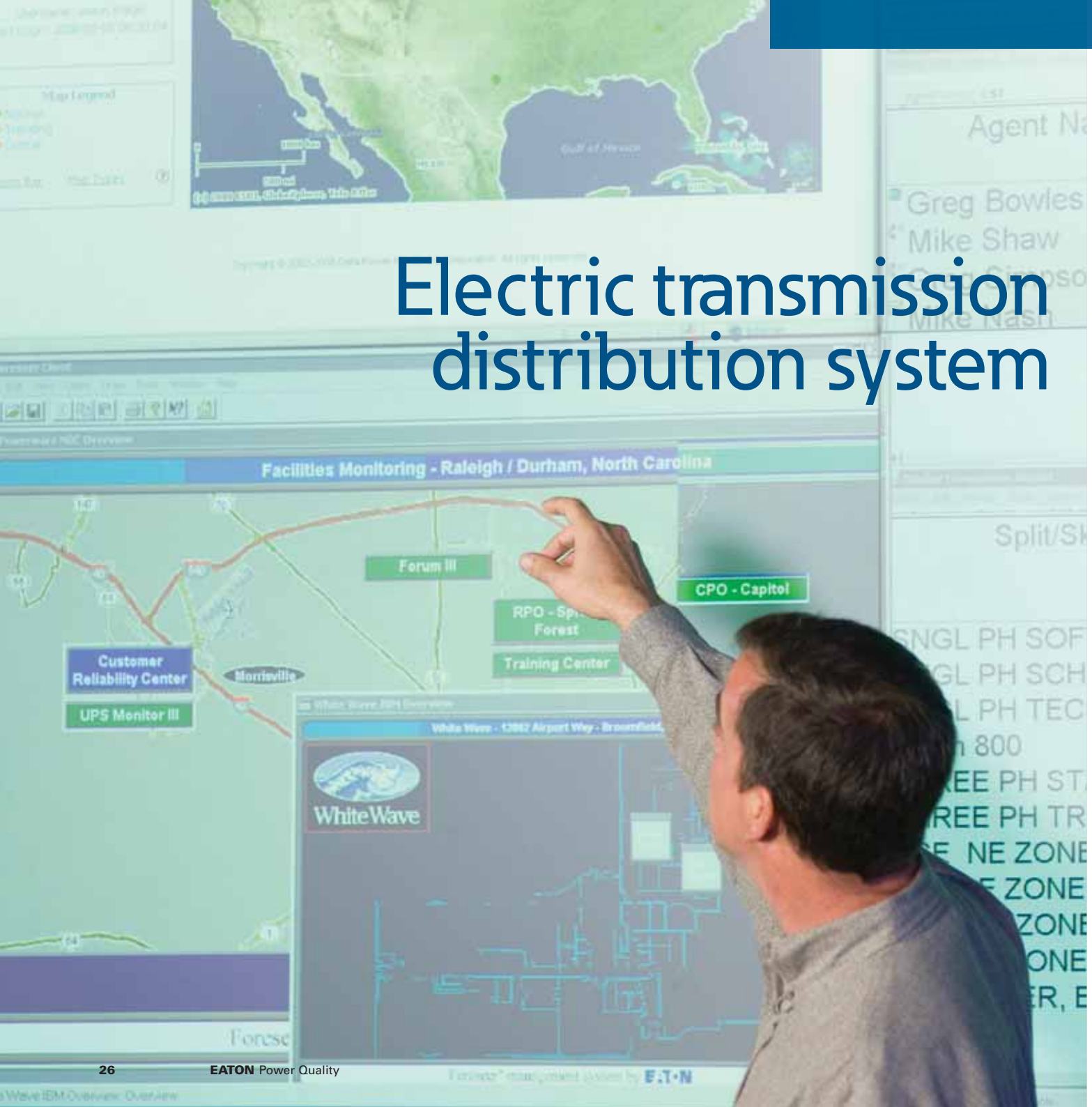
20. Will my current UPS software monitor my new Eaton UPS?

Yes, you can monitor your Eaton UPS with any UPS or facility management software that supports the industry standard Management Information Base (MIB, RFC 1628) as long as you install the optional connectivity card. Most UPS vendors support this MIB and all good facility management software such as OpenManage, OpenView, Tivoli also support this. Extended Eaton Advanced MIBs are also available for greater levels of detail for the UPS. You can also remotely control your Eaton UPS using both the Eaton UPS Management software, and if you choose the optional connectivity card to go with your Eaton UPS, you can also control your UPS through a secure Web interface. The cards also allow for automated e-mail alerts for power events without needing to install any software at all.

21. Where can I get technical help?

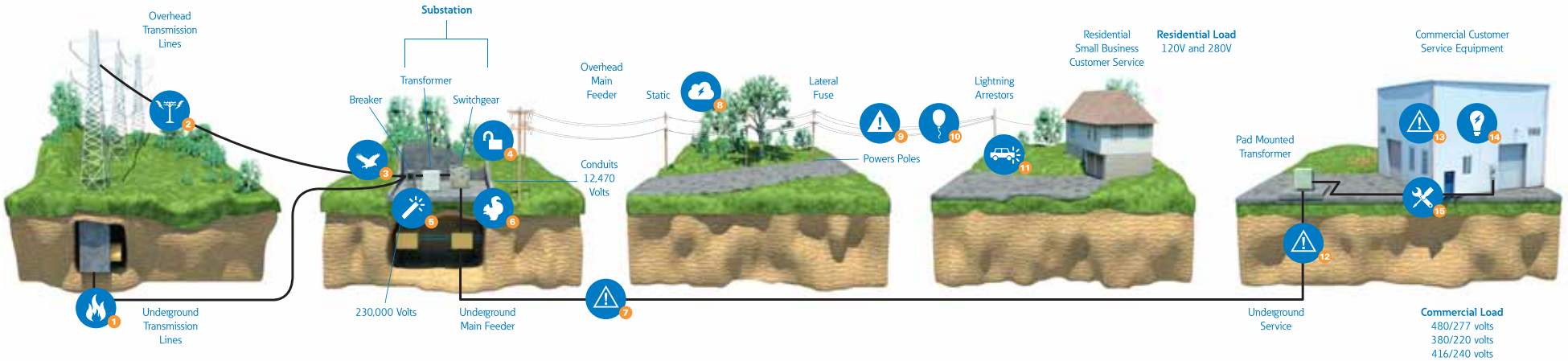
Contact your territory representative or call Eaton SEA office at +65 6825 1684 for pre-sales support. For technical support, send your enquiry to SEATS@Eaton.com. You can also visit **www.eaton.com/powerquality/SEA.**

Electric transmission distribution system



The flow of electricity begins at the utility company where it is created at the generating station. The voltage is then stepped up by a generator transformer at the station switchyard. This is done to minimize the cable size and electrical losses.

For example, in the United States, the transmission substation then increases the voltage from 69,000-765,000 volts. The voltage depends upon the distance the power needs to travel and the amount desired. Electricity then enters the transmission system, traveling at nearly the speed of light, over heavy cables strung between tall towers. A step-down transformer located at a substation near the final destination reduces the voltage to between 22,000 and 69,000 volts, so the electricity can be carried on smaller cables. Distribution lines then carry the electricity to the end user. At or near each end user facility are transformers that adjust the voltages down to the proper level for use.



Threats to the system

At each stage, there are a number of threats that can interrupt the flow and distribution of electricity. From lightning strikes to failed equipment, threats can severely affect the end user and disrupt important and vital processes.

1. Fire sparked by weak wire burns through line
2. Lighting strike damages transmission line
3. Bird flies in causing short circuit
4. Thieves stealing copper
5. Blown fuse at substation transformer
6. Squirrels and raccoons chew through a wire or wander into the wrong area
7. Underground explosion causes cable failure
8. Storm blows branches and limbs down which crash into power lines
9. Equipment malfunction
10. Mylar balloons drift into power lines
11. Three-car collision strikes utility pole
12. Failure of underground cable
13. Equipment failure
14. The power goes out and no one knows why
15. Utilities conduct a planned outage for repairs or upgrades

Eaton product overview

Eaton's power quality portfolio encompasses a comprehensive offering of power management solutions from a single-source provider. This includes UPSs, surge protective devices, power distribution units (PDUs), remote monitoring, meters, software, connectivity, enclosures and services. Our power quality portfolio was designed to fulfill specific customer requirements, complement a new or pre-existing solution, and to deliver a comprehensive solution. With all our products, Eaton strives for continued success in leveraging technical innovation to develop next-generation solutions. The products and services listed below are just a sampling of our comprehensive solution set. To view the complete offering or to request a product catalog, please visit **www.eaton.com/powerquality/SEA.**

PC/workstation and home A/V UPS

Power range: 500 VA – 1500 VA

The Eaton UPSs provide the perfect level of protection for small office/home office (SOHO) applications. These essential, cost-effective products prevent damage such as data loss, file corruption, flickering lights, hardware damage and equipment shutoff, and they are most commonly used to protect single workstations, telephone systems and point-of-sale (POS) equipment.

Eaton 5110, 500 – 1500 VA, tower

— The Eaton 5110 UPS provides cost-effective, line-interactive backup power and voltage regulation. With its compact form factor, the 5110 can be utilized as a standalone tower or under a computer monitor. This UPS is also equipped with eight outlets—four with surge suppression and battery backup and four with surge suppression only.

Eaton Nova AVR, 625 – 1250VA, tower

— The NOVA AVR UPS provides the user with cost effective and rugged protection against electrical interference and power outages. Its line-interactive technology is ideal protection for 1 to 3 PCs, either in a business environment or at home.

Eaton Ellipse ASR, 600 – 1500VA, rackmount and tower

— The Eaton Ellipse ASR UPS (Pulsar Series) not only provide a battery backed up supply to keep equipment operating when there is a power cut, it also provide effective protection against damaging surges. With a wide range of sockets and easy installation, the Ellipse ASR is designed for compatibility with a wide variety of computers.

Eaton Ellipse MAX, 600 – 1500VA, rackmount and tower

— The Eaton Ellipse MAX (Pulsar Series) provides effective protection, even in disturbed electrical environments. With its line-interactive technology, fluctuations in voltage are automatically corrected by an AVR device (booster/fader) without using the batteries.

Network and server UPS

Power range: 700 VA – 20000 VA

Eaton offers an extensive and innovative line of network and server UPS solutions to protect rack servers, data storage, storage systems, VoIP equipment, network equipment and other critical devices. Get industry-leading power protection with the highest efficiency for increased energy savings in optimized rack, tower and rack/tower form factors.

Eaton 9130, 700 – 3000 VA, rack and tower

— The 9130 delivers more real power with a 0.9 power factor and offers a high efficiency mode, performing at a remarkable 95 percent efficiency or higher. This online UPS delivers superior power protection for IT and networking environments, medical and manufacturing systems.

The Right UPS solution for your business

Eaton Evolution, 1250 – 3000 VA, rackmount and tower

— The Eaton Evolution UPS (Pulsar Series) delivers high density protection for network devices. Protection for 1 to 15 servers, ideal for network devices and application.

Eaton EX, 1 – 3 kVA, rackmount and tower

— The Eaton EX UPS is a modular, online UPS with automatic internal bypass for fault-tolerance. Its multilingual LCD display, individually controlled outlets and long backup time capability delivers high density protection for typical applications such as servers, data storage and network equipment, medical equipment, telephony – VOIP and industrial processes.

Eaton MX, 5 – 20 kVA, rackmount and tower

— A truly scalable optimized rack solution that allows you to add power as your business grows. Its high performance UPS is upgradeable from 5 kVA to 20 kVA and can be used for 20 to 110 servers that is ideal for departmental networks and server rooms.

Eaton EX RT, 7 – 11 kVA, rackmount/tower

— Ideal for high-density server environments and harsh industrial applications, the Eaton EX RT UPS is specifically engineered to meet the high availability demands of customers with switches, IT systems, measuring instruments, PLCs, industrial PCs and other sensitive electronic equipment.

Eaton product overview

Data center and facility UPS

Power range: 8 – 1100 kVA

Featuring an array of inventive features, Eaton's data center and facility UPS solutions incorporate the design elements essential to protecting the most critical of applications. These groundbreaking solutions address current and future power protection requirements, featuring scalable architecture that grows with you to manage changing needs with the highest levels of efficiency and reliability. And, with Eaton's Energy Saver System technology, an Eaton UPS can run at 99% efficiency, the energy savings from which usually recover the total cost of the UPS in 3-5 years.

Eaton 9155 and 9355, 8 – 40 kVA, tower

— The Eaton 9155 and 9355 UPS combine good looks with uncompromised efficiency and reliability that provides premium double-conversion backup power and scalable battery runtimes for IT and electrical engineering infrastructure in corporate, healthcare and banking applications.

Eaton 9390, 40 – 160 kVA, tower

— The 9390 UPS provides a high-end power quality solution for data centers, banks and other critical computing applications.

Eaton BladeUPS, 12 – 60 kW, rackmount

— The scalable and modular BladeUPS expands power protection up to 60 kW in a single 19-inch rack while reducing energy and cooling costs with its energy-efficient UPS design. The BladeUPS packs 12 kW of power into only 6U of rack space.

Eaton 9395, 225 – 1100 kVA

— Eaton 9395 UPS combines technical innovation with a rich feature set to provide best-in-class power protection with high energy density for large data centers, healthcare applications, and other critical systems. Premium level efficiency cuts utility costs, and with double conversion topology there are no compromises in reliability. HotSync paralleling technology ensures this UPS system will fit your current and future power requirements.

Power distribution

Eaton's power distribution solutions are designed to help you save money, prevent downtime and use energy more efficiently. Our comprehensive portfolio includes enclosures, rackmount UPSs, ePDUs (rackmount power distribution units) and a host of other power quality equipment

ePDU

— Eaton's line ePDU products distribute 1.4 to 15 kW of power and offer five levels of functionality. From basic, economical power distribution to automatic transfer switch capabilities, Eaton ePDU products satisfy demands of every data center.

Eaton enclosures

— Designed specifically for IT applications, this 42U modern enclosure offers strength, stability and a vendor-neutral environment to house any IT equipment. The enclosure is complemented with a range of cable management, cooling and power distribution accessories to enable you to tailor your enclosures to your specific application.

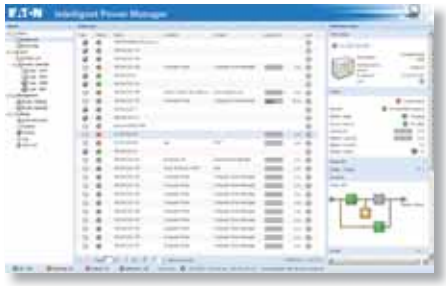
Surge suppressors

— Eaton's Eclipse surge suppressors offer the best price/performance ratio for home office / small office users looking for a convenient way to combine multiple receptacles and excellent surge suppression capabilities.

Software and connectivity

Eaton's software products deliver the ability to manage all your power devices over your network or the web, from one or more PCs. With both supervisory and protection capability, our software allows you to monitor your power devices and even gracefully shut them down in the event of an extended power outage.

Eaton's connectivity products are accessory hardware options that link UPS products with external power and communication devices. Our connectivity products provide communication compatibility with a variety of external devices through the web, serial, relays or SNMP.



Eaton services

Eaton's comprehensive, world-class service solutions for our AC, DC, software and connectivity products are designed to improve costs, uptime, reliability, power quality and safety. We have an extensive sales network and more than 40 key strategic business partnership across the region, serving both local and global customers. We are committed to build strong customer relationships through our technical expertise and expansive support services.

U.S. Case study example

Here is an example of a customer request that Eaton can help you respond to with a complete solution.

Challenge

A small college with multiple satellite campuses is consolidating data centers to a brand new facility. The branch you are visiting is a small community branch with only single-phase loads left in the data center. This facility supports only small processes and equipment.

The facility does have generator backup, which works for long-term outages, but the IT Manager wants 15 minutes of runtime. When you inquire about the need for that amount of time, you learn that the usual shutdown process takes six to seven minutes, but the IT manager prefers to have 15 minutes for peace of mind. The main IT support and servers will be handled from the main campus, but some of the backup and support processes will be run from this data center and need power protection.

There is no need for scalability as the load at the various branches will most likely decrease over the next several years. With the move to the central data center, the expectation is that over the next five years almost 100 percent of IT equipment will be housed at the main campus.

The IT manager provides you with a list of equipment that shows the majority of the load that needs protection is telecom equipment. There are three 120V telephony racks with an average power draw of 1.5 kW each. There are two 208V racks of servers to handle the support processes that average 2.5 kW each.

Operation and maintenance: With the move to the main data center, the support staff on site will be minimal. The IT manager wants a comprehensive support plan to handle all service and maintenance.

Budget: The budget is a major consideration, since the satellite campus IT budgets have been reduced due to consolidation of IT equipment. The IT manager expects to spend less than $20,000.

Management: The IT manager wants to continue to manage the equipment over the network but only minimal monitoring is needed.

Power distribution: The facility has several rackmount UPSs being fed from an upstream distribution panel. There is a mixture of 5-20R and L6-30R receptacles available on this distribution panel. The IT manager prefers to continue using the existing distribution panel without bringing in an electrician to rewire the facility. Eaton 9130 UPSs are available with these options in both tower and rackmount models. The IT manager can separate racks based on 208V or 120V, due to the limited equipment and ample rack space from the consolidation.

Additional power quality needs: You inquire about the hierarchy in the new centralized data center approach with respect to IT and facilities decisions. You learn that all purchasing decisions in the future will be made at the main campus. You also ask about the power protection of the workstations and computer labs and are given the facility manager's name and contact information for each campus.

Recommended solution

Customer equipment

1. On-site generator
2. Distribution panel
3. Single-phase power
4. Three telephony racks with a total load of 4.5 kW (120V)
5. Two server racks with a total load of 5 kW (208V)

Eaton solution

1. Three Eaton 9130 UPSs and three EBMs provide 1.8 kW of power each and 40 minutes of battery runtime.
2. Two Eaton 9130 UPSs and two EBMs provide 2.7 kW of power each and 20 minutes of battery runtime.
3. Six ePDU models. Two in each rack for the A and B feeds. Model with eight 5-20R output receptacles.
4. Four ePDU models. Two in each rack for the A and B feeds. Model with twelve C13 output receptacles.
5. Intelligent Power Manager UPS software (free with UPS) for comprehensive monitoring
6. Recommended service contract: Flex On-Site
   - Comprehensive coverage of UPS & batteries
   - Telephone technical support
   - eNotify Remote Monitoring
   - Connectivity support
   - Expedited delivery of replacement parts, modules & batteries
   - On-site startup
   - On-site corrective maintenance
   - Next-day 24 hour response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Commonly-used acronyms

UPS and electrical acronyms

A	Ampere
AC	Alternating Current
AFCI	Arc Fault Circuit Interrupter
AH	Ampere Hour
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
BBM	Break-Before-Make (Bypass Switch)
BDM	Bypass Distribution Module
BTU	British Thermal Unit
CSA	Canadian Standards Association
DC	Direct Current
EBC	Extended Battery Cabinet
EBM	Extended Battery Module
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Force
EMI	Electromagnetic Interference
FCC	Federal Communications Commission
GFCI	Ground-Fault Circuit Interrupter
HV	High Voltage
Hz	Hertz
HW	Hardwired
IEC	International Electrotechnical Commission (IEC)
IEEE	Institute of Electrical And Electronics Engineers
IGBT	Insulated Gate Bi-polar Transistor
ISO	International Standards Organization
ITIC	Information Technology Industry Council
kAIC	Ampere Interrupting Capacity
kVA	Kilovolt ampere
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
MBB	Make-Before-Break (bypass switch)
MIB	Management Information Base
MOV	Metal Oxide Varistor
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NIC	Network Interface Card
PDM	Power Distribution Module
PDU	Power Distribution Unit
PF	Power Factor
PFC	Power Factor Correction
PoE	Power over Ethernet
POTS	Plain Old Telephone System
PPDM	PowerPass Distribution Module
PUE	Power Usage Efficiency
REPO	Remote Emergency Power-off
RFI	Radio Frequency Interference
RM	Rackmount
RoHS	Restriction of Hazardous Substances
SCR	Silicon-Controlled Rectifier
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
SPD	Surge Protection Device
THD	Total Harmonic Distortion
TVSS	Transient Voltage Surge Suppressor
UL	Underwriter's Laboratory
UPS	Uninterruptible Power System
USB	Universal Serial Bus
V	Volt
VA	Volt Ampere
VRLA	Valve Regulated Lead Acid
W	Watt

Eaton acronyms

ABM	Advanced Battery Management
AFC	American Football Conference
AM	Advanced Monitored (ePDU)
ARG	Amphibious Ready Group
BA	Basic (ePDU)
CSE	Customer Service Engineer
EOSL	End of Service Life
EMS	Energy Management System
ESS	Energy Saver System
ME	Metered (ePDU)
MI	Ethernet Monitored (ePDU)
NFC	National Football Conference
VMMS	Variable Module Management System
PDR	Power Distribution Rack
ROO	Remote On/Off
RPO	Remote Power Off
RMA	Return Material Authorization
ROO	Remote On/Off
RPO	Remote Power Off
RPM	Rack Power Module
RPP	Remote Power Panel
SEAL	Sea Air Land
SW	Switched (ePDU)
T&M	Time and Material
CPU	Central Processing Unit

Other acronyms

DNS	Domain Name System
DSL	Digital Subscriber Line
DVV or DV2	Data, Voice, Video
E911	Enhanced 911
EMEA	Europe, Middle East, Africa
FMC	Fixed/Mobile Convergence
FTP	File Transfer Protocol
GUI	Graphical User Interface
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IP	Internet Protocol
ISP	Internet Service Provider
KVM	Keyboard, Video, Monitor
PABX	Private Automatic Branch Exchange
PBX	Private Branch Exchange
PC	Personal Computer
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
RMA	Returned Merchandise Authorization
SAN	Storage Area Network
SEA	South East Asia
SOA	Service-Oriented Architecture
SSL	Secure Socket Layer
SVGA	Super Video Graphics Array
TCP/IP	Transmission Control Protocol/ Internet Protocol
TDM	Time-division Multiplexing
URL	Uniform Resource Locator
VGA	Video Graphics Array
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network
WAN	Wide Area Network

Glossary of power terms

In the following glossary, we have attempted to capture the common terms related to UPS and power distribution products. If you look closely, you might see us trying to have a little fun!

Advanced Battery Management
Three-stage charging technique that automatically tests battery health. Provides advance notification when preventive maintenance is needed, allowing ample time to hot-swap batteries without ever having to shut down connected equipment significantly extending the life of your UPS's battery (and, quite possibly, your contract).

Alternating Current (AC)
An electric current that reverses its direction at regularly recurring intervals, as opposed to direct current, which is constant. Usually in a sine wave pattern, for optimal transmission of energy.

Ampere (A or Amp)
The unit of measure for the rate of flow of electricity, analogous to gallons per minute. VA x 0.7 (power factor) = watts

Apparent Power
Applied voltage multiplied by current in an AC circuit—this value would not take the power factor into account. Unit is volt amperes (VA).

Arc
Sparking that results when undesirable current flows between two points of differing potential; this may be due to leakage through the intermediate insulation or a leakage path due to contamination. In astronomy, an arc is the part of a circle representing the apparent course of a heavenly body.

Audible Noise
A measure of the noise emanating from a device at audible frequencies.

Backup Time
The amount of time the battery in a UPS is designed to support the load.

Balanced Load
(1) AC power system using more than two wires, where the current and voltage are of equal value in each energized conductor. (2) Laundry with equal parts of light and dark clothes.

Blackout
A zero-voltage condition lasting for more than two cycles. Also known as a power outage or failure.

BTU – British Thermal Unit
This is used to measure heat dissipation and is the amount of energy required to raise one pound of water one degree Fahrenheit. One pound of water at 32 degrees F requires the transfer of 144 BTUs to freeze into solid ice.

Brownout
A steady state of low voltage, but not zero voltage. Brownouts often occur during summer months when energy use is high.

Capacitor
An electronic component that can store an electrical charge on conductive plates.

Cloud Computing
(1) Internet- (cloud-) based development and use of computer technology. This is a new supplement, consumption and delivery model for IT services based on the Internet, and it typically involves the provision of dynamically scalable, and often virtualized, resources as a service over the Internet. (2) Work done on a commercial passenger jet.

Common Mode Noise
An undesirable voltage that appears between the power conductors and ground.

Commercial Power
The power supplied by local utility companies. The quality of commercial power in the US varies drastically depending on location, weather and other factors.

Communication Bay
A communication bay or option slot on a UPS enables you to add various connectivity cards for Web, SNMP, Modbus or serial connectivity interface capabilities.

Eaton 9130 equipped with a communication bay.

Converter
A device that delivers DC power when energized by a DC source. It is also a section of a switching power supply that performs the actual power conversion and final rectification.

Crest Factor
Usually refers to current. It is the mathematical relationship between RMS current and peak current. A normal resistive load will have a crest factor of 1.4142, which is the normal relationship between peak and RMS current. A typical PC will have a crest factor of 3. Unrelated to toothpaste.

Critical Equipment
Equipment such as computers, communications systems or electronic process controls, whose continuous availability is imperative.

Delta Connection
A circuit formed by connecting three electrical devices in series to form a closed loop; most often used in three-phase connections. If you fly Delta Airlines, this is something that most likely takes place in Atlanta, Salt Lake City or Cincinnati.

Derating
A reduction of some operating parameters to compensate for a change in one or more other parameters. In power systems, the output power rating is generally reduced at elevated temperatures.

Direct Current (DC)
An electric current in which the flow of electrons is in one direction, such as supplied by a battery.

Double Conversion
A UPS design in which the primary power path consists of a rectifier and inverter. Double-con-version isolates the output power from all input anomalies such as low voltage surges and frequency variations.

Downtime
The time during which a functional unit cannot be used because of a fault within the functional unit or within the environment.

Efficiency
The ratio of output power to input power. It is generally measured at full-load and nominal line conditions. If power efficiency of a device is 90%, you get back ninety watts for every hundred you put in. The rest is mainly dissipated as heat from the filtration process. In other terms, this would be equivalent to the bartender pouring off about an ounce and a half of your beer before handing you the remaining 14.5 ounces!

Electrical Line Noise
Radio frequency interference (RFI), electromagnetic interference (EMI) and other voltage or frequency disturbances.

Electromagnetic Interference (EMI)
Electrical interference that can cause equipment to work improperly. EMI can be separated into conducted EMI (interference conducted through cables out of the UPS) and radiated EMI (interference conducted through the air).

Energy Saver System (ESS)
Innovative technology from Eaton that enables select UPS models to operate at 99% efficiency without compromising reliablility. Not to be confused with inferior "eco" modes.

ePDU
A power distribution unit that mounts to rack enclosures and distributes power to connected devices via a wide variety of output receptacles.

Frequency
The number of complete cycles of AC voltage which occurs during one second (Hz). In Asia, electrical current is supplied mainly at 50 Hz, or 50 cycles per second.

Ground
A conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the earth, or to some conducting body of relatively large extent that serves in place of the earth.

Earth ground symbol

Harmonics
A sinusoidal component of an AC voltage that is multiple of the fundamental waveform frequency. Certain harmonic patterns may cause equipment problems.

Harmonic Distortion
Regularly appearing distortion of the sine wave whose frequency is a multiple of the fundamental frequency. Converts the normal sine wave into a complex waveform.

Hertz (Hz)
A unit of frequency equal to one cycle per second.

High Efficiency Mode
A mode of UPS operation that cuts energy usage and operating costs.

High Voltage (HV)
In the context of UPS products, high voltage is anything ≥200V: 200V, 208V, 220V, 230V, 240V, 250V, 480V and 600V.

High Voltage Spike
Rapid voltage peak up to 6,000 volts.

Hot Swappable
The ability to change a module without taking the critical load off the UPS. Also see "user replaceable."

The batteries on this Eaton 9130 UPS are hot swappable.

Impedance
The total opposition to alternating current flow in an electrical circuit.

Input Voltage Range
The voltage range within which a UPS operates in "normal" mode and does not require battery power.

Inverter
UPS assembly that converts internal DC power to output AC power to run the user's equipment. When the inverter is supporting 100% of the load at all times, as with an online UPS, there is no break from utility power to battery power.

System i Server
One of a family of general-purpose systems that supports IBM i5/OS and Operating System 400 and that provides application portability across all models.

Kilovolt Ampere (kVA)
One thousand volt-amperes. Common measurement of equipment capacity. An approximation of available power in an AC system that does not take the power factor into account.

Kinetic Energy
The energy an object possesses because of its motion.

Line Interactive
An offline UPS topology in which the system interacts with the utility line in order to regulate the power to the load. Provides better protection than a standby system but is not as fully prepared against irregularities as a full double-conversion system, making it the "Goldilocks" of UPS topologies.

Load
The equipment connected to and protected by a UPS. Pretty rockin' Metallica album.

Load Segment
UPS configuration with separate receptacle groups, enabling scheduled shutdowns and maximum backup power time for critical devices.

This Eaton 9130 UPS is equipped with two load segments, each with three 5-15R

Low Voltage (LV)
In the contect of UPS products, low voltage is anything <200V (100V and 120V).

Maintenance Bypass
An external wiring path to which the load can be transferred in order to upgrade or perform service on the UPS without powering down the load.

Make Before Break
Operational sequence of a switch or relay where the new connection is made prior to disconnecting the existing connection, also soft-load-transfer switching.

Network Transient Protector
UPS feature that isolates networks, modems and cables from power threats including surges and spikes.

Noise
(1) A disturbance that affects a signal; it can distort the information carried by the signal. (2) Random variations of one or more characteristics of any entity such as voltage, current or data. (3) Loosely, any disturbance tending to interfere with normal operation of a device. (4) What parents with children deal with every day.

Nominal Output Voltage
The intended, ideal voltage of any given output.

Offline
Any UPS that does not fit the definition of online. Line-interactive and standby topologies are offline, as are minor skirmishes that take place just outside the boardroom.

Ohm
The unit of measurement for electrical resistance or opposition to current flow.

Online
(1) A UPS that provides power to the load from its inverter 100% of the time, regulating BOTH voltage and frequency, usually double-conversion topology.

Orderly Shutdown
The sequenced shutdown of units comprising a computer system to prevent damage to the system and subsequent corruption or loss of data.

Parallel Operation
The ability of UPSs to be connected so that the current from corresponding outputs can be combined into a single load.

Partition
A logical division of a hard disk created to have different operating systems on the same hard disk or to create the appearance of having separate hard drives for file management, multiple users, or other purposes.

Peak Demand
The highest 15- or 30-minute demand recorded during a 12-month period.

Phase
Time relationship between current and voltage in AC circuits

Plug and Play
An electrical device that does not require extensive setup to operate.

Power Factor (PF)
(1) The ratio of real power to apparent power. Watts divided by VA. Most power supplies used in communication and computer equipment have a power factor of 0.9.

(PF = 0.9)

VA x PF = W

W/PF = VA

(2) Why DeNiro can get immediate seating in any restaurant he wants, and you can't.

Power Sag
Low voltage (below nominal 120 volts).

Power Surge
High voltage (above nominal 120 volts).

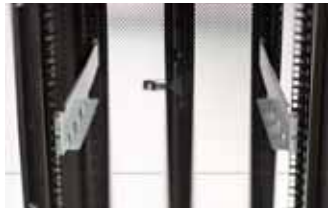
Pulse Width Modulation (PWM)
a circuit used in switching regulated power supplies where the switching frequency is held constant and the width of the power pulse is varied, controlling both lines and load changes with minimal dissipation.

Rackmount
Ability to mount an electrical assembly into a standardized rack. Generally stacked up to 42U and 19 inches wide—about the size of a pizza box but not as greasy.

Rack Unit (U)
A unit of height measurement in a rack enclosure. A U is equivalent to 1.75 inches.

The Eaton 5130 UPS occupies 2U of rack space and the optional extended battery module also occupies 2U.

Rail Kit
A set of metal brackets that allow you install a UPS or extended battery module in a 2- or 4-post rack.



4-post rail kit

Rectifier
UPS component that converts incoming AC power to DC power for feeding the inverter and for charging the battery.

Redundancy
The ability to connect units in parallel so that if one fails the other(s) will provide continual power to the load. This mode is used in systems when power failure cannot be tolerated.

Relay Communication
Communication between a UPS and a computer through the opening and closing of solid-state relays that are pre-defined to indicate UPS status.

RS-232
(1) The standard for serial interfaces (serial refers to the eight bits of each character successively sent down one wire) used by most computers, modems and printers. (2) A little known droid in the Star Wars trilogy.

Sine Wave
Mathematical function that plots three qualities of an electrical signal over time: amplitude, frequency and phase. Clean, uninterrupted power is represented by a sine wave. Can also resemble ocean waves, though they're rarely very perfect.

Single Phase
(1) Power system with one primary waveform. Lower-capacity distribution of power using only one portion of a power source that is three-phase, like what's supplied by most electric utilities. Used for heating and lighting, no large motors or other heavy-drain devices. (2) That part of junior high school in which you briefly but fiercely embrace an unusual hobby or interest, like lawn bowling, never to return to it again.

Sliding Demand
Calculating average demand by averaging the average demand over several successive time intervals, advancing one interval at a time.

Standby
(1) UPS type that "stands by," waiting for a power problem from the utility company and rapidly switching to UPS battery power to protect equipment against power failures, sags and surges. (2) The person you call after your hot date falls through, and the two of you go out for milkshakes in your sweatpants instead.

Step Load
An instantaneous change in the loading conditions presented to the output of a UPS.

Switching Frequency
The rate at which the source voltage is switched in a switching regulator or chopped in a DC to DC converter.

Thermal Regulation
Monitoring the temperature of the batteries to assure proper charging.

Three Phase
(1) Power supplied through at least three wires, each carrying power from a common generator but offset in its cycle from the other two. Used for heavy-duty applications. (2) The universal healing process after buying inferior power protection:

1. Denial
2. Anger
3. Calling Eaton

Total Harmonic Distortion (THD)
(1) How much the circuit voltage deviates from a perfect sine wave. When viewed on a meter, a poor voltage THD is most often manifested in a flat topped waveform that comes from the inability of a power source to respond to the demands of highly nonlinear loads. (2) The parts of a difficult lecture that didn't quite make it into your brain, but rather united in a "blahblahblah" cacophony of scratchy-sounding jargon and esoteric corollaries.

Transformer
A magnetic device that converts AC voltages to AC voltages at any level. An ideal transformer is a lossless device in which no energy is stored and that requires no magnetic current. A transformer is also an alien robot that can disguise itself by transforming into everyday machinery.

Transient
A temporary and brief change in a given parameter. Typically associated with input voltage or output loading parameters. Transient killer whale pods are generally comprised of an adult female and two or three of her offspring. Among the differences between residents and transients are that while resident orcas of both sexes stay within shouting distance of their mothers their entire lives, only first-born male transients maintain such intense fidelity to their mothers.

TUV (Technischer Uberwachungs-Verein)
An independent non-profit organization that tests and certifies electrical equipment for public safety in the US and worldwide.

Unbalanced Load
An AC power system using more that two wires, where the current is not equal in the current-carrying wires due to an uneven loading of the phases. A load that makes your washing machine go "whump, whump, whump."

Underwriters Laboratories (UL)
An independent, not-for-profit organization that tests for public safety in the U.S. UL recognition is required for equipment used in some applications.

Uninterruptible Power System (UPS)
(1) An electrical system designed to provide instant, transient-free back up power during power failure or fault. Some UPSs also filter and/or regulate utility power (line conditioning). (2) Device whose sole purpose is to save your equipment, your data and your job.

User Replaceable
Capable of being replaced by an end user. Connected equipment may need to be shut down first. Also see "hot swappable."

Variable Module Management System (VMMS)
Innovative technology from Eaton that maximizes UPS efficiencies at low load levels while supplying the load with continuous double-conversion power.

Virtualization
The creation of a virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resource. Operating system virtualization is the use of software to allow a piece of hardware to run multiple operating system images at the same time.

Volt/Voltage (V)
Electrical pressure that pushes current through a circuit. High voltage in a computer circuit is represented by 1; low (or zero) voltage is represented by 0.

Volt Amps (VA)
(1) The voltage applied to a given piece of equipment, multiplied by the current it draws. Not to be confused with Watts, which are similar but represent the actual power drawn by the equipment, and can be somewhat lower than the VA rating. (2) Legendary Brigadier General from Planet Zap.

Volts Direct Current (Vdc)

Volts Alternating Current (Vac)

Watts (W)
The measure of real power. It is the rate of doing electrical work. W x 1.3 = VA.

Wye Connection
A connection of three components made in such a manner that one end of each component is connected. It is generally used to connect devices to a three-phase power system.

Notes and numbers

Use these pages to keep track of additional helpful numbers and commonly referenced data.

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