

EMEA version

UPS Handbook

EATON

Powering Business Worldwide

Welcome to the Eaton UPS Handbook

This comprehensive guide includes all the information that resellers need to help them understand and sell the industry-leading power protection solutions from Eaton®.

You'll find a wealth of useful resources, all designed to help you develop the best solution for your customers. This handbook includes information about power problems, factors affecting battery life, an overview of various UPS topologies in addition to plug and receptacle charts.

Eaton is a global leader in power protection, distribution and management solutions. Eaton offers a comprehensive range of products and services designed to serve the power system needs of the industrial, institutional, government, utility, commercial, residential, IT and mission-critical OEM markets globally. Eaton's portfolio includes uninterruptible power supplies (UPSs), surge protective devices, power distribution units (ePDUs), remote monitoring, meters, software, connectivity, enclosures and services.

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 UPS Handbook is your one-stop source for essential information.



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The basics of voltage, amperes and frequency



Three of the most common terms used when talking about electricity and electrical products are voltage, amperes and frequency.

Put simply, a volt (V) is the measure of the “pressure” with which electricity moves through a wire or circuit, while an ampere (A), or amp for short, is a measure of the “volume”. Volts and amps are often compared to water in a hose, with volts representing the amount of pressure and amps the volume of water.

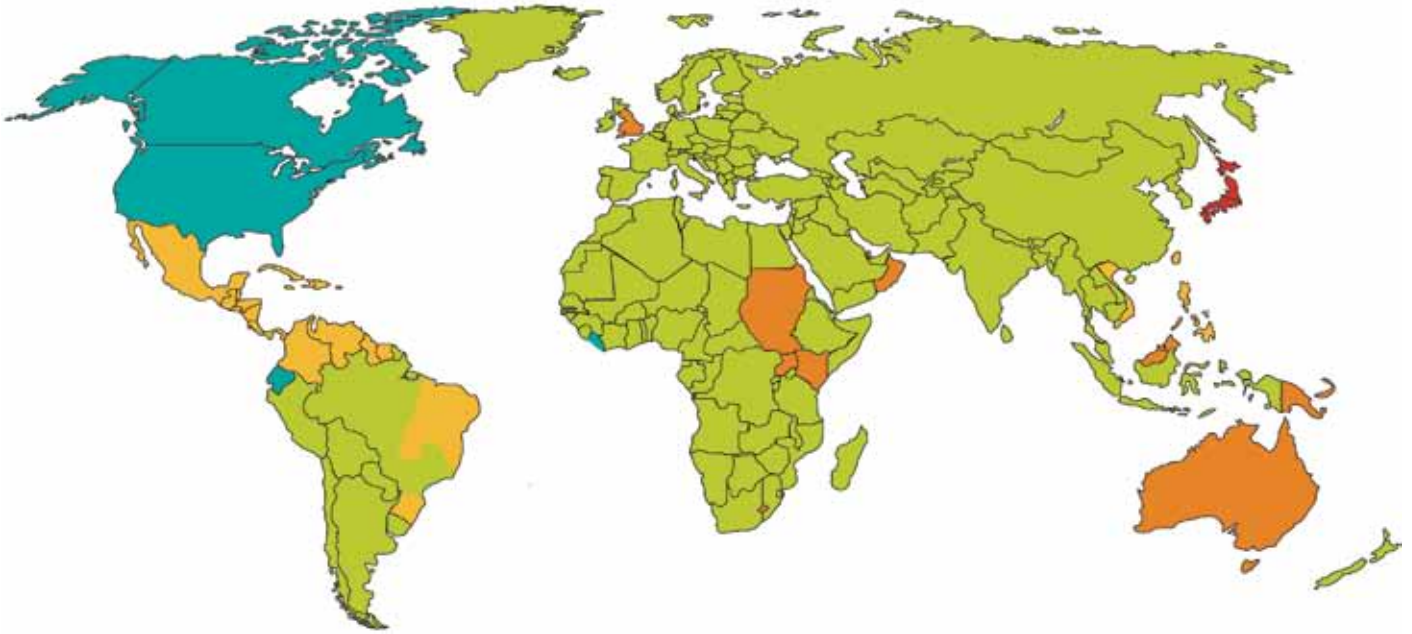
When you turn on a hose without a nozzle at the end, there is a lot of water (amps) but not much pressure (volts). By placing your thumb over the end of the hose, you reduce the volume and increase the pressure, so the water squirts further.

In terms of electricity, the number of amps is a measure of how many electrons are flowing in the wire, while the voltage level tells us how hard those electrons are being pushed. In the same way as a fire hose operating at the same pressure as a garden hose delivers a larger volume of water, a wire carrying a higher current needs to have a larger diameter for an equivalent voltage.

Frequency (Hz) is a measure of how many times a second the electrical signal oscillates. The frequency of household voltages varies according to geographical location; in industrial voltages it can be customised to meet specific site requirements.

Making sure that the volts, amps and frequency of connected equipment are compatible with the electrical supply can be compared to filling up a car with the correct type of fuel.

Worldwide voltage map



Single-phase voltages

- 110-127V; 60Hz (also 208V; 60Hz)
- 110-127V; 60Hz
- 100V
- 220/230V; 50Hz
- 240V; 50Hz

Country	Single phase voltage (V)	Three-Phase voltage (V)	Frequency (Hz)
Afghanistan	220	380	50
Albania	230	400	50
Algeria	230	400	50
Angola	220	380	50
Argentina	220	380	50
Armenia	230	380	50
Australia	240	415	50
Austria	230	400	50
Azerbaijan	220	380	50
Bahrain	230	400	50
Bangladesh	220	380	50
Belarus	220	380	50
Belgium	230	400	50
Benin	220	380	50
Bolivia	115/230	400	50
Bosnia-Herzegovina	220	380	50
Botswana	220	380	50
Brazil	110-127	220/380	60
	220		60
Brunei	240	415	50
Bulgaria	230	400	50
Burkina Faso	220	380	50
Burma (Myanmar)	230	400	50
Burundi	220	380	50
Cambodia	230	400	50
Cameroon	220	380	50

Canada	110/120	220/240	60
Central African Republic	220	380	50
Chad	220	380	50
Chile	220	380	50
China	220	380	50
Colombia	110/220	220	60
Congo	220	220/380	50
Congo, Dem. Rep. of (formerly Zaire)	220	380	50
Costa Rica	120/240	240	60
Croatia	230	400	50
Cyprus	240	415	50
Czech Republic	230	400	50
Denmark	230	400	50
Djibouti	220	380	50
Dominica	230	400	50
Dominican Republic	110	415	60
Ecuador	120	190	60
Egypt	220	380	50
El Salvador	115	400	60
England	240	415	50
Estonia	230	400	50
Ethiopia	220	380	50
Faroe Islands	230	400	50
Falkland Islands	240	415	50
Finland	230	400	50
France	230	400	50
Gabon	220	380	50
Gambia	230	400	50

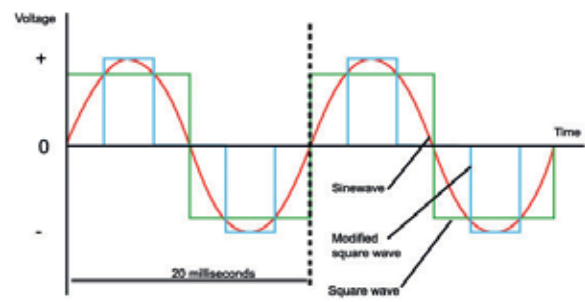
Country	Single phase voltage (V)	Three-Phase voltage (V)	Frequency (Hz)
Gaza	230	400	50
Georgia	220	380	50
Germany	220-230	400	50
Ghana	230	400	50
Greece	220-230	400	50
Guadeloupe	220	380	50
Guatemala	120/127/220	200/240	60
Guinea	220	380	50
Guinea-Bissau	220	380	50
Guyana	110/220	220	50-60
Haiti	110/220	220	50-60
Honduras	110/220	220	60
Hong Kong	220	380	50
Hungary	230	400	50
Iceland	230	400	50
India	230	400	50
Indonesia	220	380	50
Iraq	230	400	50
Ireland	230	400	50
Israel	230	400	50
Italy	220-230	400	50
Ivory Coast	220	380	50
Jamaica	110/220	200	60
Japan	100/200	200	50&60
Jordan	220	380	50
Kazakhstan	220	380	50
Kenya	240	415	50
Korea, South	220	380	50&60
Kuwait	240	415	50
Kyrgyzstan	220	380	50
Laos	230	400	50
Latvia	220	380	50
Lebanon	110-220	400	50
Lesotho	220	380	50
Liberia	120	208	60
Libya	127-220	220/380	50
Liechtenstein	230	400	50
Lithuania	220	380	50
Luxembourg	120/208	220/380	50
Macedonia	230	400	50
Madagascar	220	380	50
Malawi	230	400	50
Malaysia	240	415	50
Mali	220	380	50
Malta	240	415	50
Martinique	220	380	50
Mauritania	220	380	50
Mauritius	230	400	50
Mexico	127	220/480	60
Moldova	220	380	50
Monaco	230	400	50
Mongolia	220	380	50
Morocco	220	380	50
Mozambique	220	380	50
Namibia	220-250	380	50
Nauru	240	415	50
Nepal	230	400	50
Netherlands Antilles	120-127/220	220/380	50/60
Netherlands	220	380	50

New Zealand	230	400	50
Nicaragua	120/240	240	60
Niger	220	380	50
Nigeria	230	400	50
Northern Ireland	240	415	50
Norway	230	400	50
Oman	240	415	50
Pakistan	230	400	50
Panama	110/220/120	220/240	60
Paraguay	220	380	50
Peru	110/220	220/380	50/60
Philippines	220	380	60
Poland	230	400	50
Portugal	220	380	50
Puerto Rico	120	208	60
Qatar	240	415	50
Réunion Island	230	400	50
Romania	230	400	50
Russia	220	380	50
Rwanda	220	380	50
Saudi Arabia	127/220	380	50/60
Scotland	240	415	50
Senegal	230	400	50
Serbia	230	400	50
Seychelles	240	415	50
Singapore	230	400	50
Slovakia	230	400	50
Slovenia	230	400	50
Somalia	110/220	380	50
South Africa	220-250	380	50
Spain	220-230	400	50
Sri Lanka	230	400	50
Sudan	230	400	50
Surinam	110/220	220/230	60
Swaziland	230	400	50
Sweden	230	400	50
Switzerland	230	400	50
Taiwan	110/220	220	60
Tajikistan	220	380	50
Tanzania	230	400	50
Thailand	220/230	380	50
Togo	220	380	50
Tonga	240	415	60
Tunisia	230	400	50
Turkey	230	400	50
Turkmenistan	220	380	50
Uganda	240	415	50
Ukraine	220	380	50
United Arab Emirates	220/230	400	50
United Kingdom	240	415	50
United States	120/240	208/480	60
Uruguay	220	220	50
Uzbekistan	220	380	50
Venezuela	120	240	60
Vietnam	120/220	220/380	50
Wales	220	380	50
Yemen	230	400	50
Zambia	220	380	50
Zimbabwe	220	380	50

Single-phase power

In electrical engineering, single-phase electric power refers to the distribution of alternating current electric power using a system in which all the voltages of the supply vary in unison. Single-phase distribution is used when loads are mostly lighting and heating, with few small electric motors.

Single-phase electricity is what you have in your house. In general, household electrical supply is a single-phase, 220-230 volt AC supply. If you were to take an oscilloscope and measure the power from a normal wall socket in your house, the voltage would be seen as a sine wave, with an effective root mean square (RMS) voltage of 230 volts and an oscillation rate of 50 cycles per second, or 50 Hz. Power that oscillates in this way is generally referred to as alternating current, or AC.



The alternative to AC is DC, or direct current, such as that produced by batteries. AC has at least three advantages over DC in an electrical distribution grid:

1. Large electricity generators generate AC naturally, so conversion to DC requires an extra step.
2. Electrical transformers, which the power distribution grid depends on, need an alternating current in order to operate.
3. Converting AC to DC is easy, whereas converting DC to AC is expensive. This makes AC a better choice.



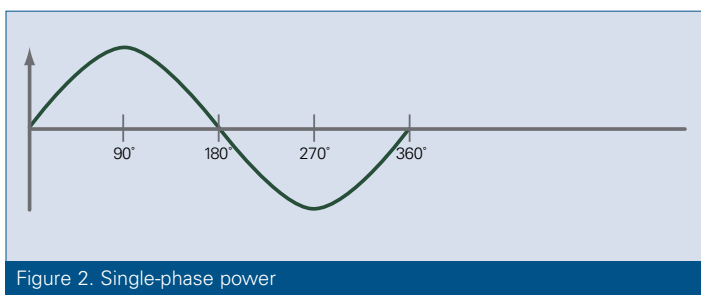
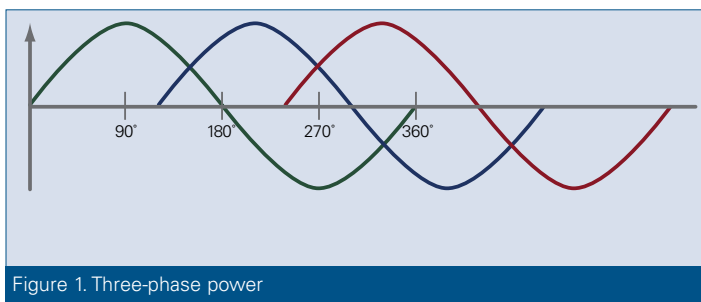
Three-phase power



As well being the most efficient way to distribute power over long distances, three-phase power also enables industrial equipment to operate more efficiently. Three-phase power is characterised by three single-phase waves that are offset in their phase angle by 120 degrees, or one third of the sine wave period (see Figure 1 below).

Three-phase voltage can be measured from each phase to neutral or from one phase to any other. The voltage relation between phase to neutral and phase to phase is a factor of square root of three (e.g. 230 V versus 400 V).

Conversely, single-phase power is distributed through household outlets to power everyday equipment such as laptops, lighting and televisions. As shown in Figure 2, if you were to look at the voltage coming from a single-phase outlet on an oscilloscope, you would see a single wave. This is because single-phase power is obtained by simply using one phase of a three-phase system. Its RMS voltage is 230V and it oscillates at 50 Hz (or 50 times a second).



Why use a UPS?

In general, a UPS protects IT equipment and other electrical loads from problems that plague our electrical supply. A UPS performs the following three basic functions:

1. It prevents hardware damage typically caused by surges and spikes. Many UPS models continually condition incoming power as well.
2. It prevents data loss and corruption. Without a UPS, data stored on devices that are subjected to a hard system shutdown may become corrupted or even lost completely. In conjunction with power management software, a UPS can facilitate a graceful system shutdown.
3. It provides availability for networks and other applications while preventing downtime. UPSs can also be paired with generators in order to give the generators sufficient time to power up in the event of a power cut.












Nine power problems

And how a UPS helps solve them

Eaton UPSs address all of the nine common power protection problems described below. They are designed to meet the power protection, distribution and management needs of offices, computer networks, data centres as well as in the telecommunications, healthcare and industrial markets.

For small office/home office (SOHO) applications, Eaton offers low-cost solutions such as the Eaton 3S and Eaton Ellipse ECO UPS for the protection of general desktop systems. For safeguarding mission-critical systems like network servers and power-hungry blade servers, Eaton's offering includes line-interactive and online UPSs such as the Eaton 5PX, 9130, Evolution, EX, MX, MX Frame, 9155, 9355, 9390, 9395 and BladeUPS.

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.	<div style="display: flex; flex-direction: column; align-items: center; justify-content: center;"> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Single-phase Series 3 UPS</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">Single-phase Series 5 UPS</div> <div style="border: 1px solid black; padding: 5px;">Single- and three-phase Series 9 UPS</div> </div>
2 Power sag 	Short-term low voltage	Triggered by the startup of large loads, utility switching, utility equipment failure, lightning, and power service being insufficient to meet demand. In addition to causing equipment crashes, power sags can also damage hardware.	
3 Power surge (spike) 	Short-term high voltage above 110per cent 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 Undervoltage (brownout) 	Reduced line voltage for periods ranging from a few minutes to a few 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 Overvoltage 	Increased line voltage for periods ranging from a few minutes to a few days	Triggered by a rapid reduction in power loads, heavy equipment being turned off, or by utility switching. Can result in damage to 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 under-voltage (notch)	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.	

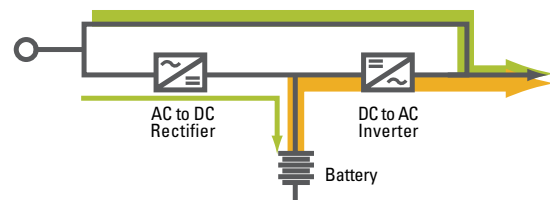
*Reference IEEE E-050R & old FIPS PUB 94

UPS topologies

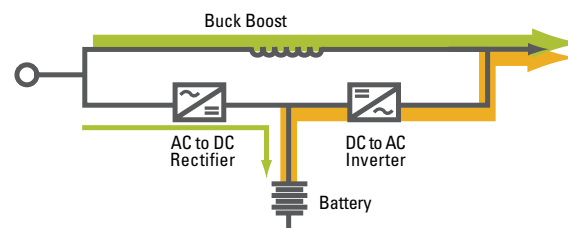
Which one best fits your customers' needs?

The different UPS topologies provide varying degrees of protection. There are several factors that determine which one will best fit your customers' needs, including the level of reliability and availability they require, the type of equipment being protected and the application or environment in question. While the three most common topologies outlined below all meet the input voltage requirements for IT equipment, there are key differences in how they work as well as in the frequency and duration of demands on the battery.

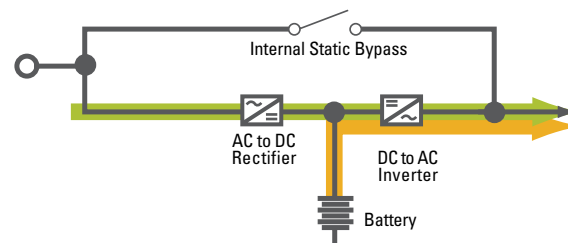
Passive standby topology (off-line) is used for protecting PCs against power failure, power sag and power surge. In normal mode, the UPS supplies power to the application directly from the mains, filtered but without active conversion. The battery is charged from the mains. In the event of a power cut or fluctuation, the UPS delivers stable power from the battery. This topology is low cost and provides sufficient protection for office environments. Passive standby topology is not suitable in cases where the power supply is of low quality (for example, on industrial sites) or subject to frequent disruptions.



Line interactive topology is used for protecting enterprise network and IT applications against power failure, power sag, power surge, undervoltage and overvoltage. In normal mode, the device is controlled by a microprocessor that monitors the quality of the supply and reacts to fluctuations. A voltage compensation circuit is enabled to boost or reduce the supply voltage in order to compensate for fluctuations. The main advantage of line-interactive topology is that it enables compensation for under- and overvoltage without using the batteries.



Double-conversion topology (on-line) is a basis for UPSs designed for continuous power protection of critical equipment against all nine of the common power problems described on page 9. It ensures a consistent quality of power supply regardless of disturbances in the incoming mains. The output voltage is entirely regenerated by a sequence of AC to DC conversion followed by DC to AC conversion in order to create power supply without any electrical interference. Double-conversion UPSs can be used with any type of equipment as there are no transients when changing over to battery power.



█ Normal operation
█ Battery power

UPS form factors

Because UPSs are used for many different applications - ranging from desktop systems to large data centres - they come in a wide variety of form factors.



1. Desktop and tower UPS

- a. The Eaton Ellipse fits easily on top of or under a desk
- b. The Eaton 9130 tower UPS fits under a desk or in a network cabinet

2. Wallmount UPS

The Eaton 5115 rackmount UPS includes hardware for mounting it on 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

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

5. Scalable UPS

- a. The Eaton BladeUPS is a scalable, redundant rackmount UPS
- b. Eaton MX Frame

6. Large tower UPS

The Eaton 9390 and 9395 UPSs are designed to be a central backup for multiple loads, for example in data centres.













Input plugs and output outlets

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

Input plug and output outlet chart

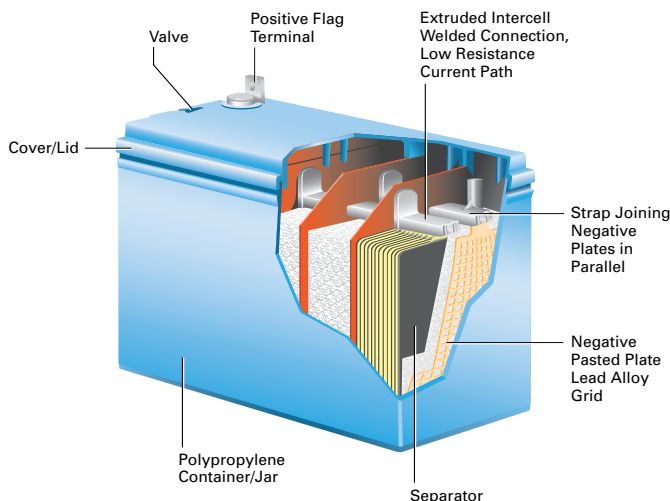
IEC-320-C13 (female)	IEC-320-C14 (male)	IEC-320-C19 (female)	IEC-320-C20 (male)
			
FR	BS	IEC-309, 16A	IEC-309, 32A
			
Schuko	Terminal block (Hardwired)		
			

UPS battery overview

It's a well-known fact that the battery is the most vulnerable part of a UPS. In fact, battery failure is a leading cause of load loss. Understanding how to properly maintain and manage UPS batteries can not only extend battery service life, but can also help prevent costly downtime.



VRLA batteries are sealed, usually within polypropylene plastic, the advantage being that there is no liquid sloshing around that might leak or drip.



The most common type of battery used in UPSs is the valve-regulated lead acid (VRLA) battery, also known as a sealed or maintenance-free 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:

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 per cent of its rated capacity in ampere-hours. When your battery reaches 80 per cent of its rated capacity, the ageing 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, thereby 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 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 (50°F) or less.

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

Hot-swappable batteries can 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.



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 its capacity. Ensure that your UPS has sufficient capacity to support 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. 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 useful life. The typical life of an Eaton UPS with ABM® technology is 50 per cent longer than standard models.

8. 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, valve-regulated lead acid battery 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 ensure proper operation. Eaton's ABM technology extends the life of valve-regulated lead acid batteries by applying sophisticated logic to the charging regime. ABM also provides an additional feature for monitoring battery condition and advance warning about the end of battery life upon detection of a weak battery.

9. 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.

10. What are the risks associated with a lack of battery maintenance?

The primary risks of improperly maintained batteries are load loss, fire, property damage and personal injury.

11. What is thermal runaway?

Thermal runaway occurs when the heat generated in a lead acid cell exceeds its ability to dissipate that heat, which can lead to an explosion, especially in sealed cells. The heat generated in the cell may occur without any warning signs and may be caused by overcharging, excessive charging, internal physical damage, internal short circuit or a hot environment.

12. Why do batteries fail?

Batteries can fail for a multitude of reasons, but common reasons are:

- high or uneven temperatures
- inaccurate float charge voltage
- loose inter-cell links or connections
- loss of electrolyte due to drying out or damage to the case
- lack of maintenance, ageing

13. How is battery performance generally measured?

Batteries are generally rated for 100+ discharges and recharges, but many batteries show a marked decline in charging capacity after as few as 10 discharges. The lower the charge the battery can accept, the less runtime it can deliver. Look for batteries with a high-rate design that sustains stable performance for a long service term.

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 affect a battery's overall lifespan.



1. Ambient temperature

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

2. Battery chemistry

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 per cent of its rated capacity, but each discharge and subsequent recharge slightly reduces the relative capacity of the battery. Once the chemistry is depleted, the cells fail and the battery must be replaced.

4. Maintenance

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 - maintenance free refers only to the fact that they do not require replacement of fluid.

5. Battery service life

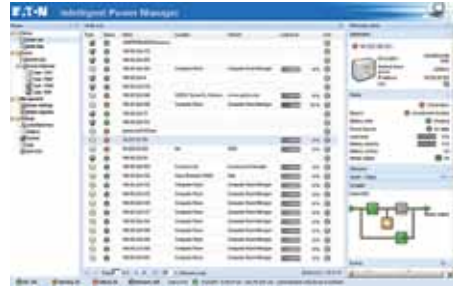
Most UPS batteries on the market today are constantly "trickle-charged" - a process that degrades the battery's internal chemical composition and reduces potential battery service life by as much as 50 per cent. In contrast, Eaton's ABM technology uses sophisticated sensing circuitry and an innovative three-stage charging technique that extends the useful service life of UPS batteries while optimising the battery recharge time. ABM technology also provides up to 60 days' notice of the end of useful battery service life to allow you ample time to hot swap batteries without ever having to shut down connected equipment.

UPS software overview

Operating a UPS without power management software is like driving in the rain without windscreen 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 operating systems are gracefully shut down if the power outage exceeds the battery runtime of the UPS.

Monitoring functions in power management software and web/SNMP cards help in making sure that UPS and its batteries are in good shape and by notifying administrators of power or equipment failures they make it possible to minimize or prevent downtime.



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

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 solution, management software keeps a constant watch over power system 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 predefined recipients based on the condition, text messages, 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 or mobile device with an internet browser. Software can also provide a complete log of events and UPS utility data, which is invaluable when debugging a power anomaly. Many power management products have the ability to centralise alarms, organise data by customised 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 this 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 virtualised environments. Shutdown software is now compatible with VMware's ESXi and vSphere and Microsoft's Hyper-V, enabling graceful shutdown of multiple virtual machines and hypervisors. Best in class power management software integrates with Virtual Machine Managers like vCenter, SCVMM and XenCenter to provide additional functionality such as zero application downtime through live migration of virtual machines in case of power failure.

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

Service overview

One of the best ways to protect your customers' investment is by including a service contract with your UPS sales. Scheduled preventive maintenance can help detect a wide range of problems 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 can significantly reduce the likelihood that a UPS will succumb to downtime. The 2007 Study of Root Causes of Load Losses compiled by Eaton revealed that customers who did not take advantage of preventive maintenance visits were almost twice more likely to experience a UPS failure than those who had completed the one recommended preventive maintenance visit per year.

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 properly planned maintenance contract delivered by trained and experienced personnel can greatly minimise the risk of failure.

Types of UPS service

There are several different UPS service delivery methods, each designed to meet the varying needs of your customers. These include:

- Depot exchange repair or replace. The customer contacts the UPS service provider and ships the UPS to a repair facility. The service provider returns the repaired unit or a refurbished unit.
- Advance swap depot exchange. The customer contacts the UPS service provider, who ships a refurbished unit to them; the original UPS unit is returned to a repair facility.



Smaller UPS models are usually sent to a repair facility

- On-site repair. The customer contacts the UPS service provider and a factory-trained field technician diagnoses and repairs electrical or battery-related problems on site.

Smaller UPS products up to 3000 VA are repaired at a depot, while products over 3000 VA are normally serviced on-site as they are either hardwired (cannot be unplugged) or too heavy to ship.

Types of service contracts

A variety of different UPS service options are available, all designed to help save customers' time and money by minimising business disruption and downtime costs. These service options are also designed to improve return on investment by extending the lifespan of critical power equipment.

- Service contracts usually combine parts and labour coverage (electronics, batteries or both), at least one or more UPS preventive maintenance inspections annually, and a combination of coverage hours and arrival response time. Plans can be tailored to meet almost any need. Special features such as remote monitoring, battery replacement insurance and spare part kits may also be added.
- An extended warranty (or basic warranty) may also be purchased for many UPS products. A warranty commonly covers specified parts and labour such as electronic components for a fixed period of time. It will not include 24/7 coverage or arrival response times, nor will it include preventive maintenance, although extra services can be purchased in addition to a warranty extension. The more services 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 carries out a repair only when something breaks. T&M can be done either via depot repair or on site, depending on the UPS. This method may not be the best 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, for non-contract customers T&M response times may be as long as several days, depending on the product and location.



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



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

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 (ePDUs), remote monitoring, meters, software, connectivity, enclosures and services. Our power quality portfolio is 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 represent a sample of our comprehensive set of solutions. To view the complete offering or to request a product catalogue, please visit www.eaton.com/powerquality.

Surge suppressors



Eaton's Protection Box surge suppressors offer the best price/performance ratio for SOHO users looking for a convenient way to combine multiple receptacles and excellent surge suppression capabilities.

PC/workstation and home A/V UPS

Power range: 500 VA–1500 VA

These 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 Ellipse MAX, 600–1500 VA



The Eaton Ellipse MAX UPS provides cost-effective, line-interactive backup power and voltage regulation. With its compact form factor, the Ellipse MAX can be utilised as a standalone tower or under a computer monitor. This UPS is also equipped with local outlets.

Network and server UPS

Power range: 500 VA–18000 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 optimised rack, tower and rack/tower form factors.

Eaton 9130, 700–6000 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 per cent efficiency or higher. This UPS delivers superior power protection for IT and networking environments as well as medical and manufacturing systems.

Eaton EX RT, 5–11 kVA, rackmount/tower



Ideal for high-density server environments and demanding 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.

Data centre and facility UPS

Power range: 10–1100 kVA

Featuring an array of inventive features, Eaton's data centre 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 per cent efficiency, meaning that the total cost of the UPS can usually be recovered in three to five years.

Eaton BladeUPS, 12–60 kW



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 9390, 40–160 kVA



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

Eaton 9395, 225-1100 kVA



The 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 centres, healthcare applications and other critical systems.

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 as well as standard and custom ePDUs (enclosure power distribution units) that are based on different technologies including Basic, Metered, Monitored, Advanced Monitored, Inline Monitored and Managed.

ePDU



From basic, efficient power distribution to intelligent power management capabilities, Eaton ePDU products are designed to meet the demands of every data centre.

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.

Software and connectivity

Eaton's Intelligent Power® Software delivers the ability to manage all your power devices over your network or via the internet. With both supervisory and protection capability, our software allows you to monitor your power devices and even gracefully shut operating systems and computers down in the event of an extended power outage.

Eaton's connectivity products are accessory hardware options that link UPS products with external monitoring system devices. Our connectivity products provide communication compatibility through the internet, serial, ModBus or SNMP.



Eaton services

Eaton provides an extensive technical support network to cover the power protection needs of our customers. We offer a number of distinct service packages to match different types of maintenance needs and budgets. Whichever package you choose, you can rest assured that it will deliver power security and reliability to keep your core business running. For more information, please contact your local Eaton service organisation or authorised service partner.

Eaton offers power quality services for its UPS products as well as for related equipment such as power distribution units (ePDUs) and batteries. Eaton also services products from legacy brands including Fiskars, Powerware, Exide Electronics, Best Power and MGE Office Protection Systems.



Eaton technologies

Eaton has been developing its innovative technical solutions in the power protection field since receiving its first patent in 1962. As a technology leader, Eaton continues to meet its customers' rapidly changing needs with advanced patented technologies.

Transformer-free technology

The transformer-free technology used in Eaton UPSs brings improved performance and value. This is achieved with small and lightweight filter inductors, high-performance IGBTs in both the inverter and rectifier, and an advanced control algorithm. A transformer-free UPS typically weighs 50 per cent less than legacy UPS topology designs and occupies just 60 per cent of the footprint. Low input THD (<4.5per cent at full load) and high input power factor (>0.99) are supported down to nearly 10per cent load without the need for an additional input filter. In addition, full load efficiency can reach 94.5per cent and above.

Energy Saver System (ESS)

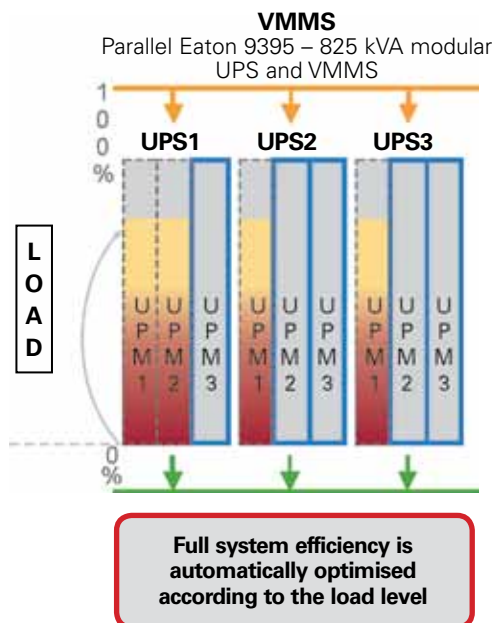


Eaton's innovative ESS technology enables the UPS to reach an industry-leading efficiency level of 99 per cent by allowing the UPS to safely provide mains current directly to a load when the input is within acceptable voltage and frequency limits. ESS's fast detection algorithms continuously monitor incoming power quality. If the predefined limits are exceeded, ESS immediately engages the UPS power converters, allowing transition to full voltage and frequency independent (VFI) double-conversion mode in less than two milliseconds. ESS is available in Eaton 9395 and Eaton 9390 UPSs.

Variable Module Management System (VMMS)



UPS systems are rarely loaded at full capacity; lighter loads are the rule rather than the exception. At loads less than 40 per cent of the full load rating, UPS efficiency decreases, thus increasing the system's overall energy consumption. The solution is Eaton's VMMS technology (implemented in the Eaton 9395 UPS), which allows the UPS to achieve higher efficiency for lighter loads. With VMMS, the UPS can decide which of the power modules are in idle mode. This way, the remaining power modules drive the load with higher efficiency. When the load increases again and more power modules are needed, the system immediately shifts the load into additional modules. VMMS adapts both to a single UPS consisting of multiple power modules and multiple UPS parallel systems.



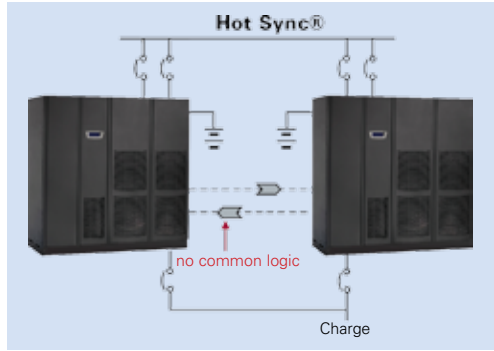
Variable Module Management System (VMMS) technology maximises efficiencies at lighter loads without compromising reliability.

Hot Sync® technology

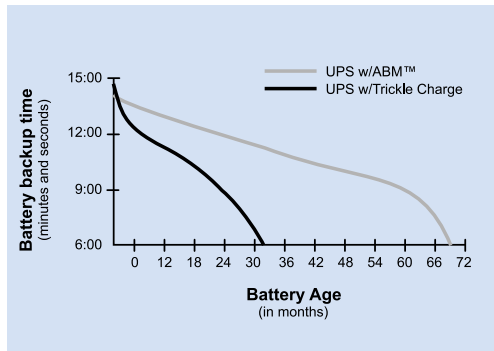
Patented Hot Sync® parallel load-sharing technology guarantees maximum system availability by eliminating the risk of single point of failure. Hot Sync is based on a parallel configuration in which two or more units share the same load. If one unit fails, the other units take over its tasks, isolates the damaged unit and continues to supply electricity without interruption. The technology is unique because it enables the UPS units to operate completely independently; no communication wiring between units is required to transmit system-level information for output phase adjusting. The technology is available for all three-phase UPSs.

ABM technology

Eaton has created ABM technology to extend the life of valve regulated lead acid batteries by applying sophisticated logic to the charging regime. Using the traditional trickle-charge method, batteries become subject to electrode corrosion and electrolyte dry-out, especially in standby service use due to continuous float charging. ABM essentially enables a more intelligent charging routine by preventing unnecessary charging, thus significantly reducing wear and tear. ABM provides an additional feature for monitoring battery condition and advance warning about the end of battery life upon detection of a weak battery. It also optimises the recharge time, which is advantageous when there may be consecutive power outages within a short period. ABM has been used for over 15 years in our UPSs ranging from 1 to 160 kVA and is now incorporated into in UPSs up to 1100 kVA.



Patented Hot Sync technology provides highest availability for load.



ABM technology significantly increases battery service life.

Easy Capacity Test

With Easy Capacity Test, Eaton's UPSs (Eaton 9390 and Eaton 9395) are able to test their entire power train under a full load stress without an external load being connected. Because UPS uses its rectifiers and inverters as internal load banks and draws only minimal power (five per cent) from the mains supply, the energy consumption of the UPS testing is significantly reduced.

Top 10 UPS design considerations

The following 10 factors outline the key design considerations to take into account when analysing your customers' needs and presenting the most appropriate Eaton solution. By properly assessing the information they provide, you can help them to make important trade-off decisions during the selection and purchase process.



1. Power environment: single-phase 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 primarily deal with single-phase equipment, often at the rack level.

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

2. Installation environment

It is imperative that you understand how a prospective UPS will be deployed. Since most environments support several different solutions, you may need to help the customer evaluate the available 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 given 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 them in estimating the power requirements of their equipment. Be sure to take into account future growth in the customer's power load; especially in single-phase deployments, it often makes sense to select a UPS that exceeds the customer's current power requirements in order to offer greater runtimes and allow 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 contribute 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 on what will be most beneficial for 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, whether it be 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 internal IT or facilities staff and who 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 in the long term due to additional hardware and installation costs. Depending on the customer's specific needs, a larger, centralised, modular system might ultimately be the most cost-effective solution.

6. Power distribution

It is imperative that you understand your customer's power distribution scheme. Keep in mind that Eaton's 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 directly address a customer's needs and ultimately, sell the solution. In some instances, data centre managers want to more effectively monitor departmental usage of resources in order to better allocate overheads for the organisation. In deploying metering at the rack level, one Eaton customer was able to track each department's demand and allocate expenses based on meter readings. Combined with using the most efficient servers available, the ability to analyse peak hours of usage for computing processes 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 at every available opportunity in order to offer the customer a complete solution and help lower the total cost of ownership.

As an example, one customer had 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 that would enable 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 - that 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 value the ability to independently swap modules or replace batteries within their products, others prefer a hands-off approach to power in their data centre. In addition, the type of installation (decentralised or centralised 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, centralised, 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 salespeople consider these factors 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 centre 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 capitalise on the opportunity to learn their main concerns and tailor a proposal that addresses those concerns. Failure to do so is a common cause of missed sales opportunities. 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 opportunities to introduce 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. By focusing on only one product or business segment, you miss the opportunity to offer the customer a complete 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 web site for detailed UPS dimensions and specifications: www.eaton.com/powerquality.

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 floor can support the weight of the equipment.

5. Confirm that the UPS will have adequate ventilation

Eaton UPS models use internal fans for cooling. The UPS should not be installed in a sealed container or small, sealed room.

6. Assess the need for hardwired connections

Hardwired outputs are generally useful if you want the UPS output to be distributed via electrical panels. Using an electrical distribution panel allows for flexibility with receptacles types.

7. 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's power supply, and to avoid overheating or potential overloading of the larger UPS, which may result in failure of the all UPS units in the string.

8. 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 online.

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: firstly, UPSs aren't 100 per cent efficient and secondly, 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 20 kVA and above the capacity of the auxiliary generators should be one-and-a-half times the size of the output rating of the UPS in kW, while for 20 kVA and below the capacity should be twice that of the UPS output rating in kW. It is also important to note that the capacity of gas-powered generators should be slightly larger still.

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

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

Decentralised or centralised UPS?

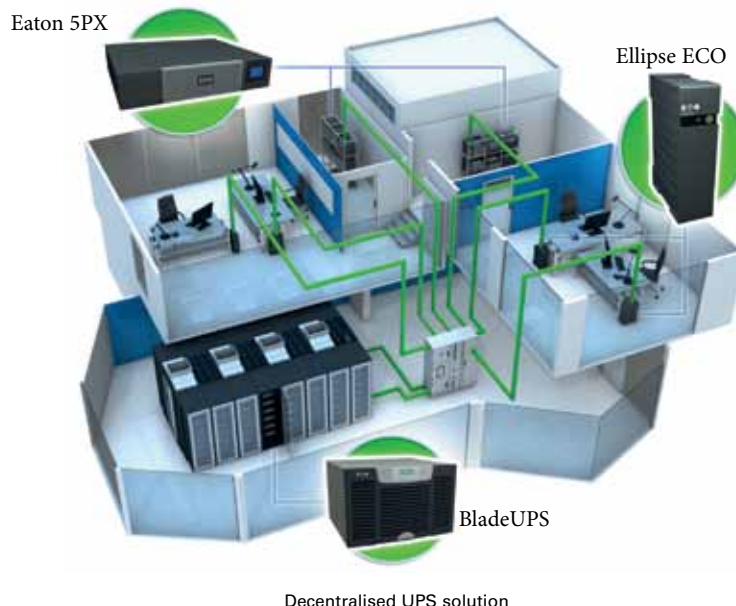
Is a single, larger UPS better? Or is it better to have multiple, smaller UPSs? The answer depends on a number of factors. In a decentralised (also known as distributed) UPS configuration, multiple UPSs support a handful of devices or perhaps only a single piece of equipment. Decentralised UPSs typically use plug and play connections and are usually less than, or equal to, 6 kVA. In a centralised UPS configuration, a larger UPS supports multiple devices. A centralised UPS is typically hardwired into an electrical panelboard. The following tables illustrate a number of factors that should be considered when making a decision between a decentralised UPS and a centralised UPS.

Decentralised UPS

Advantages

Disadvantages

No rewiring required. Existing wall sockets can be used.	If the building is supported by a generator, smaller standby and line-interactive UPSs may not be able to function while the generator is running.
Provides room for future capacity growth and avoids being locked into a specific UPS.	Time and effort is required to monitor multiple UPS units, to keep up with replacing batteries and maintaining the individual units.
Existing smaller UPS units need not be discarded. (However, most manufacturers offer a trade-in scheme.)	A decentralised design doesn't offer the opportunity to simply shut down a single UPS with emergency power off. Also, it may not offer redundancy and other capabilities provided by a larger, centralised UPS.
Power conditioning is implemented at the point of use, which mitigates any electrical disturbances that may be coupled into the distribution wiring of centralised system.	Adding redundancy, extended runtime or maintenance bypass functionality to multiple UPSs can be costly.
Provides flexibility in terms of power protection and functionality. For example, extended runtime can be configured for specific applications, eliminating the need to add additional battery modules for less critical equipment.	Multiple audible alarms/alerts may be irritating.



Centralised UPS

Advantages

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

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

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

A centralised UPS is often housed away from busy areas. As a result, it is less easily disrupted, accidentally damaged or maliciously interfered with.

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

Though a technician may need to replace the batteries, you only have to worry about a single UPS. A distributed UPS configuration may result in various models that require different batteries. Consider the time it takes to replace the batteries for between five and 20 UPSs.

Disadvantages

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

The single UPS may not be in close physical proximity to the equipment that it will protect. It is very likely that not all the equipment will be fed by a single electrical distribution panel.

A centralised solution requires more space for a large UPS, which may not be available.

Generally requires a trained service technician or electrician to install, service and maintain, which means additional costs.

Installation and wiring costs may be higher.

Combining the configurations

It is important to keep in mind that decentralised and centralised power protection deployment strategies are not necessarily mutually exclusive. The two strategies can be used in combination to provide redundancy for mission-critical applications. For example, an entire facility may be protected by a large, centralised UPS, but a specific department such as a 24/7 call centre may also employ UPSs to provide redundant protection and possibly extend runtime for equipment.



Centralised UPS solution

Critical questions to ask prospective customers



By asking your prospective customers the following questions, you can familiarise yourself with their needs and expectations and, in doing so, provide even better customer service.

Applications

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

UPS-specific questions

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 fed from the UPS to the equipment?
2. Do you need enclosures, communications, seismic mounting, floor stands or rail kits?
3. Do you need a maintenance bypass switch?

Software

1. Do you use or plan to use server virtualization?
2. Is scheduled shutdown of systems needed?
3. Does the software you use require orderly shutdown?
4. Do you want to remotely monitor the UPS?
5. Would you like to remotely notify users of UPS events?

Service

1. Do you need immediate service centre response?
2. What kind of parts and labour coverage do you need?
3. Do you want any type of preventive maintenance?
4. When did you last check the batteries in your existing UPS units?

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 check the UPS battery overview section on page 14.

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 in order to provide additional output receptacles.

2. How much UPS capacity should I use?

To allow for future expansion, we recommend that you install a UPS at approximately 75 per cent capacity. In addition, the batteries degrade over time; by oversizing, you can allow for this. The online Eaton UPS sizing tool (www.eaton.com/powerquality) includes 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 not restricted to larger organisations. Your PCs, servers and network are just as critical to your business as a data centre is to a large enterprise. Downtime is costly in terms of hardware and potential loss of goodwill, reputation and sales. You must also consider the inevitable delays that occur when rebooting locked-up equipment, restoring damaged files and re-running processes that were interrupted. A sound power protection strategy provides 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 are more frequent and more costly than ever before.

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 is reliability measured?

Power reliability is usually stated as the percentage of time for which the power is available. For example, if the power grid system provides "three nines" of reliability, the power is available for 99.9 per cent of the time. Because those 8.8 hours of downtime translate into significant expense, IT and telephone network services require at least five nines of reliability.

Reliability average	Non-availability per year
99 per cent	88 hours
99.9 per cent	8.8 hours
99.99 per cent	53 minutes
99.999 per cent	5.3 minutes
99.9999 per cent	32 seconds
99.99999 per cent+	3.2 seconds

9. 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.

10. We have a generator - do we still need a UPS?

Many customers do not realise that a generator will not protect their equipment against power problems. You need a UPS to guarantee that the equipment stays running until the generator kicks in, which often requires several minutes. In addition, UPSs also improve the quality of the power produced by generators.

11. How much UPS capacity do I need?

Determine the total load (in watts) of the equipment you want to protect. Add 10-20 per cent to allow 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.

12. 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 IT & telecom equipment. Eaton UPSs provide reliable, clean power to your equipment at all times. Over time, poor quality power will degrade your equipment.

13. 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.

14. What causes a UPS to become overloaded?

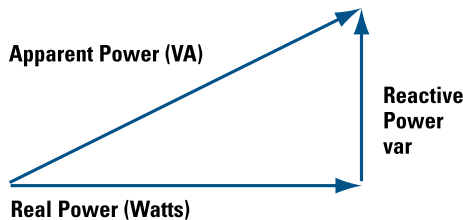
There are two possible answers: (1) the UPS was undersized (e.g. the load was rated at 1200 VA but a 1000 VA UPS was provided), or (2) the customer plugged more equipment into the UPS than it was designed to handle.

15. 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 first think about power terminology. Real power (measured in watts) is the proportion 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 proportion of power flow resulting from 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 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.

The missing quantity can be calculated using one of the following formulas:

$$\text{Watts} = \text{VA} * \text{Power Factor} \text{ or } \text{VA} = \text{Watts} / \text{Power Factor}$$

Since many types of equipment are rated in watts, it is important to consider the PF when sizing a UPS. If you do not take PF into account, you may undersize your UPS. As an example, a piece of equipment that is rated at 525 watts and which has a power factor of 0.7 results in a 750 VA load.

$$750 \text{ VA} = 525 \text{ Watts} / 0.7 \text{ PF}$$

Sizing the UPS to operate at 75 per cent capacity results in a UPS with a 1000 VA rating ($750 \text{ VA} / 0.75 = 1000 \text{ VA}$).

16. How do you convert watts to VA?

Divide watts by the power factor, for example $1000\text{W}/0,7 \text{ p.f.}=1429 \text{ VA}$

17. How do you convert amps to VA?

Multiply amps by voltage. $10\text{A} \times 230\text{V} = 2300 \text{ VA}$

18. What is the difference between a centralised and a decentralised UPS solution?

In a centralised configuration, a larger UPS supports multiple loads from a single point. Centralised UPSs are often hardwired into an electrical panelboard. A decentralised configuration allows multiple UPSs to protect a handful of devices. Decentralised UPSs generally utilise 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?

Most UPS and power management software support SNMP with the RFC-1628 MIB, which is available for many Eaton UPSs through an optional network card. Some more advanced monitoring systems such as OpenView, Tivoli and Nagios allow importing SNMP MIBs; this would allow you to use Eaton proprietary, which provide more information and a greater level of detail. On the other hand, Eaton network cards have a built-in web interface for viewing data and controlling the UPS as well as email capability for generating alarm without any additional software.

21. 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 electronic devices use single-phase power. Higher power industrial motors or large air-conditioning systems often use three-phase power.

22. My data centre only went down for a couple of minutes. What's the big deal?

If the servers in a data centre are without power for a few minutes or even seconds it may actually mean hours or even days of downtime. A sudden uncontrolled power off is very likely to cause database and file system corruption. Starting up many services takes a long time because they have to repair their data and some may need to be restored from backup media. Some operating systems may have to be reinstalled completely. Many systems have to wait for other servers to boot up first so that they can get access to the many services required for their operation.

23. Where can I get technical help?

Please visit www.eaton.com/powerquality

Glossary of power terms

This glossary includes the most common terms used when talking about UPSs and other power distribution products.

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.

Apparent Power

Applied voltage multiplied by current in an AC circuit - this value does 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.

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

AC power system using more than two wires, where the current and voltage are of equal value in each energised conductor.

Battery String

A group of batteries connected together in a series.

Blackout

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

BTU – British Thermal Unit

BTUs are used to measure heat dissipation.

Brownout

A steady state of low voltage, but not zero voltage.

Capacitor

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

Cloud Computing

Internet (cloud)-based development and use of computer technology. This is a new supplement, consumption and delivery model for IT services, and it typically involves the provision of dynamically scalable, and often virtualised resources as a service over the internet.

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 can vary 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 relay connectivity interface capabilities.



Eaton 9130 equipped with a communication bay.

Converter

A device that delivers DC power when energised 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.

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.

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 the power supplied by a battery.

DC Distribution (DCD)

A module in a DC power system that distributes DC power to the loads. It also provides protection for the load cables.

DC Power System

An AC to DC power supply with integrated control and monitoring, and standby batteries designed to supply no-break DC power (usually 24 V or 48 V) to telecommunications and IT network equipment.

Double Conversion

A UPS design in which the primary power path consists of a rectifier and inverter. Double-conversion 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.

Dry Contact

Dry contact refers to a contact of a relay which does not make or break a current.

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 90per cent, you get back ninety watts for every hundred you put in. The rest is mainly dissipated as heat from the filtration process.

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).

ePDU

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

Flooded Battery

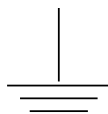
A form of battery where the plates are completely immersed in a liquid electrolyte.

Frequency

The number of complete cycles of AC voltage which occurs during one second (Hz). In EMEA region, 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 a 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 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. See also User Replaceable.

The batteries on this Eaton 9130 UPS are hot swappable.



IGBT

Insulated gate bipolar transistor or IGBT is a three-terminal power semiconductor device, noted for high efficiency and fast switching. It switches electrical power in many modern applications such as electric cars, trains and UPSs.

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 without requiring battery power.

Inrush Current

The maximum, instantaneous input current drawn by an electrical device when first turned on. Some electrical devices draw several times their normal full-load current when first energised.

Inverter

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

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.

Linear Load

AC electrical loads where the voltage and current waveforms are sinusoidal. The current at any time is proportional to the voltage.

Line Conditioner

A device intended to improve the quality of the power that is delivered to electrical load equipment. A line conditioner is generally designed to improve power quality (e.g. proper voltage level, noise suppression, transient impulse protection, etc.).

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.

Load

The equipment connected to and protected by a UPS.

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 IEC320-C13

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 known as soft-load-transfer switching.

Modbus

Modbus is a serial communications protocol which is now the most commonly available means of connecting industrial electronic devices. Modbus allows for communication between many devices connected to the same network.

Network Transient Protector

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

Noise

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.

Nominal Output Voltage

The intended, ideal voltage of any given output.

Non-linear Load

AC electrical loads where the current is not proportional to the voltage. Non-linear loads often generate harmonics in the current waveform, which leads to distortion of the voltage waveform.

Offline

Any UPS that does not fit the definition of online. Line-interactive and standby topologies are offline.

Ohm

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

Online

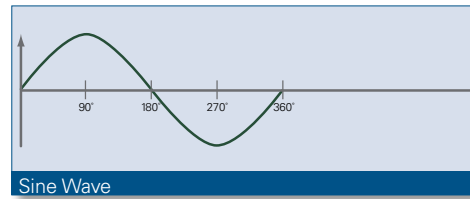
A UPS that provides power to the load from its inverter 100 per cent of the time, regulating both voltage and frequency, usually double-conversion topology.

Orderly Shutdown

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

Output Waveform (UPS)

The shape of the graph of alternating current on the output side of a UPS. The highest quality of an output waveform from a UPS is the sine wave. However, some UPSs provide step wave or modified sine waves.



Parallel Operation

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

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)

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)

$$VA \times PF = W \quad W/PF = VA$$

Power Sag

Low voltage.

Power Surge

High voltage.

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 standardised rack.

Rack Unit (U)

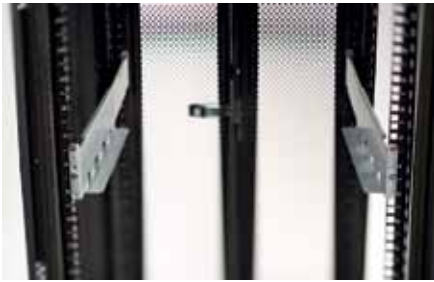
A unit of height measurement in a rack enclosure. A U is equivalent to 1.75 inches.



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.



Four-post rail kit

Rectifier

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

Rectifier Magazine (RM)

A module in the DC power system used to connect the rectifiers in the power system.

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 where 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 predefined to indicate UPS status.

RS-232

The standard for serial interfaces (serial refers to the eight bits of each character successively sent down one wire) traditionally used by computers, modems and printers. Largely superseded by USB.

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.

Single Phase

Power system with one primary waveform. Lower-capacity distribution of power using only one portion of a power source that is three-phase, such as that supplied by most household mains electrical supplies. Used for heating and lighting, no large motors or other heavy-draw devices.

Sliding Demand

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

SNMP

Simple Network Management Protocol is a User Datagram Protocol (UDP)-based network protocol. It is used mostly in network management systems to monitor network-attached devices for conditions that warrant administrative attention.

Standby

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.

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.

System i Server

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

Thermal Regulation

Monitoring the temperature of the batteries to assure proper charging.

Three Phase

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.

Topology (UPS)

The core technology of a UPS. Typically, a UPS is either standby, line interactive or online though other hybrid technologies have been introduced.

Total Harmonic Distortion (THD)

The amount by which 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 non-linear loads.

Transfer Time

The length of time it takes a UPS to transfer to battery power. Typically measured in milliseconds (ms).

Transient

A temporary and brief change in a given parameter. Typically associated with input voltage or output loading parameters.

Unbalanced Load

An AC power system using more than two wires, where the current is not equal in the current-carrying wires due to an uneven loading of the phases.

Uninterruptible Power System (UPS)

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).

Universal Serial Bus (USB)

The current communication standard used in computers to connect a wide variety of peripherals. It has widely replaced traditional serial and parallel connections.

User Replaceable

Capable of being replaced by an end user. Connected equipment may need to be shut down first. See also Hot Swappable.

Virtualisation

The creation of a virtual (rather than actual) version of something, such as an operating system, server, storage device or network resource. Operating system Virtualisation 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)

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.

Watts (W)

The measure of real power. It is the rate of doing electrical work. $W/PF = VA$.

Wye Connection

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

Common UPS and electrical acronyms

A	Ampere	MOV	Metal Oxide Varistor
ABM	Advanced Battery Management	MSP	Managed Service Platform
AC	Alternating Current	MTBF	Mean Time Between Failure
AH	Ampere Hour	MTTR	Mean Time To Repair
BBM	Break-Before-Make (Bypass Switch)	NIC	Network Interface Card
BDM	Bypass Distribution Module	PABX	Private Automatic Branch Exchange
BTU	British Thermal Unit	PBX	Private Branch Exchange
CI	Converger Infra-structure	PC	Personal Computer
CPU	Central Processing Unit	PDM	Power Distribution Module
CRAC	Computer Room Air Conditioning	PDU	Power Distribution Unit
CRAH	Computer Room Air Handler	PF	Power Factor
DC	Direct Current	PFC	Power Factor Correction
DNS	Domain Name System	PMDC	Portable Modular Data centre
DSL	Digital Subscriber Line	PoE	Power over Ethernet
DVV or DV2	Data, Voice, Video	PSAP	Public Safety Answering Point
EAA	Energy Advantage Architecture	PSTN	Public Switched Telephone Network
EBC	Extended Battery Cabinet	PUE	Power Usage Efficiencies
EBM	Extended Battery Module	RAM	Random Access Memory
EMEA	Europe, Middle East, Africa	REPO	Remote Emergency Power-off
EMC	Electromagnetic Compatibility	RFI	Radio Frequency Interference
EMF	Electromagnetic Force	RM	Rackmount or Rectifier Magazine
EMI	Electromagnetic Interference	RMA	Return Material Authorization
EMS	Energy Management System	RoHS	Restriction of Hazardous Substances
EOSL	End of Service Life	ROO	Remote On/Off
ePDU	Enclosure Power Distribution Unit	RPO	Remote Power Off
ESS	Energy Saver System	RPM	Rack Power Module
FMC	Fixed/Mobile Convergence	SAN	Storage Area Network
FTP	File Transfer Protocol	SCR	Silicon-Controlled Rectifier
GFCI	Ground-Fault Circuit Interrupter	SLA	Service Level Agreement
GUI	Graphical User Interface	SNMP	Simple Network Management Protocol
HPC	High Performance Computer	SOA	Service-Oriented Architecture
HTML	HyperText Markup Language	SPD	Surge Protection Device
HTTP	HyperText Transfer Protocol	SSL	Secure Socket Layer
HV	High Voltage	TCP/IP	Transmission Control Protocol/Internet Protocol
HVAC	Heating, Ventilating and Air Conditioning	TDM	Time-division Multiplexing
HW	Hardwired	THD	Total Harmonic Distortion
Hz	Hertz	T&M	Time and Material
IEC	International Electrotechnical Commission (IEC)	TVSS	Transient Voltage Surge Suppressor
IEEE	Institute of Electrical And Electronics Engineers	UC	Unified Communications
IGBT	Insulated Gate Bi-polar Transistor	UPS	Uninterruptible Power System (or Supply)
IP	Internet Protocol	URL	Uniform Resource Locator
ISP	Internet Service Provider	USB	Universal Serial Bus
ISO	International Standards Organization	V	Volt
ITIC	Information Technology Industry Council	VA	Volt Ampere
kAIC	Kilo Ampere Interrupting Capacity	VAC	Volts Alternating Current
kVA	Kilovolt ampere	VDC	Volts Direct Current
KVM	Keyboard, Video, Monitor	VGA	Video Graphics Array
LAN	Local Area Network	VM	Virtual Machine
LCD	Liquid Crystal Display	VMMS	Variable Module Management System
LED	Light-Emitting Diode	VoIP	Voice over Internet Protocol
LEED	Leadership in Energy and Environmental Design	VPN	Virtual Private Network
LV	Low Voltage	VRLA	Valve Regulated Lead Acid
MBB	Make-Before-Break (bypass switch)	W	Watt
MIB	Management Information Base	WAN	Wide Area Network
		XML	Extensible Markup Language

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. With unparalleled knowledge of electrical power management across industries, experts at Eaton deliver customized, integrated solutions to solve our customers' most critical challenges.

Our focus is on delivering the right solution for the application. But, decision makers demand more than just innovative products. They turn to Eaton for an unwavering commitment to personal support that makes customer success a top priority. For more information, visit www.eaton.com/electrical.

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