

CyberPower®

CHOOSING AN UNINTERRUPTIBLE POWER SUPPLY SYSTEM

A Power Management Primer



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New to the world of uninterruptible power supply (UPS) systems? Consider this primer your introduction to the basic concepts behind UPS systems and which type will work best for your requirements.

WHAT IS A UPS SYSTEM?

A UPS system is a battery backup power system that provides a power bridge for momentary power losses and keeping critical equipment up and running.

In addition to backup power, a UPS system also provides surge protection against power problems, like surges or abnormal voltages, which can damage, reduce lifespan, or affect the performance of connected devices.

WHY DO YOU NEED A UPS SYSTEM?

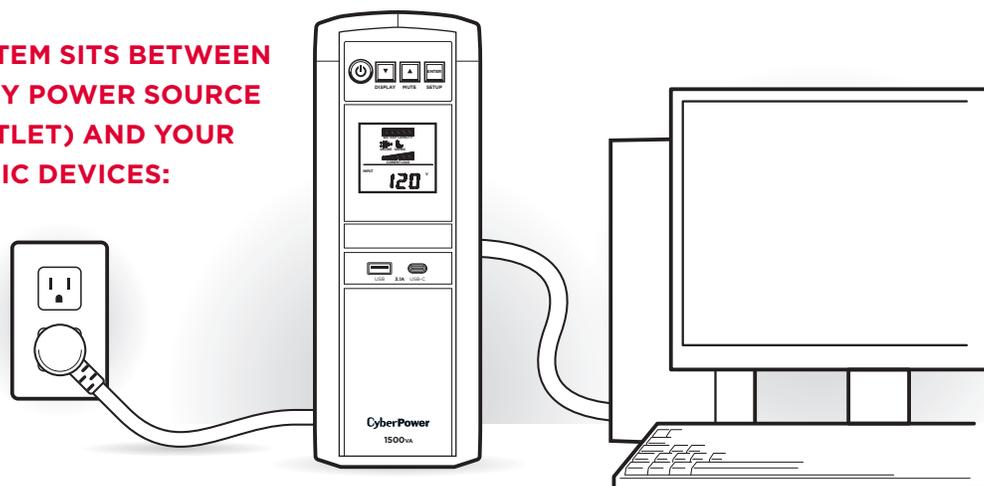
Temporary power losses are common and a UPS system provides a seamless bridge to cover these blips to keep you powered and productive. In case of power loss, the UPS system immediately activates to provide a continuous power source. The battery backup gives you time to power down sensitive equipment, servers, or even gaming consoles without loss of data or progress. UPS systems also provide protection from other power problems that arise.

FINDING THE RIGHT UPS SYSTEM

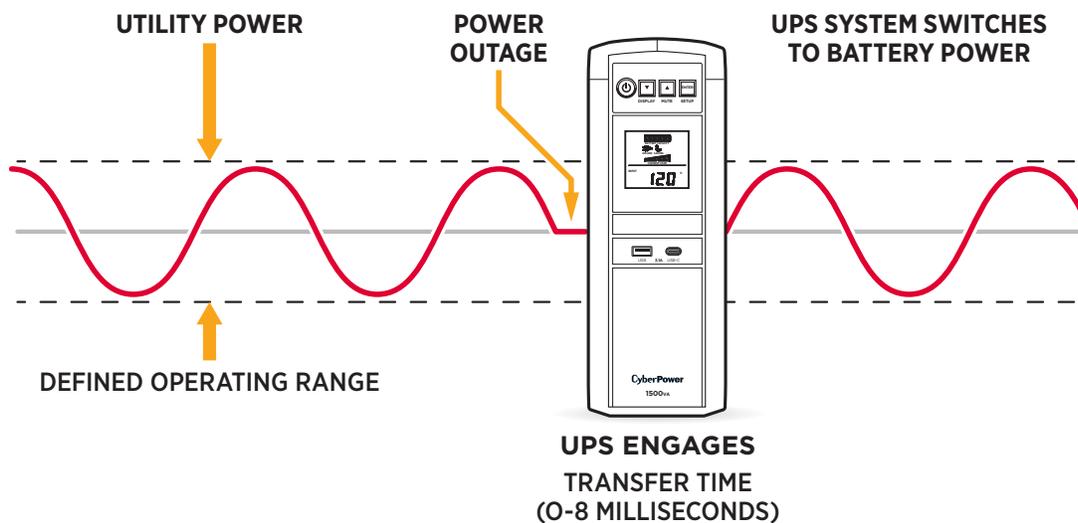
In this primer, we will review how a UPS system works, the power issues you may encounter, UPS system topologies, waveforms, and the key factors to consider when purchasing a UPS system, such as size, runtime, and form factor.

HOW A UPS SYSTEM WORKS

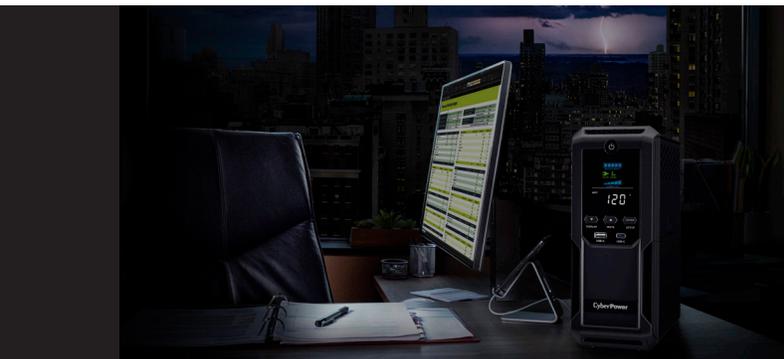
A UPS SYSTEM SITS BETWEEN THE UTILITY POWER SOURCE (WALL OUTLET) AND YOUR ELECTRONIC DEVICES:



When a UPS system is in place, it recognizes that a power event occurred. At that point, the UPS system engages, providing power to the devices plugged into it for a period of time, creating a bridge of power until the utility power is back on line.

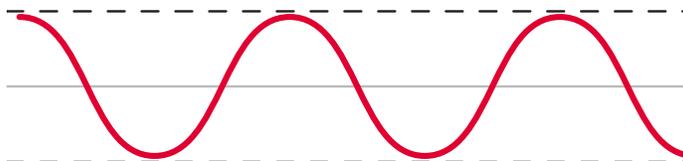


TYPES OF POWER EVENTS



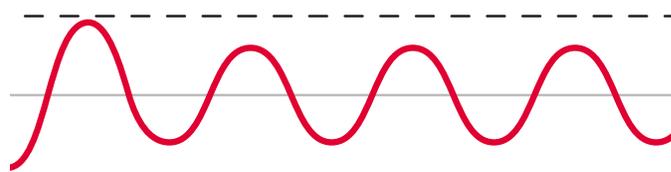
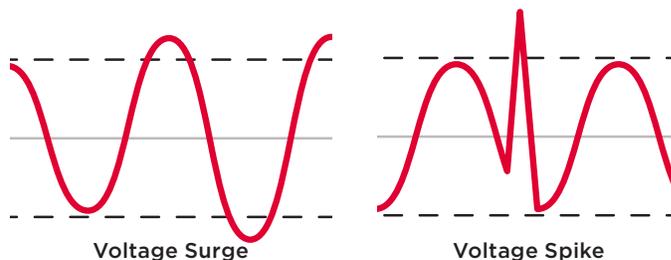
When a power event occurs, the electric current, or waveform, diverges from its normal operation. Each power problem produces a different deviation from the ideal waveform. Many people are aware of only one type of power problem: a blackout. This occurs when the power goes out and stays out for a few seconds up to a few days. However, many more common power problems and waveform deviations exist.

IDEAL WAVEFORM:

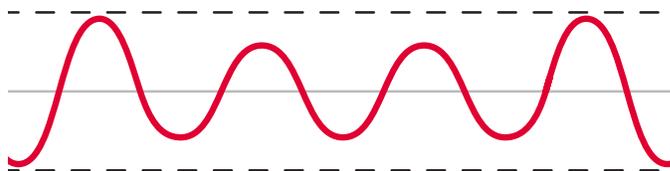


POWER PROBLEMS YOU MIGHT EXPERIENCE:

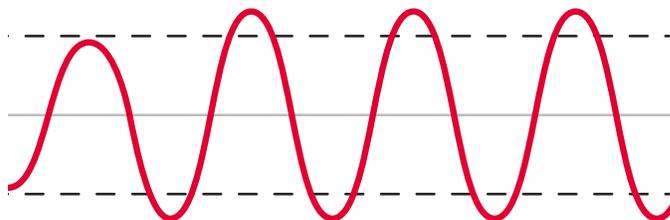
- **Surge/Spike:** A brief, but intense, spike in electricity commonly caused by lightning. Surges can be detrimental, and may damage and destroy electronics.
- **Blackout:** A power outage lasting anywhere from seconds to days. These are most often caused by severe weather and utility power grid failures.
- **Brownout:** A drop in voltage for an extended period of time. In emergency conditions, power companies may lower the voltage of your electricity to reduce strained resources and avoid a total blackout.



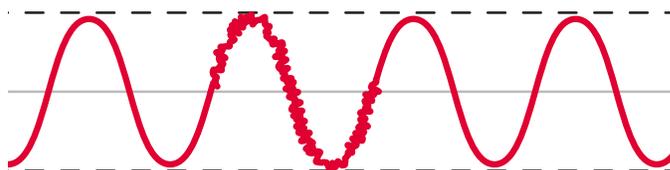
- **Voltage Sag:** A sag is also a type of under voltage, but, unlike a brownout, it's typically brief.



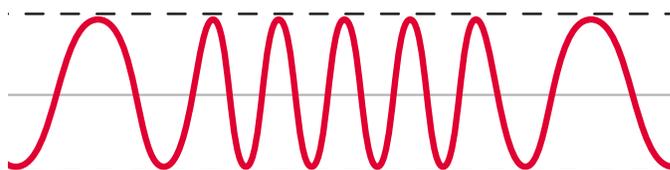
- **Over Voltage:** Occurs when incoming voltage is higher than normal and lasts longer than a surge.



- **Frequency Noise:** Also known as line noise, frequency noise can disrupt or degrade the performance of a circuit by injecting abnormalities into the system.



- **Frequency Variation:** Not a common problem when power supplies are stable, but it can occur when using generators and power frequency fluctuates more than desired.



- **Harmonic Distortion:** A departure from the ideal electrical signal on a given power source.



While we can't choose when these power events occur, we can choose to be prepared for them by protecting connected equipment with the right UPS system.

DETERMINE YOUR POWER SOURCE

Now that you can identify the types of power events that you may encounter and how a UPS system can protect your devices and data from these issues, let's review the key considerations for purchasing the right UPS system for your power needs.

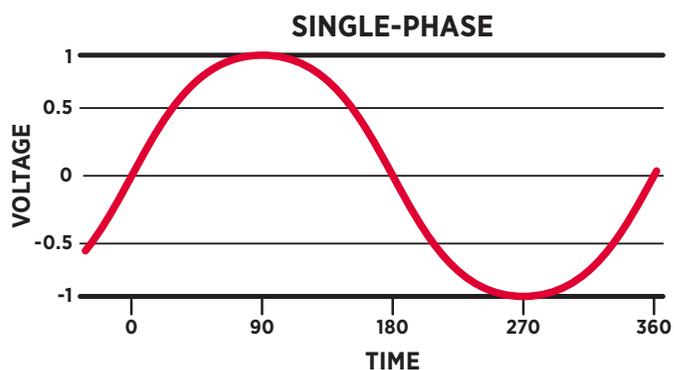
The first step is determining your power source. Depending on your location and building type, you may have either single-phase or three-phase power. If you're not sure, ask a licensed electrician.

SINGLE-PHASE POWER

Single-phase power consists of a single sine wave current from a utility power source that flows into a facility.

Typical applications:

- Most homes and residential buildings
- Most small offices
- Business offices
- IT installations

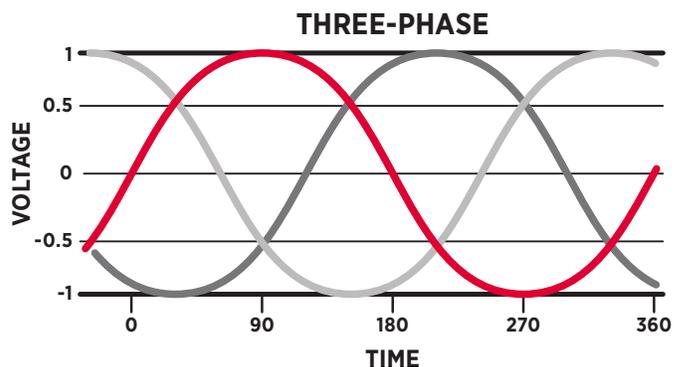


THREE-PHASE POWER

Three-phase power consists of three sine wave currents that flow from a utility source into a facility.

Typical applications:

- Commercial environments
- Large industrial businesses
- High-density installations found in data centers



UPS SYSTEM TOPOLOGIES

Next, UPS systems have different topologies, or categories, each providing varying levels of power protection. Each topology safeguards your devices against a different combination of power issues. For the purposes of this primer, we'll review three common topologies: Standby, Line-Interactive, and Double-Conversion.

UPS TOPOLOGY OVERVIEW:



SX650U



PR1500RT2U



OL10KRT

TOPOLOGY	STANDBY	LINE-INTERACTIVE	DOUBLE-CONVERSION
Protection Level	Good	Better	Best
Battery Usage	Frequent	Semi-Frequent	Semi-Frequent
Voltage Regulation	None	Automatic Voltage Regulation (AVR)	Isolated and Filtered Power
Typical Transfer Time	4-8 Milliseconds	4-8 Milliseconds	0 Milliseconds (Zero Transfer Time)

While each topology will protect against most power issues, some topologies are specifically designed to handle certain power issues better than others. The key is to determine the best topology to fit your power needs by considering where you will use the UPS system and the most common power issues you experience.

WHAT UPS TOPOLOGY IS RIGHT FOR ME?

TOPOLOGY	STANDBY	LINE-INTERACTIVE	DOUBLE-CONVERSION
Surge	●	●	●
Blackout	●	●	●
Brownout	●	●	●
Under Voltage	○	●	●
Over Voltage	○	●	●
Line Noise			●
Frequency Variation			●
Harmonic Distortion			●

● = in all modes

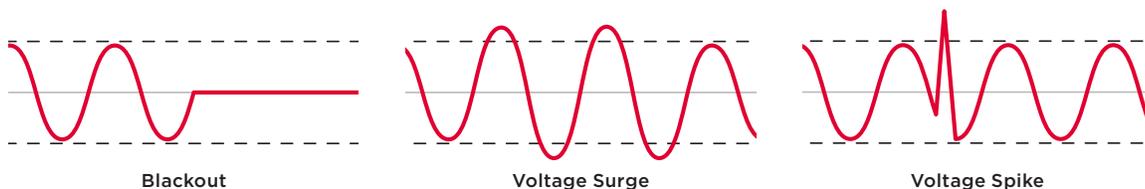
○ = protection available, but requires more frequent battery use



TOPOLOGY: STANDBY

A Standby UPS system is the most basic topology. When incoming power drops below or surges above safe voltage levels, a Standby UPS system switches to battery power, providing a bridge of power until utility power is restored.

Standby UPS systems are designed to protect against these power events:



Standby UPS systems are designed for these applications:

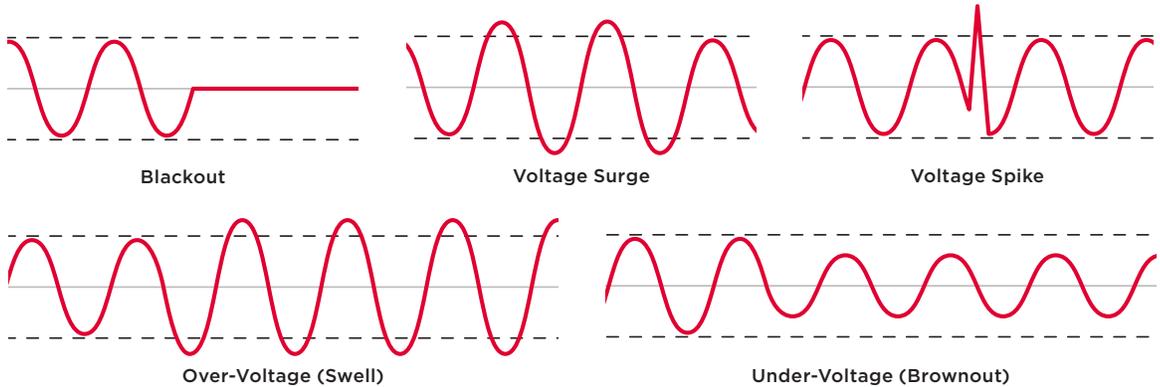
PERSONAL USE	BUSINESS USE
<ul style="list-style-type: none"> • Computers • Home theater • Modems and routers 	<ul style="list-style-type: none"> • Workstations • Point-of-Sale systems • Audio/video equipment • ATMs and kiosks • Network and storage devices • VoIP systems



TOPOLOGY: LINE-INTERACTIVE

Line-Interactive UPS systems feature Automatic Voltage Regulation (AVR) functionality. AVR is a process which utilizes an autotransformer to regulate voltage levels without having to switch to battery power. This process results in clean, consistent AC power that preserves the battery power for when you really need it, such as during significant power outages.

Line-Interactive UPS systems are designed to protect against these power events:



Line-Interactive UPS systems are designed for these applications:

PERSONAL USE	BUSINESS USE
<ul style="list-style-type: none"> • Home office • Home theater • Gaming computers and systems • Networking equipment • Security systems 	<ul style="list-style-type: none"> • Corporate and department servers • Workstations • Point-of-Sale systems • Casino gaming machines • Audio/video equipment • ATMs and kiosks • Security systems • Voting machines • Network and storage devices • VoIP/Telecom systems



TOPOLOGY: DOUBLE-CONVERSION/ONLINE

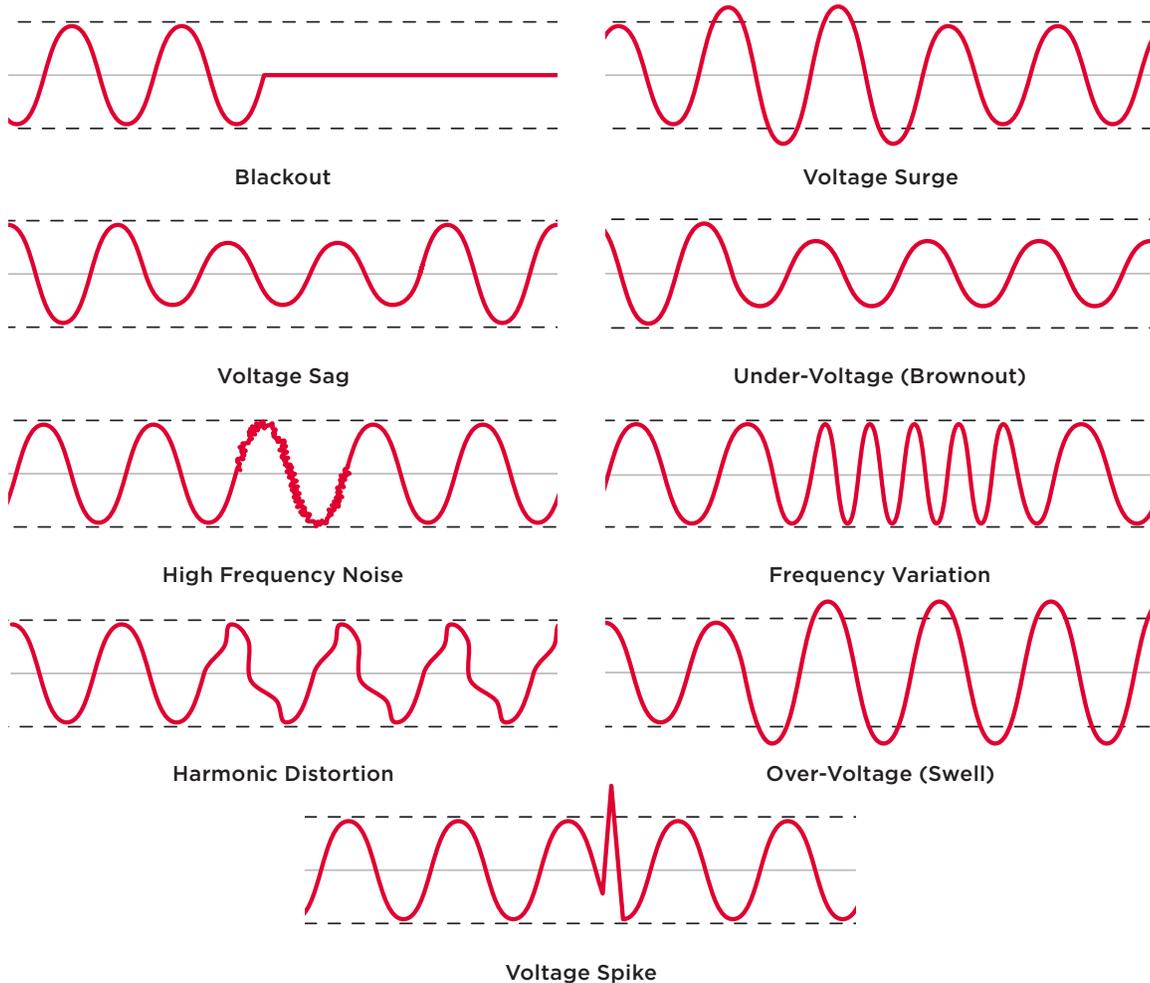
An Online Double-Conversion UPS system, or often referred to simply as an Online UPS system, converts incoming AC power to DC and then back to AC, providing consistent, clean and near perfect power, regardless of the condition of incoming power. UPS systems with this technology have a zero-transfer time.

If you have generator backup, an Online UPS system is recommended because generators can produce inconsistencies and fluctuations in voltage and frequency ranges. An Online UPS system is specifically designed to handle the “dirty power” produced by a generator, converting it into clean power with a smooth, consistent sine wave.



Only UPS systems with an Online topology can efficiently regulate large fluctuations in voltage often created by generator power. When a non-Online UPS system recognizes a fluctuation in power that it cannot handle, it automatically switches to battery power. This constant switching to battery power will prevent the UPS from recharging and eventually shuts down once battery power is exhausted.

Online UPS systems are designed for protect against these power events:



Online UPS systems are designed for these applications:

PERSONAL USE	BUSINESS USE
<ul style="list-style-type: none"> • May be used for an advanced home networking center but typically not used for home office or household applications 	<ul style="list-style-type: none"> • Enterprise servers • Corporate and department servers • Network and storage devices • Edge closets • Audio/video equipment • Security systems • VoIP systems

UPS SYSTEM WAVEFORMS

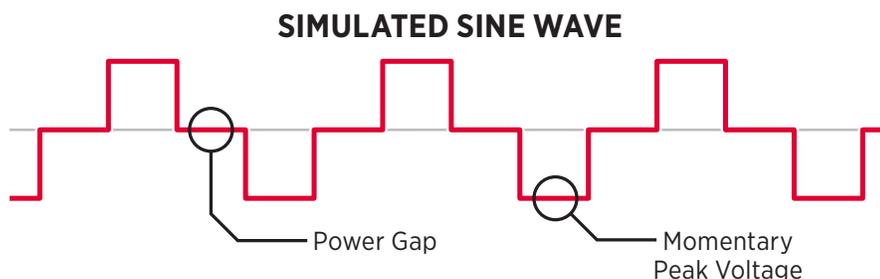
Beyond topology, the primary difference between types of UPS systems is which waveform each type utilizes to deliver power to connected equipment. The two types of waveforms are sine wave and simulated sine wave.

SINE WAVE VERSUS SIMULATED SINE WAVE

Ideal for non-sensitive electronics, and found in both Standby and Line-Interactive topologies, a UPS system with a simulated sine wave output generates a stepped sine wave to supply cost-effective battery backup power.

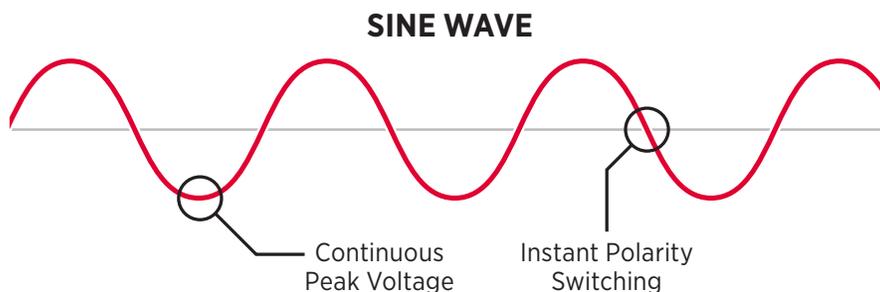


SIMULATED SINE WAVE



SINE WAVE

Common in Line-Interactive and Online UPS system topologies, sine wave output is clean with no power gaps, making it ideal for running today's sensitive electronics and computers using Active Power Factor Correction (PFC) power supplies.



Computers, workstations, and servers using switching power supplies with Active PFC may shut down unexpectedly when using UPS systems with simulated sine wave output, resulting in data loss or equipment damage. UPS systems with sine wave output reduce unnecessary shutdowns and the potential damage from a power event.

If you need help determining whether a device has a power supply with Active PFC, contact the device manufacturer.

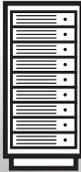
UPS SYSTEM SIZE

Now that we've reviewed power source, topology, and waveform, the next step is to determine the size, or capacity, of the system you need. In order to run properly, your UPS system should be large enough to support all of the equipment plugged into it - in terms of number of plugs and the wattage capacity. The capacity of a UPS system is how much power it can support (measured in watts). The higher the capacity, the more electronic equipment it can support. To determine the size of UPS you need, calculate the load of connected devices by adding up the combined amount of power that each device uses.

To calculate the load, make an equipment list, including the total watts each piece of equipment requires to run. As shown in the examples below, include all of the devices the UPS system will need to support. If a piece of equipment has a redundant power supply, only count the wattage of ONE power supply.

If you don't know the wattage your equipment requires, consult the manufacturer or power supply specifications in the user manual.

EXAMPLES OF EQUIPMENT LISTS

WORKSTATION		IT SERVER RACK	
			
PC	120W	Router	100W
Monitor	60W	Server	500W
External Hard Drive	20W	Switch	250W
Wireless Router	10W	Switch	250W
Load	210W	Load	1100W
Minimum UPS Capacity	263W	Minimum UPS Capacity	1375W

The load wattage should not exceed 80% of the capacity of the UPS system. To calculate the minimum capacity needed for the UPS system:

LOAD x 1.25 = MINIMUM CAPACITY

In the examples above:

Workstation: 210 (Load) x 1.25 = 263 (Minimum UPS Capacity)

IT Server Rack: 1100 (Load) x 1.25 = 1375 (Minimum UPS Capacity)

When determining the size of your UPS, consider your future plans for expansion and account for that additional wattage and the number of outlets you may need.

CyberPower can help you determine the right UPS system to match your needs. Just click on Power Assessment on CyberPowerSystems.com.

UPS SYSTEM RUNTIME

If a blackout occurs, how much time will you need to either keep devices running to save important data and/or safely shutdown your equipment? This is your runtime.

When determining the runtime needed, look at the length of time the batteries in the UPS system can support equipment through a power outage. Keep in mind the number of watts supported affects runtime:

- The smaller the wattage load connected, the longer the batteries will last.
- The larger the wattage load, the shorter the runtime.

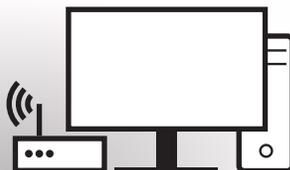
TO DETERMINE THE MINIMUM RUNTIME NEEDED:

1. Make a checklist of critical tasks to execute if a power outage occurs.
2. Then, determine how much time it will take to execute the list.
3. This time is your minimum runtime.

Common devices and their estimated battery run times connected to a 1500VA UPS:



Workstation PC
70W | 93 MIN*



Desktop Computer
+ Modem + Router
170W | 47 MIN*

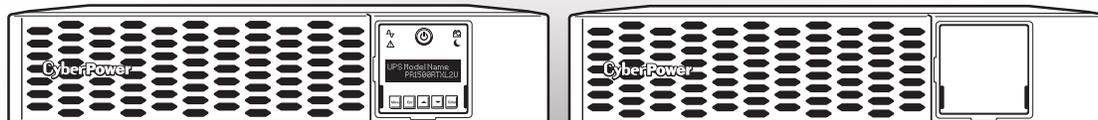
Common IT rack setup and its estimated battery run times connected to a 6000 VA UPS:



Rack Setup
3300W | 11 MIN*

LOOKING FOR EXTRA RUNTIME?

When connected equipment needs more runtime, it can be extended with one or more **Extended Battery Modules (EBM)**. Available for select Line-Interactive and all Online UPS systems, an EBM expands runtime. Fast Charge Technology quickly restores backup power when utility power returns.



UPS + EBM = TOTAL RUNTIME

MONITORING YOUR UPS SYSTEM

Staying on top of your power protection is critical to protecting your expensive equipment and valuable data. A UPS system can be monitored in many ways, from a basic LCD screen to a full software package that allows you to monitor and control the UPS system remotely.

LOCAL MANAGEMENT

UPS systems may provide both visible alerts and audible alerts to any changes in your utility or battery backup power status.



Visible alerts

LCD panels are available on many models, and quickly communicate the status of your UPS system at a glance, displaying detailed information about potential problems before connected equipment is impacted.

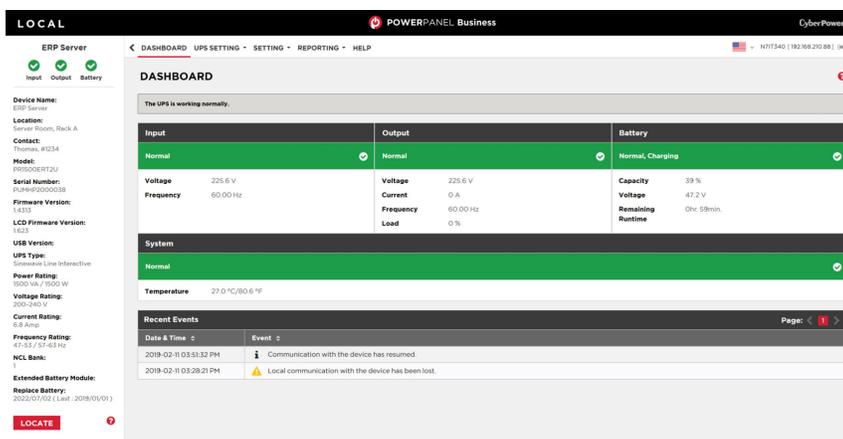


Audible alerts

All CyberPower UPS systems include audible alarms, which notifies you of varying status conditions such as on-battery, low-battery, and overload.

MONITORING SOFTWARE

Monitoring software provides a user-friendly dashboard interface for controlling and monitoring your UPS system. This software can be controlled locally, if a computer is connected to the UPS system, or remotely on models that are connected to a network and/or feature a remote network management card.



For more information on PowerPanel®, free downloadable monitoring software, visit CyberPowerSystems.com/products/software/

UPS SYSTEM FORM FACTORS

The form factor of a UPS system indicates the shape and size of its housing. When choosing the form factor, the main consideration is where you are going to use it – on a desk or shelf, in an entertainment center, mounted to a wall, or in a server rack. The most common three types of UPS system form factors are:

DESKTOP OR COMPACT

A desktop or compact UPS system is small enough to be placed on a desk or inside furniture out of view. Many models include keyhole mounting slots for the UPS system to be easily mounted to a desk or wall.



TOWER OR MINI-TOWER

A tower or mini-tower is typically placed on the floor. Some models feature an aesthetic design allowing it to be placed on top of a desk or table.



RACK/TOWER OR RACKMOUNT

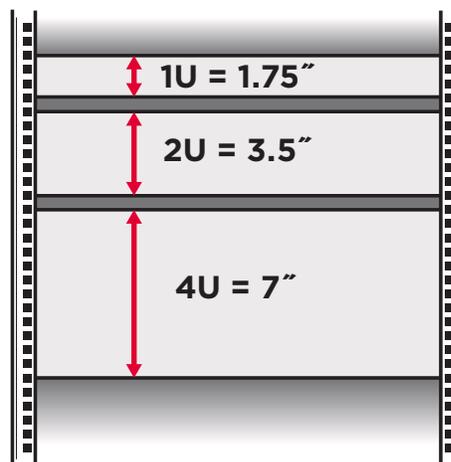
A rack/tower UPS system is a flexible design that can be configured vertically as a tower, or horizontally to fit in a rack. A rackmount UPS system is designed only to be configured horizontally, mounted in a rack, and secured with screws.



PLANNING YOUR RACK SPACE

Planning the layout of your IT equipment in a rack can be a difficult task. You need to ensure you include all of the right equipment in the right capacities - and the rack space - to support your IT requirements.

Typically, IT racks are planned in terms of vertical space, commonly referred to as “U”. A “U” is a rack standard of measurement of 1.75 inches high. IT equipment sizes are expressed in their “U” space occupied: 1U, 2U, etc.



The size of UPS systems and other IT equipment may vary, but are commonly found in 1U, 2U, or 4U sizes. We recommend planning out your IT needs and rack space before installing any components to ensure you have the right equipment and enough space to support it.

OTHER CONSIDERATIONS

CONNECTIONS



Outlets

- What type(s) of outlets do you need?
- How many total outlets do you need?



Surge protection

Surge protected outlets can offer additional protection for your devices against damaging spikes and surges, but do not provide battery backup.



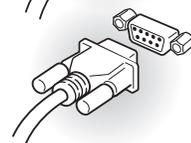
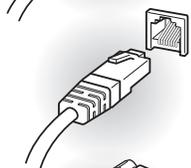
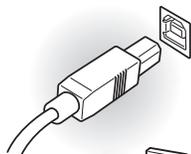
Plug space

Widely-spaced outlets will prevent oversized plugs from crowding access to other outlets.



USB charging port

USB charging ports may be used to power and charge mobile devices.



Other connection ports

- **USB communication ports** are used for communication with PowerPanel® monitoring software.
- Network protection prevents power surges that travel through **Ethernet lines** from causing damage to electronics.
- **Serial ports** allow you to connect your UPS system to a computer and access additional power management features using PowerPanel® Business software.
- **A network management card** allows administrators to control and configure the UPS remotely via a standard web browser or network management system (NMS).

EQUIPMENT GUARANTEES

Warranty

Make sure the manufacturer backs up their product with a product warranty.

Connected Equipment Guarantee

In the event of a power issue that damages connected devices, ensure the manufacturer will repair or replace properly connected equipment if it is damaged by a power surge.

FIND THE RIGHT MATCH



Power events are common and the consequences of power interruptions to your data, productivity and equipment can be severe. The key to choosing the right power solution is matching your specific needs to the UPS system that best fits your requirements.

The key factors to consider when choosing a UPS system:

- Power Source: Single-phase or Three-phase
- Topology: Standby, Line-Interactive, or Online
- Waveform: Sinewave or Simulated sine wave
- Size: Capacity in terms of wattage
- Runtime: Duration of power bridge
- Monitoring: The status of your UPS
- Form Factor: Desktop/Compact, Tower, Rack/Tower, or Rackmount
- Other considerations: Connections and Equipment Guarantees

WHY CHOOSE CYBERPOWER?

Quality isn't just a corporate slogan; it's a core value at CyberPower. As a direct manufacturer, CyberPower controls the quality through the entire manufacturing process. This allows innovative new solutions to get to the market faster and at a greater value.

Each product is delivered with unprecedented assurance and industry-leading warranties. And with 100% US-based service, you can count on prompt and responsive service at every point of contact.

CyberPower can help you find the right UPS system for your power needs:

- Visit [CyberPowerSystems.com](https://www.CyberPowerSystems.com)
- Contact our sales team at sales@cpsww.com



CONTACT | Cyber Power Systems (USA), Inc. | 877.901.1930 | sales@cpsww.com | [cyberpowersystems.com](https://www.cyberpowersystems.com)

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