Liebert®

IT White Paper

POWER PROTECTION FOR SMALL NETWORK AND STANDALONE SYSTEMS

EMERSON™
Network Power

Summary

Developing a large data center without adequate power protection and conditioning would be unthinkable today. The cost of downtime is so high relative to the cost of protection that the question is not whether a power protection system is required, but how much redundancy should be designed into the system.

Small networks and standalone systems are often just as important to the businesses they support as the systems in large data centers. Yet, too often these systems are left vulnerable to damage and downtime from power outages and disturbances. The technical issues at each level differ; however, the basic challenge is the same: providing an appropriate level of protection as simply and cost-effectively as possible.

There are a range of power protection systems sized for small network and desktop applications. Determining the right system for a particular application requires an understanding of the cost of downtime and how UPS systems differ in terms of topology and features.

The Basics of Power Protection

Electric utilities provide a decent level of power reliability and quality for some types of equipment; however, computers have special requirements. They are more sensitive to fluctuations in power quality and can be more seriously impacted by even brief interruptions in incoming power. Consequently, special protection is required to guard against:

- Equipment damage caused by power surges.
- Lost or corrupted data that occur when systems shutdown unexpectedly because of an interruption in utility power.
- The cost of downtime when computer systems become "unavailable" as a result of equipment damage or loss of power.

There are two basic types of equipment used to protect computers from power problems: transient voltage surge suppressors (TVSS) and uninterruptible power supplies (UPS). These systems are deployed in one of four basic architectures, each of which provides a different level of protection and availability.

Basic Protection
Basic hardware protection is provided by installing a TVSS device at the input to protected equipment. This prevents noise and high voltages from reaching the connected equipment, but does not protect against lost data or outages caused by disruptions in the power source.

Operational Support
Adding a UPS to the protection scheme provides the ability to protect against short-term interruptions in utility power and to ensure a controlled shutdown in the event of longer term outages. Depending upon UPS topology, the UPS can also condition the power being delivered to the load.

High Availability
To drive levels of availability higher, redundancy is added at the UPS level. This allows the system to compensate for the failure of any UPS, while eliminating downtime during UPS maintenance.

Continuous Availability
For applications that cannot tolerate any downtime, redundancy is added across the entire system, utilizing a dual-bus with distributed redundancy across all components.

Because of the level of investment required, high and continuous availability systems are typically used in mid-size or large data centers. Small businesses and remote offices usually utilize either a basic protection or operational support protection scheme.

Several trends are making operational support a more attractive alternative than basic hardware protection. First, computer hardware costs have come down – while storage capacities and system performance have increased dramatically.

This shifts the focus from protecting hardware to protecting data.

If there is any question as to whether a UPS should be included as part of the protection scheme, downtime costs should be calculated for a given application.

In addition, more powerful systems are allowing small businesses to do more with their computers, creating greater reliance on computer systems. In most cases, the more reliant a business is on its computers, the higher the cost of downtime. The basic protection scheme provides no protection from downtime resulting from interruptions in utility power.

The cost of downtime is different for each business. If there is any question as to whether a UPS should be included as part of the protection scheme, downtime costs should be calculated for a given application. Knowing the cost of downtime cannot only guide the decision of whether a UPS is required; it can also be used to determine what type of UPS should be installed. Typically, the following costs are added together to determine the cost of downtime for a particular system:

Employee costs
This includes the total hourly costs for all employees who are impacted by the downtime, multiplied by the percent of the impact for the time that the system is down. Also included is the cost of the time it takes for employees to "catch up" once power is restored.

Lost revenue
The impact of downtime on customers, either through an inability to complete transactions or reduced service as a result of the inability to access customer-related systems.

The cost of loss of goodwill and reduced customer confidence should also be considered.

Recovery Costs
The time and out-of-pocket expense required to restore the system as well as the cost to replace damaged systems. Recovery costs are often particularly high for small businesses that do not have internal resources that can be devoted to the recovery.

Defining UPS Topologies

The topology of a UPS system refers to the internal design of the system. This determines the relationship between the UPS and incoming utility power. A variety of terms have been used to define UPS topologies and the precise meaning of some of these terms has become muddied during the years as they were applied to product designs that didn't fit the generally accepted definition.

Consequently, the International Electrotechnical Commission (IEC), the leading global organization that publishes international standards for all electrical, electronic and related technologies, addressed the issue to provide clarity and consistency. In 1999, the IEC issued its standard 62040-3 covering UPS topologies. This has become the accepted standard for defining UPS topology and performance. It defines three types of UPS topology:

- Passive Standby
- Line Interactive
- Double Conversion

Passive Standby

Passive Standby is the term the IEC adopted to more accurately describe the topology traditionally referred to as "offline." In short, the passive standby system monitors incoming utility power and transfers the protected system to battery when utility power goes outside of preset specifications. This is a very cost-effective approach to bridging short power interruptions and ensuring a safe shutdown in the event the interruption exceeds battery capacity. The limitations of this approach are that it does not really "condition" incoming power and the UPS may not be able to react quick enough to prevent the shutdown of high-speed server switches, which can be sensitive to interruptions in incoming power as brief as one cycle.

Line Interactive

Line interactive systems utilize a transformer or inductor between the utility power source and the load to provide increased ability to correct or filter variations in input power. The line interactive system provides backup power similar to the offline system; however, it operates in parallel with the incoming power so it can utilize a transformer to compensate for sags or surges in utility power. This is often referred to as "buck-and-boost" technology and provides an added degree of power conditioning compared to the passive standby system. It does not fully isolate protected equipment from the incoming power source and does not provide the speed-of-response required by high-speed switches; however, it does represent a good balance between cost and power quality for small business or desktop applications.

Double Conversion

What was traditionally referred to as an online topology has been redefined by the IEC as a double conversion UPS to more accurately distinguish between this topology and the line interactive approach. With the double conversion approach, incoming AC power is converted to DC power within the UPS and then converted back to AC for delivery to the load. This has a number of advantages compared to line interactive and passive standby systems because the UPS is actually generating the power used by the connected equipment. Advantages include more effective isolation of the protected system from the power source, increased tolerance to fluctuations in incoming power quality, and longer battery life because the batteries are not being used to condition power. The downside of these systems is their higher cost.

Other Application Considerations

While topology is the most important decision that must be made when determining the right UPS for a particular application, there are other features that can impact how well the UPS will function in a particular application. These include:

Data Line Protection

Almost every computer system is now connected to either an internal network or the Internet. This exposes systems to surges that travel through phone and data lines. For connected systems, ensure the UPS provides a surge-protected data input.

Any systems that are necessary to serve customers should be protected. In addition, systems that contain business critical data, such as financial records ... should be protected.

Surge Only Outlets
Peripheral equipment, such as printers, scanners and fax machines, need to be protected from surges but do not typically require backup power during outages. A UPS that provides surge-only outlets can more efficiently protect computer systems with multiple peripherals.

Outlet Spacing
An increasing number of electronic devices utilize transformer blocks at the plug. If outlets on the UPS are spaced too close together, a transformer block can reduce the number of outlets available.

Computer System Interface
USB is now the standard interface for system connectivity. However, in many organizations a number of pre-USB systems are still in place. In these cases, a UPS that can provide both serial and USB connectivity can simplify UPS acquisition and management because the same system can be used for both new and legacy systems. In addition, it can eliminate the need to purchase a new UPS when legacy systems are upgraded.

Software compatibility
Microsoft Windows 2000 and Windows XP systems include an automatic shutdown utility. Apple Macintosh OS X has a similar feature. Look for a UPS that can integrate with these operating systems and utilize these utilities when outages exceed battery life. The UPS should also include its own shutdown software for legacy systems.

Battery capacity
UPS manufacturers provide runtime tables that show the expected battery capacity of the system when used with popular computer system configurations. At least five minutes of battery capacity at full load is recommended for most applications.

User-replaceable batteries
UPS batteries will eventually require replacement. Batteries should be "hot-swappable," meaning they can be replaced without powering down the UPS.

Configurable input voltage
Some UPS systems enable the user to easily configure the UPS for either 110V, 120V or 127V inputs. This increases the versatility of the system.

Matching Power Protection to Application Requirements

Matching protection to application requirements requires an audit of system requirements as follows:

1. *Determine what systems need to be protected.* Any systems that are necessary to serve customers should be protected. In addition, systems that contain business critical data, such as financial records, or those being used to directly support business operations, such as design stations or network switches, should also be protected.
2. *Identify the current level of protection.* Is the system protected against surges on both power and data lines? Is a UPS currently installed? If so, what is the topology of the UPS system? What is the battery capacity?

3. *Identify the system capacity required.* UPS systems are sized by Volt Amperes (VA). To size a UPS, first, decide which pieces of equipment need UPS support. Typically, only the CPU and monitor are supported on desktop systems to cut down on power draw to the UPS. Then consult the equipment manufacturer's specifications to determine the power draw for each piece of protected equipment. If the power draw is expressed in Amps, multiply by your nominal line voltage (120 for North America, 230 for Europe) to determine VA. If the power draw is expressed in Watts, multiply by 1.4 for VA load. Add the draw of all equipment that will be connected to the battery-protected outlets and select a UPS slightly larger than the combined draw.

4. *Select the appropriate topology.* If the system load is less than 700 VA, the selection of topology is limited to line interactive and passive standby. If the system being protected is considered "business-critical" – the business could not operate without it – a line interactive system should be selected for the added protection it delivers.

   Desktop systems that are not business critical can be effectively protected by a passive standby system.

   If capacities are above 700 VA, the choice is typically between a line interactive and double conversion system.

   Again, systems that are deemed "business-critical" should be afforded a higher level of protection, which, in this case, is provided by the double conversion system. Also, systems such as high-speed network switches that have been shown to be extremely sensitive to small variations in power quality should be protected by a double conversion system.

   If there is a question as to what topology should be selected, compare the difference in cost between the two topologies with the estimated cost of downtime per hour to determine whether the increased investment is justified.

5. *Ensure adequate battery capacity.* Using the power draw for the protected equipment, determine how long the system can run on battery. In most cases, five minutes of run time will be sufficient to ride out the majority of outages and to ensure a safe shutdown in the event the outage exceeds five minutes.

6. *What type of data line protection is required?* Is phone, Ethernet or coaxial cable protection required? Ensure the UPS has the appropriate data line protection.

7. *How many outlets are required?* When calculating outlets distinguish between UPS protected and surge-only outlets. Utilizing surge-only outlets for peripherals, such as printers and scanners, can extend battery life.

8. *What type of system connectivity is required?* Do all systems that are being protected have a USB or do some legacy systems require a serial interface?

9. *Does the system need to accommodate variable input voltages?* Being able to easily configure input voltage allows the UPS to match a wider range of application requirements.

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				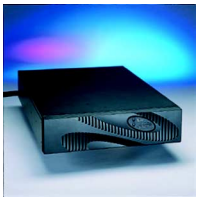	
Topology	Off Line	Off Line	Line Interactive	Line Interactive	On Line
Capacity Range (VA/W)	350/225 to 500/300	350/210 to 650/390	350/210 to 1000/600	1000/750 to 3000/2250	700/490 to 3000/2100
Dataline Protection	Yes	Yes	Yes	Yes	No
Software Compatibility*	WindowsXP, 2000 Macintosh OS 10.2	WindowsXP, 2000 Macintosh OS 10.2	WindowsXP, 2000 Macintosh OS 10.2	WindowsXP, 2000 Macintosh OS 10.2	Windows
Number of Outlets	5	6	6 or 8	7 or 8	4
Interface	USB	USB, Serial, Contact Closure	USB, Serial, Contact Closure	USB, Serial, SNMP Contact Closure	Serial, SNMP Contact Closure
Hot-Swappable Batteries	No	Yes	Yes	Yes	Yes
Configurable Input Voltage	110, 120, 127	110, 120, 127	110, 120, 127	110, 120, 127	100, 110, 115, 120, 127
Rack-Mountable	No	No	No	Yes	Yes

Figure 1. Comparison of features and topology for small UPS systems. This table shows Liebert UPS systems smaller than 3 kVA. Liebert also offers a complete range of online double conversion UPS systems from 3 kVA to 1000+ kVA.

* Compatibility refers to the ability to use the operating system's automatic shutdown utility. Previous generation operating systems can be supported through the serial interface and the UPS system's own shutdown software.

Conclusion

The systems that protect small network and desktop systems can be just as important to the survival of a business as the systems that protect a large data center. There are a variety of UPSs designed specifically for smaller computer systems to protect against the damage and downtime caused by power fluctuations and outages.

To protect non-critical desktop systems, consider a passive standby UPS with appropriate data line protection and at least two surge-only outlets for peripherals. Ensure the UPS has the connectivity options required by the system being protected and can provide at least five minutes of backup power at full load.

For business-critical desktop systems, network switches, and servers requiring protection at a moderate price, a line interactive system is recommended. Again, desktop systems should provide appropriate data line protection and the option to provide surge-only protection for some equipment.

For switches and servers above 3,000 VA, double conversion systems should be utilized whenever possible because of the added protection they deliver.

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