Power Quality Issues Cause Computer Problems

By Drew Robb

Rampant Power Quality Issues Causing Blue Screens, System Freezes and Logic Errors Electronic power conditioners are necessary to provide "computer grade" power.

Data protection is a strange subject. Companies spend a fortune on anti-virus software, intrusion detection systems, firewalls, and spyware blockers. Yet according to W. Curtis Preston, a data protection specialist at GlassHouse Technologies Inc., most problems lie within, with over 80 percent of security leaks are generated internally.

Similarly, when people think of preventing data loss due to power supply problems, they typically consider an Uninterruptible Power Supply (UPS) or a surge suppressor. Recent studies by Bell Laboratories, however, indicate that less that four percent of power-related problems would be addressed by such devices. Thus, even networks and computer systems that are well protected by UPS and surge protectors are at serious risk.

"Power problems caused by small surges, spikes, and sags in the electricity supply cause 15 times more problems today than viruses," says Bahram Mechanic, CEO of SmartPower Systems Inc. of Houston, TX, a maker of power protection and conditioning equipment. "Servers, workstations and networking gear can best be protected by using transformer-based filters. Whereas old style power conditioners were large and expensive, a new breed of inexpensive electronic power conditioner is being deployed today in the computer room."

Studying the Problem

Downtime causes millions of dollars in damage annually to computer networks around the globe. In many cases, people attempting to troubleshoot the cause of downtime waste hours addressing the wrong problem. They blame the software, the network, viruses, spyware, and a host of other causes. Sometimes they are correct and this resolves the problem. Often, however, they are correcting the wrong problem. Power-related issues are frequently the cause of time outs, unexplained downtime, and other commonplace system or networking glitches.

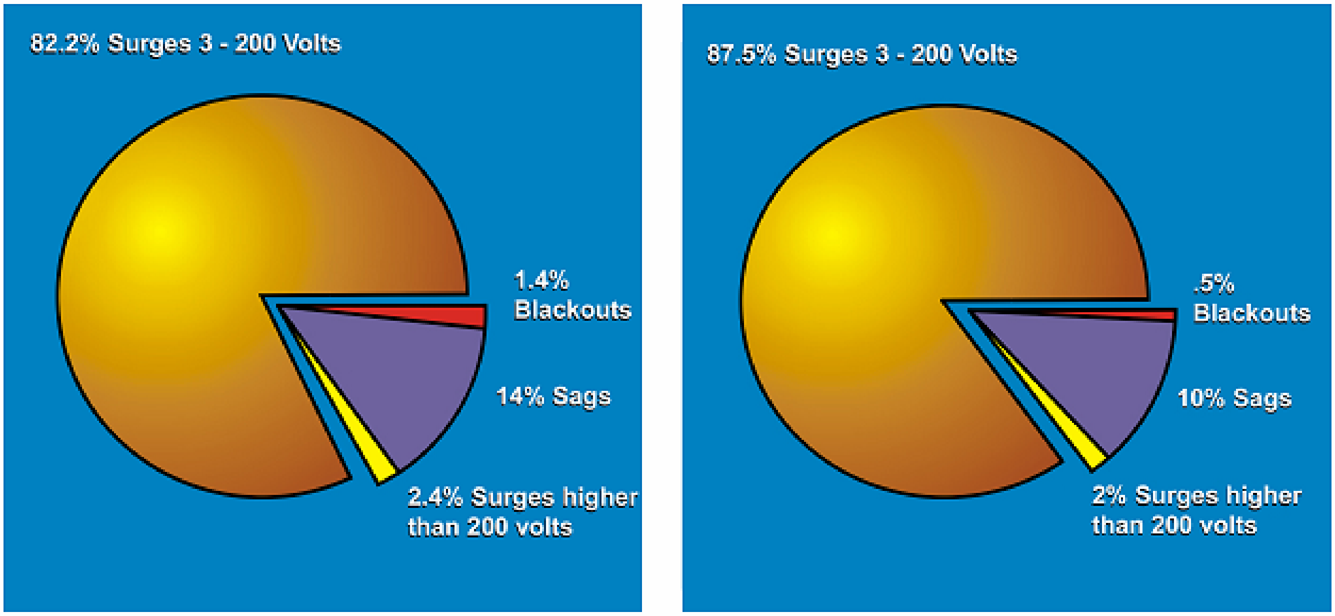
Two major studies of power quality have been completed in recent years. The first one, by Bell Labs, found the following areas accounted for most power-related issues:

- Blackouts – 1.4%
- Surges higher than 200 volts – 2.4%
- Sags – 14%
- Surges less than 200 volts – 82.2%.

These results are confirmed by a similar study performed by IBM which found:

- Blackouts – 0.5%
- Surges higher than 200 volts – 2%
- Sags – 10%
- Surges less than 200 volts – 87.5%

Thus around 80 to 90 percent of the time, electronic equipment is being affected by tiny surges as opposed to lightening flashes or blackouts. To make matters worse, these little spikes wreak havoc in terms of logic confusion, system errors, and frozen screens.



Two major studies of power quality, one by Bell Labs and the other by IBM, show strikingly similar results: That blackouts and large surges only make up a small percentage of power quality problems. On the other hand, 80 to 90 percent are caused by low voltage surges that cause networking problems such as logic confusion, system errors and frozen screens.

"Everyone has had their computer lock up on them," says Anthony Loguidice, assistant vice president of service for Sharp Electronics of Canada Ltd. "If there's spikes and surges on the line it can cause quality issues and a lot of odd problems."

The reason this situation has remained largely under the radar screen lies in the fact that there are actually two distinct types of spikes and surges. Most people protect themselves against one (occurring in what is known as "normal mode") but fail to pay any attention to the other (occurring in "common mode")

Most electrical wiring inside any building has three wires: two wires that carry the power are called "hot" and "neutral"; and a third typically green wire which is for safety and a logic reference point called the "ground." Normal mode power noise occurs between the hot wire and the neutral wire causing damage to power supplies, PC board blowouts, and other catastrophic issues. Common mode noise, on the other hand, occurs between the hot or neutral wire and the ground wire causing logic confusion, data loss, system errors, blue screens, or mysterious service calls that end without an actual problem being located.

Relating this back to the two studies, blackouts and large surges account for less than five percent of all power problems and happen in normal mode. As these events are catastrophic, most people who have experienced one tend to deploy protection technology to guard against further normal mode hazards. Yet 80 to 90% of all problems actually happen in common mode. While these events are usually not disastrous, they generate all kinds of mischief, consume end user time, result in data loss, and generate a torrent of help desk traffic.

Why is this? Microprocessors normally work with five volts DC (some of the newer models work with 2.7 volts DC, which makes them even more sensitive to small power anomalies). In effect, they act as high-speed switches being turned on and off millions of times per second. The off-state (zero volts) equates to the binary 0 and the on state (5 volts) equates to 1. This gives you the foundation of the binary language (0100110010) by which computing functions.

"Any spike greater than one volt confuses the logic – the microprocessor being read as a 1 rather than a 0," says Mechanic. "The end result is screen lock-ups, time-outs or delays."

But in this day and age, surely electrical wiring is such a precise science that such issues are minimized. Not so. Apart from the fact that the power coming in from the average utility is dirty – way below the level of stability required to safely run electronic equipment – many big cities suffer from decidedly poor wiring.

"Surprisingly, the San Francisco Bay area has some of the worst wiring," says Bob Schoon, President of Schoon Corporation, a copier-fax-printer business in San Leandro, California. "The neutral voltage there is always all over the map."

Protection Options

What should be done, then, to better protect computer systems and networks? Let's take a look at the pros and cons of the various options available on the market.

Surge Protectors or surge protectors are devices that protect equipment from excessive voltage (spikes and power surges) in the power line. They divert power from the incoming hot line to the neutral and/or ground wires. Alternatively, they can absorb the energy within the unit. Surge protectors are relatively inexpensive and offer excellent protection against catastrophic high-voltage spikes in normal mode. However, they fail to handle the relatively small over and under-voltages that occur in common mode which momentarily disrupt computer networks. As large scale normal mode surges account for only about two percent of all power problems, they are an incomplete solution.

UPS is a backup power supply used when the main electrical feed has failed or drops to an unacceptable voltage level. Small UPS systems provide battery power for a few minutes. This gives users enough time to power down critical servers without suffering data loss – otherwise anything stored in the computer's memory is lost during a blackout. More sophisticated systems are tied to electrical generators so power is available for several days. UPS systems can also include a surge suppressor.

UPS should clearly be part of any power protection strategy. But it has to be understood that blackouts make up around one percent of power quality situations. Even including large sags (10 to 14% of the problems), that leaves over 80 percent of the power quality concerns untouched.

Isolation Transformers (also known as line conditioners) have gained popularity in recent years. A transformer changes one voltage to another and is made from two coils of wire close to each other (or wrapped around an metal core). Power is fed into one coil to create an electromagnetic field. The electromagnetic field causes current to flow in the other coil. An isolation transformer uses this technology to prevent current from flowing directly from one side of a circuit to the other. These devices are an excellent way to filter out normal mode voltage spikes (down to less than 10 volts) and common mode spikes (down to less than 0.5 volts). On the downside, they are heavier and more expensive than more modern alternatives – costing about $1,000 for a unit with adequate server protection.

Transformer-Based Filtering (Electronic Power Conditioner)

Recent technological advancements in the field of power conditioning have now yielded devices that provide "computer grade" power at the same price as limited-function surge protectors and a fraction of the price, weight, and size of isolation transformers. Known as transformer based filtering (TBF) devices, the latest circuits include transistors, thyristors, capacitors, and relays to handle power conditioning duties in tandem with a small transformer. This intelligent digital circuitry provides greater functionality than a traditional line conditioner or isolation transformer.

TBF units provide basic protection against massive spikes up to 6000 volts as well as small common mode spikes and surges. In addition, they constantly monitor the line power. If voltage goes too high for more than 5 cycles (80 milliseconds), for instance, the motherboard could blow out. The TBF cuts the power off to prevent damage to the machine.

Further, new TBF technology can identify miss-wired outlets. If a ground wire is loose, or the neutral and hot wires are reversed, the device will not let the power reach the protected machine. Prolonged over-voltage protection (POVP) is another feature built in to the device. The loss of the neutral wire, for example, can lead the voltage to increase to the 160 to 200 volt range for an extended period of time. A TBF unit disconnects the output to keep mission-critical systems safe.

SmartPower Systems' TBF, for example, compresses all this functionality into a 17-ounce package the size of handheld cassette tape recorder. Built-in RJ11 and RJ45 connectors extend protection to telephone and network lines.

Independent Testing

A 2005 research study by PowerCET Corp confirms that TBF technology matches and in some areas betters the performance of more expensive isolation transformers.

"The SmartPower Electronic Power Conditioner kept let-through voltages below 10 volts line/neutral and 0.5 volts neutral/ground," says Thomas Shaughnessy, vice president of research at PowerCET, a Santa Clara, CA-based power quality consulting firm. "The Smart Power products removed output power when applied voltages exceeded preset limits and automatically reset when applied voltage returned to normal levels."

On one test, for example, surges of 3000 volts were used on a variety of isolation transforms as well as the TBF. The results showed that TBF surge attenuation on common mode was less than 0.5 volts, the same as an isolation transformer.

Power Energy Number One

Blackouts and line sags make it essential to protect servers, workstations and networking gear from electrical harm. UPS and surge suppressors offer safeguards against catastrophic events such as burned-out motherboards, and keep computers operating at least long enough to prevent data loss. But these methods are not enough in a dirty-power environment as they fail to address power enemy number one – low voltage spikes. That's why isolation transformers or TBF units are required to cleanse the power coming along the utility line and take care of other low voltage factors. Otherwise freezes, system hangs and data loss will result. UPSs with TBF units are recommended as they are about half the price of a comparable UPS with line conditioner unit, and are much smaller and lighter.

SmartPower Systems offers a wide range of UPS with TBF products. For those with UPS and surge suppressors already in place, TBF technology (model Smart Cord) can be added inexpensively to upgrade those units.

For more information on power conditioning, call SmartPower Systems at 713-464-8000 or visit www.smartpowersystems.com.

SmartPower Systems, Inc.
1760 Stebbins Drive
Houston, TX 77043