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Power Quality

With blue screens, system freezes and logic errors resulting from power quality issues, electronic power conditioners may be today's solution for "computer grade" power.

By Carlo Chatman & Charles Petersen



Good communications are essential to the success of any utility, whether its sector is telephone, electric power or CATV. It's normal to think of utility workers as people on boom trucks, installing, maintaining or repairing the lines, because that is how the public usually sees them in action. It may be too easy to forget that there are many utility workers who are in offices, keeping efficient communications between office and field, relying on electricity and computers, trusting the accurate function of those computers. Data protection is a prerequisite for successful communications, in the office or on the boom truck.

Companies spend many thousands (it must be millions now) of dollars on anti-virus software, intrusion detection systems, firewalls and spyware blockers. "Most problems with over 80 percent of security leaks are generated internally," observes W. Curtis Preston, a data protection specialist at Glass House Technologies Inc. Similarly, when people think of preventing data loss due to power supply problems, it is typical for them to consider an Uninterruptible Power Supply (UPS) or a surge suppressor.

Recent studies by Bell Laboratories indicate that *less than four percent* of power-related problems would be addressed by such devices. Networks and computer systems that are well protected by UPS and surge protectors are, therefore, still at serious risk. "Power problems caused by small surges, spikes and sags in the electricity supply cause 15 times more problems today than viruses," comments Bahram Mechanic, CEO of SmartPower Systems Inc. of Houston, Texas, a maker of power protection and conditioning equipment. "Servers, workstations and networking gear can be protected best 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." That means better accuracy and better protection for all utilities.



Downtime damage

Downtime causes millions of dollars in damage annually to computer networks worldwide. In many cases, people try to troubleshoot the cause of wasted downtime hours by addressing the wrong problem. They typically blame the software, the network, viruses, spyware and all those other much-advertised enemies. Often, however, they are correcting the

wrong problem, because it turns out that power-related issues are frequently the cause of time-outs, unexplained downtime and other commonplace system or networking glitches.



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Two recently completed major studies of power quality offer some interesting revelations. Bell Labs, found the following areas accounted for most power-related issues:

- Blackouts – 0.5%
- Surges higher than 200 volts – 2.4%
- Sags – 14%
- Surges less than 200 volts – 82.2%

A similar study from IBM seemed to confirm these findings.

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

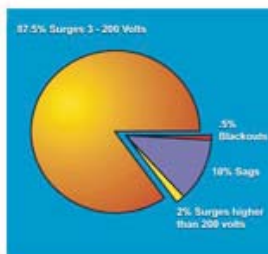
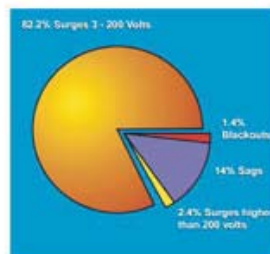
Thus, for some 80% to 90% of the time, electronic equipment is being affected by tiny surges as opposed to lightning flashes or blackouts. To worsen the situation, these little spikes wreak havoc in terms of logic confusion, system errors and frozen screens. "All of us have had our computer lock up on us," notes Anthony Loguidice, assistant vice president of service for Sharp Electronics of Canada, Ltd. "If there are spikes and surges on the line, they 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 users protect themselves against one type (occurring in what is known as "Normal Mode") but fail to pay any attention to the other (occurring in "Common Mode").

What happens?

You probably know all this, but let's repeat it to emphasize a point. Most electrical wiring inside any building has three wires: two wires that carry the power are called "hot" and "neutral", and a third (usually green) wire which is for safety and a logic reference point called the "ground". Normal Mode power noise occurs between the hot wire and neutral wire, causing damage to power supplies, PC board blowouts and other issues (some catastrophic, all infuriating). 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 located.

Relating that information back to the two studies mentioned above (from Bell Labs and IBM), *blackouts and large surges account for less than 5% 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. But 80% to 90% of all problems actually happen in Common Mode. While these events are usually not disastrous, they may generate all kinds of mischief, consume end user time, resulting data loss, and generate a veritable torrent of help desk traffic.*

Why does this happen? Microprocessors normally work with 5 volts DC (with some newer models working with 2.7 volts DC, which may make them even more sensitive to small power anomalies). They act like high-speed switches, turned on and off millions of times per second. The OFF state (zero volts) equates to the binary "0" and the ON state (five volts) equates to binary "1". Therein is the foundation of the binary language (0100110010) through which computing functions. "Any spike greater than one volt will confuse the logic, with the microprocessor being read as a 1 rather than a 0," explains Mechanic. "The end results are screen lockups, time-outs or delays."



You'd think that, in this day and age, electrical wiring would be such a precise science that those issues have been minimized. Not so! Some power coming is far below the level of stability required to safely run electronic equipment. Many cities suffer from inferior wiring, and it's not just the small communities. "Surprisingly, the San Francisco Bay area has some of the worst wiring," comments 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."

Options for protection

Surge protectors or surge suppressors 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. They fail, however, to handle the relatively small over and under voltages that occur in the Common Mode – those events that will momentarily disrupt computer networks. As large scale Normal Mode surges account for only about 2% of all power problems, surge protectors must be considered an incomplete solution.

UPS (Uninterruptible Power Supply) 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 IT enough time to power down critical servers without suffering data loss; otherwise, anything stored in RAM 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 be part of any power protection strategy, but it should be understood that blackouts make up about 1% of power quality situations. Even if you include large sags (10% to 14% of the problems), you are still leaving more than 80% of the power quality concerns untouched.

In recent years, Isolation transformers (also known as line conditioners) have enjoyed considerable popularity. A transformer changes one voltage to another and is made from two coils of wire close to each other (or wrapped around a metal core). Power is fed into one coil to create a magnetic field. The magnetic field causes current to flow into the other coil. An isolation transformer uses this basic technology to prevent current from flowing directly from one side of a circuit to another. 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). A perceived disadvantage of isolation transformers is that they are heavier and more expensive than more modern alternatives, costing about \$1,000 for a unit with adequate server protection.

Technological advances in the field of power conditioning have now produced 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. These electronic power conditioners, 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/isolation transformer. TBF units provide basic protection against massive spikes up to 6,000 volts, as well as small Common Mode spikes and surges. And they constantly monitor the line power. If voltage goes too high for more than five cycles (80 milliseconds), the motherboard could blow out. The TBF would cut power off to prevent damage to the machine.

Not just another technology

Today's TBF technology can identify miss-wired outlets, too. If a ground wire is loose or the polarity between neutral and hot is reversed, the TBF device will not allow the power to reach the protected machine. Prolonged over-voltage protection (PVOP) is another feature built into 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. The TBF unit disconnects the output to keep mission-critical systems safe. One TBF system (from SmartPower Systems) compresses all this functionality in a package weighing only 17 ounces (ounces, not pounds!) that is about the size of a handheld tape recorder. Built-in RJ11 and RJ45 connectors extend protection to telephone and network lines.

In these times when a new technology seems to be presented to us every week, we are cautious about all claims. A 2005 research study by PowerCET Corp, a power quality consulting firm based in Santa Clara, California, confirms that TBF technology matches and, in some aspects, betters the performance of more expensive isolation transformers. "The SmartPower ElectronicPower Conditioner kept let-through voltages below 10 volts

line/neutral and 05 volts neutral/ground," observes Thomas Shaughnessy vice president of research at PowerCET. "These products removed output power when applied voltages exceeded preset limits and automatically reset when applied voltage returned to normal levels." On one test, surges of 3,000 volts were used on a variety of isolation transformers as well as on the TBF. The results showed that TBF surge attenuation on Common Mode was less than 0.5 volts, the same as an isolation transformer.

Blackouts and line sags make it essential that you protect servers, networking gear and workstations 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. These protection methods, however, are not adequate in a dirty-power environment, as they fail to address Power Enemy #1: low voltage spikes. Isolation transformers or TBF units are required to cleanse the power coming along the utility line and to take care of other low voltage factors. Otherwise freezes, system hangs and data lost will result. UPS's with TBF units are recommended, as they are about half the price of a comparable UPS with line conditioner unit. They are also much smaller and lighter. Do your homework! Find out which protection systems offer you the best solutions, to make communications in your company both safe and accurate.