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A good surge protector
can be the difference
between a functioning
system and a fried one

Don't Get Zapped

BY KEVIN JAMES

While many of us obsess over our gear choices as if we're ordering our last meal, we often neglect to think about how we're going to protect that gear once we get it home. Even worse, many of us simply plug the system into a cheap power-strip-style surge protector, which we bought because we needed a couple of extra outlets, not because we were confident it would keep an AC surge from damaging any gear. But that can be dangerous, since power surges are common occurrences around the home.

Surges — or more accurately, transient-voltage surges — happen whenever the power streaming through electrical wires increases significantly above the 120-volt U.S. standard. Technically, a surge is an excess power burst that lasts 3 nanoseconds or longer; shorter bursts are called spikes. A lightning strike has become the poster boy for the worst-case-scenario surge, and it can certainly be catastrophic. But far more likely to damage your gear is the other stuff you have plugged into your household outlets.

Big appliances like refrigerators, washing machines, and air conditioners have compressors or motors that draw lots of power and that constantly switch on and off. Those switching motors cause momentary ebbs and flows in power supplies, sucking power away from A/V equipment when the motors kick in and sending bursts of extra voltage through the system when they shut off. Even if a single one of these surges isn't strong enough to hurt your gear, over time they can gradually damage or even kill your components.

There are other potential sources for dangerous surges. The much-feared direct lightning strike will of course destroy any gear in its path, even with surge protection, but indirect strikes can also wreak havoc. (The only sure-fire remedy is to unplug your equipment during a thunderstorm.) Less dramatic but more common is uneven power flow coming from your local utility, which delivers electricity through a complicated maze of grids and distribution lines — all subject to failure at any moment. A downed power line from a storm (or from a careless neighbor more occupied by an incoming cellphone call than by his driving) can cause an outage, followed by a significant surge when power is restored. And even the growing number of smaller household appliances equipped with small switching motors can take their toll on the consistency of the power running to your wall outlets.

Surges, of course, aren't anything new. And in fact, the power coming into our homes is more consistent than it's ever been. What's changed is that most gear is now transistor-based (tubes are far better able to handle extra voltage), with delicate components like surface-power supplies and microprocessors that can't stand up to surges and spikes. The computer microchips that control many components these days have made them smarter but also wimpier.

That's why many A/V enthusiasts today use a surge protector — more accurately called a transient-voltage surge suppressor, or TVSS — between the wall outlet and their big-screen TV and home-theater receiver. Many are also opting for units that combine surge protection with both line conditioning, which can eliminate noise and "dirt" in AC power lines, and an uninterruptible power supply (UPS), which provides battery backup in the event of sudden power loss so you can safely power down your gear. (For an overview of the different types of surge suppressors, line conditioners, and UPS

devices, see "Powerhouse," under Feature Articles in the Features section at soundandvisionmag.com.)

Surge suppressors vary widely in both price and performance. Chances are that \$20 suppressor you bought for the extra outlets has already outlived its protective usefulness. That's because it probably uses a metal oxide varistor (MOV) as its primary source of protection, which degrades over time. All suppressors deal with surges by diverting excess energy away from your gear — typically either by shunting it to ground or by absorbing it, most frequently by storing it in capacitors. By far the most common suppressors are so-called shunt-mode models, such as those that use MOVs, which are pancake-shaped components constructed from pressurized zinc-oxide fragments. MOVs have wires on either side, one connected to the "hot" wire, the other to the ground. An MOV is a variable resistor that acts like a pressure valve. When the voltage is below a certain level, the MOVs are inactive. But once it gets too high, they become conductive, taking excess voltage from the "hot" line (which goes to your gear) and bleeding it off to the ground. Once the level drops, the MOVs once again become inactive, so they don't drain needed voltage from your gear.

A number of companies, including APC, Panamax/Furman Sound, and Monster Power, use MOVs in well-regarded products, often in conjunction with other technologies. (For a look inside an APC surge protector, see "Inner Workings," page 80.) MOVs react quickly to surges, can handle large currents, and are inexpensive. But they're "sacrificial" components that degrade after every surge, since the zinc-oxide particles weaken after conducting current, so their ability to continue protecting your gear declines with use.

There are two other shunt-based options: gas discharge tubes and silicon avalanche diodes. Gas discharge tubes use specially designed electrodes housed in a tube with one or more inert gases under pressure. The gas acts as the conductor between two lines. At normal voltages, it has low conductivity. But when the voltage is high enough, the gas is ionized and becomes highly conductive, passing the excess voltage to the ground wire. Gas discharge tubes have low breakdown ratings, and they can reduce voltages in a

matter of nanoseconds. But while they're adept at handling very high peak voltages, lower voltages that still have enough power to cause damage can sometimes get through.

Silicon avalanche diodes (SADs) are also semiconductors that can respond very quickly to transient voltages, and they have a wide clamping voltage range (the amount of energy they let through before activating). As long as their rated capacity isn't exceeded, they won't degrade. But a suppressor generally requires multiple SADs in order to dissipate extra voltage without sacrificing the device, which makes this kind of suppressor more expensive.

Because each approach has its limitations, many of the better surge suppressors use a combination of these devices, most typically MOVs and SADs. And because of the sacrificial nature of MOVs, many suppressors have backup fuses in case the MOVs fail. Many also have a light that shows when the unit's not functioning properly.

Because of the limitations of MOV-based suppressors — and the argument that shunting excess voltage to ground can contaminate the system — companies like ZeroSurge and Brick Wall prefer so-called "series-mode" suppressors. These suppressors use an inductor (also called a choke, or a toroidal choke coil) that inhibits surge frequencies while allowing power frequencies to pass undeterred. Essentially a copper core winding, an inductor acts as a low-pass filter that inhibits surge energy, some of which is stored in capacitors and then slowly released to the neutral wire.

According to their proponents, series-mode protectors have several advantages. Because there's nothing to "turn on," reaction is instantaneous. They have very low dynamic clamping levels and, perhaps more important, even lower let-through voltage. Also, because excess energy is contained in the capacitors rather than diverted elsewhere in the power system, that energy can't degrade the system or find its way into other cables and interconnects. Critics of the approach say that unlike shunt-mode suppressors, series-mode devices don't protect against common-mode surges or surges on other lines, such as coaxial cables. →

SURGE PROTECTORS

ZEROSURGE 1RM15D

ZeroSurge takes a "series-mode" approach to surge protection. Unlike MOV-based protectors, which need to be set at a specific over-voltage level, series-mode suppressors can track and suppress *all* excess voltages.



RICHARD GRAY'S POWER COMPANY 600S

Products from Richard Gray's Power Company use "dual-stage" suppression, sending power straight to the components while surges are handled by an alternate path.



THE AUDIOPHILE ISSUE surge protectors



Today's A/V gear has delicate components that can't stand up to power surges and spikes.

To understand how these various surge suppressors work, let's take a closer look at how three well-regarded companies — ZeroSurge, Richard Gray's Power Company, and Furman Sound — address transient-voltage surges in their lines of products.

ZeroSurge

Leading the series-mode charge is ZeroSurge, which believes that MOV-based designs have significant design flaws that the technology can't overcome. ZeroSurge pioneered the series-mode approach.

The company's patented Wide Voltage Range filters use an input inductor that absorbs the initial surge. Capacitors then gradually release the excess energy to neutral when voltage returns to normal. Unlike MOV-based suppressors, which need to be set at a specific over-voltage level, series-mode filters can track and suppress *all* excess voltages.

ZeroSurge's Total Surge Cancellation filters use additional winding on the inductor — basically making it a transformer — to generate a canceling voltage that eliminates any residual over-voltage. Because surges are canceled at the output, and because the filters don't wear out, series-mode filters don't have Joule ratings, clamping voltages, or suppressed voltage ratings, which are used as benchmarks in establishing the performance of shunt-based suppressors.

Richard Gray's Power Company

While it might be better known for power conditioning, Richard Gray's Power Company offers many products that feature surge protection. Concerned that having passive and active surge components wired in a series can restrict the current needed by many high-powered amps, RGPC uses what it calls "dual-stage" suppression that can deal with both major spikes and smaller, consistent surges.

While the company employs MOVs, it relies mainly on a massive, 20-pound inductor to absorb surges and spikes. But RGPC products are wired in parallel with the AC line, not in the signal path between the AC outlets and the components, so the inductor places a very low resistive load in parallel with the line. This means the power is sent straight to the components, while the surge is handled via an alternate path. The inductor protects the MOV by absorbing spikes and surges before they get to a high-enough level to activate the MOV. Should the surge exceed the inductor's capability, the MOV doesn't sacrifice itself; instead, it directs the surge voltage to a fast-acting internal fuse.

Furman Sound

Furman's Series Multi-Stage Protection Plus (SMP+) addresses some of the shortcomings of traditional MOV-based protectors by employing a variety of circuits to clamp, absorb, and dissipate transient voltages without having the device sacrifice itself. The company claims that MOVs used in a properly designed circuit will not fail.

Furman's SMP+ circuitry takes pages from both shunt- and series-mode playbooks and adds its own twist. Along with a high-voltage MOV and a high-amperage thermo-fuse varistor, SMP+ uses a tuned circuit that includes series inductors, a bridge rectifier (which converts AC to DC power), and high-voltage capacitors. This parallel circuit amounts to a critically damped low-pass filter that can absorb enough excess voltage so that the MOV is never stressed. Transient voltages are shunted to the capacitor rather than ground, avoiding ground contamination. Also, the system works in conjunction with Furman's Extreme Voltage Shutdown (EVS) circuitry, which protects against excess voltage or sustained over-voltages caused by faulty wiring by shutting down the power before it ever reaches the outlet.

Each of these approaches to surge suppression has its fans and critics, although all of the products mentioned do provide significant protection. While MOVs continue to be most commonly used, a growing number of products combine two or more types of protection. Enthusiasts can debate the merits of the various approaches, but almost everyone agrees that if you've made a significant investment in your gear, you should certainly protect it.

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SURGE PROTECTORS

FURMAN SOUND

Elite-15 PF

Furman uses a number of technologies, including MOVs, to suppress surges.

