

Power Quality Equipment: Transient Voltage Surge Suppressors

Although you may be unfamiliar with the term power quality (PQ), you are likely aware of the consequences of PQ problems. Losing critical computer data to a blackout or experiencing damage to process or medical equipment due to a lightning strike are just two examples of how these problems can affect your business. Technically speaking, power quality refers to the degree to which electricity is free of disturbances that can cause electricity-consuming devices to malfunction or fail. PQ problems can affect many types of equipment in your facility, but especially electronic equipment that's dependent on microprocessors. Computers, network servers, energy management systems, machinery, and food-processing and medical equipment could be damaged or fail prematurely if they are not protected from harmful voltage changes and related disturbances.

Electronic devices function properly as long as the voltage delivered to your facility falls within a consistent range. Swells, transients, sags, and momentary interruptions occur when the voltage fluctuates outside this normal range.

Utilities strive to provide highly reliable and consistent electric power, but it's impossible for utilities to maintain perfectly constant voltage 100 percent of the time. In the course of normal utility operations, voltage will inevitably fluctuate as loads come onto or leave the power system or the utility switches among various sources of electricity supply.

PQ events also occur for reasons that have nothing to do with your utility. Lightning strikes can cause major power disturbances. More subtle PQ problems often originate within the walls of your building and can be traced to the starting and stopping of refrigerator and air-conditioner motors, circuit overloads, or grounding and wiring problems. Experts estimate that up to 80 percent of transients and swells originate within the facilities that they affect.

Why Is This Important?

Depending on the size of the voltage fluctuation, PQ problems can vary in severity, ranging from brief malfunctions to immediate equipment failure. Small fluctuations may not cause any problems initially, but, if left unchecked, these events can lead to equipment degradation over time. If a loss of data or productive time would have a significant impact on your business, or if the cost of replacing failed electronic equipment is high, you need to protect your company against PQ-related damage.

What Are the Options?

There are two major ways to protect your equipment from voltage transients. First, you can provide protection at the point of entry—that is, at your electrical panel or meter. Second, you can install protection at the point of use, where sensitive pieces of equipment connect to electrical outlets. A combination of point-of-entry and point-of-use devices will provide the greatest level of protection.

Point-of-entry protection. Panel-mount surge suppressors can be installed in or adjacent to your electrical panel(s) to provide protection throughout your facility. These

panel-mount or hard-wired surge suppressors protect against transients that come through utility power lines (**Figure 1**). In addition, they can prevent transients that originate on one of your facility's electrical circuits from affecting other circuits.

Figure 1: Panel-mount suppressors

This is an example of a panel-mount device for transient suppression located in a small manufacturing facility



Courtesy: Danaher Power Solutions

Transients caused by lightning can enter buildings through underground circuits that supply electricity for sprinkler systems, pole-mounted lights, outbuildings, or other external uses. A transient on one of these circuits could damage equipment on other circuits unless blocked by a suppressor at the electrical panel. Transients from lightning can also enter your building through telephone and cable-television circuits. Special hard-wired suppressors can be installed on these circuits by a qualified electrician.

Another way to provide whole-facility protection is to use a meter-based transient voltage surge suppressor (TVSS). Note, however, that these devices can be installed only by your utility, and many utilities do not offer this service.

Point of use: plug-in surge suppressors. Plug-in surge suppressors provide affordable but somewhat limited protection for sensitive equipment. Often designed as power strips with multiple outlets, they protect only the devices that are plugged into them (**Figure 2**). Other plug-in surge protectors fit over wall outlets. Some models include jacks for telephone and cable-television lines.

Figure 2: Plug-in surge suppressors

This plug-in device incorporates status lights as well as input and output jacks to protect a phone line.



Courtesy: Tripp Lite

Can They Save Energy?

A small number of TVSS manufacturers and vendors continue to claim that their devices can save users substantial amounts of energy. These claims persist despite the fact that they were thoroughly refuted decades ago. Companies that offer TVSSs as energy-savers have proposed a wide variety of physical mechanisms by which the devices save energy, but none of these mechanisms have the potential to save even an appreciable amount of energy, let alone the 20 percent savings promised by some vendors.

Not only is there no credible mechanism by which TVSSs could save an appreciable amount of energy, there is simply no opportunity for them to do so. Even in industrial facilities with the noisiest electrical environments, TVSSs are active for no more than a small fraction of 0.01 percent of the time. To provide energy savings of even 2 percent during such a brief time, these devices would have to cut power consumption in a very dramatic way—something they clearly do not do.

Companies that offer energy-savings "guarantees" for their TVSSs invariably rely on month-to-month changes in whole-facility electric bills to demonstrate savings. But billing analyses are notoriously inaccurate, because they fail to account for a host of variables that influence a facility's overall electricity consumption. TVSSs do a great job of protecting electrical equipment, but purchasers would be wise to get multiple bids for any TVSS installation and to steer clear of vendors promising energy savings.

How to Make the Best Choice

You should select devices that are UL 1449 Listed, meaning that samples have been found to meet the Underwriters Laboratories (UL) standard for surge suppressors. Associated with the UL listing is a number indicating the maximum amount of voltage the suppressor will allow your equipment to be exposed to. The lower this voltage rating, the better.

You can purchase plug-in surge suppressors from computer, hardware, and office supply stores for anywhere from \$10 to more than \$100. A higher price doesn't ensure a higher level of protection. **Table 1** presents selection criteria for these devices. The more-effective units combine several different transient-protection components. Sine wave tracking is a sophisticated feature that is advisable only if you have equipment that is particularly sensitive to harmonic distortion; this is not an issue for most small businesses.

Table 1: Choosing plug-in surge suppressors

	Surge-suppression rating	Durability	Protection method	Additional features
Good	UL Listed at 500 volts	1000 transients at 2000 volts and 1000 amps	Transients are diverted to ground	
Better	UL Listed at 400 volts	1000 transients at 4000 volts and 2000 amps	Transients are absorbed and not diverted to ground circuit	Indicator lights (showing that surge suppression is working, not just that the device is plugged in)
Best	UL Listed at 330 volts or below	1000 transients at 6000 volts and 3000 amps	Transients are absorbed by multiple, redundant internal components	Data port protection, sine wave tracking, phone/fax/coaxial plug-ins, metal housing, space to accommodate transformer plugs, and warranties offered to cover damage to equipment connected to the suppressor

Source: E SOURCE

What's on the Horizon?

Change in the national electrical code in January 2002 required TVSS devices be rated to carry the fault current capability (that is, the amount of current that a phase conductor would carry in the case of a bolted fault to ground) of the circuit to which they are connected. This change created a flurry of activity among TVSS manufacturers, as many designs were not previously required to carry these currents and could catch on fire under certain conditions. Now UL1449 requires all surge suppressors to identify the approved short-circuit current rating for the product.

Another recent development is that manufacturers have begun to offer remote (in some cases Internet-based) monitoring and notification when a TVSS device is no longer providing protection to a circuit. This option might be useful in an industrial facility with numerous, widely dispersed critical process controllers or for companies with numerous geographically dispersed facilities.