

## **Surge Protection 101**

The service life of any piece of electronically controlled equipment is, to a large degree, determined by the quality of the electrical service that it receives power from. Most electronics have an incredibly long theoretical life, but a fairly short “real-world” life. This is mainly due to two factors. The first, and by far the most critical, is the quality of the supply power. The second is environmental, actually dust and dirt getting on and in the equipment.

The number one complaint from electronics owners (commercial and residential) is downtime. The number one cause of downtime (other than user error, neglect, or abuse) is poor power quality. According to Utility Industry information, power quality is at an all time low. And, with deregulation rolling along, it's getting worse.

With today's electronics becoming smaller, more sensitive, and more expensive no one can escape the need for quality surge protection. Every day hundreds of short duration voltage surges (some potentially larger than 5000 volts) can enter your business. These surges are also referred to as “spikes” or “transients”. Because transients last for a very short time (generally less than one millisecond (1/1,000 of a second)) they do not always destroy your equipment. Sometimes they may only cause flicker on your computer screen. Other times, you may be left with a smoking wreck where your new home theater was. The most costly result of these small surges is the wear and tear they put on all electronics. Electronic equipment can last up to 30% longer with the proper protection.

For our purposes a surge is defined as a high amplitude, short duration electrical fluctuation. A surge can be induced onto ANY metallic conductor. Surges can be categorized in two ways. Transients, also called spikes, are the events we're concerned with. These are defined in the sentence above. Swells are a “continuous” rise in normal line voltage and require different types of devices to protect equipment.

### **What Causes A Power Surge?**

There are three primary causes of surges, “Her”, “They”, and “You”.

“Her” is, of course, Mother Nature and she is responsible for the most feared and dramatic transients, those caused by lightning. While lightning is certainly spectacular, only about 2% of surge damage is caused by direct lightning strikes. Lightning hitting the ground can travel up to ½ mile so indirectly it can induce a spike on any wiring buried in the ground. Static discharge can affect building to building wire runs.

“They” refers to any source outside of the building (or room) being analyzed. The most common source for these surges is the local electric company. Major events like grid shifting, open neutral events and high voltage cross-over can induce large transients onto the power lines. Smaller, daily events like capacitor switching are responsible for ongoing degradation of electronics. “They” also can be any electric user on the same utility circuit from the sub-station. A large current draw such as a large motor at a gravel plant or the HVAC equipment at a school or hospital will create several surges a day as they cycle on and off.

# **VALLEY**

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“You” is the actual owner, manager, etc. of any commercial, industrial or residential building or facility. Studies by GE and the National Power Lab, in Kenosha Wisconsin, show that between 65% and 80% of all surges are generated within the facility itself. These spikes tend to be rather small and are responsible more for equipment degradation than destruction. The primary causes are HVAC equipment, pumps and motors (pool, well, etc), refrigeration equipment, anything that on startup has an inrush current greater than its operational draw. Once the device reaches its normal run speed the excess inrush current is reflected back onto the circuit in the form of a transient surge.

### **How Do Surges Effect Equipment?**

Transient surges result in one of three things... Destruction, Degradation and Downtime. Destruction (“It’s broken”) is, erroneously, most people’s main concern. The gradual degradation of equipment causes more frequent replacement and those annoying “glitches” so prevalent in electronics today. Downtime is easily the most expensive result of a spike. A large brokerage firm loses in excess of \$5,000,000.00 an HOUR if their phone and / or internet service goes down due to a surge.

### **Applying Surge Protection**

A properly designed surge protection system can protect electronics from most incoming and internally generated surges. In reality the design of the system and the quality of the installation can be more important than the protector itself. The reason for this is because of how most surge protection works. A surge protector sits on a line, basically invisible, until it “sees” voltage above its rated level. It then goes into a low impedance state opening a path to ground. A surge, like all electricity (and water, for that matter), tries to find the “path of least resistance” to ground. This is why installation and grounding are such critical components of a surge protection system. Once the transient is safely diverted to ground, the protector resets to its passive state and waits for the next event.

Most solid-state surge devices will shunt thousands of voltage spikes without suffering any damage. If a surge protector does self-sacrifice, it will stay in the shunt to ground mode until disconnected and replaced. There are really only two things that can damage TVSS equipment. The first is a major transient surge larger than the device’s capacity. The second, as mentioned before, is a “continuous” over-voltage situation. Generally speaking, well-designed surge protection devices will provide years of trouble-free, invisible equipment protection.