A Rocky Mountain Chapter White Paper: “Transient Voltage Surge Suppression”

Ron Hranac
Associate Board Member, SCTE Rocky Mountain Chapter

The following is adapted from an article I wrote for the March 2008 issue of *Communications Technology*.

A bit more than a dozen years ago, among the highlights of 2008’s International Consumer Electronics Show in Las Vegas was Panasonic president Toshihiro Sakamoto’s introduction of the company’s Life Screen, a concept 150-inch high definition plasma display panel. At 4096 x 2160 pixels, that HDTV had four times the resolution of then-available 1080p displays and an effective viewing area of 11 x 6-1/4 feet. No price was given, but Panasonic showed a 103-inch high-def plasma display at the 2007 CES that was said to cost $70,000. Some estimates pegged the 150-incher in the $150k range.

Assuming you could get one of those beasts through the front door, how would you go about ensuring the longevity of a 150-inch display? Transient voltage surge suppression (TVSS) would likely be near the top of the list. After all, it would be anything but cool if an electrical surge zapped that new über TV. If a Life Screen were in my house, I’d probably also think about line regulation and a UPS. At the least, it would make sense to follow the display manufacturer’s recommendations.

These days the typical household has a lot of expensive gadgets connected to commercial power, and in many cases also to the cable drop. What, if anything, should we be thinking about when it comes to subscriber premises TVSS and other ways to deal with electrical gremlins? I found some useful definitions of power quality in Chapter VII (“Power Grid Interconnection Optimization”) of the 1992 CableLabs document *Outage Reduction*. Side note: *Outage Reduction* was published in a three-ring gray binder, and your company may well have a copy on a shelf or perhaps boxed away in a warehouse. If you do, dig it out and give it a read. The document contains a lot of useful information.

“**Outages** (Interruptions) – An outage is a complete loss of voltage usually lasting from as short as 30 cycles up to several hours (or in some cases even days). Outages are usually caused by the fault induced operation of circuit breakers or fuses. Some of these interruptions might be classified as permanent while others might be classified as temporary (momentaries).

“**Impulses** (Lightning or Switching Surges) – A surge is a transient voltage or current which can have extremely short duration and high magnitude. Typically, surges are caused by switching operations or lightning. Surges can be generated by customers due to the switching of their own loads or may be caused by utility switching operations (capacitors, breakers, etc.).

“**Undervoltage** (Voltage Drop) – A customer who experiences a long duration (several seconds or longer) service or utilization voltage less than the proper nominal operating low voltage limits ([at the time *Outage Reduction* was published] the ANSI Range [A] service and utilization low voltage limits [were] 114 volts and 110 volts respectively) can be considered to be experiencing an undervoltage situation. Such a condition may be

caused by a number of factors such as overloaded or poor house wiring, poor connections and/or voltage drop on the utility system.
"**Harmonics** – These are the non-fundamental frequency components of a distorted 60 Hz power wave. They have frequencies which are integral multiples of the 60 Hz fundamental frequency. Harmonics are not generally produced by the utility but rather by the customer's equipment. For example, a large non-linear industrial load may produce harmonics which, if they are of sufficient magnitude, can travel back through the power system and affect other customers.
"**Voltage Sags** – A short severe momentary voltage dip that may last for several seconds is classified as a voltage sag. Voltage sags may be caused by faults on the transmission or distribution system or by the switching of loads with large amounts of initial starting/inrush currents (motors, transformers, large dc power supplies). Voltage sags may be sufficiently severe especially in the case of faults to cause sensitive loads (computers, VCRs, clocks, etc.) to reset.
"**Voltage Swell** – When a fault occurs on one phase of a 3 phase, 4 wire system, the other two phases rise in voltage relative to ground (about 20%). This steady state rise in voltage is referred to as a swell. Referred to by some as surges.
"**Overvoltage** – Any steady state (several seconds or longer) voltage delivered to the customer's meter which is above the ANSI Standards upper service voltage limit of 126 volts is classified as an overvoltage. Overvoltages usually occur as a result of improper regulation practices (misadjustments of regulators and capacitors)."

If you're using a personal computer at home, you probably have it plugged it in to a surge suppression-equipped AC strip, also known as point-of-use TVSS. What about your cable modem or eMTA? Your TV, stereo and other audio-visual equipment? Telco twisted pair wiring? If you're reading this, the odds are pretty good that you're technically saavy, and probably have some type of point-of-use TVSS installed on most, if not all of your home electronics gear. For instance, my own home has a whole-house surge suppressor in the breaker panel (installed by an electrician), a surge suppressor-equipped ground block in my cable drop (I installed that), and point-of-use TVSS for most of the in-home electronics, including the microwave oven, dishwasher, and even the lawn sprinkler timer.

But what about our cable subscribers?

One of the first things to do is ensure that the drop installation complies with relevant local, county or state codes, which are usually based upon the National Electrical Code (NEC).

A second step is to consider the use of ground or bonding blocks that incorporate surge suppression. These are available from certain cable industry vendors. Some drop splitters also include surge suppression. Be sure to follow your company's guidelines for use of these devices.

Beyond that, should we even tell our subscribers that they ought to install point-of-use TVSS? That's a potentially controversial area. Cable operators fall into the "darned if we do, darned if we don't" arena. I can envision a scenario in which a cable operator recommends that its subscribers install those devices, then a direct or nearby lightning strike takes out a bunch of consumer electronics connected to a subscriber's drop. Yep, the subscriber goes after the cable company even though the cable operator's

intent was to help that same subscriber protect his or her own equipment! Another scenario that's possible is one in which we don't recommend TVSS devices, and a subscriber's home gets hit with a nasty surge that takes out a bunch of electronics gear connected directly or indirectly to the drop. This time the subscriber goes after the cable company for *not* suggesting that third-party TVSS devices might have been a good idea.

It's important to understand that consumer grade point-of-use TVSS is not suitable protection from a direct lightning strike. Whole-house lightning protection is beyond the scope of this paper, and tends to get complicated and fairly expensive to implement.

What, then, should we do? If we tell our subscribers anything, it should be along the lines of "consider installing third party surge suppression devices" and "consult with a licensed electrician, the computer or consumer electronics device manufacturer, etc., regarding whether or not external surge suppression devices are warranted, along with the specific surge suppression device types and installation guidelines."

Why the legalese? To avoid being perceived as promising subscribers that we're going to pay for damaged equipment because TVSS was recommended by the cable company! I had a discussion about this with an industry friend and colleague who holds a high-level engineering position with a major cable operator. He noted "Customers are my first priority. They pay my salary. Over the years I've observed that the majority of customers are terrific. They understand how business works and will give you a break if problems with service are promptly and courteously resolved. However, a small percentage will attempt to take advantage of every business they interact with, and the cable operator is not an exception. A lightning strike on a customer's home is not the cable operator's fault, but a few customers will attempt to play it that way."

The seemingly ubiquitous electronic gadgets in subscribers' homes are an invitation to problems if at least some attempt isn't made to combat the electrical gremlins discussed previously. An analogy might be made to the PC and whether or not up-to-date antivirus software has been installed and is in use. Is it the PC manufacturer's fault that a user's computer gets infected with a virus because that user didn't bother to keep the antivirus software's definitions up to date?

We have to assume that our subscribers are responsible for their homes, automobiles, TVs, microwaves, and whatever else they own. Does it make sense for cable operators to suggest that subscribers at least consider third party TVSS for devices connected to the cable? Somewhere in all of this there has to be a clear separation maintained between the respective responsibilities of subscribers and the cable company. At the same time, we need to think about how we can educate our subscribers while minimizing our own legal and financial exposure.