SURGE SUPPRESSION

The second step in securing effective lightning protection is surge suppression.

The energy and raw power contained in a lightning strike are truly awesome. It is easy to imagine the havoc which a direct strike to your facility can cause.

However, the majority of electronics damage is not caused by direct lightning strikes, but is rather the result of transient voltage and current surges induced on power, telecommunications or RF transmission lines by the strong electromagnetic fields created during a lightning strike, and by more mundane causes such as power company switching, nearby heavy loads, traffic accidents involving utility poles, etc. These surges can propagate for miles on metallic conductors, ending up at your facility service entrances retaining sufficient energy to damage or destroy electronic equipment.

If you do not take steps to stop them, power surges can enter your facility and damage or upset your equipment. These transients were not so much of a problem in the days of vacuum tubes which operated on high internal voltages. However, with the introduction of microprocessors which operate on very low internal voltages, they have become a very real problem. Every day, transients of all types are causing wear and tear on your equipment. With the move towards faster, digital equipment, the problem will become more noticeable and expensive. The faster the electronic device, the more susceptible it is to transients. It is not possible to make electricity travel faster. Therefore, if you want to make a device operate faster, the distance which the electricity travels must be reduced. When you reduce the distance, the arc-over voltage becomes lower. Therefore, the device is more susceptible to a transient.

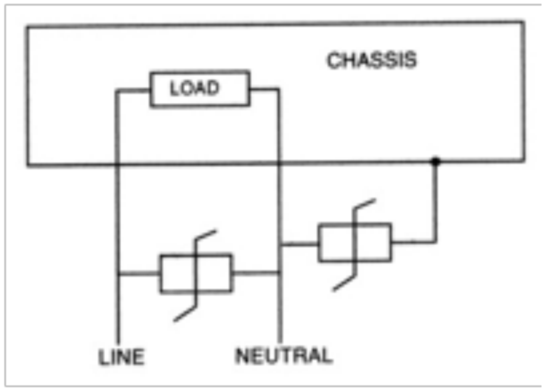
This establishes the need for some type of device to stop power surges before they enter your facility, and to stop internally generated transients before they are distributed to your equipment. A transient voltage surge suppressor (TVSS) is simply a device that becomes conductive at a certain voltage. It limits the voltage to a value slightly above the nominal operating value of the system to allow normal operations, yet below a value which will allow damage to connected equipment. When the transient goes away, the device becomes non-conductive, allowing normal operations and awaiting the next transient.

All-Mode Protection

There are two types of transients: common mode and transverse mode. To illustrate, let us examine the simplest type of system, a two-wire, 120 volt circuit. One wire, the line wire, is nominally at 120 volts compared to the electronic device. The other wire, the neutral or return wire, is nominally at zero volts compared to the equipment. As long as the different in voltage is 120 volts, the electronic device is happy. However, there are two types of transients which may appear on these wires. The first type is a transient on one wire. Say the line wire suddenly momentarily jumps from 120 volts to 2,120 volts with a 2,000 volt transient. The electronic device is straddling the two wires looking for 120 volts. If it suddenly sees 2,120 volts, it may sustain damage.

The second type is a transient on both wires. With the same 2,000 volt transient, the potential, or voltage, on the line wire jumps to 2,120 volts, and the potential of the neutral wire jumps to 2,000 volts relative to the electronic device. In this case, the excess voltage may cause arcing between the electronic device and the chassis in which it is contained, which nominally remained at zero volts.

Therefore, in a two-wire system, two modes, or legs, of surge suppression are required; one mode between the line and neutral wires and a second mode between the neutral wire and the equipment chassis or ground. The same principle applies to multiple wire systems; the more wires, the more modes of surge suppression required.



APPLICATIONS

AC Power. Because of the size of conductors, high voltage, high amperage transients may enter your facility on the AC power service. Therefore, it is important to employ a robust TVSS device at your AC power service entrance. This protects your facility from transients delivered from the outside world.

However, power company studies have revealed that the majority of the transients seen by your equipment do not come from outside your facility, but rather are generated inside your own facility by motors and other loads.

Therefore, additional surge suppressors should be installed on sub-distribution panels to limit the “sharing” of internally generated transients. When a transient originating on one circuit travels back to its sub-distribution panel, the TVSS device limits it before it can be redistributed onto other circuits within the panel, including circuits feeding your sensitive equipment. This approach of installing multiple TVSS devices in series is called “staged protection”.

Telephone and Data. Telephone and data line transients may be high voltage, but are usually relatively low amperage, the current being ultimately limited by the wire size. However, telephone and data devices tend to be very susceptible to damage or interruptions caused by transients. Therefore, high speed, tight clamping value TVSS devices should be employed at your telephone and data service entrances.

RF Transmission Line. Since RF transmission lines are connected to antennas which are often the highest structure in the area, they are capable of delivering high voltage, high amperage transients to your facility. Since DC power may be fed up a transmission line to power equipment near the antenna, TVSS devices for this application may have to be designed to allow DC power to pass unattenuated. Conventional devices employing internal RF coupling and gas tubes wired at a right angle to the main path through to the equipment are no longer capable of protecting modern equipment. State-of-the-art devices, devices in which the low impedance path leads to ground, and the higher impedance path leads to the equipment need to be employed to secure maximum protection.

When planning system layout, it is important to avoid routing unprotected wires adjacent and parallel to protected wires, where transients can be coupled from the unprotected wires to the protected wires downstream of the surge suppressor rendering it ineffective.

Lightning Master will assist you with your system layout to eliminate such problems. Long conductors, and bends in the conductors between a TVSS device and the load it protects can dramatically affect surge suppressor performance. At a 3 kA, 8 X 20 microsecond pulse (IEEE standard pulse), each foot of conductor length can produce in an increase in clamping voltage of 150 to 200 volts. Therefore, in the case of a surge suppressor connected to a load with three feet of conductor, just the inductive reactance of the conductor can increase the clamping voltage of the surge suppressor by 900 to 1200 volts (three feet in each direction between the surge suppressor and the load). Also, the travel time along the longer conductors can delay surge suppressor response time. Lightning Master will assist you in the proper location and wire routing for your TVSS installations.