Surge Suppression Incorporated®
What Makes Them Tick

There are many Surge Suppression Incorporated® TVSS products because there are many applications with differing requirements. It is impossible to make a single statement of how all of the different Surge Suppression Incorporated® products work, or what is in them, that would encompass all of the Surge Suppression Incorporated® products. However, we can explore several different Surge Suppression Incorporated® features that reveal the scope of the engineering that goes into each device.

TVSS Componentry

Metal Oxide Varistors

Most Surge Suppression Incorporated® units are based upon time proven, reliable metal oxide varistor technology. Surge Suppression Incorporated uses parts manufactured by the world’s leading producers of ceramics. Some of these parts are custom designed and manufactured to our specifications giving the Surge Suppression Incorporated® a performance advantage over our competitors. The Surge Suppression Incorporated® products boast let-through voltages among the lowest in the industry. This performance is directly related to our unique designs and insistence on parts made to exacting specifications.

The metal oxide part of the varistor represents an early 1970’s ceramics discovery by Matsushita ceramics group. The varistor operates as a non-linear device whose resistance decreases rapidly once a predefined voltage level is reached. A downside of metal oxide varistors is their short life expectancy. This life expectancy is short when exposed to rapid and continuous medium to small energy impulses, such as those found in ANSI/IEEE C62.41-1994 category B2 (4kV, 2kA) & B3 (6kV, 3kA). Metal oxide varistor manufacturers rate their 40mm products at 100 to 200 impulses of this (6kV, 3kA) IEEE stated magnitude. These types of impulses are found in most manufacturing and commercial facilities. Surge Suppression Incorporated has broad experience with this common phenomenon and has developed a way to extend the life of the metal oxide varistor. Our engineers tested this development using the B3 IEEE level at thirty-second intervals. The test was stopped at over 17,000 impulses because of time constraints. There was no measurable degradation of the MOV. Based on their testing, our engineers say that this design improves the life expectancy of metal oxide varistor 80 to 90 times.

Mechanical Components

Encapsulating Technology

Encapsulation technology is time proven as effective protection for electronic components and circuits. Many military and industrial products are required to be encapsulated. Surge Suppression Incorporated uses an encapsulant that thermally, electrically and mechanically stabilizes components and circuits over the Surge Suppression Incorporated® product’s life. The thermal stability keeps components from prematurely going into thermal runaway and keeps the Surge Suppression Incorporated® performing consistently over extended periods of operation.

A major benefit of using encapsulating technology is the dramatic improvement in the circuit’s dielectric strength. The function of air dielectric is very unstable because the
condition of air changes constantly at the installed location. The use of our proprietary encapsulant removes dielectric variance caused by changing atmospheric conditions effecting dielectric strength. When multiplied over several cubic millimeters, the tremendous dielectric strength of the Surge Suppression Incorporated® units is realized. This benefit allows the Surge Suppression Incorporated® devices to consistently withstand strong destructive transients better, and for a much longer period of time, than non-encapsulated units.

Our encapsulant also provides mechanical benefits. Typical industrial environments create vibration and sometimes mechanical shocks. The Surge Suppression Incorporated® product circuits are kept mechanically stable in these environments because of the encapsulant. In fact, Surge Suppression Incorporated® products have been environmentally tested to duplicate this environment with no evidence of damage or wear. Other benefits of encapsulation technology include protection from dirt, dust, fungus, water, gases and high altitude.

A very significant mechanical benefit of an encapsulant is the effect on the physical dynamics of the MOV. With encapsulation, the physical expansion and contraction of the MOV disc and associated leads, caused by thermal cycling, is kept to a minimum. This prevents the MOV leads from separating from the disc prematurely, allowing the MOV to continue operating during a catastrophic transient event. These precious few additional microseconds are usually the difference between protecting equipment and not. Without an encapsulant, the MOV is vulnerable to dramatic physical changes in the disc/lead relationship. This vulnerability means that disc/lead separation can occur quickly, removing the MOV from service and leaving the equipment unprotected. Many manufacturers, that do not use encapsulating material, use a plurality of parallel MOV’s to give the circuit redundant protection. This is not altogether a bad approach, but it is a costly one. Using encapsulating technology, that is time and field proven, makes the Surge Suppression Incorporated® TVSS products robust and reliable for many years. This is why we guarantee them for 25 years.

**Printed Circuit Technology**

Another time and field proven technology is printed circuits. Surge Suppression Incorporated uses printed circuit boards in its products. Meticulous engineering goes into each printed circuit board. Surge Suppression Incorporated® circuit boards are not typical computer type boards, as some may believe. In the development of Surge Suppression Incorporated® circuit boards our Engineers combine principles of high current, high voltage, high power and RF circuit board design. Using these engineering principles, we are able to reduce circuit impedance resulting in low let-through-voltage and higher peak surge current withstand capability, providing greater equipment protection.

Here are some facts. Some of our printed circuit traces contain the equivalent copper weight of 6 AWG wire. The traces are mounted on a substrate of UL94-V0 fiberglass material. The Surge Suppression Incorporated design approach gives the Surge Suppression Incorporated® products their ability to achieve extraordinarily low let-through-voltages and outstanding voltage and current performance by reducing the circuit impedance.

A troublesome concern for some is an opinion that printed circuits are weak. Quite the contrary, with better reliability and longevity, many power supply companies use printed circuits to carry hundreds and even thousands of amps.
The resulting reliability and longevity are evidenced in the Surge Suppression Incorporated® products. Surge Suppression Incorporated does not experience printed circuit board failures. Surge suppression components will fail before the circuit cards during destructive transients.

Compared to bus bar technology, printed circuits have significant advantages. The use of a bus bar requires some type of mechanical connection (a bolt, nut or rivet, etc.) to connect the TVSS components. Mechanical connections deteriorate over time, especially in industrial environments where mechanical vibration is expected. A familiar example: Electricians are often called to "tighten" panel board connections. Loose connections within a TVSS unit will dramatically and adversely affect that unit's performance. Loose connections increase internal junction impedance. An increase in junction impedance will increase junction temperature further contributing to the loose connection problem because of thermal cycling. Additionally, an increase in junction impedance causes an increase in let-through-voltage performance leaving the equipment attached to the panel more vulnerable to transient damage - exactly what the TVSS device was intended to prevent.

By using printed circuit technology, TVSS circuits inside Surge Suppression Incorporated® devices are permanently mechanically connected and metallurgically bonded by use of solder. Internal junction impedance is kept to a minimum and remains consistent for the life of the Surge Suppression Incorporated® unit because of printed circuit technology. There is never any need to "tighten" any TVSS part inside a Surge Suppression Incorporated® unit.

**Enclosures**

All Surge Suppression Incorporated® panel units use NEMA rated enclosures. The standard enclosures are seam welded, cold rolled steel that is phosphor dipped and powder coated. Because plastic enclosures need flame ratings from UL, metal is the better choice for panel mount type surge suppressors. Ground continuity is critical when using a metal enclosure. This type of construction detail assures the user of long lasting, robust mechanical performance. The mechanical componentry is another reason for Surge Suppression Incorporated’s industry leading 25-year product warranty.

**Filtering Components**

**Sine Wave Tracking**

Many years ago our engineer friends searched for a parallel circuit that would attenuate ever-occurring ringing transients, no matter where they occurred on the sine wave. They were challenged with creating a design without adding components that would intentionally weaken the unit under strong impulse type transients. This accomplishment required carefully designed components. The result was TVSS devices that suppress frequent low-level ringwave type transients while still maintaining the strength required to mitigate lightning type impulses. These circuits use parallel resistor/capacitor (RC) filters.

Harmonics in an electrical system are an ever-increasing phenomena that if left alone can cause problems within the electrical system. The Surge Suppression Incorporated® Enhanced Sinewave Tracking circuitry is not designed as a harmonic filter and should not be expected to attenuate harmonic distortion in the electrical system.
EMI/RFI

An added benefit of transient voltage surge suppression, and sine wave tracking in particular, is its attenuation of low-level electrical noise (EMI/RFI) that travels along with the power sine wave. This type of noise can be disruptive. EMI/RFI noise, which though not necessarily destructive to equipment, can cause equipment malfunction resulting in equipment downtime. Typically, any frequency beyond 30MHz becomes a radiated rather than conducted phenomenon, especially when using simple electrical wiring like 12 AWG wire. Therefore, numbers or test results indicating TVSS filter performance beyond 30MHz should be considered suspicious at best and probably irrelevant and invalid.

Discrete All Mode Protection

A quality surge suppression device should incorporate true “All-Mode” protection. This simply means that in a device classified as an “All Mode” device there is discrete circuitry for each mode. For instance, a three-phase wye system consists of ten modes. There are three Line-to-Line modes, three Line-to-Neutral modes, three Line-to-Ground modes and one Neutral-to-Ground mode. The total of the modes is ten. By incorporating dedicated surge suppression components for each mode, this design provides the best protection with the lowest let-through voltage performance. Any device that does not incorporate discrete all mode protection is classified as a “Reduced Mode” device and should not be considered when evaluating “Quality” TVSS devices.

In Conclusion

Surge Suppression Incorporated® products are well designed, robust TVSS units that fit a variety of applications. It should be noted that a well-designed surge suppressor is only one part of a successful protection plan. A well designed Total Protection Network™, covering all potential transient entry points, is the other part of a reliable protection scheme. Additionally, proper installation of the surge suppressor products is crucial to protection success. Gaining all benefits is the result of contacting a well-trained and experienced sales representative with factory engineering support. Surge Suppression Incorporated has just such a representative waiting to serve you. For further information about Surge Suppression Incorporated and Surge Suppression Incorporated® products, please contact us at 1-888-987-8877 or info@surgesuppression.com.