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# Clamping Game

White Paper

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Usually SPD performance references the level at which the suppressor limits transient overvoltages. Manufacturers use various terms to identify this level: clamp points, voltage protection levels (VPL), let-through voltages, or breakdown voltage values. For several years many SPD manufacturers seemed to be in a contest for the right to claim that their products have the lowest clamping suppressors available. It is not uncommon to see these manufacturers boast clamping levels of 200 volt/peak or lower for their products that are intended to protect upon 120 VRMS circuits. Considering that the peak value of the 120VRMS AC sine wave is about 169.68 volts, that 200-volt/peak-clamp point sounds impressive. However, winning this contest is not a valid basis to claim they manufacture better products.

It is important to select SPDs that limit transient voltages to safe levels in order to protect sensitive equipment loads from damage. At the same time, it is important not to sacrifice more important performance characteristics of quality SPDs to unimportant incremental clamping points. But, where is the watermark? At what specific level should the Equipment manufacturers of quality SPDs limit transient overvoltages so that sensitive electronic equipment is effectively protected? The Information Technology Industry Council (ITIC) address this issue. They are a collective of numerous representatives from the leading providers of information technology products and services throughout the country.

Several years ago the ITIC published the CBEMA curve with an application note that suggests AC power disturbance vulnerability thresholds for modern Information Technology Equipment. Revised in 2000, it is publicly available on the ITIC web site. The revised CBEMA curve suggests that modern equipment is built to withstand short duration transient voltage amplitudes, like those induced by lightning activity, above nominal peak sine wave voltage values to at least 400% and approaching 500%. In terms of voltages, SPDs must limit lightning generated pulses to values between 678 and 848 volts/peak to protect these devices. Longer duration impulses resulting from non-lightning events, according to ITIC, need suppressed to levels ranging downward from 500% to limits that do not exceed 200% of the nominal peak sine wave voltage value. Clamping below those thresholds bears no benefit.

### Self-defeating Characteristics of Low Clamping SPDs

A low clamping SPD's performance can fluctuate dramatically as it is stressed by transients. The suppressor cannot clamp to limit the actual sine wave peak voltage value to safe levels. Slight voltage swells, a common regulation abnormality, may cause those suppressors to conduct current inappropriately. When SPDs attempt to serve as voltage regulators, at best, they compound the regulation problem by making it harder to identify and to resolve. In the worst case, they significantly add to fire and safety hazards. Lower clamping SPD will also be stressed more often and more frequently than one that is designed to properly protect sensitive equipment loads. It will needlessly activate more often, conduct transient current longer, and dissipate more energy than required. The end results may find the poorly designed SPD's performance characteristics rapidly degrade with use. Furthermore, low clamping suppressor products may well falter during intense and catastrophic transient events when they are relied upon to be most effective. That raises a very important question.

## **At what current values do low clamping suppressors base their reported clamp points?**

It is common to see SPDs specifications boast surge current capacities upward to one million amps. However, some of those products' published clamp points are based on conducting surge current in low milliamp ranges. Obviously, that is not a valid benchmark that can be used to aid in the selection of adequate SPDs for real-world applications.

SPDs that limit surge voltages to reasonable levels at milliamp current values will likely exhibit dramatic clamp point increases as they are called upon to operate at their maximum rated surge current capacity. Those SPDs with specifications that boast extreme value surge current capacities rarely state their clamp points for surge current values exceeding 10,000 amps. If the suppressor is listed to or recognized by current UL 1449 standards, its reported clamp point is often based upon a 500 amp current test pulse. Few if any SPD manufacturers report their SPD's clamping performance at their products' full rated surge current capacity. This is, in part, because surge current test equipment capable of generating surge currents in the high six figure amperage ranges does not exist.

### **Deteriorating Clamping Voltage Levels**

Another suppressor performance consideration that is routinely omitted from most specifications are increasing VPLs after the suppressor has been subjected to repeated high current transient impulses. With this activity, many SPDs exhibit a pattern of degradation, and their clamping performance often deteriorates under stressful conditions. Suppressor clamp points typically move up to levels that may no longer provide adequate protection against transient activity. At higher surge current capacities a poorly designed SPD's voltage protection level (VPL) will increase significantly.

It can be counterproductive to base the selection of surge suppression equipment solely on a product's advertised clamp point. Some manufacturers are honest about this while others are not. Simple research of popular SPD models, available from a variety of manufacturers, bears this conclusion. For example, one competitor boasts that a specific SPD model, intended to protect upon 208/120 VRMS 3-phase distribution panels, limits transient overvoltages to 270 volts peak on individual 120 VRMS lines. That product's specifications report that the clamp point is based upon the suppressor being subjected to an IEEE C62.41 Category C1 (6kV/3kA 1.2/50 8/20usec) combination wave transient test pulse. However, as stated by their own specifications, that voltage protection level increases to 660 volts as the device is subjected to a higher voltage, higher current Category C3 test pulse. You see similar clamping characteristics across the board for this particular manufacturer's entire product line.

In another example, a company reports that their products clamp anywhere between 325V and 625V under identical test conditions, even though their UL 1449 clamp point is reported at 400V. Many examples were found of manufacturers that make no mention at what current value their product's clamp point is based.

### **Conclusion**

It can be counterproductive to base the selection of surge suppression equipment solely on a product's advertised clamp point. It is important though to select inherently safe suppressor products that limit transient overvoltages to levels that are contained within and throughout the parameters set forth in CBEMA's curve. This alone assures sensitive equipment users that their equipment will be adequately protected against transient activity.