

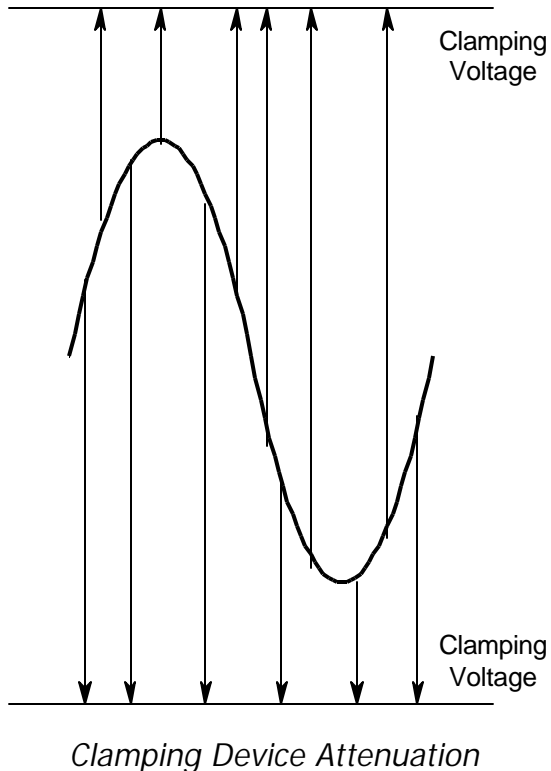
## MOV's and SASD's

Transient Voltage Surge Suppression (TVSS) is an important part of any power conditioning strategy. High energy impulses are some of the most damaging and visible types of power problem. A successful power conditioning strategy *must* protect sensitive equipment from these impulses.

### Clamping Impulses

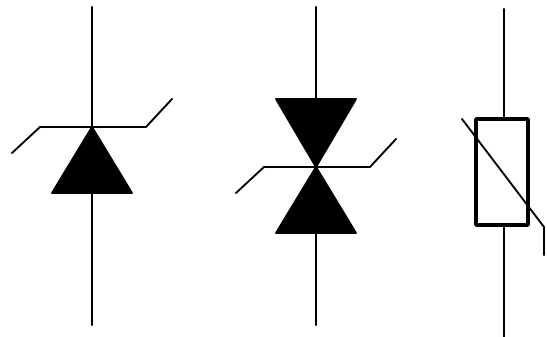
There are several methods of suppressing high energy voltage transients. *Filtering* uses capacitive and inductive elements to absorb the impulse energy. However, most TVSS devices use *clamping* elements to limit the transient voltage.

*Clamping* devices use a non-linear element that conducts or shorts when exposed to overvoltage. Such a device absorbs a large portion of the impulse energy, converting it to heat.



## Application Note - AN-11

There are many types of clamping devices available. Two of the most common are *Metal Oxide Varistors (MOV)* and *Silicon Avalanche Suppression Diodes (SASD)*. This application note describes the technical merits and drawbacks of these two types of clamping devices, and identifies the best applications for each.



**Silicon  
Avalanche  
Suppression  
Diode (SASD)**

**Bi-directional  
SASD**

**Metal Oxide-  
Varisto (MOV)**

### Metal Oxide Varistors

The MOV is one of the most common clamping devices. MOV's are used throughout the electronics industry as overvoltage protection devices. They are bidirectional devices, working in both positive and negative directions. This makes them suitable to use on AC circuits.

MOV's are composed of a thin disc or wafer of a material (metal oxide) that has a known voltage breakdown characteristic. At low voltages, the MOV conducts very little current (micro-amperes). As the voltage approaches breakdown, the MOV begins to conduct current. At voltages slightly above the breakdown, large currents flow, effectively clamping the output voltage.

MOV devices are inherently consumable. Many small impulses, or one large one, cause degradation in the

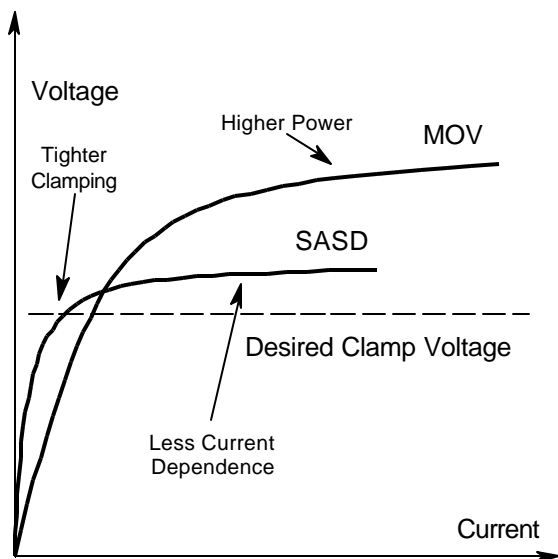
metal oxide material, which eventually leads to component failure.

### Silicon Avalanche Suppression Diodes

SASD devices perform similarly to MOV devices. Instead of metal oxide, the SASD uses a silicon based diode, similar to a Zener Diode. The SASD device is inherently unidirectional. Two devices in a back to back configuration are required to clamp AC voltages.

SASD devices have some inherent advantages over MOV's. They have a sharper bend in the curve around the breakdown voltage. As a result, they can be specified to clamp closer to the normal peak voltage of the AC waveform. In addition, they do not degrade with repeated uses, as do MOV devices.

Balancing these benefits are the relatively low power handling of the SASD devices. To provide the equivalent energy rating of an MOV, many SASD devices in parallel are required. As a result, SASD based surge suppression often costs much more than MOV based devices.



### Deciding on a TVSS Technology

For a given application, a decision must be made regarding which TVSS device is best suited. Each device has benefits, costs, and limitations, and the right answer for one application is not necessarily the right answer for all applications.

Parameter	MOV	SASD
Clamping Voltage	Higher	Lower
Degradation	Yes	No
Current Dependence	Higher	Lower
Cost	Lower	Higher
Complexity	Lower	Higher
Power Handling Capacity	Higher	Lower

In most cases, an MOV-based surge suppressor must provide for eventual device degradation. TVSS manufacturers that rely on MOV devices often design in redundancy, replaceable modules, and fault indicators to provide for MOV degradation and/or failure.

The SASD device provides some benefits in terms of better clamping. However, the higher cost of this clamping can only be justified if the load truly requires this tighter protection.

### TVSS Devices in Power Conditioners

Most stand-alone TVSS devices use clamping devices alone to provide surge suppression. It is not practical to add filtering to these devices. As a result, the MOV vs. SASD decision is critical in stand-alone surge suppressors.

In power conditioners, which incorporate filtering and isolation transformers, the type of clamping suppression is far less critical, for a number of reasons:

- 1) The high energy filter provides primary impulse attenuation. As a result, the clamping device is required only during the worst case impulses.
- 2) The transformer impedance limits impulse currents, reducing the energy that the clamping device must absorb.
- 3) Clamping device failure is not as critical, since the high energy filter will remain active to provide superior protection

Because of these reasons, most power conditioning manufacturers choose MOV based clamping devices as an effective device to clamp impulse voltages.

**TEAL Electronics** designs power conditioners using both filters and clamping elements to provide the highest levels of impulse protection available.