Paralleling Transient Voltage Suppressors for Higher Power Capability

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Silicon avalanche transient voltage suppressors (TVSs) offer a great deal of flexibility in circuit protection. These devices are available in voltages ranging from 5 through 400 V, and in power ratings from 300 through 6000 W.

In addition, they have been successfully used in higher voltage and power combinations, by configuring multiple TVSs in series (see "Series Stacking of TVS for Higher Voltages and Power"), or in parallel.

PARALLELING FOR HIGHER POWER – THE BASICS

Power ratings for individual TVSs are expressed in Watts, based on an industry standard pulse waveform, which has a 10 ms rise time, and an exponential decay to 1/2 its peak at 1000 µs. They can be derated for other pulse waveshapes in accordance with the power vs time graphs on datasheets (see "Using the Power vs Time Curve").

For an application in which known transient power exceeds these limits, it is possible (with appropriate cautions) to configure two or more TVSs in parallel. In this configuration, they will provide the same voltage response (reverse stand-off voltage and breakdown voltage) as a single unit. Leakage current will increase in proportion to the number of units paralleled. The primary advantage in paralleling TVSs in this manner is increased current and power handling capability.

The basic requirement is that they be matched in terms of clamping voltage, in order to share transient current equally.

CURRENT SHARING

As a first approximation, Figure 1 shows an example in which a 300 V transient of 150 A total current is divided among three TVSs (p/n 1.5KE15) in parallel. 150 A is greater than the rated capability of a single such TVS. However, by sharing the current equally, each TVS shunts 1/3 of the current or 50 A to ground. This value is within its rated capability, and the transient is safely clamped to 20 V, protecting the load from damage.

MATCHING

While all three TVSs in this example are of the same part number, each individual unit has its own value of breakdown voltage, reverse leakage and clamping voltage. These shifts are due to minor differences in dynamic impedance; all within the allowable specification. If close attention is not paid to matching these units, the device with the lowest breakdown voltage will typically conduct first and will be required to handle a disproportionate share of the transient current.

Matching of devices on the basis of clamping voltage under pulse conditions at a moderate current level is recommended. Rather than measuring low-current breakdown voltage only, this method provides accurate voltage matching by taking into account the dynamic effects under higher current. Each device is subjected to a known pulse level, such as a 1 A, 1 ms rectangular pulse. Clamping voltage is then monitored by a storage oscilloscope or peak reading voltmeter with sufficiently fast response. Units can then be sorted into groups of 1 % tolerance for best current sharing performance. In board layout, keep lead lengths and circuit board traces in the shunt path as short as possible.

Through proper selection and configuration, an effective transient suppressor combination can be achieved for almost any protection need.

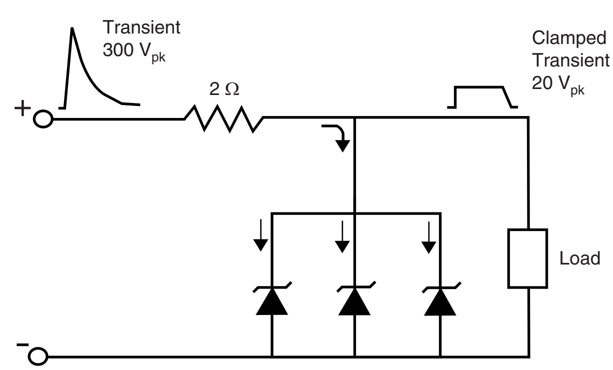

Figure 1.