MicroNote 106

Crowbars and Clamps: What Are Their Major Differences?

By Kent Walters and Mel Clark

This note highlights the differences between thyristor surge protective device (TSPD) crowbars and conventional silicon transient voltage suppressor (TVS) clamp components used for protecting vulnerable silicon microchips from voltage spikes. Each type has its unique features that complement each other.

The advantage of the TSPD is its low on-state voltage after triggering, which provides much higher surge current capability for a relatively small chip size compared to a clamp device. A 1.5KE200C (bidirectional TVS clamp) will handle 5 A for a 10/1000 µs surge while a TSPD with the same chip size can safely conduct 200 A for the same surge duration.

The reason for this major difference is illustrated by comparing characteristic curves of the two devices. Figure 1 (see page 1) depicts the familiar V-I curve for a bidirectional TVS. Peak pulse power rating (P_{PP}) is the product of clamping voltage (V_C) times peak pulse current rating (I_{PP}), and is limited by the maximum allowable junction temperature.

Figure 1: TVS V-I Curve (Bidirectional shown)

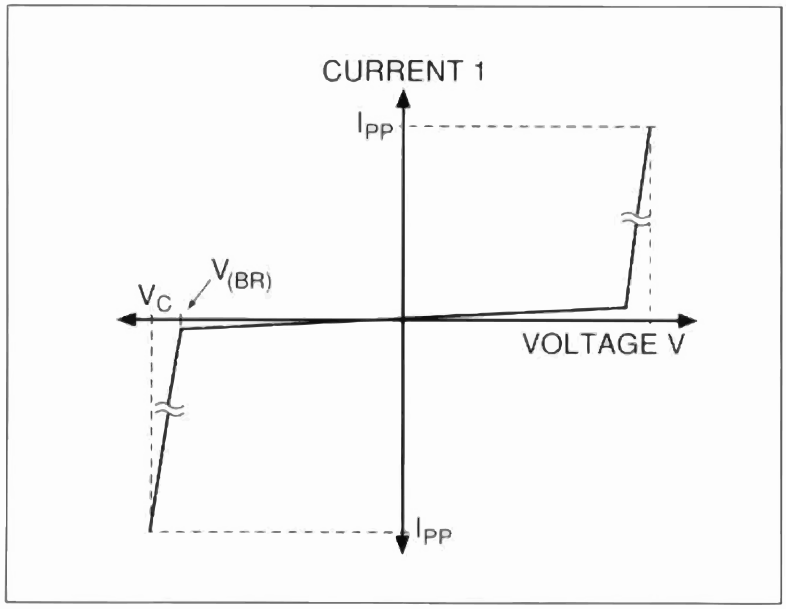
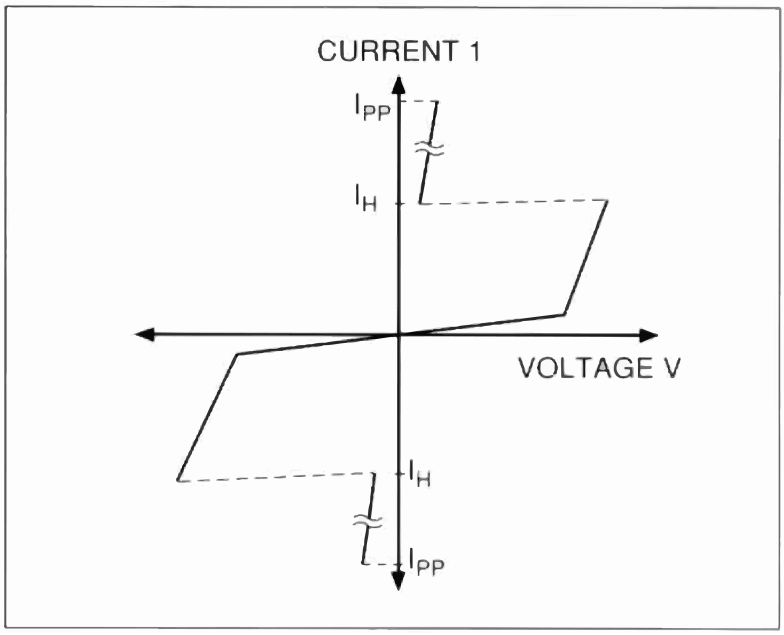


Figure 2: TSPD V-I Curve (Bidirectional shown)



The TSPD on-state condition allows greater surge current conduction (for equivalent power) compared to a clamp device, since the TSPD on-state voltage is significantly lower than the TVS clamping voltage.

For restoration to nonconduction, TSPD current must be interrupted or reduced below the holding current (I_H). This limits the use of TPDs to applications associated with low driving currents, such as signal and communication lines. In contrast, silicon TVSs restore to nonconduction when the driving voltage drops below breakdown voltage ($V_{(BR)}$) so they are not subject to this limitation.

Surge current capability of TSPDs often include 50 A, 100 A, and 200 A ratings for a 10/1000 µs surge. Operating voltages typically cover a broad range, from 12 V up through several hundred volts.

A typical use for TSPDs includes protection across signal and control lines exposed to harsh lightning conditions. These include central office telephone systems, PABXs, consumer subscriber stations, faxes, and modems. Other applications include protection of instrumentation and SCR switches for remote controls.

Silicon avalanche TVSs find use across signal lines in less harsh environments for protection from secondary lightning effects and electrostatic discharge (ESD). TVSs are also used across power supplies where the device must restore to nonconduction without interrupting or severely limiting voltage or current flow to the load.

The capacitance of the TSPD is considerably lower than its TVS counterpart, particularly at the lower end of the voltage spectrum. This lower capacitance minimizes signal attenuation for high-data-rate signals.

TVS devices are available over a continuous voltage spectrum from 5 V up through several hundred volts, providing more voltage selections compared to the TSPD.

The TSPD crowbar is most useful for protection across communication and control lines exposed to harsh lightning environments. The TVS is applicable for protection from secondary transient effects, ESD, and across dc power buses. Each of these two device types is suited for specific uses and complements the other in providing optimal protection.

Support

For additional technical information, please contact Design Support at:
http://www.microsemi.com/designsupport
or
Kent Walters (kwalters@microsemi.com) at 480-302-1144

Microsemi
a Microchip company

Microsemi Headquarters
One Enterprise, Aliso Viejo,
CA 92656 USA
Within the USA: +1 (800) 713-4113
Outside the USA: +1 (949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996
Email: sales.support@microsemi.com
www.microsemi.com

Microsemi, a wholly owned subsidiary of Microchip Technology Inc. (Nasdaq: MCHP), offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions; security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, California, and has approximately 4,800 employees globally. Learn more at www.microsemi.com.