MicroNote 128

1 Unidirectional/Bidirectional TVS Differences

By Mel Clark and Kent Walters

Silicon transient voltage suppressor (TVS) datasheets normally depict the unidirectional types. These have either no suffix or an "A" suffix denoting a lower clamping voltage level. At the bottom of the datasheet, or in the Features section, is a notation to add a "C" or "CA" suffix to denote bidirectional. Device series specifically for bi-directional applications are so noted on the datasheet masthead.

Unidirectional TVSs fit the normal diode characteristic curve with avalanche conduction in the third quadrant, as shown in Figure 1 (see page 1), for the normal operating polarity where the cathode is biased positively in the circuit shown. This characteristic clips short duration spikes in the avalanche direction.

Figure 1 • Figure 1: Unidirectional TVS

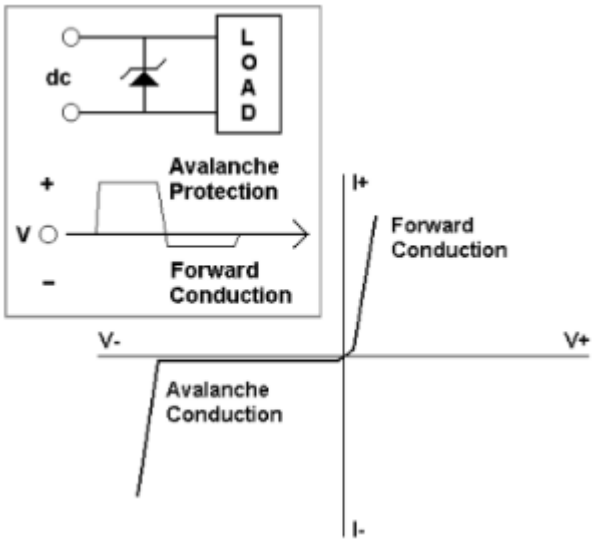
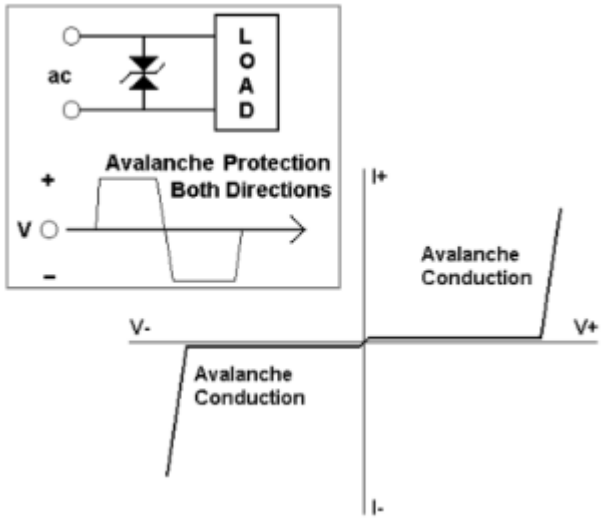


Figure 2 • Figure 2: Bidirectional TVS



Shown in the first quadrant of Figure 1 (see page 1), where the anode is biased positively relative to the cathode, is the diode forward-voltage characteristic for the low voltage conduction mode. Transients are clipped in this direction as well but at a low level on the order of a volt or two. Higher power devices including the 15KPxxx and 30KPxxx series use stacked die and have higher V_F values. Newer surface mount MPLADxxx devices with similar high power ratings and much larger p-n junctions only have one or two die in series, resulting in low V_F values. Unidirectional devices are used across dc power and dc signal lines. CMOS ICs are very vulnerable to transients in the forward direction, so the TVS low clamping in the forward diode direction prevents failure. Many discrete components fail from voltage spikes in the forward conduction mode, hence the need for unidirectional protection. If either a unidirectional or bidirectional TVS device will work in a given circuit, a unidirectional TVS is usually selected for lower cost.

Bidirectional TVSs are bilaterally symmetrical (see Figure 2 (see page 2)) and intended for use on ac power lines and signal lines having both positive and negative excursions. A unidirectional device would obviously fail in an ac circuit while conducting in the negative direction and also clip off one side of the data on a signal line. For low current unidirectional applications in which polarity is of no importance, engineers occasionally specify bidirectional devices as ensurance against wrong polarity TVS hookups for field installation. Bidirectional devices can be made with two p-n junction in the same chip or with two separate chips in series facing opposite directions in the same package. There is no polarity symbol or cathode band on bidirectional devices.

1.1 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 (see page 1)

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

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