The Differences Between Unidirectional and Bidirectional TVS Devices

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UNIDIRECTIONAL TVS DEVICES

Figure 1 shows a positive and negative transient at the input of a device protected by a unidirectional TVS diode.

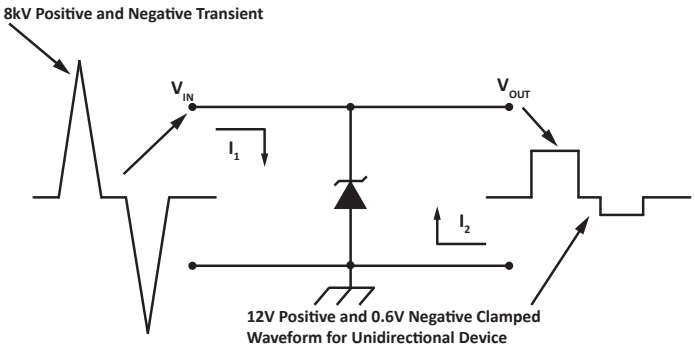

Figure 1. Unidirectional Device (Asymmetrical Clamping)

During a transient's positive cycle, the TVS diode junction is reversed biased. The diode acts in avalanche mode as the transient current (I_1) flows to ground. The transient clamps at or below the maximum clamping level provided by the TVS diode.

During a transient's negative cycle, the TVS diode junction is forward biased. The transient is clamped at one diode drop (~0.6V) as the TVS conducts the transient current (I_2) in the forward direction.

The avalanche breakdown ($V_{(BR)}$ - I_R) depicted on a Unidirectional V-I curve is shown in Figure 2. This is the level in which a diode will start conducting in the reverse direction with the application of a transient (not to be confused with the maximum clamping voltage).

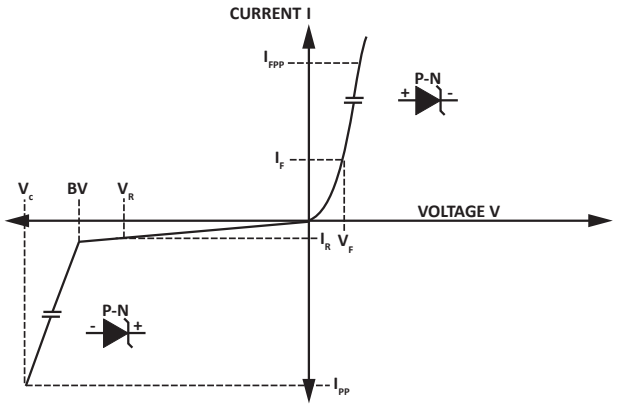

Figure 2. Unidirectional V-I Curve

Discrete components can fail from voltage spikes in the forward direction. While both unidirectional and bidirectional TVS devices offer circuit protection for this type of transient, the unidirectional device is usually lower in cost.

BIDIRECTIONAL TVS DEVICES

Figure 3 shows a positive and negative transient at the input of a device protected by a bidirectional TVS diode.

During a transient's positive cycle, the TVS diode D1 is reversed biased while the other diode D2 is forward biased. D1 acts in avalanche mode (similar to a unidirectional diode) as the transient current (I_1) flows to ground. The transient clamps at or below the maximum clamping level provided by the TVS diode.

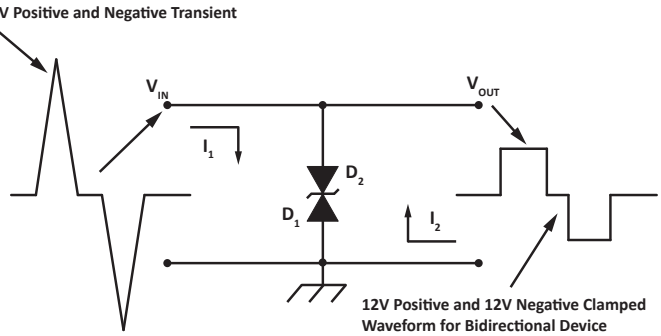

Figure3. Bidirectional Device (Symmetrical Clamping)

During a transient's negative cycle, D2 is reversed biased, while the other diode D1 is now forward biased. D2 acts in avalanche mode as the transient current (I_2) is clamped at one diode drop (~12V) as the TVS conducts the transient current in the forward direction.

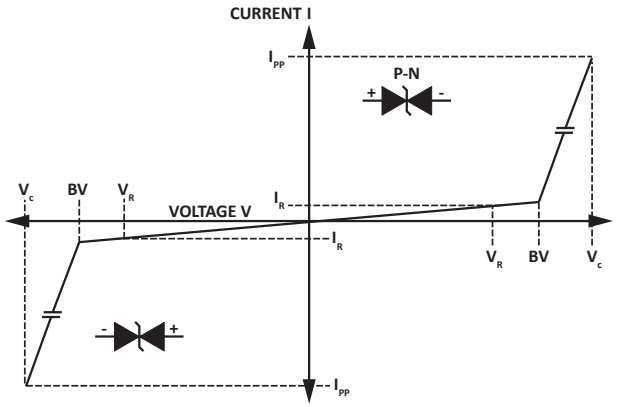

Figure 4. Bidirectional V-I Curve

The avalanche breakdown ($V_{(BR)}$ - I_R) depicted on a Bidirectional V-I curve is shown in Figure 4. This is the level in which a diode will start conducting in either directions with the application of a transient (not to be confused with the maximum clamping voltage).

Bidirectional devices typically offer multiple lines of circuit protection and are used in applications where a unidirectional configuration is not sufficient.

COMPANY INFORMATION

COMPANY PROFILE

ProTek Devices, based in Tempe, Arizona USA, is a manufacturer of Transient Voltage Suppression (TVS) products designed specifically for the protection of electronic systems from the effects of lightning, Electrostatic Discharge (ESD), Nuclear Electromagnetic Pulse (NEMP), inductive switching and EMI/RFI. With over 25 years of engineering and manufacturing experience, ProTek designs TVS devices that provide application specific protection solutions for all electronic equipment/systems.

ProTek Devices Analog Products Division, also manufactures analog interface, control, RF and power management products.

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