

**PROTECTION PRODUCTS**

**TVS Diode Selection**

Selection of a suitable component will depend on the number of lines to be protected, the available board space, and the electrical characteristics of the circuit to be protected. TVS diodes are available in a variety of packages and configurations suitable for use today's advanced electronic systems. For high power applications, single device surface mount and axial leaded packages are used. TVS arrays available in standard JEDEC S0 packages may be used to protect multiple lines. In situations where board space is at a premium, devices available in SOT23 packages are a low cost alternative.

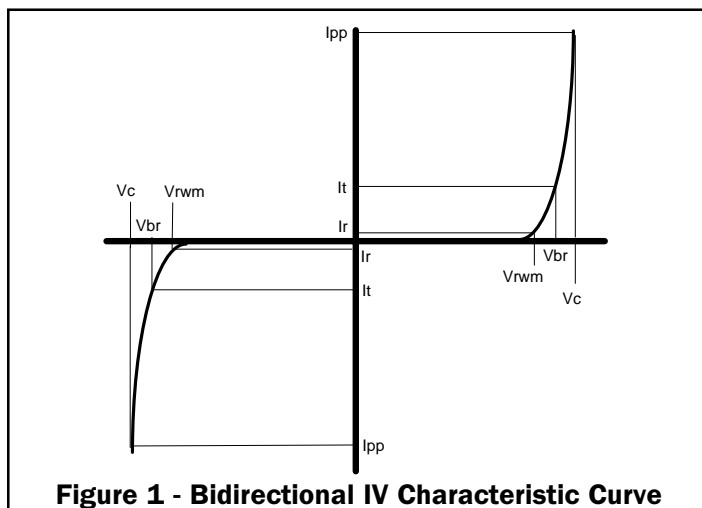
No matter what the application however, certain device parameters and guidelines form the basis for device selection.

**TVS Diode Terminology**

A typical IV characteristic curve for a bidirectional TVS diode is shown in Figure 1. The key device parameters are:

**Reverse Standoff Voltage ( $V_{RWM}$ )** : This is the normal dc operating voltage of the device. At this point, the device will appear as a high impedance to the protected circuit. Discrete devices are available with standoff voltages ranging from 2.8V - 440V. This parameter is also referred to as working voltage.

**Reverse Breakdown Voltage ( $V_{BR}$ )** : This is the point where the device begins to conduct in avalanche mode and becomes a low impedance path for the transient. Breakdown voltage is measured at a test current ( $I_T$ ), typically 1mA or 10mA.



**Figure 1 - Bidirectional IV Characteristic Curve**

**Peak Pulse Current ( $I_{PP}$ )** : Maximum permissible surge current which the device can withstand without damage. TVS diode data sheets specify a peak pulse capability for a particular transient waveform. Most TVS diodes are rated using an 8/20 $\mu$ s or 10/1000 $\mu$ s impulse waveform.

TVS diodes can withstand higher peak pulse current for shorter duration pulses.

**Clamping Voltage ( $V_C$ )** : Maximum voltage drop across the TVS for a particular peak pulse current.

**Selection Guidelines**

TVS diode selection involves comparison of device parameters with circuit conditions. The following selection guidelines are recommended:

- 1 Select a device with a reverse standoff voltage greater than or equal to the normal operating voltage of the circuit.
- 2 Select a device which is capable of dissipating the expected transient peak pulse current.
- 3 The device clamping voltage should be less than the maximum voltage handling capability of the protected circuit for the same pulse waveform.
- 4 For systems using high speed data rates, device junction capacitance will have to be considered. Semtech manufactures special low capacitance devices for those applications.

There may be applications where the actual transient current cannot be defined. Often, the designer will have to meet the requirements of certain transient immunity specifications. At the very least, identification of the source of the threat is necessary; lightning, inductive switching, ESD, etc.

Device Parameter		Circuit Conditions
$V_{RWM}$	$\geq$	Normal circuit operating voltage
$I_{PP}$	$\geq$	Expected transient current
$V_C$	$\leq$	Maximum allowable voltage across the protected component
$C_J$	$<$	Maximum loading capacitance for signal integrity

**Figure 2 - Selection Summary**