MicroNote 118

TVS/Chip Product Overview

By Mel Clark and Kent Walters

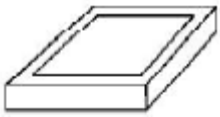
To reduce the size and weight of discrete diodes, the most common practice is to strip the package, leaving only the silicon chip (die). This can effectively reduce 90%–95% of both weight and volume for direct mounting on high-density substrates.

All Microsemi TVS diodes are available in TVS/chip or TVS/cell options. Zeners, reference diodes, and rectifiers are also available in chip or cell forms. Chips are typically mounted to the substrate with conductive epoxy, while wire bonds connect to the top of the die for high-density packaging. Microsemi's selection of TVS chip size products include: TVS/Chip™, TVS/Cell™, SMT/Cell™, TVS/FlipChip™, and others.

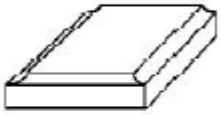
TVS/Chip

Three different TVS/chip types (planar, mesa, and bidirectional mesa) are shown in the following illustration. Bidirectional mesa chips may require a disc on the underside to prevent shorting of the bottom side junction when mounted. Chips are usually square or hexagonal, depending on footprint and surge rating requirements.

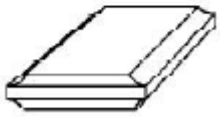
TVS/Chip Options



A. Planar



B. Mesa



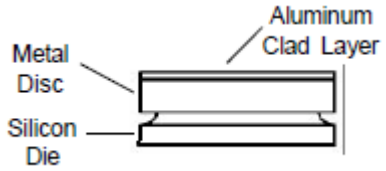
C. Bidirectional Mesa

Metalization is solderable on both top and bottom for attachment. For wire bonding, aluminum top is offered with gold bottom for conductive epoxy or gold-silicon eutectic bonding.

TVS/Cell

For multiple wire attachment and more parallel bond wires, the windows can be enlarged by a factor of four to five by adding an aluminum clad disc on the top side as shown in the following illustration. A chip with a single disc is called a half cell.

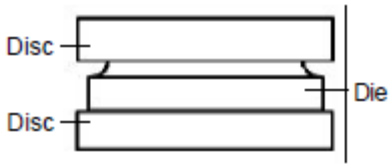
TVS/Cell for Enlarging Bond Area



The attached disc (typically with 95Pb5Sn) in the previous illustration adds additional thermal mass to the junction side of the die. This improves pulse power capability by conducting heat away from the junction and also spreads the current more evenly across the junction. A TVS/chip by itself is limited to about one-half to two-thirds of its capability, compared to the same chip mounted in a leaded package with optimum electrical and thermal conductivity.

The TVS/cell with discs on both top and bottom are even more rugged for transient suppression, because thermal mass is greatest in this configuration. This is illustrated in the following illustration.

Double Disc TVS/Cell Device

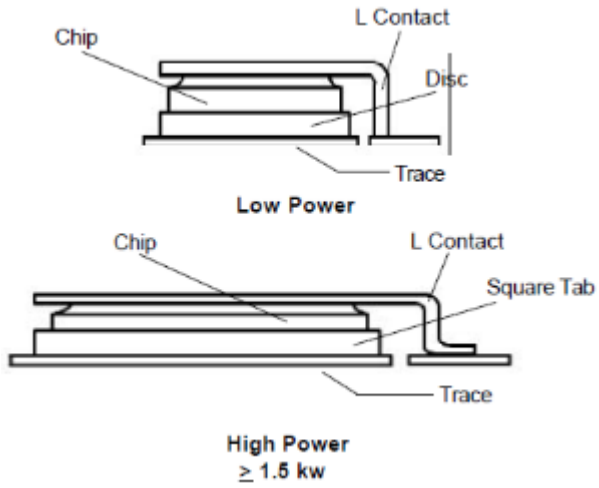


Chips can be stacked for higher power on a single cell footprint. For example, two 14-V, 1.5-kW chips can be stacked in series to produce a 28-V, 3-kW cell. See MicroNote 112 on stacking TVSs for higher power. The maximum stack height is typically three chips.

SMT/Cell

Cellular-type TVS devices are available with both attachments on the bottom and do not require wire bonding. Both cathode and anode terminals of the device are in the same plane and can be surface mounted between closely spaced bond pads with negligible parasitic inductance in the protective surge current path. Mounting is shown in the following illustration.

SMT/Cell TVS Device



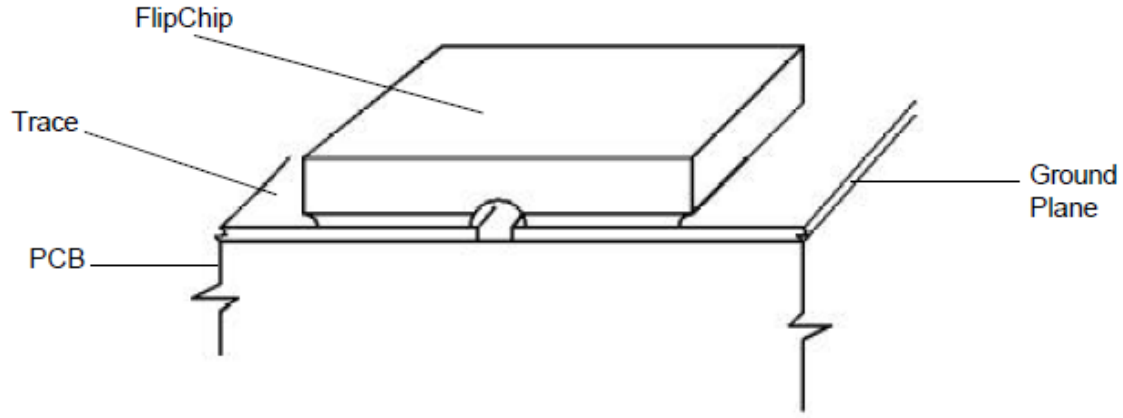
Higher power ratings (up to 6,000 W) are available in the SMT/cell configurations. The chips may be hexagonal with round discs at the bottom or square with corresponding L contact, depending on footprint or size requirements. Higher power requirements require proportionally greater size.

All TVS/cell and SMT/cell devices are fabricated with high temperature solder or bonding materials with melting temperatures greater than 300 °C to prevent remelt in subsequent processing.

TVS/FlipChip

For low profile and pulse power ratings of 600 W and below, the TVS/FlipChip is an excellent option for surface mount applications. The major advantage of this device is there is virtually no parasitic inductance, hence no L(di/dt) effects. As a result, 100 ps rise-time ESD events are clamped to lowest possible levels. TVS/FlipChip mounting is shown in the following illustration.

FlipChip on Substrate



All trace lengths in the protection path must be virtually zero for optimum performance (see MicroNote 111).

Voltages are offered across the spectrum of discrete component equivalents. If standard products do not meet your needs, custom devices can usually be tailored for voltage and power rating.

Other Chip Products

Microsemi also offers a broad line of Zener diodes, rectifiers, Schottky rectifiers, thyristor suppressors, and a host of other diode types to meet your needs. These are also available in chip, cell, or SMT/Cell forms as required.

Microsemi offers the broadest diode chip and cell offerings to the growing multichip module markets and we would like to assist with your design requirements.

Note: TVS/chip, TVS/cell, SMT/cell, and TVS/FlipChip are registered trade marks of Microsemi Corporation.

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
Power Matters.

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