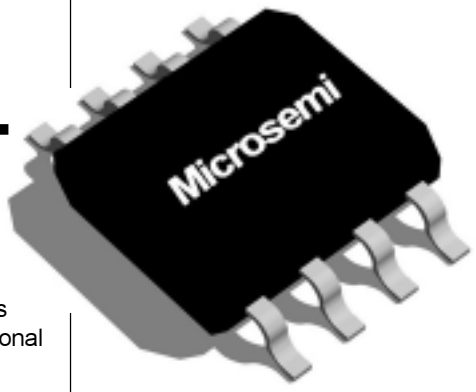
MicroNotes

MicroNote Series 121

by Mel Clark and Kent Walters

Protecting Data I/O Ports With TVSarrays™



Downsizing of packaging has mandated the consolidation of protective diodes into small transient voltage suppressor (TVS) arrays which occupy a fraction of the board space of their discrete equivalents. To meet this demand, Microsemi now offers TVSarrays in the most frequently used operating voltages; 3, 5, 12, 15 and 24 volts in the tiny SOIC-8 package.

Microsemi's multi-diode TVSarrays protect from conditions described by IEC-1000-4-2, electrostatic discharge (ESD) and IEC-1000-4-4, electrical fast transients (EFT) along with induced lightning effects. More than ten separate series are now available to provide the design engineer with a broad range of choices for optimizing his/her circuit board layout.

These include separate components in the SMDA (300 watt) and SMDB (500 watt) series for applications requiring circuit isolation. Four line unidirectional protection is illustrated in figure 1. This configuration is for signal voltages biased in only one direction. For signals that swing in both the positive and negative directions, bidirectional protection is required as illustrated in figure 2. Both 300 watt and 500 watt peak pulse power (8/20 μs) ratings are offered in the SMDA and SMDB series respectively.

Additional TVSarray configurations offered include bidirectional 5 line and 7 line protection arrays as illustrated in figures 3 and 4. These are for protecting lines having a common ground reference and signals having both positive and negative excursions. Note that in each array, one diode (pin 8) provides the final ground path and bidirectional feature.

Six line unidirectional protection is provided by the TVSarray illustrated in figure 5. This device is intended for protection of unidirectional signal circuits sharing a common ground reference.

High data rate protection with minimal signal attenuation is provided by reducing the effective capacitance of the suppressor by adding a low capacitance rectifier chip in series and in opposite polarity to the TVS chip as shown in figure 6. The rectifier in the USB series has ultra low capacitance to provide excellent performance at multi-megabit data rates of less than 2.5 pf per line (5 pf/line pair). The USB0805C (5 V) was designed specifically for Universal Serial Bus protection while operating at 12 Mbs. From initial market tests and prototype evaluation at the system level, Microsemi's USB protector has proven capability. For additional information on this product refer to MicroNote Series 117 on our web site or in the Winter 1997 issue of MicroCurrents.

Each low capacitance TVSarray (figure 6)protects two wires. Pins 1 and 2 are connected together as are pins 7 and 8. This provides bidirectional protection for one wire. Pins 3 and 4 are tied together as are 5 and 6 for protecting the second wire of the USB data line.

The major advantage of the USB0805C is its suppression method where the voltage spike is conducted directly to common. Alternative methods which suppress by directing the transient to the voltage rails can induce spikes onto the power rails and subsequently to other circuit components. For unidirectional protection, the TVSarray

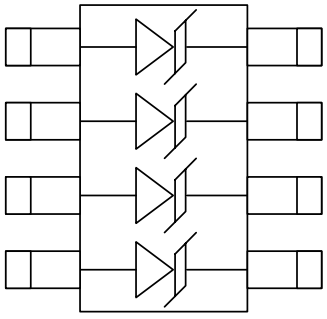


Figure 1
Unidirectional

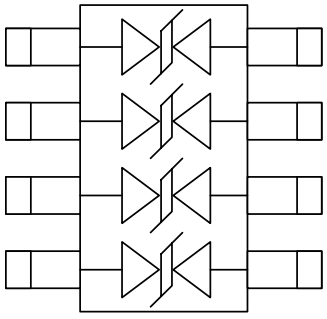


Figure 2
Bidirectional

* TVSarray - Copyright of Microsemi Corp.

Application notes

is reverse biased on the signal line with its breakdown voltage approximately 10% greater than its operating voltage. When a positive voltage spike exceeds the TVS breakdown voltage, it is limited to the clamping voltage with the excess energy converted to heat in the TVS chip which is subsequently dissipated through the mounting leads. Negative transients are clipped by the diode in the forward conductive mode.

For signals that swing both positive and negative, bidirectional TVSarrays are available for these applications. All electrical specifications are symmetrically bilateral for each line; they are identical in both positive and negative going directions.

Placement of a TVSarray should be immediately adjacent to the input line to minimize radiation into the protected circuit. If compatible with the circuit impedance, series resistors can be added at the signal line inputs to reduce current levels of the incoming transient voltage spikes as illustrated in figure 7.

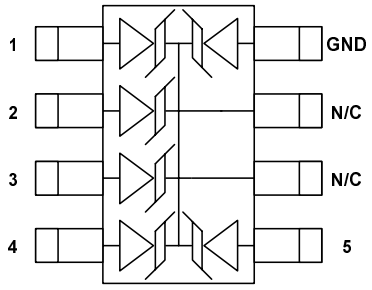


Figure 3
Bidirectional Five line

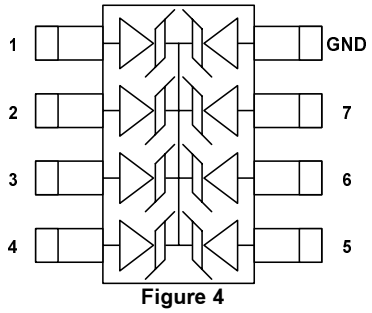


Figure 4
Bidirectional Seven line

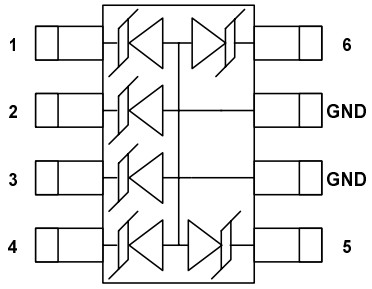


Figure 5
Six Line Unidirectional Protection

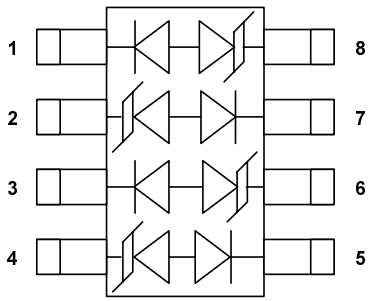


Figure 6
Low Capacitance Array
USB0805C

Microsemi's USB0805C was designed for ultra low capacitance data line transient suppression. The device was developed for the emerging Universal Serial Buss technology which is beginning to surface in desktop computers and peripherals. Microsemi's device offers 1/2 the capacitance of similar industry products and is typically less costly to implement.

Fig. 7. Input Protection Enhancement TVSarrays are intended to provide protection across data lines in EIA standards RS-232, RS-422, and RS-423 systems. The low capacitance TVSarray is designed for RS-485 (for 25pf) with the ultra low capacitance TVSarray (2.5 pf) for use on multi-megabit data lines for USB, video, “Fire Wire” and other high speed data lines.

For more information on this product and its applications, visit our web site or call Microsemi - Scottsdale at 602-941-6300 and ask for Mel Clark, Steve Bulissa, or Kent Walters.

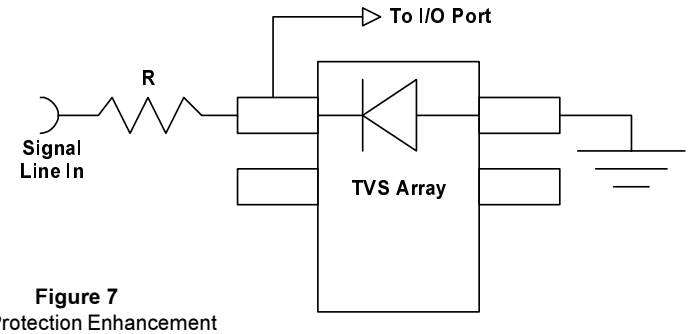


Figure 7
Input Protection Enhancement