

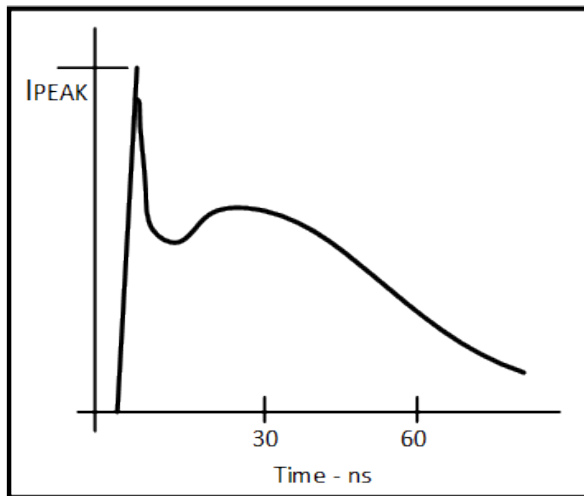
MicroNote 109

Protection from Electrostatic Discharge

By Mel Clark and Kent Walters

Electrostatic discharge (ESD) has reportedly caused more damage and upset to microchip electronics than any other threat. IEC 801-2 specification defines the worst case as a discharge of 15 kV with a current of 15 A. The current waveform of this threat is shown in the following figure. Some manufacturers qualify equipment for ESD levels up to 25 kV.

Figure 1: IEC 801-2 ESD Current Waveform



According to susceptibility data published by the government-funded Reliability Analysis Center in Rome, New York, most integrated circuits are susceptible to ESD levels of 2,000 V or less. Your fingertips can't feel 3,000 V, but your computer can. You can cause damage without even knowing it.

ESD can enter a circuit through conduction (for example, from a fingertip arc) or through the radiation of a nearby spark. Movable metal furniture—such as chairs and carts—are also sources of static buildup and discharge. Air discharges can have very fast rise times of less than 100 picoseconds for values below 1 kV. Equipment upset at voltages below 4 kV (but not 10 kV) are attributed to super fast rise times, which readily induce unwanted voltages into sensitive circuits.

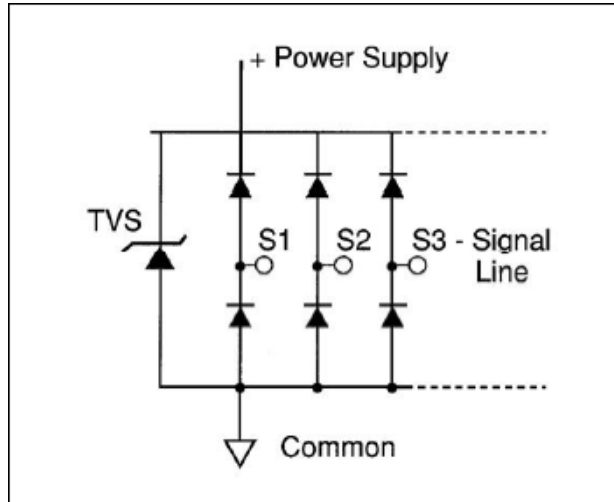
A low clamping suppressor device with fast turn-on time—such as a silicon transient voltage suppressor (TVS)—is often used to protect from such a destructive phenomenon. These devices have a proven history of protecting from ESD in communication systems, computer data ports, keyboards, laser printers, instrumentation, medical monitoring apparatus, and various other applications. For ESD, a relatively small device is adequate, such as one of Microsemi's 1.4K ESD axial lead series or the SM1.4KESD and MLL1.4KESD surface-mount series. However, if induced lightning is also a threat, a larger device rated at 600 W, or even 1500 W, may be required to withstand the more severe lightning surges.

For high data rate lines, the small devices referenced above normally have sufficiently low capacitance for acceptable attenuation up to 10 Mbps.

For higher data rates, Microsemi also offers very low capacitance TVS options in its new USB0805C and SM8LC series in SO-8 packages.

The 600 W and 1.5 kW higher power devices have proportionally higher capacitance that will significantly attenuate at high baud rates. To minimize capacitance for these high threat applications, low capacitance steering diodes (such as 1N4001 rectifiers) are sometimes used. Two diodes are used per line to direct transients to either the + side of the power supply line or to the ground plane, as shown in the following figure. A silicon TVS directs the surge to ground, keeping it out of the power system.

Figure 2: Steering Diodes with TVS



For greater efficiency and fewer components, Microsemi offers TVSs with low capacitance rectifiers integrated into one package for 500 W (SAC series) and 1500 W (LC series).

For effective ESD protection, it is necessary to have low parasitic inductance in the TVS conductive path. The TVS should be placed where the transient enters the circuit board to reduce radiation from reaching sensitive components beyond that point.

Support

For additional technical information, please contact Design Support at:

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