MicroNote 104

Using the Power vs. Time Curve

By Kent Walters and Mel Clark

The maximum transient power and current capability of a silicon transient voltage suppressor (TVS) can be derived for conditions other than the 10/1000 µs pulse specified on datasheets by using its peak pulse power versus pulse time curve.

Most TVSs are rated for 10/1000 µs non-repetitive pulses—10 µs being the rise time and 1000 µs being the time to decay to one-half peak value—based on an early telecom specification. Real world conditions produce a vast array of waveforms having pulse widths ranging from tens of nanoseconds to tens of milliseconds in duration. For example, IEC 801-5 describes 1.2/50 µs lightning threats to signal lines.

The graph in Figure 1 (see page 1) relates peak pulse power versus time for 600 W suppressors. Similar graphs depict power versus time for TVSs rated at other power levels. At 1000 µs, the maximum peak pulse power (P_{PP}) for this series is 600 W (the device rating).

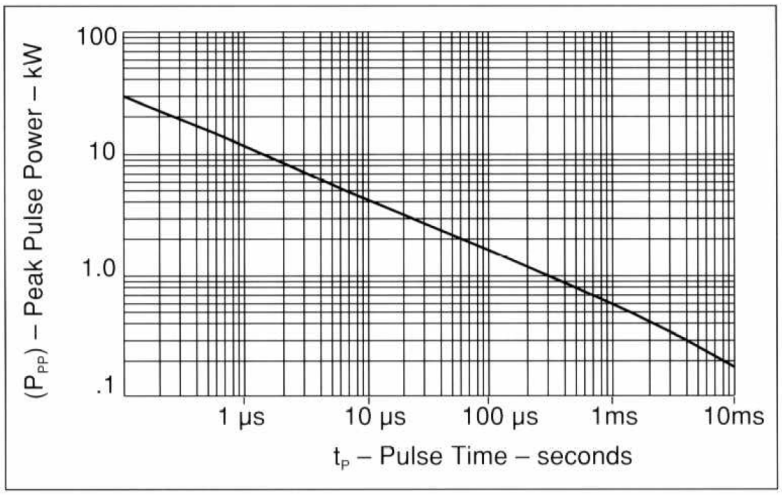
For short pulse widths, the TVS will sustain higher peak pulse currents (I_{PP}). As the graph illustrates, at 20 µs, the P_{PP} rating is 3.2 kW (or 5.3 times its rating at 1000 µs). Hence the I_{PP} rating of an SMBJ12C would increase by a factor of 5.3 from 27.3 A to 145 A for a 20 µs pulse.

For longer pulses, the TVS will withstand lower I_{PP} values. At 10,000 µs (10 ms), P_{PP} rating is down to approximately 200 W, one-third of its 1000 µs rating. The I_{PP} for an SMBJ12C would be reduced by a factor of .33, from 27.3 A to 9.1 A for a 10,000 µs pulse. This applies to all devices in the 600 W series regardless of their operating voltage.

In the same manner, the P_{PP} and/or I_{PP} can be derived for a component of any other TVS series using its associated power versus time curve.

Most silicon TVSs are rated for 10/1000 µs double exponential waveforms, including the example shown here. For one-half sine wave pulses, derate to 75% of the peak exponential value and for square wave pulses derate to 66%. Further information on this subject is available in MicroNote 120.

Figure 1: Peak Pulse Power vs. Pulse Time



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