Determining Clamping Voltage Levels for a Broad Range of Pulse Currents

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In Transient Voltage Suppressor (TVS) data sheets, all clamping voltage (V_C) levels are specified at maximum rated peak pulse current (I_{PP}). How do you interpolate the V_C levels for transient currents (I_P) other than the rated maximum?

This figure is easily calculated using the parameters on the data sheet with the formula:

$$V_C = (I_P/I_{PP})(V_C\ max. - V_{(BR)}\ max.) + V_{(BR)}\ max.$$

Where: I_P = test pulse current
I_{PP} = max rated pulse current
V_C max. = maximum specified clamping voltage
$V_{(BR)}$ max. = upper limit of breakdown voltage

This calculation assumes a linear increase in V_C between $V_{(BR)}$ and V_C max, which is realistic. Figure 1 illustrates the DV_C vs DI_P relationship for two voltage levels, 10V and 64V, in the SMB 600W series between $V_{(BR)}$ and V_C as determined by this formula. Results are linear as expected. $V_{(BR)}$ max is used in this calculation as it is the upper limit of specified breakdown voltage.

In those instances where $V_{(BR)}$ max is not given on the data sheet, it can be closely approximated. For "A" suffix parts, multiply the minimum $V_{(BR)}$ by 1.11 and for non-suffix parts, multiply by 1.22 to obtain the maximum $V_{(BR)}$.

The curves derived from measured data are compared with calculated values in Fig. 1. Surge tests were performed for a 30 piece sample at 25°C ambient with a 10/1000µs waveform.

Note that the curves based on actual surge data have a more shallow slope than those from the calculation, indicating that the devices are conservatively rated and that the formula shown provides a sufficient level of confidence for worst-case design.

Fig. 1

V_C vs I_{PP} for SMBJ10A and SMBJ64A Calculated and Measured