MicroNotes

MicroNote #108

Determining Clamping Voltage Levels for a Range of Pulse Currents

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Clamping voltage (V_C) is specified only at the maximum limit on most silicon transient voltage suppressor (TVS) data sheets. Often the designer needs to determine the V_C at some intermediate level between breakdown voltage ($V_{(BR)}$) and maximum V_C.

The value can be calculated with the data sheet parameters using the formula:

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

Where:

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

Based on previous data, a linear increase in V_C can be assumed between $V_{(BR)}$ and V_C max for this formula. The V_C versus I_P relationship for the SMCJ15A for a 1.5 kW TVS between $V_{(BR)}$ and V_C as calculated by this method is shown in Figure 1. Results are as expected. This calculation assumes the TVS to be at the $V_{(BR)}$ upper limit, hence it would be conservative for most of the distribution. Note that when I_P equals I_{PP}, V_C equals V_C max.

If only $V_{(BR)}$ min is listed on the data sheet, $V_{(BR)}$ max can be approximated. For "A" suffix parts, multiply $V_{(BR)}$ min by 1.20 and for non-suffix parts, multiply by 1.25 to obtain $V_{(BR)}$ max.

An example of a calculated curve compared to one derived from test measurements (Figure 1) illustrates the feasibility and conservative aspects of this method. Surge tests were performed on a 20 piece sample at 25 degrees C with a 10/1000 µs waveform.

The curve based on surge test data has a more-shallow slope than the curve interpolated through calculation. This indicates that the devices are conservatively rated and the formula given is adequate for interpolating intermediate values of V_C for a fractional part of I_{PP}.

The linear relationship between I_P and V_C can be applied in determining greater I_{PP} ratings for applications requiring lower than normal values of V_C. In the equation above, insert the desired value for V_C and solve for the higher I_{PP} value. This often requires upgrading to a higher peak pulse power (P_{PP}) rated device.

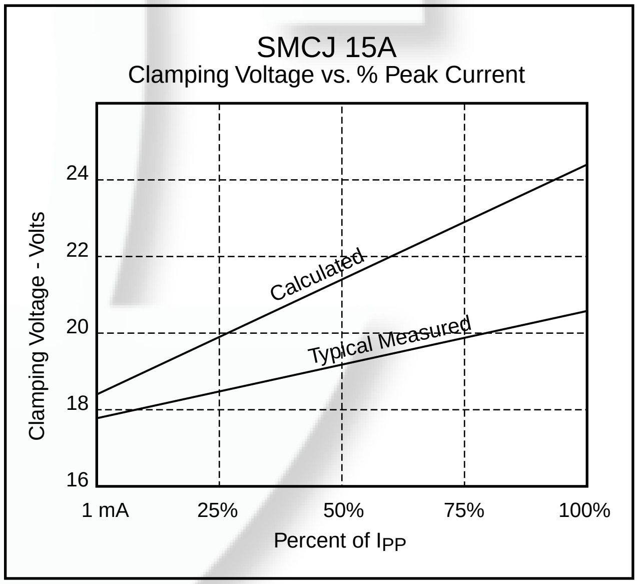

Figure 1

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