TVS Surge Rating: Power vs. Current
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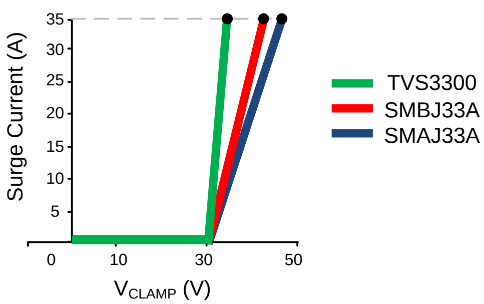
For a long time, Transient Voltage Suppressor (TVS) diodes have been protecting supply or signal lines from transient surge events which are define by IEC 61000-4-5 Surge Immunity Test. These TVS diodes have often been rated for their maximum power capability. For example TVS diodes in SMA packages are typically rated for 4kW 8/20µs surge pulse. This can be misleading to some customers to think that more power dissipation means a high surge pulse that can be protected against.

$$P = I * V \quad (1)$$

The most important thing to remember about TVS diodes is that they still follow the same diode IV curve as all diodes do where after the breakdown voltage the diode begins to conduct current proportional to the inherent dynamic resistance. These diodes curves that can be seen in Figure 1. Notice this is showing the corresponding clamping voltage for a particular 8x20µs surge current level. If you are unfamiliar with the basics of TVS diodes you can check out Demystifying Surge Protection.

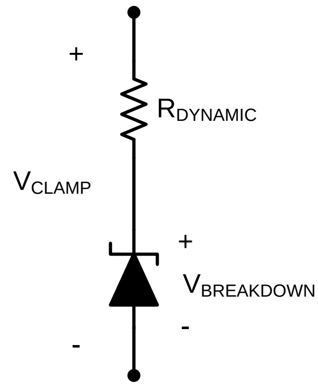
Figure 1. Different Diode IV curves



Device	Surge Current	Clamping Voltage	Power
TVS3300	35 A	37 V	1295 W
SMAJ33A	35 A	46 V	1610 W
SMBJ33A	35 A	43 V	1505 W

If you took a certain point on the IV graph for the SMAJ33A, the power calculated at that point would be 46V * 35A = 1610W. This seems like quite a bit but if you look at the TVS3300 at the same surge current of 35A the clamping voltage is ~37V which gives a power of 1295W. Obviously the TVS3300 took 315W less power than the SMAJ33A but it was still able to provide the same amount of protection. The clamping voltage of a TVS diode, as explained in Demystifying Surge Protection, is dependant on the breakdown voltage and the dynamic resistance of the device. Therefore, if the voltage is only dependant on the TVS device itself, the other parameter that can show the level of protection is surge current.

Figure 2. TVS Diode Characteristics



Surge current is generated by the combinational waveform generator outlined in IEC61000-4-X. This current has to be dissipated by the system and more specifically the TVS diode. Since the Flat-Clamp devices have a much lower dynamic resistance the current will be conducted through the device easily while not causing a large clamping voltage for the rest of the system.

In conclusion, when calculating the surge protection level of a device, remember that the TVS diode itself is what effects the clamping voltage and the surge current is the best representation of how severe a surge pulse is. Since the Flat-Clamp devices have best in class dynamic resistance, they naturally have best in class clamping voltage. This is one of the many differentiating aspects of TI's Flat-Clamp devices. For more information about the family of devices and the patented technology please see Flat-Clamp Surge Protection Technology For Efficient System Protection.

Table 1. Flat-Clamp Device Recommendations

DEVICE	V_{rwm}	V_{clamp} at I_{pp}	I_{pp} (8/20 µs)
TVS0500	5	9.2 V	43 A
TVS0701	7	11 V	30 A
TVS1400	14	18.6 V	43 A
TVS1401	14	20.5 V	30 A
TVS2700	27	32.5 V	40 A

Table 1. Flat-Clamp Device Recommendations (continued)

DEVICE	V_{rwm}	V_{clamp} at I_{pp}	I_{pp} (8/20 µs)
TVS2701	27	34 V	27 A
TVS3300	33	38 V	35 A
TVS3301	33	40 V	27 A

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