

Series Stacking of TVS for Higher Voltages and Power

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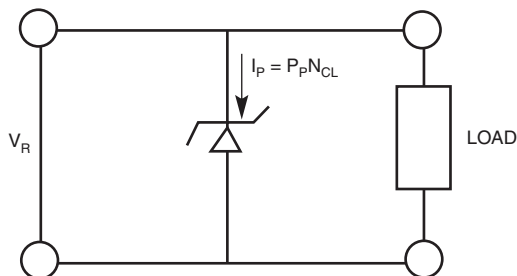
HIGHER VOLTAGES

In normal operation, a transient voltage suppressor should be invisible to the protected circuit. This is guaranteed by a very low leakage current at reverse stand-off voltage. As long as this voltage is not exceeded, the above mentioned feature is applicable. Some TVS applications require a very high stand-off voltage, which is beyond the highest available value for a certain TVS series. In the past, TVS voltages up to 440 V were available in axial parts. This was achieved by stacking chips inside the axial package.

In surface mount packages, this is no longer possible and the maximum available voltage is 170 V (working voltage). Applications requiring a working voltage that is higher than 170 V can be solved by putting TVS diodes in series.

When putting TVS diodes in series to obtain higher stand-off voltages, then the sum of the stand-off voltages of the single diodes should be equal to the desired value.

This sounds like a simple solution of the whole problem but current rating must also be taken into account. Preferably one uses devices with the same V_R rating for series stacking. Thus the I_{PP} rating is the same for each part. I_{PP} is the peak pulse current that can be reached with a corresponding clamping voltage V_{CL} , where $I_{PP} \times V_{CL}$ is the peak pulse power that the TVS device is capable of. If TVS diodes with different V_R ratings are used to get the desired voltage by series stacking, the I_{PP} for the combination is determined by the device with the lowest I_{PP} capability. V_F is something to observe at series stacking of TVS, as it will be multiplied by the number of devices.



Where: P_p = Power rating of used TVS
 V_R = Reverse working voltages
 I_p = Peak pulse current
 $V_R 1/2/3$ = Reverse working voltages for single TVS
 $I_p \text{ max}$ = Lowest I_p of the TVS diodes put in series

HIGHER POWER

In applications with a fixed working and clamping voltage, a designer can increase the surge rating of his design by putting several lower voltage parts in series. Power handling capability is increased because lower voltage types tends to be limited, e.g. for a 1.5KE200 it is 5.2 A. The 5KP series is only available up to V_R 110 V. Some transients, however, have higher pulse currents.

To keep the advantages of AJTVS, several TVS diodes can be put in series.

The designer needs to pay attention to the fact that the voltages need to be split equally. If all working voltages of the TVS devices put in series are equal, also the peak currents and power dissipated is equal.

In this case, the total power capability of the TVS diodes put in series is equal to the sum of each TVS diode.

AVAILABILITY AND PRICING

Another reason to consider series stacking of TVS diodes is availability and price of different types of TVS. If you have an application with a high working voltage and the total power is just over the wattage in Vishay General Semiconductor's range (400, 500, 600, 1500, 5000 W), it might be worth it to contact your Vishay General Semiconductor representative to discuss price and availability for a solution where diodes are put into a series.

