TVS Diode Loading Capacitance vs Data Transmission Rate

Consideration of device capacitance is necessary in applications employing high speed data rates. TVS diodes have an inherent voltage dependent capacitance. The total capacitance is a function of the doping concentration and junction area. The lower the voltage rating of the device the higher the doping concentration resulting in high capacitance values. Devices with higher voltage values have exponentially decreasing junction capacitance. Similarly, increasing the bias voltage across a device results in decreasing capacitance. Since the current handling capability of the device is proportionate to the effective area of the junction, devices with higher power ratings for a given pulse will have correspondingly higher capacitance values.

In high speed data transmission circuits, too much loading capacitance causes significant signal attenuation.

While the precise analysis of the rise time degradation is complex and depends on a number of factors, the graph below serves as a guide when determining the effects of adding a particular TVS device. A device with a capacitance value below the curve should have no appreciable effect on the pulse for a given transmission rate. As always, the final design should undergo appropriate testing for verification.

Interface Standards	
RS232	20Kbs
RS422	10Mbs
RS423	100Kbs
RS485	10Mbs
USB	12Mbs

Networking	
ISDN BRI (PRI)	124Kbps (1.5Mbps)
T1 (E1)	1.54Mbps (2.05Mbps)
T2 (E3)	45Mbs (34.368Mbps)
STS-1, OC-1	51.840Mbps
HDSL	2.05Mbs
Ethernet	10Mbps
Fast Ethernet	100Mbps

Data Transmission Rates