

What is a Thyristor Surge Protective Device and How does it Work?

Thyristor surge protective devices (TSPDs) are avalanche triggered components used to protect vulnerable circuits from moderate to severe electrical overstress largely caused by induced lightning. TSPDs protect by switching to a low on-state voltage (V_T) of a few volts, thus providing a "crowbar" effect with high current capability (up to 100A). They are available in bidirectional or unidirectional configurations. For unidirectional, the opposite direction (quadrant) from the switching mode may be specified either forward conducting or reverse blocking.

The TSPD should be "invisible" in the circuit until a voltage spike is present. Electrical parameters such as off-state leakage (I_{DRM}), breakdown voltage (V_{BR}) and capacitance should have no effect on normal circuit performance. The TSPD breakdown voltage (V_{BR}) is 20% to 30% greater than the maximum repetitive off-state voltage (V_{DRM}). This V_{DRM} is the normal operating voltage level. Transition to on-state voltage (mode) is initiated at the device's maximum breakover voltage (V_{BO}). Once the TSPD is in on-state conduction, the current through

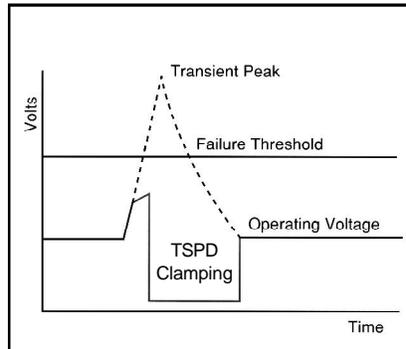


Figure 1. TSPD crowbars to on-state to protect from damaging transient.

the device must be interrupted or drop below minimum holding current (I_H) to restore to nonconduction after the transient has subsided.

Figure 1 illustrates performance of the TSPD as the transient drives the device first to V_{BO} , crowbar to on-state, then on to restoration. Minimum holding current values typically range from 50mA to 250mA @ 25°C (depending on device surge current rating) and decrease by 60% at 100°C, so ambient temperatures must be considered in selecting a device. This feature may limit use for some applications. TSPDs are normally not used for protection across dc power or low impedance voltage sources because after switching to on-state, they may not restore to non-conduction. A silicon transient voltage suppressor (TVS) is the best choice for dc applications.

The surge current capability of a TSPD is determined by structure as well as size. Devices are available in ratings from 30A through 100A for 10/1000 μ s. Operating voltage levels begin at

12V and are available in several increments up through several hundred volts. TSPDs do not wear out, but when electrically overstressed fail short.

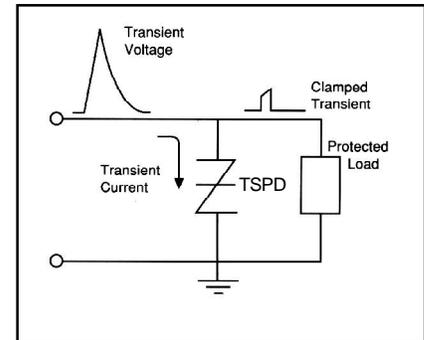


Figure 2. Diverting transient to ground through TSPD.

TSPDs provide protection across communication and control lines exposed to harsh radiated lightning conditions. These include central office telecommunication systems, PABXs, subscriber station protectors and related peripherals. Other uses include protection for instrumentation and SCR switches for remote controls. Major advantages of the TSPD are high surge current rating, low on-state crowbar voltage and low capacitance. Disadvantages include broad breakover voltage tolerance, vulnerability to high di/dt excursions, premature turn-on from excessive dv/dt and a minimum holding current for turn-off.