MicroNote 105

Thyristor Surge Protective Devices

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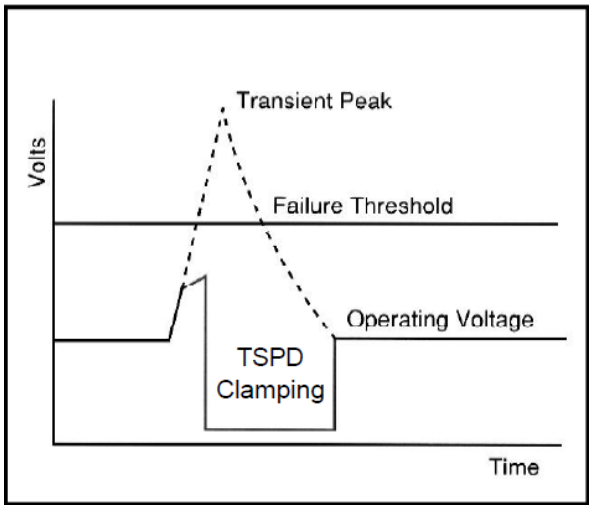
Thyristor surge protective devices (TSPDs) are avalanche-triggered components used to protect vulnerable circuits from moderate to severe electrical overstress, which are commonly caused by induced lightning. TSPDs protect circuits by switching to a low on-state voltage (V_T) of a few volts. This provides a crowbar effect with high current capability (up to 200 A). They are available in bidirectional or unidirectional configurations. For a unidirectional configuration, the quadrant opposite 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 running through the device must be interrupted, or drop below the minimum holding current (I_H), to restore to nonconduction after the transient has subsided.

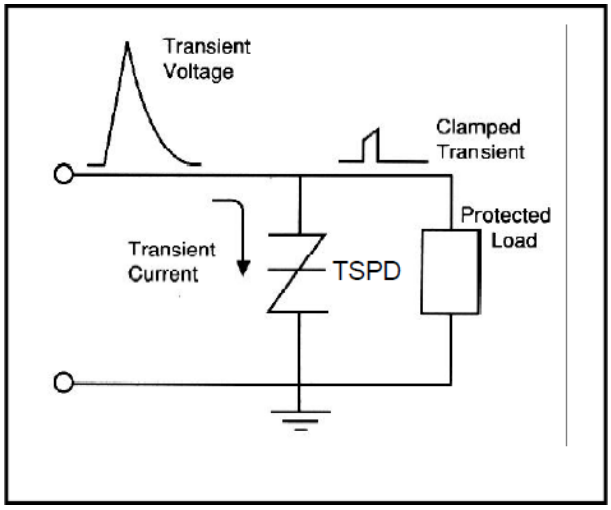
Figure 1: TSPD Crowbars to On-State to Protect from Damaging Transient



The preceding illustration shows TSPD performance as the transient drives the device from $V_{(BO)}$, crowbar to on-state, and then on to restoration. Minimum holding current values typically range from 50 mA to
250 mA at 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 nonconduction. A silicon transient voltage suppressor (TVS) is the best choice for dc applications. Both types of devices are used in parallel to the protected load, as shown in Figure 2 (see page 1).

The surge current capability of a TSPD is determined by both structure and size. Devices are available in ratings from 30 A to 200 A for 10/1000 µs . Operating voltage levels begin at 12 V and are available in several increments up to several hundred volts. TSPDs do not wear out, but will fail short when electrically overstressed.

Figure 2: Diverting Transient to Ground through TSPD



TSPDs also provide protection across communication and control lines exposed to harsh radiated lightning conditions, as shown in the illustration above. 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 its 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.

Support

For additional technical information, please contact Design Support at:
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