# AND8290/D

# TSPD vs. SIDAC

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**General Description**

Transient surge voltages are a major cause of poor reliability in telecom applications. Designers face the importance of having to protect the circuitry while maintaining overall performance and cost. With many different manufacturers and naming conventions of protection devices the task of choosing the proper solution can become challenging. One of the most common misunderstandings is a Sidactor; also know as a Thyristor Surge Protection Device (TSPD) versus Sidac. Both Sidactors and Sidacs are voltage triggered switches but the Sidactor or TSPD is used to protect telecom lines from high current levels and a Sidac is mainly intended to be used more as a triggering device.

TSPD is one of the most reliable semiconductor devices used for reducing telecom infrastructure overvoltage issues. The TSPD is a silicon structure device typically manufactured on a n-type substrate. TSPD is equivalent of two SCR's "connected" in anti-parallel, which allows the flow of the electric current in both directions. The TSPD is capable of draining a surge current pulse to ground when transient voltage appears in between its two terminals, this occurs when the maximum breakover voltage of the device is reached. The device typically operates symmetrically, protecting in the positive and negative direction. The TSPD turns from the off-state to the on-state based on the breakdown and breakover voltage levels that appear between the two main terminals. The devices have a current and voltage curve that has "snap back" affect, where the breakover is high, while the clamping voltage is low, basically a short, after the device turns-on giving it high surge abilities. Figure 1 shows the symbol for a TSPD or SIDAC:

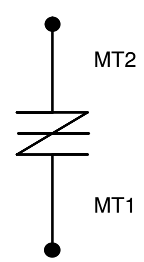


**Figure 1. TSPD and SIDAC Symbol**

The TSPD is a crowbar device, meaning it has two states of functionality: Open Circuit and Short Circuit.

Open Circuit: TSPD remain transparent during normal circuit operation. The device looks like an open across the two wire lines.

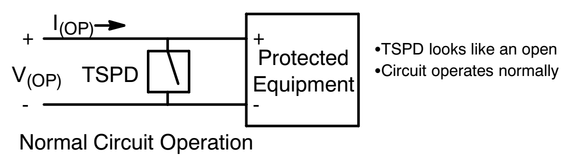


**Figure 2. Open Circuit**

Short Circuit: When a transient surge fault exceeds the TSPD protection voltage threshold, the devices switches on and shorts the transient to ground, safely protecting the circuit.

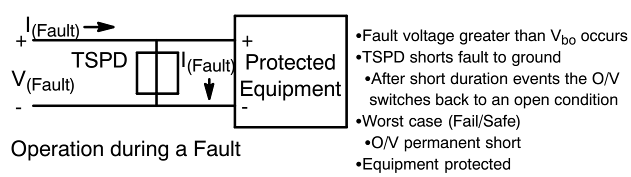


**Figure 3. Short Circuit**

The following I/V curve shows what the Electrical characteristics of a TSPD are:

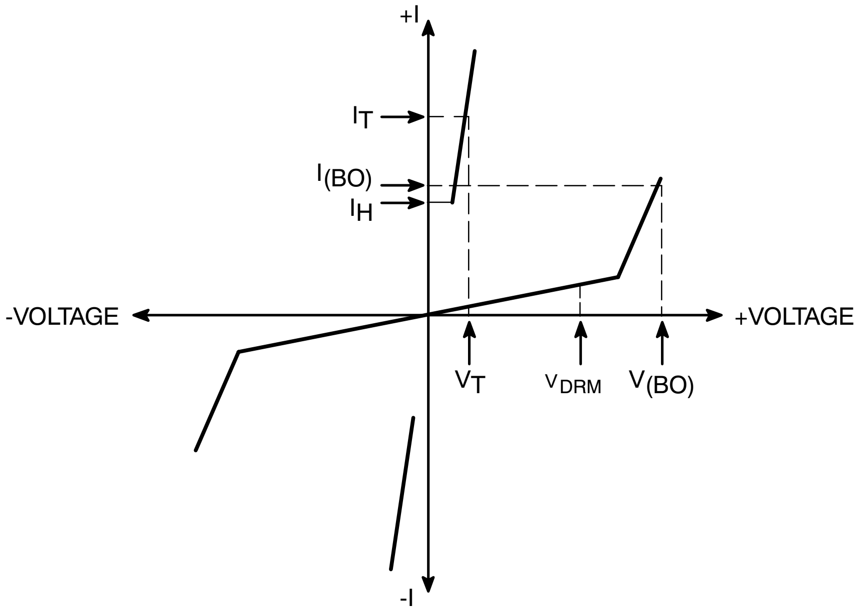


**Figure 4. TSPD Characteristics**

The SIDAC is a multi-layer silicon semiconductor usually manufactured on a P-type substrate. Being a bilateral device, it will switch from a blocking state to a conducting state when the applied voltage of either polarity exceeds the breakover voltage. As in the other trigger devices, the SIDAC switches through a negative resistance region to the low voltage on-state and will remain on until the main terminal current is interrupted or drops below the holding current. When the SIDAC switches to the on state, the voltage across the device drops to less than 5 V, depending on magnitude of the current flow. The main application for SIDAC is ignition circuits or inexpensive high voltage power supplies.

The difference between a TSPD and a SIDAC is that the SIDAC is intended to be used as a triggering device. The TSPD is intended to withstand Surge Current Levels which involves high levels of Peak Power under telecommunication protection standards. Most of the applications for the SIDAC's are related to capacitor discharge circuitry, as part of a RLC circuit; commonly as lamp starters, strobes and flasher, stove igniter, etc. When comparing a similar TSPD with a SIDAC device, the surge current abilities of the TSPD are much larger then the SIDAC. Other key parameters that TSPDs have advantage over SIDACs are lower leakage current ($I_{DRM}$) and dV/dt immunity.

The following I/V curve shows what the electrical characteristics of a SIDAC are:

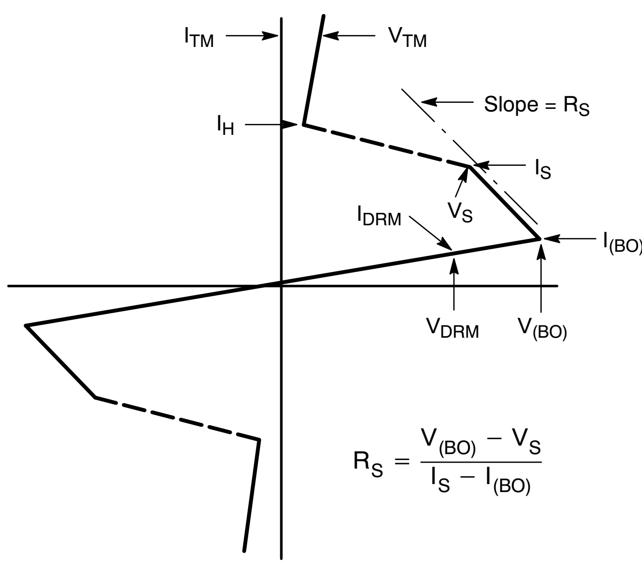


**Figure 5. SIDAC Characteristics**

Figure 6 is a typical application of a SIDAC being used as a stove top triggering device. Once the capacitor voltage reaches the SIDAC breakover voltage, the device will fire, dumping the charged capacitor through a step-transfomer generating the high voltage pulse. The high voltage pulse causes a spark igniting the stove top. Figure 7. shows a typical application for a TSPD in a telecom system. The TSPD devices will be acting as an open circuit whenever the signal voltage in the Tip and Ring lines is lower than their $V_{(BO)}$. Typically the voltage in the Tip and Ring lines is in between 50 V and 140 V depending in the kind of application. If a transient voltage occurs in any of the two telecom lines (Tip or Ring), the corresponding TSPD device will be triggered draining the surge current to ground and protecting the telecom equipment. As soon as the surge current drops below the $I_H$ value of the TSPD it will return to off-state, open circuit, until another transient occurs.

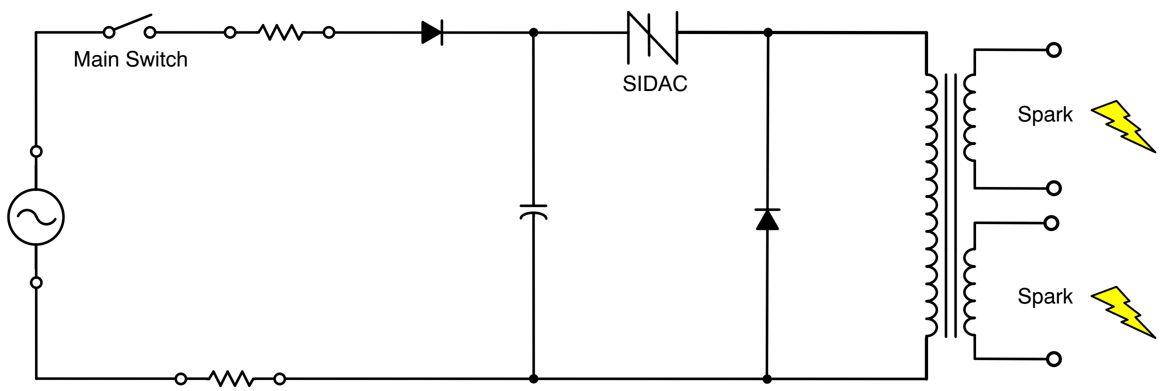


**Figure 6. SIDAC Application: Stove Igniter**

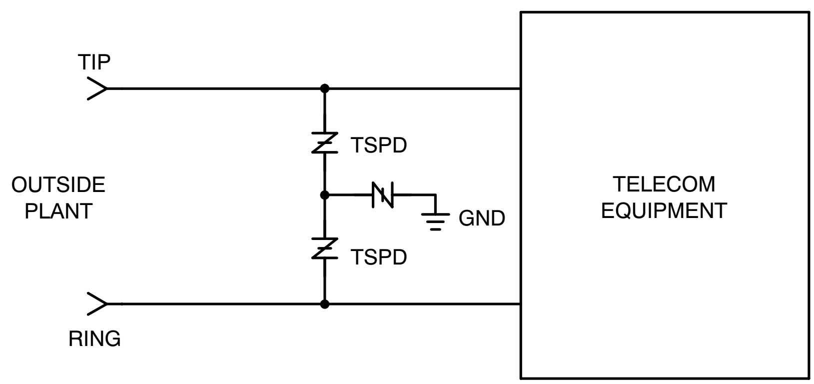


**Figure 7. TSPD Application**

**Table 1. Attributes to TSPD And SIDAC**

| Devices | Advantages | Disadvantages | Applications |
|---|---|---|---|
| TSPD | Durable<br>Fast turn-on<br>High Immunity<br>Consistent Parameters ($V_{BO}$, $V_{BR}$, $I_H$)<br>High surge capabilities | Capacitance | Telecom<br>Lightning Protection |
| SIDAC | Durable<br>Glass Passivation | Lower surge capabilities than TSPD<br>Slow turn-on vs. TSPD | Light ignitor<br>Pulse generator |

**Table 2. Important Parameters TSPD And SIDAC**

| Device | DC | AC |
|---|---|---|
| TSPD | $V_{(BO)}$<br>$I_{(BO)}$<br>$I_T$<br>$I_H$<br>$V_{DRM}$<br>$I_{DRM}$ | Surge Capability Spec (10 x 1000 μs)<br>Capacitance<br>dv/dt |
| SIDAC | Same as TSPD | Surge Capability $I_{TSM}$<br>di/dt<br>$IT_{(RMS)}$ |

In summary, the application note has demonstrated differences that TSPD devices can offer over a SIDAC in protection and the different applications for the devices. When looking for devices for high current surge protection a TSPD would be the one to use. TSPDs are used to protect telecom lines from high current levels based on their high surge capabilities. Sidacs are intended to be used more as a triggering device. It is important to mention ON Semiconductor offers a full line of TSPD devices in the NP series. The product line meets the specifications established in the industrial standard GR-1089-CORE, ITU-K.20, ITU-K.21, ITU-K.45, FCC Part 68, UL1950 and EN 60950.

**Glossary:**

- $V_{(BO)}$: Max Breakover Voltage The maximum voltage across the device in or at breakdown measured under a specified voltage and current rate of rise.
- $I_{(BO)}$: Breakover Current The instantaneous current flowing at the breakover voltage ($V_{BO}$).
- $I_H$: Holding Current The minimum current required to maintain the device in the on-state.
- $I_T$: On-State Current The current through the device in the on-state condition.
- $V_T$: On-State Voltage The voltage across the device in the on-state condition at a specified current ($I_T$).
- $V_{DRM}$: Rated Repetitive Peak Off-State Voltage Rated maximum (peak) continuous voltage that may be applied in the off-state condition.
- $I_{DRM}$: Repetitive Peak Off-State Current The maximum (peak) value of the current that results from the application of ($V_{DRM}$).

**Bibliography:**


1. “AND8022/D - TSPD (Thyristor Surge Protection Device)”, On Semiconductor, 2000.
2. “TND322 - What is a TSPD?”, On Semiconductor , 2007
3. “HBD855/D - Thyristor Theory & Design Handbook”, On Semiconductor, 2006




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