# DATA SHEET

# TSP058B~TSP320B

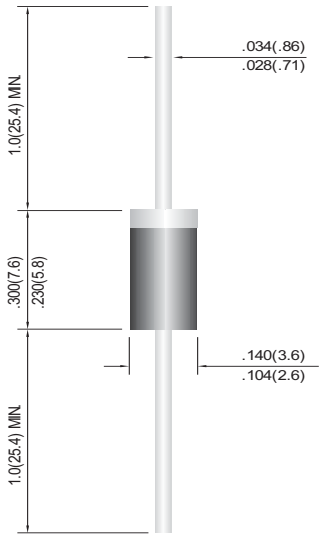
## AXIAL LEAD BI-DIRECTIONAL THYRISTOR SURGE PROTECTOR DEVICE

### FEATURES

- Protects by limiting voltages and shunting surge currents away from sensitive circuits
- Designed for telecommunications applications such as line cards, modems, PBX, FAX, LAN,VHDSL
- Helps meet standards such as GR1089, ITU K.20, IEC950, UL1459&50, FCC part 68
- Low capacitance, High surge (A, B, C rating available), precise voltage limiting, Long life

DO-15

Unit: inch ( mm )




### MECHANICAL DATA

- Case: JEDEC DO-15 molded plastic
- Terminals: Plated Axial leads, solderable per MIL-STD-750, Method 2026
- Polarity: Bi-directional
- Weight: 0.015 ounce, 0.4 gram

### SUMMARY ELECTRICAL CHARACTERISTICS

| Part Number | Rated Repetitive PeakOff-State Voltage | Breakover Voltage | On-State Voltage | Repetitive PeakOff-State Current | Breakover Current | Holding Currnet | Off-State Capacitance (f = 1 MHz, Vac = 15 mVRMS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Max. | Max. | Max. | Max. | Min. | Typ. | Max. | Typ. | Max. |
| | $V_{DRM}$ | $V_{BO}$ @ $I_{BO}$ | $V_T$ @ 1A | $I_{DRM}$ | $I_{BO}$ | $I_H$ | $C_O$ @ 0 Vdc | | $C_O$ @ 50 Vdc | |
| | V | V | V | μA | mA | mA | pF | | pF | |
| TSP058B | 58 | 77 | 5 | 5 | 800 | 150 | 70 | 100 | 24 | 29 |
| TSP065B | 65 | 88 | 5 | 5 | 800 | 150 | 67 | 90 | 22 | 28 |
| TSP075B | 75 | 98 | 5 | 5 | 800 | 150 | 67 | 78 | 23 | 27 |
| TSP090B | 90 | 130 | 5 | 5 | 800 | 150 | 57 | 61 | 19 | 21 |
| TSP120B | 120 | 160 | 5 | 5 | 800 | 150 | 50 | 58 | 17 | 20 |
| TSP140B | 140 | 180 | 5 | 5 | 800 | 150 | 49 | 54 | 16 | 19 |
| TSP160B | 160 | 220 | 5 | 5 | 800 | 150 | 46 | 53 | 15 | 18 |
| TSP190B | 190 | 260 | 5 | 5 | 800 | 150 | 45 | 53 | 14 | 18 |
| TSP220B | 220 | 300 | 5 | 5 | 800 | 150 | 44 | 52 | 13 | 18 |
| TSP275B | 275 | 350 | 5 | 5 | 800 | 150 | 44 | 51 | 13 | 18 |
| TSP320B | 320 | 400 | 5 | 5 | 150 | 150 | 43 | 50 | 13 | 17 |

NOTES:

1. Specific $V_{DRM}$ values are available by request.
2. Specific $I_H$ values are available by request.
3. All ratings and characteristics are at 25 °C unless otherwise specified.
4. $V_{DRM}$ applies for the life of the device. $I_{DRM}$ will be in spec during and following operation of the device.
5. $V_{BO1}$ is at 100V/msec, $I_{SC}$ =10$A_{pk}$, $V_{OC}$=1K$V_{pk}$, 10/1000 Waveform
6. $V_{BO2}$ is at f = 60 Hz, $I_{SC}$ = 1 $A_{(RMS)}$, Vac = 1K$V_{(RMS)}$, $R_L$ = 1 KW, 1/2 AC cycle

## CAPACITANCE CHARACTERISTICS

F = 1 MHz, $V_{ac}$ = 15 $mV_{rms}$

| Part Number | Rated Repetitive PeakOff-State Voltage | Breakover Voltage | On-State Voltage | Repetitive PeakOff-State Current | Breakover Current | Holding Currnet | Off-State Capacitance (f = 1 MHz, Vac = 15 mVRMS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Max. | Max. | Max. | Max. | Min. | Typ. | Max. | Typ. | Max. |
| | $V_{DRM}$ | $V_{BO}$ @ $I_{BO}$ | $V_T$ @ 1A | $I_{DRM}$ | $I_{BO}$ | $I_H$ | $C_O$ @ 0 Vdc | | $C_O$ @ 50 Vdc | |
| | V | V | V | μA | mA | mA | pF | | pF | |
| TSP058B | 58 | 77 | 5 | 5 | 800 | 150 | 70 | 100 | 24 | 29 |
| TSP065B | 65 | 88 | 5 | 5 | 800 | 150 | 67 | 90 | 22 | 28 |
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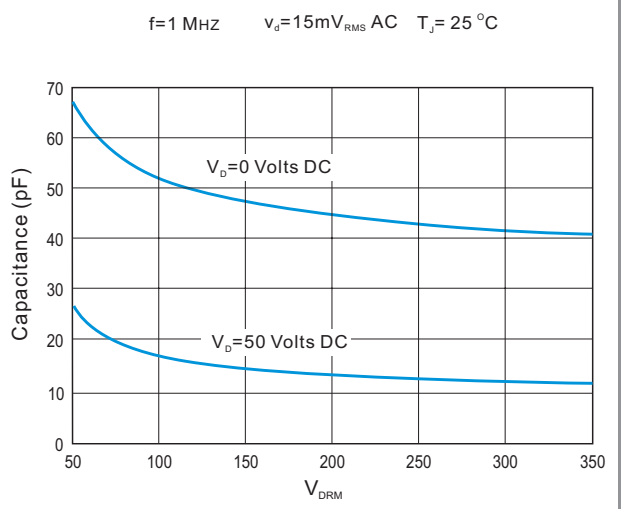
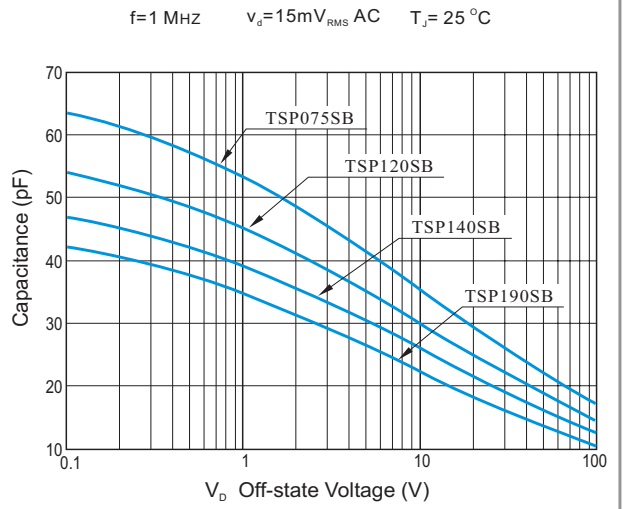
| TSP160B | 160 | 220 | 5 | 5 | 800 | 150 | 46 | 53 | 15 | 18 |
| TSP190B | 190 | 260 | 5 | 5 | 800 | 150 | 45 | 53 | 14 | 18 |
| TSP220B | 220 | 300 | 5 | 5 | 800 | 150 | 44 | 52 | 13 | 18 |
| TSP275B | 275 | 350 | 5 | 5 | 800 | 150 | 44 | 51 | 13 | 18 |
| TSP320B | 320 | 400 | 5 | 5 | 150 | 150 | 43 | 50 | 13 | 17 |

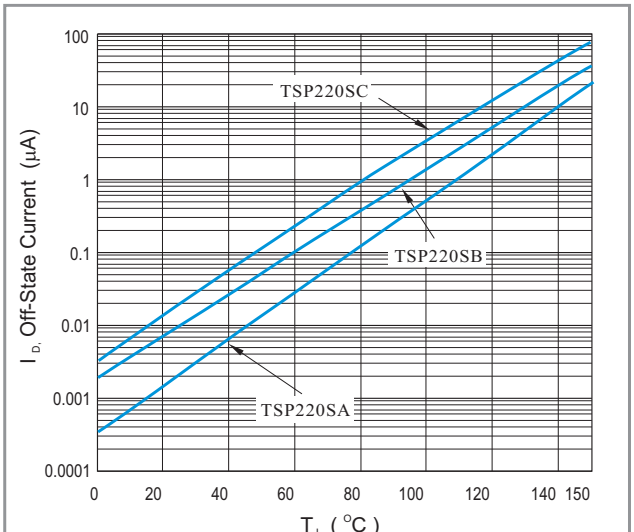
## RATING AND CHARACTERISTIC CURVES



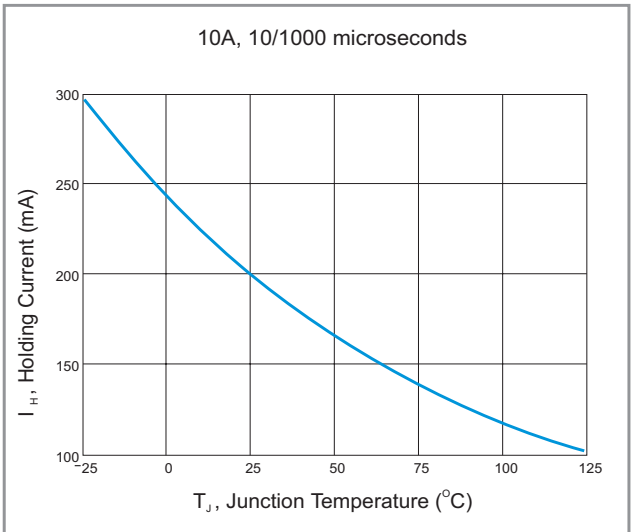

Typical Capacitance v.s. Rated Repetitive Off-state Voltage




Typical Capacitance v.s. Off-state Voltage

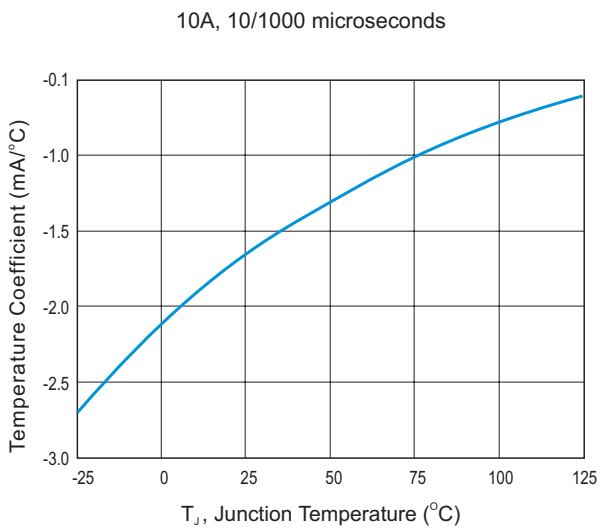



Typical Off-state Current v.s Junction Temperature

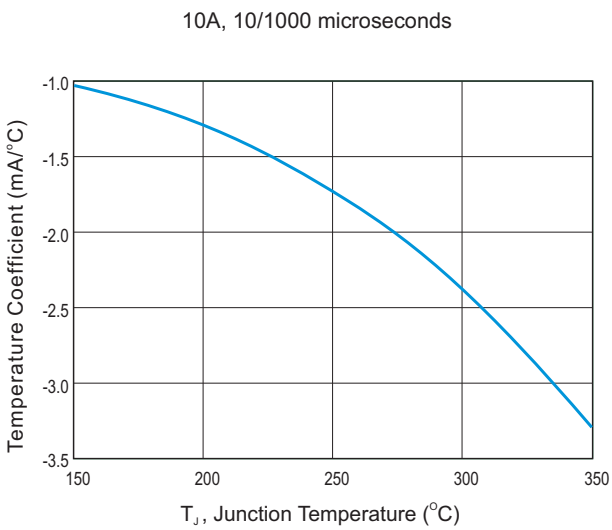



Typical Holding Current

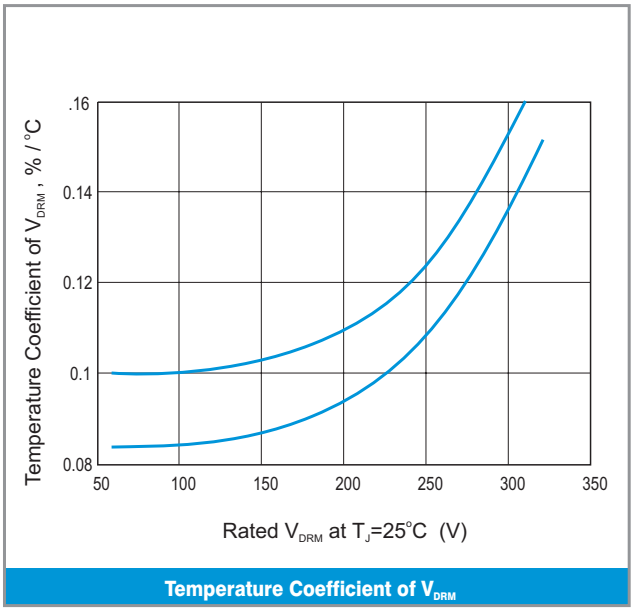
## RATING AND CHARACTERISTIC CURVES




Typical Holding Current Temperature Coefficient




Typical Holding Current Temperature Coefficient




Temperature Coefficient of $V_{DRM}$

## IMPORTANT NOTICE

This information is intended to unambiguously characterize the product in order to facilitate the customer's evaluation of the device in the application. It will help the customer's technical experts determine that the device is compatible and interchangeable with similar devices made by other vendors. The information in this data sheet is believed to be reliable and accurate. The specifications and information herein are subject to change without notice. New products and improvements in products and their characterization are constantly in process. This provides a superior performing and the highest value product. The factory should be consulted for the most recent information and for any special characteristics not described or specified.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## SELECTION GUIDE

Follow these steps to select the proper Thyristor surge protector for your application:

1. Define the operating parameters for the circuit:
   - Ambient operating temperature range
   - Maximum telephone line operating current (highest battery and shortest copper loop)
   - Maximum operating voltage: (Maximum DC bias + peak ringing voltage)
   - Maximum surge current
   - System voltage damage threshold
   - Select device with an off-state voltage rating ($V_{DRM}$) above the maximum operating voltage at the minimum operating temperature.
3. Select surge current ratings ($I_{PPS}$ and $I_{TSM}$) ³ those which the application must withstand.
4. Verify that the minimum holding current of the device at the maximum ambient temperature is above the maximum dc current of the system.
5. Verify that the maximum breakover voltage of the device is below the system damage threshold.
6. Verify that the circuit's ambient operating temperatures are within the device's operating temperature range.
7. Verify that the device's dimensions fit the application's space considerations.
8. Independently evaluate and test the suitability and performance of the device in the application

## MAXIMUM SURGE RATINGS ($T_J$ = 25 °C UNLESS OTHERWISE NOTED)

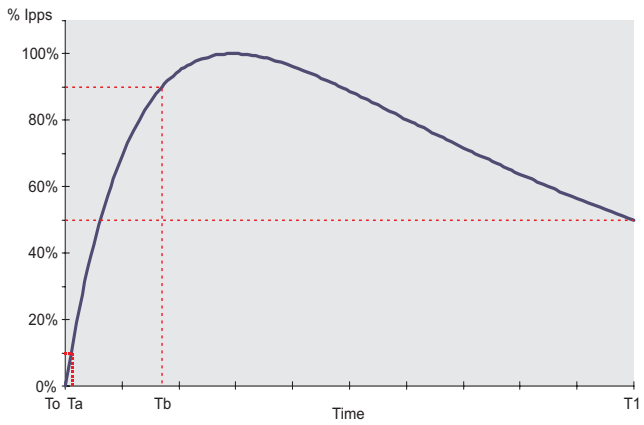
| Rating | Non-Repetitive Peak Pulse Current | | | | | | Non-Repetitive Peak On-State Surge Current |
|---|---|---|---|---|---|---|---|
| Symbol | $I_{PPS}$ | | | | | | $I_{TSM}$ |
| Short-Circuit Current Wave | 2/10 µs | 8/20 µs | 10/160 µs | 5/310 µs | 10/560 µs | 10/1000 µs | |
| Open-Circuit Voltage Wave | 2/10 µs | 1.2/50 µs | 10/160 µs | 10/700 µs | 10/560 µs | 10/1000 µs | **20A** |
| Value | **175 A** | **150 A** | **100 A** | **85 A** | **70 A** | **50 A** | |
| Notes | (1,2,4,5,6) | | | | | | (1,2,3,4) |

Notes:

1. Thermal accumulation between successive surge tests is not allowed.
2. The device under test initially must be in thermal equilibrium with $T_J$ = 25 °C.
3. Test at 1 cycle, 60 Hz.
4. Surge ratings are non-repetitive because instantaneous junction temperatures may exceed the maximum rated $T_J$. Nevertheless, devices will survive many surge applications without degradation. Surge capability will not degrade over a device's typical operating life.
5. Adjust the surge generator for optimum current-wave accuracy when both voltage and current wave specifications cannot be exactly met. The current wave is more important than the voltage wave for accurate surge evaluation.
6. The waveform is defined as A/B ms where:

   A: (Virtual front time) = 1.25 X Rise time = 1.25 X ($T_b$ - $T_a$)

   B (Duration time to 50% level of Ipps) = $T_1$ - $T_0$



## MAXIMUM THERMAL RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Storage Junction Temperature Range | $T_{STG}$ | -50 to 150 | °C |
| Operating Junction Temperature Range | $T_J$ | -40 to 150 | °C |
| Operating Ambient Temperature Range | $T_a$ | -40 to 65 | °C |

Notes:
PCB board mounted on minimum foot print.

## THERMAL CHARACTERISTICS

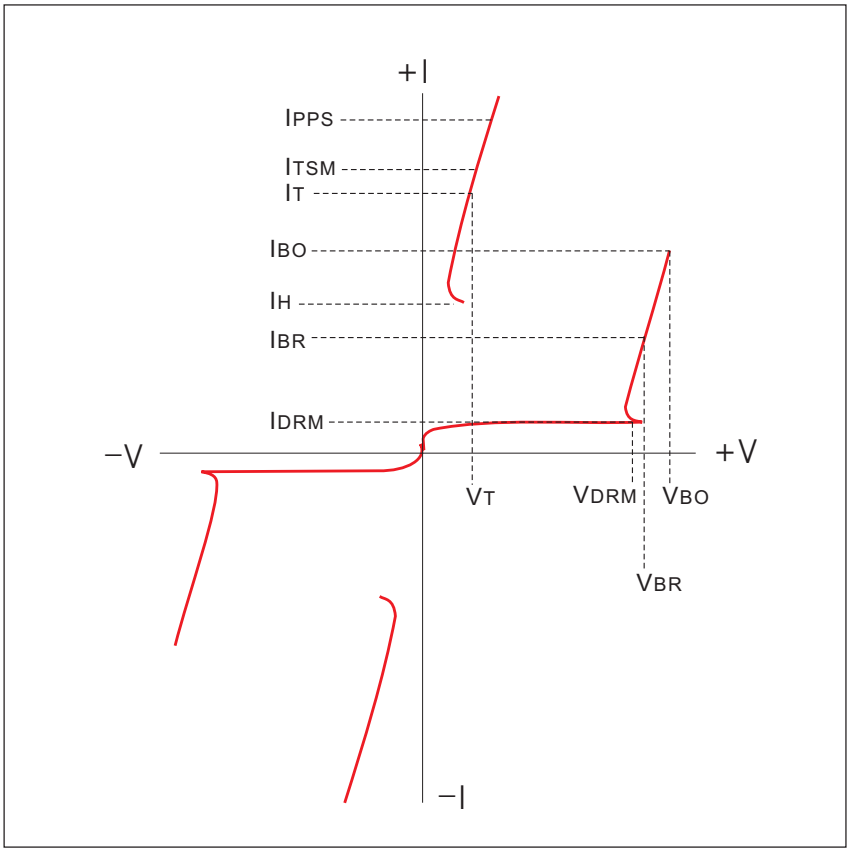
| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance Junction to Leads $T_L$ on tab adjacent to plastic. Both leads soldered to identical pad sizes. | $R_{\theta JL}$ | Max. 20 | °C / W |

Notes:
The junction to lead thermal resistance represents a minimum limiting value with both leads soldered to a large near-infinite heatsink. The junction to ambient thermal resistance depends strongly on board mounting conditions and typically is 3 to 6 times higher than the junction to lead resistance. The data shown is to be used as guideline values for preliminary engineering.

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C UNLESS OTHERWISE NOTED)

| Parameters | Test Conditions | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|---|
| Repetitive Peak Off-State Current | $V_D$ = rated $V_{DRM}$ | $I_{DRM}$ | | 5 | µA |
| Breakover Current | f = 60 Hz, $I_{SC}$ = 1 Arms, $V_{ac}$ = 1 KVrms, $R_L$ = 1 KΩ , 1/2 AC cycle | $I_{BO}$ | | 800 | mA |
| Holding Current1 | 10/1000µs waveform, $I_{SC}$ = 10A, $V_{OC}$ = 62 V, $R_L$ = 400 Ω | $I_H$ | 150 | | mA |
| On-State Voltage | $I_T$ = 1 A, Tw = 300 µs, 1 pulse | $V_T$ | | 5 | V |

Notes:
Specific $I_H$ values are available by request.




| Characteristic | Symbol | Value |
|---|---|---|
| $V_{BO}$ | Breakover Voltage | Maximum voltage across the device in or at breakdown measured under a specified voltage and current rate of rise |
| $I_{BO}$ | Breakover Current | Instantaneous current flowing at the breakover voltage ($V_{BO}$) |
| $I_H$ | Holding Current | Minimum current required to maintain the device in the on-state |
| $I_T$ | On-state current | Current through the device in the on-state condition |
| $V_T$ | On-state voltage | Voltage across the device in the on-state condition at a specified current ($I_T$) |
| $V_{DRM}$ | Rated Repetitive Peak Off-State Voltage | The highest instantaneous value of the off-state voltage, including all repetitive transient voltages but excluding all nonrepetitive transient voltages |
| $I_{DRM}$ | Repetitive Peak Off-State Current | The maximum (peak) value of current that results from the application of $V_{DRM}$ |
| $I_{PPS}$ | Non-Repetitive Peak pulse current | Rated maximum value of peak impulse current of specified amplitude and waveshape that may be applied without damage to the device under test |
| di/dt | Critical rate of rise of on-state current | Rated value of the rate of rise of current that the device can withstand without damage. |
| dv/dt | Critical Rate of Rise of Off-State Voltage | The maximum rate of rise of voltage (below$V_{DRM}$) that will not cause switching from the off-state to the on-state. |