# TVS Diodes

**Transient Voltage Suppression Diodes**

**SM8TxxCA Series**



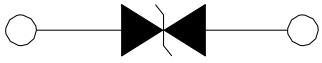
## Description

Transient Voltage Suppressor (TVS) is a circuit protection component that either attenuates (reduces) or filters a transient voltage spike (overvoltage), TVS diodes provide critical protection by going into avalanche breakdown within no more than a few nanoseconds after a strike, clamping the transient voltage, and routing its current to the ground.

## Applications

- Communication Equipment
- Security & Protection
- Industrial Control Equipment
- Power Supply
- Automotive Electronics
- New Energy
- Lightning Protection

## Functional Diagram



Bi-Directional

## Features

- Junction passivation optimized design passivated anisotropic rectifier technology
- $T_J$ = 175 °C capability suitable for high reliability and automotive requirement
- Available in bi-directional polarity only
- Low leakage current
- Low forward voltage drop
- High surge capability
- Meets ISO16750-2 surge specification(varied by test condition)
- Meets MSL-1, per J-STD-020, LF maximum peak of 260 °C
- AEC-Q101 qualified
- Compliant to RoHS directive 2011/65/EU and in accordance to WEEE 2002/96/EC

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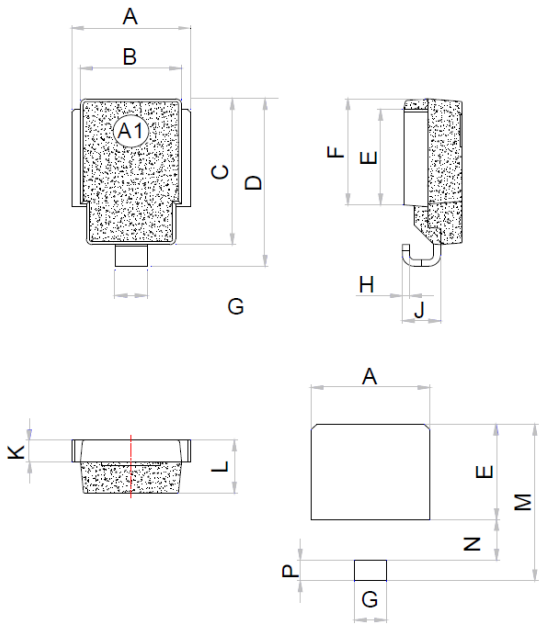
## Package Outline Dimensions (DO-218AB)




| Symbol | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 9.5 | 10.5 | 0.374 | 0.413 |
| B | 8.3 | 8.7 | 0.327 | 0.342 |
| C | 13.3 | 13.7 | 0.524 | 0.539 |
| D | 15.0 | 16.0 | 0.592 | 0.628 |
| E | 8.5 | 9.1 | 0.335 | 0.358 |
| F | 9.5 | 10.1 | 0.374 | 0.398 |
| G | 2.4 | 3.0 | 0.094 | 0.118 |
| H | 0.5 | 0.7 | 0.020 | 0.028 |
| J | 2.7 | 3.7 | 0.106 | 0.146 |
| K | 1.9 | 2.1 | 0.075 | 0.083 |
| L | 4.7 | 5.1 | 0.185 | 0.201 |
| M | 14.2 | 14.8 | 0.559 | 0.583 |
| N | 3.5 | 4.1 | 0.138 | 0.161 |
| P | 1.6 | 2.2 | 0.063 | 0.087 |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## Maximum Ratings and Characteristics

(Ratings at 25°C ambient temperature unless otherwise specified.)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Peak pulse power dissipation on 10/1000 μS waveform | $P_{PPM}$ | 8000 | W |
| Peak pulse power dissipation on 10/10000 μS waveform | $P_{PPM}$ | 6000 | W |
| Peak Power Dissipation on Infinite Heat Sink at $T_C$=50 °C | $P_D$ | 8.5 | W |
| Peak pulse current with 10/1000 μS waveform | $I_{PPM}$ | See page 6 | A |
| Operating junction and storage temperature range | $T_J$ , $T_{STG}$ | -55 to 175 | °C |
| Typical Thermal Resistance Junction to Lead | $R_{\theta JL}$ | 0.85 | °C / W |
| Typical Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | 11 | °C / W |


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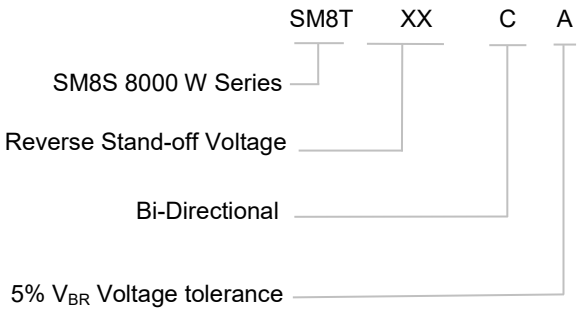
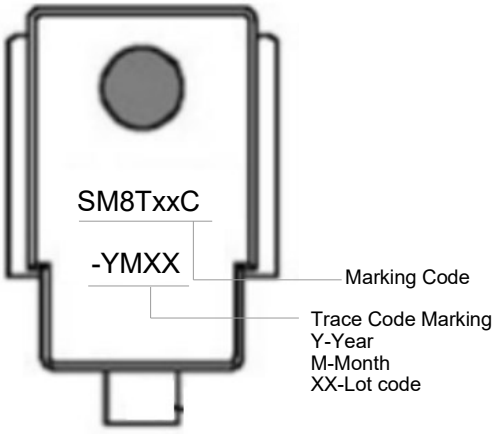
Note
1. Non-repetitive current pulse derated above TA = 25 °C .

## Part Numbering System




## Marking



## Glossary

| Item | Description |
|---|---|
| $V_C$ | **Clamping Voltage**<br>Voltage across TVS in a region of low differential resistance that serves to limit the voltage across the device terminals. |
| $V_R$ | **Reverse Stand-off Voltage**<br>Maximum voltage that can be applied to the TVS without operation.<br>NOTE : It is also shown as $V_{WM}$ (maximum working voltage (maximum d.c. voltage)) and known as rated stand-off voltage ($V_{so}$). |
| $I_R$ | **Reverse Leakage Current**<br>Current measured at $V_R$.<br>NOTE : Also shown as $I_D$ for stand-by current. |
| $V_{BR}$ | **Breakdown Voltage**<br>Voltage across TVS at a specified current $I_T$ in the breakdown region. |
| $I_{PPM}$ | **Rated Random Recurring Peak Impulse Current**<br>Maximum-rated value of random recurring peak impulse current that may be applied to a device. |
| $P_{M(AV)}$ | **Rated Average Power Dissipation**<br>Maximum-rated value of power dissipation resulting from all sources, including transients and standby current, averaged over a short period of time. |
| $P_{PPM}$ | **Rated Random Recurring Peak Impulse Power Dissipation**<br>Maximum-rated value of the product of rated random recurring peak impulse current ($I_{PPM}$) multiplies by specified maximum clamping voltage ($V_C$). |
| $C_J$ | **Capacitance**<br>Capacitance across the TVS measured at a specified frequency and voltage. |
| $V_{FS}$ | **Peak Forward Surge Voltage**<br>Peak voltage across an TVS for a specified forward surge current ($I_{FS}$) and time duration.<br>NOTE : Also shown as $V_F$. |
| $I_{FS}$ | **Forward Surge Current**<br>Pulsed current through TVS in the forward conducting region.<br>NOTE : Also shown as $I_F$. |
| $\alpha_{V(BR)}$ | **Temperature Coefficient of Breakdown Voltage**<br>The change of breakdown voltage divided by the change of temperature. |
| $I_{PP}$ | **Peak pulse Current**<br>Peak pulse current value applied across the TVS to determine the clamping voltage $V_C$ for a specified wave shape. |
| $I_T$ | **Pulsed D.C. Test Current**<br>Test current for measurement of the breakdown voltage $V_{BR}$. This is defined by the manufacturer and usually given in milliamperes with a pulse duration of less than 40 ms.<br>NOTE : Also shown as $I_{BR}$. |

—(GB-T 18802.321 / IEC 61643-321 / JESD210A)

## Electrical Characteristics ($T_A$=25 °C unless otherwise noted )Table 1

| Part Number | Breakdown Voltage $V_{BR}@I_T$ | | Test Current $I_T$ | Reverse Stand-off Voltage $V_R$ | Max. Reverse Leakage $I_R@V_R$ | | Max. Peak Pulse Current $I_{PPM}$ | Max. Clamping Voltage $V_C@I_{PPM}$ |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | | | | | | |
| Uni | (V) | | (mA) | (V) | (μA @ 25 °C) | (μA @ 175 °C) | (A) | (V) |
| SM8T33CA | 36.7 | 40.6 | 5 | 33 | 5 | 150 | 150 | 53.3 |
| SM8T36CA | 40.0 | 44.2 | 5 | 36 | 5 | 150 | 138 | 58.1 |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## Performance Curve for Reference ($T_A$=25 °C unless otherwise noted)

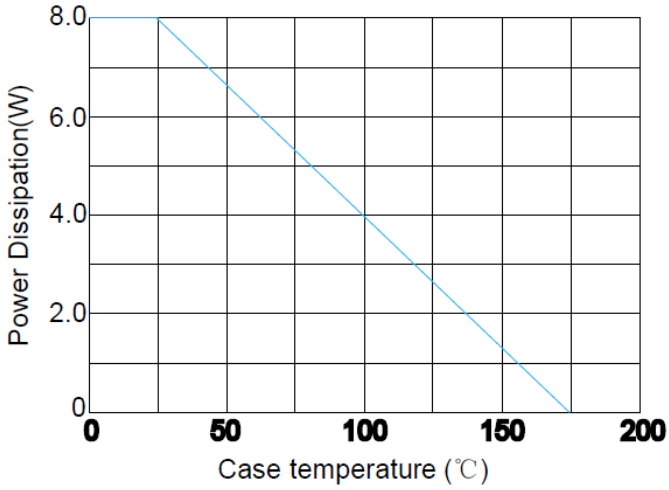



FIGURE 1
Power Derating Curve

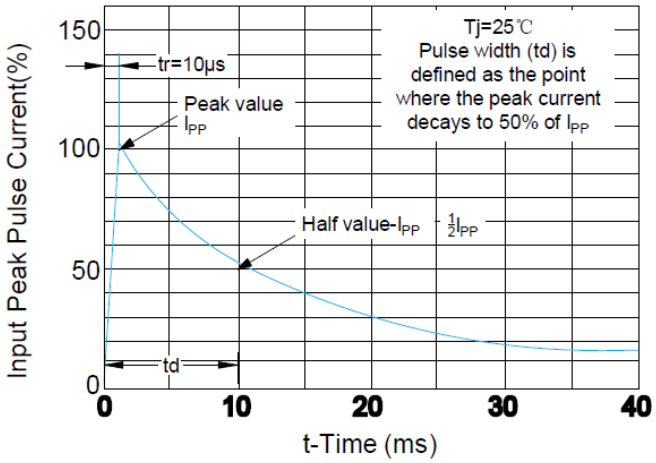



FIGURE 2
Pulse Waveform

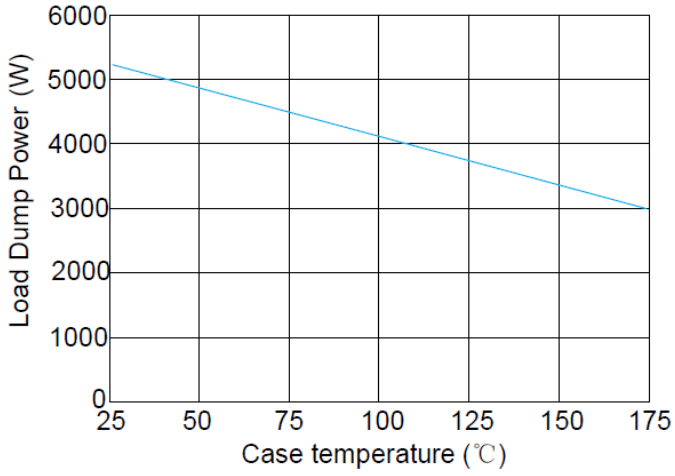



FIGURE 3
Load Dump Power Characteristics
(10 mS Exponential Waveform)

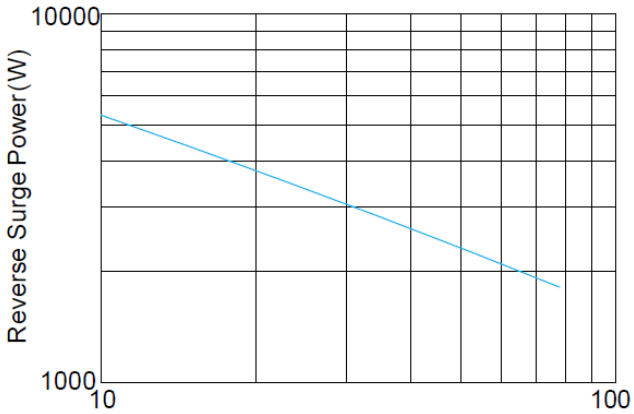



FIGURE 4
Reverse Power Capability

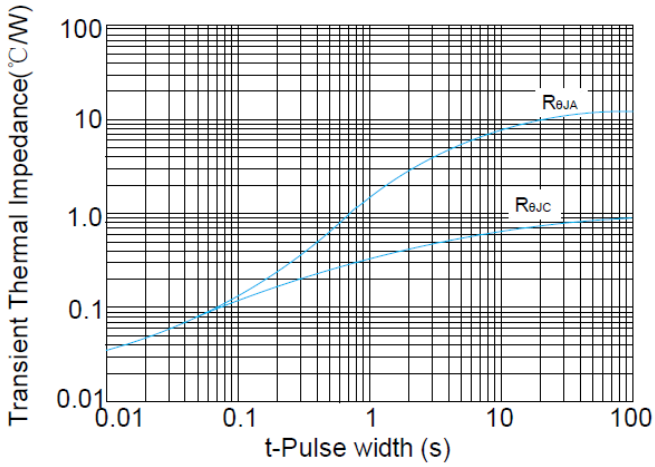



FIGURE 5
Typical Transient Thermal Impedance

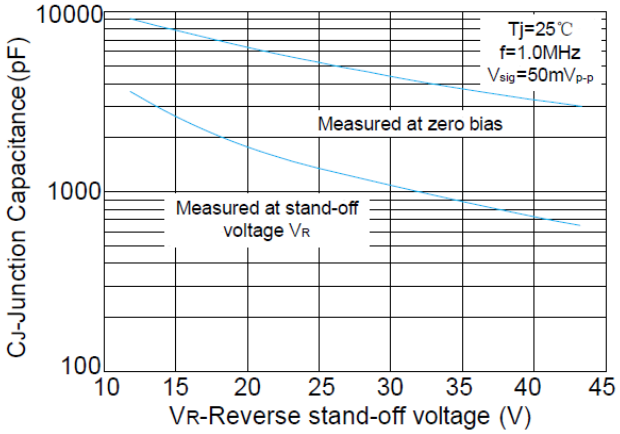
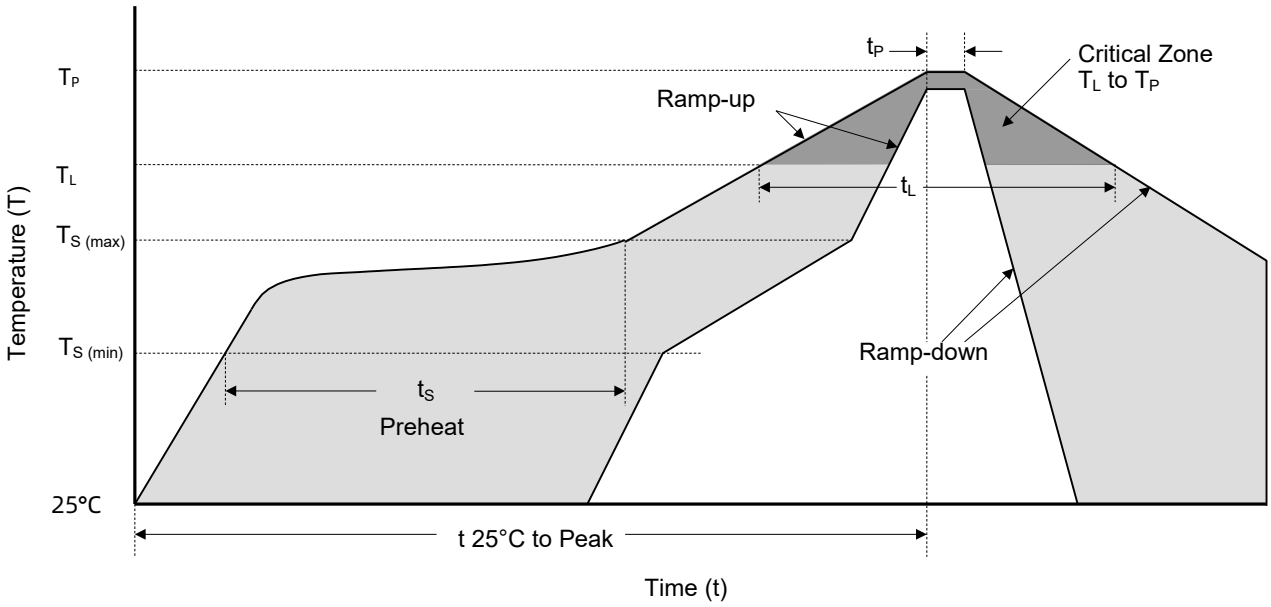



FIGURE 6
Typical Junction Capacitance

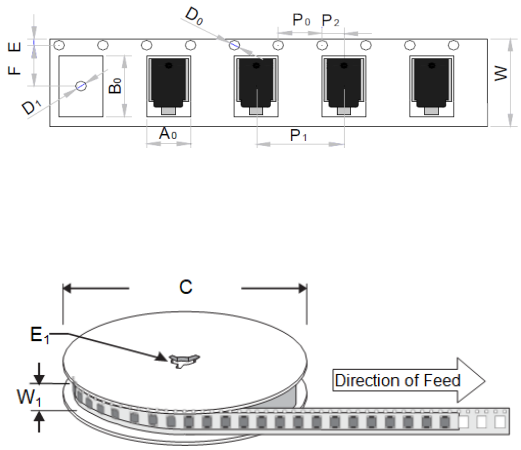
## Soldering Parameters




Reflowing Condition

| Reflow Soldering Parameters | | Lead-Free Assembly |
|---|---|---|
| Pre-heat | Temperature Min ($T_{S\ (min)}$) | 150 °C |
| | Temperature Max ($T_{S\ (max)}$) | 200 °C |
| | Time (min to max) ($t_s$) | 60 ~ 180 seconds |
| Average Ramp Up Rate (Liquidus Temp (TL) to Peak | | 3 °C / second max. |
| $T_S$ (max) to $T_L$ Ramp-up Rate | | 3 °C / second max. |
| Reflow | Temperature ($T_L$) (Liquidus) | 217 °C |
| | Time (min to max) ($t_L$) | 60 ~ 150 seconds |
| Peak Temperature ($T_P$) | | $260^{+0/-5}$ °C |
| Time of within 5 °C of Actual Peak Temperature ($t_P$) | | 20 ~ 40 seconds |
| Ramp-down Rate | | 6 °C / second max. |
| Time from 25 °C to Peak Temperature | | 8 Minutes max. |
| Do Not Exceed | | 260 °C |

## Packaging Information

| Tape | Symbol | Dimension | |
|---|---|---|---|
| | | Millimeters | Inches |
|  | $A_0$ | 10.8 ± 0.3 | 0.425 ± 0.012 |
| | $B_0$ | 16.13±0.3 | 0.635 ± 0.012 |
| | C | 330.0 ± 0.3 | 13.0 ± 0.012 |
| | $D_0$ | 1.55 ± 0.2 | 0.061 ± 0.008 |
| | $D_1$ | 1.55 ± 0.2 | 0.061 ± 0.008 |
| | E | 1.75 ± 0.2 | 0.069 ± 0.008 |
| | $E_1$ | 13.30 ± 0.2 | 0.524 ± 0.008 |
| | F | 11.50 ± 0.2 | 0.453 ± 0.008 |
| | $P_0$ | 4.00 ± 0.2 | 0.157 ± 0.008 |
| | $P_1$ | 16.00 ± 0.2 | 0.630 ± 0.008 |
| | $P_2$ | 2.00 ± 0.2 | 0.079 ± 0.008 |
| | W | 24.00 ± 0.2 | 0.945 ± 0.008 |
| | $W_1$ | 25.85 ± 0.2 | 1.018 ± 0.008 |



| Part Number | Package | QTY (Reel) | Packaging Option | Packaging Specification |
|---|---|---|---|---|
| SM8TxxCA-AL | DO-218AB | 750 PCS | Tape & Reel 13” reel | EIA STD RS-481 |

# ATTENTION



## Usage

1.TVS must be operated in the specified ambient temp.

2.Do not clean the TVS with strong polar solvent such as ketone, esters, benzene and halogenated hydrocarbon, to avoid damaging the encapsulating layer.

3.Please do not apply severe vibration, shock or pressure to TVS, to avoid element cracking.

## Replacement

1.If TVS is visually damaged, please replace it.

2.TVS is a non-repairable product. For safety sake, please use equivalent TVS for replacement.

## Storage

1.Storage Temp. Range: (-55 to 175) °C.

2.Do not store the TVS at the high temp., high humidity or corrosive gas environment, to avoid influencing the solder- ability of the lead wires. The product shall be used up within 1 year after receiving the goods.

## Environmental Conditions

1.TVS should not be exposed to the open air, nor direct sunshine.

2.TVS should avoid rain, water vapor or other condition of high temp. and high humidity.

3.TVS should avoid sand dust, salt mist, or other harmful gases.

## Max. Typical Capacitance of TVS

The typical capacitance of TVS is listed in the specifications. Designers may refer to it when designing TVS in High frequency circuit.

## Installation Mechanical Stress

1.Do not knock TVS when installing, to avoid mechanical damage.

2.Please do not apply severe vibration, shock or pressure to TVS, to avoid surface resin or element cracking.