

# SOT-23 Dual Monolithic Common Anode Zener Transient Voltage Suppressor For ESD Protection

This dual monolithic silicon zener diode is designed for applications requiring transient overvoltage protection capability. It is intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment and other applications. Its dual junction common anode design protects two separate lines using only one package. These devices are ideal for situations where board space is at a premium.

## Specification Features:

- SOT-23 Package Allows Either Two Separate Unidirectional Configurations or a Single Bidirectional Configuration
- Peak Power — 24 Watts @ 1.0 ms (Unidirectional), per Figure 5 Waveform
- Maximum Clamping Voltage @ Peak Pulse Current
- Low Leakage < 5.0  $\mu$ A
- ESD Rating of Class N (exceeding 16 kV) per the Human Body Model

## Mechanical Characteristics:

- Void Free, Transfer-Molded, Thermosetting Plastic Case
- Corrosion Resistant Finish, Easily Solderable
- Package Designed for Optimal Automated Board Assembly
- Small Package Size for High Density Applications
- Available in 8 mm Tape and Reel  
Use the Device Number to Order the 7 inch/3,000 Unit Reel  
Replace "T1" with "T3" in the Device Number to Order the 13 inch/10,000 Unit Reel

**WAFER FAB LOCATION:** Phoenix, Arizona

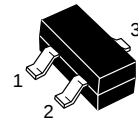
**ASSEMBLY/TEST LOCATION:** Seremban, Malaysia

## MMBZ5V6ALT1

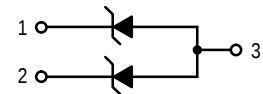
ADDITIONAL VOLTAGES AVAILABLE

Motorola Preferred Device

**SOT-23 DUAL  
ZENER OVERVOLTAGE  
TRANSIENT SUPPRESSOR  
5.6 VOLTS  
24 WATTS PEAK POWER**



**CASE 318-07  
STYLE 12  
LOW PROFILE SOT-23  
PLASTIC**



PIN 1. CATHODE  
2. CATHODE  
3. ANODE

## THERMAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic                                                                                                 | Symbol             | Value        | Unit                       |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------|----------------------------|
| Peak Power Dissipation @ 1.0 ms (1)<br>@ $T_A \leq 25^\circ\text{C}$                                           | $P_{pk}$           | 24           | Watts                      |
| Total Power Dissipation on FR-5 Board (2) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$        | $P_D$              | 225<br>1.8   | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient                                                                         | $R_{\theta JA}$    | 556          | $^\circ\text{C/W}$         |
| Total Power Dissipation on Alumina Substrate (3) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$              | 300<br>2.4   | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient                                                                         | $R_{\theta JA}$    | 417          | $^\circ\text{C/W}$         |
| Junction and Storage Temperature Range                                                                         | $T_J$<br>$T_{stg}$ | - 55 to +150 | $^\circ\text{C}$           |
| Lead Solder Temperature — Maximum<br>(10 Second Duration)                                                      | $T_L$              | 260          | $^\circ\text{C}$           |

(1) Non-repetitive current pulse per Figure 5 and derate above  $T_A = 25^\circ\text{C}$  per Figure 6.

(2) FR-5 = 1.0 x 0.75 x 0.62 in.

(3) Alumina = 0.4 x 0.3 x 0.024 in., 99.5% alumina

Thermal Clad is a trademark of the Bergquist Company.

**Preferred** devices are Motorola recommended choices for future use and best overall value.

# MMBZ5V6ALT1

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

**UNIDIRECTIONAL** (Circuit tied to pins 1 and 3 or Pins 2 and 3) ( $V_F = 0.9\text{ V Max @ } I_F = 10\text{ mA}$ )

| Breakdown Voltage          |                    |      | Max Reverse Leakage Current | Max Zener Impedance (6)                     |                                               |                                               | Max Reverse Surge Current<br>I <sub>RSM</sub> (5)<br>(A) | Max Reverse Voltage @<br>I <sub>RSM</sub> (5)<br>(Clamping Voltage)<br>V <sub>RSM</sub><br>(V) | Maximum Temperature Coefficient of<br>V <sub>Z</sub><br>(mV/°C) |     |      |
|----------------------------|--------------------|------|-----------------------------|---------------------------------------------|-----------------------------------------------|-----------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-----|------|
| V <sub>ZT</sub> (4)<br>(V) |                    |      |                             | I <sub>R</sub> @ V <sub>R</sub><br>(uA) (V) | Z <sub>ZT</sub> @ I <sub>ZT</sub><br>(Ω) (mA) | Z <sub>ZK</sub> @ I <sub>ZK</sub><br>(Ω) (mA) |                                                          |                                                                                                |                                                                 |     |      |
| Min                        | Nom                | Max  |                             |                                             |                                               |                                               |                                                          |                                                                                                |                                                                 |     |      |
| 5.32                       | 5.6 <sup>(7)</sup> | 5.88 | 20                          | 5.0                                         | 3.0                                           | 11                                            | 1600                                                     | 0.25                                                                                           | 3.0                                                             | 8.0 | 1.26 |

(4)  $V_Z$  measured at pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

(5) Surge current waveform per Figure 5 and derate per Figure 6.

(6)  $Z_{ZT}$  and  $Z_{ZK}$  are measured by dividing the AC voltage drop across the device by the AC current supplied. The specified limits are  $I_{Z(AC)} = 0.1 I_{Z(DC)}$ , with AC frequency = 1 kHz.

(7) Other voltages may be available upon request. Please contact your Motorola representative.

## TYPICAL CHARACTERISTICS

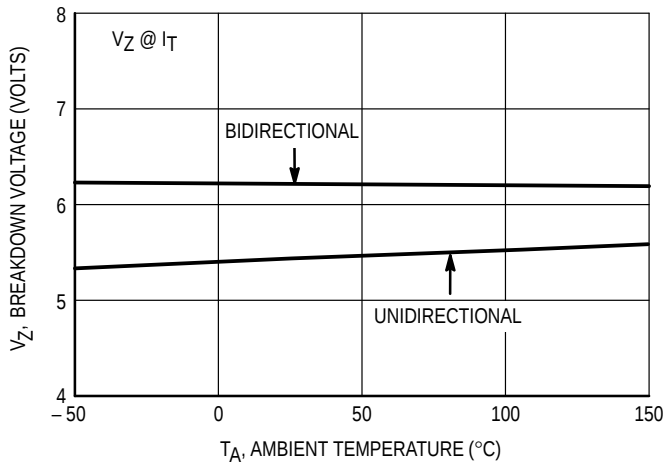


Figure 1. Typical Breakdown Voltage versus Temperature

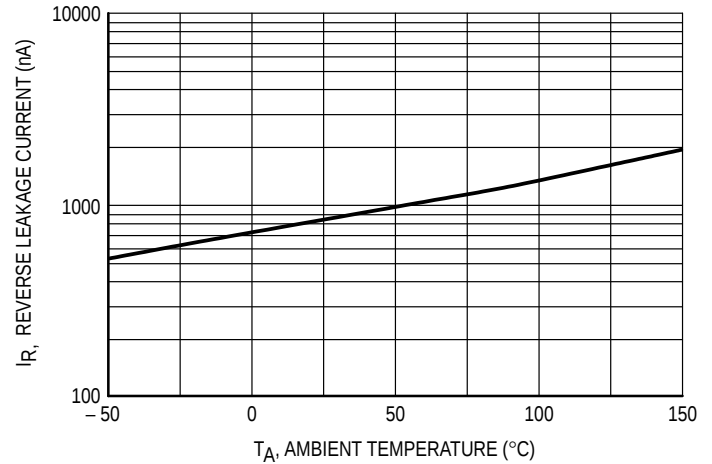


Figure 2. Typical Leakage Current versus Temperature

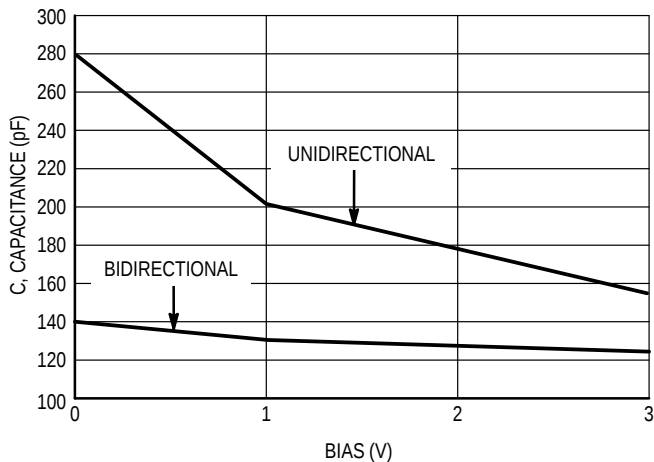


Figure 3. Typical Capacitance versus Bias Voltage

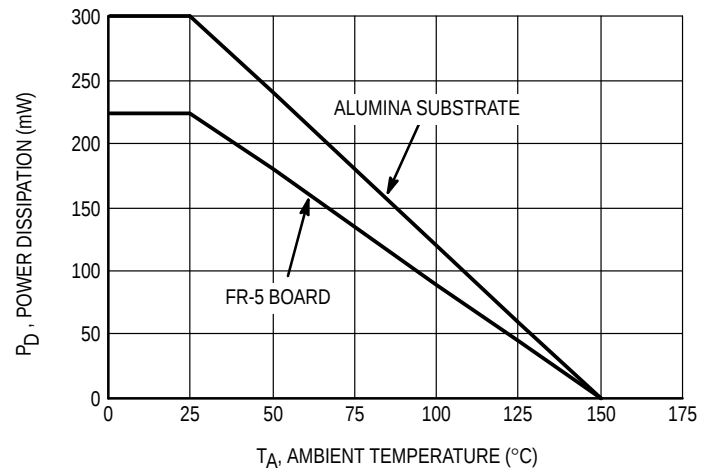


Figure 4. Steady State Power Derating Curve

# MMBZ5V6ALT1

## TYPICAL CHARACTERISTICS

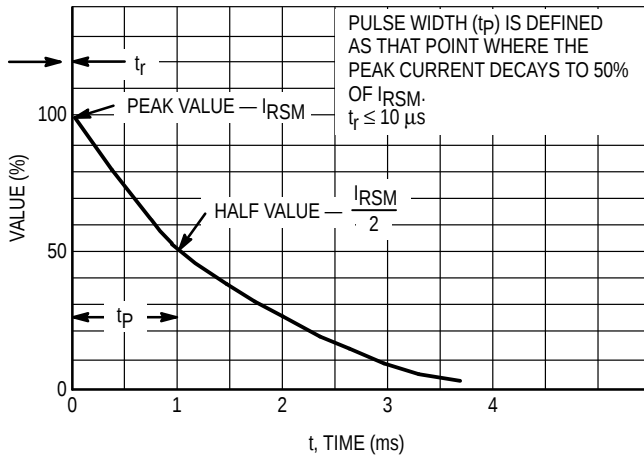


Figure 5. Pulse Waveform

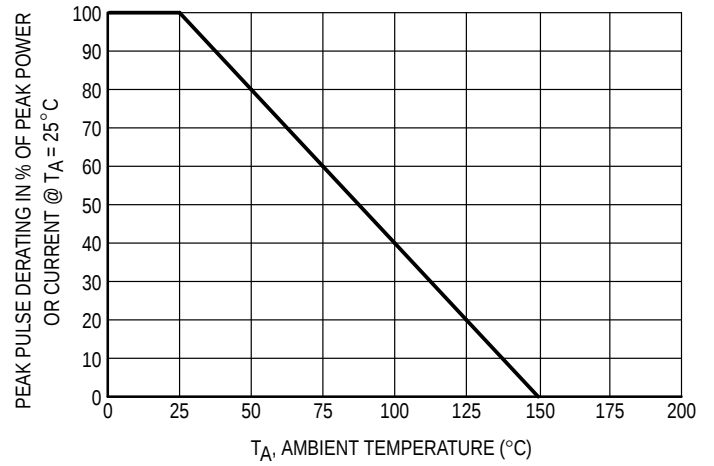


Figure 6. Pulse Derating Curve

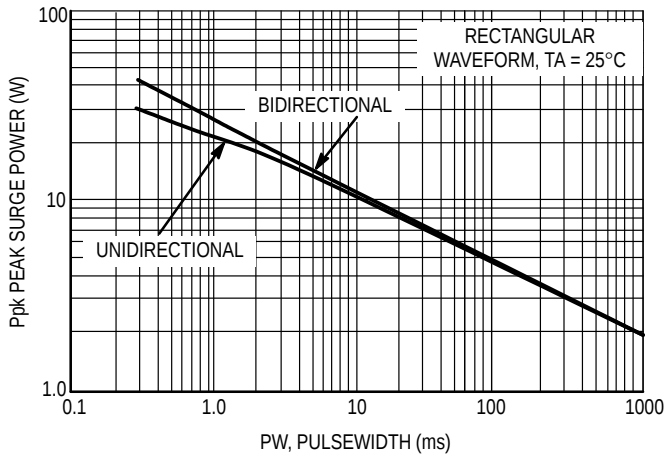


Figure 7. Maximum Non-repetitive Surge Power,  $P_{pk}$  versus PW

Power is defined as  $V_{RSM} \times I_Z(pk)$  where  $V_{RSM}$  is the clamping voltage at  $I_Z(pk)$ .

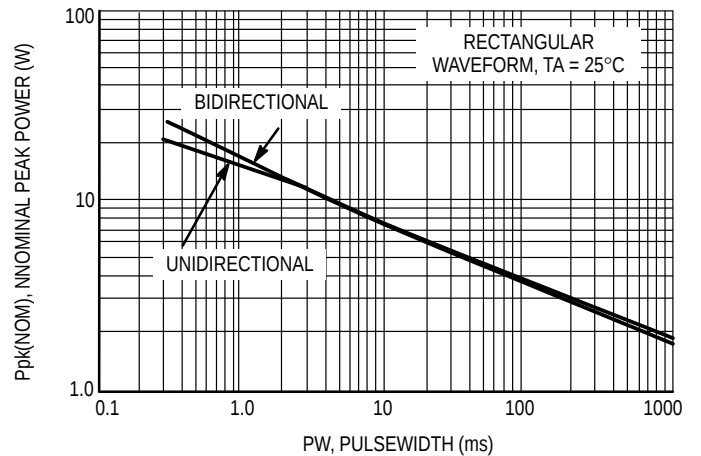


Figure 8. Maximum Non-repetitive Surge Power,  $P_{pk}(NOM)$  versus PW

Power is defined as  $V_Z(NOM) \times I_Z(pk)$  where  $V_Z(NOM)$  is the nominal zener voltage measured at the low test current used for voltage classification.

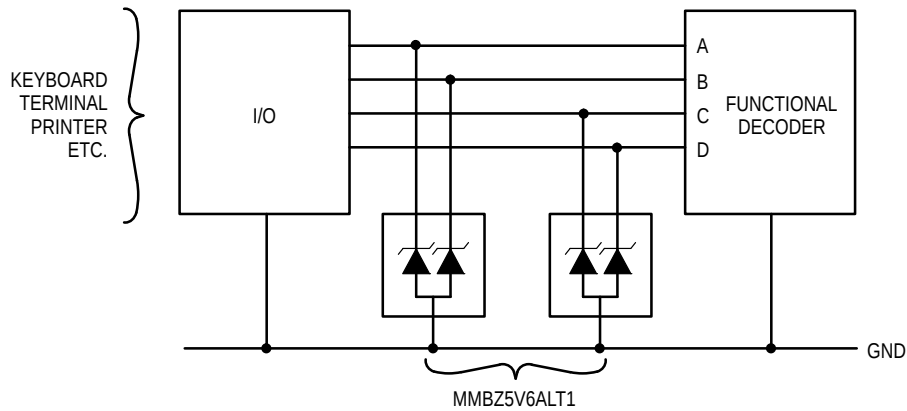
# MMBZ5V6ALT1

## TYPICAL COMMON ANODE APPLICATIONS

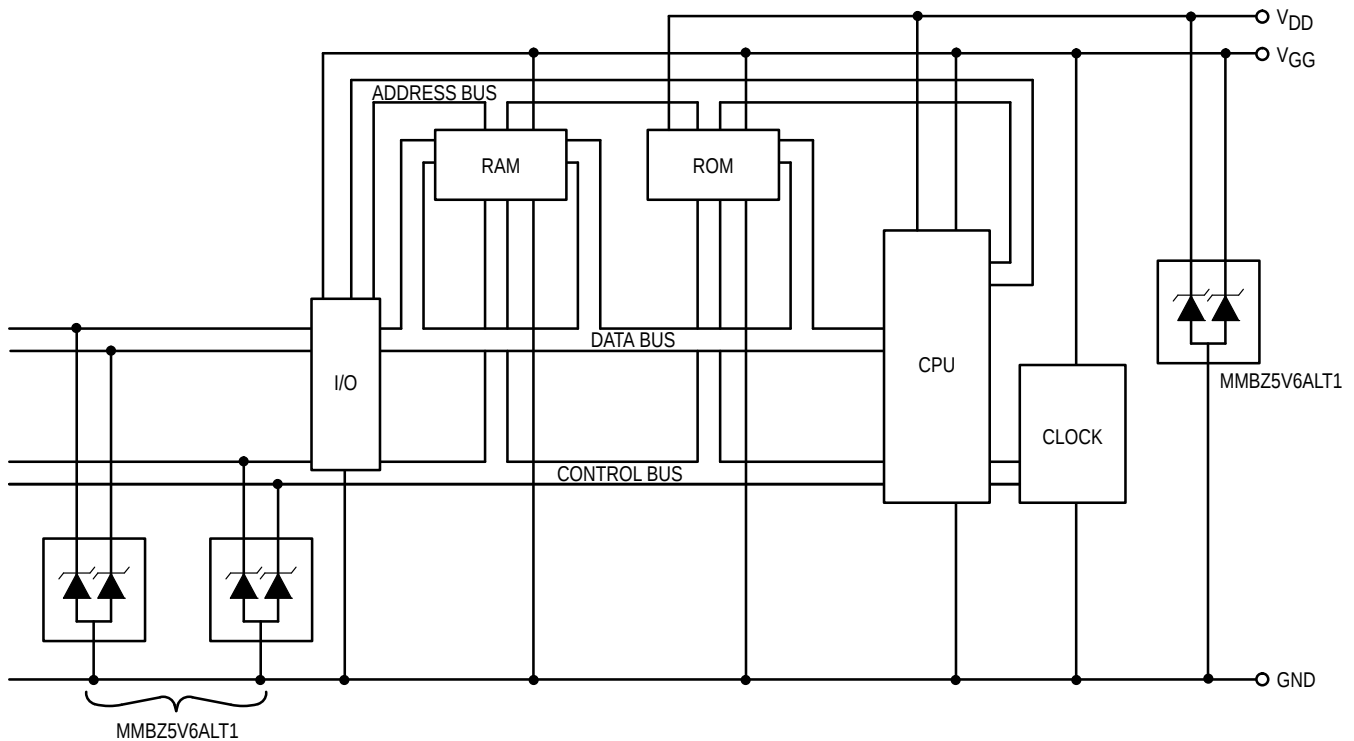
A dual junction common anode design in a SOT-23 package protects two separate lines using only one package. This adds flexibility and creativity to PCB design especially when

board space is at a premium. Two simplified examples of MMBZ5V6ALT1 TVS applications are illustrated below.

### Computer Interface Protection



### Microprocessor Protection

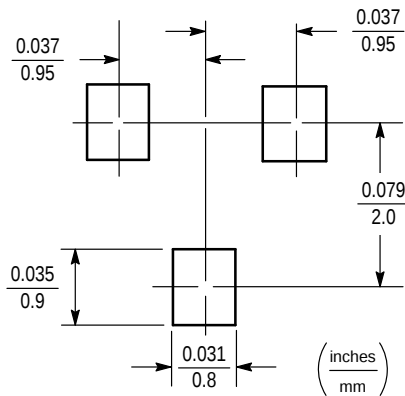


## INFORMATION FOR USING THE SOT-23 SURFACE MOUNT PACKAGE

### MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface

between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SOT-23

### SOT-23 POWER DISSIPATION

The power dissipation of the SOT-23 is a function of the drain pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by  $T_{J(max)}$ , the maximum rated junction temperature of the die,  $R_{\theta JA}$ , the thermal resistance from the device junction to ambient, and the operating temperature,  $T_A$ . Using the values provided on the data sheet for the SOT-23 package,  $P_D$  can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature  $T_A$  of 25°C, one can calculate the power dissipation of the device which in this case is 225 milliwatts.

$$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{556^\circ\text{C/W}} = 225 \text{ milliwatts}$$

The 556°C/W for the SOT-23 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 225 milliwatts. There are other alternatives to achieving higher power dissipation from the SOT-23 package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

### SOLDERING PRECAUTIONS

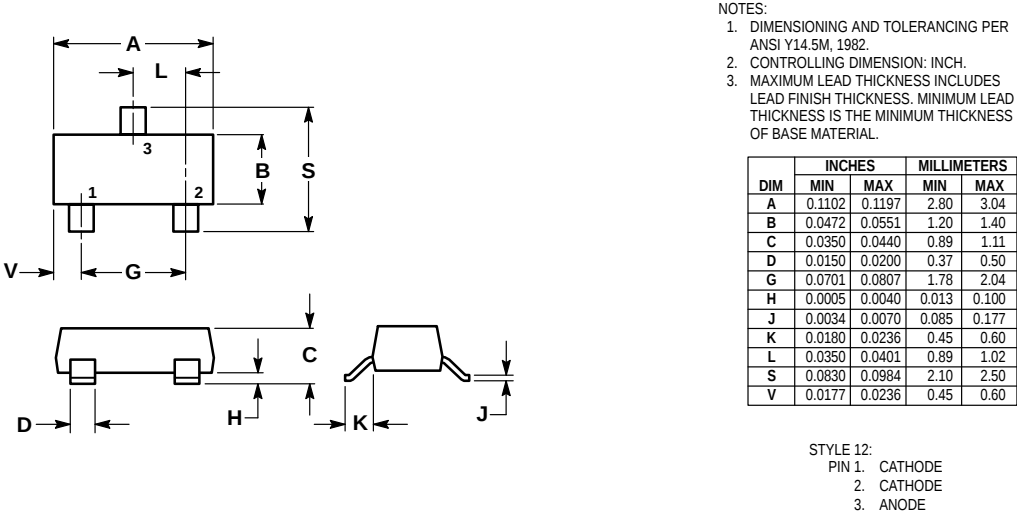
The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.\*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

\* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

# Transient Voltage Suppressors — Surface Mounted

## 24 Watt Peak Power



CASE 318-07  
PLASTIC

(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

### MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

| Package Option | Type No. Suffix | MPQ (Units) |
|----------------|-----------------|-------------|
| Tape and Reel  | T1              | 3K          |
| Tape and Reel  | T3              | 10K         |

(Refer to Section 10 for more information on Packaging Specifications.)

# 15 & 27 Volt SOT-23 Dual Monolithic Common Cathode Zeners

## Transient Voltage Suppressors for ESD Protection

These dual monolithic silicon zener diodes are designed for applications requiring transient overvoltage protection capability. They are intended for use in voltage and ESD sensitive equipment such as computers, printers, business machines, communication systems, medical equipment and other applications. Their dual junction common cathode design protects two separate lines using only one package. These devices are ideal for situations where board space is at a premium.

### Specification Features:

- SOT-23 Package Allows Either Two Separate Unidirectional Configurations or a Single Bidirectional Configuration
- Peak Power — 40 Watts @ 1.0 ms (Bidirectional), per Figure 5 Waveform
- Maximum Clamping Voltage @ Peak Pulse Current
- Low Leakage < 100 nA
- ESD Rating of Class N (exceeding 16 kV) per the Human Body Model

### Mechanical Characteristics:

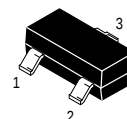
- Void Free, Transfer-Molded, Thermosetting Plastic Case
- Corrosion Resistant Finish, Easily Solderable
- Package Designed for Optimal Automated Board Assembly
- Small Package Size for High Density Applications
- Available in 8 mm Tape and Reel

Use the Device Number to order the 7 inch/3,000 unit reel. Replace the "T1" with "T3" in the Device Number to order the 13 inch/10,000 unit reel.

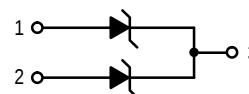
## MMBZ15VDLT1 MMBZ27VCLT1

Motorola Preferred Devices

SOT-23  
COMMON CATHODE  
DUAL ZENER  
OVERVOLTAGE  
TRANSIENT SUPPRESSORS  
40 WATTS  
PEAK POWER



CASE 318-08  
TO-236AB  
LOW PROFILE SOT-23



TERMINAL 1 – ANODE  
TERMINAL 2 – ANODE  
TERMINAL 3 – CATHODE

### THERMAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic                                                                                                 | Symbol             | Value        | Unit                       |
|----------------------------------------------------------------------------------------------------------------|--------------------|--------------|----------------------------|
| Peak Power Dissipation @ 1.0 ms (1)<br>@ $T_A \leq 25^\circ\text{C}$                                           | $P_{pk}$           | 40           | Watts                      |
| Total Power Dissipation on FR-5 Board (2) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$        | $P_D$              | 225<br>1.8   | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient                                                                         | $R_{\theta JA}$    | 556          | $^\circ\text{C}/\text{W}$  |
| Total Power Dissipation on Alumina Substrate (3) @ $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$              | 300<br>2.4   | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance Junction to Ambient                                                                         | $R_{\theta JA}$    | 417          | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature Range                                                                         | $T_J$<br>$T_{stg}$ | - 55 to +150 | $^\circ\text{C}$           |
| Lead Solder Temperature — Maximum (10 Second Duration)                                                         | $T_L$              | 230          | $^\circ\text{C}$           |

1. Non-repetitive current pulse per Figure 5 and derate above  $T_A = 25^\circ\text{C}$  per Figure 6.

2. FR-5 =  $1.0 \times 0.75 \times 0.62$  in.

3. Alumina =  $0.4 \times 0.3 \times 0.024$  in., 99.5% alumina

Thermal Clad is a trademark of the Bergquist Company

Preferred devices are Motorola recommended choices for future use and best overall value.



# **ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

## **UNIDIRECTIONAL** (Circuit tied to Pins 1 and 3 or Pins 2 and 3)

( $V_F = 0.9\text{ V Max @ } I_F = 10\text{ mA}$ )

| Breakdown Voltage  |     |      |                 | Reverse Voltage<br>Working Peak<br>$V_{RWM}$<br>(V) | Max Reverse<br>Leakage Current<br>$I_{RWM}$<br>$I_R$ (nA) | Max Reverse<br>Surge Current<br>$I_{RSM(5)}$<br>(A) | Max Reverse<br>Voltage @ $I_{RSM(5)}$<br>(Clamping Voltage)<br>$V_{RSM}$<br>(V) | Maximum<br>Temperature<br>Coefficient of<br>$V_{BR}$<br>(mV/°C) |
|--------------------|-----|------|-----------------|-----------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------|
| $V_{BR(4)}$<br>(V) |     |      | @ $I_T$<br>(mA) |                                                     |                                                           |                                                     |                                                                                 |                                                                 |
| Min                | Nom | Max  |                 |                                                     |                                                           |                                                     |                                                                                 |                                                                 |
| 14.3               | 15  | 15.8 | 1.0             | 12.8                                                | 100                                                       | 1.9                                                 | 21.2                                                                            | 12                                                              |

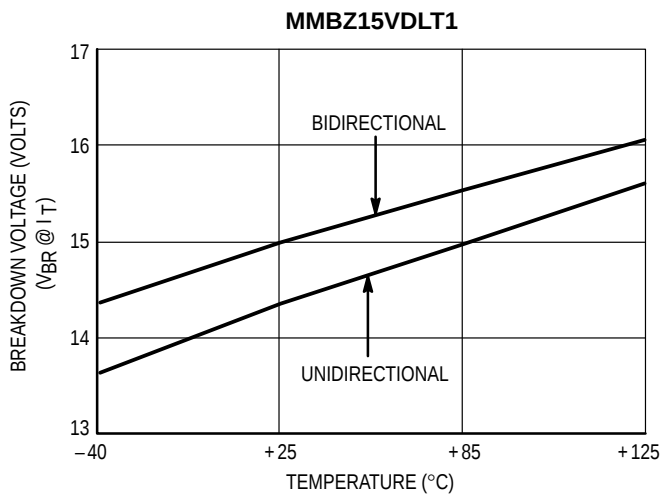
( $V_F = 1.1\text{ V Max @ } I_F = 200\text{ mA}$ )

| Breakdown Voltage  |     |       |                 | Reverse Voltage<br>Working Peak<br>$V_{RWM}$<br>(V) | Max Reverse<br>Leakage Current<br>$I_{RWM}$<br>$I_R$ (nA) | Max Reverse<br>Surge Current<br>$I_{RSM(5)}$<br>(A) | Max Reverse<br>Voltage @ $I_{RSM(5)}$<br>(Clamping Voltage)<br>$V_{RSM}$<br>(V) | Maximum<br>Temperature<br>Coefficient of<br>$V_{BR}$<br>(mV/°C) |
|--------------------|-----|-------|-----------------|-----------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------|
| $V_{BR(4)}$<br>(V) |     |       | @ $I_T$<br>(mA) |                                                     |                                                           |                                                     |                                                                                 |                                                                 |
| Min                | Nom | Max   |                 |                                                     |                                                           |                                                     |                                                                                 |                                                                 |
| 25.65              | 27  | 28.35 | 1.0             | 22                                                  | 50                                                        | 1.0                                                 | 38                                                                              | 26                                                              |

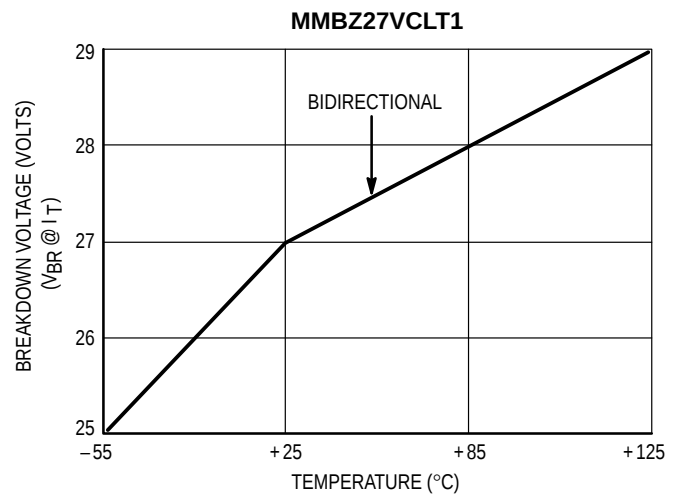
(4)  $V_{BR}$  measured at pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

(5) Surge current waveform per Figure 5 and derate per Figure 6.

## **TYPICAL CHARACTERISTICS**



**Figure 1A. Typical Breakdown Voltage versus Temperature**



**Figure 1B. Typical Breakdown Voltage versus Temperature**

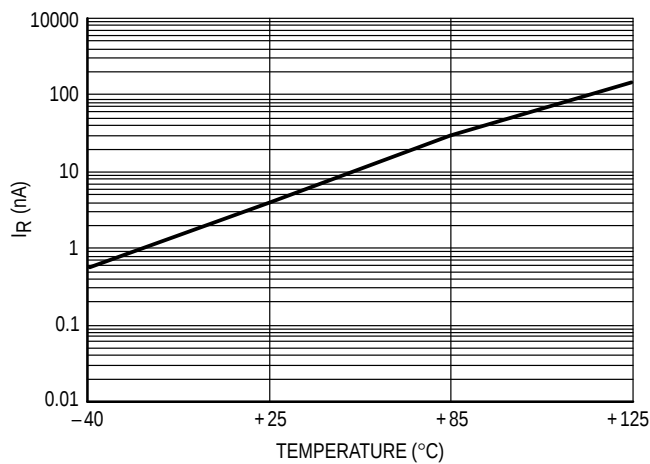


Figure 2. Typical Leakage Current versus Temperature

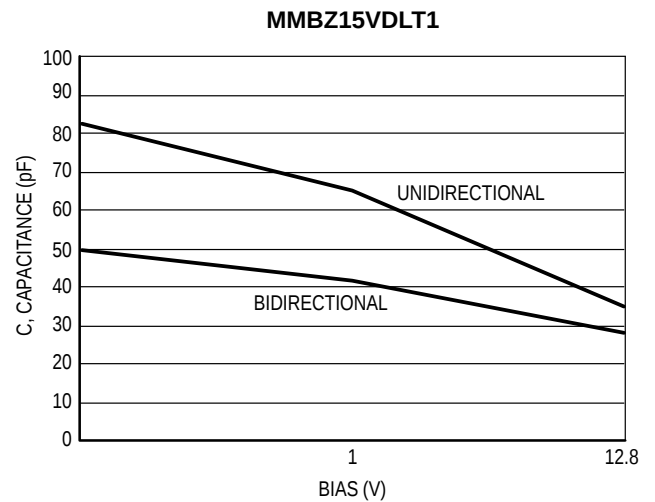


Figure 3. Typical Capacitance versus Bias Voltage

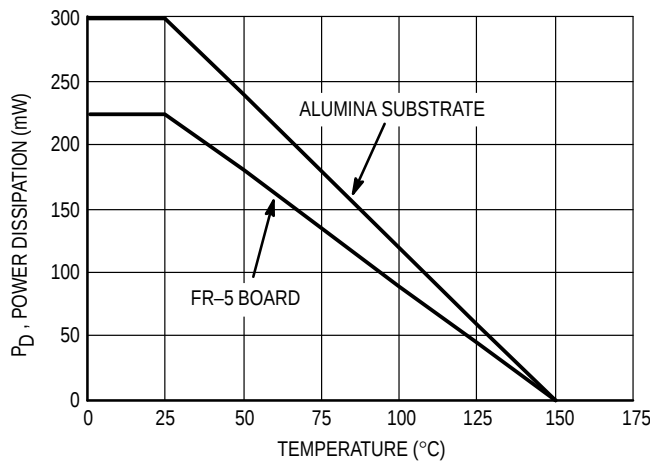


Figure 4. Steady State Power Derating Curve

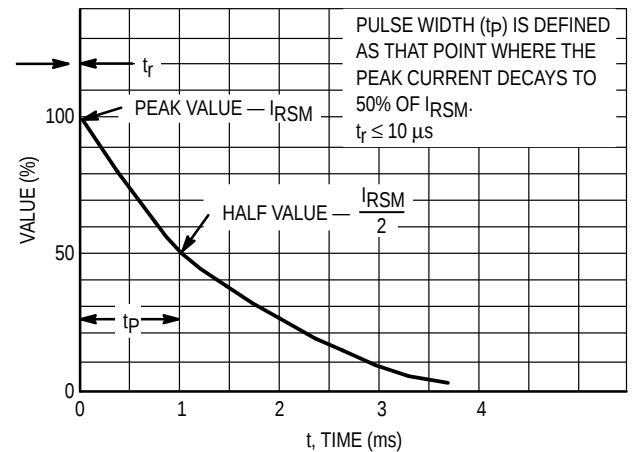


Figure 5. Pulse Waveform

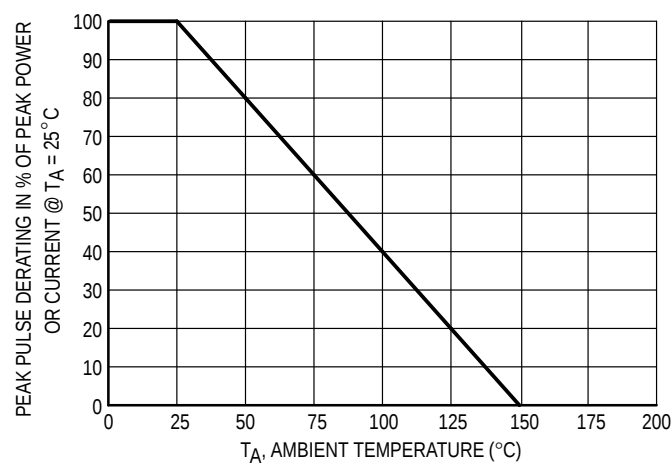


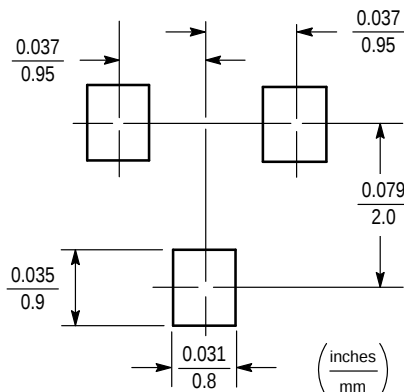
Figure 6. Pulse Derating Curve

## INFORMATION FOR USING THE SOT-23 SURFACE MOUNT PACKAGE

### MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection

interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



SOT-23

### SOT-23 POWER DISSIPATION

The power dissipation of the SOT-23 is a function of the drain pad size. This can vary from the minimum pad size for soldering to a pad size given for maximum power dissipation. Power dissipation for a surface mount device is determined by  $T_{J(max)}$ , the maximum rated junction temperature of the die,  $R_{\theta JA}$ , the thermal resistance from the device junction to ambient, and the operating temperature,  $T_A$ . Using the values provided on the data sheet for the SOT-23 package,  $P_D$  can be calculated as follows:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The values for the equation are found in the maximum ratings table on the data sheet. Substituting these values into the equation for an ambient temperature  $T_A$  of 25°C, one can calculate the power dissipation of the device which in this case is 225 milliwatts.

$$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{556^\circ\text{C/W}} = 225 \text{ milliwatts}$$

The 556°C/W for the SOT-23 package assumes the use of the recommended footprint on a glass epoxy printed circuit board to achieve a power dissipation of 225 milliwatts. There are other alternatives to achieving higher power dissipation from the SOT-23 package. Another alternative would be to use a ceramic substrate or an aluminum core board such as Thermal Clad™. Using a board material such as Thermal Clad, an aluminum core board, the power dissipation can be doubled using the same footprint.

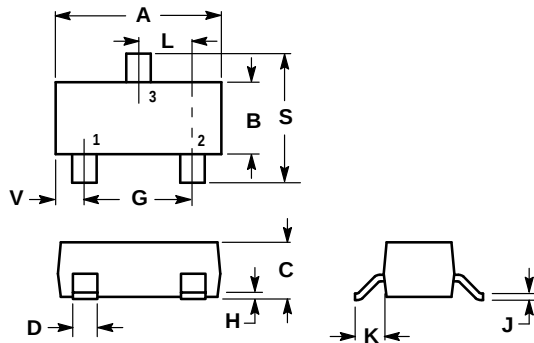
### SOLDERING PRECAUTIONS

The melting temperature of solder is higher than the rated temperature of the device. When the entire device is heated to a high temperature, failure to complete soldering within a short time could result in device failure. Therefore, the following items should always be observed in order to minimize the thermal stress to which the devices are subjected.

- Always preheat the device.
- The delta temperature between the preheat and soldering should be 100°C or less.\*
- When preheating and soldering, the temperature of the leads and the case must not exceed the maximum temperature ratings as shown on the data sheet. When using infrared heating with the reflow soldering method, the difference shall be a maximum of 10°C.
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual cooling should be used as the use of forced cooling will increase the temperature gradient and result in latent failure due to mechanical stress.
- Mechanical stress or shock should not be applied during cooling.

\* Soldering a device without preheating can cause excessive thermal shock and stress which can result in damage to the device.

## OUTLINE DIMENSIONS



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.085       | 0.177 |
| K   | 0.0140 | 0.0285 | 0.35        | 0.69  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.1039 | 2.10        | 2.64  |
| V   | 0.0177 | 0.0236 | 0.45        | 0.60  |

### STYLE 9:

- PIN 1. ANODE
2. ANODE
3. CATHODE

**CASE 318-08  
ISSUE AE  
TO-236AB**

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**MOTOROLA**



MMBZ15VDLT1/D



# Transient Voltage Suppressors — Surface Mounted

## 40 Watt Peak Power

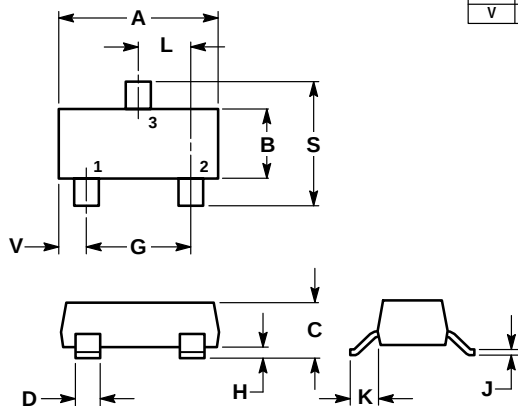
### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

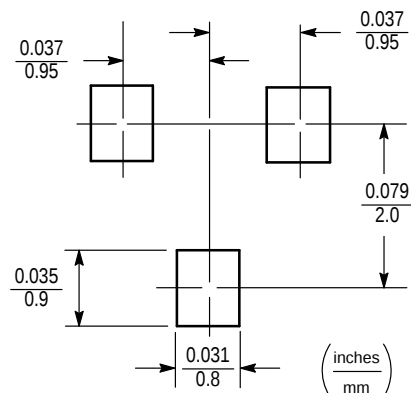
| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.085       | 0.177 |
| K   | 0.0180 | 0.0236 | 0.45        | 0.60  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.0984 | 2.10        | 2.50  |
| V   | 0.0177 | 0.0236 | 0.45        | 0.60  |

### STYLE 9:

- PIN 1. ANODE  
2. ANODE  
3. CATHODE



CASE 318-07  
PLASTIC



SOT-23 Footprint

(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

### MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

| Package Option | Type No. Suffix | MPQ (Units) |
|----------------|-----------------|-------------|
| Tape and Reel  | T1              | 3K          |
| Tape and Reel  | T3              | 10K         |

(Refer to Section 10 for more information on Packaging Specifications.)

**GENERAL DATA APPLICABLE TO ALL SERIES IN  
THIS GROUP**

**Zener Transient Voltage Suppressors**

The SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMB series is supplied in Motorola's exclusive, cost-effective, highly reliable Surmetic package and is ideally suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

**Specification Features:**

- Standard Zener Breakdown Voltage Range — 6.8 to 200 V
- Stand-off Voltage Range — 5 to 170 V
- Peak Power — 600 Watts @ 1 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5  $\mu$ A Above 10 V
- UL Recognition
- Response Time Typically < 1 ns

**Mechanical Characteristics:**

**CASE:** Void-free, transfer-molded, thermosetting plastic

**FINISH:** All external surfaces are corrosion resistant and leads are readily solderable

**POLARITY:** Cathode indicated by molded polarity notch. When operated in zener mode, will be positive with respect to anode

**MOUNTING POSITION:** Any

**LEADS:** Modified L-Bend providing more contact area to bond pad

**MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES:** 260°C for 10 seconds

**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seremban, Malaysia

**GENERAL  
DATA  
600 WATT  
PEAK POWER**

**PLASTIC SURFACE MOUNT  
ZENER OVERVOLTAGE  
TRANSIENT  
SUPPRESSORS  
6.8–200 VOLTS  
600 WATT PEAK POWER**



**CASE 403A  
PLASTIC**

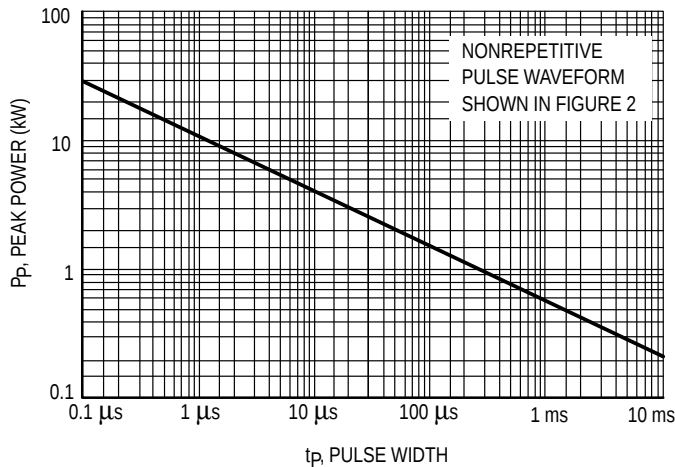
**MAXIMUM RATINGS**

| Rating                                                      | Symbol          | Value        | Unit               |
|-------------------------------------------------------------|-----------------|--------------|--------------------|
| Peak Power Dissipation (1)<br>@ $T_L \leq 25^\circ\text{C}$ | $P_{PK}$        | 600          | Watts              |
| Forward Surge Current (2)<br>@ $T_A = 25^\circ\text{C}$     | $I_{FSM}$       | 100          | Amps               |
| Thermal Resistance from Junction to Lead (typical)          | $R_{\theta JL}$ | 25           | $^\circ\text{C/W}$ |
| Operating and Storage Temperature Range                     | $T_J, T_{stg}$  | – 65 to +150 | $^\circ\text{C}$   |

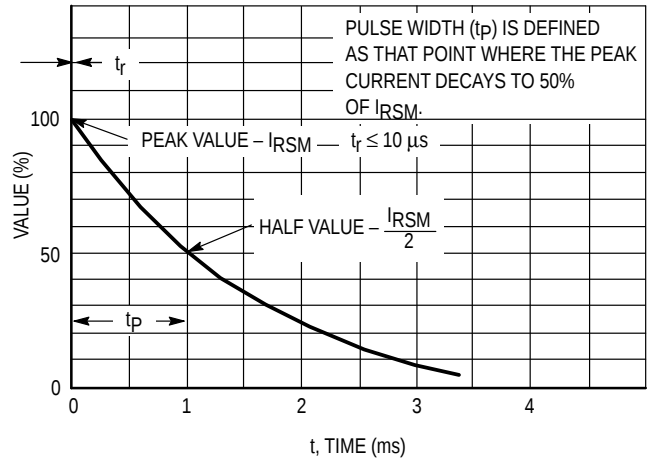
NOTES: 1. Nonrepetitive current pulse per Figure 2 and derated above  $T_A = 25^\circ\text{C}$  per Figure 3.

2. 1/2 sine wave (or equivalent square wave),  $PW = 8.3$  ms, duty cycle = 4 pulses per minute maximum.

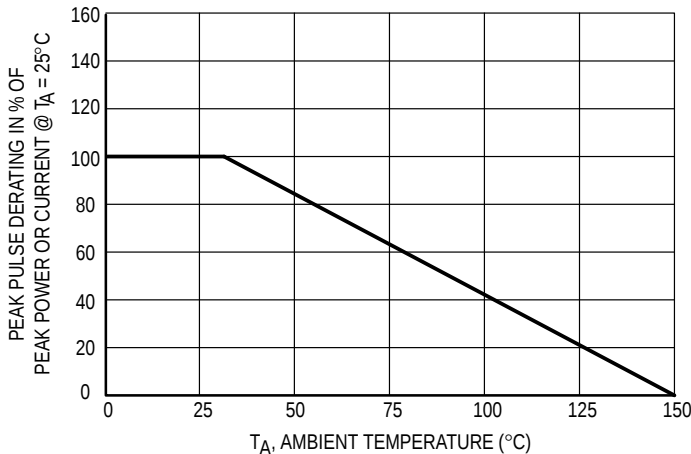
# GENERAL DATA — 600 WATT PEAK POWER



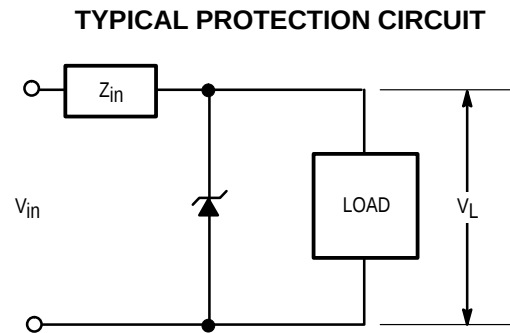
**Figure 1. Pulse Rating Curve**



**Figure 2. Pulse Waveform**



**Figure 3. Pulse Derating Curve**



## APPLICATION NOTES

### RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 4.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 5. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMB series have a very good response time, typically  $< 1$  ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing

the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by  $Z_{in}$  is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

### DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 6. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

## GENERAL DATA — 600 WATT PEAK POWER

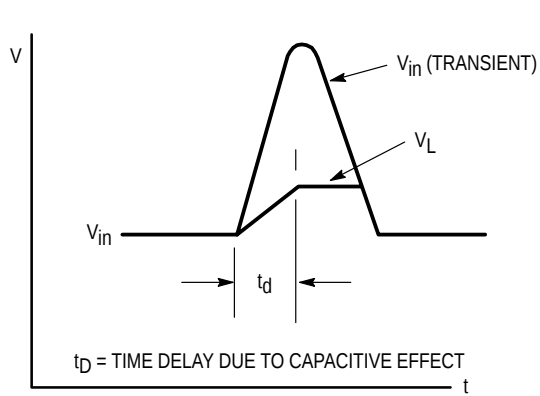


Figure 4.

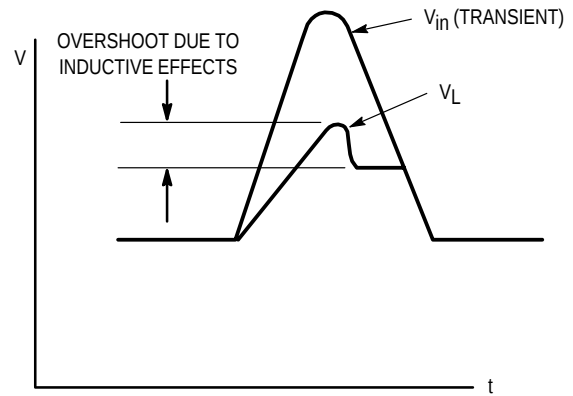


Figure 5.

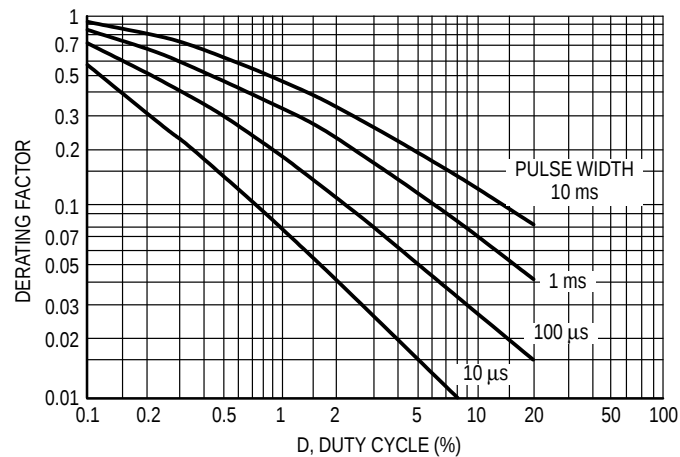


Figure 6. Typical Derating Factor for Duty Cycle

### UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage

Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

# 1SMB5.0AT3 through 1SMB170AT3

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted).

| Device††          | Reverse Stand-Off Voltage<br>V <sub>R</sub><br>Volts (1) | Breakdown Voltage*<br>V <sub>BR</sub> @ I <sub>T</sub> |            | Maximum Clamping Voltage<br>V <sub>C</sub> @ I <sub>pp</sub><br>Volts | Peak Pulse Current<br>(See Figure 2)<br>I <sub>pp</sub> †<br>Amps | Maximum Reverse Leakage<br>@ V <sub>R</sub><br>I <sub>R</sub><br>μA | Device Marking |
|-------------------|----------------------------------------------------------|--------------------------------------------------------|------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------|----------------|
|                   |                                                          | Volts Min                                              | mA         |                                                                       |                                                                   |                                                                     |                |
| <b>1SMB5.0AT3</b> | <b>5.0</b>                                               | <b>6.40</b>                                            | <b>10</b>  | <b>9.2</b>                                                            | <b>65.2</b>                                                       | <b>800</b>                                                          | <b>KE</b>      |
| <b>1SMB6.0AT3</b> | <b>6.0</b>                                               | <b>6.67</b>                                            | <b>10</b>  | <b>10.3</b>                                                           | <b>58.3</b>                                                       | <b>800</b>                                                          | <b>KG</b>      |
| 1SMB6.5AT3        | 6.5                                                      | 7.22                                                   | 10         | 11.2                                                                  | 53.6                                                              | 500                                                                 | KK             |
| 1SMB7.0AT3        | 7.0                                                      | 7.78                                                   | 10         | 12.0                                                                  | 50.0                                                              | 200                                                                 | KM             |
| 1SMB7.5AT3        | 7.5                                                      | 8.33                                                   | 1.0        | 12.9                                                                  | 46.5                                                              | 100                                                                 | KP             |
| 1SMB8.0AT3        | 8.0                                                      | 8.89                                                   | 1.0        | 13.6                                                                  | 44.1                                                              | 50                                                                  | KR             |
| 1SMB8.5AT3        | 8.5                                                      | 9.44                                                   | 1.0        | 14.4                                                                  | 41.7                                                              | 10                                                                  | KT             |
| 1SMB9.0AT3        | 9.0                                                      | 10.0                                                   | 1.0        | 15.4                                                                  | 39.0                                                              | 5.0                                                                 | KV             |
| 1SMB10AT3         | 10                                                       | 11.1                                                   | 1.0        | 17.0                                                                  | 35.3                                                              | 5.0                                                                 | KX             |
| 1SMB11AT3         | 11                                                       | 12.2                                                   | 1.0        | 18.2                                                                  | 33.0                                                              | 5.0                                                                 | KZ             |
| 1SMB12AT3         | 12                                                       | 13.3                                                   | 1.0        | 19.9                                                                  | 30.2                                                              | 5.0                                                                 | LE             |
| 1SMB13AT3         | 13                                                       | 14.4                                                   | 1.0        | 21.5                                                                  | 27.9                                                              | 5.0                                                                 | LG             |
| 1SMB14AT3         | 14                                                       | 15.6                                                   | 1.0        | 23.2                                                                  | 25.8                                                              | 5.0                                                                 | LK             |
| 1SMB15AT3         | 15                                                       | 16.7                                                   | 1.0        | 24.4                                                                  | 24.0                                                              | 5.0                                                                 | LM             |
| 1SMB16AT3         | 16                                                       | 17.8                                                   | 1.0        | 26.0                                                                  | 23.1                                                              | 5.0                                                                 | LP             |
| 1SMB17AT3         | 17                                                       | 18.9                                                   | 1.0        | 27.6                                                                  | 21.7                                                              | 5.0                                                                 | LR             |
| 1SMB18AT3         | 18                                                       | 20.0                                                   | 1.0        | 29.2                                                                  | 20.5                                                              | 5.0                                                                 | LT             |
| 1SMB20AT3         | 20                                                       | 22.2                                                   | 1.0        | 32.4                                                                  | 18.5                                                              | 5.0                                                                 | LV             |
| <b>1SMB22AT3</b>  | <b>22</b>                                                | <b>24.4</b>                                            | <b>1.0</b> | <b>35.5</b>                                                           | <b>16.9</b>                                                       | <b>5.0</b>                                                          | <b>LX</b>      |
| 1SMB24AT3         | 24                                                       | 26.7                                                   | 1.0        | 38.9                                                                  | 15.4                                                              | 5.0                                                                 | LZ             |
| 1SMB26AT3         | 26                                                       | 28.9                                                   | 1.0        | 42.1                                                                  | 14.2                                                              | 5.0                                                                 | ME             |
| 1SMB28AT3         | 28                                                       | 31.1                                                   | 1.0        | 45.4                                                                  | 13.2                                                              | 5.0                                                                 | MG             |
| 1SMB30AT3         | 30                                                       | 33.3                                                   | 1.0        | 48.4                                                                  | 12.4                                                              | 5.0                                                                 | MK             |
| 1SMB33AT3         | 33                                                       | 36.7                                                   | 1.0        | 53.3                                                                  | 11.3                                                              | 5.0                                                                 | MM             |
| 1SMB36AT3         | 36                                                       | 40.0                                                   | 1.0        | 58.1                                                                  | 10.3                                                              | 5.0                                                                 | MP             |
| 1SMB40AT3         | 40                                                       | 44.4                                                   | 1.0        | 64.5                                                                  | 9.3                                                               | 5.0                                                                 | MR             |
| 1SMB43AT3         | 43                                                       | 47.8                                                   | 1.0        | 69.4                                                                  | 8.6                                                               | 5.0                                                                 | MT             |
| 1SMB45AT3         | 45                                                       | 50.0                                                   | 1.0        | 72.7                                                                  | 8.3                                                               | 5.0                                                                 | MV             |
| 1SMB48AT3         | 48                                                       | 53.3                                                   | 1.0        | 77.4                                                                  | 7.7                                                               | 5.0                                                                 | MX             |
| 1SMB51AT3         | 51                                                       | 56.7                                                   | 1.0        | 82.4                                                                  | 7.3                                                               | 5.0                                                                 | MZ             |
| 1SMB54AT3         | 54                                                       | 60.0                                                   | 1.0        | 87.1                                                                  | 6.9                                                               | 5.0                                                                 | NE             |
| <b>1SMB58AT3</b>  | <b>58</b>                                                | <b>64.4</b>                                            | <b>1.0</b> | <b>93.6</b>                                                           | <b>6.4</b>                                                        | <b>5.0</b>                                                          | <b>NG</b>      |
| 1SMB60AT3         | 60                                                       | 66.7                                                   | 1.0        | 96.8                                                                  | 6.2                                                               | 5.0                                                                 | NK             |
| 1SMB64AT3         | 64                                                       | 71.1                                                   | 1.0        | 103                                                                   | 5.8                                                               | 5.0                                                                 | NM             |
| 1SMB70AT3         | 70                                                       | 77.8                                                   | 1.0        | 113                                                                   | 5.3                                                               | 5.0                                                                 | NP             |
| 1SMB75AT3         | 75                                                       | 83.3                                                   | 1.0        | 121                                                                   | 4.9                                                               | 5.0                                                                 | NR             |
| 1SMB78AT3         | 78                                                       | 86.7                                                   | 1.0        | 126                                                                   | 4.7                                                               | 5.0                                                                 | NT             |
| 1SMB85AT3         | 85                                                       | 94.4                                                   | 1.0        | 137                                                                   | 4.4                                                               | 5.0                                                                 | NV             |
| 1SMB90AT3         | 90                                                       | 100                                                    | 1.0        | 146                                                                   | 4.1                                                               | 5.0                                                                 | NX             |
| 1SMB100AT3        | 100                                                      | 111                                                    | 1.0        | 162                                                                   | 3.7                                                               | 5.0                                                                 | NZ             |
| 1SMB110AT3        | 110                                                      | 122                                                    | 1.0        | 177                                                                   | 3.4                                                               | 5.0                                                                 | PE             |
| 1SMB120AT3        | 120                                                      | 133                                                    | 1.0        | 193                                                                   | 3.1                                                               | 5.0                                                                 | PG             |
| 1SMB130AT3        | 130                                                      | 144                                                    | 1.0        | 209                                                                   | 2.9                                                               | 5.0                                                                 | PK             |
| 1SMB150AT3        | 150                                                      | 167                                                    | 1.0        | 243                                                                   | 2.5                                                               | 5.0                                                                 | PM             |
| 1SMB160AT3        | 160                                                      | 178                                                    | 1.0        | 259                                                                   | 2.3                                                               | 5.0                                                                 | PP             |
| 1SMB170AT3        | 170                                                      | 189                                                    | 1.0        | 275                                                                   | 2.2                                                               | 5.0                                                                 | PR             |

Note 1: A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V<sub>R</sub>) which should be equal to or greater than the DC or continuous peak operating voltage level.

\* V<sub>BR</sub> measured at pulse test current I<sub>T</sub> at an ambient temperature of 25°C.

† Surge current waveform per Figure 2 and derate per Figure 3 of the General Data — 600 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

### ABBREVIATIONS AND SYMBOLS

**V<sub>R</sub>** Stand Off Voltage. Applied reverse voltage to assure a non-conductive condition (See Note 1).

**V<sub>(BR)min</sub>** This is the minimum breakdown voltage the device will exhibit and is used to assure that conduction does not occur prior to this voltage level at 25°C.

**V<sub>C</sub>** Maximum Clamping Voltage. The maximum peak voltage appearing across the transient suppressor when

subjected to the peak pulse current in a one millisecond time interval. The peak pulse voltages are the combination of voltage rise due to both the series resistance and thermal rise.

Peak Pulse Current — See Figure 2

Peak Pulse Power

Reverse Leakage

**I<sub>pp</sub>**  
**P<sub>p</sub>**  
**I<sub>R</sub>**

Devices listed in bold, italic are Motorola preferred devices.

# P6SMB6.8AT3 through P6SMB200AT3

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted).

| Device††          | Reverse<br>Stand-Off Voltage<br>V <sub>R</sub><br>Volts (1) | Breakdown Voltage*               |            | Maximum<br>Clamping Voltage<br>V <sub>C</sub> @ I <sub>pp</sub><br>Volts | Peak<br>Pulse Current<br>(See Figure 2)<br>I <sub>pp</sub> †<br>Amps | Maximum<br>Reverse Leakage<br>@ V <sub>R</sub><br>I <sub>R</sub><br>μA | Device<br>Marking |
|-------------------|-------------------------------------------------------------|----------------------------------|------------|--------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------|-------------------|
|                   |                                                             | V <sub>BR</sub> @ I <sub>T</sub> |            |                                                                          |                                                                      |                                                                        |                   |
|                   |                                                             | Volts<br>Min                     | mA         |                                                                          |                                                                      |                                                                        |                   |
| 1SMB10CAT3        | 10                                                          | 11.1                             | 1.0        | 17.0                                                                     | 35.3                                                                 | 5.0                                                                    | KXC               |
| 1SMB11CAT3        | 11                                                          | 12.2                             | 1.0        | 18.2                                                                     | 33.0                                                                 | 5.0                                                                    | KZC               |
| 1SMB12CAT3        | 12                                                          | 13.3                             | 1.0        | 19.9                                                                     | 30.2                                                                 | 5.0                                                                    | LEC               |
| 1SMB13CAT3        | 13                                                          | 14.4                             | 1.0        | 21.5                                                                     | 27.9                                                                 | 5.0                                                                    | LGC               |
| 1SMB14CAT3        | 14                                                          | 15.6                             | 1.0        | 23.2                                                                     | 25.8                                                                 | 5.0                                                                    | LKC               |
| <b>1SMB15CAT3</b> | <b>15</b>                                                   | <b>16.7</b>                      | <b>1.0</b> | <b>24.4</b>                                                              | <b>24.0</b>                                                          | <b>5.0</b>                                                             | <b>LMC</b>        |
| 1SMB16CAT3        | 16                                                          | 17.8                             | 1.0        | 26.0                                                                     | 23.1                                                                 | 5.0                                                                    | LPC               |
| 1SMB17CAT3        | 17                                                          | 18.9                             | 1.0        | 27.6                                                                     | 21.7                                                                 | 5.0                                                                    | LRC               |
| 1SMB18CAT3        | 18                                                          | 20.0                             | 1.0        | 29.2                                                                     | 20.5                                                                 | 5.0                                                                    | LTC               |
| 1SMB20CAT3        | 20                                                          | 22.2                             | 1.0        | 32.4                                                                     | 18.5                                                                 | 5.0                                                                    | LVC               |
| 1SMB22CAT3        | 22                                                          | 24.4                             | 1.0        | 35.5                                                                     | 16.9                                                                 | 5.0                                                                    | LXC               |
| 1SMB24CAT3        | 24                                                          | 26.7                             | 1.0        | 38.9                                                                     | 15.4                                                                 | 5.0                                                                    | LZC               |
| 1SMB26CAT3        | 26                                                          | 28.9                             | 1.0        | 42.1                                                                     | 14.2                                                                 | 5.0                                                                    | MEC               |
| 1SMB28CAT3        | 28                                                          | 31.1                             | 1.0        | 45.4                                                                     | 13.2                                                                 | 5.0                                                                    | MGC               |
| 1SMB30CAT3        | 30                                                          | 33.3                             | 1.0        | 48.4                                                                     | 12.4                                                                 | 5.0                                                                    | MKC               |
| 1SMB33CAT3        | 33                                                          | 36.7                             | 1.0        | 53.3                                                                     | 11.3                                                                 | 5.0                                                                    | MMC               |
| 1SMB36CAT3        | 36                                                          | 40.0                             | 1.0        | 58.1                                                                     | 10.3                                                                 | 5.0                                                                    | MPC               |
| 1SMB40CAT3        | 40                                                          | 44.4                             | 1.0        | 64.5                                                                     | 9.3                                                                  | 5.0                                                                    | MRC               |
| 1SMB43CAT3        | 43                                                          | 47.8                             | 1.0        | 69.4                                                                     | 8.6                                                                  | 5.0                                                                    | MTC               |
| 1SMB45CAT3        | 45                                                          | 50.0                             | 1.0        | 72.7                                                                     | 8.3                                                                  | 5.0                                                                    | MVC               |
| 1SMB48CAT3        | 48                                                          | 53.3                             | 1.0        | 77.4                                                                     | 7.7                                                                  | 5.0                                                                    | MXC               |
| 1SMB51CAT3        | 51                                                          | 56.7                             | 1.0        | 82.4                                                                     | 7.3                                                                  | 5.0                                                                    | MZC               |
| 1SMB54CAT3        | 54                                                          | 60.0                             | 1.0        | 87.1                                                                     | 6.9                                                                  | 5.0                                                                    | NEC               |
| 1SMB58CAT3        | 58                                                          | 64.4                             | 1.0        | 93.6                                                                     | 6.4                                                                  | 5.0                                                                    | NGC               |
| 1SMB60CAT3        | 60                                                          | 66.7                             | 1.0        | 96.8                                                                     | 6.2                                                                  | 5.0                                                                    | NKC               |
| 1SMB64CAT3        | 64                                                          | 71.1                             | 1.0        | 103                                                                      | 5.8                                                                  | 5.0                                                                    | NMC               |
| 1SMB70CAT3        | 70                                                          | 77.8                             | 1.0        | 113                                                                      | 5.3                                                                  | 5.0                                                                    | NPC               |
| 1SMB75CAT3        | 75                                                          | 83.3                             | 1.0        | 121                                                                      | 4.9                                                                  | 5.0                                                                    | NRC               |
| 1SMB78CAT3        | 78                                                          | 86.7                             | 1.0        | 126                                                                      | 4.7                                                                  | 5.0                                                                    | NTC               |

Note 1: A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V<sub>R</sub>) which should be equal to or greater than the DC or continuous peak operating voltage level.

\* V<sub>BR</sub> measured at pulse test current I<sub>T</sub> at an ambient temperature of 25°C.

† Surge current waveform per Figure 2 and derate per Figure 3 of the General Data — 600 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

## ABBREVIATIONS AND SYMBOLS

**V<sub>R</sub>** Stand Off Voltage. Applied reverse voltage to assure a non-conductive condition (See Note 1).

**V<sub>(BR)min</sub>** This is the minimum breakdown voltage the device will exhibit and is used to assure that conduction does not occur prior to this voltage level at 25°C.

**V<sub>C</sub>** Maximum Clamping Voltage. The maximum peak voltage appearing across the transient suppressor when

**I<sub>pp</sub>**  
**P<sub>p</sub>**  
**I<sub>R</sub>**

subjected to the peak pulse current in a one millisecond time interval. The peak pulse voltages are the combination of voltage rise due to both the series resistance and thermal rise.

Peak Pulse Current — See Figure 2

Peak Pulse Power

Reverse Leakage

Devices listed in bold, italic are Motorola preferred devices.

# 1SMB10CAT3 through 1SMB78CAT3

## Bi-Directional

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 3.5\text{ V Max}$ ,  $I_F^{**} = 50\text{ A}$  for all types.

| Device††    | Breakdown Voltage*                        |     |      |    | Working Peak Reverse Voltage<br>V <sub>RWM</sub><br>Volts | Maximum Reverse Leakage<br>@ V <sub>RWM</sub><br>I <sub>R</sub><br>μA | Maximum Reverse Surge Current<br>I <sub>RSM</sub> †<br>Amps | Maximum Reverse Voltage<br>@ I <sub>RSM</sub><br>(Clamping Voltage)<br>V <sub>RSM</sub><br>Volts | Maximum Temperature Coefficient<br>of V <sub>BR</sub><br>%/°C | Device Marking |
|-------------|-------------------------------------------|-----|------|----|-----------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------|----------------|
|             | V <sub>BR</sub> @ I <sub>T</sub><br>Volts |     |      |    |                                                           |                                                                       |                                                             |                                                                                                  |                                                               |                |
|             | Min                                       | Nom | Max  | mA |                                                           |                                                                       |                                                             |                                                                                                  |                                                               |                |
| P6SMB6.8AT3 | 6.45                                      | 6.8 | 7.14 | 10 | 5.8                                                       | 1000                                                                  | 57                                                          | 10.5                                                                                             | 0.057                                                         | 6V8A           |
| P6SMB7.5AT3 | 7.13                                      | 7.5 | 7.88 | 10 | 6.4                                                       | 500                                                                   | 53                                                          | 11.3                                                                                             | 0.061                                                         | 7V5A           |
| P6SMB8.2AT3 | 7.79                                      | 8.2 | 8.61 | 10 | 7.02                                                      | 200                                                                   | 50                                                          | 12.1                                                                                             | 0.065                                                         | 8V2A           |
| P6SMB9.1AT3 | 8.65                                      | 9.1 | 9.55 | 1  | 7.78                                                      | 50                                                                    | 45                                                          | 13.4                                                                                             | 0.068                                                         | 9V1A           |
| P6SMB10AT3  | 9.5                                       | 10  | 10.5 | 1  | 8.55                                                      | 10                                                                    | 41                                                          | 14.5                                                                                             | 0.073                                                         | 10A            |
| P6SMB11AT3  | 10.5                                      | 11  | 11.6 | 1  | 9.4                                                       | 5                                                                     | 38                                                          | 15.6                                                                                             | 0.075                                                         | 11A            |
| P6SMB12AT3  | 11.4                                      | 12  | 12.6 | 1  | 10.2                                                      | 5                                                                     | 36                                                          | 16.7                                                                                             | 0.078                                                         | 12A            |
| P6SMB13AT3  | 12.4                                      | 13  | 13.7 | 1  | 11.1                                                      | 5                                                                     | 33                                                          | 18.2                                                                                             | 0.081                                                         | 13A            |
| P6SMB15AT3  | 14.3                                      | 15  | 15.8 | 1  | 12.8                                                      | 5                                                                     | 28                                                          | 21.2                                                                                             | 0.084                                                         | 15A            |
| P6SMB16AT3  | 15.2                                      | 16  | 16.8 | 1  | 13.6                                                      | 5                                                                     | 27                                                          | 22.5                                                                                             | 0.086                                                         | 16A            |
| P6SMB18AT3  | 17.1                                      | 18  | 18.9 | 1  | 15.3                                                      | 5                                                                     | 24                                                          | 25.2                                                                                             | 0.088                                                         | 18A            |
| P6SMB20AT3  | 19                                        | 20  | 21   | 1  | 17.1                                                      | 5                                                                     | 22                                                          | 27.7                                                                                             | 0.09                                                          | 20A            |
| P6SMB22AT3  | 20.9                                      | 22  | 23.1 | 1  | 18.8                                                      | 5                                                                     | 20                                                          | 30.6                                                                                             | 0.092                                                         | 22A            |
| P6SMB24AT3  | 22.8                                      | 24  | 25.2 | 1  | 20.5                                                      | 5                                                                     | 18                                                          | 33.2                                                                                             | 0.094                                                         | 24A            |
| P6SMB27AT3  | 25.7                                      | 27  | 28.4 | 1  | 23.1                                                      | 5                                                                     | 16                                                          | 37.5                                                                                             | 0.096                                                         | 27A            |
| P6SMB30AT3  | 28.5                                      | 30  | 31.5 | 1  | 25.6                                                      | 5                                                                     | 14.4                                                        | 41.4                                                                                             | 0.097                                                         | 30A            |
| P6SMB33AT3  | 31.4                                      | 33  | 34.7 | 1  | 28.2                                                      | 5                                                                     | 13.2                                                        | 45.7                                                                                             | 0.098                                                         | 33A            |
| P6SMB36AT3  | 34.2                                      | 36  | 37.8 | 1  | 30.8                                                      | 5                                                                     | 12                                                          | 49.9                                                                                             | 0.099                                                         | 36A            |
| P6SMB39AT3  | 37.1                                      | 39  | 41   | 1  | 33.3                                                      | 5                                                                     | 11.2                                                        | 53.9                                                                                             | 0.1                                                           | 39A            |
| P6SMB43AT3  | 40.9                                      | 43  | 45.2 | 1  | 36.8                                                      | 5                                                                     | 10.1                                                        | 59.3                                                                                             | 0.101                                                         | 43A            |
| P6SMB47AT3  | 44.7                                      | 47  | 49.4 | 1  | 40.2                                                      | 5                                                                     | 9.3                                                         | 64.8                                                                                             | 0.101                                                         | 47A            |
| P6SMB51AT3  | 48.5                                      | 51  | 53.6 | 1  | 43.6                                                      | 5                                                                     | 8.6                                                         | 70.1                                                                                             | 0.102                                                         | 51A            |
| P6SMB56AT3  | 53.2                                      | 56  | 58.8 | 1  | 47.8                                                      | 5                                                                     | 7.8                                                         | 77                                                                                               | 0.103                                                         | 56A            |
| P6SMB62AT3  | 58.9                                      | 62  | 65.1 | 1  | 53                                                        | 5                                                                     | 7.1                                                         | 85                                                                                               | 0.104                                                         | 62A            |
| P6SMB68AT3  | 64.6                                      | 68  | 71.4 | 1  | 58.1                                                      | 5                                                                     | 6.5                                                         | 92                                                                                               | 0.104                                                         | 68A            |
| P6SMB75AT3  | 71.3                                      | 75  | 78.8 | 1  | 64.1                                                      | 5                                                                     | 5.8                                                         | 103                                                                                              | 0.105                                                         | 75A            |
| P6SMB82AT3  | 77.9                                      | 82  | 86.1 | 1  | 70.1                                                      | 5                                                                     | 5.3                                                         | 113                                                                                              | 0.105                                                         | 82A            |
| P6SMB91AT3  | 86.5                                      | 91  | 95.5 | 1  | 77.8                                                      | 5                                                                     | 4.8                                                         | 125                                                                                              | 0.106                                                         | 91A            |
| P6SMB100AT3 | 95                                        | 100 | 105  | 1  | 85.5                                                      | 5                                                                     | 4.4                                                         | 137                                                                                              | 0.106                                                         | 100A           |
| P6SMB110AT3 | 105                                       | 110 | 116  | 1  | 94                                                        | 5                                                                     | 4                                                           | 152                                                                                              | 0.107                                                         | 110A           |
| P6SMB120AT3 | 114                                       | 120 | 126  | 1  | 102                                                       | 5                                                                     | 3.6                                                         | 165                                                                                              | 0.107                                                         | 120A           |
| P6SMB130AT3 | 124                                       | 130 | 137  | 1  | 111                                                       | 5                                                                     | 3.3                                                         | 179                                                                                              | 0.107                                                         | 130A           |
| P6SMB150AT3 | 143                                       | 150 | 158  | 1  | 128                                                       | 5                                                                     | 2.9                                                         | 207                                                                                              | 0.108                                                         | 150A           |
| P6SMB160AT3 | 152                                       | 160 | 168  | 1  | 136                                                       | 5                                                                     | 2.7                                                         | 219                                                                                              | 0.108                                                         | 160A           |
| P6SMB170AT3 | 162                                       | 170 | 179  | 1  | 145                                                       | 5                                                                     | 2.6                                                         | 234                                                                                              | 0.108                                                         | 170A           |
| P6SMB180AT3 | 171                                       | 180 | 189  | 1  | 154                                                       | 5                                                                     | 2.4                                                         | 246                                                                                              | 0.108                                                         | 180A           |
| P6SMB200AT3 | 190                                       | 200 | 210  | 1  | 171                                                       | 5                                                                     | 2.2                                                         | 274                                                                                              | 0.108                                                         | 200A           |

\*  $V_{BR}$  measured at pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

\*\* 1/2 sine wave (or equivalent square wave),  $PW = 8.3\text{ ms}$ , duty cycle = 4 pulses per minute maximum.

† Surge current waveform per Figure 2 and derate per Figure 3 of the General Data — 600 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

Devices listed in bold, italic are Motorola preferred devices.

# P6SMB11CAT3 through P6SMB91CAT3

## Bi-Directional

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 3.5\text{ V Max}$ ,  $I_F^{**} = 50\text{ A}$  for all types.

| Device††           | Breakdown Voltage* |           |             |          | Working Peak Reverse Voltage<br>$V_{RWM}$<br>Volts | Maximum Reverse Leakage<br>@ $V_{RWM}$<br>$I_R$<br>$\mu\text{A}$ | Maximum Reverse Surge Current<br>$I_{RSM}^\dagger$<br>Amps | Maximum Reverse Voltage<br>@ $I_{RSM}$<br>(Clamping Voltage)<br>$V_{RSM}$<br>Volts | Maximum Temperature Coefficient<br>of $V_{BR}$<br>$\%/^\circ\text{C}$ | Device Marking |
|--------------------|--------------------|-----------|-------------|----------|----------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------|
|                    | Min                | Nom       | Max         | mA       |                                                    |                                                                  |                                                            |                                                                                    |                                                                       |                |
| P6SMB11CAT3        | 10.5               | 11        | 11.6        | 1        | 9.4                                                | 5                                                                | 38                                                         | 15.6                                                                               | 0.075                                                                 | 11C            |
| P6SMB12CAT3        | 11.4               | 12        | 12.6        | 1        | 10.2                                               | 5                                                                | 36                                                         | 16.7                                                                               | 0.078                                                                 | 12C            |
| P6SMB13CAT3        | 12.4               | 13        | 13.7        | 1        | 11.1                                               | 5                                                                | 33                                                         | 18.2                                                                               | 0.081                                                                 | 13C            |
| P6SMB15CAT3        | 14.3               | 15        | 15.8        | 1        | 12.8                                               | 5                                                                | 28                                                         | 21.2                                                                               | 0.084                                                                 | 15C            |
| P6SMB16CAT3        | 15.2               | 16        | 16.8        | 1        | 13.6                                               | 5                                                                | 27                                                         | 22.5                                                                               | 0.086                                                                 | 16C            |
| P6SMB18CAT3        | 17.1               | 18        | 18.9        | 1        | 15.3                                               | 5                                                                | 24                                                         | 25.2                                                                               | 0.088                                                                 | 18C            |
| P6SMB20CAT3        | 19                 | 20        | 21          | 1        | 17.1                                               | 5                                                                | 22                                                         | 27.7                                                                               | 0.09                                                                  | 20C            |
| P6SMB22CAT3        | 20.9               | 22        | 23.1        | 1        | 18.8                                               | 5                                                                | 20                                                         | 30.6                                                                               | 0.092                                                                 | 22C            |
| P6SMB24CAT3        | 22.8               | 24        | 25.2        | 1        | 20.5                                               | 5                                                                | 18                                                         | 33.2                                                                               | 0.094                                                                 | 24C            |
| P6SMB27CAT3        | 25.7               | 27        | 28.4        | 1        | 23.1                                               | 5                                                                | 16                                                         | 37.5                                                                               | 0.096                                                                 | 27C            |
| P6SMB30CAT3        | 28.5               | 30        | 31.5        | 1        | 25.6                                               | 5                                                                | 14.4                                                       | 41.4                                                                               | 0.097                                                                 | 30C            |
| <b>P6SMB33CAT3</b> | <b>31.4</b>        | <b>33</b> | <b>34.7</b> | <b>1</b> | <b>28.2</b>                                        | <b>5</b>                                                         | <b>13.2</b>                                                | <b>45.7</b>                                                                        | <b>0.098</b>                                                          | <b>33C</b>     |
| P6SMB36CAT3        | 34.2               | 36        | 37.8        | 1        | 30.8                                               | 5                                                                | 12                                                         | 49.9                                                                               | 0.099                                                                 | 36C            |
| P6SMB39CAT3        | 37.1               | 39        | 41          | 1        | 33.3                                               | 5                                                                | 11.2                                                       | 53.9                                                                               | 0.1                                                                   | 39C            |
| P6SMB43CAT3        | 40.9               | 43        | 45.2        | 1        | 36.8                                               | 5                                                                | 10.1                                                       | 59.3                                                                               | 0.101                                                                 | 43C            |
| P6SMB47CAT3        | 44.7               | 47        | 49.4        | 1        | 40.2                                               | 5                                                                | 9.3                                                        | 64.8                                                                               | 0.101                                                                 | 47C            |
| P6SMB51CAT3        | 48.5               | 51        | 53.6        | 1        | 43.6                                               | 5                                                                | 8.6                                                        | 70.1                                                                               | 0.102                                                                 | 51C            |
| P6SMB56CAT3        | 53.2               | 56        | 58.8        | 1        | 47.8                                               | 5                                                                | 7.8                                                        | 77                                                                                 | 0.103                                                                 | 56C            |
| P6SMB62CAT3        | 58.9               | 62        | 65.1        | 1        | 53                                                 | 5                                                                | 7.1                                                        | 85                                                                                 | 0.104                                                                 | 62C            |
| P6SMB68CAT3        | 64.6               | 68        | 71.4        | 1        | 58.1                                               | 5                                                                | 6.5                                                        | 92                                                                                 | 0.104                                                                 | 68C            |
| P6SMB75CAT3        | 71.3               | 75        | 78.8        | 1        | 64.1                                               | 5                                                                | 5.8                                                        | 103                                                                                | 0.105                                                                 | 75C            |
| P6SMB82CAT3        | 77.9               | 82        | 86.1        | 1        | 70.1                                               | 5                                                                | 5.3                                                        | 113                                                                                | 0.105                                                                 | 82C            |
| P6SMB91CAT3        | 86.5               | 91        | 95.5        | 1        | 77.8                                               | 5                                                                | 4.8                                                        | 125                                                                                | 0.106                                                                 | 91C            |

\*  $V_{BR}$  measured at pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

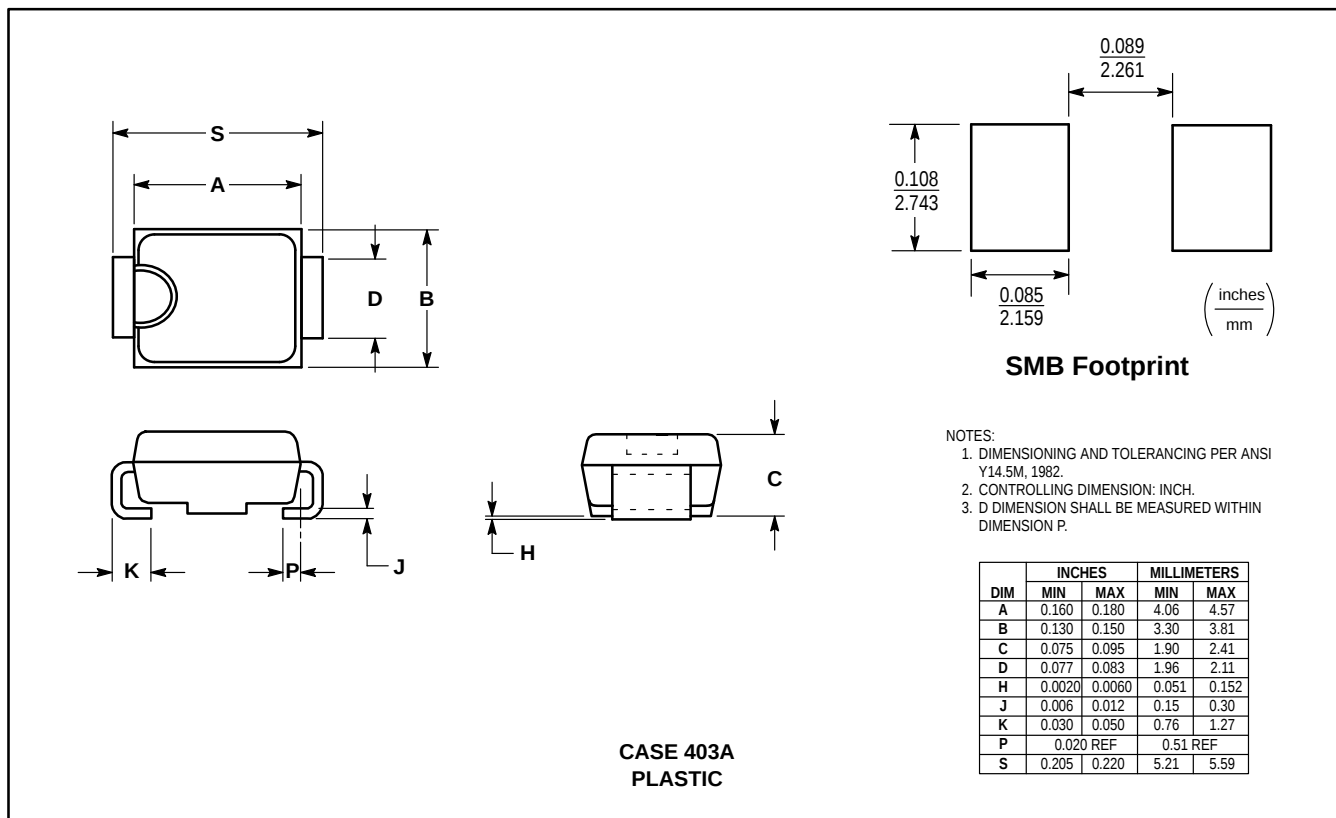
\*\* 1/2 sine wave (or equivalent square wave),  $PW = 8.3\text{ ms}$ , duty cycle = 4 pulses per minute maximum.

† Surge current waveform per Figure 2 and derate per Figure 3 of the General Data — 600 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

# Transient Voltage Suppressors — Surface Mounted

## 600 Watt Peak Power



(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

### MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

| Package Option | Type No. Suffix   | MPQ (Units) |
|----------------|-------------------|-------------|
| Tape and Reel  | T3 (13 inch reel) | 2.5K        |

(Refer to Section 10 for more information on Packaging Specifications.)

Devices listed in bold, italic are Motorola preferred devices.

**GENERAL DATA APPLICABLE TO ALL SERIES IN THIS GROUP**

**Zener Transient Voltage Suppressors**

The SMC series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low zener impedance and fast response time. The SMC series is supplied in Motorola's exclusive, cost-effective, highly reliable Surmetic package and is ideally suited for use in communication systems, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

**Specification Features:**

- Standard Zener Breakdown Voltage Range — 6.8 to 91 V
- Stand-off Voltage Range — 5 to 78 V
- Peak Power — 1500 Watts @ 1 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5  $\mu$ A Above 10 V
- UL Recognition
- Maximum Temperature Coefficient Specified
- Available in Tape and Reel
- Response Time Typically < 1 ns

**Mechanical Characteristics:**

**CASE:** Void-free, transfer-molded, thermosetting plastic

**FINISH:** All external surfaces are corrosion resistant and leads are readily solderable

**POLARITY:** Cathode indicated by molded polarity notch. When operated in zener mode, will be positive with respect to anode

**MOUNTING POSITION:** Any

**LEADS:** Modified L-Bend providing more contact area to bond pads

**MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES:** 260°C for 10 seconds

**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seremban, Malaysia

**GENERAL  
DATA  
1500 WATT  
PEAK POWER**

**PLASTIC SURFACE MOUNT  
ZENER OVERVOLTAGE  
TRANSIENT  
SUPPRESSORS  
6.8–91 VOLTS  
1500 WATT PEAK POWER**



**CASE 403  
PLASTIC**

**MAXIMUM RATINGS**

| Rating                                                      | Symbol          | Value        | Unit               |
|-------------------------------------------------------------|-----------------|--------------|--------------------|
| Peak Power Dissipation (1)<br>@ $T_L \leq 25^\circ\text{C}$ | PPK             | 1500         | Watts              |
| Forward Surge Current (2)<br>@ $T_A = 25^\circ\text{C}$     | $I_{FSM}$       | 200          | Amps               |
| Thermal Resistance from Junction to Lead (typical)          | $R_{\theta JL}$ | 15           | $^\circ\text{C/W}$ |
| Operating and Storage Temperature Range                     | $T_J, T_{stg}$  | – 65 to +150 | $^\circ\text{C}$   |

NOTES: 1. Nonrepetitive current pulse per Figure 2 and derated above  $T_A = 25^\circ\text{C}$  per Figure 3.

2. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum.

## GENERAL DATA — 1500 WATT PEAK POWER

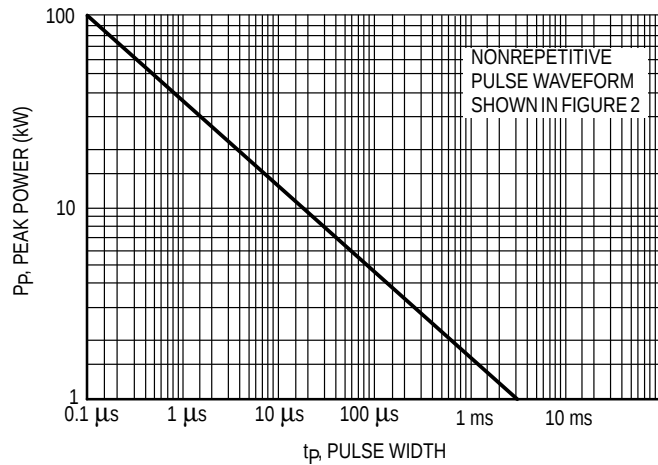


Figure 1. Pulse Rating Curve

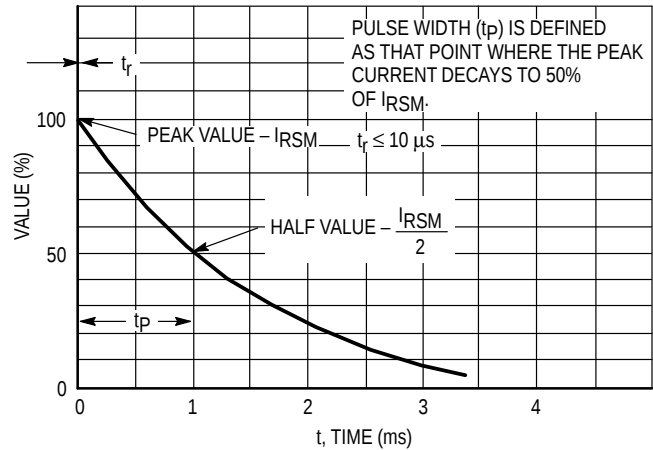


Figure 2. Pulse Waveform

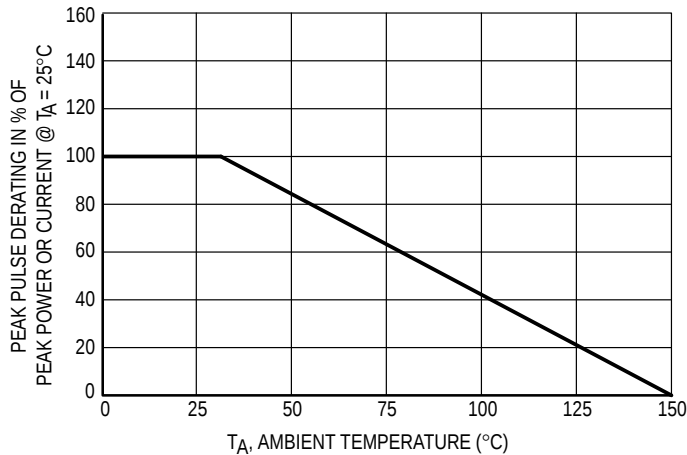


Figure 3. Pulse Derating Curve

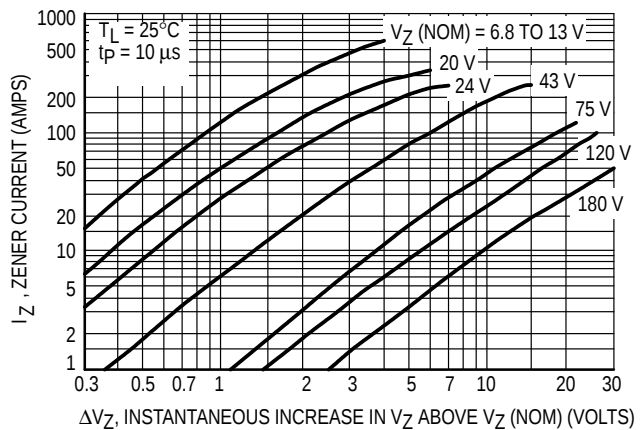


Figure 4. Dynamic Impedance

## UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests including Strike Voltage

Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

# GENERAL DATA — 1500 WATT PEAK POWER

## APPLICATION NOTES

### RESPONSE TIME

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 5.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 6. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMC series have a very good response time, typically  $< 1$  ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout, minimum lead lengths and placing the

suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by  $Z_{in}$  is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

### DUTY CYCLE DERATING

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 7. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 7 appear to be in error as the 10 ms pulse has a higher derating factor than the 10  $\mu$ s pulse. However, when the derating factor for a given pulse of Figure 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

### TYPICAL PROTECTION CIRCUIT

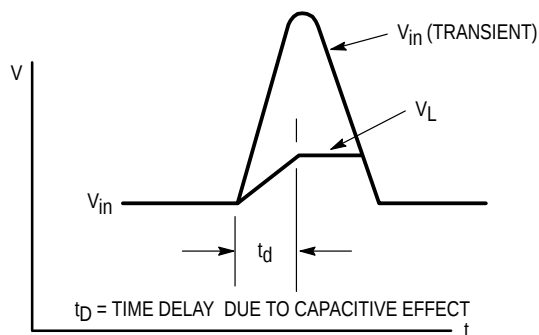
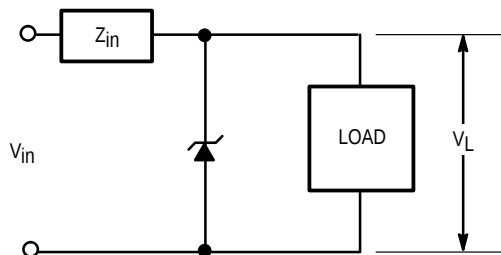


Figure 5.

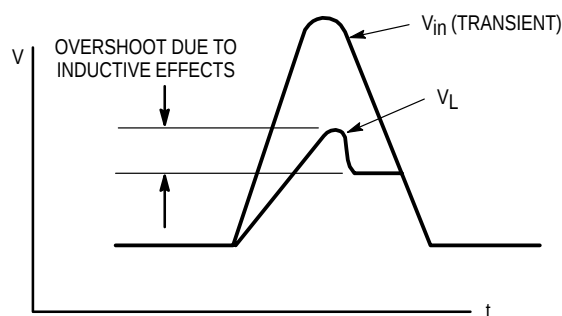


Figure 6.

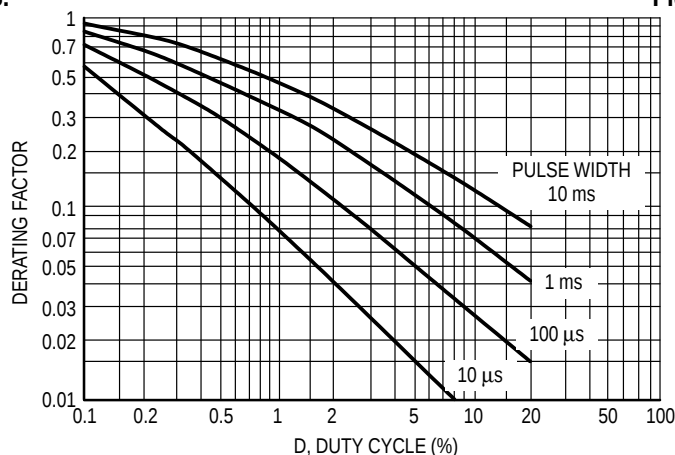


Figure 7. Typical Derating Factor for Duty Cycle

# 1SMC5.0AT3 through 1SMC78AT3

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted).

| Device††         | Reverse Stand-Off Voltage<br>V <sub>R</sub><br>Volts (1) | Breakdown Voltage*<br>V <sub>BR</sub> @ I <sub>T</sub> |            | Maximum Clamping Voltage<br>V <sub>C</sub> @ I <sub>pp</sub><br>Volts | Peak Pulse Current<br>(See Figure 2)<br>I <sub>pp</sub> †<br>Amps | Maximum Reverse Leakage<br>@ V <sub>R</sub><br>I <sub>R</sub><br>μA | Device Marking |
|------------------|----------------------------------------------------------|--------------------------------------------------------|------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|---------------------------------------------------------------------|----------------|
|                  |                                                          | Volts Min                                              | mA         |                                                                       |                                                                   |                                                                     |                |
| 1SMC5.0AT3       | 5.0                                                      | 6.40                                                   | 10         | 9.2                                                                   | 163.0                                                             | 1000                                                                | GDE            |
| 1SMC6.0AT3       | 6.0                                                      | 6.67                                                   | 10         | 10.3                                                                  | 145.6                                                             | 1000                                                                | GDG            |
| 1SMC6.5AT3       | 6.5                                                      | 7.22                                                   | 10         | 11.2                                                                  | 133.9                                                             | 500                                                                 | GDK            |
| 1SMC7.0AT3       | 7.0                                                      | 7.78                                                   | 10         | 12.0                                                                  | 125.0                                                             | 200                                                                 | GDM            |
| 1SMC7.5AT3       | 7.5                                                      | 8.33                                                   | 1.0        | 12.9                                                                  | 116.3                                                             | 100                                                                 | GDP            |
| 1SMC8.0AT3       | 8.0                                                      | 8.89                                                   | 1.0        | 13.6                                                                  | 110.3                                                             | 50                                                                  | GDR            |
| 1SMC8.5AT3       | 8.5                                                      | 9.44                                                   | 1.0        | 14.4                                                                  | 104.2                                                             | 20                                                                  | GDT            |
| 1SMC9.0AT3       | 9.0                                                      | 10.0                                                   | 1.0        | 15.4                                                                  | 97.4                                                              | 10                                                                  | GDV            |
| 1SMC10AT3        | 10                                                       | 11.1                                                   | 1.0        | 17.0                                                                  | 88.2                                                              | 5.0                                                                 | GDX            |
| 1SMC11AT3        | 11                                                       | 12.2                                                   | 1.0        | 18.2                                                                  | 82.4                                                              | 5.0                                                                 | GDZ            |
| 1SMC12AT3        | 12                                                       | 13.3                                                   | 1.0        | 19.9                                                                  | 75.3                                                              | 5.0                                                                 | GEE            |
| 1SMC13AT3        | 13                                                       | 14.4                                                   | 1.0        | 21.5                                                                  | 69.7                                                              | 5.0                                                                 | GEG            |
| 1SMC14AT3        | 14                                                       | 15.6                                                   | 1.0        | 23.2                                                                  | 64.7                                                              | 5.0                                                                 | GEK            |
| 1SMC15AT3        | 15                                                       | 16.7                                                   | 1.0        | 24.4                                                                  | 61.5                                                              | 5.0                                                                 | GEM            |
| 1SMC16AT3        | 16                                                       | 17.8                                                   | 1.0        | 26.0                                                                  | 57.7                                                              | 5.0                                                                 | GEP            |
| 1SMC17AT3        | 17                                                       | 18.9                                                   | 1.0        | 27.6                                                                  | 53.3                                                              | 5.0                                                                 | GER            |
| 1SMC18AT3        | 18                                                       | 20.0                                                   | 1.0        | 29.2                                                                  | 51.4                                                              | 5.0                                                                 | GET            |
| 1SMC20AT3        | 20                                                       | 22.2                                                   | 1.0        | 32.4                                                                  | 46.3                                                              | 5.0                                                                 | GEV            |
| 1SMC22AT3        | 22                                                       | 24.4                                                   | 1.0        | 35.5                                                                  | 42.2                                                              | 5.0                                                                 | GEX            |
| 1SMC24AT3        | 24                                                       | 26.7                                                   | 1.0        | 38.9                                                                  | 38.6                                                              | 5.0                                                                 | GEZ            |
| 1SMC26AT3        | 26                                                       | 28.9                                                   | 1.0        | 42.1                                                                  | 35.6                                                              | 5.0                                                                 | GFE            |
| 1SMC28AT3        | 28                                                       | 31.1                                                   | 1.0        | 45.4                                                                  | 33.0                                                              | 5.0                                                                 | GFG            |
| 1SMC30AT3        | 30                                                       | 33.3                                                   | 1.0        | 48.4                                                                  | 31.0                                                              | 5.0                                                                 | GFK            |
| 1SMC33AT3        | 33                                                       | 36.7                                                   | 1.0        | 53.3                                                                  | 28.1                                                              | 5.0                                                                 | GFM            |
| 1SMC36AT3        | 36                                                       | 40.0                                                   | 1.0        | 58.1                                                                  | 25.8                                                              | 5.0                                                                 | GFP            |
| 1SMC40AT3        | 40                                                       | 44.4                                                   | 1.0        | 64.5                                                                  | 23.2                                                              | 5.0                                                                 | GFR            |
| 1SMC43AT3        | 43                                                       | 47.8                                                   | 1.0        | 69.4                                                                  | 21.6                                                              | 5.0                                                                 | GFT            |
| 1SMC45AT3        | 45                                                       | 50.0                                                   | 1.0        | 72.7                                                                  | 20.6                                                              | 5.0                                                                 | GFV            |
| 1SMC48AT3        | 48                                                       | 53.3                                                   | 1.0        | 77.4                                                                  | 19.4                                                              | 5.0                                                                 | GFX            |
| 1SMC51AT3        | 51                                                       | 56.7                                                   | 1.0        | 82.4                                                                  | 18.2                                                              | 5.0                                                                 | GFZ            |
| 1SMC54AT3        | 54                                                       | 60.0                                                   | 1.0        | 87.1                                                                  | 17.2                                                              | 5.0                                                                 | GGE            |
| <b>1SMC58AT3</b> | <b>58</b>                                                | <b>64.4</b>                                            | <b>1.0</b> | <b>93.6</b>                                                           | <b>16.0</b>                                                       | <b>5.0</b>                                                          | <b>GGG</b>     |
| 1SMC60AT3        | 60                                                       | 66.7                                                   | 1.0        | 96.8                                                                  | 15.5                                                              | 5.0                                                                 | GGK            |
| 1SMC64AT3        | 64                                                       | 71.1                                                   | 1.0        | 103                                                                   | 14.6                                                              | 5.0                                                                 | GGM            |
| 1SMC70AT3        | 70                                                       | 77.8                                                   | 1.0        | 113                                                                   | 13.3                                                              | 5.0                                                                 | GGP            |
| 1SMC75AT3        | 75                                                       | 83.3                                                   | 1.0        | 121                                                                   | 12.4                                                              | 5.0                                                                 | GGR            |
| 1SMC78AT3        | 78                                                       | 86.7                                                   | 1.0        | 126                                                                   | 11.4                                                              | 5.0                                                                 | GGT            |

Note 1: A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V<sub>R</sub>) which should be equal to or greater than the DC or continuous peak operating voltage level.

\* V<sub>BR</sub> measured at pulse test current I<sub>T</sub> at an ambient temperature of 25°C.

† Surge current waveform per Figure 2 and derate per Figure 3 of the General Data — 1500 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

## ABBREVIATIONS AND SYMBOLS

**V<sub>R</sub>** Stand Off Voltage. Applied reverse voltage to assure a non-conductive condition (See Note 1).

**V<sub>(BR)min</sub>** This is the minimum breakdown voltage the device will exhibit and is used to assure that conduction does not occur prior to this voltage level at 25°C.

**V<sub>C</sub>** Maximum Clamping Voltage. The maximum peak voltage appearing across the transient suppressor when

subjected to the peak pulse current in a one millisecond time interval. The peak pulse series resistance and thermal rise.

Peak Pulse Current — See Figure 2

Peak Pulse Power

Reverse Leakage

**I<sub>pp</sub>**  
**P<sub>p</sub>**  
**I<sub>R</sub>**

Devices listed in bold, italic are Motorola preferred devices.

# 1SMC6.8AT3 through 1.5SMC91AT3

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 3.5\text{ V Max}$ ,  $I_F^{**} = 100\text{ A}$  for all types.

| Device††           | Breakdown Voltage*     |           |             |          | Working Peak Reverse Voltage $V_{RWM}$ Volts | Maximum Reverse Leakage @ $V_{RWM}$ $I_R$ $\mu$ A | Maximum Reverse Surge Current $I_{RSM}^\dagger$ Amps | Maximum Reverse Voltage @ $I_{RSM}$ (Clamping Voltage) $V_{RSM}$ Volts | Maximum Temperature Coefficient of $V_{BR}$ %/°C | Device Marking |
|--------------------|------------------------|-----------|-------------|----------|----------------------------------------------|---------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------|----------------|
|                    | $V_{BR}$ @ $I_T$ Volts |           |             |          |                                              |                                                   |                                                      |                                                                        |                                                  |                |
|                    | Min                    | Nom       | Max         | mA       |                                              |                                                   |                                                      |                                                                        |                                                  |                |
| 1.5SMC6.8AT3       | 6.45                   | 6.8       | 7.14        | 10       | 5.8                                          | 1000                                              | 143                                                  | 10.5                                                                   | 0.057                                            | 6V8A           |
| 1.5SMC7.5AT3       | 7.13                   | 7.5       | 7.88        | 10       | 6.4                                          | 500                                               | 132                                                  | 11.3                                                                   | 0.061                                            | 7V5A           |
| 1.5SMC8.2AT3       | 7.79                   | 8.2       | 8.61        | 10       | 7.02                                         | 200                                               | 124                                                  | 12.1                                                                   | 0.065                                            | 8V2A           |
| 1.5SMC9.1AT3       | 8.65                   | 9.1       | 9.55        | 1        | 7.78                                         | 50                                                | 112                                                  | 13.4                                                                   | 0.068                                            | 9V1A           |
| 1.5SMC10AT3        | 9.5                    | 10        | 10.5        | 1        | 8.55                                         | 10                                                | 103                                                  | 14.5                                                                   | 0.073                                            | 10A            |
| 1.5SMC11AT3        | 10.5                   | 11        | 11.6        | 1        | 9.4                                          | 5                                                 | 96                                                   | 15.6                                                                   | 0.075                                            | 11A            |
| 1.5SMC12AT3        | 11.4                   | 12        | 12.6        | 1        | 10.2                                         | 5                                                 | 90                                                   | 16.7                                                                   | 0.078                                            | 12A            |
| 1.5SMC13AT3        | 12.4                   | 13        | 13.7        | 1        | 11.1                                         | 5                                                 | 82                                                   | 18.2                                                                   | 0.081                                            | 13A            |
| <b>1.5SMC15AT3</b> | <b>14.3</b>            | <b>15</b> | <b>15.8</b> | <b>1</b> | <b>12.8</b>                                  | <b>5</b>                                          | <b>71</b>                                            | <b>21.2</b>                                                            | <b>0.084</b>                                     | <b>15A</b>     |
| 1.5SMC16AT3        | 15.2                   | 16        | 16.8        | 1        | 13.6                                         | 5                                                 | 67                                                   | 22.5                                                                   | 0.086                                            | 16A            |
| 1.5SMC18AT3        | 17.1                   | 18        | 18.9        | 1        | 15.3                                         | 5                                                 | 59.5                                                 | 25.2                                                                   | 0.088                                            | 18A            |
| 1.5SMC20AT3        | 19                     | 20        | 21          | 1        | 17.1                                         | 5                                                 | 54                                                   | 27.7                                                                   | 0.09                                             | 20A            |
| 1.5SMC22AT3        | 20.9                   | 22        | 23.1        | 1        | 18.8                                         | 5                                                 | 49                                                   | 30.6                                                                   | 0.092                                            | 22A            |
| <b>1.5SMC24AT3</b> | <b>22.8</b>            | <b>24</b> | <b>25.2</b> | <b>1</b> | <b>20.5</b>                                  | <b>5</b>                                          | <b>45</b>                                            | <b>33.2</b>                                                            | <b>0.094</b>                                     | <b>24A</b>     |
| 1.5SMC27AT3        | 25.7                   | 27        | 28.4        | 1        | 23.1                                         | 5                                                 | 40                                                   | 37.5                                                                   | 0.096                                            | 27A            |
| 1.5SMC30AT3        | 28.5                   | 30        | 31.5        | 1        | 25.6                                         | 5                                                 | 36                                                   | 41.4                                                                   | 0.097                                            | 30A            |
| <b>1.5SMC33AT3</b> | <b>31.4</b>            | <b>33</b> | <b>34.7</b> | <b>1</b> | <b>28.2</b>                                  | <b>5</b>                                          | <b>33</b>                                            | <b>45.7</b>                                                            | <b>0.098</b>                                     | <b>33A</b>     |
| <b>1.5SMC36AT3</b> | <b>34.2</b>            | <b>36</b> | <b>37.8</b> | <b>1</b> | <b>30.8</b>                                  | <b>5</b>                                          | <b>30</b>                                            | <b>49.9</b>                                                            | <b>0.099</b>                                     | <b>36A</b>     |
| <b>1.5SMC39AT3</b> | <b>37.1</b>            | <b>39</b> | <b>41</b>   | <b>1</b> | <b>33.3</b>                                  | <b>5</b>                                          | <b>28</b>                                            | <b>53.9</b>                                                            | <b>0.1</b>                                       | <b>39A</b>     |
| <b>1.5SMC43AT3</b> | <b>40.9</b>            | <b>43</b> | <b>45.2</b> | <b>1</b> | <b>36.8</b>                                  | <b>5</b>                                          | <b>25.3</b>                                          | <b>59.3</b>                                                            | <b>0.101</b>                                     | <b>43A</b>     |
| <b>1.5SMC47AT3</b> | <b>44.7</b>            | <b>47</b> | <b>49.4</b> | <b>1</b> | <b>40.2</b>                                  | <b>5</b>                                          | <b>23.2</b>                                          | <b>64.8</b>                                                            | <b>0.101</b>                                     | <b>47A</b>     |
| 1.5SMC51AT3        | 48.5                   | 51        | 53.6        | 1        | 43.6                                         | 5                                                 | 21.4                                                 | 70.1                                                                   | 0.102                                            | 51A            |
| 1.5SMC56AT3        | 53.2                   | 56        | 58.8        | 1        | 47.8                                         | 5                                                 | 19.5                                                 | 77                                                                     | 0.103                                            | 56A            |
| 1.5SMC62AT3        | 58.9                   | 62        | 65.1        | 1        | 53                                           | 5                                                 | 17.7                                                 | 85                                                                     | 0.104                                            | 62A            |
| 1.5SMC68AT3        | 64.6                   | 68        | 71.4        | 1        | 58.1                                         | 5                                                 | 16.3                                                 | 92                                                                     | 0.104                                            | 68A            |
| <b>1.5SMC75AT3</b> | <b>71.3</b>            | <b>75</b> | <b>78.8</b> | <b>1</b> | <b>64.1</b>                                  | <b>5</b>                                          | <b>14.6</b>                                          | <b>103</b>                                                             | <b>0.105</b>                                     | <b>75A</b>     |
| 1.5SMC82AT3        | 77.9                   | 82        | 86.1        | 1        | 70.1                                         | 5                                                 | 13.3                                                 | 113                                                                    | 0.105                                            | 82A            |
| 1.5SMC91AT3        | 86.5                   | 91        | 95.5        | 1        | 77.8                                         | 5                                                 | 12                                                   | 125                                                                    | 0.106                                            | 91A            |

\*  $V_{BR}$  measured at pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

\*\* 1/2 sine wave (or equivalent square wave),  $PW = 8.3\text{ ms}$ , duty cycle = 4 pulses per minute maximum.

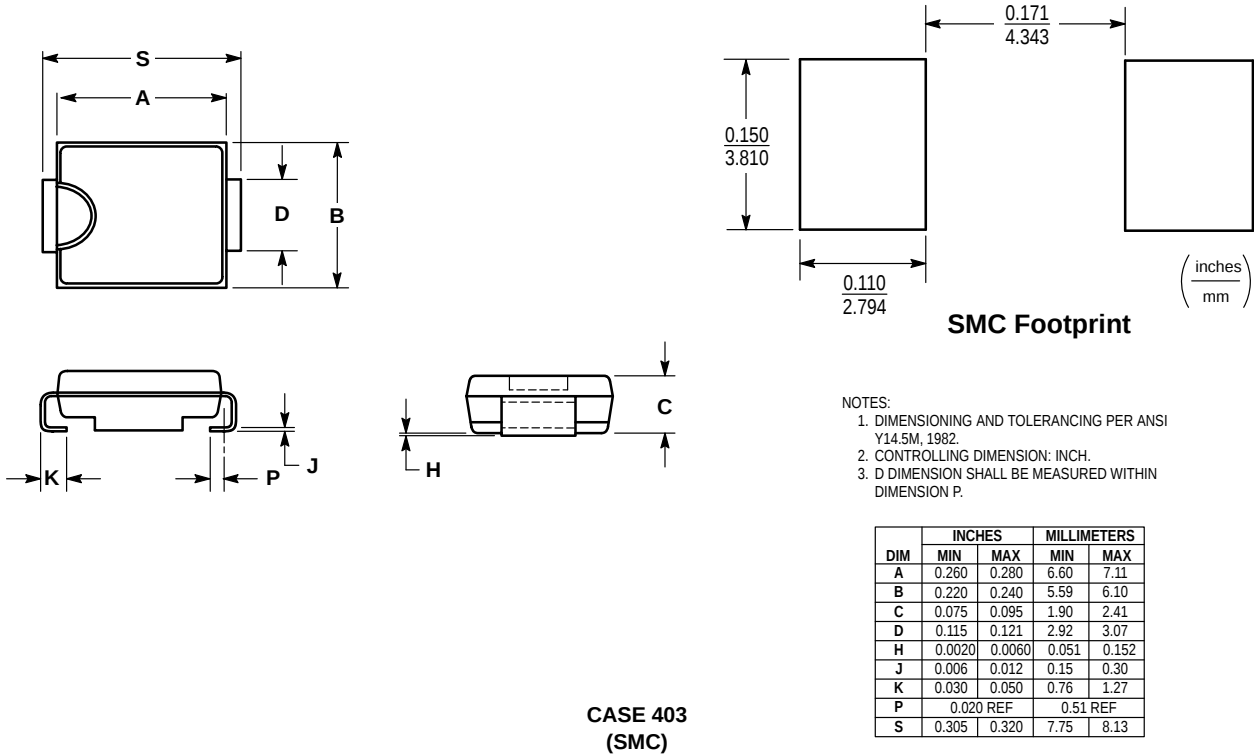
† Surge current waveform per Figure 2 and derate per Figure 3 of General Data — 1500 Watt at the beginning of this group.

†† T3 suffix designates tape and reel of 2500 units.

Devices listed in bold, italic are Motorola preferred devices.

Transient Voltage Suppressors — Surface Mounted

1500 Watt Peak Power



(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

| Package Option | Type No. Suffix   | MPQ (Units) |
|----------------|-------------------|-------------|
| Tape and Reel  | T3 (13 inch reel) | 2.5K        |

(Refer to Section 10 for more information on Packaging Specifications.)

Devices listed in bold, italic are Motorola preferred devices.