# MMBZxxxALT1G Series, SZMMBZxxxALT1G Series

# 24 and 40 Watt Peak Power Zener Transient Voltage Suppressors

## SOT−23 Dual Common Anode Zeners 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 anode design protects two separate lines using only one package. These devices are ideal for situations where board space is at a premium.

**Features**

- SOT−23 Package Allows Either Two Separate Unidirectional Configurations or a Single Bidirectional Configuration
- Working Peak Reverse Voltage Range − 3 V to 26 V
- Standard Zener Breakdown Voltage Range − 5.6 V to 33 V
- Peak Power − 24 or 40 W @ 1.0 ms (Unidirectional), per Figure 6 Waveform
- ESD Rating:
  - − Class 3B (> 16 kV) per the Human Body Model
  - − Class C (> 400 V) per the Machine Model
- ESD Rating of IEC61000−4−2 Level 4, ±30 kV Contact Discharge
- Maximum Clamping Voltage @ Peak Pulse Current
- Low Leakage < 5.0 μA
- Flammability Rating UL 94 V−0
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free and are RoHS Compliant*

**Mechanical Characteristics**

**CASE:** Void-free, transfer-molded, thermosetting plastic case
**FINISH:** Corrosion resistant finish, easily solderable
**MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES:**
260°C for 10 Seconds
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.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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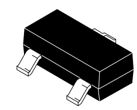
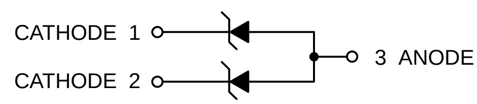
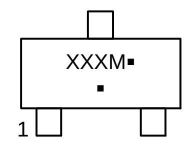


**SOT−23**
**CASE 318**
**STYLE 12**




**MARKING DIAGRAM**




XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

**ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

**DEVICE MARKING INFORMATION**

See specific marking information in the device marking column of the table on page 3 of this data sheet.

## MAXIMUM RATINGS

| Rating | | Symbol | Value | Unit |
|---|---|---|---|---|
| Peak Power Dissipation @ 1.0 ms (Note 1) @ $T_L \le 25°C$ | MMBZ5V6ALT1G thru MMBZ9V1ALT1G<br>MMBZ12VALT1G thru MMBZ33VALT1G | $P_{pk}$ | 24<br>40 | W |
| Total Power Dissipation on FR−5 Board (Note 2)<br>@ $T_A = 25°C$<br>Derate above 25°C | | $P_D$ | <br>225<br>1.8 | <br>mW<br>mW/°C |
| Thermal Resistance Junction−to−Ambient | | $R_{\theta JA}$ | 556 | °C/W |
| Total Power Dissipation on Alumina Substrate (Note 3)<br>@ $T_A = 25°C$<br>Derate above 25°C | | $P_D$ | <br>300<br>2.4 | <br>mW<br>mW/°C |
| Thermal Resistance Junction−to−Ambient | | $R_{\theta JA}$ | 417 | °C/W |
| Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | − 55 to +150 | °C |
| Lead Solder Temperature − Maximum (10 Second Duration) | | $T_L$ | 260 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Non−repetitive current pulse per Figure 6 and derate above $T_A = 25°C$ per Figure 7.
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.

*Other voltages may be available upon request.

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| MMBZ5V6ALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| SZMMBZ5V6ALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| MMBZ5V6ALT3G | SOT−23 (Pb−Free) | 10,000 / Tape & Reel |
| MMBZ6VxALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| SZMMBZ6VxALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| MMBZ6VxALT3G | SOT−23 (Pb−Free) | 10,000 / Tape & Reel |
| MMBZ9V1ALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| MMBZ9V1ALT13G | SOT−23 (Pb−Free) | 10,000 / Tape & Reel |
| MMBZxxVALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| SZMMBZxxVALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |
| MMBZxxVALT3G | SOT−23 (Pb−Free) | 10,000 / Tape & Reel |
| SZMMBZxxVALT3G | SOT−23 (Pb−Free) | 10,000 / Tape & Reel |
| SZMMBZxxVTALT1G | SOT−23 (Pb−Free) | 3,000 / Tape & Reel |

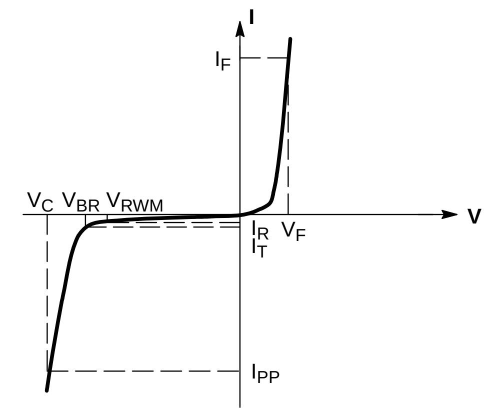
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

## ELECTRICAL CHARACTERISTICS

($T_A$ = 25°C unless otherwise noted)

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

| Symbol | Parameter |
|---|---|
| $I_{PP}$ | Maximum Reverse Peak Pulse Current |
| $V_C$ | Clamping Voltage @ $I_{PP}$ |
| $V_{RWM}$ | Working Peak Reverse Voltage |
| $I_R$ | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$ | Breakdown Voltage @ $I_T$ |
| $I_T$ | Test Current |
| $\Theta V_{BR}$ | Maximum Temperature Coefficient of $V_{BR}$ |
| $I_F$ | Forward Current |
| $V_F$ | Forward Voltage @ $I_F$ |
| $Z_{ZT}$ | Maximum Zener Impedance @ $I_{ZT}$ |
| $I_{ZK}$ | Reverse Current |
| $Z_{ZK}$ | Maximum Zener Impedance @ $I_{ZK}$ |




**Uni−Directional TVS**

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

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

($V_F$ = 0.9 V Max @ $I_F$ = 10 mA) (5% Tolerance) **24 WATTS**

| Device* | Device Marking | $V_{RWM}$ | $I_R$ @ $V_{RWM}$ | Breakdown Voltage $V_{BR}$ (Note 4) (V) | | | @ $I_T$ | Max Zener Impedance (Note 5) $Z_{ZT}$ @ $I_{ZT}$ | $Z_{ZK}$ @ $I_{ZK}$ | | $V_C$ @ $I_{PP}$ (Note 6) $V_C$ | $I_{PP}$ | $\Theta V_{BR}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Volts | μA | Min | Nom | Max | mA | Ω | Ω | mA | V | A | mV/°C |
| MMBZ5V6ALT1G/T3G | 5A6 | 3.0 | 5.0 | 5.32 | 5.6 | 5.88 | 20 | 11 | 1600 | 0.25 | 8.0 | 3.0 | 1.26 |
| MMBZ6V2ALT1G | 6A2 | 3.0 | 0.5 | 5.89 | 6.2 | 6.51 | 1.0 | − | − | − | 8.7 | 2.76 | 2.80 |
| MMBZ6V8ALT1G | 6A8 | 4.5 | 0.5 | 6.46 | 6.8 | 7.14 | 1.0 | − | − | − | 9.6 | 2.5 | 3.4 |
| MMBZ9V1ALT1G | 9A1 | 6.0 | 0.3 | 8.65 | 9.1 | 9.56 | 1.0 | − | − | − | 14 | 1.7 | 7.5 |

($V_F$ = 0.9 V Max @ $I_F$ = 10 mA) (5% Tolerance) **40 WATTS**

| Device* | Device Marking | $V_{RWM}$ | $I_R$ @ $V_{RWM}$ | Breakdown Voltage $V_{BR}$ (Note 4) (V) | | | @ $I_T$ | $V_C$ @ $I_{PP}$ (Note 6) $V_C$ | $I_{PP}$ | $\Theta V_{BR}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volts | nA | Min | Nom | Max | mA | V | A | mV/°C |
| MMBZ12VALT1G | 12A | 8.5 | 200 | 11.40 | 12 | 12.60 | 1.0 | 17 | 2.35 | 7.5 |
| MMBZ15VALT1G | 15A | 12 | 50 | 14.25 | 15 | 15.75 | 1.0 | 21 | 1.9 | 12.3 |
| MMBZ16VALT1G | 16A | 13 | 50 | 15.20 | 16 | 16.80 | 1.0 | 23 | 1.7 | 13.8 |
| MMBZ18VALT1G | 18A | 14.5 | 50 | 17.10 | 18 | 18.90 | 1.0 | 25 | 1.6 | 15.3 |
| MMBZ20VALT1G | 20A | 17 | 50 | 19.00 | 20 | 21.00 | 1.0 | 28 | 1.4 | 17.2 |
| MMBZ27VALT1G/T3G | 27A | 22 | 50 | 25.65 | 27 | 28.35 | 1.0 | 40 | 1.0 | 24.3 |
| MMBZ33VALT1G | 33A | 26 | 50 | 31.35 | 33 | 34.65 | 1.0 | 46 | 0.87 | 30.4 |

($V_F$ = 0.9 V Max @ $I_F$ = 10 mA) (2% Tolerance) **40 WATTS**

| Device* | Device Marking | $V_{RWM}$ | $I_R$ @ $V_{RWM}$ | Breakdown Voltage $V_{BR}$ (Note 4) (V) | | | @ $I_T$ | $V_C$ @ $I_{PP}$ (Note 6) $V_C$ | $I_{PP}$ | $\Theta V_{BR}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Volts | nA | Min | Nom | Max | mA | V | A | mV/°C |
| MMBZ16VTALT1G | 16T | 13 | 50 | 15.68 | 16 | 16.32 | 1.0 | 23 | 1.7 | 13.8 |

4. $V_{BR}$ measured at pulse test current $I_T$ at an ambient temperature of 25°C.
5. $Z_{ZT}$ and $Z_{ZK}$ are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for $I_{Z(AC)}$ = 0.1 $I_{Z(DC)}$, with the AC frequency = 1.0 kHz.
6. Surge current waveform per Figure 6 and derate per Figure 7

* Include SZ-prefix devices where applicable.

## TYPICAL CHARACTERISTICS

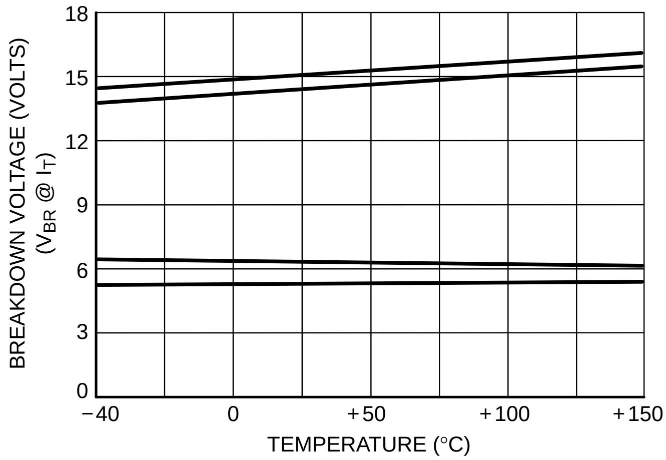



**Figure 1. Typical Breakdown Voltage versus Temperature**
(Upper curve for each voltage is bidirectional mode, lower curve is unidirectional mode)

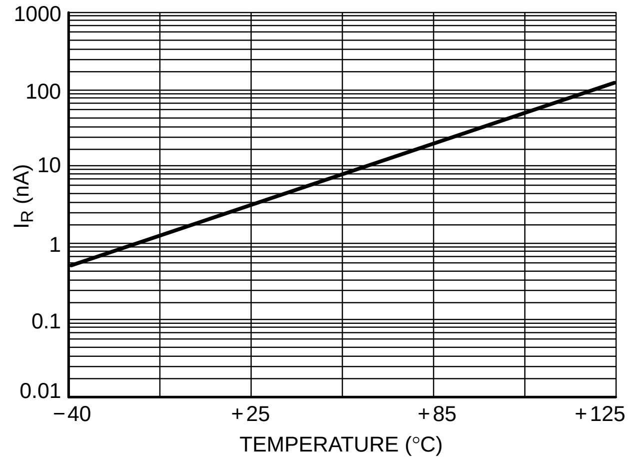



**Figure 2. Typical Leakage Current versus Temperature**

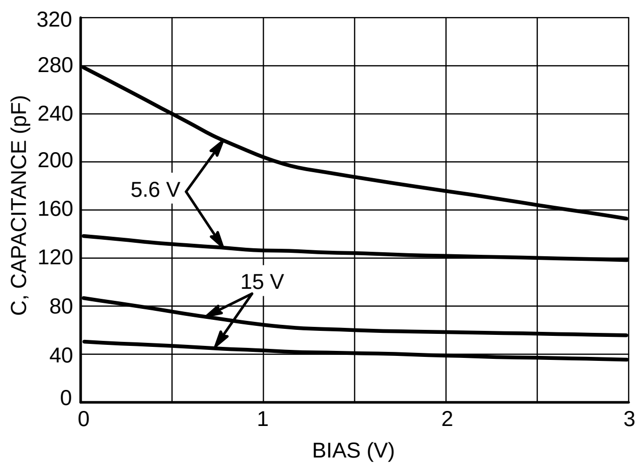



**Figure 3. Typical Capacitance versus Bias Voltage**
(Upper curve for each voltage is unidirectional mode, lower curve is bidirectional mode)

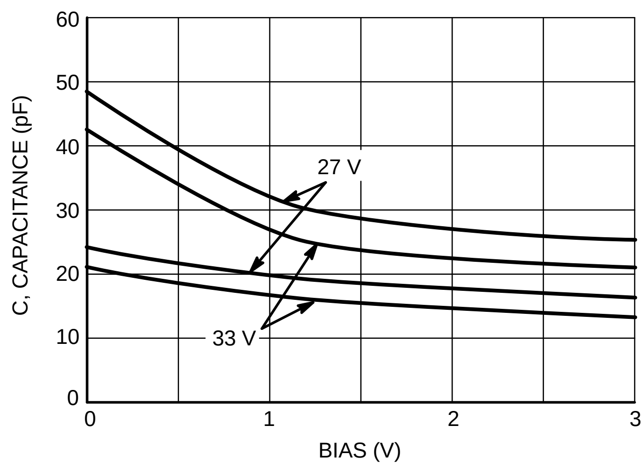



**Figure 4. Typical Capacitance versus Bias Voltage**
(Upper curve for each voltage is unidirectional mode, lower curve is bidirectional mode)

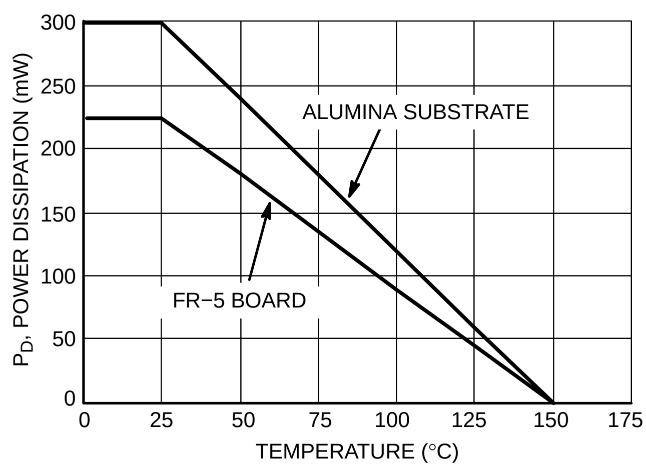



**Figure 5. Steady State Power Derating Curve**

## TYPICAL CHARACTERISTICS

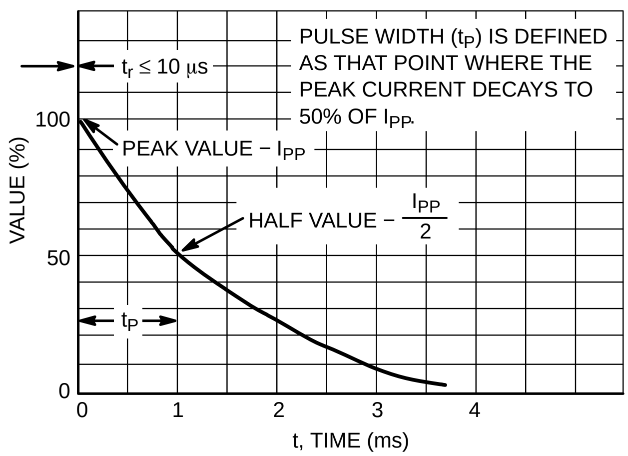



**Figure 6. Pulse Waveform**

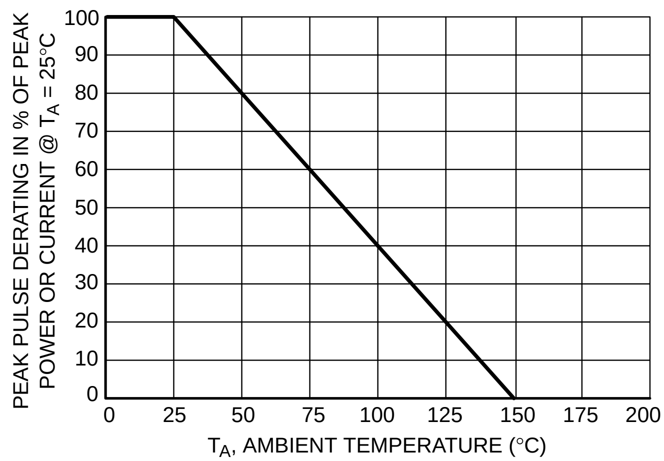



**Figure 7. Pulse Derating Curve**

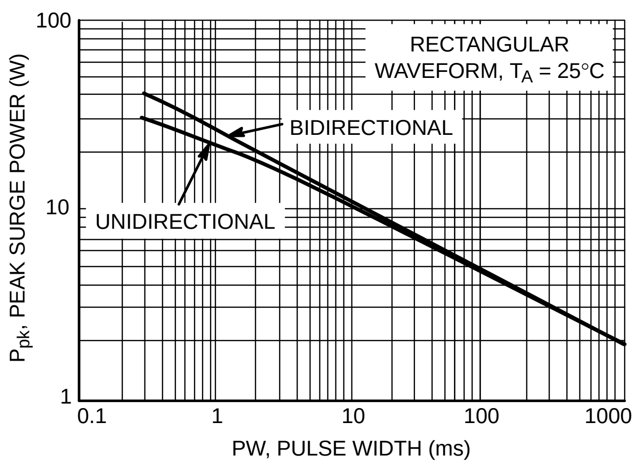



**Figure 8. Maximum Non−repetitive Surge Power, $P_{pk}$ versus PW**

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

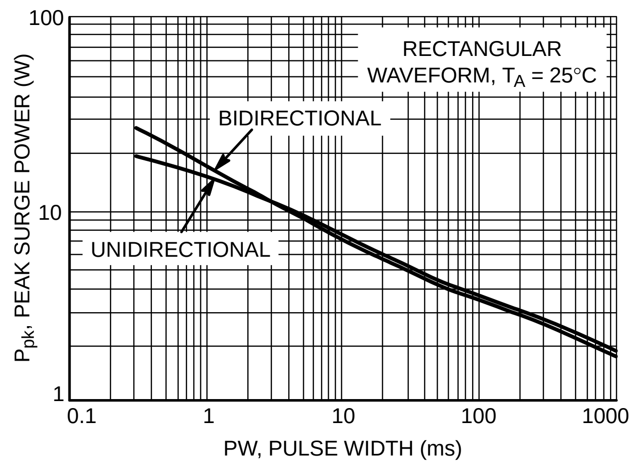


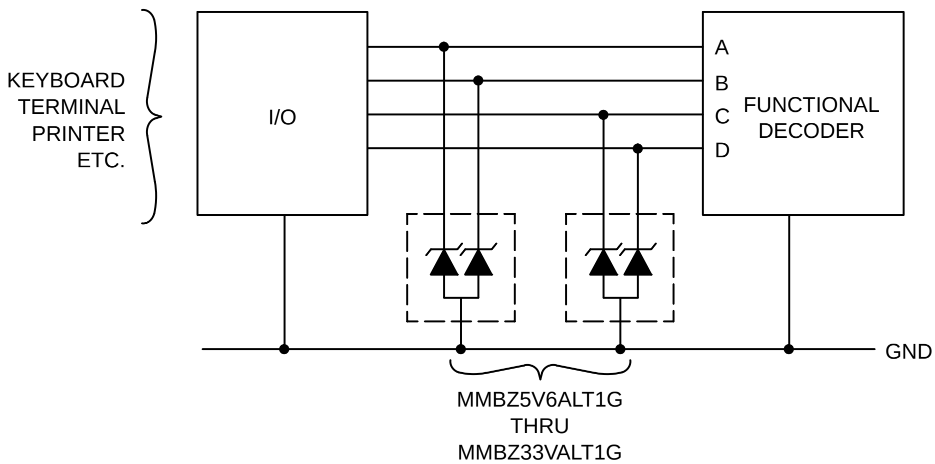

**Figure 9. Maximum Non−repetitive Surge Power, $P_{pk}$(NOM) versus PW**

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

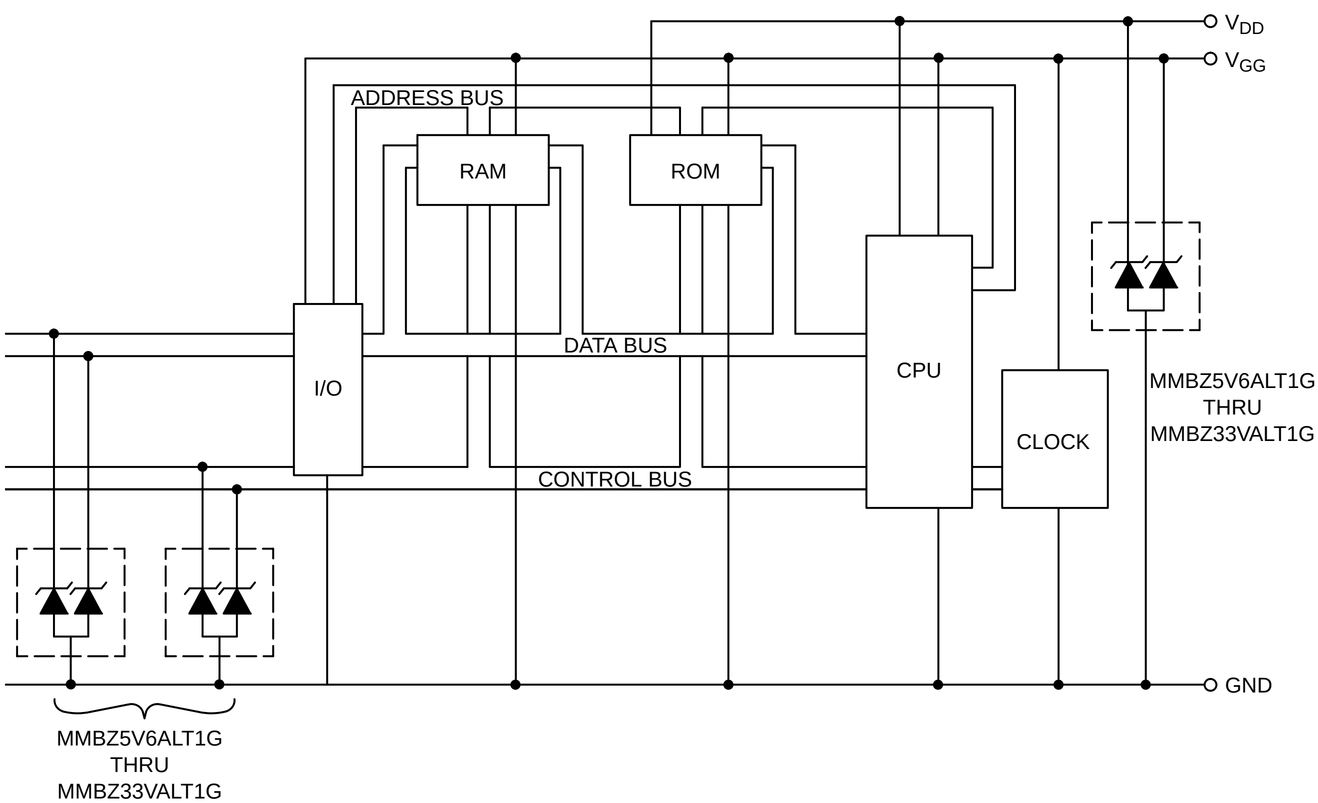
## TYPICAL COMMON ANODE APPLICATIONS

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 TVS applications are illustrated below.

**Computer Interface Protection**

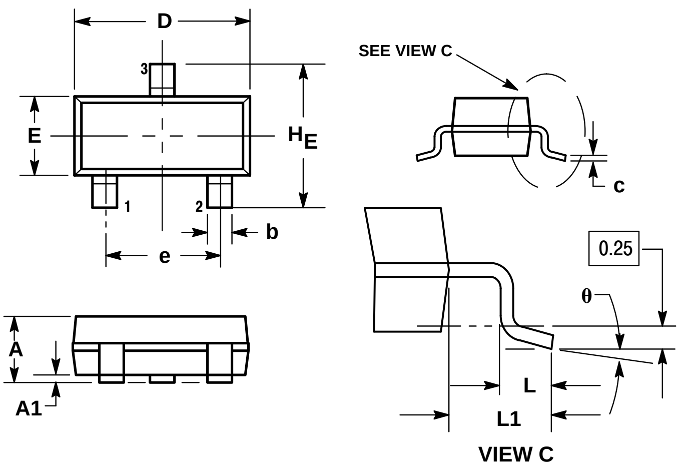



**Microprocessor Protection**



## PACKAGE DIMENSIONS

**SOT−23 (TO−236)**
CASE 318−08
ISSUE AP

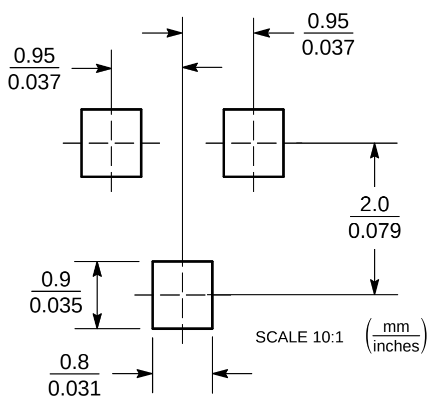



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| **DIM** | **MIN** | **NOM** | **MAX** | **MIN** | **NOM** | **MAX** |
| **A** | 0.89 | 1.00 | 1.11 | 0.035 | 0.040 | 0.044 |
| **A1** | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| **b** | 0.37 | 0.44 | 0.50 | 0.015 | 0.018 | 0.020 |
| **c** | 0.09 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| **D** | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| **E** | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| **e** | 1.78 | 1.90 | 2.04 | 0.070 | 0.075 | 0.081 |
| **L** | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| **L1** | 0.35 | 0.54 | 0.69 | 0.014 | 0.021 | 0.029 |
| **$H_E$** | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |
| **θ** | 0° | −−− | 10° | 0° | −−− | 10° |

STYLE 12:
PIN 1. CATHODE
2. CATHODE
3. ANODE

## SOLDERING FOOTPRINT




*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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