# Zener Voltage Regulators

## 500 mW SOD−123 Surface Mount

# MMSZxxxT1G Series, SZMMSZxxxT1G Series

Three complete series of Zener diodes are offered in the convenient, surface mount plastic SOD−123 package. These devices provide a convenient alternative to the leadless 34−package style.

### Features

- 500 mW Rating on FR−4 or FR−5 Board
- Wide Zener Reverse Voltage Range − 2.4 V to 56 V
- Package Designed for Optimal Automated Board Assembly
- Small Package Size for High Density Applications
- ESD Rating of Class 3 (> 16 kV) per Human Body Model
- AEC−Q101 Qualified and PPAP Capable
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements
- Pb−Free Packages are Available*

### 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
**POLARITY:** Cathode indicated by polarity band
**FLAMMABILITY RATING:** UL 94 V−0

### MAXIMUM RATINGS

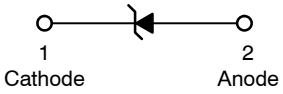
| Rating | Symbol | Max | Unit |
|---|---|---|---|
| Total Power Dissipation on FR−5 Board, (Note 1) @ $T_L$ = 75°C<br>Derated above 75°C | $P_D$ | 500<br>6.7 | mW<br>mW/°C |
| Thermal Resistance, Junction−to−Ambient (Note 2) | $R_{\theta JA}$ | 340 | °C/W |
| Thermal Resistance, Junction−to−Lead (Note 2) | $R_{\theta JL}$ | 150 | °C/W |
| Junction and Storage Temperature Range | $T_J$, $T_{stg}$ | −55 to +150 | °C |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. FR−5 = 3.5 X 1.5 inches.
2. Thermal Resistance measurement obtained via infrared Scan Method.

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



**SOD−123**
**CASE 425**
**STYLE 1**




### MARKING DIAGRAM




xx = Device Code
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| MMSZxxxT1G | SOD−123 (Pb−Free) | 3,000 / Tape & Reel |
| SZMMSZxxxT1G | SOD−123 (Pb−Free) | 3,000 / Tape & Reel |
| MMSZxxxT3G | SOD−123 (Pb−Free) | 10,000 / Tape & Reel |
| SZMMSZxxxT3G | SOD−123 (Pb−Free) | 10,000 / 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.

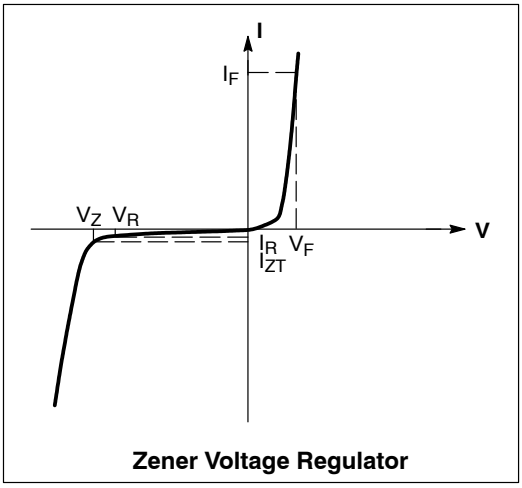
### DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the Electrical Characteristics table on page 2 of this data sheet.

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**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted, $V_F$ = 0.95 V Max. @ $I_F$ = 10 mA)

| Symbol | Parameter |
|---|---|
| $V_Z$ | Reverse Zener Voltage @ $I_{ZT}$ |
| $I_{ZT}$ | Reverse Current |
| $Z_{ZT}$ | Maximum Zener Impedance @ $I_{ZT}$ |
| $I_R$ | Reverse Leakage Current @ $V_R$ |
| $V_R$ | Reverse Voltage |
| $I_F$ | Forward Current |
| $V_F$ | Forward Voltage @ $I_F$ |




**Zener Voltage Regulator**

**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted, $V_F$ = 0.9 V Max. @ $I_F$ = 10 mA)

| Device* | Device Marking | $V_{Z1}$ (Volts) (Notes 3 and 4) @ $I_{ZT1}$ = 5 mA | | | $Z_{ZT1}$ (Note 5) | $V_{Z2}$ (Volts) (Notes 3 and 4) @ $I_{ZT2}$ = 1 mA | | $Z_{ZT2}$ (Note 5) | Max Reverse Leakage Current $I_R$ @ $V_R$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Nom | Max | Ω | Min | Max | Ω | μA | Volts |
| MMSZ2V4T1G | T1 | 2.28 | 2.4 | 2.52 | 100 | 1.7 | 2.1 | 600 | 50 | 1 |
| MMSZ2V7T1G | T2 | 2.57 | 2.7 | 2.84 | 100 | 1.9 | 2.4 | 600 | 20 | 1 |
| MMSZ3V0T1G | T3 | 2.85 | 3.0 | 3.15 | 95 | 2.1 | 2.7 | 600 | 10 | 1 |
| MMSZ3V3T1G | T4 | 3.14 | 3.3 | 3.47 | 95 | 2.3 | 2.9 | 600 | 5 | 1 |
| MMSZ3V6T1G | T5 | 3.42 | 3.6 | 3.78 | 90 | 2.7 | 3.3 | 600 | 5 | 1 |
| MMSZ3V9T1G | U1 | 3.71 | 3.9 | 4.10 | 90 | 2.9 | 3.5 | 600 | 3 | 1 |
| MMSZ4V3T1G | U2 | 4.09 | 4.3 | 4.52 | 90 | 3.3 | 4.0 | 600 | 3 | 1 |
| MMSZ4V7T1G | U3 | 4.47 | 4.7 | 4.94 | 80 | 3.7 | 4.7 | 500 | 3 | 2 |
| ***MMSZ5V1T1G*** | ***U4*** | ***4.85*** | ***5.1*** | ***5.36*** | ***60*** | ***4.2*** | ***5.3*** | ***480*** | ***2*** | ***2*** |
| ***MMSZ5V6T1G/T3G*** | ***U5*** | ***5.32*** | ***5.6*** | ***5.88*** | ***40*** | ***4.8*** | ***6.0*** | ***400*** | ***1*** | ***2*** |
| ***MMSZ6V2T1G*** | ***V1*** | ***5.89*** | ***6.2*** | ***6.51*** | ***10*** | ***5.6*** | ***6.6*** | ***150*** | ***3*** | ***4*** |
| MMSZ6V8T1G | V2 | 6.46 | 6.8 | 7.14 | 15 | 6.3 | 7.2 | 80 | 2 | 4 |
| MMSZ7V5T1G | V3 | 7.13 | 7.5 | 7.88 | 15 | 6.9 | 7.9 | 80 | 1 | 5 |
| MMSZ8V2T1G | V4 | 7.79 | 8.2 | 8.61 | 15 | 7.6 | 8.7 | 80 | 0.7 | 5 |
| MMSZ9V1T1G | V5 | 8.65 | 9.1 | 9.56 | 15 | 8.4 | 9.6 | 100 | 0.5 | 6 |
| MMSZ10T1G/T3G | A1 | 9.50 | 10 | 10.50 | 20 | 9.3 | 10.6 | 150 | 0.2 | 7 |
| MMSZ11T1G | A2 | 10.45 | 11 | 11.55 | 20 | 10.2 | 11.6 | 150 | 0.1 | 8 |
| MMSZ12T1G | A3 | 11.40 | 12 | 12.60 | 25 | 11.2 | 12.7 | 150 | 0.1 | 8 |
| MMSZ13T1G | A4 | 12.35 | 13 | 13.65 | 30 | 12.3 | 14.0 | 170 | 0.1 | 8 |
| MMSZ15T1G | A5 | 14.25 | 15 | 15.75 | 30 | 13.7 | 15.5 | 200 | 0.05 | 10.5 |
| MMSZ16T1G | X1 | 15.20 | 16 | 16.80 | 40 | 15.2 | 17.0 | 200 | 0.05 | 11.2 |
| ***MMSZ18T1G/T3G*** | ***X2*** | ***17.10*** | ***18*** | ***18.90*** | ***45*** | ***16.7*** | ***19.0*** | ***225*** | ***0.05*** | ***12.6*** |
| MMSZ20T1G | X3 | 19.00 | 20 | 21.00 | 55 | 18.7 | 21.1 | 225 | 0.05 | 14 |
| MMSZ22T1G | X4 | 20.90 | 22 | 23.10 | 55 | 20.7 | 23.2 | 250 | 0.05 | 15.4 |
| MMSZ24T1G | X5 | 22.80 | 24 | 25.20 | 70 | 22.7 | 25.5 | 250 | 0.05 | 16.8 |

3. The type numbers shown have a standard tolerance of ±5% on the nominal Zener Voltage.
4. Tolerance and Voltage Designation: Zener Voltage ($V_Z$) is measured with the Zener Current applied for PW = 1 ms.
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 kHz.

*Include SZ-prefix devices where applicable.



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**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted, $V_F$ = 0.9 V Max. @ $I_F$ = 10 mA)

| Device* | Device Marking | $V_{Z1}$ (Volts) (Notes 6 and 7) @ $I_{ZT1}$ = 2 mA | | | $Z_{ZT1}$ (Note 8) | $V_{Z2}$ (Volts) (Notes 6 and 7) @ $I_{ZT2}$ = 0.1 mA | | $Z_{ZT2}$ (Note 8) @ $I_{ZT2}$ = 0.5 mA | Max Reverse Leakage Current $I_R$ @ $V_R$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Nom | Max | Ω | Min | Max | Ω | μA | Volts |
| MMSZ27T1G/T3G | Y1 | 25.65 | 27 | 28.35 | 80 | 25 | 28.9 | 300 | 0.05 | 18.9 |
| MMSZ30T1G | Y2 | 28.50 | 30 | 31.50 | 80 | 27.8 | 32 | 300 | 0.05 | 21 |
| MMSZ33T1G | Y3 | 31.35 | 33 | 34.65 | 80 | 30.8 | 35 | 325 | 0.05 | 23.1 |
| MMSZ36T1G | Y4 | 34.20 | 36 | 37.80 | 90 | 33.8 | 38 | 350 | 0.05 | 25.2 |
| MMSZ39T1G | Y5 | 37.05 | 39 | 40.95 | 130 | 36.7 | 41 | 350 | 0.05 | 27.3 |
| MMSZ43T1G | Z1 | 40.85 | 43 | 45.15 | 150 | 39.7 | 46 | 375 | 0.05 | 30.1 |
| MMSZ47T1G | Z2 | 44.65 | 47 | 49.35 | 170 | 43.7 | 50 | 375 | 0.05 | 32.9 |
| MMSZ51T1G | Z3 | 48.45 | 51 | 53.55 | 180 | 47.6 | 54 | 400 | 0.05 | 35.7 |
| MMSZ56T1G/T3G | Z4 | 53.20 | 56 | 58.80 | 200 | 51.5 | 60 | 425 | 0.05 | 39.2 |

6. The type numbers shown have a standard tolerance of ±5% on the nominal Zener Voltage.
7. Tolerance and Voltage Designation: Zener Voltage ($V_Z$) is measured with the Zener Current applied for PW = 1 ms.
8. $Z_{ZT}$ 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 kHz.

*Include SZ-prefix devices where applicable.



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## TYPICAL CHARACTERISTICS

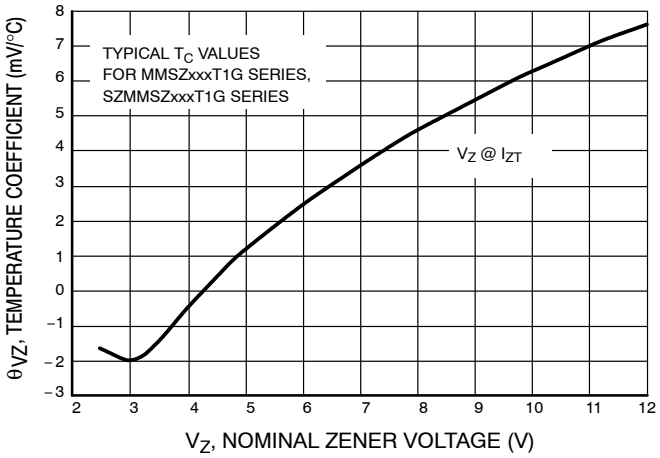



**Figure 1. Temperature Coefficients (Temperature Range −55°C to +150°C)**

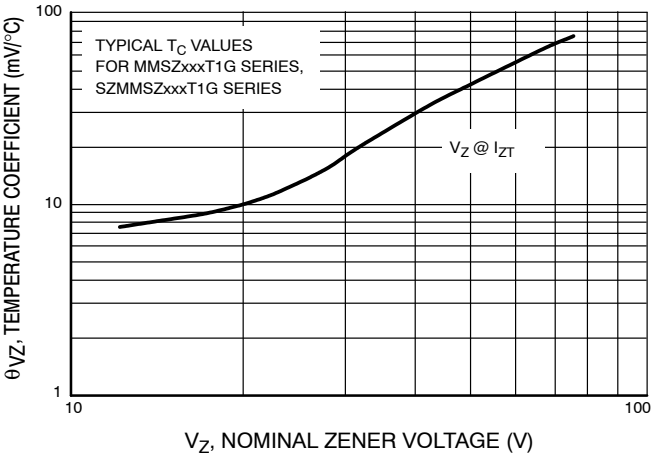



**Figure 2. Temperature Coefficients (Temperature Range −55°C to +150°C)**

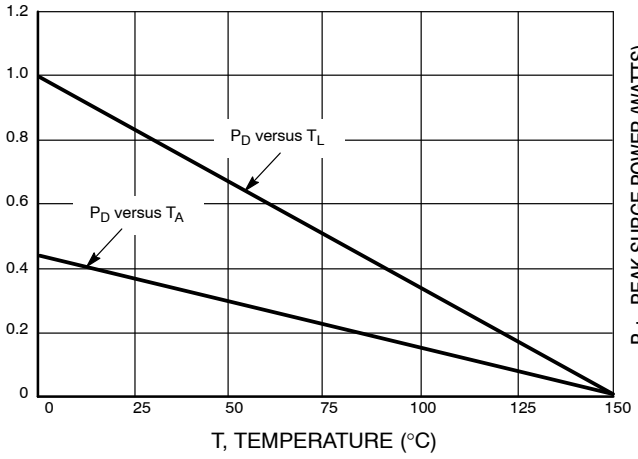



**Figure 3. Steady State Power Derating**

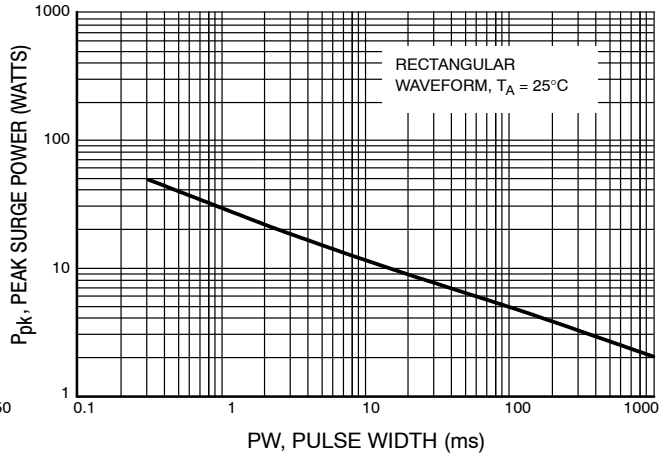



**Figure 4. Maximum Nonrepetitive Surge Power**

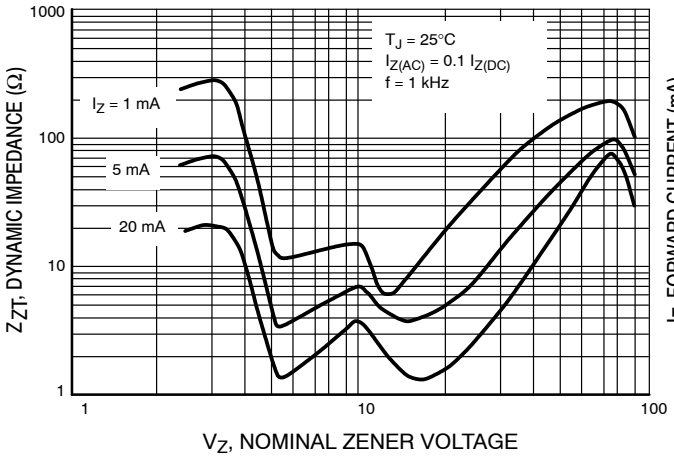



**Figure 5. Effect of Zener Voltage on Zener Impedance**

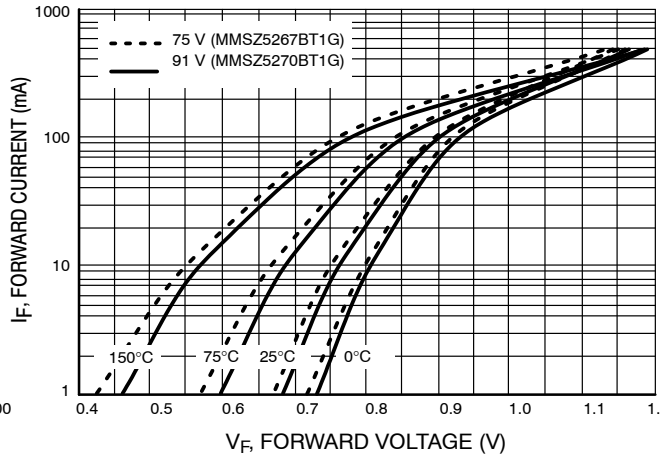



**Figure 6. Typical Forward Voltage**



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## TYPICAL CHARACTERISTICS

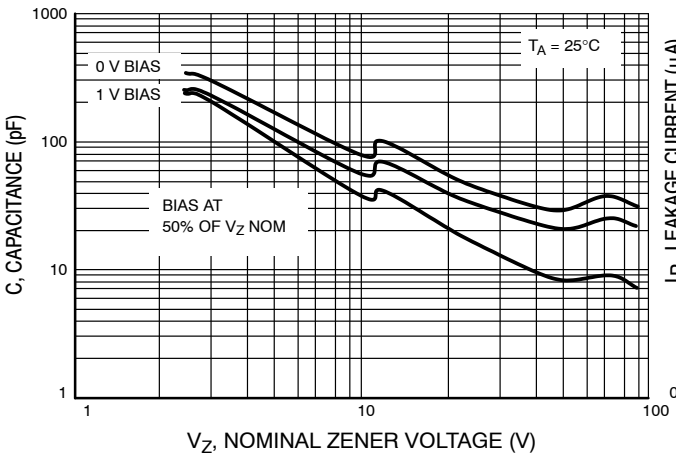



**Figure 7. Typical Capacitance**

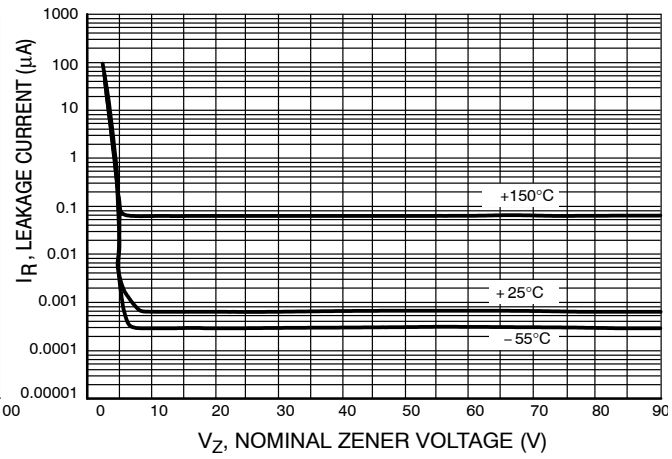



**Figure 8. Typical Leakage Current**

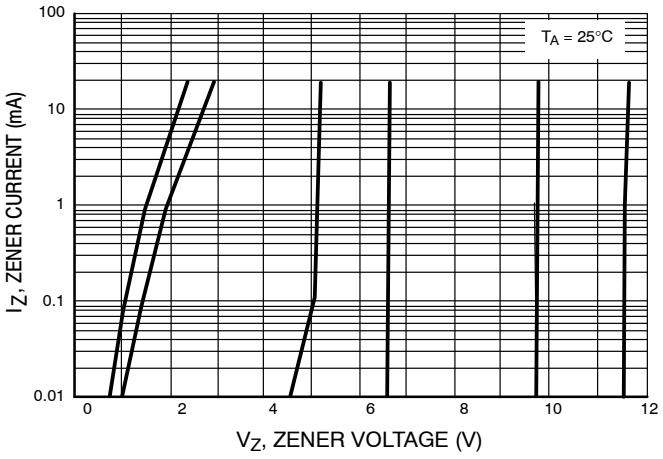



**Figure 9. Zener Voltage versus Zener Current ($V_Z$ Up to 12 V)**

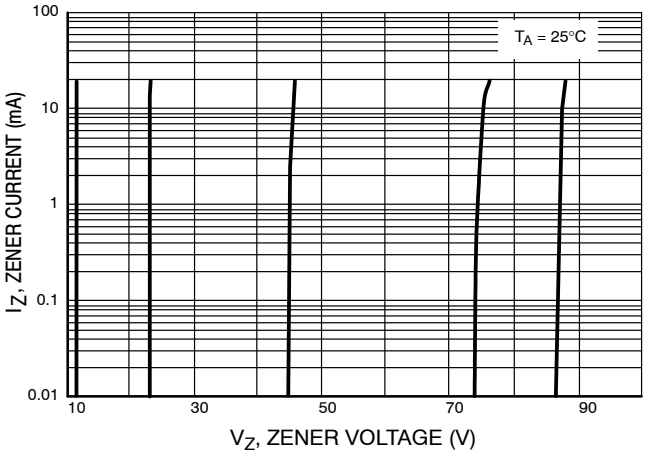
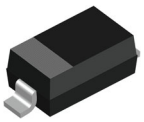



**Figure 10. Zener Voltage versus Zener Current (12 V to 91 V)**

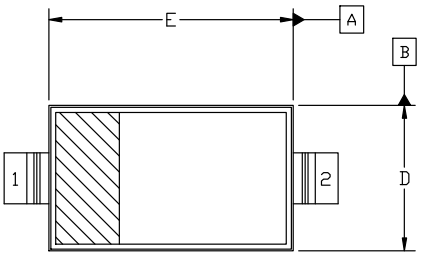


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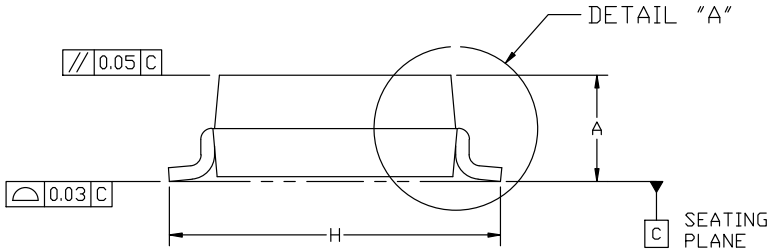


**SOD−123 2−LEAD, 1.60x2.69x1.16**
CASE 425
ISSUE H

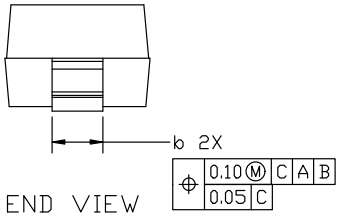
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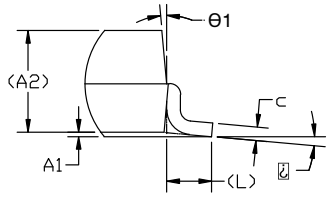

TOP VIEW




SIDE VIEW



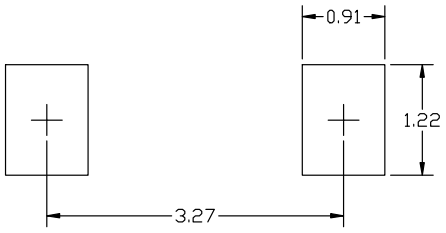

END VIEW




DETAIL "A"

NOTES:
1. DIMENSION AND TOLERANCING PER ASME Y14.5M, 2018
2. CONTROLLING DIMENSION: MILLIMETERS

| | MILLIMETER | | |
|---|---|---|---|
| DIM | MIN. | NOM. | MAX. |
| A | 0.94 | 1.17 | 1.35 |
| A1 | 0.00 | 0.05 | 0.10 |
| A2 | | 1.16 REF. | |
| b | 0.51 | 0.61 | 0.71 |
| c | – | – | 0.15 |
| D | 1.40 | 1.60 | 1.80 |
| E | 2.54 | 2.69 | 2.84 |
| H | 3.56 | 3.68 | 3.86 |
| L | | 0.25 REF. | |
| ∠ | 0° | | 10° |
| θ1 | 0° | | 10° |




RECOMMENDED MOUNTING FOOTPRINT

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

## GENERIC MARKING DIAGRAM*




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

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1:
PIN 1. CATHODE
2. ANODE

| | | |
|---|---|---|
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| **DESCRIPTION:** | **SOD−123 2−LEAD, 1.60x2.69x1.16** | **PAGE 1 OF 1** |

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