

# MMSZxxxET1G Series, SZMMSZxxxET1G Series

## Zener Voltage Regulators

### 500 mW SOD-123 Surface Mount

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.

#### Specification 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
- Peak Power – 225 W (8 X 20  $\mu$ s)
- 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        |
|---|-----------------|-------------|-------------|
| Peak Power Dissipation @ 20 $\mu$ s (Note 1)<br>@ $T_L \leq 25^\circ\text{C}$                       | $P_{pk}$        | 225         | W           |
| Total Power Dissipation on FR-5 Board,<br>(Note 2) @ $T_L = 75^\circ\text{C}$<br>Derated above 75°C | $P_D$           | 500<br>6.7  | mW<br>mW/°C |
| Thermal Resistance, Junction-to-Ambient<br>(Note 3)   | $R_{\theta JA}$ | 340         | °C/W        |
| Thermal Resistance, Junction-to-Lead<br>(Note 3)  | $R_{\theta JL}$ | 150         | °C/W        |
| Junction and Storage Temperature Range  | $T_J, T_{stg}$  | -55 to +150 | °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. Nonrepetitive current pulse per Figure 11
2. FR-5 = 3.5 X 1.5 inches, using the ON minimum recommended footprint
3. Thermal Resistance measurement obtained via infrared Scan Method

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

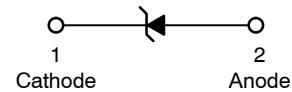


ON Semiconductor®

<http://onsemi.com>



SOD-123  
CASE 425  
STYLE 1



#### MARKING DIAGRAM



xxx = Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device        | Package              | Shipping†               |
|---------------|----------------------|-------------------------|
| MMSZxxxET1G   | SOD-123<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |
| SZMMSZxxxET1G | SOD-123<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |
| MMSZxxxET3G   | SOD-123<br>(Pb-Free) | 10,000 /<br>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.

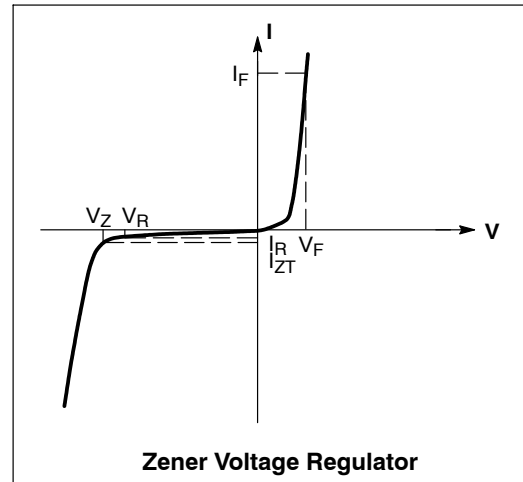
#### DEVICE MARKING INFORMATION

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

## MMSZxxxET1G Series, SZMMSZxxxET1G Series

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 0.95\text{ V Max. @ } I_F = 10\text{ mA}$ )

| 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 @ $I_F$            |



**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 0.9\text{ V Max. @ } I_F = 10\text{ mA}$ )

| Device*            | Device Marking | $V_{Z1}$ (V)<br>(Notes 4 and 5) |            |              | $Z_{ZT1}$<br>(Note 6) | $V_{Z2}$ (V)<br>(Notes 4 and 5) |             | $Z_{ZT2}$<br>(Note 6) | Max Reverse Leakage Current |             |
|--------------------|----------------|---------------------------------|------------|--------------|-----------------------|---------------------------------|-------------|-----------------------|-----------------------------|-------------|
|                    |                | @ $I_{ZT1} = 5\text{ mA}$       |            |              |                       | @ $I_{ZT2} = 1\text{ mA}$       |             |                       | $I_R$ @ $V_R$               |             |
|                    |                | Min                             | Nom        | Max          | $\Omega$              | Min                             | Max         | $\Omega$              | $\mu\text{A}$               | V           |
| MMSZ2V4ET1G        | CL1            | 2.28                            | 2.4        | 2.52         | 100                   | 1.7                             | 2.1         | 600                   | 50                          | 1           |
| MMSZ2V7ET1G        | CL2            | 2.57                            | 2.7        | 2.84         | 100                   | 1.9                             | 2.4         | 600                   | 20                          | 1           |
| MMSZ3V0ET1G        | CL3            | 2.85                            | 3.0        | 3.15         | 95                    | 2.1                             | 2.7         | 600                   | 10                          | 1           |
| MMSZ3V3ET1G        | CL4            | 3.14                            | 3.3        | 3.47         | 95                    | 2.3                             | 2.9         | 600                   | 5                           | 1           |
| MMSZ3V6ET1G        | CL5            | 3.42                            | 3.6        | 3.78         | 90                    | 2.7                             | 3.3         | 600                   | 5                           | 1           |
| MMSZ3V9ET1G        | CL6            | 3.71                            | 3.9        | 4.10         | 90                    | 2.9                             | 3.5         | 600                   | 3                           | 1           |
| MMSZ4V3ET1G        | CL7            | 4.09                            | 4.3        | 4.52         | 90                    | 3.3                             | 4.0         | 600                   | 3                           | 1           |
| MMSZ4V7ET1G        | CL8            | 4.47                            | 4.7        | 4.94         | 80                    | 3.7                             | 4.7         | 500                   | 3                           | 2           |
| <b>MMSZ5V1ET1G</b> | <b>CL9</b>     | <b>4.85</b>                     | <b>5.1</b> | <b>5.36</b>  | <b>60</b>             | <b>4.2</b>                      | <b>5.3</b>  | <b>480</b>            | <b>2</b>                    | <b>2</b>    |
| <b>MMSZ5V6ET1G</b> | <b>CM1</b>     | <b>5.32</b>                     | <b>5.6</b> | <b>5.88</b>  | <b>40</b>             | <b>4.8</b>                      | <b>6.0</b>  | <b>400</b>            | <b>1</b>                    | <b>2</b>    |
| <b>MMSZ6V2ET1G</b> | <b>CM2</b>     | <b>5.89</b>                     | <b>6.2</b> | <b>6.51</b>  | <b>10</b>             | <b>5.6</b>                      | <b>6.6</b>  | <b>150</b>            | <b>3</b>                    | <b>4</b>    |
| MMSZ6V8ET1G        | CM3            | 6.46                            | 6.8        | 7.14         | 15                    | 6.3                             | 7.2         | 80                    | 2                           | 4           |
| MMSZ7V5ET1G        | CM4            | 7.13                            | 7.5        | 7.88         | 15                    | 6.9                             | 7.9         | 80                    | 1                           | 5           |
| MMSZ8V2ET1G        | CM5            | 7.79                            | 8.2        | 8.61         | 15                    | 7.6                             | 8.7         | 80                    | 0.7                         | 5           |
| MMSZ9V1ET1G        | CM6            | 8.65                            | 9.1        | 9.56         | 15                    | 8.4                             | 9.6         | 100                   | 0.5                         | 6           |
| MMSZ10ET1G         | CM7            | 9.50                            | 10         | 10.50        | 20                    | 9.3                             | 10.6        | 150                   | 0.2                         | 7           |
| MMSZ11ET1G         | CM8            | 10.45                           | 11         | 11.55        | 20                    | 10.2                            | 11.6        | 150                   | 0.1                         | 8           |
| MMSZ12ET1G         | CM9            | 11.40                           | 12         | 12.60        | 25                    | 11.2                            | 12.7        | 150                   | 0.1                         | 8           |
| MMSZ13ET1G         | CN1            | 12.35                           | 13         | 13.65        | 30                    | 12.3                            | 14.0        | 170                   | 0.1                         | 8           |
| MMSZ15ET1G         | CN2            | 14.25                           | 15         | 15.75        | 30                    | 13.7                            | 15.5        | 200                   | 0.05                        | 10.5        |
| MMSZ16ET1G         | CN3            | 15.20                           | 16         | 16.80        | 40                    | 15.2                            | 17.0        | 200                   | 0.05                        | 11.2        |
| <b>MMSZ18ET1G</b>  | <b>CN4</b>     | <b>17.10</b>                    | <b>18</b>  | <b>18.90</b> | <b>45</b>             | <b>16.7</b>                     | <b>19.0</b> | <b>225</b>            | <b>0.05</b>                 | <b>12.6</b> |
| MMSZ20ET1G         | CN5            | 19.00                           | 20         | 21.00        | 55                    | 18.7                            | 21.1        | 225                   | 0.05                        | 14          |
| MMSZ22ET1G         | CN6            | 20.90                           | 22         | 23.10        | 55                    | 20.7                            | 23.2        | 250                   | 0.05                        | 15.4        |
| MMSZ24ET1G         | CN7            | 22.80                           | 24         | 25.20        | 70                    | 22.7                            | 25.5        | 250                   | 0.05                        | 16.8        |

4. The type numbers shown have a standard tolerance of  $\pm 5\%$  on the nominal Zener Voltage.

5. Tolerance and Voltage Designation: Zener Voltage ( $V_Z$ ) is measured with the Zener Current applied for  $PW = 1\text{ ms}$ .

6.  $Z_{ZT}$  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.

Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

\*Include SZ-prefix devices where applicable.

## MMSZxxxET1G Series, SZMMSZxxxET1G Series

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 0.9\text{ V Max.}$  @  $I_F = 10\text{ mA}$ )

| Device*           | Device Marking | $V_{Z1}$ (V)<br>(Notes 7 and 8) |           |              | $Z_{ZT1}$<br>(Note 9) | $V_{Z2}$ (V)<br>(Notes 7 and 8) |           | $Z_{ZT2}$<br>(Note 9)       | Max Reverse Leakage Current |             |
|-------------------|----------------|---------------------------------|-----------|--------------|-----------------------|---------------------------------|-----------|-----------------------------|-----------------------------|-------------|
|                   |                | @ $I_{ZT1} = 2\text{ mA}$       |           |              |                       | @ $I_{ZT2} = 0.1\text{ mA}$     |           | @ $I_{ZT2} = 0.5\text{ mA}$ | $I_R @ V_R$                 |             |
|                   |                | Min                             | Nom       | Max          | $\Omega$              | Min                             | Max       | $\Omega$                    | $\mu\text{A}$               | V           |
| MMSZ27ET1G        | CN8            | 25.65                           | 27        | 28.35        | 80                    | 25                              | 28.9      | 300                         | 0.05                        | 18.9        |
| MMSZ30ET1G        | CN9            | 28.50                           | 30        | 31.50        | 80                    | 27.8                            | 32        | 300                         | 0.05                        | 21          |
| MMSZ33ET1G        | CP1            | 31.35                           | 33        | 34.65        | 80                    | 30.8                            | 35        | 325                         | 0.05                        | 23.1        |
| MMSZ36ET1G        | CP2            | 34.20                           | 36        | 37.80        | 90                    | 33.8                            | 38        | 350                         | 0.05                        | 25.2        |
| <b>MMSZ39ET1G</b> | <b>CP3</b>     | <b>37.05</b>                    | <b>39</b> | <b>40.95</b> | <b>130</b>            | <b>36.7</b>                     | <b>41</b> | <b>350</b>                  | <b>0.05</b>                 | <b>27.3</b> |
| MMSZ43ET1G        | CP4            | 40.85                           | 43        | 45.15        | 150                   | 39.7                            | 46        | 375                         | 0.05                        | 30.1        |
| MMSZ47ET1G        | CP5            | 44.65                           | 47        | 49.35        | 170                   | 43.7                            | 50        | 375                         | 0.05                        | 32.9        |
| MMSZ51ET1G        | CP6            | 48.45                           | 51        | 53.55        | 180                   | 47.6                            | 54        | 400                         | 0.05                        | 35.7        |
| MMSZ56ET1G        | CP7            | 53.20                           | 56        | 58.80        | 200                   | 51.5                            | 60        | 425                         | 0.05                        | 39.2        |

7. The type numbers shown have a standard tolerance of  $\pm 5\%$  on the nominal Zener Voltage.

8. Tolerance and Voltage Designation: Zener Voltage ( $V_Z$ ) is measured with the Zener Current applied for  $PW = 1\text{ ms}$ .

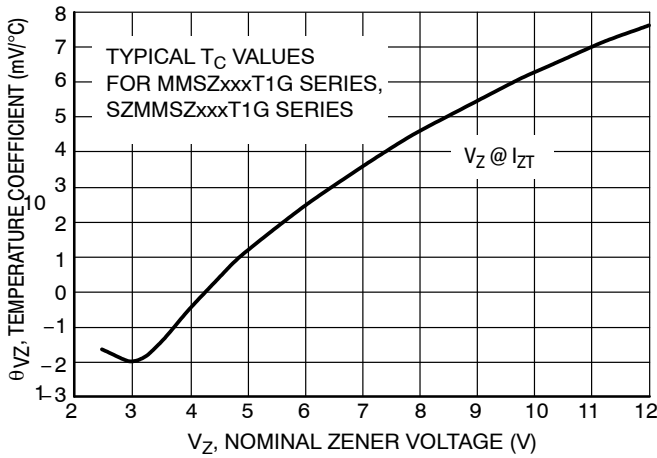
9.  $Z_{ZT}$  and  $Z_{ZK}$  are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for  $I_{Z(AC)} = 0.1 I_{Z(DC)}$ , with the AC frequency = 1 kHz.

Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

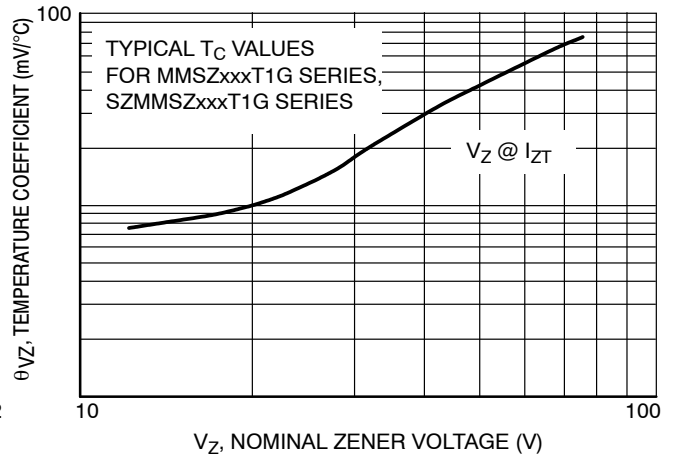
\*Include SZ-prefix devices where applicable.

# MMSZxxxET1G Series, SZMMSZxxxET1G Series

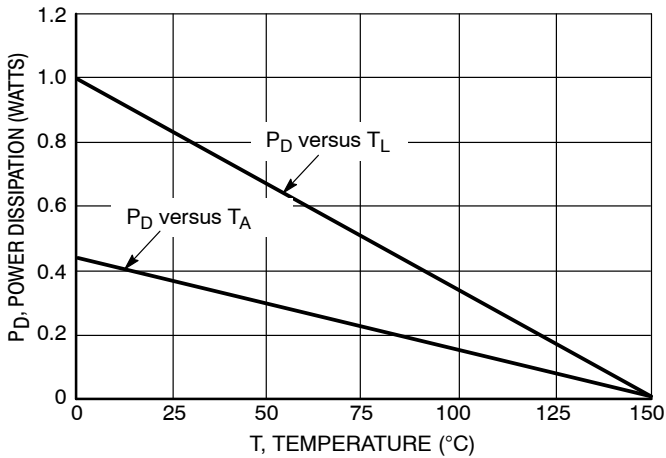
## TYPICAL CHARACTERISTICS



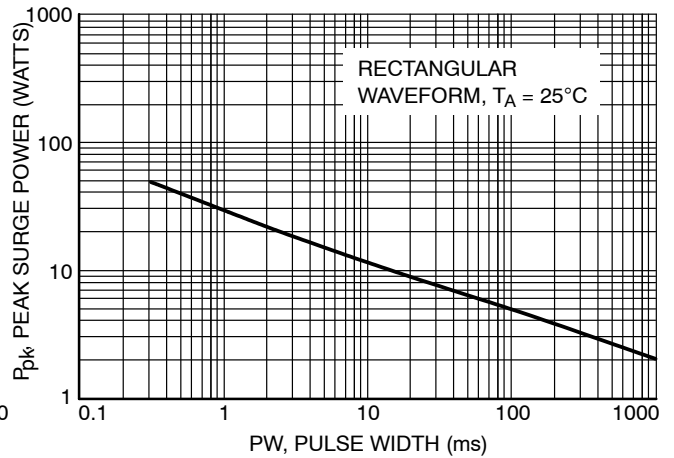
**Figure 1. Temperature Coefficients (Temperature Range -55°C to +150°C)**



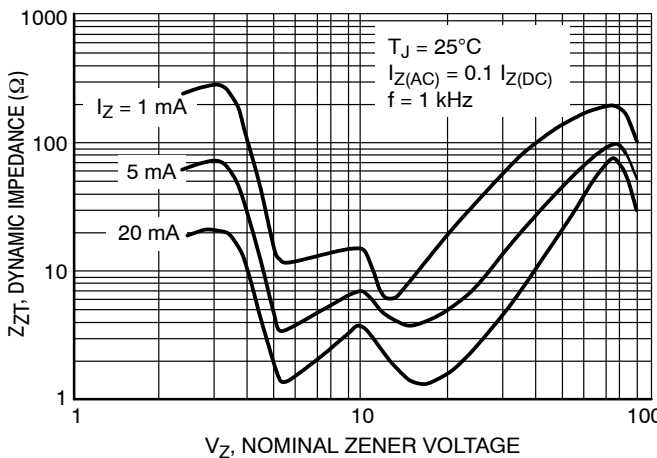
**Figure 2. Temperature Coefficients (Temperature Range -55°C to +150°C)**



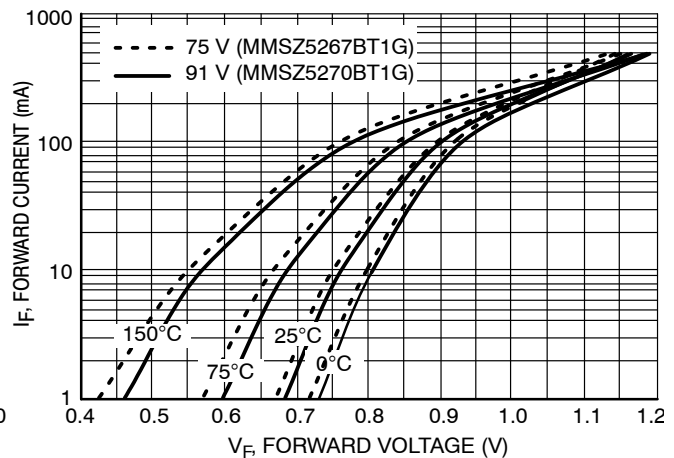
**Figure 3. Steady State Power Derating**



**Figure 4. Maximum Nonrepetitive Surge Power**



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



**Figure 6. Typical Forward Voltage**

# MMSZxxxET1G Series, SZMMSZxxxET1G Series

## TYPICAL CHARACTERISTICS

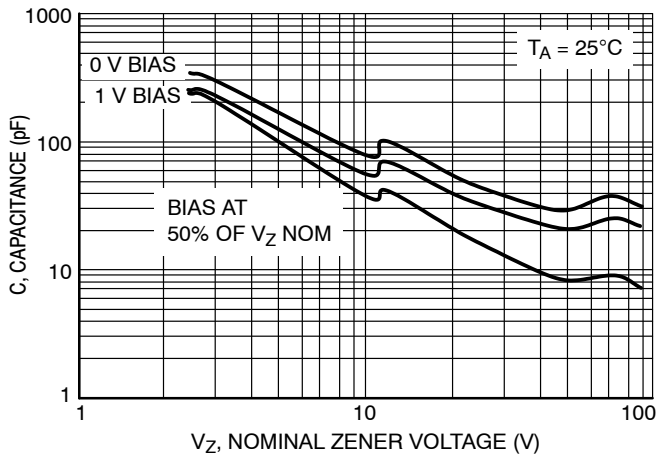


Figure 7. Typical Capacitance

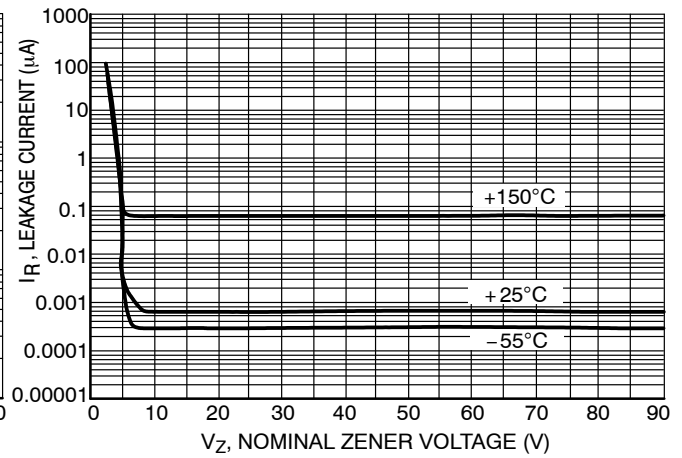


Figure 8. Typical Leakage Current

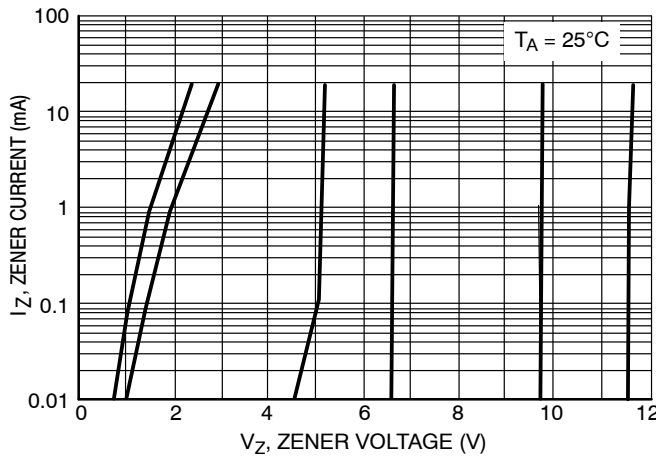


Figure 9. Zener Voltage versus Zener Current (V<sub>Z</sub> Up to 12 V)

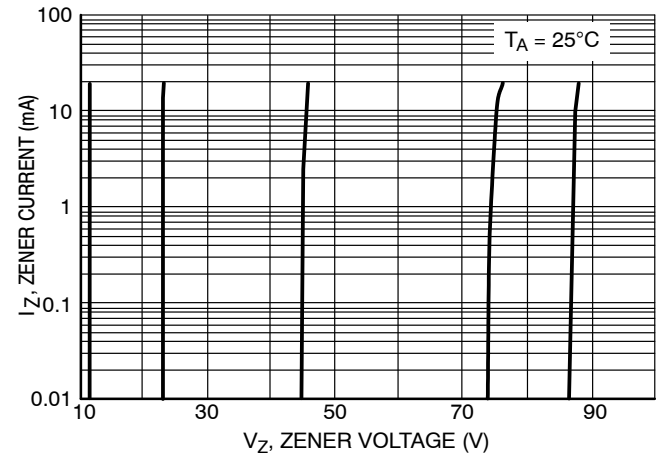


Figure 10. Zener Voltage versus Zener Current (12 V to 91 V)

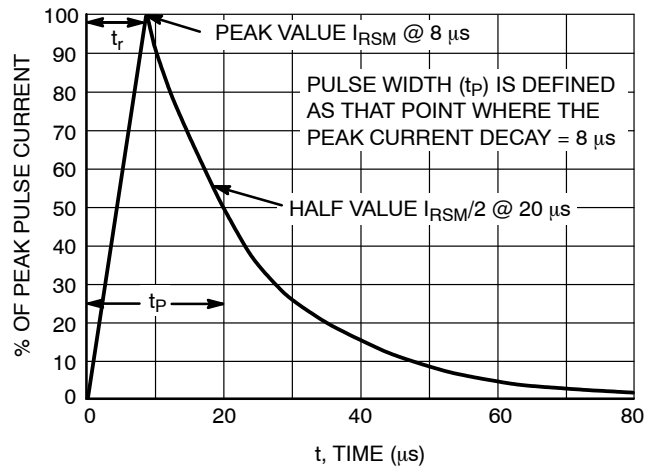


Figure 11. 8 × 20 μs Pulse Waveform

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 5:1

SOD-123  
CASE 425-04  
ISSUE G

DATE 07 OCT 2009



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.94        | 1.17 | 1.35 | 0.037  | 0.046 | 0.053 |
| A1  | 0.00        | 0.05 | 0.10 | 0.000  | 0.002 | 0.004 |
| b   | 0.51        | 0.61 | 0.71 | 0.020  | 0.024 | 0.028 |
| c   | ---         | ---  | 0.15 | ---    | ---   | 0.006 |
| D   | 1.40        | 1.60 | 1.80 | 0.055  | 0.063 | 0.071 |
| E   | 2.54        | 2.69 | 2.84 | 0.100  | 0.106 | 0.112 |
| HE  | 3.56        | 3.68 | 3.86 | 0.140  | 0.145 | 0.152 |
| L   | 0.25        | ---  | ---  | 0.010  | ---   | ---   |
| θ   | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

### SOLDERING FOOTPRINT\*



SCALE 10:1 (mm/inches)

### 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.

STYLE 1:  
PIN 1. CATHODE  
2. ANODE

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

|                  |             |  |
|------------------|-------------|--|
| DOCUMENT NUMBER: | 98ASB42927B | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION:     | SOD-123     | PAGE 1 OF 1  |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative