

# 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 $75^\circ\text{C}$ | $P_D$           | 500<br>6.7  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient<br>(Note 3)                                                               | $R_{\theta JA}$ | 340         | $^\circ\text{C/W}$         |
| Thermal Resistance, Junction-to-Lead<br>(Note 3)                                                                  | $R_{\theta JL}$ | 150         | $^\circ\text{C/W}$         |
| Junction and Storage Temperature Range                                                                            | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

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.

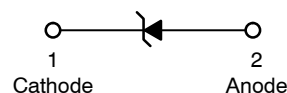


ON Semiconductor®

<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 <sup>†</sup>   |
|---------------|----------------------|-------------------------|
| 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 |

<sup>†</sup>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.

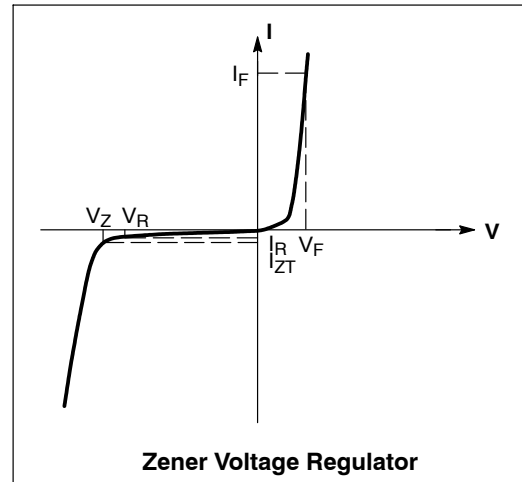
#### DEVICE MARKING INFORMATION

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 | $V_{Z1}\text{ (V)}$<br>(Notes 7 and 8) |           |              | $Z_{ZT1}$<br>(Note 9) | $V_{Z2}\text{ (V)}$<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  $PW = 1\text{ ms}$ .

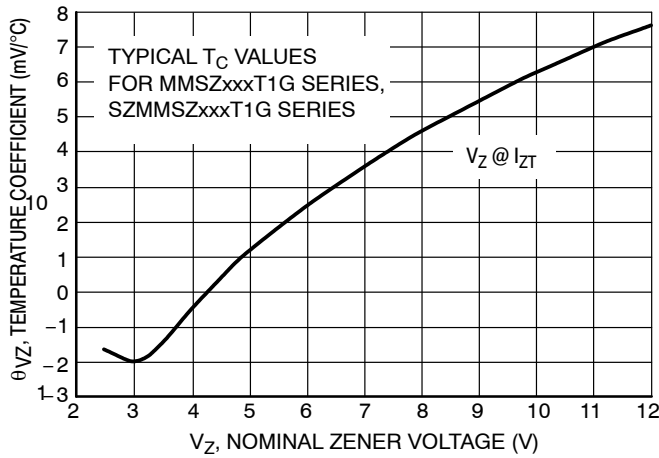
9.  $Z_{ZT}$  and  $Z_{ZK}$  are measured by dividing the AC voltage drop across the device by the AC current applied. The specified limits are for  $I_{Z(AC)} = 0.1 I_{Z(DC)}$ , with the AC frequency = 1 kHz.

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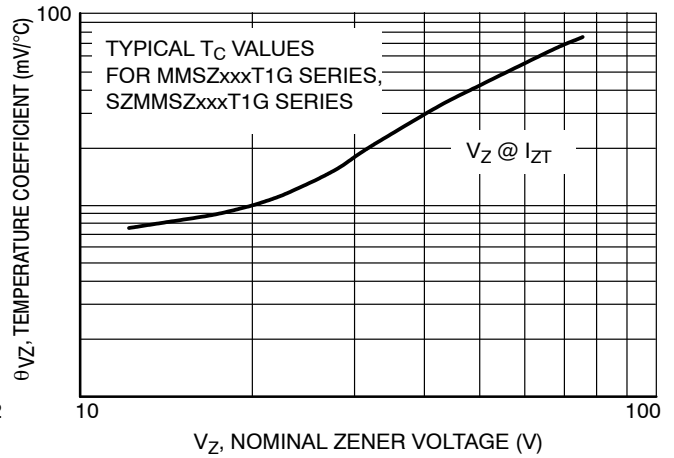
\*Include SZ-prefix devices where applicable.

# MMSZxxxET1G Series, SZMMSZxxxET1G Series

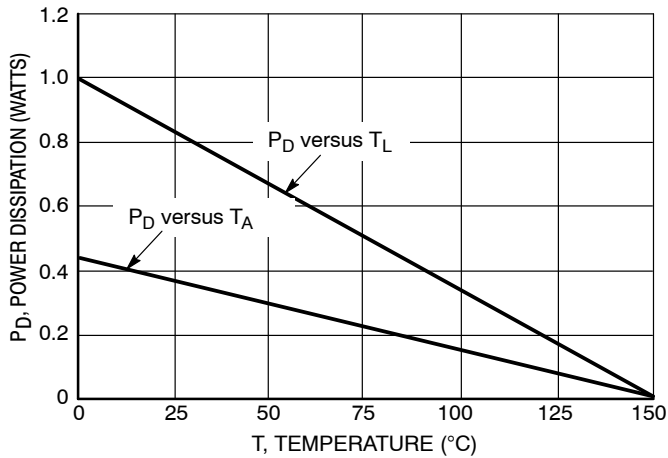
## TYPICAL CHARACTERISTICS



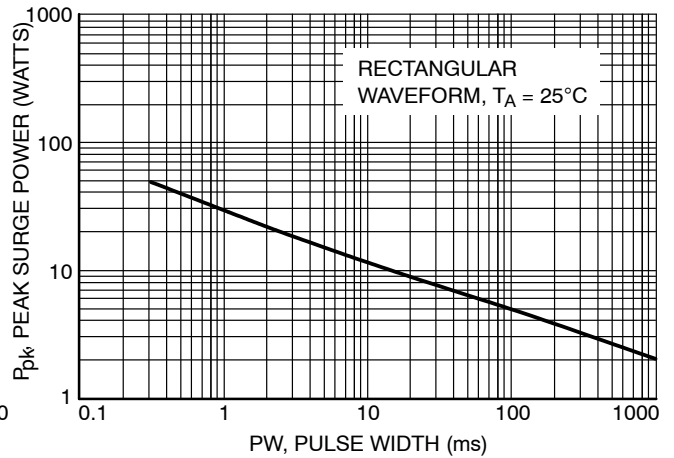
**Figure 1. Temperature Coefficients**  
(Temperature Range -55°C to +150°C)



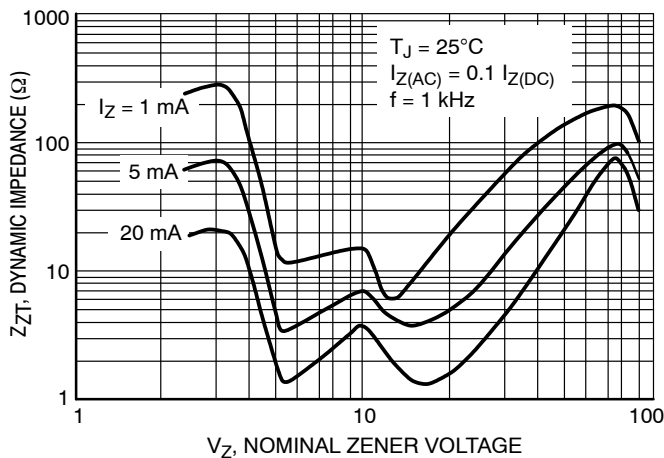
**Figure 2. Temperature Coefficients**  
(Temperature Range -55°C to +150°C)



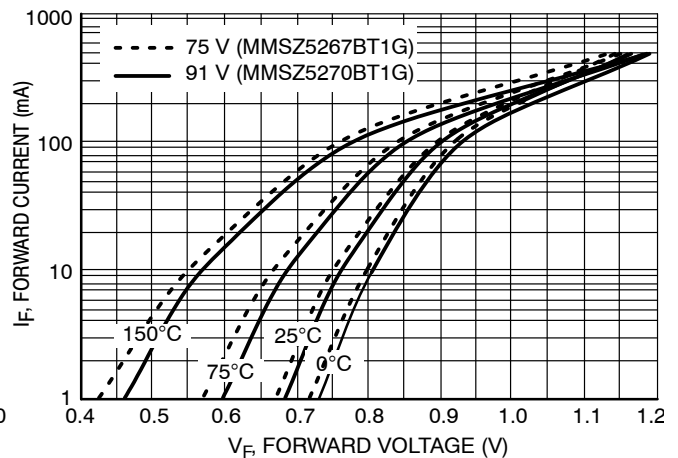
**Figure 3. Steady State Power Derating**



**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

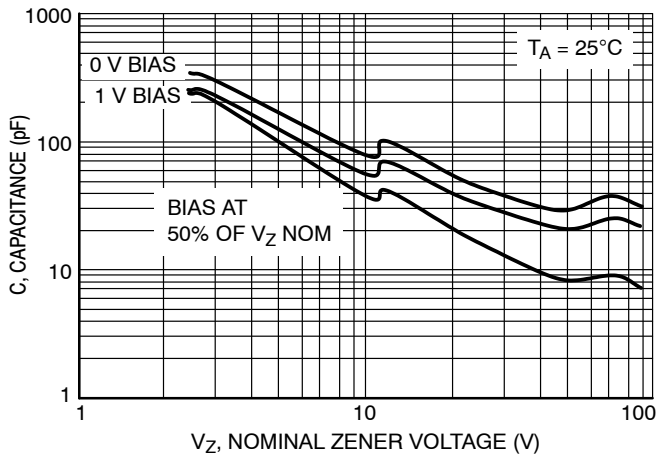


Figure 7. Typical Capacitance

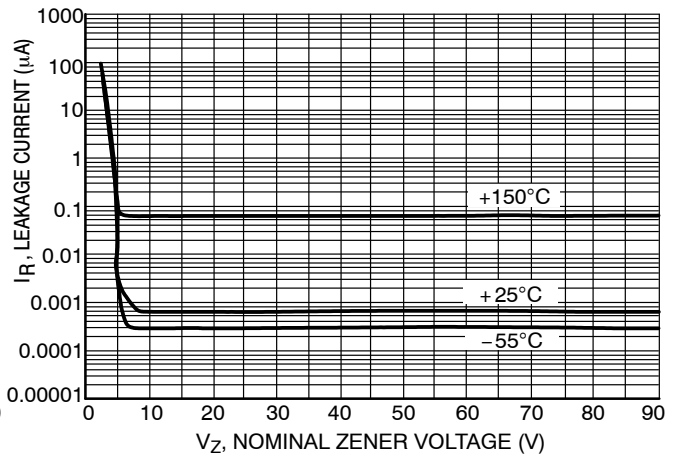


Figure 8. Typical Leakage Current

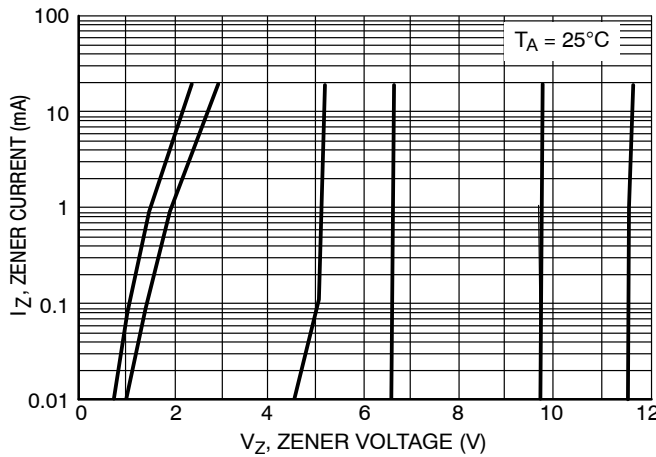


Figure 9. Zener Voltage versus Zener Current ( $V_Z$  Up to 12 V)

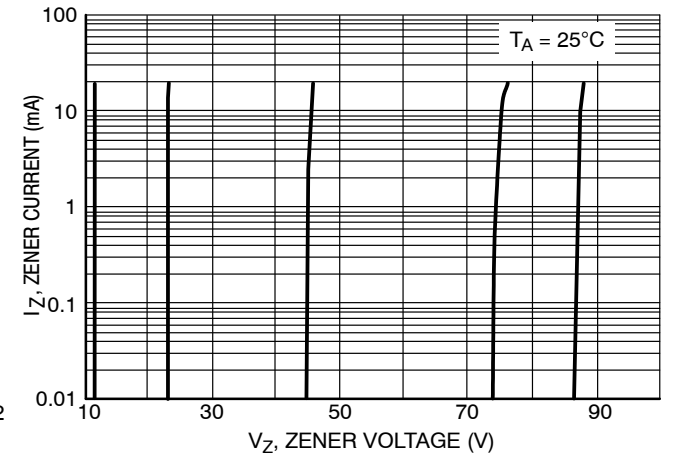


Figure 10. Zener Voltage versus Zener Current (12 V to 91 V)

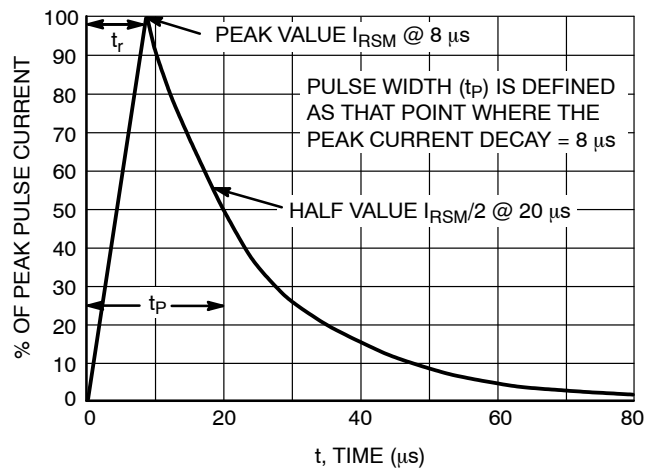
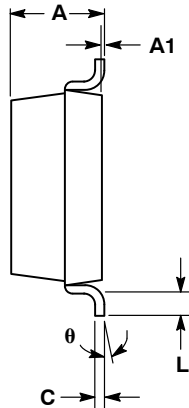
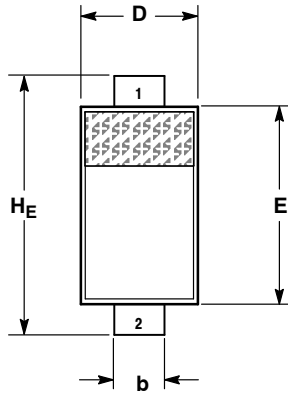


Figure 11.  $8 \times 20 \mu\text{s}$  Pulse Waveform

# MMSZxxxET1G Series, SZMMSZxxxET1G Series

## PACKAGE DIMENSIONS

SOD-123  
CASE 425-04  
ISSUE G

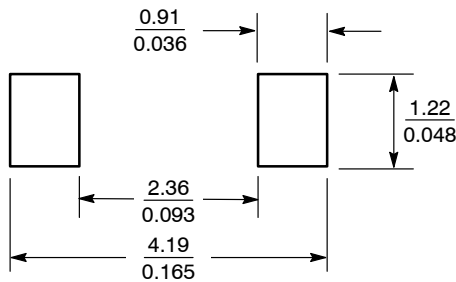


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

| 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 |
| H_E   | 3.56        | 3.68 | 3.86 | 0.140  | 0.145 | 0.152 |
| L     | 0.25        | ---  | ---  | 0.010  | ---   | ---   |
| theta | 0°          | ---  | 10°  | 0°     | ---   | 10°   |

STYLE 1:  
PIN 1. CATHODE  
2. ANODE

## SOLDERING FOOTPRINT\*



SCALE 10:1 (mm/inches)

\*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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