

# MMSZ2V4T1 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

#### 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:** UL94 V-0

#### MAXIMUM RATINGS

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

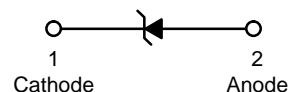
1. FR-5 = 3.5 X 1.5 inches, using the On minimum recommended footprint as shown in Figure 11

2. Thermal Resistance measurement obtained via infrared Scan Method



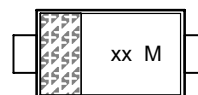
ON Semiconductor®

<http://onsemi.com>



SOD-123  
CASE 425  
STYLE 1

#### MARKING DIAGRAM



xx = Specific Device Code  
M = Date Code

#### ORDERING INFORMATION

Device †	Package	Shipping
MMSZxxxT1	SOD-123	3000/Tape & Reel
MMSZxxxT3*	SOD-123	10,000/Tape & Reel

\*MMSZ3V0T1, MMSZ5V6T1, and MMSZ6V2T1 Not Available in 10,000/Tape & Reel

#### DEVICE MARKING INFORMATION

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

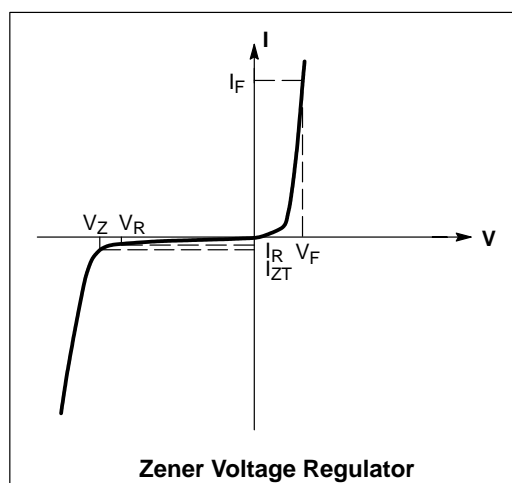
Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

†The "T1" suffix refers to an 8 mm, 7 inch reel.  
The "T3" suffix refers to an 8 mm, 13 inch reel.

## MMSZ2V4T1 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	$V_{Z1}$ (Volts) (Notes 3 and 4)			$Z_{ZT1}$ (Note 5)	$V_{Z2}$ (Volts) (Notes 3 and 4)		$Z_{ZT2}$ (Note 5)	Leakage Current	
		@ $I_{ZT1} = 5\text{ mA}$				@ $I_{ZT2} = 1\text{ mA}$			$I_R$ @ $V_R$	
		Min	Nom	Max	$\Omega$	Min	Max	$\Omega$	$\mu\text{A}$	Volts
MMSZ2V4T1	T1	2.28	2.4	2.52	100	1.7	2.1	600	50	1
MMSZ2V7T1	T2	2.57	2.7	2.84	100	1.9	2.4	600	20	1
MMSZ3V0T1*	T3	2.85	3.0	3.15	95	2.1	2.7	600	10	1
MMSZ3V3T1	T4	3.14	3.3	3.47	95	2.3	2.9	600	5	1
MMSZ3V6T1	T5	3.42	3.6	3.78	90	2.7	3.3	600	5	1
MMSZ3V9T1	U1	3.71	3.9	4.10	90	2.9	3.5	600	3	1
MMSZ4V3T1	U2	4.09	4.3	4.52	90	3.3	4.0	600	3	1
MMSZ4V7T1	U3	4.47	4.7	4.94	80	3.7	4.7	500	3	2
<b>MMSZ5V1T1</b>	<b>U4</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>MMSZ5V6T1*</b>	<b>U5</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>MMSZ6V2T1*</b>	<b>V1</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>
MMSZ6V8T1	V2	6.46	6.8	7.14	15	6.3	7.2	80	2	4
MMSZ7V5T1	V3	7.13	7.5	7.88	15	6.9	7.9	80	1	5
MMSZ8V2T1	V4	7.79	8.2	8.61	15	7.6	8.7	80	0.7	5
MMSZ9V1T1	V5	8.65	9.1	9.56	15	8.4	9.6	100	0.5	6
MMSZ10T1	A1	9.50	10	10.50	20	9.3	10.6	150	0.2	7
MMSZ11T1	A2	10.45	11	11.55	20	10.2	11.6	150	0.1	8
MMSZ12T1	A3	11.40	12	12.60	25	11.2	12.7	150	0.1	8
MMSZ13T1	A4	12.35	13	13.65	30	12.3	14.0	170	0.1	8
MMSZ15T1	A5	14.25	15	15.75	30	13.7	15.5	200	0.05	10.5
MMSZ16T1	X1	15.20	16	16.80	40	15.2	17.0	200	0.05	11.2
<b>MMSZ18T1</b>	<b>X2</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>
MMSZ20T1	X3	19.00	20	21.00	55	18.7	21.1	225	0.05	14
MMSZ22T1	X4	20.90	22	23.10	55	20.7	23.2	250	0.05	15.4
MMSZ24T1	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  $\pm 5\%$  on the nominal Zener Voltage.

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

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.

\*Not Available in the 10,000/Tape & Reel.

## MMSZ2V4T1 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	$V_{Z1}$ (Volts) (Notes 6 and 7)			$Z_{ZT1}$ (Note 8)	$V_{Z2}$ (Volts) (Notes 6 and 7)		$Z_{ZT2}$ (Note 8)	Leakage Current	
		@ $I_{ZT1} = 2\text{ mA}$				@ $I_{ZT2} = 0.1\text{ mA}$		@ $I_{ZT3} = 0.5\text{ mA}$	$I_R$ @ $V_R$	
		Min	Nom	Max	$\Omega$	Min	Max	$\Omega$	$\mu\text{A}$	Volts
MMSZ27T1	Y1	25.65	27	28.35	80	25	28.9	300	0.05	18.9
MMSZ30T1	Y2	28.50	30	31.50	80	27.8	32	300	0.05	21
MMSZ33T1	Y3	31.35	33	34.65	80	30.8	35	325	0.05	23.1
MMSZ36T1	Y4	34.20	36	37.80	90	33.8	38	350	0.05	25.2
<b>MMSZ39T1</b>	<b>Y5</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>
MMSZ43T1	Z1	40.85	43	45.15	150	39.7	46	375	0.05	30.1
MMSZ51T1	Z3	48.45	51	53.55	180	47.6	54	400	0.05	35.7
MMSZ56T1	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  $\pm 5\%$  on the nominal Zener Voltage.

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

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.

# MMSZ2V4T1 Series

## TYPICAL CHARACTERISTICS

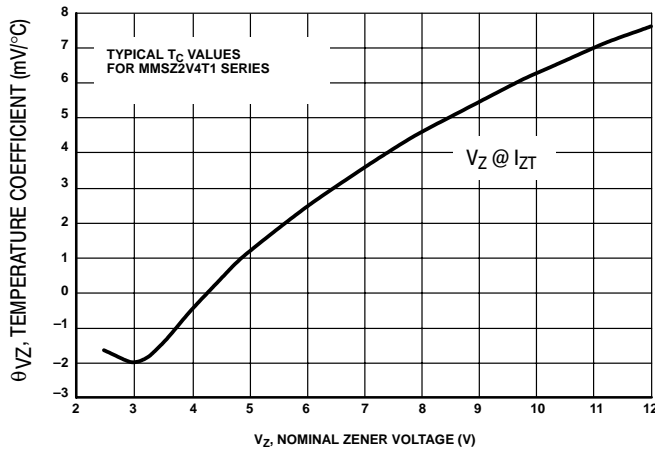


Figure 1. Temperature Coefficients  
(Temperature Range -55°C to +150°C)

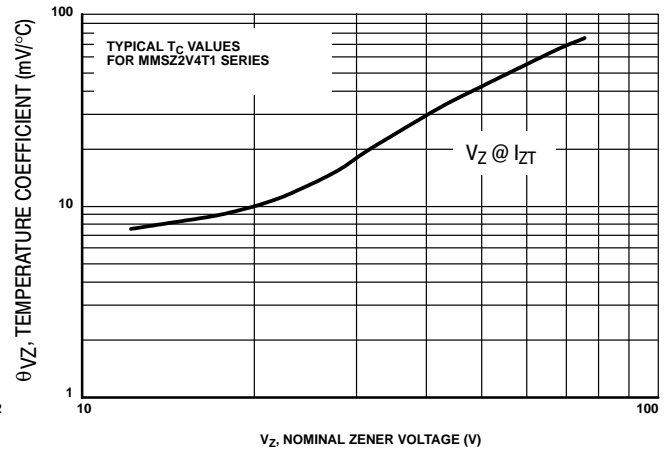


Figure 2. Temperature Coefficients  
(Temperature Range -55°C to +150°C)

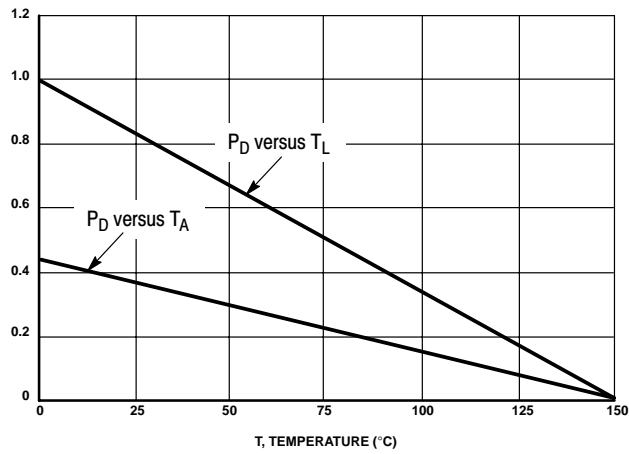


Figure 3. Steady State Power Derating

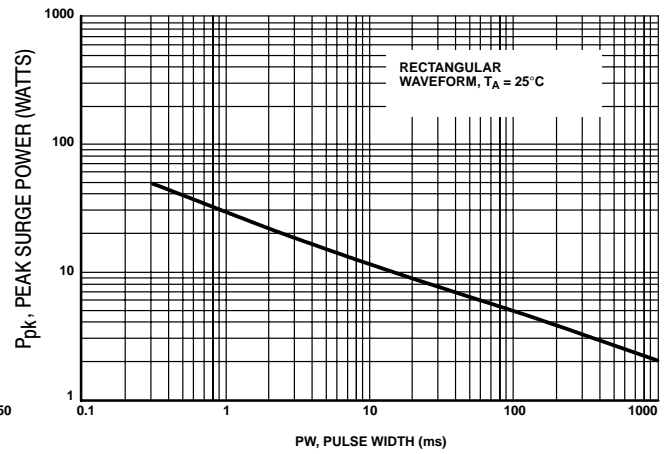


Figure 4. Maximum Nonrepetitive Surge Power

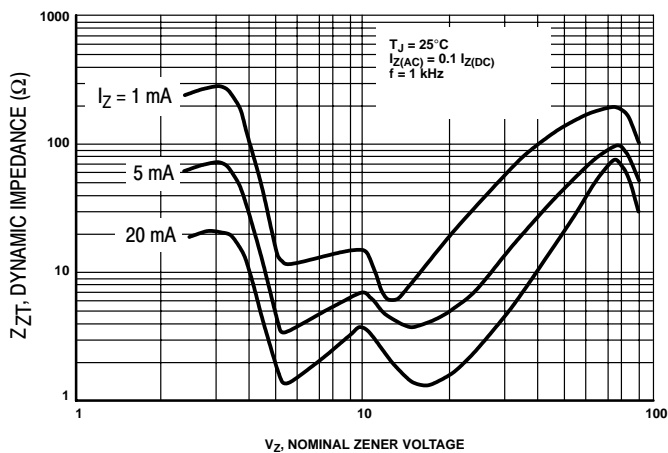


Figure 5. Effect of Zener Voltage on  
Zener Impedance

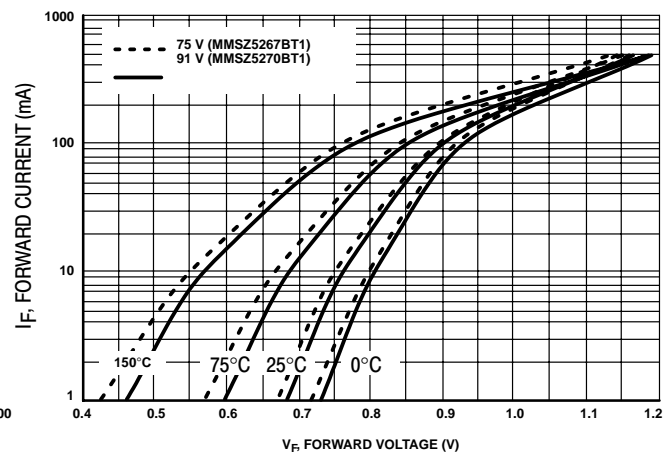


Figure 6. Typical Forward Voltage

# MMSZ2V4T1 Series

## TYPICAL CHARACTERISTICS

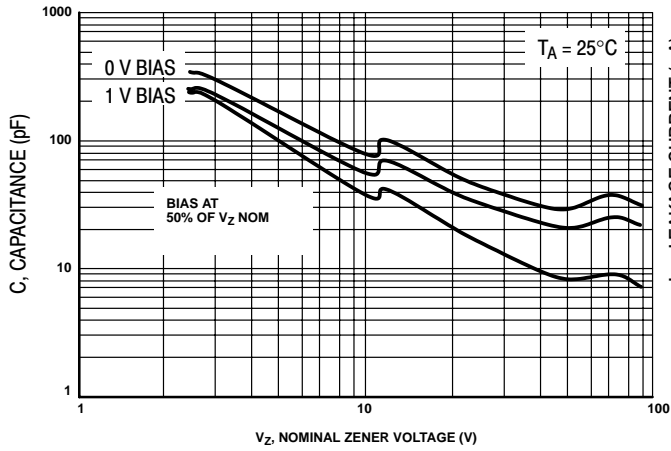


Figure 7. Typical Capacitance

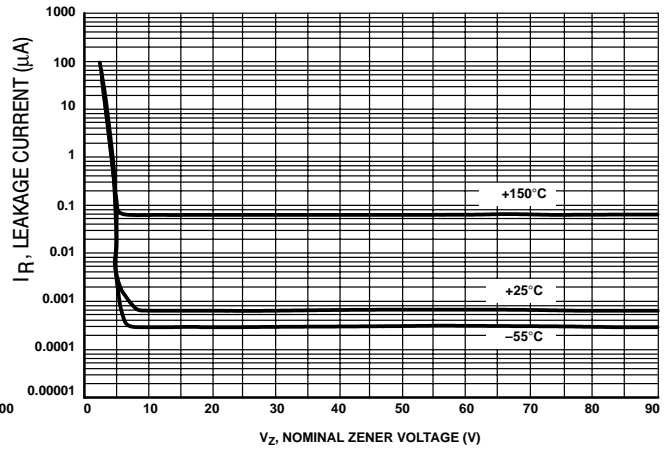


Figure 8. Typical Leakage Current

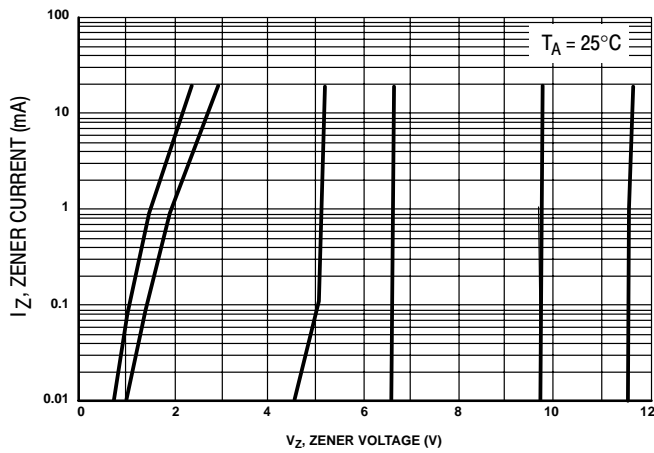


Figure 9. Zener Voltage versus Zener Current  
( $V_Z$  Up to 12 V)

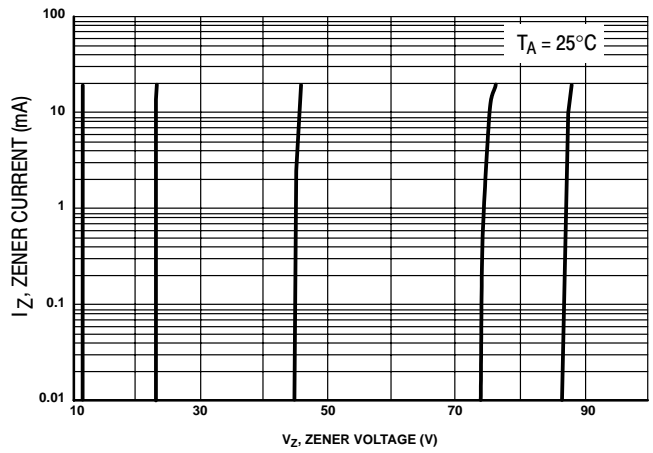


Figure 10. Zener Voltage versus Zener Current  
(12 V to 91 V)

## INFORMATION FOR USING THE SOD-123 SURFACE MOUNT PACKAGE

### MINIMUM RECOMMENDED FOOTPRINTS FOR SURFACE MOUNT 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 ensure proper solder connection interface between the board and the package.

The minimum recommended footprint for the SOD-123 is shown at the right.

The SOD-123 package can be used on existing surface mount boards which have been designed for the leadless 34 package style. The footprint compatibility makes conversion from leadless 34 to SOD-123 straightforward.

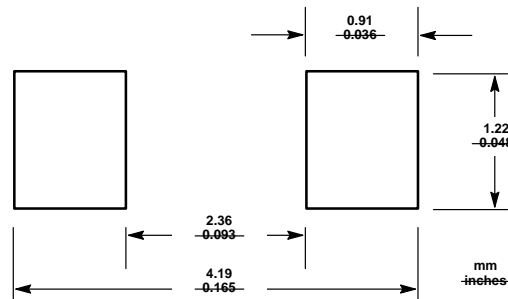


Figure 11. Minimum Recommended Footprint

### SOD-123 POWER DISSIPATION

The power dissipation of the SOD-123 is a function of the 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 SOD-123 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 0.37 watts.

$$P_D = \frac{150^\circ\text{C} - 25^\circ\text{C}}{340^\circ\text{C/W}} = 0.37 \text{ watts}$$

The 340°C/W for the SOD-123 package assumes using recommended footprint shown on FR-4 glass epoxy printed circuit board. Another alternative is to use a ceramic substrate or an aluminum core board such as Thermal Clad®. By using an aluminum core board material such as Thermal Clad, the power dissipation can be doubled using the same footprint.

### GENERAL 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.

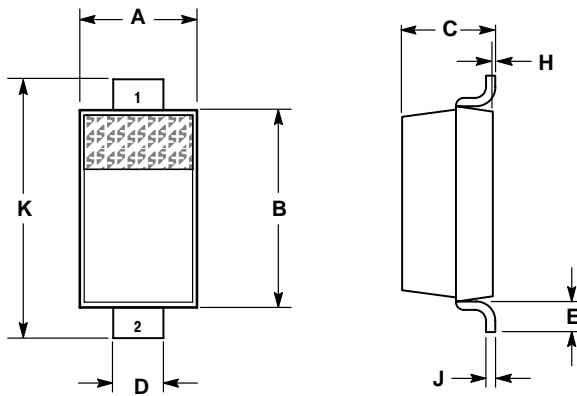
- The soldering temperature and time shall not exceed 260°C for more than 10 seconds.
- When shifting from preheating to soldering, the maximum temperature gradient shall be 5°C or less.
- After soldering has been completed, the device should be allowed to cool naturally for at least three minutes. Gradual 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.

# Zener Voltage Regulators – Surface Mounted

## 500 mW SOD–123

SOD–123  
CASE 425–04  
ISSUE C



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.055	0.071	1.40	1.80
B	0.100	0.112	2.55	2.85
C	0.037	0.053	0.95	1.35
D	0.020	0.028	0.50	0.70
E	0.01	---	0.25	---
H	0.000	0.004	0.00	0.10
J	---	0.006	---	0.15
K	0.140	0.152	3.55	3.85

STYLE 1:  
PIN 1. CATHODE  
2. ANODE

## MMSZ2V4T1 Series

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