MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

Order this data sheet
by MMSZ5221B/D

MMSZ5221B-MMSZ5270B* MMSZ4678-MMSZ4717 MMSZ2V4-MMSZ75

*Motorola Preferred Device Series

PLASTIC SURFACE MOUNT ZENER DIODES 500 MILLIWATTS 1.8–91 VOLTS

Designer's™ Data Sheet

Surface Mount Silicon Zener Diodes

Plastic SOD-123 Package

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.

- 500 mW Rating on FR-4 or FR-5 Board
- Package Designed for Optimal Automated Board Assembly
- Corrosion Resistant Finish, Easily Solderable
- ESD Rating of Class 3 (exceeding 16 kV) per the Human Body Model
- Small Package Size for High Density Applications
- Available in 8 mm Tape and Reel
  Add "T1" to the device number to order the 7 inch/3000 unit reel.
  Add "T3" to the device number to order the 13 inch/10,000 unit reel.

MMSZ5221B thru MMSZ5270B

- General Purpose, Medium Current
- Wide Voltage Range — 2.4 to 91 V

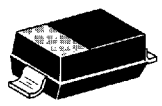
MMSZ4678 thru MMSZ4717

- Low Operating Currents, Low Leakage, Sharp Breakdown Characteristics
- Wide Voltage Range — 1.8 to 43 V

MMSZ2V4 thru MMSZ75

- Specified Similar to European BZV55C Series
- Wide Voltage Range — 2.4 to 75 V

1: CATHODE
2: ANODE



CASE 425-04 STYLE 1
PLASTIC

DEVICE RATING (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Power Dissipation on FR-4 or FR-5 Board [1] Derate above T_L = 75°C	P_D —	500 6.7	mW mW/°C
Thermal Resistance Junction to Lead [2] Thermal Resistance Junction to Ambient [2]	$R_{\theta JL}$ $R_{\theta JA}$	150 340	°C/W
Junction Temperature Range	T_J	–55 to +150	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C
Lead Solder Temperature – Maximum (10 sec. duration)	—	260	°C

[1] FR-4 or FR-5 = 3 5 x 1 5 inches, using the Motorola minimum recommended footprint as shown in Figure 11.
[2] Thermal Resistance measurement obtained via Infrared Scan Method

Designer's Data for "Worst Case" Conditions — The Designer's Data Sheet permits the design of most circuits entirely from the information presented Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design

Designer's is a trademark of Motorola, Inc
Thermal Clad is a trademark of the Bergquist Company

Preferred devices are Motorola recommended choices for future use and best overall value

TYPICAL CHARACTERISTICS

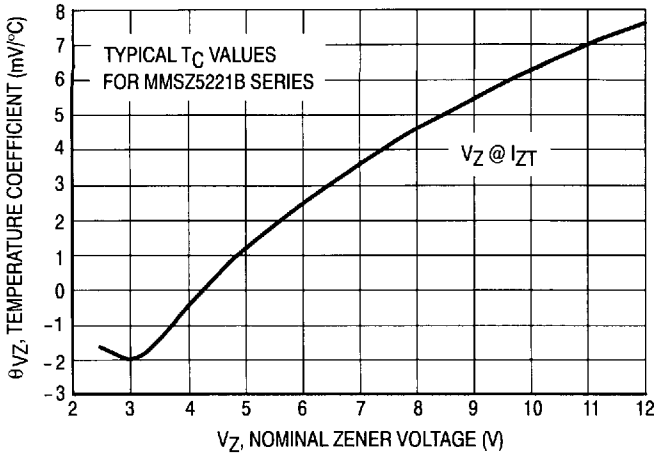


Figure 1. Temperature Coefficients (Temperature Range −55°C to +150°C)

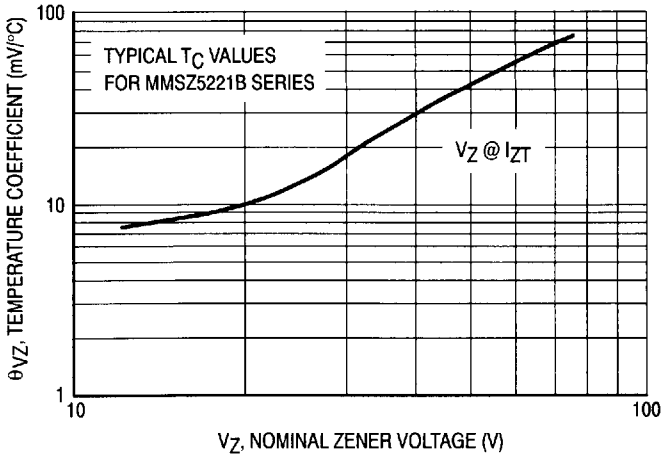


Figure 2. Temperature Coefficients (Temperature Range −55°C to +150°C)

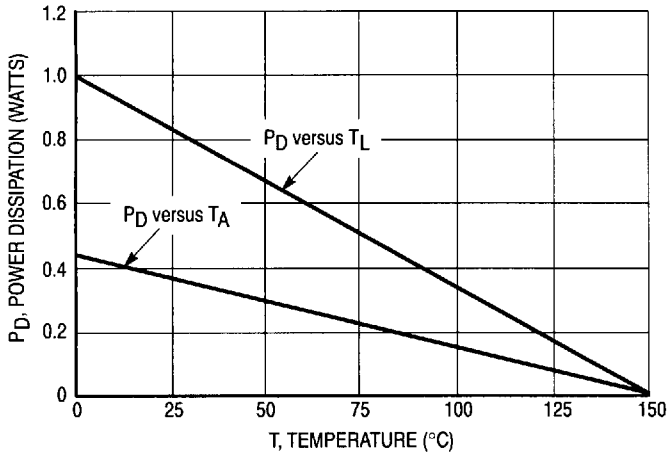


Figure 3. Steady State Power Derating

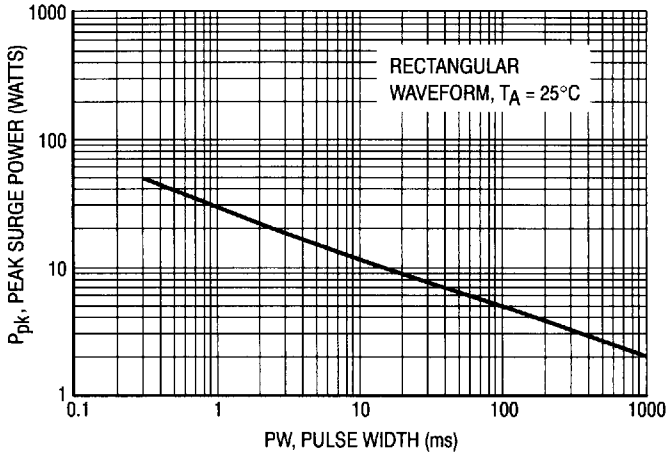


Figure 4. Maximum Nonrepetitive Surge Power

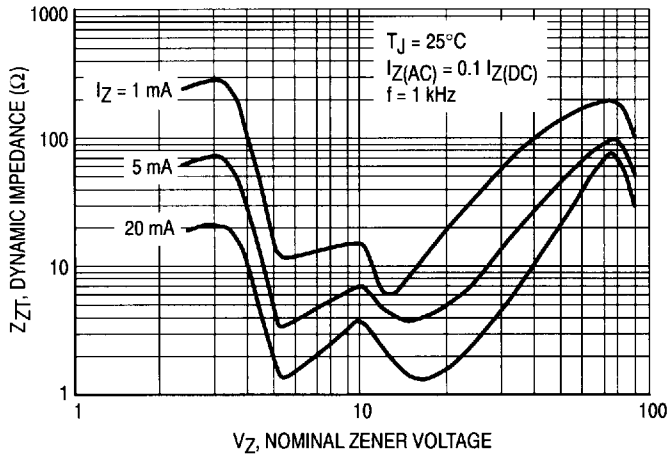


Figure 5. Effect of Zener Voltage on Zener Impedance

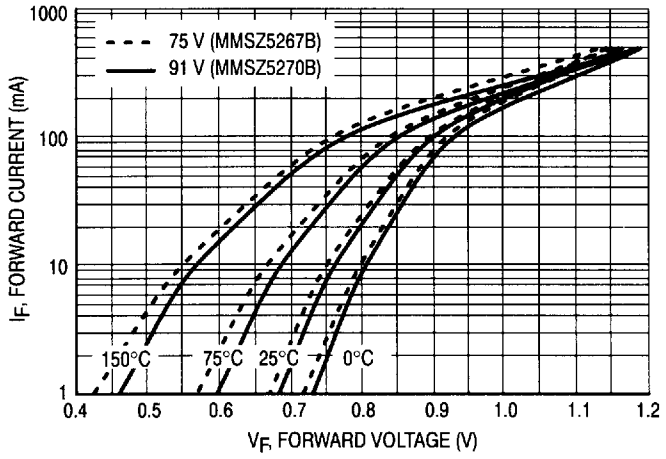


Figure 6. Typical Forward Voltage

TYPICAL CHARACTERISTICS

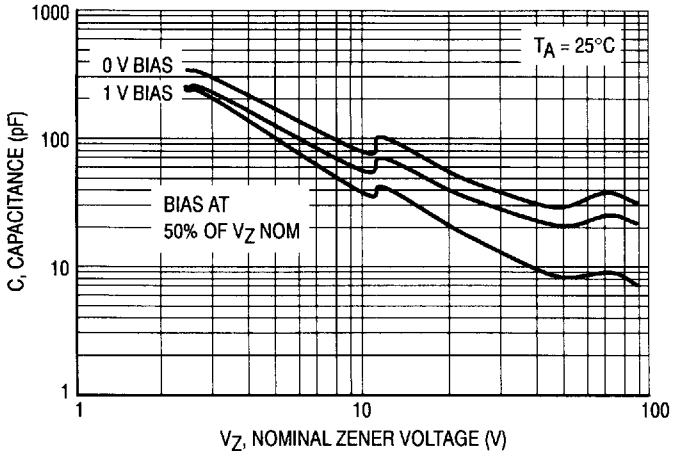


Figure 7. Typical Capacitance

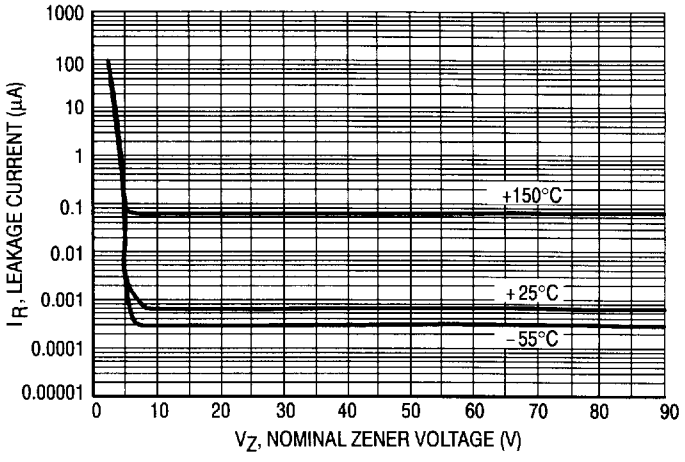


Figure 8. Typical Leakage Current

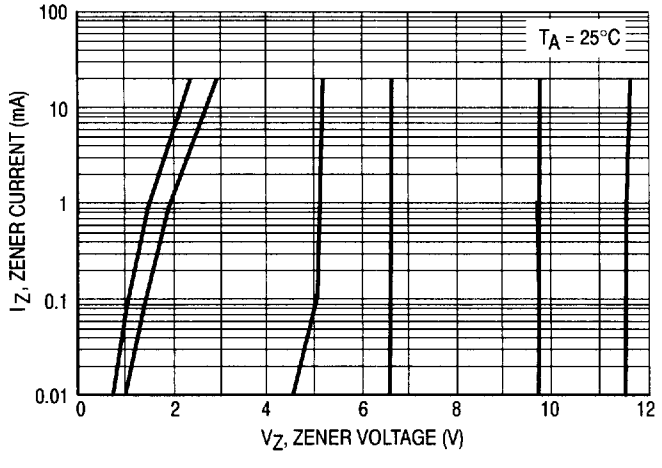


Figure 9. Zener Voltage versus Zener Current (V_Z Up to 12 V)

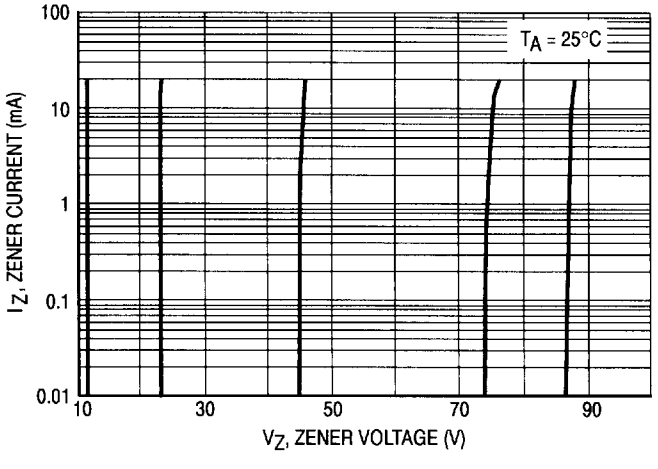


Figure 10. Zener Voltage versus Zener Current (12 V to 91 V)

TYPICAL CHARACTERISTICS FOR MMSZ5221B thru MMSZ5270B ONLY

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted [1]), (V_F = 0.9 V Max. @ I_F = 10 mA for all types)

Type Number	Marking	Zener Voltage V_Z @ I_{ZT} Volts [1] [2] Nom	Min	Max	Test Current I_{ZT} mA	Max Zener Impedance [3] Z_{ZT} @ $I_Z = I_{ZT}$ Ω	Z_{ZK} @ I_{ZK} = 0.25 mA Ω	Max Reverse Leakage Current I_R @ V_R µA	Test Voltage V_R Volts
MMSZ5221B	C1	2.4	2.28	2.52	20	30	1200	100	1
MMSZ5222B	C2	2.5	2.38	2.63	20	30	1250	100	1
MMSZ5223B	C3	2.7	2.57	2.84	20	30	1300	75	1
MMSZ5224B	C4	2.8	2.66	2.94	20	30	1400	75	1
MMSZ5225B	C5	3.0	2.85	3.15	20	30	1600	50	1
MMSZ5226B	D1	3.3	3.14	3.47	20	28	1600	25	1
MMSZ5227B	D2	3.6	3.42	3.78	20	24	1700	15	1
MMSZ5228B	D3	3.9	3.71	4.10	20	23	1900	10	1
MMSZ5229B	D4	4.3	4.09	4.52	20	22	2000	5	1
MMSZ5230B	D5	4.7	4.47	4.94	20	19	1900	5	2
MMSZ5231B	E1	5.1	4.85	5.36	20	17	1600	5	2
MMSZ5232B	E2	5.6	5.32	5.88	20	11	1600	5	3
MMSZ5233B	E3	6.0	5.70	6.30	20	7	1600	5	3.5
MMSZ5234B	E4	6.2	5.89	6.51	20	7	1000	5	4
MMSZ5235B	E5	6.8	6.46	7.14	20	5	750	3	5
MMSZ5236B	F1	7.5	7.13	7.88	20	6	500	3	6
MMSZ5237B	F2	8.2	7.79	8.61	20	8	500	3	6.5
MMSZ5238B	F3	8.7	8.27	9.14	20	8	600	3	6.5
MMSZ5239B	F4	9.1	8.65	9.56	20	10	600	3	7
MMSZ5240B	F5	10	9.50	10.50	20	17	600	3	8
MMSZ5241B	H1	11	10.45	11.55	20	22	600	2	8.4
MMSZ5242B	H2	12	11.40	12.60	20	30	600	1	9.1
MMSZ5243B	H3	13	12.35	13.65	9.5	13	600	0.5	9.9
MMSZ5244B	H4	14	13.30	14.70	9.0	15	600	0.1	10
MMSZ5245B	H5	15	14.25	15.75	8.5	16	600	0.1	11
MMSZ5246B	J1	16	15.20	16.80	7.8	17	600	0.1	12
MMSZ5247B	J2	17	16.15	17.85	7.4	19	600	0.1	13
MMSZ5248B	J3	18	17.10	18.90	7.0	21	600	0.1	14
MMSZ5249B	J4	19	18.05	19.95	6.6	23	600	0.1	14
MMSZ5250B	J5	20	19.00	21.00	6.2	25	600	0.1	15
MMSZ5251B	K1	22	20.90	23.10	5.6	29	600	0.1	17
MMSZ5252B	K2	24	22.80	25.20	5.2	33	600	0.1	18
MMSZ5253B	K3	25	23.75	26.25	5.0	35	600	0.1	19
MMSZ5254B	K4	27	25.65	28.35	4.6	41	600	0.1	21
MMSZ5255B	K5	28	26.60	29.40	4.5	44	600	0.1	21

[1] Nominal zener voltage is measured with the device junction in thermal equilibrium at T_L = 30°C ± 1°C

[2] All part numbers shown indicate a V_Z tolerance of ±5%

[3] 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

TYPICAL CHARACTERISTICS FOR MMSZ5221B thru MMSZ5270B ONLY (continued)

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted [1]), (V_F = 0.9 V Max. @ I_F = 10 mA for all types)

Type Number	Marking	Zener Voltage V_Z @ I_{ZT} Volts [1] [2]			Test Current I_{ZT}	Max Zener Impedance [3]		Max Reverse Leakage Current I_R @ V_R	Test Voltage V_R
		Nom	Min	Max	mA	Z_{ZT} @ $I_Z = I_{ZT}$ Ω	Z_{ZK} @ I_{ZK} = 0.25 mA Ω	μA	Volts
MMSZ5256B	M1	30	28.50	31.50	4.2	49	600	0.1	23
MMSZ5257B	M2	33	31.35	34.65	3.8	58	700	0.1	25
MMSZ5258B	M3	36	34.20	37.80	3.4	70	700	0.1	27
MMSZ5259B	M4	39	37.05	40.95	3.2	80	800	0.1	30
MMSZ5260B	M5	43	40.85	45.15	3.0	93	900	0.1	33
MMSZ5261B	N1	47	44.65	49.35	2.7	105	1000	0.1	36
MMSZ5262B	N2	51	48.45	53.55	2.5	125	1100	0.1	39
MMSZ5263B	N3	56	53.20	58.80	2.2	150	1300	0.1	43
MMSZ5264B	N4	60	57.00	63.00	2.1	170	1400	0.1	46
MMSZ5265B	N5	62	58.90	65.10	2.0	185	1400	0.1	47
MMSZ5266B	P1	68	64.60	71.40	1.8	230	1600	0.1	52
MMSZ5267B	P2	75	71.25	78.75	1.7	270	1700	0.1	56
MMSZ5268B	P3	82	77.90	86.10	1.5	330	2000	0.1	62
MMSZ5269B	P4	87	82.65	91.35	1.4	370	2200	0.1	68
MMSZ5270B	P5	91	86.45	95.55	1.4	400	2300	0.1	69

[1] Nominal zener voltage is measured with the device junction in thermal equilibrium at T_L = 30°C ± 1°C

[2] All part numbers shown indicate a V_Z tolerance of ±5%

[3] 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

TYPICAL CHARACTERISTICS FOR MMSZ4678 thru MMSZ4717 ONLY

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted [1], (V_F = 0.9 V Max. @ I_F = 10 mA for all types)

Type Number	Marking	Zener Voltage V_Z @ I_{ZT} = 50 μA Volts [1] [2]			Max Reverse Leakage Current I_R @ V_R	Test Voltage V_R
		Nom	Min	Max	μA	Volts
MMSZ4678	CC	1.8	1.71	1.89	7.5	1
MMSZ4679	CD	2.0	1.90	2.10	5	1
MMSZ4680	CE	2.2	2.09	2.31	4	1
MMSZ4681	CF	2.4	2.28	2.52	2	1
MMSZ4682	CH	2.7	2.57	2.84	1	1
MMSZ4683	CJ	3.0	2.85	3.15	0.8	1
MMSZ4684	CK	3.3	3.14	3.47	7.5	1.5
MMSZ4685	CM	3.6	3.42	3.78	7.5	2
MMSZ4686	CN	3.9	3.71	4.10	5	2
MMSZ4687	CP	4.3	4.09	4.52	4	2
MMSZ4688	CT	4.7	4.47	4.94	10	3
MMSZ4689	CU	5.1	4.85	5.36	10	3
MMSZ4690	CV	5.6	5.32	5.88	10	4
MMSZ4691	CA	6.2	5.89	6.51	10	5
MMSZ4692	CX	6.8	6.46	7.14	10	5.1
MMSZ4693	CY	7.5	7.13	7.88	10	5.7
MMSZ4694	CZ	8.2	7.79	8.61	1	6.2
MMSZ4695	DC	8.7	8.27	9.14	1	6.6
MMSZ4696	DD	9.1	8.65	9.56	1	6.9
MMSZ4697	DE	10	9.50	10.50	1	7.6
MMSZ4698	DF	11	10.45	11.55	0.05	8.4
MMSZ4699	DH	12	11.40	12.60	0.05	9.1
MMSZ4700	DJ	13	12.35	13.65	0.05	9.8
MMSZ4701	DK	14	13.30	14.70	0.05	10.6
MMSZ4702	DM	15	14.25	15.75	0.05	11.4
MMSZ4703	DN	16	15.20	16.80	0.05	12.1
MMSZ4704	DP	17	16.15	17.85	0.05	12.9
MMSZ4705	DT	18	17.10	18.90	0.05	13.6
MMSZ4706	DU	19	18.05	19.95	0.05	14.4
MMSZ4707	DV	20	19.00	21.00	0.01	15.2
MMSZ4708	DA	22	20.90	23.10	0.01	16.7
MMSZ4709	DZ	24	22.80	25.20	0.01	18.2
MMSZ4710	DY	25	23.75	26.25	0.01	19.00
MMSZ4711	EA	27	25.65	28.35	0.01	20.4
MMSZ4712	EC	28	26.60	29.40	0.01	21.2
MMSZ4713	ED	30	28.50	31.50	0.01	22.8
MMSZ4714	EE	33	31.35	34.65	0.01	25.0
MMSZ4715	EF	36	34.20	37.80	0.01	27.3
MMSZ4716	EH	39	37.05	40.95	0.01	29.6
MMSZ4717	EJ	43	40.85	45.15	0.01	32.6

[1] Nominal zener voltage is measured with the device junction in thermal equilibrium at T_L = 30°C ± 1°C

[2] All part numbers shown indicate a V_Z tolerance of ± 5%

TYPICAL CHARACTERISTICS FOR MMSZ2V4 thru MMSZ75 ONLY

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

Type Number	Marking	Zener Voltage V_{Z1} (Volts) @ I_{ZT1} = 5 mA [1][2]			Max Zener Impedance Z_{ZT1} @ I_{ZT1} = 5 mA [3] Ω	Max Reverse Leakage Current		Zener Voltage V_{Z2} (Volts) @ I_{ZT2} = 1 mA [1]		Max Zener Impedance Z_{ZT2} @ I_{ZT1} = 1 mA [3] Ω
		Nom	Min	Max		I_R μA	@ V_R Volts	Min	Max	
MMSZ2V4	T1	2.4	2.28	2.52	100	50	1	1.7	2.1	600
MMSZ2V7	T2	2.7	2.57	2.84	100	20	1	1.9	2.4	600
MMSZ3V0	T3	3.0	2.85	3.15	95	10	1	2.1	2.7	600
MMSZ3V3	T4	3.3	3.14	3.47	95	5	1	2.3	2.9	600
MMSZ3V6	T5	3.6	3.42	3.78	90	5	1	2.7	3.3	600
MMSZ3V9	U1	3.9	3.71	4.10	90	3	1	2.9	3.5	600
MMSZ4V3	U2	4.3	4.09	4.52	90	3	1	3.3	4.0	600
MMSZ4V7	U3	4.7	4.47	4.94	80	3	2	3.7	4.7	500
MMSZ5V1	U4	5.1	4.85	5.36	60	2	2	4.2	5.3	480
MMSZ5V6	U5	5.6	5.32	5.88	40	1	2	4.8	6.0	400
MMSZ6V2	V1	6.2	5.89	6.51	10	3	4	5.6	6.6	150
MMSZ6V8	V2	6.8	6.46	7.14	15	2	4	6.3	7.2	80
MMSZ7V5	V3	7.5	7.13	7.88	15	1	5	6.9	7.9	80
MMSZ8V2	V4	8.2	7.79	8.61	15	0.7	5	7.6	8.7	80
MMSZ9V1	V5	9.1	8.65	9.56	15	0.5	6	8.4	9.6	100
MMSZ10	A1	10	9.50	10.50	20	0.2	7	9.3	10.6	150
MMSZ11	A2	11	10.45	11.55	20	0.1	8	10.2	11.6	150
MMSZ12	A3	12	11.40	12.60	25	0.1	8	11.2	12.7	150
MMSZ13	A4	13	12.35	13.65	30	0.1	8	12.3	14.0	170
MMSZ15	A5	15	14.25	15.75	30	0.05	10.5	13.7	15.5	200
MMSZ16	X1	16	15.20	16.80	40	0.05	11.2	15.2	17.0	200
MMSZ18	X2	18	17.10	18.90	45	0.05	12.6	16.7	19.0	225
MMSZ20	X3	20	19.00	21.00	55	0.05	14	18.7	21.1	225
MMSZ22	X4	22	20.80	23.10	55	0.05	15.4	20.7	23.2	250
MMSZ24	X5	24	22.80	25.20	70	0.05	16.8	22.7	25.5	250

Type Number	Marking	Zener Voltage V_{Z1} (Volts) @ I_{ZT1} = 2 mA [1][2]			Max Zener Impedance Z_{ZT1} @ I_{ZT1} = 2 mA [3] Ω	Max Reverse Leakage Current		Zener Voltage V_{Z2} (Volts) @ I_{ZT2} = 0.1 mA [1]		Max Zener Impedance Z_{ZT2} @ I_{ZT1} = 0.5 mA [3][4] Ω
		Nom	Min	Max		I_R μA	@ V_R Volts	Min	Max	
MMSZ27	Y1	27	25.65	28.35	80	0.05	18.9	25	28.9	300
MMSZ30	Y2	30	28.50	31.50	80	0.05	21	27.8	32	300
MMSZ33	Y3	33	31.35	34.65	80	0.05	23.1	30.8	35	325
MMSZ36	Y4	36	34.20	37.80	90	0.05	25.2	33.8	38	350
MMSZ39	Y5	39	37.05	40.95	130	0.05	27.3	36.7	41	350
MMSZ43	Z1	43	40.85	45.15	150	0.05	30.1	39.7	46	375
MMSZ47	Z2	47	44.65	49.35	170	0.05	32.9	43.7	50	375
MMSZ51	Z3	51	48.45	53.55	180	0.05	35.7	47.6	54	400
MMSZ56	Z4	56	53.20	58.80	200	0.05	39.2	51.5	60	425
MMSZ62	Z5	62	58.90	65.10	215	0.05	43.4	57.4	66	450
MMSZ68	Z6	68	64.60	71.40	240	0.05	47.6	63.4	72	475
MMSZ75	Z7	75	71.25	78.75	255	0.05	52.5	69.4	79	500

[1] Zener voltage is measured with the zener current applied for PW = 1 0 ms

[2] All part numbers shown indicate a V_Z tolerance of ±5%

[3] Z_{ZT1} and Z_{ZT2} 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

[4] The zener impedance, Z_{ZT2}, for the 27 through 75 volt types is tested at 0 5 mA rather than the test current of 0 1 mA used for V_{Z2}

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.

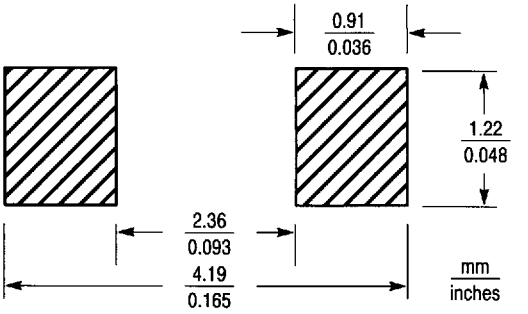


Figure 11. Minimum Recommended Footprint

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.

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

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.

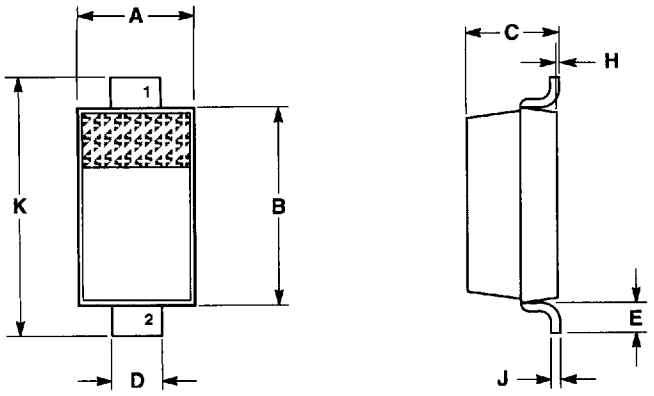
GENERAL SOLDERING PRECAUTIONS

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.

OUTLINE DIMENSIONS



STYLE 1:
PIN 1 CATHODE
2. ANODE

NOTES:
1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2 CONTROLLING DIMENSION: INCH
3 425-01 THRU -03 OBSOLETE, NEW STANDARD 425-04

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.40	1.80	0.055	0.071
B	2.55	2.85	0.100	0.112
C	0.95	1.35	0.037	0.053
D	0.50	0.70	0.020	0.028
E	0.25	—	0.010	—
H	0.00	0.10	0.000	0.004
J	—	0.15	—	0.006
K	3.55	3.85	0.140	0.152

CASE 425-04
(SOD-123)