MOTOROLA SEMICONDUCTOR

5 Watt Surmetic 40 Silicon Zener Diodes

This is a complete series of 5 Watt Zener Diodes with tight limits and better operating characteristics that reflect the superior capabilities of silicon-oxide-passivated junctions. All this is in an axial-lead, transfer-molded plastic package that offers protection in all common environmental conditions.

Specification Features:

- Up to 180 Watt Surge Rating @ 8.3 ms
- Maximum Limits Guaranteed on Seven Electrical Parameters

Mechanical Characteristics:

CASE: Void-free, transfer-molded, thermosetting plastic
FINISH: All external surfaces are corrosion resistant and leads are readily solderable
POLARITY: Cathode indicated by color band. When operated in zener mode, cathode will be positive with respect to anode

MOUNTING POSITION: Any WEIGHT: 0.7 gram (approx) WAFER FAB LOCATION: Phoenix, Arizona ASSEMBLY/TEST LOCATION: Seoul, Korea

1N5333B through 1N5388B





MAXIMUM RATINGS

Rating	Symbol	Value	Unit
DC Power Dissipation @ $T_L = 75^{\circ}C$ Lead Length = $3/8''$	PD	5	Watts
Derate above 75°C		40	mW/°C
Operating and Storage Junction Temperature Range	TJ, T _{stg}	- 65 to +200	°C

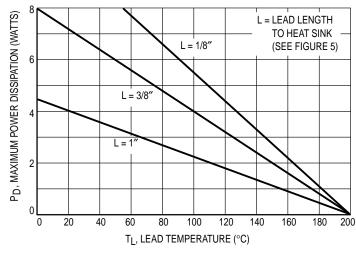


Figure 1. Power Temperature Derating Curve

			$(1A = 25^{\circ}C un)$	less otherwise noted,	vF = 1.2 W	iax ≝ IF =	TA IOI all type	=5)	
	Nominal Zener Voltage	Test	Max Ze	ner Impedance	Max Reverse Leakage Current		Max Surge	Max Voltage	Maximum Regulator Current
JEDEC Type No. (Note 1)	Vz @ IzT Volts (Note 2)	Current IZT mA	Z _{ZT} @I _{ZT} Ohms (Note 2)	Z _{ZK} @ I _{ZK} = 1 mA Ohms (Note 2)	I R (μ Α	⊇ V _R Volts	Current i _r , Amps (Note 3)	Regulation ∆Vz, Volt (Note 4)	IZM mA (Note 5)
1N5333B	3.3	380	3	400	300	1	20	0.85	1440
1N5334B	3.6	350	2.5	500	150	1	18.7	0.8	1320
1N5335B	3.9	320	2	500	50	1	17.6	0.54	1220
1N5336B	4.3	290	2	500	10	1	16.4	0.49	1100
1N5337B	4.7	260	2	450	5	1	15.3	0.44	1010
1N5338B	5.1	240	1.5	400	1	1	14.4	0.39	930
1N5339B	5.6	220	1	400	1	2	13.4	0.25	865
1N5340B	6	200	1	300	1	3	12.7	0.19	790
1N5341B	6.2 6.2	200	1	200	1	3	12.4	0.1	765
1N5342B	6.8	175	1	200	10	5.2	11.5	0.15	700
1N5343B	7.5	175	1.5	200	10	5.7	10.7	0.15	630
1N5344B	8.2	150	1.5	200	10	6.2	10	0.2	580
1N5345B	8.7	150	2	200	10	6.6	9.5	0.2	545
1N5346B 1N5347B	9.1 10	150 125	2 2	150 125	7.5 5	6.9 7.6	9.2 8.6	0.22 0.22	520 475
1N5348B 1N5349B	11 12	125 100	2.5 2.5	125 125	5	8.4 9.1	8	0.25	430 395
1N5350B	12	100	2.5 2.5	125	2 1	9.1 9.9	7.5 7	0.25 0.25	395 365
1N5351B	13	100	2.5	75	1	9.9 10.6	6.7	0.25	340
1N5352B	15	75	2.5	75	1	11.5	6.3	0.25	315
1N5353B	16	75	2.5	75	1	12.2	6	0.3	295
1N5354B	17	70	2.5	75 75	0.5	12.2	5.8	0.35	295
1N5355B	18	65	2.5	75	0.5	13.7	5.5	0.4	265
1N5356B	19	65	3	75	0.5	14.4	5.3	0.4	250
1N5357B	20	65	3	75	0.5	15.2	5.1	0.4	237
1N5358B	22	50	3.5	75	0.5	16.7	4.7	0.45	216
1N5359B	24	50	3.5	100	0.5	18.2	4.4	0.55	198
1N5360B	25	50	4	110	0.5	19	4.3	0.55	190
1N5361B	27	50	5	120	0.5	20.6	4.1	0.6	176
1N5362B	28	50	6	130	0.5	21.2	3.9	0.6	170
1N5363B	30	40	8	140	0.5	22.8	3.7	0.6	158
1N5364B	33	40	10	150	0.5	25.1	3.5	0.6	144
1N5365B	36	30	11	160	0.5	27.4	3.3	0.65	132
1N5366B	39	30	14	170	0.5	29.7	3.1	0.65	122
1N5367B	43	30	20	190	0.5	32.7	2.8	0.7	110
1N5368B	47	25	25	210	0.5	35.8	2.7	0.8	100
1N5369B	51	25	27	230	0.5	38.8	2.5	0.9	93
1N5370B	56	20	35	280	0.5	42.6	2.3	1	86
1N5371B	60	20	40	350	0.5	42.5	2.2	1.2	79
1N5372B	62	20	42	400	0.5	47.1	2.1	1.35	76
1N5373B	68	20	44	500	0.5	51.7	2	1.5	70
1N5374B	75	20	45	620	0.5	56	1.9	1.6	63
1N5375B	82	15	65 75	720	0.5	62.2	1.8	1.8	58 54 5
1N5376B	87 01	15 15	75 75	760 760	0.5	66 60 2	1.7	2 2.2	54.5
1N5377B	91	15	75	760	0.5	69.2	1.6		52.5
1N5378B	100	12	90	800	0.5	76	1.5	2.5	47.5
1N5379B	110	12	125	1000	0.5	83.6	1.4	2.5	43 20 5
1N5380B 1N5381B	120 130	10 10	170 190	1150 1250	0.5	91.2 98.8	1.3	2.5 2.5	39.5 36.6
1N5381B 1N5382B	130	8	230	1250	0.5 0.5	98.8 106	1.2 1.2	2.5 2.5	36.6 34
1110302D	140	U U	230	1500	0.0	100	1.2	2.0	34

ELECTRICAL CHARACTERISTICS ($T_A = 25^{\circ}C$ unless otherwise noted, $V_F = 1.2$ Max @ $I_F = 1$ A for all types)

(continued)

Devices listed in bold, italic are Motorola preferred devices.

	Nominal Zener Voltage	Test	Max Ze	ner Impedance		Reverse Je Current	Max	Max Voltage Regulation ∆Vz, Volt (Note 4)	Maximum Regulator Current
JEDEC Type No. (Note 1)	Voltage Vz @ IzT Volts (Note 2)	Current IZT mA	Z _{ZT} @I _{ZT} Ohms (Note 2)	Z _{ZK} @ I _{ZK} = 1 mA Ohms (Note 2)	Ι μ Α	@ V _R Volts	Surge Current i _r , Amps (Note 3)		IZM MA (Note 5)
1N5383B	150	8	330	1500	0.5	114	1.1	3	31.6
1N5384B	160	8	350	1650	0.5	122	1.1	3	29.4
1N5385B	170	8	380	1750	0.5	129	1	3	28
1N5386B	180	5	430	1750	0.5	137	1	4	26.4
1N5387B	190	5	450	1850	0.5	144	0.9	5	25
1N5388B	200	5	480	1850	0.5	152	0.9	5	23.6

ELECTRICAL CHARACTERISTICS — continued (T_A = 25°C unless otherwise noted, V_F = 1.2 Max @ I_F = 1 A for all types)

NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION

The JEDEC type numbers shown indicate a tolerance of ±5%.

NOTE 2. ZENER VOLTAGE (VZ) AND IMPEDANCE (ZZT & ZZK)

Test conditions for zener voltage and impedance are as follows: I_Z is applied 40 \pm 10 ms prior to reading. Mounting contacts are located 3/8" to 1/2" from the inside edge of mounting clips to the body of the diode. (T_A = $25^{\circ}C$ +8, $-2^{\circ}C$).

NOTE 3. SURGE CURRENT (ir)

Surge current is specified as the maximum allowable peak, non-recurrent square-wave current with a pulse width, PW, of 8.3 ms. The data given in Figure 6 may be used to find the maximum surge current for a square wave of any pulse width between 1ms and 1000 ms by plotting the applicable points on logarithmic paper. Examples of this, using the 3.3 V and 200 V zeners, are shown in Figure 7. Mounting contact located as specified in Note 3. (T_A = 25°C +8, -2°C.)

NOTE 4. VOLTAGE REGULATION (AV7)

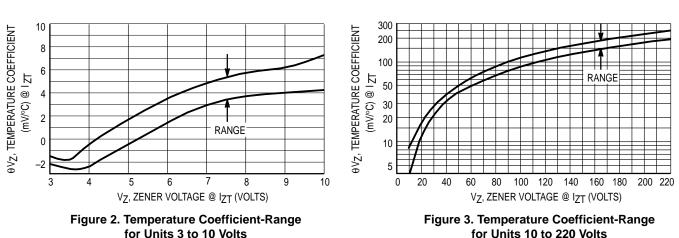
Test conditions for voltage regulation are as follows: V_Z measurements are made at 10% and then at 50% of the I7 max value listed in the electrical characteristics table. The test current time duration for each V_Z measurement is 40 ± 10 ms. (T_A = 25°C + 8, -2°C). Mounting contact located as specified in Note 2.

NOTE 5. MAXIMUM REGULATOR CURRENT (IZM)

The maximum current shown is based on the maximum voltage of a 5% type unit, therefore, it applies only to the B-suffix device. The actual ${\rm I}_{ZM}$ for any device may not exceed the value of 5 watts divided by the actual V_Z of the device. $T_L = 75^{\circ}C$ at 3/8" maximum from the device body.

NOTE 6. SPECIALS AVAILABLE INCLUDE:

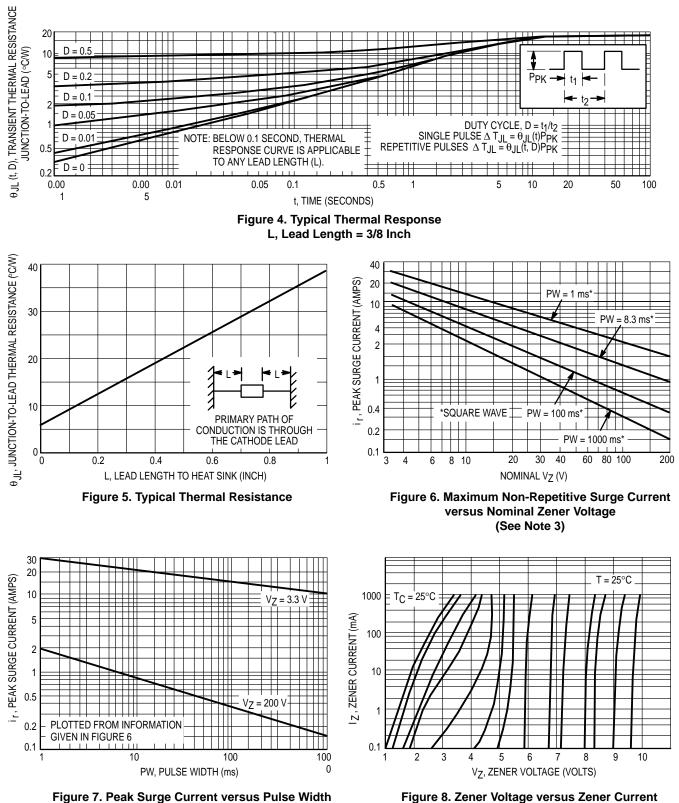
Nominal zener voltages between the voltages shown and tighter voltage tolerance such as ±1% and ±2%. Consult factory.



TEMPERATURE COEFFICIENTS

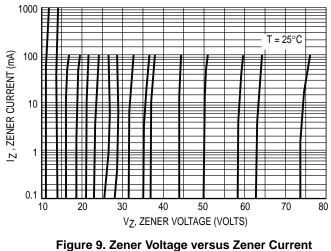
for Units 10 to 220 Volts

Devices listed in bold, italic are Motorola preferred devices.



Vz = 3.3 thru 10 Volts

(See Note 3)



Vz = 11 thru 75 Volts

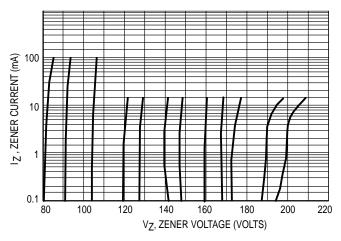


Figure 10. Zener Voltage versus Zener Current Vz = 82 thru 200 Volts

APPLICATION NOTE

Since the actual voltage available from a given zener diode is temperature dependent, it is necessary to determine junction temperature under any set of operating conditions in order to calculate its value. The following procedure is recommended:

Lead Temperature, TL, should be determined from:

$$T_L = \theta_{LA} P_D + T_A$$

 θ_{LA} is the lead-to-ambient thermal resistance and P_D is the power dissipation.

Junction Temperature, TJ, may be found from:

$$\mathsf{T}_{\mathsf{J}} = \mathsf{T}_{\mathsf{L}} + \Delta \mathsf{T}_{\mathsf{J}}\mathsf{L}$$

 ΔT_{JL} is the increase in junction temperature above the lead temperature and may be found from Figure 4 for a train of power pulses or from Figure 5 for dc power.

$$\Delta T_{JL} = \theta_{JL} P_D$$

For worst-case design, using expected limits of I_Z, limits of P_D and the extremes of T_J (Δ T_J) may be estimated. Changes in voltage, V_Z, can then be found from:

$$\Delta V = \theta_{VZ} \Delta T_J$$

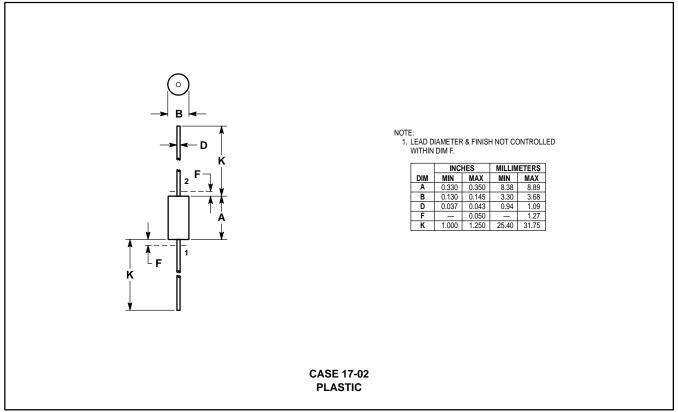
 θ_{VZ} , the zener voltage temperature coefficient, is found from Figures 2 and 3.

Under high power-pulse operation, the zener voltage will vary with time and may also be affected significantly by the zener resistance. For best regulation, keep current excursions as low as possible.

Data of Figure 4 should not be used to compute surge capability. Surge limitations are given in Figure 6. They are lower than would be expected by considering only junction temperature, as current crowding effects cause temperatures to be extremely high in small spots resulting in device degradation should the limits of Figure 6 be exceeded.

Zener Voltage Regulator Diodes — Axial Leaded

5 Watt Surmetic 40



(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

Package Option	Type No. Suffix	MPQ (Units)
Tape and Reel	RL	4K
Tape and Ammo	ТА	2K

(Refer to Section 10 for more information on Packaging Specifications.)

Devices listed in bold, italic are Motorola preferred devices.