GENERAL DATA

500 mW DO-35 GLASS

500 mW DO-35 Glass Zener Voltage Regulator Diodes

GENERAL DATA APPLICABLE TO ALL SERIES IN THIS GROUP

500 Milliwatt Hermetically Sealed Glass Silicon Zener Diodes

GLASS ZENER DIODES
500 MILLIWATTS
1.8–200 VOLTS

CASE 299
DO-204AH
GLASS

Specification Features:

- Complete Voltage Range — 1.8 to 200 Volts
- DO-204AH Package — Smaller than Conventional DO-204AA Package
- Double Slug Type Construction
- Metallurgically Bonded Construction

Mechanical Characteristics:

CASE: Double slug type, hermetically sealed glass
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES: 230°C, 1/16″ from case for 10 seconds
FINISH: All external surfaces are corrosion resistant with readily solderable leads
POLARITY: Cathode indicated by color band. When operated in zener mode, cathode will be positive with respect to anode
MOUNTING POSITION: Any
WAFER FAB LOCATION: Phoenix, Arizona
ASSEMBLY/TEST LOCATION: Seoul, Korea

MAXIMUM RATINGS (Motorola Devices)*

Rating	Symbol	Value	Unit
DC Power Dissipation and $T_L \leq 75°C$ Lead Length = 3/8″ Derate above $T_L = 75°C$	P_D	 500 4	 mW mW/°C
Operating and Storage Temperature Range	T_J, T_{stg}	– 65 to +200	°C

* Some part number series have lower JEDEC registered ratings.

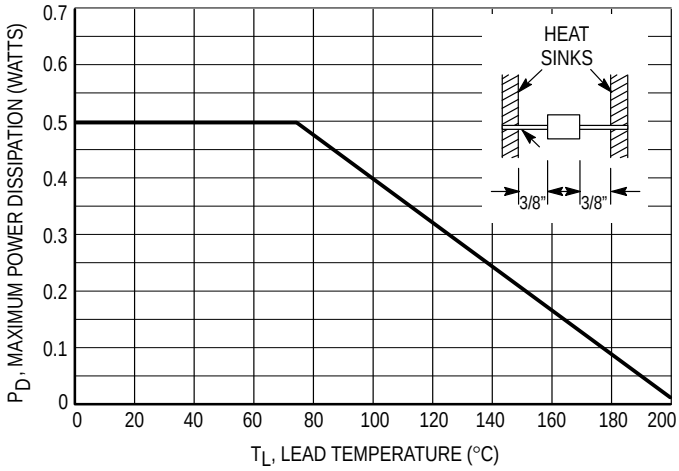


Figure 1. Steady State Power Derating

APPLICATION NOTE — ZENER VOLTAGE

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, T_L, should be determined from:

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

θ_{LA} is the lead-to-ambient thermal resistance (°C/W) and P_D is the power dissipation. The value for θ_{LA} will vary and depends on the device mounting method. θ_{LA} is generally 30 to 40°C/W for the various clips and tie points in common use and for printed circuit board wiring.

The temperature of the lead can also be measured using a thermocouple placed on the lead as close as possible to the tie point. The thermal mass connected to the tie point is normally large enough so that it will not significantly respond to heat surges generated in the diode as a result of pulsed operation once steady-state conditions are achieved. Using the measured value of T_L, the junction temperature may be determined by:

$$T_J = T_L + \Delta T_{JL}.$$

ΔT_{JL} is the increase in junction temperature above the lead temperature and may be found from Figure 2 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 $T_J(\Delta T_J)$ may be estimated. Changes in voltage, V_Z, can then be found from:

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

θ_{VZ}, the zener voltage temperature coefficient, is found from Figures 4 and 5.

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.

Surge limitations are given in Figure 7. 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 7 be exceeded.

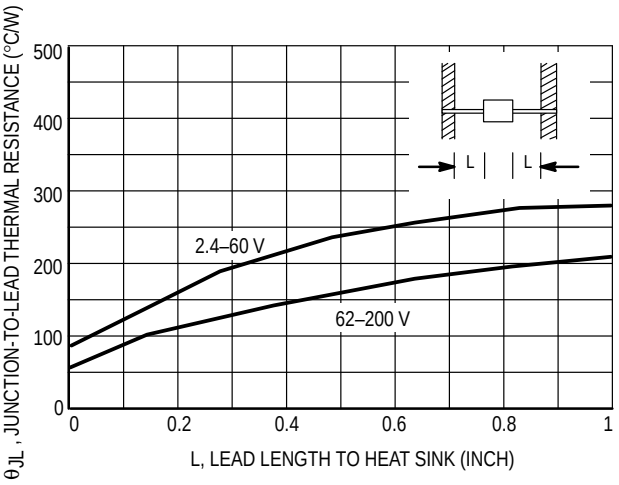


Figure 2. Typical Thermal Resistance

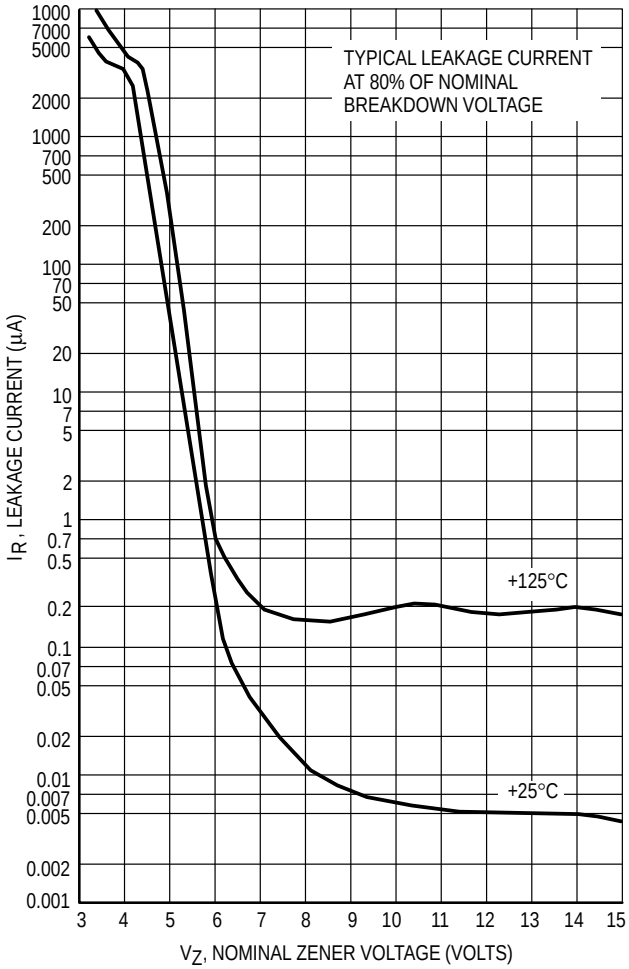


Figure 3. Typical Leakage Current

TEMPERATURE COEFFICIENTS
(–55°C to +150°C temperature range; 90% of the units are in the ranges indicated.)

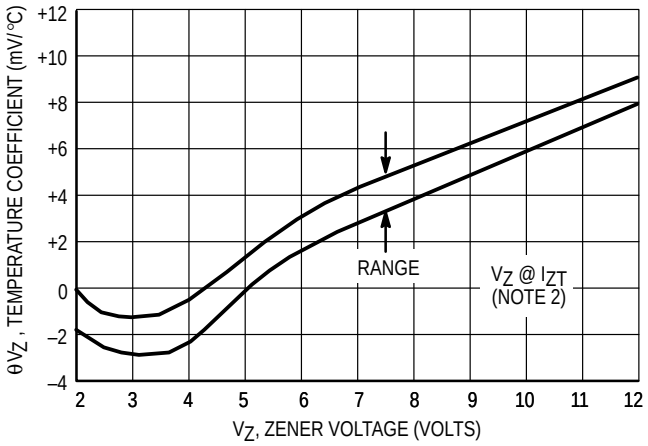


Figure 4a. Range for Units to 12 Volts

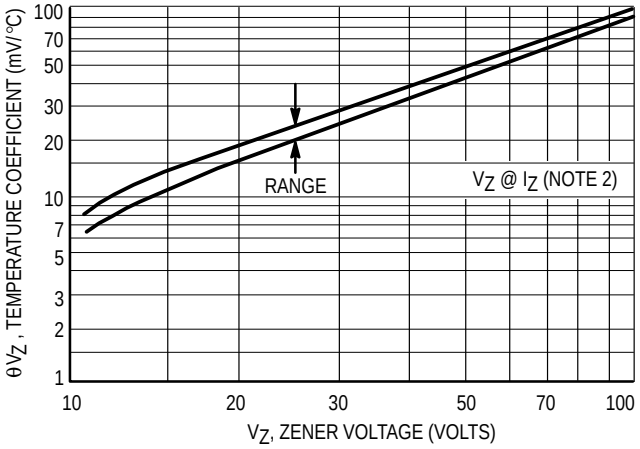


Figure 4b. Range for Units 12 to 100 Volts

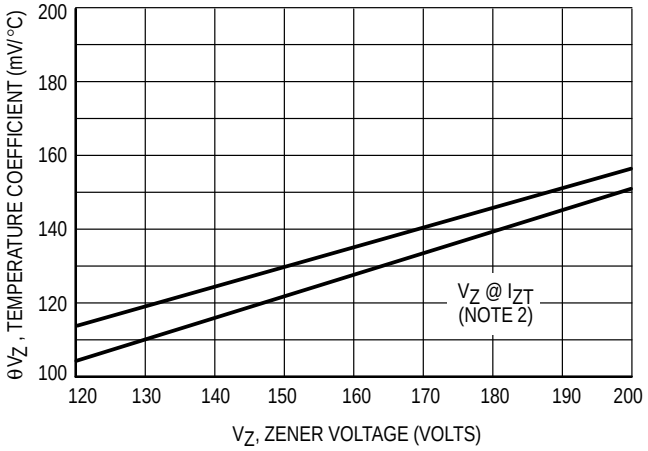


Figure 4c. Range for Units 120 to 200 Volts

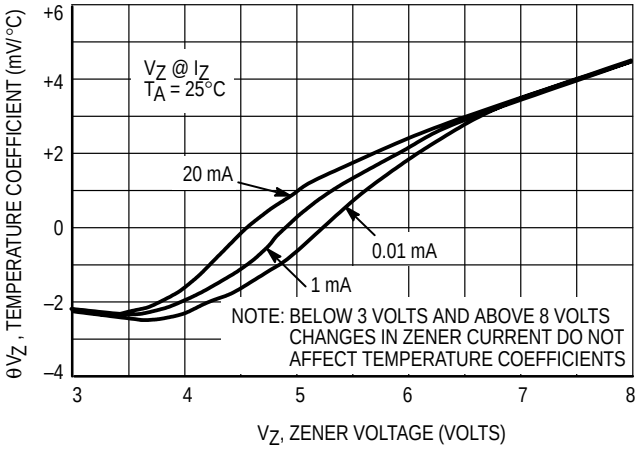


Figure 5. Effect of Zener Current

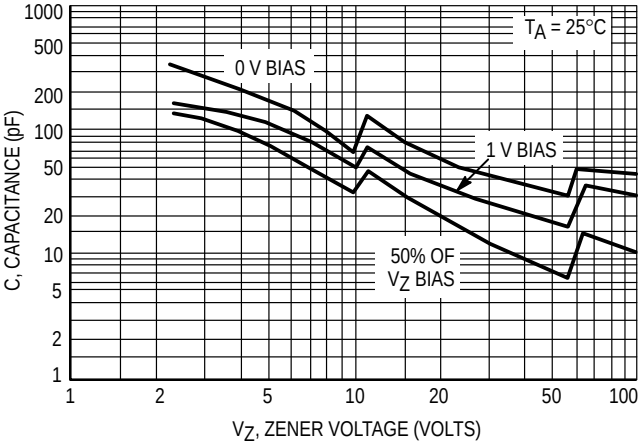


Figure 6a. Typical Capacitance 2.4–100 Volts

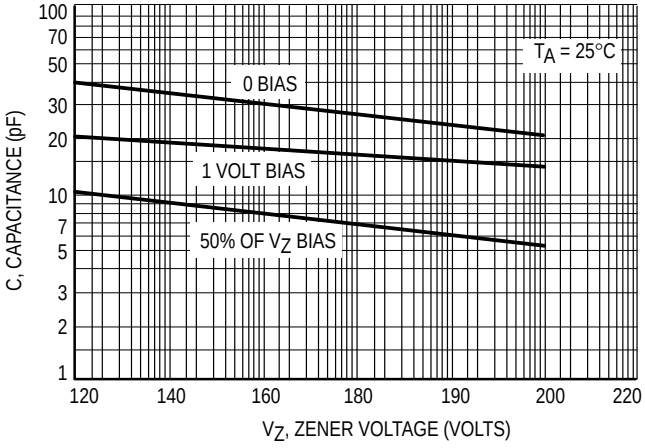


Figure 6b. Typical Capacitance 120–200 Volts

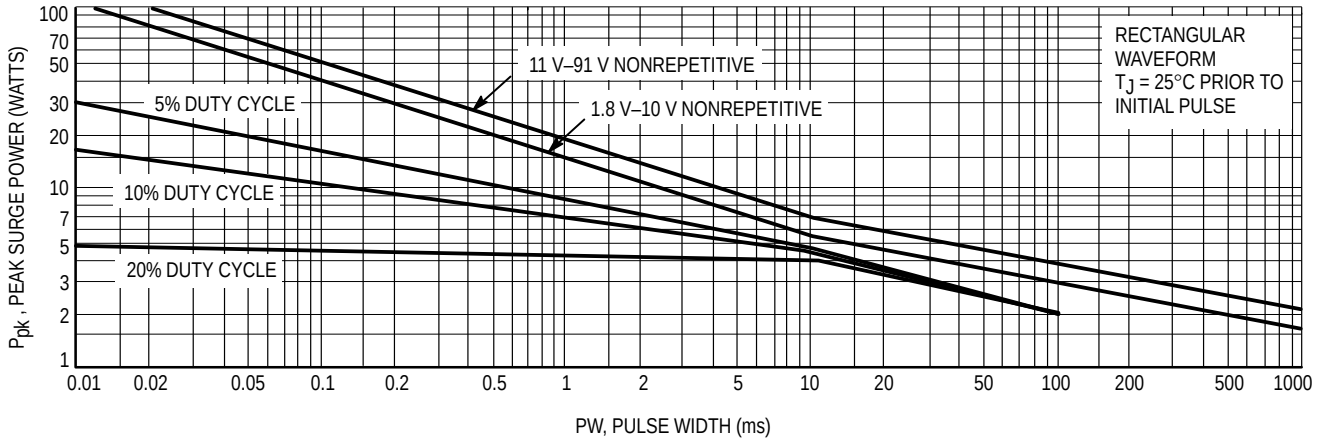


Figure 7a. Maximum Surge Power 1.8–91 Volts

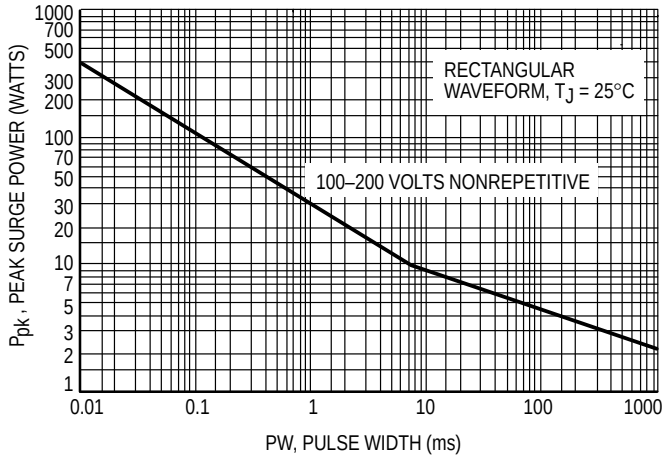


Figure 7b. Maximum Surge Power DO-204AH 100–200 Volts

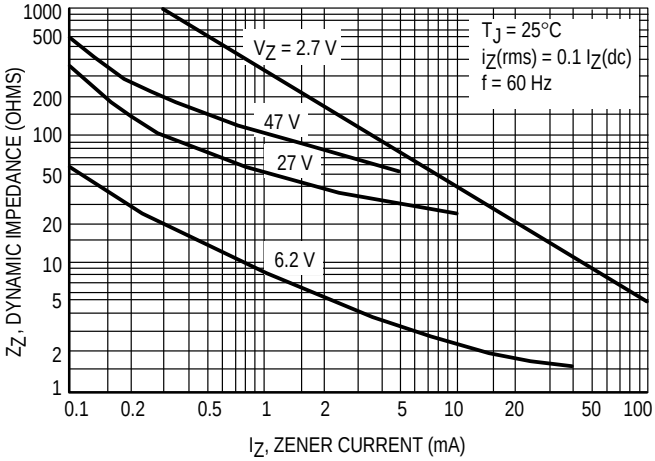


Figure 8. Effect of Zener Current on Zener Impedance

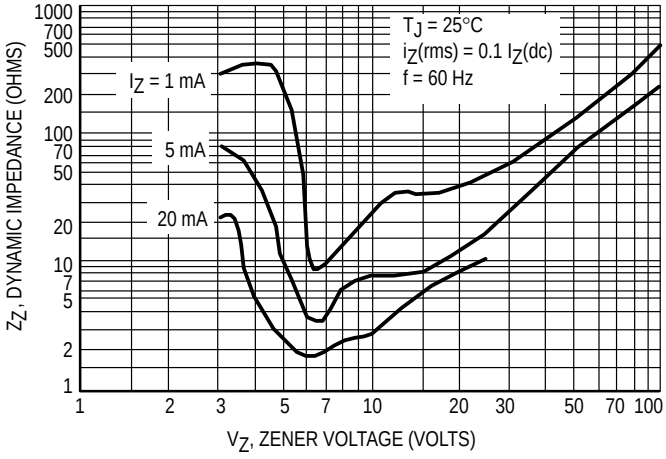


Figure 9. Effect of Zener Voltage on Zener Impedance

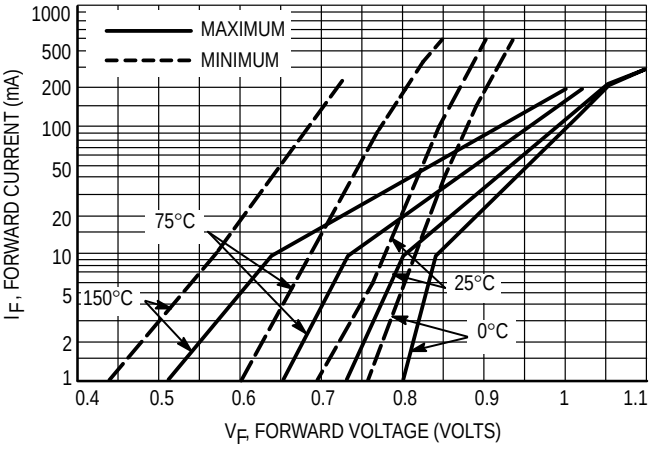


Figure 10. Typical Forward Characteristics

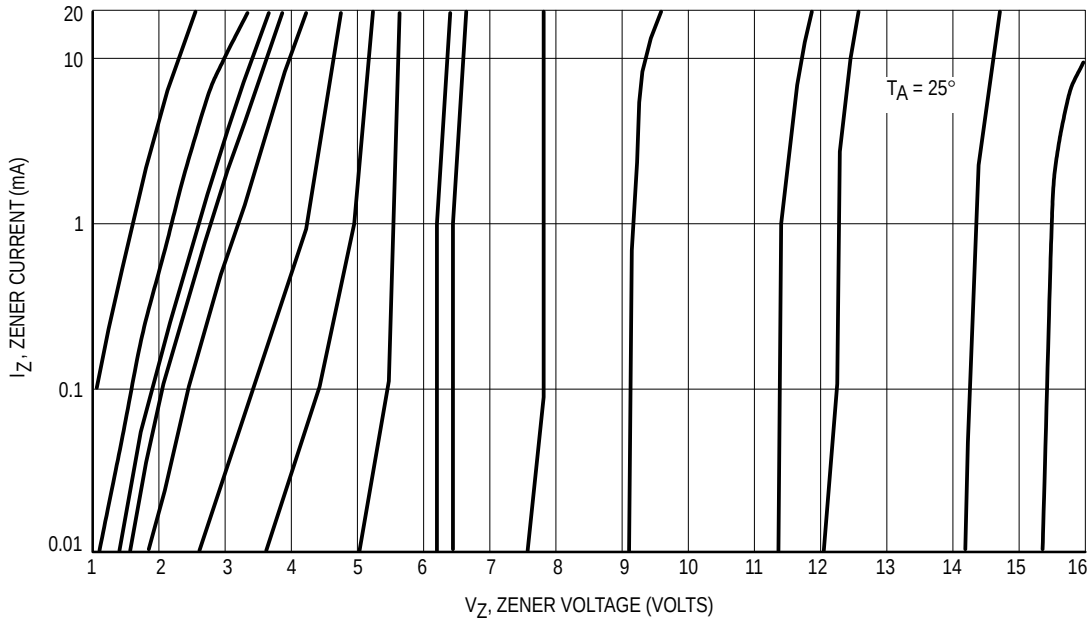


Figure 11. Zener Voltage versus Zener Current — V_Z = 1 thru 16 Volts

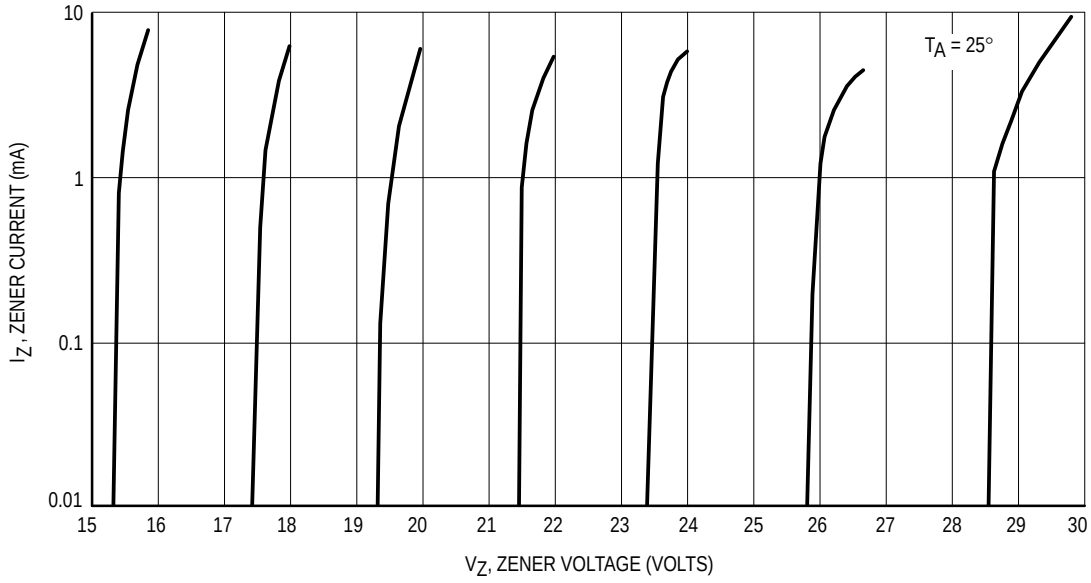


Figure 12. Zener Voltage versus Zener Current — V_Z = 15 thru 30 Volts

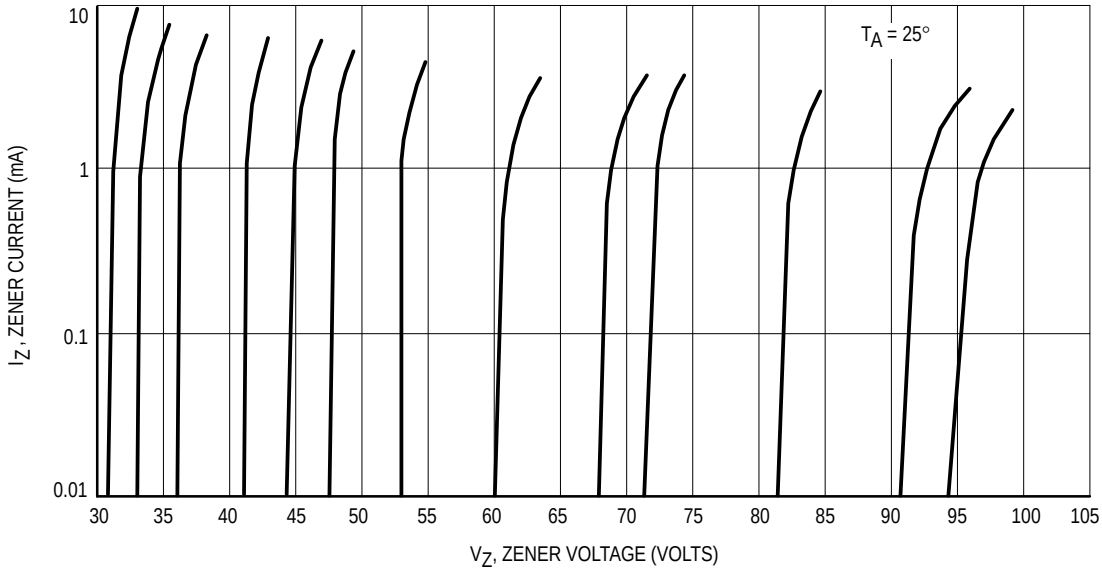


Figure 13. Zener Voltage versus Zener Current — V_Z = 30 thru 105 Volts

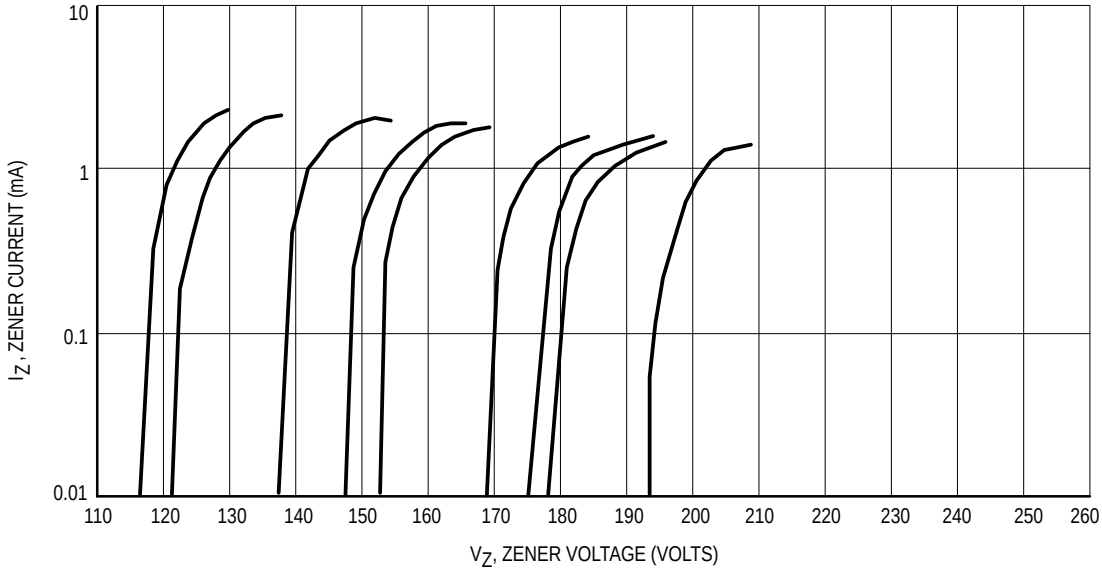


Figure 14. Zener Voltage versus Zener Current — V_Z = 110 thru 220 Volts

GENERAL DATA — 500 mW DO-35 GLASS

ELECTRICAL CHARACTERISTICS (T_A = 25°C, V_F = 1.5 V Max at 200 mA for all types)

Type Number (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} (Note 2) Volts	Test Current I_{ZT} mA	Maximum Zener Impedance Z_{ZT} @ I_{ZT} (Note 3) Ohms	Maximum DC Zener Current I_{ZM} (Note 4) mA	Maximum Reverse Leakage Current	
					T_A = 25°C I_R @ V_R = 1 V μA	T_A = 150°C I_R @ V_R = 1 V μA
1N4370A	2.4	20	30	150	100	200
1N4371A	2.7	20	30	135	75	150
1N4372A	3	20	29	120	50	100
1N746A	***3.3***	***20***	***28***	***110***	***10***	***30***
1N747A	3.6	20	24	100	10	30
1N748A	3.9	20	23	95	10	30
1N749A	4.3	20	22	85	2	30
1N750A	4.7	20	19	75	2	30
1N751A	***5.1***	***20***	***17***	***70***	***1***	***20***
1N752A	***5.6***	***20***	***11***	***65***	***1***	***20***
1N753A	***6.2***	***20***	***7***	***60***	***0.1***	***20***
1N754A	6.8	20	5	55	0.1	20
1N755A	7.5	20	6	50	0.1	20
1N756A	8.2	20	8	45	0.1	20
1N757A	9.1	20	10	40	0.1	20
1N758A	10	20	17	35	0.1	20
1N759A	12	20	30	30	0.1	20

Type Number (Note 1)	Nominal Zener Voltage V_Z (Note 2) Volts	Test Current I_{ZT} mA	Maximum Zener Impedance (Note 3)			Maximum DC Zener Current I_{ZM} (Note 4) mA	Maximum Reverse Current	
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} Ohms	I_{ZK} mA		I_R Maximum μA	Test Voltage Vdc V_R
1N957B	6.8	18.5	4.5	700	1	47	150	5.2
1N958B	7.5	16.5	5.5	700	0.5	42	75	5.7
1N959B	8.2	15	6.5	700	0.5	38	50	6.2
1N960B	9.1	14	7.5	700	0.5	35	25	6.9
1N961B	10	12.5	8.5	700	0.25	32	10	7.6
1N962B	11	11.5	9.5	700	0.25	28	5	8.4
1N963B	12	10.5	11.5	700	0.25	26	5	9.1
1N964B	13	9.5	13	700	0.25	24	5	9.9
1N965B	15	8.5	16	700	0.25	21	5	11.4
1N966B	16	7.8	17	700	0.25	19	5	12.2
1N967B	18	7	21	750	0.25	17	5	13.7
1N968B	20	6.2	25	750	0.25	15	5	15.2
1N969B	22	5.6	29	750	0.25	14	5	16.7
1N970B	24	5.2	33	750	0.25	13	5	18.2
1N971B	27	4.6	41	750	0.25	11	5	20.6
1N972B	30	4.2	49	1000	0.25	10	5	22.8
1N973B	33	3.8	58	1000	0.25	9.2	5	25.1
1N974B	36	3.4	70	1000	0.25	8.5	5	27.4
1N975B	39	3.2	80	1000	0.25	7.8	5	29.7
1N976B	43	3	93	1500	0.25	7	5	32.7
1N977B	47	2.7	105	1500	0.25	6.4	5	35.8
1N978B	51	2.5	125	1500	0.25	5.9	5	38.8
1N979B	56	2.2	150	2000	0.25	5.4	5	42.6
1N980B	62	2	185	2000	0.25	4.9	5	47.1

GENERAL DATA — 500 mW DO-35 GLASS

Type Number (Note 1)	Nominal Zener Voltage V_Z (Note 2) Volts	Test Current I_{ZT} mA	Maximum Zener Impedance (Note 3)			Maximum DC Zener Current I_{ZM} (Note 4) mA	Maximum Reverse Leakage Current	
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} Ohms	I_{ZK} mA		I_R Maximum μA	Test Voltage Vdc V_R
1N981B	68	1.8	230	2000	0.25	4.5	5	51.7
1N982B	75	1.7	270	2000	0.25	4.1	5	56
1N983B	82	1.5	330	3000	0.25	3.7	5	62.2
1N984B	91	1.4	400	3000	0.25	3.3	5	69.2
1N985B	100	1.3	500	3000	0.25	3	5	76
1N986B	110	1.1	750	4000	0.25	2.7	5	83.6
1N987B	120	1	900	4500	0.25	2.5	5	91.2
1N988B	130	0.95	1100	5000	0.25	2.3	5	98.8
1N989B	150	0.85	1500	6000	0.25	2	5	114
1N990B	160	0.8	1700	6500	0.25	1.9	5	121.6
1N991B	180	0.68	2200	7100	0.25	1.7	5	136.8
1N992B	200	0.65	2500	8000	0.25	1.5	5	152

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION

Tolerance Designation

The type numbers shown have tolerance designations as follows:
1N4370A series: ±5% units, C for ±2%, D for ±1%.
1N746A series: ±5% units, C for ±2%, D for ±1%.
1N957B series: ±5% units, C for ±2%, D for ±1%.

NOTE 2. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal zener voltage is measured with the device junction in thermal equilibrium at the lead temperature of 30°C ±1°C and 3/8″ lead length.

NOTE 3. ZENER IMPEDANCE (Z_Z) DERIVATION

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 = 60 Hz.

NOTE 4. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})

Values shown are based on the JEDEC rating of 400 mW. Where the actual zener voltage (V_Z) is known at the operating point, the maximum zener current may be increased and is limited by the derating curve.

GENERAL DATA — 500 mW DO-35 GLASS

Low level oxide passivated zener diodes for applications requiring extremely low operating currents, low leakage, and sharp breakdown voltage.

- Zener Voltage Specified @ I_{ZT} = 50 μA
- Maximum Delta V_Z Given from 10 to 100 μA

ELECTRICAL CHARACTERISTICS (T_A = 25°C, V_F = 1.5 V Max at I_F = 100 mA for all types)

Type Number (Note 1)	Zener Voltage V_Z @ I_{ZT} = 50 μA Volts			Maximum Reverse Current I_R μA (Note 3)	Test Voltage V_R Volts	Maximum Zener Current I_{ZM} mA (Note 2)	Maximum Voltage Change ΔV_Z Volts (Note 4)
	Nom (Note 1)	Min	Max				
1N4678	1.8	1.71	1.89	7.5	1	120	0.7
1N4679	2	1.9	2.1	5	1	110	0.7
1N4680	2.2	2.09	2.31	4	1	100	0.75
1N4681	2.4	2.28	2.52	2	1	95	0.8
1N4682	2.7	2.565	2.835	1	1	90	0.85
1N4683	3	2.85	3.15	0.8	1	85	0.9
1N4684	3.3	3.135	3.465	7.5	1.5	80	0.95
1N4685	3.6	3.42	3.78	7.5	2	75	0.95
1N4686	3.9	3.705	4.095	5	2	70	0.97
1N4687	4.3	4.085	4.515	4	2	65	0.99
1N4688	***4.7***	***4.465***	***4.935***	***10***	***3***	***60***	***0.99***
1N4689	5.1	4.845	5.355	10	3	55	0.97
1N4690	5.6	5.32	5.88	10	4	50	0.96
1N4691	6.2	5.89	6.51	10	5	45	0.95
1N4692	6.8	6.46	7.14	10	5.1	35	0.9
1N4693	7.5	7.125	7.875	10	5.7	31.8	0.75
1N4694	8.2	7.79	8.61	1	6.2	29	0.5
1N4695	8.7	8.265	9.135	1	6.6	27.4	0.1
1N4696	9.1	8.645	9.555	1	6.9	26.2	0.08
1N4697	10	9.5	10.5	1	7.6	24.8	0.1
1N4698	11	10.45	11.55	0.05	8.4	21.6	0.11
1N4699	12	11.4	12.6	0.05	9.1	20.4	0.12
1N4700	13	12.35	13.65	0.05	9.8	19	0.13
1N4701	14	13.3	14.7	0.05	10.6	17.5	0.14
1N4702	15	14.25	15.75	0.05	11.4	16.3	0.15
1N4703	16	15.2	16.8	0.05	12.1	15.4	0.16
1N4704	17	16.15	17.85	0.05	12.9	14.5	0.17
1N4705	18	17.1	18.9	0.05	13.6	13.2	0.18
1N4706	19	18.05	19.95	0.05	14.4	12.5	0.19
1N4707	20	19	21	0.01	15.2	11.9	0.2
1N4708	22	20.9	23.1	0.01	16.7	10.8	0.22
1N4709	24	22.8	25.2	0.01	18.2	9.9	0.24
1N4710	25	23.75	26.25	0.01	19	9.5	0.25
1N4711	27	25.65	28.35	0.01	20.4	8.8	0.27
1N4712	28	26.6	29.4	0.01	21.2	8.5	0.28
1N4713	30	28.5	31.5	0.01	22.8	7.9	0.3
1N4714	33	31.35	34.65	0.01	25	7.2	0.33
1N4715	36	34.2	37.8	0.01	27.3	6.6	0.36
1N4716	39	37.05	40.95	0.01	29.6	6.1	0.39
1N4717	43	40.85	45.15	0.01	32.6	5.5	0.43

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION (V_Z)

The type numbers shown have a standard tolerance of ±5% on the nominal Zener voltage, C for ±2%, D for ±1%.

NOTE 2. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})

Maximum Zener current ratings are based on maximum Zener voltage of the individual units and JEDEC 250 mW rating.

NOTE 3. REVERSE LEAKAGE CURRENT (I_R)

Reverse leakage currents are guaranteed and measured at V_R as shown on the table.

NOTE 4. MAXIMUM VOLTAGE CHANGE (ΔV_Z)

Voltage change is equal to the difference between V_Z at 100 μA and V_Z at 10 μA.

NOTE 5. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal Zener voltage is measured with the device junction in thermal equilibrium at the lead temperature at 30°C ±1°C and 3/8″ lead length.

GENERAL DATA — 500 mW DO-35 GLASS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted. Based on dc measurements at thermal equilibrium; lead length = 3/8″; thermal resistance of heat sink = 30°C/W) V_F = 1.1 Max @ I_F = 200 mA for all types.

JEDEC Type No. (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Note 3)	Test Current I_{ZT} mA	Max Zener Impedance (Note 4)		Max Reverse Leakage Current		Max Zener Voltage Temperature Coeff. θ_{VZ} (%/°C) (Note 2)
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} = 0.25 mA Ohms	I_R μA	V_R Volts	
1N5221B	2.4	20	30	1200	100	1	–0.085
1N5222B	2.5	20	30	1250	100	1	–0.085
1N5223B	2.7	20	30	1300	75	1	–0.08
1N5224B	2.8	20	30	1400	75	1	–0.08
1N5225B	3	20	29	1600	50	1	–0.075
1N5226B	***3.3***	***20***	***28***	***1600***	***25***	***1***	***–0.07***
1N5227B	3.6	20	24	1700	15	1	–0.065
1N5228B	***3.9***	***20***	***23***	***1900***	***10***	***1***	***–0.06***
1N5229B	4.3	20	22	2000	5	1	±0.055
1N5230B	4.7	20	19	1900	5	2	±0.03
1N5231B	***5.1***	***20***	***17***	***1600***	***5***	***2***	***±0.03***
1N5232B	***5.6***	***20***	***11***	***1600***	***5***	***3***	***+0.038***
1N5233B	6	20	7	1600	5	3.5	+0.038
1N5234B	***6.2***	***20***	***7***	***1000***	***5***	***4***	***+0.045***
1N5235B	***6.8***	***20***	***5***	***750***	***3***	***5***	***+0.05***
1N5236B	7.5	20	6	500	3	6	+0.058
1N5237B	***8.2***	***20***	***8***	***500***	***3***	***6.5***	***+0.062***
1N5238B	8.7	20	8	600	3	6.5	+0.065
1N5239B	9.1	20	10	600	3	7	+0.068
1N5240B	***10***	***20***	***17***	***600***	***3***	***8***	***+0.075***
1N5241B	11	20	22	600	2	8.4	+0.076
1N5242B	***12***	***20***	***30***	***600***	***1***	***9.1***	***+0.077***
1N5243B	13	9.5	13	600	0.5	9.9	+0.079
1N5244B	14	9	15	600	0.1	10	+0.082
1N5245B	***15***	***8.5***	***16***	***600***	***0.1***	***11***	***+0.082***
1N5246B	***16***	***7.8***	***17***	***600***	***0.1***	***12***	***+0.083***
1N5247B	17	7.4	19	600	0.1	13	+0.084
1N5248B	18	7	21	600	0.1	14	+0.085
1N5249B	19	6.6	23	600	0.1	14	+0.086
1N5250B	***20***	***6.2***	***25***	***600***	***0.1***	***15***	***+0.086***
1N5251B	22	5.6	29	600	0.1	17	+0.087
1N5252B	24	5.2	33	600	0.1	18	+0.088
1N5253B	25	5	35	600	0.1	19	+0.089
1N5254B	27	4.6	41	600	0.1	21	+0.09
1N5255B	28	4.5	44	600	0.1	21	+0.091
1N5256B	30	4.2	49	600	0.1	23	+0.091
1N5257B	33	3.8	58	700	0.1	25	+0.092
1N5258B	36	3.4	70	700	0.1	27	+0.093
1N5259B	39	3.2	80	800	0.1	30	+0.094
1N5260B	43	3	93	900	0.1	33	+0.095
1N5261B	47	2.7	105	1000	0.1	36	+0.095
1N5262B	51	2.5	125	1100	0.1	39	+0.096
1N5263B	56	2.2	150	1300	0.1	43	+0.096
1N5264B	60	2.1	170	1400	0.1	46	+0.097
1N5265B	62	2	185	1400	0.1	47	+0.097

(continued)

ELECTRICAL CHARACTERISTICS — continued (T_A = 25°C unless otherwise noted. Based on dc measurements at thermal equilibrium; lead length = 3/8″; thermal resistance of heat sink = 30°C/W) V_F = 1.1 Max @ I_F = 200 mA for all types.

JEDEC Type No. (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Note 3)	Test Current I_{ZT} mA	Max Zener Impedance (Note 4)		Max Reverse Leakage Current		Max Zener Voltage Temperature Coeff. θ_{VZ} (%/°C) (Note 2)
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} = 0.25 mA Ohms	I_R μA	V_R Volts	
1N5266B	68	1.8	230	1600	0.1	52	+0.097
1N5267B	75	1.7	270	1700	0.1	56	+0.098
1N5268B	82	1.5	330	2000	0.1	62	+0.098
1N5269B	87	1.4	370	2200	0.1	68	+0.099
1N5270B	91	1.4	400	2300	0.1	69	+0.099
1N5271B	100	1.3	500	2600	0.1	76	+0.11
1N5272B	110	1.1	750	3000	0.1	84	+0.11
1N5273B	120	1	900	4000	0.1	91	+0.11
1N5274B	130	0.95	1100	4500	0.1	99	+0.11
1N5275B	140	0.9	1300	4500	0.1	106	+0.11
1N5276B	150	0.85	1500	5000	0.1	114	+0.11
1N5277B	160	0.8	1700	5500	0.1	122	+0.11
1N5278B	170	0.74	1900	5500	0.1	129	+0.11
1N5279B	180	0.68	2200	6000	0.1	137	+0.11
1N5280B	190	0.66	2400	6500	0.1	144	+0.11
1N5281B	200	0.65	2500	7000	0.1	152	+0.11

NOTE 1. TOLERANCE

The JEDEC type numbers shown indicate a tolerance of ±5%. For tighter tolerance devices use suffixes “C” for ±2% and “D” for ±1%.

NOTE 2. TEMPERATURE COEFFICIENT (θ_{VZ}) †

Test conditions for temperature coefficient are as follows:

a. I_{ZT} = 7.5 mA, T_1 = 25°C,
T_2 = 125°C (1N5221B through 1N5242B).

b. I_{ZT} = Rated I_{ZT}, T_1 = 25°C,
T_2 = 125°C (1N5243B through 1N5281B).

Device to be temperature stabilized with current applied prior to reading breakdown voltage at the specified ambient temperature.

NOTE 3. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal zener voltage is measured with the device junction in thermal equilibrium at the lead temperature of 30°C ±1°C and 3/8″ lead length.

NOTE 4. ZENER IMPEDANCE (Z_Z) DERIVATION

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 = 60 Hz.

† For more information on special selections contact your nearest Motorola representative.

GENERAL DATA — 500 mW DO-35 GLASS

***ELECTRICAL CHARACTERISTICS** (T_L = 30°C unless otherwise noted.) (V_F = 1.5 Volts Max @ I_F = 100 mAdc for all types.)

Motorola Type Number (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Note 4)	Test Current I_{ZT} mA	Max Zener Impedance (Note 3)		Max Reverse Leakage Current		Max DC Zener Current I_{ZM} (Note 2)
			Z_{ZT} @ I_{ZT} Ohms	Z_{ZK} @ I_{ZK} = Ohms 0.25 mA	I_R μA	@ V_R Volts	
1N5985B	2.4	5	100	1800	100	1	208
1N5986B	2.7	5	100	1900	75	1	185
1N5987B	3	5	95	2000	50	1	167
1N5988B	3.3	5	95	2200	25	1	152
1N5989B	3.6	5	90	2300	15	1	139
1N5990B	3.9	5	90	2400	10	1	128
1N5991B	4.3	5	88	2500	5	1	116
1N5992B	4.7	5	70	2200	3	1.5	106
1N5993B	***5.1***	***5***	***50***	***2050***	***2***	***2***	***98***
1N5994B	***5.6***	***5***	***25***	***1800***	***2***	***3***	***89***
1N5995B	6.2	5	10	1300	1	4	81
1N5996B	6.8	5	8	750	1	5.2	74
1N5997B	7.5	5	7	600	0.5	6	67
1N5998B	***8.2***	***5***	***7***	***600***	***0.5***	***6.5***	***61***
1N5999B	9.1	5	10	600	0.1	7	55
1N6000B	10	5	15	600	0.1	8	50
1N6001B	11	5	18	600	0.1	8.4	45
1N6002B	12	5	22	600	0.1	9.1	42
1N6003B	13	5	25	600	0.1	9.9	38
1N6004B	15	5	32	600	0.1	11	33
1N6005B	16	5	36	600	0.1	12	31
1N6006B	18	5	42	600	0.1	14	28
1N6007B	20	5	48	600	0.1	15	25
1N6008B	22	5	55	600	0.1	17	23
1N6009B	24	5	62	600	0.1	18	21
1N6010B	27	5	70	600	0.1	21	19
1N6011B	30	5	78	600	0.1	23	17
1N6012B	33	5	88	700	0.1	25	15
1N6013B	36	5	95	700	0.1	27	14
1N6014B	39	2	130	800	0.1	30	13
1N6015B	43	2	150	900	0.1	33	12
1N6016B	47	2	170	1000	0.1	36	11
1N6017B	51	2	180	1300	0.1	39	9.8
1N6018B	56	2	200	1400	0.1	43	8.9
1N6019B	62	2	225	1400	0.1	47	8
1N6020B	68	2	240	1600	0.1	52	7.4
1N6021B	75	2	265	1700	0.1	56	6.7
1N6022B	82	2	280	2000	0.1	62	6.1
1N6023B	91	2	300	2300	0.1	69	5.5
1N6024B	100	1	500	2600	0.1	76	5
1N6025B	110	1	650	3000	0.1	84	4.5

*Indicates JEDEC Registered Data

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION

Tolerance designation — Device tolerances of ±5% are indicated by a “B” suffix, ±2% by a “C” suffix, ±1% by a “D” suffix.

NOTE 2.

This data was calculated using nominal voltages. The maximum current handling capability on a worst case basis is limited by the actual zener voltage at the operating point and the power derating curve.

NOTE 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 = 1.0 kHz.

NOTE 4.

Nominal Zener Voltage (V_Z) is measured with the device junction in thermal equilibrium at the lead temperature of 30°C ±1°C and 3/8″ lead length.

GENERAL DATA — 500 mW DO-35 GLASS

ELECTRICAL CHARACTERISTICS (T_L = 30°C unless otherwise noted.) (V_F = 1.3 Volts Max, I_F = 100 mAdc for all types.)

Motorola Type Number	V_{ZT} at I_{ZT} (V) Min (Note 1)	V_{ZT} at I_{ZT} (V) Max (Note 1)	Max Zener Impedance (Note 3) Z_{ZT} @ I_{ZT} (Ohms) Max	I_{ZT} (mA)	Max Reverse Leakage Current I_R at V_R (μA) T_{amb} 25°C Max	Max Reverse Leakage Current I_R at V_R (μA) T_{amb} 125°C Max	V_R (V)	I_{ZM} (mA) (Note 2)
BZX55C2V4RL	2.28	2.56	85	5	50	100	1	155
BZX55C2V7RL	2.5	2.9	85	5	10	50	1	135
BZX55C3V0RL	2.8	3.2	85	5	4	40	1	125
BZX55C3V3RL	3.1	3.5	85	5	2	40	1	115
BZX55C3V6RL	3.4	3.8	85	5	2	40	1	105
BZX55C3V9RL	3.7	4.1	85	5	2	40	1	95
BZX55C4V3RL	4	4.6	75	5	1	20	1	90
BZX55C4V7RL	4.4	5	60	5	0.5	10	1	85
BZX55C5V1RL	4.8	5.4	35	5	0.1	2	1	80
BZX55C5V6RL	5.2	6	25	5	0.1	2	1	70
BZX55C6V2RL	5.8	6.6	10	5	0.1	2	2	64
BZX55C6V8RL	6.4	7.2	8	5	0.1	2	3	58
BZX55C7V5RL	7	7.9	7	5	0.1	2	5	53
BZX55C8V2RL	7.7	8.7	7	5	0.1	2	6	47
BZX55C9V1RL	8.5	9.6	10	5	0.1	2	7	43
BZX55C10RL	9.4	10.6	15	5	0.1	2	7.5	40
BZX55C11RL	10.4	11.6	20	5	0.1	2	8.5	36
BZX55C12RL	11.4	12.7	20	5	0.1	2	9	32
BZX55C13RL	12.4	14.1	26	5	0.1	2	10	29
BZX55C15RL	13.8	15.6	30	5	0.1	2	11	27
BZX55C16RL	15.3	17.1	40	5	0.1	2	12	24
BZX55C18RL	16.8	19.1	50	5	0.1	2	14	21
BZX55C20RL	18.8	21.1	55	5	0.1	2	15	20
BZX55C22RL	20.8	23.3	55	5	0.1	2	17	18
BZX55C24RL	22.8	25.6	80	5	0.1	2	18	16
BZX55C27RL	25.1	28.9	80	5	0.1	2	20	14
BZX55C30RL	28	32	80	5	0.1	2	22	13
BZX55C33RL	31	35	80	5	0.1	2	24	12
BZX55C36RL	34	38	80	5	0.1	2	27	11
BZX55C39RL	37	41	90	2.5	0.1	5	28	10
BZX55C43RL	40	46	90	2.5	0.1	5	32	9.2
BZX55C47RL	44	50	110	2.5	0.1	5	35	8.5
BZX55C51RL	48	54	125	2.5	0.1	10	38	7.8
BZX55C56RL	52	60	135	2.5	0.1	10	42	7
BZX55C62RL	58	66	150	2.5	0.1	10	47	6.4
BZX55C68RL	64	72	160	2.5	0.1	10	51	5.9
BZX55C75RL	70	80	170	2.5	0.1	10	56	5.3
BZX55C82RL	77	87	200	2.5	0.1	10	62	4.8
BZX55C91RL	85	96	250	1	0.1	10	69	4.3

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION

Tolerance designation — The type numbers listed have zener voltage min/max limits as shown. Device tolerance of ±2% are indicated by a "B" instead of a "C". Zener voltage is measured with the device junction in thermal equilibrium at the lead temperature of 30°C ±1°C and 3/8″ lead length.

NOTE 2.

This data was calculated using nominal voltages. The maximum current handling capability on a worst case basis is limited by the actual zener voltage at the operating point and the power derating curve.

NOTE 3.

Z_{ZT} and Z_{ZK} are measured by dividing the ac voltage drop across the device by the ac current applied. The specified limtis are for I_Z(ac) = 0.1 I_Z(dc) with the ac frequency = 1.0 kHz.

GENERAL DATA — 500 mW DO-35 GLASS

***ELECTRICAL CHARACTERISTICS** (T_L = 30°C unless otherwise noted.) (V_F = 1.5 Volts Max @ I_F = 100 mAdc for all types.)

Device Type (Note 2)	Zener Voltage (Note 1) (Note 4)			Impedance (Ohm) @ I_{ZT} f = 1000 Hz	Leakage Current (μA)		Temp. Coefficient (Typical) (mV/°C)		Capacitance (Typical) (pF)
	Min	Max	I_{ZT} = (mA)	Max (Note 3)	Max	@ V_R = (Volt)	Min	Max	V_R = 0, f = 1.0 MHz
BZX79C2V4RL	2.2	2.6	5	100	100	1	–3.5	0	255
BZX79C2V7RL	2.5	2.9	5	100	75	1	–3.5	0	230
BZX79C3V0RL	2.8	3.2	5	95	50	1	–3.5	0	215
BZX79C3V3RL	3.1	3.5	5	95	25	1	–3.5	0	200
BZX79C3V6RL	3.4	3.8	5	90	15	1	–3.5	0	185
BZX79C3V9RL	3.7	4.1	5	90	10	1	–3.5	+0.3	175
BZX79C4V3RL	4	4.6	5	90	5	1	–3.5	+1	160
BZX79C4V7RL	4.4	5	5	80	3	2	–3.5	+0.2	130
BZX79C5V1RL	4.8	5.4	5	60	2	2	–2.7	+1.2	110
BZX79C5V6RL	5.2	6	5	40	1	2	–2	+2.5	95
BZX79C6V2RL	5.8	6.6	5	10	3	4	0.4	3.7	90
BZX79C6V8RL	6.4	7.2	5	15	2	4	1.2	4.5	85
BZX79C7V5RL	7	7.9	5	15	1	5	2.5	5.3	80
BZX79C8V2RL	7.7	8.7	5	15	0.7	5	3.2	6.2	75
BZX79C9V1RL	8.5	9.6	5	15	0.5	6	3.8	7	70
BZX79C10RL	9.4	10.6	5	20	0.2	7	4.5	8	70
BZX79C11RL	10.4	11.6	5	20	0.1	8	5.4	9	65
BZX79C12RL	11.4	12.7	5	25	0.1	8	6	10	65
BZX79C13RL	12.4	14.1	5	30	0.1	8	7	11	60
BZX79C15RL	13.8	15.6	5	30	0.05	10.5	9.2	13	55
BZX79C16RL	15.3	17.1	5	40	0.05	11.2	10.4	14	52
BZX79C18RL	16.8	19.1	5	45	0.05	12.6	12.9	16	47
BZX79C20RL	18.8	21.2	5	55	0.05	14	14.4	18	36
BZX79C22RL	20.8	23.3	5	55	0.05	15.4	16.4	20	34
BZX79C24RL	22.8	25.6	5	70	0.05	16.8	18.4	22	33
BZX79C27RL	25.1	28.9	2	80	0.05	18.9		23.5	30
BZX79C30RL	28	32	2	80	0.05	21		26	27
BZX79C33RL	31	35	2	80	0.05	23.1		29	25
BZX79C36RL	34	38	2	90	0.05	25.2		31	23
BZX79C39RL	37	41	2	130	0.05	27.3		34	21
BZX79C43RL	40	46	2	150	0.05	30.1		37	21
BZX79C47RL	44	50	2	170	0.05	32.9		40	19
BZX79C51RL	48	54	2	180	0.05	35.7		44	19
BZX79C56RL	52	60	2	200	0.05	39.2		47	18
BZX79C62RL	58	66	2	215	0.05	43.4		51	17
BZX79C68RL	64	72	2	240	0.05	47.6		56	17
BZX79C75RL	70	79	2	255	0.05	52.5		60	16.5
BZX79C82RL	77	87	2	280	0.1	62	46	95	29
BZX79C91RL	85	96	2	300	0.1	69	51	107	28
BZX79C100RL	94	106	1	500	0.1	76	57	119	27
BZX79C110RL	104	116	1	650	0.1	84	63	131	26
BZX79C120RL	114	127	1	800	0.1	91	69	144	24
BZX79C130RL	124	141	1	950	0.1	99	75	158	23
BZX79C150RL	138	156	1	1250	0.1	114	87	185	21
BZX79C160RL	153	171	1	1400	0.1	122	93	200	20
BZX79C180RL	168	191	1	1700	0.1	137	105	228	18
BZX79C200RL	188	212	1	2000	0.1	152	120	255	17

NOTE 1. Zener voltage is measured under pulse conditions such that T_J is no more than 2°C above T_A.

NOTE 2. TOLERANCE AND VOLTAGE DESIGNATION

Tolerance designation — The type numbers listed have zener voltage min/max limits as shown. Device tolerances of ±2% are indicated by a "B" instead of a "C," and ±1% by "A."

NOTE 3. Z_{ZT} is 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 = 1.0 kHz.

ELECTRICAL CHARACTERISTICS (at T_A = 25°C)

Motorola ZPD and BZX83C series. Forward Voltage V_F = 1 Volt Max at I_F = 50 mA.

Device Type		Zener Voltage (Note 1) at I_{ZT} = 5.0 mA			Impedance (Ω) Max (Note 2)			Typ. Temp. Coeff. at I_{ZT} % per °C	V_R Min V		
						at I_Z = 1 mA					
		Nominal	Min	Max	at I_{ZT}	BZX83	ZPD		BZX83	ZPD	at I_R
BZX83C2V7RL	ZPD2.7RL	2.7	2.5	2.9	85	600	500	–0.09...–0.04	1	—	100 A
BZX83C3V0RL	ZPD3.0RL	3	2.8	3.2	90	600	500	–0.09...–0.03	1	—	60 A
BZX83C3V3RL	ZPD3.3RL	3.3	3.1	3.5	90	600	500	–0.08...–0.03	1	—	30 A
BZX83C3V6RL	ZPD3.6RL	3.6	3.4	3.8	90	600	500	–0.08...–0.03	1	—	20 A
BZX83C3V9RL	ZPD3.9RL	3.9	3.7	4.1	85	600	500	–0.07...–0.03	1	—	10 A
BZX83C4V3RL	ZPD4.3RL	4.3	4	4.6	80	600	500	–0.06...–0.01	1	—	5 A
BZX83C4V7RL	ZPD4.7RL	4.7	4.4	5	78	600	500	–0.05...+0.02	1	—	2 A
BZX83C5V1RL	ZPD5.1RL	5.1	4.8	5.4	60	550	480	–0.03...+0.04	0.8		100 nA
BZX83C5V6RL	ZPD5.6RL	5.6	5.2	6	40	450	400	–0.02...+0.06	1		100 nA
BZX83C6V2RL	ZPD6.2RL	6.2	5.8	6.6	10	200		–0.01...+0.07	2		100 nA
BZX83C6V8RL	ZPD6.8RL	6.8	6.4	7.2	8	150		+0.02...+0.07	3		100 nA
BZX83C7V5RL	ZPD7.5RL	7.5	7	7.9	7	50		+0.03...+0.07	5		100 nA
BZX83C8V2RL	ZPD8.2RL	8.2	7.7	8.7	7	50		+0.04...+0.07	6		100 nA
BZX83C9V1RL	ZPD9.1RL	9.1	8.5	9.6	10	50		+0.05...+0.08	7		100 nA
BZX83C10RL	ZPD10RL	10	9.4	10.6	15	70		+0.05...+0.08	7.5		100 nA
BZX83C11RL	ZPD11RL	11	10.4	11.6	20	70		+0.05...+0.09	8.5		100 nA
BZX83C12RL	ZPD12RL	12	11.4	12.7	20	90		+0.06...+0.09	9		100 nA
BZX83C13RL	ZPD13RL	13	12.4	14.1	25	110		+0.07...+0.09	10		100 nA
BZX83C15RL	ZPD15RL	15	13.8	15.6	30	110		+0.07...+0.09	11		100 nA
BZX83C16RL	ZPD16RL	16	15.3	17.1	40	170		+0.08...+0.095	12		100 nA
BZX83C18RL	ZPD18RL	18	16.8	19.1	50	170		+0.08...+0.10	14		100 nA
BZX83C20RL	ZPD20RL	20	18.8	21.2	55	220		+0.08...+0.10	15		100 nA
BZX83C22RL	ZPD22RL	22	20.8	23.3	55	220		+0.08...+0.10	17		100 nA
BZX83C24RL	ZPD24RL	24	22.8	25.6	80	220		+0.08...+0.10	18		100 nA
BZX83C27RL	ZPD27RL	27	25.1	28.9	80	250		+0.08...+0.10	20		100 nA
BZX83C30RL	ZPD30RL	30	28	32	80	250		+0.08...+0.10	22		100 nA
BZX83C33RL	ZPD33RL	33	31	35	80	250		+0.08...+0.10	24		100 nA

NOTE 1. Pulse test.

NOTE 2. f = 1.0 kHz, I_Z(ac) = 0.1 I_Z(dc).

GENERAL DATA — 500 mW DO-35 GLASS

Designed for 250 mW applications requiring low leakage, low impedance. Same as 1N4099 through 1N4104 and 1N4614 through 1N4627 except low noise test omitted.

- Voltage Range from 1.8 to 10 Volts
- Zener Impedance and Zener Voltage Specified for Low-Level Operation at I_{ZT} = 250 μA

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified. I_{ZT} = 250 μA and V_F = 1 V Max @ I_F = 200 mA for all types)

Type Number (Note 1)	Nominal Zener Voltage V_Z (Note 2) (Volts)	Max Zener Impedance Z_{ZT} (Note 3) (Ohms)	Max Reverse Current I_R (μA)	@ (Note 5)	Test Voltage V_R (Volts)	Max Zener Current I_{ZM} (Note 4) (mA)
MZ4614	1.8	1200	7.5		1	120
MZ4615	2	1250	5		1	110
MZ4616	2.2	1300	4		1	100
MZ4617	2.4	1400	2		1	95
MZ4618	2.7	1500	1		1	90
MZ4619	3	1600	0.8		1	85
MZ4620	3.3	1650	7.5		1.5	80
MZ4621	3.6	1700	7.5		2	75
MZ4622	3.9	1650	5		2	70
MZ4623	4.3	1600	4		2	65
MZ4624	4.7	1550	10		3	60
MZ4625	5.1	1500	10		3	55
MZ4626	5.6	1400	10		4	50
MZ4627	6.2	1200	10		5	45
MZ4099	6.8	200	10		5.2	35
MZ4100	7.5	200	10		5.7	31.8
MZ4101	8.2	200	1		6.3	29
MZ4102	8.7	200	1		6.7	27.4
MZ4103	9.1	200	1		7	26.2
MZ4104	10	200	1		7.6	24.8

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION
The type numbers shown have a standard tolerance of ±5% on the nominal zener voltage.

NOTE 2. ZENER VOLTAGE (V_Z) MEASUREMENT
Nominal Zener Voltage is measured with the device junction in the thermal equilibrium with ambient temperature of 25°C.

NOTE 3. ZENER IMPEDANCE (Z_{ZT}) DERIVATION
The zener impedance is derived from the 60 cycle ac voltage, which results when an ac current having an rms value equal to 10% of the dc zener current (I_{ZT}) is superimposed on I_{ZT}.

NOTE 4. MAXIMUM ZENER CURRENT RATINGS (I_{ZM})
Maximum zener current ratings are based on maximum zener voltage of the individual units.

NOTE 5. REVERSE LEAKAGE CURRENT I_R
Reverse leakage currents are guaranteed and are measured at V_R as shown on the table.

NOTE 6. SPECIAL SELECTORS AVAILABLE INCLUDE:
A) Tighter voltage tolerances. Contact your nearest Motorola representative for more information.

Low Voltage Avalanche Passivated Silicon Oxide Zener Regulator Diodes

Same as 1N5520B through 1N5530B except low noise test spec omitted.

- Low Maximum Regulation Factor
- Low Zener Impedance
- Low Leakage Current

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified. Based on dc measurements at thermal equilibrium; V_F = 1.1 Max @ I_F = 200 mA for all types.)

Motorola Type No. (Note 1)	Nominal Zener Voltage V_Z @ I_{ZT} Volts (Note 2)	Test Current I_{ZT} mAdc	Max Zener Impedance Z_{ZT} @ I_{ZT} Ohms (Note 3)	Max Reverse Leakage Current		Maximum DC Zener Current I_{ZM} mAdc (Note 5)	Regulation Factor ΔV_Z Volts (Note 6)	Low V_Z Current I_{ZL} mAdc
				I_R μAdc (Note 4)	V_R – Volts			
MZ5520B	3.9	20	22	1	1	98	0.85	2.0
MZ5521B	4.3	20	18	3	1.5	88	0.75	2.0
MZ5522B	4.7	10	22	2	2	81	0.6	1.0
MZ5523B	5.1	5	26	2	2.5	75	0.65	0.25
MZ5524B	5.6	3	30	2	3.5	68	0.3	0.25
MZ5525B	6.2	1	30	1	5	61	0.2	0.01
MZ5526B	6.8	1	30	1	6.2	56	0.1	0.01
MZ5527B	7.5	1	35	0.5	6.8	51	0.05	0.01
MZ5528B	8.2	1	40	0.5	7.5	46	0.05	0.01
MZ5529B	9.1	1	45	0.1	8.2	42	0.05	0.01
MZ5530B	10	1	60	0.05	9.1	38	0.1	0.01

NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION

The "B" suffix type numbers listed are ±5% tolerance of nominal V_Z.

NOTE 2. ZENER VOLTAGE (V_Z) MEASUREMENT

Nominal zener voltage is measured with the device junction in thermal equilibrium with ambient temperature of 25°C.

NOTE 3. ZENER IMPEDANCE (Z_Z) DERIVATION

The zener impedance is derived from the 60 Hz ac voltage, which results when an ac current having an rms value equal to 10% of the dc zener current (I_{ZT}) is superimposed on I_{ZT}.

NOTE 4. REVERSE LEAKAGE CURRENT I_R

Reverse leakage currents are guaranteed and are measured at V_R as shown on the table.

NOTE 5. MAXIMUM REGULATOR CURRENT (I_{ZM})

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 I_{ZM} for any device may not exceed the value of 400 milliwatts divided by the actual V_Z of the device.

NOTE 6. MAXIMUM REGULATION FACTOR (ΔV_Z)

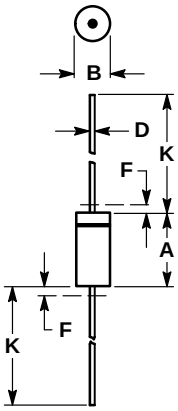
ΔV_Z is the maximum difference between V_Z at I_{ZT} and V_Z at I_{ZL} measured with the device junction in thermal equilibrium.

NOTE 7. SPECIAL SELECTORS AVAILABLE INCLUDE:

A) Tighter voltage tolerances. Contact your nearest Motorola representative for more information.

Zener Voltage Regulator Diodes — Axial Leaded

500 mW DO-35 Glass



NOTES:
1. PACKAGE CONTOUR OPTIONAL WITHIN A AND B HEAT SLUGS, IF ANY, SHALL BE INCLUDED WITHIN THIS CYLINDER, BUT NOT SUBJECT TO THE MINIMUM LIMIT OF B.
2. LEAD DIAMETER NOT CONTROLLED IN ZONE F TO ALLOW FOR FLASH, LEAD FINISH BUILDUP AND MINOR IRREGULARITIES OTHER THAN HEAT SLUGS.
3. POLARITY DENOTED BY CATHODE BAND.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	3.05	5.08	0.120	0.200
B	1.52	2.29	0.060	0.090
D	0.46	0.56	0.018	0.022
F	—	1.27	—	0.050
K	25.40	38.10	1.000	1.500

All JEDEC dimensions and notes apply.

CASE 299-02
DO-204AH
GLASS

(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, RL2(1)	5K
Tape and Ammo	TA, TA2(1)	5K

NOTES: 1. The “2” suffix refers to 26 mm tape spacing.
2. Radial Tape and Reel may be available. Please contact your Motorola representative.

Refer to Section 10 for more information on Packaging Specifications.