

**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**

**GENERAL  
DATA  
500 mW  
DO-35 GLASS**

**GLASS ZENER DIODES  
500 MILLIWATTS  
1.8-200 VOLTS**



**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

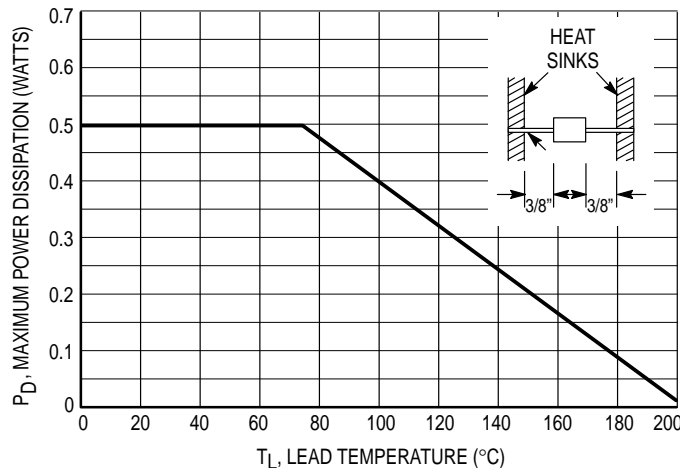
**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seoul, Korea

**MAXIMUM RATINGS (Motorola Devices)\***

| Rating  | Symbol         | Value        | Unit        |
|---|----------------|--------------|-------------|
| DC Power Dissipation and $T_L \leq 75^\circ\text{C}$<br>Lead Length = 3/8"<br>Derate above $T_L = 75^\circ\text{C}$ | $P_D$          | 500<br>4     | mW<br>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**

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## 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:

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

$\theta_{LA}$  is the lead-to-ambient thermal resistance ( $^{\circ}\text{C}/\text{W}$ ) and  $P_D$  is the power dissipation. The value for  $\theta_{LA}$  will vary and depends on the device mounting method.  $\theta_{LA}$  is generally 30 to  $40^{\circ}\text{C}/\text{W}$  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:

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

$\Delta T_{JL}$  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:

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

$\theta_{VZ}$ , 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

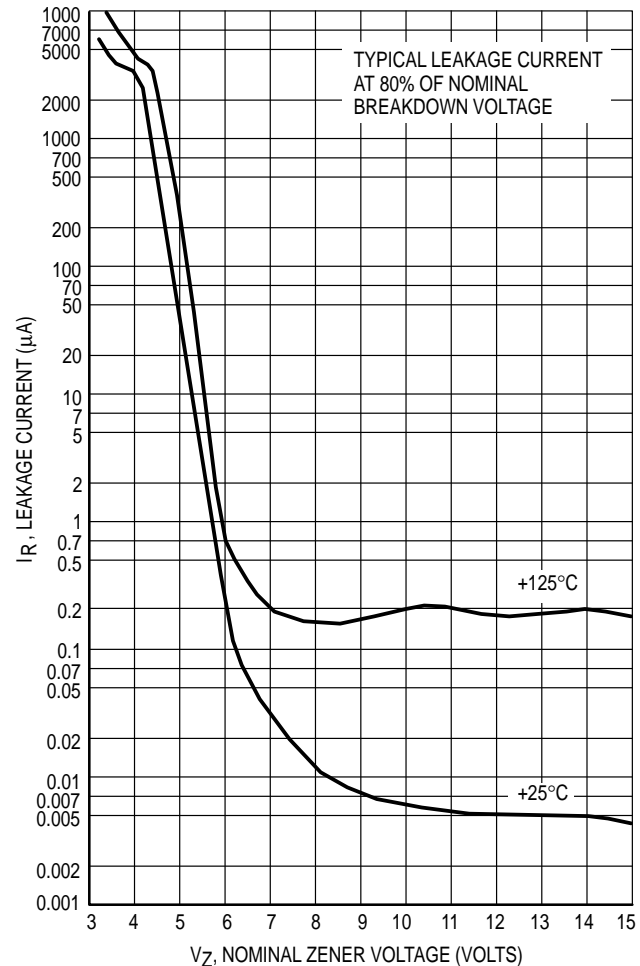


Figure 3. Typical Leakage Current

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## TEMPERATURE COEFFICIENTS

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

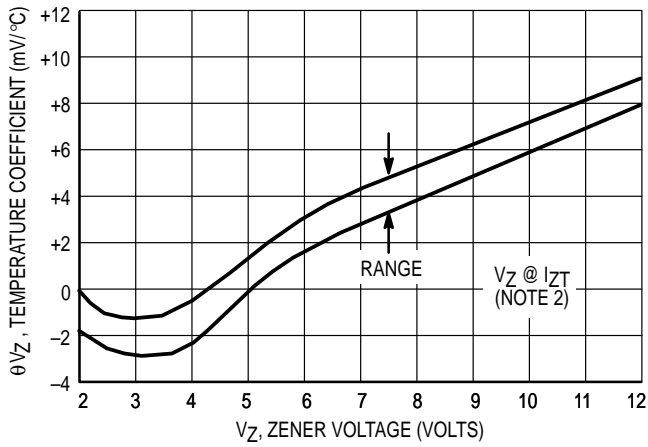


Figure 4a. Range for Units to 12 Volts

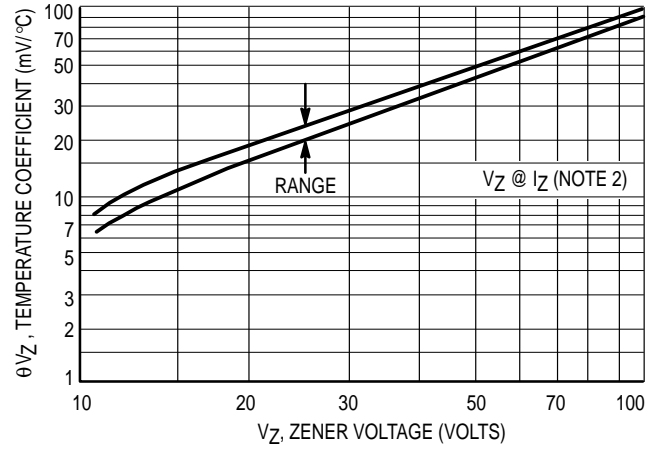


Figure 4b. Range for Units 12 to 100 Volts

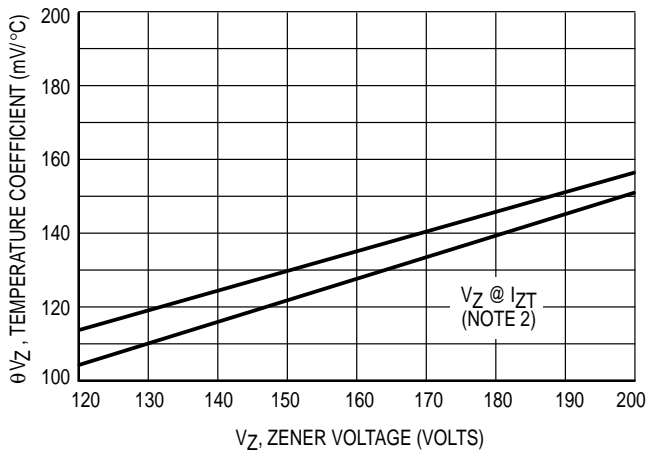


Figure 4c. Range for Units 120 to 200 Volts

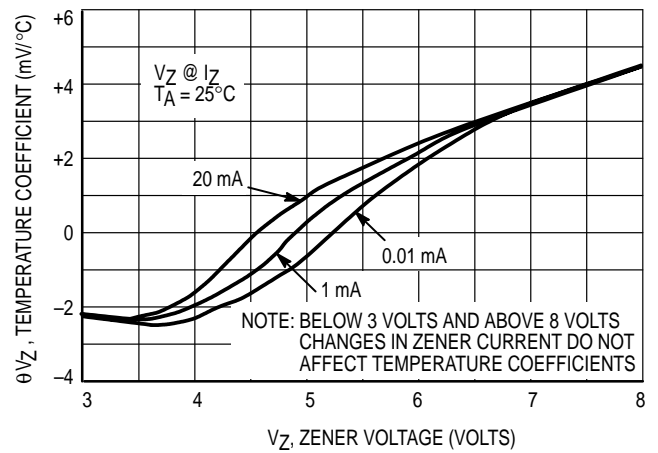


Figure 5. Effect of Zener Current

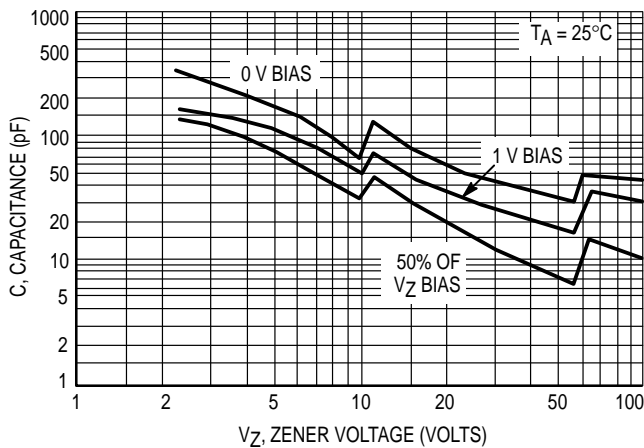


Figure 6a. Typical Capacitance 2.4–100 Volts

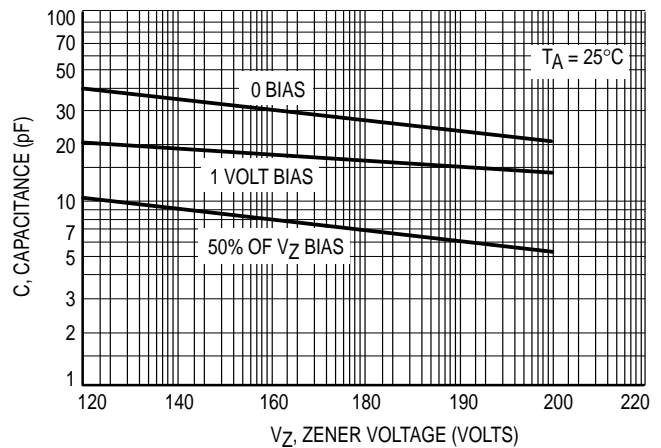


Figure 6b. Typical Capacitance 120–200 Volts

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Figure 7a. Maximum Surge Power 1.8–91 Volts

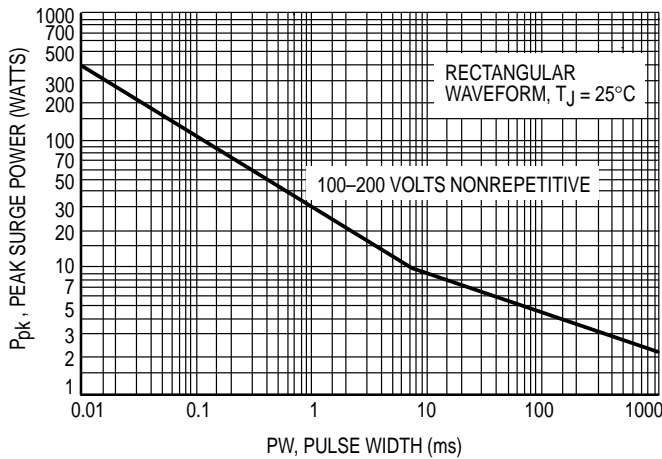


Figure 7b. Maximum Surge Power DO-204AH  
100–200 Volts

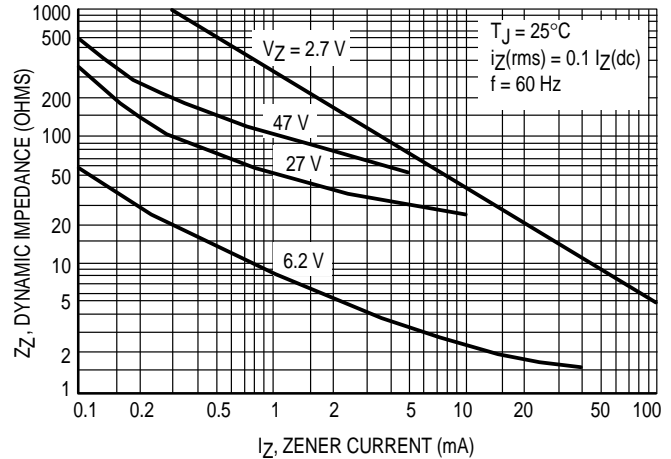


Figure 8. Effect of Zener Current on  
Zener Impedance

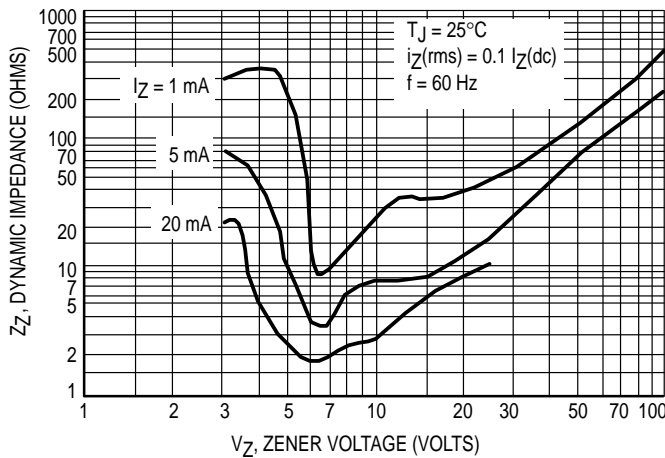


Figure 9. Effect of Zener Voltage on Zener Impedance

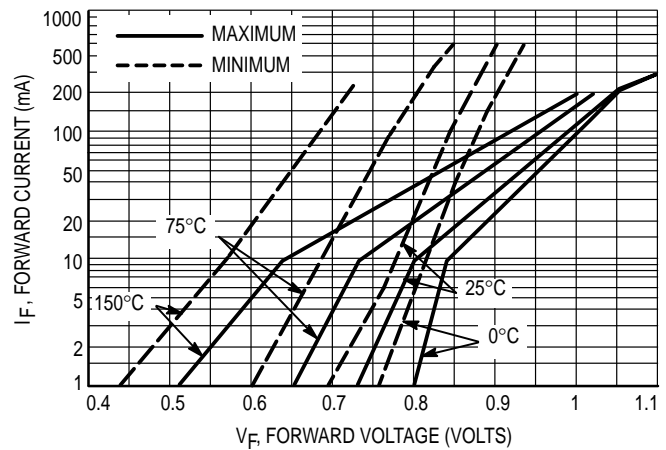


Figure 10. Typical Forward Characteristics

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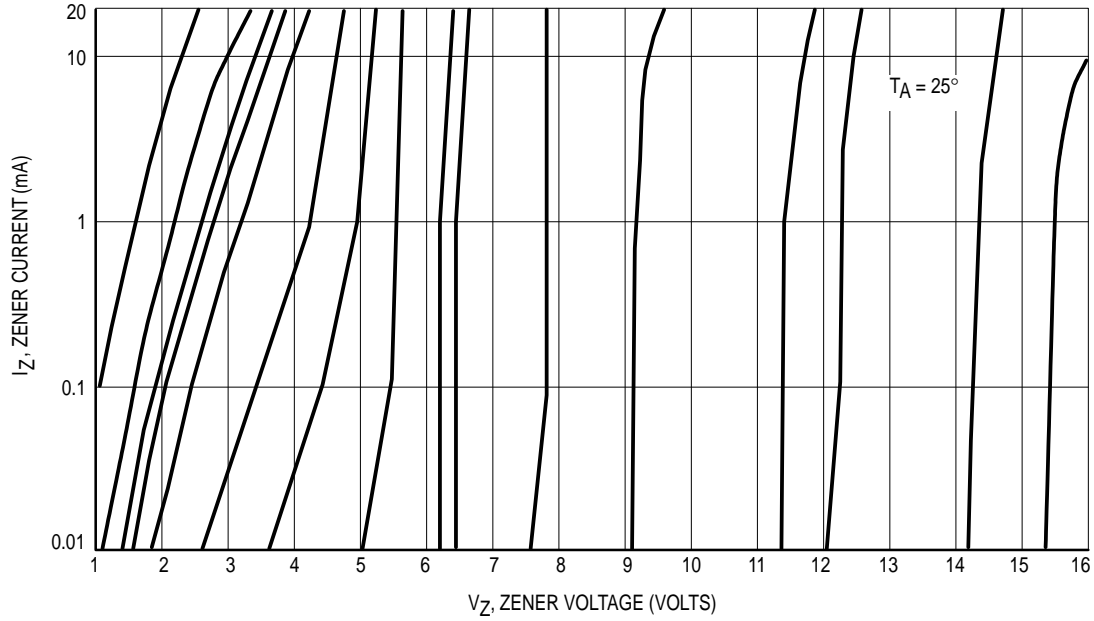


Figure 11. Zener Voltage versus Zener Current —  $V_Z = 1$  thru 16 Volts

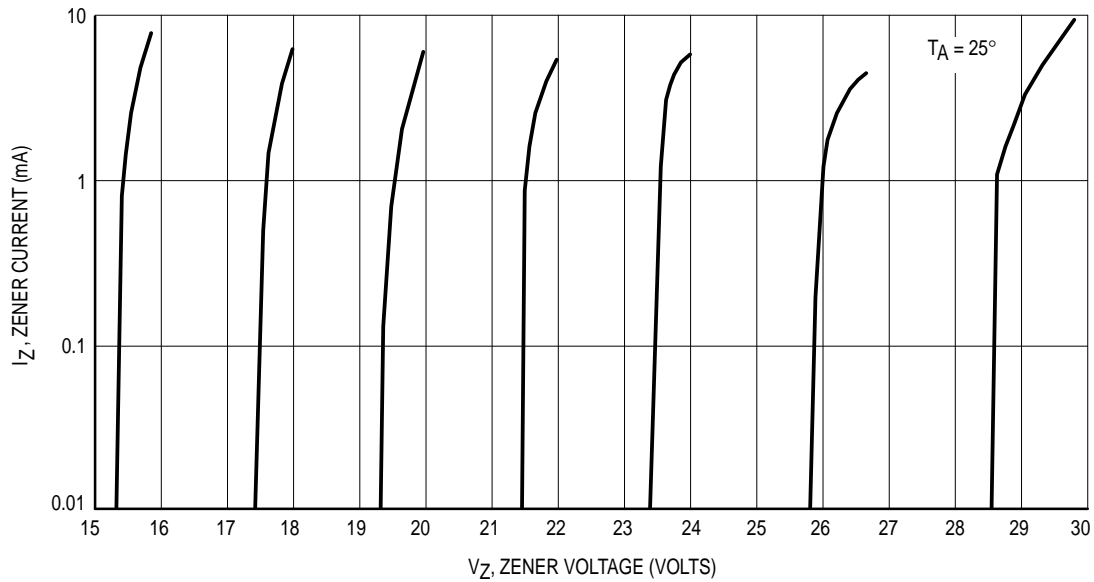


Figure 12. Zener Voltage versus Zener Current —  $V_Z = 15$  thru 30 Volts

# GENERAL DATA — 500 mW DO-35 GLASS

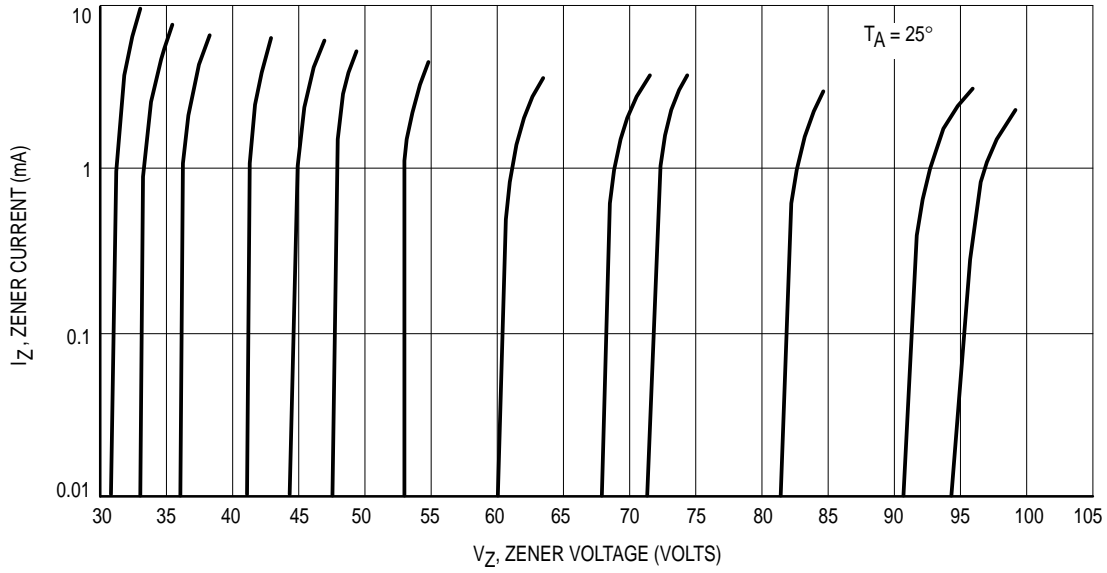


Figure 13. Zener Voltage versus Zener Current —  $V_Z = 30$  thru 105 Volts

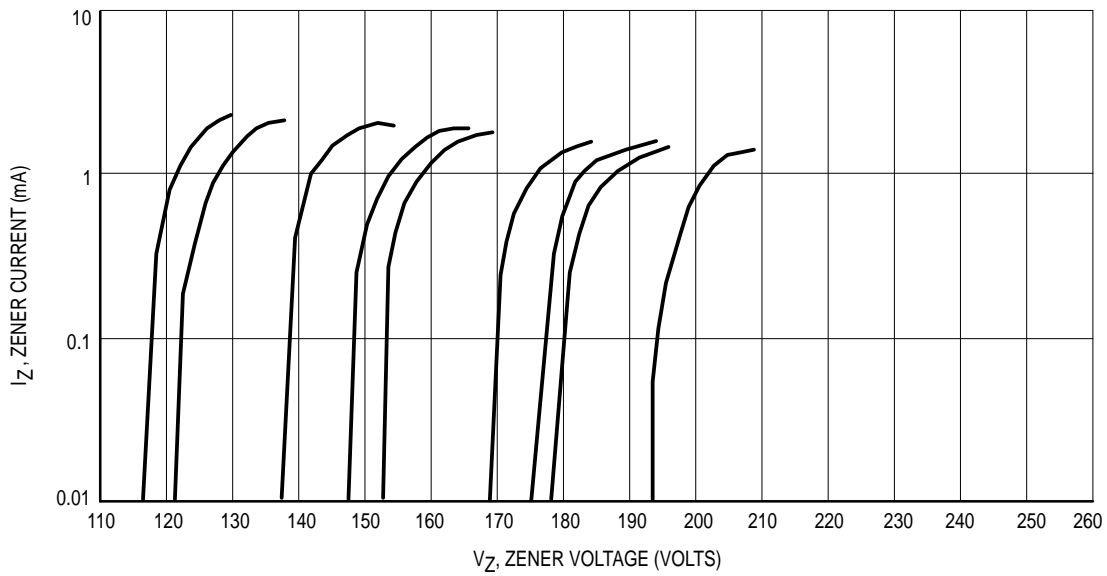


Figure 14. Zener Voltage versus Zener Current —  $V_Z = 110$  thru 220 Volts

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ ,  $V_F = 1.5\text{ V}$  Max at 200 mA for all types)

| Type Number<br>(Note 1) | Nominal Zener Voltage<br>$V_Z @ I_{ZT}$<br>(Note 2)<br>Volts | Test Current<br>$I_{ZT}$<br>mA | Maximum Zener Impedance<br>$Z_{ZT} @ I_{ZT}$<br>(Note 3)<br>Ohms | Maximum DC Zener Current<br>$I_{ZM}$<br>(Note 4)<br>mA | Maximum Reverse Leakage Current                                       |  |
|-------------------------|--|--------------------------------|--|--|---|--|
|                         |  |                                |  |  | $T_A = 25^\circ\text{C}$<br>$I_R @ V_R = 1\text{ V}$<br>$\mu\text{A}$ | $T_A = 150^\circ\text{C}$<br>$I_R @ V_R = 1\text{ V}$<br>$\mu\text{A}$ |
| 1N4370A                 | 2.4  | 20                             | 30   | 150  | 100   | 200  |
| 1N4371A                 | 2.7  | 20                             | 30   | 135  | 75  | 150  |
| 1N4372A                 | 3  | 20                             | 29   | 120  | 50  | 100  |
| <b>1N746A</b>           | <b>3.3</b>   | <b>20</b>                      | <b>28</b>  | <b>110</b>   | <b>10</b>   | <b>30</b>  |
| 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   |
| <b>1N751A</b>           | <b>5.1</b>   | <b>20</b>                      | <b>17</b>  | <b>70</b>  | <b>1</b>  | <b>20</b>  |
| <b>1N752A</b>           | <b>5.6</b>   | <b>20</b>                      | <b>11</b>  | <b>65</b>  | <b>1</b>  | <b>20</b>  |
| <b>1N753A</b>           | <b>6.2</b>   | <b>20</b>                      | <b>7</b>   | <b>60</b>  | <b>0.1</b>  | <b>20</b>  |
| 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<br>(Note 1) | Nominal Zener Voltage<br>$V_Z$<br>(Note 2)<br>Volts | Test Current<br>$I_{ZT}$<br>mA | Maximum Zener Impedance<br>(Note 3) |                           |                | Maximum DC Zener Current<br>$I_{ZM}$<br>(Note 4)<br>mA | Maximum Reverse Current        |                           |
|-------------------------|---|--------------------------------|-------------------------------------|---------------------------|----------------|--|--------------------------------|---------------------------|
|                         |   |                                | $Z_{ZT} @ I_{ZT}$<br>Ohms           | $Z_{ZK} @ I_{ZK}$<br>Ohms | $I_{ZK}$<br>mA |  | $I_R$ Maximum<br>$\mu\text{A}$ | Test Voltage Vdc<br>$V_R$ |
| 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<br>(Note 1) | Nominal Zener Voltage $V_Z$<br>(Note 2)<br>Volts | Test Current $I_{ZT}$<br>mA | Maximum Zener Impedance<br>(Note 3) |                             |                | Maximum DC Zener Current $I_{ZM}$<br>(Note 4)<br>mA | Maximum Reverse Leakage Current |                           |
|-------------------------|--|-----------------------------|-------------------------------------|-----------------------------|----------------|---|---------------------------------|---------------------------|
|                         |  |                             | $Z_{ZT}$ @ $I_{ZT}$<br>Ohms         | $Z_{ZK}$ @ $I_{ZK}$<br>Ohms | $I_{ZK}$<br>mA |   | $I_R$ Maximum<br>$\mu A$        | Test Voltage Vdc<br>$V_R$ |
| 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:  $\pm 5\%$  units, C for  $\pm 2\%$ , D for  $\pm 1\%$ .

1N746A series:  $\pm 5\%$  units, C for  $\pm 2\%$ , D for  $\pm 1\%$ .

1N957B series:  $\pm 5\%$  units, C for  $\pm 2\%$ , D for  $\pm 1\%$ .

#### NOTE 2. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT

Nominal zener voltage is measured with the device junction in thermal equilibrium at the lead temperature of  $30^\circ C \pm 1^\circ C$  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 @  $I_{ZT} = 50 \mu\text{A}$
- Maximum Delta  $V_Z$  Given from 10 to 100  $\mu\text{A}$

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , $V_F = 1.5 \text{ V}$ Max at $I_F = 100 \text{ mA}$ for all types)

| Type Number<br>(Note 1) | Zener Voltage<br>$V_Z$ @ $I_{ZT} = 50 \mu\text{A}$<br>Volts |              |              | Maximum<br>Reverse Current<br>$I_R \mu\text{A}$<br><br>(Note 3) | Test<br>Voltage<br>$V_R$ Volts | Maximum<br>Zener Current<br>$I_{ZM} \text{ mA}$<br>(Note 2) | Maximum<br>Voltage Change<br>$\Delta V_Z$ Volts<br>(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  |
| <b>1N4688</b>           | <b>4.7</b>  | <b>4.465</b> | <b>4.935</b> | <b>10</b>   | <b>3</b>                       | <b>60</b>   | <b>0.99</b>   |
| 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  $\pm 5\%$  on the nominal Zener voltage, C for  $\pm 2\%$ , D for  $\pm 1\%$ .

### 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 ( $\Delta V_Z$ )

Voltage change is equal to the difference between  $V_Z$  at 100  $\mu\text{A}$  and  $V_Z$  at 10  $\mu\text{A}$ .

### NOTE 5. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT

Nominal Zener voltage is measured with the device junction in thermal equilibrium at the lead temperature at  $30^\circ\text{C} \pm 1^\circ\text{C}$  and 3/8" lead length.

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  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. $\theta_{VZ}$ (%/°C) (Note 2) |
|-------------------------|---|--------------------------|------------------------------|------------------------------------|-----------------------------|-------------|--|
|                         |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms     | $Z_{ZK}$ @ $I_{ZK} = 0.25$ mA Ohms | $I_R$ $\mu\text{A}$         | $V_R$ 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   |
| <b>1N5226B</b>          | <b>3.3</b>  | <b>20</b>                | <b>28</b>                    | <b>1600</b>                        | <b>25</b>                   | <b>1</b>    | <b>-0.07</b>   |
| 1N5227B                 | 3.6   | 20                       | 24                           | 1700                               | 15                          | 1           | -0.065   |
| <b>1N5228B</b>          | <b>3.9</b>  | <b>20</b>                | <b>23</b>                    | <b>1900</b>                        | <b>10</b>                   | <b>1</b>    | <b>-0.06</b>   |
| 1N5229B                 | 4.3   | 20                       | 22                           | 2000                               | 5                           | 1           | $\pm 0.055$  |
| 1N5230B                 | 4.7   | 20                       | 19                           | 1900                               | 5                           | 2           | $\pm 0.03$   |
| <b>1N5231B</b>          | <b>5.1</b>  | <b>20</b>                | <b>17</b>                    | <b>1600</b>                        | <b>5</b>                    | <b>2</b>    | <b><math>\pm 0.03</math></b>                                       |
| <b>1N5232B</b>          | <b>5.6</b>  | <b>20</b>                | <b>11</b>                    | <b>1600</b>                        | <b>5</b>                    | <b>3</b>    | <b>+0.038</b>  |
| 1N5233B                 | 6   | 20                       | 7                            | 1600                               | 5                           | 3.5         | +0.038   |
| <b>1N5234B</b>          | <b>6.2</b>  | <b>20</b>                | <b>7</b>                     | <b>1000</b>                        | <b>5</b>                    | <b>4</b>    | <b>+0.045</b>  |
| <b>1N5235B</b>          | <b>6.8</b>  | <b>20</b>                | <b>5</b>                     | <b>750</b>                         | <b>3</b>                    | <b>5</b>    | <b>+0.05</b>   |
| 1N5236B                 | 7.5   | 20                       | 6                            | 500                                | 3                           | 6           | +0.058   |
| <b>1N5237B</b>          | <b>8.2</b>  | <b>20</b>                | <b>8</b>                     | <b>500</b>                         | <b>3</b>                    | <b>6.5</b>  | <b>+0.062</b>  |
| 1N5238B                 | 8.7   | 20                       | 8                            | 600                                | 3                           | 6.5         | +0.065   |
| 1N5239B                 | 9.1   | 20                       | 10                           | 600                                | 3                           | 7           | +0.068   |
| <b>1N5240B</b>          | <b>10</b>   | <b>20</b>                | <b>17</b>                    | <b>600</b>                         | <b>3</b>                    | <b>8</b>    | <b>+0.075</b>  |
| 1N5241B                 | 11  | 20                       | 22                           | 600                                | 2                           | 8.4         | +0.076   |
| <b>1N5242B</b>          | <b>12</b>   | <b>20</b>                | <b>30</b>                    | <b>600</b>                         | <b>1</b>                    | <b>9.1</b>  | <b>+0.077</b>  |
| 1N5243B                 | 13  | 9.5                      | 13                           | 600                                | 0.5                         | 9.9         | +0.079   |
| 1N5244B                 | 14  | 9                        | 15                           | 600                                | 0.1                         | 10          | +0.082   |
| <b>1N5245B</b>          | <b>15</b>   | <b>8.5</b>               | <b>16</b>                    | <b>600</b>                         | <b>0.1</b>                  | <b>11</b>   | <b>+0.082</b>  |
| <b>1N5246B</b>          | <b>16</b>   | <b>7.8</b>               | <b>17</b>                    | <b>600</b>                         | <b>0.1</b>                  | <b>12</b>   | <b>+0.083</b>  |
| 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   |
| <b>1N5250B</b>          | <b>20</b>   | <b>6.2</b>               | <b>25</b>                    | <b>600</b>                         | <b>0.1</b>                  | <b>15</b>   | <b>+0.086</b>  |
| 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)

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS — continued** ( $T_A = 25^\circ\text{C}$  unless otherwise noted. Based on dc measurements at thermal equilibrium; lead length = 3/8"; thermal resistance of heat sink =  $30^\circ\text{C/W}$ )  $V_F = 1.1$  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. $\theta_{VZ}$ (%/°C) (Note 2) |
|-------------------------|---|--------------------------|------------------------------|------------------------------------|-----------------------------|-------------|--|
|                         |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms     | $Z_{ZK}$ @ $I_{ZK} = 0.25$ mA Ohms | $I_R$ $\mu\text{A}$         | $V_R$ 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  $\pm 5\%$ . For tighter tolerance devices use suffixes "C" for  $\pm 2\%$  and "D" for  $\pm 1\%$ .

**NOTE 2. TEMPERATURE COEFFICIENT ( $\theta_{VZ}$ )<sup>†</sup>**

Test conditions for temperature coefficient are as follows:

- a.  $I_{ZT} = 7.5$  mA,  $T_1 = 25^\circ\text{C}$ ,  
 $T_2 = 125^\circ\text{C}$  (1N5221B through 1N5242B).
- b.  $I_{ZT} = \text{Rated } I_{ZT}$ ,  $T_1 = 25^\circ\text{C}$ ,  
 $T_2 = 125^\circ\text{C}$  (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  $30^\circ\text{C} \pm 1^\circ\text{C}$  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  $I_Z(\text{ac}) = 0.1 I_Z(\text{dc})$  with the ac frequency = 60 Hz.

<sup>†</sup> For more information on special selections contact your nearest Motorola representative.

# GENERAL DATA — 500 mW DO-35 GLASS

\*ELECTRICAL CHARACTERISTICS ( $T_L = 30^\circ\text{C}$  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       | $Z_{ZK} @ I_{ZK} = 0.25$ mA | $I_R$ $\mu\text{A}$         | @ $V_R$ 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                                    |
| <b>1N5993B</b>                | <b>5.1</b>  | <b>5</b>                 | <b>50</b>                    | <b>2050</b>                 | <b>2</b>                    | <b>2</b>      | <b>98</b>                              |
| <b>1N5994B</b>                | <b>5.6</b>  | <b>5</b>                 | <b>25</b>                    | <b>1800</b>                 | <b>2</b>                    | <b>3</b>      | <b>89</b>                              |
| 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                                     |
| <b>1N5998B</b>                | <b>8.2</b>  | <b>5</b>                 | <b>7</b>                     | <b>600</b>                  | <b>0.5</b>                  | <b>6.5</b>    | <b>61</b>                              |
| 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  $\pm 5\%$  are indicated by a "B" suffix,  $\pm 2\%$  by a "C" suffix,  $\pm 1\%$  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  $I_Z(\text{ac}) = 0.1 I_Z(\text{dc})$  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  $30^\circ\text{C} \pm 1^\circ\text{C}$  and 3/8" lead length.

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_L = 30^\circ\text{C}$  unless otherwise noted.) ( $V_F = 1.3$  Volts Max,  $I_F = 100$  mAdc for all types.)

| Motorola<br>Type<br>Number | $V_{ZT}$ at $I_{ZT}$<br>(V) |                 | Max Zener<br>Impedance<br>(Note 3)<br>$Z_{ZT}$ @ $I_{ZT}$<br>(Ohms)<br>Max | $I_{ZT}$<br>(mA) | Max Reverse<br>Leakage Current<br>$I_R$ at $V_R$<br>( $\mu\text{A}$ ) |                           | $V_R$<br>(V) | $I_{ZM}$<br>(mA)<br>(Note 2) |
|----------------------------|-----------------------------|-----------------|--|------------------|---|---------------------------|--------------|------------------------------|
|                            | Min<br>(Note 1)             | Max<br>(Note 1) |  |                  | $T_{amb}$<br>25°C<br>Max  | $T_{amb}$<br>125°C<br>Max |              |                              |
| 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  $\pm 2\%$  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  $30^\circ\text{C} \pm 1^\circ\text{C}$  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 limits 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** ( $T_L = 30^\circ\text{C}$  unless otherwise noted.) ( $V_F = 1.5$  Volts Max @  $I_F = 100$  mAdc for all types.)

| Device Type<br>(Note 2) | Zener Voltage (Note 1)<br>(Note 4) |      |                    | Impedance (Ohm)<br>@ $I_{ZT}$<br>$f = 1000$ Hz | Leakage Current<br>( $\mu\text{A}$ ) |                     | Temp. Coefficient<br>(Typical)<br>(mV/ $^\circ\text{C}$ ) |      | Capacitance<br>(Typical)<br>(pF)<br>$V_R = 0$ ,<br>$f = 1.0$ MHz |
|-------------------------|------------------------------------|------|--------------------|--|--------------------------------------|---------------------|---|------|--|
|                         | Min                                | Max  | $I_{ZT} =$<br>(mA) | Max<br>(Note 3)                                | Max                                  | @ $V_R =$<br>(Volt) | Min   | Max  |  |
| 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  $2^\circ\text{C}$  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  $\pm 2\%$  are indicated by a "B" instead of a "C," and  $\pm 1\%$  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.

# GENERAL DATA — 500 mW DO-35 GLASS

## ELECTRICAL CHARACTERISTICS (at $T_A = 25^\circ\text{C}$ )

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

| Device Type |          | Zener Voltage (Note 1)<br>at $I_{ZT} = 5.0$ mA |      |      | Impedance ( $\Omega$ )<br>Max (Note 2) |                 |     | Typ. Temp.<br>Coeff.<br>at $I_{ZT}$<br>% per $^\circ\text{C}$ | $V_R$ Min |     |          |
|-------------|----------|--|------|------|--|-----------------|-----|---|-----------|-----|----------|
|             |          | Nominal  | Min  | Max  | at $I_{ZT}$                            | at $I_Z = 1$ mA |     |   | V         |     | at $I_R$ |
|             |          |  |      |      |  | BZX83           | ZPD |   | BZX83     | ZPD |          |
| 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,  $I_Z(\text{ac}) = 0.1 I_Z(\text{dc})$ .

# 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  $I_{ZT} = 250 \mu\text{A}$

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified.  $I_{ZT} = 250 \mu\text{A}$  and  $V_F = 1 \text{ V Max @ } I_F = 200 \text{ mA}$  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 $I_R$ ( $\mu\text{A}$ ) | @ (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  $\pm 5\%$  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  $25^\circ\text{C}$ .

**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.



# GENERAL DATA — 500 mW DO-35 GLASS

## 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** ( $T_A = 25^\circ\text{C}$  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 $\Delta V_Z$ Volts (Note 6) | Low $V_Z$ Current $I_{ZL}$ mAdc |
|----------------------------|---|----------------------------|---|--------------------------------|---------------|---|---|---------------------------------|
|                            |   |                            |   | $I_R$ $\mu\text{Adc}$ (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  $\pm 5\%$  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  $25^\circ\text{C}$ .

**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  $\pm 5\%$  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 ( $\Delta V_Z$ )**

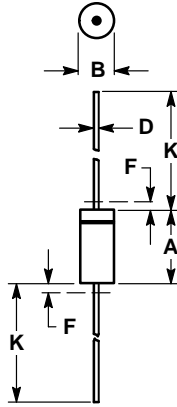
$\Delta V_Z$  is the maximum difference between  $V_Z$  at  $I_{ZT}$  and  $V_Z$  at  $I_{ZL}$  measured with the device junction in thermal equilibrium.

**NOTE 7. SPECIAL SELECTORS AVAILABLE INCLUDE:**

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

# Zener Voltage Regulator Diodes — Axial Led

## 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.

| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | 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.

# GENERAL DATA — 500 mW DO-35 GLASS

## 1–1.3 Watt DO-41 Glass Zener Voltage Regulator Diodes GENERAL DATA APPLICABLE TO ALL SERIES IN THIS GROUP One Watt Hermetically Sealed Glass Silicon Zener Diodes

### Specification Features:

- Complete Voltage Range — 3.3 to 100 Volts
- DO-41 Package
- Double Slug Type Construction
- Metallurgically Bonded Construction
- Oxide Passivated Die

### 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

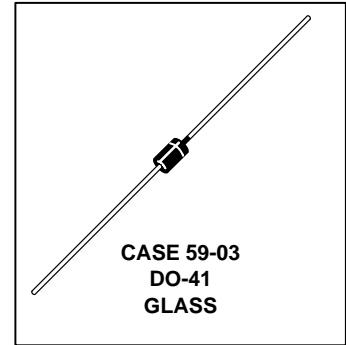
**MOUNTING POSITION:** Any

**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seoul, Korea

**GENERAL  
DATA  
1–1.3 WATT  
DO-41 GLASS**

**1 WATT  
ZENER REGULATOR  
DIODES  
3.3–100 VOLTS**



### MAXIMUM RATINGS

| Rating   | Symbol         | Value       | Unit                               |
|--|----------------|-------------|------------------------------------|
| DC Power Dissipation @ $T_A = 50^\circ\text{C}$<br>Derate above $50^\circ\text{C}$ | $P_D$          | 1<br>6.67   | Watt<br>$\text{mW}/^\circ\text{C}$ |
| Operating and Storage Junction Temperature Range                                   | $T_J, T_{stg}$ | -65 to +200 | $^\circ\text{C}$                   |

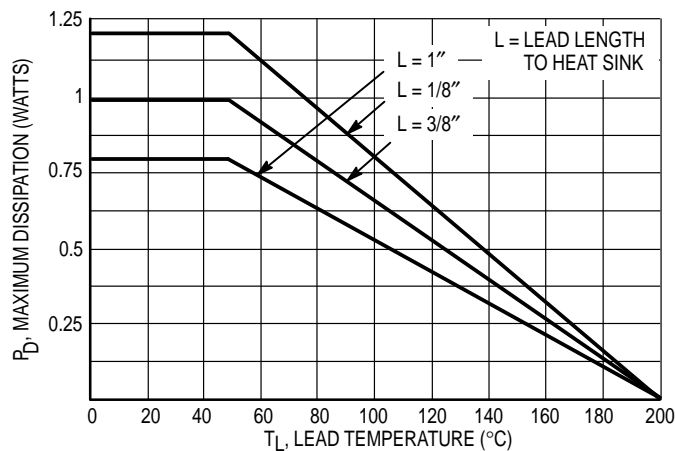
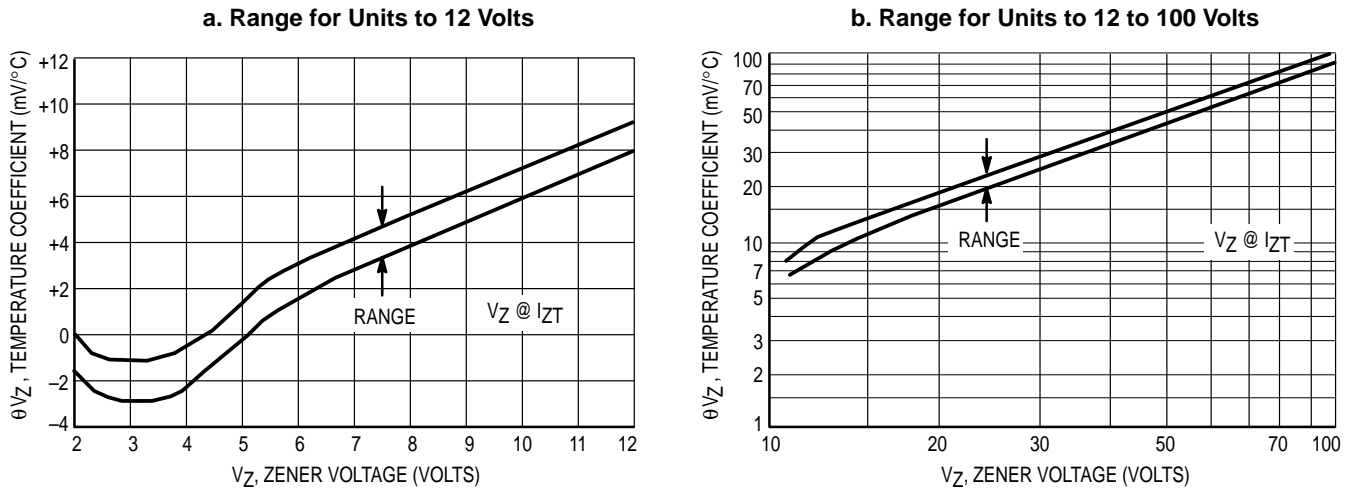
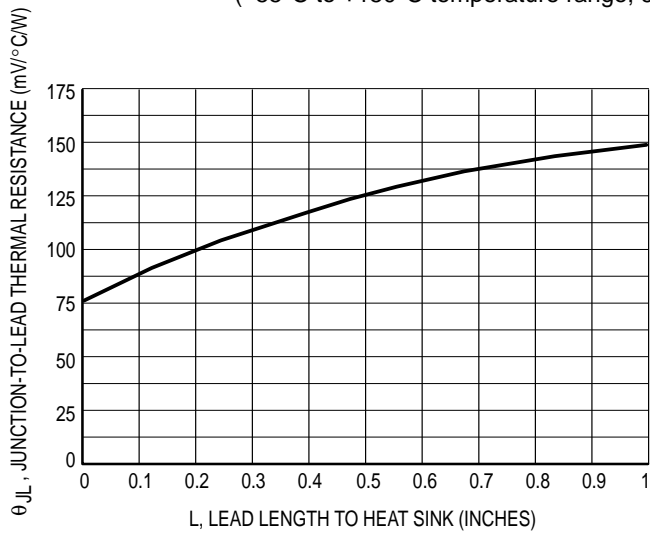


Figure 1. Power Temperature Derating Curve

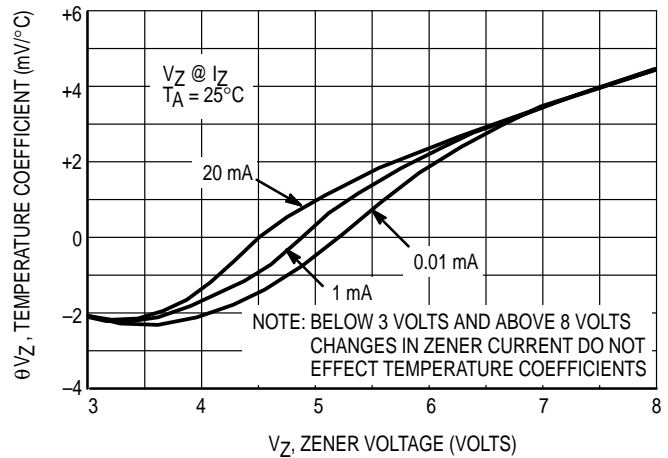
# GENERAL DATA — 500 mW DO-35 GLASS



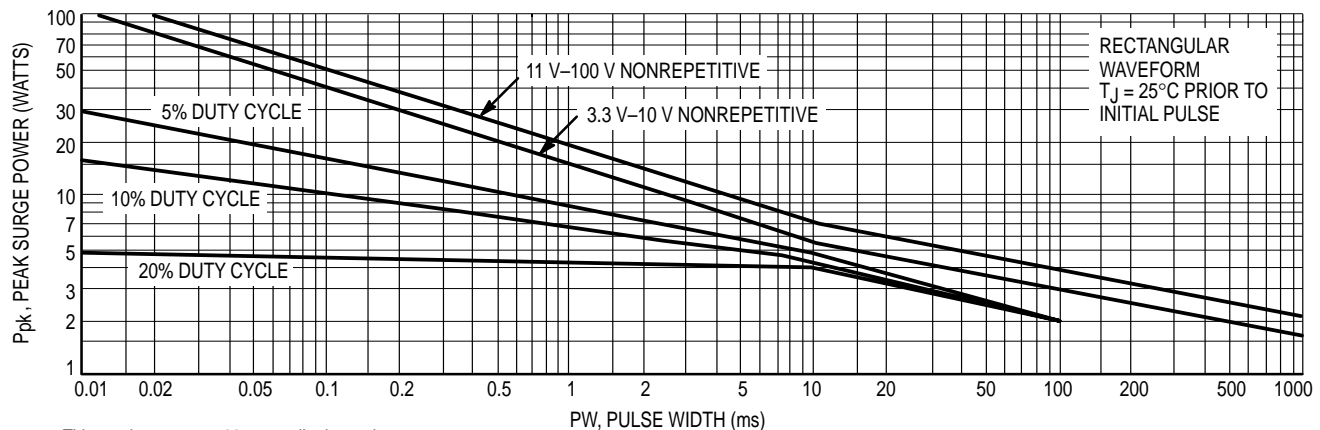
**Figure 2. Temperature Coefficients**  
 (−55°C to +150°C temperature range; 90% of the units are in the ranges indicated.)



**Figure 3. Typical Thermal Resistance versus Lead Length**



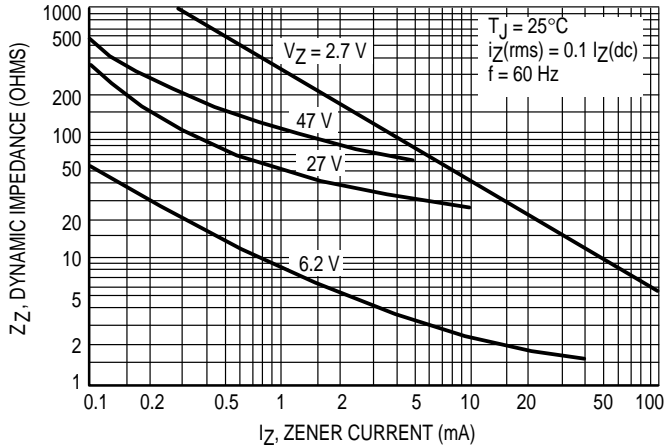
**Figure 4. Effect of Zener Current**



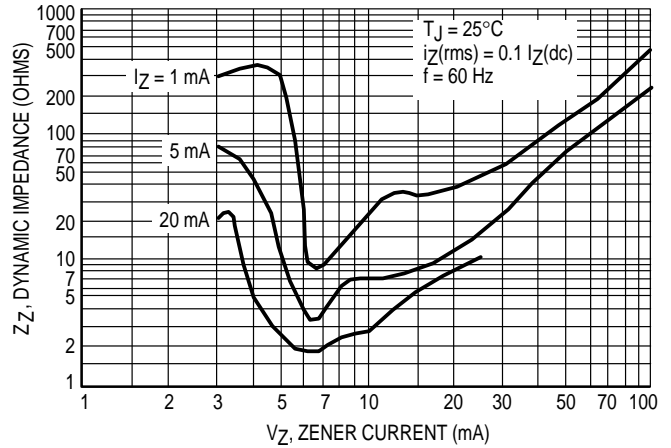
This graph represents 90 percentile data points.  
 For worst case design characteristics, multiply surge power by 2/3.

**Figure 5. Maximum Surge Power**

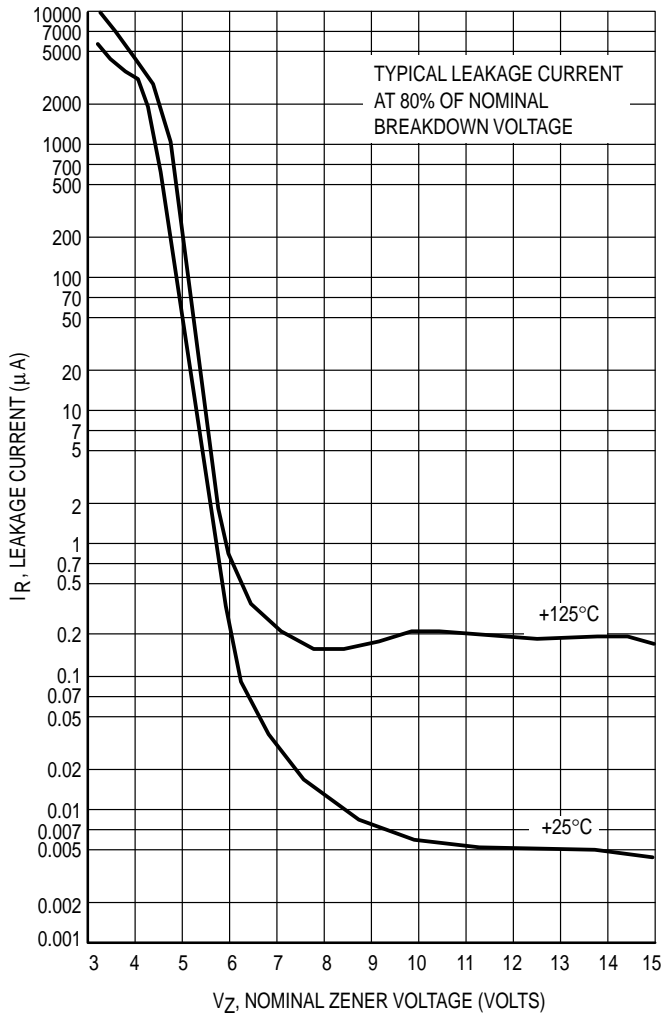
# GENERAL DATA — 500 mW DO-35 GLASS



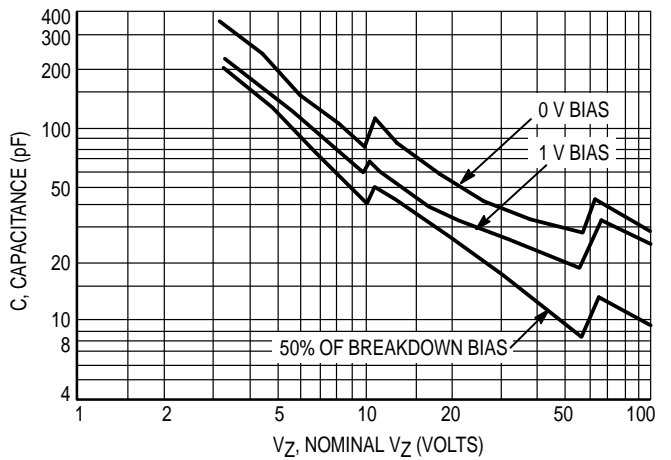
**Figure 6. Effect of Zener Current on Zener Impedance**



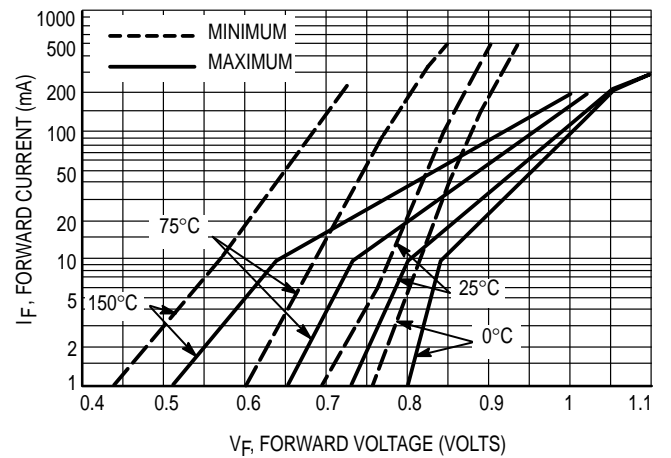
**Figure 7. Effect of Zener Voltage on Zener Impedance**



**Figure 8. Typical Leakage Current**



**Figure 9. Typical Capacitance versus  $V_Z$**



**Figure 10. Typical Forward Characteristics**

# GENERAL DATA — 500 mW DO-35 GLASS

## 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,  $T_L$ , should be determined from:

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

$\theta_{LA}$  is the lead-to-ambient thermal resistance ( $^{\circ}\text{C}/\text{W}$ ) and  $P_D$  is the power dissipation. The value for  $\theta_{LA}$  will vary and depends on the device mounting method.  $\theta_{LA}$  is generally 30 to 40 $^{\circ}\text{C}/\text{W}$  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:

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

$\Delta T_{JL}$  is the increase in junction temperature above the lead

temperature and may be found as follows:

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

$\theta_{JL}$  may be determined from Figure 3 for dc power conditions. 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:

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

$\theta_{VZ}$ , the zener voltage temperature coefficient, is found from Figure 2.

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 5. 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 5 be exceeded.

# GENERAL DATA — 500 mW DO-35 GLASS

\*ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 1.2\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types.

| JEDEC Type No. (Note 1) | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Notes 2 and 3) | Test Current $I_{ZT}$ mA | Maximum Zener Impedance (Note 4) |                          |             | Leakage Current         |             | Surge Current @ $T_A = 25^\circ\text{C}$ $i_r$ - mA (Note 5) |
|-------------------------|--|--------------------------|----------------------------------|--------------------------|-------------|-------------------------|-------------|--|
|                         |  |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms         | $Z_{ZK}$ @ $I_{ZK}$ Ohms | $I_{ZK}$ mA | $I_R$ $\mu\text{A Max}$ | $V_R$ Volts |  |
| 1N4728A                 | 3.3  | 76                       | 10                               | 400                      | 1           | 100                     | 1           | 1380   |
| 1N4729A                 | 3.6  | 69                       | 10                               | 400                      | 1           | 100                     | 1           | 1260   |
| 1N4730A                 | 3.9  | 64                       | 9                                | 400                      | 1           | 50                      | 1           | 1190   |
| 1N4731A                 | 4.3  | 58                       | 9                                | 400                      | 1           | 10                      | 1           | 1070   |
| 1N4732A                 | 4.7  | 53                       | 8                                | 500                      | 1           | 10                      | 1           | 970  |
| <b>1N4733A</b>          | <b>5.1</b>   | <b>49</b>                | <b>7</b>                         | <b>550</b>               | <b>1</b>    | <b>10</b>               | <b>1</b>    | <b>890</b>   |
| <b>1N4734A</b>          | <b>5.6</b>   | <b>45</b>                | <b>5</b>                         | <b>600</b>               | <b>1</b>    | <b>10</b>               | <b>2</b>    | <b>810</b>   |
| <b>1N4735A</b>          | <b>6.2</b>   | <b>41</b>                | <b>2</b>                         | <b>700</b>               | <b>1</b>    | <b>10</b>               | <b>3</b>    | <b>730</b>   |
| <b>1N4736A</b>          | <b>6.8</b>   | <b>37</b>                | <b>3.5</b>                       | <b>700</b>               | <b>1</b>    | <b>10</b>               | <b>4</b>    | <b>660</b>   |
| 1N4737A                 | 7.5  | 34                       | 4                                | 700                      | 0.5         | 10                      | 5           | 605  |
| <b>1N4738A</b>          | <b>8.2</b>   | <b>31</b>                | <b>4.5</b>                       | <b>700</b>               | <b>0.5</b>  | <b>10</b>               | <b>6</b>    | <b>550</b>   |
| 1N4739A                 | 9.1  | 28                       | 5                                | 700                      | 0.5         | 10                      | 7           | 500  |
| <b>1N4740A</b>          | <b>10</b>  | <b>25</b>                | <b>7</b>                         | <b>700</b>               | <b>0.25</b> | <b>10</b>               | <b>7.6</b>  | <b>454</b>   |
| <b>1N4741A</b>          | <b>11</b>  | <b>23</b>                | <b>8</b>                         | <b>700</b>               | <b>0.25</b> | <b>5</b>                | <b>8.4</b>  | <b>414</b>   |
| <b>1N4742A</b>          | <b>12</b>  | <b>21</b>                | <b>9</b>                         | <b>700</b>               | <b>0.25</b> | <b>5</b>                | <b>9.1</b>  | <b>380</b>   |
| 1N4743A                 | 13   | 19                       | 10                               | 700                      | 0.25        | 5                       | 9.9         | 344  |
| <b>1N4744A</b>          | <b>15</b>  | <b>17</b>                | <b>14</b>                        | <b>700</b>               | <b>0.25</b> | <b>5</b>                | <b>11.4</b> | <b>304</b>   |
| <b>1N4745A</b>          | <b>16</b>  | <b>15.5</b>              | <b>16</b>                        | <b>700</b>               | <b>0.25</b> | <b>5</b>                | <b>12.2</b> | <b>285</b>   |
| <b>1N4746A</b>          | <b>18</b>  | <b>14</b>                | <b>20</b>                        | <b>750</b>               | <b>0.25</b> | <b>5</b>                | <b>13.7</b> | <b>250</b>   |
| <b>1N4747A</b>          | <b>20</b>  | <b>12.5</b>              | <b>22</b>                        | <b>750</b>               | <b>0.25</b> | <b>5</b>                | <b>15.2</b> | <b>225</b>   |
| <b>1N4748A</b>          | <b>22</b>  | <b>11.5</b>              | <b>23</b>                        | <b>750</b>               | <b>0.25</b> | <b>5</b>                | <b>16.7</b> | <b>205</b>   |
| <b>1N4749A</b>          | <b>24</b>  | <b>10.5</b>              | <b>25</b>                        | <b>750</b>               | <b>0.25</b> | <b>5</b>                | <b>18.2</b> | <b>190</b>   |
| <b>1N4750A</b>          | <b>27</b>  | <b>9.5</b>               | <b>35</b>                        | <b>750</b>               | <b>0.25</b> | <b>5</b>                | <b>20.6</b> | <b>170</b>   |
| <b>1N4751A</b>          | <b>30</b>  | <b>8.5</b>               | <b>40</b>                        | <b>1000</b>              | <b>0.25</b> | <b>5</b>                | <b>22.8</b> | <b>150</b>   |
| <b>1N4752A</b>          | <b>33</b>  | <b>7.5</b>               | <b>45</b>                        | <b>1000</b>              | <b>0.25</b> | <b>5</b>                | <b>25.1</b> | <b>135</b>   |
| 1N4753A                 | 36   | 7                        | 50                               | 1000                     | 0.25        | 5                       | 27.4        | 125  |
| 1N4754A                 | 39   | 6.5                      | 60                               | 1000                     | 0.25        | 5                       | 29.7        | 115  |
| 1N4755A                 | 43   | 6                        | 70                               | 1500                     | 0.25        | 5                       | 32.7        | 110  |
| 1N4756A                 | 47   | 5.5                      | 80                               | 1500                     | 0.25        | 5                       | 35.8        | 95   |
| 1N4757A                 | 51   | 5                        | 95                               | 1500                     | 0.25        | 5                       | 38.8        | 90   |
| 1N4758A                 | 56   | 4.5                      | 110                              | 2000                     | 0.25        | 5                       | 42.6        | 80   |
| 1N4759A                 | 62   | 4                        | 125                              | 2000                     | 0.25        | 5                       | 47.1        | 70   |
| 1N4760A                 | 68   | 3.7                      | 150                              | 2000                     | 0.25        | 5                       | 51.7        | 65   |
| 1N4761A                 | 75   | 3.3                      | 175                              | 2000                     | 0.25        | 5                       | 56          | 60   |
| 1N4762A                 | 82   | 3                        | 200                              | 3000                     | 0.25        | 5                       | 62.2        | 55   |
| 1N4763A                 | 91   | 2.8                      | 250                              | 3000                     | 0.25        | 5                       | 69.2        | 50   |
| 1N4764A                 | 100  | 2.5                      | 350                              | 3000                     | 0.25        | 5                       | 76          | 45   |

\*Indicates JEDEC Registered Data.

#### NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION

The JEDEC type numbers listed have a standard tolerance on the nominal zener voltage of  $\pm 5\%$ . C for  $\pm 2\%$ , D for  $\pm 1\%$ .

#### NOTE 2. SPECIALS AVAILABLE INCLUDE:

Nominal zener voltages between the voltages shown and tighter voltage tolerances.

For detailed information on price, availability, and delivery, contact your nearest Motorola representative.

#### NOTE 3. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT

Motorola guarantees the zener voltage when measured at 90 seconds while maintaining the lead temperature ( $T_L$ ) at  $30^\circ\text{C} \pm 1^\circ\text{C}$ ,  $3/8''$  from the diode body.

#### NOTE 4. ZENER IMPEDANCE ( $Z_Z$ ) 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 ( $I_{ZT}$  or  $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

#### NOTE 5. SURGE CURRENT ( $i_r$ ) NON-REPETITIVE

The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current,  $I_{ZT}$ , per JEDEC registration; however, actual device capability is as described in Figure 5 of the General Data — DO-41 Glass.

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted.) ( $V_F = 1.2\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types.)

| Type<br>(Note 1) | Zener Voltage<br>$V_{ZT}$ (V)<br>(Notes 2 and 3) |              | Test<br>Current<br>$I_{ZT}$<br>(mA) | Zener Impedance<br>$Z_Z$ (ohms)<br>(Note 4) |                      |      | Leakage<br>Current<br>( $\mu\text{A}$ ) |              | Surge<br>Current<br>$T_A = 25^\circ\text{C}$<br>$i_r$ (mA)<br>(Note 5) |
|------------------|--|--------------|-------------------------------------|---|----------------------|------|---|--------------|--|
|                  | $V_Z$<br>Min                                     | $V_Z$<br>Max |                                     | Max<br>at $I_{ZT}$                          | Max at $I_Z$<br>(mA) |      | $V_R$ (V)                               | $I_R$<br>Max |  |
| BZX85C3V3RL      | 3.1  | 3.5          | 80                                  | 20  | 400                  | 1    | 1                                       | 60           | 1380   |
| BZX85C3V6RL      | 3.4  | 3.8          | 60                                  | 15  | 500                  | 1    | 1                                       | 30           | 1260   |
| BZX85C3V9RL      | 3.7  | 4.1          | 60                                  | 15  | 500                  | 1    | 1                                       | 5            | 1190   |
| BZX85C4V3RL      | 4  | 4.6          | 50                                  | 13  | 500                  | 1    | 1                                       | 3            | 1070   |
| BZX85C4V7RL      | 4.4  | 5            | 45                                  | 13  | 600                  | 1    | 1.5                                     | 3            | 970  |
| BZX85C5V1RL      | 4.8  | 5.4          | 45                                  | 10  | 500                  | 1    | 2                                       | 1            | 890  |
| BZX85C5V6RL      | 5.2  | 6            | 45                                  | 7   | 400                  | 1    | 2                                       | 1            | 810  |
| BZX85C6V2RL      | 5.8  | 6.6          | 35                                  | 4   | 300                  | 1    | 3                                       | 1            | 730  |
| BZX85C6V8RL      | 6.4  | 7.2          | 35                                  | 3.5   | 300                  | 1    | 4                                       | 1            | 660  |
| BZX85C7V5RL      | 7  | 7.9          | 35                                  | 3   | 200                  | 0.5  | 4.5                                     | 1            | 605  |
| BZX85C8V2RL      | 7.7  | 8.7          | 25                                  | 5   | 200                  | 0.5  | 5                                       | 1            | 550  |
| BZX85C9V1RL      | 8.5  | 9.6          | 25                                  | 5   | 200                  | 0.5  | 6.5                                     | 1            | 500  |
| BZX85C10RL       | 9.4  | 10.6         | 25                                  | 7   | 200                  | 0.5  | 7                                       | 0.5          | 454  |
| BZX85C11RL       | 10.4   | 11.6         | 20                                  | 8   | 300                  | 0.5  | 7.7                                     | 0.5          | 414  |
| BZX85C12RL       | 11.4   | 12.7         | 20                                  | 9   | 350                  | 0.5  | 8.4                                     | 0.5          | 380  |
| BZX85C13RL       | 12.4   | 14.1         | 20                                  | 10  | 400                  | 0.5  | 9.1                                     | 0.5          | 344  |
| BZX85C15RL       | 13.8   | 15.6         | 15                                  | 15  | 500                  | 0.5  | 10.5                                    | 0.5          | 304  |
| BZX85C16RL       | 15.3   | 17.1         | 15                                  | 15  | 500                  | 0.5  | 11                                      | 0.5          | 285  |
| BZX85C18RL       | 16.8   | 19.1         | 15                                  | 20  | 500                  | 0.5  | 12.5                                    | 0.5          | 250  |
| BZX85C20RL       | 18.8   | 21.2         | 10                                  | 24  | 600                  | 0.5  | 14                                      | 0.5          | 225  |
| BZX85C22RL       | 20.8   | 23.3         | 10                                  | 25  | 600                  | 0.5  | 15.5                                    | 0.5          | 205  |
| BZX85C24RL       | 22.8   | 25.6         | 10                                  | 25  | 600                  | 0.5  | 17                                      | 0.5          | 190  |
| BZX85C27RL       | 25.1   | 28.9         | 8                                   | 30  | 750                  | 0.25 | 19                                      | 0.5          | 170  |
| BZX85C30RL       | 28   | 32           | 8                                   | 30  | 1000                 | 0.25 | 21                                      | 0.5          | 150  |
| BZX85C33RL       | 31   | 35           | 8                                   | 35  | 1000                 | 0.25 | 23                                      | 0.5          | 135  |
| BZX85C36RL       | 34   | 38           | 8                                   | 40  | 1000                 | 0.25 | 25                                      | 0.5          | 125  |
| BZX85C39RL       | 37   | 41           | 6                                   | 45  | 1000                 | 0.25 | 27                                      | 0.5          | 115  |
| BZX85C43RL       | 40   | 46           | 6                                   | 50  | 1000                 | 0.25 | 30                                      | 0.5          | 110  |
| BZX85C47RL       | 44   | 50           | 4                                   | 90  | 1500                 | 0.25 | 33                                      | 0.5          | 95   |
| BZX85C51RL       | 48   | 54           | 4                                   | 115   | 1500                 | 0.25 | 36                                      | 0.5          | 90   |
| BZX85C56RL       | 52   | 60           | 4                                   | 120   | 2000                 | 0.25 | 39                                      | 0.5          | 80   |
| BZX85C62RL       | 58   | 66           | 4                                   | 125   | 2000                 | 0.25 | 43                                      | 0.5          | 70   |
| BZX85C68RL       | 64   | 72           | 4                                   | 130   | 2000                 | 0.25 | 47                                      | 0.5          | 65   |
| BZX85C75RL       | 70   | 80           | 4                                   | 150   | 2000                 | 0.25 | 51                                      | 0.5          | 60   |
| BZX85C82RL       | 77   | 87           | 2.7                                 | 200   | 3000                 | 0.25 | 56                                      | 0.5          | 55   |
| BZX85C91RL       | 85   | 96           | 2.7                                 | 250   | 3000                 | 0.25 | 62                                      | 0.5          | 50   |
| BZX85C100RL      | 96   | 106          | 2.7                                 | 350   | 3000                 | 0.25 | 68                                      | 0.5          | 45   |

**NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION**

The type numbers listed have zener voltage min/max limits as shown. Device tolerance of  $\pm 2\%$  are indicated by a "B" instead of "C."

**NOTE 2. SPECIALS AVAILABLE INCLUDE:**

Nominal zener voltages between the voltages shown and tighter voltage tolerances.

For detailed information on price, availability, and delivery, contact your nearest Motorola representative.

**NOTE 3. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

$V_Z$  is measured after the test current has been applied to  $40 \pm 10$  msec., while maintaining the lead temperature ( $T_L$ ) at  $30^\circ\text{C} \pm 1^\circ\text{C}$ ,  $3/8"$  from the diode body.

**NOTE 4. ZENER IMPEDANCE ( $Z_Z$ ) DERIVATION**

The zener impedance is derived from the 1 kHz cycle ac voltage, which results when an ac current having an rms value equal to 10% of the dc zener current ( $I_{ZT}$ ) or ( $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

**NOTE 5. SURGE CURRENT ( $i_r$ ) NON-REPETITIVE**

The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current  $I_{ZT}$ . However, actual device capability is as described in Figure 5 of General Data DO-41 glass.



# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 1.2\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types.

| Type No.<br>(Note 1) | Zener Voltage (V)<br>(Notes 2 and 3) |           | Test Current<br>$I_{ZT}$<br>(mA) | Zener Impedance<br>(Note 4)<br>$f = 1\text{ kHz (ohms)}$ |     | Blocking<br>Volt Min (V)<br>$I_R = 1\ \mu\text{A}$ | Surge<br>Current<br>$T_A = 25^\circ\text{C}$<br>$I_r$ (ma)<br>(Note 5) |
|----------------------|--------------------------------------|-----------|----------------------------------|--|-----|--|--|
|                      | $V_Z$ Min                            | $V_Z$ Max |                                  | Typ  | Max |  |  |
| MZPY3.9RL            | 3.7                                  | 4.1       | 100                              | 4  | 7   | —  | 1190   |
| MZPY4.3RL            | 4                                    | 4.6       | 100                              | 4  | 7   | —  | 1070   |
| MZPY4.7RL            | 4.4                                  | 5         | 100                              | 4  | 7   | —  | 970  |
| MZPY5.1RL            | 4.8                                  | 5.4       | 100                              | 2  | 5   | 0.7  | 890  |
| MZPY5.6RL            | 5.2                                  | 6         | 100                              | 1  | 2   | 1.5  | 810  |
| MZPY6.2RL            | 5.8                                  | 6.6       | 100                              | 1  | 2   | 2  | 730  |
| MZPY6.8RL            | 6.4                                  | 7.2       | 100                              | 1  | 2   | 3  | 660  |
| MZPY7.5RL            | 7                                    | 7.9       | 100                              | 1  | 2   | 5  | 605  |
| MZPY8.2RL            | 7.7                                  | 8.7       | 100                              | 1  | 2   | 6  | 550  |
| MZPY9.1RL            | 8.5                                  | 9.6       | 50                               | 2  | 4   | 7  | 500  |
| MZPY10RL             | 9.4                                  | 10.6      | 50                               | 2  | 4   | 7.5  | 454  |
| MZPY11RL             | 10.4                                 | 11.6      | 50                               | 3  | 7   | 8.5  | 414  |
| MZPY12RL             | 11.4                                 | 12.7      | 50                               | 3  | 7   | 9  | 380  |
| MZPY13RL             | 12.4                                 | 14.1      | 50                               | 4  | 9   | 10   | 344  |
| MZPY15RL             | 14.2                                 | 15.8      | 50                               | 4  | 9   | 11   | 304  |
| MZPY16RL             | 15.3                                 | 17.1      | 25                               | 5  | 10  | 12   | 285  |
| MZPY18RL             | 16.8                                 | 19.1      | 25                               | 5  | 11  | 14   | 250  |
| MZPY20RL             | 18.8                                 | 21.2      | 25                               | 6  | 12  | 15   | 225  |
| MZPY22RL             | 20.8                                 | 23.3      | 25                               | 7  | 13  | 17   | 205  |
| MZPY24RL             | 22.8                                 | 25.6      | 25                               | 8  | 14  | 18   | 190  |
| MZPY27RL             | 25.1                                 | 28.9      | 25                               | 9  | 15  | 20   | 170  |
| MZPY30RL             | 28                                   | 32        | 25                               | 10   | 20  | 22.5   | 150  |
| MZPY33RL             | 31                                   | 35        | 25                               | 11   | 20  | 25   | 135  |
| MZPY36RL             | 34                                   | 38        | 10                               | 25   | 60  | 27   | 125  |
| MZPY39RL             | 37                                   | 41        | 10                               | 30   | 60  | 29   | 115  |
| MZPY43RL             | 40                                   | 46        | 10                               | 35   | 80  | 32   | 110  |
| MZPY47RL             | 44                                   | 50        | 10                               | 40   | 80  | 35   | 95   |
| MZPY51RL             | 48                                   | 54        | 10                               | 45   | 100 | 38   | 90   |
| MZPY56RL             | 52                                   | 60        | 10                               | 50   | 100 | 42   | 80   |
| MZPY62RL             | 58                                   | 66        | 10                               | 60   | 130 | 47   | 70   |
| MZPY68RL             | 64                                   | 72        | 10                               | 65   | 130 | 51   | 65   |
| MZPY75RL             | 70                                   | 79        | 10                               | 70   | 160 | 56   | 60   |
| MZPY82RL             | 77                                   | 88        | 10                               | 80   | 160 | 61   | 55   |
| MZPY91RL             | 85                                   | 96        | 5                                | 120  | 250 | 68   | 50   |
| MZPY100RL            | 94                                   | 106       | 5                                | 130  | 250 | 75   | 45   |

**NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION**

The type numbers listed have zener voltage min/max limits as shown. Device tolerance of  $\pm 2\%$  are indicated by a "C" and  $\pm 1\%$  by a "D" suffix.

**NOTE 2. SPECIALS AVAILABLE INCLUDE:**

Nominal zener voltages between the voltages shown and tighter voltage tolerances.

For detailed information on price, availability, and delivery, contact your nearest Motorola representative.

**NOTE 3. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

$V_Z$  is measured after the test current has been applied to  $40 \pm 10\text{ msec.}$ , while maintaining the lead temperature ( $T_L$ ) at  $30^\circ\text{C} \pm 1^\circ\text{C}$ ,  $3/8"$  from the diode body.

**NOTE 4. ZENER IMPEDANCE ( $Z_Z$ ) DERIVATION**

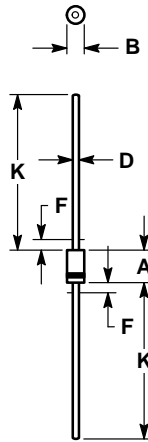
The zener impedance is derived from the 1 kHz cycle ac voltage, which results when an ac current having an rms value equal to 10% of the dc zener current ( $I_{ZT}$ ) of ( $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

**NOTE 5. SURGE CURRENT ( $I_r$ ) NON-REPETITIVE**

The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current  $I_{ZT}$ , however, actual device capability is as described in Figure 5 of General Data DO-41 glass.

# Zener Voltage Regulator Diodes — Axial Ledged

## 1–1.3 Watt DO-41 Glass



- NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
  2. POLARITY DENOTED BY CATHODE BAND.
  3. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 4.07        | 5.20 | 0.160  | 0.205 |
| B   | 2.04        | 2.71 | 0.080  | 0.107 |
| D   | 0.71        | 0.86 | 0.028  | 0.034 |
| F   | —           | 1.27 | —      | 0.050 |
| K   | 27.94       | —    | 1.100  | —     |

CASE 59-03  
DO-41  
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         | 6K          |
| Tape and Ammo  | TA, TA2         | 4K          |

NOTE: 1. The "2" suffix refers to 26 mm tape spacing.

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

# GENERAL DATA — 500 mW DO-35 GLASS

## 1 to 3 Watt DO-41 Surmetic 30 Zener Voltage Regulator Diodes GENERAL DATA APPLICABLE TO ALL SERIES IN THIS GROUP 1 to 3 Watt Surmetic 30 Silicon Zener Diodes

**GENERAL  
DATA  
1-3 WATT  
DO-41  
SURMETIC 30**

**1 TO 3 WATT  
ZENER REGULATOR  
DIODES  
3.3-400 VOLTS**

... a complete series of 1 to 3 Watt Zener Diodes with limits and operating characteristics that reflect the superior capabilities of silicon-oxide-passivated junctions. All this in an axial-lead, transfer-molded plastic package offering protection in all common environmental conditions.

### Specification Features:

- Surge Rating of 98 Watts @ 1 ms
- Maximum Limits Guaranteed On Up To Six Electrical Parameters
- Package No Larger Than the Conventional 1 Watt Package

### Mechanical Characteristics:

**CASE:** Void-free, transfer-molded, thermosetting plastic

**FINISH:** All external surfaces are corrosion resistant and leads are readily solderable

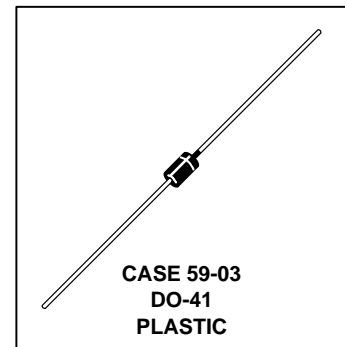
**POLARITY:** Cathode indicated by color band. When operated in zener mode, cathode will be positive with respect to anode

**MOUNTING POSITION:** Any

**WEIGHT:** 0.4 gram (approx)

**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seoul, Korea



### MAXIMUM RATINGS

| Rating   | Symbol         | Value        | Unit           |
|--|----------------|--------------|----------------|
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$<br>Lead Length = 3/8"<br>Derate above 75°C | $P_D$          | 3<br>24      | Watts<br>mW/°C |
| DC Power Dissipation @ $T_A = 50^\circ\text{C}$<br>Derate above 50°C                       | $P_D$          | 1<br>6.67    | Watt<br>mW/°C  |
| Operating and Storage Junction Temperature Range   | $T_J, T_{stg}$ | - 65 to +200 | °C             |

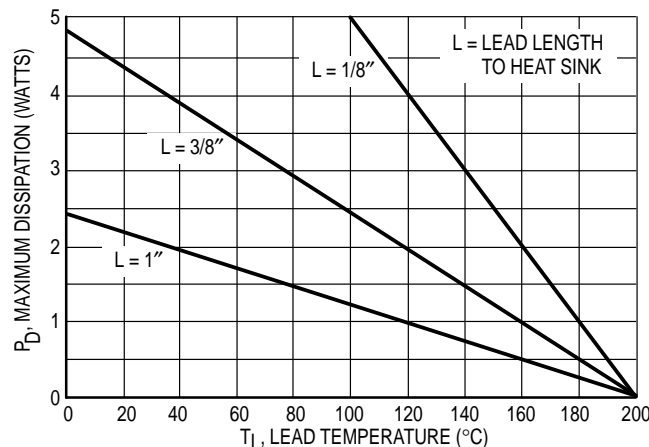


Figure 1. Power Temperature Derating Curve

# GENERAL DATA — 500 mW DO-35 GLASS

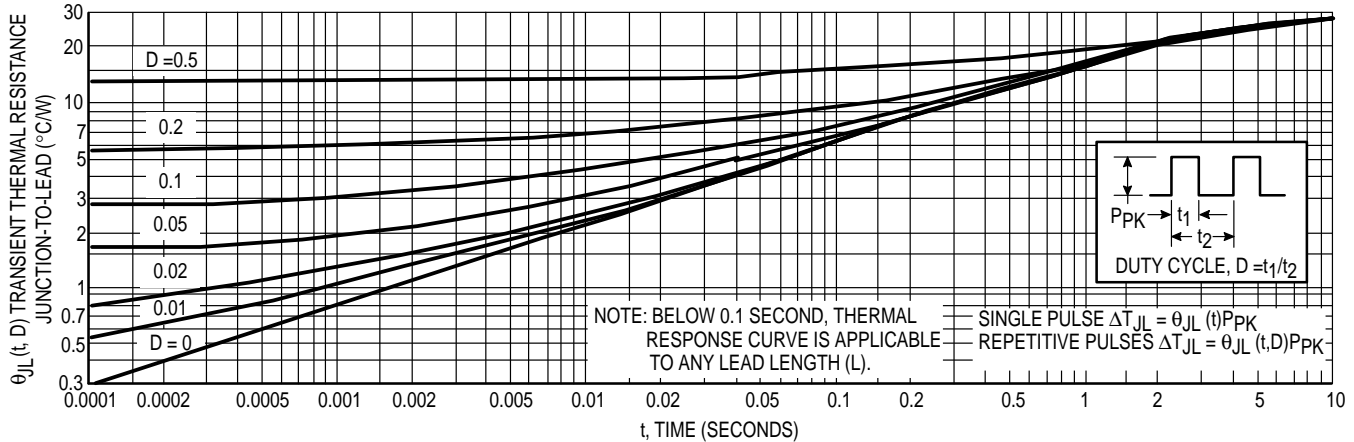


Figure 2. Typical Thermal Response L, Lead Length = 3/8 Inch

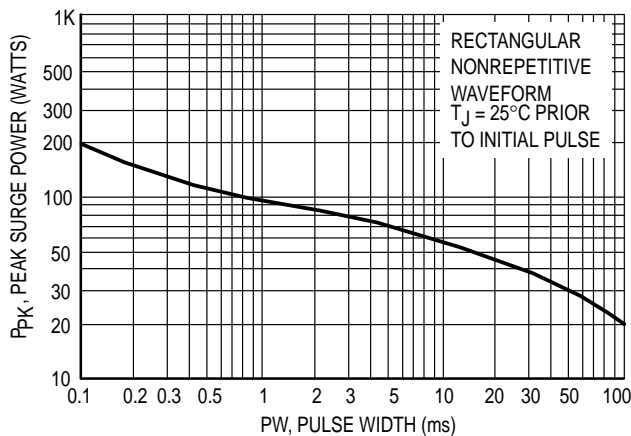


Figure 3. Maximum Surge Power

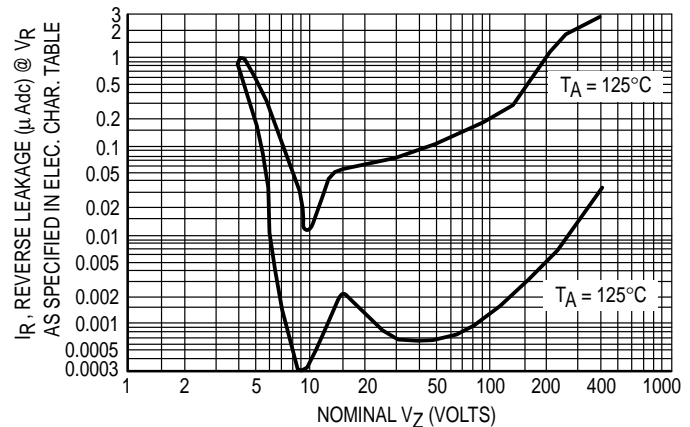


Figure 4. Typical Reverse Leakage

## 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,  $T_L$ , should be determined from:

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

$\theta_{LA}$  is the lead-to-ambient thermal resistance ( $^{\circ}\text{C}/\text{W}$ ) and  $P_D$  is the power dissipation. The value for  $\theta_{LA}$  will vary and depends on the device mounting method.  $\theta_{LA}$  is generally  $30\text{--}40^{\circ}\text{C}/\text{W}$  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:

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

$\Delta T_{JL}$  is the increase in junction temperature above the lead temperature and may be found from Figure 2 for a train of power pulses ( $L = 3/8$  inch) or from Figure 10 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:

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

$\theta_{VZ}$ , the zener voltage temperature coefficient, is found from Figures 5 and 6.

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 2 should not be used to compute surge capability. Surge limitations are given in Figure 3. 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 3 be exceeded.

# GENERAL DATA — 500 mW DO-35 GLASS

## TEMPERATURE COEFFICIENT RANGES

(90% of the Units are in the Ranges Indicated)

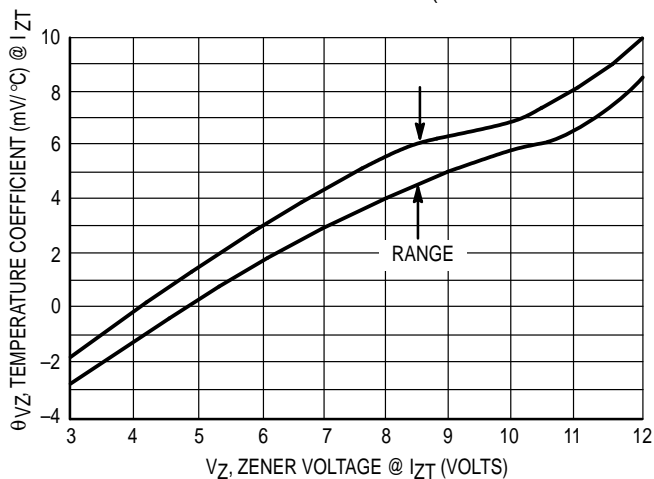


Figure 5. Units To 12 Volts

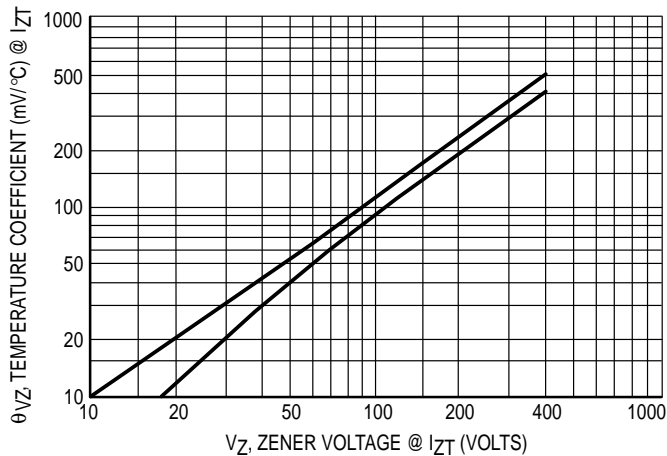


Figure 6. Units 10 To 400 Volts

## ZENER VOLTAGE versus ZENER CURRENT

(Figures 7, 8 and 9)

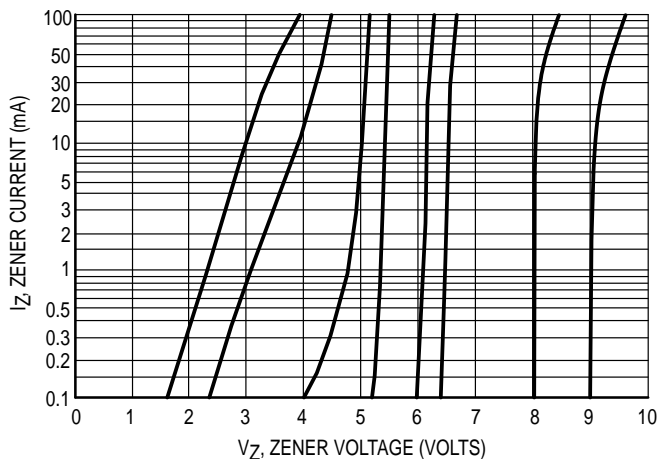


Figure 7.  $V_Z = 3.3$  thru 10 Volts

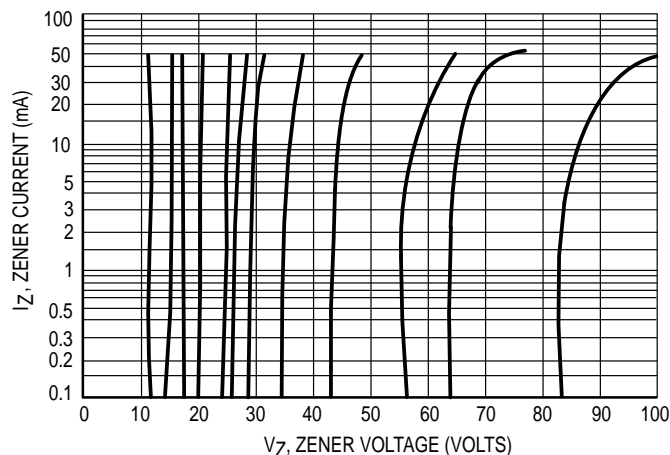


Figure 8.  $V_Z = 12$  thru 82 Volts

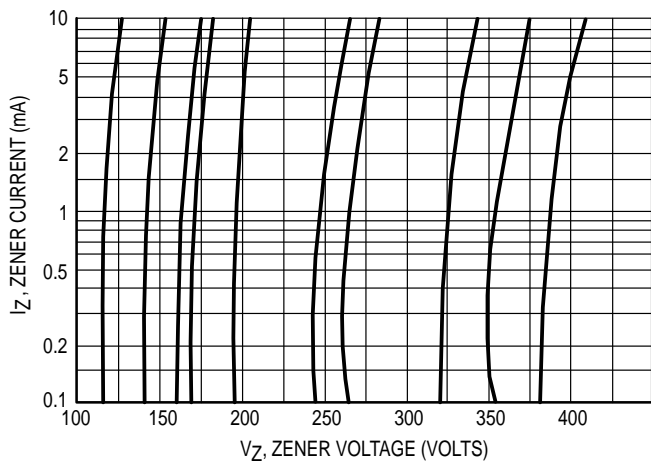


Figure 9.  $V_Z = 100$  thru 400 Volts

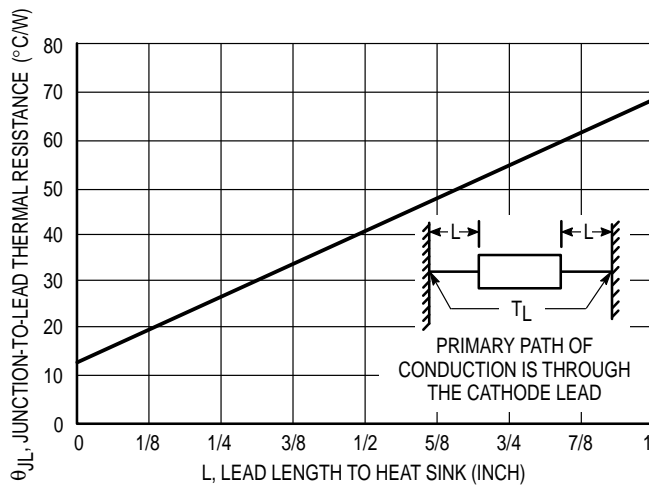


Figure 10. Typical Thermal Resistance

# GENERAL DATA — 500 mW DO-35 GLASS

## \*MAXIMUM RATINGS

| Rating   | Symbol | Value | Unit                 |
|--|--------|-------|----------------------|
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$ , Lead Length = 3/8" | $P_D$  | 1.5   | Watts                |
| Derate above $75^\circ\text{C}$                                      |        | 12    | mW/ $^\circ\text{C}$ |

## \*ELECTRICAL CHARACTERISTICS ( $T_L = 30^\circ\text{C}$ unless otherwise noted. $V_F = 1.5$ Volts Max @ $I_F = 200$ mAdc for all types.)

| Motorola Type Number (Note 1) | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Note 2 and 3) | Test Current $I_{ZT}$ mA | Max. Zener Impedance (Note 4) |                 |             | Max. Reverse Leakage Current      |             | Maximum DC Zener Current $I_{ZM}$ mAdc |
|-------------------------------|---|--------------------------|-------------------------------|-----------------|-------------|-----------------------------------|-------------|--|
|                               |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms      | $Z_{ZK}$ Ohms @ | $I_{ZK}$ mA | $I_R$ @ $V_R$ $\mu\text{A}$ Volts |             |  |
| 1N5913B                       | 3.3   | 113.6                    | 10                            | 500             | 1           | 100                               | 1           | 454                                    |
| 1N5914B                       | 3.6   | 104.2                    | 9                             | 500             | 1           | 75                                | 1           | 416                                    |
| 1N5915B                       | 3.9   | 96.1                     | 7.5                           | 500             | 1           | 25                                | 1           | 384                                    |
| 1N5916B                       | 4.3   | 87.2                     | 6                             | 500             | 1           | 5                                 | 1           | 348                                    |
| 1N5917B                       | 4.7   | 79.8                     | 5                             | 500             | 1           | 5                                 | 1.5         | 319                                    |
| <b>1N5918B</b>                | <b>5.1</b>  | <b>73.5</b>              | <b>4</b>                      | <b>350</b>      | <b>1</b>    | <b>5</b>                          | <b>2</b>    | <b>294</b>                             |
| 1N5919B                       | 5.6   | 66.9                     | 2                             | 250             | 1           | 5                                 | 3           | 267                                    |
| <b>1N5920B</b>                | <b>6.2</b>  | <b>60.5</b>              | <b>2</b>                      | <b>200</b>      | <b>1</b>    | <b>5</b>                          | <b>4</b>    | <b>241</b>                             |
| 1N5921B                       | 6.8   | 55.1                     | 2.5                           | 200             | 1           | 5                                 | 5.2         | 220                                    |
| 1N5922B                       | 7.5   | 50                       | 3                             | 400             | 0.5         | 5                                 | 6           | 200                                    |
| 1N5923B                       | 8.2   | 45.7                     | 3.5                           | 400             | 0.5         | 5                                 | 6.5         | 182                                    |
| 1N5924B                       | 9.1   | 41.2                     | 4                             | 500             | 0.5         | 5                                 | 7           | 164                                    |
| 1N5925B                       | 10  | 37.5                     | 4.5                           | 500             | 0.25        | 5                                 | 8           | 150                                    |
| 1N5926B                       | 11  | 34.1                     | 5.5                           | 550             | 0.25        | 1                                 | 8.4         | 136                                    |
| 1N5927B                       | 12  | 31.2                     | 6.5                           | 550             | 0.25        | 1                                 | 9.1         | 125                                    |
| 1N5928B                       | 13  | 28.8                     | 7                             | 550             | 0.25        | 1                                 | 9.9         | 115                                    |
| <b>1N5929B</b>                | <b>15</b>   | <b>25</b>                | <b>9</b>                      | <b>600</b>      | <b>0.25</b> | <b>1</b>                          | <b>11.4</b> | <b>100</b>                             |
| 1N5930B                       | 16  | 23.4                     | 10                            | 600             | 0.25        | 1                                 | 12.2        | 93                                     |
| 1N5931B                       | 18  | 20.8                     | 12                            | 650             | 0.25        | 1                                 | 13.7        | 83                                     |
| 1N5932B                       | 20  | 18.7                     | 14                            | 650             | 0.25        | 1                                 | 15.2        | 75                                     |
| 1N5933B                       | 22  | 17                       | 17.5                          | 650             | 0.25        | 1                                 | 16.7        | 68                                     |
| 1N5934B                       | 24  | 15.6                     | 19                            | 700             | 0.25        | 1                                 | 18.2        | 62                                     |
| 1N5935B                       | 27  | 13.9                     | 23                            | 700             | 0.25        | 1                                 | 20.6        | 55                                     |
| <b>1N5936B</b>                | <b>30</b>   | <b>12.5</b>              | <b>26</b>                     | <b>750</b>      | <b>0.25</b> | <b>1</b>                          | <b>22.8</b> | <b>50</b>                              |
| 1N5937B                       | 33  | 11.4                     | 33                            | 800             | 0.25        | 1                                 | 25.1        | 45                                     |
| 1N5938B                       | 36  | 10.4                     | 38                            | 850             | 0.25        | 1                                 | 27.4        | 41                                     |
| 1N5939B                       | 39  | 9.6                      | 45                            | 900             | 0.25        | 1                                 | 29.7        | 38                                     |
| 1N5940B                       | 43  | 8.7                      | 53                            | 950             | 0.25        | 1                                 | 32.7        | 34                                     |
| 1N5941B                       | 47  | 8                        | 67                            | 1000            | 0.25        | 1                                 | 35.8        | 31                                     |
| 1N5942B                       | 51  | 7.3                      | 70                            | 1100            | 0.25        | 1                                 | 38.8        | 29                                     |
| 1N5943B                       | 56  | 6.7                      | 86                            | 1300            | 0.25        | 1                                 | 42.6        | 26                                     |
| 1N5944B                       | 62  | 6                        | 100                           | 1500            | 0.25        | 1                                 | 47.1        | 24                                     |
| 1N5945B                       | 68  | 5.5                      | 120                           | 1700            | 0.25        | 1                                 | 51.7        | 22                                     |
| 1N5946B                       | 75  | 5                        | 140                           | 2000            | 0.25        | 1                                 | 56          | 20                                     |
| 1N5947B                       | 82  | 4.6                      | 160                           | 2500            | 0.25        | 1                                 | 62.2        | 18                                     |

(continued)

\*Indicates JEDEC Registered Data.

# GENERAL DATA — 500 mW DO-35 GLASS

**\*ELECTRICAL CHARACTERISTICS — continued** ( $T_L = 30^\circ\text{C}$  unless otherwise noted.  $V_F = 1.5$  Volts Max @  $I_F = 200$  mAdc for all types.)

| Motorola Type Number (Note 1) | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Note 2 and 3) | Test Current $I_{ZT}$ mA | Max. Zener Impedance (Note 4) |                          |               | Max. Reverse Leakage Current      |              | Maximum DC Zener Current $I_{ZM}$ mAdc |
|-------------------------------|---|--------------------------|-------------------------------|--------------------------|---------------|-----------------------------------|--------------|--|
|                               |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms      | $Z_{ZK}$ @ $I_{ZK}$ Ohms | @ $I_{ZK}$ mA | $I_R$ @ $V_R$ $\mu\text{A}$ Volts |              |  |
| 1N5948B                       | 91  | 4.1                      | 200                           | 3000                     | 0.25          | 1                                 | 69.2         | 16                                     |
| 1N5949B                       | 100   | 3.7                      | 250                           | 3100                     | 0.25          | 1                                 | 76           | 15                                     |
| 1N5950B                       | 110   | 3.4                      | 300                           | 4000                     | 0.25          | 1                                 | 83.6         | 13                                     |
| 1N5951B                       | 120   | 3.1                      | 380                           | 4500                     | 0.25          | 1                                 | 91.2         | 12                                     |
| 1N5952B                       | 130   | 2.9                      | 450                           | 5000                     | 0.25          | 1                                 | 98.8         | 11                                     |
| 1N5953B                       | 150   | 2.5                      | 600                           | 6000                     | 0.25          | 1                                 | 114          | 10                                     |
| 1N5954B                       | 160   | 2.3                      | 700                           | 6500                     | 0.25          | 1                                 | 121.6        | 9                                      |
| <b>1N5955B</b>                | <b>180</b>  | <b>2.1</b>               | <b>900</b>                    | <b>7000</b>              | <b>0.25</b>   | <b>1</b>                          | <b>136.8</b> | <b>8</b>                               |
| 1N5956B                       | 200   | 1.9                      | 1200                          | 8000                     | 0.25          | 1                                 | 152          | 7                                      |

\*Indicates JEDEC Registered Data.

**NOTE 1. TOLERANCE AND VOLTAGE DESIGNATION**

Tolerance designation — Device tolerances of  $\pm 5\%$  are indicated by a "B" suffix.

**NOTE 2. SPECIAL SELECTIONS AVAILABLE INCLUDE:**

Nominal zener voltages between those shown and  $\pm 1\%$  and  $\pm 2\%$  tight voltage tolerances. Consult factory.

**NOTE 3. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

Motorola guarantees the zener voltage when measured at 90 seconds while maintaining the lead temperature ( $T_L$ ) at  $30^\circ\text{C} \pm 1^\circ\text{C}$ ,  $3/8"$  from the diode body.

**NOTE 4. ZENER IMPEDANCE ( $Z_Z$ ) 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 ( $I_{ZT}$  or  $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 1.5\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types)

| Motorola<br>Type No.<br>(Note 1) | Nominal<br>Zener Voltage<br>$V_Z @ I_{ZT}$<br>Volts<br>(Note 2) | Test<br>Current<br>$I_{ZT}$<br>mA | Max Zener Impedance<br>(Note 3) |                           |                | Leakage<br>Current                     |               | Maximum<br>Zener<br>Current<br>$I_{ZM}$<br>mA | Surge<br>Current<br>$I_r - \text{mA}$<br>(Note 4)<br>@ $T_A = 25^\circ\text{C}$ |
|----------------------------------|---|-----------------------------------|---------------------------------|---------------------------|----------------|--|---------------|---|---|
|                                  |   |                                   | $Z_{ZT} @ I_{ZT}$<br>Ohms       | $Z_{ZK} @ I_{ZK}$<br>Ohms | $I_{ZK}$<br>mA | $I_R @ V_R$<br>$\mu\text{A Max}$ Volts |               |   |   |
| 3EZ3.9D5<br><b>3EZ4.3D5</b>      | 3.9<br><b>4.3</b>   | 192<br><b>174</b>                 | 4.5<br><b>4.5</b>               | 400<br><b>400</b>         | 1<br><b>1</b>  | 80<br><b>30</b>                        | 1<br><b>1</b> | 630<br><b>590</b>                             | 4.4<br><b>4.1</b>   |
| 3EZ4.7D5                         | 4.7   | 160                               | 4                               | 500                       | 1              | 20                                     | 1             | 550   | 3.8   |
| 3EZ5.1D5                         | 5.1   | 147                               | 3.5                             | 550                       | 1              | 5                                      | 1             | 520   | 3.5   |
| 3EZ5.6D5                         | 5.6   | 134                               | 2.5                             | 600                       | 1              | 5                                      | 2             | 480   | 3.3   |
| 3EZ6.2D5                         | 6.2   | 121                               | 1.5                             | 700                       | 1              | 5                                      | 3             | 435   | 3.1   |
| 3EZ6.8D5                         | 6.8   | 110                               | 2                               | 700                       | 1              | 5                                      | 4             | 393   | 2.9   |
| 3EZ7.5D5                         | 7.5   | 100                               | 2                               | 700                       | 0.5            | 5                                      | 5             | 360   | 2.66  |
| 3EZ8.2D5                         | 8.2   | 91                                | 2.3                             | 700                       | 0.5            | 5                                      | 6             | 330   | 2.44  |
| 3EZ9.1D5                         | 9.1   | 82                                | 2.5                             | 700                       | 0.5            | 3                                      | 7             | 297   | 2.2   |
| 3EZ10D5                          | 10  | 75                                | 3.5                             | 700                       | 0.25           | 3                                      | 7.6           | 270   | 2   |
| 3EZ11D5                          | 11  | 68                                | 4                               | 700                       | 0.25           | 1                                      | 8.4           | 245   | 1.82  |
| 3EZ12D5                          | 12  | 63                                | 4.5                             | 700                       | 0.25           | 1                                      | 9.1           | 225   | 1.66  |
| 3EZ13D5                          | 13  | 58                                | 4.5                             | 700                       | 0.25           | 0.5                                    | 9.9           | 208   | 1.54  |
| 3EZ14D5                          | 14  | 53                                | 5                               | 700                       | 0.25           | 0.5                                    | 10.6          | 193   | 1.43  |
| 3EZ15D5                          | 15  | 50                                | 5.5                             | 700                       | 0.25           | 0.5                                    | 11.4          | 180   | 1.33  |
| 3EZ16D5                          | 16  | 47                                | 5.5                             | 700                       | 0.25           | 0.5                                    | 12.2          | 169   | 1.25  |
| 3EZ17D5                          | 17  | 44                                | 6                               | 750                       | 0.25           | 0.5                                    | 13            | 159   | 1.18  |
| 3EZ18D5                          | 18  | 42                                | 6                               | 750                       | 0.25           | 0.5                                    | 13.7          | 150   | 1.11  |
| 3EZ19D5                          | 19  | 40                                | 7                               | 750                       | 0.25           | 0.5                                    | 14.4          | 142   | 1.05  |
| 3EZ20D5                          | 20  | 37                                | 7                               | 750                       | 0.25           | 0.5                                    | 15.2          | 135   | 1   |
| 3EZ22D5                          | 22  | 34                                | 8                               | 750                       | 0.25           | 0.5                                    | 16.7          | 123   | 0.91  |
| 3EZ24D5                          | 24  | 31                                | 9                               | 750                       | 0.25           | 0.5                                    | 18.2          | 112   | 0.83  |
| 3EZ27D5                          | 27  | 28                                | 10                              | 750                       | 0.25           | 0.5                                    | 20.6          | 100   | 0.74  |
| 3EZ28D5                          | 28  | 27                                | 12                              | 750                       | 0.25           | 0.5                                    | 21            | 96  | 0.71  |
| 3EZ30D5                          | 30  | 25                                | 16                              | 1000                      | 0.25           | 0.5                                    | 22.5          | 90  | 0.67  |
| 3EZ33D5                          | 33  | 23                                | 20                              | 1000                      | 0.25           | 0.5                                    | 25.1          | 82  | 0.61  |
| 3EZ36D5                          | 36  | 21                                | 22                              | 1000                      | 0.25           | 0.5                                    | 27.4          | 75  | 0.56  |
| 3EZ39D5                          | 39  | 19                                | 28                              | 1000                      | 0.25           | 0.5                                    | 29.7          | 69  | 0.51  |
| 3EZ43D5                          | 43  | 17                                | 33                              | 1500                      | 0.25           | 0.5                                    | 32.7          | 63  | 0.45  |
| 3EZ47D5                          | 47  | 16                                | 38                              | 1500                      | 0.25           | 0.5                                    | 35.6          | 57  | 0.42  |
| 3EZ51D5                          | 51  | 15                                | 45                              | 1500                      | 0.25           | 0.5                                    | 38.8          | 53  | 0.39  |
| 3EZ56D5                          | 56  | 13                                | 50                              | 2000                      | 0.25           | 0.5                                    | 42.6          | 48  | 0.36  |
| 3EZ62D5                          | 62  | 12                                | 55                              | 2000                      | 0.25           | 0.5                                    | 47.1          | 44  | 0.32  |
| 3EZ68D5                          | 68  | 11                                | 70                              | 2000                      | 0.25           | 0.5                                    | 51.7          | 40  | 0.29  |
| 3EZ75D5                          | 75  | 10                                | 85                              | 2000                      | 0.25           | 0.5                                    | 56            | 36  | 0.27  |
| 3EZ82D5                          | 82  | 9.1                               | 95                              | 3000                      | 0.25           | 0.5                                    | 62.2          | 33  | 0.24  |
| 3EZ91D5                          | 91  | 8.2                               | 115                             | 3000                      | 0.25           | 0.5                                    | 69.2          | 30  | 0.22  |
| 3EZ100D5                         | 100   | 7.5                               | 160                             | 3000                      | 0.25           | 0.5                                    | 76            | 27  | 0.2   |
| 3EZ110D5                         | 110   | 6.8                               | 225                             | 4000                      | 0.25           | 0.5                                    | 83.6          | 25  | 0.18  |
| 3EZ120D5                         | 120   | 6.3                               | 300                             | 4500                      | 0.25           | 0.5                                    | 91.2          | 22  | 0.16  |
| 3EZ130D5                         | 130   | 5.8                               | 375                             | 5000                      | 0.25           | 0.5                                    | 98.8          | 21  | 0.15  |
| 3EZ140D5                         | 140   | 5.3                               | 475                             | 5000                      | 0.25           | 0.5                                    | 106.4         | 19  | 0.14  |
| 3EZ150D5                         | 150   | 5                                 | 550                             | 6000                      | 0.25           | 0.5                                    | 114           | 18  | 0.13  |
| 3EZ160D5                         | 160   | 4.7                               | 625                             | 6500                      | 0.25           | 0.5                                    | 121.6         | 17  | 0.12  |
| 3EZ170D5                         | 170   | 4.4                               | 650                             | 7000                      | 0.25           | 0.5                                    | 130.4         | 16  | 0.12  |
| 3EZ180D5                         | 180   | 4.2                               | 700                             | 7000                      | 0.25           | 0.5                                    | 136.8         | 15  | 0.11  |
| 3EZ190D5                         | 190   | 4                                 | 800                             | 8000                      | 0.25           | 0.5                                    | 144.8         | 14  | 0.1   |

(continued)



# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS — continued** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 1.5\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types)

| Motorola Type No. (Note 1) | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Note 2) | Test Current $I_{ZT}$ mA | Max Zener Impedance (Note 3) |                          |             | Leakage Current                 |       | Maximum Zener Current $I_{ZM}$ mA | Surge Current @ $T_A = 25^\circ\text{C}$ $i_r$ - mA (Note 4) |
|----------------------------|---|--------------------------|------------------------------|--------------------------|-------------|---------------------------------|-------|-----------------------------------|--|
|                            |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms     | $Z_{ZK}$ @ $I_{ZK}$ Ohms | $I_{ZK}$ mA | $I_R$ @ $V_R$ $\mu\text{A Max}$ | Volts |                                   |  |
| 3EZ200D5                   | 200   | 3.7                      | 875                          | 8000                     | 0.25        | 0.5                             | 152   | 13                                | 0.1  |
| 3EZ220D5                   | 220   | 3.4                      | 1600                         | 9000                     | 0.25        | 1                               | 167   | 12                                | 0.09   |
| 3EZ240D5                   | 240   | 3.1                      | 1700                         | 9000                     | 0.25        | 1                               | 182   | 11                                | 0.09   |
| 3EZ270D5                   | 270   | 2.8                      | 1800                         | 9000                     | 0.25        | 1                               | 205   | 10                                | 0.08   |
| 3EZ300D5                   | 300   | 2.5                      | 1900                         | 9000                     | 0.25        | 1                               | 228   | 9                                 | 0.07   |
| 3EZ330D5                   | 330   | 2.3                      | 2200                         | 9000                     | 0.25        | 1                               | 251   | 8                                 | 0.06   |
| 3EZ360D5                   | 360   | 2.1                      | 2700                         | 9000                     | 0.25        | 1                               | 274   | 8                                 | 0.06   |
| 3EZ400D5                   | 400   | 1.9                      | 3500                         | 9000                     | 0.25        | 1                               | 304   | 7                                 | 0.06   |

**NOTE 1. TOLERANCES**

Suffix 5 indicates 5% tolerance. Any other tolerance will be considered as a special device.

**NOTE 2. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

Motorola guarantees the zener voltage when measured at  $40\text{ ms} \pm 10\text{ ms}$   $3/8''$  from the diode body, and an ambient temperature of  $25^\circ\text{C}$  ( $+8^\circ\text{C}$ ,  $-2^\circ\text{C}$ )

**NOTE 3. ZENER IMPEDANCE ( $Z_Z$ ) 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 ( $I_{ZT}$  or  $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

**NOTE 4. SURGE CURRENT ( $i_r$ ) NON-REPETITIVE**

The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current,  $I_{ZT}$ , per JEDEC standards, however, actual device capability is as described in Figure 3 of General Data sheet for Surmetic 30s.

**NOTE 5. SPECIAL SELECTIONS AVAILABLE INCLUDE:**

Nominal zener voltages between those shown. Tight voltage tolerances such as  $\pm 1\%$  and  $\pm 2\%$ . Consult factory.

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted.)  $V_F = 1.5\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types.

| Type No.<br>(Note 1) | Zener Voltage<br>(Note 2) |             | Test Current<br>$I_{ZT}$<br>mA | Zener Impedance at $I_{ZT}$<br>$f = 1000\text{ Hz (Ohm)}$ |           | Blocking Voltage<br>$I_R = 1\ \mu\text{A}$ | Typical<br>$T_C$<br>%/°C | Surge Current<br>@ $T_L = 25^\circ\text{C}$<br>$i_r - \text{mA}$<br>(Note 3) |
|----------------------|---------------------------|-------------|--------------------------------|---|-----------|--|--------------------------|--|
|                      | Min                       | Max         |                                | Typ   | Max       |  |                          |  |
| MZD3.9               | 3.7                       | 4.1         | 100                            | 3.8   | 7         | —  | -0.06                    | 1380   |
| MZD4.3               | 4                         | 4.6         | 100                            | 3.8   | 7         | —  | 0.055                    | 1260   |
| MZD4.7               | 4.4                       | 5           | 100                            | 3.8   | 7         | —  | 0.03                     | 1190   |
| MZD5.1               | 4.8                       | 5.4         | 100                            | 2   | 5         | —  | 0.03                     | 1070   |
| MZD5.6               | 5.2                       | 6           | 100                            | 1   | 2         | 1.5  | +0.038                   | 970  |
| MZD6.2               | 5.8                       | 6.6         | 100                            | 1   | 2         | 1.5  | +0.045                   | 890  |
| MZD6.8               | 6.4                       | 7.2         | 100                            | 1   | 2         | 2  | +0.05                    | 810  |
| MZD7.5               | 7                         | 7.9         | 100                            | 1   | 2         | 2  | +0.058                   | 730  |
| MZD8.2               | 7.7                       | 8.7         | 100                            | 1   | 2         | 3.5  | +0.062                   | 660  |
| MZD9.1               | 8.5                       | 9.6         | 50                             | 2   | 4         | 3.5  | +0.068                   | 605  |
| MZD10                | 9.4                       | 10.6        | 50                             | 2   | 4         | 5  | +0.075                   | 550  |
| MZD11                | 10.4                      | 11.6        | 50                             | 4   | 7         | 5  | +0.076                   | 500  |
| MZD12                | 11.4                      | 12.7        | 50                             | 4   | 7         | 7  | +0.077                   | 454  |
| MZD13                | 12.4                      | 14.1        | 50                             | 5   | 10        | 7  | +0.079                   | 414  |
| MZD15                | 13.8                      | 15.8        | 50                             | 5   | 10        | 10   | +0.082                   | 380  |
| MZD16                | 15.3                      | 17.1        | 25                             | 6   | 15        | 10   | +0.083                   | 344  |
| <b>MZD18</b>         | <b>16.8</b>               | <b>19.1</b> | <b>25</b>                      | <b>6</b>  | <b>15</b> | <b>10</b>                                  | <b>+0.085</b>            | <b>304</b>   |
| MZD20                | 18.8                      | 21.2        | 25                             | 6   | 15        | 10   | +0.086                   | 285  |
| MZD22                | 20.8                      | 23.3        | 25                             | 6   | 15        | 12   | +0.087                   | 250  |
| MZD24                | 22.8                      | 25.6        | 25                             | 7   | 15        | 12   | +0.088                   | 225  |
| MZD27                | 25.1                      | 28.9        | 25                             | 7   | 15        | 14   | +0.09                    | 205  |
| MZD30                | 28                        | 32          | 25                             | 8   | 15        | 14   | +0.091                   | 190  |
| MZD33                | 31                        | 35          | 25                             | 8   | 15        | 17   | +0.092                   | 170  |
| MZD36                | 34                        | 38          | 10                             | 21  | 40        | 17   | +0.093                   | 150  |
| MZD39                | 37                        | 41          | 10                             | 21  | 40        | 20   | +0.094                   | 135  |
| MZD43                | 40                        | 46          | 10                             | 24  | 45        | 20   | +0.095                   | 125  |
| MZD47                | 44                        | 50          | 10                             | 24  | 45        | 24   | +0.095                   | 115  |
| MZD51                | 48                        | 54          | 10                             | 25  | 60        | 24   | +0.096                   | 110  |
| MZD56                | 52                        | 60          | 10                             | 25  | 60        | 28   | +0.096                   | 95   |
| MZD62                | 58                        | 66          | 10                             | 25  | 80        | 28   | +0.097                   | 90   |
| MZD68                | 64                        | 72          | 10                             | 25  | 80        | 34   | +0.097                   | 80   |
| MZD75                | 70                        | 79          | 10                             | 30  | 100       | 34   | +0.098                   | 70   |
| MZD82                | 77                        | 88          | 10                             | 30  | 100       | 41   | +0.098                   | 65   |
| MZD91                | 85                        | 96          | 5                              | 60  | 200       | 41   | +0.099                   | 60   |
| MZD100               | 94                        | 106         | 5                              | 60  | 200       | 50   | +0.11                    | 55   |
| MZD110               | 104                       | 116         | 5                              | 80  | 250       | 50   | +0.11                    | 50   |
| MZD120               | 114                       | 127         | 5                              | 80  | 250       | 60   | +0.11                    | 45   |
| MZD130               | 124                       | 141         | 5                              | 110   | 300       | 60   | +0.11                    | —  |
| MZD150               | 138                       | 156         | 5                              | 110   | 300       | 75   | +0.11                    | —  |
| MZD160               | 153                       | 171         | 5                              | 150   | 350       | 75   | +0.11                    | —  |
| MZD180               | 168                       | 191         | 5                              | 150   | 350       | 90   | +0.11                    | —  |
| MZD200               | 188                       | 212         | 5                              | 150   | 350       | 90   | +0.11                    | —  |

**NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION**

The type numbers listed have zener voltage min/max limits as shown.

**NOTE 2. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

The zener voltage is measured after the test current ( $I_{ZT}$ ) has been applied for  $40 \pm 10$  milliseconds, while maintaining a lead temperature ( $T_L$ ) of  $30^\circ\text{C}$  at a point of 10 mm from the diode body.

**NOTE 3. ( $i_r$ ) NON-REPETITIVE SURGE CURRENT**

Maximum peak, non-repetitive reverse surge current of half square wave or equivalent sine wave pulse of 50 ms duration, superimposed on the test current ( $I_{ZT}$ ).

**NOTE 4. SPECIAL SELECTIONS AVAILABLE INCLUDE:**

Nominal zener voltages between those shown. Tight voltage tolerances such as  $\pm 1\%$  and  $\pm 2\%$ . Consult factory.

# GENERAL DATA — 500 mW DO-35 GLASS

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)  $V_F = 1.5\text{ V Max}$ ,  $I_F = 200\text{ mA}$  for all types

| Motorola<br>Type No.<br>(Note 1) | Nominal<br>Zener Voltage<br>$V_Z$ @ $I_{ZT}$<br>Volts<br>(Note 2) | Test Current<br>$I_{ZT}$<br>mA | Max Zener Impedance<br>(Note 3) |                             |                | Leakage<br>Current                       |             | Surge<br>Current<br>@ $T_A = 25^\circ\text{C}$<br>$i_r - \text{mA}$<br>(Note 4) |
|----------------------------------|---|--------------------------------|---------------------------------|-----------------------------|----------------|--|-------------|---|
|                                  |   |                                | $Z_{ZT}$ @ $I_{ZT}$<br>Ohms     | $Z_{ZK}$ @ $I_{ZK}$<br>Ohms | $I_{ZK}$<br>mA | $I_R$ @ $V_R$<br>$\mu\text{A Max}$ Volts |             |   |
| MZP4728A                         | 3.3   | 76                             | 10                              | 400                         | 1              | 100                                      | 1           | 1380  |
| MZP4729A                         | 3.6   | 69                             | 10                              | 400                         | 1              | 100                                      | 1           | 1260  |
| MZP4730A                         | 3.9   | 64                             | 9                               | 400                         | 1              | 50                                       | 1           | 1190  |
| MZP4731A                         | 4.3   | 58                             | 9                               | 400                         | 1              | 10                                       | 1           | 1070  |
| MZP4732A                         | 4.7   | 53                             | 8                               | 500                         | 1              | 10                                       | 1           | 970   |
| MZP4733A                         | 5.1   | 49                             | 7                               | 550                         | 1              | 10                                       | 1           | 890   |
| MZP4734A                         | 5.6   | 45                             | 5                               | 600                         | 1              | 10                                       | 2           | 810   |
| MZP4735A                         | 6.2   | 41                             | 2                               | 700                         | 1              | 10                                       | 3           | 730   |
| MZP4736A                         | 6.8   | 37                             | 3.5                             | 700                         | 1              | 10                                       | 4           | 660   |
| MZP4737A                         | 7.5   | 34                             | 4                               | 700                         | 0.5            | 10                                       | 5           | 605   |
| MZP4738A                         | 8.2   | 31                             | 4.5                             | 700                         | 0.5            | 10                                       | 6           | 550   |
| MZP4739A                         | 9.1   | 28                             | 5                               | 700                         | 0.5            | 10                                       | 7           | 500   |
| MZP4740A                         | 10  | 25                             | 7                               | 700                         | 0.25           | 10                                       | 7.6         | 454   |
| MZP4741A                         | 11  | 23                             | 8                               | 700                         | 0.25           | 5  | 8.4         | 414   |
| MZP4742A                         | 12  | 21                             | 9                               | 700                         | 0.25           | 5  | 9.1         | 380   |
| MZP4743A                         | 13  | 19                             | 10                              | 700                         | 0.25           | 5  | 9.9         | 344   |
| MZP4744A                         | 15  | 17                             | 14                              | 700                         | 0.25           | 5  | 11.4        | 304   |
| MZP4745A                         | 16  | 15.5                           | 16                              | 700                         | 0.25           | 5  | 12.2        | 285   |
| <b>MZP4746A</b>                  | <b>18</b>   | <b>14</b>                      | <b>20</b>                       | <b>750</b>                  | <b>0.25</b>    | <b>5</b>                                 | <b>13.7</b> | <b>250</b>  |
| MZP4747A                         | 20  | 12.5                           | 22                              | 750                         | 0.25           | 5  | 15.2        | 225   |
| MZP4748A                         | 22  | 11.5                           | 23                              | 750                         | 0.25           | 5  | 16.7        | 205   |
| <b>MZP4749A</b>                  | <b>24</b>   | <b>10.5</b>                    | <b>25</b>                       | <b>750</b>                  | <b>0.25</b>    | <b>5</b>                                 | <b>18.2</b> | <b>190</b>  |
| MZP4750A                         | 27  | 9.5                            | 35                              | 750                         | 0.25           | 5  | 20.6        | 170   |
| <b>MZP4751A</b>                  | <b>30</b>   | <b>8.5</b>                     | <b>40</b>                       | <b>1000</b>                 | <b>0.25</b>    | <b>5</b>                                 | <b>22.8</b> | <b>150</b>  |
| MZP4752A                         | 33  | 7.5                            | 45                              | 1000                        | 0.25           | 5  | 25.1        | 135   |
| MZP4753A                         | 36  | 7                              | 50                              | 1000                        | 0.25           | 5  | 27.4        | 125   |
| MZP4754A                         | 39  | 6.5                            | 60                              | 1000                        | 0.25           | 5  | 29.7        | 115   |
| MZP4755A                         | 43  | 6                              | 70                              | 1500                        | 0.25           | 5  | 32.7        | 110   |
| MZP4756A                         | 47  | 5.5                            | 80                              | 1500                        | 0.25           | 5  | 35.8        | 95  |
| MZP4757A                         | 51  | 5                              | 95                              | 1500                        | 0.25           | 5  | 38.8        | 90  |
| MZP4758A                         | 56  | 4.5                            | 110                             | 2000                        | 0.25           | 5  | 42.6        | 80  |
| MZP4759A                         | 62  | 4                              | 125                             | 2000                        | 0.25           | 5  | 47.1        | 70  |
| MZP4760A                         | 68  | 3.7                            | 150                             | 2000                        | 0.25           | 5  | 51.7        | 65  |
| MZP4761A                         | 75  | 3.3                            | 175                             | 2000                        | 0.25           | 5  | 56          | 60  |
| MZP4762A                         | 82  | 3                              | 200                             | 3000                        | 0.25           | 5  | 62.2        | 55  |
| MZP4763A                         | 91  | 2.8                            | 250                             | 3000                        | 0.25           | 5  | 69.2        | 50  |
| MZP4764A                         | 100   | 2.5                            | 350                             | 3000                        | 0.25           | 5  | 76          | 45  |
| 1M110ZS5                         | 110   | 2.3                            | 450                             | 4000                        | 0.25           | 5  | 83.6        | —   |
| 1M120ZS5                         | 120   | 2                              | 550                             | 4500                        | 0.25           | 5  | 91.2        | —   |
| 1M130ZS5                         | 130   | 1.9                            | 700                             | 5000                        | 0.25           | 5  | 98.8        | —   |
| 1M150ZS5                         | 150   | 1.7                            | 1000                            | 6000                        | 0.25           | 5  | 114         | —   |
| 1M160ZS5                         | 160   | 1.6                            | 1100                            | 6500                        | 0.25           | 5  | 121.6       | —   |
| 1M180ZS5                         | 180   | 1.4                            | 1200                            | 7000                        | 0.25           | 5  | 136.8       | —   |
| 1M200ZS5                         | 200   | 1.2                            | 1500                            | 8000                        | 0.25           | 5  | 152         | —   |

**NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION**

The type numbers listed have a standard tolerance on the nominal zener voltage of  $\pm 5\%$ . The tolerance on the 1M type numbers is indicated by the digits following ZS in the part number. "5" indicates a  $\pm 5\%$   $V_Z$  tolerance.

**NOTE 2. ZENER VOLTAGE ( $V_Z$ ) MEASUREMENT**

Motorola guarantees the zener voltage when measured at 90 seconds while maintaining the lead temperature ( $T_L$ ) at  $30^\circ\text{C} \pm 1^\circ\text{C}$ ,  $3/8"$  from the diode body.

**NOTE 3. ZENER IMPEDANCE ( $Z_Z$ ) 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 ( $I_{ZT}$  or  $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ .

**NOTE 4. SURGE CURRENT ( $i_r$ ) NON-REPETITIVE**

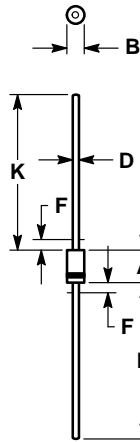
The rating listed in the electrical characteristics table is maximum peak, non-repetitive, reverse surge current of 1/2 square wave or equivalent sine wave pulse of 1/120 second duration superimposed on the test current,  $I_{ZT}$ , however, actual device capability is as described in Figure 3 of General Data — Surmetic 30.

**NOTE 5. SPECIAL SELECTIONS AVAILABLE INCLUDE:**

Nominal zener voltages between those shown. Tight voltage tolerances such as  $\pm 1\%$  and  $\pm 2\%$ . Consult factory.

# Zener Voltage Regulator Diodes — Axial Leaded

## 1–3 Watt DO-41 Surmetic 30



- NOTES:
1. ALL RULES AND NOTES ASSOCIATED WITH JEDEC DO-41 OUTLINE SHALL APPLY.
  2. POLARITY DENOTED BY CATHODE BAND.
  3. LEAD DIAMETER NOT CONTROLLED WITHIN F DIMENSION.

| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 4.07        | 5.20 | 0.160  | 0.205 |
| B   | 2.04        | 2.71 | 0.080  | 0.107 |
| D   | 0.71        | 0.86 | 0.028  | 0.034 |
| F   | —           | 1.27 | —      | 0.050 |
| K   | 27.94       | —    | 1.100  | —     |

CASE 59-03  
DO-41  
PLASTIC

(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              | 6K          |
| Tape and Ammo  | TA              | 4K          |

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

## 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

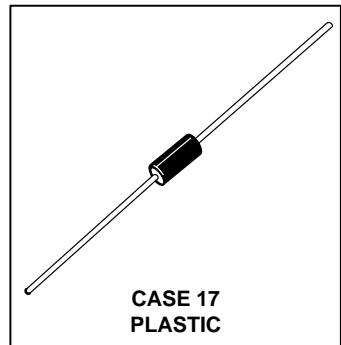
**WEIGHT:** 0.7 gram (approx)

**WAFER FAB LOCATION:** Phoenix, Arizona

**ASSEMBLY/TEST LOCATION:** Seoul, Korea

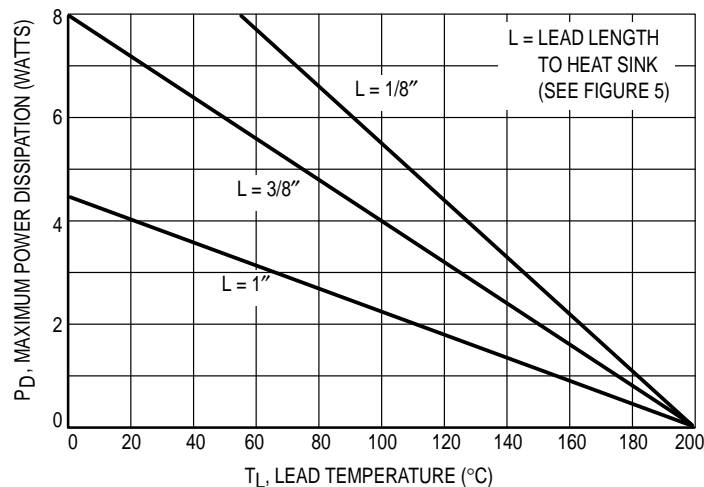
**1N5333B  
through  
1N5388B**

**5 WATT  
ZENER REGULATOR  
DIODES  
3.3-200 VOLTS**



**MAXIMUM RATINGS**

| Rating   | Symbol         | Value       | Unit           |
|--|----------------|-------------|----------------|
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$<br>Lead Length = 3/8"<br>Derate above 75°C | $P_D$          | 5<br>40     | Watts<br>mW/°C |
| Operating and Storage Junction Temperature Range   | $T_J, T_{stg}$ | -65 to +200 | °C             |



**Figure 1. Power Temperature Derating Curve**

# 1N5333B through 1N5388B

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

| JEDEC Type No. (Note 1) | Nominal Zener Voltage $V_Z$ @ $I_{ZT}$ Volts (Note 2) | Test Current $I_{ZT}$ mA | Max Zener Impedance               |  | Max Reverse Leakage Current       |             | Max Surge Current $i_{FS}$ Amps (Note 3) | Max Voltage Regulation $\Delta V_Z$ , Volt (Note 4) | Maximum Regulator Current $I_{ZM}$ mA (Note 5) |
|-------------------------|---|--------------------------|-----------------------------------|--|-----------------------------------|-------------|--|---|--|
|                         |   |                          | $Z_{ZT}$ @ $I_{ZT}$ Ohms (Note 2) | $Z_{ZK}$ @ $I_{ZK} = 1$ mA Ohms (Note 2) | $I_R$ @ $V_R$ $\mu\text{A}$ Volts |             |  |   |  |
| <b>1N5333B</b>          | <b>3.3</b>  | <b>380</b>               | <b>3</b>                          | <b>400</b>                               | <b>300</b>                        | <b>1</b>    | <b>20</b>                                | <b>0.85</b>   | <b>1440</b>                                    |
| 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   |
| <b>1N5337B</b>          | <b>4.7</b>  | <b>260</b>               | <b>2</b>                          | <b>450</b>                               | <b>5</b>                          | <b>1</b>    | <b>15.3</b>                              | <b>0.44</b>   | <b>1010</b>                                    |
| <b>1N5338B</b>          | <b>5.1</b>  | <b>240</b>               | <b>1.5</b>                        | <b>400</b>                               | <b>1</b>                          | <b>1</b>    | <b>14.4</b>                              | <b>0.39</b>   | <b>930</b>                                     |
| <b>1N5339B</b>          | <b>5.6</b>  | <b>220</b>               | <b>1</b>                          | <b>400</b>                               | <b>1</b>                          | <b>2</b>    | <b>13.4</b>                              | <b>0.25</b>   | <b>865</b>                                     |
| 1N5340B                 | 6   | 200                      | 1                                 | 300                                      | 1                                 | 3           | 12.7                                     | 0.19  | 790  |
| <b>1N5341B</b>          | <b>6.2</b>  | <b>200</b>               | <b>1</b>                          | <b>200</b>                               | <b>1</b>                          | <b>3</b>    | <b>12.4</b>                              | <b>0.1</b>  | <b>765</b>                                     |
| <b>1N5342B</b>          | <b>6.8</b>  | <b>175</b>               | <b>1</b>                          | <b>200</b>                               | <b>10</b>                         | <b>5.2</b>  | <b>11.5</b>                              | <b>0.15</b>   | <b>700</b>                                     |
| 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                 | 9.1   | 150                      | 2                                 | 150                                      | 7.5                               | 6.9         | 9.2                                      | 0.22  | 520  |
| <b>1N5347B</b>          | <b>10</b>   | <b>125</b>               | <b>2</b>                          | <b>125</b>                               | <b>5</b>                          | <b>7.6</b>  | <b>8.6</b>                               | <b>0.22</b>   | <b>475</b>                                     |
| 1N5348B                 | 11  | 125                      | 2.5                               | 125                                      | 5                                 | 8.4         | 8  | 0.25  | 430  |
| <b>1N5349B</b>          | <b>12</b>   | <b>100</b>               | <b>2.5</b>                        | <b>125</b>                               | <b>2</b>                          | <b>9.1</b>  | <b>7.5</b>                               | <b>0.25</b>   | <b>395</b>                                     |
| <b>1N5350B</b>          | <b>13</b>   | <b>100</b>               | <b>2.5</b>                        | <b>100</b>                               | <b>1</b>                          | <b>9.9</b>  | <b>7</b>                                 | <b>0.25</b>   | <b>365</b>                                     |
| 1N5351B                 | 14  | 100                      | 2.5                               | 75                                       | 1                                 | 10.6        | 6.7                                      | 0.25  | 340  |
| <b>1N5352B</b>          | <b>15</b>   | <b>75</b>                | <b>2.5</b>                        | <b>75</b>                                | <b>1</b>                          | <b>11.5</b> | <b>6.3</b>                               | <b>0.25</b>   | <b>315</b>                                     |
| <b>1N5353B</b>          | <b>16</b>   | <b>75</b>                | <b>2.5</b>                        | <b>75</b>                                | <b>1</b>                          | <b>12.2</b> | <b>6</b>                                 | <b>0.3</b>  | <b>295</b>                                     |
| 1N5354B                 | 17  | 70                       | 2.5                               | 75                                       | 0.5                               | 12.9        | 5.8                                      | 0.35  | 280  |
| 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  |
| <b>1N5358B</b>          | <b>22</b>   | <b>50</b>                | <b>3.5</b>                        | <b>75</b>                                | <b>0.5</b>                        | <b>16.7</b> | <b>4.7</b>                               | <b>0.45</b>   | <b>216</b>                                     |
| <b>1N5359B</b>          | <b>24</b>   | <b>50</b>                | <b>3.5</b>                        | <b>100</b>                               | <b>0.5</b>                        | <b>18.2</b> | <b>4.4</b>                               | <b>0.55</b>   | <b>198</b>                                     |
| 1N5360B                 | 25  | 50                       | 4                                 | 110                                      | 0.5                               | 19          | 4.3                                      | 0.55  | 190  |
| <b>1N5361B</b>          | <b>27</b>   | <b>50</b>                | <b>5</b>                          | <b>120</b>                               | <b>0.5</b>                        | <b>20.6</b> | <b>4.1</b>                               | <b>0.6</b>  | <b>176</b>                                     |
| 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  |
| <b>1N5365B</b>          | <b>36</b>   | <b>30</b>                | <b>11</b>                         | <b>160</b>                               | <b>0.5</b>                        | <b>27.4</b> | <b>3.3</b>                               | <b>0.65</b>   | <b>132</b>                                     |
| 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  |
| <b>1N5368B</b>          | <b>47</b>   | <b>25</b>                | <b>25</b>                         | <b>210</b>                               | <b>0.5</b>                        | <b>35.8</b> | <b>2.7</b>                               | <b>0.8</b>  | <b>100</b>                                     |
| 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                                | 720                                      | 0.5                               | 62.2        | 1.8                                      | 1.8   | 58   |
| 1N5376B                 | 87  | 15                       | 75                                | 760                                      | 0.5                               | 66          | 1.7                                      | 2   | 54.5   |
| 1N5377B                 | 91  | 15                       | 75                                | 760                                      | 0.5                               | 69.2        | 1.6                                      | 2.2   | 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   |
| 1N5380B                 | 120   | 10                       | 170                               | 1150                                     | 0.5                               | 91.2        | 1.3                                      | 2.5   | 39.5   |
| 1N5381B                 | 130   | 10                       | 190                               | 1250                                     | 0.5                               | 98.8        | 1.2                                      | 2.5   | 36.6   |
| 1N5382B                 | 140   | 8                        | 230                               | 1500                                     | 0.5                               | 106         | 1.2                                      | 2.5   | 34   |

(continued)

Devices listed in bold, italic are Motorola preferred devices.

# 1N5333B through 1N5388B

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

| JEDEC Type No. (Note 1) | Nominal Zener Voltage $V_Z @ I_{ZT}$ Volts (Note 2) | Test Current $I_{ZT}$ mA | Max Zener Impedance             |  | Max Reverse Leakage Current     |            | Max Surge Current $i_F$ , Amps (Note 3) | Max Voltage Regulation $\Delta V_Z$ , Volt (Note 4) | Maximum Regulator Current $I_{ZM}$ mA (Note 5) |
|-------------------------|---|--------------------------|---------------------------------|--|---------------------------------|------------|---|---|--|
|                         |   |                          | $Z_{ZT} @ I_{ZT}$ Ohms (Note 2) | $Z_{ZK} @ I_{ZK} = 1 \text{ mA}$ Ohms (Note 2) | $I_R @ V_R$ $\mu\text{A}$ Volts |            |   |   |  |
| <b>1N5383B</b>          | <b>150</b>  | <b>8</b>                 | <b>330</b>                      | <b>1500</b>                                    | <b>0.5</b>                      | <b>114</b> | <b>1.1</b>                              | <b>3</b>  | <b>31.6</b>                                    |
| 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   |

### NOTE 1. TOLERANCE AND TYPE NUMBER DESIGNATION

The JEDEC type numbers shown indicate a tolerance of  $\pm 5\%$ .

### NOTE 2. ZENER VOLTAGE ( $V_Z$ ) AND IMPEDANCE ( $Z_{ZT}$ & $Z_{ZK}$ )

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. ( $T_A = 25^\circ\text{C} +8, -2^\circ\text{C}$ ).

### NOTE 3. SURGE CURRENT ( $i_F$ )

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. ( $T_A = 25^\circ\text{C} +8, -2^\circ\text{C}$ ).

### NOTE 4. VOLTAGE REGULATION ( $\Delta V_Z$ )

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

### 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 5 watts divided by the actual  $V_Z$  of the device.  $T_L = 75^\circ\text{C}$  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  $\pm 1\%$  and  $\pm 2\%$ . Consult factory.

## TEMPERATURE COEFFICIENTS

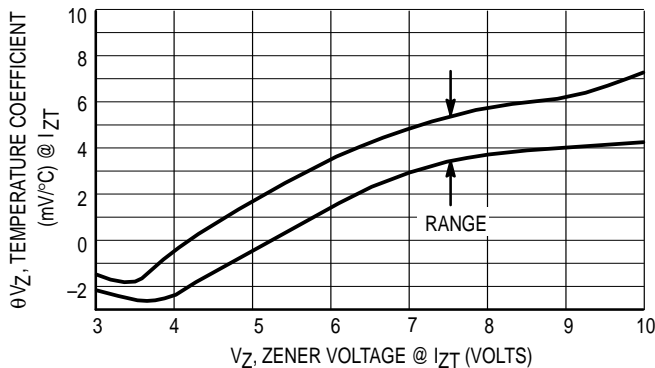


Figure 2. Temperature Coefficient-Range for Units 3 to 10 Volts

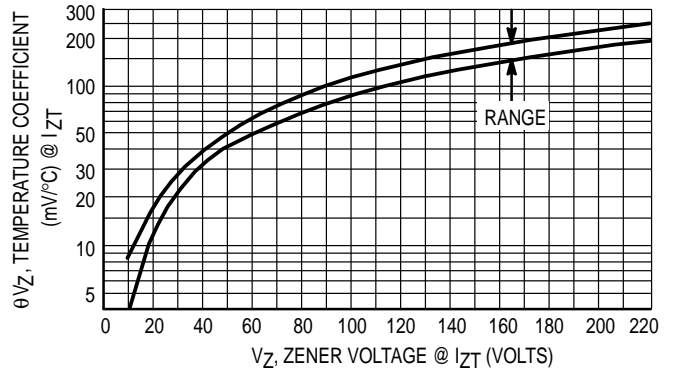
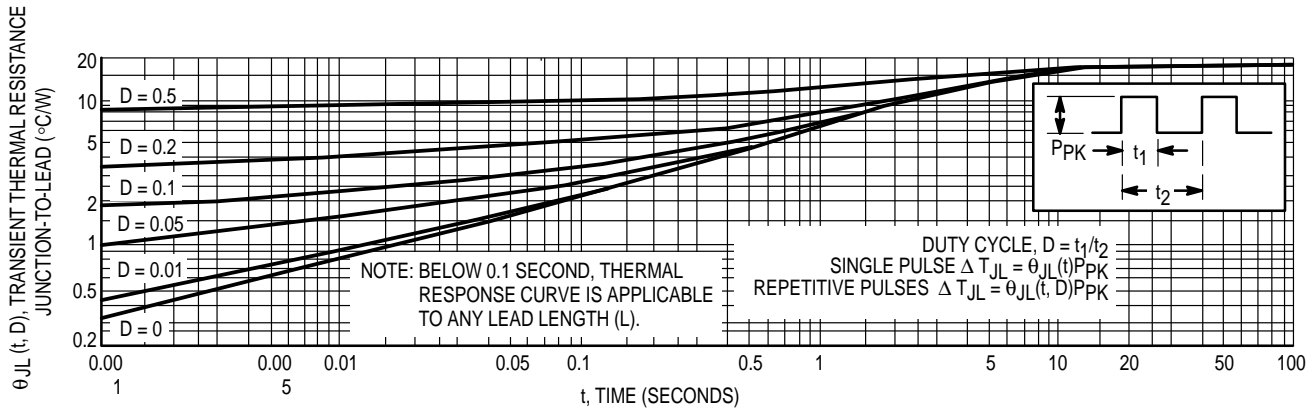


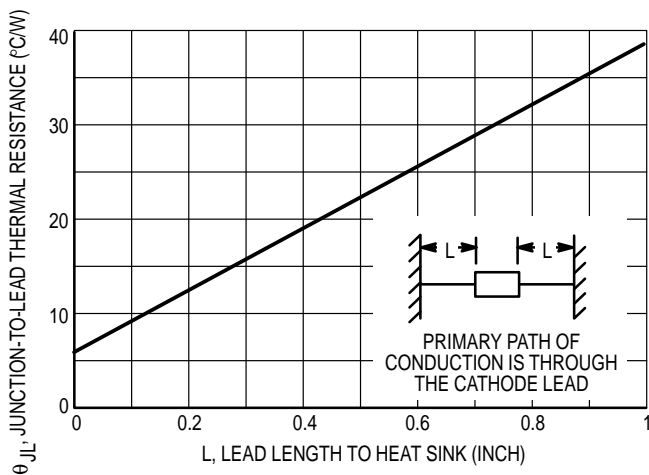
Figure 3. Temperature Coefficient-Range for Units 10 to 220 Volts

Devices listed in bold, italic are Motorola preferred devices.

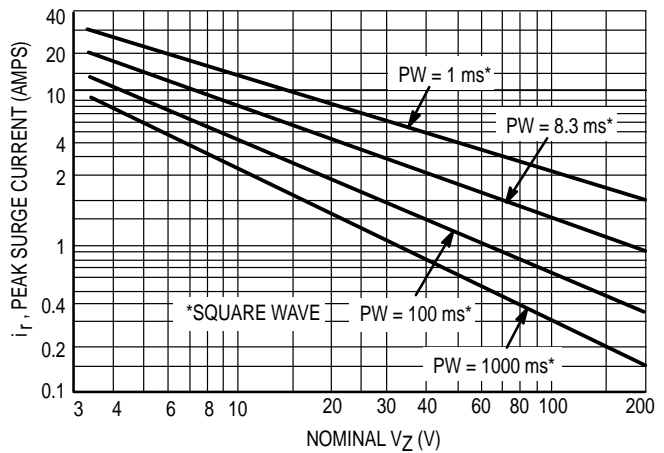
# 1N5333B through 1N5388B



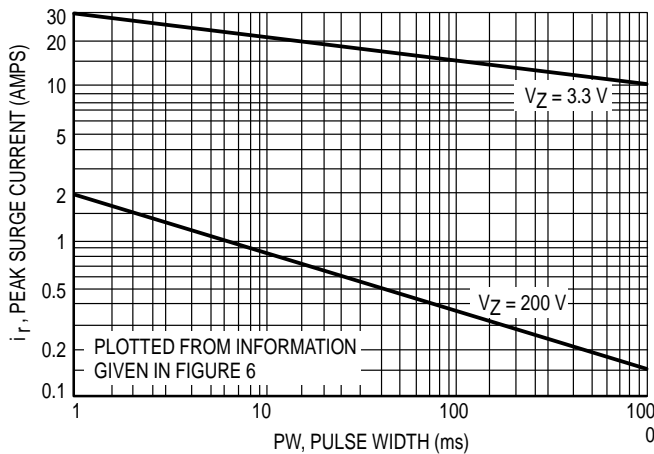
**Figure 4. Typical Thermal Response**  
L, Lead Length = 3/8 Inch



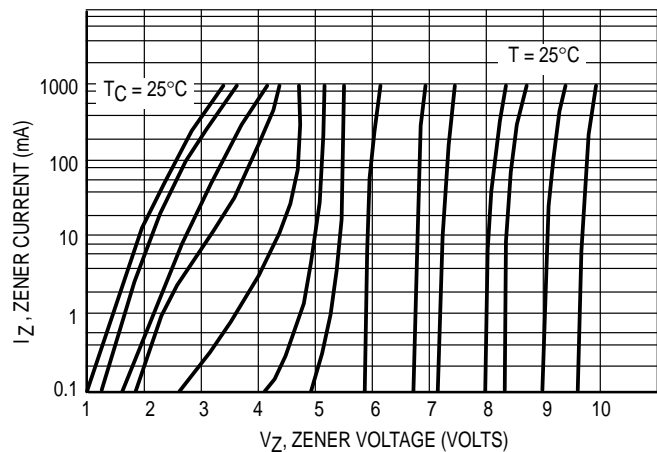
**Figure 5. Typical Thermal Resistance**



**Figure 6. Maximum Non-Repetitive Surge Current versus Nominal Zener Voltage**  
(See Note 3)



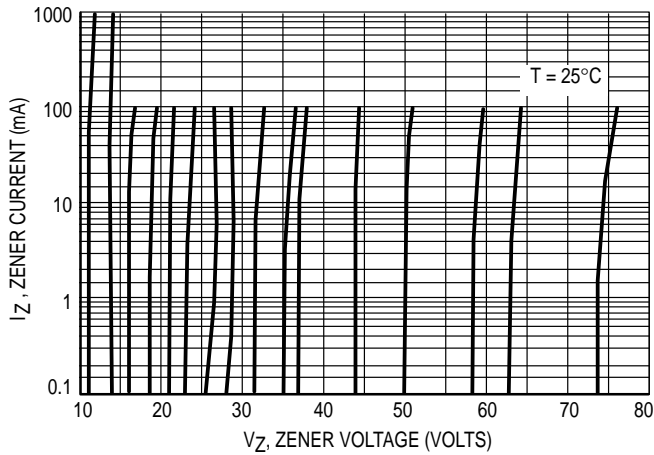
**Figure 7. Peak Surge Current versus Pulse Width**  
(See Note 3)



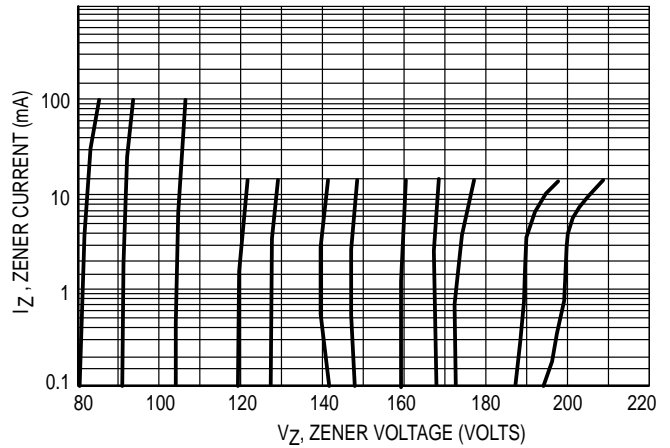
**Figure 8. Zener Voltage versus Zener Current**  
 $V_Z = 3.3$  thru 10 Volts



# 1N5333B through 1N5388B



**Figure 9. Zener Voltage versus Zener Current**  
 **$V_Z = 11$  thru  $75$  Volts**



**Figure 10. Zener Voltage versus Zener Current**  
 **$V_Z = 82$  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,  $T_L$ , should be determined from:

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

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

Junction Temperature,  $T_J$ , may be found from:

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

$\Delta T_{JL}$  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  $T_J$  ( $\Delta T_J$ ) may be estimated. Changes in voltage,  $V_Z$ , can then be found from:

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

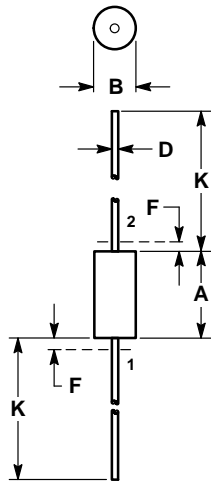
$\theta_{VZ}$ , the zener voltage temperature coefficient, is found from Figures 2 and 3.

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



NOTE:  
1. LEAD DIAMETER & FINISH NOT CONTROLLED  
WITHIN DIM F.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.330  | 0.350 | 8.38        | 8.89  |
| B   | 0.130  | 0.145 | 3.30        | 3.68  |
| D   | 0.037  | 0.043 | 0.94        | 1.09  |
| F   | —      | 0.050 | —           | 1.27  |
| K   | 1.000  | 1.250 | 25.40       | 31.75 |

CASE 17-02  
PLASTIC

(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  | TA              | 2K          |

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

This datasheet has been download from:

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Datasheets for electronics components.