

### FEATURES

- Available as High Reliability, JANTX level by adding “-HR” suffix.
- Available as non-RoHS (Sn/Pb plating), standard, and as RoHS by adding “-PBF” suffix.

### MAXIMUM RATINGS

| Parameter            | Value                                    |
|----------------------|--|
| Junction temperature | -65°C to +175°C                          |
| Storage temperature  | -65°C to +200°C                          |
| DC power dissipation | 10 watts                                 |
| Power derating       | 80 mW/°C above 50°C                      |
| Forward voltage      | @ 2.0 A: 1.5 volts                       |
| Thermal resistance   | 10°C/W (typical) junction to case (stud) |
| Solder temperature   | 260°C for 10 s (max)                     |

### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise specified)

| Part number<br>(note 1) | Nominal zener voltage<br>V <sub>Z</sub> @ I <sub>ZT</sub><br>(note 2) | Zener test current<br>(I <sub>ZT</sub> ) | Max. dynamic impedance<br>(note 3)        |   | Max DC zener current (I <sub>ZM</sub> )<br>@ 75°C stud temp<br>(note 4) | Typical temp. coefficient<br>α <sub>VZ</sub> | Max. reverse current<br>I <sub>R</sub> @ V <sub>R</sub> |       | Polarity                             |
|-------------------------|---|--|---|---|---|--|---|-------|--------------------------------------|
|                         | Volts   | mA                                       | Z <sub>ZT</sub> @ I <sub>ZT</sub><br>ohms | Z <sub>ZK</sub> @ 1mA<br>(I <sub>ZK</sub> )<br>ohms | mA  | %/°C   | μA  | Volts |                                      |
| 1N3993A                 | 3.9   | 640                                      | 2.0                                       | 400   | 2380  | -.046  | 100   | 0.5   | Standard polarity<br>cathode to stud |
| 1N3994A                 | 4.3   | 580                                      | 1.5                                       | 400   | 2130  | -.033  | 100   | 0.5   |                                      |
| 1N3995A                 | 4.7   | 530                                      | 1.2                                       | 500   | 1940  | -.015  | 50  | 1.0   |                                      |
| 1N3996A                 | 5.1   | 490                                      | 1.1                                       | 550   | 1780  | +/- .010                                     | 10  | 1.0   |                                      |
| 1N3997A                 | 5.6   | 445                                      | 1.0                                       | 600   | 1620  | + .030                                       | 10  | 1.0   |                                      |
| 1N3998A                 | 6.2   | 405                                      | 1.1                                       | 750   | 1460  | + .049                                       | 10  | 2.0   |                                      |
| 1N3999A                 | 6.8   | 370                                      | 1.2                                       | 500   | 1330  | + .040                                       | 10  | 2.0   |                                      |
| 1N4000A                 | 7.5   | 335                                      | 1.3                                       | 250   | 1210  | + .045                                       | 10  | 3.0   |                                      |
| 1N2970B                 | 6.8   | 370                                      | 1.2                                       | 500   | 1320  | .040   | 150   | 5.2   | Standard polarity<br>anode to stud   |
| 1N2971B                 | 7.5   | 335                                      | 1.3                                       | 250   | 1180  | .045   | 100   | 5.7   |                                      |
| 1N2972B                 | 8.2   | 305                                      | 1.5                                       | 250   | 1040  | .048   | 50  | 6.2   |                                      |
| 1N2973B                 | 9.1   | 275                                      | 2.0                                       | 250   | 960   | .051   | 25  | 6.9   |                                      |
| 1N2974B                 | 10  | 250                                      | 3   | 250   | 860   | .055   | 25  | 7.6   |                                      |
| 1N2975B                 | 11  | 230                                      | 3   | 250   | 780   | .060   | 10  | 8.4   |                                      |
| 1N2976B                 | 12  | 210                                      | 3   | 250   | 720   | .065   | 10  | 9.1   |                                      |
| 1N2977B                 | 13  | 190                                      | 3   | 250   | 660   | .065   | 10  | 9.9   |                                      |
| 1N2978B                 | 14  | 180                                      | 3   | 250   | 600   | .070   | 10  | 10.5  |                                      |
| 1N2979B                 | 15  | 170                                      | 3   | 250   | 560   | .070   | 10  | 11.4  |                                      |

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

| Part number<br>(note 1) | Nominal zener voltage<br>$V_Z @ I_{ZT}$<br>(note 2) | Zener test current<br>( $I_{ZT}$ ) | Max. dynamic impedance<br>(note 3) |   | Max DC zener current ( $I_{ZM}$ )<br>@ $75^\circ\text{C}$ stud temp<br>(note 4) | Typical temp. coefficient<br>$\alpha_{VZ}$ | Max. reverse current<br>$I_R @ V_R$ |       | Polarity                           |
|-------------------------|---|------------------------------------|------------------------------------|---|---|--|-------------------------------------|-------|------------------------------------|
|                         | Volts   | mA                                 | $Z_{ZT} @ I_{ZT}$<br>ohms          | $Z_{ZK} @ 1\text{mA}$<br>( $I_{ZK}$ )<br>ohms | mA  | %/ $^\circ\text{C}$                        | $\mu\text{A}$                       | Volts |                                    |
| 1N2980B                 | 16  | 155                                | 4                                  | 250   | 530   | .070                                       | 10                                  | 12.2  | Standard polarity<br>anode to stud |
| 1N2981B                 | 17  | 145                                | 4                                  | 250   | 500   | .075                                       | 10                                  | 13.0  |                                    |
| 1N2982B                 | 18  | 140                                | 4                                  | 250   | 460   | .075                                       | 10                                  | 13.7  |                                    |
| 1N2983B                 | 19  | 130                                | 4                                  | 250   | 440   | .075                                       | 10                                  | 14.0  |                                    |
| 1N2984B                 | 20  | 125                                | 4                                  | 250   | 420   | .075                                       | 10                                  | 15.2  |                                    |
| 1N2985B                 | 22  | 115                                | 5                                  | 250   | 380   | .080                                       | 10                                  | 16.7  |                                    |
| 1N2986B                 | 24  | 105                                | 5                                  | 250   | 350   | .080                                       | 10                                  | 18.2  |                                    |
| 1N2987B                 | 25  | 100                                | 6                                  | 250   | 310   | .080                                       | 10                                  | 18.2  |                                    |
| 1N2988B                 | 27  | 95                                 | 7                                  | 250   | 300   | .085                                       | 10                                  | 20.6  |                                    |
| 1N2989B                 | 30  | 85                                 | 8                                  | 300   | 280   | .085                                       | 10                                  | 22.8  |                                    |
| 1N2990B                 | 33  | 75                                 | 9                                  | 300   | 260   | .085                                       | 10                                  | 25.1  |                                    |
| 1N2991B                 | 36  | 70                                 | 10                                 | 300   | 230   | .085                                       | 10                                  | 27.4  |                                    |
| 1N2992B                 | 39  | 65                                 | 11                                 | 300   | 210   | .090                                       | 10                                  | 29.7  |                                    |
| 1N2993B                 | 43  | 60                                 | 12                                 | 400   | 195   | .090                                       | 10                                  | 32.7  |                                    |
| 1N2994B                 | 45  | 55                                 | 13                                 | 400   | 185   | .090                                       | 10                                  | 33.0  |                                    |
| 1N2995B                 | 47  | 55                                 | 14                                 | 400   | 175   | .090                                       | 10                                  | 35.8  |                                    |
| 1N2996B                 | 50  | 50                                 | 15                                 | 500   | 165   | .090                                       | 10                                  | 36.0  |                                    |
| 1N2997B                 | 51  | 50                                 | 15                                 | 500   | 160   | .090                                       | 10                                  | 38.8  |                                    |
| 1N2998B                 | 52  | 50                                 | 15                                 | 500   | 160   | .090                                       | 10                                  | 39.0  |                                    |
| 1N3099B                 | 56  | 45                                 | 16                                 | 500   | 150   | .090                                       | 10                                  | 42.6  |                                    |
| 1N3000B                 | 62  | 40                                 | 17                                 | 600   | 130   | .090                                       | 10                                  | 47.1  |                                    |
| 1N3001B                 | 68  | 37                                 | 18                                 | 600   | 120   | .090                                       | 10                                  | 51.7  |                                    |
| 1N3002B                 | 75  | 33                                 | 22                                 | 600   | 110   | .090                                       | 10                                  | 56.0  |                                    |
| 1N3003B                 | 82  | 30                                 | 25                                 | 700   | 100   | .090                                       | 10                                  | 62.2  |                                    |
| 1N3004B                 | 91  | 28                                 | 35                                 | 800   | 85  | .090                                       | 10                                  | 69.2  |                                    |
| 1N3005B                 | 100   | 25                                 | 40                                 | 900   | 80  | .090                                       | 10                                  | 76.0  |                                    |
| 1N3006B                 | 105   | 25                                 | 45                                 | 1000  | 75  | .095                                       | 10                                  | 76.0  |                                    |
| 1N3007B                 | 110   | 23                                 | 55                                 | 1100  | 72  | .095                                       | 10                                  | 83.6  |                                    |
| 1N3008B                 | 120   | 20                                 | 75                                 | 1200  | 67  | .095                                       | 10                                  | 91.2  |                                    |
| 1N3009B                 | 130   | 19                                 | 100                                | 1300  | 62  | .095                                       | 10                                  | 98.8  |                                    |
| 1N3010B                 | 140   | 18                                 | 125                                | 1400  | 58  | .095                                       | 10                                  | 100.0 |                                    |

| Part number<br>(note 1) | Nominal zener voltage<br>$V_z @ I_{ZT}$<br>(note 2) | Zener test current<br>( $I_{ZT}$ ) | Max. dynamic impedance<br>(note 3) |  | Max DC zener current ( $I_{ZM}$ )<br>@ 75°C stud temp<br>(note 4) | Typical temp. coefficient<br>$\alpha_{VZ}$ | Max. reverse current<br>$I_R @ V_R$ |       | Polarity                           |
|-------------------------|---|------------------------------------|------------------------------------|--|---|--|-------------------------------------|-------|------------------------------------|
|                         | Volts   | mA                                 | $Z_{ZT} @ I_{ZT}$<br>ohms          | $Z_{ZK} @ 1mA$<br>( $I_{ZK}$ )<br>ohms | mA  | %/°C                                       | $\mu A$                             | Volts |                                    |
| 1N3011B                 | 150   | 17                                 | 175                                | 1500                                   | 54  | .095                                       | 10                                  | 114.0 | Standard polarity<br>anode to stud |
| 1N3012B                 | 160   | 16                                 | 200                                | 1600                                   | 50  | .095                                       | 10                                  | 121.6 |                                    |
| 1N3013B                 | 175   | 14                                 | 250                                | 1750                                   | 46  | .095                                       | 10                                  | 135.0 |                                    |
| 1N3014B                 | 180   | 14                                 | 260                                | 1850                                   | 45  | .095                                       | 10                                  | 136.8 |                                    |
| 1N3015B                 | 200   | 12                                 | 300                                | 2000                                   | 40  | .100                                       | 10                                  | 152.0 |                                    |

Note 1: 1N3993-1N4000 series: suffix A indicates +/-5% tolerance, no suffix indicates +/-10% tolerance.

1N2970-1N3015 series: suffix B indicates +/-5% tolerance, suffix A indicates +/-10% no suffix indicates +/-20% tolerance, suffix C indicates +/-2% tolerance, suffix D indicates +/-1% tolerance.

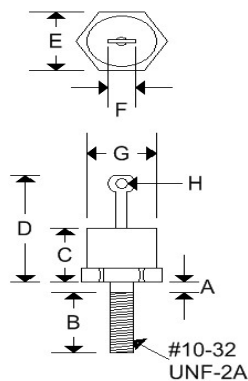
Note 2: The electrical characteristics are measured after allowing the device to stabilize for 90 seconds with 30°C base temperature

Note 3: The Zener impedance ( $Z_{ZT}$ ) 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 ( $I_{ZT}$  or  $I_{ZK}$ ) is superimposed on  $I_{ZT}$  or  $I_{ZK}$ . When making Zener impedance measurements at the  $I_{ZK}$  test point, it may be necessary to insert a 60 Hz band pass filter between the diode and the voltmeter to avoid errors resulting from low level noise signals.

Note 4: These values of  $I_{ZM}$  may be exceeded in the case of the individual diodes. The values shown are calculated for the worst case that is a unit of +/-5% tolerance at the high voltage end of its tolerance range. Allowance has also been made for the rise in Zener voltage above  $V_{ZT}$ , which results from Zener impedance and the increase in junction temperature as power dissipation approaches 10 watts.

### MECHANICAL CHARACTERISTICS

|          |                                 |
|----------|---------------------------------|
| Case     | DO-4                            |
| Marking  | Alpha-numeric                   |
| Polarity | Anode to stud (1N2970-1N3015)   |
|          | Cathode to stud (1N3993-1N4000) |



|   | DO-4   |       |             |        |
|---|--------|-------|-------------|--------|
|   | Inches |       | Millimeters |        |
|   | Min    | Max   | Min         | Max    |
| A | -      | 0.078 | -           | 1.981  |
| B | 0.422  | 0.453 | 10.719      | 11.506 |
| C | -      | 0.405 | -           | 10.287 |
| D | -      | 0.800 | -           | 20.320 |
| E | 0.420  | 0.440 | 10.668      | 11.176 |
| F | -      | 0.250 | -           | 6.350  |
| G | -      | 0.424 | -           | 10.770 |
| H | 0.066  | -     | 1.676       | -      |



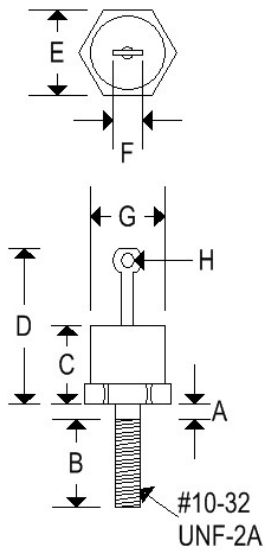
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# 1N2970-1N3015B, 1N3993-1N4000A

10 WATT ZENER DIODES

## MECHANICAL CHARACTERISTICS

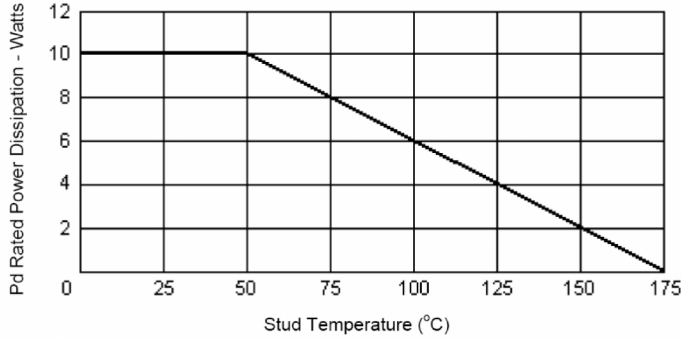
|                 |                                 |
|-----------------|---------------------------------|
| <b>Case</b>     | DO-4R                           |
| <b>Marking</b>  | Alpha-numeric                   |
| <b>Polarity</b> | Cathode to stud (1N2970-1N3015) |
|                 | Anode to stud (1N3993-1N4000)   |



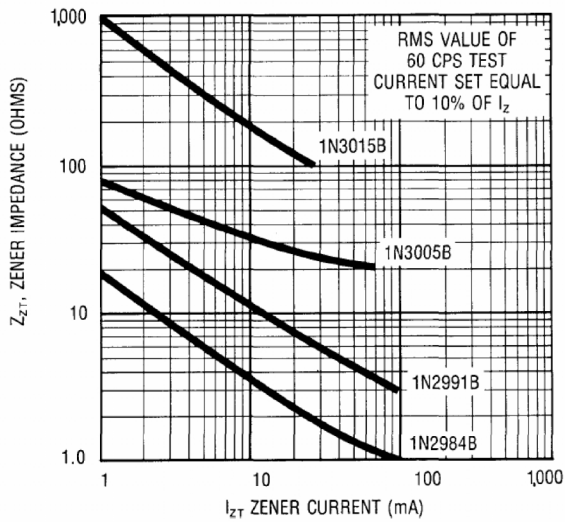
|          | DO-4R  |       |             |        |
|----------|--------|-------|-------------|--------|
|          | Inches |       | Millimeters |        |
|          | Min    | Max   | Min         | Max    |
| <b>A</b> | -      | 0.078 | -           | 1.981  |
| <b>B</b> | 0.422  | 0.453 | 10.719      | 11.506 |
| <b>C</b> | -      | 0.405 | -           | 10.287 |
| <b>D</b> | -      | 0.800 | -           | 20.320 |
| <b>E</b> | 0.420  | 0.440 | 10.668      | 11.176 |
| <b>F</b> | -      | 0.250 | -           | 6.350  |
| <b>G</b> | -      | 0.424 | -           | 10.770 |
| <b>H</b> | 0.066  | -     | 1.676       | -      |

# 1N2970-1N3015B, 1N3993-1N4000A

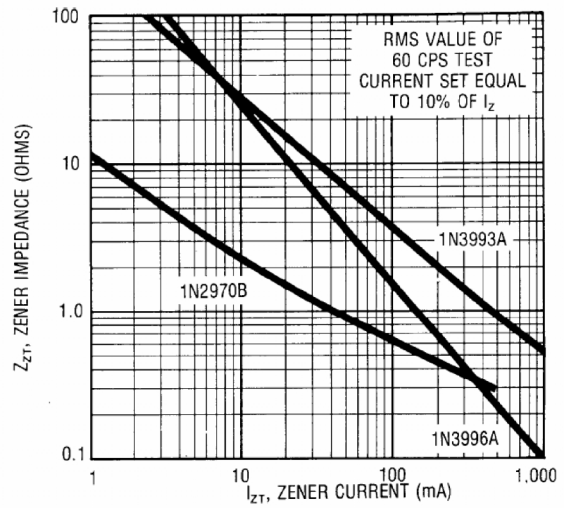
## 10 WATT ZENER DIODES



**FIGURE 1**  
Power Derating Curve



**FIGURE 2**  
Typical Zener Impedance vs. Zener Current  
For Types Shown



**FIGURE 3**  
Typical Zener Impedance vs. Zener Current  
For Types Shown