Microsemi
SCOTTSDALE DIVISION

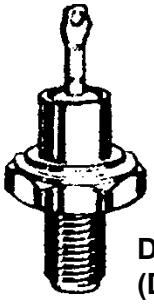
# 1N2970 thru 1N3015B and 1N3993 thru 1N4000A

## 10 WATT ZENER DIODES

## DESCRIPTION

These high power 10 W Zener diodes represented by the JEDEC registered 1N2970 thru 1N3015B and 1N3993 thru 1N4000A series provide voltage regulation in a selection over a 3.9 V to 200 V broad range of voltages. They may be operated up to 10 W with adequate mounting and heat sinking with their low thermal resistance. These Zeners are also available in JAN, JANTX, JANTXV military qualifications. Microsemi also offers numerous other Zener products to meet higher and lower power applications.

## APPEARANCE



**DO-4**
**(DO-203AA)**

**IMPORTANT:** For the most current data, consult *MICROSEMI's* website: http://www.microsemi.com

## FEATURES

- JEDEC registered 1N2970 thru 1N3015B and 1N3993 thru 1N4000A
- Internal solder bond construction
- Hermetically sealed (welded)
- Zener Voltage 3.9V to 200V.
- Also available in JAN, JANTX, and JANTXV qualifications per MIL-PRF-19500/124 by adding the JAN, JANTX, or JANTXV prefixes to part numbers for desired level of screening; (e.g. JANTX1N2970B, JANTXV1N3996A, etc.
- Standard polarity is anode to case (stud) for 1N2970 thru 1N3015B and cathode to case for 1N3993 thru 1N4000A
- Reverse polarity is cathode to case for 1N2970 thru 1N3015B and anode to case for 1N3993 thru 1N4000A by designating R suffix, e.g. 1N2970RB, 1N3993RA, etc.
- Consult factory for surface mount equivalents

## APPLICATIONS / BENEFITS

- Regulates voltage over a broad operating current and temperature range
- Standard voltage tolerances are +/- 5% with B suffix, +/-10% with an A suffix, and +/-20% with no suffix
- Consult factory for +/-2% or +/-1% voltage tolerance with a C or D suffix respectively
- Reverse polarity available
- Nonsensitive to ESD per MIL-STD-750 Method 1020
- Inherently radiation hard as described in Microsemi MicroNote 050

## MAXIMUM RATINGS

- Junction Temperatures: -65°C to +175°C
- Storage Temperatures: -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 temperatures: 260 °C for 10 s (max)

## MECHANICAL AND PACKAGING

- CASE: Industry Standard DO-4, (DO-203AA), 7/16" Hex, stud with 10-32 threads, welded, hermetically sealed metal and glass
- FINISH: All external surfaces are corrosion resistant and terminal solderable
- POLARITY: **1N3993 – 1N4000**: Std. Polarity is cathode to stud. Reverse polarity (anode to stud) indicated by suffix "R"
  **1N2970 – 1N3015**: Std. Polarity is anode to stud. Reverse polarity indicated by suffix "R"
- WEIGHT: 7.5 grams
- MOUNTING HARDWARE: Consult factory for optional insulator, bushing solder terminal, washers, and nut
- See package dimension on last page



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## ELECTRICAL CHARACTERISTICS @ 30°C Case Temperature

| JEDEC TYPE NO. (Note 1) | NOMINAL ZENER VOLTAGE $V_Z$ @ $I_{ZT}$ (Note 2) | ZENER TEST CURRENT ($I_{ZT}$) | MAX. DYNAMIC IMPEDANCE (Note 3) | | MAX. DC ZENER CURRENT ($I_{ZM}$) @ 75°C Stud Temp. (Note 4) | TYPICAL TEMP. COEFF. $\alpha_{VZ}$ | MAX** REVERSE CURRENT $I_R$ @ $V_R$ | | POLARITY |
|---|---|---|---|---|---|---|---|---|---|
| | | | $Z_{ZT}$ @ $I_{ZT}$ OHMS | $Z_{ZK}$ @ 1mA ($I_{ZK}$) OHMS | | | | | |
| | Volts | mA | | | mA | %/°C | µA | Volts | |
| †1N3993A | 3.9 | 640 | 2.0 | 400 | 2380 | -.046 | 100 | 0.5 | |
| †1N3994A | 4.3 | 580 | 1.5 | 400 | 2130 | -.033 | 100 | 0.5 | STD. |
| †1N3995A | 4.7 | 530 | 1.2 | 500 | 1940 | -.015 | 50 | 1.0 | POLARITY |
| †1N3996A | 5.1 | 490 | 1.1 | 550 | 1780 | +/-.010 | 10 | 1.0 | CATHODE |
| †1N3997A | 5.6 | 445 | 1.0 | 600 | 1620 | +.030 | 10 | 1.0 | TO |
| †1N3998A | 6.2 | 405 | 1.1 | 750 | 1460 | +.049 | 10 | 2.0 | STUD |
| †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 | |
| †1N2971B | 7.5 | 335 | 1.3 | 250 | 1180 | .045 | 100 | 5.7 | STD. |
| †1N2972B | 8.2 | 305 | 1.5 | 250 | 1040 | .048 | 50 | 6.2 | POLARITY |
| †1N2973B | 9.1 | 275 | 2.0 | 250 | 960 | .051 | 25 | 6.9 | ANODE |
| †1N2974B | 10 | 250 | 3 | 250 | 860 | .055 | 25 | 7.6 | TO STUD |
| †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 | |
| †1N2980B | 16 | 155 | 4 | 250 | 530 | .070 | 10 | 12.2 | |
| 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 | |
| †1N3011B | 150 | 17 | 175 | 1500 | 54 | .095 | 10 | 114.0 | |
| †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 | |

*JEDEC Registered Data. **Not JEDEC Data.

†Have JAN and JANTX Qualifications to MIL-PRF-19500/124.

See further notes on following page

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**NOTES:**

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. If tighter tolerance is required, consult factory.
2. The electrical characteristics are measured after allowing the device to stabilize for 90 seconds with 30°C Base temperature.
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 voltmeter to avoid errors resulting from low level noise signals. A curve showing the variation of zener impedance vs. zener current for three representative types is shown in Figures 2 and 3. Also see Microsemi MicroNote 202.
4. These values of $I_{ZM}$ may be exceeded in the case of 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.

## GRAPHS

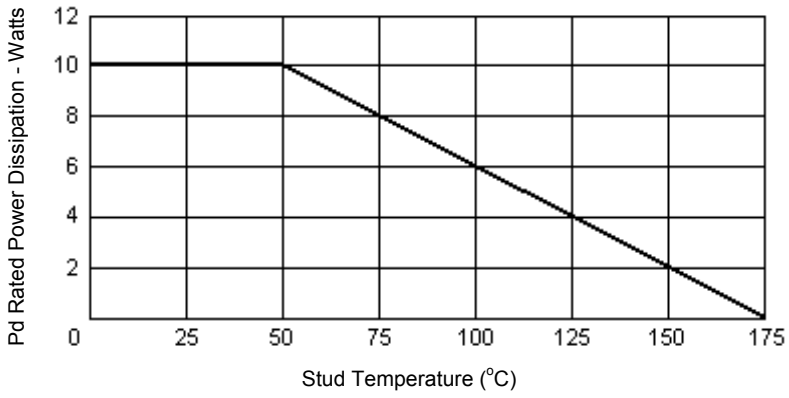



**FIGURE 1**
Power Derating Curve

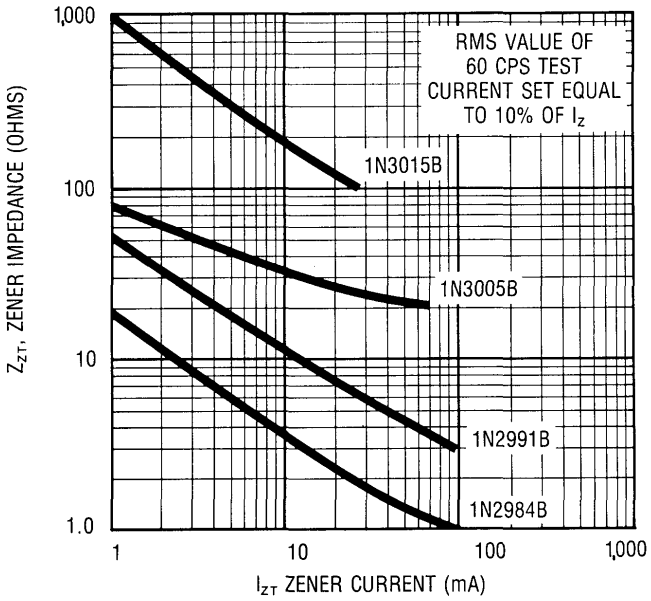



**FIGURE 2**
Typical Zener Impedance vs. Zener Current
For Types Shown

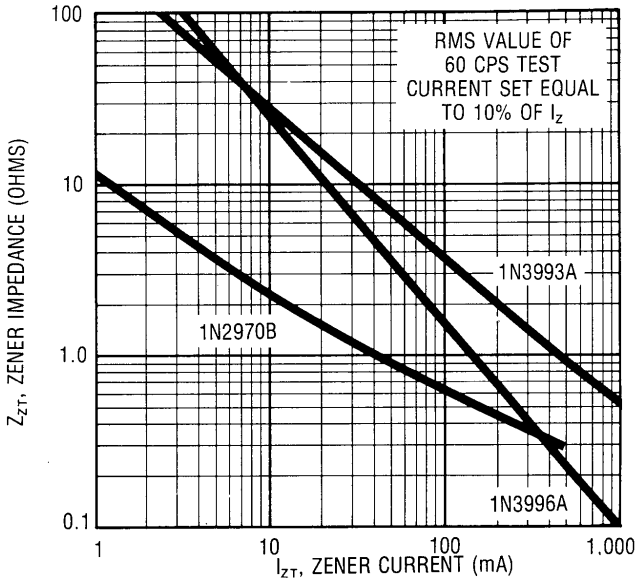
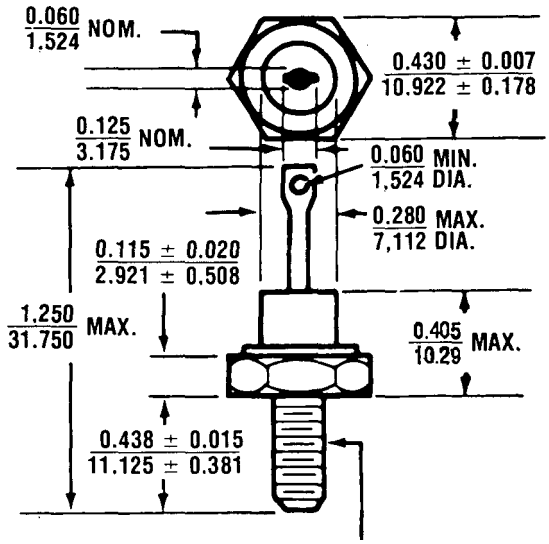



**FIGURE 3**
Typical Zener Impedance vs. Zener Current
For Types Shown



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## PACKAGE DIMENSIONS




10-32 UNF-2A (MOD) PITCH DIA.
MIN. .1658 MAX. .1697 TO WITH-
STAND A TORQUE UP TO 30 IN-LB.
WHEN NUT IS TIGHTENED ON STUD

All dimensions in: INCH
mm



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