

# 1N5333B Series

Preferred Device

## 5 Watt Surmetic™ 40 Zener Voltage Regulators

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 in an axial lead, transfer-molded plastic package that offers protection in all common environmental conditions.

### Features

- Zener Voltage Range – 3.3 V to 200 V
- ESD Rating of Class 3 (>16 kV) per Human Body Model
- Surge Rating of up to 180 W @ 8.3 ms
- Maximum Limits Guaranteed on up to Six Electrical Parameters
- Pb-Free Packages are Available

### Mechanical Characteristics

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

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

**MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES:** 230°C, 1/16 in. from the case for 10 seconds

**POLARITY:** Cathode indicated by polarity band

**MOUNTING POSITION:** Any

### MAXIMUM RATINGS

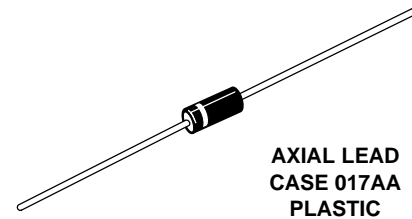
| Rating  | Symbol         | Value       | Unit  |
|---|----------------|-------------|-------|
| Max. Steady State Power Dissipation<br>@ $T_L = 75^\circ\text{C}$ , Lead Length = 3/8 in<br>Derate above 75°C | $P_D$          | 5           | W     |
|   |                | 40          | mW/°C |
| Operating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

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

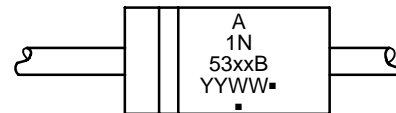


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### MARKING DIAGRAM



A = Assembly Location  
1N53xxB = Device Number  
(Refer to Tables on Pages 3 & 4)  
YY = Year  
WW = Work Week  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package                 | Shipping†        |
|--------------|-------------------------|------------------|
| 1N53xxB, G   | Axial Lead<br>(Pb-Free) | 1000 Units/Box   |
| 1N53xxBRL, G | Axial Lead<br>(Pb-Free) | 4000/Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Preferred devices are recommended choices for future use and best overall value.

# 1N5333B Series

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 1.2\text{ V Max}$  @  $I_F = 1.0\text{ A}$  for all types)

| Device <sup>†</sup><br>(Note 1) | Device<br>Marking | Zener Voltage (Note 2) |            |              |            | Zener Impedance (Note 2) |                     |          | Leakage<br>Current |             | $I_R$<br>(Note 3) | $\Delta V_Z$<br>(Note 4) | $I_{ZM}$<br>(Note 5) |
|---------------------------------|-------------------|------------------------|------------|--------------|------------|--------------------------|---------------------|----------|--------------------|-------------|-------------------|--------------------------|----------------------|
|                                 |                   | $V_Z$ (Volts)          |            |              | @ $I_{ZT}$ | $Z_{ZT}$ @ $I_{ZT}$      | $Z_{ZK}$ @ $I_{ZK}$ | $I_{ZK}$ | $I_R$ @ $V_R$      |             |                   |                          |                      |
|                                 |                   | Min                    | Nom        | Max          | mA         | $\Omega$                 | $\Omega$            | mA       | $\mu\text{A Max}$  | Volts       |                   |                          |                      |
| <b>1N5333B, G</b>               | <b>1N5333B</b>    | <b>3.14</b>            | <b>3.3</b> | <b>3.47</b>  | <b>380</b> | <b>3</b>                 | <b>400</b>          | <b>1</b> | <b>300</b>         | <b>1</b>    | <b>20</b>         | <b>0.85</b>              | <b>1440</b>          |
| 1N5334B, G                      | 1N5334B           | 3.42                   | 3.6        | 3.78         | 350        | 2.5                      | 500                 | 1        | 150                | 1           | 18.7              | 0.8                      | 1320                 |
| 1N5335B, G                      | 1N5335B           | 3.71                   | 3.9        | 4.10         | 320        | 2                        | 500                 | 1        | 50                 | 1           | 17.6              | 0.54                     | 1220                 |
| 1N5336B, G                      | 1N5336B           | 4.09                   | 4.3        | 4.52         | 290        | 2                        | 500                 | 1        | 10                 | 1           | 16.4              | 0.49                     | 1100                 |
| <b>1N5337B, G</b>               | <b>1N5337B</b>    | <b>4.47</b>            | <b>4.7</b> | <b>4.94</b>  | <b>260</b> | <b>2</b>                 | <b>450</b>          | <b>1</b> | <b>5</b>           | <b>1</b>    | <b>15.3</b>       | <b>0.44</b>              | <b>1010</b>          |
| <b>1N5338B, G</b>               | <b>1N5338B</b>    | <b>4.85</b>            | <b>5.1</b> | <b>5.36</b>  | <b>240</b> | <b>1.5</b>               | <b>400</b>          | <b>1</b> | <b>1</b>           | <b>1</b>    | <b>14.4</b>       | <b>0.39</b>              | <b>930</b>           |
| <b>1N5339B, G</b>               | <b>1N5339B</b>    | <b>5.32</b>            | <b>5.6</b> | <b>5.88</b>  | <b>220</b> | <b>1</b>                 | <b>400</b>          | <b>1</b> | <b>1</b>           | <b>2</b>    | <b>13.4</b>       | <b>0.25</b>              | <b>865</b>           |
| 1N5340B, G                      | 1N5340B           | 5.70                   | 6.0        | 6.30         | 200        | 1                        | 300                 | 1        | 1                  | 3           | 12.7              | 0.19                     | 790                  |
| <b>1N5341B, G</b>               | <b>1N5341B</b>    | <b>5.89</b>            | <b>6.2</b> | <b>6.51</b>  | <b>200</b> | <b>1</b>                 | <b>200</b>          | <b>1</b> | <b>1</b>           | <b>3</b>    | <b>12.4</b>       | <b>0.1</b>               | <b>765</b>           |
| <b>1N5342B, G</b>               | <b>1N5342B</b>    | <b>6.46</b>            | <b>6.8</b> | <b>7.14</b>  | <b>175</b> | <b>1</b>                 | <b>200</b>          | <b>1</b> | <b>10</b>          | <b>5.2</b>  | <b>11.5</b>       | <b>0.15</b>              | <b>700</b>           |
| 1N5343B, G                      | 1N5343B           | 7.13                   | 7.5        | 7.88         | 175        | 1.5                      | 200                 | 1        | 10                 | 5.7         | 10.7              | 0.15                     | 630                  |
| 1N5344B, G                      | 1N5344B           | 7.79                   | 8.2        | 8.61         | 150        | 1.5                      | 200                 | 1        | 10                 | 6.2         | 10                | 0.2                      | 580                  |
| 1N5345B, G                      | 1N5345B           | 8.27                   | 8.7        | 9.14         | 150        | 2                        | 200                 | 1        | 10                 | 6.6         | 9.5               | 0.2                      | 545                  |
| 1N5346B, G                      | 1N5346B           | 8.65                   | 9.1        | 9.56         | 150        | 2                        | 150                 | 1        | 7.5                | 6.9         | 9.2               | 0.22                     | 520                  |
| <b>1N5347B, G</b>               | <b>1N5347B</b>    | <b>9.50</b>            | <b>10</b>  | <b>10.5</b>  | <b>125</b> | <b>2</b>                 | <b>125</b>          | <b>1</b> | <b>5</b>           | <b>7.6</b>  | <b>8.6</b>        | <b>0.22</b>              | <b>475</b>           |
| 1N5348B, G                      | 1N5348B           | 10.45                  | 11         | 11.55        | 125        | 2.5                      | 125                 | 1        | 5                  | 8.4         | 8.0               | 0.25                     | 430                  |
| <b>1N5349B, G</b>               | <b>1N5349B</b>    | <b>11.4</b>            | <b>12</b>  | <b>12.6</b>  | <b>100</b> | <b>2.5</b>               | <b>125</b>          | <b>1</b> | <b>2</b>           | <b>9.1</b>  | <b>7.5</b>        | <b>0.25</b>              | <b>395</b>           |
| <b>1N5350B, G</b>               | <b>1N5350B</b>    | <b>12.35</b>           | <b>13</b>  | <b>13.65</b> | <b>100</b> | <b>2.5</b>               | <b>100</b>          | <b>1</b> | <b>1</b>           | <b>9.9</b>  | <b>7.0</b>        | <b>0.25</b>              | <b>365</b>           |
| 1N5351B, G                      | 1N5351B           | 13.3                   | 14         | 14.7         | 100        | 2.5                      | 75                  | 1        | 1                  | 10.6        | 6.7               | 0.25                     | 340                  |
| <b>1N5352B, G</b>               | <b>1N5352B</b>    | <b>14.25</b>           | <b>15</b>  | <b>15.75</b> | <b>75</b>  | <b>2.5</b>               | <b>75</b>           | <b>1</b> | <b>1</b>           | <b>11.5</b> | <b>6.3</b>        | <b>0.25</b>              | <b>315</b>           |
| <b>1N5353B, G</b>               | <b>1N5353B</b>    | <b>15.2</b>            | <b>16</b>  | <b>16.8</b>  | <b>75</b>  | <b>2.5</b>               | <b>75</b>           | <b>1</b> | <b>1</b>           | <b>12.2</b> | <b>6.0</b>        | <b>0.3</b>               | <b>295</b>           |
| 1N5354B, G                      | 1N5354B           | 16.15                  | 17         | 17.85        | 70         | 2.5                      | 75                  | 1        | 0.5                | 12.9        | 5.8               | 0.35                     | 280                  |
| 1N5355B, G                      | 1N5355B           | 17.1                   | 18         | 18.9         | 65         | 2.5                      | 75                  | 1        | 0.5                | 13.7        | 5.5               | 0.4                      | 264                  |
| 1N5356B, G                      | 1N5356B           | 18.05                  | 19         | 19.95        | 65         | 3                        | 75                  | 1        | 0.5                | 14.4        | 5.3               | 0.4                      | 250                  |
| 1N5357B, G                      | 1N5357B           | 19                     | 20         | 21           | 65         | 3                        | 75                  | 1        | 0.5                | 15.2        | 5.1               | 0.4                      | 237                  |
| <b>1N5358B, G</b>               | <b>1N5358B</b>    | <b>20.9</b>            | <b>22</b>  | <b>23.1</b>  | <b>50</b>  | <b>3.5</b>               | <b>75</b>           | <b>1</b> | <b>0.5</b>         | <b>16.7</b> | <b>4.7</b>        | <b>0.45</b>              | <b>216</b>           |
| <b>1N5359B, G</b>               | <b>1N5359B</b>    | <b>22.8</b>            | <b>24</b>  | <b>25.2</b>  | <b>50</b>  | <b>3.5</b>               | <b>100</b>          | <b>1</b> | <b>0.5</b>         | <b>18.2</b> | <b>4.4</b>        | <b>0.55</b>              | <b>198</b>           |
| 1N5360B, G                      | 1N5360B           | 23.75                  | 25         | 26.25        | 50         | 4                        | 110                 | 1        | 0.5                | 19          | 4.3               | 0.55                     | 190                  |
| <b>1N5361B, G</b>               | <b>1N5361B</b>    | <b>25.65</b>           | <b>27</b>  | <b>28.35</b> | <b>50</b>  | <b>5</b>                 | <b>120</b>          | <b>1</b> | <b>0.5</b>         | <b>20.6</b> | <b>4.1</b>        | <b>0.6</b>               | <b>176</b>           |
| 1N5362B, G                      | 1N5362B           | 26.6                   | 28         | 29.4         | 50         | 6                        | 130                 | 1        | 0.5                | 21.2        | 3.9               | 0.6                      | 170                  |

Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

**1. TOLERANCE AND TYPE NUMBER DESIGNATION**

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

**2. ZENER VOLTAGE ( $V_Z$ ) and IMPEDANCE ( $I_{ZT}$  and  $I_{ZK}$ )**

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

**3. SURGE CURRENT ( $I_R$ )**

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 5 may be used to find the maximum surge current for a square wave of any pulse width between 1 ms and 1000 ms by plotting the applicable points on logarithmic paper. Examples of this, using the 3.3 V and 200 V zener are shown in Figure 6. Mounting contact located as specified in Note 2 ( $T_A = 25^\circ\text{C} + 8^\circ\text{C}, -2^\circ\text{C}$ ).

**4. VOLTAGE REGULATION ( $\Delta V_Z$ )**

The 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. Mounting contact located as specified in Note 2 ( $T_A = 25^\circ\text{C} + 8^\circ\text{C}, -2^\circ\text{C}$ ).

**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.

†The "G" suffix indicates Pb-Free package available.

# 1N5333B Series

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 1.2\text{ V Max}$  @  $I_F = 1.0\text{ A}$  for all types)

| Device <sup>†</sup><br>(Note 6) | Device<br>Marking | Zener Voltage (Note 7) |            |              |            | Zener Impedance (Note 7) |                     |          | Leakage<br>Current |             | $I_R$<br>(Note 8) | $\Delta V_Z$<br>(Note 9) | $I_{ZM}$<br>(Note 10) |
|---------------------------------|-------------------|------------------------|------------|--------------|------------|--------------------------|---------------------|----------|--------------------|-------------|-------------------|--------------------------|-----------------------|
|                                 |                   | $V_Z$ (Volts)          |            |              | @ $I_{ZT}$ | $Z_{ZT}$ @ $I_{ZT}$      | $Z_{ZK}$ @ $I_{ZK}$ | $I_{ZK}$ | $I_R$ @ $V_R$      |             |                   |                          |                       |
|                                 |                   | Min                    | Nom        | Max          | mA         | $\Omega$                 | $\Omega$            | mA       | $\mu\text{A Max}$  | Volts       |                   |                          |                       |
| 1N5363B, G                      | 1N5363B           | 28.5                   | 30         | 31.5         | 40         | 8                        | 140                 | 1        | 0.5                | 22.8        | 3.7               | 0.6                      | 158                   |
| 1N5364B, G                      | 1N5364B           | 31.35                  | 33         | 34.65        | 40         | 10                       | 150                 | 1        | 0.5                | 25.1        | 3.5               | 0.6                      | 144                   |
| <b>1N5365B, G</b>               | <b>1N5365B</b>    | <b>34.2</b>            | <b>36</b>  | <b>37.8</b>  | <b>30</b>  | <b>11</b>                | <b>160</b>          | <b>1</b> | <b>0.5</b>         | <b>27.4</b> | <b>3.5</b>        | <b>0.65</b>              | <b>132</b>            |
| 1N5366B, G                      | 1N5366B           | 37.05                  | 39         | 40.95        | 30         | 14                       | 170                 | 1        | 0.5                | 29.7        | 3.1               | 0.65                     | 122                   |
| 1N5367B, G                      | 1N5367B           | 40.85                  | 43         | 45.15        | 30         | 20                       | 190                 | 1        | 0.5                | 32.7        | 2.8               | 0.7                      | 110                   |
| <b>1N5368B, G</b>               | <b>1N5368B</b>    | <b>44.65</b>           | <b>47</b>  | <b>49.35</b> | <b>25</b>  | <b>25</b>                | <b>210</b>          | <b>1</b> | <b>0.5</b>         | <b>35.8</b> | <b>2.7</b>        | <b>0.8</b>               | <b>100</b>            |
| 1N5369B, G                      | 1N5369B           | 48.45                  | 51         | 53.55        | 25         | 27                       | 230                 | 1        | 0.5                | 38.8        | 2.5               | 0.9                      | 93                    |
| 1N5370B, G                      | 1N5370B           | 53.2                   | 56         | 58.8         | 20         | 35                       | 280                 | 1        | 0.5                | 42.6        | 2.3               | 1.0                      | 86                    |
| 1N5371B, G                      | 1N5371B           | 57                     | 60         | 63           | 20         | 40                       | 350                 | 1        | 0.5                | 45.5        | 2.2               | 1.2                      | 79                    |
| 1N5372B, G                      | 1N5372B           | 58.9                   | 62         | 65.1         | 20         | 42                       | 400                 | 1        | 0.5                | 47.1        | 2.1               | 1.35                     | 76                    |
| 1N5373B, G                      | 1N5373B           | 64.6                   | 68         | 71.4         | 20         | 44                       | 500                 | 1        | 0.5                | 51.7        | 2.0               | 1.52                     | 70                    |
| 1N5374B, G                      | 1N5374B           | 71.25                  | 75         | 78.75        | 20         | 45                       | 620                 | 1        | 0.5                | 56          | 1.9               | 1.6                      | 63                    |
| 1N5375B, G                      | 1N5375B           | 77.9                   | 82         | 86.1         | 15         | 65                       | 720                 | 1        | 0.5                | 62.2        | 1.8               | 1.8                      | 58                    |
| 1N5376B, G                      | 1N5376B           | 82.65                  | 87         | 91.35        | 15         | 75                       | 760                 | 1        | 0.5                | 66          | 1.7               | 2.0                      | 54.5                  |
| 1N5377B, G                      | 1N5377B           | 86.45                  | 91         | 95.55        | 15         | 75                       | 760                 | 1        | 0.5                | 69.2        | 1.6               | 2.2                      | 52.5                  |
| 1N5378B, G                      | 1N5378B           | 95                     | 100        | 105          | 12         | 90                       | 800                 | 1        | 0.5                | 76          | 1.5               | 2.5                      | 47.5                  |
| 1N5379B, G                      | 1N5379B           | 104.5                  | 110        | 115.5        | 12         | 125                      | 1000                | 1        | 0.5                | 83.6        | 1.4               | 2.5                      | 43                    |
| 1N5380B, G                      | 1N5380B           | 114                    | 120        | 126          | 10         | 170                      | 1150                | 1        | 0.5                | 91.2        | 1.3               | 2.5                      | 39.5                  |
| 1N5381B, G                      | 1N5381B           | 123.5                  | 130        | 136.5        | 10         | 190                      | 1250                | 1        | 0.5                | 98.8        | 1.2               | 2.5                      | 36.6                  |
| 1N5382B, G                      | 1N5382B           | 133                    | 140        | 147          | 8          | 230                      | 1500                | 1        | 0.5                | 106         | 1.2               | 2.5                      | 34                    |
| <b>1N5383B, G</b>               | <b>1N5383B</b>    | <b>142.5</b>           | <b>150</b> | <b>157.5</b> | <b>8</b>   | <b>330</b>               | <b>1500</b>         | <b>1</b> | <b>0.5</b>         | <b>114</b>  | <b>1.1</b>        | <b>3.0</b>               | <b>31.6</b>           |
| 1N5384B, G                      | 1N5384B           | 152                    | 160        | 168          | 8          | 350                      | 1650                | 1        | 0.5                | 122         | 1.1               | 3.0                      | 29.4                  |
| 1N5385B, G                      | 1N5385B           | 161.5                  | 170        | 178.5        | 8          | 380                      | 1750                | 1        | 0.5                | 129         | 1.0               | 3.0                      | 28                    |
| 1N5386B, G                      | 1N5386B           | 171                    | 180        | 189          | 5          | 430                      | 1750                | 1        | 0.5                | 137         | 1.0               | 4.0                      | 26.4                  |
| 1N5387B, G                      | 1N5387B           | 180.5                  | 190        | 199.5        | 5          | 450                      | 1850                | 1        | 0.5                | 144         | 0.9               | 5.0                      | 25                    |
| 1N5388B, G                      | 1N5388B           | 190                    | 200        | 210          | 5          | 480                      | 1850                | 1        | 0.5                | 152         | 0.9               | 5.0                      | 23.6                  |

Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. **Preferred** devices are recommended choices for future use and best overall value.

**6. TOLERANCE AND TYPE NUMBER DESIGNATION**

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

**7. ZENER VOLTAGE ( $V_Z$ ) and IMPEDANCE ( $I_{ZT}$  and  $I_{ZK}$ )**

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

**8. SURGE CURRENT ( $I_R$ )**

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 5 may be used to find the maximum surge current for a square wave of any pulse width between 1 ms and 1000 ms by plotting the applicable points on logarithmic paper. Examples of this, using the 3.3 V and 200 V zener are shown in Figure 6. Mounting contact located as specified in Note 7 ( $T_A = 25^\circ\text{C}$   $+8^\circ\text{C}$ ,  $-2^\circ\text{C}$ ).

**9. VOLTAGE REGULATION ( $\Delta V_Z$ )**

The 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. Mounting contact located as specified in Note 7 ( $T_A = 25^\circ\text{C}$   $+8^\circ\text{C}$ ,  $-2^\circ\text{C}$ ).

**10. 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.

†The "G" suffix indicates Pb-Free package available.

# 1N5333B Series

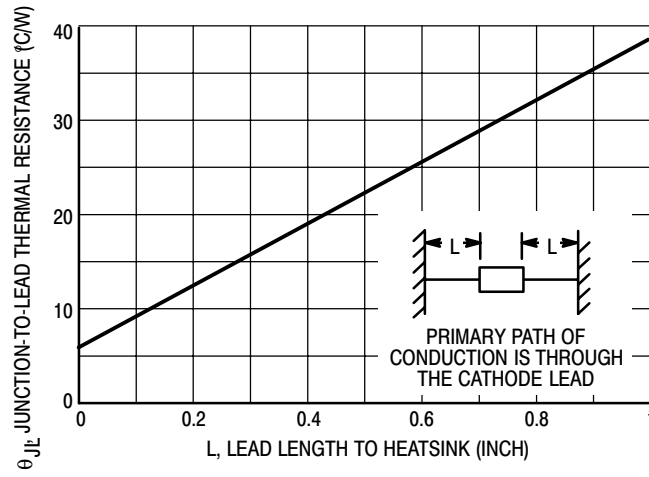


Figure 1. Typical Thermal Resistance

## TEMPERATURE COEFFICIENTS

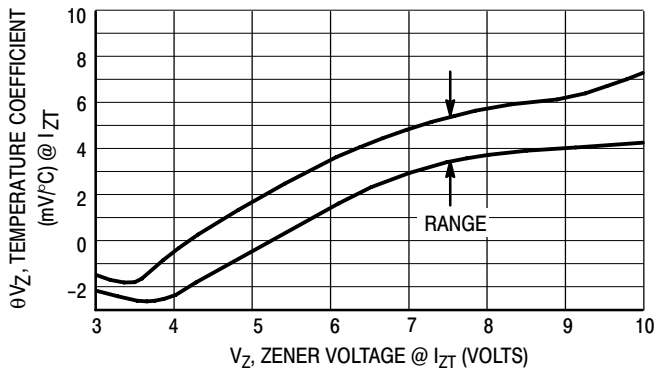


Figure 2. Temperature Coefficient-Range for Units 3 to 10 Volts

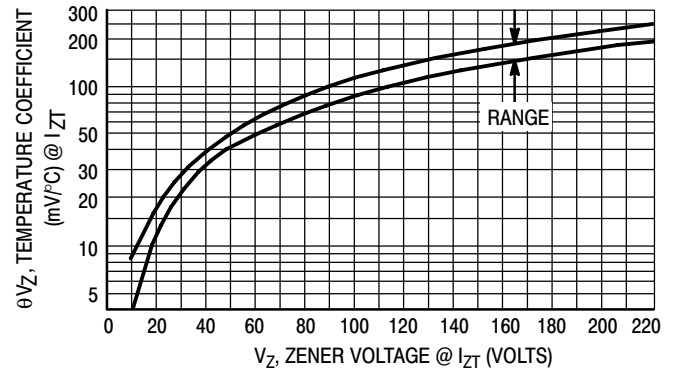


Figure 3. Temperature Coefficient-Range for Units 10 to 220 Volts