

### SZP6SMB Series



#### Description

The SZP6SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, low breakdown impedance and fast response time. The SZP6SMB series is supplied in the Littelfuse exclusive, cost-effective, highly reliable package and is ideally suited for use in communication systems, automotive, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

#### Agency Approvals

| AGENCY  | AGENCY FILE NUMBER |
|---|--------------------|
|  | E128662            |

#### Maximum Ratings and Thermal Characteristics

| Parameter  | Symbol          | Value       | Unit                       |
|--|-----------------|-------------|----------------------------|
| Peak Power Dissipation (Note 1) @ $T_L = 25^\circ\text{C}$ , Pulse Width = 1 ms  | $P_{PK}$        | 600         | W                          |
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$<br>Measured Zero Lead Length (Note 2)<br>Derate Above $75^\circ\text{C}$<br>Thermal Resistance from Junction-to-Lead | PD              | 3.0         | W                          |
|  | $R_{\theta JL}$ | 40          | $\text{mW}/^\circ\text{C}$ |
|  |                 | 25          | $^\circ\text{C}/\text{W}$  |
| DC Power Dissipation (Note 3) @ $T_A = 25^\circ\text{C}$<br>Derate Above $25^\circ\text{C}$<br>Thermal Resistance from Junction-to-Ambient                           | $P_D$           | 0.55        | W                          |
|  | $R_{\theta JL}$ | 4.4         | $\text{mW}/^\circ\text{C}$ |
|  |                 | 226         | $^\circ\text{C}/\text{W}$  |
| Forward Surge Current (Note 4) @ $T_A = 25^\circ\text{C}$  | $I_{FSM}$       | 100         | A                          |
| Operating and Storage Temperature Range  | $T_J, T_{stg}$  | -65 to +150 | $^\circ\text{C}$           |

Stresses exceeding those listed in the Maximum Ratings table may damage the component. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- 10/1000  $\mu\text{s}$ , non-repetitive.
- 1" square copper pad, FR-4 board.
- FR-4 board, using Littelfuse minimum recommended footprint, as shown in 403A-03 case outline dimensions spec.
- 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, duty cycle = 4 pulses per minute maximum. For Unidirectional only.

#### Features

- Working Peak Reverse Voltage Range – 5.8 to 171 V (for Uni-directional), 9.4 to 70.1 V (for Bi-directional)
- Standard Breakdown Voltage Range – 6.8 to 200 V (for Uni-directional), 11 to 91 V (for Bi-directional)
- Peak Power – 600 W @ 1 ms
- ESD Rating of Class 3 (> 16 kV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5  $\mu\text{A}$  Above 10 V
- Response Time is Typically < 1 ns
- Pb-free means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable

#### Additional Information



Datasheet

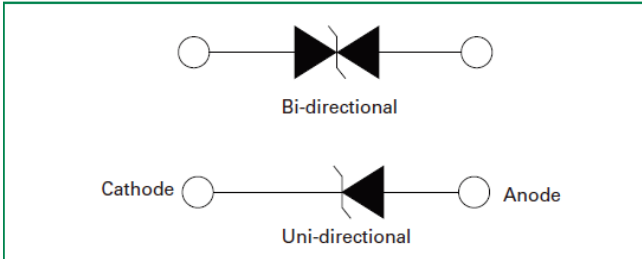


Resources

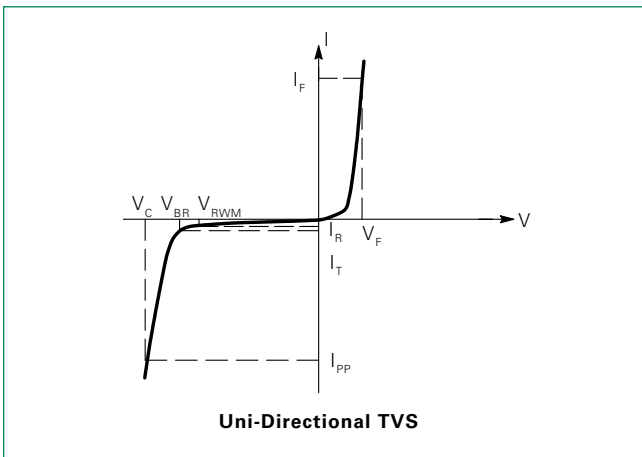


Samples

**Functional Diagram**



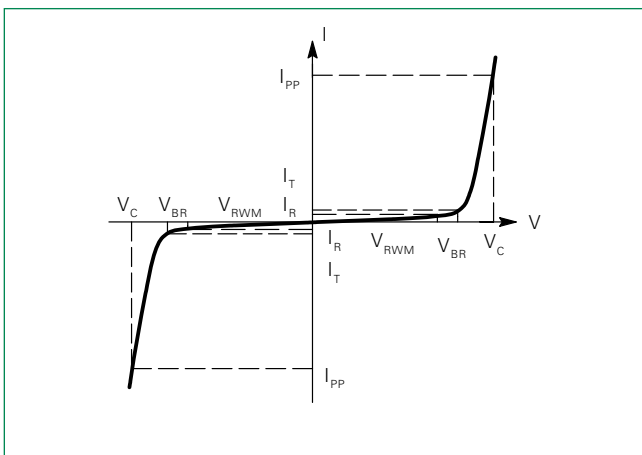
**I-V Curve Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted,  $V_F = 3.5\text{ V Max.}$  @  $I_F$  (Note 5) = 30 A) **For Unidirectional**



| Symbol    | Parameter                                   |
|-----------|---|
| $I_{PP}$  | Maximum Reverse Peak Pulse Current          |
| $V_C$     | Clamping Voltage @ $I_{PP}$                 |
| $V_{RWM}$ | Working Peak Reverse Voltage                |
| $I_R$     | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$  | Breakdown Voltage @ $I_T$                   |
| $I_T$     | Test Current                                |
| $I_F$     | Maximum Temperature Coefficient of $V_{BR}$ |
| $V_F$     | Forward Voltage @ $I_F$                     |
| VF        | Forward Voltage @ $I_F$                     |

5. 1/2 sine wave (or equivalent square wave), PW = 8.3 ms, non-repetitive duty cycle.

**I-V Curve Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) – **For Bidirectional**



| Symbol    | Parameter                                   |
|-----------|---|
| $I_{PP}$  | Maximum Reverse Peak Pulse Current          |
| $V_C$     | Clamping Voltage @ $I_{PP}$                 |
| $V_{RWM}$ | Working Peak Reverse Voltage                |
| $I_R$     | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$  | Breakdown Voltage @ $I_T$                   |
| $I_T$     | Test Current                                |

### Electrical Characteristics - For Unidirectional

| Component      | Component Marking | Breakdown Voltage  |                 |                             |       |      |         | $V_C @ I_{PP}$ (Note 8) |          | $V_{BR}$ | $C_{TYP}$ (Note 9) |
|----------------|-------------------|--------------------|-----------------|-----------------------------|-------|------|---------|-------------------------|----------|----------|--------------------|
|                |                   | $V_{RWM}$ (Note 6) | $I_R @ V_{RWM}$ | $V_{BR} @ I_T$ (V) (Note 7) |       |      | @ $I_T$ | $V_C$                   | $I_{PP}$ |          |                    |
|                |                   | Volts              | $\mu A$         | MIN                         | NOM   | MAX  | mA      | Volts                   | Amps     | %/°C     | pF                 |
| SZP6SMB6.8AT3G | 6V8A              | 5.8                | 1000            | 6.45                        | 6.8   | 7.14 | 10      | 10.5                    | 57       | 0.057    | 2380               |
| SZP6SMB7.5AT3G | 7V5A              | 6.4                | 500             | 7.13                        | 7.51  | 7.88 | 10      | 11.3                    | 53       | 0.061    | 2180               |
| SZP6SMB8.2AT3G | 8V2A              | 7.02               | 200             | 7.79                        | 8.2   | 8.61 | 10      | 12.1                    | 50       | 0.065    | 2015               |
| SZP6SMB9.1AT3G | 9V1A              | 7.78               | 50              | 8.65                        | 9.1   | 9.55 | 1       | 13.4                    | 45       | 0.068    | 1835               |
| SZP6SMB10AT3G  | 10A               | 8.55               | 10              | 9.5                         | 10    | 10.5 | 1       | 14.5                    | 41       | 0.073    | 1690               |
| SZP6SMB12AT3G  | 12A               | 10.2               | 5               | 11.4                        | 12    | 12.6 | 1       | 16.7                    | 36       | 0.078    | 1435               |
| SZP6SMB13AT3G  | 13A               | 11.1               | 5               | 12.4                        | 13.05 | 13.7 | 1       | 18.2                    | 33       | 0.081    | 1335               |
| SZP6SMB15AT3G  | 15A               | 12.8               | 5               | 14.3                        | 15.05 | 15.8 | 1       | 21.2                    | 28       | 0.084    | 1175               |
| SZP6SMB16AT3G  | 16A               | 13.6               | 5               | 15.2                        | 16    | 16.8 | 1       | 22.5                    | 27       | 0.086    | 1110               |
| SZP6SMB18AT3G  | 18A               | 15.3               | 5               | 17.1                        | 18    | 18.9 | 1       | 25.2                    | 24       | 0.088    | 1000               |
| SZP6SMB20AT3G  | 20A               | 17.1               | 5               | 19                          | 20    | 21   | 1       | 27.7                    | 22       | 0.09     | 910                |
| SZP6SMB22AT3G  | 22A               | 18.8               | 5               | 20.9                        | 22    | 23.1 | 1       | 30.6                    | 20       | 0.092    | 835                |
| SZP6SMB24AT3G  | 24A               | 20.5               | 5               | 22.8                        | 24    | 25.2 | 1       | 33.2                    | 18       | 0.094    | 775                |
| SZP6SMB27AT3G  | 27A               | 23.1               | 5               | 25.7                        | 27.05 | 28.4 | 1       | 37.5                    | 16       | 0.096    | 700                |
| SZP6SMB30AT3G  | 30A               | 25.6               | 5               | 28.5                        | 30    | 31.5 | 1       | 41.4                    | 14.4     | 0.097    | 635                |
| SZP6SMB33AT3G  | 33A               | 28.2               | 5               | 31.4                        | 33.05 | 34.7 | 1       | 45.7                    | 13.2     | 0.098    | 585                |
| SZP6SMB36AT3G  | 36A               | 30.8               | 5               | 34.2                        | 36    | 37.8 | 1       | 49.9                    | 12       | 0.099    | 540                |
| SZP6SMB39AT3G  | 39A               | 33.3               | 5               | 37.1                        | 39.05 | 41   | 1       | 53.9                    | 11.2     | 0.1      | 500                |
| SZP6SMB43AT3G  | 43A               | 36.8               | 5               | 40.9                        | 43.05 | 45.2 | 1       | 59.3                    | 10.1     | 0.101    | 460                |
| SZP6SMB47AT3G  | 47A               | 40.2               | 5               | 44.7                        | 47.05 | 49.4 | 1       | 64.8                    | 9.3      | 0.101    | 425                |
| SZP6SMB51AT3G  | 51A               | 43.6               | 5               | 48.5                        | 51.05 | 53.6 | 1       | 70.1                    | 8.6      | 0.102    | 395                |
| SZP6SMB56AT3G  | 56A               | 47.8               | 5               | 53.2                        | 56    | 58.8 | 1       | 77                      | 7.8      | 0.103    | 365                |
| SZP6SMB62AT3G  | 62A               | 53                 | 5               | 58.9                        | 62    | 65.1 | 1       | 85                      | 7.1      | 0.104    | 335                |
| SZP6SMB68AT3G  | 68A               | 58.1               | 5               | 64.6                        | 68    | 71.4 | 1       | 92                      | 6.5      | 0.104    | 305                |
| SZP6SMB75AT3G  | 75A               | 64.1               | 5               | 71.3                        | 75.05 | 78.8 | 1       | 103                     | 5.8      | 0.105    | 280                |
| SZP6SMB91AT3G  | 91A               | 77.8               | 5               | 86.5                        | 91    | 95.5 | 1       | 125                     | 4.8      | 0.106    | 235                |
| SZP6SMB100AT3G | 100A              | 85.5               | 5               | 95                          | 100   | 105  | 1       | 137                     | 4.4      | 0.106    | 215                |
| SZP6SMB120AT3G | 120A              | 102                | 5               | 114                         | 120   | 126  | 1       | 165                     | 3.6      | 0.107    | 185                |
| SZP6SMB130AT3G | 130A              | 111                | 5               | 124                         | 130.5 | 137  | 1       | 179                     | 3.3      | 0.107    | 170                |
| SZP6SMB150AT3G | 150A              | 128                | 5               | 143                         | 150.5 | 158  | 1       | 207                     | 2.9      | 0.108    | 150                |
| SZP6SMB160AT3G | 160A              | 136                | 5               | 152                         | 160   | 168  | 1       | 219                     | 2.7      | 0.108    | 140                |
| SZP6SMB180AT3G | 180A              | 154                | 5               | 171                         | 180   | 189  | 1       | 246                     | 2.4      | 0.108    | 130                |
| SZP6SMB200AT3G | 200A              | 171                | 5               | 190                         | 200   | 210  | 1       | 274                     | 2.2      | 0.108    | 115                |

### Electrical Characteristics - For Bidirectional

| Component      | Component Marking | $V_{RWM}$<br>(Note 5) | $I_R @ V_{RWM}$ | Breakdown Voltage           |         |      |         | $V_C @ I_{PP}$<br>(Note 8) |          | $V_{BR}$ | $C_{Typ.}$<br>(Note 9) |
|----------------|-------------------|-----------------------|-----------------|-----------------------------|---------|------|---------|----------------------------|----------|----------|------------------------|
|                |                   |                       |                 | $V_{BR} @ I_T (V)$ (Note 7) |         |      | @ $I_T$ | $V_C$                      | $I_{PP}$ |          |                        |
|                |                   |                       |                 | Volts                       | $\mu A$ | MIN  | NOM     | MAX                        | mA       | Volts    | Amps                   |
| SZP6SMB11CAT3G | 11C               | 9.4                   | 5               | 10.5                        | 11.05   | 11.6 | 1       | 15.6                       | 38       | 0.075    | 865                    |
| SZP6SMB12CAT3G | 12C               | 10.2                  | 5               | 11.4                        | 12      | 12.6 | 1       | 16.7                       | 36       | 0.078    | 800                    |
| SZP6SMB15CAT3G | 15C               | 12.8                  | 5               | 14.3                        | 15.05   | 15.8 | 1       | 21.2                       | 28       | 0.084    | 645                    |
| SZP6SMB16CAT3G | 16C               | 13.6                  | 5               | 15.2                        | 16      | 16.8 | 1       | 22.5                       | 27       | 0.086    | 610                    |
| SZP6SMB18CAT3G | 18C               | 15.3                  | 5               | 17.1                        | 18      | 18.9 | 1       | 25.2                       | 24       | 0.088    | 545                    |
| SZP6SMB20CAT3G | 20C               | 17.1                  | 5               | 19                          | 20      | 21   | 1       | 27.7                       | 22       | 0.09     | 490                    |
| SZP6SMB22CAT3G | 22C               | 18.8                  | 5               | 20.9                        | 22      | 23.1 | 1       | 30.6                       | 20       | 0.09     | 450                    |
| SZP6SMB24CAT3G | 24C               | 20.5                  | 5               | 22.8                        | 24      | 25.2 | 1       | 33.2                       | 18       | 0.094    | 415                    |
| SZP6SMB27CAT3G | 27C               | 23.1                  | 5               | 25.7                        | 27.05   | 28.4 | 1       | 37.5                       | 16       | 0.096    | 370                    |
| SZP6SMB30CAT3G | 30C               | 25.6                  | 5               | 28.5                        | 30      | 31.5 | 1       | 41.4                       | 14.4     | 0.097    | 335                    |
| SZP6SMB33CAT3G | 33C               | 28.2                  | 5               | 31.4                        | 33.05   | 34.7 | 1       | 45.7                       | 13.2     | 0.098    | 305                    |
| SZP6SMB36CAT3G | 36C               | 30.8                  | 5               | 34.2                        | 36      | 37.8 | 1       | 49.9                       | 12       | 0.099    | 280                    |
| SZP6SMB39CAT3G | 39C               | 33.3                  | 5               | 37.1                        | 39.05   | 41   | 1       | 53.9                       | 11.2     | 0.1      | 260                    |
| SZP6SMB43CAT3G | 43C               | 36.8                  | 5               | 40.9                        | 43.05   | 45.2 | 1       | 59.3                       | 10.1     | 0.101    | 240                    |
| SZP6SMB47CAT3G | 47C               | 40.2                  | 5               | 44.7                        | 47.05   | 49.4 | 1       | 64.8                       | 9.3      | 0.101    | 220                    |
| SZP6SMB51CAT3G | 51C               | 43.6                  | 5               | 48.5                        | 51.05   | 53.6 | 1       | 70.1                       | 8.6      | 0.102    | 205                    |
| SZP6SMB56CAT3G | 56C               | 47.8                  | 5               | 53.2                        | 56      | 58.8 | 1       | 77                         | 7.8      | 0.103    | 185                    |
| SZP6SMB62CAT3G | 62C               | 53                    | 5               | 58.9                        | 62      | 65.1 | 1       | 85                         | 7.1      | 0.104    | 170                    |
| SZP6SMB68CAT3G | 68C               | 58.1                  | 5               | 64.6                        | 68      | 71.4 | 1       | 92                         | 6.5      | 0.104    | 155                    |
| SZP6SMB82CAT3G | 82C               | 70.1                  | 5               | 77.9                        | 82      | 86.1 | 1       | 113                        | 5.3      | 0.105    | 130                    |

6. A transient suppressor is normally selected according to the working peak reverse voltage ( $V_{RWM}$ ), which should be equal to or greater than the DC or continuous peak operating voltage level.

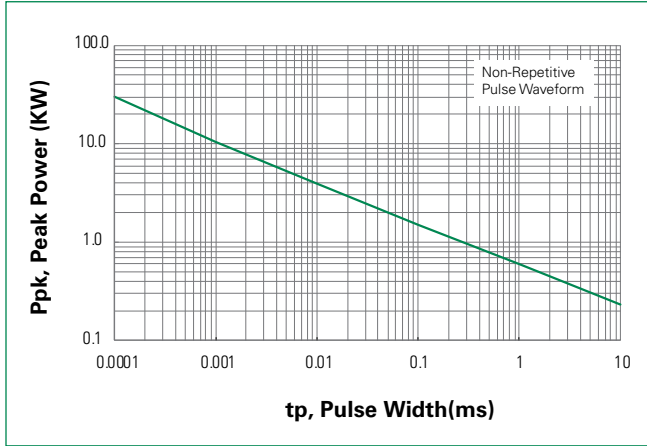
7.  $V_{BR}$  measured at pulse test current  $I_T$  at an ambient temperature of 25°C.

8. Surge current waveform per Figure 2 and derate per Figure 3 of the General Data – 600 Watt at the beginning of this group.

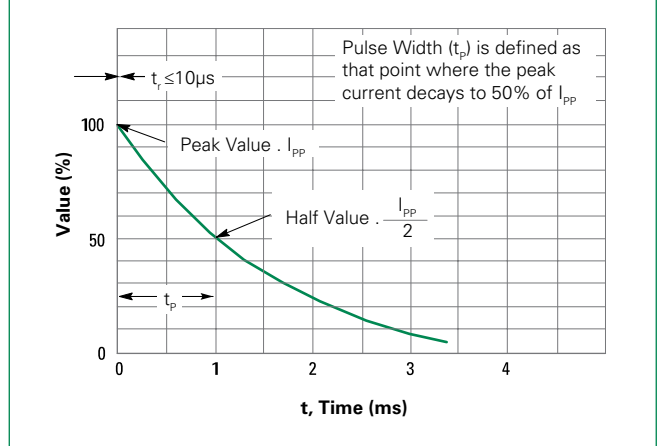
9. Bias Voltage = 0 V, F = 1 MHz,  $T_J = 25^\circ C$

**Ratings and Characteristic Curves - For Unidirectional**

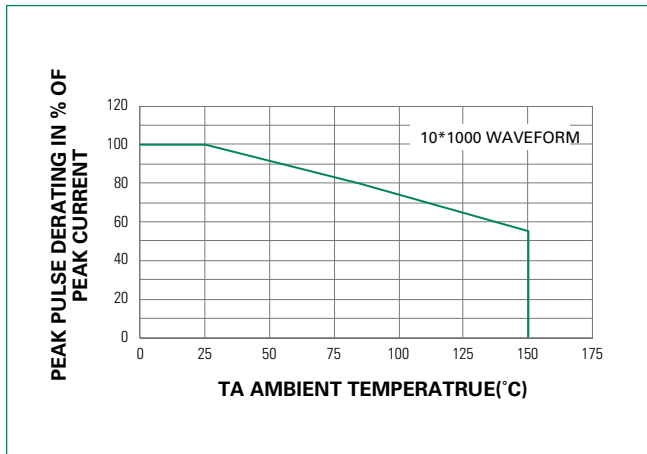
**Figure 1. Pulse Rating Curve**



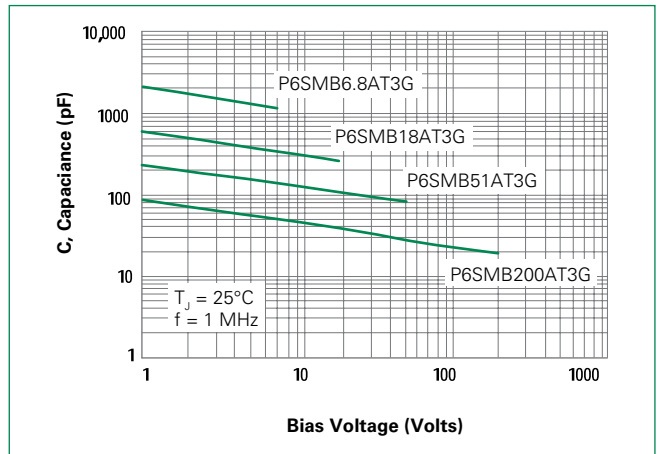
**Figure 2. Pulse Waveform**



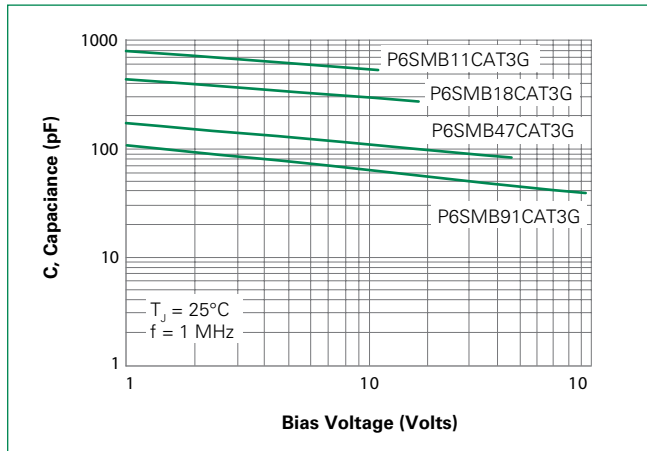
**Figure 3. Pulse Derating Curve**



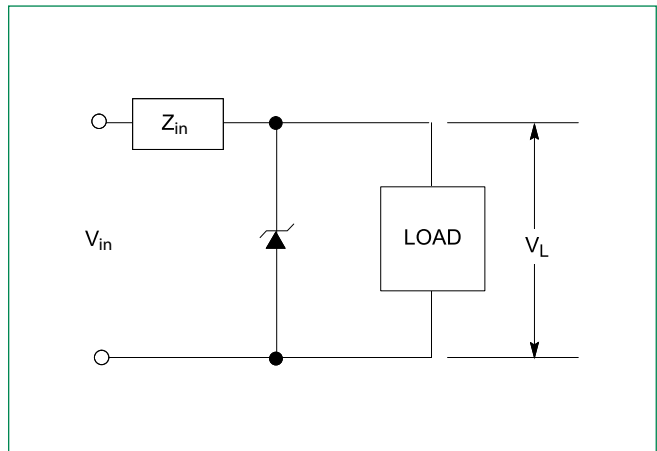
**Figure 4. Typical Junction Capacitance vs. Bias Voltage**



**Figure 9. Typical Junction Capacitance vs. Bias Voltage**

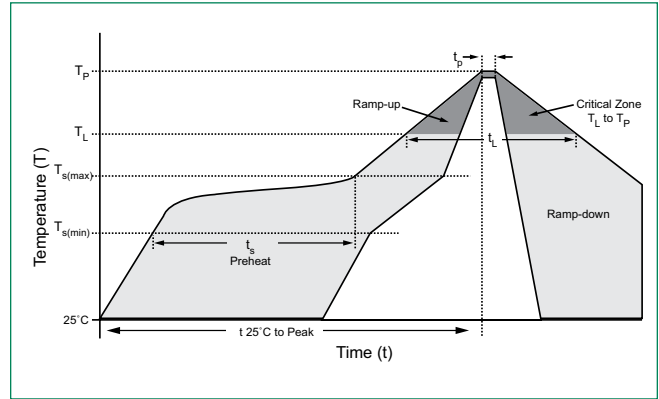


**Figure 5. Typical Protection Circuit**



**Soldering Parameters**

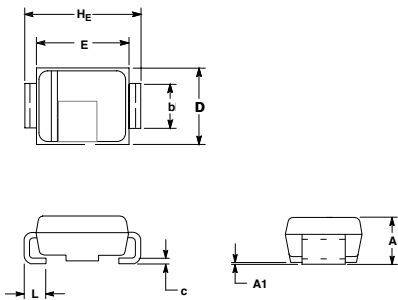
|  |                                    |                         |
|--|------------------------------------|-------------------------|
| <b>Reflow Condition</b>  |                                    | Lead-free assembly      |
| <b>Pre Heat</b>  | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|  | - Time (min to max) ( $t_p$ )      | 60 – 120 secs           |
| <b>Average ramp up rate (Liquidus Temp (<math>T_L</math>) to peak)</b> |                                    | 3°C/second max          |
| <b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>      |                                    | 3°C/second max          |
| <b>Reflow</b>  | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|  | - Time (min to max) ( $t_L$ )      | 60 – 150 seconds        |
| <b>Peak Temperature (<math>T_p</math>)</b>                             |                                    | 260 <sup>+0/-5</sup> °C |
| <b>Time within 5°C of actual peak Temperature (<math>t_p</math>)</b>   |                                    | 30 seconds max          |
| <b>Ramp-down Rate</b>  |                                    | 6°C/second max          |
| <b>Time 25°C to peak Temperature (<math>T_p</math>)</b>                |                                    | 8 minutes max.          |
| <b>Do not exceed</b>   |                                    | 260°C                   |



**Physical Specifications**

|                 |   |
|-----------------|---|
| <b>Weight</b>   | 0.00326 ounce, 0.1015 grams   |
| <b>Case</b>     | JEDEC DO214AA. Void-Free, Transfer-Molded, Thermosetting Plastic Epoxy Meets UL 94V-0 |
| <b>Polarity</b> | Color band denotes cathode for unidirectional components.                             |
| <b>Terminal</b> | Matte Tin-plated leads, Solderable per JESD22-B102                                    |

**Dimensions**

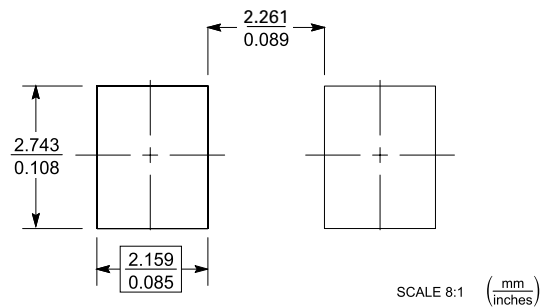


| Dim | Inches   |       |       | Millimeters |      |      |
|-----|----------|-------|-------|-------------|------|------|
|     | Min      | Nom   | Max   | Min         | Nom  | Max  |
| A   | 0.077    | 0.091 | 0.097 | 1.95        | 2.30 | 2.47 |
| A1  | 0.002    | 0.004 | 0.008 | 0.05        | 0.10 | 0.20 |
| b   | 0.077    | 0.080 | 0.087 | 1.96        | 2.03 | 2.20 |
| c   | 0.006    | 0.009 | 0.012 | 0.15        | 0.23 | 0.31 |
| D   | 0.130    | 0.140 | 0.156 | 3.30        | 3.56 | 3.95 |
| E   | 0.160    | 0.170 | 0.181 | 4.06        | 4.32 | 4.60 |
| HE  | 0.205    | 0.214 | 0.220 | 5.21        | 5.44 | 5.60 |
| L   | 0.030    | 0.040 | 0.063 | 0.76        | 1.02 | 1.60 |
| L1  | 0.51 REF |       |       | 0.020 REF   |      |      |

**Environmental Specifications**

|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>                 | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>               | JESD22-A101              |
| <b>RSH</b>                 | JESD22-A111              |

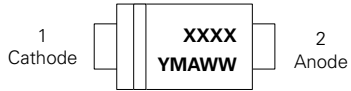
**Soldering Footprint**



**ORDERING INFORMATION**

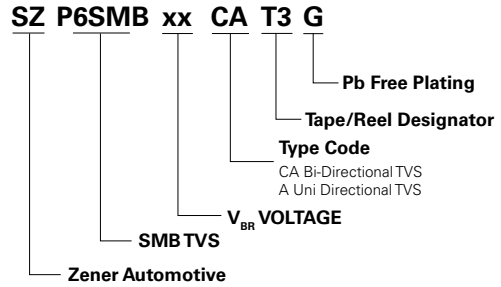
| Device         | Package       | Shipping            |
|----------------|---------------|---------------------|
| SZP6SMBxxxAT3G | SMB (Pb-Free) | 2,500 / Tape & Reel |

**Part Marking System**

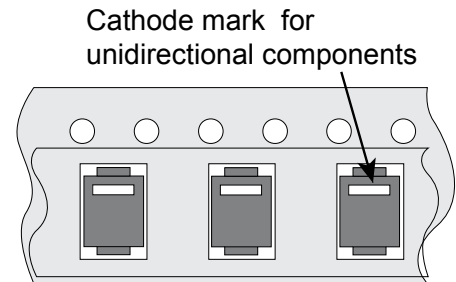
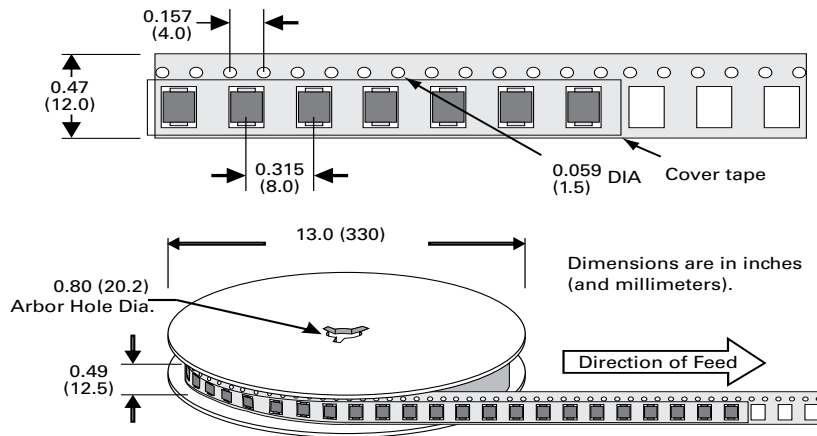


XXXX = Device Code (Max four Digits)  
 Y = Year  
 M = Month  
 A = Assembly Location  
 WW = Lot Code

**Part Number Marketing System**



**Tape and Reel Specification**



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