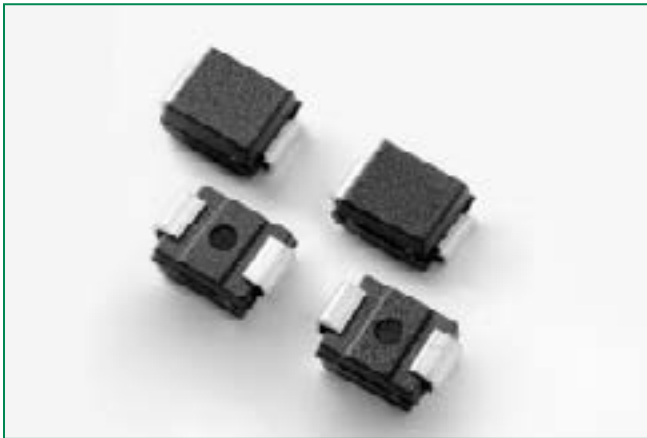




**THE DATASHEET OF
1SMB10AT3G**



SZ1SMB Series



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 @ $T_L = 75^\circ\text{C}$ Measured Zero Lead Length (Note 2) Derate Above 75°C | P_D | 3.0 | W |
| Thermal Resistance from Junction-to-Lead | $R_{\theta JL}$ | 40 | $\text{mW}/^\circ\text{C}$ |
| DC Power Dissipation (Note 3) @ $T_A = 25^\circ\text{C}$ Derate Above 25°C | P_D | 0.55 | W |
| Thermal Resistance from Junction-to-Ambient | $R_{\theta JL}$ | 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 μs , 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), $PW = 8.3 \text{ ms}$, duty cycle = 4 pulses per minute maximum - For Unidirectional only.

Description

The SZ1SMB series is designed to protect voltage sensitive components from high voltage, high energy transients. They have excellent clamping capability, high surge capability, and fast response time. The SZ1SMB 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.

Features

- Working Peak Reverse Voltage Range – 5.0 V to 170 V for unidirectional, and 10 V to 75 V for bidirectional
- Standard Avalanche Breakdown Voltage Range – 6.7 V to 199 V for uni-directional, 11.7 V to 91.7 V for bi-directional
- Peak Power – 600 W @ 1.0 ms
- ESD Rating of Class 3 (> 16 kV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5.0 μA Above 10 V
- Intended for UL 497B Type Protection
- Response Time is Typically < 1.0 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

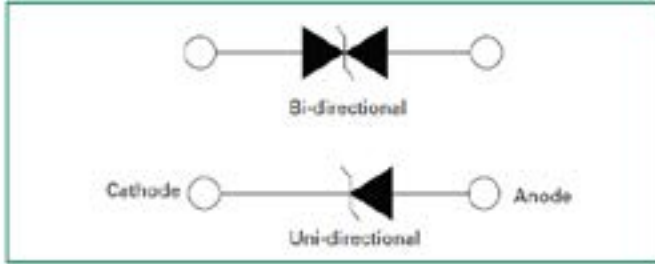


Resources

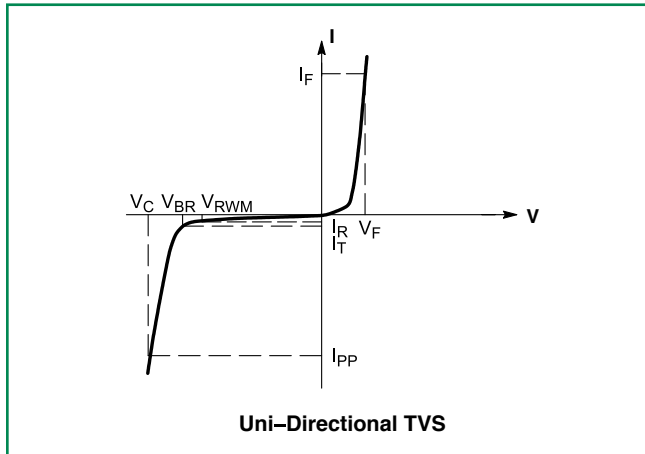


Samples

Functional Diagram



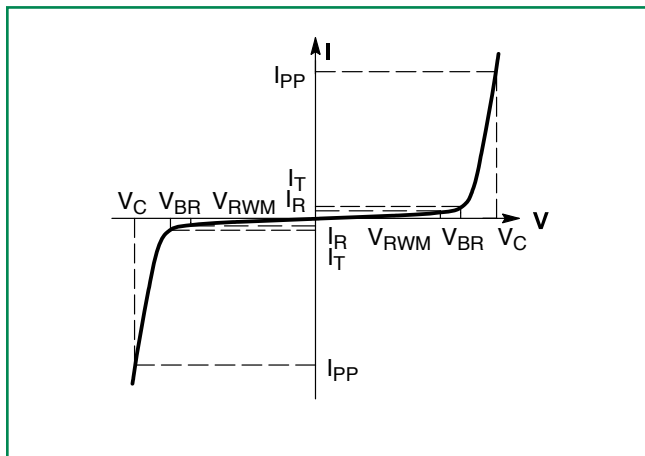
I-V Curve Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 3.5\text{ V Max.}$ @ I_F (Note 5) = 30 A) (For Unidirectional)



| 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 | On-State Current |
| I_F | Maximum Temperature Coefficient of V_{BR} |
| V_F | Forward Voltage @ I_F |

5. 1/2 sine wave (or equivalent square wave), $PW = 8.3\text{ ms}$, 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 | On-State Current |
| I_F | Maximum Temperature Coefficient of V_{BR} |
| V_F | Forward Voltage @ I_F |
| V_F | Forward Voltage @ I_F |

Electrical Characteristics - For Unidirectional

| Device* | Device Marking | V_{RWM} (Note 6) | $I_R @ V_{RWM}$ | Breakdown Voltage | | | | $V_C @ I_{PP}$ (Note 8) | | C Typ. (Note 9) |
|---------------|----------------|-----------------------|-----------------|-----------------------------|---------|------|---------|----------------------------|----------|--------------------|
| | | | | $V_{BR} @ I_T$ (V) (Note 7) | | | @ I_T | V_C | I_{PP} | |
| | | | | Volts | μA | MIN | NOM | MAX | mA | Volts |
| SZ1SMB5.0AT3G | KE | 5.0 | 800 | 6.40 | 6.7 | 7.0 | 10 | 9.2 | 65.2 | 2700 |
| SZ1SMB6.0AT3G | KG | 6.0 | 800 | 6.67 | 7.02 | 7.37 | 10 | 10.3 | 58.3 | 2300 |
| SZ1SMB6.5AT3G | KK | 6.5 | 500 | 7.22 | 7.6 | 7.98 | 10 | 11.2 | 53.6 | 2140 |
| SZ1SMB7.0AT3G | KM | 7.0 | 500 | 7.78 | 8.19 | 8.6 | 10 | 12.0 | 50.0 | 2005 |
| SZ1SMB7.5AT3G | KP | 7.5 | 100 | 8.33 | 8.77 | 9.21 | 1.0 | 12.9 | 46.5 | 1890 |
| SZ1SMB8.0AT3G | KR | 8.0 | 50 | 8.89 | 9.36 | 9.83 | 1.0 | 13.6 | 44.1 | 1780 |
| SZ1SMB8.5AT3G | KT | 8.5 | 10 | 9.44 | 9.92 | 10.4 | 1.0 | 14.4 | 41.7 | 1690 |
| SZ1SMB9.0AT3G | KV | 9.0 | 5.0 | 10.0 | 10.55 | 11.1 | 1.0 | 15.4 | 39.0 | 1605 |
| SZ1SMB10AT3G | KX | 10 | 5.0 | 11.1 | 11.7 | 12.3 | 1.0 | 17.0 | 35.3 | 1460 |
| SZ1SMB11AT3G | KZ | 11 | 5.0 | 12.2 | 12.85 | 13.5 | 1.0 | 18.2 | 33.0 | 1345 |
| SZ1SMB12AT3G | LE | 12 | 5.0 | 13.3 | 14 | 14.7 | 1.0 | 19.9 | 30.2 | 1245 |
| SZ1SMB13AT3G | LG | 13 | 5.0 | 14.4 | 15.15 | 15.9 | 1.0 | 21.5 | 27.9 | 1160 |
| SZ1SMB14AT3G | LK | 14 | 5.0 | 15.6 | 16.4 | 17.2 | 1.0 | 23.2 | 25.8 | 1085 |
| SZ1SMB15AT3G | LM | 15 | 5.0 | 16.7 | 17.6 | 18.5 | 1.0 | 24.4 | 24.0 | 1020 |
| SZ1SMB16AT3G | LP | 16 | 5.0 | 17.8 | 18.75 | 19.7 | 1.0 | 26.0 | 23.1 | 965 |
| SZ1SMB17AT3G | LR | 17 | 5.0 | 18.9 | 19.9 | 20.9 | 1.0 | 27.6 | 21.7 | 915 |
| SZ1SMB18AT3G | LT | 18 | 5.0 | 20.0 | 21.05 | 22.1 | 1.0 | 29.2 | 20.5 | 870 |
| SZ1SMB20AT3G | LV | 20 | 5.0 | 22.2 | 23.35 | 24.5 | 1.0 | 32.4 | 18.5 | 790 |
| SZ1SMB22AT3G | LX | 22 | 5.0 | 24.4 | 25.65 | 26.9 | 1.0 | 35.5 | 16.9 | 730 |
| SZ1SMB24AT3G | LZ | 24 | 5.0 | 26.7 | 28.1 | 29.5 | 1.0 | 38.9 | 15.4 | 675 |
| SZ1SMB26AT3G | ME | 26 | 5.0 | 28.9 | 30.4 | 31.9 | 1.0 | 42.1 | 14.2 | 630 |
| SZ1SMB28AT3G | MG | 28 | 5.0 | 31.1 | 32.75 | 34.4 | 1.0 | 45.4 | 13.2 | 590 |
| SZ1SMB30AT3G | MK | 30 | 5.0 | 33.3 | 35.05 | 36.8 | 1.0 | 48.4 | 12.4 | 555 |
| SZ1SMB33AT3G | MM | 33 | 5.0 | 36.7 | 38.65 | 40.6 | 1.0 | 53.3 | 11.3 | 510 |
| SZ1SMB36AT3G | MP | 36 | 5.0 | 40.0 | 42.1 | 44.2 | 1.0 | 58.1 | 10.3 | 470 |
| SZ1SMB40AT3G | MR | 40 | 5.0 | 44.4 | 46.75 | 49.1 | 1.0 | 64.5 | 9.3 | 430 |
| SZ1SMB43AT3G | MT | 43 | 5.0 | 47.8 | 50.3 | 52.8 | 1.0 | 69.4 | 8.6 | 400 |
| SZ1SMB45AT3G | MV | 45 | 5.0 | 50.0 | 52.65 | 55.3 | 1.0 | 72.7 | 8.3 | 385 |
| SZ1SMB48AT3G | MX | 48 | 5.0 | 53.3 | 56.1 | 58.9 | 1.0 | 77.4 | 7.7 | 365 |
| SZ1SMB51AT3G | MZ | 51 | 5.0 | 56.7 | 59.7 | 62.7 | 1.0 | 82.4 | 7.3 | 345 |
| SZ1SMB54AT3G | NE | 54 | 5.0 | 60.0 | 63.15 | 66.3 | 1.0 | 87.1 | 6.9 | 330 |
| SZ1SMB58AT3G | NG | 58 | 5.0 | 64.4 | 67.8 | 71.2 | 1.0 | 93.6 | 6.4 | 310 |
| SZ1SMB60AT3G | NK | 60 | 5.0 | 66.7 | 70.2 | 73.7 | 1.0 | 96.8 | 6.2 | 300 |
| SZ1SMB64AT3G | NM | 64 | 5.0 | 71.1 | 74.85 | 78.6 | 1.0 | 103 | 5.8 | 280 |
| SZ1SMB70AT3G | NP | 70 | 5.0 | 77.8 | 81.9 | 86 | 1.0 | 113 | 5.3 | 260 |
| SZ1SMB75AT3G | NR | 75 | 5.0 | 83.3 | 87.7 | 92.1 | 1.0 | 121 | 4.9 | 245 |

Electrical Characteristics - For Unidirectional - Continued

| Device* | Device Marking | V _{RWM} (Note 6) | I _R @ V _{RWM} | Breakdown Voltage | | | | V _C @ I _{PP} (Note 8) | | C Typ. (Note 9) |
|---------------|----------------|------------------------------|--------------------------------------|---|-------|-----|------------------|--|-----------------|--------------------|
| | | | | V _{BR} @ I _T (V) (Note 7) | | | @ I _T | V _C | I _{PP} | |
| | | | | Volts | μA | MIN | NOM | MAX | mA | Volts |
| SZ1SMB85AT3G | NV | 85 | 55.0 | 94.4 | 99.2 | 104 | 1.0 | 137 | 4.4 | 220 |
| SZ1SMB90AT3G | NX | 90 | 5.0 | 100 | 105.5 | 111 | 1.0 | 146 | 4.1 | 210 |
| SZ1SMB100AT3G | NZ | 100 | 5.0 | 111 | 117 | 123 | 1.0 | 162 | 3.7 | 190 |
| SZ1SMB110AT3G | PE | 110 | 5.0 | 122 | 128.5 | 135 | 1.0 | 177 | 3.4 | 175 |
| SZ1SMB120AT3G | PG | 120 | 5.0 | 133 | 140 | 147 | 1.0 | 193 | 3.1 | 160 |
| SZ1SMB130AT3G | PK | 130 | 5.0 | 144 | 151.5 | 159 | 1.0 | 209 | 2.9 | 150 |
| SZ1SMB150AT3G | PM | 150 | 5.0 | 167 | 176 | 185 | 1.0 | 243 | 2.5 | 135 |
| SZ1SMB160AT3G | PP | 160 | 5.0 | 178 | 187.5 | 197 | 1.0 | 259 | 2.3 | 125 |
| SZ1SMB170AT3G | PR | 170 | 5.0 | 189 | 199 | 209 | 1.0 | 275 | 2.2 | 120 |

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 1 and derate per Figure 3 of the General Data – 600 W at the beginning of this group.

9. Bias Voltage = 0 V, F = 1 MHz, T_J = 25°C

Electrical Characteristics - For Bidirectional

| Device * | Device Marking | V _{RWM} (Note 6) | I _R @ V _{RWM} | Breakdown Voltage | | | | V _C @ I _{PP} (Note 8) | | C Typ. (Note 9) |
|---------------|----------------|------------------------------|--------------------------------------|---|-------|-------|------------------|--|-----------------|--------------------|
| | | | | V _{BR} @ I _T (V) (Note 7) | | | @ I _T | V _C | I _{PP} | |
| | | | | Volts | μA | MIN | NOM | MAX | mA | Volts |
| SZ1SMB10CAT3G | KXC | 10 | 5.0 | 11.1 | 11.69 | 12.27 | 1.0 | 17.0 | 35.3 | 805 |
| SZ1SMB11CAT3G | KZC | 11 | 5.0 | 12.2 | 12.84 | 13.5 | 1.0 | 18.2 | 33.0 | 740 |
| SZ1SMB12CAT3G | LEC | 12 | 5.0 | 13.3 | 14.00 | 14.7 | 1.0 | 19.9 | 30.2 | 680 |
| SZ1SMB13CAT3G | LGC | 13 | 5.0 | 14.4 | 15.16 | 15.9 | 1.0 | 21.5 | 27.9 | 630 |
| SZ1SMB14CAT3G | LKC | 14 | 5.0 | 15.6 | 16.42 | 17.2 | 1.0 | 23.2 | 25.8 | 590 |
| SZ1SMB15CAT3G | LMC | 15 | 5.0 | 16.7 | 17.58 | 18.5 | 1.0 | 24.4 | 24.0 | 555 |
| SZ1SMB16CAT3G | LPC | 16 | 5.0 | 17.8 | 18.74 | 19.7 | 1.0 | 26.0 | 23.1 | 520 |
| SZ1SMB17CAT3G | LRC | 17 | 5.0 | 18.9 | 19.90 | 20.9 | 1.0 | 27.6 | 21.7 | 490 |
| SZ1SMB18CAT3G | LTC | 18 | 5.0 | 20.0 | 21.06 | 22.1 | 1.0 | 29.2 | 20.5 | 465 |
| SZ1SMB20CAT3G | LVC | 20 | 5.0 | 22.2 | 23.37 | 24.5 | 1.0 | 32.4 | 18.5 | 425 |
| SZ1SMB22CAT3G | LXC | 22 | 5.0 | 24.4 | 25.69 | 27.0 | 1.0 | 35.5 | 16.9 | 390 |
| SZ1SMB24CAT3G | LZC | 24 | 5.0 | 26.7 | 28.11 | 29.5 | 1.0 | 38.9 | 15.4 | 366 |
| SZ1SMB26CAT3G | MEC | 26 | 5.0 | 28.9 | 30.42 | 31.9 | 1.0 | 42.1 | 14.2 | 330 |
| SZ1SMB28CAT3G | MGC | 28 | 5.0 | 31.1 | 32.74 | 34.4 | 1.0 | 45.4 | 13.2 | 310 |
| SZ1SMB30CAT3G | MKC | 30 | 5.0 | 33.3 | 35.06 | 36.8 | 1.0 | 48.4 | 12.4 | 290 |
| SZ1SMB33CAT3G | MMC | 33 | 5.0 | 36.7 | 38.63 | 40.6 | 1.0 | 53.3 | 11.3 | 265 |
| SZ1SMB36CAT3G | MPC | 36 | 5.0 | 40.0 | 42.11 | 44.2 | 1.0 | 58.1 | 10.3 | 245 |
| SZ1SMB40CAT3G | MRC | 40 | 5.0 | 44.4 | 46.74 | 49.1 | 1.0 | 64.5 | 9.3 | 220 |
| SZ1SMB43CAT3G | MTC | 43 | 5.0 | 47.8 | 50.32 | 52.8 | 1.0 | 69.4 | 8.6 | 210 |
| SZ1SMB45CAT3G | MVC | 45 | 5.0 | 50.0 | 52.63 | 55.3 | 1.0 | 72.2 | 8.3 | 200 |
| SZ1SMB48CAT3G | MXC | 48 | 5.0 | 53.3 | 56.11 | 58.9 | 1.0 | 77.4 | 7.7 | 190 |
| SZ1SMB51CAT3G | MZC | 51 | 5.0 | 56.7 | 59.69 | 62.7 | 1.0 | 82.4 | 7.3 | 175 |
| SZ1SMB54CAT3G | NEC | 54 | 5.0 | 60.0 | 63.16 | 66.32 | 1.0 | 87.1 | 6.9 | 170 |
| SZ1SMB58CAT3G | NGC | 58 | 5.0 | 64.4 | 67.79 | 71.18 | 1.0 | 93.6 | 6.4 | 155 |
| SZ1SMB60CAT3G | NKC | 60 | 5.0 | 66.7 | 70.21 | 73.72 | 1.0 | 96.8 | 6.2 | 150 |
| SZ1SMB64CAT3G | NMC | 64 | 5.0 | 71.1 | 74.84 | 78.58 | 1.0 | 103 | 5.8 | 145 |
| SZ1SMB75CAT3G | NRC | 75 | 5.0 | 83.3 | 91.65 | 92.07 | 1.0 | 121 | 4.9 | 125 |

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 1 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°C

Ratings and Characteristic Curves - For Unidirectional

Figure 1. Pulse Rating Curve

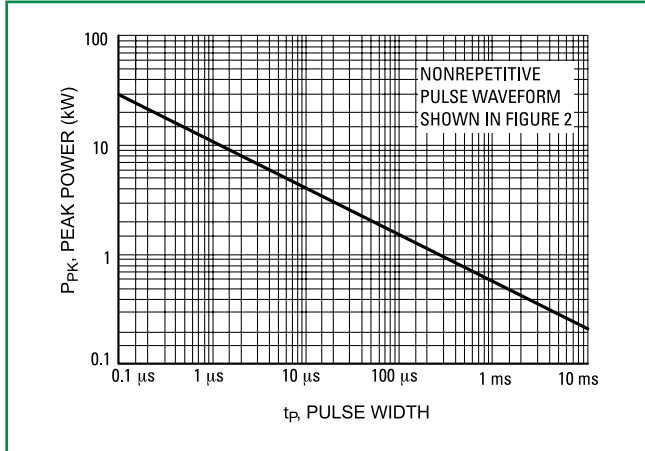


Figure 2. Pulse Waveform

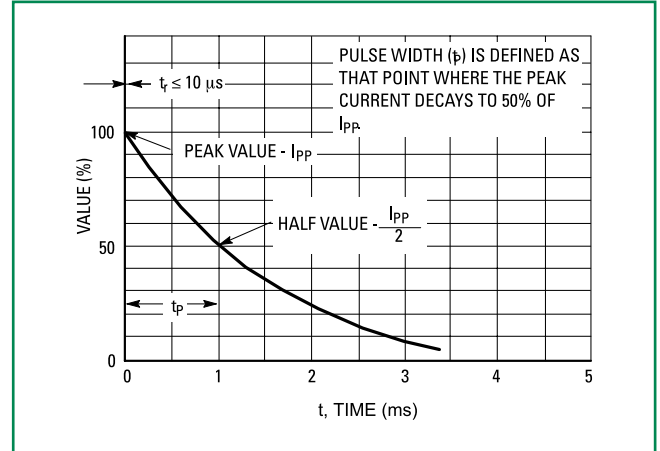


Figure 3 - Pulse Derating Curve

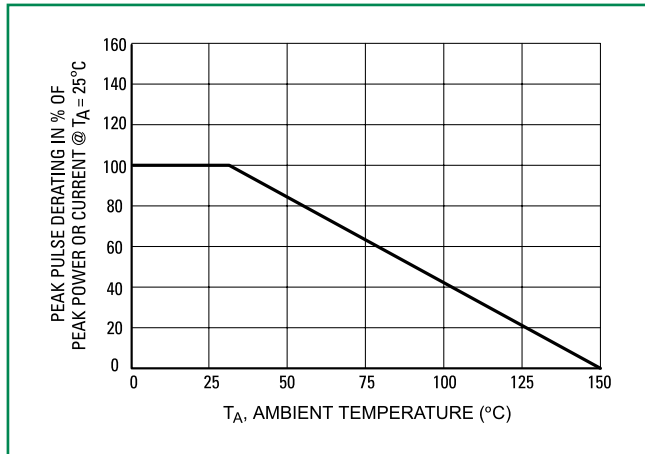


Figure 4. Typical Junction Capacitance vs. Bias Voltage

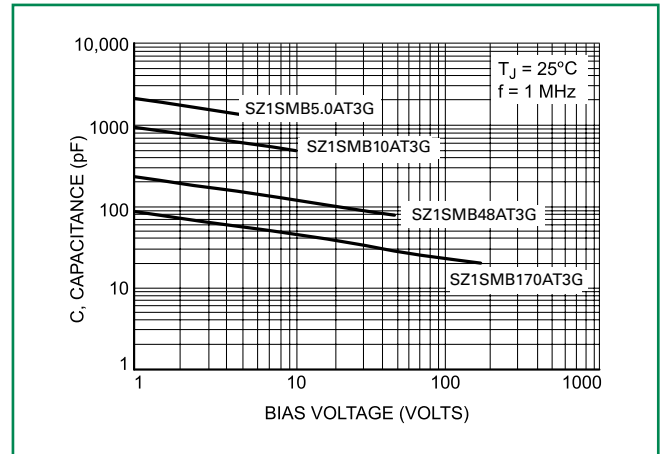
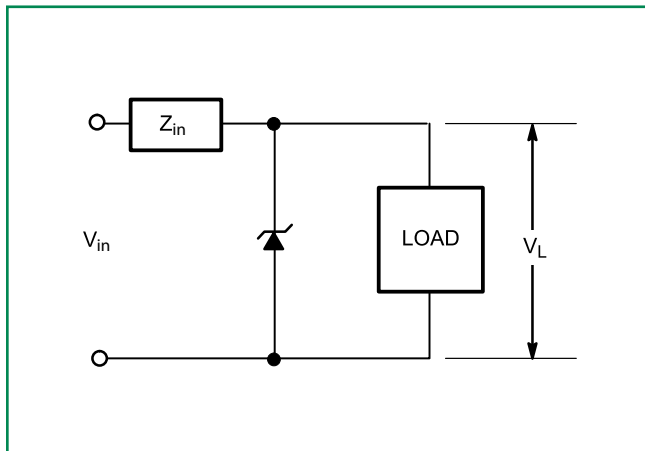


Figure 5. Typical Protection Circuit



Ratings and Characteristic Curves - For Bidirectional

Figure 6. Pulse Rating Curve

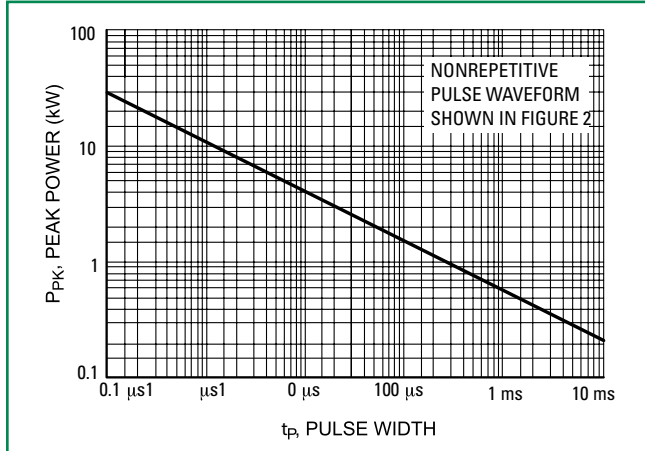


Figure 7. Pulse Waveform

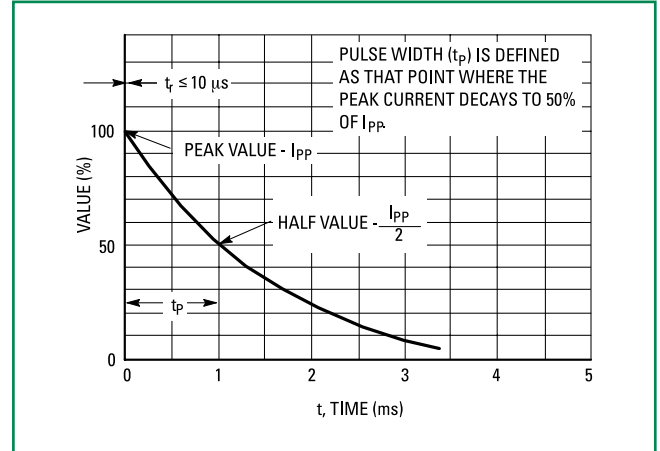


Figure 8. Pulse Derating Curve

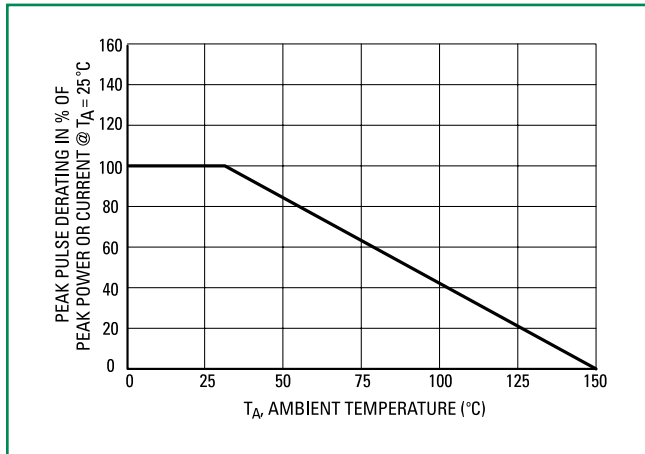


Figure 9. Typical Junction Capacitance vs. Bias Voltage

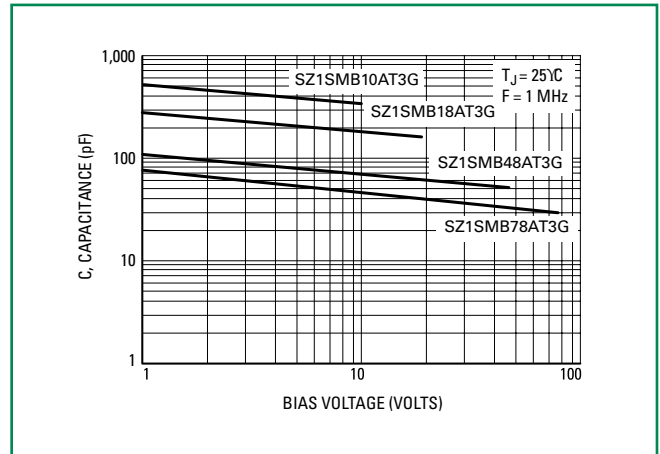
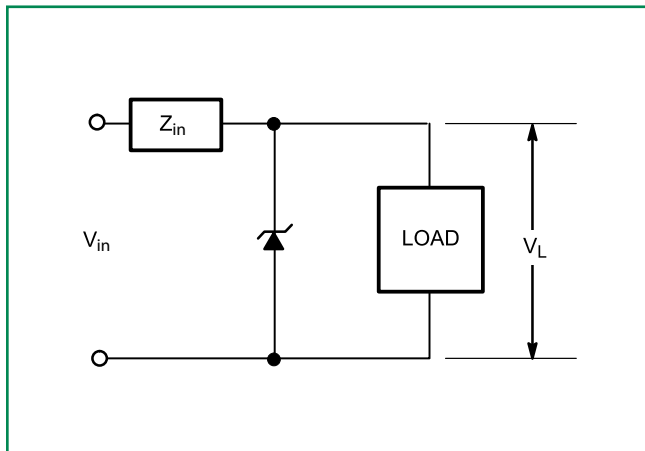
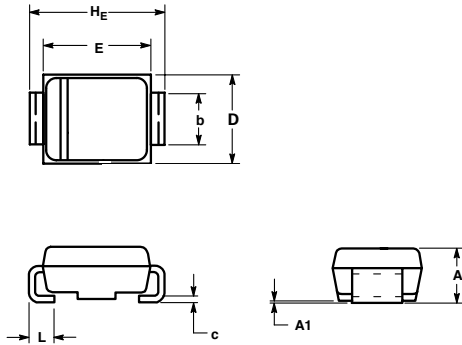


Figure 10. Typical Protection Circuit



Dimensions

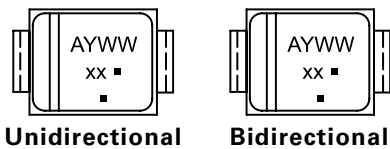


| Dim | Inches | | | Millimeters | | |
|-----|-----------|-------|-------|-------------|------|------|
| | Min | Nom | Max | Min | Nom | Max |
| A | 0.077 | 0.091 | 0.097 | 1.95 | 2.30 | 2.47 |
| A1 | 0.002 | 0.004 | 0.008 | 0.05 | 0.10 | 0.20 |
| b | 0.077 | 0.080 | 0.087 | 1.96 | 2.03 | 2.20 |
| c | 0.006 | 0.09 | 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 | 0.020 REF | | | 0.51 REF | | |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. D DIMENSION SHALL BE MEASURED WITHIN DIMENSION P.

Part Marking System

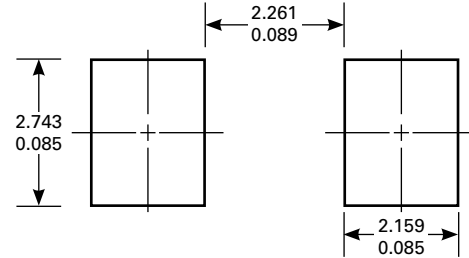


Unidirectional **Bidirectional**

- A = Assembly Location
- Y = Year
- WW = Work Week
- xx = Device Code (Refer to page 3)
- = Pb-Free Package

(Note: Microdot may be in either location)

Soldering Footprint



Scale 8:1 ($\frac{\text{mm}}{\text{Inches}}$)

ORDERING INFORMATION

| Device** | Package | Shipping† |
|---------------|---------------|---------------------|
| SZ1SMBxxAT3G | SMB (Pb-Free) | 2,500 / Tape & Reel |
| SZ1SMBxxCAT3G | SMB (Pb-Free) | 2,500 / Tape & Reel |

Flow/Wave Soldering (Solder Dipping)

| | |
|--------------------|------------|
| Peak Temperature : | 260°C |
| Dipping Time : | 10 seconds |

Physical Specifications

| | |
|-------------------|--|
| Case | Void-free, transfer-molded, thermosetting plastic |
| Polarity | Cathode indicated by polarity band |
| Mounting Position | Any |
| Finish | All external surfaces are corrosion resistant and leads are readily solderable |
| Leads | Modified L-Bend providing more contact area to bond pads |

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-  Alternative Solution
-  Excess Inventory Management