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1SMB5.0AT3G Series, SZ1SMB5.0AT3G Series

MAXIMUM RATINGS

| Rating | 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 Thermal Resistance from Junction-to-Lead | P_D | 3.0 | W |
| | $R_{\theta JL}$ | 40 25 | $\text{mW}/^\circ\text{C}$ $^\circ\text{C}/\text{W}$ |
| DC Power Dissipation (Note 3) @ $T_A = 25^\circ\text{C}$ Derate Above 25°C Thermal Resistance from Junction-to-Ambient | P_D | 0.55 | W |
| | $R_{\theta JA}$ | 4.4 226 | $\text{mW}/^\circ\text{C}$ $^\circ\text{C}/\text{W}$ |
| 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 | $^\circ\text{C}$ |

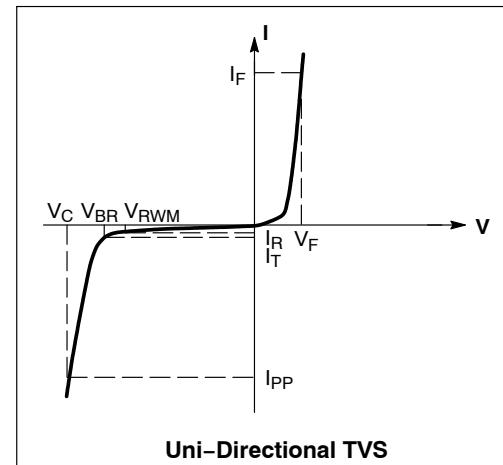
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 3.5 \text{ V Max.} @ I_F$ (Note 5) = 30 A)

| 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 | Forward Current |
| V_F | Forward Voltage @ I_F |

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



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ELECTRICAL CHARACTERISTICS

| 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} (Note 7) Volts | | | @ I _T | V _C | |
| V | μA | Min | Nom | Max | mA | V | A | pF | |
| 1SMB5.0AT3G | KE | 5.0 | 800 | 6.40 | 6.7 | 7.0 | 10 | 9.2 | 65.2 |
| 1SMB6.0AT3G | KG | 6.0 | 800 | 6.67 | 7.02 | 7.37 | 10 | 10.3 | 58.3 |
| 1SMB6.5AT3G | KK | 6.5 | 500 | 7.22 | 7.6 | 7.98 | 10 | 11.2 | 53.6 |
| 1SMB7.0AT3G | KM | 7.0 | 500 | 7.78 | 8.19 | 8.6 | 10 | 12.0 | 50.0 |
| 1SMB7.5AT3G | KP | 7.5 | 100 | 8.33 | 8.77 | 9.21 | 1.0 | 12.9 | 46.5 |
| 1SMB8.0AT3G | KR | 8.0 | 50 | 8.89 | 9.36 | 9.83 | 1.0 | 13.6 | 44.1 |
| 1SMB8.5AT3G | KT | 8.5 | 10 | 9.44 | 9.92 | 10.4 | 1.0 | 14.4 | 41.7 |
| 1SMB9.0AT3G | KV | 9.0 | 5.0 | 10.0 | 10.55 | 11.1 | 1.0 | 15.4 | 39.0 |
| 1SMB10AT3G | KX | 10 | 5.0 | 11.1 | 11.7 | 12.3 | 1.0 | 17.0 | 35.3 |
| 1SMB11AT3G | KZ | 11 | 5.0 | 12.2 | 12.85 | 13.5 | 1.0 | 18.2 | 33.0 |
| 1SMB12AT3G | LE | 12 | 5.0 | 13.3 | 14 | 14.7 | 1.0 | 19.9 | 30.2 |
| 1SMB13AT3G | LG | 13 | 5.0 | 14.4 | 15.15 | 15.9 | 1.0 | 21.5 | 27.9 |
| 1SMB14AT3G | LK | 14 | 5.0 | 15.6 | 16.4 | 17.2 | 1.0 | 23.2 | 25.8 |
| 1SMB15AT3G | LM | 15 | 5.0 | 16.7 | 17.6 | 18.5 | 1.0 | 24.4 | 24.0 |
| 1SMB16AT3G | LP | 16 | 5.0 | 17.8 | 18.75 | 19.7 | 1.0 | 26.0 | 23.1 |
| 1SMB17AT3G | LR | 17 | 5.0 | 18.9 | 19.9 | 20.9 | 1.0 | 27.6 | 21.7 |
| 1SMB18AT3G | LT | 18 | 5.0 | 20.0 | 21.05 | 22.1 | 1.0 | 29.2 | 20.5 |
| 1SMB20AT3G | LV | 20 | 5.0 | 22.2 | 23.35 | 24.5 | 1.0 | 32.4 | 18.5 |
| 1SMB22AT3G | LX | 22 | 5.0 | 24.4 | 25.65 | 26.9 | 1.0 | 35.5 | 16.9 |
| 1SMB24AT3G | LZ | 24 | 5.0 | 26.7 | 28.1 | 29.5 | 1.0 | 38.9 | 15.4 |
| 1SMB26AT3G | ME | 26 | 5.0 | 28.9 | 30.4 | 31.9 | 1.0 | 42.1 | 14.2 |
| 1SMB28AT3G | MG | 28 | 5.0 | 31.1 | 32.75 | 34.4 | 1.0 | 45.4 | 13.2 |
| 1SMB30AT3G | MK | 30 | 5.0 | 33.3 | 35.05 | 36.8 | 1.0 | 48.4 | 12.4 |
| 1SMB33AT3G | MM | 33 | 5.0 | 36.7 | 38.65 | 40.6 | 1.0 | 53.3 | 11.3 |
| 1SMB36AT3G | MP | 36 | 5.0 | 40.0 | 42.1 | 44.2 | 1.0 | 58.1 | 10.3 |
| 1SMB40AT3G | MR | 40 | 5.0 | 44.4 | 46.75 | 49.1 | 1.0 | 64.5 | 9.3 |
| 1SMB43AT3G | MT | 43 | 5.0 | 47.8 | 50.3 | 52.8 | 1.0 | 69.4 | 8.6 |
| 1SMB45AT3G | MV | 45 | 5.0 | 50.0 | 52.65 | 55.3 | 1.0 | 72.7 | 8.3 |
| 1SMB48AT3G | MX | 48 | 5.0 | 53.3 | 56.1 | 58.9 | 1.0 | 77.4 | 7.7 |
| 1SMB51AT3G | MZ | 51 | 5.0 | 56.7 | 59.7 | 62.7 | 1.0 | 82.4 | 7.3 |
| 1SMB54AT3G | NE | 54 | 5.0 | 60.0 | 63.15 | 66.3 | 1.0 | 87.1 | 6.9 |
| 1SMB58AT3G | NG | 58 | 5.0 | 64.4 | 67.8 | 71.2 | 1.0 | 93.6 | 6.4 |
| 1SMB60AT3G | NK | 60 | 5.0 | 66.7 | 70.2 | 73.7 | 1.0 | 96.8 | 6.2 |
| 1SMB64AT3G | NM | 64 | 5.0 | 71.1 | 74.85 | 78.6 | 1.0 | 103 | 5.8 |
| 1SMB70AT3G | NP | 70 | 5.0 | 77.8 | 81.9 | 86 | 1.0 | 113 | 5.3 |
| 1SMB75AT3G | NR | 75 | 5.0 | 83.3 | 87.7 | 92.1 | 1.0 | 121 | 4.9 |
| 1SMB85AT3G | NV | 85 | 55.0 | 94.4 | 99.2 | 104 | 1.0 | 137 | 4.4 |
| 1SMB90AT3G | NX | 90 | 5.0 | 100 | 105.5 | 111 | 1.0 | 146 | 4.1 |
| 1SMB100AT3G | NZ | 100 | 5.0 | 111 | 117 | 123 | 1.0 | 162 | 3.7 |
| 1SMB110AT3G | PE | 110 | 5.0 | 122 | 128.5 | 135 | 1.0 | 177 | 3.4 |
| 1SMB120AT3G | PG | 120 | 5.0 | 133 | 140 | 147 | 1.0 | 193 | 3.1 |
| 1SMB130AT3G | PK | 130 | 5.0 | 144 | 151.5 | 159 | 1.0 | 209 | 2.9 |
| 1SMB150AT3G | PM | 150 | 5.0 | 167 | 176 | 185 | 1.0 | 243 | 2.5 |
| 1SMB160AT3G | PP | 160 | 5.0 | 178 | 187.5 | 197 | 1.0 | 259 | 2.3 |
| 1SMB170AT3G | PR | 170 | 5.0 | 189 | 199 | 209 | 1.0 | 275 | 2.2 |

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.

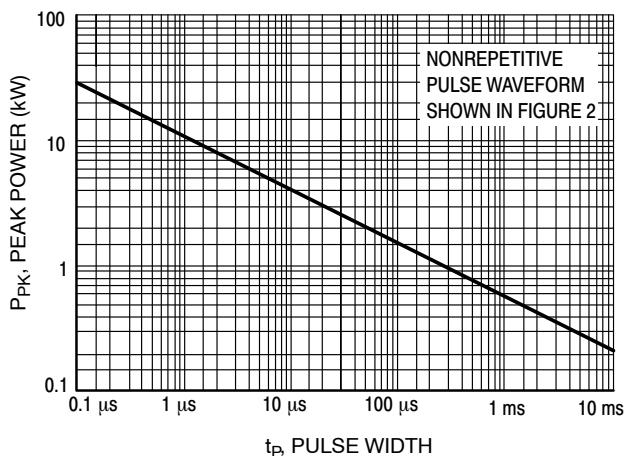
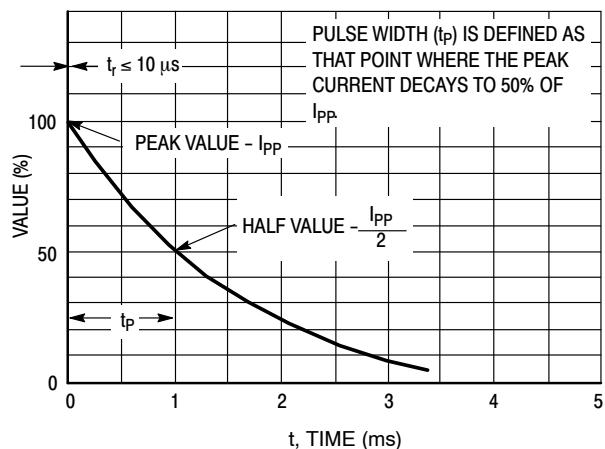
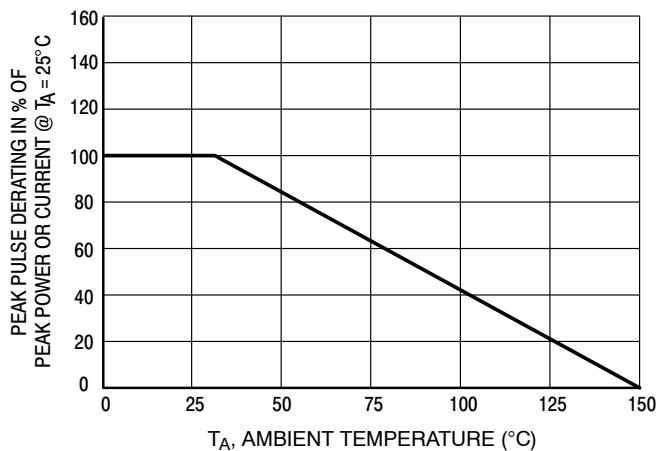
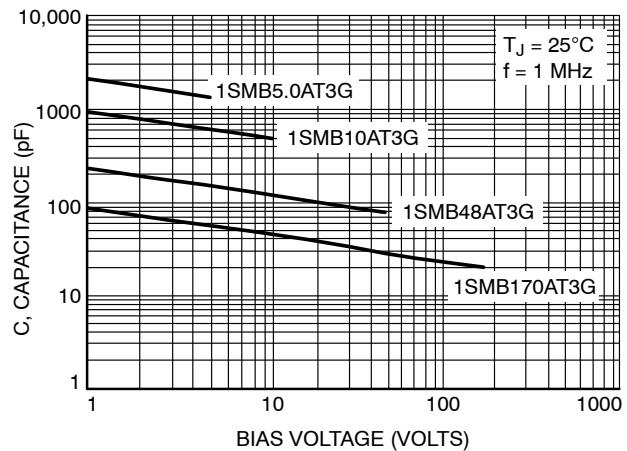
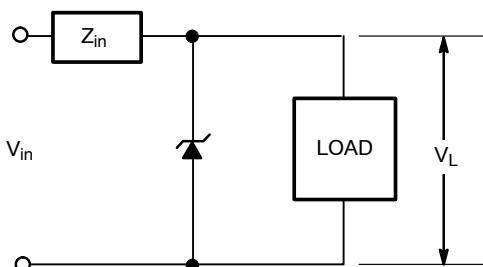
7. V_{BR} measured at pulse test current I_T at an ambient temperature of 25°C.

8. Surge current waveform per Figure 2 and derate per Figure 4 of the General Data – 600 W at the beginning of this group.

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

†Please see 1SMB10CAT3 to 1SMB78CAT3 for Bidirectional devices.

* Include SZ-prefix devices where applicable.

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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

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APPLICATION NOTES

Response Time

In most applications, the transient suppressor device is placed in parallel with the equipment or component to be protected. In this situation, there is a time delay associated with the capacitance of the device and an overshoot condition associated with the inductance of the device and the inductance of the connection method. The capacitive effect is of minor importance in the parallel protection scheme because it only produces a time delay in the transition from the operating voltage to the clamp voltage as shown in Figure 6.

The inductive effects in the device are due to actual turn-on time (time required for the device to go from zero current to full current) and lead inductance. This inductive effect produces an overshoot in the voltage across the equipment or component being protected as shown in Figure 7. Minimizing this overshoot is very important in the application, since the main purpose for adding a transient suppressor is to clamp voltage spikes. The SMB series have a very good response time, typically < 1.0 ns and negligible inductance. However, external inductive effects could produce unacceptable overshoot. Proper circuit layout,

minimum lead lengths and placing the suppressor device as close as possible to the equipment or components to be protected will minimize this overshoot.

Some input impedance represented by Z_{in} is essential to prevent overstress of the protection device. This impedance should be as high as possible, without restricting the circuit operation.

Duty Cycle Derating

The data of Figure 1 applies for non-repetitive conditions and at a lead temperature of 25°C. If the duty cycle increases, the peak power must be reduced as indicated by the curves of Figure 8. Average power must be derated as the lead or ambient temperature rises above 25°C. The average power derating curve normally given on data sheets may be normalized and used for this purpose.

At first glance the derating curves of Figure 8 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μ s pulse. However, when the derating factor for a given pulse of Figure 8 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

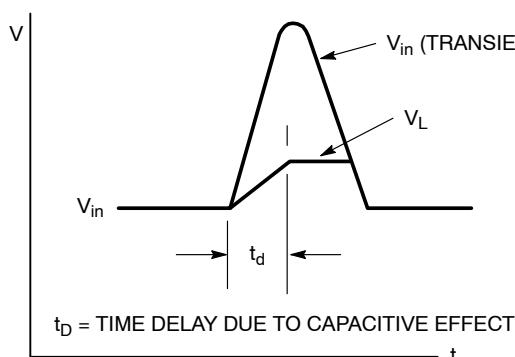


Figure 6.

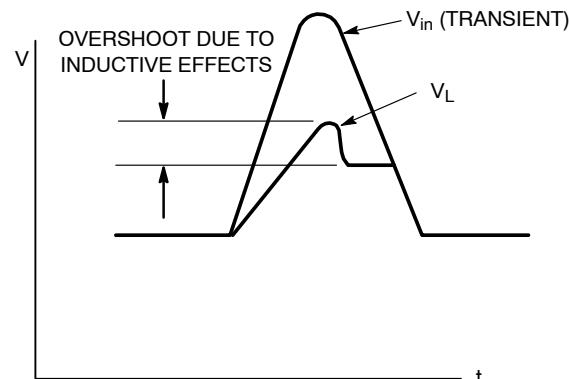


Figure 7.

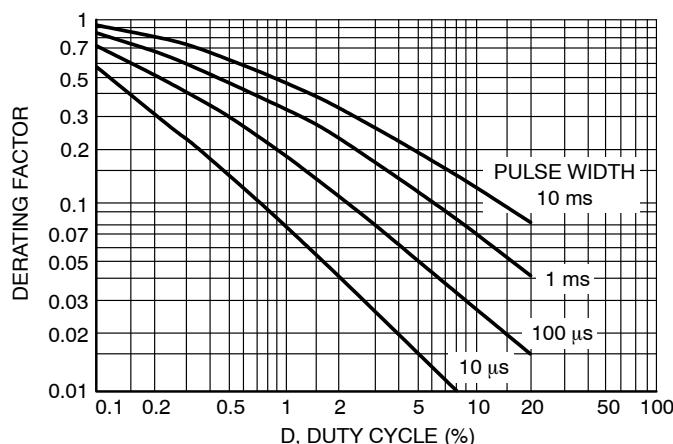


Figure 8. Typical Derating Factor for Duty Cycle

1SMB5.0AT3G Series, SZ1SMB5.0AT3G Series**UL RECOGNITION**

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGQ2) under the UL standard for safety 497B and File #E210057. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition at all. With the UL497B recognition, our parts successfully passed several tests

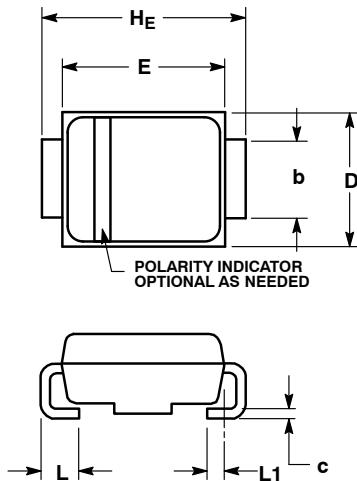
including Strike Voltage Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

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PACKAGE DIMENSIONS

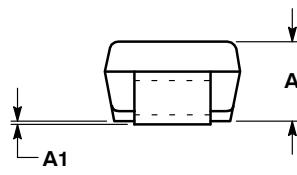
SMB
CASE 403A-03
ISSUE H



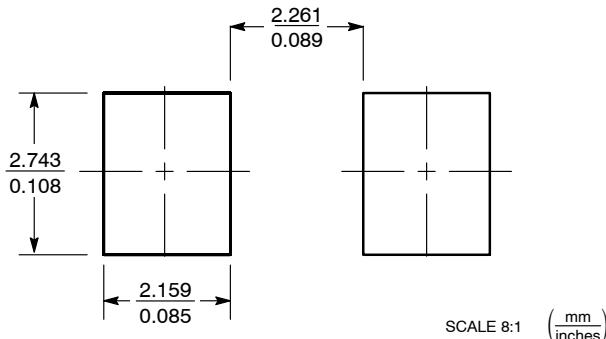
NOTES:

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

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.90 | 2.20 | 2.28 | 0.075 | 0.087 | 0.090 |
| A1 | 0.05 | 0.10 | 0.19 | 0.002 | 0.004 | 0.007 |
| b | 1.96 | 2.03 | 2.20 | 0.077 | 0.080 | 0.087 |
| c | 0.15 | 0.23 | 0.31 | 0.006 | 0.009 | 0.012 |
| D | 3.30 | 3.56 | 3.95 | 0.130 | 0.140 | 0.156 |
| E | 4.06 | 4.32 | 4.60 | 0.160 | 0.170 | 0.181 |
| H_E | 5.21 | 5.44 | 5.60 | 0.205 | 0.214 | 0.220 |
| L | 0.76 | 1.02 | 1.60 | 0.030 | 0.040 | 0.063 |
| L1 | 0.51 REF | | | 0.020 REF | | |



SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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