

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

GENERAL DATA APPLICABLE TO ALL SERIES IN THIS GROUP Zener Transient Voltage Suppressors

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

Specification Features:

- Standard Zener Breakdown Voltage Range — 6.8 to 200 V
- Stand-off Voltage Range — 5 to 170 V
- Peak Power — 600 Watts @ 1 ms
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μ A Above 10 V
- UL Recognition
- Response Time Typically < 1 ns

Mechanical Characteristics:

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

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

POLARITY: Cathode indicated by molded polarity notch. When operated in zener mode, will be positive with respect to anode

MOUNTING POSITION: Any

LEADS: Modified L-Bend providing more contact area to bond pad

MAXIMUM CASE TEMPERATURE FOR SOLDERING PURPOSES: 260°C for 10 seconds

WAFER FAB LOCATION: Phoenix, Arizona

ASSEMBLY/TEST LOCATION: Seremban, Malaysia

**1SMB5.0AT3
SERIES
600 WATT
PEAK POWER**

**PLASTIC SURFACE MOUNT
ZENER OVERVOLTAGE
TRANSIENT
SUPPRESSORS
6.8–200 VOLTS
600 WATT PEAK POWER**



**CASE 403A
PLASTIC**

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|-----------------|--------------|--------------------|
| Peak Power Dissipation (1) @ $T_L \leq 25^\circ\text{C}$ | P_{PK} | 600 | Watts |
| Forward Surge Current (2) @ $T_A = 25^\circ\text{C}$ | I_{FSM} | 100 | Amps |
| Thermal Resistance from Junction to Lead (typical) | $R_{\theta JL}$ | 25 | $^\circ\text{C/W}$ |
| Operating and Storage Temperature Range | T_J, T_{stg} | – 65 to +150 | $^\circ\text{C}$ |

NOTES: 1. Nonrepetitive current pulse per Figure 2 and derated above $T_A = 25^\circ\text{C}$ per Figure 3.

2. 1/2 sine wave (or equivalent square wave), $PW = 8.3$ ms, duty cycle = 4 pulses per minute maximum.

GENERAL DATA — 600 WATT PEAK POWER

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted).

| Device†† | Reverse Stand-Off Voltage V _R Volts (1) | Breakdown Voltage* | | Maximum Clamping Voltage V _C @ I _{pp} Volts | Peak Pulse Current (See Figure 2) I _{pp} † Amps | Maximum Reverse Leakage @ V _R I _R μA | Device Marking |
|-------------------|---|----------------------------------|------------|--|--|--|-------------------|
| | | V _{BR} @ I _T | | | | | |
| | | Volts Min | mA | | | | |
| 1SMB5.0AT3 | 5.0 | 6.40 | 10 | 9.2 | 65.2 | 800 | KE |
| 1SMB6.0AT3 | 6.0 | 6.67 | 10 | 10.3 | 58.3 | 800 | KG |
| 1SMB6.5AT3 | 6.5 | 7.22 | 10 | 11.2 | 53.6 | 500 | KK |
| 1SMB7.0AT3 | 7.0 | 7.78 | 10 | 12.0 | 50.0 | 200 | KM |
| 1SMB7.5AT3 | 7.5 | 8.33 | 1.0 | 12.9 | 46.5 | 100 | KP |
| 1SMB8.0AT3 | 8.0 | 8.89 | 1.0 | 13.6 | 44.1 | 50 | KR |
| 1SMB8.5AT3 | 8.5 | 9.44 | 1.0 | 14.4 | 41.7 | 10 | KT |
| 1SMB9.0AT3 | 9.0 | 10.0 | 1.0 | 15.4 | 39.0 | 5.0 | KV |
| 1SMB10AT3 | 10 | 11.1 | 1.0 | 17.0 | 35.3 | 5.0 | KX |
| 1SMB11AT3 | 11 | 12.2 | 1.0 | 18.2 | 33.0 | 5.0 | KZ |
| 1SMB12AT3 | 12 | 13.3 | 1.0 | 19.9 | 30.2 | 5.0 | LE |
| 1SMB13AT3 | 13 | 14.4 | 1.0 | 21.5 | 27.9 | 5.0 | LG |
| 1SMB14AT3 | 14 | 15.6 | 1.0 | 23.2 | 25.8 | 5.0 | LK |
| 1SMB15AT3 | 15 | 16.7 | 1.0 | 24.4 | 24.0 | 5.0 | LM |
| 1SMB16AT3 | 16 | 17.8 | 1.0 | 26.0 | 23.1 | 5.0 | LP |
| 1SMB17AT3 | 17 | 18.9 | 1.0 | 27.6 | 21.7 | 5.0 | LR |
| 1SMB18AT3 | 18 | 20.0 | 1.0 | 29.2 | 20.5 | 5.0 | LT |
| 1SMB20AT3 | 20 | 22.2 | 1.0 | 32.4 | 18.5 | 5.0 | LV |
| 1SMB22AT3 | 22 | 24.4 | 1.0 | 35.5 | 16.9 | 5.0 | LX |
| 1SMB24AT3 | 24 | 26.7 | 1.0 | 38.9 | 15.4 | 5.0 | LZ |
| 1SMB26AT3 | 26 | 28.9 | 1.0 | 42.1 | 14.2 | 5.0 | ME |
| 1SMB28AT3 | 28 | 31.1 | 1.0 | 45.4 | 13.2 | 5.0 | MG |
| 1SMB30AT3 | 30 | 33.3 | 1.0 | 48.4 | 12.4 | 5.0 | MK |
| 1SMB33AT3 | 33 | 36.7 | 1.0 | 53.3 | 11.3 | 5.0 | MM |
| 1SMB36AT3 | 36 | 40.0 | 1.0 | 58.1 | 10.3 | 5.0 | MP |
| 1SMB40AT3 | 40 | 44.4 | 1.0 | 64.5 | 9.3 | 5.0 | MR |
| 1SMB43AT3 | 43 | 47.8 | 1.0 | 69.4 | 8.6 | 5.0 | MT |
| 1SMB45AT3 | 45 | 50.0 | 1.0 | 72.7 | 8.3 | 5.0 | MV |
| 1SMB48AT3 | 48 | 53.3 | 1.0 | 77.4 | 7.7 | 5.0 | MX |
| 1SMB51AT3 | 51 | 56.7 | 1.0 | 82.4 | 7.3 | 5.0 | MZ |
| 1SMB54AT3 | 54 | 60.0 | 1.0 | 87.1 | 6.9 | 5.0 | NE |
| 1SMB58AT3 | 58 | 64.4 | 1.0 | 93.6 | 6.4 | 5.0 | NG |
| 1SMB60AT3 | 60 | 66.7 | 1.0 | 96.8 | 6.2 | 5.0 | NK |
| 1SMB64AT3 | 64 | 71.1 | 1.0 | 103 | 5.8 | 5.0 | NM |
| 1SMB70AT3 | 70 | 77.8 | 1.0 | 113 | 5.3 | 5.0 | NP |
| 1SMB75AT3 | 75 | 83.3 | 1.0 | 121 | 4.9 | 5.0 | NR |
| 1SMB78AT3 | 78 | 86.7 | 1.0 | 126 | 4.7 | 5.0 | NT |
| 1SMB85AT3 | 85 | 94.4 | 1.0 | 137 | 4.4 | 5.0 | NV |
| 1SMB90AT3 | 90 | 100 | 1.0 | 146 | 4.1 | 5.0 | NX |
| 1SMB100AT3 | 100 | 111 | 1.0 | 162 | 3.7 | 5.0 | NZ |
| 1SMB110AT3 | 110 | 122 | 1.0 | 177 | 3.4 | 5.0 | PE |
| 1SMB120AT3 | 120 | 133 | 1.0 | 193 | 3.1 | 5.0 | PG |
| 1SMB130AT3 | 130 | 144 | 1.0 | 209 | 2.9 | 5.0 | PK |
| 1SMB150AT3 | 150 | 167 | 1.0 | 243 | 2.5 | 5.0 | PM |
| 1SMB160AT3 | 160 | 178 | 1.0 | 259 | 2.3 | 5.0 | PP |
| 1SMB170AT3 | 170 | 189 | 1.0 | 275 | 2.2 | 5.0 | PR |

Note 1: A transient suppressor is normally selected according to the reverse "Stand Off Voltage" (V_R) which should be equal to or greater than the DC or continuous peak operating voltage level.

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

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

†† T3 suffix designates tape and reel of 2500 units.

ABBREVIATIONS AND SYMBOLS

V_R Stand Off Voltage. Applied reverse voltage to assure a non-conductive condition (See Note 1).

V_{(BR)min} This is the minimum breakdown voltage the device will exhibit and is used to assure that conduction does not occur prior to this voltage level at 25°C.

V_C Maximum Clamping Voltage. The maximum peak voltage appearing across the transient suppressor when

I_{pp}
P_p
I_R

subjected to the peak pulse current in a one millisecond time interval. The peak pulse voltages are the combination of voltage rise due to both the series resistance and thermal rise.

Peak Pulse Current — See Figure 2

Peak Pulse Power

Reverse Leakage

GENERAL DATA — 600 WATT PEAK POWER

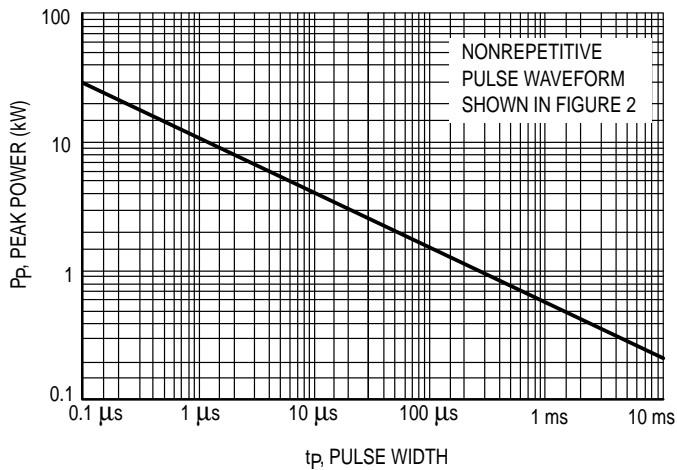


Figure 1. Pulse Rating Curve

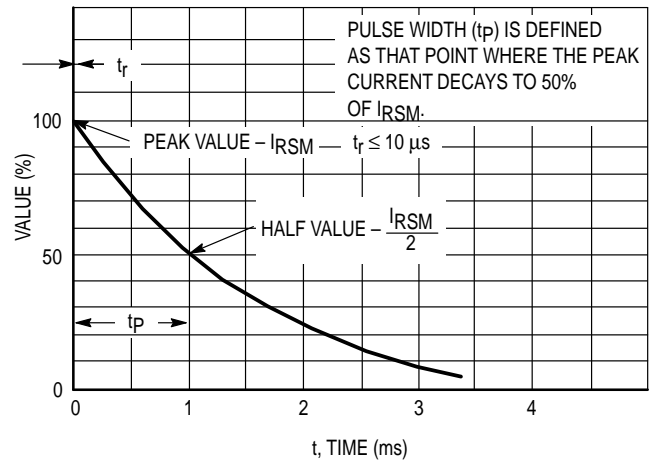


Figure 2. Pulse Waveform

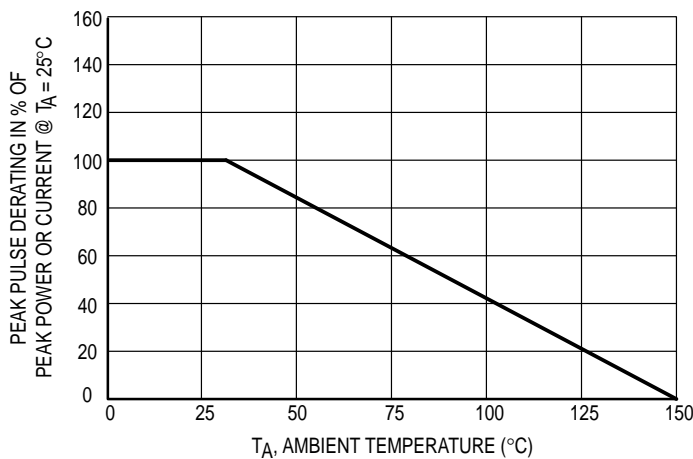
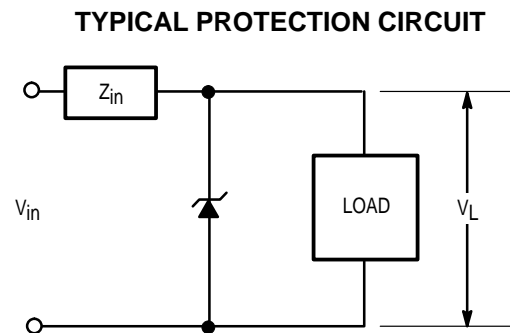


Figure 3. Pulse Derating Curve



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 4.

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 5. 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 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 6. 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 6 appear to be in error as the 10 ms pulse has a higher derating factor than the 10 μs pulse. However, when the derating factor for a given pulse of Figure 6 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

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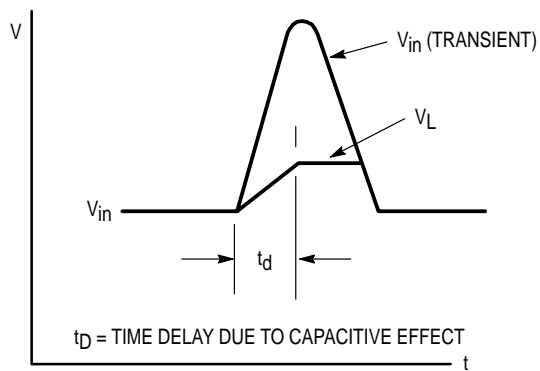


Figure 4.

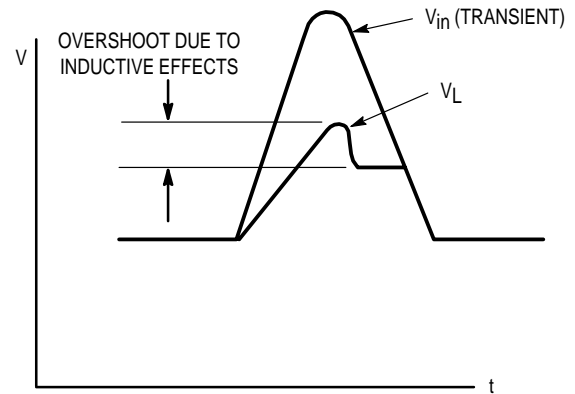


Figure 5.

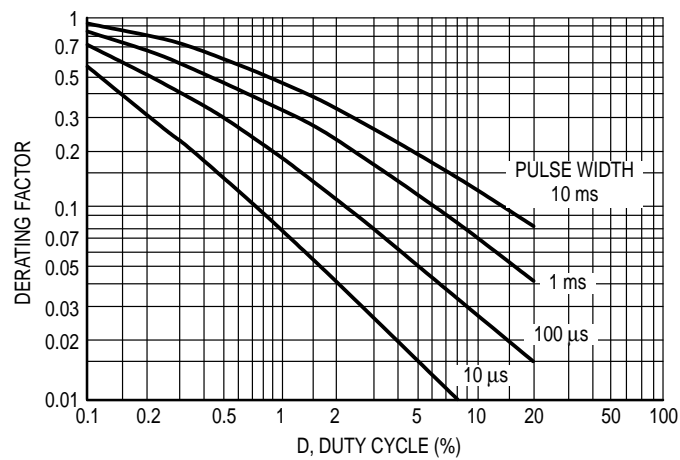


Figure 6. Typical Derating Factor for Duty Cycle

UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. 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

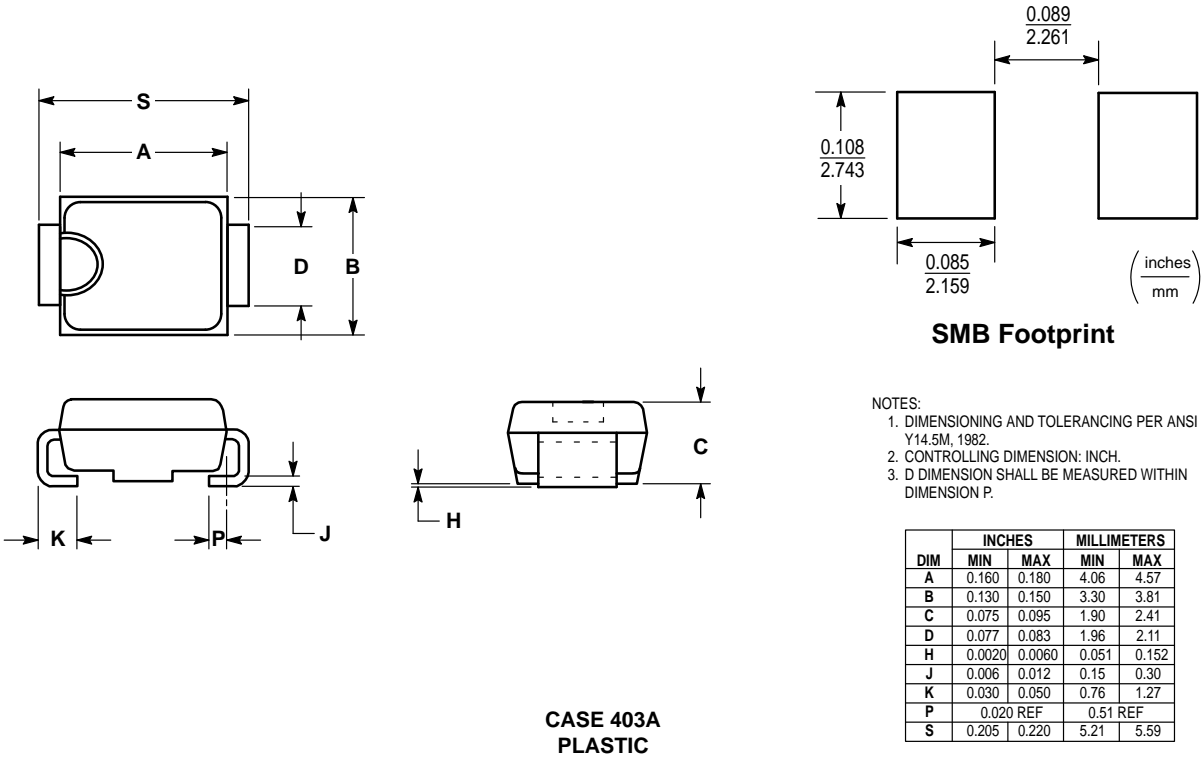
Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

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.

GENERAL DATA — 600 WATT PEAK POWER

Transient Voltage Suppressors — Surface Mounted

600 Watt Peak Power



(Refer to Section 10 for Surface Mount, Thermal Data and Footprint Information.)

MULTIPLE PACKAGE QUANTITY (MPQ) REQUIREMENTS

| Package Option | Type No. Suffix | MPQ (Units) |
|----------------|-------------------|-------------|
| Tape and Reel | T3 (13 inch reel) | 2.5K |

(Refer to Section 10 for more information on Packaging Specifications.)