

# MOTOROLA SEMICONDUCTOR TECHNICAL DATA

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

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

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.

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

### 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  $\mu$ 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



**CASE 403A  
PLASTIC**

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (1) @ $T_L \leq 25^\circ\text{C}$	P <sub>PK</sub>	600	Watts
Forward Surge Current (2) @ $T_A = 25^\circ\text{C}$	I <sub>FSM</sub>	100	Amps
Thermal Resistance from Junction to Lead (typical)	R <sub><math>\theta</math>JL</sub>	25	$^\circ\text{C}/\text{W}$
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 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<sub>A</sub> = 25°C unless otherwise noted).

Device††	Reverse Stand-Off Voltage V <sub>R</sub> Volts (1)	Breakdown Voltage*		Maximum Clamping Voltage V <sub>C</sub> @ I <sub>pp</sub> Volts	Peak Pulse Current (See Figure 2) I <sub>pp</sub> † Amps	Maximum Reverse Leakage @ V <sub>R</sub> I <sub>R</sub> μA	Device Marking
		V <sub>BR</sub> @ I <sub>T</sub>					
		Volts Min	mA				
<b>1SMB5.0AT3</b>	<b>5.0</b>	<b>6.40</b>	<b>10</b>	<b>9.2</b>	<b>65.2</b>	<b>800</b>	<b>KE</b>
<b>1SMB6.0AT3</b>	<b>6.0</b>	<b>6.67</b>	<b>10</b>	<b>10.3</b>	<b>58.3</b>	<b>800</b>	<b>KG</b>
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
<b>1SMB22AT3</b>	<b>22</b>	<b>24.4</b>	<b>1.0</b>	<b>35.5</b>	<b>16.9</b>	<b>5.0</b>	<b>LX</b>
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
<b>1SMB58AT3</b>	<b>58</b>	<b>64.4</b>	<b>1.0</b>	<b>93.6</b>	<b>6.4</b>	<b>5.0</b>	<b>NG</b>
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<sub>R</sub>) which should be equal to or greater than the DC or continuous peak operating voltage level.

\* V<sub>BR</sub> measured at pulse test current I<sub>T</sub> 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<sub>R</sub>** 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<sub>C</sub>** Maximum Clamping Voltage. The maximum peak voltage appearing across the transient suppressor when

**I<sub>pp</sub>**  
**P<sub>p</sub>**  
**I<sub>R</sub>**

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

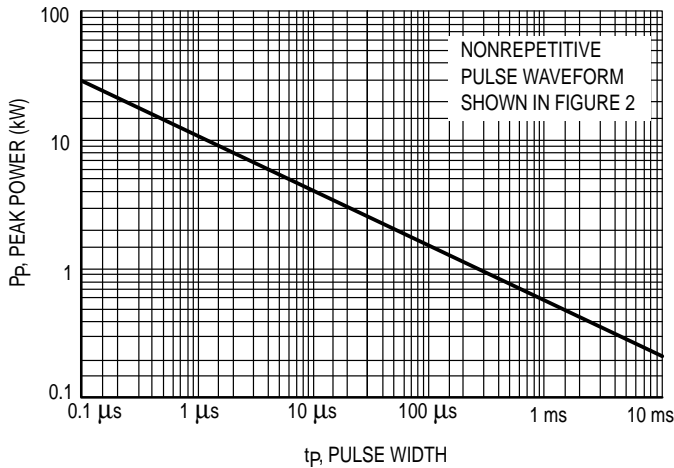


Figure 1. Pulse Rating Curve

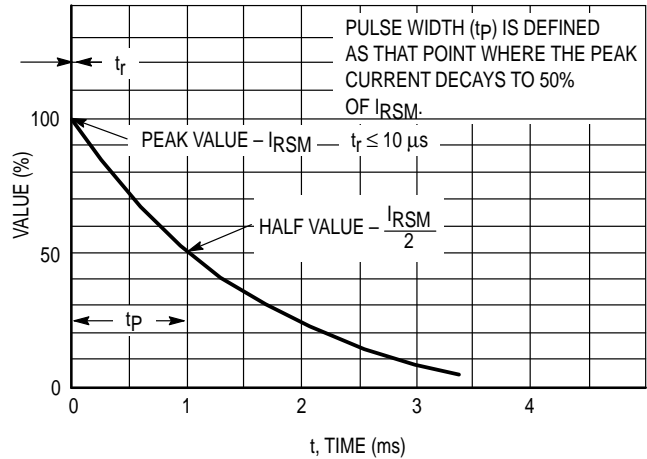


Figure 2. Pulse Waveform

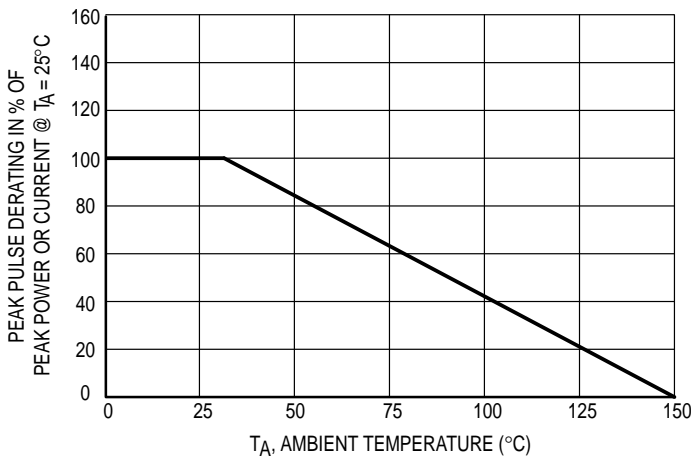
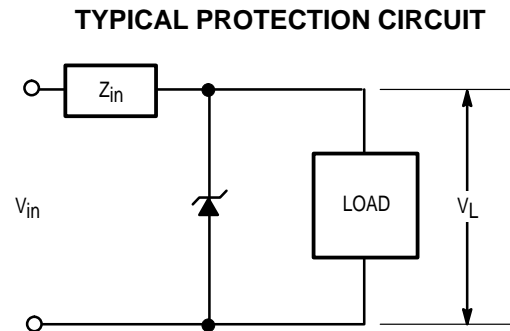


Figure 3. Pulse Derating Curve



## 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  $\mu$ s 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.

## GENERAL DATA — 600 WATT PEAK POWER

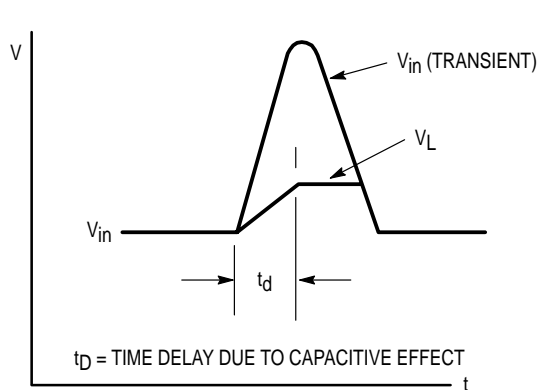


Figure 4.

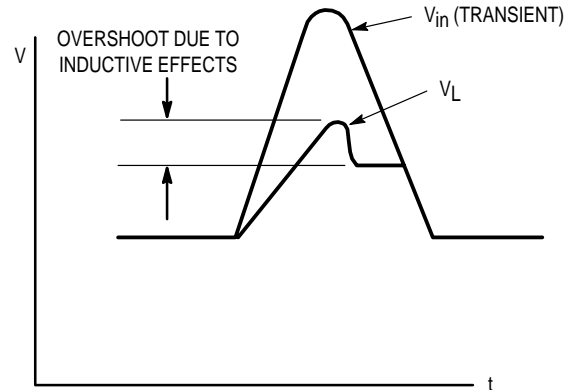


Figure 5.

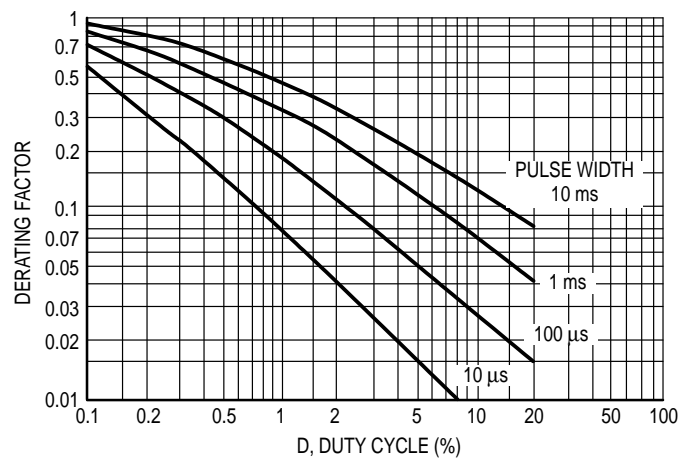


Figure 6. Typical Derating Factor for Duty Cycle

### UL RECOGNITION

The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QGV2) 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

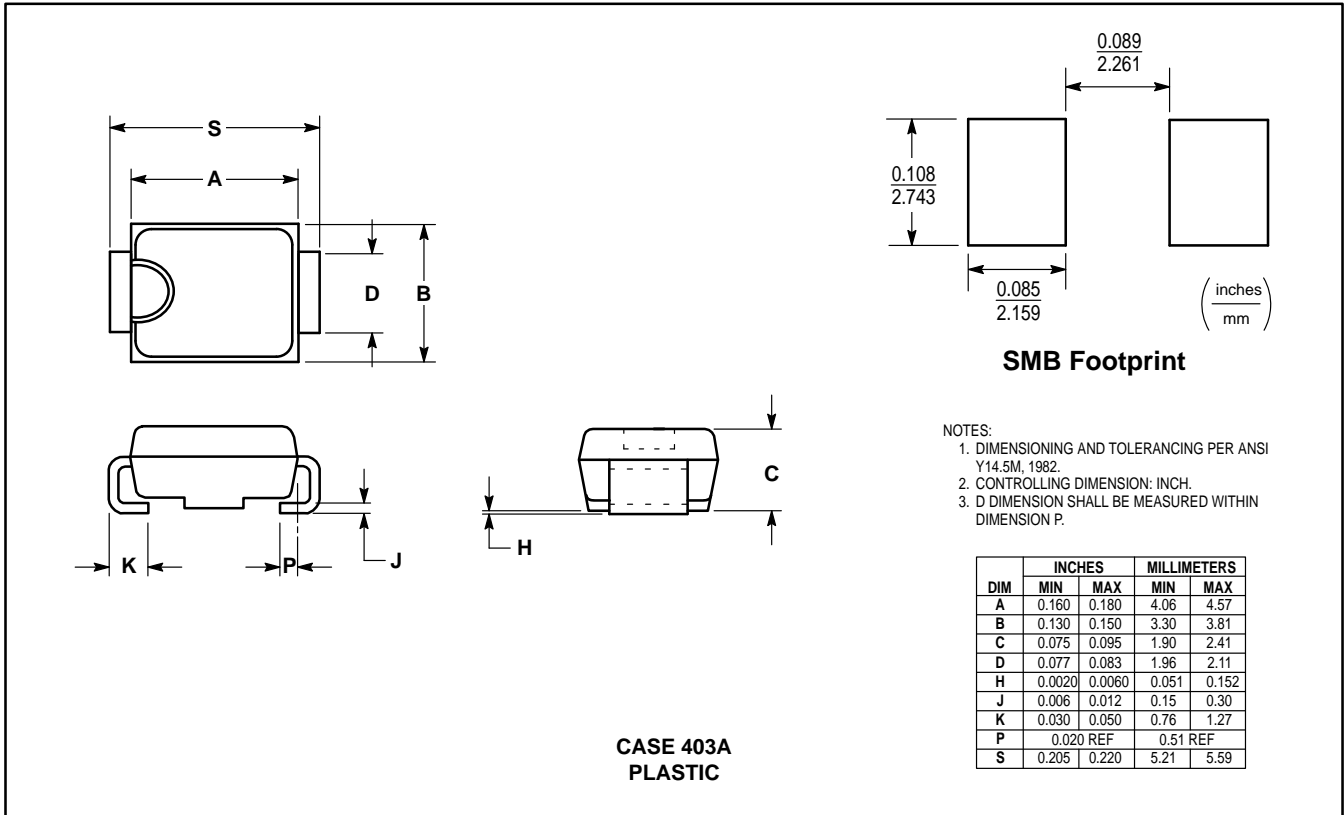
Breakdown test, Endurance Conditioning, Temperature test, Dielectric Voltage-Withstand test, Discharge test and several more.

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.)