

# 1SMB5.0AT3 Series

## 600 Watt Peak Power Zener Transient Voltage Suppressors

### Unidirectional\*

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 ON Semiconductor's exclusive, cost-effective, highly reliable Surmetic™ 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.

#### Specification Features:

- Working Peak Reverse Voltage Range – 5.0 V to 170 V
- Standard Zener Breakdown Voltage Range – 6.7 V to 199 V
- Peak Power – 600 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5  $\mu$ A Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1 ns

#### Mechanical Characteristics:

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

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

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

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

**POLARITY:** Cathode indicated by polarity band

**MOUNTING POSITION:** Any

#### MAXIMUM RATINGS

Please See the Table on the Following Page

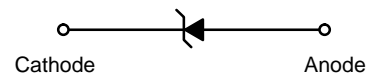
\*Please see 1SMB10CAT3 to 1SMB78CAT3 for Bidirectional devices.



ON Semiconductor™

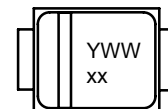
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**PLASTIC SURFACE MOUNT  
ZENER OVERVOLTAGE  
TRANSIENT SUPPRESSORS  
5.0–170 VOLTS  
600 WATT PEAK POWER**



**SMB  
CASE 403A  
PLASTIC**

#### MARKING DIAGRAM



Y = Year  
WW = Work Week  
xx = Specific Device Code  
(See Table Page 3)

#### ORDERING INFORMATION

Device †	Package	Shipping
1SMBxxxAT3	SMB	2500/Tape & Reel

Devices listed in **bold, italic** are ON Semiconductor **Preferred** devices. Preferred devices are recommended choices for future use and best overall value.

†The "T3" suffix refers to a 13 inch reel.

# 1SMB5.0AT3 Series

## MAXIMUM RATINGS

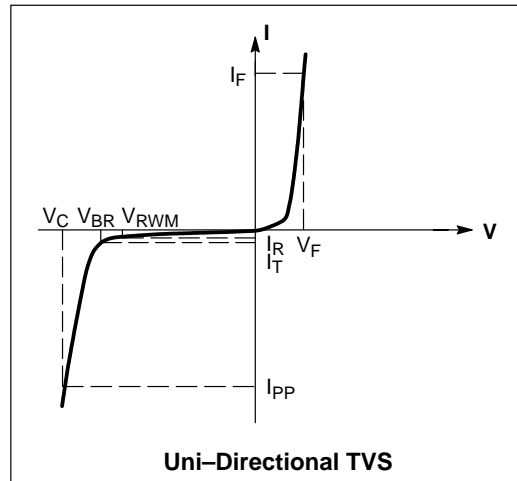
Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1.) @ $T_L = 25^\circ\text{C}$ , Pulse Width = 1 ms	$P_{PK}$	600	W
DC Power Dissipation @ $T_L = 75^\circ\text{C}$ Measured Zero Lead Length (Note 2.) Derate Above $75^\circ\text{C}$	$P_D$	3.0	W
Thermal Resistance from Junction to Lead	$R_{\theta JL}$	40 25	mW/ $^\circ\text{C}$ $^\circ\text{C}/\text{W}$
DC Power Dissipation (Note 3.) @ $T_A = 25^\circ\text{C}$ Derate Above $25^\circ\text{C}$	$P_D$	0.55 4.4	W mW/ $^\circ\text{C}$
Thermal Resistance from Junction to Ambient	$R_{\theta JA}$	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	$^\circ\text{C}$

- 10 X 1000  $\mu\text{s}$ , non-repetitive
- 1" square copper pad, FR-4 board
- FR-4 board, using ON Semiconductor minimum recommended footprint, as shown in 403A case outline dimensions spec.
- 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 @ $I_F$

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



# 1SMB5.0AT3 Series

## ELECTRICAL CHARACTERISTICS (Devices listed in bold, italic are ON Semiconductor Preferred devices.)

Device	Device Marking	$V_{RWM}$ (Note 6.)	$I_R$ @ $V_{RWM}$	Breakdown Voltage			$V_C$ @ $I_{PP}$ (Note 8.)		
				$V_{BR}$ (Note 7.) Volts			$I_T$	$V_C$	$I_{PP}$
		Volts	$\mu A$	Min	Nom	Max	mA	Volts	Amps
<b>1SMB5.0AT3</b>	<b>KE</b>	<b>5.0</b>	<b>800</b>	<b>6.40</b>	<b>6.7</b>	<b>7.0</b>	<b>10</b>	<b>9.2</b>	<b>65.2</b>
<b>1SMB6.0AT3</b>	<b>KG</b>	<b>6.0</b>	<b>800</b>	<b>6.67</b>	<b>7.02</b>	<b>7.37</b>	<b>10</b>	<b>10.3</b>	<b>58.3</b>
1SMB6.5AT3	KK	6.5	500	7.22	7.6	7.98	10	11.2	53.6
1SMB7.0AT3	KM	7.0	500	7.78	8.19	8.6	10	12.0	50.0
1SMB7.5AT3	KP	7.5	100	8.33	8.77	9.21	1.0	12.9	46.5
1SMB8.0AT3	KR	8.0	50	8.89	9.36	9.83	1.0	13.6	44.1
1SMB8.5AT3	KT	8.5	10	9.44	9.92	10.4	1.0	14.4	41.7
1SMB9.0AT3	KV	9.0	5.0	10.0	10.55	11.1	1.0	15.4	39.0
1SMB10AT3	KX	10	5.0	11.1	11.7	12.3	1.0	17.0	35.3
1SMB11AT3	KZ	11	5.0	12.2	12.85	13.5	1.0	18.2	33.0
1SMB12AT3	LE	12	5.0	13.3	14	14.7	1.0	19.9	30.2
1SMB13AT3	LG	13	5.0	14.4	15.15	15.9	1.0	21.5	27.9
1SMB14AT3	LK	14	5.0	15.6	16.4	17.2	1.0	23.2	25.8
1SMB15AT3	LM	15	5.0	16.7	17.6	18.5	1.0	24.4	24.0
1SMB16AT3	LP	16	5.0	17.8	18.75	19.7	1.0	26.0	23.1
1SMB17AT3	LR	17	5.0	18.9	19.9	20.9	1.0	27.6	21.7
1SMB18AT3	LT	18	5.0	20.0	21.05	22.1	1.0	29.2	20.5
1SMB20AT3	LV	20	5.0	22.2	23.35	24.5	1.0	32.4	18.5
<b>1SMB22AT3</b>	<b>LX</b>	<b>22</b>	<b>5.0</b>	<b>24.4</b>	<b>25.65</b>	<b>26.9</b>	<b>1.0</b>	<b>35.5</b>	<b>16.9</b>
1SMB24AT3	LZ	24	5.0	26.7	28.1	29.5	1.0	38.9	15.4
1SMB26AT3	ME	26	5.0	28.9	30.4	31.9	1.0	42.1	14.2
1SMB28AT3	MG	28	5.0	31.1	32.75	34.4	1.0	45.4	13.2
1SMB30AT3	MK	30	5.0	33.3	35.05	36.8	1.0	48.4	12.4
1SMB33AT3	MM	33	5.0	36.7	38.65	40.6	1.0	53.3	11.3
1SMB36AT3	MP	36	5.0	40.0	42.1	44.2	1.0	58.1	10.3
1SMB40AT3	MR	40	5.0	44.4	46.75	49.1	1.0	64.5	9.3
1SMB43AT3	MT	43	5.0	47.8	50.3	52.8	1.0	69.4	8.6
1SMB45AT3	MV	45	5.0	50.0	52.65	55.3	1.0	72.7	8.3
1SMB48AT3	MX	48	5.0	53.3	56.1	58.9	1.0	77.4	7.7
1SMB51AT3	MZ	51	5.0	56.7	59.7	62.7	1.0	82.4	7.3
1SMB54AT3	NE	54	5.0	60.0	63.15	66.3	1.0	87.1	6.9
<b>1SMB58AT3</b>	<b>NG</b>	<b>58</b>	<b>5.0</b>	<b>64.4</b>	<b>67.8</b>	<b>71.2</b>	<b>1.0</b>	<b>93.6</b>	<b>6.4</b>
1SMB60AT3	NK	60	5.0	66.7	70.2	73.7	1.0	96.8	6.2
1SMB64AT3	NM	64	5.0	71.1	74.85	78.6	1.0	103	5.8
1SMB70AT3	NP	70	5.0	77.8	81.9	86	1.0	113	5.3
1SMB75AT3	NR	75	5.0	83.3	87.7	92.1	1.0	121	4.9
1SMB78AT3	NT	78	5.0	86.7	91.25	95.8	1.0	126	4.7
1SMB85AT3	NV	85	5.0	94.4	99.2	104	1.0	137	4.4
1SMB90AT3	NX	90	5.0	100	105.5	111	1.0	146	4.1
1SMB100AT3	NZ	100	5.0	111	117	123	1.0	162	3.7
1SMB110AT3	PE	110	5.0	122	128.5	135	1.0	177	3.4
1SMB120AT3	PG	120	5.0	133	140	147	1.0	193	3.1
1SMB130AT3	PK	130	5.0	144	151.5	159	1.0	209	2.9
1SMB150AT3	PM	150	5.0	167	176	185	1.0	243	2.5
1SMB160AT3	PP	160	5.0	178	187.5	197	1.0	259	2.3
1SMB170AT3	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 3 of the General Data – 600 W at the beginning of this group.

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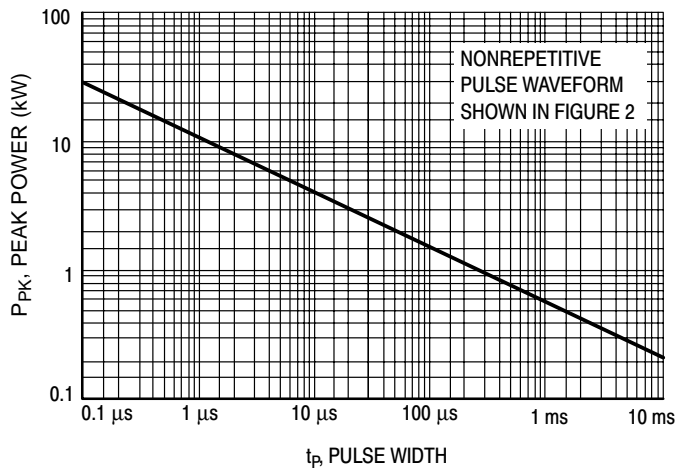


Figure 1. Pulse Rating Curve

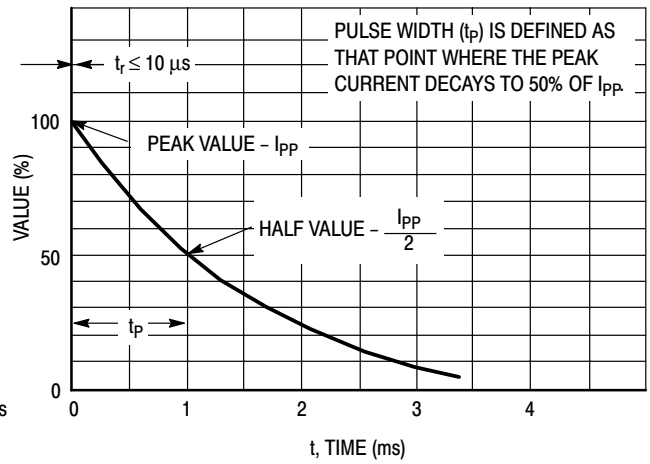


Figure 2. Pulse Waveform

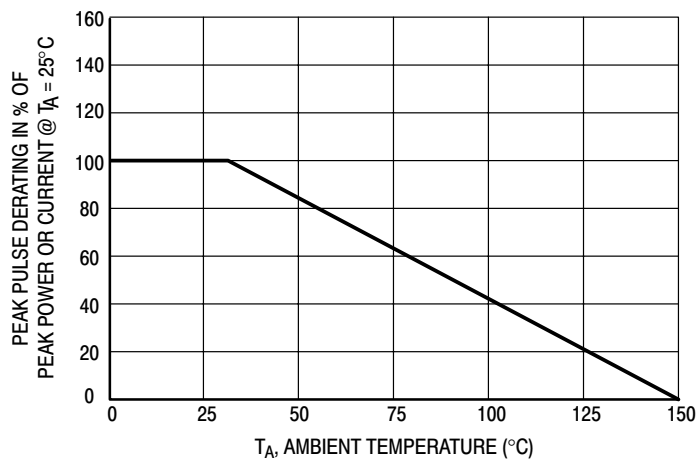


Figure 3. Pulse Derating Curve

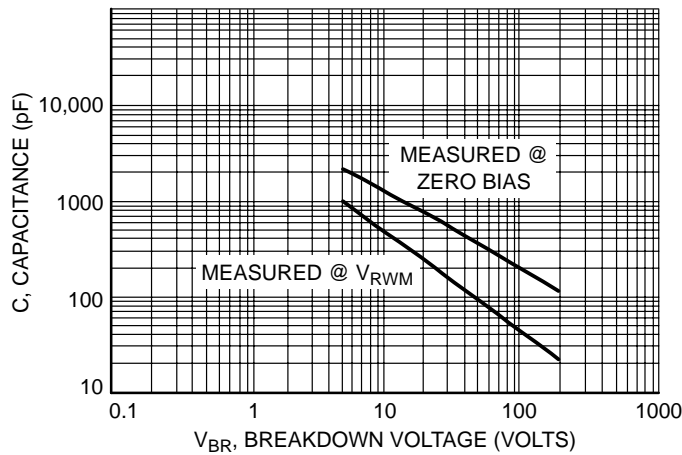
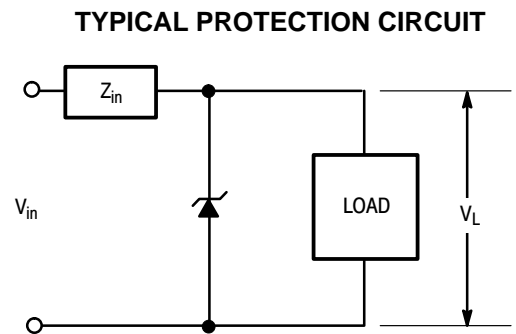


Figure 4. Capacitance versus Breakdown Voltage

## 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 5.

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 6. 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 7. 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 7 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 7 is multiplied by the peak power value of Figure 1 for the same pulse, the results follow the expected trend.

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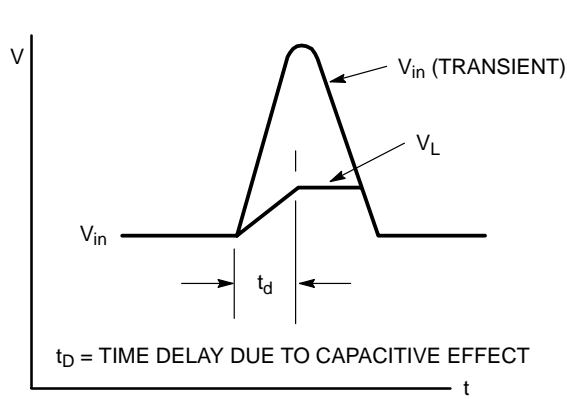


Figure 5.

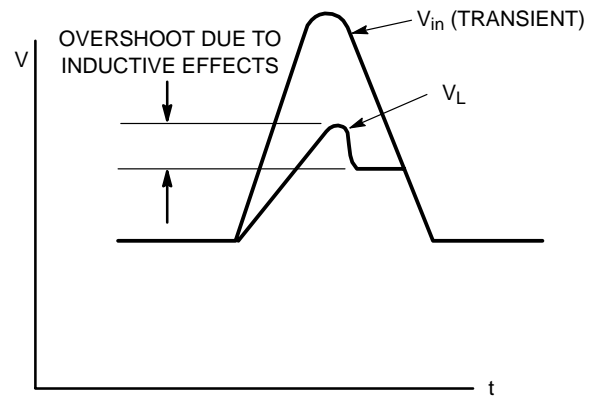


Figure 6.

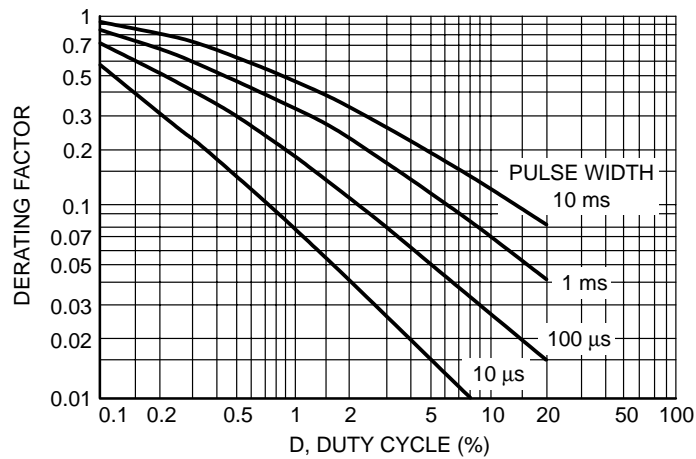


Figure 7. Typical Derating Factor for Duty Cycle

## 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.

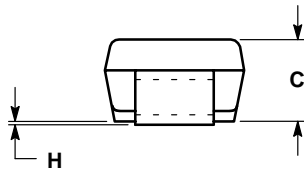
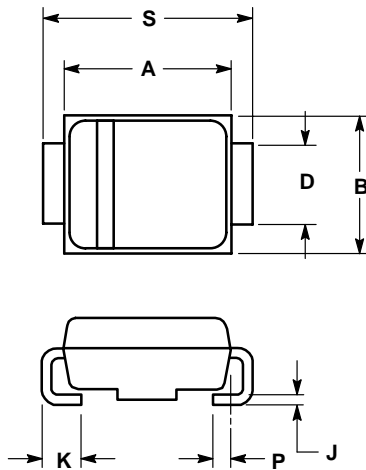
# 1SMB5.0AT3 Series

## OUTLINE DIMENSIONS

# Transient Voltage Suppressors – Surface Mounted

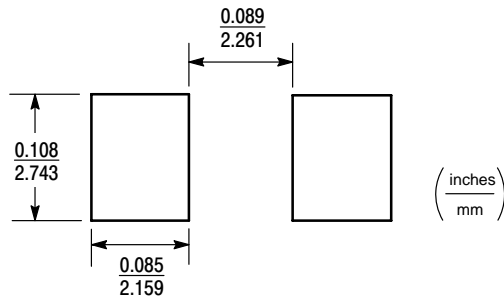
## 600 Watt Peak Power

**SMB**  
**DO-214AA**  
CASE 403A-03  
ISSUE D



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.160	0.180	4.06	4.57
B	0.130	0.150	3.30	3.81
C	0.075	0.095	1.90	2.41
D	0.077	0.083	1.96	2.11
H	0.0020	0.0060	0.051	0.152
J	0.006	0.012	0.15	0.30
K	0.030	0.050	0.76	1.27
P	0.020 REF		0.51 REF	
S	0.205	0.220	5.21	5.59



**SMB Footprint**

# 1SMB5.0AT3 Series

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