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.

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 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
- UL 497B for Isolated Loop Circuit Protection
- Response Time is Typically < 1.0 ns
- Pb−Free Packages are Available

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

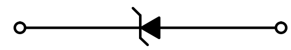
POLARITY: Cathode indicated by polarity band

MOUNTING POSITION: Any

ON Semiconductor®

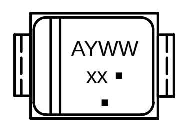
http://onsemi.com

PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 5.0 V − 170 V, 600 W PEAK POWER



SMB
CASE 403A
PLASTIC

MARKING DIAGRAM



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)

ORDERING INFORMATION

Device	Package	Shipping†
1SMBxxxAT3	SMB	2500/Tape & Reel
1SMBxxxAT3G	SMB (Pb−Free)	2500/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the Electrical Characteristics table on page 3 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (Note 1) @ T_L = 25°C, Pulse Width = 1 ms	P_{PK}	600	W
DC Power Dissipation @ T_L = 75°C Measured Zero Lead Length (Note 2) Derate Above 75°C Thermal Resistance from Junction−to−Lead	P_D $R_{\theta JL}$	3.0 40 25	W mW/°C °C/W
DC Power Dissipation (Note 3) @ T_A = 25°C Derate Above 25°C Thermal Resistance from Junction−to−Ambient	P_D $R_{\theta JA}$	0.55 4.4 226	W mW/°C °C/W
Forward Surge Current (Note 4) @ T_A = 25°C	I_{FSM}	100	A
Operating and Storage Temperature Range	T_J, T_{stg}	−65 to +150	°C

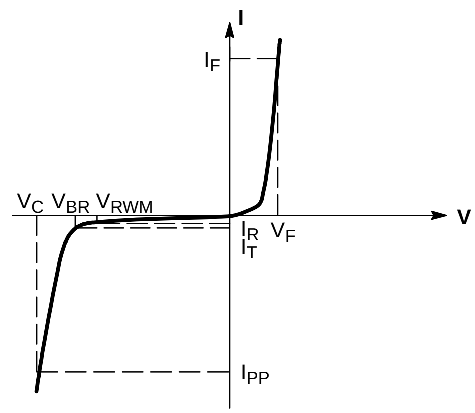
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. 10 X 1000 μs, 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°C unless otherwise noted, V_F = 3.5 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.



Uni−Directional TVS

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	μA	Min	Nom	Max	mA	Volts	Amps
1SMB5.0AT3, G	***KE***	***5.0***	***800***	***6.40***	***6.7***	***7.0***	***10***	***9.2***	***65.2***
1SMB6.0AT3, G	***KG***	***6.0***	***800***	***6.67***	***7.02***	***7.37***	***10***	***10.3***	***58.3***
1SMB6.5AT3, G	KK	6.5	500	7.22	7.6	7.98	10	11.2	53.6
1SMB7.0AT3, G	KM	7.0	500	7.78	8.19	8.6	10	12.0	50.0
1SMB7.5AT3, G	KP	7.5	100	8.33	8.77	9.21	1.0	12.9	46.5
1SMB8.0AT3, G	KR	8.0	50	8.89	9.36	9.83	1.0	13.6	44.1
1SMB8.5AT3, G	KT	8.5	10	9.44	9.92	10.4	1.0	14.4	41.7
1SMB9.0AT3, G	KV	9.0	5.0	10.0	10.55	11.1	1.0	15.4	39.0
1SMB10AT3, G	KX	10	5.0	11.1	11.7	12.3	1.0	17.0	35.3
1SMB11AT3, G	KZ	11	5.0	12.2	12.85	13.5	1.0	18.2	33.0
1SMB12AT3, G	LE	12	5.0	13.3	14	14.7	1.0	19.9	30.2
1SMB13AT3, G	LG	13	5.0	14.4	15.15	15.9	1.0	21.5	27.9
1SMB14AT3, G	LK	14	5.0	15.6	16.4	17.2	1.0	23.2	25.8
1SMB15AT3, G	LM	15	5.0	16.7	17.6	18.5	1.0	24.4	24.0
1SMB16AT3, G	LP	16	5.0	17.8	18.75	19.7	1.0	26.0	23.1
1SMB17AT3, G	LR	17	5.0	18.9	19.9	20.9	1.0	27.6	21.7
1SMB18AT3, G	LT	18	5.0	20.0	21.05	22.1	1.0	29.2	20.5
1SMB20AT3, G	LV	20	5.0	22.2	23.35	24.5	1.0	32.4	18.5
1SMB22AT3, G	***LX***	***22***	***5.0***	***24.4***	***25.65***	***26.9***	***1.0***	***35.5***	***16.9***
1SMB24AT3, G	LZ	24	5.0	26.7	28.1	29.5	1.0	38.9	15.4
1SMB26AT3, G	ME	26	5.0	28.9	30.4	31.9	1.0	42.1	14.2
1SMB28AT3, G	MG	28	5.0	31.1	32.75	34.4	1.0	45.4	13.2
1SMB30AT3, G	MK	30	5.0	33.3	35.05	36.8	1.0	48.4	12.4
1SMB33AT3, G	MM	33	5.0	36.7	38.65	40.6	1.0	53.3	11.3
1SMB36AT3, G	MP	36	5.0	40.0	42.1	44.2	1.0	58.1	10.3
1SMB40AT3, G	MR	40	5.0	44.4	46.75	49.1	1.0	64.5	9.3
1SMB43AT3, G	MT	43	5.0	47.8	50.3	52.8	1.0	69.4	8.6
1SMB45AT3, G	MV	45	5.0	50.0	52.65	55.3	1.0	72.7	8.3
1SMB48AT3, G	MX	48	5.0	53.3	56.1	58.9	1.0	77.4	7.7
1SMB51AT3, G	MZ	51	5.0	56.7	59.7	62.7	1.0	82.4	7.3
1SMB54AT3, G	NE	54	5.0	60.0	63.15	66.3	1.0	87.1	6.9
1SMB58AT3, G	***NG***	***58***	***5.0***	***64.4***	***67.8***	***71.2***	***1.0***	***93.6***	***6.4***
1SMB60AT3, G	NK	60	5.0	66.7	70.2	73.7	1.0	96.8	6.2
1SMB64AT3, G	NM	64	5.0	71.1	74.85	78.6	1.0	103	5.8
1SMB70AT3, G	NP	70	5.0	77.8	81.9	86	1.0	113	5.3
1SMB75AT3, G	NR	75	5.0	83.3	87.7	92.1	1.0	121	4.9
1SMB85AT3, G	NV	85	55.0	94.4	99.2	104	1.0	137	4.4
1SMB90AT3, G	NX	90	5.0	100	105.5	111	1.0	146	4.1
1SMB100AT3, G	NZ	100	5.0	111	117	123	1.0	162	3.7
1SMB110AT3, G	PE	110	5.0	122	128.5	135	1.0	177	3.4
1SMB120AT3, G	PG	120	5.0	133	140	147	1.0	193	3.1
1SMB130AT3, G	PK	130	5.0	144	151.5	159	1.0	209	2.9
1SMB150AT3, G	PM	150	5.0	167	176	185	1.0	243	2.5
1SMB160AT3, G	PP	160	5.0	178	187.5	197	1.0	259	2.3
1SMB170AT3, G	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.

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

* The “G” suffix indicates Pb−Free package available.

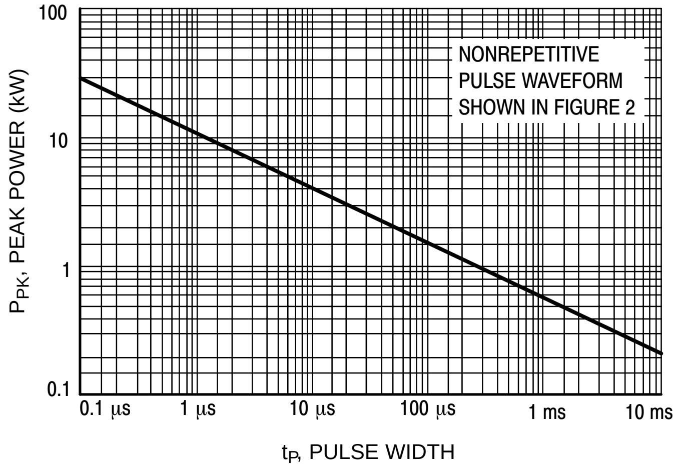


Figure 1. Pulse Rating Curve

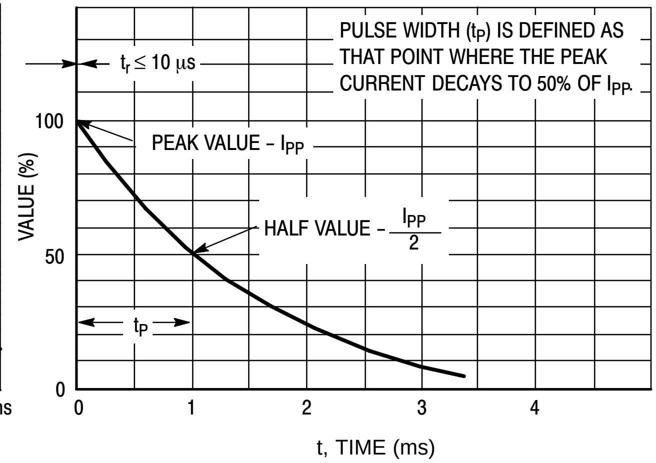


Figure 2. Pulse Waveform

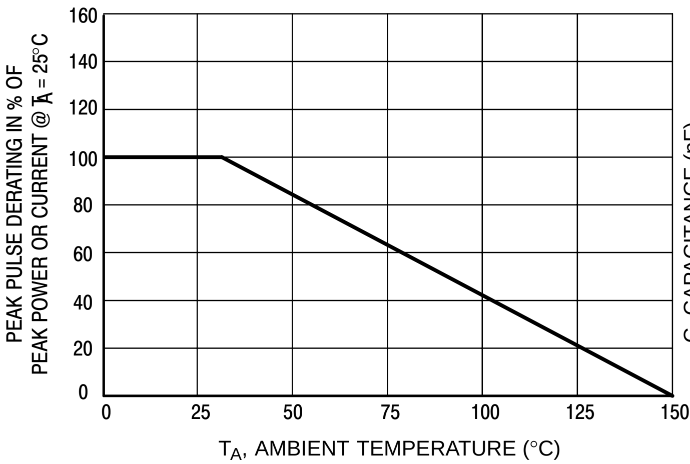


Figure 4. Pulse Derating Curve

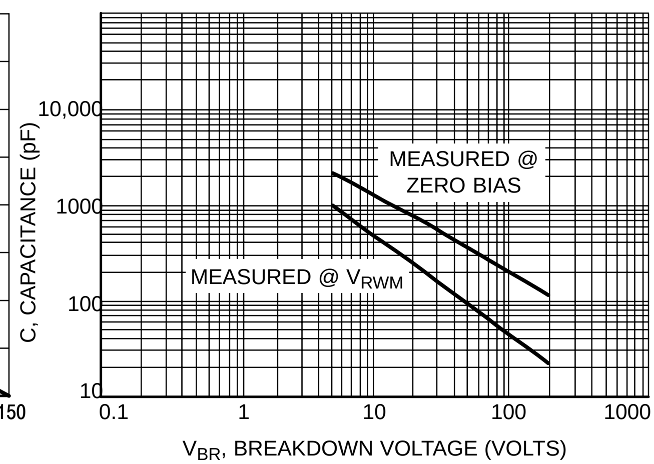


Figure 5. Capacitance versus Breakdown Voltage

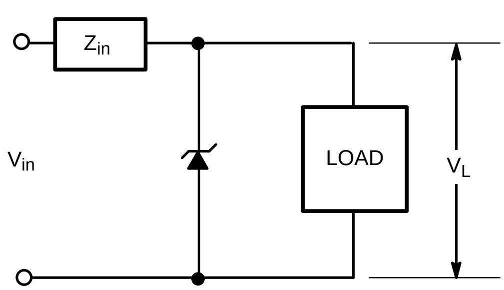


Figure 3. Typical Protection Circuit

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 μs 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.

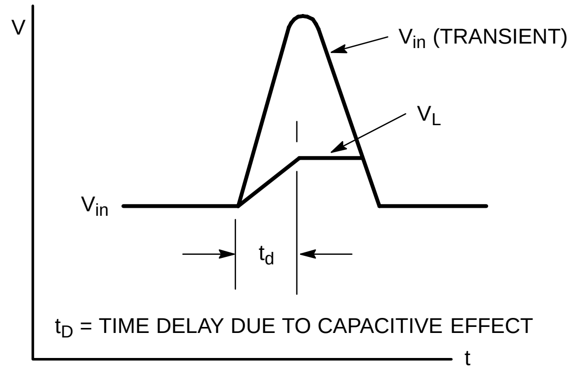


Figure 6.

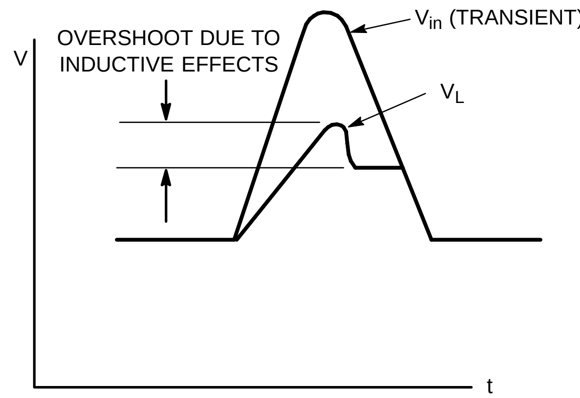


Figure 7.

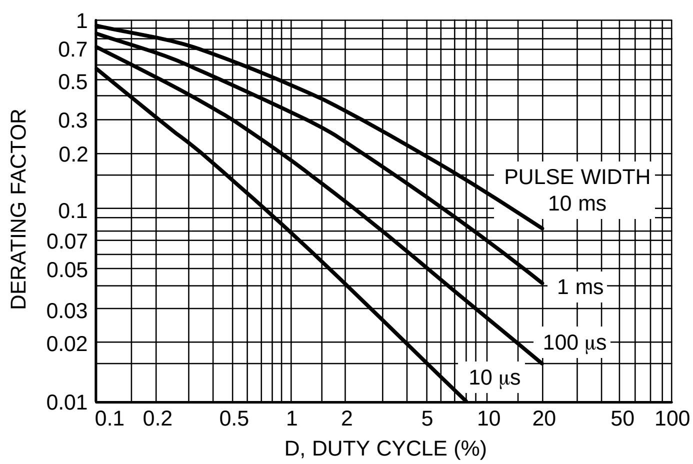


Figure 8. Typical Derating Factor for Duty Cycle

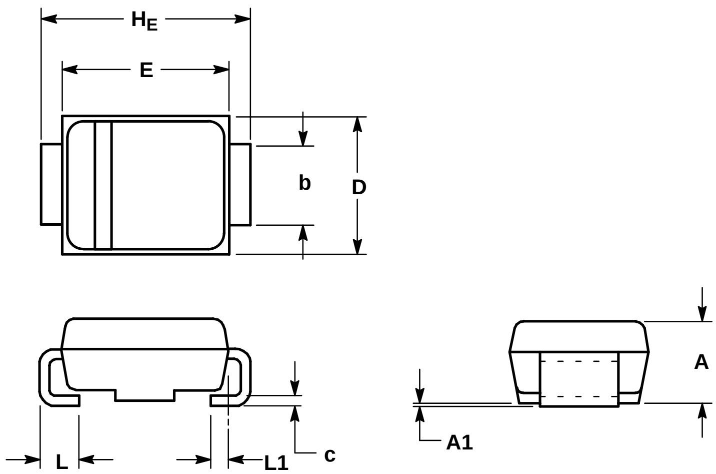
UL RECOGNITION

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.

PACKAGE DIMENSIONS

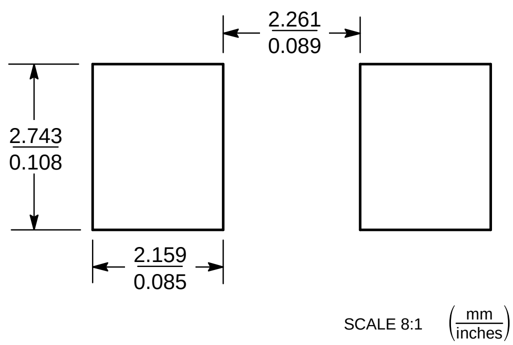
SMB
CASE 403A−03
ISSUE E



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

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	1.90	2.13	2.41	0.075	0.084	0.095
A1	0.05	0.10	0.15	0.002	0.004	0.006
b	1.96	2.03	2.11	0.077	0.080	0.083
c	0.15	0.23	0.30	0.006	0.009	0.012
D	3.30	3.56	3.81	0.130	0.140	0.150
E	4.06	4.32	4.57	0.160	0.170	0.180
H_E	5.21	5.44	5.59	0.205	0.214	0.220
L	0.76	1.02	1.27	0.030	0.040	0.050
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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PUBLICATION ORDERING INFORMATION

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