

# 1SMBXXCAT3 Series

## Zener Transient Voltage Suppressors

### GENERAL DATA IS APPLICABLE TO ALL SERIES IN THIS GROUP

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, numerical controls, process controls, medical equipment, business machines, power supplies and many other industrial/consumer applications.

#### Specification Features:

- Standard Zener Breakdown Voltage Range — 11 to 87 V
- Stand-off Voltage Range — 10 to 78 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 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

**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



**ON Semiconductor**

Formerly a Division of Motorola

<http://onsemi.com>

### PLASTIC SURFACE MOUNT ZENER OVERVOLTAGE TRANSIENT SUPPRESSORS 10–78 VOLTS 600 WATT PEAK POWER



PLASTIC  
CASE 403A

#### ORDERING INFORMATION

Device	Package	Shipping
1SMBXXCAT3	CASE 403A	Tape and Reel 2500 Units/Reel

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

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Peak Power Dissipation (1) @ $T_L \leq 25^\circ\text{C}$	PPK	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	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	– 55 to +150	°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.

# 1SMBXXCAT3 Series

## 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				
1SMB10CAT3	10	11.1	1.0	17.0	35.3	5.0	KXC
1SMB11CAT3	11	12.2	1.0	18.2	33.0	5.0	KZC
1SMB12CAT3	12	13.3	1.0	19.9	30.2	5.0	LEC
1SMB13CAT3	13	14.4	1.0	21.5	27.9	5.0	LGC
1SMB14CAT3	14	15.6	1.0	23.2	25.8	5.0	LKC
<b>1SMB15CAT3</b>	<b>15</b>	<b>16.7</b>	<b>1.0</b>	<b>24.4</b>	<b>24.0</b>	<b>5.0</b>	<b>LMC</b>
1SMB16CAT3	16	17.8	1.0	26.0	23.1	5.0	LPC
1SMB17CAT3	17	18.9	1.0	27.6	21.7	5.0	LRC
1SMB18CAT3	18	20.0	1.0	29.2	20.5	5.0	LTC
1SMB20CAT3	20	22.2	1.0	32.4	18.5	5.0	LVC
1SMB22CAT3	22	24.4	1.0	35.5	16.9	5.0	LXC
1SMB24CAT3	24	26.7	1.0	38.9	15.4	5.0	LZC
1SMB26CAT3	26	28.9	1.0	42.1	14.2	5.0	MEC
1SMB28CAT3	28	31.1	1.0	45.4	13.2	5.0	MGC
1SMB30CAT3	30	33.3	1.0	48.4	12.4	5.0	MKC
1SMB33CAT3	33	36.7	1.0	53.3	11.3	5.0	MMC
1SMB36CAT3	36	40.0	1.0	58.1	10.3	5.0	MPC
1SMB40CAT3	40	44.4	1.0	64.5	9.3	5.0	MRC
1SMB43CAT3	43	47.8	1.0	69.4	8.6	5.0	MTC
1SMB45CAT3	45	50.0	1.0	72.7	8.3	5.0	MVC
1SMB48CAT3	48	53.3	1.0	77.4	7.7	5.0	MXC
1SMB51CAT3	51	56.7	1.0	82.4	7.3	5.0	MZC
1SMB54CAT3	54	60.0	1.0	87.1	6.9	5.0	NEC
1SMB58CAT3	58	64.4	1.0	93.6	6.4	5.0	NGC
1SMB60CAT3	60	66.7	1.0	96.8	6.2	5.0	NKC
1SMB64CAT3	64	71.1	1.0	103	5.8	5.0	NMC
1SMB70CAT3	70	77.8	1.0	113	5.3	5.0	NPC
1SMB75CAT3	75	83.3	1.0	121	4.9	5.0	NRC
1SMB78CAT3	78	86.7	1.0	126	4.7	5.0	NTC

Devices listed in bold, italic are ON Semiconductor Preferred devices.

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<sub>(BR)min</sub>** 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

# 1SMBXXCAT3 Series

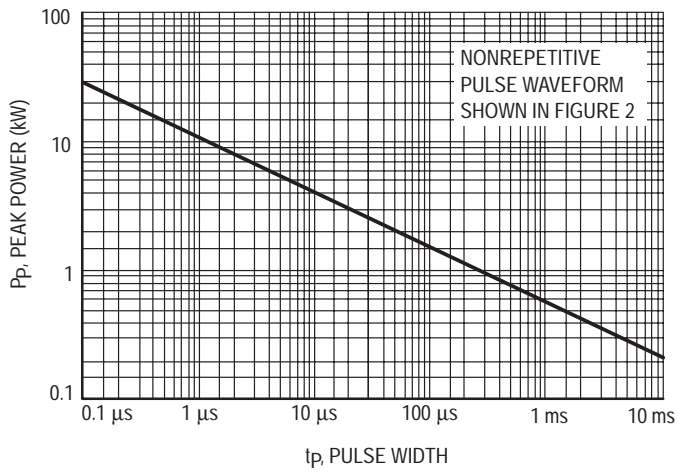


Figure 1. Pulse Rating Curve

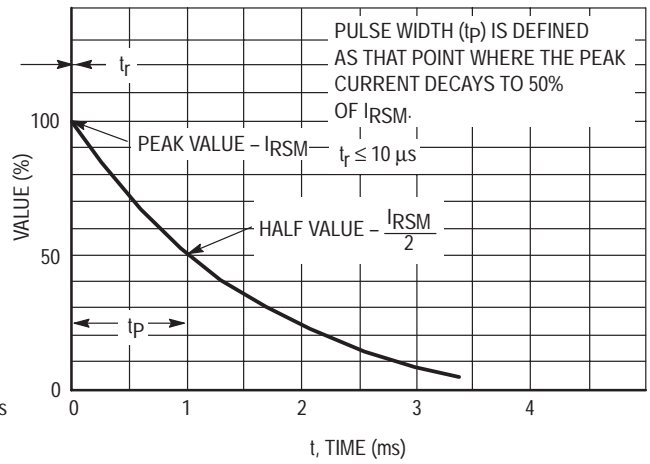


Figure 2. Pulse Waveform

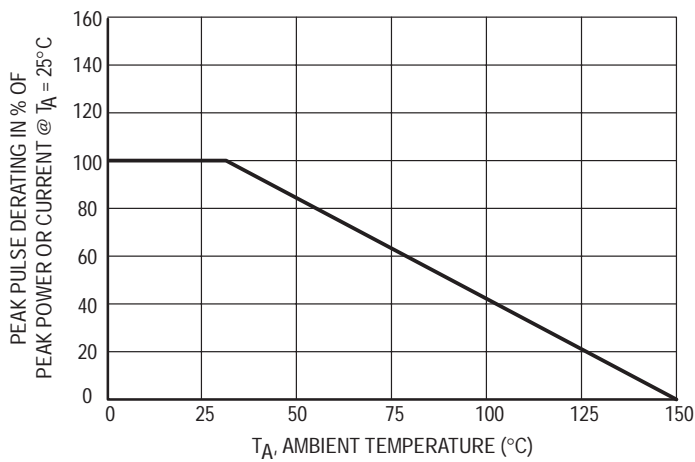
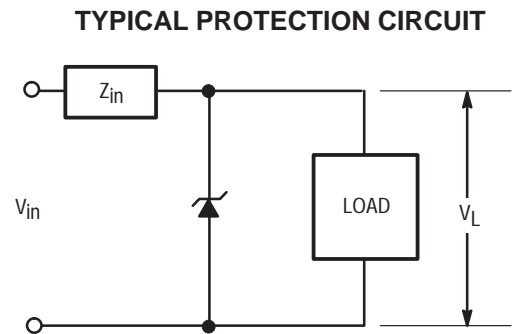


Figure 3. Pulse Derating Curve



## 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.

## 1SMBXXCAT3 Series

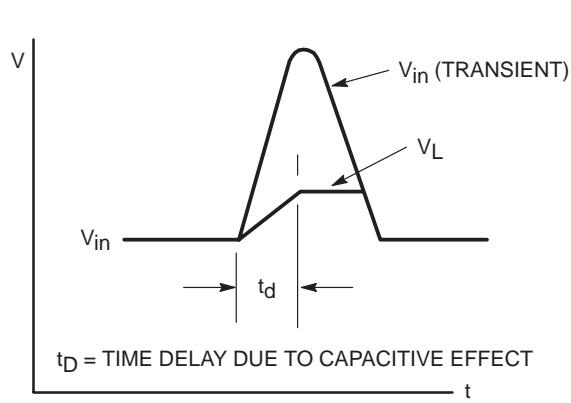


Figure 4.

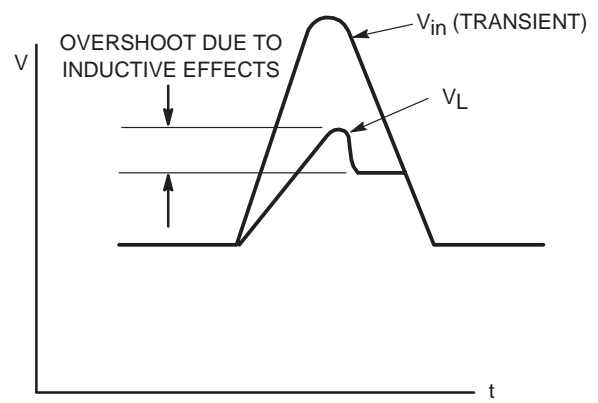


Figure 5.

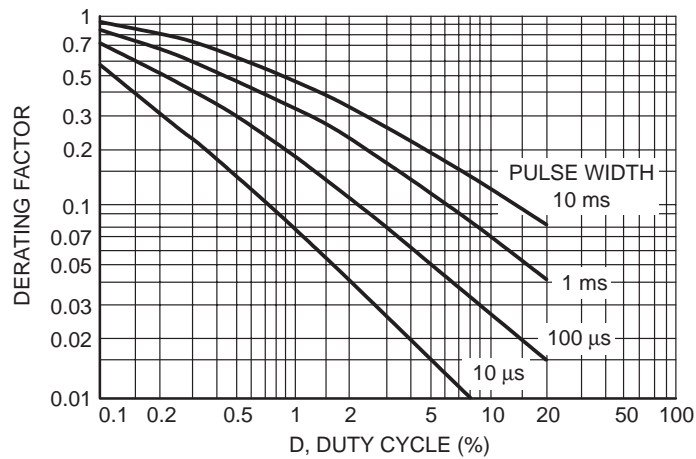


Figure 6. Typical Derating Factor for Duty Cycle

## UL RECOGNITION

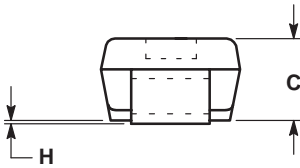
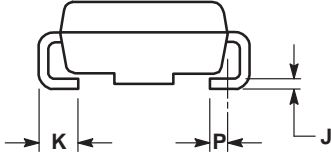
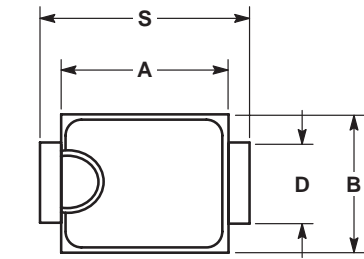
The entire series has *Underwriters Laboratory Recognition* for the classification of protectors (QVGV2) under the UL standard for safety 497B and File #116110. Many competitors only have one or two devices recognized or have recognition in a non-protective category. Some competitors have no recognition 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.

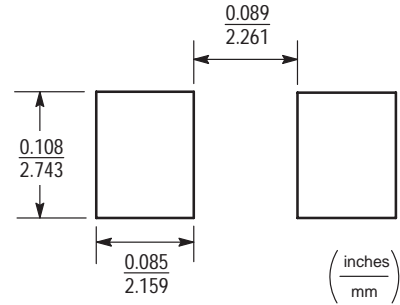
Whereas, some competitors have only passed a flammability test for the package material, we have been recognized for much more to be included in their Protector category.

# Transient Voltage Suppressors – Surface Mounted

## 600 Watt Peak Power



**CASE 403A  
PLASTIC**



**SMB Footprint**

**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

(Refer to Section 10 of the TVS/Zener Data Book (DL150/D) for Surface Mount, Thermal Data and Footprint Information.)

## **Notes**

# 1SMBXXCAT3 Series

**ON Semiconductor** and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

## PUBLICATION ORDERING INFORMATION

### North America Literature Fulfillment:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** ONlit@hibbertco.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada

### EUROPE: LDC for ON Semiconductor – European Support

**German Phone:** (+1) 303-308-7140 (M–F 2:30pm to 5:00pm Munich Time)  
**Email:** ONlit-german@hibbertco.com  
**French Phone:** (+1) 303-308-7141 (M–F 2:30pm to 5:00pm Toulouse Time)  
**Email:** ONlit-french@hibbertco.com  
**English Phone:** (+1) 303-308-7142 (M–F 1:30pm to 5:00pm UK Time)  
**Email:** ONlit@hibbertco.com

### ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support

**Phone:** 303-675-2121 (Tue–Fri 9:00am to 1:00pm, Hong Kong Time)  
Toll Free from Hong Kong 800-4422-3781  
**Email:** ONlit-asia@hibbertco.com

### JAPAN: ON Semiconductor, Japan Customer Focus Center

4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-8549  
**Phone:** 81-3-5487-8345  
**Email:** r14153@onsemi.com

**Fax Response Line:** 303-675-2167  
800-344-3810 Toll Free USA/Canada

**ON Semiconductor Website:** <http://onsemi.com>

For additional information, please contact your local Sales Representative.