

1SMC5.0AT3 Series

1500 Watt Peak Power Zener Transient Voltage Suppressors

Unidirectional*

The SMC 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 SMC 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 78 V
- Standard Zener Breakdown Voltage Range – 6.7 V to 91.25 V
- Peak Power – 1500 Watts @ 1 ms
- ESD Rating of Class 3 (>16 KV) per Human Body Model
- Maximum Clamp Voltage @ Peak Pulse Current
- Low Leakage < 5 μ A Above 10 V
- UL 497B for Isolated Loop Circuit Protection
- Maximum Temperature Coefficient Specified
- 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 molded polarity notch

MOUNTING POSITION: Any

MAXIMUM RATINGS

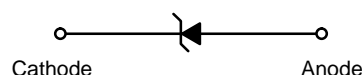
Please See the Table on the Following Page



ON Semiconductor™

<http://onsemi.com>

PLASTIC SURFACE MOUNT ZENER TRANSIENT VOLTAGE SUPPRESSORS 5.0–78 VOLTS 1500 WATT PEAK POWER



SMC
CASE 403
PLASTIC

MARKING DIAGRAM



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

ORDERING INFORMATION

| Device † | Package | Shipping |
|------------|---------|------------------|
| 1SMCxxxAT3 | SMC | 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.

*Bidirectional devices will not be available in this series.

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

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MAXIMUM RATINGS

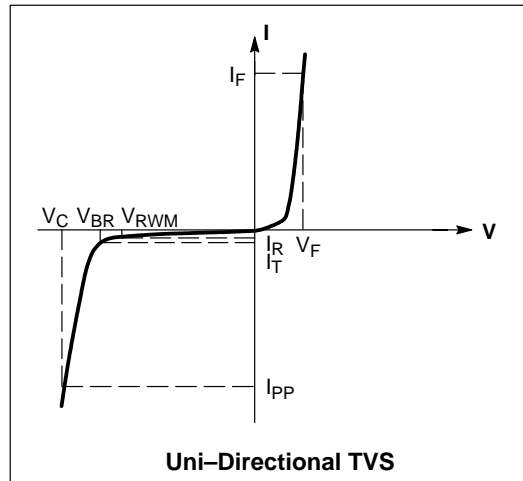
| Rating | Symbol | Value | Unit |
|---|-----------------|--------------|---|
| Peak Power Dissipation (Note 1.) @ $T_L = 25^\circ\text{C}$, Pulse Width = 1 ms | P_{PK} | 1500 | W |
| DC Power Dissipation @ $T_L = 75^\circ\text{C}$ Measured Zero Lead Length (Note 2.) Derate Above 75°C | P_D | 4.0 | W |
| Thermal Resistance from Junction to Lead | $R_{\theta JL}$ | 54.6 18.3 | mW/ $^\circ\text{C}$ $^\circ\text{C}/\text{W}$ |
| DC Power Dissipation (Note 3.) @ $T_A = 25^\circ\text{C}$ Derate Above 25°C | P_D | 0.75 6.1 | W mW/ $^\circ\text{C}$ |
| Thermal Resistance from Junction to Ambient | $R_{\theta JA}$ | 165 | $^\circ\text{C}/\text{W}$ |
| Forward Surge Current (Note 4.) @ $T_A = 25^\circ\text{C}$ | I_{FSM} | 200 | A |
| Operating and Storage Temperature Range | T_J, T_{stg} | -65 to +150 | $^\circ\text{C}$ |

- 10 X 1000 μs , non-repetitive
- 1" square copper pad, FR-4 board
- FR-4 board, using ON Semiconductor minimum recommended footprint, as shown in 403 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, $V_F = 3.5\text{ V Max}$ @ $I_F = 100\text{ A}$) (Note 5.)

| 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, PW = 8.3 ms non-repetitive duty cycle



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

| Device | Device Marking | V _{RWM} (Note 6.) | I _R @ V _{RWM} | Breakdown Voltage | | | | V _C @ I _{PP} (Note 8.) | |
|------------------|----------------|-------------------------------|-----------------------------------|---------------------------------|-------------|-------------|------------------|--|-----------------|
| | | | | V _{BR} Volts (Note 7.) | | | @ I _T | V _C | I _{PP} |
| | | Volts | μA | Min | Nom | Max | mA | Volts | Amps |
| 1SMC5.0AT3 | GDE | 5.0 | 1000 | 6.4 | 6.7 | 7.0 | 10 | 9.2 | 163 |
| 1SMC6.0AT3 | GDG | 6.0 | 1000 | 6.67 | 7.02 | 7.37 | 10 | 10.3 | 145.6 |
| 1SMC6.5AT3 | GDK | 6.5 | 500 | 7.22 | 7.6 | 7.98 | 10 | 11.2 | 133.9 |
| 1SMC7.0AT3 | GDM | 7.0 | 200 | 7.78 | 8.19 | 8.6 | 10 | 12 | 125 |
| 1SMC7.5AT3 | GDP | 7.5 | 100 | 8.33 | 8.77 | 9.21 | 1 | 12.9 | 116.3 |
| 1SMC8.0AT3 | GDR | 8.0 | 50 | 8.89 | 9.36 | 9.83 | 1 | 13.6 | 110.3 |
| 1SMC8.5AT3 | GDT | 8.5 | 25 | 9.44 | 9.92 | 10.4 | 1 | 14.4 | 104.2 |
| 1SMC9.0AT3 | GDV | 9.0 | 10 | 10 | 10.55 | 11.1 | 1 | 15.4 | 97.4 |
| 1SMC10AT3 | GDX | 10 | 5 | 11.1 | 11.7 | 12.3 | 1 | 17 | 88.2 |
| 1SMC11AT3 | GDZ | 11 | 5 | 12.2 | 12.85 | 13.5 | 1 | 18.2 | 82.4 |
| 1SMC12AT3 | GEE | 12 | 5 | 13.3 | 14 | 14.7 | 1 | 19.9 | 75.3 |
| 1SMC13AT3 | GEG | 13 | 5 | 14.4 | 15.15 | 15.9 | 1 | 21.5 | 69.7 |
| 1SMC14AT3 | GEK | 14 | 5 | 15.6 | 16.4 | 17.2 | 1 | 23.2 | 64.7 |
| 1SMC15AT3 | GEM | 15 | 5 | 16.7 | 17.6 | 18.5 | 1 | 24.4 | 61.5 |
| 1SMC16AT3 | GEP | 16 | 5 | 17.8 | 18.75 | 19.7 | 1 | 26 | 57.7 |
| 1SMC17AT3 | GER | 17 | 5 | 18.9 | 19.9 | 20.9 | 1 | 27.6 | 53.3 |
| 1SMC18AT3 | GET | 18 | 5 | 20 | 21.05 | 22.1 | 1 | 29.2 | 51.4 |
| 1SMC20AT3 | GEV | 20 | 5 | 22.2 | 23.35 | 24.5 | 1 | 32.4 | 46.3 |
| 1SMC22AT3 | GEX | 22 | 5 | 24.4 | 25.65 | 26.9 | 1 | 35.5 | 42.2 |
| 1SMC24AT3 | GEZ | 24 | 5 | 26.7 | 28.1 | 29.5 | 1 | 38.9 | 38.6 |
| 1SMC26AT3 | GFE | 26 | 5 | 28.9 | 30.4 | 31.9 | 1 | 42.1 | 35.6 |
| 1SMC28AT3 | GFG | 28 | 5 | 31.1 | 32.75 | 34.4 | 1 | 45.4 | 33 |
| 1SMC30AT3 | GFK | 30 | 5 | 33.3 | 35.05 | 36.8 | 1 | 48.4 | 31 |
| 1SMC33AT3 | GFM | 33 | 5 | 36.7 | 38.65 | 40.6 | 1 | 53.3 | 28.1 |
| 1SMC36AT3 | GFP | 36 | 5 | 40 | 42.1 | 44.2 | 1 | 58.1 | 25.8 |
| 1SMC40AT3 | GFR | 40 | 5 | 44.4 | 46.75 | 49.1 | 1 | 64.5 | 32.2 |
| 1SMC43AT3 | GFT | 43 | 5 | 47.8 | 50.3 | 52.8 | 1 | 69.4 | 21.6 |
| 1SMC45AT3 | GFV | 45 | 5 | 50 | 52.65 | 55.3 | 1 | 72.2 | 20.6 |
| 1SMC48AT3 | GFX | 48 | 5 | 53.3 | 56.1 | 58.9 | 1 | 77.4 | 19.4 |
| 1SMC51AT3 | GFZ | 51 | 5 | 56.7 | 59.7 | 62.7 | 1 | 82.4 | 18.2 |
| 1SMC54AT3 | GGE | 54 | 5 | 60 | 63.15 | 66.3 | 1 | 87.1 | 17.2 |
| 1SMC58AT3 | GGG | 58 | 5 | 64.4 | 67.8 | 71.2 | 1 | 93.6 | 16 |
| 1SMC60AT3 | GGK | 60 | 5 | 66.7 | 70.2 | 73.7 | 1 | 96.8 | 15.5 |
| 1SMC64AT3 | GGM | 64 | 5 | 71.1 | 74.85 | 78.6 | 1 | 103 | 14.6 |
| 1SMC70AT3 | GGP | 70 | 5 | 77.8 | 81.9 | 86 | 1 | 113 | 13.3 |
| 1SMC75AT3 | GGR | 75 | 5 | 83.3 | 87.7 | 92.1 | 1 | 121 | 12.4 |
| 1SMC78AT3 | GGT | 78 | 5 | 86.7 | 91.25 | 95.8 | 1 | 126 | 11.4 |

6. A transient suppressor is normally selected according to the maximum 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 – 1500 Watt at the beginning of this group.

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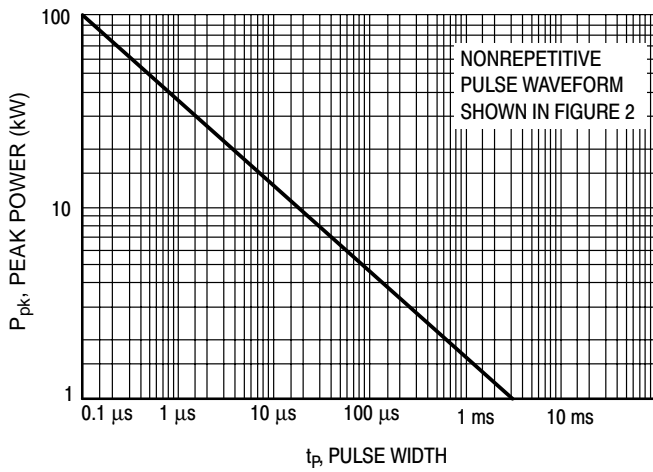


Figure 1. Pulse Rating Curve

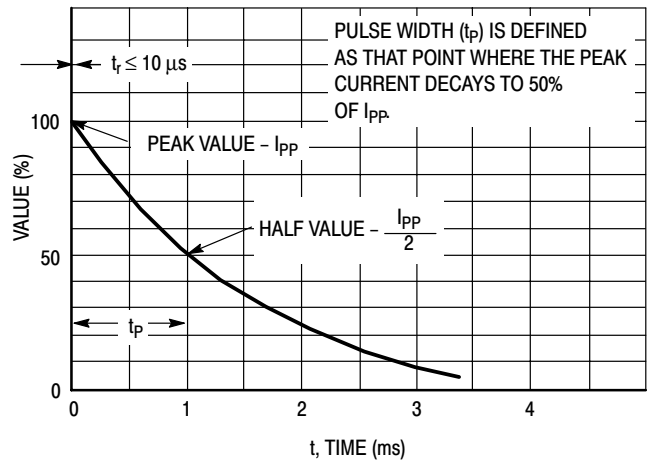


Figure 2. Pulse Waveform

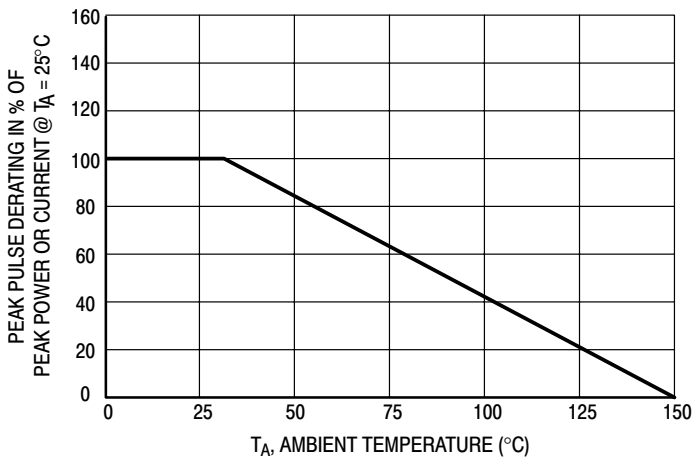


Figure 3. Pulse Derating Curve

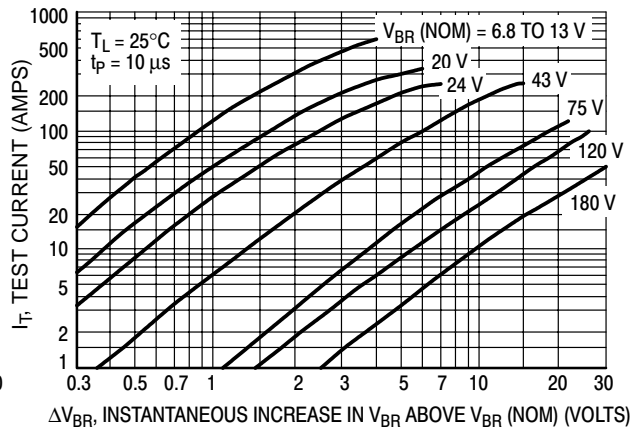


Figure 4. Dynamic Impedance

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.

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 SMC 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 μ 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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TYPICAL PROTECTION CIRCUIT

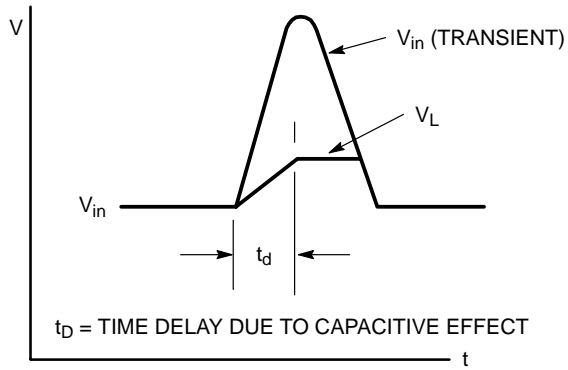
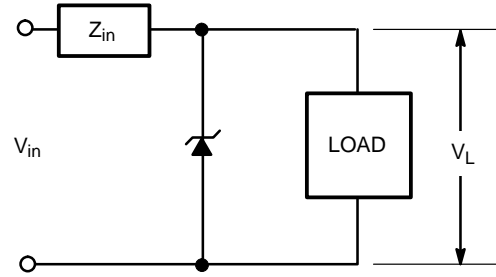


Figure 5.

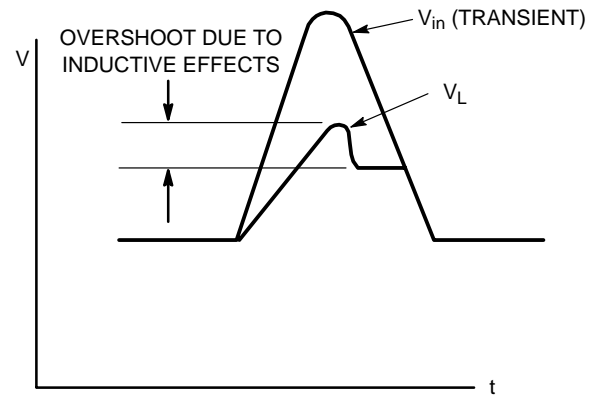


Figure 6.

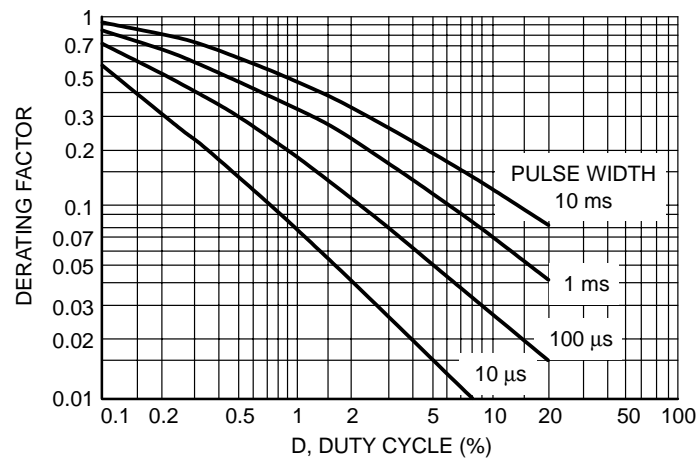


Figure 7. Typical Derating Factor for Duty Cycle

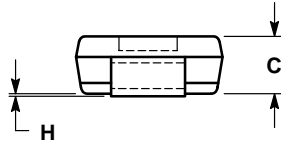
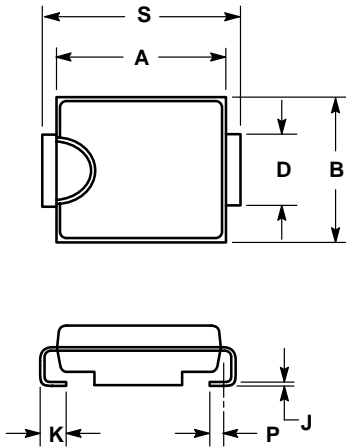
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OUTLINE DIMENSIONS

Transient Voltage Suppressors – Surface Mounted

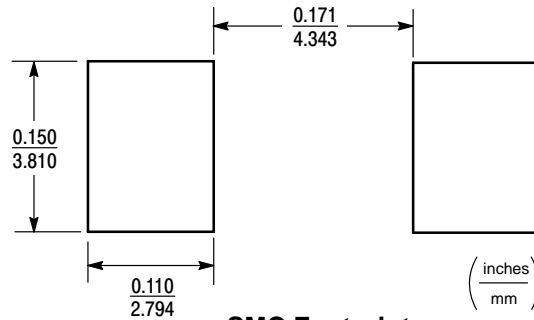
1500 Watt Peak Power

SMC
CASE 403-03
ISSUE B



- 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 | 0.260 | 0.280 | 6.60 | 7.11 |
| B | 0.220 | 0.240 | 5.59 | 6.10 |
| C | 0.075 | 0.095 | 1.90 | 2.41 |
| D | 0.115 | 0.121 | 2.92 | 3.07 |
| 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 | 0.305 | 0.320 | 7.75 | 8.13 |



SMC Footprint

1SMC5.0AT3 Series

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