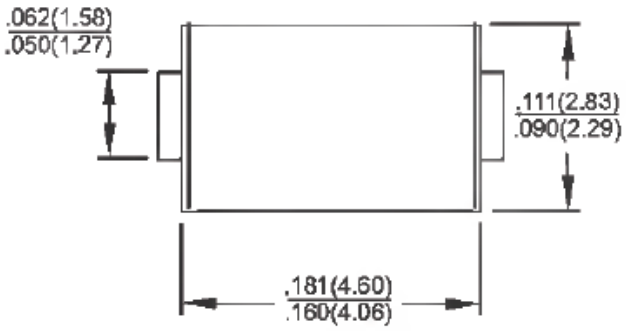
TAIWAN SEMICONDUCTOR

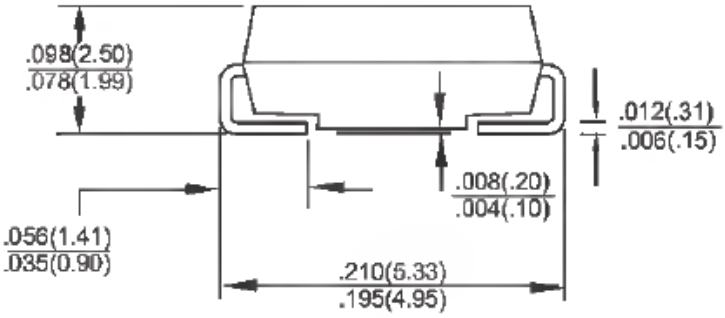
# SMAJ SERIES

400 Watts Suface Mount Transient Voltage Suppressor

**SMA/DO-214AC**

Pb RoHS COMPLIANCE




## Features

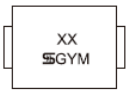
- ✧ UL Recognized File # E-326243
- ✧ For surface mounted application
- ✧ Low profile package
- ✧ Built-in strain relief
- ✧ Glass passivated junction
- ✧ Excellent clamping capability
- ✧ Fast response time: Typically less than 1.0ps from 0 volt to BV min
- ✧ Typical $I_R$ less than 1uA above 10V
- ✧ High temperature soldering guaranteed: 260℃ / 10 seconds at terminals
- ✧ Plastic material used carried Underwriters Laboratory Flammability Classification 94V-0
- ✧ 400 watts peak pulse power capability with a 10 / 1000 us waveform (300W above 78V)
- ✧ Green compound with suffix "G" on packing code & prefix "G" on datecode

## Mechanical Data

- ✧ Case: Molded plastic
- ✧ Terminals: Pure tin plated, lead free
- ✧ Polarity: Indicated by cathode band
- ✧ Packaging: 12mm tape per EIA Std RS-481
- ✧ Weight: 0.064 gram

**Dimensions in inches and (millimeters)**

**Marking Diagram**




XX = Specific Device Code
G = Green Compound
Y = Year
M = Work Month

## Maximum Ratings and Electrical Characteristics

Rating at 25 ℃ ambient temperature unless otherwise specified.

| Type Number | Symbol | Value | Unit |
|---|---|---|---|
| Peak Power Dissipation at $T_A$=25℃, Tp=1ms(Note 1) | $P_{PK}$ | Minimum 400 | Watts |
| Steady State Power Dissipation | $P_D$ | 1 | Watts |
| Peak Forward Surge Current, 8.3ms Single Half Sine-wave Superimposed on Rated Load (JEDEC method) (Note 2, 3) | $I_{FSM}$ | 40 | Amps |
| Maximum Instantaneous Forward Voltage at 25.0A for Unidirectional Only | $V_F$ | 3.5 | Volts |
| Operating and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | ℃ |

Note 1: Non-repetitive Current Pulse Per Fig. 3 and Derated above $T_A$=25℃ Per Fig. 2

Note 2: Mounted on 5 x 5mm (.013mm Think) Copper Pads to Each Terminal

Note 3: 8.3ms Single Half Sine-wave or Equivalent Square Wave, Duty Cycle=4 Pulses Per Minute Maximum

Devices for Bipolar Applications

1. For Bidirectional Use C or CA Suffix for Types SMAJ5.0 through Types SMAJ188
2. Electrical Characterstics Apply in Both Directions

# RATINGS AND CHARACTERISTIC CURVES (SMAJ SERIES)

FIG. 1 PEAK PULSE POWER RATING CURVE

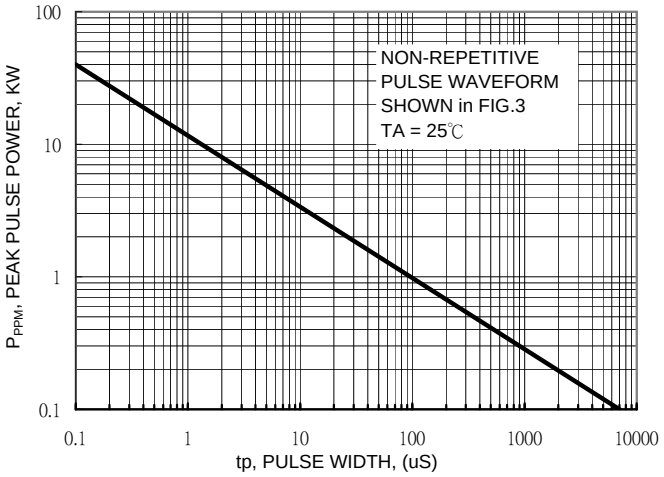



FIG.2 PULSE DERATING CURVE

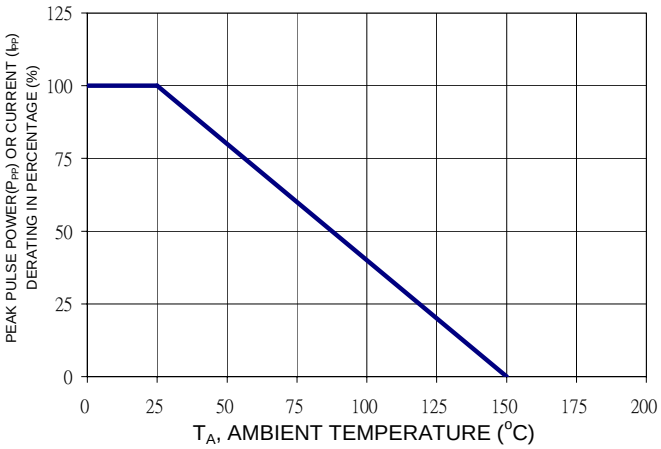



FIG. 3 CLAMPING POWER PULSE WAVEFORM

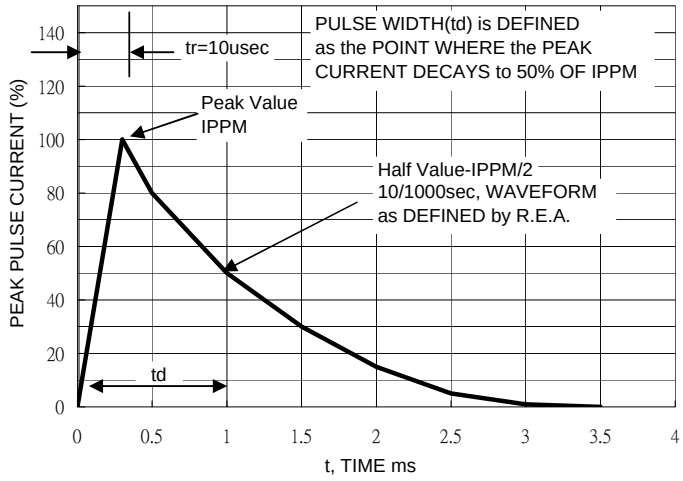



FIG. 4 MAXIMUM NON-REPETITIVE FORWARD SURGE CURRENT UNIDIRECTIONAL ONLY

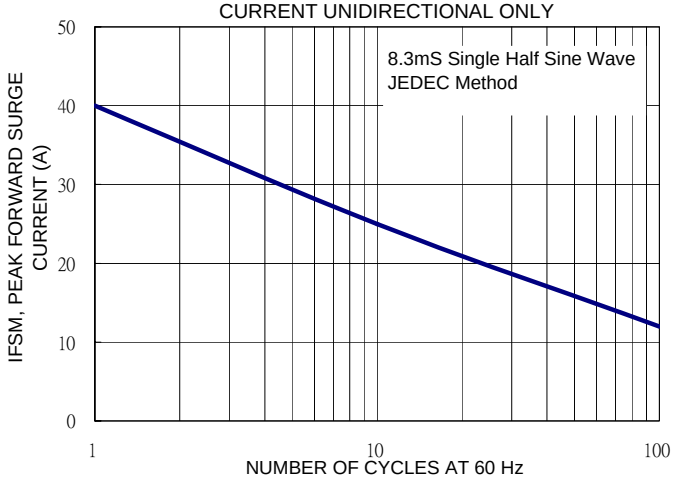
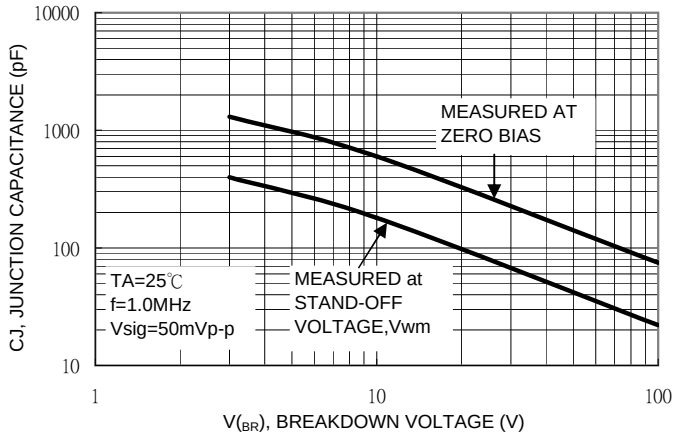



FIG. 5 TYPICAL JUNCTION CAPACITANCE



TAIWAN SEMICONDUCTOR

## ELECTRICAL CHARACTERISTICS (TA=25℃ unless otherwise noted)

| Device | Device Marking Code | Working Peak Reverse Voltage $V_{WM}$ | Breakdown Voltage VBR (V) at $I_T$ | | Test Current IT (mA) | Maximum Clamping Voltage at IPPM Vc(V) (Note5) | Maximum Peak Pulse Surge Current $I_{PPM}$ (A)(Note5) | Maximum Reverse Leakage @ $V_{WM}$ ID (uA) |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | | | | |
| SMAJ5.0 | AD | 5 | 6.4 | 7.3 | 10 | 9.6 | 41.7 | 800 |
| SMAJ5.0A | AE | 5 | 6.4 | 7 | 10 | 9.2 | 43.5 | 800 |
| SMAJ6.0 | AF | 6 | 6.67 | 8.15 | 10 | 11.4 | 35.1 | 800 |
| SMAJ6.0A | AG | 6 | 6.67 | 7.37 | 10 | 10.3 | 38.8 | 800 |
| SMAJ6.5 | AH | 6.5 | 7.22 | 8.82 | 10 | 12.3 | 32.5 | 500 |
| SMAJ6.5A | AK | 6.5 | 7.22 | 7.98 | 10 | 11.2 | 35.7 | 500 |
| SMAJ7.0 | AL | 7 | 7.78 | 9.51 | 10 | 13.3 | 30.1 | 200 |
| SMAJ7.0A | AM | 7 | 7.78 | 8.6 | 10 | 12.0 | 33.3 | 200 |
| SMAJ7.5 | AN | 7.5 | 8.33 | 10.30 | 1.0 | 14.3 | 28.0 | 100 |
| SMAJ7.5A | AP | 7.5 | 8.33 | 9.21 | 1.0 | 12.9 | 31.0 | 100 |
| SMAJ8.0 | AQ | 8 | 8.89 | 10.9 | 1.0 | 15.0 | 26.7 | 50.0 |
| SMAJ8.0A | AR | 8 | 8.89 | 9.83 | 1.0 | 13.6 | 29.4 | 50.0 |
| SMAJ8.5 | AS | 8.5 | 9.44 | 11.5 | 1.0 | 15.9 | 25.2 | 10.0 |
| SMAJ8.5A | AT | 8.5 | 9.44 | 10.4 | 1.0 | 14.4 | 27.8 | 10.0 |
| SMAJ9.0 | AU | 9 | 10 | 12.2 | 1.0 | 16.9 | 23.7 | 5.0 |
| SMAJ9.0A | AV | 9 | 10 | 11.1 | 1.0 | 15.4 | 26.0 | 5.0 |
| SMAJ10 | AW | 10 | 11.1 | 13.6 | 1.0 | 18.8 | 21.3 | 5.0 |
| SMAJ10A | AX | 10 | 11.1 | 12.3 | 1.0 | 17.0 | 23.5 | 5.0 |
| SMAJ11 | AY | 11 | 12.2 | 14.9 | 1.0 | 20.1 | 19.9 | 5.0 |
| SMAJ11A | AZ | 11 | 12.2 | 13.5 | 1.0 | 18.2 | 22.0 | 5.0 |
| SMAJ12 | BD | 12 | 13.3 | 16.3 | 1.0 | 22.0 | 18.2 | 5.0 |
| SMAJ12A | BE | 12 | 13.3 | 14.7 | 1.0 | 19.9 | 20.1 | 5.0 |
| SMAJ13 | BF | 13 | 14.4 | 17.6 | 1.0 | 23.8 | 16.8 | 5.0 |
| SMAJ13A | BG | 13 | 14.4 | 15.9 | 1.0 | 21.5 | 18.6 | 5.0 |
| SMAJ14 | BH | 14 | 15.6 | 19.1 | 1.0 | 25.8 | 15.5 | 5.0 |
| SMAJ14A | BK | 14 | 15.6 | 17.2 | 1.0 | 23.2 | 17.2 | 5.0 |
| SMAJ15 | BL | 15 | 16.7 | 20.4 | 1.0 | 26.9 | 14.9 | 5.0 |
| SMAJ15A | BM | 15 | 16.7 | 18.5 | 1.0 | 24.4 | 16.4 | 5.0 |
| SMAJ16 | BN | 16 | 17.8 | 21.8 | 1.0 | 28.8 | 13.9 | 5.0 |
| SMAJ16A | BP | 16 | 17.8 | 19.7 | 1.0 | 26.0 | 15.4 | 5.0 |
| SMAJ17 | BQ | 17 | 18.9 | 23.1 | 1.0 | 30.5 | 13.1 | 5.0 |
| SMAJ17A | BR | 17 | 18.9 | 20.9 | 1.0 | 27.6 | 14.5 | 5.0 |
| SMAJ18 | BS | 18 | 20 | 24.4 | 1.0 | 32.2 | 12.4 | 5.0 |
| SMAJ18A | BT | 18 | 20 | 22.1 | 1.0 | 29.2 | 13.7 | 5.0 |
| SMAJ20 | BU | 20 | 22.2 | 27.1 | 1.0 | 35.8 | 11.2 | 5.0 |
| SMAJ20A | BV | 20 | 22.2 | 24.5 | 1.0 | 32.4 | 12.3 | 5.0 |
| SMAJ22 | BW | 22 | 24.4 | 29.8 | 1.0 | 39.4 | 10.2 | 5.0 |
| SMAJ22A | BX | 22 | 24.4 | 26.9 | 1.0 | 35.5 | 11.3 | 5.0 |
| SMAJ24 | BY | 24 | 26.7 | 32.6 | 1.0 | 43.0 | 9.3 | 5.0 |
| SMAJ24A | BZ | 24 | 26.7 | 29.5 | 1.0 | 38.9 | 10.3 | 5.0 |
| SMAJ26 | CD | 26 | 28.9 | 35.3 | 1.0 | 46.6 | 8.6 | 5.0 |
| SMAJ26A | CE | 26 | 28.9 | 31.9 | 1.0 | 42.1 | 9.5 | 5.0 |
| SMAJ28 | CF | 28 | 31.1 | 38 | 1.0 | 50.0 | 8.0 | 5.0 |
| SMAJ28A | CG | 28 | 31.1 | 34.4 | 1.0 | 45.4 | 8.8 | 5.0 |
| SMAJ30 | CH | 30 | 33.3 | 40.7 | 1.0 | 53.5 | 7.5 | 5.0 |
| SMAJ30A | CK | 30 | 33.3 | 36.8 | 1.0 | 48.4 | 8.3 | 5.0 |
| SMAJ33 | CL | 33 | 36.7 | 44.9 | 1.0 | 59.0 | 6.8 | 5.0 |
| SMAJ33A | CM | 33 | 36.7 | 40.6 | 1.0 | 53.3 | 7.5 | 5.0 |
| SMAJ36 | CN | 36 | 40 | 48.9 | 1.0 | 64.3 | 6.2 | 5.0 |
| SMAJ36A | CP | 36 | 40 | 44.2 | 1.0 | 58.1 | 6.9 | 5.0 |
| SMAJ40 | CQ | 40 | 44.4 | 54.3 | 1.0 | 71.4 | 5.6 | 5.0 |
| SMAJ40A | CR | 40 | 44.4 | 49.1 | 1.0 | 64.5 | 6.2 | 5.0 |
| SMAJ43 | CS | 43 | 47.8 | 58.4 | 1.0 | 76.7 | 5.2 | 5.0 |
| SMAJ43A | CT | 43 | 47.8 | 52.8 | 1.0 | 69.4 | 5.8 | 5.0 |

## ELECTRICAL CHARACTERISTICS (TA=25℃ unless otherwise noted)

| Device | Device Marking Code | Working Peak Reverse Voltage $V_{WM}$ | Breakdown Voltage VBR (V) at $I_T$ | | Test Current IT (mA) | Maximum Clamping Voltage at IPPM Vc(V) (Note5) | Maximum Peak Pulse Surge Current $I_{PPM}$ (A)(Note5) | Maximum Reverse Leakage @ $V_{WM}$ ID (uA) |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | | | | |
| SMAJ45 | CU | 45 | 50 | 61.1 | 1.0 | 80.3 | 5.0 | 5.0 |
| SMAJ45A | CV | 45 | 50 | 55.3 | 1.0 | 72.7 | 5.5 | 5.0 |
| SMAJ48 | CW | 48 | 53.3 | 65.1 | 1.0 | 85.5 | 4.7 | 5.0 |
| SMAJ48A | CX | 48 | 53.3 | 58.9 | 1.0 | 77.4 | 5.2 | 5.0 |
| SMAJ51 | CY | 51 | 56.7 | 69.3 | 1.0 | 91.1 | 4.4 | 5.0 |
| SMAJ51A | CZ | 51 | 56.7 | 62.7 | 1.0 | 82.4 | 4.9 | 5.0 |
| SMAJ54 | RD | 54 | 60 | 73.3 | 1.0 | 96.3 | 4.2 | 5.0 |
| SMAJ54A | RE | 54 | 60 | 66.3 | 1.0 | 87.1 | 4.6 | 5.0 |
| SMAJ58 | RF | 58 | 64.4 | 78.7 | 1.0 | 103 | 3.9 | 5.0 |
| SMAJ58A | RG | 58 | 64.4 | 71.2 | 1.0 | 93.6 | 4.3 | 5.0 |
| SMAJ60 | RH | 60 | 66.7 | 81.5 | 1.0 | 107 | 3.7 | 5.0 |
| SMAJ60A | RK | 60 | 66.7 | 73.7 | 1.0 | 96.8 | 4.1 | 5.0 |
| SMAJ64 | RL | 64 | 71.1 | 86.9 | 1.0 | 114 | 3.5 | 5.0 |
| SMAJ64A | RM | 64 | 71.1 | 78.6 | 1.0 | 103 | 3.9 | 5.0 |
| SMAJ70 | RN | 70 | 77.8 | 95.1 | 1.0 | 125 | 3.2 | 5.0 |
| SMAJ70A | RP | 70 | 77.8 | 86 | 1.0 | 113 | 3.5 | 5.0 |
| SMAJ75 | RQ | 75 | 83.3 | 102 | 1.0 | 134 | 3.0 | 5.0 |
| SMAJ75A | RR | 75 | 83.3 | 92.1 | 1.0 | 121 | 3.3 | 5.0 |
| SMAJ78 | RS | 78 | 86.7 | 106 | 1.0 | 139 | 2.9 | 5.0 |
| SMAJ78A | RT | 78 | 86.7 | 95.8 | 1.0 | 126 | 3.2 | 5.0 |
| SMAJ85 | RU | 85 | 94.4 | 115 | 1.0 | 151 | 2 | 5.0 |
| SMAJ85A | RV | 85 | 94.4 | 104 | 1.0 | 137 | 2.2 | 5.0 |
| SMAJ90 | RW | 90 | 100 | 122 | 1.0 | 160 | 1.9 | 5.0 |
| SMAJ90A | RX | 90 | 100 | 111 | 1.0 | 146 | 2.1 | 5.0 |
| SMAJ100 | RY | 100 | 111 | 136 | 1.0 | 179 | 1.7 | 5.0 |
| SMAJ100A | RZ | 100 | 111 | 123 | 1.0 | 162 | 1.9 | 5.0 |
| SMAJ110 | SD | 110 | 122 | 149 | 1.0 | 196 | 1.6 | 5.0 |
| SMAJ110A | SE | 110 | 122 | 135 | 1.0 | 177 | 1.7 | 5.0 |
| SMAJ120 | SF | 120 | 133 | 163 | 1.0 | 214 | 1.4 | 5.0 |
| SMAJ120A | SG | 120 | 133 | 147 | 1.0 | 193 | 1.6 | 5.0 |
| SMAJ130 | SH | 130 | 144 | 176 | 1.0 | 231 | 1.3 | 5.0 |
| SMAJ130A | SK | 130 | 144 | 159 | 1.0 | 209 | 1.5 | 5.0 |
| SMAJ150 | SL | 150 | 167 | 204 | 1.0 | 266 | 1.1 | 5.0 |
| SMAJ150A | SM | 150 | 167 | 185 | 1.0 | 243 | 1.3 | 5.0 |
| SMAJ160 | SN | 160 | 178 | 218 | 1.0 | 287 | 1 | 5.0 |
| SMAJ160A | SP | 160 | 178 | 197 | 1.0 | 259 | 1.2 | 5.0 |
| SMAJ170 | SQ | 170 | 189 | 231 | 1.0 | 304 | 1 | 5.0 |
| SMAJ170A | SR | 170 | 189 | 209 | 1.0 | 275 | 1.1 | 5.0 |
| SMAJ188 | ST | 188 | 209 | 255 | 1.0 | 344 | 0.9 | 5.0 |
| SMAJ188A | SS | 188 | 209 | 231 | 1.0 | 328 | 0.91 | 5.0 |

Notes:

1. Non-repetitive current pulse, per Fig. 3 and derated above $T_A$=25℃ per Fig. 2
2. Mounted on 5 x 5mm copper pads to each terminal
3. Lead temperature at $T_L$=75℃
4. Measure on 8.3ms single half sine-wave duty cycle=4 pulses per minutes maximum
5. Peak pulse power waveform is 10/1000 us
6. For Bi-Directional devices having $V_R$ of 10 volts and under, the $I_R$ limit is double.

## TVS APPLICATION NOTES:

Transient Voltage Suppressors may be used at various points in a circuit to provide various degrees of protection. The following is a typical linear power supply with transient voltage suppressor units plaved at different points. All provide protection

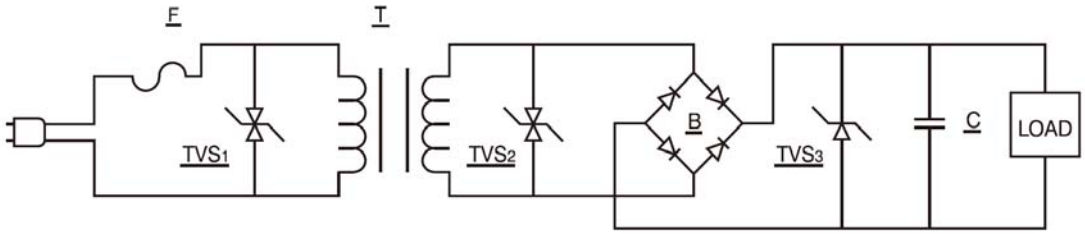



FIGURE 1

Transient Voltage Suppressor 1 provides maximum protection. However, the system will probably require replacement of the line fuse(F) since it provides a dominant portion of the series impedance when a surge is encountered.

Hower, we do not recommend to use the TVS diode here, unless we can know the electric circuit impedance and the magnitude of surge rushed into the circuit. Otherwise the TVS diode is easy to be destroyed by voltage surge.

Transient Voltage Suppressor 2 provides execllent protection of circuitry excluding the transformer(T). However, since the transformer is a large part of the series impedance, the chance of the line fuse opening during the surge condition is reduced.

Transient Voltage Suppressor 3 provides the load with complete protection. It uses a unidirectional Transient Voltage Suppressor, which is a cost advantage. The series impedance now includes the line fuse, transformer, and bridge rectifier(B) so failure

Any combination of this three, or any one of these applivations, will prevent damage to the load. This would require varying trade-offs in power supply protection versus maintenance(changing the time fuse).
An additional method is to utilize the Trans

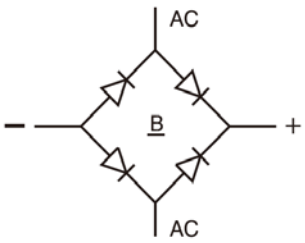
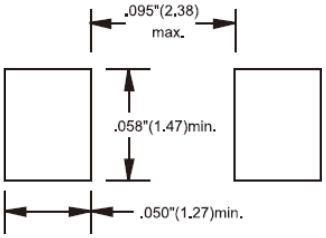



FIGURE 2

**RECOMMENDED PAD SIZES**

**The pad dimensions should be 0.010"(0.25mm) longer than the contact size, in the lead axis. This allows a solder filler to form, see figure below. Contact factort for soldering methods.**




Dimensions in inches and (millimeters)

Version : F11