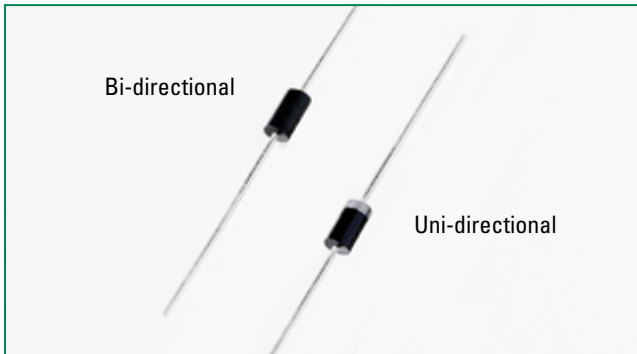



### SA Series



#### Agency Approvals

| AGENCY  | AGENCY FILE NUMBER |
|---|--------------------|
|  | E230531            |

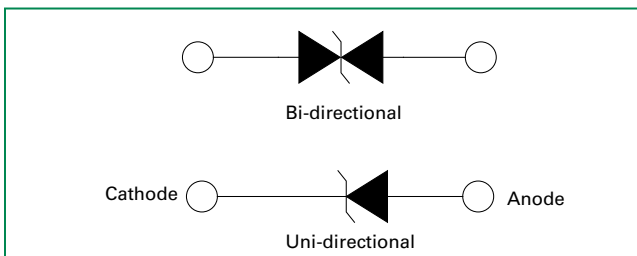
#### Maximum Ratings and Thermal Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

| Parameter  | Symbol                            | Value      | Unit |
|--|-----------------------------------|------------|------|
| Peak Pulse Power Dissipation by 10/1000µs Test Waveform (Fig.2) (Note 1)             | P <sub>PPM</sub>                  | 500        | W    |
| Steady State Power Dissipation on Infinite Heat Sink at T <sub>L</sub> =75°C         | P <sub>D</sub>                    | 3.0        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave Unidirectional Only (Note 2) | I <sub>FSM</sub>                  | 70         | A    |
| Maximum Instantaneous Forward Voltage at 35A for Unidirectional Only                 | V <sub>F</sub>                    | 3.5        | V    |
| Operating Junction and Storage Temperature Range                                     | T <sub>J</sub> , T <sub>STG</sub> | -65 to 175 | °C   |
| Typical Thermal Resistance Junction to Lead  | R <sub>θJL</sub>                  | 20         | °C/W |
| Typical Thermal Resistance Junction to Ambient                                       | R <sub>θJA</sub>                  | 75         | °C/W |

**Notes:**

1. Non-repetitive current pulse, per Fig. 4 and derated above T<sub>J</sub> (initial) =25°C per Fig. 3.
2. Measured on 8.3ms single half sine wave or equivalent square wave, duty cycle=4 per minute maximum.

#### Functional Diagram



#### Description

The SA Series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

#### Features

- 500W peak pulse capability at 10/1000µs waveform, repetition rate (duty cycles):0.01%
- V<sub>BR</sub> @ T<sub>J</sub>= V<sub>BR</sub>@25°C x (1+ α T x (T<sub>J</sub> - 25)) (α T: Temperature Coefficient, typical value is 0.1%)
- Glass passivated chip junction in DO-15 Package
- Fast response time: typically less than 1.0ps from 0 Volts to BV min
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 30kV(Air), 30kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Low incremental surge resistance
- Typical I<sub>R</sub> less than 1µA when V<sub>BR</sub> max>13V
- High temperature to reflow soldering guaranteed: 260°C/40sec / 0.375"/(9.5mm) lead length, 5 lbs., (2.3kg) tension
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

#### Applications

TVS devices are ideal for the protection of I/O interfaces, V<sub>CC</sub> bus and other vulnerable circuits used in telecom, computer, industrial and consumer electronic applications.

#### Additional Information



**Datasheet**



**Resources**



**Samples**

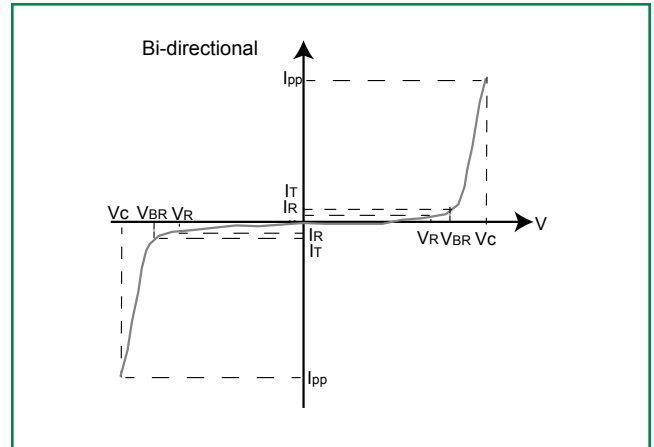
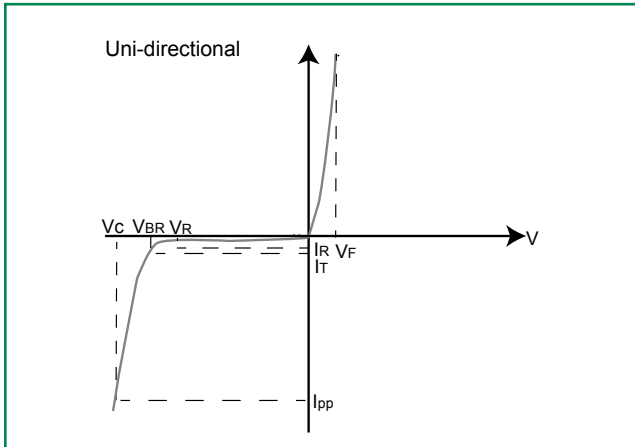
**Electrical Characteristics** ( $T_A=25^\circ\text{C}$  unless otherwise noted)

| Part Number (Uni) | Part Number (Bi) | Reverse Stand off Voltage $V_R$ (V) | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ |        | Test Current $I_T$ (mA) | Maximum Clamping Voltage $V_C @ I_{PP}$ (V) | Maximum Peak Pulse Current $I_{PP}$ (A) | Maximum Reverse Leakage $I_R @ V_R$ ( $\mu\text{A}$ ) | Agency Approval  |
|-------------------|------------------|-------------------------------------|--|--------|-------------------------|---|---|---|---|
|                   |                  |                                     | MIN  | MAX    |                         |   |   |   |   |
| SA5.0A            | SA5.0CA          | 5.0                                 | 6.40                                       | 7.00   | 10                      | 9.2   | 55.4                                    | 600   | X   |
| SA6.0A            | SA6.0CA          | 6.0                                 | 6.67                                       | 7.37   | 10                      | 10.3  | 49.5                                    | 600   | X   |
| SA6.5A            | SA6.5CA          | 6.5                                 | 7.22                                       | 7.98   | 10                      | 11.2  | 45.5                                    | 400   | X   |
| SA7.0A            | SA7.0CA          | 7.0                                 | 7.78                                       | 8.60   | 10                      | 12.0  | 42.5                                    | 150   | X   |
| SA7.5A            | SA7.5CA          | 7.5                                 | 8.33                                       | 9.21   | 1                       | 12.9  | 39.5                                    | 50  | X   |
| SA8.0A            | SA8.0CA          | 8.0                                 | 8.89                                       | 9.83   | 1                       | 13.6  | 37.5                                    | 25  | X   |
| SA8.5A            | SA8.5CA          | 8.5                                 | 9.44                                       | 10.40  | 1                       | 14.4  | 35.4                                    | 10  | X   |
| SA9.0A            | SA9.0CA          | 9.0                                 | 10.00                                      | 11.10  | 1                       | 15.4  | 33.1                                    | 5   | X   |
| SA10A             | SA10CA           | 10.0                                | 11.10                                      | 12.30  | 1                       | 17.0  | 30.0                                    | 3   | X   |
| SA11A             | SA11CA           | 11.0                                | 12.20                                      | 13.50  | 1                       | 18.2  | 28.0                                    | 1   | X   |
| SA12A             | SA12CA           | 12.0                                | 13.30                                      | 14.70  | 1                       | 19.9  | 25.6                                    | 1   | X   |
| SA13A             | SA13CA           | 13.0                                | 14.40                                      | 15.90  | 1                       | 21.5  | 23.7                                    | 1   | X   |
| SA14A             | SA14CA           | 14.0                                | 15.60                                      | 17.20  | 1                       | 23.2  | 22.0                                    | 1   | X   |
| SA15A             | SA15CA           | 15.0                                | 16.70                                      | 18.50  | 1                       | 24.4  | 20.9                                    | 1   | X   |
| SA16A             | SA16CA           | 16.0                                | 17.80                                      | 19.70  | 1                       | 26.0  | 19.6                                    | 1   | X   |
| SA17A             | SA17CA           | 17.0                                | 18.90                                      | 20.90  | 1                       | 27.6  | 18.5                                    | 1   | X   |
| SA18A             | SA18CA           | 18.0                                | 20.00                                      | 22.10  | 1                       | 29.2  | 17.5                                    | 1   | X   |
| SA20A             | SA20CA           | 20.0                                | 22.20                                      | 24.50  | 1                       | 32.4  | 15.7                                    | 1   | X   |
| SA22A             | SA22CA           | 22.0                                | 24.40                                      | 26.90  | 1                       | 35.5  | 14.4                                    | 1   | X   |
| SA24A             | SA24CA           | 24.0                                | 26.70                                      | 29.50  | 1                       | 38.9  | 13.1                                    | 1   | X   |
| SA26A             | SA26CA           | 26.0                                | 28.90                                      | 31.90  | 1                       | 42.1  | 12.1                                    | 1   | X   |
| SA28A             | SA28CA           | 28.0                                | 31.10                                      | 34.40  | 1                       | 45.4  | 11.2                                    | 1   | X   |
| SA30A             | SA30CA           | 30.0                                | 33.30                                      | 36.80  | 1                       | 48.4  | 10.5                                    | 1   | X   |
| SA33A             | SA33CA           | 33.0                                | 36.70                                      | 40.60  | 1                       | 53.3  | 9.6                                     | 1   | X   |
| SA36A             | SA36CA           | 36.0                                | 40.00                                      | 44.20  | 1                       | 58.1  | 8.8                                     | 1   | X   |
| SA40A             | SA40CA           | 40.0                                | 44.40                                      | 49.10  | 1                       | 64.5  | 7.9                                     | 1   | X   |
| SA43A             | SA43CA           | 43.0                                | 47.80                                      | 52.80  | 1                       | 69.4  | 7.3                                     | 1   | X   |
| SA45A             | SA45CA           | 45.0                                | 50.00                                      | 55.30  | 1                       | 72.7  | 7.0                                     | 1   | X   |
| SA48A             | SA48CA           | 48.0                                | 53.30                                      | 58.90  | 1                       | 77.4  | 6.6                                     | 1   | X   |
| SA51A             | SA51CA           | 51.0                                | 56.70                                      | 62.70  | 1                       | 82.4  | 6.2                                     | 1   | X   |
| SA54A             | SA54CA           | 54.0                                | 60.00                                      | 66.30  | 1                       | 87.1  | 5.9                                     | 1   | X   |
| SA58A             | SA58CA           | 58.0                                | 64.40                                      | 71.20  | 1                       | 93.6  | 5.4                                     | 1   | X   |
| SA60A             | SA60CA           | 60.0                                | 66.70                                      | 73.70  | 1                       | 96.8  | 5.3                                     | 1   | X   |
| SA64A             | SA64CA           | 64.0                                | 71.10                                      | 78.60  | 1                       | 103.0                                       | 5.0                                     | 1   | X   |
| SA70A             | SA70CA           | 70.0                                | 77.80                                      | 86.00  | 1                       | 113.0                                       | 4.5                                     | 1   | X   |
| SA75A             | SA75CA           | 75.0                                | 83.30                                      | 92.10  | 1                       | 121.0                                       | 4.2                                     | 1   | X   |
| SA78A             | SA78CA           | 78.0                                | 86.70                                      | 95.80  | 1                       | 126.0                                       | 4.0                                     | 1   | X   |
| SA85A             | SA85CA           | 85.0                                | 94.40                                      | 104.00 | 1                       | 137.0                                       | 3.7                                     | 1   | X   |
| SA90A             | SA90CA           | 90.0                                | 100.00                                     | 111.00 | 1                       | 146.0                                       | 3.5                                     | 1   | X   |
| SA100A            | SA100CA          | 100.0                               | 111.00                                     | 123.00 | 1                       | 162.0                                       | 3.1                                     | 1   | X   |
| SA110A            | SA110CA          | 110.0                               | 122.00                                     | 135.00 | 1                       | 177.0                                       | 2.9                                     | 1   | X   |
| SA120A            | SA120CA          | 120.0                               | 133.00                                     | 147.00 | 1                       | 193.0                                       | 2.6                                     | 1   | X   |
| SA130A            | SA130CA          | 130.0                               | 144.00                                     | 159.00 | 1                       | 209.0                                       | 2.4                                     | 1   | X   |
| SA150A            | SA150CA          | 150.0                               | 167.00                                     | 185.00 | 1                       | 243.0                                       | 2.1                                     | 1   | X   |
| SA160A            | SA160CA          | 160.0                               | 178.00                                     | 197.00 | 1                       | 259.0                                       | 2.0                                     | 1   | X   |
| SA170A            | SA170CA          | 170.0                               | 189.00                                     | 209.00 | 1                       | 275.0                                       | 1.9                                     | 1   | X   |
| SA180A            | SA180CA          | 180.0                               | 200.00                                     | 221.00 | 1                       | 289.0                                       | 1.7                                     | 1   | X   |

For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  limit is double.

For parts without A, the  $V_{BR}$  is  $\pm 10\%$  and  $V_C$  is 5% higher than with A parts.

### I-V Curve Characteristics



**$P_{PPM}$  Peak Pulse Power Dissipation** – Max power dissipation

**$V_R$  Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation

**$V_{BR}$  Breakdown Voltage** – Maximum voltage that flows through the TVS at a specified test current ( $I_R$ )

**$V_C$  Clamping Voltage** – Peak voltage measured across the TVS at a specified  $I_{ppm}$  (peak impulse current)

**$I_R$  Reverse Leakage Current** – Current measured at  $V_R$

**$V_F$  Forward Voltage Drop for Uni-directional**

### Ratings and Characteristic Curves ( $T_A=25^\circ\text{C}$ unless otherwise noted)

Figure 1 - TVS Transients Clamping Waveform

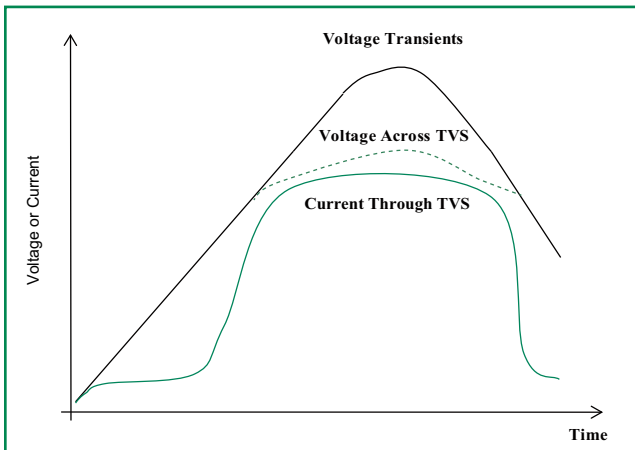
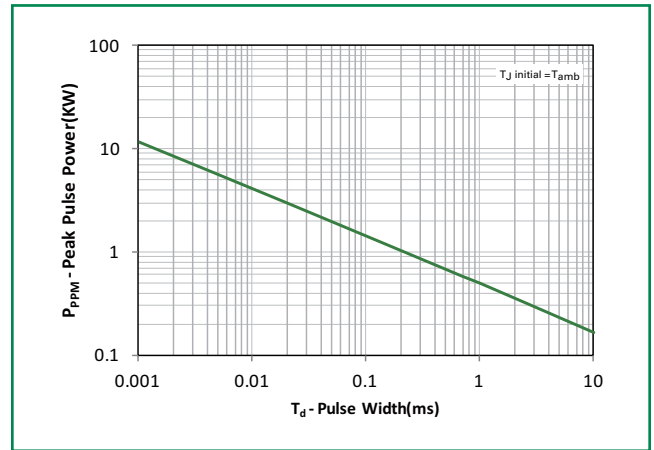


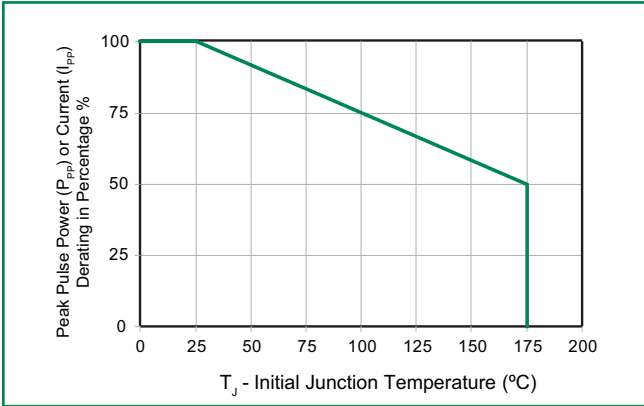
Figure 2 - Peak Pulse Power Rating



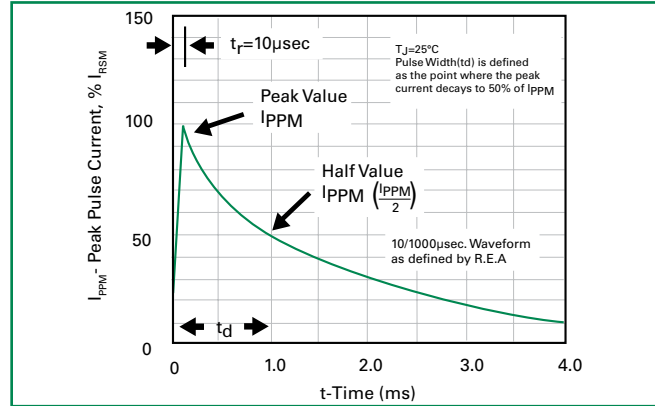
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### Ratings and Characteristic Curves ( $T_A=25^\circ\text{C}$ unless otherwise noted) (Continued)

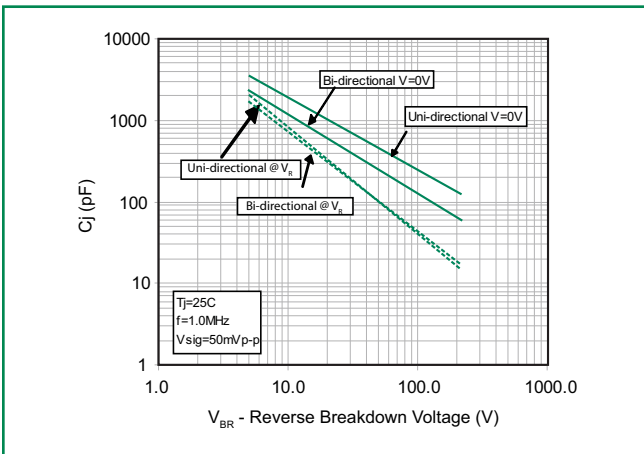
**Figure 3 - Peak Pulse Power Derating Curve**



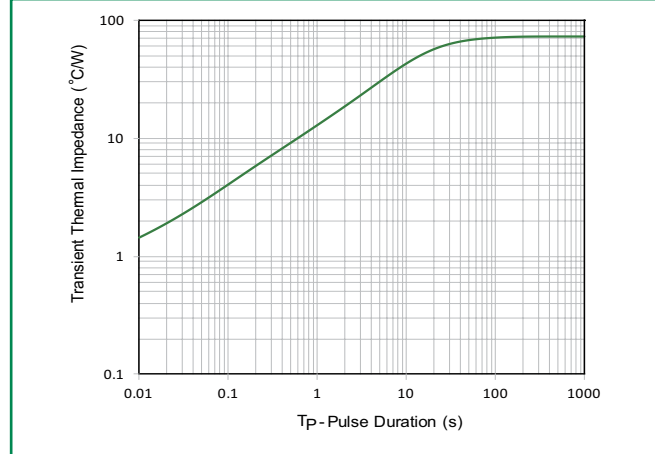
**Figure 4 - Pulse Waveform**



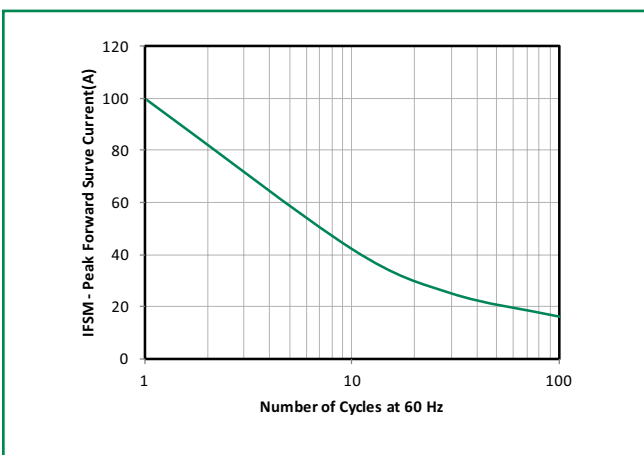
**Figure 5 - Typical Junction Capacitance**



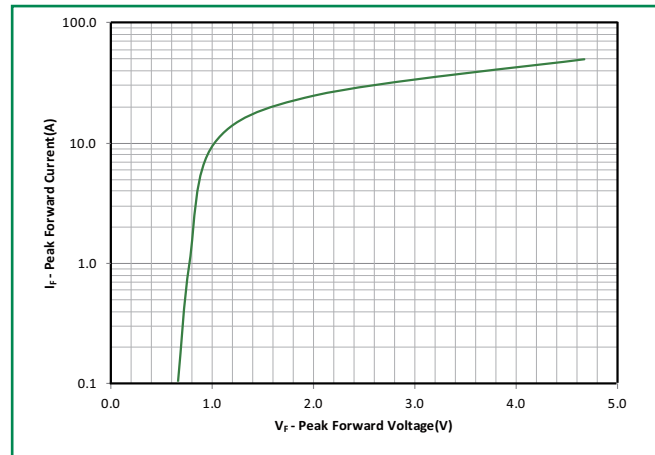
**Figure 6 - Typical Transient Thermal Impedance**



**Figure 7 - Maximum Non-Repetitive Forward Surge Current Uni-Directional Only**

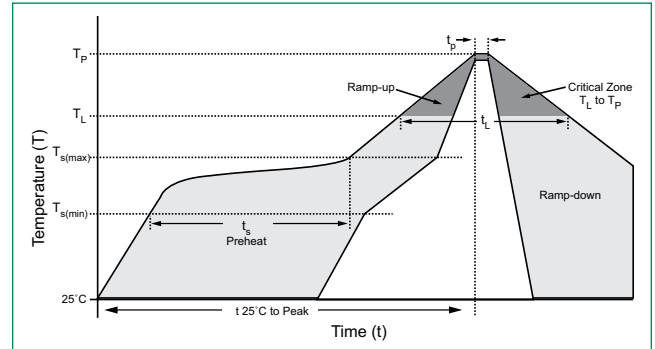


**Figure 8 - Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)**



### Soldering Parameters

|  |                                    |                         |
|--|------------------------------------|-------------------------|
| Reflow Condition                                       |                                    | Lead-free assembly      |
| Pre Heat   | - Temperature Min ( $T_{s(min)}$ ) | 150°C                   |
|  | - Temperature Max ( $T_{s(max)}$ ) | 200°C                   |
|  | - Time (min to max) ( $t_s$ )      | 60 – 180 secs           |
| Average ramp up rate (Liquidus Temp ( $T_A$ ) to peak) |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_A$ - Ramp-up Rate                   |                                    | 3°C/second max          |
| Reflow   | - Temperature ( $T_A$ ) (Liquidus) | 217°C                   |
|  | - Time (min to max) ( $t_s$ )      | 60 – 150 seconds        |
| Peak Temperature ( $T_p$ )                             |                                    | 260 <sup>+0/-5</sup> °C |
| Time within 5°C of actual peak Temperature ( $t_p$ )   |                                    | 20 – 40 seconds         |
| Ramp-down Rate   |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )                |                                    | 8 minutes Max.          |
| Do not exceed  |                                    | 260°C                   |



### Flow/Wave Soldering (Solder Dipping)

|                           |            |
|---------------------------|------------|
| <b>Peak Temperature :</b> | 265°C      |
| <b>Dipping Time :</b>     | 10 seconds |
| <b>Soldering :</b>        | 1 time     |

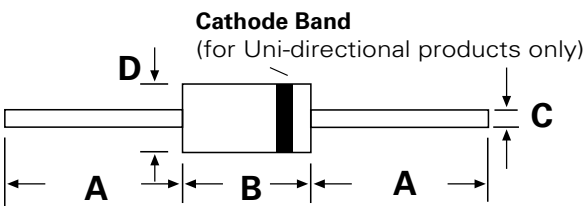
### Physical Specifications

|                 |  |
|-----------------|--|
| <b>Weight</b>   | 0.015oz., 0.4g   |
| <b>Case</b>     | JEDEC DO-204AC (DO-15) molded plastic body over passivated junction. |
| <b>Polarity</b> | Color band denotes the cathode except Bipolar.                       |
| <b>Terminal</b> | Matte Tin axial leads, solderable per JESD22-B102.                   |

### Environmental Specifications

|                            |             |
|----------------------------|-------------|
| <b>High Temp. Storage</b>  | JESD22-A103 |
| <b>HTRB</b>                | JESD22-A108 |
| <b>Temperature Cycling</b> | JESD22-A104 |
| <b>H3TRB</b>               | JESD22-A101 |
| <b>RSH</b>                 | JESD22-B106 |

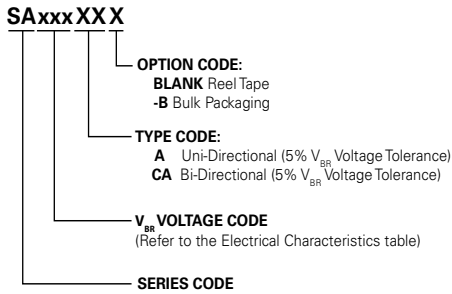
### Dimensions



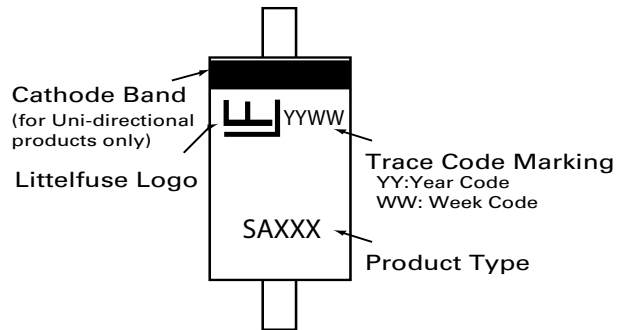
**DO-204AC (DO-15)**

| Dimensions | Inches |       | Millimeters |      |
|------------|--------|-------|-------------|------|
|            | Min    | Max   | Min         | Max  |
| A          | 1.000  | -     | 25.40       | -    |
| B          | 0.230  | 0.300 | 5.80        | 7.60 |
| C          | 0.028  | 0.034 | 0.71        | 0.86 |
| D          | 0.104  | 0.140 | 2.60        | 3.60 |

### Part Numbering System



### Part Marking System



### Packaging

| Part Number | Component Package | Quantity | Packaging Option | Packaging Specification |
|-------------|-------------------|----------|------------------|-------------------------|
| SAxxxXX     | DO-204AC          | 4000     | Tape & Reel      | EIA STD RS-296          |
| SAxxxXX-B   | DO-204AC          | 1000     | Bulk             | Littelfuse Spec.        |

### Tape and Reel Specification

