

# 1.5SMB Series

## Surface Mount – 1500W



### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                                                 | Symbol                | Value      | Unit               |
|-------------------------------------------------------------------------------------------|-----------------------|------------|--------------------|
| Peak Pulse Power Dissipation by 10/1000 $\mu\text{s}$ Waveform (Fig.2) (Note 1), (Note 2) | $P_{\text{PPM}}$      | 1500       | W                  |
| Power Dissipation on Infinite Heat Sink at $T_J=50^\circ\text{C}$                         | $P_D$                 | 5.0        | W                  |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                          | $I_{\text{FSM}}$      | 120        | A                  |
| Maximum Instantaneous Forward Voltage at 50A for Unidirectional Only                      | $V_F$                 | 5.0        | V                  |
| Operating Temperature Range                                                               | $T_J$                 | -65 to 150 | $^\circ\text{C}$   |
| Storage Temperature Range                                                                 | $T_{\text{STG}}$      | -65 to 175 | $^\circ\text{C}$   |
| Typical Thermal Resistance Junction to Lead                                               | $R_{\theta\text{JL}}$ | 20         | $^\circ\text{C/W}$ |
| Typical Thermal Resistance Junction to Ambient                                            | $R_{\theta\text{JA}}$ | 100        | $^\circ\text{C/W}$ |

#### Notes:

1. Non-repetitive current pulse, per Fig. 4 and derated above  $T_J$  (initial)  $=25^\circ\text{C}$  per Fig. 3.
2. Mounted on copper pad area of 0.2x0.2" (5.0 x 5.0mm) to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional component only, duty cycle=4 per minute maximum.

## Description

The 1.5SMB Series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

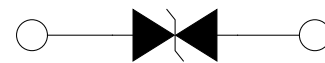
## Features & Benefits

- For surface mounted applications to optimize board space
- Low profile package
- 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
- ESD protection of data lines in accordance with IEC 61000-4-2, 30kV(Air), 30kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Built-in strain relief
- Glass passivated chip junction
- 1500W peak pulse power capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycles):0.01%
- $V_{\text{BR}} @ T_J = V_{\text{BR}} @ 25^\circ\text{C} \times (1 + \alpha_T \times (T_J - 25))$  ( $\alpha_T$ : Temperature Coefficient, typical value is 0.1%)
- Excellent clamping capability
- Low incremental surge resistance
- Meet MSL level 1 per J-STD-020, and high temperature soldering guaranteed: 260C/10sec
- Matte tin lead-free Plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2<sup>nd</sup> level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

## Applications

TVS components are ideal for the protection of I/O Interfaces,  $V_{\text{CC}}$  bus and other vulnerable circuits used in Telecom, Computer, Industrial and Consumer electronic applications.

### Functional Diagram



Bi-directional



Uni-directional

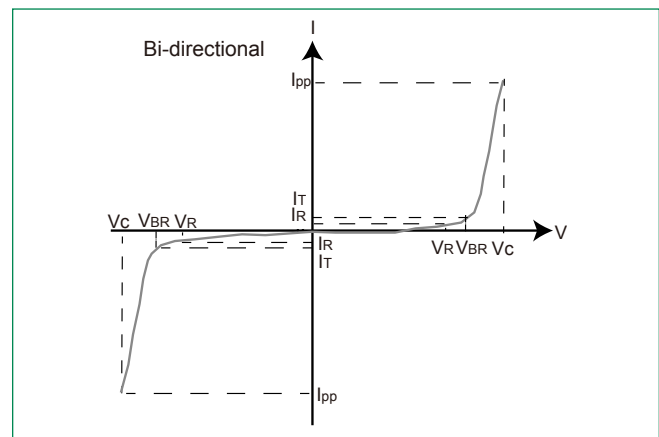
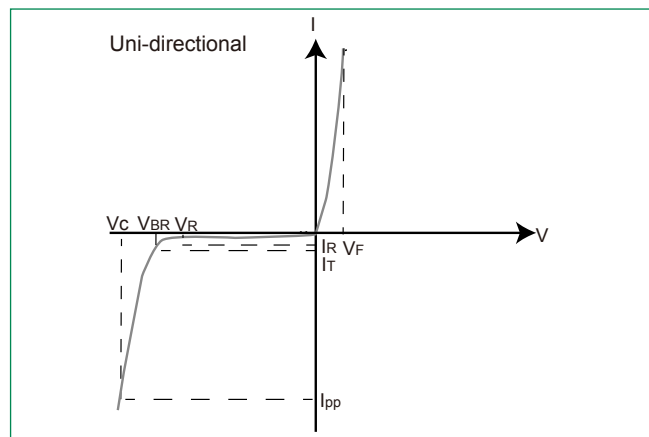
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### Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Part Number (Uni) | Part Number (Bi) | Marking |      | Reverse Stand off Voltage $V_R$ (Volts) | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ |       | Test Current $I_T$ (mA) | Maximum Clamping Voltage $V_C$ @ $I_{PP}$ (10/1000 $\mu\text{s}$ ) (V) | Maximum Peak Pulse Current $I_{PP}$ (10/1000 $\mu\text{s}$ ) (A) | Maximum Clamping Voltage $V_C$ @ $I_{PP}$ (8/20 $\mu\text{s}$ ) (V) | Maximum Peak Pulse Current $I_{PP}$ (8/20 $\mu\text{s}$ ) (A) | Maximum Reverse Leakage $I_R$ @ $V_R$ ( $\mu\text{A}$ ) | Maximum Temperature coefficient of $V_{BR}$ (%/C) |
|-------------------|------------------|---------|------|-----------------------------------------|--------------------------------------------|-------|-------------------------|------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------|
|                   |                  | UNI     | BI   |                                         | MIN                                        | MAX   |                         |                                                                        |                                                                  |                                                                     |                                                               |                                                         |                                                   |
| 1.5SMB20A         | 1.5SMB20CA       | H15I    | B15I | 17.1                                    | 19.0                                       | 21.0  | 1                       | 27.7                                                                   | 54.9                                                             | 34.8                                                                | 302.0                                                         | 20                                                      | 0.085                                             |
| 1.5SMB22A         | 1.5SMB22CA       | H15K    | B15K | 18.8                                    | 20.9                                       | 23.1  | 1                       | 30.6                                                                   | 49.7                                                             | 35.0                                                                | 273.4                                                         | 10                                                      | 0.088                                             |
| 1.5SMB23A         | 1.5SMB23CA       | H10L    | B10L | 20.0                                    | 22.0                                       | 24.2  | 1                       | 33.2                                                                   | 45.0                                                             | 35.0                                                                | 250.0                                                         | 1                                                       | 0.088                                             |
| 1.5SMB24A         | 1.5SMB24CA       | H15N    | B15N | 20.5                                    | 22.8                                       | 25.2  | 1                       | 33.2                                                                   | 45.0                                                             | 42.9                                                                | 249.0                                                         | 1                                                       | 0.091                                             |
| 1.5SMB27A         | 1.5SMB27CA       | H15P    | B15P | 23.1                                    | 25.7                                       | 28.4  | 1                       | 37.5                                                                   | 40.5                                                             | 48.4                                                                | 222.8                                                         | 1                                                       | 0.092                                             |
| 1.5SMB30A         | 1.5SMB30CA       | H15S    | B15S | 25.6                                    | 28.5                                       | 31.5  | 1                       | 41.4                                                                   | 36.7                                                             | 53.5                                                                | 201.9                                                         | 1                                                       | 0.093                                             |
| 1.5SMB33A         | 1.5SMB33CA       | H15V    | B15V | 28.2                                    | 31.4                                       | 34.7  | 1                       | 45.7                                                                   | 33.3                                                             | 59.0                                                                | 183.2                                                         | 1                                                       | 0.094                                             |
| 1.5SMB36A         | 1.5SMB36CA       | H15Z    | B15Z | 30.8                                    | 34.2                                       | 37.8  | 1                       | 49.9                                                                   | 30.5                                                             | 64.5                                                                | 167.8                                                         | 1                                                       | 0.096                                             |
| 1.5SMB39A         | 1.5SMB39CA       | N15B    | C15B | 33.3                                    | 37.1                                       | 41.0  | 1                       | 53.9                                                                   | 28.2                                                             | 69.6                                                                | 155.1                                                         | 1                                                       | 0.097                                             |
| 1.5SMB43A         | 1.5SMB43CA       | N15D    | C15D | 36.8                                    | 40.9                                       | 45.2  | 1                       | 59.3                                                                   | 25.6                                                             | 76.6                                                                | 140.8                                                         | 1                                                       | 0.098                                             |
| 1.5SMB47A         | 1.5SMB47CA       | N15F    | C15F | 40.2                                    | 44.7                                       | 49.4  | 1                       | 64.8                                                                   | 23.5                                                             | 83.7                                                                | 129.3                                                         | 1                                                       | 0.099                                             |
| 1.5SMB51A         | 1.5SMB51CA       | N15G    | C15G | 43.6                                    | 48.5                                       | 53.6  | 1                       | 70.1                                                                   | 21.7                                                             | 90.6                                                                | 119.4                                                         | 1                                                       | 0.100                                             |
| 1.5SMB56A         | 1.5SMB56CA       | N15I    | C15I | 47.8                                    | 53.2                                       | 58.8  | 1                       | 77.0                                                                   | 19.7                                                             | 99.5                                                                | 108.4                                                         | 1                                                       | 0.101                                             |
| 1.5SMB62A         | 1.5SMB62CA       | N15K    | C15K | 53.0                                    | 58.9                                       | 65.1  | 1                       | 85.0                                                                   | 17.9                                                             | 109.8                                                               | 98.5                                                          | 1                                                       | 0.102                                             |
| 1.5SMB68A         | 1.5SMB68CA       | N15L    | C15L | 58.1                                    | 64.6                                       | 71.4  | 1                       | 92.0                                                                   | 16.5                                                             | 118.9                                                               | 90.8                                                          | 1                                                       | 0.103                                             |
| 1.5SMB75A         | 1.5SMB75CA       | N15N    | C15N | 64.1                                    | 71.3                                       | 78.8  | 1                       | 103.0                                                                  | 14.8                                                             | 133.1                                                               | 81.4                                                          | 1                                                       | 0.104                                             |
| 1.5SMB82A         | 1.5SMB82CA       | N15P    | C15P | 70.1                                    | 77.9                                       | 86.1  | 1                       | 113.0                                                                  | 13.5                                                             | 146.0                                                               | 74.3                                                          | 1                                                       | 0.105                                             |
| 1.5SMB91A         | 1.5SMB91CA       | N15S    | C15S | 77.8                                    | 86.5                                       | 95.5  | 1                       | 125.0                                                                  | 12.2                                                             | 161.5                                                               | 67.1                                                          | 1                                                       | 0.106                                             |
| 1.5SMB100A        | 1.5SMB100CA      | N15V    | C15V | 85.5                                    | 95.0                                       | 105.0 | 1                       | 137.0                                                                  | 11.1                                                             | 177.0                                                               | 61.1                                                          | 1                                                       | 0.106                                             |

### 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 ( $I_T$ )

$V_C$  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

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

Figure 1 - TVS Transients Clamping Waveform

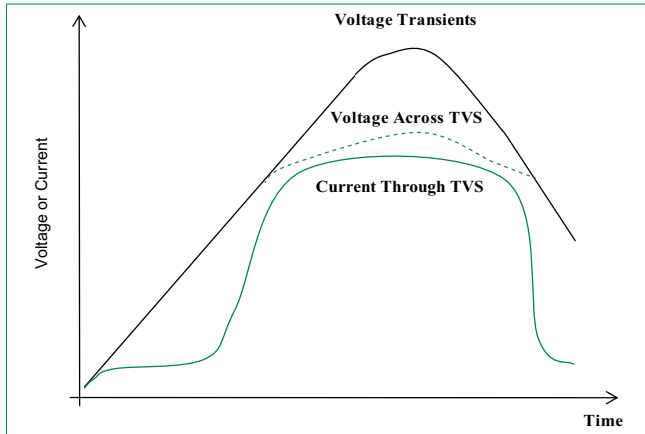


Figure 2 - Peak Pulse Power Rating Curve

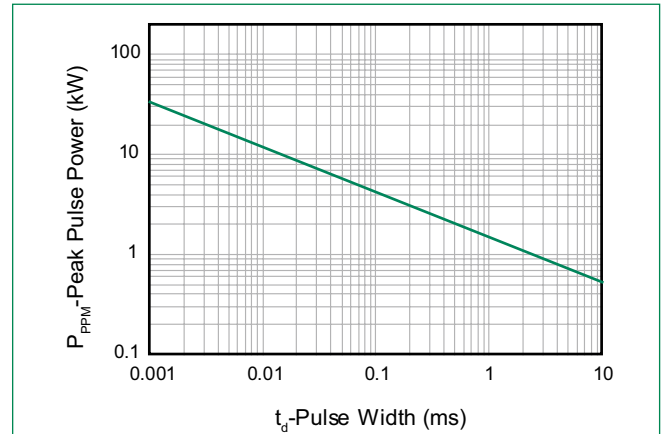


Figure 3 - Peak Pulse Power Derating Curve

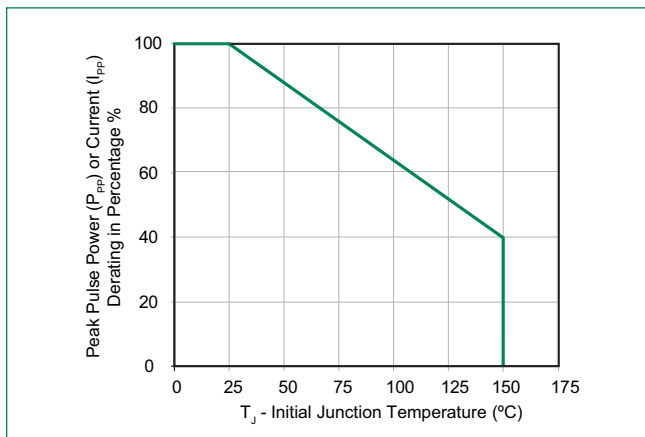


Figure 4 - Pulse Waveform

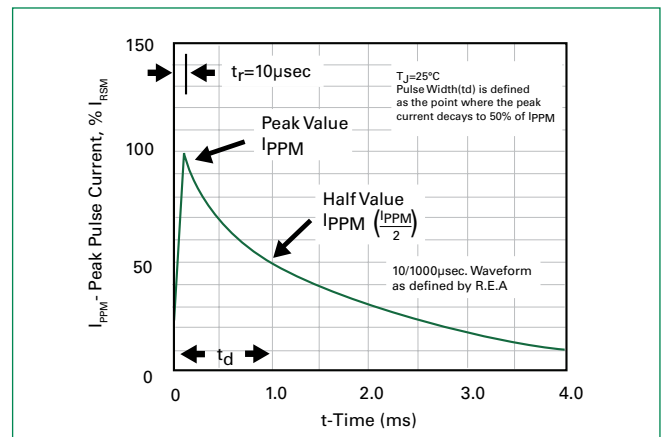


Figure 5 - Typical Junction Capacitance

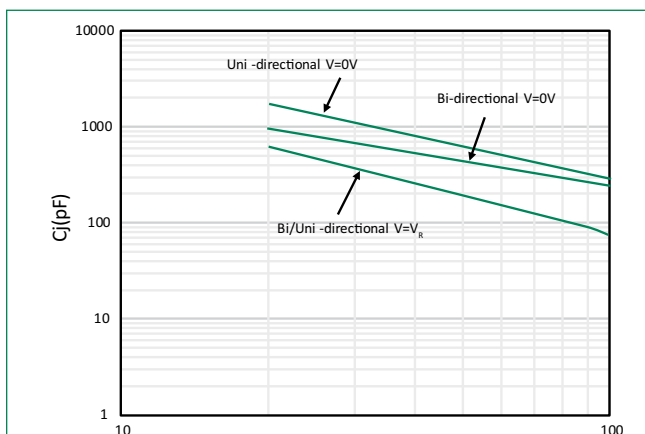
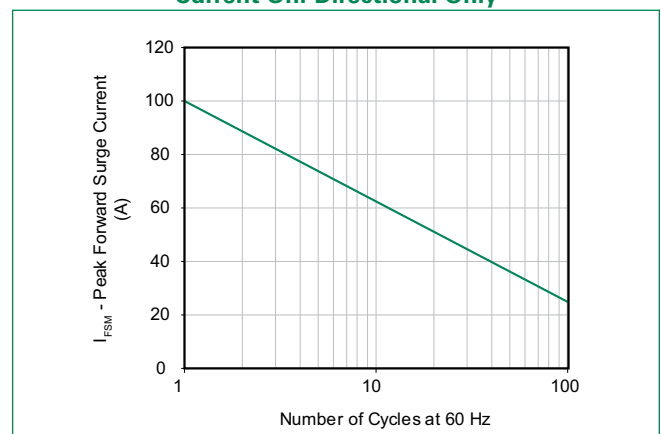


Figure 6 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional Only



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Figure 7 - Typical Transient Thermal Impedance

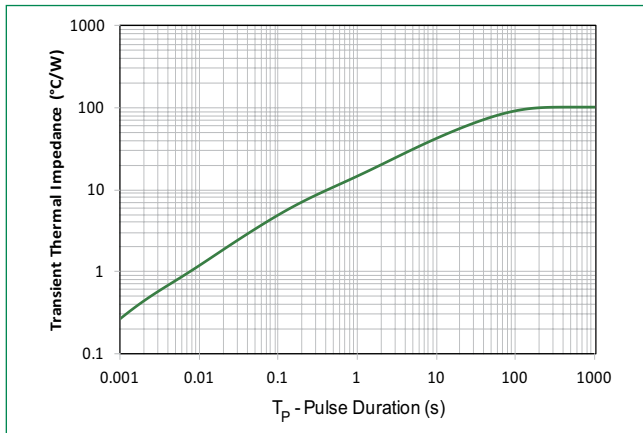
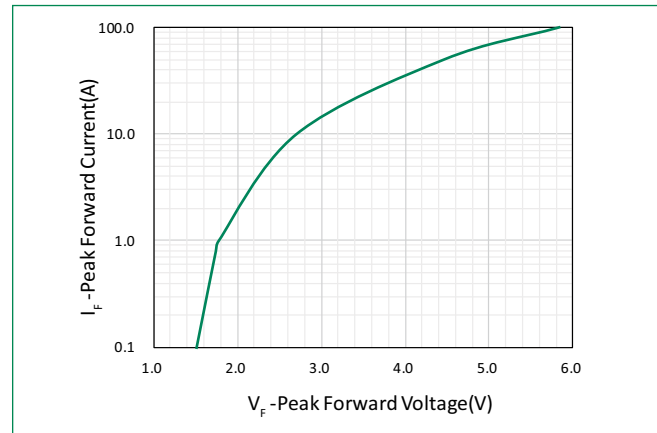
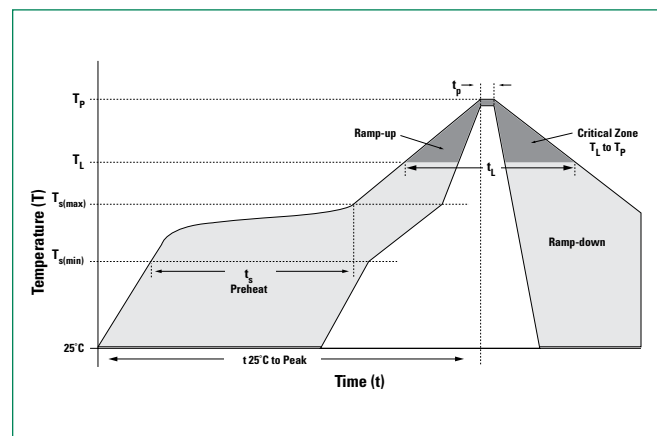


Figure 8 - Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)



### Soldering Parameters

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



### Physical Specifications

|                 |                                                                   |
|-----------------|-------------------------------------------------------------------|
| <b>Weight</b>   | 0.003 ounce, 0.093 grams                                          |
| <b>Case</b>     | JEDEC DO214AA. Molded plastic body over glass passivated junction |
| <b>Polarity</b> | Color band denotes cathode except Bidirectional.                  |
| <b>Terminal</b> | Matte Tin-plated leads, Solderable per JESD22-B102                |

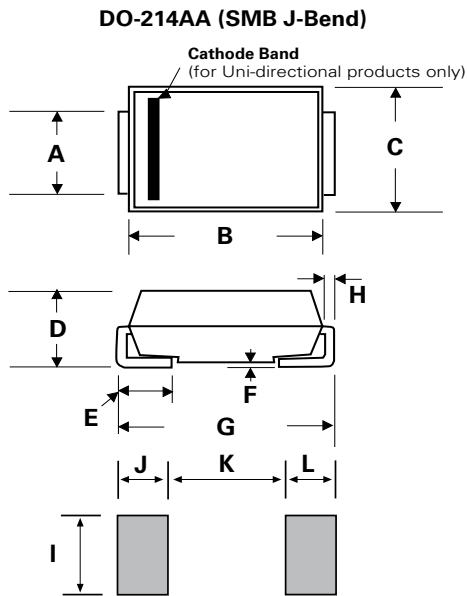
### Environmental Specifications

|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>                 | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>               | JESD22-A101              |
| <b>RSH</b>                 | JESD22-A111              |

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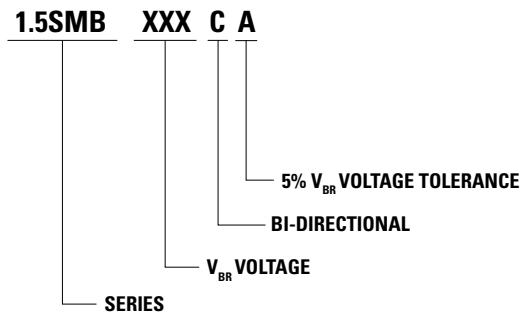
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### Dimensions

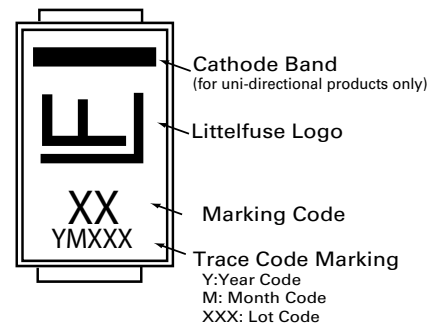


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.077  | 0.086 | 1.950       | 2.200 |
| B          | 0.160  | 0.180 | 4.060       | 4.570 |
| C          | 0.130  | 0.155 | 3.300       | 3.940 |
| D          | 0.084  | 0.096 | 2.130       | 2.440 |
| E          | 0.030  | 0.060 | 0.760       | 1.520 |
| F          | -      | 0.008 | -           | 0.203 |
| G          | 0.205  | 0.220 | 5.210       | 5.590 |
| H          | 0.006  | 0.012 | 0.152       | 0.305 |
| I          | 0.089  | -     | 2.260       | -     |
| J          | 0.085  | -     | 2.160       | -     |
| K          | -      | 0.107 | -           | 2.740 |
| L          | 0.085  | -     | 2.160       | -     |

### Part Numbering System



### Part Marking System



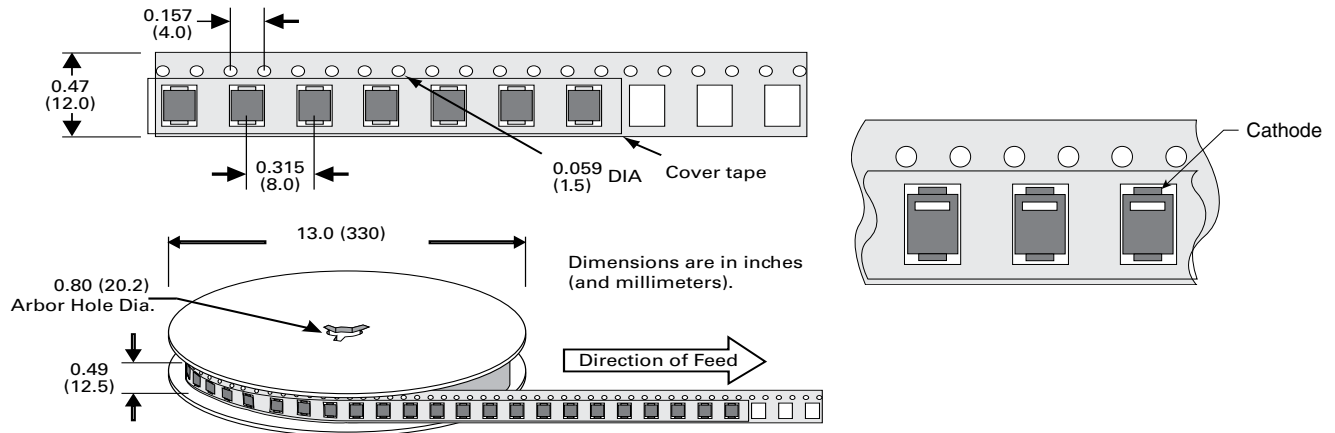
### Packaging

| Part number | Component Package | Quantity | Packaging Option                 | Packaging Specification |
|-------------|-------------------|----------|----------------------------------|-------------------------|
| 1.5SMBxxxXX | DO-214AA          | 3000     | Tape & Reel - 12mm tape/13" reel | EIA STD RS-481          |

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### Tape and Reel Specification



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