

## TPSMD Series



### Agency Approvals

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

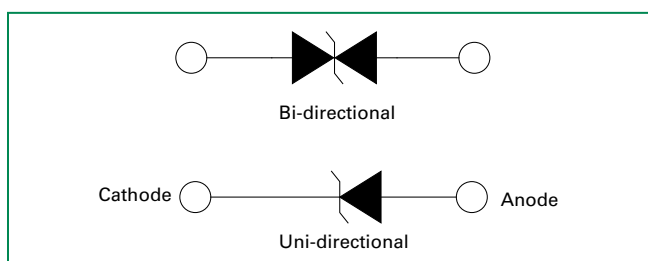
### Maximum Ratings and Thermal Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

| Parameter                                                                    | Symbol                            | Value      | Unit |
|------------------------------------------------------------------------------|-----------------------------------|------------|------|
| Peak Pulse Power Dissipation by 10/1000µs Waveform (Fig.2)(Note 1), (Note 2) | P <sub>PPM</sub>                  | 3000       | W    |
| Power Dissipation on Infinite Heat Sink at T <sub>A</sub> =50°C              | P <sub>MAV</sub>                  | 6.5        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)             | I <sub>FSM</sub>                  | 300        | A    |
| Maximum Instantaneous Forward Voltage at 100A 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 150 | °C   |
| Typical Thermal Resistance Junction to Lead                                  | R <sub>ωL</sub>                   | 15         | °C/W |
| Typical Thermal Resistance Junction to Ambient                               | R <sub>ωJA</sub>                  | 75         | °C/W |

#### Notes:

1. Non-repetitive current pulse per Fig. 4 and derated above T<sub>A</sub> = 25°C per Fig. 3.
2. Mounted on copper pad area of 0.31x0.31" (8.0 x 8.0mm) 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.

### Functional Diagram



### Description

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

### Features

- Hi reliability application and automotive grade AEC-Q101 qualified
- SMT for minimal board footprint
- 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
- IEC-61000-4-2 ESD 30kV(Air), 30kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Built-in strain relief
- 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)
- Glass passivated chip junction
- 3000W peak pulse power capability at 10/1000µs waveform, repetition rate (duty cycles): 0.01 %
- Fast response time: typically less than 1.0ps from 0V to V<sub>BR</sub> min
- Excellent clamping capability
- Low incremental surge resistance
- Typical I<sub>R</sub> ≤ 2µA for V<sub>R</sub> > 10V
- High temperature soldering guaranteed: 260°C/10 seconds at terminals
- UL Recognized compound meeting flammability rating V-0.
- Meet MSL level1, per J-STD-020, high temperature soldering guaranteed.
- 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)

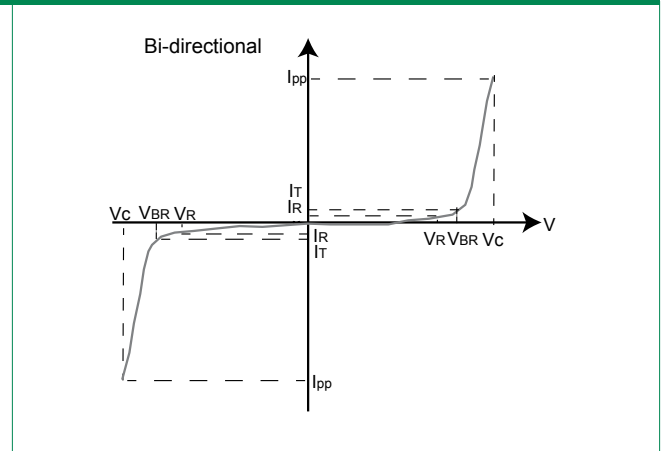
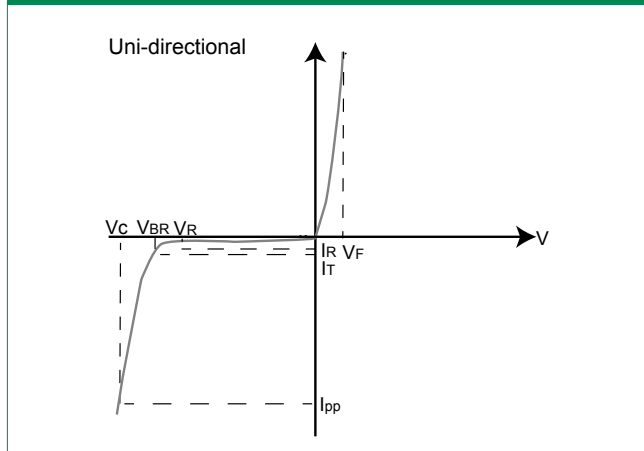
### Applications

TVS Components 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.

### Electrical Characteristics

| 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 $V_C$ @ $I_{CP}$ (V) | Maximum Peak Pulse Current $I_{PP}$ (A) | Maximum Reverse Leakage $I_R$ @ $V_R$ ( $\mu A$ ) | Agency Approval  |
|-------------------|------------------|---------|------|-----------------------------------------|--------------------------------------------|--------|-------------------------|-----------------------------------------------|-----------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------------------------------|
|                   |                  | UNI     | BI   |                                         | MIN                                        | MAX    |                         |                                               |                                         |                                                   |                                                                                                     |
| TPSMD10A          | TPSMD10CA        | PDXA    | DDXA | 10.0                                    | 11.10                                      | 12.30  | 1                       | 17.0                                          | 176.5                                   | 5                                                 | X                                                                                                   |
| TPSMD11A          | TPSMD11CA        | PDZA    | DDZA | 11.0                                    | 12.20                                      | 13.50  | 1                       | 18.2                                          | 164.8                                   | 2                                                 | X                                                                                                   |
| TPSMD12A          | TPSMD12CA        | PEEA    | DEEA | 12.0                                    | 13.30                                      | 14.70  | 1                       | 19.9                                          | 150.8                                   | 2                                                 | X                                                                                                   |
| TPSMD13A          | TPSMD13CA        | PEGA    | DEGA | 13.0                                    | 14.40                                      | 15.90  | 1                       | 21.5                                          | 139.5                                   | 2                                                 | X                                                                                                   |
| TPSMD14A          | TPSMD14CA        | PEKA    | DEKA | 14.0                                    | 15.60                                      | 17.20  | 1                       | 23.2                                          | 129.3                                   | 2                                                 | X                                                                                                   |
| TPSMD15A          | TPSMD15CA        | PEMA    | DEMA | 15.0                                    | 16.70                                      | 18.50  | 1                       | 24.4                                          | 123.0                                   | 2                                                 | X                                                                                                   |
| TPSMD16A          | TPSMD16CA        | PEPA    | DEPA | 16.0                                    | 17.80                                      | 19.70  | 1                       | 26.0                                          | 115.4                                   | 2                                                 | X                                                                                                   |
| TPSMD17A          | TPSMD17CA        | PERA    | DERA | 17.0                                    | 18.90                                      | 20.90  | 1                       | 27.6                                          | 108.7                                   | 2                                                 | X                                                                                                   |
| TPSMD18A          | TPSMD18CA        | PETA    | DETA | 18.0                                    | 20.00                                      | 22.10  | 1                       | 29.2                                          | 102.7                                   | 2                                                 | X                                                                                                   |
| TPSMD20A          | TPSMD20CA        | PEVA    | DEVA | 20.0                                    | 22.20                                      | 24.50  | 1                       | 32.4                                          | 92.6                                    | 2                                                 | X                                                                                                   |
| TPSMD22A          | TPSMD22CA        | PEXA    | DEXA | 22.0                                    | 24.40                                      | 26.90  | 1                       | 35.5                                          | 84.5                                    | 2                                                 | X                                                                                                   |
| TPSMD24A          | TPSMD24CA        | PEZA    | DEZA | 24.0                                    | 26.70                                      | 29.50  | 1                       | 38.9                                          | 77.1                                    | 2                                                 | X                                                                                                   |
| TPSMD26A          | TPSMD26CA        | PFEA    | DFEA | 26.0                                    | 28.90                                      | 31.90  | 1                       | 42.1                                          | 71.3                                    | 2                                                 | X                                                                                                   |
| TPSMD28A          | TPSMD28CA        | PFGA    | DFGA | 28.0                                    | 31.10                                      | 34.40  | 1                       | 45.4                                          | 66.1                                    | 2                                                 | X                                                                                                   |
| TPSMD30A          | TPSMD30CA        | PFKA    | DFKA | 30.0                                    | 33.30                                      | 36.80  | 1                       | 48.4                                          | 62.0                                    | 2                                                 | X                                                                                                   |
| TPSMD33A          | TPSMD33CA        | PFMA    | DFMA | 33.0                                    | 36.70                                      | 40.60  | 1                       | 53.3                                          | 56.3                                    | 2                                                 | X                                                                                                   |
| TPSMD36A          | TPSMD36CA        | PFPA    | DFPA | 36.0                                    | 40.00                                      | 44.20  | 1                       | 58.1                                          | 51.6                                    | 2                                                 | X                                                                                                   |
| TPSMD40A          | TPSMD40CA        | PFRA    | DFRA | 40.0                                    | 44.40                                      | 49.10  | 1                       | 64.5                                          | 46.5                                    | 2                                                 | X                                                                                                   |
| TPSMD43A          | TPSMD43CA        | PFTA    | DFTA | 43.0                                    | 47.80                                      | 52.80  | 1                       | 69.4                                          | 43.2                                    | 2                                                 | X                                                                                                   |
| TPSMD45A          | TPSMD45CA        | PFVA    | DFVA | 45.0                                    | 50.00                                      | 55.30  | 1                       | 72.7                                          | 41.3                                    | 2                                                 | X                                                                                                   |
| TPSMD48A          | TPSMD48CA        | PFXA    | DFXA | 48.0                                    | 53.30                                      | 58.90  | 1                       | 77.4                                          | 38.8                                    | 2                                                 | X                                                                                                   |
| TPSMD51A          | TPSMD51CA        | PFZA    | DFZA | 51.0                                    | 56.70                                      | 62.70  | 1                       | 82.4                                          | 36.4                                    | 2                                                 | X                                                                                                   |
| TPSMD54A          | TPSMD54CA        | RGEA    | DGEA | 54.0                                    | 60.00                                      | 66.30  | 1                       | 87.1                                          | 34.4                                    | 2                                                 | X                                                                                                   |
| TPSMD58A          | TPSMD58CA        | PGGA    | DGGA | 58.0                                    | 64.40                                      | 71.20  | 1                       | 93.6                                          | 32.1                                    | 2                                                 | X                                                                                                   |
| TPSMD60A          | TPSMD60CA        | PGKA    | DGKA | 60.0                                    | 66.70                                      | 73.70  | 1                       | 96.8                                          | 31.0                                    | 2                                                 | X                                                                                                   |
| TPSMD64A          | TPSMD64CA        | PGMA    | DGMA | 64.0                                    | 71.10                                      | 78.60  | 1                       | 103.0                                         | 29.1                                    | 2                                                 | X                                                                                                   |
| TPSMD70A          | TPSMD70CA        | PGPA    | DGPA | 70.0                                    | 77.80                                      | 86.00  | 1                       | 113.0                                         | 26.5                                    | 2                                                 | X                                                                                                   |
| TPSMD75A          | TPSMD75CA        | PGRA    | DGRA | 75.0                                    | 83.30                                      | 92.10  | 1                       | 121.0                                         | 24.8                                    | 2                                                 | X                                                                                                   |
| TPSMD78A          | TPSMD78CA        | PGTA    | DGTA | 78.0                                    | 86.70                                      | 95.80  | 1                       | 126.0                                         | 23.8                                    | 2                                                 | X                                                                                                   |
| TPSMD85A          | TPSMD85CA        | PGVA    | DGVA | 85.0                                    | 94.40                                      | 104.00 | 1                       | 137.0                                         | 21.9                                    | 2                                                 | X                                                                                                   |

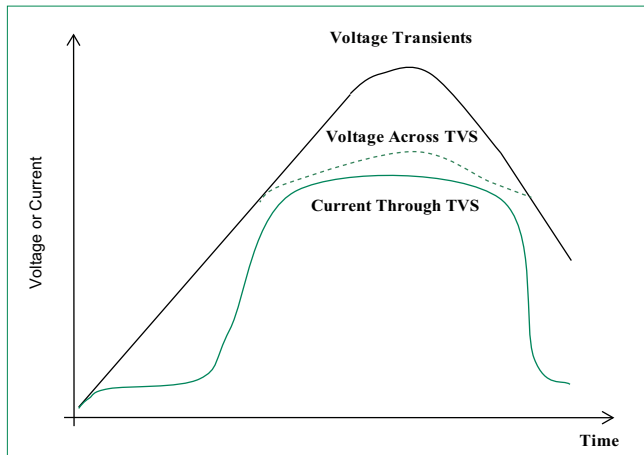
### I-V Curve Characteristics



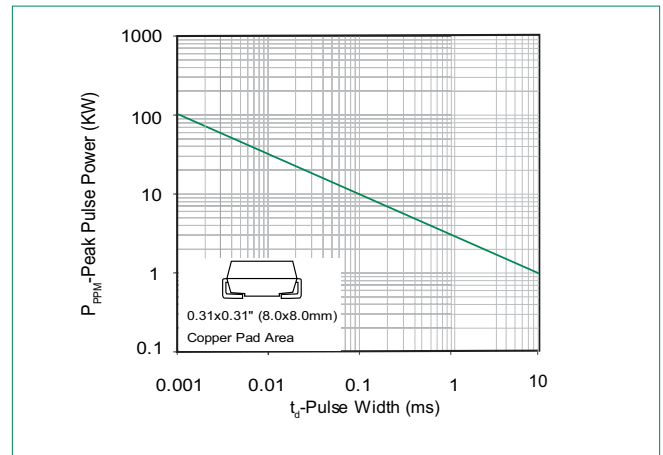
- $P_{PPM}$  Peak Pulse Power Dissipation** – Max power dissipation
- $V_R$  Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation
- $V_{BR}$  Breakdown Voltage** – Maximum voltage that flows through the TVS at a specified test current ( $I_T$ )
- $V_C$  Clamping Voltage** – 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**

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

**Figure 1 - TVS Transients Clamping Waveform**



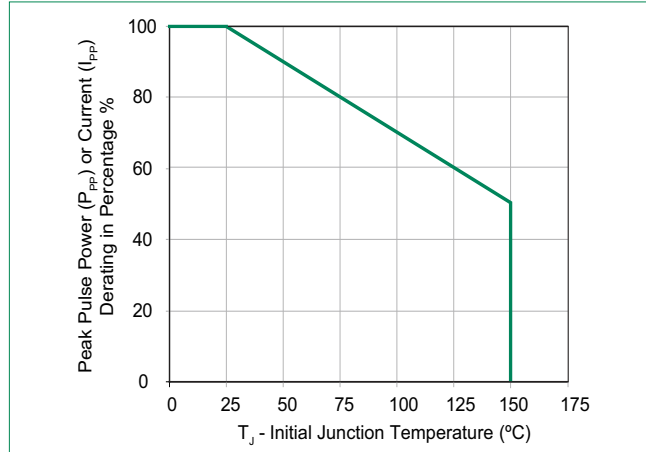
**Figure 2 - Peak Pulse Power Rating**



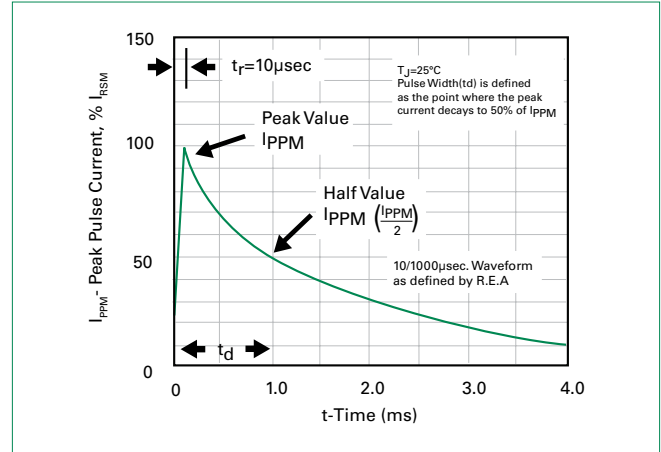
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**Ratings and Characteristic Curves** ( $T_J = 25^\circ\text{C}$  unless otherwise noted) (Continued)

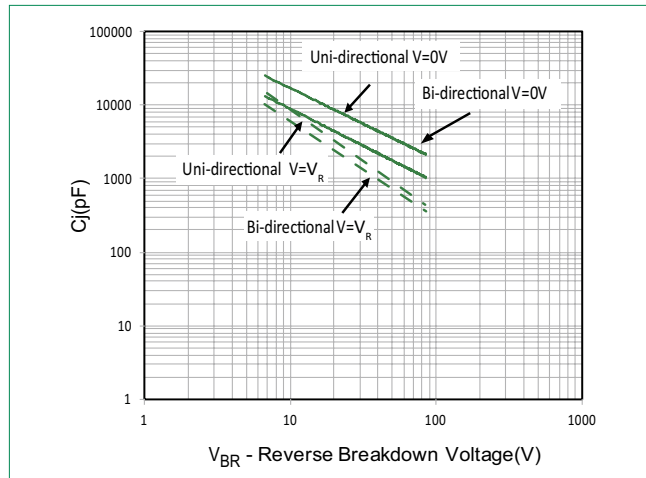
**Figure 3 - Peak Pulse Power Derating Curve**



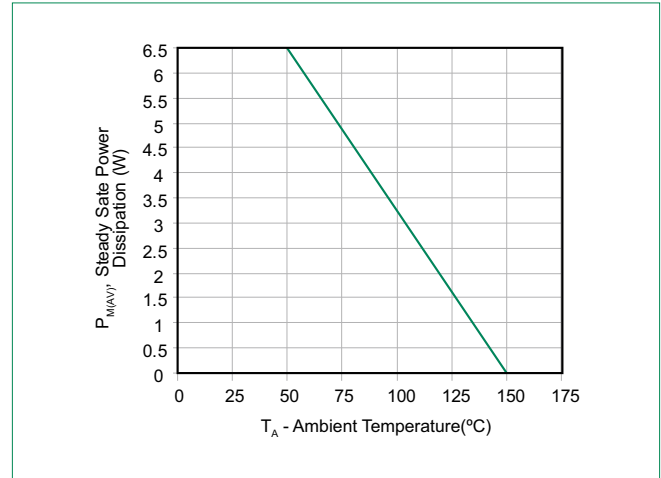
**Figure 4 - Pulse Waveform**



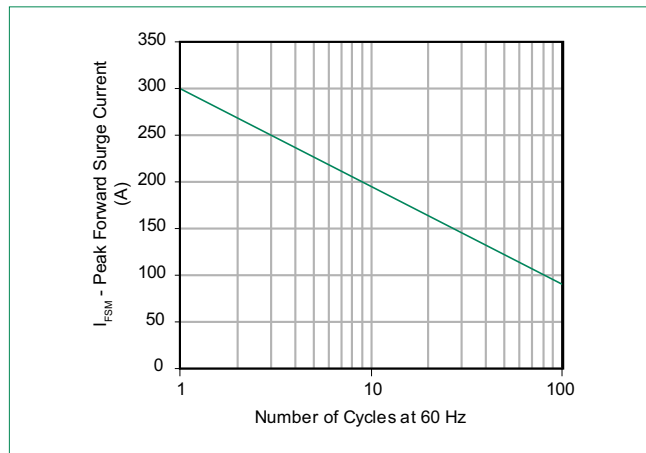
**Figure 5 - Typical Junction Capacitance**



**Figure 6 - Steady State Power Derating Curve**

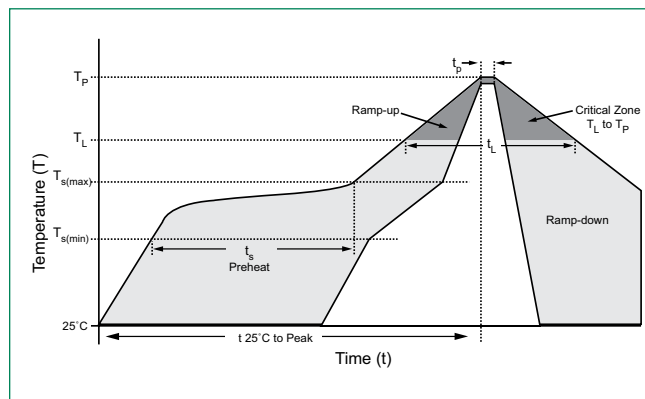


**Figure 7 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional only**



## 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 – 120 secs           |
| Average ramp up rate (Liquidus Temp ( $T_L$ ) to peak |                                    | 3°C/second max          |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                  |                                    | 3°C/second max          |
| Reflow                                                | - Temperature ( $T_L$ ) (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 ( $t_p$ )  |                                    | 30 seconds max          |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes max.          |
| Do not exceed                                         |                                    | 260°C                   |



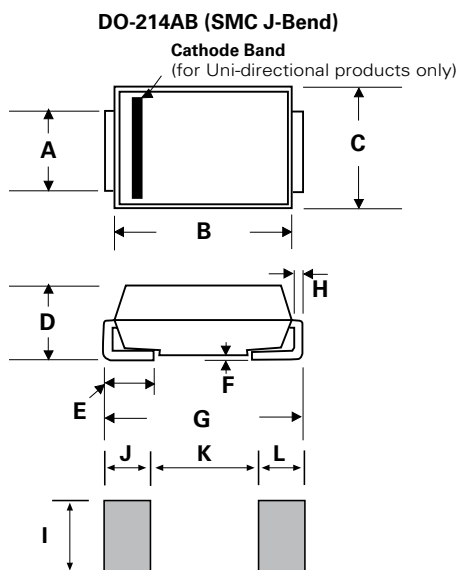
## Physical Specifications

|                 |                                                                   |
|-----------------|-------------------------------------------------------------------|
| <b>Weight</b>   | 0.007 ounce, 0.21 grams                                           |
| <b>Case</b>     | JEDEC DO214AB. Molded plastic body over glass passivated junction |
| <b>Polarity</b> | Color band denotes positive end (cathode) except Bidirectional.   |
| <b>Terminal</b> | Matte Tin-plated leads, Solderable per JESD22-B102                |

## Environmental Specifications

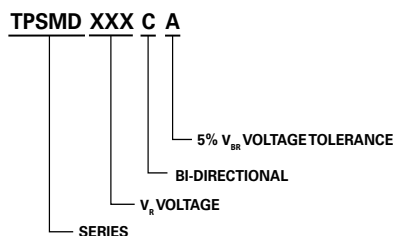
|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>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

## Dimensions

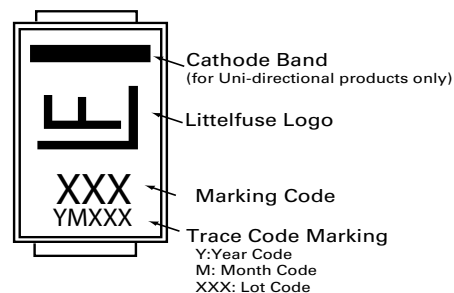


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.114  | 0.126 | 2.900       | 3.200 |
| B          | 0.260  | 0.280 | 6.600       | 7.110 |
| C          | 0.220  | 0.245 | 5.590       | 6.220 |
| D          | 0.079  | 0.103 | 2.060       | 2.620 |
| E          | 0.030  | 0.060 | 0.760       | 1.520 |
| F          | -      | 0.008 | -           | 0.203 |
| G          | 0.305  | 0.320 | 7.750       | 8.130 |
| H          | 0.006  | 0.012 | 0.152       | 0.305 |
| I          | 0.129  | -     | 3.300       | -     |
| J          | 0.094  | -     | 2.400       | -     |
| K          | -      | 0.165 | -           | 4.200 |
| L          | 0.094  | -     | 2.400       | -     |

### Part Numbering System



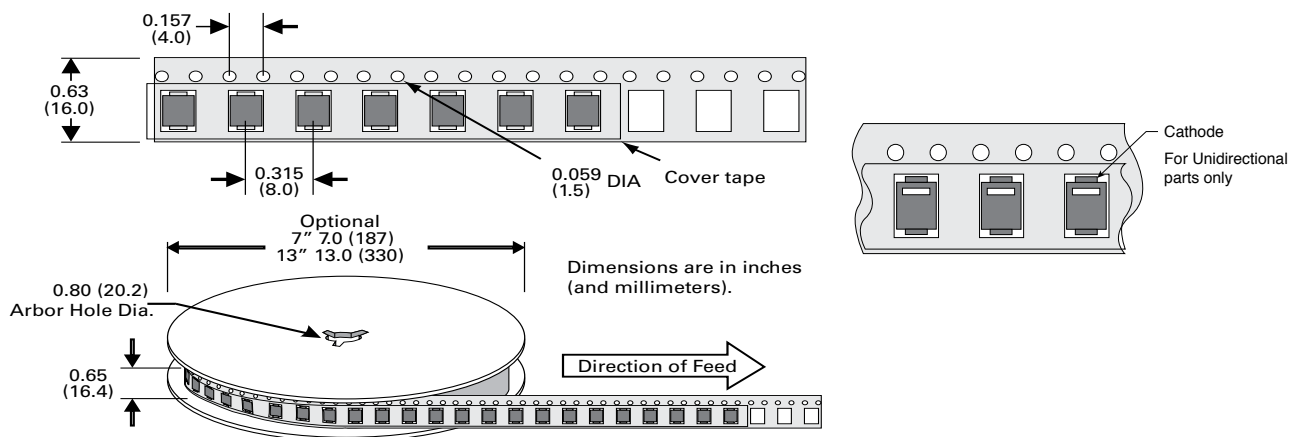
### Part Marking System



### Packaging Options

| Part number   | Component Package | Quantity | Packaging Option                 | Packaging Specification |
|---------------|-------------------|----------|----------------------------------|-------------------------|
| TPSMDxxxXX    | DO-214AB          | 3000     | Tape & Reel - 16mm tape/13" reel | EIA STD RS-481          |
| TPSMDxxxXX-T7 | DO-214AB          | 500      | Tape & Reel - 16mm tape /7" reel | EIA STD RS-481          |

### Tape and Reel Specification



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