



# THE DATASHEET OF TPSMB24CA



# TPSMB Series

## Surface Mount – 600W



### Agency Approvals

| Agency | Agency Number |
|--------|---------------|
|        | E230531       |

### Maximum Ratings & 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.1)(Note 1), (Note 2) | $P_{PPM}$       | 600        | W    |
| Power Dissipation on infinite heat sink at $T_L=50^{\circ}\text{C}$                      | $P_{M(AV)}$     | 5.0        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                         | $I_{FSM}$       | 100        | A    |
| Maximum Instantaneous Forward Voltage at 50A for Unidirectional only (Note 4)            | $V_F$           | 3.5/5      | V    |
| Operating Junction Temperature Range ( $V_{BR} \leq 91\text{V}$ )                        | $T_J$           | -65 to 175 | °C   |
| Operating Junction Temperature Range ( $V_{BR} > 91\text{V}$ )                           | $T_J$           | -65 to 150 |      |
| Storage Temperature Range  | $T_{STG}$       | -65 to 175 |      |
| Typical Thermal Resistance Junction to Lead  | $R_{\theta JL}$ | 20         | °C/W |
| Typical Thermal Resistance Junction to Ambient   | $R_{\theta JA}$ | 100        | °C/W |

#### Notes:

- Non-repetitive current pulse, per Fig.4 and derated above  $T_A=25^{\circ}\text{C}$  per Fig. 3.
- Mounted on copper pad area of 0.2x0.2" (5.0 x 5.0mm) to each terminal.
- Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional component only, duty cycle=4 per minute maximum.
- $V_F < 3.5\text{V}$  for part number with  $V_{BR} < 300\text{V}$ ,  $V_F < 5.0\text{V}$  for part number with  $V_{BR} \geq 300\text{V}$ .

### Description

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

### Features

- High reliability application and automotive grade AEC Q101 qualified
- Surface mount component 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
- Glass passivated chip junction
- 600W PPM (peak pulse power) capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycles):0.01 %
- Fast response time: typically less than 1.0ns from 0V to  $V_{BR}$  min
- Excellent clamping capability
- Low incremental surge resistance
- Typical  $I_R \leq 1\mu\text{A}$  for  $V_R > 10.2\text{V}$
- UL Recognized compound meeting flammability rating V-0
- Meet MSL level1, per J-STD-020, High temperature soldering guaranteed: 260°C/10 seconds at terminals
- 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,  $V_{CC}$  bus and other vulnerable circuits used in Automotive applications.

#### Functional Diagram



Bi-directional



Uni-directional

# TPSMB Series

## Surface Mount – 600W

### Electrical Characteristics

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

| Part Number (Uni) | Part Number (Bi) | Marking |      | Typical $I_R$ @ $150^\circ\text{C}$ ( $\mu\text{A}$ ) | Reverse Stand off Voltage $V_R$ (Volts) | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ |        | Test Current $I_T$ (mA) | Maximum Clamping Voltage $V_C$ @ $I_{PP}$ (V) | Maximum Peak Pulse Current $I_{PP}$ (A) | Maximum Reverse Leakage $I_R$ @ $V_R$ ( $\mu\text{A}$ ) | Maximum Temperature coefficient of $V_{BR}$ (%/C) | Agency Approval  |
|-------------------|------------------|---------|------|---|---|--|--------|-------------------------|---|---|---|---|---|
|                   |                  | Uni     | Bi   |   |   | Min  | Max    |                         |   |   |   |   |   |
| TPSMB75A          | -                | 7V5AA   | -    | 500   | 6.40                                    | 7.13                                       | 7.88   | 10                      | 11.3  | 54.0                                    | 500   | 0.052   | X   |
| TPSMB8.2A         | -                | 8V2AA   | -    | 200   | 7.02                                    | 7.79                                       | 8.61   | 10                      | 12.1  | 50.4                                    | 200   | 0.058   | X   |
| TPSMB9.1A         | -                | 9V1AA   | -    | 50  | 7.78                                    | 8.65                                       | 9.55   | 1                       | 13.4  | 45.5                                    | 50  | 0.063   | X   |
| TPSMB10A          | TPSMB10CA        | 10AA    | 10CA | 20  | 8.55                                    | 9.50                                       | 10.50  | 1                       | 14.5  | 42.1                                    | 10  | 0.066   | X   |
| TPSMB11A          | TPSMB11CA        | 11AA    | 11CA | 8   | 9.40                                    | 10.50                                      | 11.60  | 1                       | 15.6  | 39.1                                    | 5   | 0.069   | X   |
| TPSMB12A          | TPSMB12CA        | 12AA    | 12CA | 8   | 10.20                                   | 11.40                                      | 12.60  | 1                       | 16.7  | 36.5                                    | 5   | 0.071   | X   |
| TPSMB13A          | TPSMB13CA        | 13AA    | 13CA | 8   | 11.10                                   | 12.40                                      | 13.70  | 1                       | 18.2  | 33.5                                    | 1   | 0.074   | X   |
| TPSMB15A          | TPSMB15CA        | 15AA    | 15CA | 8   | 12.80                                   | 14.30                                      | 15.80  | 1                       | 21.2  | 28.8                                    | 1   | 0.076   | X   |
| TPSMB16A          | TPSMB16CA        | 16AA    | 16CA | 8   | 13.60                                   | 15.20                                      | 16.80  | 1                       | 22.5  | 27.1                                    | 1   | 0.080   | X   |
| TPSMB18A          | TPSMB18CA        | 18AA    | 18CA | 8   | 15.30                                   | 17.10                                      | 18.90  | 1                       | 25.5  | 24.2                                    | 1   | 0.083   | X   |
| TPSMB20A          | TPSMB20CA        | 20AA    | 20CA | 8   | 17.10                                   | 19.00                                      | 21.00  | 1                       | 27.7  | 22.0                                    | 1   | 0.085   | X   |
| TPSMB22A          | TPSMB22CA        | 22AA    | 22CA | 8   | 18.80                                   | 20.90                                      | 23.10  | 1                       | 30.6  | 19.9                                    | 1   | 0.088   | X   |
| TPSMB24A          | TPSMB24CA        | 24AA    | 24CA | 8   | 20.50                                   | 22.80                                      | 25.20  | 1                       | 33.2  | 18.4                                    | 1   | 0.091   | X   |
| TPSMB27A          | TPSMB27CA        | 27AA    | 27CA | 8   | 23.10                                   | 25.70                                      | 28.40  | 1                       | 37.5  | 16.3                                    | 1   | 0.092   | X   |
| TPSMB30A          | TPSMB30CA        | 30AA    | 30CA | 8   | 25.60                                   | 28.50                                      | 31.50  | 1                       | 41.4  | 14.7                                    | 1   | 0.093   | X   |
| TPSMB33A          | TPSMB33CA        | 33AA    | 33CA | 8   | 28.20                                   | 31.40                                      | 34.70  | 1                       | 45.7  | 13.3                                    | 1   | 0.094   | X   |
| TPSMB36A          | TPSMB36CA        | 36AA    | 36CA | 8   | 30.80                                   | 34.20                                      | 37.80  | 1                       | 49.9  | 12.2                                    | 1   | 0.096   | X   |
| TPSMB39A          | TPSMB39CA        | 39AA    | 39CA | 8   | 33.30                                   | 37.10                                      | 41.00  | 1                       | 53.9  | 11.3                                    | 1   | 0.097   | X   |
| TPSMB43A          | TPSMB43CA        | 43AA    | 43CA | 8   | 36.80                                   | 40.90                                      | 45.20  | 1                       | 59.3  | 10.3                                    | 1   | 0.098   | X   |
| TPSMB47A          | TPSMB47CA        | 47AA    | 47CA | 8   | 40.20                                   | 44.70                                      | 49.40  | 1                       | 64.8  | 9.4                                     | 1   | 0.099   | X   |
| TPSMB51A          | TPSMB51CA        | 51AA    | 51CA | 8   | 43.60                                   | 48.50                                      | 53.60  | 1                       | 70.1  | 8.7                                     | 1   | 0.100   | X   |
| TPSMB56A          | TPSMB56CA        | 56AA    | 56CA | 8   | 47.80                                   | 53.20                                      | 58.80  | 1                       | 77.0  | 7.9                                     | 1   | 0.101   | X   |
| TPSMB58A          | TPSMB58CA        | 58AA    | 58CA | 8   | 52.78                                   | 55.10                                      | 60.90  | 1                       | 79.8  | 7.7                                     | 1   | 0.101   | X   |
| TPSMB62A          | TPSMB62CA        | 62AA    | 62CA | 8   | 53.00                                   | 58.90                                      | 65.10  | 1                       | 85.0  | 7.2                                     | 1   | 0.102   | X   |
| TPSMB64A          | TPSMB64CA        | 64AA    | 64CA | 8   | 54.40                                   | 60.80                                      | 67.20  | 1                       | 86.90   | 7.0                                     | 1   | 0.102   | X   |
| TPSMB68A          | TPSMB68CA        | 68AA    | 68CA | 8   | 58.10                                   | 64.60                                      | 71.40  | 1                       | 92.0  | 6.6                                     | 1   | 0.103   | X   |
| TPSMB75A          | TPSMB75CA        | 75AA    | 75CA | 8   | 64.10                                   | 71.30                                      | 78.80  | 1                       | 103.0   | 5.9                                     | 1   | 0.104   | X   |
| TPSMB82A          | TPSMB82CA        | 82AA    | 82CA | 8   | 70.10                                   | 77.90                                      | 86.10  | 1                       | 113.0   | 5.4                                     | 1   | 0.105   | X   |
| TPSMB91A          | TPSMB91CA        | 91AA    | 91CA | 8   | 77.80                                   | 86.50                                      | 95.50  | 1                       | 125.0   | 4.9                                     | 1   | 0.106   | X   |
| TPSMB100A         | TPSMB100CA       | 100A    | 100C | -   | 85.50                                   | 95.00                                      | 105.00 | 1                       | 137.0   | 4.5                                     | 1   | 0.106   | X   |
| TPSMB110A         | TPSMB110CA       | 110A    | 110C | -   | 94.00                                   | 105.00                                     | 116.00 | 1                       | 152.0   | 4.0                                     | 1   | 0.107   | X   |
| TPSMB120A         | TPSMB120CA       | 120A    | 120C | -   | 102.00                                  | 114.00                                     | 126.00 | 1                       | 165.0   | 3.7                                     | 1   | 0.107   | X   |
| TPSMB130A         | TPSMB130CA       | 130A    | 130C | -   | 111.00                                  | 124.00                                     | 137.00 | 1                       | 179.0   | 3.4                                     | 1   | 0.107   | X   |
| TPSMB150A         | TPSMB150CA       | 150A    | 150C | -   | 128.00                                  | 143.00                                     | 158.00 | 1                       | 207.0   | 2.9                                     | 1   | 0.108   | X   |
| TPSMB160A         | TPSMB160CA       | 160A    | 160C | -   | 136.00                                  | 152.00                                     | 168.00 | 1                       | 219.0   | 2.8                                     | 1   | 0.108   | X   |
| TPSMB170A         | TPSMB170CA       | 170A    | 170C | -   | 145.00                                  | 162.00                                     | 179.00 | 1                       | 234.0   | 2.6                                     | 1   | 0.108   | X   |
| TPSMB180A         | TPSMB180CA       | 180A    | 180C | -   | 154.00                                  | 171.00                                     | 189.00 | 1                       | 246.0   | 2.5                                     | 1   | 0.108   | X   |
| TPSMB200A         | TPSMB200CA       | 200A    | 200C | -   | 171.00                                  | 190.00                                     | 210.00 | 1                       | 274.0   | 2.2                                     | 1   | 0.108   | X   |
| TPSMB210A         | TPSMB210CA       | 210A    | 210C | -   | 179.60                                  | 199.50                                     | 220.50 | 1                       | 288.0   | 2.1                                     | 1   | 0.110   | X   |
| TPSMB220A         | TPSMB220CA       | 220A    | 220C | -   | 185.00                                  | 209.00                                     | 231.00 | 1                       | 328.0   | 1.9                                     | 1   | 0.110   | X   |
| TPSMB250A         | TPSMB250CA       | 250A    | 250C | -   | 214.00                                  | 237.00                                     | 263.00 | 1                       | 344.0   | 1.8                                     | 1   | 0.110   | X   |
| TPSMB300A-A       | TPSMB300CA-A     | 300A    | 300C | -   | 256.00                                  | 285.00                                     | 315.00 | 1                       | 414.0   | 1.5                                     | 1   | 0.110   | X   |
| TPSMB350A-A       | TPSMB350CA-A     | 350A    | 350C | -   | 300.00                                  | 332.00                                     | 368.00 | 1                       | 482.0   | 1.3                                     | 1   | 0.112   | X   |
| TPSMB400A-A       | TPSMB400CA-A     | 400A    | 400C | -   | 342.00                                  | 380.00                                     | 420.00 | 1                       | 548.0   | 1.1                                     | 1   | 0.112   | X   |
| TPSMB440A-A       | TPSMB440CA-A     | 440A    | 440C | -   | 376.00                                  | 418.00                                     | 462.00 | 1                       | 602.0   | 1.0                                     | 1   | 0.112   | X   |
| TPSMB480A-A       | TPSMB480CA-A     | 480A    | 480C | -   | 408.00                                  | 456.00                                     | 504.00 | 1                       | 658.0   | 0.9                                     | 1   | 0.112   | X   |
| TPSMB510A-A       | TPSMB510CA-A     | 510A    | 510C | -   | 434.00                                  | 485.00                                     | 535.00 | 1                       | 698.0   | 0.9                                     | 1   | 0.112   | X   |
| TPSMB520A-A       | TPSMB520CA-A     | 520A    | 520C | -   | 443.00                                  | 494.50                                     | 545.50 | 1                       | 718.0   | 0.9                                     | 1   | 0.112   | X   |
| TPSMB530A-A       | TPSMB530CA-A     | 530A    | 530C | -   | 451.00                                  | 503.50                                     | 556.50 | 1                       | 725.0   | 0.8                                     | 1   | 0.112   | X   |
| TPSMB540A-A       | TPSMB540CA-A     | 540A    | 540C | -   | 460.00                                  | 513.00                                     | 567.00 | 1                       | 740.0   | 0.8                                     | 1   | 0.112   | X   |
| TPSMB550A-A       | TPSMB550CA-A     | 550A    | 550C | -   | 468.00                                  | 522.50                                     | 577.50 | 1                       | 760.0   | 0.8                                     | 1   | 0.112   | X   |
| -                 | TPSMB600CA-A     | -       | 600C | -   | 511.00                                  | 570.00                                     | 630.00 | 1                       | 828.0   | 0.8                                     | 1   | 0.112   | -   |
| -                 | TPSMB650CA-A     | -       | 650C | -   | 553.00                                  | 617.50                                     | 682.50 | 1                       | 897.0   | 0.8                                     | 1   | 0.112   | -   |

**Note:**

- For bidirectional type having  $V_R$  of 10 volts and less, the  $I_R$  limit is double.
- $V_{BR}$  @  $T_j = 25^\circ\text{C} \times (1 + \alpha T \times (T_j - 25))$  ( $\alpha T$ : Temperature Coefficient).
- The CTI (Comparative Tracking Index) of TPSMB600CA-A and TPSMB650CA-A is 600 and other parts is 550

# TPSMB Series

## Surface Mount – 600W

### 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 thogh 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 3 - Peak Pulse Power Derating Curve



Figure 2 - Peak Power Rating Curve



Figure 4 - Pulse Waveform



# TPSMB Series

## Surface Mount – 600W

Figure 5 - Typical Junction Capacitance

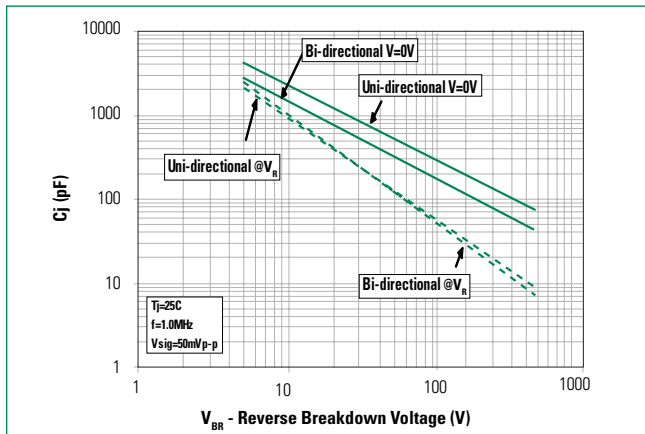
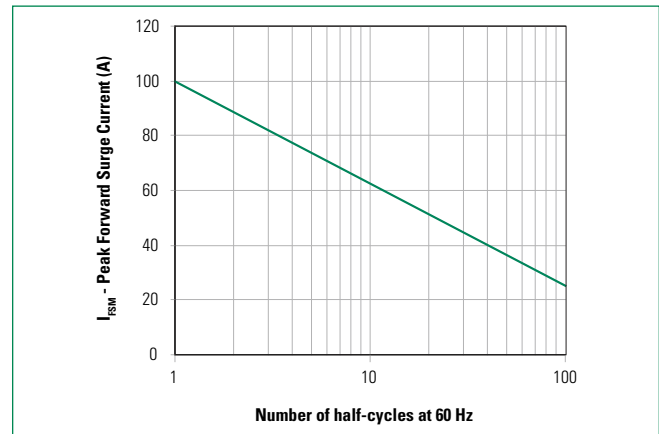


Figure 6 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional Only



### 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) ( $t_s$ )      | 60 – 120 secs           |
| <b>Average ramp up rate (Liquidus Temp (<math>T_L</math>) to peak)</b> |                                    | 3°C/second max          |
| <b><math>T_{s(max)}</math> to <math>T_L</math> - Ramp-up Rate</b>      |                                    | 3°C/second max          |
| <b>Reflow</b>  | - Temperature ( $T_L$ ) (Liquidus) | 217°C                   |
|  | - Time (min to max) ( $t_s$ )      | 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>   |                                    | 30 seconds max          |
| <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 gram   |
| <b>Case</b>     | JEDEC DO214AA. Molded plastic body over glass passivated junction |
| <b>Polarity</b> | Color band denotes cathode for unidirectional components.         |
| <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              |

# TPSMB Series

## Surface Mount – 600W

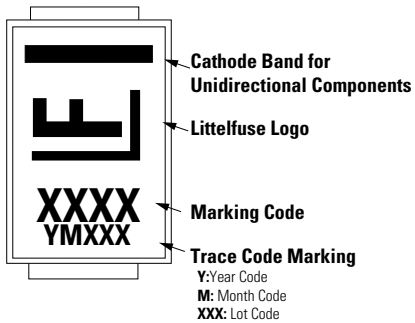
### Dimensions



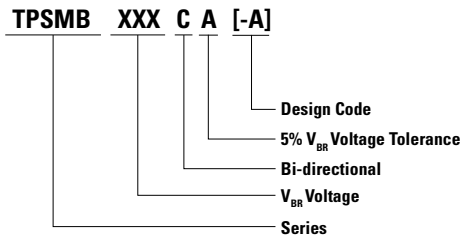
| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.077  | 0.086 | 1.950       | 2.200 |
| B          | 0.160  | 0.180 | 4.060       | 4.570 |
| C          | 0.130  | 0.155 | 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       | -     |

Note: Dimension in inches and (millimeters)

### Part Marking System



### Part Numbering System



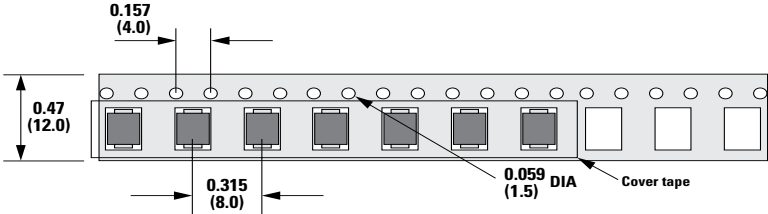
### Packaging

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

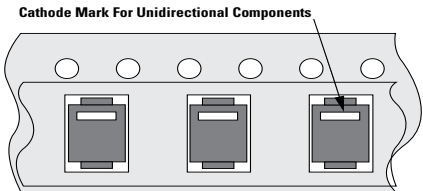
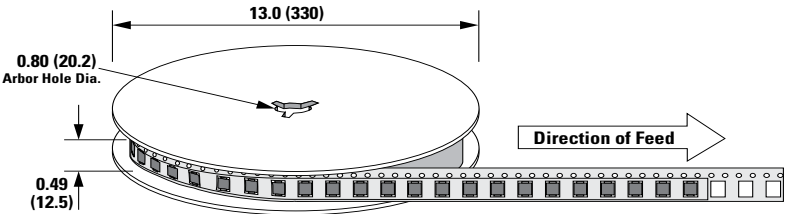
# TPSMB Series

Surface Mount – 600W

### Tape and Reel Specification



Note: Dimensions are in inches (and millimeters).



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