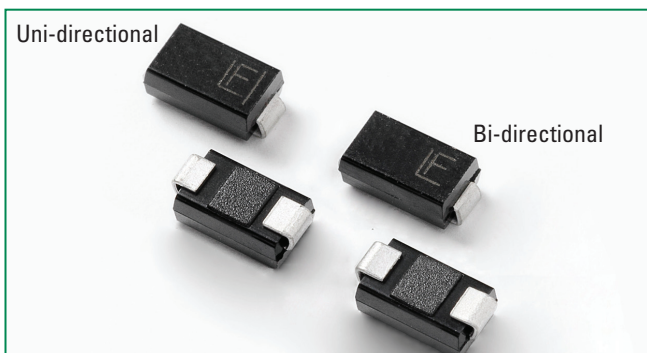


## P4SMA Series



### Description

The P4SMA series is designed specifically to protect sensitive electronic equipment from voltage transients induced by lightning and other transient voltage events.

### Agency Approvals

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

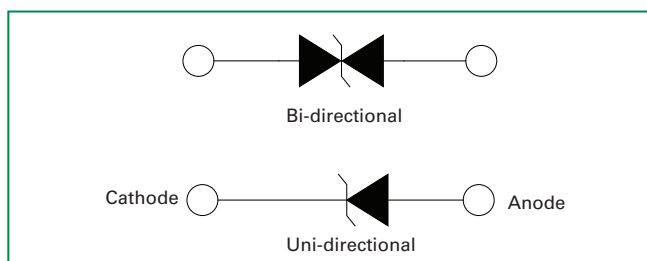
### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                                                                          | Symbol         | Value      | Unit               |
|--------------------------------------------------------------------------------------------------------------------|----------------|------------|--------------------|
| Peak Pulse Power Dissipation at $T_A=25^\circ\text{C}$ by 10/1000 $\mu\text{s}$ Waveform (Fig.2)(Note 1), (Note 2) | $P_{PPM}$      | 400        | W                  |
| Power Dissipation on Infinite Heat Sink at $T_A=50^\circ\text{C}$                                                  | $P_{M(AV)}$    | 3.3        | W                  |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)                                                   | $I_{FSM}$      | 40         | A                  |
| Maximum Instantaneous Forward Voltage at 25A for Unidirectional Only (Note 4)                                      | $V_F$          | 3.5V/6.5   | V                  |
| Operating Junction and Storage Temperature Range                                                                   | $T_J, T_{STG}$ | -55 to 150 | $^\circ\text{C}$   |
| Typical Thermal Resistance Junction to Lead                                                                        | $R_{JL}$       | 30         | $^\circ\text{C/W}$ |
| Typical Thermal Resistance Junction to Ambient                                                                     | $R_{JA}$       | 120        | $^\circ\text{C/W}$ |

#### Notes:

1. Non-repetitive current pulse, per Fig. 4 and derated above  $T_A = 25^\circ\text{C}$  per Fig. 3.
2. Mounted on 0.2x0.2" (5.0 x 5.0mm) copper pad to each terminal.
3. Measured on 8.3ms single half sine wave or equivalent square wave for unidirectional device only, duty cycle=4 per minute maximum.
4.  $V_F < 3.5\text{V}$  for  $V_{BR} \leq 200\text{V}$  and  $V_F < 6.5\text{V}$  for  $V_{BR} \geq 201\text{V}$ .

### Functional Diagram



### Features

- Excellent clamping capability
- Low incremental surge resistance
- Typical  $I_R$  less than  $1\mu\text{A}$  above 12V
- 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
- IEC-61000-4-2 ESD 15kV(Air), 8kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2 (IEC801-2)
- EFT protection of data lines in accordance with IEC 61000-4-4 (IEC801-4)
- Built-in strain relief
- 400W peak pulse power capability at 10/1000 $\mu\text{s}$  waveform, repetition rate (duty cycles):0.01%
- Fast response time: typically less than 1.0ps from 0V to BV min
- $V_{BR} @ T_J = V_{BR} @ 25^\circ\text{C} \times (1 + \alpha T \times (T_J - 25))$  ( $\alpha$  T: Temperature Coefficient)
- Glass passivated chip junction
- High Temperature soldering guaranteed:  $260^\circ\text{C}/40$  seconds at terminals
- Plastic package has underwriters laboratory flammability 94V-O
- Meet MSL level1, per J-STD-020, LF maximum peak of  $260^\circ\text{C}$
- Matte tin lead-free Plated
- Halogen-free and RoHS compliant
- 2nd level interconnect is Pb-free per IPC/JEDEC J-STD-609A.01

### Applications

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

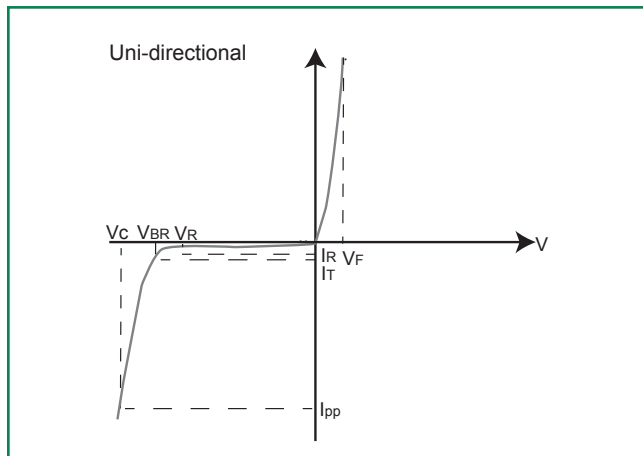
### Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

| Part Number (Uni) | Part Number (Bi) | Marking |      | Reverse Stand off Voltage V <sub>R</sub> (Volts) | Breakdown Voltage V <sub>BR</sub> (Volts) @ I <sub>T</sub> |        | Test Current I <sub>T</sub> (mA) | Maximum Clamping Voltage V <sub>C</sub> @ I <sub>PP</sub> (V) | Maximum Peak Pulse Current I <sub>PP</sub> (A) | Maximum Reverse Leakage I <sub>R</sub> @ V <sub>R</sub> (μA) | Agency Approval  |
|-------------------|------------------|---------|------|--------------------------------------------------|------------------------------------------------------------|--------|----------------------------------|---------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
|                   |                  | UNI     | BI   |                                                  | MIN                                                        | MAX    |                                  |                                                               |                                                |                                                              |                                                                                                     |
| P4SMA6.8A         | P4SMA6.8CA       | 6V8A    | 6V8C | 5.80                                             | 6.45                                                       | 7.14   | 10                               | 10.5                                                          | 39.0                                           | 1000                                                         | X                                                                                                   |
| P4SMA7.5A         | P4SMA7.5CA       | 7V5A    | 7V5C | 6.40                                             | 7.13                                                       | 7.88   | 10                               | 11.3                                                          | 36.3                                           | 500                                                          | X                                                                                                   |
| P4SMA8.2A         | P4SMA8.2CA       | 8V2A    | 8V2C | 7.02                                             | 7.79                                                       | 8.61   | 10                               | 12.1                                                          | 33.9                                           | 200                                                          | X                                                                                                   |
| P4SMA9.1A         | P4SMA9.1CA       | 9V1A    | 9V1C | 7.78                                             | 8.65                                                       | 9.55   | 1                                | 13.4                                                          | 30.6                                           | 50                                                           | X                                                                                                   |
| P4SMA10A          | P4SMA10CA        | 10A     | 10C  | 8.55                                             | 9.50                                                       | 10.50  | 1                                | 14.5                                                          | 28.3                                           | 10                                                           | X                                                                                                   |
| P4SMA11A          | P4SMA11CA        | 11A     | 11C  | 9.40                                             | 10.50                                                      | 11.60  | 1                                | 15.6                                                          | 26.3                                           | 5                                                            | X                                                                                                   |
| P4SMA12A          | P4SMA12CA        | 12A     | 12C  | 10.20                                            | 11.40                                                      | 12.60  | 1                                | 16.7                                                          | 24.6                                           | 5                                                            | X                                                                                                   |
| P4SMA13A          | P4SMA13CA        | 13A     | 13C  | 11.10                                            | 12.40                                                      | 13.70  | 1                                | 18.2                                                          | 22.5                                           | 1                                                            | X                                                                                                   |
| P4SMA15A          | P4SMA15CA        | 15A     | 15C  | 12.80                                            | 14.30                                                      | 15.80  | 1                                | 21.2                                                          | 19.3                                           | 1                                                            | X                                                                                                   |
| P4SMA16A          | P4SMA16CA        | 16A     | 16C  | 13.60                                            | 15.20                                                      | 16.80  | 1                                | 22.5                                                          | 18.2                                           | 1                                                            | X                                                                                                   |
| P4SMA18A          | P4SMA18CA        | 18A     | 18C  | 15.30                                            | 17.10                                                      | 18.90  | 1                                | 25.5                                                          | 16.1                                           | 1                                                            | X                                                                                                   |
| P4SMA20A          | P4SMA20CA        | 20A     | 20C  | 17.10                                            | 19.00                                                      | 21.00  | 1                                | 27.7                                                          | 14.8                                           | 1                                                            | X                                                                                                   |
| P4SMA22A          | P4SMA22CA        | 22A     | 22C  | 18.80                                            | 20.90                                                      | 23.10  | 1                                | 30.6                                                          | 13.4                                           | 1                                                            | X                                                                                                   |
| P4SMA24A          | P4SMA24CA        | 24A     | 24C  | 20.50                                            | 22.80                                                      | 25.20  | 1                                | 33.2                                                          | 12.3                                           | 1                                                            | X                                                                                                   |
| P4SMA27A          | P4SMA27CA        | 27A     | 27C  | 23.10                                            | 25.70                                                      | 28.40  | 1                                | 37.5                                                          | 10.9                                           | 1                                                            | X                                                                                                   |
| P4SMA30A          | P4SMA30CA        | 30A     | 30C  | 25.60                                            | 28.50                                                      | 31.50  | 1                                | 41.4                                                          | 9.9                                            | 1                                                            | X                                                                                                   |
| P4SMA33A          | P4SMA33CA        | 33A     | 33C  | 28.20                                            | 31.40                                                      | 34.70  | 1                                | 45.7                                                          | 9.0                                            | 1                                                            | X                                                                                                   |
| P4SMA36A          | P4SMA36CA        | 36A     | 36C  | 30.80                                            | 34.20                                                      | 37.80  | 1                                | 49.9                                                          | 8.2                                            | 1                                                            | X                                                                                                   |
| P4SMA39A          | P4SMA39CA        | 39A     | 39C  | 33.30                                            | 37.10                                                      | 41.00  | 1                                | 53.9                                                          | 7.6                                            | 1                                                            | X                                                                                                   |
| P4SMA43A          | P4SMA43CA        | 43A     | 43C  | 36.80                                            | 40.90                                                      | 45.20  | 1                                | 59.3                                                          | 6.9                                            | 1                                                            | X                                                                                                   |
| P4SMA47A          | P4SMA47CA        | 47A     | 47C  | 40.20                                            | 44.70                                                      | 49.40  | 1                                | 64.8                                                          | 6.3                                            | 1                                                            | X                                                                                                   |
| P4SMA51A          | P4SMA51CA        | 51A     | 51C  | 43.60                                            | 48.50                                                      | 53.60  | 1                                | 70.1                                                          | 5.8                                            | 1                                                            | X                                                                                                   |
| P4SMA56A          | P4SMA56CA        | 56A     | 56C  | 47.80                                            | 53.20                                                      | 58.80  | 1                                | 77.0                                                          | 5.3                                            | 1                                                            | X                                                                                                   |
| P4SMA62A          | P4SMA62CA        | 62A     | 62C  | 53.00                                            | 58.90                                                      | 65.10  | 1                                | 85.0                                                          | 4.8                                            | 1                                                            | X                                                                                                   |
| P4SMA68A          | P4SMA68CA        | 68A     | 68C  | 58.10                                            | 64.60                                                      | 71.40  | 1                                | 92.0                                                          | 4.5                                            | 1                                                            | X                                                                                                   |
| P4SMA75A          | P4SMA75CA        | 75A     | 75C  | 64.10                                            | 71.30                                                      | 78.80  | 1                                | 103.0                                                         | 4.0                                            | 1                                                            | X                                                                                                   |
| P4SMA82A          | P4SMA82CA        | 82A     | 82C  | 70.10                                            | 77.90                                                      | 86.10  | 1                                | 113.0                                                         | 3.6                                            | 1                                                            | X                                                                                                   |
| P4SMA91A          | P4SMA91CA        | 91A     | 91C  | 77.80                                            | 86.50                                                      | 95.50  | 1                                | 125.0                                                         | 3.3                                            | 1                                                            | X                                                                                                   |
| P4SMA100A         | P4SMA100CA       | 100A    | 100C | 85.50                                            | 95.00                                                      | 105.00 | 1                                | 137.0                                                         | 3.0                                            | 1                                                            | X                                                                                                   |
| P4SMA110A         | P4SMA110CA       | 110A    | 110C | 94.00                                            | 105.00                                                     | 116.00 | 1                                | 152.0                                                         | 2.7                                            | 1                                                            | X                                                                                                   |
| P4SMA120A         | P4SMA120CA       | 120A    | 120C | 102.00                                           | 114.00                                                     | 126.00 | 1                                | 165.0                                                         | 2.5                                            | 1                                                            | X                                                                                                   |
| P4SMA130A         | P4SMA130CA       | 130A    | 130C | 111.00                                           | 124.00                                                     | 137.00 | 1                                | 179.0                                                         | 2.3                                            | 1                                                            | X                                                                                                   |
| P4SMA150A         | P4SMA150CA       | 150A    | 150C | 128.00                                           | 143.00                                                     | 158.00 | 1                                | 207.0                                                         | 2.0                                            | 1                                                            | X                                                                                                   |
| P4SMA160A         | P4SMA160CA       | 160A    | 160C | 136.00                                           | 152.00                                                     | 168.00 | 1                                | 219.0                                                         | 1.9                                            | 1                                                            | X                                                                                                   |
| P4SMA170A         | P4SMA170CA       | 170A    | 170C | 145.00                                           | 162.00                                                     | 179.00 | 1                                | 234.0                                                         | 1.8                                            | 1                                                            | X                                                                                                   |
| P4SMA180A         | P4SMA180CA       | 180A    | 180C | 154.00                                           | 171.00                                                     | 189.00 | 1                                | 246.0                                                         | 1.7                                            | 1                                                            | X                                                                                                   |
| P4SMA200A         | P4SMA200CA       | 200A    | 200C | 171.00                                           | 190.00                                                     | 210.00 | 1                                | 274.0                                                         | 1.5                                            | 1                                                            | X                                                                                                   |
| P4SMA220A         | P4SMA220CA       | 220A    | 220C | 185.00                                           | 209.00                                                     | 231.00 | 1                                | 328.0                                                         | 1.3                                            | 1                                                            |                                                                                                     |
| P4SMA250A         | P4SMA250CA       | 250A    | 250C | 214.00                                           | 237.00                                                     | 263.00 | 1                                | 344.0                                                         | 1.2                                            | 1                                                            |                                                                                                     |
| P4SMA300A         | P4SMA300CA       | 300A    | 300C | 256.00                                           | 285.00                                                     | 315.00 | 1                                | 414.0                                                         | 1.0                                            | 1                                                            |                                                                                                     |
| P4SMA350A         | P4SMA350CA       | 350A    | 350C | 300.00                                           | 332.00                                                     | 368.00 | 1                                | 482.0                                                         | 0.9                                            | 1                                                            |                                                                                                     |
| P4SMA400A         | P4SMA400CA       | 400A    | 400C | 342.00                                           | 380.00                                                     | 420.00 | 1                                | 548.0                                                         | 0.8                                            | 1                                                            |                                                                                                     |
| P4SMA440A         | P4SMA440CA       | 440A    | 440C | 376.00                                           | 418.00                                                     | 462.00 | 1                                | 602.0                                                         | 0.7                                            | 1                                                            |                                                                                                     |
| P4SMA480A         | P4SMA480CA       | 480A    | 480C | 408.00                                           | 456.00                                                     | 504.00 | 1                                | 658.0                                                         | 0.6                                            | 1                                                            |                                                                                                     |
| P4SMA510A         | P4SMA510CA       | 510A    | 510C | 434.00                                           | 485.00                                                     | 535.00 | 1                                | 698.0                                                         | 0.6                                            | 1                                                            |                                                                                                     |
| P4SMA530A         | P4SMA530CA       | 530A    | 530C | 451.00                                           | 503.50                                                     | 556.50 | 1                                | 725.0                                                         | 0.6                                            | 1                                                            |                                                                                                     |
| P4SMA540A         | P4SMA540CA       | 540A    | 540C | 460.00                                           | 513.00                                                     | 567.00 | 1                                | 740.0                                                         | 0.5                                            | 1                                                            |                                                                                                     |
| P4SMA550A         | P4SMA550CA       | 550A    | 550C | 468.00                                           | 522.50                                                     | 577.50 | 1                                | 760.0                                                         | 0.5                                            | 1                                                            |                                                                                                     |

For bidirectional type having V<sub>R</sub> of 10 volts and less, the I<sub>R</sub> limit is double.

For parts without A, the V<sub>BR</sub> is ± 10% and V<sub>C</sub> 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 ( $I_R$ )

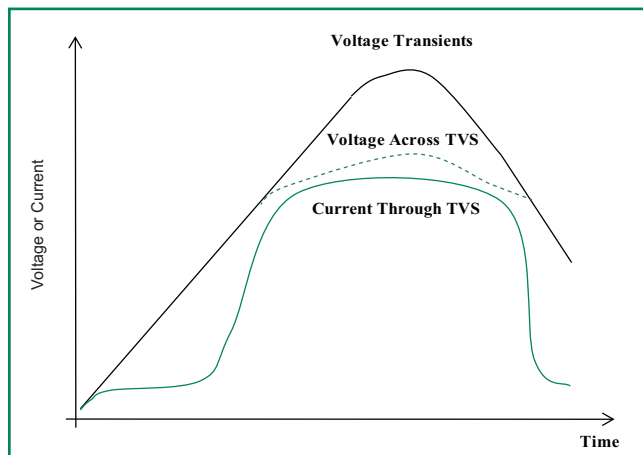
**$V_C$  Clamping Voltage** – Peak voltage measured across the suppressor at a specified  $I_{PPM}$  (peak impulse current)

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

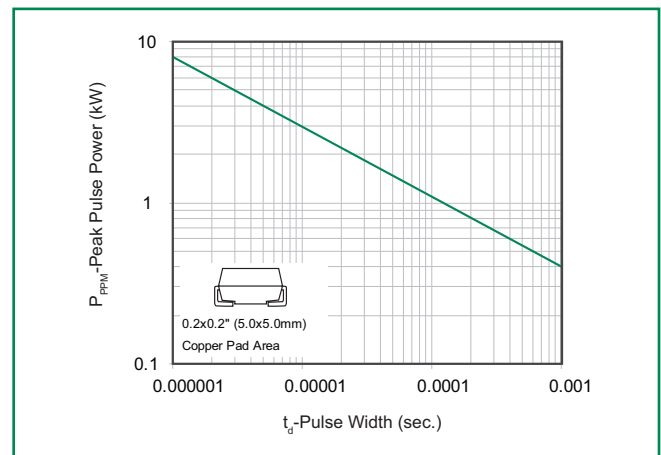
**$V_F$  Forward Voltage Drop for Uni-directional**

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

**Figure 1 - TVS Transients Clamping Waveform**



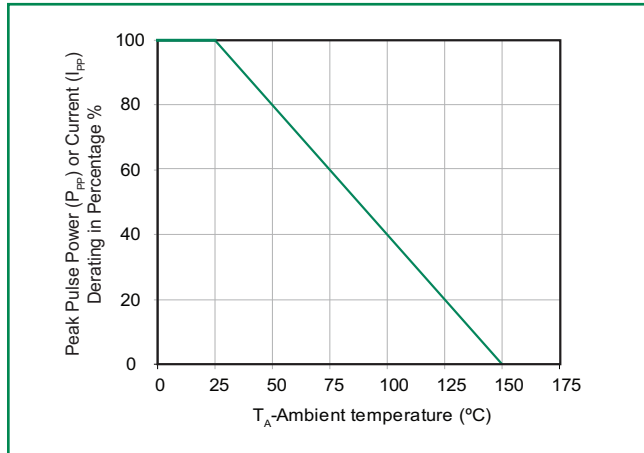
**Figure 2 - Peak Pulse Power Rating Curve**



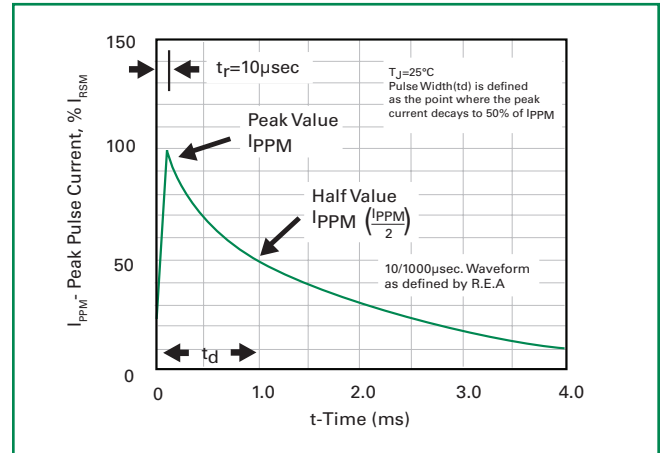
continues on next page.

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

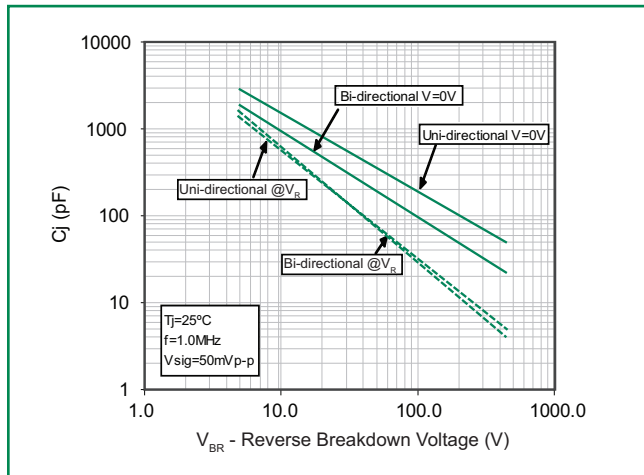
**Figure 3 - Pulse Derating Curve**



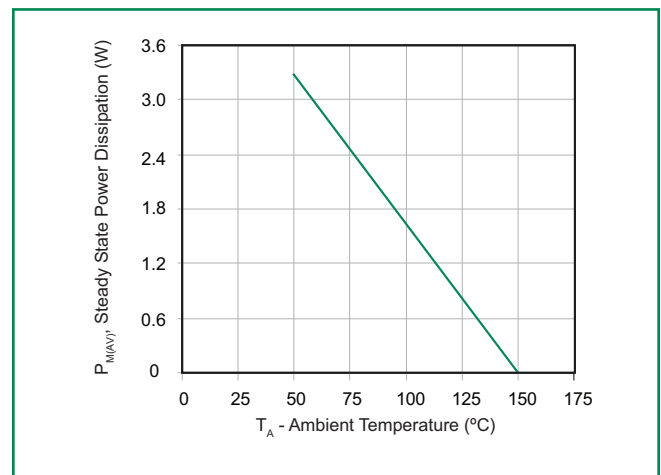
**Figure 4 - Pulse Waveform**



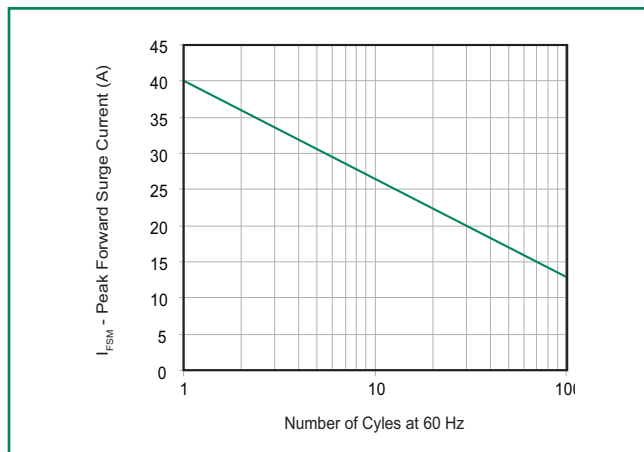
**Figure 5 - Typical Junction Capacitance**



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



**Figure 7 - Maximum Non-Repetitive 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 – 180 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 ( $t_p$ )  |                                    | 20 – 40 seconds         |
| Ramp-down Rate                                        |                                    | 6°C/second max          |
| Time 25°C to peak Temperature ( $T_p$ )               |                                    | 8 minutes Max.          |
| Do not exceed                                         |                                    | 280°C                   |



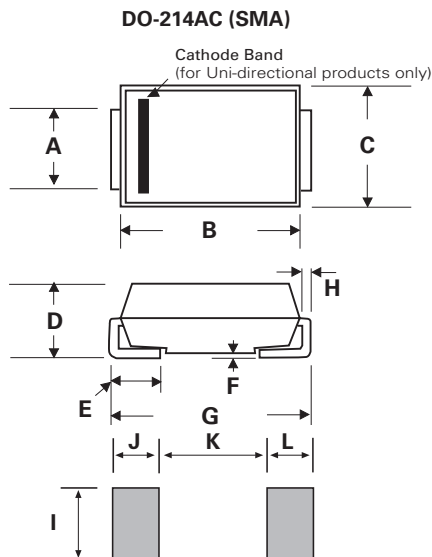
## Physical Specifications

|                 |                                                                    |
|-----------------|--------------------------------------------------------------------|
| <b>Weight</b>   | 0.002 ounce, 0.061 gram                                            |
| <b>Case</b>     | JEDEC DO-214AC. 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

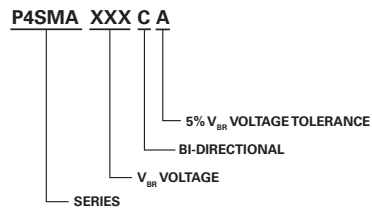
|                            |                          |
|----------------------------|--------------------------|
| <b>High Temp. Storage</b>  | JESD22-A103              |
| <b>HTRB</b>                | JESD22-A108              |
| <b>Temperature Cycling</b> | JESD22-A104              |
| <b>MSL</b>                 | JEDEC-J-STD-020, Level 1 |
| <b>H3TRB</b>               | JESD22-A101              |
| <b>RSH</b>                 | JESD22-B106              |

## Dimensions

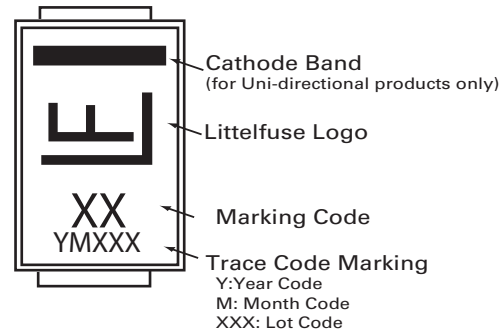


| Dimensions | Inches |       | Millimeters |       |
|------------|--------|-------|-------------|-------|
|            | Min    | Max   | Min         | Max   |
| A          | 0.049  | 0.065 | 1.250       | 1.650 |
| B          | 0.157  | 0.177 | 3.990       | 4.500 |
| C          | 0.100  | 0.110 | 2.540       | 2.790 |
| D          | 0.078  | 0.090 | 1.980       | 2.290 |
| E          | 0.030  | 0.060 | 0.780       | 1.520 |
| F          | -      | 0.008 | -           | 0.203 |
| G          | 0.194  | 0.208 | 4.930       | 5.280 |
| H          | 0.006  | 0.012 | 0.152       | 0.305 |
| I          | 0.070  | -     | 1.800       | -     |
| J          | 0.082  | -     | 2.100       | -     |
| K          | -      | 0.090 | -           | 2.300 |
| L          | 0.082  | -     | 2.100       | -     |

### Part Numbering System



### Part Marking System



### Packaging

| Part number | Component Package | Quantity | Packaging Option                 | Packaging Specification |
|-------------|-------------------|----------|----------------------------------|-------------------------|
| P4SMAxxxXX  | DO-214AC          | 5000     | Tape & Reel - 12mm tape/13" reel | EIA STD RS-481          |

### Tape and Reel Specification

