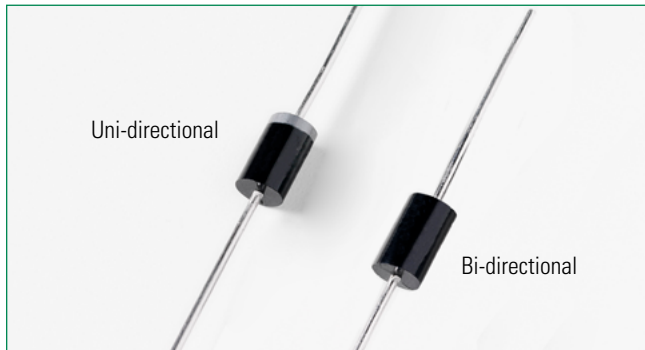



### 1.5KE Series



#### Agency Approvals

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

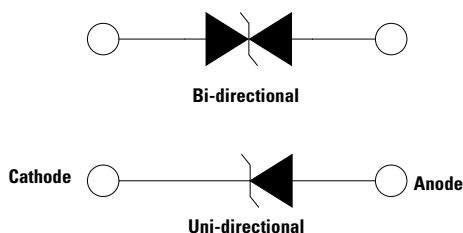
#### Maximum Ratings and Thermal Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

| Parameter   | Symbol                            | Value      | Unit |
|---|-----------------------------------|------------|------|
| Peak Pulse Power Dissipation (Fig.2) by 10/1000µs Test Waveform (Fig.4) (Note 1) -Single Die Parts        | P <sub>PPM</sub>                  | 1500       | W    |
| Peak Pulse Power Dissipation(Fig.2) by 10/1000µs Test Waveform(Fig.4)(Note 1) -Stacked Die Parts (Note 4) | P <sub>PPM</sub>                  | 2000       | W    |
| Steady State Power Dissipation on Infinite Heat Sink at T <sub>L</sub> = 75°C                             | P <sub>D</sub>                    | 6.5        | W    |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave Unidirectional Only (Note 2)                      | I <sub>FSM</sub>                  | 200        | A    |
| Maximum Instantaneous Forward Voltage at 100A for Unidirectional Only (Note 3)                            | V <sub>F</sub>                    | 3.5/5.0    | V    |
| Operating Junction and Storage Temperature Range  | T <sub>J</sub> , T <sub>STG</sub> | -55 to 175 | °C   |
| Typical Thermal Resistance Junction to Lead   | R <sub>θJL</sub>                  | 15         | °C/W |
| Typical Thermal Resistance Junction to Ambient  | R <sub>θJA</sub>                  | 75         | °C/W |

#### Notes:

1. Non-repetitive current pulse, per Fig. 4 and derated above T<sub>J</sub> (initial) = 25°C per Fig. 3.
2. Measured on 8.3ms single half sine wave or equivalent square wave, duty cycle=4 per minute maximum.
3. V<sub>F</sub> < 3.5V for single die parts and V<sub>F</sub> < 5.0V for stacked-die parts.
4. For stacked die component details, please refer to part numbers labeled by \* in Electrical Characteristics.

#### Functional Diagram



#### Description

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

#### Features

- 1500W peak pulse capability at 10/1000µs waveform, repetition rate (duty cycles):0.01%
- Glass passivated chip junction in DO-201 Package
- Fast response time: typically less than 1.0ps from 0 Volts to BV min
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- IEC-61000-4-2 ESD 30kV(Air), 30kV (Contact)
- ESD protection of data lines in accordance with IEC 61000-4-2
- EFT protection of data lines in accordance with IEC 61000-4-4
- Low incremental surge resistance
- Typical I<sub>R</sub> less than 1µA when V<sub>BR</sub> min > 12V
- High temperature to reflow soldering guaranteed: 260°C/30sec / 0.375"(9.5mm) lead length, 5 lbs., (2.3kg) tension
- V<sub>BR</sub> @ T<sub>J</sub> = V<sub>BR</sub> @ 25°C x (1 + αT x (T<sub>J</sub> - 25)) (αT: Temperature Coefficient, typical value is 0.1%)
- Plastic package is flammability rated V-0 per Underwriters Laboratories
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

#### Applications

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

#### Additional Information



Datasheet




Resources



Samples

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

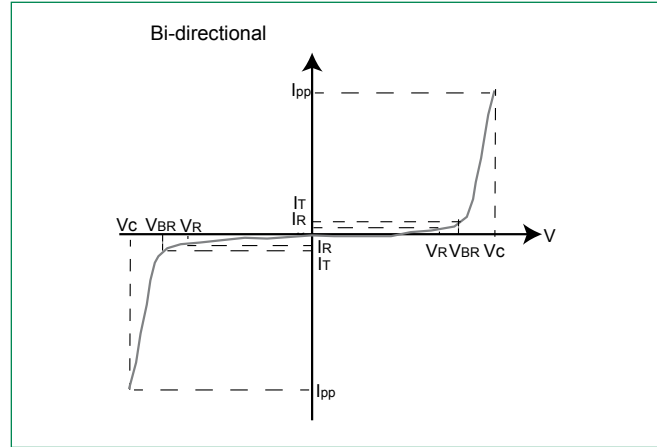
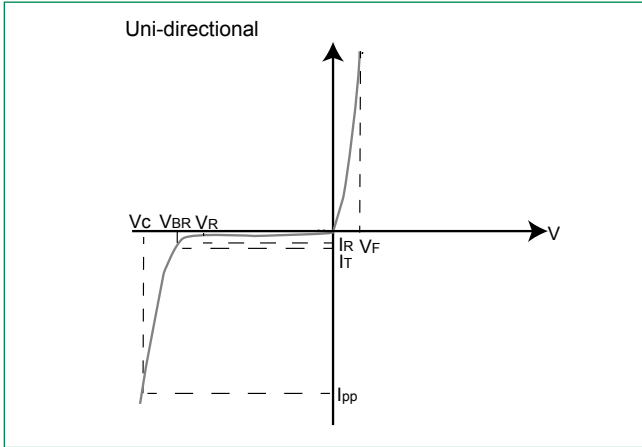
| Part Number (Uni) | Part Number (Bi) | Reverse Stand off Voltage V <sub>R</sub> (Volts) | Breakdown Voltage V <sub>BR</sub> (Volts) @ I <sub>T</sub> |        | Test Current I <sub>T</sub> (mA) | Maximum Clamping Voltage V <sub>C</sub> @ I <sub>PP</sub> (Volts) | Maximum Peak Pulse Current I <sub>PP</sub> (A) | Maximum Reverse Leakage I <sub>R</sub> @ V <sub>R</sub> (µA) | Agency Approval  |
|-------------------|------------------|--|--|--------|----------------------------------|---|--|--|---|
|                   |                  |  | Min.   | Max.   |                                  |   |  |  |   |
| 1.5KE6.8A         | 1.5KE6.8CA       | 5.80   | 6.45   | 7.14   | 10                               | 10.5  | 144.8  | 1000   | X   |
| 1.5KE7.5A         | 1.5KE7.5CA       | 6.40   | 7.13   | 7.88   | 10                               | 11.3  | 134.5  | 500  | X   |
| 1.5KE8.2A         | 1.5KE8.2CA       | 7.02   | 7.79   | 8.61   | 10                               | 12.1  | 125.6  | 200  | X   |
| 1.5KE9.1A         | 1.5KE9.1CA       | 7.78   | 8.65   | 9.50   | 1                                | 13.4  | 113.4  | 50   | X   |
| 1.5KE10A          | 1.5KE10CA        | 8.55   | 9.50   | 10.50  | 1                                | 14.5  | 104.8  | 10   | X   |
| 1.5KE11A          | 1.5KE11CA        | 9.40   | 10.50  | 11.60  | 1                                | 15.6  | 97.4   | 5  | X   |
| 1.5KE12A          | 1.5KE12CA        | 10.20  | 11.40  | 12.60  | 1                                | 16.7  | 91.0   | 5  | X   |
| 1.5KE13A          | 1.5KE13CA        | 11.10  | 12.40  | 13.70  | 1                                | 18.2  | 83.5   | 1  | X   |
| 1.5KE15A          | 1.5KE15CA        | 12.80  | 14.30  | 15.80  | 1                                | 21.2  | 71.7   | 1  | X   |
| 1.5KE16A          | 1.5KE16CA        | 13.60  | 15.20  | 16.80  | 1                                | 22.5  | 67.6   | 1  | X   |
| 1.5KE18A          | 1.5KE18CA        | 15.30  | 17.10  | 18.90  | 1                                | 25.2  | 60.3   | 1  | X   |
| 1.5KE20A          | 1.5KE20CA        | 17.10  | 19.00  | 21.00  | 1                                | 27.7  | 54.9   | 1  | X   |
| 1.5KE22A          | 1.5KE22CA        | 18.80  | 20.90  | 23.10  | 1                                | 30.6  | 49.7   | 1  | X   |
| 1.5KE24A          | 1.5KE24CA        | 20.50  | 22.80  | 25.20  | 1                                | 33.2  | 45.8   | 1  | X   |
| 1.5KE27A          | 1.5KE27CA        | 23.10  | 25.70  | 28.40  | 1                                | 37.5  | 40.5   | 1  | X   |
| 1.5KE30A          | 1.5KE30CA        | 25.60  | 28.50  | 31.50  | 1                                | 41.4  | 36.7   | 1  | X   |
| 1.5KE33A          | 1.5KE33CA        | 28.20  | 31.40  | 34.70  | 1                                | 45.7  | 33.3   | 1  | X   |
| 1.5KE36A          | 1.5KE36CA        | 30.80  | 34.20  | 37.80  | 1                                | 49.9  | 30.5   | 1  | X   |
| 1.5KE39A          | 1.5KE39CA        | 33.30  | 37.10  | 41.00  | 1                                | 53.9  | 28.2   | 1  | X   |
| 1.5KE43A          | 1.5KE43CA        | 36.80  | 40.90  | 45.20  | 1                                | 59.3  | 25.6   | 1  | X   |
| 1.5KE47A          | 1.5KE47CA        | 40.20  | 44.70  | 49.40  | 1                                | 64.8  | 23.5   | 1  | X   |
| 1.5KE51A          | 1.5KE51CA        | 43.60  | 48.50  | 53.60  | 1                                | 70.1  | 21.7   | 1  | X   |
| 1.5KE56A          | 1.5KE56CA        | 47.80  | 53.20  | 58.80  | 1                                | 77.0  | 19.7   | 1  | X   |
| 1.5KE62A          | 1.5KE62CA        | 53.00  | 58.90  | 65.10  | 1                                | 85.0  | 17.9   | 1  | X   |
| 1.5KE68A          | 1.5KE68CA        | 58.10  | 64.60  | 71.40  | 1                                | 92.0  | 16.5   | 1  | X   |
| 1.5KE75A          | 1.5KE75CA        | 64.10  | 71.30  | 78.80  | 1                                | 103.0   | 14.8   | 1  | X   |
| 1.5KE82A          | 1.5KE82CA        | 70.10  | 77.90  | 86.10  | 1                                | 113.0   | 13.5   | 1  | X   |
| 1.5KE91A          | 1.5KE91CA        | 77.80  | 86.50  | 95.50  | 1                                | 125.0   | 12.2   | 1  | X   |
| 1.5KE100A         | 1.5KE100CA       | 85.50  | 95.00  | 105.00 | 1                                | 137.0   | 11.1   | 1  | X   |
| 1.5KE110A         | 1.5KE110CA       | 94.00  | 105.00   | 116.00 | 1                                | 152.0   | 10.0   | 1  | X   |
| 1.5KE120A         | 1.5KE120CA       | 102.00   | 114.00   | 126.00 | 1                                | 165.0   | 9.2  | 1  | X   |
| 1.5KE130A         | 1.5KE130CA       | 111.00   | 124.00   | 137.00 | 1                                | 179.0   | 8.5  | 1  | X   |
| 1.5KE150A         | 1.5KE150CA       | 128.00   | 143.00   | 158.00 | 1                                | 207.0   | 7.3  | 1  | X   |
| 1.5KE160A         | 1.5KE160CA       | 136.00   | 152.00   | 168.00 | 1                                | 219.0   | 6.9  | 1  | X   |
| 1.5KE170A         | 1.5KE170CA       | 145.00   | 162.00   | 179.00 | 1                                | 234.0   | 6.5  | 1  | X   |
| 1.5KE180A         | 1.5KE180CA       | 154.00   | 171.00   | 189.00 | 1                                | 246.0   | 6.2  | 1  | X   |
| 1.5KE200A         | 1.5KE200CA       | 171.00   | 190.00   | 210.00 | 1                                | 274.0   | 5.5  | 1  | X   |
| 1.5KE220A         | 1.5KE220CA       | 185.00   | 209.00   | 231.00 | 1                                | 328.0   | 4.6  | 1  | X   |
| 1.5KE250A         | -                | 214.00   | 237.00   | 263.00 | 1                                | 344.0   | 4.4  | 1  | X   |
| -                 | 1.5KE250CA*      | 214.00   | 237.00   | 263.00 | 1                                | 344.0   | 5.9  | 1  | X   |
| 1.5KE300A*        | 1.5KE300CA*      | 256.00   | 285.00   | 315.00 | 1                                | 414.0   | 4.9  | 1  | X   |
| 1.5KE320A*        | 1.5KE320CA*      | 273.00   | 304.00   | 336.00 | 1                                | 441.0   | 4.6  | 1  | X   |
| 1.5KE350A*        | 1.5KE350CA*      | 300.00   | 332.00   | 368.00 | 1                                | 482.0   | 4.2  | 1  | X   |
| 1.5KE400A*        | 1.5KE400CA*      | 342.00   | 380.00   | 420.00 | 1                                | 548.0   | 3.7  | 1  | X   |
| 1.5KE440A*        | 1.5KE440CA*      | 376.00   | 418.00   | 462.00 | 1                                | 602.0   | 3.1  | 1  | X   |
| 1.5KE480A*        | 1.5KE480CA*      | 408.00   | 456.00   | 504.00 | 1                                | 658.0   | 3.1  | 1  | -   |
| 1.5KE510A*        | 1.5KE510CA*      | 434.00   | 485.00   | 535.00 | 1                                | 698.0   | 2.9  | 1  | -   |
| 1.5KE530A*        | 1.5KE530CA*      | 451.00   | 503.50   | 556.50 | 1                                | 725.0   | 2.8  | 1  | -   |
| 1.5KE540A*        | 1.5KE540CA*      | 460.00   | 513.00   | 567.00 | 1                                | 740.0   | 2.8  | 1  | -   |
| 1.5KE550A*        | 1.5KE550CA*      | 468.00   | 522.50   | 577.50 | 1                                | 760.0   | 2.7  | 1  | -   |
| 1.5KE600A*        | 1.5KE600CA*      | 512.00   | 570.00   | 630.00 | 1                                | 828.0   | 2.5  | 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, the parts without A are currently available, but not recommended for new designs. The parts with A are preferred.

For stack-die parts, use \* to label the part number.

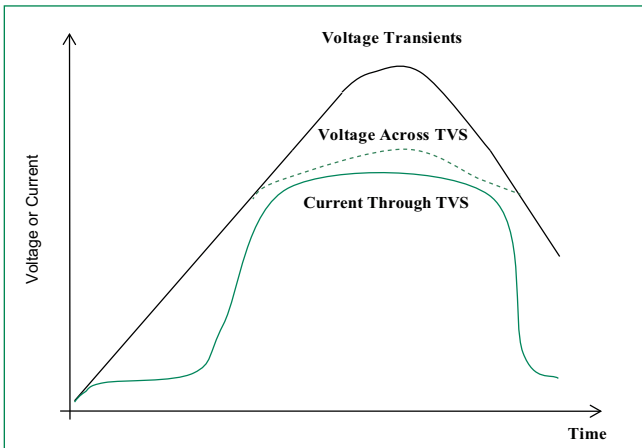
**I-V Curve Characteristics**



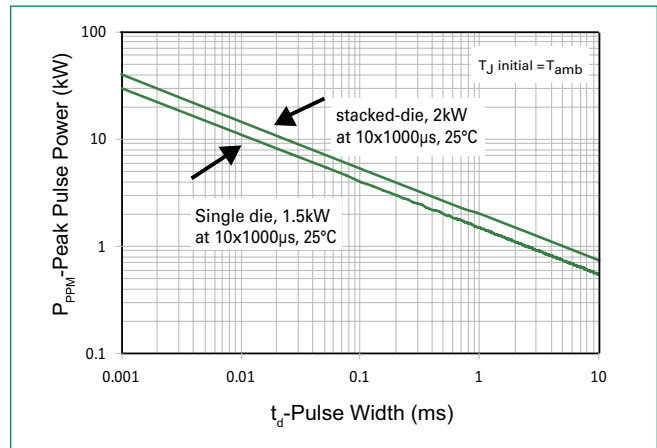
- $P_{PPM}$  Peak Pulse Power Dissipation** – Max power dissipation
- $V_R$  Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation
- $V_{BR}$  Breakdown Voltage** – Maximum voltage that flows through the TVS at a specified test current ( $I_T$ )
- $V_C$  Clamping Voltage**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

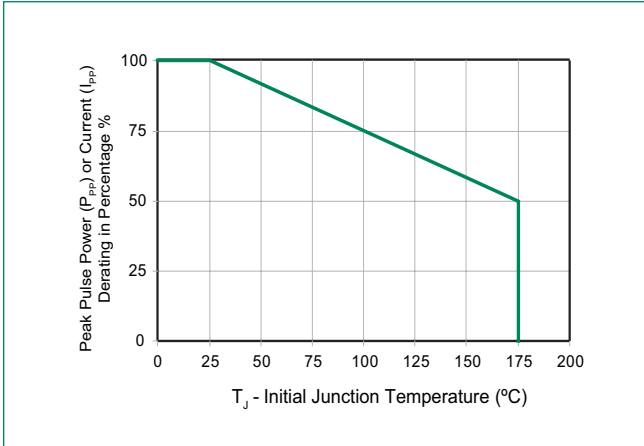


**Figure 2 - Peak Pulse Power Rating**

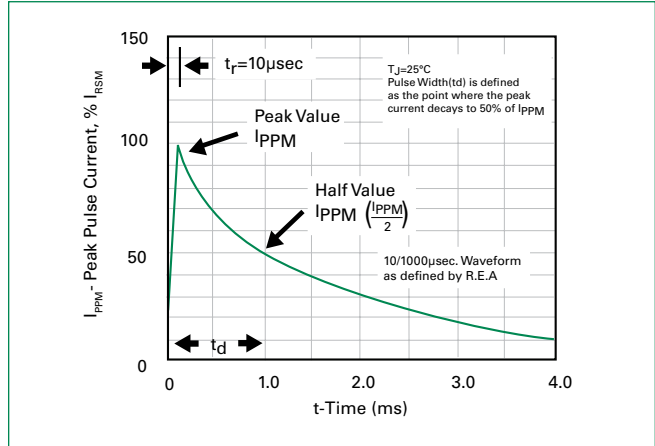


**Ratings and Characteristic Curves** ( $T_A=25^\circ\text{C}$  unless otherwise noted) (Continued)

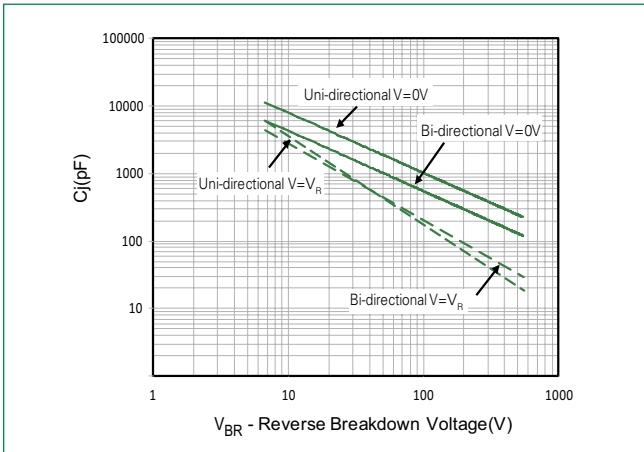
**Figure 3 - Peak Pulse Power Derating Curve**



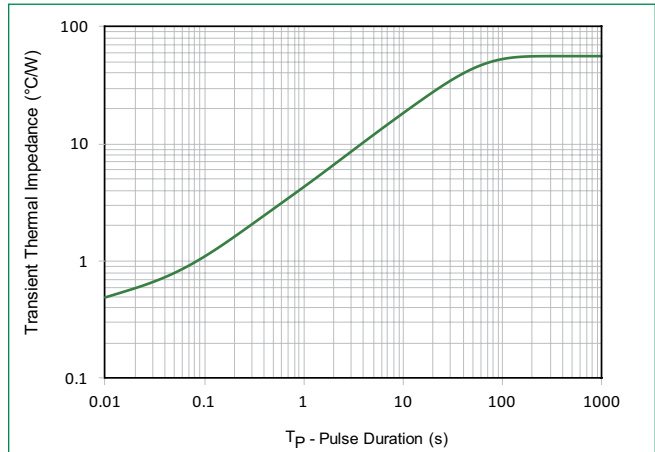
**Figure 4 - Pulse Waveform**



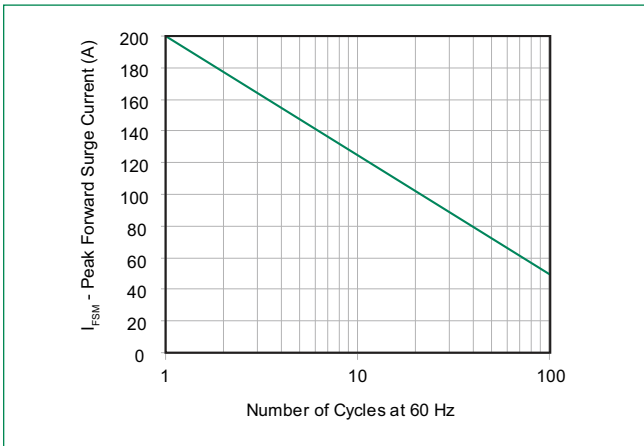
**Figure 5 - Typical Junction Capacitance**



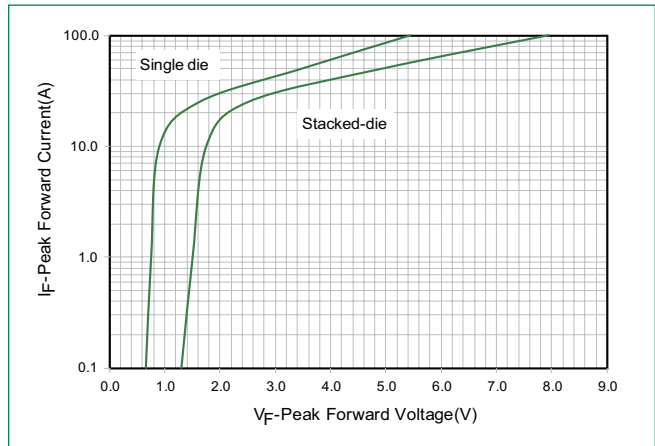
**Figure 6 - Typical Transient Thermal Impedance**



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

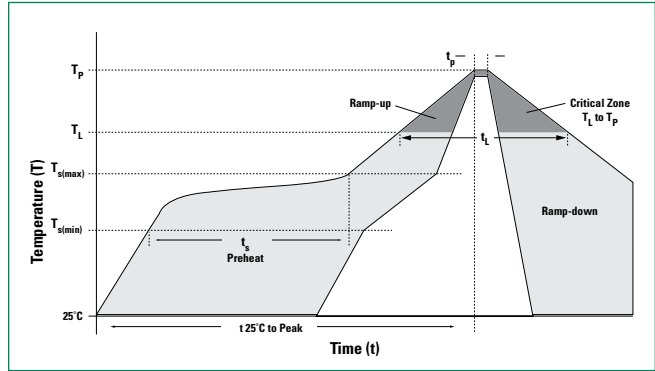


**Figure 8 - Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)**



**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) ( $t_s$ )      | 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) ( $t_L$ )      | 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>   |                                    | 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                   |



**Flow/Wave Soldering (Solder Dipping)**

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

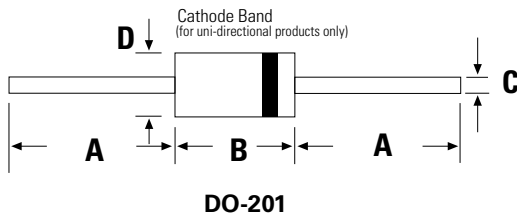
**Physical Specifications**

|                 |  |
|-----------------|--|
| <b>Weight</b>   | 0.045oz., 1.2g   |
| <b>Case</b>     | JEDEC DO-201 molded plastic body over passivated junction. |
| <b>Polarity</b> | Color band denotes the cathode except Bipolar.             |
| <b>Terminal</b> | Matte Tin axial leads, solderable per JESD22-B102.         |

**Environmental Specifications**

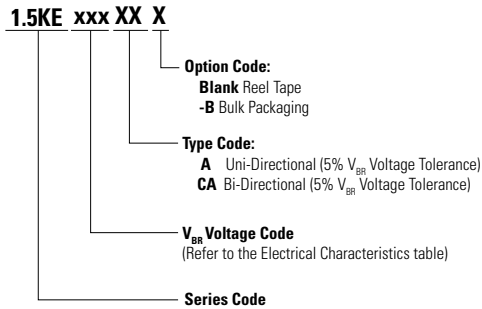
|                            |             |
|----------------------------|-------------|
| <b>High Temp. Storage</b>  | JESD22-A103 |
| <b>HTRB</b>                | JESD22-A108 |
| <b>Temperature Cycling</b> | JESD22-A104 |
| <b>H3TRB</b>               | JESD22-A101 |
| <b>RSH</b>                 |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

**Dimensions**

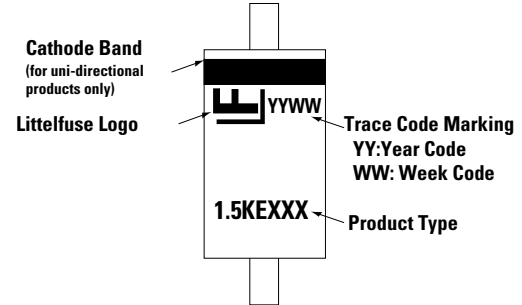


| Dimensions | Inches |       | Millimeters |      |
|------------|--------|-------|-------------|------|
|            | Min    | Max   | Min         | Max  |
| <b>A</b>   | 1.000  | -     | 25.40       | -    |
| <b>B</b>   | 0.285  | 0.375 | 7.20        | 9.50 |
| <b>C</b>   | 0.038  | 0.042 | 0.96        | 1.07 |
| <b>D</b>   | 0.190  | 0.210 | 4.80        | 5.30 |

### Part Numbering System



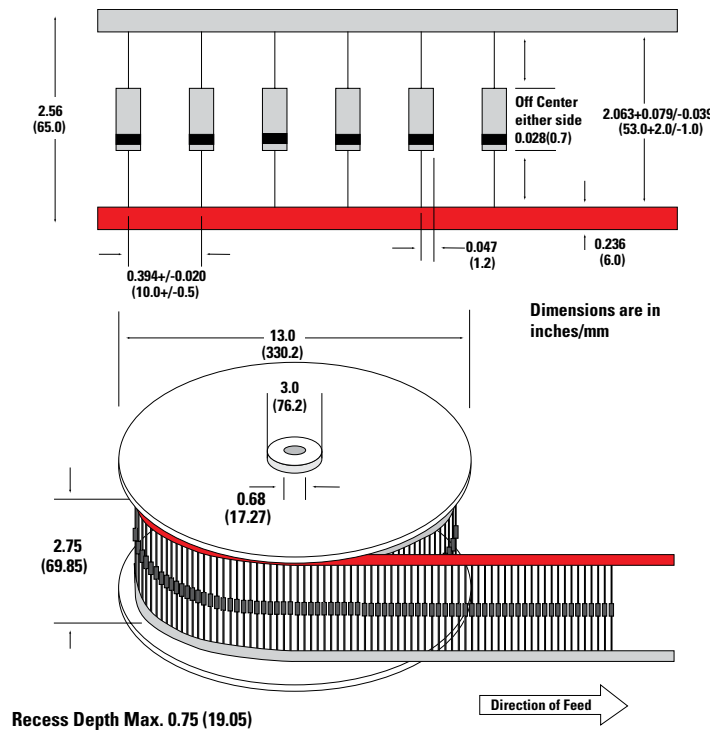
### Part Marking System



### Packaging

| Part Number  | Component Package | Quantity | Packaging Option | Packaging Specification |
|--------------|-------------------|----------|------------------|-------------------------|
| 1.5KExxxXX   | DO-201            | 1200     | Tape & Reel      | EIA STD RS-296          |
| 1.5KExxxXX-B | DO-201            | 500      | BULK             | Littelfuse Spec.        |

### Tape and Reel Specification



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Revised: JC.10/30/20