# THE DATASHEET OF

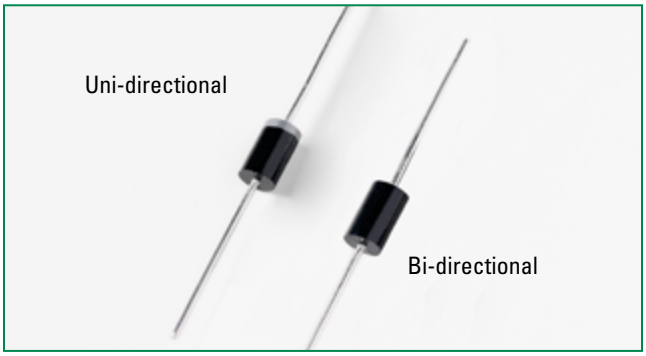
# 1.5KE12CA

# Transient Voltage Suppression Diodes

Axial Leaded – 1500W > 1.5KE series

Littelfuse
Expertise Applied | Answers Delivered

## 1.5KE Series




## Agency Approvals

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

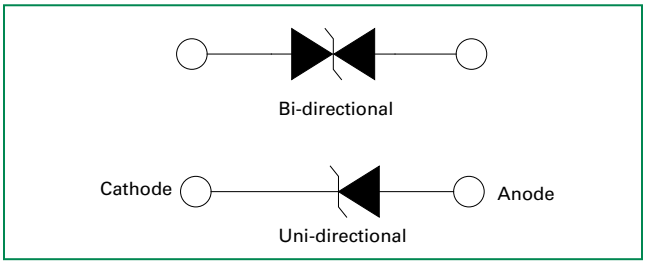
## Maximum Ratings and Thermal Characteristics ($T_A$=25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Peak Pulse Power Dissipation by 10/1000μs Test Waveform (Fig.2) (Note 1), (Note 4) | $P_{PPM}$ | 1500 | W |
| Steady State Power Dissipation on Infinite Heat Sink at $T_L$=75°C | $P_D$ | 6.5 | W |
| Peak Forward Surge Current, 8.3ms Single Half Sine Wave Unidirectional Only (Note 2) | $I_{FSM}$ | 200 | A |
| Maximum Instantaneous Forward Voltage at 100A for Unidirectional Only (Note 3) | $V_F$ | 3.5/5.0 | V |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to 175 | °C |
| Typical Thermal Resistance Junction to Lead | $R_{\theta JL}$ | 15 | °C/W |
| Typical Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | 75 | °C/W |

**Notes:**

1. Non-repetitive current pulse , per Fig. 4 and derated above $T_J$ (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. $V_F$ < 3.5V for single die parts and $V_F$< 5.0V for stacked-die parts.
4. The $P_{PPM}$ of stacked-die parts is 2kW and please contact littelfuse for the detail stacked-die parts.

## 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 $I_R$ less than 1μA when $V_{BR}$ min>12V
- High temperature to reflow soldering guaranteed: 260°C/40sec / 0.375",(9.5mm) lead length, 5 lbs., (2.3kg) tension
- $V_{BR}$ @ $T_J$= $V_{BR}$@25°C x (1+ $\alpha$T x ($T_J$ - 25)) ($\alpha$T: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, $V_{CC}$ bus and other vulnerable circuits used in telecom, computer, industrial and consumer electronic applications.

## Additional Infomarion

Datasheet | Resources | Samples

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# Transient Voltage Suppression Diodes

## Axial Leaded – 1500W > 1.5KE series

### Electrical Characteristics ($T_A$=25°C unless otherwise noted)

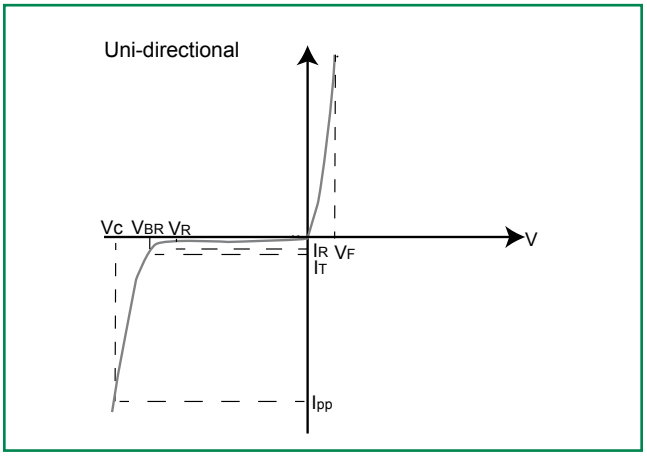
| Part Number (Uni) | Part Number (Bi) | Reverse Stand off Voltage $V_R$ (Volts) | Breakdown Voltage $V_{BR}$ (Volts) @ $I_T$ | | Test Current $I_T$ (mA) | Maximum Clamping Voltage $V_C$ @ $I_{PP}$ (Volts) | Maximum Peak Pulse Current $I_{PP}$ (A) | Maximum Reverse Leakage $I_R$ @ $V_R$ (µA) | Agency 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 | 1.5KE250CA | 214.00 | 237.00 | 263.00 | 1 | 344.0 | 4.4 | 1 | X |
| 1.5KE300A | 1.5KE300CA | 256.00 | 285.00 | 315.00 | 1 | 414.0 | 3.7 | 1 | X |
| 1.5KE320A | 1.5KE320CA | 273.00 | 304.00 | 336.00 | 1 | 441.0 | 3.5 | 1 | X |
| 1.5KE350A | 1.5KE350CA | 300.00 | 332.00 | 368.00 | 1 | 482.0 | 3.2 | 1 | X |
| 1.5KE400A | 1.5KE400CA | 342.00 | 380.00 | 420.00 | 1 | 548.0 | 2.8 | 1 | X |
| 1.5KE440A | 1.5KE440CA | 376.00 | 418.00 | 462.00 | 1 | 602.0 | 2.5 | 1 | X |
| 1.5KE480A | 1.5KE480CA | 408.00 | 456.00 | 504.00 | 1 | 658.0 | 2.3 | 1 | |
| 1.5KE510A | 1.5KE510CA | 434.00 | 485.00 | 535.00 | 1 | 698.0 | 2.1 | 1 | |
| 1.5KE530A | 1.5KE530CA | 451.00 | 503.50 | 556.50 | 1 | 725.0 | 2.1 | 1 | |
| 1.5KE540A | 1.5KE540CA | 460.00 | 513.00 | 567.00 | 1 | 740.0 | 2.0 | 1 | |
| 1.5KE550A | 1.5KE550CA | 468.00 | 522.50 | 577.50 | 1 | 760.0 | 2.0 | 1 | |
| 1.5KE600A | 1.5KE600CA | 512.00 | 570.00 | 630.00 | 1 | 828.0 | 1.8 | 1 | |

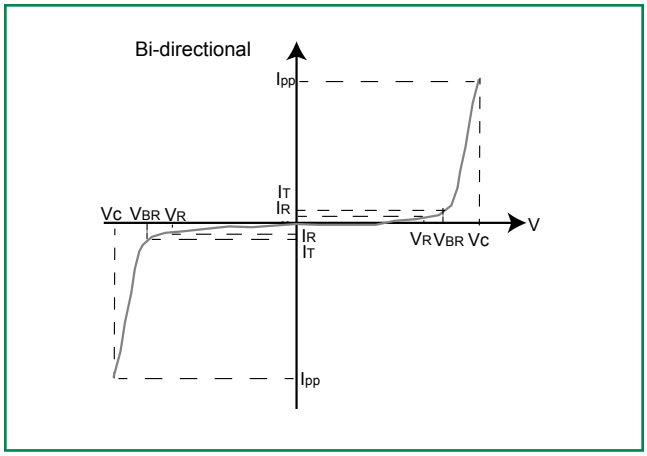
For bidirectional type having $V_R$ of 10 volts and less, the $I_R$ limit is double.

For parts without A, the $V_{BR}$ is ± 10% and $V_C$ is 5% higher than with A parts.

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## I-V Curve Characteristics

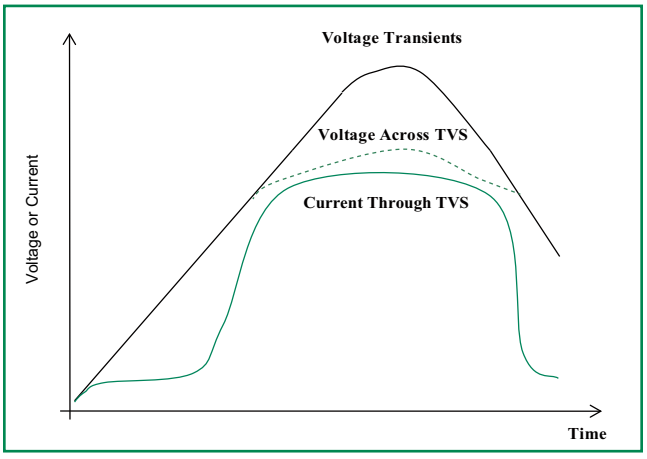


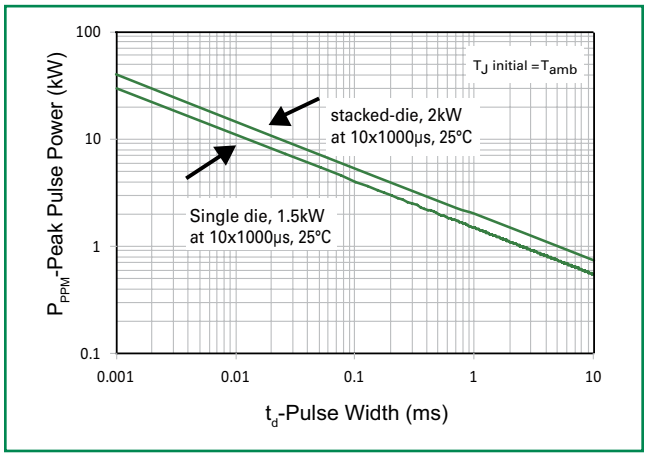

**$P_{PPM}$ Peak Pulse Power Dissipation** – Max power dissipation
**$V_R$ Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation
**$V_{BR}$ Breakdown Voltage** – Maximum voltage that flows though the TVS at a specified test current ($I_T$)
**$V_C$ Clamping Voltage** –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

### Figure 1 - TVS Transients Clamping Waveform




### Figure 2 - Peak Pulse Power Rating

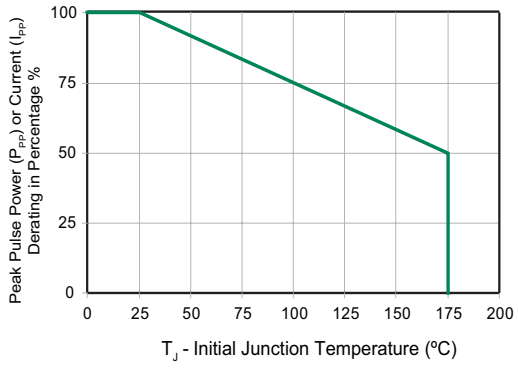



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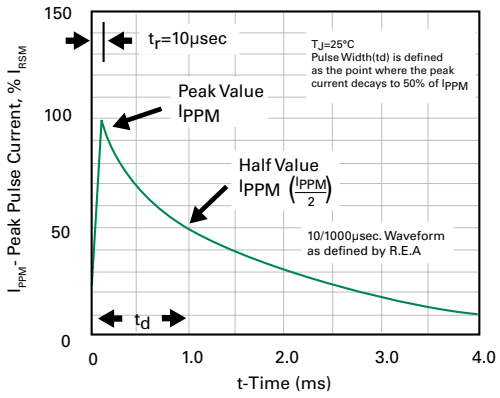
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## Ratings and Characteristic Curves ($T_A$=25°C unless otherwise noted) (Continued)

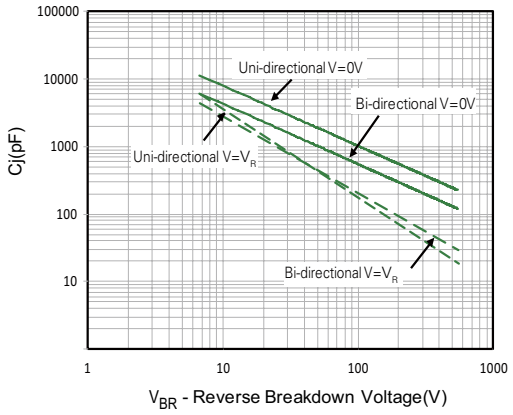
### Figure 3 - Peak Pulse Power Derating Curve



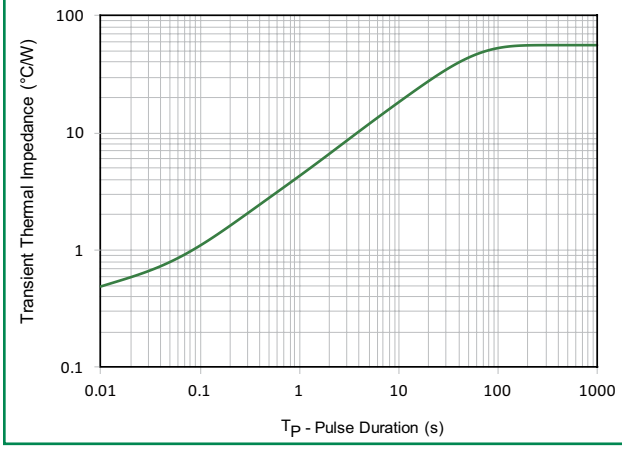

### Figure 4 - Pulse Waveform




### Figure 5 - Typical Junction Capacitance



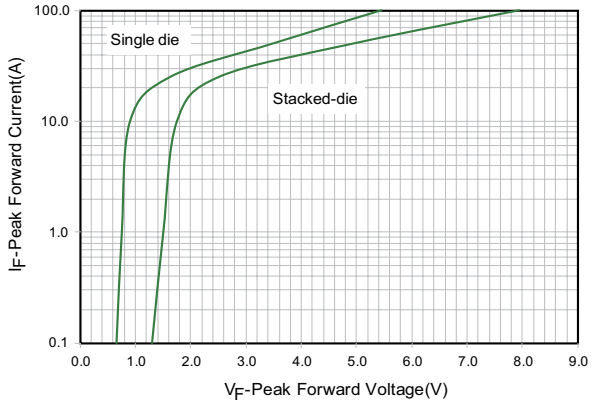

### Figure 6 - Typical Transient Thermal Impedance




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



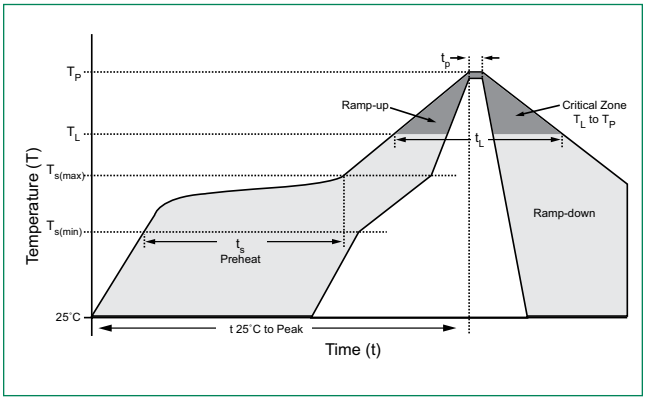

### Figure 8 - Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)




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## 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 ($T_A$) to peak | | 3°C/second max |
| $T_{S(max)}$ to $T_A$ - Ramp-up Rate | | 3°C/second max |
| Reflow | - Temperature ($T_A$) (Liquidus) | 217°C |
| | - Time (min to max) ($t_s$) | 60 – 150 seconds |
| Peak Temperature ($T_P$) | | $260^{+0/-5}$ °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 | | 260°C |




## Flow/Wave Soldering (Solder Dipping)

| | |
|---|---|
| **Peak Temperature :** | 265°C |
| **Dipping Time :** | 10 seconds |
| **Soldering :** | 1 time |

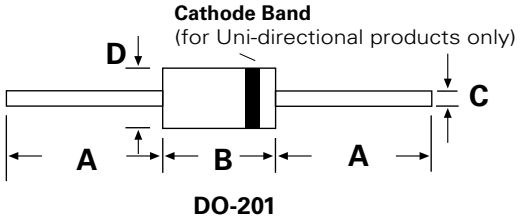
## Physical Specifications

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

## Environmental Specifications

| | |
|---|---|
| **High Temp. Storage** | JESD22-A103 |
| **HTRB** | JESD22-A108 |
| **Temperature Cycling** | JESD22-A104 |
| **H3TRB** | JESD22-A101 |
| **RSH** | JESD22-B106 |

## Dimensions




DO-201

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


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# Transient Voltage Suppression Diodes

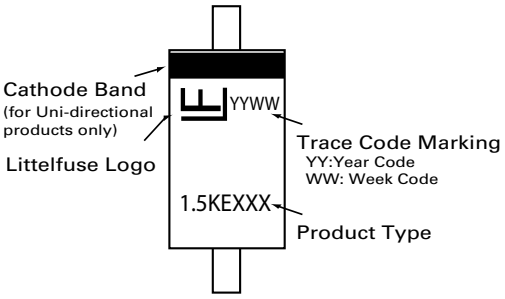
## Axial Leaded – 1500W > 1.5KE series

## Part Numbering System

**1.5KE xxx XX X**

- **OPTION CODE:**
  - **BLANK** Reel Tape
  - **-B** Bulk Packaging
- **TYPE CODE:**
  - **A** Uni-Directional (5% $V_{BR}$ Voltage Tolerance)
  - **CA** Bi-Directional (5% $V_{BR}$ Voltage Tolerance)
- **$V_{BR}$ VOLTAGE CODE**
  (Refer to the Electrical Characteristics table)
- **SERIES CODE**

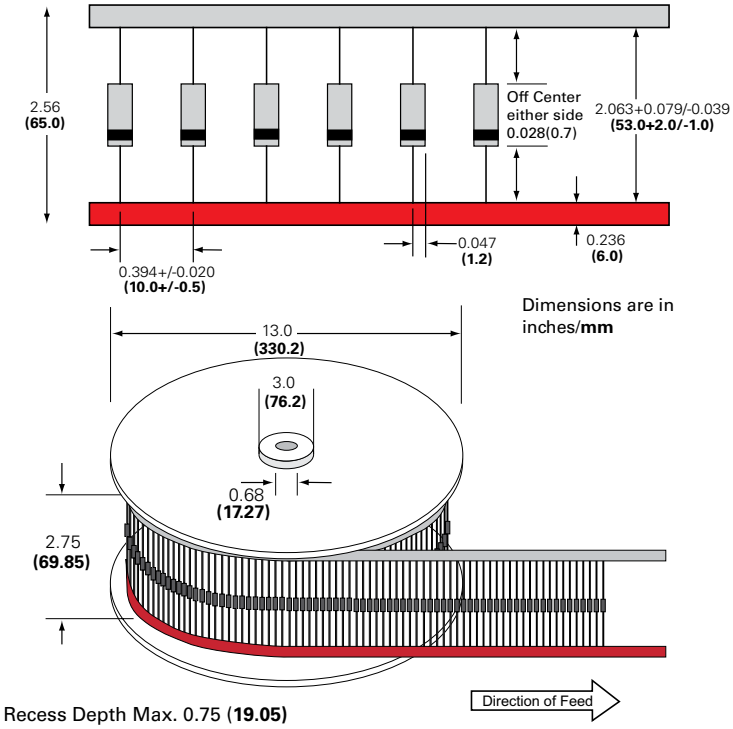
## Part Marking System




## 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




Recess Depth Max. 0.75 (**19.05**)

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