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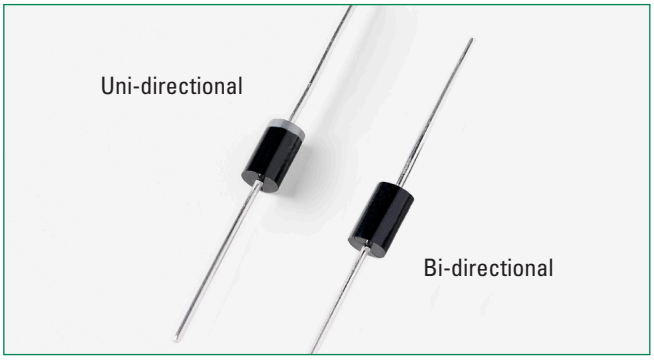
# TVS Diodes

## Axial Leaded – 1500W > TP1.5KE series

## TP1.5KE Series

AUTOMOTIVE GRADE HF RoHS




## Agency Approvals

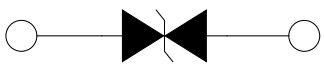
| Agency | Agency File Number |
|---|---|
| | E230531 |

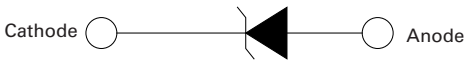
## Maximum Ratings and Thermal Characteristics ($T_A$=25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Peak Pulse Power Dissipation by 10/1000µs Test Waveform (Fig.2)(Note 1) | $P_{PPM}$ | 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 | V |
| Operating Junction Temperature Range | $T_J$ | -55 to 150 | °C |
| Storage Temperature Range | $T_{STG}$ | -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.

## Functional Diagram


Bi-directional



Uni-directional

## Description

The TP1.5KE 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 rev D qualified
- Glass passivated chip junction in DO-201 Package
- 1500W peak pulse capability at 10/1000µs waveform, repetition rate (duty cycles):0.01%
- 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
- High temperature to reflow soldering guaranteed: 260°C/10sec / 0.375",(9.5mm) lead length, 5 lbs., (2.3kg) tension
- $V_{BR}$ @ $T_J$= $V_{BR}$@25°C x (1+αT x ($T_J$ - 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, $V_{CC}$ bus and other vulnerable circuits used in telecom, computer, industrial and consumer electronic applications.

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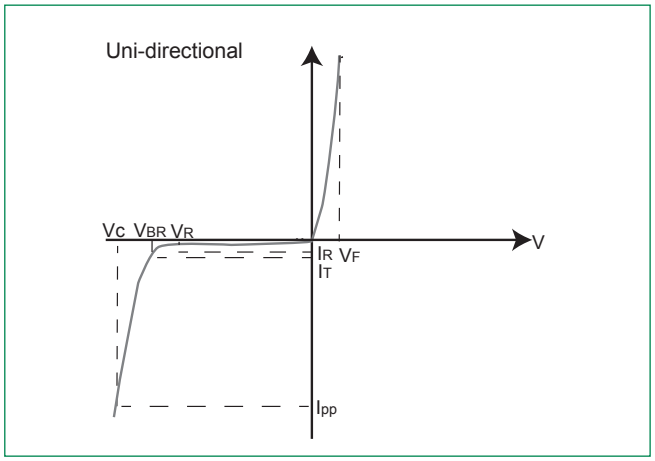
# TVS Diodes

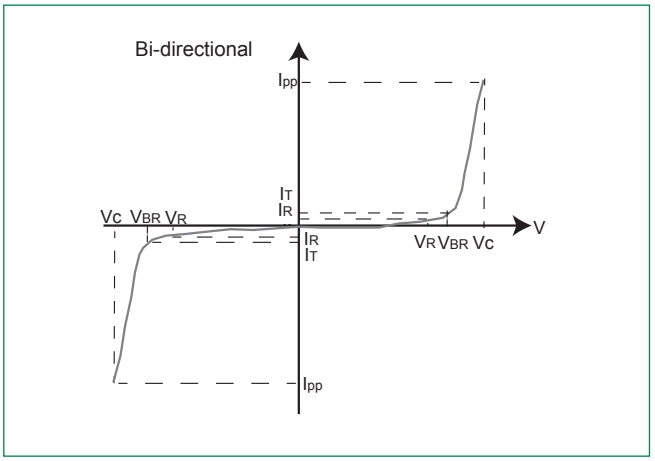
## Axial Leaded – 1500W > TP1.5KE series

## 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 | | | | | |
| TP1.5KE12A | TP1.5KE12CA | 10.20 | 11.40 | 12.60 | 1 | 16.7 | 91.0 | 5 | X |
| TP1.5KE13A | TP1.5KE13CA | 11.10 | 12.40 | 13.70 | 1 | 18.2 | 83.5 | 1 | X |
| TP1.5KE15A | TP1.5KE15CA | 12.80 | 14.30 | 15.80 | 1 | 21.2 | 71.7 | 1 | X |
| TP1.5KE16A | TP1.5KE16CA | 13.60 | 15.20 | 16.80 | 1 | 22.5 | 67.6 | 1 | X |
| TP1.5KE18A | TP1.5KE18CA | 15.30 | 17.10 | 18.90 | 1 | 25.2 | 60.3 | 1 | X |
| TP1.5KE20A | TP1.5KE20CA | 17.10 | 19.00 | 21.00 | 1 | 27.7 | 54.9 | 1 | X |
| TP1.5KE22A | TP1.5KE22CA | 18.80 | 20.90 | 23.10 | 1 | 30.6 | 49.7 | 1 | X |
| TP1.5KE24A | TP1.5KE24CA | 20.50 | 22.80 | 25.20 | 1 | 33.2 | 45.8 | 1 | X |
| TP1.5KE27A | TP1.5KE27CA | 23.10 | 25.70 | 28.40 | 1 | 37.5 | 40.5 | 1 | X |
| TP1.5KE30A | TP1.5KE30CA | 25.60 | 28.50 | 31.50 | 1 | 41.4 | 36.7 | 1 | X |
| TP1.5KE33A | TP1.5KE33CA | 28.20 | 31.40 | 34.70 | 1 | 45.7 | 33.3 | 1 | X |
| TP1.5KE36A | TP1.5KE36CA | 30.80 | 34.20 | 37.80 | 1 | 49.9 | 30.5 | 1 | X |
| TP1.5KE39A | TP1.5KE39CA | 33.30 | 37.10 | 41.00 | 1 | 53.9 | 28.2 | 1 | X |
| TP1.5KE43A | TP1.5KE43CA | 36.80 | 40.90 | 45.20 | 1 | 59.3 | 25.6 | 1 | X |
| TP1.5KE47A | TP1.5KE47CA | 40.20 | 44.70 | 49.40 | 1 | 64.8 | 23.5 | 1 | X |

## I-V Curve Characteristics




**$P_{PPM}$ Peak Pulse Power Dissipation** -- Max power dissipation
**$V_R$ Stand-off Voltage** -- Maximum voltage that can be applied to the TVS without operation
**$V_{BR}$ Breakdown Voltage** -- Maximum voltage that flows 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**

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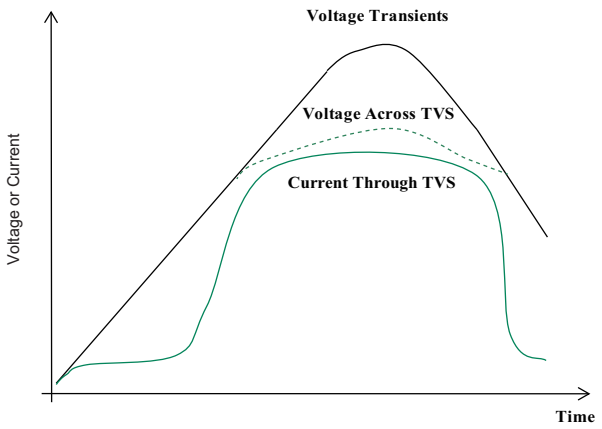
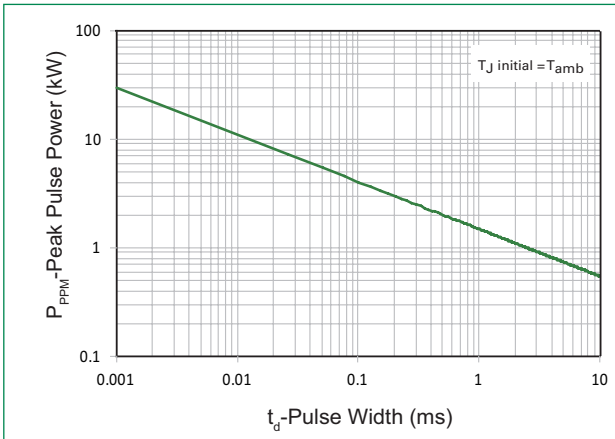
## Ratings and Characteristic Curves ($T_A$=25°C unless otherwise noted)

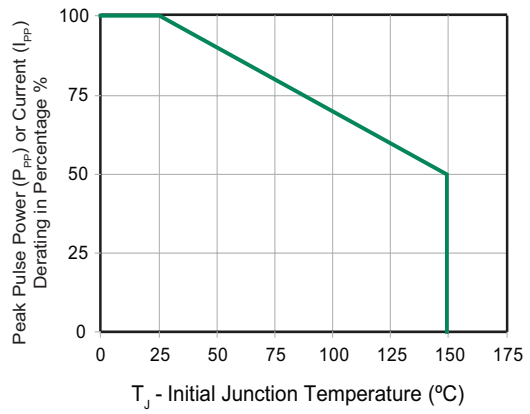
### Figure 1 - TVS Transients Clamping Waveform



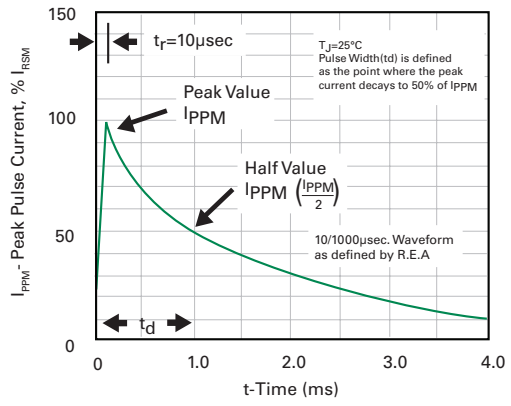

### Figure 2 - Peak Pulse Power Rating



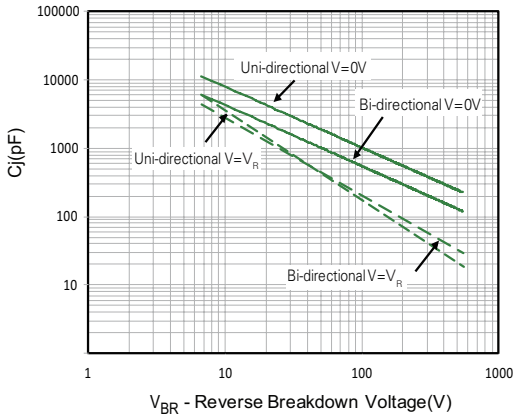

### Figure 3 - Peak Pulse Power Derating Curve



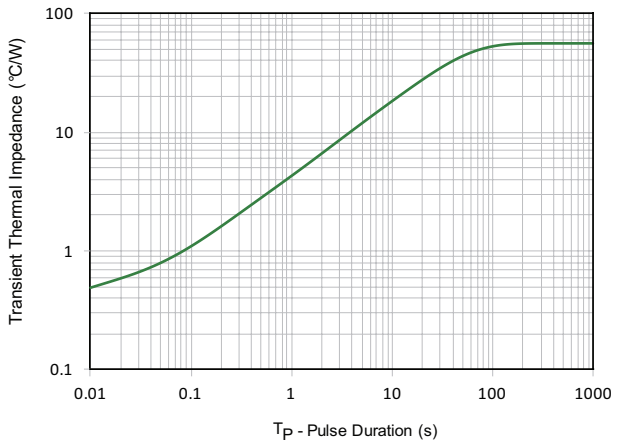

### Figure 4 - Pulse Waveform




### Figure 5 - Typical Junction Capacitance




### Figure 6 - Typical Transient Thermal Impedance

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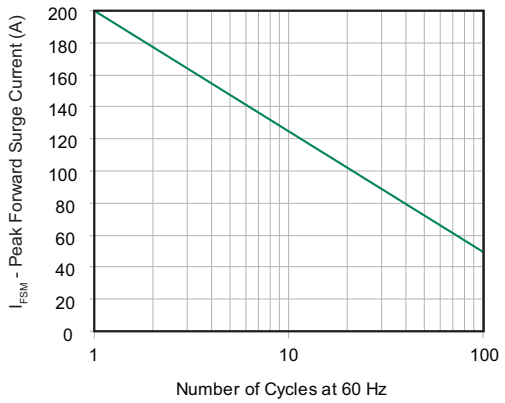
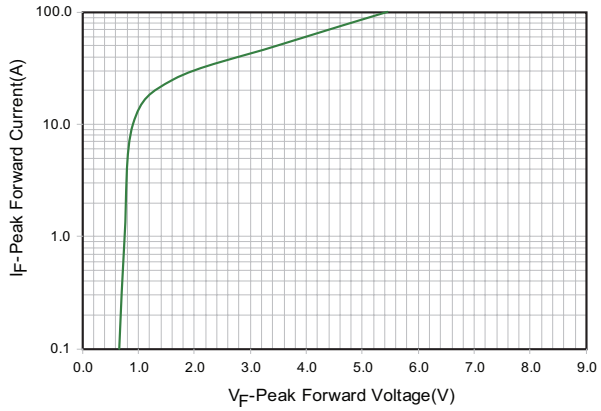
## Ratings and Characteristic Curves ($T_A$=25°C unless otherwise noted) (Continued)

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

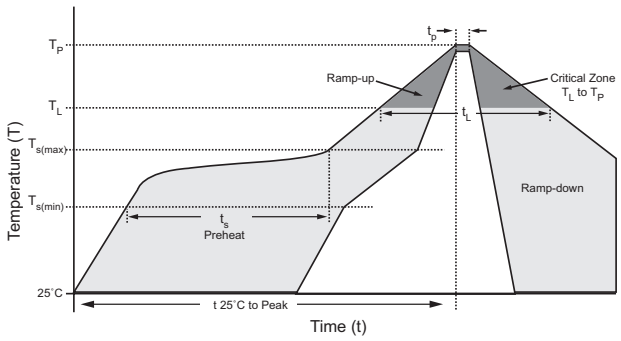



### Figure 8 - Peak Forward Voltage Drop vs Peak Forward Current (Typical Values)




## Soldering Parameters

| | | |
|---|---|---|
| **Reflow Condition** | | Lead–free assembly |
| **Pre Heat** | **- Temperature Min ($T_{s(min)}$)** | 150°C |
| | **- Temperature Max ($T_{s(max)}$)** | 200°C |
| | **- Time (min to max) ($t_s$)** | 60 – 120 secs |
| **Average ramp up rate (Liquidus Temp ($T_L$) to peak** | | 3°C/second max |
| **$T_{S(max)}$ to $T_L$ - Ramp-up Rate** | | 3°C/second max |
| **Reflow** | **- Temperature ($T_L$) (Liquidus)** | 217°C |
| | **- Time (min to max) ($t_L$)** | 60 – 150 seconds |
| **Peak Temperature ($T_P$)** | | $260^{+0/-5}$ °C |
| **Time within 5°C of actual peak Temperature ($t_p$)** | | 30 seconds max |
| **Ramp-down Rate** | | 6°C/second max |
| **Time 25°C to peak Temperature ($T_P$)** | | 8 minutes max. |
| **Do not exceed** | | 260°C |




## 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 |

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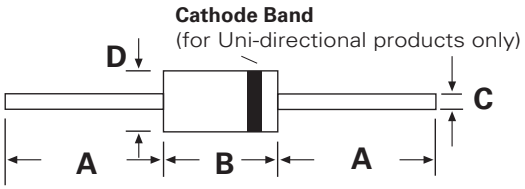
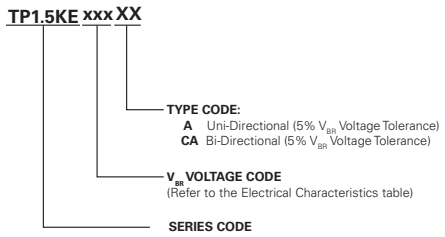
## Axial Leaded – 1500W > TP1.5KE series

## Dimensions

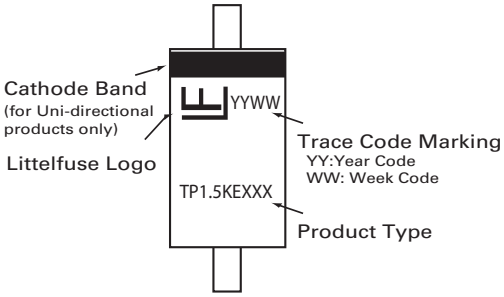



| Dimensions | Inches | | Millimeters | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.000 | - | 25.40 | - |
| B | 0.285 | 0.375 | 7.20 | 9.50 |
| C | 0.038 | 0.042 | 0.96 | 1.07 |
| D | 0.190 | 0.210 | 4.80 | 5.30 |

## Part Numbering System



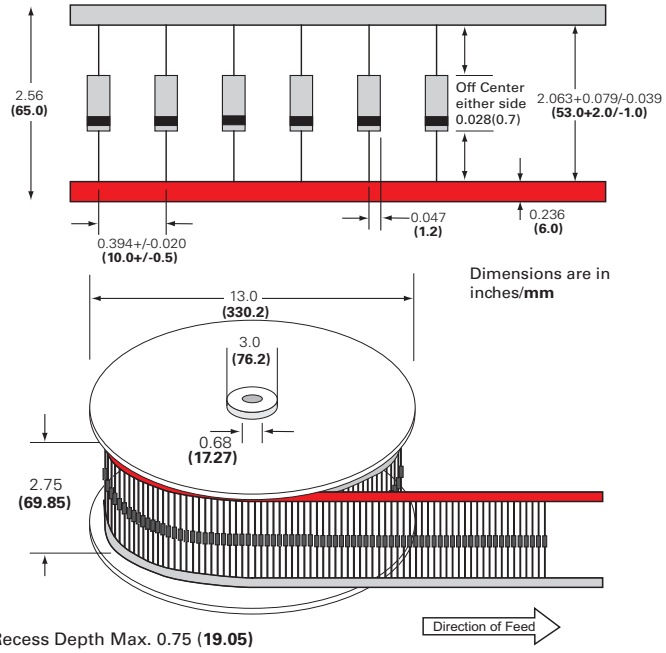

## Part Marking System




## Packaging

| Part Number | Component Package | Quantity | Packaging Option | Packaging Specification |
|---|---|---|---|---|
| TP1.5KExxxXX | DO-201 | 1200 | Tape & Reel | EIA STD RS-296 |

## Tape and Reel Specification




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

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