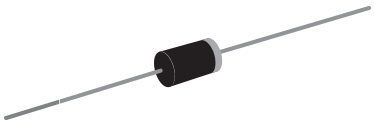
# TRANSZORB® Transient Voltage Suppressors



DO-204AC (DO-15)

## FEATURES

- Glass passivated chip junction
- Available in uni-directional and bi-directional
- 600 W peak pulse power capability with a 10/1000 µs waveform, repetitive rate (duty cycle): 0.01 %
- Excellent clamping capability
- Very fast response time
- Low incremental surge resistance
- Solder dip 260 °C, 40 s
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC

RoHS COMPLIANT

| PRIMARY CHARACTERISTICS | |
|---|---|
| $V_{BR}$ uni-directional | 6.8 V to 540 V |
| $V_{BR}$ bi-directional | 6.8 V to 440 V |
| $P_{PPM}$ | 600 W |
| $P_D$ | 5.0 W |
| $I_{FSM}$ (uni-directional only) | 100 A |
| $T_J$ max. | 175 °C |

## TYPICAL APPLICATIONS

Use in sensitive electronics protection against voltage transients induced by inductive load switching and lighting on ICs, MOSFET, signal lines of sensor units for consumer, computer, industrial, automotive and telecommunication.

## DEVICES FOR BI-DIRECTION APPLICATIONS

For bi-directional types, use C or CA suffix (e.g. P6KE440CA).

Electrical characteristics apply in both directions.

## MECHANICAL DATA

**Case:** DO-204AC, molded epoxy over passivated chip

Molding compound meets UL 94 V-0 flammability rating

Base P/N-E3 - RoHS compliant, commercial grade

Base P/NHE3 - RoHS compliant, high reliability/ automotive grade (AEC Q101 qualified)

**Terminals:** Matte tin plated leads, solderable per J-STD-002 and JESD22-B102

E3 suffix meets JESD 201 class 1A whisker test, HE3 suffix meets JESD 201 class 2 whisker test

**Note:**

- P6KE250 ~ P6KE540A and P6KE250C ~ P6KE440CA for commercial grade only

**Polarity:** For uni-directional types the color band denotes cathode end, no marking on bi-directional types

**MAXIMUM RATINGS** ($T_A$ = 25 °C unless otherwise noted)

| PARAMETER | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| Peak power dissipation with a 10/1000 µs waveform (1) (Fig. 1) | $P_{PPM}$ | 600 | W |
| Peak pulse current with a 10/1000 µs waveform (1) | $I_{PPM}$ | See next table | A |
| Power dissipation on infinite heatsink at $T_L$ = 75 °C (Fig. 5) | $P_D$ | 5.0 | W |
| Peak forward surge current, 8.3 ms single half sine-wave (2) | $I_{FSM}$ | 100 | A |
| Maximum instantaneous forward voltage at 50 A for uni-directional only (3) | $V_F$ | 3.5/5.0 | V |
| Operating junction and storage temperature range | $T_J$, $T_{STG}$ | - 55 to + 175 | °C |

**Notes:**

(1) Non-repetitive current pulse, per Fig. 3 and derated above $T_A$ = 25 °C per Fig. 2

(2) Measured on 8.3 ms single half sine-wave or equivalent square wave, duty cycle = 4 per minute maximum

(3) $V_F$ = 3.5 V for P6KE220(A) and below; $V_F$ = 5.0 V for P6KE250(A) and above

| **ELECTRICAL CHARACTERISTICS** ($T_A$ = 25 °C unless otherwise noted) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **DEVICE TYPE** | **BREAKDOWN VOLTAGE $V_{BR}$ AT $I_T$ (1) (V)** | | **TEST CURRENT $I_T$ (mA)** | **STAND-OFF VOLTAGE $V_{WM}$ (V)** | **MAXIMUM REVERSE LEAKAGE AT $V_{WM}$ (3) $I_D$ (µA)** | **PEAK PULSE CURRENT $I_{PPM}$ (2) (A)** | **MAXIMUM CLAMPING VOLTAGE AT $I_{PPM}$ $V_C$ (V)** | **MAXIMUM TEMPERATURE COEFFICIENT OF $V_{BR}$ (%/°C)** |
| | **MIN.** | **MAX.** | | | | | | |
| (+)P6KE6.8 | 6.12 | 7.48 | 10 | 5.50 | 1000 | 55.6 | 10.8 | 0.057 |
| (+)P6KE6.8A | 6.45 | 7.14 | 10 | 5.80 | 1000 | 57.1 | 10.5 | 0.057 |
| (+)P6KE7.5 | 6.75 | 8.25 | 10 | 6.05 | 500 | 51.3 | 11.7 | 0.061 |
| (+)P6KE7.5A | 7.13 | 7.88 | 10 | 6.40 | 500 | 53.1 | 11.3 | 0.061 |
| (+)P6KE8.2 | 7.38 | 9.02 | 10 | 6.63 | 200 | 48.0 | 12.5 | 0.065 |
| (+)P6KE8.2A | 7.79 | 8.61 | 10 | 7.02 | 200 | 49.6 | 12.1 | 0.065 |
| (+)P6KE9.1 | 8.19 | 10.0 | 1.0 | 7.37 | 50 | 43.5 | 13.8 | 0.068 |
| (+)P6KE9.1A | 8.65 | 9.55 | 1.0 | 7.78 | 50 | 44.8 | 13.4 | 0.068 |
| (+)P6KE10 | 9.00 | 11.0 | 1.0 | 8.10 | 10 | 40.0 | 15.0 | 0.073 |
| (+)P6KE10A | 9.50 | 10.5 | 1.0 | 8.55 | 10 | 41.4 | 14.5 | 0.073 |
| (+)P6KE11 | 9.90 | 12.1 | 1.0 | 8.92 | 5.0 | 37.0 | 16.2 | 0.075 |
| (+)P6KE11A | 10.5 | 11.6 | 1.0 | 9.40 | 5.0 | 38.5 | 15.6 | 0.075 |
| (+)P6KE12 | 10.8 | 13.2 | 1.0 | 9.72 | 5.0 | 34.7 | 17.3 | 0.078 |
| (+)P6KE12A | 11.4 | 12.6 | 1.0 | 10.2 | 5.0 | 35.9 | 16.7 | 0.078 |
| (+)P6KE13 | 11.7 | 14.3 | 1.0 | 10.5 | 5.0 | 31.6 | 19.0 | 0.081 |
| (+)P6KE13A | 12.4 | 13.7 | 1.0 | 11.1 | 5.0 | 33.0 | 18.2 | 0.081 |
| (+)P6KE15 | 13.5 | 16.5 | 1.0 | 12.1 | 1.0 | 27.3 | 22.0 | 0.084 |
| (+)P6KE15A | 14.3 | 15.8 | 1.0 | 12.8 | 1.0 | 28.3 | 21.2 | 0.084 |
| (+)P6KE16 | 14.4 | 17.6 | 1.0 | 12.9 | 1.0 | 25.5 | 23.5 | 0.086 |
| (+)P6KE16A | 15.2 | 16.8 | 1.0 | 13.6 | 1.0 | 26.7 | 22.5 | 0.086 |
| (+)P6KE18 | 16.2 | 19.8 | 1.0 | 14.5 | 1.0 | 22.6 | 26.5 | 0.088 |
| (+)P6KE18A | 17.1 | 18.9 | 1.0 | 15.3 | 1.0 | 23.8 | 25.2 | 0.088 |
| (+)P6KE20 | 18.0 | 22.0 | 1.0 | 16.2 | 1.0 | 20.6 | 29.1 | 0.090 |
| (+)P6KE20A | 19.0 | 21.0 | 1.0 | 17.1 | 1.0 | 21.7 | 27.7 | 0.090 |
| (+)P6KE22 | 19.8 | 24.2 | 1.0 | 17.8 | 1.0 | 18.8 | 31.9 | 0.092 |
| (+)P6KE22A | 20.9 | 23.1 | 1.0 | 18.8 | 1.0 | 19.6 | 30.6 | 0.092 |
| (+)P6KE24 | 21.6 | 26.4 | 1.0 | 19.4 | 1.0 | 17.3 | 34.7 | 0.094 |
| (+)P6KE24A | 22.8 | 25.2 | 1.0 | 20.5 | 1.0 | 18.1 | 33.2 | 0.094 |
| (+)P6KE27 | 24.3 | 29.7 | 1.0 | 21.8 | 1.0 | 15.3 | 39.1 | 0.096 |
| (+)P6KE27A | 25.7 | 28.4 | 1.0 | 23.1 | 1.0 | 16.0 | 37.5 | 0.096 |
| (+)P6KE30 | 27.0 | 33.0 | 1.0 | 24.3 | 1.0 | 13.8 | 43.5 | 0.097 |
| (+)P6KE30A | 28.5 | 31.5 | 1.0 | 25.6 | 1.0 | 14.5 | 41.4 | 0.097 |
| (+)P6KE33 | 29.7 | 36.3 | 1.0 | 26.8 | 1.0 | 12.6 | 47.7 | 0.098 |
| (+)P6KE33A | 31.4 | 34.7 | 1.0 | 28.2 | 1.0 | 13.1 | 45.7 | 0.098 |
| (+)P6KE36 | 32.4 | 39.6 | 1.0 | 29.1 | 1.0 | 11.5 | 52.0 | 0.099 |
| (+)P6KE36A | 34.2 | 37.8 | 1.0 | 30.8 | 1.0 | 12.0 | 49.9 | 0.099 |
| (+)P6KE39 | 35.1 | 42.9 | 1.0 | 31.6 | 1.0 | 10.6 | 56.4 | 0.100 |
| (+)P6KE39A | 37.1 | 41.0 | 1.0 | 33.3 | 1.0 | 11.1 | 53.9 | 0.100 |
| (+)P6KE43 | 38.7 | 47.3 | 1.0 | 34.8 | 1.0 | 9.7 | 61.9 | 0.101 |
| (+)P6KE43A | 40.9 | 45.2 | 1.0 | 36.8 | 1.0 | 10.1 | 59.3 | 0.101 |
| (+)P6KE47 | 42.3 | 51.7 | 1.0 | 38.1 | 1.0 | 8.8 | 67.8 | 0.101 |
| (+)P6KE47A | 44.7 | 49.4 | 1.0 | 40.2 | 1.0 | 9.3 | 64.8 | 0.101 |

| **ELECTRICAL CHARACTERISTICS** ($T_A$ = 25 °C unless otherwise noted) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **DEVICE TYPE** | **BREAKDOWN VOLTAGE $V_{BR}$ AT $I_T$ (1) (V)** | | **TEST CURRENT $I_T$ (mA)** | **STAND-OFF VOLTAGE $V_{WM}$ (V)** | **MAXIMUM REVERSE LEAKAGE AT $V_{WM}$ (3) $I_D$ (µA)** | **PEAK PULSE CURRENT $I_{PPM}$ (2) (A)** | **MAXIMUM CLAMPING VOLTAGE AT $I_{PPM}$ $V_C$ (V)** | **MAXIMUM TEMPERATURE COEFFICIENT OF $V_{BR}$ (%/°C)** |
| | **MIN.** | **MAX.** | | | | | | |
| (+)P6KE51 | 45.9 | 56.1 | 1.0 | 41.3 | 1.0 | 8.2 | 73.5 | 0.102 |
| (+)P6KE51A | 48.5 | 53.6 | 1.0 | 43.6 | 1.0 | 8.6 | 70.1 | 0.102 |
| (+)P6KE56 | 50.4 | 61.6 | 1.0 | 45.4 | 1.0 | 7.5 | 80.5 | 0.103 |
| (+)P6KE56A | 53.2 | 58.8 | 1.0 | 47.8 | 1.0 | 7.8 | 77.0 | 0.103 |
| (+)P6KE62 | 55.8 | 68.2 | 1.0 | 50.2 | 1.0 | 6.7 | 89.0 | 0.104 |
| (+)P6KE62A | 58.9 | 65.1 | 1.0 | 53.0 | 1.0 | 7.1 | 85.0 | 0.104 |
| (+)P6KE68 | 61.2 | 74.8 | 1.0 | 55.1 | 1.0 | 6.1 | 98.0 | 0.104 |
| (+)P6KE68A | 64.6 | 71.4 | 1.0 | 58.1 | 1.0 | 6.5 | 92.0 | 0.104 |
| (+)P6KE75 | 67.5 | 82.5 | 1.0 | 60.7 | 1.0 | 5.6 | 108 | 0.105 |
| (+)P6KE75A | 71.3 | 78.8 | 1.0 | 64.1 | 1.0 | 5.8 | 103 | 0.105 |
| (+)P6KE82 | 73.8 | 90.2 | 1.0 | 66.4 | 1.0 | 5.1 | 118 | 0.105 |
| (+)P6KE82A | 77.9 | 86.1 | 1.0 | 70.1 | 1.0 | 5.3 | 113 | 0.105 |
| (+)P6KE91 | 81.9 | 100 | 1.0 | 73.7 | 1.0 | 4.6 | 131 | 0.106 |
| (+)P6KE91A | 86.5 | 95.5 | 1.0 | 77.8 | 1.0 | 4.8 | 125 | 0.106 |
| (+)P6KE100 | 90.0 | 110 | 1.0 | 81.0 | 1.0 | 4.2 | 144 | 0.106 |
| (+)P6KE100A | 95.0 | 105 | 1.0 | 85.5 | 1.0 | 4.4 | 137 | 0.106 |
| (+)P6KE110 | 99.0 | 121 | 1.0 | 89.2 | 1.0 | 3.8 | 158 | 0.107 |
| (+)P6KE110A | 105 | 116 | 1.0 | 94.0 | 1.0 | 3.9 | 152 | 0.107 |
| (+)P6KE120 | 108 | 132 | 1.0 | 97.2 | 1.0 | 3.5 | 173 | 0.107 |
| (+)P6KE120A | 114 | 126 | 1.0 | 102 | 1.0 | 3.6 | 165 | 0.107 |
| (+)P6KE130 | 117 | 143 | 1.0 | 105 | 1.0 | 3.2 | 187 | 0.107 |
| (+)P6KE130A | 124 | 137 | 1.0 | 111 | 1.0 | 3.4 | 179 | 0.107 |
| (+)P6KE150 | 135 | 165 | 1.0 | 121 | 1.0 | 2.8 | 215 | 0.108 |
| (+)P6KE150A | 143 | 158 | 1.0 | 128 | 1.0 | 2.9 | 207 | 0.108 |
| (+)P6KE160 | 144 | 176 | 1.0 | 130 | 1.0 | 2.6 | 230 | 0.108 |
| (+)P6KE160A | 152 | 168 | 1.0 | 136 | 1.0 | 2.7 | 219 | 0.108 |
| (+)P6KE170 | 153 | 187 | 1.0 | 138 | 1.0 | 2.5 | 244 | 0.108 |
| (+)P6KE170A | 162 | 179 | 1.0 | 145 | 1.0 | 2.6 | 234 | 0.108 |
| (+)P6KE180 | 162 | 198 | 1.0 | 146 | 1.0 | 2.3 | 258 | 0.108 |
| (+)P6KE180A | 171 | 189 | 1.0 | 154 | 1.0 | 2.4 | 246 | 0.108 |
| (+)P6KE200 | 180 | 220 | 1.0 | 162 | 1.0 | 2.1 | 287 | 0.108 |
| (+)P6KE200A | 190 | 210 | 1.0 | 171 | 1.0 | 2.2 | 274 | 0.108 |
| (+)P6KE220 | 198 | 242 | 1.0 | 175 | 1.0 | 1.7 | 344 | 0.108 |
| (+)P6KE220A | 209 | 231 | 1.0 | 185 | 1.0 | 1.8 | 328 | 0.108 |
| (+)P6KE250 | 225 | 275 | 1.0 | 202 | 1.0 | 1.7 | 360 | 0.110 |
| (+)P6KE250A | 237 | 263 | 1.0 | 214 | 1.0 | 1.7 | 344 | 0.110 |
| (+)P6KE300 | 270 | 330 | 1.0 | 243 | 1.0 | 1.4 | 430 | 0.110 |
| (+)P6KE300A | 285 | 315 | 1.0 | 256 | 1.0 | 1.4 | 414 | 0.110 |
| (+)P6KE350 | 315 | 385 | 1.0 | 284 | 1.0 | 1.2 | 504 | 0.110 |
| (+)P6KE350A | 333 | 368 | 1.0 | 300 | 1.0 | 1.2 | 482 | 0.110 |
| (+)P6KE400 | 360 | 440 | 1.0 | 324 | 1.0 | 1.0 | 574 | 0.110 |
| (+)P6KE400A | 380 | 420 | 1.0 | 342 | 1.0 | 1.1 | 548 | 0.110 |

| **ELECTRICAL CHARACTERISTICS** ($T_A$ = 25 °C unless otherwise noted) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **DEVICE TYPE** | **BREAKDOWN VOLTAGE $V_{BR}$ AT $I_T$ (1) (V)** | | **TEST CURRENT $I_T$ (mA)** | **STAND-OFF VOLTAGE $V_{WM}$ (V)** | **MAXIMUM REVERSE LEAKAGE AT $V_{WM}$ (3) $I_D$ (µA)** | **PEAK PULSE CURRENT $I_{PPM}$ (2) (A)** | **MAXIMUM CLAMPING VOLTAGE AT $I_{PPM}$ $V_C$ (V)** | **MAXIMUM TEMPERATURE COEFFICIENT OF $V_{BR}$ (%/°C)** |
| | **MIN.** | **MAX.** | | | | | | |
| (+)P6KE440 | 396 | 484 | 1.0 | 356 | 1.0 | 0.95 | 631 | 0.110 |
| (+)P6KE440A | 418 | 462 | 1.0 | 376 | 1.0 | 1.00 | 602 | 0.110 |
| P6KE480 | 432 | 528 | 1.0 | 389 | 1.0 | 0.88 | 686 | 0.110 |
| P6KE480A | 456 | 504 | 1.0 | 408 | 1.0 | 0.91 | 658 | 0.110 |
| P6KE510 | 459 | 561 | 1.0 | 413 | 1.0 | 0.82 | 729 | 0.110 |
| P6KE510A | 485 | 535 | 1.0 | 434 | 1.0 | 0.86 | 698 | 0.110 |
| P6KE540 | 486 | 594 | 1.0 | 437 | 1.0 | 0.78 | 772 | 0.110 |
| P6KE540A | 513 | 567 | 1.0 | 459 | 1.0 | 0.81 | 740 | 0.110 |

**Notes:**

(1) Pulse test: $t_p \leq 50$ ms

(2) Surge current waveform per Fig. 3 and derate per Fig. 2ogm

(3) For bi-directional types with $V_{WM}$ of 10 V and less, the $I_D$ limit is doubled

(4) All terms and symbols are consistent with ANSI/IEEE C62.35

(+) Underwriters laboratory recognition for the classification of protectors (QVGQ2) under the UL standard for safety 497B and file number E136766 for both uni-directional and bi-directional devices

| **THERMAL CHARACTERISTICS** ($T_A$ = 25 °C unless otherwise noted) | | | |
|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **VALUE** | **UNIT** |
| Typical thermal resistance, junction to lead | $R_{\theta JL}$ | 20 | °C/W |
| Typical thermal resistance, junction to ambient | $R_{\theta JA}$ | 75 | °C/W |

| **ORDERING INFORMATION** (Example) | | | | |
|---|---|---|---|---|
| **PREFERRED P/N** | **UNIT WEIGHT (g)** | **PREFERRED PACKAGE CODE** | **BASE QUANTITY** | **DELIVERY MODE** |
| P6KE6.8A-E3/54 | 0.432 | 54 | 4000 | 13" diameter paper tape and reel |
| P6KE6.8AHE3/54 (1) | 0.432 | 54 | 4000 | 13" diameter paper tape and reel |

**Note:**

(1) Automotive grade AEC-Q101 qualified

## RATINGS AND CHARACTERISTICS CURVES

($T_A$ = 25 °C unless otherwise noted)

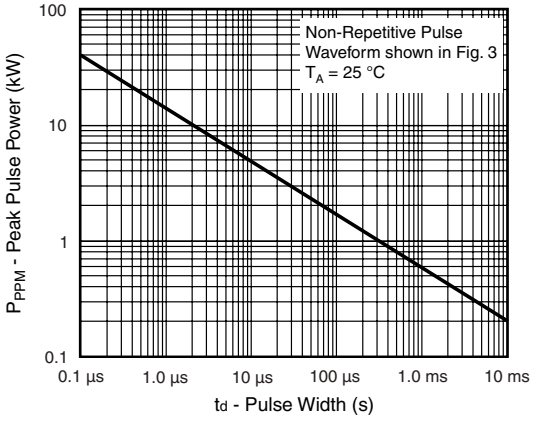



Figure 1. Peak Pulse Power Rating Curve

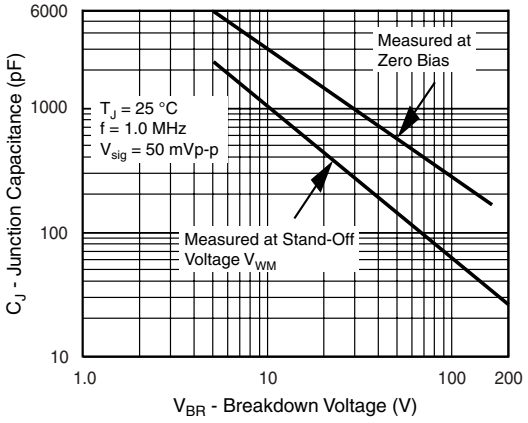



Figure 4. Typical Junction Capacitance Uni-Directional

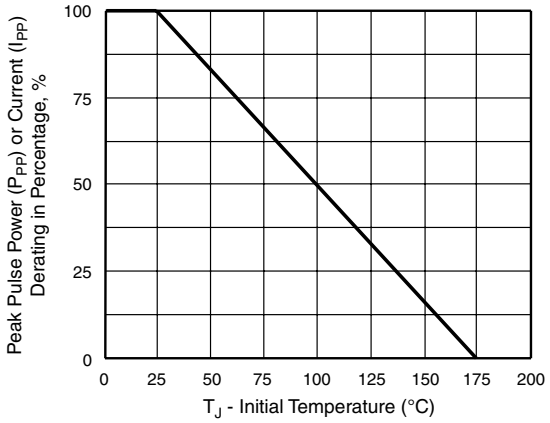



Figure 2. Pulse Power or Current vs. Initial Junction Temperature

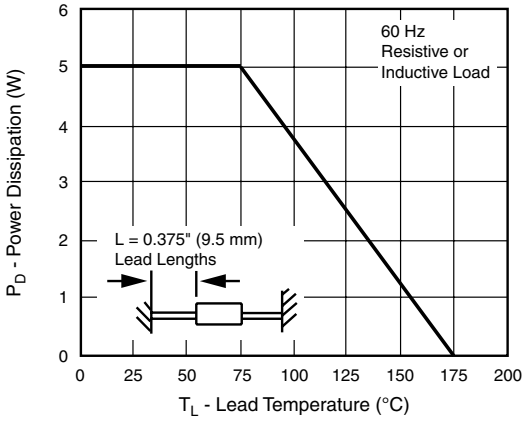



Figure 5. Power Derating Curve

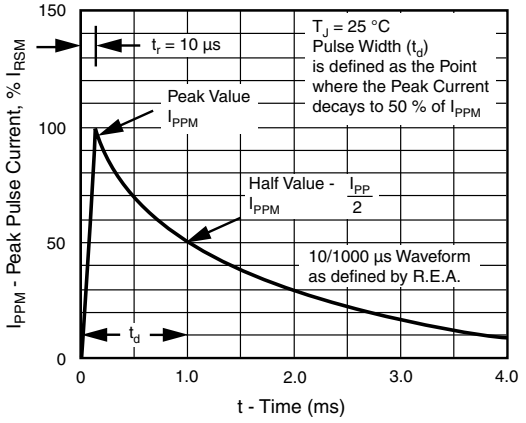



Figure 3. Pulse Waveform

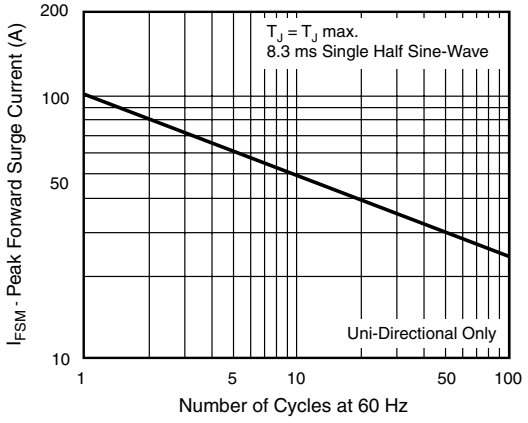



Figure 6. Maximum Non-Repetitive Forward Surge Current

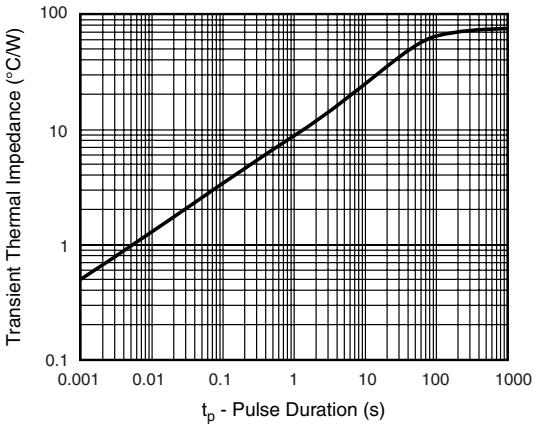
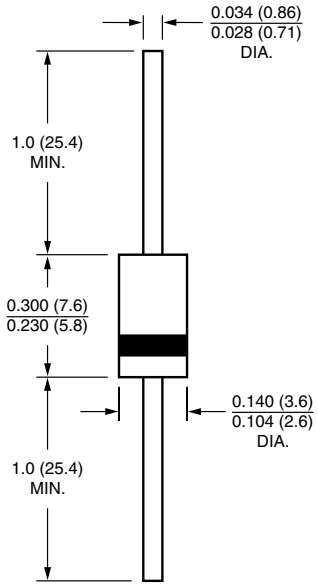



Figure 7. Typical Transient Thermal Impedance

## PACKAGE OUTLINE DIMENSIONS in inches (millimeters)

**DO-204AC (DO-15)**




## APPLICATION NOTE

This P6KE TVS series is a low cost commercial product for use in applications where large voltage transients can permanently damage voltage-sensitive components.

The P6KE series device types are designed in a small package size where power and space is a consideration. They are characterized by their high surge capability, extremely fast response time, and low impedance, ($R_{on}$). Because of the unpredictable nature of transients, and the variation of the impedance with respect to these transients, impedance, per se, is not specified as a parametric value. However, a minimum voltage at low current conditions (BV) and a maximum clamping voltage ($V_c$) at a maximum peak pulse current is specified.

In some instances, the thermal effect (see $V_c$ Clamping Voltage) may be responsible for 50 % to 70 %. of the observed voltage differential when subjected to high current pulses for several duty cycles, thus making a maximum impedance specification insignificant.

In case of a severe current overload or abnormal transient beyond the maximum ratings, the Transient Voltage Suppressor will initially fail 'short' thus tripping the system's circuit breaker or fuse while protecting the entire circuit. Curves depicting clamping voltage vs. various current pulses are available from the factory. Extended power curves vs. pulse time are also available.

# Disclaimer

All product specifications and data are subject to change without notice.

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