

TRANSZORB® Transient Voltage Suppressors



Case Style 1.5KE

| PRIMARY CHARACTERISTICS | |
|----------------------------------|----------------|
| V_{BR} uni-directional | 6.8 V to 540 V |
| V_{BR} bi-directional | 6.8 V to 440 V |
| P_{PPM} | 1500 W |
| P_D | 6.5 W |
| I_{FSM} (uni-directional only) | 200 A |
| T_J max. | 175 °C |

DEVICES FOR BI-DIRECTION APPLICATIONS

For bi-directional types, use C or CA suffix (e.g. 1.5KE440CA).

Electrical characteristics apply in both directions.

FEATURES

- Glass passivated chip junction
- Available in uni-directional and bi-directional
- 1500 W peak pulse power capability with a 10/1000 μ s 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

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.

MECHANICAL DATA

Case: Molded epoxy body over passivated junction
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:

- 1.5KE250 ~ 1.5KE540A and 1.5KE250C ~ 1.5KE440CA 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 | LIMIT | UNIT |
| Peak pulse power dissipation with a 10/1000 μ s waveform ⁽¹⁾ (Fig. 1) | P_{PPM} | 1500 | W |
| Peak pulse current with a 10/1000 μ s waveform ⁽¹⁾ | I_{PPM} | See next table | A |
| Power dissipation on infinite heatsink at $T_L = 75$ °C (Fig. 5) | P_D | 6.5 | W |
| Peak forward surge current 8.3 ms single half sine-wave uni-directional only ⁽²⁾ | I_{FSM} | 200 | A |
| Maximum instantaneous forward voltage at 100 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 pulses per minute maximum

(3) $V_F = 3.5$ V for 1.5KE220 (A) and below; $V_F = 5.0$ V for 1.5KE250(A) and above

1.5KE6.8 thru 1.5KE540A, 1N6267 thru 1N6303



Vishay General Semiconductor

| ELECTRICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted) | | | | | | | | | |
|--|-----------------------------------|--|------|-------------------------|--------------------------------|--|---|---|---|
| JEDEC TYPE NUMBER | GENERAL SEMICONDUCTOR PART NUMBER | 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} I_D ⁽⁴⁾ (μA) | MAXIMUM PEAK PULSE CURRENT I_{PPM} ⁽²⁾ (A) | MAXIMUM CLAMPING VOLTAGE AT I_{PPM} V_C (V) | MAXIMUM TEMP. COEFFICIENT OF V_{BR} ($\%/^\circ\text{C}$) |
| | | MIN. | MAX. | | | | | | |
| 1N6267 | (+)1.5KE6.8 | 6.12 | 7.48 | 10 | 5.50 | 1000 | 139 | 10.8 | 0.057 |
| 1N6267A | (+)1.5KE6.8A | 6.45 | 7.14 | 10 | 5.80 | 1000 | 143 | 10.5 | 0.057 |
| 1N6268 | (+)1.5KE7.5 | 6.75 | 8.25 | 10 | 6.05 | 500 | 128 | 11.7 | 0.061 |
| 1N6268A | (+)1.5KE7.5A | 7.13 | 7.88 | 10 | 6.40 | 500 | 133 | 11.3 | 0.061 |
| 1N6269 | (+)1.5KE8.2 | 7.38 | 9.02 | 10 | 6.63 | 200 | 120 | 12.5 | 0.065 |
| 1N6269A | (+)1.5KE8.2A | 7.79 | 8.61 | 10 | 7.02 | 200 | 124 | 12.1 | 0.065 |
| 1N6270 | (+)1.5KE9.1 | 8.19 | 10.0 | 1.0 | 7.37 | 50 | 109 | 13.8 | 0.068 |
| 1N6270A | (+)1.5KE9.1A | 8.65 | 9.55 | 1.0 | 7.78 | 50 | 112 | 13.4 | 0.068 |
| 1N6271 | (+)1.5KE10 | 9.00 | 11.0 | 1.0 | 8.10 | 10 | 100 | 15.0 | 0.073 |
| 1N6271A | (+)1.5KE10A | 9.50 | 10.5 | 1.0 | 8.55 | 10 | 103 | 14.5 | 0.073 |
| 1N6272 | (+)1.5KE11 | 9.90 | 12.1 | 1.0 | 8.92 | 5.0 | 92.6 | 16.2 | 0.075 |
| 1N6272A | (+)1.5KE11A | 10.5 | 11.6 | 1.0 | 9.40 | 5.0 | 96.2 | 15.6 | 0.075 |
| 1N6273 | (+)1.5KE12 | 10.8 | 13.2 | 1.0 | 9.72 | 5.0 | 86.7 | 17.3 | 0.076 |
| 1N6273A | (+)1.5KE12A | 11.4 | 12.6 | 1.0 | 10.2 | 5.0 | 89.8 | 16.7 | 0.078 |
| 1N6274 | (+)1.5KE13 | 11.7 | 14.3 | 1.0 | 10.5 | 5.0 | 78.9 | 19.0 | 0.081 |
| 1N6274A | (+)1.5KE13A | 12.4 | 13.7 | 1.0 | 11.1 | 5.0 | 82.4 | 18.2 | 0.081 |
| 1N6275 | (+)1.5KE15 | 13.5 | 16.5 | 1.0 | 12.1 | 1.0 | 68.2 | 22.0 | 0.084 |
| 1N6275A | (+)1.5KE15A | 14.3 | 15.8 | 1.0 | 12.8 | 1.0 | 70.8 | 21.2 | 0.084 |
| 1N6276 | (+)1.5KE16 | 14.4 | 17.6 | 1.0 | 12.9 | 1.0 | 63.8 | 23.5 | 0.086 |
| 1N6276A | (+)1.5KE16A | 15.2 | 16.8 | 1.0 | 13.6 | 1.0 | 66.7 | 22.5 | 0.086 |
| 1N6277 | (+)1.5KE18 | 16.2 | 19.8 | 1.0 | 14.5 | 1.0 | 56.6 | 26.5 | 0.088 |
| 1N6277A | (+)1.5KE18A | 17.1 | 18.9 | 1.0 | 15.3 | 1.0 | 59.5 | 25.2 | 0.089 |
| 1N6278 | (+)1.5KE20 | 18.0 | 22.0 | 1.0 | 16.2 | 1.0 | 51.5 | 29.1 | 0.090 |
| 1N6278A | (+)1.5KE20A | 19.0 | 21.0 | 1.0 | 17.1 | 1.0 | 54.2 | 27.7 | 0.090 |
| 1N6279 | (+)1.5KE22 | 19.8 | 24.2 | 1.0 | 17.8 | 1.0 | 47.0 | 31.9 | 0.092 |
| 1N6279A | (+)1.5KE22A | 20.9 | 23.1 | 1.0 | 18.8 | 1.0 | 49.0 | 30.6 | 0.092 |
| 1N6280 | (+)1.5KE24 | 21.6 | 26.4 | 1.0 | 19.4 | 1.0 | 43.2 | 34.7 | 0.094 |
| 1N6280A | (+)1.5KE24A | 22.8 | 25.2 | 1.0 | 20.5 | 1.0 | 45.2 | 33.2 | 0.094 |
| 1N6281 | (+)1.5KE27 | 24.3 | 29.7 | 1.0 | 21.8 | 1.0 | 38.4 | 39.1 | 0.096 |
| 1N6281A | (+)1.5KE27A | 25.7 | 28.4 | 1.0 | 23.1 | 1.0 | 40.0 | 37.5 | 0.096 |
| 1N6282 | (+)1.5KE30 | 27.0 | 33.0 | 1.0 | 24.3 | 1.0 | 34.5 | 43.5 | 0.097 |
| 1N6282A | (+)1.5KE30A | 28.5 | 31.5 | 1.0 | 25.6 | 1.0 | 36.2 | 41.4 | 0.097 |
| 1N6283 | (+)1.5KE33 | 29.7 | 36.3 | 1.0 | 26.8 | 1.0 | 31.4 | 47.7 | 0.098 |
| 1N6283A | (+)1.5KE33A | 31.4 | 34.7 | 1.0 | 28.2 | 1.0 | 32.8 | 45.7 | 0.098 |
| 1N6284 | (+)1.5KE36 | 32.4 | 39.6 | 1.0 | 29.1 | 1.0 | 28.8 | 52.0 | 0.099 |
| 1N6284A | (+)1.5KE36A | 34.2 | 37.8 | 1.0 | 30.8 | 1.0 | 30.1 | 49.9 | 0.099 |
| 1N6285 | (+)1.5KE39 | 35.1 | 42.9 | 1.0 | 31.6 | 1.0 | 26.6 | 56.4 | 0.100 |
| 1N6285A | (+)1.5KE39A | 37.1 | 41.0 | 1.0 | 33.3 | 1.0 | 27.8 | 53.9 | 0.100 |
| 1N6286 | (+)1.5KE43 | 38.7 | 47.3 | 1.0 | 34.8 | 1.0 | 24.2 | 61.9 | 0.101 |
| 1N6286A | (+)1.5KE43A | 40.9 | 45.2 | 1.0 | 36.8 | 1.0 | 25.3 | 59.3 | 0.101 |
| 1N6287 | (+)1.5KE47 | 42.3 | 51.7 | 1.0 | 38.1 | 1.0 | 22.1 | 67.8 | 0.101 |
| 1N6287A | (+)1.5KE47A | 44.7 | 49.4 | 1.0 | 40.2 | 1.0 | 23.1 | 64.8 | 0.101 |
| 1N6288 | (+)1.5KE51 | 45.9 | 56.1 | 1.0 | 41.3 | 1.0 | 20.4 | 73.5 | 0.102 |
| 1N6288A | (+)1.5KE51A | 48.5 | 53.6 | 1.0 | 43.6 | 1.0 | 21.4 | 70.1 | 0.102 |
| 1N6289 | (+)1.5KE56 | 50.4 | 61.8 | 1.0 | 45.4 | 1.0 | 18.6 | 80.5 | 0.103 |
| 1N6289A | (+)1.5KE56A | 53.2 | 58.8 | 1.0 | 47.8 | 1.0 | 19.5 | 77.0 | 0.103 |
| 1N6290 | (+)1.5KE62 | 55.8 | 68.2 | 1.0 | 50.2 | 1.0 | 16.9 | 89.0 | 0.104 |
| 1N6290A | (+)1.5KE62A | 58.9 | 65.1 | 1.0 | 53.0 | 1.0 | 17.6 | 85.0 | 0.104 |
| 1N6291 | (+)1.5KE68 | 61.2 | 74.8 | 1.0 | 55.1 | 1.0 | 15.3 | 98.0 | 0.104 |
| 1N6291A | (+)1.5KE68A | 64.6 | 71.4 | 1.0 | 58.1 | 1.0 | 16.3 | 92.0 | 0.104 |
| 1N6292 | (+)1.5KE75 | 67.5 | 82.5 | 1.0 | 60.7 | 1.0 | 13.9 | 109 | 0.105 |
| 1N6292A | (+)1.5KE75A | 71.3 | 78.8 | 1.0 | 64.1 | 1.0 | 14.6 | 104 | 0.105 |



1.5KE6.8 thru 1.5KE540A, 1N6267 thru 1N6303

Vishay General Semiconductor

| ELECTRICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted) | | | | | | | | | |
|--|-----------------------------------|--|-------|-------------------------|--------------------------------|--|---|---|--|
| JEDEC TYPE NUMBER | GENERAL SEMICONDUCTOR PART NUMBER | 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} I_D ⁽⁴⁾ (μA) | MAXIMUM PEAK PULSE CURRENT I_{PPM} ⁽²⁾ (A) | MAXIMUM CLAMPING VOLTAGE AT I_{PPM} V_C (V) | MAXIMUM TEMP. COEFFICIENT OF V_{BR} (%/ $^\circ\text{C}$) |
| | | MIN. | MAX. | | | | | | |
| 1N6293 | (+)1.5KE82 | 73.8 | 90.2 | 1.0 | 66.4 | 1.0 | 12.7 | 118 | 0.105 |
| 1N6293A | (+)1.5KE82A | 77.9 | 86.1 | 1.0 | 70.1 | 1.0 | 13.3 | 113 | 0.105 |
| 1N6294 | (+)1.5KE91 | 81.9 | 100.0 | 1.0 | 73.7 | 1.0 | 11.5 | 131 | 0.106 |
| 1N6294A | (+)1.5KE91A | 86.5 | 95.5 | 1.0 | 77.8 | 1.0 | 12.0 | 125 | 0.106 |
| 1N6295 | (+)1.5KE100 | 90.0 | 110 | 1.0 | 81.0 | 1.0 | 10.4 | 144 | 0.106 |
| 1N6295A | (+)1.5KE100A | 95.0 | 105 | 1.0 | 85.5 | 1.0 | 10.9 | 137 | 0.106 |
| 1N6296 | (+)1.5KE110 | 99.0 | 121 | 1.0 | 89.2 | 1.0 | 9.5 | 158 | 0.107 |
| 1N6296A | (+)1.5KE 110A | 105 | 116 | 1.0 | 94.0 | 1.0 | 9.9 | 152 | 0.107 |
| 1N6297 | (+)1.5KE120 | 108 | 132 | 1.0 | 97.2 | 1.0 | 8.7 | 173 | 0.107 |
| 1N6297A | (+)1.5KE120A | 114 | 126 | 1.0 | 102 | 1.0 | 9.1 | 165 | 0.107 |
| 1N6298 | (+)1.5KE130 | 117 | 143 | 1.0 | 105 | 1.0 | 8.0 | 187 | 0.107 |
| 1N6298A | (+)1.5KE130A | 124 | 137 | 1.0 | 111 | 1.0 | 8.4 | 179 | 0.107 |
| 1N6299 | (+)1.5KE150 | 136 | 165 | 1.0 | 121 | 1.0 | 7.0 | 215 | 0.108 |
| 1N6299A | (+)1.5KE150A | 143 | 158 | 1.0 | 128 | 1.0 | 7.2 | 207 | 0.106 |
| 1N6300 | (+)1.5KE160 | 144 | 176 | 1.0 | 130 | 1.0 | 6.5 | 230 | 0.106 |
| 1N6300A | (+)1.5KE160A | 152 | 168 | 1.0 | 136 | 1.0 | 6.8 | 219 | 0.108 |
| 1N6301 | (+)1.5KE170 | 153 | 187 | 1.0 | 138 | 1.0 | 6.1 | 244 | 0.108 |
| 1N6301A | (+)1.5KE170A | 162 | 179 | 1.0 | 145 | 1.0 | 6.4 | 234 | 0.108 |
| 1N6302 | 1.5KE180 | 162 | 198 | 1.0 | 146 | 1.0 | 5.8 | 258 | 0.108 |
| 1N6302A | 1.5KE180A | 171 | 189 | 1.0 | 154 | 1.0 | 6.1 | 246 | 0.108 |
| 1N6303 | 1.5KE200 | 180 | 220 | 1.0 | 162 | 1.0 | 5.2 | 287 | 0.108 |
| 1N6303A | 1.5KE200A* | 190 | 210 | 1.0 | 171 | 1.0 | 5.5 | 274 | 0.108 |
| | 1.5KE220 | 198 | 242 | 1.0 | 175 | 1.0 | 4.4 | 344 | 0.108 |
| | 1.5KE220A* | 209 | 231 | 1.0 | 185 | 1.0 | 4.6 | 328 | 0.108 |
| | 1.5KE250 | 225 | 275 | 1.0 | 202 | 1.0 | 4.2 | 360 | 0.110 |
| | 1.5KE250A | 237 | 263 | 1.0 | 214 | 1.0 | 4.4 | 344 | 0.110 |
| | 1.5KE300 | 270 | 330 | 1.0 | 243 | 1.0 | 3.5 | 430 | 0.110 |
| | 1.5KE300A | 285 | 315 | 1.0 | 256 | 1.0 | 3.6 | 414 | 0.110 |
| | 1.5KE350 | 315 | 385 | 1.0 | 284 | 1.0 | 3.0 | 504 | 0.110 |
| | 1.5KE350A | 333 | 368 | 1.0 | 300 | 1.0 | 3.1 | 482 | 0.110 |
| | 1.5KE400 | 360 | 440 | 1.0 | 324 | 1.0 | 2.6 | 574 | 0.110 |
| | 1.5KE400A | 380 | 420 | 1.0 | 342 | 1.0 | 2.7 | 548 | 0.110 |
| | 1.5KE440 | 396 | 484 | 1.0 | 356 | 1.0 | 2.4 | 631 | 0.110 |
| | 1.5KE440A | 418 | 462 | 1.0 | 376 | 1.0 | 2.5 | 602 | 0.110 |
| | 1.5KE480 | 432 | 528 | 1.0 | 389 | 1.0 | 2.19 | 686 | 0.110 |
| | 1.5KE480A | 456 | 504 | 1.0 | 408 | 1.0 | 2.28 | 658 | 0.110 |
| | 1.5KE510 | 459 | 561 | 1.0 | 413 | 1.0 | 2.06 | 729 | 0.110 |
| | 1.5KE510A | 485 | 535 | 1.0 | 434 | 1.0 | 2.15 | 698 | 0.110 |
| | 1.5KE540 | 486 | 594 | 1.0 | 437 | 1.0 | 1.94 | 772 | 0.110 |
| | 1.5KE540A | 513 | 567 | 1.0 | 459 | 1.0 | 2.03 | 740 | 0.110 |

Notes:

- (1) Pulse test: $t_p \leq 50\text{ ms}$
- (2) Surge current waveform per Fig. 3 and derate per Fig. 2
- (3) All terms and symbols are consistent with ANSI/IEEE CA62.35
- (4) For bi-directional types with V_R 10 V and less the I_D limit is doubled
- * Bi-directional versions are UL approved under component across the line protection, ULV1414 file number E108274 (1.5KE200CA, 1.5KE220CA)
- (+) Underwriters laboratory recognition for the classification of protectors (QVGGQ2) under the UL standard for safety 497B and file number E136766 for both uni-directional and bi-directional devices



| THERMAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted) | | | |
|--|-----------------|-------|--------------------|
| PARAMETER | SYMBOL | VALUE | UNIT |
| Typical thermal resistance, junction to ambient | $R_{\theta JA}$ | 75 | $^\circ\text{C/W}$ |
| Typical thermal resistance, junction to lead | $R_{\theta JL}$ | 15.4 | |

| ORDERING INFORMATION (Example) | | | | |
|--------------------------------|-----------------|------------------------|---------------|----------------------------------|
| PREFERRED P/N | UNIT WEIGHT (g) | PREFERRED PACKAGE CODE | BASE QUANTITY | DELIVERY MODE |
| 1.5KE6.8A-E3/54 | 0.968 | 54 | 1400 | 13" diameter paper tape and reel |
| 1.5KE6.8AHE3/54 ⁽¹⁾ | 0.968 | 54 | 1400 | 13" diameter paper tape and reel |

Note:

(1) Automotive grade AEC-Q101 qualified

RATINGS AND CHARACTERISTICS CURVES

($T_A = 25\text{ }^\circ\text{C}$ unless otherwise noted)

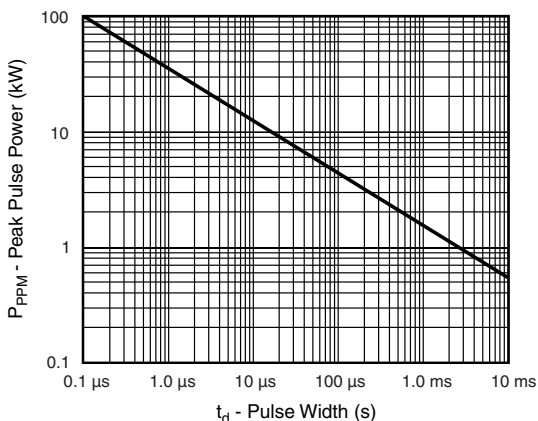


Figure 1. Peak Pulse Power Rating Curve

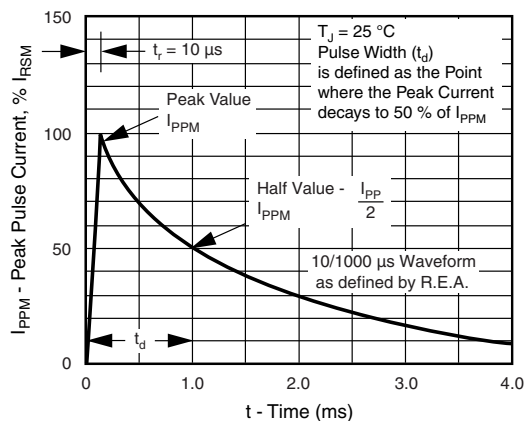


Figure 3. Pulse Waveform

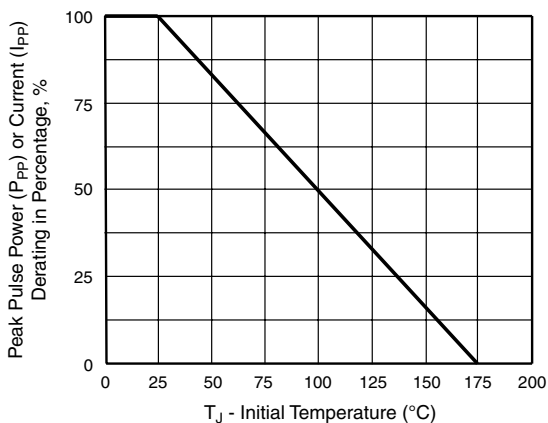


Figure 2. Pulse Power or Current vs. Initial Junction Temperature

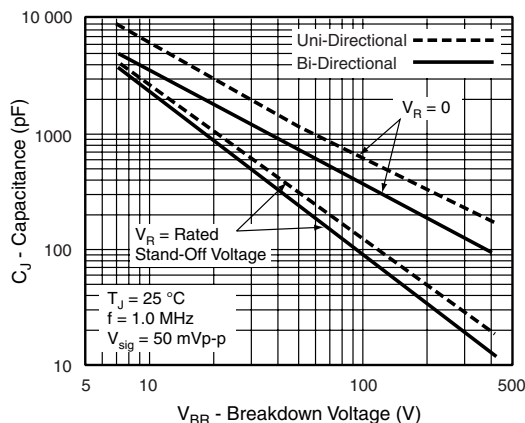


Figure 4. Typical Junction Capacitance

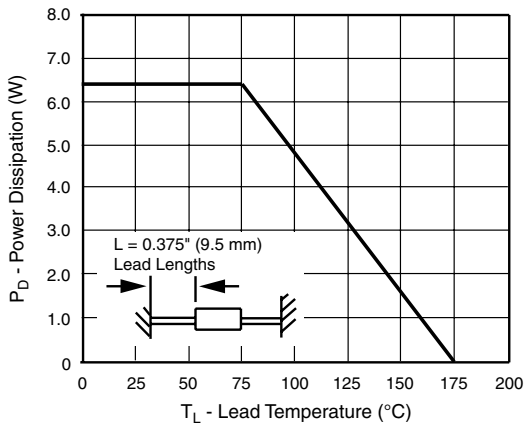


Figure 5. Power Derating Curve



Figure 8. Incremental Clamping Voltage Curve (Uni-Directional)

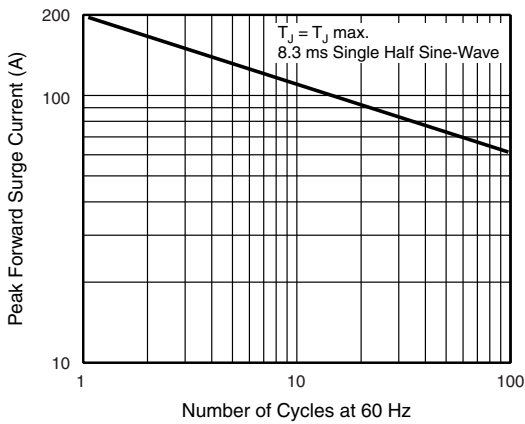


Figure 6. Maximum Non-Repetitive Forward Surge Current Uni-Directional only



Figure 9. Incremental Clamping Voltage Curve (Bi-directional)

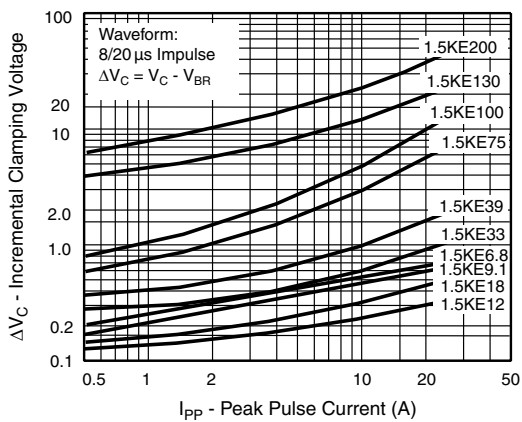


Figure 7. Incremental Clamping Voltage Curve (Uni-Directional)



Figure 10. Incremental Clamping Voltage Curve (Bi-Directional)



Figure 11. Instantaneous Forward Voltage Characteristics Curve



Figure 12. Typical Transient Thermal Impedance

PACKAGE OUTLINE DIMENSIONS in inches (millimeters)



APPLICATION NOTES

- This series of Silicon Transient Suppressors is used in applications where large voltage transients can permanently damage voltage-sensitive components.
- The TVS diode can be used in applications where induced lightning on rural or remote transmission lines presents a hazard to electronic circuitry (ref: R.E.A. specification P.E. 60).
- This Transient Voltage Suppressor diode has a pulse power rating of 1500 W for 1 ms. The response time of TVS diode clamping action is effectively instantaneous (1×10^{-9} s bi-directional); therefore, they can protect integrated circuits, MOS devices, hybrids, and other voltage sensitive semiconductors and components. TVS diodes can also be used in series or parallel to increase the peak power ratings.



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