

TRANSZORB Transient Voltage Suppressors

Major Ratings and Characteristics

| | |
|---------------------------------|----------------|
| $V_{(BR)}$ Unidirectional | 6.8 V to 540 V |
| $V_{(BR)}$ Bidirectional | 6.8 v to 440 V |
| P_{PPM} | 1500 W |
| $P_{M(AV)}$ | 6.5 W |
| I_{FSM} (Unidirectional only) | 200 A |
| T_j max. | 175 °C |



Case Style 1.5KE

Features

- Glass passivated chip junction
- Available in Unidirectional and Bidirectional
- 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
- Meets MSL level 1, per J-STD-020C
- AEC-Q101 qualified

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 plastic body over passivated junction
Epoxy meets UL-94V-0 Flammability rating

Terminals: Matte tin plated (E3 Suffix) leads, solderable per J-STD-002B and MIL-STD-750, Method 2026

Polarity: For unidirectional types the color band denotes cathode end, no marking on bidirectional types

Devices for bidirection Applications

For bidirectional types, use C or CA suffix for types (e.g. 1.5KE440CA).

Electrical characteristics apply in both directions.

Maximum Ratings

($T_A = 25\text{ °C}$ 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 |
| Steady state power dissipation lead lengths 0.375" (9.5 mm) ⁽²⁾ , $T_L = 75\text{ °C}$ | $P_{M(AV)}$ | 6.5 | W |
| Peak forward surge current 8.3 ms single half sine-wave unidirectional only ⁽³⁾ | I_{FSM} | 200 | A |
| Maximum instantaneous forward voltage at 100 A for unidirectional only ⁽⁴⁾ | 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 $T_A = 25\text{ °C}$ per Fig. 2

(2) Mounted on copper pad area of 1.6 x 1.6" (40 x 40 mm) per Fig. 5

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

(4) $V_F = 3.5\text{ V}$ for 1.5KE220(A) & below; $V_F = 5.0\text{ V}$ for 1.5KE250(A) & above



Electrical Characteristics

(T_A = 25 °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) (% / °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 Semiconductors

| 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⁾ (μ A) | Maximum Peak Pulse Current I_{PPM} ⁽²⁾ (A) | Maximum Clamping Voltage at I_{PPM} V_C (V) | Maximum Temp Coefficient of $V_{(BR)}$ (% / °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: $t_p \leq 50$ 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 bidirectional types with V_R 10 volts and less the I_D limit is doubled

* Bidirectional 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 (QVQG2) under the UL standard for safety 497B and file number E136766 for both uni-directional and bi-directional devices



Vishay Semiconductors

Thermal Characteristics

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

| Parameter | Symbol | Limit | Unit |
|--|-----------------|-------|--------------------|
| Typical thermal resistance junction-to-lead | $R_{\theta JL}$ | 20 | $^\circ\text{C/W}$ |
| Typical thermal resistance junction-to-ambient | $R_{\theta JA}$ | 75 | $^\circ\text{C/W}$ |

Application

- 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 watts for one millisecond. The response time of TVS diode clamping action is effectively instantaneous (1×10^{-9} seconds bidirectional); 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.

Ratings and Characteristics Curves

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



Figure 1. Peak Pulse Power Rating Curve



Figure 3. Pulse Waveform



Figure 2. Pulse Derating Curve

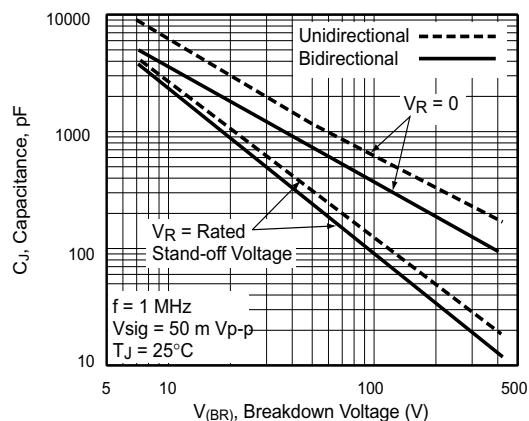


Figure 4. Typical Junction Capacitance



Figure 5. Steady State Power Derating Curve



Figure 8. Incremental Clamping Voltage Curve (Unidirectional)



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



Figure 9. Incremental Clamping Voltage Curve (Bidirectional)



Figure 7. Incremental Clamping Voltage Curve (Unidirectional)



Figure 10. Incremental Clamping Voltage Curve (Bidirectional)



Figure 11. Instantaneous Forward Voltage Characteristics Curve

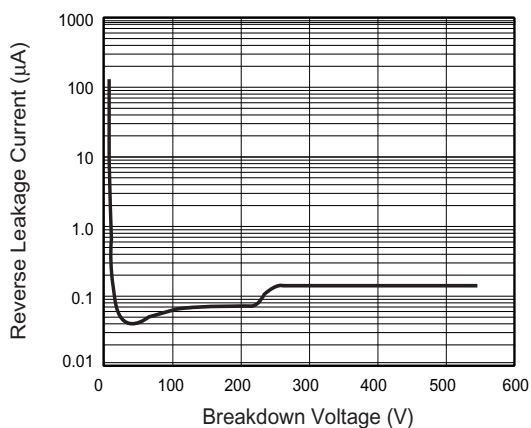


Figure 13. Typical Reverse Leakage Characteristics



Figure 12. Typical Transient Thermal Impedance

Package outline dimensions in inches (millimeters)





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