

Transient Voltage Suppressor Diode

1.5KE56

(1.5KE6.8 thru 1.5KE440CA Series)

Breakdown-Voltage 6.8 to 440V

Peak Pulse Power 1500W

DATASHEET

OEM – General Semiconductor

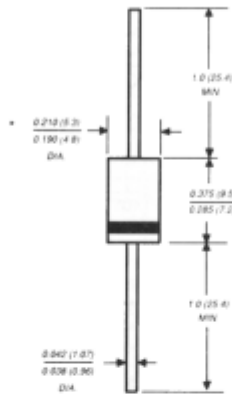
Source: General Semiconductor Databook 1998

1.5KE6.8 THRU 1.5KE440CA

GLASS PASSIVATED JUNCTION TRANSIENT VOLTAGE SUPPRESSOR

Breakdown Voltage - 6.8 to 440 Volts Peak Pulse Power - 1500 Watts

Case Style 1.5KE



Dimensions in inches and millimeters

FEATURES

- ◆ Plastic package has Underwriters Laboratory Flammability Classification 94V-0
- ◆ Glass passivated junction
- ◆ 1500W peak pulse power capability on 10/1000 μ s waveform repetition rate (duty cycle): 0.05%
- ◆ Excellent clamping capability
- ◆ Low incremental surge resistance
- ◆ Fast response time: typically less than 1.0ps from 0 Volts to $V_{(BR)}$ for unidirectional and 5.0ns for bidirectional types
- ◆ For devices with $V_{(BR)} \geq 10V$, I_D are typically less than 1.0 μ A
- ◆ High temperature soldering guaranteed: 265°C/10 seconds, 0.375" (9.5mm) lead length, 5lbs. (2.3 kg) tension

MECHANICAL DATA

Case: Molded plastic body over passivated junction
Terminals: Plated axial leads, solderable per MIL-STD-750, Method 2026
Polarity: Color band denotes positive end (cathode) except for bidirectional
Mounting Position: Any
Weight: 0.045 ounce, 1.2 grams

DEVICES FOR BIDIRECTIONAL APPLICATIONS

For bidirectional use C or CA suffix for types 1.5KE6.8 thru types 1.5KE440A (e.g. 1.5KE6.8C, 1.5KE440CA). Electrical characteristics apply in both directions.

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25°C ambient temperature unless otherwise specified.

| | SYMBOL | VALUE | UNITS |
|---|----------------|--------------|------------------|
| Peak pulse power dissipation with a 10/1000 μ s waveform (NOTE 1) | PPPM | Minimum 1500 | Watts |
| Peak pulse current with a 10/1000 μ s waveform (NOTE 1, FIG. 1) | IPPM | SEE TABLE 1 | Amps |
| Steady state power dissipation at $T_L=75^\circ\text{C}$ lead lengths, 0.375" (9.5mm) (NOTE 2) | $P_{M(AV)}$ | 5.0 | Watts |
| Peak forward surge current, 8.3ms single half sine-wave superimposed on rated load (JEDEC Method) unidirectional only | I_{FSM} | 200 | Amps |
| Maximum instantaneous forward current at 100.0A for unidirectional only (NOTE 3) | V_F | 3.5/5.0 | Volts |
| Operating junction and storage temperature range | T_J, T_{STG} | -55 to +175 | $^\circ\text{C}$ |

NOTES:

- (1) Non-repetitive current pulse, per Fig. 3 and derated above $T_A=25^\circ\text{C}$ per Fig. 2
- (2) Mounted on copper pad area of 0.8 x 0.8" (20 x 20mm) per Fig. 5
- (3) $V_F=3.5V$ for devices of $V_{(BR)} \leq 200V$ and $V_F=5.0$ Volt max. for devices of $V_{(BR)} > 200V$

ELECTRICAL CHARACTERISTICS at (TA=25°C unless otherwise noted)

| JEDEC TYPE NUMBER | GENERAL PART NUMBER | Breakdown Voltage V _{BR} (NOTE 1) | | Test Current at (mA) I _T | Stand-off Voltage V _{WM} (Volts) | Maximum Reverse Leakage at V _{WM} I _R (NOTE 4) (µA) | Maximum Peak Pulse Current I _{PPM} (NOTE 2) (Amps) | Maximum Clamping Voltage at I _{PPM} V _C (Volts) | Maximum Temperature Coefficient of V _{BR} (% / °C) |
|-------------------|---------------------|--|------|-------------------------------------|---|---|---|---|---|
| | | Min | Max | | | | | | |
| 1N6267 | +1.5KE6.8 | 6.12 | 7.48 | 10.0 | 5.50 | 1000 | 139 | 10.8 | 0.057 |
| 1N6267A | +1.5KE6.8A | 6.45 | 7.14 | 10.0 | 5.80 | 1000 | 143 | 10.5 | 0.057 |
| 1N6268 | +1.5KE7.5 | 6.75 | 8.25 | 10.0 | 6.05 | 500 | 128 | 11.7 | 0.061 |
| 1N6268A | +1.5KE7.5A | 7.13 | 7.88 | 10.0 | 6.40 | 500 | 133 | 11.3 | 0.061 |
| 1N6269 | +1.5KE8.2 | 7.38 | 9.02 | 10.0 | 6.63 | 200 | 120 | 12.5 | 0.065 |
| 1N6269A | +1.5KE8.2A | 7.79 | 8.61 | 10.0 | 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 | 5.0 | 68.2 | 22.0 | 0.084 |
| 1N6275A | +1.5KE15A | 14.3 | 15.8 | 1.0 | 12.8 | 5.0 | 70.8 | 21.2 | 0.084 |
| 1N6276 | +1.5KE16 | 14.4 | 17.6 | 1.0 | 12.9 | 5.0 | 63.8 | 23.5 | 0.086 |
| 1N6276A | +1.5KE16A | 15.2 | 16.8 | 1.0 | 13.6 | 5.0 | 66.7 | 22.5 | 0.086 |
| 1N6277 | +1.5KE18 | 16.2 | 19.8 | 1.0 | 14.5 | 5.0 | 56.6 | 26.5 | 0.088 |
| 1N6277A | +1.5KE18A | 17.1 | 18.9 | 1.0 | 15.3 | 5.0 | 59.5 | 26.2 | 0.089 |
| 1N6278 | +1.5KE20 | 18.0 | 22.0 | 1.0 | 16.2 | 5.0 | 51.5 | 29.1 | 0.090 |
| 1N6278A | +1.5KE20A | 19.0 | 21.0 | 1.0 | 17.1 | 5.0 | 54.2 | 27.7 | 0.090 |
| 1N6279 | +1.5KE22 | 19.8 | 24.2 | 1.0 | 17.8 | 5.0 | 47.0 | 31.9 | 0.092 |
| 1N6279A | +1.5KE22A | 20.9 | 23.1 | 1.0 | 18.8 | 5.0 | 49.0 | 30.6 | 0.092 |
| 1N6280 | +1.5KE24 | 21.6 | 26.4 | 1.0 | 19.4 | 5.0 | 43.2 | 34.7 | 0.094 |
| 1N6280A | +1.5KE24A | 22.8 | 25.2 | 1.0 | 20.5 | 5.0 | 45.2 | 33.2 | 0.094 |
| 1N6281 | +1.5KE27 | 24.3 | 29.7 | 1.0 | 21.8 | 5.0 | 38.4 | 39.1 | 0.096 |
| 1N6281A | +1.5KE27A | 25.7 | 28.4 | 1.0 | 23.1 | 5.0 | 40.0 | 37.5 | 0.096 |
| 1N6282 | +1.5KE30 | 27.0 | 33.0 | 1.0 | 24.3 | 5.0 | 34.5 | 43.5 | 0.097 |
| 1N6282A | +1.5KE30A | 28.5 | 31.5 | 1.0 | 25.6 | 5.0 | 36.2 | 41.4 | 0.097 |
| 1N6283 | +1.5KE33 | 29.7 | 36.3 | 1.0 | 26.8 | 5.0 | 31.4 | 47.7 | 0.098 |
| 1N6283A | +1.5KE33A | 31.4 | 34.7 | 1.0 | 28.2 | 5.0 | 32.8 | 45.7 | 0.098 |
| 1N6284 | +1.5KE36 | 32.4 | 39.6 | 1.0 | 29.1 | 5.0 | 28.8 | 52.0 | 0.099 |
| 1N6284A | +1.5KE36A | 34.2 | 37.8 | 1.0 | 30.8 | 5.0 | 30.1 | 49.9 | 0.099 |
| 1N6285 | +1.5KE39 | 35.1 | 42.9 | 1.0 | 31.6 | 5.0 | 26.6 | 56.4 | 0.100 |
| 1N6285A | +1.5KE39A | 37.1 | 41.0 | 1.0 | 33.3 | 5.0 | 27.8 | 53.9 | 0.100 |
| 1N6286 | +1.5KE43 | 38.7 | 47.3 | 1.0 | 34.8 | 5.0 | 24.2 | 61.9 | 0.101 |
| 1N6286A | +1.5KE43A | 40.9 | 45.2 | 1.0 | 36.8 | 5.0 | 25.3 | 59.3 | 0.101 |
| 1N6287 | +1.5KE47 | 42.3 | 51.7 | 1.0 | 36.1 | 5.0 | 22.1 | 67.8 | 0.101 |
| 1N6287A | +1.5KE47A | 44.7 | 49.4 | 1.0 | 40.2 | 5.0 | 23.1 | 64.8 | 0.101 |
| 1N6288 | 1.5KE51 | 45.9 | 56.1 | 1.0 | 41.3 | 5.0 | 20.4 | 73.5 | 0.102 |
| 1N6288A | 1.5KE51A | 48.5 | 53.6 | 1.0 | 43.6 | 5.0 | 21.4 | 70.1 | 0.102 |
| 1N6289 | 1.5KE56 | 50.4 | 61.8 | 1.0 | 45.4 | 5.0 | 18.6 | 80.5 | 0.103 |
| 1N6289A | 1.5KE56A | 53.2 | 58.8 | 1.0 | 47.8 | 5.0 | 19.5 | 77.0 | 0.103 |
| 1N6290 | 1.5KE62 | 55.8 | 68.2 | 1.0 | 50.2 | 5.0 | 16.9 | 89.0 | 0.104 |
| 1N6290A | 1.5KE62A | 58.9 | 65.1 | 1.0 | 53.0 | 5.0 | 17.6 | 85.0 | 0.104 |
| 1N6291 | 1.5KE68 | 61.2 | 74.8 | 1.0 | 55.1 | 5.0 | 15.3 | 98.0 | 0.104 |

ELECTRICAL CHARACTERISTICS at (TA=25°C unless otherwise noted)

| JEDEC TYPE NUMBER | GENERAL PART NUMBER | Breakdown Voltage V _(BR) (NOTE 1) | | Test Current at (mA) I _T | Stand-off Voltage V _{WM} (Volts) | Maximum Reverse Leakage at V _{WM} I _D (NOTE 4) (µA) | Maximum Peak Pulse Current I _{PPM} (NOTE 2) Amps | Maximum Clamping Voltage at I _{PPM} V _C (Volts) | Maximum Temperature Coefficient of V _(BR) (% / °C) |
|-------------------|---------------------|--|-------|-------------------------------------|---|---|---|---|---|
| | | Min | Max | | | | | | |
| 1N6291A | 1.5KE68A | 64.6 | 71.4 | 1.0 | 58.1 | 5.0 | 16.3 | 92.0 | 0.104 |
| 1N6292 | 1.5KE75 | 67.5 | 82.5 | 1.0 | 60.7 | 5.0 | 13.9 | 109 | 0.105 |
| 1N6292A | 1.5KE75A | 71.3 | 78.8 | 1.0 | 64.1 | 5.0 | 14.6 | 104 | 0.105 |
| 1N6293 | 1.5KE82 | 73.8 | 90.2 | 1.0 | 66.4 | 5.0 | 12.7 | 118 | 0.105 |
| 1N6293A | 1.5KE82A | 77.9 | 86.1 | 1.0 | 70.1 | 5.0 | 13.3 | 113 | 0.105 |
| 1N6294 | 1.5KE91 | 81.9 | 100.0 | 1.0 | 73.7 | 5.0 | 11.5 | 131 | 0.106 |
| 1N6294A | 1.5KE91A | 86.5 | 95.5 | 1.0 | 77.8 | 5.0 | 12.0 | 125 | 0.106 |
| 1N6295 | 1.5KE100 | 90.0 | 110 | 1.0 | 81.0 | 5.0 | 10.4 | 144 | 0.106 |
| 1N6295A | 1.5KE100A | 95.0 | 105 | 1.0 | 85.5 | 5.0 | 10.9 | 137 | 0.106 |
| 1N6296 | 1.5KE110 | 99.0 | 121 | 1.0 | 89.2 | 5.0 | 9.5 | 158 | 0.107 |
| 1N6296A | 1.5KE 110A | 106 | 116 | 1.0 | 94.0 | 5.0 | 9.9 | 152 | 0.107 |
| 1N6297 | 1.5KE120 | 108 | 132 | 1.0 | 97.2 | 5.0 | 8.7 | 173 | 0.107 |
| 1N6297A | 1.5KE120A | 114 | 126 | 1.0 | 102 | 5.0 | 9.1 | 165 | 0.107 |
| 1N6298 | 1.5KE130 | 117 | 143 | 1.0 | 106 | 5.0 | 8.0 | 187 | 0.107 |
| 1N6298A | 1.5KE130A | 124 | 137 | 1.0 | 111 | 5.0 | 8.4 | 179 | 0.107 |
| 1N6299 | 1.5KE150 | 136 | 165 | 1.0 | 121 | 5.0 | 7.0 | 215 | 0.108 |
| 1N6299A | 1.5KE150A | 143 | 158 | 1.0 | 128 | 5.0 | 7.2 | 207 | 0.106 |
| 1N6300 | 1.5KE160 | 144 | 176 | 1.0 | 130 | 5.0 | 6.5 | 230 | 0.106 |
| 1N6300A | 1.5KE160A | 152 | 168 | 1.0 | 136 | 5.0 | 6.8 | 219 | 0.108 |
| 1N6301 | 1.5KE170 | 153 | 167 | 1.0 | 138 | 5.0 | 6.1 | 244 | 0.108 |
| 1N6301A | 1.5KE170A | 162 | 179 | 1.0 | 145 | 5.0 | 6.4 | 234 | 0.108 |
| 1N6302 | 1.5KE180 | 162 | 198 | 1.0 | 146 | 5.0 | 5.8 | 258 | 0.108 |
| 1N6302A | 1.5KE180A | 171 | 189 | 1.0 | 154 | 5.0 | 6.1 | 246 | 0.108 |
| 1N6303 | 1.5KE200 | 180 | 220 | 1.0 | 162 | 5.0 | 5.2 | 287 | 0.108 |
| 1N6303A | 1.5KE200A* | 190 | 210 | 1.0 | 171 | 5.0 | 5.5 | 274 | 0.108 |
| | 1.5KE220 | 196 | 242 | 1.0 | 175 | 5.0 | 4.4 | 344 | 0.108 |
| | 1.5KE220A* | 209 | 231 | 1.0 | 185 | 5.0 | 4.6 | 328 | 0.108 |
| | 1.5KE250 | 225 | 275 | 1.0 | 202 | 5.0 | 4.2 | 360 | 0.110 |
| | 1.5KE250A | 237 | 263 | 1.0 | 214 | 5.0 | 4.4 | 344 | 0.110 |
| | 1.5KE300 | 270 | 330 | 1.0 | 243 | 5.0 | 3.5 | 430 | 0.110 |
| | 1.5KE300A | 285 | 315 | 1.0 | 256 | 5.0 | 3.6 | 414 | 0.110 |
| | 1.5KE350 | 315 | 385 | 1.0 | 284 | 5.0 | 3.0 | 504 | 0.110 |
| | 1.5KE350A | 333 | 368 | 1.0 | 300 | 5.0 | 3.1 | 482 | 0.110 |
| | 1.5KE400 | 360 | 440 | 1.0 | 324 | 5.0 | 2.6 | 574 | 0.110 |
| | 1.5KE400A | 380 | 420 | 1.0 | 342 | 5.0 | 2.7 | 548 | 0.110 |
| | 1.5KE440 | 396 | 484 | 1.0 | 356 | 5.0 | 2.4 | 631 | 0.110 |
| | 1.5KE440A | 418 | 462 | 1.0 | 376 | 5.0 | 2.5 | 602 | 0.110 |

NOTES:

- (1) V_(BR) measured after I_T applied for 300µs, I_T=square wave pulse or equivalent
- (2) Surge current waveform per Fig. 3 and derate per Fig. 2
- (3) All terms and symbols are consistent with ANS/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)
- + UL listed for Telecom applications protection, 497B, file number E133766 for both unidirectional and bidirectional devices

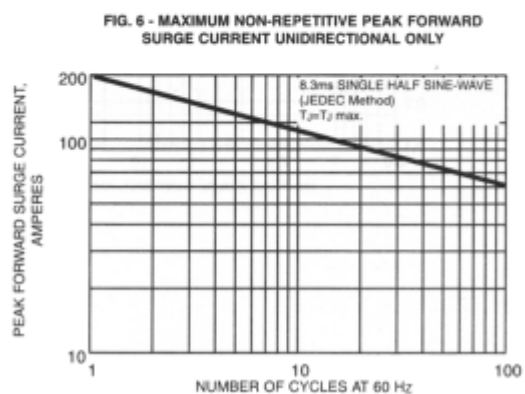
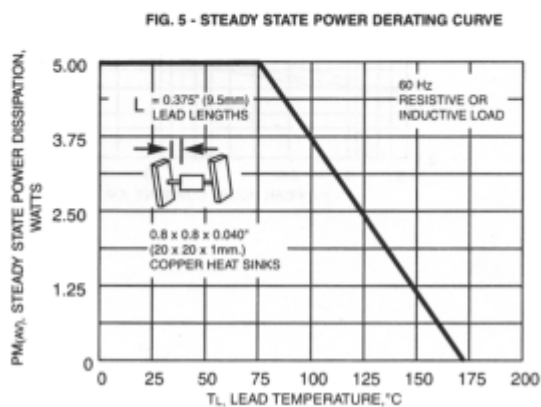
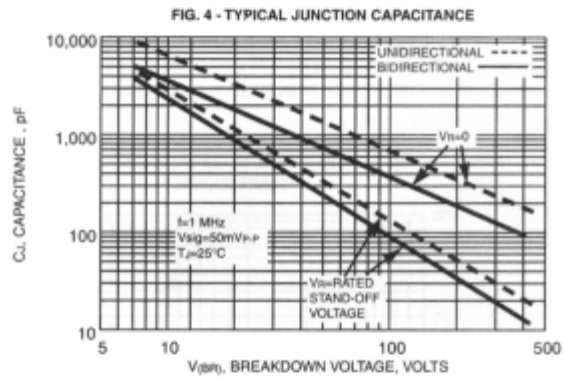
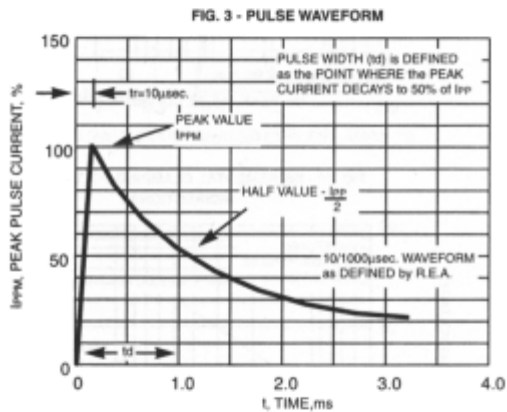
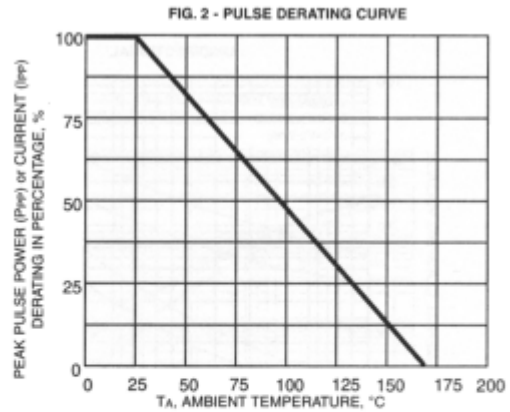
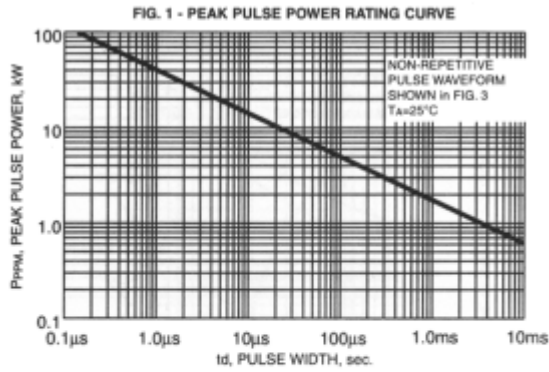
APPLICATION

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 x 10⁻⁸ 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 CHARACTERISTIC CURVES 1.5KE6.8 THRU 1.5KE440CA



RATINGS AND CHARACTERISTIC CURVES 1.5KE6.8 THRU 1.5KE440CA

FIG. 7 - INCREMENTAL CLAMPING VOLTAGE CURVE UNIDIRECTIONAL

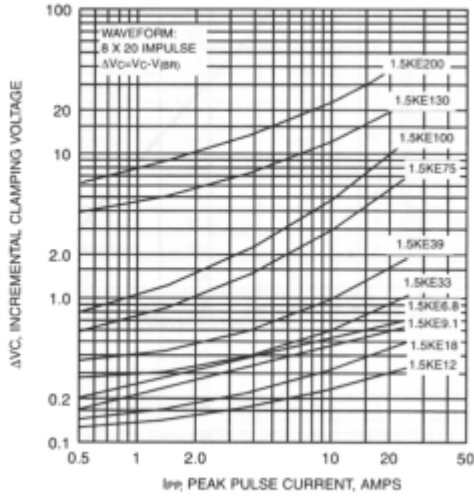


FIG. 8 - INCREMENTAL CLAMPING VOLTAGE CURVE UNIDIRECTIONAL

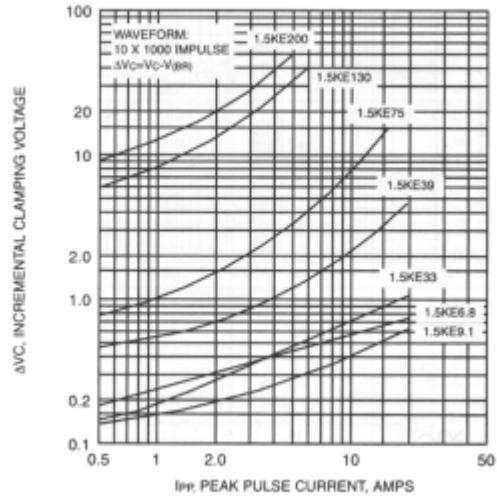


FIG. 9 - INCREMENTAL CLAMPING VOLTAGE CURVE BIDIRECTIONAL

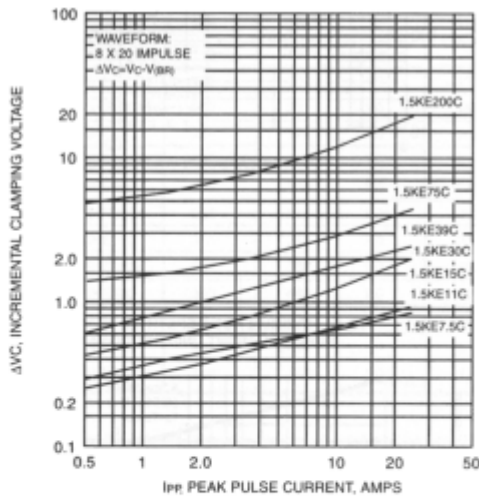


FIG. 10 - INCREMENTAL CLAMPING VOLTAGE CURVE BIDIRECTIONAL



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RATINGS AND CHARACTERISTIC CURVES 1.5KE6.8 THRU 1.5KE440CA

FIG. 11 - INSTANTANEOUS FORWARD VOLTAGE CHARACTERISTICS CURVE



FIG. 12 - BREAKDOWN VOLTAGE TEMPERATURE COEFFICIENT CURVE

