



## 1500 Watt Unidirectional and Bidirectional Transient Voltage Suppressor

Screening in reference to MIL-PRF-19500 available

### DESCRIPTION

The popular Transient Voltage Suppressor series of M1.5KE6.8 – M1.5KE400CA with its various upscreaming options offer an extended voltage range and provides a wide variety of commercial, high reliability, RoHS and bidirectional options. All have the same high peak pulse power rating of 1500 W and extremely fast response time. They can protect from secondary effects of lightning per IEC61000-4-5 and the class levels as shown below as well as voltage transients from inductive switching and RFI. Since their response time is virtually instantaneous, they also protect from ESD and EFT per IEC61000-4-2 and IEC61000-4-4.

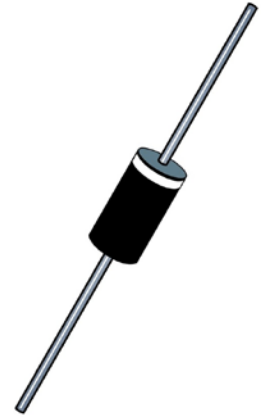
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### FEATURES

- High reliability devices with fabrication and assembly lot traceability
- Economical plastic encapsulated TVS series for thru-hole mounting
- $3\sigma$  lot norm screening performed on standby current ( $I_D$ )
- 100% surge tested devices suppress transients up to 1500 watts @ 10/1000  $\mu$ s (see [figure 1](#))
- Enhanced reliability screening available in reference to MIL-PRF-19500. Refer to [Hirel Non-Hermetic Product Portfolio](#) for more details on the screening options. (See [part nomenclature](#) for all options.)
- Enhanced reliability source controlled devices have wafer fabrication and assembly lot traceability
- Moisture classification is "Level 1" with no dry pack required per IPC/JEDEC J-STD-020B
- RoHS compliant versions available

### APPLICATIONS / BENEFITS

- High-reliability devices
- Protection from switching and RFI induced transients
- Compliant to IEC 61000-4-2 and IEC 61000-4-4 for ESD and EFT protection respectively
- Secondary lightning protection per IEC61000-4-5 with 42 ohms source impedance:
  - Class 1: M1.5KE6.8A to M1.5KE200CA
  - Class 2: M1.5KE6.8A to M1.5KE180CA
  - Class 3: M1.5KE6.8A to M1.5KE91CA
  - Class 4: M1.5KE6.8A to M1.5KE43CA
- Secondary lightning protection per IEC61000-4-5 with 12 ohms source impedance:
  - Class 1: M1.5KE6.8A to M1.5KE110CA
  - Class 2: M1.5KE6.8A to M1.5KE56CA
  - Class 3: M1.5KE6.8A to M1.5KE27CA
  - Class 4: M1.5KE6.8A to M1.5KE13CA
- Secondary lightning protection per IEC61000-4-5 with 2 ohms source impedance:
  - Class 2: M1.5KE6.8A to M1.5KE24CA
  - Class 3: M1.5KE6.8A to M1.5KE12CA



**Case 1 Package**

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**MAXIMUM RATINGS**

| Parameters/Test Conditions  | Symbol                              | Value                    | Unit     |
|---|-------------------------------------|--------------------------|----------|
| Junction and Storage Temperature  | T <sub>J</sub> and T <sub>STG</sub> | -65 to +150              | °C       |
| Thermal Resistance, Junction to Lead @ 0.375 inch (10 mm) from body                 | R <sub>θJL</sub>                    | 22                       | °C/W     |
| Thermal Resistance, Junction to Ambient <sup>(1)</sup>                              | R <sub>θJA</sub>                    | 82                       | °C/W     |
| Peak Pulse Power @ T <sub>L</sub> = +25 °C <sup>(2)</sup>                           | P <sub>PP</sub>                     | 1500                     | W        |
| Rated Average Power Dissipation @ T <sub>L</sub> = +40 °C @ T <sub>A</sub> = +25 °C | P <sub>M(AV)</sub>                  | 5<br>1.52 <sup>(1)</sup> | W        |
| T <sub>clamping</sub> (0 volts to V <sub>(BR)</sub> min)                            | Unidirectional<br>Bidirectional     | < 100<br>< 5             | ps<br>ns |
| Surge Peak Forward Current <sup>(3)</sup>   | I <sub>FSM</sub>                    | 200                      | A        |
| Solder Temperature @ 10 s   | T <sub>SP</sub>                     | 260                      | °C       |

- Notes:**
- When mounted on FR4 PC board with 4 mm<sup>2</sup> copper pads (1 oz) and track width 1 mm, length 25 mm.
  - At 10/1000 μs with repetition rate of 0.01% or less (see [Figure 1](#)).
  - At 8.3 ms half-sine wave for unidirectional devices only.

**MECHANICAL and PACKAGING**

- CASE: Void-free transfer molded thermosetting epoxy body meeting UL94V-0
- TERMINALS: Tin-lead or RoHS compliant annealed matte-tin plating readily solderable per MIL-STD-750 method 2026
- MARKING: Part number and polarity band
- POLARITY: Cathode indicated by band. No cathode band on bidirectional devices.
- TAPE & REEL option: Standard per EIA-296 (add "TR" suffix to part number). Consult factory for quantities.
- WEIGHT: Approximately 1.5 grams
- See [Package Dimensions](#) on last page.

**PART NOMENCLATURE**


| <b>SYMBOLS &amp; DEFINITIONS</b> |   |
|----------------------------------|---|
| <b>Symbol</b>                    | <b>Definition</b>   |
| $\alpha_{V(BR)}$                 | Temperature Coefficient of Breakdown Voltage: The change in breakdown voltage divided by the change in temperature that caused it expressed in %/°C or mV/°C.   |
| $I_{(BR)}$                       | Breakdown Current: The current used for measuring breakdown voltage $V_{(BR)}$ .  |
| $V_{(BR)}$                       | Breakdown Voltage: The voltage across the device at a specified current $I_{(BR)}$ in the breakdown region.   |
| $V_{WM}$                         | Working Standoff Voltage: The maximum-rated value of dc or repetitive peak positive cathode-to-anode voltage that may be continuously applied over the standard operating temperature.  |
| $V_C$                            | Clamping Voltage: The voltage across the device in a region of low differential resistance during the application of an impulse current ( $I_{PP}$ ) for a specified waveform.  |
| $I_{PP}$                         | Peak Impulse Current: The maximum rated random recurring peak impulse current or nonrepetitive peak impulse current that may be applied to a device. A random recurring or nonrepetitive transient current is usually due to an external cause, and it is assumed that its effect will have completely disappeared before the next transient arrives. |
| $P_{PP}$                         | Peak Pulse Power. The rated random recurring peak impulse power or rated nonrepetitive peak impulse power. The impulse power is the maximum-rated value of the product of $I_{PP}$ and $V_C$ .  |
| $I_D$                            | Standby Current: The current through the device at rated stand-off voltage.   |

**ELECTRICAL CHARACTERISTICS @ 25 °C**

| Industry Type Number | Rated Standoff Voltage $V_{WM}$ (Note 1) | Breakdown Voltage       |    | Maximum Clamping Voltage $V_C @ I_{PP}$ | Maximum Standby Current $I_D @ V_{WM}$ | Maximum Peak Pulse Current $I_{PP}$ (Fig. 2) | Maximum Temperature Coefficient of $V_{(BR)}$ $\alpha V_{(BR)}$ |
|----------------------|--|-------------------------|----|---|--|--|---|
|                      |  | $V_{(BR)}$ @ $I_{(BR)}$ |    |   |  |  |   |
|                      |  | Volts                   | mA |   |  |  |   |
| M1.5KE6.8A           | 5.80                                     | 6.45 – 7.14             | 10 | 10.5                                    | 1000                                   | 143.0  | 0.057   |
| M1.5KE7.5A           | 6.40                                     | 7.13 – 7.88             | 10 | 11.3                                    | 500                                    | 132.0  | 0.061   |
| M1.5KE8.2A           | 7.02                                     | 7.79 – 8.61             | 10 | 12.1                                    | 200                                    | 124.0  | 0.065   |
| M1.5KE9.1A           | 7.78                                     | 8.65 – 9.55             | 1  | 13.4                                    | 50                                     | 112.0  | 0.068   |
| M1.5KE10A            | 8.55                                     | 9.50 – 10.50            | 1  | 14.5                                    | 10                                     | 103.0  | 0.073   |
| M1.5KE11A            | 9.40                                     | 10.50 – 11.60           | 1  | 15.6                                    | 5                                      | 96.0   | 0.075   |
| M1.5KE12A            | 10.22                                    | 11.40 – 12.60           | 1  | 16.7                                    | 5                                      | 90.0   | 0.078   |
| M1.5KE13A            | 11.10                                    | 12.40 – 13.70           | 1  | 18.2                                    | 5                                      | 82.0   | 0.081   |
| M1.5KE15A            | 12.80                                    | 14.30 – 15.80           | 1  | 21.2                                    | 1                                      | 71.0   | 0.084   |
| M1.5KE16A            | 13.60                                    | 15.20 – 16.80           | 1  | 22.5                                    | 1                                      | 67.0   | 0.086   |
| M1.5KE18A            | 15.30                                    | 17.10 – 18.90           | 1  | 25.2                                    | 1                                      | 59.5   | 0.088   |
| M1.5KE20A            | 17.10                                    | 19.00 – 21.00           | 1  | 27.7                                    | 1                                      | 54.0   | 0.090   |
| M1.5KE22A            | 18.80                                    | 20.90 – 23.10           | 1  | 30.6                                    | 1                                      | 49.0   | 0.092   |
| M1.5KE24A            | 20.50                                    | 22.80 – 25.20           | 1  | 33.2                                    | 1                                      | 45.0   | 0.094   |
| M1.5KE27A            | 23.10                                    | 25.70 – 28.40           | 1  | 37.5                                    | 1                                      | 40.0   | 0.096   |
| M1.5KE30A            | 25.60                                    | 28.50 – 31.50           | 1  | 41.4                                    | 1                                      | 36.0   | 0.097   |
| M1.5KE33A            | 28.20                                    | 31.40 – 34.70           | 1  | 45.7                                    | 1                                      | 33.0   | 0.098   |
| M1.5KE36A            | 30.80                                    | 34.20 – 37.80           | 1  | 49.9                                    | 1                                      | 30.0   | 0.099   |
| M1.5KE39A            | 33.30                                    | 37.10 – 41.00           | 1  | 53.9                                    | 1                                      | 28.0   | 0.100   |
| M1.5KE43A            | 36.80                                    | 40.90 – 45.20           | 1  | 59.3                                    | 1                                      | 25.3   | 0.101   |
| M1.5KE47A            | 40.20                                    | 44.70 – 49.40           | 1  | 64.8                                    | 1                                      | 23.2   | 0.101   |
| M1.5KE51A            | 43.60                                    | 48.50 – 53.60           | 1  | 70.1                                    | 1                                      | 21.4   | 0.102   |
| M1.5KE56A            | 47.80                                    | 53.20 – 58.80           | 1  | 77.0                                    | 1                                      | 19.5   | 0.103   |
| M1.5KE62A            | 53.00                                    | 58.90 – 65.10           | 1  | 85.0                                    | 1                                      | 17.7   | 0.104   |
| M1.5KE68A            | 58.10                                    | 64.60 – 71.40           | 1  | 92.0                                    | 1                                      | 16.3   | 0.104   |
| M1.5KE75A            | 64.10                                    | 71.30 – 78.80           | 1  | 103.0                                   | 1                                      | 14.6   | 0.105   |
| M1.5KE82A            | 70.10                                    | 77.90 – 86.10           | 1  | 113.0                                   | 1                                      | 13.3   | 0.105   |
| M1.5KE91A            | 77.80                                    | 86.50 – 95.50           | 1  | 125.0                                   | 1                                      | 12.0   | 0.106   |
| M1.5KE100A           | 85.50                                    | 95.00 – 105.00          | 1  | 137.0                                   | 1                                      | 11.0   | 0.106   |
| M1.5KE110A           | 94.00                                    | 105.00 – 116.00         | 1  | 152.0                                   | 1                                      | 9.9  | 0.107   |
| M1.5KE120A           | 102.00                                   | 114.00 – 126.00         | 1  | 165.0                                   | 1                                      | 9.1  | 0.107   |
| M1.5KE130A           | 111.00                                   | 124.00 – 137.00         | 1  | 179.0                                   | 1                                      | 8.4  | 0.107   |
| M1.5KE150A           | 128.00                                   | 143.00 – 158.00         | 1  | 207.0                                   | 1                                      | 7.2  | 0.108   |
| M1.5KE160A           | 136.00                                   | 152.00 – 168.00         | 1  | 219.0                                   | 1                                      | 6.8  | 0.108   |
| M1.5KE170A           | 145.00                                   | 162.00 – 179.00         | 1  | 234.0                                   | 1                                      | 6.4  | 0.108   |
| M1.5KE180A           | 154.00                                   | 171.00 – 189.00         | 1  | 246.0                                   | 1                                      | 6.1  | 0.108   |
| M1.5KE200A           | 171.00                                   | 190.00 – 210.00         | 1  | 274.0                                   | 1                                      | 5.5  | 0.108   |
| M1.5KE220A           | 185.00                                   | 209.00 – 231.00         | 1  | 328.0                                   | 1                                      | 4.6  | 0.110   |
| M1.5KE250A           | 214.00                                   | 237.00 – 263.00         | 1  | 344.0                                   | 1                                      | 5.0  | 0.110   |
| M1.5KE300A           | 256.00                                   | 285.00 – 315.00         | 1  | 414.0                                   | 1                                      | 5.0  | 0.111   |
| M1.5KE350A           | 300.00                                   | 332.00 – 368.00         | 1  | 482.0                                   | 1                                      | 4.0  | 0.111   |
| M1.5KE400A           | 324.00                                   | 380.00 – 420.00         | 1  | 548.0                                   | 1                                      | 4.0  | 0.111   |

- NOTES:**
1. Normal selection criteria for TVS devices is by rated stand-off voltage ( $V_{WM}$ ) and should be equal or greater than dc or continuous peak operating voltage.
  2. TVS devices are tested to maximum peak pulse current ( $I_{PP}$ ) with clamping voltage monitored. This surge capability is one of the most significant electrical characteristics of the device and should be considered as part of customer quality inspections.
  3. For Bidirectional types having  $V_{WM}$  of 8 volts and under, the  $I_D$  leakage current is doubled. Also for bidirectional parts, the capacitance will be half that shown in Fig. 2 for zero bias.
  4. For unidirectional, the forward voltage ( $V_F$ ) is 3.5 volts maximum at 100 Amps peak for 8.3 ms half-sine wave.

GRAPHS



**FIGURE 1**  
Peak Pulse Power vs Pulse Time ( $t_w$ ) in  $\mu s$



**FIGURE 2**  
Pulse Waveform for 10/1000 Exponential Surge

GRAPHS (continued)



**FIGURE 3**  
Derating Curve



**FIGURE 4**  
Typical Capacitance vs. Breakdown Voltage

**PACKAGE DIMENSIONS**

**NOTES:**

- 1 Dimensions are in inches.
- 2 Millimeter equivalents are given for information only.
- 3 The major diameter is essentially constant along its length.
- 4 In accordance with ASME Y14.5M, diameters are equivalent to  $\Phi$ x symbology.

| Symbol    | Dimensions |       |             |       |
|-----------|------------|-------|-------------|-------|
|           | Inches     |       | Millimeters |       |
|           | Min        | Max   | Min         | Max   |
| <b>BD</b> | 0.190      | 0.205 | 4.826       | 5.207 |
| <b>BL</b> | 0.360      | 0.375 | 9.146       | 9.527 |
| <b>LD</b> | 0.038      | 0.042 | 0.958       | 1.074 |
| <b>LL</b> | 1.10       | 1.625 | 27.9        | 41.28 |