

# DATA SHEET

## METAL OXIDE VARISTORS POWER SUPPLY

10D series

RoHS compliant & Halogen free



Product specification— February 12, 2019 V.0



## Metal Oxide Varistors (MOV) Data Sheet

### Features

- Wide operating voltage ( $V_{1mA}$ ) range from 18V to 1100V
- Fast responding to transient over-voltage
- Large absorbing transient energy capability
- Low clamping ratio and no follow-on current
- Meets MSL level 1, per J-STD-020
- Operating Temperature:  $-40^{\circ}\text{C} \sim +105^{\circ}\text{C}$
- Storage Temperature:  $-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$
- Safety certification:   UL: E327997  
                                  CSA: 246579  
                                  VDE: 40027827



### Applications

- Transistor, diode, IC, thyristor or triac semiconductor protection
- Surge protection in consumer electronics
- Surge protection in industrial electronics
- Surge protection in electronic home appliances, gas and petroleum appliances
- Relay and electromagnetic valve surge absorption

### Part Number Code



**Dimensions**



| Table 1  |           |
|----------|-----------|
| Unit: mm |           |
| Symbol   | Dimension |
| H        | 10.5~16.0 |
| H1       | 13.0~17.5 |
| L(min.)  | 20.0      |
| L1(min.) | 15.0      |
| D        | 10.0~12.5 |
| F(±0.8)  | 7.5       |
| T        | Table 2   |
| e(±0.8)  | Table 2   |
| d(±0.05) | 0.8       |
| d1(±0.4) | 1.4       |

| Table 2  |         |     |       |         |     |
|----------|---------|-----|-------|---------|-----|
| Unit: mm |         |     |       |         |     |
| Model    | T       | e   | Model | T       | e   |
| 180K     | 2.0~4.6 | 1.5 | 301K  | 2.7~5.5 | 2.5 |
| 220K     | 2.1~4.7 | 1.6 | 331K  | 2.7~5.8 | 2.5 |
| 270K     | 2.1~4.8 | 1.8 | 361K  | 2.9~6.0 | 2.7 |
| 330K     | 2.2~5.0 | 1.7 | 391K  | 3.0~6.2 | 2.8 |
| 390K     | 2.1~5.3 | 1.8 | 431K  | 3.2~6.5 | 3.0 |
| 470K     | 2.2~5.4 | 1.9 | 471K  | 3.3~6.7 | 3.2 |
| 560K     | 2.3~5.5 | 2.1 | 511K  | 3.4~6.8 | 3.4 |
| 680K     | 2.4~5.6 | 2.4 | 561K  | 3.6~7.0 | 3.6 |
| 820K     | 2.1~4.7 | 1.8 | 621K  | 3.8~7.3 | 3.9 |
| 101K     | 2.4~4.9 | 2.0 | 681K  | 4.0~7.6 | 4.2 |
| 121K     | 2.4~5.1 | 2.2 | 751K  | 4.3~8.0 | 4.3 |
| 151K     | 2.2~5.4 | 1.8 | 781K  | 4.4~8.1 | 4.4 |
| 181K     | 2.3~4.8 | 1.9 | 821K  | 4.6~8.3 | 4.6 |
| 201K     | 2.4~5.0 | 2.0 | 911K  | 4.8~8.8 | 5.0 |
| 221K     | 2.5~5.1 | 2.1 | 102K  | 5.4~9.3 | 5.0 |
| 241K     | 2.6~5.2 | 2.2 | 112K  | 5.8~9.9 | 5.4 |
| 271K     | 2.6~5.4 | 2.4 |       |         |     |

**METAL OXIDE VARISTORS**

10D

**Electrical Characteristics**

| Part Number |            | Maximum Allowable Voltage |                     | Varistor Voltage     | Maximum Clamping Voltage |                    | Withstanding Surge Current |                  | Maximum Energy (10/1000µs) |                | Rated Power | Typical Capacitance (Reference) |
|-------------|------------|---------------------------|---------------------|----------------------|--------------------------|--------------------|----------------------------|------------------|----------------------------|----------------|-------------|---------------------------------|
| Standard    | High Surge | V <sub>AC</sub> (V)       | V <sub>DC</sub> (V) | V <sub>1mA</sub> (V) | I <sub>P</sub> (A)       | V <sub>C</sub> (V) | I (A) Standard             | I (A) High Surge | (J) Standard               | (J) High Surge | (W)         | @1KHz (pf)                      |
| 180KD10     | 180KD10J   | 11                        | 14                  | 18(15~21.6)          | 5                        | 36                 | 500                        | 1000             | 2.1                        | 3.0            | 0.05        | 5600                            |
| 220KD10     | 220KD10J   | 14                        | 18                  | 22(19.5~26)          | 5                        | 43                 | 500                        | 1000             | 2.5                        | 5.0            | 0.05        | 4500                            |
| 270KD10     | 270KD10J   | 17                        | 22                  | 27(25~31)            | 5                        | 53                 | 500                        | 1000             | 3.0                        | 6.0            | 0.05        | 3700                            |
| 330KD10     | 330KD10J   | 20                        | 26                  | 33(29.5~36.5)        | 5                        | 65                 | 500                        | 1000             | 4.0                        | 7.0            | 0.05        | 3000                            |
| 390KD10     | 390KD10J   | 25                        | 31                  | 39(35~43)            | 5                        | 77                 | 500                        | 1000             | 4.6                        | 9.0            | 0.05        | 2400                            |
| 470KD10     | 470KD10J   | 30                        | 38                  | 47(42~52)            | 5                        | 93                 | 500                        | 1000             | 5.5                        | 11.0           | 0.05        | 2100                            |
| 560KD10     | 560KD10J   | 35                        | 45                  | 56(50~62)            | 5                        | 110                | 500                        | 1000             | 7.0                        | 13.0           | 0.05        | 1800                            |
| 680KD10     | 680KD10J   | 40                        | 56                  | 68(61~75)            | 5                        | 135                | 500                        | 1000             | 8.2                        | 15.0           | 0.05        | 1500                            |
| 820KD10     | 820KD10J   | 50                        | 65                  | 82(74~90)            | 25                       | 135                | 2500                       | 3500             | 12.0                       | 17.0           | 0.4         | 1200                            |
| 101KD10     | 101KD10J   | 60                        | 85                  | 100(90~110)          | 25                       | 165                | 2500                       | 3500             | 15.0                       | 18.0           | 0.4         | 1000                            |
| 121KD10     | 121KD10J   | 75                        | 100                 | 120(108~132)         | 25                       | 200                | 2500                       | 3500             | 18.0                       | 21.0           | 0.4         | 830                             |
| 151KD10     | 151KD10J   | 95                        | 125                 | 150(135~165)         | 25                       | 250                | 2500                       | 3500             | 22.0                       | 25.0           | 0.4         | 670                             |
| 181KD10     | 181KD10J   | 115                       | 150                 | 180(162~198)         | 25                       | 300                | 2500                       | 3500             | 27.0                       | 30.0           | 0.4         | 560                             |
| 201KD10     | 201KD10J   | 130                       | 170                 | 200(180~220)         | 25                       | 340                | 2500                       | 3500             | 30.0                       | 35.0           | 0.4         | 500                             |
| 221KD10     | 221KD10J   | 140                       | 180                 | 220(198~242)         | 25                       | 360                | 2500                       | 3500             | 32.0                       | 39.0           | 0.4         | 450                             |
| 241KD10     | 241KD10J   | 150                       | 200                 | 240(216~264)         | 25                       | 395                | 2500                       | 3500             | 35.0                       | 42.0           | 0.4         | 420                             |
| 271KD10     | 271KD10J   | 175                       | 225                 | 270(243~297)         | 25                       | 455                | 2500                       | 3500             | 37.0                       | 49.0           | 0.4         | 370                             |
| 301KD10     | 301KD10J   | 190                       | 250                 | 300(270~330)         | 25                       | 500                | 2500                       | 3500             | 40.0                       | 54.0           | 0.4         | 330                             |
| 331KD10     | 331KD10J   | 210                       | 275                 | 330(297~363)         | 25                       | 550                | 2500                       | 3500             | 43.0                       | 58.0           | 0.4         | 300                             |
| 361KD10     | 361KD10J   | 230                       | 300                 | 360(324~396)         | 25                       | 595                | 2500                       | 3500             | 47.0                       | 65.0           | 0.4         | 280                             |
| 391KD10     | 391KD10J   | 250                       | 320                 | 390(351~429)         | 25                       | 650                | 2500                       | 3500             | 60.0                       | 70.0           | 0.4         | 260                             |
| 431KD10     | 431KD10J   | 275                       | 350                 | 430(387~473)         | 25                       | 710                | 2500                       | 3500             | 65.0                       | 80.0           | 0.4         | 230                             |
| 471KD10     | 471KD10J   | 300                       | 385                 | 470(423~517)         | 25                       | 775                | 2500                       | 3500             | 67.0                       | 85.0           | 0.4         | 210                             |
| 511KD10     | 511KD10J   | 320                       | 415                 | 510(459~561)         | 25                       | 845                | 2500                       | 3500             | 69.0                       | 90.0           | 0.4         | 200                             |
| 561KD10     | 561KD10J   | 350                       | 460                 | 560(504~616)         | 25                       | 925                | 2500                       | 3500             | 70.0                       | 92.0           | 0.4         | 180                             |
| 621KD10     | 621KD10J   | 385                       | 505                 | 620(558~682)         | 25                       | 1025               | 2500                       | 3500             | 72.0                       | 95.0           | 0.4         | 160                             |
| 681KD10     | 681KD10J   | 420                       | 560                 | 680(612~748)         | 25                       | 1120               | 2500                       | 3500             | 75.0                       | 98.0           | 0.4         | 150                             |
| 751KD10     | 751KD10J   | 460                       | 615                 | 750(675~825)         | 25                       | 1240               | 2500                       | 3500             | 77.0                       | 100.0          | 0.4         | 130                             |
| 781KD10     | 781KD10J   | 485                       | 640                 | 780(702~858)         | 25                       | 1290               | 2500                       | 3500             | 80.0                       | 105.0          | 0.4         | 125                             |
| 821KD10     | 821KD10J   | 510                       | 670                 | 820(738~902)         | 25                       | 1355               | 2500                       | 3500             | 85.0                       | 110.0          | 0.4         | 120                             |
| 911KD10     | 911KD10J   | 550                       | 745                 | 910(819~1001)        | 25                       | 1500               | 2500                       | 3500             | 93.0                       | 130.0          | 0.4         | 110                             |
| 102KD10     | 102KD10J   | 625                       | 825                 | 1000(900~1100)       | 25                       | 1650               | 2500                       | 3500             | 102.0                      | 140.0          | 0.4         | 100                             |
| 112KD10     | 112KD10J   | 680                       | 895                 | 1100(990~1210)       | 25                       | 1815               | 2500                       | 3500             | 115.0                      | 155.0          | 0.4         | 90                              |

Notes: 1. The tolerance of varistor voltage between 18V and 27V is more than 10%.

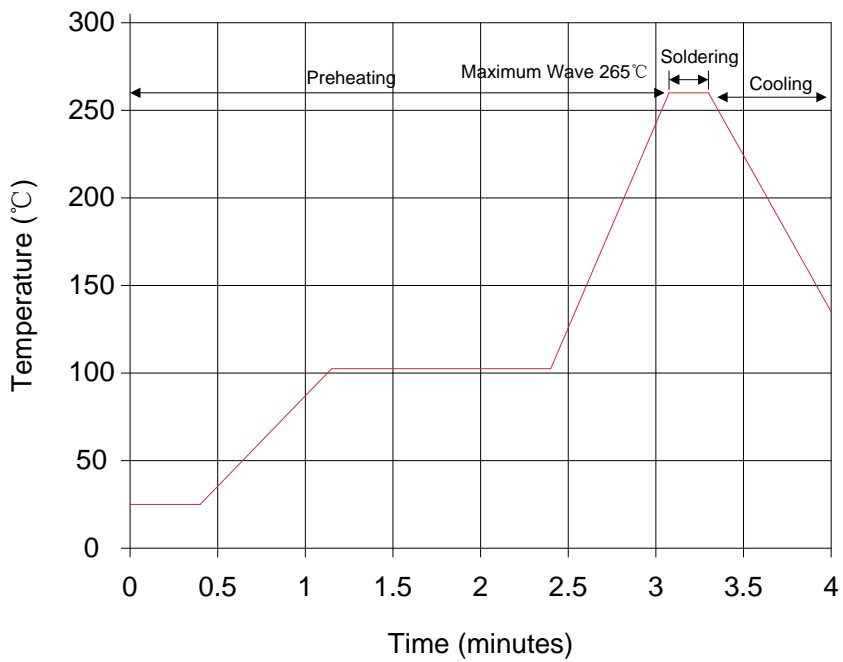
2. Leakage Current (@83% of V<sub>1mA</sub>): IR≤50µA (180K~680K)  
IR≤25µA (820K~112K)

**Electrical Ratings**

| Items                              | Test Condition/Description  | Requirement   |                             |              |              |               |  |
|------------------------------------|---|---------------|-----------------------------|--------------|--------------|---------------|--|
| Varistor Voltage                   | The voltage between two terminals with the specified measuring current 1mA.DC applied is called Vb.   |               |                             |              |              |               |  |
| Maximum Allowable Voltage          | The recommended maximum sine wave voltage (RMS) or the Maximum DC voltage can be applied continuously.  |               |                             |              |              |               |  |
| Maximum Clamping Voltage           | <p>The maximum voltage between two terminals with the specification standard impulse current.<br/>Applied waveform: 8/20µs</p>  |               | To meet the Specified value |              |              |               |  |
| Rated Wattage                      | The maximum average power that can be applied within the specified ambient temperature.   |               |                             |              |              |               |  |
| Energy                             | The maximum energy within the varistor voltage change of ±10% when one impulse of 10/1000µs or 2ms is applied.  |               |                             |              |              |               |  |
| Withstanding Surge Current         | The maximum current within the varistor voltage change of ±10% with the standard impulse current (8/20µs) applied one time.   |               |                             |              |              |               |  |
| Varistor Voltage Temp. Coefficient | $\left  \frac{V_{1mA@85^{\circ}C} - V_{1mA@25^{\circ}C}}{V_{1mA@25^{\circ}C}} \times \frac{1}{60} \times 100\% (\%/^{\circ}C) \right $<br>$\left  \frac{V_{1mA@-40^{\circ}C} - V_{1mA@25^{\circ}C}}{V_{1mA@25^{\circ}C}} \times \frac{1}{65} \times 100\% (\%/^{\circ}C) \right $   | ≤0.05%/°C     |                             |              |              |               |  |
| Surge Life                         | <p>The change of Vb shall be measured after the impulse listed below which is applied 10,000 times continuously with the interval of ten seconds at room temperature.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td rowspan="2" style="text-align: center;">10Φ series</td> <td style="text-align: center;">180K to 680K</td> <td style="text-align: center;">50A (8/20µs)</td> </tr> <tr> <td style="text-align: center;">820K to 112K</td> <td style="text-align: center;">100A (8/20µs)</td> </tr> </table> | 10Φ series    | 180K to 680K                | 50A (8/20µs) | 820K to 112K | 100A (8/20µs) | $\frac{\Delta V_b}{V_b} \leq \pm 10\%$ |
| 10Φ series                         | 180K to 680K  |               | 50A (8/20µs)                |              |              |               |  |
|                                    | 820K to 112K  | 100A (8/20µs) |                             |              |              |               |  |

**Soldering Recommendation**

Wave Lead Free Soldering Recommendation



| Item             | Conditions        |
|------------------|-------------------|
| Peak Temperature | 265°C             |
| Dipping Time     | 10 seconds (max.) |
| Soldering        | 1 time            |

Recommendation Reworking Conditions with Soldering Iron

| Item                              | Conditions       |
|-----------------------------------|------------------|
| Temperature of Soldering Iron-tip | 360°C (max.)     |
| Soldering Time                    | 3 seconds (max.) |
| Distance from Varistor            | 2mm (min.)       |

**Mechanical Characteristics**

| Items                         | Test conditions / Methods   | Specifications   |            |           |     |            |     |        |     |   |
|-------------------------------|---|--|------------|-----------|-----|------------|-----|--------|-----|---|
| Tensile Strength of Terminals | Gradually applying the force specified and keeping the unit fixed for 10±1 sec.<br><br><table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Force (kg)</th> </tr> </thead> <tbody> <tr> <td>0.5&lt;d≤0.8</td> <td>1.0</td> </tr> <tr> <td>0.8&lt;d≤1.25</td> <td>2.0</td> </tr> <tr> <td>1.25&lt;d</td> <td>4.0</td> </tr> </tbody> </table>   | Terminal diameter (mm)   | Force (kg) | 0.5<d≤0.8 | 1.0 | 0.8<d≤1.25 | 2.0 | 1.25<d | 4.0 | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5% |
| Terminal diameter (mm)        | Force (kg)  |  |            |           |     |            |     |        |     |   |
| 0.5<d≤0.8                     | 1.0   |  |            |           |     |            |     |        |     |   |
| 0.8<d≤1.25                    | 2.0   |  |            |           |     |            |     |        |     |   |
| 1.25<d                        | 4.0   |  |            |           |     |            |     |        |     |   |
| Bending Strength of Terminals | Hold specimen and apply the force specified below to each lead. Bend the specimen to 90°, then return to the original position. Repeat the procedure in the opposite direction.<br><br><table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Force (kg)</th> </tr> </thead> <tbody> <tr> <td>0.5&lt;d≤0.8</td> <td>0.5</td> </tr> <tr> <td>0.8&lt;d≤1.25</td> <td>1.0</td> </tr> <tr> <td>1.25&lt;d</td> <td>2.0</td> </tr> </tbody> </table> | Terminal diameter (mm)   | Force (kg) | 0.5<d≤0.8 | 0.5 | 0.8<d≤1.25 | 1.0 | 1.25<d | 2.0 | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5% |
| Terminal diameter (mm)        | Force (kg)  |  |            |           |     |            |     |        |     |   |
| 0.5<d≤0.8                     | 0.5   |  |            |           |     |            |     |        |     |   |
| 0.8<d≤1.25                    | 1.0   |  |            |           |     |            |     |        |     |   |
| 1.25<d                        | 2.0   |  |            |           |     |            |     |        |     |   |
| Vibration                     | Frequency range: 10~55 Hz<br>Amplitude: 0.75mm or 98m/s <sup>2</sup><br>Direction: 3 mutually perpendicular directions, 2hrs each.  | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5%  |            |           |     |            |     |        |     |   |
| Solder ability                | Solder Temp: 245±5°C<br>Dipping Time: 2±0.5 sec   | At least 95% of terminal electrode is covered by new solder      |            |           |     |            |     |        |     |   |
| Resistance to Soldering Heat  | Solder Temp: 260±5°C<br>Dipping Time: 10±1 sec  | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤10% |            |           |     |            |     |        |     |   |

**Reliability**

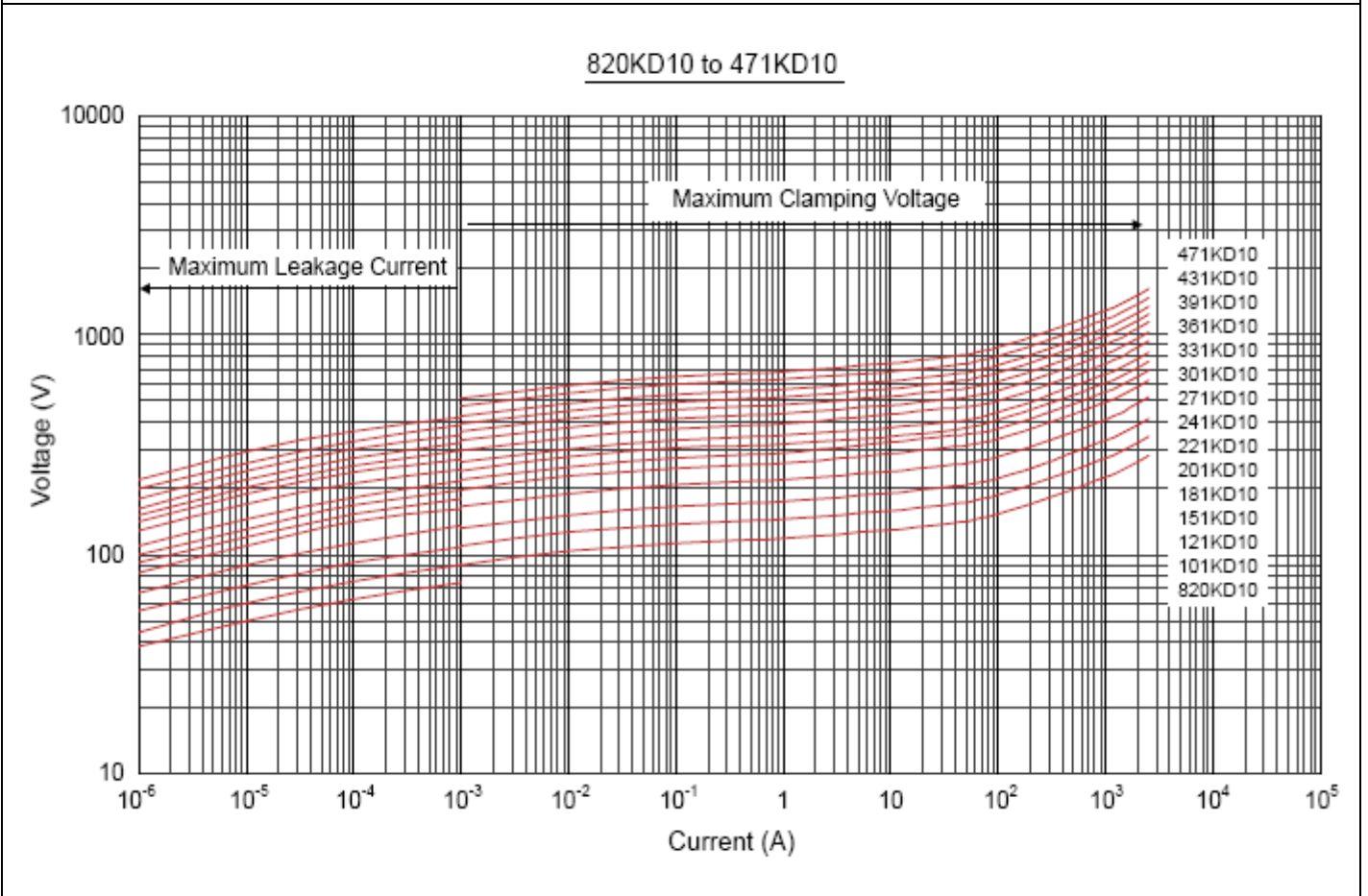
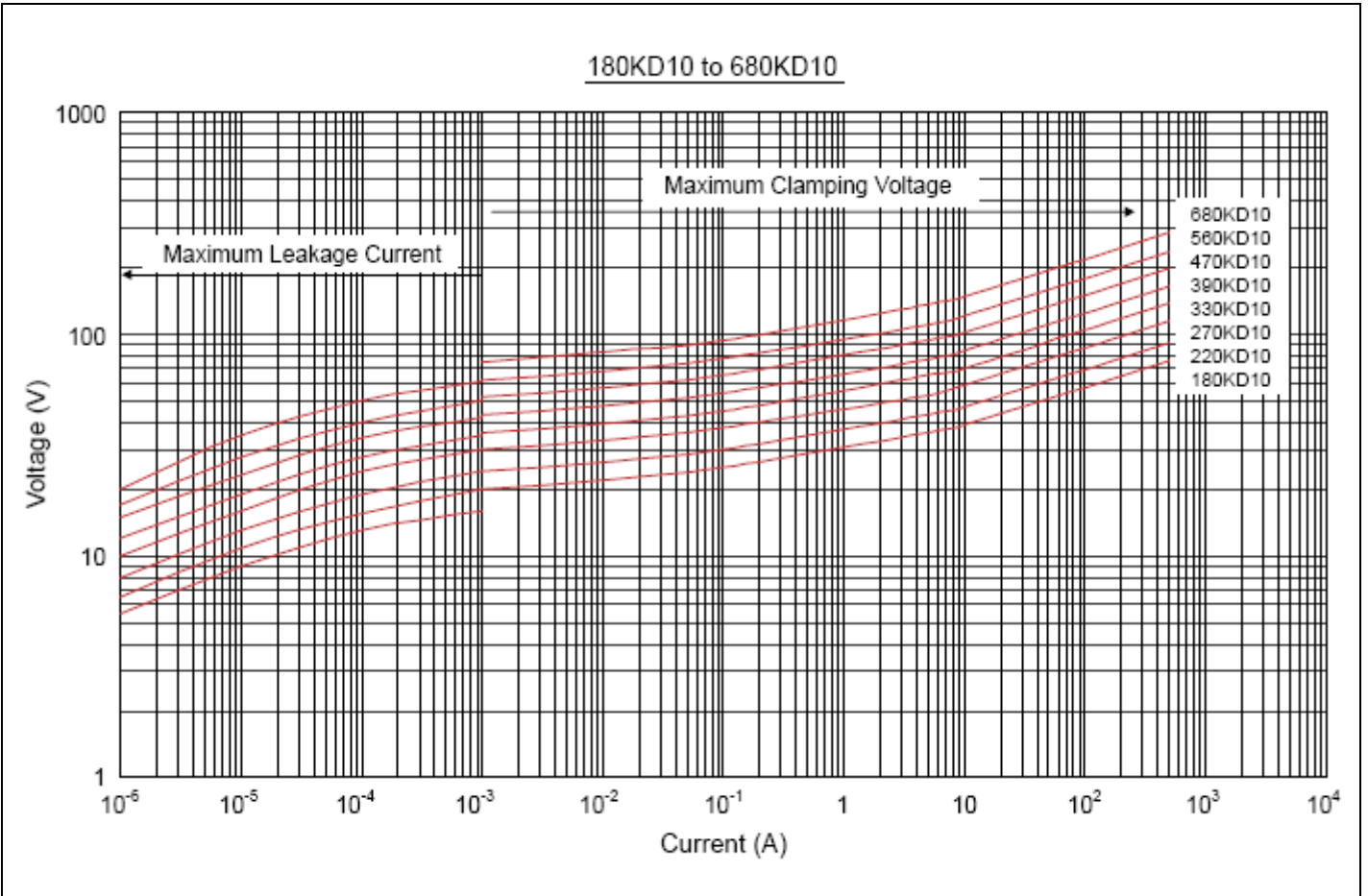
| Items                    | Test conditions / Methods   | Specifications   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
|--------------------------|---|--|------------------|------------------|---|-------|------|---|------------------|------|---|-------|------|---|------------------|------|---|
| High Temperature Storage | Ambient Temp: 125±2°C<br>Duration: 1000hrs  | ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5%                        |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| Low Temperature Storage  | Ambient Temp: -40±2°C<br>Duration: 1000hrs  | ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5%                        |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| Humidity                 | Ambient Temp: 40±2°C, 90~95% R.H.<br>Duration: 1000hrs  | ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5%                        |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| Temperature Cycle        | The conditions shown below shall be repeated 5 cycles<br><table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Period (minutes)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40±3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>15±3</td> </tr> <tr> <td>3</td> <td>125±3</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>15±3</td> </tr> </tbody> </table> | Step   | Temperature (°C) | Period (minutes) | 1 | -40±3 | 30±3 | 2 | Room temperature | 15±3 | 3 | 125±3 | 30±3 | 4 | Room temperature | 15±3 | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤5% |
| Step                     | Temperature (°C)  | Period (minutes)   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| 1                        | -40±3   | 30±3   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| 2                        | Room temperature  | 15±3   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| 3                        | 125±3   | 30±3   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| 4                        | Room temperature  | 15±3   |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| High Temperature Load    | Ambient Temp: 105±2°C      Duration: 1000hrs<br>Load: Max. Allowable Voltage In AC era.   | ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤10%                       |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| Damp Heat Load           | Ambient Temp: 40±2°C, 90~95% R.H.<br>Duration: 1000hrs      Load: Max. Allowable Voltage  | No visible damage<br> ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤10% |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |
| Voltage Proof            | Metal balls method, 2500Vac 1 min.  | No visible damage  |                  |                  |   |       |      |   |                  |      |   |       |      |   |                  |      |   |

**Maximum Surge Current Derating Curve**





Maximum Leakage Current and Maximum Clamping Voltage Curve



**Maximum Leakage Current and Maximum Clamping Voltage Curve**



Maximum Leakage Current and Maximum Clamping Voltage Curve

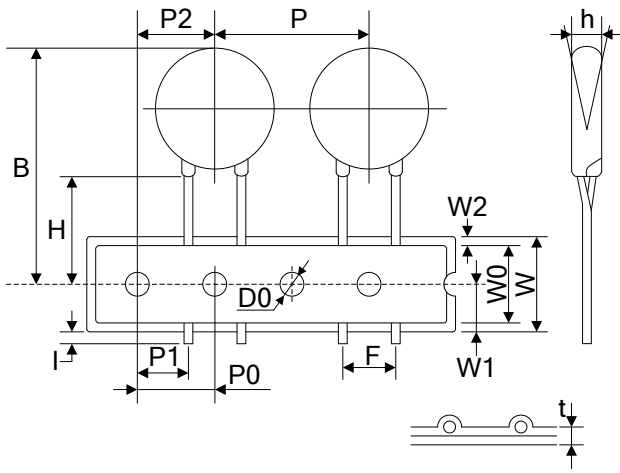


**Marking Code**



① Brightking Logo  
 ② Varistor Voltage  
 ③ UL Accreditation Logo  
 ④ CSA Accreditation Logo  
 ⑤ VDE Accreditation Logo  
 ⑥ “J” is High Surge Code, no “J” is Standard Surge  
 ⑦ Disk Size  
 ⑧ Product Line Code (“Y” may be A(a) thru Z(z))  
 ⑨ Date Code

**Taping Dimensions**



| Symbol | Dimension (mm) |
|--------|----------------|
| P      | 25.4±1.0       |
| P0     | 12.7±1.0       |
| P1     | 8.95±0.7       |
| P2     | 12.7±1.3       |
| F      | 7.5±0.8        |
| h      | 0±2            |
| W      | 18.0±1.0       |
| W0     | 12.0±1.0       |
| W1     | 9.0±0.5        |
| W2     | 3.0max         |
| H      | 20.0±2.0       |
| I      | 1.0max         |
| D0     | 4.0±0.2        |
| t      | 0.6±0.3        |
| B      | 36max          |

**Quantity**

| Packaging Dimensions (Unit: mm)   | Quantity                               |
|---|--|
| Exposure in bulk<br>     | 500pcs/bag<br>4bags/box<br>(180K~621K) |
|   | 400pcs/bag<br>4bags/box<br>(681K~112K) |
| Cut the feet in bulk<br> | 500pcs/bag<br>4bags/box<br>(180K~621K) |
|   | 400pcs/bag<br>4bags/box<br>(681K~112K) |
| Tape & Box<br>         | 750pcs/box<br>(180K~391K)              |
|   | 500pcs/box<br>(431K~621K)              |
|   | 300pcs/box<br>(681K~751K)              |
| Tape & Reel<br>       | 1000pcs/reel<br>(180K~391K)            |
|   | 750pcs/reel<br>(431K~621K)             |
|   | 500pcs/reel<br>(681K~751K)             |

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкуренеспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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