



## Features

- Formerly a **KEKOVARICON** product
- Five model sizes available - 7, 10, 14, 20 and 23 mm
- Broad range of current and energy handling capabilities
- 60 to 550  $V_{rms}$  AC voltage range; higher voltages available upon request
- 85 to 745 Vdc DC operating voltage range
- Available in tape and reel packaging for automatic pick-and-place (7-20 mm)
- RoHS compliant\*

## CVQ Series - Extended Medium Voltage Disc Varistors

### General Information

The CVQ series of transient surge suppressors is the extended version of CV series disc shaped varistors. The CVQ series consists of 7 mm, 10 mm, 14 mm, 20 mm and 23 mm sized varistors with extremely high current and energy capabilities. This series provides an increased level of protection for the transients expected in telecommunication and AC power networks. The AC operating voltage of these varistors ranges from 60 V to 550 V.

### Absolute Maximum Ratings

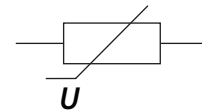
| Parameter                                                            | Value         | Units      |
|----------------------------------------------------------------------|---------------|------------|
| <b>Continuous:</b>                                                   |               |            |
| Steady State Applied Voltage                                         |               |            |
| DC Voltage Range ( $V_{dc}$ )                                        | 85 to 745     | V          |
| AC Voltage Range ( $V_{rms}$ )                                       | 60 to 550     | V          |
| <b>Transient:</b>                                                    |               |            |
| Peak Single Pulse Surge Current, 8/20 $\mu s$ Waveform ( $I_{max}$ ) | 1750 to 15000 | A          |
| Single Pulse Surge Energy, 10/1000 $\mu s$ Waveform ( $W_{max}$ )    | 9 to 627      | J          |
| Operating Ambient Temperature                                        | -40 to +85    | °C         |
| Storage Temperature Range                                            | -40 to +125   | °C         |
| Threshold Voltage Temperature Coefficient                            | < +0.05       | %/°C       |
| Insulation Resistance                                                | > 1           | G $\Omega$ |
| Isolation Voltage Capability                                         | > 2.5         | kV         |
| Response Time                                                        | < 25          | ns         |
| Climatic Category                                                    | 40 / 85 / 56  |            |

### Agency Recognition

| Standard    | UL 1449                   |
|-------------|---------------------------|
| File Number | <a href="#">E313168**</a> |

\*\*Not all rated voltages are UL recognized; check the file for details.

### Varistor Symbol



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**WARNING Cancer and Reproductive Harm - [www.P65Warnings.ca.gov](http://www.P65Warnings.ca.gov)**

\*RoHS Directive 2015/863, Mar 31, 2015 and Annex.

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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Device Ratings

| Model        | V <sub>rms</sub> | V <sub>dc</sub> | V <sub>n</sub><br>@ 1 mA | V <sub>c</sub> | I <sub>c</sub> | W <sub>max</sub><br>10/1000 $\mu$ s | P<br>max. | I <sub>max</sub><br>8/20 $\mu$ s | C Typ.<br>@ 1 kHz |
|--------------|------------------|-----------------|--------------------------|----------------|----------------|-------------------------------------|-----------|----------------------------------|-------------------|
|              | V                | V               | V                        | V              | A              | J                                   | W         | A                                | pF                |
| CVQ 60 K 7   | 60               | 85              | 100                      | 165            | 10             | 9                                   | 0.25      | 1750                             | 680               |
| CVQ 60 K 10  | 60               | 85              | 100                      | 165            | 25             | 18                                  | 0.4       | 3500                             | 1200              |
| CVQ 60 K 14  | 60               | 85              | 100                      | 165            | 50             | 38                                  | 0.6       | 6000                             | 2200              |
| CVQ 60 K 20  | 60               | 85              | 100                      | 165            | 100            | 77                                  | 1         | 12000                            | 4100              |
| CVQ 75 K 7   | 75               | 100             | 120                      | 200            | 10             | 11                                  | 0.25      | 1750                             | 550               |
| CVQ 75 K 10  | 75               | 100             | 120                      | 200            | 25             | 24                                  | 0.4       | 3500                             | 950               |
| CVQ 75 K 14  | 75               | 100             | 120                      | 200            | 50             | 46                                  | 0.6       | 6000                             | 1800              |
| CVQ 75 K 20  | 75               | 100             | 120                      | 200            | 100            | 88                                  | 1         | 12000                            | 3300              |
| CVQ 95 K 7   | 95               | 125             | 150                      | 250            | 10             | 14                                  | 0.25      | 1750                             | 440               |
| CVQ 95 K 10  | 95               | 125             | 150                      | 250            | 25             | 28                                  | 0.4       | 3500                             | 750               |
| CVQ 95 K 14  | 95               | 125             | 150                      | 250            | 50             | 58                                  | 0.6       | 6000                             | 1400              |
| CVQ 95 K 20  | 95               | 125             | 150                      | 250            | 100            | 116                                 | 1         | 12000                            | 2600              |
| CVQ 115 K 7  | 115              | 150             | 180                      | 300            | 10             | 16                                  | 0.25      | 1750                             | 360               |
| CVQ 115 K 10 | 115              | 150             | 180                      | 300            | 25             | 34                                  | 0.4       | 3500                             | 650               |
| CVQ 115 K 14 | 115              | 150             | 180                      | 300            | 50             | 71                                  | 0.6       | 6000                             | 1200              |
| CVQ 115 K 20 | 115              | 150             | 180                      | 300            | 100            | 128                                 | 1         | 12000                            | 2100              |
| CVQ 130 K 7  | 130              | 170             | 205                      | 340            | 10             | 19                                  | 0.25      | 1750                             | 360               |
| CVQ 130 K 10 | 130              | 170             | 205                      | 340            | 25             | 38                                  | 0.4       | 3500                             | 580               |
| CVQ 130 K 14 | 130              | 170             | 205                      | 340            | 50             | 77                                  | 0.6       | 6000                             | 1050              |
| CVQ 130 K 20 | 130              | 170             | 205                      | 340            | 100            | 154                                 | 1         | 12000                            | 1900              |
| CVQ 130 K 23 | 130              | 170             | 205                      | 340            | 100            | 172                                 | 1         | 15000                            | 3500              |
| CVQ 140 K 7  | 140              | 180             | 220                      | 360            | 10             | 22                                  | 0.25      | 1750                             | 300               |
| CVQ 140 K 10 | 140              | 180             | 220                      | 360            | 25             | 42                                  | 0.4       | 3500                             | 540               |
| CVQ 140 K 14 | 140              | 180             | 220                      | 360            | 50             | 85                                  | 0.6       | 6000                             | 980               |
| CVQ 140 K 20 | 140              | 180             | 220                      | 360            | 100            | 170                                 | 1         | 12000                            | 1800              |
| CVQ 140 K 23 | 140              | 180             | 220                      | 360            | 100            | 190                                 | 1         | 15000                            | 3200              |
| CVQ 150 K 7  | 150              | 200             | 240                      | 395            | 10             | 23                                  | 0.25      | 1750                             | 280               |
| CVQ 150 K 10 | 150              | 200             | 240                      | 395            | 25             | 46                                  | 0.4       | 3500                             | 510               |
| CVQ 150 K 14 | 150              | 200             | 240                      | 395            | 50             | 92                                  | 0.6       | 6000                             | 900               |
| CVQ 150 K 20 | 150              | 200             | 240                      | 395            | 100            | 185                                 | 1         | 12000                            | 1600              |
| CVQ 150 K 23 | 150              | 200             | 240                      | 395            | 100            | 207                                 | 1         | 15000                            | 2900              |
| CVQ 175 K 7  | 175              | 225             | 270                      | 455            | 10             | 26                                  | 0.25      | 1750                             | 250               |
| CVQ 175 K 10 | 175              | 225             | 270                      | 455            | 25             | 53                                  | 0.4       | 3500                             | 440               |
| CVQ 175 K 14 | 175              | 225             | 270                      | 455            | 50             | 108                                 | 0.6       | 6000                             | 800               |
| CVQ 175 K 20 | 175              | 225             | 270                      | 455            | 100            | 210                                 | 1         | 12000                            | 1400              |
| CVQ 175 K 23 | 175              | 225             | 270                      | 455            | 100            | 235                                 | 1         | 15000                            | 2500              |
| CVQ 230 K 7  | 230              | 300             | 360                      | 595            | 10             | 35                                  | 0.25      | 1750                             | 190               |
| CVQ 230 K 10 | 230              | 300             | 360                      | 595            | 25             | 71                                  | 0.4       | 3500                             | 350               |
| CVQ 230 K 14 | 230              | 300             | 360                      | 595            | 50             | 143                                 | 0.6       | 6000                             | 620               |
| CVQ 230 K 20 | 230              | 300             | 360                      | 595            | 100            | 280                                 | 1         | 12000                            | 1100              |
| CVQ 230 K 23 | 230              | 300             | 360                      | 595            | 100            | 313                                 | 1         | 15000                            | 2200              |
| CVQ 250 K 7  | 250              | 320             | 390                      | 650            | 10             | 38                                  | 0.25      | 1750                             | 180               |
| CVQ 250 K 10 | 250              | 320             | 390                      | 650            | 25             | 77                                  | 0.4       | 3500                             | 320               |
| CVQ 250 K 14 | 250              | 320             | 390                      | 650            | 50             | 154                                 | 0.6       | 6000                             | 580               |
| CVQ 250 K 20 | 250              | 320             | 390                      | 650            | 100            | 300                                 | 1         | 12000                            | 1000              |

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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Device Ratings (Continued)

| Model        | V <sub>rms</sub> | V <sub>dc</sub> | V <sub>n</sub><br>@ 1 mA | V <sub>c</sub> | I <sub>c</sub> | W <sub>max</sub><br>10/1000 $\mu$ s | P<br>max. | I <sub>max</sub><br>8/20 $\mu$ s | C Typ.<br>@ 1 kHz |
|--------------|------------------|-----------------|--------------------------|----------------|----------------|-------------------------------------|-----------|----------------------------------|-------------------|
|              | V                | V               | V                        | V              | A              | J                                   | W         | A                                | pF                |
| CVQ 250 K 23 | 250              | 320             | 390                      | 650            | 100            | 336                                 | 1         | 15000                            | 1900              |
| CVQ 275 K 7  | 275              | 350             | 430                      | 710            | 10             | 44                                  | 0.25      | 1750                             | 160               |
| CVQ 275 K 10 | 275              | 350             | 430                      | 710            | 25             | 88                                  | 0.4       | 3500                             | 300               |
| CVQ 275 K 14 | 275              | 350             | 430                      | 710            | 50             | 170                                 | 0.6       | 6000                             | 530               |
| CVQ 275 K 20 | 275              | 350             | 430                      | 710            | 100            | 330                                 | 1         | 12000                            | 900               |
| CVQ 275 K 23 | 275              | 350             | 430                      | 710            | 100            | 370                                 | 1         | 15000                            | 1600              |
| CVQ 300 K 7  | 300              | 385             | 470                      | 775            | 10             | 46                                  | 0.25      | 1750                             | 150               |
| CVQ 300 K 10 | 300              | 385             | 470                      | 775            | 25             | 93                                  | 0.4       | 3500                             | 280               |
| CVQ 300 K 14 | 300              | 385             | 470                      | 775            | 50             | 192                                 | 0.6       | 6000                             | 490               |
| CVQ 300 K 20 | 300              | 385             | 470                      | 775            | 100            | 380                                 | 1         | 12000                            | 850               |
| CVQ 300 K 23 | 300              | 385             | 470                      | 775            | 100            | 426                                 | 1         | 15000                            | 1300              |
| CVQ 320 K 10 | 320              | 420             | 510                      | 840            | 25             | 104                                 | 0.4       | 3500                             | 260               |
| CVQ 320 K 14 | 320              | 420             | 510                      | 840            | 50             | 209                                 | 0.6       | 6000                             | 460               |
| CVQ 320 K 20 | 320              | 420             | 510                      | 840            | 100            | 420                                 | 1         | 12000                            | 800               |
| CVQ 320 K 23 | 320              | 420             | 510                      | 840            | 100            | 470                                 | 1         | 15000                            | 1100              |
| CVQ 385 K 10 | 385              | 505             | 620                      | 1025           | 25             | 106                                 | 0.4       | 3500                             | 230               |
| CVQ 385 K 14 | 385              | 505             | 620                      | 1025           | 50             | 219                                 | 0.6       | 6000                             | 390               |
| CVQ 385 K 20 | 385              | 505             | 620                      | 1025           | 100            | 430                                 | 1         | 12000                            | 650               |
| CVQ 385 K 23 | 385              | 505             | 620                      | 1025           | 100            | 480                                 | 1         | 15000                            | 1000              |
| CVQ 420 K 10 | 420              | 560             | 680                      | 1120           | 25             | 110                                 | 0.4       | 3500                             | 210               |
| CVQ 420 K 14 | 420              | 560             | 680                      | 1120           | 50             | 230                                 | 0.6       | 6000                             | 370               |
| CVQ 420 K 20 | 420              | 560             | 680                      | 1120           | 100            | 460                                 | 1         | 12000                            | 620               |
| CVQ 420 K 23 | 420              | 560             | 680                      | 1120           | 100            | 515                                 | 1         | 15000                            | 950               |
| CVQ 460 K 10 | 460              | 615             | 750                      | 1240           | 25             | 120                                 | 0.4       | 3500                             | 200               |
| CVQ 460 K 14 | 460              | 615             | 750                      | 1240           | 50             | 250                                 | 0.6       | 6000                             | 340               |
| CVQ 460 K 20 | 460              | 615             | 750                      | 1240           | 100            | 500                                 | 1         | 12000                            | 560               |
| CVQ 460 K 23 | 460              | 615             | 750                      | 1240           | 100            | 560                                 | 1         | 15000                            | 900               |
| CVQ 510 K 10 | 510              | 670             | 820                      | 1355           | 25             | 131                                 | 0.4       | 3500                             | 180               |
| CVQ 510 K 14 | 510              | 670             | 820                      | 1355           | 50             | 258                                 | 0.6       | 6000                             | 310               |
| CVQ 510 K 20 | 510              | 670             | 820                      | 1355           | 100            | 520                                 | 1         | 12000                            | 510               |
| CVQ 510 K 23 | 510              | 670             | 820                      | 1355           | 100            | 582                                 | 1         | 15000                            | 650               |
| CVQ 550 K 10 | 550              | 745             | 910                      | 1500           | 25             | 153                                 | 0.4       | 3500                             | 170               |
| CVQ 550 K 14 | 550              | 745             | 910                      | 1500           | 50             | 300                                 | 0.6       | 6000                             | 290               |
| CVQ 550 K 20 | 550              | 745             | 910                      | 1500           | 100            | 560                                 | 1         | 12000                            | 480               |
| CVQ 550 K 23 | 550              | 745             | 910                      | 1500           | 100            | 627                                 | 1         | 15000                            | 800               |

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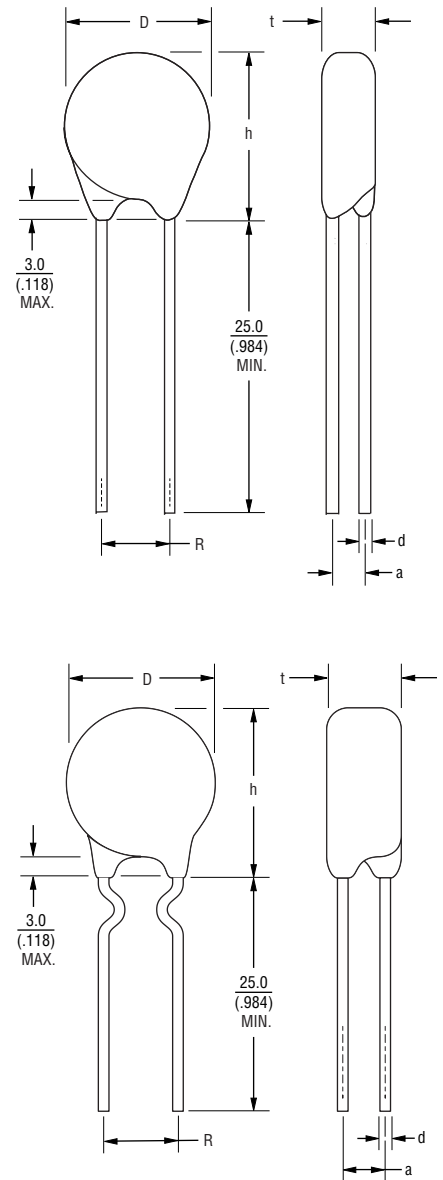
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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Product Dimensions

| Model        | Dimension             |                      |                      |                      |                       |                      |
|--------------|-----------------------|----------------------|----------------------|----------------------|-----------------------|----------------------|
|              | D (Max.)              | t (Max.)             | R                    | d                    | h (Max.)              | a                    |
| CVQ 60 K 7   | $\frac{9}{(.354)}$    | $\frac{3.5}{(.138)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.1}{(.043)}$ |
| CVQ 60 K 10  | $\frac{12.5}{(.492)}$ | $\frac{4.1}{(.161)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{1.4}{(.055)}$ |
| CVQ 60 K 14  | $\frac{16.5}{(.650)}$ | $\frac{4.2}{(.165)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{1.5}{(.059)}$ |
| CVQ 60 K 20  | $\frac{22.5}{(.886)}$ | $\frac{4.6}{(.186)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{1.7}{(.067)}$ |
| CVQ 75 K 7   | $\frac{9}{(.354)}$    | $\frac{3.6}{(.142)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.2}{(.047)}$ |
| CVQ 75 K 10  | $\frac{12.5}{(.492)}$ | $\frac{4.2}{(.165)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{1.5}{(.059)}$ |
| CVQ 75 K 14  | $\frac{16.5}{(.650)}$ | $\frac{4.2}{(.165)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{1.5}{(.059)}$ |
| CVQ 75 K 20  | $\frac{22.5}{(.886)}$ | $\frac{4.6}{(.186)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{1.7}{(.067)}$ |
| CVQ 95 K 7   | $\frac{9}{(.354)}$    | $\frac{3.8}{(.150)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.4}{(.055)}$ |
| CVQ 95 K 10  | $\frac{12}{(.472)}$   | $\frac{4.3}{(.169)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{1.7}{(.067)}$ |
| CVQ 95 K 14  | $\frac{16}{(.630)}$   | $\frac{4.3}{(.169)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{1.7}{(.067)}$ |
| CVQ 95 K 20  | $\frac{22.5}{(.886)}$ | $\frac{4.6}{(.186)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{1.9}{(.075)}$ |
| CVQ 115 K 7  | $\frac{9}{(.354)}$    | $\frac{4.0}{(.157)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.6}{(.063)}$ |
| CVQ 115 K 10 | $\frac{12.5}{(.492)}$ | $\frac{4.3}{(.169)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{1.9}{(.075)}$ |
| CVQ 115 K 14 | $\frac{16.5}{(.650)}$ | $\frac{4.4}{(.173)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{1.9}{(.075)}$ |
| CVQ 115 K 20 | $\frac{22.5}{(.886)}$ | $\frac{4.8}{(.189)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{2.1}{(.083)}$ |
| CVQ 130 K 7  | $\frac{9}{(.354)}$    | $\frac{4.0}{(.157)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.8}{(.071)}$ |
| CVQ 130 K 10 | $\frac{12.5}{(.492)}$ | $\frac{4.5}{(.177)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{2.0}{(.079)}$ |
| CVQ 130 K 14 | $\frac{16.5}{(.650)}$ | $\frac{4.6}{(.181)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{2.0}{(.079)}$ |
| CVQ 130 K 20 | $\frac{22.5}{(.886)}$ | $\frac{5.0}{(.197)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{2.2}{(.087)}$ |
| CVQ 130 K 23 | $\frac{25}{(.984)}$   | $\frac{5.0}{(.197)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{2.2}{(.087)}$ |
| CVQ 140 K 7  | $\frac{9}{(.354)}$    | $\frac{4.1}{(.161)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{1.9}{(.075)}$ |
| CVQ 140 K 10 | $\frac{12.5}{(.492)}$ | $\frac{4.6}{(.181)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{2.1}{(.083)}$ |
| CVQ 140 K 14 | $\frac{16.5}{(.650)}$ | $\frac{4.7}{(.185)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{2.1}{(.083)}$ |
| CVQ 140 K 20 | $\frac{22.5}{(.886)}$ | $\frac{5.1}{(.201)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{2.3}{(.091)}$ |
| CVQ 140 K 23 | $\frac{25}{(.984)}$   | $\frac{5.1}{(.201)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{2.3}{(.091)}$ |
| CVQ 150 K 7  | $\frac{9}{(.354)}$    | $\frac{4.3}{(.169)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{2.0}{(.079)}$ |
| CVQ 150 K 10 | $\frac{12.5}{(.492)}$ | $\frac{4.6}{(.181)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{2.2}{(.087)}$ |
| CVQ 150 K 14 | $\frac{16.5}{(.650)}$ | $\frac{4.8}{(.189)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{2.2}{(.087)}$ |
| CVQ 150 K 20 | $\frac{22.5}{(.886)}$ | $\frac{5.2}{(.205)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{2.4}{(.094)}$ |



DIMENSIONS:  $\frac{\text{MM}}{(\text{INCHES})}$

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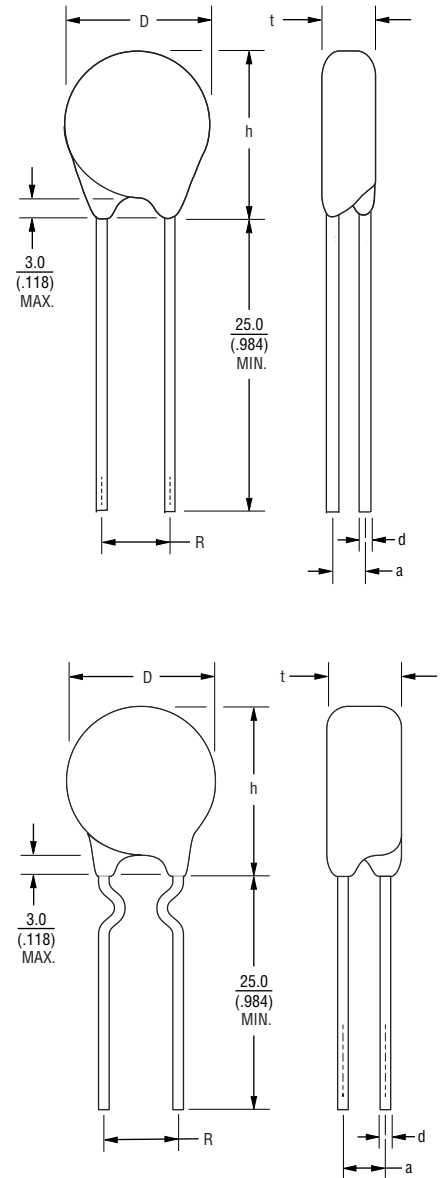
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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Product Dimensions (Continued)

| Model        | Dimension             |                      |                      |                      |                       |                      |
|--------------|-----------------------|----------------------|----------------------|----------------------|-----------------------|----------------------|
|              | D (Max.)              | t (Max.)             | R                    | d                    | h (Max.)              | a                    |
| CVQ 150 K 23 | $\frac{25}{(.984)}$   | $\frac{5.2}{(.205)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{2.4}{(.094)}$ |
| CVQ 175 K 7  | $\frac{9}{(.354)}$    | $\frac{4.8}{(.189)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{2.1}{(.083)}$ |
| CVQ 175 K 10 | $\frac{12.5}{(.492)}$ | $\frac{4.9}{(.193)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{2.3}{(.091)}$ |
| CVQ 175 K 14 | $\frac{16.5}{(.650)}$ | $\frac{4.9}{(.193)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{2.3}{(.091)}$ |
| CVQ 175 K 20 | $\frac{22.5}{(.886)}$ | $\frac{5.3}{(.209)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{2.5}{(.098)}$ |
| CVQ 175 K 23 | $\frac{25}{(.984)}$   | $\frac{5.3}{(.209)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{2.5}{(.098)}$ |
| CVQ 230 K 7  | $\frac{9}{(.354)}$    | $\frac{4.8}{(.189)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{2.6}{(.102)}$ |
| CVQ 230 K 10 | $\frac{12.5}{(.492)}$ | $\frac{5.4}{(.213)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{2.8}{(.110)}$ |
| CVQ 230 K 14 | $\frac{16.5}{(.650)}$ | $\frac{5.5}{(.217)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{2.8}{(.110)}$ |
| CVQ 230 K 20 | $\frac{22.5}{(.886)}$ | $\frac{5.9}{(.232)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{3.0}{(.118)}$ |
| CVQ 230 K 23 | $\frac{25}{(.984)}$   | $\frac{5.9}{(.232)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{3.0}{(.118)}$ |
| CVQ 250 K 7  | $\frac{9}{(.354)}$    | $\frac{5.0}{(.197)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{2.8}{(.110)}$ |
| CVQ 250 K 10 | $\frac{12.5}{(.492)}$ | $\frac{5.6}{(.220)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{3.0}{(.118)}$ |
| CVQ 250 K 14 | $\frac{16.5}{(.650)}$ | $\frac{5.7}{(.224)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{3.0}{(.118)}$ |
| CVQ 250 K 20 | $\frac{22.5}{(.886)}$ | $\frac{6.1}{(.240)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{3.2}{(.126)}$ |
| CVQ 250 K 23 | $\frac{25}{(.984)}$   | $\frac{6.1}{(.240)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{3.2}{(.126)}$ |
| CVQ 275 K 7  | $\frac{9}{(.354)}$    | $\frac{5.6}{(.220)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{3.0}{(.118)}$ |
| CVQ 275 K 10 | $\frac{12.5}{(.492)}$ | $\frac{5.8}{(.228)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{3.2}{(.126)}$ |
| CVQ 275 K 14 | $\frac{16.5}{(.650)}$ | $\frac{5.9}{(.232)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{3.2}{(.126)}$ |
| CVQ 275 K 20 | $\frac{22.5}{(.886)}$ | $\frac{6.3}{(.248)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{26}{(1.024)}$  | $\frac{3.4}{(.134)}$ |
| CVQ 275 K 23 | $\frac{25}{(.984)}$   | $\frac{6.3}{(.248)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{3.4}{(.134)}$ |
| CVQ 300 K 7  | $\frac{9}{(.354)}$    | $\frac{5.8}{(.228)}$ | $\frac{5}{(.197)}$   | $\frac{0.6}{(.024)}$ | $\frac{11.5}{(.453)}$ | $\frac{3.2}{(.126)}$ |
| CVQ 300 K 10 | $\frac{12.5}{(.492)}$ | $\frac{6.1}{(.240)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{15}{(.591)}$   | $\frac{3.4}{(.134)}$ |
| CVQ 300 K 14 | $\frac{16.5}{(.650)}$ | $\frac{6.1}{(.240)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{20}{(.787)}$   | $\frac{3.4}{(.134)}$ |
| CVQ 300 K 20 | $\frac{22.5}{(.886)}$ | $\frac{6.0}{(.236)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{3.6}{(.142)}$ |
| CVQ 300 K 23 | $\frac{25}{(.984)}$   | $\frac{6.6}{(.260)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$  | $\frac{3.6}{(.142)}$ |
| CVQ 320 K 10 | $\frac{12.5}{(.492)}$ | $\frac{5.9}{(.232)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$   | $\frac{3.6}{(.142)}$ |
| CVQ 320 K 14 | $\frac{16.5}{(.650)}$ | $\frac{6.5}{(.256)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$   | $\frac{3.6}{(.142)}$ |
| CVQ 320 K 20 | $\frac{22.5}{(.886)}$ | $\frac{6.8}{(.268)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$  | $\frac{3.8}{(.150)}$ |
| CVQ 320 K 23 | $\frac{25}{(.984)}$   | $\frac{6.8}{(.268)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$  | $\frac{3.8}{(.150)}$ |



DIMENSIONS:  $\frac{\text{MM}}{(\text{INCHES})}$

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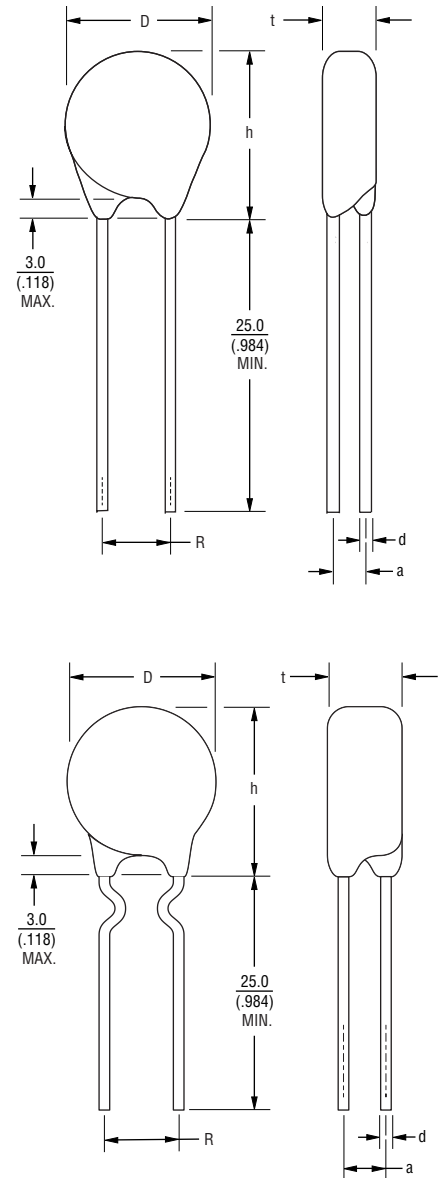
# CVQ Series - Extended Medium Voltage Disc Varistors

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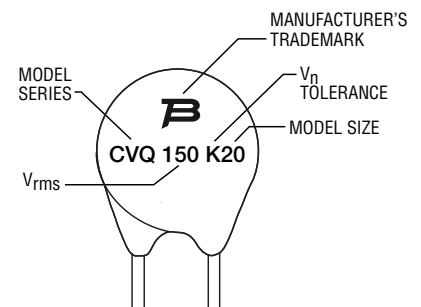
## Product Dimensions (Continued)

| Model        | Dimension             |                      |                      |                      |                      |                      |
|--------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|              | D (Max.)              | t (Max.)             | R                    | d                    | h (Max.)             | a                    |
| CVQ 385 K 10 | $\frac{12.5}{(.492)}$ | $\frac{6.4}{(.252)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$  | $\frac{4.2}{(.165)}$ |
| CVQ 385 K 14 | $\frac{16.5}{(.650)}$ | $\frac{6.9}{(.272)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$  | $\frac{4.2}{(.165)}$ |
| CVQ 385 K 20 | $\frac{22.5}{(.886)}$ | $\frac{7.5}{(.295)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$ | $\frac{4.4}{(.173)}$ |
| CVQ 385 K 23 | $\frac{25}{(.984)}$   | $\frac{7.5}{(.295)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$ | $\frac{4.4}{(.173)}$ |
| CVQ 420 K 10 | $\frac{12.5}{(.492)}$ | $\frac{7.3}{(.287)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$  | $\frac{4.4}{(.173)}$ |
| CVQ 420 K 14 | $\frac{16.5}{(.650)}$ | $\frac{7.4}{(.291)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$  | $\frac{4.4}{(.173)}$ |
| CVQ 420 K 20 | $\frac{22.5}{(.886)}$ | $\frac{7.8}{(.307)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$ | $\frac{4.6}{(.181)}$ |
| CVQ 420 K 23 | $\frac{25}{(.984)}$   | $\frac{7.8}{(.307)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$ | $\frac{4.6}{(.181)}$ |
| CVQ 460 K 10 | $\frac{12.5}{(.492)}$ | $\frac{7.8}{(.307)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$  | $\frac{4.8}{(.189)}$ |
| CVQ 460 K 14 | $\frac{16.5}{(.650)}$ | $\frac{7.8}{(.307)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$  | $\frac{4.8}{(.189)}$ |
| CVQ 460 K 20 | $\frac{22.5}{(.886)}$ | $\frac{8.2}{(.323)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$ | $\frac{5.0}{(.197)}$ |
| CVQ 460 K 23 | $\frac{25}{(.984)}$   | $\frac{8.2}{(.323)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$ | $\frac{5.0}{(.197)}$ |
| CVQ 510 K 10 | $\frac{12.5}{(.492)}$ | $\frac{8.2}{(.323)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$  | $\frac{5.1}{(.201)}$ |
| CVQ 510 K 14 | $\frac{16.5}{(.650)}$ | $\frac{8.2}{(.323)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$  | $\frac{5.1}{(.201)}$ |
| CVQ 510 K 20 | $\frac{22.5}{(.886)}$ | $\frac{8.7}{(.343)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$ | $\frac{5.3}{(.209)}$ |
| CVQ 510 K 23 | $\frac{25}{(.984)}$   | $\frac{8.7}{(.343)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$ | $\frac{5.3}{(.209)}$ |
| CVQ 550 K 10 | $\frac{12.5}{(.492)}$ | $\frac{8.8}{(.346)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{16}{(.630)}$  | $\frac{5.6}{(.220)}$ |
| CVQ 550 K 14 | $\frac{16.5}{(.650)}$ | $\frac{8.8}{(.346)}$ | $\frac{7.5}{(.295)}$ | $\frac{0.8}{(.031)}$ | $\frac{21}{(.827)}$  | $\frac{5.6}{(.220)}$ |
| CVQ 550 K 20 | $\frac{22.5}{(.886)}$ | $\frac{9.2}{(.362)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{27}{(1.063)}$ | $\frac{5.8}{(.228)}$ |
| CVQ 550 K 23 | $\frac{25}{(.984)}$   | $\frac{9.2}{(.362)}$ | $\frac{10}{(.394)}$  | $\frac{1.0}{(.039)}$ | $\frac{29}{(1.142)}$ | $\frac{5.8}{(.228)}$ |

DIMENSIONS:  $\frac{\text{MM}}{(\text{INCHES})}$



## Typical Part Marking



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# CVQ Series - Extended Medium Voltage Disc Varistors

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## How to Order

**CVQ150K20RL1yy**

Series Designator \_\_\_\_\_  
 CVQ = CVQ Series

Max. Continuous Operating Voltage ( $V_{rms}$ ) \_\_\_\_\_  
 $V_n$  Tolerance \_\_\_\_\_  
 K =  $\pm 10\%$

Model Size \_\_\_\_\_  
 7 = 7 mm      20 = 20 mm  
 10 = 10 mm    23 = 23 mm  
 14 = 14 mm

Packaging \_\_\_\_\_  
 R = Reel\*  
 B = Bulk  
 A = Ammo Pack (Available only upon special request)\*  
 \*Reel and Ammo Pack options not available for Model Sizes 20 and 23.

Lead Style \_\_\_\_\_  
 L1 = Straight Leads  
 L5 = Crimped Leads

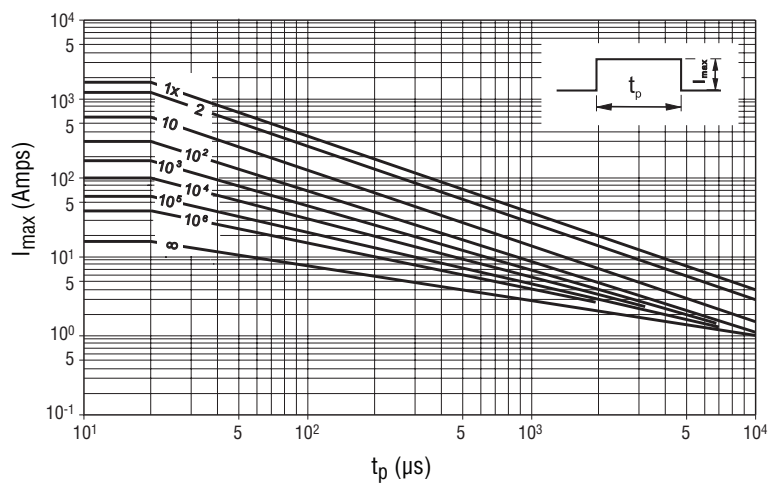
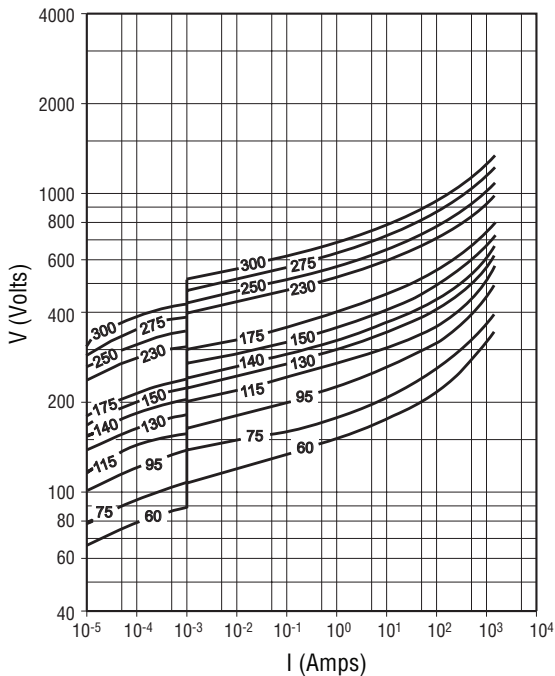
Special Parameters \_\_\_\_\_  
 yy = Unique two digit suffix is assigned to each customer requesting special parameters.  
 Please contact Bourns for more information.

## Instructions for Creating Orderable Part Number:

- 1) Start with base part number in characteristics table  
 (example: CVQ150K20).
- 2) Add Packaging: R  
 (example part number becomes CVQ150K20R).
- 3) Add Lead Style: L1  
 (example part number becomes CVQ150K20RL1).
- 4) Part number can have no spaces or lower case letters.

## Pulse Rating Curves - Protection level with worst-case condition in the tolerance region

### Model Size 7 - (CVQ 60 ~ CVQ 300)



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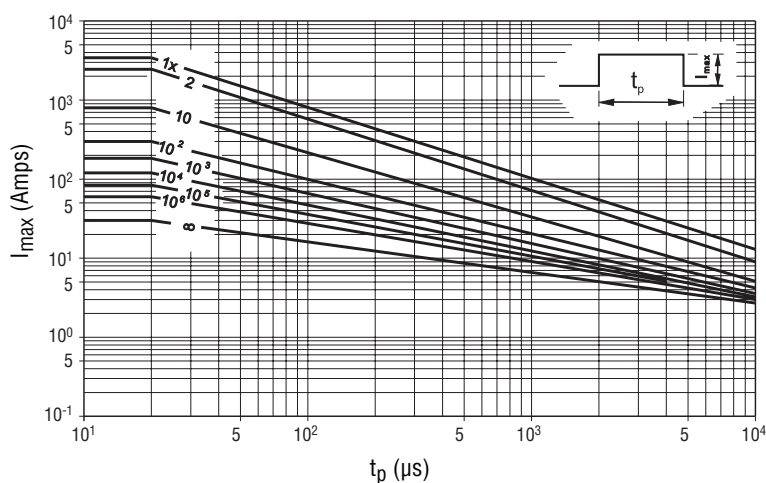
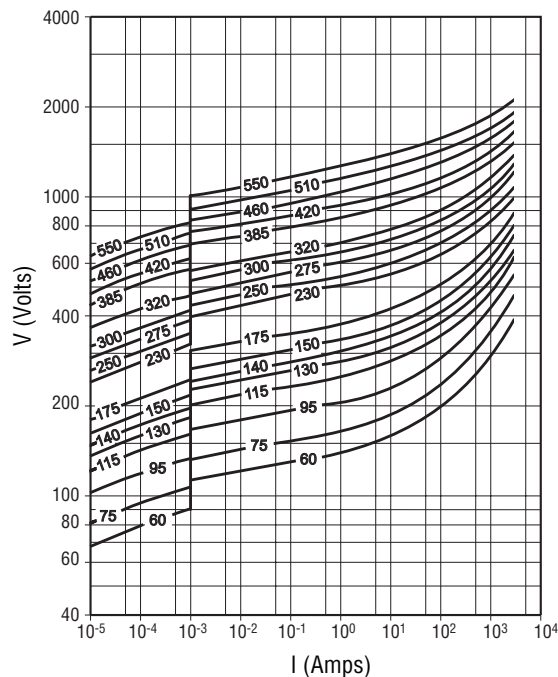
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# CVQ Series - Extended Medium Voltage Disc Varistors

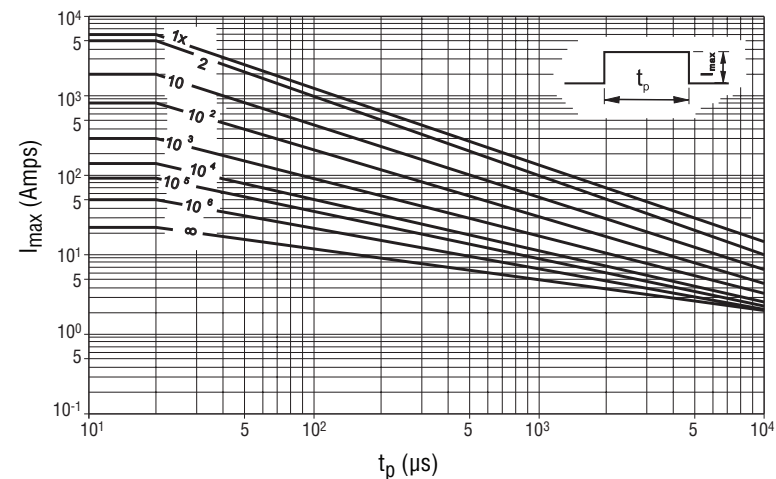
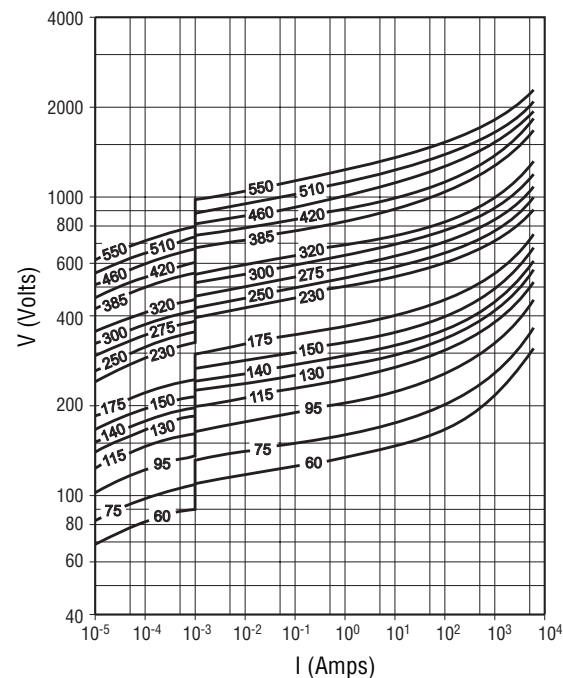
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**Pulse Rating Curves (Continued)** - Protection level with worst-case condition in the tolerance region

## Model Size 10 - (CVQ 60 ~ CVQ 550)



## Model Size 14 - (CVQ 60 ~ CVQ 550)



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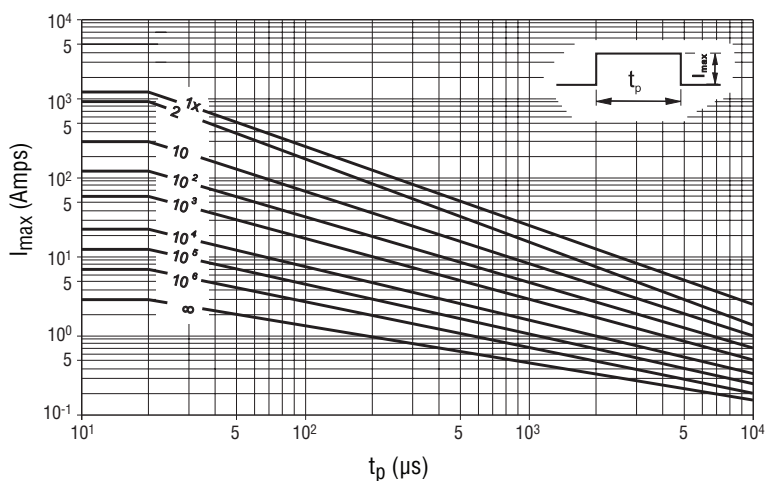
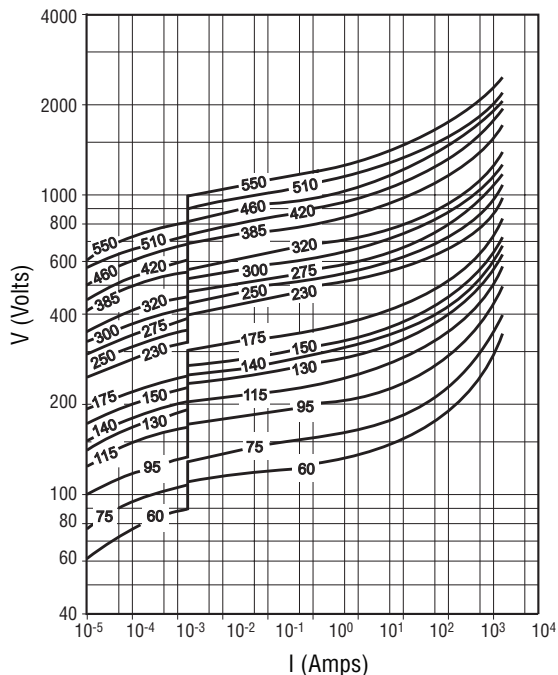
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# CVQ Series - Extended Medium Voltage Disc Varistors

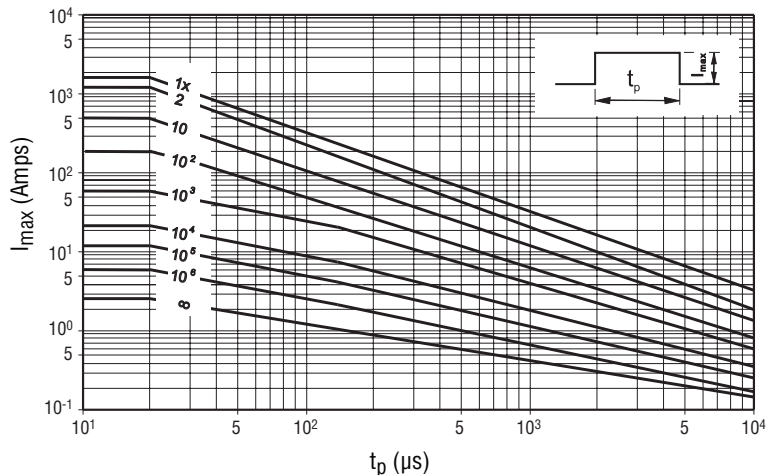
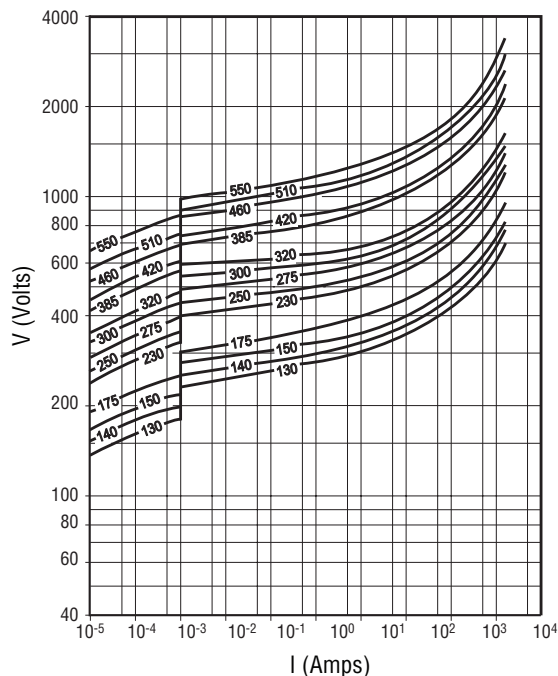
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**Pulse Rating Curves (Continued)** - Protection level with worst-case condition in the tolerance region

## Model Size 20 - (CVQ 60 ~ CVQ 550)



## Model Size 23 - (CVQ 60 ~ CVQ 550)



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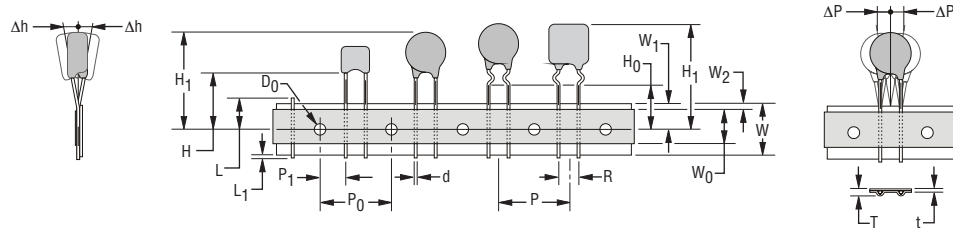
# CVQ Series - Extended Medium Voltage Disc Varistors

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## Packaging Specifications - Tape

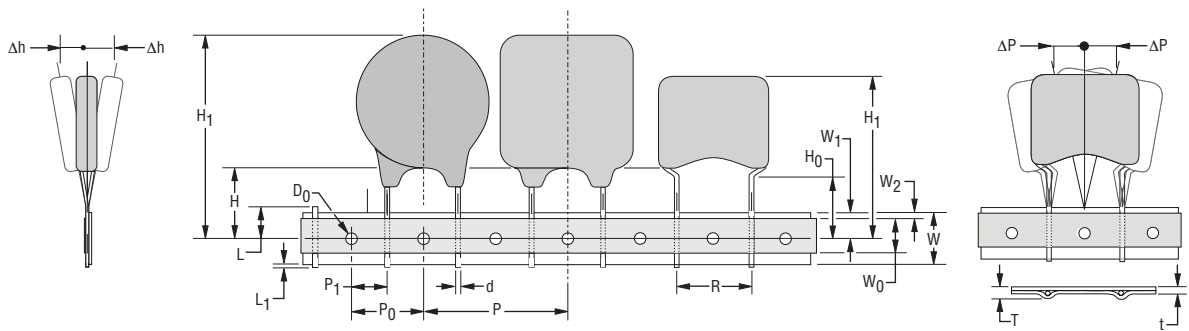
Conforms to IES Publication 286-2 Ed. 3: 2008-03

### Dimension R = 5 mm



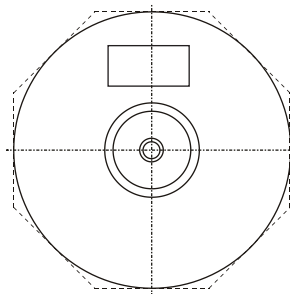
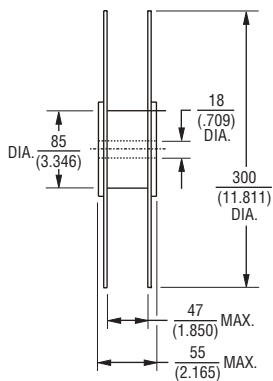
Dimensions on Next Page

### Dimension R = 7.5 mm & 10 mm



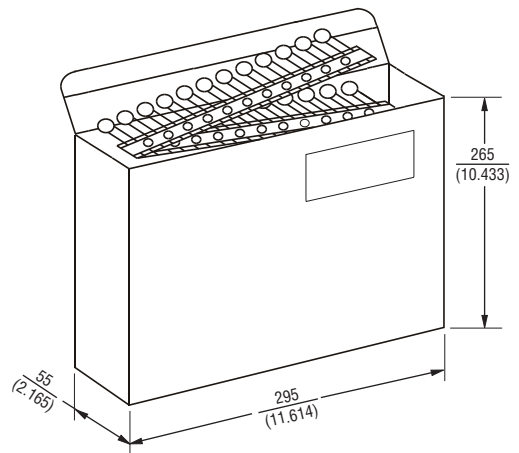
Dimensions on Next Page

### Reel



DIMENSIONS:  $\frac{\text{MM}}{(\text{INCHES})}$

### Ammo Pack (Available upon Special Request)



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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Packaging Specifications - Tape (Continued)

| Symbol         | Parameter                                                               | Model Size                                       |                                                   |                                         |                                                  |    |
|----------------|-------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------|-----------------------------------------|--------------------------------------------------|----|
|                |                                                                         | 7                                                | 10                                                | 14                                      | 20                                               | 23 |
| W              | Carrier tape width                                                      | $\frac{18 \pm 1.0/-0.5}{(.709 \pm .039/- .020)}$ |                                                   |                                         |                                                  |    |
| W <sub>0</sub> | Hold down tape width                                                    | $\frac{5}{(.197)} \text{ MIN.}$                  |                                                   |                                         |                                                  |    |
| W <sub>1</sub> | Sprocket hole position                                                  | $\frac{9 \pm 0.75/-0.5}{(.354 \pm .030/- .020)}$ |                                                   |                                         |                                                  |    |
| W <sub>2</sub> | Distance between the upper edges of the carrier tape and hold down tape | $\frac{3}{(.118)} \text{ MAX.}$                  |                                                   |                                         |                                                  |    |
| T              | Total tape thickness                                                    | $\frac{1.5}{(.059)} \text{ MAX.}$                | $\frac{1.7}{(.067)} \text{ MAX.}$                 |                                         | $\frac{1.9}{(.075)} \text{ MAX.}$                |    |
| t              | Tape thickness                                                          | $\frac{0.9}{(.035)} \text{ MAX.}$                |                                                   |                                         |                                                  |    |
| P              | Pitch of component                                                      | $\frac{12.7 \pm 1.0}{(.500 \pm .039)}$           |                                                   | $\frac{25.4 \pm 1.0}{(1.000 \pm .039)}$ |                                                  |    |
| P <sub>0</sub> | Feed hole pitch                                                         | $\frac{12.7 \pm 0.3}{(.500 \pm .012)}$           |                                                   |                                         |                                                  |    |
| P <sub>1</sub> | Feed hole center to pitch                                               | $\frac{3.85 \pm 0.7}{(.152 \pm .028)}$           | $\frac{8.95 \pm 0.7}{(.352 \pm .028)}$            |                                         | $\frac{7.7 \pm 0.7}{(.303 \pm .028)}$            |    |
| R              | Lead spacing                                                            | $\frac{5 \pm 0.5/-0.2}{(.197 \pm .020/- .008)}$  | $\frac{7.5 \pm 0.5/-0.2}{(.295 \pm .020/- .008)}$ |                                         | $\frac{10 \pm 0.5/-0.2}{(.394 \pm .020/- .008)}$ |    |
| ΔP             | Component alignment                                                     | $\frac{\pm 1.3}{(\pm .051)} \text{ MAX.}$        |                                                   |                                         |                                                  |    |
| Δh             | Component alignment                                                     | $\frac{\pm 2}{(\pm .079)} \text{ MAX.}$          |                                                   |                                         |                                                  |    |
| d              | Wire diameter                                                           | $\frac{0.6}{(.024)} \text{ MAX.}$                | $\frac{0.8}{(.031)} \text{ MAX.}$                 |                                         | $\frac{1}{(.039)} \text{ MAX.}$                  |    |
| D <sub>0</sub> | Feed hold diameter                                                      | $\frac{4 \pm 0.2}{(.157 \pm .008)}$              |                                                   |                                         |                                                  |    |
| H              | Height from tape center to component base                               | $\frac{18 \pm 2.0/-0.0}{(.709 \pm .079/- .000)}$ |                                                   |                                         |                                                  |    |
| H <sub>0</sub> | Seating plane height                                                    | $\frac{16 \pm 0.5}{(.630 \pm .020)}$             |                                                   |                                         |                                                  |    |
| H <sub>1</sub> | Component height                                                        | $\frac{32.2}{(1.268)} \text{ MAX.}$              | $\frac{46.5}{(1.831)} \text{ MAX.}$               |                                         |                                                  |    |
| L              | Protrusion - cut out                                                    | $\frac{11}{(.433)} \text{ MAX.}$                 |                                                   |                                         |                                                  |    |
| L <sub>1</sub> | Protrusion - cut off                                                    | $\frac{0.5}{(.020)} \text{ MAX.}$                |                                                   |                                         |                                                  |    |

DIMENSIONS:  $\frac{\text{MM}}{(\text{INCHES})}$

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# CVQ Series - Extended Medium Voltage Disc Varistors

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## Packaging Quantities - Bulk

| Voltage | Model Size |     |     |     |     |
|---------|------------|-----|-----|-----|-----|
|         | 7          | 10  | 14  | 20  | 23  |
| 60      | 1500       | 600 | 400 | 300 |     |
| 75      | 1500       | 600 | 400 | 300 |     |
| 95      | 1000       | 600 | 400 | 300 |     |
| 115     | 1000       | 500 | 400 | 300 |     |
| 130     | 1000       | 500 | 400 | 300 | 250 |
| 140     | 1000       | 500 | 400 | 300 | 250 |
| 150     | 1000       | 500 | 400 | 300 | 250 |
| 175     | 1000       | 500 | 400 | 300 | 250 |
| 230     | 1000       | 500 | 300 | 200 | 200 |
| 250     | 1000       | 500 | 300 | 200 | 200 |
| 275     | 1000       | 500 | 300 | 200 | 200 |
| 300     | 1000       | 500 | 300 | 200 | 200 |
| 320     |            | 500 | 300 | 200 | 200 |
| 385     |            | 400 | 300 | 200 | 200 |
| 420     |            | 400 | 300 | 200 | 150 |
| 460     |            | 400 | 300 | 200 | 150 |
| 510     |            | 400 | 300 | 200 | 150 |
| 550     |            | 400 | 300 | 200 | 150 |

## Packaging Quantities - Reel

| Voltage | Model Size |      |     |    |    |
|---------|------------|------|-----|----|----|
|         | 7          | 10   | 14  | 20 | 23 |
| 60      | 1500       | 1300 | 700 |    |    |
| 75      | 1500       | 1300 | 700 |    |    |
| 95      | 1000       | 1300 | 600 |    |    |
| 115     | 1000       | 1000 | 600 |    |    |
| 130     | 1000       | 1000 | 600 |    |    |
| 140     | 1000       | 1000 | 600 |    |    |
| 150     | 1000       | 1000 | 600 |    |    |
| 175     | 1000       | 1000 | 500 |    |    |
| 230     | 1000       | 1000 | 500 |    |    |
| 250     | 1000       | 800  | 400 |    |    |
| 275     | 1000       | 800  | 400 |    |    |
| 300     | 1000       | 800  | 400 |    |    |
| 320     |            | 800  | 400 |    |    |
| 385     |            | 700  | 400 |    |    |
| 420     |            | 700  | 300 |    |    |
| 460     |            | 600  | 300 |    |    |
| 510     |            | 600  | 300 |    |    |
| 550     |            | 600  | 300 |    |    |

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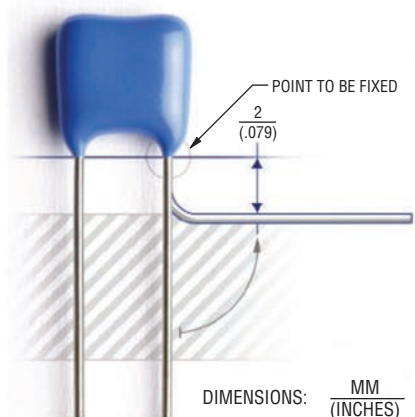
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### Assembly Recommendations for Through-Hole Components



Very often before soldering through-hole components, their leads get bent. It is important not to damage the components during lead bending. Damage incurred during bending is cracks in epoxy parts, which can lead to increased humidity sensitivity of a component and, consequentially, a shorter lifetime.

In order to avoid epoxy damage, it is necessary to:

- fix the most sensitive point (epoxy parts) of a component body
- bend the wire at least 2 mm below the end of epoxy parts

Other potential damage to a component which can lead to component failure or a shorter lifetime is thermal shock during manual soldering with a soldering iron. This can occur when a soldering iron is placed too close to one point of the component body and it happens most often when the solder joint is too close to the varistor body.

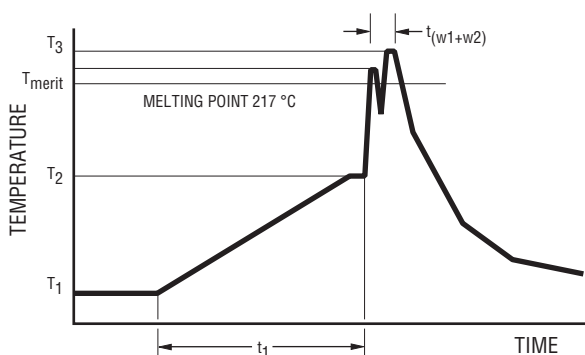
### Resistance to Soldering Heat

In the case of automatic wave soldering, it is important to provide sufficient resistance to soldering heat. In order to prevent any potential problems, internal standards were introduced for testing the resistance to soldering heat of through-hole components: 300 °C, 10 seconds.

### Pb-free Wave Soldering Profile Recommendations

Recommended soldering profiles for all above components are in accordance with JEDEC standard curves (J-STD-020D) and are, therefore, compatible with the Pb-free process.

### Lead-free Wave Soldering Profile - Pb-free wave profile requirements for soldering heat resistance of components



| Parameter                                      | Symbol            | Specification   |
|------------------------------------------------|-------------------|-----------------|
| Preheating temperature gradient                |                   | 4 °C/sec. max.  |
| Preheating time                                | $t_1$             | 2 to 5 min.     |
| Min. preheating temperature                    | $T_1$             | 130 °C          |
| Max. preheating temperature                    | $T_2$             | 180 °C          |
| Melting temperature/point                      | $T_{meltv}$       | 217 °C          |
| Time in wave soldering phase ( $w_1 + w_2$ )   | $t_{w1+w2}$       | 10 sec.         |
| Max. wave temperature ( $w_1 + w_2$ )          | $T_s$             | 265 °C +0/-5 °C |
| Cooling temperature gradient                   |                   | 6° C/sec. max.  |
| Temperature jump from $T_2$ to $T_3$ ( $w_1$ ) | $T_{3(w1)} - T_2$ | 120 °C max      |
| Time from 25 °C to $T_3$ (wave temperature)    |                   | 8 min. max.     |

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### Reliability Testing Procedures

Varistor test procedures comply with CECC 42200, IEC 1051-1/2 (and AEC-Q200, if applicable). Test results are available upon customer request. Special tests can be performed upon customer request.

| Reliability Parameter                        | Test                                 | Tested According to                                                                                                                                                                                                                                                                                                   | Condition to be Satisfied after Testing                      |
|----------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| <b>AC/DC Bias Reliability</b>                | AC/DC Life Test                      | CECC 42200, Test 4.20 or<br>IEC 1051-1, Test 4.20,<br>AEC-Q200 Test 8 - 1000 h at UCT                                                                                                                                                                                                                                 | $  \delta V_N (1 \text{ mA})   < 10 \%$                      |
| <b>Pulse Current Capability</b>              | $I_{\text{max}} 8/20 \mu\text{s}$    | CECC 42200, Test C 2.1 or<br>IEC 1051-1, Test 4.5<br>10 pulses in the same direction at<br>2 pulses per minute at maximum peak current for 10 pulses                                                                                                                                                                  | $  \delta V_N (1 \text{ mA})   < 10 \%$<br>no visible damage |
| <b>Pulse Energy Capability</b>               | $W_{\text{max}} 10/1000 \mu\text{s}$ | CECC 42200, Test C 2.1 or<br>IEC 1051-1, Test 4.5<br>10 pulses in the same direction at<br>1 pulse every 2 minutes at maximum peak current for 10 pulses                                                                                                                                                              | $  \delta V_N (1 \text{ mA})   < 10 \%$<br>no visible damage |
| <b>WLD Capability</b>                        | WLD x 10                             | ISO 7637, Test pulse 5, 10 pulses at rate of 1 per minute                                                                                                                                                                                                                                                             | $  \delta V_N (1 \text{ mA})   < 15 \%$<br>no visible damage |
| <b>V<sub>jump</sub> Capability</b>           | V <sub>jump</sub> 5 min.             | Increase of supply voltage to $V \geq V_{\text{jump}}$ for 1 minute                                                                                                                                                                                                                                                   | $  \delta V_N (1 \text{ mA})   < 15 \%$<br>no visible damage |
| <b>Environmental and Storage Reliability</b> | Climatic Sequence                    | CECC 42200, Test 4.16 or<br>IEC 1051-1, Test 4.17<br>a) Dry heat, 16h, UCT, Test Ba, IEC 68-2-2<br>b) Damp heat, cyclic, the first cycle: 55 °C, 93 % RH, 24 h, Test Db 68-2-4<br>c) Cold, LCT, 2 h, Test Aa, IEC 68-2-1<br>d) Damp heat cyclic, remaining 5 cycles: 55 °C, 93 % RH, 24 h/cycle, Test Bd, IEC 68-2-30 | $  \delta V_N (1 \text{ mA})   < 10 \%$                      |
|                                              | Thermal Shock                        | CECC 42200, Test 4.12, Test Na, IEC 68-2-14,<br>AEC-Q200 Test 16, 5                                                                                                                                                                                                                                                   | $  \delta V_N (1 \text{ mA})   < 10 \%$<br>no visible damage |
|                                              | Steady State Damp Heat               | CECC 42200, Test 4.17, Test Ca, IEC 68-2-3,<br>AEC-Q200 Test 6, 56 days, 40 °C, 93 % RH,<br>AEC-Q200 Test 7: Bias, Rh, T all at 85.                                                                                                                                                                                   | $  \delta V_N (1 \text{ mA})   < 10 \%$                      |
|                                              | Storage Test                         | IEC 68-2-2, Test Ba, AEC-Q200 Test 3, 1000 h at maximum storage temperature                                                                                                                                                                                                                                           | $  \delta V_N (1 \text{ mA})   < 5 \%$                       |

*Continued on Next Page*

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## Reliability Testing Procedures (Continued)

| Reliability Parameter                  | Test                         | Tested According to                                                                                                                                                                                                                                                                            | Condition to be Satisfied after Testing                                                                           |
|----------------------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Mechanical Reliability</b>          | Solderability                | CECC 42200, Test 4.10.1, Test Ta, IEC 68-2-20 solder bath and reflow method                                                                                                                                                                                                                    | Solderable at shipment and after 2 years of storage, criteria: >95% must be covered by solder for reflow meniscus |
|                                        | Resistance to Soldering Heat | CECC 42200, Test 4.10.2, Test Tb, IEC 68-2-20 solder bath nad reflow method                                                                                                                                                                                                                    | $ \delta V_n (1 \text{ mA})  < 5 \%$                                                                              |
|                                        | Terminal Strength            | JIS-C-6429, App. 1, 18N for 60 sec. - same for AEC-Q200 Test 22                                                                                                                                                                                                                                | No visual damage                                                                                                  |
|                                        | Board Flex                   | JIS-C-6429, App. 2, 2 mm min.<br>AEC-Q200 test 21 - Board flex: 2 mm flex min.                                                                                                                                                                                                                 | $ \delta V_n (1 \text{ mA})  < 2 \%$<br>No visible damage                                                         |
|                                        | Vibration                    | CECC 42200, Test 4.15, Test Fc, IEC 68-2-6,<br>AEC-Q200 Test 14<br>Frequency range 10 to 55 Hz (AEC: 10-2000 Hz)<br>Amplitude 0.75 m/s <sup>2</sup> or 98 m/s <sup>2</sup> (AEC: 5 g for 20 minutes) Total duration 6 h (3x2 h) (AEC: 12 cycles each of 3 directions)<br>Waveshape - half sine | $ \delta V_n (1 \text{ mA})  < 2 \%$<br>No visible damage                                                         |
|                                        | Mechanical Shock             | CECC 42200, Test 4.14, Test Ea, IEC 68-2-27, AEC-Q200 Test 13.<br>Acceleration = 490 m/s <sup>2</sup> (AEC: MIL-STD-202-Method 213),<br>Pulse duration = 11 ms,<br>Waveshape - half sine; Number of shocks = 3x6                                                                               | $ \delta V_n (1 \text{ mA})  < 10 \%$<br>No visible damage                                                        |
| <b>Electrical Transient Conduction</b> | ISO-7637-1 Pulses            | AEC-Q200 Test 30: Test pulses 1 to 3.<br>Also other pulses - freestyle.                                                                                                                                                                                                                        | $ \delta V_n (1 \text{ mA})  < 10 \%$<br>No visible damage                                                        |

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## Terminology

| Term                               | Symbol              | Definition                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rated AC Voltage .....             | $V_{rms}$ .....     | Maximum continuous sinusoidal AC voltage (<5 % total harmonic distortion) which may be applied to the component under continuous operation conditions at +25 °C                                                                                                                                                                                                                                   |
| Rated DC Voltage .....             | $V_{dc}$ .....      | Maximum continuous DC voltage (<5 % ripple) which may be applied to the component under continuous operating conditions at +25 °C                                                                                                                                                                                                                                                                 |
| Supply Voltage .....               | $V$ .....           | The voltage by which the system is designated and to which certain operating characteristics of the system are referred; $V_{rms} = 1.1 \times V$                                                                                                                                                                                                                                                 |
| Leakage Current .....              | $I_{dc}$ .....      | The current passing through the varistor at $V_{dc}$ and at +25 ° or at any other specified temperature                                                                                                                                                                                                                                                                                           |
| Varistor Voltage .....             | $V_n$ .....         | Voltage across the varistor measured at a given reference current ( $I_n$ )                                                                                                                                                                                                                                                                                                                       |
| Reference Current .....            | $I_n$ .....         | Reference current = 1 mA DC                                                                                                                                                                                                                                                                                                                                                                       |
| Clamping Voltage .....             | $V_c$ .....         | The peak voltage developed across the varistor under standard atmospheric conditions, when passing an 8/20 $\mu s$ class current pulse                                                                                                                                                                                                                                                            |
| Protection Level                   |                     |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Class Current .....                | $I_c$ .....         | A peak value of current which is 1/10 of the maximum peak current for 100 pulses at two per minute for the 8/20 $\mu s$ pulse                                                                                                                                                                                                                                                                     |
| Voltage Clamping Ratio .....       | $V_c/V_{app}$ ..... | A figure of merit measure of the varistor clamping effectiveness as defined by the symbols $V_c/V_{app}$ , where ( $V_{app} = V_{rms}$ or $V_{dc}$ )                                                                                                                                                                                                                                              |
| Jump Start Transient .....         | $V_{jump}$ .....    | The jump start transient results from the temporary application of an overvoltage in excess of the rated battery voltage. The circuit power supply may be subjected to a temporary overvoltage condition due to the voltage regulation failing or it may be deliberately generated when it becomes necessary to boost start the car.                                                              |
| Rated Single Pulse .....           | $W_{max}$ .....     | Energy which may be dissipated for a single 10/1000 $\mu s$ pulse of a maximum rated current, with rated AC voltage or rated DC voltage also applied, without causing device failure                                                                                                                                                                                                              |
| Transient Energy                   |                     |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Load Dump Transient .....          | WLD .....           | Load Dump is a transient which occurs in automotive environments. It is an exponentially decaying positive voltage which occurs in the event of a battery disconnect while the alternator is still generating charging current with other loads remaining on the alternator circuit at the time of battery disconnect.                                                                            |
| Rated Peak Single Pulse .....      | $I_{max}$ .....     | Maximum peak current which may be applied for a single 8/20 $\mu s$ pulse, with rated line voltage also applied, without causing device failure                                                                                                                                                                                                                                                   |
| Transient Current                  |                     |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Rated Transient Average .....      | $P$ .....           | Maximum average power which may be dissipated due to a group of pulses occurring within a specified isolated time period, without causing device failure at 25 °C                                                                                                                                                                                                                                 |
| Power Dissipation                  |                     |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Capacitance .....                  | $C$ .....           | Capacitance between two terminals of the varistor measured @ 1 kHz                                                                                                                                                                                                                                                                                                                                |
| Non-linearity Exponent .....       | $\alpha$ .....      | A measure of varistor nonlinearity between two given operating currents, $I_n$ and $I_1$ as described by $I = k V \exp(a)$ , where:<br>- $k$ is a device constant,<br>- $I_1 < I < I_n$ and<br>- $a \log(I_1/I_n) / \log(V_1/V_n) = 1 / \log(V_1/V_n)$ , where:<br>- $I_r$ is reference current (1 mA) and $V_n$ is varistor voltage<br>- $I_1 = 10 I_n$ , $V_1$ is the voltage measured at $I_1$ |
| Response Time .....                | $t_r$ .....         | The time lag between application of a surge and varistor's "turn-on" conduction action                                                                                                                                                                                                                                                                                                            |
| Varistor Voltage Temperature ..... | TC .....            | $(V_n @ 85 ^\circ C - V_n @ 25 ^\circ C) / (V_n @ 25 ^\circ C) \times 60 ^\circ C \times 100$                                                                                                                                                                                                                                                                                                     |
| Coefficient                        |                     |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Insulation Resistance .....        | IR .....            | Minimum resistance between shorted terminals and varistor surface                                                                                                                                                                                                                                                                                                                                 |
| Isolation Voltage .....            |                     | The maximum peak voltage which may be applied under continuous operating conditions between the varistor terminations and any conducting mounting surface                                                                                                                                                                                                                                         |
| Operating Temperature .....        |                     | The range of ambient temperature for which the varistor is designed to operate continuously as defined by the temperature limits of its climatic category                                                                                                                                                                                                                                         |
| Climatic Category .....            | LCT/UCT/DHD .....   | LCT & UCT = Lower and Upper Category Temperature - the minimum and maximum ambient temperatures for which a varistor has been designed to operate continuously.<br>DHD = Dump Heat Test Duration                                                                                                                                                                                                  |
| Storage Temperature .....          |                     | Storage temperature range without voltage applied                                                                                                                                                                                                                                                                                                                                                 |
| Current/Energy Derating .....      |                     | Derating of maximum values when operated above UCT                                                                                                                                                                                                                                                                                                                                                |

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