

### **High Energy Radial Lead Varistors**

The C-III Series of metal-oxide varistors are specifically designed for high surge energy absorption ratings. This is achieved through a special dielectric material formulation which also results in higher repetitive surge ratings than other MOV types.

The C-III series is primarily intended for use in AC line Transient Voltage Surge Suppressor (TVSS) product environment and other similar applications requiring high transient energy and peak current capability in a relatively small package size.

The C-III series is supplied in 14 and 20mm disc versions with various lead options.

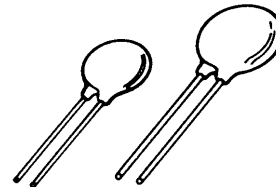
These types are shipped in bulk or Tape and Reel packaging. Part number and brand information is provided in the Ratings table.

### **Features**

- Recognized as "Transient Voltage Surge Suppressors" to UL 1449; File # E75961, Second Edition
- CSA Certification to Standard C22.2, No. 1; File #LR91788
- VDE Certified - License Number 116895E
- CECC Certified to 42201-006
- High Energy Absorption Capability  
 $W_{TM}$  ..... 45J to 210J (2ms)
- High Pulse Life Rating
- High Peak Pulse Current Capability  
 $I_{TM}$  ..... 6000A to 9000A (8/20 $\mu$ s)
- Wide Operating Voltage Range  
 $V_{M(AC)RMS}$  ..... 130V to 320V
- Available in Tape and Reel for Automatic Insertion; Also Available with Crimped and/or Trimmed Lead Styles
- No Derating Up to 85°C Ambient

### **Packaging**

#### **C-III SERIES**



## C-III Series

**Absolute Maximum Ratings** For ratings of individual members of a series, see Device Ratings and Specifications chart

|                                                                                                | C-III SERIES | UNITS |
|------------------------------------------------------------------------------------------------|--------------|-------|
| Continuous:                                                                                    |              |       |
| Steady State AC Voltage Range ( $V_{M(AC)RMS}$ )                                               | 130 to 320   | V     |
| Transients:                                                                                    |              |       |
| Single-Pulse Peak Current ( $I_{TM}$ ) 8/20 $\mu$ s Wave (See Figure 2)                        | 6000 to 9000 | A     |
| Single-Pulse Energy Range ( $W_{TM}$ ) 2ms Rectangular Wave                                    | 45 to 210    | J     |
| Maximum Temporary Overvoltage of $V_{M(AC)}$ , (5 Minutes Duration)                            | 130 (25°C)   | %     |
|                                                                                                | 120 (125°C)  | %     |
| Operating Ambient Temperature Range ( $T_A$ )                                                  | -55 to 85    | °C    |
| Storage Temperature Range ( $T_{STG}$ )                                                        | -55 to 125   | °C    |
| Temperature Coefficient ( $\alpha V$ ) of Clamping Voltage ( $V_C$ ) at Specified Test Current | <0.01        | %/°C  |

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### C-III Series Ratings

| PART<br>NUMBER | BRAND    | MAXIMUM RATINGS (85°C)                  |                                              |                             |                           |
|----------------|----------|-----------------------------------------|----------------------------------------------|-----------------------------|---------------------------|
|                |          | MAXIMUM $V_{RMS}$<br>$V_{M(AC)}$<br>(V) | WITHSTANDING<br>ENERGY (2ms)<br>$W_{TM}$ (J) | TRANSIENT                   |                           |
|                |          |                                         |                                              | PEAK CURRENT (8/20 $\mu$ s) |                           |
|                |          |                                         |                                              | $I_{TM1}$ 1 PULSE<br>(A)    | $I_{TM2}$ 2 PULSES<br>(A) |
| V130LA10C      | 130L10C  | 130                                     | 45                                           | 6000                        | 5000                      |
| V130LA20C      | 130L20C  | 130                                     | 90                                           | 9000                        | 7000                      |
| V130LA20CX325  | 130CX325 | 130                                     | 90                                           | 9000                        | 7000                      |
| V140LA10C      | 140L10C  | 140                                     | 50                                           | 6000                        | 5000                      |
| V140LA20C      | 140L20C  | 140                                     | 100                                          | 9000                        | 7000                      |
| V140LA20CX340  | 140CX340 | 140                                     | 100                                          | 9000                        | 7000                      |
| V150LA10C      | 150L10C  | 150                                     | 55                                           | 6000                        | 5000                      |
| V150LA20C      | 150L20C  | 150                                     | 110                                          | 9000                        | 7000                      |
| V150LA20CX360  | 150CX360 | 150                                     | 110                                          | 9000                        | 7000                      |
| V175LA10C      | 175L10C  | 175                                     | 60                                           | 6000                        | 5000                      |
| V175LA20C      | 175L20C  | 175                                     | 120                                          | 9000                        | 7000                      |
| V175LA20CX425  | 175CX425 | 175                                     | 120                                          | 9000                        | 7000                      |
| V230LA20C      | 230L20C  | 230                                     | 80                                           | 6000                        | 5000                      |
| V230LA40C      | 230L40C  | 230                                     | 160                                          | 9000                        | 7000                      |
| V230LA40CX570  | 230X570  | 230                                     | 160                                          | 9000                        | 7000                      |
| V250LA20C      | 250L20C  | 250                                     | 100                                          | 6000                        | 5000                      |
| V250LA40C      | 250L40C  | 250                                     | 170                                          | 9000                        | 7000                      |
| V250LA40CX620  | 250CX620 | 250                                     | 170                                          | 9000                        | 7000                      |
| V275LA20C      | 275L20C  | 275                                     | 110                                          | 6000                        | 5000                      |
| V275LA40C      | 275L40C  | 275                                     | 190                                          | 9000                        | 7000                      |
| V275LA40CX680  | 275CX680 | 275                                     | 190                                          | 9000                        | 7000                      |
| V300LA20C      | 300L20C  | 300                                     | 120                                          | 6000                        | 5000                      |
| V300LA40C      | 300L40C  | 300                                     | 210                                          | 9000                        | 7000                      |
| V300LA40CX745  | 300CX745 | 300                                     | 210                                          | 9000                        | 7000                      |
| V320LA20C      | 320L20C  | 320                                     | 130                                          | 6000                        | 5000                      |
| V320LA40C      | 320L40C  | 320                                     | 220                                          | 9000                        | 7000                      |

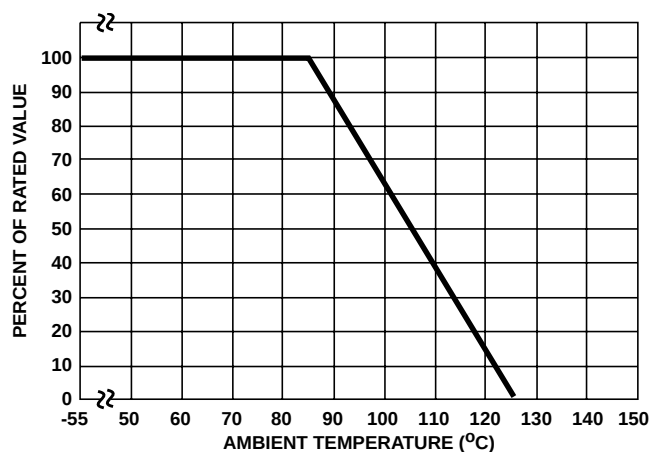
**C-III Series Specifications**

| PART<br>NUMBER | MODEL SIZE<br>DISC<br>DIAMETER (mm) | SPECIFICATIONS (25°C)                      |                           |                                         |                       |                             |                              |
|----------------|-------------------------------------|--------------------------------------------|---------------------------|-----------------------------------------|-----------------------|-----------------------------|------------------------------|
|                |                                     | VARISTOR VOLTAGE AT 1mA<br>DC TEST CURRENT |                           | MAXIMUM CLAMPING<br>VOLTAGE<br>(8/20μs) |                       | DUTY CYCLE<br>SURGE RATING  |                              |
|                |                                     | V <sub>N</sub> MIN<br>(V)                  | V <sub>N</sub> MAX<br>(V) | V <sub>C</sub><br>(V)                   | I <sub>p</sub><br>(A) | 3kA<br>(8/20μs)<br># PULSES | 750A<br>(8/20μs)<br># PULSES |
| V130LA10C      | 14                                  | 184                                        | 228                       | 340                                     | 50                    | 10                          | 80                           |
| V130LA20C      | 20                                  | 184                                        | 228                       | 340                                     | 100                   | 20                          | 120                          |
| V130LA20CX325  | 20                                  | 184                                        | 220                       | 325                                     | 100                   | 20                          | 120                          |
| V140LA10C      | 14                                  | 198                                        | 242                       | 360                                     | 50                    | 10                          | 80                           |
| V140LA20C      | 20                                  | 198                                        | 242                       | 360                                     | 100                   | 20                          | 120                          |
| V140LA20CX340  | 20                                  | 198                                        | 230                       | 340                                     | 100                   | 20                          | 120                          |
| V150LA10C      | 14                                  | 212                                        | 268                       | 395                                     | 50                    | 10                          | 80                           |
| V150LA20C      | 20                                  | 212                                        | 268                       | 395                                     | 100                   | 20                          | 120                          |
| V150LA20CX360  | 20                                  | 212                                        | 243                       | 360                                     | 100                   | 20                          | 120                          |
| V175LA10C      | 14                                  | 247                                        | 303                       | 455                                     | 50                    | 10                          | 80                           |
| V175LA20C      | 20                                  | 247                                        | 303                       | 455                                     | 100                   | 20                          | 120                          |
| V175LA20CX425  | 20                                  | 247                                        | 285                       | 425                                     | 100                   | 20                          | 120                          |
| V230LA20C      | 14                                  | 324                                        | 396                       | 595                                     | 50                    | 10                          | 80                           |
| V230LA40C      | 20                                  | 324                                        | 396                       | 595                                     | 100                   | 20                          | 120                          |
| V230LA40CX570  | 20                                  | 324                                        | 384                       | 570                                     | 100                   | 20                          | 120                          |
| V250LA20C      | 14                                  | 354                                        | 429                       | 650                                     | 50                    | 10                          | 80                           |
| V250LA40C      | 20                                  | 354                                        | 429                       | 650                                     | 100                   | 20                          | 120                          |
| V250LA40CX620  | 20                                  | 354                                        | 413                       | 620                                     | 100                   | 20                          | 120                          |
| V275LA20C      | 14                                  | 389                                        | 473                       | 710                                     | 50                    | 10                          | 80                           |
| V275LA40C      | 20                                  | 389                                        | 473                       | 710                                     | 100                   | 20                          | 120                          |
| V275LA40CX680  | 20                                  | 389                                        | 453                       | 680                                     | 100                   | 20                          | 120                          |
| V300LA20C      | 14                                  | 420                                        | 517                       | 775                                     | 50                    | 10                          | 80                           |
| V300LA40C      | 20                                  | 420                                        | 517                       | 775                                     | 100                   | 20                          | 120                          |
| V300LA40CX745  | 20                                  | 420                                        | 490                       | 745                                     | 100                   | 20                          | 120                          |
| V320LA20C      | 14                                  | 462                                        | 565                       | 850                                     | 50                    | 10                          | 80                           |
| V320LA40C      | 20                                  | 462                                        | 565                       | 850                                     | 100                   | 20                          | 120                          |

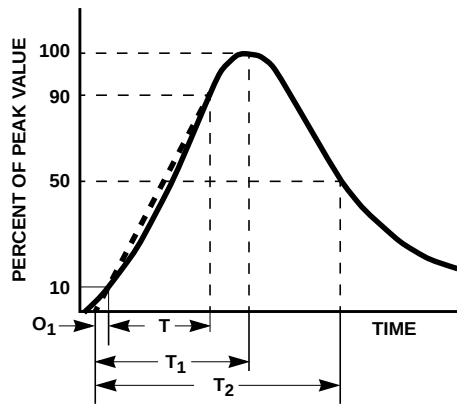
NOTE: Average power dissipation of transients not to exceed 0.6W and 1W for model sizes 14mm and 20mm, respectively.

**Power Dissipation Ratings**

Should transients occur in rapid succession, the average power dissipation is the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications table for the specific device. The operating values of a MOV need to be derated at high temperatures as shown in Figure 1. Because varistors only dissipate a relatively small amount of average power they are not suitable for repetitive applications that involve substantial amounts of average power dissipation.



**FIGURE 1. CURRENT, ENERGY AND POWER DERATING CURVE**



$O_1$  = Virtual Origin of Wave  
 $T$  = Time From 10% to 90% of Peak  
 $T_1$  = Virtual Front time =  $1.25 \cdot t$   
 $T_2$  = Virtual Time to Half Value (Impulse Duration)  
 Example: For an 8/20 $\mu$ s Current Waveform:  
 $8\mu$ s =  $T_1$  = Virtual Front Time  
 $20\mu$ s =  $T_2$  = Virtual Time to Half Value

FIGURE 2. PEAK PULSE CURRENT TEST WAVEFORM

### Transient V-I Characteristics Curves

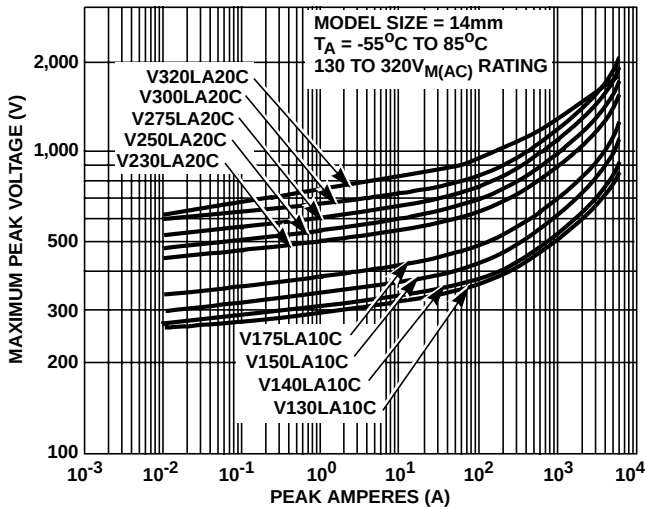


FIGURE 3. MAXIMUM CLAMPING VOLTAGE FOR V130LA10C TO V320LA20C

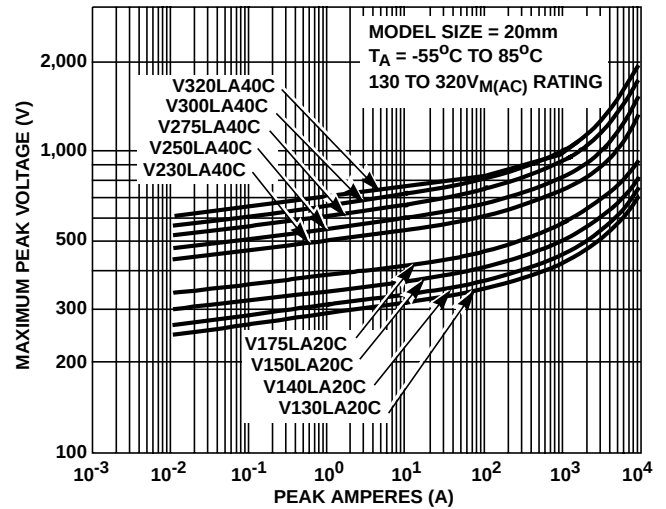


FIGURE 4. MAXIMUM CLAMPING VOLTAGE FOR V130LA20C TO V320LA40C

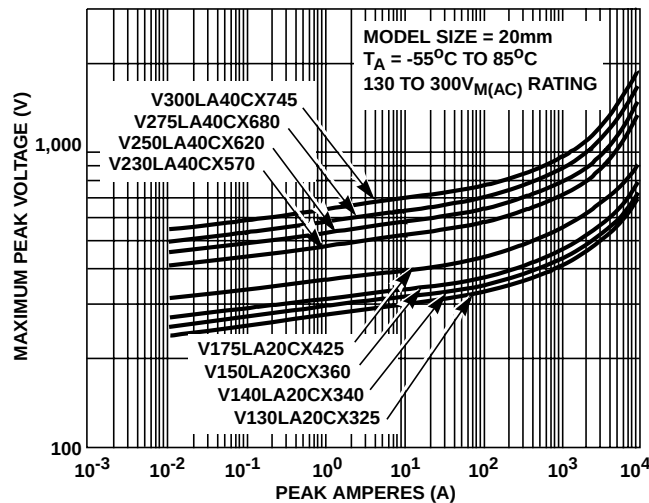


FIGURE 5. MAXIMUM CLAMPING VOLTAGE FOR V130LA20CX325 TO V300LACX745

## Pulse Rating Curves

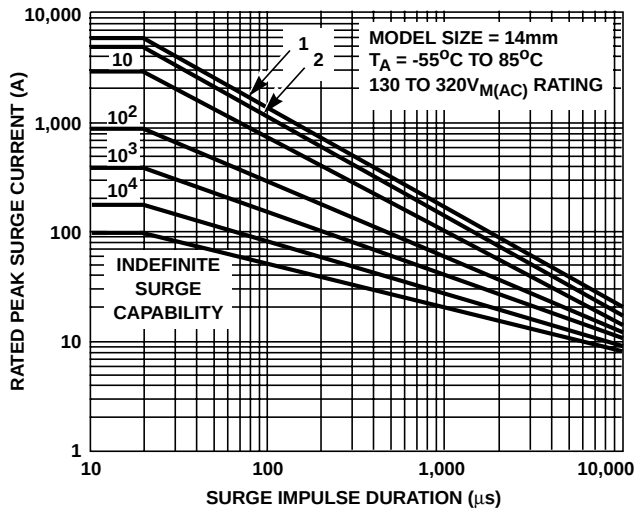


FIGURE 6. REPETITIVE SURGE CAPABILITY FOR V130LA10C TO V320LA20C

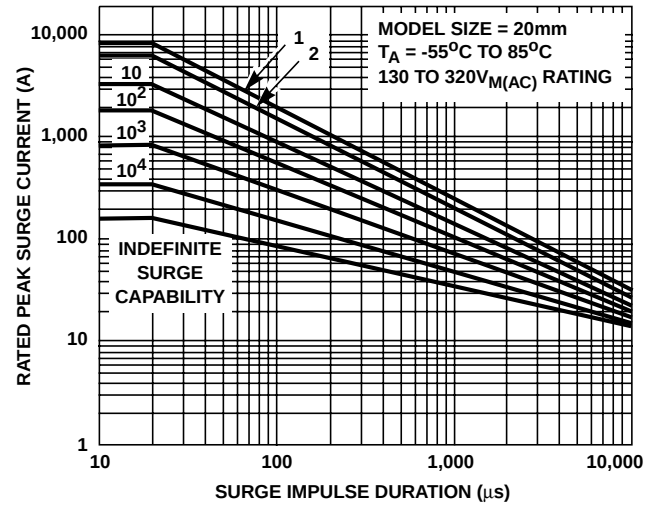
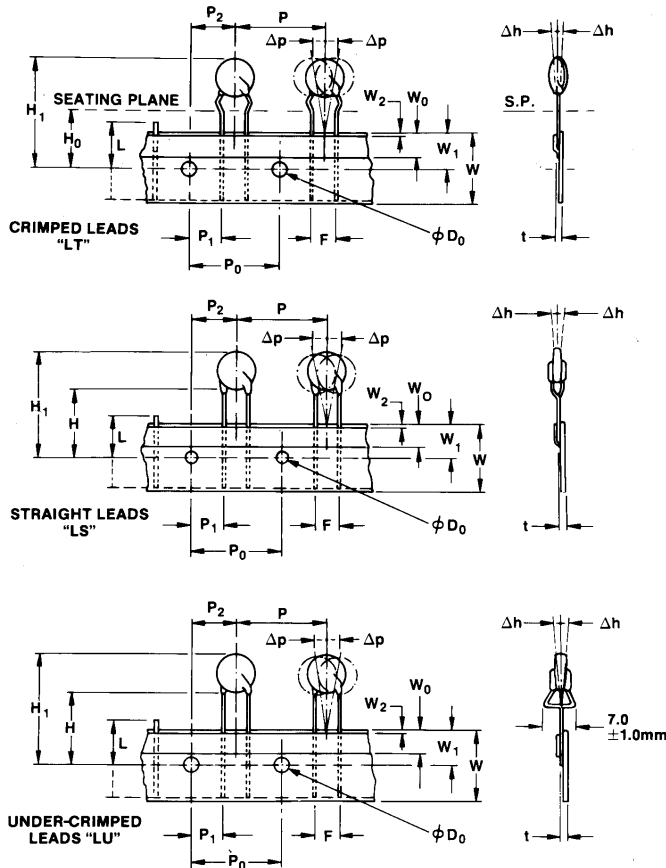


FIGURE 7. REPETITIVE SURGE CAPABILITY FOR V130LA20C TO V320LA40C

## Tape and Reel Specification



| SYMBOL         | DESCRIPTION                               | MODEL SIZE    |            |
|----------------|-------------------------------------------|---------------|------------|
|                |                                           | 14mm          | 20mm       |
| P              | Pitch of Component                        | 25.4 ± 1.0    |            |
| P <sub>0</sub> | Feed Hole Pitch                           | 12.7 ± 0.2    |            |
| P <sub>1</sub> | Feed Hole Center to Pitch                 | 2.60 ± 0.7    |            |
| P <sub>2</sub> | Hole Center to Component Center           | 6.35 ± 1.0    |            |
| F              | Lead to Lead Distance                     | 7.50 ± 0.8    |            |
| h              | Component Alignment                       | 2.00 Max      |            |
| W              | Tape Width                                | 18.25 ± 0.75  |            |
| W <sub>0</sub> | Hold Down Tape Width                      | 6.00 ± 0.3    | 12.0 ± 0.3 |
| W <sub>1</sub> | Hole Position                             | 9.125 ± 0.625 |            |
| W <sub>2</sub> | Hold Down Tape Position                   | 0.5 Max       |            |
| H              | Height From Tape Center To Component Base | 19.0 ± 1.0    |            |
| H <sub>0</sub> | Seating Plane Height                      | 16.0 ± 0.5    |            |
| H <sub>1</sub> | Component Height                          | 40 Max        | 46.5 Max   |
| D <sub>0</sub> | Feed Hole Diameter                        | 4.0 ± 0.2     |            |
| t              | Total Tape Thickness                      | 0.7 ± 0.2     |            |
| L              | Length of Clipped Lead                    | 12.0 Max      |            |
| p              | Component Alignment                       | 3° Max        |            |

### Tape and Reel Data

- Conforms to ANSI and EIA Specifications
- Can be supplied to IEC publication 286-2
- Radial devices on tape and reel are supplied with either crimped leads, straight leads, or under-crimped leads

### Tape and Reel Ordering Information

- Crimped leads are standard on LA types supplied in tape and reel and are denoted by the model letter "T". Also, in tape and reel, model letter "S" denotes straight leads and letter "U" denotes special under-crimped leads.

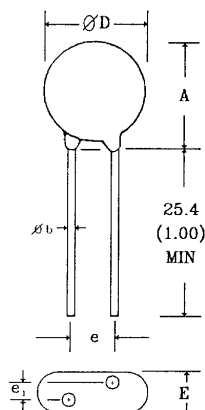
Example:

| STANDARD MODEL | CRIMPED LEADS | STRAIGHT LEADS | UNDER CRIMP LEADS |
|----------------|---------------|----------------|-------------------|
| V130LA20C      | V130LT20C     | V130LS20C      | V130LU20C         |

### Shipping Quantity

| DEVICE SIZE | QUANTITY PER REEL |          |          |
|-------------|-------------------|----------|----------|
|             | "T" REEL          | "S" REEL | "U" REEL |
| 14mm        | 500               | 500      | 500      |
| 20mm        | 500               | 500      | 500      |

### Mechanical Dimensions



| SYMBOL | VARISTOR MODEL SIZE |                 |                 |                 |
|--------|---------------------|-----------------|-----------------|-----------------|
|        | 14mm                |                 | 20mm            |                 |
|        | MIN                 | MAX             | MIN             | MAX             |
| A      | 13.5<br>(0.531)     | 20<br>(0.787)   | 17.5<br>(0.689) | 26.5<br>(1.043) |
| ØD     | 13.5<br>(0.531)     | 17<br>(0.669)   | 17.5<br>(0.689) | 23<br>(0.906)   |
| e      | 6.5 (0.256)         | 8.5 (0.335)     | 6.5 (0.256)     | 8.5 (0.335)     |
| e1     | 1.5 (0.059)         | 3.5 (0.138)     | 1.5 (0.059)     | 3.5 (0.138)     |
| E      | -                   | 5.6 (0.220)     | -               | 5.6 (0.220)     |
| Øb     | 0.76<br>(0.030)     | 0.86<br>(0.034) | 0.76<br>(0.030) | 0.86<br>(0.034) |

Dimensions are in millimeters (inches)

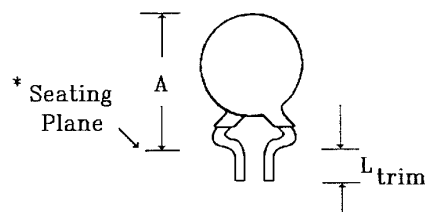
NOTE: 10mm lead spacing also available. See additional lead style options.

### Additional Lead Style Options

Radial lead types can be supplied with combination preformed crimp and trimmed leads. This option is supplied to the dimensions shown below.

| SYMBOL            | VARISTOR MODEL SIZE |                 |                 |                 |
|-------------------|---------------------|-----------------|-----------------|-----------------|
|                   | 14mm                |                 | 20mm            |                 |
|                   | MIN                 | MAX             | MIN             | MAX             |
| A                 | -                   | 24.5<br>(0.96)  | -               | 31<br>(1.22)    |
| L <sub>TRIM</sub> | 2.41<br>(0.095)     | 4.69<br>(0.185) | 2.41<br>(0.095) | 4.69<br>(0.185) |

NOTE: Dimensions are in millimeters (inches).



CRIMPED AND TRIMMED LEAD

\*Seating plane interpretation per IEC-717

- To order this crimped and trimmed lead style, the standard radial type model number "LA" is changed to the model number "LC". This option is supplied in bulk only.

Example:

| STANDARD MODEL | ORDER AS  |
|----------------|-----------|
| V130LA20C      | V130LC20C |

- For 10 ± 1mm lead spacing on 20mm units only; append standard model numbers by adding "X10" suffix.

Example:

| STANDARD MODEL | ORDER AS     |
|----------------|--------------|
| V130LA20C      | V130LA20CX10 |

- For other lead style variations to the above, please contact Harris Power Marketing.

## Reliability Performance of C-III Series

The electrical ratings of the C-III series of MOVs are conservatively stated. Samples of these devices have been tested under additional stresses, over and above those called out in the data sheet. The results of this testing show an enhanced device performance.

The series of stress tests to which the units were subjected are a combination of electrical, environmental and mechanical tests. A summary of the reliability tests performed on the C-III series are described in Table 1.

TABLE 1.

| TEST                  | REFERENCE STANDARD                             | TEST CONDITIONS                                         | TEST RESULTS |
|-----------------------|------------------------------------------------|---------------------------------------------------------|--------------|
| Surge Current         | UL 1449<br>IEEE/ANSI<br>C62.41<br><br>IEC 1051 | 9000A<br>(8/20 $\mu$ s)<br>1 Pulse                      | 0/165        |
|                       |                                                | 7000A<br>(8/20 $\mu$ s)<br>2 Pulses                     | 0/105        |
|                       |                                                | 3000A<br>(8/20 $\mu$ s)<br>20 Pulses                    | 0/75         |
|                       |                                                | 750A<br>(8/20 $\mu$ s)<br>120 Pulses                    | 0/65         |
| Surge Energy          | UL 1449<br>IEEE/ANSI<br>C62.41<br>IEC 1051     | 90J<br>(2ms)<br>1 Pulse                                 | 0/125        |
| Operating Life        | Mil-Std-202<br>Method 204D                     | 125°C, 1000 Hours,<br>Rated Bias Voltage                | 0/180        |
| Temporary Overvoltage | N/A                                            | 120% Maximum<br>Rated Varistor Voltage<br>For 5 Minutes | 0/70         |

## AC Bias Reliability

The C-III series of metal oxide varistors was designed for use on the AC line. The varistor is connected across the AC line and is biased with a constant amplitude sinusoidal voltage. It should be noted that the definition of failure is a shift in the nominal varistor voltage ( $V_N$ ) exceeding  $\pm 10\%$ . Although this type of varistor is still functioning normally after this magnitude of shift, devices at the lower extremities of  $V_N$  tolerance will begin to dissipate more power.

Because of this possibility, an extensive series of statistically designed tests were performed to determine the reliability of the C-III type of varistor under AC bias combined with high levels of temperature stress. To date, this test has generated over 50,000 device hours of operation at a temperature of 125°C, although only rated at 85°C. Changes in the nominal varistor voltage, measured at 1mA, of less than 2% have been recorded (Figure 8).

## Transient Surge Current/Energy Capability

The transient surge rating serves as an excellent figure of merit for the C-III varistor. This inherent surge handling capability is one of the C-III varistor's best features. The enhanced surge absorption capability results from improved process uniformity and enhanced construction. The homogeneity of the raw material powder and improved control over the sintering and assembly processes are contributing factors to this improvement.

In the low power AC mains environment, industry standards (UL, IEC, NEMA and IEEE) all suggest that the worst case surge occurrence will be 3kA. Such a transient event may occur up to five times over the equipment life time (approximately 10 years). While the occurrences of five 3kA transients is the required capability, the conservatively rated, repetitive surge current for the C-III series is 20 pulses for the 20mm units and 10 pulses for the 14mm series.

Additionally, all 20mm C-III devices are listed to the "Permanently Connected" category (10kA) of UL1449, by Underwriter's Laboratories, Inc.

As a measure of the inherent device capability, samples of the 20mm V130LA20C devices were subjected to a worst case repetitive transient surges test. After 100 pulses, each of 3kA, there was negligible change in the device characteristics. Changes in the clamping voltage, measured at 100 amps, of less than 3% were recorded (Figure 9). Samples of the 14mm Series V175LA20C were subjected to repetitive surge occurrences of 750A. Again, there was negligible changes in any of the device characteristics after 250 pulses (Figure 10). In both cases the inherent device capability is far in excess of the expected worst case scenario.

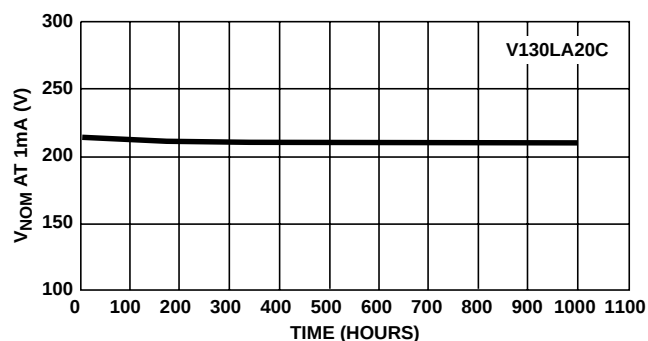


FIGURE 8. HIGH TEMPERATURE OPERATING LIFE 125°C FOR 1000 HOURS AT RATED BIAS

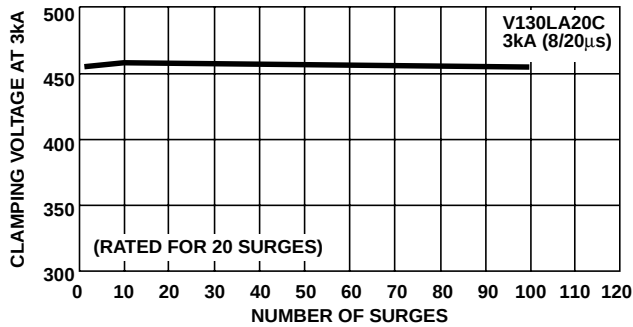


FIGURE 9. TYPICAL REPETITIVE SURGE CURRENT CAPABILITY OF C-III SERIES MOVs

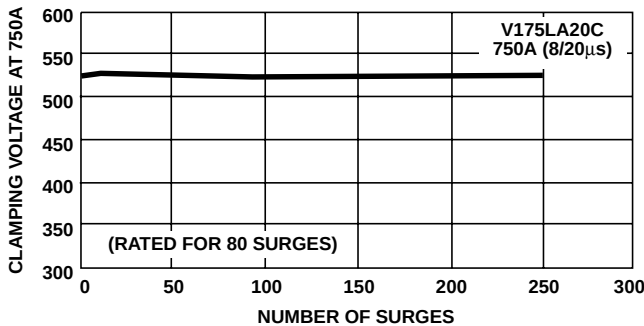


FIGURE 10. TYPICAL REPETITIVE SURGE CURRENT CAPABILITY OF C-III SERIES MOVs

## Terms and Descriptions

### Rated AC Voltage ( $V_{M(AC)RMS}$ )

This is the maximum continuous sinusoidal voltage which may be applied to the MOV. This voltage may be applied at any temperature up to the maximum operating temperature of 85°C.

### Maximum Non-Repetitive Surge Current ( $I_{TM}$ )

This is the maximum peak current which may be applied for an 8/20μs impulse, with rated line voltage also applied, without causing device failure. (See Figure 2.)

### Maximum Non-Repetitive Surge Energy ( $W_{TM}$ )

This is the maximum rated transient energy which may be dissipated for a single current pulse at a specified impulse and duration (2ms), with the rated  $V_{RMS}$  applied, without causing device failure.

### Nominal Voltage ( $V_{N(DC)}$ )

This is the voltage at which the device changes from the off state to the on state and enters its conduction mode of operation. This voltage is characterized at the 1mA point and has specified minimum and maximum voltage levels.

### Clamping Voltage ( $V_C$ )

This is the peak voltage appearing across the MOV when measured at conditions of specified pulse current amplitude and specified waveform (8/20μs).

All Harris Semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

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