

RoHS  **MA Varistor Series**



### Agency Approvals

| Agency | Agency File Number |
|--------|--------------------|
|        | None               |

### Description

The MA Series of transient surge suppressors are axial lead Metal Oxide Varistors (MOVs) for use in a wide variety of board level industrial and commercial electronic equipment. They are intended to protect components and signal/data lines from low energy transients where the small axial lead package is required.

The MA Series is offered with standard ('S' suffix) or tightened ('B' suffix) clamping voltage.

See MA Series Device Ratings and Specifications Table for part number and brand information.

### Features

- 3mm diameter disc size
- Small axial lead package
- Wide operating voltage range:  
 $V_{M(AC)RMS}$  9V to 264V  
 $V_{M(DC)}$  13V to 365V
- Available in tape and reel or bulk packaging
- No derating up to 85°C ambient
- New black epoxy offers improved performance for high temperature Lead-free wave soldering process.

### Absolute Maximum Ratings

• For ratings of individual members of a series, see Device Ratings and Specifications chart

| Continuous                                                                                                                                                | MA Series   | Units      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|
| Steady State Applied Voltage:                                                                                                                             |             |            |
| AC Voltage Range ( $V_{M(AC)RMS}$ )                                                                                                                       | 9 to 264    | V          |
| DC Voltage Range ( $V_{M(DC)}$ )                                                                                                                          | 13 to 365   | V          |
| Transient:                                                                                                                                                |             |            |
| Peak Pulse Current ( $I_{TM}$ )                                                                                                                           |             |            |
| For 8/20 $\mu$ s Current Wave(See Figure 2)                                                                                                               | 40 to 100   | A          |
| Single-Pulse Energy Range                                                                                                                                 |             |            |
| For 2ms Current Square Wave ( $W_{TM}$ )                                                                                                                  | 0.06 to 1.7 | J          |
| 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       |
| Hi-Pot Encapsulation (COATING Isolation Voltage Capability)<br>Dielectric must withstand indicated DC voltage for one minute per MIL-STD 202, Method 301) | 1000        | V          |
| COATING Insulation Resistance                                                                                                                             | 1000        | M $\Omega$ |

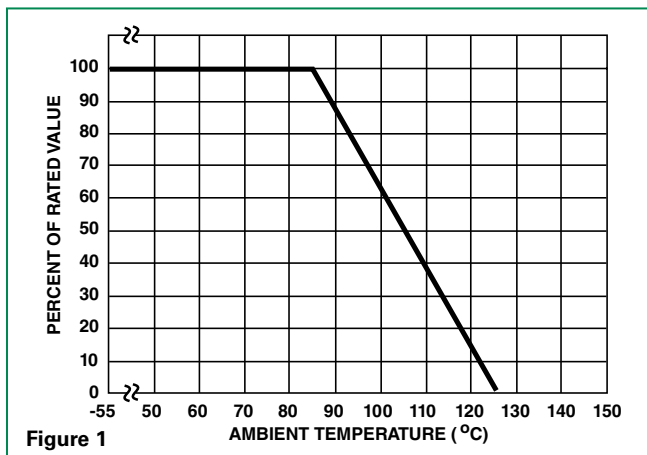
**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### MA Series Ratings & Specifications

| Part Number | Brand (mm) | Maximum Rating (85°C) |             |                          |                             | Specifications (25°C)                   |             |      |                                                |                     |
|-------------|------------|-----------------------|-------------|--------------------------|-----------------------------|-----------------------------------------|-------------|------|------------------------------------------------|---------------------|
|             |            | Continuous            |             | Transient                |                             | Varistor Voltage at 1mA DC Test Current |             |      | Max Clamping Volt $V_C$ at 2.0A (8/20 $\mu$ s) | Typical Capacitance |
|             |            | $V_{RMS}$             | $V_{DC}$    | Energy (10/1000 $\mu$ s) | Peak Current (8/20 $\mu$ s) |                                         |             |      |                                                |                     |
|             |            | $V_{M(AC)}$           | $V_{M(DC)}$ | $W_{TM}$                 | $I_{TM}$                    | Min                                     | $V_{N(DC)}$ | Max  | $V_C$                                          | $f = 1\text{MHz}$   |
|             |            | (V)                   | (V)         | (J)                      | (A)                         | (V)                                     | (V)         | (V)  | (A)                                            | (pF)                |
| V18MA1A     | 18A        | 9                     | 13          | 0.06                     | 40                          | 14                                      | 18          | 23   | 49                                             | 550                 |
| V18MA1A     | 18B        | 10                    | 14          | 0.07                     | 40                          | 15                                      | 18          | 21   | 44                                             | 550                 |
| V18MA1A     | 18C        | 10                    | 14          | 0.06                     | 40                          | 15                                      | 18          | 21   | 49                                             | 550                 |
| V22MA1A     | 22A        | 10                    | 15          | 0.09                     | 40                          | 16                                      | 22          | 28   | 55                                             | 410                 |
| V22MA1B     | 22B        | 14                    | 18          | 0.10                     | 40                          | 19                                      | 22          | 26   | 51                                             | 410                 |
| V22MA1S     | 22S        | 14                    | 18          | 0.09                     | 40                          | 19                                      | 22          | 26   | 55                                             | 410                 |
| V27MA1A     | 27A        | 13                    | 19          | 0.10                     | 40                          | 21                                      | 27          | 34   | 67                                             | 370                 |
| V27MA1B     | 27B        | 17                    | 22          | 0.11                     | 40                          | 24                                      | 27          | 31   | 59                                             | 370                 |
| V27MA1S     | 27S        | 17                    | 22          | 0.10                     | 40                          | 24                                      | 27          | 31   | 67                                             | 370                 |
| V33MA1A     | 33A        | 18                    | 23          | 0.13                     | 40                          | 26                                      | 33          | 40   | 73                                             | 300                 |
| V33MA1B     | 33B        | 20                    | 26          | 0.15                     | 40                          | 29.5                                    | 33          | 36.5 | 67                                             | 300                 |
| V33MA1S     | 33S        | 20                    | 26          | 0.14                     | 40                          | 29.5                                    | 33          | 36.5 | 73                                             | 300                 |
| V39MA2A     | 39A        | 22                    | 28          | 0.16                     | 40                          | 31                                      | 39          | 47   | 86                                             | 250                 |
| V39MA2B     | 39B        | 25                    | 31          | 0.18                     | 40                          | 35                                      | 39          | 43   | 79                                             | 250                 |
| V39MA2S     | 39S        | 25                    | 31          | 0.17                     | 40                          | 35                                      | 39          | 43   | 86                                             | 250                 |
| V47MA2A     | 47A        | 27                    | 34          | 0.19                     | 40                          | 37                                      | 47          | 57   | 99                                             | 210                 |
| V47MA2B     | 47B        | 30                    | 38          | 0.21                     | 40                          | 42                                      | 47          | 52   | 90                                             | 210                 |
| V47MA2S     | 47S        | 30                    | 38          | 0.19                     | 40                          | 42                                      | 47          | 52   | 99                                             | 210                 |
| V56MA2A     | 56A        | 32                    | 40          | 0.23                     | 40                          | 44                                      | 56          | 68   | 117                                            | 180                 |
| V56MA2B     | 56B        | 35                    | 45          | 0.25                     | 40                          | 50                                      | 56          | 62   | 108                                            | 180                 |
| V56MA2S     | 56S        | 35                    | 45          | 0.23                     | 40                          | 50                                      | 56          | 62   | 117                                            | 180                 |
| V68MA3A     | 68A        | 38                    | 48          | 0.26                     | 40                          | 54                                      | 68          | 82   | 138                                            | 150                 |
| V68MA3B     | 68B        | 40                    | 56          | 0.30                     | 40                          | 61                                      | 68          | 75   | 127                                            | 150                 |
| V68MA3S     | 68S        | 40                    | 56          | 0.27                     | 40                          | 61                                      | 68          | 75   | 138                                            | 150                 |
| V82MA3A     | 82A        | 45                    | 60          | 0.33                     | 40                          | 65                                      | 82          | 99   | 163                                            | 120                 |
| V82MA3B     | 82B        | 50                    | 66          | 0.37                     | 40                          | 73                                      | 82          | 91   | 150                                            | 120                 |
| V82MA3S     | 82S        | 50                    | 66          | 0.34                     | 40                          | 73                                      | 82          | 91   | 163                                            | 120                 |
| V100MA4A    | 100        | 57                    | 72          | 0.40                     | 40                          | 80                                      | 100         | 120  | 200                                            | 100                 |
| V100MA4B    | 101        | 60                    | 81          | 0.45                     | 40                          | 90                                      | 100         | 110  | 185                                            | 100                 |
| V100MA4S    | 102        | 60                    | 81          | 0.42                     | 40                          | 90                                      | 100         | 110  | 200                                            | 100                 |
| V120MA1A    | 120        | 72                    | 97          | 0.40                     | 100                         | 102                                     | 120         | 138  | 220                                            | 40                  |
| V120MA2B    | 121        | 75                    | 101         | 0.50                     | 100                         | 108                                     | 120         | 132  | 205                                            | 40                  |
| V120MA2S    | 122        | 75                    | 101         | 0.46                     | 100                         | 108                                     | 120         | 132  | 220                                            | 40                  |
| V150MA1A    | 150        | 88                    | 121         | 0.50                     | 100                         | 127                                     | 150         | 173  | 255                                            | 32                  |
| V150MA2B    | 151        | 92                    | 127         | 0.60                     | 100                         | 135                                     | 150         | 165  | 240                                            | 32                  |
| V180MA1A    | 180        | 105                   | 144         | 0.60                     | 100                         | 153                                     | 180         | 207  | 310                                            | 27                  |
| V180MA3B    | 181        | 110                   | 152         | 0.70                     | 100                         | 162                                     | 180         | 198  | 290                                            | 27                  |
| V220MA2A    | 220        | 132                   | 181         | 0.80                     | 100                         | 187                                     | 220         | 253  | 380                                            | 21                  |
| V220MA4B    | 221        | 138                   | 191         | 0.90                     | 100                         | 198                                     | 220         | 242  | 360                                            | 21                  |
| V270MA2A    | 270        | 163                   | 224         | 0.90                     | 100                         | 229                                     | 270         | 311  | 460                                            | 17                  |
| V270MA4B    | 271        | 171                   | 235         | 1.00                     | 100                         | 243                                     | 270         | 297  | 440                                            | 17                  |
| V330MA2A    | 330        | 188                   | 257         | 1.00                     | 100                         | 280                                     | 330         | 380  | 570                                            | 14                  |
| V330MA5B    | 331        | 200                   | 274         | 1.10                     | 100                         | 297                                     | 330         | 363  | 540                                            | 14                  |
| V390MA3A    | 390        | 234                   | 322         | 1.20                     | 100                         | 331                                     | 390         | 449  | 670                                            | 12                  |
| V390MA6B    | 391        | 242                   | 334         | 1.30                     | 100                         | 351                                     | 390         | 429  | 640                                            | 12                  |
| V430MA3A    | 430        | 253                   | 349         | 1.50                     | 100                         | 365                                     | 430         | 495  | 740                                            | 11                  |
| V430MA7B    | 431        | 264                   | 365         | 1.70                     | 100                         | 387                                     | 430         | 473  | 700                                            | 11                  |

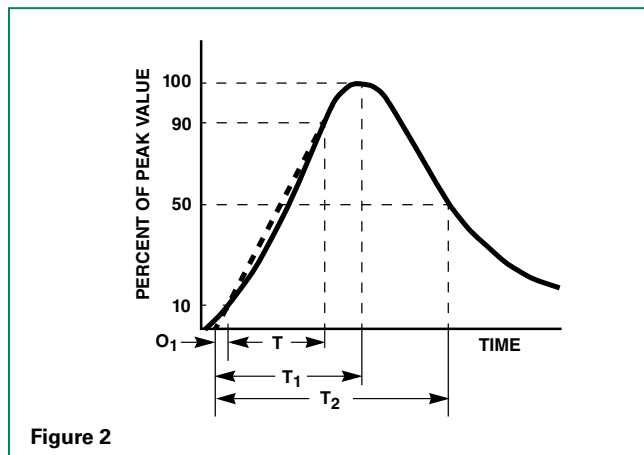
NOTE: Average power dissipation of transients not to exceed 200mW.

### Power Dissipation Ratings



Should transients occur in rapid succession, the average power dissipation required is simply 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. Furthermore, the operating values need to be derated at high temperatures as shown above. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

### Peak Pulse Current Test Waveform



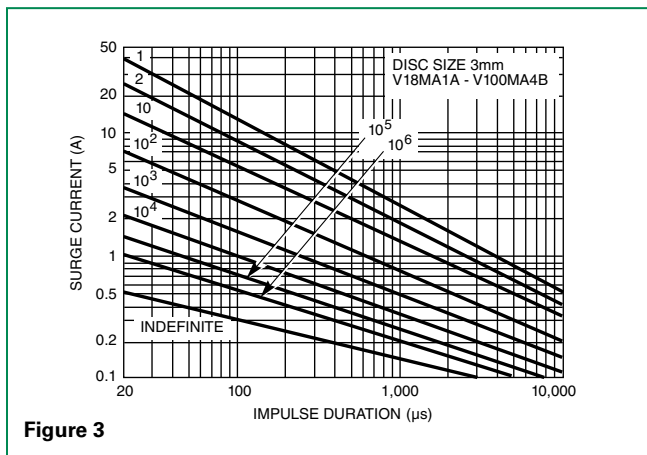
$O_1$  = Virtual Origin of Wave  
 $T$  = Time from 10% to 90% of Peak  
 $T_1$  = Rise Time =  $1.25 \times T$   
 $T_2$  = Decay Time

**Example** - For an  $8/20 \mu s$  Current Waveform:

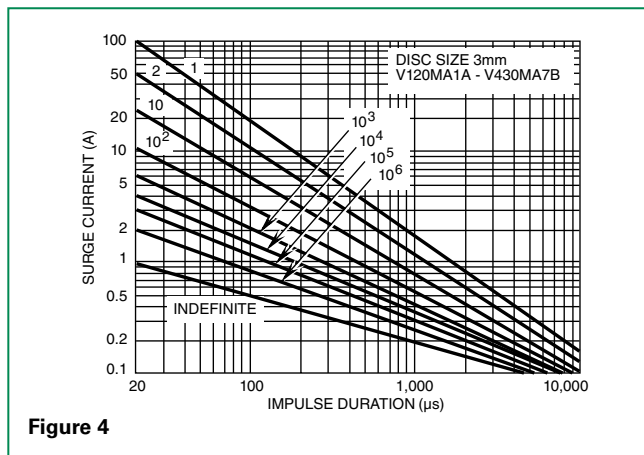
$8 \mu s = T_1$  = Rise Time  
 $20 \mu s = T_2$  = Decay Time

### Repetitive Surge Capability

#### V18MA - V100MA



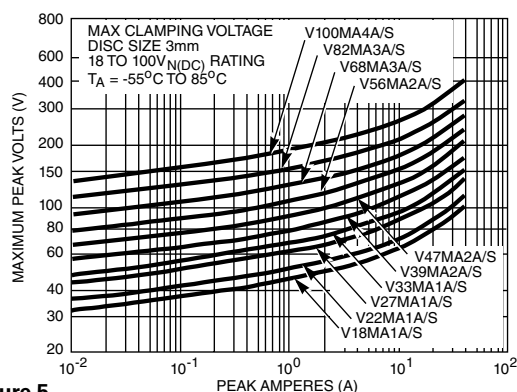
#### V120MA1A/S - V430MA3A



NOTE: If pulse ratings are exceeded, a shift of  $V_{NDC}$  (at specified current) of more than  $\pm 10\%$  could result. This type of shift, which normally results in a decrease of  $V_{NDC}$ , may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

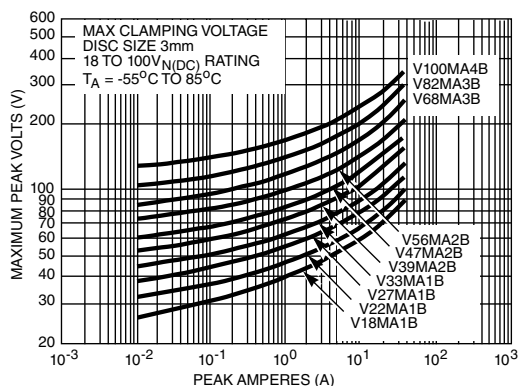
### Maximum Clamping Voltage

**V18MA1A/S - V100MA4A/S**



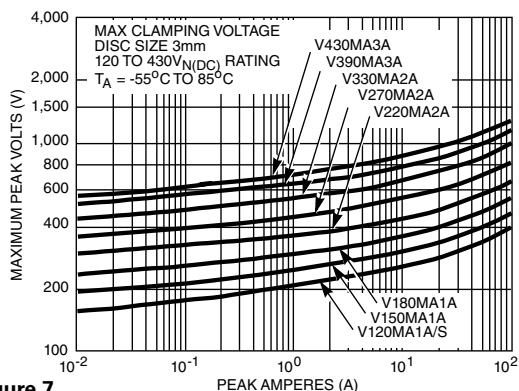
**Figure 5**

**V18MA1B - V100MA4B**



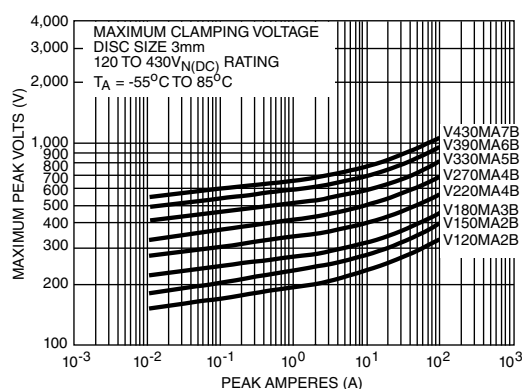
**Figure 6**

**V120MA1A/S - V430MA3A**



**Figure 7**

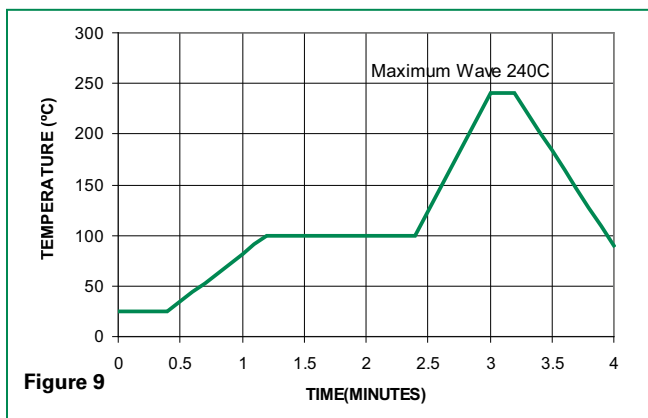
**V120MA2B - V430MA7B**



**Figure 8**

## Wave Solder Profile

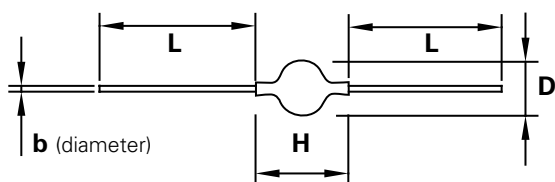
### Non Lead-free Profile



### Lead-free Profile

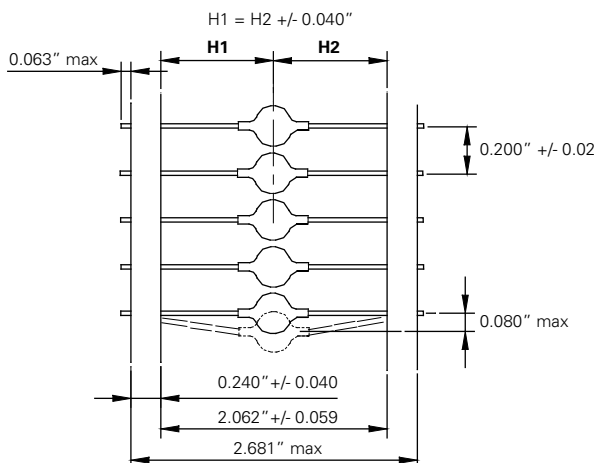


## Product Dimensions



| Symbol                | Inches |       | Millimeters |      |
|-----------------------|--------|-------|-------------|------|
|                       | Min    | Max   | Min         | Max  |
| Øb                    | 0.024  | 0.026 | 0.61        | 0.66 |
| ØD                    | 0.118  | 0.177 | 3.0         | 4.5  |
| H                     | 0.177  | 0.276 | 4.5         | 7.0  |
| L                     | 1.740  | 1.220 | 27.3        | 31.0 |
| Typical Weight = 0.5g |        |       |             |      |

## Tape and Reel Dimensions



Conforms to EIA Standard RS-296-E

## Physical Specifications

|                                  |                                                                 |
|----------------------------------|-----------------------------------------------------------------|
| <b>Lead Material</b>             | Tin-plated Copper clad steel                                    |
| <b>Soldering Characteristics</b> | Solderability per MIL-STD-202, Method 208E                      |
| <b>Insulating Material</b>       | Cured, flame retardant epoxy polymer meets UL94V-0 requirements |
| <b>Device Labeling</b>           | Marked with LF, voltage and date code                           |

## Environmental Specifications

|                                      |                                                            |
|--------------------------------------|------------------------------------------------------------|
| <b>Operating/Storage Temperature</b> | -40°C to +85°C                                             |
| <b>Passive Aging</b>                 | +85°C, 1000 hours<br>+/-10% typical voltage change         |
| <b>Humidity Aging</b>                | +85°C, 85% RH, 1000 hours<br>+/-10% typical voltage change |
| <b>Thermal Shock</b>                 | +85°C to -40°C 5 times<br>+/-10% typical voltage change    |
| <b>Solvent Resistance</b>            | MIL-STD-202, Method 215F                                   |
| <b>Moisture Sensitivity</b>          | Level 1, J-STD-020C                                        |

## Part Numbering System

