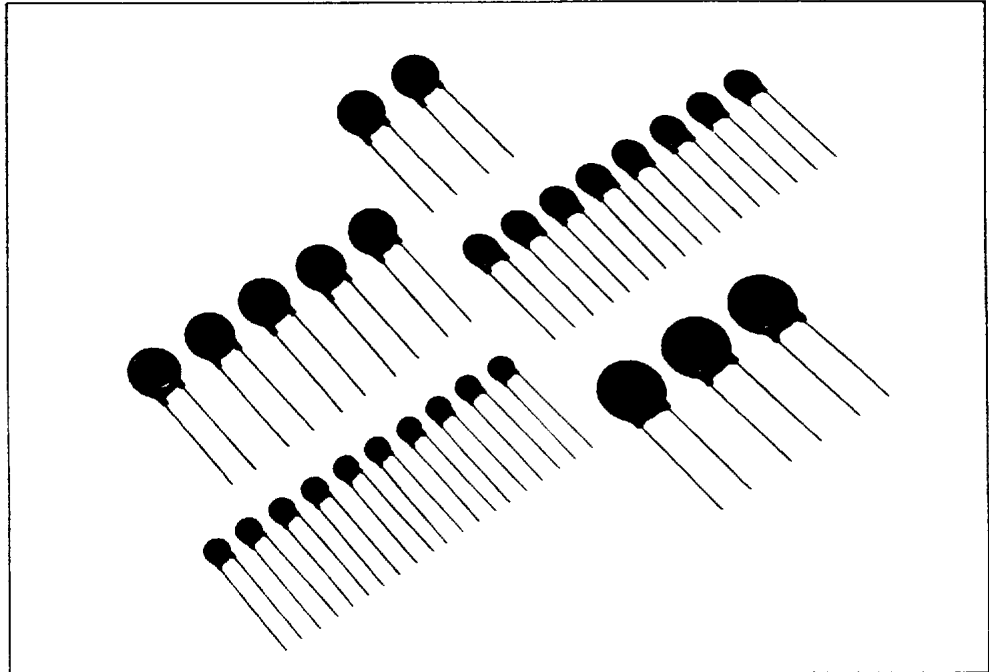




METAL OXIDE VARISTOR

# ZENAMIC



ZENAMIC is the product name of a metal oxide varistor.

### Features

- High energy absorption
- Excellent voltage clamping characteristics
- Symmetrical characteristics — for use on AC or DC
- Fast response
- Compact and robust construction
- Low idle power
- High surge current capability
- Specific types for PACE/paks and Solid State Relays

### Applications

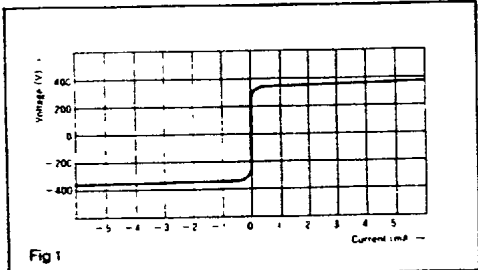
- For protection of all types of semiconductors
- Suppression of switching transients
- Voltage clipping, and circuit damping
- Absorption of surge voltages associated with lightning strikes
- Prolongation of contact life
- Protection in industrial switching circuits

Zenamic voltage suppressors are metal oxide varistors having a non-linear current-voltage characteristic which exhibits an almost constant voltage over a wide range of current. They are ideally suited to all transient voltage protection applications and their high clamping ratios and low steady state power consumption offer considerable circuit advantages over more traditional methods of protection.

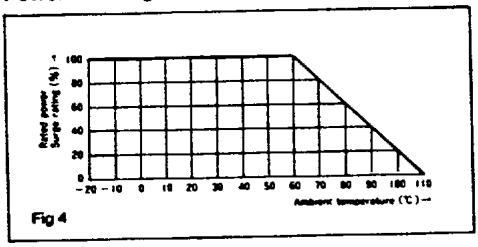
Normally the Zenamic idles at a low current level at the nominal voltage. When a transient over-voltage occurs in the circuit, the Zenamic current increases rapidly, its voltage remaining virtually constant. The transient energy is thus absorbed by the Zenamic and the associated circuit impedances.

**V-I characteristics**

ZENAMIC has the forward-reverse symmetrical electrical characteristics as shown in the figure 1. The voltage-current curves show the varistor characteristics in the range 1 μA to 10<sup>4</sup> A, and show the resistance characteristics for the range under 1 μA and over 10<sup>4</sup> A in the figure 2. The voltage across terminals when test current (It: 1 mA) is applied to ZENAMIC is a standard varistor voltage (Vz), and the voltage across terminals when a standard surge (Ip) is applied represents the maximum suppression voltage (Vc).

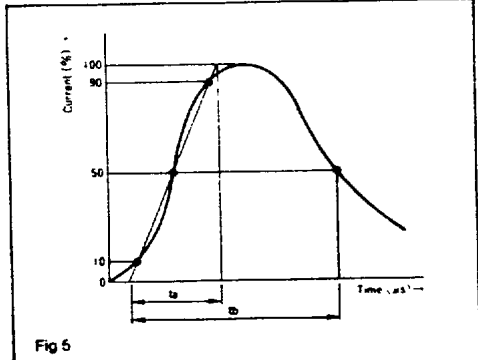


**Power derating**



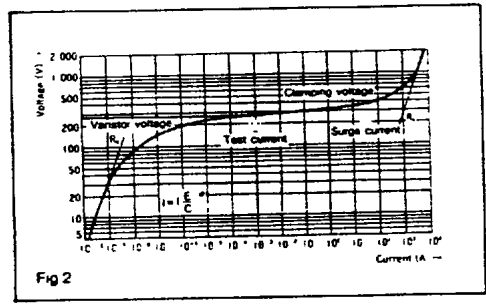
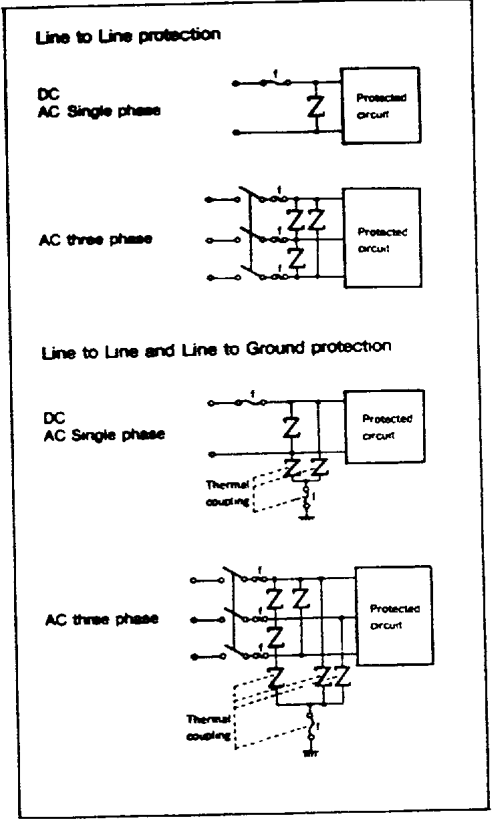
**Surge waveform**

A surge waveform varies according to the sources. An EXP waveform is used for surge testing of ZENAMIC, while a AC half-wave is used for the energy absorption test. The EXP waveform reaches its peak voltage (current) at [ta] as shown in the figure 5, and then decreases as time passes and reaches half of the peak voltage (current) at [tb]. This type of the EXP waveform is shown as a [ta/tb] voltage (current) waveform. For surge testing of ZENAMIC, the 8/20 μ sec current waveform is used.



**Application**

A few examples show. Power lines and surge absorption units with error display (SA series).



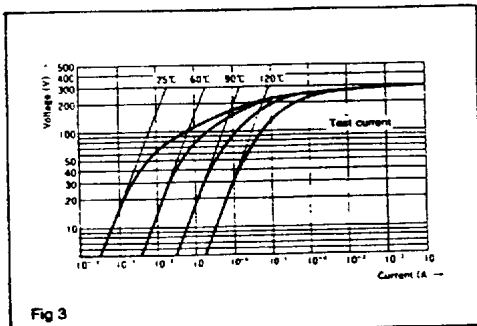
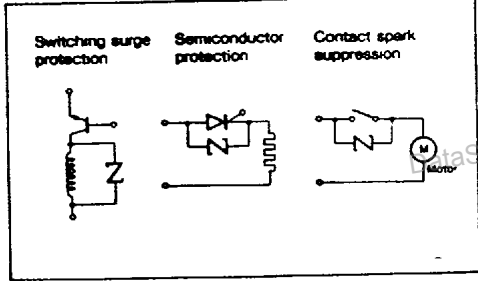
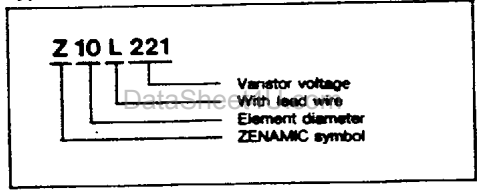
**Temperature Characteristics**

In the small current range, Zenamic features outstanding temperature characteristics. A shunt resistance Rp of metal oxide varistor has the temperature characteristics which is determined by the following equation.

$$R_p = A e^{E_g/2kT} \quad (2)$$

- T: Absolute temperature
- k: Boltzmann constant
- A, Eg: constants

**Type No.**



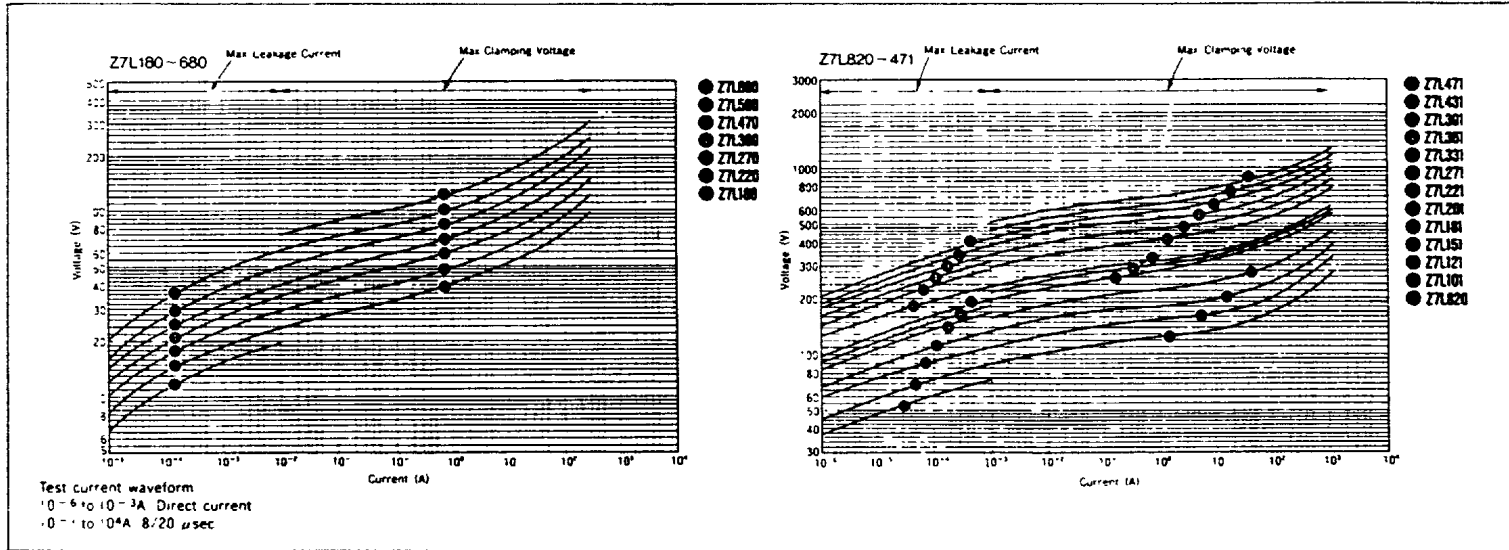
As shown in the figure 3, the temperature dependence characteristics are shown clearly in the low current area.

# Z7L Series

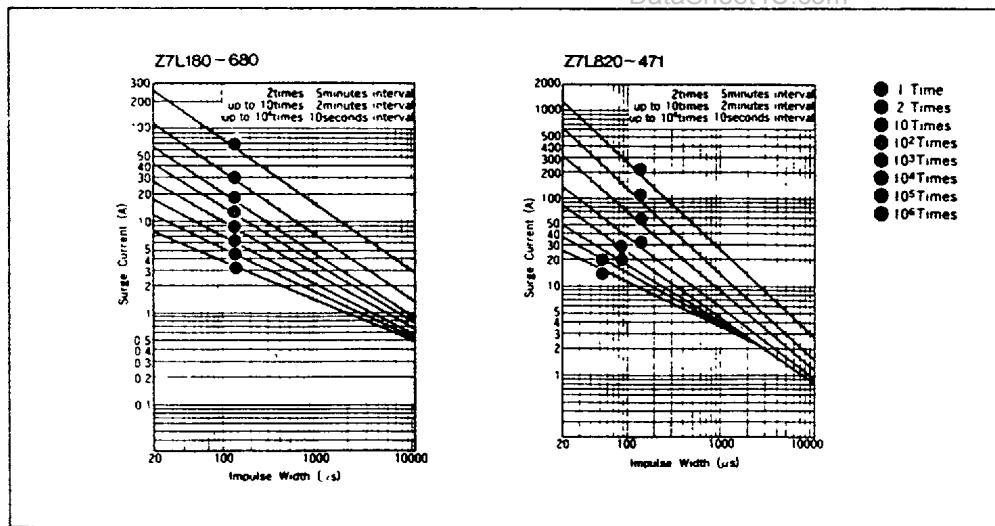
## Specifications

| Type No. | Varistor voltage $V_{Vrms}$ (V) |     | Maximum allowable voltage |         | Maximum clamping voltage<br>V | Rated wattage<br>W | Energy (2ms)<br>J | Withstanding Surge current (8/20 $\mu$ s) |         | Typical capacitance (@ 1kHz)<br>pF |
|----------|---------------------------------|-----|---------------------------|---------|-------------------------------|--------------------|-------------------|---|---------|------------------------------------|
|          | Min                             | Max | AC<br>$V_{rms}$           | DC<br>V |                               |                    |                   | 1 Time                                    | 2 Times |                                    |
| Z7L180   | 18 (16~20)                      |     | 11                        | 14      | 36 at 2.5A                    |                    | 0.8               |   |         | 3,500                              |
| Z7L220   | 22 (20~24)                      |     | 14                        | 18      | 43                            |                    | 0.9               |   |         | 2,800                              |
| Z7L270   | 27 (24~30)                      |     | 17                        | 22      | 53                            |                    | 1.0               |   |         | 2,000                              |
| Z7L330   | 33 (30~36)                      |     | 20                        | 26      | 65                            |                    | 1.2               |   |         | 1,500                              |
| Z7L390   | 39 (35~43)                      |     | 25                        | 31      | 77                            | 0.02               | 1.5               | 250A                                      | 125A    | 1,350                              |
| Z7L470   | 47 (42~52)                      |     | 30                        | 38      | 93                            |                    | 1.8               |   |         | 1,150                              |
| Z7L560   | 56 (50~62)                      |     | 35                        | 45      | 110                           |                    | 2.2               |   |         | 960                                |
| Z7L680   | 68 (61~75)                      |     | 40                        | 56      | 135                           |                    | 2.5               |   |         | 700                                |
| Z7L820   | 82 (74~90)                      |     | 50                        | 65      | 135 at 10A                    |                    | 3.5               |   |         | 550                                |
| Z7L101   | 100 (90~110)                    |     | 60                        | 85      | 165                           |                    | 4.0               |   |         | 500                                |
| Z7L121   | 120 (108~132)                   |     | 75                        | 100     | 200                           |                    | 5.0               |   |         | 450                                |
| Z7L151   | 150 (135~165)                   |     | 95                        | 125     | 250                           |                    | 6.0               |   |         | 350                                |
| Z7L181   | 180 (162~198)                   |     | 110                       | 145     | 300                           |                    | 8.0               |   |         | 300                                |
| * Z7L201 | 200 (185~225)                   |     | 130                       | 170     | 340                           |                    | 10.0              |   |         | 250                                |
| * Z7L221 | 220 (198~242)                   |     | 140                       | 180     | 360                           | 0.25               | 10.0              | 1200A                                     | 600A    | 250                                |
| * Z7L271 | 270 (247~303)                   |     | 175                       | 225     | 455                           |                    | 12.0              |   |         | 170                                |
| * Z7L331 | 330 (297~363)                   |     | 210                       | 275     | 550                           |                    | 15.0              |   |         | 150                                |
| * Z7L361 | 360 (324~396)                   |     | 230                       | 300     | 595                           |                    | 15.0              |   |         | 130                                |
| * Z7L381 | 390 (351~429)                   |     | 250                       | 320     | 650                           |                    | 17.0              |   |         | 130                                |
| * Z7L431 | 430 (387~473)                   |     | 275                       | 350     | 710                           |                    | 20.0              |   |         | 110                                |
| * Z7L471 | 470 (423~517)                   |     | 300                       | 385     | 775                           |                    | 20.0              |   |         | 100                                |

## V-I characteristics



## Surge Life Time Ratings (Relation between impulse width and surge repetition time)



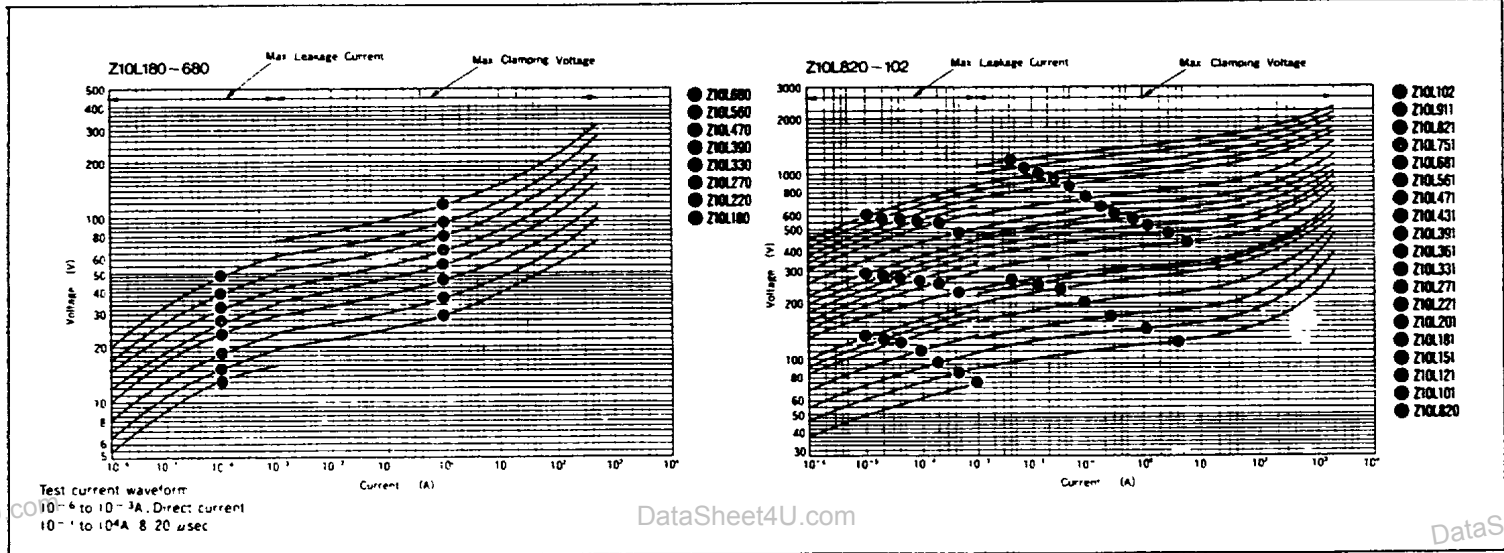
- 1 Operating temperature range -40 to 85 °C
- 2 Storage temperature range -40 to 125 °C
- 3 \* UL approved model

# Z10L Series

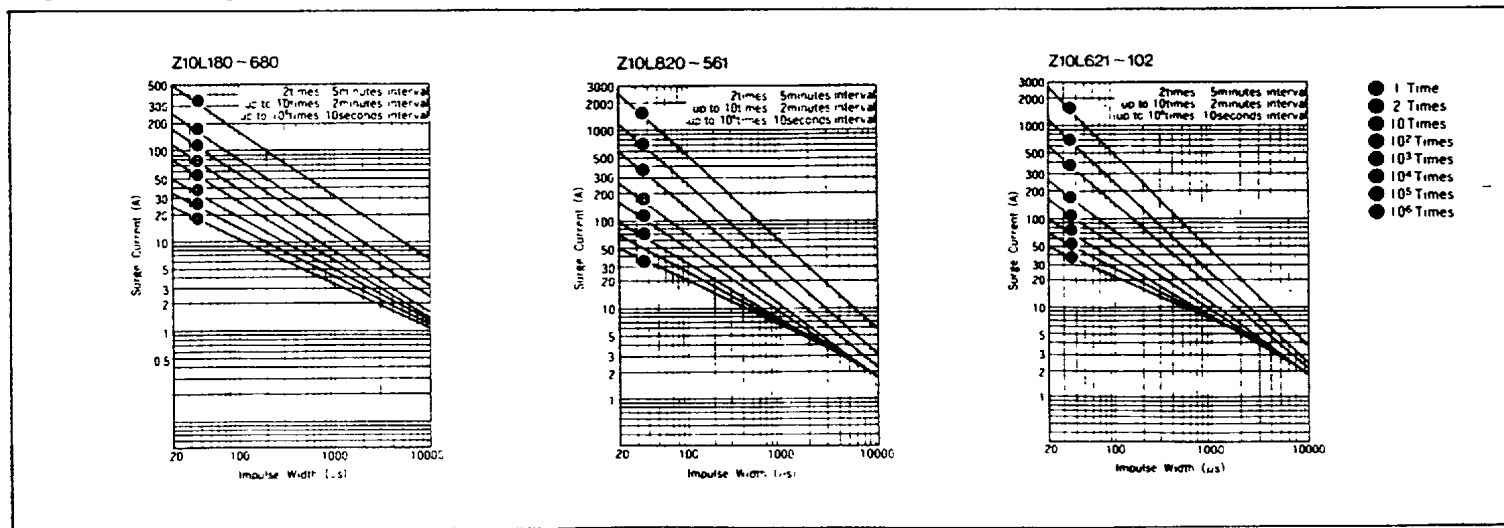
## Specifications

| Type No. | Varistor voltage $V_{1mA}$ (V) |     | Maximum allowable voltage |     | Maximum clamping voltage | Rated wattage | Energy (Jms) | Withstanding Surge Current (8/20 $\mu$ s) |         | Typical capacitance (@ 1kHz) |
|----------|--------------------------------|-----|---------------------------|-----|--------------------------|---------------|--------------|---|---------|------------------------------|
|          |                                |     | AC                        | DC  |                          |               |              | 1 Time                                    | 2 Times |                              |
|          | Min                            | Max | Vrms                      | V   | V                        | W             | J            |   |         | pF                           |
| Z10L180  | 18 (16~20)                     |     | 11                        | 14  | 36 at 5A                 | 0.05          | 1.5          | 500A                                      | 250A    | 7,500                        |
| Z10L220  | 22 (20~24)                     |     | 14                        | 18  | 43                       |               | 2.0          |   |         | 6,000                        |
| Z10L270  | 27 (24~30)                     |     | 17                        | 22  | 53                       |               | 2.5          |   |         | 4,000                        |
| Z10L330  | 33 (30~36)                     |     | 20                        | 26  | 65                       |               | 3.0          |   |         | 3,000                        |
| Z10L390  | 39 (35~43)                     |     | 25                        | 31  | 77                       |               | 3.5          |   |         | 2,600                        |
| Z10L470  | 47 (42~52)                     |     | 30                        | 38  | 93                       |               | 4.5          |   |         | 2,200                        |
| Z10L560  | 56 (50~62)                     |     | 35                        | 45  | 110                      |               | 5.5          |   |         | 1,800                        |
| Z10L680  | 68 (61~75)                     |     | 40                        | 56  | 135                      |               | 6.5          |   |         | 1,300                        |
| Z10L820  | 82 (74~90)                     |     | 50                        | 65  | 135 at 25A               | 0.4           | 8            | 2500A                                     | 1250A   | 1,800                        |
| Z10L101  | 100 (90~110)                   |     | 60                        | 85  | 165                      |               | 10           |   |         | 1,400                        |
| Z10L121  | 120 (108~132)                  |     | 75                        | 100 | 200                      |               | 12           |   |         | 1,100                        |
| Z10L151  | 150 (135~165)                  |     | 95                        | 125 | 250                      |               | 16           |   |         | 900                          |
| Z10L181  | 180 (162~198)                  |     | 110                       | 145 | 300                      |               | 18           |   |         | 700                          |
| *Z10L201 | 200 (185~225)                  |     | 130                       | 170 | 340                      |               | 20           |   |         | 500                          |
| *Z10L221 | 220 (198~242)                  |     | 140                       | 180 | 350                      |               | 23           |   |         | 450                          |
| *Z10L271 | 270 (247~303)                  |     | 175                       | 225 | 455                      |               | 30           |   |         | 350                          |
| *Z10L331 | 330 (297~363)                  |     | 210                       | 275 | 650                      |               | 33           |   |         | 330                          |
| *Z10L361 | 360 (324~396)                  |     | 230                       | 300 | 565                      |               | 35           |   |         | 300                          |
| *Z10L381 | 390 (351~429)                  |     | 250                       | 320 | 650                      |               | 40           |   |         | 270                          |
| *Z10L431 | 430 (387~473)                  |     | 275                       | 350 | 710                      |               | 45           |   |         | 250                          |
| *Z10L471 | 470 (423~517)                  |     | 300                       | 385 | 775                      |               | 45           |   |         | 230                          |
| *Z10L561 | 560 (504~616)                  |     | 350                       | 460 | 925                      |               | 45           |   |         | 150                          |
| *Z10L681 | 680 (612~748)                  |     | 420                       | 560 | 1,120                    |               | 45           |   |         | 130                          |
| *Z10L751 | 750 (675~825)                  |     | 460                       | 615 | 1,240                    |               | 50           |   |         | 120                          |
| *Z10L821 | 820 (738~902)                  |     | 510                       | 670 | 1,355                    | 55            | 110          |   |         |                              |
| *Z10L911 | 910 (819~1,001)                |     | 550                       | 745 | 1,500                    | 60            | 100          |   |         |                              |
| *Z10L102 | 1,000 (900~1,100)              |     | 625                       | 825 | 1,650                    | 65            | 90           |   |         |                              |

### V-I characteristics



### Surge Life Time Ratings (Relation between impulse width and surge repetition time)



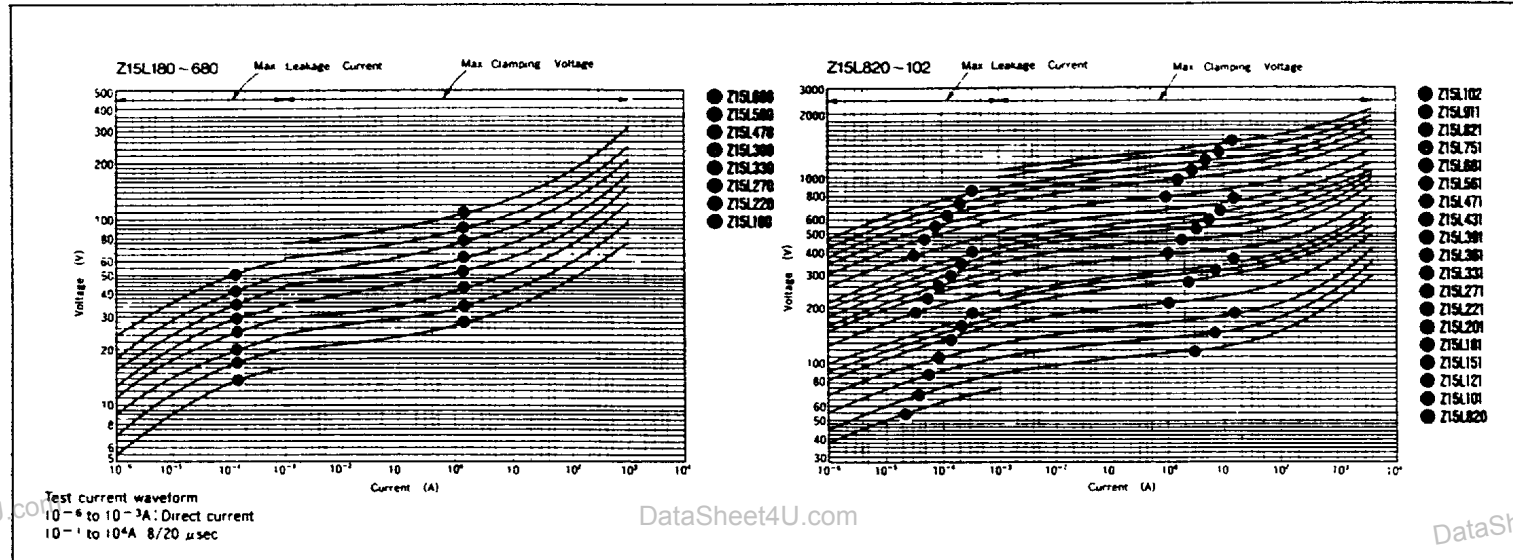
1. Operating temperature range -40 to 85 °C
2. Storage temperature range -40 to 125 °C
3. \* : UL approved model

# Z15L Series

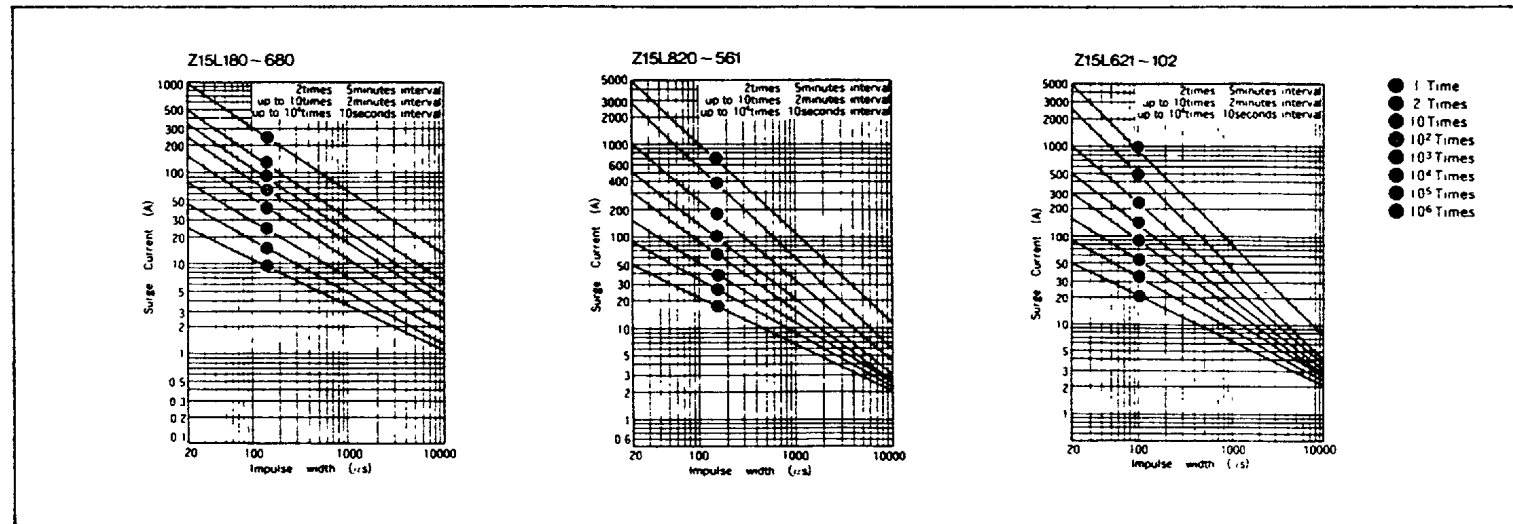
## Specifications

| Type No. | Varistor voltage $V_{1mA}$ (V) |     | Maximum allowable voltage |            | Maximum clamping voltage<br>V | Rated wattage<br>W | Energy (2ms)<br>J | Withstanding Surge current (8/20 $\mu$ s) |         | Typical capacitance (@ 1kHz)<br>pF |
|----------|--------------------------------|-----|---------------------------|------------|-------------------------------|--------------------|-------------------|---|---------|------------------------------------|
|          |                                |     | AC                        | DC         |                               |                    |                   | 1 Time                                    | 2 Times |                                    |
|          | Min                            | Max | $V_{rms}$                 | V          |                               |                    |                   |   |         |                                    |
| Z15L180  | 18 (16~20)                     | 11  | 14                        | 36 at 10A  | 0.1                           | 3.5                | 1000A             | 500A                                      | 18,000  |                                    |
| Z15L220  | 22 (20~24)                     | 14  | 18                        | 43         |                               |                    |                   |   | 15,000  |                                    |
| Z15L270  | 27 (24~30)                     | 17  | 22                        | 53         |                               |                    |                   |   | 10,000  |                                    |
| Z15L330  | 33 (30~36)                     | 20  | 26                        | 65         |                               |                    |                   |   | 7,500   |                                    |
| Z15L390  | 39 (35~43)                     | 25  | 31                        | 77         |                               |                    |                   |   | 6,500   |                                    |
| Z15L470  | 47 (42~52)                     | 30  | 38                        | 93         |                               |                    |                   |   | 5,500   |                                    |
| Z15L560  | 56 (50~62)                     | 36  | 45                        | 110        |                               |                    |                   |   | 4,500   |                                    |
| Z15L680  | 68 (61~75)                     | 40  | 56                        | 135        | 3,300                         |                    |                   |   |         |                                    |
| Z15L820  | 82 (74~90)                     | 50  | 65                        | 135 at 50A | 0.6                           | 14                 | 4500A             | 2500A                                     | 2,900   |                                    |
| Z15L101  | 100 (90~110)                   | 60  | 85                        | 165        |                               |                    |                   |   | 2,400   |                                    |
| Z15L121  | 120 (108~132)                  | 75  | 100                       | 200        |                               |                    |                   |   | 1,900   |                                    |
| Z15L151  | 150 (135~165)                  | 95  | 125                       | 250        |                               |                    |                   |   | 1,500   |                                    |
| Z15L181  | 180 (162~198)                  | 110 | 145                       | 300        |                               |                    |                   |   | 1,200   |                                    |
| Z15L201  | 200 (185~225)                  | 130 | 170                       | 340        |                               |                    |                   |   | 1,000   |                                    |
| Z15L221  | 220 (198~242)                  | 140 | 180                       | 360        |                               |                    |                   |   | 1,000   |                                    |
| Z15L271  | 270 (247~303)                  | 175 | 225                       | 455        |                               |                    |                   |   | 750     |                                    |
| Z15L331  | 330 (297~363)                  | 210 | 275                       | 550        |                               |                    |                   |   | 650     |                                    |
| Z15L361  | 360 (324~396)                  | 230 | 300                       | 595        |                               |                    |                   |   | 550     |                                    |
| Z15L391  | 390 (351~429)                  | 250 | 320                       | 650        |                               |                    |                   |   | 500     |                                    |
| Z15L431  | 430 (387~473)                  | 275 | 350                       | 710        |                               |                    |                   |   | 450     |                                    |
| Z15L471  | 470 (423~517)                  | 300 | 385                       | 775        |                               |                    |                   |   | 400     |                                    |
| Z15L561  | 560 (504~616)                  | 350 | 460                       | 825        |                               |                    |                   |   | 300     |                                    |
| Z15L681  | 680 (612~748)                  | 420 | 560                       | 1,120      | 250                           |                    |                   |   |         |                                    |
| Z15L751  | 750 (675~825)                  | 480 | 615                       | 1,240      | 230                           |                    |                   |   |         |                                    |
| Z15L821  | 820 (738~902)                  | 510 | 670                       | 1,355      | 200                           |                    |                   |   |         |                                    |
| Z15L911  | 910 (819~1,001)                | 550 | 745                       | 1,500      | 180                           |                    |                   |   |         |                                    |
| Z15L102  | 1,000 (900~1,100)              | 625 | 825                       | 1,650      | 150                           |                    |                   |   |         |                                    |

## V-I characteristics



## Surge Life Time Ratings (Relation between impulse width and surge repetition time)



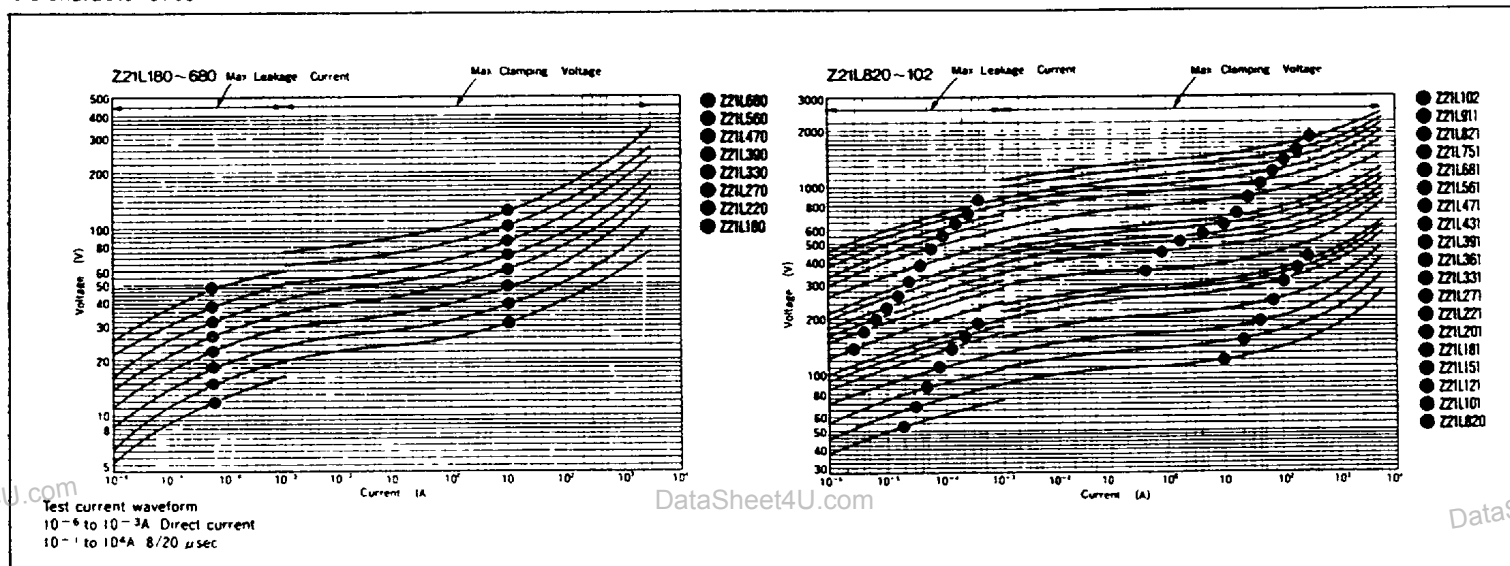
1. Operating temperature range: -40 to 85 °C
2. Storage temperature range: -40 to 125 °C
3. \*: UL approved model

# Z21L Series

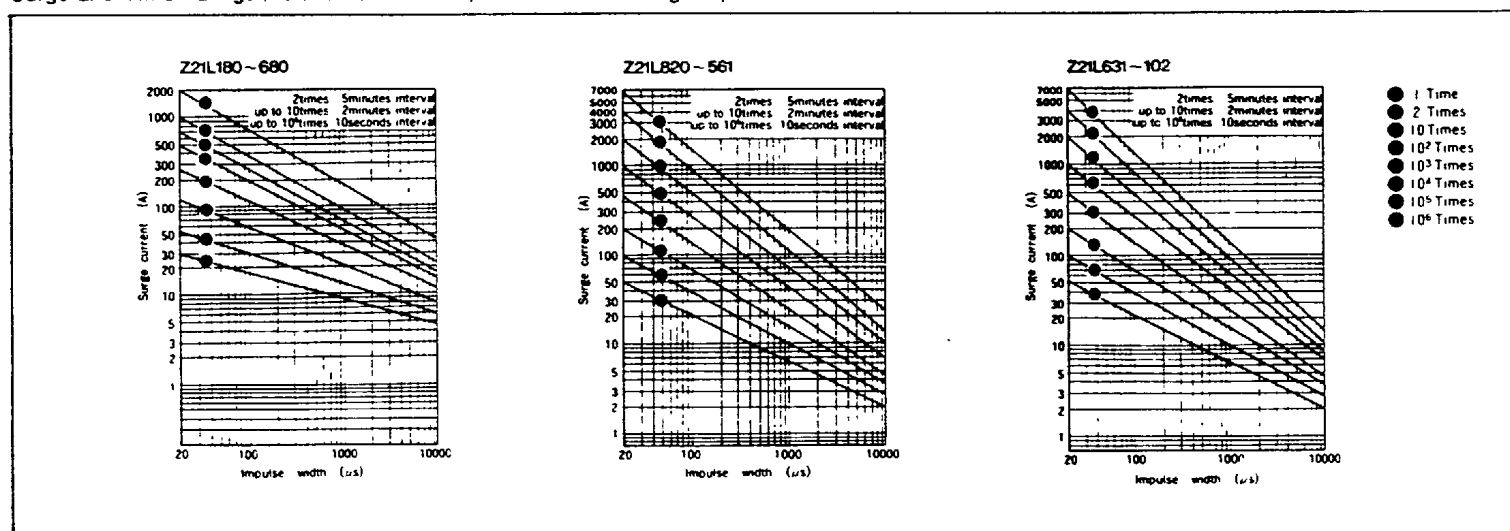
## Specifications

| Type No. | Varistor voltage $V_{VMA}$ (V) |     | Maximum allowable voltage |             | Maximum clamping voltage | Rated wattage | Energy (Jms) | Withstanding Surge current (8/20 $\mu$ s) |        | Typical capacitance (@ 1kHz) |
|----------|--------------------------------|-----|---------------------------|-------------|--------------------------|---------------|--------------|---|--------|------------------------------|
|          |                                |     | AC                        | DC          |                          |               |              | 1 Time                                    | 2 Time |                              |
|          | Min                            | Max | $V_{rms}$                 | V           | V                        | W             | J            |   |        | pF                           |
| Z21L180  | 18 (16 ~ 20)                   | 11  | 14                        | 36 at 20A   | 0.2                      | 10            | 2000A        | 1000A                                     | 37,000 |                              |
| Z21L220  | 22 (20 ~ 24)                   | 11  | 14                        | 43          |                          | 13            |              |   | 30,000 |                              |
| Z21L270  | 27 (24 ~ 30)                   | 17  | 22                        | 53          |                          | 15            |              |   | 22,000 |                              |
| Z21L330  | 33 (30 ~ 36)                   | 20  | 26                        | 65          |                          | 20            |              |   | 17,000 |                              |
| Z21L390  | 39 (35 ~ 43)                   | 25  | 31                        | 77          |                          | 24            |              |   | 15,000 |                              |
| Z21L470  | 47 (42 ~ 52)                   | 30  | 38                        | 93          |                          | 30            |              |   | 13,000 |                              |
| Z21L560  | 56 (50 ~ 62)                   | 35  | 45                        | 110         |                          | 35            |              |   | 11,000 |                              |
| Z21L680  | 68 (61 ~ 75)                   | 40  | 56                        | 135         |                          | 40            |              |   | 7,000  |                              |
| Z21L820  | 82 (74 ~ 90)                   | 50  | 65                        | 135 at 100A | 1.0                      | 27            | 6500A        | 4000A                                     | 5,500  |                              |
| Z21L101  | 100 (90 ~ 110)                 | 60  | 85                        | 165         |                          | 30            |              |   | 4,800  |                              |
| Z21L121  | 120 (108 ~ 132)                | 75  | 100                       | 200         |                          | 40            |              |   | 3,800  |                              |
| Z21L151  | 150 (135 ~ 165)                | 95  | 125                       | 250         |                          | 50            |              |   | 3,000  |                              |
| Z21L181  | 180 (162 ~ 198)                | 110 | 145                       | 300         |                          | 65            |              |   | 2,500  |                              |
| Z21L201  | 200 (185 ~ 225)                | 130 | 170                       | 340         |                          | 70            |              |   | 2,000  |                              |
| Z21L221  | 220 (198 ~ 242)                | 140 | 180                       | 380         |                          | 75            |              |   | 2,000  |                              |
| Z21L271  | 270 (247 ~ 303)                | 175 | 225                       | 455         |                          | 90            |              |   | 1,800  |                              |
| Z21L331  | 330 (297 ~ 363)                | 210 | 275                       | 550         |                          | 110           |              |   | 1,400  |                              |
| Z21L361  | 360 (324 ~ 396)                | 230 | 300                       | 595         |                          | 120           |              |   | 1,200  |                              |
| Z21L391  | 390 (351 ~ 429)                | 250 | 320                       | 650         |                          | 130           |              |   | 1,000  |                              |
| Z21L431  | 430 (387 ~ 473)                | 275 | 350                       | 710         |                          | 140           |              |   | 900    |                              |
| Z21L471  | 470 (423 ~ 517)                | 300 | 385                       | 775         |                          | 150           |              |   | 800    |                              |
| Z21L561  | 560 (504 ~ 616)                | 350 | 460                       | 925         |                          | 150           |              |   | 460    |                              |
| Z21L681  | 680 (612 ~ 748)                | 420 | 560                       | 1,120       |                          | 160           |              |   | 420    |                              |
| Z21L751  | 750 (675 ~ 825)                | 460 | 615                       | 1,240       |                          | 175           |              |   | 400    |                              |
| Z21L821  | 820 (738 ~ 902)                | 510 | 670                       | 1,355       |                          | 190           |              |   | 350    |                              |
| Z21L911  | 910 (819 ~ 1,001)              | 550 | 745                       | 1,500       |                          | 215           |              |   | 320    |                              |
| Z21L102  | 1,000 (900 ~ 1,100)            | 625 | 825                       | 1,650       |                          | 230           |              |   |        |                              |

### V-I characteristics



### Surge Life Time Ratings (Relation between impulse width and surge repetition time)



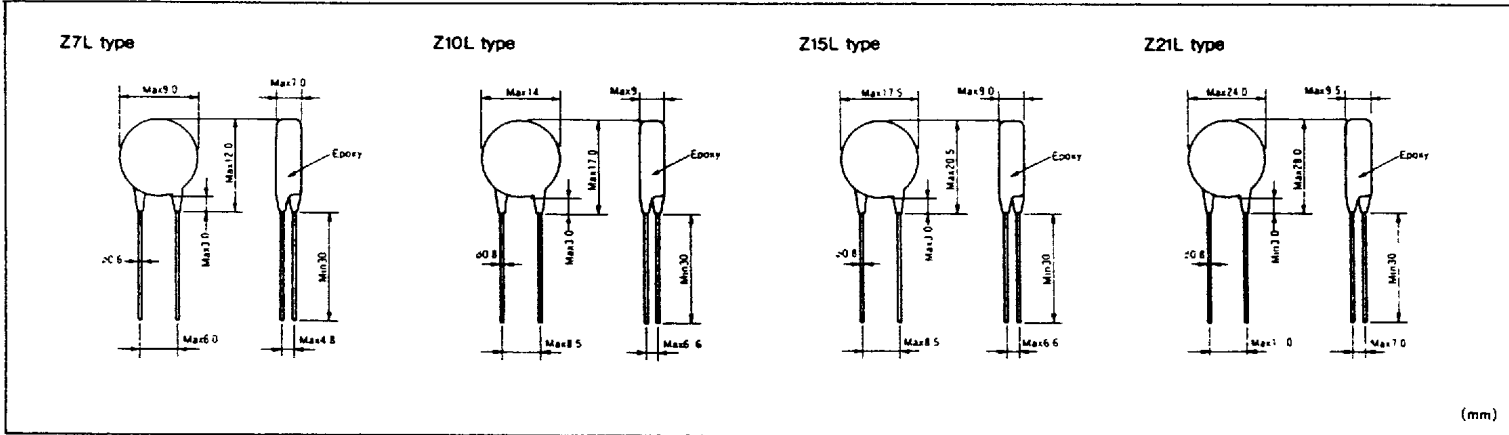
1. Operating temperature range: -40 to 85 °C
2. Storage temperature range: -40 to 125 °C
3. \* : UL approved model

Specifications

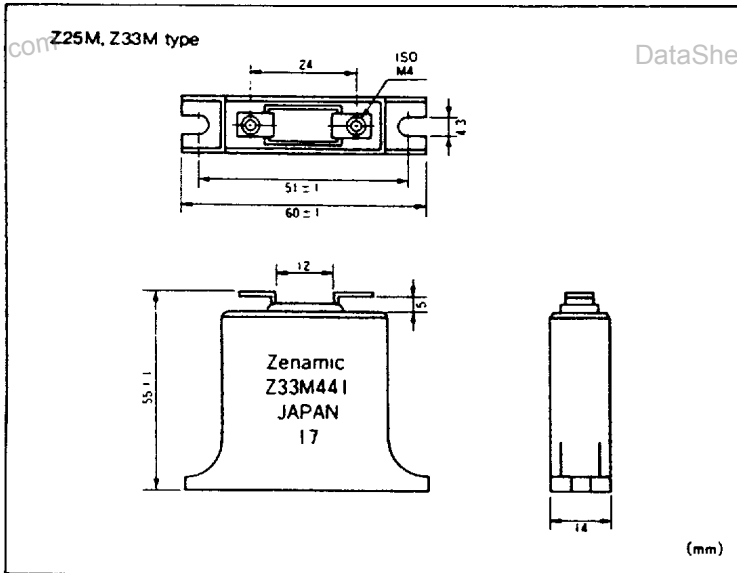
| Type No. | Varistor voltage $V_{\text{max}}$ (V) |     | Maximum allowable voltage |             | Maximum clamping voltage | Rated wattage | Energy (Joule) | Withstanding Surge current (8/20 $\mu$ s) |         | Typical capacitance (@ 1kHz) |
|----------|---------------------------------------|-----|---------------------------|-------------|--------------------------|---------------|----------------|---|---------|------------------------------|
|          |                                       |     | AC                        | DC          |                          |               |                | 1 Time                                    | 2 Times |                              |
|          | Min                                   | Max | $V_{\text{rms}}$          | V           | V                        | W             | J              |   |         | $\mu$ F                      |
| Z25M221S | 220 (187 ~ 253)                       | 120 | 165                       | 380 at 100A | 125                      | 1.0           | 15000A         | 10000A                                    | 3.300   |                              |
| Z25M271S | 270 (228.5 ~ 310.5)                   | 150 | 210                       | 465         | 2.200                    |               |                |   |         |                              |
| Z25M331S | 330 (280.5 ~ 379.5)                   | 175 | 245                       | 570         | 1.900                    |               |                |   |         |                              |
| Z25M381S | 380 (331.5 ~ 448.5)                   | 210 | 295                       | 675         | 1.700                    |               |                |   |         |                              |
| Z25M441S | 440 (374 ~ 506)                       | 240 | 335                       | 780         | 1.500                    |               |                |   |         |                              |
| Z25M471S | 470 (399.5 ~ 540.5)                   | 250 | 350                       | 810         | 1.500                    |               |                |   |         |                              |
| Z25M561S | 560 (476 ~ 644)                       | 300 | 420                       | 970         | 1.400                    |               |                |   |         |                              |
| Z25M681S | 680 (578 ~ 782)                       | 365 | 510                       | 1,175       | 1,250                    |               |                |   |         |                              |
| Z25M821S | 820 (697 ~ 943)                       | 440 | 615                       | 1,415       | 800                      |               |                |   |         |                              |
| Z25M102S | 1000 (850 ~ 1,150)                    | 520 | 730                       | 1,725       | 500                      |               |                |   |         |                              |
| Z33M221S | 220 (187 ~ 253)                       | 120 | 165                       | 380 at 100A | 200                      | 1.2           | 25000A         | 20000A                                    | 5.500   |                              |
| Z33M271S | 270 (228.5 ~ 310.5)                   | 150 | 210                       | 465         | 4.200                    |               |                |   |         |                              |
| Z33M331S | 330 (280.5 ~ 379.5)                   | 175 | 245                       | 570         | 3.700                    |               |                |   |         |                              |
| Z33M381S | 380 (331.5 ~ 448.5)                   | 210 | 295                       | 675         | 3.200                    |               |                |   |         |                              |
| Z33M441S | 440 (374 ~ 506)                       | 240 | 335                       | 780         | 2.800                    |               |                |   |         |                              |
| Z33M471S | 470 (399.5 ~ 540.5)                   | 250 | 350                       | 810         | 2.800                    |               |                |   |         |                              |
| Z33M561S | 560 (476 ~ 644)                       | 300 | 420                       | 970         | 2.200                    |               |                |   |         |                              |
| Z33M681S | 680 (578 ~ 782)                       | 365 | 510                       | 1,175       | 1.800                    |               |                |   |         |                              |
| Z33M821S | 820 (697 ~ 943)                       | 440 | 615                       | 1,415       | 1,500                    |               |                |   |         |                              |
| Z33M102S | 1000 (850 ~ 1,150)                    | 520 | 730                       | 1,725       | 1,000                    |               |                |   |         |                              |

- 1. Operating temperature range: -40 to 85 °C
- 2. Storage temperature range: -40 to 125 °C

Dimensions



Dimensions



Taping

