

TRANSIENT VOLTAGE SUPPRESSOR

VRD

VRD is a transient voltage suppressor used for protecting electric circuits from surge voltage and thus preventing breakdown.

VRD has superior surge suppression characteristics, such as extremely fast response time, very low clamping voltage, and high surge capacity. Unlike metal oxide varistors, VRD does not have characteristics to change with surge variations within the rated capacity. This feature comprises another superior characteristics of the VRD as a transient voltage suppressors.



Part number

| | |
|-----------------------|---|
| Z2 033 U - 52Z | 52Z : Axial tapping winding type |
| | 52R : Axial tapping relay type |
| | FT : Radial form tapping type |
| | Nil : individually packed in a bag |
| | U : Uni-Polar |
| | Nil : Bi-Polar |
| | Break down voltage |
| | Type |
| | Z2 : Rated electricity 1.0W |
| | Z6 : Rated electricity 2.0W |
| | ZD : Rated electricity 0.5W (reverse blocking type) |

Electrical characteristics

Figure 1 shows the electrical characteristics. Bipolar type has almost symmetrical breakdown Voltage (V_B) The reverse breakdown voltage of the ZD type is 200 Volts or more at $10\mu A$ DC.



Fig 1

Taping

One of standard taping is as shown in Figure.



Fig 2

Taping qty

| Part series | Taping method | Qty(pcs) | |
|-------------|----------------|--------------|-------|
| Z2,Z2U | Axial tapping | reel type | 5,000 |
| | | winding type | 2,000 |
| | Radial tapping | winding type | 2,000 |
| | | | |
| Z6,Z6U | Axial tapping | reel type | 2,500 |
| | | winding type | 1,000 |

Surge capability

Allowable surge capability (P_{PPM}) is determined by the following equation:

$$P_{PPM} = I_{PPM} \times V_C$$

I_{PPM} : Rated peak impulse current

V_C : clamping voltage

The allowable surge capability (Rated peak impulse power dissipation P_{PPM}) of VRD is shown in following Figure 3 and the surge capability derating characteristics are shown in Figure 6.



Fig 3

Surge waveform

There are many types of surge waveform depending on the source of the surge. For the VRD surge suppression characteristics test, the EXP waveform shown below is used. The EXP waveform is shown as t_a/t_b depending on the time width, however 10/1000 waveform is used as the standard test waveform.



Fig 4

Surge suppression characteristics

When EXP waveform is applied, the surge suppression waveform shown in the figure 5 can be observed.



Power derating



Z2 type VRD has bipolar or unipolar electrical characteristics.

Maximum ratings

Rated peak impulse power dissipation
:500 W (10/1000 μ s)
6.00 kW (8/20 μ s)

Rated average power dissipation:1W
Operating and storage temperature
: -40°C to 125°C

Symbol mark



| Part No. | | Stand-off voltage V_s V | Stand-by current I_b μ A | Breakdown voltage $V_{(BR)}$ V | Pulsed d.c. test current I_T mA | Clamping Voltage & Rated peak impulse current | | | | Temperature coefficient (TYP) | Capacitance (TYP) pF |
|---------------|----------------|---------------------------------|--------------------------------------|--------------------------------------|---|---|----------------|--------------|----------------|-------------------------------|----------------------|
| Bi-polar type | Uni-polar type | | | | | 10/1000 μ s | | 8/20 μ s | | | |
| | | | | | | V_C V | I_{PPM} A | V_C V | I_{PPM} A | | |
| - | Z2008U | 6.63 | 500 | 7.38-9.02 | 10 | 12.5 | 40.0 | 16.3 | 372 | 0.063 | 2400 |
| - | Z2010U | 8.10 | 20 | 9.00-11.0 | | 15.0 | 33.4 | 19.5 | 311 | 0.071 | 1900 |
| Z2012 | - | 9.72 | | 10.8-13.2 | | 17.3 | 28.9 | 22.7 | 267 | 0.066 | 790 |
| - | Z2012U | | | 10.8-13.2 | | | | | | 0.074 | 1580 |
| Z2015 | - | 12.1 | | 13.5-16.5 | | 22.0 | 22.7 | 28.4 | 213 | 0.075 | 640 |
| - | Z2015U | | | 13.5-16.5 | | | | | | 0.079 | 1280 |
| Z2018 | - | 14.5 | | 16.2-19.8 | | 26.5 | 18.8 | 34.0 | 178 | 0.079 | 520 |
| - | Z2018U | | | 16.2-19.8 | | | | | | 0.083 | 1040 |
| Z2022 | - | 17.8 | | 19.8-24.2 | | 31.9 | 15.7 | 41.2 | 147 | 0.082 | 420 |
| - | Z2022U | | | 19.8-24.2 | | | | | | 0.086 | 840 |
| Z2027 | - | 21.8 | | 24.3-29.7 | | 39.1 | 12.8 | 50.5 | 120 | 0.085 | 340 |
| - | Z2027U | | | 24.3-29.7 | | | | | | 0.089 | 680 |
| Z2033 | - | 26.8 | | 29.7-36.3 | | 47.7 | 10.5 | 61.7 | 98.2 | 0.087 | 280 |
| - | Z2033U | | | 29.7-36.3 | | | | | | 0.092 | 560 |
| Z2039 | - | 31.6 | | 35.1-42.9 | | 56.4 | 8.86 | 73.0 | 83.0 | 0.090 | 240 |
| - | Z2039U | | | 35.1-42.9 | | | | | | 0.095 | 480 |
| Z2047 | - | 38.1 | 5 | 42.3-51.7 | 1 | 67.8 | 7.37 | 88.0 | 68.9 | 0.092 | 200 |
| - | Z2047U | | | 42.3-51.7 | | | | | | 0.097 | 400 |
| Z2056 | - | 45.4 | | 50.4-61.6 | | 80.5 | 6.21 | 105.0 | 57.7 | 0.094 | 160 |
| - | Z2056U | | | 50.4-61.6 | | | | | | 0.099 | 320 |
| Z2068 | - | 55.1 | | 61.2-74.8 | | 98.0 | 5.10 | 127.0 | 47.7 | 0.096 | 130 |
| - | Z2068U | | | 61.2-74.8 | | | | | | 0.100 | 260 |
| Z2082 | - | 66.4 | | 73.8-90.2 | | 118.0 | 4.24 | 153.0 | 39.6 | 0.099 | 110 |
| - | Z2082U | | | 73.8-90.2 | | | | | | 0.102 | 220 |
| Z2100 | - | 81.0 | | 90.0-110 | | 144.0 | 3.47 | 187.0 | 32.4 | 0.101 | 90 |
| - | Z2100U | | | 90.0-110 | | | | | | 0.104 | 180 |
| Z2120 | - | 97.2 | | 108-132 | | 173.0 | 2.89 | 222.0 | 27.3 | 0.103 | 75 |
| - | Z2120U | | | 108-132 | | | | | | 0.106 | 150 |
| Z2150 | - | 121.0 | | 135-165 | | 215.0 | 2.32 | 277.0 | 21.9 | 0.105 | 60 |
| - | Z2150U | | | 135-165 | | | | | | 0.107 | 120 |
| Z2180 | - | 146.0 | | 162-198 | | 258.0 | 1.94 | 333.0 | 18.2 | 0.106 | 49 |
| - | Z2180U | | | 162-198 | | | | | | 0.108 | 98 |

NOTE: Nonsuffix:bi-polar, suffix"U" : uni-polar.

| Part No. | | Stand-off voltage V _s V | Stand-by current I _b μA | Breakdown voltage V _(BR) V | Pulsed d.c. test current I _T mA | Clamping Voltage & Rated peak impulse current | | | | Max. temp. coef. %/°C | Capacitance (TYP) pF |
|---------------|----------------|--|--|---|--|---|-----------------------|---------------------|-----------------------|--------------------------|-------------------------|
| Bi-polar type | Uni-polar type | | | | | 10/1000μs | | 8/20μs | | | |
| | | | | | | V _C V | I _{PPM} A | V _C V | I _{PPM} A | | |
| Z6012 | - | 9.72 | 10 | 10.8-13.2 | 1 | 17.3 | 86.7 | 22.7 | 802 | 0.066 | 4400 |
| - | Z6012U | | | 10.8-13.2 | | | | | | 0.074 | 8800 |
| Z6015 | - | 12.1 | 10 | 13.5-16.5 | 1 | 22.0 | 68.2 | 28.4 | 641 | 0.075 | 3300 |
| - | Z6015U | | | 13.5-16.5 | | | | | | 0.079 | 6600 |
| Z6018 | - | 14.5 | 10 | 16.2-19.8 | 1 | 26.5 | 56.6 | 34.0 | 535 | 0.079 | 2700 |
| - | Z6018U | | | 16.2-19.8 | | | | | | 0.083 | 5400 |
| Z6022 | - | 17.8 | 10 | 19.8-24.2 | 1 | 31.9 | 47.0 | 41.2 | 442 | 0.082 | 2400 |
| - | Z6022U | | | 19.8-24.2 | | | | | | 0.086 | 4400 |
| Z6027 | - | 21.8 | 10 | 24.3-29.7 | 1 | 39.1 | 38.4 | 50.5 | 360 | 0.085 | 1700 |
| - | Z6027U | | | 24.3-29.7 | | | | | | 0.089 | 3300 |
| Z6033 | - | 26.8 | 5 | 29.7-36.3 | 1 | 47.7 | 31.4 | 61.7 | 295 | 0.087 | 1400 |
| - | Z6033U | | | 29.7-36.3 | | | | | | 0.092 | 2800 |
| Z6039 | - | 31.6 | 5 | 35.1-42.9 | 1 | 56.4 | 26.6 | 73.0 | 249 | 0.090 | 1200 |
| - | Z6039U | | | 35.1-42.9 | | | | | | 0.095 | 2400 |
| Z6047 | - | 38.1 | 5 | 42.3-51.7 | 1 | 67.8 | 22.1 | 88.0 | 207 | 0.092 | 1000 |
| - | Z6047U | | | 42.3-51.7 | | | | | | 0.097 | 2000 |
| Z6056 | - | 45.4 | 5 | 50.4-61.6 | 1 | 80.5 | 18.6 | 105.0 | 173 | 0.094 | 850 |
| - | Z6056U | | | 50.4-61.6 | | | | | | 0.099 | 1700 |
| Z6068 | - | 55.1 | 5 | 61.2-74.8 | 1 | 98.0 | 15.3 | 127.0 | 143 | 0.096 | 720 |
| - | Z6068U | | | 61.2-74.8 | | | | | | 0.100 | 1440 |
| Z6082 | - | 66.4 | 5 | 73.8-90.2 | 1 | 118.0 | 12.7 | 153.0 | 119 | 0.099 | 610 |
| - | Z6082U | | | 73.8-90.2 | | | | | | 0.102 | 1220 |
| Z6100 | - | 81.0 | 5 | 90.0-110 | 1 | 144.0 | 10.4 | 187.0 | 97.3 | 0.101 | 520 |
| - | Z6100U | | | 90.0-110 | | | | | | 0.104 | 1040 |
| Z6120 | - | 97.2 | 5 | 108-132 | 1 | 173.0 | 8.67 | 222.0 | 82.0 | 0.103 | 440 |
| - | Z6120U | | | 108-132 | | | | | | 0.106 | 880 |
| - | Z6150U | 121.0 | 5 | 135-165 | 1 | 215.0 | 6.98 | 277.0 | 65.7 | 0.107 | 720 |

NOTE : Nonsuffix : Bi-polar, suffix "U" : Uni-polar.

Z6 type VRD has bipolar or unipolar electrical characteristics.

Maximum ratings
 Rated peak impulse power dissipation : 1.5kW(10/1000μs)
 18.0kW(8/20μs)
 Rated average power dissipation: 2W
 Operating and storage temperature : -40°C to 125°C

Symbol mark



| VRD part No. | Stand-off voltage V _s V | Stand-by current I _b μA | Breakdown voltage V _(BR) V | Pulsed d.c. test current I _T mA | Clamping Voltage & Rated peak impulse current | | | | Max. temp. coef. %/°C | Capacitance (TYP) pF |
|--------------|--|--|---|--|---|-----------------------|---------------------|-----------------------|--------------------------|-------------------------|
| | | | | | 10/1000μs | | 8/20μs | | | |
| | | | | | V _C V | I _{PPM} A | V _C V | I _{PPM} A | | |
| ZD015 | 11.4 | 10 | 12.8-17.2 | 1 | 24.0 | 10.4 | 31.0 | 96.7 | 0.075 | 31.5 |
| ZD018 | 13.7 | | 15.3-20.7 | | 28.0 | 8.93 | 36.0 | 83.3 | 0.079 | 31.0 |
| ZD022 | 16.8 | 5 | 18.7-25.3 | 1 | 33.2 | 7.53 | 43.0 | 69.7 | 0.082 | 29.0 |
| ZD027 | 20.6 | | 23.0-31.0 | | 40.0 | 6.25 | 52.0 | 57.7 | 0.085 | 28.2 |
| ZD033 | 25.2 | 5 | 28.1-37.9 | 1 | 48.6 | 5.14 | 63.0 | 47.6 | 0.087 | 27.2 |
| ZD039 | 29.8 | | 33.2-44.8 | | 57.4 | 4.35 | 74.0 | 40.5 | 0.090 | 26.3 |
| ZD047 | 35.9 | 5 | 40.0-54.0 | 1 | 68.5 | 3.65 | 89.0 | 33.7 | 0.092 | 25.0 |
| ZD056 | 42.8 | | 47.6-64.4 | | 81.0 | 3.08 | 106.0 | 28.6 | 0.094 | 24.1 |
| ZD068 | 52.0 | 5 | 57.8-78.2 | 1 | 98.0 | 2.55 | 127.0 | 23.8 | 0.096 | 22.0 |

Low capacitance type

Maximum ratings
 Reverse voltage: 200 VDC
 Rated peak impulse power dissipation : 250 W(10/1000μs)
 3.00 kW(8/20μs)
 Rated average power dissipation: 500 mW
 Operating and storage temperature : -40°C to 125°C

Symbol mark



SMD VRD

Part number



Dimensions



Marking



| | Rating |
|--------------------------------------|-----------------------|
| Rated average power dissipation | 1.0W |
| Rated peak impulse power dissipation | 300W(10/1000 μ s) |
| | 1200W(1.2/50 μ s) |
| | 2000W(8/20 μ s) |
| Storage temp. range | -40°C~150°C |

Taping



| A | B | W | F | E | P ₁ |
|----------------|----------------|--------------------|--------------------|----------------|----------------|
| 3.0 ±0.1 | 5.2 ±0.1 | 12.0 ±0.3 | 5.5 ±0.05 | 1.75 ±0.1 | 4.0 ±0.1 |
| P ₂ | P ₀ | phi D ₀ | phi D ₁ | T ₁ | T ₂ |
| 2.0 ±0.1 | 4.0 ±0.1 | 1.5 +0.1 -0 | 1.5 +0.2 -0 | 0.3 ±0.05 | (2.6) |

Unit (mm)

Specifications

ZS type

| Part No. | Breakdown voltage | Stand-off voltage | Stand-by current | Maximum clamping voltage & Maximum peak pulse current | | | | Temperature coefficient (TYP) | Capacitance (TYP) | | | |
|----------|-------------------|-------------------|------------------|---|----------------|--------------------|-----------------|-------------------------------|-------------------|-----------|--------------|---|
| | | | | V _{Cmax} /I _{PPM} | | | | | | 25°C~50°C | | |
| | | | | V _(BR) | V _S | I _L max | 10/1000 μ s | | | | 8/20 μ s | |
| | | | | | | | V | | | | | A |
| ZS1012 | 12(10.8~13.2) | 9.72 | 10 | 17.3 | 17.3 | 22.4 | 89.3 | 0.066 | 551 | | | |
| ZS1015 | 15(13.5~16.5) | 12.1 | 5 | 22.0 | 13.6 | 28.5 | 70.2 | 0.075 | 465 | | | |
| ZS1018 | 18(16.2~19.8) | 14.5 | | 26.5 | 11.3 | 34.4 | 58.1 | 0.079 | 376 | | | |
| ZS1022 | 22(19.8~24.2) | 17.8 | | 31.9 | 9.40 | 41.4 | 48.3 | 0.082 | 299 | | | |
| ZS1027 | 27(24.3~29.7) | 21.8 | | 39.1 | 7.67 | 50.7 | 39.4 | 0.085 | 248 | | | |
| ZS1033 | 33(29.7~36.3) | 26.8 | | 47.7 | 6.29 | 61.8 | 32.4 | 0.087 | 198 | | | |
| ZS1039 | 39(35.1~42.9) | 31.6 | | 56.4 | 5.32 | 73.1 | 27.4 | 0.090 | 164 | | | |
| ZS1047 | 47(42.3~51.7) | 38.1 | | 67.8 | 4.42 | 88.0 | 22.7 | 0.092 | 137 | | | |

ZS-U type

| Part No. | Breakdown voltage | Stand-off voltage | Stand-by current | Maximum clamping voltage & Maximum peak pulse current | | | | Temperature coefficient (TYP) | Capacitance (TYP) | | | |
|----------|-------------------|-------------------|------------------|---|----------------|--------------------|-----------------|-------------------------------|-------------------|-----------|--------------|---|
| | | | | V _{Cmax} /I _{PPM} | | | | | | 25°C~50°C | | |
| | | | | V _(BR) | V _S | I _L max | 10/1000 μ s | | | | 8/20 μ s | |
| | | | | | | | V | | | | | A |
| ZS1012U | 12(10.8~13.2) | 9.72 | 10 | 17.3 | 17.3 | 22.4 | 89.3 | 0.066 | 1,102 | | | |
| ZS1015U | 15(13.5~16.5) | 12.1 | 5 | 22.0 | 13.6 | 28.5 | 70.2 | 0.075 | 929 | | | |
| ZS1018U | 18(16.2~19.8) | 14.5 | | 26.5 | 11.3 | 34.4 | 58.1 | 0.079 | 751 | | | |
| ZS1022U | 22(19.8~24.2) | 17.8 | | 31.9 | 9.40 | 41.4 | 48.3 | 0.082 | 598 | | | |
| ZS1027U | 27(24.3~29.7) | 21.8 | | 39.1 | 7.67 | 50.7 | 39.4 | 0.085 | 497 | | | |
| ZS1033U | 33(29.7~36.3) | 26.8 | | 47.7 | 6.29 | 61.8 | 32.4 | 0.087 | 395 | | | |
| ZS1039U | 39(35.1~42.9) | 31.6 | | 56.4 | 5.32 | 73.1 | 27.4 | 0.090 | 328 | | | |
| ZS1047U | 47(42.3~51.7) | 38.1 | | 67.8 | 4.42 | 88.0 | 22.7 | 0.092 | 274 | | | |

ZS-D type

| Part No. | Breakdown voltage | Stand-off voltage | Stand-by current | Maximum clamping voltage & Maximum peak pulse current | | | | Temperature coefficient (TYP) | Capacitance (TYP) | | | |
|----------|-------------------|-------------------|------------------|---|----------------|--------------------|-----------------|-------------------------------|-------------------|-----------|--------------|---|
| | | | | V _{Cmax} /I _{PPM} | | | | | | 25°C~50°C | | |
| | | | | V _(BR) | V _S | I _L max | 10/1000 μ s | | | | 8/20 μ s | |
| | | | | | | | V | | | | | A |
| ZS1012D | 12(10.8~13.2) | 9.72 | 10 | 17.3 | 17.3 | 22.4 | 89.3 | 0.066 | 30.2 | | | |
| ZS1015D | 15(13.5~16.5) | 12.1 | 5 | 22.0 | 13.6 | 28.5 | 70.2 | 0.075 | 29.1 | | | |
| ZS1018D | 18(16.2~19.8) | 14.5 | | 26.5 | 11.3 | 34.4 | 58.1 | 0.079 | 28.2 | | | |
| ZS1022D | 22(19.8~24.2) | 17.8 | | 31.9 | 9.40 | 41.4 | 48.3 | 0.082 | 27.3 | | | |
| ZS1027D | 27(24.3~29.7) | 21.8 | | 39.1 | 7.67 | 50.7 | 39.4 | 0.085 | 26.4 | | | |
| ZS1033D | 33(29.7~36.3) | 26.8 | | 47.7 | 6.29 | 61.8 | 32.4 | 0.087 | 25.5 | | | |
| ZS1039D | 39(35.1~42.9) | 31.6 | | 56.4 | 5.32 | 73.1 | 27.4 | 0.090 | 24.8 | | | |
| ZS1047D | 47(42.3~51.7) | 38.1 | | 67.8 | 4.42 | 88.0 | 22.7 | 0.092 | 24.0 | | | |