"ZNR"Transient/Surge Absorbers, Type D, Series V
"ZNR"Transient/Surge Absorbers, Type SMD, Series HF, VF

Handling Precautions

⚠ Safety Precautions

In case that a ZNR Surge Absorber (hereafter referred to as the ZNR, or product name) is used, if an abnormality takes place because of peripheral conditions of the ZNR(material, environments, power source conditions, circuit conditions, etc. in equipment design), fire, electric shock, burn, or product failure may be occur. The precautions for this product are described below, understand the content thoroughly before usage. For more questions, contact us.

1.⚠ Precautions to be strictly observed

1.1 Confirmation of performance ratings

Use the ZNR within its rated range of performance such as the Max. allowable voltage, withstanding surge current, withstanding energy, impulse life(surge life), average pulse power, and operating temperature range. If used outside the range, the ZNR can be degrade and have element fracture, which may result in smoking and ignition.

1.2 To avoid accidents due to unexpected phenomena, take the following measures

1) In the event of fracture of the ZNR, its pieces may scatter ; hence, put the case or cover of the set product in place.
2) Do not install the ZNR near combustible substances(polyvinyl chloride wires, resin moldings, etc.). If it is difficult to do, install a nonflammable cover.
3) Across-the-line use
   When the ZNR is used across a line, put a current fuse in series with the ZNR(Refer to Item 2.1.1). (4) and Table 1.
4) Use between line to ground
   (1) If the case that the ZNR is used between a line to the ground, the short-circuit of the ZNR may not blow the current fuse because of grounding resistance, which may cause smoking and ignition of the ZNR's exterior resin. As the measure against it, install an earth leakage breaker on the power supply side of the ZNR position. If no earth leakage breaker is installed, use a thermal fuse together wth a current fuse in series. (Refer to Table 1.)
   (2) If the case that the ZNR is used between a live part to metal case, an electric shock may develop at a shortcircuit of the ZNR ; hence, ground the metal case to the ground or keep it from the human body.

2. Application notes

2.1 Pay attention to the following items to avoid the shortened life and failure of the ZNR

1) Circuit conditions
   (1) Select a ZNR of which the maximum voltage including fluctuations in source voltage allows for the maximum permissible circuit voltage. (Refer to Table 1.)
   (2) In cases that surges are intermittently applied at short intervals(for example, in case that the voltage of the noise simulator test is implemented etc.), do not let them exceed the ZNR's rated power.
   (3) Select a ZNR recommended in Table 1.
      <1> Across-the-line use
      If possible, use a Part No. marked with ∗ in case of voltage temporarily rises load unbalance of separately-wired loads, short between hot and neutral-line, open of neutral line in single-phase-three-wired system, and due to resonance at switching for a capacitive, inductive load.
      <2> Used between line to ground
      Use a different Part No. from "Across-the-line use" as table 1, because of raising voltage in case of "Line to Ground Fault".
      Use a Part No. marked with ∗∗ in table 1, in case of the insulation resistance test(500 VDC) for equipment. When using a Part of the varistor voltage that the insulation efficiency examination can not be cleared, there is a case where the surge absorber can be done by removing it from the circuit depending on the circuit condition(Refer examination of Japan Domestic Safety Regulations).
      Use a Part No. marked with ∗∗∗ in table 1, in case of the withstanding voltage test(1000 VAC or 1200 VAC) for equipment.

(4) Concerning current fuse

<1> We recommend selecting a ZNR and the rated current of a current fuse as follows.
Finally, please be sure that there is no danger if the ZNR mounted on the equipment breaks.

● Type D, Series V

Standard Part No.	ERZV05D□□□	ERZV07D□□□	ERZV09D□□□	ERZV10D□□□	ERZV14D□□□	ERZV20D□□□
Fuse rated current	3 A max.	5 A max.	7 A max.	7 A max.	10 A max.	10 A max.

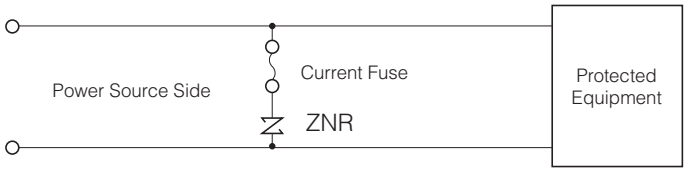
✻ Fuses shall use rated voltages appropriate for circuits.

● Type SMD, Series VF

Standard Part No.	ERZVF□M□□□
Fuse rated current	5 A max.

✻ Fuses shall use rated voltages appropriate for circuits.
✻ Concerning HF series, please confirm adjusted to load dump surge and protection cooperation.

<2> The recommended fuse position is shown in table 1, "Example of ZNR application", however, if the load current of protected equipment is larger than that of the above recommended fuse rated current, install a current fuse at the position shown below.



(5) Concerning thermal fuse

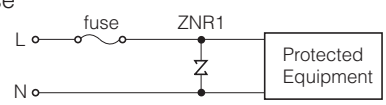
Set a thermal fuse to get high thermal conductivity with ZNR.

Table 1 Example of ZNR application

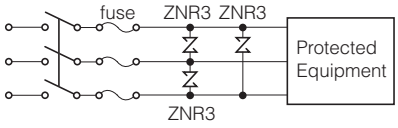
Connections example

Across-the-Line use

DC/AC Single-phase

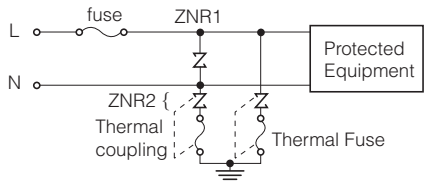


AC 3-phase

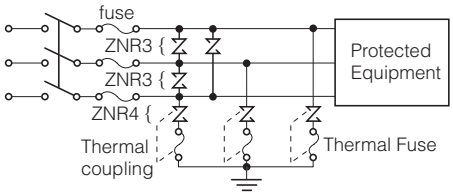


Use between Line to ground

DC/AC Single-phase



AC 3-phase



Example of varistor voltage

ZNR	Source voltage	Nominai varistor voltage	
		Type D	SMD Mold Type
ZNR1 ZNR3	AC100 V	201 to 361*	201 to 361*
	AC120 V	241 to 431*	241 to 431*
	AC200 V	471 to 621*	471
	AC220 V	471 to 621*	471
	AC240 V	511, 621*	—
	AC380 V	821	—

ZNR	Source voltage	Nominai varistor voltage	
		Type D	SMD Mold Type
ZNR2 ZNR4	AC100 V AC220 V	471	471
		511	—
		621*	—
		821 and more**	—
		182***	—
	AC230 V AC240 V	511	—
		621*	—
		821 and more**	—
		182***	—
	AC380 V	112**	—
		182***	—

Note : Element size is selected by impulse Condition.

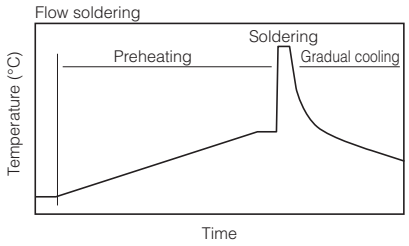
2) Operating environments
(1) The ZNR is designed to be used indoors. Do not use it exposed outdoors.
(2) Do not use the ZNR in places exposed to temperatures beyond the operating temperature range, such as places exposed to sunlight and vicinities of heating equipment.
(3) Do not use the ZNR in places exposed to high temperatures and high humidity, such as places exposed directly to rain, wind, dew condensation, and vapor.
(4) Do not use the ZNR in dusty and salinity environment and atmospheres polluted by corrosive gases.

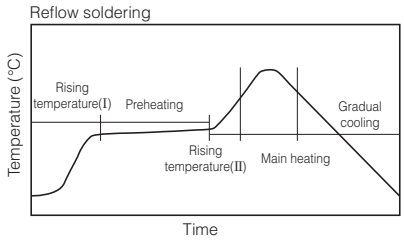
3) Processing conditions
(1) Do not wash the ZNR by such solvents(thinner, acetone, etc.) as its exterior resin deteriorates.
(2) Do not apply a strong vibration or shock (by falling, etc.) to the ZNR, cracking to its exterior resin and element may occur.
(3) When coating the ZNR with resin(including molding), do not use such resin.
(4) Do not bend the ZNR type D lead wires at the position close to its ZNR type D exterior resin, or apply external force to the position.
(5) When soldering the ZNR lead wires, follow the recommended conditions and do not melt the solder and insulating materials constituting the ZNR.

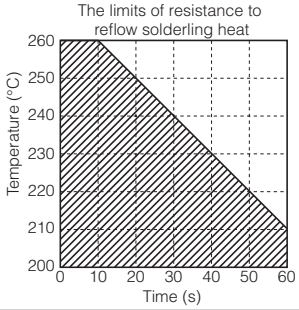
	Soldering Method	Recommended Condition	Attention Item
Type D	Flow soldering	260 °C, within 10 sec.	Type D is not Reflow soldering object part.
SMD Type	Flow soldering	260 °C, within 10 sec.	When the package density of the part is high pill out gas because the solderability sometimes becomes bad.
	Reflow soldering	Refer to Reflow soldering profile	When Land is too big compared with the size of the terminal surface of the part, be careful because the part sometimes upset when solder fuses.

✻1 Soldering iron temperature should not exceed 400 °C and should not be applied for mor than 5 seconds.
✻2 Profile be careful because there is a margin of error in the way of measuring.
✻3 The temperature depend on the size and the package density of the substrate. Therefore, confirm every kind of the substrate.

● Soldering temperature-time profile to recommend







Preheating	The normal to 130 °C	max. 120s
Soldering	max. 260 °C	max. 10s
Gradual cooling	Gradual cooling	

Rising temperature I	The normal to preheating temperature	30 to 60 s
Preheating	150 to 180 °C	60 to 120 s
Rising temperature II	Preheating to 200 °C	2 to 6 °C/s
Main heating	(cf. The limit of resistance to reflow soldering heat)	
Gradual cooling	200 to 100 °C	1 to 4 °C/s

(Reflow soldering shall be within two times)

(6) Mounting (only for SMD Type)
In case of mounting ZNR on a Printed Circuit Board, be careful not to put excessive impact load, such as pressure from adsorption nozzle, and mechanical impact/stress of position-shifting or positioning.
Also, we recommend you to fix a Printed Circuit Board to sheathing resin with an adhesive in case of position-shifting of ZNR when mounting.

4) Long-term storage
(1)Do not store the ZNR under high temperature and high humidity. Store it at a temperature up to 40 °C and at humidity below 75 %RH, and use it within two years.
Before using the ZNR that has been stored for a long period(two years or longer), confirm the solderability.
(2) Avoid atmospheres full of corrosive gases(hydrogen sulfide, sulfurous acid, chlorine, ammonia, etc.).
(3) Avoid direct sunlight and dew condensation.

3. Notices
3.1 In cases that the ZNR is used in equipment(aerospace equipment, medical equipment, etc.) requiring extremely high reliability, ask us for a selection of Part No., and protection coordination, etc. in advance.
3.2 Note that we do not take any responsibility for faults and abnormalities resulting from the use not in conformity with the contents of entries in the delivery specification.
3.3 There is a possibility that the ZNR will unexpectedly cause smoke or ignite because of an abnormal rise of the circuit voltage and invasion of excessive surge. To prevent that accident from spreading over the equipment and not to expand the damage, use multiplex protection such as the adoption of frame-retardant materials for housing parts and structural parts.

"ZNR" Transient/Surge Absorbers, Type E
"ZNR" Transient/Surge Absorbers, Type CK, SC

Handling Precautions

1. ⚠Precautions for Safety

The "ZNR" Transient/Surge Absorbers (hereafter referred to as "The ZNR Varistors") may fail in a short-circuit mode or in an open-circuit mode, when subjected to severe conditions of electrical, environmental and/or mechanical stresses beyond their specified "Ratings" and specified "Conditions", resulting in burnout, flaming or glowing in the worst case. Following "⚠Precautions for Safety" and "Application Notes" shall be taken in your major consideration. If you have a question about the "Precautions for Handling", please contact our engineering section or factory.

1.1 ⚠Operating Conditions

1.1.1 The ZNR Varistors shall not be operated beyond the specified "Ratings" and "Environmental Conditions" in the Catalog or the Specifications to prevent them from deterioration, breakdown, flaming or glowing.

- The ZNR Varistors shall not be operated exceeding the specified "Maximum Allowable Voltage" in the Catalog or the Specification.
- The ZNR Varistors shall not be subjected to energy levels above their specified "Maximum Energy Ratings" in the Catalog or the Specifications.
- In case of application to repeated surge/overvoltages, the ZNR Varistors shall not be subjected to surge currents and energy levels above the specified maximum ratings in "Impulse Life Rating" in the Catalog or the Specifications.
- When surge/overvoltages are intermittently applied to the ZNR Varistors with short durations, the devices shall not be operated beyond the specified "Rated Power" in the Catalog or the Specifications.
- The ZNR Varistors shall not be operated beyond the specified "Operating Temperature Range" in the Catalog or the Specifications.
- It is recommended that the ZNR Varistors, if not fused, shall be located away from other combustible components.

1.1.2 The ZNR Varistor shall be operated correctly under following conditions to prevent Varistors from causing mechanical damages and ruptures and to protect human from serious injuries;

- The ZNR Varistors shall not be operated exceeding the specified "Maximum Allowable Voltage Ratings" in the Catalog.
- The ZNR Varistors shall not be operated beyond the "Maximum Peak Current Ratings" in the Catalog.
- Some safety countermeasure such as a protective case covering the Varistor is recommended, if necessary.

1.1.3 When the ZNR Varistors are applied to between a live part and a metallic chassis of equipment, following safety countermeasures shall be taken to protect human from electric shock.

A) The metallic chassis shall be earthed to the ground.

B) The live part shall be equipped with a protective cover for preventing electric shock.

- Recommendation fuse

Series	ERZC20EK□□□	ERZC32□K□□□	ERZVS34C□□□	ERZC40CK□□□
Current Fuse (Line - Line)	10 A max.	20 A max.	20 A max.	20 A max.
Thermal. Fuse (Line - Ground)	100 to 120 °C 5 A	100 to 120 °C 10 A	100 to 120 °C 10 A	100 to 120 °C 10 A

✻ Fuses shall use rated voltages appropriate for circuits.
✻ Finally, confirm that the secondary disaster does not occur even if the ZNR mounted on equipment breaks.
✻ Set a thermal fuse to get high thermal conductivity with ZNR.

2. Application Notes

2.1 Protective Devices for Varistors

2.1.1 The ZNR Varistors shall be protected from serious accidents due to unexpected physical phenomenor by following safety countermeasures.

- In case of "Across-the Line Use", the ZNR Varistors shall be protected by connecting a ground fault circuit interrupter of fusing in series to the devices. (See Table 1)
- In case of "Line to Ground Use", the short-circuit of the Varistor may not blow the current type fuse due to the grounding resistance (between Line and Ground), which may cause flaming or burnout of the devices in the worst case.
  Following safety countermeasures (A or B) are recommended;

A) Connecting a "leakage current circuit breaker" in series to the Varistor to be protected. (See Table 1)

B) Use current type fuses and a thermal type fuse which are thermally coupled each others. (See Table 1)

2.2 Circuit Design 1 (Selection of Varistor Voltage Rating)

2.2.1 General Precautions

In selection of Varistor Voltage Ratings for line protection, following general precautions shall be taken in your consideration;

(1) Maximum operating voltage shall be lower than the specified "Maximum Allowable Voltage" of the Varistor applied.

(2) Some reasonable margin is required against fluctuation of the primary AC line Voltage where the Varistor is applied for preventing mechanical and/or electrical failures of the device.

2.2.2 Across-the-Line Use(Line to Line surge protection)

● Select the ZNR Varistors recommended in Table 1.

Notes : Because the primary line voltage temporarily rises due to load unbalance of separately wired loads, short circuit between the live line and the nutral line or LC resonance at switching for a capacitive load, ZNR Varistors with ✻ are recommended for AC120 V or 240 V applications. (See Table 1)

2.2.3 Line to Ground Use(Line to Ground Surge protection)

● Select the ZNR Varistors recommended in Table 1.

Notes : When 500 V insulation resistance test of the circuits employing ZNR Varistor is conducted, the ZNR Varistor shall be removed after getting approval from the customer, or the ZNR Varistor ✻ ✻ with the Maximum Allowable Voltage exceeding to the test voltage shall be applied. (See Table 1)

When AC1000 V or 1200 V dielectric with standing test is conducted, ZNR Varistors shall be removed after getting approval from the customer according to the relevant regulations, or ZNR Varistor ✻ ✻ ✻ with the Maximum Allowable Voltage exceeding to the test voltage shall be applied. (See Table 1)

2.3 Circuit Design 2 (Fusing Varistors)

2.3.1 When a line current of equipment is higher than the recommended current rating of the fuse in Table 2, the location of the fuse shall be arranged according to Fig 2.

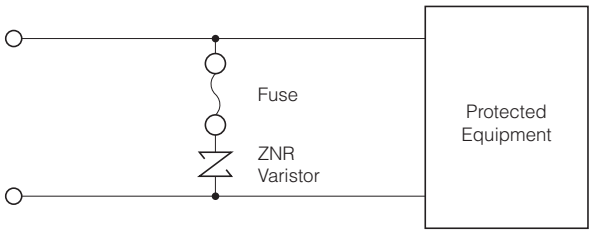


Fig. 2 Alternative Fuse Location/placement for Varistor Protection

2.4 Environmental Conditions

(1) The ZNR Varistors shall not be exposed outdoors, because of being designed for indoors use.

(2) The ZNR Varistors shall not be operated beyond the Specified Operating Temperature Range and shall not be exposed to direct sunlight and heating part of equipment.

(3) The ZNR Varistors shall not be operated under severe conditions of high temperatures and high humidities such as places exposed to rain, wind and vapor.

(4) The ZNR Varistors shall be free from dust, salinity environment and atomospheres polluted by corrosive gas.

2.5 Precautions for Assemblies and Handlings

2.5.1 Solvent Cleaning

Organic solvents such as thinner and acetone etc. shall not be applied to the ZNR Varistors for preventing deterioration of the external coating or molding resin.

2.5.2 Abnormal Mechanical Stresses

Abnormal mechanical stresses beyond the specified values such as strong falling shocks, ribrations and bending/pulling forces, shall be kept minimum to preventmechanical/electrical failures of the devices.

2.5.3 Plastic Molding

If another plastic molding is applied to the ZNR Varistors on your option, the influences on reliability of the ZNR Varistors shall be carefully investigated in your equipment.

2.6 Long Term Storage

(1) The ZNR Varistors shall not be stored under severe conditions of high temperatures and high humidities. Store them indoors under 40 °C max. and 75 %RH max. Use them within one year, if stored beyond the limit, check the solderbility before use.

(2) The ZNR Varistors shall not be stored under corrosive atomospheres such as hydrogen sulfide, sulfurous acid, chlorine and ammonia.

(3) The ZNR Varistors shall not be exposed to direct sunlight and shall not be stored under dew formation.

2.7 Regarding to "Safety Regulations of the Varistors"

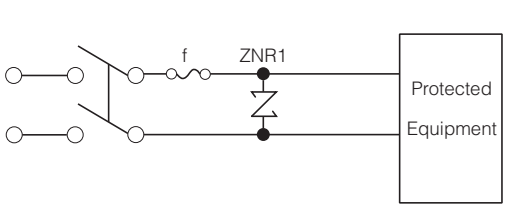
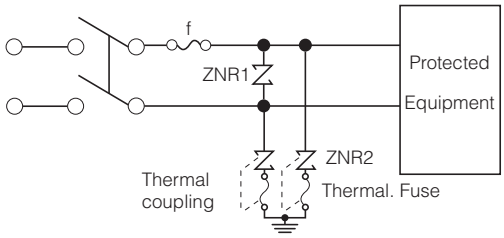
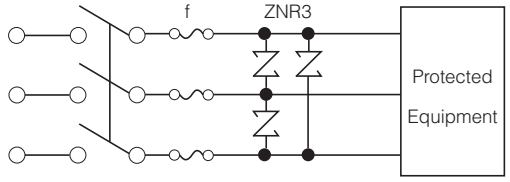
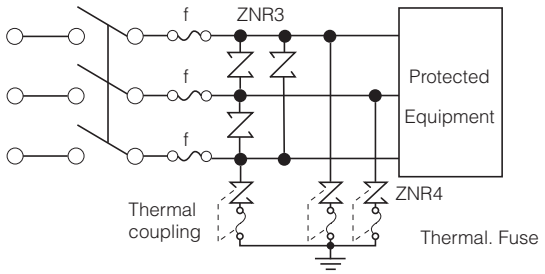
In case of applications to UL and CSA standards, refer to "Application Notes for UL and CSA Recognized" ZNR "Varistors"

2.8 Parallel Capacitances of the ZNR Varistors

The ZNR Varistors have relatively high capacitances specified in the individual specifications, special consideration shall be taken into account in applications to high frequency transmission lines or circuits.

Table 1. Application Examples

Connections

Across-the-Line/Line to Line Protection	Line to Line and Line to Ground Protection
D.C. A.C. Single phase  f : fuse	D.C. A.C. Single phase  f : fuse
A.C. 3 phase  f : fuse	A.C. 3 phase  f : fuse

Selection Examples

Across the Line Use/Line to Line				Line to Ground Use			
ZNR	Nominal Line Voltage	Part Number of ZNR Type E, CK, SC		ZNR	Nominal Line Voltage	Part Number of ZNR Type E, CK, SC	
ZNR1 ZNR3	AC 100 V	ERZC□□EK ERZC□□CK ERZVS34C	201 241 271	ZNR2 ZNR4	AC 100 V to AC 220 V	ERZC□□EK ERZC□□CK ERZVS34C	471 511 821 ✻✻
	AC 120 V		241 271 ✻				
	AC 200 V to AC 220 V		471		AC 240 V		511 821 ✻✻
	AC 240 V		511				