English

CHEMI-CON

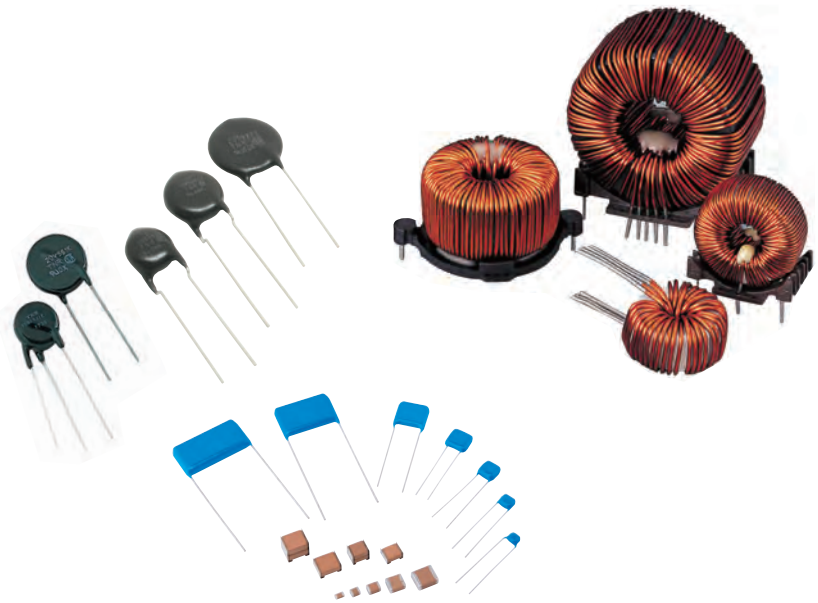
2024

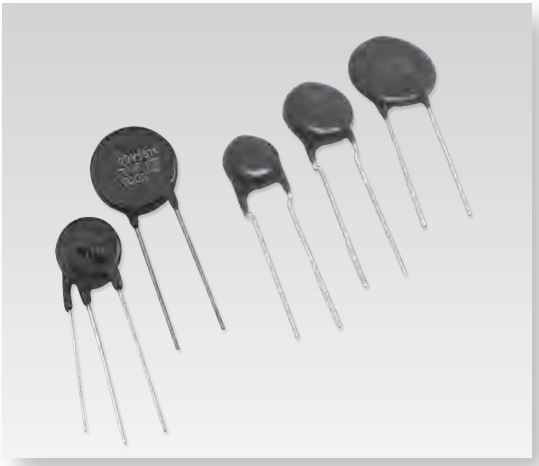
# CERAMIC CAPACITORS

# VARISTORS

# CHOKE COILS

CAT.NO.E1002D / E1006G / E1008Y





# METAL OXIDE VARISTOR TNR™

| Item | Series | Varistor voltage (V) | Surge current withstand (A) | Features | Page |
|---|---|---|---|---|---|
| Disk Type | V | 15 to 1800 | 250 to 10000 | Excellent responsiveness and high reliability<br>Products conforming to overseas safety standards (UL, CSA, VDE)<br>Ideal for general use and absorbing various kinds of surges | 58 |
| | SV | 22 to 1000 | 125 to 10000 | Highly flame-retardant exterior material (halogen free) is used<br>Suppresses burning and scattering of exterior materials even if they are destroyed due to application of excessive voltage<br>Product with improved safety | 79 |
| | H | 22 to 47 | 5 to 40* | Large surge energy withstand (5 to 40J)<br>Broad operating temperature range (between -40 and +125°C)<br>Highly resistant to thermal shock (between -40 and +150°C, 50 cycles)<br>Ideal for absorbing various kinds of surges for automobiles | 90 |
| | GF | 270 to 820 | 2500 to 4000 | With built-in thermal fuse<br>Product with improved safety | 94 |

* Surge energy withstand (J)

The circuits described as examples in this catalog and the "delivery specifications" are featured in order to show the operations and usage of our products, however, this fact does not guarantee that the circuits are available to function in your equipment systems.
We are not in any case responsible for any failures or damage caused by the use of information contained herein.
You should examine our products, of which the characteristics are described in the "delivery specifications" and other documents, and determine whether or not our products suit your requirements according to the specifications of your equipment systems. Therefore, you bear final responsibility regarding the use of our products.
Please make sure that you take appropriate safety measures such as use of redundant design and malfunction prevention measures in order to prevent fatal accidents and/or fires in the event any of our products malfunction.

**1** The performance of varistors may deteriorate, the inside elements may be damaged, and they cause the varistors to smoke or catch fire, if the following precautions are not observed.

(1) Do not use varistors in places whose temperature exceeds their rated operating temperature due to direct sunlight or heating objects.
(2) Do not use varistors in a humid place directly exposed to the weather or steam.
(3) Do not use varistors in places filled with dust, salt-mist or corrosive gas.
(4) The soldering method is flow soldering and iron soldering. The recommended conditions are as follows.
- Flow soldering : Pre-heat 100±20°C, 60 to 90 sec., Soldering 260±5°C, 10±1sec.
- Iron soldering : 350±10°C, less than 4sec.

(5) Do not use solvents such as thinner and acetone which dissolve or make the exterior covering of varistors deteriorate.
Ultrasonic cleaning shall be so set that the vibration can not travel the assembly boards.
(6) Do not expose varistors to intense vibration, shock (drop shock etc.) or pressure making the exterior covering or inside element crack.
(7) Do not apply high voltage exceeding the rated maximum applying voltage to varistors.
In the case of automotive jump starts, however, use the varistors within short-term allowable voltage limits prescribed in the catalog.
If voltage wave form is not complete DC, a maximum value of peak voltages shall not exceed the rated maximum applying voltage.
(8) Do not apply peak currents exceeding the rated maximum energy.
(9) When peak currents are repeatedly applied to varistors, do not exceed the pulse life time ratings prescribed in the catalog.
(10) When peak currents are intermittently applied to varistors at short intervals, do not exceed the rated wattage.
(11) Using varistors in circuits whose frequency exceeds 1kHz may damage their elements by heat generation due to dielectric loss.
(12) In the case of coating or molding varistors with resin, do not use the resin which makes the varistors deteriorate.
(13) Do not install varistors in places near by flammable substances.

**2** Varistors may blow up, if the following precautions are not observed.

(1) Do not use varistors in circuits applied peak currents exceeding the specified limits.
(2) Do not exceed the rated maximum applying voltage.

**3** Varistors do not function but damages devices, if the following precautions are not observed.

(1) Hold the root of the varistor lead when bending or cutting the lead.
(2) The lead close to insulation cover shall not be bent or applied to outer force.
(3) When soldering the lead, do not damage a solder material and insulator fabricating the varistor.

**4** The following preventive measures should be made for avoiding unexpected accident.

(1) When using a varistor in between circuits, connect an earth leakage breaker (ground-fault circuit interrupter) or current fuse in series with the varistor.
(2) When using a varistor in between a circuit and ground, connect an earth leakage breaker (ground-fault circuit interrupter) or both of a current fuse and thermal fuse in series with the varistor. Also, in case of excessive voltage due to ground short circuit accident, use the varistor with the rated voltage higher than the excessive voltage.

**5** Store varistors in their packages in an environment with a temperature of –10 to + 40°C and a relative humidity of less than 75%.
Avoid storing in an environment subject to rapid changes in temperature, direct sunlight, corrosive gases, or dust.
The storage life is two years from the time of purchase as a general rule.

**6** Follow safety standards such as Electrical, UL, CSA and so forth, which specify the use of varistors.

**7** Catalogs

Product specifications in this catalog are subject to change without notice.
Please request and make sure our product specifications before purchase and/or use.
Parformance test data in the catalogs show typical values, which are not assured in the catalogs.

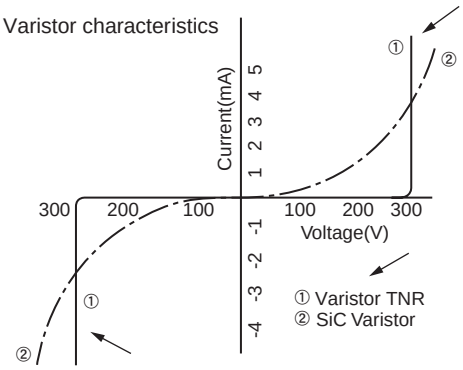
**8** Response to the Substances of Concern

(1) Nippon Chemi-Con aims for developing products that meet laws and regulations concerning substances of concern.
(Some products may contain regulated substances for exempted application.)
Please contact us for more information about law-compliance status.
(2) According to the content of REACH handbook (Guidance on requirements for substances in articles which is published on May 2008), our electronic components are "articles without any intended release". Therefore they are not applicable for "Registration" for EU REACH Regulation Article 7 (1).
Reference: Electrolytic Condenser Investigation Society
"Study of REACH Regulation in EU about Electrolytic Capacitor" (publicized on 13 March 2008)

TNR is a our metal oxide varistor metal oxide varistor having steep non-linear V-I characteristics and high discharge current capability, as follows:

## ◆Metal oxide varistor Features

1. Excellent transient voltage suppression
2. High discharge current capability
3. Wide range of voltage ratings
4. Symmetrical V-I characteristics (Non Polarity)
5. Fast response
6. Steady operation for repeating surge
7. Low temperature coefficient
8. High reliability
9. UL recognized
10. CSA recognized



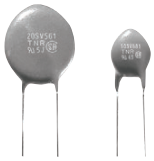

## ◆Applications

1. Electronics instrument protection
2. Telephone system protection
3. Relay contact point protection
4. Rectification diode protection
5. SCR protection
6. Reduction of abnormal voltage in high voltage current
7. Switching transistor proteciton
8. Reduction of switching surge in electromagnetic brake
9. Prevention of error in digital circuit
10. Reduction of noise from an abnormal voltage

## ◆Group Chart

**V Series**

**SV Series**



**H Series**

**GF Series**

## ◆Part Numbering System

**The current parts numbering system is changed to new system for global coding.**
**Your cooperation will be very much appreciated.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | 1 | 4 | V | – | 2 | 7 | 1 | K | B | | | | | | |

Design Code
Lead Forming / Taping
Packing Style⑥
Varistor Volt. Tolerance⑤
Varistor Voltage④
Series③
Size code
Product Form②
Category①

| ①Category | |
|---|---|
| T | Metal Oxide Varistors TNR |

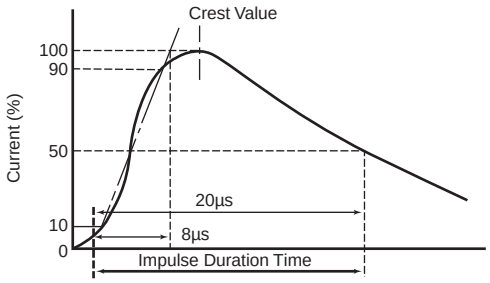
| ②Product Form | |
|---|---|
| ND | Disk Type |
| NL | Sleeve Type |

| ③Series | |
|---|---|
| V– | V Series |

| ④Varistor Voltage |
|---|
| The first two digits are significant figures and the third one denotes the number of following zeros. |

| ⑤Varistor Volt. Tolerance | |
|---|---|
| K | ±10% |

| ⑥Packing Style | |
|---|---|
| B | Bulk |
| T | Taping |

| Technical Term | Description |
|---|---|
| Varistor Voltage | Voltage across the varistor measured at CmA DC.<br>C = 0.1 or 1.0 as specified. |
| Max. Allowable Voltage (ACrms) | Maximum continuous sinusoidal RMS voltage which may be applied. |
| Max. Allowable Voltage (DC) | Maximum continuous DC voltage which may be applied. |
| Maximum Clamping Voltage | Peak voltage across the varistor, measured under conditions of a specified peak impulse current and specified waveform (8/20µs) applied 1 time. |
| Rated Wattage | Maximum power that can be applied within the specified ambient temperature. |
| Maximum Peak Current | Surge current withstand refers to the maximum current value that is within 10% of the varistor voltage against an initial value when the standard impulse current at 8/20 µs in accordance with IEC standards is applied once or twice within a five-minute interval. If this value is exceeded, a Varistor malfunction may result. When selecting a Varistor, select one that has a higher rate for a surge current than the anticipated surge current rate. |
| Current Wave Form for Clamping Voltage Test and Maximum Peak Current |  |
| Energy | Surge energy withstand refers to the maximum energy value that is within 10% of the varistor voltage against an initial value when a 2ms shortwave is applied once.<br>When a Varistor absorbs energy exceeding this value, it may malfunction. Therefore, when selecting a Varistor, select one that can withstand a higher energy surge than the anticipated surge energy rate. |
| Capacitance | Typical value measured at a 1kHz test frequency.<br>(Sin wave. Reference purpose only) |

## SAFETY STANDARDS for V Series

### ◆TNR V Series / Recognized safety standards

| Standards | Category Name | Title | File No. | Varistor Voltage Ranges | Symbol |
|---|---|---|---|---|---|
| UL1449 | VZCA2 (USA)<br>VZCA8 (Canada) | Surge Protective Devices | E323623 | 82～1800 V | ○ |
| CSA C22.2 No.269.5-17 Class 2213 31 | ----- | Type 5-Component Surge Protective Devices(SPD), Varistor Type V Series | 097864 0 000 | 200～1800 V | ☆ |
| VDE | ----- | Varistor<br>DIN EN 61051-1:2009-04<br>IEC<br>61051-1:2007-04<br>61051-2:1991-01<br>61051-2(ed.1);am1:2009-05<br>61051-2-2:1991-01 | 118623 | 15～1800 V | □ |
| CQC | ----- | GB/T10193, GB/T10194<br>GB4943.1, GB8898 | (1) | 82～1800 V | ◇ |

Note(1) File number of CQC varies according to a part number. Pleasee refer to us.

### Recognized Part numbers

| Rating | Varistor voltage (V) | Part Number | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TND05V-***K | TND07V-***K | TND09V-***K | TND10V-***K | TND10V-***KS | TND12V-***K | TND14V-***K | TND20V-***K |
| 820K | 82 | ○ □ | ○ □ | ○ □ | ○ □ ◇ | | | ○ □ ◇ | ○ □ ◇ |
| 101K | 100 | ○ □ | ○ □ | ○ □ | ○ □ ◇ | | | ○ □ ◇ | ○ □ ◇ |
| 121K | 120 | ○ □ | ○ □ | ○ □ | ○ □ ◇ | | | ○ □ ◇ | ○ □ ◇ |
| 151K | 150 | ○ □ | ○ □ | ○ □ | ○ □ ◇ | | | ○ □ ◇ | ○ □ ◇ |
| 181K | 180 | ○ □ | ○ □ | ○ □ | ○ □ ◇ | | | ○ □ ◇ | ○ □ ◇ |
| 201K | 200 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 221K | 220 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 241K | 240 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 271K | 270 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 331K | 330 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 361K | 360 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 391K | 390 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 431K | 430 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 471K | 470 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 511K | 510 | | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 561K | 560 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 621K | 620 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 681K | 680 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 751K | 750 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 821K | 820 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 911K | 910 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 102K | 1000 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 112K | 1100 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 122K | 1200 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 152K | 1500 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 182K | 1800 | | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |

"***K" or "***KS": Ratings

○: UL1449, ☆: CSA, □: VDE, ■: VDE and IEC 62368-1:2014 G.8.2
◇: CQC(GB/T10193, GB/T10194), ◆: CQC(GB/T10193, GB/T10194, GB4943.1, GB8898)

*Recognized marking

UL, CSA : on the products VDE, CQC: on the package label

*The safety standards may be changed without a notice. Please refer for the latest certificate to us.
Please refer to each certification organization for the inquiry about the contents of the safety standards.

## ◆The AC Rated Voltage and Maximum Allowable Voltage

| Rating | Maximum Allowable Voltage | | AC Rated Voltage (Vrms) | |
|---|---|---|---|---|
| | ACrms (V) | DC (V) | UL1449 | CSA・CLASS 2213 31 |
| 820K | 50 | 65 | 45 | N/A |
| 101K | 60 | 85 | 55 | N/A |
| 121K | 75 | 100 | 68 | N/A |
| 151K | 95 | 125 | 86 | N/A |
| 181K | 110 | 145 | 100 | N/A |
| 201K | 130 | 170 | 118 | 118 |
| 221K | 140 | 180 | 127 | 127 |
| 241K | 150 | 200 | 136 | 136 |
| 271K | 175 | 225 | 159 | 159 |
| 331K | 210 | 270 | 189 | 189 |
| 361K | 230 | 300 | 209 | 209 |
| 391K | 250 | 320 | 227 | 227 |
| 431K | 275 | 350 | 250 | 250 |
| 471K | 300 | 385 | 272 | 272 |
| 511K | 320 | 410 | 286 | 286 |
| 561K | 350 | 460 | 318 | 318 |
| 621K | 385 | 505 | 350 | 350 |
| 681K | 420 | 560 | 381 | 381 |
| 751K | 460 | 615 | 418 | 418 |
| 821K | 510 | 670 | 463 | 463 |
| 911K | 550 | 745 | 500 | 500 |
| 102K | 625 | 825 | 568 | 568 |
| 112K | 680 | 895 | 600 | 600 |
| 122K | 720 | 980 | 600 | 600 |
| 152K | 860 | 1220 | 600 | 600 |
| 182K | 1000 | 1465 | 600 | 600 |

## ◆Application Notes

1) CSA regulate "Maximum Rating Fuse" for using Varistor to "Audio, Video and Similar Electronic Equipment" as below

| Maximum Peak Current 8/20μs, 1 time(A) | Type of TNR | Maximum Rating of Fuse (A) |
|---|---|---|
| Up to 500 | | 3 |
| 501～2000 | TND05V, TND07V | 5 |
| 2001～6000 | TND09V, TND10V, TND12V, TND14V | 10 |
| Over 6000 | TND20V | Not specified |

2) "Rated Voltages" are specified for UL/CSA recognized components besides Maximum Allowable Voltage because of conforming to the Standby Current specified in safety standards.
In case of making an application to UL/CSA approval for equipment with Varistor, the maximum AC operating voltage of equipment shall be lower than the Varistor Rated Voltage.

## SAFETY STANDARDS for SV Series

### ◆TNR SV Series / Recognized safety standards

| Standards | Category Name | Title | File No. | Varistor Voltage Ranges | Symbol |
|---|---|---|---|---|---|
| UL1449 | VZCA2 (USA)<br>VZCA8 (Canada) | Surge Protective Devices | E323623 | SV : 220～1000 V | ○ |
| CSA C22.2 No.269.5-17 Class 2213 31 | ----- | Type 5-Component Surge Protective Devices(SPD), Varistor Type SV Series | 097864 0 000 | SV : 220～1000 V | ☆ |
| VDE | ----- | Varistor<br>DIN EN 61051-1:2009-04<br>IEC<br>61051-1:2007-04<br>61051-2:1991-01<br>61051-2(ed.1);am1:2009-05<br>61051-2-2:1991-01 | 118623 | SV : 220～1000 V | □ |
| CQC | ----- | GB/T10193, GB/T10194<br>GB4943.1 | (1) | SV : 220～1000 V | ◇ |

Note(1) File number of CQC varies according to a part number. Pleasee refer to us.

Recognized Part numbers

| Rating | Varistor voltage (V) | Part Number | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | TND05SV***K | TND07SV***K | TND10SV***K | TND10SV***KS | TND12SV***K | TND14SV***K | TND14V-***K |
| 221K | 220 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 241K | 240 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 271K | 270 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 431K | 430 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ | ○ ☆ ■ ◇ |
| 471K | 470 | ○ ☆ □ | ○ ☆ □ | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 511K | 510 | | ○ ☆ □ | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 561K | 560 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 621K | 620 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 681K | 680 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 751K | 750 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 821K | 820 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 911K | 910 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |
| 102K | 1000 | | | ○ ☆ □ ◇ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ | ○ ☆ ■ ◆ |

"***K" or "***KS": Ratings

○ : UL1449, ☆ : CSA, □ : VDE, ■ : VDE and IEC 62368-1:2014 G.8.2
◇ : CQC(GB/T10193, GB/T10194), ◆ : CQC(GB/T10193, GB/T10194, GB4943.1)

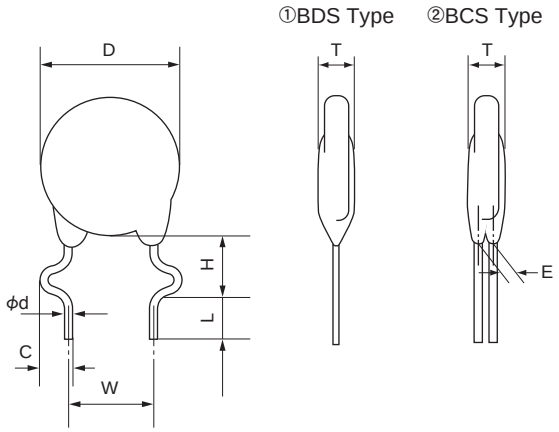
*Recognized marking

UL, CSA : on the products VDE, CQC: on the package label

*The safety standards may be changed without a notice. Please refer for the latest certificate to us.
Please refer to each certification organization for the inquiry about the contents of the safety standards.

●This Specifies the lead forming specifications for Disk Type (V, H series)

## ◆FORM




## ◆DIMENSIONS

Unit : mm

| Type | 5V, 7V, 9V, 9H | 10V, 12V, 14V, 12H, 15H | 20V, 23H |
|---|---|---|---|
| Lead style code | BDS | BCS | BCS |
| D | refer to each spec. | refer to each spec. | refer to each spec. |
| T | refer to each spec. | refer to each spec. | refer to each spec. |
| H | $6.0^{+2.0}_{-1.0}$ | $6.0^{+2.0}_{-1.0}$ | $6.0^{+2.0}_{-1.0}$ |
| L | 5.0±1.0 | 5.0±1.0 | 5.0±1.0 |
| W | 5.0±1.0 | 7.5±1.0 | 10.0±1.0 |
| φd | 0.6±0.05 | 0.8±0.05 | 0.8±0.05 |
| C | 2.0±0.5 | 2.0±0.5 | 2.0±0.5 |
| E | — | refer to each spec. | refer to each spec. |

## ◆PART NUMBERING SYSTEM (BULK)

| Code | Category |
|---|---|
| T | Metal Oxyde Varistor TNR |

| Code | Product Form |
|---|---|
| ND | Disk Type |

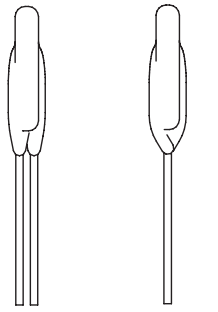
| Varistor Voltage |
|---|
| The first two digits are sighificant figures and the third one denote the number of following zeros. |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | 1 | 2 | V | - | 4 | 7 | 1 | K | B | 0 | 0 | A | A | A | 0 |
| Category | Product Form | | Size | | Series | | Varistor Voltage | | | Varistor Voltage Tolerance | Bulk Forming Code | | | Design code | | | |

| Code | Size |
|---|---|
| 05 | φ5 |
| 07 | φ7 |
| 09 | φ9 |
| 10 | φ10 |
| 12 | φ12 |
| 14 | φ14 |
| 15 | φ15 |
| 20 | φ20 |
| 23 | φ23 |

| Code | Series |
|---|---|
| V- | V Series |
| SV | SV Series |
| H- | H Series |
| GF | GF Series |

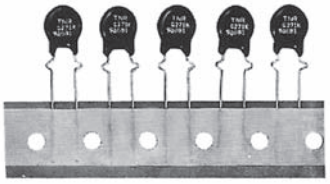
| Code | Varistor Volt. Tolerance |
|---|---|
| K | ±10% |




| Code | Type | Lead Style |
|---|---|---|
| BDS (300) | 5V,7V,9V,9H | Crimped (Form-B) |
| B00 (None) | | Straight (Form-B) |
| BCS (300) | 10V,12V,14V,20V, 12H,15H,23H | Crimped (Form-A) |
| B00 (None) | | Straight (Form-A) |

Note : The Code (300) is the Previous Code.

●This Specifies taping specifications for varistors which have normal disk diameter of 5 to 15mm and nominal varistor voltage of 15 to 510V.



## ◆PART NUMBERING SYSTEM

| Code | Category |
|---|---|
| T | Metal Oxyde Varistor TNR |

| Code | Product Form |
|---|---|
| ND | Disk Type |

**Varistor Voltage**
The first two digits are sighificant figures and the third one denote the number of following zeros.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | 1 | 2 | V | - | 4 | 7 | 1 | K | T | F | A | A | A | A | 0 |
| Category | Product Form | | Size | | Series | | Varistor Voltage | | | Varistor Voltage Tolerance | Taping Code | | | Design code | | | |

| Code | Size |
|---|---|
| 05 | φ5 |
| 07 | φ7 |
| 09 | φ9 |
| 10 | φ10 |
| 12 | φ12 |
| 14 | φ14 |
| 15 | φ15 |

| Code | Series |
|---|---|
| V- | V Series |
| H- | H Series |

| Code | Varistor Volt. Tolerance |
|---|---|
| K | ±10% |

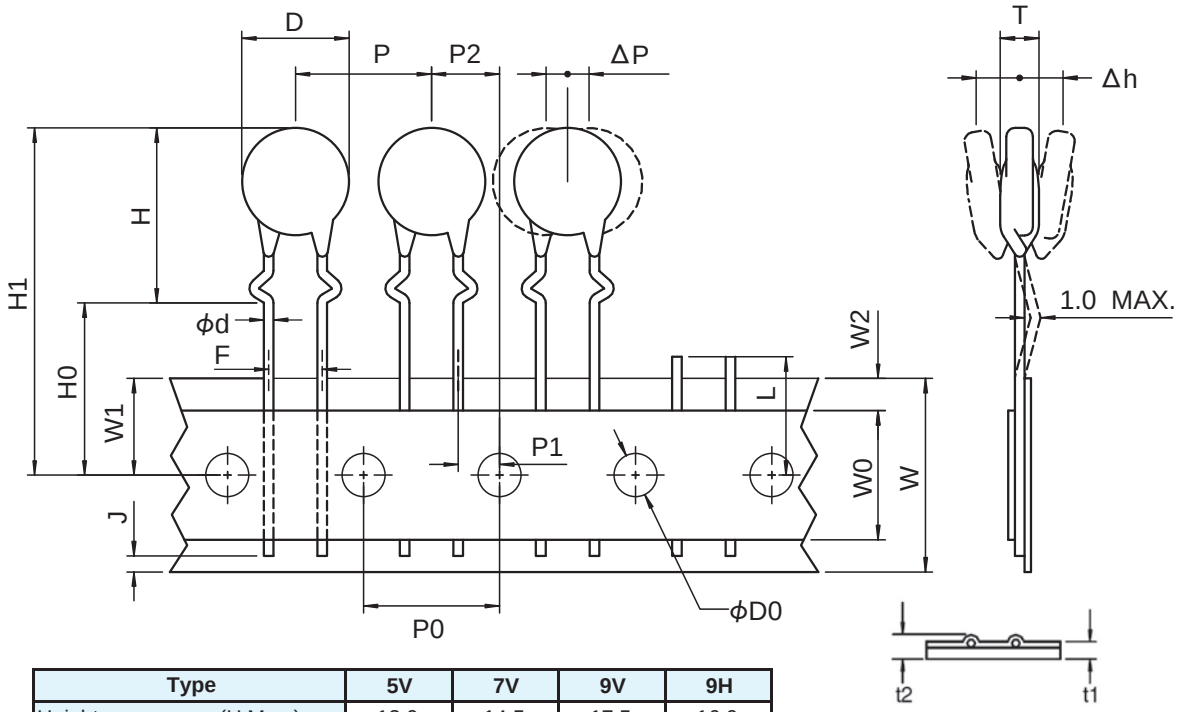
Form-A

Form-B (Parallel)

| Feed hole pitch 12.7mm | Feed hole pitch 15.0mm | | |
|---|---|---|---|
| **Code** | **Code** | **Type** | **Lead Style** |
| TFA (T15) | — | 5V,7V,9V,9H | Crimped (Form-B) |
| TBA (T25) | — | | Straight (Form-B) |
| TEA (T1) | — | 10V,12V,14V | Crimped (Form-A) |
| TFA (T15) | TFB (T8) | | Crimped (Form-B) |
| TAA (T2) | — | | Straight (Form-A) |
| TBA (T25) | TBB (T7) | | Straight (Form-B) |
| TEA (T1) | — | 12H,15H | Crimped (Form-A) |
| TFA (T15) | — | | Crimped (Form-B) |
| TAA (T2) | — | | Straight (Form-A) |
| TBA (T25) | — | | Straight (Form-B) |

Note : The Code (T1,T15,T2,T25,T8,T7) are the old taping code.

## ◆5V, 7V, 9V, 9H : TYPE TFA(T15) (Crimped Lead)

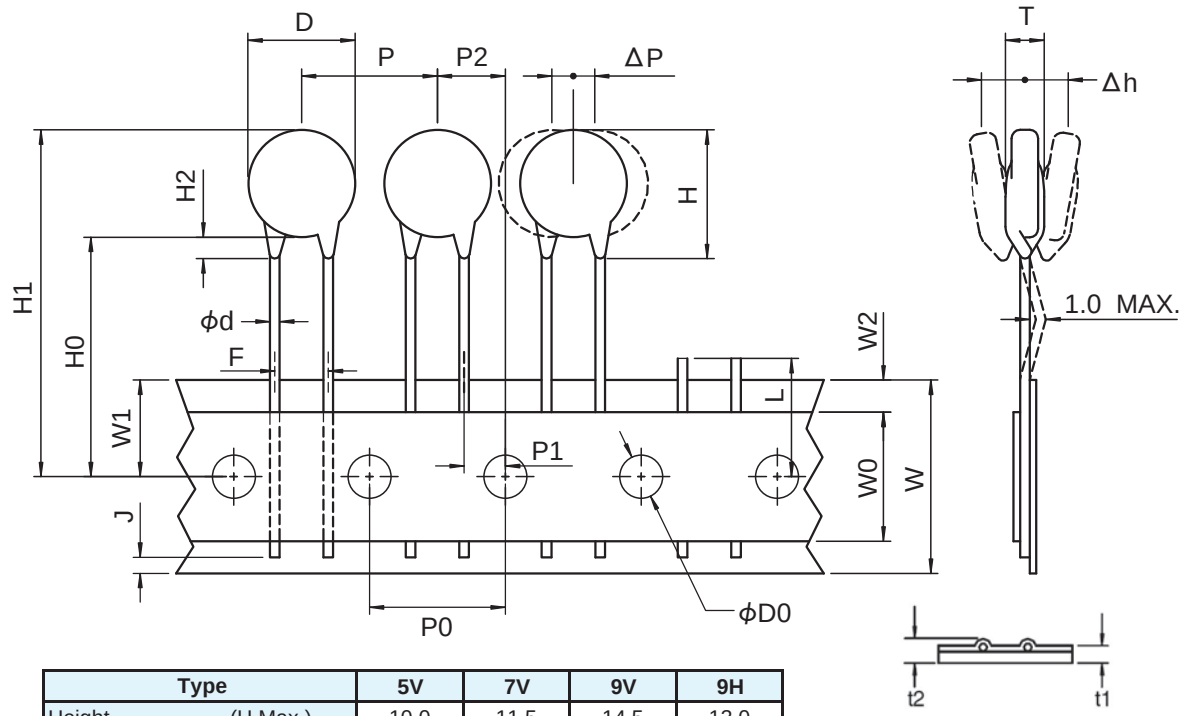



| Type | 5V | 7V | 9V | 9H |
|---|---|---|---|---|
| Height (H Max.) | 13.0 | 14.5 | 17.5 | 16.0 |
| Component Height (H1 Max.) | 30.0 | 31.0 | 34.0 | 33.0 |

## ◆TYPE TFA(T15)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | ϕd | 0.6±0.05 | |
| Pitch of component | P | 12.7±1.0 | |
| Feed hole pitch | P0 | 12.7±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | ϕD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 3.85±0.7 | Measured at the upper end of tape |
| Feed hole center to component center | P2 | 6.35±1.3 | |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F | 5.0±0.8 | |
| Deviation across tape | Δh | 0±2.0 | |
| Deviation along tape | ΔP | 0±1.0 | |
| Carrier tape width | W | $18.0\pm^{1.0}_{0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Seating plane height | H0 | 16.0±0.5 | |
| Component height | H1 | — | Please refer to the above list |
| Lead position | J | 6.0 Max. | |
| Defective article cut position | L | 11.0 Max. | |

## ◆ 5V, 7V, 9V, 9H : TYPE TBA(T25) (Straight Lead)

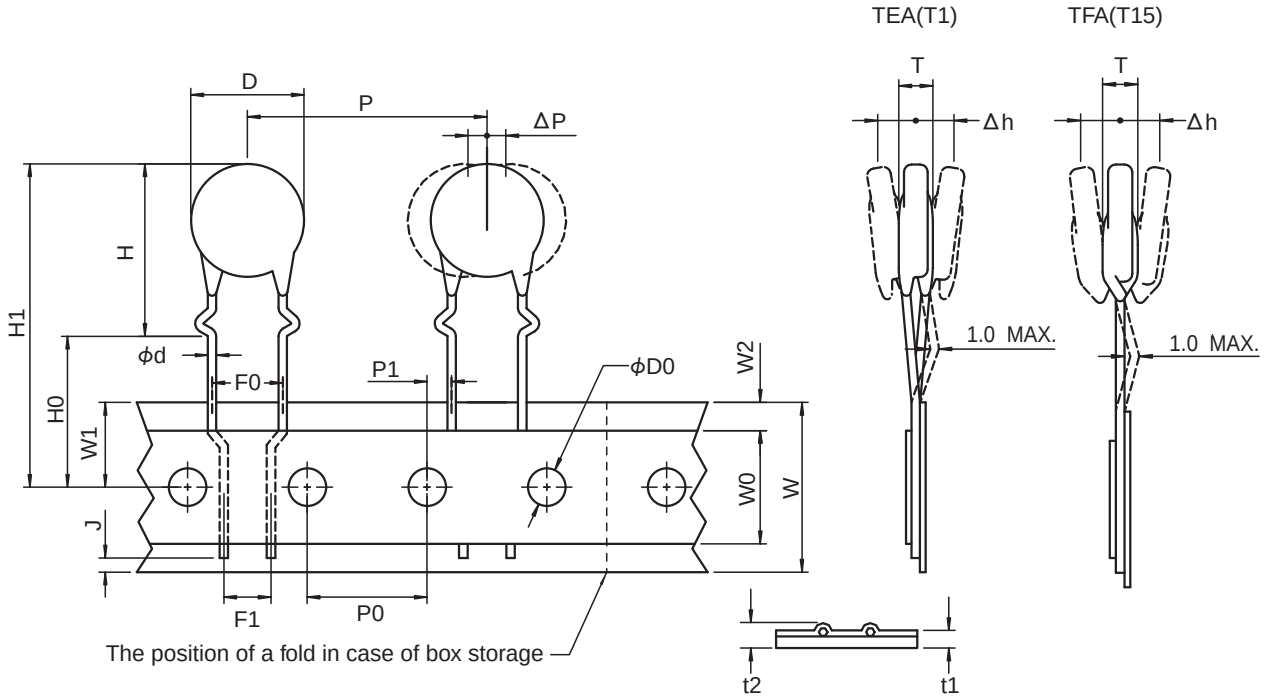



| Type | 5V | 7V | 9V | 9H |
|---|---|---|---|---|
| Height (H Max.) | 10.0 | 11.5 | 14.5 | 13.0 |
| Component Height (H1 Max.) | 29.0 | 30.0 | 33.0 | 32.0 |

## ◆TYPE TBA(T25)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | φd | 0.6±0.05 | |
| Pitch of component | P | 12.7±1.0 | |
| Feed hole pitch | P0 | 12.7±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | φD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 3.85±0.7 | Measured at the upper end of tape |
| Feed hole center to component center | P2 | 6.35±1.3 | |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F | 5.0±0.8 | |
| Deviation across tape | Δh | 0±2.0 | 9V : 34.0 Max. |
| Deviation along tape | ΔP | 0±1.0 | |
| Carrier tape width | W | $18.0\pm^{1.0}_{0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Height from tape center to component base | H0 | $20.0\pm^{1.5}_{1.0}$ | |
| Component height | H1 | — | Please refer to the above list |
| | H2 | 3.0 Max. | |
| Lead position | J | 6.0 Max. | |
| Defective article cut position | L | 11.0 Max. | |

## ◆10V, 12V, 14V, 12H, 15H : TYPE TEA(T1), TFA(T15) (Crimped Lead)

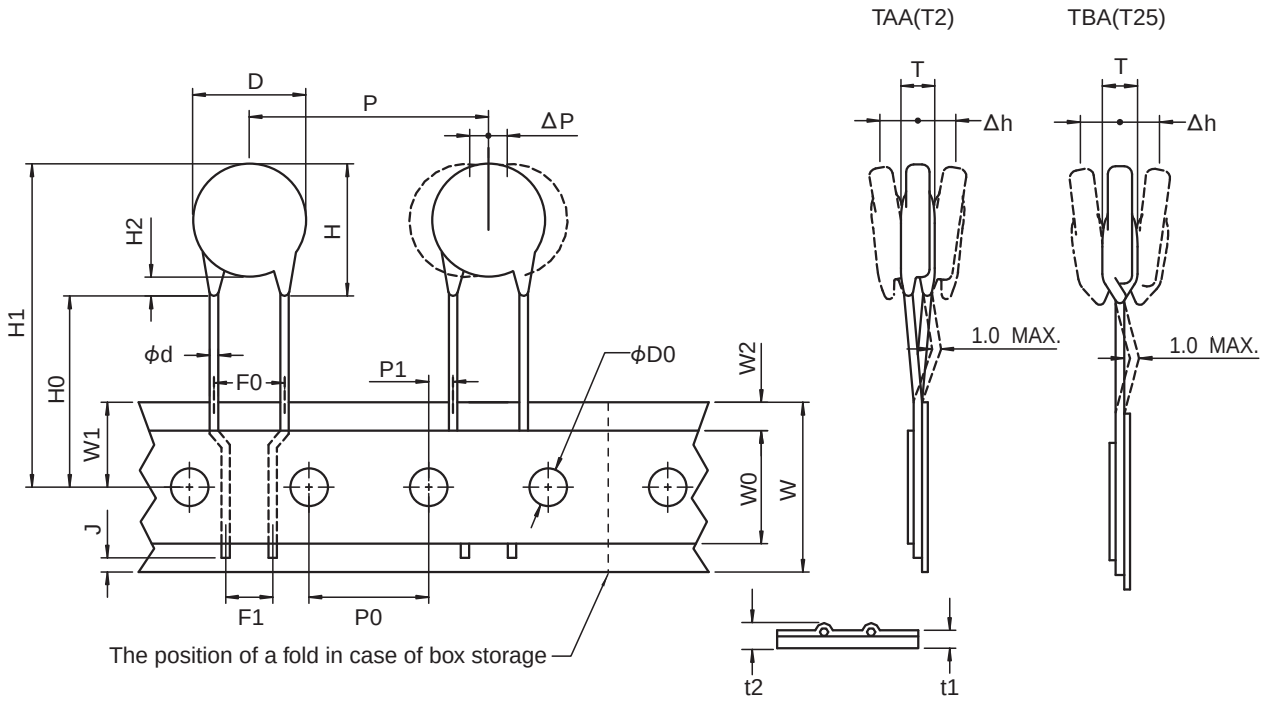



| Type | 10V | 12V | 14V | 12H | 15H |
|---|---|---|---|---|---|
| Height (H Max.) | 17.5 | 19.0 | 21.0 | 21.0 | 24.0 |
| Component Height (H1 Max.) | 35.0 | 36.0 | 38.0 | 38.0 | 41.0 |

## ◆TYPE TEA(T1), TFA(T15)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | ϕd | 0.8±0.05 | |
| Pitch of component | P | 25.4±1.0 | |
| Feed hole pitch | P0 | 12.7±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | ϕD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 2.6±0.5 | Measured at the upper end of tape |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F0 | 7.5±0.8 | |
| | F1 | 5.0 Nom. | |
| Deviation across tape | Δh | 0±2.0 | |
| Deviation along tape | ΔP | 0±1.0 | |
| Carrier tape width | W | $18.0^{+1.0}_{-0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Seating plane height | H0 | 16.0±1.0 | |
| Component height | H1 | — | Please refer to the above list |
| Lead position | J | 6.0 Max. | |

## ◆10V, 12V, 14V, 12H, 15H : TYPE TAA(T2), TBA(T25) (Straight Lead)

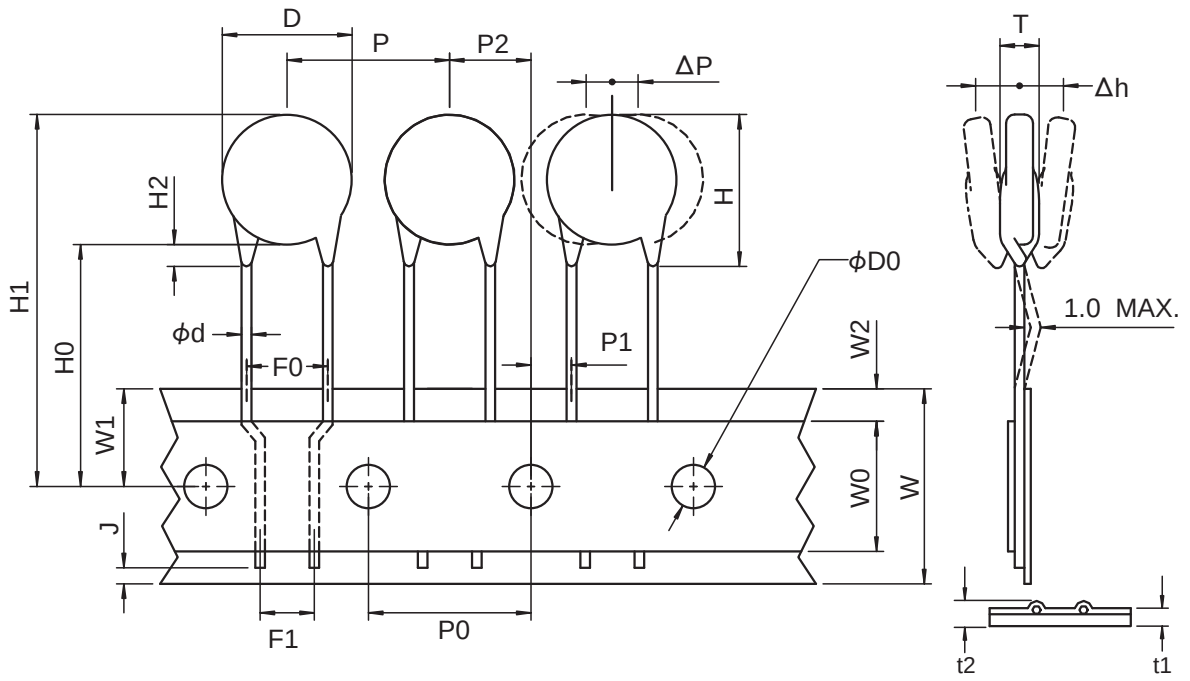



| Type | 10V | 12V | 14V | 12H | 15H |
|---|---|---|---|---|---|
| Height (H Max.) | 15.5 | 17.0 | 19.0 | 16.5 | 19.0 |
| Component Height (H1 Max.) | 40.0 | 41.0 | 43.0 | 41.0 | 44.0 |

## ◆TYPE TAA(T2), TBA(T25)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | ϕd | 0.8±0.05 | |
| Pitch of component | P | 25.4±1.0 | |
| Feed hole pitch | P0 | 12.7±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | ϕD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 2.6±0.5 | Measured at the upper end of tape |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F0 | 7.5±0.8 | |
| | F1 | 5.0 Nom. | |
| Deviation across tape | Δh | 0±2.0 | |
| Deviation along tape | ΔP | 0±1.0 | |
| Carrier tape width | W | $18.0^{+1.0}_{-0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Height from tape center to component base | H0 | 20.0 Min. | SE : 19.0 Min. |
| Component height | H1 | — | Please refer to the above list |
| | H2 | 3.0 Max. | |
| Lead position | J | 6.0 Max. | |

## ◆10V, 12V, 14V : TYPE TBB(T7) (Straight Lead, 15mm Pitch)

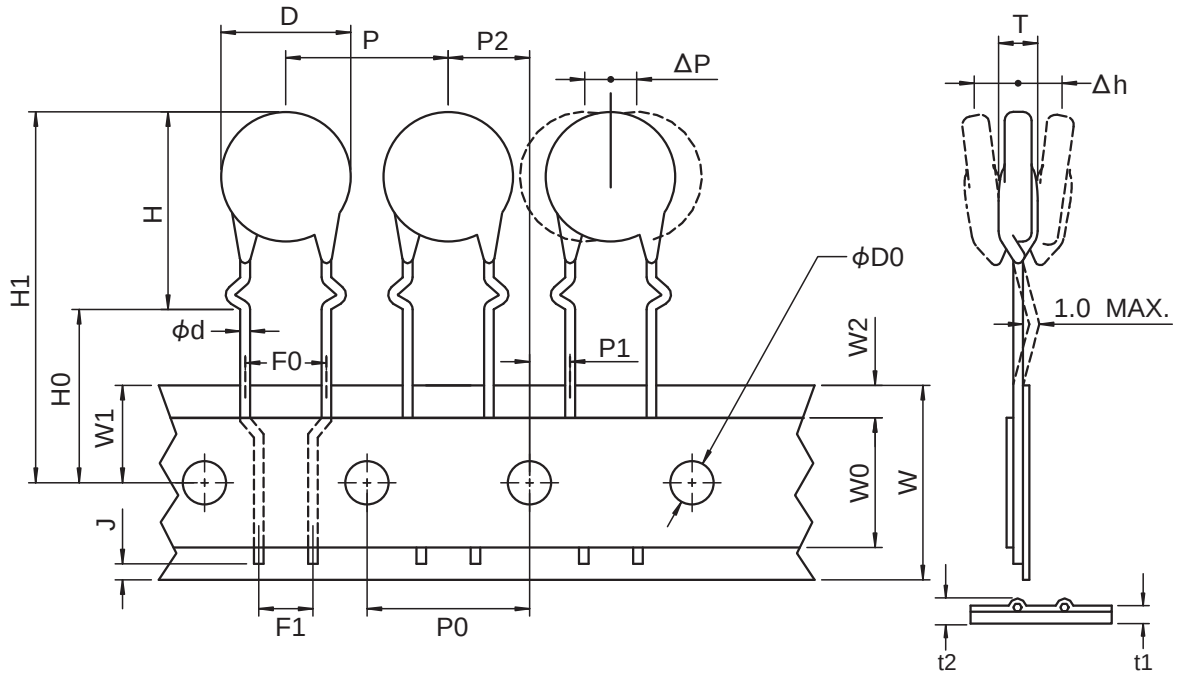



| Type | 10V | 12V | 14V |
|---|---|---|---|
| Height (H Max.) | 15.5 | 17.0 | 19.0 |
| Component Height (H1 Max.) | 37.0 | 39.0 | 41.0 |

## ◆TYPE TBB(T7)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec (14V : 15.0 Max.) |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | ϕd | 0.8±0.05 | |
| Pitch of component | P | 15.0±1.0 | 14SE : 30.0 ±1.0 mm |
| Feed hole pitch | P0 | 15.0±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | ϕD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 3.75±0.5 | Measured at the upper end of tape |
| Feed hole center to component center | P2 | 7.5±1.3 | |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F0 | 7.5±0.8 | |
| | F1 | 5.0 Nom. | |
| Deviation across tape | Δh | 0±2.0 | |
| Deviation along tape | ΔP | 0±1.3 | |
| Carrier tape width | W | $18.0^{+1.0}_{-0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Height from tape center to component base | H0 | $20.0^{+1.5}_{-1.0}$ | |
| Component height | H1 | — | Please refer to above list |
| | H2 | 3.0 Max. | |
| Lead position | J | 6.0 Max. | |

## ◆10V, 12V, 14V : TYPE TFB(T8) (Crimped Lead, 15mm Pitch)

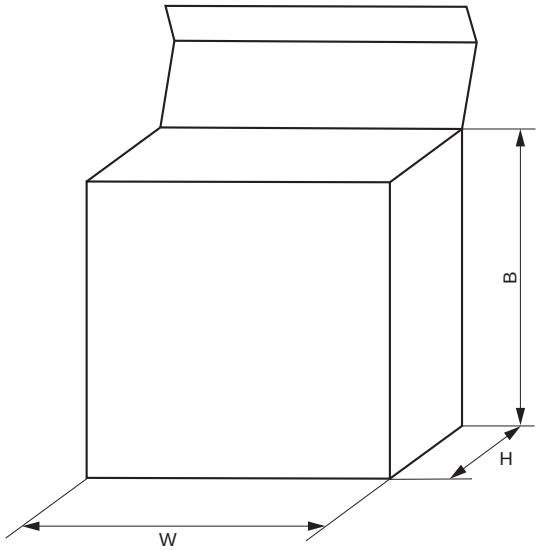



| Type | 10V | 12V | 14V |
|---|---|---|---|
| Height (H Max.) | 17.5 | 19.0 | 21.0 |
| Component Height (H1 Max.) | 35.0 | 36.0 | 38.0 |

## ◆TYPE TFB(T8)

| Parameter | Code | Dimensions (mm) | Note |
|---|---|---|---|
| Diameter of component | D | — | Refer to the applicable detail spec (14V : 15.0 Max.) |
| Thickness of component | T | — | Refer to the applicable detail spec |
| Lead diameter | ϕd | 0.8±0.05 | |
| Pitch of component | P | 15.0±1.0 | 14SE : 30.0±1.0 mm |
| Feed hole pitch | P0 | 15.0±0.3 | Cumulative pitch error : ±1 mm/20 pitches |
| Feed hole diameter | ϕD0 | 4.0±0.2 | |
| Feed hole center to lead | P1 | 3.75±0.5 | Measured at the upper end of tape |
| Feed hole center to component center | P2 | 7.5±1.3 | |
| Feed hole position | W1 | 9.0±0.5 | |
| Lead spacing | F0 | 7.5±0.8 | |
| | F1 | 5.0 Nom. | |
| Deviation across tape | Δh | 0±2.0 | |
| Deviation along tape | ΔP | 0±1.3 | |
| Carrier tape width | W | $18.0^{+1.0}_{-0.5}$ | |
| Hold down tape width | W0 | 5.0 Min. | |
| Tape thickness | t1 | 0.6±0.3 | |
| Total tape thickness | t2 | 1.5 Max. | |
| Hold down tape position | W2 | 3.0 Max. | |
| Seating plane height | H | — | 10V ; 17.5 Max. 14V ; 21.0 Max. |
| | H0 | 16.0±1.0 | |
| Component height | H1 | — | Please refer to above list |
| Lead position | J | 6.0 Max. | |

## ◆Packaging

| | Box | | | |
|---|---|---|---|---|
| Configuration |  | | | |
| Dimensions (mm) | | TFA, TBA (T15, T25) | TEA, TFA, TAA, TBA (T1, T15, T2, T25) | TFB, TBB, TLB (T8, T7, T71) |
| | | 5V, 7V, 9V, 9H, 5SV, 7SV | 10V, 12V, 14V, 12H, 15H | 10V, 12V, 10SV, 12SV, 14SV |
| | W | 325±5 | 330±5 | 340 max. |
| | H | 47±3 | 57±3 | 65 max. |
| | B | 280±10 | 315±10 | 360 max. |

## ◆Others

1) On the box, the following are noted.
   1. Part number
   2. Lot number
   3. Quantity
   4. Country of origin
2) Minimum order quantity shall be the packaging quantity per one box one reel.

## Minimum Packaging Quantity

**Please order by units of minimum packaging quantity.**

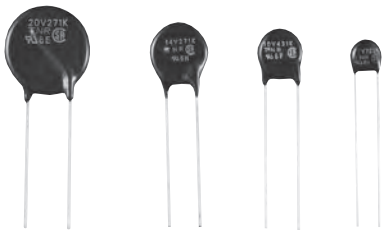
### ◆Disk Type

| Series | Type | Varistor Voltage Range (V) | Taping Type | | Bulk Type | |
|---|---|---|---|---|---|---|
| | | | Feed hole pitch (mm) | (pcs) | Straight Lead (pcs/bag) | Formed/Cut Lead (pcs/bag) |
| V | 5V, 7V | 15 to 270 | 12.7 | 1,500 | 3,000 | 5,000 |
| | | 330 to 620 | 12.7 | 1,000 | 3,000 | 5,000 |
| | 9V | 15 to 270 | 12.7 | 1,500 | 2,000 | 5,000 |
| | | 330 to 620 | 12.7 | 1,000 | 2,000 | 5,000 |
| | 10V | 18 to 270 | 12.7 | 800 | 1,500 | 2,500 |
| | | | 15.0 | 1,000 | | |
| | | 330 to 390 | 12.7 | 500 | 1,500 | 2,500 |
| | | | 15.0 | 1,000 | | |
| | | 430 to 620 | 12.7 | 500 | 1,000 | 2,500 |
| | | | 15.0 | 1,000 | | |
| | | 680 to 750 | – | – | 1,000 | 2,500 |
| | | 820 to 1000 | – | – | 1,000 | 2,000 |
| | | 1100 to 1800 | – | – | 500 | 1,000 |
| | 12V | 430 to 620 | 12.7 | 500 | 1,000 | 2,500 |
| | | | 15.0 | 1,000 | | |
| | | 680 to 750 | – | – | 1,000 | 2,500 |
| | | 820 to 1000 | – | – | 1,000 | 2,000 |
| | | 1100 to 1800 | – | – | 500 | 500 |
| | 14V | 18 to 270 | 12.7 | 800 | 1,500 | 2,000 |
| | | | 15.0 | 1,000 | | |
| | | 330 to 390 | 12.7 | 500 | 1,500 | 2,000 |
| | | | 15.0 | 1,000 | | |
| | | 430 to 620 | 12.7 | 500 | 1,000 | 2,000 |
| | | | 15.0 | 1,000 | | |
| | | 680 to 750 | – | – | 1,000 | 2,000 |
| | | 820 to 1000 | – | – | 1,000 | 1,500 |
| | | 1100 to 1200 | – | – | 500 | 500 |
| | | 1500 to 1800 | – | – | 500 | 500 |
| | 20V | 18 to 430 | – | – | 700 | 1,000 |
| | | 470 to 620 | – | – | 500 | 1,000 |
| | | 680 to 1100 | – | – | 500 | 500 |
| | | 1200 | – | – | 500 | 500 |
| | | 1500 to 1800 | – | – | 200 | 500 |
| SV | 5SV | 220 to 470 | 12.7 | 1,500 | 3,000 | 5,000 |
| | 7SV | 220 to 270 | 12.7 | 1,500 | 3,000 | 5,000 |
| | | 390 to 510 | | 1,000 | | |
| | 10SV | 220 to 680 | 15.0 | 500 | – | – |
| | | 750 to 1000 | – | – | 1,000 | – |
| | 12SV | 430 to 680 | 15.0 | 500 | – | – |
| | | 750 to 1000 | – | – | 1,000 | – |
| | 14SV | 220 to 680 | 15.0 | 300 | – | – |
| | | 750 to 1000 | – | – | 1,000 | – |
| | 20SV | 220 to 390 | – | – | 700 | 700 |
| | | 430 to 1000 | – | – | 500 | 500 |
| SV (22 to 68V) | 5SV | 22 to 68 | 12.7 | 1,500 | – | – |
| | 7SV | 22 to 68 | 12.7 | 1,500 | – | – |
| | 10SV | 22 to 68 | 12.7 | 800 | – | – |
| | 14SV | 22 to 68 | 12.7 | 800 | – | – |
| | 20SV | 22 to 68 | – | – | 700 | 700 |
| H | 9H | 22 to 47 | 12.7 | 1,500 | 3,000 | 5,000 |
| | 12H | 22 to 47 | 12.7 | 800 | 1,500 | 2,500 |
| | 15H | 22 to 47 | 12.7 | 800 | 1,500 | 2,000 |
| | 23H | 22 to 47 | – | – | 700 | 1,000 |
| GF | 15GF | All Voltage range | – | – | 800 | – |
| | 23GF | 270 to 470 | – | – | 500 | – |
| | | 820 | – | – | 400 | – |

# Metal Oxide Varistors TNR™
# Disk Type

# V Series

RoHS2 Compliant



## ◆FEATURES

- ●Excellent voltage non-linear coefficient.
  Low clamping voltage.
- ●Symmetrical V-I characteristics (No polarity).
- ●Fast response.
- ●Stable characteristics against repeated surges.
- ●Superior temperature characteristics.
- ●High reliability
- ●UL, CSA and VDE recognized components
  UL 1449 3rd File : E323623
  CSA File : LR97864
  VDE File : 118623
- ●Coating resin : UL94V-0

## ◆APPLICATIONS

- ●Protection for semiconductors from over voltage.
- ●Protection for electronic instruments from lightning surges.
- ●Absorption of on-off surges from motors and relays.

Operating Temperature Range: -40 to +85℃
Storage Temperature Range: -50 to +125℃

## ◆PART NUMBERING SYSTEM

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | | | V | – | | | | K | B | | | | | | |

- Design Code
- Lead Forming / Taping
- Packing Style⑦
- Varistor Volt. Tolerance⑥
- Varistor Voltage⑤
- Series④
- Element Diameter③
- Product Form②
- Category①

| ①Category | |
|---|---|
| T | Metal Oxide Varistors TNR |

| ②Product Form | |
|---|---|
| ND | Disk Type |

| ③Element Diameter | |
|---|---|
| 05 | ϕ 5 mm |
| 07 | ϕ 7 mm |
| 09 | ϕ 9 mm |
| 10 | ϕ10 mm |
| 12 | ϕ12 mm |
| 14 | ϕ14 mm |
| 20 | ϕ20 mm |

| ④Series | |
|---|---|
| V– | V Series |

| ⑤Varistor Voltage |
|---|
| The first two digits are significant figures and the third one denotes the number of following zeros. |

| ⑥Varistor Volt. Tolerance | |
|---|---|
| K | ±10% |

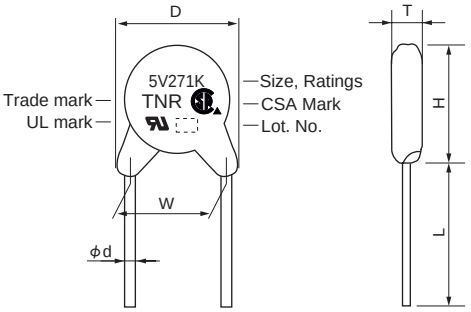
| ⑦Packing Style | |
|---|---|
| B | Bulk |
| T | Taping |

# V Series

## ◆STANDARD RATINGS (Type 5V)

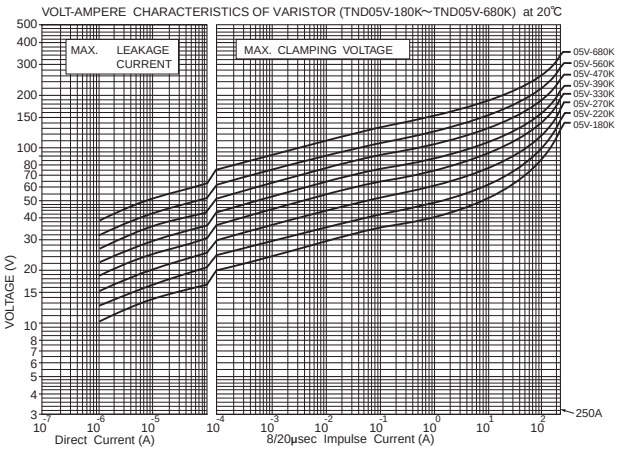
| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V0.1mA | T Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) |
| TND05V-180KB00AAA0 | TNR5V180K | 11 | 14 | 250A/1 time<br>125A/2 times | 0.4 | 0.01 | 1 | 40 | 2540 | 18 ( 16～ 20) | 4.5 |
| TND05V-220KB00AAA0 | TNR5V220K | 14 | 18 | | 0.5 | | | 48 | 2090 | 22 ( 20～ 24) | |
| TND05V-270KB00AAA0 | TNR5V270K | 17 | 22 | | 0.7 | | | 60 | 1790 | 27 ( 24～ 30) | |
| TND05V-330KB00AAA0 | TNR5V330K | 20 | 26 | | 0.8 | | | 73 | 1480 | 33 ( 30～ 36) | |
| TND05V-390KB00AAA0 | TNR5V390K | 25 | 30 | | 0.9 | | | 86 | 1310 | 39 ( 35～ 43) | |
| TND05V-470KB00AAA0 | TNR5V470K | 30 | 37 | | 1.1 | | | 104 | 1140 | 47 ( 42～ 52) | |
| TND05V-560KB00AAA0 | TNR5V560K | 35 | 44 | | 1.3 | | | 123 | 1000 | 56 ( 50～ 62) | |
| TND05V-680KB00AAA0 | TNR5V680K | 40 | 55 | | 1.6 | | | 150 | 870 | 68 ( 61～ 75) | |
| TND05V-820KB00AAA0 | TNR5V820K | 50 | 65 | 800A/1 time<br>600A/2 times | 2.5 | 0.1 | 5 | 145 | 400 | 82 ( 74～ 90) | 4.1 |
| TND05V-101KB00AAA0 | TNR5V101K | 60 | 85 | | 3 | | | 175 | 350 | 100 ( 90～110) | 4.3 |
| TND05V-121KB00AAA0 | TNR5V121K | 75 | 100 | | 3.5 | | | 210 | 310 | 120 (108～132) | 4.5 |
| TND05V-151KB00AAA0 | TNR5V151K | 95 | 125 | | 4.5 | | | 260 | 270 | 150 (135～165) | 4.8 |
| TND05V-181KB00AAA0 | TNR5V181K | 110 | 145 | | 5 | | | 325 | 190 | 180 (162～198) | 4.3 |
| TND05V-201KB00AAA0 | TNR5V201K | 130 | 170 | | 6 | | | 355 | 110 | 200 (185～225) | 4.4 |
| TND05V-221KB00AAA0 | TNR5V221K | 140 | 180 | | 6.5 | | | 380 | 110 | 220 (198～242) | 4.5 |
| TND05V-241KB00AAA0 | TNR5V241K | 150 | 200 | | 7.5 | | | 415 | 100 | 240 (216～264) | 4.6 |
| TND05V-271KB00AAA0 | TNR5V271K | 175 | 225 | | 8 | | | 475 | 90 | 270 (247～303) | 4.8 |
| TND05V-331KB00AAA0 | TNR5V331K | 210 | 270 | | 9.5 | | | 570 | 80 | 330 (297～363) | 5.1 |
| TND05V-361KB00AAA0 | TNR5V361K | 230 | 300 | | 11 | | | 620 | 80 | 360 (324～396) | 5.3 |
| TND05V-391KB00AAA0 | TNR5V391K | 250 | 320 | | 12 | | | 675 | 70 | 390 (351～429) | 5.4 |
| TND05V-431KB00AAA0 | TNR5V431K | 275 | 350 | | 13.5 | | | 745 | 70 | 430 (387～473) | 5.6 |
| TND05V-471KB00AAA0 | TNR5V471K | 300 | 385 | | 15 | | | 810 | 60 | 470 (423～517) | 5.8 |

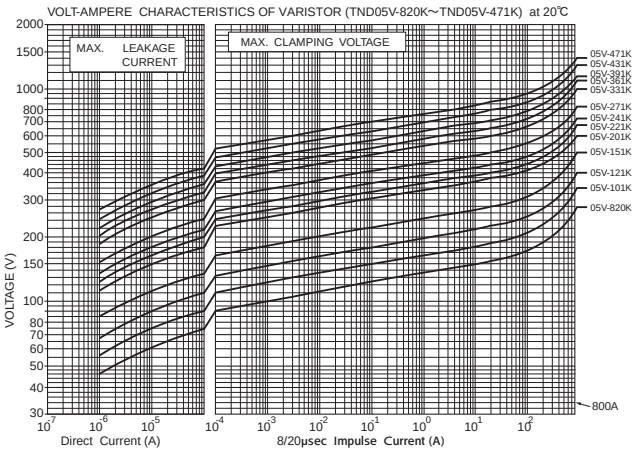
## ◆DIMENSIONS [mm]




| D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|
| 7.5 | 10.0 | Ref. to RATINGS | 20.0 | 0.6 | 5.0 |

## ◆V-I CURVE



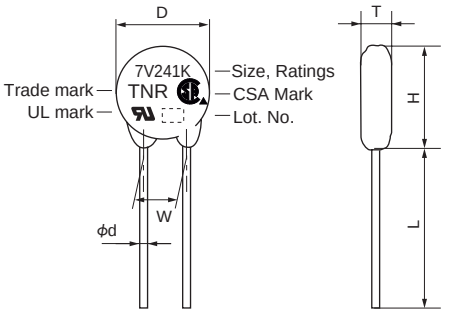



# V Series

## ◆STANDARD RATINGS (Type 7V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA | T Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) |
| TND07V-150KB00AAA0 | TNR7V150K | 8 | 12 | | 0.7 | | | 30 | 4600 | 15 ( 13～ 17) | 4.5 |
| TND07V-180KB00AAA0 | TNR7V180K | 11 | 14 | | 0.9 | | | 36 | 3800 | 18 ( 16～ 20) | 4.5 |
| TND07V-220KB00AAA0 | TNR7V220K | 14 | 18 | | 1.1 | | | 43 | 3200 | 22 ( 20～ 24) | 4.6 |
| TND07V-270KB00AAA0 | TNR7V270K | 17 | 22 | 500A/1 time | 1.3 | | | 53 | 2800 | 27 ( 24～ 30) | 4.7 |
| TND07V-330KB00AAA0 | TNR7V330K | 20 | 26 | | 1.6 | 0.02 | 2.5 | 65 | 2300 | 33 ( 30～ 36) | 4.9 |
| TND07V-390KB00AAA0 | TNR7V390K | 25 | 30 | 250A/2 times | 1.9 | | | 77 | 2100 | 39 ( 35～ 43) | 4.8 |
| TND07V-470KB00AAA0 | TNR7V470K | 30 | 37 | | 2.3 | | | 93 | 1900 | 47 ( 42～ 52) | 4.9 |
| TND07V-560KB00AAA0 | TNR7V560K | 35 | 44 | | 2.7 | | | 110 | 1700 | 56 ( 50～ 62) | 5.0 |
| TND07V-680KB00AAA0 | TNR7V680K | 40 | 55 | | 3.3 | | | 135 | 1500 | 68 ( 61～ 75) | 5.2 |
| TND07V-820KB00AAA0 | TNR7V820K | 50 | 65 | | 5 | | | 135 | 800 | 82 ( 74～ 90) | 4.1 |
| TND07V-101KB00AAA0 | TNR7V101K | 60 | 85 | | 6 | | | 165 | 700 | 100 ( 90～110) | 4.3 |
| TND07V-121KB00AAA0 | TNR7V121K | 75 | 100 | | 7 | | | 200 | 650 | 120 (108～132) | 4.5 |
| TND07V-151KB00AAA0 | TNR7V151K | 95 | 125 | | 9 | | | 250 | 600 | 150 (135～165) | 4.8 |
| TND07V-181KB00AAA0 | TNR7V181K | 110 | 145 | | 11 | | | 300 | 430 | 180 (162～198) | 4.3 |
| TND07V-201KB00AAA0 | TNR7V201K | 130 | 170 | | 12.5 | | | 340 | 250 | 200 (185～225) | 4.4 |
| TND07V-221KB00AAA0 | TNR7V221K | 140 | 180 | 1750A/1 time | 13.5 | | | 360 | 230 | 220 (198～242) | 4.5 |
| TND07V-241KB00AAA0 | TNR7V241K | 150 | 200 | | 15 | 0.25 | 10 | 395 | 210 | 240 (216～264) | 4.6 |
| TND07V-271KB00AAA0 | TNR7V271K | 175 | 225 | 1250A/2 times | 17 | | | 455 | 190 | 270 (247～303) | 4.8 |
| TND07V-331KB00AAA0 | TNR7V331K | 210 | 270 | | 20 | | | 545 | 160 | 330 (297～363) | 5.1 |
| TND07V-361KB00AAA0 | TNR7V361K | 230 | 300 | | 23 | | | 595 | 150 | 360 (324～396) | 5.3 |
| TND07V-391KB00AAA0 | TNR7V391K | 250 | 320 | | 25 | | | 650 | 140 | 390 (351～429) | 5.4 |
| TND07V-431KB00AAA0 | TNR7V431K | 275 | 350 | | 27.5 | | | 710 | 130 | 430 (387～473) | 5.6 |
| TND07V-471KB00AAA0 | TNR7V471K | 300 | 385 | | 30 | | | 775 | 120 | 470 (423～517) | 5.8 |
| TND07V-511KB00AAA0 | TNR7V511K | 320 | 410 | | 32 | | | 845 | 110 | 510 (459～561) | 6.0 |

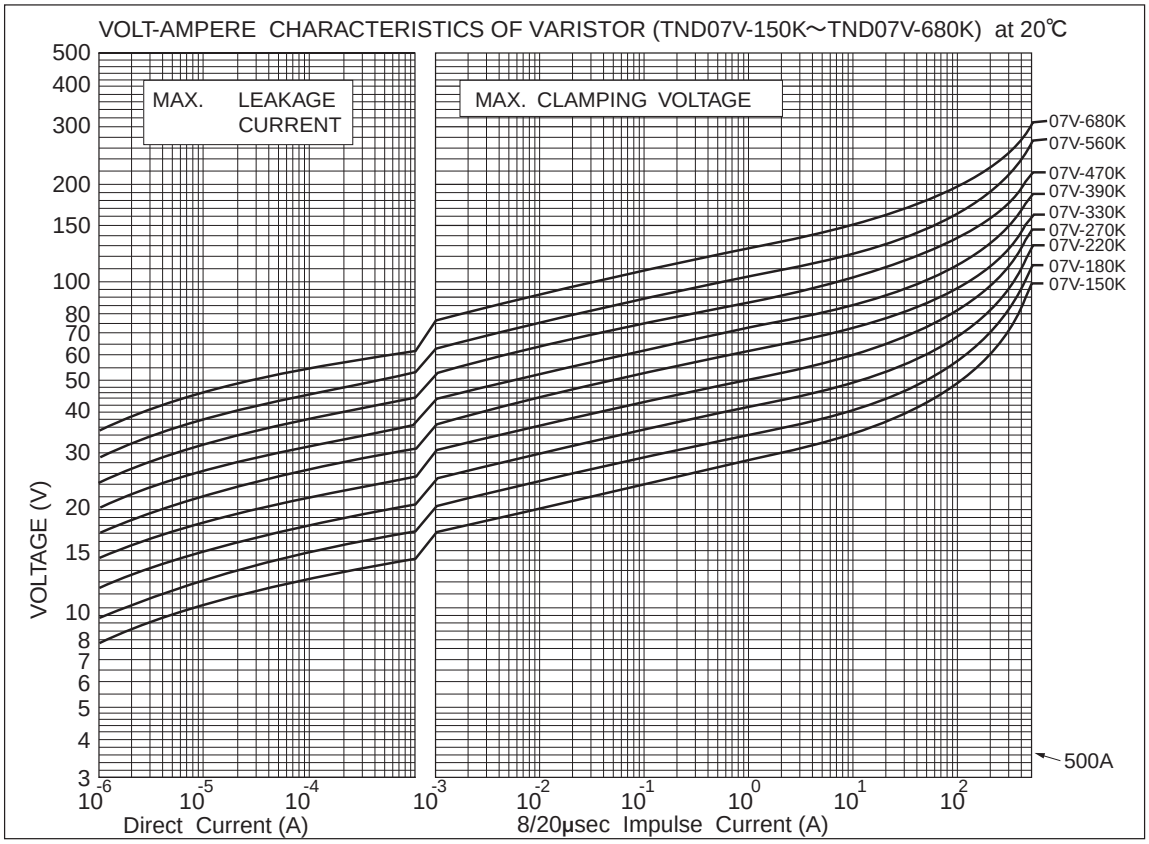
## ◆DIMENSIONS [mm]

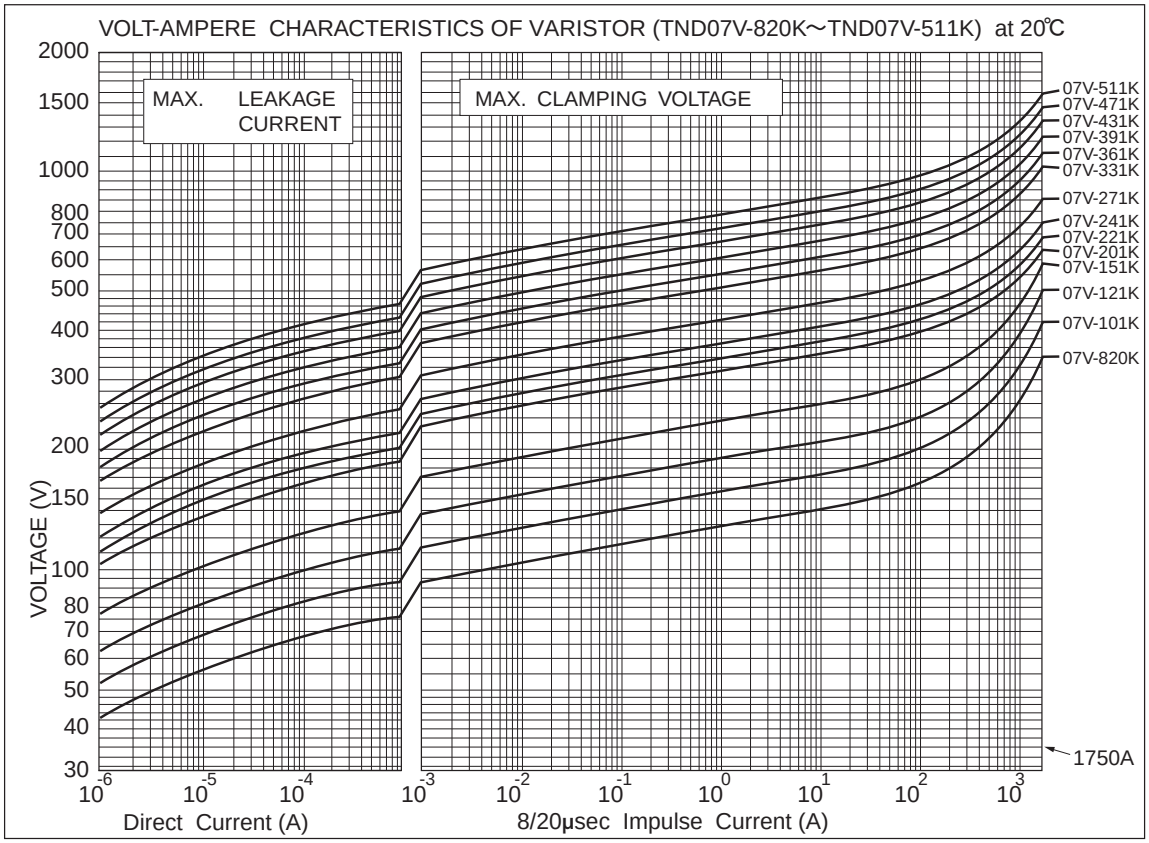



| D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|
| 8.5 | 11.5 | Ref. to RATINGS | 20.0 | 0.6 | 5.0 |

# V Series

## ◆V-I CURVE (Type 7V)



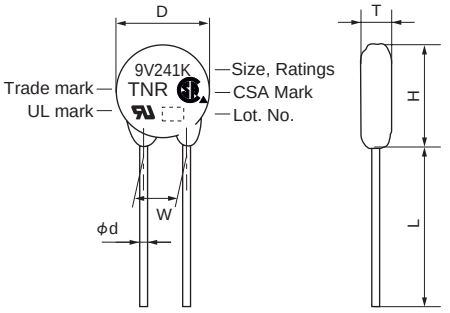



# V Series

## ◆RATINGS (Type 9V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA | T Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) |
| TND09V-150KB00AAA0 | TNR9V150K | 8 | 12 | | 2.0 | | | 30 | 9600 | 15 ( 13～ 17) | 3.8 |
| TND09V-180KB00AAA0 | TNR9V180K | 11 | 14 | | 2.2 | | | 36 | 8000 | 18 ( 16～ 20) | 3.8 |
| TND09V-220KB00AAA0 | TNR9V220K | 14 | 18 | | 2.6 | | | 43 | 7000 | 22 ( 20～ 24) | 4.0 |
| TND09V-270KB00AAA0 | TNR9V270K | 17 | 22 | 800A/1 time | 3.2 | | | 53 | 6000 | 27 ( 24～ 30) | 4.2 |
| TND09V-330KB00AAA0 | TNR9V330K | 20 | 26 | | 4.0 | 0.02 | 5 | 65 | 5000 | 33 ( 30～ 36) | 4.5 |
| TND09V-390KB00AAA0 | TNR9V390K | 25 | 30 | 400A/2 times | 4.7 | | | 77 | 4500 | 39 ( 35～ 43) | 4.0 |
| TND09V-470KB00AAA0 | TNR9V470K | 30 | 37 | | 5.6 | | | 93 | 4000 | 47 ( 42～ 52) | 4.2 |
| TND09V-560KB00AAA0 | TNR9V560K | 35 | 44 | | 6.7 | | | 110 | 3500 | 56 ( 50～ 62) | 4.4 |
| TND09V-680KB00AAA0 | TNR9V680K | 40 | 55 | | 8.2 | | | 135 | 3200 | 68 ( 61～ 75) | 4.5 |
| TND09V-820KB00AAA0 | TNR9V820K | 50 | 65 | | 10 | | | 135 | 1700 | 82 ( 74～ 90) | 3.8 |
| TND09V-101KB00AAA0 | TNR9V101K | 60 | 85 | | 12 | | | 165 | 1600 | 100 ( 90～110) | 3.9 |
| TND09V-121KB00AAA0 | TNR9V121K | 75 | 100 | | 14.5 | | | 200 | 1400 | 120 (108～132) | 4.1 |
| TND09V-151KB00AAA0 | TNR9V151K | 95 | 125 | | 18 | | | 250 | 1300 | 150 (135～165) | 4.4 |
| TND09V-181KB00AAA0 | TNR9V181K | 110 | 145 | | 22 | | | 300 | 900 | 180 (162～198) | 4.0 |
| TND09V-201KB00AAA0 | TNR9V201K | 130 | 170 | | 25 | | | 340 | 500 | 200 (185～225) | 4.1 |
| TND09V-221KB00AAA0 | TNR9V221K | 140 | 180 | 3000A/1 time | 27.5 | | | 360 | 450 | 220 (198～242) | 4.2 |
| TND09V-241KB00AAA0 | TNR9V241K | 150 | 200 | | 30 | 0.25 | 25 | 395 | 400 | 240 (216～264) | 4.3 |
| TND09V-271KB00AAA0 | TNR9V271K | 175 | 225 | 2000A/2 times | 35 | | | 455 | 350 | 270 (247～303) | 4.5 |
| TND09V-331KB00AAA0 | TNR9V331K | 210 | 270 | | 42 | | | 545 | 300 | 330 (297～363) | 4.8 |
| TND09V-361KB00AAA0 | TNR9V361K | 230 | 300 | | 45 | | | 595 | 280 | 360 (324～396) | 5.0 |
| TND09V-391KB00AAA0 | TNR9V391K | 250 | 320 | | 50 | | | 650 | 260 | 390 (351～429) | 5.1 |
| TND09V-431KB00AAA0 | TNR9V431K | 275 | 350 | | 55 | | | 710 | 240 | 430 (387～473) | 5.3 |
| TND09V-471KB00AAA0 | TNR9V471K | 300 | 385 | | 60 | | | 775 | 220 | 470 (423～517) | 5.6 |
| TND09V-511KB00AAA0 | TNR9V511K | 320 | 410 | | 67 | | | 845 | 210 | 510 (459～561) | 5.8 |

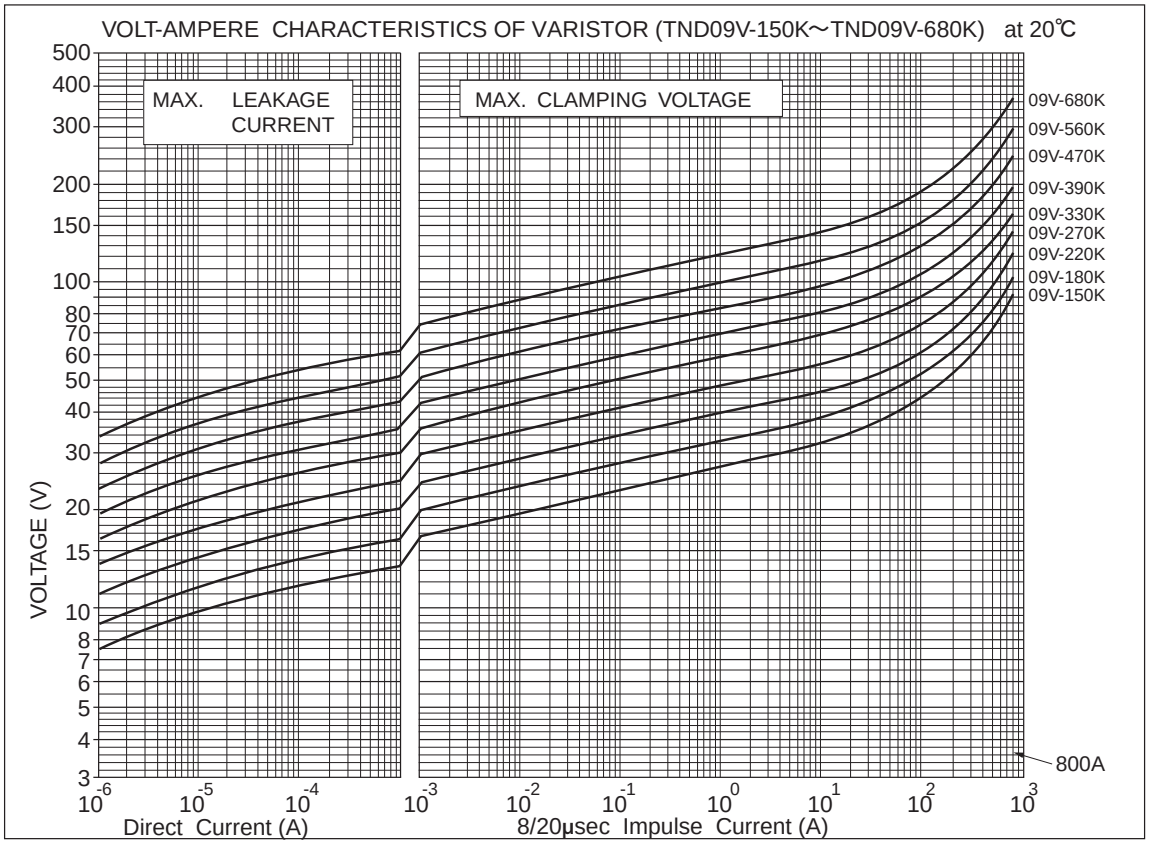
## ◆DIMENSIONS [mm]

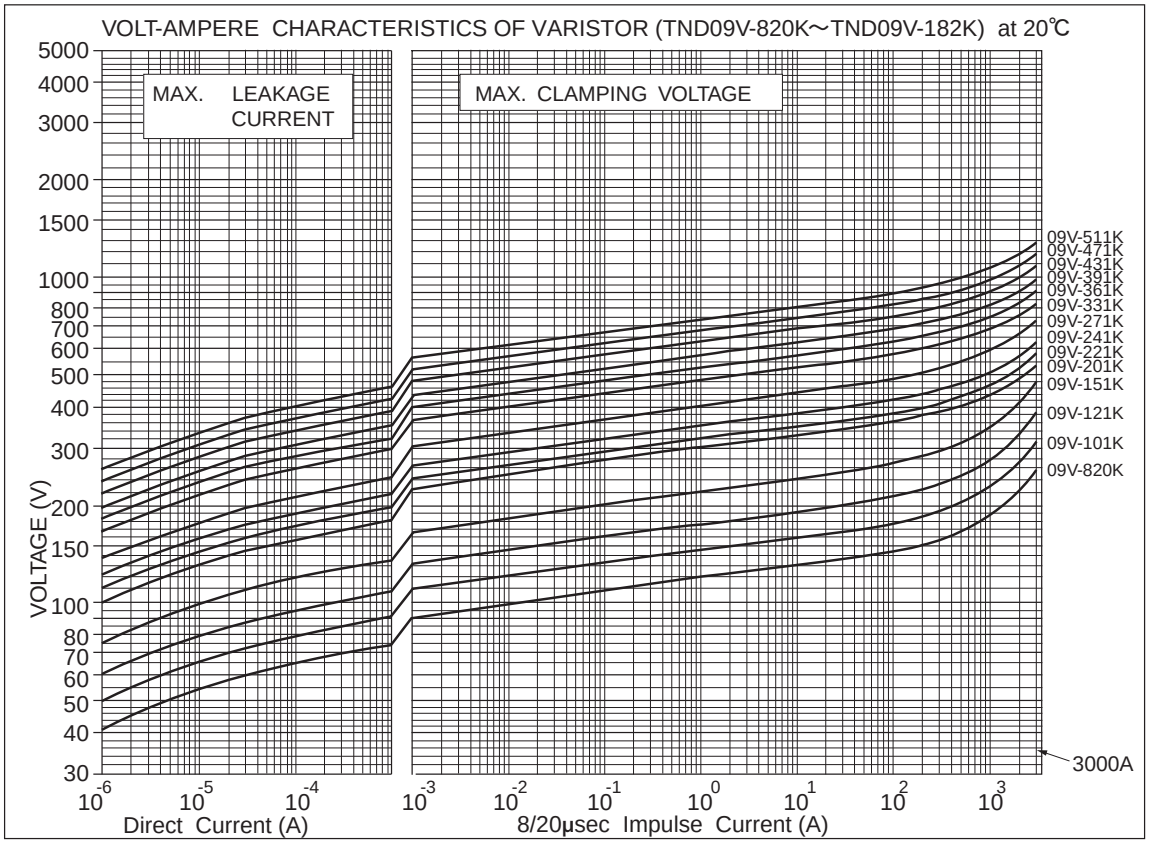



| D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|
| 11.5 | 14.5 | Ref. to RATINGS | 20.0 | 0.6 | 5.0 |

# V Series

## ◆V-I CURVE (Type 9V)



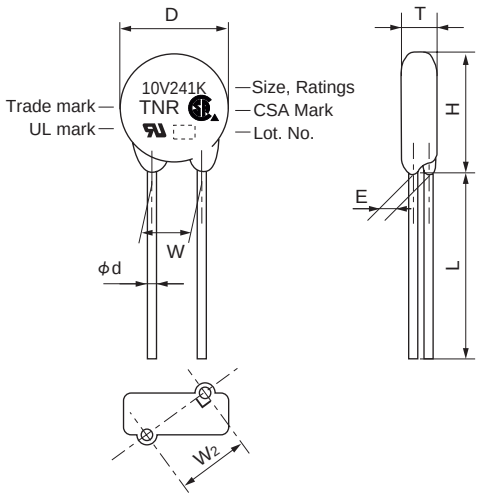
# V Series

## ◆RATINGS (Type 10V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage $V_{1mA}$ | T Max. | E ±1.0 | W2 reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) | (mm) | (mm) |
| TND10V-150KB00AAA0 | TNR10V150K | 8 | 12 | | 2.0 | | | 30 | 9600 | 15 ( 13～ 17) | 4.5 | 1.0 | 7.6 |
| TND10V-180KB00AAA0 | TNR10V180K | 11 | 14 | | 2.2 | | | 36 | 8000 | 18 ( 16～ 20) | 4.6 | 1.1 | 7.6 |
| TND10V-220KB00AAA0 | TNR10V220K | 14 | 18 | | 2.6 | | | 43 | 7000 | 22 ( 20～ 24) | 4.7 | 1.2 | 7.6 |
| TND10V-270KB00AAA0 | TNR10V270K | 17 | 22 | 1000A/1 time | 3.2 | | | 53 | 6000 | 27 ( 24～ 30) | 4.8 | 1.3 | 7.6 |
| TND10V-330KB00AAA0 | TNR10V330K | 20 | 26 | | 4.0 | 0.05 | 5 | 65 | 5000 | 33 ( 30～ 36) | 5.0 | 1.5 | 7.6 |
| TND10V-390KB00AAA0 | TNR10V390K | 25 | 30 | 500A/2 times | 4.7 | | | 77 | 4500 | 39 ( 35～ 43) | 4.9 | 1.3 | 7.6 |
| TND10V-470KB00AAA0 | TNR10V470K | 30 | 37 | | 5.6 | | | 93 | 4000 | 47 ( 42～ 52) | 5.0 | 1.4 | 7.6 |
| TND10V-560KB00AAA0 | TNR10V560K | 35 | 44 | | 6.7 | | | 110 | 3500 | 56 ( 50～ 62) | 5.1 | 1.6 | 7.7 |
| TND10V-680KB00AAA0 | TNR10V680K | 40 | 55 | | 8.2 | | | 135 | 3200 | 68 ( 61～ 75) | 5.3 | 1.8 | 7.7 |
| TND10V-820KB00AAA0 | TNR10V820K | 50 | 65 | | 10 | | | 135 | 1700 | 82 ( 74～ 90) | 4.5 | 1.1 | 7.6 |
| TND10V-101KB00AAA0 | TNR10V101K | 60 | 85 | | 12 | | | 165 | 1600 | 100 ( 90～ 110) | 4.7 | 1.3 | 7.6 |
| TND10V-121KB00AAA0 | TNR10V121K | 75 | 100 | | 14.5 | | | 200 | 1400 | 120 ( 108～ 132) | 4.9 | 1.4 | 7.6 |
| TND10V-151KB00AAA0 | TNR10V151K | 95 | 125 | | 18 | | | 250 | 1300 | 150 ( 135～ 165) | 5.2 | 1.7 | 7.7 |
| TND10V-181KB00AAA0 | TNR10V181K | 110 | 145 | | 22 | | | 300 | 900 | 180 ( 162～ 198) | 4.7 | 1.1 | 7.6 |
| TND10V-201KB00AAA0 | TNR10V201K | 130 | 170 | | 25 | | | 340 | 500 | 200 ( 185～ 225) | 4.8 | 1.2 | 7.6 |
| TND10V-221KB00AAA0 | TNR10V221K | 140 | 180 | | 27.5 | | | 360 | 450 | 220 ( 198～ 242) | 4.9 | 1.3 | 7.6 |
| TND10V-241KB00AAA0 | TNR10V241K | 150 | 200 | | 30 | | | 395 | 400 | 240 ( 216～ 264) | 5.0 | 1.3 | 7.6 |
| TND10V-271KB00AAA0 | TNR10V271K | 175 | 225 | | 35 | | | 455 | 350 | 270 ( 247～ 303) | 5.2 | 1.4 | 7.6 |
| TND10V-331KB00AAA0 | TNR10V331K | 210 | 270 | | 42 | | | 545 | 300 | 330 ( 297～ 363) | 5.5 | 1.6 | 7.7 |
| TND10V-361KB00AAA0 | TNR10V361K | 230 | 300 | | 45 | | | 595 | 280 | 360 ( 324～ 396) | 5.7 | 1.8 | 7.7 |
| TND10V-391KB00AAA0 | TNR10V391K | 250 | 320 | 3500A/1 time | 50 | | | 650 | 260 | 390 ( 351～ 429) | 5.8 | 1.9 | 7.7 |
| TND10V-431KB00AAA0 | TNR10V431K | 275 | 350 | | 55 | 0.4 | 25 | 710 | 240 | 430 ( 387～ 473) | 6.0 | 2.0 | 7.8 |
| TND10V-471KB00A◇A0 | TNR10V471K□ | 300 | 385 | 2500A/2 times | 60 | | | 775 | 220 | 470 ( 423～ 517) | 6.2 | 2.1 | 7.8 |
| TND10V-511KB00A◇A0 | TNR10V511K□ | 320 | 410 | | 67 | | | 845 | 210 | 510 ( 459～ 561) | 6.4 | 2.3 | 7.8 |
| TND10V-561KB00A◇A0 | TNR10V561K□ | 350 | 460 | | 67 | | | 922 | 195 | 560 ( 504～ 616) | 6.7 | 2.5 | 7.9 |
| TND10V-621KB00A◇A0 | TNR10V621K□ | 385 | 505 | | 67 | | | 1025 | 180 | 620 ( 558～ 682) | 7.1 | 2.7 | 8.0 |
| TND10V-681KB00A◇A0 | TNR10V681K□ | 420 | 560 | | 67 | | | 1120 | 165 | 680 ( 612～ 748) | 7.4 | 2.9 | 8.0 |
| TND10V-751KB00A◇A0 | TNR10V751K□ | 460 | 615 | | 70 | | | 1240 | 150 | 750 ( 675～ 825) | 7.8 | 3.1 | 8.1 |
| TND10V-821KB00A◇A0 | TNR10V821K□ | 510 | 670 | | 80 | | | 1355 | 140 | 820 ( 738～ 902) | 8.1 | 3.4 | 8.2 |
| TND10V-911KB00A◇A0 | TNR10V911K□ | 550 | 745 | | 90 | | | 1500 | 125 | 910 ( 819～1001) | 8.6 | 3.7 | 8.4 |
| TND10V-102KB00A◇A0 | TNR10V102K□ | 625 | 825 | | 100 | | | 1650 | 115 | 1000 ( 900～1100) | 9.1 | 4.0 | 8.5 |
| TND10V-112KB00A◇A0 | TNR10V112K□ | 680 | 895 | | 110 | | | 1815 | 105 | 1100 ( 990～1210) | 9.7 | 4.4 | 8.7 |
| TND10V-122KB00A◇A0 | TNR10V122K□ | 720 | 980 | | 120 | | | 1950 | 95 | 1200 (1080～1320) | 10.5 | 4.7* | 8.9** |
| TND10V-152KB00A◇A0 | TNR10V152K□ | 860 | 1220 | | 150 | | | 2440 | 85 | 1500 (1350～1650) | 12.4 | 5.8* | 9.5** |
| TND10V-182KB00A◇A0 | TNR10V182K□ | 1000 | 1465 | | 183 | | | 2970 | 70 | 1800 (1700～1980) | 14.4 | 6.9* | 10.2** |

*E±2 **W2±2

## ◆DIMENSIONS [mm]




| | ◇ | □ |
|---|---|---|
| Standard | A | N/A |
| ϕ10 IEC 62368-1:2014 G.8.2 conforming product | S | S |

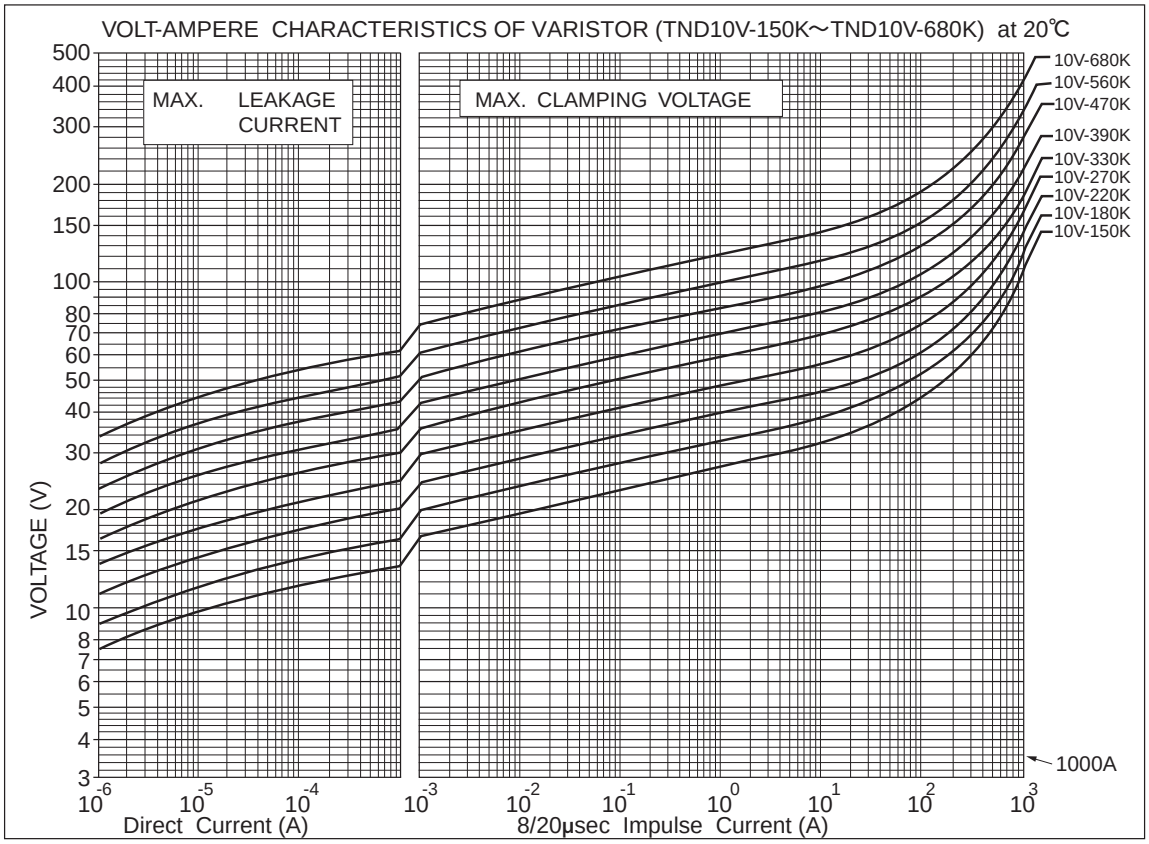
| Part Number | D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|---|
| TND10V-150K to TND10V-511K | 11.5 | 14.5 | Ref. to RATINGS | 20.0 | 0.8 | 7.5 |
| TND10V-561K to TND10V-112K | 12.5 | 15.5 | | | | |
| TND10V-122K to TND10V-182K | 13.5 | 16.5 | | | | |

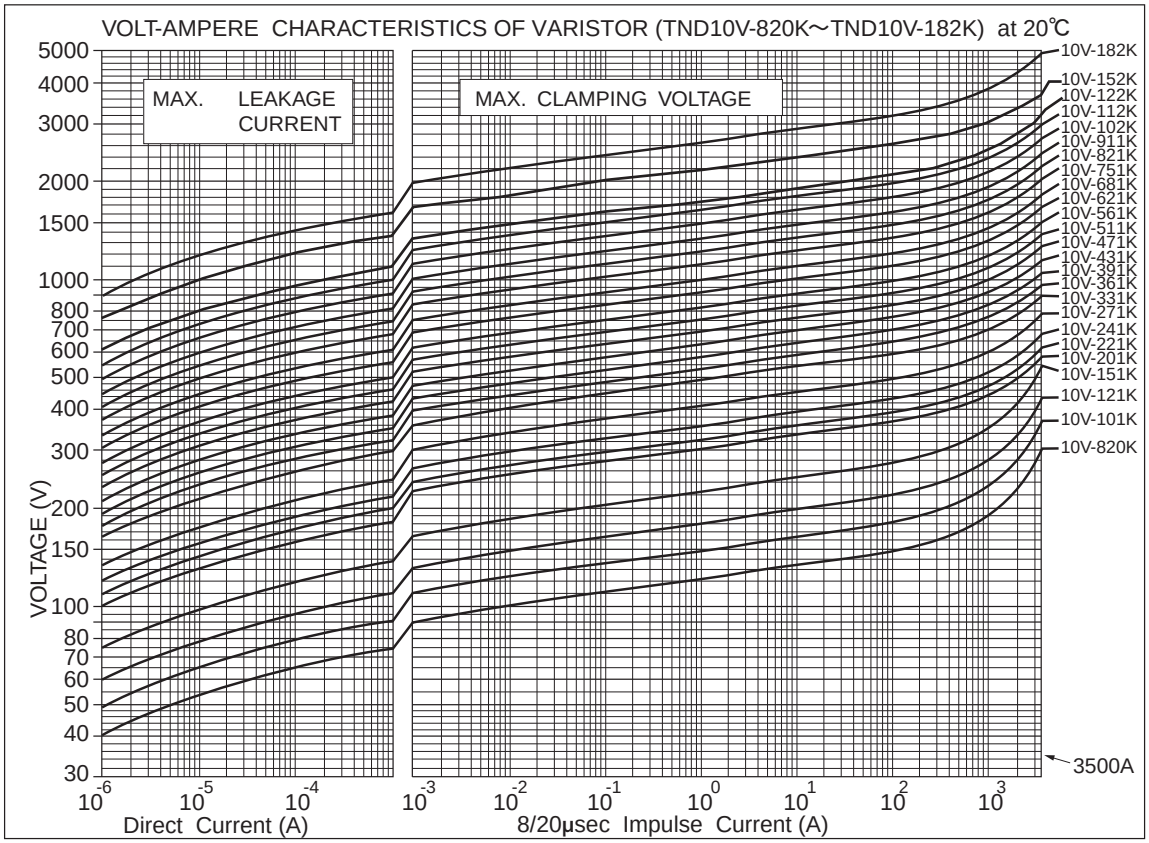
●Common to standard product and IEC 62368-1:2014 G.8.2 conforming product

●The product with less than 620V of varistor voltage, taping is possible.
Please refer to taping and forming specifications.
The lead type parallel to a straight prepares, too.

# V Series

## ◆V-I CURVE (Type 10V)



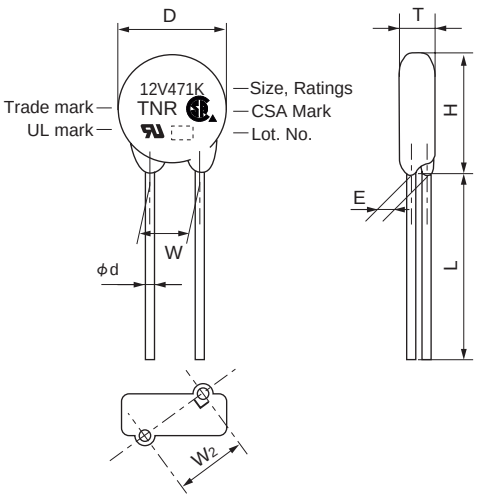
# V Series

## ◆RATINGS (Type 12V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage $V_{1mA}$ | T Max. | E ±1.0 | W2 reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) | (mm) | (mm) |
| TND12V-431KB00AAA0 | TNR12V431K | 275 | 350 | | 55 | | | 710 | 375 | 430 ( 387～ 473) | 6.0 | 2.0 | 7.8 |
| TND12V-471KB00AAA0 | TNR12V471K | 300 | 385 | | 60 | | | 775 | 345 | 470 ( 423～ 517) | 6.2 | 2.1 | 7.8 |
| TND12V-511KB00AAA0 | TNR12V511K | 320 | 410 | | 67 | | | 845 | 330 | 510 ( 459～ 561) | 6.4 | 2.3 | 7.8 |
| TND12V-561KB00AAA0 | TNR12V561K | 350 | 460 | | 67 | | | 922 | 305 | 560 ( 504～ 616) | 6.7 | 2.5 | 7.9 |
| TND12V-621KB00AAA0 | TNR12V621K | 385 | 505 | | 67 | | | 1025 | 280 | 620 ( 558～ 682) | 7.1 | 2.7 | 8.0 |
| TND12V-681KB00AAA0 | TNR12V681K | 420 | 560 | 4,200A/1 time | 67 | | | 1120 | 260 | 680 ( 612～ 748) | 7.4 | 2.9 | 8.0 |
| TND12V-751KB00AAA0 | TNR12V751K | 460 | 615 | | 70 | 0.4 | 25 | 1240 | 235 | 750 ( 675～ 825) | 7.8 | 3.1 | 8.1 |
| TND12V-821KB00AAA0 | TNR12V821K | 510 | 670 | 3,000A/2 times | 80 | | | 1355 | 220 | 820 ( 738～ 902) | 8.1 | 3.4 | 8.2 |
| TND12V-911KB00AAA0 | TNR12V911K | 550 | 745 | | 90 | | | 1500 | 195 | 910 ( 819～1001) | 8.6 | 3.7 | 8.4 |
| TND12V-102KB00AAA0 | TNR12V102K | 625 | 825 | | 100 | | | 1650 | 180 | 1000 ( 900～1100) | 9.1 | 4.0 | 8.5 |
| TND12V-112KB00AAA0 | TNR12V112K | 680 | 895 | | 110 | | | 1815 | 165 | 1100 ( 990～1210) | 9.7 | 4.4 | 8.7 |
| TND12V-122KB00AAA0 | TNR12V122K | 720 | 980 | | 120 | | | 1950 | 150 | 1200 (1080～1320) | 10.5 | 4.7* | 8.9** |
| TND12V-152KB00AAA0 | TNR12V152K | 860 | 1220 | | 150 | | | 2440 | 135 | 1500 (1350～1650) | 12.4 | 5.8* | 9.5** |
| TND12V-182KB00AAA0 | TNR12V182K | 1000 | 1465 | | 183 | | | 2970 | 110 | 1800 (1700～1980) | 14.4 | 6.9* | 10.2** |

*E±2 **W2±2

## ◆DIMENSIONS [mm]

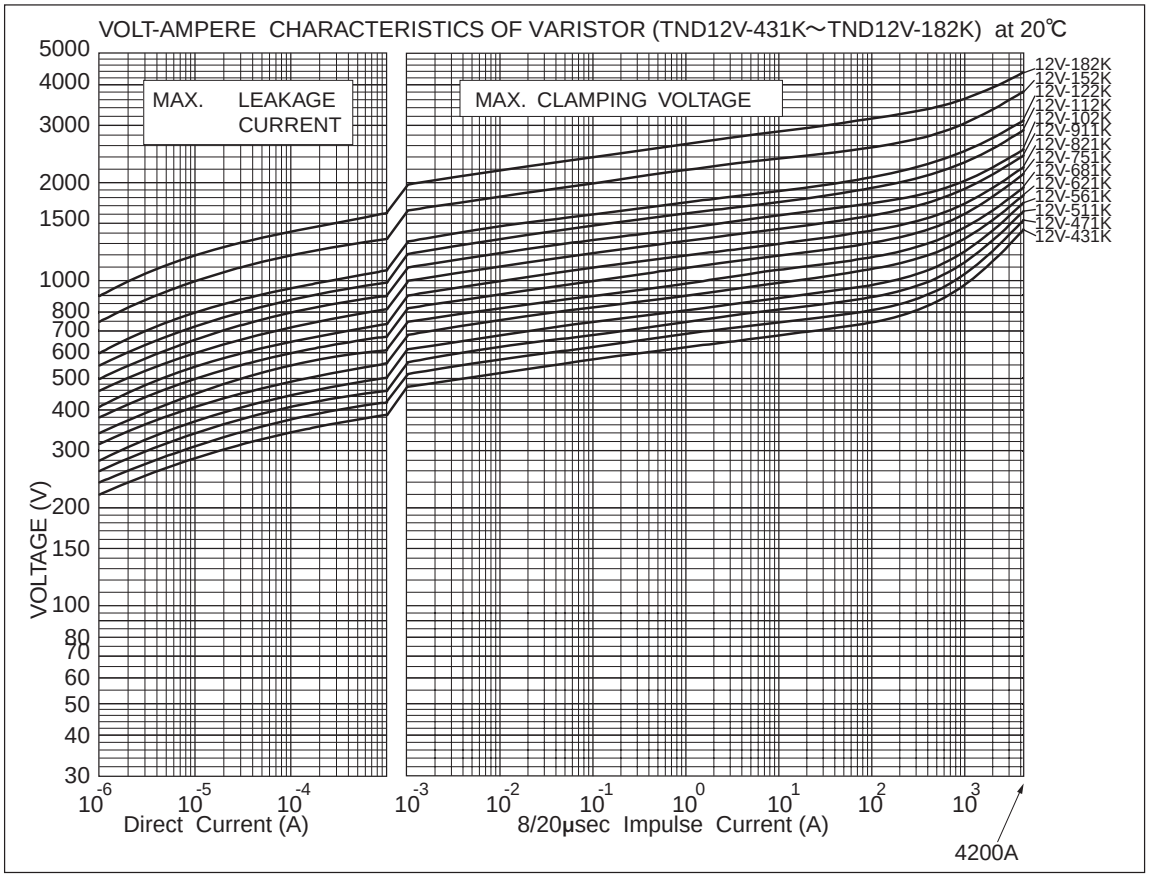



| Part Number | D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|---|
| TND12V-431K to TND12V-102K | 14.0 | 17.0 | Ref. to RATINGS | 20 | 0.8 | 7.5 |
| TND12V-112K | 15.0 | 18.0 | | | | |
| TND12V-122K | | | | | | |
| TND12V-152K to TND12V-182K | 16.0 | 19.0 | | | | |

●The product with less than 620V of varistor voltage, taping is possible.
Please refer to taping and forming specifications.
The lead type parallel to a straight prepares, too.

# V Series

## ◆V-I CURVE (Type 12V)



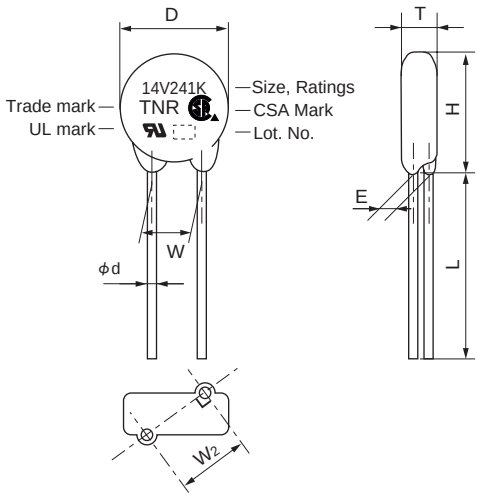
# V Series

## ◆RATINGS (Type 14V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA | T Max. | E ±1.0 | W2 Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) | (mm) | (mm) |
| TND14V-150KB00AAA0 | TNR14V150K | 8 | 12 | | 3.6 | | | 30 | 19500 | 15 ( 13～ 17) | 4.5 | 1.0 | 7.6 |
| TND14V-180KB00AAA0 | TNR14V180K | 11 | 14 | | 4.3 | | | 36 | 16500 | 18 ( 16～ 20) | 4.6 | 1.1 | 7.6 |
| TND14V-220KB00AAA0 | TNR14V220K | 14 | 18 | | 5.3 | | | 43 | 13500 | 22 ( 20～ 24) | 4.7 | 1.2 | 7.6 |
| TND14V-270KB00AAA0 | TNR14V270K | 17 | 22 | 2000A/1 time | 6.5 | | | 53 | 12000 | 27 ( 24～ 30) | 4.8 | 1.4 | 7.6 |
| TND14V-330KB00AAA0 | TNR14V330K | 20 | 26 | | 7.9 | 0.1 | 10 | 65 | 10000 | 33 ( 30～ 36) | 5.0 | 1.6 | 7.7 |
| TND14V-390KB00AAA0 | TNR14V390K | 25 | 30 | 1000A/2 times | 9.4 | | | 77 | 9000 | 39 ( 35～ 43) | 4.9 | 1.3 | 7.6 |
| TND14V-470KB00AAA0 | TNR14V470K | 30 | 37 | | 11 | | | 93 | 8000 | 47 ( 42～ 52) | 5.0 | 1.5 | 7.6 |
| TND14V-560KB00AAA0 | TNR14V560K | 35 | 44 | | 13 | | | 110 | 7500 | 56 ( 50～ 62) | 5.1 | 1.7 | 7.7 |
| TND14V-680KB00AAA0 | TNR14V680K | 40 | 55 | | 16 | | | 135 | 6500 | 68 ( 61～ 75) | 5.3 | 2.0 | 7.8 |
| TND14V-820KB00AAA0 | TNR14V820K | 50 | 65 | | 20 | | | 135 | 3000 | 82 ( 74～ 90) | 4.5 | 1.1 | 7.6 |
| TND14V-101KB00AAA0 | TNR14V101K | 60 | 85 | | 25 | | | 165 | 2700 | 100 ( 90～ 110) | 4.7 | 1.3 | 7.6 |
| TND14V-121KB00AAA0 | TNR14V121K | 75 | 100 | | 30 | | | 200 | 2500 | 120 ( 108～ 132) | 4.9 | 1.4 | 7.6 |
| TND14V-151KB00AAA0 | TNR14V151K | 95 | 125 | | 37 | | | 250 | 2300 | 150 ( 135～ 165) | 5.2 | 1.7 | 7.7 |
| TND14V-181KB00AAA0 | TNR14V181K | 110 | 145 | | 45 | | | 300 | 1650 | 180 ( 162～ 198) | 4.7 | 1.1 | 7.6 |
| TND14V-201KB00AAA0 | TNR14V201K | 130 | 170 | | 50 | | | 340 | 950 | 200 ( 185～ 225) | 4.8 | 1.2 | 7.6 |
| TND14V-221KB00AAA0 | TNR14V221K | 140 | 180 | 6000A/1 time | 55 | | | 360 | 850 | 220 ( 198～ 242) | 4.9 | 1.3 | 7.6 |
| TND14V-241KB00AAA0 | TNR14V241K | 150 | 200 | | 60 | | | 395 | 800 | 240 ( 216～ 264) | 5.0 | 1.4 | 7.6 |
| TND14V-271KB00AAA0 | TNR14V271K | 175 | 225 | 5000A/2 times | 70 | | | 455 | 700 | 270 ( 247～ 303) | 5.2 | 1.5 | 7.6 |
| TND14V-331KB00AAA0 | TNR14V331K | 210 | 270 | | 80 | | | 545 | 600 | 330 ( 297～ 363) | 5.5 | 1.7 | 7.7 |
| TND14V-361KB00AAA0 | TNR14V361K | 230 | 300 | | 90 | | | 595 | 550 | 360 ( 324～ 396) | 5.7 | 1.8 | 7.7 |
| TND14V-391KB00AAA0 | TNR14V391K | 250 | 320 | | 100 | | | 650 | 500 | 390 ( 351～ 429) | 5.8 | 1.9 | 7.7 |
| TND14V-431KB00AAA0 | TNR14V431K | 275 | 350 | | 110 | 0.6 | 50 | 710 | 460 | 430 ( 387～ 473) | 6.0 | 2.1 | 7.8 |
| TND14V-471KB00AAA0 | TNR14V471K | 300 | 385 | | 125 | | | 775 | 420 | 470 ( 423～ 517) | 6.2 | 2.2 | 7.8 |
| TND14V-511KB00AAA0 | TNR14V511K | 320 | 410 | | 136 | | | 845 | 390 | 510 ( 459～ 561) | 6.4 | 2.4 | 7.9 |
| TND14V-561KB00AAA0 | TNR14V561K | 350 | 460 | | 136 | | | 922 | 360 | 560 ( 504～ 616) | 6.7 | 2.6 | 7.9 |
| TND14V-621KB00AAA0 | TNR14V621K | 385 | 505 | | 136 | | | 1025 | 330 | 620 ( 558～ 682) | 7.1 | 2.8 | 8.0 |
| TND14V-681KB00AAA0 | TNR14V681K | 420 | 560 | | 136 | | | 1120 | 310 | 680 ( 612～ 748) | 7.4 | 3.0 | 8.1 |
| TND14V-751KB00AAA0 | TNR14V751K | 460 | 615 | | 150 | | | 1240 | 280 | 750 ( 675～ 825) | 7.8 | 3.3 | 8.2 |
| TND14V-821KB00AAA0 | TNR14V821K | 510 | 670 | 5000A/1 time | 165 | | | 1355 | 250 | 820 ( 738～ 902) | 8.1 | 3.5 | 8.3 |
| TND14V-911KB00AAA0 | TNR14V911K | 550 | 745 | | 180 | | | 1500 | 230 | 910 ( 819～1001) | 8.6 | 3.9 | 8.5 |
| TND14V-102KB00AAA0 | TNR14V102K | 625 | 825 | 4500A/2 times | 200 | | | 1650 | 210 | 1000 ( 900～1100) | 9.1 | 4.2 | 8.6 |
| TND14V-112KB00AAA0 | TNR14V112K | 680 | 895 | | 220 | | | 1815 | 190 | 1100 ( 990～1210) | 9.7 | 4.6 | 8.8 |
| TND14V-122KB00AAA0 | TNR14V122K | 720 | 980 | | 240 | | | 1950 | 170 | 1200 (1080～1320) | 10.5 | 4.9* | 9.0** |
| TND14V-152KB00AAA0 | TNR14V152K | 860 | 1220 | | 300 | | | 2440 | 150 | 1500 (1350～1650) | 12.4 | 6.0* | 9.6** |
| TND14V-182KB00AAA0 | TNR14V182K | 1000 | 1465 | | 360 | | | 2970 | 120 | 1800 (1700～1980) | 14.4 | 7.1* | 10.3** |

*E±2 **W2±2

## ◆DIMENSIONS [mm]

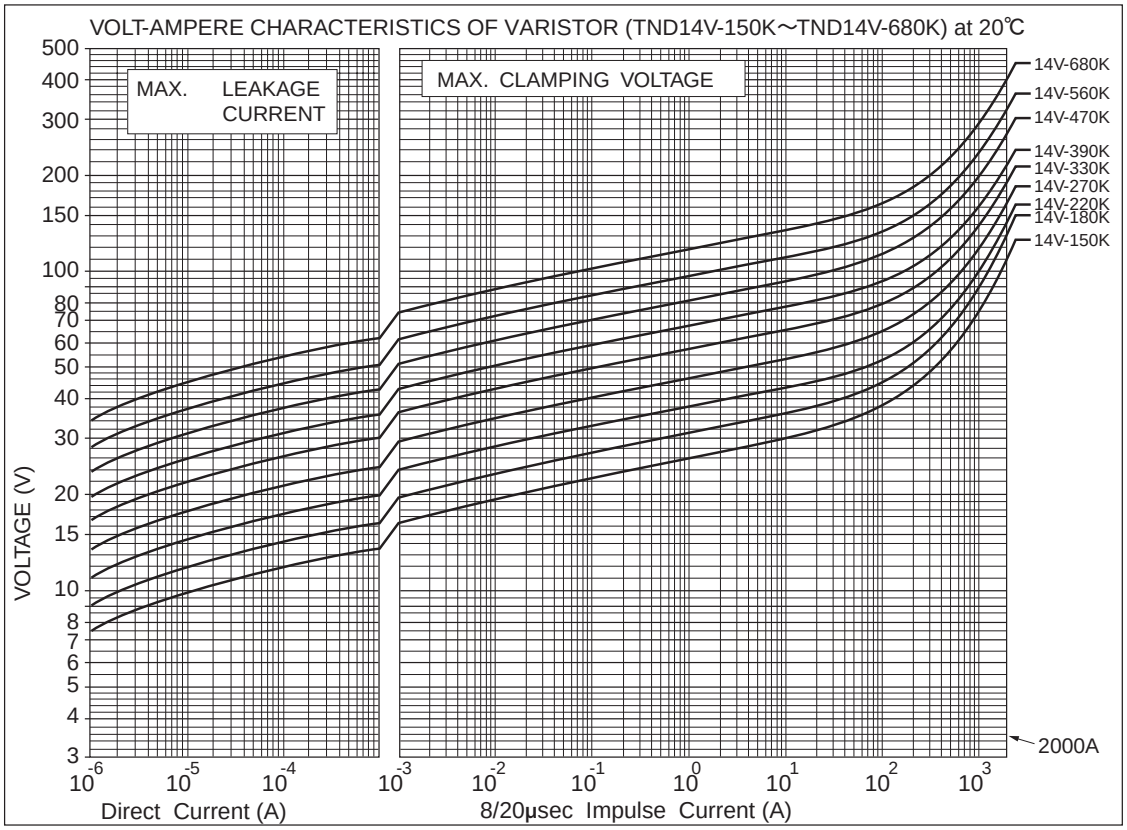


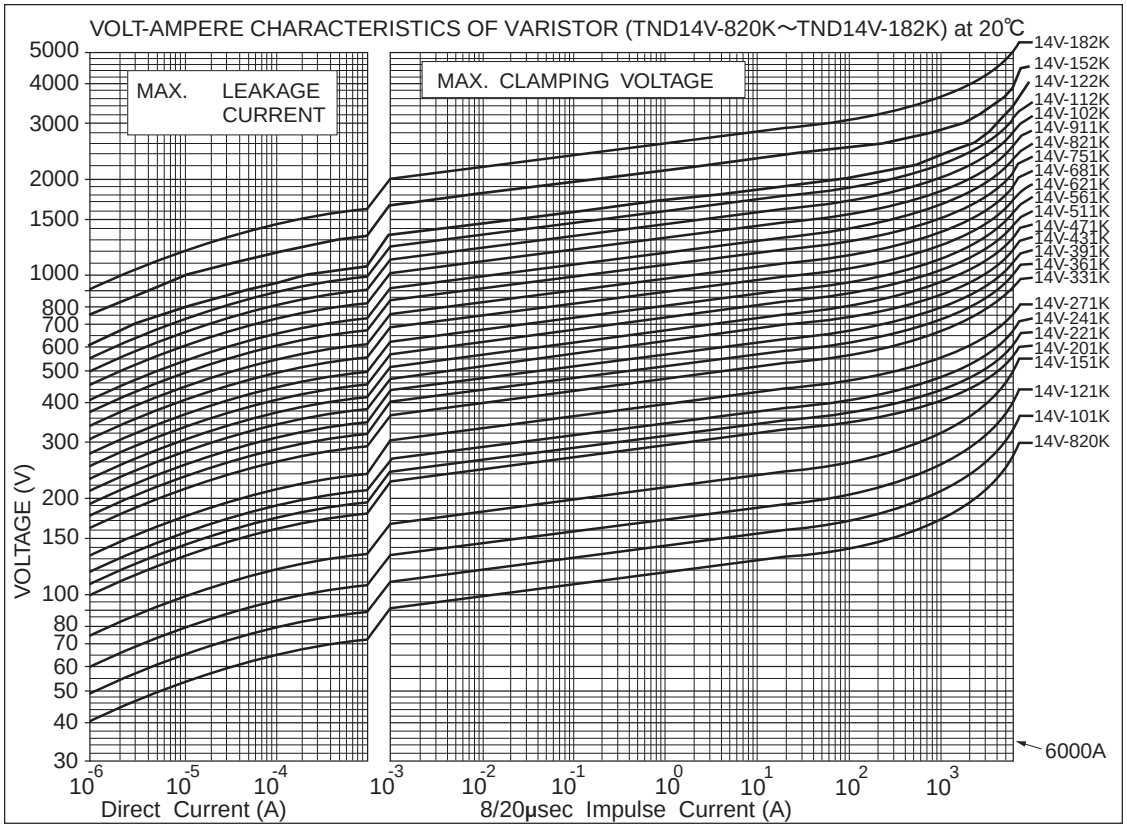

| Part Number | D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|---|
| TND14V-150K to TND14V-511K | 15.5 | 18.5 | Ref. to RATINGS | 20 | 0.8 | 7.5 |
| TND14V-561K to TND14V-112K | 16.0 | 19.0 | | | | |
| TND14V-122K to TND14V-182K | 17.0 | 20.5 | | | | |

●The product with less than 620V of varistor voltage, taping is possible.
Please refer to taping and forming specifications.
The lead type parallel to a straight prepares, too.

# V Series

## ◆V-I CURVE (Type 14V)



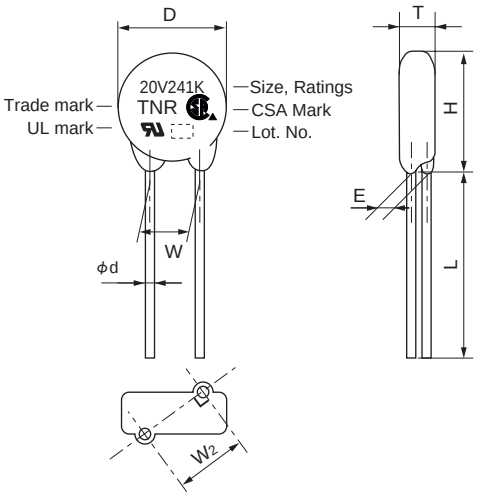
# V Series

## ◆RATINGS (Type 20V)

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA | T Max. | E ±1.0 | W2 Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | | | |
| | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | (A) | (V) | (pF) | (V) | (mm) | (mm) | (mm) |
| TND20V-180KB00AAA0 | TNR20V180K | 11 | 14 | | 12 | | | 36 | 39000 | 18 ( 16～ 20) | 5.1 | 1.1 | 10.1 |
| TND20V-220KB00AAA0 | TNR20V220K | 14 | 18 | | 14 | | | 43 | 33000 | 22 ( 20～ 24) | 5.2 | 1.2 | 10.1 |
| TND20V-270KB00AAA0 | TNR20V270K | 17 | 22 | 3000A/1 time | 17 | | | 53 | 28000 | 27 ( 24～ 30) | 5.3 | 1.4 | 10.1 |
| TND20V-330KB00AAA0 | TNR20V330K | 20 | 26 | | 21 | 0.2 | 20 | 65 | 24000 | 33 ( 30～ 36) | 5.5 | 1.6 | 10.1 |
| TND20V-390KB00AAA0 | TNR20V390K | 25 | 30 | 2000A/2 times | 25 | | | 77 | 21000 | 39 ( 35～ 43) | 5.5 | 1.3 | 10.1 |
| TND20V-470KB00AAA0 | TNR20V470K | 30 | 37 | | 30 | | | 93 | 19000 | 47 ( 42～ 52) | 5.6 | 1.5 | 10.1 |
| TND20V-560KB00AAA0 | TNR20V560K | 35 | 44 | | 36 | | | 110 | 17000 | 56 ( 50～ 62) | 5.7 | 1.7 | 10.1 |
| TND20V-680KB00AAA0 | TNR20V680K | 40 | 55 | | 44 | | | 135 | 15000 | 68 ( 61～ 75) | 5.8 | 2.0 | 10.2 |
| TND20V-820KB00AAA0 | TNR20V820K | 50 | 65 | | 40 | | | 135 | 6700 | 82 ( 74～ 90) | 4.9 | 1.2 | 10.1 |
| TND20V-101KB00AAA0 | TNR20V101K | 60 | 85 | | 50 | | | 165 | 6100 | 100 ( 90～ 110) | 5.1 | 1.4 | 10.1 |
| TND20V-121KB00AAA0 | TNR20V121K | 75 | 100 | | 60 | | | 200 | 5600 | 120 ( 108～ 132) | 5.3 | 1.5 | 10.1 |
| TND20V-151KB00AAA0 | TNR20V151K | 95 | 125 | | 75 | | | 250 | 5100 | 150 ( 135～ 165) | 5.6 | 1.8 | 10.2 |
| TND20V-181KB00AAA0 | TNR20V181K | 110 | 145 | | 85 | | | 300 | 3900 | 180 ( 162～ 198) | 5.1 | 1.2 | 10.1 |
| TND20V-201KB00AAA0 | TNR20V201K | 130 | 170 | | 100 | | | 340 | 2700 | 200 ( 185～ 225) | 5.2 | 1.2 | 10.1 |
| TND20V-221KB00AAA0 | TNR20V221K | 140 | 180 | 10000A/1 time | 110 | | | 360 | 2500 | 220 ( 198～ 242) | 5.3 | 1.3 | 10.1 |
| TND20V-241KB00AAA0 | TNR20V241K | 150 | 200 | | 120 | | | 395 | 2300 | 240 ( 216～ 264) | 5.4 | 1.4 | 10.1 |
| TND20V-271KB00AAA0 | TNR20V271K | 175 | 225 | 7000A/2 times | 135 | | | 455 | 2000 | 270 ( 247～ 303) | 5.6 | 1.5 | 10.1 |
| TND20V-331KB00AAA0 | TNR20V331K | 210 | 270 | | 160 | | | 545 | 1700 | 330 ( 297～ 363) | 5.9 | 1.7 | 10.1 |
| TND20V-361KB00AAA0 | TNR20V361K | 230 | 300 | | 180 | | | 595 | 1500 | 360 ( 324～ 396) | 6.1 | 1.9 | 10.2 |
| TND20V-391KB00AAA0 | TNR20V391K | 250 | 320 | | 195 | | | 650 | 1400 | 390 ( 351～ 429) | 6.2 | 2.0 | 10.2 |
| TND20V-431KB00AAA0 | TNR20V431K | 275 | 350 | | 215 | 1.0 | 100 | 710 | 1300 | 430 ( 387～ 473) | 6.4 | 2.1 | 10.2 |
| TND20V-471KB00AAA0 | TNR20V471K | 300 | 385 | | 250 | | | 775 | 1200 | 470 ( 423～ 517) | 6.6 | 2.3 | 10.3 |
| TND20V-511KB00AAA0 | TNR20V511K | 320 | 410 | | 273 | | | 845 | 1100 | 510 ( 459～ 561) | 6.8 | 2.4 | 10.3 |
| TND20V-561KB00AAA0 | TNR20V561K | 350 | 460 | | 273 | | | 922 | 1000 | 560 ( 504～ 616) | 7.1 | 2.6 | 10.3 |
| TND20V-621KB00AAA0 | TNR20V621K | 385 | 505 | | 273 | | | 1025 | 900 | 620 ( 558～ 682) | 7.5 | 2.9 | 10.4 |
| TND20V-681KB00AAA0 | TNR20V681K | 420 | 560 | | 273 | | | 1120 | 830 | 680 ( 612～ 748) | 7.8 | 3.1 | 10.5 |
| TND20V-751KB00AAA0 | TNR20V751K | 460 | 615 | | 300 | | | 1240 | 750 | 750 ( 675～ 825) | 8.2 | 3.4 | 10.6 |
| TND20V-821KB00AAA0 | TNR20V821K | 510 | 670 | 7500A/1 time | 325 | | | 1355 | 700 | 820 ( 738～ 902) | 8.5 | 3.6 | 10.6 |
| TND20V-911KB00AAA0 | TNR20V911K | 550 | 745 | | 360 | | | 1500 | 620 | 910 ( 819～1001) | 9.0 | 4.0 | 10.8 |
| TND20V-102KB00AAA0 | TNR20V102K | 625 | 825 | 6500A/2 times | 400 | | | 1650 | 560 | 1000 ( 900～1100) | 9.5 | 4.3 | 10.9 |
| TND20V-112KB00AAA0 | TNR20V112K | 680 | 895 | | 440 | | | 1815 | 510 | 1100 ( 990～1210) | 10.1 | 4.7 | 11.0 |
| TND20V-122KB00AAA0 | TNR20V122K | 720 | 980 | | 480 | | | 1950 | 450 | 1200 (1080～1320) | 10.8 | 5.1* | 11.2** |
| TND20V-152KB00AAA0 | TNR20V152K | 860 | 1220 | | 600 | | | 2440 | 390 | 1500 (1350～1650) | 12.8 | 6.2* | 11.8** |
| TND20V-182KB00AAA0 | TNR20V182K | 1000 | 1465 | | 720 | | | 2970 | 340 | 1800 (1700～1980) | 14.8 | 7.4* | 12.4** |

*E±2 **W2±2

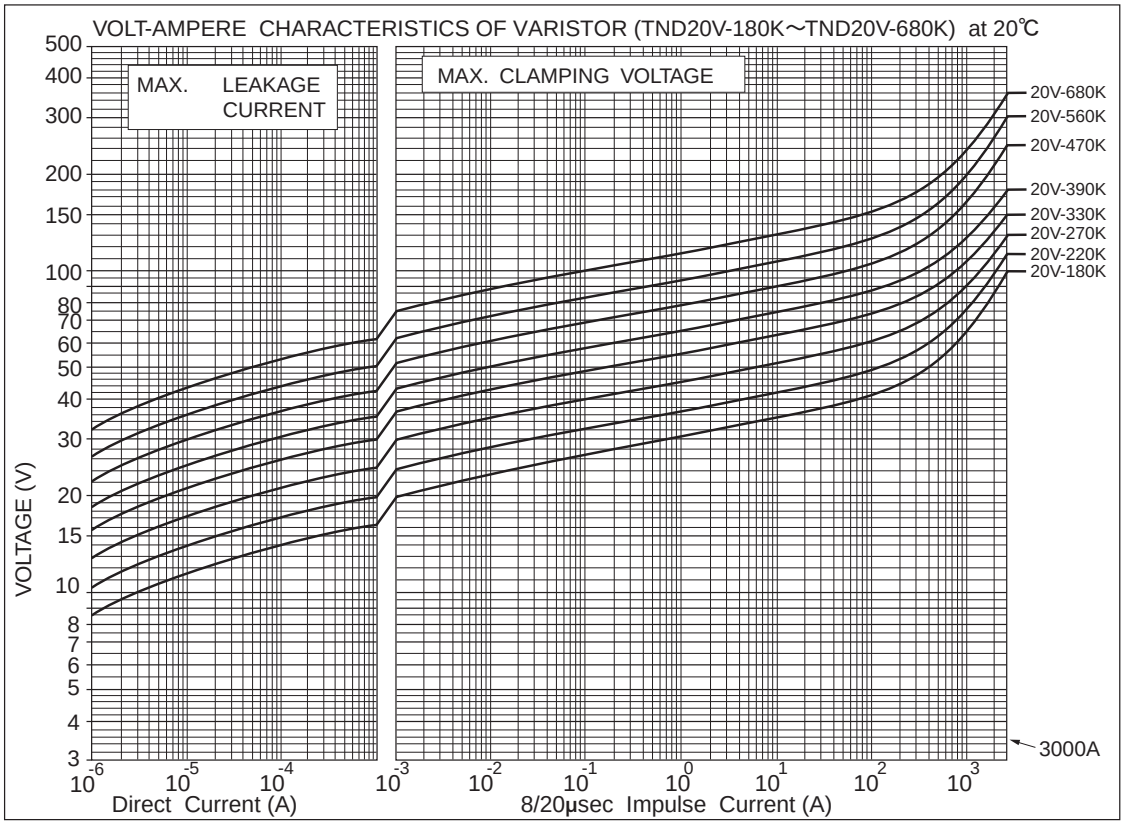
## ◆DIMENSIONS [mm]

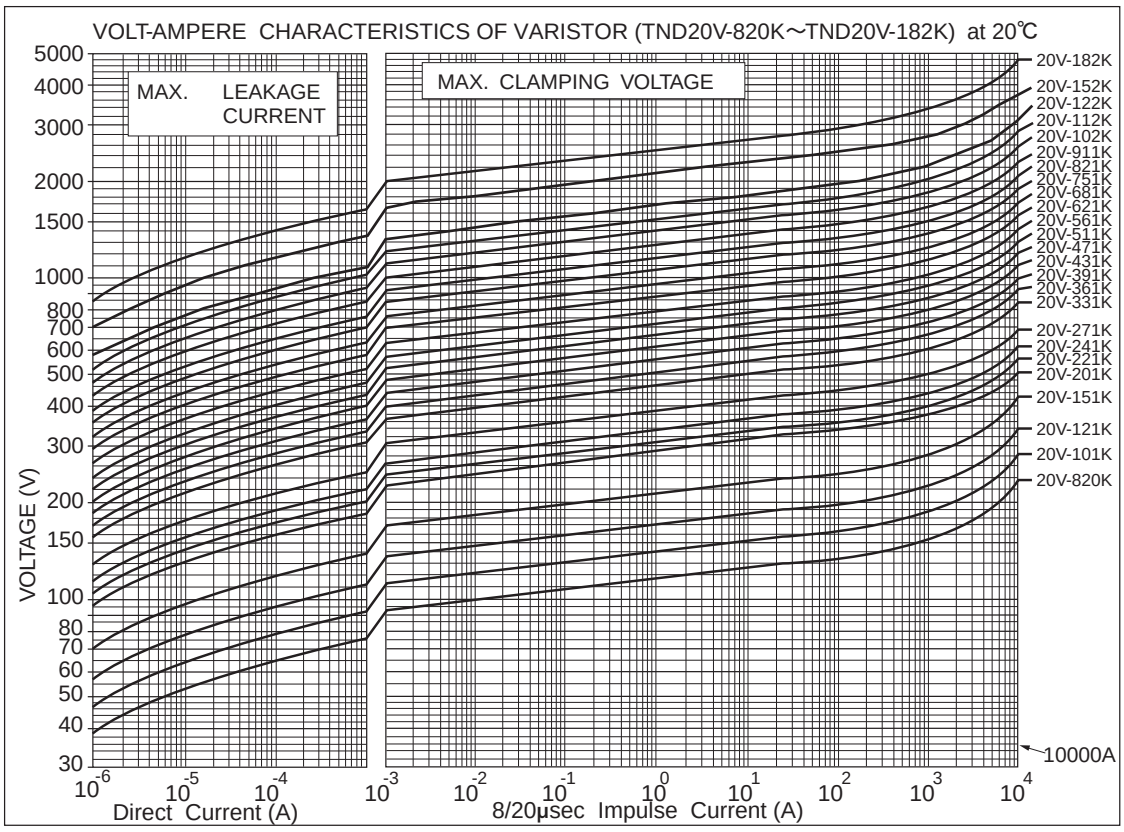



| Part Number | D Max. | H Max. | T Max. | L Min. | ϕd ±0.05 | W ±1.0 |
|---|---|---|---|---|---|---|
| TND20V-180K to TND20V-511K | 21.5 | 24.5 | Ref. to Ratings | 20 | 0.8 | 10.0 |
| TND20V-561K to TND20V-112K | 22.5 | 25.5 | | | | |
| TND20V-122K to TND20V-182K | 23.5 | 28.0 | | | | |

# V Series

## ◆V-I CURVE (Type 20V)



# V Series

## ◆GENERAL SPECIFICATIONS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Standard Test Condition** | 20±15℃, 85%RH Max. | |
| **Varistor Voltage** | Voltage across varistor at specified current.<br>Type: 5V — Current CmA: 0.1<br>Type: 7V, 9V, 10V, 12V, 14V, 20V — Current CmA: 1.0 | Satisfy the specification |
| **Maximum Allowable Voltage** | Maximum continuous AC voltage (50 to 60Hz AC) and maximum DC voltage which can be applied. | Satisfy the specification |
| **Maximum Peak Surge Current** | Maximum surge current (8/20μs pulse wave to be applied once, or twice, 5 minutes apart) for varistor voltage change within±10% of the initial value. | Satisfy the specification |
| **Energy Rating** | Maximum energy (2 ms. square wave to be applied once) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Rated Wattage** | Maximum power (50 to 60Hz AC power to be applied for 1000 hours at 85±2℃) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Maximum Clamping Voltage** | Maximum voltage across varistor when 8/20μs rated current surge is applied. | Satisfy the specification |
| **Capacitance** | Varistor's capacitance at 1kHz, standard test condition. | For reference only. |
| **Voltage Temperature Coefficient** | $\frac{\text{VcmA at 85℃} - \text{VcmA at 25℃}}{\text{VcmA at 25℃}} \times \frac{1}{60} \times 100\ (\%/℃)$<br>VcmA : Actual varistor voltage | Within ±0.05%/℃ |
| **Insulation** | Short circuit the two leads of varistor, and put the varistor body into metal balls (1.6mm diameter) leaving 2mm epoxy coating outside. Then, apply 2.5kVrms between the leads and the metal balls for 60±5 sec.. | The varistor shall withstand with no abnormality. |

## ◆ENVIRONMENTAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **High Temperature Storage (Dry heat)** | The specimen shall be subjected 125±2℃ for 1000±12 hours without load. | ΔVcmA/VcmA≦±5%<br>However, on varistors have nominal varistor voltages from 15V to 68V, the varistor voltage change shall be<br>ΔVcmA/VcmA≦±10% |
| **Low Temperature Storage** | The specimen shall be subjected -40±2℃ for 1000±12 hours without load. | ΔVcmA/VcmA≦±5% |
| **Damp heat (Humidity)** | The specimen shall be subjected to 40±2℃, 90 to 95%RH for 1000±12 hours without load. | ΔVcmA/VcmA≦±5% |
| **Temperature Cycle** | The temperature cycle shown below shall be repeated 5 cycles.<br>-40±3℃, 30 minutes ⇔ +85±2℃, 30 minutes | ΔVcmA/VcmA≦±5%<br>No remarkable damage |
| **High Temperature Operating** | The specimen shall be subjected to 85±2℃ with the maximum allowable voltage for 1000±12 hours. | ΔVcmA/VcmA≦±10% |
| **Damp heat Operating** | The specimen shall be subjected to 40±2℃, 90 to 95%RH with the maximum allowable voltage for 1000±12 hours. | ΔVcmA/VcmA≦±10% |

Varistor voltage change of forward direction shall be measured in the test of unipolar surge life and DC load life.
Varistor voltage change is measured after stored at Standard Test Conditions for 1 to 2 hours.
Note : For 42V battery line, please contact our sales office.

# V Series

## ◆MECHANICAL CHARACTERISTICS

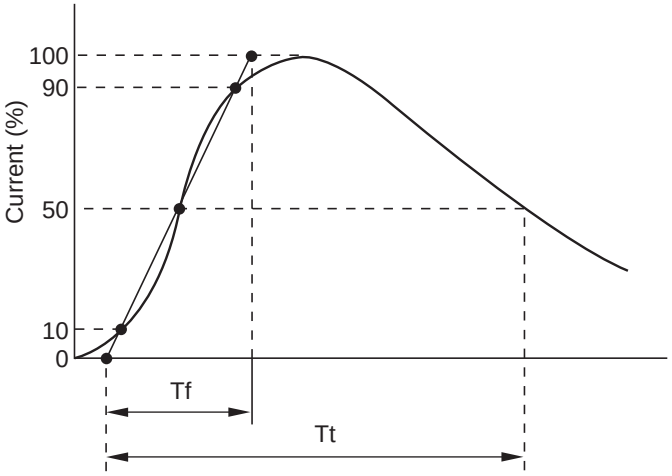
<table>
<tr><th>Item</th><th>Test Conditions</th><th>Specifications</th></tr>
<tr><td>Resistance to Soldering Heat</td><td>Each lead shall be dipped into a solder bath having a temperature of 350±10℃ to a point 2.0 to 2.5 mm from the body of the unit, be held there for $3^{+1}_{-0}$sec and then be stored at room temperature for 1 to 2 hours. The ΔVcmA and mechanical damage shall be examined.<br>or<br>Each lead shall be dipped into a solder bath having a temperature of 260±10℃ to a point 2.0 to 2.5 mm from the body of the unit, be held there for 10±1 sec and then be stored at room temperature for 1 to 2 hours. The ΔVcmA and mechanical damage shall be examined.</td><td>ΔVcmA/VcmA ≦±5%<br>No remarkable damage</td></tr>
<tr><td>Solderability</td><td>Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec.<br>Then each lead shall be dipped into a solder.
<table>
<tr><td>Solder</td><td>Pb free (Sn-3.0Ag-0.5Cu)</td><td>Eutectic (Sn/Pb)</td></tr>
<tr><td>Solder Temp.</td><td>245±5℃</td><td>235±5℃</td></tr>
<tr><td>Dipping Time</td><td colspan="2">2±0.5sec.</td></tr>
<tr><td>Dipping Depth</td><td colspan="2">1.5 to 2.0mm (from the body)</td></tr>
</table></td><td>At least, 95% of the leads shall be covered with solder uniformly.</td></tr>
<tr><td>Lead Pull Strength</td><td>Fix varistor body, and suspend specified weight toward direction of lead axis.
<table>
<tr><td>Type</td><td>Lead Diameter</td><td>Weight</td></tr>
<tr><td>5V, 7V, 9V</td><td>0.6mm</td><td>10N</td></tr>
<tr><td>10V, 12V, 14V, 20V</td><td>0.8mm</td><td>10N</td></tr>
</table></td><td>No abnormality such as disconnection.<br><br>ΔVcmA/VcmA ≦±5%</td></tr>
<tr><td>Lead Bend Strength</td><td>Fix varistor body vertically. Then suspend specified weight and bent the varistor body by 90°, and return it to the original position. Carry out the operation in the opposite direction and return the body to the original position.
<table>
<tr><td>Type</td><td>Lead Diameter</td><td>Weight</td></tr>
<tr><td>5V, 7V, 9V</td><td>0.6mm</td><td>5N</td></tr>
<tr><td>10V, 12V, 14V, 20V</td><td>0.8mm</td><td>5N</td></tr>
</table></td><td>The leads shall not disconnect, slacken and peel off.</td></tr>
<tr><td>Vibration</td><td>Mount varistor body on vibrator, and conduct the follwing vibration test.<br>Peak-to-Peak amplitude : 1.5mm<br>Vibration frequency range : 10Hz to 55Hz<br>Sweeping time:<br>Approximately one minute for 10Hz →55Hz →10Hz<br>Direction and duration of vibration :<br>Three directions of X, Y and Z. Two hours each.<br>Six hours total.</td><td>No remarkable appearance abnormality.<br><br>ΔVcmA/VcmA ≦±5%</td></tr>
</table>

# PULSE LIFE TIME RATINGS

When the following factors are different from the specified conditions,
the peak pulse current should be revised based on the PULSE LIFE TIME RATINGS.

- Impulse duration time
- Number of impulse

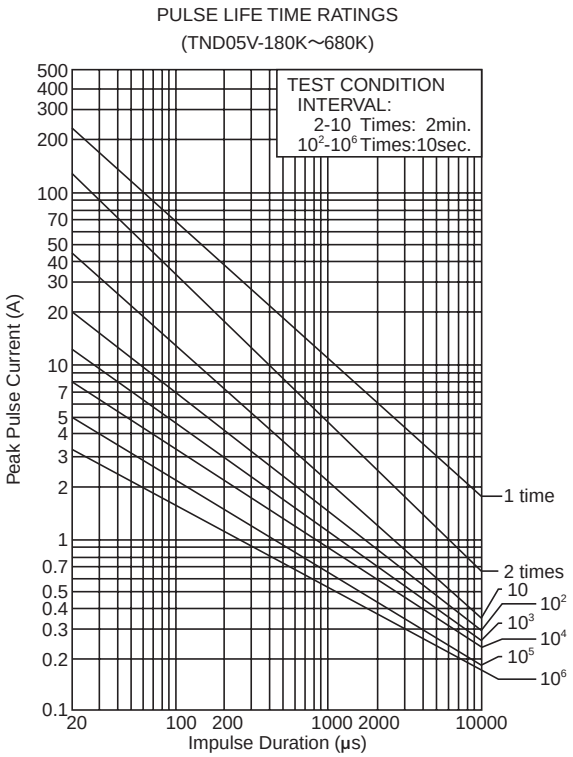
(Impulse Current Wave Form)

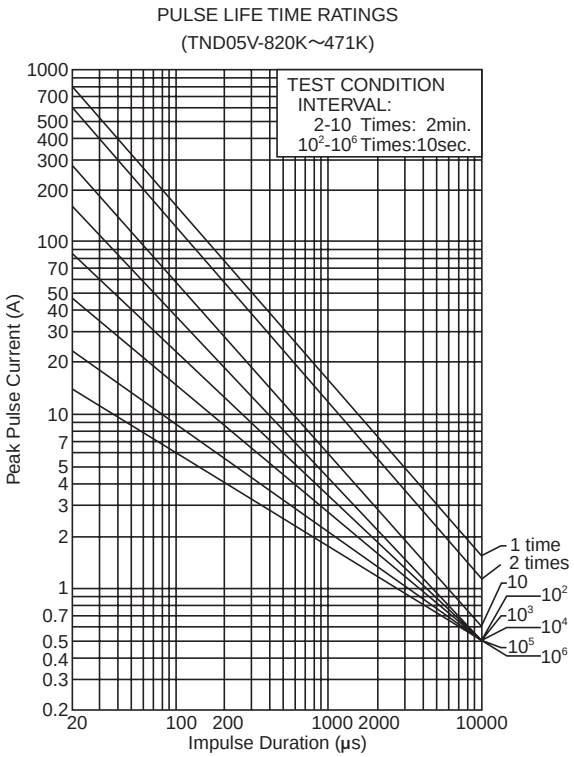



Tf : (Rise Time)

Tt : (Impulse Duration)

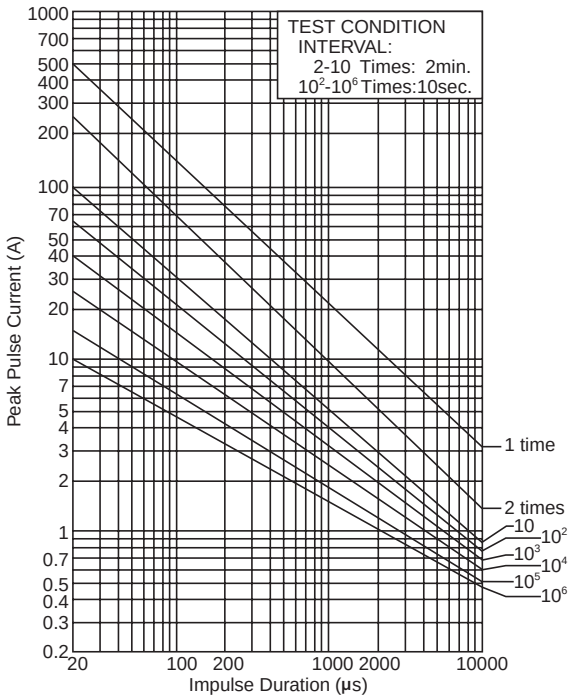
●V series



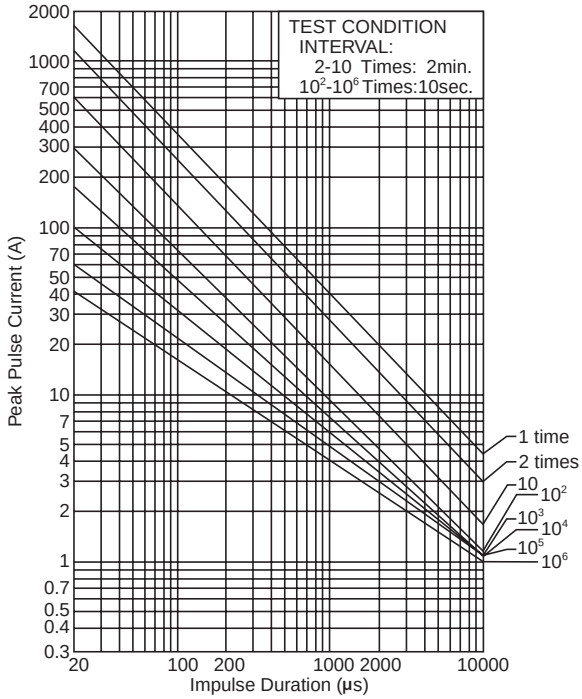



●V series

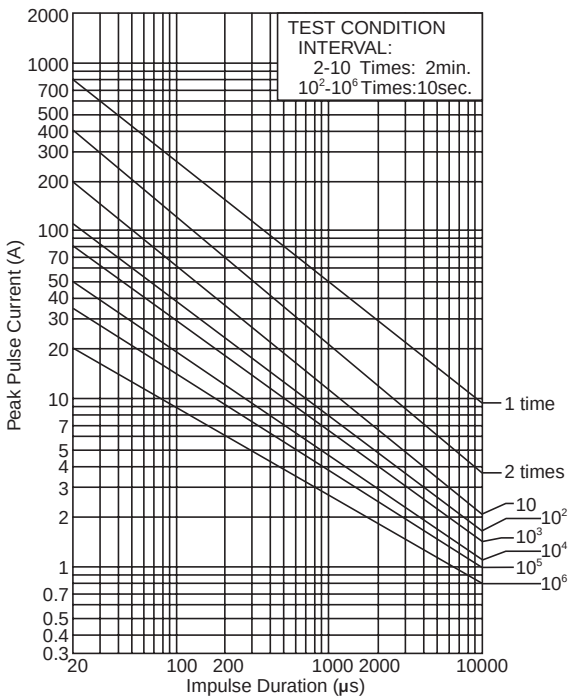
PULSE LIFE TIME RATINGS
(TND07V-150K～680K)



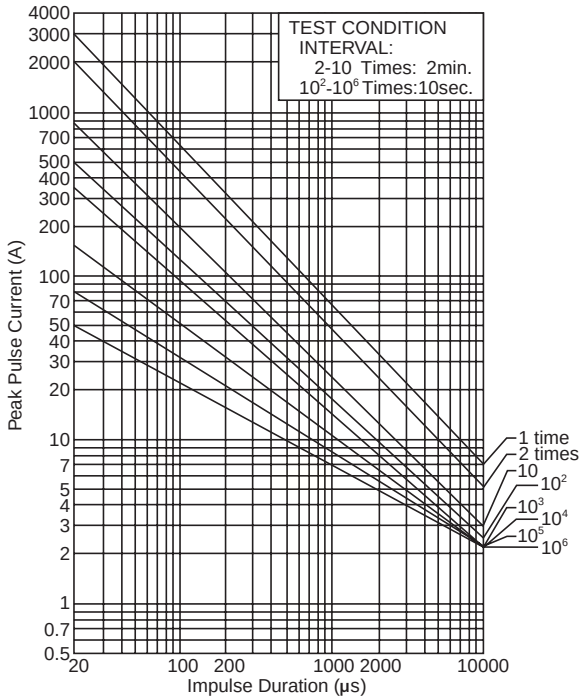

PULSE LIFE TIME RATINGS
(TND07V-820K～511K)




PULSE LIFE TIME RATINGS
(TND09V-150K～680K)

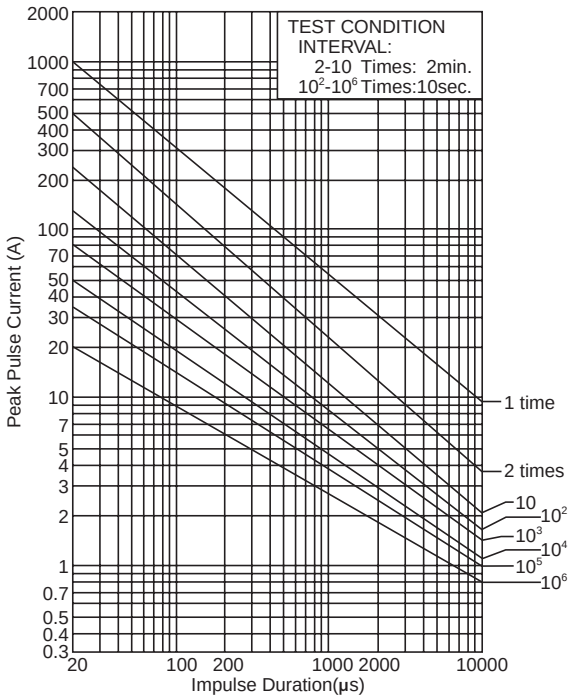



PULSE LIFE TIME RATINGS
(TND09V-820K～511K)

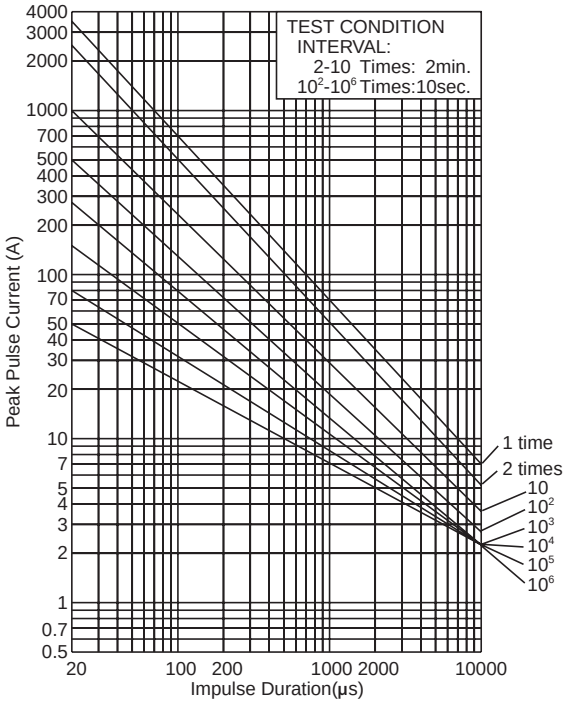


●V series

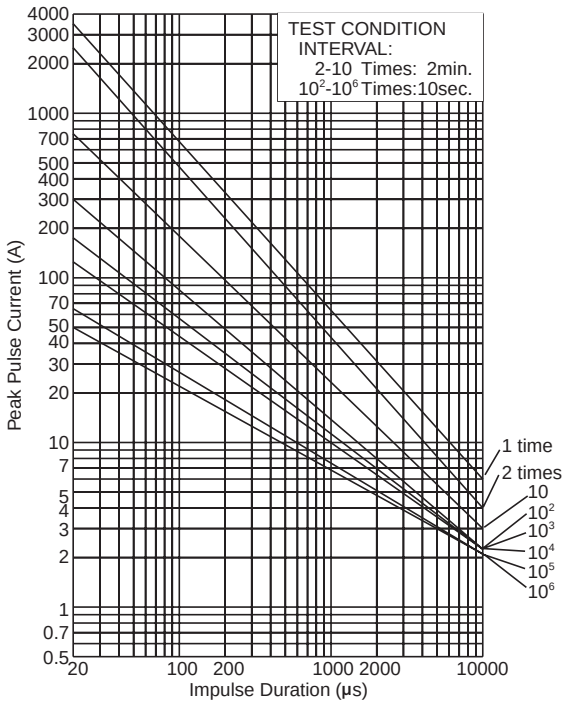
PULSE LIFE TIME RATINGS
(TND10V-150K～680K)



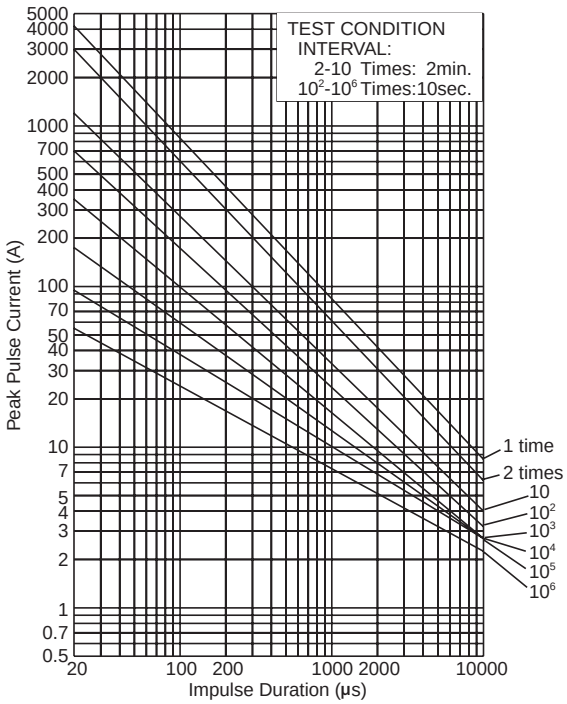

PULSE LIFE TIME RATINGS
(TND10V-820K～511K)




PULSE LIFE TIME RATINGS
(TND10V-561K～182K)

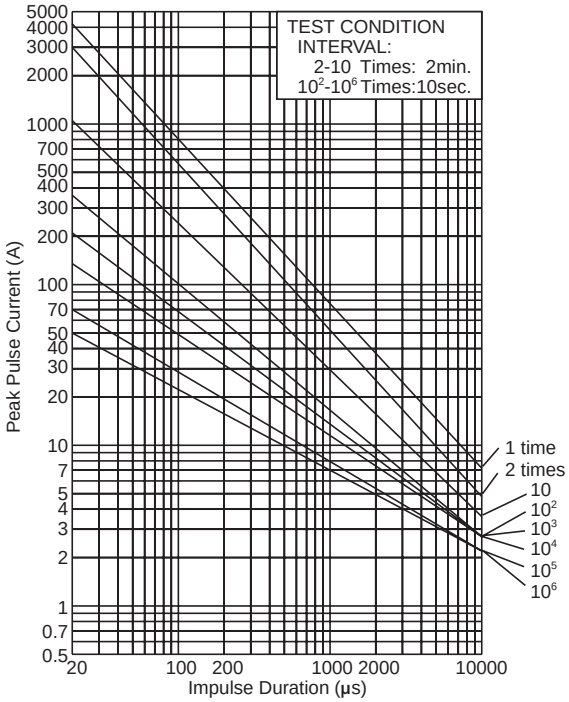



PULSE LIFE TIME RATINGS
(TND12V-431K～511K)

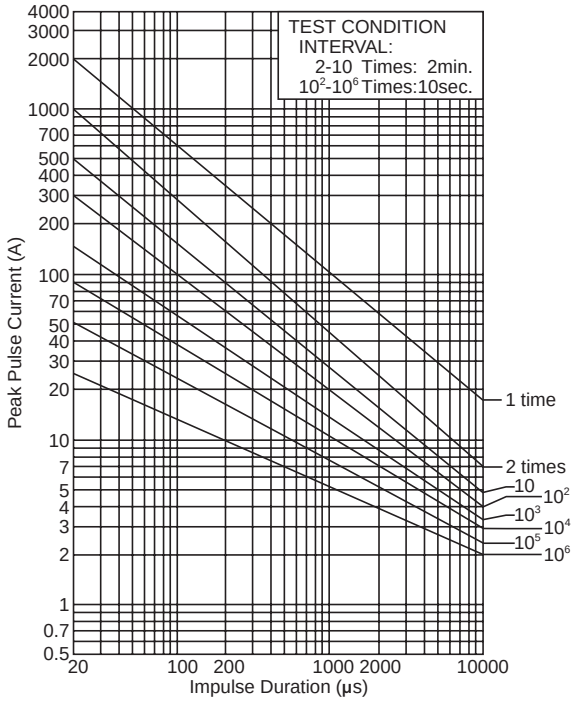


●V series

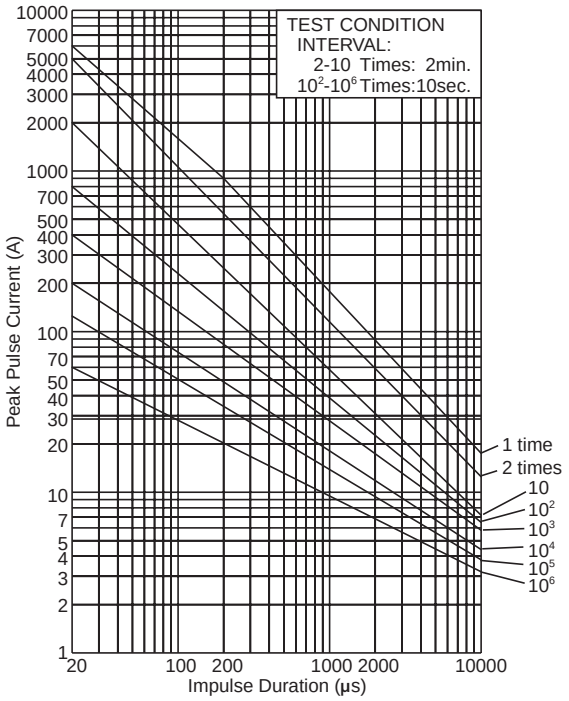
PULSE LIFE TIME RATINGS
(TND12V-561K～182K)



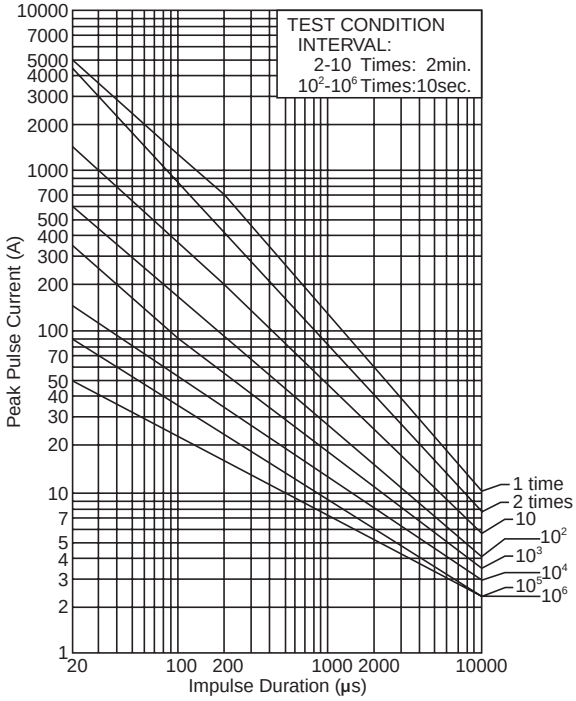

PULSE LIFE TIME RATINGS
(TND14V-150K～680K)




PULSE LIFE TIME RATINGS
(TND14V-820K～511K)

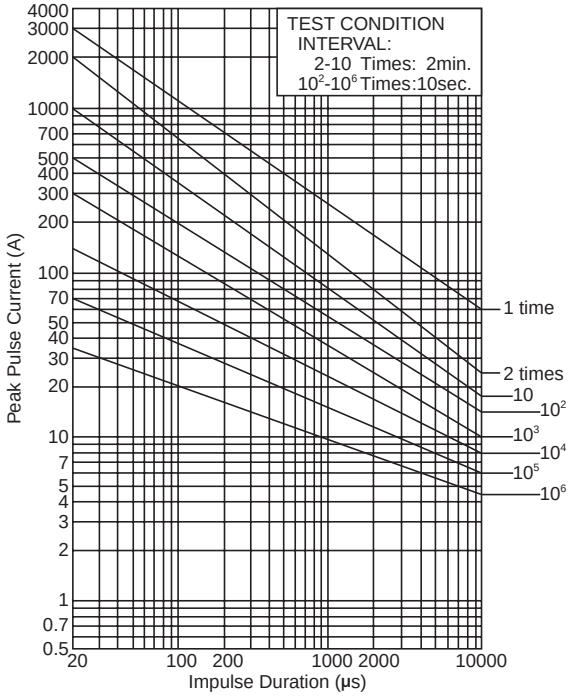



PULSE LIFE TIME RATINGS
(TND14V-561K～182K)

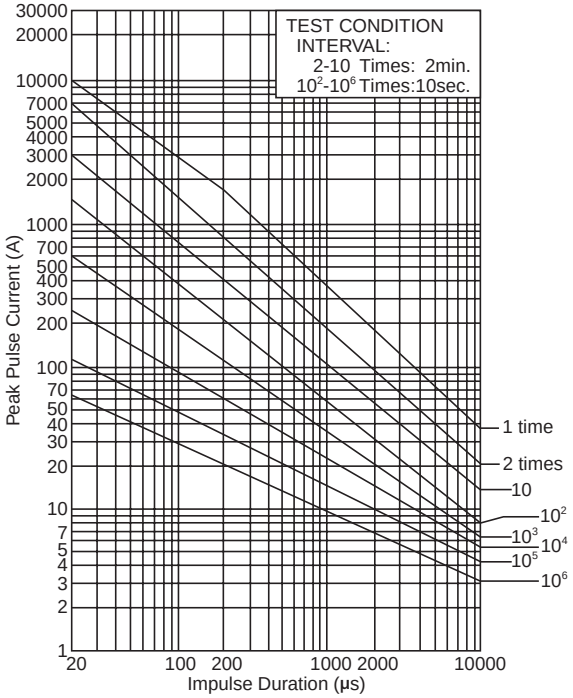


●V series

PULSE LIFE TIME RATINGS
(TND20V-180K～680K)

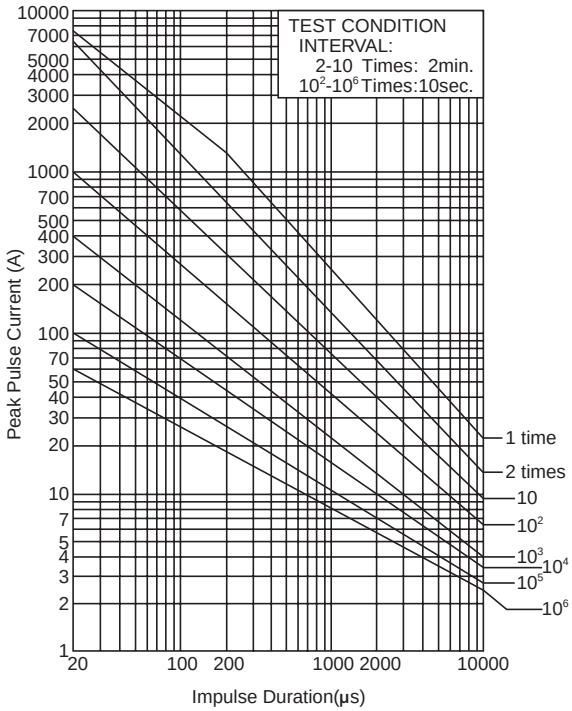



PULSE LIFE TIME RATINGS
(TND20V-820K～511K)



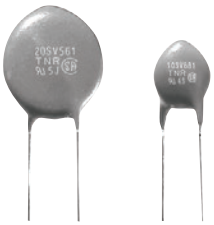

●V series

PULSE LIFE TIME RATINGS
(TND20V-561K～182K)



# SV Series

Upgrade! RoHS2 Compliant High temperature



Our newly developed TNR SV series is to prevent from being caught fire even very high surge energy is applied.
Thus electric appliance using TNR SV series can be much safer like TNR SE series.

## ◆FEATURES

- ●Little scatter at the destruction under over voltage.
- ●Environmental characteristics (Upgrade)
  High temperature operating : 125℃,1000hours
  Damp heat operating : 85℃,85%RH, 1000hours
  Temperature cycle : -40℃ ⇔ +125℃, 1000cycles
- ●Coating resin doesn't burn under the flammability test of UL.
- ●Material of Coating resin:UL94V-0 and Halogen free
- ●UL, CSA and VDE recognized components

| | |
|---|---|
| UL1449 | File：E323623 |
| CSA | File：097864 0 000 |
| VDE | File：118623 |
| CQC | File number varies according to a part number. Pleasee refer to us. |

- ●AEC-Q200 compliant : φ10～φ14 (220V～680V) Please contact Chemi-con for more details, test data, information.

## ◆APPLICATIONS

- ●Protection for semiconductors from over voltage.
- ●Protection for electronic instruments from lightning surge.
- ●Absorption of on-off surge from motors and relays.

Operating Temperature Range： -40 ～ +125℃
Storage Temperature Range ： -50 ～ +150℃

## ◆PART NUMBERING SYSTEM

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | 1 | 0 | S | V | 4 | 7 | 1 | K | T | L | B | P | A | A | 0 |

Design Code
Lead Forming / Taping
⑦Packing Style
⑥Varistor Voltage Tolerance
⑤Varistor Voltage
④Series
③Element Diameter
②Product Form
①Category

| ①Category | |
|---|---|
| T | Metal Oxide Varistor TNR |

| ②Product Form | |
|---|---|
| ND | Disk Type |

| ③Element Diameter | |
|---|---|
| 05 | φ5 mm |
| 07 | φ7 mm |
| 10 | φ10 mm |
| 12 | φ12 mm |
| 14 | φ14 mm |
| 20 | φ20 mm |

| ④Series | |
|---|---|
| SV | SV series |

| ⑤Varistor Voltage |
|---|
| The first two digits are significant figures and the third one denotes the number of folowing zeros. |

| ⑥Varistor Voltage Tolerance | |
|---|---|
| K | ±10% |

| ⑦Packing Style | |
|---|---|
| B | Bulk |
| T | Taping |

## ◆CAUTIONS and WARNINGS

Varistors may be short-circuit or be destroyed, in case of absorbing over rating voltage or over rating surge.
Please connect a current fuse or a circuit breaker in series with varistors.

# SV Series

| | ◇ | □ |
|---|---|---|
| Standard | A | 417 |
| ϕ10 IEC 62368-1:2014 G.8.2 conforming product | S | S417 |

## ◆RATING AND CHARACTERISTICS

| Part Number | Previous Part Number | Maximum Ratings | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA 5SV : V0.1mA | Thickness T MAX. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | |
| | | AC (Vrms) | DC (V) | 8/20us (A) | 2ms (J) | (W) | (A) | (V) | (pF) | (V) | |
| TND05SV221KTBAAAA0 | TNR5SV221K-T25 | 140 | 180 | | 6.5 | | | 380 | 110 | 220 (198 to 242) | 5.0 |
| TND05SV241KTBAAAA0 | TNR5SV241K-T25 | 150 | 200 | 800A/1time | 7.5 | | | 415 | 100 | 240 (216 to 264) | 5.1 |
| TND05SV271KTBAAAA0 | TNR5SV271K-T25 | 175 | 225 | 600A/2time | 8.0 | 0.1 | 5 | 475 | 90 | 270 (247 to 303) | 5.4 |
| TND05SV431KTBAAAA0 | TNR5SV431K-T25 | 275 | 350 | | 13.5 | | | 745 | 70 | 430 (387 to 473) | 6.2 |
| TND05SV471KTBAAAA0 | TNR5SV471K-T25 | 300 | 385 | | 15.0 | | | 810 | 60 | 470 (423 to 517) | 6.4 |
| TND07SV221KTBAAAA0 | TNR7SV221K-T25 | 140 | 180 | | 13.5 | | | 360 | 230 | 220 (198 to 242) | 5.0 |
| TND07SV241KTBAAAA0 | TNR7SV241K-T25 | 150 | 200 | | 15 | | | 395 | 210 | 240 (216 to 264) | 5.1 |
| TND07SV271KTBAAAA0 | TNR7SV271K-T25 | 175 | 225 | 1,750A/1time | 17 | 0.25 | 10 | 455 | 190 | 270 (247 to 303) | 5.2 |
| TND07SV431KTBAAAA0 | TNR7SV431K-T25 | 275 | 350 | 1,250A/2times | 27.5 | | | 710 | 130 | 430 (387 to 473) | 6.2 |
| TND07SV471KTBAAAA0 | TNR7SV471K-T25 | 300 | 385 | | 30 | | | 775 | 120 | 470 (423 to 517) | 6.3 |
| TND07SV511KTBAAAA0 | TNR7SV511K-T25 | 320 | 410 | | 32 | | | 845 | 110 | 510 (459 to 561) | 6.6 |
| TND10SV221KTLBPAA0 | TNR10SV221K417-T71 | 140 | 180 | | 27.5 | | | 360 | 450 | 220 (198 to 242) | 5.4 |
| TND10SV241KTLBPAA0 | TNR10SV241K417-T71 | 150 | 200 | | 30 | | | 395 | 400 | 240 (216 to 264) | 5.5 |
| TND10SV271KTLBPAA0 | TNR10SV271K417-T71 | 175 | 225 | | 35 | | | 455 | 350 | 270 (247 to 303) | 5.7 |
| TND10SV431KTLBPAA0 | TNR10SV431K417-T71 | 275 | 350 | | 55 | | | 710 | 240 | 430 (387 to 473) | 6.5 |
| TND10SV471KTLBP◇A0 | TNR10SV471K□-T71 | 300 | 385 | | 60 | | | 775 | 220 | 470 (423 to 517) | 6.7 |
| TND10SV511KTLBP◇A0 | TNR10SV511K□-T71 | 320 | 410 | | 67 | | | 845 | 210 | 510 (459 to 561) | 6.9 |
| TND10SV561KTLBP◇A0 | TNR10SV561K□-T71 | 350 | 460 | 3,500A/1time | 67 | 0.4 | 25 | 922 | 195 | 560 (504 to 616) | 7.2 |
| TND10SV621KTLBP◇A0 | TNR10SV621K□-T71 | 385 | 505 | 2,500A/2times | 67 | | | 1025 | 180 | 620 (558 to 682) | 7.5 |
| TND10SV681KTLBP◇A0 | TNR10SV681K□-T71 | 420 | 560 | | 67 | | | 1120 | 165 | 680 (612 to 748) | 7.9 |
| TND10SV751KB00A◇A0 | TNR10SV751K□ | 460 | 615 | | 70 | | | 1240 | 150 | 750 (675 to 825) | 8.2 |
| TND10SV821KB00A◇A0 | TNR10SV821K□ | 510 | 670 | | 80 | | | 1355 | 140 | 820 (738 to 902) | 8.6 |
| TND10SV911KB00A◇A0 | TNR10SV911K□ | 550 | 745 | | 90 | | | 1500 | 125 | 910 (819 to 1001) | 9.1 |
| TND10SV102KB00A◇A0 | TNR10SV102K□ | 625 | 825 | | 100 | | | 1650 | 115 | 1000 (900 to 1100) | 9.6 |
| TND12SV431KTLBPAA0 | TNR12SV431K417-T71 | 275 | 350 | | 55 | | | 710 | 375 | 430 (387 to 473) | 6.5 |
| TND12SV471KTLBPAA0 | TNR12SV471K417-T71 | 300 | 385 | | 60 | | | 775 | 345 | 470 (423 to 517) | 6.7 |
| TND12SV511KTLBPAA0 | TNR12SV511K417-T71 | 320 | 410 | | 67 | | | 845 | 330 | 510 (459 to 561) | 6.9 |
| TND12SV561KTLBPAA0 | TNR12SV561K417-T71 | 350 | 460 | | 67 | | | 922 | 305 | 560 (504 to 616) | 7.2 |
| TND12SV621KTLBPAA0 | TNR12SV621K417-T71 | 385 | 505 | 4,200A/1time | 67 | 0.4 | 25 | 1025 | 280 | 620 (558 to 682) | 7.5 |
| TND12SV681KTLBPAA0 | TNR12SV681K417-T71 | 420 | 560 | 3,000A/2times | 67 | | | 1120 | 260 | 680 (612 to 748) | 7.9 |
| TND12SV751KB00AAA0 | TNR12SV751K | 460 | 615 | | 70 | | | 1240 | 235 | 750 (675 to 825) | 8.4 |
| TND12SV821KB00AAA0 | TNR12SV821K | 510 | 670 | | 80 | | | 1355 | 220 | 820 (738 to 902) | 8.8 |
| TND12SV911KB00AAA0 | TNR12SV911K | 550 | 745 | | 90 | | | 1500 | 195 | 910 (819 to 1001) | 9.2 |
| TND12SV102KB00AAA0 | TNR12SV102K | 625 | 825 | | 100 | | | 1650 | 180 | 1000 (900 to 1100) | 9.7 |
| TND14SV221KTLBPAA0 | TNR14SV221K417-T71 | 140 | 180 | | 55 | | | 360 | 850 | 220 (198 to 242) | 5.4 |
| TND14SV241KTLBPAA0 | TNR14SV241K417-T71 | 150 | 200 | | 60 | | | 395 | 800 | 240 (216 to 264) | 5.5 |
| TND14SV271KTLBPAA0 | TNR14SV271K417-T71 | 175 | 225 | 6,000A/1time | 70 | | | 455 | 700 | 270 (247 to 303) | 5.7 |
| TND14SV431KTLBPAA0 | TNR14SV431K417-T71 | 275 | 350 | 5,000A/2times | 110 | | | 710 | 460 | 430 (387 to 473) | 6.5 |
| TND14SV471KTLBPAA0 | TNR14SV471K417-T71 | 300 | 385 | | 125 | | | 775 | 420 | 470 (423 to 517) | 6.7 |
| TND14SV511KTLBPAA0 | TNR14SV511K417-T71 | 320 | 410 | | 136 | | | 845 | 390 | 510 (459 to 561) | 6.9 |
| TND14SV561KTLBPAA0 | TNR14SV561K417-T71 | 350 | 460 | | 136 | 0.6 | 50 | 922 | 360 | 560 (504 to 616) | 7.2 |
| TND14SV621KTLBPAA0 | TNR14SV621K417-T71 | 385 | 505 | | 136 | | | 1025 | 330 | 620 (558 to 682) | 7.5 |
| TND14SV681KTLBPAA0 | TNR14SV681K417-T71 | 420 | 560 | 5,000A/1time | 136 | | | 1120 | 310 | 680 (612 to 748) | 7.9 |
| TND14SV751KB00AAA0 | TNR14SV751K | 460 | 615 | 4,500A/2times | 150 | | | 1240 | 280 | 750 (675 to 825) | 8.4 |
| TND14SV821KB00AAA0 | TNR14SV821K | 510 | 670 | | 165 | | | 1355 | 250 | 820 (738 to 902) | 8.8 |
| TND14SV911KB00AAA0 | TNR14SV911K | 550 | 745 | | 180 | | | 1500 | 230 | 910 (819 to 1001) | 9.2 |
| TND14SV102KB00AAA0 | TNR14SV102K | 625 | 825 | | 200 | | | 1650 | 210 | 1000 (900 to 1100) | 9.7 |
| TND20SV221KB00AAA0 | TNR20SV221K | 140 | 180 | | 110 | | | 360 | 2500 | 220 (198 to 242) | 5.4 |
| TND20SV241KB00AAA0 | TNR20SV241K | 150 | 200 | | 120 | | | 395 | 2300 | 240 (216 to 264) | 5.5 |
| TND20SV271KB00AAA0 | TNR20SV271K | 175 | 225 | 10,000A/1time | 135 | | | 455 | 2000 | 270 (247 to 303) | 5.7 |
| TND20SV431KB00AAA0 | TNR20SV431K | 275 | 350 | 7,000A/2times | 215 | | | 710 | 1300 | 430 (387 to 473) | 6.5 |
| TND20SV471KB00AAA0 | TNR20SV471K | 300 | 385 | | 250 | | | 775 | 1200 | 470 (423 to 517) | 6.7 |
| TND20SV511KB00AAA0 | TNR20SV511K | 320 | 410 | | 273 | | | 845 | 1100 | 510 (459 to 561) | 6.9 |
| TND20SV561KB00AAA0 | TNR20SV561K | 350 | 460 | | 273 | 1.0 | 100 | 922 | 1000 | 560 (504 to 616) | 7.2 |
| TND20SV621KB00AAA0 | TNR20SV621K | 385 | 505 | | 273 | | | 1025 | 900 | 620 (558 to 682) | 7.6 |
| TND20SV681KB00AAA0 | TNR20SV681K | 420 | 560 | 7,500A/1time | 273 | | | 1120 | 830 | 680 (612 to 748) | 7.9 |
| TND20SV751KB00AAA0 | TNR20SV751K | 460 | 615 | 6,500A/2times | 300 | | | 1240 | 750 | 750 (675 to 825) | 8.4 |
| TND20SV821KB00AAA0 | TNR20SV821K | 510 | 670 | | 325 | | | 1355 | 700 | 820 (738 to 902) | 8.8 |
| TND20SV911KB00AAA0 | TNR20SV911K | 550 | 745 | | 360 | | | 1500 | 620 | 910 (819 to 1001) | 9.2 |
| TND20SV102KB00AAA0 | TNR20SV102K | 625 | 825 | | 400 | | | 1650 | 560 | 1000 (900 to 1100) | 9.7 |

# SV Series

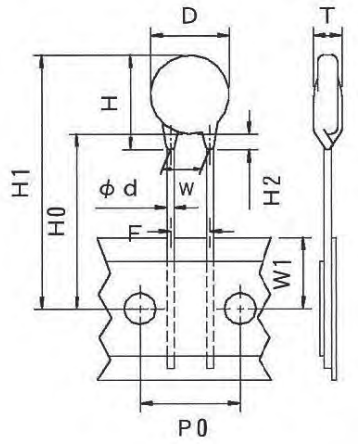
## ◆DIMENSIONS [mm]

● Refer to the table below for standard packing styles.

| Rating | TND05SV | TND07SV | TND10SV | TND12SV | TND14SV | TND20SV |
|---|---|---|---|---|---|---|
| 221K to 511K* | Taping | Taping | Taping | Taping | Taping | Bulk |
| 561K to 681K | — | — | Taping | Taping | Taping | Bulk |
| 751K to 102K | — | — | Bulk | Bulk | Bulk | Bulk |

* The rating range for TND05SV is 221K to 471K

·TND05SV and TND07SV are taping models.

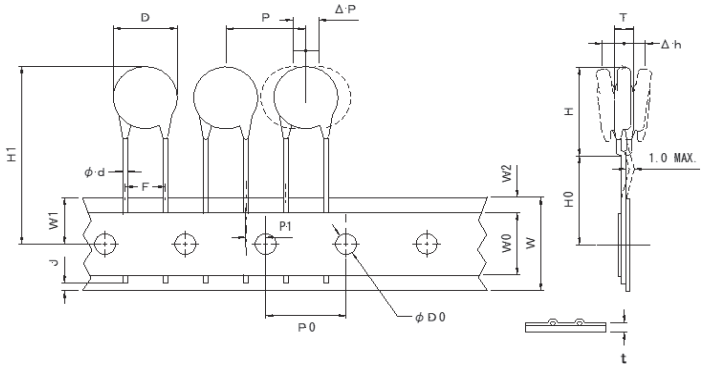



| Symbol | 5SV | 7SV |
|---|---|---|
| D | 7.5Max | 9.0 Max. |
| H | 13.0Max | 14.0 Max. |
| T | Ref. to RATINGS | |
| ϕd | 0.6±0.05 | |
| P0 | 12.7±0.3 | |
| W1 | 9.0±0.5 | |
| W | 5.0±1.0 | |
| F | 5.0±0.8 | |
| H0 | $20.0^{+1.5}_{-1.0}$ | |
| H1 | 31.5 Max. | 32.5 Max. |
| H2 | 5.0 Max. | |

·Taping specifications of TND10SV/TND12SV/TND14SV

Taping Code：TLB

| Symbol | 10SV | 12SV | 14SV |
|---|---|---|---|
| D | 12.5 MAX. | 14.5 MAX. | 16.5 MAX. |
| ϕd | 0.8±0.05 | ← | ← |
| P | 15.0±1.0 | 15.0±1.0 | 30.0±1.0 |
| P0 | 15.0±0.3 | ← | ← |
| ϕD0 | 4.0±0.2 | ← | ← |
| P1 | 3.75±0.5 | ← | ← |
| W1 | 9.0±0.5 | ← | ← |
| F | 7.5±0.8 | ← | ← |
| Δh | 0±2.0 | ← | ← |
| ΔP | 0±1.3 | ← | ← |
| W | $18.0^{+1.0}_{-0.5}$ | ← | ← |
| W0 | 5.0 MIN. | ← | ← |
| W2 | 3.0 MAX. | ← | ← |
| t | 0.6±0.3 | ← | ← |
| H | 20.0 MAX. | 23.5 MAX | 25.0 MAX. |
| H0 | 19.0±1.0 | ← | ← |
| H1 | 46.5 MAX. | ← | ← |
| J | 6.0 MAX. | ← | ← |



# SV Series

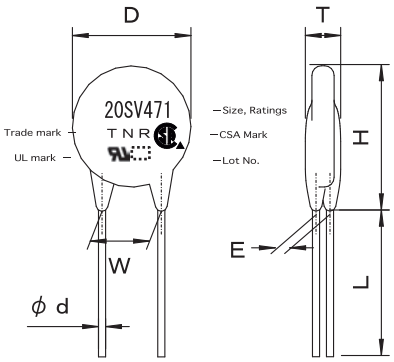
## ◆DIMENSION

Unit : mm

| Part Number | D MAX. | H MAX. | L MIN. | φd ±0.05 | W ±1.0 | E ±1.0 |
|---|---|---|---|---|---|---|
| TND10SV751KB00A◇A0 | 13.0 | 18.0 | 20.0 | 0.8 | 7.5 | 3.1 |
| TND10SV821KB00A◇A0 | | | | | | 3.4 |
| TND10SV911KB00A◇A0 | | | | | | 3.7 |
| TND10SV102KB00A◇A0 | | | | | | 4.0 |
| TND12SV751KB00AAA0 | 15.0 | 20.0 | | | | 3.1 |
| TND12SV821KB00AAA0 | | | | | | 3.4 |
| TND12SV911KB00AAA0 | | | | | | 3.7 |
| TND12SV102KB00AAA0 | | | | | | 4.0 |
| TND14SV751KB00AAA0 | 16.5 | 21.5 | | | | 3.3 |
| TND14SV821KB00AAA0 | | | | | | 3.5 |
| TND14SV911KB00AAA0 | | | | | | 3.9 |
| TND14SV102KB00AAA0 | | | | | | 4.2 |
| TND20SV221KB00AAA0 | 22.5 | 27.5 | | | 10.0 | 1.3 |
| TND20SV241KB00AAA0 | | | | | | 1.4 |
| TND20SV271KB00AAA0 | | | | | | 1.5 |
| TND20SV431KB00AAA0 | | | | | | 2.1 |
| TND20SV471KB00AAA0 | | | | | | 2.3 |
| TND20SV511KB00AAA0 | | | | | | 2.4 |
| TND20SV561KB00AAA0 | 23.0 | 28.5 | | | | 2.6 |
| TND20SV621KB00AAA0 | | | | | | 2.9 |
| TND20SV681KB00AAA0 | | | | | | 3.1 |
| TND20SV751KB00AAA0 | 23.5 | 29.5 | | | | 3.4 |
| TND20SV821KB00AAA0 | | | | | | 3.6 |
| TND20SV911KB00AAA0 | | | | | | 4.0 |
| TND20SV102KB00AAA0 | | | | | | 4.3 |

## ◆MARKING

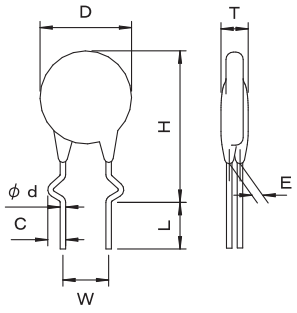
EX)




•TND10SV/TND12SV/TND14SV with the rating 751K or above and TND20SV are packaged in bulk.

Lead forming Type

| Part No. | TND10SV***KBESA◇A0 ◇ : P80 See the above section. | TND12SV***KBESAAA0 | TND14SV***KBESAAA0 | TND20SV***KBESAAA0 |
|---|---|---|---|---|
| Forming Code | BES（310） | | | |
| D | Refer to each spec (see the above table). | | | |
| T | Refer to each spec (see the above table). | | | |
| H | 23.0 Max. | 25.0 Max. | 26.5 Max. | 33.5 Max. |
| L | 5.0 ± 1.0 | ← | ← | ← |
| W | 7.5 ± 1.0 | ← | ← | 10.0 ± 1.0 |
| Φd | 0.8 ± 0.05 | ← | ← | ← |
| C | 2.0 ± 0.5 | ← | ← | ← |
| E | Refer to each spec (see the above table). | | | |




## ◆V-I CURVE

V-I characteristics and PULE LIFE TIME RATINGS are same as those of V series.
Please see V-I CURVE and PULE LIFE TIME RATINGS of V series.

CROSS REFERENCE TABLE（Common to standard product and IEC 62368-1:2014 G.8.2 conforming product）

| TNR SV SERIES | TNR V SERIES | V-I CURVE GO TO REF. PAGE | PULSE LIFE TIME RATINGS GO TO REF. PAGE |
|---|---|---|---|
| TND05SV221K to TND05SV471K | TND05V-221K to TND05V-471K | P.59 | P.74 |
| TND07SV221K to TND07SV511K | TND07V-221K to TND07V-511K | P.61 | P.75 |
| TND10SV221K to TND10SV102K | TND10V-221K to TND10V-102K | P.65 | P.76 |
| TND12SV431K to TND12SV102K | TND12V-431K to TND12V-102K | P.67 | P.76 to 77 |
| TND14SV221K to TND14SV102K | TND14V-221K to TND14V-102K | P.69 | P.77 |
| TND20SV221K to TND20SV102K | TND20V-221K to TND20V-102K | P.71 | P.78 |

# SV Series

## ◆GENERAL SPECIFICATIONS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Standard Test Condition** | 20±15℃, 85%RH Max. | – |
| **Varistor Voltage** | The voltage between the two terminals measured at CmA DC is called Varistor Voltage.<br>The measurement shall be made as fast as possible to avoid heat affection.<br>Type / Current CmA: 5SV / 0.1; Others / 1.0 | Satisfy the specification |
| **Maximum Allowable Voltage** | Maximum continuous AC voltage (50 to 60Hz AC) and maximum DC voltage which can be applied. | Satisfy the specification |
| **Maximum Peak Surge Current** | Maximum surge current (8/20μs pulse wave to be applied once, or twice, 5 minutes apart) for varistor voltage change within±10% of the initial value. | Satisfy the specification |
| **Energy Rating** | Maximum energy (2 ms. square wave to be applied once) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Rated Wattage** | Maximum power (50 to 60Hz/AC power to be applied for 1000 hours at 125□) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Maximum Clamping Voltage** | Maximum voltage across varistor when 8/20μs rated current surge is applied. | Satisfy the specification |
| **Capacitance** | Varistor's capacitance at 1kHz, standard test condition. | For reference only. |
| **Voltage Temperature Coefficient** | $\frac{VC\text{ at }125℃ - VC\text{ at }25℃}{VC\text{ at }25℃} \times \frac{1}{100} \times 100\ (\%/℃)$<br>VC : Actual varistor voltage | Within ±0.05%/℃(≦681K)<br>Within ±0.10%/℃(751K≦) |
| **Insulation** | Short circuit the two leads of varistor, and put the varistor body into metal balls (1.6mm diameter) leaving 2mm resin coating outside. Then, apply 2.5kVrms between the leads and the metal balls for 60±5 sec. | The varistor shall withstand with no abnormality. |

## ◆ENVIRONMENTAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **High Temperature Storage (Dry heat)** | The specimen shall be subjected 150±2□ for 1000±12 hours without load. | ΔVCmA/VCmA≦±10% |
| **Low Temperature Storage** | The specimen shall be subjected -40±2□ for 1000±12 hours without load. | ΔVCmA/VCmA≦±5% |
| **Damp heat (Humidity)** | The specimen shall be subjected to 85±2□, 80 to 85%RH for 1000±12 hours without load. | ΔVCmA/VCmA≦±5% |
| **Temperature Cycle** | The temperature cycle shown below shall be repeated 1000 cycles.<br>−40±3□, 30 minutes⇔ +125±2□, 30 minutes | ΔVCmA/VCmA≦±5%<br>No remarkable damage |
| **High Temperature Operating** | The specimen shall be subjected to 125±2□ with the maximum allowable voltage for 1000± 12 hours. | ΔVCmA/VCmA≦±10% |
| **Damp heat Operating** | The specimen shall be subjected to 85±2□, 80 to 85%RH with the maximum allowable voltage for 1000±12 hours. | ΔVCmA/VCmA≦±10% |

Varistor voltage change of forward direction shall be measured in the test of unipolar surge life and DC load life.
Varistor voltage change is measured after stored at Standard Test Conditions for 1 to 2 hours.

# SV Series

## ◆MECHANICAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Resistance to Soldering Heat** | Each lead shall be dipped into a solder bath having a temperature of 350±10°C to a point 2.0 to 2.5 mm from the body of unit, be held there for $3^{+1}_{0}$ sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined.<br>or<br>Each lead shall be dipped into a solder bath having a temperature of 260±10°C to a point 2.0 to 2.5 mm from the body of the unit, be held there for 10±1 sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined. | ΔVCmA/VCmA ≦±5%<br>No remarkable damage |
| **Solderability** | Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec.<br>Then each lead shall be dipped into a solder.<br>Solder: Pb free (Sn-3.0Ag-0.5Cu) / Eutectic (Sn/Pb)<br>Solder Temp.: 245±5℃ / 235±5℃<br>Dipping Time: 2±0.5sec.<br>Dipping Depth: 1.5 to 2.0mm (from the body) | At least, 95% of the leads shall be covered with solder uniformly. |
| **Lead Pull Strength** | Fix varistor body, and suspend specified weight toward direction of lead axis.<br>Lead diameter: ϕ0.8mm — Force: 10N | No abnormality such as disconnection.<br>ΔVCmA/VCmA ≦±5% |
| **Lead Bend Strength** | The varistor shall be secured with its terminal kept vertical and the force specified below shall be applied in the axial direction.<br>The terminal shall granually be bend by 90 in one direction then back to original position.<br>The damage of the terminal shall be visually examined.<br>5SV, 7SV: Lead Diameter 0.6mm, Force 10N<br>10SV, 12SV, 14SV, 20SV: Lead Diameter 0.8mm, Force 10N | No remarkable damage as remarkable the innner ceramic element or terminal open. |
| **Vibration** | Mount varistor body on vibrator, and conduct the following vibration test.<br>Peak-to-Peak amplitude : 1.5mm<br>Vibration frequency range : 10 to 55Hz<br>Sweeping time:<br>å Approximately one minute for 10Hz → 55Hz → 10Hz<br>Direction and duration of vibration : Three directions of X, Y, and Z. 2 hours each. 6 hours total. | No remarkable apperance abnormality.<br>ΔVCmA/VCmA ≦±5% |
| **Flammability test** | The varistor shall be subjected 60 sec. applications of test flame.<br>Burnar : Bunsen gas burner 9000kcal / $m^3$<br>Diameter of flame nozzle : ϕ9.5mm<br>Position : The spesimen shall be fixed horizonal.<br>Point of application shall be approximately center of the specimen. | No catching fire, and no flaming drops. |

# SV Series Low varistor voltage

New!

RoHS2 Compliant | AEC-Q200 | High temperature


By using the resin properties of the SV series to a low varistor voltage products, it has achieved a high heat resistance and temperature cycle resistance.
Low varistor voltage SV series is for automotive in compliance with the AEC-Q200.

## ◆FEATURES

- High temperature operating : 1,000 hours at 125℃.
- Damp heat oprerating : 1,000 hours at 85℃/85%RH.
- Temperature cycle : -40℃⇔+125℃, 1000cycle.
- Material of Coating resin:UL94V-0 and Halogen free.
- AEC-Q200 compliant : Please contact Chemi-con for more details, test data, information.

## ◆APPLICATIONS

- Absorption of automotive load dump surge.
- Absorption of ignition-off surge.
- Absorption of switching surge of horn, motor, and relay.
- Protection of automotive electronics and semi conductors.

Operating Temperature Range : -40 ～ +125℃
Storage Temperature Range : -50 ～ +150℃

## ◆PART NUMBERING SYSTEM

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | N | D | 1 | 0 | S | V | 2 | 2 | 0 | K | T | B | A | A | A | A | 0 |

- Design Code
- Lead Forming/Taping
- ⑦Packing Style
- ⑥Varistor Voltage Tolerance
- ⑤Varistor Voltage
- ④Series
- ③Element Diameter
- ②Product Form
- ①Category

| ①Category | |
|---|---|
| T | Metal Oxide Varistor TNR |

| ②Product Form | |
|---|---|
| ND | Disk Type |

| ③Element Diameter | |
|---|---|
| 5 | φ5mm |
| 7 | φ7mm |
| 10 | φ10mm |
| 14 | φ14mm |
| 20 | φ20mm |

| ④Series | |
|---|---|
| SV | SV series |

| ⑤Varistor Voltage |
|---|
| The first two digits are significant figures and the third one denotes the number of folowing zeros. |

| ⑥Varistor Voltage Tolerance | |
|---|---|
| K | ±10% |

| ⑦Packing Style | |
|---|---|
| B | Bulk |
| T | Taping |

# SV Series Low varistor voltage

## ◆RATING AND CHARACTERISTICS

| Part Number | Previous Part Number | Maximum Ratings | | | | | | Max. Clamping Voltage | | Capacitance Typical @1kHz | Varistor Voltage V1mA 5SV：V0.1mA | Thickness T MAX. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max.Peak Current | Max. Energy | Max.Applicable voltage for short period /5 minutes | Rated Wattage | | | | | |
| | | AC(Vrms) | DC(V) | 8/20μs(A) | 2ms(J) | DC(V) | (W) | (A) | (V) | (pF) | (V) | |
| TND05SV220KTBAAAA0 | TNR5SV220K-T25 | 12 | 16 | | 0.5 | 24 | | | 48 | 3600 | 22（20～24） | 5.0 |
| TND05SV270KTBAAAA0 | TNR5SV270K-T25 | 15 | 19 | | 0.7 | 29 | | | 60 | 3100 | 27（24～30） | 5.0 |
| TND05SV330KTBAAAA0 | TNR5SV330K-T25 | 18 | 24 | | 0.8 | 36 | | | 73 | 2500 | 33（30～36） | 5.5 |
| TND05SV390KTBAAAA0 | TNR5SV390K-T25 | 22 | 28 | 125A | 0.9 | 42 | 0.01 | 1 | 86 | 2300 | 39（35～43） | 5.0 |
| TND05SV470KTBAAAA0 | TNR5SV470K-T25 | 26 | 34 | /2 times | 1.1 | 50 | | | 104 | 2000 | 47（42～52） | 5.0 |
| TND05SV560KTBAAAA0 | TNR5SV560K-T25 | 30 | 42 | | 1.3 | 50 | | | 123 | 1700 | 56（50～62） | 5.5 |
| TND05SV680KTBAAAA0 | TNR5SV680K-T25 | 40 | 55 | | 1.6 | 65 | | | 150 | 1500 | 68（61～75） | 5.5 |
| TND07SV220KTBAAAA0 | TNR7SV220K-T25 | 12 | 16 | | 1.1 | 24 | | | 43 | 5400 | 22（20～24） | 5.0 |
| TND07SV270KTBAAAA0 | TNR7SV270K-T25 | 15 | 19 | | 1.3 | 29 | | | 53 | 4800 | 27（24～30） | 5.0 |
| TND07SV330KTBAAAA0 | TNR7SV330K-T25 | 18 | 24 | | 1.6 | 36 | | | 65 | 3900 | 33（30～36） | 5.5 |
| TND07SV390KTBAAAA0 | TNR7SV390K-T25 | 22 | 28 | 250A | 1.9 | 42 | 0.02 | 2.5 | 77 | 3600 | 39（35～43） | 5.0 |
| TND07SV470KTBAAAA0 | TNR7SV470K-T25 | 26 | 34 | /2 times | 2.3 | 50 | | | 93 | 3300 | 47（42～52） | 5.0 |
| TND07SV560KTBAAAA0 | TNR7SV560K-T25 | 30 | 42 | | 2.7 | 50 | | | 110 | 2900 | 56（50～62） | 5.5 |
| TND07SV680KTBAAAA0 | TNR7SV680K-T25 | 40 | 55 | | 3.3 | 65 | | | 135 | 2600 | 68（61～75） | 5.5 |
| TND10SV220KTBAAAA0 | TNR10SV220K-T25 | 12 | 16 | | 2.6 | 24 | | | 43 | 12000 | 22（20～24） | 6.0 |
| TND10SV270KTBAAAA0 | TNR10SV270K-T25 | 15 | 19 | | 3.2 | 29 | | | 53 | 11000 | 27（24～30） | 6.0 |
| TND10SV330KTBAAAA0 | TNR10SV330K-T25 | 18 | 24 | | 4.0 | 36 | | | 65 | 8500 | 33（30～36） | 6.5 |
| TND10SV390KTBAAAA0 | TNR10SV390K-T25 | 22 | 28 | 500A | 4.7 | 42 | 0.05 | 5 | 77 | 7600 | 39（35～43） | 6.0 |
| TND10SV470KTBAAAA0 | TNR10SV470K-T25 | 26 | 34 | /2 times | 5.6 | 50 | | | 93 | 6800 | 47（42～52） | 6.0 |
| TND10SV560KTBAAAA0 | TNR10SV560K-T25 | 30 | 42 | | 6.7 | 50 | | | 110 | 6000 | 56（50～62） | 6.5 |
| TND10SV680KTBAAAA0 | TNR10SV680K-T25 | 40 | 55 | | 8.2 | 65 | | | 135 | 5400 | 68（61～75） | 6.5 |
| TND14SV220KTBAAAA0 | TNR14SV220K-T25 | 12 | 16 | | 5.3 | 24 | | | 43 | 23000 | 22（20～24） | 6.0 |
| TND14SV270KTBAAAA0 | TNR14SV270K-T25 | 15 | 19 | | 6.5 | 29 | | | 53 | 21000 | 27（24～30） | 6.0 |
| TND14SV330KTBAAAA0 | TNR14SV330K-T25 | 18 | 24 | | 7.9 | 36 | | | 65 | 17000 | 33（30～36） | 6.5 |
| TND14SV390KTBAAAA0 | TNR14SV390K-T25 | 22 | 28 | 1000A | 9.4 | 42 | 0.1 | 10 | 77 | 16000 | 39（35～43） | 6.0 |
| TND14SV470KTBAAAA0 | TNR14SV470K-T25 | 26 | 34 | /2 times | 11 | 50 | | | 93 | 14000 | 47（42～52） | 6.0 |
| TND14SV560KTBAAAA0 | TNR14SV560K-T25 | 30 | 42 | | 13 | 50 | | | 110 | 13000 | 56（50～62） | 6.5 |
| TND14SV680KTBAAAA0 | TNR14SV680K-T25 | 40 | 55 | | 16 | 65 | | | 135 | 11000 | 68（61～75） | 6.5 |
| TND20SV220KB00AAA0 | TNR20SV220K | 12 | 16 | | 14 | 24 | | | 43 | 56000 | 22（20～24） | 6.0 |
| TND20SV270KB00AAA0 | TNR20SV270K | 15 | 19 | | 17 | 29 | | | 53 | 48000 | 27（24～30） | 6.0 |
| TND20SV330KB00AAA0 | TNR20SV330K | 18 | 24 | | 21 | 36 | | | 65 | 41000 | 33（30～36） | 6.5 |
| TND20SV390KB00AAA0 | TNR20SV390K | 22 | 28 | 2000A | 25 | 42 | 0.2 | 20 | 77 | 36000 | 39（35～43） | 6.0 |
| TND20SV470KB00AAA0 | TNR20SV470K | 26 | 34 | /2 times | 30 | 50 | | | 93 | 33000 | 47（42～52） | 6.0 |
| TND20SV560KB00AAA0 | TNR20SV560K | 30 | 42 | | 36 | 50 | | | 110 | 29000 | 56（50～62） | 6.5 |
| TND20SV680KB00AAA0 | TNR20SV680K | 40 | 55 | | 44 | 65 | | | 135 | 26000 | 68（61～75） | 6.5 |

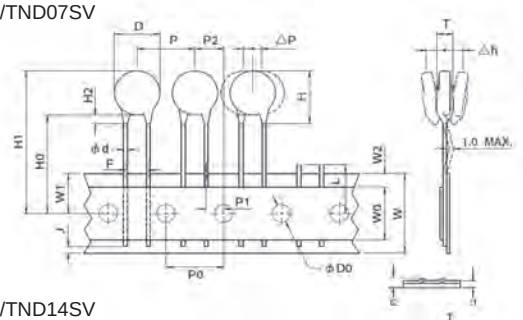
## ◆DIMENSION

TND05SV/TND07SV/TND10SV/TND14SV：Taping product is normal specifications.

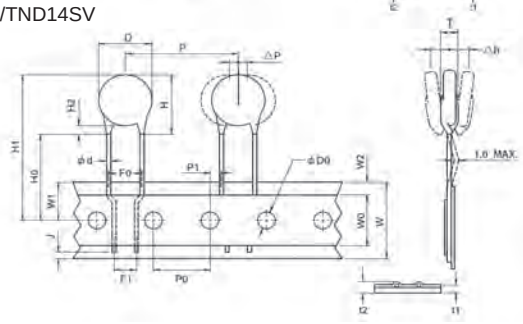
Taping Code：TBA (T25)　　Unit：mm

| Symbol | 5SV | 7SV | 10SV | 14SV |
|---|---|---|---|---|
| D | 8.0 Max. | 9.0 Max. | 12.0 Max. | 16.0 Max. |
| φd | 0.6±0.05 | ← | 0.8±0.05 | ← |
| P | 12.7±1.0 | ← | 25.4±1.0 | ← |
| P0 | 12.7±0.3 | ← | 12.7±0.3 | ← |
| φD0 | 4.0±0.2 | ← | 4.0±0.2 | ← |
| P1 | 3.85±0.7 | ← | 2.6±0.5 | ← |
| P2 | 6.35±1.3 | ← | - | - |
| W1 | 9.0±0.5 | ← | 9.0±0.5 | ← |
| F | 5.0±0.8 | ← | - | |
| F0 | - | - | 7.5±0.8 | ← |
| F1 | - | - | 5.0 Nom. | ← |
| Δh | 0±2.0 | ← | 0±2.0 | ← |
| ΔP | 0±1.0 | ← | 0±1.0 | ← |
| W | $18.0^{+1.0}_{-0.5}$ | ← | $18.0^{+1.0}_{-0.5}$ | ← |
| W0 | 5.0 Min. | ← | 5.0 Min. | ← |
| t1 | 0.6±0.3 | ← | 0.6±0.3 | ← |
| t2 | 1.5 Max. | ← | 1.5 Max. | ← |
| W2 | 3.0 Max. | ← | 3.0 Max. | ← |
| H0 | $20.0^{+1.5}_{-1.0}$ | ← | 19.0 Min. | ← |
| H | 11.0 Max. | 12.0 Max. | 17.0 Max. | 20.0 Max. |
| H1 | 29.0 Max. | 30.0 Max. | 41.5 Max. | 43.5 Max. |
| H2 | 3.0 Max. | ← | 5.0 Max. | ← |
| J | 6.0 Max. | ← | 6.0 Max. | ← |
| L | 11.0 Max. | ← | - | - |

●TND05SV/TND07SV




●TND10SV/TND14SV



# SV Series Low varistor voltage

## ◆DIMENSION

TND20SV：Bulk only

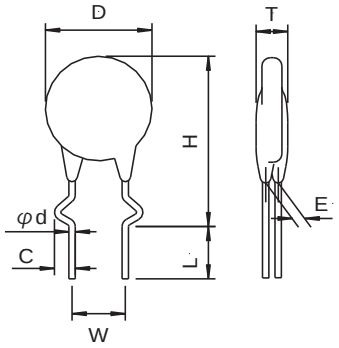
Stlaight lead Type

Unit : mm

| Part Number | D MAX. | H MAX. | L MIN. | φd ±0.05 | W ±1.0 | E ±1.0 |
|---|---|---|---|---|---|---|
| TND20SV220KB00AAA0 | 22.5 | 27.0 | 20.0 | 0.8 | 10 | 1.2 |
| TND20SV270KB00AAA0 | | | | | | 1.4 |
| TND20SV330KB00AAA0 | | | | | | 1.6 |
| TND20SV390KB00AAA0 | | | | | | 1.3 |
| TND20SV470KB00AAA0 | | | | | | 1.5 |
| TND20SV560KB00AAA0 | | | | | | 1.7 |
| TND20SV680KB00AAA0 | | | | | | 2.0 |

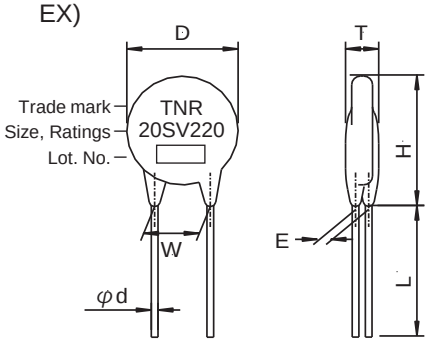
Lead forming Type

| Part No. | TND20SV***KBESAAA0 |
|---|---|
| Forming Code | BES (310) |
| D | refer to each spec. |
| T | refer to each spec. |
| H | 30.5 MAX. |
| L | 5.0 ± 1.0 |
| W | 10.0 ± 1.0 |
| φd | 0.8 ± 0.05 |
| C | 2.0 ± 0.5 |
| E | refer to each spec. |




## ◆MARKING

EX)




## ◆V-I CURVE

V-I characteristics and PULE LIFE TIME RATINGS are same as those of V series.
Please see V-I CURVE and PULE LIFE TIME RATINGS of V series.

CROSS REFERENCE TABLE

| TNR SV SERIES | TNR V SERIES | V-I CURVE GO TO REF. PAGE | PULSE LIFE TIME RATINGS GO TO REF. PAGE |
|---|---|---|---|
| TND05SV220K | TND05V-220K | P.59 | P.74 |
| TND05SV270K | TND05V-270K | | |
| TND05SV330K | TND05V-330K | | |
| TND05SV390K | TND05V-390K | | |
| TND05SV470K | TND05V-470K | | |
| TND05SV560K | TND05V-560K | | |
| TND05SV680K | TND05V-680K | | |
| TND07SV220K | TND07V-220K | P.61 | P.75 |
| TND07SV270K | TND07V-270K | | |
| TND07SV330K | TND07V-330K | | |
| TND07SV390K | TND07V-390K | | |
| TND07SV470K | TND07V-470K | | |
| TND07SV560K | TND07V-560K | | |
| TND07SV680K | TND07V-680K | | |
| TND10SV220K | TND10V-220K | P.65 | P.76 |
| TND10SV270K | TND10V-270K | | |
| TND10SV330K | TND10V-330K | | |
| TND10SV390K | TND10V-390K | | |
| TND10SV470K | TND10V-470K | | |
| TND10SV560K | TND10V-560K | | |
| TND10SV680K | TND10V-680K | | |
| TND14SV220K | TND14V-220K | P.69 | P.77 |
| TND14SV270K | TND14V-270K | | |
| TND14SV330K | TND14V-330K | | |
| TND14SV390K | TND14V-390K | | |
| TND14SV470K | TND14V-470K | | |
| TND14SV560K | TND14V-560K | | |
| TND14SV680K | TND14V-680K | | |
| TND20SV220K | TND20V-220K | P.71 | P.78 |
| TND20SV270K | TND20V-270K | | |
| TND20SV330K | TND20V-330K | | |
| TND20SV390K | TND20V-390K | | |
| TND20SV470K | TND20V-470K | | |
| TND20SV560K | TND20V-560K | | |
| TND20SV680K | TND20V-680K | | |

# SV Series Low varistor voltage

## ◆GENERAL SPECIFICATIONS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Standard Test Condition** | 20±15°C, 85%RH Max. | – |
| **Varistor Voltage** | The voltage between the two terminals measured at CmA DC is called Varistor Voltage. The measurement shall be made as fast as possible to avoid heat affection.<br>Type / Current CmA: 5SV / 0.1; Others / 1.0 | Satisfy the specification |
| **Maximum Allowable Voltage** | Maximum continuous AC voltage (50 to 60Hz/AC) and maximum DC voltage which can be applied. | Satisfy the specification |
| **Maximum Peak Surge Current** | Maximum surge current (8/20μs pulse wave to be applied twice, 5 minutes apart) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Energy Rating** | Maximum energy (2ms square wave to be applied once) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Rated Wattage** | Maximum power (50 to 60Hz/AC power to be applied for 1000 hours at 125°C) for varistor voltage change within ±10% of the initial value. | Satisfy the specification |
| **Maximum Clamping Voltage** | Maximum voltage across varistor when 8/20μs rated current surge is applied. | Satisfy the specification |
| **Capacitance** | Varistor's capacitance at 1kHz, standard test condition. | For reference only. |
| **Voltage Temperature Coefficient** | $\frac{VC\text{ at }125℃ - VC\text{ at }25℃}{VC\text{ at }25℃} \times \frac{1}{100} \times 100\ (\%/℃)$<br>VC : Actual Varistor Voltage | Within ±0.05%/°C |
| **Maximum Applicable Voltage for a Short Period (5 minutes)** | Maximum DC voltage to be applied for only 5 minutes. | ΔVCmA/VCmA≦±15% |

## ◆ENVIRONMENTAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **High Temperature Storage (Dry heat)** | The specimen shall be subjected 150±2°C for 1000±12 hours without load. | ΔVCmA/VCmA≦±10% |
| **Low Temperature Storage** | The specimen shall be subjected −40±2°C for 1000±12 hours without load. | ΔVCmA/VCmA≦±5% |
| **Damp heat (Humidity)** | The specimen shall be subjected to 85±2°C, 80 to 85%RH for 1000±12 hours without load. | ΔVCmA/VCmA≦±10% |
| **Temperature Cycle** | The temperature cycle shown below shall be repeated 1000 cycles.<br>−40±3°C, 30 minutes ⇔ +125±2°C, 30 minutes | ΔVCmA/VCmA≦±10%<br>No remarkable damage |
| **High Temperature Operating** | The specimen shall be subjected to 125±2°C with the maximum allowable voltage for 1000±12 hours. | ΔVCmA/VCmA≦±10% |
| **Damp heat Operating** | The specimen shall be subjected to 85±2°C, 80 to 85%RH with the maximum allowable voltage for 1000±12 hours. | ΔVCmA/VCmA≦±10% |

Varistor voltage change of forward direction shall be measured in the test of unipolar surge life and DC load life.
Varistor voltage change is measured after stored at Standard Test Conditions for 1 to 2 hours.

# SV Series Low varistor voltage

## ◆MECHANICAL CHARACTERISTICS

<table>
<tr><th>Item</th><th>Test Conditions</th><th>Specifications</th></tr>
<tr><td>Resistance to Soldering Heat</td><td>Each lead shall be dipped into a solder bath having a temperature of 350±10°C to a point 2.0 to 2.5 mm from the body of unit, be held there for $3^{+1}_{0}$ sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined.<br>or<br>Each lead shall be dipped into a solder bath having a temperature of 260±10°C to a point 2.0 to 2.5 mm from the body of the unit, be held there for 10±1 sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined.</td><td>ΔVCmA/VCmA≦±5%<br>No remarkable damage</td></tr>
<tr><td>Solderability</td><td>Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec.<br>Then each lead shall be dipped into a solder.
<table>
<tr><td>Solder</td><td>Pb free (Sn-3.0Ag-0.5Cu)</td><td>Eutectic (Sn/Pb)</td></tr>
<tr><td>Solder Temp.</td><td>245±5℃</td><td>235±5℃</td></tr>
<tr><td>Dipping Time</td><td colspan="2">2±0.5sec.</td></tr>
<tr><td>Dipping Depth</td><td colspan="2">1.5 to 2.0mm (from the body)</td></tr>
</table></td><td>At least, 95% of the leads shall be covered with solder uniformly.</td></tr>
<tr><td>Lead Pull Strength</td><td>After gradually applying the load keeping the unit fixed for 10±5 seconds in axial direction.
<table>
<tr><td>Type</td><td>Lead Diameter</td><td>Force</td></tr>
<tr><td>5SV,7SV</td><td>0.6mm</td><td>10N</td></tr>
<tr><td>10SV,14SV,20SV</td><td>0.8mm</td><td>10N</td></tr>
</table></td><td>No abnormality such as disconnection.<br>ΔVCmA/VCmA≦±5%</td></tr>
<tr><td>Lead Bend Strength</td><td>The unit shall be secured with its terminal kept vertical and the weight specified below be applied in the axial direction.<br>The terminal shall gradually be bend by 90 ° in one direction then 90 ° in the opposite direction, and again back to original position. The damage of the terminal shall be visually examined.
<table>
<tr><td>Type</td><td>Lead Diameter</td><td>Force</td></tr>
<tr><td>5SV,7SV</td><td>0.6mm</td><td>5N</td></tr>
<tr><td>10SV,14SV,20SV</td><td>0.8mm</td><td>5N</td></tr>
</table></td><td>No remarkable damage as remarkable the innner ceramic element or terminal open.</td></tr>
<tr><td>Vibration</td><td>Mount varistor body on vibrator, and conduct the following vibration test.<br>Peak-to-Peak amplitude : 1.5mm , Acceleration : 5G<br>Vibration frequency range : 10 to 500Hz<br>Sweeping time: Approximately 20 minutes for 10Hz→500Hz→10Hz<br>Direction and duration of vibration : Three directions of X, Y, and Z. 2 hours each. 6 hours total.</td><td>No remarkable apperance abnormality.<br>ΔVCmA/VCmA≦±5%</td></tr>
<tr><td>Flammability test</td><td>The varistor shall be subjected 60 sec. applications of test flame.<br><br>Burnar : Bunsen gas burner 9000kcal / $m^3$<br>Diameter of flame nozzle : ϕ9.5mm<br>Position : The spesimen shall be fixed horizonal.<br>Point of application shall be approximately center of the specimen .</td><td>No catching fire, and no flaming drops.</td></tr>
</table>

# H Series

RoHS2 Compliant

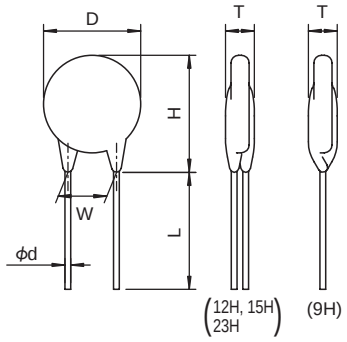
High Energy, Low Varistor Voltage Series

## ◆STANDARD RATINGS

Operating Temperature Range: -40 to +125℃
Storage Temperature Range: -50 to +150℃

| Part Number | Previous Part Number (Just for your reference) | Max. Allowable Voltage | | Maximum applicable voltage for a short period | Max. Energy | Max. Clamping Voltage | | Varistor Voltage V1mA |
|---|---|---|---|---|---|---|---|---|
| | | Continuous | | 5 minutes | | | | |
| | | AC (Vrms) | DC (V) | DC (V) | 20ms(J) | (A) | (V) | (V) |
| TND09H-220KB00AAA0 | TNR9H220K | 12 | 16 | 24 | | | 43 | 22 (20～24) |
| TND09H-270KB00AAA0 | TNR9H270K | 15 | 19 | 29 | | | 53 | 27 (24～30) |
| TND09H-330KB00AAA0 | TNR9H330K | 18 | 24 | 36 | 5 | 2 | 65 | 33 (30～36) |
| TND09H-390KB00AAA0 | TNR9H390K | 22 | 28 | 42 | | | 77 | 39 (35～43) |
| TND09H-470KB00AAA0 | TNR9H470K | 26 | 34 | 50 | | | 93 | 47 (42～52) |
| TND12H-220KB00AAA0 | TNR12H220K | 12 | 16 | 24 | | | 43 | 22 (20～24) |
| TND12H-270KB00AAA0 | TNR12H270K | 15 | 19 | 29 | | | 53 | 27 (24～30) |
| TND12H-330KB00AAA0 | TNR12H330K | 18 | 24 | 36 | 10 | 5 | 65 | 33 (30～36) |
| TND12H-390KB00AAA0 | TNR12H390K | 22 | 28 | 42 | | | 77 | 39 (35～43) |
| TND12H-470KB00AAA0 | TNR12H470K | 26 | 34 | 50 | | | 93 | 47 (42～52) |
| TND15H-220KB00AAA0 | TNR15H220K | 12 | 16 | 24 | | | 43 | 22 (20～24) |
| TND15H-270KB00AAA0 | TNR15H270K | 15 | 19 | 29 | | | 53 | 27 (24～30) |
| TND15H-330KB00AAA0 | TNR15H330K | 18 | 24 | 36 | 20 | 10 | 65 | 33 (30～36) |
| TND15H-390KB00AAA0 | TNR15H390K | 22 | 28 | 42 | | | 77 | 39 (35～43) |
| TND15H-470KB00AAA0 | TNR15H470K | 26 | 34 | 50 | | | 93 | 47 (42～52) |
| TND23H-220KB00AAA0 | TNR23H220K | 12 | 16 | 24 | | | 43 | 22 (20～24) |
| TND23H-270KB00AAA0 | TNR23H270K | 15 | 19 | 29 | | | 53 | 27 (24～30) |
| TND23H-330KB00AAA0 | TNR23H330K | 18 | 24 | 36 | 40 | 25 | 65 | 33 (30～36) |
| TND23H-390KB00AAA0 | TNR23H390K | 22 | 28 | 42 | | | 77 | 39 (35～43) |
| TND23H-470KB00AAA0 | TNR23H470K | 26 | 34 | 50 | | | 93 | 47 (42～52) |

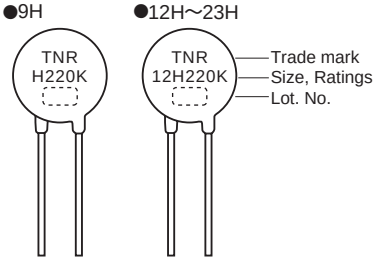
## ◆DIMENSIONS [mm]




| Type | D Max. | H Max. | T Max. | W ±1.0 | L Min. | ϕd ±0.05 |
|---|---|---|---|---|---|---|
| 9H | 10.0 | 13.0 | 5.0 | 5.0 | 25.0 | 0.6 |
| 12H | 13.5 | 16.5 | 5.0 | 7.5 | 25.0 | 0.8 |
| 15H | 16.5 | 19.0 | 5.0 | 7.5 | 25.0 | 0.8 |
| 23H | 24.0 | 27.0 | 5.0 | 10.0 | 25.0 | 0.8 |

## ◆MARKING

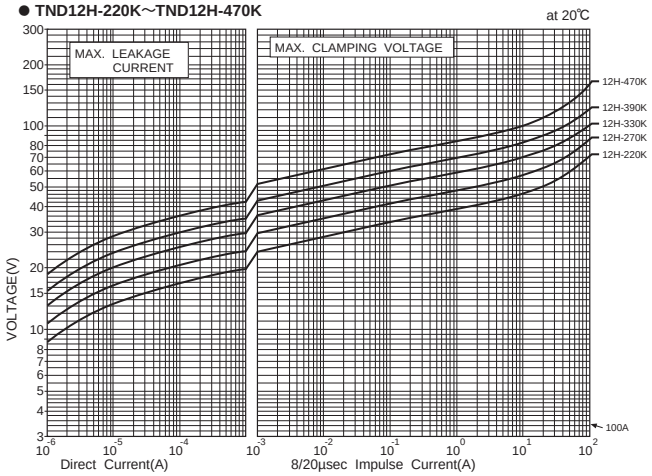
EX)



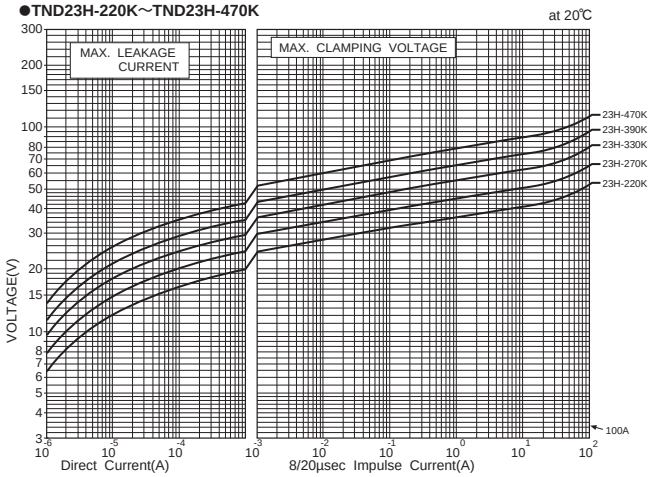
# H Series

## ◆V-I CURVE

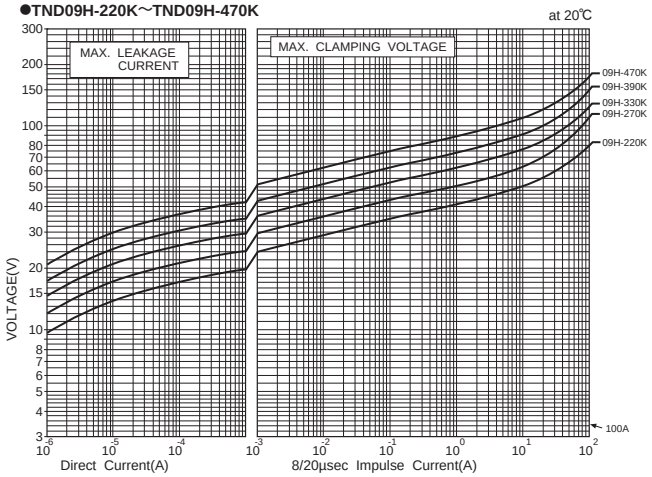
● TND12H-220K～TND12H-470K



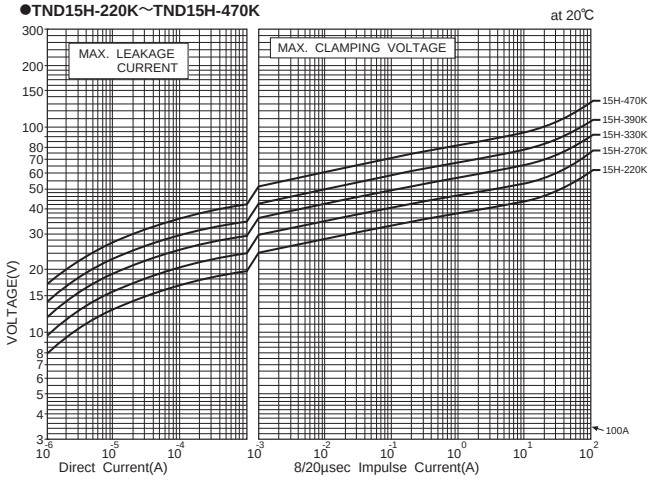

●TND23H-220K～TND23H-470K




●TND09H-220K～TND09H-470K




●TND15H-220K～TND15H-470K



# H Series

## ◆GENERAL SPECIFICATIONS

Operating Temperature Range: -40 to +125℃
Storage Temperature Range: -50 to +150℃

| Item | Test Conditions | Specifications |
|---|---|---|
| **Standard Test Condition** | 20±15℃, 85%RH Max. | |
| **Varistor Voltage** | The voltage between the two terminals measured at 1mA DC is called Varistor Voltage.<br>The measurement shall be made as fast as possible to avoid heat affection. | Satisfy the specification. |
| **Maximum Allowable Voltage** | Maximum continuous sinusoidal RMS voltage or<br>Maximum continuous DC voltage which may be applied. | Refer to Ratings. |
| **Maximum applicable voltage for a short period (5 minutes)** | Maximum DC voltage to be applied for only 5 minutes. | Refer to Ratings. |
| **Maximum Clamping Voltage** | The maximum voltage between the terminals, measured standard impulse current (8/20 μs). | Satisfy the specification. |
| **Maximum Energy** | Maximum energy within the ±10% varistor voltage change when 1 impulse 20 ms long is applied. | Satisfy the specification. |
| **Temperature Coefficient** | $\frac{\text{V1mA at 85℃} - \text{V1mA at 25℃}}{\text{V1mA at 25℃}} \times \frac{1}{60} \times 100\ (\%/℃)$ | Within<br>±0.05 % / ℃ |

## ◆MECHANICAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Terminal Pull Strength** | After gradually applying the force keeping the unit fixed for 10±1 sec. in axial direction, the damage of the terminals shall be visually examined.<br>Lead diameter: ϕ0.6mm. ϕ0.8mm — Force: 10 N | ΔV1mA / V1mA ≦±5%<br>No remarkable damage |
| **Terminal Bending Strength** | The unit shall be secured with its terminal kept vertical and the weight specified below be applied in the axial direction.<br>The terminal shall gradually be bend by 90° in one direction then 90º in the opposite direction, and again back to original position.<br>The damage of the terminal shall be visually examined.<br>Lead diameter: ϕ0.6mm. ϕ0.8mm — Force: 5 N | No remarkable damage |
| **Vibration** | After repeatedly applying a single harmonic vibration (amplitude : 0.75mm) double amplitude : 1.5mm with 1 minute vibration frequency cycle (10Hz→500Hz→10Hz) to each three perpendicular directions for 2 hours. Total 6 hours. The devices shall be visually examined. | ΔV1mA / V1mA ≦±5%<br>No remarkable damage |
| **Resistance to Soldering Heat** | Each lead shall be dipped into a solder bath having a temperature of 350±10℃ to a point 2.0 to 2.5 mm from the body of the unit, be held there for $3^{+1}_{-0}$ sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined.<br>or<br>Each lead shall be dipped into a solder bath having a temperature of 260±10℃ to a point 2.0 to 2.5 mm from the body of the unit, be held there for 10±1 sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined. | ΔV1mA / V1mA ≦±5%<br>No remarkable damage |
| **Solderability** | Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec.<br>Then each lead shall be dipped into a solder. | At least, 95% of the leads shall be covered with solder uniformly. |

| Solder | Pb free (Sn-3.0Ag-0.5Cu) | Eutectic (Sn/Pb) |
|---|---|---|
| Solder Temp. | 245±5℃ | 235±5℃ |
| Dipping Time | 2±0.5sec. | |
| Dipping Depth | 1.5 to 2.0mm (from the body) | |

# H Series

## ◆ENVIRONMENTAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **High Temperature Storage (Dry heat)** | The specimen shall be subjected 150±2℃ for 1000±12 hours without load. | ΔV1mA/V1mA≦±10% |
| **Low Temperature Storage** | The specimen shall be subjected -40±2℃ for 1000±12 hours without load. | ΔV1mA/V1mA≦±5% |
| **Damp heat (Humidity)** | The specimen shall be subjected to 60±2℃, 90 to 95%RH for 1000±12 hours without load. | ΔV1mA/V1mA≦±10% |
| **Temperature Cycle** | The temperature cycle shown below shall be repeated 50 cycles.<br>-40±3℃, 30 minutes ⇔ +150±2℃, 30 minutes | ΔV1mA/V1mA≦±10%<br>No remarkable damage |
| **High Temperature Operating** | The specimen shall be subjected to 125±2℃ with the maximum allowable voltage for 1000±12 hours. | ΔV1mA/V1mA≦±20% |
| **Damp heat Operating** | The specimen shall be subjected to 60±2℃, 90 to 95%RH with the maximum allowable voltage for 1000±12 hours. | ΔV1mA/V1mA≦±10% |

Varistor voltage change of forward direction shall be measured in the test of unipolar surge life and DC load life.
Varistor voltage change is measured after stored at Standard Test Conditions for 1 to 2 hours.
Note : For 42V battery line, please contact our sales office.

# GF Series

RoHS2 Compliant

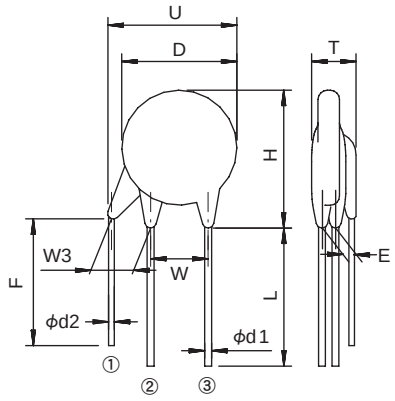
GF Series are combined Varistor with Thermal Fuse
●Coating resin : UL94V-0

Operating Temperature Range: -40 to +85℃
Storage Temperature Range: -50 to +125℃

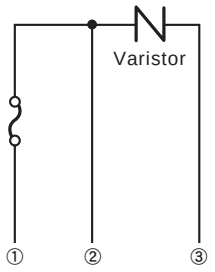
## ◆STANDARD RATINGS

| Part Number | Previous Part Number (Just for your reference) | Maximum Ratings | | | | | Max. Clamping Voltage | Capacitance Typical @1kHz | Varistor Voltage V1mA | T Max. | E ±1.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. Allowable Voltage | | Max. Peak Current | Max. Energy | Rated Wattage | | | | | |
| 15GF Type | | AC(Vrms) | DC(V) | 8/20μs(A) | 2ms(J) | (W) | V50A (V) | (pF) | (V) | (mm) | (mm) |
| TND15GF271KB00EAA0 | TNR15GF271K-E | 175 | 225 | | 50 | 0.6 | 440 | 680 | 270 (243～297) | 9 | 1.5 |
| TND15GF471KB00EAA0 | TNR15GF471K-E | 300 | 385 | 2500A/2 times | 80 | 0.6 | 765 | 450 | 470 (423～517) | 10 | 2.2 |
| TND15GF821KB00EAA0 | TNR15GF821K-E | 510 | 670 | | 110 | 0.6 | 1340 | 280 | 820 (738～902) | 12 | 3.5 |
| 23GF Type | | AC (Vrms) | DC (V) | 8/20μs(A) | 2ms(J) | (W) | V100A (V) | (pF) | (V) | (mm) | (mm) |
| TND23GF271KB00EAA0 | TNR23GF271K-E | 175 | 225 | | 90 | 0.8 | 440 | 1850 | 270 (243～297) | 9 | 1.5 |
| TND23GF471KB00EAA0 | TNR23GF471K-E | 300 | 385 | 4000A/2 times | 150 | 1.0 | 765 | 1200 | 470 (423～517) | 10 | 2.3 |
| TND23GF821KB00EAA0 | TNR23GF821K-E | 510 | 670 | | 190 | 1.5 | 1340 | 800 | 820 (738～902) | 12 | 3.6 |

## ◆DIMENSIONS [mm]



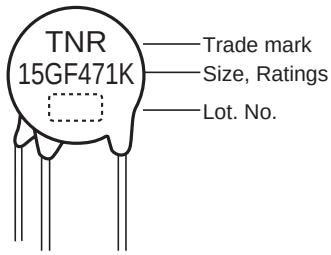

| | 15GF | 23GF |
|---|---|---|
| D | 18 Max. | 25 Max. |
| T | Refer to Standard Ratings | |
| H | 22 Max. | 32 Max. |
| W | 7.5±1 | 10±1 |
| W3 | 2.5 Min. | 2.5 Min. |
| L | 25 Min. | 25 Min. |
| U | 23 Max. | 28 Max. |
| F | 17 Min. | 17 Min. |
| E | Refer to Standard Ratings | |
| ϕd1 | 0.8±0.05 | 0.8±0.05 |
| ϕd2 | 0.53±0.05 | 0.58±0.05 |




| Type | Thermal fuse ratings |
|---|---|
| 15GF | 145℃-250V-1A |
| 23GF | 145℃-250V-3A |

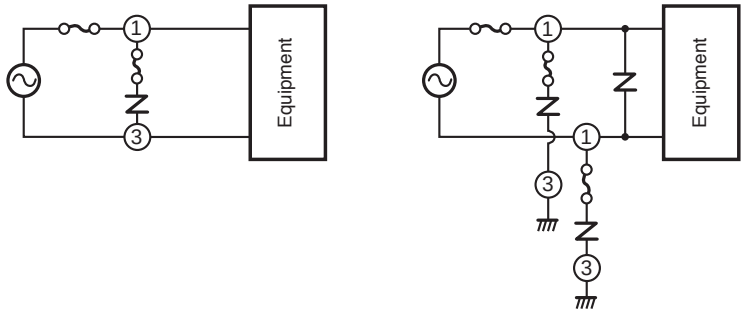
## ◆MARKING

EX)



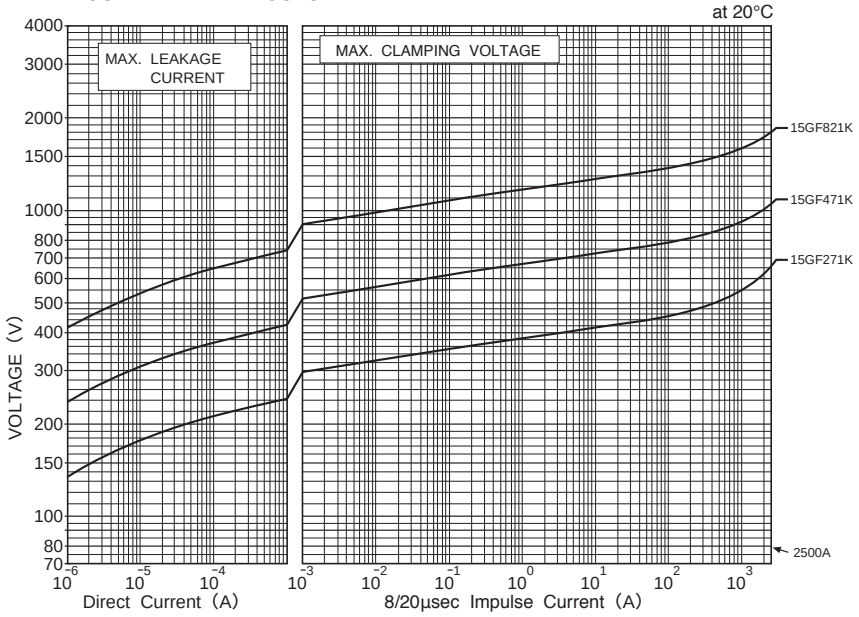
# GF Series

## ◆APPLICATION CIRCUIT EXAMPLE

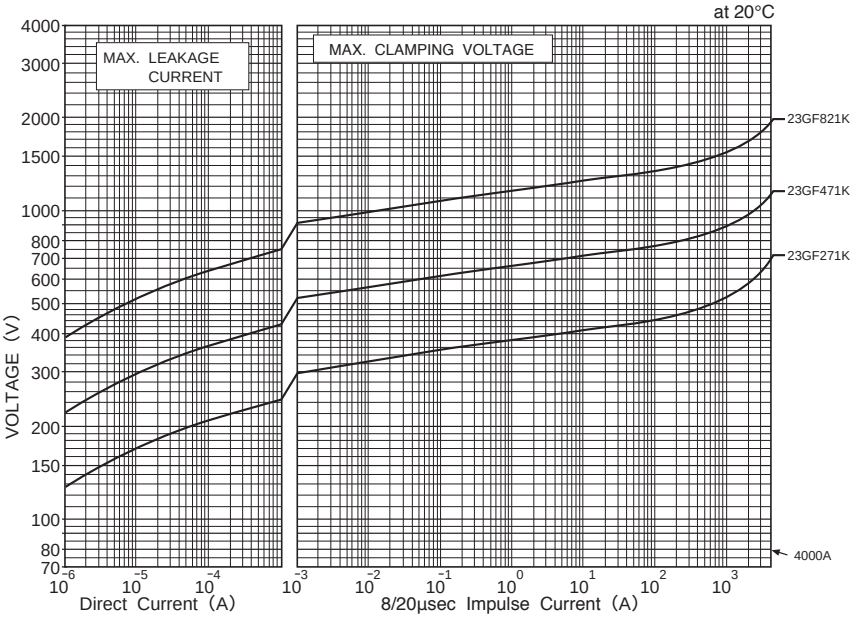



## ◆V-I CURVE

● TND15GF271K ～ TND15GF821K

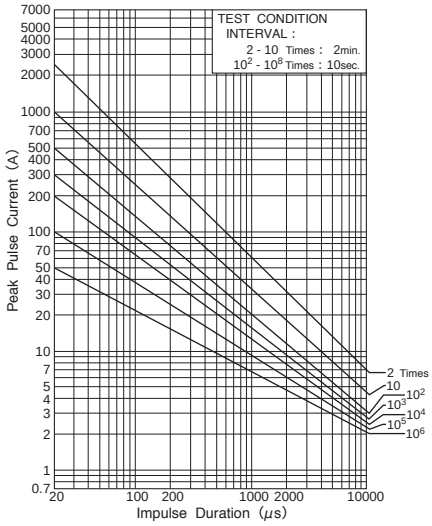



● TND23GF271K ～ TND23GF821K

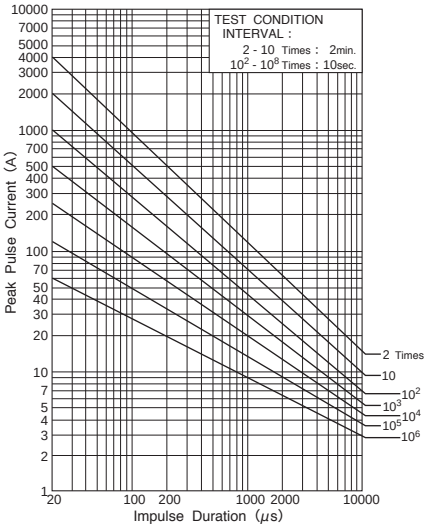



## ◆PULSE LIFE TIME RAITINGS

● TND15GF271K ～ TND15GF821K




● TND23GF271K ～ TND23GF821K



# GF Series

## ◆GENERAL SPECIFICATIONS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Standard Test Condition** | 20±15℃ , 85%RH Max. | |
| **Varistor Voltage** | The V1 mA voltage between the two leads at 1 mA DC is quickly measured. | Satisfy the specification. |
| **Maximum Allowable Voltage** | The maximum DC voltage to be continuously applied, and the maximum sinusoidal AC voltage effective value. | |
| **Maximum Peak Surge Current** | The maximum current value if the change rate is ±10% of the varistor voltage against an initial value when the standard impulse current at 8/20 μs is applied in one direction twice within a five-minute interval. | |
| **Energy Rating** | The maximum energy if the change rate is ±10% of the varistor voltage against an initial value when a 2 ms square wave is applied once. | |
| **Rated Wattage** | The maximum electric power if the change rate of the varistor voltage is ±10% when commercial frequency AC power is applied in 85±2℃ for 1000±12 hours. | |
| **Maximum Clamping Voltage** | The maximum voltage between the terminals, measured standard impulse current (8/20 μs). | |
| **Temperature Coefficient** | The varistor voltage is measured at 25±2℃ and 85±2℃ , and the change rate of the varistor voltage per 1℃ is calculated. | Within ±0.05 % / ℃ |
| **Insulation** | Short circuit the two leads of the varistor, and put the varistor body into metal balls (approximately 1 mm diameter) leaving approximately 2 mm between the leads and the balls. Then, apply AC2000 Vrms between the leads and the metal balls for 60±5 seconds. | No abnormalities caused by insulation breakdown, etc. |
| **Capacitance** | The capacitance measured by 1kHz, 1 Vrms sinusoidal wave. | For reference only |

Note: In DC load or unipolar surge tests, apply varistor voltage in the test voltage forward direction to measure and evaluate.
Varistor voltage change is measured after stored at Standard Test Conditions for 1 to 2 hours.

## ◆MECHANICAL CHARACTERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **Terminal Pull Strength** | Fix the unit, and gradually apply and maintain the rated tensile force to the lead wire for 10±5 seconds.(Conform to JIS C 5035)<br>Type / Lead Diameter / Force<br>15GF, 23GF / 0.8mm / 10N<br>Thermal fuse (15GF) / 0.53mm / 5N<br>Thermal fuse (23GF) / 0.58mm / 10N | No abnormality such as disconnection. |
| **Terminal Bending Strength** | The unit shall be secured with its terminal kept vertical and the weight specified below be applied in the axial direction. The terminal shall gradually be bent by 90º in one direction then 90º in the opposite direction, and again back to the original position. (Conform to JIS C 5035)<br>Type / Lead Diameter / Force<br>15GF, 23GF / 0.8mm / 5N<br>Thermal fuse (15GF) / 0.53mm / 2.5N<br>Thermal fuse (23GF) / 0.58mm / 5N | The leads shall not disconnect, slacken, or peel off after bending twice. |
| **Vibration** | Mount varistor body on vibrator, and conduct the following vibration test.<br>Peak-to-Peak amplitude : 1.5mm, Acceleration : 5G<br>Vibration frequency range : 10 to 500Hz<br>Sweeping time: Approximately 20 minutes for 10Hz → 500Hz → 10Hz<br>Direction and duration of vibration : Three directions of X, Y, and Z. 2 hours each. 6 hours total. | No remarkable apperance abnormality. |
| **Solderability** | Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec.<br>Then each lead shall be dipped into a solder.<br>Solder / Pb free (Sn-3.0Ag-0.5Cu) / Eutectic (Sn/Pb)<br>Solder Temp. / 245±5℃ / 235±5℃<br>Dipping Time / 2±0.5sec.<br>Dipping Depth / 1.5 to 2.0mm (from the body) | At least, 95% of the leads shall be covered with solder uniformly. |
| **Resistance to Soldering Heat** | Each lead shall be dipped into a solder bath having a temperature of 350±10℃ to a point 2.0 to 2.5 mm from the body of the unit, be held there for 3 sec and then be stored at room temperature for 1 to 2 hours. The ΔV1mA and mechanical damage shall be examined. (Conform to JIS C 5102) | ΔV1mA / V1mA ≦ ±5%<br>No remarkable damage |

## ◆ENVIRONMENTAL CHAR AC TERISTICS

| Item | Test Conditions | Specifications |
|---|---|---|
| **High Temperature Storage (Dry heat)** | The specimen shall be subjected 125±2℃ for 1000±12 hours without load. | ΔV1mA/V1mA ≦ ±5% |
| **Damp heat (Humidity)** | The specimen shall be subjected 40±2℃ for 1000±12 hours without load. | ΔV1mA/V1mA ≦ ±5% |
| **Temperature Cycle** | The temperature cycle shown below shall be repeated 50 cycles.<br>-40±3℃ , 30 minutes ⇔ +150±2℃ , 30 minutes | ΔV1mA/V1mA ≦ ±5%<br>No remarkable damage<br>No thermal fuse disconnection. |
| **Damp heat Operating** | The specimen shall be subjected to 40±2℃ , 90 to 95%RH with the maximum allowable voltage for 1000±12 hours. | ΔV1mA/V1mA ≦ ±10% |
| **High Temperature Operating** | The specimen shall be subjected to 85±2℃ with the maximum allowable voltage for 1000±12 hours. | ΔV1mA/V1mA ≦ ±10%<br>No thermal fuse disconnection. |

# Metal Oxide Varistors TNR™
## Technical Note, Application Examples

# 1. WHAT IS A VARISTOR?

A varistor has the volt-ampere characteristics in which current suddenly starts to flow through the device at a certain voltage, as shown in Figure 1.

The varistors are used to protect semiconductor devices in electronic and electric circuits from overvoltage. As shown in Figure 2, a varistor is inserted in parallel with a circuit to be protected. When an impulse is applied to the circuit, pulse current Is, which is determined by pulse voltage Vs and pulse impedance Zs, flows to limit the pulse voltage to the varistor limit voltage Vclamp.

The relation can be expressed by the equations as follows:

$$Vs = Is \times Zs + Vclamp \quad (1)$$

$$Vclamp = Vs - Is \times Zs \quad (2)$$

The pulse current Is is easily obtained by the following equation because of Vs >> Vclamp.

$$Is \fallingdotseq \frac{Vs}{Zs} \quad (3)$$

Thus, the circuit can be protected from being damaged by pulse voltages as long as it has withstand voltage larger than the maximum limit voltage.

Owing to the characteristic, the varistors are extremely effective as protecting devices of electronic and electric equipment by absorption of abnormal voltages and lightening pulses.

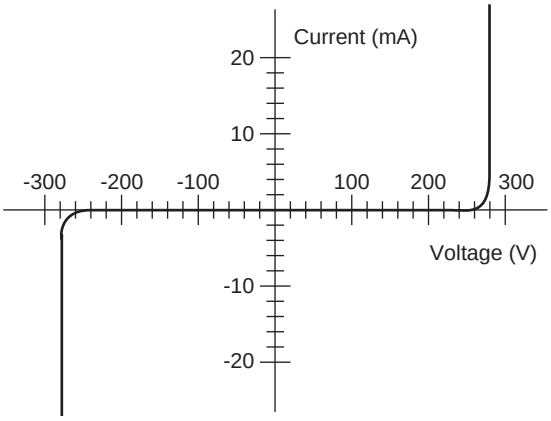



**Fig. 1 Volt-ampere characteristics of varistor**

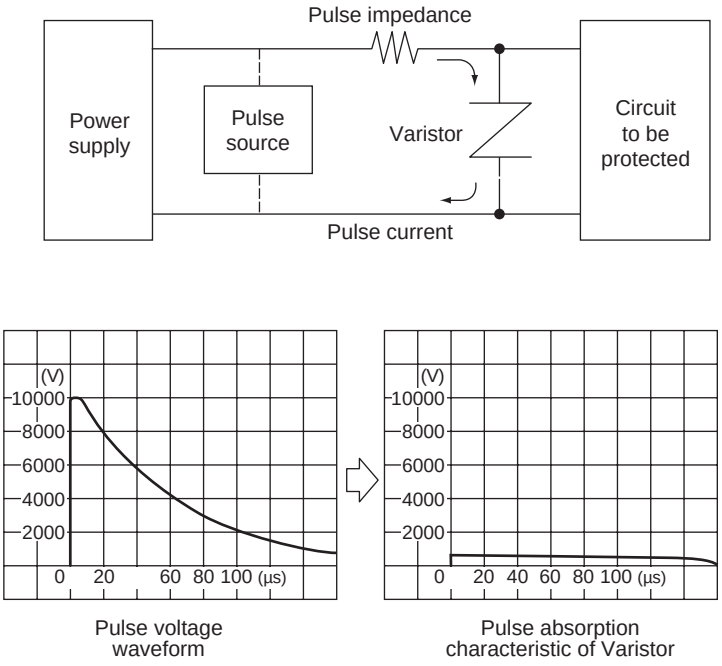


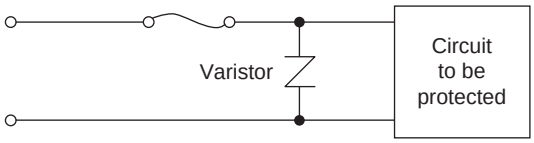
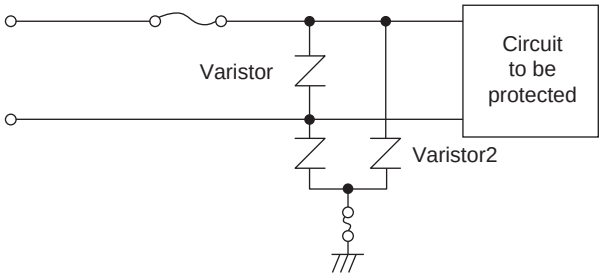
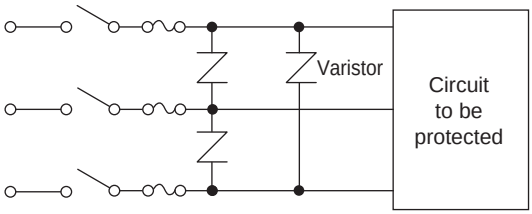
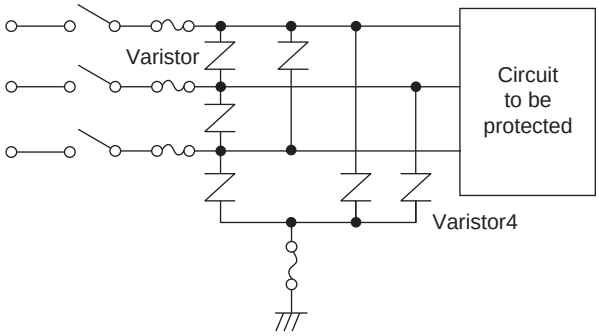

**Fig. 2 Pulse absorption by varistor**

# 2. SAMPLE USED AND NOTES ON Varistor

This chapter describes general sample uses and notes on use of Varistors. Take these conditions into consideration when you select Varistors of appropriate ratings.

## 2-1 PROTECTION FROM POWER PULSE

(1)Examples of wiring

| Line to line protection | Line to line and line to ground protection |
|---|---|
| DC or single-phase AC<br>  | DC or single-phase AC<br>  |
| Three-phase AC<br>  | Three-phase AC<br>  |

(2)Examples of rating selections

**Varistor used for line to line**

| Power Voltage | Type |
|---|---|
| AC100V | TND□□V-221K<br>TND□□V-241K<br>TND□□V-271K* |
| AC200V | TND□□V-391K<br>TND□□V-431K<br>TND□□V-471K* |
| DC12V | TND□□V-220K<br>TND□□V-270K |
| DC24V | TND□□V-330K<br>TND□□V-390K<br>TND□□V-470K |

Notes:

1)If a Varistor is used at power voltage other than the examples above, never make the power voltage increase over the maximum allowable voltage.

2)For individual wiring or capacitive load, the power voltage is temporarily increased by resonance at switch on or off. Thus, use a Varistor of the type with mark * for the power of 100 VAC or 200 VAC.

**Varistor used for line to ground**

| Varistor | Power Voltage | Type |
|---|---|---|
| Varistor2 | AC100V<br>AC200V | TND□□V-431K<br>TND□□V-471K<br>TND□□V-911K≦**<br>TND□□V-182K *** |
| Varistor4 | AC200V | TND□□V-431K<br>TND□□V-471K<br>TND□□V-911K≦**<br>TND□□V-182K *** |

Notes:

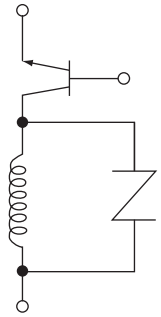
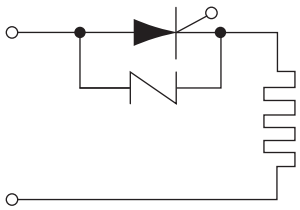
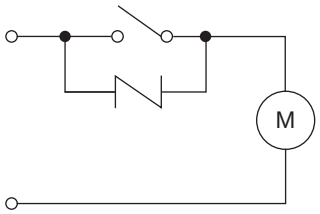
1)In an insulation resistance test (500V mega test) of a unit, it may incorrectly judged to be bad due to its leak current from the Varistor mounted on the unit. Test the unit with the Varistor removed after obtaining approval of the unit user on removing the Varistor. Or use a Varistor with mark ** for the test unit.

2)In a withstand voltage test (1000 VAC test) of a unit, it may incorrectly judged to be bad due to its leakage current from the Varistor mounted on the unit. Test the unit with the Varistor removed after obtaining approval of the unit user on removing the Varistor. Or use a Varistor with mark *** for the test unit.

3)Use a Varistor of 200 VAC type between the 100 VAC power line to ground to prevent the power supply from being damaged by overvoltage such as ground-fault.

## 2-2 PROTECTION OF SEMICONDUCTORS AND ICs FROM INDUCTIVE ON/OFF PULSES AND ERASE OF CONTACT SPARKS

(1)Examples of wiring

| Switching surge protection | Semiconductor protection | Erasing contact sparks |
|---|---|---|
|  |  |  |

(2)Examples of rating selections

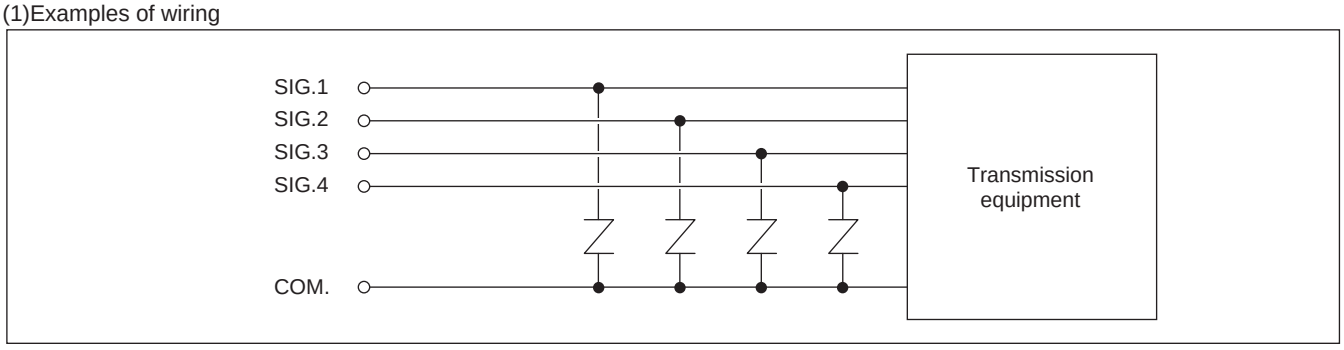
| Examples of general selections | | |
|---|---|---|
| Power Voltage | Type | Notes: |
| DC 12V | TND□□V-220K | 1)If a Varistor is used at power voltage other than the examples to the left, never make the power voltage increase over the maximum allowable voltage. |
| DC 24V | TND□□V-390K | 2)For other than a complete DC voltage, never make the maximum peak voltage increase over the maximum allowable voltage. |
| DC100V | TND□□V-151K | 3)Take the pulse energy generated in load into account sufficiently to define the maximum peak current, maximum energy, and rated wattage. |
| AC100V | TND□□V-221K<br>TND□□V-241K<br>TND□□V-271K | |

(3)Notes on use of Varistor

1. Be careful of the notes described in Section 2-1 "PROTECTION FROM POWER PULSE."
2. Select a proper Varistor satisfying the desired relationship between the number of pulse applications and the Varistor rating, referring to the reduction curve of pulse life time ratings.
3. Select a Varistor having rated wattage larger than averaged pulse wattage to make the Varistor absorb high-frequent pulses.

## 2-3 REDUCING PULSES ON SIGNAL TRANSMISSION LINES

(1)Examples of wiring




(2)Examples of rating selections

| Examples of general selections | | |
|---|---|---|
| Signal Carrier Voltage | Type | Notes: |
| DC 12V max. | TND□□V-150K<br>TND□□V-220K<br>TND□□V-820K≦ | 1)Any Varistor includes electrostatic capacitor listed in the rating table. Take special note when a Varistor is applied to high-frequency signal. |
| DC 24V | TND□□V-390K<br>TND□□V-820K≦ | 2)When signal of higher voltage than that of normal signals (such as bell signal) is superimposed on normal signals, select an appropriate Varistor available for the higher voltage. |
| | | 3)Use a Varistor with a type of varistor voltage 82V or higher if signal is too low to be attenuated. |

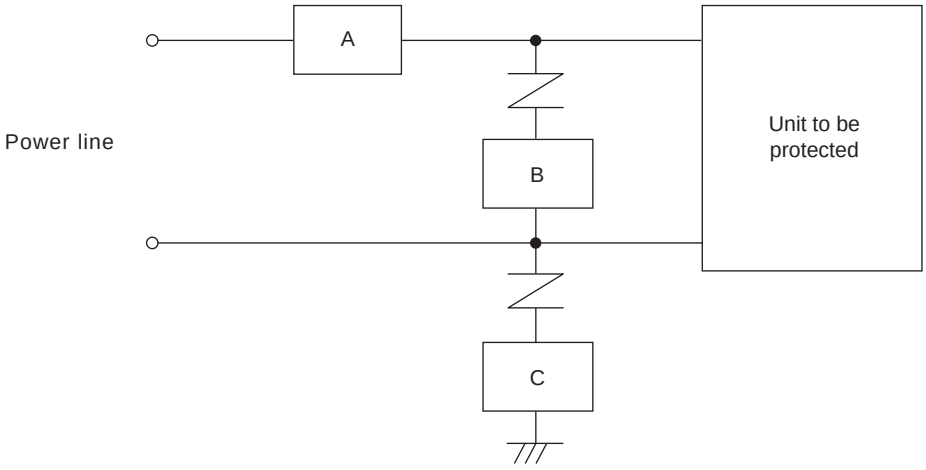
## 2-4 Examples of selections in fields

| Example of general selections | | | |
|---|---|---|---|
| Use | Location | Type | |
| Commercial | Indoor | TND05V-□□□K<br>TND07V-□□□K<br>TND10V-□□□K<br>TND12V-□□□K | Notes<br>1)Each number in the range between 5 to 20 specifies the diameter of a Varistor. The larger the diameter is the greater the maximum peak current of the Varistor is. Select a Varistor of the type covering the expected peak current.<br>2)Pay sufficient attention to the conditions peculiar to the unit on which the selected Varistor is mounted as well as normal selection examples. |
| | Outdoor | TND07V-□□□K<br>TND10V-□□□K<br>TND12V-□□□K<br>TND14V-□□□K | |
| Communication, Measurement, Control | Indoor | TND07V-□□□K<br>TND10V-□□□K<br>TND12V-□□□K<br>TND14V-□□□K | |
| | Outdoor | TND07V-□□□K<br>TND10V-□□□K<br>TND12V-□□□K<br>TND14V-□□□K | |
| Industry, Power | Indoor or outdoor | TND14V-□□□K<br>TND20V-□□□K | |

## 2-5 Notes on use

Take the notes for reduction of power pulses into account as well as those explained below.

1. Take the action shown in the figure below because the Varistor may be short-circuited or broken when it absorbs a pulse exceeding its rating.




1)Mount the Varistor closer to the circuit than the overcurrent protector such as a breaker or fuse to disconnect the Varistor from the power supply immediately at short circuit of the Varistor.

2)Mount the overcurrent protector at location B if it cannot be mounted at location A.

3)Selection examples of ratings of fuses mounted at location A or B are listed below:

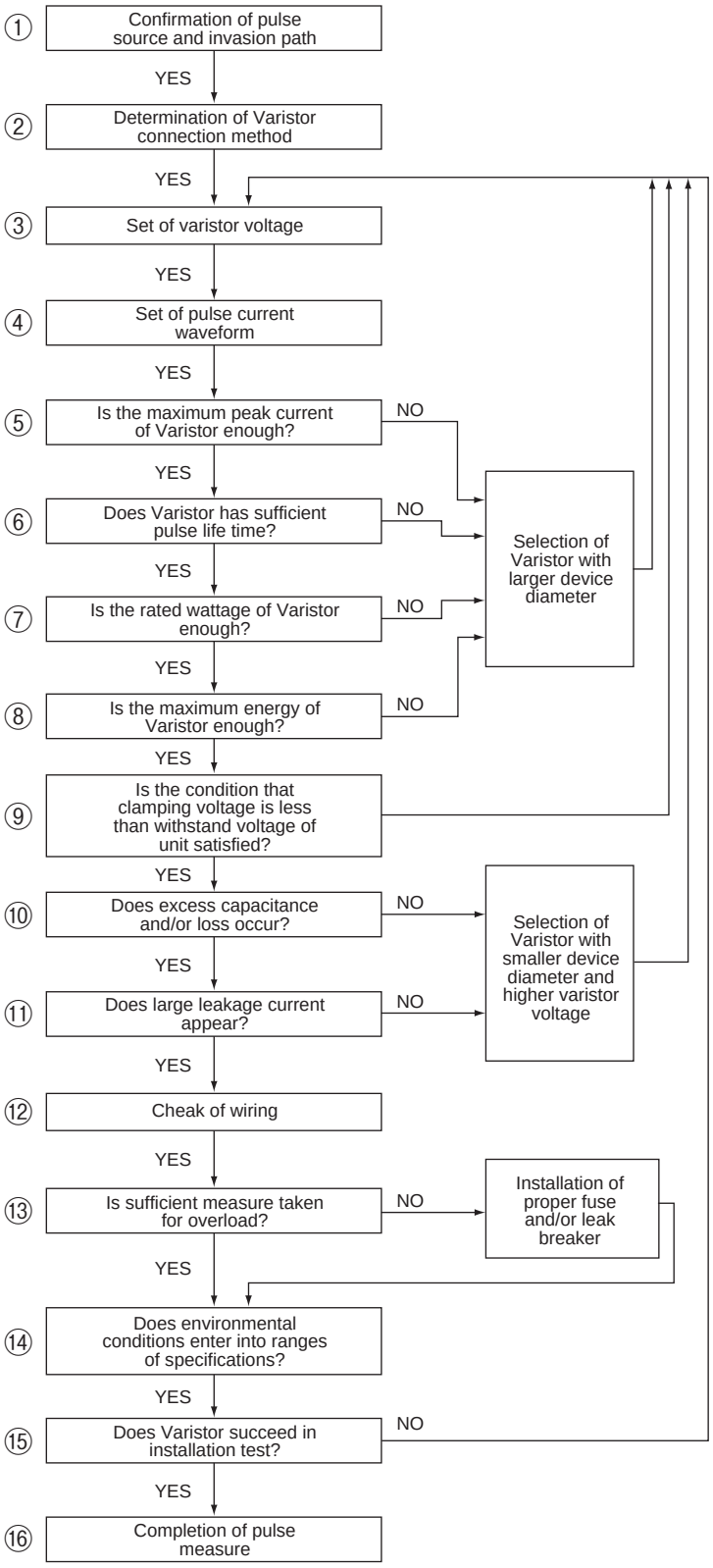
| **Type (TND-)** | 05V-□□□K | 07V-□□□K | 09V-□□□K<br>10V-□□□K<br>12V-□□□K | 14V-□□□K<br>20V-□□□K |
|---|---|---|---|---|
| **Fuse rating** | 3A max. | 5A max. | 7A max. | 10A max. |

4)Use a leak breaker or at position A or mount a temperature fuse connected thermally to the Varistor at position C if the Varistor inserted between the power line and the earth is grounded to the unit earth. It is also effective to use a Varistor of the GF series which includes a thermal fuse.

2. Check that the Varistor is used within the range of the rating operating temperature if it is exposed to direct sunlight or placed near a heating unit.
3. Make wiring of the Varistor as short as possible. With long wiring, large voltage drop occurring at a rapid rising pulse on the L component of the wiring causes the Varistor not to be effective enough for surge absorption.

# 3. SELECTION OF Varistor RATING

## 3-1 RATING SELECTION PROCEDURE




①Make clear pulse sources and invasion paths including outer lightening, inner lightening (on/off lightening), line to line portion, line to ground portion, power line, and signal line.

②See the Sample uses and notes on Varistor described earlier for the connections of Varistors.

③Set the varistor voltage so that the circuit voltage may not exceed the maximum allowable voltage. Take fully care of the applied voltage in insulating resistance or withstand voltage test if the Varistor is inserted between a line to ground.

④The peak pulse current is almost equal to the value obtained by dividing the expected pulse voltage by the pulse impedance.

⑤Select a Varistor with device diameter for the maximum peak current larger than the peak pulse current if the expected number of pulses are not more than 2.

⑥if many impulses are expected, select a Varistor with device diameter for pulse life time longer than the requested life time, referring to the figure of pulse life time ratings.

⑦Select a Varistor with device diameter for rated wattages larger than the averaged pulse wattage if pulses are applied continuously to the Varistor at a high rate.

⑧Take care of the maximum energy as well if impulses are expected to have high energy.

⑨Select the varistor voltage and diameter of Varistor so that the withstand voltage of the unit to be protected exceeds the maximum clamping voltage. If no Varistor can satisfy the requested characteristics, it may be necessary to make the withstand voltage of the unit higher.

⑩Contact us when you use a high frequency circuit. The capacitance of the Varistor may attenuate high frequency signals and the Varistor may be heated by the loss.

⑪See the maximum leakage current known from the volt-ampere characteristic curve.

⑫Make wiring as short as possible. With long wiring, large voltage drop occurring at a rapid rising pulse on the L component of the wiring and its magnetic joint with other wiring cause the Varistor not to be effective enough for surge absorption.

⑬Connect a fuse before the Varistor. See 2-5 for selection of a fuse.

⑭Take note that the temperature around the Varistor does not become larger than the maximum operating temperature.

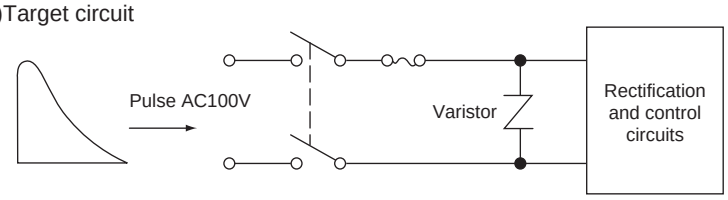
⑮Perform installation test as much as possible to confirm the performance of the Varistor.

⑯The action for absorbing pulses by Varistor is now completed.

## 3-2 EXAMPLES OF Varistor SELECTION

3-2-1 ACTION FOR EXTERNAL LIGHTENING PULSES OF POWER SUPPLY OF CONTROL UNIT

(1)Target circuit




Conditions
1)Withstand voltage Vt: 600V
2)Pulse impedance Zs: 50ohm
3)Pulse voltage Vs: 12kV at duty cycle of 1.2/50μsec
4)Number of pulses: 100 = 10times × 10years
5)Pulse interval: 2 minutes or more

(2)Selection of Varistor based on rating selection procedure

1. Confirmation of pulse source and invasion path: Circuit between external lightening pulse and power line. (The unit is not grounded.)
2. Determination of Varistor connection method: Between power lines. (AC power input side of unit to be protected.)
3. Set of varistor voltage
   Select the Varistor of 270V type based on the above sample use, because it is inserted between the 100 VAC power lines. Select a proper type of a Varistor if the relationship between the withstand and clamping voltages of the unit to be protected does not satisfy the condition described in item 9.
4. Set of pulse current waveform
   a)Pulse current peak value (Ip)

$$Ip = \frac{Vs}{Zs} = \frac{12{,}000}{50} = 240[A]$$

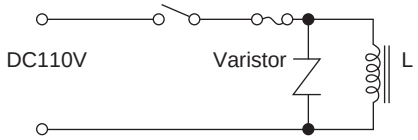
   b)Duration of wave tail of pulse current
   The duration of wave tail of pulse current can be shorter than that of pulse voltage. However, set the duration of wave tail of pulse current T to 40μs for safety. (In actual, it is about 25μs if the pulse voltage wave has the duty cycle of 1.2/50μs.
5. Is the maximum peak current of Varistor enough?
   Because the maximum peak current is 240A, it is often considered that a Varistor of 5V type with the maximum peak current of 250A (secured for two pulses) can be available. However, the duration of wave tail of pulse current is not 20μs for a total of 100 pulses. Thus it is necessary to check the pulse life time of the Varistor.
6. Does Varistor have sufficient pulse life time?
   The conditions include Ip = 240A, T = 40μA, total number of pulses = 100, and pulse interval = 2 minutes or more. Collate these four conditions with the pulse life ratings of the Varistor. (Refer to the manual of CAT. No. 1006 for the pulse life time ratings.)

| Varistor Type | Number of pulses |
|---|---|
| 5V | 2 to 10 |
| 7V | 10 to 100 |
| 10V | 100 to 1000 |
| 14V | 1000 to 10000 |

   Depending on the above specification, a Varistor of the 10V type can be selected. Thus the Varistor of type TND10V-271K is determined as a candidate from the results above together with the result described in Item 3.
7. Is rated wattage of Varistor enough?
   The rated wattage of the Varistor should not particularly be taken into account because the pulses are supplied to the unit at a low frequency.
8. Is the maximum energy of Varistor enough?
   The maximum energy of the Varistor should not be taken into account because lightening pulses of short duration of wave tail is only applied to the unit.
9. Is the condition that clamping voltage is less than withstand voltage of unit satisfied?
   The maximum clamping voltage of TND10V-271K is defined as $V_{25A} = 455V_{max}$ in the rating table. However, since the maximum current flowing through the circuit is 240A, the voltage at 240A should be read from the Varistor volt-ampere characteristics to compare it with the unit withstand voltage of 600V. The relationship is satisfied as follows: $V_{240A} = 510V < 600V$
   (See the manual CAT. NO. 1006 for the Varistor volt-ampere characteristics.)
10. Does excess capacitance and/or loss occur?
    As the power line of commercial frequency 50 to 60 Hz is low frequency, it does not cause severe problems.
11. Does large leakage current appear?
    As the 100 VAC power line produces only a small leakage current of several μA, it does not cause severe problems.
12. Check of wiring
    Note that the wiring to the Varistor is not be electrostatically and magnetically coupled with the rectification circuit and control circuit lines. Make the wiring as short as possible to minimize the stray inductance.
13. Is sufficient measure taken for overload?
    Attach a fuse of about 5A before the Varistor for occurrence of overvoltage. (See 2-5.)
14. Do environmental conditions enter into ranges of specifications?
    Check operating temperature range of the unit unless it is used near heaters such as coils.
15. Does Varistor succeed in installation test?
    Perform the test with TND10V-271K connected to confirm the performance of the unit.
16. Completion of pulse measure
    After insertion of TND10V-271K to the unit as shown in the figure, the action required for absorbing pulses is now completed.

3-2-2 ACTION FOR ON-OFF PULSE FROM RELAY

(1)Target circuit




Conditions
1)Coil rating: I = 0.25 A, L = 1H
2)Relay operation: 2 times per sec, 8 hours per day, and 6 days per week
3)Life: 5 years
4)Number of pulses: $2 \times 3600 \times 8 \times 313 \times 5 = 0.9 \times 10^8$
5)Desired suppress voltage: up to 250 V

(2)Selection of Varistor based on rating selection procedure

1. Confirmation of pulse source and invasion path: Wiring between on/off relay line and power line.
2. Determination of Varistor connection method: Between power line (in parallel with coil).
3. Set of varistor voltage
   A Varistor will be inserted between the 110 VDC power lines. Because the application is not defined as a typical example, the varistor voltage must be determined from the relationship between the circuit voltage and the maximum allowable voltage. Select the Varistor of type 151K (150V) with the maximum allowable voltage of 121V or more, assuming voltage fluctuation of + 10%.
4. Set of pulse current waveform
   a)Pulse peak current (Ip): 0.25A same as load current.
   b)Duration of wave tail of pulse current
   The duration of wave tail of pulse current can be calculated from the following equation assuming the pulse current wave to be a square wave.
   $E = 1/2L\ Ip^2 = 0.5 \times 1 \times 0.25 \times 0.25 = 0.031[J]$

   $$T = \frac{E}{Ip \cdot Vp} = \frac{0.031 \times 1000}{0.25 \times 220} = 0.56[ms]$$

   where Vp: estimated clamping voltage of Varistor of type 151K at 0.25A read from the Varistor volt-ampere characteristics.
5. Is the maximum peak current of Varistor enough?
   Check the pulse life time of the Varistor because pulses occur at a high frequency.
6. Does Varistor have sufficient pulse life time?
   The conditions include Ip = 0.25A, T = 0.56msec, number of applied pulses = $0.9 \times 10^8$, and applied pulse interval = 0.5 sec. Since the applied pulse interval is shorter than the specification of 10 sec, the equivalent current and the equivalent number of applied pulses should be found with the equivalent interval set to 10 sec.

   $$\text{Equivalent current} = 0.25 \times \frac{10}{0.5} = 5[A]$$

   $$\text{Equivalent number of applied pulses} = 0.9 \times 10^8 \times \frac{0.5}{10} = 4.5 \times 10^6$$

   In addition, the duration of wave tail of the pulse current T is 0.56msec = 560µsec as known from the result of Item 4. Collate these conditions with the pulse life time rating of the Varistor.

| Varistor type | Number of pulses |
|---|---|
| 7V | $10^5$ to $10^6 < 4.5 \times 10^6$ |
| 10V | $> 4.5 \times 10^6$ |

   Depending on the above specification, a Varistor of the 10V type can be selected. Thus, the Varistor of type TND10V-151K is determined as a candidate from the results above together with the result described in Item 3.
7. Is rated wattage of Varistor enough?
   The averaged wattage Ps[W] absorbed by the Varistor is, $Ps = E\ fs = 0.031 \times 2 = 0.062[W]$
   where fs is the repeated pulse frequency [times per sec]. From the viewpoint of the absorbing wattage, a Varistor of 5V type (0.1W) may be available. However, a Varistor of 10V type (0.4W) is better if the pulse life time ratings of the Varistor in Item 6 is also taken into account.
8. Is the maximum energy of Varistor enough?
   This is already considered in the pulse life time because many pulses are applied to the Varistor (see Item 6).
9. Is the condition that clamping voltage is less than withstand voltage of unit satisfied?
   The maximum clamping voltage of TND10V-151K was assumed to be about 220V in Item 4. By checking it with the Varistor volt-ampere characteristics, we find $V_{0.25A} = 210V < 250V$. Thus this requested characteristic is satisfied.
10. Does excess capacitance and/or loss occur?
    As the DC power line does not cause severe problems.
11. Does large leakage current appear?
    As the 110 VDC power line produces only a small leakage current of several µA, it does not cause severe problems.
12. Check of wiring
    Insert the Varistor near the coil as much as possible to reduce induction to other components.
13. Is sufficient measure taken for overload?
    Attach a fuse of 3A to 5A before the Varistor for occurrence of overvoltage.
14. Do. environmental conditions enter into ranges of specifications?
    Check operating temperature range of the unit and temperature near the coils.
15. Does Varistor succeed in installation test?
    Perform the test with TND10V-151K connected to confirm the performance of the unit.
16. Completion of pulse measure
    After insertion of TND10V-151K to the unit as shown in the figure, the action required for absorbing pulses is now completed.

# 4. LOAD REDUCTION CURVE OF Varistor FOR TEMPERATURE

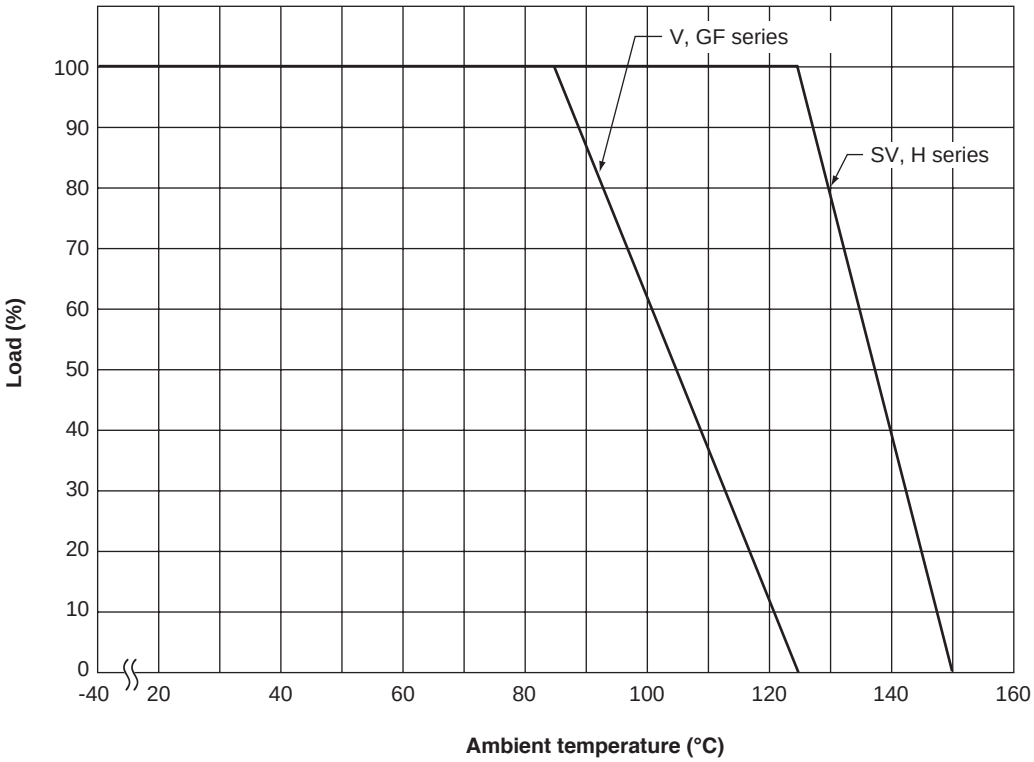



**Fig. 3 Load reduction curve**

The load includes the rated wattage, maximum allowable voltage, maximum peak current (SV series : Values of 2 times), maximum energy. For example, when TND10V-221K is used at 95□, the load is found to be 75% from the load reduction curve above. Thus, the parameters can be calculated as follows.

| | |
|---|---|
| 1. Rated wattages | 0.4W × 0.75 = 0.3W |
| 2. Maximum allowable voltage | AC : 140V × 0.75 = 105V<br>DC : 180V × 0.75 = 135V |
| 3. Maximum peak current | 2500A × 0.75 = 1875A |
| 4. Maximum energy | 27.5J × 0.75 = 20.63J |

# 5. DETERIORATION OF Varistor

## 5-1 DETERIORATION OF Varistor

(1)In case where no pulses are applied to Varistor

As known from the relationship between mean life of Varistor and ambient temperature shown in the figure below, a Varistor can have the mean life of longer than 100 years if it is used at ambient temperature and circuit voltage within their maximum ratings. Accordingly it can be said that the Varistor has hardly been deteriorated.

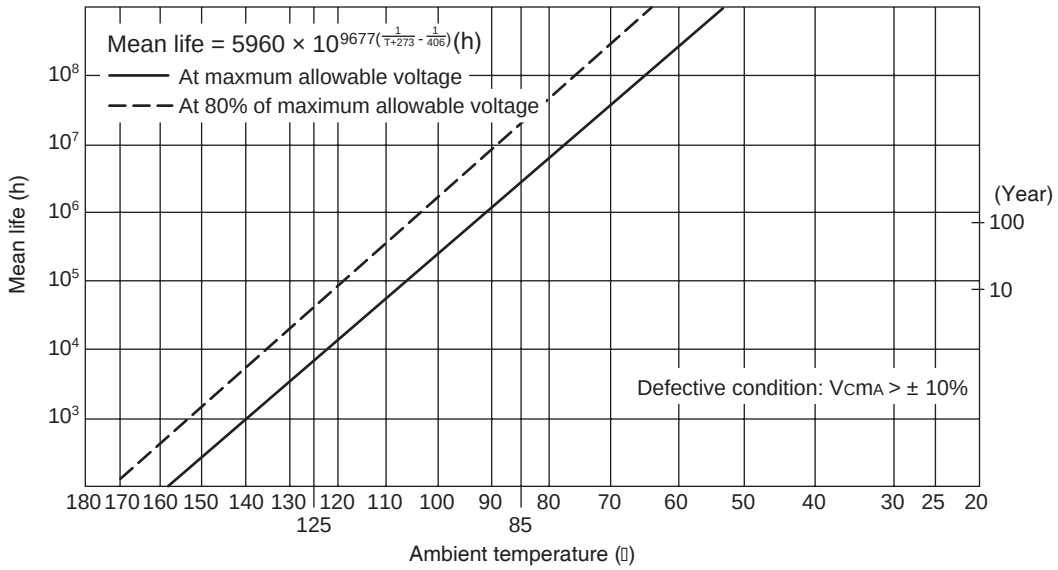



**Fig. 4 Relationship between mean life Varistor and ambient temperature**

(2)In case where pulses are applied to Varistor

Being a pulse absorption component, the Varistor is deteriorated if it is subject to pulses exceeding its rating.

1. With lightening pulses applied to a Varistor, the waveform, energy, and frequency cannot be defined. Thus the period taken until the Varistor is deteriorated cannot also be determined.
2. With on/off pulses applied to a Varistor, the waveform, energy, and frequency can be measured or estimated. Thus the period taken until the Varistor can almost be estimated from the pulse life time ratings.
   However, because a Varistor with the rating suited to the requested pulse life time ratings is normally selected, the Varistor will hardly be deteriorated within the life of equipment including the Varistor.

## 5-2 HOW TO CHECK DETERIORATION OF Varistor AND FREQUENCY OF THE CHECKING

(1)Deterioration of Varistor

The Varistor is deteriorated by overvoltage application caused by overpulses and fluctuation of power voltage.

Adsorption of Excess Energy → Increase in Leakage Current → Heat Generation → Thermal Runaway →

Short Circut → Destruction (The Varistor may be opened depending on conditions)

(2)How to check deterioration of Varistor

As described in (1) of Section 5-2, the deterioration of a Varistor is known by increase in leakage current. Accordingly, how a Varistor is deteriorated can be measured by the leakage current.

The initial value of the leakage current of a Varistor (or leakage current occurring when the DC voltage half of the nominal varistor voltage is applied to the Varistor) is about 1μA though the value varies depending on the rating of the Varistor. The leakage current of 10μA is a sign that deterioration begins in the Varistor, so the Varistor should be replaced with a new one.

However, the leakage current of 10μA causes the Varistor to generate only the minimum heat, which will not lead the thermal runaway immediately. The Varistor has a shorter pulse life than that in the initial state.

# 6. PULSE PESPONSE CHARACTERISTICS OF Varistor

The Varistor itself has a response time for a pulse as extremely short as 1 nsec. However, it is difficult to measure the time because of a large influence of the inductance of lead wire.

In actual use, the clamping voltage is increased a little with a fast rising pulse even at the same current because of influence of the inductance of lead wire. Figure 5 shows the ratio of clamping voltages at faster pulse rise times to the clamping voltage at application of standard pulse current waveform of 8/20μs, which is called overshoot ratio. The figure is an example when pulse current having rising time of 0.5μs to 8μs and constant peak current of 10A are applied to TND14V-271K. In the figure, the overshoot of about 10% appears at the rising time of 0.5μs.

In actual use of Varistor, the rising of pulse voltage is limited by inductance and capacitance on the way to transmit in line. The rise time is almost not less than 1μs.

The wiring should be as short as possible because longer wiring make the overshoot higher.

Figures 6 and 7 show pulse absorption characteristics of a Varistor with the wiring lengths of 5mm and 25cm respectively, as extreme examples. In these examples, the clamping voltage with wiring length of 25cm is about 1250V, which is about two times and a half of the clamping voltage of about 500V with wiring length of 5mm.

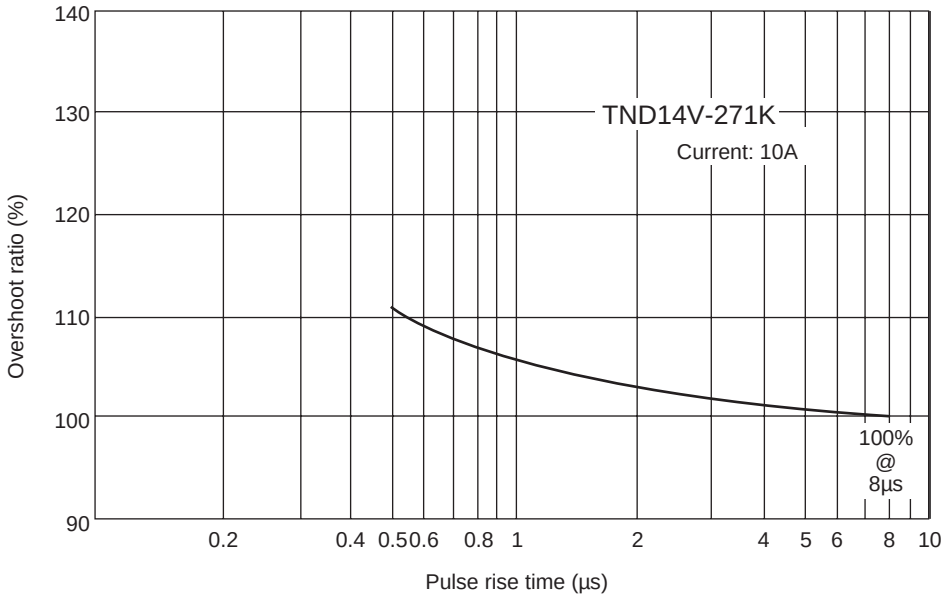



**Fig. 5 Relationship between pulse rise time and overshoot ratio**

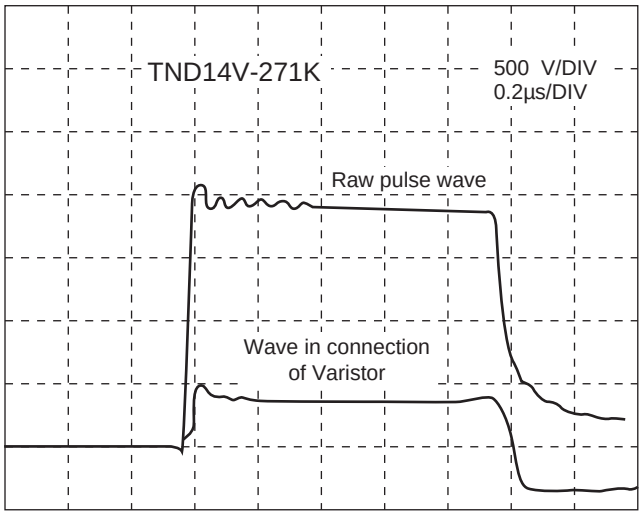



**Fig. 6 Pulse absorption characteristic of Varistor (wiring length of 5mm)**

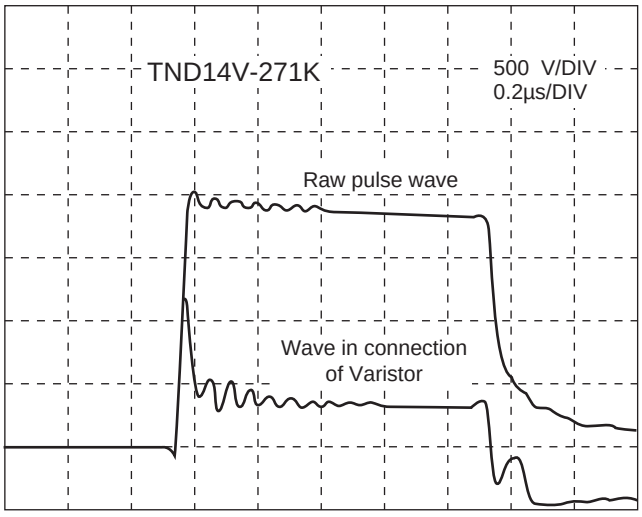
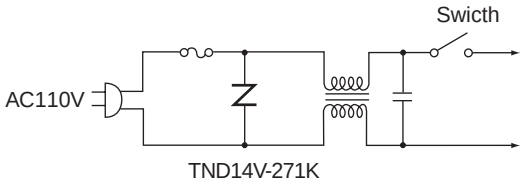
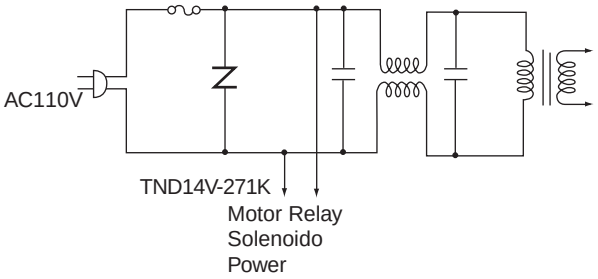



**Fig. 7 Pulse absorption characteristic of Varistor (wiring length of 25cm)**

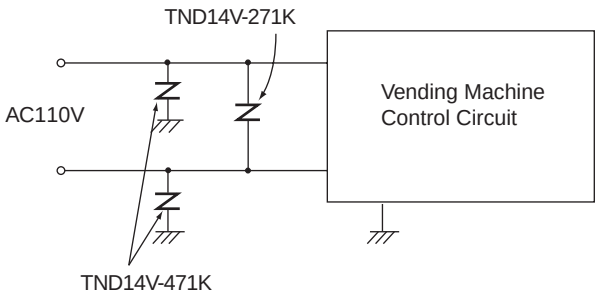
### (1)Power Source Curcuit



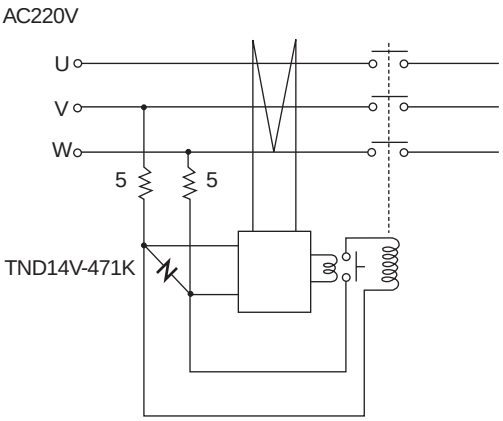

### (2)Micro Computer Equipment



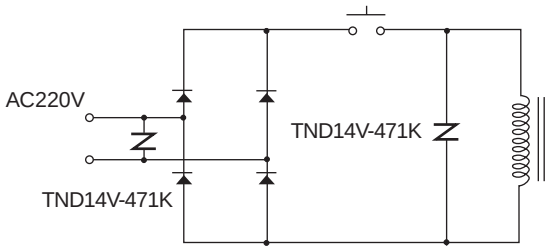

### (3)Vending Machine



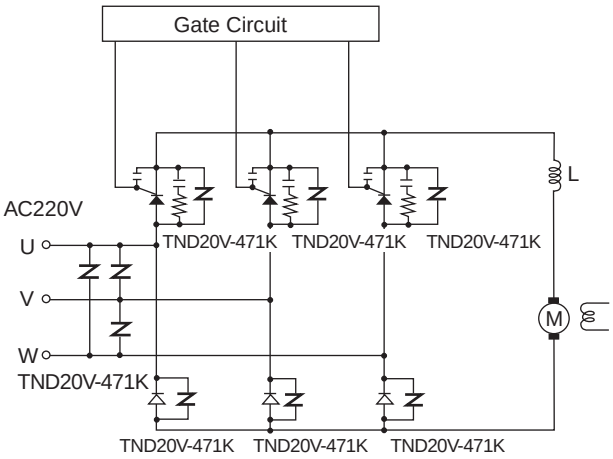

### (4)Leakage Current Detector



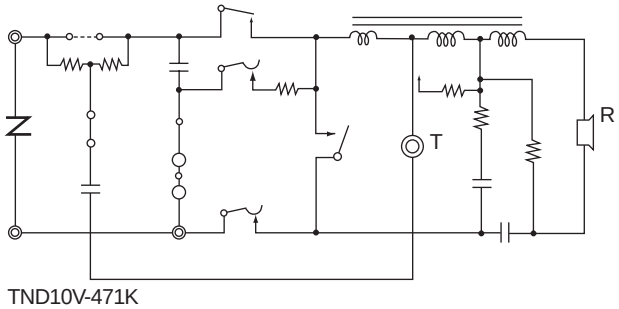

### (5)Maganetic Brake




### (6)Control of 20kW DC Motor




### (7)Telephone



# ELECTRONIC COMPONENTS & DEVICES

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