English

CHEMI-CON

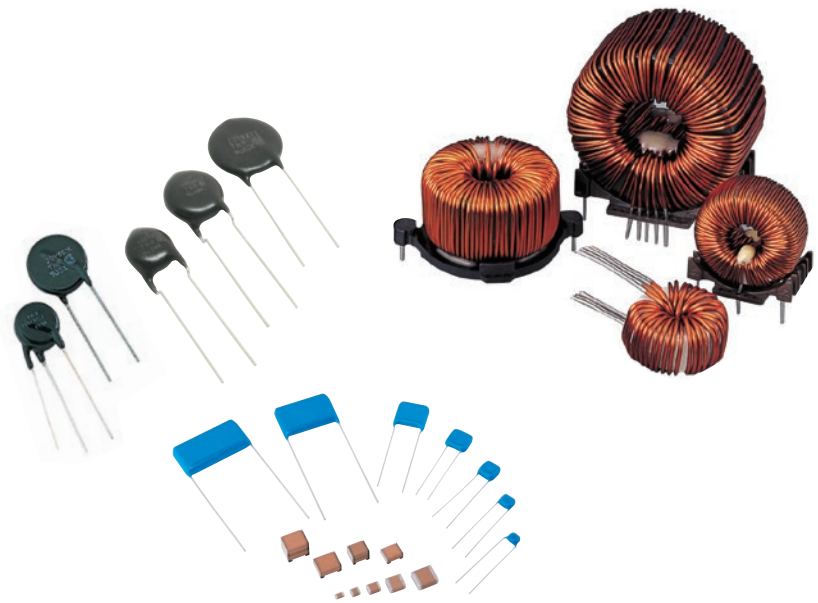
2025

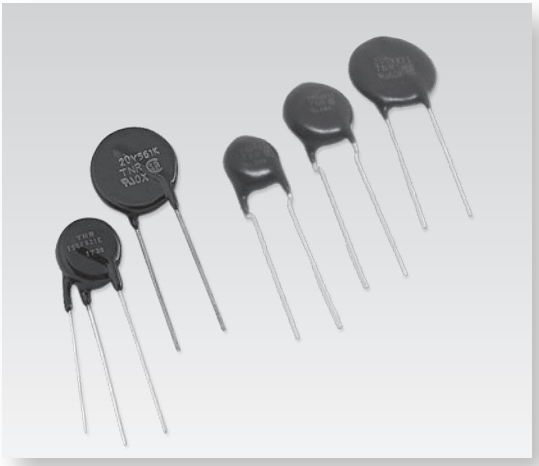
CERAMIC CAPACITORS

VARISTORS

CHOKE COILS

CAT.NO.E1002E / E1006H / E1008Z





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 Products conforming to overseas safety standards (UL, CSA, VDE) Ideal for general use and absorbing various kinds of surges	60
	SV	22 to 1000	125 to 10000	Highly flame-retardant exterior material (halogen free) is used Suppresses burning and scattering of exterior materials even if they are destroyed due to application of excessive voltage Product with improved safety	81
	H	22 to 47	5 to 40*	Large surge energy withstand (5 to 40J) Broad operating temperature range (between -40 and +125°C) Highly resistant to thermal shock (between -40 and +150°C, 50 cycles) Ideal for absorbing various kinds of surges for automobiles	92
	GF	270 to 820	2500 to 4000	With built-in thermal fuse Product with improved safety	96

* 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.

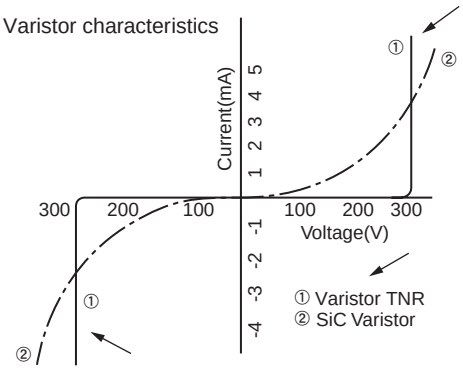
8 Response to the Substances of Concern

(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

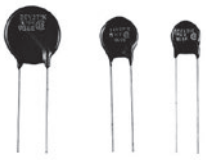


◆Applications

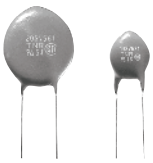
1. Electronics instrument protection
2. Telephone system protection
3. Relay contact point protection
4. Rectification diode protection
5. SCR protection
6. Reduction of abnormal voltage in high voltage current
7. Switching transistor proteciton
8. Reduction of switching surge in electromagnetic brake
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

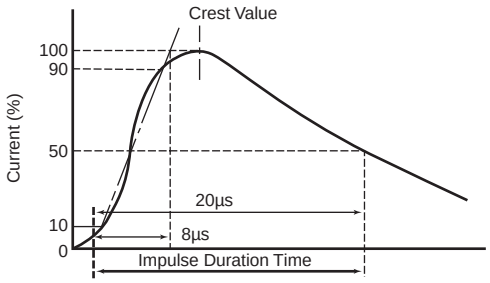
②Product Form	
ND	Disk Type
NL	Sleeve Type

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. 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. 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. (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) 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 DIN EN IEC 61051-1:2019-07; EN IEC 61051-1:2018 DIN EN IEC 61051-2:2023-10; EN IEC 61051-2:2021 IEC 61051-1:2018 61051-2:2021 61051-2-2	118623	15～1800 V	□
CQC	-----	GB/T10193, GB/T10194 GB4943.1	(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 62368-1:2018 G.8.1
◇: 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.

◆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) 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 DIN EN IEC 61051-1:2019-07; EN IEC 61051-1:2018 DIN EN IEC 61051-2:2023-10; EN IEC 61051-2:2021 IEC 61051-1:2018 61051-2:2021 61051-2-2	118623	SV : 220～1000 V	□
CQC	-----	GB/T10193, GB/T10194 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	TND20SV***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 62368-1:2018 G.8.1
◇ : CQC(GB/T10193, GB/T10194), ◆ : CQC(GB/T10193, GB/T10194, GB4943.1)

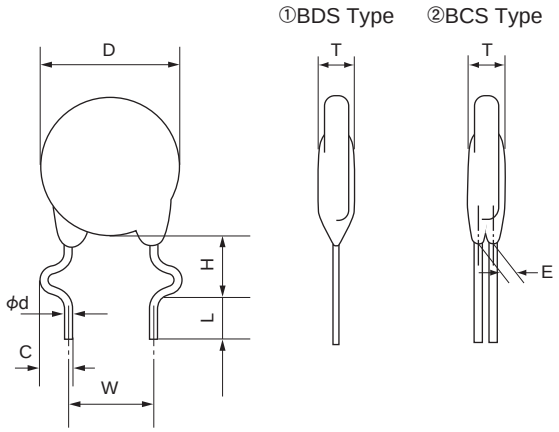
*Recognized marking

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

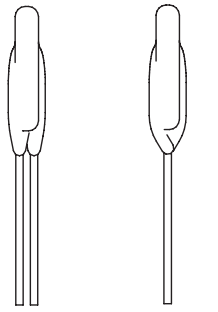
Varistor Voltage
The first two digits are sighificant figures and the third one denote the number of following zeros.

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%

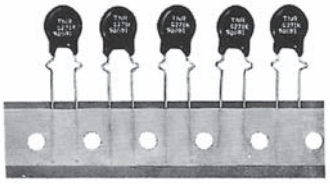


Form-A Form-B (Parallel)

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%

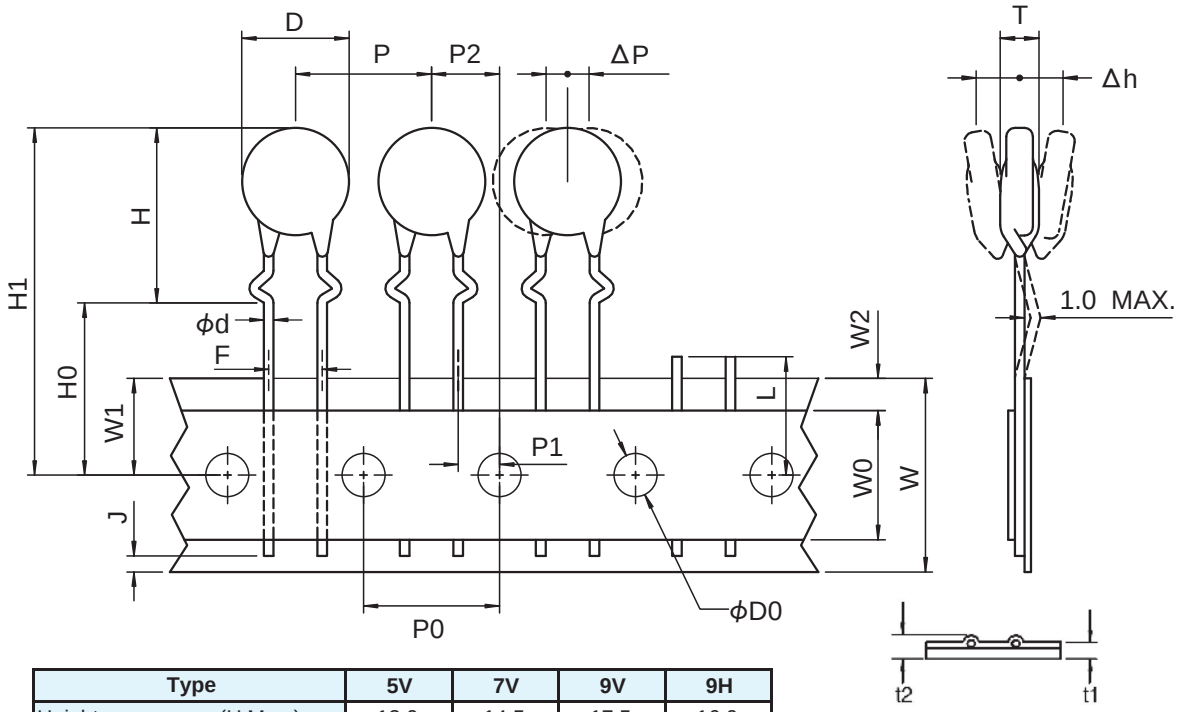
Form-A

Form-B (Parallel)

Feed hole pitch 12.7mm Code	Feed hole pitch 15.0mm 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)

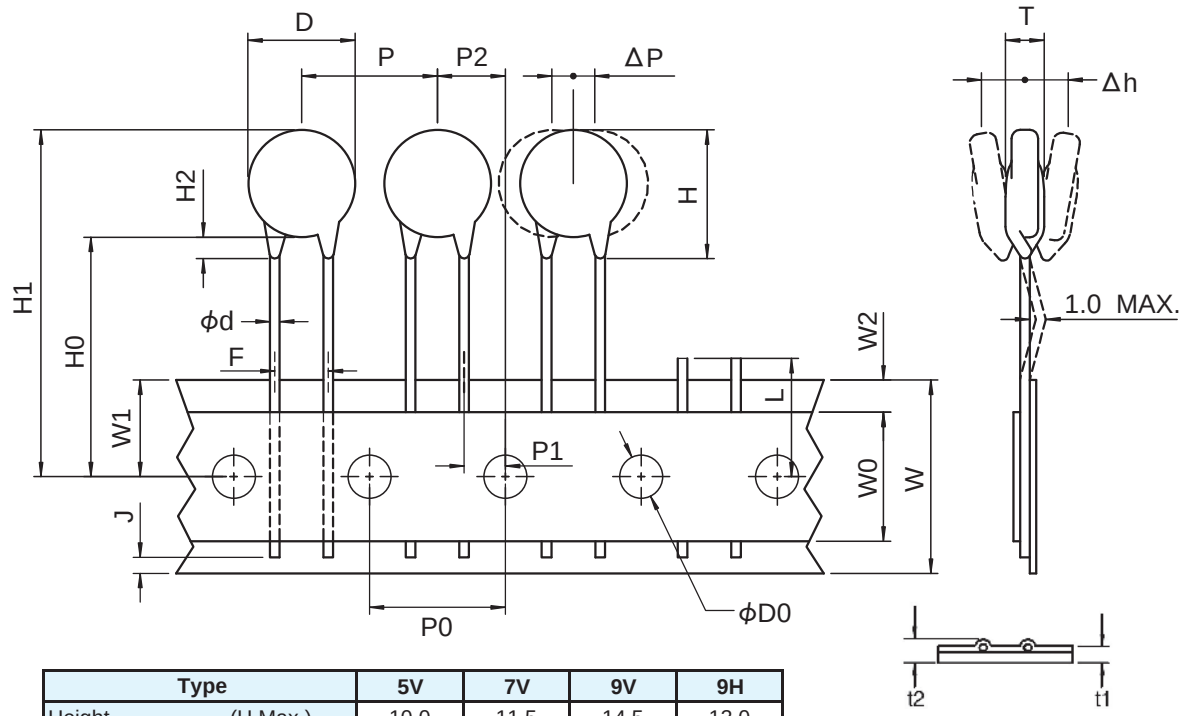


Type	5V	7V	9V	9H
Height (H Max.)	13.0	14.5	17.5	16.0
Component Height (H1 Max.)	30.0	31.0	34.0	33.0

◆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)

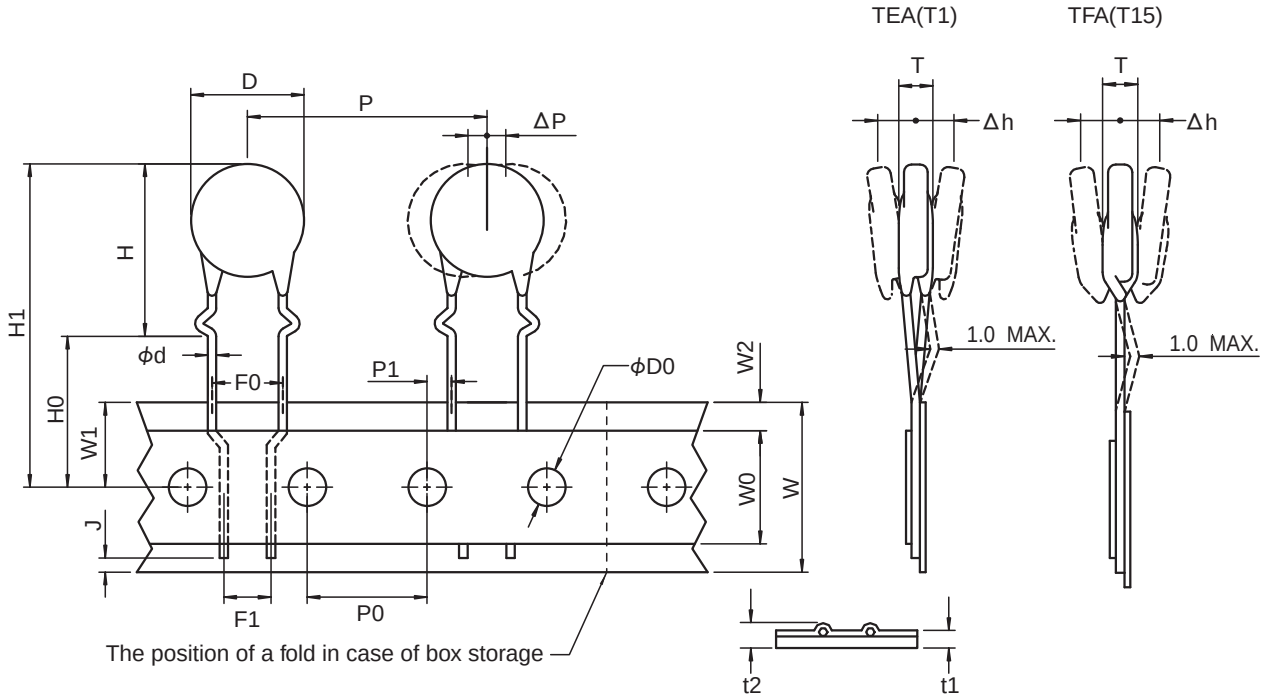


Type	5V	7V	9V	9H
Height (H Max.)	10.0	11.5	14.5	13.0
Component Height (H1 Max.)	29.0	30.0	33.0	32.0

◆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)

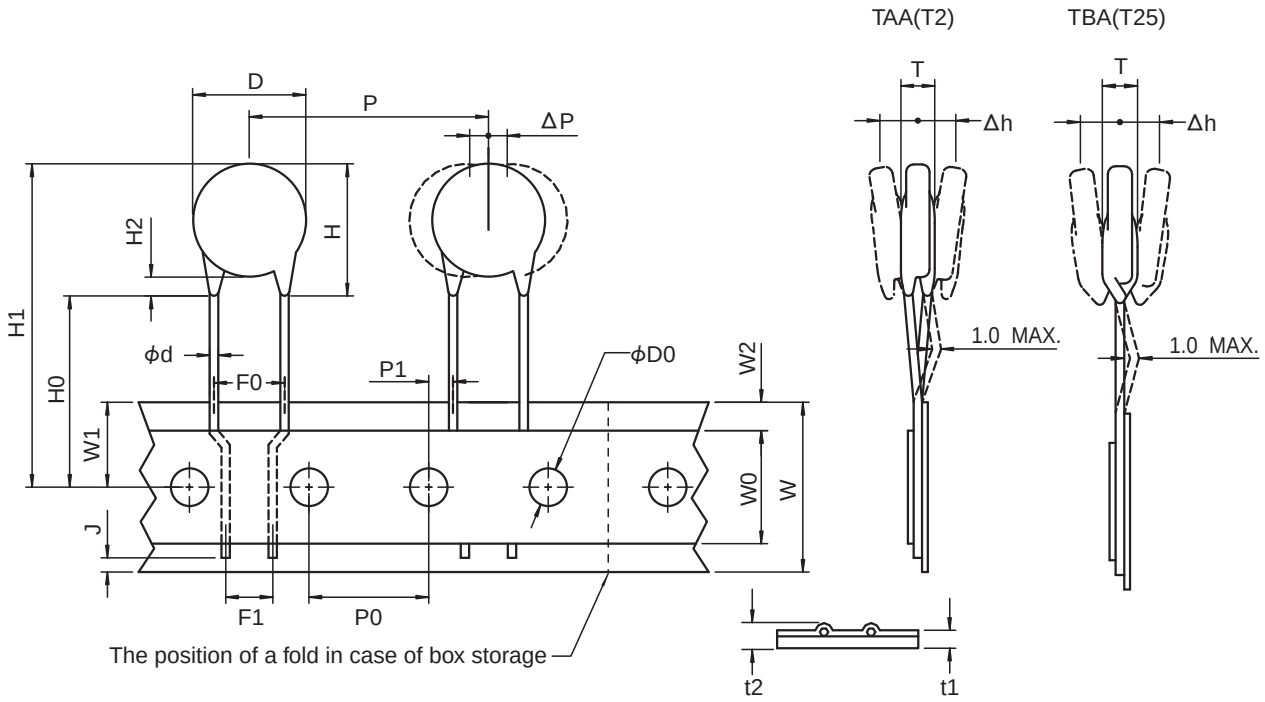


Type	10V	12V	14V	12H	15H
Height (H Max.)	17.5	19.0	21.0	21.0	24.0
Component Height (H1 Max.)	35.0	36.0	38.0	38.0	41.0

◆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)

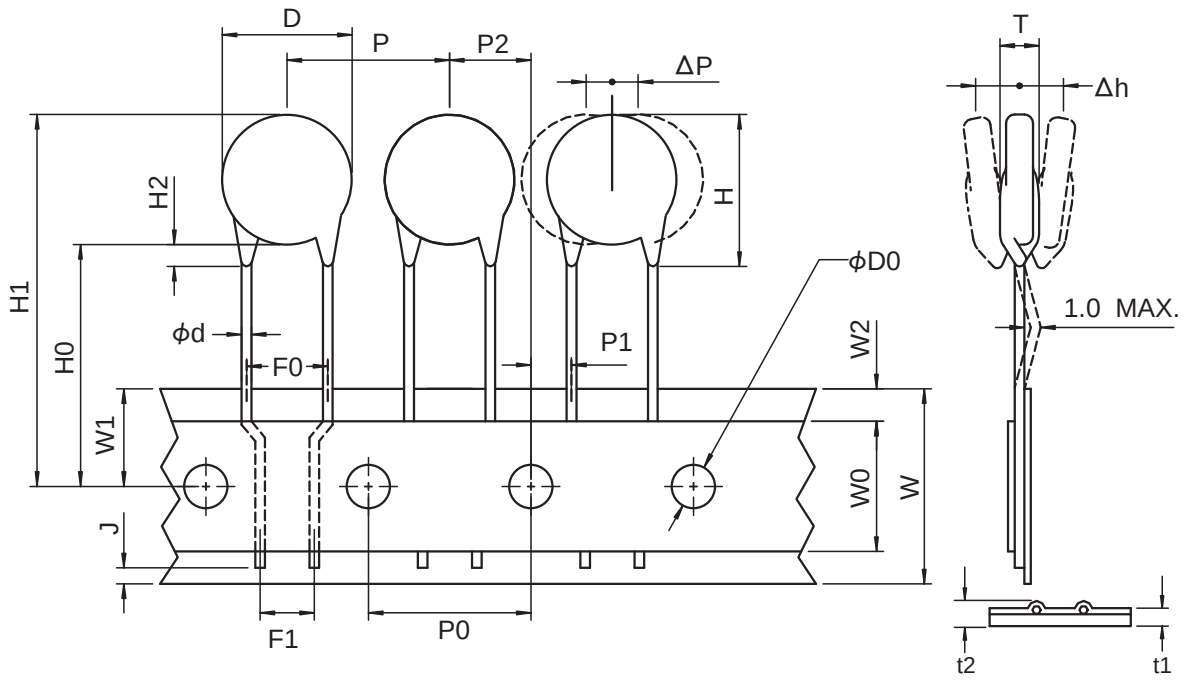


Type	10V	12V	14V	12H	15H
Height (H Max.)	15.5	17.0	19.0	16.5	19.0
Component Height (H1 Max.)	40.0	41.0	43.0	41.0	44.0

◆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)

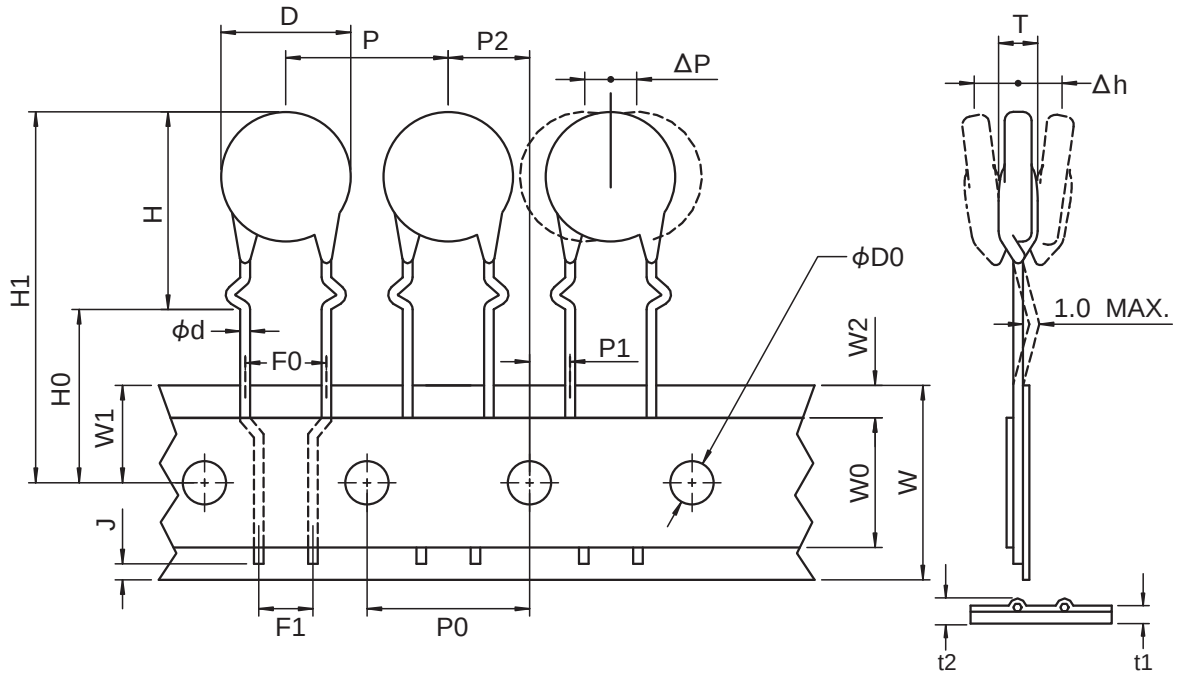


Type	10V	12V	14V
Height (H Max.)	15.5	17.0	19.0
Component Height (H1 Max.)	37.0	39.0	41.0

◆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)

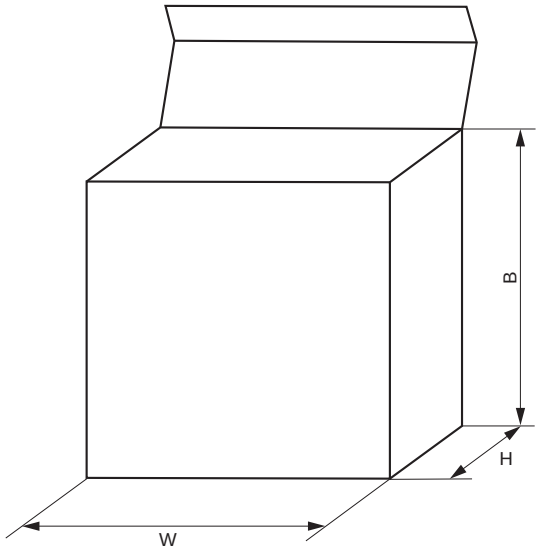


Type	10V	12V	14V
Height (H Max.)	17.5	19.0	21.0
Component Height (H1 Max.)	35.0	36.0	38.0

◆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.

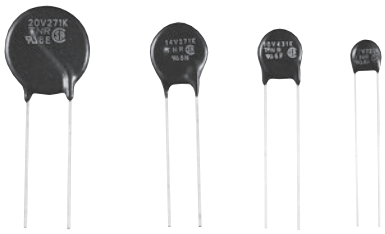
◆Disk Type

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%

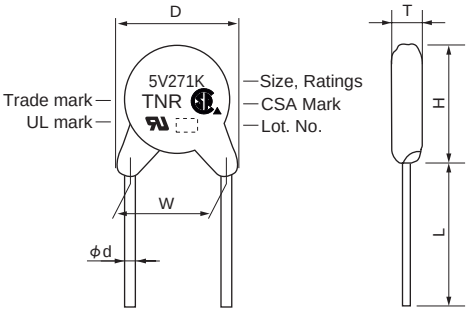
⑦Packing Style	
B	Bulk
T	Taping

V Series

◆STANDARD RATINGS (Type 5V)

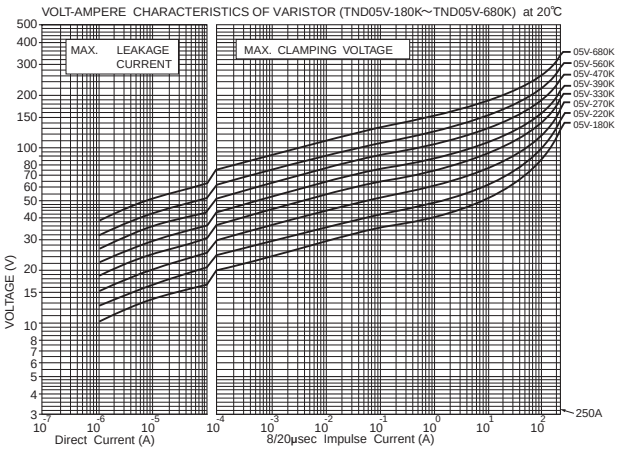
Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V0.1mA	T Max.
		Max. Allowable Voltage		Max. Peak Current	Max. Energy	Rated Wattage					
		AC (Vrms)	DC (V)	8/20μs(A)	2ms(J)	(W)	(A)	(V)	(pF)	(V)	(mm)
TND05V-180KB00AAA0	TNR5V180K	11	14	250A/1 time 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 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

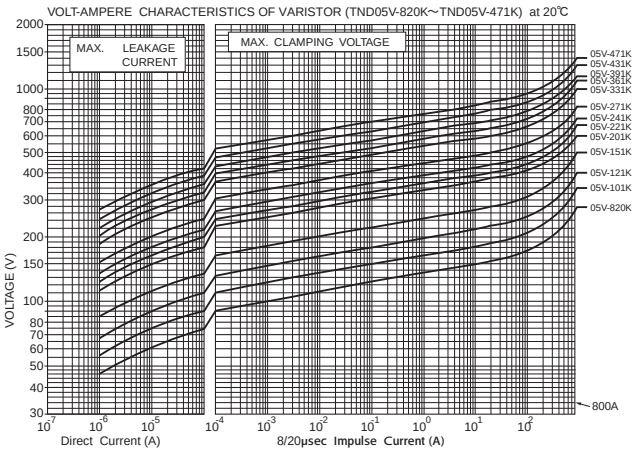
◆DIMENSIONS [mm]



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



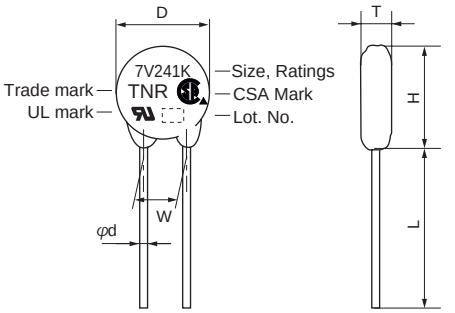


V Series

◆STANDARD RATINGS (Type 7V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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

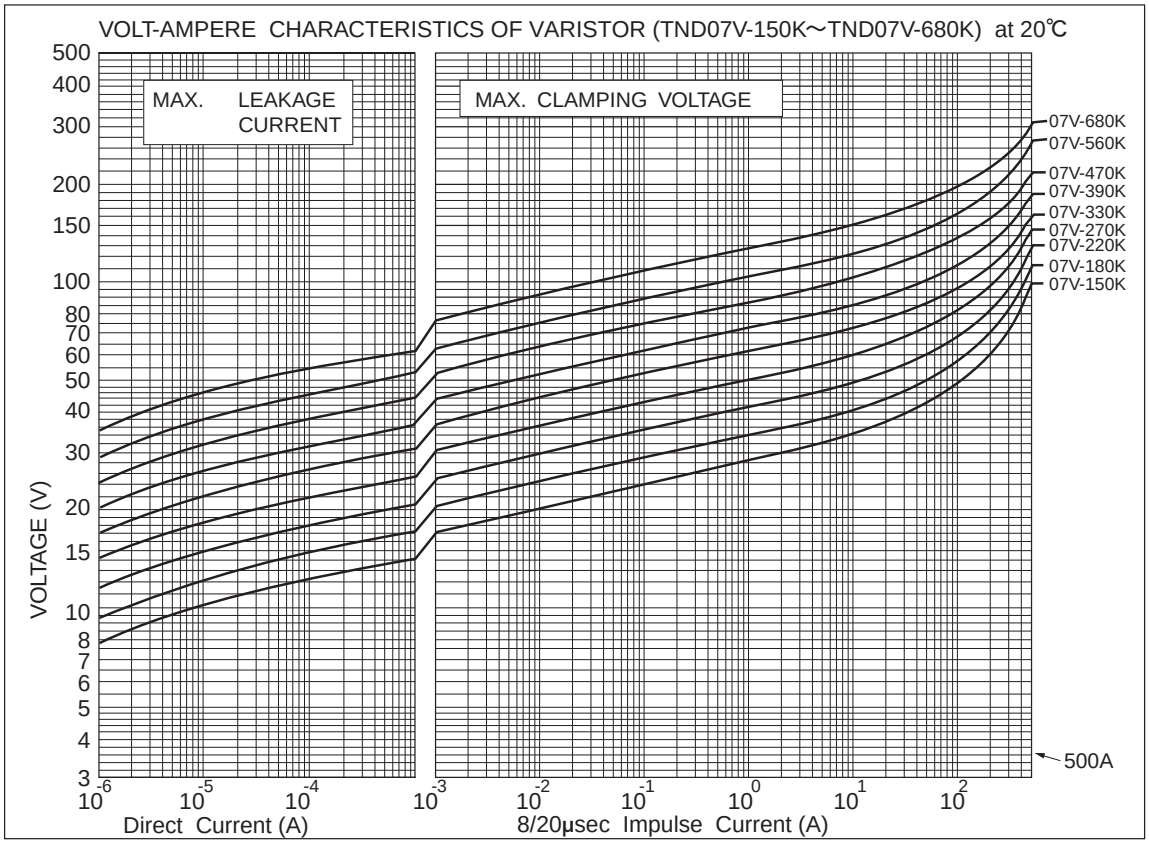
◆DIMENSIONS [mm]

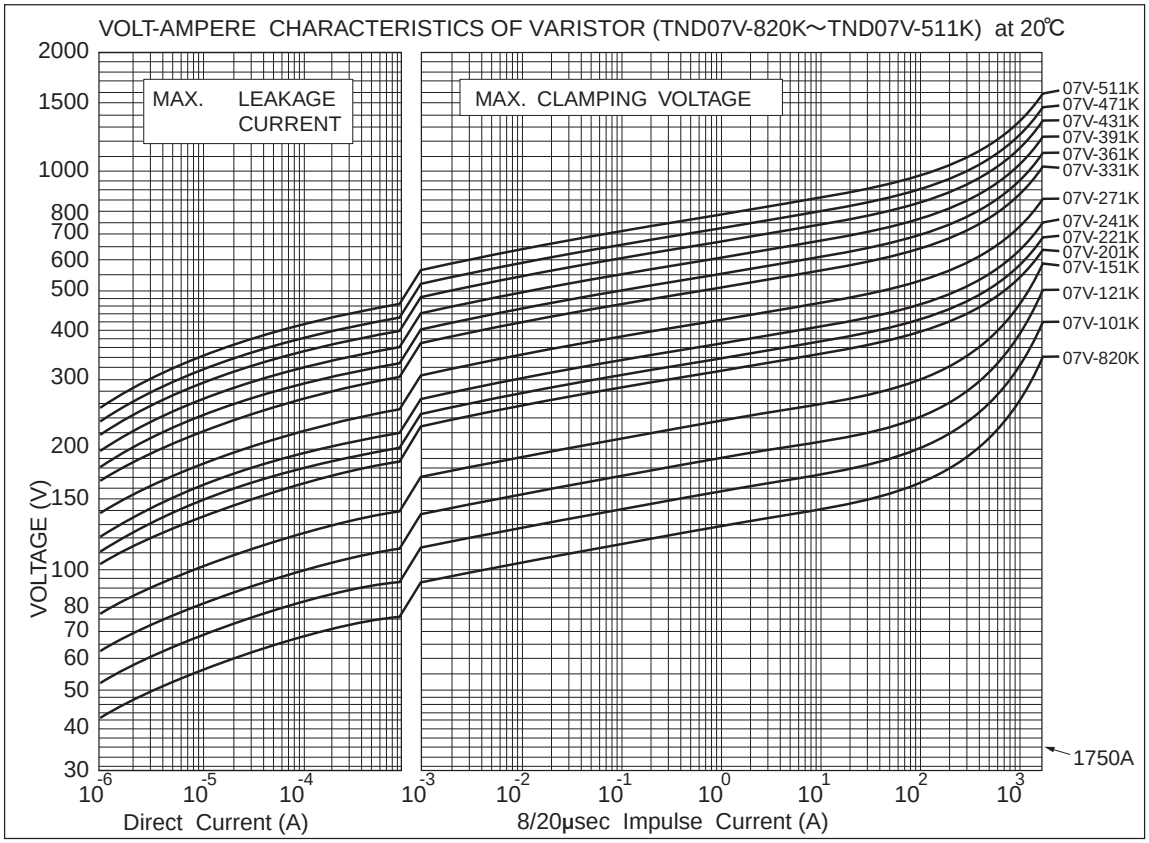


D Max.	H Max.	T Max.	L Min.	φd ±0.05	W ±1.0
8.5	11.5	Ref. to RATINGS	20.0	0.6	5.0

V Series

◆V-I CURVE (Type 7V)



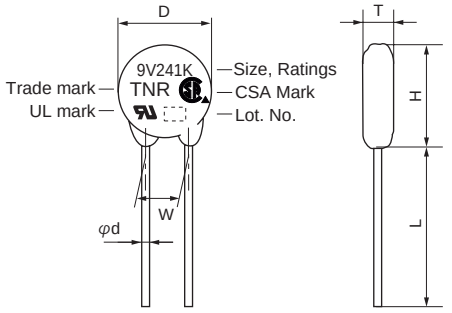


V Series

◆RATINGS (Type 9V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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

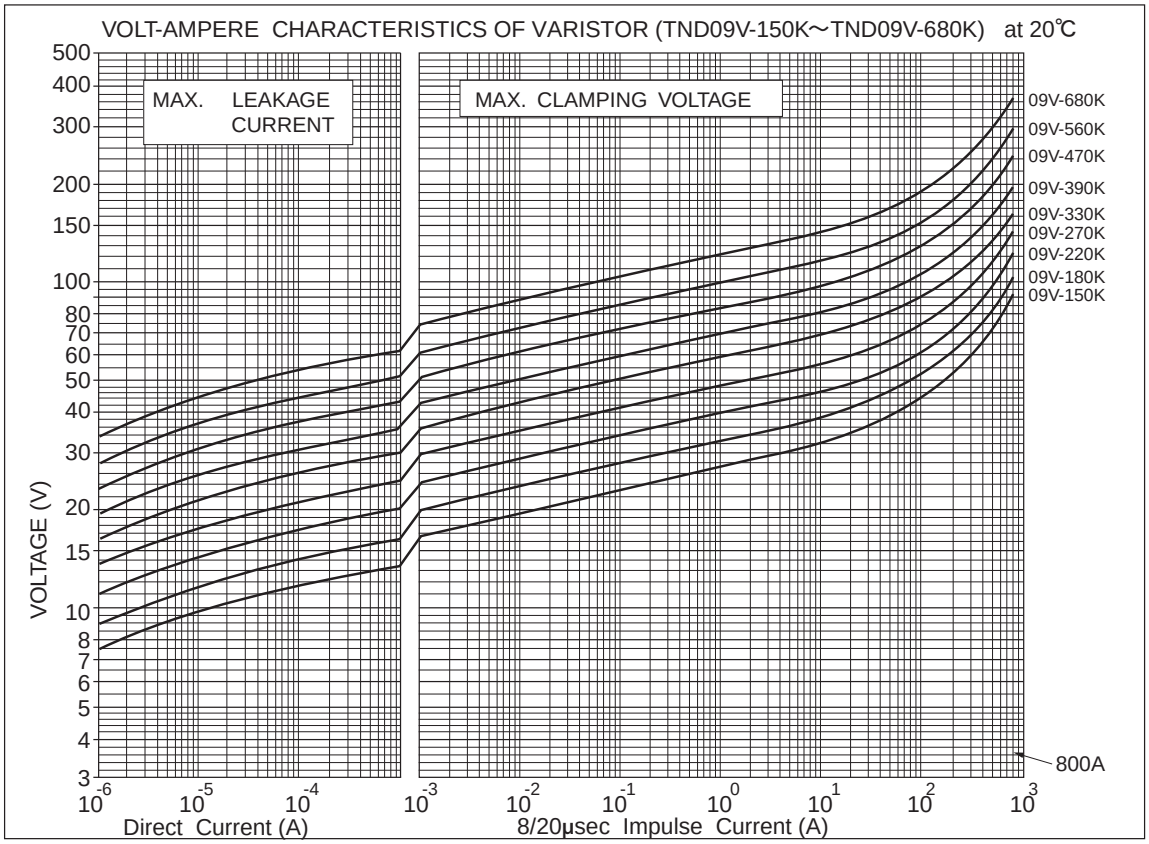
◆DIMENSIONS [mm]

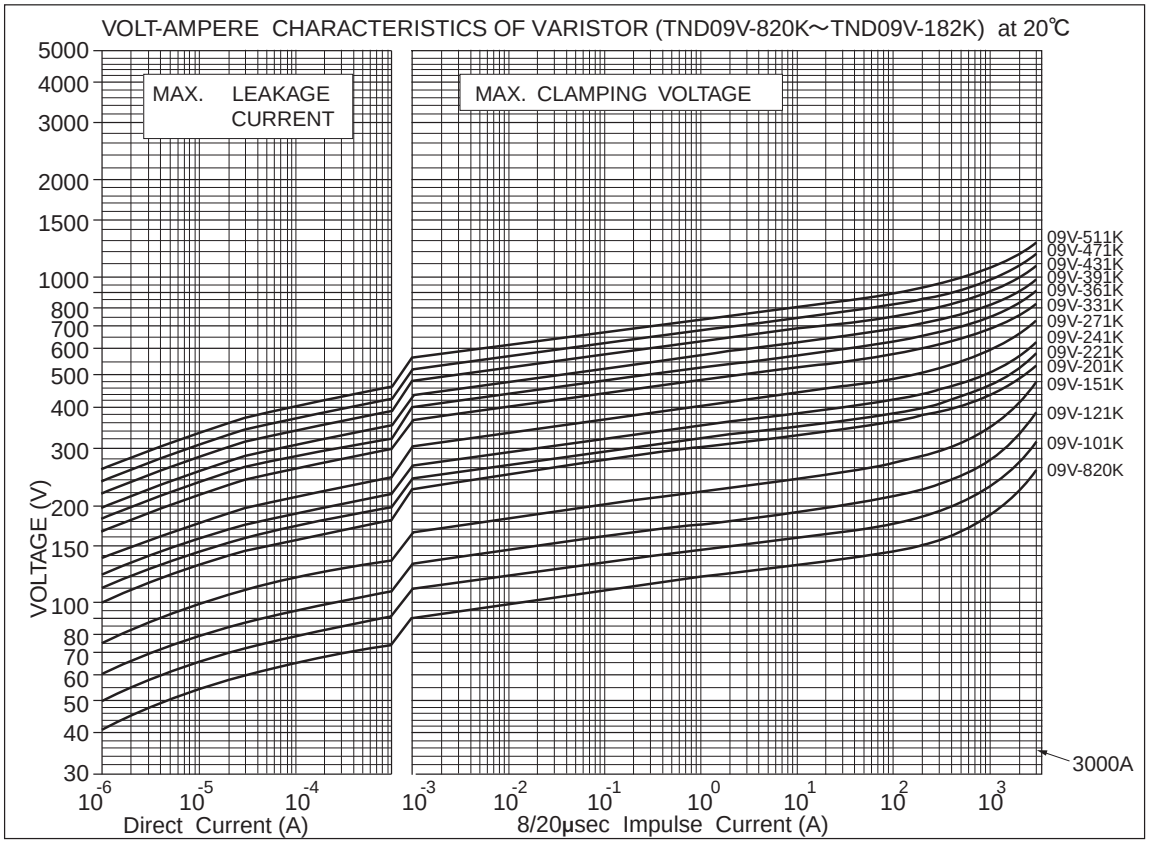


D Max.	H Max.	T Max.	L Min.	φd ±0.05	W ±1.0
11.5	14.5	Ref. to RATINGS	20.0	0.6	5.0

V Series

◆V-I CURVE (Type 9V)





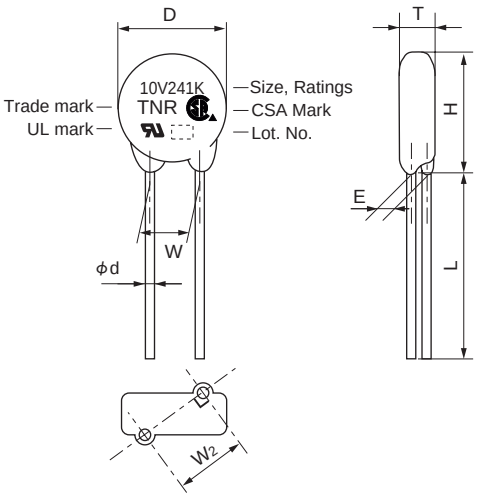
V Series

◆RATINGS (Type 10V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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

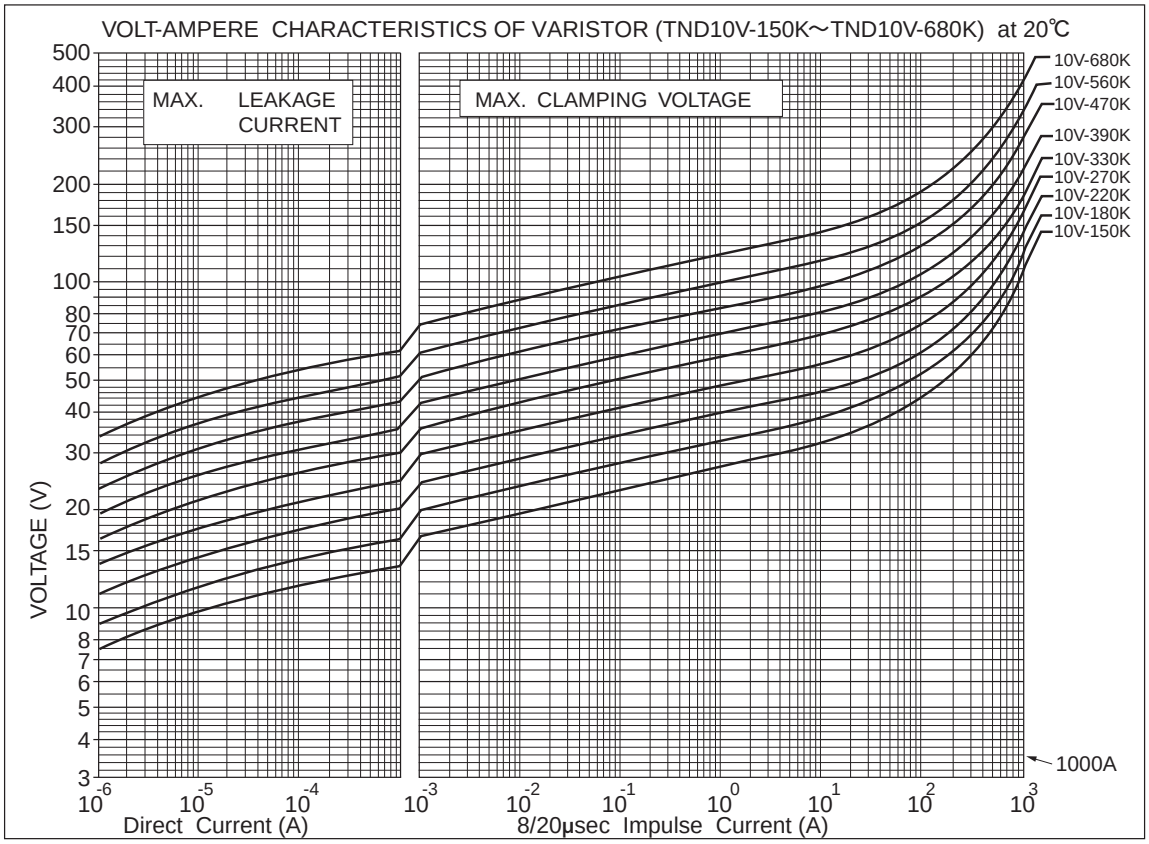
Part Number	D Max.	H Max.	T Max.	L Min.	ϕd ±0.05	W ±1.0
TND10V-150K to TND10V-511K	11.5	14.5	Ref. to RATINGS	20.0	0.8	7.5
TND10V-561K to TND10V-112K	12.5	15.5				
TND10V-122K to TND10V-182K	13.5	16.5				

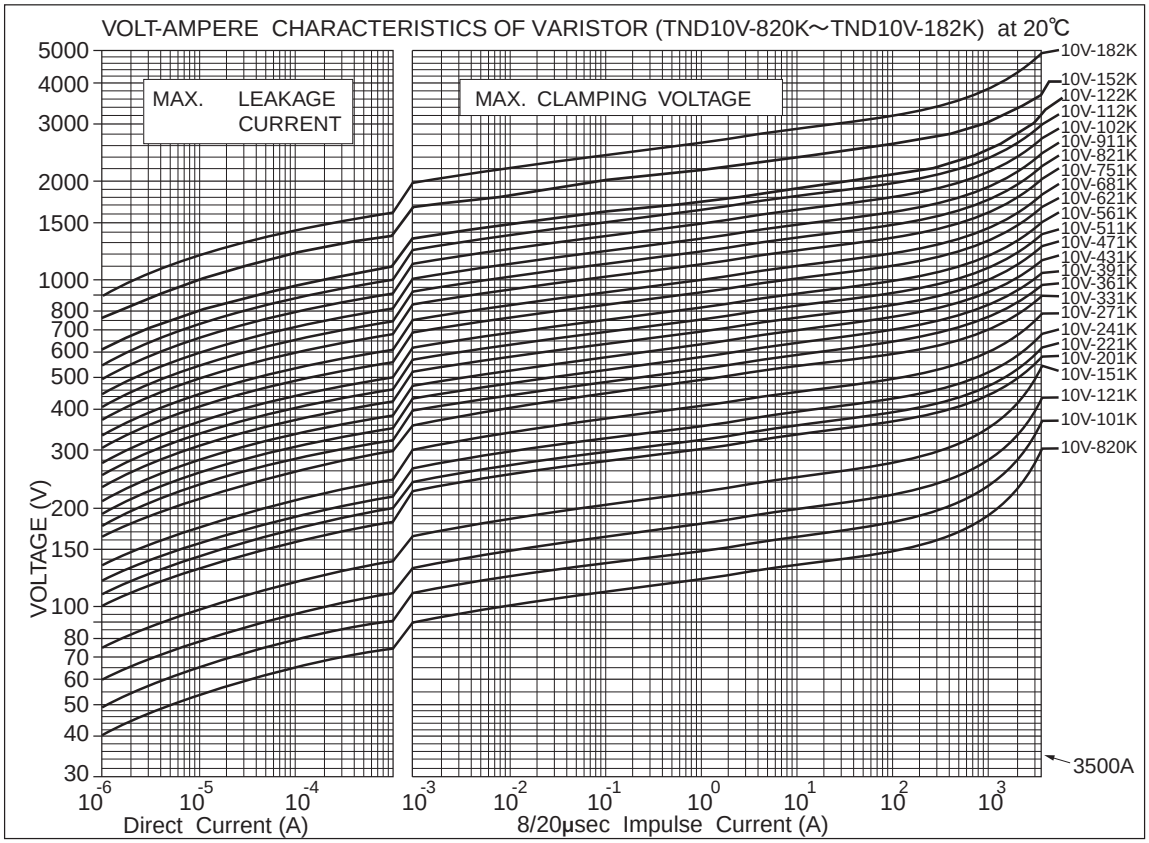
●Common to standard product and IEC 62368-1:2014 G.8.2 conforming product

●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)





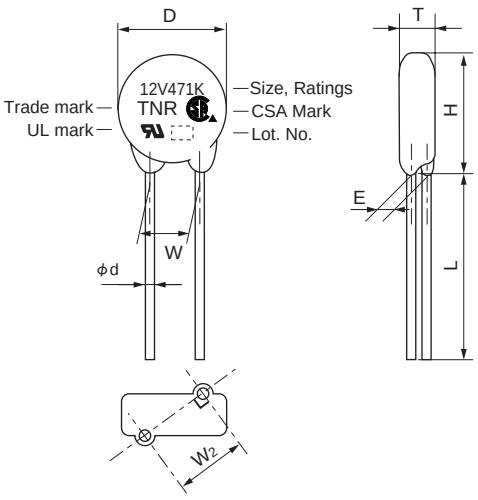
V Series

◆RATINGS (Type 12V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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]

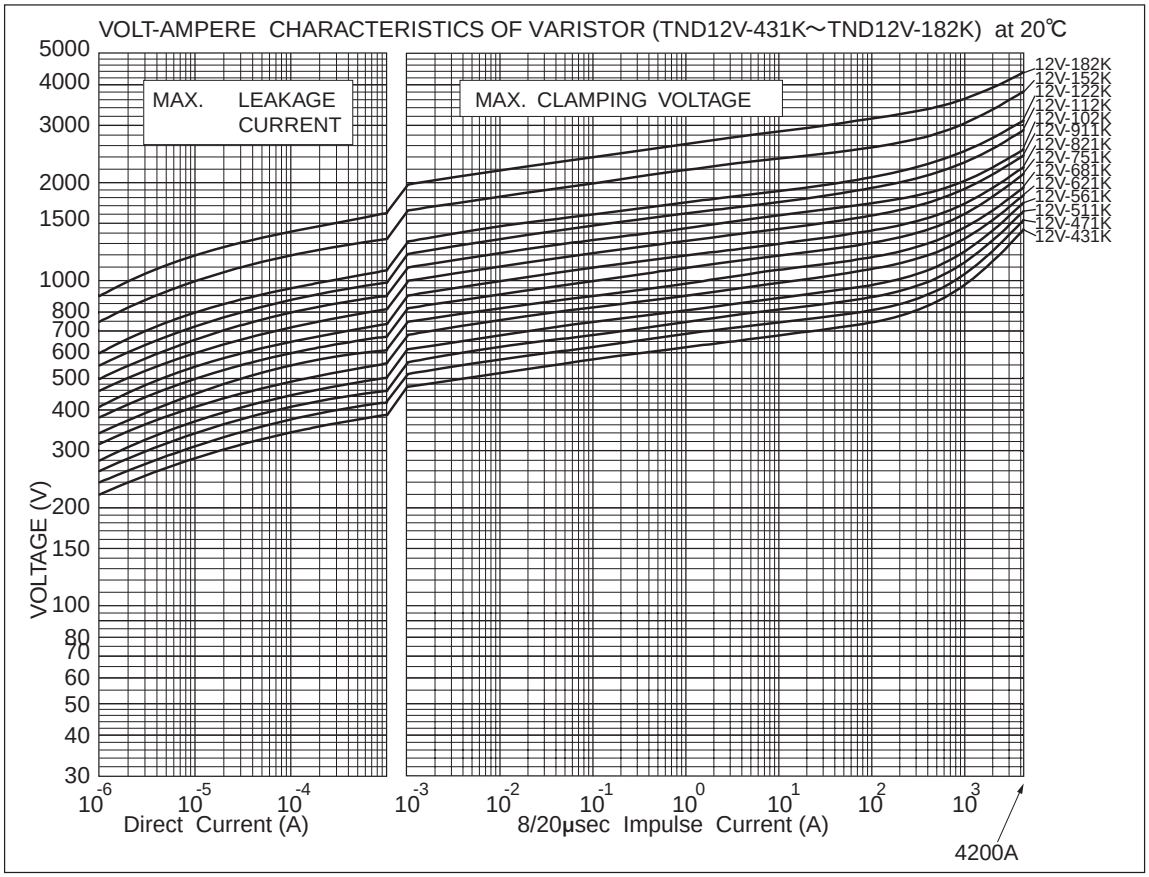


Part Number	D Max.	H Max.	T Max.	L Min.	ϕd ±0.05	W ±1.0
TND12V-431K to TND12V-102K	14.0	17.0	Ref. to RATINGS	20	0.8	7.5
TND12V-112K	15.0	18.0				
TND12V-122K						
TND12V-152K to TND12V-182K	16.0	19.0				

●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)



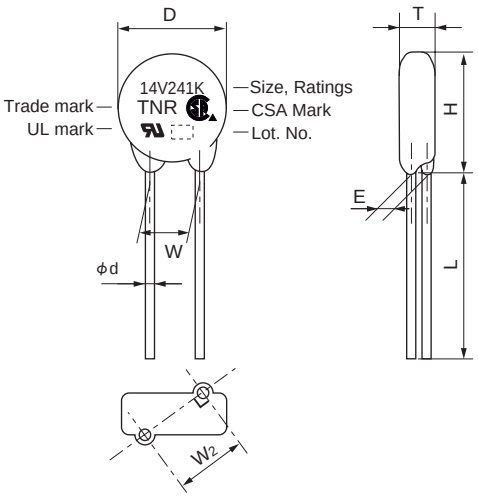
V Series

◆RATINGS (Type 14V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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			710	460	430 (387～ 473)	6.0	2.1	7.8
TND14V-471KB00AAA0	TNR14V471K	300	385		125	0.6	50	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]

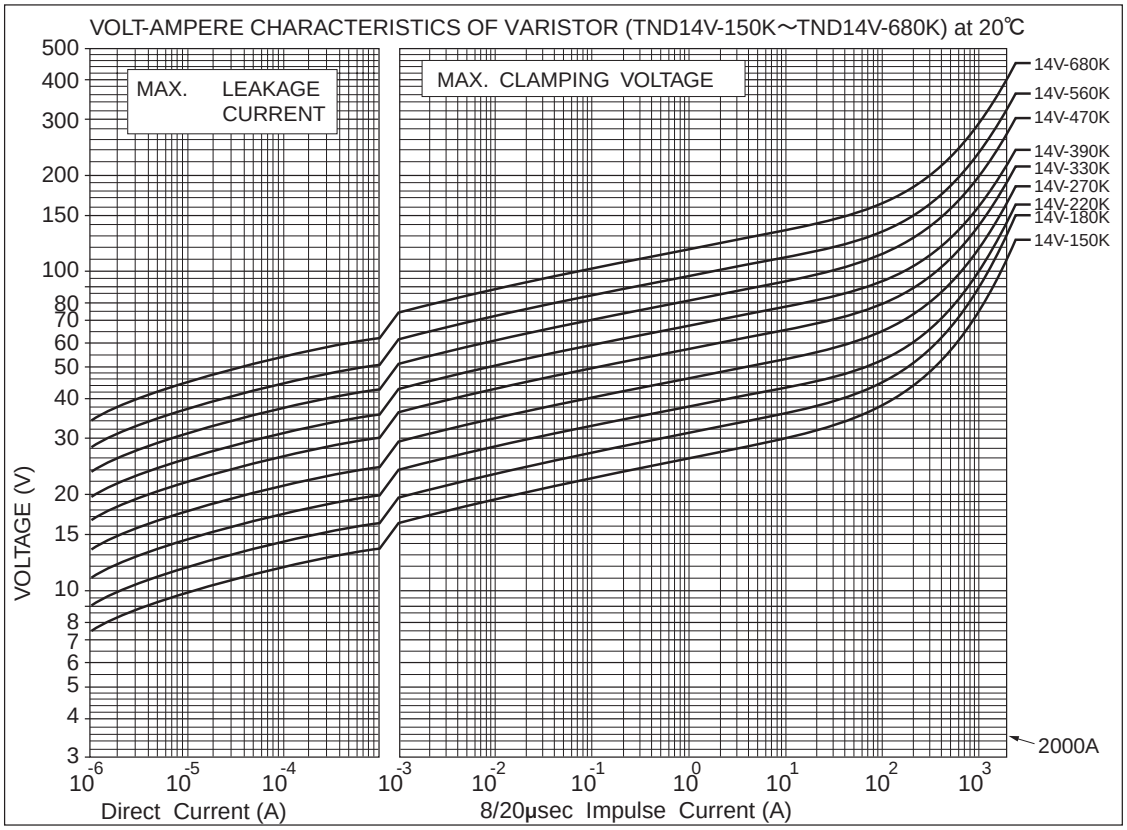


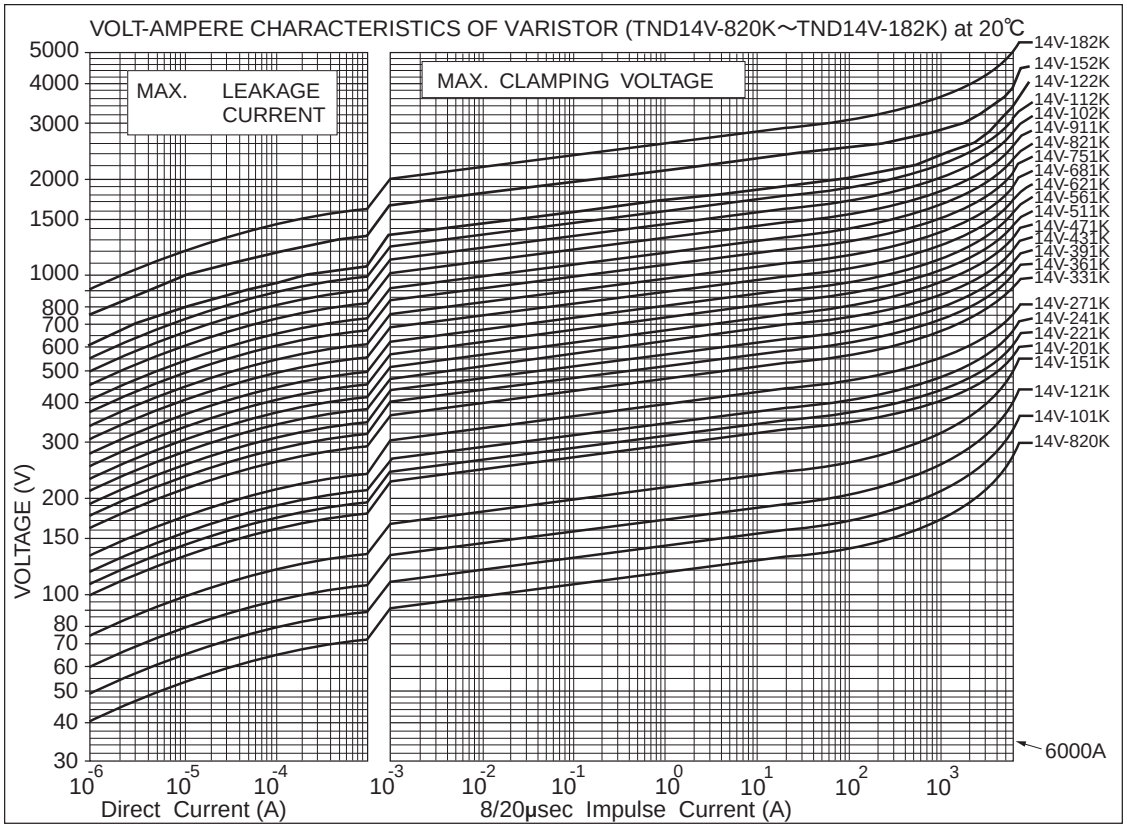
Part Number	D Max.	H Max.	T Max.	L Min.	ϕd ±0.05	W ±1.0
TND14V-150K to TND14V-511K	15.5	18.5	Ref. to RATINGS	20	0.8	7.5
TND14V-561K to TND14V-112K	16.0	19.0				
TND14V-122K to TND14V-182K	17.0	20.5				

●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)





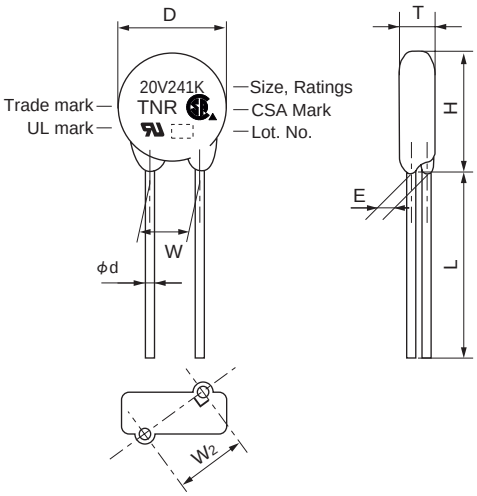
V Series

◆RATINGS (Type 20V)

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA	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

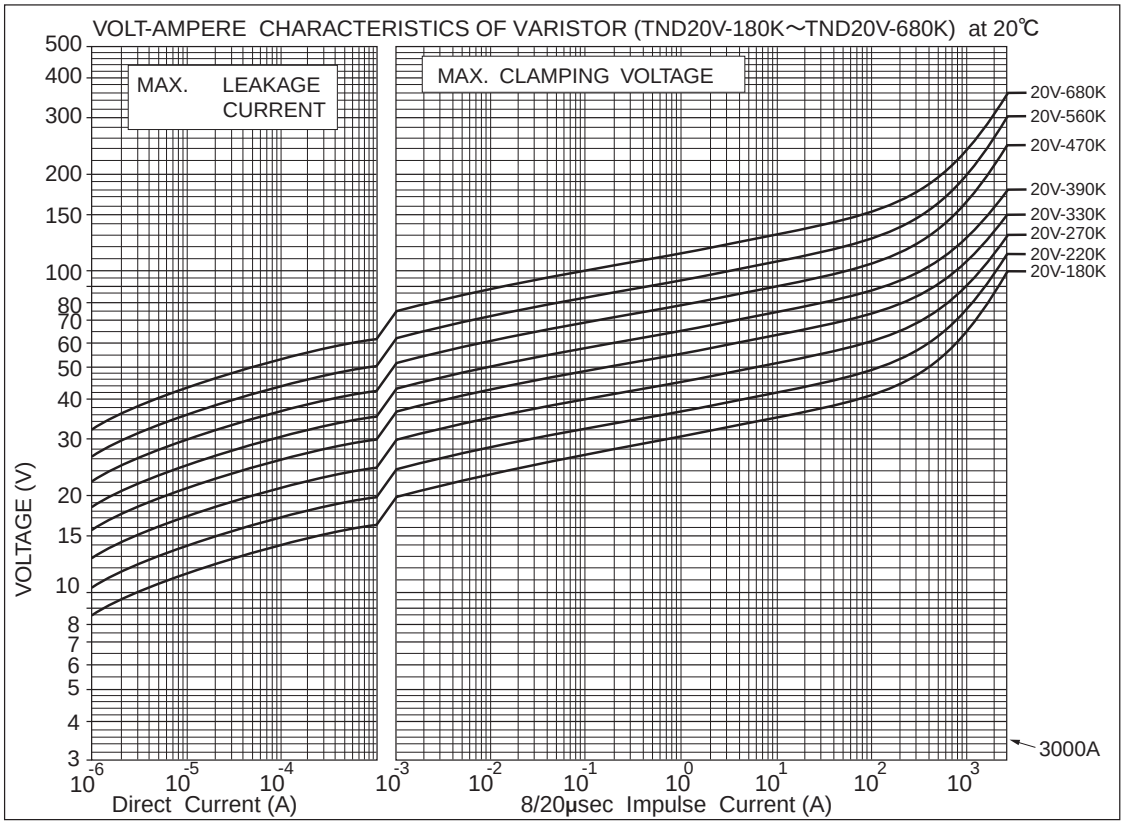
◆DIMENSIONS [mm]

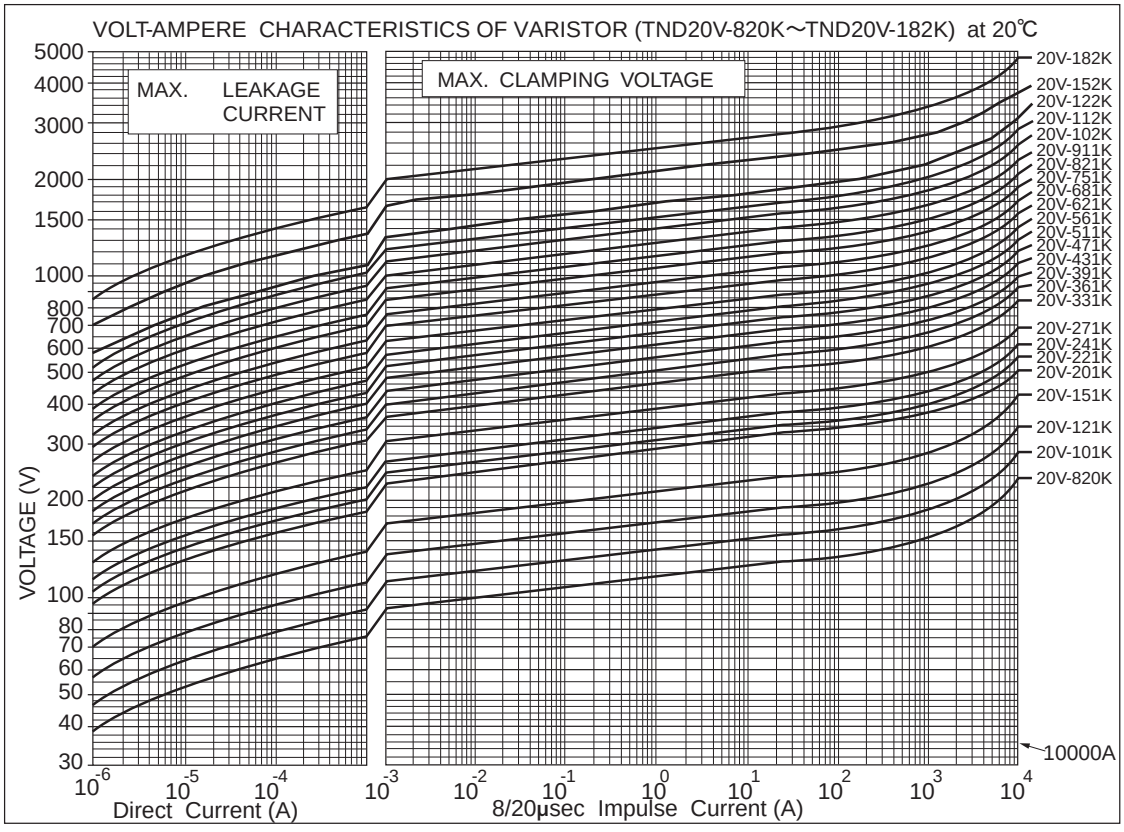


Part Number	D Max.	H Max.	T Max.	L Min.	ϕd ±0.05	W ±1.0
TND20V-180K to TND20V-511K	21.5	24.5	Ref. to Ratings	20	0.8	10.0
TND20V-561K to TND20V-112K	22.5	25.5				
TND20V-122K to TND20V-182K	23.5	28.0				

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. Type: 5V — Current CmA: 0.1 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	$\frac{\text{V CmA at 85℃} - \text{V CmA at 25℃}}{\text{V CmA at 25℃}} \times \frac{1}{60} \times 100\ (\%/℃)$ V CmA : 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.	ΔV CmA/V CmA≦±5% However, on varistors have nominal varistor voltages from 15V to 68V, the varistor voltage change shall be ΔV CmA/V CmA≦±10%
Low Temperature Storage	The specimen shall be subjected -40±2℃ for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Damp heat (Humidity)	The specimen shall be subjected to 40±2℃, 90 to 95%RH for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Temperature Cycle	The temperature cycle shown below shall be repeated 5 cycles. -40±3℃, 30 minutes ⇔ +85±2℃, 30 minutes	ΔV CmA/V CmA≦±5% No remarkable damage
High Temperature Operating	The specimen shall be subjected to 85±2℃ with the maximum allowable voltage for 1000±12 hours.	ΔV CmA/V CmA≦±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.	ΔV CmA/V CmA≦±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>After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 350±10°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 3^{+1}_{-0} seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)
or
After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 260±10°C to a point 2.0 to 2.5 mm from the root of the lead, be held there for 10±1 seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)</td><td>ΔV CmA/V CmA≦±5%
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.
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.

ΔV CmA/V CmA≦±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.
Peak-to-Peak amplitude : 1.5mm
Vibration frequency range : 10Hz to 55Hz
Sweeping time:
Approximately one minute for 10Hz →55Hz →10Hz
Direction and duration of vibration :
Three directions of X, Y and Z. Two hours each.
Six hours total.</td><td>No remarkable appearance abnormality.

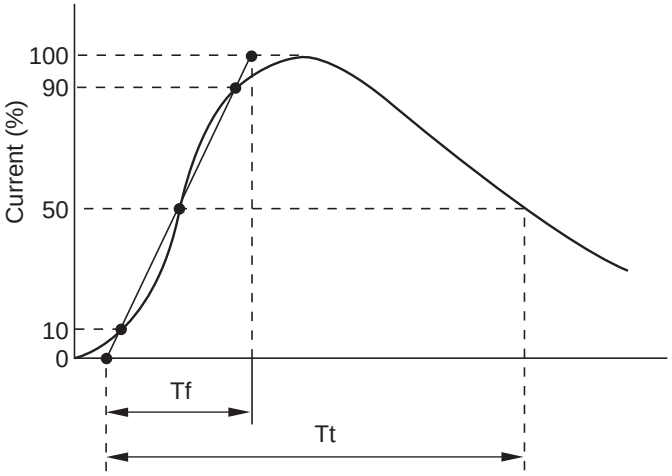
ΔV CmA/V CmA≦±5%</td></tr>
</table>

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

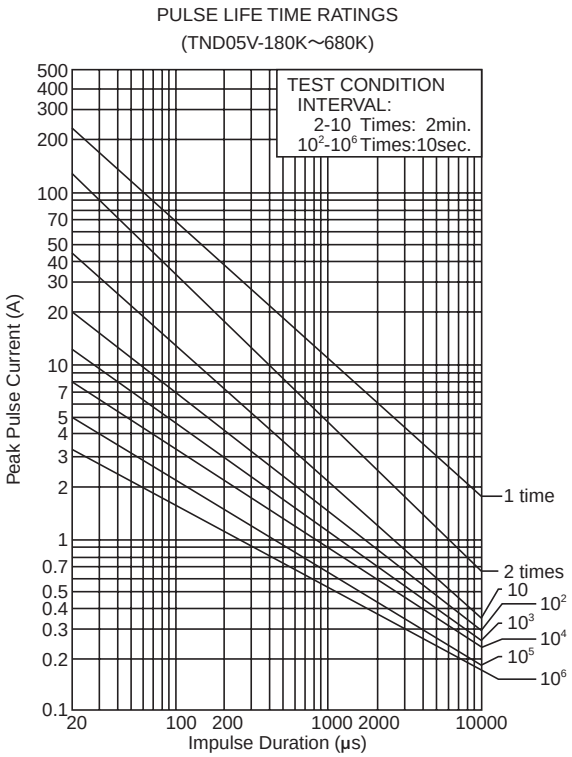
(Impulse Current Wave Form)

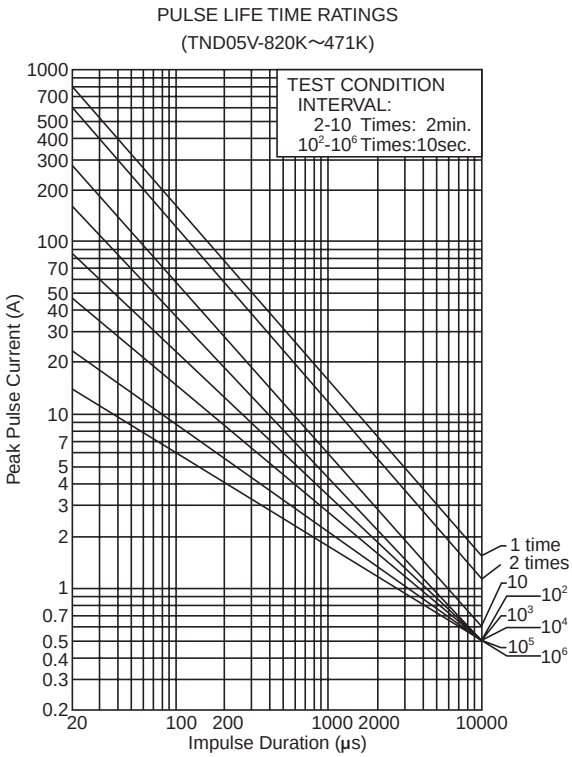


Tf : (Rise Time)

Tt : (Impulse Duration)

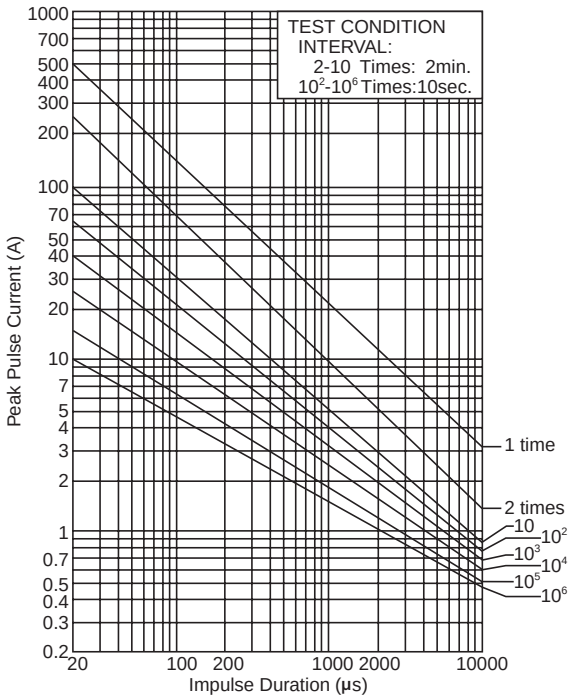
●V series



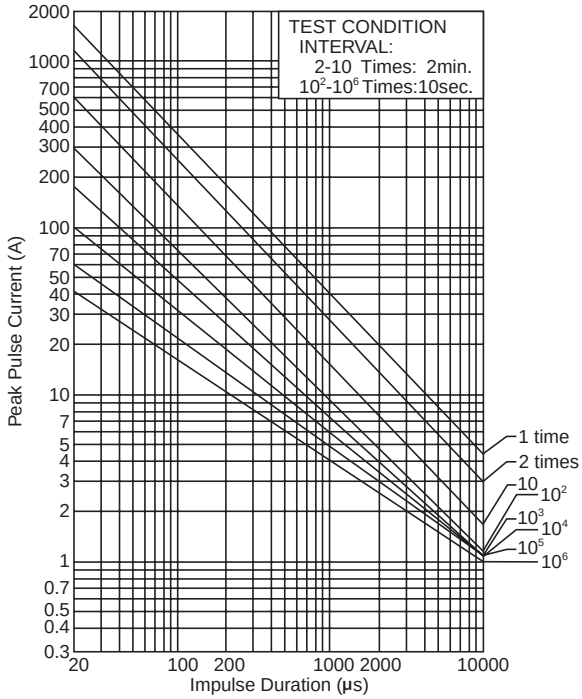


●V series

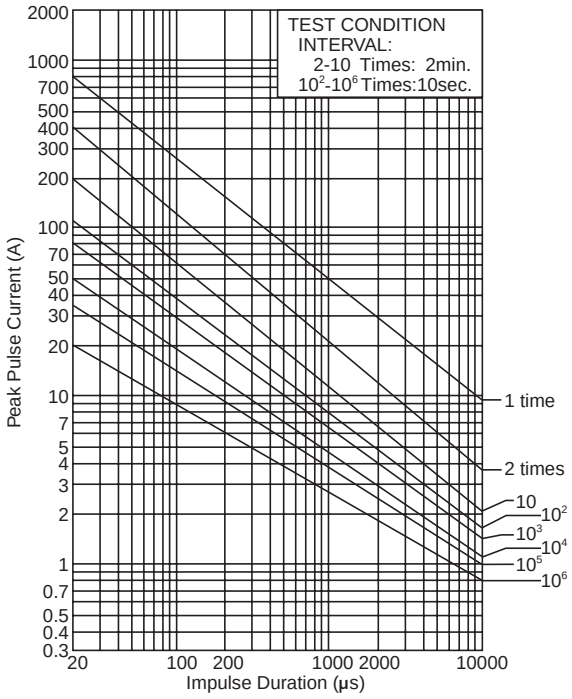
PULSE LIFE TIME RATINGS
(TND07V-150K～680K)



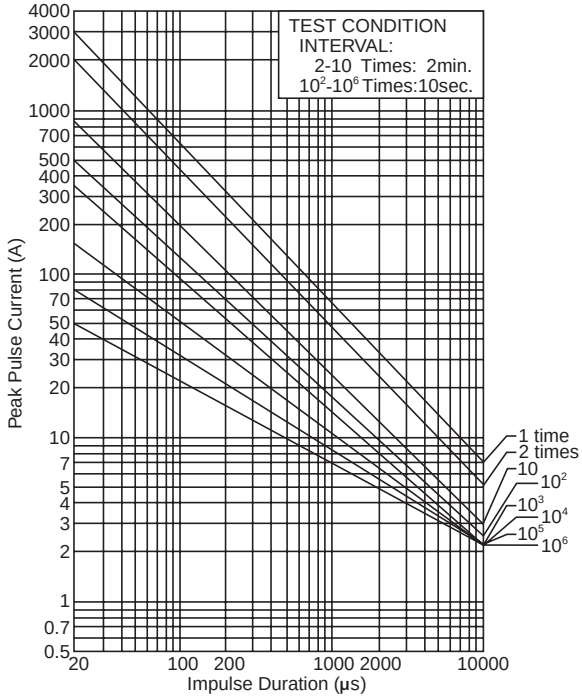
PULSE LIFE TIME RATINGS
(TND07V-820K～511K)



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

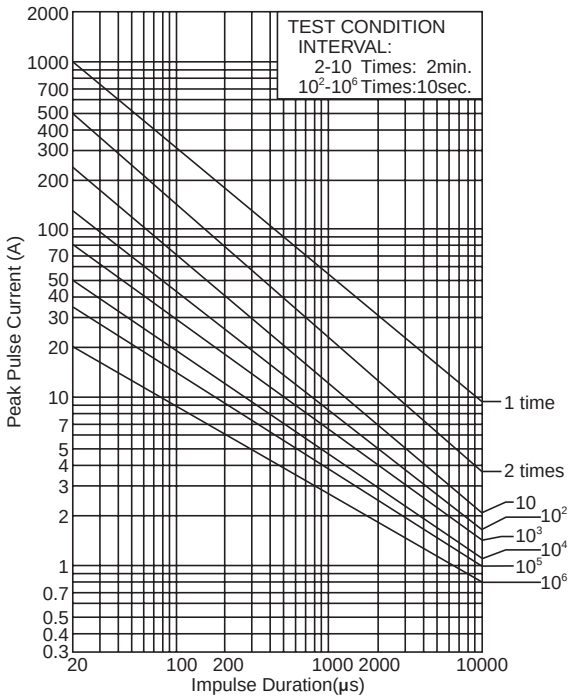


PULSE LIFE TIME RATINGS
(TND09V-820K～511K)

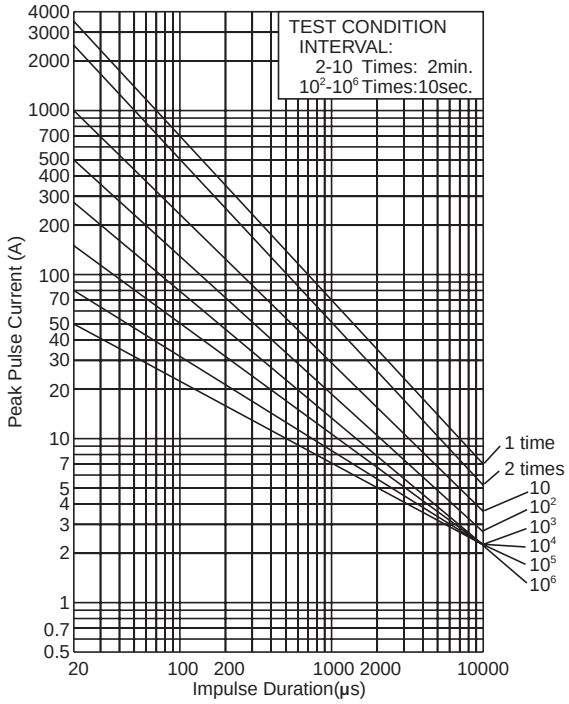


●V series

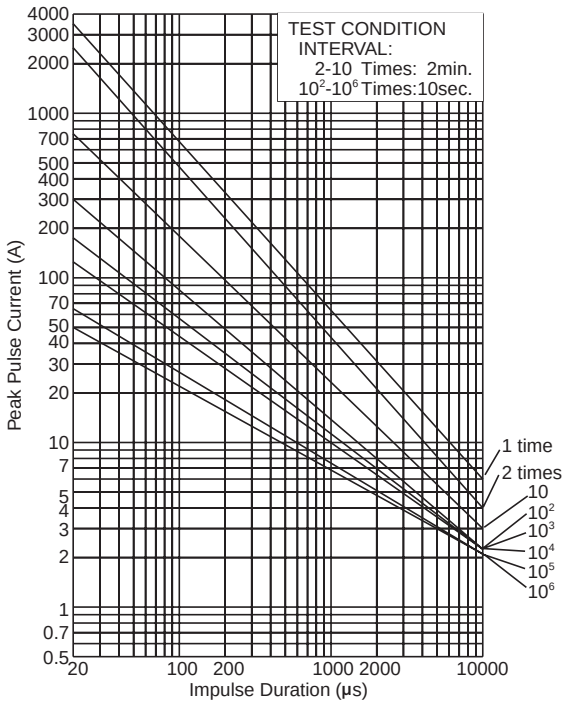
PULSE LIFE TIME RATINGS
(TND10V-150K～680K)



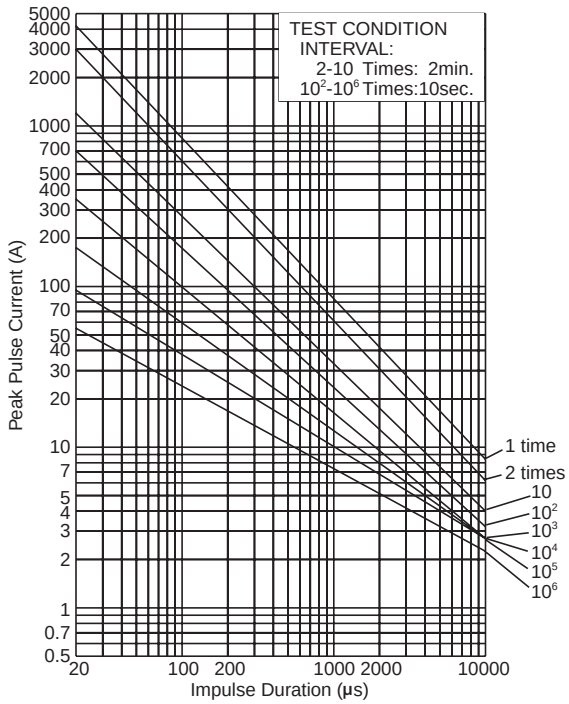
PULSE LIFE TIME RATINGS
(TND10V-820K～511K)



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

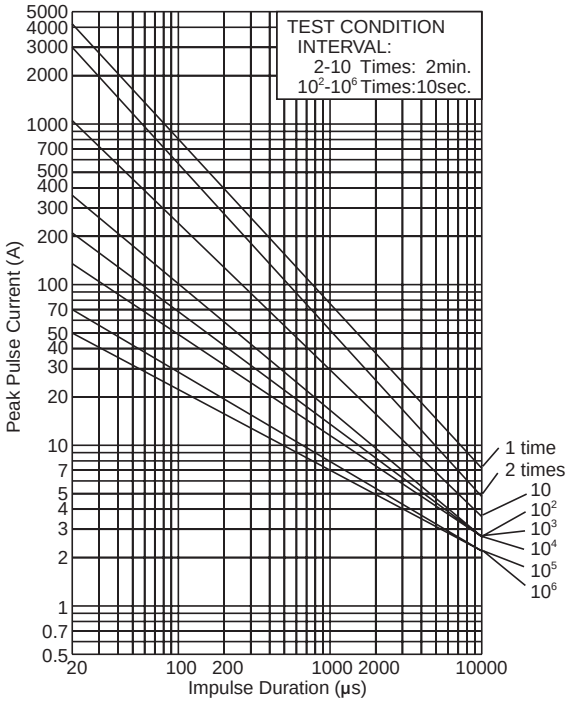


PULSE LIFE TIME RATINGS
(TND12V-431K～511K)

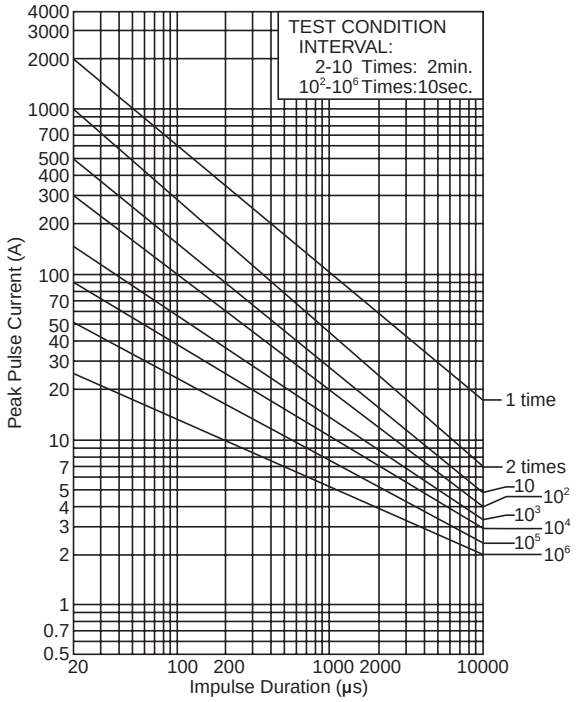


●V series

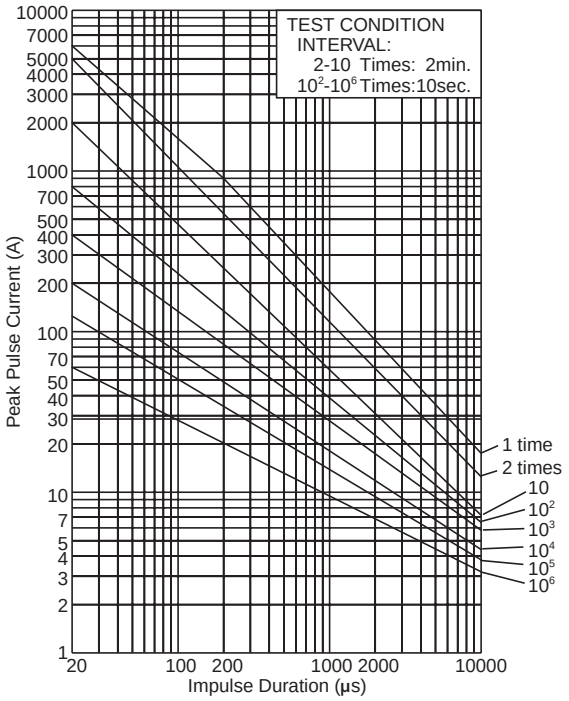
PULSE LIFE TIME RATINGS
(TND12V-561K～182K)



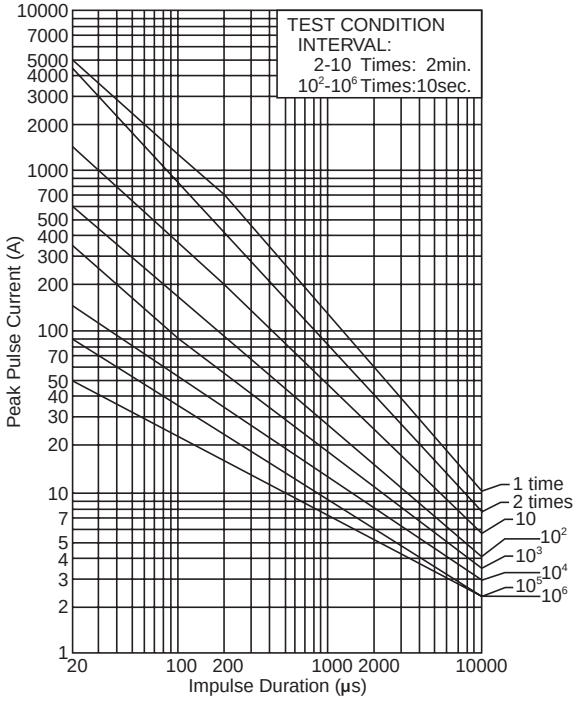
PULSE LIFE TIME RATINGS
(TND14V-150K～680K)



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

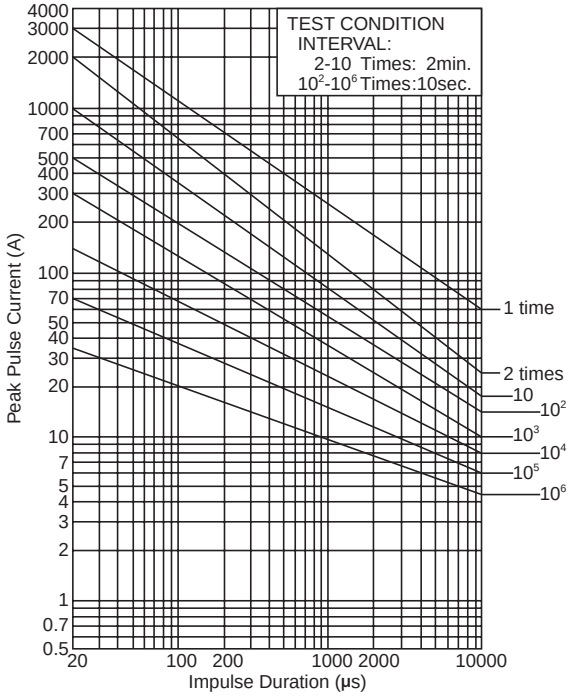


PULSE LIFE TIME RATINGS
(TND14V-561K～182K)

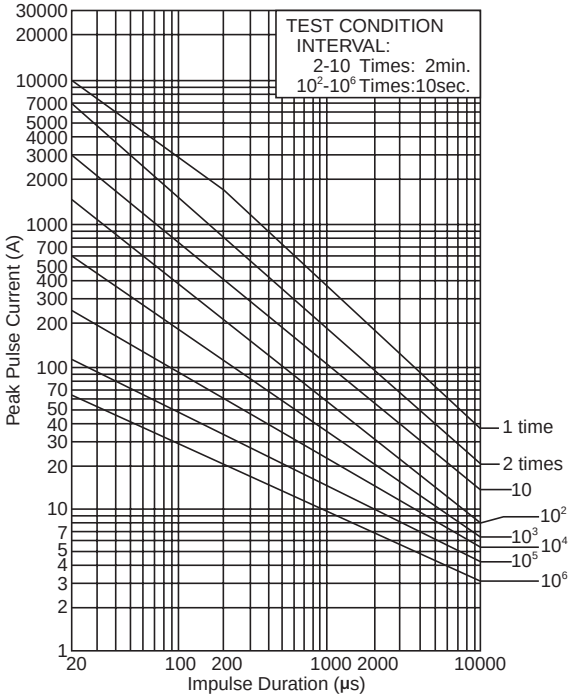


●V series

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

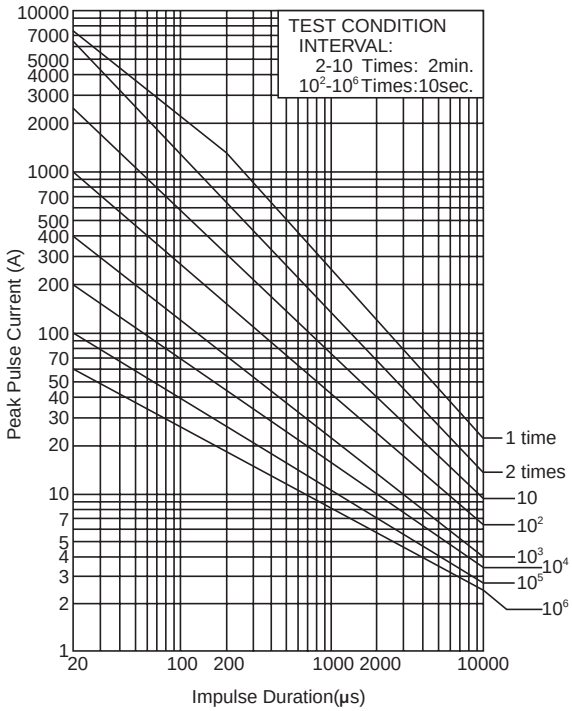


PULSE LIFE TIME RATINGS
(TND20V-820K～511K)



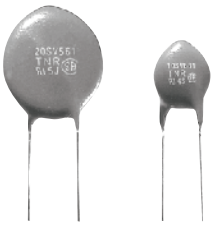
●V series

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 62368-1:2018 G.8.1 conforming product	S	S417

◆RATING AND CHARACTERISTICS

Part Number	Previous Part Number	Maximum Ratings					Max. Clamping Voltage		Capacitance Typical @1kHz	Varistor Voltage V CmA 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		273			1120	830	680 (612 to 748)	7.9
TND20SV751KB00AAA0	TNR20SV751K	460	615	7,500A/1time	300			1240	750	750 (675 to 825)	8.4
TND20SV821KB00AAA0	TNR20SV821K	510	670	6,500A/2times	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

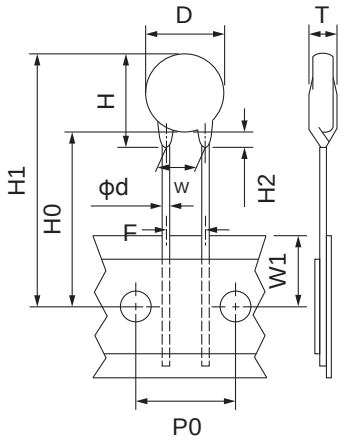
◆DIMENSIONS [mm]

● 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.

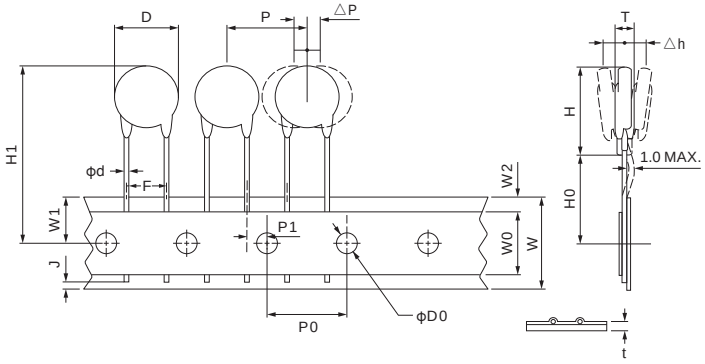


Symbol	5SV	7SV
D	7.5Max	9.0 Max.
H	13.0Max	14.0 Max.
T	Ref. to RATINGS	
ϕd	0.6±0.05	
P0	12.7±0.3	
W1	9.0±0.5	
W	5.0±1.0	
F	5.0±0.8	
H0	$20.0^{+1.5}_{-1.0}$	
H1	31.5 Max.	32.5 Max.
H2	5.0 Max.	

·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

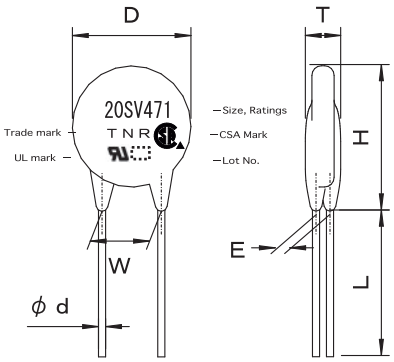
◆DIMENSION

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

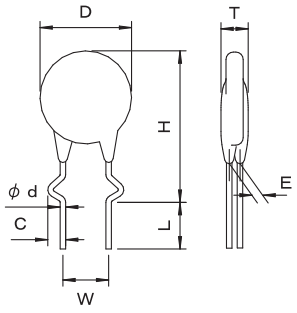
EX)



•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.61	P.76
TND07SV221K to TND07SV511K	TND07V-221K to TND07V-511K	P.63	P.77
TND10SV221K to TND10SV102K	TND10V-221K to TND10V-102K	P.67	P.78
TND12SV431K to TND12SV102K	TND12V-431K to TND12V-102K	P.69	P.78 to 79
TND14SV221K to TND14SV102K	TND14V-221K to TND14V-102K	P.71	P.79
TND20SV221K to TND20SV102K	TND20V-221K to TND20V-102K	P.73	P.80

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. The measurement shall be made as fast as possible to avoid heat affection. Type: 5SV — Current CmA: 0.1 Type: Others — 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 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	$\frac{VC \text{ at } 125℃ - VC \text{ at } 25℃}{VC \text{ at } 25℃} \times \frac{1}{100} \times 100\ (\%/℃)$ VC : Actual varistor voltage	Within ±0.05%/℃(≦681K) 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°C for 1000±12 hours without load.	ΔV CmA/V CmA≦±10%
Low Temperature Storage	The specimen shall be subjected -40±2°C for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Damp heat (Humidity)	The specimen shall be subjected to 85±2°C, 80 to 85%RH for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Temperature Cycle	The temperature cycle shown below shall be repeated 1000 cycles. −40±3°C, 30 minutes⇔ +125±2°C, 30 minutes	ΔV CmA/V CmA≦±5% No remarkable damage
High Temperature Operating	The specimen shall be subjected to 125±2°C with the maximum allowable voltage for 1000± 12 hours.	ΔV CmA/V CmA≦±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.	ΔV CmA/V CmA≦±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

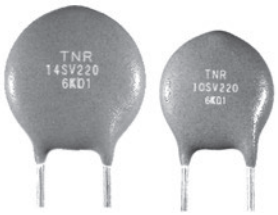
◆MECHANICAL CHARACTERISTICS

<table>
<tr><th>Item</th><th>Test Conditions</th><th>Specifications</th></tr>
<tr><td>Resistance to Soldering Heat</td><td>After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 350±10°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 3^{+1}_{-0} seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)
or
After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 260±10°C to a point 2.0 to 2.5 mm from the root of the lead, be held there for 10±1 seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)</td><td>ΔV CmA/V CmA≦±5%
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.
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>Lead diameter</td><td>Force</td></tr>
<tr><td>ϕ0.8mm</td><td>10N</td></tr>
</table></td><td>No abnormality such as disconnection.
ΔV CmA/V CmA≦±5%</td></tr>
<tr><td>Lead Bend Strength</td><td>The varistor shall be secured with its terminal kept vertical and the force specified below shall be applied in the axial direction.
The terminal shall granually be bend by 90 in one direction then 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>10N</td></tr>
<tr><td>10SV, 12SV, 14SV, 20SV</td><td>0.8mm</td><td>10N</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.
Peak-to-Peak amplitude : 1.5mm
Vibration frequency range : 10 to 55Hz
Sweeping time:
å Approximately one minute for 10Hz → 55Hz → 10Hz
Direction and duration of vibration : Three directions of X, Y, and Z. 2 hours each. 6 hours total.</td><td>No remarkable apperance abnormality.
ΔV CmA/V CmA≦±5%</td></tr>
<tr><td>Flammability test</td><td>The varistor shall be subjected 60 sec. applications of test flame.
Burnar : Bunsen gas burner 9000kcal / m^3
Diameter of flame nozzle : ϕ9.5mm
Position : The spesimen shall be fixed horizonal.
Point of application shall be approximately center of the specimen.</td><td>No catching fire, and no flaming drops.</td></tr>
</table>

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

- 18 Design Code
- 13 14 Lead Forming/Taping
- 12 ⑦Packing Style
- 11 ⑥Varistor Voltage Tolerance
- 8 9 10 ⑤Varistor Voltage
- 6 7 ④Series
- 4 5 ③Element Diameter
- 2 3 ②Product Form
- 1 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 V CmA 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

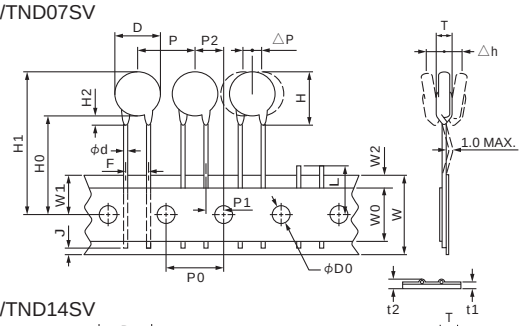
◆DIMENSION

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

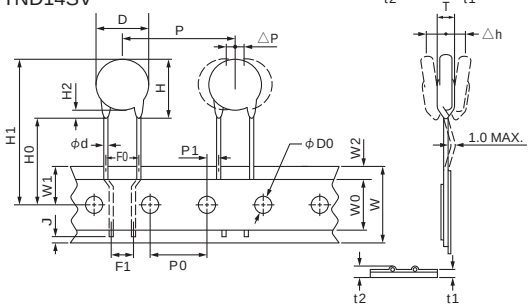
Taping Code：TBA (T25)　　Unit：mm

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

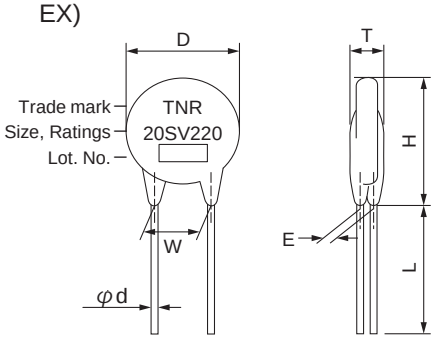
Stlaight lead Type

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

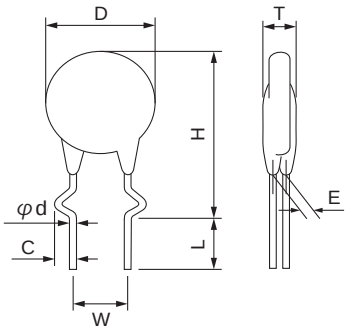
◆MARKING

EX)



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.



◆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.61	P.76
TND05SV270K	TND05V-270K		
TND05SV330K	TND05V-330K		
TND05SV390K	TND05V-390K		
TND05SV470K	TND05V-470K		
TND05SV560K	TND05V-560K		
TND05SV680K	TND05V-680K		
TND07SV220K	TND07V-220K	P.63	P.77
TND07SV270K	TND07V-270K		
TND07SV330K	TND07V-330K		
TND07SV390K	TND07V-390K		
TND07SV470K	TND07V-470K		
TND07SV560K	TND07V-560K		
TND07SV680K	TND07V-680K		
TND10SV220K	TND10V-220K	P.67	P.78
TND10SV270K	TND10V-270K		
TND10SV330K	TND10V-330K		
TND10SV390K	TND10V-390K		
TND10SV470K	TND10V-470K		
TND10SV560K	TND10V-560K		
TND10SV680K	TND10V-680K		
TND14SV220K	TND14V-220K	P.71	P.79
TND14SV270K	TND14V-270K		
TND14SV330K	TND14V-330K		
TND14SV390K	TND14V-390K		
TND14SV470K	TND14V-470K		
TND14SV560K	TND14V-560K		
TND14SV680K	TND14V-680K		
TND20SV220K	TND20V-220K	P.73	P.80
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. Type: 5SV — Current CmA: 0.1 Type: Others — 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 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	$\frac{VC\text{ at }125℃ - VC\text{ at }25℃}{VC\text{ at }25℃} \times \frac{1}{100} \times 100\ (\%/℃)$ 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.	ΔV CmA/V CmA≦±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.	ΔV CmA/V CmA≦±10%
Low Temperature Storage	The specimen shall be subjected −40±2°C for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Damp heat (Humidity)	The specimen shall be subjected to 85±2°C, 80 to 85%RH for 1000±12 hours without load.	ΔV CmA/V CmA≦±10%
Temperature Cycle	The temperature cycle shown below shall be repeated 1000 cycles. −40±3°C, 30 minutes ⇔ +125±2°C, 30 minutes	ΔV CmA/V CmA≦±10% No remarkable damage
High Temperature Operating	The specimen shall be subjected to 125±2°C with the maximum allowable voltage for 1000±12 hours.	ΔV CmA/V CmA≦±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.	ΔV CmA/V CmA≦±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>After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 350±10°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 3^{+1}_{-0} seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)
or
After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 260±10°C to a point 2.0 to 2.5 mm from the root of the lead, be held there for 10±1 seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)</td><td>ΔV CmA/V CmA≦±5%
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.
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.
ΔV CmA/V CmA≦±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.
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.
Peak-to-Peak amplitude : 1.5mm , Acceleration : 5G
Vibration frequency range : 10 to 500Hz
Sweeping time: Approximately 20 minutes for 10Hz→500Hz→10Hz
Direction and duration of vibration : Three directions of X, Y, and Z. 2 hours each. 6 hours total.</td><td>No remarkable apperance abnormality.
ΔV CmA/V CmA≦±5%</td></tr>
<tr><td>Flammability test</td><td>The varistor shall be subjected 60 sec. applications of test flame.

Burnar : Bunsen gas burner 9000kcal / m^3
Diameter of flame nozzle : ϕ9.5mm
Position : The spesimen shall be fixed horizonal.
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

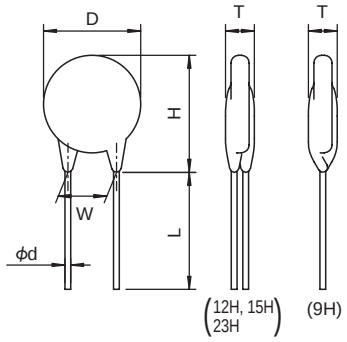
High Energy, Low Varistor Voltage Series

◆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 V CmA
		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)

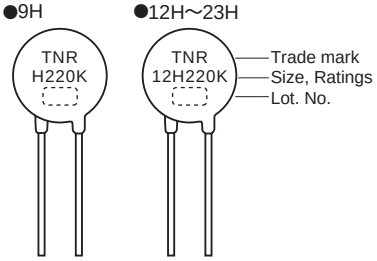
◆DIMENSIONS [mm]



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

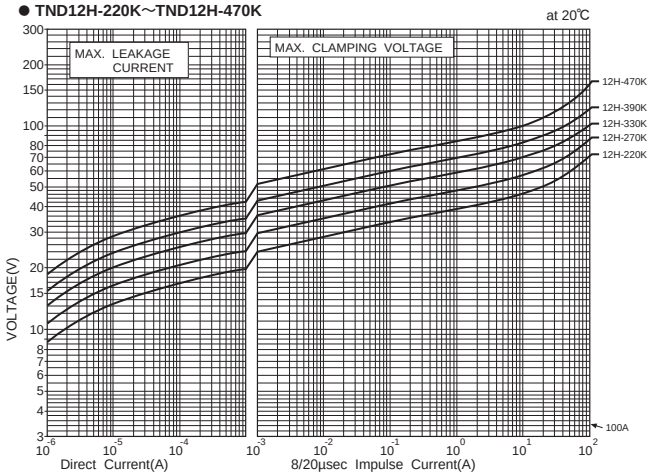
EX)



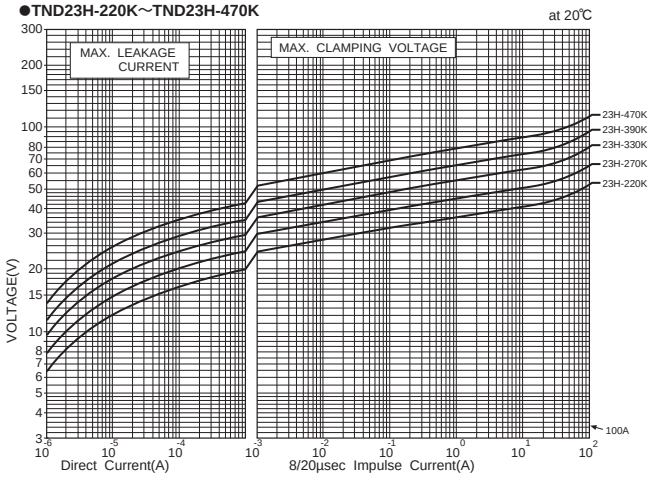
H Series

◆V-I CURVE

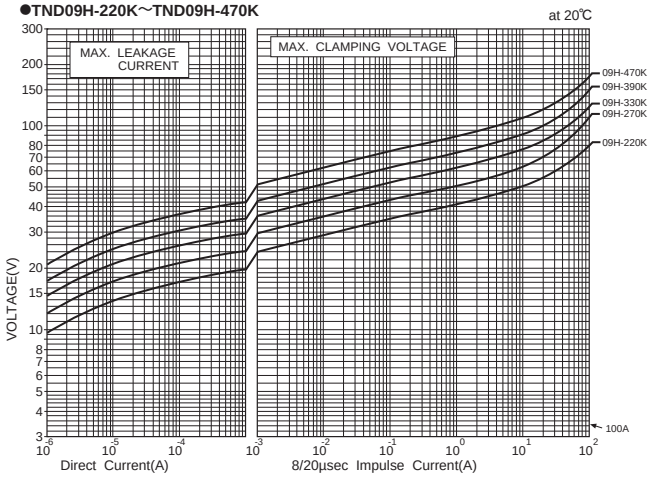
● TND12H-220K～TND12H-470K



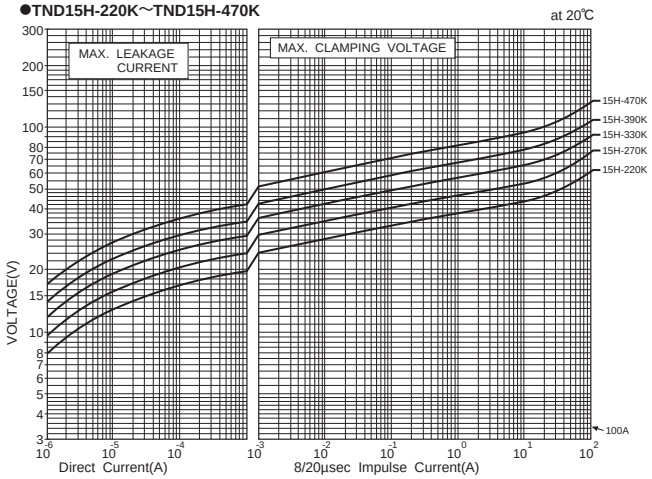
●TND23H-220K～TND23H-470K



●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. 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 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	$\frac{\text{V CmA at 85℃} - \text{V CmA at 25℃}}{\text{V CmA at 25℃}} \times \frac{1}{60} \times 100\ (\%/℃)$	Within ±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. Lead diameter: ϕ0.6mm. ϕ0.8mm — Force: 10 N	ΔV CmA / V CmA ≦±5% 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. The terminal shall gradually be bend by 90° in one direction then 90º in the opposite direction, and again back to original position. The damage of the terminal shall be visually examined. 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.	ΔV CmA / V CmA ≦±5% No remarkable damage
Resistance to Soldering Heat	After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 350±10°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 3^{+1}_{-0} seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102) or After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 260±10°C to a point 2.0 to 2.5 mm from the root of the lead, be held there for 10±1 seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)	ΔV CmA / V CmA ≦±5% No remarkable damage
Solderability	Each lead shall be dipped into a methanol solution (about 25%) of rosin for 5 to 10 sec. 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

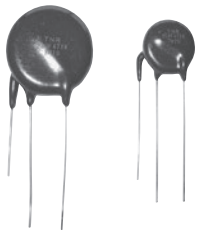
Item	Test Conditions	Specifications
High Temperature Storage (Dry heat)	The specimen shall be subjected 150±2℃ for 1000±12 hours without load.	ΔV CmA/V CmA≦±10%
Low Temperature Storage	The specimen shall be subjected -40±2℃ for 1000±12 hours without load.	ΔV CmA/V CmA≦±5%
Damp heat (Humidity)	The specimen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

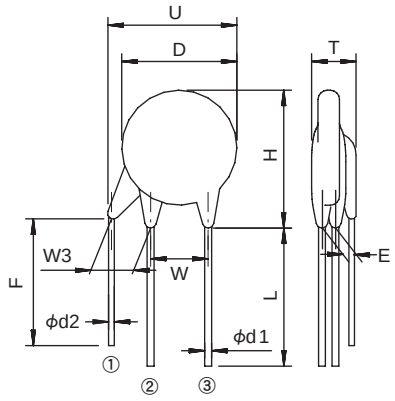


Operating Temperature Range: -40 to +85℃
Storage Temperature Range: -50 to +125℃

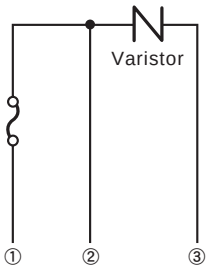
◆STANDARD RATINGS

Part Number	Previous Part Number (Just for your reference)	Maximum Ratings					Max. Clamping Voltage	Capacitance Typical @1kHz	Varistor Voltage V CmA	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]



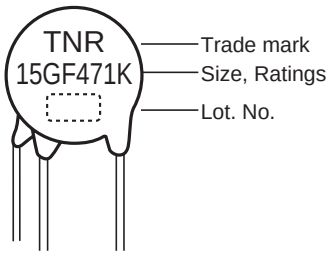
	15GF	23GF
D	18 Max.	25 Max.
T	Refer to Standard Ratings	
H	22 Max.	32 Max.
W	7.5±1	10±1
W3	2.5 Min.	2.5 Min.
L	25 Min.	25 Min.
U	23 Max.	28 Max.
F	17 Min.	17 Min.
E	Refer to Standard Ratings	
ϕd1	0.8±0.05	0.8±0.05
ϕd2	0.53±0.05	0.58±0.05



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

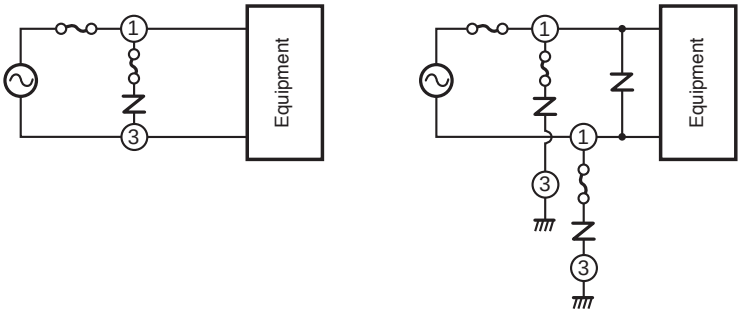
◆MARKING

EX)



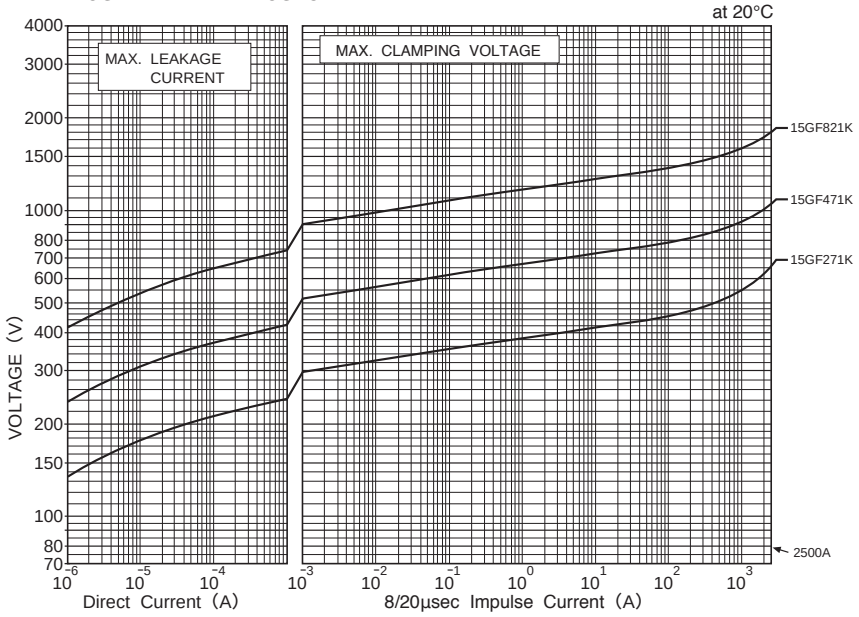
GF Series

◆APPLICATION CIRCUIT EXAMPLE

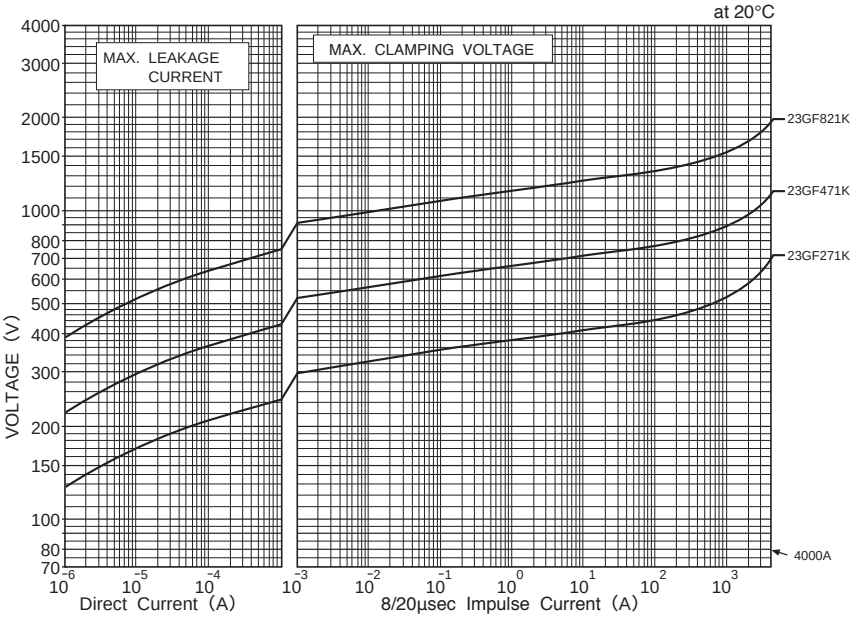


◆V-I CURVE

● TND15GF271K ～ TND15GF821K

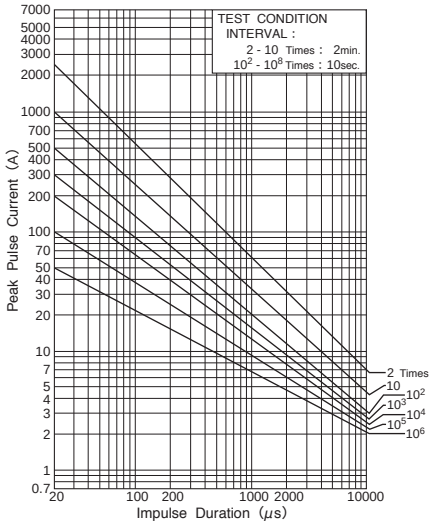


● TND23GF271K ～ TND23GF821K

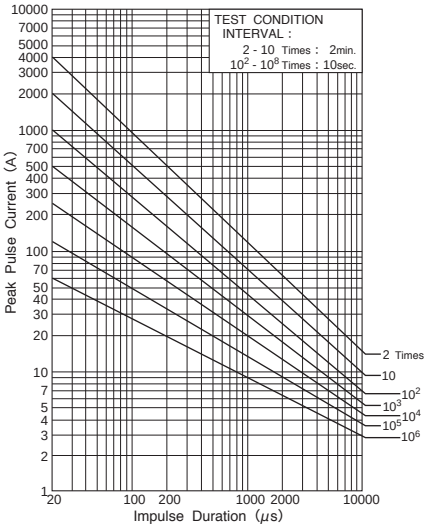


◆PULSE LIFE TIME RAITINGS

● 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) Type / Lead Diameter / Force 15GF, 23GF / 0.8mm / 10N Thermal fuse (15GF) / 0.53mm / 5N 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) Type / Lead Diameter / Force 15GF, 23GF / 0.8mm / 5N Thermal fuse (15GF) / 0.53mm / 2.5N 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. Peak-to-Peak amplitude : 1.5mm, Acceleration : 5G Vibration frequency range : 10 to 500Hz Sweeping time: Approximately 20 minutes for 10Hz → 500Hz → 10Hz 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. Then each lead shall be dipped into a solder. 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)	At least, 95% of the leads shall be covered with solder uniformly.
Resistance to Soldering Heat	After V CmA is measured at room temperature, each lead shall be dipped into a solder bath at a temperature of 350±10°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 3^{+1}_{0} seconds or a temperature of 260±5°C to a point 2.0 to 2.5 mm from the root of the lead, and be held there for 10±1 seconds, and then be stored at room temperature for 1 to 2 hours. Then, V CmA shall be examined. (Conform to JIS C 5102)	ΔV CmA / V CmA ≦ ±5% 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.	ΔV CmA/V CmA ≦ ±5%
Damp heat (Humidity)	The specimen shall be subjected 40±2℃ for 1000±12 hours without load.	ΔV CmA/V CmA ≦ ±5%
Temperature Cycle	The temperature cycle shown below shall be repeated 50 cycles. -40±3℃ , 30 minutes ⇔ +150±2℃ , 30 minutes	ΔV CmA/V CmA ≦ ±5% No remarkable damage 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.	ΔV CmA/V CmA ≦ ±10%
High Temperature Operating	The specimen shall be subjected to 85±2℃ with the maximum allowable voltage for 1000±12 hours.	ΔV CmA/V CmA ≦ ±10% 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.

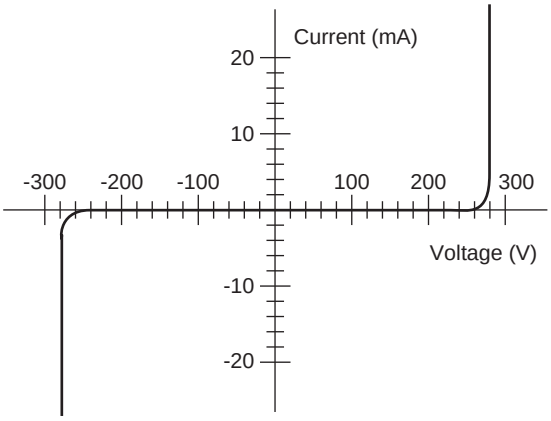


Fig. 1 Volt-ampere characteristics of varistor

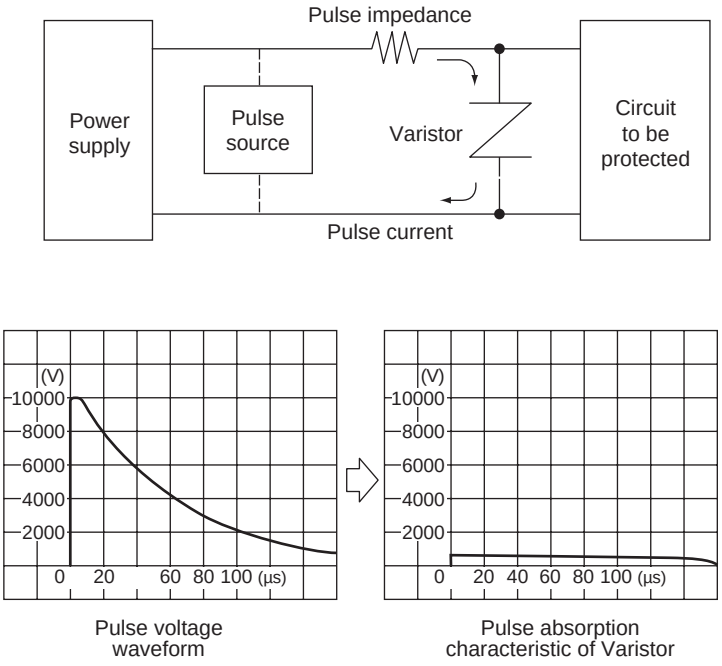


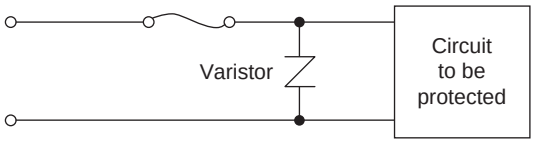
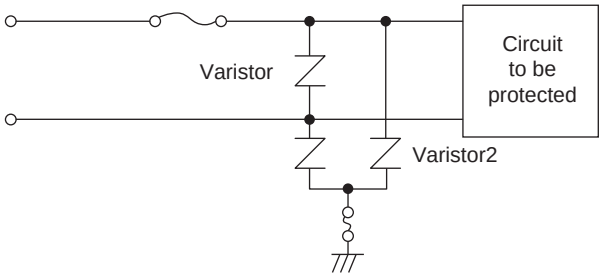
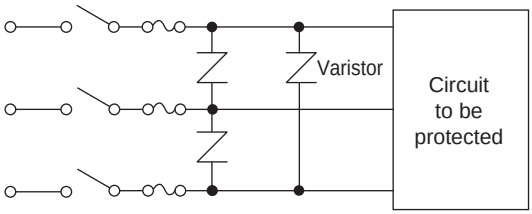
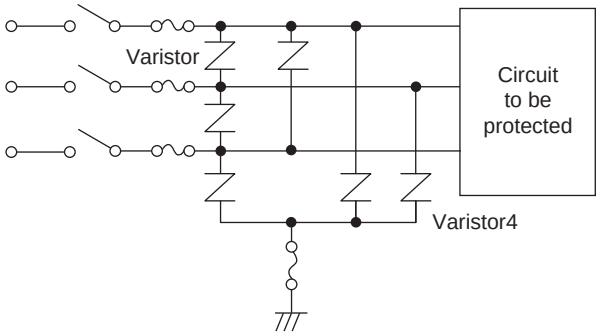
Fig. 2 Pulse absorption by varistor

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 	DC or single-phase AC 
Three-phase AC 	Three-phase AC 

(2)Examples of rating selections

Varistor used for line to line

Power Voltage	Type
AC100V	TND□□V-221K TND□□V-241K TND□□V-271K*
AC200V	TND□□V-391K TND□□V-431K TND□□V-471K*
DC12V	TND□□V-220K TND□□V-270K
DC24V	TND□□V-330K TND□□V-390K 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 AC200V	TND□□V-431K TND□□V-471K TND□□V-911K≦** TND□□V-182K ***
Varistor4	AC200V	TND□□V-431K TND□□V-471K TND□□V-911K≦** TND□□V-182K ***

Notes:

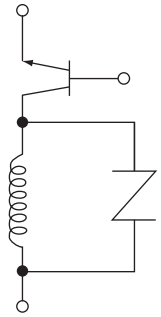
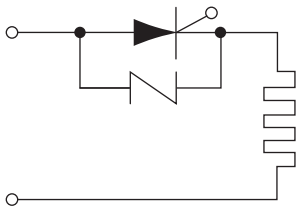
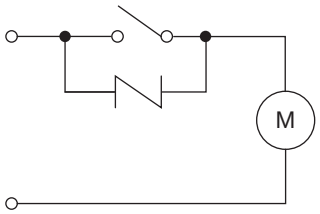
1)In an insulation resistance test (500V mega test) of a unit, it may incorrectly judged to be bad due to its leak current from the Varistor mounted on the unit. Test the unit with the Varistor removed after obtaining approval of the unit user on removing the Varistor. Or use a Varistor with mark **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

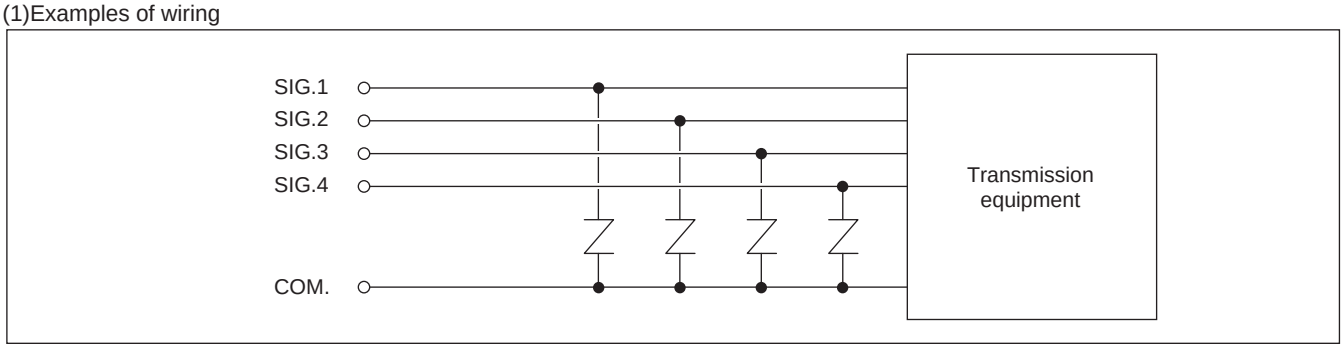
Examples of general selections		
Power Voltage	Type	Notes:
DC 12V	TND□□V-220K	1)If a Varistor is used at power voltage other than the examples to the left, never make the power voltage increase over the maximum allowable voltage.
DC 24V	TND□□V-390K	2)For other than a complete DC voltage, never make the 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 TND□□V-241K 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 TND□□V-220K 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 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.

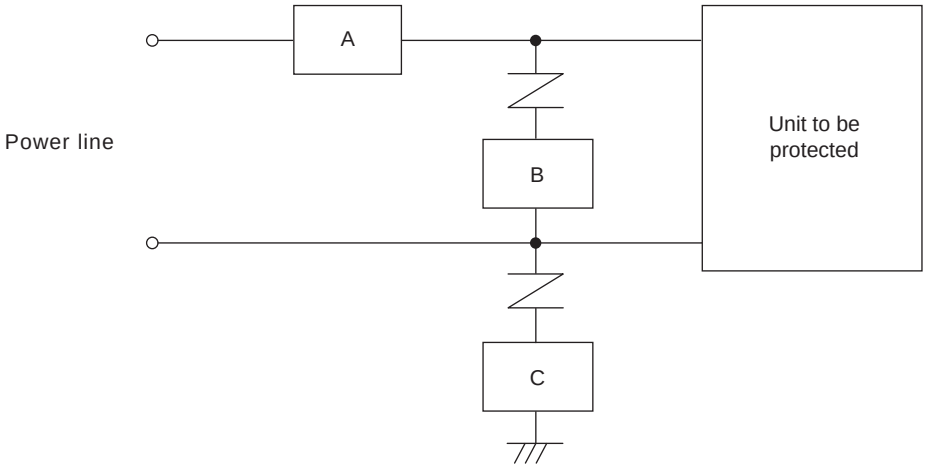
2-4 Examples of selections in fields

Example of general selections			
Use	Location	Type	
Commercial	Indoor	TND05V-□□□K TND07V-□□□K TND10V-□□□K TND12V-□□□K	Notes 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. 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 TND10V-□□□K TND12V-□□□K TND14V-□□□K	
Communication, Measurement, Control	Indoor	TND07V-□□□K TND10V-□□□K TND12V-□□□K TND14V-□□□K	
	Outdoor	TND07V-□□□K TND10V-□□□K TND12V-□□□K TND14V-□□□K	
Industry, Power	Indoor or outdoor	TND14V-□□□K 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:

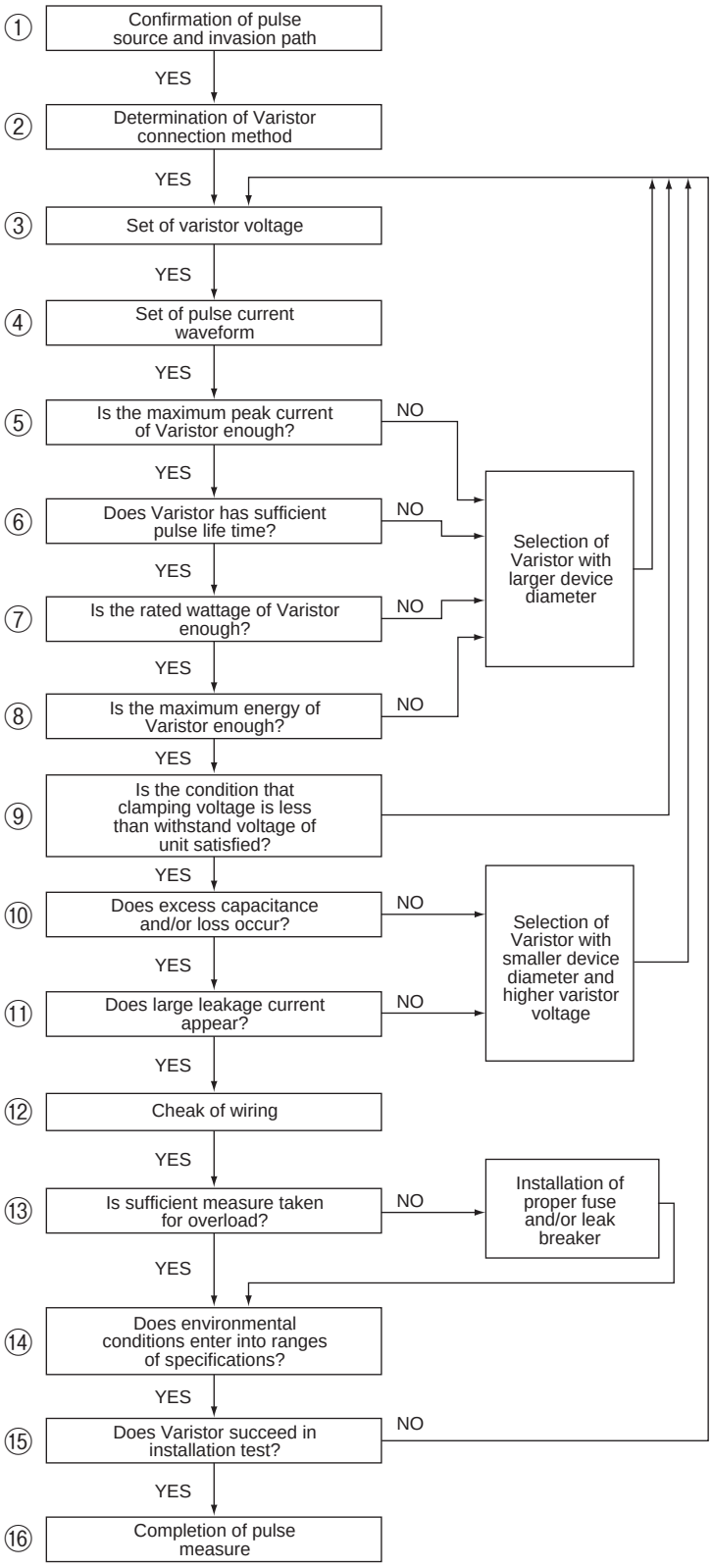
Type (TND-)	05V-□□□K	07V-□□□K	09V-□□□K 10V-□□□K 12V-□□□K	14V-□□□K 20V-□□□K
Fuse rating	3A max.	5A max.	7A max.	10A max.

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.

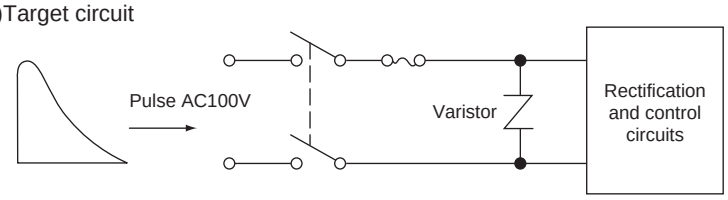
⑮Perform installation test as much as possible to confirm the performance of the Varistor.

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)

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

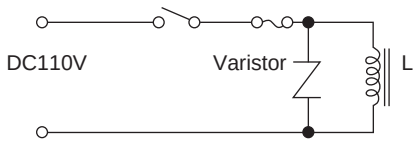
   b)Duration of wave tail of pulse current
   The duration of wave tail of pulse current can be shorter than that of pulse voltage. However, set the duration of wave tail of pulse current T to 40μs for safety. (In actual, it is about 25μs if the pulse voltage wave has the duty cycle of 1.2/50μs.
5. Is 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 = 0.9×10^8, 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

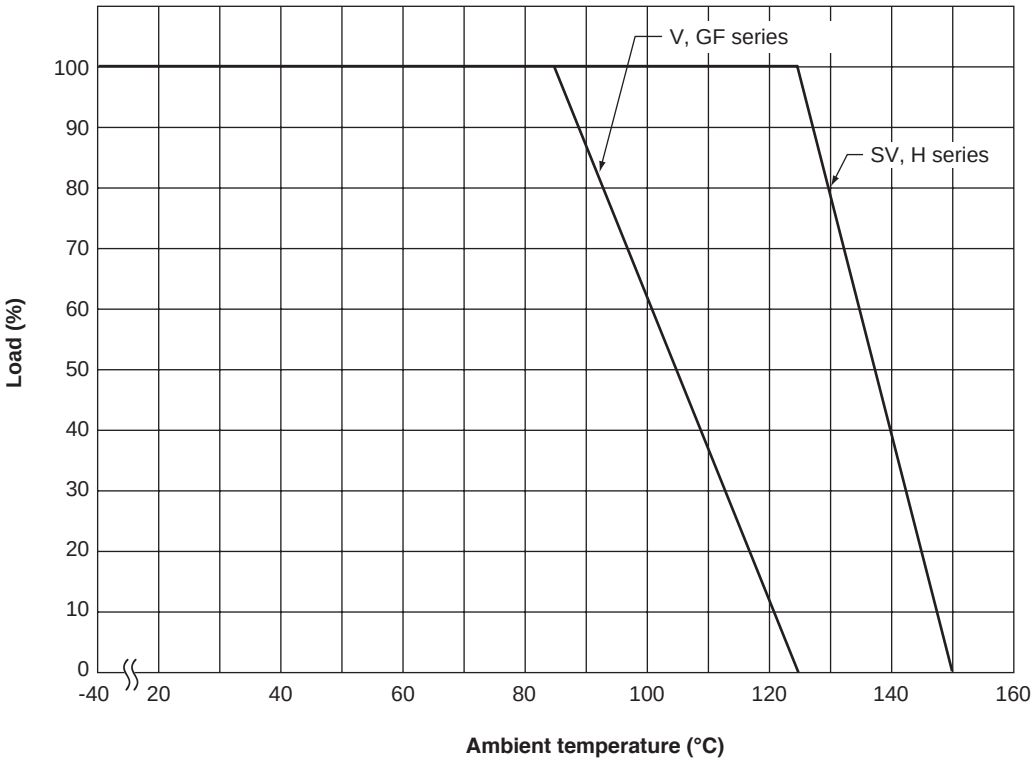


Fig. 3 Load reduction curve

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 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.

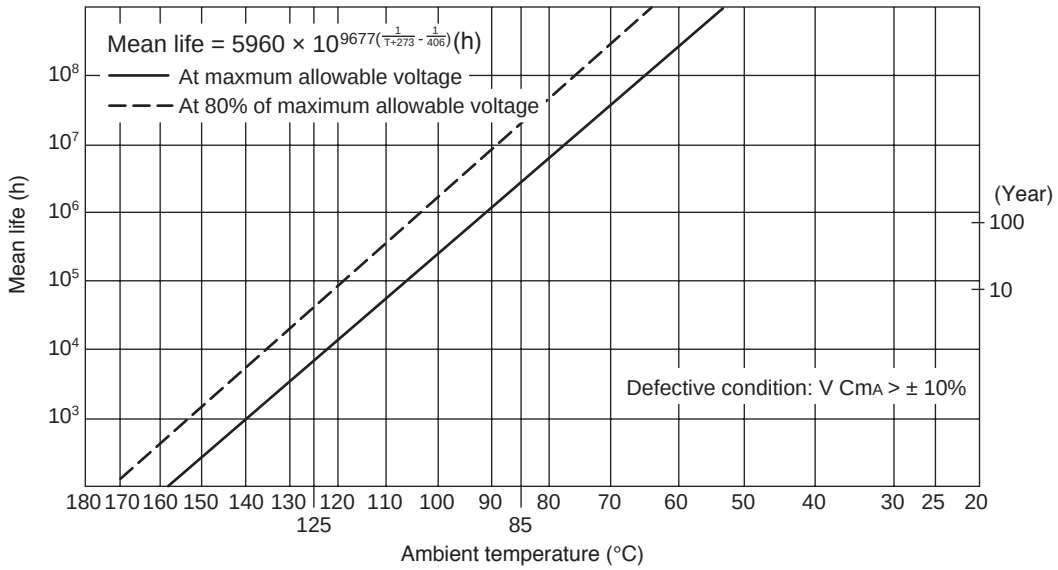


Fig. 4 Relationship between mean life Varistor and ambient temperature

(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.

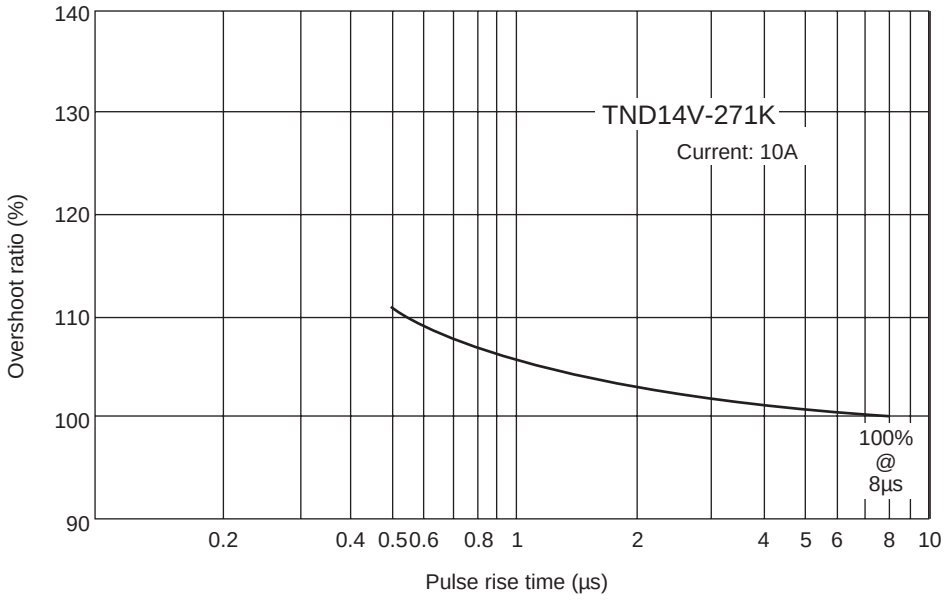


Fig. 5 Relationship between pulse rise time and overshoot ratio

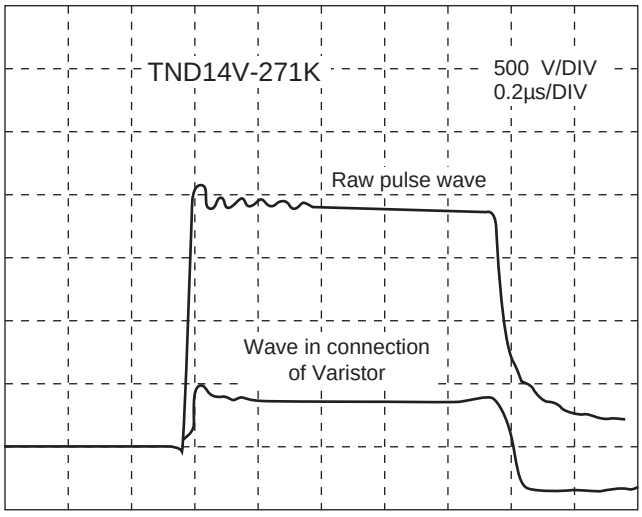


Fig. 6 Pulse absorption characteristic of Varistor (wiring length of 5mm)

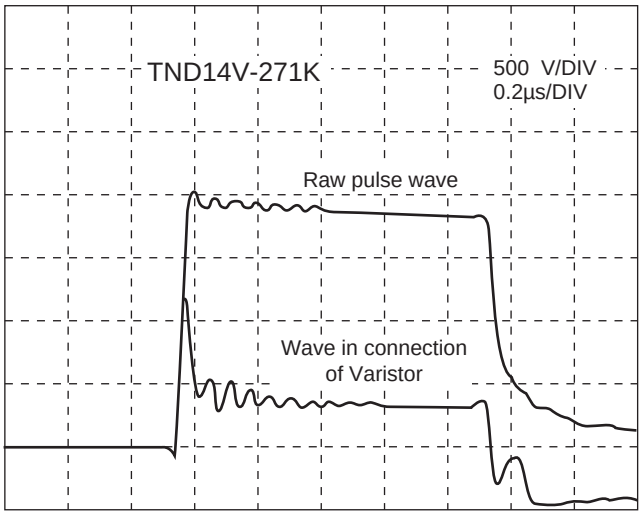
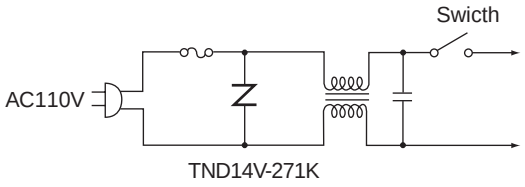
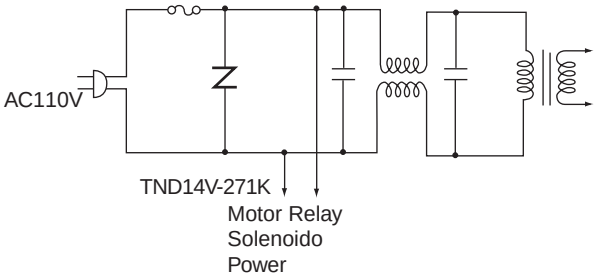


Fig. 7 Pulse absorption characteristic of Varistor (wiring length of 25cm)

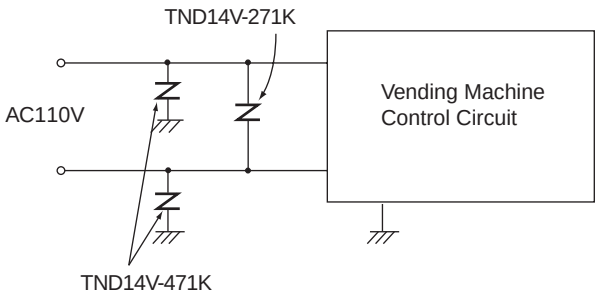
(1)Power Source Curcuit



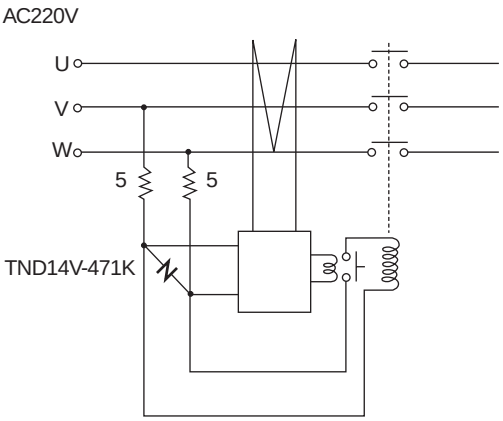
(2)Micro Computer Equipment



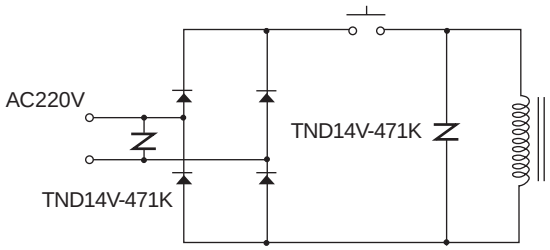
(3)Vending Machine



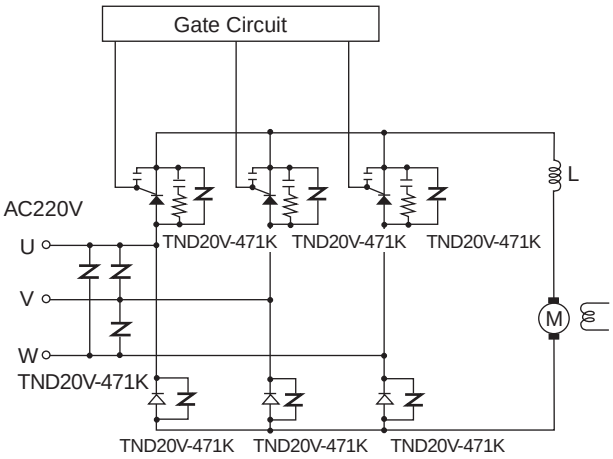
(4)Leakage Current Detector



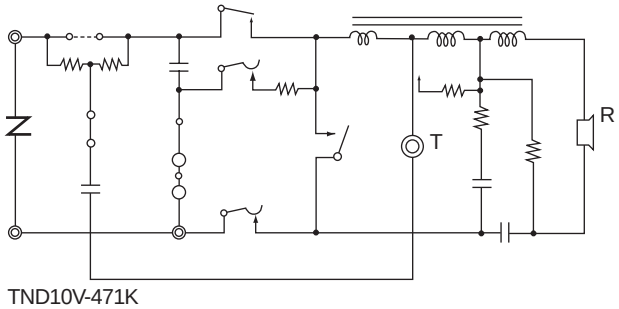
(5)Maganetic Brake



(6)Control of 20kW DC Motor



(7)Telephone



ELECTRONIC COMPONENTS & DEVICES

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