SIOV Metal Oxide Varistors

ThermoFuse Varistors, NT series

Series/Type:	**NT20 series**
Ordering code:	**B72220W/R***
Date:	2018-10-09
Version:	c

Construction

- Round varistor element, leaded
- Coating: epoxy resin, flame-retardant to UL 94 V-0
- Terminals: tinned copper wire, metal compound wire

Features

- Wide operating voltage range 130 ...750V_{RMS}
- Self-protected under abnormal overvoltage conditions
- High-energy AdvanceD series E2
- UL approval to UL 1449,4th edition, type 4CA(File number E321126)
- IEC 61051-2-2 certification
- VDE certification (certificate number 40031102）

Applications

- Home appliances
- Power supplies
- Inverters
- Photovoltaic inverters
- Drives
- Lighting applications
- Communication and data systems
- Smart meters

General technical data

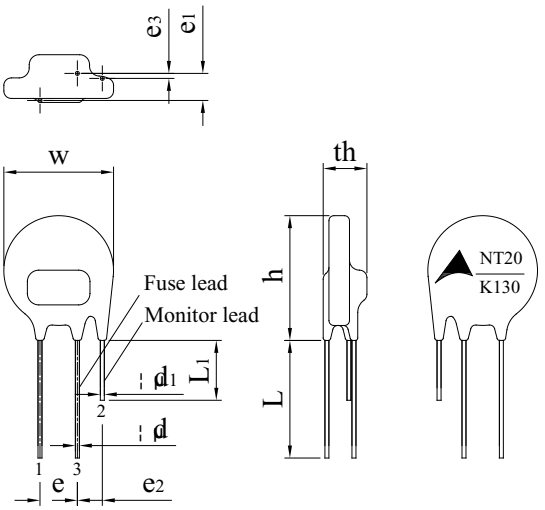
Climatic category	**to IEC 60068-1**	**40/85/56**	
Operating temperature		**-40…+85**	**°C**
Storage temperature		**-40... +85**	**°C**
Electric strength		**⩾2.5**	**kV_{RMS}**
Insulation resistance		**⩾100**	**MΩ**
Response time		**< 25**	**ns**

Nomenclature

NT	=	Series designation
20	=	Rated disk diameter (mm)
K	=	Tolerance of V_V at 1 mA: ±10%
***	=	Max. AC voltage
E2	=	Energy absorption characteristics, AdvanceD series
S5	=	Crimp design S5
K4	=	2 leads version

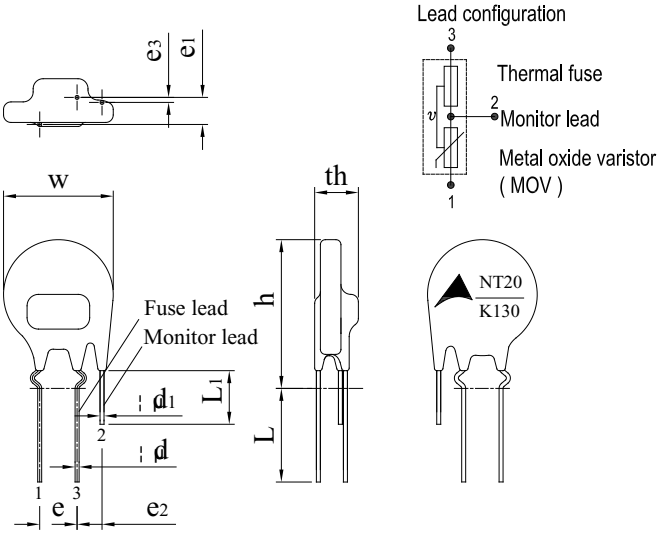
Dimensional drawings in mm

Straight leads

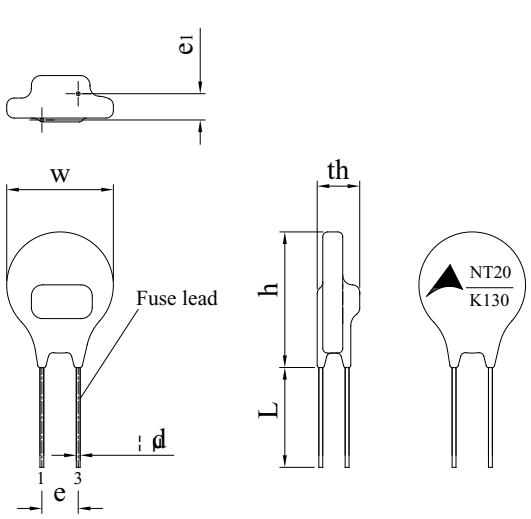


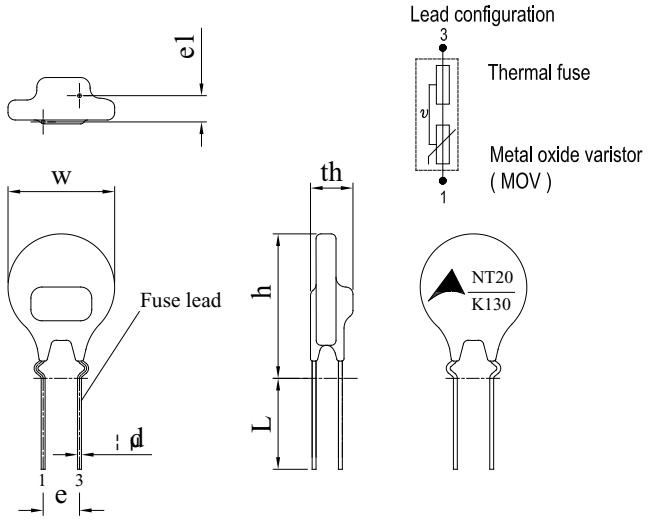
*K4

Kinked version

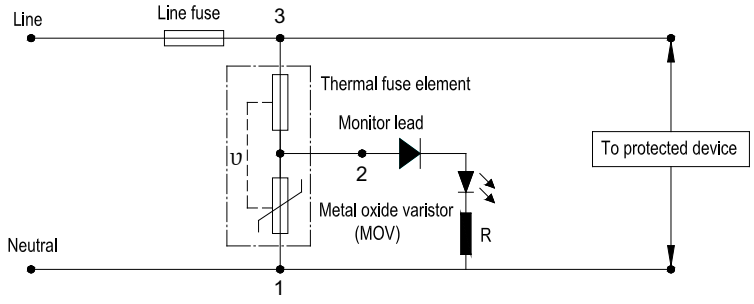


*S5K4





Typical applications



Dimension

Ordering code[1)]	Type (untaped) -SIOV	w_{max} mm	h_{max} mm	th_{max} mm	e ±1 mm	e1 ±1 mm	e2 ±1 mm	e3 ±1 mm	L_{min} mm	L_{1min} mm	∅d ±0.05 mm	$∅d_1$ ±0.05 mm
B72220W2131K101*	NT20K130E2	23	28	9.0	7.5	2.6	5	1	25	6	0.8	0.8
B72220R2131K101*	NT20K130E2K4	23	28		7.5	2.6	/	/	25	/	0.8	/
B72220W2141K101*	NT20K140E2	23	28		7.5	2.7	5	1	25	6	0.8	0.8
B72220R2141K101*	NT20K140E2K4	23	28		7.5	2.7	/	/	25	/	0.8	/
B72220W2151K101*	NT20K150E2	23	28		7.5	2.8	5	1	25	6	0.8	0.8
B72220R2151K101*	NT20K150E2K4	23	28		7.5	2.8	/	/	25	/	0.8	/
B72220W2171K101*	NT20K175E2	23	28		7.5	2.8	5	1	25	6	0.8	0.8
B72220R2171K101*	NT20K175E2K4	23	28		7.5	2.8	/	/	25	/	0.8	/
B72220W2211K101*	NT20K210E2	23	28	9.5	7.5	2.9	5	1	25	6	0.8	0.8
B72220R2211K101*	NT20K210E2K4	23	28		7.5	2.9	/	/	25	/	0.8	/
B72220W2251K101*	NT20K250E2	23	28		7.5	3.1	5	1	25	6	0.8	0.8
B72220R2251K101*	NT20K250E2K4	23	28		7.5	3.1	/	/	25	/	0.8	/
B72220W2271K101*	NT20K275E2	23	28		7.5	3.2	5	1	25	6	0.8	0.8
B72220R2271K101*	NT20K275E2K4	23	28		7.5	3.2	/	/	25	/	0.8	/
B72220W2301K101*	NT20K300E2	23	28	11.0	7.5	3.3	5	1	25	6	0.8	0.8
B72220R2301K101*	NT20K300E2K4	23	28		7.5	3.3	/	/	25	/	0.8	/
B72220W2321K101*	NT20K320E2	23	28		7.5	3.5	5	1	25	6	0.8	0.8
B72220R2321K101*	NT20K320E2K4	23	28		7.5	3.5	/	/	25	/	0.8	/
B72220W2351K101*	NT20K350E2	23	28		7.5	3.7	5	1	25	6	0.8	0.8
B72220R2351K101*	NT20K350E2K4	23	28		7.5	3.7	/	/	25	/	0.8	/
B72220W2381K101*	NT20K385E2	23	28		7.5	4.0	5	1	25	6	0.8	0.8
B72220R2381K101*	NT20K385E2K4	23	28		7.5	4.0	/	/	25	/	0.8	/
B72220W2421K101*	NT20K420E2	23	28		7.5	4.2	5	1	25	6	0.8	0.8
B72220R2421K101*	NT20K420E2K4	23	28		7.5	4.2	/	/	25	/	0.8	/
B72220W2461K101*	NT20K460E2	23	28		7.5	4.4	5	1	25	6	1.0	0.8
B72220R2461K101*	NT20K460E2K4	23	28		7.5	4.4	/	/	25	/	1.0	/
B72220W2511K101*	NT20K510E2	23	28	12.0	7.5	4.5	5	1	25	6	1.0	0.8
B72220R2511K101*	NT20K510E2K4	23	28		7.5	4.5	/	/	25	/	1.0	/
B72220W2551K101*	NT20K550E2	23	28		7.5	4.7	5	1	25	6	1.0	0.8
B72220R2551K101*	NT20K550E2K4	23	28		7.5	4.7	/	/	25	/	1.0	/
B72220W2621K101*	NT20K625E2	23	28	13.0	7.5	5.0	5	1	25	6	1.0	0.8
B72220R2621K101*	NT20K625E2K4	23	28		7.5	5.0	/	/	25	/	1.0	/
B72220W2681K101*	NT20K680E2	23	28		7.5	5.5	5	1	25	6	1.0	0.8
B72220R2681K101*	NT20K680E2K4	23	28		7.5	5.5	/	/	25	/	1.0	/
B72220W2751K101*	NT20K750E2	23	28		7.5	6.0	5	1	25	6	1.0	0.8
B72220R2751K101*	NT20K750E2K4	23	28		7.5	6.0	/	/	25	/	1.0	/

1）*May be suffix -V87: CCS wire for leads

Ordering code[1)]	Type (untaped) -SIOV	w_{max} mm	h_{max} mm	th_{max} mm	e ±1 mm	e1 ±1 mm	e2 ±1 mm	e3 ±1 mm	L_{min} mm	L_{1min} mm	∅d ±0.05 mm	$∅d_1$ ±0.05 mm
B72220W2131K501*	NT20K130E2S5	23	31	9.0	7.5	2.6	5	1	25	6	0.8	0.8
B72220R2131K501*	NT20K130E2S5K4	23	31		7.5	2.6	/	/	25	/	0.8	/
B72220W2141K501*	NT20K140E2S5	23	31		7.5	2.7	5	1	25	6	0.8	0.8
B72220R2141K501*	NT20K140E2S5K4	23	31		7.5	2.7	/	/	25	/	0.8	/
B72220W2151K501*	NT20K150E2S5	23	31		7.5	2.8	5	1	25	6	0.8	0.8
B72220R2151K501*	NT20K150E2S5K4	23	31		7.5	2.8	/	/	25	/	0.8	/
B72220W2171K501*	NT20K175E2S5	23	31		7.5	2.8	5	1	25	6	0.8	0.8
B72220R2171K501*	NT20K175E2S5K4	23	31		7.5	2.8	/	/	25	/	0.8	/
B72220W2211K501*	NT20K210E2S5	23	31	9.5	7.5	2.9	5	1	25	6	0.8	0.8
B72220R2211K501*	NT20K210E2S5K4	23	31		7.5	2.9	/	/	25	/	0.8	/
B72220W2251K501*	NT20K250E2S5	23	31		7.5	3.1	5	1	25	6	0.8	0.8
B72220R2251K501*	NT20K250E2S5K4	23	31		7.5	3.1	/	/	25	/	0.8	/
B72220W2271K501*	NT20K275E2S5	23	31		7.5	3.2	5	1	25	6	0.8	0.8
B72220R2271K501*	NT20K275E2S5K4	23	31		7.5	3.2	/	/	25	/	0.8	/
B72220W2301K501*	NT20K300E2S5	23	31	11.0	7.5	3.3	5	1	25	6	0.8	0.8
B72220R2301K501*	NT20K300E2S5K4	23	31		7.5	3.3	/	/	25	/	0.8	/
B72220W2321K501*	NT20K320E2S5	23	31		7.5	3.5	5	1	25	6	0.8	0.8
B72220R2321K501*	NT20K320E2S5K4	23	31		7.5	3.5	/	/	25	/	0.8	/
B72220W2351K501*	NT20K350E2S5	23	31		7.5	3.7	5	1	25	6	0.8	0.8
B72220R2351K501*	NT20K350E2S5K4	23	31		7.5	3.7	/	/	25	/	0.8	/
B72220W2381K501*	NT20K385E2S5	23	31		7.5	4.0	5	1	25	6	0.8	0.8
B72220R2381K501*	NT20K385E2S5K4	23	31		7.5	4.0	/	/	25	/	0.8	/
B72220W2421K501*	NT20K420E2S5	23	31		7.5	4.2	5	1	25	6	0.8	0.8
B72220R2421K501*	NT20K420E2S5K4	23	31		7.5	4.2	/	/	25	/	0.8	/
B72220W2461K501*	NT20K460E2S5	23	31		7.5	4.4	5	1	25	6	1.0	0.8
B72220R2461K501*	NT20K460E2S5K4	23	31		7.5	4.4	/	/	25	/	1.0	/
B72220W2511K501*	NT20K510E2S5	23	31	12.0	7.5	4.5	5	1	25	6	1.0	0.8
B72220R2511K501*	NT20K510E2S5K4	23	31		7.5	4.5	/	/	25	/	1.0	/
B72220W2551K501*	NT20K550E2S5	23	31		7.5	4.7	5	1	25	6	1.0	0.8
B72220R2551K501*	NT20K550E2S5K4	23	31		7.5	4.7	/	/	25	/	1.0	/
B72220W2621K501*	NT20K625E2S5	23	31	13.0	7.5	5.0	5	1	25	6	1.0	0.8
B72220R2621K501*	NT20K625E2S5K4	23	31		7.5	5.0	/	/	25	/	1.0	/
B72220W2681K501*	NT20K680E2S5	23	31		7.5	5.5	5	1	25	6	1.0	0.8
B72220R2681K501*	NT20K680E2S5K4	23	31		7.5	5.5	/	/	25	/	1.0	/
B72220W2751K501*	NT20K750E2S5	23	31		7.5	6.0	5	1	25	6	1.0	0.8
B72220R2751K501*	NT20K750E2S5K4	23	31		7.5	6.0	/	/	25	/	1.0	/

1）*May be suffix -V87: CCS wire for leads

Electrical data

Maximum ratings (85 °C):

Type (untaped) -SIOV	V_{RMS} V	V_{DC} V	i_{max} (8/20 µs) A	In [2)] (8/20 µs) 15 times A	W_{max} (2 ms) J	P_{max} W
NT20K130E2*	130	170	10000	5000	100	1.0
NT20K140E2*	140	180	10000	5000	110	1.0
NT20K150E2*	150	200	10000	5000	120	1.0
NT20K175E2*	175	225	10000	5000	135	1.0
NT20K210E2*	210	270	10000	5000	160	1.0
NT20K250E2*	250	320	10000	5000	195	1.0
NT20K275E2*	275	350	10000	5000	215	1.0
NT20K300E2*	300	385	10000	5000	250	1.0
NT20K320E2*	320	420	10000	5000	273	1.0
NT20K350E2*	350	460	10000	5000	200	1.0
NT20K385E2*	385	505	10000	5000	273	1.0
NT20K420E2*	420	560	10000	5000	273	1.0
NT20K460E2*	460	615	10000	5000	300	1.0
NT20K510E2*	510	670	10000	5000	325	1.0
NT20K550E2*	550	745	10000	5000	360	1.0
NT20K625E2*	625	825	10000	5000	400	1.0
NT20K680E2*	680	895	10000	5000	440	1.0
NT20K750E2*	750	1060	10000	3000	480	1.0

*May be suffix S5, K4

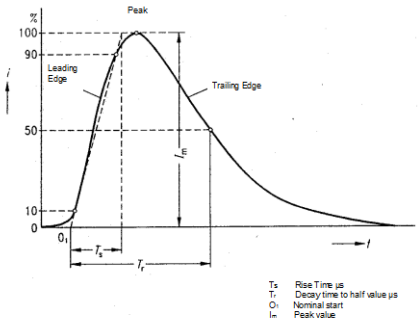
2) Note:

Nominal discharge current is the specification defined in UL1449 4th edition and tested with 8/20 µs current waveform.

Characteristics (25 °C):

Type	V_V (1 mA) V	$\triangle V_v$ (1 mA) %	$V_{c,max}$ i_c V	i_c A	C_{typ} 1 kHz pF
NT20K130E2*	205	10	340	100	1850
NT20K140E2*	220	10	360	100	1700
NT20K150E2*	240	10	395	100	1550
NT20K175E2*	270	10	455	100	1350
NT20K210E2*	330	10	545	100	1100
NT20K250E2*	390	10	650	100	940
NT20K275E2*	430	10	710	100	850
NT20K300E2*	470	10	775	100	780
NT20K320E2*	510	10	840	100	720
NT20K350E2*	560	10	910	100	660
NT20K385E2*	620	10	1025	100	600
NT20K420E2*	680	10	1120	100	550
NT20K460E2*	750	10	1240	100	500
NT20K510E2*	820	10	1355	100	460
NT20K550E2*	910	10	1500	100	410
NT20K625E2*	1000	10	1650	100	380
NT20K680E2*	1100	10	1815	100	340
NT20K750E2*	1200	10	2000	100	250

Reliability data

Test	Test methods	Requirement
Varistor voltage	The voltage between two terminals with the specified measuring current applied is called V_v (1 mA_{DC} @ 0.2 … 2 s).	To meet the specified value.
Clamping voltage	The maximum voltage between two terminals with the specified standard impulse current (8/20 µs) illustrated below applied. 	To meet the specified value.
Surge current derating, 8/20 µs	10 surge currents (8/20 µs), unipolar, interval 30 s, amplitude corresponding to derating curve for 10 impulses at 20 µs	|△V/V (1 mA)| ≤10% (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	10 surge currents (2 ms), unipolar, interval 120 s, amplitude corresponding to derating curve for 10 impulses at 2 ms	|△V/V (1 mA)|≤10% (measured in direction of surge current) No visible damage

Reliability data

Characteristics	Test methods/Description	Specifications
Tensile strength	IEC 60068-2-21, test Ua1 After gradually applying the force specified below and keeping the unit fixed for 10 s, the terminal shall be visually examined for any damage. Force for wire diameter: 0.6 mm = 10 N 0.8 mm = 10 N 1.0 mm = 20 N	$\lvert\triangle V/V\ (1\ mA)\rvert \leq 5\%$ No break of solder joint, no wire break
Vibration	IEC 60068-2-6, test Fc, method B4 Frequency range: 10 ... 55 Hz Amplitude: 0.75 mm or 98 m/s² Duration: 6 h (3 x 2 h) Pulse: sine wave After repeatedly applying a single harmonic vibration according to the table above, the change of V_v shall be measured and the part shall be visually examined.	$\lvert\triangle V/V\ (1\ mA)\rvert \leq 5\%$ No visible damage
Solderability	IEC 60068-2-20, test Ta, method 1 with modified conditions for lead-free solder alloys: 245 °C, 3 s: After dipping the terminals to a depth of approximately 3 mm from the body in a soldering bath of 245 °C for 3 s, the terminals shall be visually examined.	The inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 times. The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pinholes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area.

Characteristics	Test methods/Description	Specifications
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A, 260 °C, 10 s: Each lead shall be dipped into a solder bath having a temperature of 260 ±5 °C to a point 2.0 to 2.5 mm from the body of the unit, be held there for 10 ±1 s and then be stored at room temperature and normal humidity for 1 to 2 hours. The change of V_v shall be measured and the part shall be visually examined.	|△V/V (1 mA)| ≤5% No visible damage
Bump	IEC 60068-2-27,Test Eb Pulse duration: 6 ms Max. acceleration: 400 m/s^2 Number of bumps: 6×4000 Pulse: half sine	|△V/V (1 mA)| ≤5% No visible damage
Fire hazard	IEC 60695-11-5 (needle flame test) Severity: vertical 10 s	5 s max.
Electric strength	IEC 61051-1, test 4.9.2 Metal balls method, 2500 V_{RMS}, 60 s The varistor is placed in a container holding 1.6 ±0.2 mm diameter metal balls such that only the terminations of the varistor are protruding. The specified voltage shall be applied between both terminals of the specimen connected together and the electrode inserted between the metal balls.	No breakdown

Reliability data

Characteristics	Test methods/Description	Specifications
Endurance at upper category temperature	IEC61051-2-2, 1000 h at UCT After having continuously applied the maximum allowable AC voltage at UCT ±2 °C for 1000 h, the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_v shall be measured.	|△V/V (1 mA)| ≤10%
Damp heat, steady state	IEC 60068-2-78, test Ca The specimen shall be subjected to 40 ±2 °C, 90 to 95 % r.H. for 56 days without load / with 10% of the maximum continuous DC operating voltage V_{DC}. Then stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_v shall be measured. Thereafter, insulation resistance R_{ins} shall be measured at V = 500 V (insulated varistors only).	|△V/V (1 mA)| ≤10% R_{ins} e100 M&
Climatic sequence	The specimen shall be subjected to: a) IEC 60068-2-2, test Ba, dry heat at UCT, 16 h b) IEC 60068-2-30, test Db, damp heat, 1st cycle: 55 °C, 93% r.H., 24 h c) IEC 60068-2-1, test Aa, cold, LCT, 2 h d) IEC 60068-2-30, test Db, damp heat, additional 5 cycles: 55 °C/25 °C, 93% r.H., 24 h/cycle. Then the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_v shall be measured. Thereafter, insulation resistance R_{ins} shall be measured at V = 500 V.	|△V/V (1 mA)| ≤10% R_{ins} e100 M&
Rapid change of temperature	IEC 60068-2-14, test Na, LCT/UCT, dwell time 30 min, 5 cycles	|△V/V (1 mA)| ≤5% No visible damage

Note:

UCT = Upper category temperature

LCT = Lower category temperature

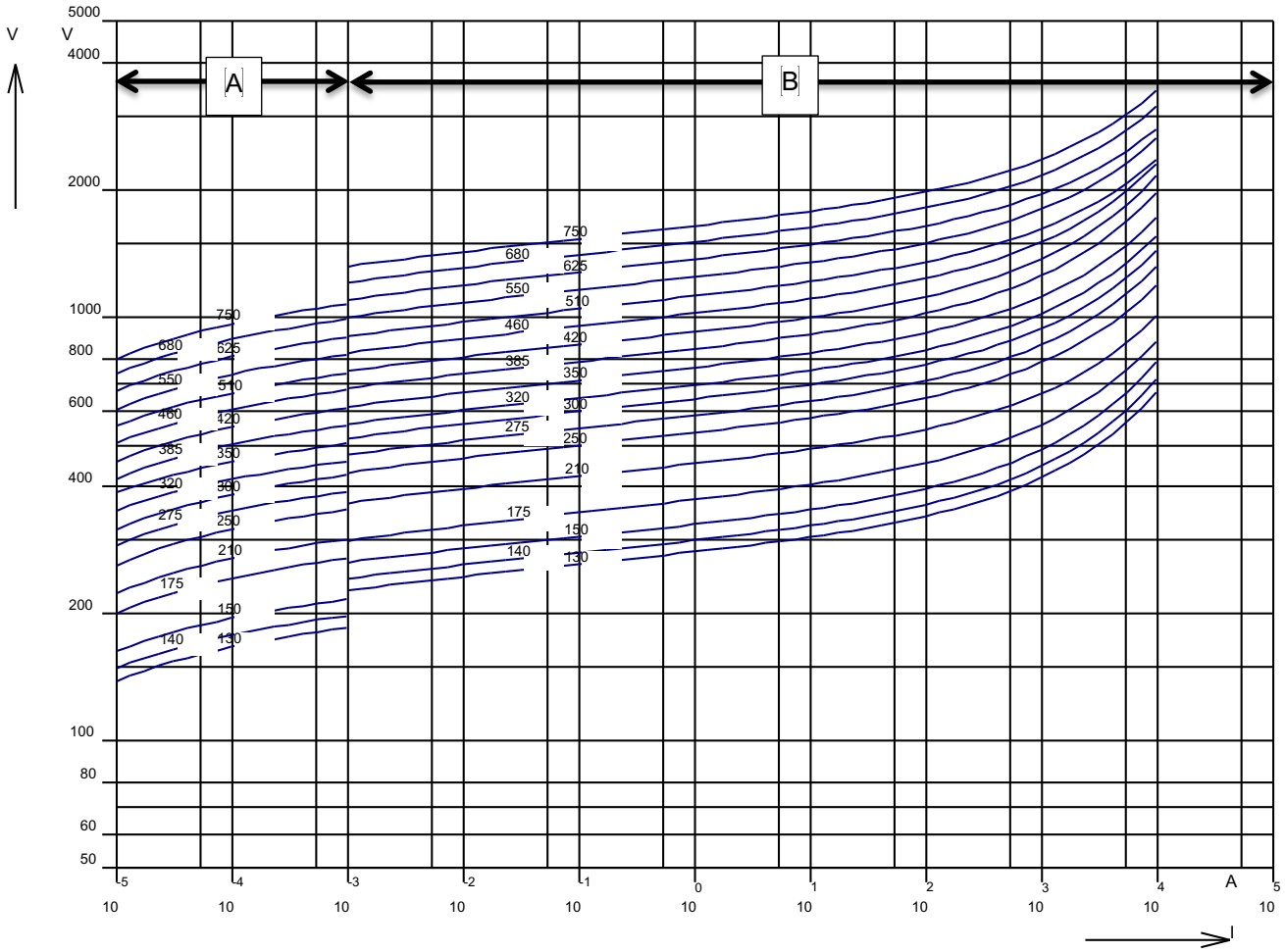
R_{ins} = Insulation resistance

All electrical tests should be performed between terminal pin1 and pin3.

v/i characteristic

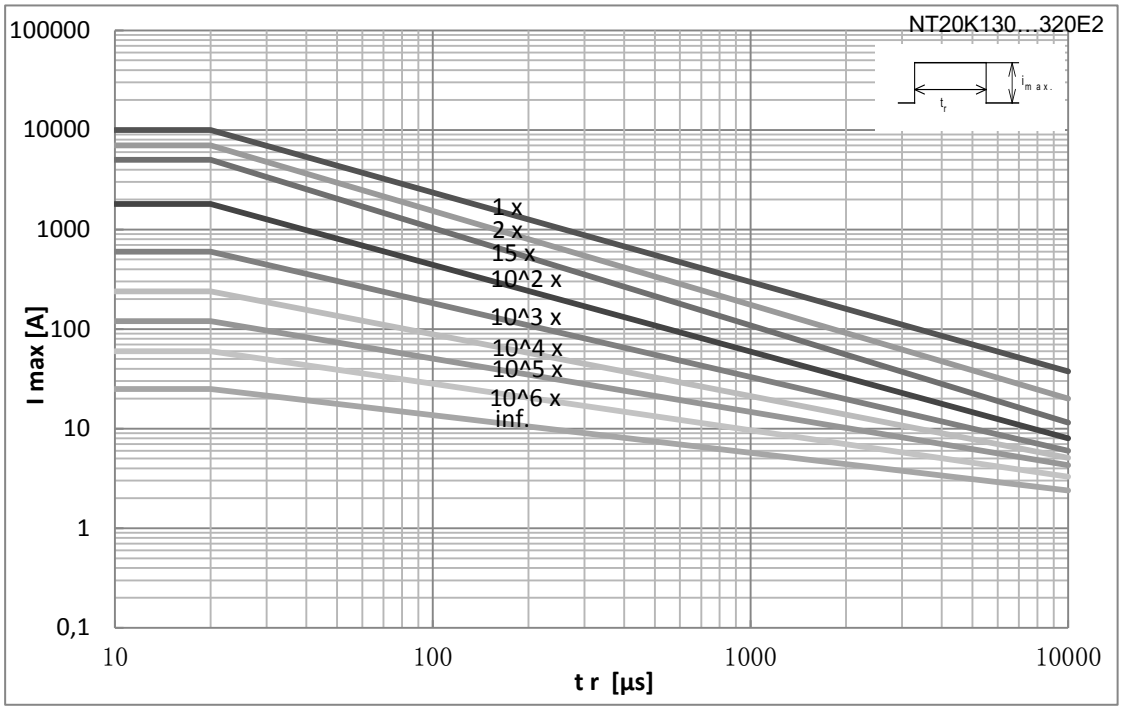
A = Leakage current, B = Protection level } for worst-case varistor tolerances

NT20K130...750

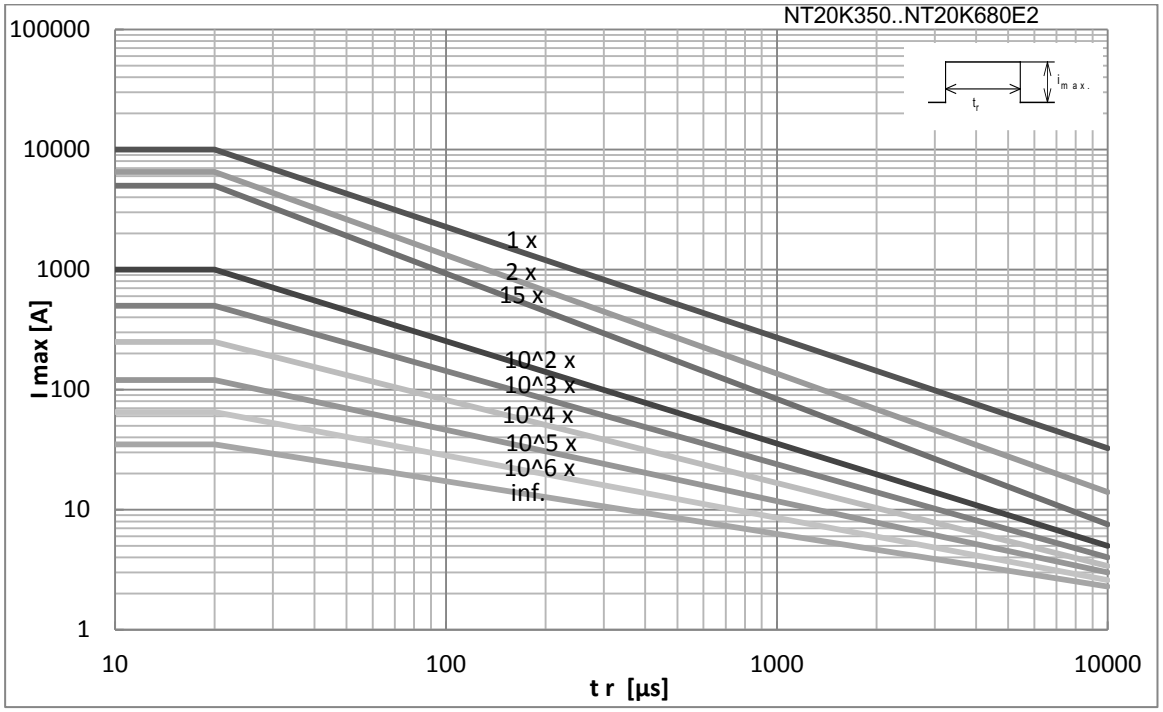


Derating curves

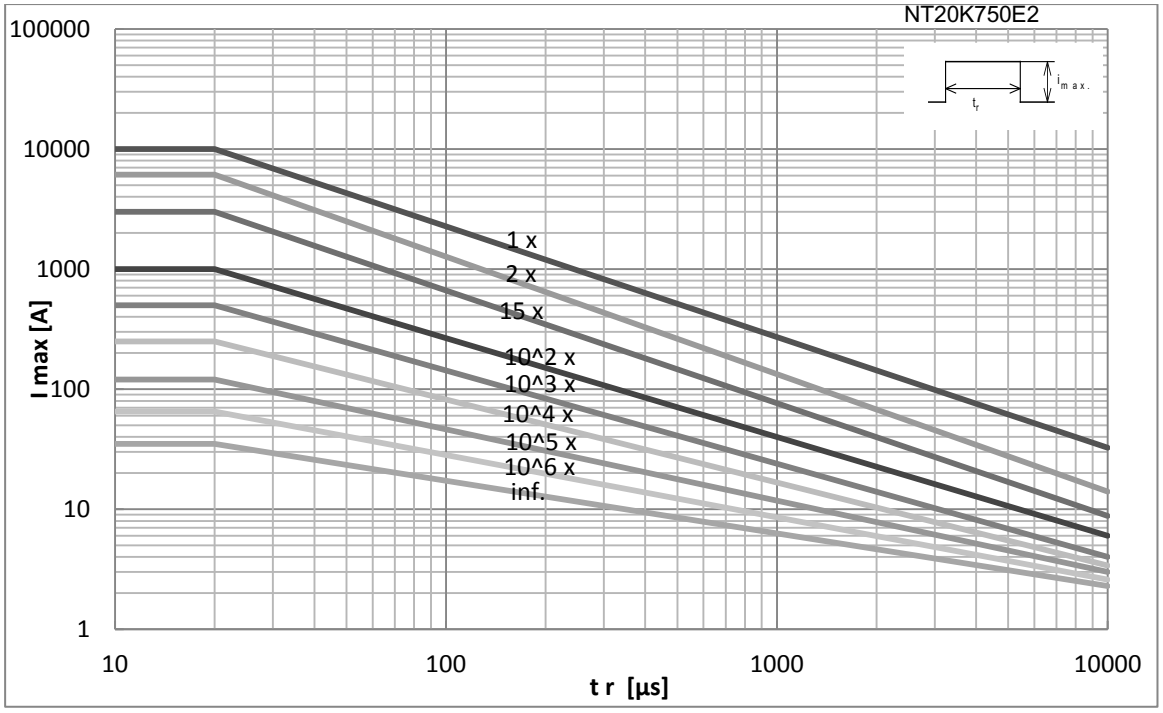
Suitable for 130E2 -320E2



Suitable for 350E2 -680E2



Suitable for 750E2



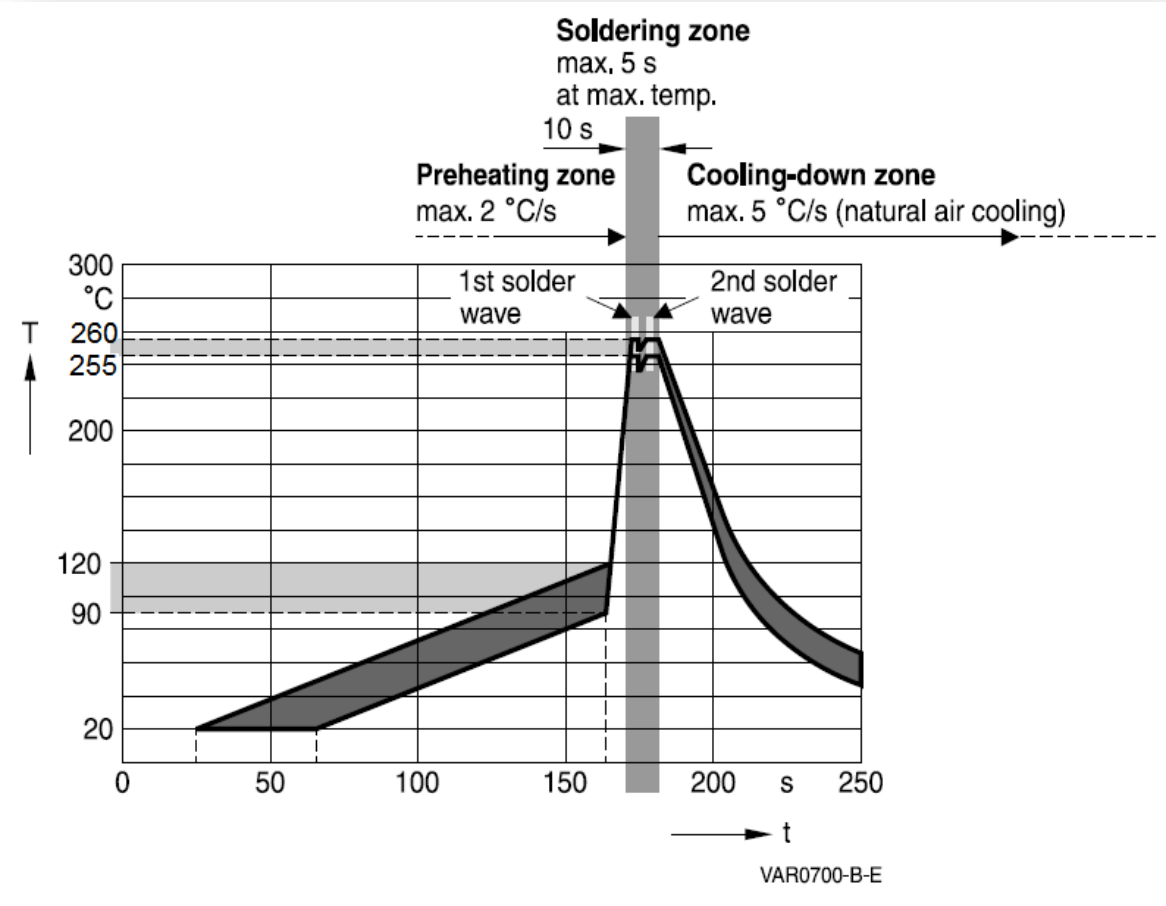
Soldering instructions only for NT series

Manual soldering

Maximum soldering temperature 350 °C for 3 s. It is recommended to heat sink the lead wires of the ThermoFuse varistors (NT series).

Wave soldering

Recommended temperature profile for wave soldering only for ThermoFuse varistors (NT series).



Important note: Temperatures of all preheat stages and the solder bath must be strictly controlled.

Cautions and warnings

General

1. EPCOS metal oxide varistors (SIOVs) are designed for specific applications and should not be used for purposes not identified in our specifications, application notes and data books unless otherwise agreed with EPCOS during the design-in-phase.

2. Ensure suitability of SIOVs through reliability testing during the design-in phase. The SIOVs should be evaluated taking into consideration worst-case conditions.

3. For applications of SIOVs in line-to ground circuits based on various international and local standards there are restrictions existing or additional safety measures required.

Storage

1. Store SIOVs only in original packaging. Do not open the package before storage.

2. Storage conditions in original packaging:

Storage temperature:	-25 °C … +45 °C
Relative humidity:	<75% annual average, <95% on maximum 30 days a year.
Dew precipitation:	Is to be avoided.

3. Avoid contamination of SIOVs surface during storage, handling and processing.

4. Avoid storage of SIOVs in harmful environments which can affect the function during long-term operation (examples given under operation precautions).

5. The SIOV type series should be soldered within the time specified.

SIOV-S, -Q, -LS	24 month
T, ETFV and NT types	12 month.

Handling

1. SIOVs must not be dropped.

2. Components must not be touched with bare hands. Gloves are recommended.

3. Avoid contamination of the surface of SIOV electrodes during handling, be careful of the sharp edge of SIOV electrodes.

Soldering (where applicable)

1. Use rosin-type flux or non-activated flux.

2. Insufficient preheating may cause ceramic cracks.

3. Rapid cooling by dipping in solvent is not recommended.

4. Complete removal of flux is recommended.

Mounting

1. Potting, sealing or adhesive compounds can produce chemical reactions in the SIOV ceramic that will degrade the component's electrical characteristics.

2. Overloading SIOVs may result in ruptured packages and expulsion of hot materials. For this reason the SIOVs should be physically shielded from adjacent components.

Operation

1. Use SIOVs only within the specified temperature operating range

2. Use SIOVs only within the specified voltage and current ranges.

3. Environmental conditions must not harm the SIOVs. Use SIOVs only in normal atmospheric conditions. Avoid use in the presence of deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas, etc), corrosive agents, humid or salty conditions, Avoid contact with any liquids and solvents.

Display of ordering codes for TDK Electronics products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.tdk-electronics.tdk.com/orderingcodes.

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1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.
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Important notes

8. The trade names EPCOS, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

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