Document Modification History List
文件修订历史清单

Document name 文件名称: B72220T2***K105
Document No. 文件号码: T20K130…680E2

No. 序号	Date 日期	Version No. 版本号	Page modified 修订页	Item No. modified 修订项目号	Modification details (main) 修订描述（主要的）	Reason 修订理由	Prepared by 拟制	Approved by 批准
1	15/10/2012	Fr: a to b	all	all	Update derating curve and pin number; delete 140V and 210V; expand to 680V	Acc. to updated electrical performance	Toky Song	Terry Tian
2	19/1/2013	Fr: b to c	all	all	Add UL certificate number	Update approval according to UL1449 3rd edition	Rongguang Zhang	Terry Tian
3	24/06.2015	Fr: c to d	all	all	Update with new data sheet format	Marketing need the new version with TDK logo	Rongguang Zhang	Terry Tian
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Please see the bold letters for details in the document.
请见文中粗体字获得详细的更改信息。

F014CO-A21B001/03**f**

Housed varistor

ThermoFuse varistor

Series/Type:	**T20K130…680E2**
Ordering code:	**B72220T2***K105**
Date:	2015-06-23
Version:	d

EPCOS AG is a TDK Group Company.

Applications

- Overvoltage protection with integrated thermal fuse
- Suitable for use in industrial and household appliance applications

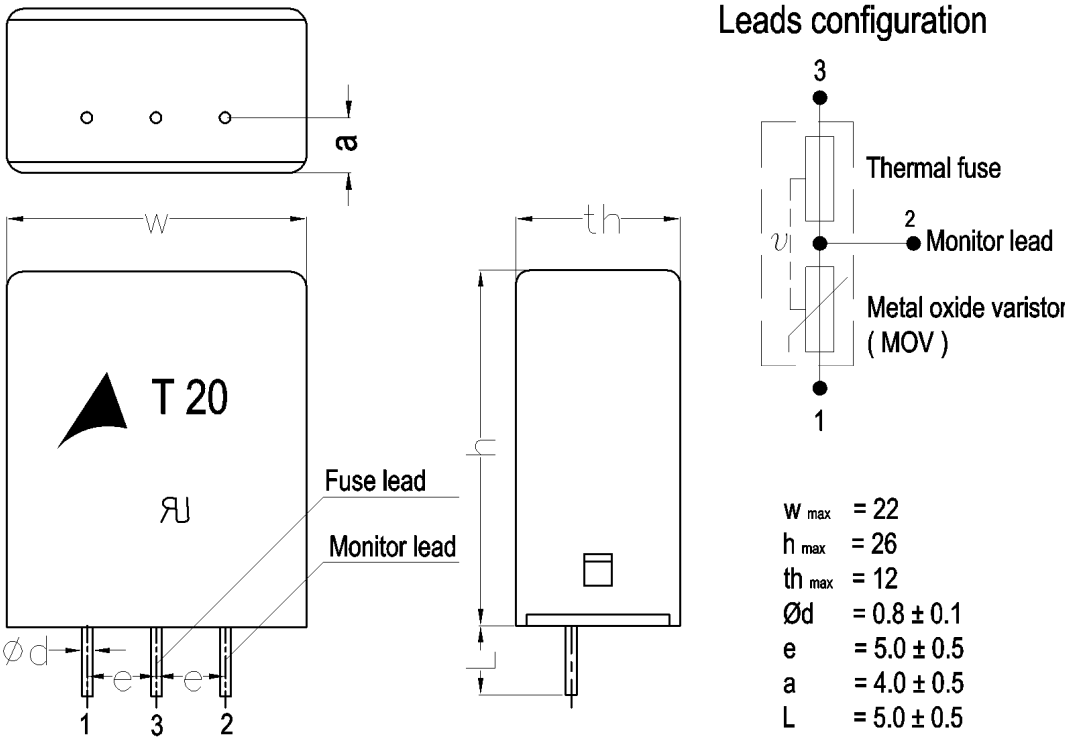
Features

- Three-leaded version for failure indication
- UL approval to UL1449 3rd edition (File number E321126)
- VDE certification (certificate number 40031102）
- IEC61051-2-2 certification
- High peak surge current rating of 10 kA at single 8/20us impulse
- Meet thermal stability according to section 8.3.5.2 of IEC 61643-11
- Failure safe for abnormal over voltage (see “Reliability Data Electrical, Abnormal over voltage”)

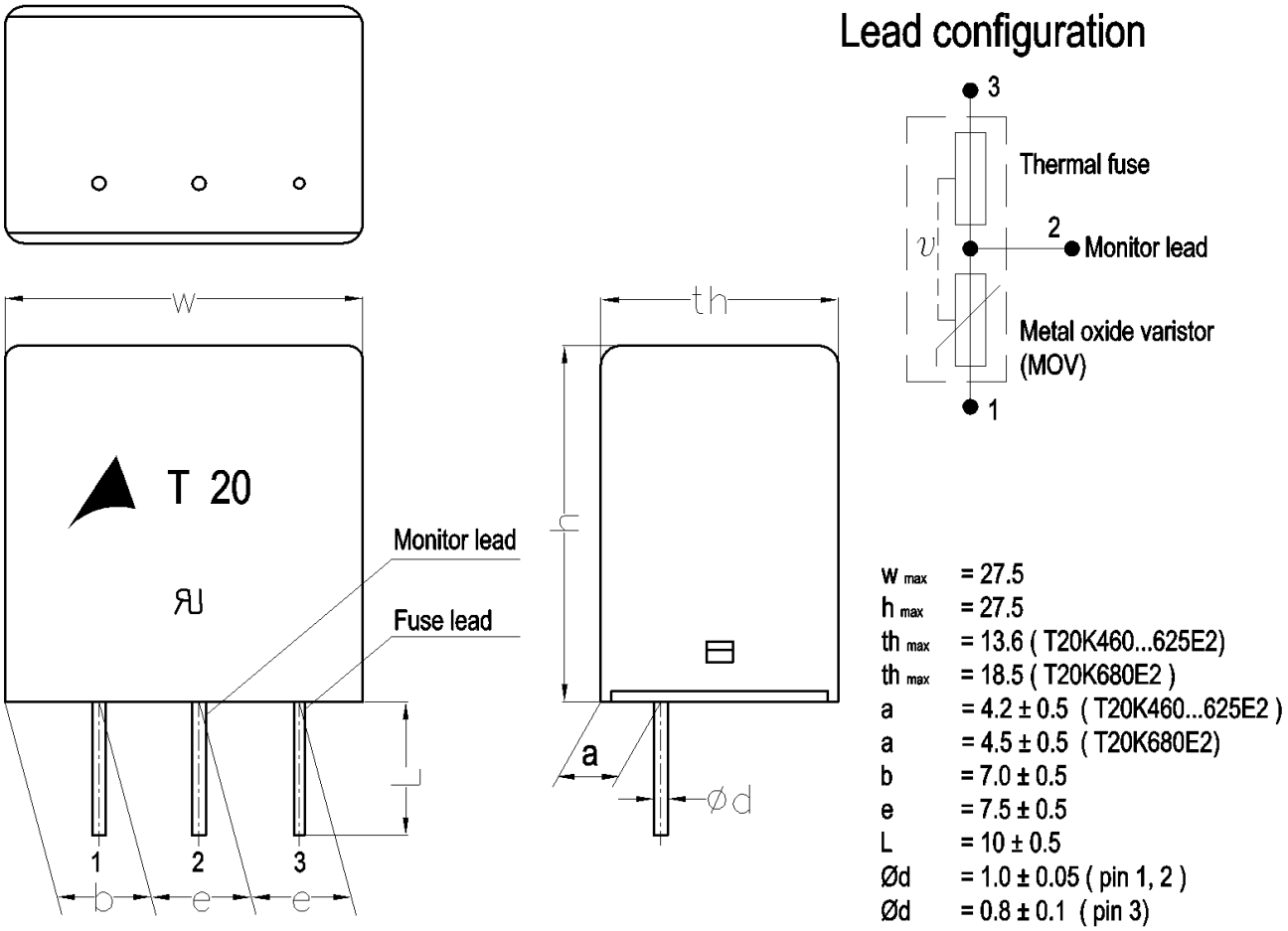
Nomenclature

T	=	EPCOS ThermoFuse varistor
20	=	Rated disk diameter (mm)
K	=	Tolerance of V_V at 1 mA: ±10%
***	=	Max. AC voltage (see table on page 4)
E2	=	Energy absorption characteristics, AdvanceD series

Dimensional drawing in mm (suitable for T20K130…420E2)



Dimensional drawing in mm (suitable for T20K460…680E2)



w_{max}	= 27.5
h_{max}	= 27.5
th_{max}	= 13.6 (T20K460...625E2)
th_{max}	= 18.5 (T20K680E2)
a	= 4.2 ± 0.5 (T20K460...625E2)
a	= 4.5 ± 0.5 (T20K680E2)
b	= 7.0 ± 0.5
e	= 7.5 ± 0.5
L	= 10 ± 0.5
Ød	= 1.0 ± 0.05 (pin 1, 2)
Ød	= 0.8 ± 0.1 (pin 3)

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

Electrical data

Maximum ratings (85 °C):

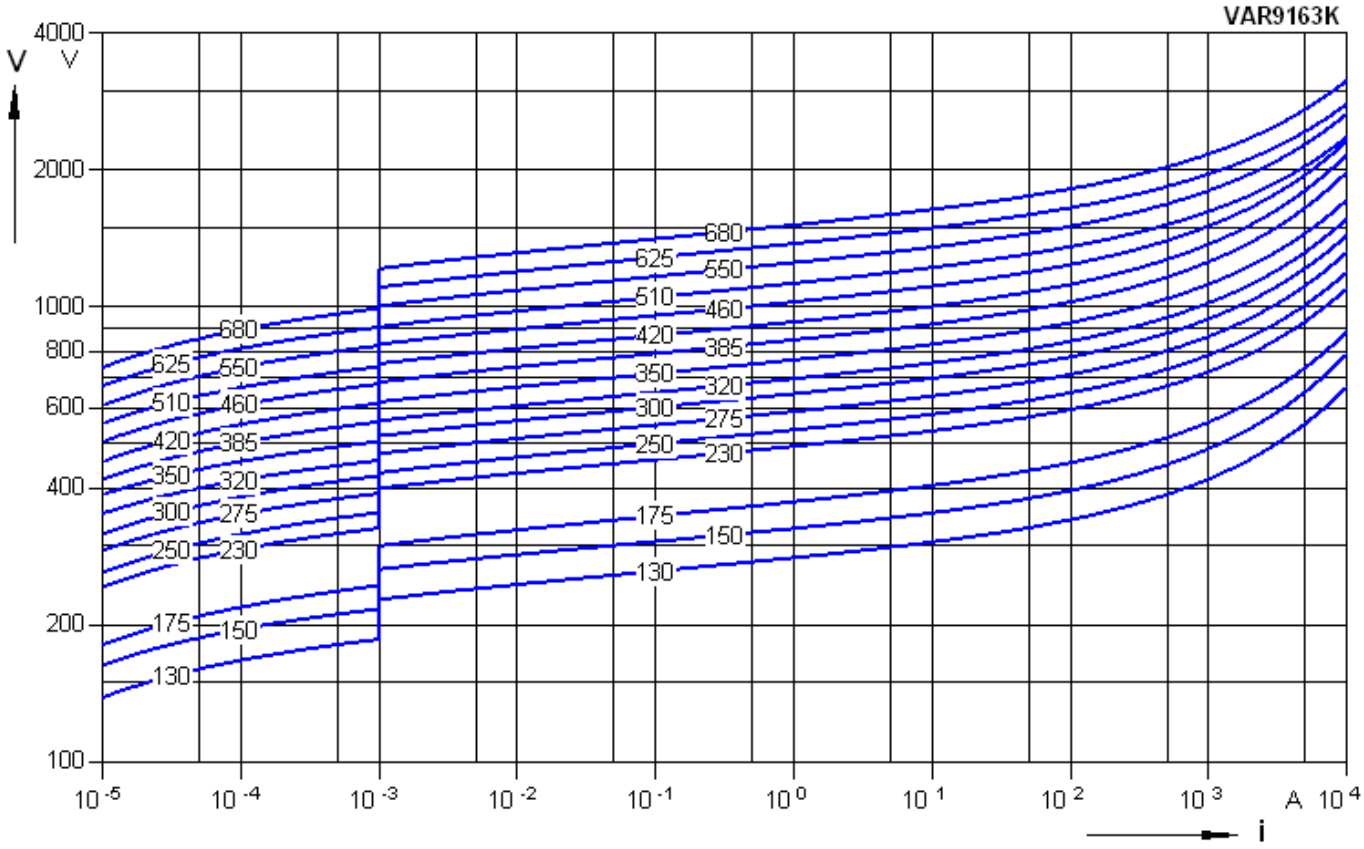
Ordering code	Type	Max. operating AC voltage V_{RMS} [V]	Max. operating DC voltage [V]	Surge current I_{max} (8/20 µs) 1 time [A]	Nominal discharge current In [1)] (8/20 µs) 15 times [A]	Energy absorption (2 ms) 1 time [J]	Max. average power dissipation P_{max} [W]
B72220T2131K105	T20K130E2	130	170	10000	3000	100	1.0
B72220T2151K105	T20K150E2	150	200	10000	3000	120	1.0
B72220T2171K105	T20K175E2	175	225	10000	3000	135	1.0
B72220T2231K105	T20K230E2	230	300	10000	3000	180	1.0
B72220T2251K105	T20K250E2	250	320	10000	3000	195	1.0
B72220T2271K105	T20K275E2	275	350	10000	3000	215	1.0
B72220T2301K105	T20K300E2	300	385	10000	3000	250	1.0
B72220T2321K105	T20K320E2	320	420	10000	3000	273	1.0
B72220T2351K105	T20K350E2	350	460	10000	3000	223	1.0
B72220T2381K105	T20K385E2	385	505	10000	3000	248	1.0
B72220T2421K105	T20K420E2	420	560	10000	3000	273	1.0
B72220T2461K105	T20K460E2	460	615	10000	3000	300	1.0
B72220T2511K105	T20K510E2	510	670	10000	3000	325	1.0
B72220T2551K105	T20K550E2	550	745	10000	3000	360	1.0
B72220T2621K105	T20K625E2	625	825	10000	3000	400	1.0
B72220T2681K105	T20K680E2	680	895	10000	3000	440	1.0

Characteristics (25 °C):

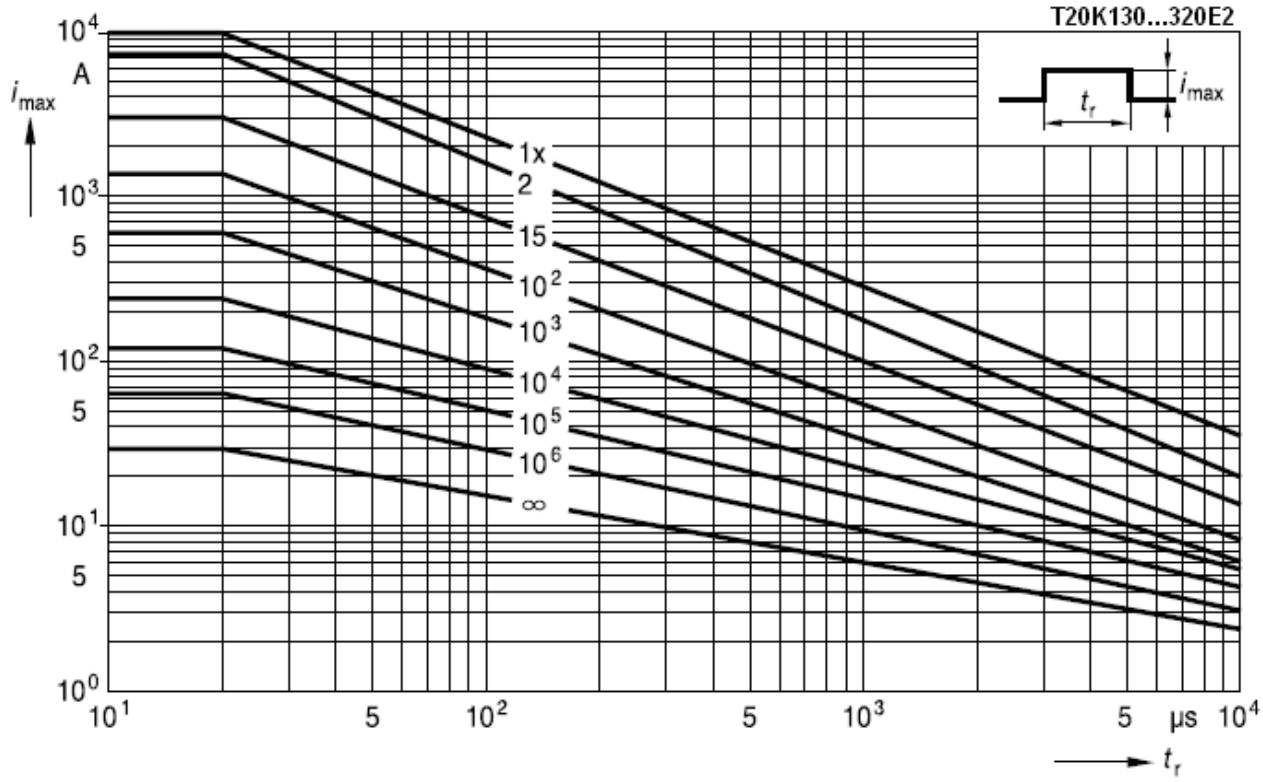
Ordering code	Type	Varistor voltage V_V at 1 mA [V]	Clamping voltage V_C at 100 A (8 / 20 µs) [V]	Typ. capacitance C_{typ} at 1 kHz [pF]
B72220T2131K105	T20K130E2	205 ±10%	340	1850
B72220T2151K105	T20K150E2	240 ±10%	395	1550
B72220T2171K105	T20K175E2	270 ±10%	455	1350
B72220T2231K105	T20K230E2	360 ±10%	595	1000
B72220T2251K105	T20K250E2	390 ±10%	650	940
B72220T2271K105	T20K275E2	430 ±10%	710	850
B72220T2301K105	T20K300E2	470 ±10%	775	780
B72220T2321K105	T20K320E2	510 ±10%	840	720
B72220T2351K105	T20K350E2	560 ±10%	910	660
B72220T2381K105	T20K385E2	620 ±10%	1025	600
B72220T2421K105	T20K420E2	680 ±10%	1120	550
B72220T2461K105	T20K460E2	750 ±10%	1240	500
B72220T2511K105	T20K510E2	820 ±10%	1355	460
B72220T2551K105	T20K550E2	910 ±10%	1500	410
B72220T2621K105	T20K625E2	1000 ±10%	1650	380
B72220T2681K105	T20K680E2	1100 ±10%	1815	340

1) Note: nominal discharge current is the specification defined in UL1449 3rd and tested with 8/20µs current waveform.

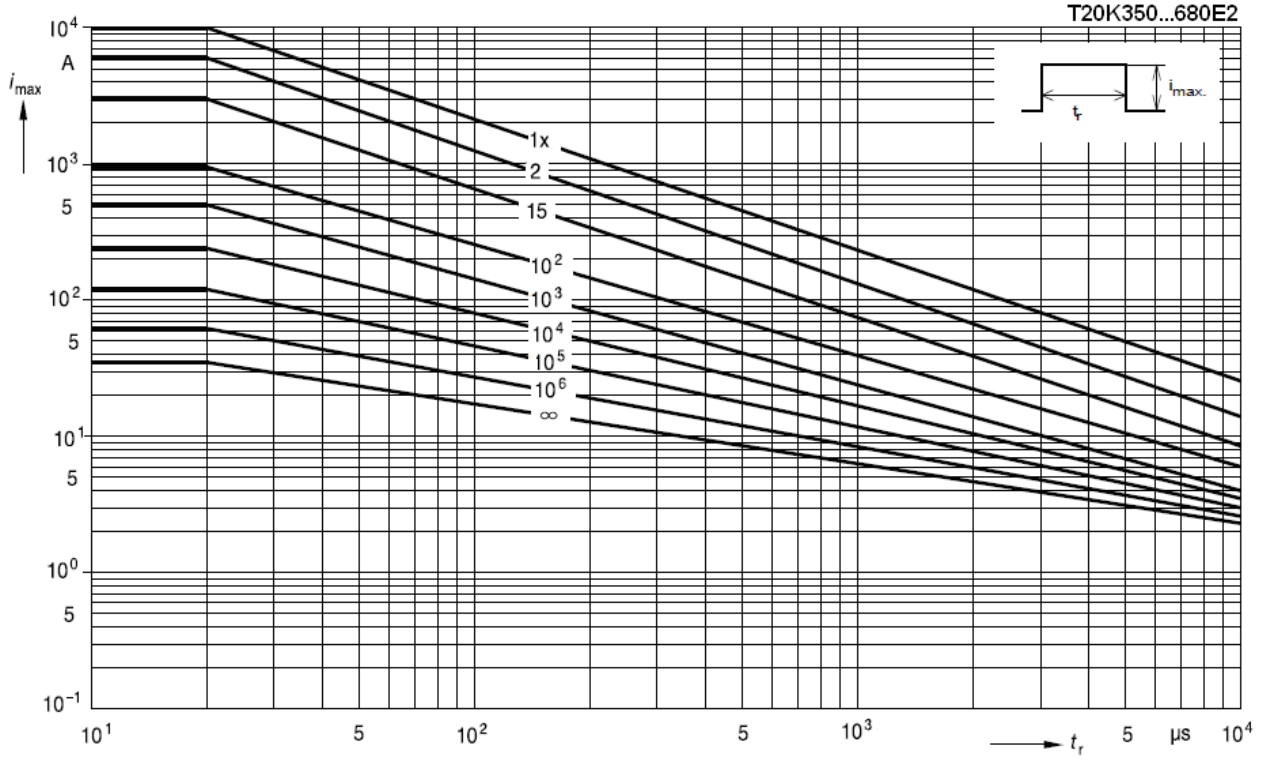
v/i characteristic



Derating curves (suitable for T20K130…320E2)

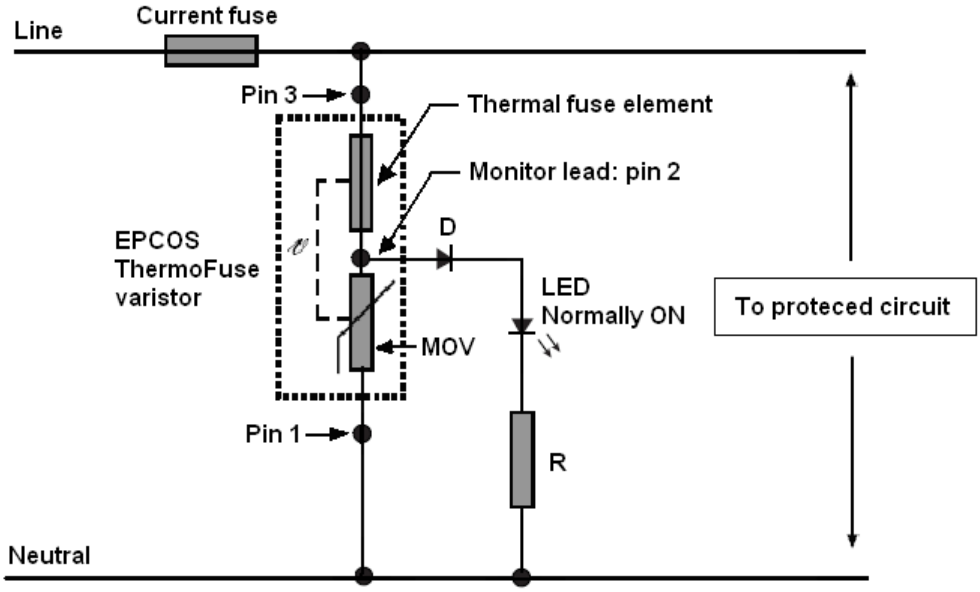


Derating curves (suitable for T20K350…680E2)



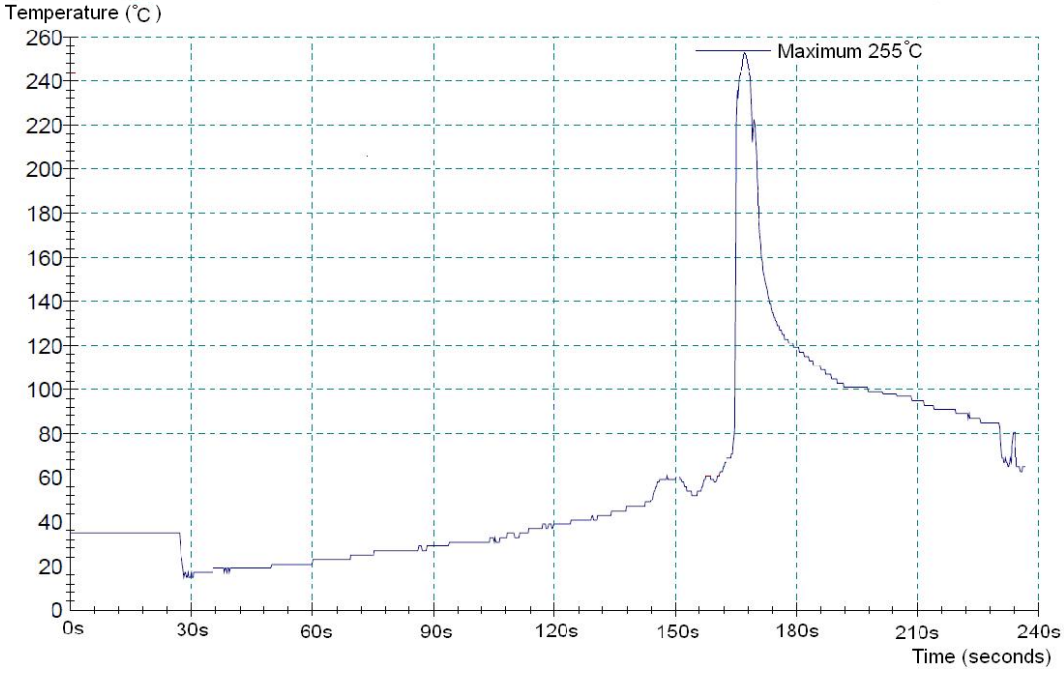
Typical application

The typical application below shows how the monitor lead on the device can be used to indicate that the thermal fuse has been opened. This denotes that the circuit will be no longer protected from surge currents by the MOV after the thermal fuse forms open circuit.

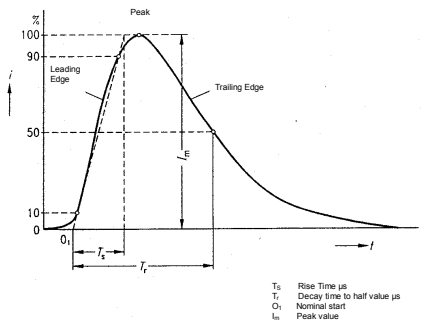


Typical wave soldering curve

Care must be taken when soldering the device into place because it contains a thermal fuse element. Two soldering methods are possible: (1) Manual soldering under max. 350℃ / 3s: it is recommended to heat-sink the leads of the device. (2) Wave soldering: it is very important that the temperatures of all preheat stages and the solder bath should be strictly controlled.



Reliability Data Electrical

Characteristics	Test methods / Description	Specifications
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	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 10\%$ (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	10 surge currents (2ms), unipolar, interval 120s, amplitude corresponding to derating curve for 10 impulses at 2 ms	$\lvert\Delta V/V\ (1\ mA)\rvert \leq 10\%$ (measured in direction of surge current) No visible damage

<table>
<tr><th>Characteristics</th><th>Test Methods/Description</th><th>Specifications</th></tr>
<tr><td>Abnormal over voltage</td><td>This device is designed to form open circuit in the event of overheating due to the limited current abnormal over voltage conditions as outlined in section 39.4 of UL1449 3rd edition.
The device (pin 1 & 3) is to be connected to a power supply having an open circuit voltage equal to the test voltage specified below. The power supply is to incorporate a series variable resistor that can be adjusted to obtain the short-circuit current (I_{sc}). The variable resistor is to be adjusted such that I_{sc} equals 10A, 5A, 2.5A, 0.5A or 0.125A respectively (measured without the device in the circuit).
The device will be energized for 7 hours, or until the device becomes disconnected from the power supply, or until current to, or temperature within the device attains equilibrium 2).
The test result will be visually inspected.
Detailed test voltages applied onto the devices are as below:
<table><tr><th rowspan="2">Type
T20K130…460E2</th><th>Device rating</th><th>Test voltage</th></tr><tr><th>(V ac)</th><th>(V ac)</th></tr><tr><td>T20K130E2</td><td>130</td><td>260</td></tr><tr><td>T20K150E2</td><td>150</td><td>300</td></tr><tr><td>T20K175E2</td><td>175</td><td>350</td></tr><tr><td>T20K230E2</td><td>230</td><td>415</td></tr><tr><td>T20K250E2</td><td>250</td><td>500</td></tr><tr><td>T20K275E2</td><td>275</td><td>480</td></tr><tr><td>T20K300E2</td><td>300</td><td>600</td></tr><tr><td>T20K320E2</td><td>320</td><td>600</td></tr><tr><td>T20K350E2</td><td>350</td><td>600</td></tr><tr><td>T20K385E2</td><td>385</td><td>600</td></tr><tr><td>T20K420E2</td><td>420</td><td>600</td></tr><tr><td>T20K460E2</td><td>460</td><td>690</td></tr></table>
<table><tr><th rowspan="2">Type
T20K510…680E2</th><th>Device rating</th><th>Test voltage 3)</th></tr><tr><th>(V dc)</th><th>(V dc)</th></tr><tr><td>T20K510E2</td><td>670</td><td>780</td></tr><tr><td>T20K550E2</td><td>745</td><td>860</td></tr><tr><td>T20K625E2</td><td>825</td><td>950</td></tr><tr><td>T20K680E2</td><td>895</td><td>1040</td></tr></table></td><td>Any of below phenomena shall not be observed, otherwise this device will be judged as failed part:
1. Emission of flame, molten metal, glowing or flaming particles through any openings (pre-existed or created as a result of the test) in the device.
2. Charring, glowing, or flaming of the supporting surface, or cheesecloth draped on the device.
3. Ignition of the enclosure.
4. Creation of any openings in the enclosure that result in accessibility of live parts.</td></tr>
</table>

Note:

2) Thermal fuse may not form open circuit under low current [e.g. 0.125A] due to less heat generated by MOV, however the device will reach thermal equilibrium within 30 minutes under a low temperature which will not be able to cause any damage to the device.

3) For "T20K510E2…T20K680E2" UL1449 3rd edition approval were according to Photovoltaic Systems applications only. The "test voltage" for T20K510…680E2 in above table is the max. dc long-duration test overvoltage for the device. Overstress above the listed "test voltage" may cause permanent damage to the device.

Reliability Data Mechanical

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	|△V/V (1 mA)| ≤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.	|△V/V (1 mA)| ≤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.
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 60068-2-29, test Eb Pulse duration: 6 ms Max. acceleration: 400m/s^2 Number of bumps: 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 Environmental

Characteristics	Test Methods/Description	Specifications
Endurance at upper category temperature	IEC61051-2-2, 1000 h at UCT After having continuously applied the maximum allowable 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} ≥100 MΩ
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} ≥100 MΩ
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
Rated functioning temperature Tf	Rated functioning temperature Tf for thermal fuse material is 146℃ according to section 11.2 of UL60691 3rd edition. The device shall be exposed in the test oven to 126℃until temperature has stabilized, shown when two consecutive readings taken 5 minutes apart, are the same. The temperature shall then be increased steadily with a rate of rise between 0.5 ℃/min to 1 ℃/min until all devices have functioned (thermal fuse open). The individual functioning temperatures shall be recorded.	All functioning temperatures shall be not less than 136℃ and not greater than 146℃.

Note:

UCT = Upper category temperature

LCT = Lower category temperature

R_{ins} = Insulation resistance

All electrical tests should be performed between terminal 1# and 3#.

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 SFS 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.

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The following applies to all products named in this publication:

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, EPCOS is 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 an EPCOS 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.**
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