NTC thermistors for inrush current limiting

Inrush Current Limiters (ICLs)

Series/Type:	**P13/**/M3*1**
Ordering code:	**B57213P0***M3*1**
Date:	2021-04-08
Version:	a

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Applications

- Inrush current limiting, e.g. in switch-mode power supplies, soft-start motors

Features

- Leaded and coated NTC thermistors
- Tinned copper wire, kinked
- Coating material flame retardant to UL 94 V-0
- Component marking includes the manufacturer's logo, resistance value and data code
- Highly stable electrical characteristics

Approvals

- UL 1434 (file number E338926)
- IEC
- VDE
- CQC

Options

- Resistance tolerance <20% and alternative lead configurations available on request

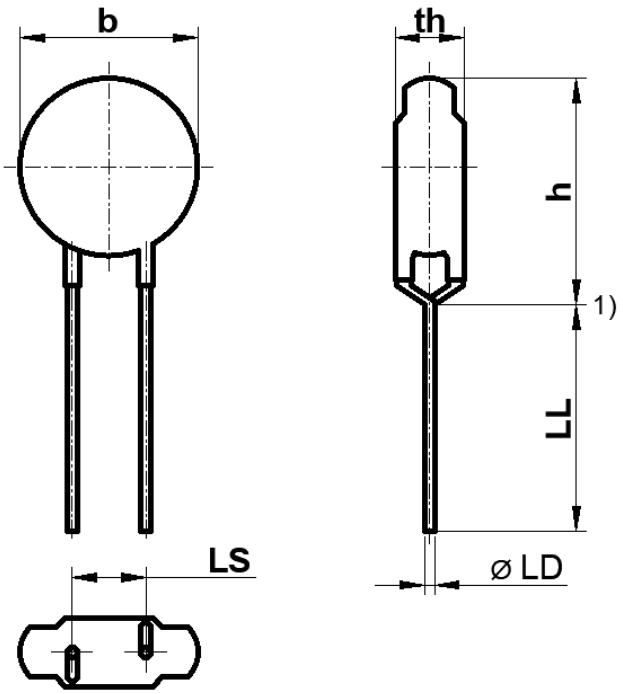
Delivery mode

- Bulk (standard), cardboard tape on reel or Ammo pack

General technical data

Climatic category	(IEC 60068-1)		40/170/21	
Max. power	(at 25 °C)	P_{max}	3.8	W
Resistance tolerance		$\Delta R_R/R_R$	± 20	%
Rated temperature		T_R	25	°C
Dissipation factor	(in air)	δ_{th}	approx. 15	mW/K
Thermal cooling time constant	(in air)	τ_{th}	approx. 80	s
Heat capacity		C_{th}	approx. 1200	mJ/K

Dimension drawings in mm



b	14.5 max.	mm
th	7.0 max.	mm
h	22.0 max.	mm
LL	25.0 min.[2)]	mm
LD	0.8 ±0.05	mm
LS	7.5 ±0.8	mm

1) Seating plane to IEC 60717

2) Effective Lead length acc. taping spec. IEC 60286-2

Approx. weight: 1.5 g

Electrical specification and ordering codes

Table 1

R_{25} Ω	I_{max1} (0...25 °C) A	C_{t1} at 230 V AC µF	C_{t1} at 110 V AC µF	R_{min} (at Imax, 25 °C) Ω	Ordering code
1	7.5	470	1880	0.043	B57213P0109M3*1
2.5	6.5	470	1880	0.066	B57213P0259M3*1
3	7	470	1880	0.062	B57213P0309M3*1
4	6	470	1880	0.088	B57213P0409M3*1
5	6	470	1880	0.092	B57213P0509M3*1
7	5	470	1880	0.122	B57213P0709M3*1
10	5	470	1880	0.130	B57213P0100M3*1
12	4	470	1880	0.189	B57213P0120M3*1
16	4	470	1880	0.197	B57213P0160M3*1
22	4	470	1880	0.200	B57213P0220M3*1
25	3	470	1880	0.319	B57213P0250M3*1
33	3	470	1880	0.354	B57213P0330M3*1
47	3	470	1880	0.359	B57213P0470M3*1
60	2	470	1880	0.695	B57213P0600M3*1
80	2	470	1880	0.624	B57213P0800M3*1
120	2	470	1880	0.693	B57213P0121M3*1

Remark: I_{max1} & C_{t1} in table 1 are UL and IEC certificated.

***= Delivery mode**

0=Bulk
4=Ammo packing
5=Reel packing

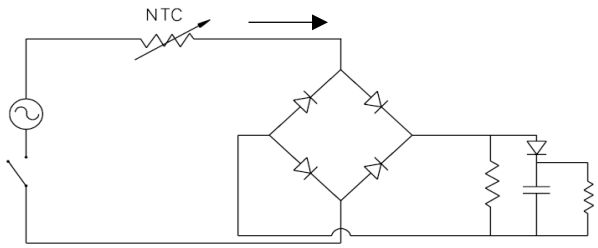
Table 2

R_{25} Ω	I_{max2} (0...25 °C) A	C_{t2} at 230 V AC µF	C_{t2} at 110 V AC µF	R_{min} (at Imax, 25 °C) Ω	Ordering code
10	5	1045	4180	0.130	B57213P0100M3*1
220	1	510	2040	2.365	B57213P0221M3*1

Remark: I_{max2} & C_{t2} in table 2 refer to below testing method.

***= Delivery mode**

0=Bulk
4=Ammo packing
5=Reel packing

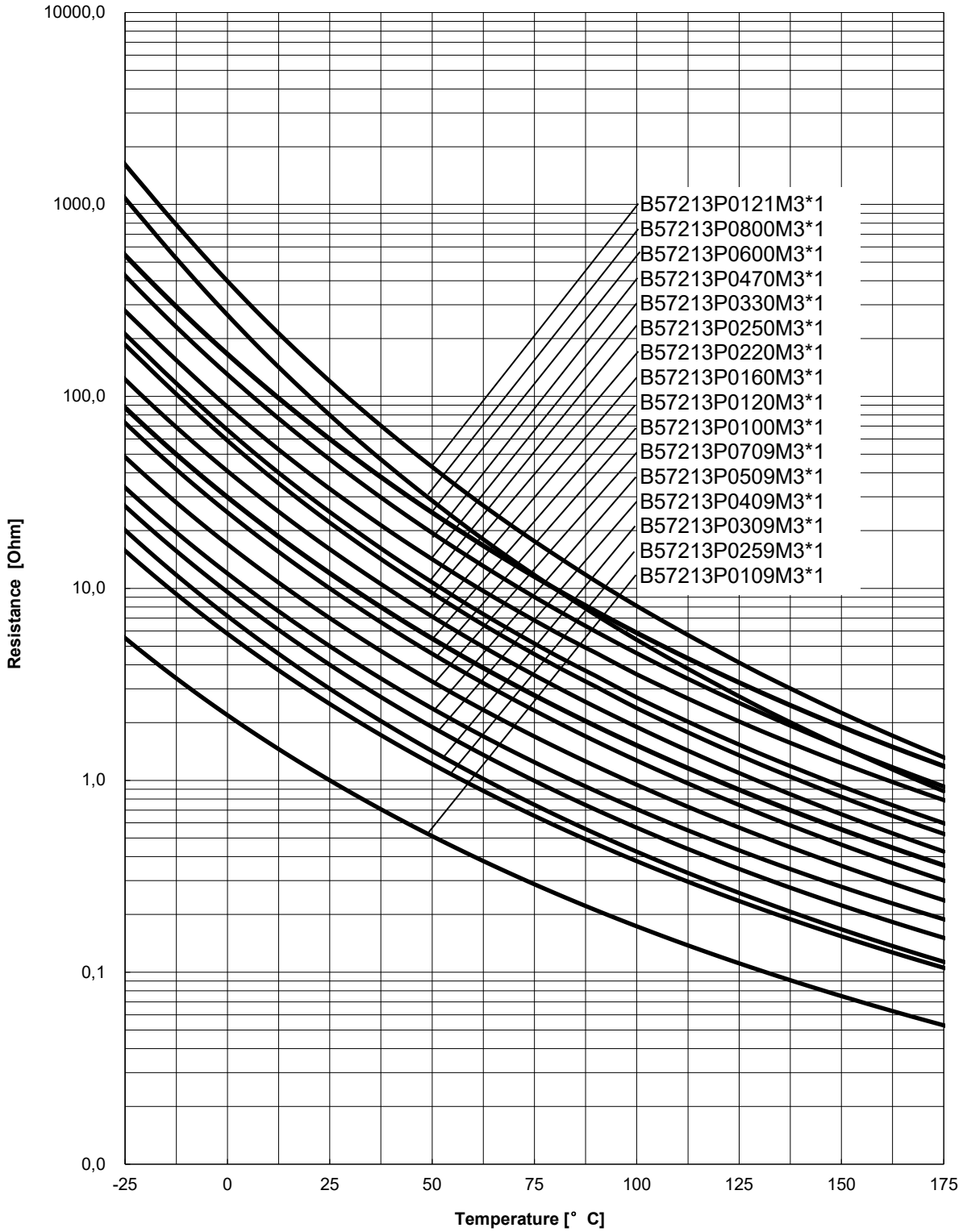


C_{t2} Test capacitance [µF]
I_{max2} Max current across the NTC under test [A]
Number of cycles: 1000

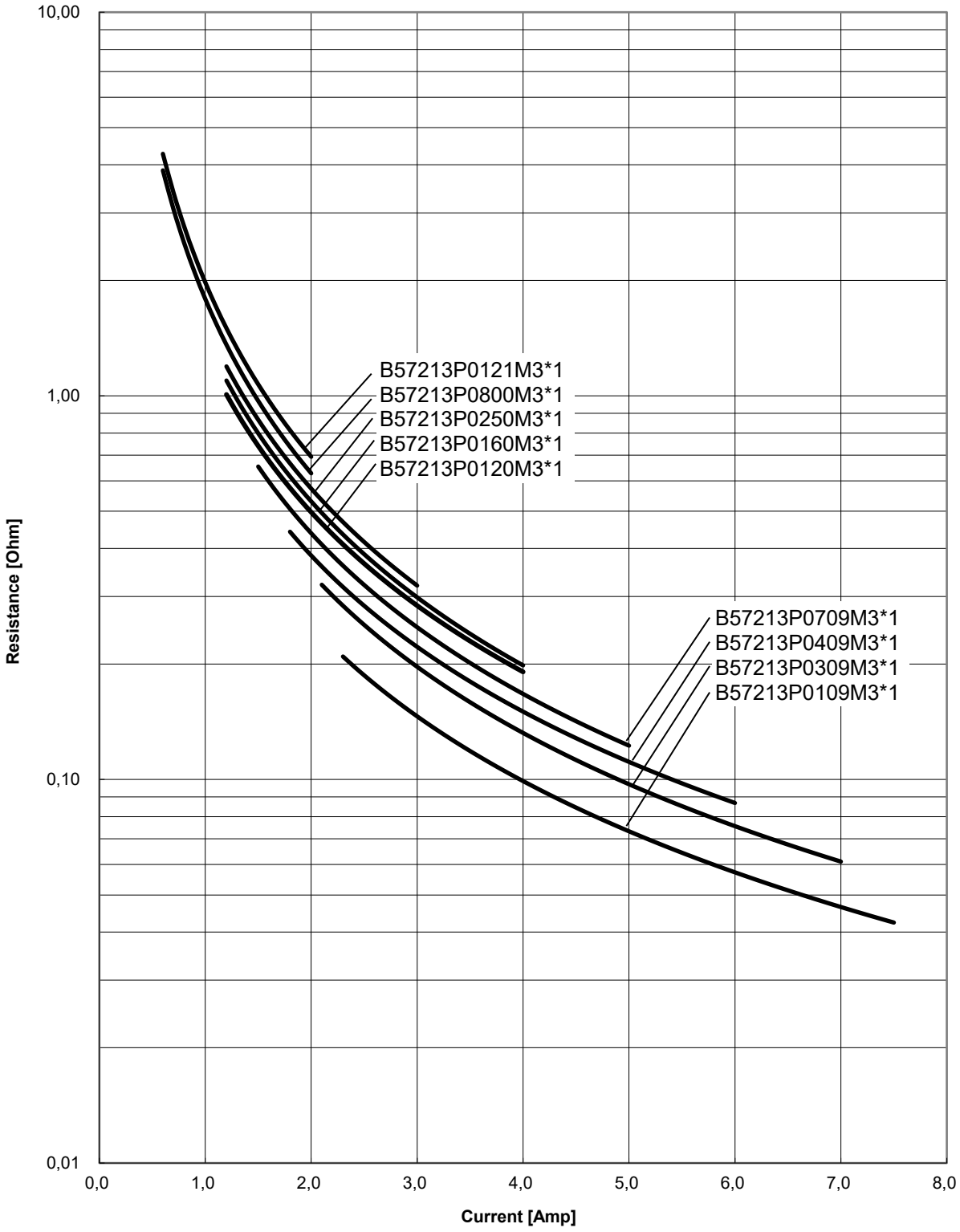
Reliability data

Test	Standard	Test conditions	$\lvert \Delta R_{25}/ R_{25} \rvert$ (typical)	Remarks
Storage in dry heat	IEC 60068-2-2	Storage at upper category temperature T: 170°C t: 1 000 h	< 20 %	No visible damage
Storage in damp heat, steady state	IEC 60068-2-78	Temperature of air: 40°C Relative humidity of air: 93 % Duration: 21 days	< 20 %	No visible damage
Rapid change of temperature	IEC 60068-2-14	Lower test temperature: -40 °C t: 30 min Upper test temperature: 150 °C t: 30 min Time to change from lower to upper temperature: < 30 s Number of cycles: 5	< 20 %	No visible damage
Endurance with max. current	IEC 60539-1	Ambient temperature: 25 ±5 °C $I = I_{max1}$ or I_{max2} t: 1000 h	< 20 %	No visible damage
Cyclic endurance	IEC 60539-1	Ambient temperature: 25 ±5 °C $I = I_{max1}$ or I_{max2} On-time = 1 min Cooling time = 5 min Number of cycles: 1000	< 20 %	No visible damage

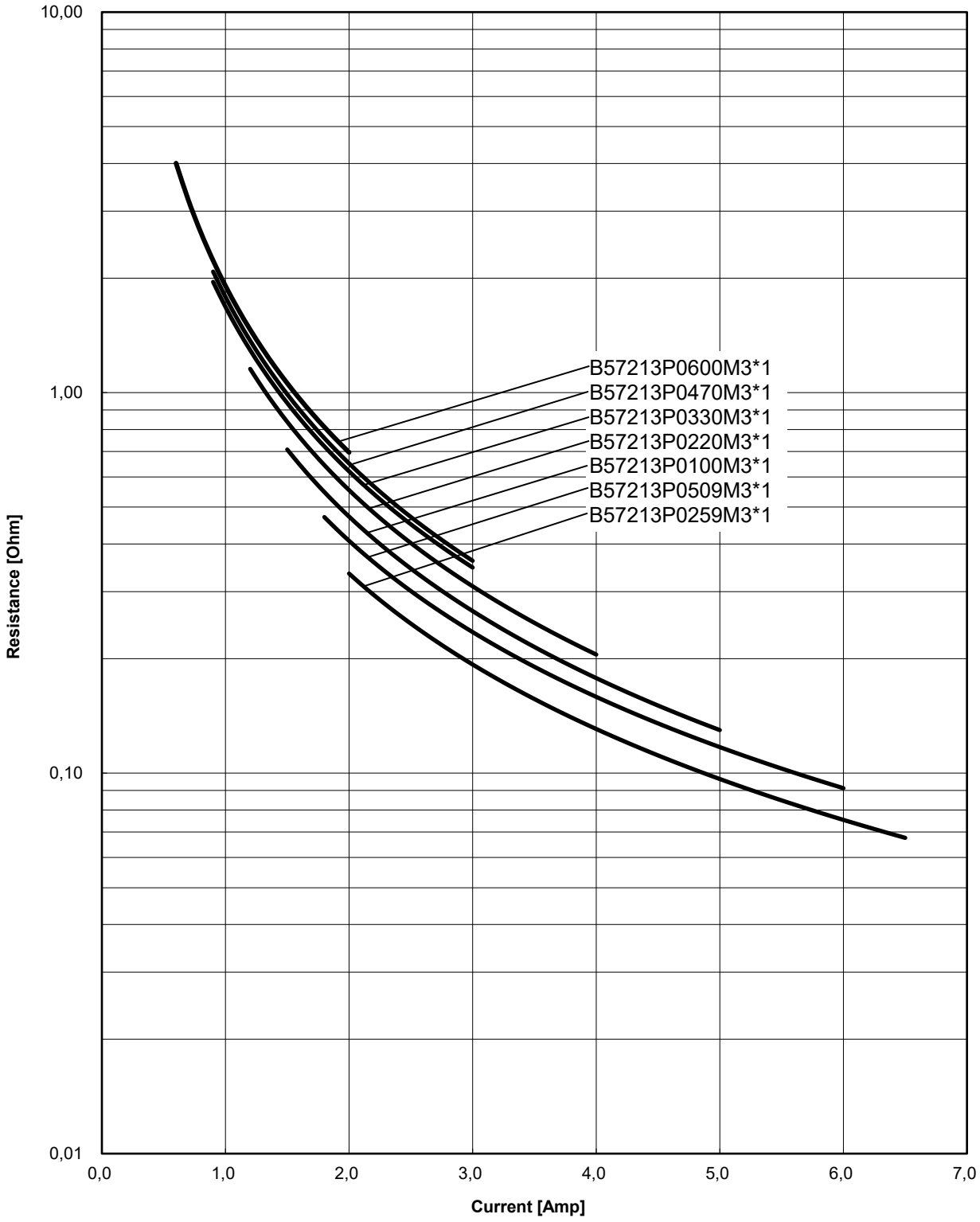
Resistance versus temperature



Resistance versus current



Resistance versus current



Cautions and warnings

See "Important notes" of this data sheet.

Storage

- Store thermistors only in original packaging. Do not open the package before storage.
- Storage conditions in original packaging: storage temperature -25 °C to +45 °C, relative humidity ≤75% annual mean, maximum 95%, dew precipitation is inadmissible.
- Avoid contamination of thermistors surface during storage, handling and processing.
- Avoid storage of thermistor in harmful environments like corrosive gases (SO_x, Cl etc).
- Solder thermistors after shipment from TDK Electronics within the time specified:
  - Leaded components: 24 months

Handling

- NTC inrush current limiters must not be dropped. Chip-offs must not be caused during handling of NTC inrush current limiters.
- Components must not be touched with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.
- In case of exposure of the NTC inrush current limiters to water, electrolytes or other aggressive media, these media can penetrate the coating and reach the surface of the ceramic. Low-ohmic or high-ohmic behavior may occur due to the formation of an electrolyte with metals (silver/lead/tin from metallization or solder). Low-ohmic behavior is caused by electrochemical migration, high-ohmic behavior by dissolving of the electrode. In either case, the functionality of the NTC inrush current limiters can not be assured.
- Washing processes may damage the product due to the possible static or cyclic mechanical loads (e.g. ultrasonic cleaning). They may cause cracks to develop on the product and its parts, which might lead to reduced reliability or lifetime.

Bending / twisting leads

- A lead (wire) may be bent at a minimum distance of twice the wire’s diameter plus 4 mm from the component head or housing. When bending ensure the wire is mechanically relieved at the component head or housing. The bending radius should be at least 0.75 mm.
- Twisting (torsion) by 180°of a lead bent by 90° is permissible at 6 mm from the bottom of the thermistor body.

Soldering

- Use resin-type flux or non-activated flux.
- Insufficient preheating may cause ceramic cracks.
- Rapid cooling by dipping in solvent is not recommended.
- Complete removal of flux is recommended.

Mounting

- When thermistors are sealed, potted or over-molded, there must be no mechanical stress caused by thermal expansion during the production process (curing/ over-molding process) and during later operation. The upper category temperature of the thermistor must not be exceeded. Ensure that the materials used (sealing / potting compound and plastic material) are chemically neutral.
- Electrode must not be scratched before/during/after the mounting process.
- Contacts and housings used for assembly with thermistor have to be clean before mounting.
- During operation, the inrush current limiters surface temperature can be very high. Ensure that adjacent components are placed at a sufficient distance from the thermistor to allow for proper cooling of the NTC inrush current limiters.
- Ensure that adjacent materials are designed for operation at temperatures comparable to the surface temperature of the thermistor. Be sure that surrounding parts and materials can withstand this temperature.
- Make sure that inrush current limiters are adequately ventilated to avoid overheating.
- Avoid contamination of thermistor surface during processing.

Operation

- Use NTC inrush current limiters only within the specified operating temperature range.
- Use NTC inrush current limiters only within the specified voltage and current ranges.
- Environmental conditions must not harm the NTC inrush current limiters. Use NTC inrush current limiters only in normal atmospheric conditions.
- Contact of NTC inrush current limiters with any liquids and solvents should be prevented. It must be ensured that no water enters the NTC inrush current limiters (e.g. through plug terminals). For measurement purposes (checking the specified resistance vs. temperature), the component must not be immersed in water but in suitable liquids (e.g. Galden).
- In case of exposure of the NTC inrush current limiters to water, electrolytes or other aggressive media, these media can penetrate the coating and reach the surface of the ceramic. Low-ohmic or high-ohmic behavior may occur due to the formation of an electrolyte with metals (silver/lead/tin from metallization or solder). Low-ohmic behavior is caused by electrochemical migration, high-ohmic behavior by dissolving of the electrode. In either case, the functionality of the NTC inrush current limiters can not be assured.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by malfunction (e.g. use a metal oxide varistor for limitation of overvoltage condition).

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Other related documents

Further information completing this data sheet is listed on the TDK website at
https://product.tdk.com/en/products/protection/current/ntc-limiter/index.html

General Technical Information

Quality and Environment

Symbols and Terms

Mounting Instructions

Taping and Packing

Climatic Conditions

RoHS and SVHC/REACH Declaration

Selection Guide

Application Note

Important notes

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 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.
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Important notes

8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap, XieldCap 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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