

## **NTC thermistors for inrush current limiting**

### **Inrush Current Limiters (ICLs)**

<b>Series/Type:</b>	<b>S364/120/M</b>
<b>Ordering code:</b>	<b>B57364S0121M000</b>
<b>Date:</b>	<b>2016-01-11</b>
<b>Version:</b>	<b>d</b>

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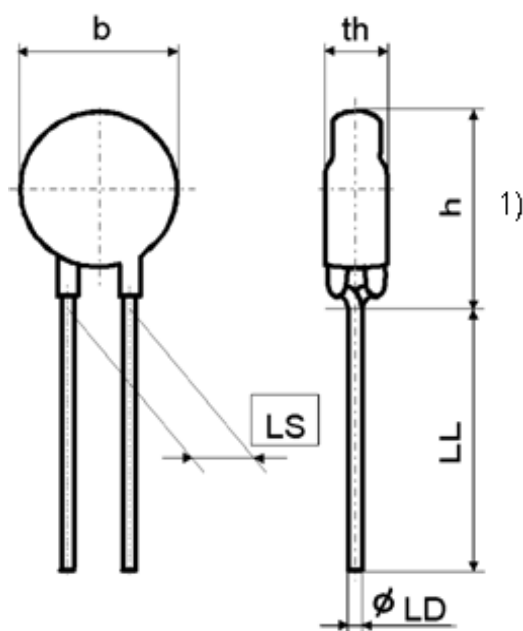
## Data sheet

## Application

- 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
- Manufacturer's logo, NTC and resistance value stamped on
- Highly stable electrical characteristics
- IEC approval (certification number 101QA12)
- VDE approval (certification number 40038223)
- CQC approval (certification number CQC09001040539)
- RoHS-compatible

**Data sheet**
**Drawing**


b	21.0 max	mm
th	7.0 max	mm
h	28.0 max	mm
LL	25.0 min	mm
LD	1.0 ±0.05	mm
LS	7.5 ±0.8	mm

1) Seating plane to IEC 60717

Approx. weight: 4 g

**General technical data**

Climatic category	(IEC 60068-1)	$P_{max}$	55/170/21	
Max. power	(at 25 °C)	$\Delta R_R/R_R$	5.1	W
Resistance tolerance		$T_R$	± 20	%
Rated temperature		$\delta_{th}$	25	°C
Dissipation factor	(in air)	$\tau_{th}$	approx. 24	mW/K
Thermal cooling time constant	(in air)	$C_{th}$	approx. 100	s
Heat capacity			approx. 2400	mJ/K

**Electrical specification and ordering codes**

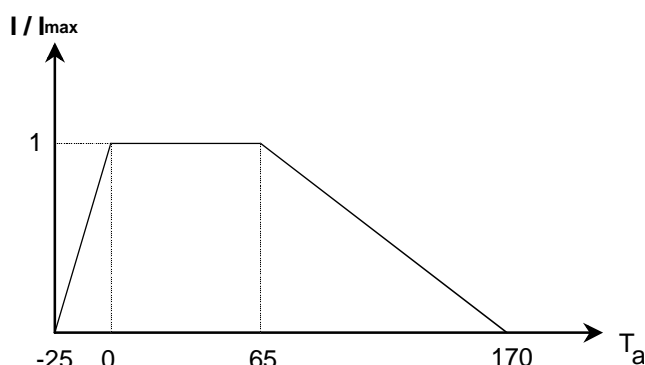
$R_{25}$	$I_{max}$ (0...65 °C)	$C_{test}$ at 230 V AC	$C_{test}$ at 110 V AC	$R_{min}$ (at $I_{max}$ , 25 °C)	Ordering code
$\Omega$	A	$\mu F$	$\mu F$	$\Omega$	
120	3.5	1000	4000	0.427	B57364S0121M000

**Data sheet**
**Maximum continuous current  $I_{\max}$** 

The  $I_{\max}$  denotes the maximum permissible continuous current (DC or RMS values for sine-shaped AC) in the temperature range from 0 to 65 °C.

**Load derating ( $I / I_{\max}$ )**

The power handling capability of an NTC thermistor cannot be fully utilized over the entire temperature range. For circuit dimensioning the derating curve given below provides information on the extent to which the current must be reduced at a certain ambient temperature ( $T_A$ ).



$$\text{Percent of } I_{\max} = 100 \left[ 1 - \frac{T_A - 65^\circ \text{C}}{T_{\max} - 65^\circ \text{C}} \right]$$

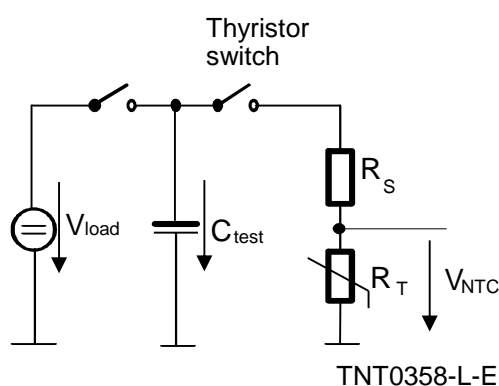
$T_A$  = ambient temperature ( $T_A > 65^\circ \text{C}$ )

$T_{\max} = 170^\circ \text{C}$

Fig. 1 Maximum current derating ( $I / I_{\max}$ )

**Maximum permissible capacitance**

The currents during turn-on are much higher than the rated currents during continuous operation. To test the effects of these current surges EPCOS uses the following standard procedure according to IEC 60539-1:



$V_{\text{load}}$  Load voltage [V]  
 $C_{\text{test}}$  Test capacitance [ $\mu\text{F}$ ]  
 $R_s$  Series resistance [ $R_s = 1 \Omega$ ]  
 $V_{\text{NTC}}$  Voltage drop across the NTC under test [V]  
 $= 180/375 \text{ V}$   
 (corresponds  $(110/230 \text{ V} + \text{dV}) \times 1.41$ )

Fig. 2 Maximum switchable capacity measuring circuit

**Marking**

- EPCOS – logo
- Resistance value
- NTC
- Date code with 4 digits (year and week of production): 1635 (example for week 35 in year 2016)

**Data sheet**
**Reliability data**

Test	Standard	Test conditions	$\Delta R_{25}/R_{25}$ (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: -55 °C t: 30 min Upper test temperature: 170 °C t: 30 min Time to change from lower to upper temperature: < 30 s Number of cycles: 10	< 20 %	No visible damage
Endurance with max. current	IEC 60539-1	Ambient temperature: 25 ± 5 °C I = I <sub>max</sub> t: 1000 h	< 20 %	No visible damage
Cyclic endurance	IEC 60539-1	Ambient temperature: 25 ± 5 °C I = I <sub>max</sub> On-time = 1 min Cooling time = 5 min Number of cycles: 1000	< 20 %	No visible damage
Maximum permissible capacitance test	IEC 60539-1	Ambient temperature: 25 ± 5 °C Capacitance = C <sub>test</sub> Number of cycles: 1000	< 20 %	No visible damage

**Note**

- The self-heating of a thermistor during operation depends on the load applied and the applicable dissipation factor.
- When loaded with maximum allowable current/power and the specified dissipation factor is taken as a basis, the NTC thermistor may reach a mean temperature of up to 250 °C.
- The heat developed during operation will also be dissipated through the lead wires. So the contact areas, too, may become quite hot at maximum load.
- When mounting NTC thermistors you have to ensure that there is an adequate distance between the thermistor and all parts which are sensitive to heat or combustible.

**Data sheet**
**Solderability**

Test to IEC 60068-2-20

Preconditioning: Immersion into flux F-SW 32.

Evaluation criterion: Wetting of soldering areas  $\geq 95\%$ .

Solder	Bath temperature (°C)	Dwell time (s)
SnAg (3.0 ... 4.0), Cu (0.5 ... 0.9)	245 $\pm$ 3	3

**Resistance to soldering heat**

Test to IEC 60068-2-20

Preconditioning: Immersion into flux F-SW 32.

Solder	Bath temperature (°C)	Dwell time (s)
SnAg (3.0 ... 4.0), Cu (0.5 ... 0.9)	260 -5	10

**Soldering instructions**

When soldering, care must be taken that the NTC thermistors are not damaged by excessive heat. The following maximum temperatures, maximum time spans and minimum distances have to be observed:

	Dip soldering	Iron soldering
Bath temperature .	max. 260 °C	max. 360 °C
Soldering time	max. 4 s	max. 2 s
Distance from thermistor	min. 6 mm	min. 6 mm

Under more severe soldering conditions the resistance may change.

**Robustness of terminations**

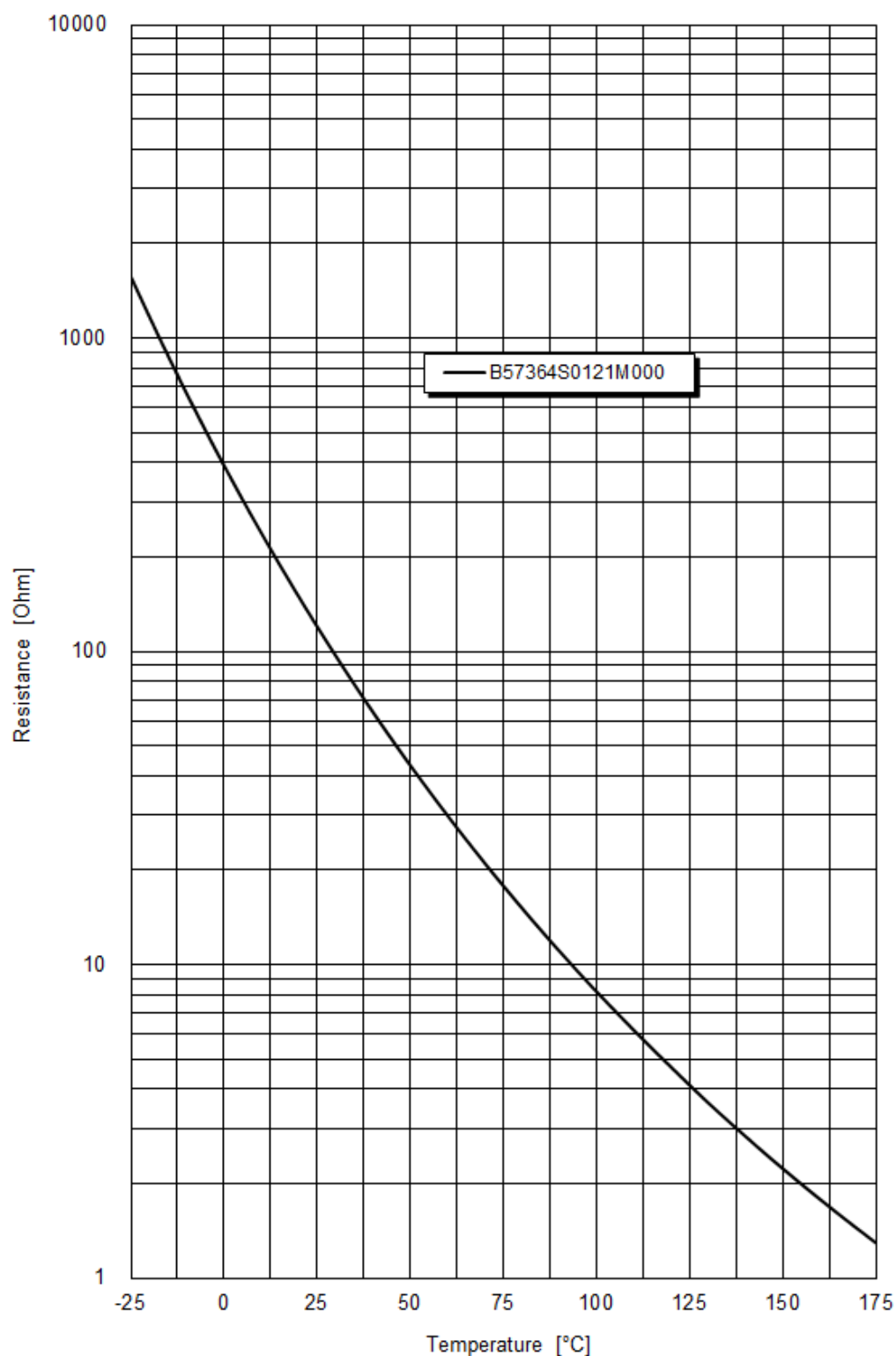
The leads meet the requirements of IEC 60068-2-21.

Test	Test conditions	Remarks
Tensile strength	Test Ua1: Fasten body with a force applied to each lead 10 N for 10 s	No visible damage
Bending strength	Test Ub: Fasten body with two 90°-bends in opposite direction at a force of 10 N	No visible damage

Remark: Peel off of coating along the lead is accepted.

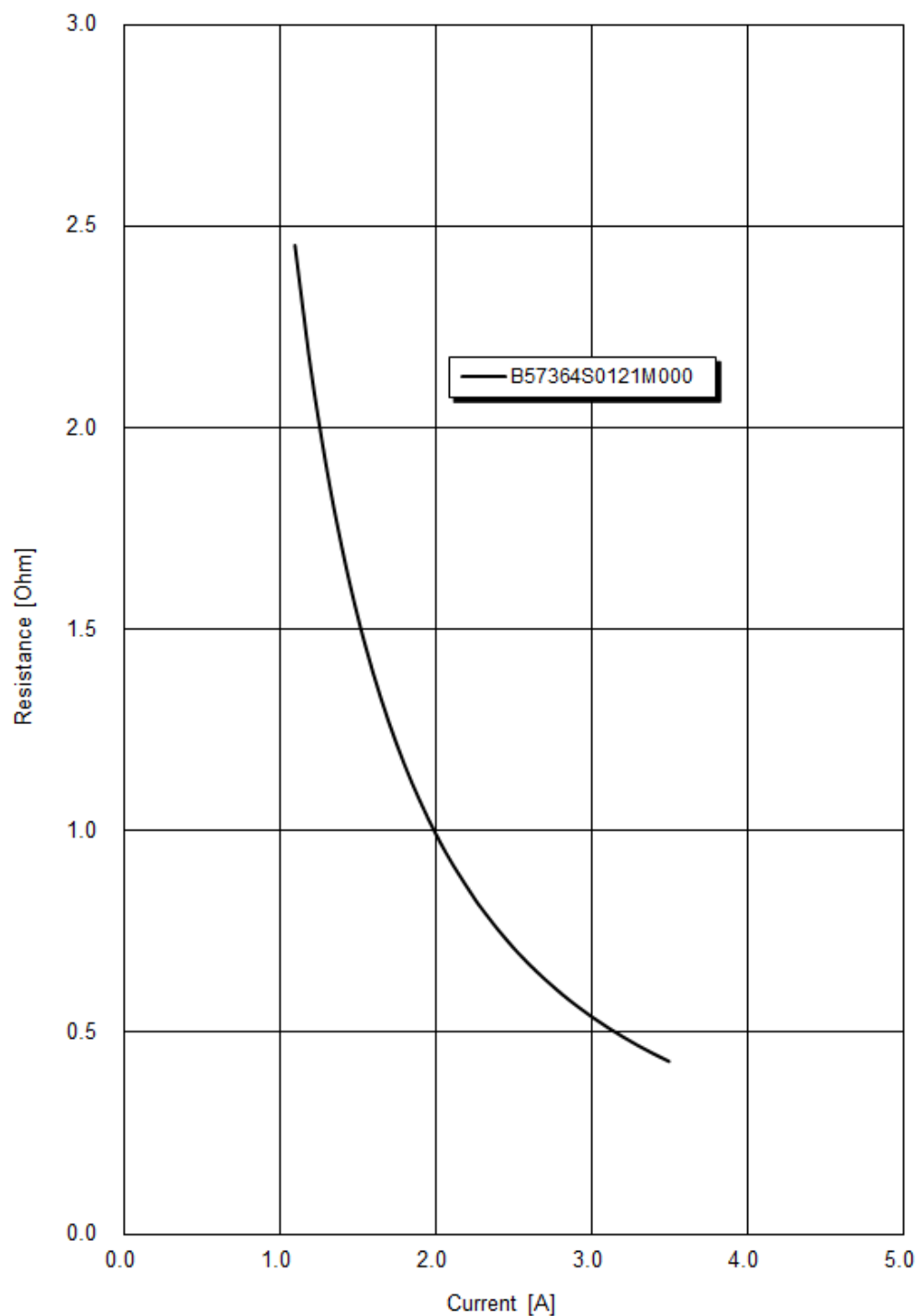
Data sheet

Resistance versus temperature



Data sheet

Resistance versus current





## Data sheet

## Packing

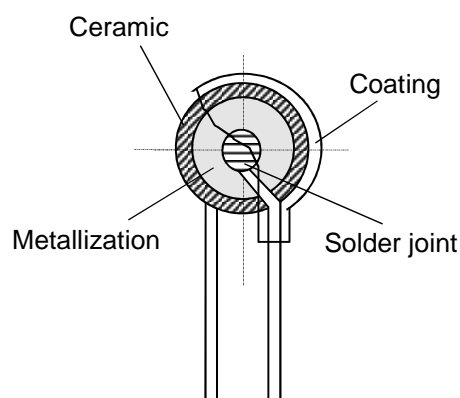
Packing	Pcs / unit	Dimensions (mm)
Bulk	250	Approx. x= 240, y= 160, z= 80

## Bar code label

The packing of all EPCOS components bears a bar code label stating the type, ordering code, quantity, date of manufacture and batch number. This enables a component to be traced back through the production process, together with its batch and test report.



## Internal construction



The above picture shows the internal construction of EPCOS ICLs.

Note: Coating may have cracks or chips due to acting mechanical force on the wire, but this does not affect the performance of the component.

## Data sheet

## 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 ... +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<sub>x</sub>, Cl etc).
- Solder thermistors after shipment from EPCOS 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.

## Data sheet

## 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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The following applies to all products named in this publication:

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