NTC thermistors for inrush current limiting

Inrush Current Limiters (ICLs)

Series/Type: **S464/40/M**
Ordering code: **B57464S 400M**

Date: 2017-07-31
Version: f

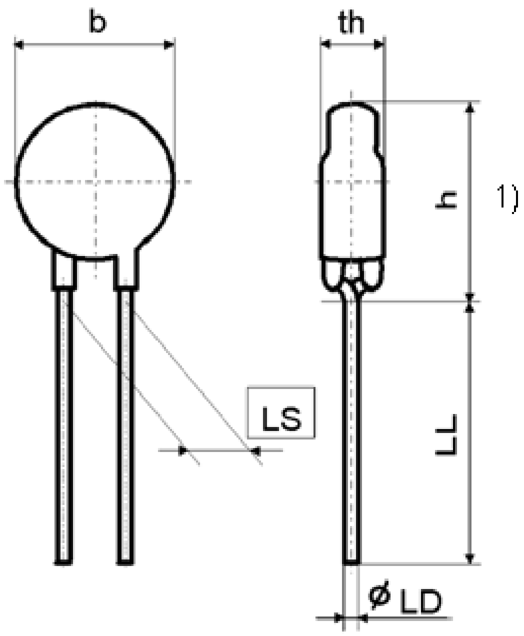
Application

- NTC-thermistor for inrush current limiting in peripheral communication equipment, e.g. in switch-mode power supplies.

Features

- Black coated thermistor disk
- Coating material is flame retardant (UL 94 V-0 approved)
- Kinked leads of tinned copper wire
- Lead spacing 7.5 mm
- High stability of electrical characteristic
- Terminals solderable in accordance with IEC 60068-2-20, test ta, method 1
- ICL support to fulfill the requirements according EN 61000 of power circuits
- Usable in series connections up to 265 V_{rms}
- UL approval (E69802)
- CQC approval (CQC09001040539)
- RoHS-compatible

Drawing



b	27.0 max	mm
th	7.0 max	mm
h	31.0 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: 9 g

General technical data

Climatic category	(IEC 60068-1)		55/170/21	
Max. power	(at 25 °C)	P_{max}	6.7	W
B value		B	3450	K
B value tolerance		$\Delta B/B$	± 3	%
Resistance tolerance		$\Delta R_R/R_R$	± 20	%
Rated temperature		T_R	25	°C
Dissipation factor	(in air)	δ_{th}	approx. 30	mW/K
Thermal cooling time constant	(in air)	τ_{th}	approx. 130	s
Heat capacity		C_{th}	approx. 3900	mJ/K

Electrical specification and ordering codes

R_{25} Ω	I_{max} (0...65 °C) A	C_{test} 2) at 230 V AC µF	C_{test} at 110 V AC µF	R_{min} (at Imax, 25 °C) Ω	Ordering code
40	4.4	2500	10000	0.28	B57464S 400M

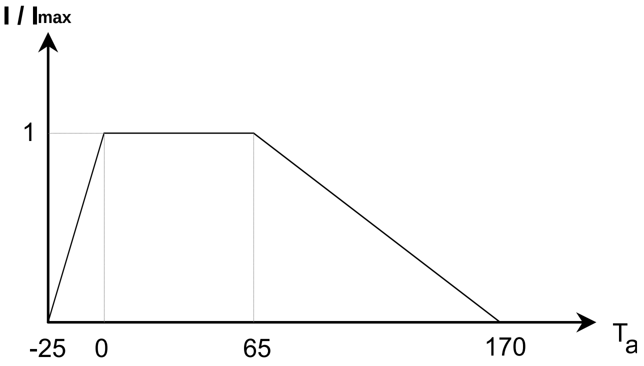
2) 1200µF at 240V and 4800µF at 120V in UL spec.

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).



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

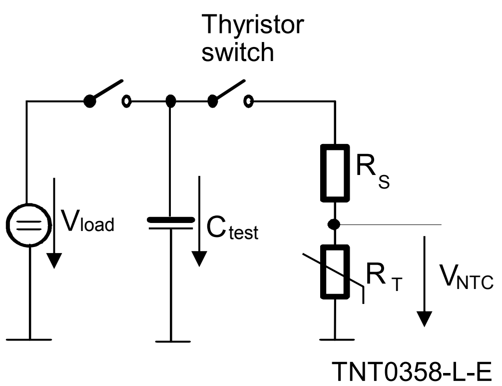
T_A = ambient temperature ($T_A > 65$°C)

T_{max} = 170°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_{load}	Load voltage [V]
C_{test}	Test capacitance [µF]
R_S	Series resistance [Rs = 1 Ω]
V_{NTC}	Voltage drop across the NTC under test [V] = 180/375 V (corresponds (110/230 V + dV) x 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): 1536 (example for week 36 in year 2015)

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 = Imax t: 1000 h	< 20 %	No visible damage
Cyclic endurance	IEC 60539-1	Ambient temperature: 25 ±5 °C I = Imax 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_{test} 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.

Solderability

Test to IEC 60068-2-20

Preconditioning: Immersion into flux F-SW 32.

Evaluation criterion: Wetting of soldering areas ≥95%.

Solder	Bath temperature (℃)	Dwell time (s)
SnAg (3.0 … 4.0), Cu (0.5 … 0.9)	245 ±3	3

Resistance to soldering heat

Test to IEC 60068-2-20

Preconditioning: Immersion into flux F-SW 32.

Solder	Bath temperature (℃)	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 ℃	max. 360 ℃
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.

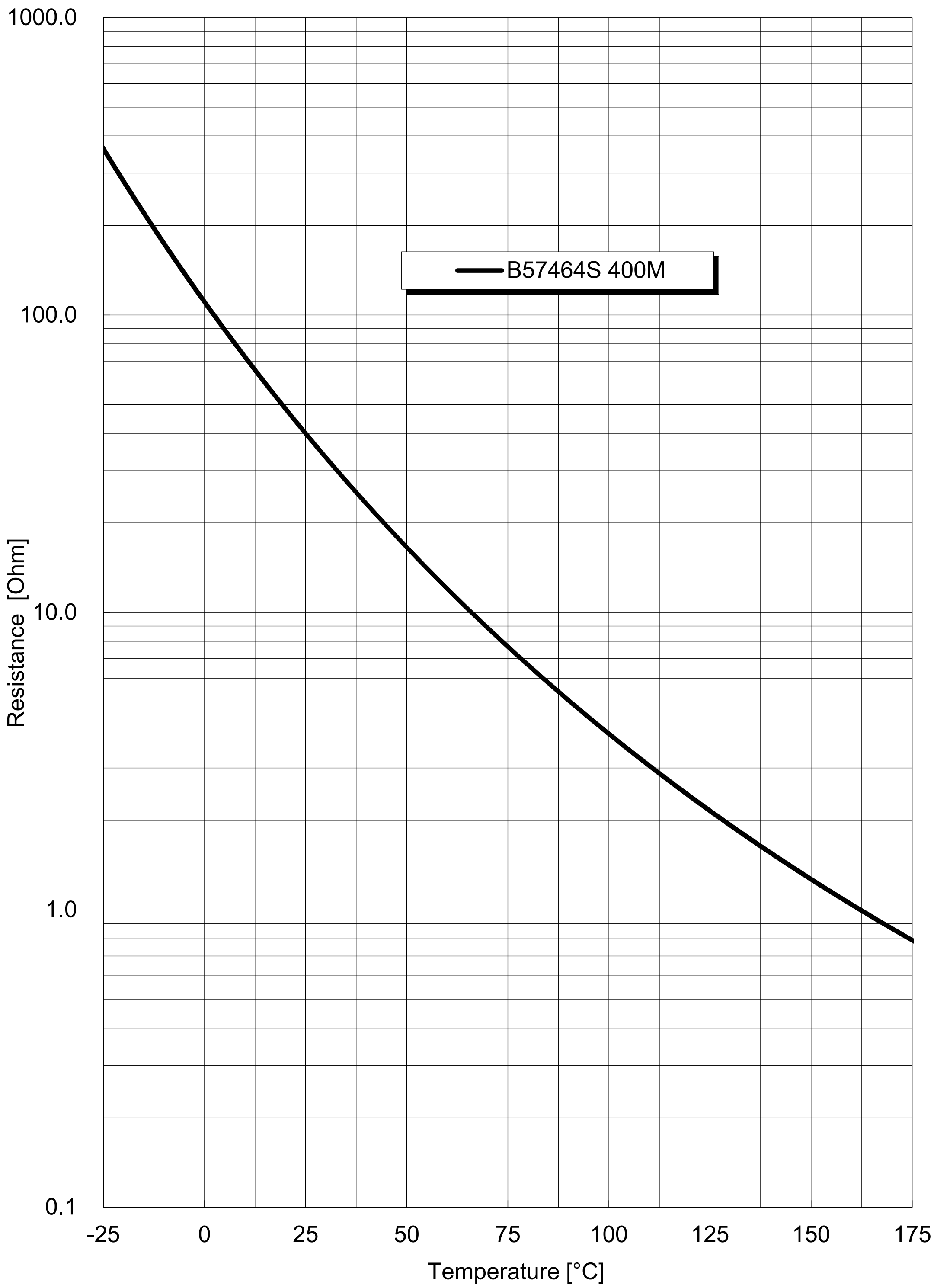
Robustness of terminations

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

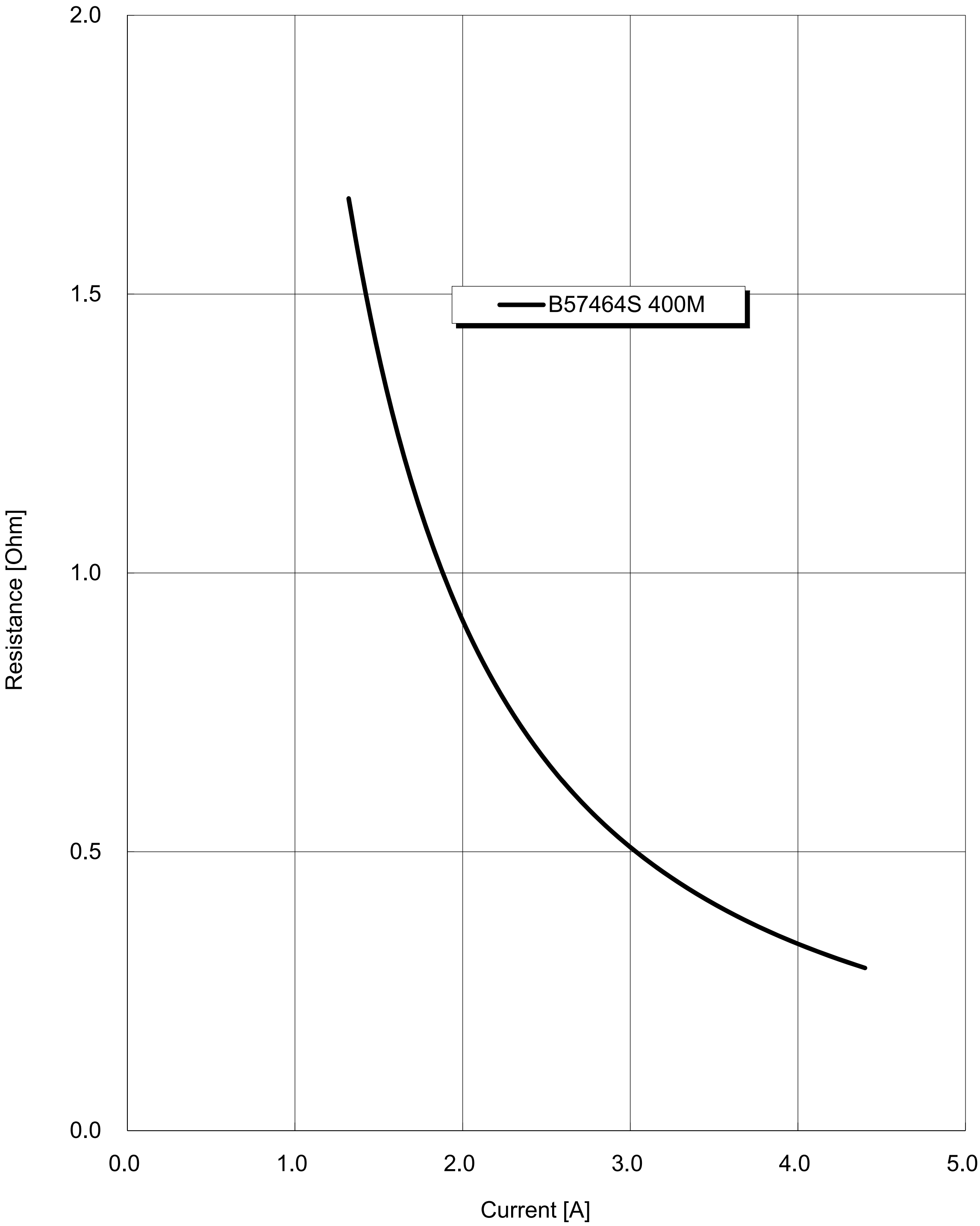
Test	Test conditions	Remarks
Tensile strength	Test Ua1: Fasten body with a force applied to each lead 10 N for 10 s	No visible damage
Bending strength	Test Ub: Fasten body with two 90°-bends in opposite direction at a force of 10 N	No visible damage

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

Resistance versus temperature



Resistance versus current



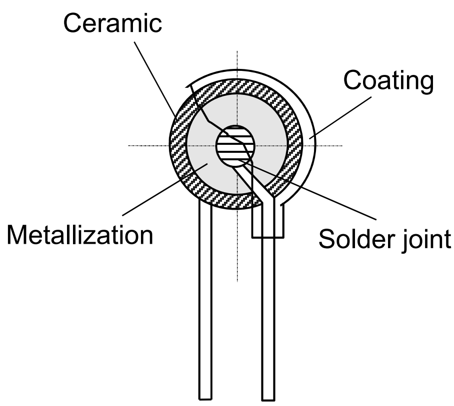
Packing

Packing	Pcs / unit	Dimensions (mm)
Bulk	200	Approx. x= 80, y= 240, z= 210

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.

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_x, 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.

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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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, 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.
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