



## PTC thermistors

Inrush current limiter

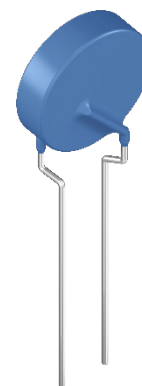
|                       |                        |
|-----------------------|------------------------|
| <b>Series/Type:</b>   | <b>C1452-A135-A70</b>  |
| <b>Ordering code:</b> | <b>B59452C1135A070</b> |
| <b>Date:</b>          | 2020-08-14             |
| <b>Version:</b>       | a                      |

## Applications

- Inrush current limiter (charging resistor) for smoothing and DC link capacitors
- To replace high-power fixed resistors for capacitor charging

## Features

- Self-protecting in case of malfunction of short-circuit relay or internal short circuit of capacitor
- Inrush current limiters are not damaged when directly connected to  $V_{\max}$  even without additional current limitation
- Marking: Type, manufacturer's logo, reference temperature in °C and date code YYWW
- Qualification base on AEC-Q200 Rev. D
- RoHS-compatible



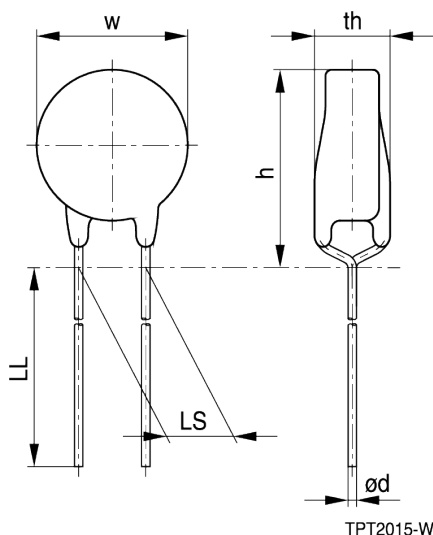
## Delivery mode

- Cardboard strips with hot-melt adhesive tape
- 8 pcs per strip

## Ordering code

[B59452C1135A070](#)

## Dimensional drawing



|             |                 |    |
|-------------|-----------------|----|
| $w_{\max}$  | 16.0            | mm |
| $th_{\max}$ | 8.0             | mm |
| $h_{\max}$  | 20.5            | mm |
| $\phi d$    | $0.8 \pm 0.05$  | mm |
| LS          | $5.0 +0.6/-0.1$ | mm |
| $LL_{\min}$ | 25              | mm |

Dimensions in mm

## General technical data

|                                                        |                        |            |                    |
|--------------------------------------------------------|------------------------|------------|--------------------|
| Maximum operating voltage                              | $V_{\max}$             | 550        | $V_{AC}$           |
| Max. DC link voltage                                   | $V_{\text{link, max}}$ | 780        | $V_{DC}$           |
| Rated resistance                                       | $R_{25}$               | 500        | $\Omega$           |
| Resistance tolerance                                   | $\Delta R_{25}$        | $\pm 30$   | %                  |
| Reference temperature (typical)                        | $T_{\text{ref}}$       | 135        | $^{\circ}\text{C}$ |
| Thermal capacity (typical)                             | $C_{\text{th}}$        | 2.3        | J/K                |
| Thermal time constant (typical)                        | $\tau_{\text{th}}$     | 150        | s                  |
| Operating cycles at $V_{\max}$ (charging of capacitor) | $N_c$                  | > 100,000  | cycles             |
| Switching cycles at $V_{\max}$ (failure mode)          | $N_f$                  | > 100      | cycles             |
| Operating temperature range ( $V = 0 \text{ V}$ )      | $T_{\text{op}}$        | -40 / +125 | $^{\circ}\text{C}$ |
| Operating temperature range ( $V = V_{\max}$ )         | $T_{\text{op}}$        | -20 / +85  | $^{\circ}\text{C}$ |

Specification for  $T_{\text{amb}} = 25 \pm 0.1 \text{ }^{\circ}\text{C}$

## Calculation of the number of required PTC elements

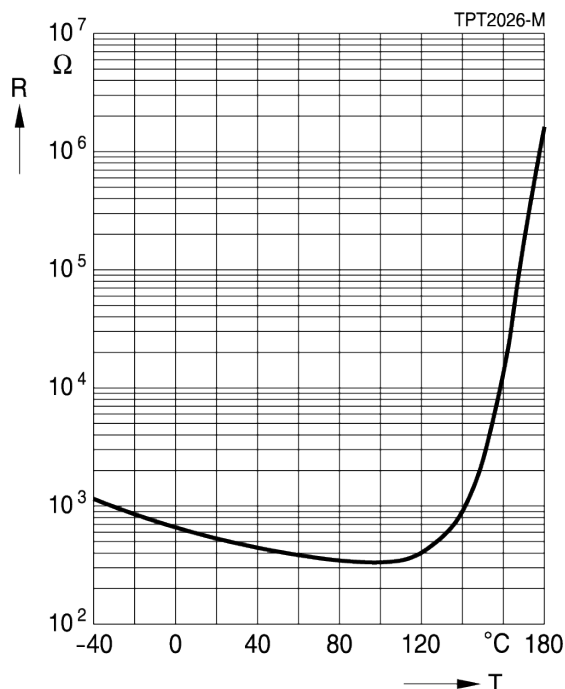
Number of required PTC elements (connected in parallel) as function of capacitance and charging voltage of smoothing or DC link capacitor:

$$N \geq \frac{K \cdot C \cdot V^2}{2 \cdot C_{\text{th}} \cdot (T_{\text{ref}} - T_{\text{A,max}})}$$

|                    |                                                                                                                        |
|--------------------|------------------------------------------------------------------------------------------------------------------------|
| K                  | K factor<br>K = 1 for DC source<br>K = 0.96 for 3-phase bridge rectifier<br>K = 0.76 for single-phase bridge rectifier |
| N                  | Number of required PTC thermistors connected in parallel                                                               |
| C                  | Capacitance of smoothing or DC link capacitor in F                                                                     |
| V                  | Charging voltage of capacitor in V                                                                                     |
| $C_{\text{th}}$    | Heat capacity in J/K                                                                                                   |
| $T_{\text{ref}}$   | Reference temperature of PTC in $^{\circ}\text{C}$                                                                     |
| $T_{\text{A,max}}$ | Expected maximum ambient temperature in $^{\circ}\text{C}$                                                             |

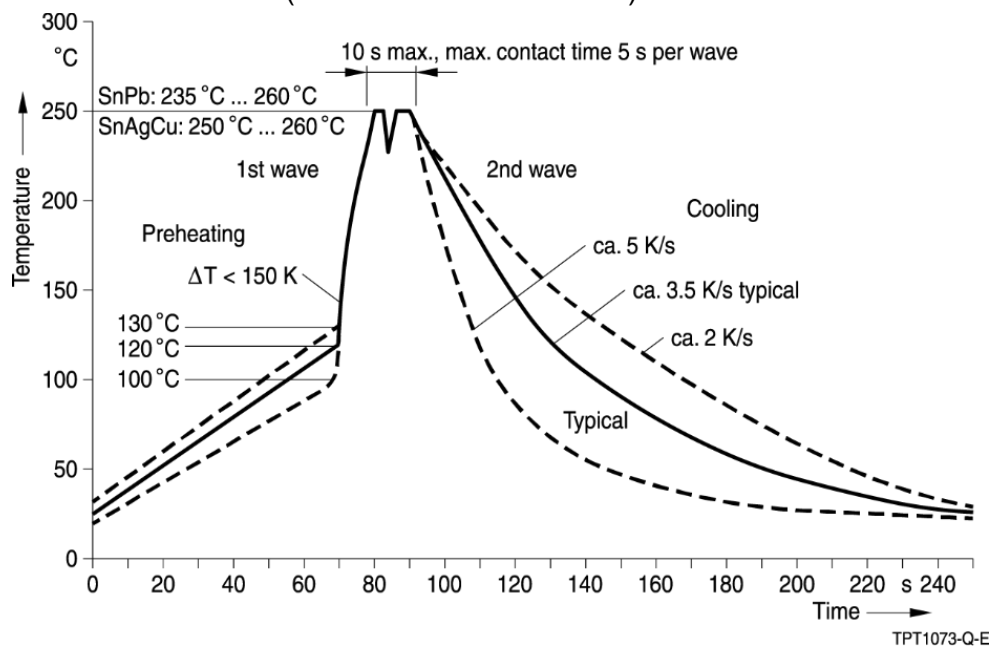
In case of large N values the resulting resistance of the parallel PTC network might be too low for effective limitation of the charging current. In this case a combination of series and parallel connected PTC thermistors can be used.

### Characteristics R/T curve (typical)



### Soldering instructions

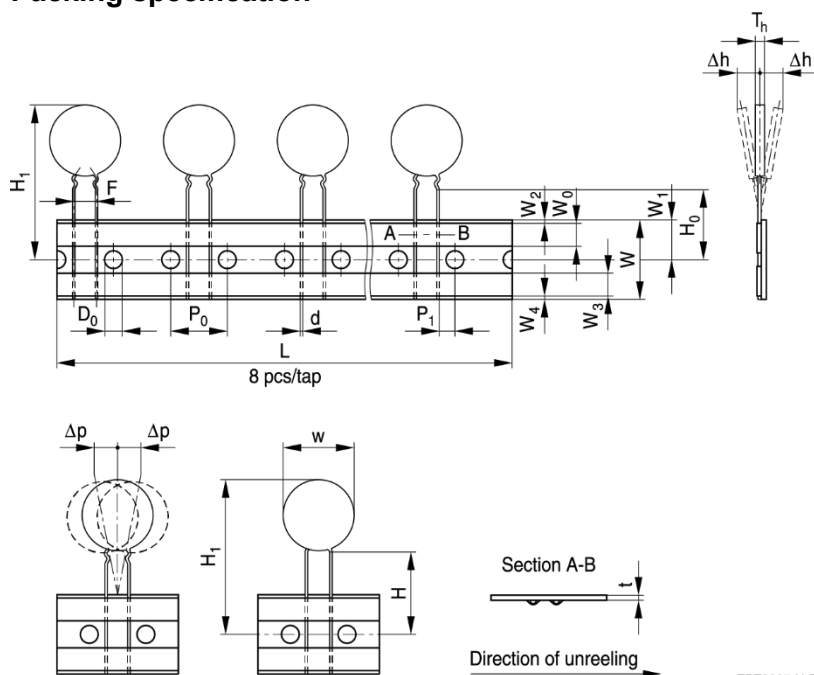
Recommended temperature profile for wave following IEC 61760-1. Applicable for leaded PTCs and selected SMD PTCs (case sizes 3225 and 4032).



## Reliability data

| Test item                    | Testing method / description                                                                                                                                                               | $I\Delta R_{25}/R_{25}I$                         |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| High temperature exposure    | MIL-STD-202, Method 108<br>1000 hrs at max. operating temperature +125 °C (V = 0)<br>Measurement at 24 +/- 2 hours after test                                                              | ≤ 20%                                            |
| Temperature cycling          | JESD22 Method JA-104<br>1000 Cycles, -55 °C to +125 °C, Dwell time = 30 min at each temperature extreme, 1 min max. transition time.<br>Measurement at 24 +/- 2 hrs after test conclusion. | ≤ 25%                                            |
| Biased humidity              | MIL-STD-202, Method 103<br>1000 hrs. 85°C/85%RH, V = 0.05*Vmax (10% rated power)<br>Measurement at 24+/-2 hrs after test conclusion                                                        | ≤ 20%                                            |
| Operational life             | MIL-STD-202, Method 108<br>1000 hrs. at max. operating temperature, + 105 °C, V = V <sub>max</sub><br>Measurement at 24+/-2 hrs after test conclusion                                      | ≤ 25%                                            |
| Terminal strength            | MIL-STD-202, Method 211<br>After gradually applying the force 2.27kg and keep the unit fixed for 10 s, the terminal shall be visually examined for any damage                              | ≤ 5%                                             |
| Resistance to solvents       | MIL-STD-202, Method 215<br>Note: Add Aqueous wash chemical - OKEM Clean or equivalent<br>Do not use banned solvents.                                                                       | ≤ 10%                                            |
| Mechanical shock             | MIL-STD-202-213 Condition C<br>Amplitude = 1,000 m/s <sup>2</sup> , Duration = 6 ms,<br>3 pulses per axis (6 directions)                                                                   | ≤ 5%                                             |
| Vibration                    | Frequency range: 10 to 55 Hz<br>Displacement amplitude: 0.75 mm<br>Test duration: 3 x 2 h<br>Test according to IEC 60068-2-6, Test Fc                                                      | ≤ 5%                                             |
| Resistance to soldering heat | MIL-STD-202 Method 210 Condition B<br>No pre-heat of samples.<br>T = 260 +/- 3 °C, Duration = 10 s                                                                                         | ≤ 20%                                            |
| ESD                          | AEC-Q200-002 or ISO/DIS10605<br>150 pF / 330 Ω; 8 kV contact discharge, polarity +/-;<br>10 pulses in each polarity                                                                        | ≤ 5%                                             |
| Solderability                | J-STD-002 Electrical test not required.<br>Magnification 50 X. Conditions<br>Solder material: Sn96.5Ag3Cu0.5<br>Solder bath, T = 245 +/- 3 °C, duration 3 s                                | Continuous solder coating with coverage<br>≥ 95% |

## Packing specification



TPT2027-N-E

| Designation                                       | Symbol         | Nominal size<br>mm | Tolerance<br>mm | Remarks                       |
|---------------------------------------------------|----------------|--------------------|-----------------|-------------------------------|
| Hole diameter                                     | D <sub>0</sub> | 4.0                | ± 0.5           |                               |
| Pitch of holes                                    | P <sub>0</sub> | 12.7               | ± 0.5           |                               |
| Hot adhesive tape width                           | W <sub>0</sub> | 5.0                | ± 0.5           | peel-off force ≤10 N          |
| Position of holes                                 | W <sub>1</sub> | 9.0                | +0.75/-0.5      |                               |
| Position of adhesive tape                         | W <sub>2</sub> | 3.0                | max.            |                               |
| Hot adhesive tape width                           | W <sub>3</sub> | 5.0                | ± 0.5           | peel-off force ≤10 N          |
| Position of adhesive tape                         | W <sub>4</sub> | 3.0                | max.            |                               |
| Spacing hole center /<br>bottom edge of component | H              | 16                 | min.            | non- kinked lead version only |
| Spacing hole center /<br>kink level               | H <sub>0</sub> | 16                 | min.            | kinked lead version only      |
| Spacing hole center /<br>upper edge of component  | H <sub>1</sub> | 38                 | max.            |                               |
| Length of cardboard strip                         | L              | 203                | ± 2             |                               |
| Cardboard strip width                             | W              | 18                 | ± 0.5           |                               |
| Spacing hole center /Leads                        | P <sub>1</sub> | 3.85               | ± 0.7           |                               |

## Cautions and warnings

### General

- EPCOS thermistors are designed for specific applications and should not be used purposes not identified in our specifications, application notes and data books unless otherwise agreed with us during the design-in-phase.
- Ensure suitability of thermistor through reliability testing during the design-in phase. The thermistors should be evaluated taking into consideration worst-case conditions.

### 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  $\leq 75\%$  annual mean, maximum 95%, dew precipitation is inadmissible.
- Avoid contamination of thermistors surface during storage, handling and processing.
- Avoid storage of thermistor in harmful environment with effect on function on long-term operation (examples given under operation precautions).
- Use thermistor within the following period after delivery:
  - Through-hole devices (housed and leaded PTCs): 24 months
  - Motor protection sensors, glass-encapsulated sensors and probe assemblies: 24 months
  - Telecom pair and quattro protectors (TPP, TQP): 24 months
  - Leadless PTC thermistors for pressure contacting: 12 months
  - Leadless PTC thermistors for soldering: 6 months
  - SMDs in EIA sizes 3225 and 4032, and for PTCs with metal tags: 24 months
  - SMDs in EIA sizes 0402, 0603, 0805 and 1210: 12 months

### Handling

- PTCs must not be dropped. Chip-offs must not be caused during handling of PTCs.
- Components must not be touched with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.

### Soldering

- Use rosin-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.
- Standard PTC heaters are not suitable for soldering.

### Mounting

- Electrode must not be scratched before/during/after in the mounting process.
- Contacts and housing used for assembly with thermistor have to be clean before mounting. Especially grease or oil must be removed.
- When PTC thermistors are encapsulated with sealing material, the precautions given in chapter "Mounting instructions", "Sealing and potting" must be observed.
- When the thermistor is mounted, there must not be any foreign body between the electrode of the thermistor and the clamping contact.
- The minimum force of the clamping contacts pressing against the PTC must be 10 N.

- During operation, the thermistor's surface temperature can be very high. Ensure that adjacent components are placed at a sufficient distance from the thermistor to allow for proper cooling at the thermistors.
- Ensure that adjacent materials are designed for operation at temperature comparable to the surface temperature of thermistor. Be sure that surrounding parts and materials can withstand this temperature.
- Avoid contamination of thermistor surface during processing.

### Operation

- Use thermistors only within the specified temperature operating range.
- Use thermistors only within the specified voltage and current ranges.
- Environmental conditions must not harm the thermistors. Use thermistors only in normal atmospheric conditions. Avoid use in deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas etc), corrosive agents, humid or salty conditions. Contact with any liquids and solvents should be prevented.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by abnormal function (e.g. use VDR for limitation of over voltage condition).

### Display of ordering codes for TDK products

The ordering code for one and the same TDK product can be represented differently in data sheets, data books, other publications, on the TDK 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](http://www.tdk-electronics.tdk.com/orderingcodes).

## 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.
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](http://www.tdk-electronics.tdk.com/material)). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply**.
7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard**. The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements ("CSR") TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System**. For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

## Important notes

8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, InsuGate, 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](http://www.tdk-electronics.tdk.com/trademarks).

Release 2022-07