# PTC thermistors for overcurrent protection

SMDs, EIA sizes 0603 and 1210, 24 V, 42 V, 63 V and 230 V

**Series/Type:**

Date: January 2009

## Overcurrent protection

### SMDs, EIA sizes 0603 and 1210, 24 V, 42 V, 63 V and 230 V

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**Applications**

- Overcurrent protection
- Short circuit protection

**Features**

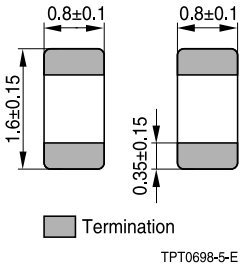
- Thermistor chip with lead-free tinned terminations
- Small size
- Short response times
- Suitable for reflow soldering only
- Suitable for automatic placement
- RoHS-compatible

**Delivery mode**

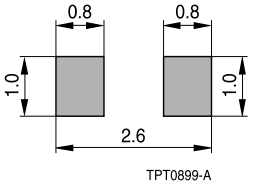
- Blister tape (case size 1210) or cardboard tape (case size 0603), 180-mm reel with 8-mm tape, taping to IEC 60286-3

**Dimensional drawings in mm**

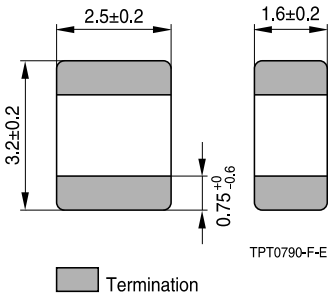
**EIA case size 0603**



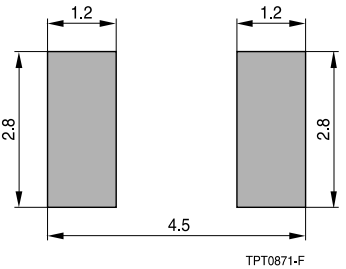

Solder pad




**EIA case size 1210**




Solder pad




Recommended maximum dimensions (mm)

## Overcurrent protection

### SMDs, EIA sizes 0603 and 1210, 24 V, 42 V, 63 V and 230 V

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**General technical data**

| | | | | |
|---|---|---|---|---|
| Switching cycles | | N | 100 | |
| Tolerance of $R_R$ | (except A907) | $\Delta R_R$ | ±25 | % |
| Tolerance of $R_R$ | (for A907) | $\Delta R_R$ | ±35 | % |
| Operating temperature range | (V = 0) | $T_{op}$ | −40/+125 | °C |
| Operating temperature range | ($V = V_{max}$, except A907) | $T_{op}$ | −20/+85 | °C |
| Operating temperature range | ($V = V_{max}$, for A907) | $T_{op}$ | −40/+85 | °C |

**Electrical specifications and ordering codes**

| Type | $I_R$ [1] | $I_S$ [1] | $I_{Smax}$ ($V = V_{max}$) | $R_R$ | $R_{min}$ | EIA case size | Ordering code |
|---|---|---|---|---|---|---|---|
| | mA | mA | A | Ω | Ω | | |
| $V_{max}$ = 30 V DC or V AC, $V_R$ = 24 V DC or V AC | | | | | | | |
| A606 | 90 | 180 | 0.5 | 27 | 17 | 1210 | B59606A0110A062 |
| A607 | 70 | 130 | 0.4 | 55 | 30 | 1210 | B59607A0120A062 |
| $V_{max}$ = 60 V DC or V AC, $V_R$ = 42 V DC or V AC | | | | | | | |
| A622 | 22 | 47 | 0.22 | 220 | 150 | 0603 | B59622A0090A062 |
| $V_{max}$ = 80 V DC or V AC, $V_R$ = 63 V DC or V AC | | | | | | | |
| A623 | 15 | 33 | 0.15 | 470 | 300 | 0603 | B59623A0090A062 |
| A707 | 50 | 90 | 0.3 | 125 | 75 | 1210 | B59707A0120A062 |
| $V_{max}$ = 265 V DC or V AC, $V_R$ = 230 V DC or V AC | | | | | | | |
| A807 | 15 | 40 | 0.2 | 400 | 200 | 1210 | B59807A0090A062 |
| $V_{max}$ = 400 V DC or V AC, $V_R$ = 230 V DC or V AC | | | | | | | |
| A907 | 12 | 22 | 0.15 | 1500 | 640 | 1210 | B59907A0120A062 |

1) Measured on component soldered to standardized PCB

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**Reliability data**

| Test | Standard | Test conditions | $\lvert\Delta R_{25}/R_{25}\rvert$ |
|---|---|---|---|
| Electrical endurance, cycling | IEC 60738-1 | Room temperature, $I_{Smax}$; $V_{max}$<br>Number of cycles: 100 | < 25% |
| Electrical endurance, constant | IEC 60738-1 | Storage at $V_{max}$ /$T_{op,max}$ ($V_{max}$)<br>Test duration: 1000 h | < 25% |
| Damp heat | IEC 60738-1 | Temperature of air: 40 °C<br>Relative humidity of air: 93%<br>Duration: 56 days<br>Test according to IEC 60068-2-78 | < 10% |
| Rapid change of temperature | IEC 60738-1 | $T_1 = T_{op,min}$ (0 V), $T_2 = T_{op,max}$ (0 V)<br>Number of cycles: 5<br>Test duration: 30 min<br>Test according to IEC 60068-2-14, Test Na | < 10% |
| Vibration | IEC 60738-1 | Frequency range: 10 to 55 Hz<br>Displacement amplitude: 0.75 mm<br>Test duration: 3 × 2 h<br>Test according to IEC 60068-2-6, Test Fc | < 5% |
| Shock | IEC 60738-1 | Acceleration: 390 m/s$^2$<br>Pulse duration: 6 ms; 6 × 4000 pulses | < 5% |
| Climatic sequence | IEC 60738-1 | Dry heat: $T = T_{op,max}$ (0 V)<br>Test duration: 16 h<br>Damp heat first cycle<br>Cold: $T = T_{op,min}$ (0 V)<br>Test duration: 2 h<br>Damp heat 5 cycles<br>Tests performed according to IEC 60068-2-30 | < 10% |
| Bending test | EN 130000/4.35 | Components reflow-soldered to test board<br>Maximum bending: 2 mm | < 10% |
| Adhesive strength on PCB | | A shear force of 5 N is applied perpendicular to the longitudinal axis of the component which is soldered on PCB. | No visible damage |

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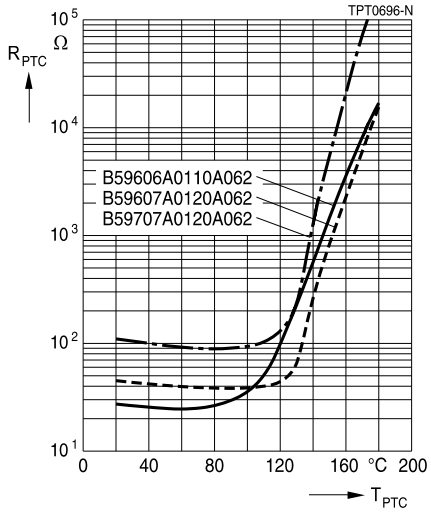
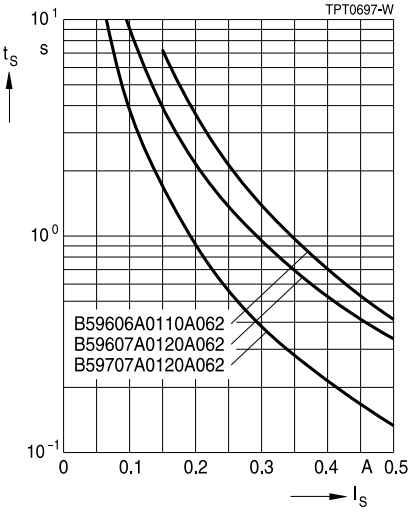
**Characteristics (typical) for A606, A607 and A707**

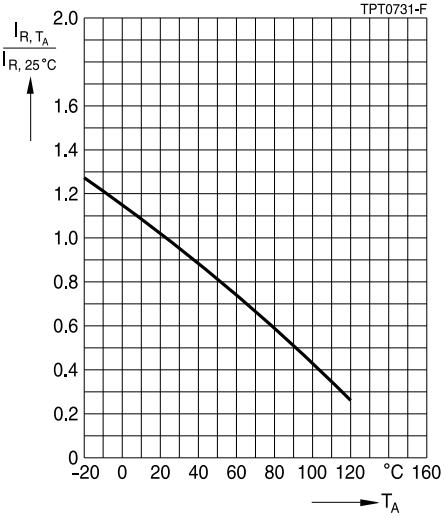
PTC resistance $R_{PTC}$ versus
PTC temperature $T_{PTC}$
(measured at low signal voltage)




Switching time $t_S$ versus switching current $I_S$
(measured at 25 °C in still air)




Rated current $I_R$ versus ambient temperature $T_A$
(measured in still air)



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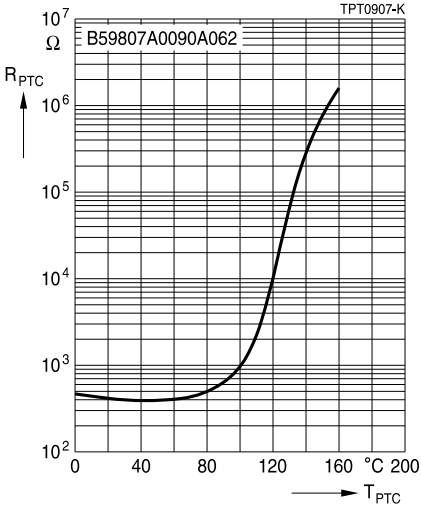
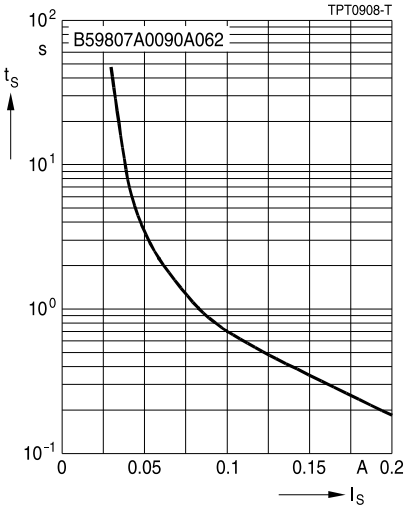
**Characteristics (typical) for A807**

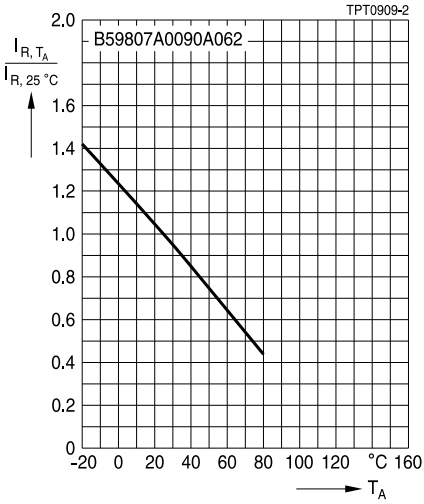
PTC resistance $R_{PTC}$ versus PTC temperature $T_{PTC}$ (measured at low signal voltage)




Switching time $t_S$ versus switching current $I_S$ (measured at 25 °C in still air)




Rated current $I_R$ versus ambient temperature $T_A$ (measured in still air)



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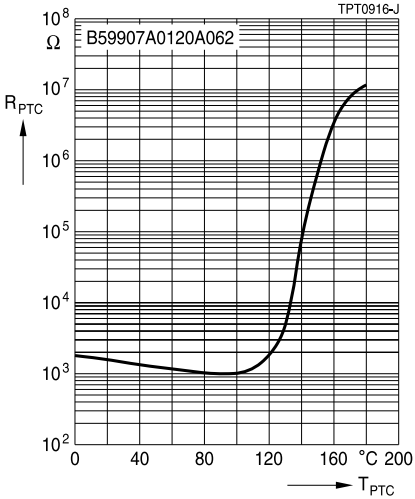
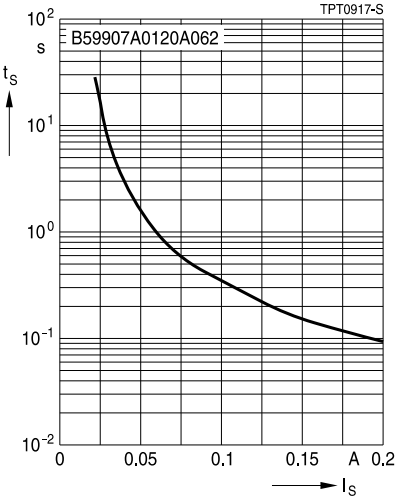
**Characteristics (typical) for A907**

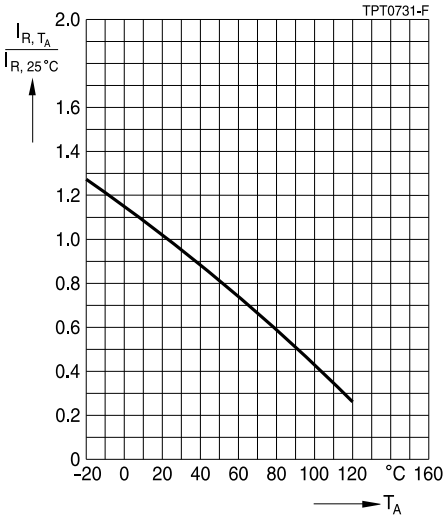
PTC resistance $R_{PTC}$ versus PTC temperature $T_{PTC}$ (measured at low signal voltage)




Switching time $t_S$ versus switching current $I_S$ (measured at 25 °C in still air)




Rated current $I_R$ versus ambient temperature $T_A$ (measured in still air)



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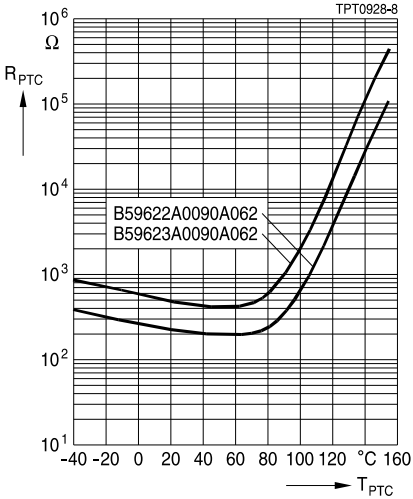
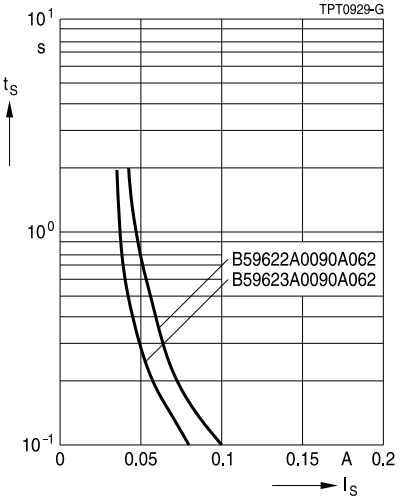
**Characteristics (typical) for A622 and A623**

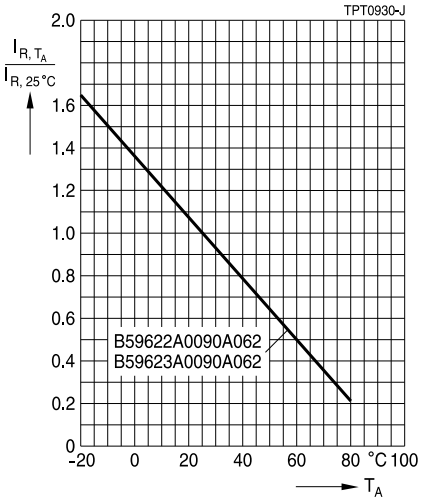
PTC resistance $R_{PTC}$ versus
PTC temperature $T_{PTC}$
(measured at low signal voltage)




Switching time $t_S$ versus switching current $I_S$
(measured at 25 °C in still air)




Rated current $I_R$ versus ambient temperature $T_A$
(measured in still air)



## Cautions and warnings

### General

- EPCOS thermistors 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.
- 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 ... +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 environment with effect on function on long-term operation (examples given under operation precautions).
- Use thermistor within 6 months after delivery.

### 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 (where applicable)

- 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.

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**Mounting**

- Electrode must not be scratched before/during/after 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 temperatures 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 overvoltage condition).

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## Symbols and terms

| | |
|---|---|
| A | Area |
| $C_{th}$ | Heat capacity |
| f | Frequency |
| I | Current |
| $I_{max}$ | Maximum current |
| $I_R$ | Rated current |
| $I_{PTC}$ | PTC current |
| $I_r$ | Residual currrent |
| $I_{r,oil}$ | Residual currrent in oil (for level sensors) |
| $I_{r,air}$ | Residual currrent in air (for level sensors) |
| $I_{RMS}$ | Root-mean-square value of current |
| $I_S$ | Switching current |
| $I_{Smax}$ | Maximum switching current |
| LCT | Lower category temperature |
| N | Number (integer) |
| $N_c$ | Operating cycles at $V_{max}$, charging of capacitor |
| $N_f$ | Switching cycles at $V_{max}$, failure mode |
| P | Power |
| $P_{25}$ | Maximum power at 25 °C |
| $P_{el}$ | Electrical power |
| $P_{diss}$ | Dissipation power |
| $R_{min}$ | Minimum resistance |
| $R_R$ | Rated resistance |
| $\Delta R_R$ | Tolerance of $R_R$ |
| $R_P$ | Parallel resistance |
| $R_{PTC}$ | PTC resistance |
| $R_{ref}$ | Reference resistance |
| $R_S$ | Series resistance |
| $R_{25}$ | Resistance at 25 °C |
| $R_{25,match}$ | Resistance matching per reel/ packing unit at 25 °C |
| $\Delta R_{25}$ | Tolerance of $R_{25}$ |
| T | Temperature |
| t | Time |
| $T_A$ | Ambient temperature |
| $t_a$ | Thermal threshold time |
| $T_C$ | Ferroelectric Curie temperature |

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| | |
|---|---|
| $t_E$ | Settling time (for level sensors) |
| $T_R$ | Rated temperature |
| $T_{sense}$ | Sensing temperature |
| $T_{op}$ | Operating temperature |
| $T_{PTC}$ | PTC temperature |
| $t_R$ | Response time |
| $T_{ref}$ | Reference temperature |
| $T_{Rmin}$ | Temperature at minimum resistance |
| $t_S$ | Switching time |
| $T_{surf}$ | Surface temperature |
| UCT | Upper category temperature |
| V or $V_{el}$ | Voltage (with subscript only for distinction from volume) |
| $V_{RMS}$ | Root-mean-square value of voltage |
| $V_{BD}$ | Breakdown voltage |
| $V_{ins}$ | Insulation test voltage |
| $V_{link,max}$ | Maximum link voltage |
| $V_{max}$ | Maximum operating voltage |
| $V_{max,dyn}$ | Maximum dynamic (short-time) operating voltage |
| $V_{meas}$ | Measuring voltage |
| $V_{meas,max}$ | Maximum measuring voltage |
| $V_R$ | Rated voltage |
| $V_{PTC}$ | Voltage drop across a PTC thermistor |
| $\alpha$ | Temperature coefficient |
| $\Delta$ | Tolerance, change |
| $\delta_{th}$ | Dissipation factor |
| $\tau_{th}$ | Thermal cooling time constant |
| $\lambda$ | Failure rate |
| $e$ | Lead spacing (in mm) |

**Abbreviations / Notes**

SMD Surface-mount devices

* To be replaced by a number in ordering codes, type designations etc.

+ To be replaced by a letter

All dimensions are given in mm.

The commas used in numerical values denote decimal points.

## 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 lifesaving 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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