PTC thermistors as limit temperature sensors

SMD, EIA case sizes 0402, 0603 and 0805, superior series

Series/Type: **B59421, B59641, B59721**

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Applications

- Over-temperature protection of power components
- DC/DC converters
- SMPS
- Notebooks
- Home appliances
- Dimmers
- Electronic ballasts
- Automotive electronics
- Secondary protection of battery packs

Features

- Qualification based on AEC-Q200 rev. D
- Reflow soldering only
- Fast and reliable response
- RoHS-compatible
- UL approval to UL1434
- Certified in accordance with IEC 60738-1 and IEC 60730-1; Annex J15 and J17
- Lead-free terminations (tinned) for case sizes 0603 and 0805
- Lead-free ceramics for case sizes 0402 and 0805

Options

- Other T_{sense} or resistance values on request

Delivery mode

- Blister tape (case size 0805) or cardboard tape (case sizes 0402 and 0603), 180-mm reel with 8-mm tape, taping to IEC 60286-3
- Packing unit: 10.000 pcs. (case size 0402), 4.000 pcs. (case size 0805 and 0603)

General technical data

Max. operating voltage		V_{max}	32	V DC
Minimum operating temperature	($V \leq V_{max}$)	T_{min}	−40	°C
Maximum operating temperature	($V \leq V_{max}$)	T_{max}	125 °C or $T_{sense,1}$ +25 °C whichever is higher	°C

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Electrical specifications and ordering codes

R_R ($V \leq V_{max}$) Ω	ΔR_R %	$T_{sense,1}$ (@ 4.7 kΩ) °C	$T_{sense,2}$ (@ 47 kΩ) °C	Ordering code
EIA case size 0402				
470	±50	75 ±5	-	B59421A0075A062
470	±50	85 ±5	-	B59421A0085A062
470	±50	95 ±5	-	B59421A0095A062
470	±50	105 ±5	-	B59421A0105A062
470	±50	115 ±5	-	B59421A0115A062
470	±50	125 ±5	-	B59421A0125A062
470	±50	135 ±5	-	B59421A0135A062
EIA case size 0603				
470	±50	75 ±5	90 ±7	B59641A0075A062
470	±50	85 ±5	100 ±7	B59641A0085A062
470	±50	95 ±5	110 ±7	B59641A0095A062
470	±50	105 ±5	120 ±7	B59641A0105A062
470	±50	115 ±5	130 ±7	B59641A0115A062
470	±50	125 ±5	140 ±7	B59641A0125A062
470	±50	135 ±5	150 ±7	B59641A0135A062
470	±50	145 ±5	-	B59641A0145A062

Note:
In order to limit self heating effects the electrical power during measurement should be below 2 mW for case size 0402 and below 4 mW for case size 0603.

Electrical specifications and ordering codes

R_R ($V \leq V_{max}$) Ω	ΔR_R %	$T_{sense,1}$ °C	R ($T_{sense,1}$ −5°C) kΩ	R ($T_{sense,1}$ +5°C) kΩ	R ($T_{sense,1}$ +15°C) kΩ	Ordering code
EIA case size 0805						
680	±50	70	≤ 5.7	≥ 5.7	≥ 40[1)]	B59721A0070A062
680	±50	80	≤ 5.7	≥ 5.7	≥ 40[1)]	B59721A0080A062
680	±50	90	≤ 5.5	≥ 13.3	≥ 40	B59721A0090A062
680	±50	100	≤ 5.5	≥ 13.3	≥ 40	B59721A0100A062
680	±50	110	≤ 5.5	≥ 13.3	≥ 40	B59721A0110A062
680	±50	120	≤ 5.5	≥ 13.3	≥ 40	B59721A0120A062
680	±50	130	≤ 5.5	≥ 13.3	≥ 40	B59721A0130A062

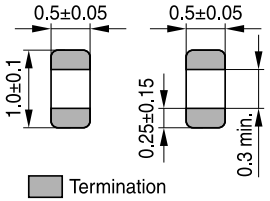
Note:
In order to limit self heating effects the electrical power during measurement should be below 6 mW for case size 0805.

1) R ($T_{sense,1}$ +25 °C)

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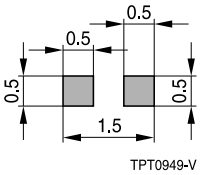
Dimensional drawings in mm

EIA case size 0402



TPT0948-M-E

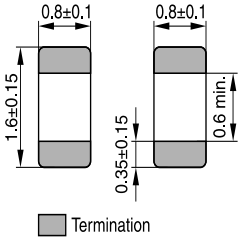
Solder pad



TPT0949-V

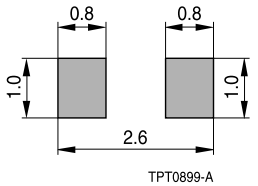
Recommended maximum dimensions (mm)

EIA case size 0603



TPT0698-5-E

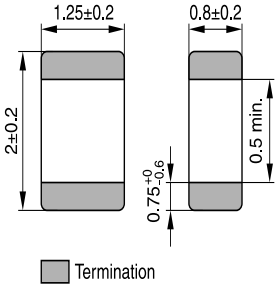
Solder pad



TPT0899-A

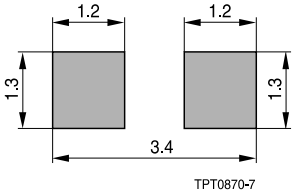
Recommended maximum dimensions (mm)

EIA case size 0805



TPT0650-F-E

Solder pad



TPT0870-7

Recommended maximum dimensions (mm)

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}; Number of cycles: 100	< 10%
Electrical endurance, constant	IEC 60738-1	Storage at V_{max}/T_{op} Test duration: 1000 h	< 20%
Damp heat	IEC 60738-1	Temperature of air: 40 °C Relative humidity of air: 93% Duration: 56 days Test according to IEC 60068-2-78	< 10%
Rapid change of temperature	IEC 60738-1	$T_{LCT} = -40$ °C, $T_{UCT} = 125$ °C Number of cycles: 5 Test duration: 30 min Test according to IEC 60068-2-14, test Na	< 10%
Vibration I	IEC 60738-1	Frequency: 10 - 55 - 10 Hz Displacement amplitude: 0.75 mm, resp. Acceleration: 50 m/s² Test duration: 3 × 2 h Test according to IEC 60028-2-6, test Fc	< 5%
Vibration II	MIL-STD-202, method 204	Frequency: 10 ... 2000 Hz Displacement amplitude: 0.75 mm, resp. Acceleration: 50 m/s² Test duration: 3 × 2 h Test according to IEC 60028-2-6, test Fc	< 5%
Shock	IEC 60738-1	Pulse shape: half-sine Acceleration: 390 m/s² Pulse duration: 6 ms; 6 x 4000 pulses Test according to IEC 60068-2-27, test Ea	< 5%
Climatic sequence	IEC 60738-1	Dry heat: $T_{UCT} = 125$ °C Test duration: 16 h Damp heat first cycle Cold: $T_{LCT} = -40$ °C Test duration: 2 h Damp heat 5 cycles Tests performed according to IEC 60068-2-30	< 10%
Bending test	IEC 60738-1	Components reflow-soldered to test board Maximum bendig: 2 mm Test according to IEC 60068-2-21, test Ue	< 5%
Adhesive strength on PCB		Shearing of the component soldered on PCB by a force of 5 N normal to components longitudinal axis	No visible damage

Sensors

Limit temperature sensors, EIA sizes 0402, 0603 and 0805 **Superior series**

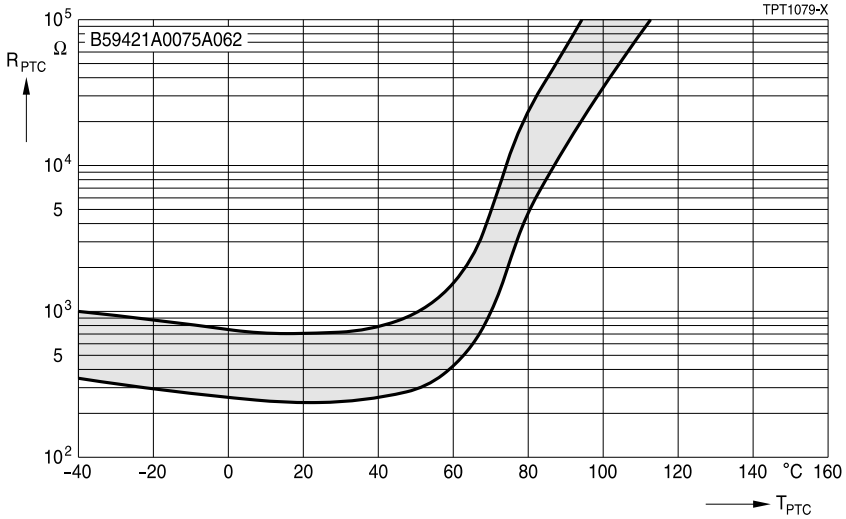
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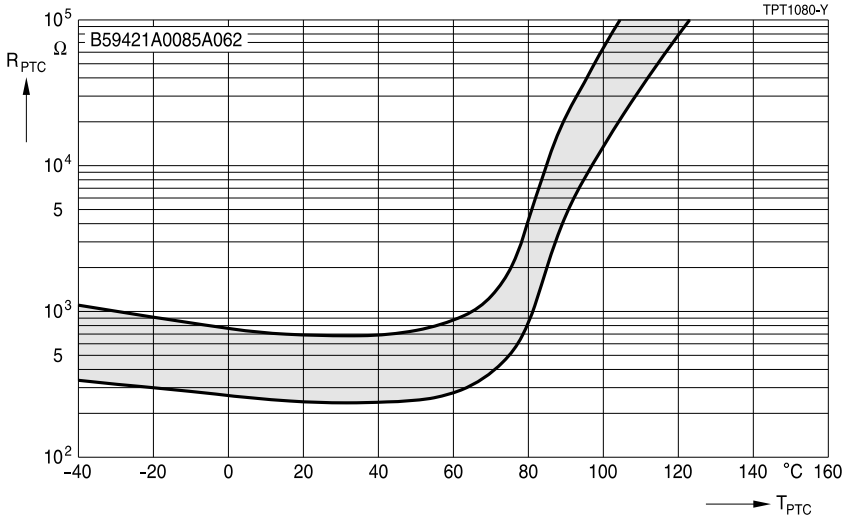
Test	Standard	Test conditions	$\lvert\Delta R_{25}/R_{25}\rvert$
Moisture resistance	AEC-Q200 / IEC 60069-2-30	Test Db2, category 25/125/56	< 10%
Humidity	AEC-Q200 / MIL-STD-202, method 103	T = 80 °C; H = 85% r.H.; t = 1000 h V = 0.05 · V_{max}	< 20%
Thermal shock	AEC-Q200 / IEC 60738-1, item 4.17	T_{LCT} = −55 °C, T_{UCT} = 125 °C Number of cycles: 1000	< 25%
Resistance to soldering heat	AEC-Q200 / IEC 60068-2-20, test Tb	Soldering bath: 260 °C; t = 20 s	< 20%
ESD	AEC-Q200-002	150 pF/ 330 Ω; 8 kV contact discharge, 10 pulses in each polarity	< 5%
High temperature load		Soldered PTC to PCB @ 85 °C, load maximum operating voltage for 1.5 h on and 0.5 h off. This cycle is repeated for 1000 ±12 h	< 20%

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Characteristics (typical) for case size 0402

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

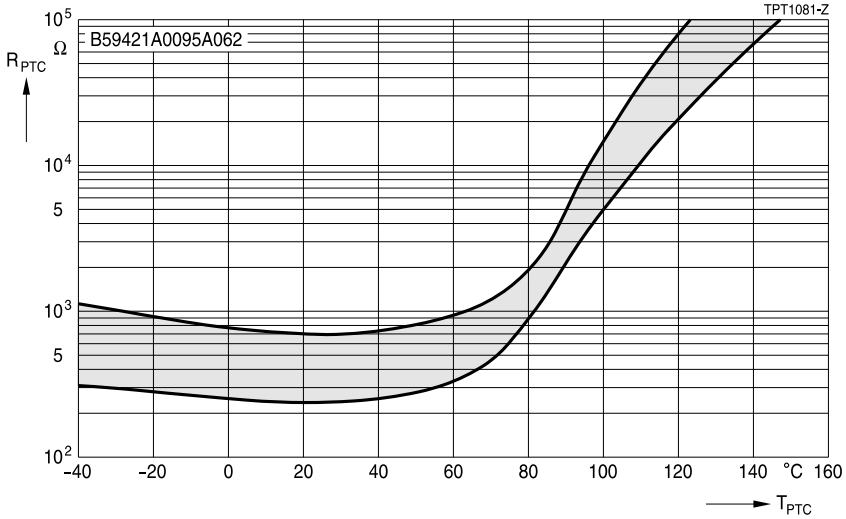


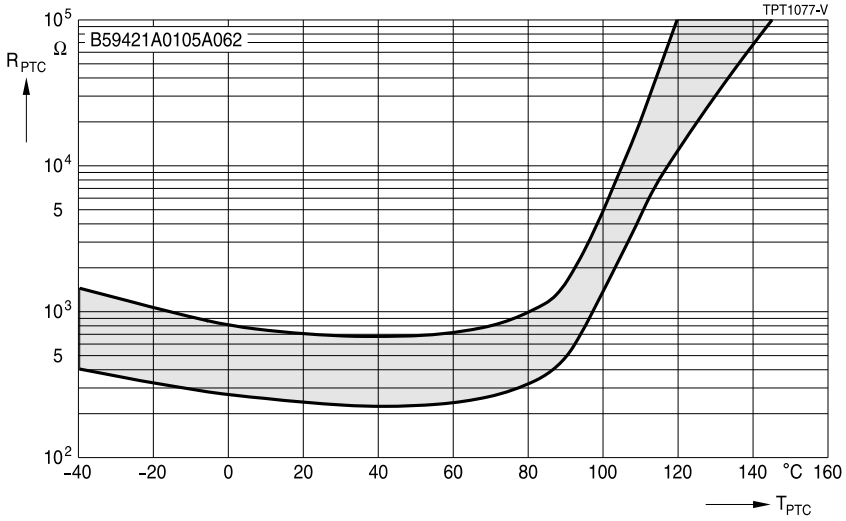


SMD

Characteristics (typical) for case size 0402

PTC resistance R_{PTC} versus PTC temperature T_{PTC}
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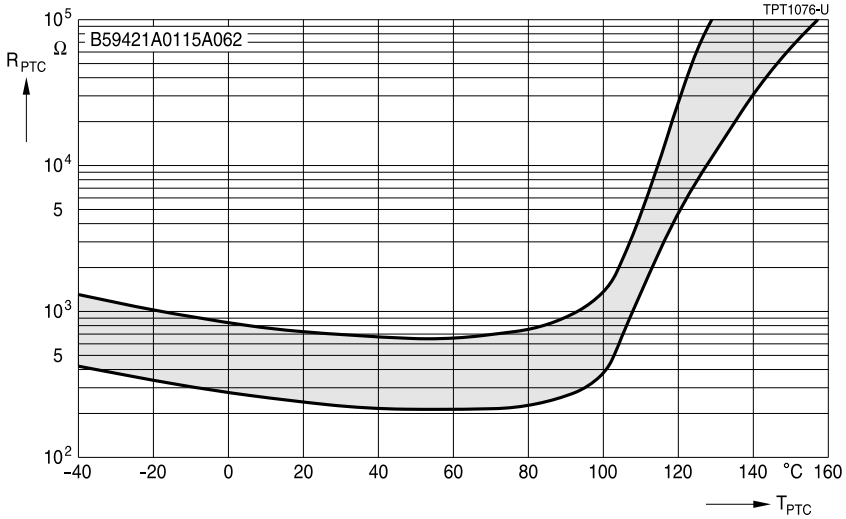


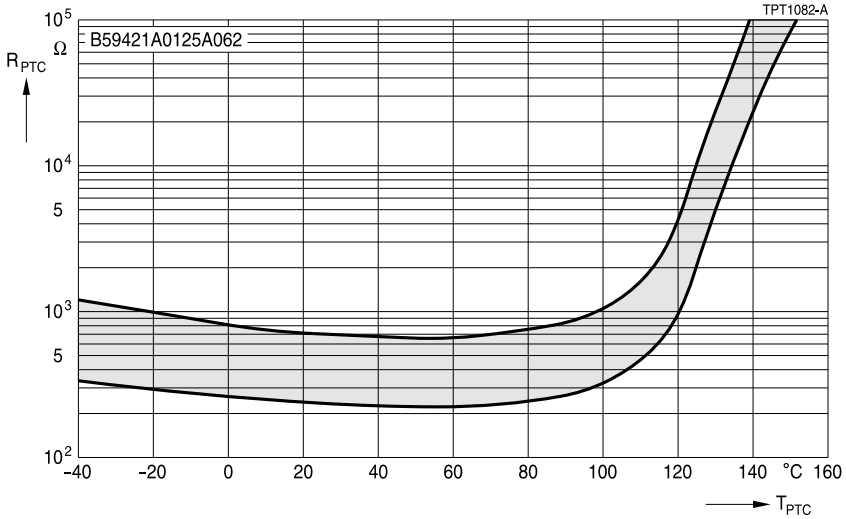


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Characteristics (typical) for case size 0402

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

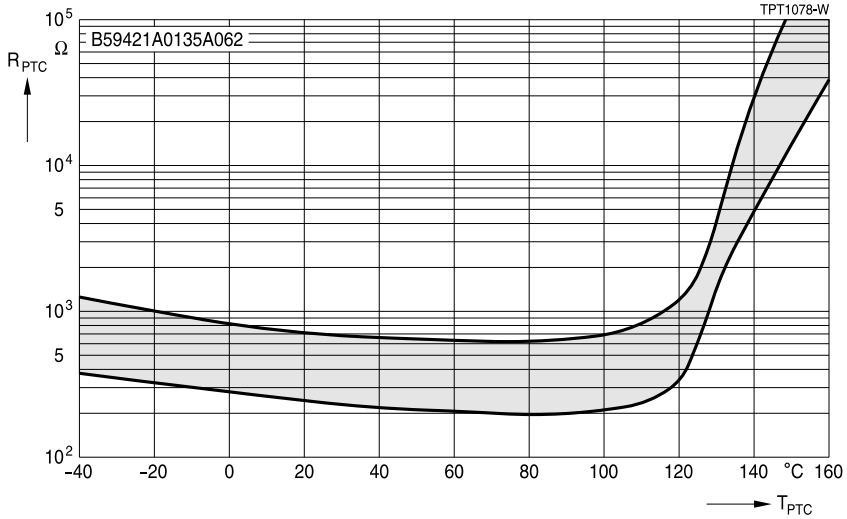




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Characteristics (typical) for case size 0402

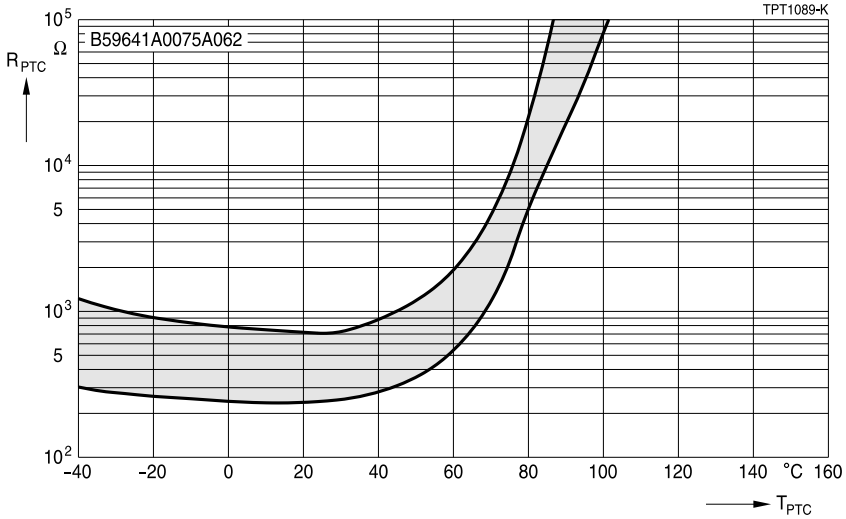
PTC resistance R_{PTC} versus PTC temperature T_{PTC}
(measured at low signal voltage)

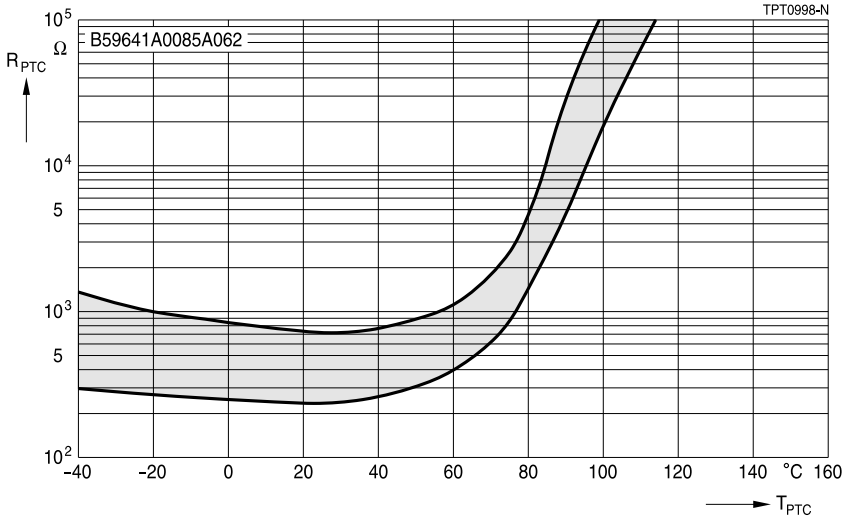


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Characteristics (typical) for case size 0603

PTC resistance R_{PTC} versus PTC temperature T_{PTC}
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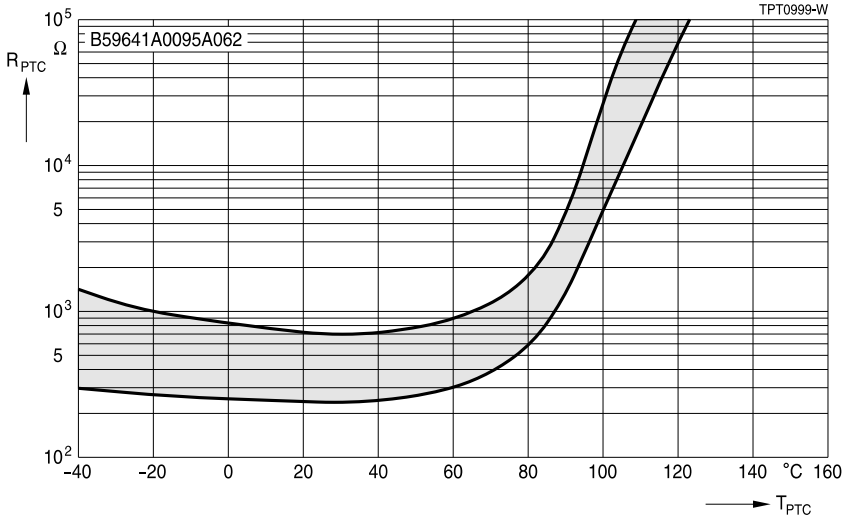


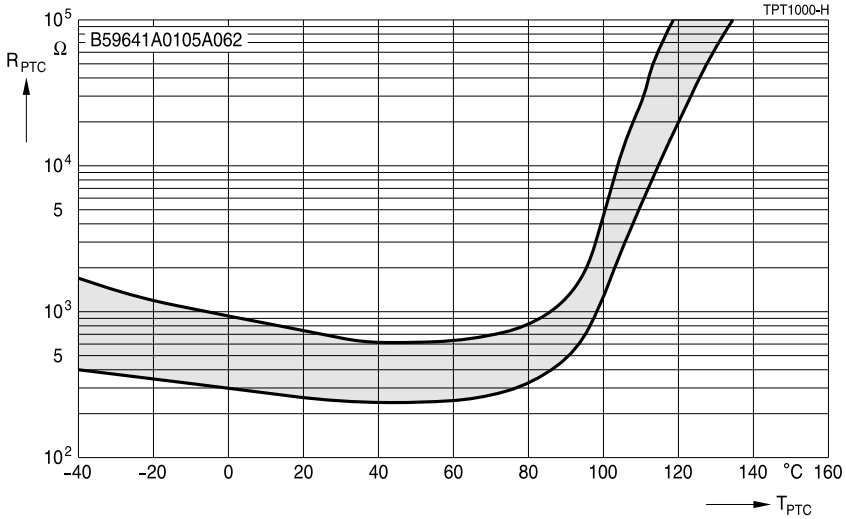


SMD

Characteristics (typical) for case size 0603

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

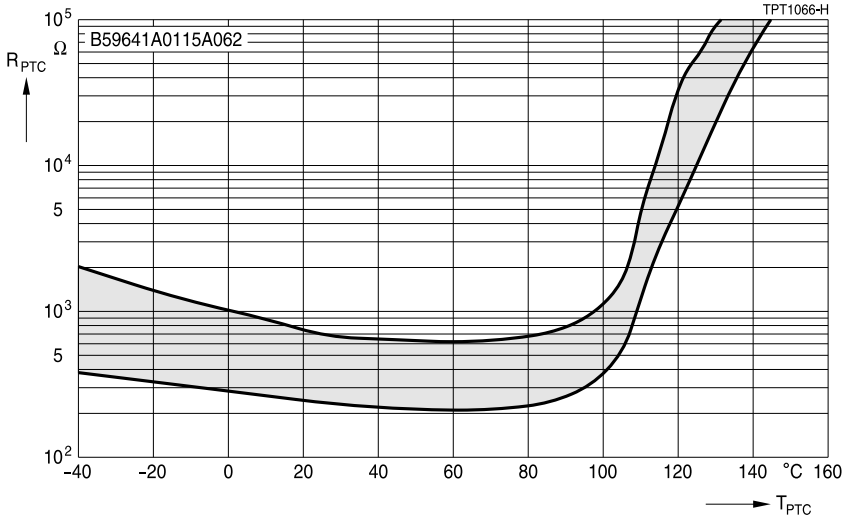


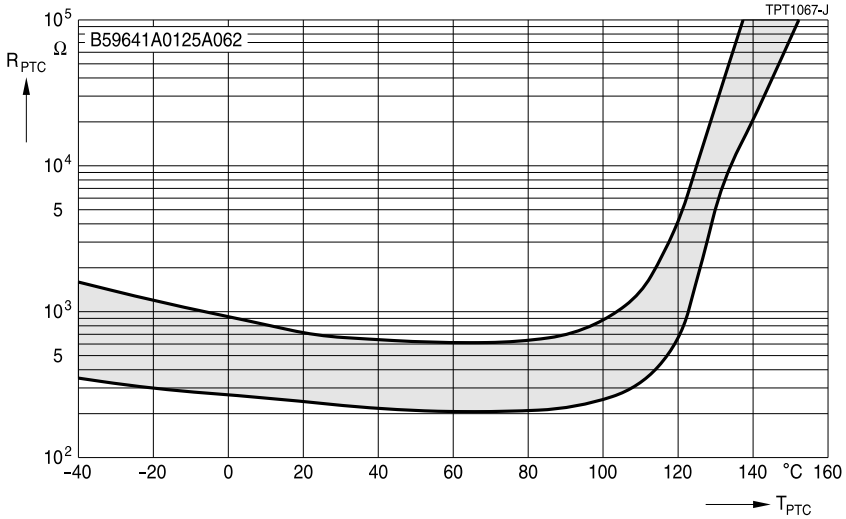


SMD

Characteristics (typical) for case size 0603

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

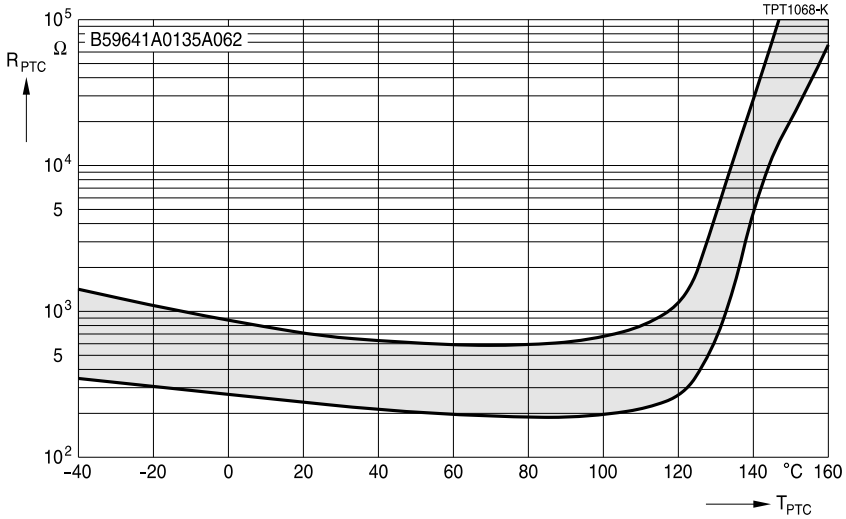


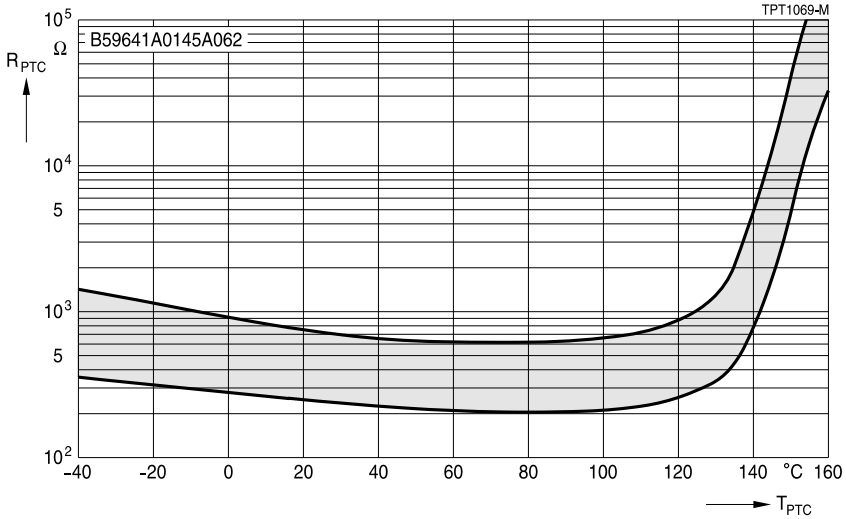


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Characteristics (typical) for case size 0603

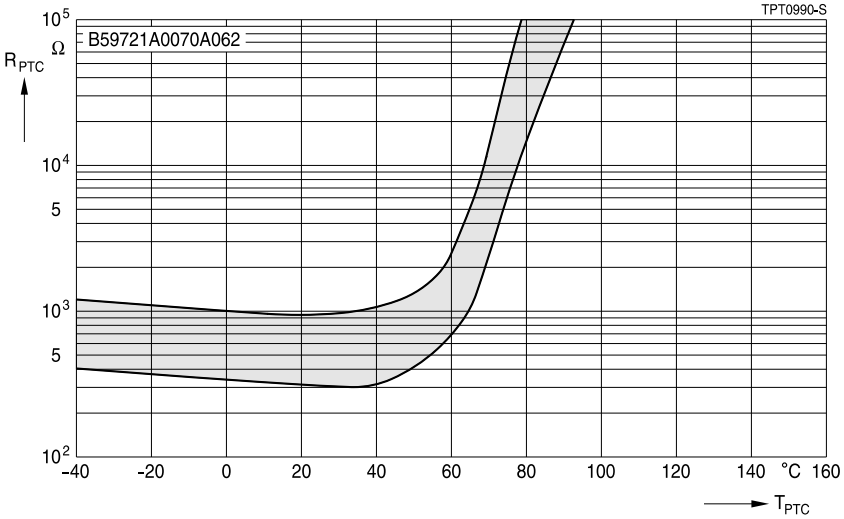
PTC resistance R_{PTC} versus PTC temperature T_{PTC}
(measured at low signal voltage)

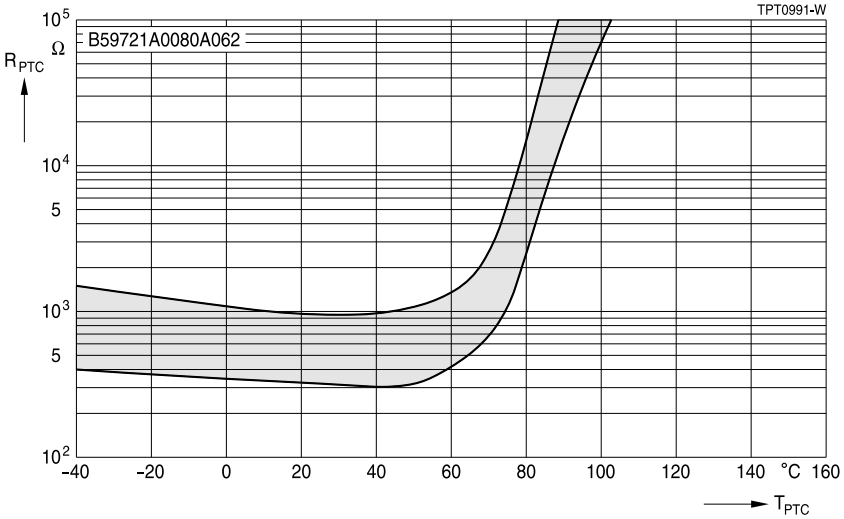




Characteristics (typical) for case size 0805

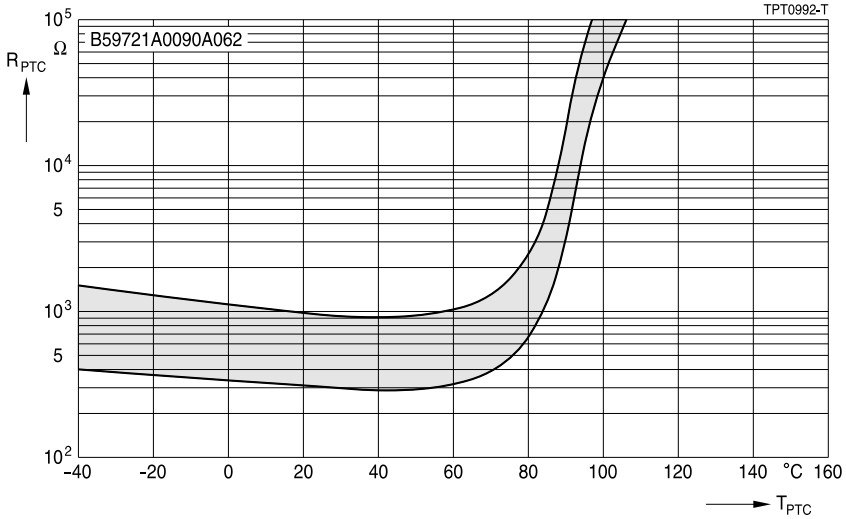
PTC resistance R_{PTC} versus PTC temperature T_{PTC}
(measured at low signal voltage)

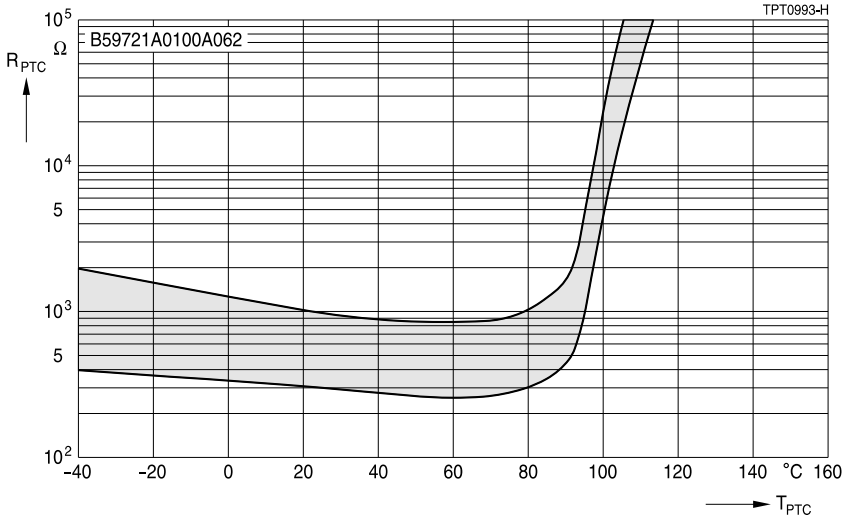




Characteristics (typical) for case size 0805

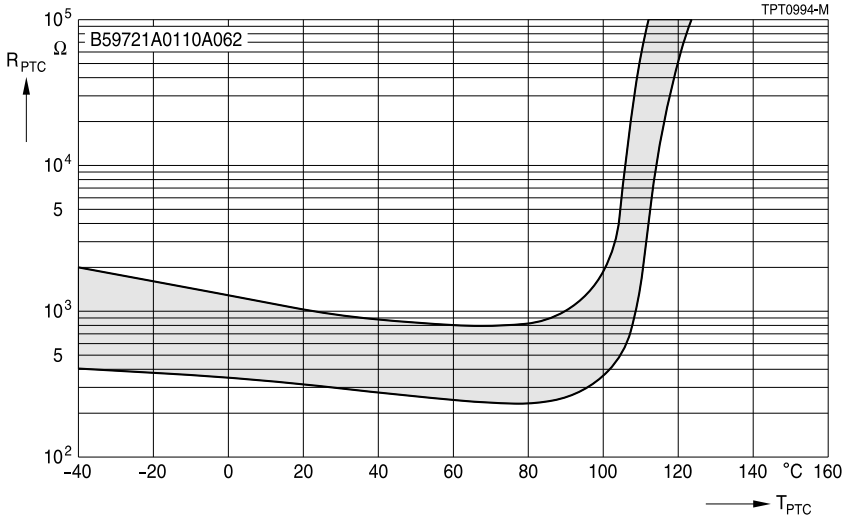
PTC resistance R_{PTC} versus PTC temperature T_{PTC}
(measured at low signal voltage)

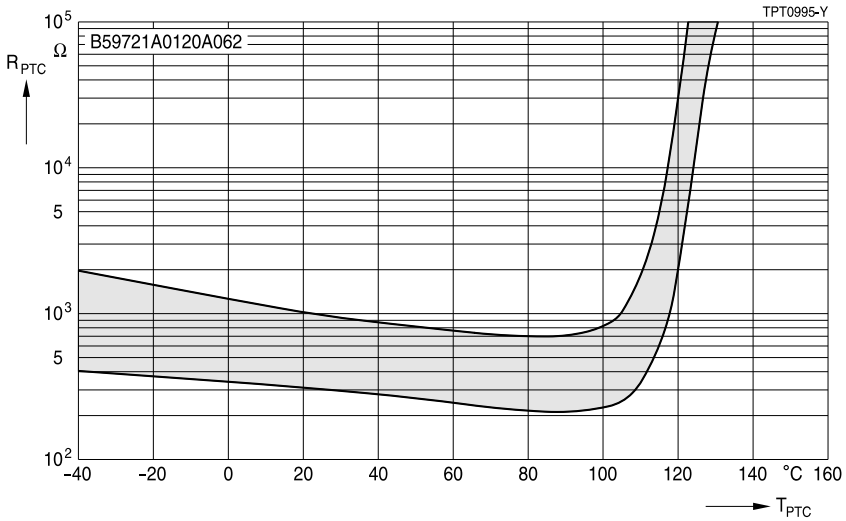




Characteristics (typical) for case size 0805

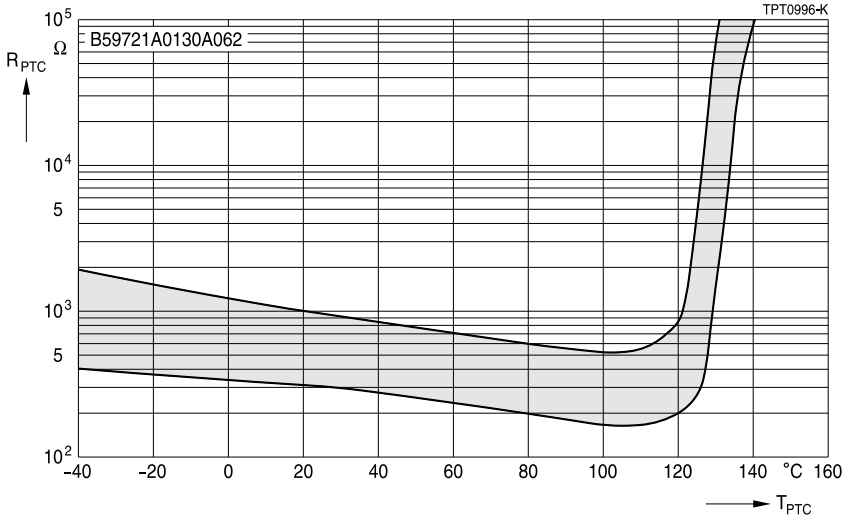
PTC resistance R_{PTC} versus PTC temperature T_{PTC}
(measured at low signal voltage)





Characteristics (typical) for case size 0805

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



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 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 (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).

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

Symbols and terms

Symbol	Term
A	Area
C	Capacitance
C_{th}	Heat capacity
f	Frequency
I	Current
I_{max}	Maximum current
I_R	Rated current
I_{res}	Residual 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_G	Generator internal resistance
R_{min}	Minimum resistance
R_R	Rated resistance
ΔR_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
ΔR_{25}	Tolerance of R_{25}
T	Temperature
t	Time
T_A	Ambient temperature

t_a	Thermal threshold time
T_C	Ferroelectric Curie temperature
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)
$V_{c(max)}$	Maximum DC charge voltage of the surge generator
$V_{F,max}$	Maximum voltage applied at fault conditions in protection mode
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
α	Temperature coefficient
Δ	Tolerance, change
δ_{th}	Dissipation factor
τ_{th}	Thermal cooling time constant
λ	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.

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