



# **PTC thermistors for thermal management in LED driver circuits**

EIA case size 0603

**Series/Type:** B59602, B59603

**Date:** November 2009

## Thermal management in LED driver circuits

### EIA case size 0603

#### Applications

- LED driver circuits
- Thermal management
- Temperature compensation

#### Features

- Tight resistance tolerance
- Well defined R/T curves
- Suitable for reflow soldering only
- RoHS-compatible

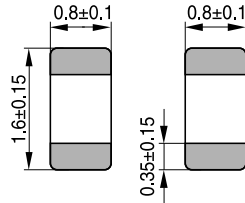
#### Options

- Other electrical parameters on request

#### Delivery mode

- Cardboard tape, 180-mm reel with 8-mm tape, taping to IEC 60286-3

#### Dimensional drawing

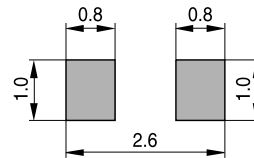


Termination

TPT0698-5-E

Dimensions in mm

#### Geometry of solder pad



TPT0899-A

Recommended maximum dimensions (mm)

#### General technical data

Max. operating voltage	$V_{max}$	32	$V_{DC}$
Tolerance of $R_R$	$\Delta R_R$	±15	%
Operating temperature range	$T_{op,min}$	-40	°C

#### Electrical specifications and ordering codes

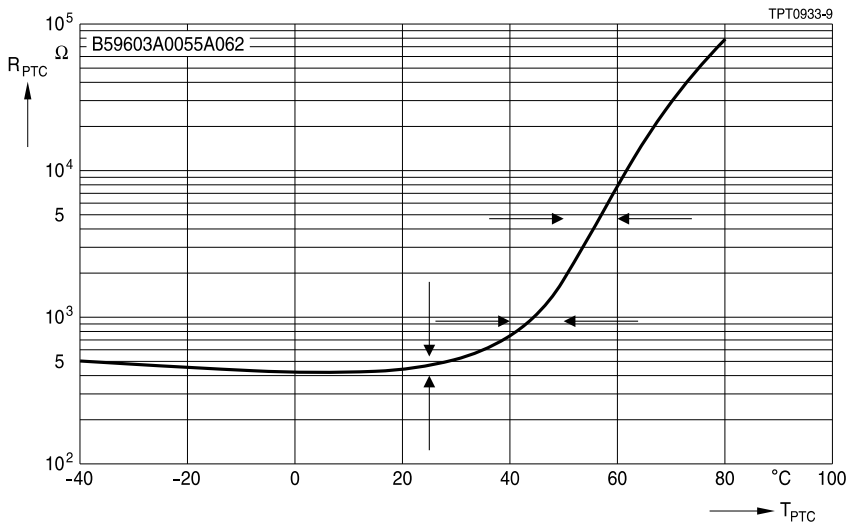
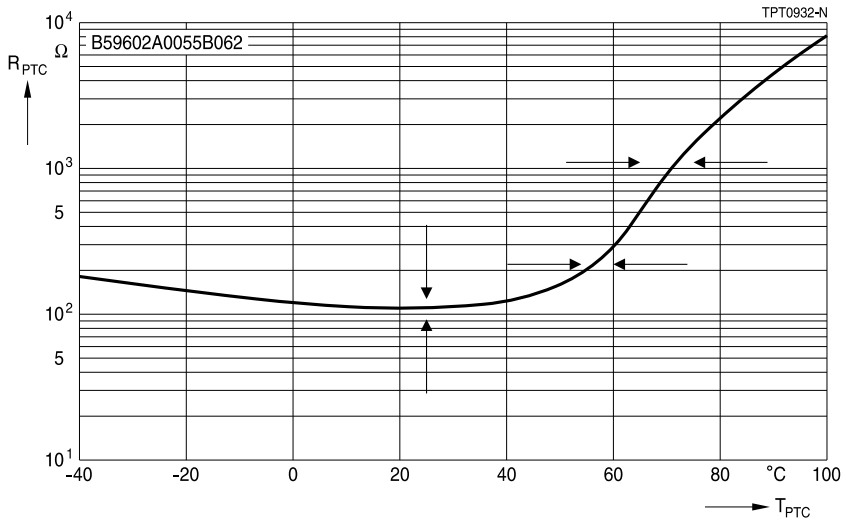
$T_{sense}$ °C	$R_R$ Ω	R ( $T_{sense} - 5\text{ °C}$ ) kΩ	R ( $T_{sense} + 5\text{ °C}$ ) kΩ	T (@ $2 \cdot R_R$ ) °C	T (typ.) (@ $R_{min}$ ) °C	$T_{op,max}$ °C	Ordering code
55	470	< 4.7	> 4.7	45 ±5	5	105	B59603A0055A062
70	110	< 1.1	> 1.1	57 ±3	15	115	B59602A0055B062
85	470	< 4.7	> 4.7	75 ±5	40	125	B59603A0085A062
105	470	< 4.7	> 4.7	95 ±5	55	145	B59603A0105A062

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**Reliability data**

Test	Standard	Test conditions	$ \Delta R_{25}/R_{25} $
Electrical endurance, constant at 85 °C	IEC 60738-1	Storage at $V_{\max}/T_{\text{op,max}}(V_{\max})$ T = 85 °C Test duration: 1000 h	< 25%
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	$T_1 = T_{\text{op,min}}(0\text{ V})$ , $T_2 = T_{\text{op,max}}(0\text{ V})$ Number of cycles: 5 Test duration: 30 min Test according to IEC 60068-2-14, Test Na	< 10%
Vibration	IEC 60738-1	Frequency: 10 to 55 Hz Displacement amplitude: 0.75 mm Test duration: 3 × 2 h Test according to IEC 60068-2-6, Test Fc	< 5%
Shock	IEC 60738-1	Acceleration: 390 m/s <sup>2</sup> Pulse duration: 6 ms; 6 × 4000 pulses	< 5%
Climatic sequence	IEC 60738-1	Dry heat: T = $T_{\text{op,max}}(0\text{ V})$ Test duration: 16 h Damp heat first cycle Cold: T = $T_{\text{op,min}}(0\text{ V})$ Test duration: 2 h Damp heat 5 cycles Tests performed according to IEC 60068-2-30	< 10%
Bending test	EN 130000/4.35	Components reflow-soldered to test board 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

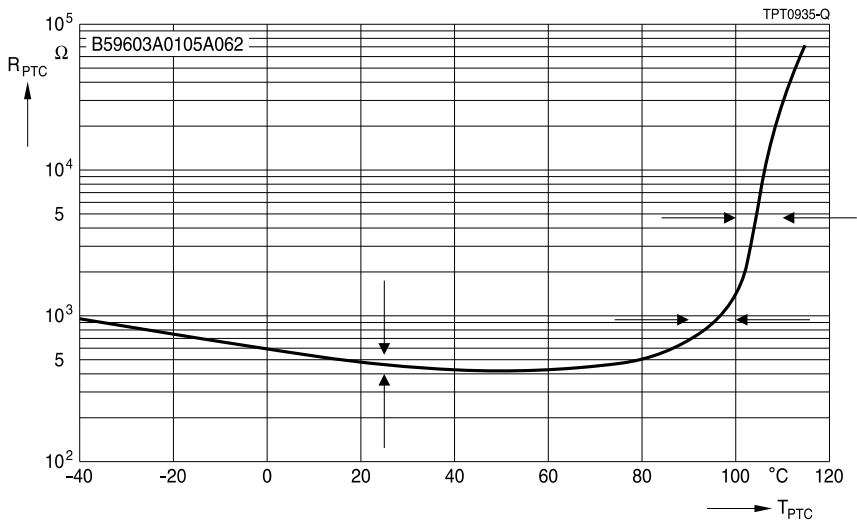
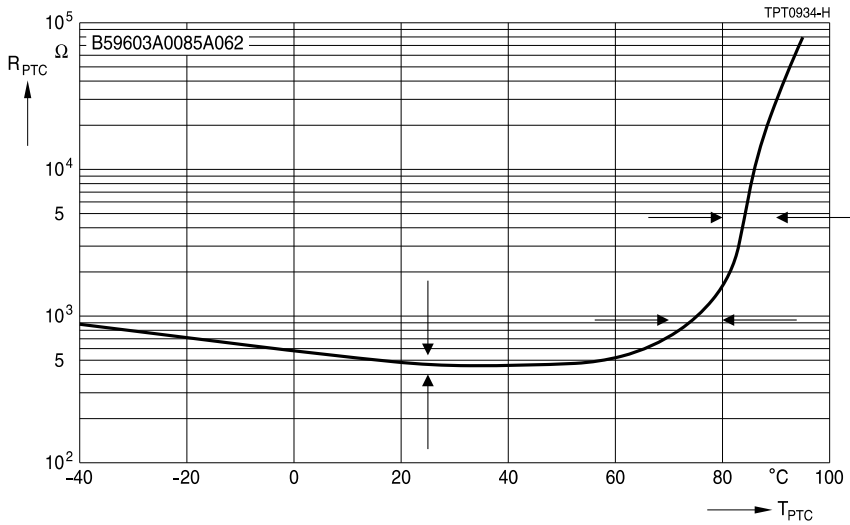
**Characteristics (typical) for type A602 and A603**

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



**Characteristics (typical) for type A603**

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  $-25\text{ }^{\circ}\text{C} \dots +45\text{ }^{\circ}\text{C}$ , 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 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.

### 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).

## 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 current
$I_{r,oil}$	Residual current in oil (for level sensors)
$I_{r,air}$	Residual current 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

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