

PTC thermistors for switching applications

Plastic case, 230 V

Series/Type: B593**

Date: January 2016

© EPCOS AG 2016. Reproduction, publication and dissemination of this publication, enclosures hereto and the information contained therein without EPCOS' prior express consent is prohibited.

EPCOS AG is a TDK Group Company.



PTC thermistors in plastic case, 230 V

Applications

- Delayed switching of loads
- For frequent switching
- Starting resistance in switch-mode power supplies

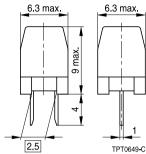
Features

- Encased thermistor disk with clamp contacts
- Flame-retardant plastic case
- Case material UL-listed
- Silver-plated lead-free solder pins
- Manufacturer's logo and type designation stamped on in white
- Stable performance throughout 100 000 switching cycles
- RoHS-compatible

Delivery mode

Packed in blister trays

General technical data



[2.5]		
Dimensions	in	mm

Switching cycles		N	100000	
Tolerance of R _R		ΔR_R	±25	%
Operating temperature range	(V = 0)	T _{op}	-25/+125	°C
Operating temperature range	$(V = V_{max})$	T _{op}	0/+60	°C

Electrical specifications and ordering codes

Туре	R_R	R _{min}	I _R	Is	I _{Smax}	I _r	ts	T _{ref}	Ordering code
					$(V = V_{max})$	$(V = V_{max})$	@ I _{Smax}	(typ.)	
	Ω	Ω	mA	mA	Α	mA	s	°C	
$V_{\text{max}} = 1$	265 V,	$V_{R} = 23$	80 V						
J286	500	260	20	40	0.27	3.5	≤ 0.5	120	B59339A1501P020
J289	2000	900	10	20	0.15	2.0	≤ 0.5	120	B59339A1202P020
J29	5000	3200	7	15	0.10	1.5	≤ 0.5	115	B59339A1502P020



PTC thermistors in plastic case, 230 V

Reliability data

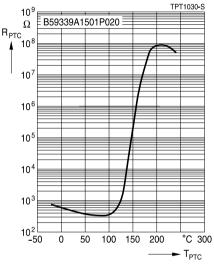
Test	Standard	Test conditions	$ \Delta R_{25}/R_{25} $
Electrical endurance,	IEC 60738-1	Room temperature, I _{Smax} ; V _{max}	< 25%
cycling		Number of cycles: 100 000	
Electrical endurance,	IEC 60738-1	Storage at V _{max} and T _{op,max} (@ V _{max})	< 25%
constant		Test duration: 1000 h	
Damp heat	IEC 60738-1	Temperature of air: 40 °C	< 10%
		Relative humidity of air: 93%	
		Duration: 56 days	
		Test according to IEC 60068-2-78	
Rapid change	IEC 60738-1	$T_1 = T_{op,min} (0 \text{ V}), T_2 = T_{op,max} (0 \text{ V})$	< 10%
of temperature		Number of cycles: 5	
		Test duration: 30 min	
		Test according to IEC 60068-2-14, test Na	
Vibration	IEC 60738-1	Frequency range: 10 to 55 Hz	< 5%
		Displacement amplitude: 0.75 mm	
		Test duration: 3 × 2 h	
		Test according to IEC 60068-2-6, test Fc	
Shock	IEC 60738-1	Acceleration: 400 m/s ²	< 5%
		Pulse duration: 6 ms; 6 × 5000 pulses	
Climatic sequence	IEC 60738-1	Dry heat: $T = T_{op,max}(0 \text{ V})$	< 10%
		Test duration: 16 h	
		Damp heat first cycle	
		Cold: $T = T_{op,min} (0 \text{ V})$	
		Test duration: 2 h	
		Damp heat 5 cycles	
		Tests performed according to	
		IEC 60068-2-30	



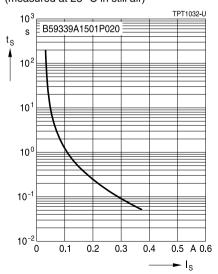
PTC thermistors in plastic case, 230 V

Characteristics (typical)

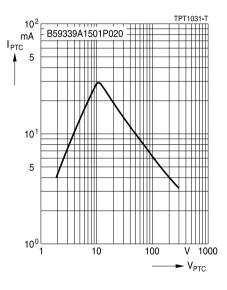
PTC resistance R_{PTC} versus PTC temperature T_{PTC} (measured at low signal voltage)



Switching time t_s versus switching current I_s (measured at 25 °C in still air)



PTC current I_{PTC} versus PTC voltage V_{PTC} (measured at 25 °C in still air)

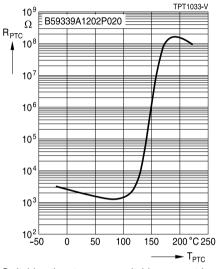




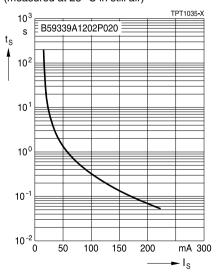
PTC thermistors in plastic case, 230 V

Characteristics (typical)

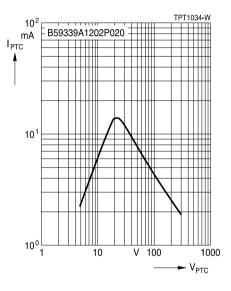
PTC resistance R_{PTC} versus PTC temperature T_{PTC} (measured at low signal voltage)



Switching time $t_{\rm S}$ versus switching current $I_{\rm S}$ (measured at 25 °C in still air)



PTC current I_{PTC} versus PTC voltage V_{PTC} (measured at 25 $^{\circ}\text{C}$ in still air)

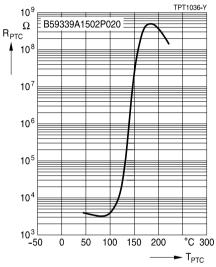




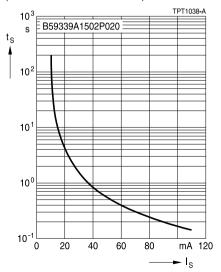
PTC thermistors in plastic case, 230 V

Characteristics (typical)

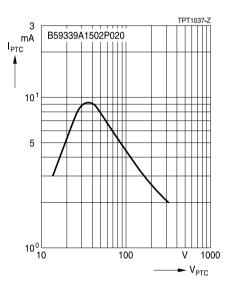
PTC resistance R_{PTC} versus PTC temperature T_{PTC} (measured at low signal voltage)



Switching time t_s versus switching current I_s (measured at 25 °C in still air)



PTC current I_{PTC} versus PTC voltage V_{PTC} (measured at 25 °C in still air)





PTC thermistors in plastic case, 230 V

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 prior to processing.
- 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 1210 and smaller: 12 months

Handling

- PTCs must not be dropped. Chip-offs must not be caused during handling of PTCs.
- The ceramic and metallization of the 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.



PTC thermistors in plastic case, 230 V

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 and pressure of the clamping contacts pressing against the PTC must be 10 N and 50 kPa, respectively. In case the assembly is exposed to mechanical shock and/ or vibration this force should be higher in order to avoid movement of the PTC during operation.
- 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.

Display of ordering codes for EPCOS products

The ordering code for one and the same EPCOS product can be represented differently in data sheets, data books, other publications, on the EPCOS 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.epcos.com/orderingcodes



PTC thermistors in plastic case, 230 V

Symbols and terms

Symbol	Term
A	Area
С	Capacitance
C_{th}	Heat capacity
f	Frequency
1	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
Is	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
Р	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 @ rated temperature T _R
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

Please



PTC thermistors in plastic case, 230 V

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 @ 25 °C or otherwise specified in the data sheet
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
ts	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
$V_{\text{link,max}}$	Maximum link voltage
V_{max}	Maximum operating voltage
$V_{max,dyn}$	Maximum dynamic (short-time) operating voltage
V_{meas}	Measuring voltage
$V_{\text{meas,max}}$	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
$ au_{\text{th}}$	Thermal cooling time constant
λ	Failure rate

Please warnings and Page 10 of 12

Lead spacing (in mm)

e



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). 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, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap 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.

Release 2018-10