

PTC thermistors as limit temperature sensors

Motor protection, triple sensors

Series/Type: B59300

Date: December 2009

© EPCOS AG 2009. Reproduction, publication and dissemination of this publication, enclosures hereto and the information contained therein without EPCOS' prior express consent is prohibited.



Motor protection, triple sensors

M1300

Applications

- Thermal protection of winding in electric motors
- Limit temperature monitoring

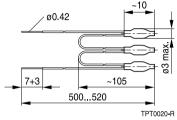
Features

- Thermistor pellets with insulating encapsulation in series connection (triple sensor)
- Low-resistance type, steep R/T curve
- Silver-plated and PTFE-insulated AWG 26 litz wires
- Characteristics for sensing temperatures
 T_{sense} = 90 up to 160 °C
 conform with DIN 44082
- Color coding of litz wires to DIN 44082, connecting wires in yellow
- UL approval to UL 1434 (file number E69802)
- RoHS-compatible

Delivery mode

■ Bulk

Dimensional drawing



Dimensions in mm

General technical data

Max. operating voltage	(T _A = 0 40 °C)	V_{max}	30	V DC
Max. measuring voltage	$(T_A = -25 {}^{\circ}\text{C} T_{\text{sense}} + 23 \text{K})$	$V_{\text{meas,max}}$	7.5	V DC
Rated resistance	$(V_{PTC} \le 2.5 \text{ V})$	R_R	≤ 300	Ω
Insulating test voltage		V_{ins}	2.5	kV AC
Thermal threshold time		ta	< 3	s
Operating temperature range	$(V \le V_{meas,max})$	T _{op}	$-25/T_{sense} + 23$	°C
Operating temperature range	$(V = V_{max})$	T _{op}	0/+40	°C



Sensors	
Motor protection, triple sensors	M1300

Electrical specifications and ordering codes

T _{sense}	R	R	R	R	Ordering code
	$(T_{sense} - \Delta T)$	$(T_{sense} + \Delta T)$	(T _{sense} + 15 K)	(T _{sense} + 23 K)	_
	$(V_{PTC} \le 2.5 \text{ V})$	(V _{PTC} ≤ 2.5 V)	$(V_{PTC} \le 7.5 \text{ V})$	$(V_{PTC} \le 2.5 \text{ V})$	
°C	Ω	Ω	Ω	Ω	
$\Delta T = \pm 5 \text{ K}$					
100	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1100A070
110	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1110A070
120	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1120A070
130	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1130A070
140	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1140A070
150	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1150A070
155	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1155A070
160	≤ 1650	≥ 3990	≥ 12 k	-	B59300M1160A070
$\Delta T = \pm 7 \text{ K}$					
170	≤ 1710	≥ 1710	-	≥ 30 k	B59300M1170A070
180	≤ 1710	≥ 1710	-	≥ 30 k	B59300M1180A070

Color coding of litz wires (to DIN 44081)

T _{sense}	Color
°C	
100	red/red
110	brown/brown
120	grey/grey
130	blue/blue
140	white/blue
150	black/black
155	blue/black
160	blue/red
170	white/green
180	white/red



Sensors Motor protection, triple sensors M1300

Reliability data

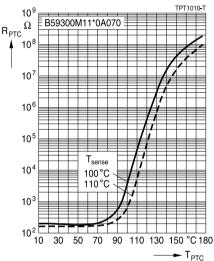
Test	Standard	Test conditions	$ \Delta R_{25}/R_{25} $
Electrical endurance, cycling	IEC 60738-1	Room temperature, I _{Smax} ; V _{max} Number of cycles: 500 000	< 25%
Electrical endurance, constant	IEC 60738-1	Storage at V _{max} /T _{op,max} (V _{max}) Test duration: 1000 h	< 25%
Damp heat	IEC 60738-1	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	< 25%
Vibration	IEC 60738-1	Frequency range: 10 to 55 Hz Displacement amplitude: 0.75 mm Test duration: 3 × 2 h Test according to IEC 60068-2-6, Test Fc	< 5%

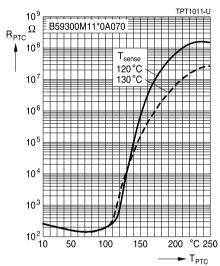
Motor protection, triple sensors

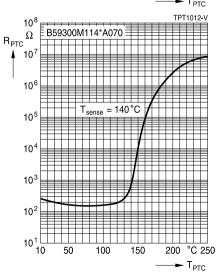
M1300

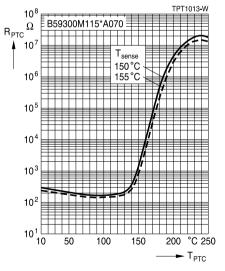
Characteristics (typical)

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









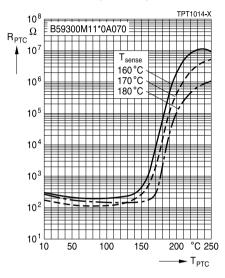


Motor protection, triple sensors

M1300

Characteristics (typical)

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





Motor protection, triple sensors

M1300

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.



Motor protection, triple sensors

M1300

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).



Motor protection, triple sensors

M1300

Symbols and terms

A Area

 $\begin{array}{ll} C_{th} & & \text{Heat capacity} \\ f & & \text{Frequency} \\ I & & \text{Current} \end{array}$

 I_{max}
 Maximum current

 I_R
 Rated current

 I_{PTC}
 PTC current

 I.
 Residual currrent

 $I_{\rm r,oil}$ Residual currrent in oil (for level sensors) $I_{\rm r,air}$ 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

P₂₅ Maximum power at 25 °C

 P_{el} Electrical power P_{diss} Dissipation power R_{min} Minimum resistance R_{R} Rated resistance ΔR_{R} Tolerance of R_R Parallel resistance R_P R_{PTC} PTC resistance Reference resistance R_{ref} Series resistance R_s

Resistance matching per reel/ packing unit at 25 °C

 ΔR_{25} Tolerance of R_{25} T Temperature

t Time

 R_{25}

T_A Ambient temperaturet_a Thermal threshold time

T_C Ferroelectric Curie temperature

Resistance at 25 °C



Motor protection, triple sensors

M1300

t_E Settling time (for level sensors)

 $\begin{array}{lll} T_{\text{R}} & & \text{Rated temperature} \\ T_{\text{sense}} & & \text{Sensing temperature} \\ T_{\text{op}} & & \text{Operating temperature} \\ T_{\text{PTC}} & & \text{PTC temperature} \\ t_{\text{R}} & & \text{Response time} \end{array}$

T_{rof} Reference temperature

T_{Bmin} 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 $V_{\text{link,max}}$ Maximum link voltage V_{max} Maximum operating voltage

V_{max dvn} Maximum dynamic (short-time) operating voltage

V_{meas} Measuring voltage

V_{meas,max} Maximum measuring voltage

V_B Rated voltage

V_{PTC} Voltage drop across a PTC thermistor

 $\begin{array}{lll} \alpha & & \text{Temperature coefficient} \\ \Delta & & \text{Tolerance, change} \\ \delta_{\text{th}} & & \text{Dissipation factor} \end{array}$

 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.



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.
- 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.epcos.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.
- Unless otherwise agreed in individual contracts, all orders are subject to the current version of the "General Terms of Delivery for Products and Services in the Electrical Industry" published by the German Electrical and Electronics Industry Association (ZVEI).
- 7. The trade names EPCOS, BAOKE, Alu-X, CeraDiode, CSMP, CSSP, CTVS, DeltaCap, DSSP, MiniBlue, MiniCell, MKK, MLSC, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SIMID, SineFormer, SIOV, SIP5D, SIP5K, ThermoFuse, WindCap are trademarks registered or pending in Europe and in other countries. Further information will be found on the Internet at www.epcos.com/trademarks.