# NTC thermistors for temperature measurement

Probe assemblies

**Series/Type:** **B57500K, B57501K**

Date: February 2009

### Applications

- Evaporator sensor for air conditioning systems
- Heating systems

### Features

- Copper case
- Twin cable (black)
- PVC-insulated wires with tinned ends, $T_{max}$ = 105 °C

### Options

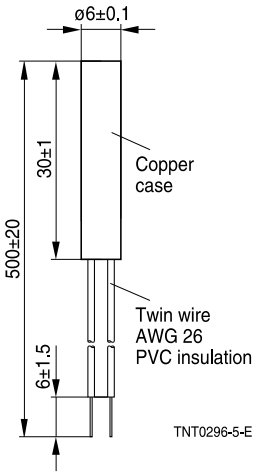
- Alternative resistance ratings, rated temperatures, resistance tolerances, wire lengths and AWG 22, AWG 24 or AWG 26 available on request.
  Also available as type K800 with improved humidity resistance for temperature measurement in heat pumps.

### Delivery mode

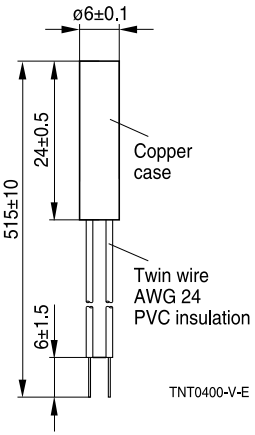
Bulk

### Dimensional drawings

**K500**




**K501**




Dimensions in mm

### General technical data

| | | | | |
|---|---|---|---|---|
| Climatic category | (IEC 60068-1) | | 30/100/56 | |
| Max. power | (at 25 °C) | $P_{25}$ | 60 | mW |
| Resistance tolerance | | $\Delta R_R/R_R$ | ±3 | % |
| Rated temperature | | $T_R$ | 25 | °C |
| Dissipation factor | (in air) | $\delta_{th}$ | approx. 7 | mW/K |
| Thermal cooling time constant | (in air) | $\tau_c$ | approx. 130 | s |
| Thermal time constant | (in water) | $\tau_a$ | approx. 8 | s |
| Heat capacity | | $C_{th}$ | approx. 900 | mJ/K |
| Insulation resistance | (V = 100 V DC) | $R_{ins}$ | > 100 | MΩ |
| Test voltage | (t = 1 s) | $V_{test}$ | 1.5 | kV AC |

### Electrical specification and ordering codes

| Type | AWG | $R_{25}$ Ω | No. of R/T characteristic | $B_{25/100}$ K | Ordering code |
|---|---|---|---|---|---|
| K500 | 26 | 10 k | 8016 | 3988 ±0.5% | B57500K0103A001 |
| K501 | 24 | 6.8 k | 8016 | 3988 ±0.5% | B57501K0682A002 |

**Reliability data**

| Test | Standard | Test conditions | $\Delta R_{25}/R_{25}$ (typical) | Remarks |
|---|---|---|---|---|
| Storage in dry heat | IEC 60068-2-2 | Storage at upper category temperature<br>T: 100 °C<br>t: 1000 h | < 2% | No visible damage |
| Storage in damp heat, steady state | IEC 60068-2-78 | Temperature of air: 40 °C<br>Relative humidity of air: 93%<br>Duration: 56 days | < 2% | No visible damage |
| Storage in coldness | | Storage at lower category temperature<br>T: −30 °C<br>t: 1000 h | < 2% | No visible damage |
| Rapid temperature cycling (in fluid) | IEC 60068-2-14 | Lower test temperature: 0 °C<br>Upper test temperature: 100 °C<br>Time to change from lower to upper temperature: <30 s<br>Number of cycles: 1000<br>Medium: oil | < 2% | No visible damage |
| Vibration resistance | IEC 60068-2-6 | Frequency range: 5 to 500 Hz<br>Amplitude: 7.5 mm, 2 *g*<br>Duration: 3 x 8 h | < 3% | No visible damage |
| Long-term stability (empirical value) | | Temperature: 100 °C<br>t: 10000 h | < 3% | No visible damage |
| Voltage proof test | | 1500 V AC,<br>1 s | | No flashover |
| Insulation test | | The sensors are placed in a vessel containing metallic balls of 1 mm diameter (with total immersed head). The applied voltage is 100 V DC. | | Above 100 MΩ |

## R/T characteristics

| R/T No. | **8016** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T (°C) | $B_{25/100}$ = 3988 K | | T (°C) | $B_{25/100}$ = 3988 K | | T (°C) | $B_{25/100}$ = 3988 K | |
| | $R_T/R_{25}$ | α (%/K) | | $R_T/R_{25}$ | α (%/K) | | $R_T/R_{25}$ | α (%/K) |
| −55.0 | 96.3 | 7.4 | 20.0 | 1.249 | 4.5 | 95.0 | 0.07885 | 3.0 |
| −50.0 | 67.01 | 7.2 | 25.0 | 1.0000 | 4.4 | 100.0 | 0.068 | 2.9 |
| −45.0 | 47.17 | 6.9 | 30.0 | 0.8057 | 4.3 | 105.0 | 0.05886 | 2.9 |
| −40.0 | 33.65 | 6.7 | 35.0 | 0.6531 | 4.1 | 110.0 | 0.05112 | 2.8 |
| −35.0 | 24.26 | 6.4 | 40.0 | 0.5327 | 4.0 | 115.0 | 0.04454 | 2.7 |
| −30.0 | 17.7 | 6.2 | 45.0 | 0.4369 | 3.9 | 120.0 | 0.03893 | 2.6 |
| −25.0 | 13.04 | 6.0 | 50.0 | 0.3603 | 3.8 | 125.0 | 0.03417 | 2.6 |
| −20.0 | 9.707 | 5.8 | 55.0 | 0.2986 | 3.7 | 130.0 | 0.03009 | 2.5 |
| −15.0 | 7.293 | 5.6 | 60.0 | 0.2488 | 3.6 | 135.0 | 0.02654 | 2.5 |
| −10.0 | 5.533 | 5.5 | 65.0 | 0.2083 | 3.5 | 140.0 | 0.02348 | 2.4 |
| −5.0 | 4.232 | 5.3 | 70.0 | 0.1752 | 3.4 | 145.0 | 0.02083 | 2.4 |
| 0.0 | 3.265 | 5.1 | 75.0 | 0.1481 | 3.3 | 150.0 | 0.01853 | 2.3 |
| 5.0 | 2.539 | 5.0 | 80.0 | 0.1258 | 3.2 | 155.0 | 0.01653 | 2.3 |
| 10.0 | 1.99 | 4.8 | 85.0 | 0.1072 | 3.2 | – | – | – |
| 15.0 | 1.571 | 4.7 | 90.0 | 0.09177 | 3.1 | – | – | – |

### Cautions and warnings General

See "Important notes" at the end of this document.

### Storage

- Store thermistors only in original packaging. Do not open the package prior to storage.
- Storage conditions in original packaging: storage temperature −25 °C ... +45 °C, relative humidity ≤75% annual mean, <95% maximum 30 days per annum, dew precipitation is inadmissible.
- Do not store thermistors where they are exposed to heat or direct sunlight. Otherwise, the packing material may be deformed or components may stick together, causing problems during mounting.
- Avoid contamination of thermistor surface during storage, handling and processing.
- Avoid storage of thermistors in harmful environments like corrosive gases ($SO_x$, Cl etc).
- Use the components as soon as possible after opening the factory seals, i.e. the polyvinyl-sealed packages.
- Solder thermistors within the time specified after shipment from EPCOS. For leaded components this is 24 months, for SMDs 12 months.

### Handling

- NTC thermistors must not be dropped. Chip-offs or any other damage must not be caused during handling of NTCs.
- Do not touch components with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.

### Bending / twisting leads

- A lead (wire) may be bent at a minimum distance of twice the wire's diameter plus 4 mm from the component head or housing. When bending ensure the wire is mechanically relieved at the component head or housing. The bending radius should be at least 0.75 mm.
- Twisting (torsion) by 180° of a lead bent by 90° is permissible at 6 mm from the bottom of the thermistor body.

### Soldering

- Use resin-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.

### Mounting

- Ensure that no thermo-mechanical stress occurs due to production processes (curing or overmolding processes) when thermistors are sealed, potted or overmolded or during their subsequent operation. The maximum temperature of the thermistor must not be exceeded. Ensure that the materials used (sealing/potting compound and plastic material) are chemically neutral.
- Electrodes/contacts must not be scratched or damaged before/during/after the mounting process.
- Contacts and housing used for assembly with the thermistor must be clean before mounting.
- Ensure that adjacent materials are designed for operation at temperatures comparable to the surface temperature of the thermistor. Be sure that surrounding parts and materials can withstand the temperature.
- Avoid contamination of the thermistor surface during processing.
- The connections of sensors (e.g. cable end, wire end, plug terminal) may only be exposed to an environment with normal atmospheric conditions.
- Tensile forces on cables or leads must be avoided during mounting and operation.
- Bending or twisting of cables or leads directly on the thermistor body is not permissible.
- Avoid using chemical substances as mounting aids. It must be ensured that no water or other liquids enter the NTC thermistors (e.g. through plug terminals). In particular, water based substances (e.g. soap suds) must not be used as mounting aids for sensors.

### Operation

- Use thermistors only within the specified operating temperature range.
- Use thermistors only within the specified power range.
- Environmental conditions must not harm the thermistors. Only use the thermistors under normal atmospheric conditions or within the specified conditions.
- Contact of NTC thermistors with any liquids and solvents should be prevented. It must be ensured that no water enters the NTC thermistors (e.g. through plug terminals). For measurement purposes (checking the specified resistance vs. temperature), the component must not be immersed in water but in suitable liquids (e.g. Galden).
- Avoid dewing and condensation unless thermistor is specified for these conditions.
- Bending or twisting of cables and/or wires is not permissible during operation of the sensor in the application.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by malfunction.

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

**Symbols and terms**

| Symbol | English | German |
|---|---|---|
| A | Area | Fläche |
| AWG | American Wire Gauge | Amerikanische Norm für Drahtquerschnitte |
| B | B value | B-Wert |
| $B_{25/100}$ | B value determined by resistance measurement at 25 °C and 100 °C | B-Wert, ermittelt durch Widerstands-messungen bei 25 °C und 100 °C |
| $C_{th}$ | Heat capacitance | Wärmekapazität |
| I | Current | Strom |
| N | Number (integer) | Anzahl (ganzzahliger Wert) |
| $P_{25}$ | Maximum power at 25 °C | Maximale Leistung bei 25 °C |
| $P_{diss}$ | Power dissipation | Verlustleistung |
| $P_{el}$ | Electrical power | Elektrische Leistung |
| $P_{max}$ | Maximum power within stated temperature range | Maximale Leistung im angegebenenTemperaturbereich |
| $\Delta R_B/R_B$ | Resistance tolerance caused by spread of B value | Widerstandstoleranz, die durch die Streuung des B-Wertes verursacht wird |
| $R_{ins}$ | Insulation resistance | Isolationswiderstand |
| $R_P$ | Parallel resistance | Parallelwiderstand |
| $R_R$ | Rated resistance | Nennwiderstand |
| $\Delta R_R/R_R$ | Resistance tolerance | Widerstandstoleranz |
| $R_S$ | Series resistance | Serienwiderstand |
| $R_T$ | Resistance at temperature T (e.g. $R_{25}$ = resistance at 25 °C) | Widerstand bei Temperatur T (z.B. $R_{25}$ = Widerstand bei 25 °C) |
| T | Temperature | Temperatur |
| $\Delta T$ | Temperature tolerance | Temperaturtoleranz |
| t | Time | Zeit |
| $T_A$ | Ambient temperature | Umgebungstemperatur |
| $T_{max}$ | Upper category temperature | Obere Grenztemperatur (Kategorietemperatur) |
| $T_{min}$ | Lower category temperature | Untere Grenztemperatur (Kategorietemperatur) |
| $T_{op}$ | Operating temperature | Betriebstemperatur |
| $T_R$ | Rated temperature | Nenntemperatur |
| $T_{surf}$ | Surface temperature | Oberflächentemperatur |
| V | Voltage | Spannung |
| $V_{ins}$ | Insulation test voltage | Isolationsprüfspannung |
| $V_{op}$ | Operating voltage | Betriebsspannung |
| $V_{test}$ | Test voltage | Prüfspannung |

| Symbol | English | German |
|---|---|---|
| $\alpha$ | Temperature coefficient | Temperaturkoeffizient |
| $\Delta$ | Tolerance, change | Toleranz, Änderung |
| $\delta_{th}$ | Dissipation factor | Wärmeleitwert |
| $\tau_c$ | Thermal cooling time constant | Thermische Abkühlzeitkonstante |
| $\tau_a$ | Thermal time constant | Thermische Zeitkonstante |

**Abbreviations / Notes**

| Symbol | English | German |
|---|---|---|
| SMD | Surface-mounted devices | Oberflächenmontierbares Bauelement |
| * | To be replaced by a number in ordering codes, type designations etc. | Platzhalter für Zahl im Bestellnummern-code oder für die Typenbezeichnung. |
| + | To be replaced by a letter. | Platzhalter für einen Buchstaben. |
| | All dimensions are given in mm. | Alle Maße sind in mm angegeben. |
| | The commas used in numerical values denote decimal points. | Verwendete Kommas in Zahlenwerten bezeichnen Dezimalpunkte. |

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