PTC-Resistor Temperature-Sensors MINIKA®
to DIN VDE V 0898-1-401 (ehem. DIN 44081/82)

General

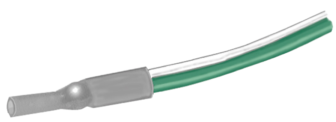
PTC-resistor temperature sensors (also called PTC-resistors or thermistors) are temperatur dependent semiconductor resistors whose main function is to alter their electrical resistance drastically when their body temperature reaches the nominal trip temperature NAT (TNF)

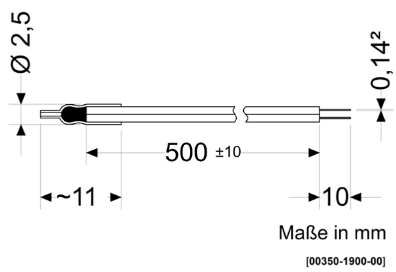
PTC-resistors are used principally to protect windings in electromotors or transformers against excess temperature. They also find application in machines, tooling machines especially machine bearings and controlling the temperature of power semiconductors.

PTC-resistor temperature sensors are particularly suited to this purpose due to their precise response range combined with small dimensions and minimal thermal inertia at low cost.

Single PTC-resistor type MINIKA® K

PTFE-insulated strand
Cu, silver-plated
Lead length: 500 ±10 mm
Stripping of lead-ends 10 mm
standard cross-section:
0,14 mm² (AWG 26)
weight: approx. 2,6 g

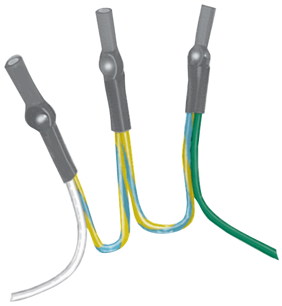


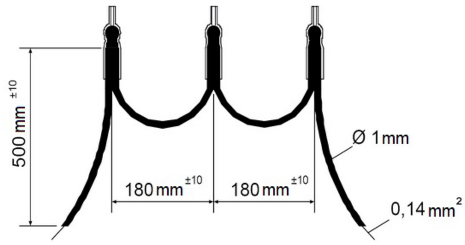


Type	NAT°C	Standard ID colour (DIN 44 081)	**Part numbers:** MINIKA®
K60	60 ± 5	white - grey	**K401000**
K70	70 ± 5	white - brown	**K401010**
K 80	80 ± 5	white - white	**K401005**
K 90	90 ± 5	green - green	**K401015**
K100	100 ± 5	red - red	**K401025**
K110	110 ± 5	brown - brown	**K401035**
K120	120 ± 5	grey - grey	**K401045**
K130	130 ± 5	blue - blue	**K401055**
K140	140 ± 5	white - blue	**K401065**
K150	150 ± 5	black - black	**K401075**
K160	160 ± 5	blue - red	**K401085**
K170	170 ± 5	white - green	**K401095**
K 180	180 ± 5	white - red	**K401090**

Triple PTC-resistor type MINIKA® KD

PTFE-insulated strand
Cu, silver-plated
Lead length:
500-180-180-500 ± 10 mm
Stripping of lead ends 10 mm
standard cross-section:
0.14 mm² (AWG 26)
weight: approx. 3,6 g

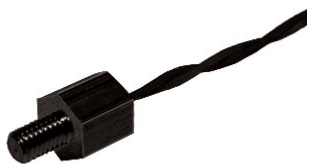


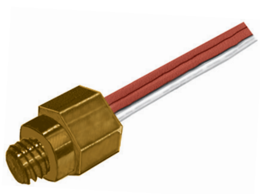


Type	NAT°C	Standard ID colour (DIN 44 082)	**Part numbers** MINIKA®
KD60	60 ± 5	white - yellow - yellow - grey	**K401300**
KD70	70 ± 5	white - yellow - yellow - brown	**K401310**
KD80	80 ± 5	white - yellow - yellow - white	**K401305**
KD90	90 ± 5	green - yellow - yellow - green	**K401315**
KD100	100 ± 5	red - yellow - yellow - red	**K401325**
KD110	110 ± 5	brown - yellow - yellow - brown	**K401335**
KD120	120 ± 5	grey - yellow - yellow - grey	**K401345**
KD130	130 ± 5	blue - yellow - yellow - blue	**K401355**
KD140	140 ± 5	white - yellow - yellow - blue	**K401365**
KD150	150 ± 5	black - yellow - yellow - black	**K401375**
KD160	160 ± 5	blue - yellow - yellow - red	**K401385**
KD170	170 ± 5	white - yellow - yellow - green	**K401395**
KD180	180 ± 5	white - yellow - yellow - red	**K401390**

Screw-in sensors in housing G2 (M4) and G3 (M6) MINIKA® KS

PTFE-insulated strand
Cu, silver-platedd
Lead length:
500 mm ± 10 mm
Stripping of lead ends 10 mm
standard cross-section:
0.14 mm² (AWG 26)
weight: G2: approx. 5 g
G3: approx. 14 g





Type	NAT°C	Standard ID colour DIN (44 081)	**Part numbers** G2 (M4)	G3 (M6)
KS80	80 ± 5	white - white	**K302005**	**K302109**
KS90	90 ± 5	green - green	**K302015**	**K302119**
KS100	100 ± 5	red - red	**K302025**	**K302129**
KS110	110 ± 5	brown - brown	**K302035**	**K302139**
KS120	120 ± 5	grey - grey	**K302045**	**K302149**

Technichal Data

Design	**K**	**KD**	**KS**
Max. operational voltage	25 V DC	25 V DC	25 V DC
Measuring voltage at NAT+15K -20...NAT+5K	≤ 7,5 V DC ≤ 2,5 V DC	≤ 7,5 V DC ≤ 2,5 V DC	≤ 7,5 V DC ≤ 2,5 V DC
Nominal response temperature NAT (TNF)	60...180°C	60...180°C	80...120°C
Tolerance NAT	± 5 K	± 5 K	± 5 K
Nominal resistance R at -20...NAT-20K VPTC ≤ 2,5 V	≤ 250 Ω	≤ 750 Ω	≤ 250 Ω
Rated ambient temperature range	-20°C...NAT+20°C		
Thermal response-time ta	≤ 5 s	≤ 5 s	-
Storage temperature	-25°C...+65°C		
Rated insulation voltage Ueff	690 V	690 V	690 V
Test voltage Ueff	2500 V AC	2500 V AC	2500 V AC

Resistors

The resistance of each individual sensor (according to standard) must, for temperatures related to the Nominal Response Temperature (NAT), have the following values:

≤ 250 Ohms at temperatures of -20°C to NAT -20 degrees. Measurement voltage up to max. 2.5 V

≤ 550 Ohms at a temperature of NAT -5 degrees. Measurement voltage max. 2.5 V

≥ 1330 Ohms at a temperature of NAT +5 degrees. Measurement voltage max. 2.5 V

≥ 4000 Ohms at a temperature of NAT +15 degrees. Measurement voltage max. 7.5 V

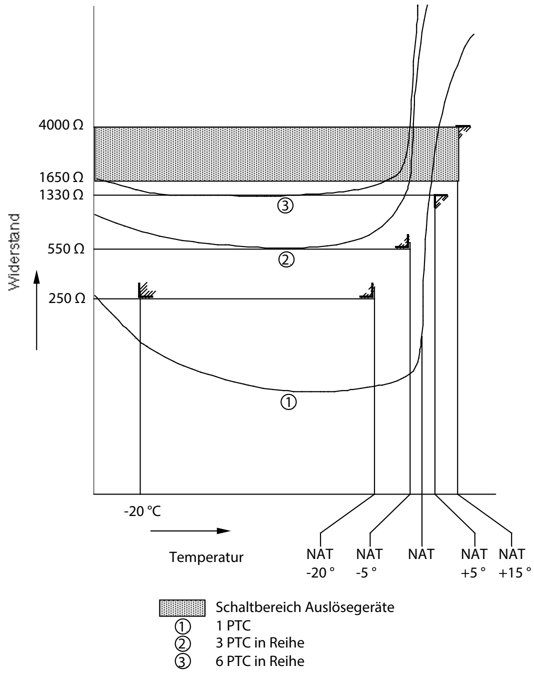
The exact values of the resistance values in the temperature ranges are not relevant. Flawless sensors should have a cold resistance of between 20 and at most 250 Ohms. Typical values (ambient temperature) lie between 50 - 150 Ohms.

When the cold resistance is within these limits, short-circuit and interruption can be excluded. For checking the nominal response temperature, the sensors have to be heated up to this temperature.

In accordance with standards, trip devices switch between 1650 Ohms and 4000 Ohms.

If a varying number of temperature sensors connected in series to a trip device are subjected to uniform heat, this results in the following cut-off point:

- 1 PTC switches at latest at NAT +15 degrees, at earliest at NAT +5 degrees.
- 3 PTC (typical instance) switch at latest at NAT +5 degrees, at earliest at NAT -5 degrees.
- 6 PTC switch at latest at NAT, at earliest at NAT -20 degrees. (Absolutely uniform heating of all sensors virtually never occurs in this instance).



Insulation classes

For built-in PTC-resistors, we recommend the following nominal cut-off temperature values for machines which are used to full capacity within permissible heating limits in keeping with their insulation class (VDE 0530).

These values can then be correspondingly reduced for machines at less than full capacity. In some instances it might prove necessary to work out nominal response temperature values which deviate somewhat from the values recommended in the table, on the basis of trial and error. When it is intended as a preliminary warning, the value recommended as nominal response temperature is 20°C below the break temperature.

Insulation material class			
120 (E)	130 (B)	155 (F)	180 (H)
120°C	130°C	150°C	

Fitting PTC-resistor temperature sensors

PTC-resistors can only be fitted before a winding has been impregnated by the motor manufacturer. It is not possible to insert them at a later stage.

Each winding has a sensor of its own. This means fitting 3 in single-speed motors and 6 in pole changing motors, with these sensors arranged in series and taken to separate terminals in the terminal box.

Measuring circuit must be provided with a separate power supply. The use of motor supply lines or other main current lines is unacceptable. Shielded supply lines must be used in case inductive or capacitive interference is produced by nearby high-voltage lines.

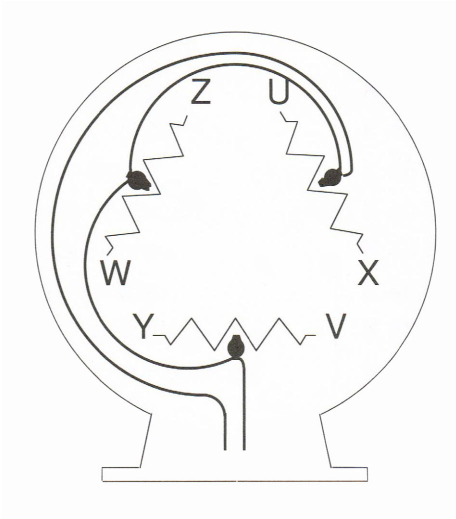
The maximum line lenght for a cable diameter of 0.5 mm^2 is approx. 500 m. For greater diameter cable, correspondingly more.

Fitting should, where possible, be carried out at the warmest winding head in the exhausted-air-side of the electrical machine. Care should be taken to ensure good heat contact between the sensors and the winding when being fitted. The more intimate the connection between a PTC-resistor and its winding, the better the winding temperature is registered, especially when temperatures rise sharply. For this reason, Temperature sensors should be implanted in the middle of the end winding-heads so as to be surrounded on all sides by the winding copper.

To fit the temperature sensors, the ready-shaped winding heads are spread apart in the centre using a piece of winding wood. The temperature sensors should be inserted parallel to the winding wires, care being taken that the winding wires are actually touching the temperature sensors. Cavities and air-occlusions impair heat contact and can be minimized by exerting pressure by hand to close the gap between winding wires and sensors. At the spot where the sensors are to be fitted, the winding wires on the end winding should be tightly bandaged. If the wire is more than 1 mm^2 thick, intervening spaces should be filled in with resin thickened with quartz powder.

If the motor manufacturer uses special saturants or impregnating resins whose chemical behaviour is anything but neutral, or if he uses some special working method, he will have to test the temperature sensors' resistivity himself in the operating conditions he will use.

To prevent peaks in interference voltage due to the formation of loops, we recommed that the connecting strand be fed back on the same side as the lead.



Assembly Tip: Do not shorten leads which are too long, roll them up and fasten them in position.

Testing fitted PTC-resistors

A maximum DC-voltage of 2.5 V can be passed through PTC-resistor temperature sensors when testing. Buzzers (voltage peaks) and similar testers should, therefore, not be used, but only meters or bridges.

For all measurement voltage values up to DC 2.5 V, resistance values ranging from -20°C to NAT -20 degrees should not exceeded 250 Ohms. Exact resistance values within this temperature range are unimportant. For flawless sensors, the lowest resistance value is generally above 20 Ohms.
When measurement values are being determined, care must be taken that the measurement results are not influenced by the selfwarming of the sensors. In the course of the manufacturing process, we test all sensors for NAT and disruptive strength.