PTC Heaters

Self-Regulating Heating Elements

TDK Electronics AG
Piezo and Protection Devices Business Group
Product Marketing PTC Thermistors
Munich, Germany
January 2020
Production plants

Šumperk, Czech Republic
Front-end, back-end
- Pressing
- Sintering
- Metalization

Deutschlandsberg, Austria
Powder
- Powder production

Kutina, Croatia
Final measurement
- Final testing
- Package

Zhuhai, China
Back-end
- Soldering
- Assembly
- Final testing
- Package
PTC product spectrum

Overload

Motor start

Heating elements

PTC ICL

Sensors

Parameters
U: 12…500 V
R: 0.3…1800 Ω
Ø: 4…22 mm
SMD: 0603…4032

Parameters
U: 180…265 V
R: 4.7…5000 Ω
Ø: 16…20 mm

Parameters
U: 12…800 V
R: 0.75…960 Ω
th: 1…3.0 mm
Ts: 40…280 °C

Parameters
U: 400…1000 V
R: 22…7500 Ω
Cth: 0.5…2.3 J/K

Parameters
Tsens: 60…180 °C
Size: Leaded, SMD, single, tripple sensor
SMD: 0402, 0603, 0805
Description of a PTC and key parameters:
Typical R/T curve

What is a PTC?

A PTC (Positive Temperature Coefficient) is a resistor whose resistance varies with temperature.

With increasing temperature, the resistance of the PTC will increase.

- $R_N$: Resistance value at 25 °C
- $R_{\text{min}}$: Minimum resistance of the PTC
- $T_{\text{ref}}$: Reference temperature or Curie temperature; at this temperature, the resistance value is $2 \times R_{\text{min}}$
PTC heaters technology advantages

- Self-regulating
- No overtemperature protection necessary
- No risk of fire compared to fixed resistors
- No changes of the product characteristics during lifetime of the application
- Quick heating
TDK company advantages PTC heaters

- 50 years experience in PTC technology
- All common voltages available (12 V to 800 V)
- Customer specific geometries available
- Wide temperature range (40 °C to 280 °C)
- 100% resistance measuring
- 100% automatic pulse testing
- 100% AOI of HV PTC heaters
# PTC heater portfolio

<table>
<thead>
<tr>
<th></th>
<th>LV PTC heater</th>
<th>HV PTC heater</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape</strong></td>
<td><img src="image1.png" alt="Cylinder" /></td>
<td><img src="image2.png" alt="Bar" /></td>
</tr>
<tr>
<td><strong>Rated voltage</strong></td>
<td>12 V, 24 V, 48 V</td>
<td>230 V, 350 V, 800V</td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td>1.0 … 1.4 mm</td>
<td>2.0 … 3.0 mm</td>
</tr>
<tr>
<td><strong>Reference temperature</strong></td>
<td>0 °C ... 220 °C</td>
<td>50 °C ... 270 °C</td>
</tr>
<tr>
<td><strong>Surface temperature</strong></td>
<td>40 °C ... 230 °C</td>
<td>100 °C ... 280 °C</td>
</tr>
<tr>
<td><strong>Min. resistance</strong></td>
<td>0.75 Ω ... 20 Ω</td>
<td>85 Ω ... 960 Ω</td>
</tr>
<tr>
<td><strong>Metalization</strong></td>
<td>Al, Ag</td>
<td>Al, Ag</td>
</tr>
</tbody>
</table>
## Comparison of PTC electrodes

<table>
<thead>
<tr>
<th>Features (pros and cons)</th>
<th>Ag</th>
<th>Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low ohmic contact to ceramic</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Adhesion to ceramic</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Resistance drift over time</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Current load capacity</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Stability against corrosion</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Stability against migration</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cost impact</td>
<td>More expensive</td>
<td>Less expensive</td>
</tr>
</tbody>
</table>
Automotive applications for PTC heaters

- Diesel filter heating
- Blowby heating
- Battery heating
- Cabin heating
- SCR system heating
Household and industrial applications for PTC heaters

- Doorlock
- Insecticide and perfume vaporizer
- Wax actuators in thermostats
## Checklist of design inputs

<table>
<thead>
<tr>
<th>Mechanical parameters</th>
<th>Electrical parameters</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (LxWxT)</td>
<td>Operating voltage (min, max)</td>
<td>Packaging</td>
</tr>
<tr>
<td>Contact method</td>
<td>Preferred $T_{\text{ref}}$</td>
<td>Marking</td>
</tr>
<tr>
<td>Contact material</td>
<td>Preferred $T_{\text{surf}}$</td>
<td>Labeling (part and packing)</td>
</tr>
<tr>
<td>Preferred electrode</td>
<td>Preferred R25 or Rmin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breakdown voltage</td>
<td></td>
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