# Important Information on the Use of SMD Polymer PPTC Resettable Over-Current SMD Thermistors

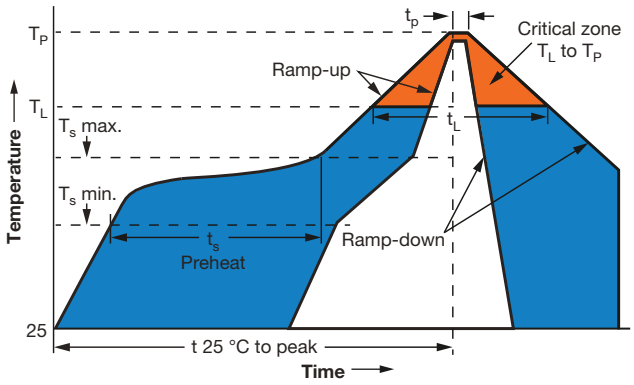
## MOUNTING AND HANDLING INSTRUCTIONS

### 1. SOLDERING

SMD PPTC resettable over-current thermistors comply with the solderability requirements as outlined in IEC 60068-2-58. For reflow soldering of RoHS-compliant PPTC thermistors, the following combined solder conditions should be respected. PPTC SMD thermistors have matte Sn (tin) plated terminations.

#### REFLOW SOLDERING

**REFLOW SOLDERING** (as specified in IPC / JEDEC® J-STD-020D)




**REFLOW PROFILE**

| PROFILE FEATURE | TIN / LEAD (Pb) REFLOW PROFILE | LEAD (Pb)-FREE REFLOW PROFILE |
|---|---|---|
| Average ramp-up rate ($T_s$ max. to $T_P$) | 3 °C/s max. | 3 °C/s max. |
| **Preheat**<br>- Temperature minimum ($T_s$ min.)<br>- Temperature maximum ($T_s$ max.)<br>- Time ($T_s$ min. to $T_s$ max.) ($t_s$) | <br>100 °C<br>150 °C<br>60 s to 120 s | <br>150 °C<br>200 °C<br>60 s to 180 s |
| **Time maintained above:**<br>- Temperature ($T_L$)<br>- Time ($t_L$) | <br>183 °C<br>60 s to 150 s | <br>217 °C<br>60 s to 150 s |
| Minimum peak temperature ($T_p$ min.) | 215 °C | 235 °C |
| Recommended peak temperature ($T_p$) | 235 °C | 250 °C |
| Maximum peak temperature ($T_p$ max.) | 260 °C | 260 °C |
| Time within 5 °C for recommended peak temperature ($t_p$) | 10 s to 30 s | 10 s to 30 s |
| Ramp-down rate | 6 °C/s max. | 6 °C/s max. |
| Time 25 °C to peak temperature | 6 min max. | 8 min max. |

Generally, for all methods of soldering:

1. Preheat the components and the board to within +100 °C of the soldering temperature for a minimum of 60 s. This ramping should not exceed 1.5 °C to 3 °C per second
2. (a) Reflow soldering temperature should not exceed +260 °C, with a maximum time of 20 s
   (b) Vapor phase reflow soldering should not exceed +220 °C, with a maximum time of 40 s
3. In all cases, gradual cooling to room temperature is recommended
4. All the above-mentioned temperatures refer to the top side of the package
5. Recommended maximum solderpaste thickness is 0.25 mm (0.010")
6. The use of resin-type flux or non-activated flux is recommended
7. Removal of flux residues is strongly recommended by using standard industry methods and cleaning agents

Failure to follow the above soldering conditions may result in thermal-electrical damage, such as material and permanent resistance changes and devices may not meet the performance requirements.

**WAVE SOLDERING**

Wave soldering of PPTC thermistors is not recommended nor supported.

**HAND SOLDERING**

Hand soldering of PPTC thermistors is not recommended. In the event of a repair process, the maximum temperature of 260 °C over a period of 5 s must not be exceeded during soldering. The use of solderpaste with resin-type or non-activated flux is recommended. No aggressive fluxes may be used. Preferably, a temperature-regulated heat gun or hot gas pencil reflow station is used. The use of a contact soldering iron (20 W max.) is not recommended, and care should be taken to avoid touching PPTC surface between the terminals. No mechanical pressure shall be applied to the terminations. By preheating the PCB assembly and components with an air flow up to 150 °C, a lower solder (iron) temperature can be used. In short:

1. Hand soldering or de-soldering is not recommended nor supported.
2. In case of repair, minimize the heating time of the PPTC during hand soldering.
3. The use of soldering paste is recommended.
4. Do not exert pressure on the PPTC while securing during hand soldering.
5. Never re-use a desoldered PPTC.
6. Always check the PPTC resistance after resting for 30 minutes at room temperature. The PPTC resistance needs to be within $R1_{max.}$

**RECOMMENDED SOLDER PADS**

See individual datasheets.

## 2. STORAGE - SHELF LIFE

PPTC resettable fuse thermistors need to be stored in their original packing containers. The storage location and package containers need to be maintained within the following limits:

Storage temperature: 10 °C up to 35 °C

Relative humidity (without condensation): 10 % RH to 70 % RH

PPTC SMD thermistors must not be stored in corrosive or deoxidizing atmospheres ($Cl_2$, $H_2S$, $NH_3$, $NO_x$, $SO_x$, etc.). Avoid storage in heat or direct (UV) sunlight. The presence of ozone or ionizing radiation must always be avoided. Humidity, temperature, and container materials are critical factors that can influence the solderability and the functionality of the parts. Touching the exposed metal terminations may change their soldering properties.

Shelf life: properly packaged and stored PPTC SMD thermistors have a minimum shelf life of 12 months after manufacturing date (DC). Thermo-electrical functionality will not be influenced after longer storage time in the described conditions. In case of doubt, the solderability of terminations should be rechecked following IEC 60068-2-58 or IEC 60068-2-69 before using parts stored more than 12 months after the manufacturing date (DC). Permitted storage time in well-defined conditions and in the original package is 2 years.

## 3. HANDLING

SMD PPTC resettable over-current thermistors must not be dropped. Do not touch components with bare hands; gloves are recommended. Avoid contamination of the sensor surface during handling. Small imperfections in the terminations or on the body will not impact on the functionality or reliability of the parts. De-soldering of PPTC thermistors for investigation or checking purposes can cause mechanical deformations, resistance change and permanent damage (see “Soldering” section).

## 4. SEALING AND POTTING

SMD PPTC thermistors cannot be potted or covered by coating material. Several liquid materials would diffuse into the polymeric matrix and would influence its properties.

Coating materials that contain solvent or silicon are prohibited. Those materials will influence the PPTC electrical resistance and characteristics potentially deteriorating its performance over time. Only solvent free acrylic (AR) material or solvent free epoxy (ER) material may be used as conformal coating material. In case of doubt, user can provide a MSDS of coating material to Vishay for checking compatibility.

## 5. CLEANING

Cleaning processes can affect the reliability of the component. The polymeric matrix is resistant to most cleaning solvents commonly used in the electronics industry, including alcohol, esters, and aqueous solutions. Washing processes should be kept short in time. Some cleaning processes may damage the product due to the possible static or cyclic mechanical loads (e.g., ultrasonic cleaning). They may lead to reduced reliability and / or lifetime. Most cleaning detergents are not easy to diffuse into the polymer matrix. If there is doubt if certain cleaning agents are appropriate, the user can provide a MSDS document for checking compatibility by Vishay.

## 6. INSPECTION MEASURING

### RESISTANCE VS. TEMPERATURE

PPTC SMD thermistors exhibit a medium to very high resistance change depending on the changing surrounding temperature. The change of resistance below the tripping point is positive, ranging from 0 to a few % per degree Celsius. When measuring or inspecting resistance values of PPTC thermistors, it is advisable to check it at low temperature (25 °C) in air. No liquid is allowed. Measuring currents that can be applied to the PPTCs should be low enough to prevent any self-heating or be limited in time. Preferably, electrical power induced by the measuring current should be lower than 1 % of the typical power $P_d$ as specified. A measuring current of 1 mA to 10 mA will not induce any significant self-heating. De-soldering of PPTC thermistors for product or resistance investigation or measuring purposes can cause mechanical deformations and resistance changes. In case of returned products for investigation, only original soldered products on (part of) PCB material can be accepted.

### DIMENSIONAL

All production batches of PPTC thermistors are controlled dimensionally on a statistical basis in order to guarantee compliance to specifications. PPTC SMD component soldering pads should be chosen in accordance with the soldering process. Recommended solder pad dimensions are mentioned in the respective datasheets.

### VISUAL

Small imperfections in the terminations or on the body will not impact the functionality nor reliability of the parts.

## 7. OPERATION

PPTC thermistors will thermally expand during a tripping event or application fault condition. They should be mounted in areas where such thermal expansion will not be influenced by surrounding materials like covers, encapsulations and alike. Any pressing, bending or other mechanical stress will adversely affect its performance and shall not be used or applied.

Use PPTC thermistors only within the specified operating temperature range. Overpowering a PPTC thermistor can cause termination re-melting and ignition of fire, in addition to open circuit failures. Environmental conditions must not harm the sensors. Avoid operation of PPTC thermistors in corrosive or deoxidizing atmospheres ($Cl_2$, $H_2S$, $NH_3$, $NO_x$, $SO_x$, etc.) unless specified. Only use the PPTC thermistors under normal atmospheric conditions or within the specified conditions. Avoid any contact with water or electrically conductive liquids. For measurement purposes, see the “Inspection” paragraph. Avoid dew formation and condensation. During operation, any bending or movement of the terminations, which induces stress on the solder joints or connection points, should be prevented.

PPTC thermistors are non-insulated. Water condensation or dew formation should always be avoided, as it can result in enhanced leakage currents or breakdown and cause electrochemical migration, which can lead to reduced resistivity or short circuits.

## 8. FAILURE MODES

PPTC thermistors are secondary protection devices and can only be used for sporadic or accidental over current or over temperature fault conditions. They shall not be used where frequent or repetitive fault conditions can occur that would let trip the PPTC to a high resistance. The protection of high inductive loads should be carefully examined and tested, as these loads can generate high V = L x di/dt peak over-voltage on the fast current limiting PPTC.

For safety-critical applications, be sure to provide an appropriate fail-safe or redundancy function in the circuit to prevent secondary (product) damage caused by a malfunction or failure of a PPTC thermistor. For failure analysis purposes, de-soldering the components is not recommended. Instead, analyze the mounted PPTC product without interference with other connected components or circuits. When investigation is performed by Vishay, a failure analysis of the PPTC product might require measurement in thermally stabilized environments and possible destructive physical analysis. For every use of Vishay products, it is the customer’s responsibility to consult and respect the Vishay disclaimer notice, which is part of every Vishay product datasheet. In case of doubt of possible failure modes in your application, consult Vishay.

This listing does not claim to be complete but merely reflects the experience of Vishay.