

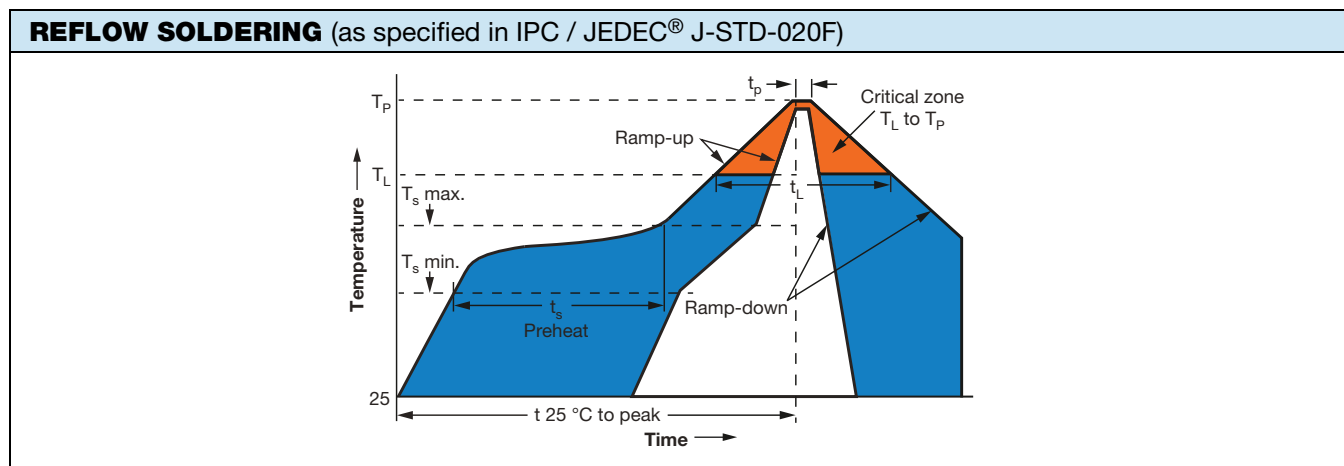
Important Information on the Use of PTCES Thermistors

MOUNTING AND HANDLING INSTRUCTIONS

1. SOLDERING

PTCES SMD PTC thermistor comply with the solderability requirements as outlined in IEC 60068-2-58. For reflow and hand / robot soldering, the following combined solder conditions should be respected.

REFLOW SOLDERING



REFLOW PROFILE		
PROFILE FEATURE	TIN / LEAD (Pb) REFLOW PROFILE	LEAD (Pb)-FREE REFLOW PROFILE
Average ramp-up rate ($T_{s \text{ max.}}$ to T_p)	3 °C/s max.	3 °C/s max.
Preheat - Temperature minimum ($T_{s \text{ min.}}$) - Temperature maximum ($T_{s \text{ max.}}$) - Time ($T_{s \text{ min.}}$ to $T_{s \text{ max.}}$) (t_s)	100 °C 150 °C 60 s to 120 s	150 °C 200 °C 60 s to 180 s
Time maintained above: - Temperature (T_L) - Time (t_L)	183 °C 60 s to 150 s	217 °C 60 s to 150 s
Minimum peak temperature ($T_p \text{ min.}$)	220 °C	240 °C
Recommended peak temperature (T_p)	240 °C	255 °C
Maximum peak temperature ($T_p \text{ max.}$)	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) Wave soldering (not recommended) temperature should not exceed +260 °C, with a maximum time of 5 s
3. In all cases, gradual cooling to room temperature is recommended
4. The use of resin-type flux or non-activated flux is recommended
5. Removal of flux residues is strongly recommended
6. Number of reflow pre-conditioning passes should be 1 (AEC-Q200)
7. Recommended stencil thickness is 0.12 mm

Failure to comply with the recommended soldering conditions may result in permanent damage to the component, including physical damage of the ceramic body, degradation of the solder joints and permanent resistance changes leading to altered inrush performance.

HAND SOLDERING

Hand soldering of PTCES thermistors is possible, but not preferred.

Maximum solder tip temperature shall be limited to 360 °C with maximum 5 s contact with the wire, and soldering iron power limited to 50 W. The soldering iron tip shall contact the terminals only at the points indicated by the red dots, as far as possible from the areas where the terminals touch the plastic case.

Failure to comply with the recommended soldering conditions may result in permanent damage to the component.



2. STORAGE - SHELF LIFE

PTCES 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 75 % RH

PTCES thermistors must not be stored in corrosive or deoxidizing atmospheres (Cl₂, H₂S, NH₃, 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 of the parts. Touching the exposed metal terminations may change their soldering properties.

Shelf life: properly packaged and stored PTCES thermistors have a minimum shelf life of 24 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 checked following IEC 60068-2-58 before using parts stored more than 24 months after the manufacturing date (DC).

3. HANDLING

PTCES thermistors must not be dropped. Any damage must not be caused during handling of the products. Rough handling of PTCES thermistors can lead to deformation of the terminations and cause solderability issues. De-soldering of PTCES thermistor for resistance investigation or measuring purposes can cause deformation of the terminations.

4. SEALING AND POTTING

It is not recommended to pot or seal PTCES thermistors. The specified characteristics of PTCES thermistors are only valid when used in standard mounting and ambient conditions. Sealing, potting, or gluing can only be made with suitable resins that are electrically non-conductive, and chemically and mechanically stable over the whole operating temperature range of the PTCES thermistor. It should be mentioned that the maximum surface or body temperature of many PTCES types can reach 180 °C or more when they are operating in the tripped high resistance mode under high voltage. For this reason Vishay recommends silicone-based adhesives or sealing compounds that have long term stability up to 180 °C, or maximum possible body temperature in the application's conditions of use. There must be no mechanical stress exerted on the component due to thermal expansion or compression during the production process (curing / overmolding / gluing) or in the final application. There must be no residual forces or stress on the device during normal operation. As PTCES thermistors are temperature-sensitive components, molding, sealing, or gluing will affect the thermal surrounding and will influence the response time, power dissipation, and thermal gradient inside the bulk ceramic material. Extensive testing is encouraged in order to determine whether molding, potting, or gluing influences the functionality and / or reliability of the component.

5. CLEANING

Cleaning processes can affect the reliability of the component. If cleaning is necessary, mild cleaning agents are recommended. Cleaning agents based on water are not allowed. Ceramic PTC material has a porous nature and can absorb liquids easily. Any absorbed cleaning liquid should be removed completely before operation.



6. INSPECTION MEASURING

RESISTANCE VS. TEMPERATURE

PTCES thermistors exhibit a large resistance change depending on the changing surrounding temperature. The change of resistance can range from -1 % to +25 % per degree Celsius. When measuring or inspecting resistance values of PTC thermistors, it is advisable to immerse the thermistor body and its connecting leads in a good thermal conductive homogeneous medium. Such a medium is preferably silicone oil or PFPE non-reactive, per-fluorinated liquid polymers. Water is not recommended because of its electrical conductivity. In any case, when PTC thermistors have been measured in liquids, the measured parts should be discarded, as the fluids can easily enter in the porous ceramic matrix. The liquid medium should be measured with a calibrated thermometer and referenced close to the PTC thermistor body. Measuring PTC thermistors in stirred air is acceptable in most cases where higher tolerance parts are specified. Temperature accuracy levels of $\pm 0.5\text{ }^{\circ}\text{C}$ are acceptable. PTC thermistors should be measured with very low self-heating ($< 0.1\text{ }^{\circ}\text{C}$ or $< 10\text{ }\%$ of specified D-factor in $\text{mW}/^{\circ}\text{C}$) and with voltage levels below 5.0 V_{DC} (preferred $\leq 1.5\text{ V}_{\text{DC}}$). When PTC resistance values are measured at higher voltage levels, only pulsed voltages can be used to limit the energy load and prevent self-heating ($< 0.1\text{ }^{\circ}\text{C}$).

DIMENSIONAL

All production batches of PTCES are controlled dimensionally on a statistical base in order to guarantee compliance to specifications.

7. OPERATION

Use thermistors only within the specified operating temperature range. PTCES thermistors should not be used above their maximum specified voltage and current levels unless specified by derating curves as a function of operating ambient temperature. PTCES thermistors that have been sealed, potted, or glued can have reduced maximum operating voltage and current levels. Specified holding and tripping currents, dissipation factor, thermal time constant, and response time will change when the parts are not used in a still-air ambient or when sealing, potting, or gluing materials have been applied. Overpowering a PTCES thermistor can cause thermal runaway and fire ignition, short circuits, or open circuit failures. Environmental conditions must not harm the thermistors. Avoid operation of PTCES thermistors in corrosive, deoxidizing or reducing atmospheres (Cl_2 , H_2S , NH_3 , NO_x , SO_x , etc.) unless specified. Only use the PTCES thermistors under normal atmospheric conditions or within the specified conditions. PTCES thermistors may not be used in vacuums, or at very low or high air pressure. Avoid any contact with water or electrically conductive liquids. For measurement purposes, see the "Inspection Measuring" section (6). Avoid dew formation and condensation unless the thermistor is specified for these conditions. PTCES thermistors can have high surface temperatures up to or above $180\text{ }^{\circ}\text{C}$ in some operation modes (tripped state at high voltage). Make sure that surrounding components can withstand higher local temperatures induced by radiation or convection of heat and remain stable at these higher temperatures.

PTCES thermistors are insulated up to 3 kV_{AC} .

Insulated thermistors should not be used above their specified dielectric withstanding voltages.

8. FAILURE MODES

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 malfunctioning or failed PTCES thermistor. For every use of Vishay thermistors, it is the customer's responsibility to consult and respect the [Vishay disclaimer notice](#), which is part of every Vishay product datasheet.

If you have any doubt as to the possible failure modes in your application, consult Vishay.

This list of guidelines and information does not claim to be complete, but represents the experiences of Vishay and may be supplemented, adapted, or enhanced at any time.