Important Information on the Use of SMD Thin Film PTS and TFPT Resistance Temperature Detectors (RTD Sensors)

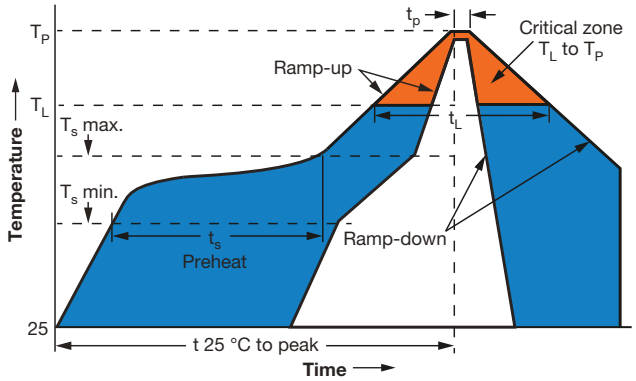
MOUNTING AND HANDLING INSTRUCTIONS

1. SOLDERING

SMD PTS and TFPT thin film temperature detectors (sensors) comply with the solderability requirements as outlined in IEC 60068-2-58. For reflow, wave, and hand / robot soldering of RoHS-compliant RTD sensors, the following combined solder conditions should be respected.

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 - Temperature minimum (T_s min.) - Temperature maximum (T_s max.) - Time (T_s min. to T_s 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 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:

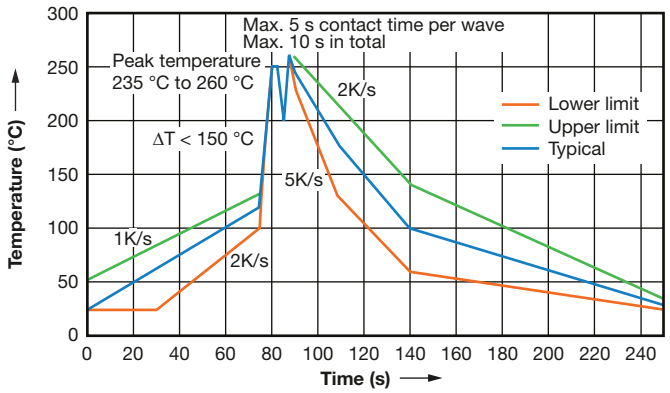
1. Preheat the components and the board to within +100 °C of the soldering temperature for a minimum of 60 s. This ramping should not exceed 1.5 °C to 3 °C per second
2. (a) Reflow soldering temperature should not exceed +260 °C, with a maximum time of 20 s
   (b) Wave soldering temperature should not exceed +260 °C, with a maximum time of 5 s
   (c) 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. The use of resin-type flux or non-activated flux is recommended
5. Removal of flux residues is strongly recommended

Failure to follow the above soldering conditions may result in thermal-electrical damage, such as material and permanent resistance changes.

WAVE SOLDERING

Care should be taken to check the gluing adhesive compatibility with the RTD product. The maximum wave temperature should always be limited to 260 °C and the total wave immersion time should be limited to 10 s max. In case of double-wave soldering, the total soldering time, including the time between waves, should also be limited to 10 s max. Proper pre-heating and limitation of the temperature difference between the pre-heating stage and maximum first wave temperature should be limited to 150 °C. See the recommended wave soldering profile below.

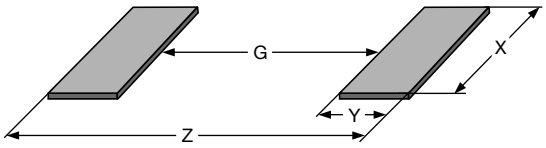
WAVE SOLDERING PROFILE



HAND SOLDERING

Hand soldering of thin film RTD sensors is not recommended. In the event of a repair process, the maximum temperature of 260 °C over a period of 10 s must not be exceeded during soldering. The use of resin-type flux 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 the glass seal or other protective coating. 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.

RECOMMENDED SOLDER PADS



RECOMMENDED SOLDER PAD DIMENSIONS

TYPE	REFLOW SOLDERING				WAVE SOLDERING			
	G (mm)	Y (mm)	X (mm)	Z (mm)	G (mm)	Y (mm)	X (mm)	Z (mm)
TFPT0402	0.5	0.4	0.6	1.3	-	-	-	-
PTS0603 / TFPT0603	0.8	0.6	0.9	2.0	0.55	0.9	1.10	2.75
PTS0805 / TFPT0805	1.0	0.8	1.4	2.6	0.8	1.0	1.5	3.4
PTS1206 / TFPT1206	1.8	1.0	1.8	3.8	1.6	1.4	1.9	4.4

2. STORAGE - SHELF LIFE

RTD thin film PTS and TFPT resistors 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: -25 °C up to 40 °C

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

RTD sensors 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 of the parts. Touching the exposed metal terminations may change their soldering properties. Packages stored or exposed to too high temperatures might show melted adhesive glue of the carrier tape and impede automatic pick and place processes.

Shelf life: properly packaged and stored PTS and TFPT (tin-plated) SMD sensors 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 or IEC 60068-2-69 before using parts stored more than 24 months after the manufacturing date (DC). Permitted storage time in well-defined conditions and in the original package is 20 years.

3. HANDLING

Thin film RTD sensors such as PTS and TFPT must not be dropped. Chip-offs or any other damage must not be caused during handling of the products. Do not touch components with bare hands; gloves are recommended. Avoid contamination of the sensor surface during handling. Rough handling of thin film RTDs may result in glass seal or protective coating failures or solderability issues. Small imperfections in or underneath the glass coating will not impact the functionality or reliability of the parts. De-soldering of thin film RTD sensors for resistance investigation or measuring purposes can cause mechanical deformations and resistance change (see “Soldering” section).

4. SEALING AND POTTING

The RTD sensor elements are covered by a protective coating designed for electrical, mechanical, and climatic protection. The use of potting resins in close contact with the protective coating or terminations is not recommended. The sensors may only be sealed, potted, or over-molded in suitable resins, if it is clearly mentioned and allowed in the respective datasheets. Sealing or potting can affect the reliability of the component. The potting material must be compatible with the use of electronic components, be electrically non-conductive, and chemically stable over the whole operating temperature range. Potting or over-molding in polyamide-based resins is not recommended. When sealing, potting, or over-molding is permitted per the datasheet, care must be taken that there is no mechanical stress exerted on the component caused by thermal expansion or compression during the production process (curing / over-molding) or in the final application.

No residual forces or stress may exist during normal operation. The upper category operating temperature of the thermistor must not be exceeded. Ensure that the materials used are chemically neutral and stable at the maximum operating temperature. If using a ceramic adhesive / potting or filling material, avoid phosphate-based binders. As RTD sensors are temperature-sensitive components, molding or sealing can affect the surrounding thermal resistances and influence the response time, power dissipation, and thermal gradient. Extensive testing is encouraged in order to determine whether over-molding or potting influences the functionality and / or reliability of the component. Glob-top encapsulation of the RTDs can provide exceptional environmental protection and physical stability, while preventing damage from overmolding techniques, especially when RTD parts are mounted on flexible substrates or circuits. The use of a stiffener in flexible circuits is recommended in the mounting area of the RTD. In case high humidity or water ingress can reach the circuit board or substrate, the application of a conformal coating is recommended to prevent leakage currents or migration effects. Conformal coatings will normally not influence the thermal response time or thermal gradient of an SMD RTD sensor.

5. CLEANING

Cleaning processes can affect the reliability of the component. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters, and aqueous solutions. Washing processes may damage the product due to the possible static or cyclic mechanical loads (e.g., ultrasonic cleaning). They may cause cracks, which might lead to reduced reliability and / or lifetime. No-clean flux residues contain weak organic acids that can be hygroscopic and adsorb moisture, which can result in enhanced leakage currents and cause electrochemical migration - leading to reduced resistivity or short circuits.

6. INSPECTION MEASURING

RESISTANCE VS. TEMPERATURE

Thin film RTD sensors exhibit a medium resistance change depending on the changing surrounding temperature. The change of resistance (TCR) is around +0.4 % per degree Celsius. When measuring or inspecting resistance values of PTS or TFPT sensors with precision, it is advisable to immerse the thermistor body and its connecting circuits 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, the measured parts should be cleaned and dried before further use or be discarded. The liquid medium should be measured with a calibrated thermometer and referenced close to the RTD sensor body. Measuring RTD sensors in air can and will be influenced by many parameters, like radiated heat or cold / heat flows from surrounding bodies or the mounting substrate. Measuring currents that can be applied to the PTS or TFPT sensor 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 10 % of the specified dissipation factor or generate a temperature increase of less than 0.1 °C. For low resistance value RTD sensors, a measuring current of 100 µA to 1 mA will not induce any self-heating. De-soldering of RTD sensors 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 RTD sensors are controlled dimensionally on a statistical base in order to guarantee compliance to specifications. RTD SMD component soldering pads should be chosen in accordance with the soldering process. Recommended solder pad dimensions are mentioned in the “Soldering” section.

VISUAL

Small vesicles, sharp edges, micro-cracks, or imperfections in the glass seal and top coating of RTD SMD sensors are cosmetic and do not impact the functionality nor the reliability of the components.

7. OPERATION

Use RTD sensors only within the specified operating temperature range. RTD sensors are not intended to be used under a self-heating power mode. Never use RTD sensors in constant current mode or outside the specified maximum or derated power. Overpowering a RTD sensor 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 RTD sensors in corrosive or deoxidizing atmospheres (Cl_2, H_2S, NH_3, NO_x, SO_x, etc.) unless specified. Only use the RTD sensors under normal atmospheric conditions or within the specified conditions. Some RTD sensors may be used in a vacuum, or at high air pressure. Avoid any contact with water or electrically conductive liquids. For measurement purposes, see the “Inspection” paragraph. Avoid dew formation and condensation unless the RTD is specified for these conditions. During operation, any bending or movement of the terminations, which induces stress on the solder joints or connection points, should be prevented.

RTD’s as PTS and TFPT products are non-insulated unless a minimum insulation dielectric withstanding voltage is clearly specified in the datasheet. Water condensation or dew formation should always be avoided, as it can result in enhanced leakage currents and cause electrochemical migration, which can lead to reduced resistivity or short circuits. The application of a conformal coating is recommended to prevent leakage currents or migration effects.

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 malfunction or failure of an RTD sensor. For failure analysis purposes, de-soldering the components is not recommended. Instead, analyze the mounted RTD without interference of other connected components or circuits. When investigation is performed by Vishay, a failure analysis of the RTD SMDs might require measurement in thermally stabilized baths 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.