PTC Thermistors

Mounting instructions

Date: April 2010

1 Soldering

1.1 Leaded PTC thermistors

Leaded PTC thermistors follow the solderability requirements of IEC 60068-2-20.

During soldering, care must be taken that the thermistors are not damaged by excessive heat. The following maximum temperatures, maximum time spans and minimum distances have to be observed:

	Solder containing lead (SnPb 60/40)	Lead-free solder (Sn96.5Ag3Cu0.5)
Solderability	Solder bath temperature 230 °C Soldering time 3 s	Solder bath temperature 245 °C Soldering time 3 s
Resistance to soldering heat	Soldering iron temperature 350 °C Soldering time 3 s	Solder bath temperature 260 °C Soldering time 10 s

Distance to thermistor has to be ≥6 mm. Under more severe soldering conditions the resistance may change. Soldering conditions for wave soldering are given in chapter 1.4.1.

1.2 Leadless PTC thermistors

In case of PTC thermistors without leads, soldering is restricted to devices which are provided with a solderable metallization. The temperature shock caused by the application of hot solder may produce fine cracks in the ceramic, resulting in changes in resistance.

In addition, soldering methods should be employed which permit short soldering times.

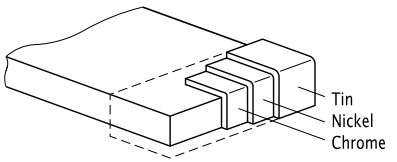
Soldering conditions for wave soldering are given in chapter 1.4.1.

1.3 SMD PTC thermistors

The notes on soldering leadless thermistors also apply to the SMD versions (refer to IEC 60068-2-58). Soldering conditions for wave soldering are given in chapter 1.4.1., for reflow soldering in chapter 1.4.2.

1.3.1 Chrome/nickel/tin terminations

(Sizes 0402, 0603, 0805, 1210)



TPT0602-V

As shown in the figure above, the terminations consists of three metallic layers. A primary chrome layer provides for good electrical contact. "Leaching" is prevented by a nickel barrier layer. The outer tin coating prevents corrosion of the nickel and ensures good component solderability.

1.3.2 Test methods for wetting and resistance to soldering heat

a) Solder bath method according to IEC 60068-2-58

Applicable for SMD components with wire or tag terminations. In case the SMD-component does not have a completely closed housing, only the wires or tags may be immersed into the solder bath.

	Lead-free solder (Sn96.5Ag3Cu0.5)	Solder containing lead (SnPb 60/40)
Wetting test	Bath temperature 250 °C Soldering time 3 s	Bath temperature 215 °C Soldering time 3 s
Resistance to soldering heat	Bath temperature 260 °C Soldering time 10 s	Bath temperature 260 °C Soldering time 10 s

b) Solder reflow method according to IEC 60068-2-58

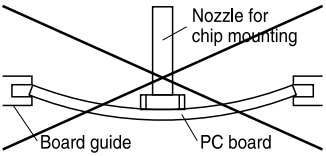
Applicable for chip-style SMD components. Reflow temperature profile is stated in IEC 60068-2-58, 8.1.2.1 for wetting test and 8.1.2.2 for resistance to soldering heat test.

	Lead-free solder (Sn96.5Ag3Cu0.5)	Solder containing lead (SnPb 60/40)
Wetting test	Peak temperature 225 ... 235 °C Duration maximum 20 s	Peak temperature 215 °C Duration maximum 10 s
Resistance to soldering heat	Peak temperature 245 ... 255 °C Duration maximum 20 s	Peak temperature 235 °C Duration maximum 30 s

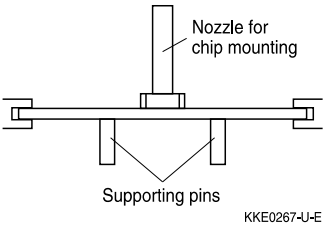
1.3.3 Placement and orientation of SMDs on PCB

a) Component placement

Incorrect

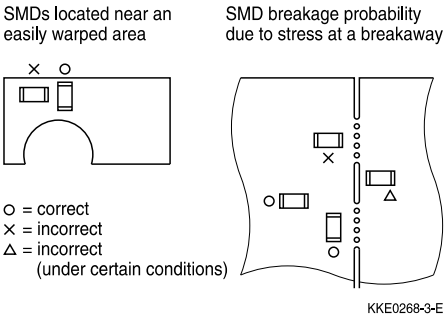


Correct



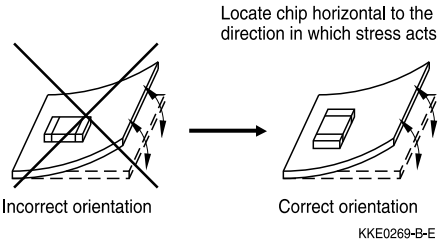
It is recommended that the PC board should be held by means of some adequate supporting pins such as shown left to prevent the SMDs from being damaged or cracked.

b) Cracks



When placing a component near an area which is apt to bend or a grid groove on the PC board, it is advisable to have both electrodes subjected to uniform stress, or to position the component's electrodes at right angles to the grid groove or bending line.

c) Component orientation

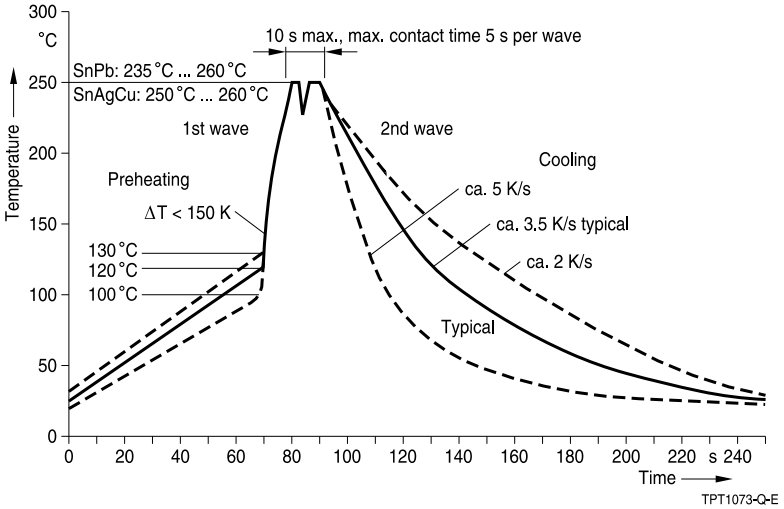


Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

1.4 Soldering profiles

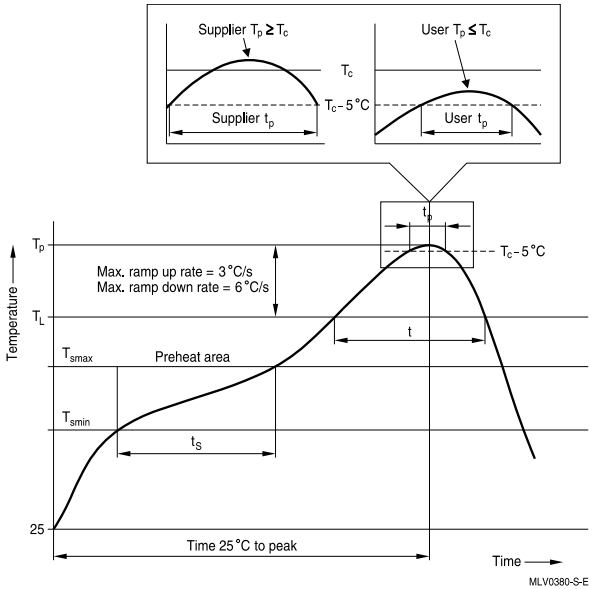
1.4.1 Wave soldering

Recommended temperature profile for wave soldering following IEC 61760-1. Applicable for leaded PTCs and selected SMD PTCs (case sizes 3225 and 4032 as well as superior series for case sizes 0402, 0603 and 0805 limit temperature sensors).



1.4.2 Reflow soldering

Recommended temperature characteristic for reflow soldering following JEDEC J-STD-020D

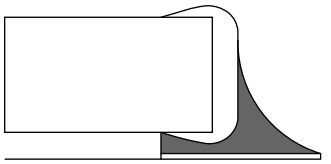


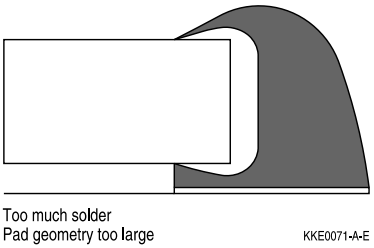
Profile feature		Sn-Pb eutectic assembly	Pb-free assembly
Preheat and soak			
- Temperature min	T_{smin}	100 °C	150 °C
- Temperature max	T_{smax}	150 °C	200 °C
- Time	t_{smin} to t_{smax}	60 ... 120 s	60 ... 180 s
Average ramp-up rate	T_{smax} to T_p	3 °C/ s max.	3 °C/ s max.
Liquidous temperature	T_L	183 °C	217 °C
Time at liquidous	t_L	60 ... 150 s	60 ... 150 s
Peak package body temperature	T_p [1)]	220 °C ... 235 °C[2)]	245 °C ... 260 °C[2)]
Time (t_P)[3)] within 5 °C of specified classification temperature (T_c)		20 s[3)]	30 s[3)]
Average ramp-down rate	T_p to T_{smax}	6 °C/ s max.	6 °C/ s max.
Time 25 °C to peak temperature		maximum 6 min	maximum 8 min

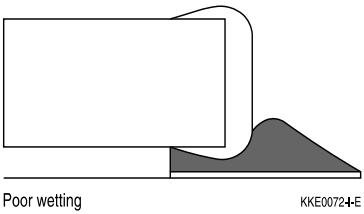
1) Tolerance for peak profile temperature (T_P) is defined as a supplier minimum and a user maximum.
2) Depending on package thickness. For details please refer to JEDEC J-STD-020D.
3) Tolerance for time at peak profile temperature (t_P) is defined as a supplier minimum and a user maximum.

Note: All temperatures refer to topside of the package, measured on the package body surface. Number of reflow cycles: 3

1.4.3 Solder joint profiles for PTC theristors with chrome/nickel/tin terminations







2 Storage of PTC thermistors

PTC thermistors should be soldered after shipment from EPCOS within the time specified:
Use thermistor within the following period after delivery:

Through-hole devices (housed and leaded PTCs)	24 months
Motor protection sensors, glass-encapsulated sensors and probe assemblies	24 months
Telecom pair and quattro protectors (TPP, TQP)	24 months
Leadless PTC thermistors for pressure contacting	12 months
Leadless PTC thermistors for soldering	6 months
SMDs in EIA sizes 3225 and 4032, and for PTCs with metal tags	24 months
SMDs in EIA sizes 0402, 0603, 0805 and 1210	12 months

The parts are to be left in the original packing.

Storage temperature: −25 ... + 45 °C
Relative humidity: ≤ 75% annual average, ≤ 95% on 30 days in a year

The solderability of the external electrodes may be deteriorated if SMDs are stored where they are exposed to high humidity, dust or harmful gas (hydrogen chloride, sulfuric acid gas or hydrogen sulfide).

Do not store SMDs where they are exposed to heat or direct sunlight. Otherwise, the packing material may be deformed or SMDs may stick together, causing problems during mounting.

After opening the factory seals, such as polyvinyl-sealed packages, it is recommended to use the components as soon as possible.

3 Conductive adhesion

An alternative to soldering is the gluing of thermistors with conductive adhesives. The benfit of this method is that it involves no thermal stress. The adhesives used must be chemically inert and suitable for the temperatures arising at the surface of the termistor.

4 Clamp contacting

Pressure contacting by springs is required for applications involving frequent switching and high turn-on powers. Soldering is not allowed for such applications in order to avoid operational failure in the long term. PTC thermistors for heating and motor starting have metallized surfaces for clamp contacting.

5 Robustness of terminations

The leads meet the requirements of IEC 60068-2-21. They may not be bent closer than 4 mm from the solder joint on the thermistor body or from the point at which they leave the feedthroughs. During bending, any mechanical stress at the outlet of the leads must be removed. The bending radius should be at least 0.75 mm.

Tensile strength:	Test Ua1: Leads $\varnothing \leq 0.5$ mm = 5 N $\varnothing > 0.5$ mm = 10 N
Bending strength:	Test Ub: Two 90°-bends in opposite directions at a weight of 0.25 kg.
Torsional strength:	Test Uc: severity 2 The lead is bent by 90° at a distance of 6 to 6.5 mm from the thermistor body. The bending radius of the leads should be approx. 0.75 mm. Two torsions of 180° each (severity 2).

When subjecting leads to mechanical stress, the following should be observed:

Tensile stress on leads
During mounting and operation tensile forces on the leads are to be avoided.

Bending of leads
Bending of the leads directly on the thermistor body is not permissible.

A lead may be bent at a minimum distance of twice the wire's diameter +2 mm from the solder joint on the thermistor body. During bending the wire must be mechanically relieved at its outlet. The bending radius should be at least 0.75 mm.

Twisting of leads
The twisting (torsion) by 180° of a lead bent by 90° is permissible at 6 mm from the bottom of the thermistor body.

6 Sealing and potting

When thermistors are sealed or potted, there must be no mechanical stress through differing thermal expansion in the curing process and during later operation. In the curing process the upper category temperature of the thermistor must not be exceeded. It is also necessary to ensure that the potting compound is chemically inert.

Sealing and potting compounds may degenerate the titanate ceramic of PTC thermistors and lead to the formation of low-ohmic conduction bridges. In conjunction with a change in dissipation conditions due to the potting compound, local overheating may finally damage the thermistor.

Therefore sealing and potting should be avoided whenever possible.

7 Cleaning

You may use common cleaners based on organic solvents (eg dowanol or alcohol) to clean ceramic and solder joints.

For sufficient cleaning flux must be completely removed.

Solvents may cause plastic encapsulations to swell or detach. So be sure to check the suitability of a solvent before using it.

Caution is required with ultrasonic processes. If the sound power is too high, for example, it can degrade the adhesive strength of the terminal metallization or couse the encapsulation to detach.

After cleaning drying is promptly necessary.