

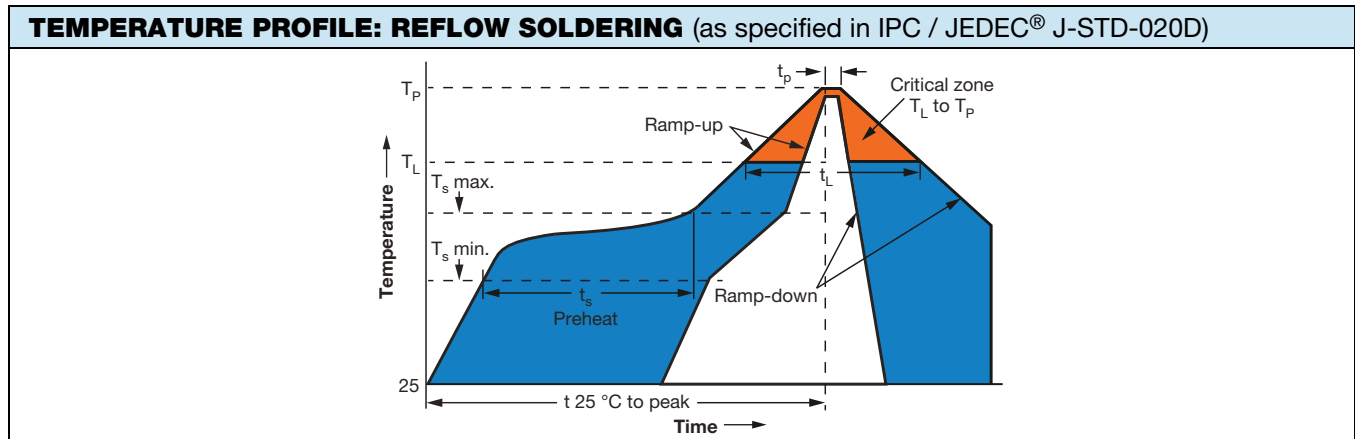
## Important Information on the Use of NTCS SMD NTC Thermistors

### MOUNTING AND HANDLING INSTRUCTIONS

#### 1. SOLDERING

SMD NTCS thermistors comply with the solderability requirements as outlined in IEC 60068-2-58. For reflow, wave, hand / robot, and laser soldering of RoHS-compliant NTC thermistors, the following combined solder conditions should be respected.

#### REFLOW SOLDERING



<b>REFLOW PROFILE</b> (as specified in IPC / JEDEC J-STD-020D)		
PROFILE FEATURE	TIN / LEAD 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.
<b>Preheat</b>		
- Temperature minimum ( $T_s$ min.)	100 °C	150 °C
- Temperature maximum ( $T_s$ max.)	150 °C	200 °C
- Time ( $T_s$ min. to $T_s$ max.) ( $t_s$ )	60 s to 120 s	60 s to 180 s
<b>Time maintained above:</b>		
- Temperature ( $T_L$ )	183 °C	217 °C
- Time ( $t_L$ )	60 s to 150 s	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 to 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.

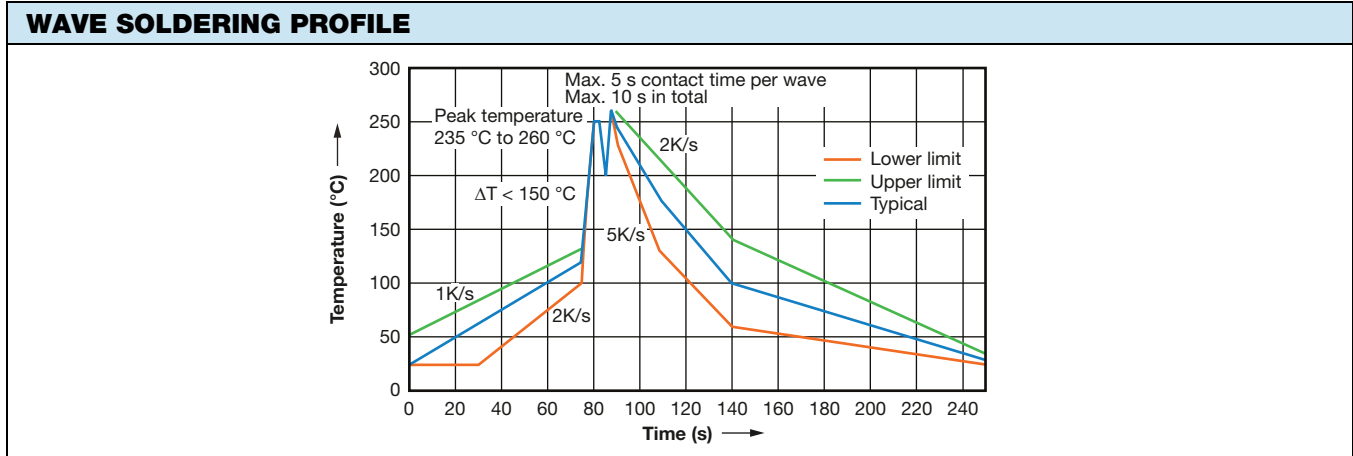
Generally, for all methods of soldering:

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 NTCS 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.



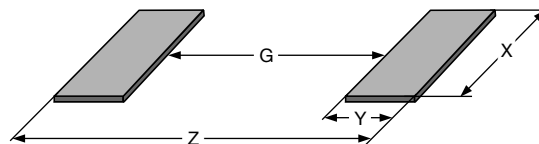
## HAND SOLDERING

Hand soldering of NTC SMD thermistors is not recommended. In the event of a repair process, the maximum temperature of 280 °C over a period of 3 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 is used. The use of a miniature soldering iron (20 W max.) is not recommended and care should be taken to avoid touching the glass seal or other protective coating. By preheating the PCB assembly and components with an air flow up to 150 °C, a much lower solder iron temperature can be used.

## LASER SOLDERING

Laser soldering of NTC SMD thermistors on flex circuits or substrates is feasible, but defined process conditions should be established by the user. Preferably, a twin-beams, temperature-controlled process is used to reflow solder the NTCS part. NTCS parts have a tin-plated nickel barrier over medium soft silver electrodes, which allows them to be mounted on flexible circuits with a limited solder quantity. The use of a stiffener in flexible circuits is recommended for mounting the part. An excess of solder can initiate cracks or thermal shock issues. Defined smaller solder pad dimensions for reflow soldering may be used for laser soldering.

## 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)
NTCS0402	0.50	0.50	0.60	1.50	-	-	-	-
NTCS0603	0.80	0.80	1.00	2.40	0.7	1.05	1.1	2.8
NTCS0805	1.00	1.00	1.30	3.00	0.9	1.25	1.4	3.4



### 2. STORAGE - SHELF LIFE

NTCS SMD NTC 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 40 °C

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

Thermistors must not be stored in corrosive or deoxidizing atmospheres (Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, etc.). Avoid storage in heat or direct (UV) sunlight. The presence of ozone or ionizing radiation must be avoided at all times. 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 NTCS\*E3 (tin-plated) SMD 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 or IEC 60068-2-69 before using parts stored more than 24 months after the manufacturing date (DC).

### 3. HANDLING

NTCS NTC SMD thermistors must not be dropped. Chip-offs or any other damage must not be caused during handling of NTCs. Do not touch components with bare hands; gloves are recommended. Avoid contamination of the thermistor surface during handling. Rough handling of NTC SMD thermistors may result in glass seal or protective coating failures or solderability issues. Small chip-offs or imperfections in or underneath the glass coating will not impact the functionality or reliability of the parts. De-soldering of NTCS thermistors for resistance investigation or measuring purposes can cause mechanical deformations and resistance change.

### 4. SEALING AND POTTING

NTC SMD thermistors 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 in 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 thermistors 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 NTCS can provide exceptional environmental protection and physical stability, while preventing damage from overmolding techniques, especially when NTCS parts are mounted on flexible substrates or circuits. The use of a stiffener in flexible circuits is recommended in the mounting area of the NTCS. 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 NTC SMD thermistor.

### 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. 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

NTC thermistors exhibit a large resistance change depending on the changing surrounding temperature. The change of resistance can be as high as -8 % per degree Celsius. When measuring or inspecting resistance values of NTC thermistors 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 NTC thermistor body. Measuring NTC thermistors 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 NTC thermistor 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 many NTC thermistors, a measuring current of 10 µA to 100 µA will not induce any self-heating. Some ohmmeters or DMMs measure resistance values with measuring currents of 1 mA or higher. These currents can heat up some NTC thermistors by more than 10 °C. De-soldering of NTCS thermistors for resistance investigation or measuring purposes can cause mechanical deformations and resistance change.

### DIMENSIONAL

All production batches of NTC thermistors are controlled dimensionally on a statistical base in order to guarantee compliance to specifications. When designing an NTC in your application, please verify that the application conditions will not induce any compression stress on the thermistor body. NTC SMD component soldering pads should be chosen in accordance with the soldering process. Recommended solder pad dimensions are mentioned in the “Soldering” section. NTCS SMD thermistors have rounded terminations, which should be considered when checking dimensions.

### VISUAL

Small vesicles, sharp edges, micro-cracks, small ceramic chip-offs, or imperfections in the glass sealing of NTCS SMD thermistors are cosmetic and do not impact the functionality nor the reliability of the components.

## 7. OPERATION

Use thermistors only within the specified operating temperature range. Never use NTC thermistors in constant voltage mode or outside the specified maximum or derated power. Overpowering a NTC thermistor can cause thermal runaway and ignition of fire, in addition to short circuit or open circuit failures. Environmental conditions must not harm the thermistors. Avoid operation of NTC thermistors in corrosive or deoxidizing atmospheres (Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>x</sub>, etc.) unless specified. Only use the thermistors under normal atmospheric conditions or within the specified conditions. NTC thermistors may not be used in a vacuum, nor at very low or 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 thermistor 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.

NTCS thermistors are non-insulated unless a minimum insulation dielectric withstanding voltage is clearly specified in the datasheet. Water condensation or dew formation on NTCS SMD thermistors 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 NTC thermistor. For failure analysis purposes, de-soldering the components is not recommended. Instead, analyze the mounted NTCS without interference of other connected components or circuits. When investigation is performed by Vishay, a failure analysis of the NTC SMDs might require measurement in thermally stabilized baths and possible destructive physical analysis. 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. 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.