

REV LETTER:A
PART NUMBER:

NTC Thermistors

Shanghai Wayon Thermo/Electro Materials Co.,Ltd.
No. 1001, Shiwan Qi Road, Shanghai, China, 201202,
Tel: 86-21- 50968320 50968322 Fax: 86-21-50968316
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MFC-XXXXX/XXXXXX

General Notes

The word "Thermistor" derives from the description "thermally sensitive resistor". NTC (Negative Temperature Coefficient) Thermistor means the resistance of the thermistor decreases as the temperature increases. This kind of resistor is manufactured from proprietary formulations of ceramic materials based on the oxides of the transition metals - manganese, cobalt, nickel, iron and copper.



The resistance values between 100 and 10⁶ ohms at room temperature can be achieved with temperature coefficients lying between -2% and -6.5% per °C.

NTC Characteristics

1) Resistance: R (Ω)

$$R_2 = R_1 \exp \{B(1/T_2 - 1/T_1)\}$$

R₂: Resistance at T₂ (K) (Ω)

R₁: Resistance at T₁ (K) (Ω)

2) Zero-power resistance rating (R₂₅) :

The resistance at a standard reference temperature, usually at 25 °C.

3) B-value

An index of the thermal sensitivity expressed by the formula, Where

B: Constant in Kelvins (K)

R1: Resistance in ohms (Ω) at temperature T₁

R2: Resistance in ohms (Ω) at temperature T₂

T₁=298.15k (+25°C), T₂=358.15k (+85°C)

The value given above for T₁ and T₂ are the preferred values. When the detail specification prescribes that the B-value shall be measured at other temperatures, the specified value (in Kelvins) shall be used for T₁ and T₂ in the calculation in place of the preferred values.

4) Thermal time constant τ (sec.)

The thermal time constant is the time required for a thermistor to change 63.2 percent of the total difference between its initial and final body temperature when subjected to a step function change in temperature under zero-power conditions. The formula is $\tau = C/\delta$.

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5) Dissipation constant (mW/°C)

The dissipation constant is the ratio (in milliwatts per degree C) at a specified ambient temperature, of a change in power dissipation in a thermistor to the resultant body temperature change. The constant can be expressed as,

$$\delta = W / (T - T_a) = I^2 R / (T - T_a), \text{ where}$$

δ : Dissipation constant δ (mW/°C)

W: Power consumed by thermistor (mW)

T: Resultant body temperature (°C)

T_a: Specified ambient temperature (°C)

I: Current when the resistor body temp.is T. (mA)

R: Resistance at T (K Ω)

6) Zero-power temperature coefficient of resistance α (%/°C)

The Zero-power temperature coefficient of resistance is the ratio at a specified temperature (T), of the rate of change of zero-power resistance with temperature to the zero-power resistance of the thermistor.

$$\alpha T = (1/R T) * (dR T / dT) = -B / T_2^2,$$

α : Zero-power temperature coefficient of resistance (%/°C)

R : Resistance at a specified temperature T (Ω)

B : B value (K)

7) Maximum current rating

The maximum current rating of a thermistor is the maximum current which a thermistor will accept at the ambient temperature 25 °C.

8) Resistance-temperature characteristic

The resistance-temperature characteristic is the relationship between the zero-power resistance of a thermistor and its body temperature. The resistance law follow approximately the formula,

$$R T_1 = R T_2 \exp \{B (1/T_1 - 1/T_2)\}.$$

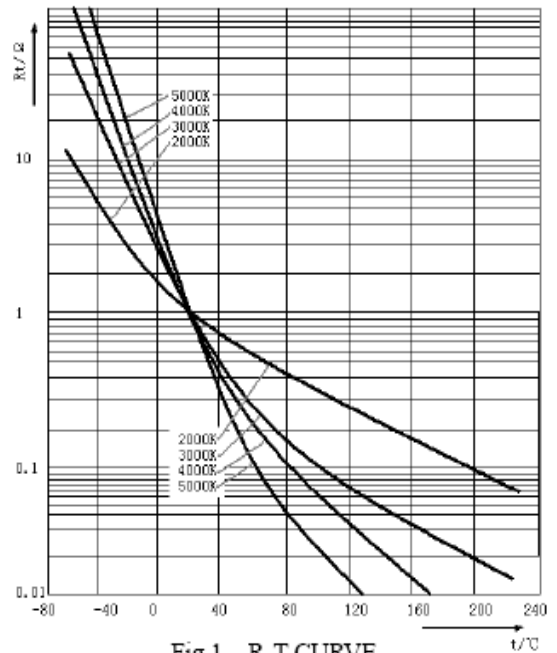


Fig.1 R-T CURVE

Features

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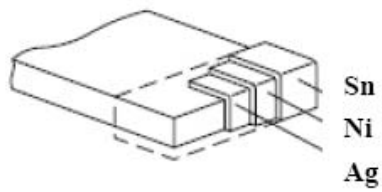
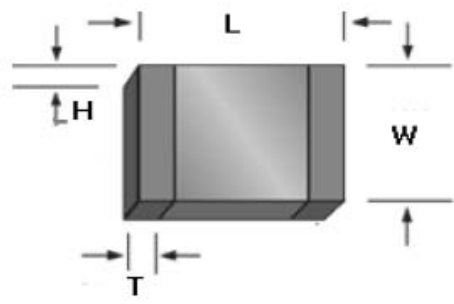
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- ✧ Excellent solderability and high stability in environment;
- ✧ Excellent long time aging stability;
- ✧ High accuracy in resistance and B-constant;
- ✧ Reflow soldering possible;
- ✧ Meet to the RoHs requirement;
- ✧ No lead wire and easy to surface mounted;
- ✧ Operation Temp. Range: -40°C~+125°C.

Applications

- ✧ Temperature compensation for Transistors , IC &TCXO.
- ✧ Temp. compensation for optical communication related equipment laser transmission circuit .
- ✧ Temp. control and protection for battery group.
- ✧ Temp. compensation for LCD.
- ✧ Temp. compensation and control for car HVACR system.
- ✧ Optical pickup for CD/DVD writing.
- ✧ Temp. compensated circuit in HDD.
- ✧ Temp. detection for MOS-FET.

Dimensions



Unit: inch (mm)

SIZE	L	W	H	T
0402 (1005)	0.040±0.006 (1.0±0.15)	0.020±0.006 (0.5±0.15)	0.020Max. (0.5Max.)	0.004Min. (0.10Min.)
0603 (1608)	0.063±0.008 (1.6±0.15)	0.031±0.006 (0.8±0.15)	0.037Max. (0.95Max.)	0.004Min. (0.10Min.)
0805 (2012)	0.08±0.008 (2.0±0.2)	0.05±0.008 (1.25±0.2)	0.05Max. (1.25Max.)	0.006Min. (0.15Min.)

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MFC-XXXXX/XXXXX

Part number system

M F C- /

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

① NTC thermistors.

② SMD type components.

③ Dimensions

④ Resistance value at 25°C is expressed in ohms,. First two digits are significant and the last digit is the number of zeros following.

⑤ Resistance Tolerance:

Code	F	G	H	J	K	M
Tolerance Value	±1%	±2%	±3%	±5%	±10%	±20%

⑥ B value, the unit is K.

⑦ B value Tolerance.

⑧ The relevant temp. of B constant (25°C excluded).

⑨ Packing form: T is for tape, and B is for bulk.

Specifications

0402	0603	0805
MFC-0402/222□3100350□	MFC-0603/222□3100350□	MFC-0805/222□3100350□
MFC-0402/222□3900350□	MFC-0603/222□3900350□	MFC-0805/222□3900350□
MFC-0402/332□3200350□	MFC-0603/332□3200350□	MFC-0805/332□3200350□
MFC-0402/472□3250350□	MFC-0603/222□3250350□	MFC-0805/472□3250350□
MFC-0402/682□3350350□	MFC-0603/682□3350350□	MFC-0805/682□3350350□
MFC-0402/103□3435350□	MFC-0603/103□3435350□	MFC-0805/103□3435350□
MFC-0402/103□3900350□	MFC-0603/103□3900350□	MFC-0805/103□3900350□
MFC-0402/153□3500350□	MFC-0603/153□3500350□	MFC-0805/153□3500350□
MFC-0402/223□3600350□	MFC-0603/223□3600350□	MFC-0805/153□3950350□
MFC-0402/333□3800350□	MFC-0603/333□3800350□	MFC-0805/223□3600350□
MFC-0402/473□3900350□	MFC-0603/473□3900350□	MFC-0805/333□3800350□
MFC-0402/473□4050350□	MFC-0603/473□4050350□	MFC-0805/473□3900350□
MFC-0402/683□3950350□	MFC-0603/683□3950350□	MFC-0805/473□4050350□
MFC-0402/104□4100350□	MFC-0603/104□4100350□	MFC-0805/683□3950350□
MFC-0402/104□4360350□	MFC-0603/104□4360350□	MFC-0805/104□4100350□
MFC-0402/224□4200350□	MFC-0603/224□4200350□	MFC-0805/104□4360350□
		MFC-0805/224□4200350□

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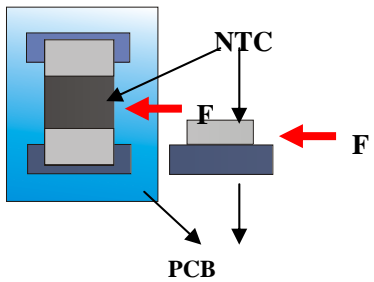
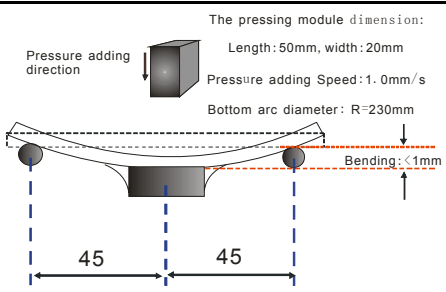
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Reliability test method

Item	Standard	Test method															
Solderability test method	<ul style="list-style-type: none"> ◇ No visible damage and crack. ◇ The electrode surface is covered by solder 90% at least. 	<ul style="list-style-type: none"> ◇ Preheating temp.: 100°C~150°C. ◇ Preheating time: 2~3Min. ◇ Soldering temp.: 235±5°C. Soldering time: 5±0.5s. 															
Soldering heat resistant test method	<ul style="list-style-type: none"> ◇ No visible damage and crack. ◇ The electrode surface is covered by solder 75% at least. ◇ $\Delta R_{25} < \pm 5\%$, $\Delta B < \pm 2\%$ 	<ul style="list-style-type: none"> ◇ Preheating temp.: 100°C~150°C. ◇ Preheating time: 2~3Min. ◇ Soldering temp.: 260±5°C. Soldering time: 10±1s. 															
Electrode strength test method	No damage in ceramic body and electrode.	 <table border="1" data-bbox="869 1209 1348 1422"> <thead> <tr> <th>Size</th> <th>Push(N)</th> <th>time(s)</th> </tr> </thead> <tbody> <tr> <td>0402</td> <td>10</td> <td>5±1</td> </tr> <tr> <td>0603</td> <td>15</td> <td>5±1</td> </tr> <tr> <td>0805</td> <td>20</td> <td>5±1</td> </tr> <tr> <td>1206</td> <td>20</td> <td>5±1</td> </tr> </tbody> </table>	Size	Push(N)	time(s)	0402	10	5±1	0603	15	5±1	0805	20	5±1	1206	20	5±1
Size	Push(N)	time(s)															
0402	10	5±1															
0603	15	5±1															
0805	20	5±1															
1206	20	5±1															
Vibration test method	<ul style="list-style-type: none"> ◇ No visible mechanical damage. ◇ $\Delta R_{25} < \pm 5\%$, $\Delta B < \pm 2\%$ 	<ul style="list-style-type: none"> ◇ Vibration frequency:10 ~55Hz ◇ Amplitude: 1.52mm ◇ Vibration time : 2hrs for X、 Y and Z directions 															
Flexural strength test method	<ul style="list-style-type: none"> ◇ No visible mechanical damage. ◇ $\Delta R_{25} < \pm 5\%$, $\Delta B < \pm 2\%$ 	 <table border="1" data-bbox="925 1859 1420 1982"> <thead> <tr> <th>Size</th> <th>Bending (mm)</th> </tr> </thead> <tbody> <tr> <td>0402、0603</td> <td>0.7</td> </tr> <tr> <td>0805、1206</td> <td>1.0</td> </tr> </tbody> </table> <p>Conditions: PCB substrate</p>	Size	Bending (mm)	0402、0603	0.7	0805、1206	1.0									
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Dropping test method	· No visible mechanical damage. · $\Delta R_{25} < \pm 5\%$; · $\Delta B < \pm 2\%$	Drop to the ground freely from 1 meter high and repeat 10 times.															
High temp. resistant test method	· No visible mechanical damage. · $\Delta R_{25} < \pm 5\%$; · $\Delta B < \pm 2\%$	Temp. : 125±2℃(No loading) Test time: 500±2hrs															
Low temp. resistant test method	· No visible mechanical damage. · $\Delta R_{25} < \pm 5\%$; · $\Delta B < \pm 2\%$	Temp.: -40±2℃ Time :500±2hrs															
Humidity resistant test method	· No visible mechanical damage. · $\Delta R_{25} < \pm 5\%$; · $\Delta B < \pm 2\%$	500 ± 2hrs in the next conditions, <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Temp.</td> <td>55 ± 2℃</td> </tr> <tr> <td>Humidity</td> <td>90~95%RH</td> </tr> </table>	Temp.	55 ± 2℃	Humidity	90~95%RH											
Temp.	55 ± 2℃																
Humidity	90~95%RH																
Temp. cycle test method	No visible mechanical damage. · $\Delta R_{25} < \pm 5\%$; · $\Delta B < \pm 2\%$	5 times in the next conditions without any other loading. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Step.</th> <th>Temp.</th> <th>Time (Min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40℃</td> <td>30 ± 3</td> </tr> <tr> <td>2</td> <td>25℃</td> <td>10 ± 2</td> </tr> <tr> <td>3</td> <td>125℃</td> <td>30 ± 3</td> </tr> <tr> <td>4</td> <td>25℃</td> <td>10 ± 2</td> </tr> </tbody> </table>	Step.	Temp.	Time (Min.)	1	-40℃	30 ± 3	2	25℃	10 ± 2	3	125℃	30 ± 3	4	25℃	10 ± 2
Step.	Temp.	Time (Min.)															
1	-40℃	30 ± 3															
2	25℃	10 ± 2															
3	125℃	30 ± 3															
4	25℃	10 ± 2															

Packaging form:

1、 packaging:

1) Appearance:



2) Quantity:

Spec.	Quantity
0402	10,000 pcs/reel
0603	4000 pcs/reel
0805	4000 pcs/reel

3) Reel dimension(Standard)

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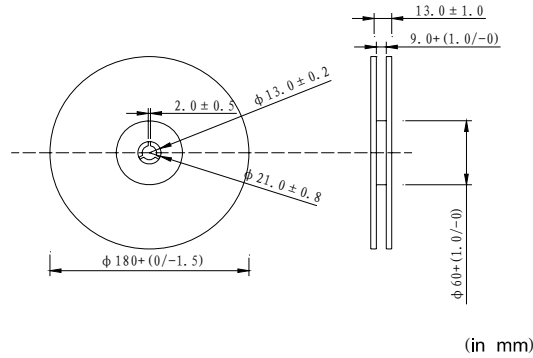
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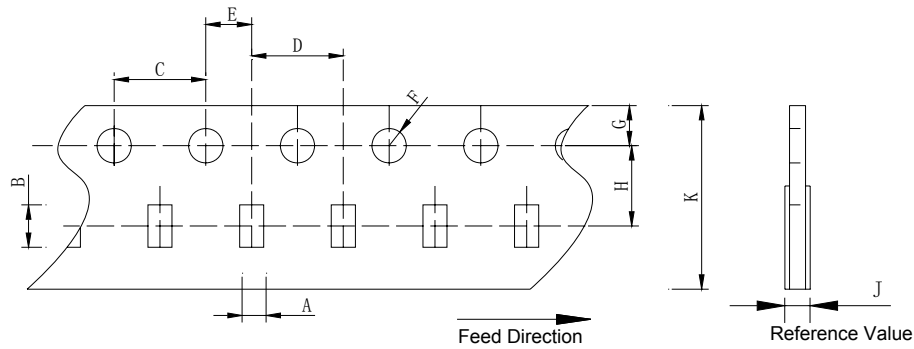
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4) Tape dimension:



(in mm)

Tape	Paper tape			
Spec.	0201 spec.	0402 spec.	0603 spec.	0805spec.
B/mm	0.68mm	1.15mm	1.85mm	2.25mm
A/mm	0.38mm	0.65mm	1.05mm	1.45mm
D/mm	2.0±0.05mm	2.0±0.05mm	4.0±0.1mm	4.0±0.1mm
F/mm	1.5+0.1/-0 mm	1.5+0.1/-0 mm	1.5+0.1/-0 mm	1.5+0.1/-1 mm
C/mm	4.0±0.1mm	4.0±0.1mm	4.0±0.1mm	4.0±0.1mm
E/mm	2.0±0.05mm	2.0±0.05mm	2.0±0.05mm	2.0±0.05mm
H/mm	3.5±0.05mm	3.5±0.05mm	3.5±0.05mm	3.5±0.05mm
K/mm	8.0±0.3mm	8.0±0.3mm	8.0±0.3mm	8.0±0.3mm
J/mm	0.5mm max.	0.8mm max.	1.1mm max.	0.2mm max.
G/mm	1.75±0.1mm	1.75±0.1mm	1.75±0.1mm	1.75±0.1mm

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5) Taping method:

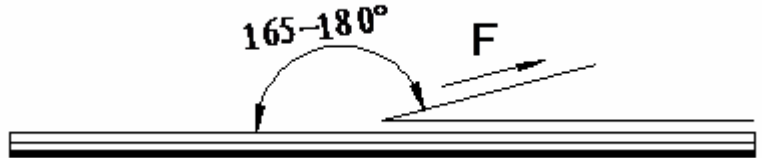
- ✧ A tape in a reel contains leader unit and Trailer unit where products are not packed ;
- ✧ The top and base tapes or plastic and cover tape are not stuck at the first five pitches minimum;

6) Other conditions:

- ✧ Packaging: Products are packaged in the cavity of the base tape and sealed by top and bottom tape;
- ✧ Taping: Top tape and bottom tape have no joints and products are packaged and sealed in the cavity of the base tape, continuously;

✧ Peeling force of top tape:

- Peeling angel: 165 to 180 degree against the fixed surface of tape;



- Peeling speed: 300mm/min;

- Peeling force: 0.1~0.6N.

✧ Pull strength:

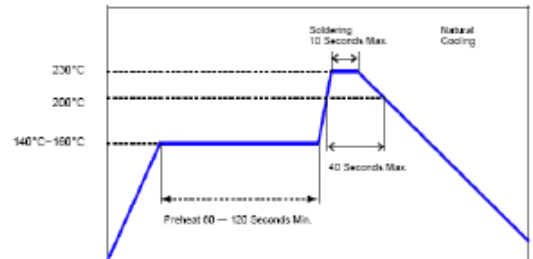
- Pull strength of top tape is specified at 10N minimum.
- Pull strength of bottom tape is specified at 5N minimum.

Soldering Temperature Profiles

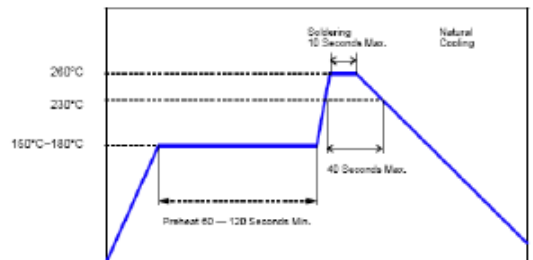
Recommended conditions for hand soldering:

- 1、 preheating: 150°C,60s(min);
- 2、 appropriate temperature(max) of soldering iron tip/soldering time (max): 280°C/10s or 350°C/3s;
- 3、 maximum temperature of soldering iron tip/solering time: 350°C/9s or 400°C/8s;
- 4、 using hot air rework station with tip that can melt the solder on both terminations of the same time is strongly recommended, don't directly contact the chip termination with the tip of soldering iron.

Recommended Temperature Profile for Sn/Pb Solder



Recommended Temperature Profile for Lead-free Solder



Maximum peak temperature 260°C for maximum 60 seconds

Storage conditions:

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- 1) Temp.: -10~40°C;
- 2) Humidity:45~75%;
- 3) Storage time: Use this product within 6 months after delivery by first-in and first-out stocking system.
- 4) Handling after unpacking:
After unpacking, reseal product promptly or store it in a sealed container with a drying agent.
- 5) Storage place:
Do not store this product in corrosive gas (sulfuric acid gas, chlorine gas, etc.) or in direct sunlight;

Circuits for use:

1) Temperature measurement

The NTC thermistor offers a practical, low-cost to most temp. measurement applications. One of the circuits suitable for temp. measurement is a Wheatstone bridge with an NTC thermistor used as one bridge leg.

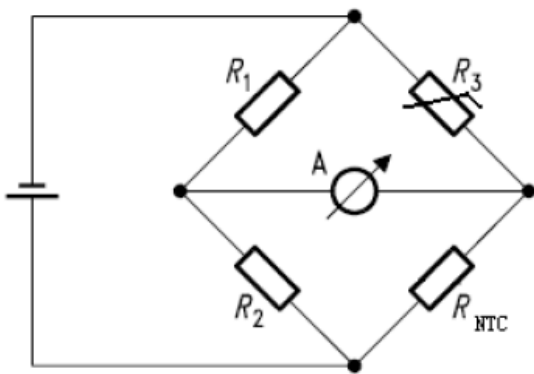


Fig1. Wheatstone bridge circuit

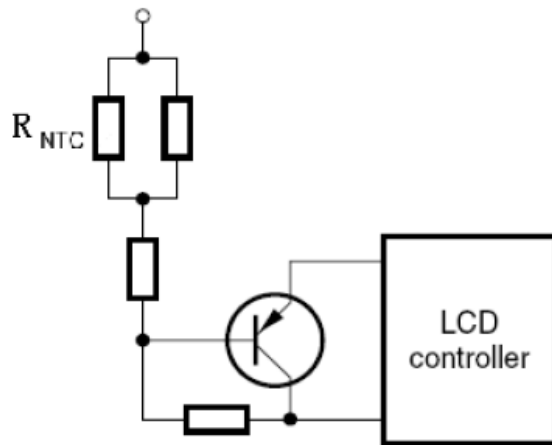


Fig.2 Circuit for the temp. compensation of LCD

2) temperature control

The NTC thermistor are the most sensitive of all temp. sensing elements they are popular in temp. control systems. By using a thermistor in a voltage comparator circuit basic on-off temp. control as well as over-temp. protection can be incorporated.

3) Temperature compensation

Many semiconductors and ICs exhibit a temperature coefficient and require temp. compensation to produce stable performance over a wide temp. range. Owing to their high positive temp. coefficient, NTC thermistors are particularly suitable for this kind of compensation.

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Cautions and warnings:

1、 Handling

- ◇ NTC thermistors must not be dropped. Chip-offs must not be caused during handing of NTCs.
- ◇ Components must not be touched with bare hands. Gloves are recommended.
- ◇ Avoid contamination of thermistor surface during handling.

2、 Soldering

- ◇ Use resin-type flux or non-activated flux.
- ◇ Insufficient preheating may cause ceramic cracks.
- ◇ Rapid cooling by dipping in solvent is not recommended.
- ◇ Complete removal of flux is recommended.

3、 Mounting

- ◇ Electrode must not be scratched before/during/after the mounting process.
- ◇ Contacts and housings used for assembly with thermistor have to be clean before mounting.
- ◇ During operation, the thermistor's surface temp. can be very high(ICL). Ensure that adjacent components are placed at a sufficient distance from the thermistor to allow for proper cooling of the thermistor.
- ◇ Ensure that adjacent materials are designed for operation at temp. comparable to the surface temp. of the thermistor. Be sure that surrounding parts and materials can withstand this temp.
- ◇ Avoid contamination of thermistor surface during processing.

4、 Operation

- ◇ Use thermistors only within the specified operating temperature range.
- ◇ Environmental conditions must not harm the thermistors. Use thermistors only in normal atmospheric conditions.
- ◇ Contact of NTC thermistors with any liquids and solvents should be prevented. It must be ensured that no water enters the NTC thermistor (e.g. through plug terminals). For measurement purposes (checking the specified resistance vs. temperature), the component must not be immersed in water but in suitable liquids (e.g. Galden).
- ◇ Avoid dewing and condensation.

Notice:

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