SPECIFICATION APPROVAL

SPEC. No. E600NAA00843

DATE: May.12.2017

MESSRS: BEIJING FOXTAR ELECTRONICS CO. , LTD.

CUSTOMER'S PRODUCT NAME:

TDK PRODUCT NAME:

NTCG20 series

THIS SPECIFICATION IS:

- ☐ FULLY APPROVED
- ☐ DENIED
- ☐ APPROVED UNDER THE FOLLOWING CONDITIONS

SIGNATURE: DATE:

NAME(PRINTED):

TITLE:

TDK Corporation				
SALES Electronic components Sales & Marketing Group		ENGINEERING TDK-EPC Corporation Piezo & Protection Devices Business Group		
APPROVED	Person in Charge	APPROVED	CHECKED	Person in Charge
		S. Hakinuma	S. sasaki	M. Sato

Product name list

This specification shall be applied to following product name.

	Customer's Product name	TDK Product name
1	NTCG203NH153JTDS	NTCG203NH153JTDS
2		

1. Scope

This specification shall be applied to chip type NTC thermistors delivered to BEIJING FOXTAR ELECTRONICS CO. , LTD..

2. Description

Revision records			
Rev.	Date.	Revised by	Revision

Business Group	Date	Spec No.
Piezo & Protection Device Business Group	**May.12.2017**	**E600NAA00843**

INSTRUCTIONS FOR CHIP NTC THERMISTOR

Please read these instructions before using the chip NTC thermistors.

SAFETY WARNING

Pay careful attention to all warnings and operate only in accordance with safety specifications.
Improper use may cause smoke emissions or fire.

⚠ WARNING

- Confirm your environment of usage and mounting for the NTC thermistors, and do not operate the NTC thermistors beyond the rating and performance specified in this specification and catalog.
- Do not operate the NTC thermistors beyond the temperature range specified in this specification.
- Do not operate the NTC thermistors beyond the maximum rated power specified in this specification.
- Do not apply instantly and directly the loads of 5mW and over by the constant voltage power supply, since NTC thermistors may burn by thermal runaway mode.
- Pay careful attention to the power applied to NTC thermistors, because the thermistor that decreased the resistance by self heating may damage to the electric machines.
- In case of the electrical machine that consumers can directly touch the NTC thermistors by bare hands, be thorough about warning that customers do not let touch to the NTC thermistors.
- Store the NTC thermistors in the packages that are used for shipment by TDK and keep the storage facility in the following environmental conditions:
  Temperature : -10 ~ +40°C
  Relative humidity : 75% or below
  To avoid direct sunshine, rapid temperature change, corrosive gas and dusty place.
  Not to apply the load stress.
  Do not use NTC thermistors if stored over 6 months.
- Confirm reliability of the NTC thermistors when adding sealant which uses molding materials, adhesive materials, resin, etc. Furthermore, do not exceed temperature limits specified in this specification when curing these materials.
- Do not apply the vibration, shock (dropping etc.) and force that are beyond the specified limits in this specification.
- Do not use or store in a wet or humid environment over 85%RH, because it damages to the NTC thermistors.
- Do not use or store in the following environmental conditions:
  Corrosive gas(Cl_2, NH_3, SO_X, NO_X, H_2S etc.)
  Electrolyte, water, salt water, etc.
  Acidic, alkaline and solvent
  Dusty place
- To prevent failure or damage to the NTC thermistors, pay careful attention for mounting as follows;
  Do not warp or twist the board before and after mounting and soldering the NTC thermistors.
  Design bilaterally symmetric land size.
  Do not use the NTC thermistors that dropped or that detached from the board.
  Do not use excessive amount of solder.
- Use resin or molding materials that hydrogen(H_2) doesn't occur, if these are covered on the NTC thermistors.
- The products listed on this specification sheet are intended for use in general electronic equipment (AV equipment, telecommunications equipment, home appliances, amusement equipment, computer equipment, personal equipment, office equipment, measurement equipment, industrial robots) under a normal operation and use condition.
  The products are not designed or warranted to meet the requirements of the applications listed below, whose performance and/or quality require a more stringent level of safety or reliability, or whose failure, malfunction or trouble could cause serious damage to society, person or property. If you intend to use the products in the applications listed below or if you have special requirements exceeding the range or conditions set forth in this catalog, please contact us.
  (1) Aerospace/Aviation equipment
  (2) Transportation equipment (cars, electric trains, ships, etc.)
  (3) Medical equipment
  (4) Power-generation control equipment
  (5) Atomic energy-related equipment
  (6) Seabed equipment
  (7) Transportation control equipment
  (8) Public information-processing equipment
  (9) Military equipment
  (10) Electric heating apparatus, burning equipment
  (11) Disaster prevention/crime prevention equipment
  (12) Safety equipment
  (13) Other applications that are not considered ge etc.
  When designing your equipment even for general-purpose applications, you are kindly requested to take into consideration securing protection circuit/device or providing backup circuits in your equipment.

3. Part code designation

(Example)

NTC	G	20	3N	H	103	J	T	□□
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1)	Product category	NTC : NTC thermistor
(2)	Structure	G : Chip type and lead free series
(3)	Dimensions	20 : 2.0×1.25×0.7mm
(4)	Resistance temperature characteristic (B constant)	3N : 3650K
(5)	Resistance temperature characteristic tolerance	J : ±5% H : ± 3%, G : ± 2%, F : ± 1%
(6)	Nominal resistance	103 : 10×10^{3}[Ω]
(7)	Nominal resistance tolerance	J : ±5% H : ±3% F : ±1%
(8)	Types of packaging	T : Taping B : Bulk

(9) TDK special code

The TDK special code does not announce by the circumstances of our company managerially and may be changed.

4. Operating temperature range

-40 ~ 125°C

5. Test condition

Unless otherwise specified, tests and measurements shall be made at the standard condition; temperature 15 ~ 35°C , humidity 25 ~ 85%RH. and atmospheric pressure 86 ~ 106kPa

Regarding the tests shown section 6.3 and 6.4, the samples shall be mounted glass-epoxy board by reflow soldering (not to be applicable for solderability nor soldering to heat).
The measurement shall be performed after the tested samples are left under room temperature and normal humidity for 12 ~ 24hours.

Soldering condition

Solder paste :	Sn-3Ag-0.5Cu
Peak temperature of reflow :	250°C

6. Performance

6.1 Electrical performance

	Items	Specifications	Test methods
1	Nominal resistance (R25) and tolerance	To meet the specifications shown on section 6.2.	Measurement shall be made applying 0.25mW max. at ambient temperature 25±0.2°C (#1). This test must be not influenced by self-heating.
2	Resistance temperature characteristic (B constant) and tolerance	To meet the specifications shown on section 6.2.	B constant calculated from the resistance between ambient temperature 25±0.2°C and 50±0.2°C (#2) or between ambient temperature 25±0.2°C and 85±0.2°C (#3) according to JIS-C-2570. $B = \frac{\ln R1 - \ln R2}{\frac{1}{T1} - \frac{1}{T2}}$ T1,T2 : Temperature[K] R1:Thermistor resistance at temperature T1 R2:Thermistor resistance at temperature T2
3	Maximum rated power	To meet the specifications shown on section 6.2.	Maximum rated power loaded consecutively in still air (25±0.2°C).
4	Permissive operating current	To meet the specifications shown on section 6.2.	Maximum current to rise 1°C in still air (25±0.2°C).

6.2 Electrical characteristic specifications

No.	TDK product name	R25 (#1) [Ω]	B constant		Maximum rated power (25°C) [mW]	Permissive operating current (25°C) [mA]
			B25/50 (#2) [K]	B25/85 (#3) [K]		
1	NTCG203EH471JTDS	470 ± 5%	-	3250 ± 3%	200	2.00
2	NTCG203EH681JTDS	680 ± 5%	-	3250 ± 3%	200	1.70
3	NTCG203BH102JTDS	1.0k ± 5%	-	3100 ± 3%	200	1.40
4	NTCG203BH152JTDS	1.5k ± 5%	-	3100 ± 3%	200	1.10
5	NTCG203FH222JTDS	2.2K ± 5%	-	3300 ± 3%	200	0.95
6	NTCG203FH332JTDS	3.3k ± 5%	-	3300 ± 3%	200	0.77
7	NTCG203JH472JTDS	4.7k ± 5%	-	3450 ± 3%	200	0.65
8	NTCG203JH682JTDS	6.8k ± 5%	-	3450 ± 3%	200	0.54
9	NTCG203NH103JTDS	10k ± 5%	-	3650 ± 3%	200	0.44
10	NTCG203NH153JTDS	15k ± 5%	-	3650 ± 3%	200	0.36
11	NTCG203SH223JTDS	22k ± 5%	-	3850 ± 3%	200	0.30
12	NTCG203SH333JTDS	33k ± 5%	-	3850 ± 3%	200	0.24
13	NTCG204AH473JTDS	47k ± 5%	-	4000 ± 3%	200	0.20
14	NTCG204AH683JTDS	68k ± 5%	-	4000 ± 3%	200	0.17
15	NTCG204CH104JTDS	100k ± 5%	-	4150 ± 3%	200	0.14
16	NTCG204CH154JTDS	150k ± 5%	-	4150 ± 3%	200	0.11
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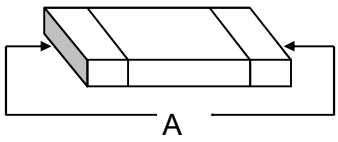
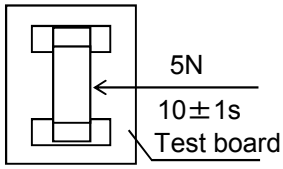
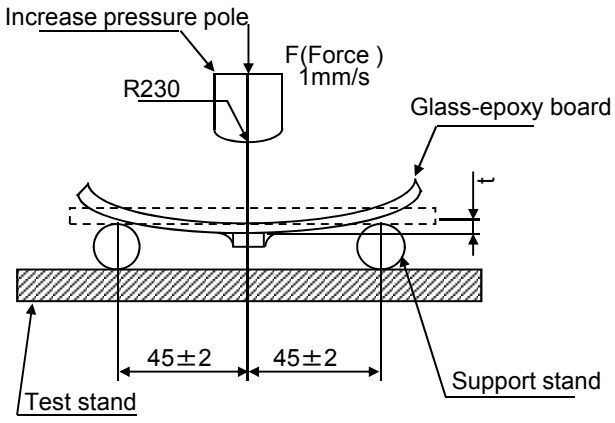
#1) R25 : Nominal resistance
#2) B25/50 : B constant between 25 and 50°C
#3) B25/85 : B constant between 25 and 85°C

6.3 Mechanical performance

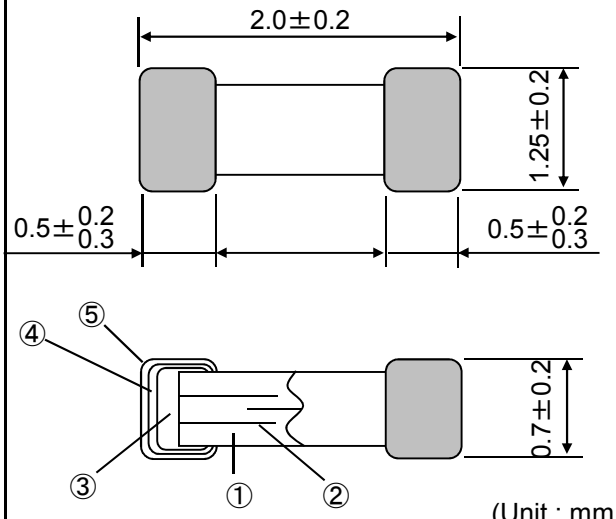
	Items	Specifications	Test methods
1	Vibration	1)External appearance shall have no mechanical damage 2)Resistance change: within ± 3% 3)B constant change: within ± 1%	Test shall be performed according to MIL-STD-202 method 204, Codition F. Test cycle: 12 cyc.
2	Shock test	1)External appearance shall have no mechanical damage at the thermistor. 2)Resistance change: within ± 3% 3)B constant change: within ± 1%	Test shall be performed according to MIL-STD-202 method 213, Codition F.
3	Solderability	More than 75% of terminal electrode sections shall be covered with new solder. 25% may have pinholes or rough spots but they shall not be collected in one position. Ceramic surface of A-sections shall not be exposed due to melting of shifting of electrode sections.  	Completely soak both terminal electrodes in solder of 245± 3°C for 3 ± 0.5 seconds. Solder : Sn-3Ag-0.5Cu Flux : Ethanol(JIS K 1501) solution of rosin (JIS K 5902) concentration with rosin approximately 20%(weight ratio) Test shall be performed according to JIS-C-2570.
4	Resistance to solder heat	1)External appearance shall have no abnormal sign at the thermistor. 2)External appearance shall have no mechanical damage at the thermistor. 3)Resistance change: within ± 3% 4)B constant change: within ± 1%	Completely dip both terminal electrodes in solder of 260± 3°C for 10 ± 0.5 seconds. Solder : Sn-3Ag-0.5Cu Flux : Ethanol(JIS K 1501) solution of rosin (JIS K 5902) concentration with rosin approximately 20%(weight ratio) Preheat Temp. : 100±10°C Time : 30±5s Test shall be performed according to JIS-C-2570. Or, passed through the reflow oven under the condition shown on §8.

	Items	Specifications	Test methods
5	Robustness of terminations	There shall be no sign of coming off terminal electrodes, breakage of ceramic, or other abnormal sign.	Test samples shall be mounted test board (1.2mm thickness glass-epoxy board) with solder. The soldering methods shall be soldering iron or reflow soldering without any thermal shock nor cause of failure. 
6	Bending strength test	No mechanical damage shall be caused on the thermistor.	Test shall be performed according to JIS-C-2570. To be soldered on the glass-epoxy board (thickness 1.6mm), the load shall be put on the until the board bends 1mm. 
7	Electrostatic discharge test	1)No mechanical damage shall be caused on the thermistor. 2)Resistance change: within ± 5% 3)B constant change: within ± 2%	HBM(Human Body Model) Discharge resistor : 330Ω Energy storage capacitance : 150pF Output voltage : ± 2kV Number of discharge : 10 times Contact discharge Test shall be performed according to IEC61000-4-2.

6.4 Life test

<table>
<tr><th></th><th>Items</th><th>Specifications</th><th>Test methods</th></tr>
<tr><td>1</td><td>High temperature storage</td><td>1)Resistance change:
within ± 5%
2)B constant change:
within ± 2%</td><td>Leave at temperature 125±5°C for 1000±12 hours.</td></tr>
<tr><td>2</td><td>Temperature cycle</td><td>1)Shall have no mechanical damage at the thermistor.
2)Resistance change:
within ± 5%
3)B constant change:
within ± 2%</td><td>Leave at temperature of the two steps of 1 to 2 sequentially, shown in the following table. With the above procedure as one cycle, repeat 1000 cycles consecutively.
<table><tr><th>Step</th><th>Temp. [°C]</th><th>Time[minutes]</th></tr><tr><td>1</td><td>-40±5</td><td>30</td></tr><tr><td>2</td><td>125±5</td><td>30</td></tr></table>The transfer time at each temperature is within a minute.</td></tr>
<tr><td>3</td><td>Moisture resistance</td><td>1)Shall have no mechanical damage at the thermistor.
2)Resistance change:
within ± 5%
3)B constant change:
within ± 2%</td><td>Test shall be performed according to MIL-STD-202 method 106
Test cycle: 10 cyc. (24 hours/cycle).
Note: Steps 7a & 7b not required. Unpowered.</td></tr>
<tr><td>4</td><td>Biased Humidity</td><td>1)Shall have no mechanical damage at the thermistor.
2)Resistance change:
within ± 5%
3)B constant change:
within ± 2%</td><td>At temperature 85±5°C and humidity 82 to 87%RH, apply the 10mW (DC voltage) for 1000±12 hours.</td></tr>
<tr><td>5</td><td>Operational life</td><td>1)Shall have no mechanical damage at the thermistor.
2)Resistance change:
within ± 5%
3)B constant change:
within ± 2%</td><td>At temperature 125±5 °C, apply the 0.1mW (DC voltage) for 1000±12 hours, and then taken out to room temperature for 2 hours before measurement.</td></tr>
</table>

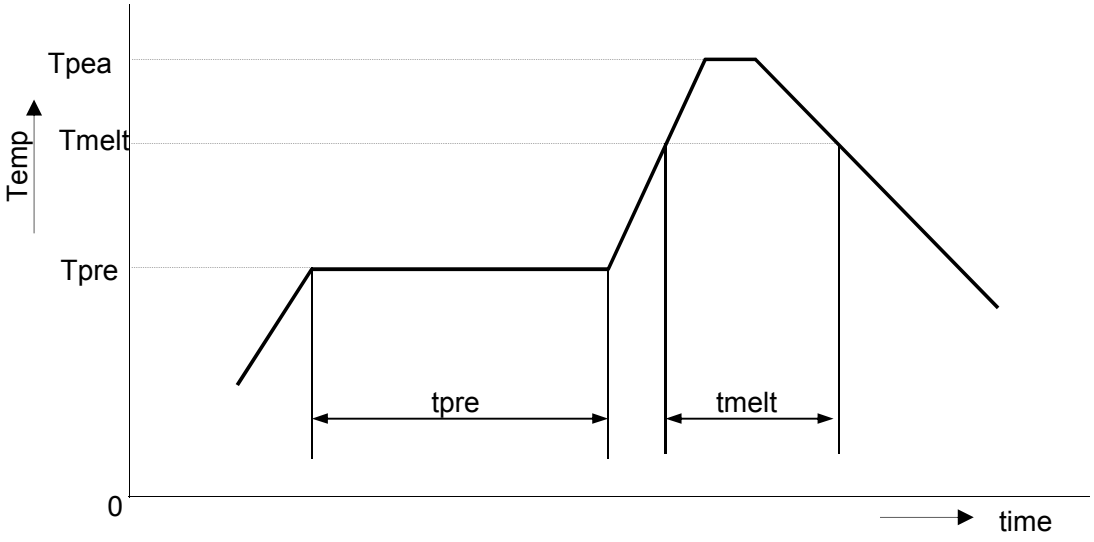
7. Shapes and dimension (Construction)



(Unit : mm)

No.	Construction	Materials, treatment
①	NTC Thermistor element	Mn, Ni, Co-oxide base ceramics materials
②	Inner electrodes	Palladium ※The number of inner electrodes may not be according to this figure.
③	Terminals	Silver base
④		Nickel-plating
⑤		Tin-plating

8. Reflow temperature profile

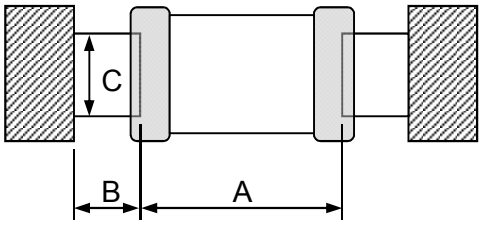


Item		Conditions	
		For Sn-Pb solder	For lead-free solder
Tpre	Preheat temp.	160 ~ 180°C	150 ~ 180°C
Tmelt	Solder melting temp.	200°C	230°C
Tpeak	Peak temp.	240°C max.	260°C max.
tpre	Preheat time	100s max.	120s max.
tmelt	Solder melting time	30s max.	40s max.
	Reflow possibility times	2 max.	2 max.

9. Application manual

	Process	Condition
1	PC Board design	The solder filet volume will directly affect the reliability of the NTC thermistors.

1)The greater the amount of solder, the higher the stress on the NTC thermistors, and the more likely that it will break. When designing a P.C.board, determine the shape and size of the solder lands to have proper amount of solder on the terminations.
2)Avoid using common solder land for multiple terminations and provide individual solder land for each termination.
3)Recommended PC Board Pattern

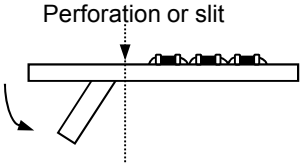
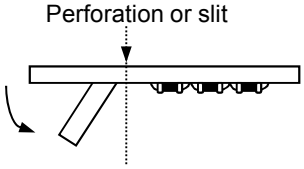
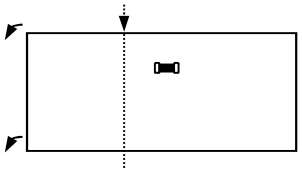
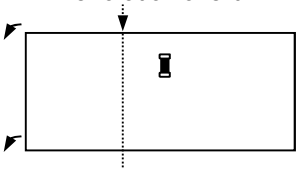
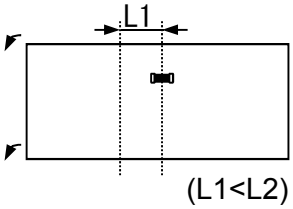
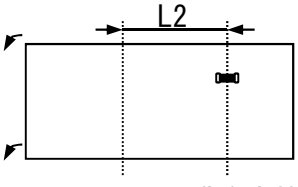


(Unit : mm)

・ Recommend land pattern for reflow use

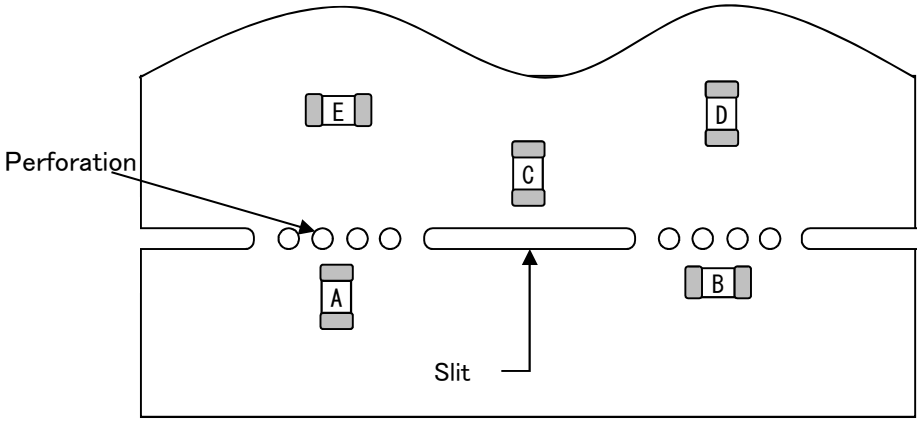
Symbol / Dimension	A	B	C
2012	0.9 ~ 1.2	0.7 ~ 0.9	0.9 ~ 1.2

4)Relationship between NTC thermistors position and flex stress during board separation

	Disadvantage against bending stress	Advantage against bending stress
Mounting face	Perforation or slit  Hold chip mounting surface upward and bend upward	Perforation or slit  Hold chip mounting surface downward and bend downward.
Chip arrangement (Direction)	Mount perpendicularly to perforation or slit Perforation or slit 	Mount in parallel with perforation or slit Perforation or slit 
Distance from slit	Closer to slit is higher stress  L1 (L1<L2)	Away from slit is less stress  L2 (L1<L2)

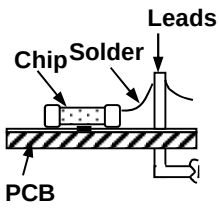
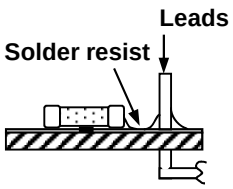
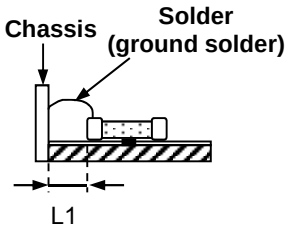
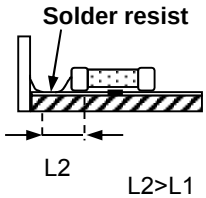
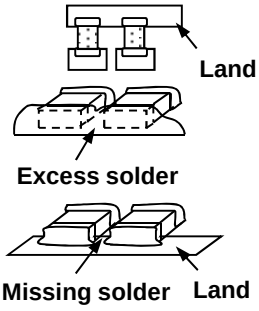
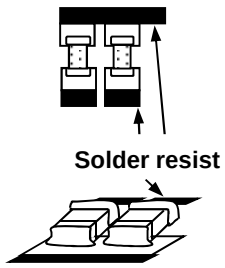
	Process	Condition

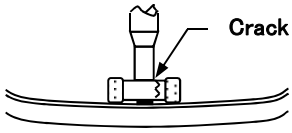
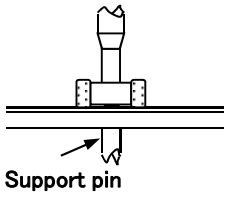
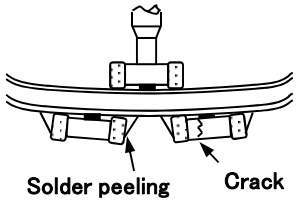
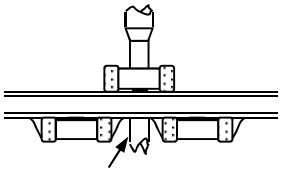
5)Mechanical stress varies according to location of NTC thermistors on the P.C.board.



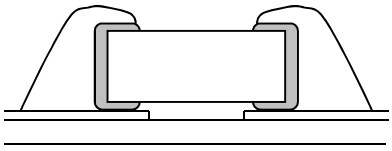
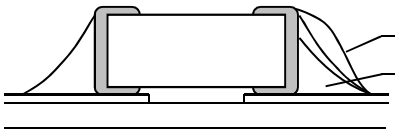
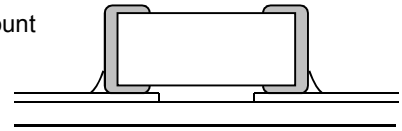
Flex stress order is A > B = C > D > E

6)Example of placement to be avoided and layout recommendations
(processing of land divisions)

Example	Need to avoid	Recommendation
Use of common solder land with PTH components		
Soldering with chassis		
Use of common solder land with other SMD		

<table>
<tr><th></th><th>Process</th><th>Condition</th></tr>
<tr><td>2</td><td>Mounting</td><td>
Pressure on installation head
If the drop point of the suction nozzle is too low, excessive forces will
be applied to the NTC thermistors during installation and that may cause breaks.
1)Realign the circuit board slide and adjust the bottom dead center over the circuit board.
2)The usual amount of mounting force is 0.1N to 0.3N (dead weight).
3)To prevent pressure from the installation head causes the circuit board to bend,
we recommend the installation of support pins for the back surface of the
circuit board. (See the model diagram as below.)
<table>
<tr><th></th><th>Locations to avoid</th><th>Recommended locations</th></tr>
<tr><td>single -sided circuit board</td><td> 
</td><td> 
</td></tr>
<tr><td>dual-sided circuit board</td><td> 
</td><td> 
</td></tr>
</table>
When the centering jaw is worn, excessive localized shock may be loaded on the
NTC thermistors during positioning and cracking may occur. To prevent problems
like this from occurring, carefully monitor the centering jaw and ensure that
periodic maintenance and inspection is performed.
</td></tr>
<tr><td>3</td><td>Soldering</td><td>
3-1 Recommended flux
Flux is one of the more important elements affecting the performance of NTC thermistors.
Before selecting and using flux, check the items shown below for the best flux.
1)Use flux that has a chlorine content of 0.1wt% or less. Do not use strong acid flux.
2)Excessive flux must be avoided. Keep the amount of flux coating minimized.
3)When water-soluble flux is used, enough washing is necessary.

3-2 Solder amount
Too much or too little solder may cause serious consequences for circuit
reliability such as cracks from solder stress and parts falling off the circuit board.
Check the diagram and make sure to provide the right amount of solder.
</td></tr>
</table>

	Process	Condition
		Excess amount of solder  Increased occurrence of solder stress and cracks
		Right amount of solder  Maximum layer quantity / Minimum layer quantity
		Insufficient amount of solder  Adhesive strength is weak producing danger of defective contacts and parts coming off of board.

3-3 Condition of re-work by a soldering iron

Basically TDK don't recommend re-work by a soldering iron.

In case of re-work, the condition is shown below.

1)The selection of a soldering iron.

The temperature of a soldering iron varies with the kinds, the size of printed circuit board and land patterns.

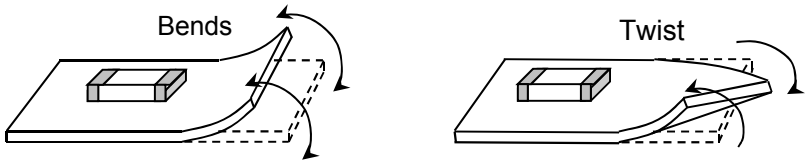
In case of high temperature soldering, the time of the soldering work may be shortened. However thermal shock may cause cracks in some cases, so please solder condition below.

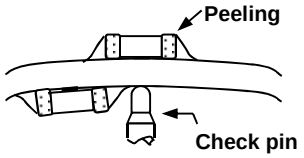
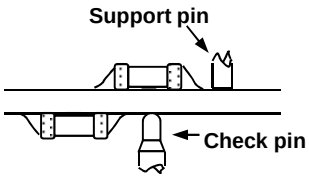
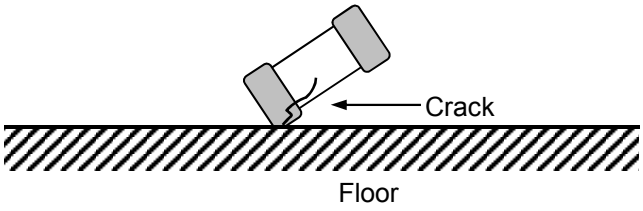
Tip temp. (°C)	Wattage (W)	Tip shape (mm)	Soldering time (s)	Number of soldering
350max.	20max.	φ3.0max.	5 max.	1 time or less for each terminals. (Total 2 times or less)

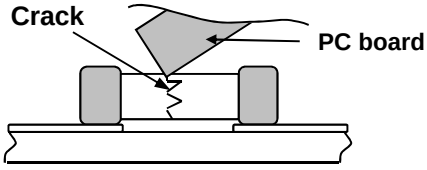
2)If the soldering iron may touch the body of NTC thermistors, the strain will be caused by thermal shock, in some case thermal crack may be caused. Don't contact a soldering iron to NTC thermistors body except terminals.

4	Cleaning	1)In the case that cleaning fluid is inappropriate, residues of flux and other foreign substance adhere on the surface of the NTC thermistors and the case may causes deterioration the performance (especially insulation resistance) of the NTC thermistors. 2)In the case that cleaning condition is inappropriate(cleaning insufficient, cleaning excessive), it may deteriorate the performance of the NTC thermistors. 2-1).Cleaning insufficient (1)The terminal electrode may corrode by the substance of the halogenate in residues of flux. (2)The halogenate in residues of flux adheres on the surface of the NTC thermistors and may deteriorate insulation resistance. (3)Water soluble flux has higher tendency to have above mentioned problems (1) and (2).

<table>
<tr><th></th><th>Process</th><th>Condition</th></tr>
<tr><td></td><td></td><td>2-2).Cleaning excessive
(1)It may deteriorate the performance of the NTC thermistors by cleaning fluid.
(2)If the ultrasonic energy output is too high during ultrasonic cleaning that will affect the adhesion of terminal electrodes so we recommend the following conditions for ultrasonic cleaning:
Output : 20W/liter or less
Frequency : 40kHz or less
Cleaning time : 5minutes or less

2-3).Pollution of cleaning fluid may resulted the such as cleaning insufficient.</td></tr>
<tr><td>5</td><td>Handling of PC board after mounting</td><td>1)As separate the board, please do not load the stress shown in the blow as much as possible, because crack may occur to the NTC thermistors.
 

2)To prevent pressure from the check pin causes the circuit board to bend, we recommend the installation of support pins for the back surface of the circuit board. (see the model diagram on the below.)
<table>
<tr><th>Item</th><th>Locations to avoid</th><th>Recommended locations</th></tr>
<tr><td>Board bends</td><td> 
</td><td> 
</td></tr>
</table></td></tr>
<tr><td>6</td><td>Handling of chip</td><td>1)Please do not use the NTC thermistors that fell, because a damage and crack may occur by the fall impact.
 

2)Please pay attention handling of the PC board after soldering, because damage and crack might occur to the NTC thermistors with the impact by the accumulation storage and the corner of the board hits to the NTC thermistors.
 
</td></tr>
</table>

10. Taping

10.1 Scope

This specification sheet is applicable to the tape packaging of chip type NTC Thermistor. When questionable matters are found regarding the specification of the products, this specification sheet shall be applicable with a priority, and the matters shall be settled with written documents upon conferring and confirming between the design groups of both companies.

10.2 Structure

(1)Taping consist of :

① Tape (Dimensions are shown in section 10.5)

② Reel (Dimensions are shown in section 10.6)

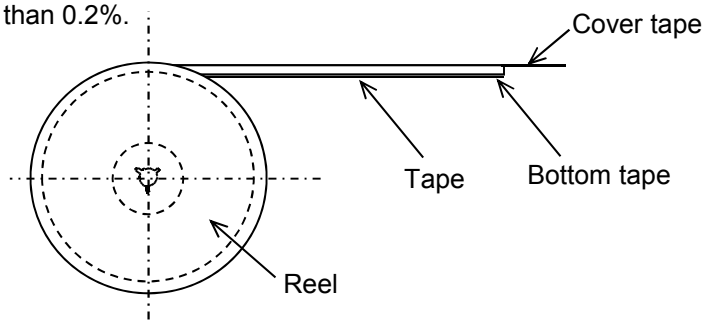
③ Cover tape

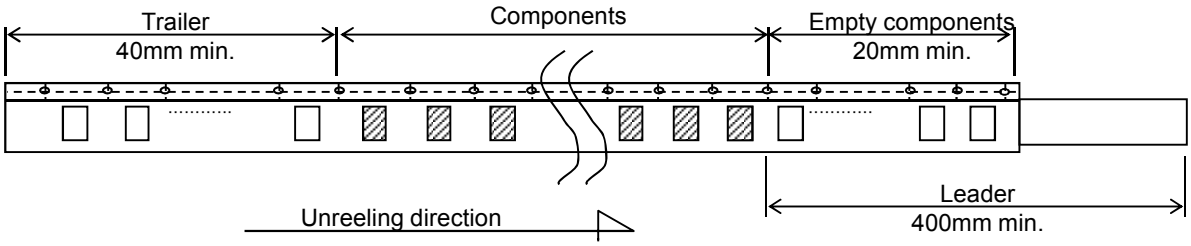
④ Bottom tape

(2)2,000 chips is in each reel.

(3)Vacant cavity of chip is less than 0.2%.

(4)Taping structure.

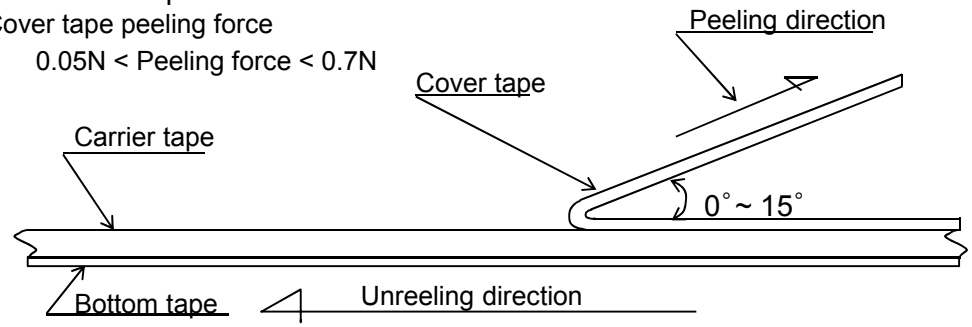




10.3 Mechanical performance

Cover tape peeling force

0.05N < Peeling force < 0.7N



(When cover tape is peeled, paper tape shall not adhere to the cover tape by broken.)

10.4 Tape packaging specification

(1) Tape bending

Taping shall show no mechanical damage nor with bending diameter of 30mm min.

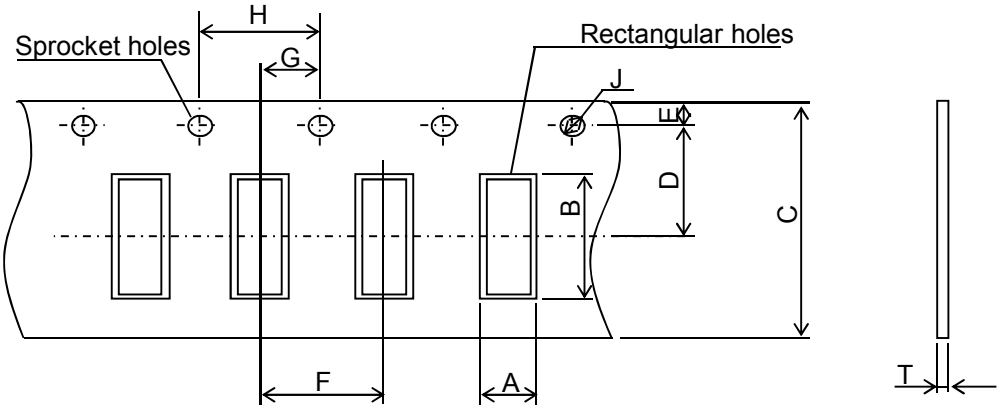
(2) Adhesion of the chip to the cover tape

Chip shall not be stuck to cover tape and exist in rectangular hole.

(3) Burr etc. of the rectangular hole

When cover tape is peeled, NTC thermistor shall be easily picked up and pick-up nozzle may not be stopped up by paper filings.

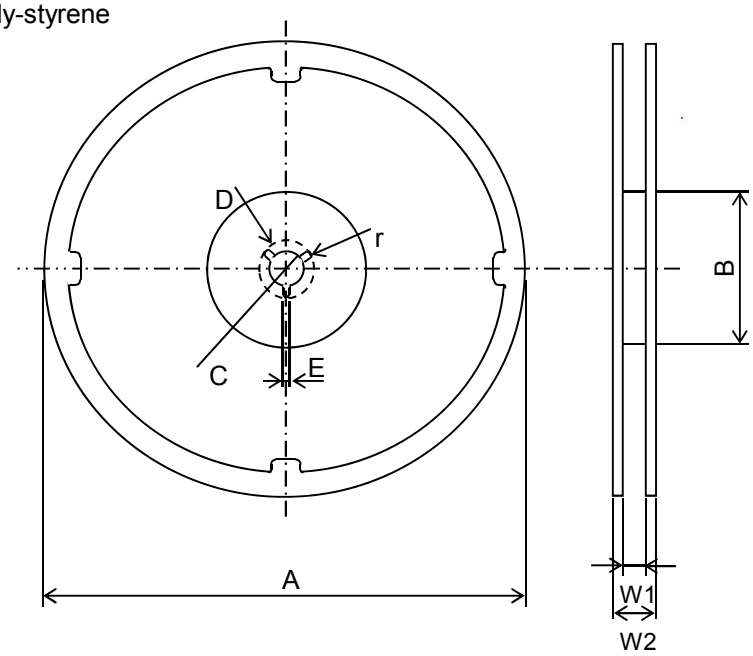
10.5 Paper tape dimension



	A	B	C	D	E	F
Dimension [mm]	1.5±0.2	2.3±0.2	8.0±0.3	3.5±0.05	1.75±0.1	4.0±0.1
	G	H	J	T		
	2.0±0.05	4.0±0.1	φ $1.5^{+0.1}_{-0}$	1.1MAX		

10.6 Reel dimension

Material : Poly-styrene



	A	B	C	D	E
Dimension [mm]	φ 180±2.0	φ 60min	φ 13±0.2	φ 21±0.8	2.0±0.5
	W1	W2	r		
	9.0min	14max	0.8		

11. Package & transport

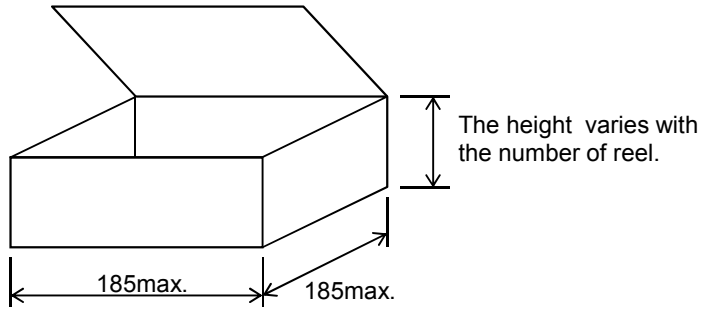
11.1 Package shall be secure from damage during transportation and storage, shipping label shall be attached.

(1) Shipping No.
(2) TDK's parts No.
(3) Customer's parts No.
(4) Quantity
(5) Production Country

Example) AE 15 E 0406701

- Ser. No.
- Shipping month A ~ M except for I&O (E : May)
- Shipping year last 2 digit（15：2015）
- Control No.

11.2 Package is shown as figure below. (unit : mm)



12. Production Country

Japan